STRALIS AS EURO 4/5

REPAIR MANUAL

MECHANICAL
ELECTRIC/ELECTRONIC

IVECO

"This document provides data, characteristics, instructions and methodology to perform repair interventions on the vehicle and its components.

Anyhow, this document is addressed to qualified and specialised personnel. Iveco commercial and assistance network personnel as well as all Iveco authorised points of assistance are specifically qualified and equipped to perform the repair interventions that are indicated in this document.

Before performing any intervention, check to have available the document relating to the vehicle model on which the intervention is being performed and also make sure that all accident prevention devices, such as, as a rough guide, goggles, helmet, gloves, shoes, as well as work tooling, lifting and transport tooling, etc., are available and efficient, and further make sure that the vehicle is put such a way that an intervention can be made in safety conditions.

Making interventions strictly observing the indications given here, as well as using specific tooling indicated, assures a correct repair intervention, execution timing observance and operators' safety.

Each repair intervention must be finalised to the recovery of functionality, efficiency and safety conditions that are provided by Iveco.
Each intervention, on the vehicle, that is finalised to a modification, alteration or else, which is not authorised by Iveco, involves the exclusion of any responsibility for Iveco, and, in particular, where the vehicle is covered by a guarantee, each such intervention involves an immediate lapse of the guarantee.

Responsibility for Iveco in repair intervention execution is excluded.

Iveco is available to provide all clarifications necessary to make interventions, as well as to provide indications in cases and situations not included in this document.

Data and information contained in this document could result not to be updated owing to modifications made by Iveco at any moment for technical or commercial reasons, or because of the need to adapt the vehicle to law requirements in different countries.

In the case of a difference between what contained here and what actually found on the vehicle, please contact Iveco network before making any intervention."

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PRELIMINARY REMARKS

Manuals for repairs are split into Sections, each one of which is marked by a numeral; the contents of these sections are indicated in the general table of contents.
Each section is generally dedicated to a main Unit (e.g.: engine, gearbox, electric system, etc.).
Sections with mechanical contents include technical data, tightening torque collections, tool lists, connections – disconnections of units to/from the vehicle, overhauls at the bench and relating troubleshooting.
On the electric/electronic system section there are the descriptions of the electric network and vehicle electronic systems, electric schemes, components electric characteristics, components codes and troubleshooting relating to the central units specific of the electric system.
The manual uses proper symbols in its descriptions; the purpose of these symbols is to classify contained information. In particular, there have been defined a set of symbols to classify warnings and a set for assistance operations.

SYMBOLS - WARNINGS

Danger for persons

Missing or incomplete observance of these prescriptions can cause serious danger for persons' safety.

Danger of serious damage for the vehicle

Partial or complete non observance of these prescriptions can cause serious damages to the vehicle and sometimes guarantee lapse too.

General danger

It includes the dangers of above described signals.

Environment protection

It indicates correct behaviour in order that vehicle use is environmentally friendly as much as possible.

NOTE It indicates an additional explanation for a piece of information.

SYMBOLS - ASSISTANCE OPERATIONS

	Removal Disconnection
	Refitting Connection
	Removal Disassembly
	Fitting in place Assembly
	Tighten to torque
	Tighten to torque + angle value
	Press or caulk
	Regulation Adjustment
	Visual inspection Fitting position check
	Measurement Value to find Check
	Equipment
	Surface for machining Machine finish
	Interference Strained assembly
	Thickness Clearance
	Lubrication Damp Grease
	Sealant Adhesive
	Air bleeding
	Replacement Original spare parts

	Intake
	Exhaust
	Operation
	Compression ratio
	Tolerance Weight difference
	Rolling torque
	Rotation
	Angle Angular value
	Preload
	Number of revolutions
	Temperature
	Pressure
>	Oversized Higher than.... Maximum, peak
<	Undersized Less than.... Minimum
	Selection Classes Oversizing
	Temperature < 0 °C Cold Winter
	Temperature > 0 °C Hot Summer

PRODUCT CODE

Each title or subtitle concerning operations being performed is preceded by a six-figure number named PRODUCT CODE. This number represents the **PRODUCT CODE** referred to by the repair operation contained in both REPAIR TIMES and TROUBLE CODE document.
As a quick reference there are shown below the guide lines to read this code (see Repair Timing, too).

Product Code:

The first and second figures identify the PRODUCT within motor vehicle.

Example :

Product 50 = Vehicle chassis;
Product 52 = Axles;
Product 53 = Transmission;
Product 76 = Electric ssystem.

Unit Code:

The third and fourth figures identify the UNIT within the PRODUCT.

Example :

Product 50 = Vehicle chassis;
Unit 01 = Chassis;
Unit 02 = Bumpers;
Unit 03 = Alternator.

Sub-assembly Code:

The fifth and sixth figures exactly identify the SUB-ASSEMBLY and Component of a Unit within a PRODUCT.

Example :

Product 50 = Vehicle chassis;
Unit 01 = Chassis;
Sub-assembly 40 = Chassis cross members;
Sub-assembly 13 = Rotor.

GENERAL WARNINGS

Warnings shown cannot be representative of all danger situations possibly occurring. Therefore, it is suggested to contact immediate superiors where a danger situation occurs which is not described.

Use both specific and general-purpose toolings according to the prescriptions contained in respective use and maintenance handbooks. Check use state and suitability of tools not subjected to regular check.

The manual handling of loads must be assessed in advance because it also depends, besides weight, on its size and on the path.

Handling by mechanical means must be with hoisters proper as for weight as well as for shape and volume. Hoisters, ropes and hooks used must contain clear indications on maximum carrying capacity acceptable. The use of said means is compulsorily permitted to authorised personnel only. Stay duly clear of the load, and, anyhow, never under it.

In disassembling operations, always observe provided prescriptions; prevent mechanical parts being taken out from accidentally striking workshop personnel.

Workshop jobs performed in pairs must always be performed in maximum safety; avoid operations which could be dangerous for the co-operator because of lack of visibility or of his/her not correct position.

Keep personnel not authorised to operations clear of working area.

Learn operation and safety knowledge necessary relating to the vehicle prior to each intervention on it. Scrupulously observe all safety warnings on the vehicle. Apply suitable signals for the vehicles being repaired. Once the repair intervention has been completed, before starting up the vehicle, perform all checks indicated on paragraph "Controls care of user" of Use and Maintenance handbook.

In lack of visibility in operating from the vehicle, charge a person on the ground with assistance. Do not leave unmanned a vehicle in motion during repair interventions.

Keep the vehicle stationary by proper chocks.

In the case of an intervention on a vehicle lifted from the ground, check the vehicle to be quite steady on special support stands and, in the case of lifting by means of a lift, check manual/automatic safeties to be activated.

When it is necessary to perform an intervention on methane-fed vehicles, observe the indications contained inside the document, as well as all specific safety regulations provided.

Only remove radiator cap when the engine is cold by cautiously unscrewing it in order to let system residual pressure out.

Inflammable fuel and all inflammable fluids and liquids must be handled with care, according to what contained on harmful materials 12-point cards. Refuelling must be performed outdoors with the engine off, avoiding lit cigarettes, free flames or sparks in order to prevent sudden fires/bursts. Adequately store inflammable, corrosive and polluting fluids and liquids according to what provided by regulations in force. Compulsorily avoid to use food containers to store harmful liquids. Avoid to drill or bore pressurised containers, and throw cloths impregnated with inflammable substances into suitable containers.

Worn out, damaged or consumable parts must be replaced by Iveco original spares.

During workshop activity, always keep the work place clean; timely clear or clean floors from accidental liquid or oil spots. Electric sockets and electric equipment necessary to perform repair interventions must meet safety rules.

For every intervention on vehicle hydraulic, pneumatic, conditioning and AIR - BAG systems, scrupulously observe indications specified in relating manual sections.

GENERAL WARNINGS

Put on, where required by the intervention, garments and protections provided in accident prevention rules; contact with moving parts can cause serious injuries. Use suitable, preferably tight-fitted garments, and avoid to use jewels, scarves, etc.

Do not leave the engine in motion at workshop locations not provided with a pipe to scavenge exhaust gas outside.

Avoid to breathe fumes coming from heating or from paint welding because they can cause damages to health; operate outdoors or in suitably ventilated areas. Put on proper inspirator if paint powder is present.

Avoid contact with hot water or steam coming from the engine, radiator and pipings because they could cause serious burns. Avoid direct contact with liquids and fluids present in vehicle systems; where an accidental contact has occurred, refer to 12-point cards for provisions to make.

Clean units or assemblies detached from the vehicle and carefully check their integrity before overhaul. Tidy up detached or disassembled parts with their securing elements (screws, nuts, etc.) into special containers.

Check for the integrity of the parts which prevent screws from being unscrewed: broken washers, dowels, clips, etc. Self-locking nuts with an insert made of nylon must always be replaced.

Avoid contact of rubber parts with diesel oil, petrol or other not compatible substances.

Before washing under pressure mechanical parts, protect electric connectors, and central units, if present.

Tightening screws and nuts must always be according to prescriptions; IVECO commercial and assistance network is available to give all clarifications necessary to perform repair interventions not provided in this document.

Before welding:

- ❑ Disconnect all electronic central units, take power cable off battery positive terminal (connect it to chassis bonding) and detach connectors.
- ❑ Remove paint by using proper solvents or paint removers and clean relevant surfices with soap and water.
- ❑ Await about 15 minutes before welding.
- ❑ Equip with suitable fire resistant protections to protect hoses or other components where fluids or other materials flow which may catch fire easily on welding.

Should the vehicle be subjected to temperatures exceeding 80°C (dryer ovens), disassemble drive electronic central units.

The disposal of all liquids and fluids must be performed with full observance of specific rules in force.

GENERAL WARNINGS ON THE ELECTRIC SYSTEM

If an intervention has to be made on the electric/electronic system, disconnect batteries from the system; in this case, always disconnect, as a first one, the chassis bonding cable from batteries negative terminal.

Before connecting the batteries to the system, make sure that the system is well isolated.

Disconnect the external recharging apparatus from the public utility network before taking apparatus pins off battery terminals.

Do not cause sparks to be generated in checking if the circuit is energised.

Do not use a test lamp in checking circuit continuity, but only use proper control apparatuses.

Make sure that the electronic devices wiring harnesses (length, lead type, location, strapping, connection to screening braiding, bonding, etc.) comply with IVECO system and are carefully recovered after repair or maintenance interventions.

Measurements in drive electronic central units, plugged connections and electric connections to components can only be made on proper testing lines with special plugs and plug bushes. Never use improper means like wires, screwdrivers, clips and the like in order to avoid the danger of causing a short circuit, as well as of damaging plugged connections, which would later cause contact problems.

To start up the engine, do not use fast chargers. Start up must only be performed with either separate batteries or special truck.

A wrong polarisation of supply voltage in drive electronic central units (for instance, a wrong polarisation of batteries) can cause them to be destroyed.

Disconnect the batteries from the system during their recharging with an external apparatus.

On connecting, only screw up connector (temperature sensors, pressure sensors etc.) nuts at prescribed tightening torque.

Before disconnecting the junction connector from an electronic central unit, isolate the system.

Do not directly supply electronic central units servo components at nominal vehicle voltage.

Cables must be arranged such as to result to be parallel to reference plane, i.e. as close as possible to chassis/body structure.

Once the intervention on the electric system has been completed, recover connectors and wiring harnesses according to original arrangement.

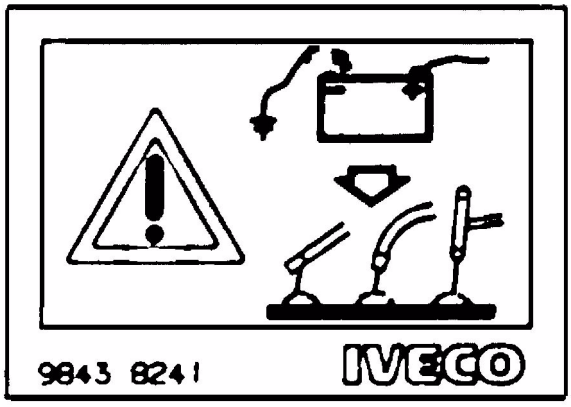
Key memorisation procedures are influenced by electromagnetic jamming (mobile phones, etc.). Therefore, during key memorisation:

1 Pay attention that jamming sources are not present in the cab or near the keys.
2. Keys not insered in the panel must be at least 1 meter away.

NOTE Connectors present must be seen from cable side. Connectors views contained in the manual are representative of cable side.

In order to prevent damage or short-circuiting of the on-board electronic control units, the following operations must be always carried out before starting any welding operation on the chassis.

❑ If electric welding has to be done on the vehicle,



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isolate the electric system as follows:

a) disconnect the power lead from the battery positive terminal and connect it to the chassis earth;

b) disconnect the power lead from the battery negative terminal;

c) disconnect the electronic control unit connectors, taking care to avoid touching the control unit connector pins.

❑ Moreover:

a) should it be necessary to carry out welding operations close to the control unit, remove it from its location.

b) whenever possible, earth the welding machine directly to the piece that has to be welded.

In the case of vehicles equipped with a DTCO digital tachograph, do not disconnect the battery leads and then connect them by jumpers to reset the electronic systems.

This operation should be avoided, as it could cause permanent damage to the DTCO tachograph CARD or other on-board electronic systems.

To reset the electronic system without running risks, disconnect the vehicle battery and wait for 10 minutes.

It is strictly forbidden to carry out any modifications or connections to the electronic control unitwiring; in particular, the line interconnecting data between the control units (CAN line) must be considered as untouchable.

Diagnostic and maintenance operations can only be carried out by authorised personnel with IVECO approved equipment.

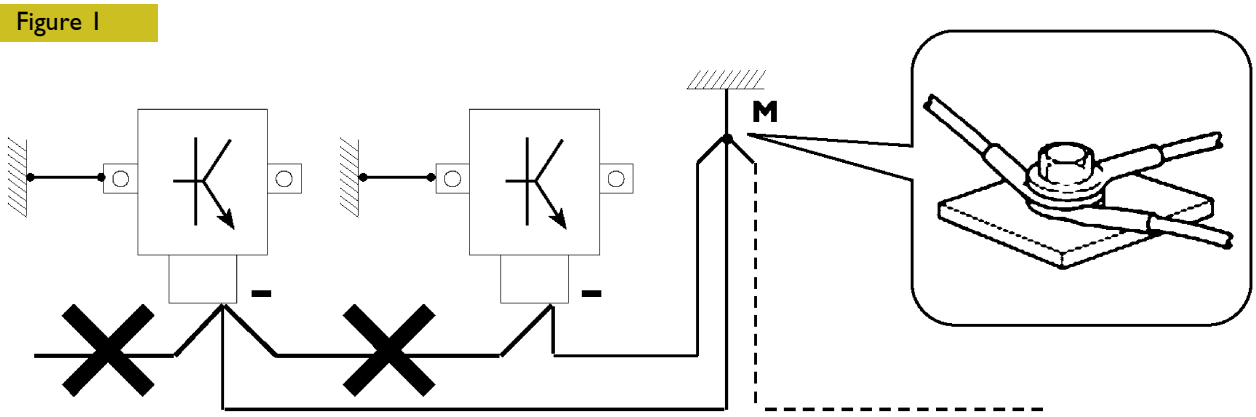
Bonding and screening

Negative leads connected to a system bonded point must be both as short and possible and "star"-connected to each other, trying then to have their centering tidily and properly made (Figure 1, re. M).

Further, following warnings are to be compulsorily observed for electronic components:

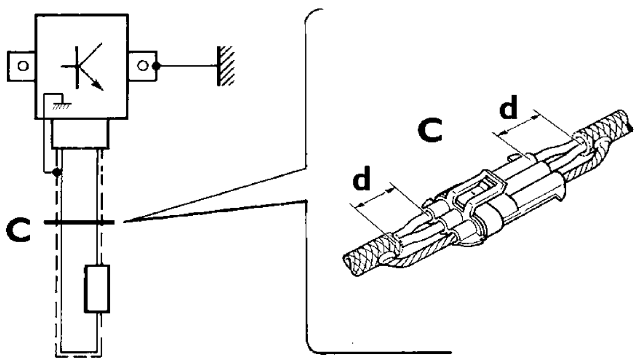
- Electronic central units must be connected to system bonding when they are provided with a metallic shell.
- Electronic central units negative cables must be connected both to a system bonding point such as the dashboard opening bonding (avoiding "serial" or "chain" connections), and to battery negative terminal.
- Analog bonding (sensors), although not connected to battery negative system/terminal bonding, must have optimal isolation. Consequently, particularly considered must be parasitic resistances in lugs: oxidising, clinching defects, etc.
- Screened circuits braiding must only electrically contact the end towards the central unit entered by the signal (Figure 2).
- If junction connectors are present, unscreened section **d**, near them, must be as short as possible (Figure 2).
- Cables must be arranged such as to result to be parallel to reference plane, i.e. as close as possible to chassis/body structure.

Figure 1



1. NEGATIVE CABLES "STAR" CONNECTION TO SYSTEM BONDING **M**

Figure 2



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2. SCREENING THROUGH METALLIC BRAIDING OF A CABLE TO AN ELECTRONIC COMPONENT – **C.** CONNECTOR **d.** DISTANCE → 0

OPTIONAL ELECTRICAL AND MECHANICAL PARTS INSTALLATIONS

Accessories mounting, additions and modifications on the vehicle are to be performed complying with IVECO mounting instructions (specific document "Instructions for transformation and preparation" is available at Assistance Network workshops). It is reminded that, especially about the electric system, several electric sockets are provided for as series (or optional) sockets in order to simplify and normalise the electrical intervention that is care of preparation personnel.
For any exception to mounting instructions, IVECO's authorisation is necessary.
Lack of observance of above described prescriptions involves guarantee lapse.

It is absolutely forbidden to make modifications or connections to electric central units wiring harnesses; in particular, the data interconnection line between central units (CAN line) is to be considered inviolable.

CONVERSIONS BETWEEN THE MAIN UNITS OF MEASUREMENT OF THE INTERNATIONAL SYSTEM AND MOST USED DERIVED QUANTITIES

Power

1 kW	=	1.36 metric HP
1 kW	=	1.34 HP
1 metric HP	=	0.736 kW
1 metric HP	=	0.986 HP
1 HP	=	0.746 kW
1 HP	=	1.014 metric HP

Torque

1 Nm	=	0.1019 kgm
1 kgm	=	9.81 Nm

Revolutions per time unit

1 rad/s	=	1 rpm x 0.1046
1 rpm	=	1 rad/s x 9.5602

Pressure

1 bar	=	1.02 kg/cm^2
1 kg/cm^2	=	0.981 bar
1 bar	=	10^5 Pa

Where accuracy is not particularly needed:

❑ Nm unit is for the sake of simplicity converted into kgm according to ratio 10:1

1 kgm = 10 Nm;

❑ bar unit is for the sake of simplicity converted into kg/cm^2 according to ratio 1:1

1 kg/cm^2 = 1 bar.

Temperature

0° C = 32° F
1° C = (1 x 1.8 + 32) ° F

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UPDATE DATA

Section	Description	Page	Revision date

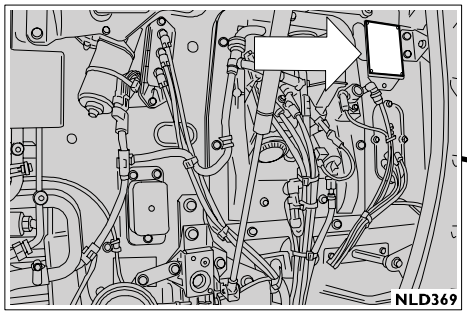
INDEX OF SECTIONS

SECTION 1

General

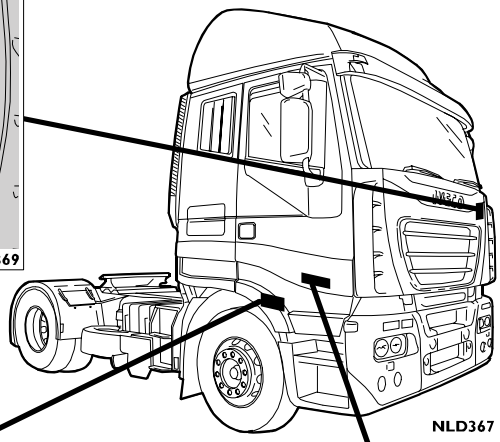
VEHICLE IDENTIFICATION DATA

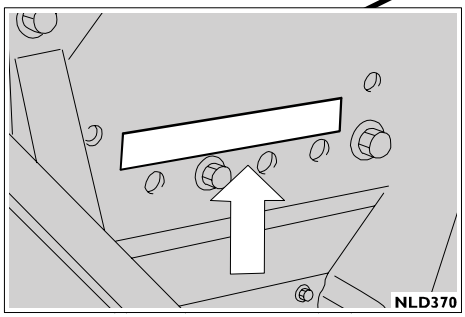
The type and number of engine, type and number of chassis and manufacturer's plate comprise the vehicle identification data.



Manufacturer's plate

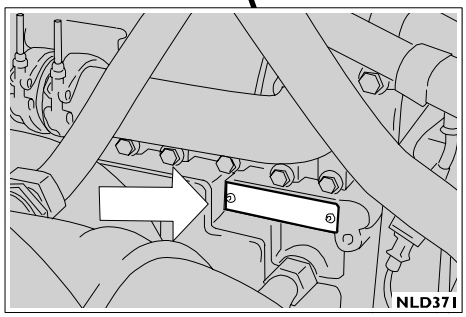
To identify the vehicle in accordance with the E.E.C. directive (under the front radiator cowling).





Chassis frame

Punching (front on right side member of chassis frame).



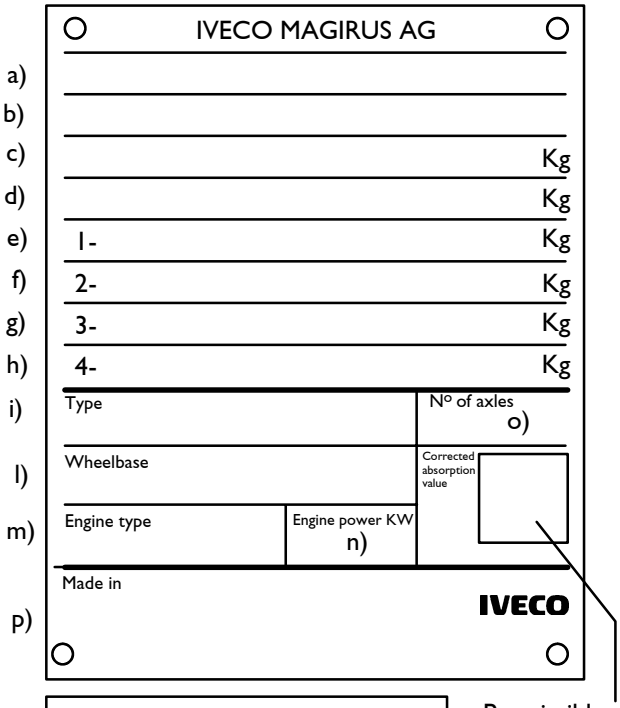
Engine

Plate on the left rear side of the crankcase.

Vehicle Identification Plate

Plate legend

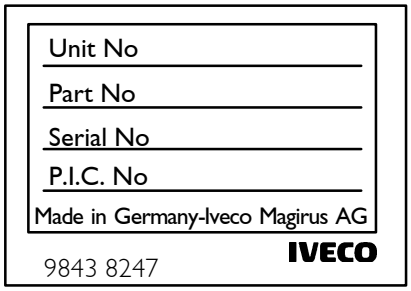
a) Type-approval number marking (if applicable).
b) Vehicle identification code number (V.I.N.).
c) Total tractor weight.
d) Total weight of tractor + trailer (if applicable).
e) Permissible weight limit on 1st axle.
f) Permissible weight limit on 2nd axle (if applicable).
g) Permissible weight limit on 3rd axle.
h) Permissible weight limit on 4th axle (if applicable).
i) Specific identification of type.
l) Wheelbase in mm.
m) Engine type.
n) Engine power.
o) No. of axles.
p) Place of manufacture.



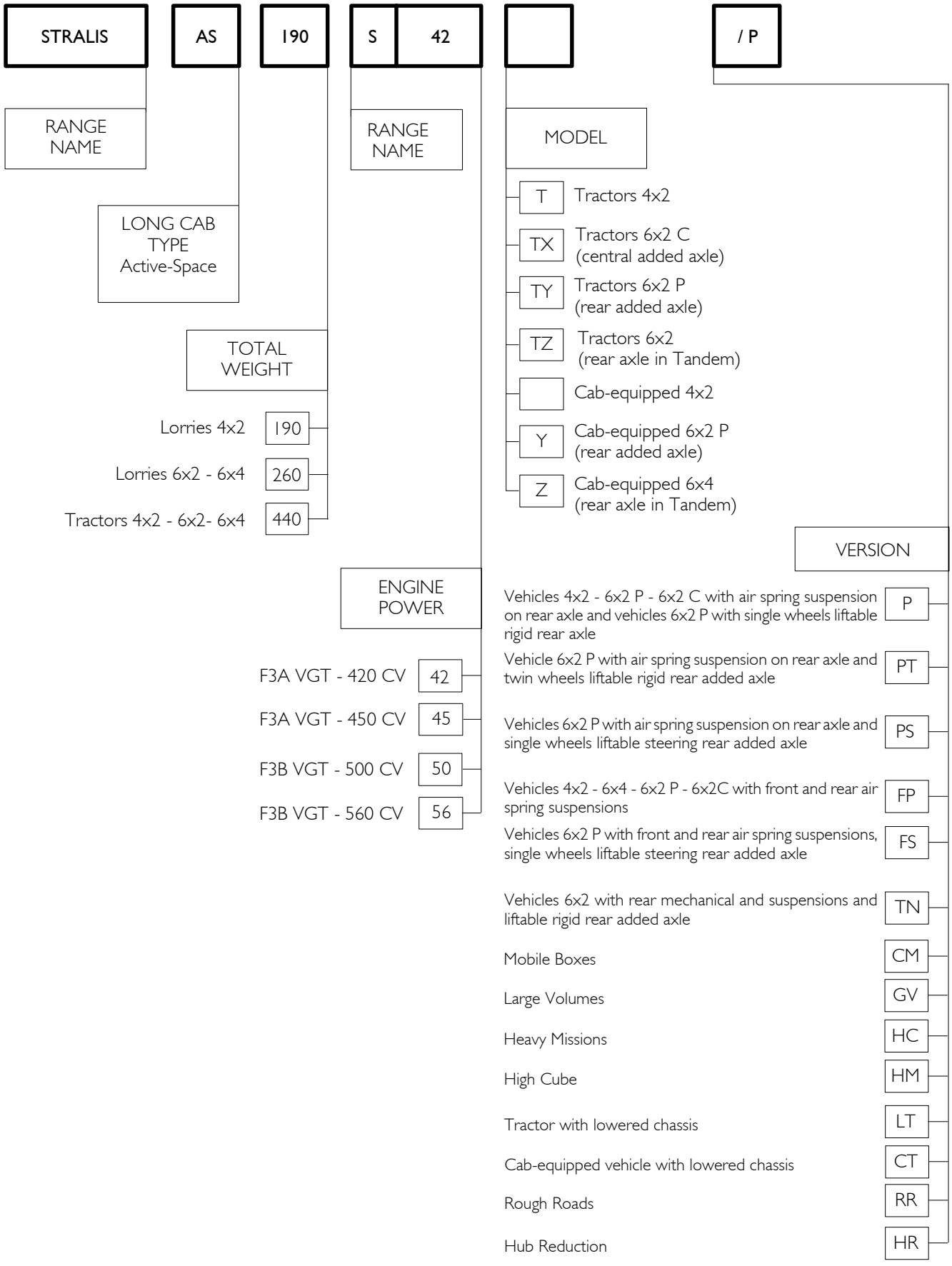
Permissible grade of smoke

Production identification plate

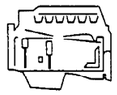
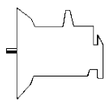
This plate shows the P.I.C. (production identification code number), which is needed when referring to the **spare parts catalogue** (electronic and/or microfiche catalogue). The P.I.C. is also given on the vehicle warranty card.
Note: When consulting the catalogues, use only the first 8 digits of the product identification code number.



COMMERCIAL CODES



COMPOSITION OF MODELS

TRACTORS - MODELS			4x2												6x2c				6x2p	6x4	
ASSEMBLIES			AS 440S 42T/P+T/P-RR	AS 440S 42T/P-HR	AS 440S 42T/FP-LT	AS 440S 45T/P+T/P-RR	AS 440S 45T/P-HR	AS 440S 45T/FP-LT	AS 440S 50T/P	AS 440S 50T/P-HR	AS 440S 50T/FP-LT	AS 440S 56T/P	AS 440S 56T/P-HR	AS 440S 56T/FP-LT	AS 440S 42TX/P	AS 440S 45TX/P	AS 440S 50TX/P	AS 440S 56TX/P	AS 440S 50TY/PT	AS 260S 50TZ/P-HM	AS 260S 56TZ/P-HM
	F3AE3681D (420 CV)		○	○	○										○						
	F3AE3681A (450 CV)					○	○	○								○					
	F3BE3681B (500 CV)								○	○	○						○		○	○	
	F3BE3681A (560 CV)											○	○	○				○			○
	Single disc 17"		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	16S 1920 TD		○		○										○						
	16S 2220 TD					○		○								○					
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	16S 2520 TO									○		○	○	○				○			○
	12 AS1930 TD		○		○										○						
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		5876/5			●			●			●			●							
		5876		○			○			○			○								
	ADDED AXLE:	5876/4													⊗	⊗	⊗	⊗			
		55080/DI																			
		57080/DI																			
		56082/DI																	○		
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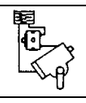
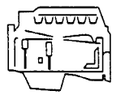
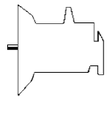
	MERITOR MT 23-155/D																			○	○
	ZF 8098		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	FRONT MECHANICAL Parabolic		○	○		○	○		○	○		○	○		○	○	○	○	○	○	○
	PNEUMATIC	Front			□			□			□			□							
		Rear	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		Added axle													○	○	○	○	○		

⊗ = With brake calliper assembly at 57° without parking brake □ = With parabolic leaf springs ● = With parabolic leaf springs

COMPOSITION OF MODELS

CAB-EQUIPPED VEHICLES - MODELS			4x2									6x2p																												6x4	
ASSEMBLIES			AS 190S 42/P	AS 190S 42/FP-CM	AS 190S 42/FP-GV	AS 190S 45/P	AS 190S 45/FP-CM	AS 190S 45/FP-GV	AS 190S 50/P	AS 190S 50/FP-CM	AS 190S 50/FP-GV	AS 260S 42Y/FP-CM	AS 260S 42Y/FP-GV	AS 260S 42Y/FS-CM	AS 260S 42Y/FS-GV	AS 260S 42Y/P	AS 260S 42Y/PS	AS 260S 42Y/PT	AS 260S 45Y/FP-CM	AS 260S 45Y/FP-GV	AS 260S 45Y/FS-CM	AS 260S 45Y/FS-GV	AS 260S 45Y/P	AS 260S 45Y/PS	AS 260S 45Y/PT	AS 260S 50Y/FP-CM	AS 260S 50Y/FP-GV	AS 260S 50Y/FS-CM	AS 260S 50Y/FS-GV	AS 260S 50Y/P	AS 260S 50Y/PS	AS 260S 50Y/PT	AS 260S 56Y/FP-CM	AS 260S 56Y/FS-CM	AS 260S 56Y/P	AS 260S 56Y/PS	AS 260S 56Y/PT	AS 260S 50Z/P-HM	AS 260S 56Z/P-HM
	F3AE3681D (420 CV)		○	○	○							○	○	○	○	○	○	○																					
	F3AE3681A (450 CV)					○	○	○											○	○	○	○	○	○	○														
	F3BE3681B (500 CV)								○	○	○															○	○	○	○	○	○	○						○	
	F3BE3681A (560 CV)																																○	○	○	○	○		○
	Single disc 17"		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	16S 1920 TD		○	○	○							○	○	○	○	○	○	○																					
	16S 2220 TD					○	○	○											○	○	○	○	○	○	○														
	16S 2220 TO																																							
	16S 2320 TD								○	○	○															○	○	○	○	○	○	○						○	
	16S 2520 TO																																○	○	○	○	○		○
	12 AS1930 TD		○	○	○							○	○	○	○	○	○	○																					
	12 AS2330 TD					○	○	○	○	○	○								○	○	○	○	○	○	○	○	○	○	○	○	○	○						○	
	12 AS2330 TO																																							
	12 AS2530 TO																																○	○	○	○	○		○
	FRONT AXLE:	5876/4	⊗	⊗		⊗	⊗		⊗	⊗		⊗		⊗		⊗	⊗	⊗	⊗		⊗		⊗	⊗	⊗					⊗	⊗	⊗			⊗	⊗	⊗	⊗	⊗
		5876/5			●			●			●		●		●					●		●				●	●	●	●				●	●					
		5876																																					
	ADDED AXLE:	5876/4																																					
		55080/DI										○	○			○			○	○			○			○	○			○			○		○				
		57080/DI												○	○		○				○	○		○				○	○		○			○		○			
		56082/DI																○							○						○					○			
	MERITOR MS 13-175/D		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		
	451391 HR																																							
	MERITOR MT 23-155/D																																						○	○
	ZF 8098		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	FRONT MECHANICAL: Parabolic		○			○			○							○	○	○					○	○	○					○	○	○			○	○	○	○	○
	PNEUMATIC	Front		◇	□		◇	□		◇	□	◇	□	◇	□				◇	□	◇	□				◇	□	◇	□				◇	◇					
		Rear	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		Added axle										○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		

⊗ = With brake calliper assembly at 57° without parking brake
● = With brake calliper assembly at 0° with parking brake
◇ = With parabolic leaf springs
□ = With drum brakes

P.I.C. NUMBER CODING

CAB LIVEABILITY

A	A	A	B	B	C	C	D

Z ⇨ = Stralis AS (Active Space)

TOTAL WEIGHT ON GROUND - AXLES CONFIGURATION

A	A	A	B	B	C	C	D

- A ⇨ = 4x2; 18-20 ton
- B ⇨ = 4x2T; 18-20 ton
- C ⇨ = 6x2P; 26 ton
- D ⇨ = 6x2P; 26 ton
- E ⇨ = 6x2C; 26 ton
- F ⇨ = 4x2; 18-20 ton
- G ⇨ = 4x2T; 18-20 ton
- H ⇨ = 6x2P; 26 ton
- J ⇨ = 6x4; 26 ton
- K ⇨ = 6x4T; 26 ton
- L ⇨ = 6x2P; 26 ton
- M ⇨ = 6x2P; 26 ton
- N ⇨ = 6x2C; 26 ton

ENGINE

A	A	A	B	B	C	C	D

- D ⇨ E 420
- E ⇨ E 450
- F ⇨ E 500
- G ⇨ E 560

SUSPENSION TYPE - REAR AXLE TYPE - TYPE OF ADDITIONAL AXLE

A	A	A	B	B	C	C	D

- **B** ⇨ Pneumatic - SR - CENT/SING/TWIN
- **C** ⇨ Integral air suspension- SR - SING
- **E** ⇨ Pneumatic - SR - STER
- **E** ⇨ Pneumatic - HR (Tractor 4x2)
- **F** ⇨ Integral air suspension- SR - STER

TWIN = Twin rear wheels
CENT = Middle axle (6x2C vehicles)
SING = Added axle with rear single wheels
STER = Added axle with rear steering single wheels
HR = Double reduction rear axle
SR = Simple reduction rear axle

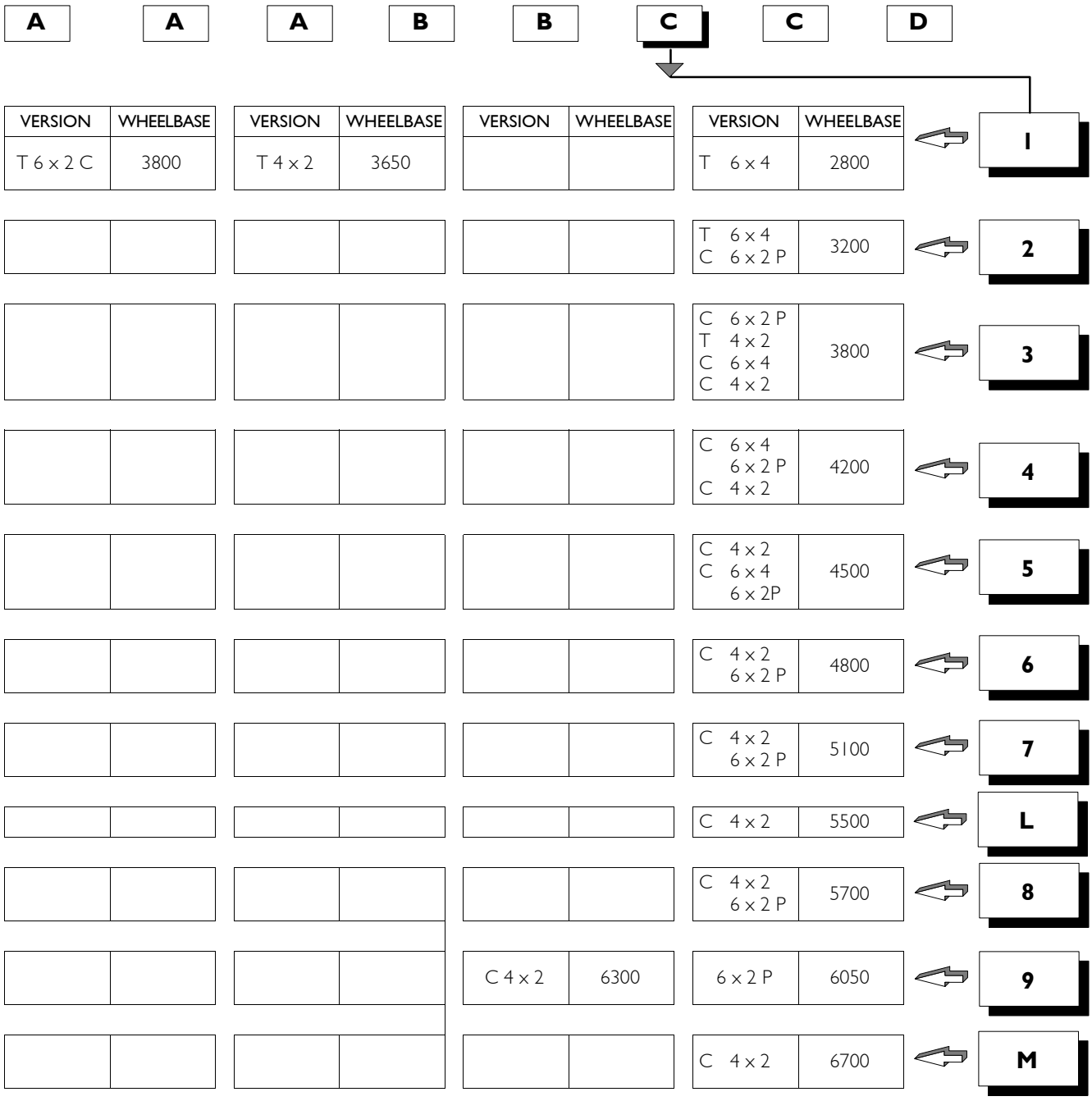
VERSION COMBINATION - USE

A	A	A	B	B	C	C	D

- **I** ⇨ = Chassis cab - STD
- **K** ⇨ = Chassis cab - GRAV
- **L** ⇨ = LOW CH - STD
- **U** ⇨ = CM - STD
- **2** ⇨ = Tractor - STD
- **H** ⇨ = Tractor - GRAV
- **T** ⇨ = LOW TR - STD

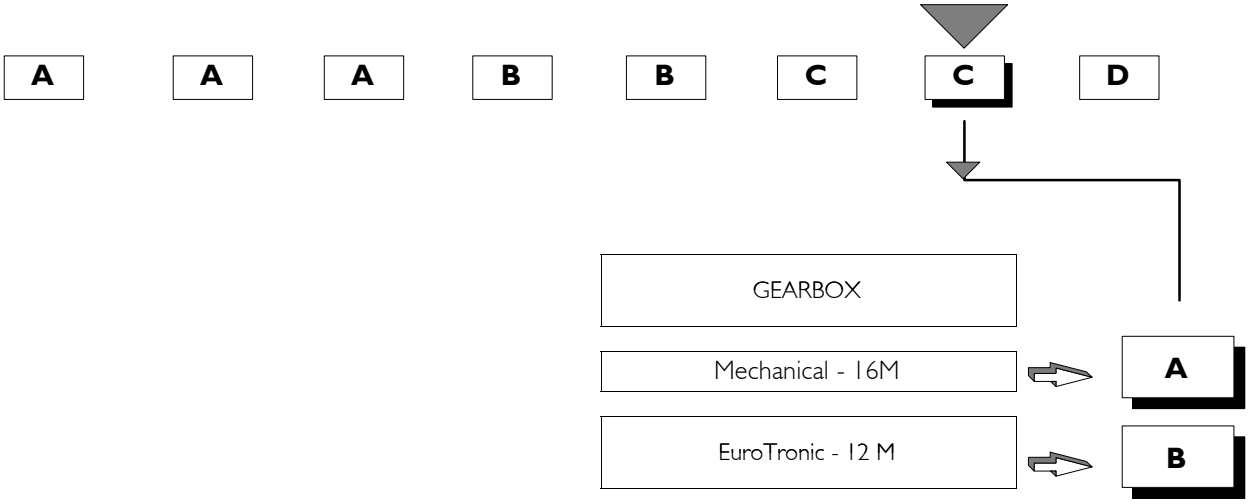
Cartran = Car transport
LOW TR = Lowered tractor
STD = Standard use
GRAV = Heavy duty use
LOW CH = Lowered chassis cab
CM = Mobile Boxes

WHEELBASE

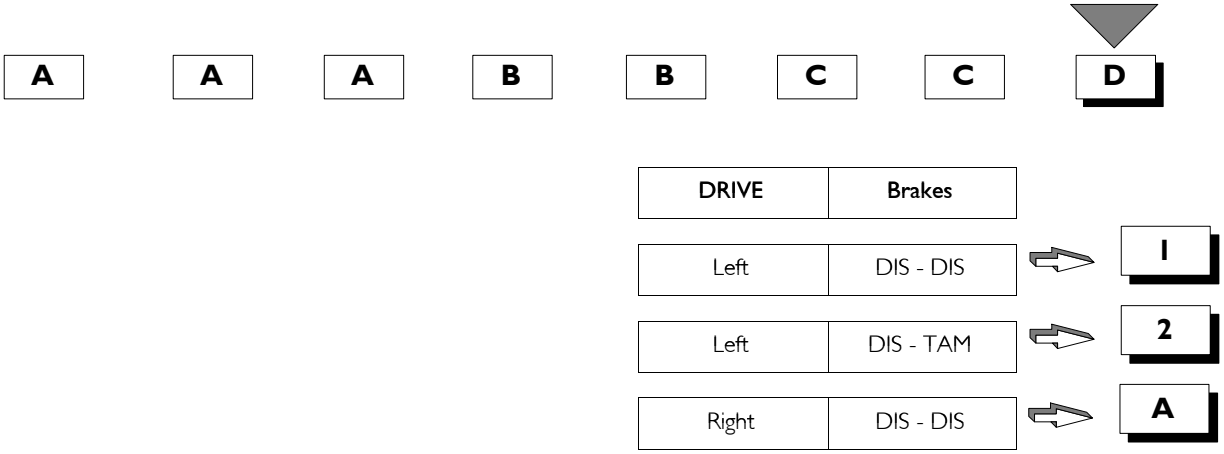


VERSION	WHEELBASE	VERSION	WHEELBASE	VERSION	WHEELBASE	VERSION	WHEELBASE	
T 6 x 2 C	3800	T 4 x 2	3650			T 6 x 4	2800	1
						T 6 x 4 C 6 x 2 P	3200	2
						C 6 x 2 P T 4 x 2 C 6 x 4 C 4 x 2	3800	3
						C 6 x 4 6 x 2 P C 4 x 2	4200	4
						C 4 x 2 C 6 x 4 6 x 2P	4500	5
						C 4 x 2 6 x 2 P	4800	6
						C 4 x 2 6 x 2 P	5100	7
						C 4 x 2	5500	L
						C 4 x 2 6 x 2 P	5700	8
				C 4 x 2	6300	6 x 2 P	6050	9
						C 4 x 2	6700	M

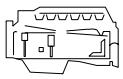
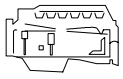
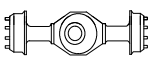
GEARBOX - COMBINATION



DRIVE - BRAKES COMBINATION



REPLENISHING FLUIDS

LUBRICANTS RECOMMENDED BY IVECO	PARTS FOR REPLENISHING		Quantity Litres	Quantity kg
Urania FE 5W30[1] Urania LD7 	Engine F3A			
	Total capacity 1st filling		32	28.8
	Capacity:			
	- engine sump at minimum level		17	15.3
	- engine sump at maximum level		25	22.5
	- quantity in circulation that does not return to sump		7	6.3
	- quantity contained in cartridge filter (to add when changing the cartridge filter)		2.5	2.3
Urania FE 5W30[1] Urania LD7 	Engine F3B			
	Total capacity 1st filling		35	31.5
	Capacity:			
	- engine sump at minimum level		20	18
	- engine sump at maximum level		28	25.5
	- quantity in circulation that does not return to sump		7	6.3
	- quantity contained in cartridge filter (to add when changing the cartridge filter)		3	2.7
Tutela Truck FE-Gear[1] Tutela ZC 90 	Gearbox			
	ZF 16 S 1920/2220/2320/2520 *		13	11,7
	ZF 16 S 1921/2221/2321/2521 * (with Intarder)		21.5	19.3
	Eurotronic 12 AS 1930/2330/2530 *		12	10,6
	Eurotronic 12 AS 1931/2331/2531 * (with Intarder)		21	18,9
* Quantity 1st filling				
Tutela Truck FE-Axle[2] Tutela W140/M-DA Tutela W90/M-DA[3]	Front hubs (single)			
	FRONT AXLE	5876/4-/5	0.33	0.30
	ADDED AXLE:			
	Steering central	5876/4	0.33	0.30
	Steering rear	57080/DI	0.33	0.30
	Rigid rear axle	55080/DI	0.33	0.30
	Rigid rear axle	56082/DI	0.33	0.30
Tutela Truck FE-Axle[2] Tutela W140/M-DA Tutela W90/M-DA[3] 	Rear axle MS 13-175		18.5	16.6
	Rear axle 451391		16	14.5
	Rear axle in tandem MT 23 - 155			
	- middle		20	18
	- rear		18.5	16.6

(1) IVECO recommends using these types of oil to derive benefit as far as fuel economy is concerned. IVECO provides new vehicles already with these types of lubricants (also suited for cold climates minimum temperature down to -30°C)
(2) Only on axles with disc brakes. Note (1) holds for these
(3) Specific for cold climates
These quantities are not decisive. An exact check must be made by verifying the levels

LUBRICANTS RECOMMENDED BY IVECO		PARTS FOR REPLENISHING		Quantity Litres	Quantity kg
Tutela GI/A		Power steering		2.7* 13.5**	2.4 12
		* Excluding vehicles with steering rear axle ** For vehicles with steering rear axle only			
Tutela TRUCK DOT SPECIAL		Clutch circuit (excluding vehicles with Euro Tronic gearbox)		0.5	0.45
Water+Paraflu[11]		Cooling system Engine 43A Engine 43A with Intarder Engine 43B Engine 43B with Intarder	 Total capacity* Total capacity* Total capacity* Total capacity*	 ~38 ~58 ~44 ~64	
		* = Protective anti-freeze (concentration 50% freezing point –35°C)			
Tutela TILT CAB		Cab tilting system		0.6	0.54

These quantities are not decisive. An exact check must be made by verifying the levels

International lubricant designation		FL products
Engine oil Meets the specifications: **ACEA E4 with a totally synthetic base** ACEA E7 with a mineral base	 **SAE 5W 30** SAE 15W 40	 **URANIA FE 5W30** Urania LD7
Oil for differential gear and wheel hubs Meets the specifications: **API GL5, MT-1 with a totally synthetic base** API GL5 with a mineral base API GL5 with a mineral base	 **SAE 75W 90** SAE 85W 140 SAE 80W 90	 **Tutela Truck FE-Axle** (1) Tutela W140/M-DA Tutela W90/M-DA (2)
Oil for mechanical gearboxes Containing non-EP anti-wear additives Meets the specifications: **API GL4 with a totally synthetic base** API GL3 with a mineral base	 **SAE 75W 80** SAE 80W 90	 **Tutela Truck FE-Gear** (3) Tutela ZC90
Oil for power steering and hydrostatic transmissions A.T.F. DEXRON II D		Tutela GI/A
Grease for general greasing based on lithium soaps, N.L.G.I. consistency no. 2		Tutela MR 2
Specific grease for bearings and wheel hubs based on lithium soaps, N.L.G.I. consistency no. 3		Tutela MR 3
Clutch drive fluid Conforming to N.H.T.S.A. standards N. 116, ISO 4925, Std. SAEJ 1703, IVECO STANDARD 18-1820		Tutela TRUCK DOT SPECIAL
Hydraulic fluid with a very high viscosity index (over 300), at performance level MIL-H- 5606 A		Tutela TILT CAB
Windscreen washer fluid, mixture of spirit, water and surfactants CUNA NC 956-11		Tutela PROFESSIONAL SC 35
Grease for central lubrication systems based on lithium soaps, with synthetic base, N.L.G.I. no. 2. Working temperatures: from –30°C to +140°C		Tutela COMAR 2
Concentrated protective fluid for radiators based on ethylene glycol containing corrosion inhibitors, conforming to the standard: IVECO-STANDARD 18-1830 To use diluted with water to 50%.		Paraflu[11]

(1) Only on axles with disc brakes. Note (3) holds for these

(2) Specific for cold climates

(3) IVECO recommends using these types of oil to derive benefit as far as fuel economy is concerned.
IVECO provides new vehicles already with these types of lubricants. Also suited for cold climates minimum (temperature down to -30°C)

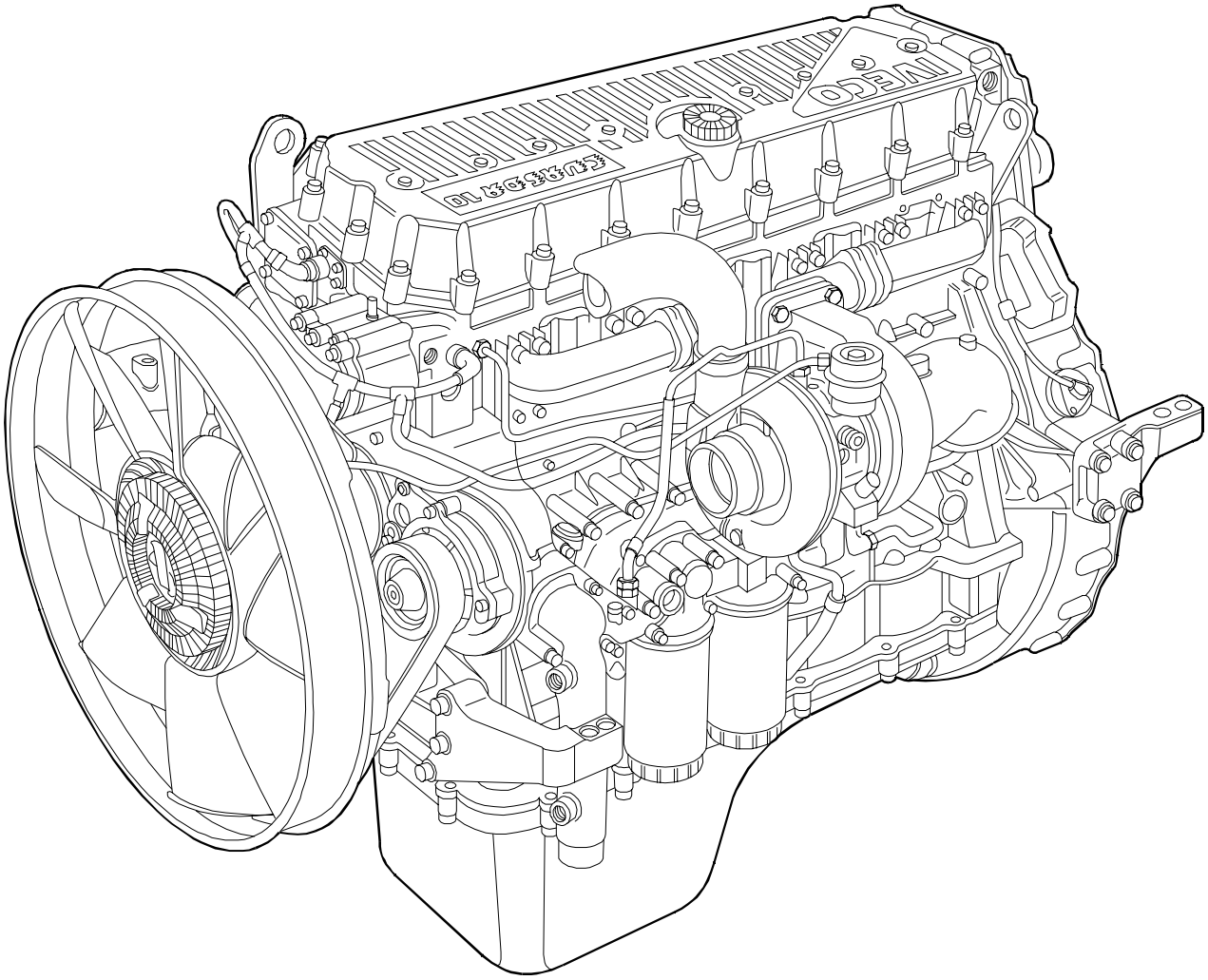
SECTION 2

Engine

F3A Engine

VIEWS OF THE ENGINE

Figure 1



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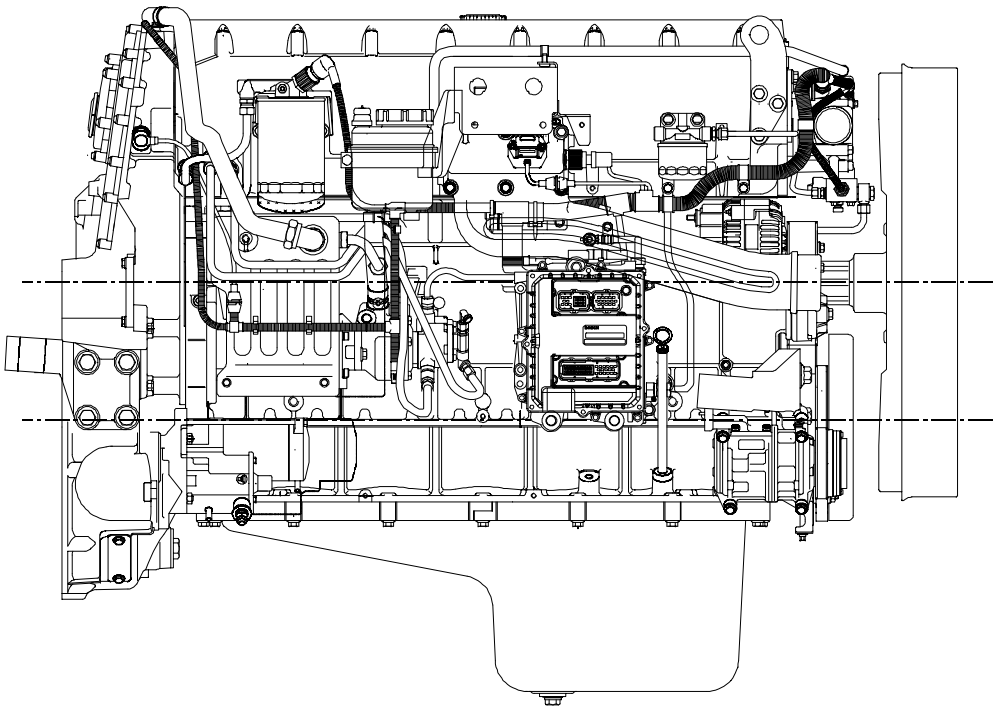
F3A ENGINE

Figure 2



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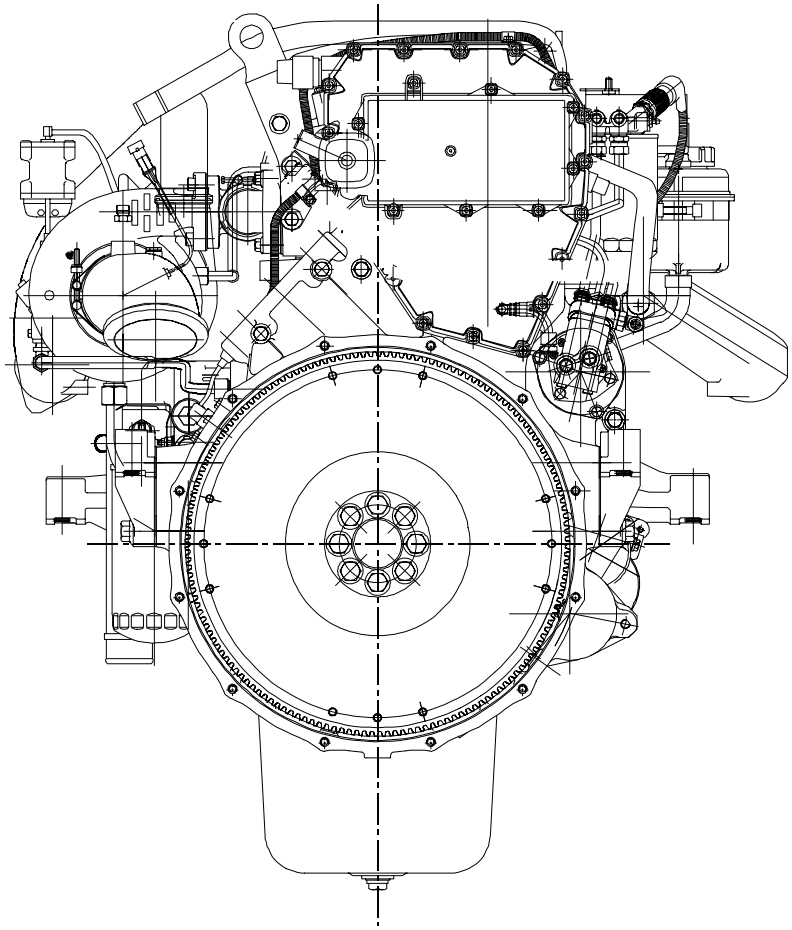
RIGHT-HAND SIDE VIEW OF THE ENGINE

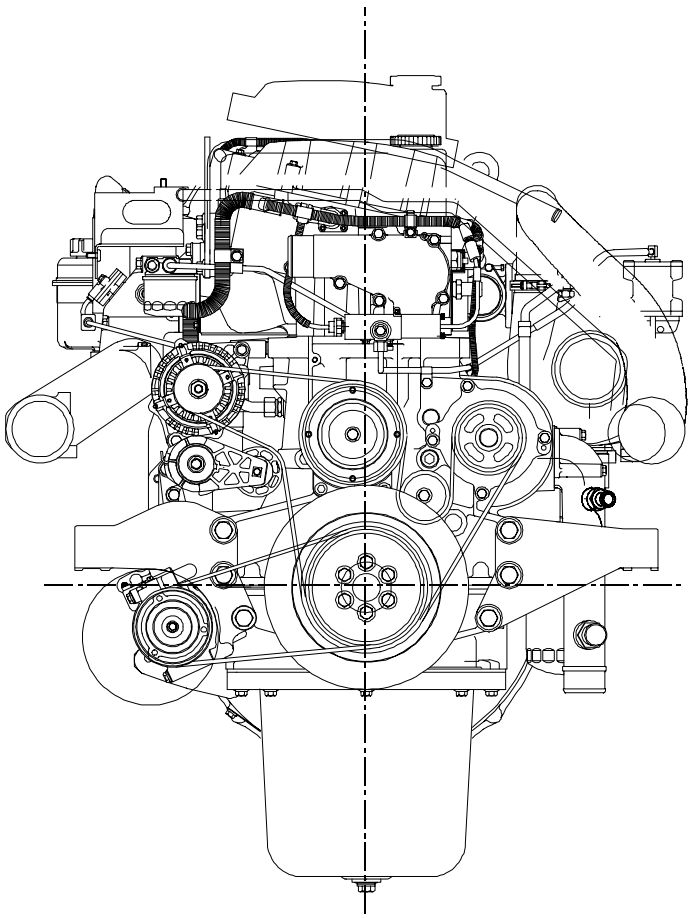
Figure 3



73527

REAR VIEW OF THE ENGINE

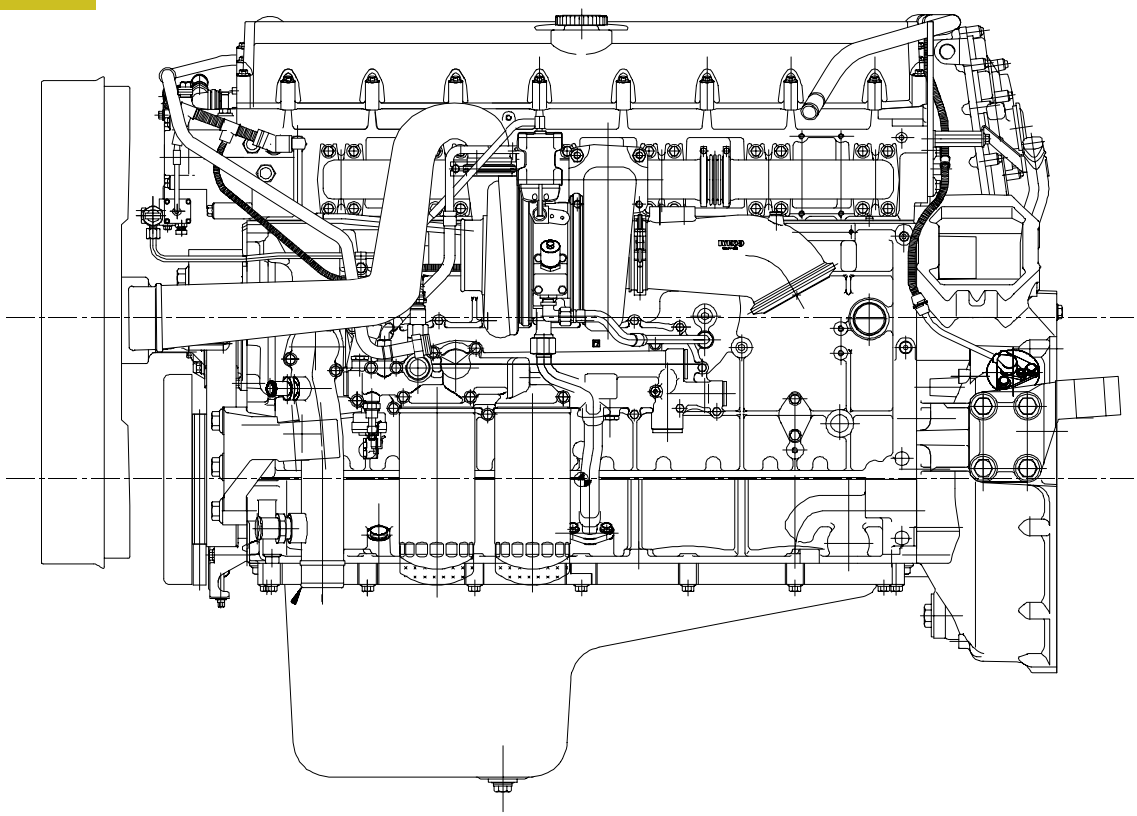
Figure 4



106681

RIGHT-HAND SIDE VIEW OF THE ENGINE

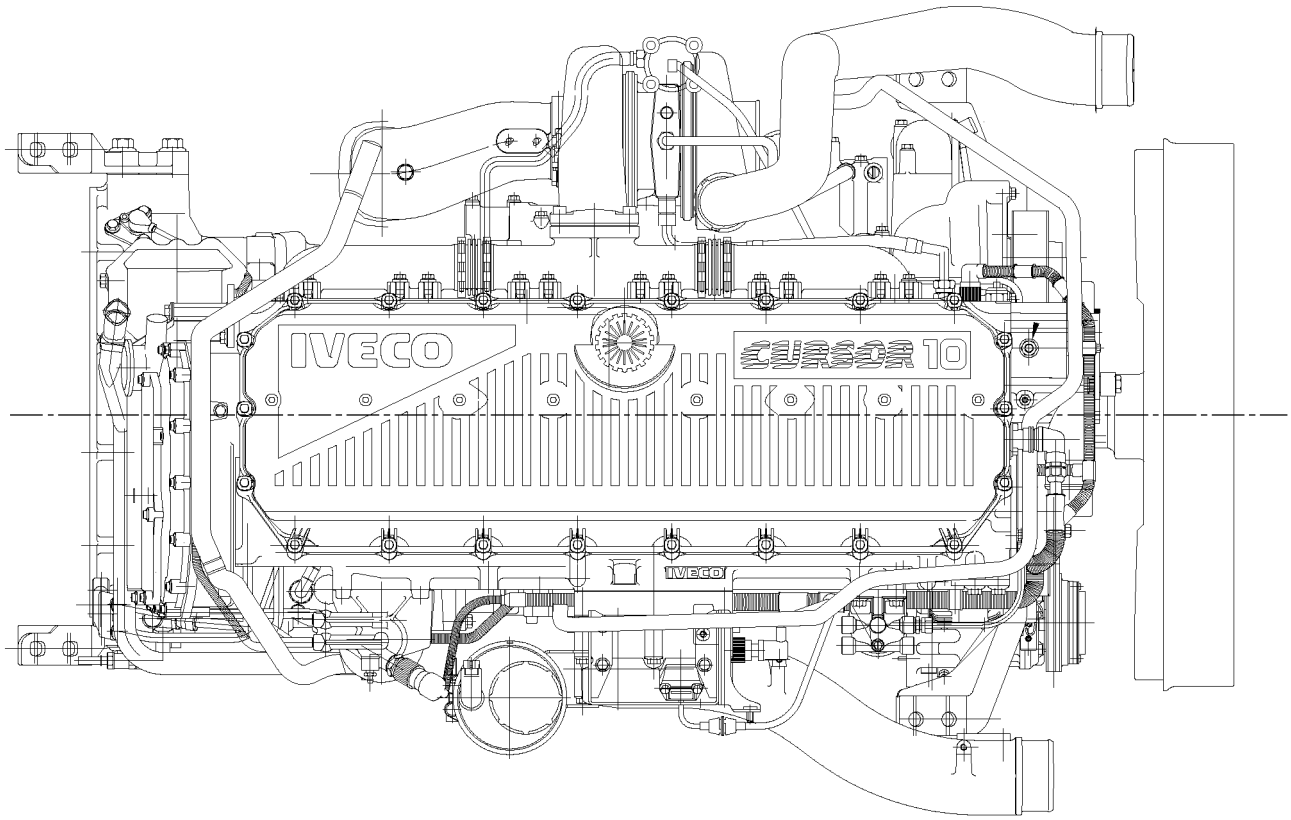
Figure 5



73529

LEFT-HAND SIDE VIEW OF THE ENGINE

Figure 6



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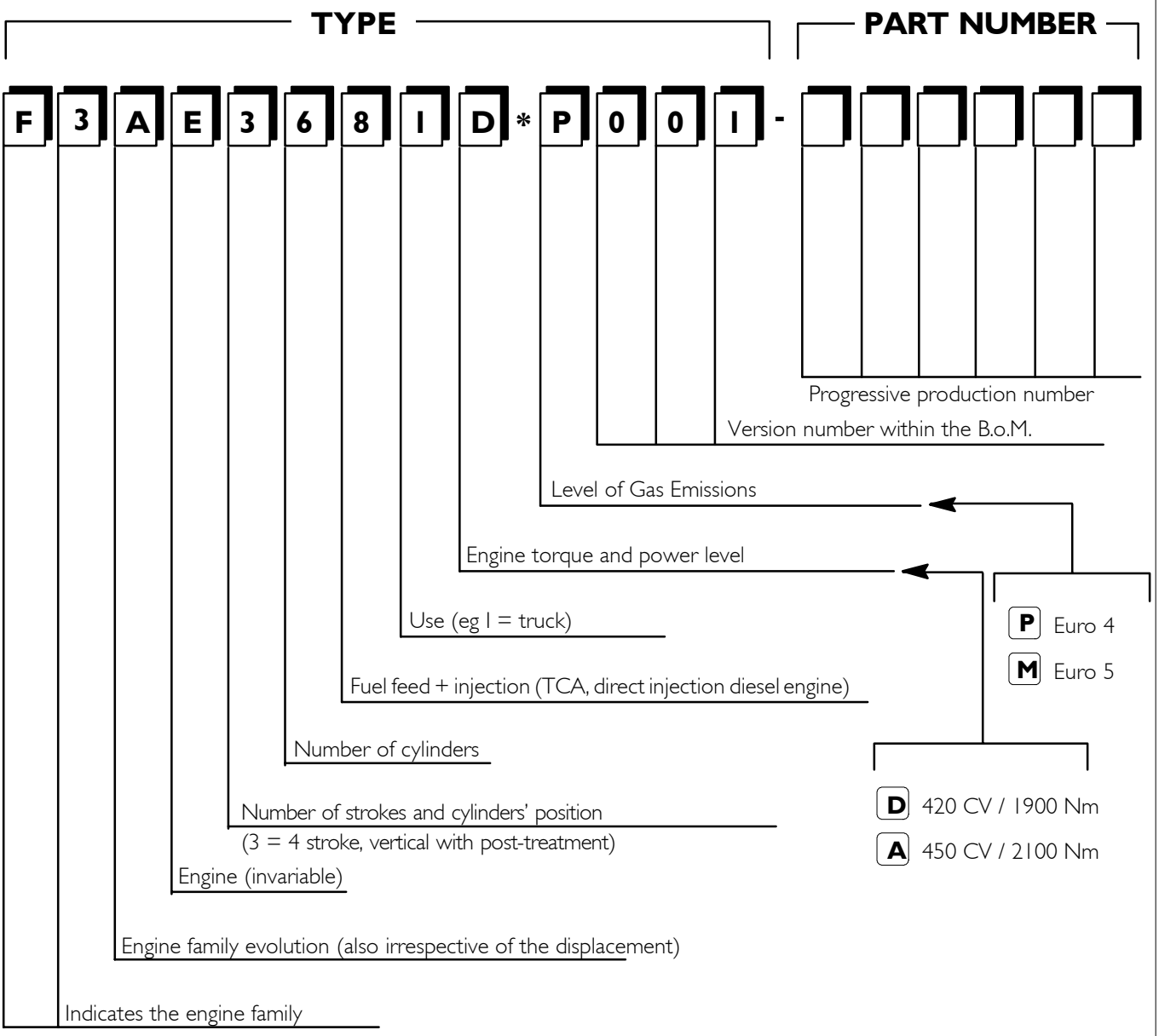
VIEW OF THE ENGINE FROM ABOVE

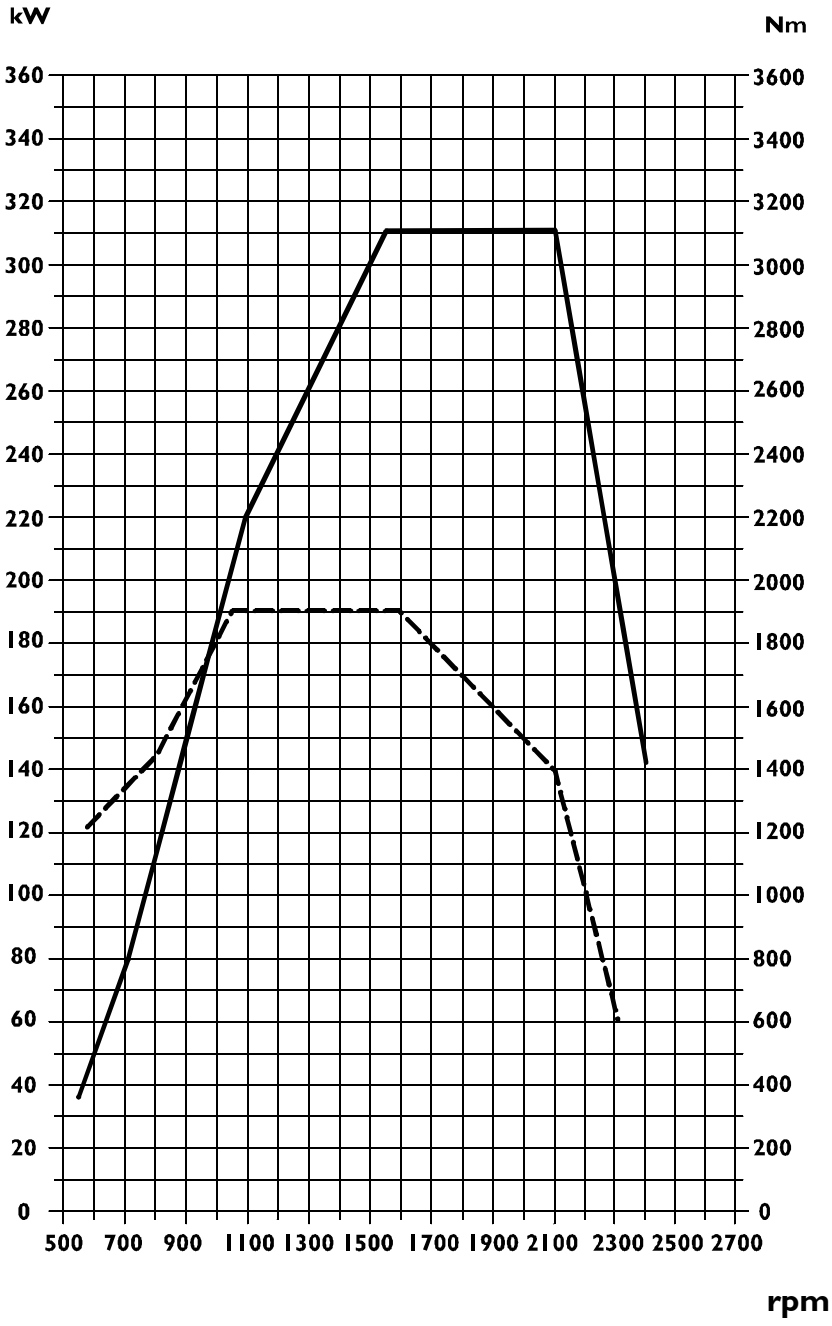
TECHNICAL DESIGNATION

ENGINE



CHARACTERISTIC CURVES

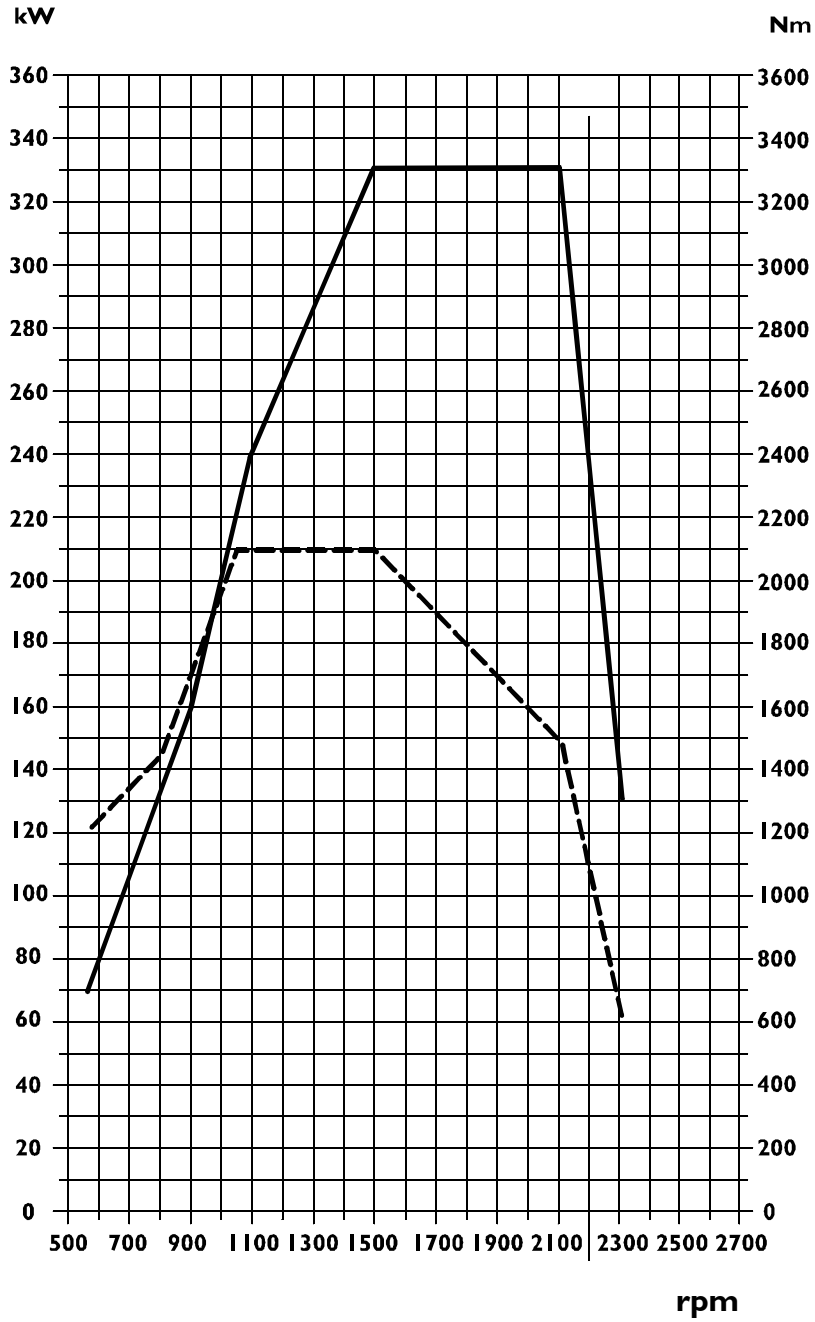
Figure 7



CHARACTERISTIC CURVES OF ENGINE F3AE 3681D

Max OUTPUT 310 kW	**420 HP**	**at 2100 rpm**
Max TORQUE 1900 Nm	**174 kgm**	**at 1050 ÷ 1550 rpm**

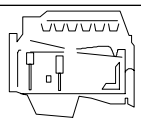
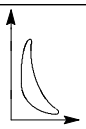
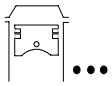
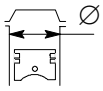
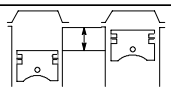
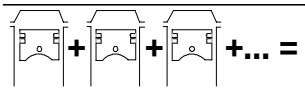
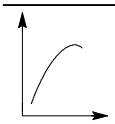
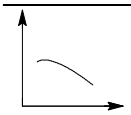
Figure 8

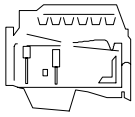
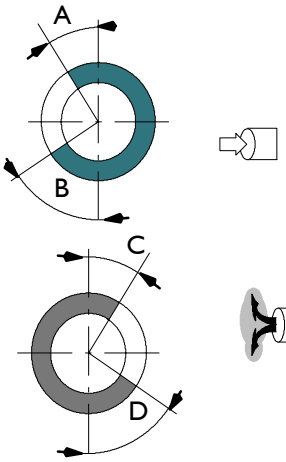
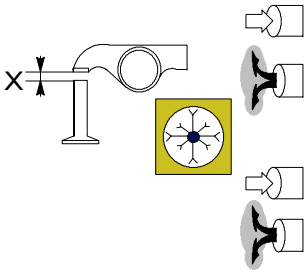
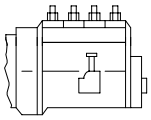
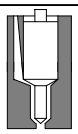
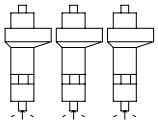


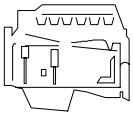
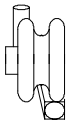
CHARACTERISTIC CURVES OF ENGINE F3A 3681A

Max OUTPUT 330 kW	**450 CV**	**at 2100 rpm**
Max TORQUE 2100 Nm	**214 kgm**	**at 1050 ÷ 1550 rpm**

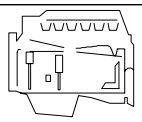
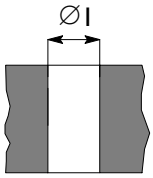
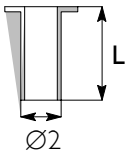
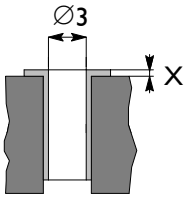
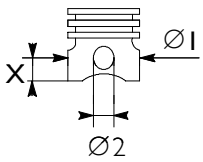
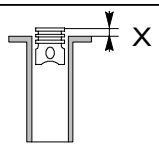
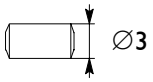
GENERAL CHARACTERISTICS

	Type		F3AE3681D	F3AE3681A
	Cycle		4-stroke Diesel engine	
	Fuel feed		Turbocharged with aftercooler	
	Injection		Direct	
	No. of cylinders		6 in line	
	Bore	mm	125	
	Stroke	mm	140	
	Total displacement	cm^3	10300	
Q	Compression ratio		16.5 : 1	
	Max output	KW (HP)	310 (420)	330 (450)
		rpm	2100	2100
	Max. torque	Nm (kgm)	1900 (193)	2100 (214)
		rpm	1050 ÷ 1550	1050 ÷ 1550
	Engine idling speed, no load	rpm	550 ± 50	
	Maximum engine speed, no load	rpm	2420 ± 50	

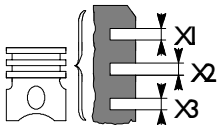
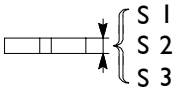
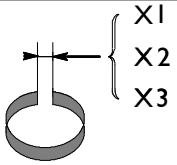
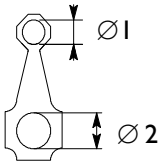
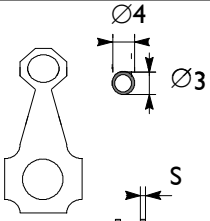
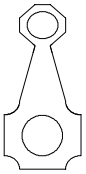
	Type	**F3A**
	VALVE TIMING opens before T.D.C. A closes after B.D.C. B opens before B.D.C. D closes after T.D.C. C	 16° 32° 50° 9°
	For timing check X mm mm Running X mm mm	 - - 0.35 to 0.45 0.45 to 0.55
	FEED	Through fuel pump - filters
	Injection type: Bosch	With electronically regulated injectors UIN3.1 pump injectors controlled by overhead camshaft
	Nozzle type	–
	Injection order	1 - 4 - 2 - 6 - 3 - 5
	Injection pressure bar Injector calibration bar	2000 296 ± 6

	Type	**F3A**
	SUPERCHARGING Turbocharger type	 Variable geometry Holset HE 531 V
	LUBRICATION	Forced by gear pump, pressure control valve, oil filter
 	Oil pressure with hot engine (100°C ±5°C): at idling speed bar at maximum rpm bar	 1.5 5
	COOLING	By centrifugal pump, regulating thermostat, viscostatic fan, radiator and heat exchanger
	Water pump control	By belt
	Thermostat initial opening maximum opening	N. 1 ~84°C ±2°C 94°C ±2°C
 **Urania FE 5W30** Urania LD7	OIL FILLING Total capacity at 1st filling litres kg	 32 28.8
	Capacities - engine sump min level litres kg - engine sump max level litres kg - quantity in circulation that does not flow back to the engine sump litres kg - quantity contained in the cartridge filter (which has to be added to the cartridge filter refill) litres kg	 17 15.3 25 22.5 7 6.3 2.5 2.3

ASSEMBLY CLEARANCE DATA

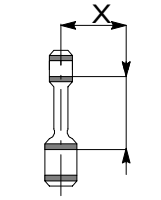
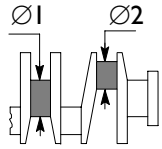
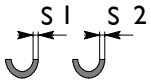
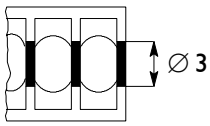
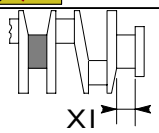
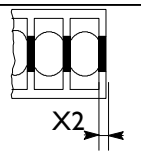
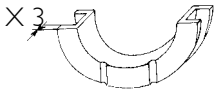
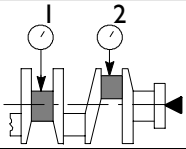
	Type	F3A
CYLINDER BLOCK AND CRANKMECHANISM COMPONENTS		mm
	Bores for cylinder liners: Ø1 upper Ø1 lower	 142.000 to 142.025 140.000 to 140.025
	Cylinder liners: external diameter: Ø2 upper Ø2 lower length L	 141.961 to 141.986 139.890 to 139.915
	Cylinder liners - crankcase bores upper lower	 0.014 to 0.064 0.085 to 0.135
	External diameter Ø2	-
 * Selection class ** Value measured under a load of 8000 kg	Cylinder sleeve inside diameter Ø3A* inside diameter Ø3B* Protrusion X**	 125.000 to 125.013 125.011 to 125.024 0.045 to 0.075
	Pistons: measuring dimension X external diameter Ø1A● external diameter Ø1B○ pin bore Ø2	 18 124.861 to 124.873 124.872 to 124.884 50.010 to 50.016
 * Selection class	Piston - cylinder sleeve A* B*	 - -
	Piston diameter Ø1	-
	Pistons protrusion X	0.23 to 0.53
	Gudgeon pin Ø3	49.994 to 50.000
	Gudgeon pin - pin housing	0.010 to 0.022

● Class A pistons supplied as spares.
○ Class B pistons are fitted in production only and are not supplied as spares.

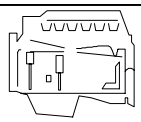
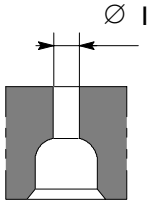
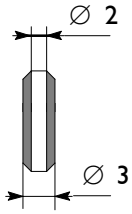
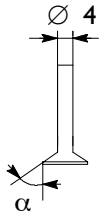
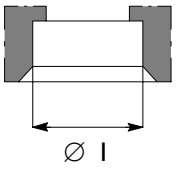
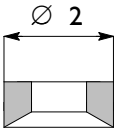
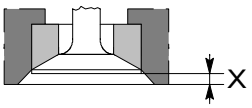
	Type		F3A mm
	Piston ring grooves * measured on Ø of 120 mm $^{+0}_{-0.15}$	X1 X2 X3	2.098 to 2.128 * 1.550 to 1.570 (••) | 3.050 to 3.070 4.020 to 4.040
	Piston rings: - trapezoidal seal - lune seal - milled scraper ring with slits and internal spring * measured at 2 mm from outer Ø	S1* S2 S3	1.929 to 1.973 1.550 to 1.570 (••) | 3.050 to 3.070 3.970 to 3.990
	Piston rings - grooves	1 2 3	0.125 to 0.199 0.050 to 0.100 0.030 to 0.070
IVECO PARTS 	Piston rings		-
	Piston ring end gap in cylinder liners	X1 X2 X3	0.35 to 0.45 0.60 to 0.75 0.35 to 0.65
	Small end bush housing Big end bearing housing - Class - Class - Class	Ø1 Ø2 1 2 3	54.000 to 54.030 87.000 to 87.010 87.011 to 87.020 87.021 to 87.030
	Small end bush diameter outside inside Big end bearing shell Red Green Yellow ●	Ø4 Ø3 S	54.085 to 54.110 50.019 to 50.035 1.970 to 1.980 1.981 to 1.990 1.991 to 2.000
	Small end bush - housing		0.055 to 0.110
	Piston pin - bush		0.019 to 0.041
IVECO PARTS 	Big end bearing		0.127 - 0.254 - 0.508
	Connecting rod weight Class	A B C	4024 to 4054 g. 4055 to 4085 g. 4086 to 4116 g.

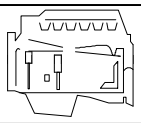
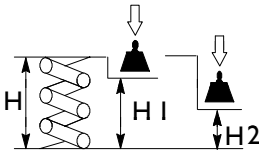
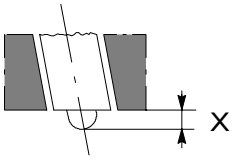
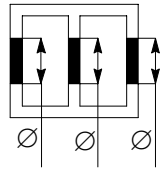
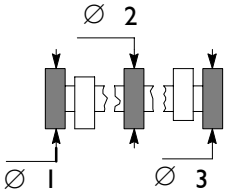
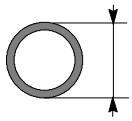
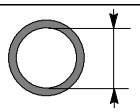
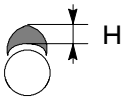
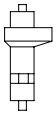
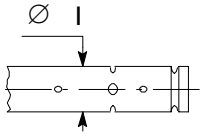
● Fitted in production only and not supplied as spares

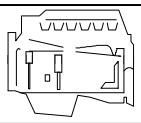
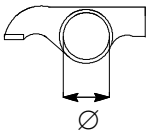
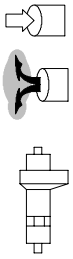
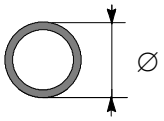
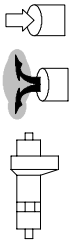
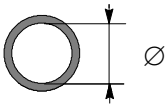
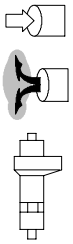
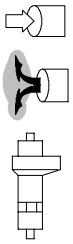
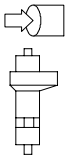
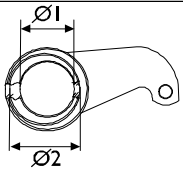
●● Old part number

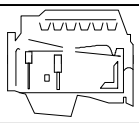
	Type	F3A
		mm
	Measuring dimension X	125
	Max. connecting rod axis misalignment tolerance //	0.08
	Main journals Ø1	
	- nominal	92.970 to 93.000
	- class 1	92.970 to 92.979
	- class 2	92.980 to 92.989
	- class 3	92.990 to 93.000
	Crankpins Ø2	
	- nominal	82.970 to 83.000
	- class 1	82.970 to 82.979
	- class 2	82.980 to 82.989
	- class 3	82.990 to 83.000
	Main bearing shells S1	
	Red	2.965 to 2.974
	Green	2.975 to 2.984
	Yellow*	2.985 to 2.995
	Big end bearing shells S2	
	Red	1.970 to 1.980
	Green	1.981 to 1.990
	Yellow*	1.991 to 2.000
	Main bearing housings Ø3	
	- nominal	99.000 to 99.030
	- class 1	99.000 to 99.009
	- class 2	99.010 to 99.019
	- class 3	99.020 to 99.030
	Bearing shells - main journals	0.050 to 0.090
	Bearing shells - big ends	0.040 to 0.080
	Main bearing shells	0.127 - 2.254 - 0.508
	Big end bearing shells	0.127 - 2.254 - 0.508
	Main journal, thrust bearing X1	45.95 to 46.00
	Main bearing housing, thrust bearing X2	38.94 to 38.99
	Thrust washer halves X3	3.38 to 3.43
	Crankshaft end float	0.10 to 0.30
	Alignment // 1 - 2	0.025
	Ovalization ⌀ 1 - 2	0.040

* Fitted in production only and not supplied as spares

	Type	F3A
CYLINDER HEAD - VALVE TRAIN		mm
	Valve guide housings in cylinder head Ø1	14.980 to 14.997
	Valve guide Ø2 Ø3	9.015 to 9.030 15.012 to 15.025
	Valve guides - housings in the cylinder heads	0.015 to 0.045
IVECO PARTS	Valve guide	0.2 - 0.4
	Valves: Ø4 α Ø4 α	 8.960 to 8.975 60° 30' ± 7' 30" 8.960 to 8.975 45° 30' ± 7' 30"
	Valve stem and its guide	0.040 to 0.070
	Valve seat in head Ø1 Ø1	44.185 to 44.220 42.985 to 43.020
	Outside diameter of valve seat; angle of valve seat in cylinder head: Ø2 Ø2	44.260 to 44.275 43.060 to 43.075
IVECO PARTS	Valve guide	0.2
	Recessing of valve	0.59 to 0.91 1.8 to 2.1
	Between valve seat and head	0.040 to 0.090

		F3A
	Type	
		mm
	Valve spring height: free height H under a load of: 660 ± 33 N H1 1140 ± 57 N H2	 80 62 48.8
	Injector protrusion X	0.32 to 1.14
	Camshaft bushing housing in the cylinder head: 1 ⇒ 7 Ø	 88.000 to 88.030
	Camshaft bearing journals: 1 ⇒ 7 Ø	 82.950 to 82.968
	Outer diameter of camshaft bushings: Ø	88.153 to 88.183
	Inner diameter of camshaft bushings: Ø	83.018 to 83.085
	Bushings and housings in the cylinder head	0.123 to 0.183
	Bushings and bearing journals	0.050 to 0.135
	Cam lift:   	 9.30 9.458 13.376
	Rocker shaft Ø1	41.984 to 42.000

	Type	F3A
		mm
	Bushing housing in rocker arms 	45.000 to 45.016 59.000 to 59.019 46.000 to 46.016
	Bushing outer diameter for rocker arms 	45.090 to 45.130 59.100 to 59.140 46.066 to 46.091
	Bushing inner diameter for rocker arms 	42.025 to 42.041 56.030 to 56.049 42.015 to 42.071
	Between bushings and housings 	0.074 to 0.130 0.081 to 0.140 0.050 to 0.091
	Between bushings of rocker arms and shaft 	0.025 to 0.057 0.015 to 0.087
	Engine brake control lever Eccentric pin outer diameter Ø1 Rocker arms shaft seat Ø2	55.981 to 56.000 42.025 to 42.041

	Type	F3A
		mm
	Rocker arms and engine brake control lever pin 	0.030 to 0.068
	Rocker arm shaft and seat on engine brake control lever 	0.025 to 0.057
TURBOCHARGER		
Type		HOLSET HE 531 V with variable geometry
End play		0.025 ÷ 0.127
Radial movement		0.381 ÷ 0.533

TIGHTENING TORQUE F3A ENGINE

PART		TORQUE Nm	TORQUE kgm
Capscrews, undercrankcase to crankcase (see Figure 9) ♦			
M12x1.75 outer screws	Stage 1: pretightening	30	3
M 17x2 inner screws	Stage 2: pretightening	120	12
Inner screws	Stage 3: angle	90°	
Inner screws	Stage 4: angle	45°	
Outer screws	Stage 5: angle	60°	
Piston cooling nozzle union ♦		35 ± 2	3.5 ± 2
Capscrews, heat exchanger to crankcase ♦ (see Figure 13)			
pretightening		11.5	1.15
tightening		19	1.9
Spacer and oil sump capscrews (see Figure 14)			
pretightening		38	3.8
tightening		45	4.5
M 12x1.75 screws, gear case to crankcase ♦		63 ± 2	6.3 ± 0.2
Cylinder head capscrews (see Figure 10) ♦			
Stage 1:	pretightening	60	6
Stage 2	pretightening	120	12
Stage 3:	angle	120°	
Stage 4:	angle	60°	
Air compressor capscrews		100	10
Rocker shaft capscrew ♦			
Stage 1:	pretightening	80	8
Stage 2:	angle	60°	
Locknut, rocker adjusting screw ♦		39 ± 5	3.9 ± 0.5
Capscrews, injector securing brackets ♦		26	2.6
Capscrews, thrust plates to head ♦		19	1.9
Screw fastening the engine supporting bracket to the cylinder head			
Stage 1:	pretightening	120	12
Stage 2:	angle	45°	
Screw fastening the engine supporting bracket to the flywheel case			
Stage 1:	pretightening	100	10
Stage 2:	angle	60°	
Camshaft gear capscrews ♦			
Stage 1:	pretightening	60	6
Stage 2:	angle	60°	
Screw fixing phonic wheel to timing system gear ♦		8.5 ± 1.5	0.8 ± 0.1
Exhaust manifold capscrews • (see Figure 11)			
pretightening		40 ± 5	4 ± 0.5
tightening		70 ± 5	7 ± 0.5
Capscrews, exhaust brake actuator cylinder ♦		19	1.9
Capscrews, connecting rod caps ♦			
Stage 1:	pretightening	60	6
Stage 2:	angle	60°	
Engine flywheel capscrews ♦			
Stage 1:	pretightening	120	12
Stage 2:	angle	90°	

♦ Before assembly, lubricate with engine oil
● Before assembly, lubricate with graphitized oil

F3A ENGINE

PART		TORQUE	
		Nm	kgm
Screws fixing damper flywheel: ♦			
First phase	pre-tightening	70	7
Second phase	closing to angle	50°	
Screws fixing intermediate gear pins: ♦			
First phase	pre-tightening	30	3
Second phase	closing to angle	90°	
Screw fixing connecting rod for idle gear		25 ± 2.5	2.5 ± 0.2
Screws fixing oil pump		25 ± 2.5	2.5 ± 0.2
Screw fixing suction strainer and oil pump pipe to crankcase		25 ± 2.5	2.5 ± 0.2
Screws fixing crankshaft gasket cover		25 ± 2.5	2.5 ± 0.2
Screws fixing fuel pump/filter		37 ± 3	3.7 ± 0.3
Screw fixing control unit mount to crankcase		19 ± 3	1.9 ± 0.3
Screw fixing fuel pump to flywheel cover box		19 ± 3	1.9 ± 0.3
Screw fixing thermostat box to cylinder head		22 ± 2	2.2 ± 0.2
Screw fixing rocker cover (see Figure 15)		8.5 ± 1.5	0.8 ± 0.1
Screws and nuts fixing turbocharger • (see Figure 12)			
pre-tightening		33.5 ± 7.5	3.3 ± 0.7
tightening		46 ± 2	4.6 ± 0.2
Screws fixing water pump to crankcase		25 ± 2.5	2.5 ± 0.2
Screws fixing spacer/pulley to fan		30 ± 3	3 ± 0.3
Screw fixing automatic tensioner to crankcase		50 ± 5	5 ± 0.5
Screw fixing fixed tensioner to crankcase		105 ± 5	10.5 ± 0.5
Screws fixing fan mount to crankcase		100 ± 5	10 ± 0.5
Screws fixing starter motor		74 ± 8	7.4 ± 0.8
Screws fixing air heater to cylinder head		37 ± 3	3.7 ± 0.3
Screw fixing air compressor		74 ± 8	7.4 ± 0.8
Nut fixing gear driving air compressor		170 ± 10	17 ± 1
Screw fixing automatic tensioner for belt driving air-conditioning compressor to crankcase		26 ± 2	2.6 ± 0.2
Screw fixing alternator bracket to crankcase	L = 35 mm	30 ± 3	3 ± 0.3
	L = 60 mm	44 ± 4	4.4 ± 0.4
	L = 30 mm	24.5 ± 2.5	2.4 ± 0.2
Screws fixing hydraulic power steering pump		46.5 ± 4.5	4.65 ± 0.45
Screws fixing air-conditioner compressor to mount		24.5 ± 2.5	2.5 ± 0.25
Screws fixing guard		24.5 ± 25	2.5 ± 0.25
Filter clogging sensor fastening		55 ± 5	5.5 ± 0.5

♦ Before assembly, lubricate with engine oil
● Before assembly, lubricate with graphitized oil

F3A ENGINE

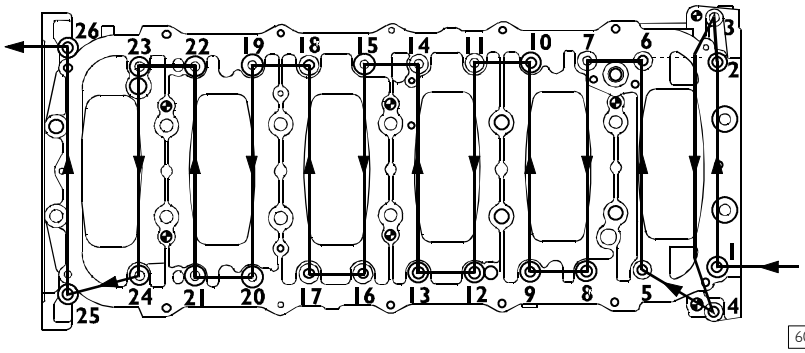
PART	TORQUE	
	Nm	kgm
Pressure transmitter fastener	8 ± 2	0.8 ± 0.2
Water/fuel temperature sensor fastener	32.5 ± 2.5	3.2 ± 0.2
Thermometric switch/transmitter fastener	23 ± 2.5	2.5 ± 0.2
Air temperature transmitter fastener	32.5 ± 2.5	3.2 ± 0.2
Pulse transmitter fastener	8 ± 2	0.8 ± 0.2
Injector-pump connections fastener	1.36 ± 1.92	0.13 ± 0.19
Screw fixing electric cables	8 ± 2	0.8 ± 0.2
Screw fixing electric cables	8 ± 2	0.8 ± 0.2
Exhaust brake solenoid valve fastener	32	3.2
PWM solenoid valve fastener	9 ± 1	0.9 ± 0.1
Motor propulsor		
M14x70/80 screw securing front and rear elastic blocks to chassis	192.5 ± 19.5	19.2 ± 1.9
M16x130 screw securing front and rear elastic blocks to engine	278 ± 28	27.8 ± 2.8
M18x62 flanged HEX screw for front engine block		
Pre-tightening 1st step	120	12
Angle closing 2nd step	45°	
M14x60 socket cheese-head TC screw for front engine block		
Pre-tightening 1st step	60	6
Angle closing 2nd step	45°	
Flanged HEX screw for rear engine block		
Pre-tightening 1st step	100	10
Angle closing 2nd step	60°	

♦ Before assembly, lubricate with engine oil
● Before assembly, lubricate with graphitized oil

F3A ENGINE
DIAGRAMS OF TIGHTENING SEQUENCE FOR MAIN PARTS OF ENGINE

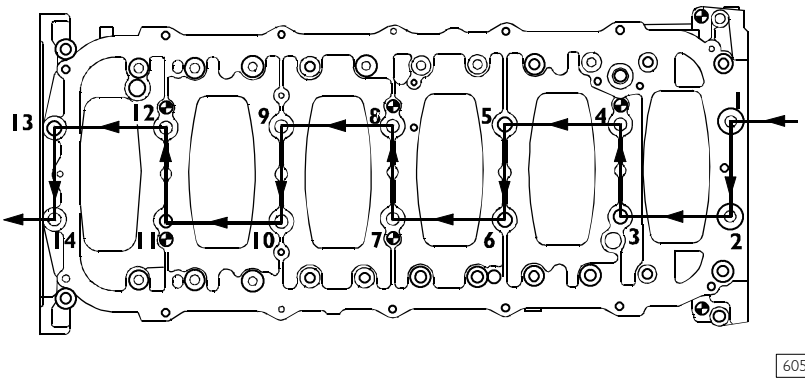
Figure 9

FRONT SIDE



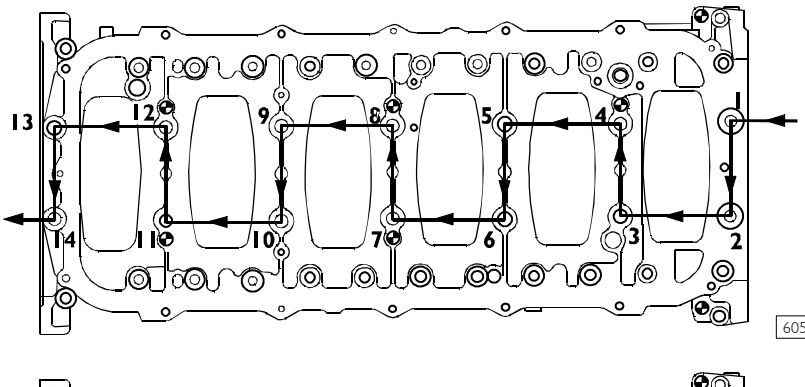
stage 1:
pretightening,
outer screws
(30 Nm)

FRONT SIDE



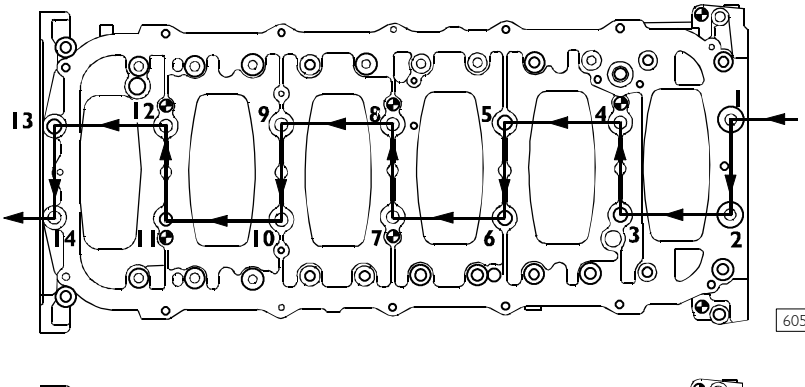
stage 2:
pretightenig,
inner screws
(120 Nm)

FRONT SIDE



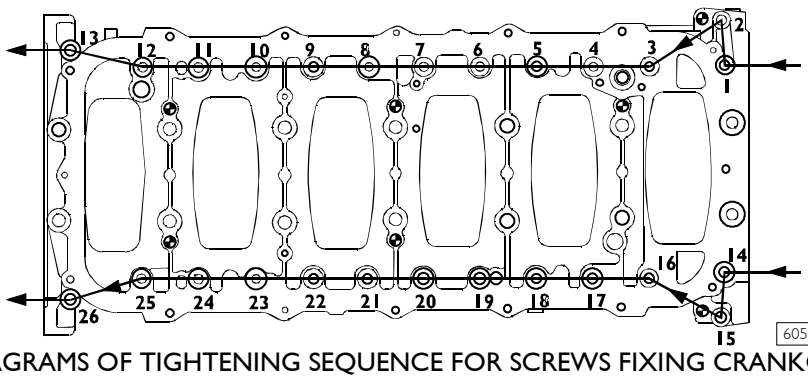
stage 3:
angle,
inner screws
90°

FRONT SIDE



stage 4:
angle,
inner screws
45°

FRONT SIDE

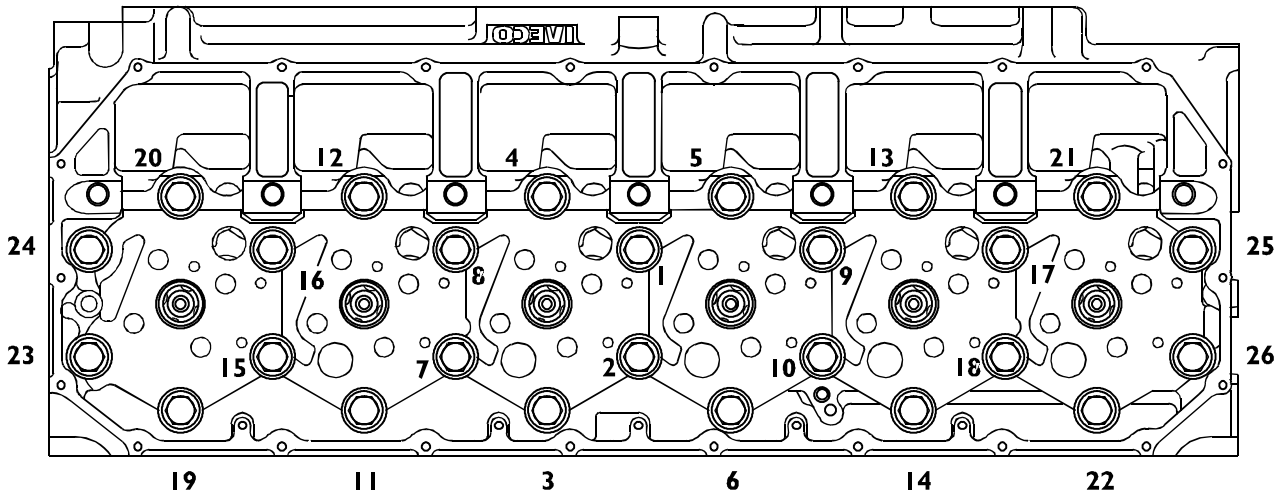


stage 5:
angle,
outer screws
60°

DIAGRAMS OF TIGHTENING SEQUENCE FOR SCREWS FIXING CRANKCASE BASE

F3A ENGINE

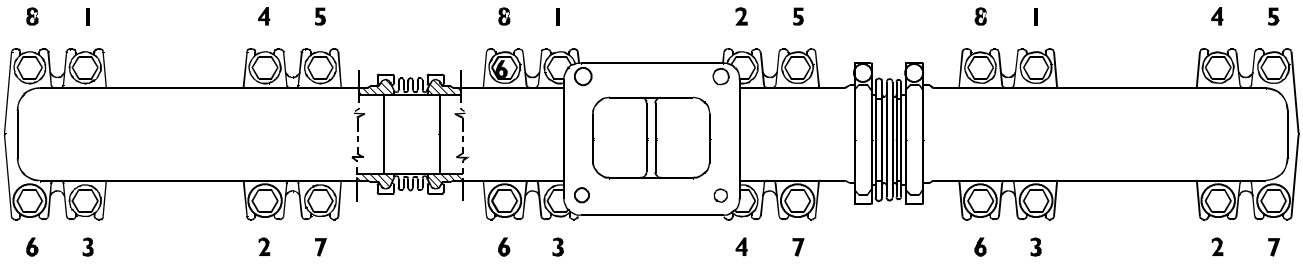
Figure 10



60580

DIAGRAM OF CYLINDER HEAD FIXING SCREWS TIGHTENING SEQUENCE

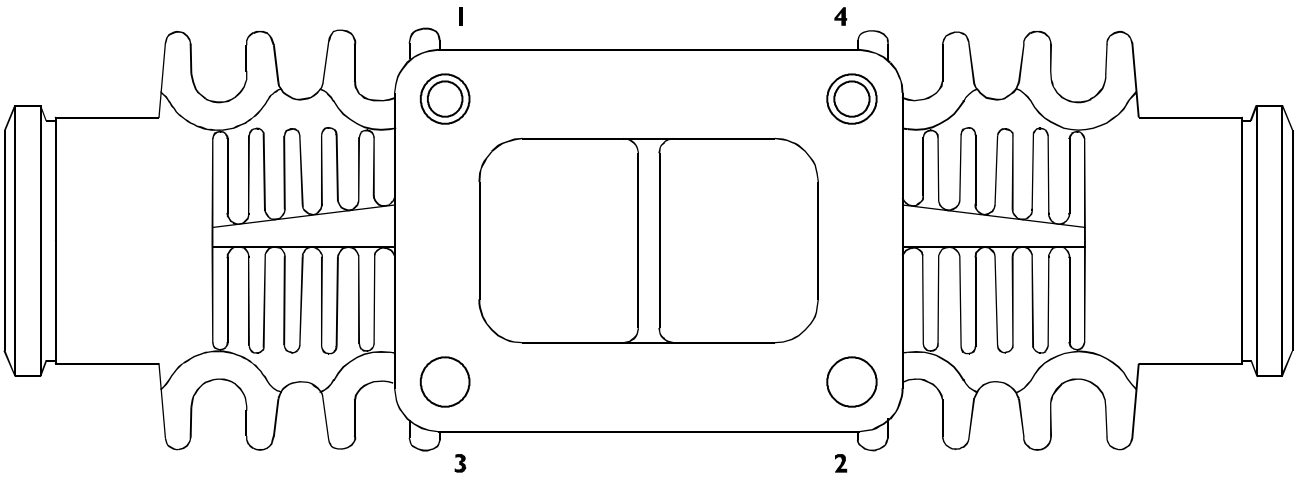
Figure 11



60581

DIAGRAM OF EXHAUST MANIFOLD FIXING SCREWS TIGHTENING SEQUENCE

Figure 12



60582

DIAGRAM OF TURBOCHARGER FIXING SCREWS AND NUTS TIGHTENING SEQUENCE

SEQUENCE: Pretightening 4 - 3 - 1 - 2
Tightening 1 - 4 - 2 - 3

F3A ENGINE

Figure 13

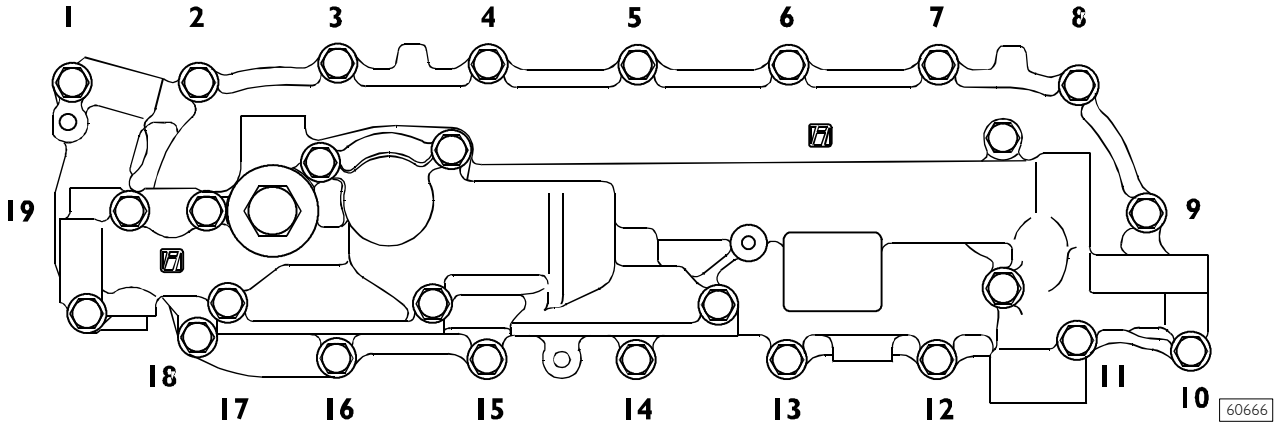


DIAGRAM OF TIGHTENING SEQUENCE FOR HEAT EXCHANGER SCREWS

Figure 14

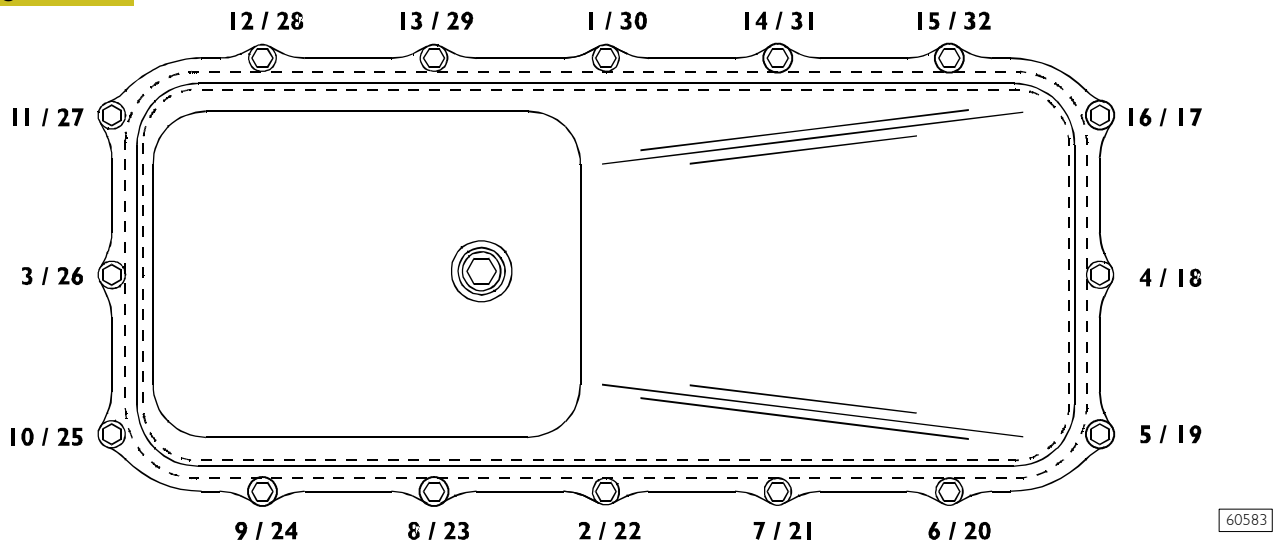


DIAGRAM OF TIGHTENING SEQUENCE FOR ENGINE OIL SUMP SCREWS

Stage 1 from 1 to 16.

Stage 2 from 17 to 32

Figure 15

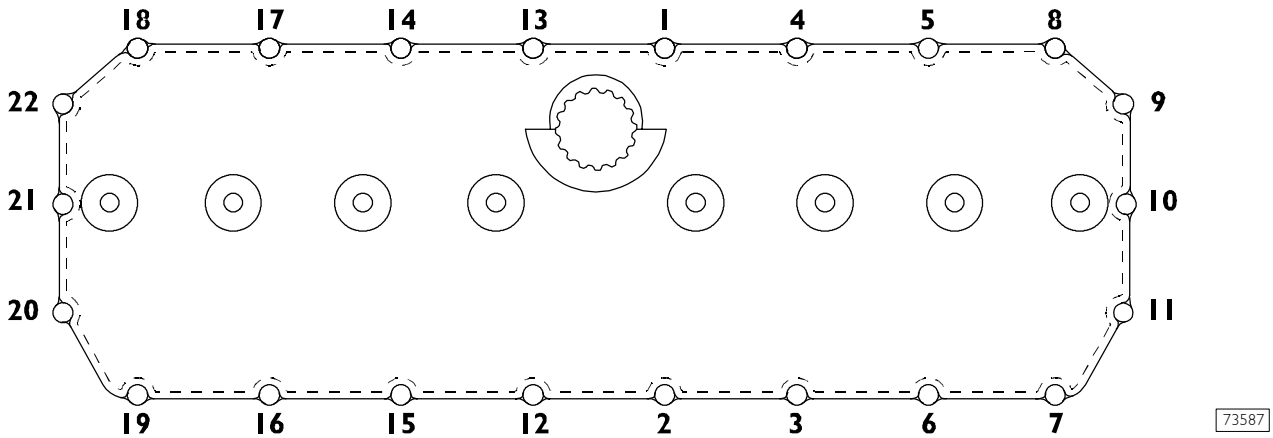
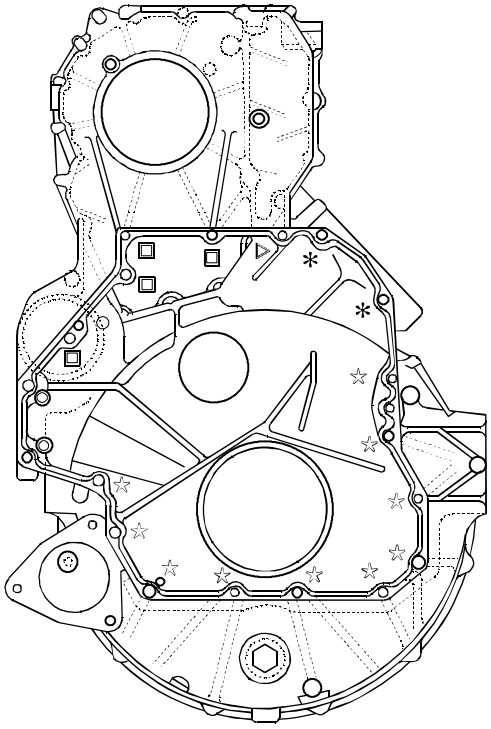


DIAGRAM OF TIGHTENING SEQUENCE FOR SCREWS FIXING ROCKER COVER

F3A ENGINE

Figure 16

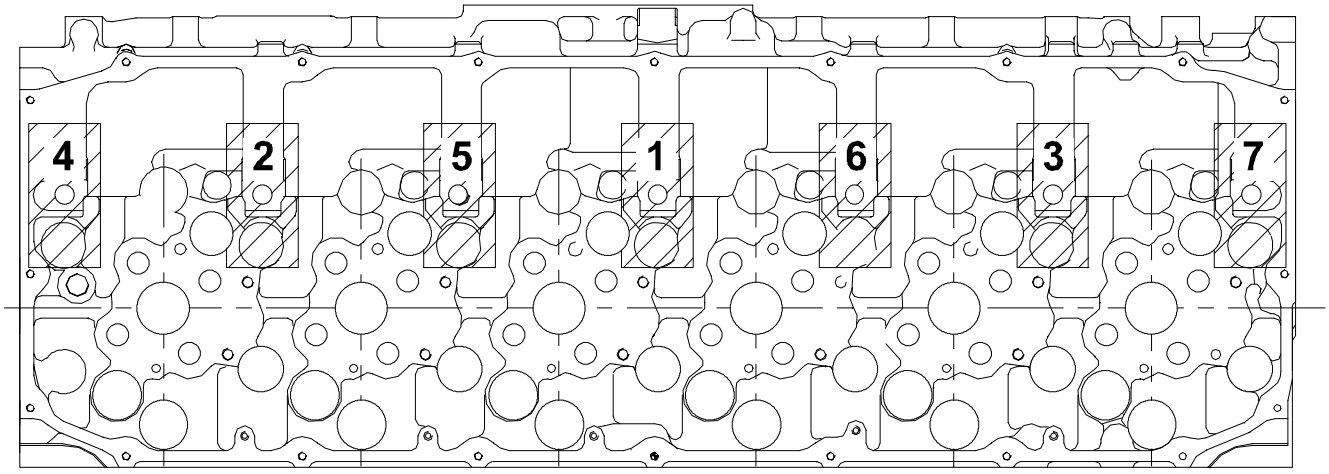


60633

Using a torque wrench, tighten the highlighted screws with the following sequence and tightening torques:

✡	10 screws M12 x 1.75 x 100	63 Nm
◎	2 screws M12 x 1.75 x 70	63 Nm
▣	4 screws M12 x 1.75 x 35	63 Nm
△	1 screw M12 x 1.75 x 120	63 Nm
✳	2 screws M12 x 1.75 x 193	63 Nm

Figure 17

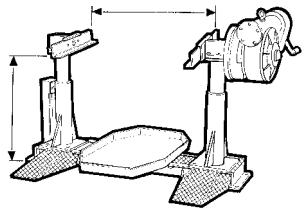
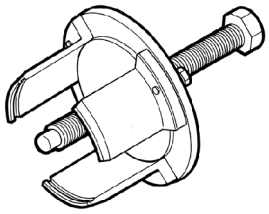
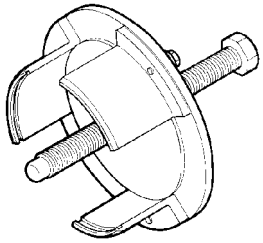
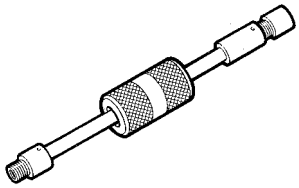
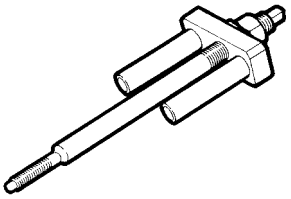
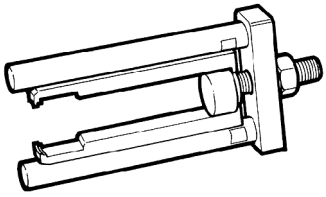


70567A

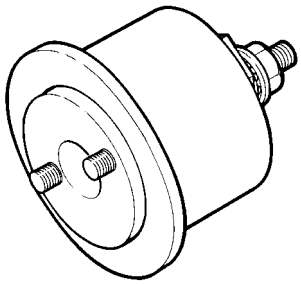
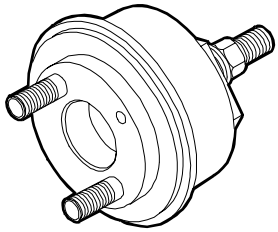
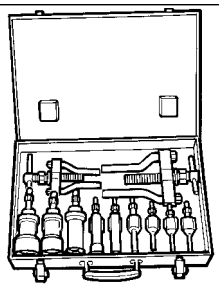
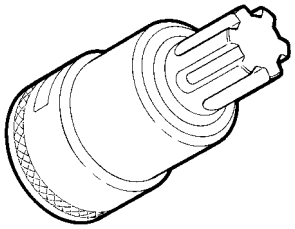
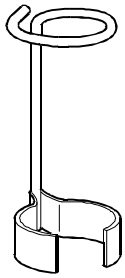
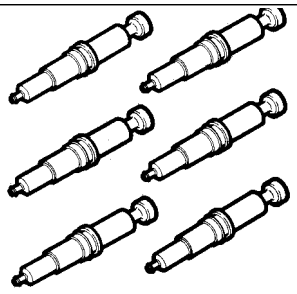
DIAGRAM OF CYLINDER HEAD FIXING SCREWS TIGHTENING SEQUENCE

1st step	80 Nm
2nd step	closing to angle 60°

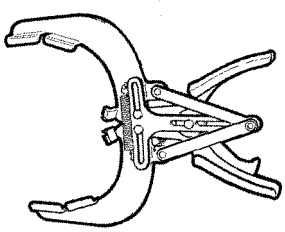
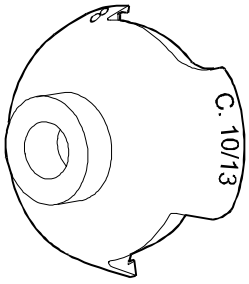
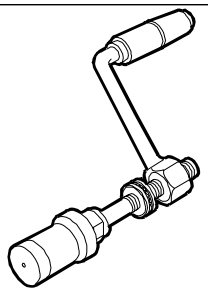
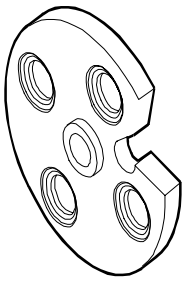
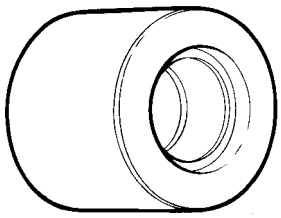
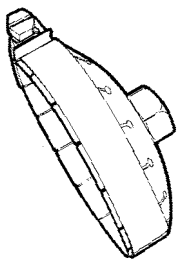
TOOLS

TOOL NO.		DESCRIPTION
99322230		Rotary telescopic stand (range 2000 daN, torque 375 daNm)
99340053		Extractor for crankshaft front gasket
99340054		Extractor for crankshaft rear gasket
99340205		Percussion extractor
99342149		Extractor for injector-holder
99342155		Tool to extract injectors

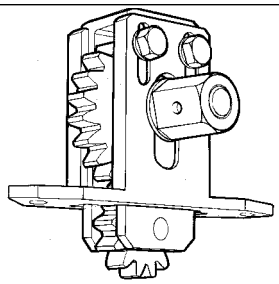
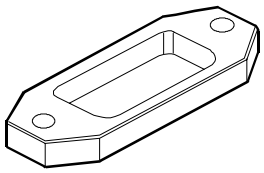
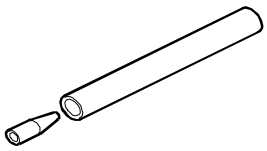
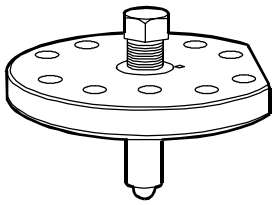
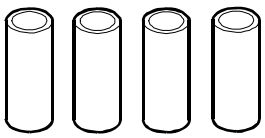
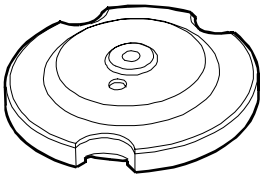
TOOLS

TOOL NO.		DESCRIPTION
99346250		Tool to install the crankshaft front gasket
99346251		Tool to install the crankshaft rear gasket
99348004		Universal extractor for 5 to 70 mm internal components
99350072		Box wrench for block junction bolts to the underblock
99360144		Tools (12 + 6) holding rocker adjustment screw blocks when removing/refitting the rocker shaft
99360180		Injector housing protecting plugs (6)

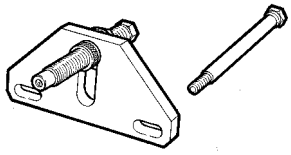
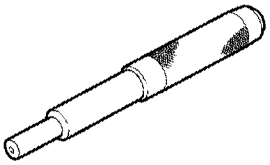
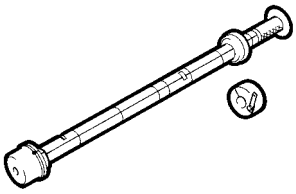
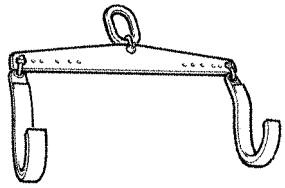
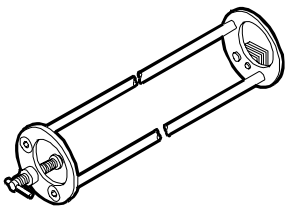
TOOLS

TOOL NO.		DESCRIPTION
99360184		Pliers for assembling and disassembling piston split rings (105-160 mm)
99360192		Guide for flexible belt
99360261		Tool to take down-fit engine valves (to be used with special plates)
99360262		Plate for take down-fit engine valves (to be used with 99360261)
99360295		Tool to fit back valve guide (to be used with 99360481)
99360314		Tool to remove oil filter (engine)

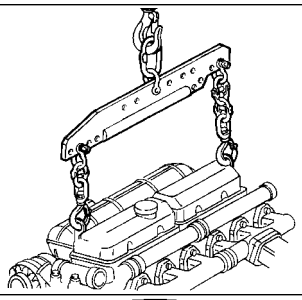
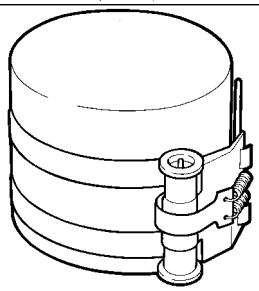
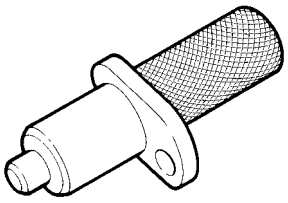
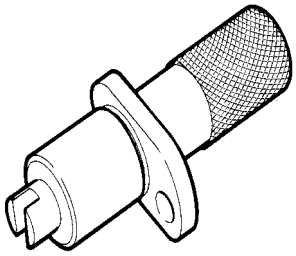
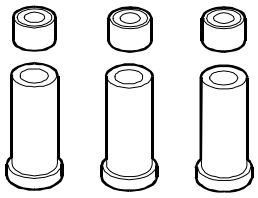
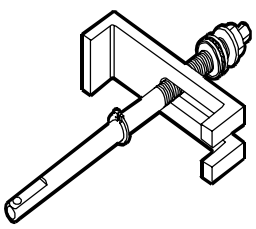
TOOLS

TOOL NO.		DESCRIPTION
99360321		Tool to rotate engine flywheel (to be used with 99360325)
99360325		Spacer (to be used with 99360321)
99360328		Tool to install gasket on valve guide
99360334		Compression tool for checking the protrusion of cylinder liners (to be used with 99370415-99395603 and special plates)
99360336		Spacer (to be used with 99360334)
99360337		Cylinder liner compression plate (to be used with 99360334-99360336)

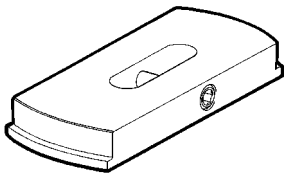
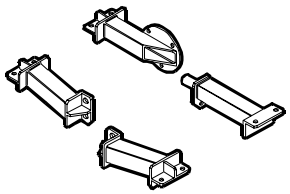
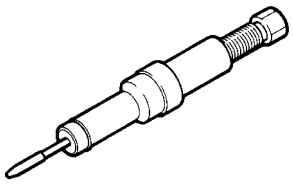
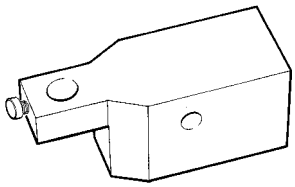
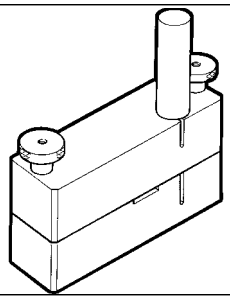
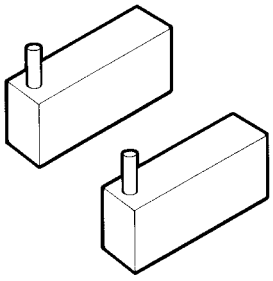
TOOLS

TOOL NO.		DESCRIPTION
99360351		Tool to stop engine flywheel
99360481		Tool to remove valve guide
99360499		Tool to take down and fit back camshaft bushes
99360500		Tool to lift crankshaft
99360551		Bracket to take down and fit engine flywheel
99360553		Tool for assembling and installing rocker arm shaft

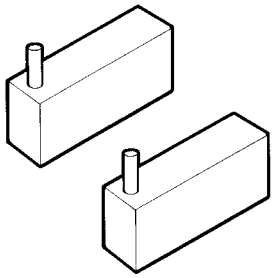
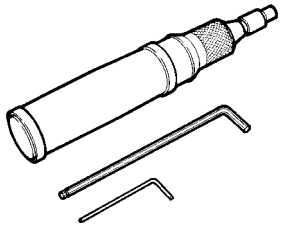
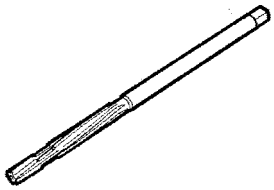
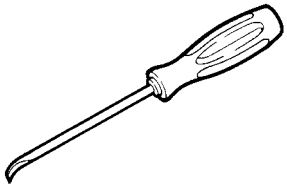
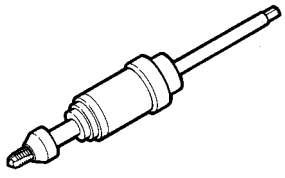
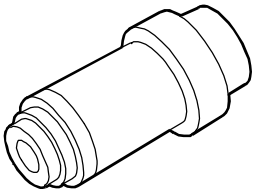
TOOLS

TOOL NO.		DESCRIPTION
99360585		Swing hoist for engine disassembly assembly
99360605		Belt to insert piston in cylinder liner (60 - 125 mm)
99360612		Tool for positioning engine P.M.S.
99360613		Tool for timing of phonic wheel on timing gear
99360703		Tool to stop cylinder liners
99360706		Tool to extract cylinder liners (to be used with specific rings)

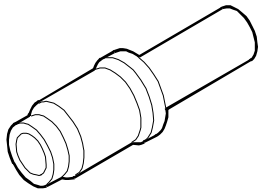
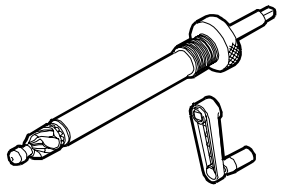
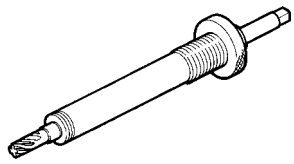
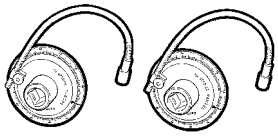
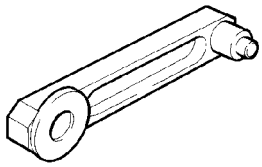
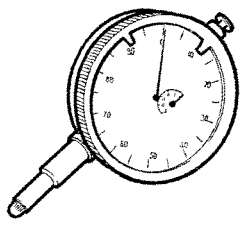
TOOLS

TOOL NO.		DESCRIPTION
99360726		Ring (125 mm) (to be used with 99360706)
99361036		Brackets fixing the engine to rotary stand 99322230
99365056		Tool for injector holder heading
99370415		Base supporting the dial gauge for checking cylinder liner protrusion (to be used with 99395603)
99378100		Tool for printing engine identification plates (to be used with special punches)
99378101 ✳ **99378102** ● **99378103** ○ **99378104** □ **99378105** ■ **99378106** ▲ **99378107** ▼ **99378108** ◆		Drifts (**A**✳ -**B**● -**C**○ - **D**□ - **E**■ - **F**▲ - **G**▼ - **V**◆) for stamping engine identification plates (components of 99378130)

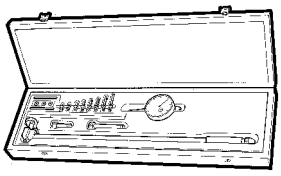
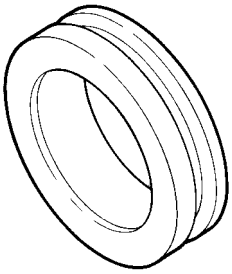
TOOLS

TOOL NO.		DESCRIPTION
99378130		Drift set for stamping engine identification plates (consisting of: 99378101 (**A**) - 99378102 (**B**) - 99378103 (**C**) - 99378104 (**D**) - 99378105 (**E**) - 99378106 (**F**) - 99378107 (**G**) - 99378108 (**V**))
99389834		Torque screwdriver for calibrating the injector solenoid valve connector check nut
99390311		Valve guide sleeker
99390772		Tool for removing injector holding case deposits
99390804		Tool for threading injector holding cases to be extracted (to be used with 99390805)
99390805		Guide bush (to be used with 99390804)

TOOLS

TOOL NO.		DESCRIPTION
99394015		Guide bush (to be used with 99394041 or 99394043)
99394041		Cutter to rectify injector holder housing (to be used with 99394015)
99394043		Reamer to rectify injector holder lower side (to be used with 99394015)
99395216		Measuring pair for angular tightening with 1/2" and 3/4" square couplings
99395218		Gauge for defining the distance between the centres of camshaft and transmission gear
99395603		Dial gauge (0 - 5 mm)

TOOLS

TOOL NO.		DESCRIPTION
99395687		Reaming gauge (50 - 178 mm)
99396035		Centering ring of crankshaft front gasket cap

540110 ENGINE REMOVAL - REFITTING

Removal

NOTE If washing the engine bay, adequately protect the electric/electronic components and their connections.

Disconnect batteries by disconnecting the electric cables or by opening the current cut-out switch, lift the radiator cowling and overturn the cabin.
Disassemble the gearbox as described in section 4.

Operations to be carried out from the lower part:

- ❑ drain the cooling liquid in a fit container by removing the cap (8) from radiator (2);
- ❑ remove the line (10) between radiator and water pump union (9);
- ❑ disconnect line (5 and 6) from water pump union (9);

On the upper side:

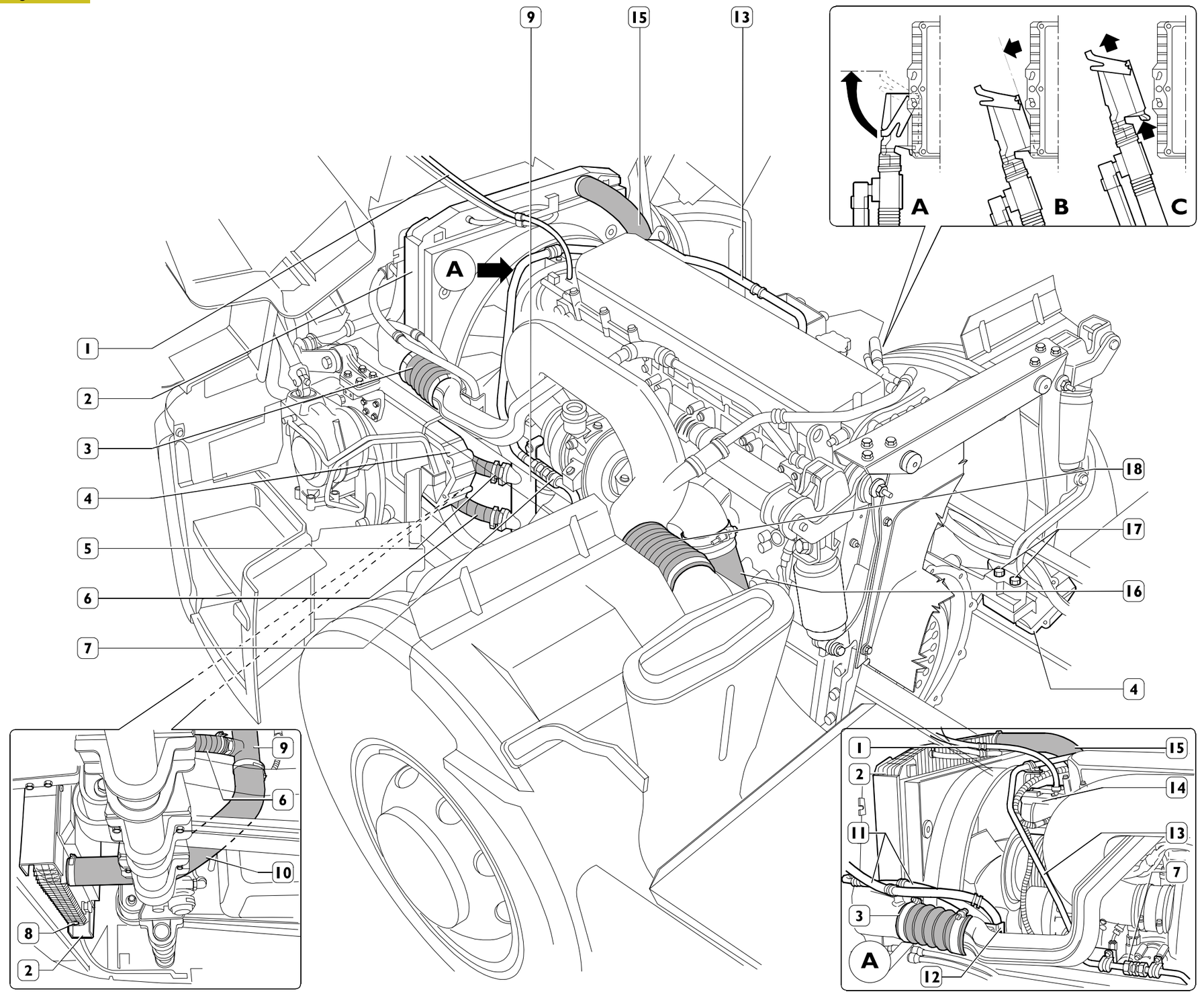
- ❑ disconnect the air line (13) from the drier filter at union (7) after releasing it from the check clamp on the chassis;
- ❑ disconnect water lines (1 and 15) form the thermostat unit (14) (see detail A);
- ❑ disconnect the sleeve (3) connecting turbocharger to aftercooler radiator;
- ❑ if present, remove the climate control pipe (11) support bracket (12).
- ❑ disconnect the sleeve (18) connecting air filter line to turbocharger manifold;
- ❑ disconnect the exhaust line (16).

Unscrew the screws (17) fastening the engine supports to the flexible support (4) on the chassis.

- ❑ disconnect the connector from the electronic unit as follows:

  A. lift the safety lever;
  B. move the connector by disconnecting it from the control unit;
  C. lift the connector by releasing the pawl.

Figure 18



Carry out the following operations from the suction side: drain the power steering system oil in a fit container by disconnecting delivery and return lines (5 and 6). Disconnect electric connections (9 and 12) from the engine and release cable from the engine air suction manifold freeing it from check clamps. Disconnect the electric cables (14) and the ground cable (4) form the starter (3). Disconnect the electric cables (15) on the alternator (11). Disconnect pipe (13) on the compressor. Disconnect the sleeve (10) connecting aftercooler radiator - suction manifold. Disconnect piping from tank overpressure valve (2) and piping (16). On vehicles fitted with climate control system, operate as follows: use the suitable wrench to operate the automatic backstand and remove the climate control system (19) compressor control belt (17). Remove the screws (18) and the climate control system compressor. Without disconnecting the compressor pipes and to prevent draining the climate control system, fasten the compressor to the vehicle so that it does not interfere with the engine removal. Tighten the chains using a hoist and swing hoist 99360595 hooked to the engine brackets. Remove the engine fixing screws of the elastic engine (1) brackets from the chassis. Slowly raise the engine from its compartment by taking it backwards so that the fan is released from the air conveyor compartment (20) on the radiator. Operate the screws to remove the fan from the hub. Remove the engine completely without interfering with the remaining fixed parts on the chassis, in particular the wiring interfering with the rear right engine support.

NOTE If washing the engine bay, adequately protect the electric/electronic components and their connections.

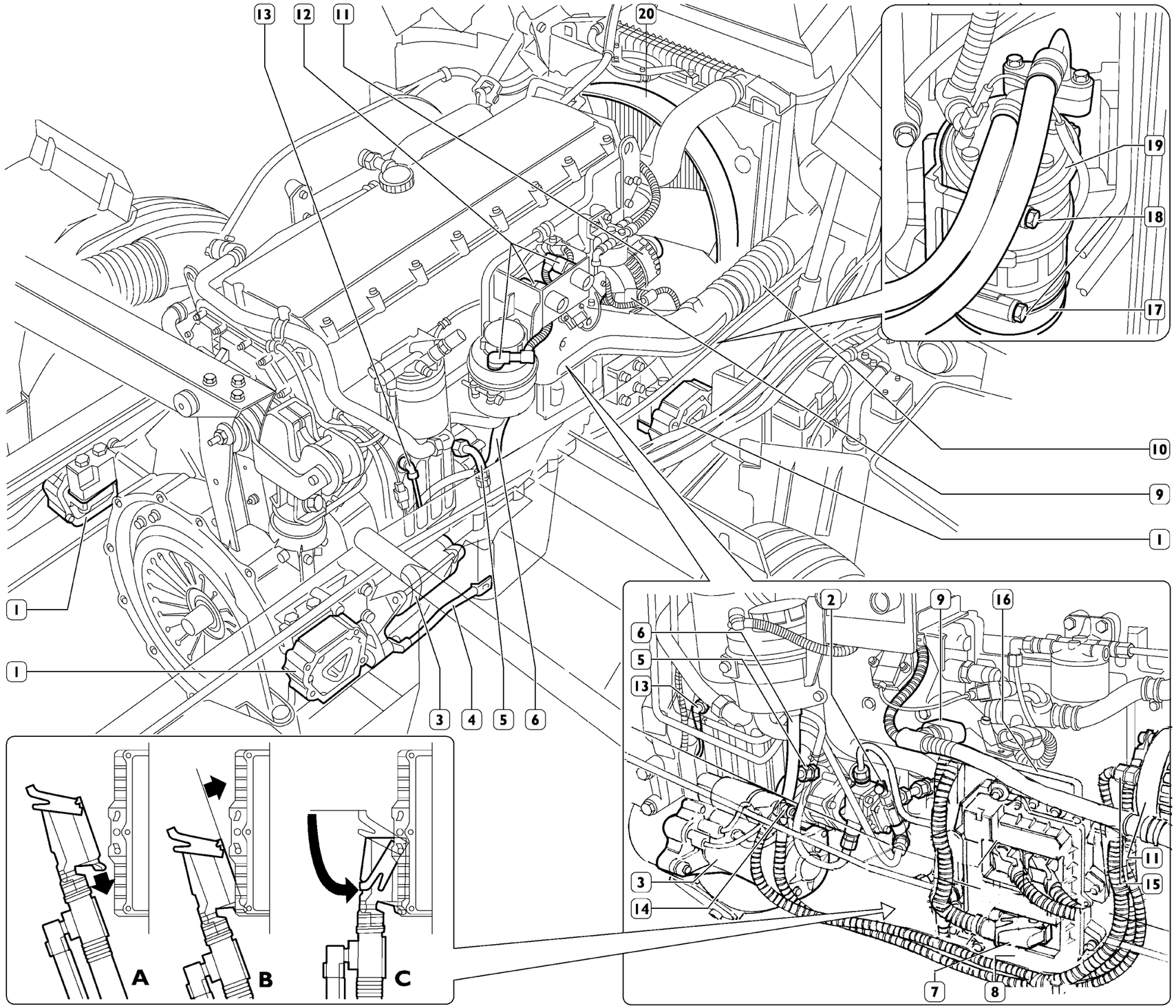
Refitting

In order to assemble the engine, carry out the operations described for disassembly in the reverse order, paying special attention to the operations required to install the assembly in the engine department and keeping to the following instructions: check engine and gearbox group flexible supports and replace them if damaged. Check that exhaust line parts are not damaged or nearly damaged; if so, replace them. Tighten the screws and/or the nuts to the prescribed torque. Fill the cooling system with cooling liquid. Bleed the air supply system;

NOTE Tighten the nuts fastening the electric cables to the starting motor terminals, by applying the torque values below:
- nut M10 x 1.5 (terminal 30): 17.6 ÷ 24.5 Nm (1.8-2.5 Kgm);
- nut M5 x 0,8 (terminal 50): 2.6 ÷ 4.6 Nm (0.27-0.47 Kgm);

Fill the cooling system with coolant as described in the paragraph relevant. Blow air off the cooling system as described in the paragraph relevant (operation 502011). Blow air off the fuel system as described in the relevant chapter (operation 542011). Fill the power steering circuit, then blow air off as described in the relevant chapter (operation 501030). Check the level of oil in the engine. Carry out the inspections and checks as described in the chapter relevant.
Connect connector (7) to control unit (8) as described below:
A, insert the pawl in its housing
B, connect the connector
C, push the safety lever until it stops.

Figure 19



Filling the cooling system

Preliminary operations

For vehicles equipped with just the standard cab heating system or manual air-conditioning:

❑ Fully open the coolant cock on the instrument panel.

For vehicles equipped with the automatic air-conditioning system:

❑ Set the temperature control in the cab on the HI position.

For vehicles equipped with an additional heater:

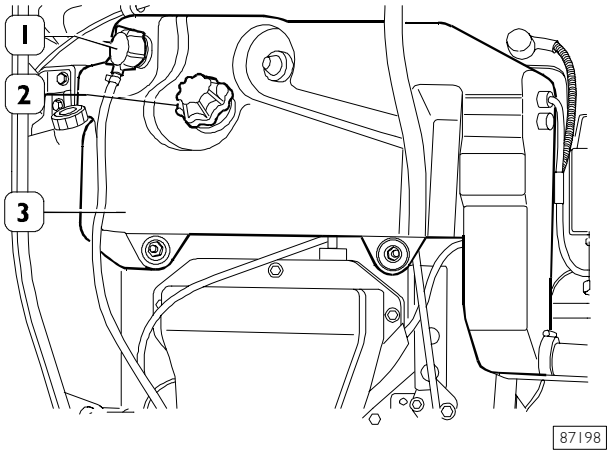
❑ The heater must not be turned on.

Operations

Place a sheet of cardboard between the coolant radiator and the intercooler radiator in order to shorten the time it takes to reach the engine's working temperature (approx. 90°C).

Filling the system

Figure 20



NOTE GENERAL WARNINGS
Filling must be done with the engine cold.
The cap (1) must not be removed for any reasons whatsoever.
To prevent pockets of air forming in the system, the fluid has to be transferred slowly (approximate flow rate 8 litres/min).
For vehicles equipped with an additional heater: the percentage of glycols in the coolant must be no greater than 50%.

After conscientiously following the above warnings, proceed as follows:

❑ Remove the cap (2) from the expansion tub (3).

❑ Pour the coolant into the expansion tub (3) till it is quite full.

Bleeding air from the system

NOTE **For vehicles equipped with an additional heater:**

❑ Turn on the heater.

❑ Start the engine and keep the speed just above idling for 5 min.

NOTE If the tub empties completely during these first few minutes, stop and engine and top it up at a slower rate than before.
Restart the engine.

❑ After 5 min. running, top up the level of fluid in the expansion tub, if necessary.

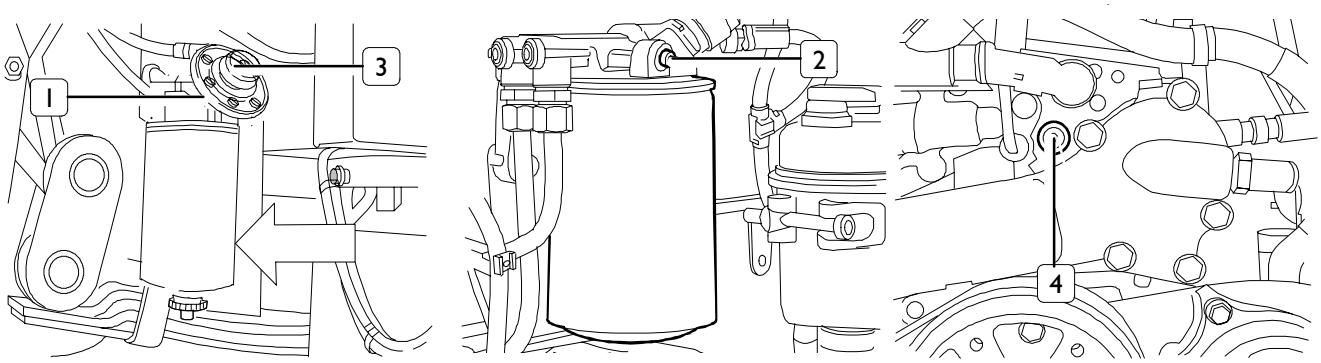
❑ Close the expansion tub filler with the cap (2).
Take the engine up to top speed so that the coolant quickly reaches the temperature of full thermostat opening (approx. 90°C) and keep it in this state until all the air is bled out of the system.
This is checked by seeing there is no foam or air bubbles in the tub.
The longest time it takes to bleed the air from the system completely is approximately 15 minutes from the moment when the thermostat opens (opening starts 85°±2° C).

Do not take the filler cap off the expansion tub until the fluid in the system has cooled completely.
Any topping up must only be done with the engine cold.

This is to avoid:
1 - Operator burns.
2 - Damage to the engine since cooling system pressurization is only created with the fluid heating from the condition of the engine cold.

542011 Bleeding air from the supply system

Figure 21



NOTE Before bleeding the fuel system connect proper pipes to the bleeding screws located on prefilter support, filter and cylinder head front part, in order to recover fuel in suitable containers during this operation.

In particular, never allow that the fuel, coming out of the cylinder head draining screw, stains the control belts of the fan, the water pump, the alternator and the conditioner compressor, thus damaging them.

- ❑ Bleed screw (1) on the pre-filter mounting.
- ❑ Bleed screw (2) on the filter mounting.
- ❑ Bleed screw (4) on the front of the cylinder head.
- ❑ Work the pump (3) on the pre-filter mounting till fuel with no air bubbles in it comes out of the screw (1); close the screw.
- ❑ Repeat this step for screw (2).
- ❑ Repeat this step for screw (4).

Checks and tests

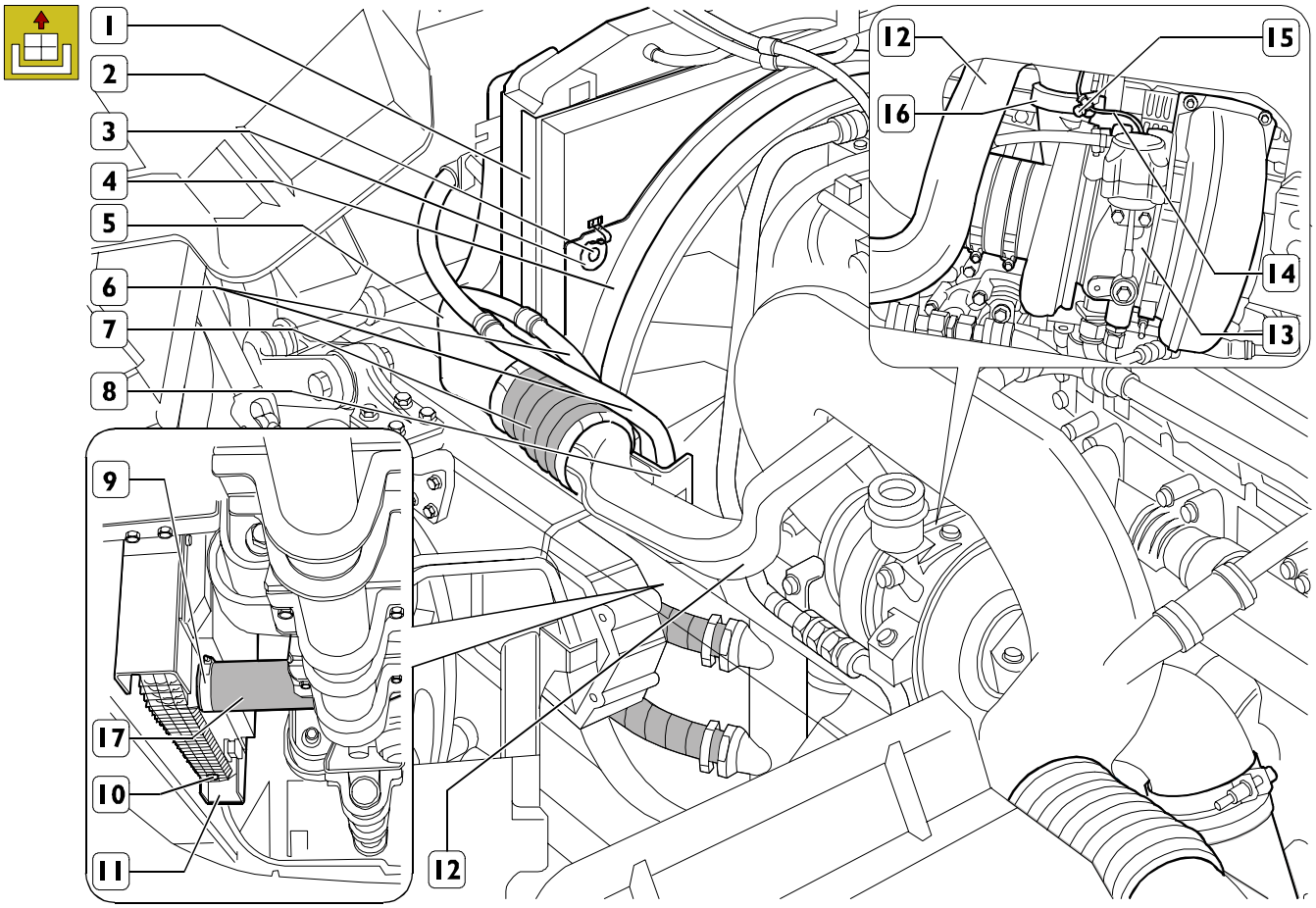
Start the engine, leave it running at just a little faster than idling speed and wait for the temperature of the coolant to reach the level to open the thermostat. Then, check that:

- ❑ No water leaks from the connecting sleeves of the pipes in the engine cooling and cab heating circuits, tightening the collars further if this is necessary.
- ❑ No oil leaks from between the cover and the cylinder head, between the oil sump and the crankcase, between the oil filter and its seat, between the heat exchanger and the crankcase, or between the various pipes in the lubrication circuit.
- ❑ No air leaks from the pipes connected to the pneumatic components involved in removal.
- ❑ The indicator lights on the instrument panel and the devices disconnected when removing the engine all work properly.

543422 ELECTRO-MAGNETIC JOINT REPLACEMENT

Removal

Figure 22



To cut off the batteries, remove the electric wires or open the main switch.

Lift the calender and tilt the cabin. Remove the coolant filling plug from the header tank.

Go under the vehicle and remove the plug (10) from the radiator (11) and drain the coolant fluid in the appropriate container.

Remove the clip (9) and disconnect the radiator (17) sleeve (11).

Remove the climate control system pipe (6) fastening screw (if fitted) to the air conveyor (12).

Remove the air conveyor (12) fastening screws (8) from the support bracket.

Remove the two sleeve fastening screws to the intercooler radiator (11).

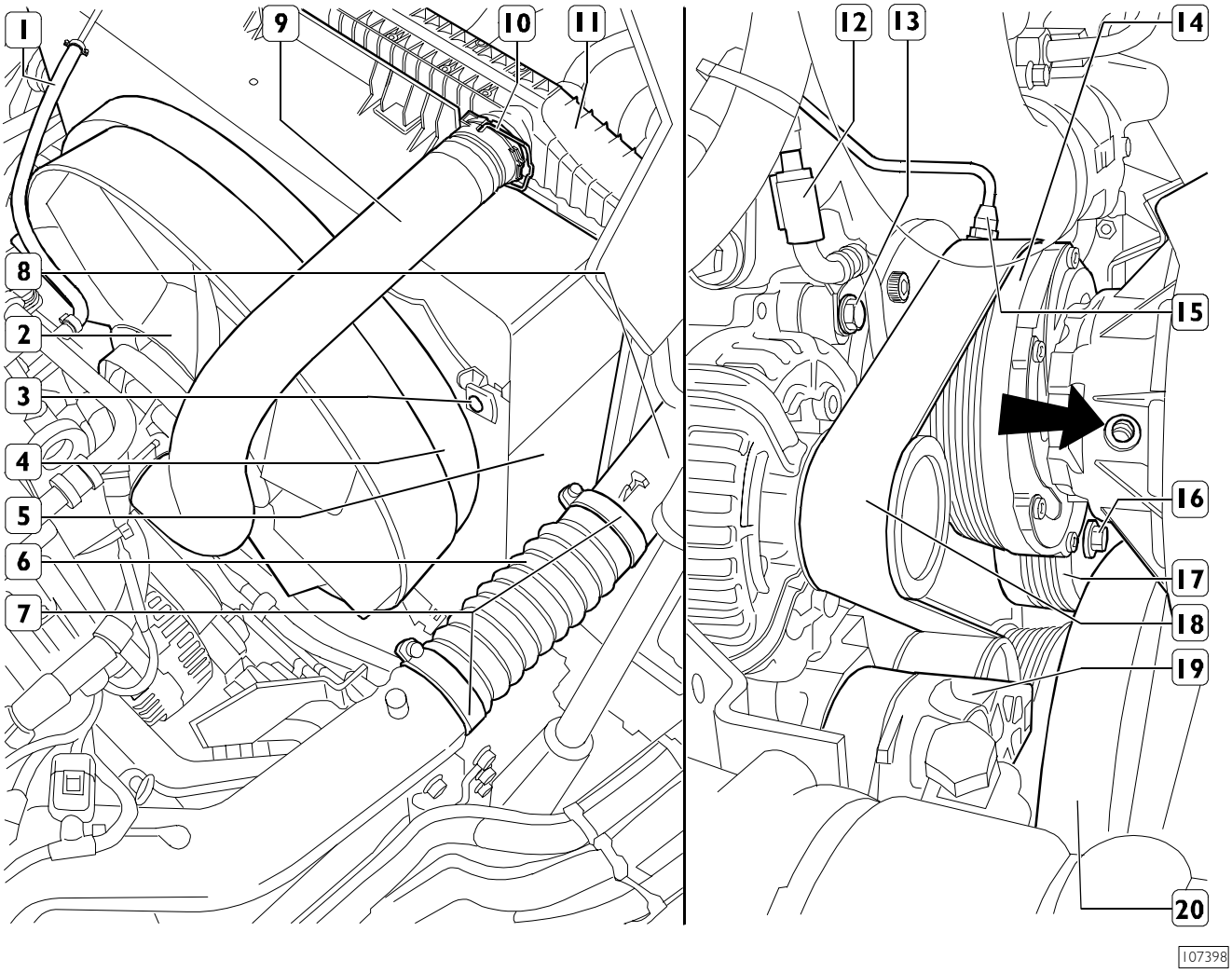
Remove the screw (15) and the electric wire (14). Slacken the clamp (16) and remove the air conveyor (12) from the turbocharger (13) and from the intercooler radiator (5).

Loosen the strap fastening sleeve (7) to intercooler radiator (5).

Drive in the suitable self-threading screw in the pin hole (2) taking care to partially take off and finally remove with a screwdriver the upper clip (3) fastening the fan air (4) conveyor to the radiator guard (1).

Remove the lower clip in the same way.

Figure 23



Disconnect the pipe (1) from the thermostat.

Remove the clip (10) and disconnect the sleeve (9) from the radiator (11).
Slacken the clamps (7) and remove the sleeve (6).
Remove the upper and lower clip (3) as described for the left-hand side.
Remove the radiator support fastening screws on the chassis and move the radiator unit forwards.
Remove the radiator support fastening screws (2) on the chassis and move the radiator unit forwards (14).
Remove the fan fastening screws (2) to the electro-magnetic joint (4).
Loosen belt (16) tension by acting on automatic belt-stretcher (17), then remove the belt from the pulleys.
Disconnect the electric connection (12) from the electro-magnetic join (14).
Disconnect pneumatic piping (15) from electromagnetic coupling (14).
Remove the fan fastening screws (13) to the electro-magnetic joint (14).
Disconnect pneumatic piping (15) from electromagnetic coupling (14).

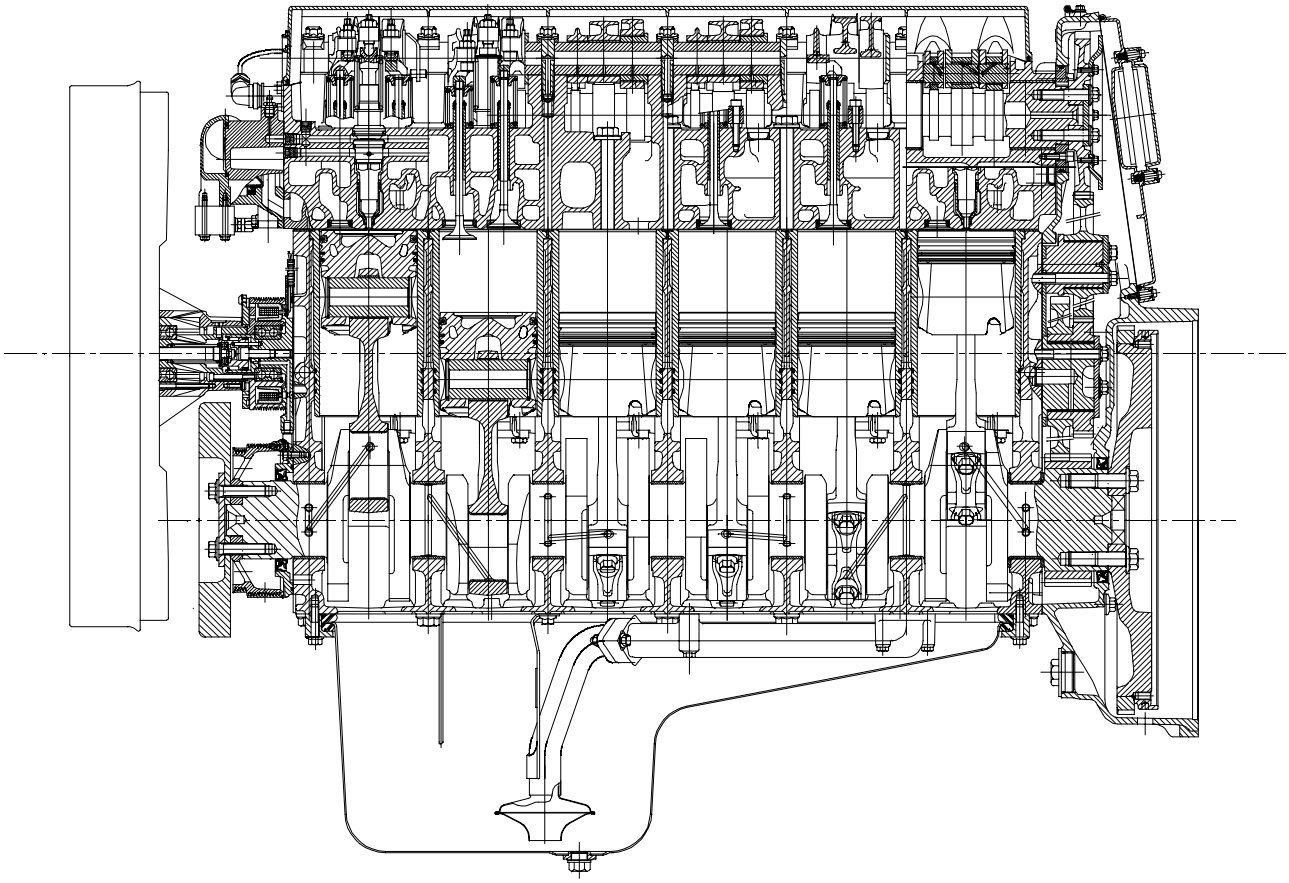
Refitting

To refit the electro-magnetic joint, reverse the removal procedure and attain to the following rules:

- ❑ check the control belt (18) conditions; replace it if damaged or worn out;
- ❑ tighten the screws and/or nuts to the prescribed torque;
- ❑ fill the cooling system with the prescribed fluid, then blow air off the cooling system as described in the respective chapter;

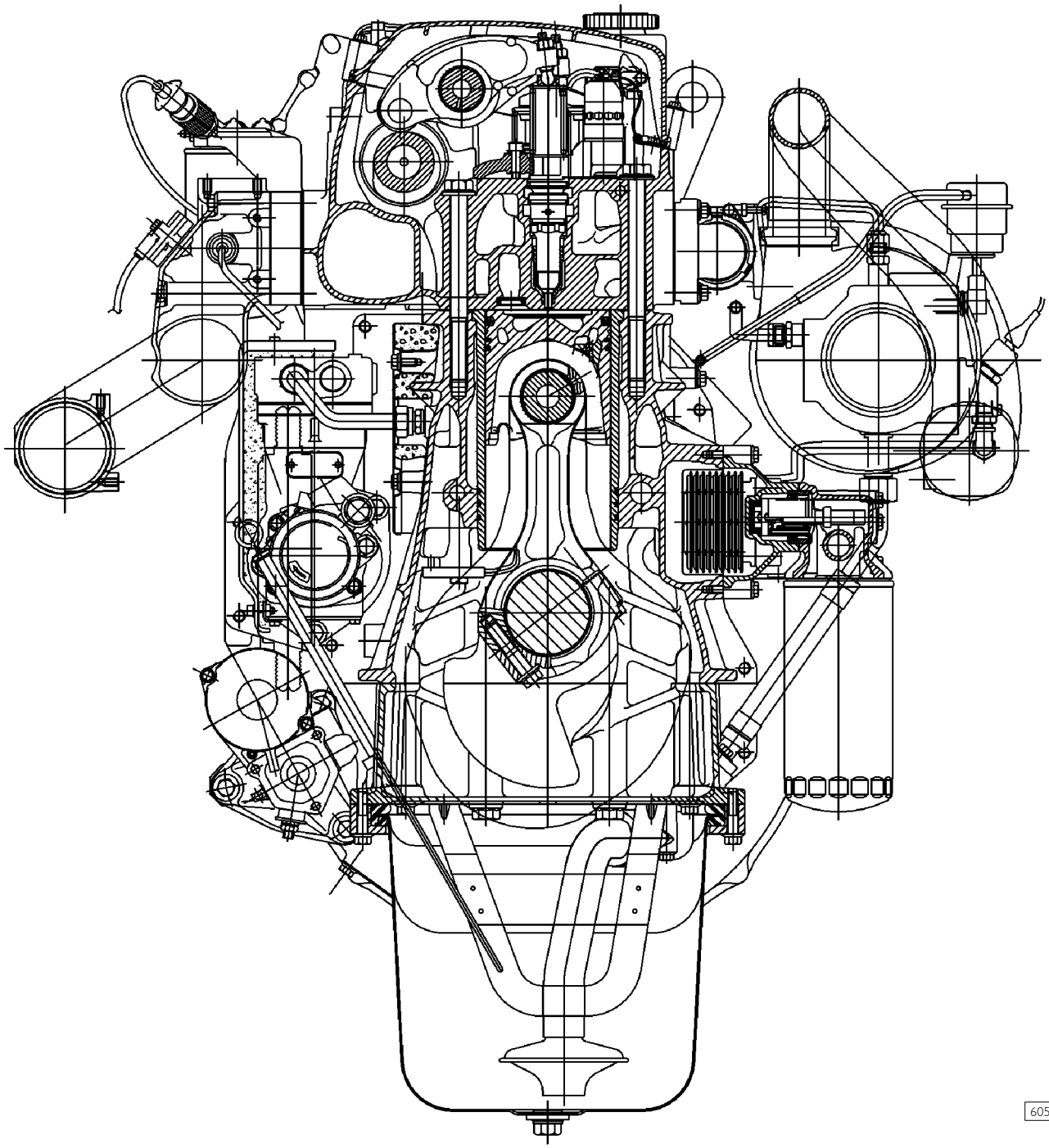
NOTE The electro-magnetic joint is fitted with two threaded holes (→) at 180° one from the other. In the event of fault, lock the joint control driving in a M8x16 mm screw in these holes. In this way it is possible to take the vehicle to the closest dealership.

Figure 24



ENGINE - LONGITUDINAL SECTION

Figure 25

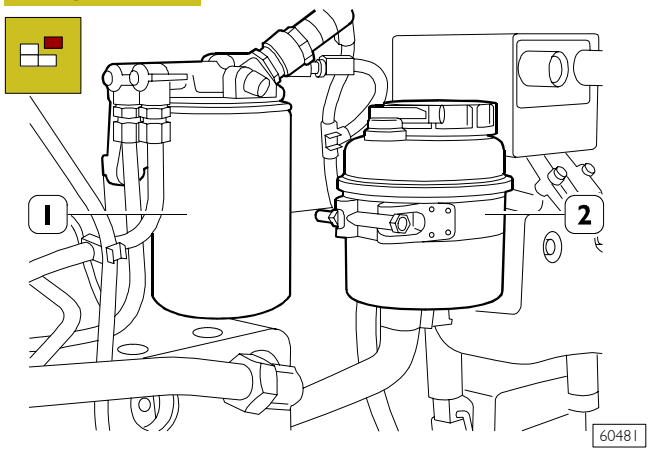


ENGINE - CROSS SECTION

540110 DISMANTLING THE ENGINE ON THE BENCH

Before fastening the engine on rotary stand 99322230, dismount or disconnect following parts:

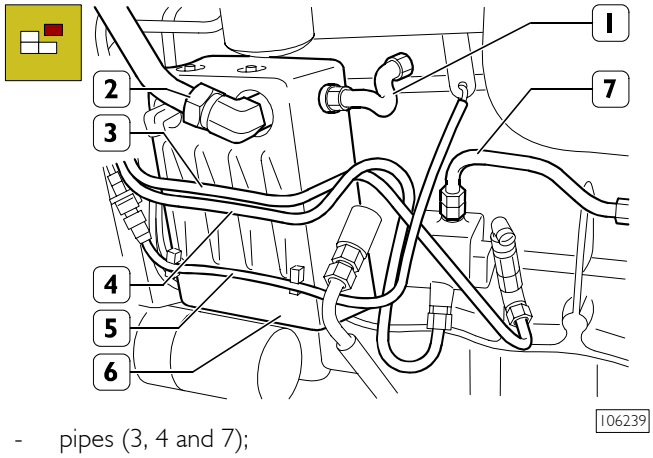
Figure 26



On the engine right-hand side

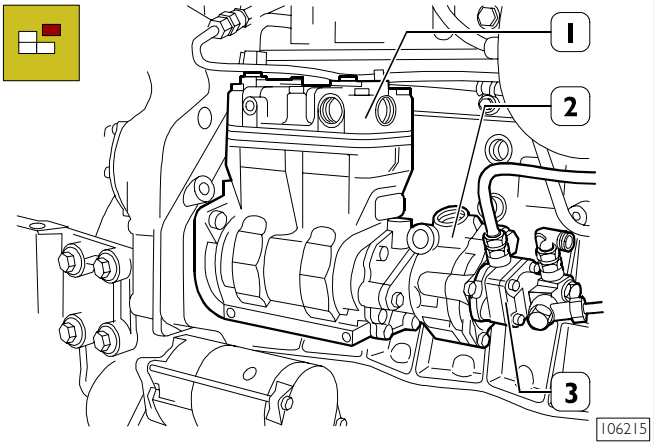
- diesel cartridge filter (1);
- power steering system tank (2);
- electric connections;

Figure 27



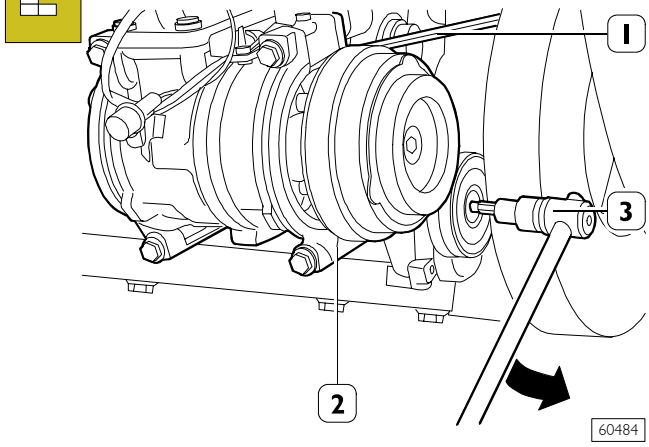
- pipes (3, 4 and 7);
- electrical cables (5);
- sound deadening guard (6);
- pipes (1 and 2).

Figure 28



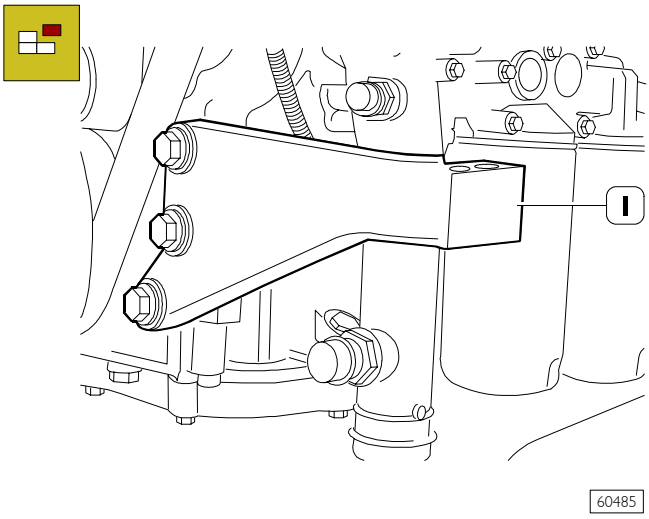
- compressor (1) complete with oversteering pump (2) and feed pump (3).

Figure 29



- remove the air conditioner control belt (1) using a fit tool (3) and acting in the direction shown by the arrow;
- disassemble the air conditioner (2) fitted with the engine support.

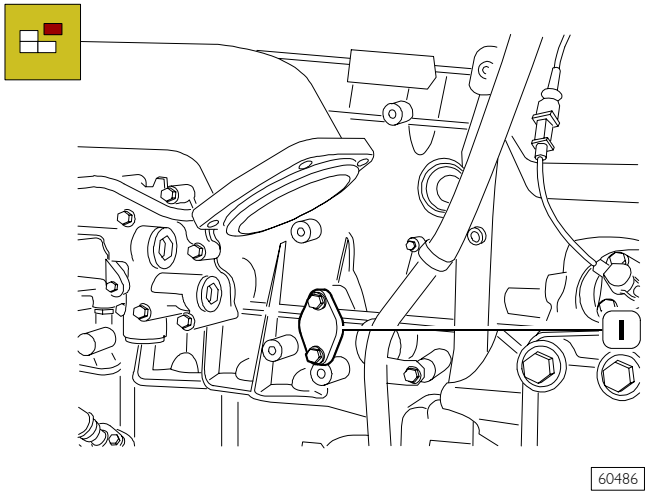
Figure 30



On the engine left-hand side

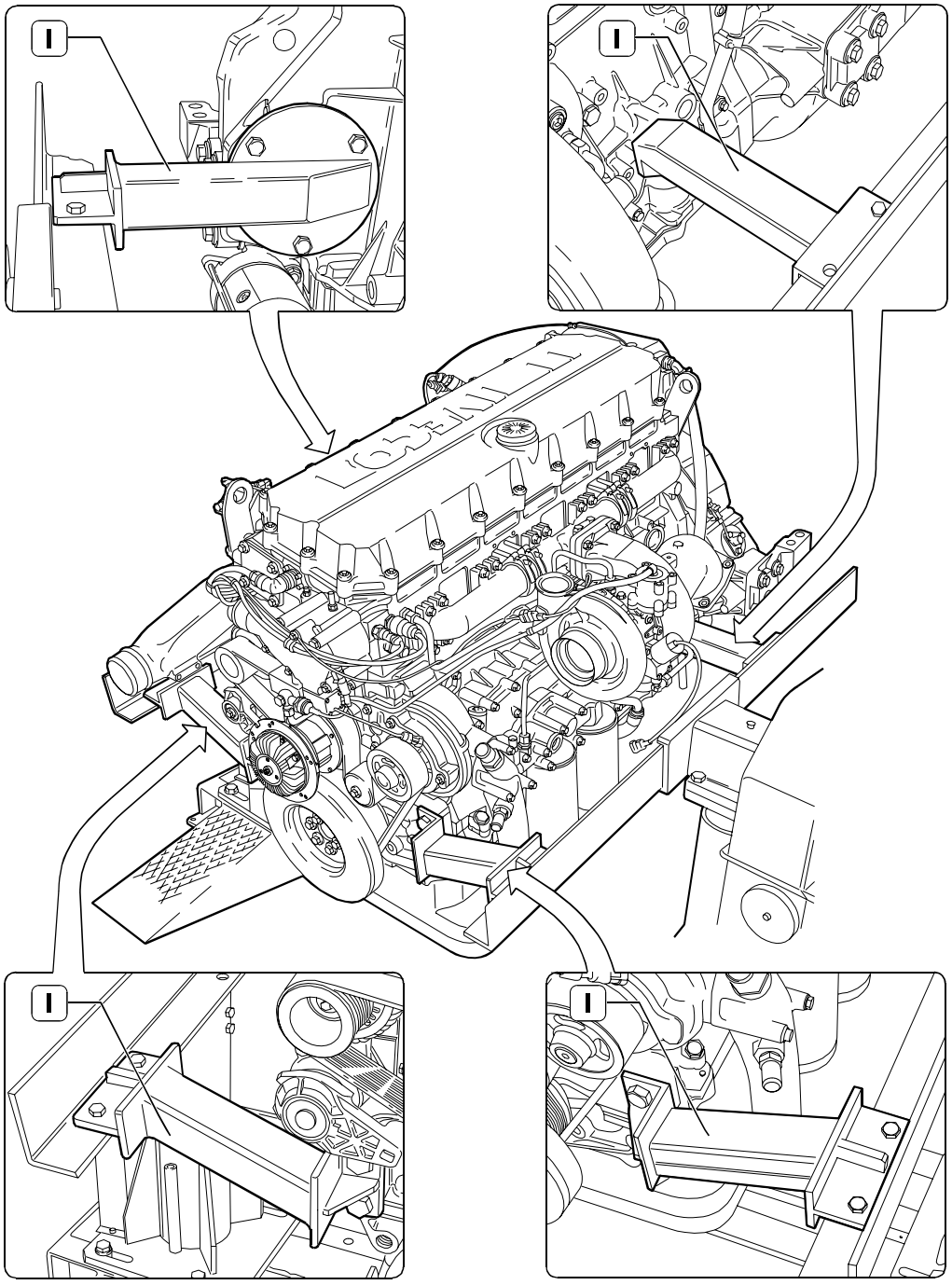
- engine support (1);

Figure 31



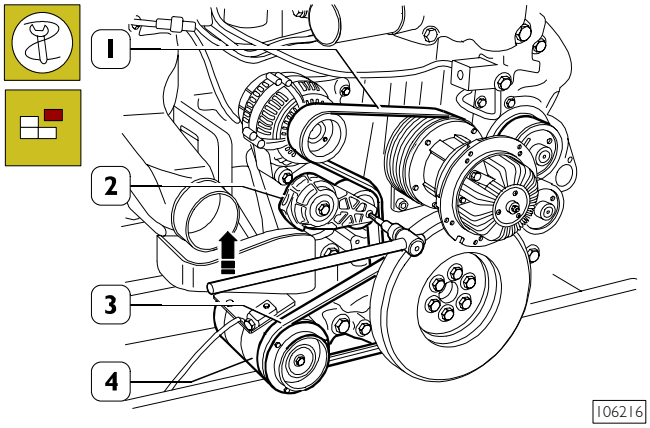
- oil pressure controlling valve (1).

Figure 32



Secure the engine to the rotary stand 99322030 with the brackets 99361036 (1).

Figure 33

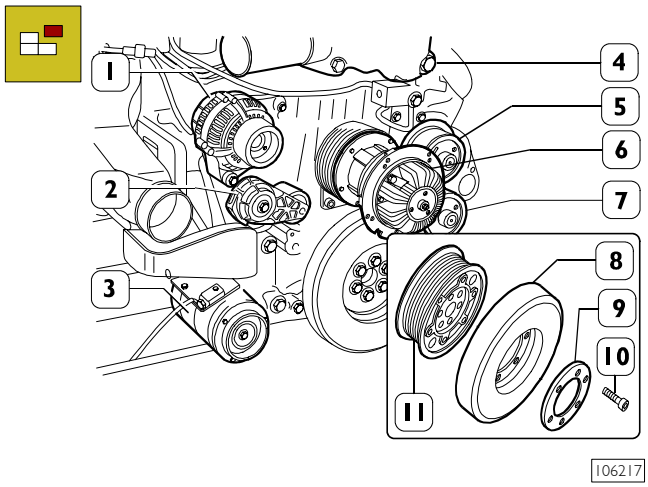


Use a suitable wrench to act on the belt-stretcher (2) roller fastening screw in the direction shown by the arrow, so as to loosen belt (1) tension, then take off the belt.

If present, dismount belt (3) driving compressor (4) for climate control system.

NOTE Belt (3) must be replaced by a new one after every dismounting operation.

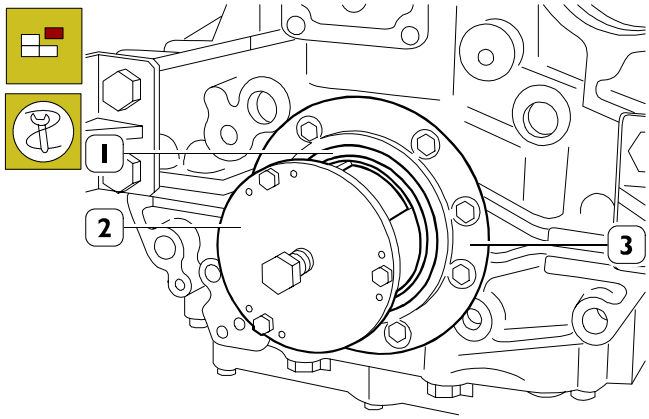
Figure 34



Remove the following components:
- thermostat unit (4) fitted with turbine actuator pressure sensor;
- alternator (1);
- electro-magnetic joint (6);
- water pump (5) and piping;
- automatic belt tightener support (2);
- fixed belt tightener (7);
- remove the screws (10), the spacer (9), the damper fly-wheel (8) and the pulley (11).
- disconnect all the electric connections and the sensors.

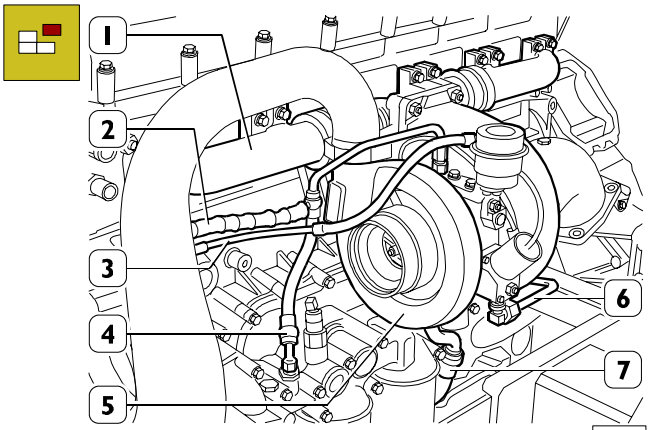
If present, remove:
❑ the climate control system compressor (3).

Figure 35



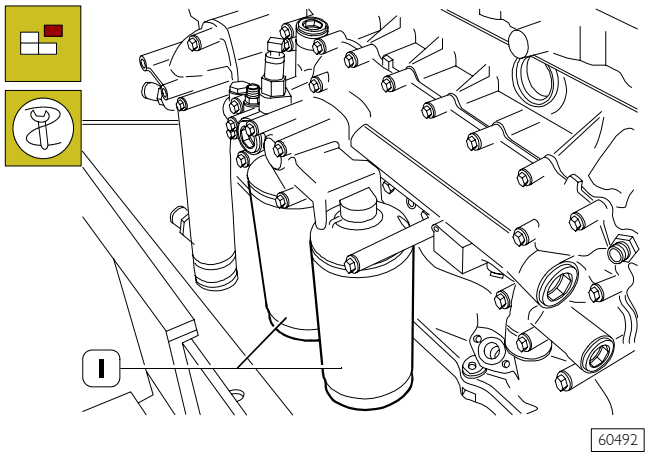
Fit the extractor 99340053 (2) and remove the engine crankshaft seal gasket (1), remove the cover (3).

Figure 36



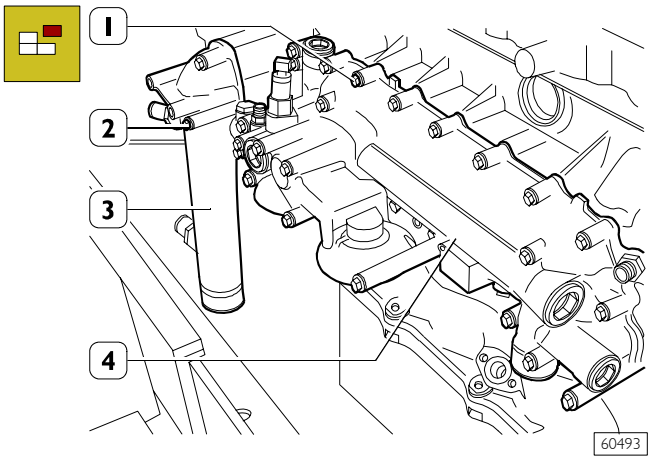
Remove the following components: water outlet line (2); oil delivery line (4); actuator air line (3); water delivery line (6); oil return line (7); turbocharger (5); exhaust manifold (1).

Figure 37



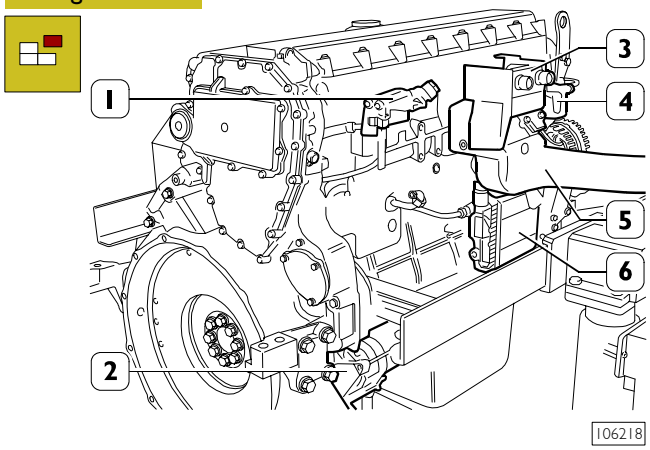
Unscrew the oil filters (1) using the tool 99360314.

Figure 38



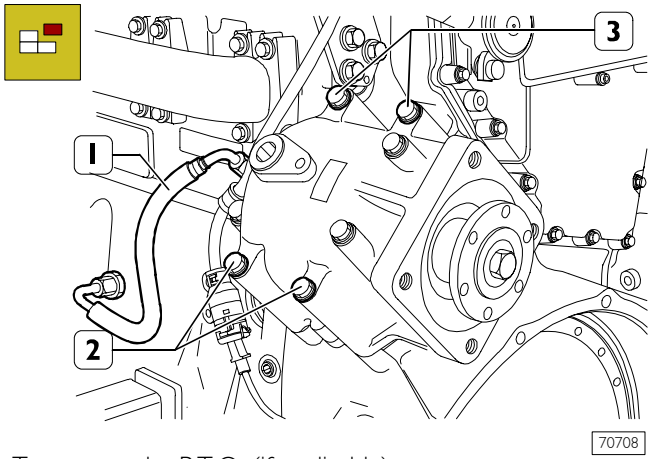
- Unscrew the screws (1) and remove the heat exchanger (4);
- unscrew the screws (2) and remove the water line (3).

Figure 39



Remove the following components: fuel filter support (1) and lines; starter (2); engine starting button support (3); PWN valve air filter (4); suction manifold (5) fitted with resistance for engine pre-heating; control unit (6).

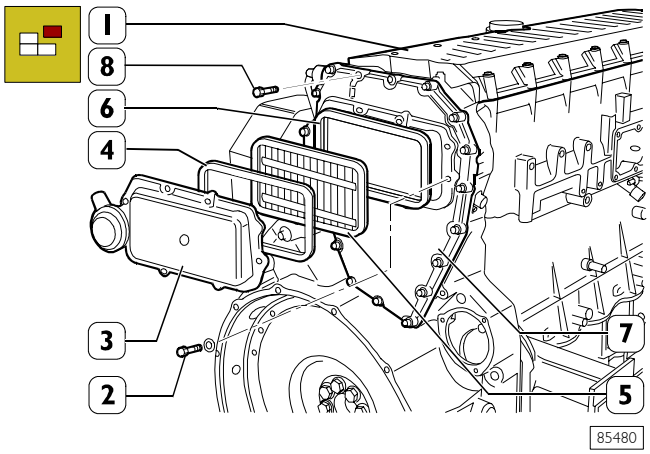
Figure 40



To remove the P.T.O. (if applicable):

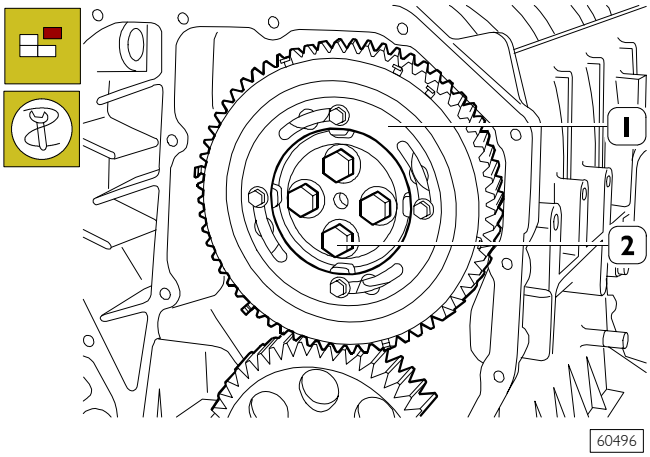
- ❑ Disconnect the oil pipe (1).
- ❑ Unscrew the 4 screws (2) and (3).

Figure 41



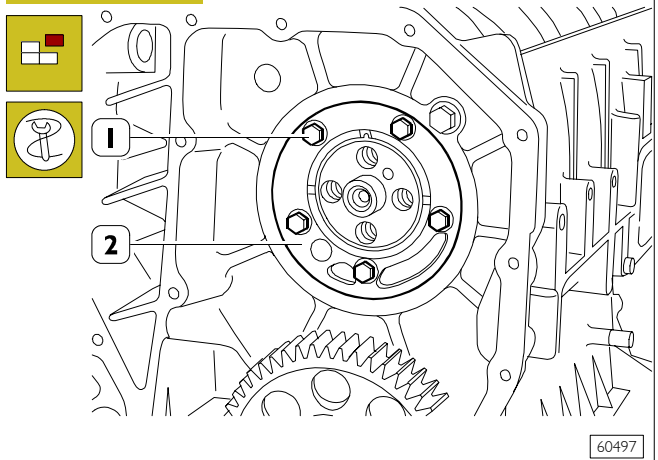
Remove the rocker arm cover (1), take off the screws (2) and remove: the cover (3), the filter (5) and the gaskets (4 and 6). Take off the screws (8) and remove the blow-by case (7).

Figure 42



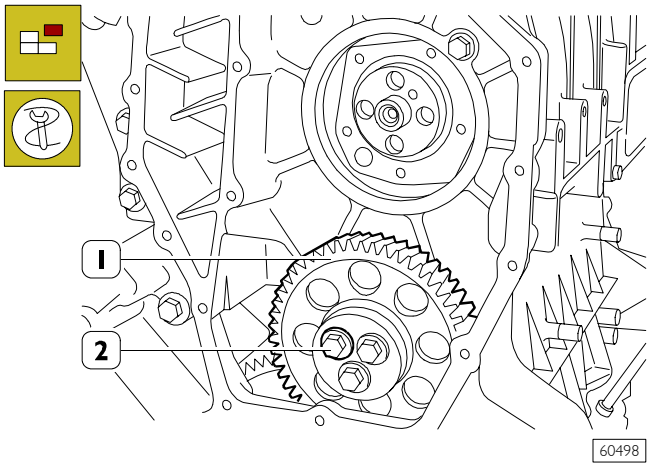
- Unscrew the screws (2) and remove the gear (1) fitted with phonic wheel.

Figure 43



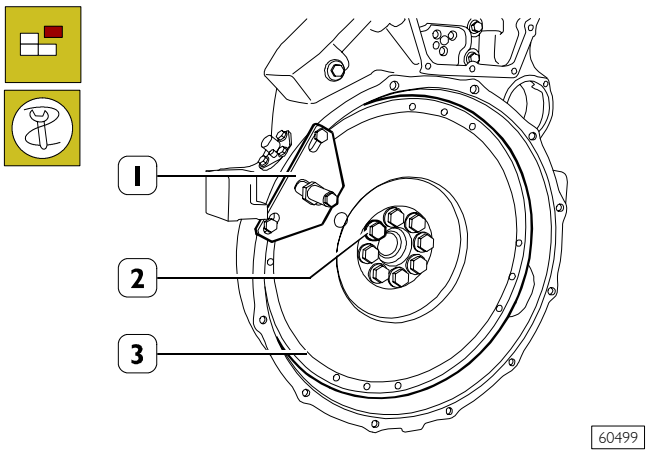
- Unscrew the screws (1); tighten one screw in a reaction hole and remove the shoulder plate (2), remove the sheet gasket.

Figure 44



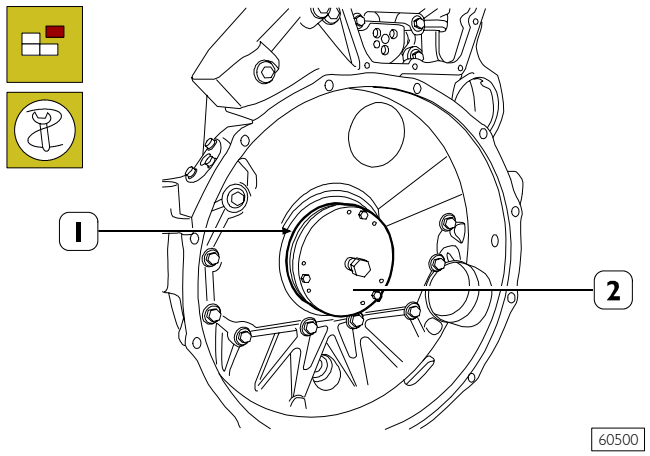
Unscrew the screws (2) and remove the transmission gear (1).

Figure 45



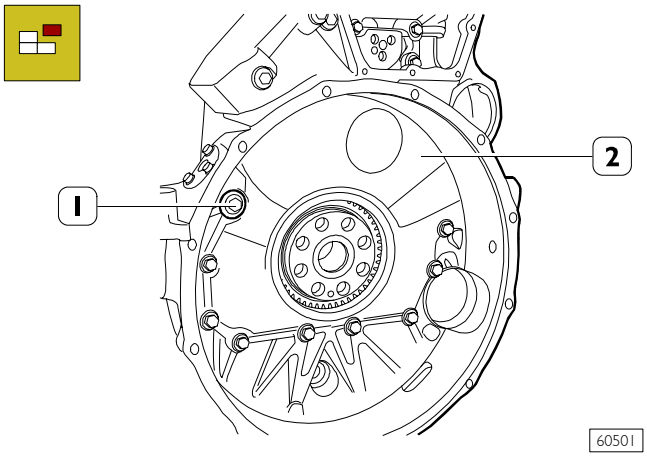
Stop the engine flywheel (3) rotation by means of tool 99360351 (1), unscrew the fixing screws (2) and remove the engine flywheel.

Figure 46



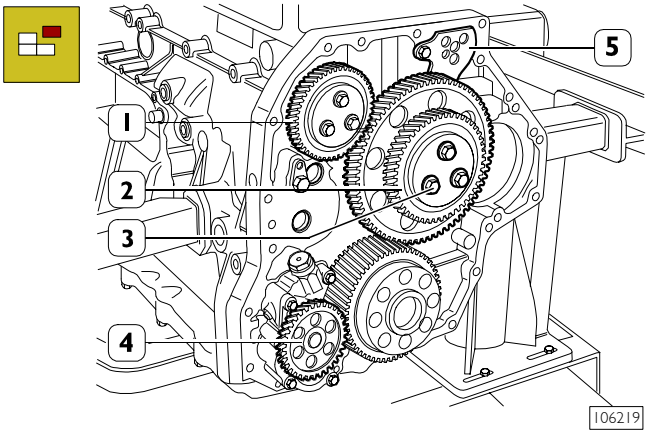
Apply the extractor 99340054 (2) and pull out the seal gasket (1).

Figure 47



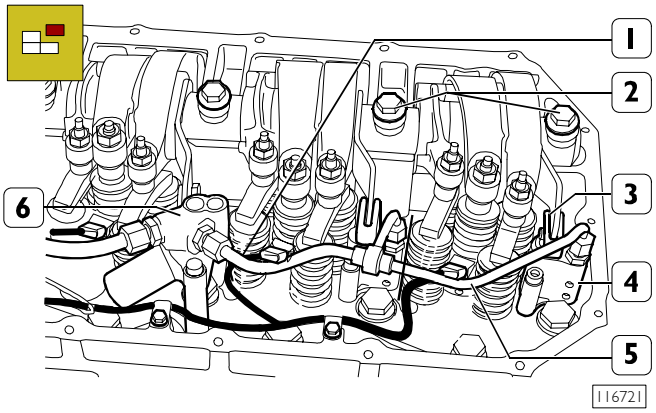
Unscrew the screws (1) and take down the gearbox (2).

Figure 48



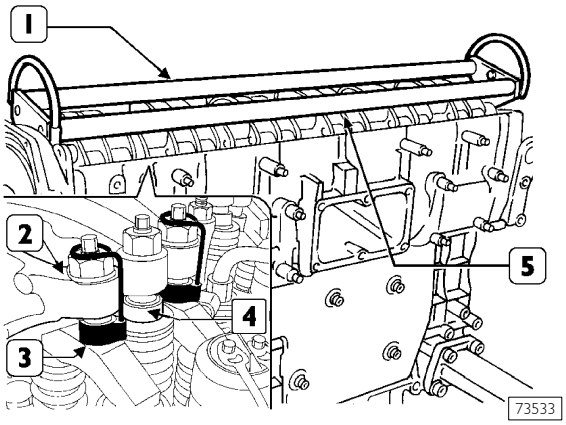
If present, dismount P.T.O. driving gear (1).
Remove screws (3) and dismount double gear (2).
Remove securing screw and dismount articulated rod (5).
Dismount oil pump (4).

Figure 49



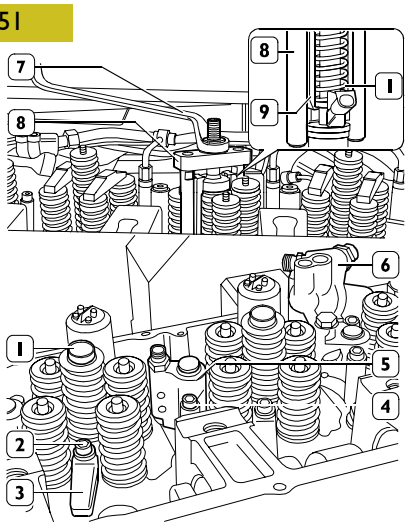
- ❑ Release the check springs (3) of the exhaust brake lever.
- ❑ Remove the electric connections (1).
- ❑ Remove exhaust brake pins (4) and slave cylinder (6) pipes (5).
- ❑ Unscrew the screws (2) fixing the rocker arm shaft.
- ❑ Remove the head injection wiring.
  The wiring has to be extracted from the front.

Figure 50



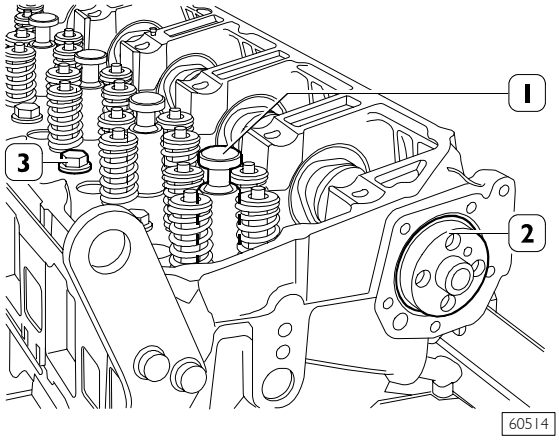
Using tool 99360144 (3), constrain the blocks (4) to the rockers (2). Apply tool 99360553 (1) to the rocker holder shaft (5) and remove the shaft (5) from the cylinder head.

Figure 51



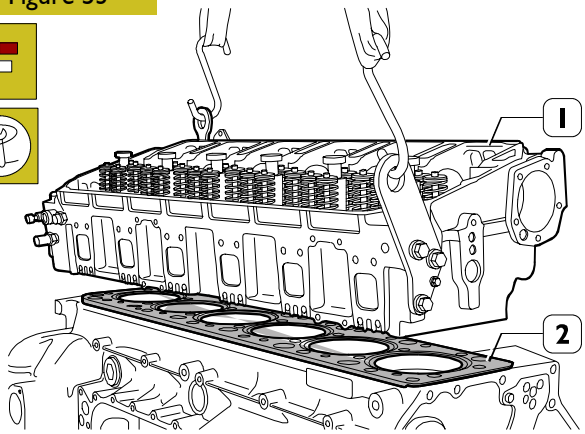
- ❑ Unscrew the screws (2) fixing the brackets (3);
- ❑ hook tool 99342155 part (9) to pump injector (1);
- ❑ mount part (8) on part (9) resting part on cylinder head;
- ❑ screw nut (7) and extract pump injector (1) from cylinder head.
- ❑ unscrew the screws (4) and remove the exhaust brake pins (5).
- ❑ unscrew the screws and remove the slave cylinder (6).

Figure 52



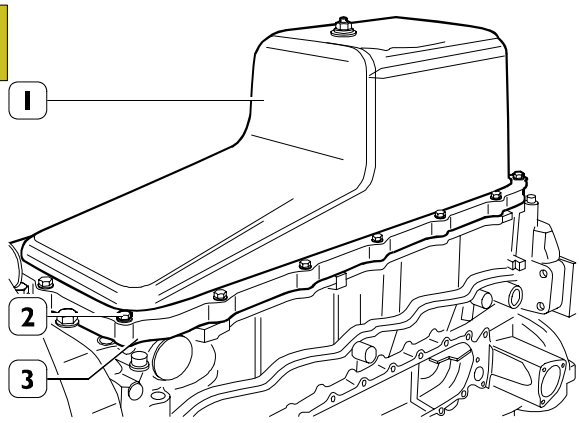
- ❑ Fit the plugs 99360180 (1) instead of injectors.
- ❑ Remove the camshaft (2).
- ❑ Unscrew the fixing screws on the cylinder head (3).

Figure 53



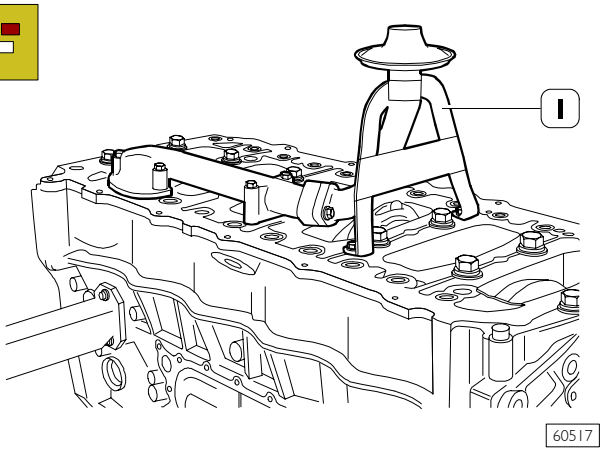
- ❑ By means of metal ropes, lift the cylinder head (1).
- ❑ Remove the seal (2)

Figure 54



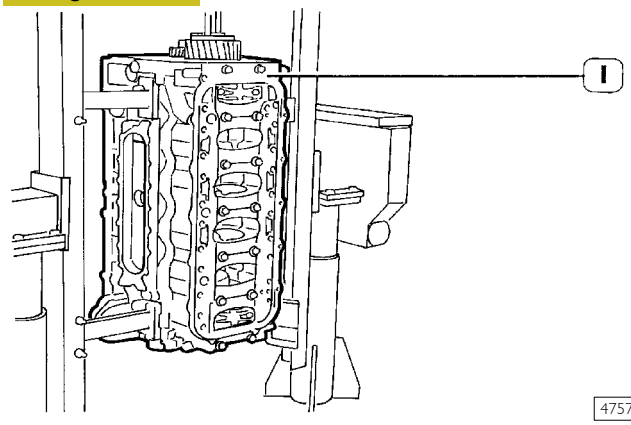
Unscrew the screws (2) and remove the engine oil sump (1) fitted with spacer (3) and seal.

Figure 55



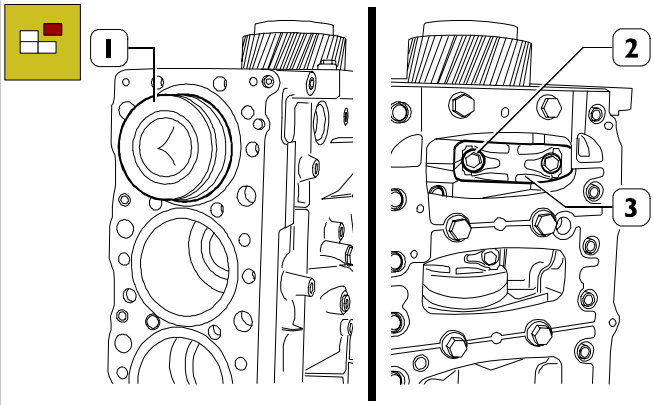
Unscrew the screws and remove suction rose (1).

Figure 56



Rotate the block (1) to the vertical position.

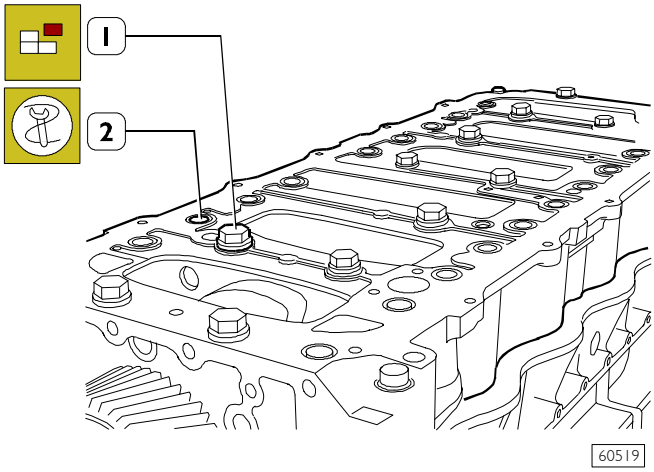
Figure 57



Untighten screws (2) fixing the connecting rod cap (3) and remove it. Remove the connecting rod-piston (1) assembly from the upper side. Repeat these operations for the other pistons.

NOTE Keep the big end bearing shells in their respective housings and/or note down their assembly position since, if reusing them, they will need to be fitted in the position found upon removal.

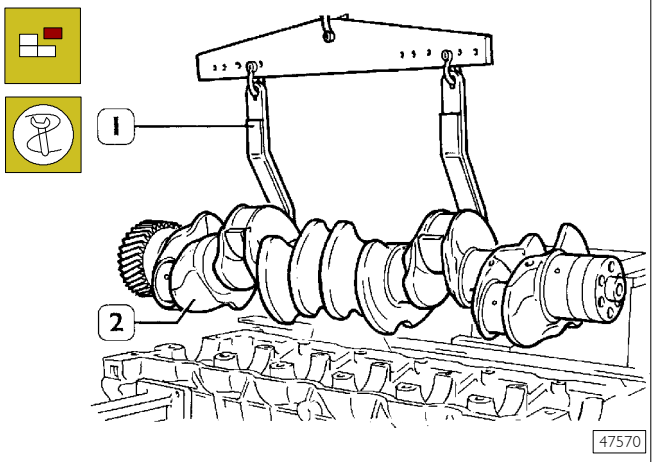
Figure 58



By means of proper and splined wrenches, untighten the screws (1) and (2) and remove the under-block.

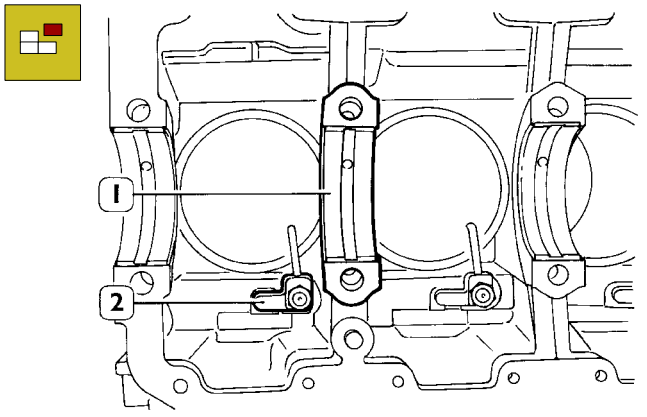
NOTE Note down the assembly position of the top and bottom main bearing shells since, if reusing them, they will need to be fitted in the position found upon removal.

Figure 59



Using tool 99360500 (1), remove the crankshaft (2).

Figure 60



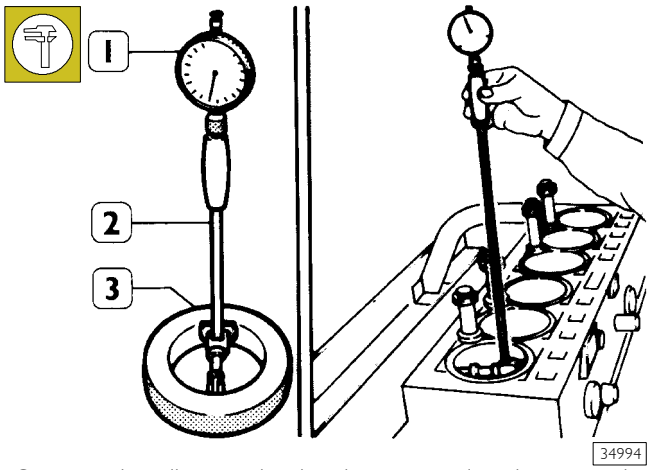
Remove the main bearing shells (1), unscrew the screws and take out the oil nozzles (2).
Remove the cylinder liners as described under the relevant subheading on page 56.

NOTE After disassembling the engine, thoroughly clean disassembled parts and check their integrity.
Instructions for main checks and measures are given in the following pages, in order to determine whether the parts can be re-used.

REPAIR OPERATIONS

540410 CYLINDER BLOCK
540420 Checks and measurements

Figure 61 (Demonstration)



Once engine dismounting has been completed, accurately clean cylinders-block assembly.

Accurately check that no cracks are present on engine block.

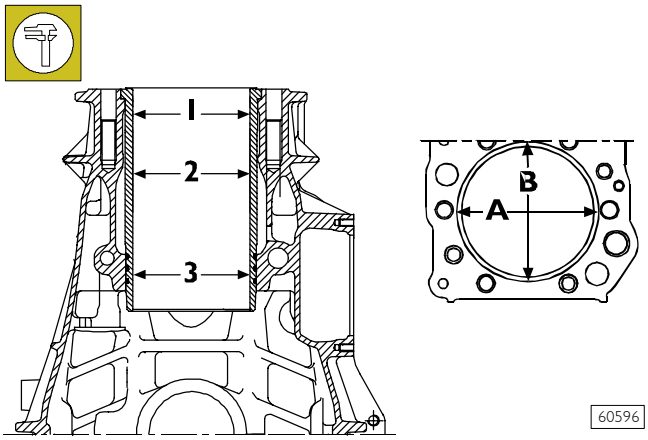
Check machining plugs conditions. If plugs are rusty or whenever any doubt arises about plugs tightness, replace plugs.

On plugs mounting, apply sealant Loctite 270 on plugs.

The inside diameter of the cylinder liners is checked to ascertain the extent of ovalization, taper and wear using the gauge 99395687 (2) fitted with the dial gauge (1), zeroed beforehand on the ring gauge (3) of diameter 135 mm.

NOTE If you do not have a ring gauge of diameter 135 mm, use a micrometer for this purpose.

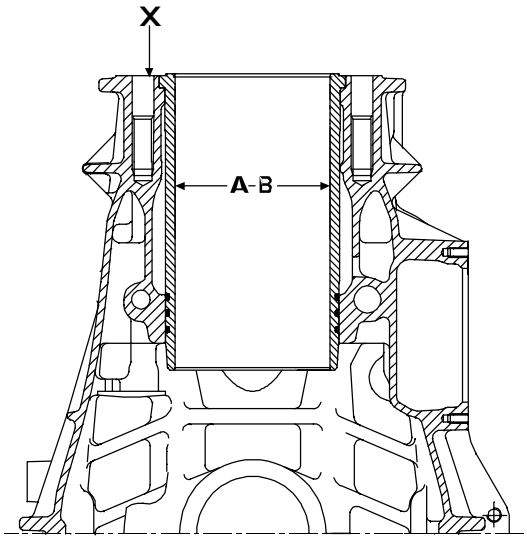
Figure 62



1 = 1st measuring
2 = 2nd measuring
3 = 3rd measuring

Carry out measurings on each cylinder liner at three different levels and on two (A-B) surfaces, to one another perpendicular, as shown in Figure 62.

Figure 63



A = Selection class Ø 125 – 125.013 mm
B = Selection class Ø 125.011 – 125.024 mm
X = Selection class marking area

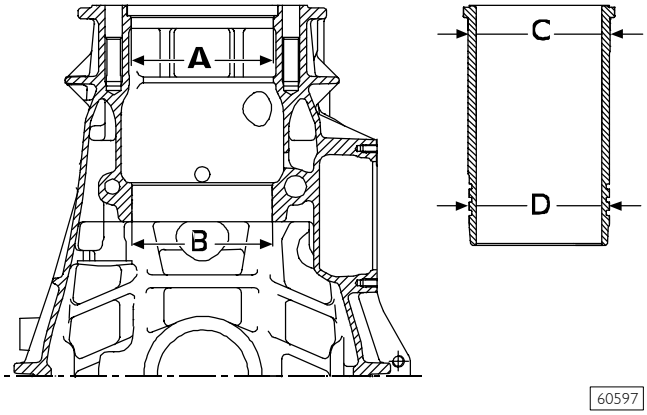
In case of maximum wear >0.150 mm or maximum ovalization >0.100 mm compared to the values indicated in the figure, the liners must be replaced as they cannot be ground, lapped or trued.

NOTE

IVECO PARTS

Cylinder liners are equipped with spare parts with "A" selection class.

Figure 64



A = Ø 142.000 to 142.025 mm
B = Ø 140.000 to 140.025 mm
C = Ø 141.961 to 141.986 mm
D = Ø 139.890 to 139.915 mm

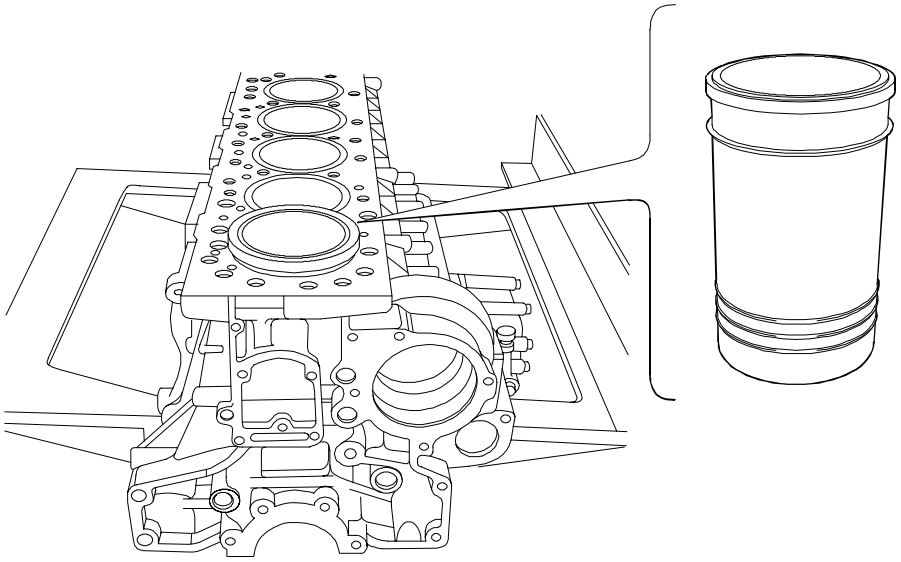
The figure shows the outer diameters of the cylinder liners and the relative seat inner diameters.

The cylinder liners can be extracted and installed several times in different seats, if necessary.

Check the state of the cylinder assembly machining plugs: if they are rusty or there is any doubt at all about their seal, change them.

Cylinder liners

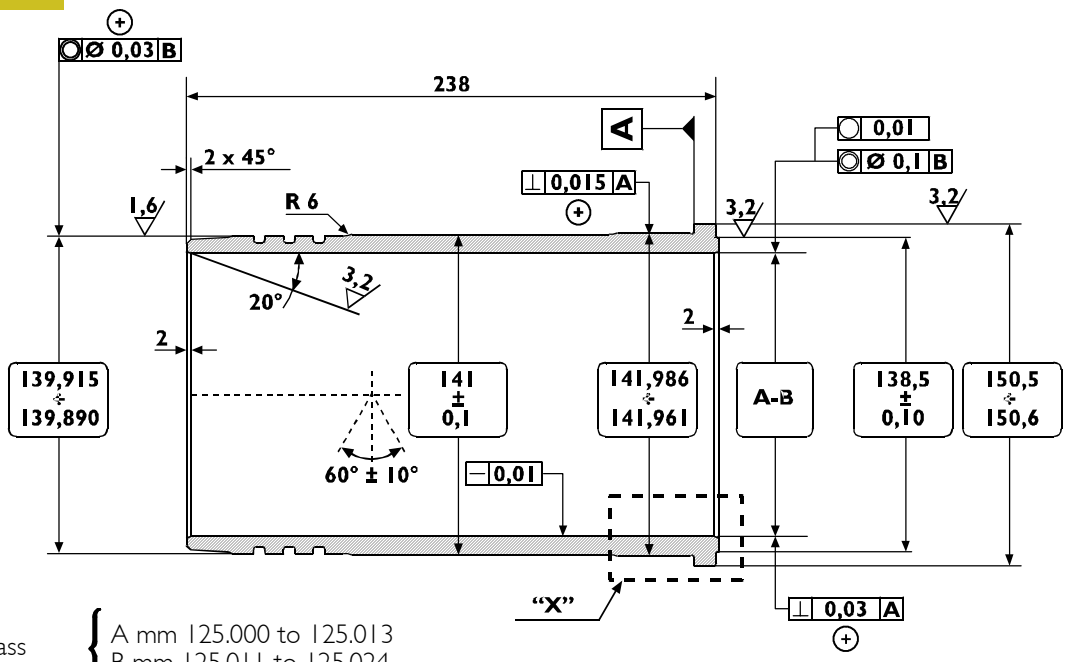
Figure 65



60598

BLOCK WITH CYLINDER LINERS

Figure 66

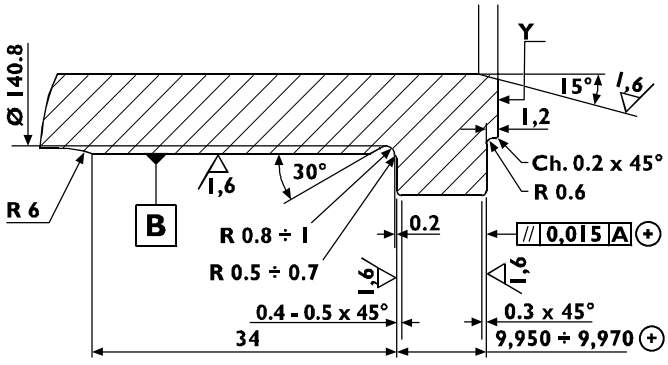


60600

Selection class { A mm 125.000 to 125.013
B mm 125.011 to 125.024

CYLINDER LINERS MAIN DATA

Figure 67



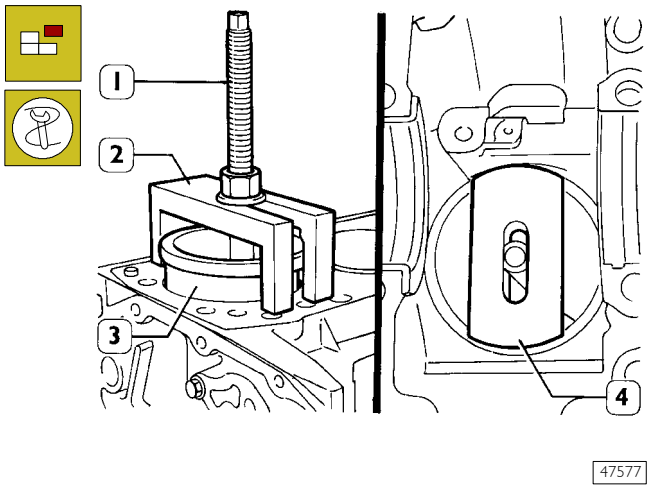
60601

DETAIL "X"
"Y" - Selection class marking area

540420 Replacing cylinder liners

Refitting

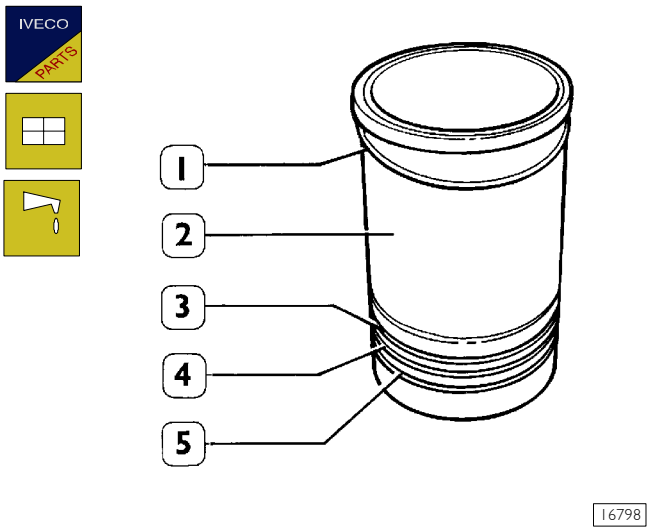
Figure 68



Position the tool 99360706 (2) and the plate 99360726 (4) as illustrated in the figure, checking that its plate (4) correctly rests on the cylinder liner.
Tighten the screw nut (1) and remove the cylinder liner (3) from the block.

Fitting and checking protrusion

Figure 69

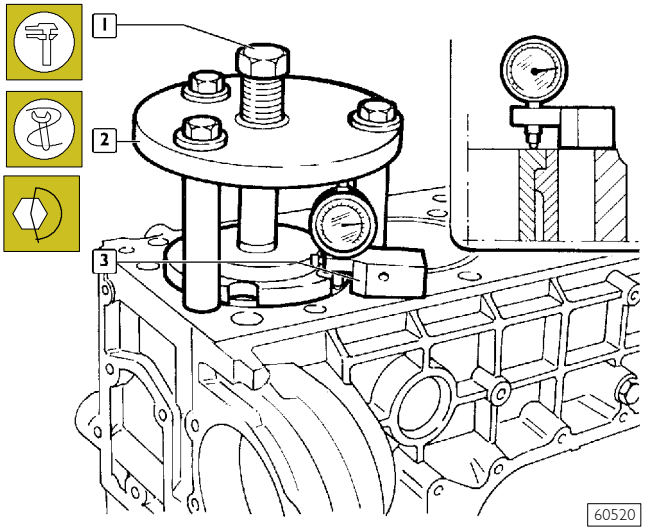


Always replace water sealing rings (3, 4 and 5).
Install the adjustment ring (1) on the cylinder liner (2); lubricate lower part of liner and install it in the cylinder unit using the proper tool.

NOTE

The adjustment ring (1) is supplied as spare parts in the following thicknesses: 0.08 mm - 0.10 mm - 0.12 mm.

Figure 70



Check the protrusion of the cylinder liners, using tool 99360472 (2) and tightening screw (1) to 225 Nm torque. Using a dial gauge (3), measure the cylinder liner protrusion, from the cylinder head supporting surface, it must be 0.045 to 0.075 (Figure 71); otherwise, replace the adjustment ring (1, Figure 69) supplied as spare parts having different thicknesses.

Figure 71

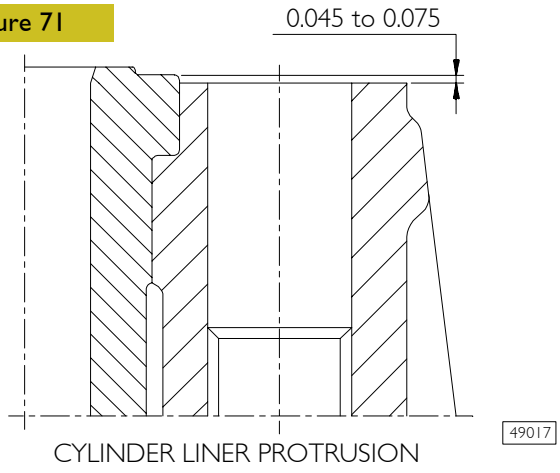
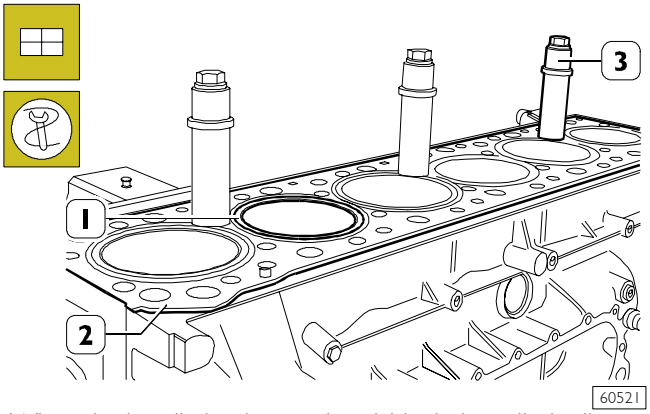


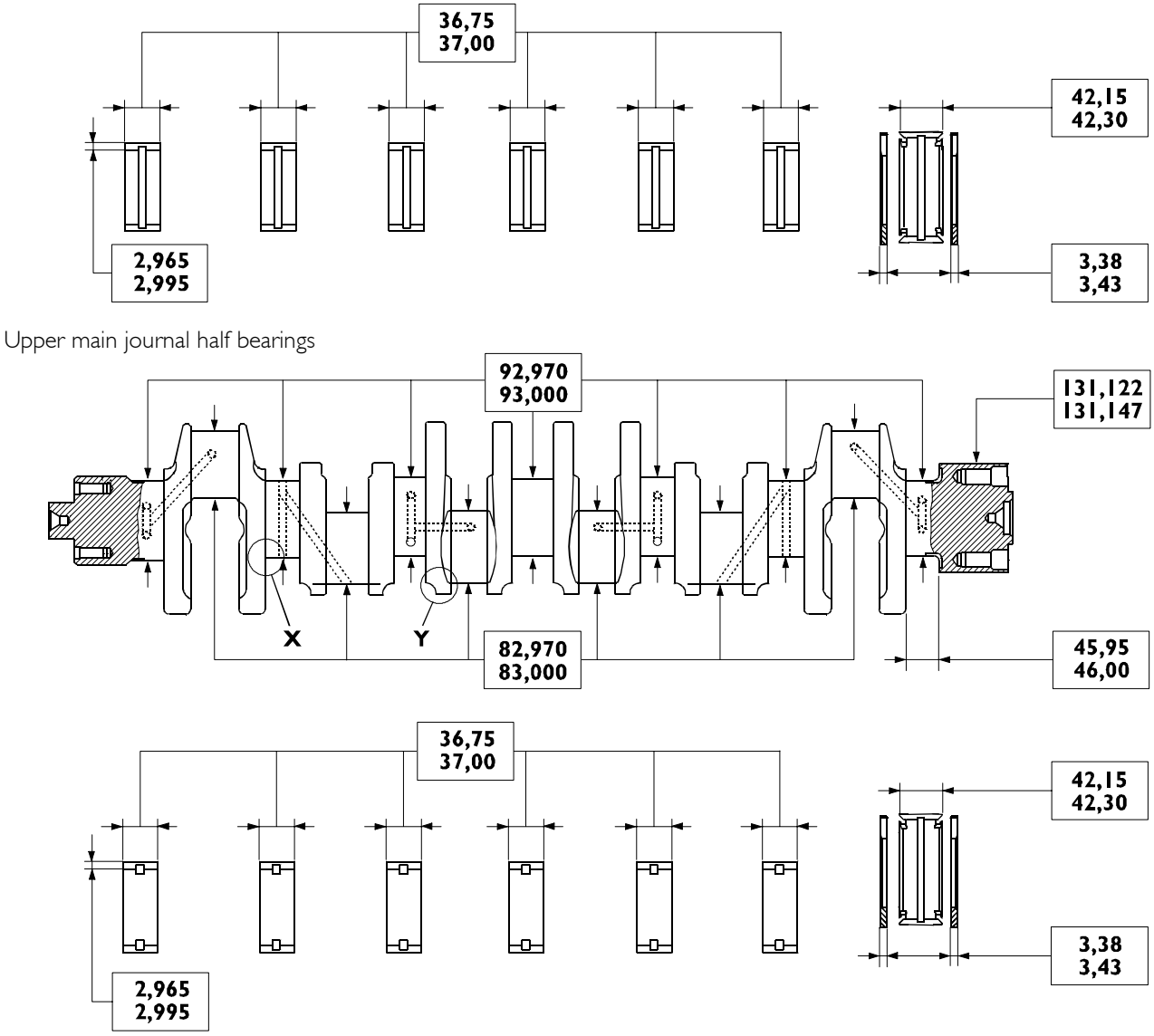
Figure 72



When the installation is completed, block the cylinder liners (1) to the block (2) with studs 99360703 (3).

5408 Crankshaft

Figure 73



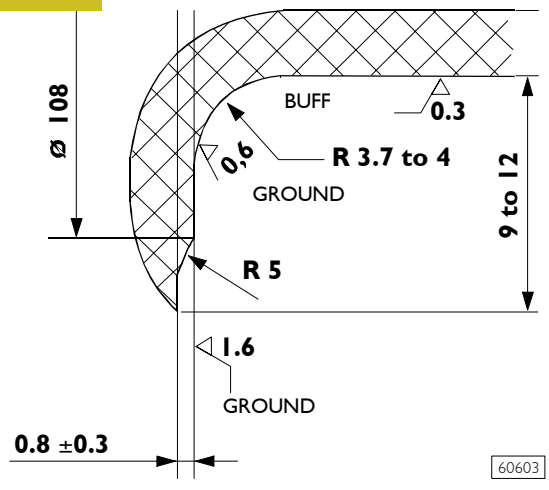
Upper main journal half bearings

Lower main journal half bearings

MAIN DATA FOR THE CRANK SHAFT PINS AND THE HALF BEARINGS

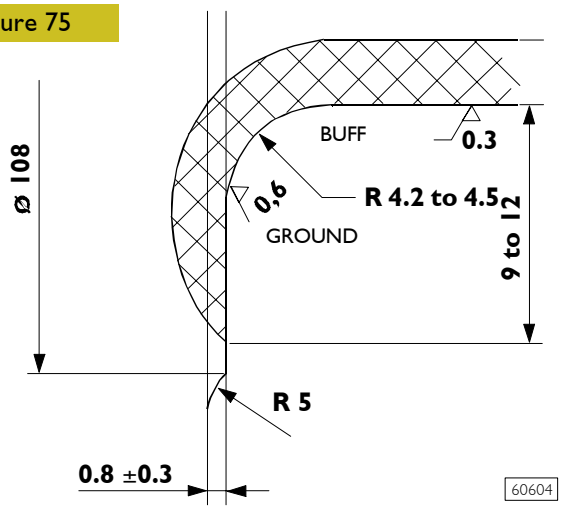
Check the condition of the journals and the big end pins; there must no be signs of scoring, ovalization or excessive wear. The data given refer to the normal diameter of the pins.

Figure 74



X. Detail of main journals connections

Figure 75

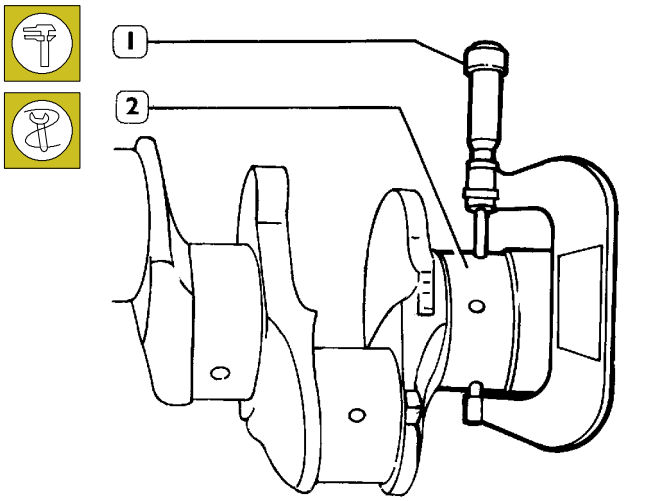


Y. Detail of crank pins connections

540812 Measuring the main journals and crankpins

Before grinding the crank pins using a micrometer (1), measure the main journals and the crank pins (2) and decide, on the basis of the undersizing of the bearings, the final diameter to which the pins are to be ground.
The undersize classes are 0.127 - 0.254 - 0.508 mm.

Figure 76

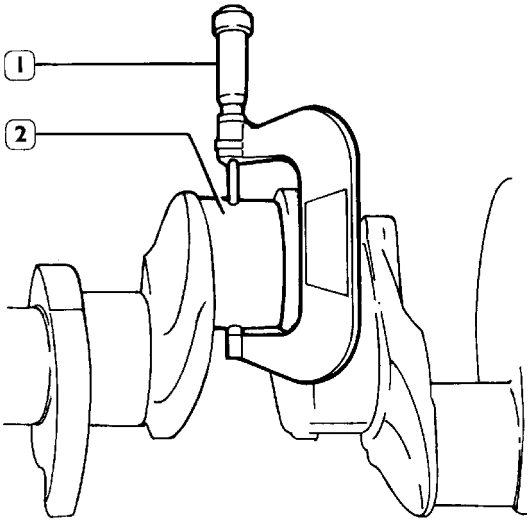


47535

MEASURING THE MAIN JOURNALS

NOTE It is advisable to enter the values found in a table (Figure 78).

Figure 77



47536

MEASURING CRANK PINS

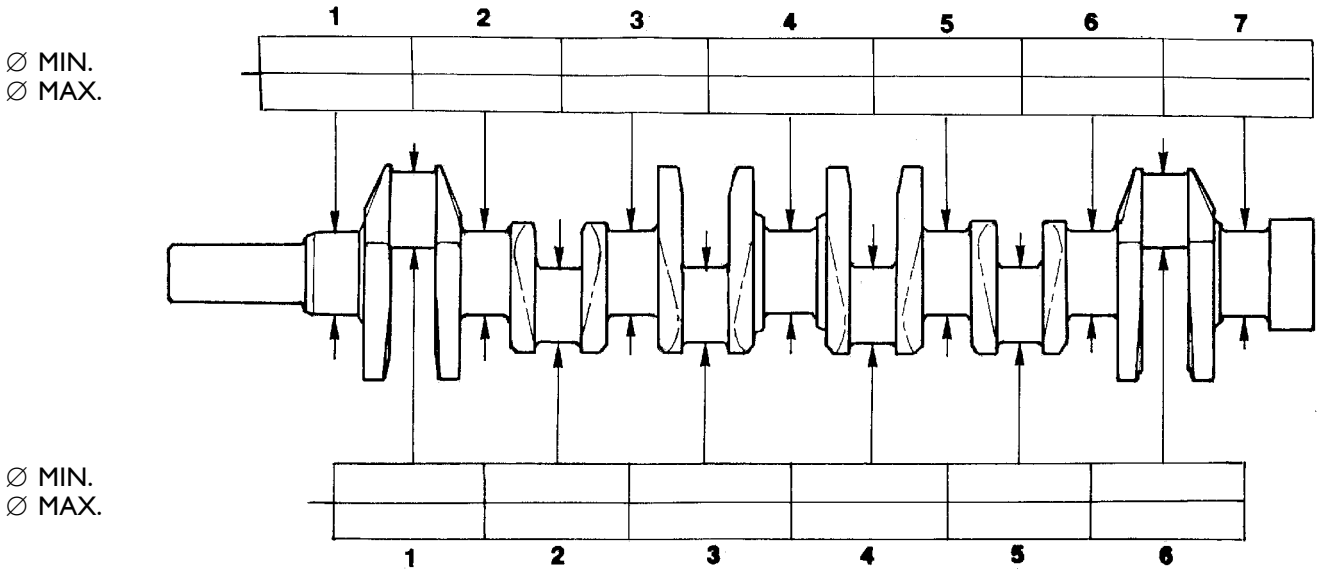
During grinding, pay attention to journal and crank pins values specified in Figure 74 and Figure 75.

NOTE All journals and crank pins must also be ground to the same undersizing class, in order to avoid any alteration to shaft balance.

Figure 78

Fill in this table with the measurements of the main journals and the crank pins.

MAIN JOURNALS



CRANK PINS

36061

Preliminary measurement of main and big end bearing shell selection data

For each of the journals of the crankshaft, it is necessary to carry out the following operations:

MAIN JOURNALS:

- ❑ Determine the class of diameter of the seat in the crankcase.
- ❑ Determine the class of diameter of the main journal.
- ❑ Select the class of the bearing shells to mount.

CRANKPINS:

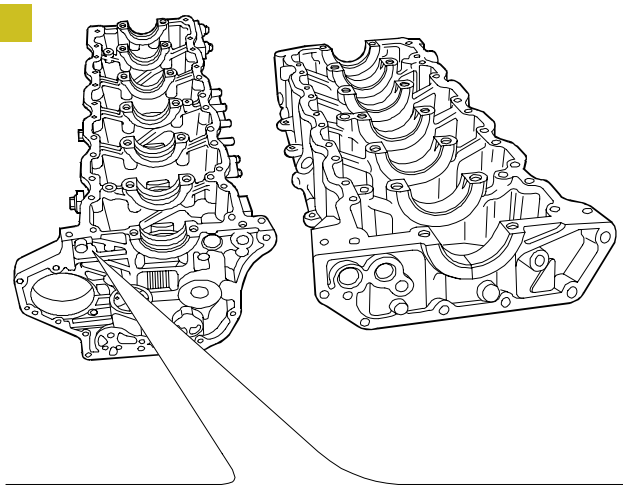
- ❑ Determine the class of diameter of the seat in the connecting rod.
- ❑ Determine the class of diameter of the crankpin.
- ❑ Select the class of the bearing shells to mount.

DEFINING THE CLASS OF DIAMETER OF THE SEATS FOR BEARING SHELLS ON THE CRANKCASE

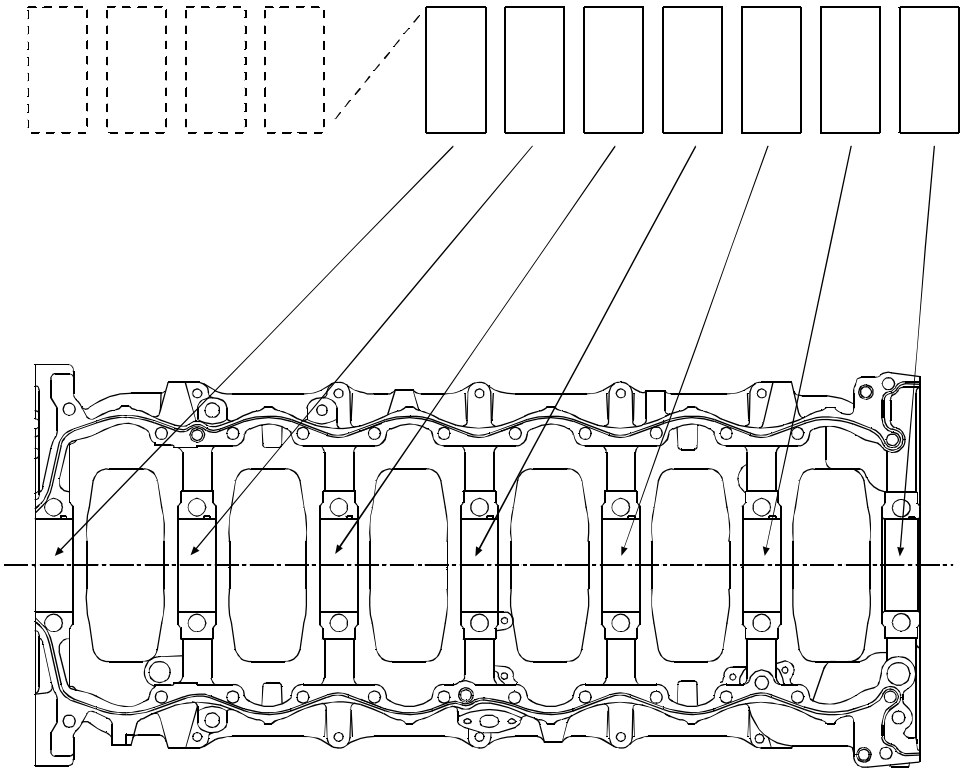
On the front of the crankcase, two sets of numbers are marked in the position shown (Figure 79 at top).

- ❑ The first set of digits (four) is the coupling number of the crankcase with its base.
- ❑ The following seven digits, taken singly, are the class of diameter of each of the seats referred to (Figure 79 at bottom).
- ❑ Each of these digits may be **1**, **2** or **3**.

Figure 79



CLASS	MAIN BEARING HOUSING NOMINAL DIAMETER
1	99.000 to 99.009
2	99.010 to 99.019
3	99.020 to 99.030



47535

Selecting the main and big end bearing shells

NOTE To obtain the required assembly clearances, the main and big end bearing shells need to be selected as described hereunder.

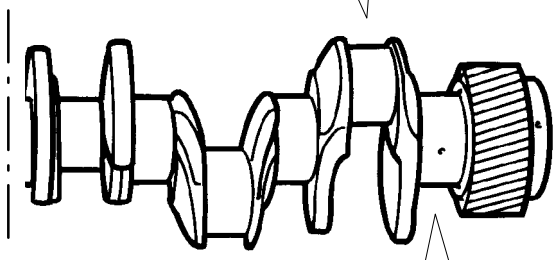
This operation makes it possible to identify the most suitable bearing shells for each of the journals (the bearing shells, if necessary, can have different classes from one journal to another).

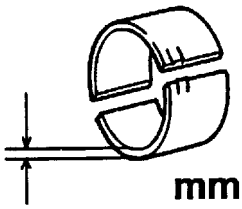
Depending on the thickness, the bearing shells are selected in classes of tolerance marked by a coloured sign (red-green – red/black – green/black).

The following tables give the specifications of the main and big end bearing shells available as spares in the standard sizes (STD) and in the permissible oversizes (+0.127, +0.254, +0.508).

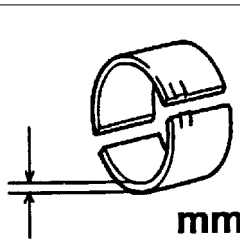
Figure 80

	STD	+0.127	+0.254	+0.508
red	1.970 to 1.980		2.097 to 2.107	2.224 to 2.234
red/black		2.033 to 2.043		
green	1.981 to 1.990		2.108 to 2.117	2.235 to 2.244
green/black		2.044 to 2.053		
yellow*	1.991 to 2.000			
yellow/black*		2.054 to 2.063		





	STD	+0.127	+0.254	+0.508
red	2.965 to 2.974		2.097 to 2.107	2.224 to 2.234
red/black		3.028 to 3.037		
green	2.975 to 2.984		2.108 to 2.117	2.235 to 2.244
green/black		3.038 to 3.047		
yellow*	2.985 to 2.995			
yellow/black*		3.048 to 3.058		



* Fitted in production only and not supplied as spares

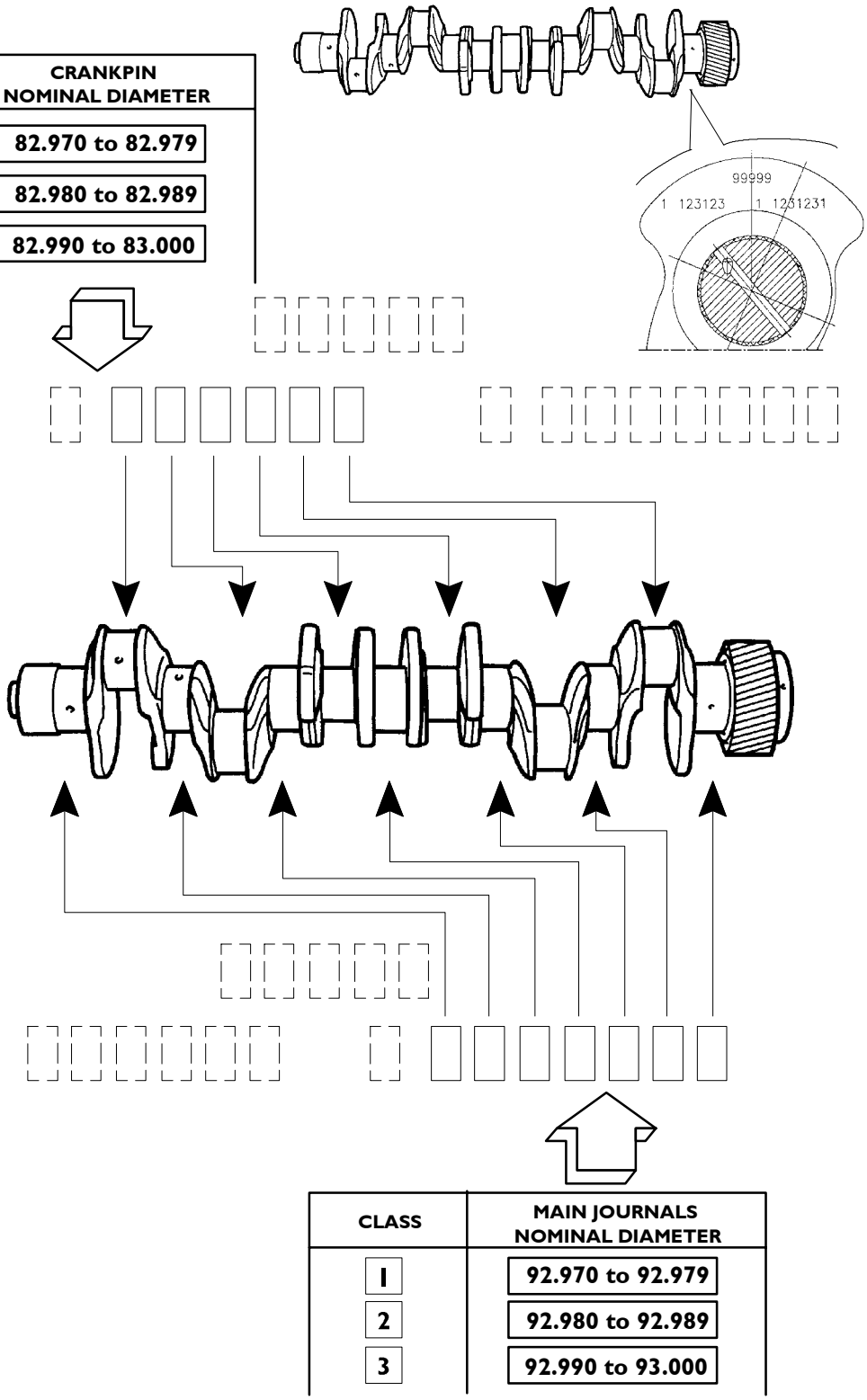
DEFINING THE CLASS OF DIAMETER OF THE MAIN JOURNALS AND CRANKPINS (Journals with nominal diameter)

Main journals and crankpins: determining the class of diameter of the journals.
Three sets of numbers are marked on the crankshaft in the position shown by the arrow (Figure 81 at top):

- The first number, of five digits, is the part number of the shaft.
- Under this number, on the left, a set of six digits refers to the crankpins and is preceded by a single digit showing the status of the journals (1 = STD, 2 = -0.127), the other six digits, taken singly, give the class of diameter of each of the crankpins they refer to (Figure 81 at top).
- The set of seven digits, on the right, refers to the main journals and is preceded by a single digit: the single digit shows the status of the journals (1 = STD, 2 = -0.127), the other seven digits, taken singly, give the class of diameter of each of the main journals they refer to (Figure 81 at bottom).

Figure 81

CLASS	CRANKPIN NOMINAL DIAMETER
1	82.970 to 82.979
2	82.980 to 82.989
3	82.990 to 83.000

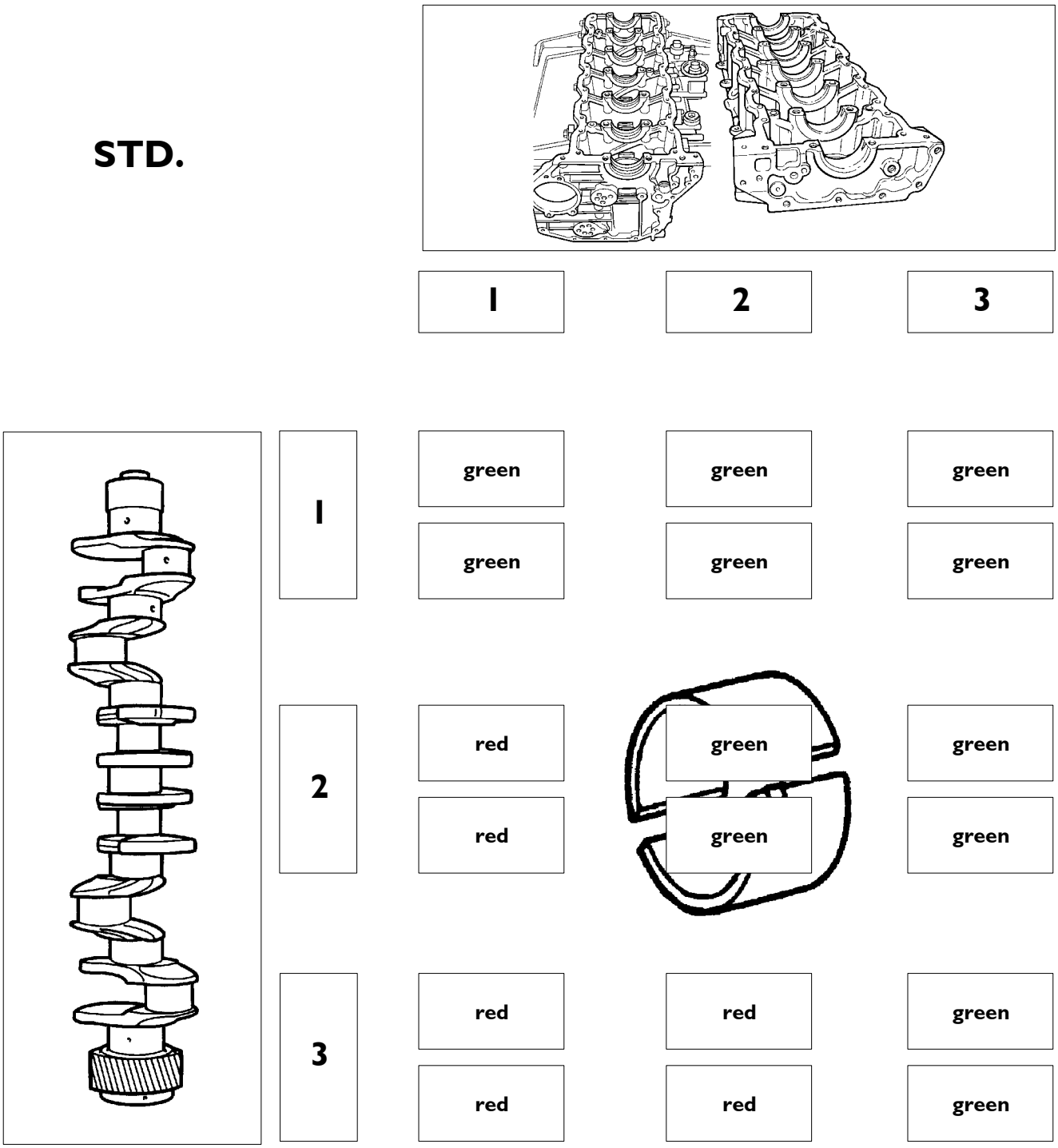


CLASS	MAIN JOURNALS NOMINAL DIAMETER
1	92.970 to 92.979
2	92.980 to 92.989
3	92.990 to 93.000

SELECTING THE MAIN BEARING SHELLS (Journals with nominal diameter)

After reading off the data, for each of the main journals, on the crankcase and crankshaft, you choose the type of bearing shells to use according to the following table:

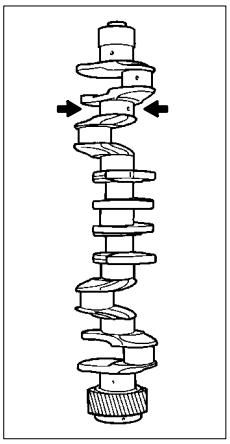
Figure 82

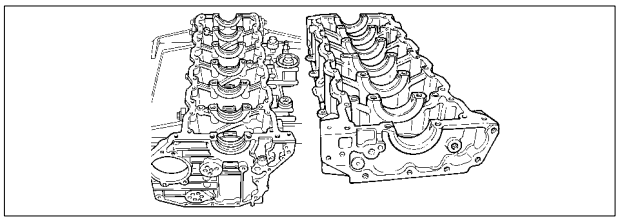


SELECTING THE MAIN BEARING SHELLS (GROUND JOURNALS)

If the journals have been ground, the procedure described so far cannot be applied.
In this case, it is necessary to check that the new diameter of the journals is as shown in the table and to mount the only type of bearing shell envisaged for the relevant undersizing.

Figure 83



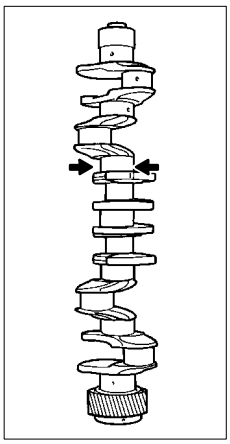


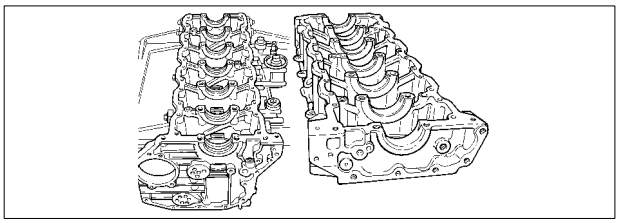
-0.127

red/black = mm 3.028 to 3.037

green/black = mm 3.038 to 3.047

	1	2	3
92.843 92.852	1	green/black	green/black	green/black
		green/black	green/black	green/black
92.853 92.862	2	red/black	green/black	green/black
		red/black	green/black	green/black
99.863 99.873	3	red/black	red/black	green/black
		red/black	red/black	green/black

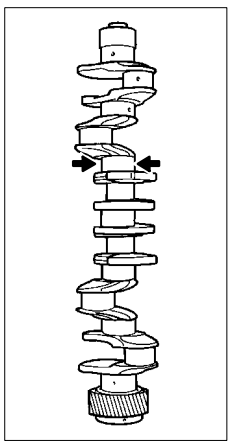


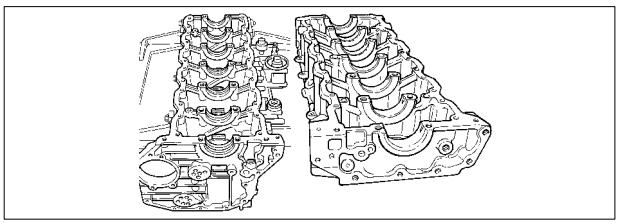


-0.254

red = mm 3.092 to 3.102

	1	2	3
92.726 92.746		red	red	red
		red	red	red





-0.508

red = mm 3.219 to 3.229

	1	2	3
92.468 92.508		red	red	red
		red	red	red

SELECTING THE BIG END BEARING SHELLS (JOURNALS WITH NOMINAL DIAMETER)

There are three markings on the body of the connecting rod in the position shown in the view from "A":

1 Letter indicating the class of weight:

A = 4024 to 4054 g.
B = 4055 to 4085 g.
C = 4086 to 4116 g.

2 Number indicating the selection of the diameter of the big end bearing seat:

1 = 87.000 to 87.010 mm
2 = 87.011 to 87.020 mm
3 = 87.021 to 87.030 mm

3 Numbers identifying the cap-connecting rod coupling.

The number, indicating the class of diameter of the bearing shell seat may be **1**, **2** o **3**.

Determine the type of big end bearing to fit on each journal by following the indications in the table (Figure 85).

Figure 84

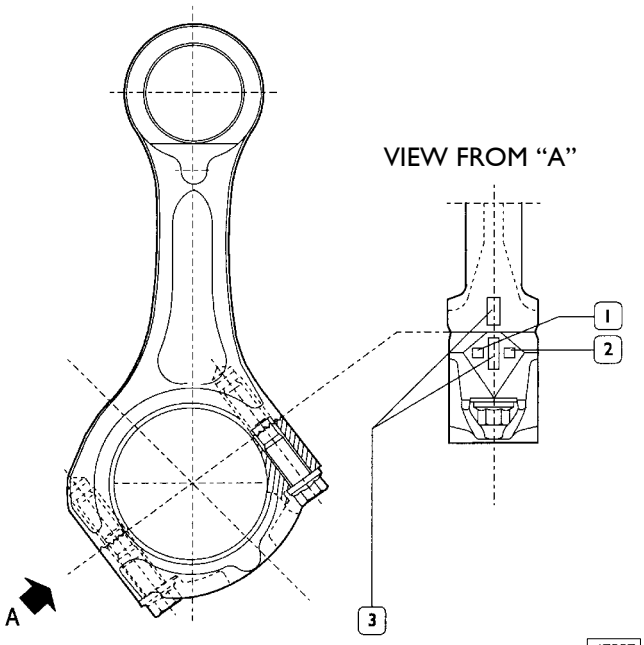
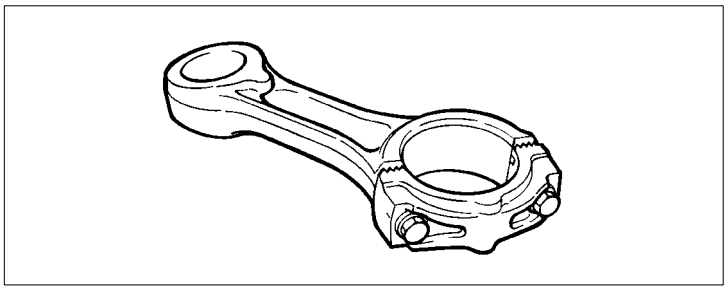
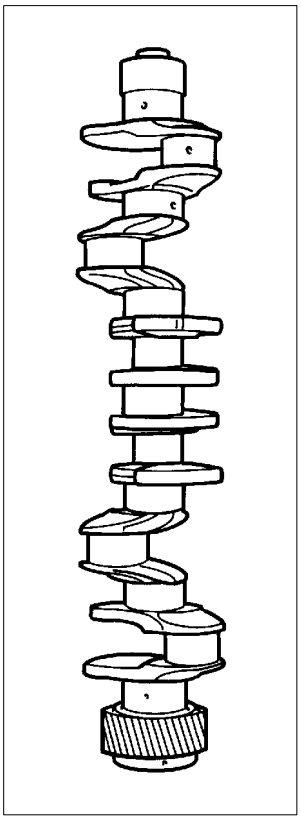


Figure 85

STD.



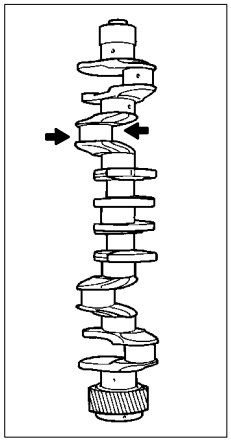


Class	1	2	3
1	green green	green green	green green
2	red red	green green	green green
3	red red	red red	green green

SELECTING BIG END BEARING SHELLS (GROUND JOURNALS)

If the journals have been ground, the procedure described so far cannot be applied.
In this case, it is necessary to check (for each of the undersizings) which field of tolerance includes the new diameter of the crankpins and to mount the bearing shells identified with the relevant table.

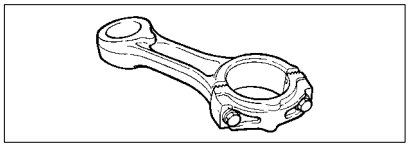
Figure 86



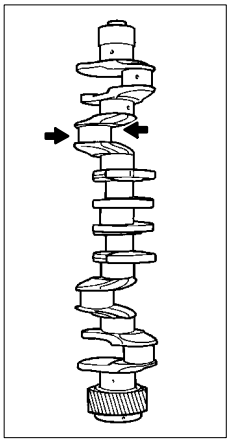
-0.127

red/black = mm 2.033 to 2.043

green/black = mm 2.044 to 2.053

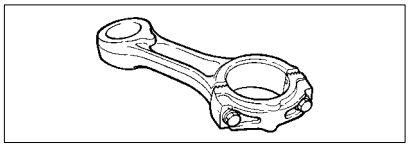


		1	2	3
82.843 82.852	1	green/black	green/black	green/black
		green/black	green/black	green/black
82.853 82.862	2	red/black	green/black	green/black
		red/black	green/black	green/black
82.863 82.873	3	red/black	red/black	green/black
		red/black	red/black	green/black

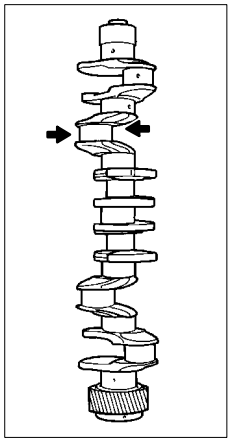


-0.254

red = mm 2.097 to 2.107
green = mm 2.108 to 2.117

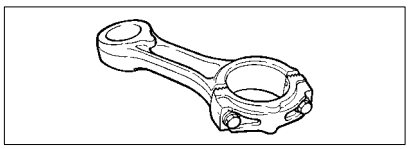


	1	2	3
82.726 82.735	red	green	green
	red	green	green
82.736 82.746	red	red	green
	red	red	green



-0.508

red = mm 2.224 to 2.234
green = mm 2.235 to 2.244

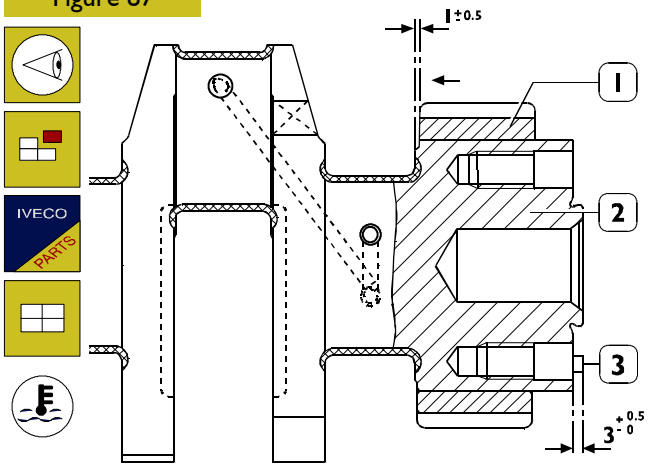


	1	2	3
82.472 82.481	red	green	green
	red	green	green
82.482 82.492	red	red	green
	red	red	green

540815 Replacing the timing gear and oil pump

Check that the toothing of the gear is neither damaged nor worn; if it is, take it out with an appropriate extractor and replace it.

Figure 87

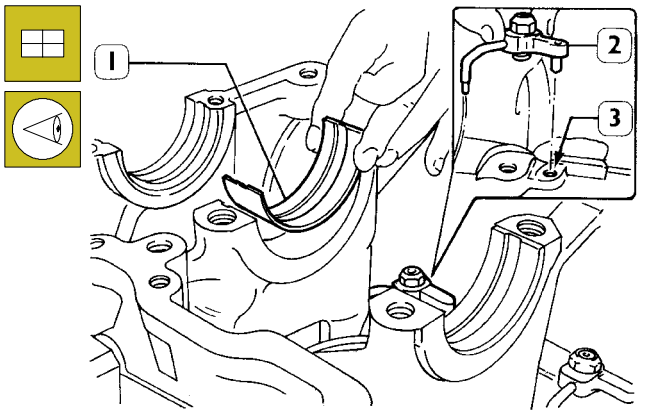


73534

When fitting the gear (1) on the crankshaft (2), heat it for no longer than 2 hours in an oven at a temperature of 180°C.
After heating the gear (1), fit it on the shaft by applying a load of 6000 N to it, positioning it at the distance shown in figura.
After cooling, the gear must have no axial movement under a load of 29100 N.
If changing the pin (3), after fitting it on, check it protrudes from the crankshaft as shown in the figure.

540811 Checking main journal assembly clearance

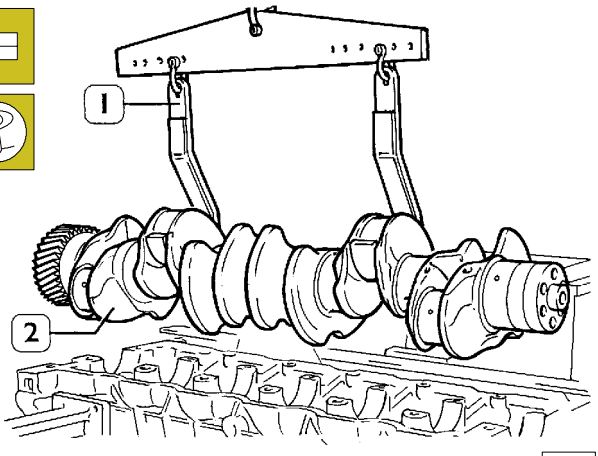
Figure 88



47579

Mount the oil nozzles (2), making the grub screw match the hole (3) on the crankcase.
Arrange the bearing shells (1) on the main bearing housings.

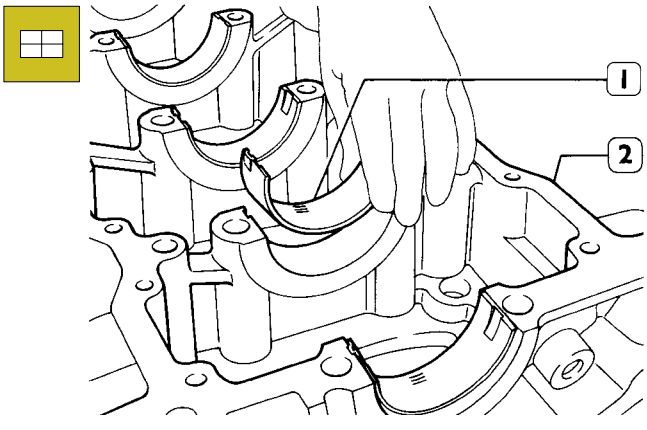
Figure 89



47578

Using the tackle and hook 99360500 (1), mount the crankshaft (2).

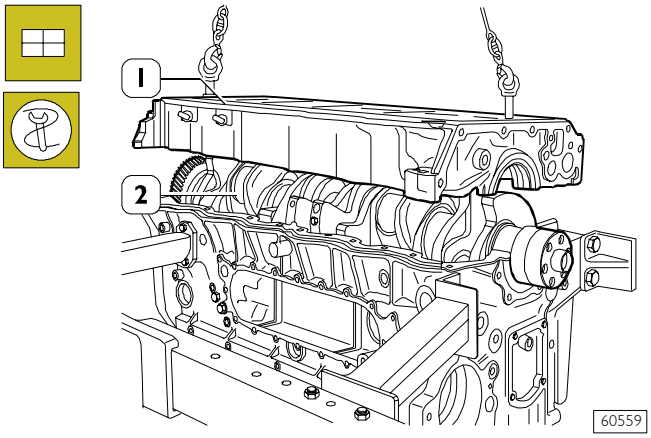
Figure 90



49021

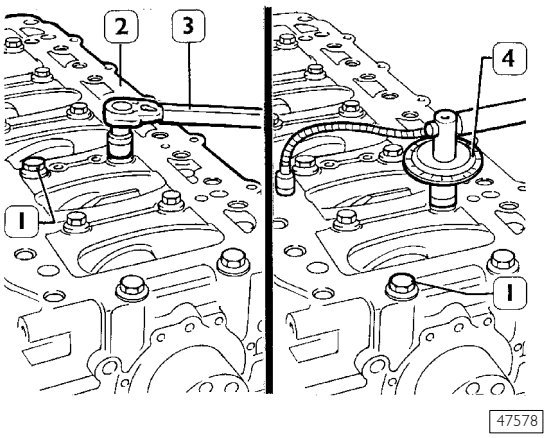
Arrange the bearing shells (1) on the main bearing housings in the crankcase base (2).
Check the assembly clearance between the main journals of the crankshaft and their bearings, proceeding as illustrated on the following pages.

Figure 91



Set two journals of the crankshaft (2) parallel to the longitudinal axis, a section of calibrated wire. Using appropriate hooks and tackle, mount the crankcase base (1).

Figure 92



❑ Lubricate the internal screws (1) with UTDM oil and tighten them with a torque wrench (3) to a torque of 120 Nm, using tool 99395216 (4), to an angle of 90°, following the diagram of Figure 93.

Figure 93

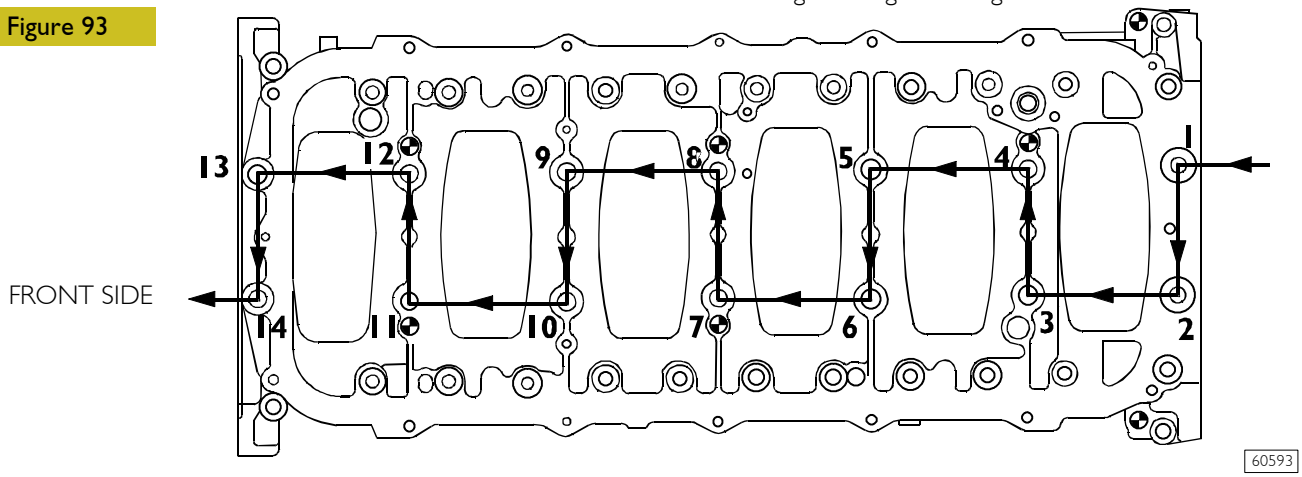
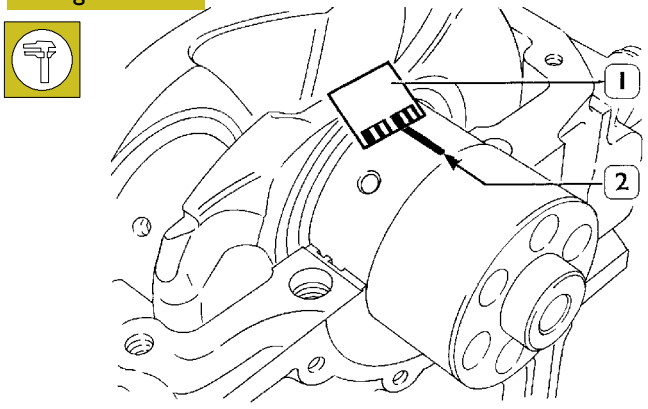


DIAGRAM OF SEQUENCE FOR TIGHTENING THE SCREWS FIXING THE BOTTOM CRANKCASE BASE TO THE CRANKCASE

Figure 94

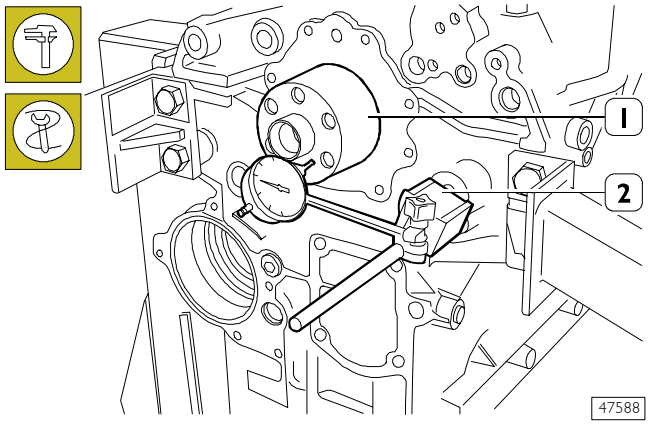


❑ Remove the crankcase base.

The clearance between the main bearings and their journals is measured by comparing the width taken on by the calibrated wire (2) at the point of greatest crushing with the graduated scale on the case (1) containing the calibrated wire.
The numbers on the scale give the clearance of the coupling in millimetres. If you find the clearance is not as required, replace the bearing shells and repeat the check.

Checking crankshaft end float

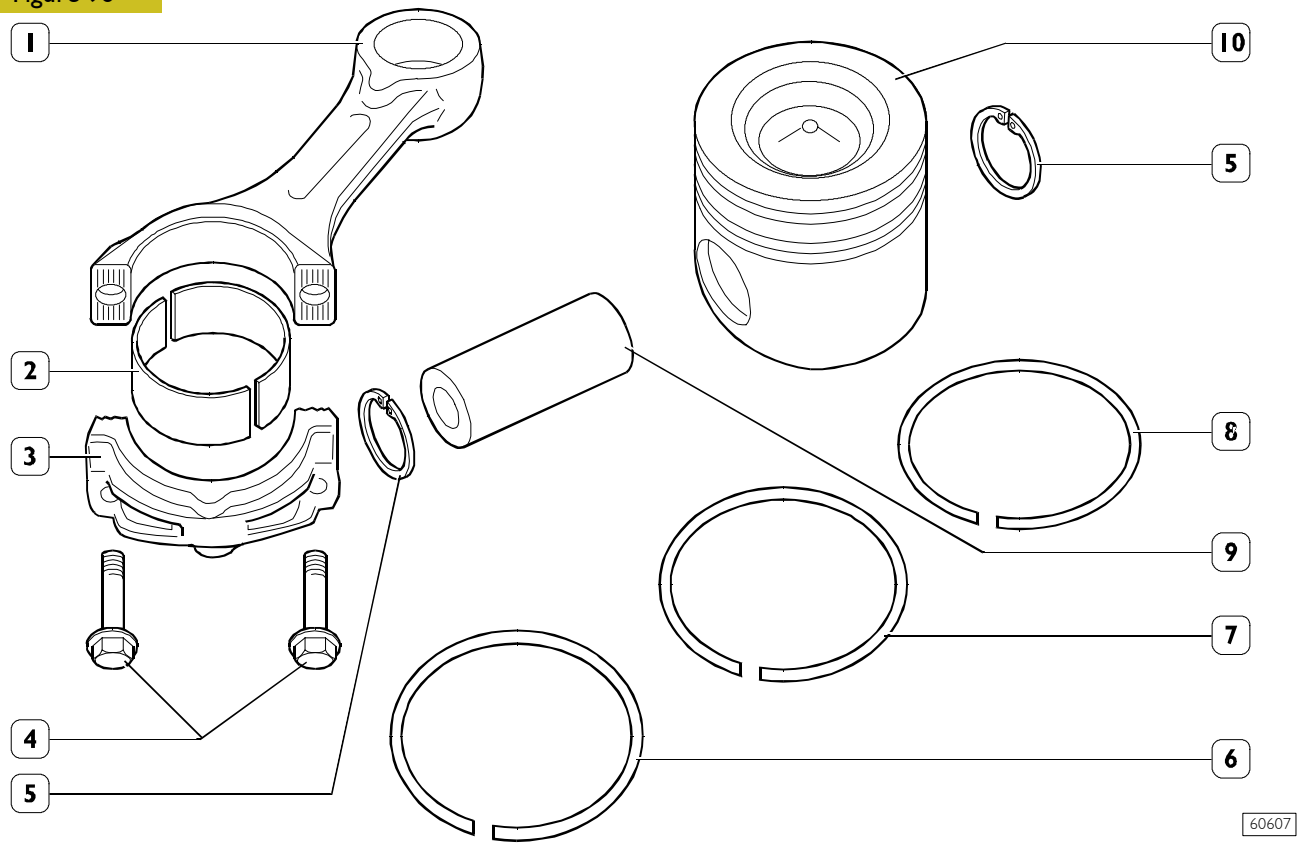
Figure 95



End float is checked by placing a magnetic dial gauge (2) on the crankshaft (1), as shown in the figure. If the value obtained is higher than specified, replace the rear thrust half-bearings and repeat this check.

5408 Piston connecting rod assembly

Figure 96



PISTON CONNECTING ROD ASSEMBLY

1. Connecting rod body - 2. Half bearings - 3. Connecting rod cap - 4. Cap fastening screws - 5. Split ring - 6. Scraper ring with spiral spring - 7. Bevel cut sealing ring - 8. Trapezoidal sealing ring - 9. Piston pin - 10. Piston

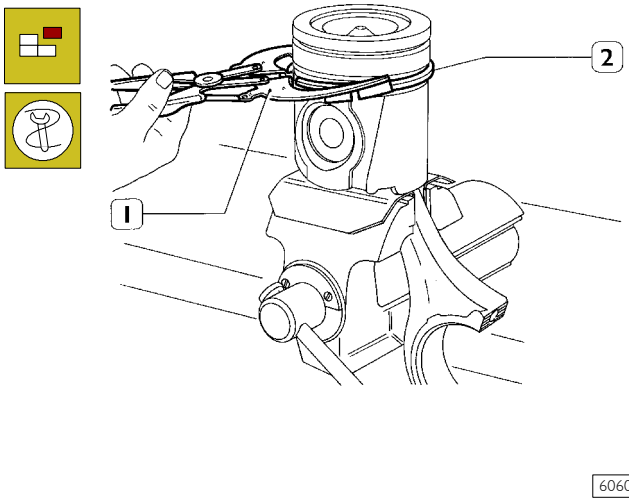
Make sure the piston does show any trace of seizing, scoring, cracking; replace as necessary.

Pistons are equipped with three elastic rings: a sealing ring, a trapezoidal ring and a scraper ring.

Pistons are grouped into classes A and B for diameter.

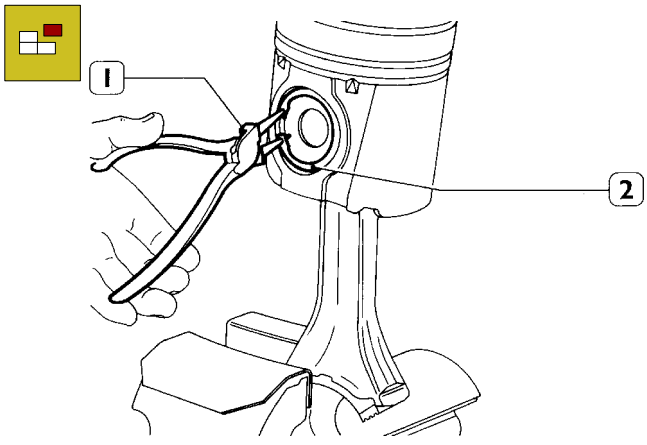
Removal

Figure 97



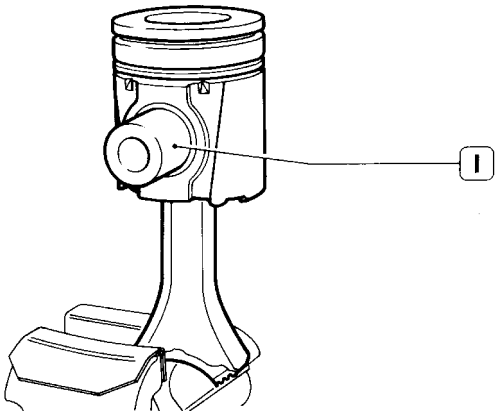
Removal of the piston split rings (2) using the pliers 99360184 (1).

Figure 98



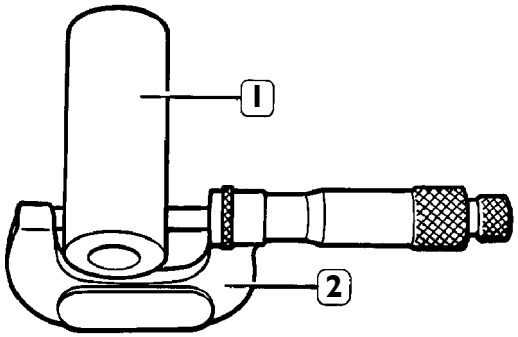
Remove the piston pin split rings (2) using the round tipped pliers (1).

Figure 99



Remove the piston pin (1).
If removal is difficult use the appropriate beater.

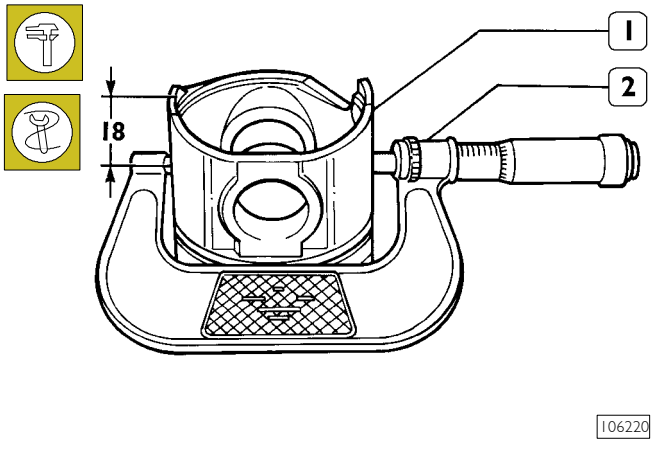
Figure 101



Measuring the gudgeon pin diameter (1) with a micrometer (2).

Measuring the diameter of the pistons

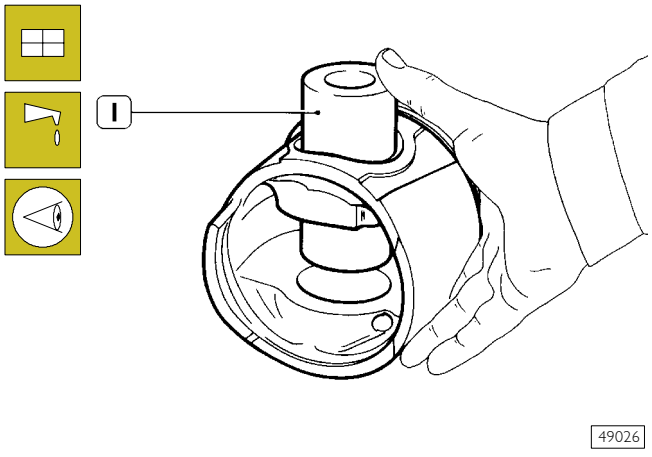
Figure 100



By micro meter (2), measure piston (1) diameter in order to determine mounting clearance; the diameter must be detected at the value indicated in figure.

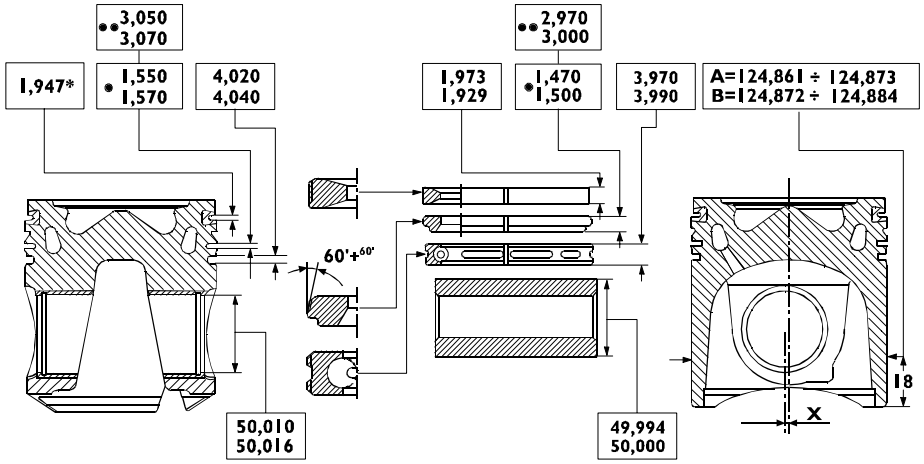
Conditions for correct gudgeon pin-piston coupling

Figure 102



Lubricate the pin (1) and the relevant housing on the piston hubs with engine oil; piston must be inserted with a slight finger pressure and it should not come out by gravity.

Figure 103



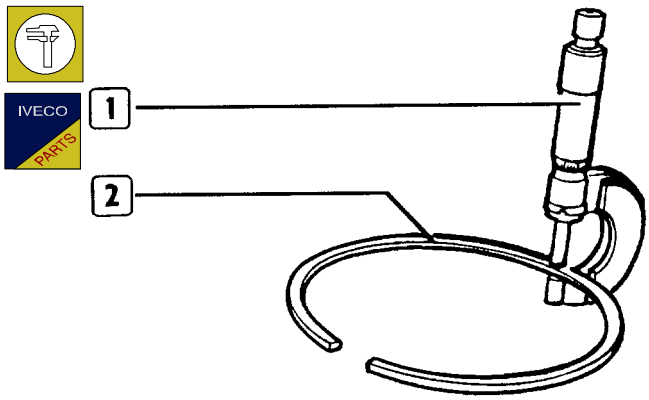
114972

MAIN DATA CONCERNING PISTONS, SPRING RINGS AND PIN

X = 0.7 ± 0.1
* = Measured on Ø of 120 mm
• = Old part number - •• = New part number

540842 Piston rings

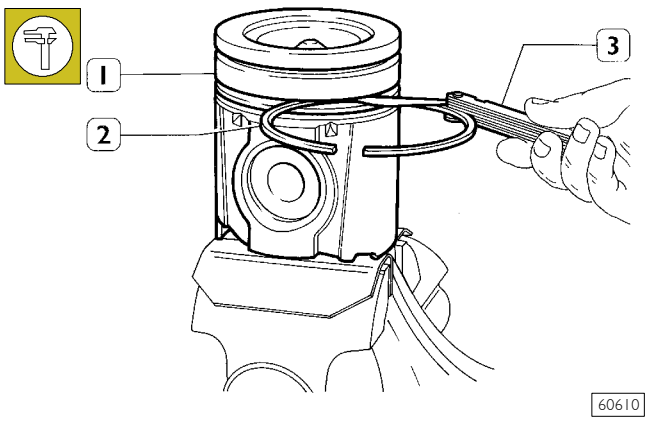
Figure 104



16552

Check the thickness of the piston ring (2) using a micrometer (1).

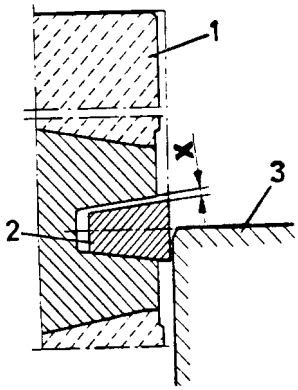
Figure 105



60610

Check the clearance between the sealing rings (2) and the relative piston housings (1) using a thikness gauge (3).

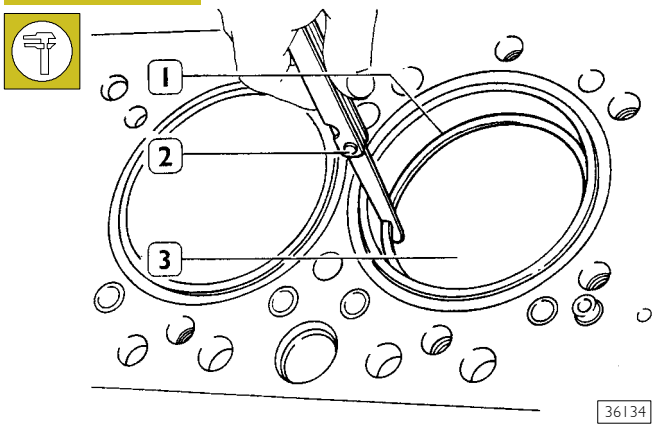
Figure 106



3513

The sealing ring (2) of the 1st cavity is trapezoidal. Clearance "X" between the sealing ring and its housing is measured by placing the piston (1) with its ring in the cylinder barrel (3), so that the sealing ring is half-projected out of the cylinder barrel.

Figure 107



36134

Check the opening between the ends of the sealing rings (1), using a thickness gauge (2), entered in the cylinder barrel (3). If the distance between ends is lower or higher than the value required, replace split rings.

540830 Connecting rods

Figure 108

Data concerning the class section of connecting rod housing and weight are stamped on the big end.

NOTE When installing connecting rods, make sure they all belong to the same weight class.

DIAGRAM OF THE CONNECTING ROD MARKS

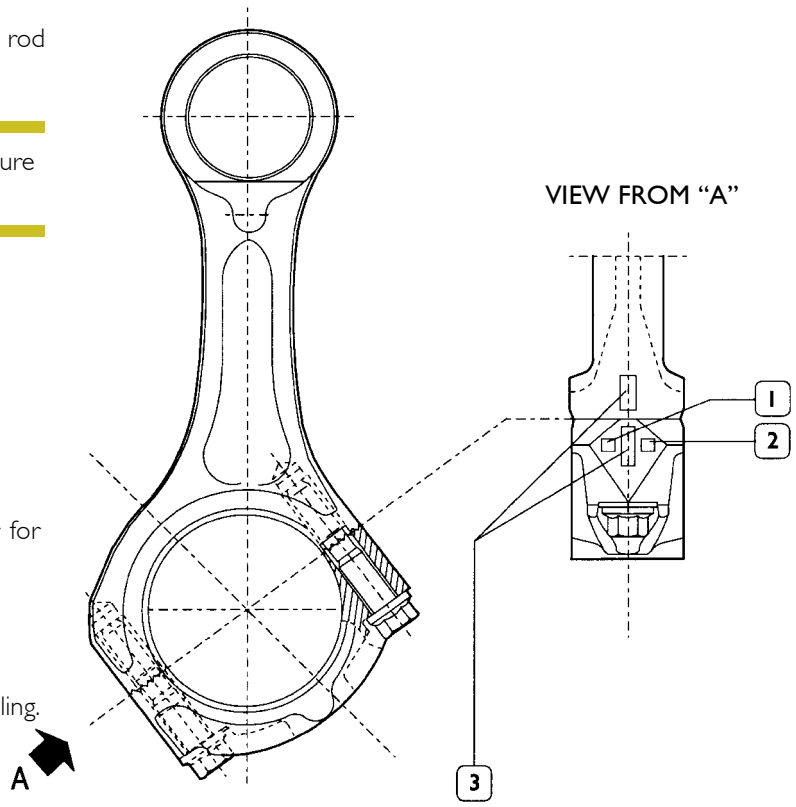
1 Letter indicating the weight class:

A = 4024 to 4054 g.
B = 4055 to 4085 g.
C = 4186 to 4116 g.

2 Number indicating the selection of diameter for the big end bearing housing:

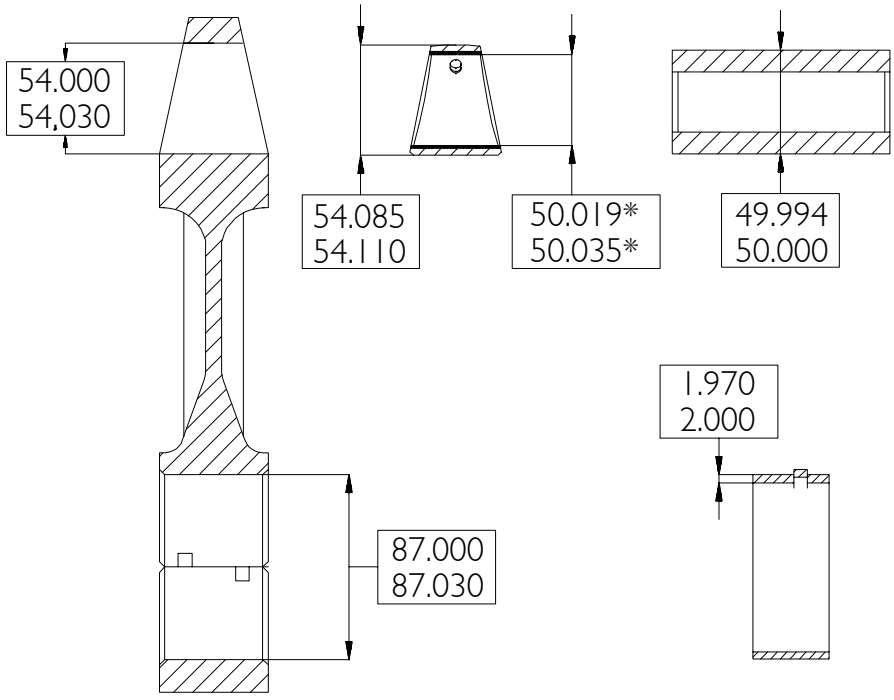
1 = 87.000 to 87.010 mm
2 = 87.011 to 87.020 mm
3 = 87.021 to 87.030 mm

3 Numbers identifying cap-connecting rod coupling.



47557

Figure 109



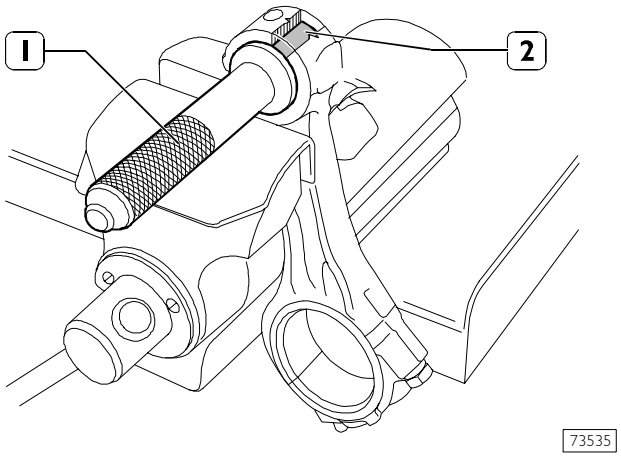
44927

MAIN DATA - BUSH, CONNECTING ROD, PIN AND HALF-BEARINGS

* Values to be obtained after installing the bush.

540842 Bushings

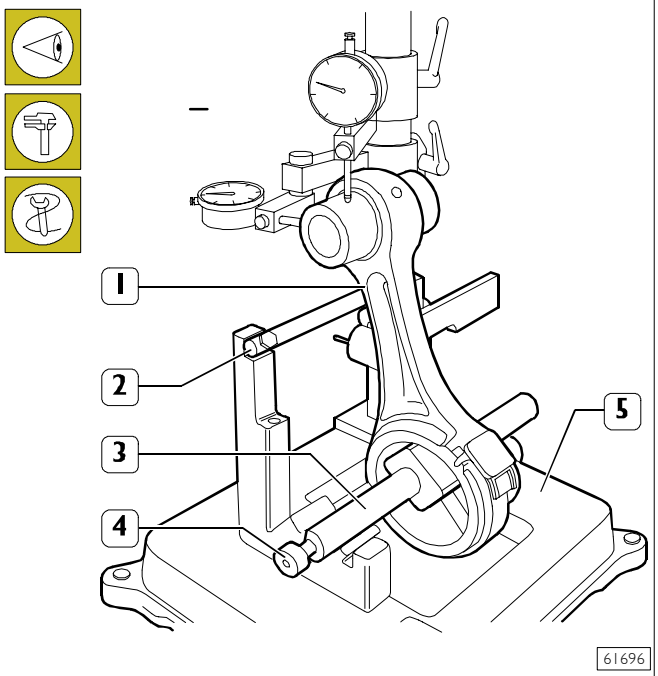
Figure 110



Check the bushing in the small end has not come loose and shows no sign of scoring or seizure; replace it if it does.
The bushing (2) is removed and fitted with a suitable drift (1). When driving it in, make absolutely sure that the holes for the oil to pass through in the bushing and small end coincide. Using a boring machine, rebore the bushing so as to obtain a diameter of 50.019 – 50.035.

Checking connecting rods

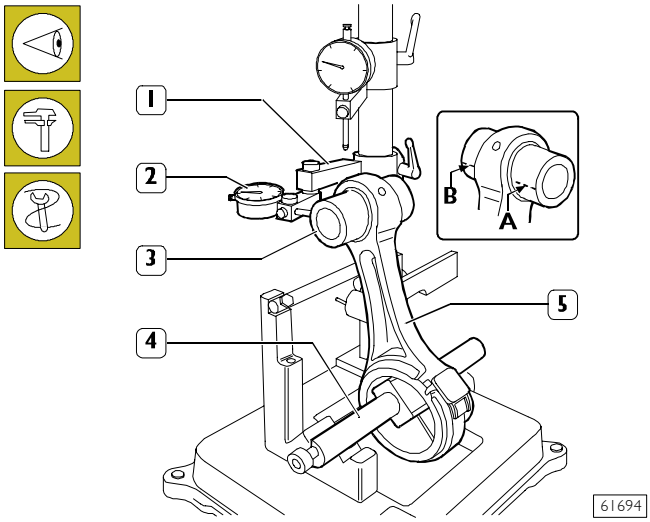
Figure 111 (Demonstration)



Checking axis alignment

Check the connecting rods axes for parallelism (1) using a suitable device (5) and proceeding as follows.
Fit the connecting rod (1) on the spindle of the tool (5) and lock it with the screw (4).
Set the spindle (3) on the V-prisms, resting the connecting rod (1) on the stop bar (2).

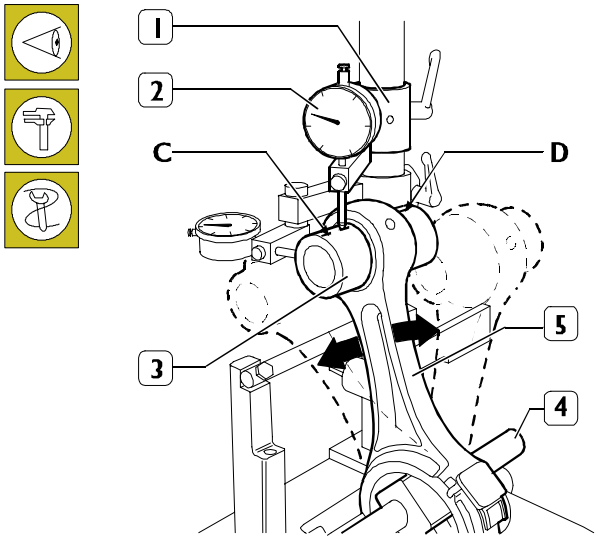
Figure 112 (Demonstration)



Check the torsion of the connecting rod (5) by comparing two points (**A** and **B**) of the pin (3) on the horizontal plane of the axis of the connecting rod.
Position the mount (1) of the dial gauge (2) so that this pre-loads by approx. 0.5 mm on the pin (3) at point **A** and zero the dial gauge (2). Shift the spindle (4) with the connecting rod (5) and compare any deviation on the opposite side **B** of the pin (3): the difference between **A** and **B** must be no greater than 0.08 mm.

Checking bending

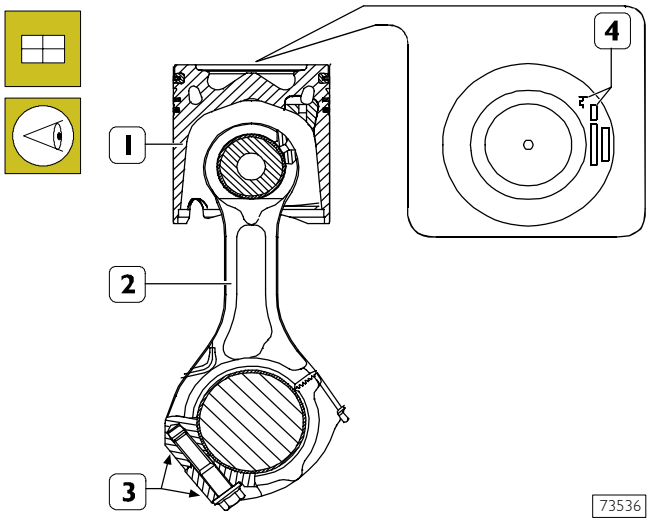
Figure 113 (Demonstration)



Check the bending of the connecting rod (5) by comparing two points **C** and **D** of the pin (3) on the vertical plane of the axis of the connecting rod.
Position the vertical mount (1) of the dial gauge (2) so that this rests on the pin (3) at point **C**.
Swing the connecting rod backwards and forwards seeking the highest position of the pin and in this condition zero the dial gauge (2).
Shift the spindle (4) with the connecting rod (5) and repeat the check on the highest point on the opposite side **D** of the pin (3). The difference between point **C** and point **D** must be no greater than 0.08 mm.

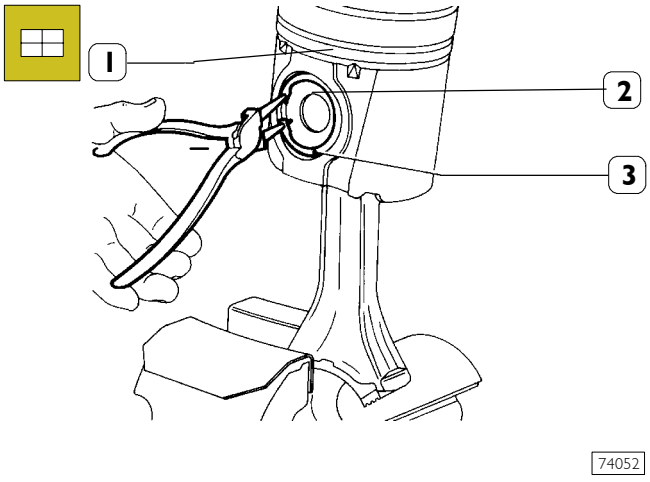
Mounting the connecting rod – piston assembly

Figure 114



The piston (1) has to be fitted on the connecting rod (2) so that the graphic symbol (4), showing the assembly position in the cylinder liner, and the punch marks (3) on the connecting rod are observed as shown in the figure.

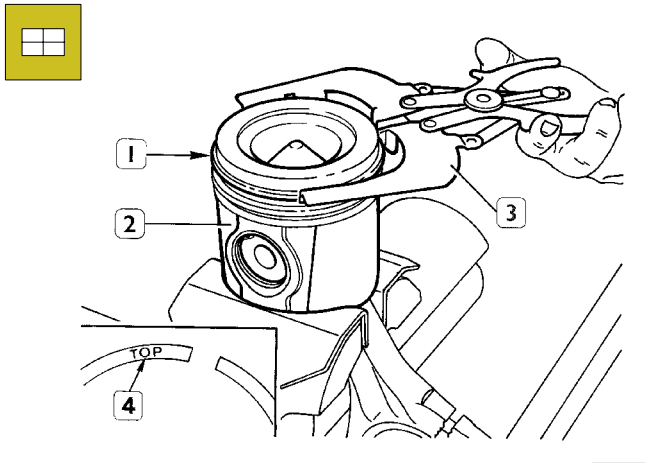
Figure 115



Fit the pin (2) and fasten it on the piston (1) with the split rings (3).

Mounting the piston rings

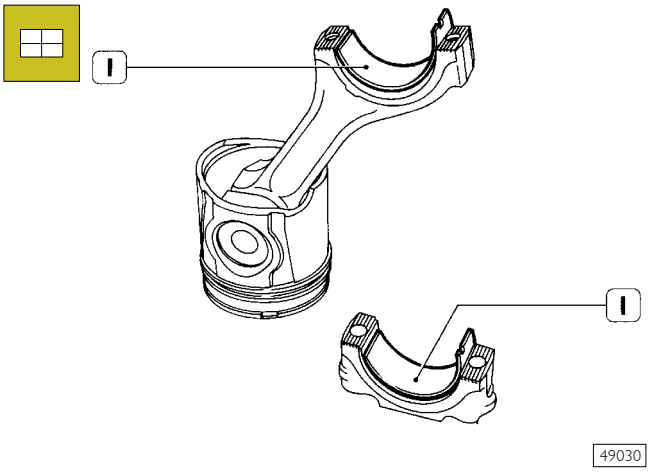
Figure 116



To fit the piston rings (1) on the piston (2) use the pliers 99360184 (3).
The rings need to be mounted with the word "TOP" (4) facing upwards. Direct the ring openings so they are staggered 120° apart.

Fitting the big end bearing shells

Figure 117



Fit the bearing shells (1), selected as described under the heading "Selecting the main and big end bearing shells", on both the connecting rod and the cap.

If reusing bearing shells that have been removed, fit them back into their respective seats in the positions marked during removal.

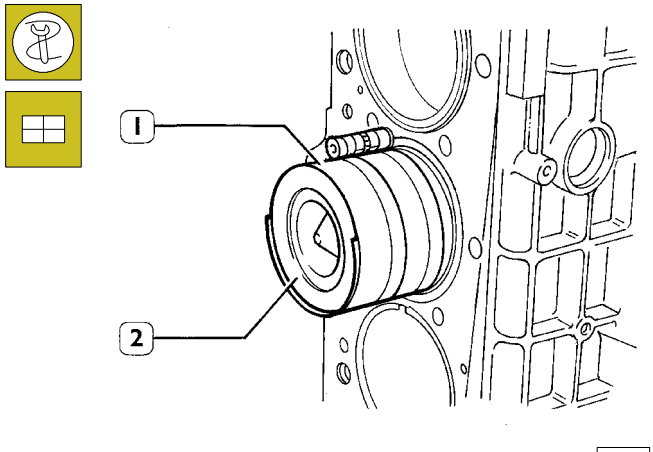
Fitting connecting rod - piston assemblies in the cylinder liners

With the aid of the clamp 99360605 (1, Figure 118), fit the connecting rod – piston assembly (2) in the cylinder liners, according to the diagram of Figure 119, checking that:

- ❑ The openings of the piston rings are staggered 120° apart.
- ❑ The pistons are all of the same class, A or B.
- ❑ The symbol punched on the top of the pistons faces the engine flywheel, or the recess in the skirt of the pistons tallies with the oil nozzles.

NOTE The pistons are supplied as spares in class A and can be fitted in class B cylinder liners.

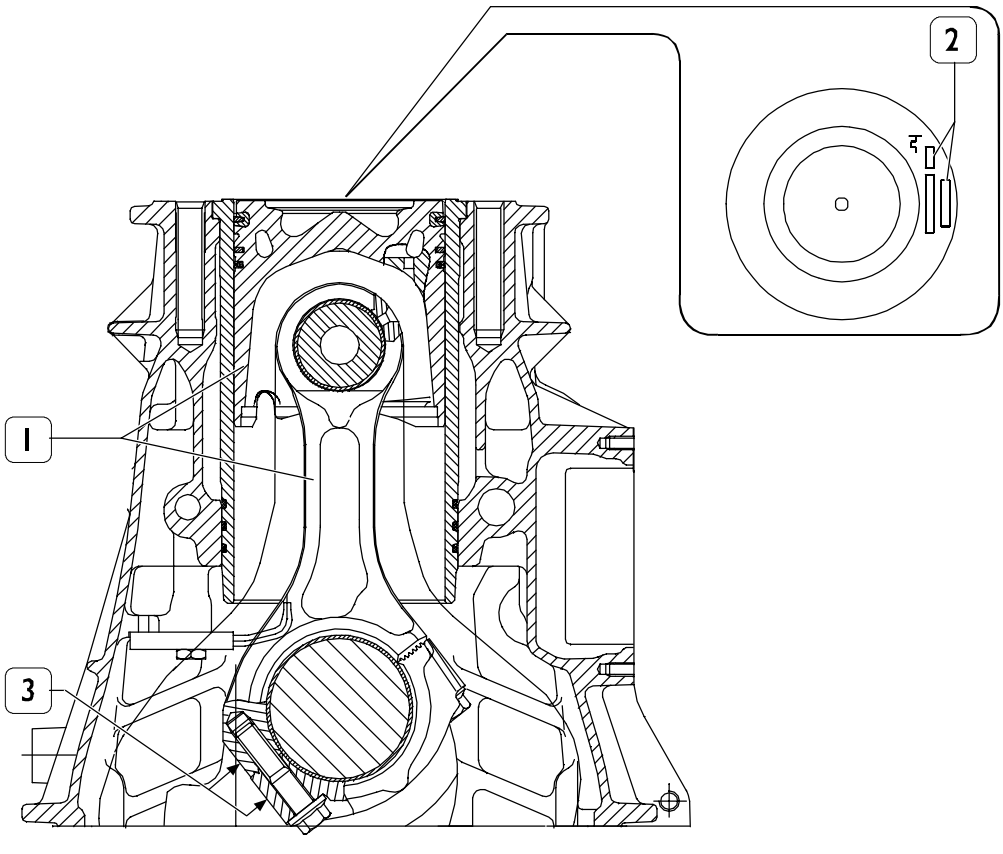
Figure 118



Checking piston protrusion

On completing assembly, check the protrusion of the pistons from the cylinder liners; it must be 0.23 – 0.53 mm.

Figure 119



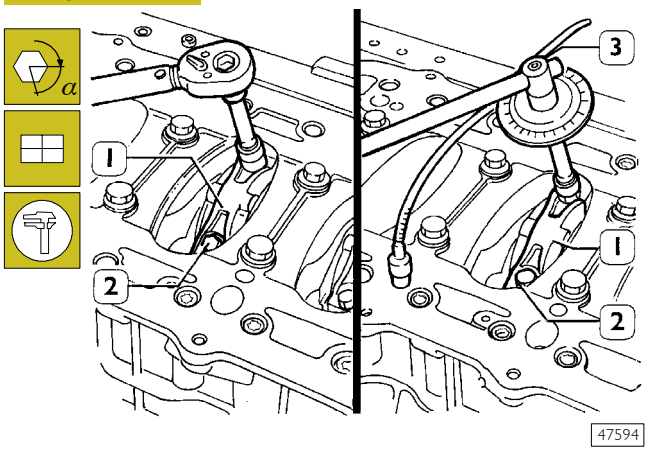
ASSEMBLY DIAGRAM OF CONNECTING ROD – PISTON ASSEMBLY IN CYLINDER LINER

1. Connecting rod – piston assembly – 2. Area of punch marking on the top of the piston, symbol showing assembly position and selection class – 3. Connecting rod punch mark area

540831 Checking crankpin assembly clearance

To measure the clearance, carry out the following operations.
Connect the connecting rods to the relevant journals of the crankshaft, placing a length of calibrated wire on the journals.

Figure 120



Mount the connecting rod caps (1) together with the bearing shells. Tighten the screws (2) fixing the connecting rod caps to a torque of 60 Nm (6 kgm). Using tool 99395216 (3), further tighten the screws with an angle of 60°.

NOTE The thread of the screws (2), before assembly, has to be lubricated with engine oil.

Remove the caps and determine the clearance by comparing the width of the calibrated wire with the graduated scale on the case containing the calibrated wire.
Upon final assembly: check the diameter of the thread of the screws (2), it must be no less than 13.4 mm; if it is, change the screw. Lubricate the crankpins and connecting rod bearings. Tighten the screws (2) as described above.

540610 CYLINDER HEAD

Before dismounting cylinder head, check cylinder head for hydraulic seal by proper tooling; in case of leaks not caused by cup plugs or threaded plugs, replace cylinder head.

NOTE At the time of replacement, the cylinder head is supplied as a spare part with a threaded plug that must be removed during the phase of assembly.

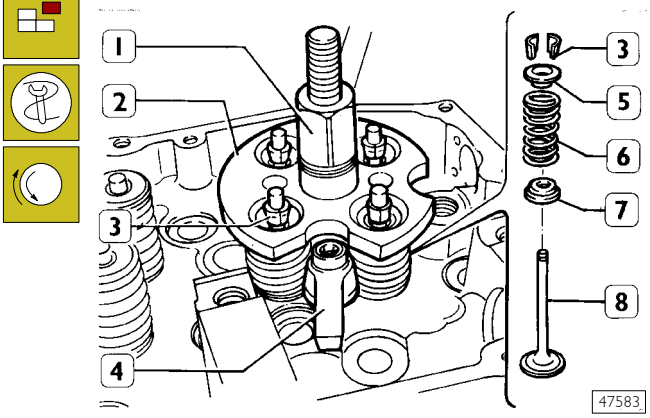
NOTE In case of plugs dismounting/replacement, on mounting, apply sealant Loctite 270 on plugs.

Disassembly the valves

NOTE Before dismounting cylinder head valves, number them in view of their remounting in the position observed on dismounting should they not have to be overhauled or replaced.

Intake valves are different form exhaust valves in that they have a notch placed at valve head centre.

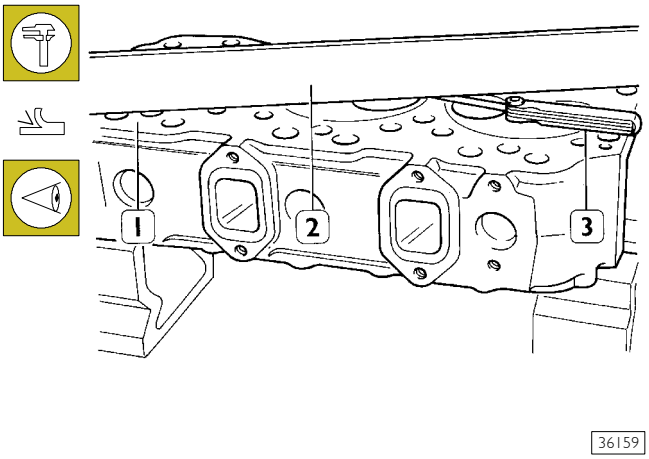
Figure 121



Mount and secure the tool 99360263 (2) with the bracket (4). Screw down with the device 99360261 (1) to be able to remove the cotters (3). Take out the tool (2) and extract the top plate (5), spring (6) and bottom plate (7).
Repeat this process on all the valves.
Turn over the cylinder head and take out the valves (8).

Checking head bearing surface on cylinder block

Figure 122 **(Demonstration)**



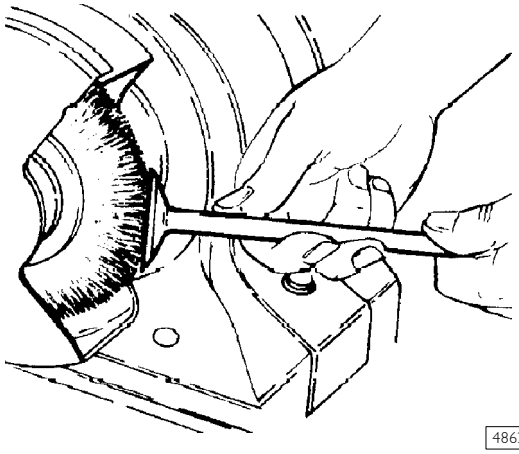
Check the supporting surface (1) of the head on the cylinder block with a rule (2) and a feeler gauge (3). If you find any deformation, level the head on a surface grinder; maximum amount of material that can be removed 0.2 mm.

NOTE After this process, you need to check the valve recessing and injector protrusion.

540622 Valves

Removing deposits and checking the valves

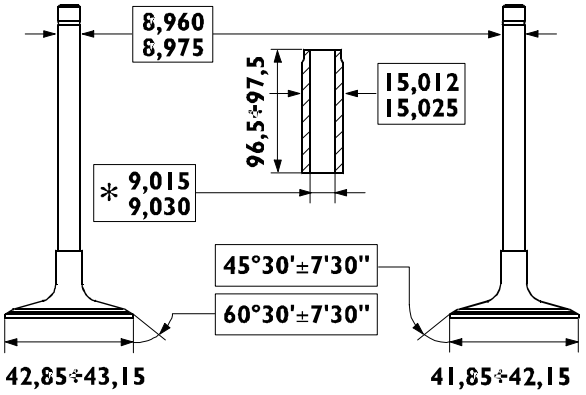
Figure 123



48625

Remove carbon deposits using the metal brush supplied. Check that the valves show no signs of seizure or cracking. Check the diameter of the valve stem using a micrometer (see Figure 124) and replace if necessary.

Figure 124



60617

MAIN DATA OF VALVES AND VALVE GUIDES

* Measurement to be made after driving in the valve guides

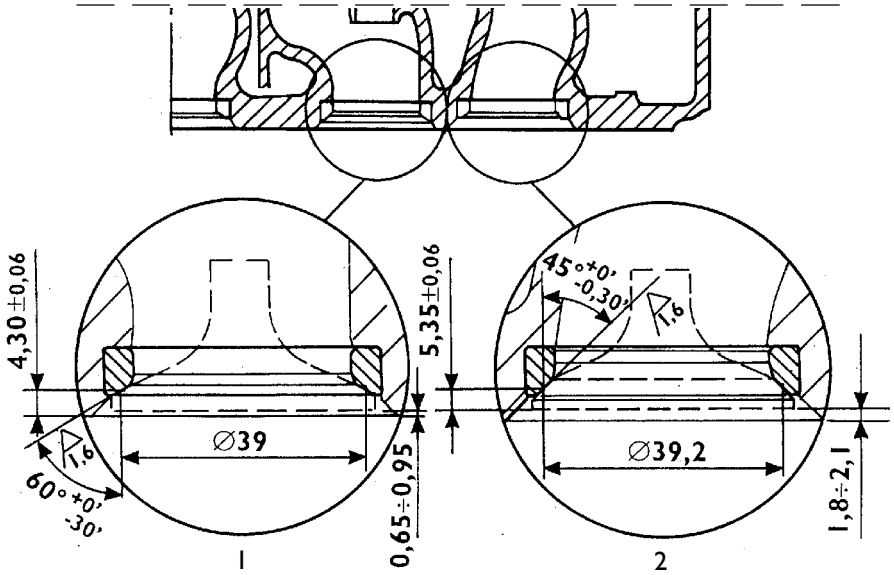
Check with a micrometer that the diameter of the valve stems is as indicated. If necessary, grind the valve seats with a grinding machine, removing as little material as possible.

540661 Valve seats

Regrinding – replacing valve seats

NOTE The valve seats are reground whenever the valves or valve guides are ground and replaced.

Figure 125

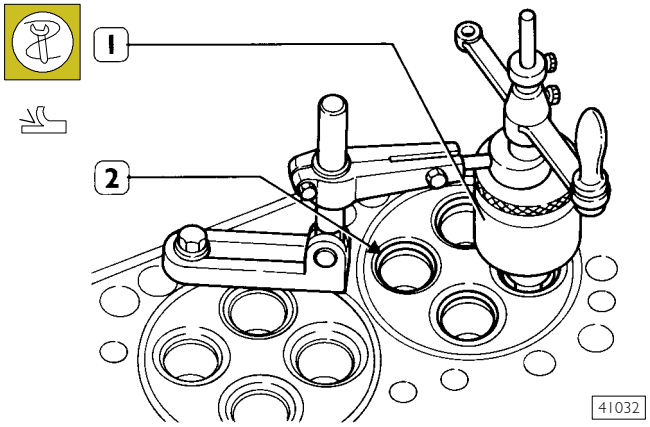


73537

MAIN DATA OF VALVE SEATS

1. Intake valve seat – 2. Exhaust valve seat

Figure 126



If there are light scorings or burnings, adjust them with a suitable device (1) following the inclination values reported in Figure 124 and in Figure 125. If it is necessary to replace them, using the same tool and taking care not to affect the cylinder head, remove as much material as possible from the valve seats so that, with a punch, it is possible to extract them from the cylinder head.
Heat the cylinder head to 80 – 100°C and, using a drift, fit in the new valve seats (2), chilled beforehand in liquid nitrogen.
Using tool (1), regrind the valve seats according to the angles shown in Figure 125.
After regrinding the valve seats, using tool 99370415 and dial gauge 99395603, check that the position of the valves in relation to the plane of the cylinder head is:
- -0.65 to -0.95 mm (recessing) intake valves;
- -1.8 to -2.1 mm (recessing) exhaust valves.

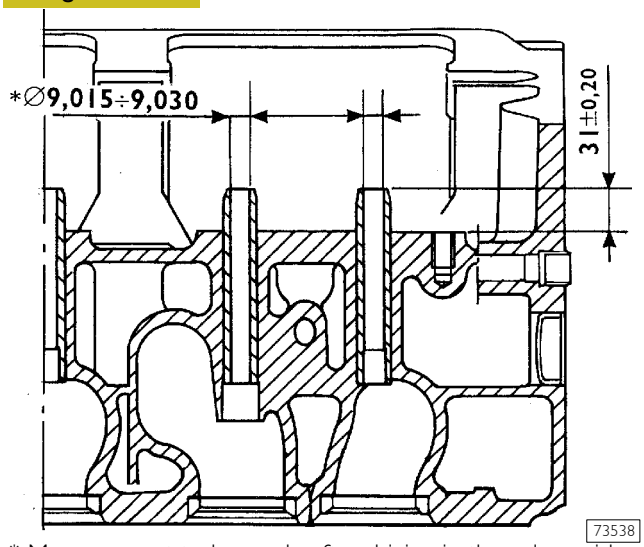
Checking clearance between valve-stem and associated valve guide

Using a dial gauge with a magnetic base, check the clearance between the valve stem and the associated guide. If the clearance is too great, change the valve and, if necessary, the valve guide.

540667 Valve guides

Replacing valve guides

Figure 127



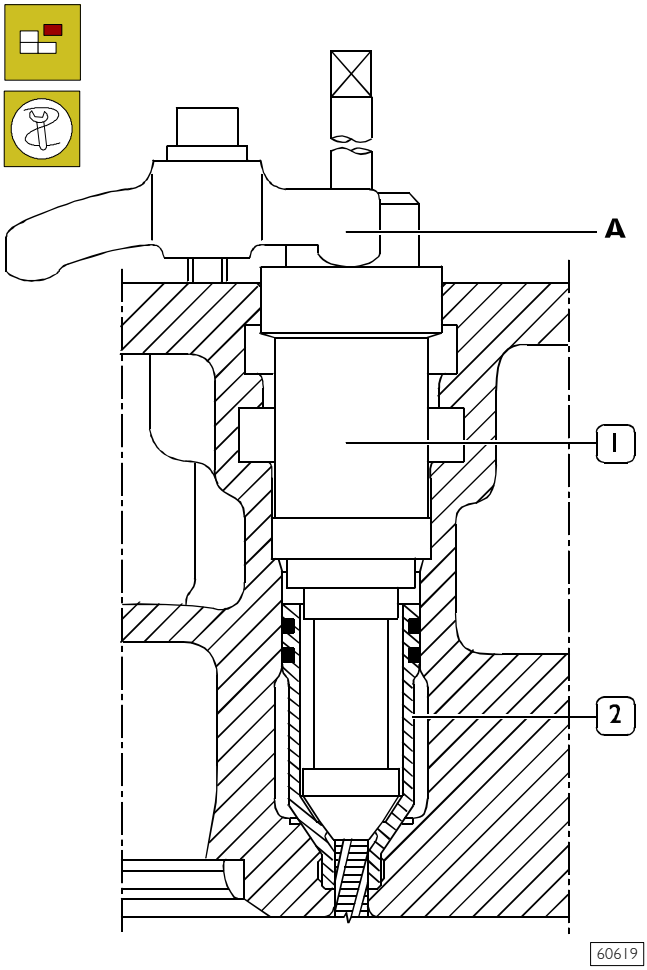
* Measurement to be made after driving in the valve guides

The valve guides are removed with the drift 99360481.
They are fitted with the drift 99360481 equipped with part 99360295.
Part 99360295 determines the exact position of assembly of the valve guides in the cylinder head. If they are not available, you need to drive the valve guides into the cylinder head so they protrude by 30.8-31.2 mm.
After driving in the valve guides, rebore their holes with the smoother 99390311.

540613 Replacing injector cases

Removal

Figure 128

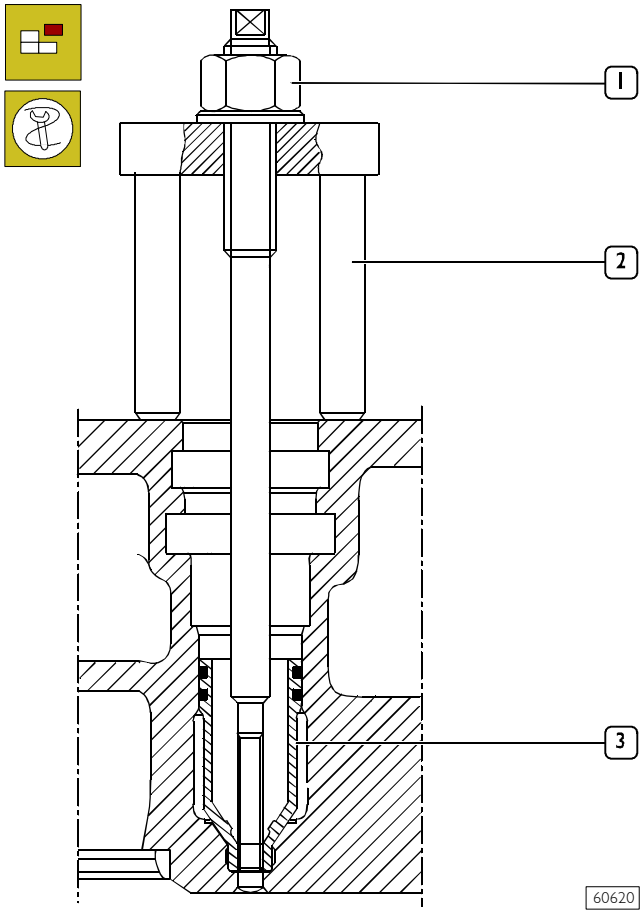


To replace the injector case (2), proceed as follows:

❑ Thread the case (2) with tool 99390804 (1).

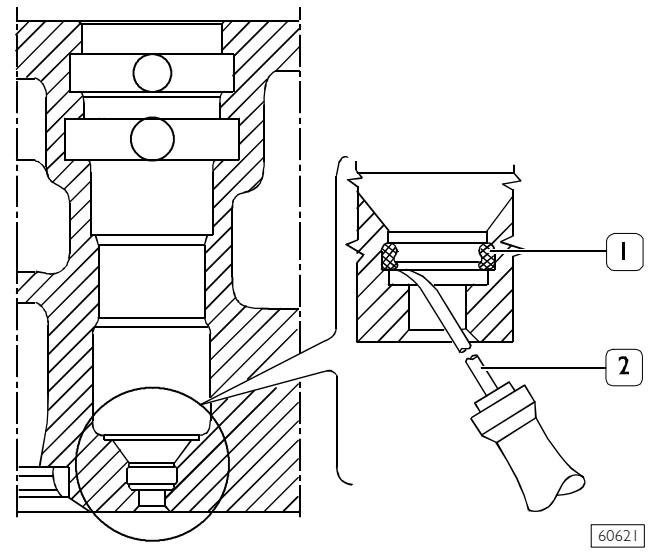
The steps described in Figs. 128 – 131 – 132 – 133 need to be carried out by fixing the tools, with the bracket A, to the cylinder head.

Figure 129



❑ Screw the extractor 99342149 (2) into the case (3). Screw down the nut (1) and take the case out of the cylinder head.

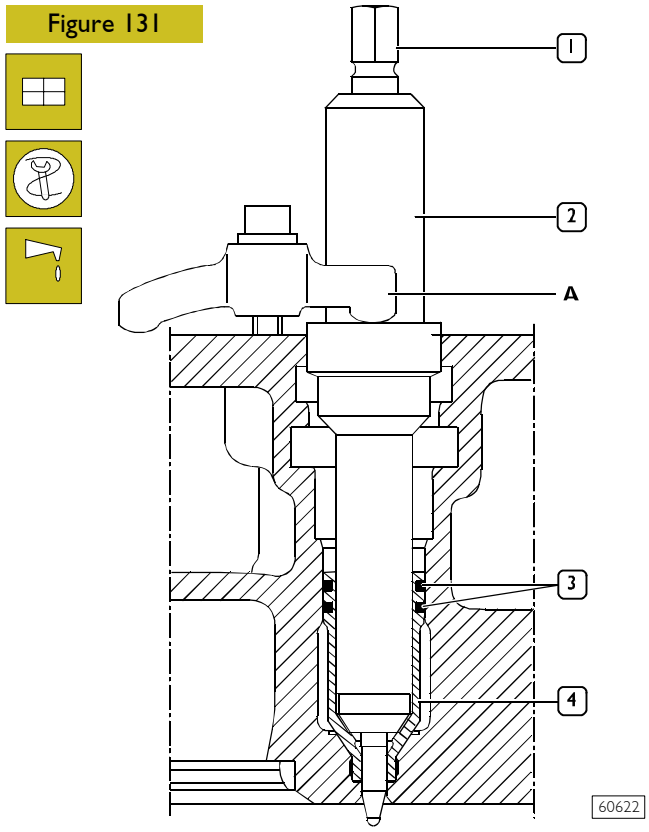
Figure 130



❑ Using the tool 99390772 (2) remove any residues (1) left in the groove of the cylinder head.

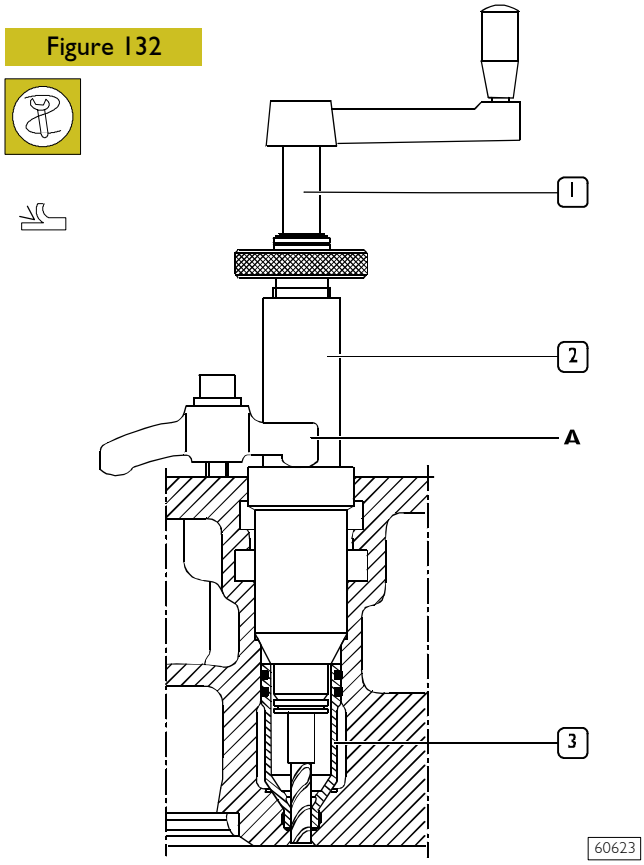
Assembly

Figure 131



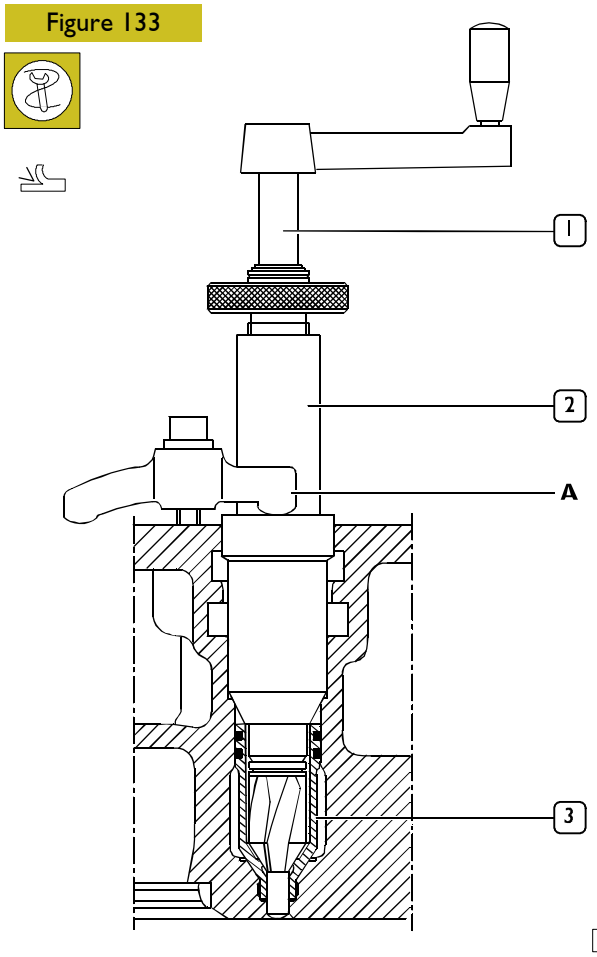
❑ Lubricate the seals (3) and fit them on the case (4). Using tool 99365056 (2) secured to the cylinder head with bracket **A**, drive in the new case, screwing down the screw (1) upsetting the bottom portion of the case.

Figure 132



❑ Using the reamer 99394041 (1-2), rebore the hole in the case (3).

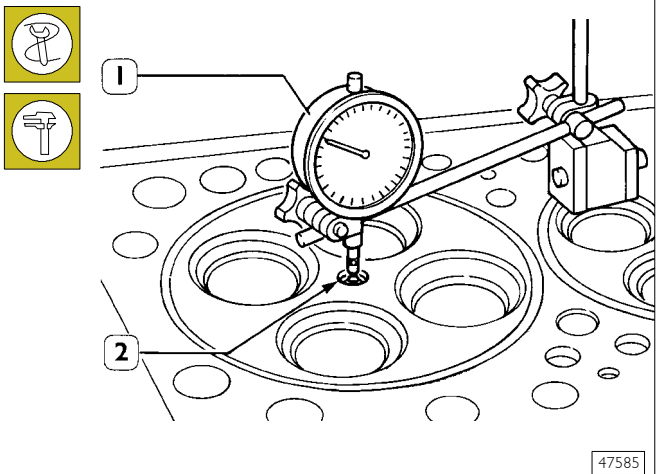
Figure 133



❑ Using grinder 99394041 (1-2), ream the injector seat in the case (3).

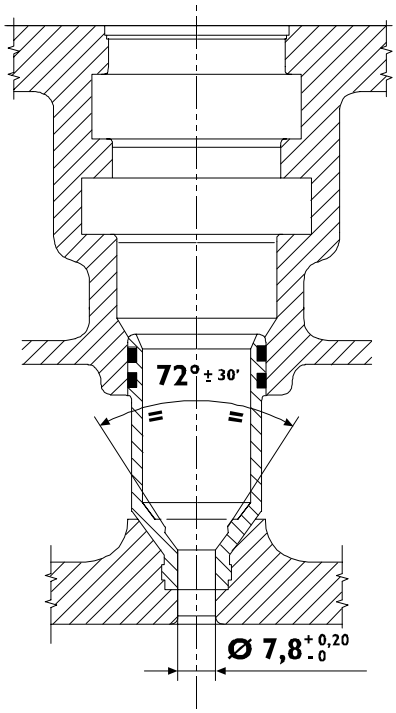
Checking injector protrusion

Figure 134



Check injector protrusion (2) with the dial gauge (1).
The protrusion must be 0.32 to 1.14 mm.

Figure 135

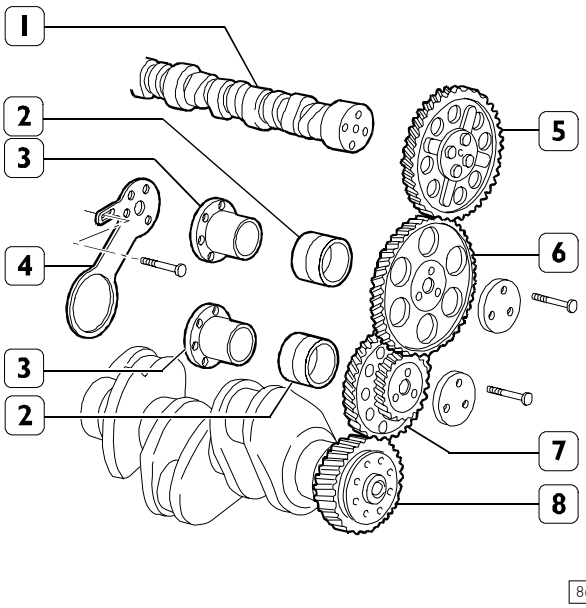


INJECTOR CASE ASSEMBLY DIAGRAM

5412 TIMING GEAR

Camshaft drive

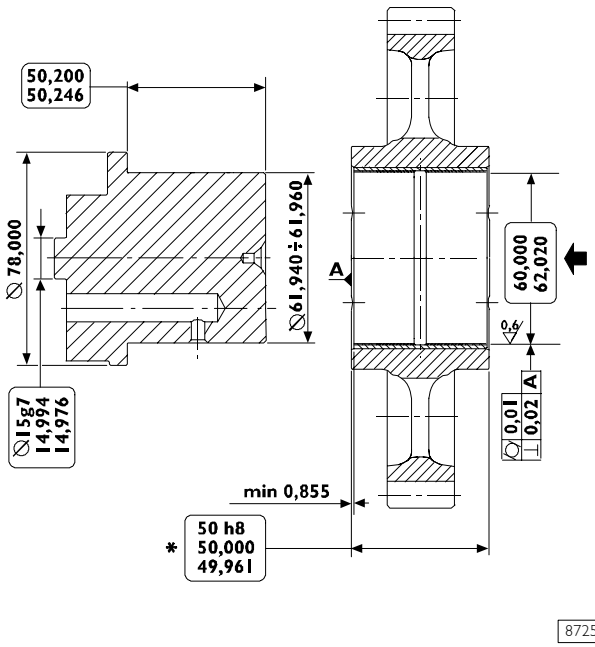
Figure 136



TIMING CONTROL COMPONENT PARTS
1. Camshaft - 2. Bushing - 3. Pin - 4. Articulated rod - 5. Camshaft control gear - 6. Idler gear - 7. Twin idler gear - 8. Drive shaft driving gear.

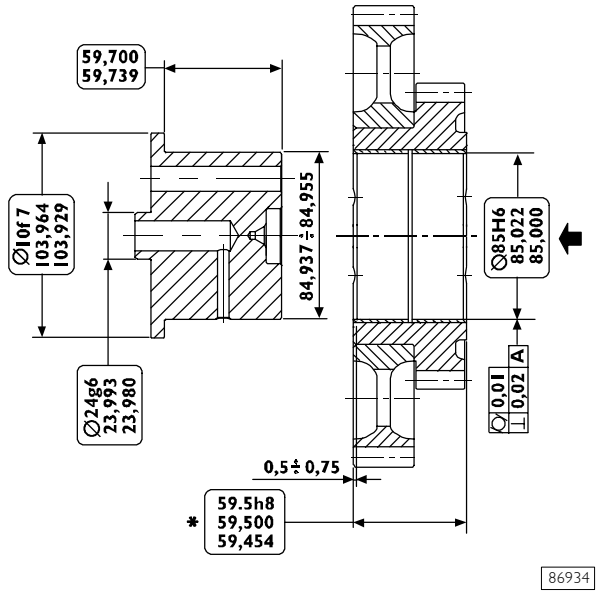
541253 Idler gear pin
541252 Idler gear

Figure 137



541253 Twin intermediate gear pin
541252 Twin idler gear

Figure 138



541254 Replacing the bushings

Gear bushings shown on Figures 137 - 138 can be replaced when they are worn. Put up the bushing, then bore it to obtain the diameter shown on Figure 137 or Figure 138.

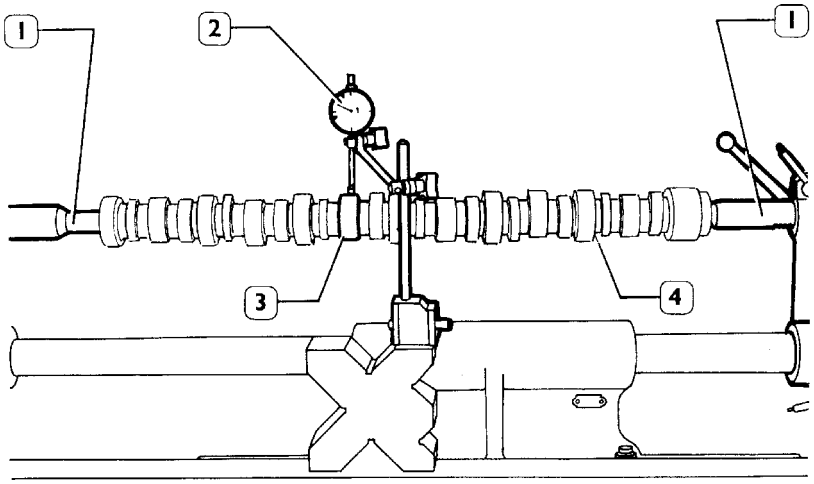
NOTE The bushing must be driven into the gear by following the direction of the arrow and setting the latter to the dimension shown on Figure 137 or Figure 138.

Rated assembling play between gear bushings and pins:
Fig. 137 – 0.040 ÷ 0.080 mm
Fig. 138 – 0.045 ÷ 0.085 mm.

541210 Timing system

541211 Checking cam lift and pin alignment

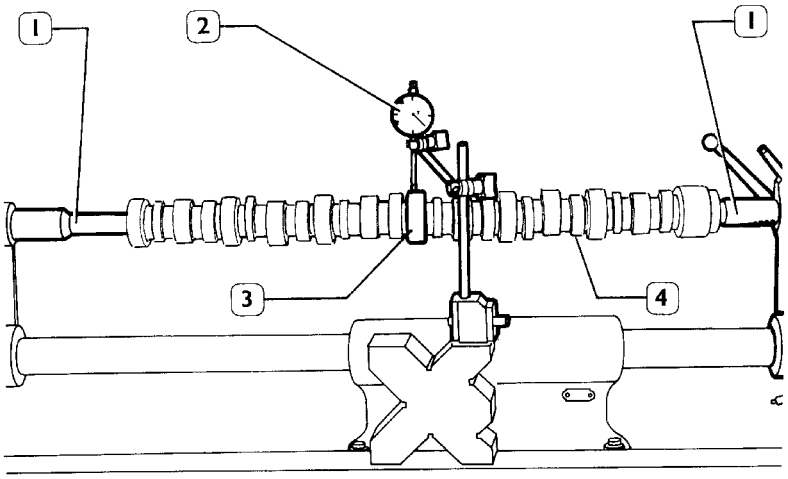
Figure 139



47506

Place the camshaft (4) on the tailstock (1) and check cam lift (3) using a centesimal gauge (2); values are shown in table on page 19.

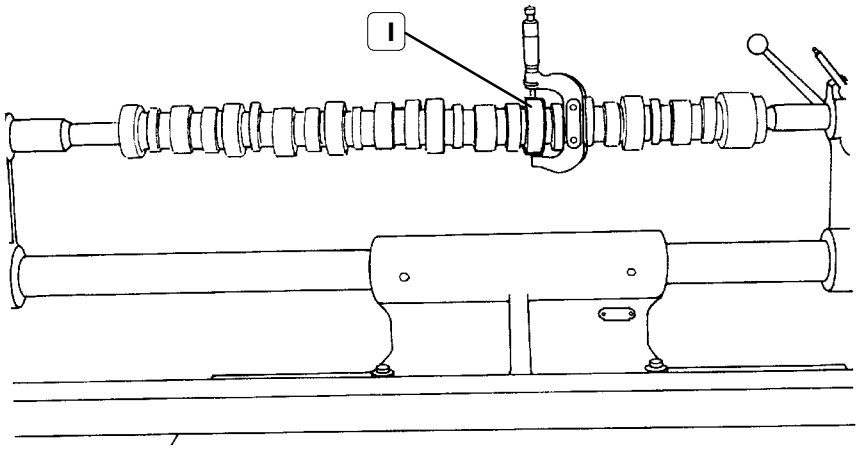
Figure 140



47507

When the camshaft (4) is on the tailstock (1), check alignment of supporting pin (3) using a centesimal gauge (2); it must not exceed 0.035 mm. If misalignment exceeds this value, replace the shaft.

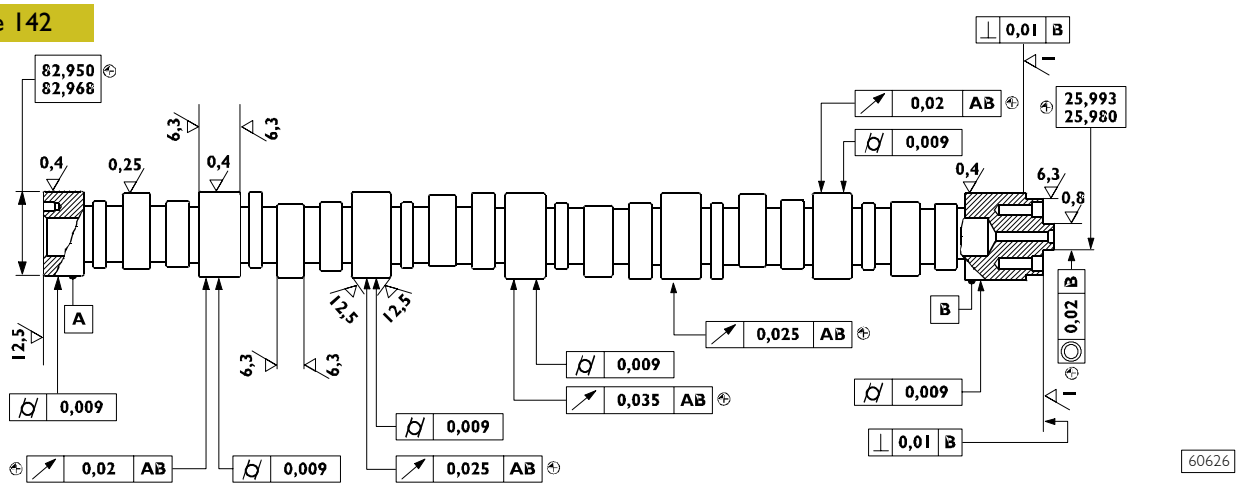
Figure 141



47505

In order to check installation clearance, measure bush inner diameter and camshaft pin (1) diameter; the real clearance is obtained by their difference.
If clearance exceeds 0.150 mm, replace bushes and, if necessary, the camshaft.

Figure 142



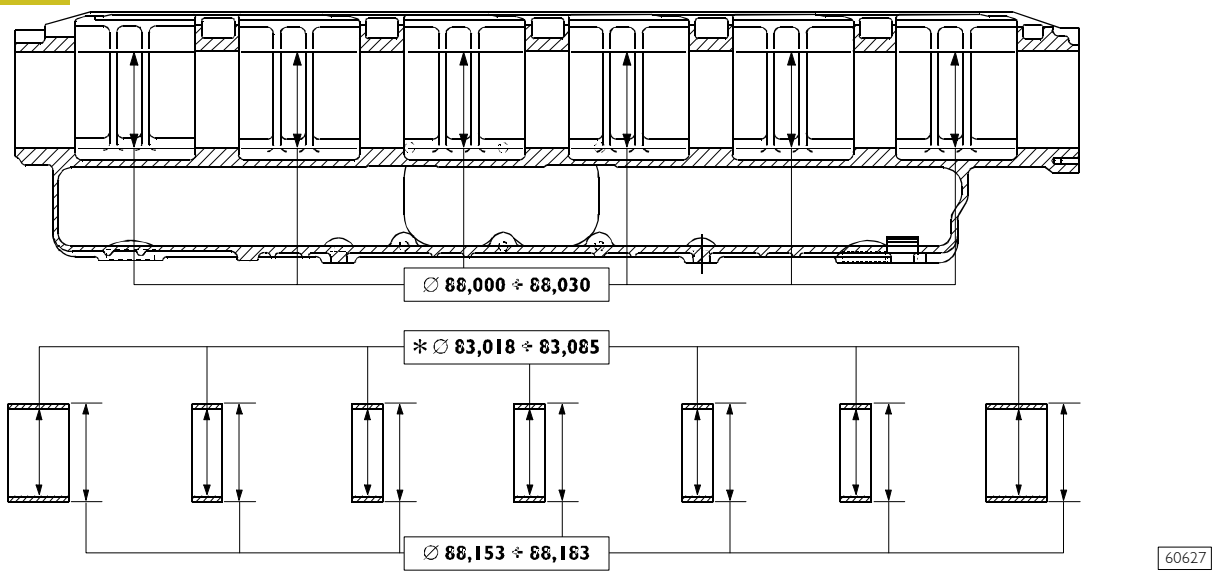
MAIN DATA - CAMSHAFT AND TOLERANCES

The surfaces of shaft supporting pin and cams must be extremely smooth; if you see any sign of seizing or scoring, replace the shaft and the relative bushes.

TOLERANCES	TOLERANCE CHARACTERISTIC	SYMBOL
ORIENTATION	Perpendicularity	⊥
POSITION	Concentricity or coaxial alignment	◎
OSCILLATION	Circular oscillation	↗
IMPORTANCE CLASS ASSIGNED TO PRODUCT CHARACTERISTICS		SYMBOL
CRITICAL		©
IMPORTANT		⊕
SECONDARY		⊖

541213 Bushings

Figure 143



MAIN DATA OF CAMSHAFT BUSHES AND RELEVANT HOUSINGS ON CYLINDER HEAD

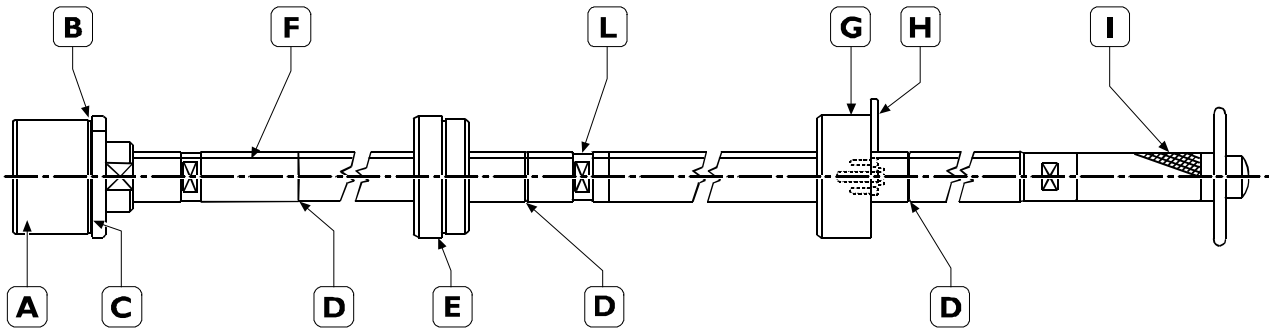
* Bush inner diameter after installation

The bush surfaces must not show any sign of seizing or scoring; if they do replace them.

Measure the bush inner diameters with a baremeter and replace them, if the value measured exceeds the tolerance value.
To take down and fit back the bushes, use the proper tool 99360499.

Replacing camshaft bushings with drift 99360499

Figure 144

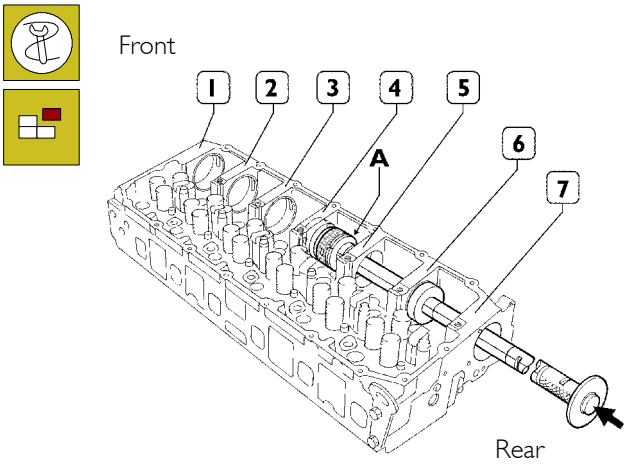


107217

A = Drift with seat for bushings to insert/extract.
B = Grub screw for positioning bushings.
C = Reference mark to insert seventh bushing correctly.
D = Reference mark to insert bushings 1, 2, 3, 4, 5, 6 correctly (red marks).
E = Guide bushing.
F = Guide line.
G = Guide bushing to secure to the seventh bushing mount.
H = Plate fixing bushing G to cylinder head.
I = Grip.
L = Extension coupling.

Removal

Figure 145

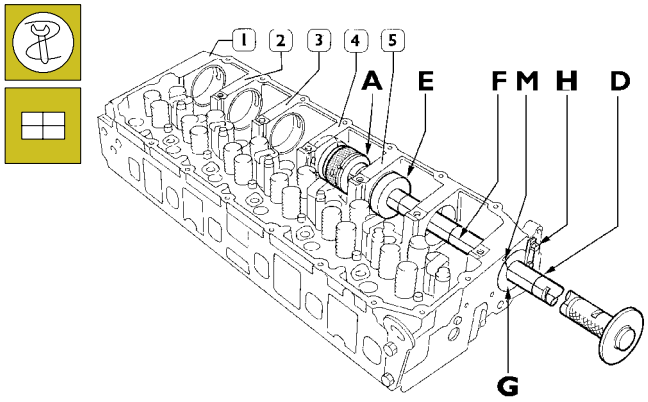


71725

The sequence for removing the bushings is 7, 6, 5, 4, 3, 2, 1.
The bushings are extracted from the front of the single seats.
Removal does not require the drift extension for bushings 5, 6 and 7 and it is not necessary to use the guide bushing.
For bushings 1, 2, 3 and 4 it is necessary to use the extension and the guide bushings.
Position the drift accurately during the phase of removal.

Assembly

Figure 146

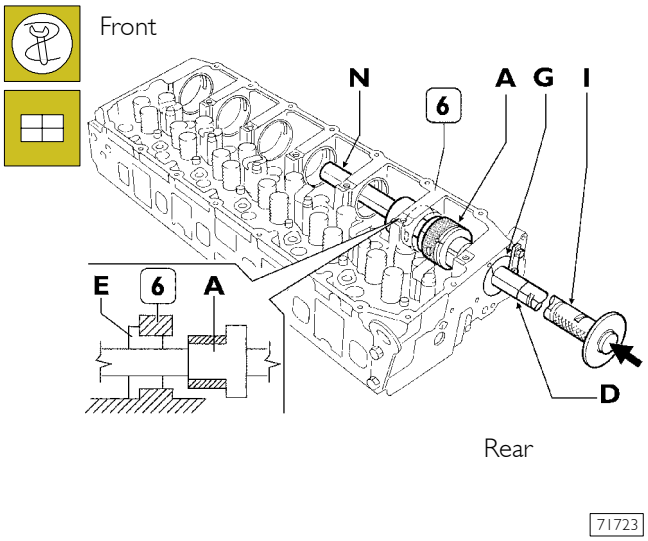


77795

Assemble the drift together with the extension.
To insert bushings 1, 2, 3, 4 and 5, proceed as follows:

1 position the bushing to insert on the drift (A) making the grub screw on it coincide with the seat (B) (Figure 144) on the bushing.
2 position the guide bushing (E) and secure the guide bushing (G) (Figure 144) on the seat of the 7th bushing with the plate (H).
3 while driving in the bushing, make the reference mark (F) match the mark (M). In this way, when it is driven home, the lubrication hole on the bushing will coincide with the oil pipe in its seat.
The bushing is driven home when the 1st red reference mark (D) is flush with the guide bushing (G).

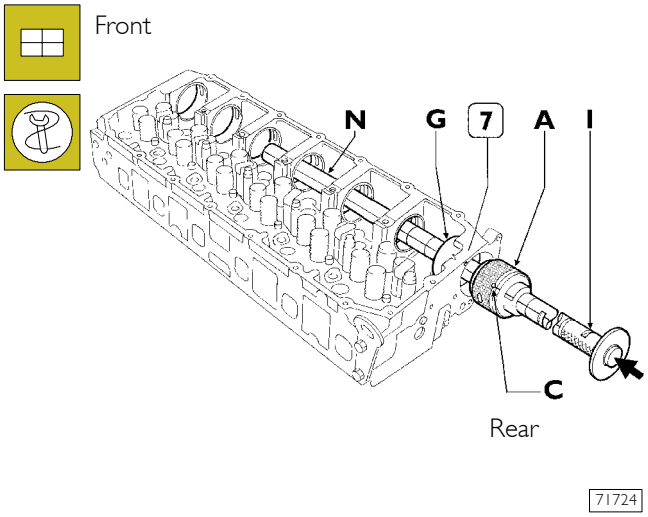
Figure 147



To insert the bushing (6), proceed as follows:

- ❑ Unscrew the grip (I) and the extension (N).
- ❑ Position the extension (N) and the guide bushing (E) as shown in the figure.
- ❑ Repeat steps 1, 2, 3.

Figure 148

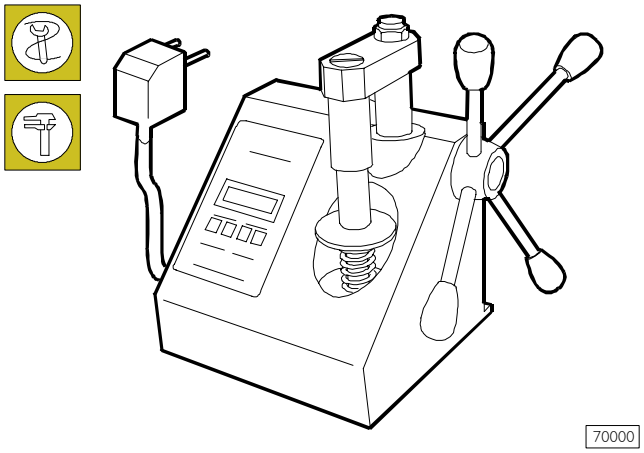


To insert bushing (7), proceed as follows:

- ❑ Unscrew the grip (I) and the extension (N).
- ❑ Refit the guide (G) from the inside as shown in the figure.
- ❑ Position the bushing on the drift (A) and bring it close up to the seat, making the bushing hole match the lubrication hole in the head. Drive it home.
  The 7th bushing is driven in when the reference mark (C) is flush with the bushing seat.

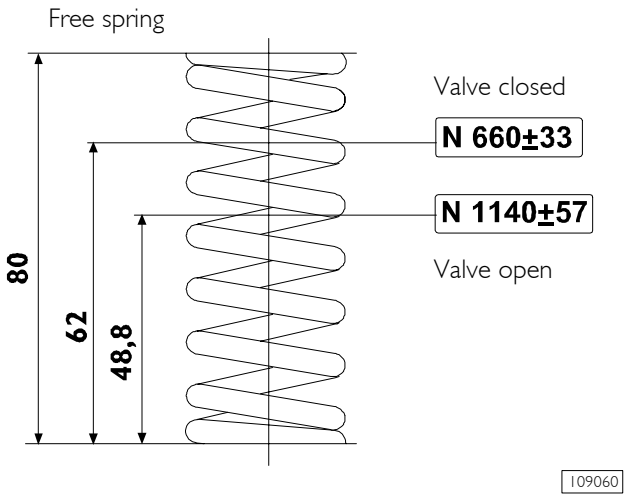
540665 Valve springs

Figure 149 (Demonstration)



Prior to assembling, check the valves springs for flexibility using a suitable device.
Compare the load and elastic deformation data with those of the new springs given in the following figure.

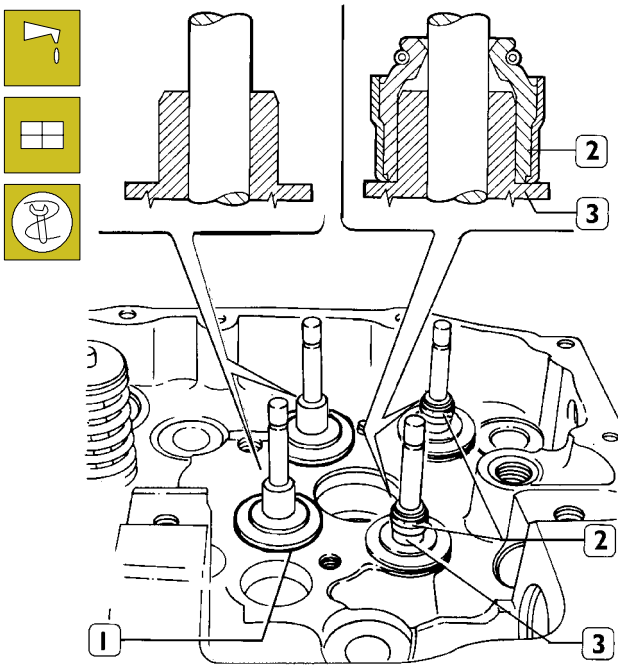
Figure 150



MAIN DATA TO CHECK THE SPRING FOR INTAKE AND EXHAUST VALVES

Fitting valves and oil seal

Figure 151



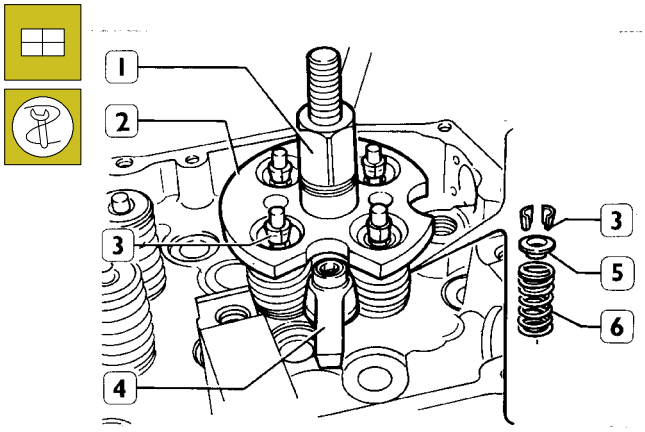
87051

Lubricate the valve stem and insert the valves in the respective valve guides; fit the lower caps (1). Use tool 99360329 to fit the oil seal (2) on the valve guides (3) of the exhaust valves; then, to fit the valves, proceed as follows.

NOTE Should valves not have been overhauled or replaced, remount them according to numbering performed on dismounting.

Intake valves are different form exhaust valves in that they have a notch placed at valve head centre.

Figure 152

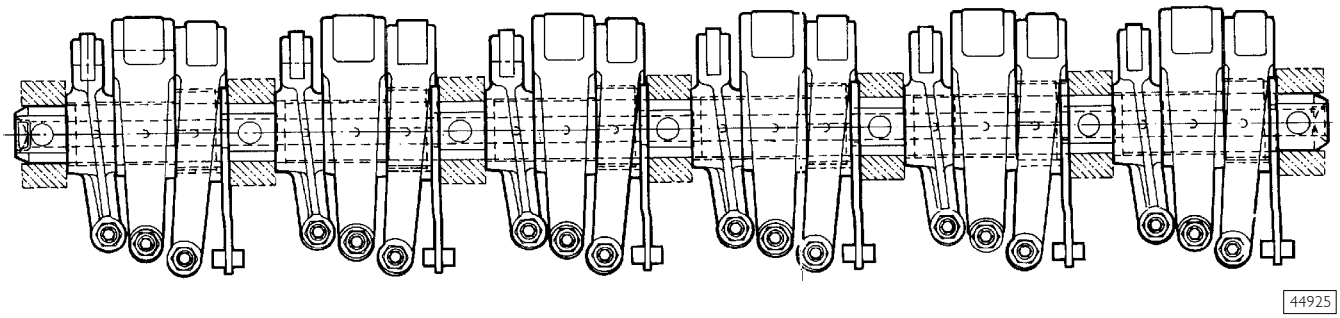


86290

- ❑ Mount the springs (6) and the top plate (5).
- ❑ Fit the tool 99360263 (2) and secure it with the bracket (4). Screw down the lever (1) to be able to fit on the cotters (3). Take off the tool (2).

5412 ROCKER SHAFT

Figure 153



44925

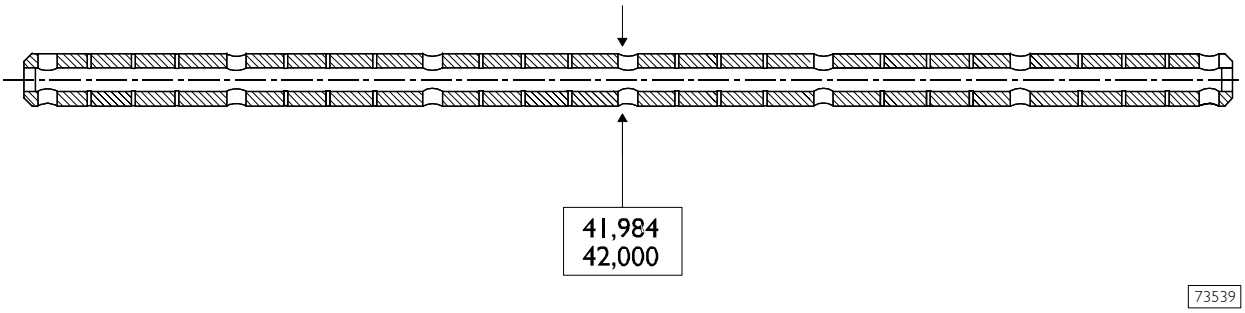
The cams of the camshaft control the rocker arms directly: 6 for the injectors and 12 for the valves.

Injectors and intake valves control rocker arms are keyed on rocker arms shaft directly. Exhaust intake valves control rocker arms are keyed on rocker arms shaft putting in between the levers with engine brake control eccentric pin.

The rocker arms run directly on the profiles of the cams by means of rollers.
The other end acts on a crosspiece that rests on the stem of the two valves.
There is a pad between the rocker arm adjustment screw and the crosspiece.
There are two lubrication ducts inside the rocker arms.
The length of the rocker arm shaft is basically the same as that of the cylinder head. It has to be detached to be able to reach all the parts beneath.

Shaft

Figure 154

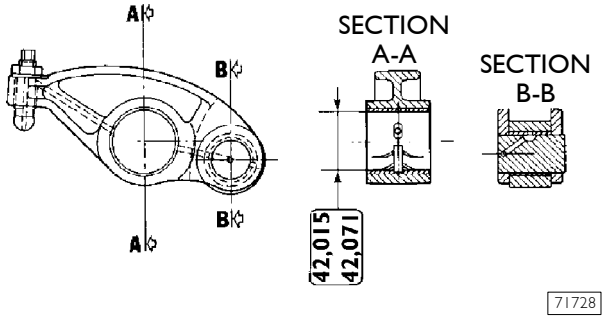


MAIN DATA OF THE ROCKER ARM SHAFT

Check that the surface of the shaft shows no scoring or signs of seizure; if it does, replace it.

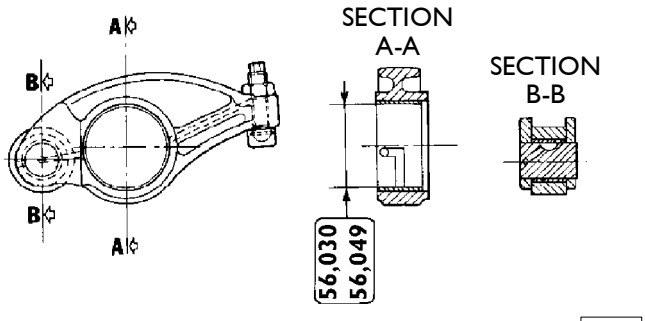
Rocker arms

Figure 155



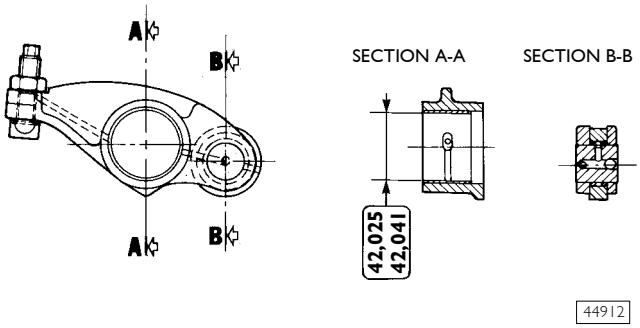
PUMP INJECTOR ROCKER ARMS

Figure 157



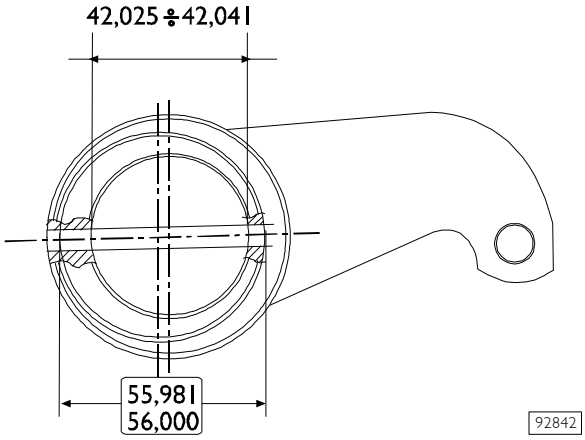
EXHAUST VALVE ROCKER ARMS

Figure 156



INTAKE VALVE ROCKER ARMS

Figure 158



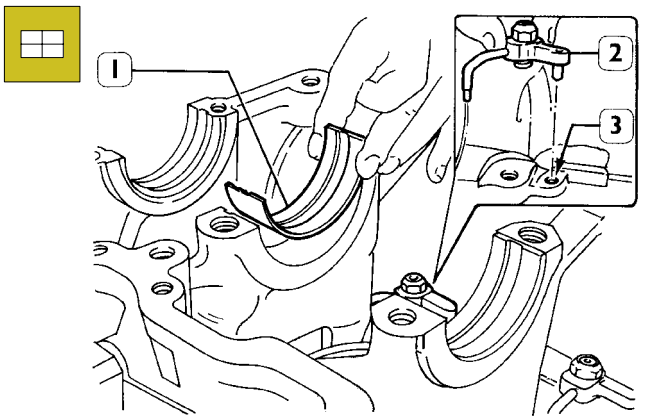
LEVER WITH ENGINE BRAKE CONTROL ECCENTRIC PIN

Check the surfaces of the bushings, which must show no signs of scoring or excessive wear; if they do, replace the rocker arm assembly.

ENGINE ASSEMBLY ON BENCH

Fix the engine block to the stand 99361036 by means of brackets 99322230.
Install the cylinder liners as described in page 56.

Figure 159



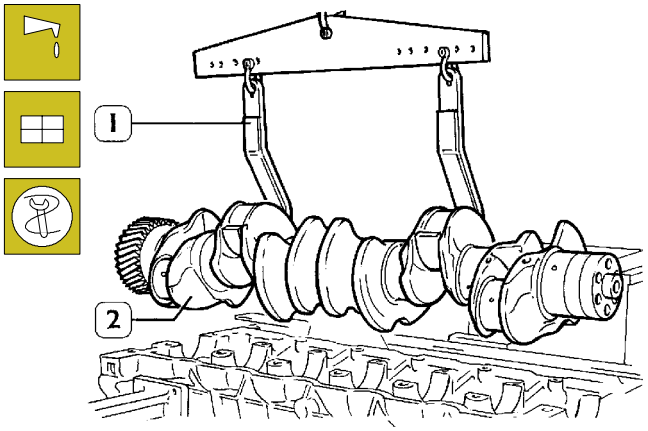
47586

Mount the oil nozzles (2), making the grub screw coincide with the hole (3) in the crankcase.

NOTE Not finding it necessary to replace the main bearings, you need to fit them back in exactly the same sequence and position as in removal. In case main bearings need replacing, choose them according to the selection described in chapter "Selecting the main and connecting-rod half bearings".

Arrange the bearing shells (1) on the main bearing housings.

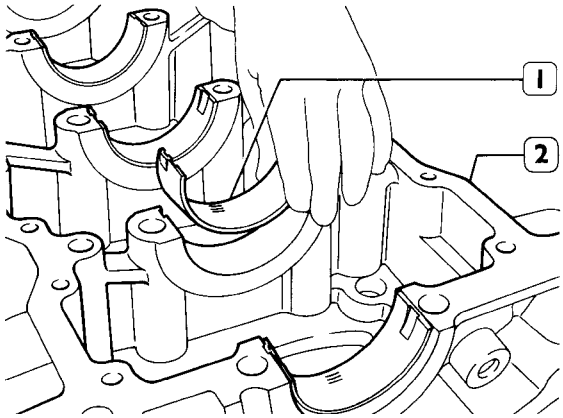
Figure 160



47570

Lubricate the half bearings, then install the crankshaft (2) by means of hoist and hook 99360500 (1).

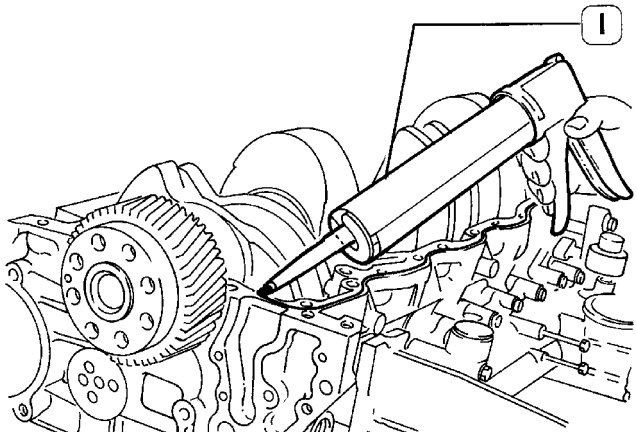
Figure 161



49021

Place the half-bearings (1) on the main bearings in the underblock (2).

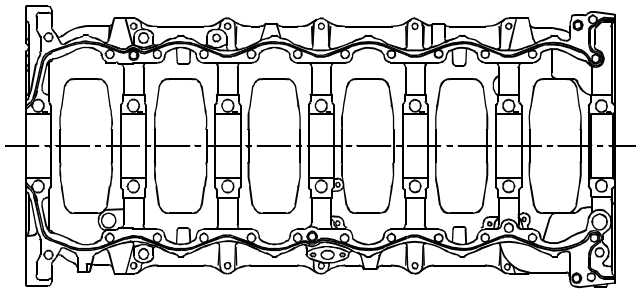
Figure 162



47595

Use a suitable tool (1) to apply LOCTITE 5970 IVECO No. 2992644, as shown on the next figure.

Figure 163

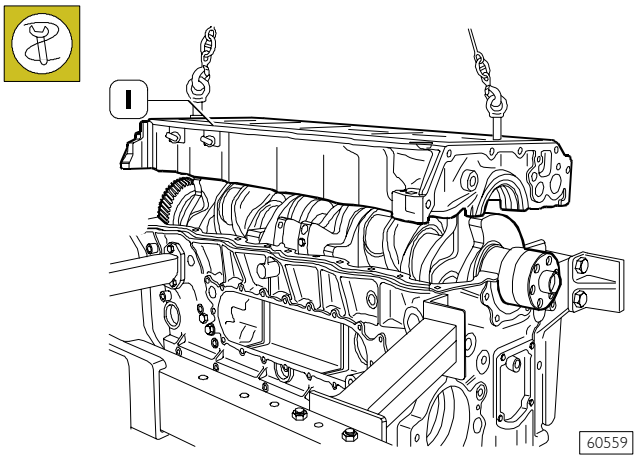


60632

Sealant application diagram.

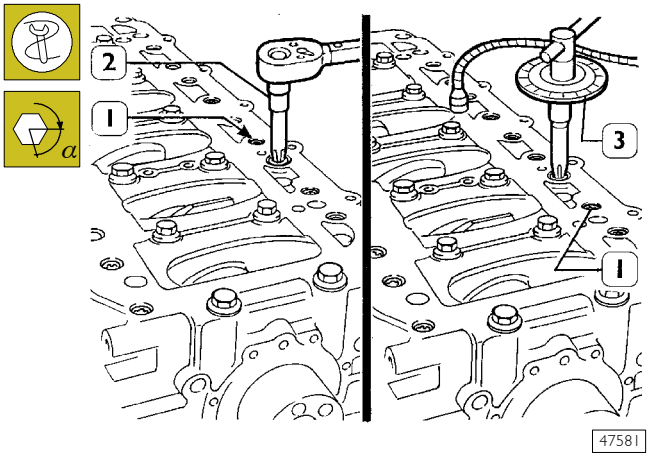
NOTE Fit the underblock within 10' of the application of the sealant.

Figure 164



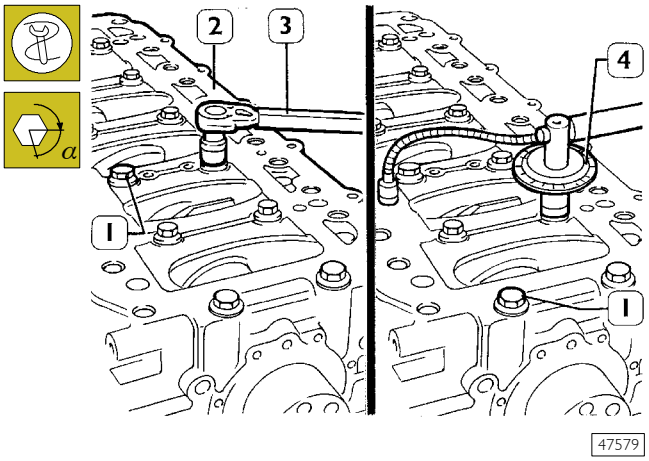
Mount the crankcase base (1) using appropriate tackle and hooks.

Figure 165



Mount the crankcase base and using a torque wrench (2), tighten the outside hex grooved screws (1) to a torque of 30 Nm following schemes contained in following page.

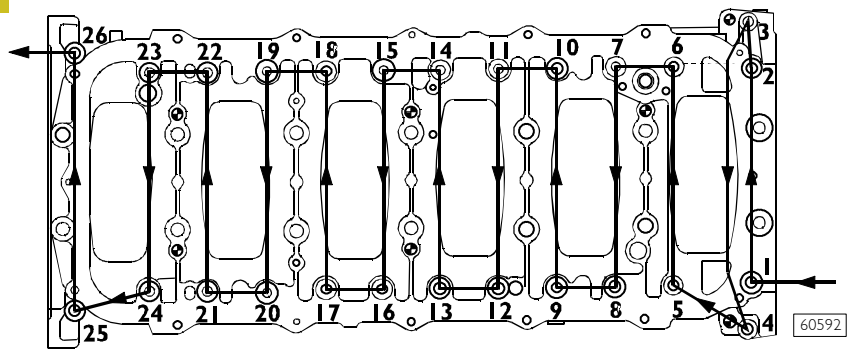
Figure 166



Using a torque wrench (3), tighten the inside screws (1) to a torque of 120 Nm. Then tighten them to an angle of 90° and 45° with tool 99395216 (4) with another two phases. Regrind the outside screws (1, Figure 165) with closure to an angle of 60° using tool 99395216 (3, Figure 165).

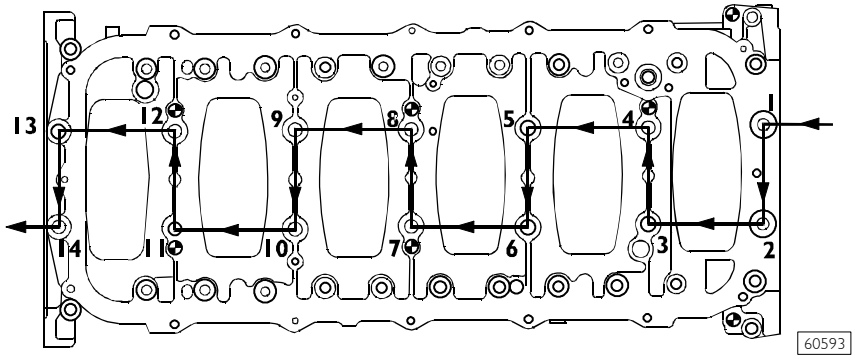
Figure 167

FRONT SIDE



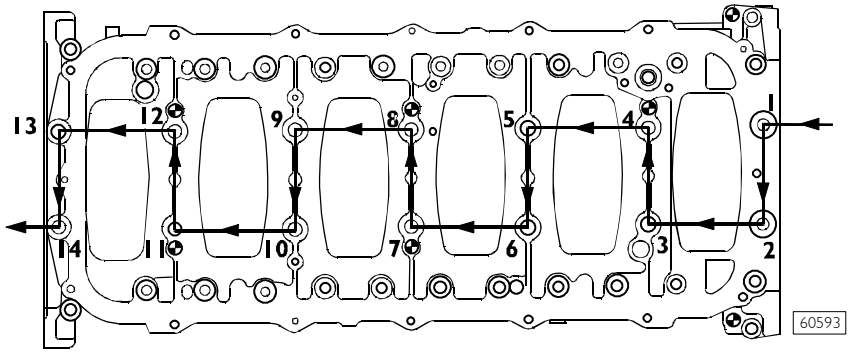
stage 1: pretightening outer screws (30 Nm)

FRONT SIDE



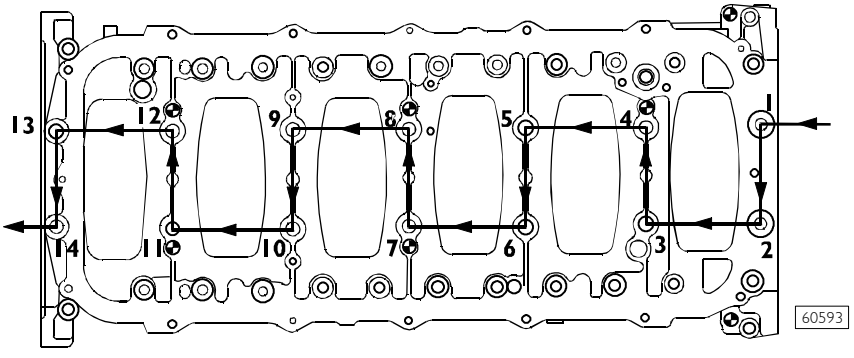
stage 2: pretightenig inner screws (120 Nm)

FRONT SIDE



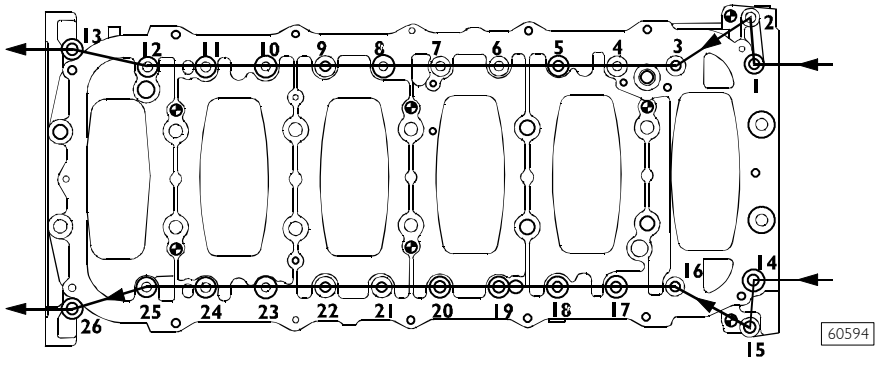
stage 3: angle inner screws (90°)

FRONT SIDE



stage 4: angle inner screws (45°)

FRONT SIDE

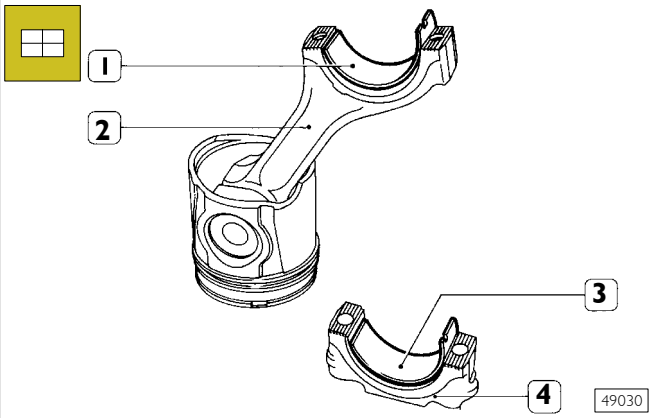


stage 5: angle outer screws (60°)

DIAGRAM OF TIGHTENING SEQUENCE OF CRANKCASE BASE FIXING SCREWS

Fitting connecting rod - piston assemblies in cylinder liners

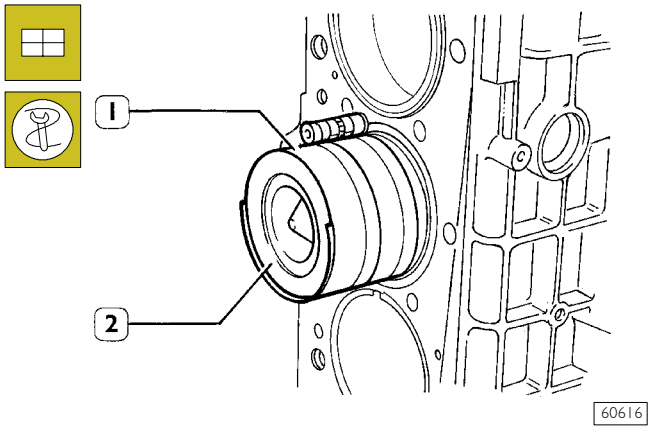
Figure 168



NOTE Not finding it necessary to replace the connecting rod bearings, you need to fit them back in exactly the same sequence and position as in removal.
Choose big end bearings, if they are to be replaced, based on selection described in chapter "Selecting main and big end bearings". Lubricate the bearing shells (1 and 3) and fit them on the connecting rod (2) and on the cap (4).

NOTE Do not make any adjustment on the bearing shells.

Figure 170



Turn the cylinder block, setting it upright.

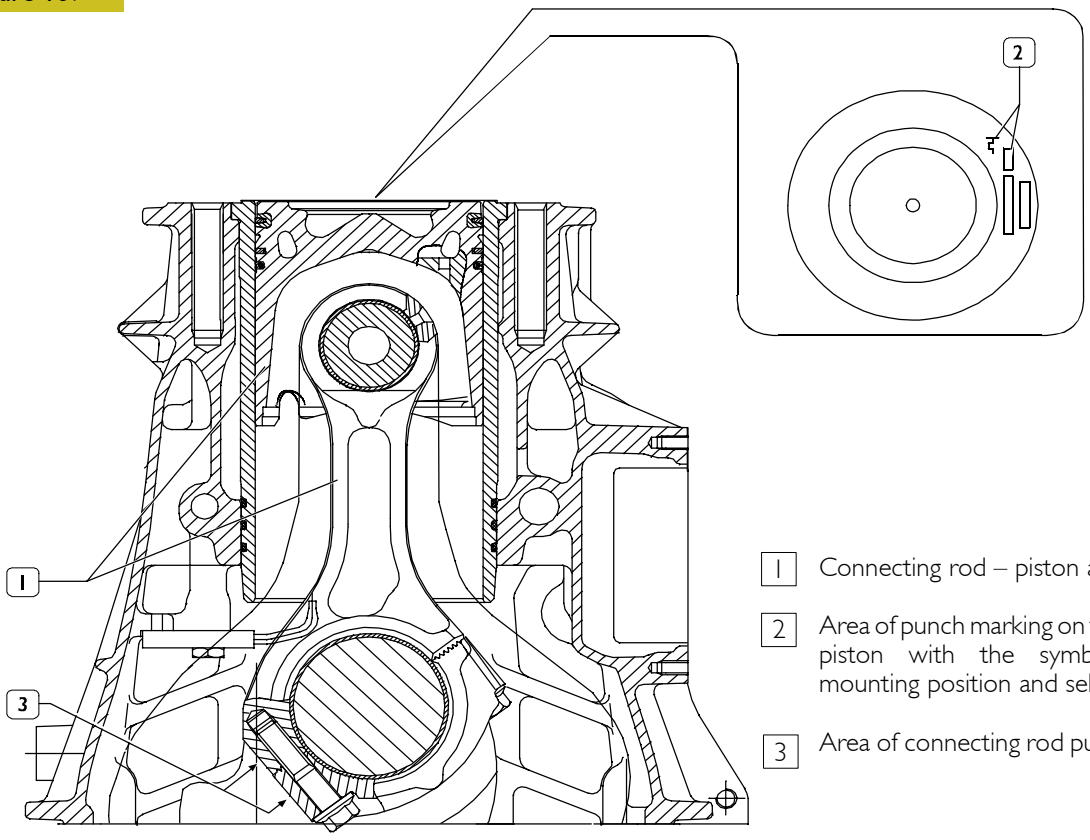
Lubricate the pistons, piston rings and inside the cylinder liners.

With the aid of the clamp 99360605 (1) mount the connecting rod – piston assemblies (2) in the cylinder liners according to Figure 169. Check that:

- ❑ The number of each connecting rod corresponds to the cap coupling number.
- ❑ The symbol (2, Figure 169) punched on the top of the pistons faces the engine flywheel or the recess in the piston skirt tallies with the position of the oil nozzles.

NOTE The pistons are supplied as spares in class A and can also be fitted in class B cylinder liners.

Figure 169

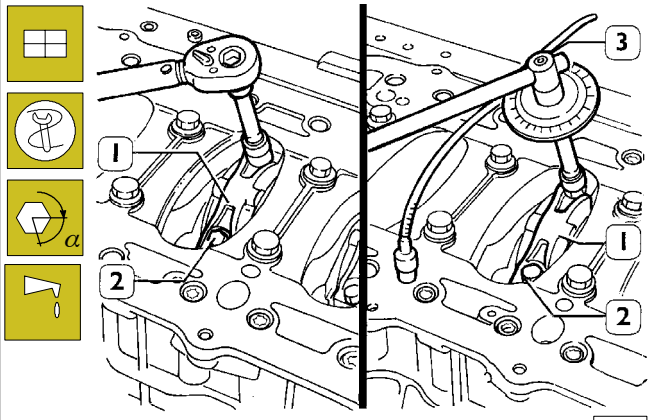


1 Connecting rod – piston assembly.

2 Area of punch marking on the top of the piston with the symbol for the mounting position and selection class.

3 Area of connecting rod punch marking.

Figure 171

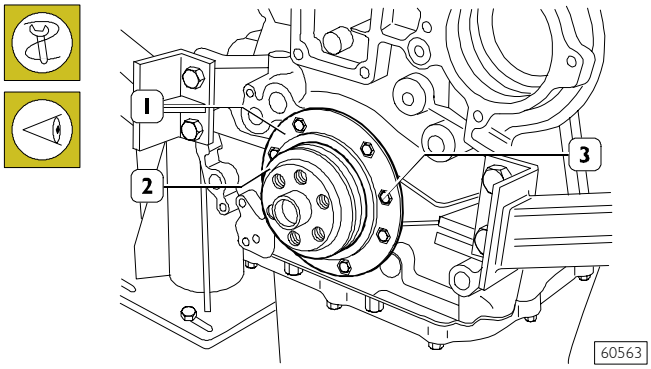


47594

Connect the connecting rods to the relevant pins of the crankshaft, mount the connecting rod caps (1) together with the bearing shells. Tighten the screws (2) fixing the connecting rod caps to a torque of 60 Nm (6 kgm). Using tool 99395216 (3), tighten the screws further with an angle of 60°.

NOTE Before reusing the screws (2), measure the diameter of the thread; it must be no less than 13.4 mm; if it is, change the screw.
Lubricate the thread of the screws with engine oil before assembly.

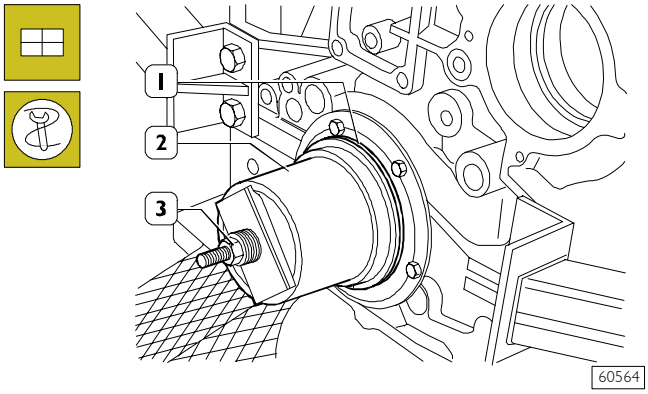
Figure 172



60563

Using the centring ring 99396035 (2), check the exact position of the cover (1). If it is wrong, proceed accordingly and lock the screws (3).

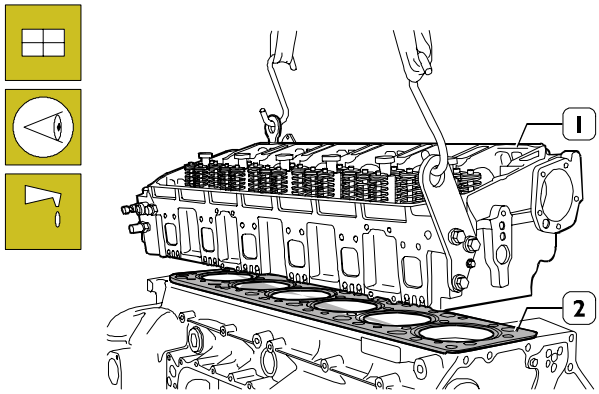
Figure 173



60564

Key on the gasket (1), mount the key 99346250 (2) and, screwing down the nut (3), drive in the gasket (1).

Figure 174

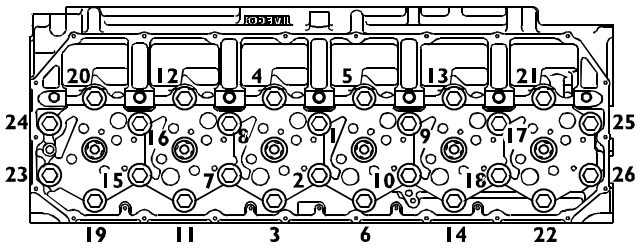


60515

Check that the pistons 1-6 are exactly at the T.D.C.
Put the gasket (2) on the crankcase.
Mount the cylinder head (1) and tighten the screws as shown in Figs. 175 – 176 – 177.

NOTE Lubricate the thread of the screws with engine oil before assembly.

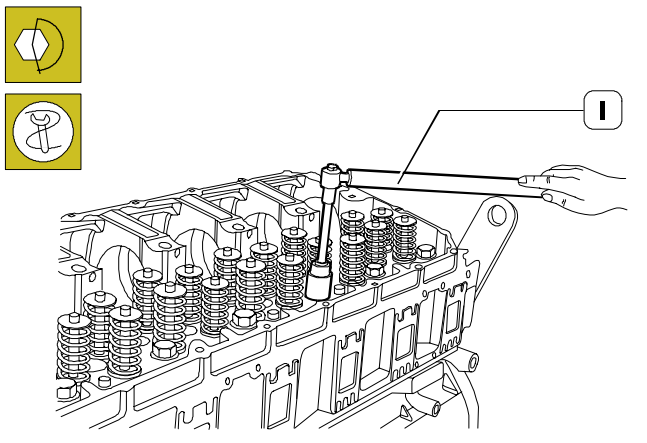
Figure 175



61270

Diagram of the tightening sequence of the screws fixing the cylinder head.

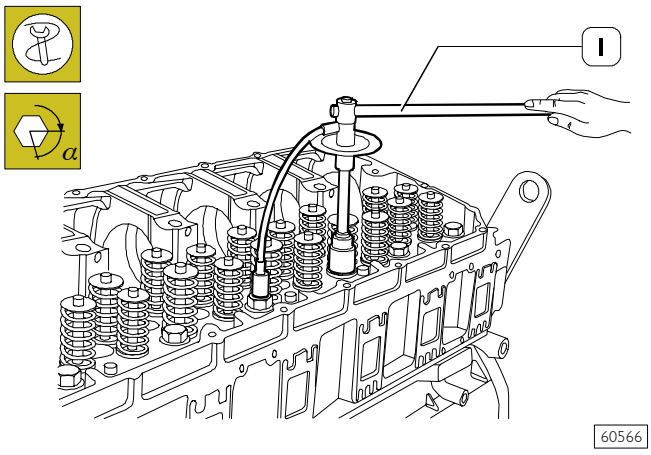
Figure 176



60565

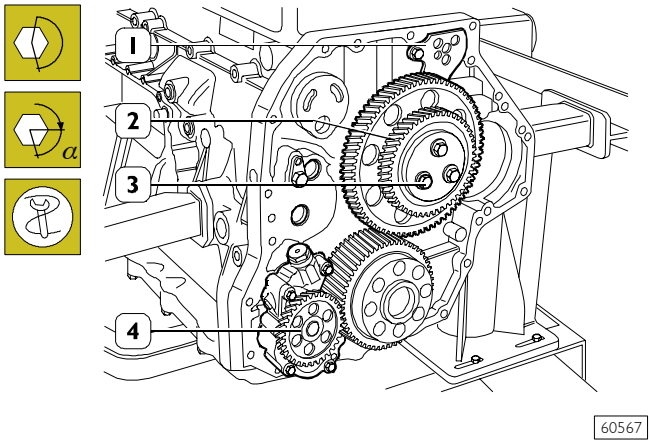
❑ Pre-tightening with the torque wrench (1):
1st phase: 60 Nm (6 kgm).
2nd phase: 120 Nm (12 kgm).

Figure 177



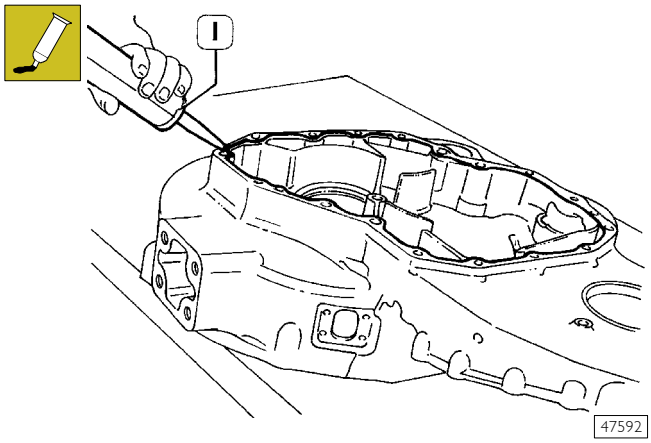
❑ Closing to angle with tool 99395216 (1):
3rd phase: angle of 120°.
4th phase: angle of 60°.

Figure 178



Mount the oil pump (4), the intermediate gears (2) together with the link rod (1) and lock the screws (3) in two phases:
pre-tightening 30 Nm.
closing to angle 90°.

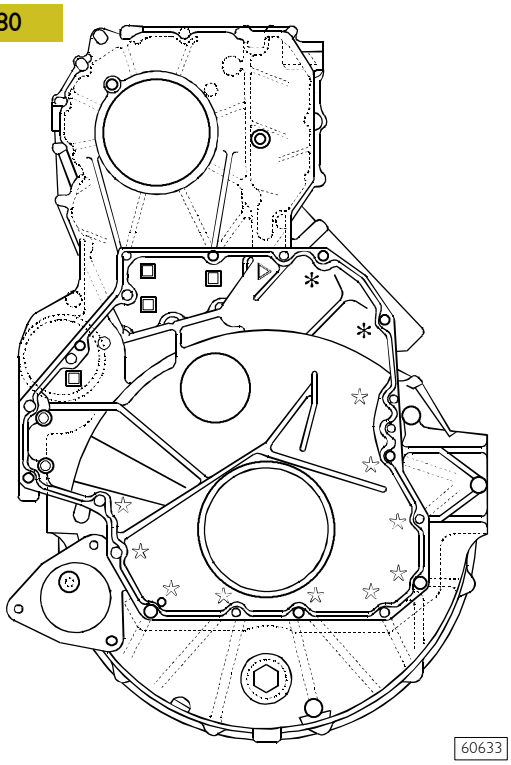
Figure 179



Apply LOCTITE 5970 IVECO No. 2995644 silicone on the gear housing, using appropriate tools (1), as shown in the figure.
The sealer string (1) diameter is to be 1,5 $\pm^{0.5}_{0.2}$

NOTE Mount the gear housing within 10 min. of applying the sealant.

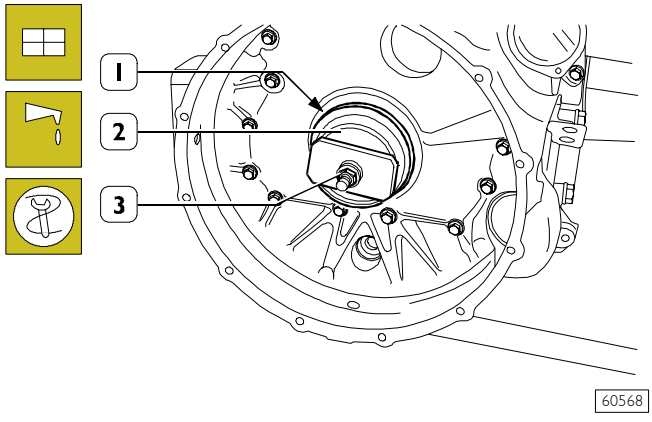
Figure 180



Using a torque wrench, tighten the highlighted screws with the following sequence and tightening torques:

☆	10 screws M12 x 1.75 x 100	63 Nm
◎	2 screws M12 x 1.75 x 70	63 Nm
□	4 screws M12 x 1.75 x 35	63 Nm
△	1 screw M12 x 1.75 x 120	63 Nm
✳	2 screws M12 x 1.75 x 193	63 Nm

Figure 181



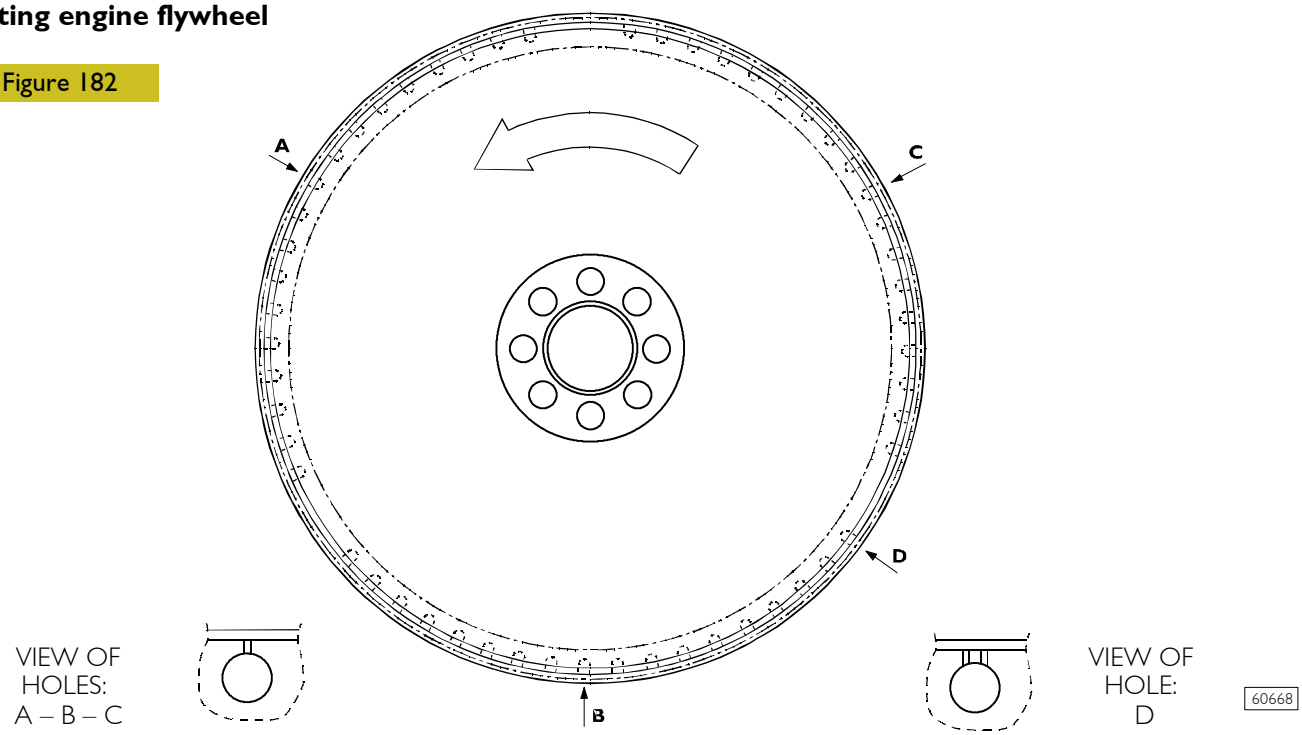
Lubricate driving shaft tang.

Key on the gasket (1), mount the keying device 99346251 (2) and, screwing down the nut (3), drive in the gasket.

540850 ENGINE FLYWHEEL

Fitting engine flywheel

Figure 182



DETAIL OF PUNCH MARKS ON ENGINE FLYWHEEL FOR PISTON POSITIONS

A = Hole on flywheel with one reference mark, corresponding to the TDC of pistons 3-4.

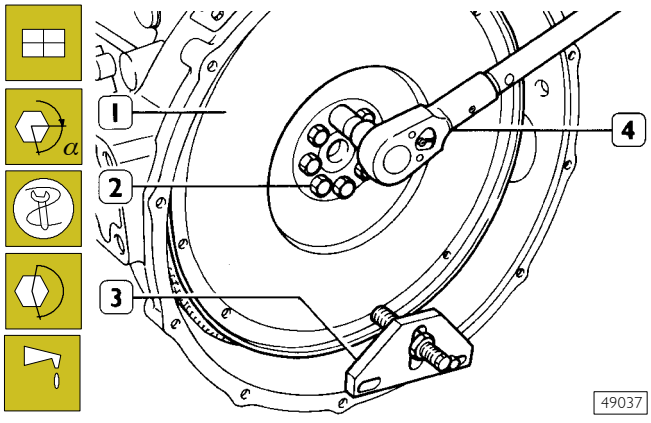
B = Hole on flywheel with one reference mark, corresponding to the TDC of pistons 1-6.

C = Hole on flywheel with one reference mark, corresponding to the TDC of pistons 2-5.

D = Hole on flywheel with two reference marks, position corresponding to 54°.

NOTE If the teeth of the ring gear mounted on the engine flywheel, for starting the engine, are very damaged, replace the ring gear. It must be fitted after heating the ring gear to a temperature of approx. 200°C.

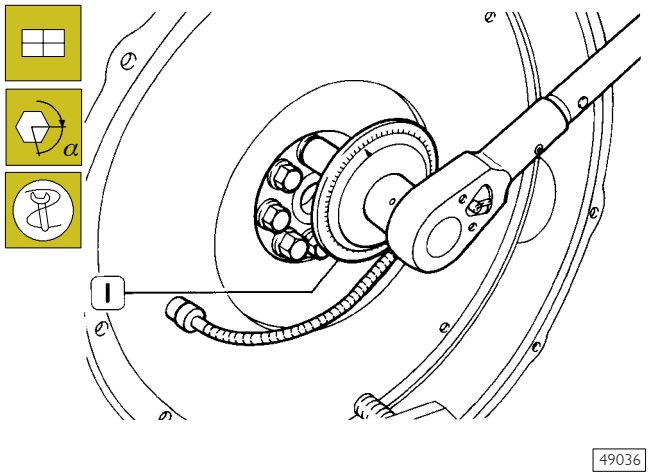
Figure 183



NOTE The crankshaft has a locating peg that has to couple with the relevant seat on the engine flywheel.

Position the flywheel (1) on the crankshaft, lubricate the thread of the screws (2) with engine oil and screw them down.
Lock rotation with tool 99360351 (3). Lock the screws (2) in two phases.
First phase: pre-tightening with torque wrench (4) to a torque of 120 Nm (12 kgm).

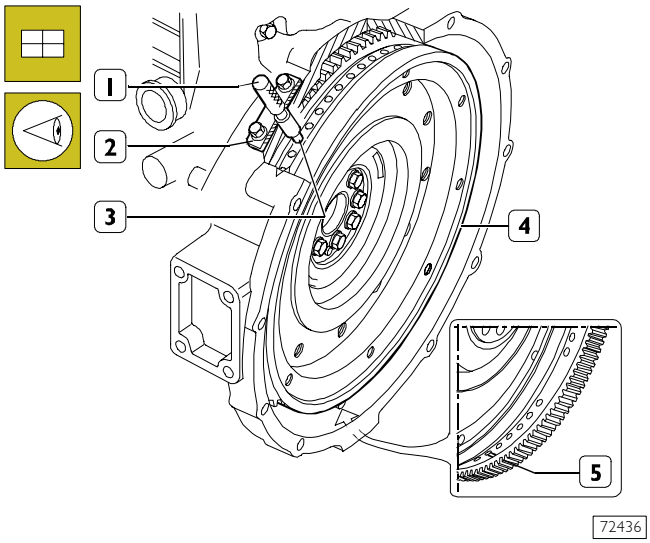
Figure 184



Second phase: closing to angle of 90° with tool 99395216 (1).

Fitting camshaft

Figure 185



Position the crankshaft with the pistons 1 and 6 at the top dead centre (T.D.C.).

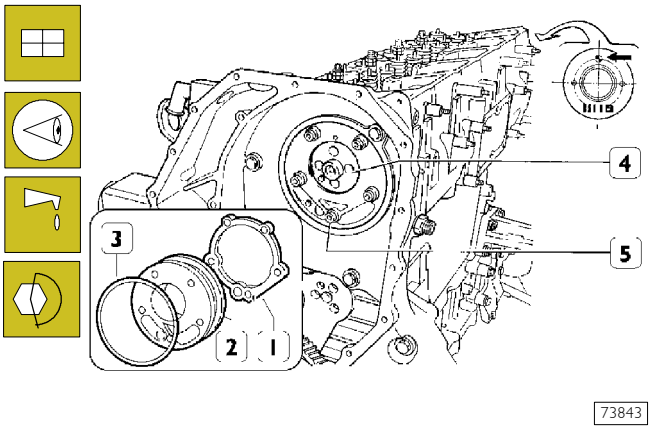
This situation occurs when:

1. The hole with reference mark (5) of the engine flywheel (4) can be seen through the inspection window.
2. The tool 99360612 (1), through the seat (2) of the engine speed sensor, enters the hole (3) in the engine flywheel (4).

If this condition does not occur, turn the engine flywheel (4) appropriately.

Remove the tool 99360612 (1).

Figure 186

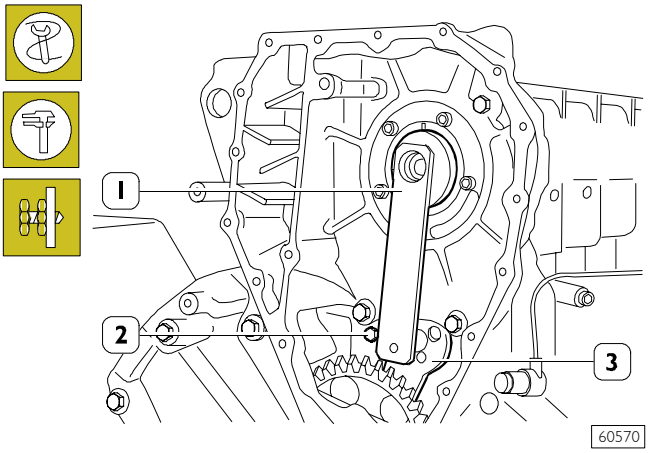


Fit the camshaft (4), positioning it observing the reference marks (→) as shown in the figure.

Lubricate the seal (3) and fit it on the shoulder plate (2).

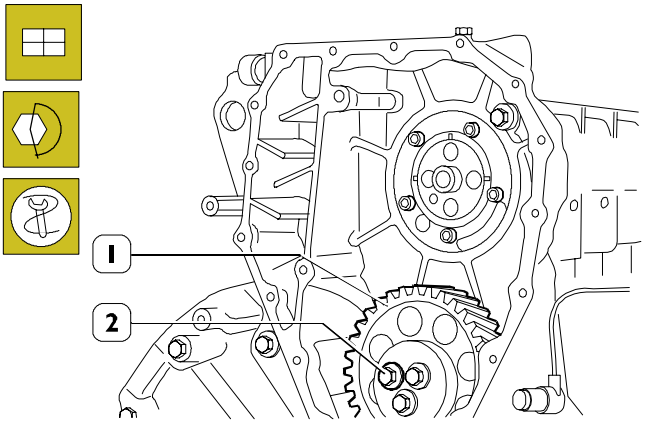
Mount the shoulder plate (2) with the sheet metal gasket (1) and tighten the screws (5) to the required torque.

Figure 187



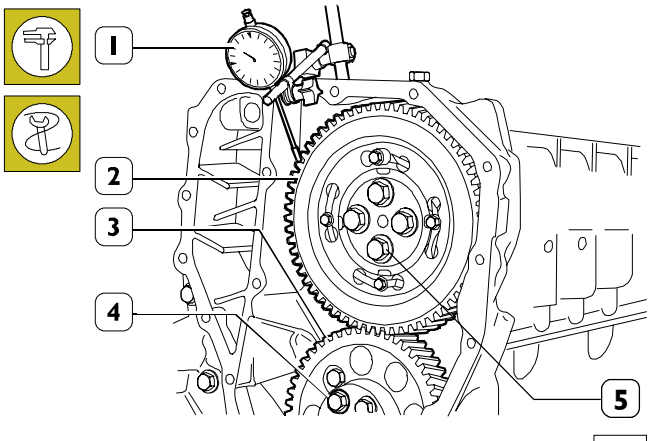
❑ Apply the gauge 99395219 (1). Check and adjust the position of the link rod (3) for the idle gear. Lock the screw (2) to the required torque.

Figure 188



❑ Fit the idle gear (1) back on and lock the screws (2) to the required torque.

Figure 189

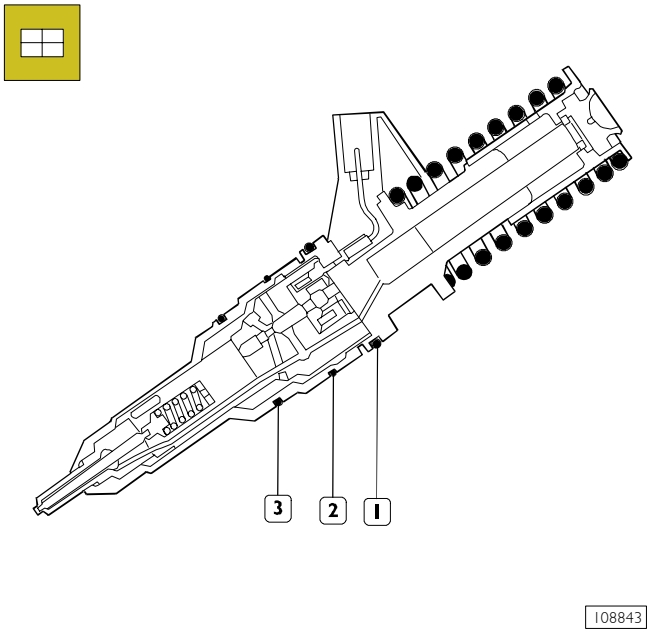


Position the gear (2) on the camshaft so that the 4 slots are centred with the holes for fixing the camshaft, without fully locking the screws (5).
Using the dial gauge with a magnetic base (1), check that the clearance between the gears (2 and 3) is 0.074 – 0.195 mm; if this is not so, adjust the clearance as follows:

- ❑ Loosen the screws (4) fixing the idle gear (3).
- ❑ Loosen the screw (2, Figure 187) fixing the link rod. Shift the link rod (3, Figure 187) to obtain the required clearance.
- ❑ Lock the screw (2, Figure 187) fixing the link rod and screws (4, Figure 189) fixing the idle gear to the required torque.

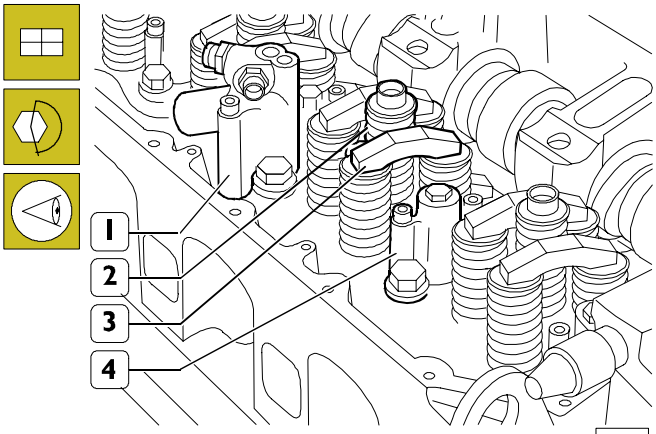
Fitting pump-injectors

Figure 190



Fit the seals (1) (2) (3) on the injectors.

Figure 191



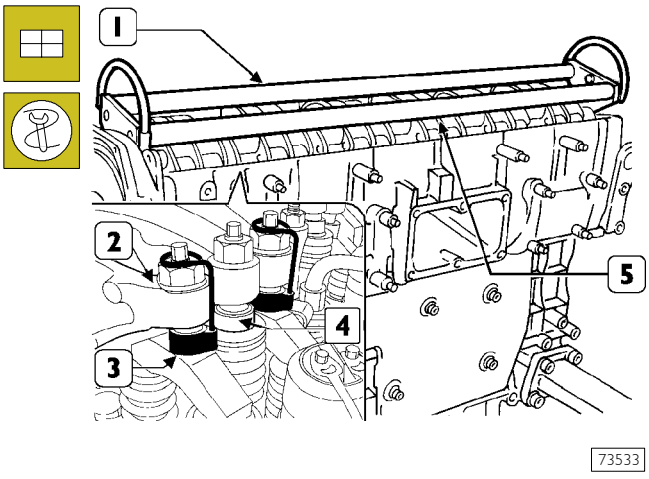
Mount:

- ❑ The injectors (2) and, using a torque wrench, lock the bracket fixing screws to a torque of 26 Nm.
- ❑ The exhaust brake cylinders (1) and (4) and, using a torque wrench, fix them to a torque of 19 Nm.
- ❑ The crosspieces (3) on the valve stem, all with the largest hole on the same side.

Fitting rocker-arm shaft assembly

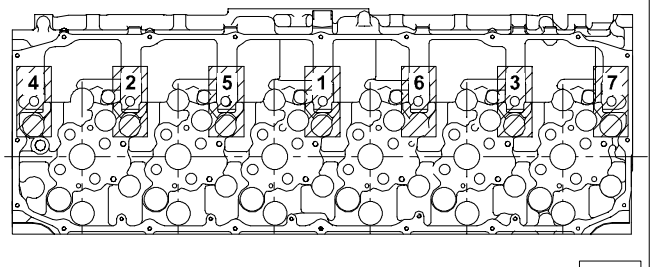
NOTE Before refitting the rocker-arm shaft assembly, make sure that all the adjustment screws have been fully unscrewed.

Figure 192



Using tool 99360144 (3), fasten the blocks (4) to the rocker arms (2).
Apply the tool 99360553 (1) to the rocker arm shaft (5) and mount the shaft on the cylinder head.

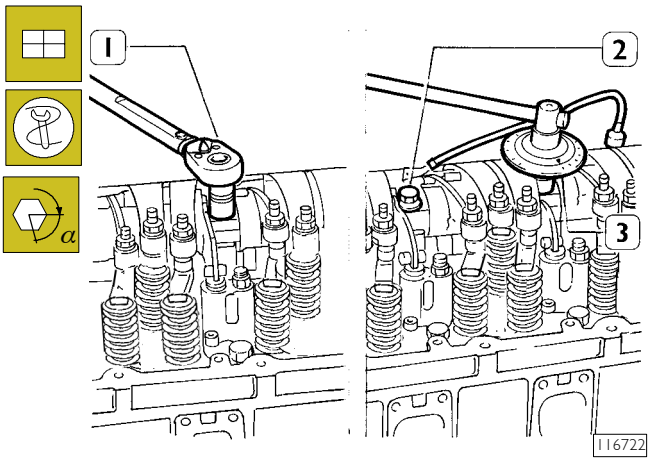
Figure 193



SCHEME OF SCREW TIGHTENING SEQUENCE SECURING ROCKER ARMS

Screw screws (1 - 2 - 3) until rocker arms are brought to contact relating seats on cylinder head, tighten the screws according to sequence indicated in figure operating in two steps as indicated in successive figure.

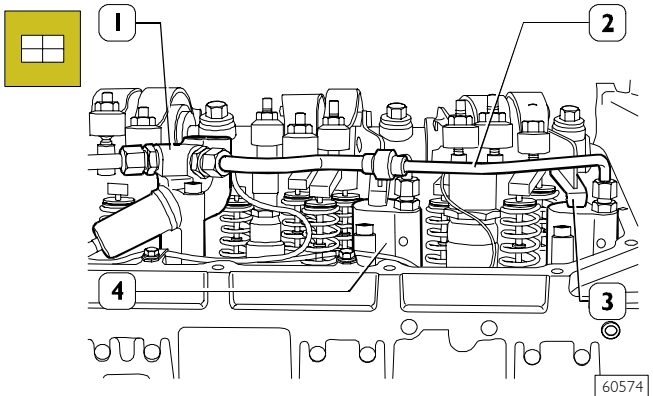
Figure 194



Lock the screws (2) fixing the rocker-arm shaft as follows:

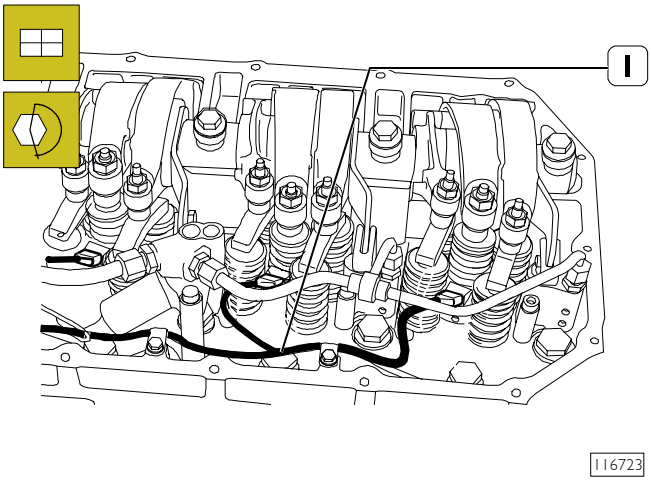
- ❑ 1st phase: tightening to a torque of 80 Nm (8 kgm) with the torque wrench (1);
- ❑ 2nd phase: closing with an angle of 60° using the tool 99395216 (3).

Figure 195



- ❑ Mount the engine brake lever retaining springs (3).
- ❑ Connect the pipe (2) to the engine brake cylinders (4) and to the cylinder with the engine brake solenoid valve (1).

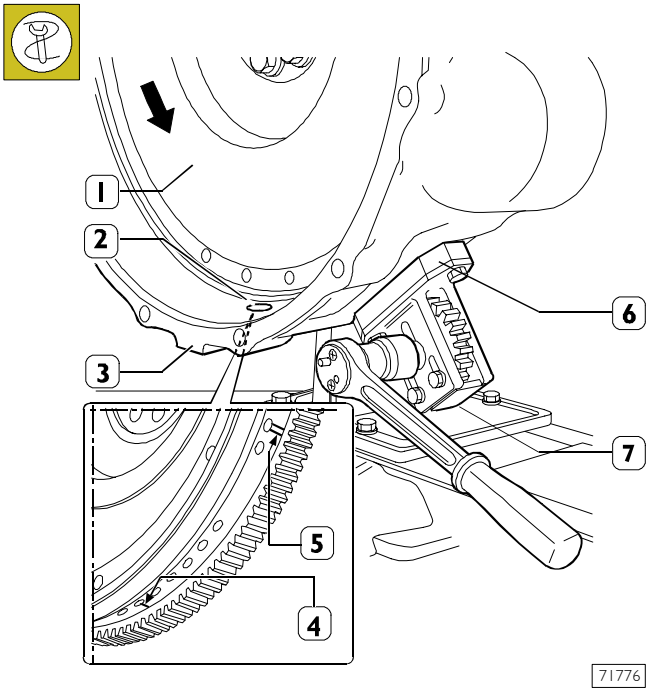
Figure 196



Mount the electric wiring (1).

Camshaft timing

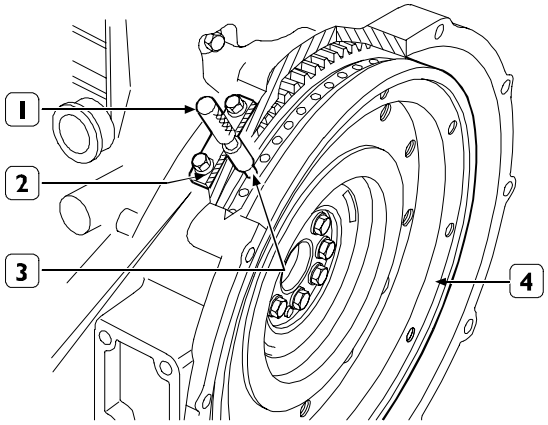
Figure 197



Apply the tool 99360321 (7) and the spacer 99360325 (6) to the gearbox (3).

NOTE The arrow shows the direction of rotation of the engine when running.
Using the above-mentioned tool, turn the engine flywheel (1) in the direction of rotation of the engine so as to take the piston of cylinder no.1 to approximately the T.D.C. in the phase of combustion.
This condition occurs when the hole with one reference mark (4), after the hole with two reference marks (5) on the engine flywheel (1), can be seen through the inspection window (2).

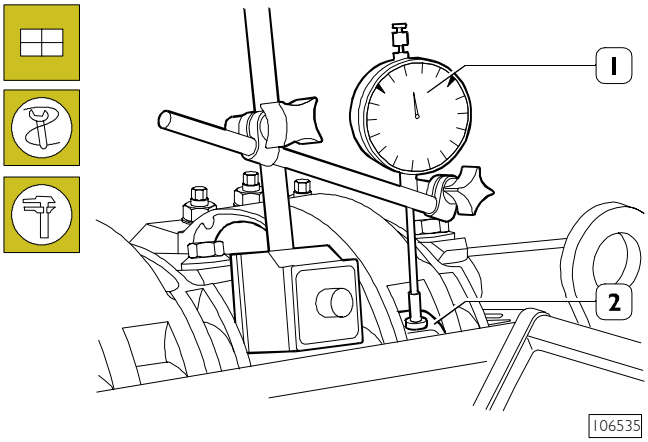
Figure 198



71774

The exact position of piston no.1 at the T.D.C. is obtained when in the above-described conditions the tool 99360612 (1) goes through the seat (2) of the engine speed sensor into the hole (3) in the engine flywheel (4).
If this is not the case, turn and adjust the engine flywheel (4) appropriately.
Remove the tool 99360612 (1).

Figure 199



106535

Adjust the magnetic comparator (1) with the rod (with flat base) located on the roller (2) of the cocker arm controlling the injector of cylinder no. 1 and preload it by 6 mm.

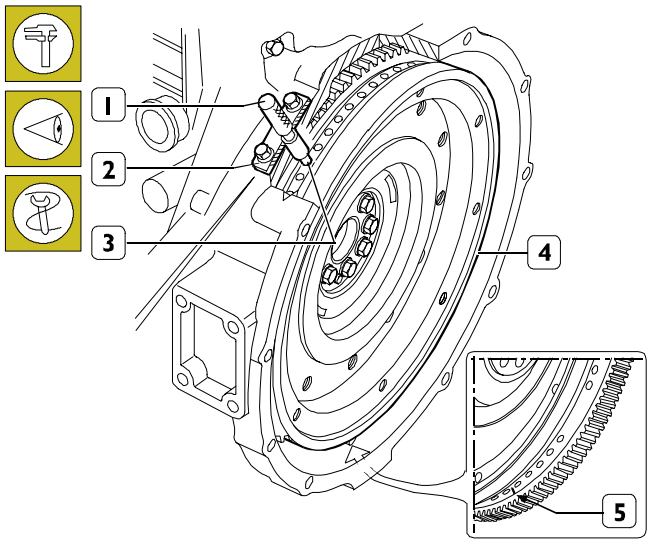
NOTE During measuring, the rod of the comparator must always be perpendicular to the engine axis and NOT to the head surface.

With tool 99360321 (7, Figure 197), turn the crankshaft clockwise until the pointer of the dial gauge reaches the minimum value beyond which it can no longer fall.

Reset the dial gauge.

Turn the engine flywheel anticlockwise until the dial gauge gives a reading for the lift of the cam of the camshaft of 5.30 ±0.05 mm.

Figure 200

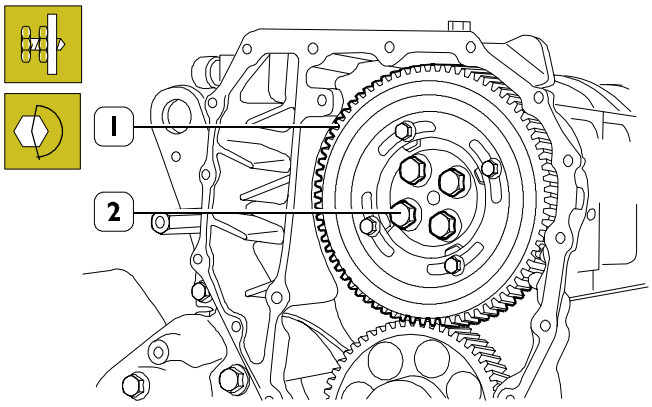


77259

The camshaft is in step if at the cam lift values of 5.30 ±0.05 mm there are the following conditions:

1) the hole marked with a notch (5) can be seen through the inspection window;
2) the tool 99360612 (1) through the seat (2) of the engine speed sensor goes into the hole (3) in the engine flywheel (4).

Figure 201



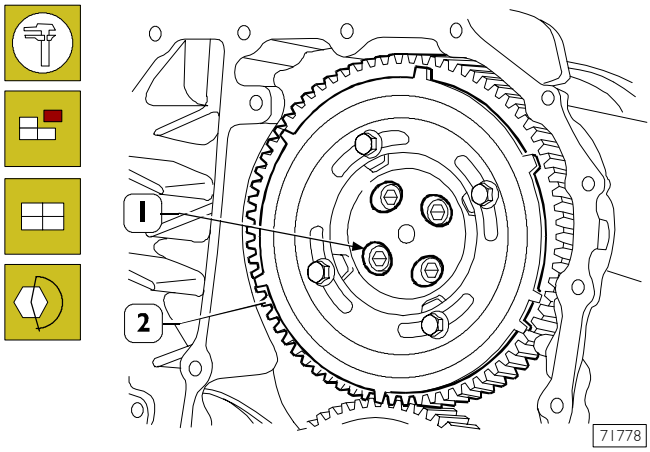
60575

If you do not obtain the conditions illustrated in Figure 200 and described in points 1 and 2, proceed as follows:

1) loosen the screws (2) securing the gear (1) to the camshaft and utilize the slots (see Figure 202) on the gear (1);
2) turn the engine flywheel appropriately so as to bring about the conditions described in points 1 and 2 Figure 200, it being understood that the cam lift must not change at all;
3) lock the screws (2) and repeat the check as described above.

Tighten the screws (2) to the required torque.

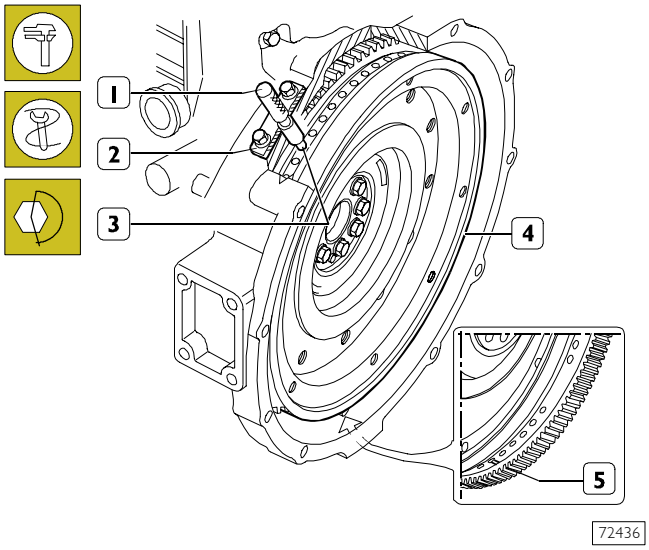
Figure 202



When the adjustment with the slots (1) is not enough to make up the phase difference and the camshaft turns because it becomes integral with the gear (2); as a result, the reference value of the cam lift varies, in this situation it is necessary to proceed as follows:

1) lock the screws (2, Figure 201) and turn the engine flywheel clockwise by approx. 1/2 turn;
2) turn the engine flywheel anticlockwise until the dial gauge gives a reading of the lift of the cam of the camshaft of 5.30 ±0.05 mm;
3) take out the screws (2, Figure 201) and remove the gear (1) from the camshaft.

Figure 203



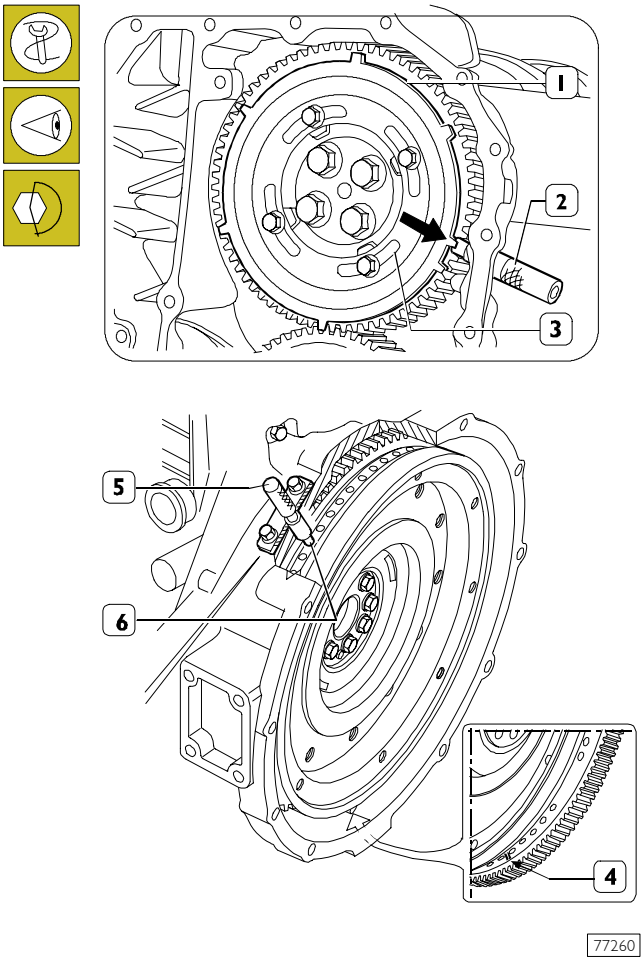
Turn the flywheel (4) again to bring about the following conditions:

- ❑ a notch (5) can be seen through the inspection window;
- ❑ the tool 99360612 (1) inserted to the bottom of the seat of the engine speed sensor (2) and (3).

Mount the gear (2) Figure 202 with the 4 slots (1) centred with the fixing holes of the camshaft, locking the relevant screws to the required tightening torque.
Check the timing of the shaft by first turning the flywheel clockwise to discharge the cylinder completely and then turn the flywheel anticlockwise until the dial gauge gives a reading of 5.30 ±0,05.
Check the timing conditions described in Figure 200.

Phonic wheel timing

Figure 204



Turn the crankshaft by taking the piston of cylinder no. 1 into the compression phase at T.D.C.; turn the flywheel in the opposite direction to the normal direction of rotation by approximately 1/4 of a turn.

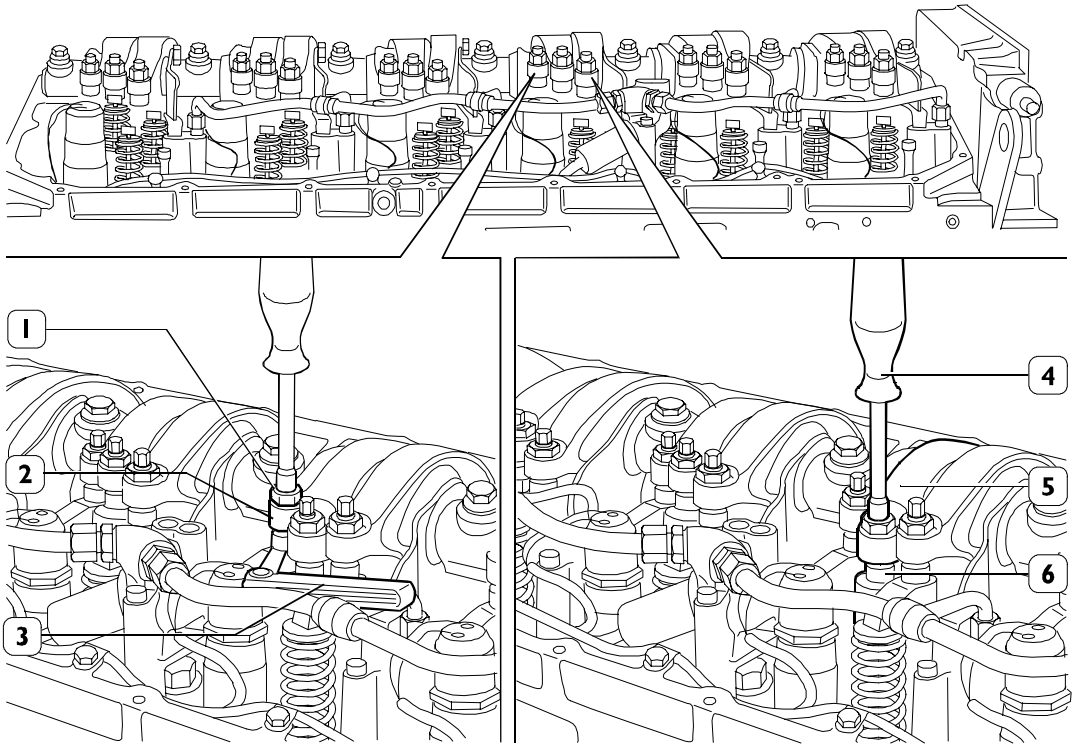
Again turn the flywheel in its normal direction of rotation until you see the hole marked with the double notch (4) through the inspection hole under the flywheel housing. Insert tool 99360612 (5) into the seat of the flywheel sensor (6).

Insert the tool 99360613 (2), via the seat of the phase sensor, onto the tooth obtained (▶) on the phonic wheel.

Should inserting the tool (2) prove difficult, loosen the screws (3) and adjust the phonic wheel (1) appropriately so that the tool (2) gets positioned on the tooth correctly. Go ahead and tighten the screws (3).

Intake and exhaust rocker play adjustment and pre-loading of rockers controlling pump injectors

Figure 205



ADJUSTMENT OF INTAKE, EXHAUST AND INJECTION ROCKERS

The adjustment of clearance between the rockers and rods controlling the intake and exhaust valves, as well as the adjustment of pre-loading of the rockers controlling pump injectors, must be carried out carefully.

Take the cylinder where clearance must be adjusted to the bursting phase; its valves are closed while balancing the symmetric cylinder valves.
Symmetric cylinders are 1-6, 2-5 and 3-4.

In order to properly operate, follow these instructions and data specified on the table.

Adjustment of clearance between the rockers and rods controlling intake and exhaust valves:

- ❑ use a box wrench to loosen rocker arm (2) adjusting screw fastening nut (1);
- ❑ insert the thickness gauge blade (3) corresponding to the operating clearance shown in the specifications and data table;
- ❑ tighten or untighten the adjustment screw with the appropriate wrench;
- ❑ make sure that the gauge blade (3) can slide with a slight friction;
- ❑ lock the nut (1), by blocking the adjustment screw.

Pre-loading of rockers controlling pump injectors:

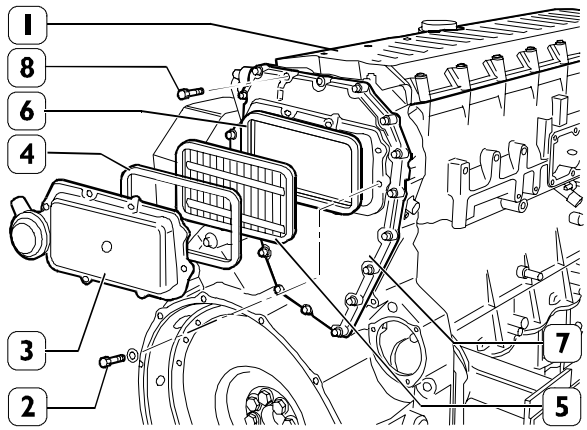
- ❑ using a polygonal wrench, loosen the nut locking the rocker adjustment screw (5) controlling the pump injector (6);
- ❑ using an appropriate wrench (4), loosen the adjustment screw until the pumping element is at the end-of-stroke;
- ❑ tighten the adjustment screw, with a dynamometric wrench, to 5 Nm tightening torque (0.5 kgm);
- ❑ untighten the adjustment screw by 1/2 to 3/4 rotation;
- ❑ tighten the locking nut.

FIRING ORDER **1-4-2-6-3-5**

Clockwise start-up and rotation	Adjusting cylinder valve no.	Adjusting clearance of cylinder valve no.	Adjusting pre-loading of cylinder injector no.
1 and 6 at TDC	6	1	5
120°	3	4	1
120°	5	2	4
120°	1	6	2
120°	4	3	6
120°	2	5	3

NOTE In order to properly carry out the above-mentioned adjustments, follow the sequence specified in the table, checking the exact position in each rotation phase by means of pin 9936612, to be inserted in the 11th hole in each of the three sectors with 18 holes each.

Figure 206



Fit the distribution cover (1).
Fit the blow-by case (7) and its gasket and then tighten the screws (8) to the prescribed torque.
Install the filter (5) and the gaskets (4 and 6).

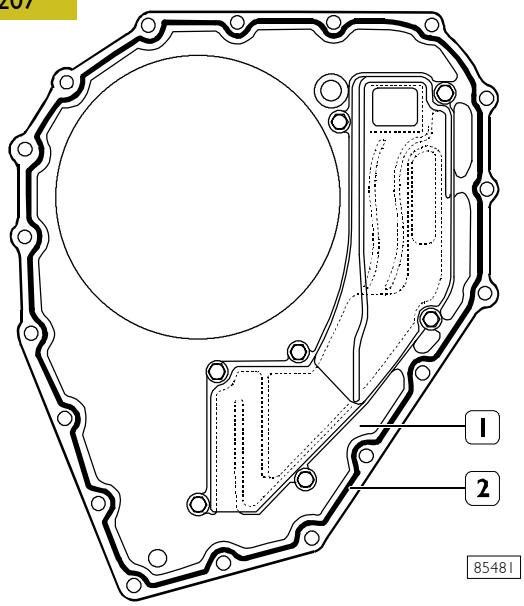
NOTE The filter (5) operation is unidirectional, therefore it must be assembled with the two sight supports as illustrated in the figure.

Accurately clean intake ducts and cover (3) drain hole.

Fit the cover (3) and tighten the fastening screws (2) to the prescribed torque.

NOTE Apply silicone LOCTITE 5970 IVECO No. 2995644 on the blow-by case (7) surface of engines fitted with P.T.O. according to the procedure described in the following figure.

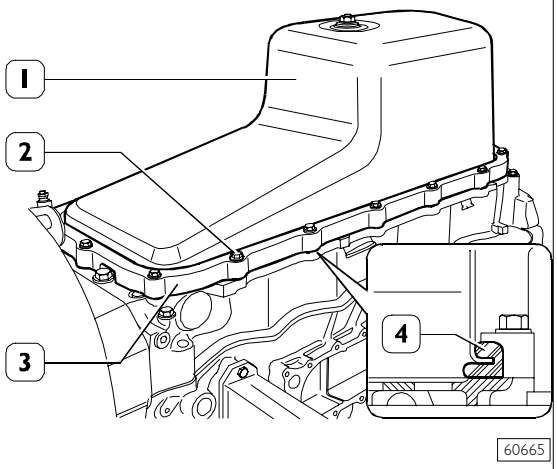
Figure 207



Apply silicone LOCTITE 5970 IVECO No. 2995644 on the blow-by case and form a string (2) of Ø 1,5 $\pm^{0.5}_{0.2}$ as shown in the figure.

NOTE Fit the blow-by case (1) within 10' from sealer application.

Figure 208



Turn engine and mount oil rose pipe.
Arrange gasket (4) on oil sump (1), position spacer (3) and mount the sump on engine block screwing up screws (2) at prescribed torque:

Completing Engine Assembly

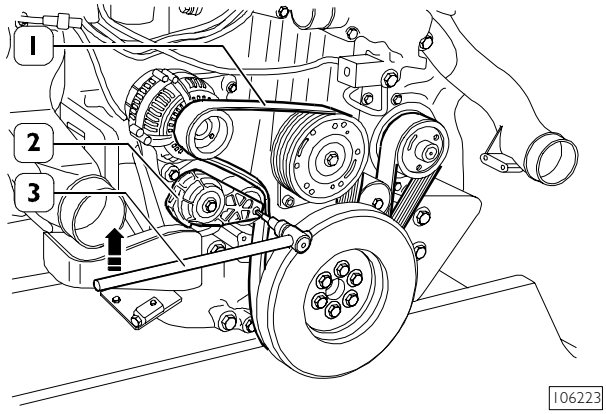
Complete the engine by fitting or hooking up the following parts:

- ❑ power take-off (P.T.O., if present) and relating pipes;
- ❑ fuel pump;
- ❑ support complete with fuel filter and pipes;
- ❑ EDC central unit;
- ❑ intake manifold;
- ❑ preheating resistance;
- ❑ heat exchanger;
- ❑ oil filters, lubricating the gasket;
- ❑ exhaust manifold;
- ❑ turbocompressor and relating water and oil pipes;
- ❑ pulley and damping flywheel;
- ❑ thermostat assembly;
- ❑ belt tensioner, water pump, alternator;
- ❑ electromagnetic joint;
- ❑ belt tensioner, if present, air-conditioner compressor;
- ❑ starter;
- ❑ oil level rod;
- ❑ electrical connections and sensors.

NOTE The fittings of the cooling water and lubricating oil pipes of the turbocharger have to be tightened to a torque of:

- ❑ 35 ±5 Nm, water pipe fittings;
- ❑ 55 ±5 Nm, oil pipe female fitting;
- ❑ 20-25 Nm, oil pipe male fitting.

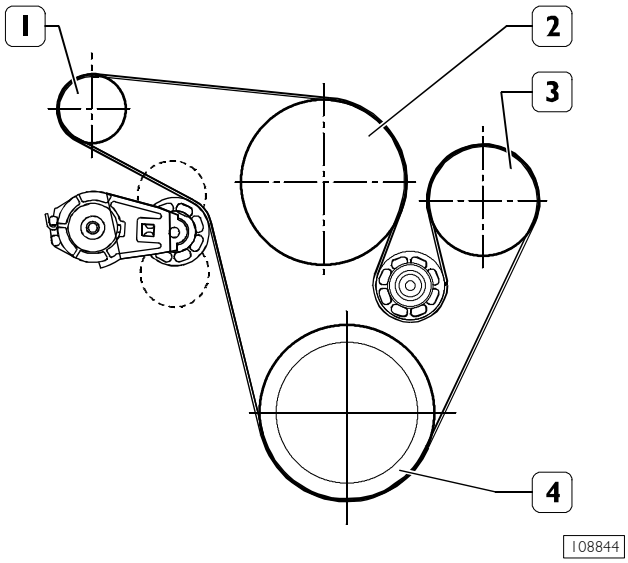
Figure 209



❑ driving belt.

To mount belt (1), belt tensioner (2) has to be operated by proper tooling (3) according to the direction indicated by the arrow in Figure.

Figure 210



ASSEMBLY DIAGRAM OF FAN – WATER PUMP – ALTERNATOR DRIVE BELT

1. Alternator – 2. Electromagnetic coupling – 3. Water pump – 4. Crankshaft

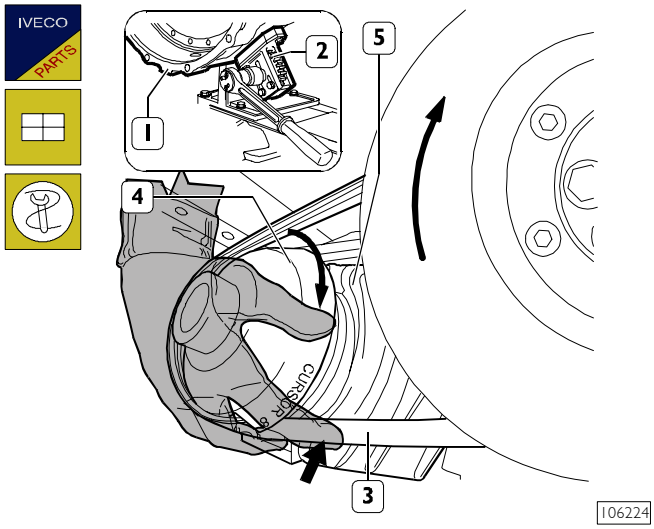
NOTE Belt tensioner is of automatic type; therefore, further adjusting is not provided after mounting.

❑ refuel engine with provided oil quantity;
❑ dismount engine from rotary stand and take off brackets (99361036) securing the engine.

Mount:

❑ oil pressure regulation valve;
❑ engine left support;
❑ air compressor complete with hydraulic guide pump;
❑ sound deadening guard;
❑ pipes.
❑ if present, climate control system compressor driving belt similarly to belt (1, Figure 209);

Figure 211



NOTE In the case of engines with climate control system compressor spring driving belt, for mounting the belt, tool 99360192 (4) must be used. Different methods may cause tensions impairing spring belt.

Apply tool 99360321 (2) provided with spacer 99360325 to gears box (1).

Mount spring belt (3) on driving shaft pulley, mount chock 99360192 (4) on compressor pulley (5) for climate control system. Position spring belt (3) in the opening of tool 99360192 marked with "cursor 10/13".

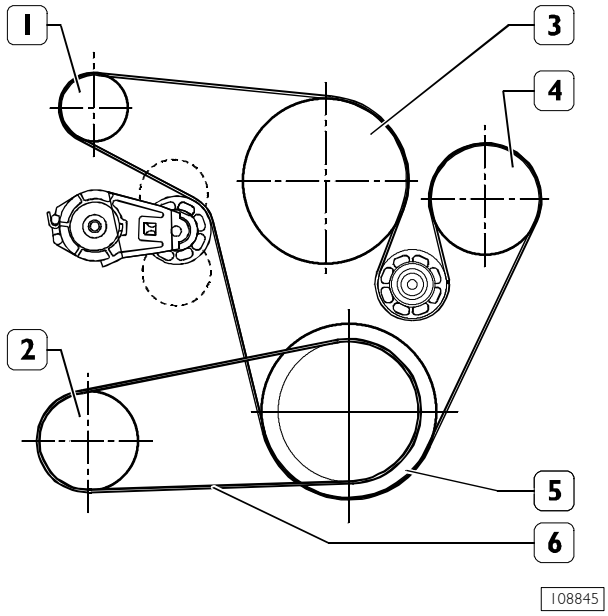
By tool 99360321 (2), rotate driving shaft according to the direction of the arrow (→) until spring belt (3) is correctly positioned on compressor pulley (5).

NOTE While operating, keep tool 99360192 (4) in contact to pulley and at the same time guide spring belt (3) in order to prevent it from twisting.

NOTE Spring belt must be replaced by a new one after every dismounting operation.

NOTE Replacing spring belt with engine on the vehicle is from engine opening after tilting the cab.

Figure 212

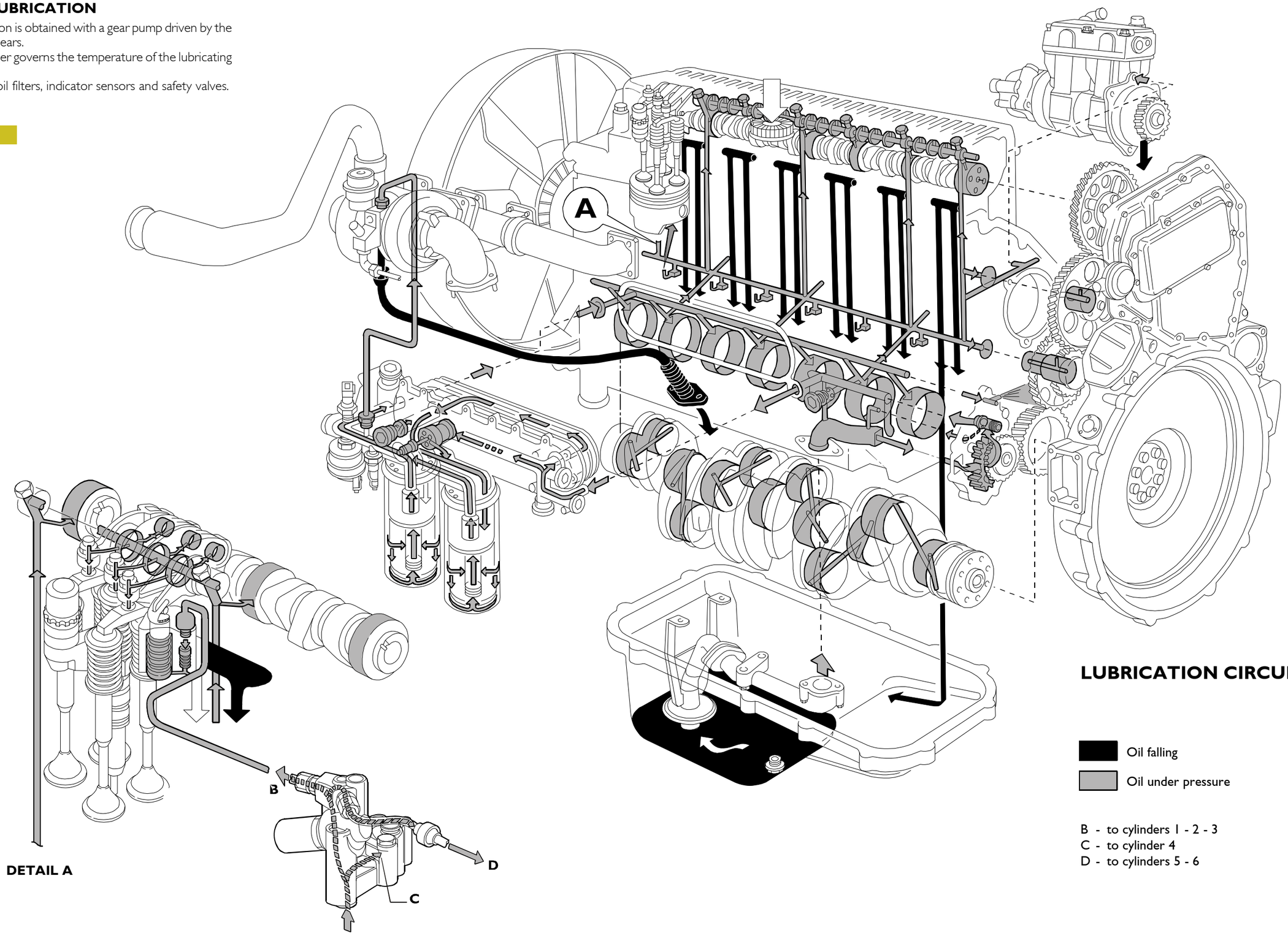


COMPRESSOR CONTROL BELT ASSEMBLY DIAGRAM
1. Alternator – 2. Climate control system compressor – 3. Electromagnetic coupling – 4. Water pump – 5. Crankshaft – 6. Spring belt.

5430 LUBRICATION

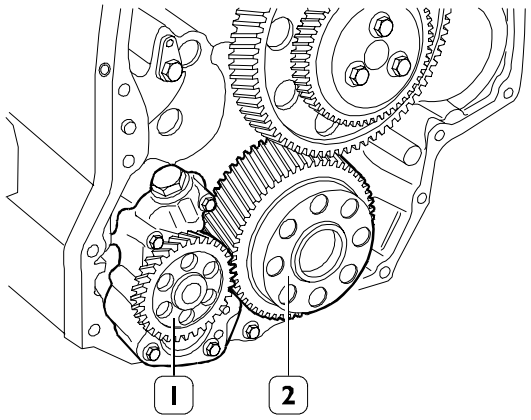
Engine lubrication is obtained with a gear pump driven by the crankshaft via gears.
A heat exchanger governs the temperature of the lubricating oil.
It houses two oil filters, indicator sensors and safety valves.

Figure 213



543010 Oil pump

Figure 214



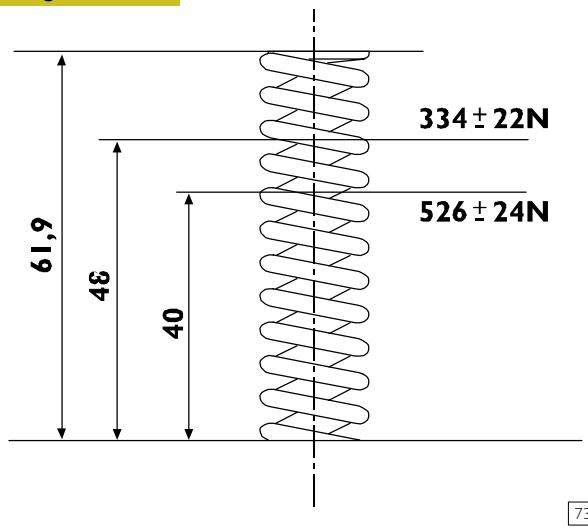
60560

The oil pump (1) cannot be overhauled. On finding any damage, replace the oil pump assembly.

See under the relevant heading for replacing the gear (2) of the crankshaft.

Overpressure valve

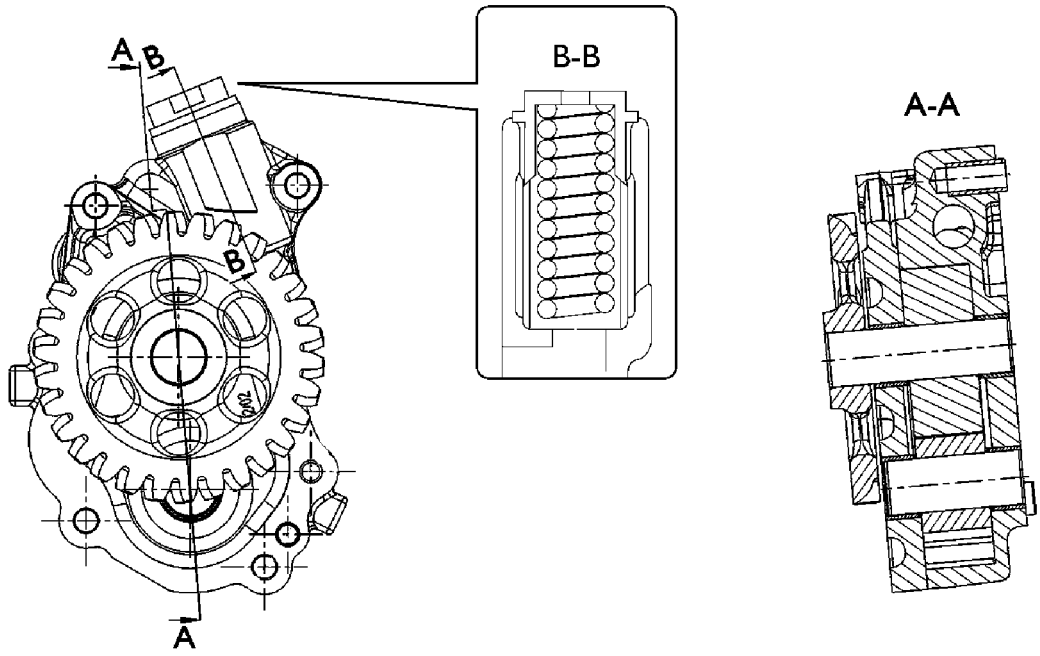
Figure 216



73540

MAIN DATA TO CHECK THE OVERPRESSURE VALVE SPRING

Figure 215

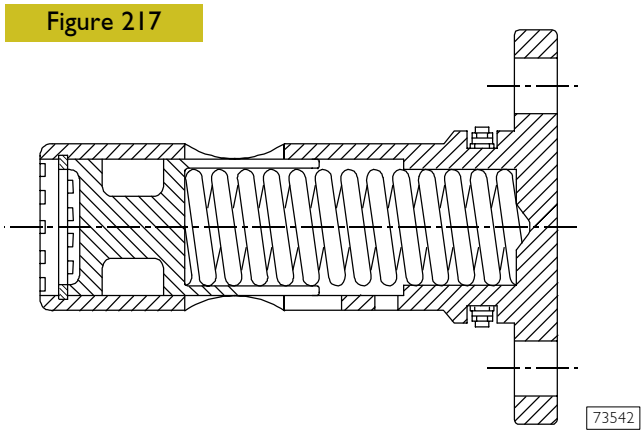


108846

OIL PUMP CROSS-SECTION
Overpressure valve – Start of opening pressure 10 ± 1 bars

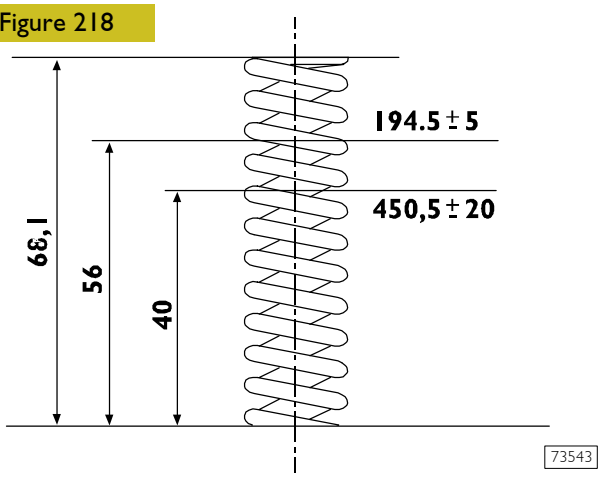
Oil pressure control valve

Figure 217



The oil pressure control valve is located on the left-hand side of the crankcase.
Start of opening pressure 5 bars.

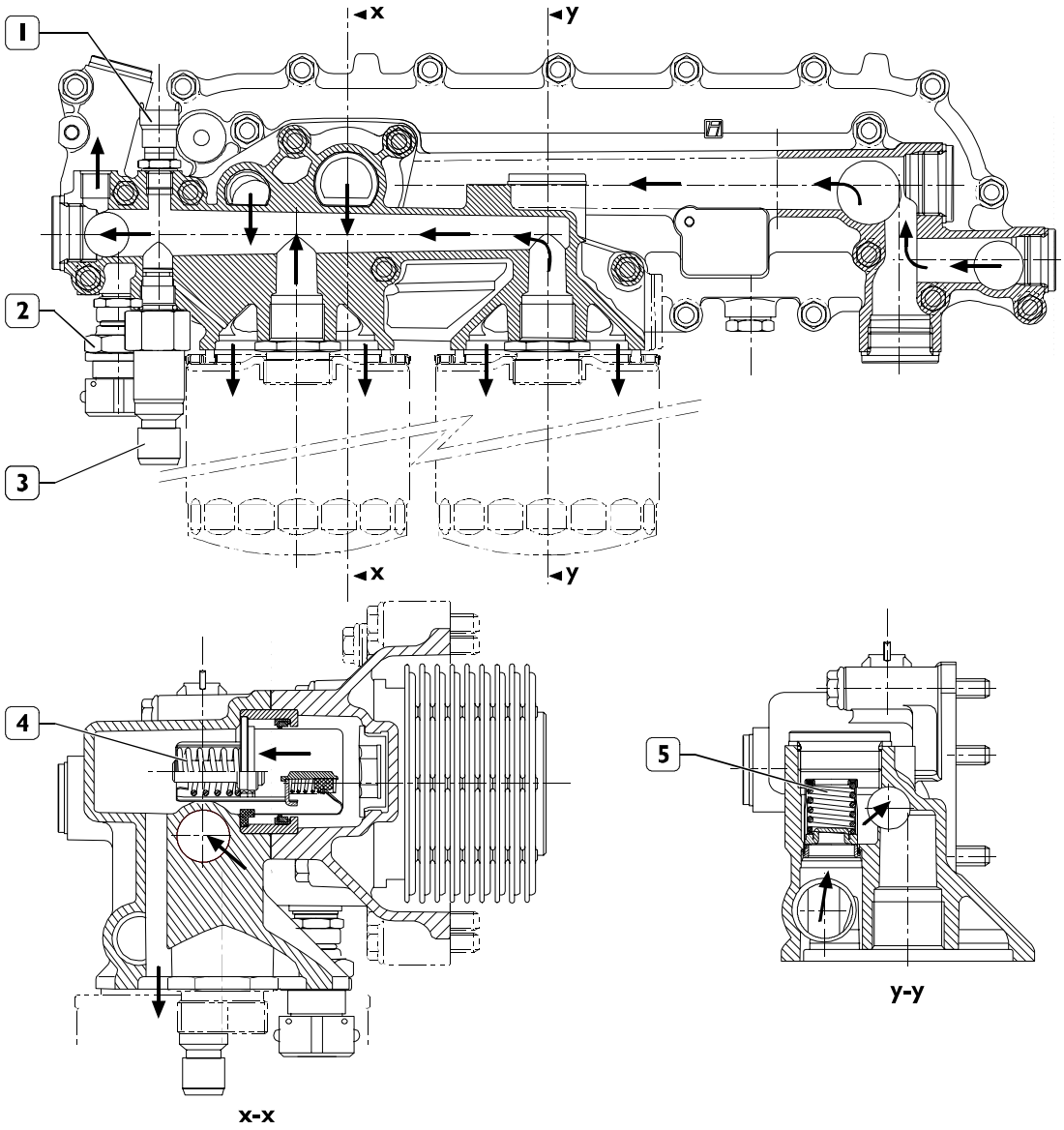
Figure 218



MAIN DATA TO CHECK THE OIL PRESSURE CONTROL VALVE SPRING

543110 Heat exchanger

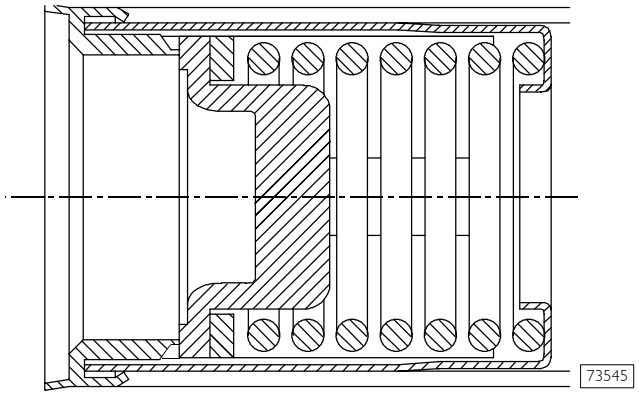
Figure 219



HEAT EXCHANGER (new drawing)
The heat exchanger is fitted with: 1. Oil temperature sensor - 2. Oil pressure sensor for pressure gauge - 3. Transmitter for low pressure warning lamp - 4. By-pass valve - 5. Heat valve. Number of elements 9

By-pass valve

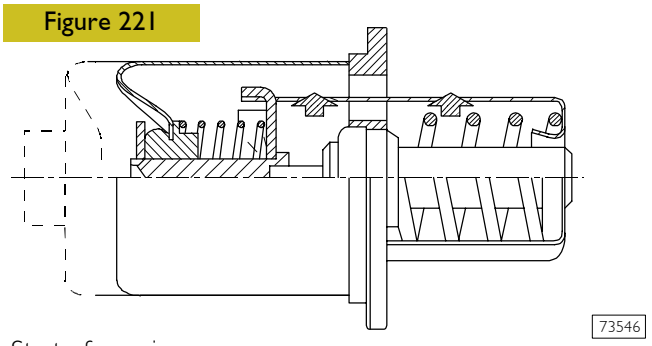
Figure 220



The valve quickly opens at a pressure of: 3 bars.

Thermostatic valve

Figure 221



Start of opening:

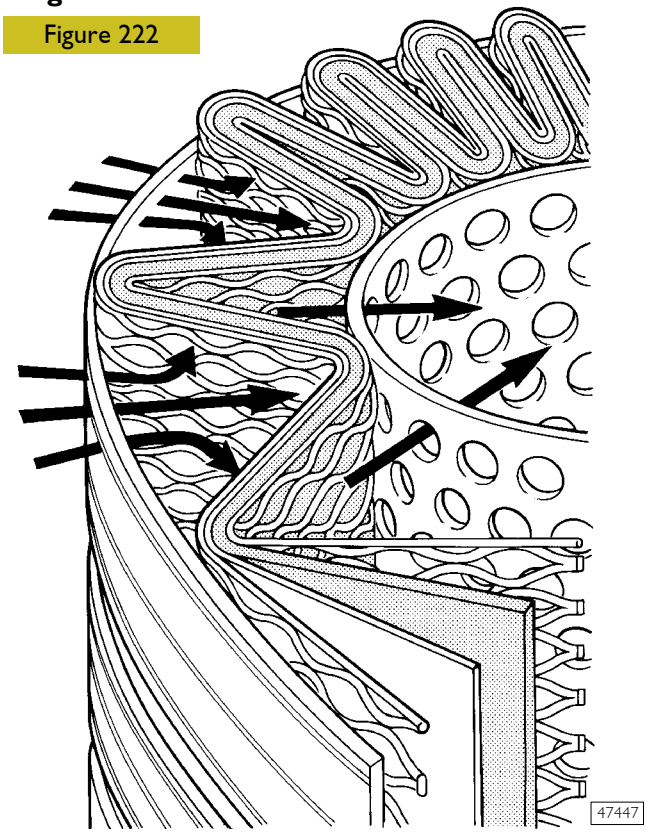
- travel 0.1 mm at a temperature of 82 ±2°C.

End of opening:

- travel 8 mm at a temperature of 97°C.

Engine oil filters

Figure 222



This is a new generation of filters that permit much more thorough filtration as they are able to holder back a greater amount of particles of smaller dimensions than those held back by conventional filters with a paper filtering element.

These high-filtration devices, to date used only in industrial processes, make it possible to:

- reduce the wear of engine components over time;
- maintain the performance/specifications of the oil and thereby lengthen the time intervals between changes.

External spiral winding

The filtering elements are closely wound by a spiral so that each fold is firmly anchored to the spiral with respect to the others. This produces a uniform use of the element even in the worst conditions such as cold starting with fluids with a high viscosity and peaks of flow. In addition, it ensures uniform distribution of the flow over the entire length of the filtering element, with consequent optimization of the loss of load and of its working life.

Mount upstream

To optimize flow distribution and the rigidity of the filtering element, this has an exclusive mount composed of a strong mesh made of nylon and an extremely strong synthetic material.

Filtering element

Composed of inert inorganic fibres bound with an exclusive resin to a structure with graded holes, the element is manufactured exclusively to precise procedures and strict quality control.

Mount downstream

A mount for the filtering element and a strong nylon mesh make it even stronger, which is especially helpful during cold starts and long periods of use. The performance of the filter remains constant and reliable throughout its working life and from one element to another, irrespective of the changes in working conditions.

Structural parts

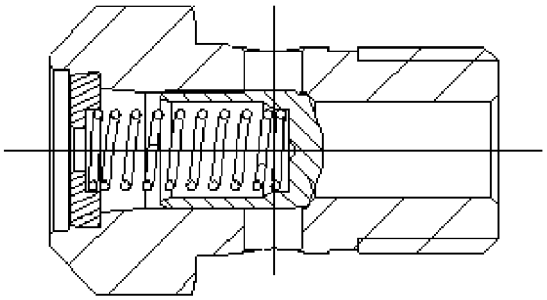
The o-rings equipping the filtering element ensure a perfect seal between it and the container, eliminating by-pass risks and keeping filter performance constant. Strong corrosion-proof bottoms and a sturdy internal metal core complete the structure of the filtering element.

When mounting the filters, keep to the following rules:

- Oil and fit new seals.
- Screw down the filters to bring the seals into contact with the supporting bases.
- Tighten the filter to a torque of 35-40 Nm.

Valve integrated in piston cooling nozzle

Figure 223



109080

The valve allows oil to enter only above the threshold pressure of 1.7 ± 0.2 bar. This permits filling the circuit and therefore lubricating the most stressed parts even when working at lower pressures.

5432 COOLING

Description

The engine cooling system works with forced circulation inside closed circuit and can be connected to an additional heater (if any) and to the intarder intercooler.
It consists mainly of the following components:

- ❑ an expansion reservoir whose plug (1) incorporates two valves – discharge and charge – controlling the system pressure.
- ❑ a coolant level sensor placed at the bottom of the expansion reservoir with two coupling points:

  right hand drive vehicles:
  - coupling point for sensor S1 6.2 ± 0.3 litres
  - coupling point for sensor S2 4.7 ± 0.3 litres

  left hand drive vehicles:
  - coupling point for sensor S1 6 litres
  - coupling point for sensor S2 3.7 litres
- ❑ an engine cooling unit to dissipate the heat taken by the coolant from the engine through the intercooler.
- ❑ a heat exchanger to cool down lubrication oil;
- ❑ a water pump with centrifugal system incorporated in the cylinder block;
- ❑ an electric fan consisting of a 2-speed electro-magnetic joint equipped with a neutral wheel shaft hub fitted with a metal plate moving along the axis and where the fan is installed. It is controlled electronically by the vehicle Multiplex system.
- ❑ a 3-way thermostat controlling the coolant circulation.

Operation

The water pump is actuated by the crankshaft through a poli-V belt and sends coolant to the cylinder block, especially to the cylinder head (bigger quantity). When the coolant temperature reaches and overcomes the operating temperature, the thermostat is opened and from here the coolant flows into the radiator and is cooled down by the fan.
The pressure inside the system depending on the temperature variation is controlled by the discharge and charge valves incorporated in the expansion reservoir filling plug (1).
The discharge valve has a double function:

- ❑ keep the system under light pressure in order to raise the coolant boiling point;
- ❑ discharge the pressure surplus in the atmosphere as a result of the coolant high temperature.

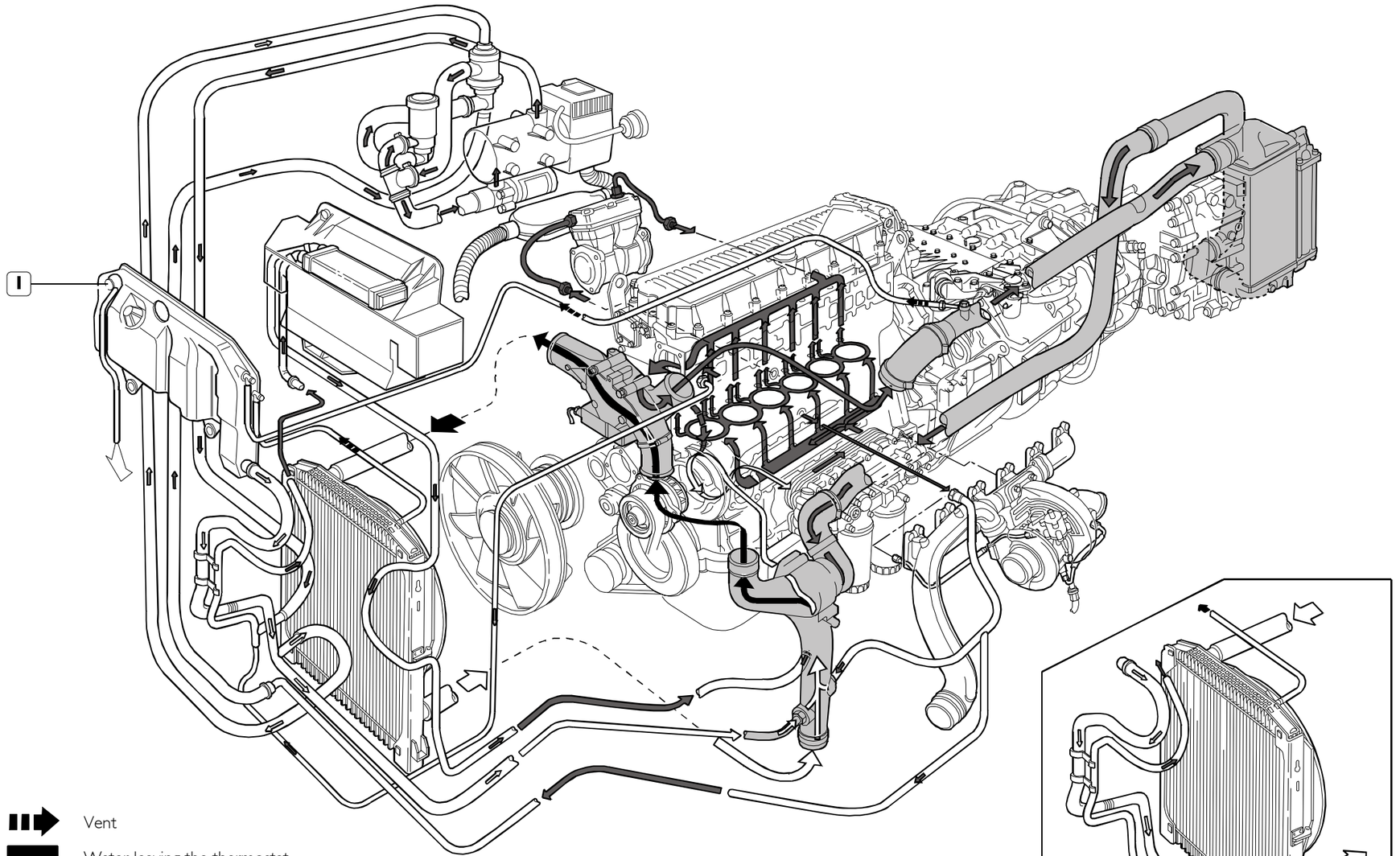
The charge valve makes it possible to transfer the coolant from the expansion reservoir to the radiator when a depression is generated inside the system as a result of the coolant volume reduction depending on the fall in the coolant temperature.
Discharge valve opening:

- 1st breather 0.9 $^{+0.2}_{-0.1}$ bar
- 2nd breather 1.2 $^{+0.2}_{-0.1}$ bar

Charge valve opening -0.03 $^{+0}_{-0.02}$ bar

Plug tightening torque (1): 8 ± 1 Nm

Figure 224



Vent

Water leaving the thermostat

Water circulating in the engine

Water entering the pump

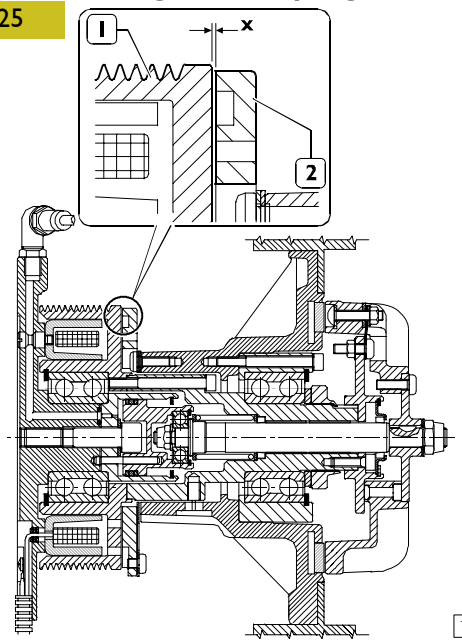
Elements specific of version with INTARDER

A Detail of system without heater

79553

543210 Electromagnetic coupling

Figure 225



ELECTROMAGNETIC COUPLING SECTION

Using a feeler gauge, check the gap between the anchor assembly (2) and the pulley (1), it must be no greater than 2.5 mm.

The electro-magnetic joint action depends on:

- ❑ the coolant temperature;
- ❑ the climate control system fluid pressure (if any);
- ❑ the slowing down action of the intarder on (if any).

Idling condition:

- ❑ water temperature is less than 93°C and both the Intarder and the air-conditioning unit (where available) are OFF;
- ❑ coolant temperature is less than 85°C and the air-conditioning system is ON (pressure inside the circuit is less than 18 bar);
- ❑ coolant temperature is less than 85°C, and the Intarder is ON, with its braking power less than 41% of its maximum power.

The first speed is actuated when:

- ❑ coolant temperature reaches 85°C, and the Intarder is ON, with its braking power greater than 41% of its maximum power;
- ❑ coolant temperature reaches 85°C and the air-conditioning system is ON (pressure inside the circuit in higher than 18 bar);

The second speed is actuated when:

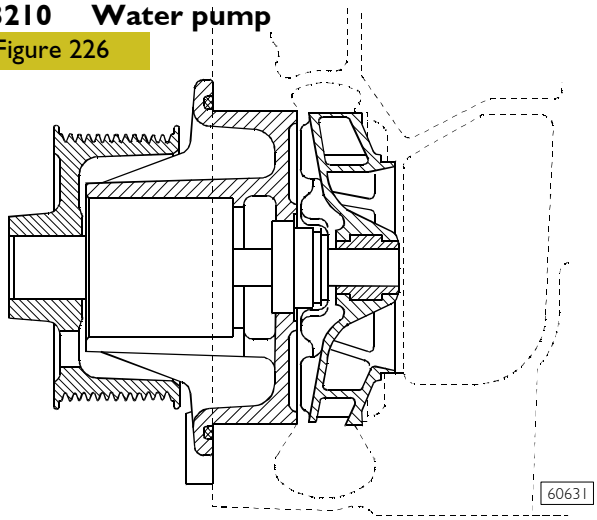
- ❑ coolant temperature reaches 93°C, and the Intarder is either OFF or ON with its braking power less than 41% (speed is deactuated when temperature falls down to 88°C);
- ❑ coolant temperature reaches 85%, the Intarder is ON (with its braking power greater than 41% of its maximum power), or the air-conditioning system is ON and the pressure inside the circuit is 22 bar.

When second speed actuation is required, the system will drive the fan for 5 seconds at the first speed and then engages the second speed. This will increase belt and fan component wear in time. When the fan first speed is actuated for more than 1 minute, the system actuates the second speed until the control parameters fall under the operation levels.

As to the description of the electro-magnetic joint operation and servicing, see the "Manual for electric/electronic system repairing" **Volume 3**.

543210 Water pump

Figure 226



CROSS-SECTION OF THE WATER PUMP

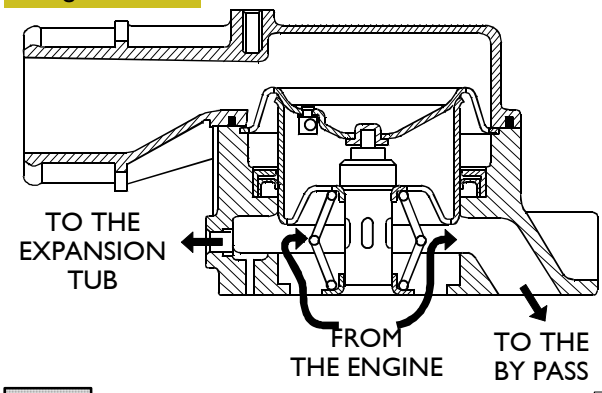
The water pump is composed of: impeller, bearing, seal and driving pulley.

NOTE Check that the pump body has no cracks or water leakage; if it does, replace the entire water pump.

543250 Thermostat

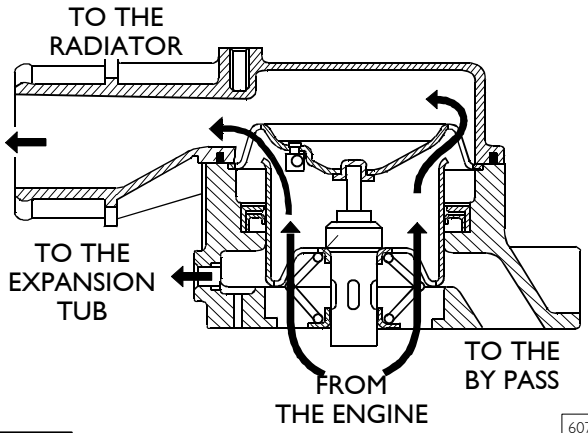
View of thermostat operation

Figure 227



Water circulating in the engine

Figure 228



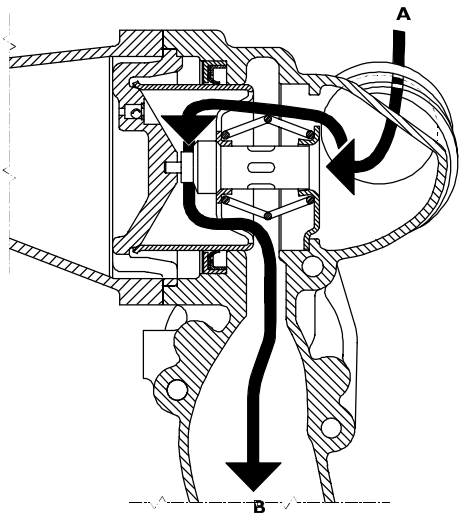
Water leaving the thermostat

Check the thermostat works properly; replace it if in doubt.

Temperature of start of travel 84°C ±2°C.
Minimum travel 15 mm at 94°C ±2°C.

View of thermostat operation for versions with Intarder

Figure 229

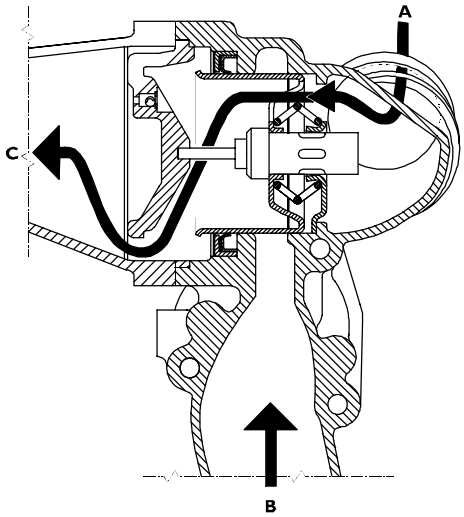


COLD OPERATION WITH CLOSED THERMOSTAT

A - Water circulating in the engine and the intarder.

B - To water pump.

Figure 230



HOT OPERATION WITH OPEN THERMOSTAT

A - Water circulating in the engine and the intarder.

B - From the radiator to the water pump.

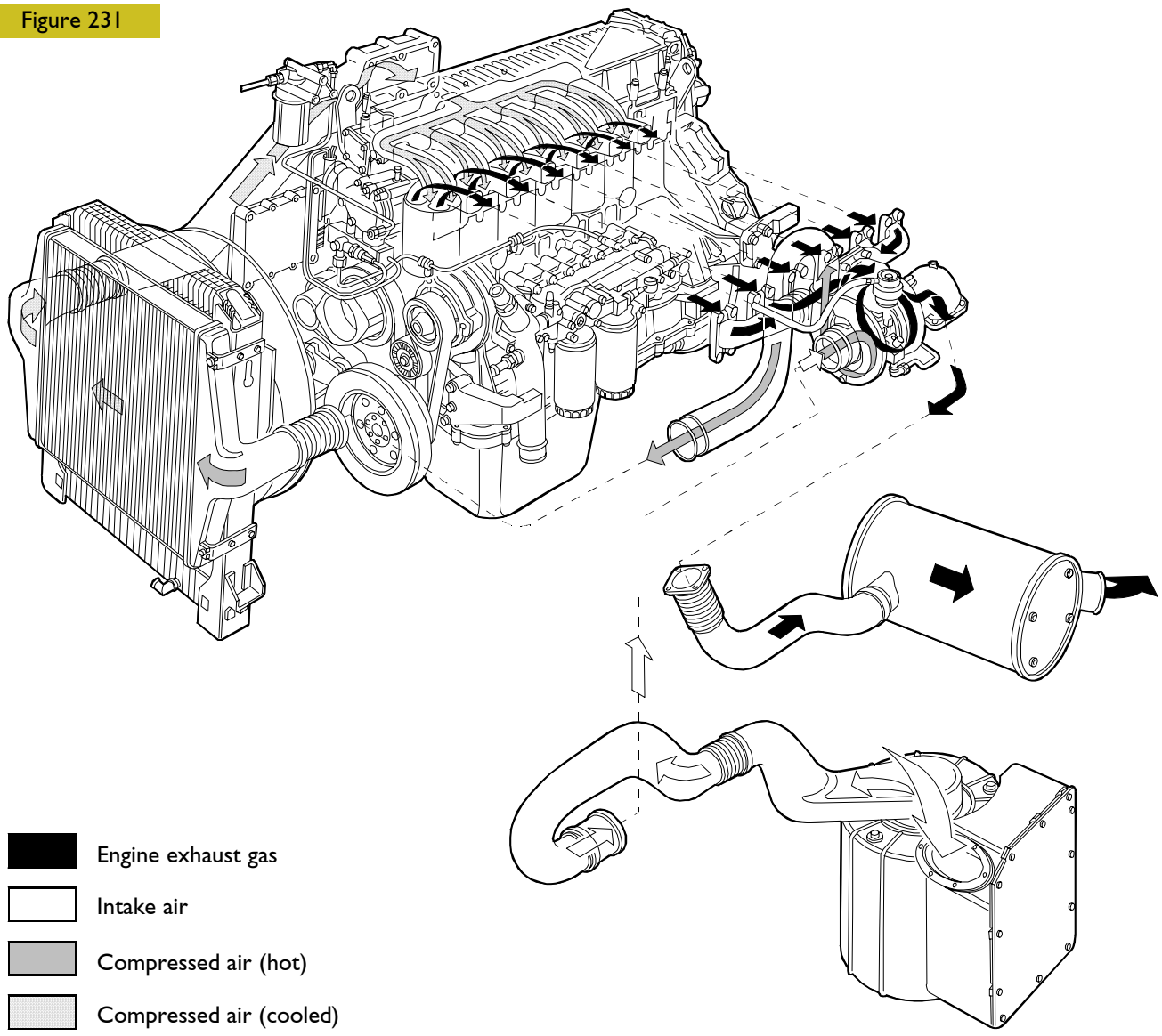
C - To radiator.

5424 TURBOCHARGING

The turbocharging system consists of:

- ❑ air filter;
- ❑ variable geometry turbocharger;
- ❑ "intercooler" radiator.

Figure 231



TURBOCHARGING DIAGRAM

Turbocharger HOLSET HE 531 V

The variable geometry turbocharger (VGT) consists of a centrifugal compressor and a turbine, equipped with a mobile device which adjusts the speed by changing the area of the passing section of exhaust gases to the turbine.

Thanks to this solution, gas velocity and turbine speed can be high even when the engine is idling.

If the gas is made to go through a narrow passage, in fact, it flows faster, so that the turbine rotates more quickly.

The movement of the device, choking the exhaust gas flowing section, is carried out by a mechanism, activated by a pneumatic actuator.

This actuator is directly controlled by the electronic control unit by a proportional solenoid valve.

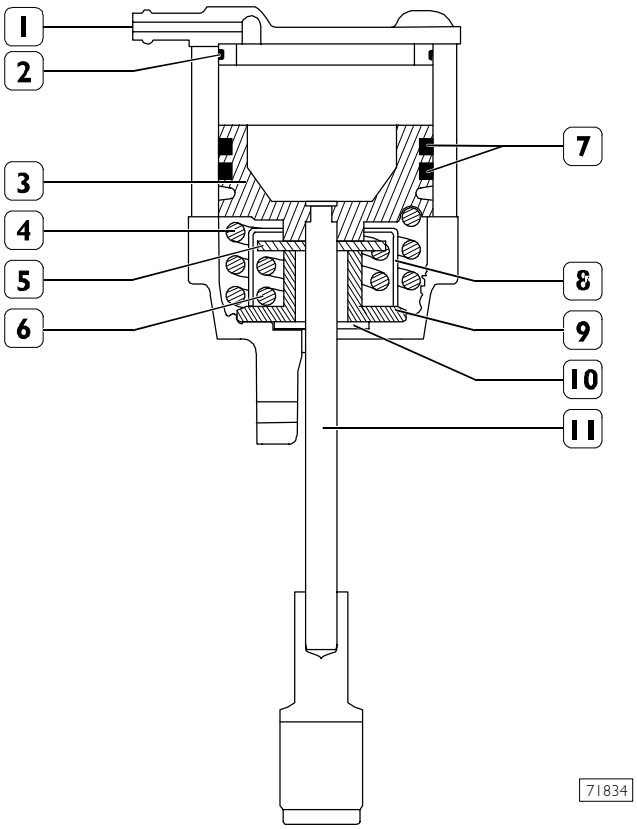
The device is in maximum closing condition at idle speed.

At high engine operating speed, the electronic control system is activated and increases the passing section, in order to allow the in-coming gases to flow without increasing their speed.

A toroidal chamber is obtained during the casting process in the central body for the passage of the coolant.

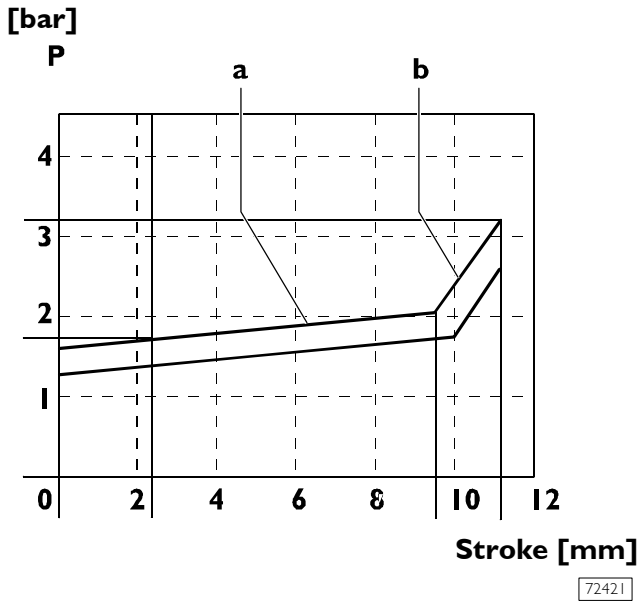
Actuator

Figure 232



1. Air inlet - 2. Gasket - 3. Piston - 4. External spring - 5. Internal spring control disc - 6. Internal spring - 7. O-ring - 8. Spring holder - 9. Limit stop - 10. Dust seal - 11. Control rod

Figure 233



a Gradient characterized by the effect of the external spring (4, Figure 232).

b Gradient characterized by the effect of the external (4, Figure 232) and internal (6, Figure 232) springs.

Working principle (See Figure 232)

The actuator piston, connected to the drive rod, is controlled with the compressed air introduced through the air inlet (1) on the top of the actuator.
Modulating the air pressure varies the movement of the piston and turbine control rod. As the piston moves, it progressively compresses the external spring (4) until the base of the piston reaches the disc (5) controlling the internal spring (6).
On further increasing the pressure, the piston, via the disc (5), interferes with the bottom limit stop (10).
Using two springs makes it possible to vary the ratio between the piston stroke and the pressure. Approximately 85% of the stroke of the rod is opposed by the external spring and 15% by the internal one.

Solenoid valve for VGT control

This N.C. proportional solenoid valve is located on the left-hand side of the crankcase under the turbine.
The electronic control unit, via a PWM signal, controls the solenoid valve, governing the supply pressure of the turbine actuator, which, on changing its position, modifies the cross-section of the flow of exhaust gases onto the blades of the impeller and therefore its speed.
The VGT solenoid valve is connected to the electronic control unit between pins C1 / C3.
The resistance of the coil is approx. 20-30 Ohms.

REPAIRING ACTIONS

NOTE If anomalous engine operation is found, which is due to the boosting system, it is advisable that you check the efficiency of seal gaskets and the fastening of connecting sleeves prior to carrying out the checks on the turboblower.
Also check for obstructions in the sucking sleeves, air filter.
If the turbocharger damage is due to a lack of lubrication, check that the oil circulation pipes are not damaged.
If so, change them or eliminate the cause.

After carrying out the above mentioned checks, check the turbocharger operation with an Engine Test by using IVECO diagnosis equipment (Modus - IT 2000 - E.A.SY.) according to the relevant procedure.

NOTE The test must be performed in following conditions:

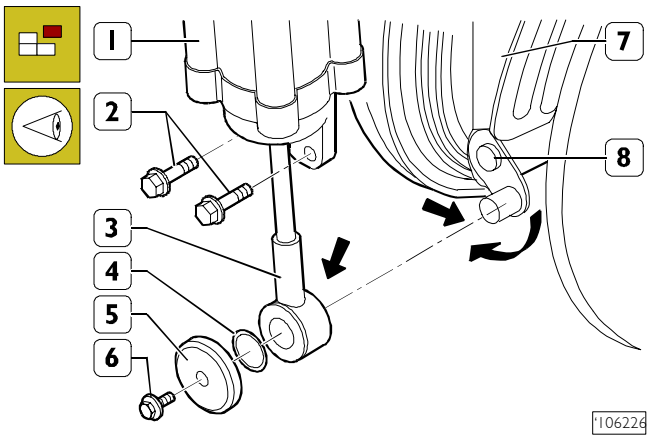
- engine coolant temperature >50 °C;
- battery up (voltage >22V) for compression test;
- efficient recharging system.

If values beyond tolerance are detected, check the efficiency of:

- shut-off valve;
- pressure sensor;
- engine cable pressure sensor connection (if oxidised, clean with a specific product);
- lack of electrical defects in solenoid valve VGT (continuity connection);
- actuator moved by active diagnosis as described in relating chapter, in case of locking, grease bushing with lubricant Kernite (for high temperatures); if the trouble persists, replace the actuator;
- sliding sleeve: it must slide freely when operated manually. If locked and if the bush check is not sufficient or effective, or no faults are detected in the other points, upon authorization of the "Help Desk" market operator, change the turbocharger according to the standard procedures.

Variable geometry movement control

Figure 234



Remove screws (2) and take actuator (1) off turbocompressor (7).
Remove screw (6), underlying disk (5), ring (4) and disconnect tie rod (3) of actuator (1) from the pin of variable geometry driving lever (8).
Accurately clean pin (→) of lever (8) and bushing (→) of tie rod (3) using a cloth made of non abrasive micro fibre.

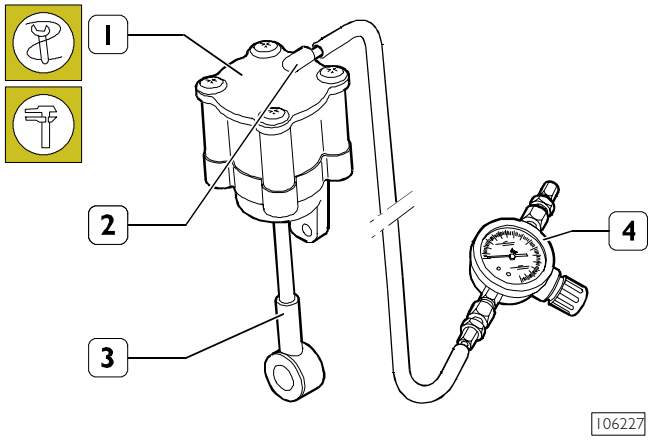
NOTE Do not use abrasive paper of any kind.

Visually check the conditions of bushing (→) of tie rod (3) and pin (→) of lever (8); where they are found to be worn out, replace actuator (1) or turbocompressor (7).

Check variable geometry inner driving mechanism movement by operating on lever (8); jamming must not occur; otherwise, clean turbine body, as described in relating chapter.

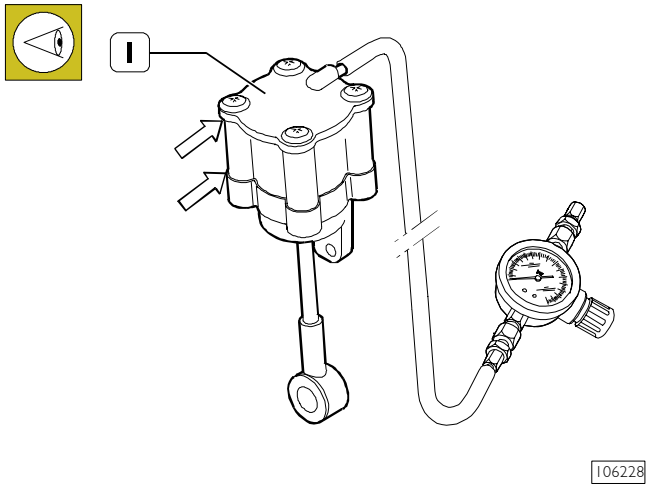
Checking the actuator

Figure 235



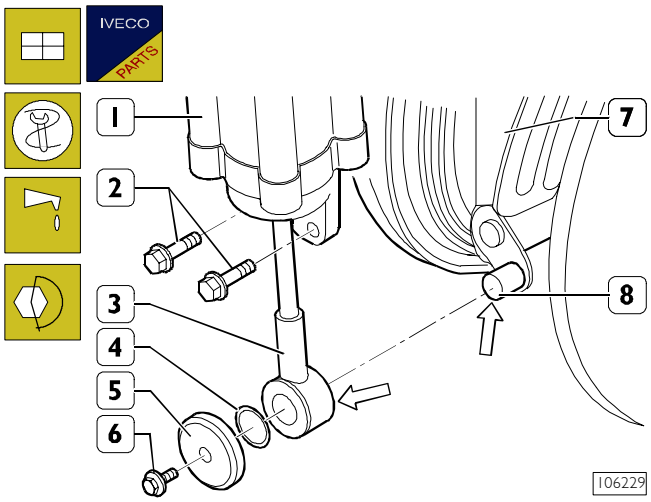
Check actuator efficiency (1) operating as follows.
Apply, to fitting (2) of actuator (1), compressed air feed piping provided with pressure regulator (4). By using the pressure regulator, introduce, into the actuator, compressed air slowly modulating it, from 0÷3.5 bar; tie rod (3) of actuator (1) must move without jamming; otherwise, replace actuator (1).

Figure 236



Check for any actuator leaks at indicated points (→) applying, on these points, a solution of suds.
When actuator (1) is fed with compressed air, no bubbles must be found at indicated points (→); otherwise, replace actuator (1).

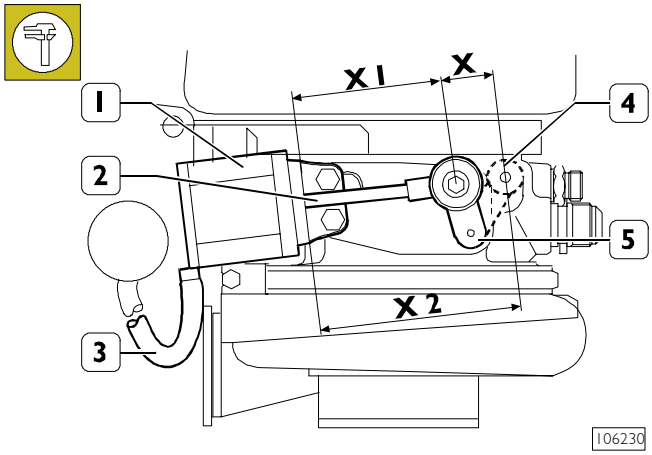
Figure 237



Lubricate bushing (→) of tie rod (3) and pin (→) of lever (8) with lithium-based Castrol LM GREASE type and reconnect actuator (1) to turbocompressor (7) operating as follows.
Connect tie rod (3) to lever (8).
Mount new ring (4), mount disk (5) and screw up screw (6).
Screw up screws (2) securing actuator (1) to turbocompressor (7).
Tighten screws (2 and 6) at 25 Nm torque.

Checking actuator travel

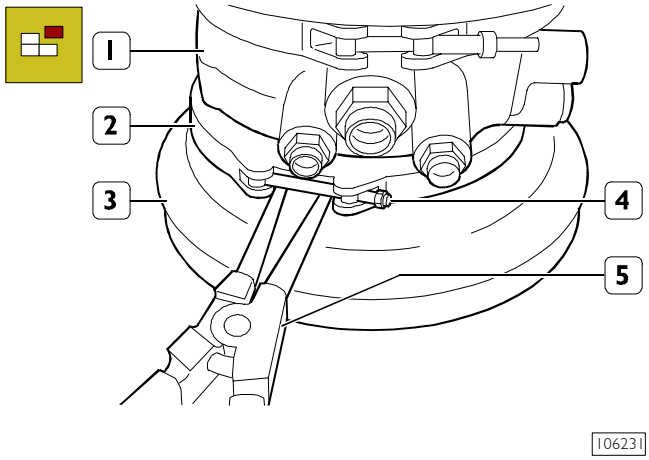
Figure 238



Check travel **X** of tie rod (2) of actuator (1) operating as follows.
Measure distance **X1** between actuator (1) and cross-axis of eyelet (4).
Apply, to fitting of actuator (1), piping (3) for compressed air feed provided with pressure regulator. By using the pressure regulator, introduce, into actuator (1) compressed air slowly modulating it, from 0÷3,5 bar, until lever (5) is taken to its end of travel.
Measure again the distance between actuator (1) and cross-axis of eyelet (4) dimension **X2**.
Travel **X** of tie rod (2) of actuator (1) is given by following subtraction **X = X2-X1** and must result to be equal to 11.5±0.5 mm.

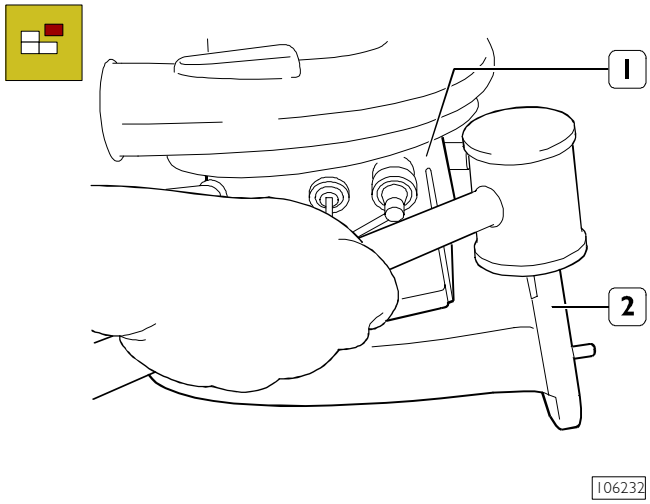
Cleaning turbine body

Figure 239



Mark mounting position of clamp (2) on central body (1).
On threading and nut (4), apply antioxidant spray lubricant and, operating on nut (4), loosen clamp (2).
Slightly rotate clamp (2) using pliers (5).
Mark mounting position of turbine body (3) on central body (1).

Figure 240

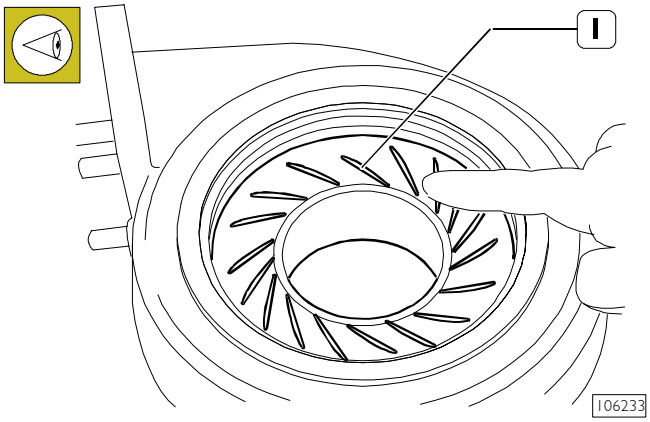


By a copper hammer, beat on two opposite points (~180°) on turbine body (2) to separate turbine body from central body (1).

NOTE In operation, take particular care to avoid damaging turbine rotor.

After dismounting turbine body, check variable geometry movement as described in relating chapter; where improvement in movement is not found with respect to previous check, replace turbocompressor.

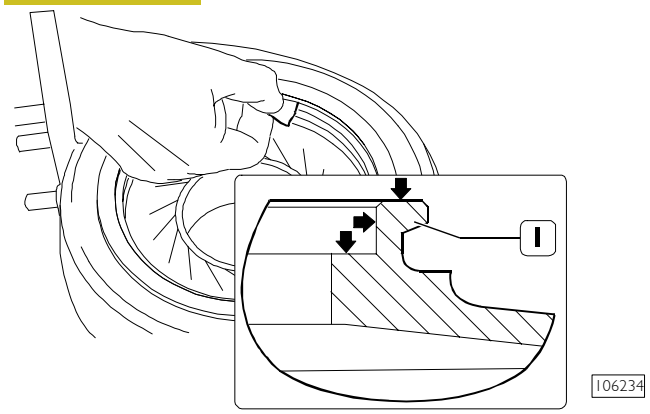
Figure 241



Accurately clean slot ring (1) and area around turbine body from carbonaceous deposits and check that the ring moves freely, otherwise, replace turbocompressor.

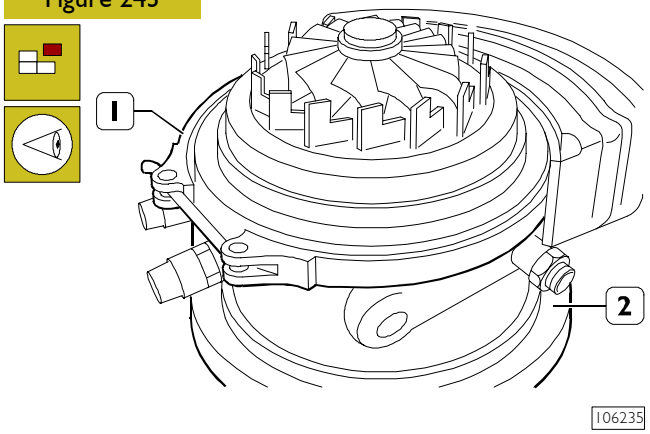
NOTE Any small cracks between slots and ring can be accepted, because they do not impair turbocompressor operation conditions.

Figure 242



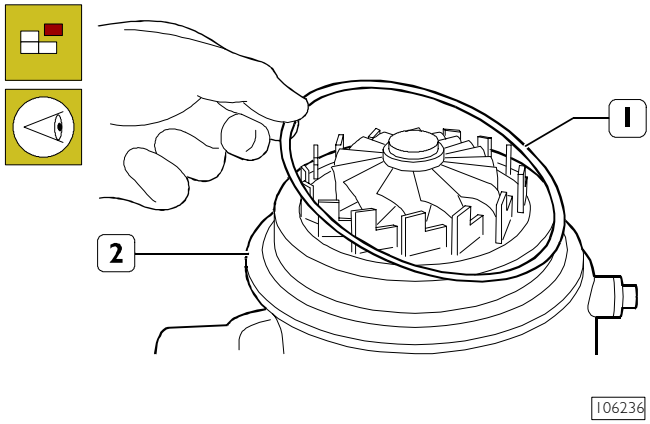
By suitable scraper and abrasive paper, accurately clean surfaces (→) of turbine body (1) from carbonaceous deposits, taking care to avoid damaging the surfaces.

Figure 243



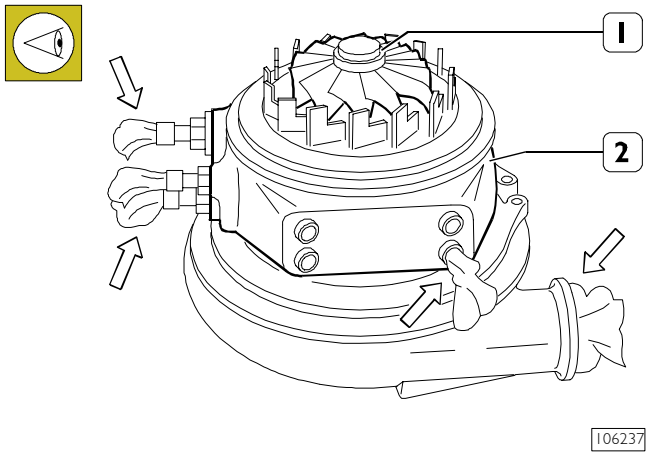
Dismount clamp (1) from central body (2) and check that the clamp does not result to be damaged; otherwise replace the clamp.

Figure 244



Dismount seal ring (1), external with respect to central body (2).
Accurately clean seal ring (1) and check that the ring does not result to be damaged; otherwise replace the ring.

Figure 245

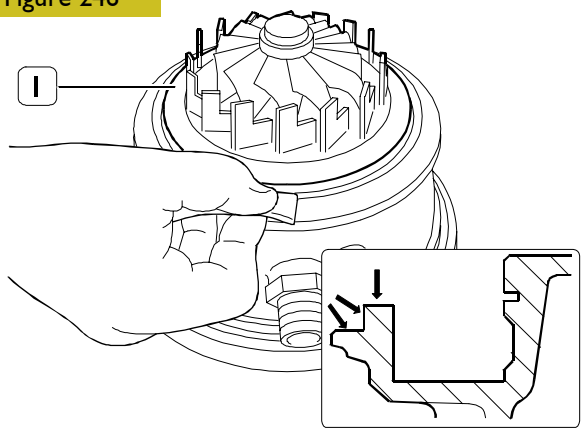


Check turbine rotor (1); there must not be found: carbonaceous deposits, deformation, cracks, blade scoring; also, turbine must turn freely.
By comparator, check clearance of turbine rotor stem (1); clearance must result to be:
- axial clearance: 0.025÷0.127 mm
- radial clearance: 0.381÷0.533 mm.

Where either clearance values over above ones or any one of above mentioned faults are found, replace turbocompressor.

NOTE Before cleaning turbine side central body, properly protect oil, water and air inlets and outlets (→) in order to prevent dirt or foreign bodies from entering turbocompressor.

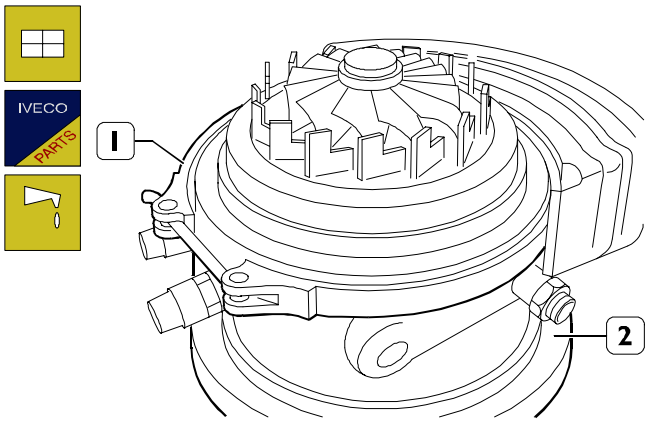
Figure 246



106238

By suitable scraper and abrasive paper, accurately clean surfaces (→) of central body (1) from carbonaceous deposits, taking care to avoid damaging the surfaces and variable geometry ring.
Then, with compressed air, clean variable geometry surfaces and ring from removed residues.
Check again, as described in relating chapters:
- variable geometry movement;
- actuator;
- actuator travel.

Figure 247



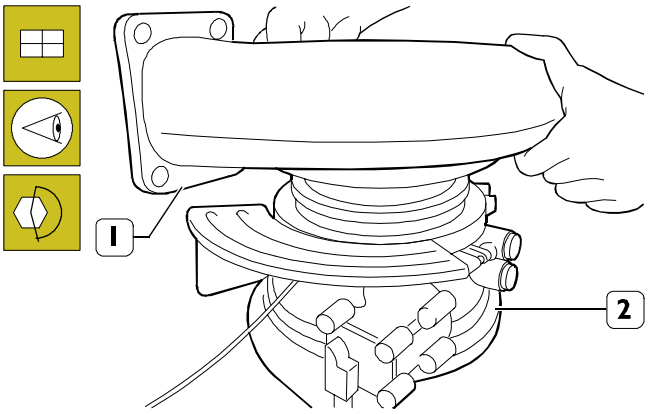
106235

Position clamp (1) on central body (2)

NOTE Should clamp (1) be replaced with an integrated heat guard, a new actuator has to be mounted with an integrated heat guard at the place of existing one.

Position accurately cleaned seal ring on central body.
Apply a thin layer of antiscuff paste on cleaned matching surfaces: central body / turbine body.

Figure 248



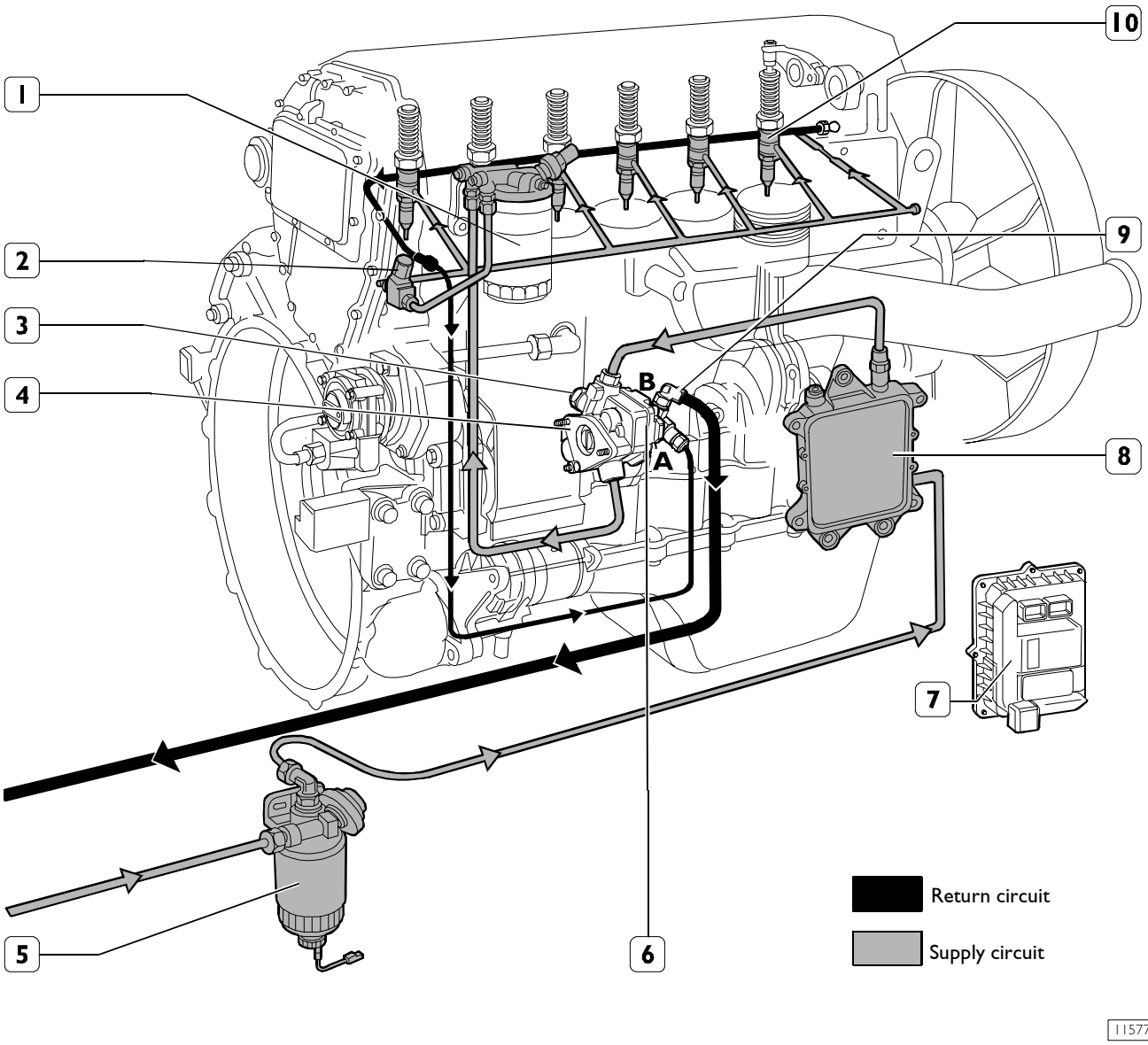
106240

Mount turbine body (1) on central body (2) taking care to avoid damaging turbine rotor and align turbine body variable geometry slot ring. Do not force mounting operation: in case of jamming, it might damage variable geometry with consequent regulation system faulty operation.
Once mounting has been completed, make sure that turbine body results to be matched correctly on central body.
Position turbine body on central body and clamp on central body in such a way that marks, made on dismounting, are matching.
Tighten nut clamping the clamp at 11.3 Nm torque.
Check again, as described in relating chapters:
- actuator;
- actuator travel.

FEEDING

Fuel is supplied via a fuel pump, filter and pre-filter, 6 pump-injectors governed by the camshaft via rocker arms and by the electronic control unit.

Figure 249



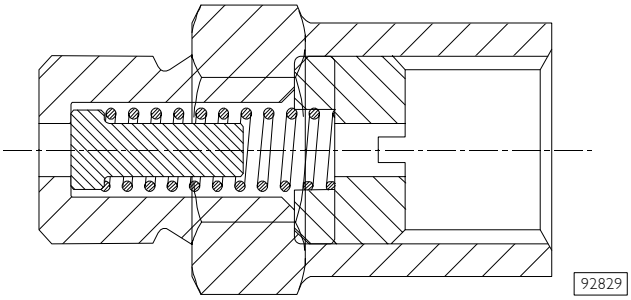
ENGINE FEED SCHEME

1. Fuel filter - 2. Pressure damping device - 3. Pressure control valve (start of opening at 5 bar) - 4. Feed pump - 5. Fuel pre-filter with priming pump - 6. Valve, to recirculate fuel from injectors, integrated in feed pump (start of opening at 3.5 bar) 7. Central unit - 8. Heat exchanger - 9. Overpressure valve to return fuel to tank (start of opening at 0.2 bar) - 10. Pump injectors

A. Fuel arriving at injectors - B. Fuel returning to tank

Overpressure valve

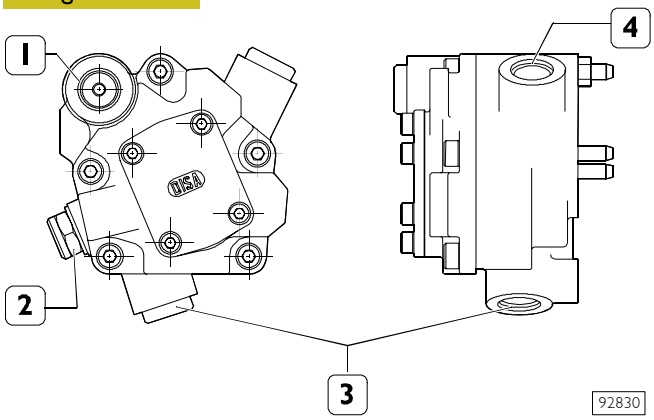
Figure 250



An overpressure valve is a single-acting valve, calibrated to 0.2 ÷ 0.3 bar, placed on the piping that returns fuel to tank. The overpressure valve prevents fuel duct in cylinder head from emptying with engine stopped.

Feed pump

Figure 251



Engine feed pump for vehicles 4x2 - 4x4 - 6x4
1. Overpressure valve - 2. Delivering fuel to injectors - 3. Sucking in fuel - 4. Pressure control valve

Pump performances					
Pump rotation speed (rpm)		2600	600	170	100
Minimum flow rate (l/h)		310	45	12	
Test conditions	Negative pressure on aspiration (bar)	0.5	0.3	0.3	0.3
	Pressure on delivery (bar)	5	3	0,3	0.3
	Test liquid temperature (°C)	30	30	30	30
	Test liquid	ISO 4113			

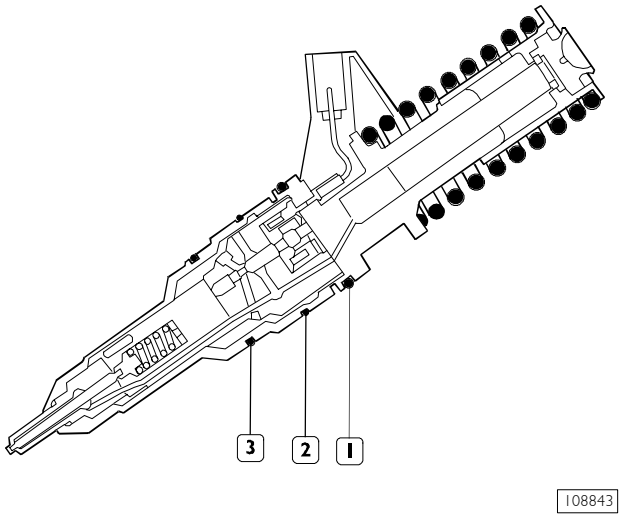
Field of use	
Pump rotation speed (rpm)	2600
Overrunning rotation speed (max 5 min) (rpm)	4100 max
Diesel oil temperature (°C)	-25/+80
Filtering rate on aspiration (micron)	30
Negative pressure on aspiration (bar)	0.5 max

Pressure control valve	
Valve calibration	5 ÷ 5.8

Injectors return valve	
Valve calibration	3.4 ÷ 3.8

Injector-pump

Figure 252



1. Fuel/oil seal – 2. Fuel/diesel seal – 3. Fuel/exhaust gas seal

The injector-pump is composed of: pumping element, nozzle, solenoid valve.

Pumping element

The pumping element is operated by a rocker arm governed directly by the cam of the camshaft.

The pumping element is able to ensure a high delivery pressure. The return stroke is made by means of a return spring.

Nozzle

Garages are authorized to perform fault diagnosis solely on the entire injection system and may not work inside the injector-pump, which must only be replaced.

A specific fault-diagnosis program, included in the control unit, is able to check the operation of each injector (it deactivates one at a time and checks the delivery of the other five).

Fault diagnosis makes it possible to distinguish errors of an electrical origin from ones of a mechanical/hydraulic origin.

It indicates broken pump-injectors.

It is therefore necessary to interpret all the control unit error messages correctly.

Any defects in the injectors are to be resolved by replacing them.

Solenoid valve

The solenoid, which is energized at each active phase of the cycle, via a signal from the control unit, controls a slide valve that shuts off the pumping element delivery pipe.

When the solenoid is not energized, the valve is open, the fuel is pumped but it flows back into the return pipe with the normal transfer pressure of approximately 5 bars.

When the solenoid is energized, the valve shuts and the fuel, not being able to flow back into the return pipe, is pumped into the nozzle at high pressure, causing the needle to lift.

The amount of fuel injected depends on the length of time the slide valve is closed and therefore on the time for which the solenoid is energized.

The solenoid valve is joined to the injector body and cannot be removed.

On the top there are two screws securing the electrical wiring from the control unit.

To ensure signal transmission, tighten the screws with a torque wrench to a torque of 1.36 – 1.92 Nm (0.136 – 0.192 kgm).

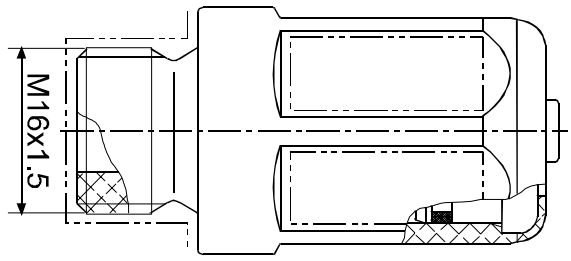
775010 Replacing injectors-pump

Injectors have to be replaced with great care (for their removal see the description on pages 51 and 52, for fitting them see the description on pages 95 and 96).

NOTE If this job is done with the engine on the vehicle, before removing the injectors-pump drain off the fuel contained in the pipes in the cylinder head by unscrewing the delivery and return fittings on the cylinder head.

Pressure damper

Figure 253



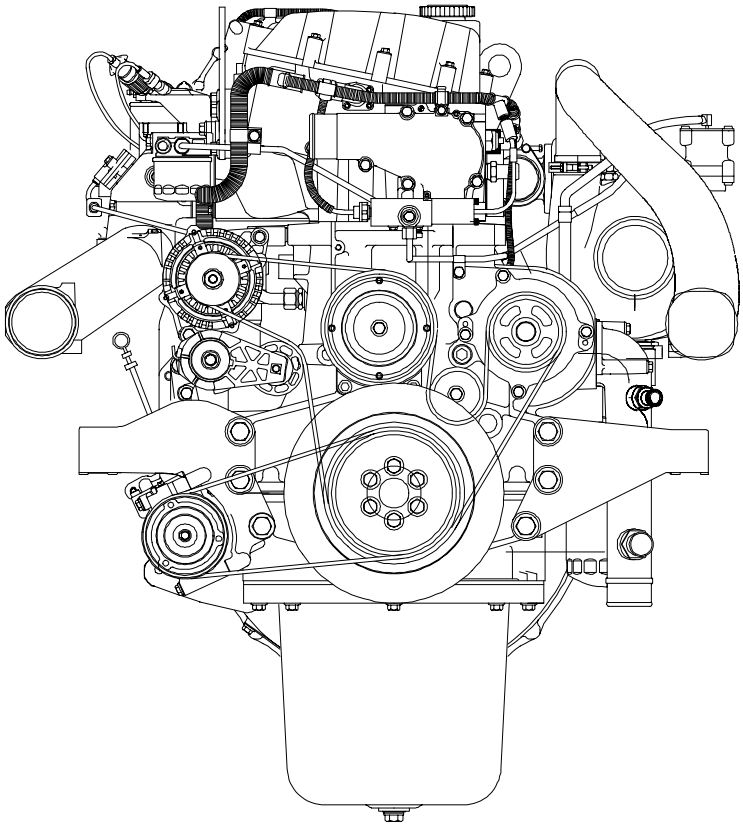
FUEL PRESSURE DAMPER

The function of the fuel pressure damper located on the delivery piping between fuel filter and cylinders head is to dampen the return counter pressures on the delivery piping and on the filter caused by the increase in the injection pressure.

F3B Engine

VIEWS OF THE ENGINE

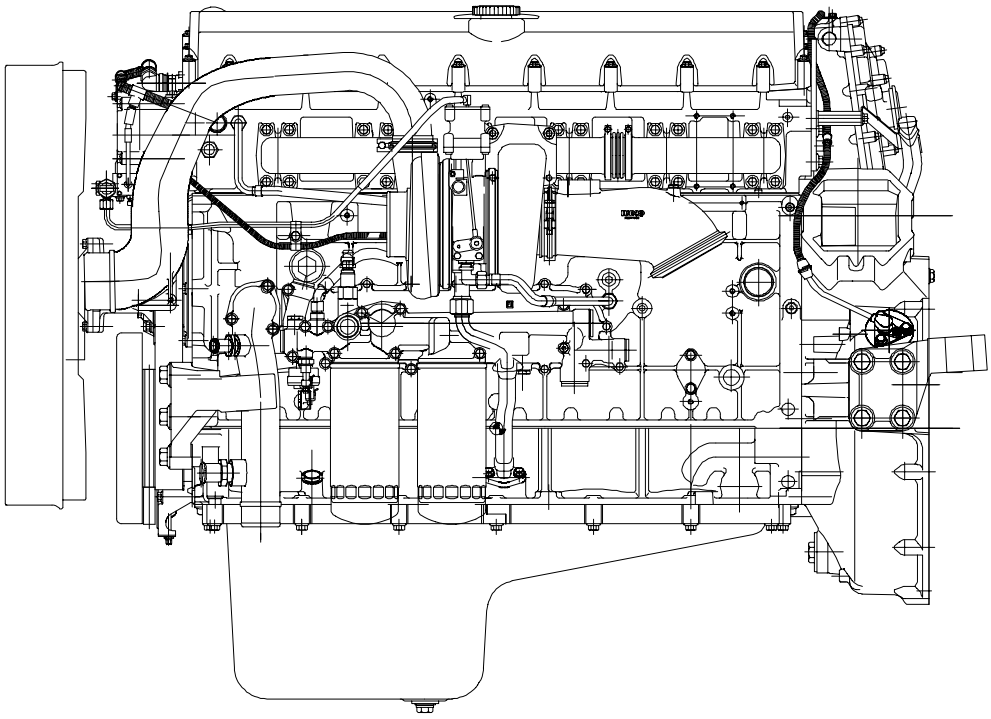
Figure 1



106682

FRONT VIEW OF ENGINE

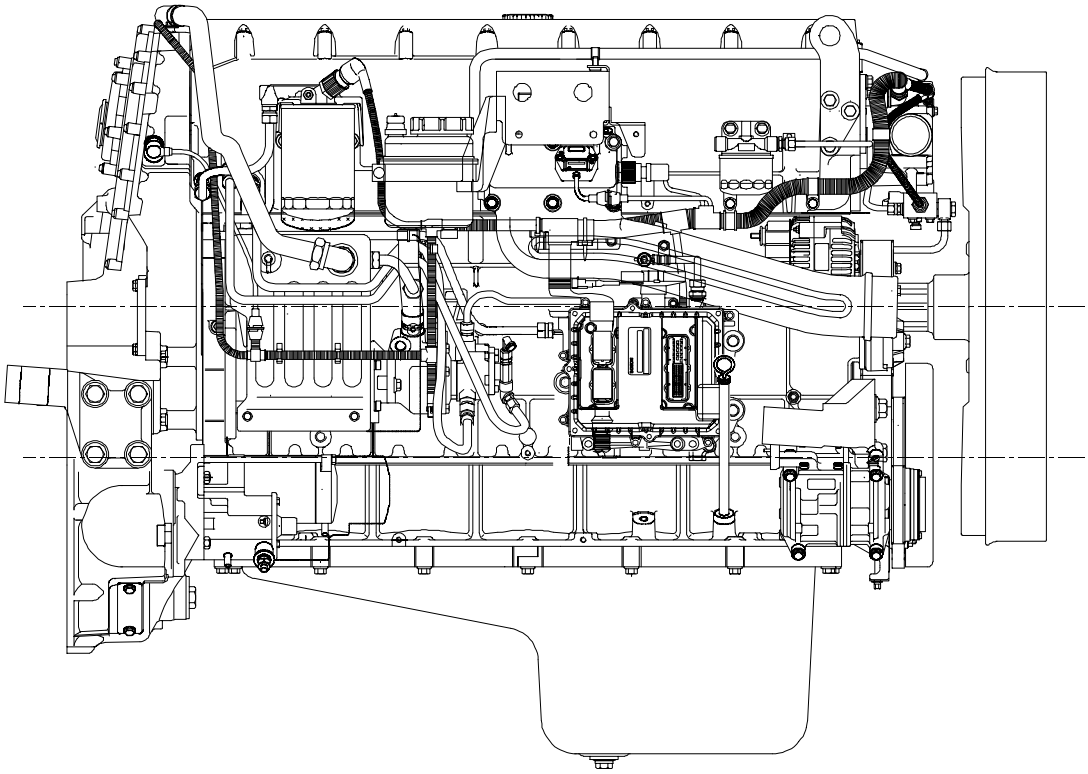
Figure 2



71695

LEFT SIDE VIEW OF ENGINE

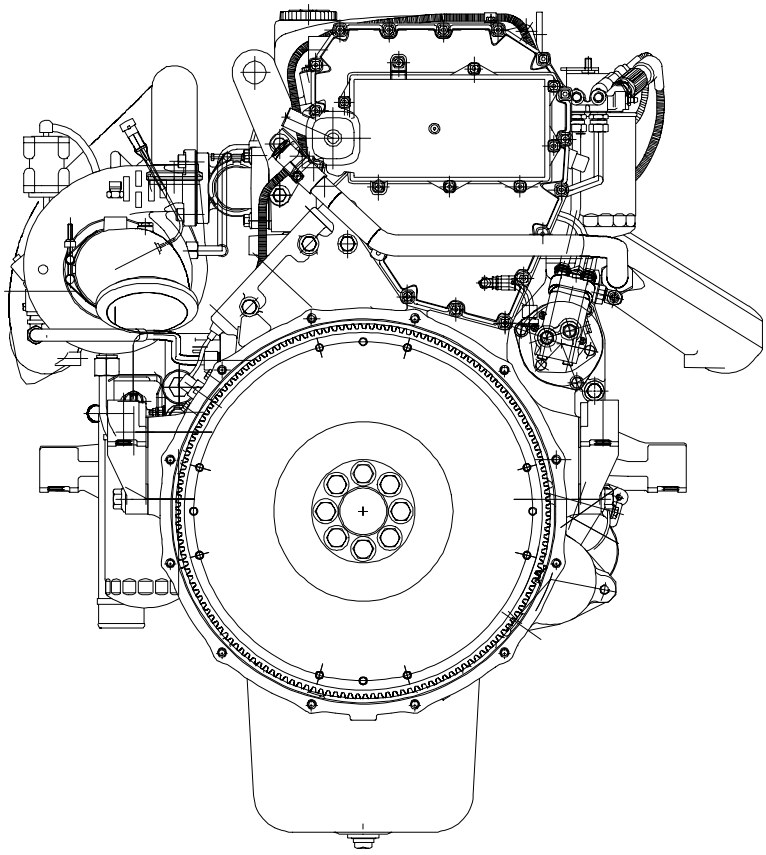
Figure 3



112172

RIGHT SIDE VIEW OF ENGINE

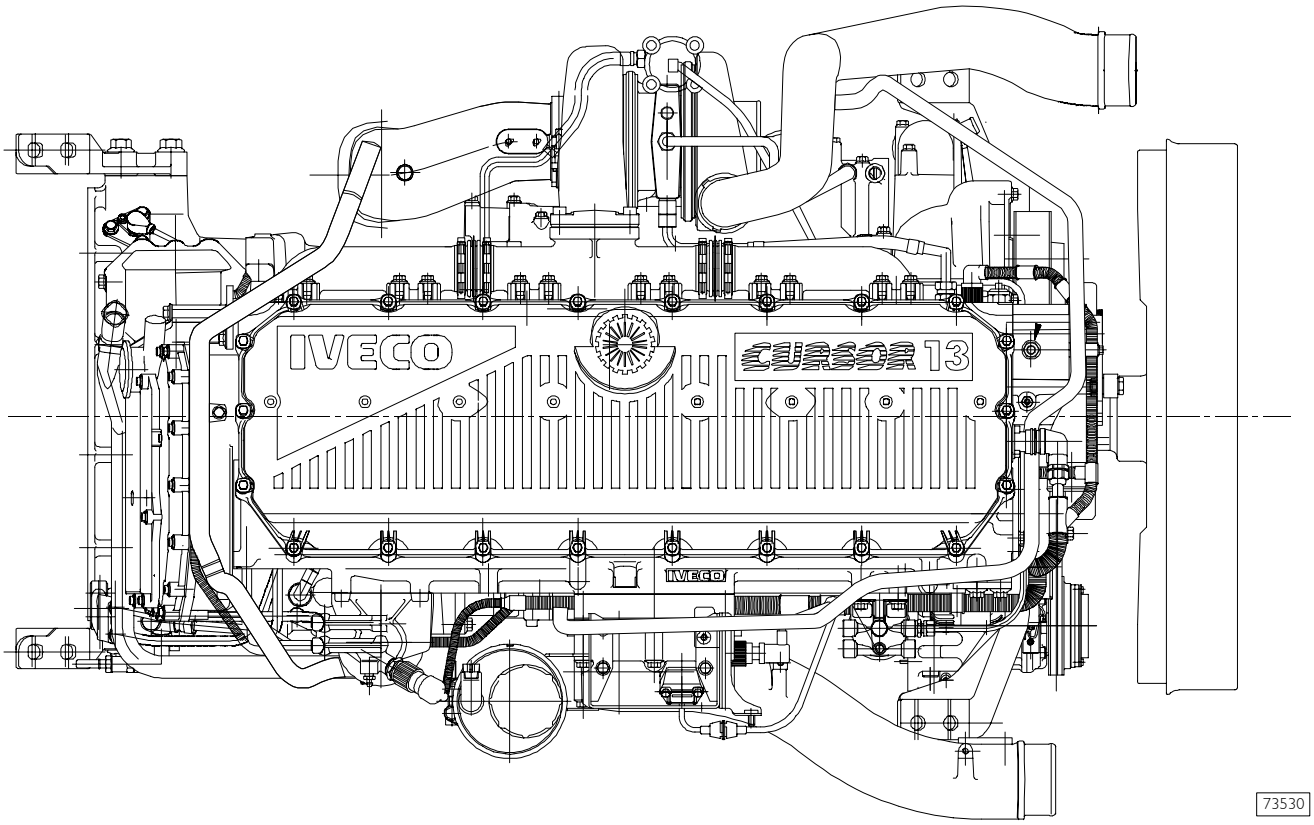
Figure 4



71694

REAR VIEW OF ENGINE

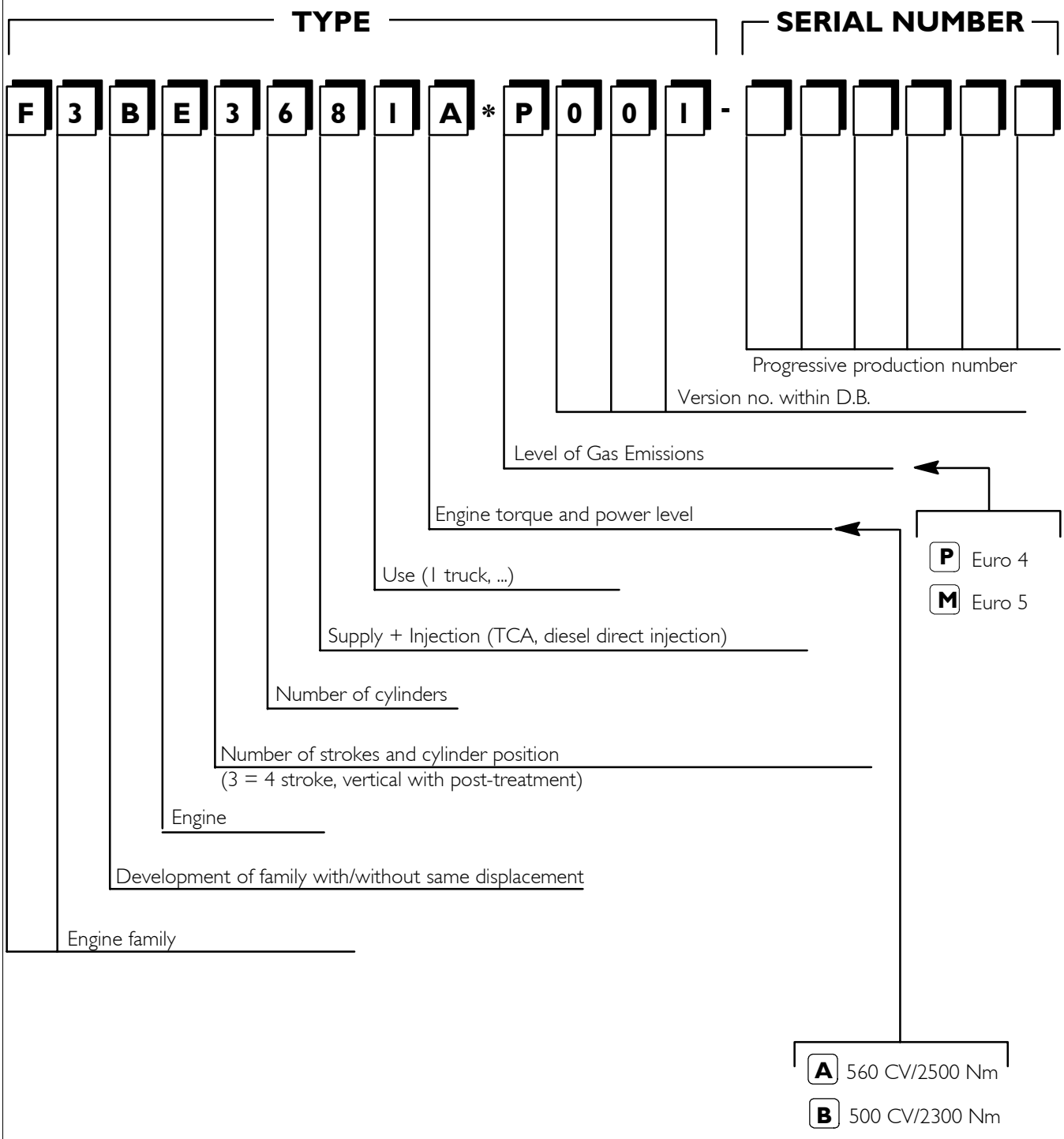
Figure 5



TOP VIEW OF ENGINE

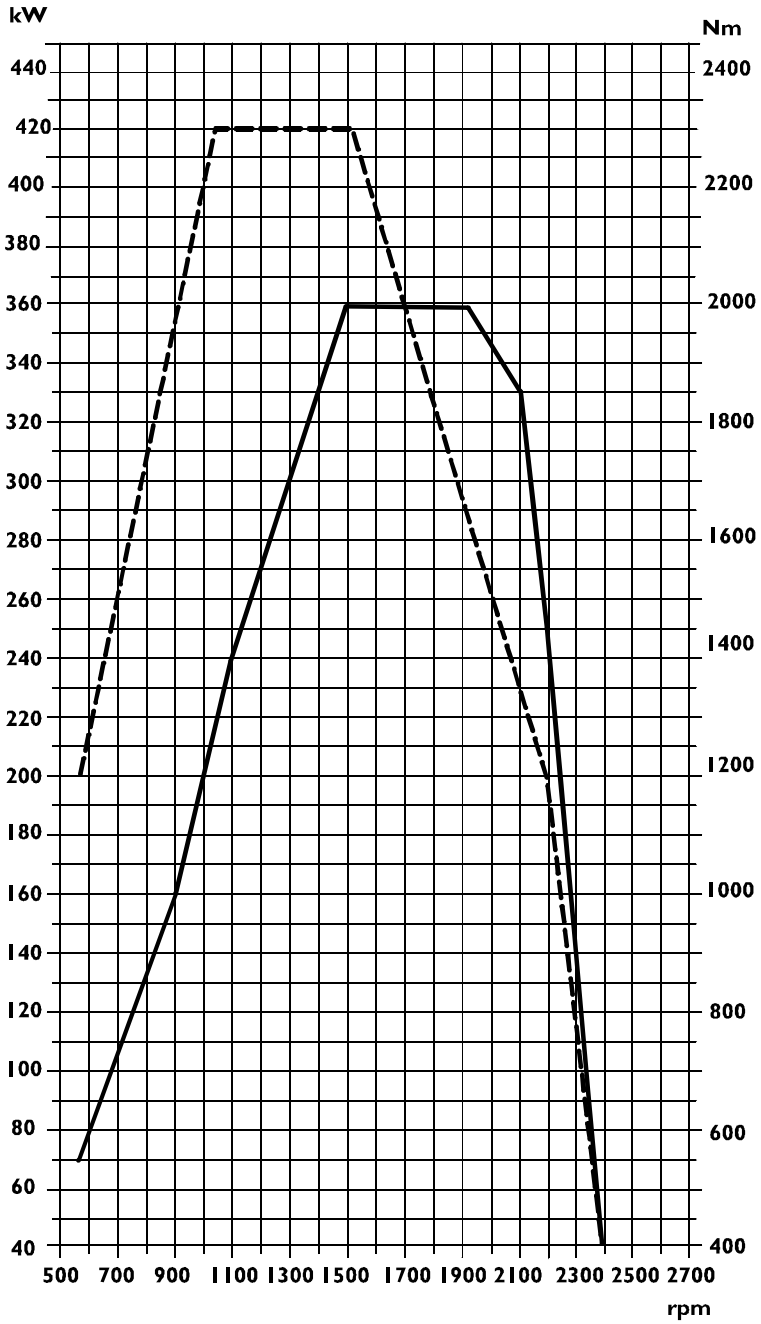
TECHNICAL DESCRIPTION

ENGINE



CHARACTERISTIC CURVES

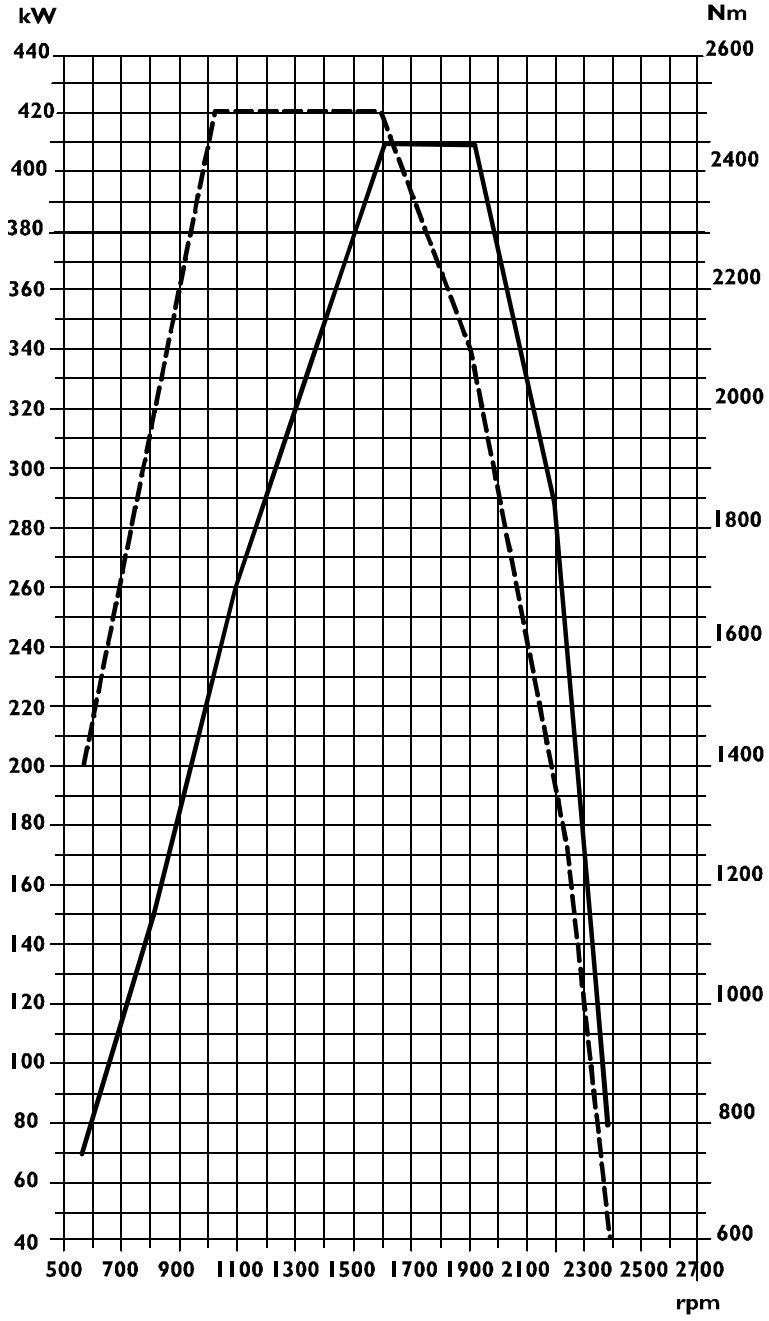
Figure 6



CHARACTERISTIC CURVES OF ENGINE F3BE3681B

Max. POWER :	**370 kW**	**500 CV**	**1900 rpm**
Max. TORQUE :	**2300 Nm**	**234 kgm**	**1000 to 1525 rpm**

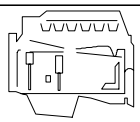
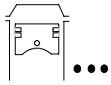
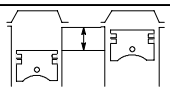
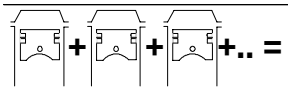
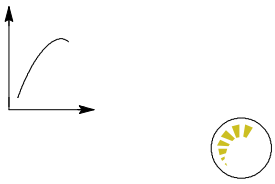
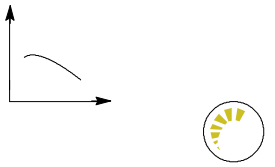
Figure 7

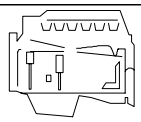
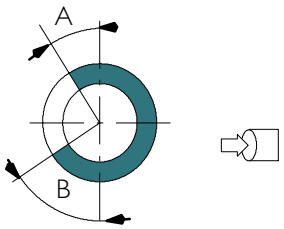
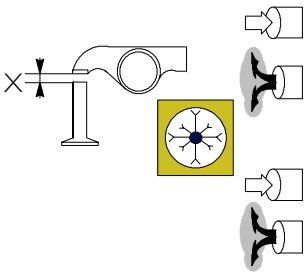
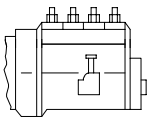
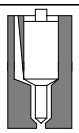
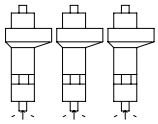
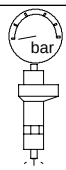


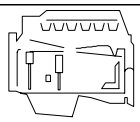
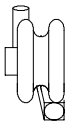
CHARACTERISTIC CURVES OF ENGINE F3BE3681A

Max. POWER :	**415 kW**	**560 CV**	**1900 rpm**
Max. TORQUE :	**2500 Nm**	**254 kgm**	**1000 to 1575 rpm**

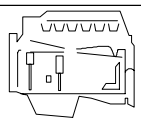
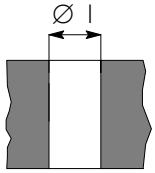
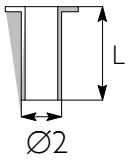
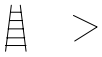
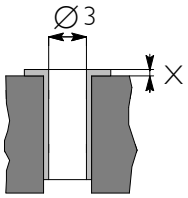
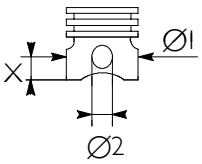
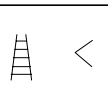
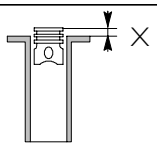
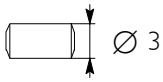
GENERAL SPECIFICATIONS

	Type		**F3BE3681B**	**F3BE3681A**
	Cycle Supply Injection		4-stroke diesel Turbocharged with intercooler Direct	
	Number of cylinders		6 in line	
	Bore	mm	135	
	Stroke	mm	150	
	Total displacement	cm^3	12880	
Q	Compression ratio		16.5 : 1	
	Maximum power	kW (HP) rpm	370 (500) 1900	415 (560) 1900
	Maximum torque	Nm (kgm) rpm	2300 1000 to 1525	2500 1000 to 1575
	Slow running with no load	rpm	550 ± 50	
	Fast idling speed with no load	rpm	2320 ± 50	

	Type		**F3B**
	TIMING SYSTEM		
	Start before T.D.C.	A	19°
	End after B.D.C.	B	36°
	Start before B.D.C.	D	50°
	End after T.D.C.	C	9°
	To check timing		
	X	mm	–
		mm	–
	Operation		
	X	mm	0.35 to 0.45
		mm	0.55 to 0.65
	SUPPLY		Via fuel pump - Filters
	Injection type Bosch		With UIN 3-1 injectors with electronic adjustment. Injectors-pump controlled by camshaft in head.
	Nozzles type		-
	Injection sequence		1 - 4 - 2 - 6 - 3 - 5
	Injection pressure	bar	2000
	Injector setting	bar	296 ± 6

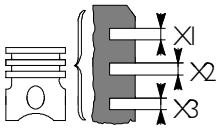
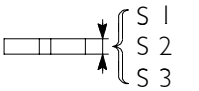
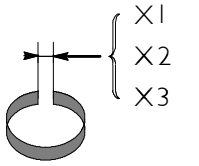
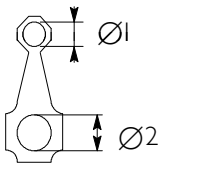
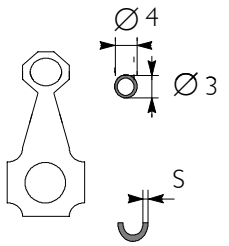
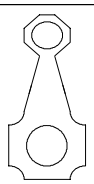
	Type	**F3B**
	TURBOCHARGING	Holset variable geometry
	Turbocharger type	HE551V
	LUBRICATION	Forced via gear pump, pressure relief valve, oil filter
 	Oil pressure with engine warm (100 ± 5°C):	
	at slow running bar	1.5
	at fast idling speed bar	5
	COOLING	Via centrifugal pump, thermostat, viscostatic fan, radiator, heat exchanger
	Water pump drive	With belt
	Thermostat	N. 1
	starts opening:	84 ± 2 °C
	full aperture	94 ± 2 °C
	REPLENISHING	
	Total capacity 1st filling	
	liters	35
	kg	31.5
	Capacity	
	- engine sump at minimum level	
	liters	20
	kg	18
 **Urania FE 5W30** Urania LD7	- engine sump at maximum level	
	liters	28
	kg	25.2
	- quantity in circulation that does not return to sump	
	liters	7
	kg	6.3
	- quantity contained in cartridge filter (to add when changing the cartridge filter)	
	liters	3
	kg	2.7

ASSEMBLY DATA - CLEARANCE

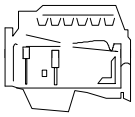
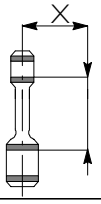
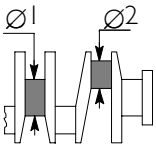
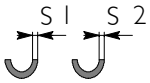
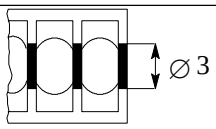
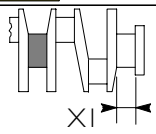
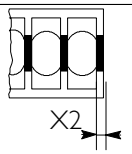
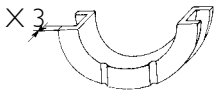
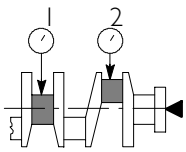
	Type		F3B
CYLINDER ASSEMBLY AND CRANK MEMBERS			mm
	Cylinder liner seats Ø 1	top	153.500 to 153.525
		bottom	152.000 to 152.025
	Cylinder liners: outside diameter: Ø 2	top	153.461 to 153.486
		bottom	151.890 to 151.915
	length	L	–
	Cylinder liners - crankcase seats	top	0.014 to 0.039
		bottom	0.085 to 0.135
IVECO PARTS 	Outside diameter	Ø2	–
	Cylinder liners:		
	inside diameter	Ø3A*	135.000 to 135.013
	inside diameter	Ø3B*	135.011 to 135.024
	protrusion	X**	0.045 to 0.075
* Selection class ** Under a load of 8000 kg			
	Pistons:		FEDERAL MOGUL
	measurement	X	18
	outside diameter	Ø1A•	134.861 to 134.873
	outside diameter	Ø1B••	134.872 to 134.884
	seat for pin	Ø2	54.010 to 54.018
	Piston - cylinder liners	A*	0.127 to 0.152
		B*	0.127 to 0.152
* Selection class			
IVECO PARTS 	Piston diameter	Ø1	–
	Piston protrusion	X	0.12 to 0.42
	Piston gudgeon pin	Ø3	53.994 to 54.000
	Piston gudgeon pin - pin seat		0.010 to 0.024

• Class A pistons supplied as spares.

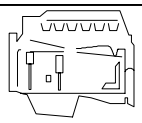
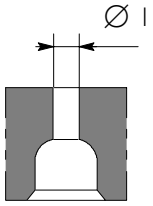
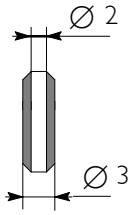
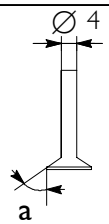
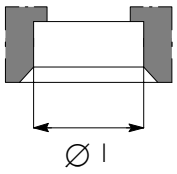
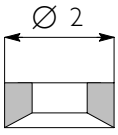
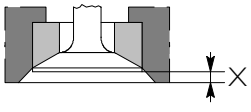
•• Class B pistons are fitted in production only and are not supplied as spares.

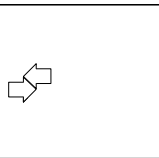
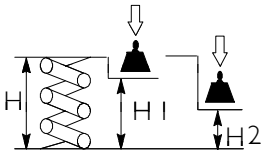
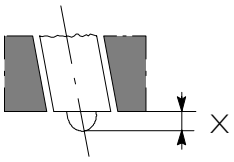
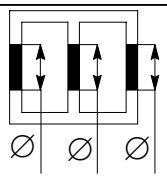
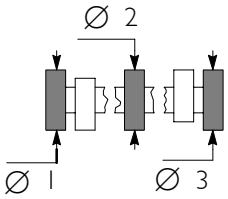
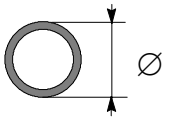
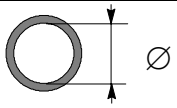
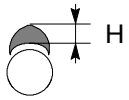
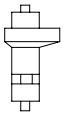
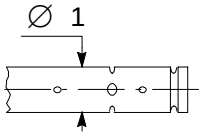
	Type	F3B
		mm
		FEDERAL MOGUL
	Piston ring slots X1*	2.427
	Piston ring slots X2	1.550 to 1.570 (••) | 3.060 to 3.080
	Piston ring slots X3	5.020 to 5.040
	* measured on Ø of 130 mm	
	Piston rings:	
	- sealing trapezoidal S1*	2.296 to 2.340
	- sealing bevelled S2	1.470 to 1.500 (••) | 2.970 to 2.990
	- milled scraper ring with slots and internal spring S3	4.970 to 2.990
	* measured at 2.5 mm from outer Ø	
	Piston rings - slots 1	0.087 to 0.131
	Piston rings - slots 2	0.050 to 0.100
	Piston rings - slots 3	0.030 to 0.070
IVECO PARTS 	Piston rings	–
	Piston ring end opening in cylinder liner	
	X1	0.40 to 0.50
	X2	0.65 to 0.80
	X3	0.40 to 0.75
	Small end bushing seat Ø1	59.000 to 59.030
	Connecting rod bearing seat Ø2	
	Selection class Ø2 1	94.000 to 94.010
	Selection class Ø2 2	94.011 to 94.020
	Selection class Ø2 3	94.021 to 94.030
	Small end bushing diameter	
	outside Ø4	59.085 to 59.110
	inside Ø3	54.019 to 54.035
	Big end bearing shells S	
	Red	1.965 to 1.975
	Green	1.976 to 1.985
	Yellow •	1.986 to 1.995
	Small end pushing - seat	0.055 to 0.110
	Piston gudgeon pin - bushing	0.019 to 0.041
IVECO PARTS 	Big end bearing shells	-
	Weight of connecting rod	
	Classes A	4741 to 4780 g.
	Classes B	4781 to 4820 g.
	Classes C	4821 to 4860 g.

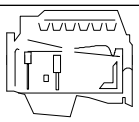
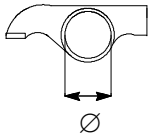
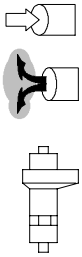
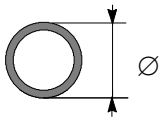
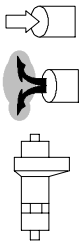
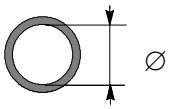
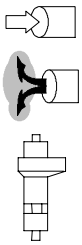
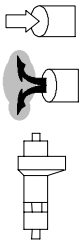
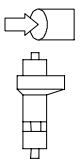
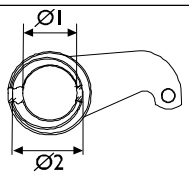
• Only mounted on production and not provided with spare.
•• Old part number

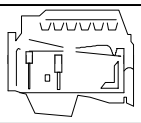
	Type	F3B
		mm
	Measurement X	125
	Maximum error on alignment of connecting rod axe //	0.08
	Main journals Ø1	
	- nominal	99.970 to 100.000
	- class 1	99.970 to 99.979
	- class 2	99.980 to 99.989
	- class 3	99.990 to 100.000
	Crankpins Ø2	
	- nominal	89.970 to 90.000
	- class 1	89.970 to 89.979
	- class 2	89.980 to 89.989
	- class 3	89.990 to 90.000
	Main bearing shells S1	
	Red	3.110 to 3.120
	Green	3.121 to 3.130
	Yellow*	3.131 to 3.140
	Big end bearing shells S2	
	Red	1.965 to 1.975
	Green	1.976 to 1.985
	Yellow*	1.986 to 1.995
	Main bearing housings Ø3	106.300 to 106.330
	Bearing shells - main journals ○	0,060 to 0,108 * - 0,061 to 0,119 ** - 0,060 to 0,130 ***
	Bearing shells - crankpins ○	0,050 to 0,108 * - 0,051 to 0,109 ** - 0,050 to 0,098 ***
	Main bearing shells	0.127 - 0.254 - 0.508
	Big end bearing shells	0.127 - 0.254 - 0.508
	Main journal for shoulder X1	47.95 to 48.00
	Main bearing housing for shoulder X2	40.94 to 40.99
	Half thrust washers X3	3.38 to 3.43
	Crankshaft shoulder	0.10 to 0.30
	Alignment // 1 - 2	0.025
	Roundness ◎ 1 - 2	0.040

* Fitted in production only and not supplied as spares
○ Supplied as spares: * standard; ** = 0.127; *** = 0.254 - 0.508

	Type		F3B	
CYLINDER HEAD - TIMING SYSTEM			mm	
	Guide valve seats on cylinder head	Ø1	15.980 to 15.997	
	Valve guides	Ø2 Ø3	10.015 to 10.030 16.012 to 16.025	
	Valve guides and seats on head		0.015 to 0.045	
IVECO PARTS	Valve guides		–	
	Valves:			
		Ø4 α	9.960 to 9.975 60° 30′ ± 7′ 30″	
		Ø4 α	9.960 to 9.975 45° 30′ ± 7′ 30″	
	Valve stem and relevant guide		0.040 to 0.070	
	Seat on head for valve seat:			
		Ø1	49.185 to 49.220	
		Ø1	46.985 to 47.020	
	Outside diameter of valve seats on cylinder head:			
		Ø2	49.260 to 49.275	49.460 to 49.475*
* provided with spare		Ø2	47.060 to 47.075	47.260 to 47.275*
IVECO PARTS	Valve seats		0,2	
	Recessing	X X	0.45 to 0.75 1.65 to 1.95	

	Type	F3B
		mm
	Between valve seat and head	0.040 to 0.090
	Valve spring height: free spring H under a load of: 775 ± 39 N H1 1366 ± 68 N H2	 76 59 46
	Injector protrusion X	0.52 to 1.34
	Seats for camshaft bushings in cylinder head: 1 ⇒ 7 Ø	88.000 to 88.030
	Camshaft supporting pins: 1 ⇒ 7 Ø	82.950 to 82.968
	Outside diameter of bushings for camshaft: Ø	88.153 to 88.183
	Bushing inside diameter: Ø	83.018 to 83.085
	Bushings and seats in cylinder head	0.123 to 0.183
	Bushings and supporting pins	0.050 to 0.135
	Useful cam height   	9.231 9.5607 13.376
	Rocker arm shaft Ø1	41.984 to 42.000

	Type	F3B
		mm
	Seats for bushings in rocker arms: 	45.000 to 45.016 59.000 to 59.019 46.000 to 46.016
	Outside diameter of bushings for rocker arms: 	45.090 to 45.130 59.100 to 59.140 46.066 to 46.091
	Inside diameter of bushings for rocker arms: 	42.025 to 42.041 56.030 to 56.049 42.015 to 42.071
	Bushings and seats: 	0.074 to 0.130 0.081 to 0.140 0.050 to 0.091
	Rocker arm bushings and shaft: 	0.025 to 0.057 0.015 to 0.087
	Engine brake control lever Eccentric pin outer diameter Ø1 Rocker arms shaft seat Ø2	55.981 to 56.000 42.025 to 42.041

	Type	**F3B**
		mm
	Rocker arms and engine brake control lever pin 	0.030 to 0.068
	Rocker arm shaft and seat on engine brake control lever 	0.025 to 0.057
TURBOCHARGER		
Type		HOLSET HE 551 V
End play		0.051 to 0.152
Radial movement		0.381 to 0.533

TIGHTENING TORQUE

PART		TORQUE Nm	TORQUE kgm
Screws fixing crankcase base to crankcase (see Figure 8) ♦			
Outside screws M12x1.75	First phase: pre-tightening	30	(3)
Inside screws M18x2	Second phase: pre-tightening	120	(12)
Inside screws M 18x2	Third phase: closing to angle	60°	
Inside screws M 18x2	Fourth phase: closing to angle	55°	
Outside screws M 12x1,75	Fifth phase: closing to angle	60°	
Piston cooling nozzle union		35 ±2	(3,5 ±0,2)
Screws fixing heat exchanger to crankcase ♦ (see Figure 12)			
pre-tightening		11.5 ±3.5	(1.15 ±0.35)
tightening		19 ±3	(1.9 ±0.3)
Screws fixing suction strainer to crankcase base		24.5 ±2.5	(2.4 ±0.25)
Screws fixing oil sump spacer (see Figure 13)			
pre-tightening (1 to 16)		38	(3.8)
tightening (17 to 32)		45	(4.5)
Screws fixing gearbox to crankcase M12x1.75 (see Figure 15)		63 ±7	(6.3 ±0.7)
Screws fixing control unit to crankcase base ♦		24 ±2.5	(2.4 ±0.25)
Screws fixing cylinder head (see Figure 9) ♦			
First phase	pre-tightening	60	(6)
Second phase	pre-tightening	120	(12)
Third phase	closing to angle	90°	
Fourth phase	closing to angle screws no. 4 - 5 - 12 - 20 - 21	65°	
Screws fixing rocker arm shaft ♦			
First phase	pre-tightening	80	(8)
Second phase	closing to angle	60°	
Lock nut for rocker arm adjustment screw		39 ±5	(3.9 ±0.5)
Screws for injector brackets ♦		26	(2.6)
Screws fixing plastic cover		8.5 ±1.5	(0.85 ±0.15)
Screws fixing shoulder plate to head		19 ±3	(1.9 ±0.3)
Screws fixing engine mount bracket to cylinder head			
First phase	pre-tightening	120	(12)
Second phase	closing to angle	45°	

♦ Before assembly, lubricate with UTDM oil

• Before assembly, lubricate with graphitized oil

PART		TORQUE	
		Nm	kgm
Screws fixing engine mount bracket to flywheel casing			
First phase	pre-tightening	100	(10)
Second phase	closing to angle	60°	
Screws fixing camshaft gear ♦			
First phase	pre-tightening irst	60	(6)
Second phase	closing to angle	60°	
Screws fixing phonic wheel on camshaft gear		8.5 ±1.5	(0.85 ±0.15)
Screws fixing exhaust manifold • (see Figure 10)			
	pre-tightening	40±5	(4±0.5)
	tightening	70±5	(3.2)
Screws fixing engine brake actuator cylinder		19	(1.9)
Screws fixing connecting rod cap ♦			
First phase	pre-tightening	60	(6)
Second phase	closing to angle	60°	
Screws fixing engine flywheel ♦			
First phase	pre-tightening	120	(12)
Second phase	closing to angle	90°	
Screws fixing damper flywheel ♦			
First phase	pre-tightening	70	(7)
Second phase	closing to angle	50°	
Screws fixing middle gear pins ♦			
First phase	pre-tightening	30	(3)
Second phase	closing to angle	90°	
Screws fixing idle gear adjustment connecting rod:		24.5 ±2.5	(2.45 ±0.25)
Screws fixing oil pump		24.5 ±2.5	(2.45 ±0.25)
Screws fixing crankshaft gasket front cover		24.5 ±2.5	(2.45 ±0.25)
Screws fixing fuel pump / filter mount		19	(1.9)
Screw fixing control unit mount		19 ±3	(1.9 ±0.3)
Screws and nuts fixing turbocharger • (see Figure 11)			
	pre-tightening	35	(3.5)
	tightening	46	(4.6)
Screw fixing thermostat assembly		22 ± 2	(2.2 ±0.2)
Screws fixing water pump		24.5 ± 2.5	(2.45 ± 0.25)
Screws fixing fan hub to spacer		30	(3)
Screw fixing fan spacer to pulley		30	(3)
Screws fixing fan mount to crankcase		100	(10)
Screw securing steady tensioner		10.5 ± 5	(10 ±0.5)
Screw securing automatic belt tensioner		50 ±5	(5 ±0.5)
Screws fixing fixed pulley for auxiliary member drive belt to crankcase		105 ±5	(10.5 ±0.5)
Screws fixing starter motor		74 ±4	(7.4 ±0.4)
Screws fixing air heater		50 ±5	(5 ±0.5)
Screws fixing air compressor		74 ±4	(7.4 ±0.4)

♦ Before assembly, lubricate with UTDM oil

• Before assembly, lubricate with graphitized oil

PART			TORQUE	
			Nm	kgm
Nut fixing air compressor gear			170 ±10	(17 ±1)
Screws fixing alternator:	M 10x1,5	l = 35 mm	44 ±4	(4.4 ±0.4)
	M 10x1,5	l = 60 mm	44 ±4	(4.4 ±0.4)
Screws fixing hydraulic power steering pump			46.5 ±4.5	(4.65 ±0.45)
Screws fixing air-conditioner compressor to the mount			24.5 ±2.5	(2.5 ±0.25)
Screws fixing guard			24.5 ±2.5	(2.5 ±0.25)
Filter clogging sensor fixing			55 ±5	(5.5 ±0.5)
Water / fuel temperature sensor fixing			35	(3.5)
Transmitter / thermometric switch fixing			25	(2.5)
Air temperature transmitter fixing			35	(3.5)
Pulse transmitter fixing			8 ±2	(0.8 ±0.2)
Fixing connections to injector			1.36 ÷ 1.92	(0.13 ÷ 0.19)
Fixing engine brake solenoid valve			32	(3.2)
Engine propulsor				
M14X70/80 screw securing front and rear spring blocks to chassis			192.5 ± 19.5	19.2 ± 1.9
M16X130 screw securing front and rear spring blocks to engine			278 ± 28	27.8 ± 2.8
M18X62 flanged hex screw for front engine block:				
First stage	pre-tightening		120	12
Second stage	angle closing		45°	
M14X60 socket cheese-head screw for front engine block:				
First stage	pre-tightening		60	6
Second stage	angle closing		45°	
Flanged hex screw for rear engine block:				
First stage	pre-tightening		100	10
Second stage	angle closing		60°	

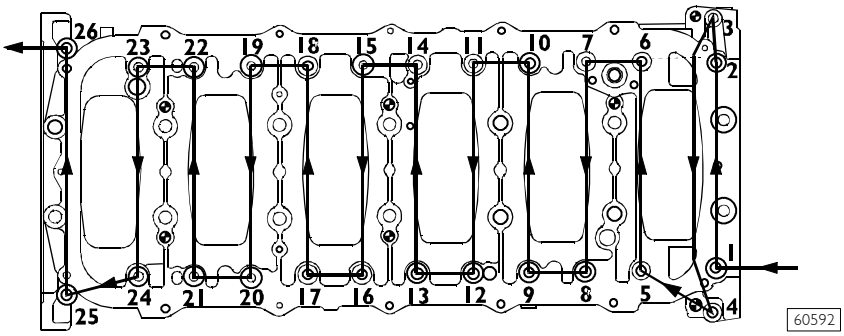
♦ Before assembly, lubricate with UTDM oil

• Before assembly, lubricate with graphitized oil

DIAGRAMS OF TIGHTENING SEQUENCE OF MAIN ENGINE COMPONENTS

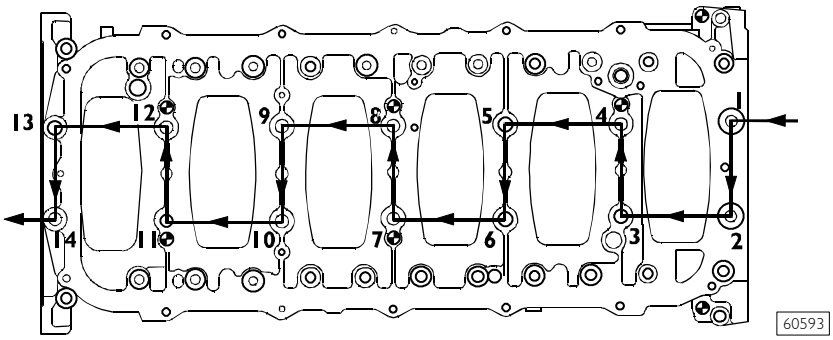
Figure 8

FRONT SIDE



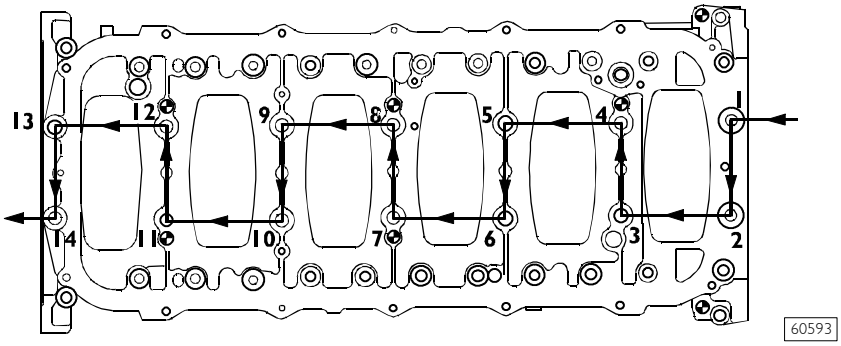
First phase: pre-tightening outside screws
30 Nm

FRONT SIDE



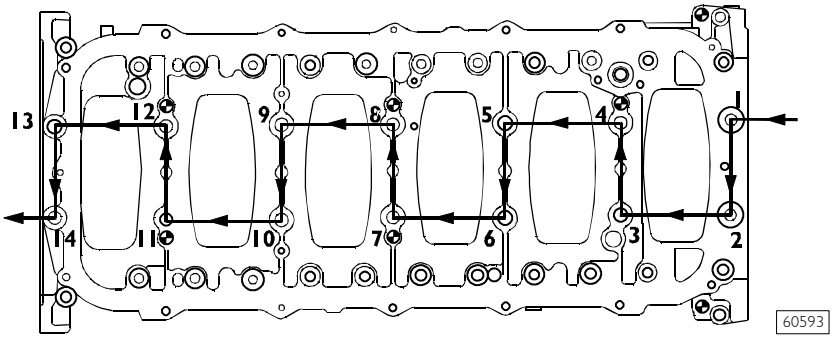
Second phase: pre-tightening inside screws
120 Nm

FRONT SIDE



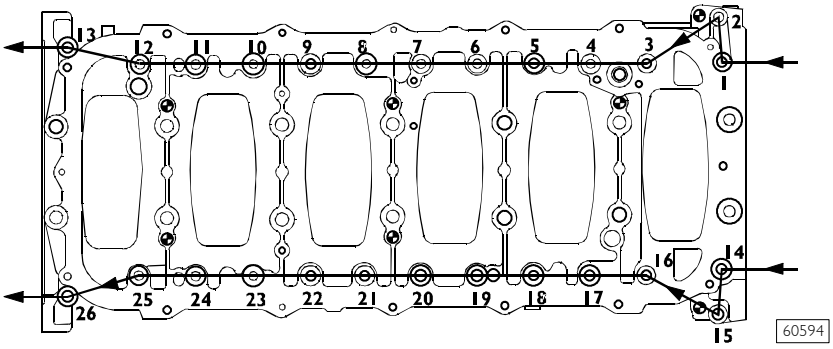
Third phase: closing inside screws to angle
60°

FRONT SIDE



Fourth phase: closing inside screws to angle
55°

FRONT SIDE



Fifth phase: closing outside screws to angle
60°

DIAGRAM OF TIGHTENING SEQUENCE OF CRANKCASE BASE FIXING SCREWS

Figure 9

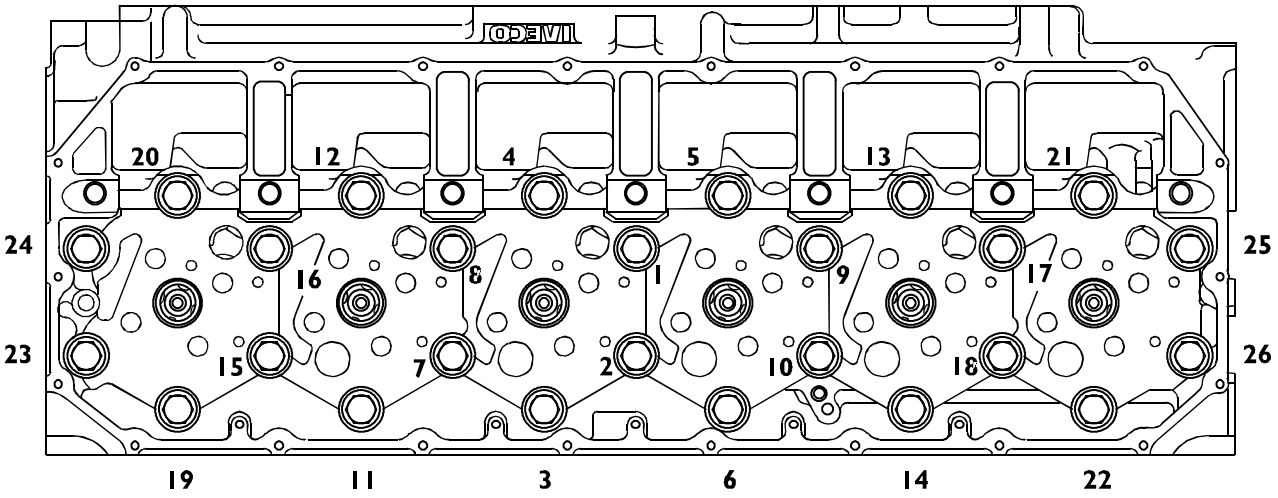


DIAGRAM OF TIGHTENING SEQUENCE OF EXHAUST MANIFOLD FIXING SCREWS

Figure 10

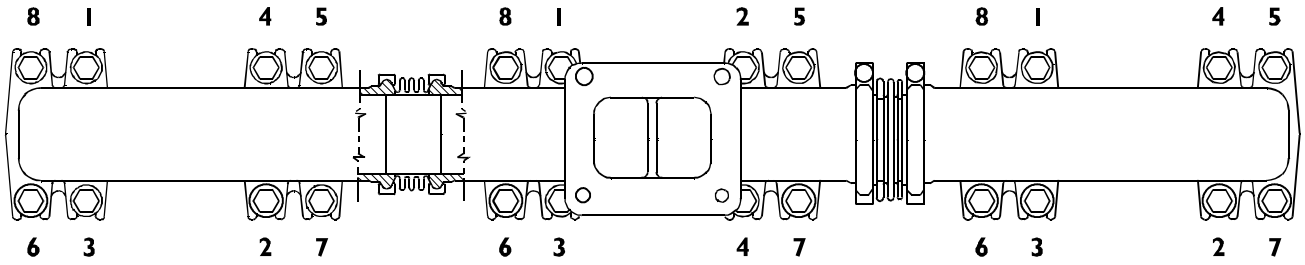


DIAGRAM OF TIGHTENING SEQUENCE OF EXHAUST MANIFOLD FIXING SCREWS

Figure 11

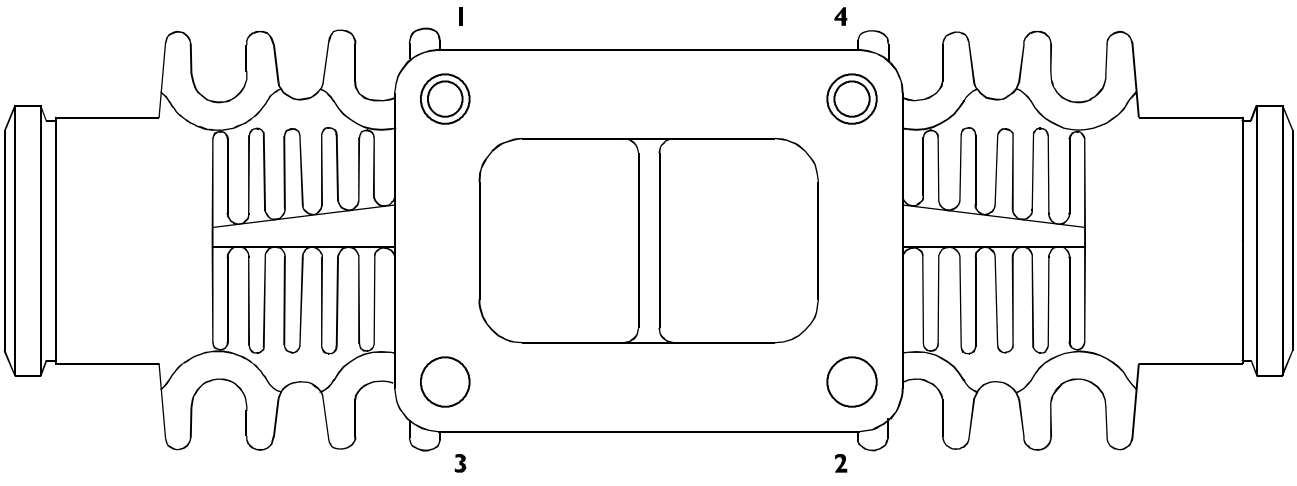


DIAGRAM OF TIGHTENING SEQUENCE OF SCREWS AND NUTS FIXING TURBOCHARGER ON EXHAUST MANIFOLD

Figure 12

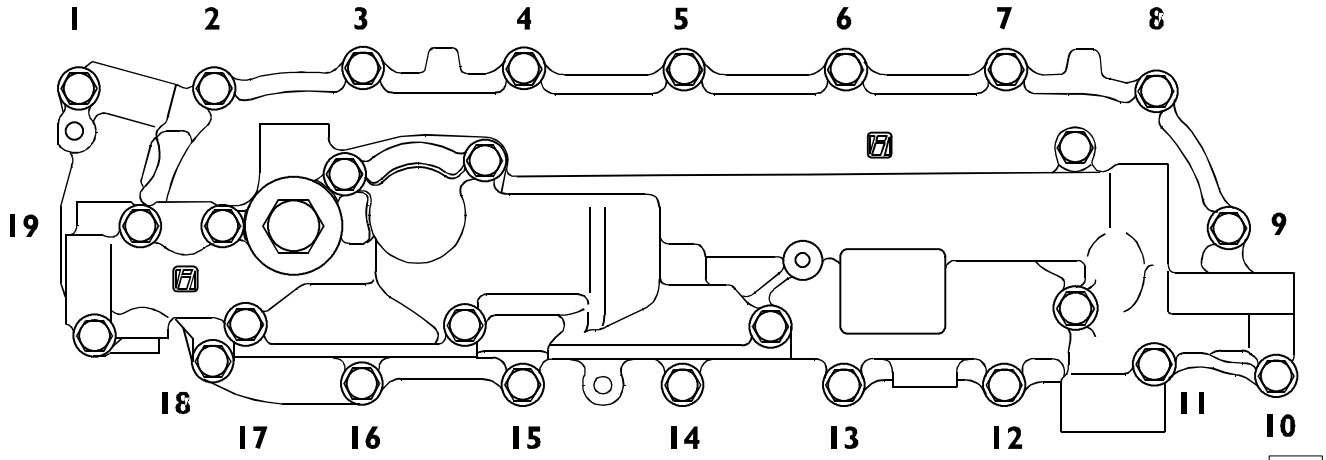


DIAGRAM OF TIGHTENING SEQUENCE OF HEAT EXCHANGER FIXING SCREWS

Figure 13

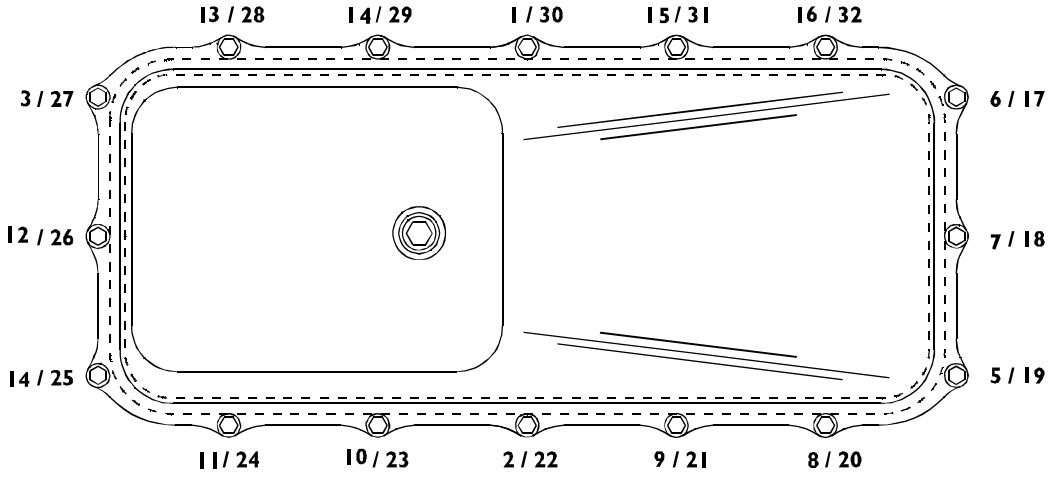


DIAGRAM OF TIGHTENING SEQUENCE OF ENGINE OIL SUMP FIXING SCREWS

Figure 14

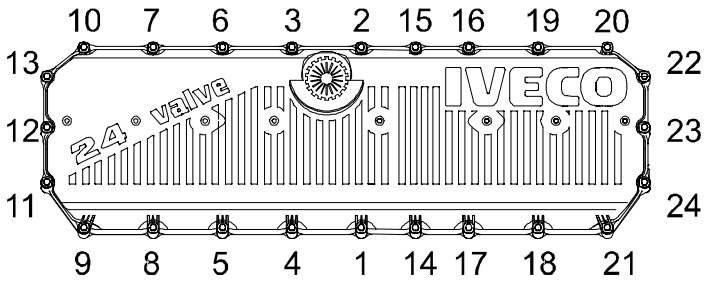


DIAGRAM OF TIGHTENING SEQUENCE FOR SCREWS FIXING ROCKER COVER

Figure 15

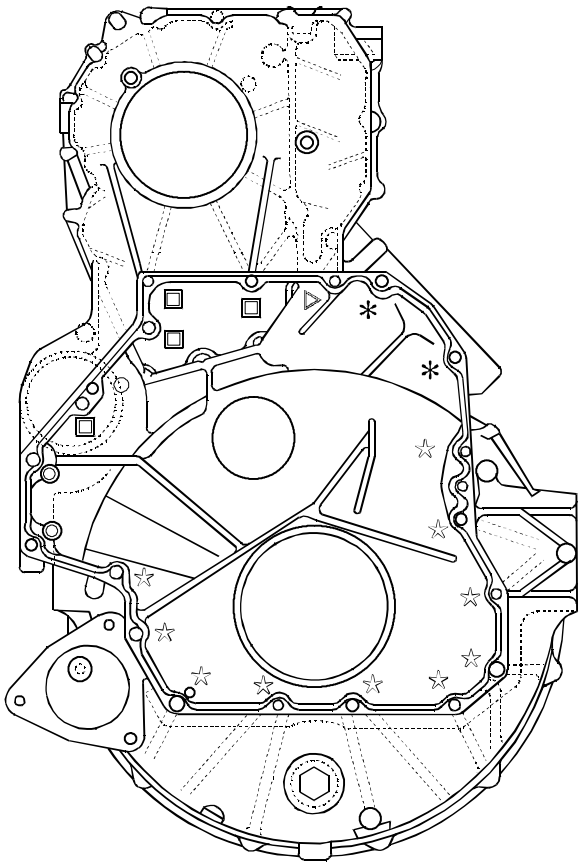


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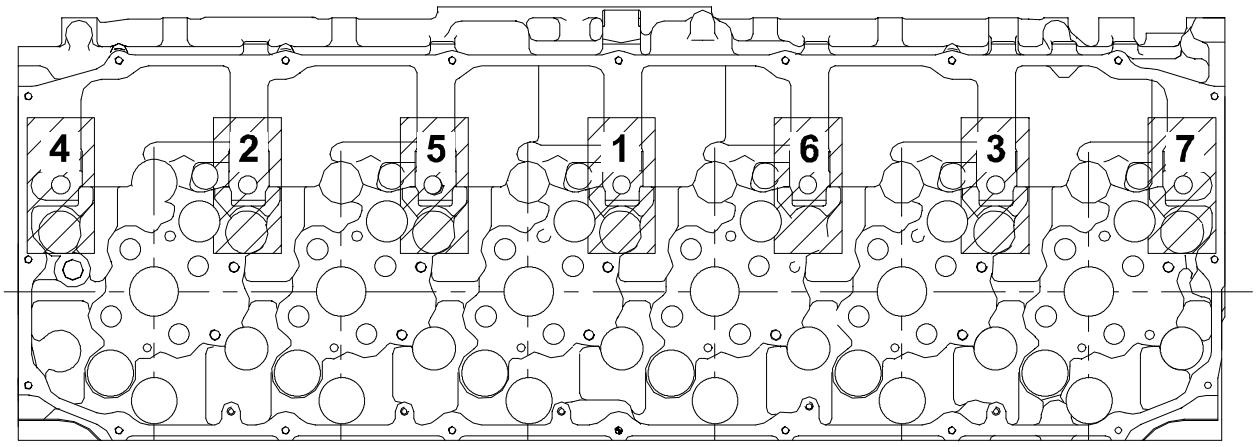
DIAGRAM OF TIGHTENING SEQUENCE OF SCREWS FIXING GEARBOX TO CRANKCASE

Tightening sequence

- ✡ 10 screws M12 x 1.75 x 100
- ◎ 2 screws M12 x 1.75 x 70
- ▣ 4 screws M12 x 1.75 x 35
- △ 1 screw M12 x 1.75 x 120
- ✳ 2 screws M12 x 1.75 x 193

Figure 16



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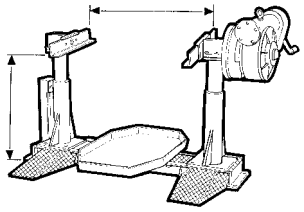
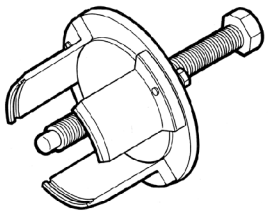
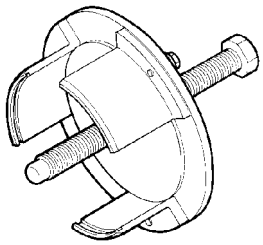
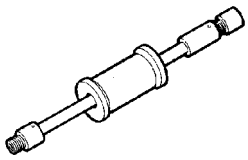
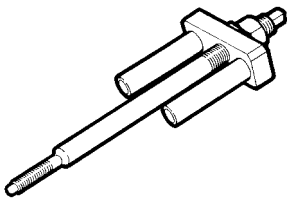
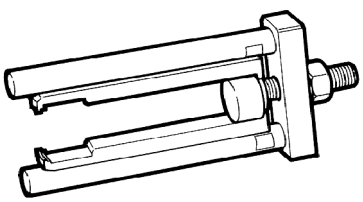
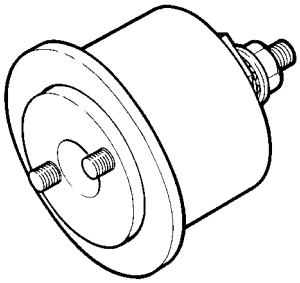
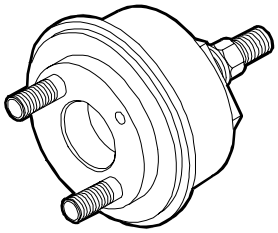
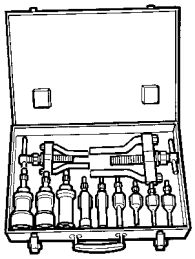
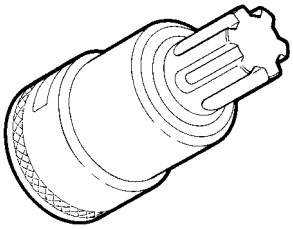
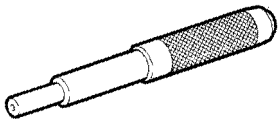
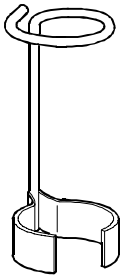
SCHEME OF THE TIGHTENING ORDER OF ROCKER ARMS SHAFTS FASTENING SCREWS

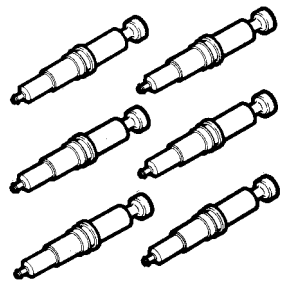
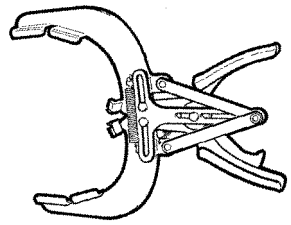
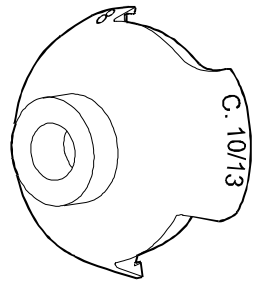
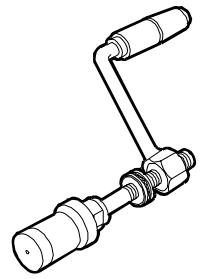
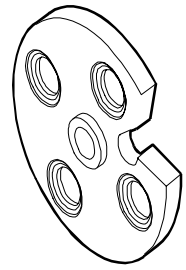
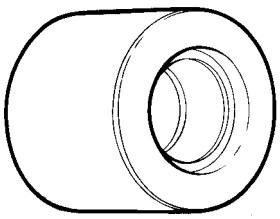
TOOLS

TOOL NO.		DESCRIPTION
99322230		Rotary telescopic stand (capacity 2000 daN, torque 375 daN/m)
99340053		Tool to remove crankshaft front gasket
99340054		Tool to remove crankshaft rear gasket
99340205		Percussion extractor
99342149		Extractor for injector box
99342155		Tool to extract injectors

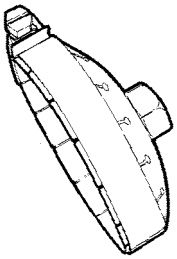
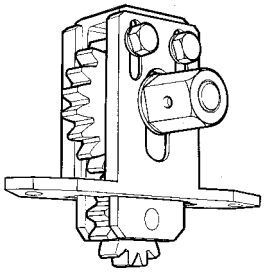
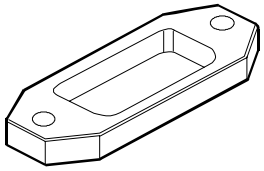
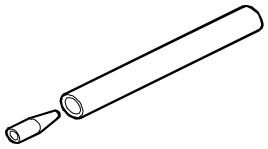
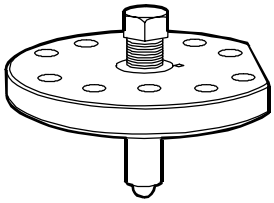
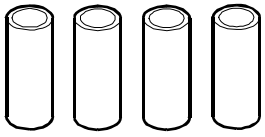
TOOLS

TOOL NO.		DESCRIPTION
99346250		Key to mount crankshaft front gasket
99346251		Key to mount crankshaft rear gasket
99348004		Universal extractor for interiors from 5 to 70 mm
99350072		Socket wrench for screws fastening crankcase to crankcase base
99360143		Drift to fit - remove valve guide
99360144		Tools (12+6) to hold rocker arm adjustment screw blocks when removing refitting rocker arm shaft

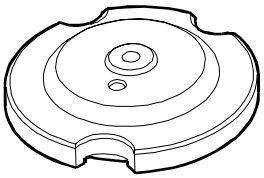
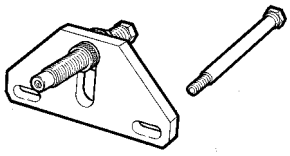
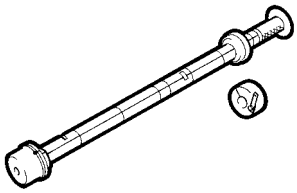
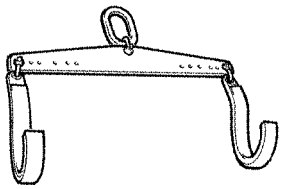
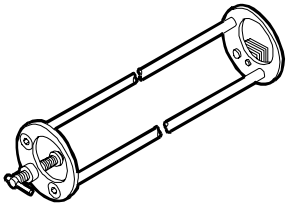
TOOLS

TOOL NO.		DESCRIPTION
99360180		Plugs (6) protecting injector seats
99360184		Pliers for removing and refitting piston rings (105-106 mm)
99360192		Guide for flexible belt
99360261		Tool for removing and refitting engine valves (use with specific plates)
99360263		Plate for removing and refitting engine valves (use with 99360261)
99360296		Drift for refitting valve guide (use with 99360143)

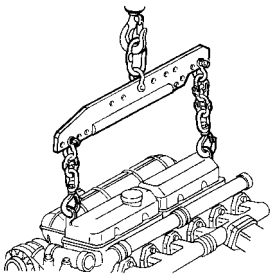
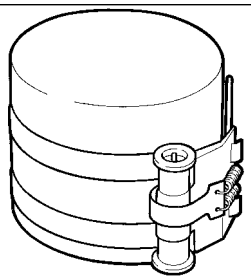
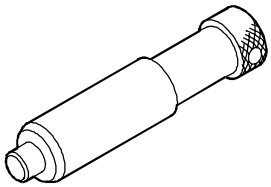
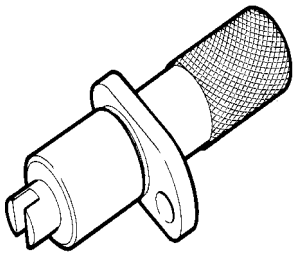
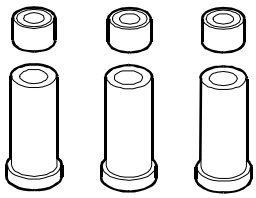
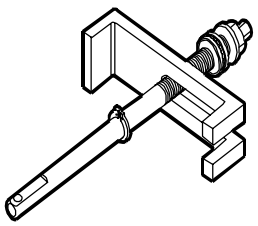
TOOLS

TOOL NO.		DESCRIPTION
99360314		Tool to remove oil filter (engine)
99360321		Tool to rotate engine flywheel (use with 99360325)
99360325		Spacer (use with 99360321)
99360329		Keying device for mounting gasket on valve guide
99360334		Compression tool to measure cylinder liner protrusion (use with 99370415-99395603 and specific plates)
99360336		Spacers (use with 99360334)

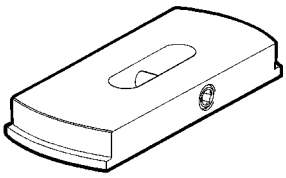
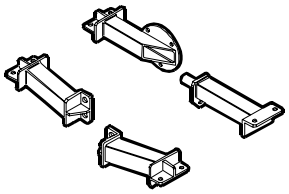
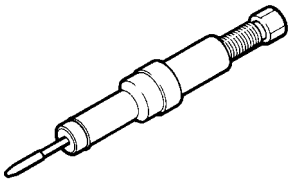
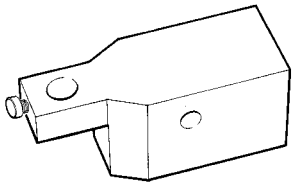
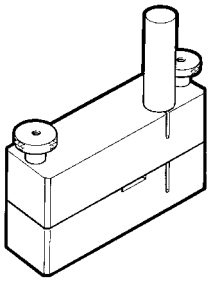
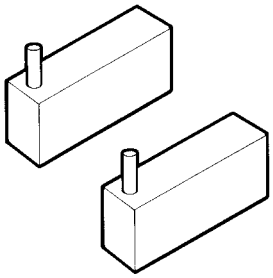
TOOLS

TOOL NO.		DESCRIPTION
99360338		Plate to compress cylinder liners (use with 99360334-99360336)
99360351		Tool to hold engine flywheel
99360499		Drift to remove and refit camshaft bushings
99360500		Tool to lift crankshaft
99360551		Bracket to remove and refit engine flywheel
99360553		Tool to assemble and install rocker arm shaft

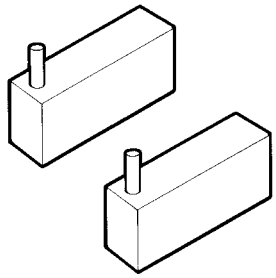
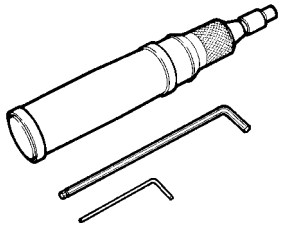
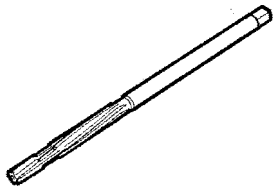
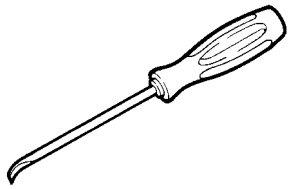
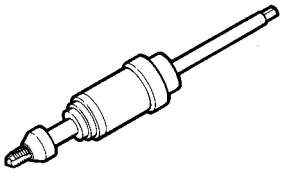
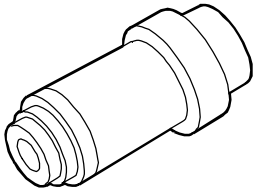
TOOLS

TOOL NO.		DESCRIPTION
99360585		Beam to remove and refit engine
99360605		Clamp to insert piston in cylinder liner (60-125 mm)
99360612		Tool to position engine T.D.C.
99360613		Tool for phonic disc timing on camshaft
99360703		Tool to hold cylinder liners
99360706		Tool to extract cylinder liners (use with specific rings)

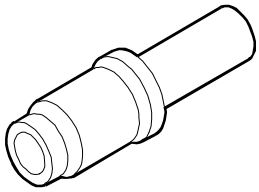
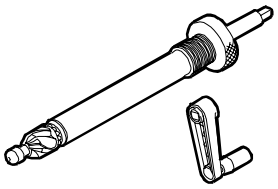
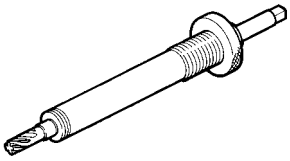
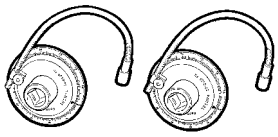
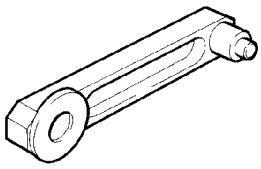
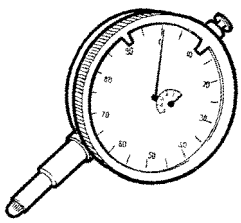
TOOLS

TOOL NO.		DESCRIPTION
99360728		Ring (135 mm) (use with 99360706)
99361036		Brackets fixing engine to rotary stand 99322230
99365056		Tool to upset injector box
99370415		Dial gauge base to measure cylinder liner protrusion (use with 99395603)
99378100		Tool to punch engine data plates (use with specific punches)
99378101 ✳ **99378102** ● **99378103** ○ **99378104** □ **99378105** ■ **99378106** ▲ **99378107** ▼ **99378108** ◆		Drifts (**A**✳ -**B**● -**C**○ - **D**□ - **E**■ - **F**▲ - **G**▼ - **V**◆) for stamping engine identification plates (components of 99378130)

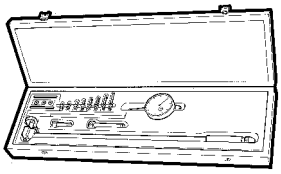
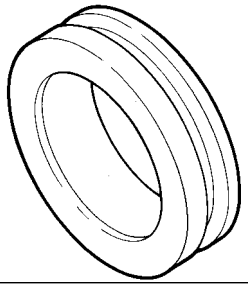
TOOLS

TOOL NO.		DESCRIPTION
99378130		Drift set for stamping engine identification plates (consisting of: 99378101 (**A**) - 99378102 (**B**) - 99378103 (**C**) - 99378104 (**D**) - 99378105 (**E**) - 99378106 (**F**) - 99378107 (**G**) - 99378108 (**V**))
99389834		Torque screwdriver to calibrate injector solenoid valve connector retaining nut
99390330		Valve guide smoother
99390772		Tool to remove remains from injector box
99390804		Tool to thread injector boxes to extract (use with 99390805)
99390805		Guide bushing (use with 99390804)

TOOLS

TOOL NO.		DESCRIPTION
99394015		Guide bushing (use with 99394041 or 99394043)
99394041		Milling cutter to regrind injector seat (use with 99394015)
99394043		Reamer to regrind bottom of injector box (use with 99394015)
99395216		Pair of meters for angular tightening with square 1/2" and 3/4" connection
99395219		Gauge to determine centre distance between camshaft and idle gear
99395603		Dial gauge (0 - 5 mm)

TOOLS

TOOL NO.		DESCRIPTION
99395687		Bore meter (50 - 178 mm)
99396035		Crankshaft front gasket cover centring ring

ENGINE REMOVAL-REFITTING
Removal

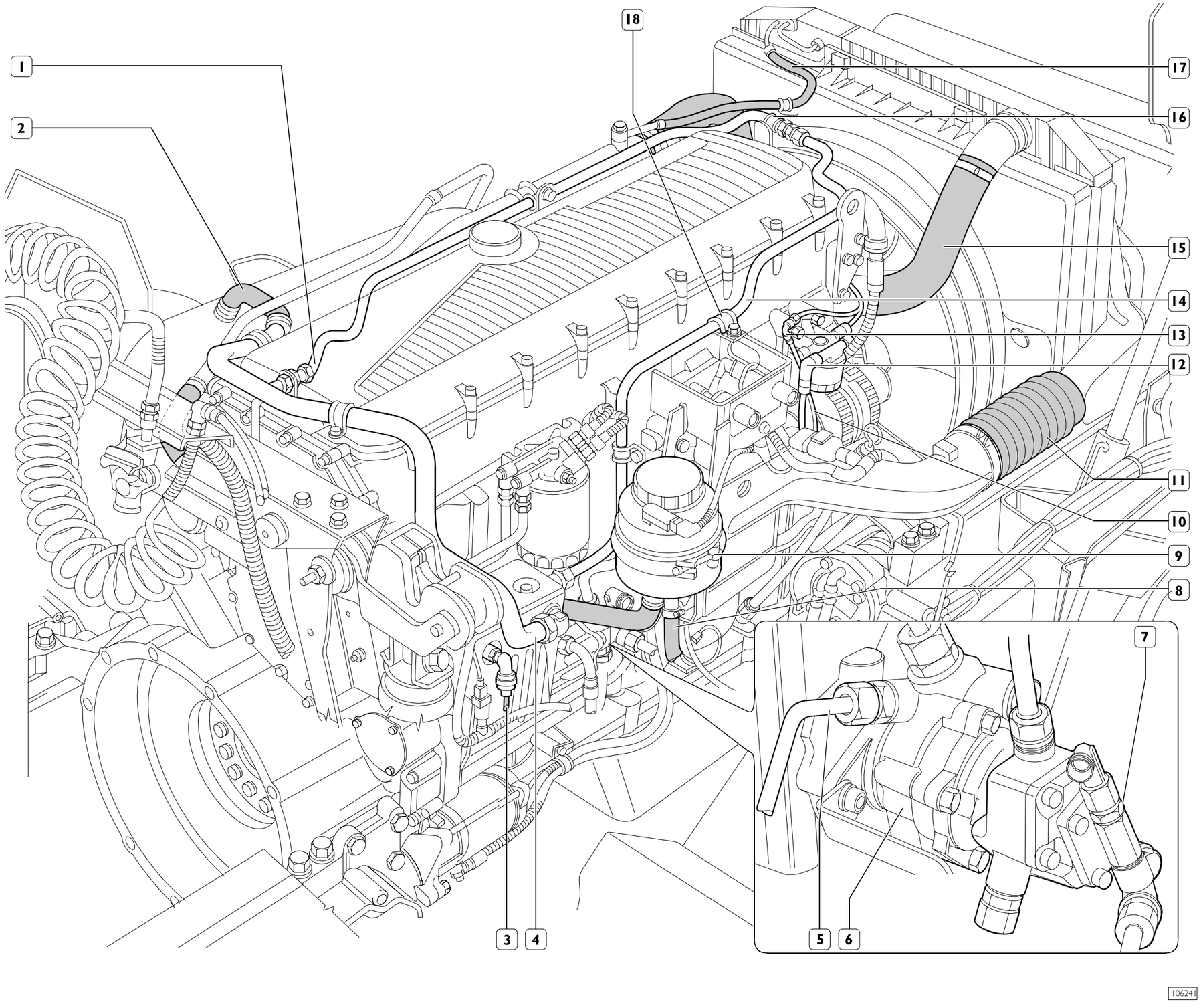
If washing the engine bay, adequately protect the electric/electronic components and their connections.

- ❑ Set the vehicle on the level over a pit. Lock the rear wheels and tilt up the cab.
- ❑ Break the electric circuit by disconnecting the positive cable of the battery.
- ❑ Lift the radiator cowling and tilt up the cab.
- ❑ Disconnect the gearbox as described under the relevant heading, "Disconnecting the Gearbox".
- ❑ Drain the hydraulic power steering and engine cooling systems.

Steps to perform on the engine intake side:

- ❑ Disconnect the pipe (8) from the power steering tank (9) and the pipe (5) from the power steering pump (6).
- ❑ Disconnect pipes from overpressure valve (7) for fuel return to tank;
- ❑ Disconnect the air pipe (12) from the turbocharger actuator air filter. Disengage the pipe (10) supplying air to the fan hub from the clamps and the fitting (13).
- ❑ Disconnect the tube (3) of the air compressor.
- ❑ Disconnect the pipes (4) and (14) from the air compressor, freeing them from the clamps (16) and (18) on the engine.
- ❑ With the hose (2), remove the pipe (4) from the seat on the intake manifold.
- ❑ With the fitting (1), remove the pipe (14).
- ❑ Disconnect the coolant piping (17) and (15) and remove it by freeing it from the clamps.
- ❑ Disconnect the engine air intake sleeve (11).

Figure 17



106241

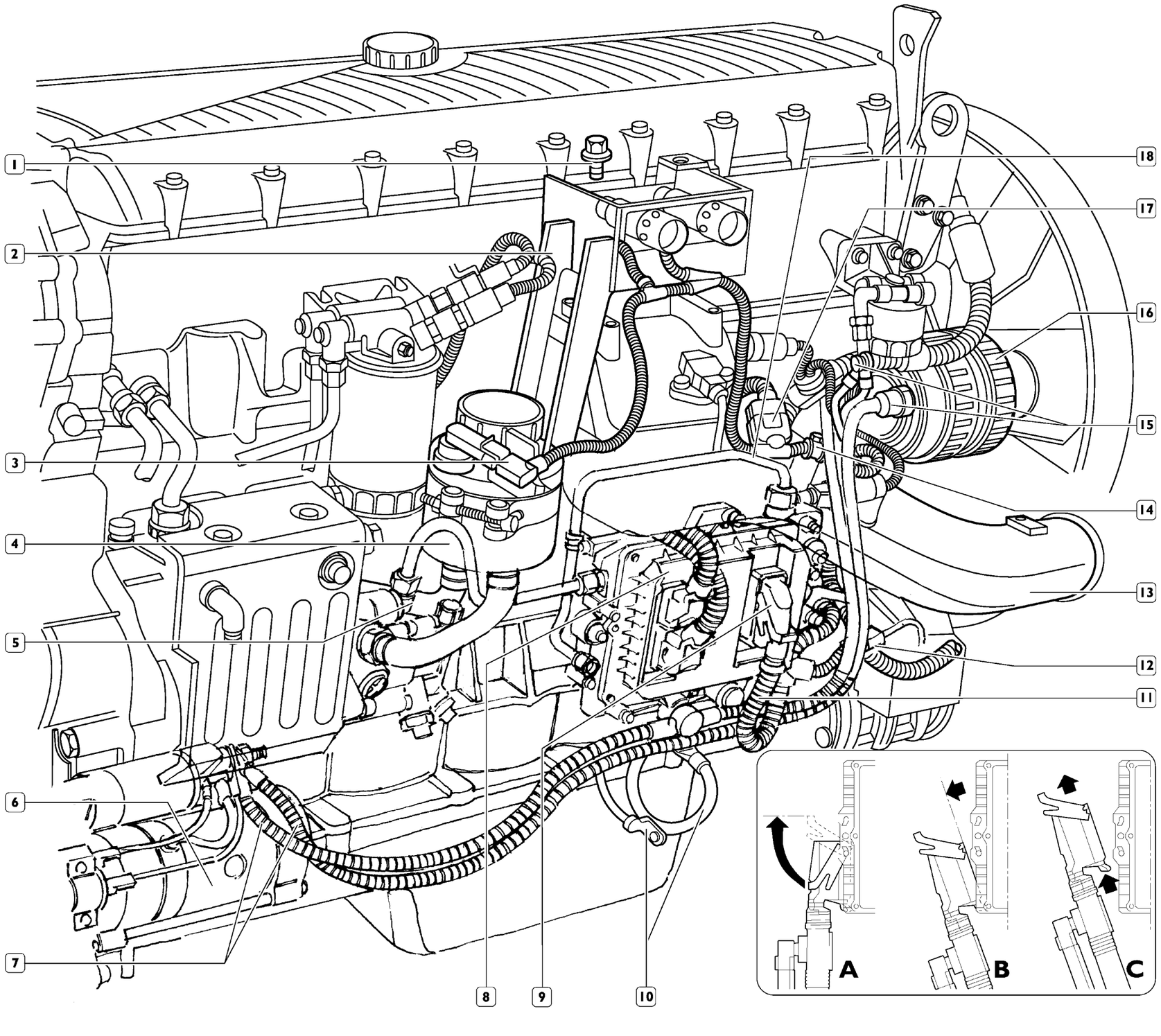
As a preliminary operation it is wise to disconnect the wiring (11) that will remain fastened to the chassis frame, proceeding as follows:

- ❑ Acting on the air intake side, disengage the wiring (11), disconnecting it from the engine cable with the connector (17).
- ❑ Disconnect the electrical connection (3) of the hydraulic power steering tank (4).
- ❑ Remove the entire mount of the engine starting and stopping buttons (2) together with the power steering tank (4), after disconnecting the pipe (5), by taking out the screws (1).

From the electronic control unit (8), disconnect the bottom connector (9), proceeding as follows:

- ❑ **A** Lift the safety lever.
- ❑ **B** Move the connector, disconnecting it from the control unit.
- ❑ **C** Lift the connector, unhooking the stop tooth.
- ❑ Disconnect the earth cable (10) from the crankcase and the electromagnetic clutch cable for the air-conditioning compressor, via the connector (12).
- ❑ Disconnect the electrical connections (7) on the starter motor (6).
- ❑ Disconnect the electrical connections (15) of the alternator (16).
- ❑ Disconnect the electrical connection from the valve on the control unit (8).
- ❑ Disconnect the diesel pipe (18) from the mount of the control unit (8).
- ❑ Then free the wiring (11) from the clamps (14) secured to the engine air intake duct (13) and carefully place it away to the side of the vehicle so it will not interfere with the removal of the engine.

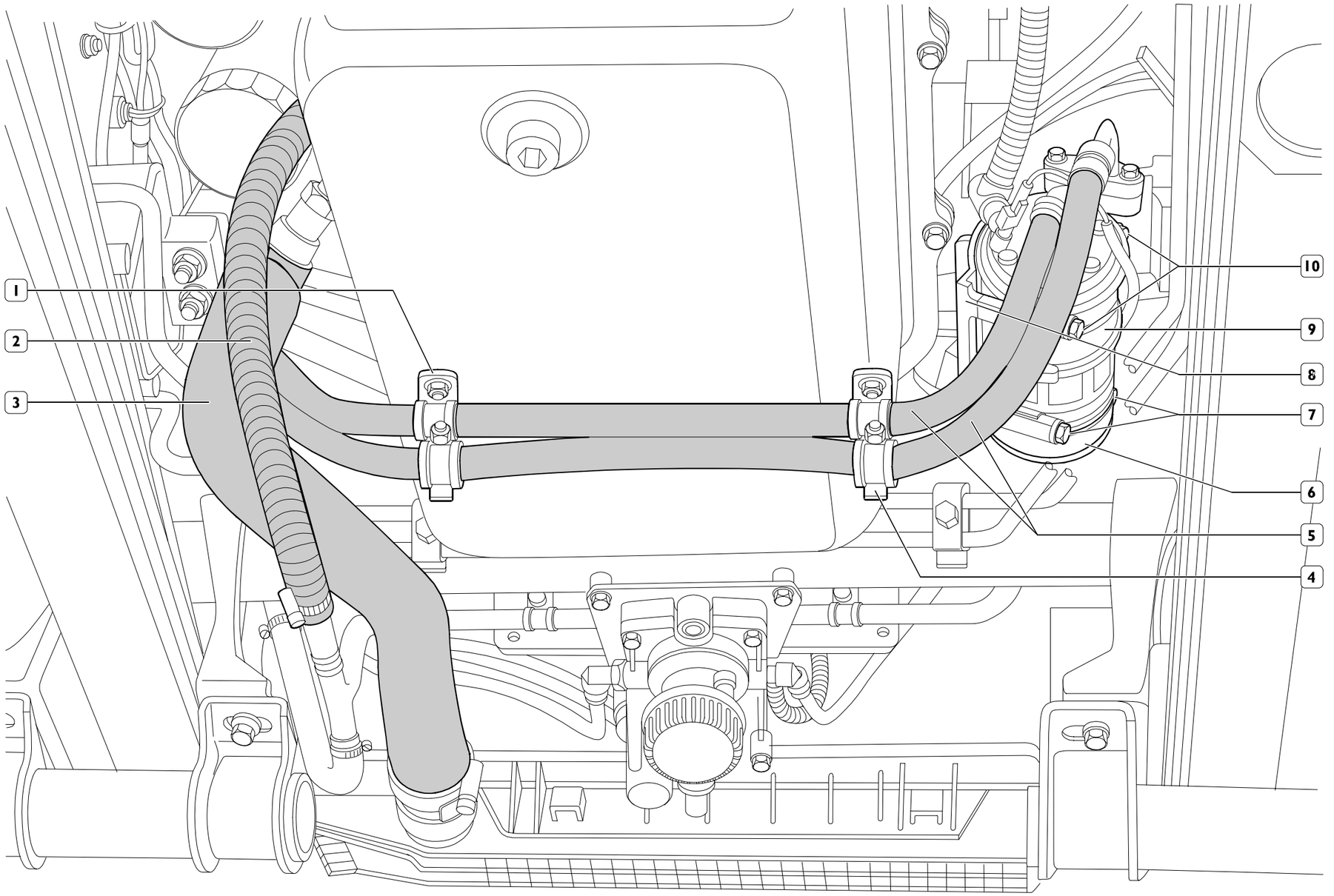
Figure 18



From underneath the vehicle:

- ❑ Disconnect the coolant pipe (3) from the engine and from the radiator, then remove it.
- ❑ Disconnect the coolant pipe (2), loosen and remove the belt (6) from the pulley of the air-conditioning compressor by using the automatic tensioner.
- ❑ Disconnect the compressor (9) from the engine mount (8) by taking out the screws (7) and (10).
- ❑ Without disconnecting the pipes of the compressor and then without discharging the air-conditioning system, free the pipes (5) from the brackets (1 and 4), suitably tie the compressor to vehicle so it does not interfere with the operations of removing the engine.

Figure 19



Working on the engine exhaust side (driver's side), proceed as follows:

- ❑ Disconnect the air sleeve (6).
- ❑ Free the air-conditioning pipes (5) from the clamp (4) secured onto the manifold (3).
- ❑ Disconnect the coolant pipes (9) and (11) from the engine.
- ❑ Remove the engine air intake manifold (12), disconnecting it from the sleeve (21), fastenings (8) and (13), flexible sleeve (14); disconnect the oil vapour recovery pipe (7) and disconnect the air intake pipe of the compressor (20).
- ❑ Disconnect the exhaust pipe (16) by acting on the collar (15) and remove the bracket (17) by undoing the fasteners.
- ❑ Anchor the engine to the beam 99360585 and keep the tool under tension before removing the engine mounts.
- ❑ Take out the front (10) and rear (18) and (19) screws fixing the engine mounts on both sides.
- ❑ Slowly take the engine out of its bay, drawing it slightly back so as to free the fan (2) from the bay of the air conveyor (1) on the radiator.
- ❑ Remove the fan from the hub by using the four screws. Take out the engine completely, taking care over any interference with the remaining parts secured to the chassis frame, especially the wiring interfering with the right-hand rear engine mount.
- ❑ Disconnect the air bleed pipe (22) from the Intarder coolant pipe.

NOTE If washing the engine, adequately protect the electric/electronic components and their connections.

Refitting

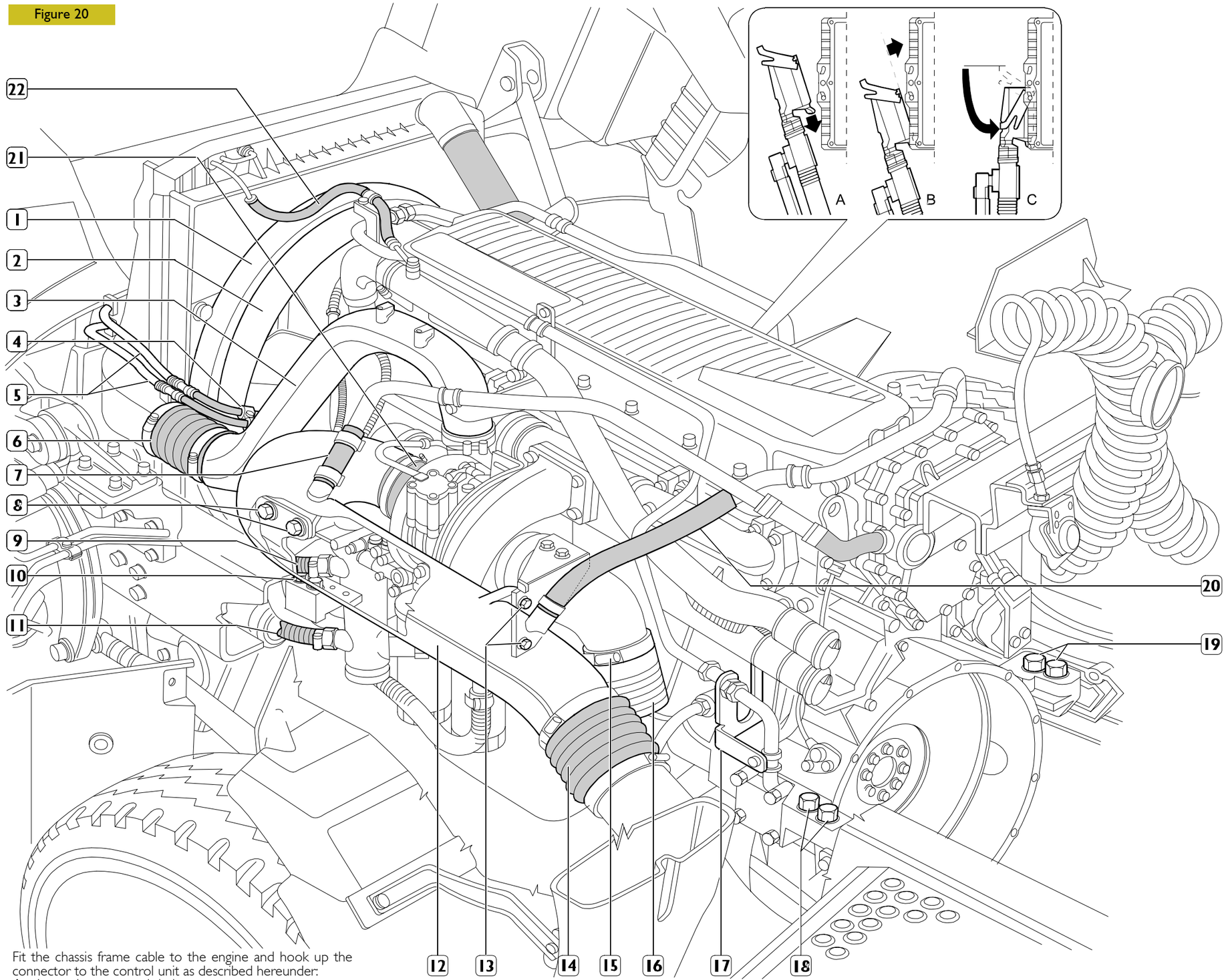
To refit the engine, carry out the steps described for removal in reverse order, taking special care over the steps required to install the assembly in the engine bay, and keep to the following instructions:

- ❑ Check the flexible mountings of the engine and gearbox assemblies; replace them if deteriorated.
- ❑ Check that the parts of the exhaust pipe have not deteriorated or are about to deteriorate, in which case they should be replaced.
- ❑ Tighten the screws and/or nuts to the required torque.
- ❑ Fill the cooling system with coolant as required under the relevant heading.
- ❑ Bleed the air from the supply system as described under the relevant heading (542011).

NOTE Before bleeding the supply system, connect tubes onto the bleed screws located on the pre-filter mount, filter and front of the cylinder head in order to recover the fuel in suitable containers during this operation. In particular, prevent the fuel, on coming out of the bleed screw on the cylinder head, from fouling the belts driving the fan, water pump, alternator and air-conditioner compressor, damaging them.

- ❑ Fill the hydraulic power steering circuit and bleed off the air as described under the relevant heading (501030).
- ❑ Check the engine oil level.

Figure 20



Fit the chassis frame cable to the engine and hook up the connector to the control unit as described hereunder:

A Insert the stop tooth in its seat.
B Hook up the connector.
C Push the safety lever as far as the stop.

73904

Filling the cooling system

Preliminary operations

For vehicles equipped with just the standard cab heating system or manual air-conditioning:

❑ Fully open the coolant cock on the instrument panel.

For vehicles equipped with the automatic air-conditioning system:

❑ Set the temperature control in the cab on the HI position.

For vehicles equipped with an additional heater:

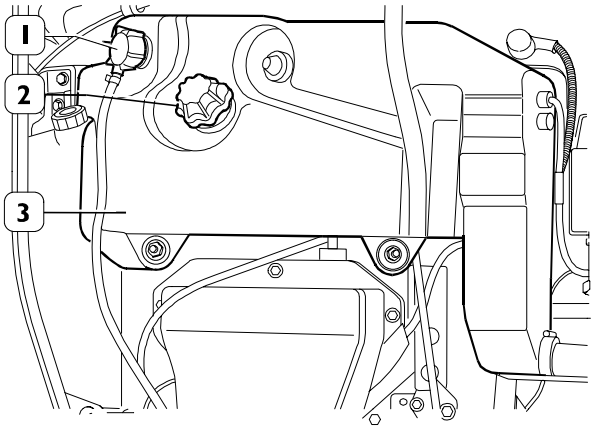
❑ The heater must not be turned on.

Operations

Place a sheet of cardboard between the coolant radiator and the intercooler radiator in order to shorten the time it takes to reach the engine's working temperature (approx. 90°C).

Filling the system

Figure 21



NOTE GENERAL WARNINGS
Filling must be done with the engine cold.
The cap (1) must not be removed for any reasons whatsoever.
To prevent pockets of air forming in the system, the fluid has to be transferred slowly (approximate flow rate 8 litres/min).
For vehicles equipped with an additional heater: the percentage of glycols in the coolant must be no greater than 50%.

After conscientiously following the above warnings, proceed as follows:

❑ Remove the cap (2) from the expansion tub (3).

❑ Pour the coolant into the expansion tub (3) till it is quite full.

Bleeding air from the system

NOTE For vehicles equipped with an additional heater:

❑ Turn on the heater.

❑ Start the engine and keep the speed just above idling for 5 min.

NOTE If the tub empties completely during these first few minutes, stop and engine and top it up at a slower rate than before.
Restart the engine.

❑ After 5 min. running, top up the level of fluid in the expansion tub, if necessary.

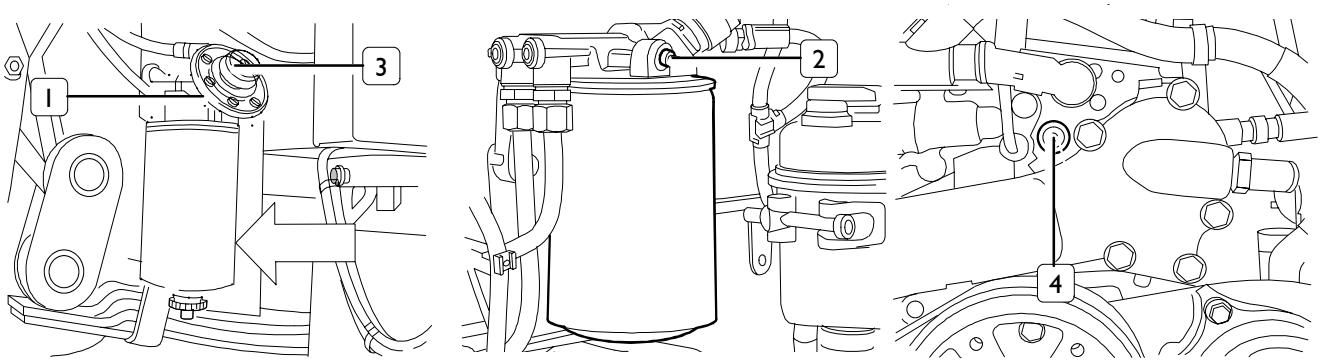
❑ Close the expansion tub filler with the cap (2).
Take the engine up to top speed so that the coolant quickly reaches the temperature of full thermostat opening (approx. 90°C) and keep it in this state until all the air is bled out of the system.
This is checked by seeing there is no foam or air bubbles in the tub.
The longest time it takes to bleed the air from the system completely is approximately 15 minutes from the moment when the thermostat opens (opening starts 85°±2°C).

NOTE Do not take the filler cap off the expansion tub until the fluid in the system has cooled completely.
Any topping up must only be done with the engine cold.

This is to avoid:
1 - Operator burns.
2 - Damage to the engine since cooling system pressurization is only created with the fluid heating from the condition of the engine cold.

542011 Bleeding air from the supply system

Figure 22



Before starting the engine, bleed the air from the supply system, applying special tubes to the bleed screws to run the bled fuel off into a specific container.

- ❑ Bleed screw (1) on the pre-filter mounting.
- ❑ Bleed screw (2) on the filter mounting.
- ❑ Bleed screw (4) on the front of the cylinder head.
- ❑ Work the pump (3) on the pre-filter mounting till fuel with no air bubbles in it comes out of the screw (1); close the screw.
- ❑ Repeat this step for screw (2).
- ❑ Repeat this step for screw (4).

NOTE Under no circumstances let fuel foul the water pump alternator drive belt, etc.

Checks and tests

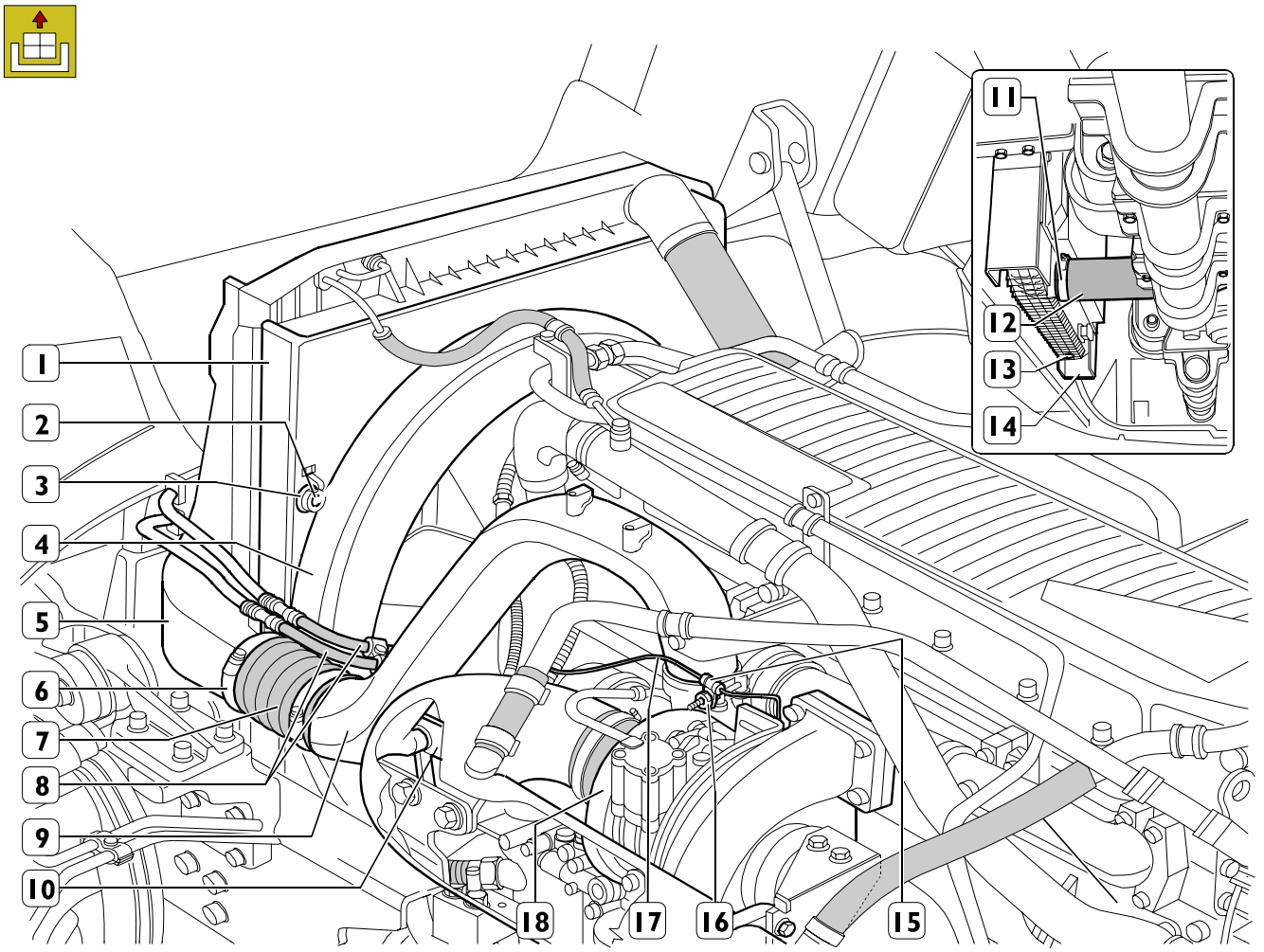
Start the engine, leave it running at just a little faster than idling speed and wait for the temperature of the coolant to reach the level to open the thermostat. Then, check that:

- ❑ No water leaks from the connecting sleeves of the pipes in the engine cooling and cab heating circuits, tightening the collars further if this is necessary.
- ❑ No oil leaks from between the cover and the cylinder head, between the oil sump and the crankcase, between the oil filter and its seat, between the heat exchanger and the crankcase, or between the various pipes in the lubrication circuit.
- ❑ No air leaks from the pipes connected to the pneumatic components involved in removal.
- ❑ The indicator lights on the instrument panel and the devices disconnected when removing the engine all work properly.

543422 ELECTRO-MAGNETIC JOINT REPLACEMENT

Removal

Figure 23



To cut off the batteries, remove the electric wires or open the main switch.

Lift the calender and tilt the cabin.

Go under the vehicle and remove the plug (13) from the radiator (14) and drain the coolant fluid in the appropriate container.

Remove the clip (11) and disconnect the radiator (12) sleeve (14).

Remove the climate control system pipe (8) fastening screw (if fitted) to the air conveyor (9).

Remove the air conveyor (9) fastening screws (10) from the support bracket.

Remove the two sleeve fastening screws to the intercooler radiator (5).

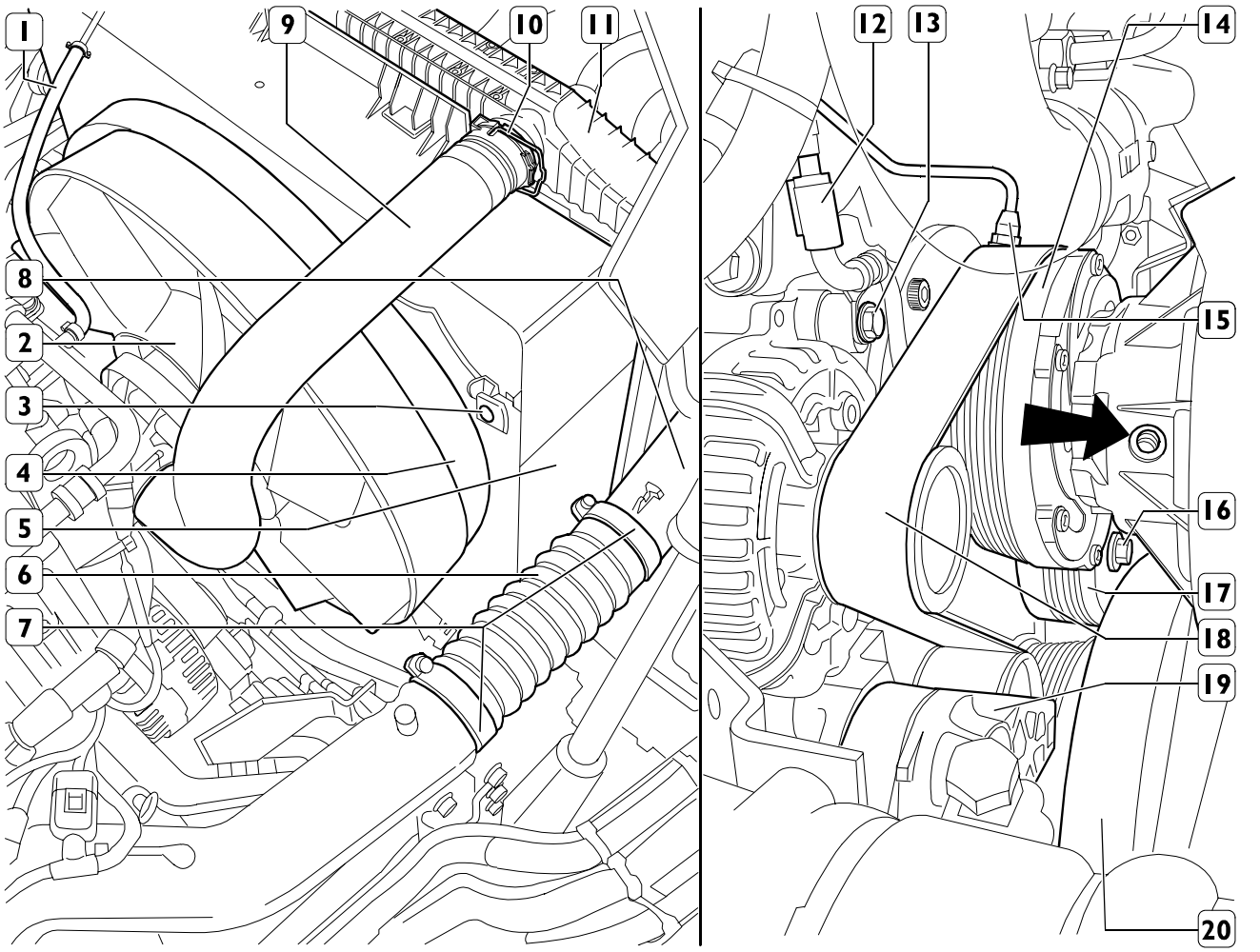
Remove nut (16), then disconnect electric cable (17). Slacken the clamp (15) and remove the air conveyor (9) from the turbocharger (18) and from the intercooler radiator (5).

Slacken the sleeve (6) fastening clamp (7) from the intercooler (5) radiator.

Drive in the suitable self-threading screw in the pin hole (2) taking care to partially take off and finally remove with a screwdriver the upper clip (3) fastening the fan air (4) conveyor to the radiator guard (1).

Remove the lower clip in the same way.

Figure 24



Disconnect the pipe (1) from the thermostat.
Remove the clip (10) and disconnect the sleeve (9) from the radiator (11).
Slacken the clamps (7) and remove the sleeve (6).
Remove the upper and lower clip (3) as described for the left-hand side.
Remove the radiator support fastening screws on the chassis and move the radiator unit forwards.
Lift air conveyor (4) and disconnect it from the vehicle.
Remove the radiator support fastening screws (2) on the chassis and move the radiator unit forwards (14).
Remove the fan fastening screws (2).
Loosen belt (18) tension by acting on automatic belt-stretcher (19), then remove the belt from the pulleys.
Disconnect the electric connection (12) from the electro-magnetic join (14).
Lock engine shaft rotation.
Remove securing screws and dismount damper flywheel (20).
Unscrew screw (16) and dismount pulley (17).
Disconnect pneumatic piping (15) from electromagnetic coupling (14).
Remove the fan fastening screws (13) to the electro-magnetic joint (14).

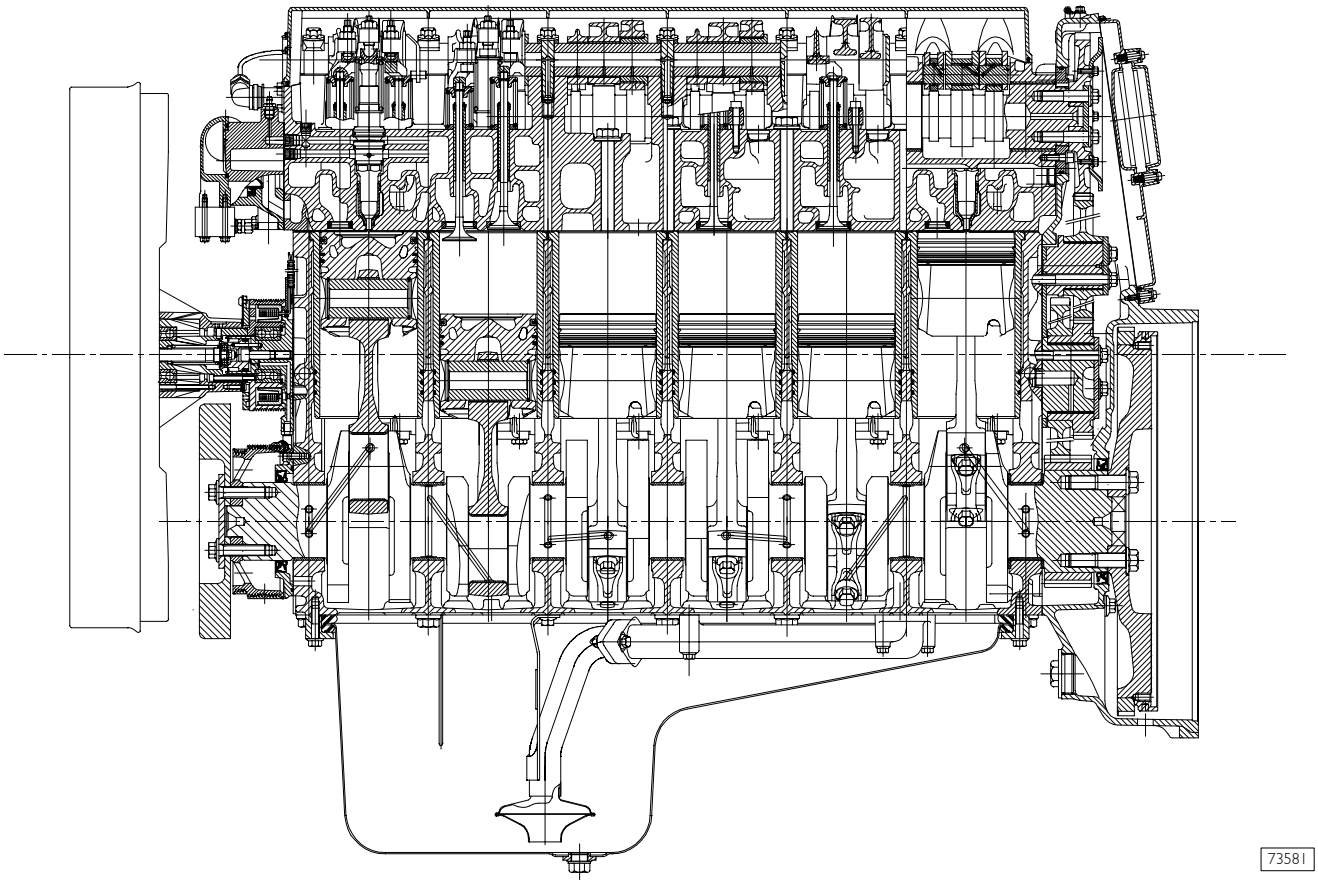
Refitting

To refit the electro-magnetic joint, reverse the removal procedure and attain to the following rules:

- ❑ check the control belt (18) conditions; replace it if damaged or worn out;
- ❑ tighten the screws and/or nuts to the prescribed torque;
- ❑ fill the cooling system with the prescribed fluid, then blow air off the cooling system as described in the respective chapter;

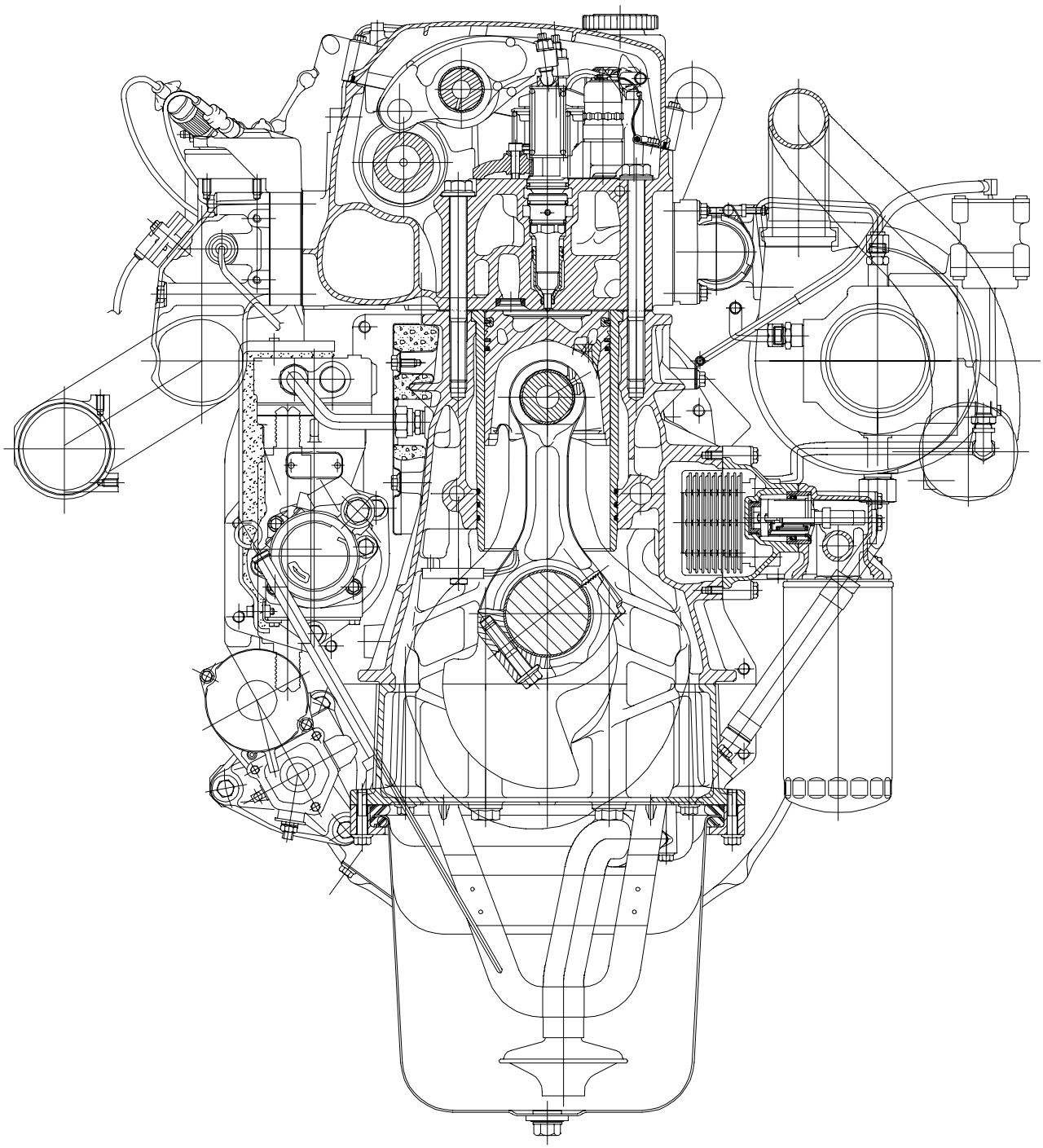
NOTE The electro-magnetic joint is fitted with two threaded holes (→) at 180° one from the other. In the event of fault, lock the joint control driving in a M8x16 mm screw in these holes. In this way it is possible to take the vehicle to the closest dealership.

Figure 25



LONGITUDINAL SECTION OF THE ENGINE

Figure 26



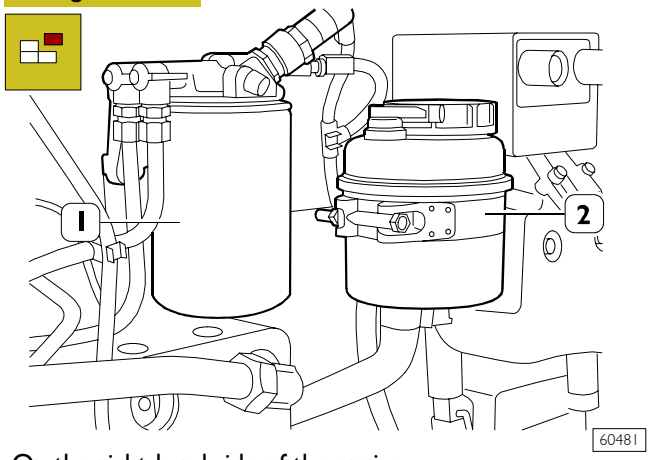
71699

TRANSVERSE SECTION OF THE ENGINE

540110 DISASSEMBLY THE ENGINE ON THE BENCH

Before fastening the engine on rotary stand 99322230, dismount or disconnect following parts:

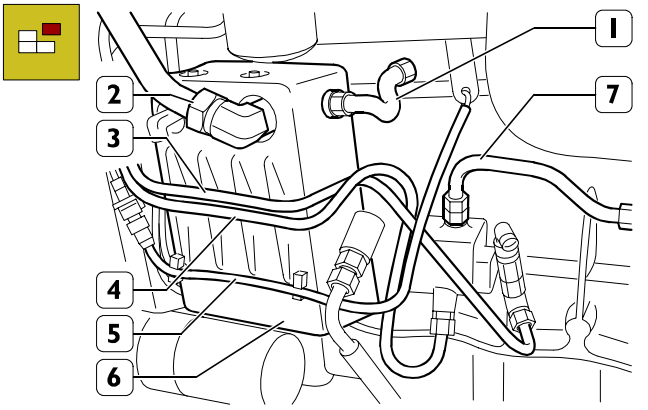
Figure 27



On the right-hand side of the engine

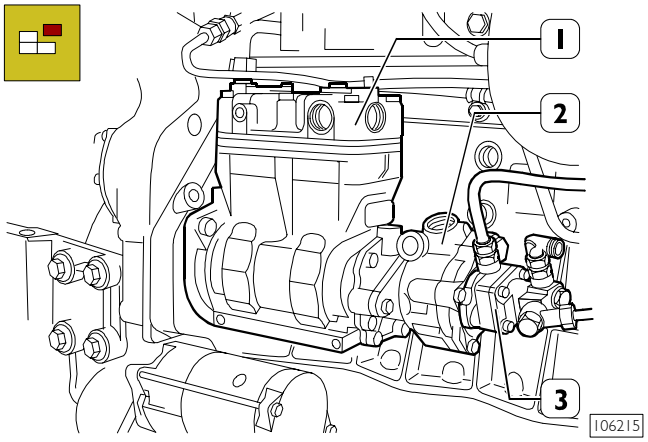
- ❑ the fuel cartridge filter (1).
- ❑ the hydraulic power steering tank (2).
- ❑ the electrical connections.

Figure 28



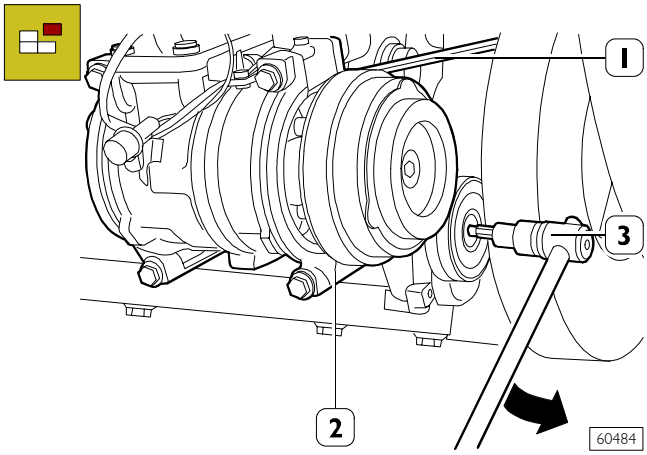
- ❑ pipes (3, 4 and 7);
- ❑ electrical cables (5);
- ❑ sound deadening guard (6);
- ❑ pipes (1 and 2).

Figure 29



- ❑ compressor (1) complete with oversteering pump (2) and feed pump (3).

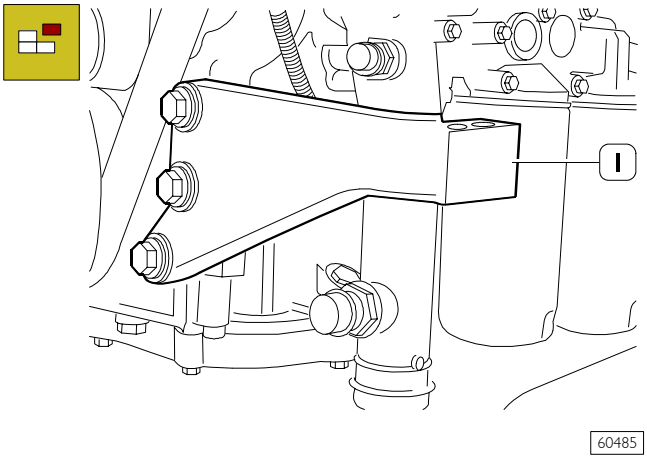
Figure 30



- ❑ Using the right tool (3), turn it in the direction shown by the arrow and remove the air-conditioner drive belt (1).
- ❑ Remove the air-conditioner (2) together with the engine mounting.

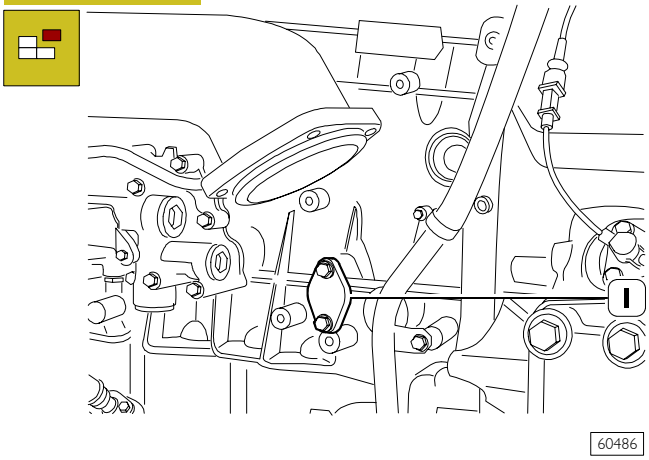
On the left-hand side of the engine

Figure 31



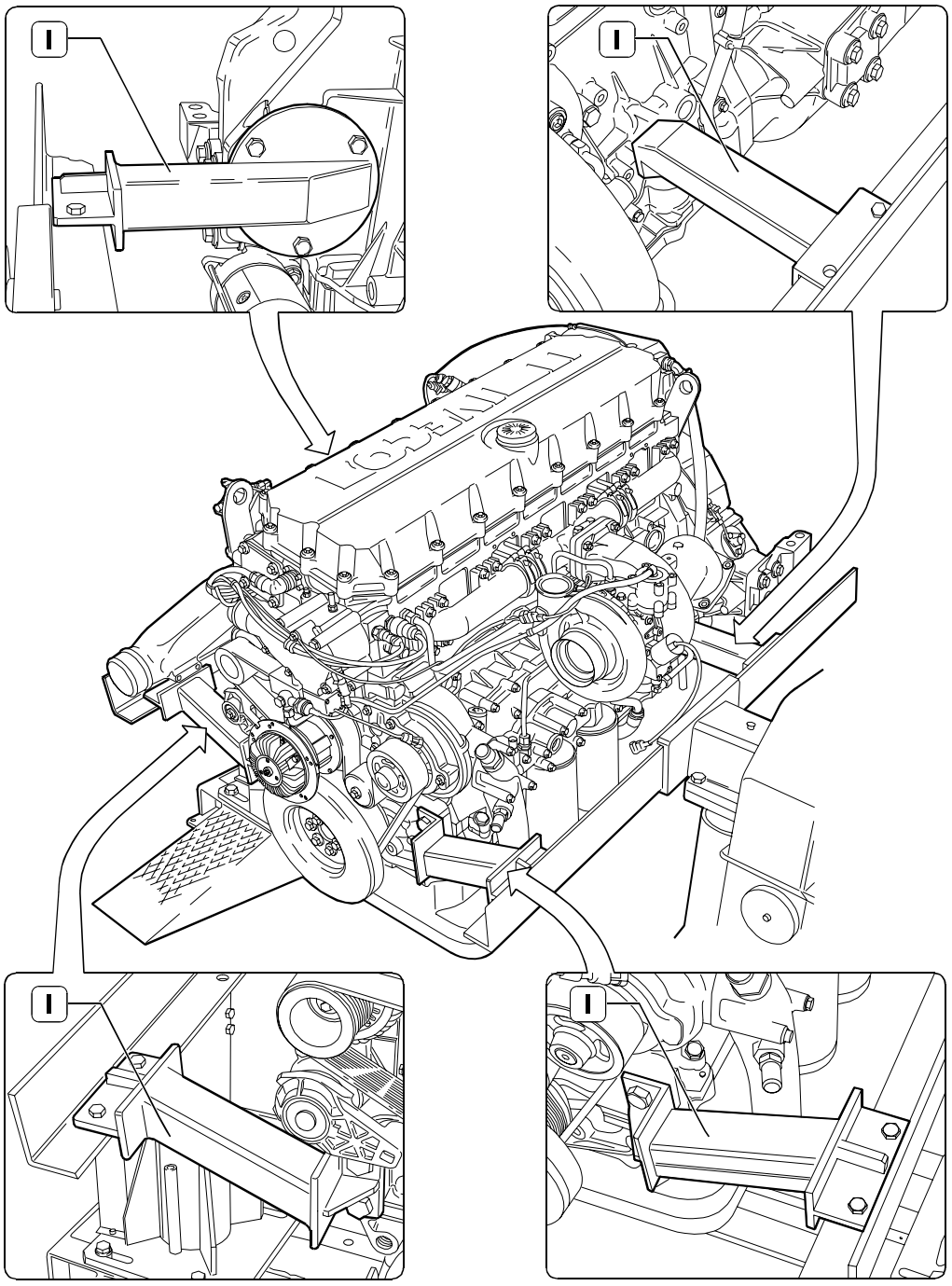
- ❑ the engine mounting (1).

Figure 32



- ❑ the oil pressure adjustment valve (1).

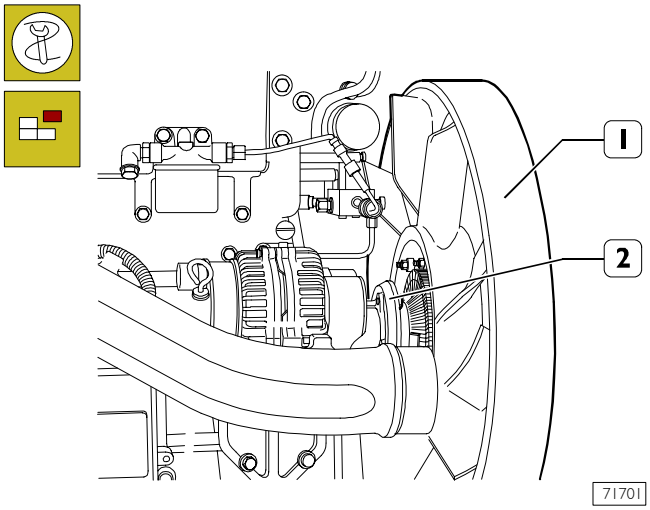
Figure 33



Secure the engine to the rotary stand 99322030 with the brackets 99361036 (1).

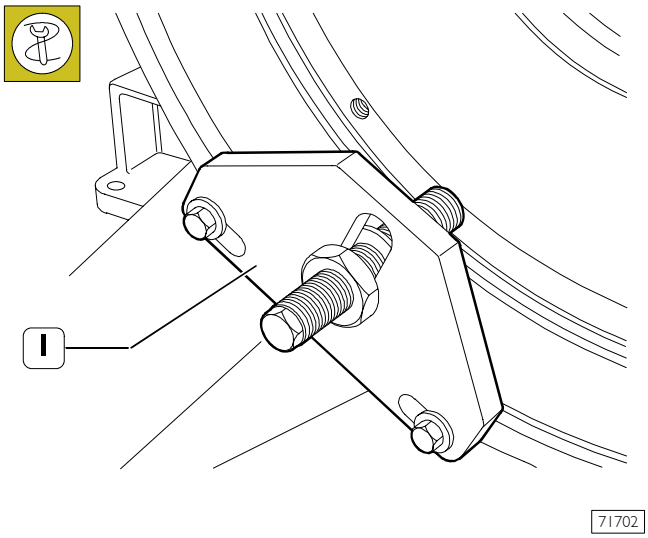
Remove the electrical wiring by disconnecting from the electrical sensors and actuators.

Figure 34



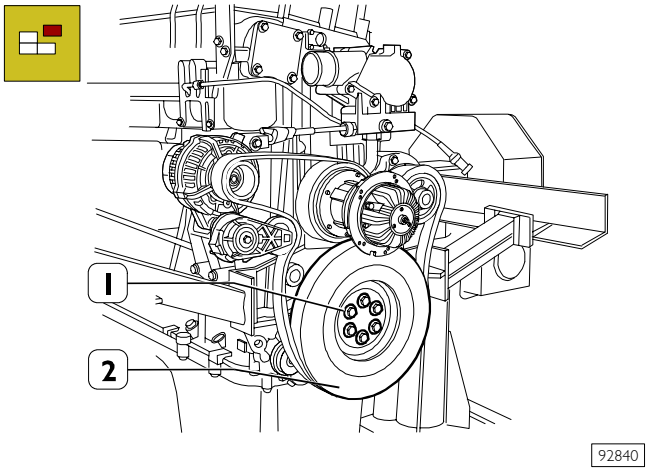
If present, dismount fan (1) from electromagnetic joint (2).

Figure 35



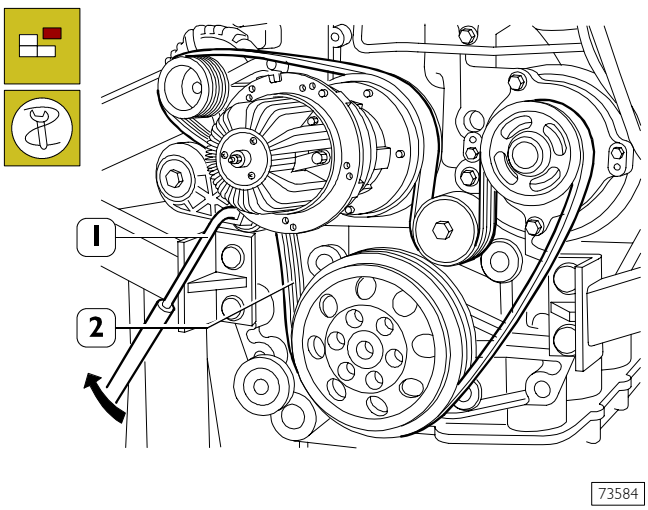
Use tool (1) 99360351 to lock the engine flywheel.

Figure 36



Operate the 6 Allen screws to remove the damper flywheel (1).

Figure 37

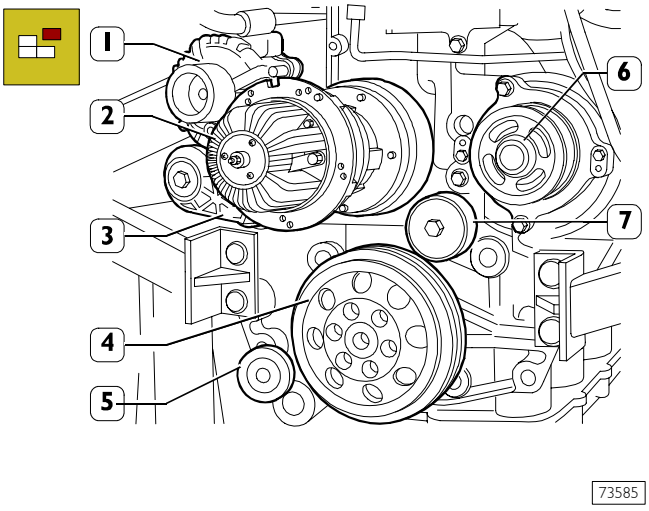


Using an appropriate tool (1), turn it in the direction shown by the arrow and remove the auxiliary member drive belt (2).

If present, dismount compressor for climate control system and relating driving spring belt.

NOTE Spring belt must be replaced by a new one after every dismounting operation.

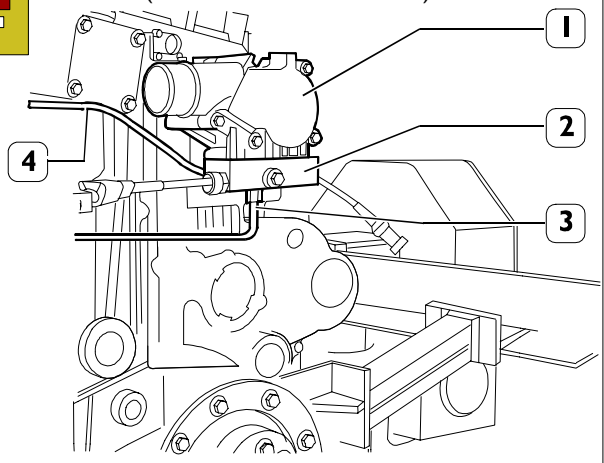
Figure 38



Remove the alternator (1), electric fan coupling (2), automatic tensioners (3 and 5), pulley (4), water pump (6) and pulley (7).

Figure 39

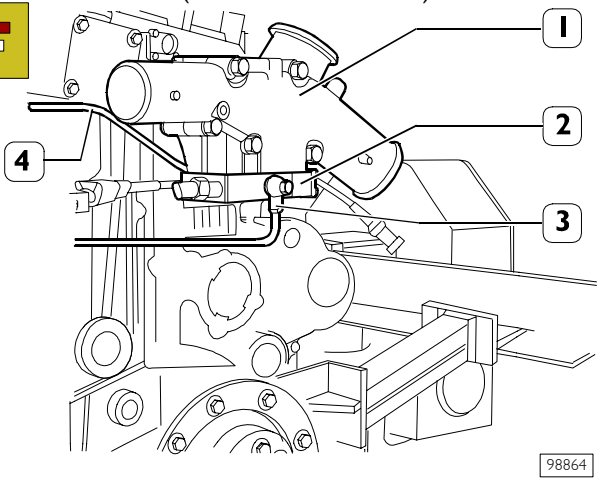
(Version without Intarder)



Disconnect the pipes (3 and 4) from the V.G.T control solenoid valves.
Remove the thermostat assembly (1) together with the V.G.T. control solenoid valve (2).

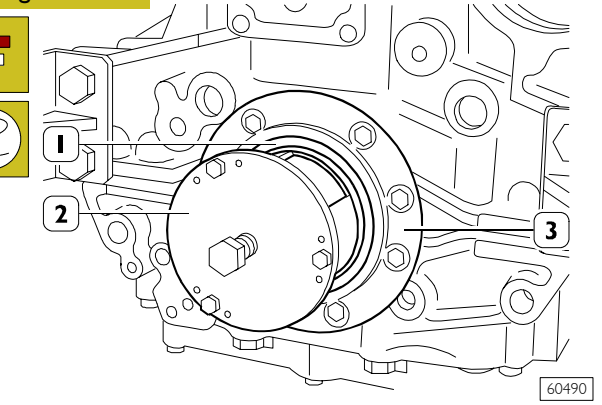
Figure 40

(Version with Intarder)



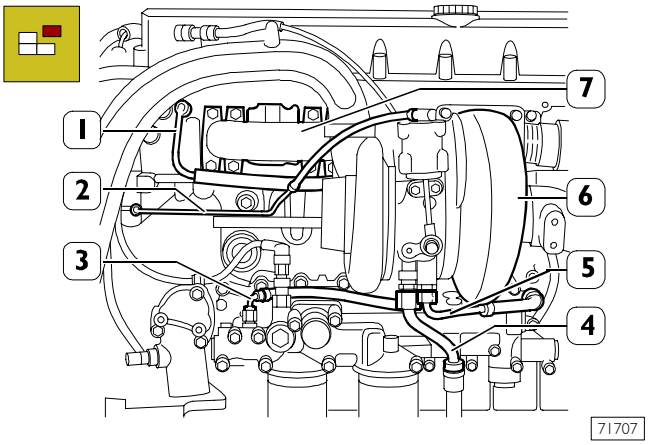
Disconnect the pipes (3 and 6) from the V.G.T control solenoid valves. Remove the water inlet/outlet pipe assembly (1) together with the V.G.T. control solenoid valve (2).

Figure 41



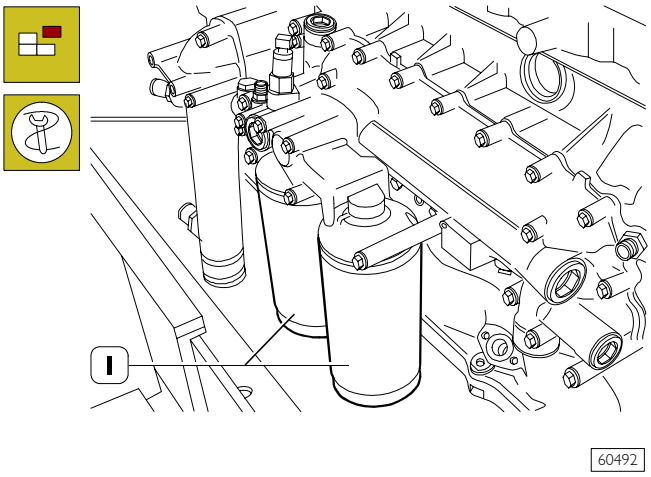
Apply extractor 99340053 (2) and take out the crankshaft seal (1); now remove the flange (3).

Figure 42



Remove the following components: water delivery pipe (5); water outlet pipe (1); actuator control air pipe (2); oil delivery pipes (3); oil return pipes (4); turbo-compressor unit (6); exhaust manifold (7).

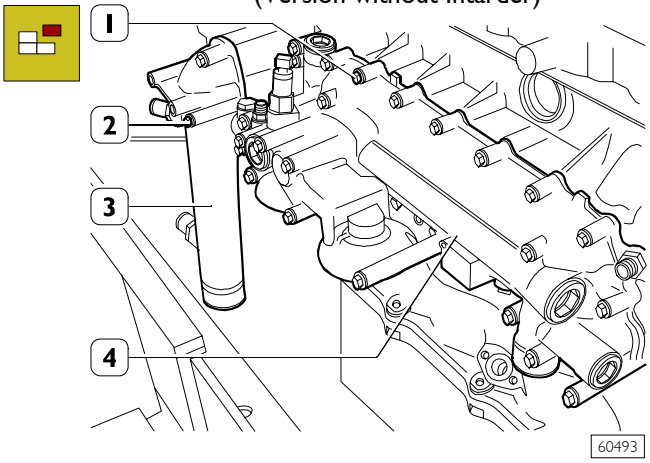
Figure 43



Use tool 99360314 to slacken the oil filters (1).

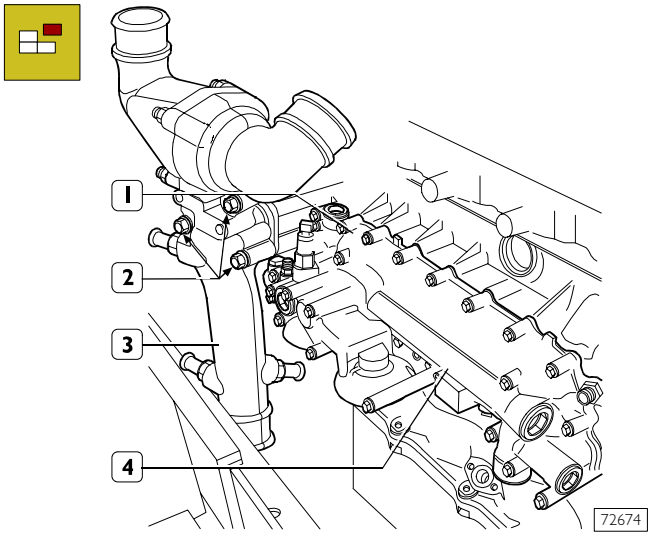
Figure 44

(Version without Intarder)



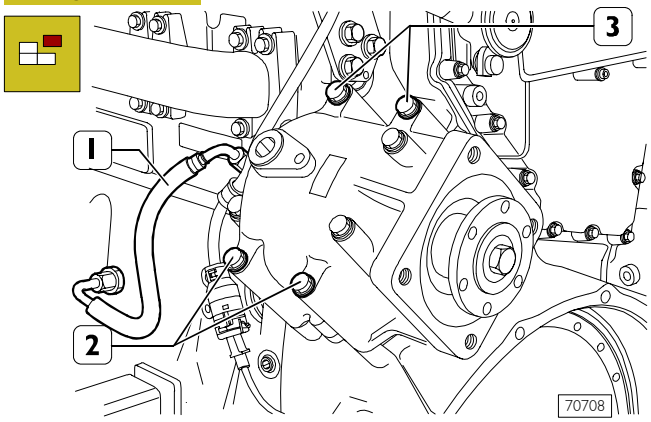
- ❑ Slacken the screws (1) and remove the intercooler (4);
- ❑ Slacken the screws (2) and remove the water pipe (3).

Figure 45 (Version with Intarder)



- ❑ Slacken the screws (1) and remove the intercooler (4);
- ❑ slacken the screws (2) and remove the thermostat (3).

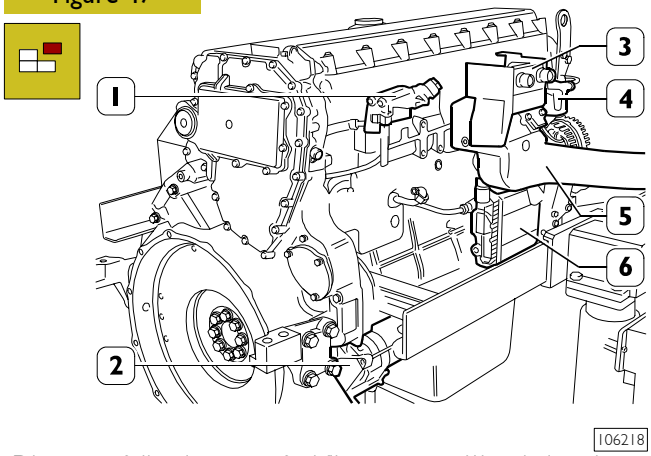
Figure 46



The remove the P.T.O. (if fitted):

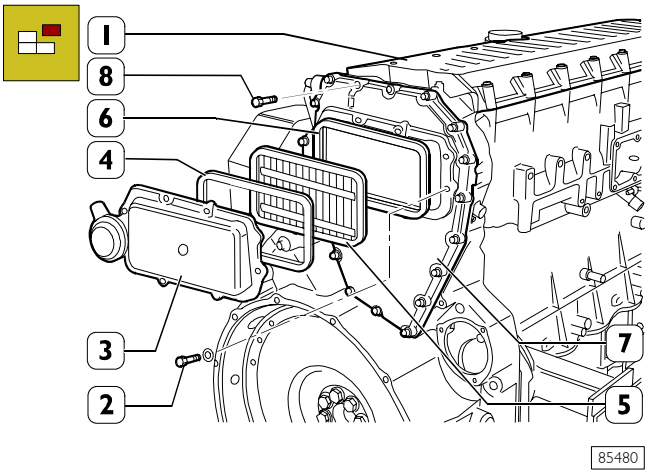
- ❑ disconnect the oil pipe (1);
- ❑ slacken the 4 screws (2) and (3).

Figure 47



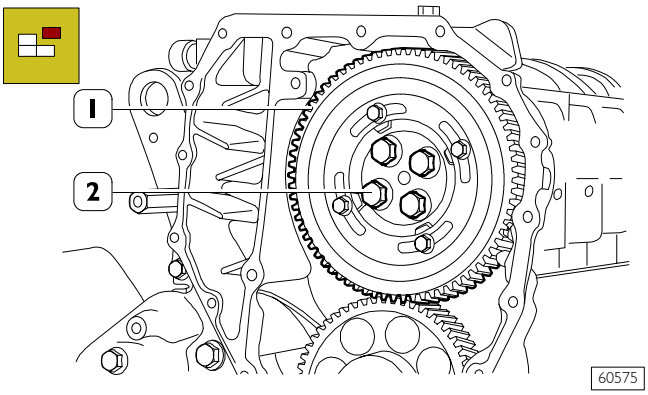
Dismount following parts: fuel filter support (1); relating pipes; starter (2); support for engine startup pushbuttons (3); air filter for PWN valve (4); intake manifold (5) complete with resistance for engine preheating; engine central unit (6);

Figure 48



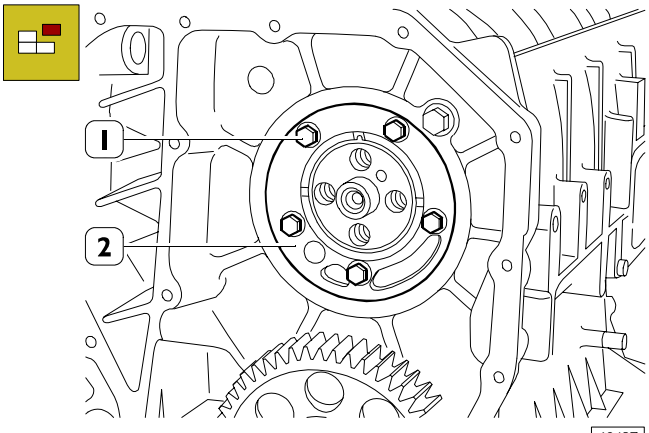
Remove the rocker arm cover (1), take off the screws (2) and extract the cover (3), the filter (5) and the gaskets (4 and 6). Remove the screws (8) and the blow-by case (7).

Figure 49



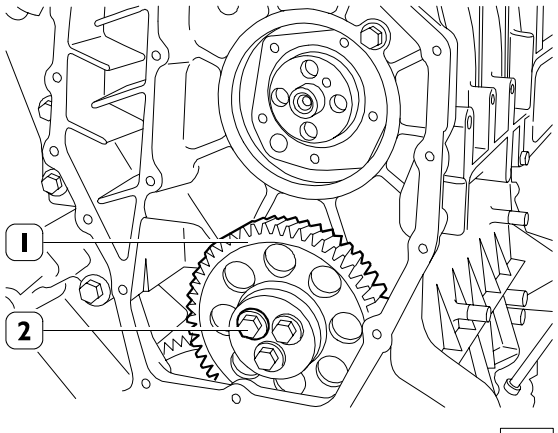
- ❑ Slacken the screws (2) and remove the gear (1) together with the phonic wheel.

Figure 50



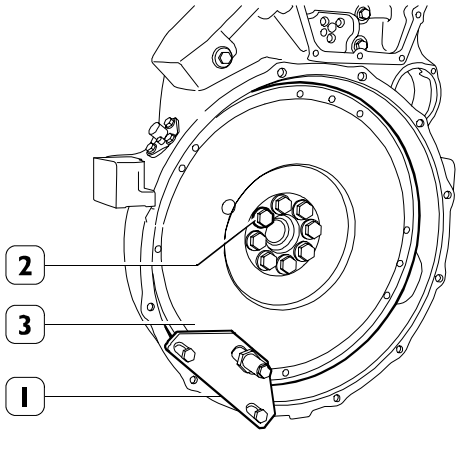
- ❑ Slacken the screws (1); drive one of them in a torque hole in order to remove the shoulder plate (2) and extract the metal sheet gasket.

Figure 51



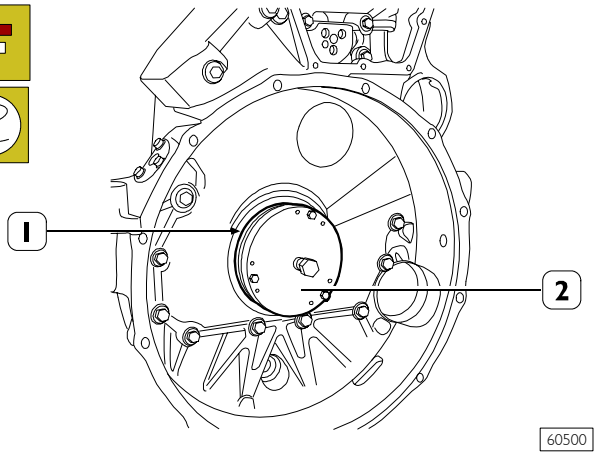
Unscrew the screws (2) and remove the idle gear (1).

Figure 52



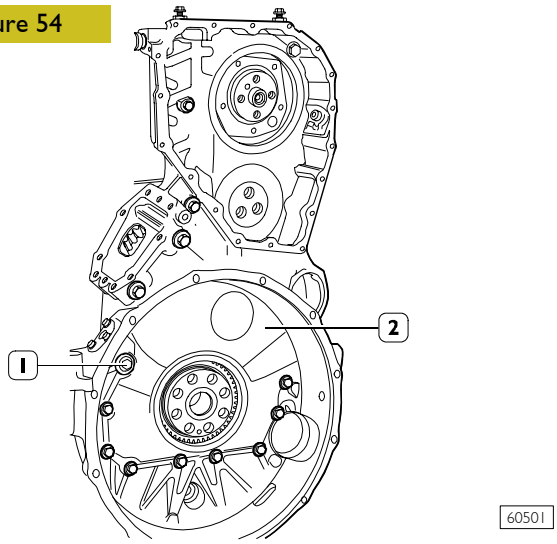
With the engine flywheel locking tool 99360351 (1) fitted, unscrew the fixing screws (2). Take off the tool (1) and extract the flywheel (3).

Figure 53



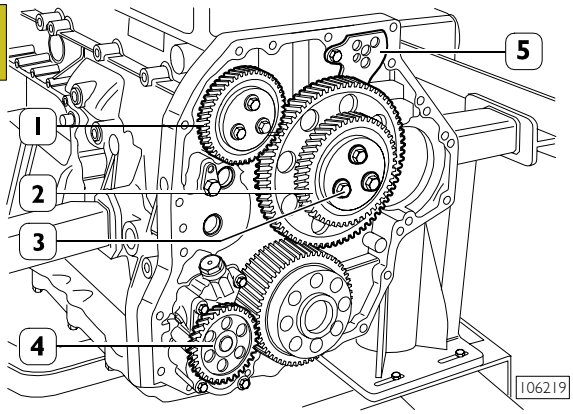
Fit on the extractor 99340054 (2) and extract the gasket (1).

Figure 54



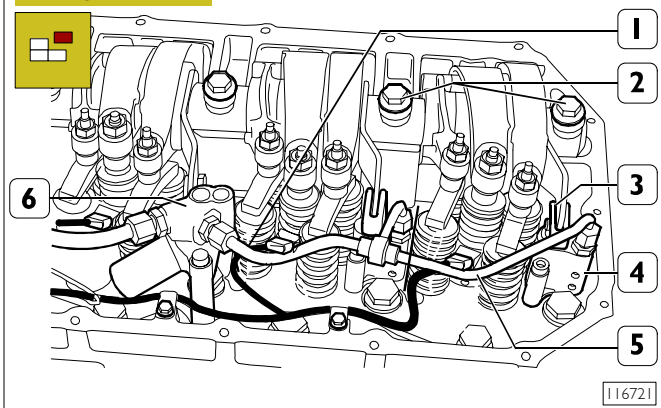
Unscrew the screws (1) and remove the gearbox (2).

Figure 55



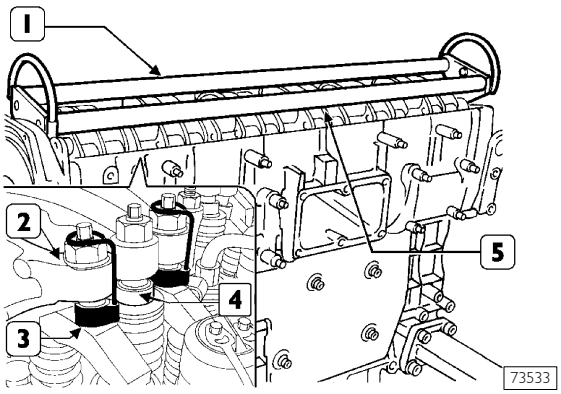
If present, dismount P.T.O. driving gear (1).
Remove screws (3) and dismount double gear (2).
Remove securing screw and dismount articulated rod (5).
Dismount oil pump (5).

Figure 56



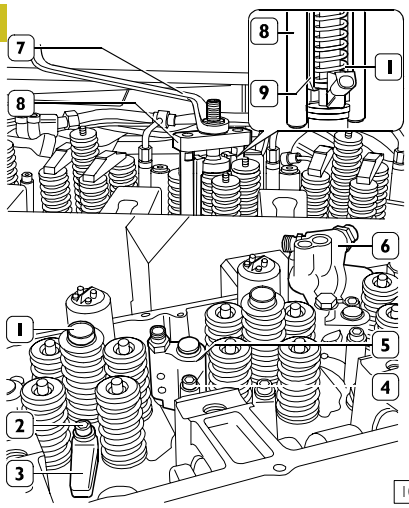
- ❑ Release the check springs (3) of the exhaust brake lever.
- ❑ Remove the electric connections (1).
- ❑ Remove exhaust brake pins (4) and slave cylinder (6) pipes (5).
- ❑ Unscrew the screws (2) fixing the rocker arm shaft.
- ❑ Remove the head injection wiring.
  The wiring has to be extracted from the front.

Figure 57



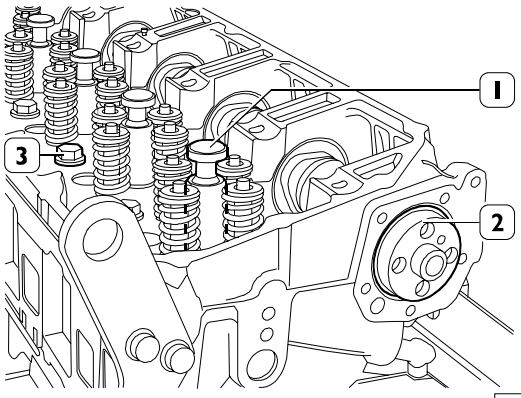
Using tool 99360144 (3), constrain the blocks (4) to the rockers (2). Apply tool 99360553 (1) to the rocker holder shaft (5) and remove the shaft (5) from the cylinder head.

Figure 58



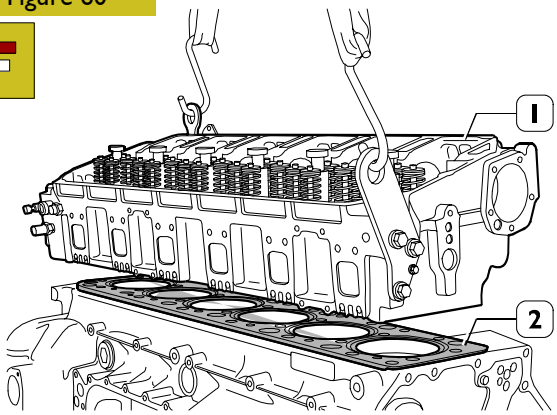
- ❑ Unscrew the screws (2) fixing the brackets (3);
- ❑ hook tool 99342155 part (9) to pump injector (1);
- ❑ mount part (8) on part (9) resting part on cylinder head;
- ❑ screw nut (7) and extract pump injector (1) from cylinder head.
- ❑ unscrew the screws (4) and remove the exhaust brake pins (5).
- ❑ unscrew the screws and remove the slave cylinder (6).

Figure 59



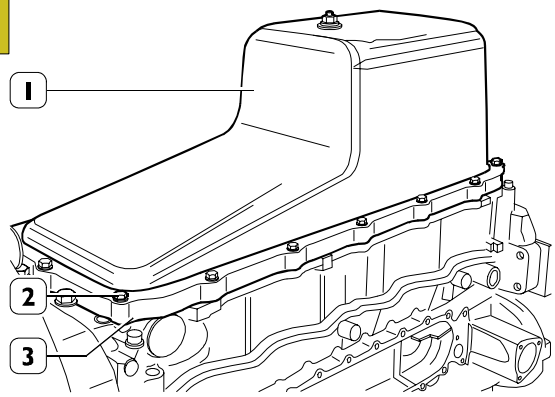
- ❑ Insert the plugs 99360180 (1) in place of the injectors.
- ❑ Extract the camshaft (2).
- ❑ Unscrew the screws fixing the cylinder head (3).

Figure 60



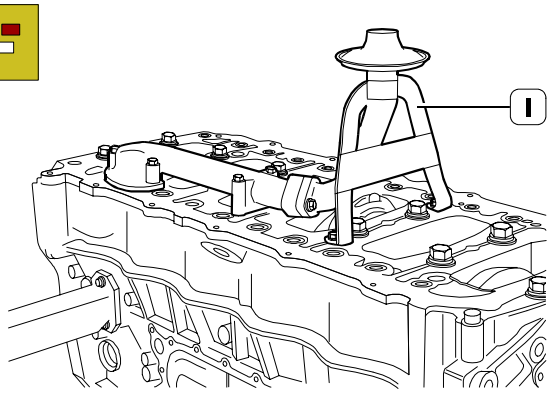
- ❑ Using metal ropes, lift the cylinder head (1).
- ❑ Take off the gasket (2).

Figure 61



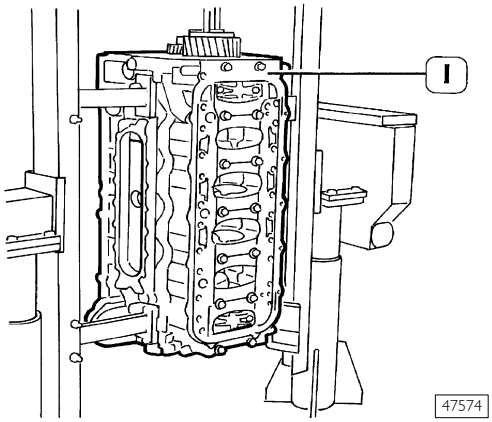
Unscrew the screws (2) and take out the engine oil sump (1) together with the spacer (3) and gasket.

Figure 62



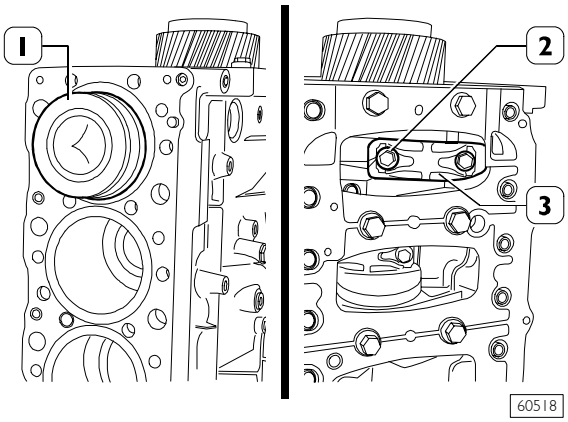
Unscrew the screws and take out the suction strainer (1).

Figure 63



Turn the crankcase (1) upright.

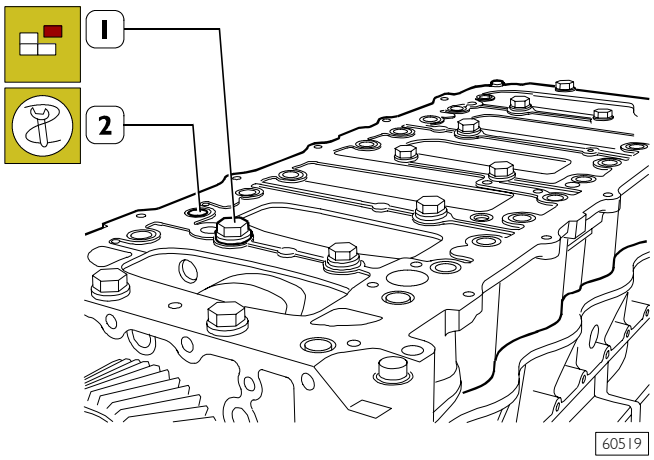
Figure 64



Untighten screws (2) fixing the connecting rod cap (3) and remove it. Remove the connecting rod-piston (1) assembly from the upper side. Repeat these operations for the other pistons.

NOTE Keep the big end bearing shells in their respective housings and/or note down their assembly position since, if reusing them, they will need to be fitted in the position found upon removal.

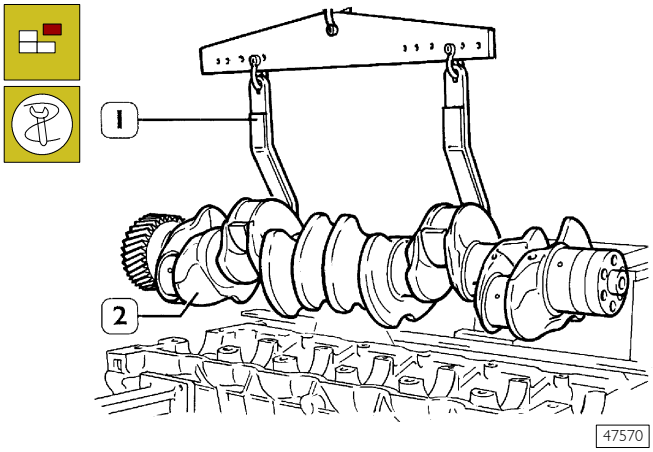
Figure 65



Using an appropriate wrench and the hex wrench unscrew the screws (1) and (2) and take off the crankcase base.

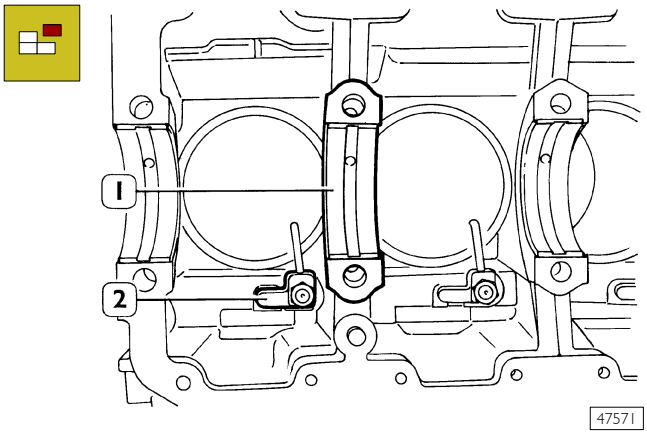
NOTE Note down the assembly position of the top and bottom main bearing shells since, if reusing them, they will need to be fitted in the position found upon removal.

Figure 66



Using tool 99360500 (1), remove the crankshaft (2).

Figure 67



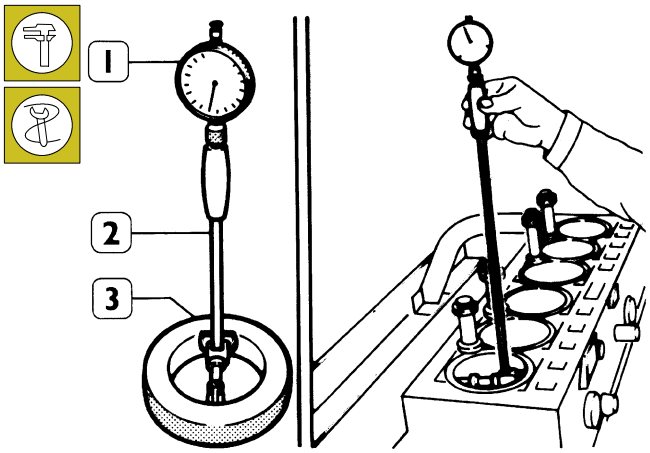
Extract the main bearing shells (1), unscrew the screws and take out the oil nozzles (2).
Remove the cylinder liners as described under the relevant heading on page 182.

NOTE After removing the engine, you need to clean the removed parts thoroughly and check their integrity. The following pages give the instructions for making the checks and the main measurements to make to determine whether the parts can be reused.

REPAIRS

540410 CYLINDER BLOCK
540420 Checks and measurements

Figure 68 (Demonstration)

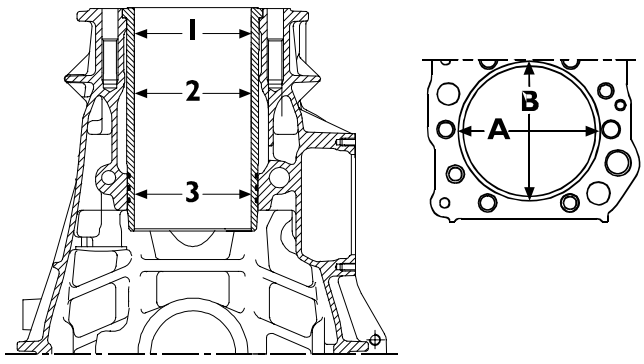


34994

The inside diameter of the cylinder liners is checked to ascertain the extent of ovalization, taper and wear using the gauge 99395687 (2) fitted with the dial gauge (1), zeroed beforehand on the ring gauge (3) of diameter 135 mm.

NOTE If you do not have a ring gauge of diameter 135 mm, use a micrometer for this purpose.

Figure 69

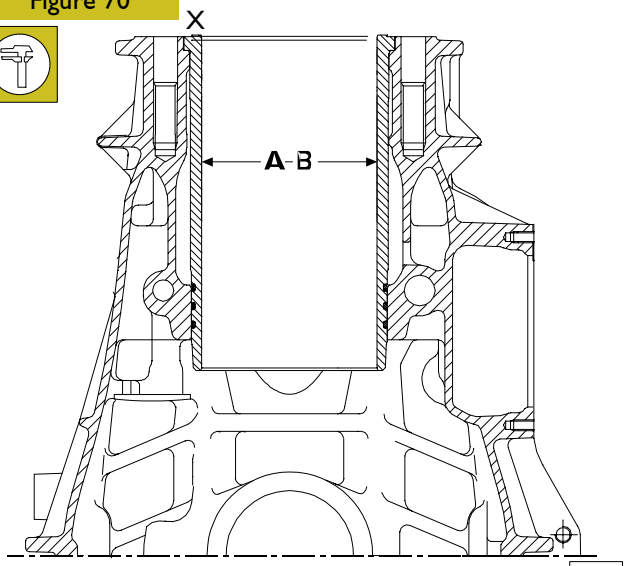


60596

1 = 1st measurement
2 = 2nd measurement
3 = 3rd measurement

The measurements have to be made on each single cylinder liner at three different heights and on two levels (A-B) at right angles to each other as shown in figure.

Figure 70



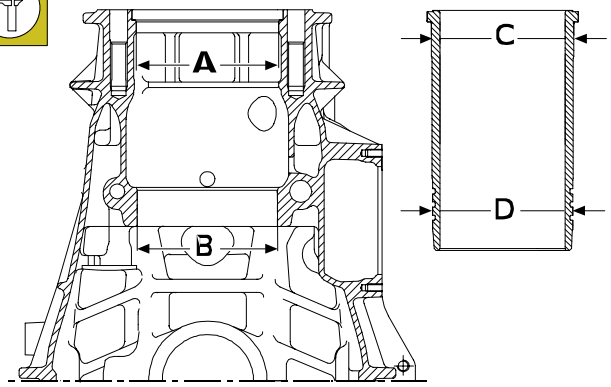
60595

A = Selection class Ø 135.000 to 135.013 mm
B = Selection class Ø 135.011 to 135.024 mm
X = Selection class marking area

On finding maximum wear greater than 0.150 mm or maximum ovalization of 0.100 mm compared to the values shown in the figure, you need to replace the cylinder liner as no grinding, facing or reconditioning is permitted.

NOTE The cylinder liners are supplied as spare parts with selection class "A".

Figure 71



60597

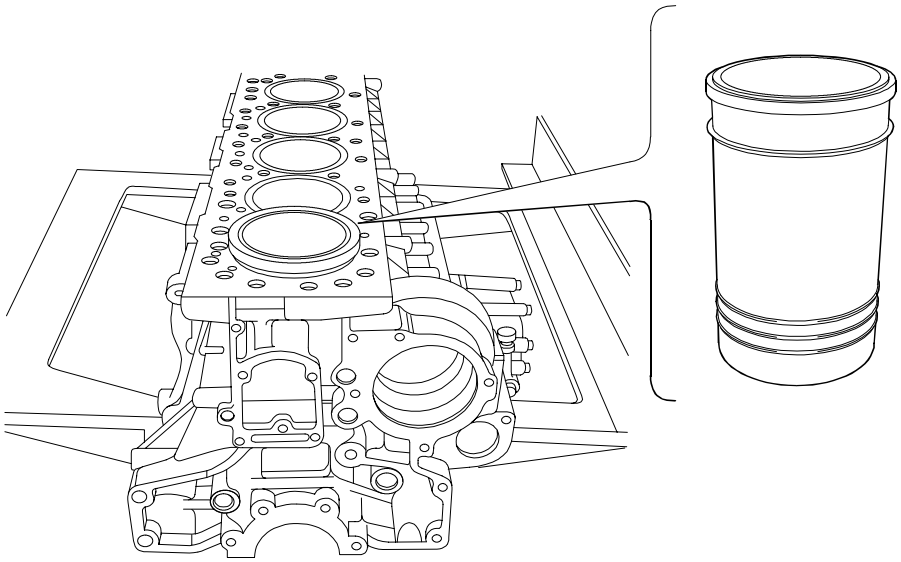
A = Ø 153.500 to 153.525 mm
B = Ø 152.000 to 152.025 mm
C = Ø 153.461 to 153.486 mm
D = Ø 151.890 to 151.915 mm

The diagram shown in the figure gives the outside diameter of the cylinder liner and inside diameter of its seat.

The cylinder liners can, if necessary, be extracted and fitted several times in different seats.

Cylinder liners

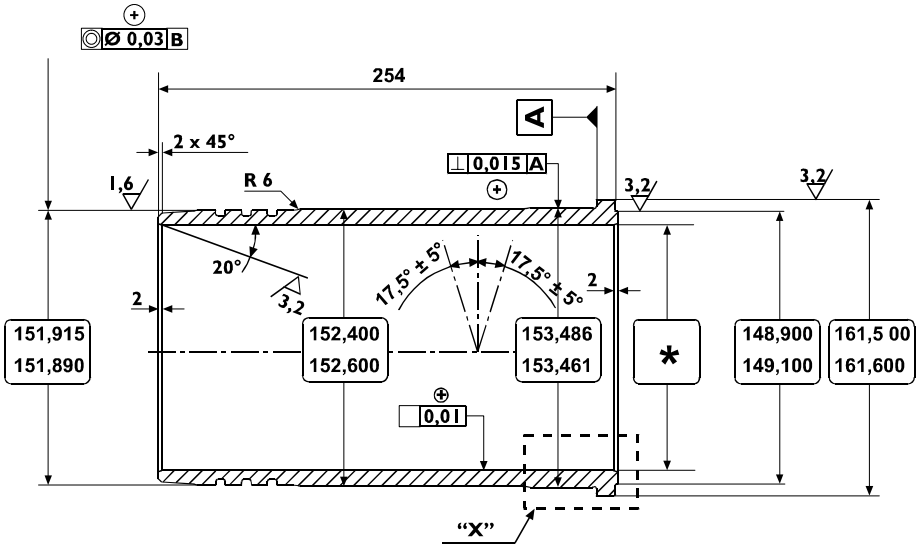
Figure 72



60598

CRANKCASE ASSEMBLY WITH CYLINDER LINERS

Figure 73

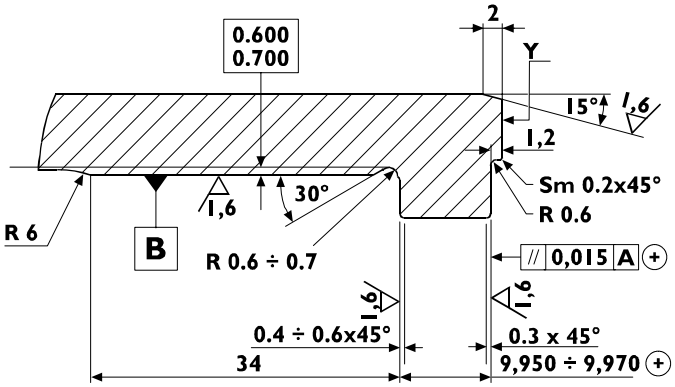


108832

* Selection class { A mm 135.000 to 135.013
B mm 135.011 to 135.024

MAIN CYLINDER LINER DATA

Figure 74



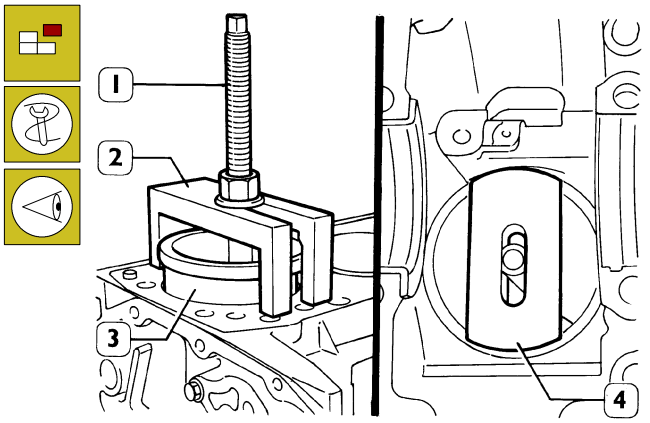
108833

DETAIL "X"
"Y" - Selection class marking area

540420 Replacing the cylinder liners

Removal

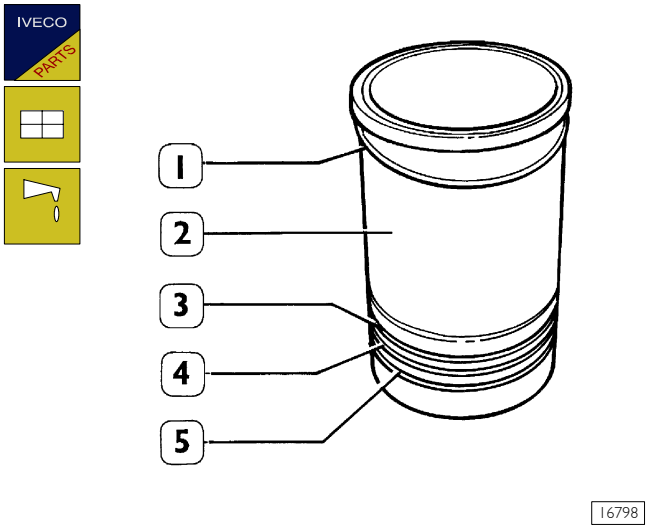
Figure 75



Position the parts 99360706 (2) and the plate 99360728 (4) as shown in the figure, checking that the plate (4) rests on the cylinder liner correctly.
Screw down the nut of screw (1) and extract the cylinder liner (3) from the crankcase.

Assembly and checking protrusion

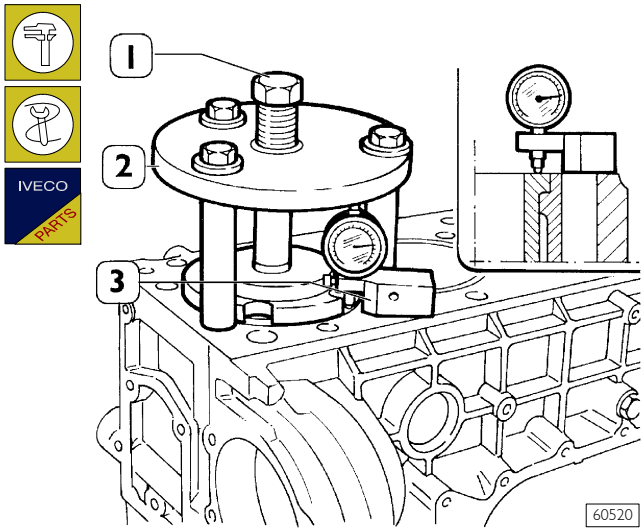
Figure 76



Always replace the water seals (3, 4 and 5).
Fit the adjustment ring (1) on the cylinder liner (2). Lubricate the bottom of it and mount it in the cylinder assembly using the appropriate tool.

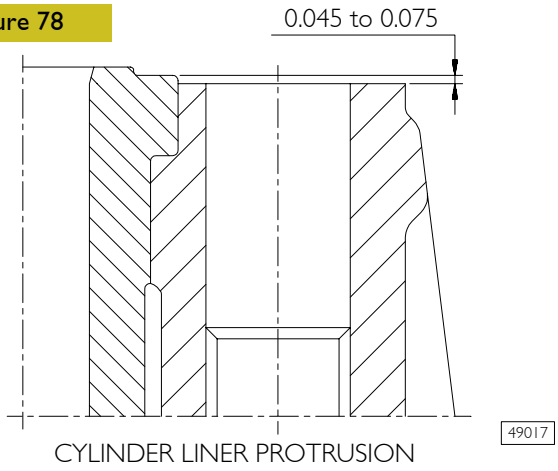
NOTE The adjustment ring (1) is supplied as a spare part with the following thicknesses: 0.08 mm - 0.10 mm - 0.12 mm - 0.14 mm.

Figure 77



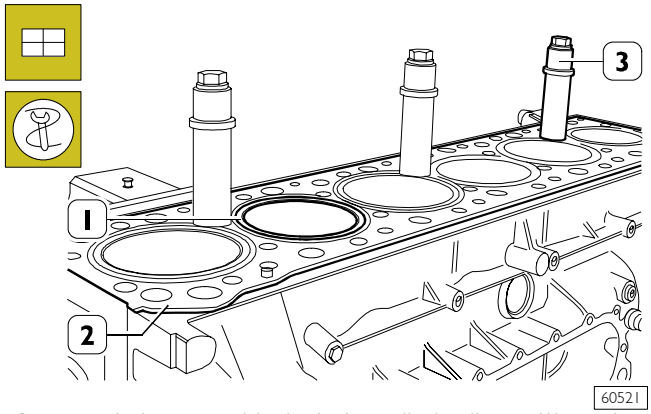
Check the protrusion of the cylinder liners with tool 99360334 (2) and tightening the screw (1) to a torque of 225 Nm.
Using the dial gauge 99395603 supplied as standard with the dial gauge base 99370415 (3), check that the protrusion of the cylinder liner over the supporting face of the cylinder head is 0.045 - 0.075 mm (Figure 78); if this is not so, replace the adjustment ring (1, Figure 76), supplied as a spare part with several thicknesses.

Figure 78



CYLINDER LINER PROTRUSION

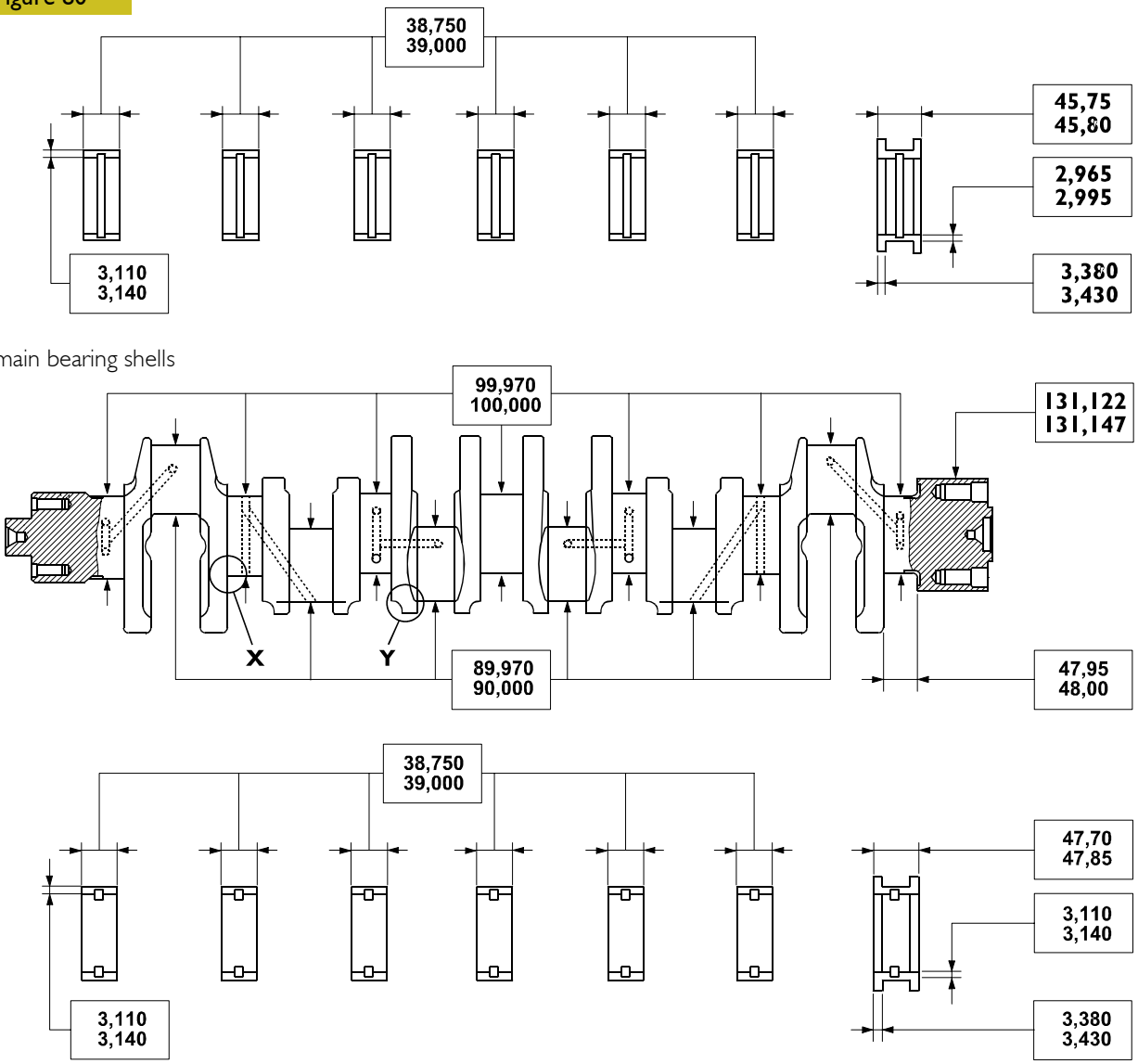
Figure 79



On completing assembly, lock the cylinder liners (1) to the crankcase (2) with the pins 99360703 (3).

5408 Crankshaft

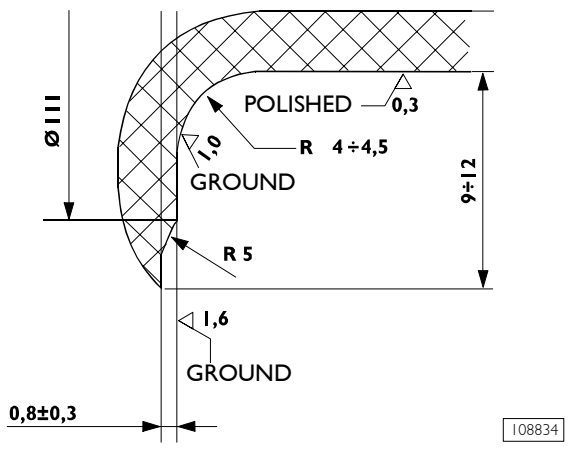
Figure 80



MAIN DATA OF CRANKSHAFT AND MAIN BEARING SHELLS

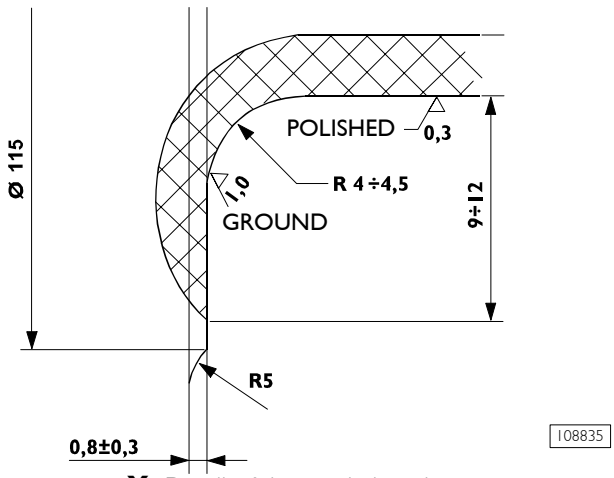
Check the state of the main journals and crankpins of the crankshaft. They must not be scored or be too ovalized or worn. The data given refer to the normal diameter of the journals.

Figure 81



X. Detail of the main journal unions

Figure 82

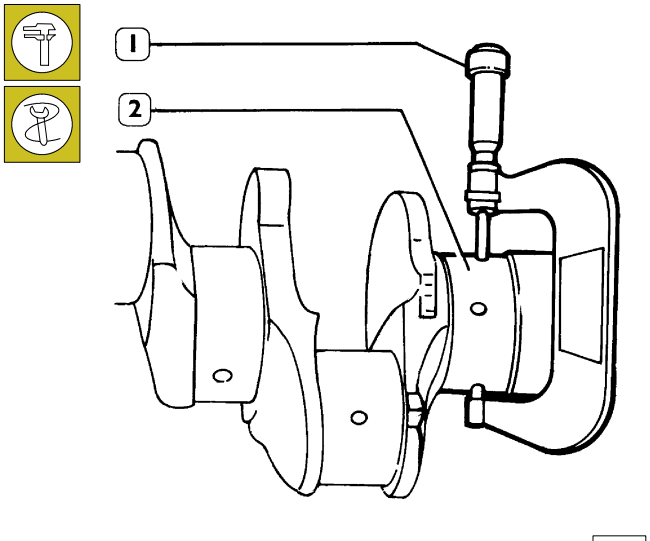


Y. Detail of the crankpin unions

540812 Measuring the main journals and crankpins

Before grinding the journals, use a micrometric gauge (1) to measure the journals of the shaft (2) and establish, on the basis of the undersizing of the spare bearing shells, to what diameter it is necessary to reduce the journals.

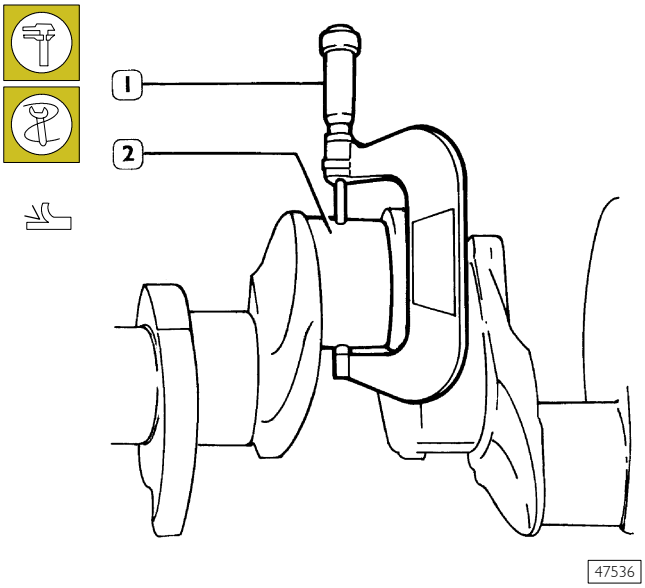
Figure 83



MEASURING THE MAIN JOURNALS

NOTE It is advisable to note the measurements in a table (Figure 84).

Figure 85



MEASURING THE CRANKPINS

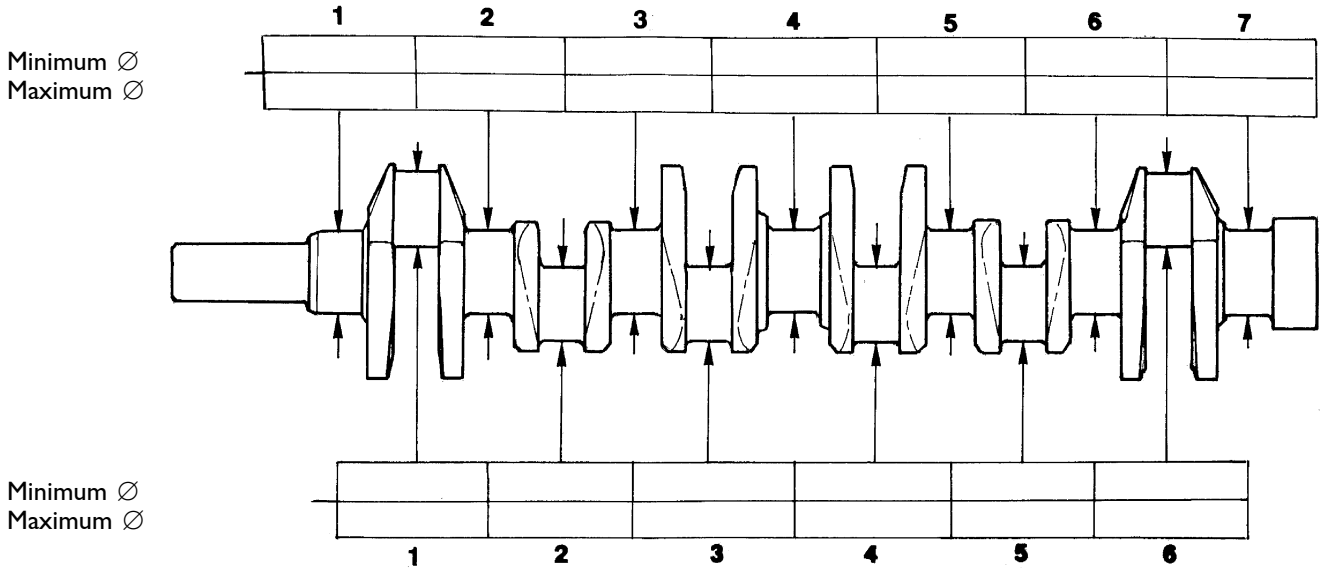
When grinding, pay the utmost attention to the values of the unions of the main journals and of the crankpins given in Figure 81 and Figure 82.

NOTE All the main journals and crankpins should always be ground to the same undersizing class so as not to alter the balance of the shaft.

Figure 84

Table for noting down the measurements of the main journals and crankpins of the crankshaft.

MAIN JOURNALS



CRANKPINS

Preliminary measurement of data to select main bearing and big end bearing shells

For each of the journals of the crankshaft, it is necessary to carry out the following operations:

MAIN JOURNALS:

- ❑ Determine the class of diameter of the seat in the crankcase.
- ❑ Determine the class of diameter of the main journal.
- ❑ Select the class of the bearing shells to mount.

CRANKPINS:

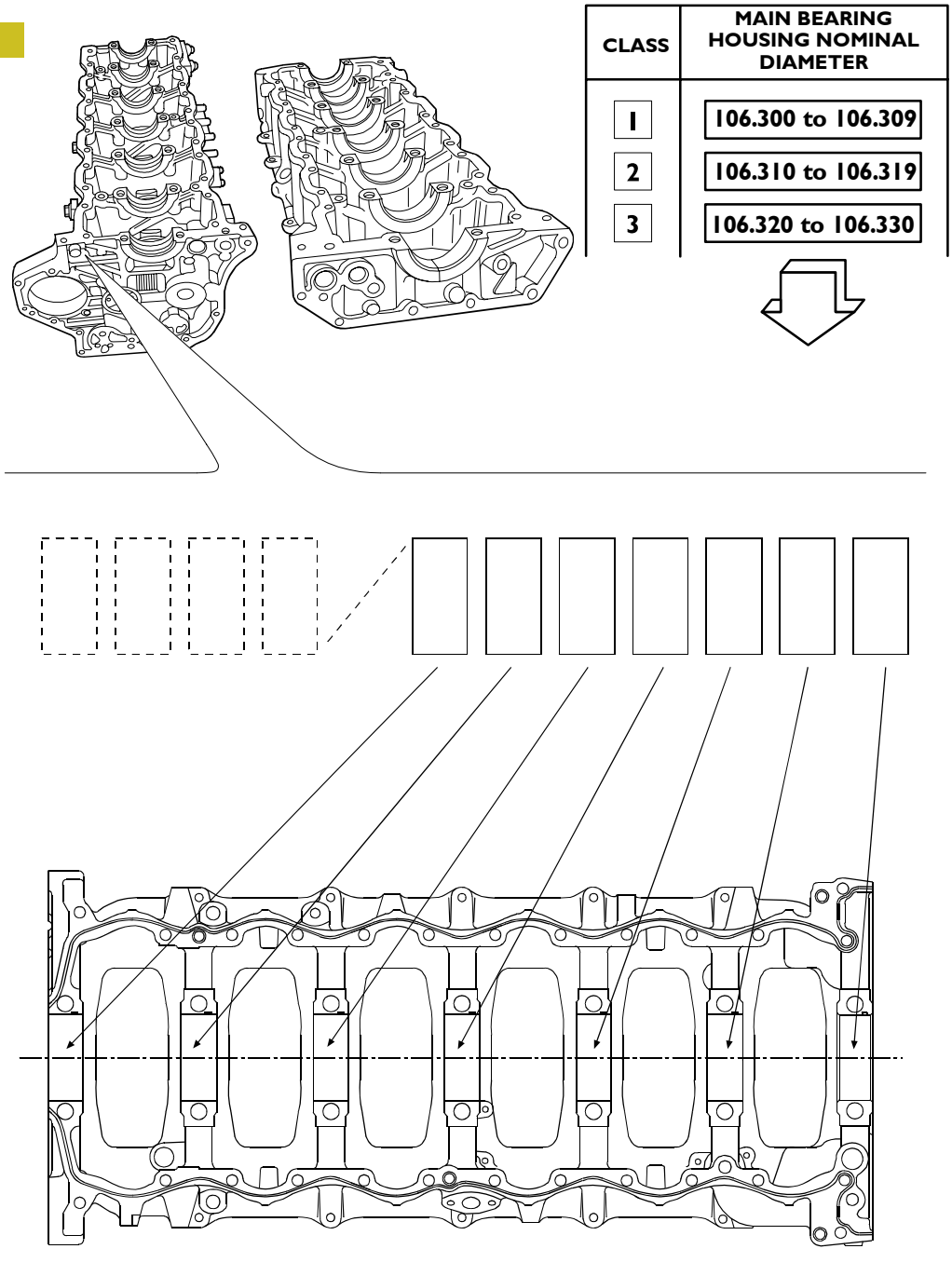
- ❑ Determine the class of diameter of the seat in the connecting rod.
- ❑ Determine the class of diameter of the crankpin.
- ❑ Select the class of the bearing shells to mount.

DEFINING THE CLASS OF DIAMETER OF THE SEATS FOR BEARING SHELLS ON THE CRANKCASE

On the front of the crankcase two sets of numbers are marked in the position shown.

- ❑ The first set of digits (four) is the coupling number of the crankcase with its base.
- ❑ The second set of digits (seven) is the class of diameter of each of the seats referred to.
- ❑ Each of these digits may be **1**, **2** or **3**.

Figure 86



Selecting the main bearing and big end bearing shells

NOTE To obtain the required assembly clearances, the main bearing and big end bearing shells have to be selected as described hereunder.

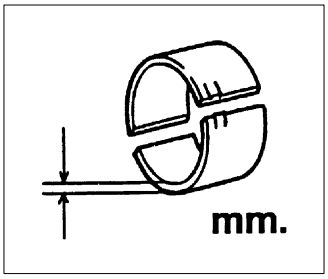
This operation makes it possible to identify the most suited bearing shells for each of the journals of the shaft (the bearing shells may even have different classes for different pins).

Depending on the thickness, the bearing shells are selected in classes of tolerance marked by a colour (red-green - red/black - green/black).

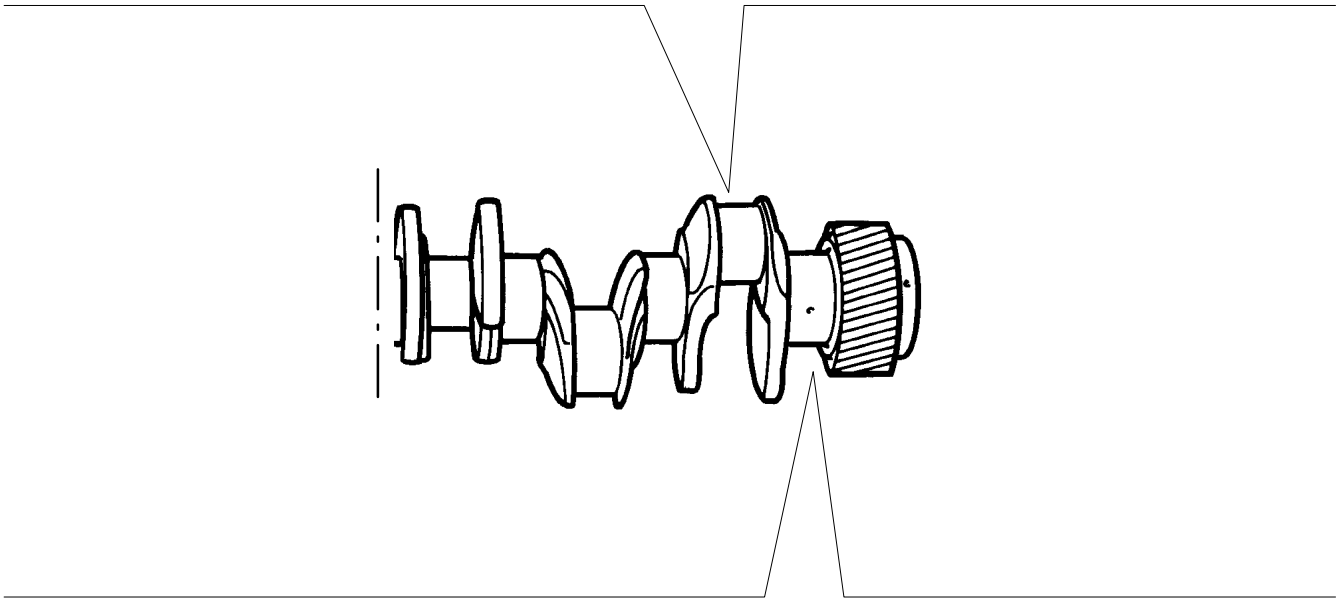
Figure 87 gives the specifications of the main bearing and big end bearing shells available as spare parts in the standard sizes (STD) and in the permissible oversizes (+0.127, +0.254, +0.508).

Figure 87

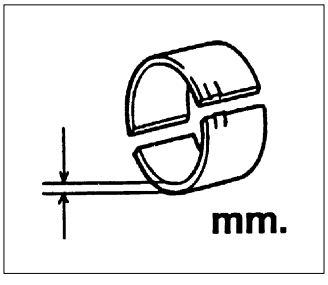
Big end bearing shells



	STD	+0.127	+0.254	+0.508
red	1.965 to 1.975		2.092 to 2.102	2.219 to 2.229
red/black		2.028 to 2.038		
green	1.976 to 1.985		2.103 to 2.112	2.230 to 2.239
green/black		2.039 to 2.048		



Main bearing shells



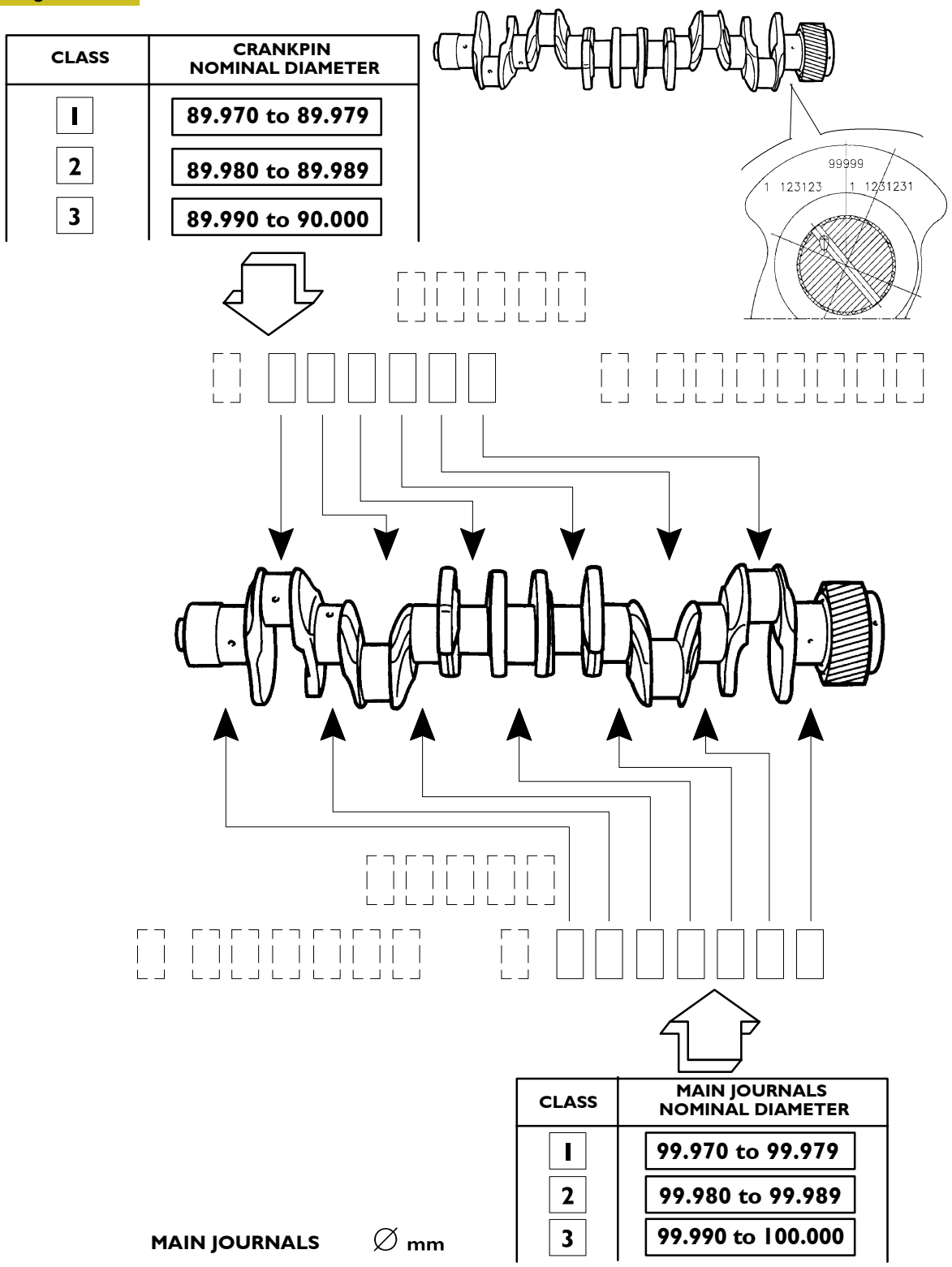
	STD	+0.127	+0.254	+0.508
red	3.110 to 3.120		3.237 to 3.247	3.364 to 3.374
red/black		3.173 to 3.183		
green	3.121 to 3.130			
green/black		3.184 to 3.193		

DEFINING THE CLASS OF DIAMETER OF THE MAIN JOURNALS AND CRANKPINS (journals with nominal diameter)

Three sets of numbers are marked on the crankshaft in the position shown by the arrow (Figure 88 at top):

- The first number, of five digits, is the part number of the shaft.
- Under this number, on the left, a set of six digits refers to the crankpins and is preceded by a single digit showing the status of the journals (1 = STD, 2 = -0.127), the other six digits, taken singly, give the class of diameter of each of the crankpins they refer to (Figure 88 at top).
- The set of seven digits, on the right, refers to the main journals and is preceded by a single digit: the single digit shows the status of the journals (1 = STD, 2 = -0.127), the other seven digits, taken singly, give the class of diameter of each of the main journals they refer to (Figure 88 at bottom).

Figure 88



CLASS	CRANKPIN NOMINAL DIAMETER
1	89.970 to 89.979
2	89.980 to 89.989
3	89.990 to 90.000

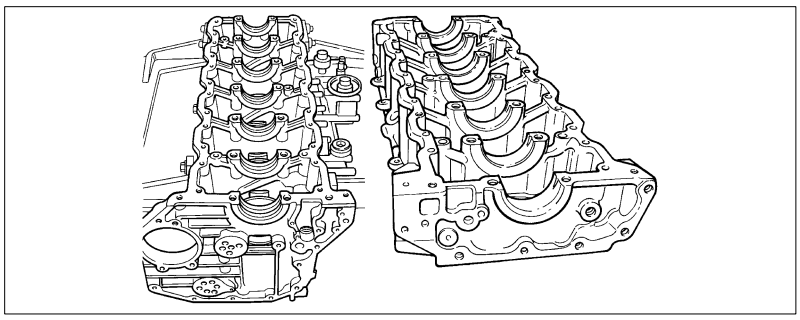
CLASS	MAIN JOURNALS NOMINAL DIAMETER
1	99.970 to 99.979
2	99.980 to 99.989
3	99.990 to 100.000

SELECTING THE MAIN BEARING SHELLS

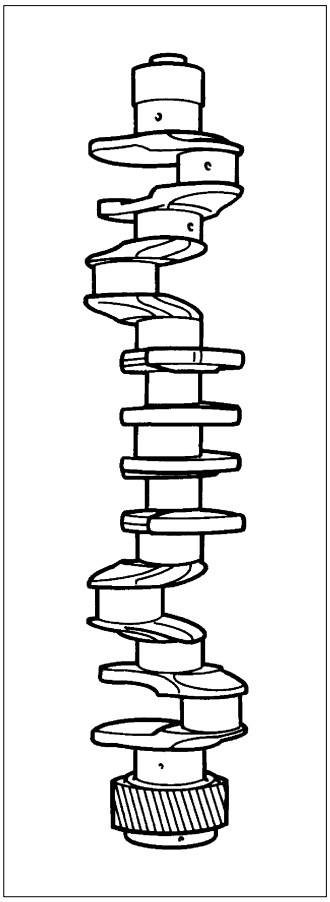
After reading off the data, for each of the main journals, on the crankcase and crankshaft, you choose the type of bearing shells to use according to the following table:

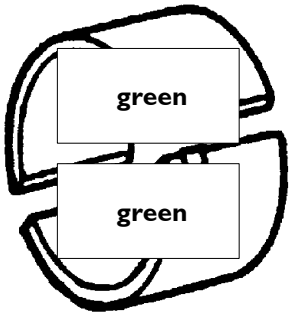
Figure 89

STD.



CLASS	1	2	3
1	green	green	green
	green	green	green
2	red	green	green
	red	green	green
3	red	red	green
	red	red	green

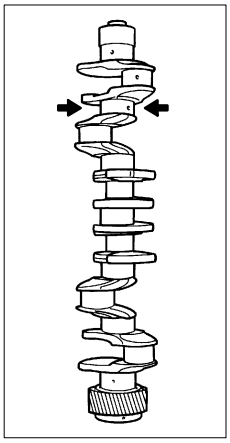


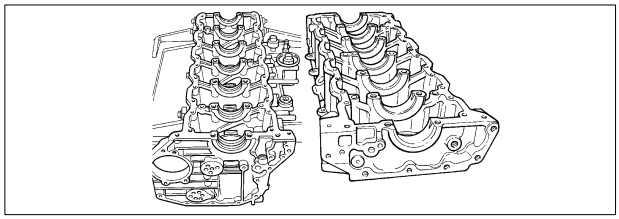


SELECTING THE MAIN BEARING SHELLS (GROUND JOURNALS)

If the journals have been ground, the procedure described so far cannot be applied.
In this case, it is necessary to check that the new diameter of the journals is as shown in the table and to mount the only type of bearing shell envisaged for the relevant undersizing.

Figure 90



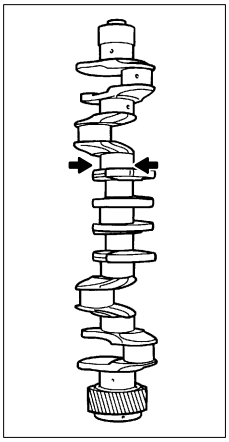


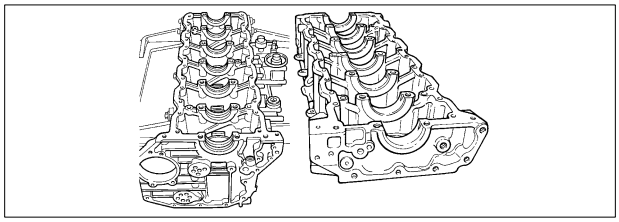
-0.127

red/black = mm 3.173 to 3.183

green/black = mm 3.184 to 3.193

CLASS		1	2	3
99.843 99.852	1	green/black	green/black	green/black
		green/black	green/black	green/black
99.853 99.862	2	red/black	green/black	green/black
		red/black	green/black	green/black
99.863 99.873	3	red/black	red/black	green/black
		red/black	red/black	green/black

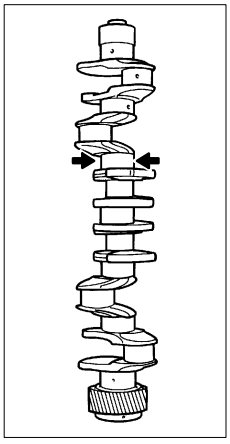


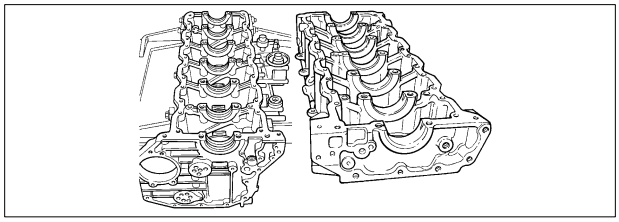


-0.254

red = mm 3.237 to 3.247

	1	2	3
99.726 99.746	red	red	red
	red	red	red





-0.508

red = mm 3.364 to 3.374

	1	2	3
99.472 99.492	red	red	red
	red	red	red

SELECTING THE BIG END BEARING SHELLS (JOURNALS WITH NOMINAL DIAMETER)

There are three markings on the body of the connecting rod in the position indicated as "A":

1 Letter indicating the class of weight:

A = 4741 to 4780 g.
B = 4781 to 4820 g.
C = 4821 to 4860 g.

2 Number indicating the selection of the diameter of the big end bearing seat:

1 = 94.000 to 94.010 mm
2 = 94.011 to 94.020 mm
3 = 94.021 to 94.030 mm

3 Numbers identifying the cap-connecting rod coupling.

The number, indicating the class of diameter of the bearing shell seat may be **1**, **2** o **3**.

Determine the type of big end bearing to fit on each journal by following the indications in the table (Figure 92).

Figure 91

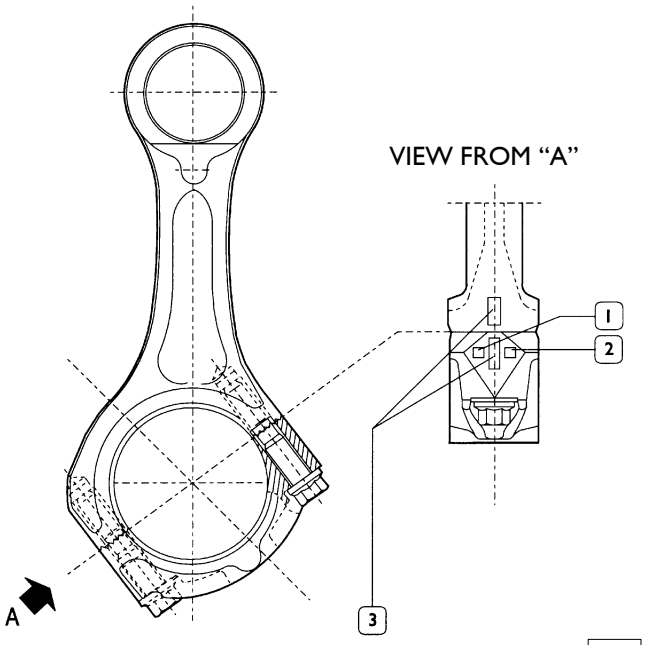
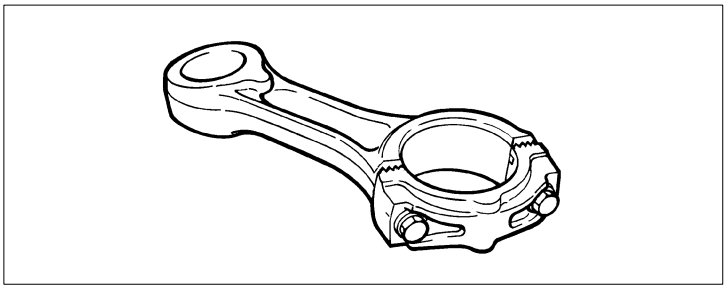
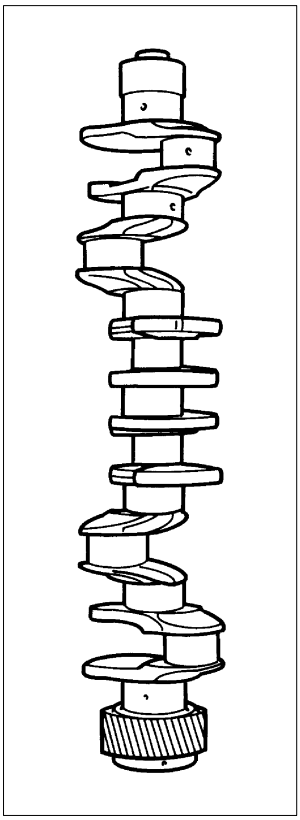


Figure 92

STD.



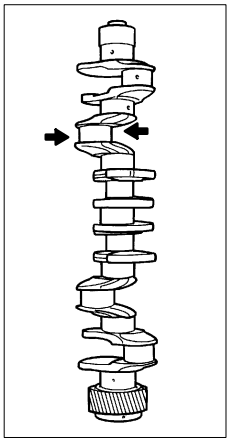


CLASS	1	2	3
1	green	green	green
	green	green	green
2	red	green	green
	red	green	green
3	red	red	green
	red	red	green

SELECTING BIG END BEARING SHELLS (GROUND JOURNALS)

If the journals have been ground, the procedure described so far cannot be applied.
In this case, it is necessary to check (for each of the undersizings) which field of tolerance includes the new diameter of the crankpins and to mount the bearing shells identified with the relevant table.

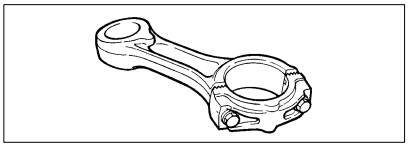
Figure 93



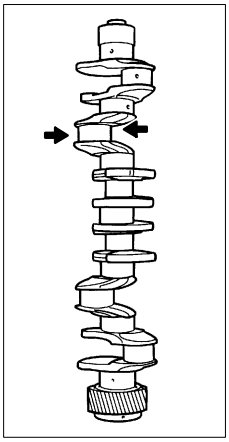
-0.127

red/black = mm 2.028 to 2.038

green/black = mm 2.039 to 2.048

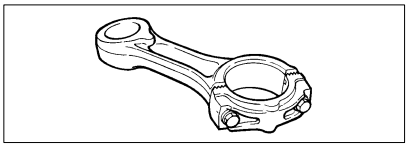


CLASS		1	2	3
89.843 89.852	1	green/black	green/black	green/black
		green/black	green/black	green/black
89.853 89.862	2	red/black	green/black	green/black
		red/black	green/black	green/black
89.863 89.873	3	red/black	red/black	green/black
		red/black	red/black	green/black

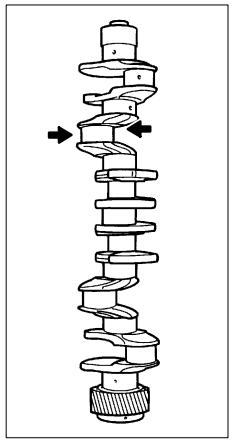


-0.254

red = mm 2.092 to 2.102
green = mm 2.103 to 2.112

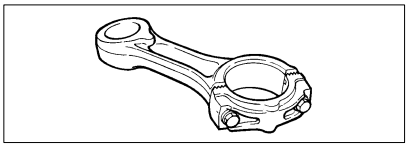


	1	2	3
89.726 89.735	red	green	green
	red	green	green
89.736 89.746	red	red	green
	red	red	green



-0.508

red = mm 2.219 to 2.229
green = mm 2.230 to 2.239

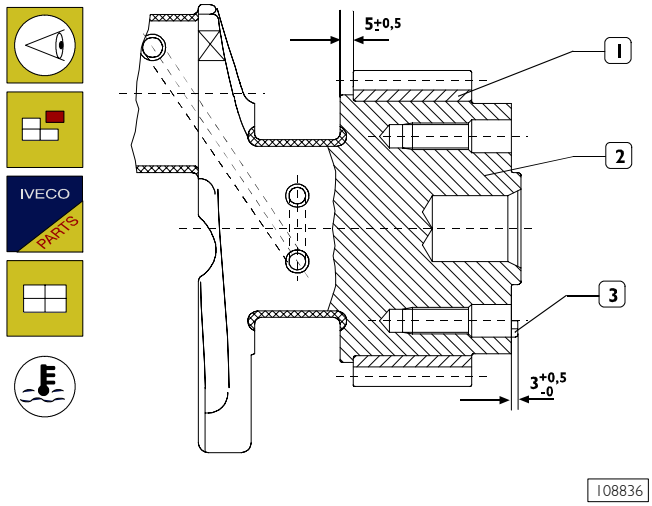


	1	2	3
89.472 89.481	red	green	green
	red	green	green
89.482 89.492	red	red	green
	red	red	green

540815 Replacing the timing gear and oil pump

Check that the toothing of the gear is neither damaged nor worn; if it is, take it out with an appropriate extractor and replace it.

Figure 94

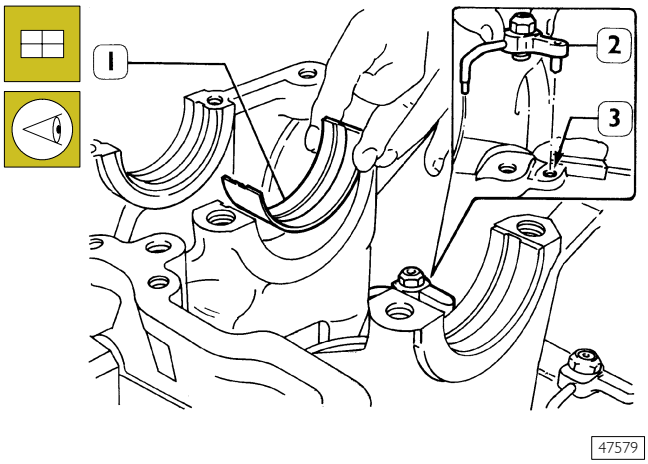


When fitting the gear (1) on the crankshaft (2), heat it for no longer than 2 hours in an oven at a temperature of 180°C. After driving it in, leave it to cool.

If changing the pin (3), after fitting it on, check it protrudes from the crankshaft as shown in the figure.

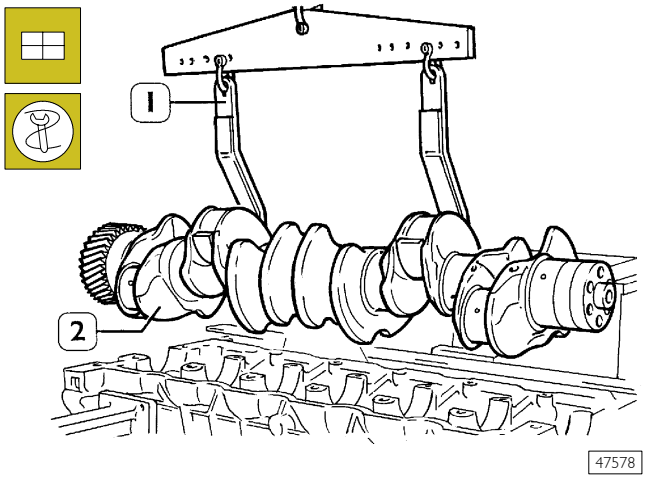
540811 Checking main journal assembly clearance

Figure 95



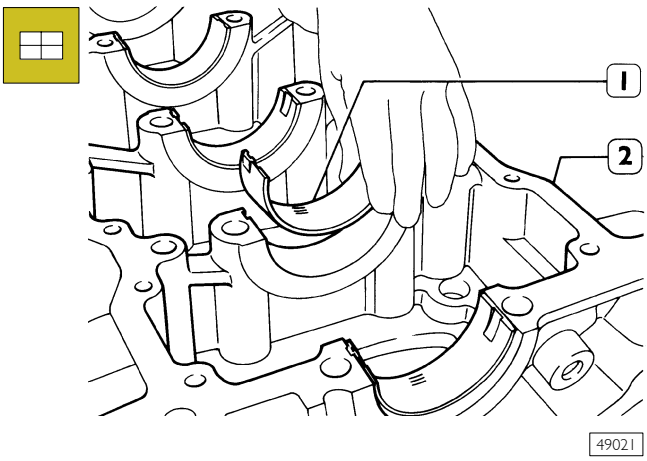
Mount the oil nozzles (2), making the grub screw match the hole (3) on the crankcase.
Arrange the bearing shells (1) on the main bearing housings.

Figure 96



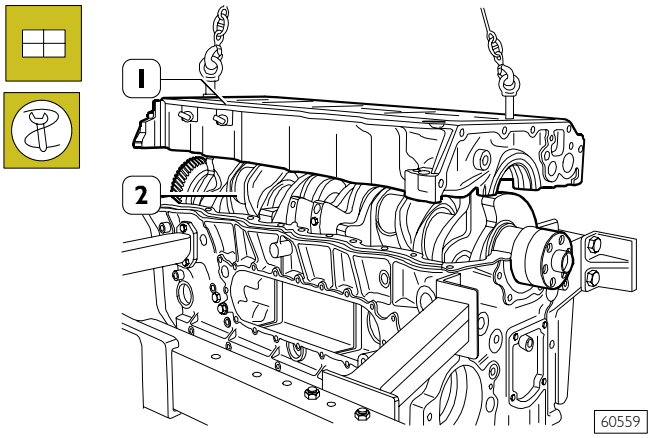
Using the tackle and hook 99360500 (1), mount the crankshaft (2).

Figure 97



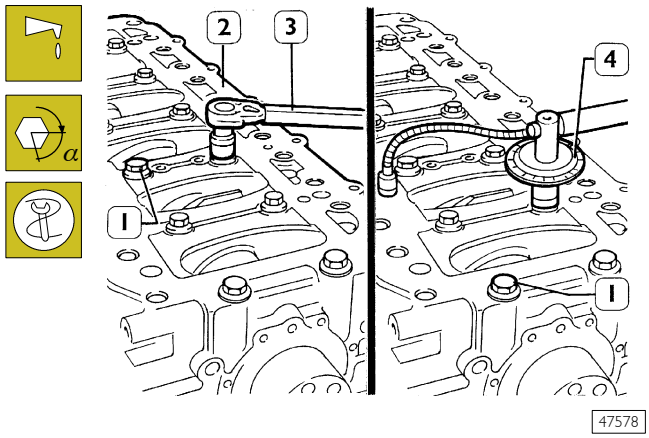
Arrange the bearing shells (1) on the main bearing housings in the crankcase base (2).
Check the assembly clearance between the main journals of the crankshaft and their bearings, proceeding as illustrated on the following pages.

Figure 98



Set two journals of the crankshaft (2) parallel to the longitudinal axis, a section of calibrated wire. Using appropriate hooks and tackle, mount the crankcase base (1).

Figure 99



❑ Lubricate the internal screws (1) with UTDM oil and tighten them with a torque wrench (3) to a torque of 120 Nm, using tool 99395216 (4), to an angle of 60°, following the diagram of Figure 100.

Figure 100

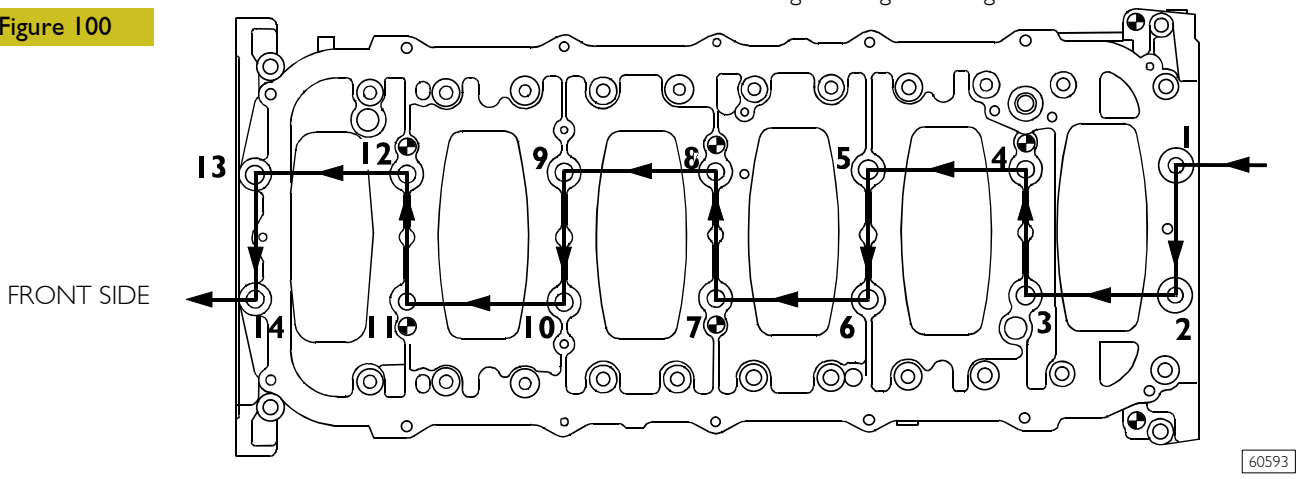
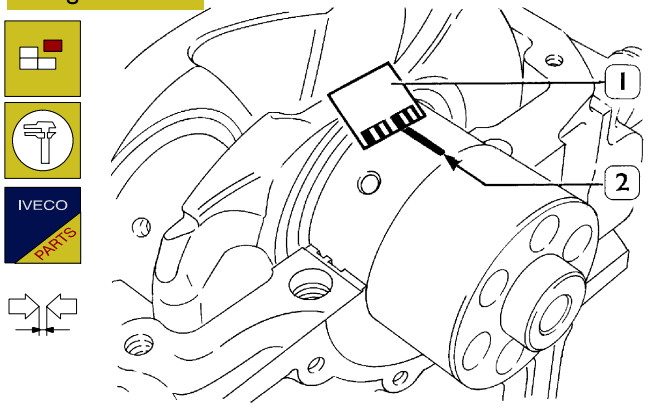


DIAGRAM OF SEQUENCE FOR TIGHTENING THE SCREWS FIXING THE BOTTOM CRANKCASE BASE TO THE CRANKCASE

Figure 101

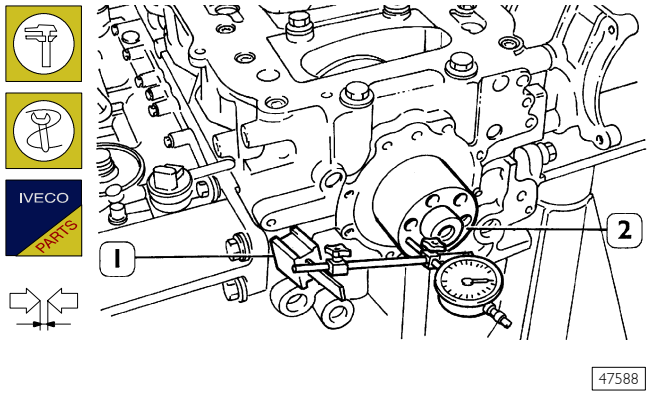


❑ Remove the crankcase base.

The clearance between the main bearings and their journals is measured by comparing the width taken on by the calibrated wire (2) at the point of greatest crushing with the graduated scale on the case (1) containing the calibrated wire.
The numbers on the scale give the clearance of the coupling in millimetres. If you find the clearance is not as required, replace the bearing shells and repeat the check.

Checking crankshaft end float

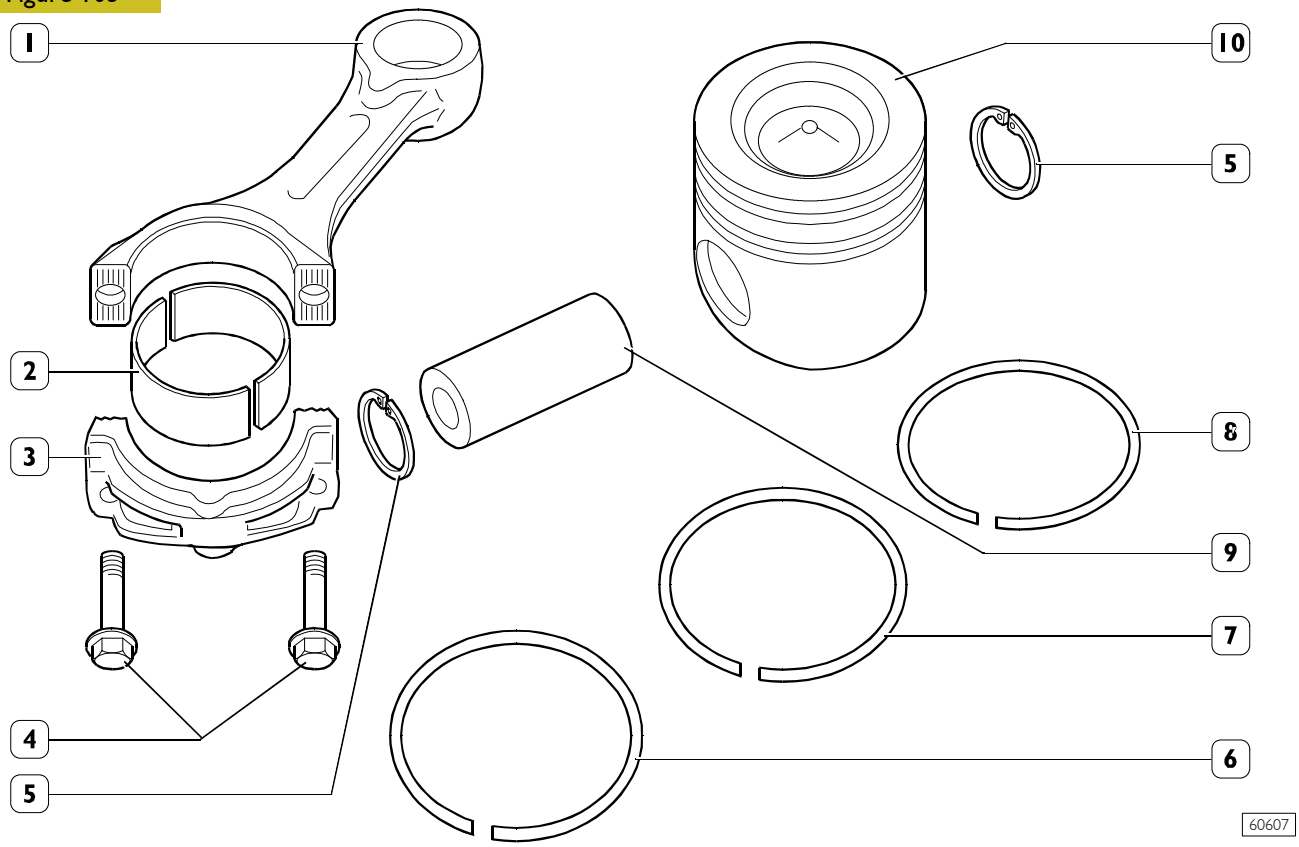
Figure 102



The end float is checked by setting a dial gauge (1) 99395603 with a magnetic base on the crankshaft (2) as shown in the figure. If you find the clearance to be greater than as required, replace the rear main bearing shells carrying the thrust bearings and repeat the clearance check.

5408 Connecting rod piston assembly

Figure 103



PISTON - CONNECTING ROD ASSEMBLY

1. Connecting rod body - 2. Bearing shells - 3. Connecting rod cap - 4. Cap fixing screws - 5. Split ring - 6. Slotted scraper ring with spiral spring - 7. Bevelled seal - 8. V-seal - 9. Piston gudgeon pin - 10. Piston

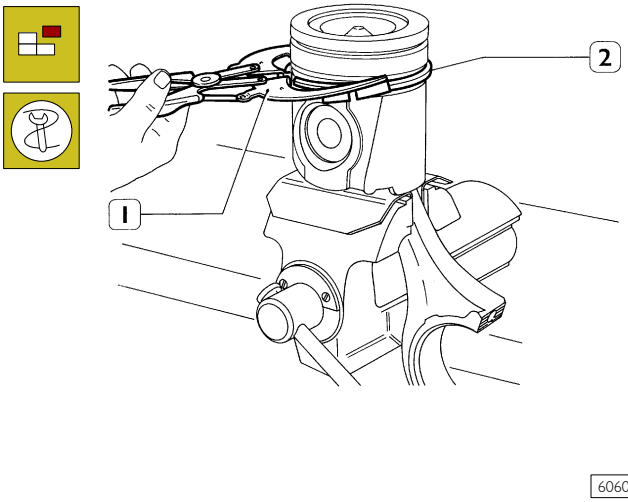
Check the pistons. They must show no signs of seizure, scoring, cracking or excessive wear; replace them if they do.

The pistons are fitted with three rings: the first one is a V-seal, the second one a bevelled seal and the third one a scraper ring.

The pistons are selected in two classes, A and B, according to diameter.

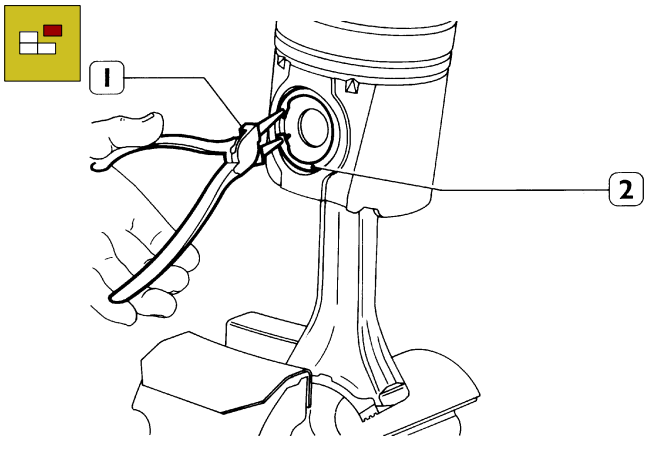
Removal

Figure 104



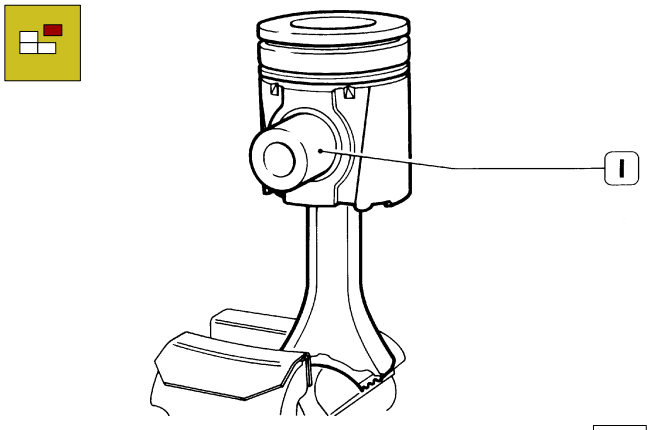
Removing the piston rings from the piston (2) using pliers 99360184 (1).

Figure 105



Removing the split rings (2) retaining the piston gudgeon pin using round-nose pliers (1).

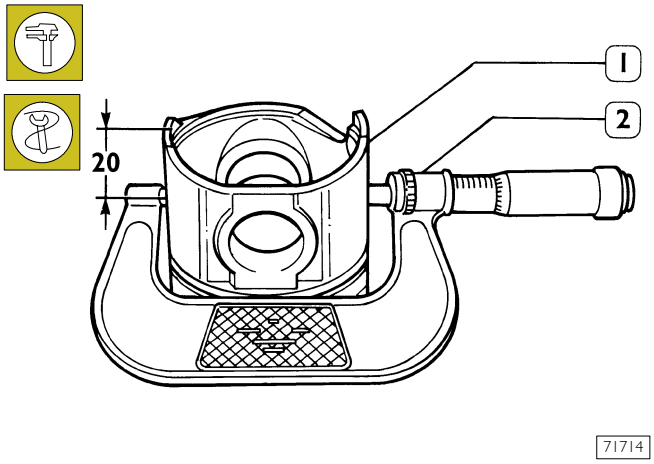
Figure 106



Removing the piston gudgeon pin (1).
If removal is difficult, use an appropriate drift.

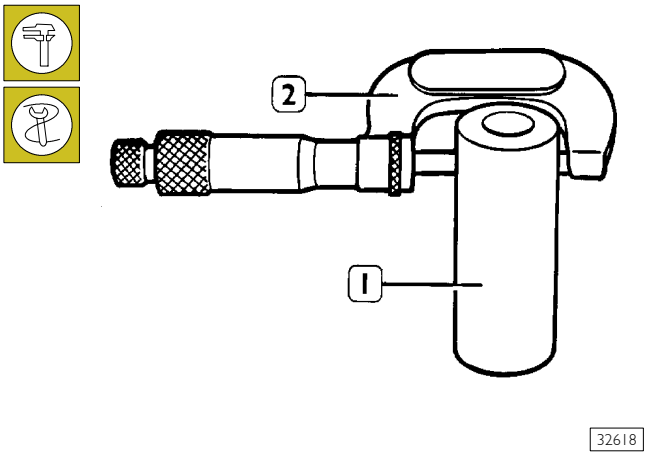
Measuring piston diameter

Figure 107



Using a micrometer (2), measure the diameter of the piston (1) to determine the assembly clearance. The diameter has to be measured at the value shown.

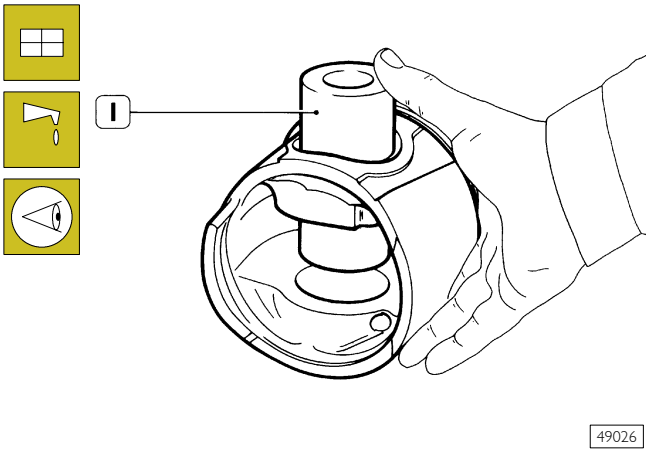
Figure 108



Measuring the diameter of the pin (1) using a micrometer (2).

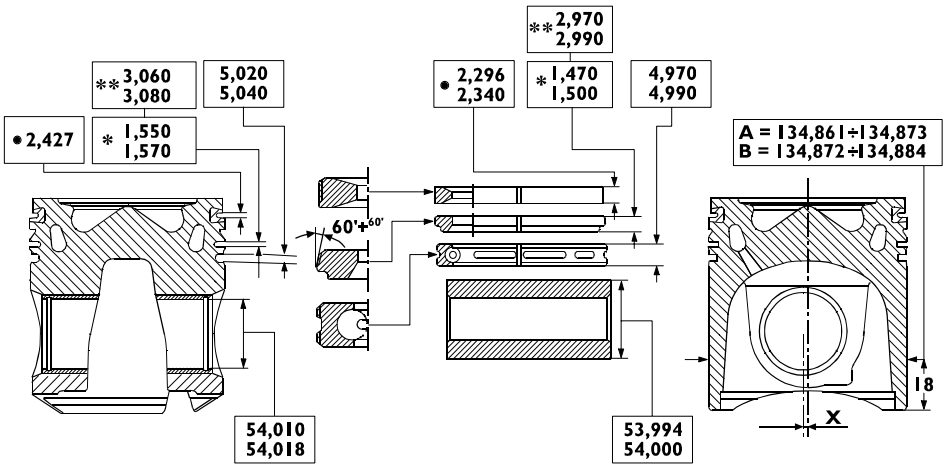
Conditions for correct pin-piston coupling

Figure 109



Lubricate the pin (1) and its seats on the hubs inside the piston with engine oil. The pin has to go into the piston by lightly pressing it with the fingers and must not drop out.

Figure 110



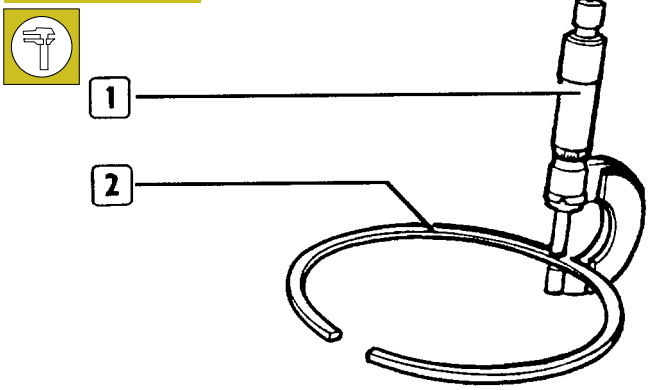
114973

MAIN DATA OF THE PISTON, PISTON RINGS AND PIN

● Dimension detected on 130 mm Ø. - ■ measured at 2.5 mm from outer Ø - X = 0,8±0,1
* Old part number - ** New part number

540842 Piston rings

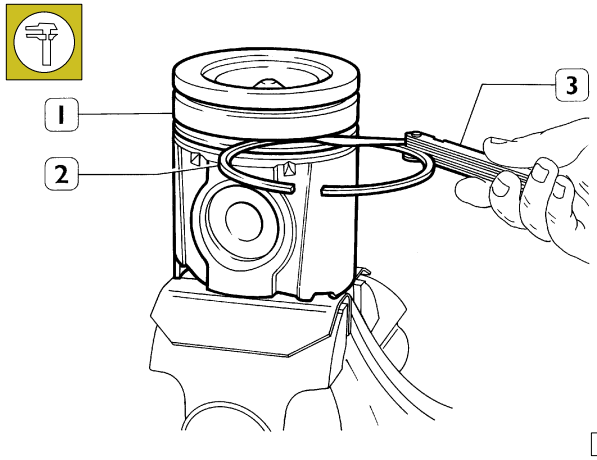
Figure 111



16552

Check the thickness of the piston ring (2) with a micrometer (1).

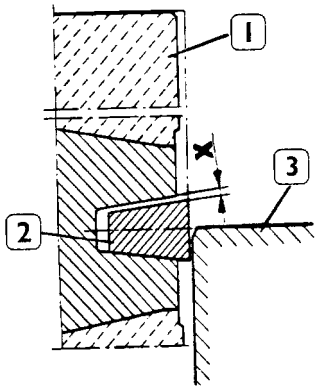
Figure 112



60610

Check the clearance between the seals (2) and their seats on the piston (1) with a feeler gauge (3).

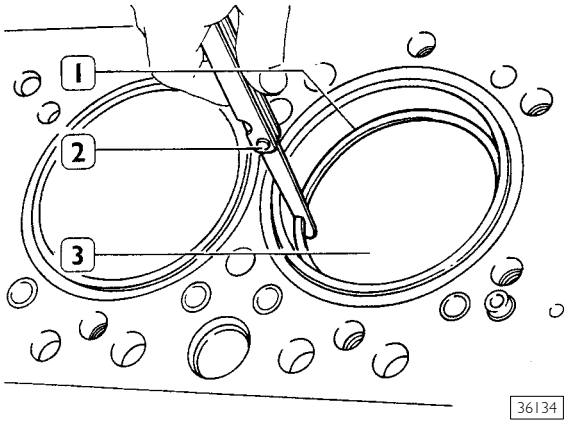
Figure 113



3513

The seal (2) of the 1st slot has a V shape. The clearance "X" between the seal and its seat is measured by setting the piston (1) with the ring in the cylinder liner (3) so that the seal comes half out of the cylinder liner.

Figure 114



36134

Using a feeler gauge (2), check the opening between the ends of the seals (1) inserted in the cylinder liner (3).
If you find the distance between the ends is less than or greater than as required, replace the piston rings.

540830 Connecting rod

Figure 115

Punched on the big end of the connecting rod are the data relating to the section in classes relating to the connecting rod seats and the weights.

NOTE On assembling the connecting rods, check they are all of the same class of weight.

Connecting rod punch markings

1 Letter indicating the class of weight:

A = 4741 to 4780 g.
B = 4781 to 4820 g.
C = 4821 to 4860 g.

2 Number indicating the selection of the diameter of the big end bearing seat:

1 = 94.000 to 94.010 mm
2 = 94.011 to 94.020 mm
3 = 94.021 to 94.030 mm

3 Number indicating the selection of diameter for the big end bearing housing:

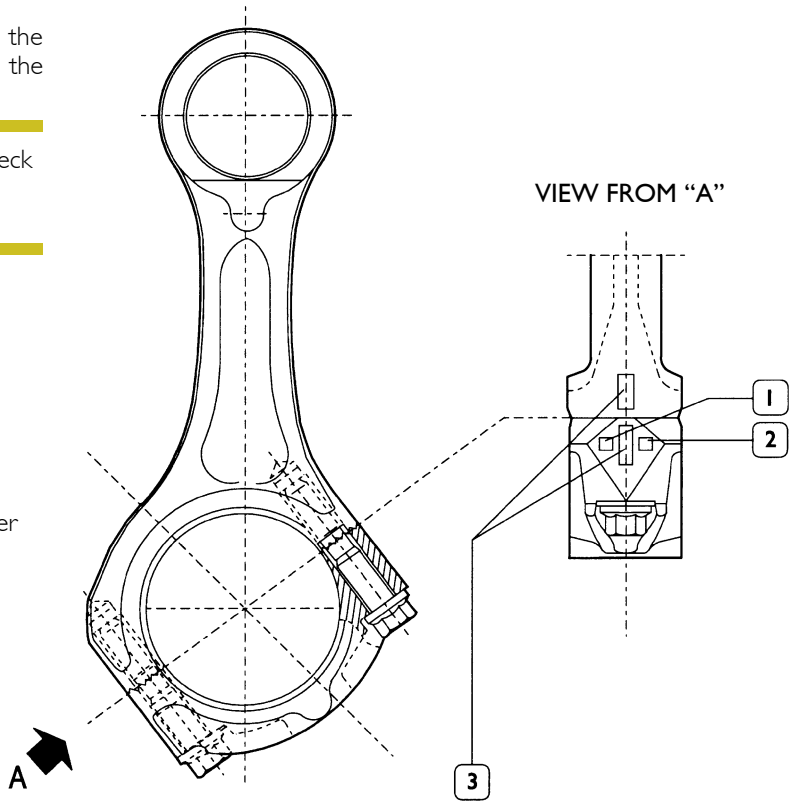
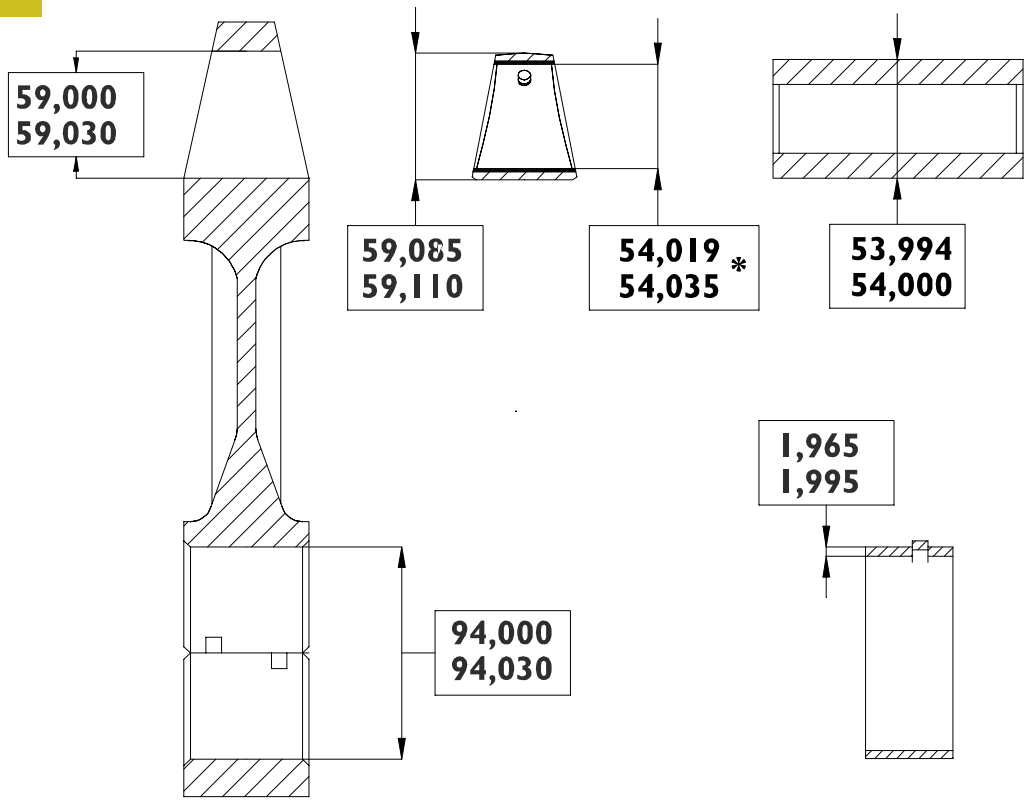


Figure 116

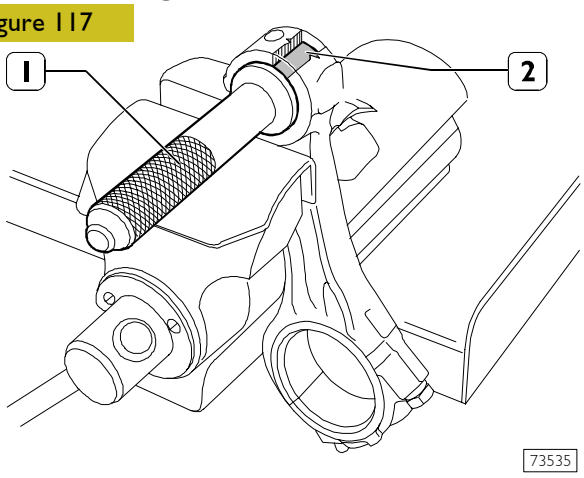


MAIN DATA OF THE BUSHING, CONNECTING ROD, PIN AND BEARING SHELLS

* Measurement to be made after driving in the bushing.

540834 Bushings

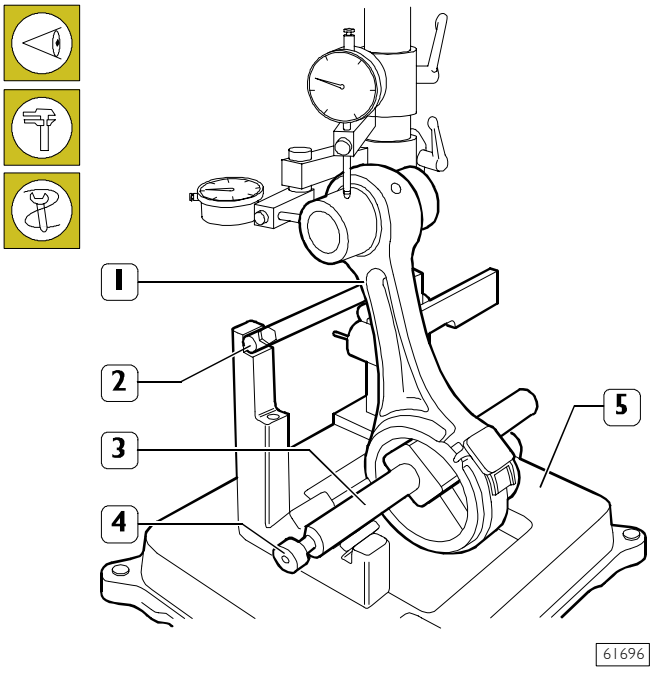
Figure 117



Check the bushing in the small end has not come loose and shows no sign of scoring or seizure; replace it if it does.
The bushing (2) is removed and fitted with a suitable drift (1). When driving it in, make absolutely sure that the holes for the oil to pass through in the bushing and small end coincide. Using a boring machine, rebore the bushing so as to obtain a diameter of 54.019 – 54.035.

Checking connecting rods

Figure 118 (Demonstration)



Checking axis alignment

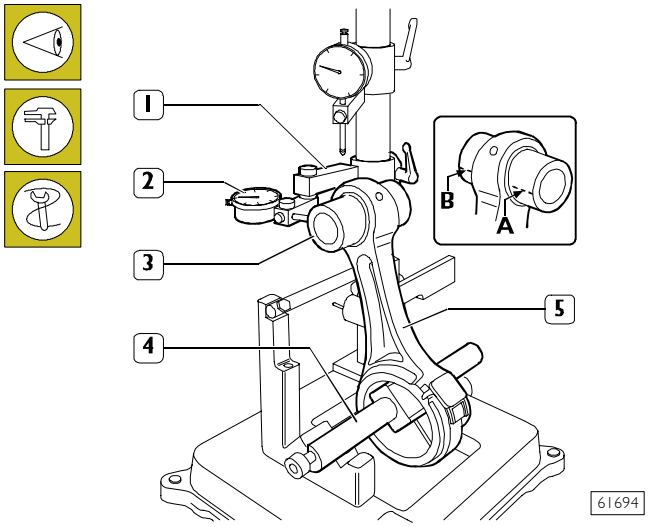
Check the connecting rods axes for parallelism (1) using a suitable device (5) and proceeding as follows.

Fit the connecting rod (1) on the spindle of the tool (5) and lock it with the screw (4).

Set the spindle (3) on the V-prisms, resting the connecting rod (1) on the stop bar (2).

Checking torsion

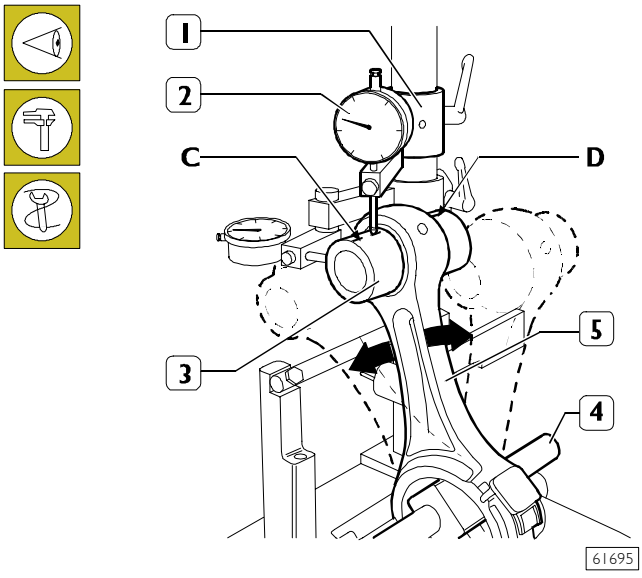
Figure 119 (Demonstration)



Check the torsion of the connecting rod (5) by comparing two points (**A** and **B**) of the pin (3) on the horizontal plane of the axis of the connecting rod.
Position the mount (1) of the dial gauge (2) so that this pre-loads by approx. 0.5 mm on the pin (3) at point **A** and zero the dial gauge (2). Shift the spindle (4) with the connecting rod (5) and compare any deviation on the opposite side **B** of the pin (3): the difference between **A** and **B** must be no greater than 0.08 mm.

Checking bending

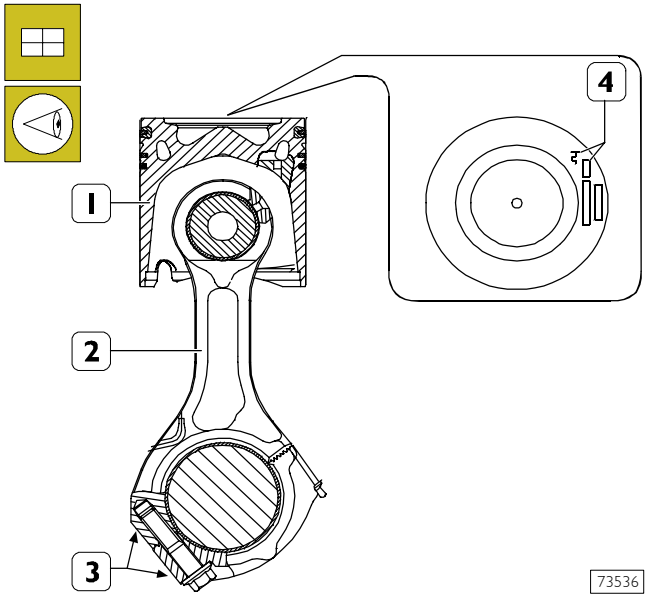
Figure 120 (Demonstration)



Check the bending of the connecting rod (5) by comparing two points **C** and **D** of the pin (3) on the vertical plane of the axis of the connecting rod.
Position the vertical mount (1) of the dial gauge (2) so that this rests on the pin (3) at point **C**.
Swing the connecting rod backwards and forwards seeking the highest position of the pin and in this condition zero the dial gauge (2). Shift the spindle (4) with the connecting rod (5) and repeat the check on the highest point on the opposite side **D** of the pin (3). The difference between point **C** and point **D** must be no greater than 0.08 mm.

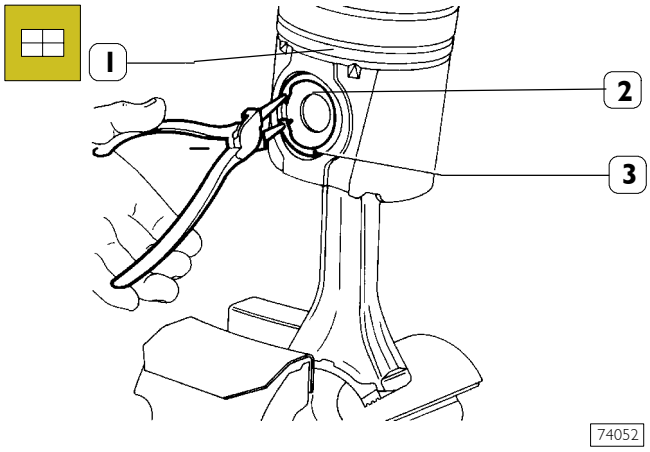
Mounting the connecting rod – piston assembly

Figure 121



The piston (1) has to be fitted on the connecting rod (2) so that the graphic symbol (4), showing the assembly position in the cylinder liner, and the punch marks (3) on the connecting rod are observed as shown in the figure.

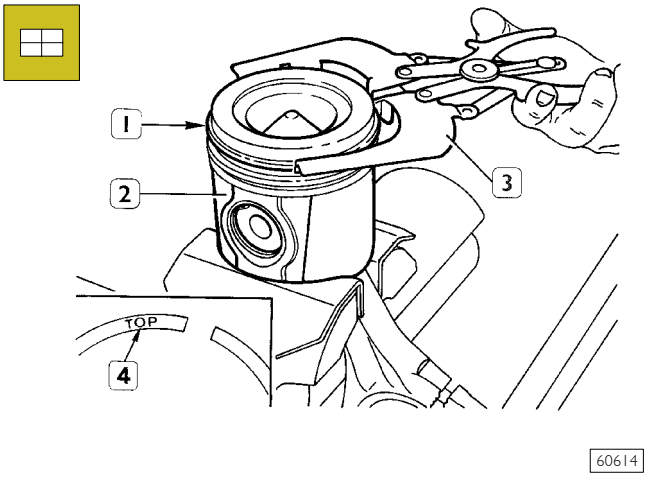
Figure 122



Fit the pin (2) and fasten it on the piston (1) with the split rings (3).

Mounting the piston rings

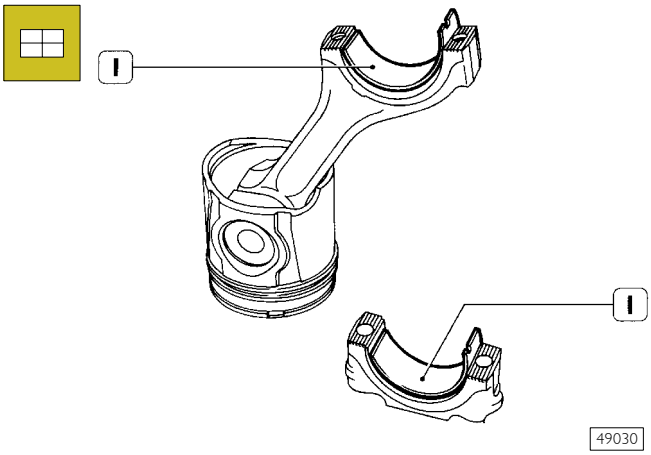
Figure 123



To fit the piston rings (1) on the piston (2) use the pliers 99360184 (3).
The rings need to be mounted with the word "TOP" (4) facing upwards. Direct the ring openings so they are staggered 120° apart.

Fitting the big end bearing shells

Figure 124



Fit the bearing shells (1), selected as described under the heading "Selecting the main and big end bearing shells", on both the connecting rod and the cap.
If reusing bearing shells that have been removed, fit them back into their respective seats in the positions marked during removal.

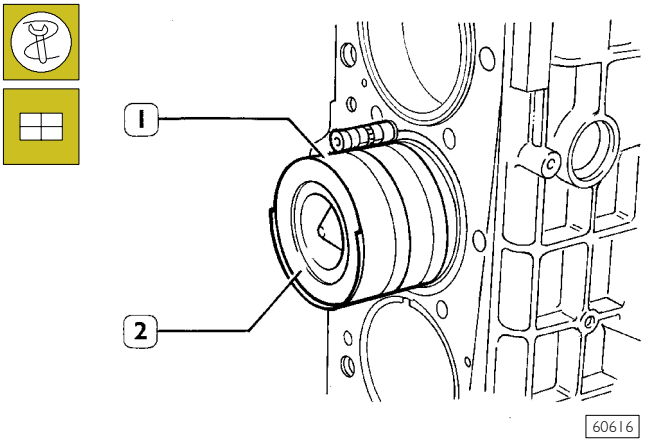
Fitting connecting rod - piston assemblies in the cylinder liners

With the aid of the clamp 99360605 (1, Figure 125), fit the connecting rod – piston assembly (2) in the cylinder liners, according to the diagram of Figure 126, checking that:

- ❑ The openings of the piston rings are staggered 120° apart.
- ❑ The pistons are all of the same class, A or B.
- ❑ The symbol punched on the top of the pistons faces the engine flywheel, or the recess in the skirt of the pistons tallies with the oil nozzles.

NOTE The pistons are supplied as spares in class A and can be fitted in class B cylinder liners.

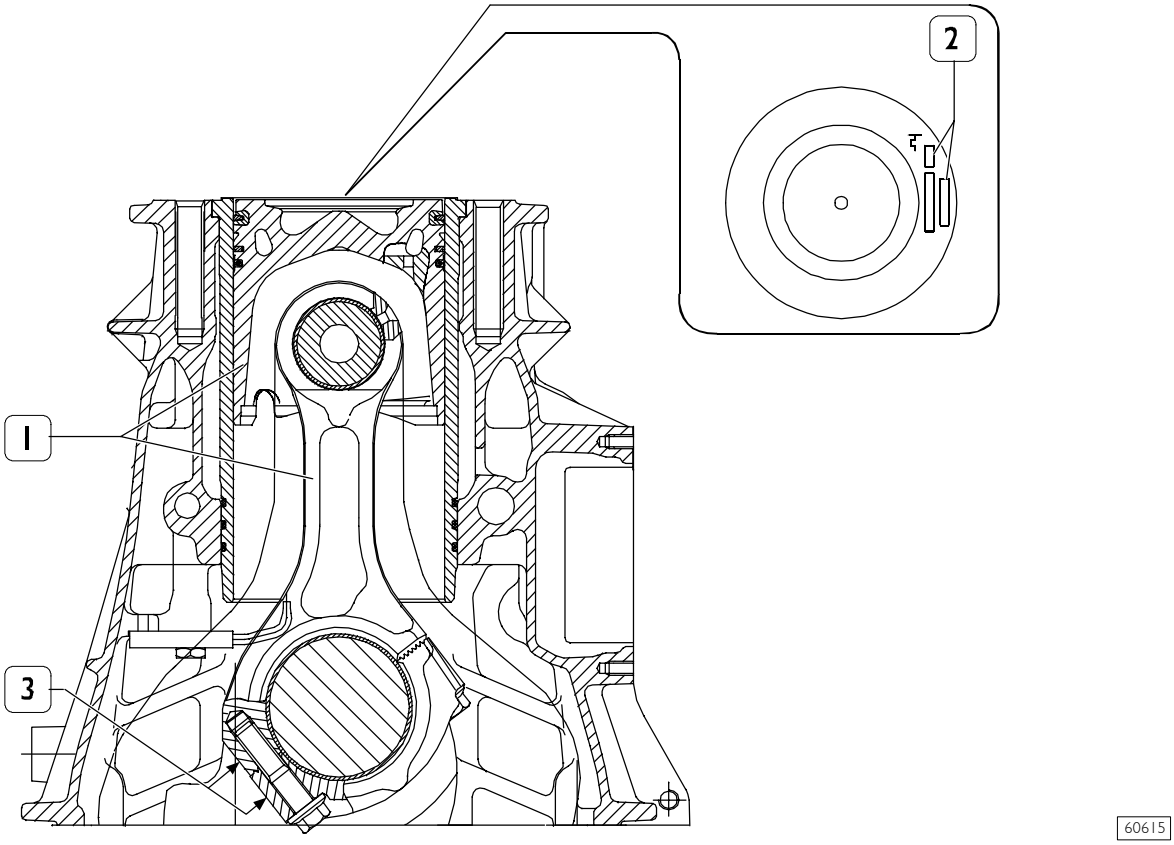
Figure 125



Checking piston protrusion

On completing assembly, check the protrusion of the pistons from the cylinder liners; it must be 0.12 – 0.42 mm.

Figure 126

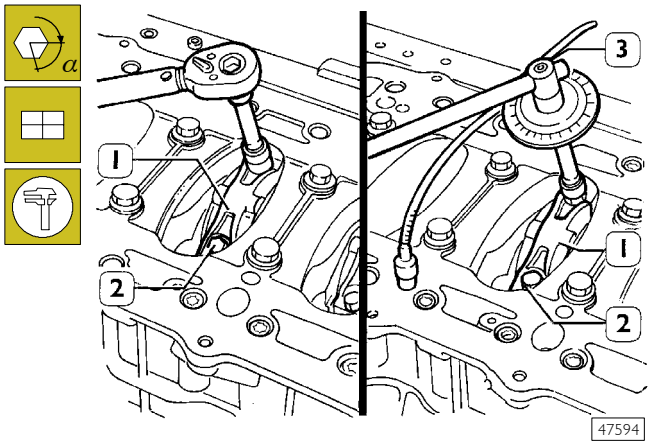


ASSEMBLY DIAGRAM OF CONNECTING ROD – PISTON ASSEMBLY IN CYLINDER LINER
1. Connecting rod – piston assembly – 2. Area of punch marking on the top of the piston, symbol showing assembly position and selection class – 3. Connecting rod punch mark area

540831 Checking crankpin assembly clearance

To measure the clearance, carry out the following operations. Connect the connecting rods to the relevant journals of the crankshaft, placing a length of calibrated wire on the journals.

Figure 127



Mount the connecting rod caps (1) together with the bearing shells. Tighten the screws (2) fixing the connecting rod caps to a torque of 60 Nm (6 kgm). Using tool 99395216 (3), further tighten the screws with an angle of 60°.

NOTE The thread of the screws (2), before assembly, has to be lubricated with engine oil.

Remove the caps and determine the clearance by comparing the width of the calibrated wire with the graduated scale on the case containing the calibrated wire.
Upon final assembly: check the diameter of the thread of the screws (2), it must be no less than 13.4 mm; if it is, change the screw. Lubricate the crankpins and connecting rod bearings. Tighten the screws (2) as described above.

540610 CYLINDER HEAD

Before dismounting cylinder head, check cylinder head for hydraulic seal by proper tooling; in case of leaks not caused by cup plugs or threaded plugs, replace cylinder head.

NOTE At the time of replacement, the cylinder head is supplied as a spare part with a threaded plug that must be removed during the phase of assembly.

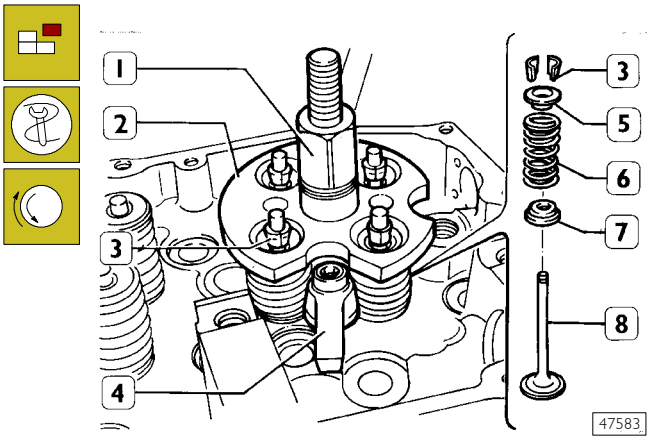
NOTE In case of plugs dismounting/replacement, on mounting, apply sealant Loctite 270 on plugs.

Disassembly the valves

NOTE Before dismounting cylinder head valves, number them in view of their remounting in the position observed on dismounting should they not have to be overhauled or replaced.

Intake valves are different form exhaust valves in that they have a notch placed at valve head centre.

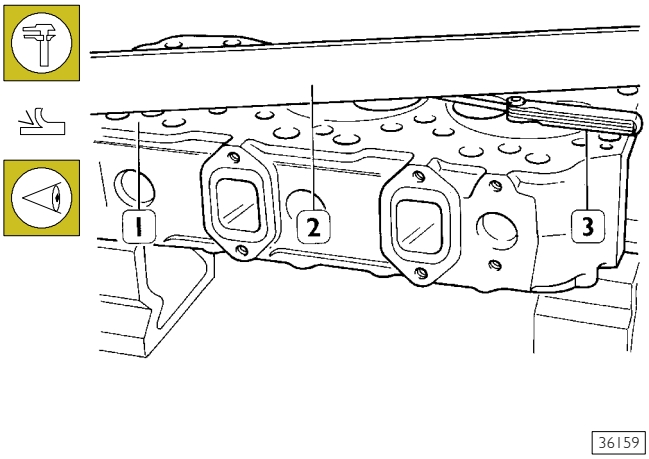
Figure 128



Mount and secure the tool 99360263 (2) with the bracket (4). Screw down with the device 99360261 (1) to be able to remove the cotters (3). Take out the tool (2) and extract the top plate (5), spring (6) and bottom plate (7).
Repeat this process on all the valves.
Turn over the cylinder head and take out the valves (8).

Checking head bearing surface on cylinder block

Figure 129 (Demonstration)



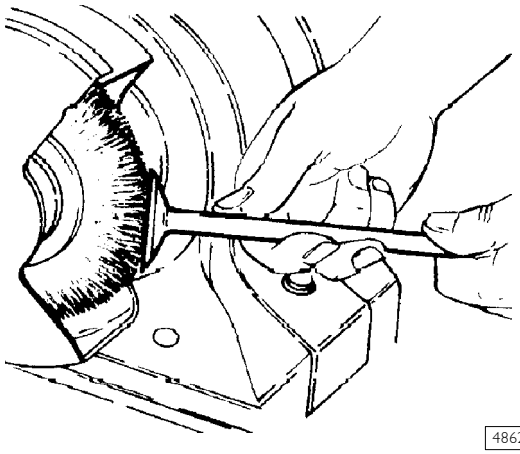
Check the supporting surface (1) of the head on the cylinder block with a rule (2) and a feeler gauge (3). If you find any deformation, level the head on a surface grinder; maximum amount of material that can be removed 0.2 mm.

NOTE After this process, you need to check the valve recessing and injector protrusion.

540622 Valves

Decarbonizing and checking valves

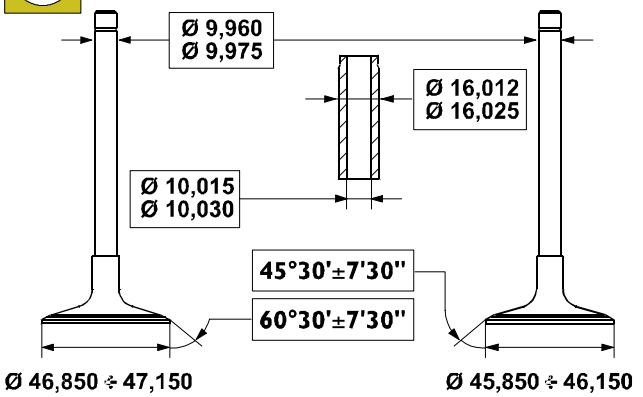
Figure 130



48625

Remove the carbon deposits on the valves with a wire brush. Check that the valves show no signs of seizure or cracking and check with a micrometer that the valve stem diameter comes within the required values (see Figure 131); replace the valves if it does not.

Figure 131



71718

MAIN DATA OF VALVES AND VALVE GUIDES

* Measurement to be made after driving in the valve guides

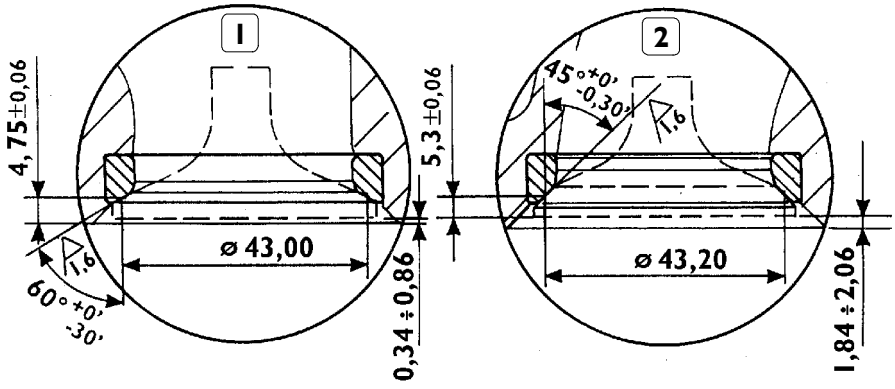
Check with a micrometer that the diameter of the valve stems is as indicated. If necessary, grind the valve seats with a grinding machine, removing as little material as possible.

540661 Valve seats

Regrinding – replacing valve seats

NOTE The valve seats are reground whenever the valves or valve guides are ground and replaced.

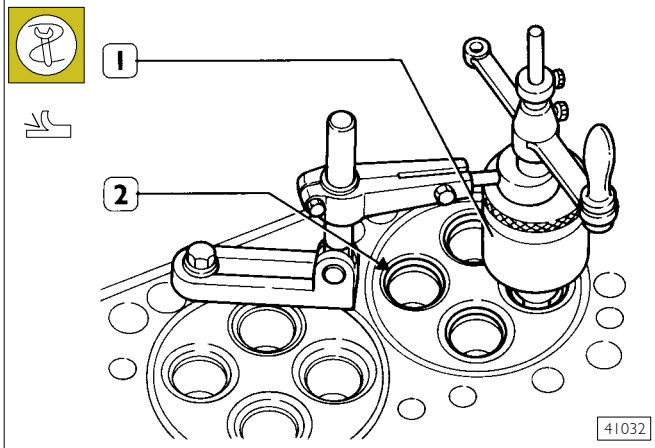
Figure 132



73555

MAIN DATA OF VALVE SEATS
1. Intake valve seat – 2. Exhaust valve seat

Figure 133



If there are light scorings or burnings, adjust them with a suitable device (1) following the inclination values reported in Figure 132. If it is necessary to replace them, using the same tool and taking care not to affect the cylinder head, remove as much material as possible from the valve seats so that, with a punch, it is possible to extract them from the cylinder head.

Heat the cylinder head to 80 ÷ 100°C and, using a drift, fit in the new valve seats (2), chilled beforehand in liquid nitrogen. Using tool (1), regrind the valve seats according to the angles shown in Figure 132.

After regrinding the valve seats, using tool 99370415 and dial gauge 99395603, check that the position of the valves in relation to the plane of the cylinder head is:

- ❑ -0.45 ÷ -0.75 mm (recessing) intake valves
- ❑ -1.65 ÷ -1.95 mm (recessing) exhaust valves.

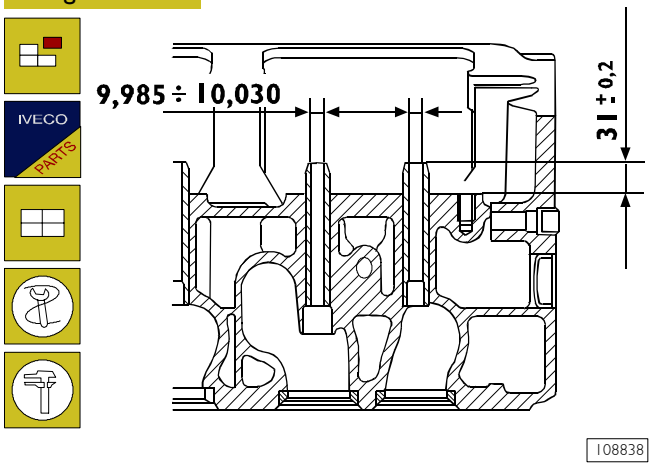
Checking clearance between valve-stem and associated valve guide

Using a dial gauge with a magnetic base, check the clearance between the valve stem and the associated guide. If the clearance is too great, change the valve and, if necessary, the valve guide.

540667 Valve guides

Replacing valve guides

Figure 134



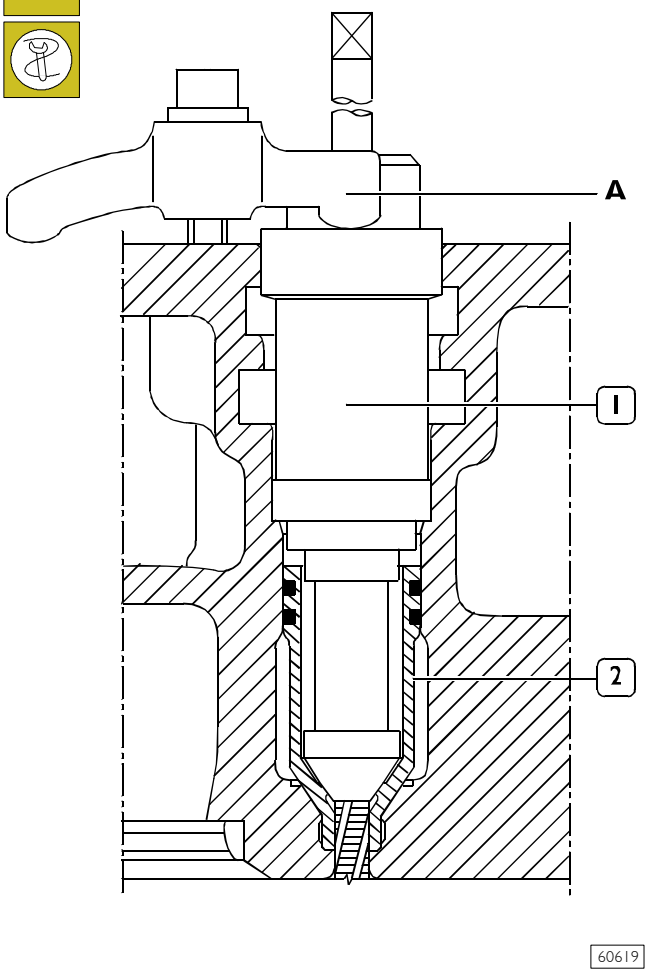
The valve guides are removed with the drift 99360143.
They are fitted with the drift 99360143 equipped with part 99360296.

Part 99360296 determines the exact position of assembly of the valve guides in the cylinder head. If they are not available, you need to drive the valve guides into the cylinder head so they protrude by 30.8÷31.2 mm.
After driving in the valve guides, rebore their holes with the smoother 99390330.

540613 Replacing injector cases

Removal

Figure 135

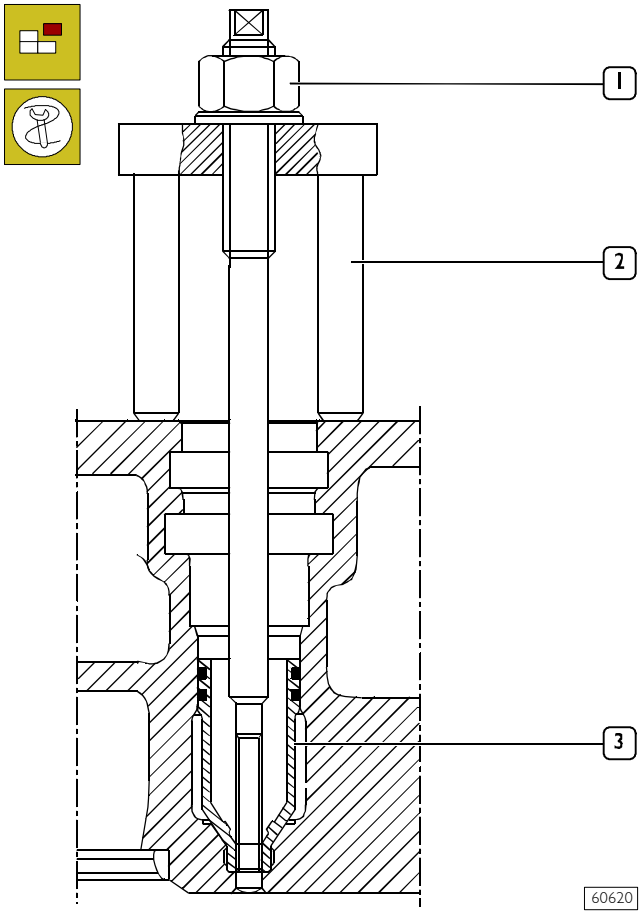


To replace the injector case (2), proceed as follows:

- ❑ Thread the case (2) with tool 99390804 (1).

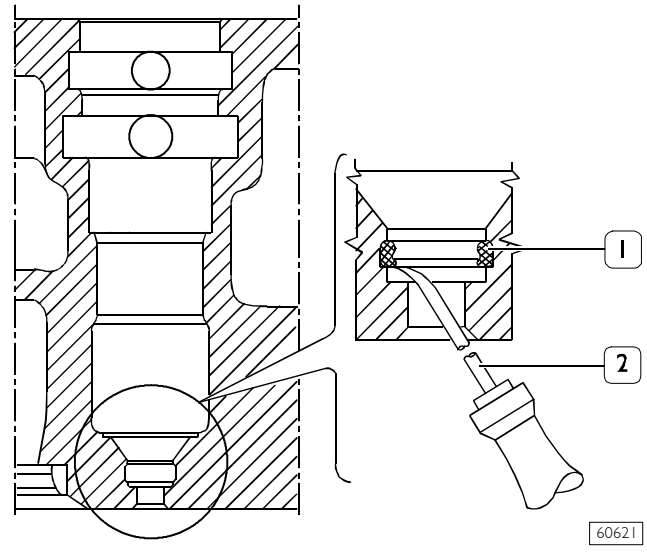
The steps described in Figs. 136 - 138 - 139 - 140 need to be carried out by fixing the tools, with the bracket A, to the cylinder head.

Figure 136



❑ Screw the extractor 99342149 (2) into the case (3). Screw down the nut (1) and take the case out of the cylinder head.

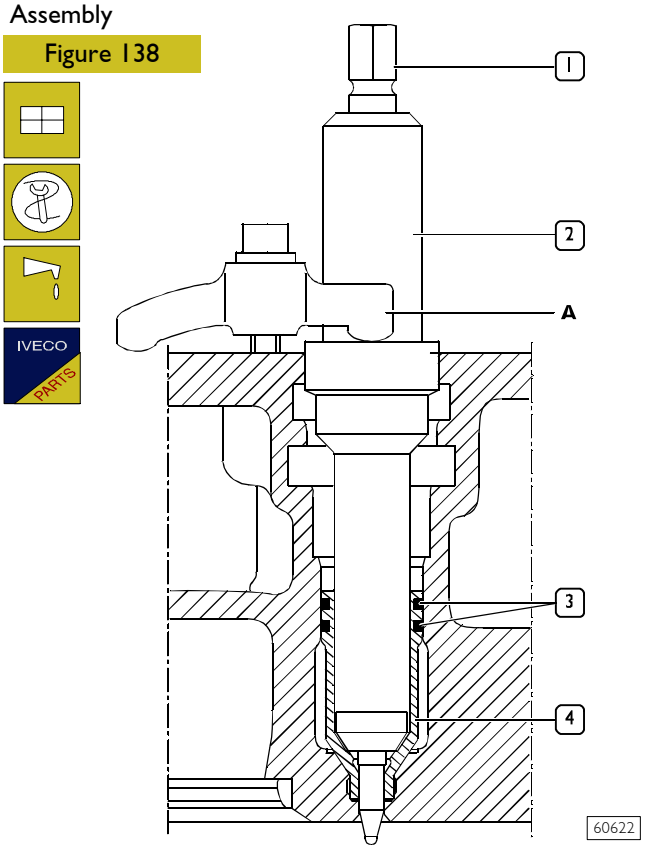
Figure 137



❑ Using the tool 99390772 (2) remove any residues (1) left in the groove of the cylinder head.

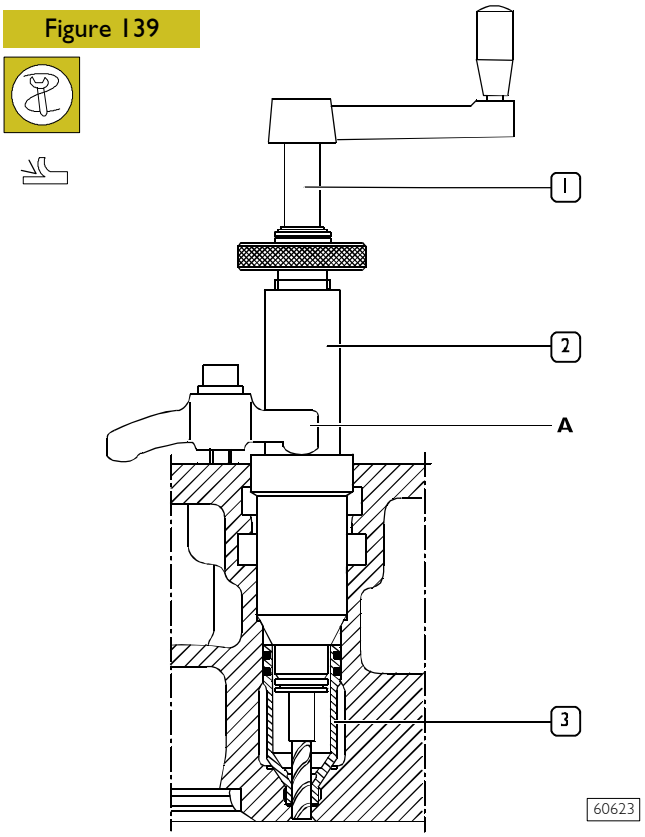
Assembly

Figure 138



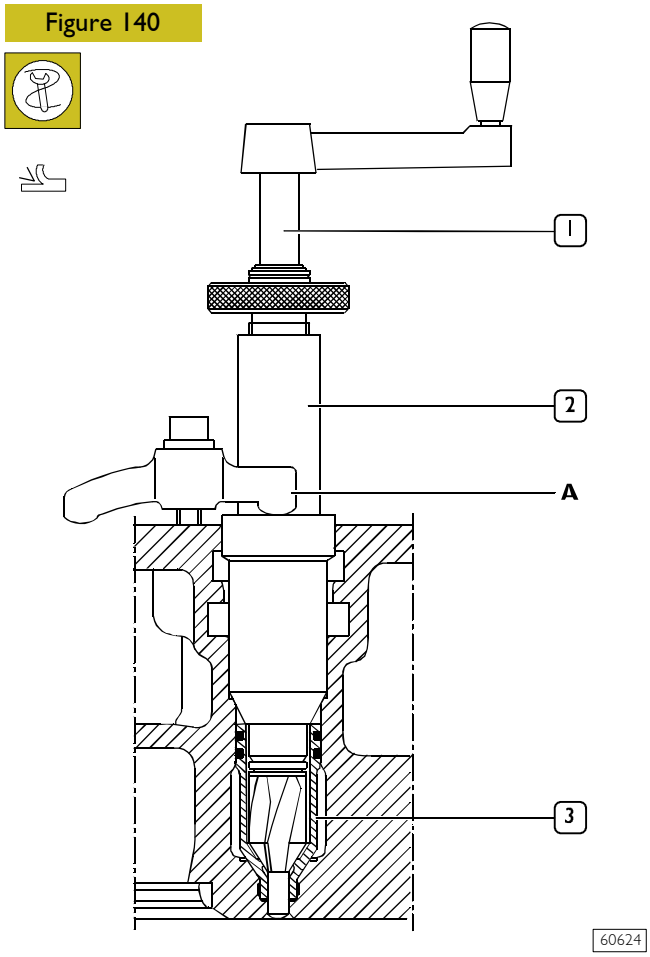
❑ Lubricate the seals (3) and fit them on the case (4). Using tool 99365056 (2) secured to the cylinder head with bracket **A**, drive in the new case, screwing down the screw (1) upsetting the bottom portion of the case.

Figure 139



❑ Using the reamer 99394041 (1-2), rebore the hole in the case (3).

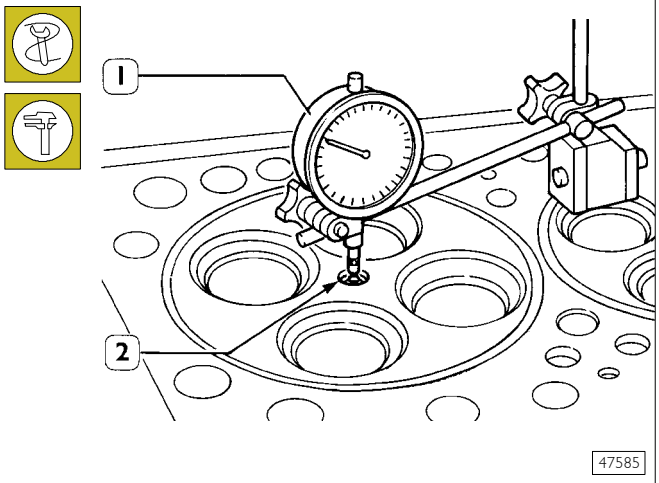
Figure 140



❑ Using the milling cutter 99394043 (1-2), regrind the injector seat in the case (3).

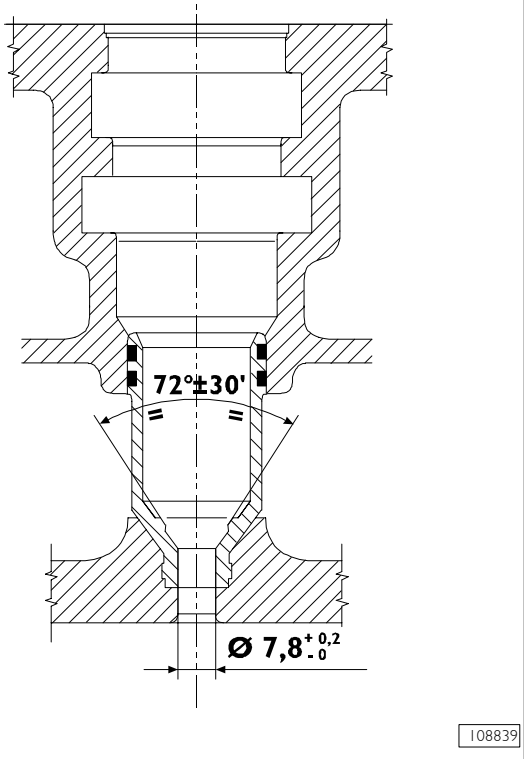
Checking injector protrusion

Figure 141



Check injector protrusion (2) with the dial gauge (1).
The protrusion must be 0.52 - 1.34 mm.

Figure 142

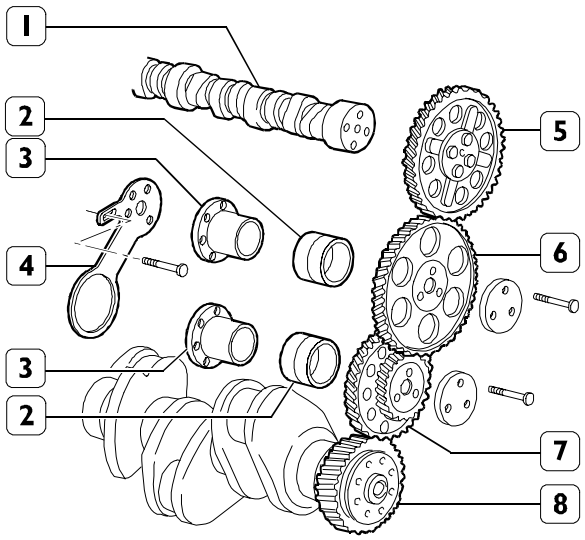


INJECTOR CASE ASSEMBLY DIAGRAM

5412 TIMING GEAR

Camshaft drive

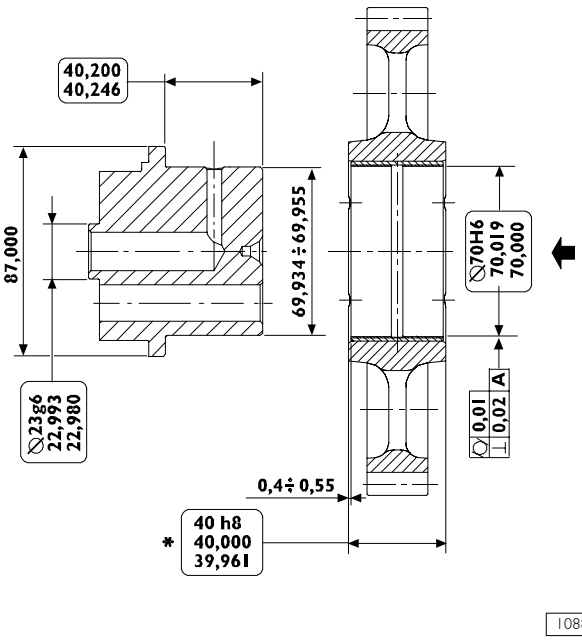
Figure 143



TIMING CONTROL COMPONENT PARTS
1. Camshaft - 2. Bushing - 3. Pin - 4. Articulated rod - 5. Camshaft control gear - 6. Idler gear - 7. Twin idler gear - 8. Drive shaft driving gear.

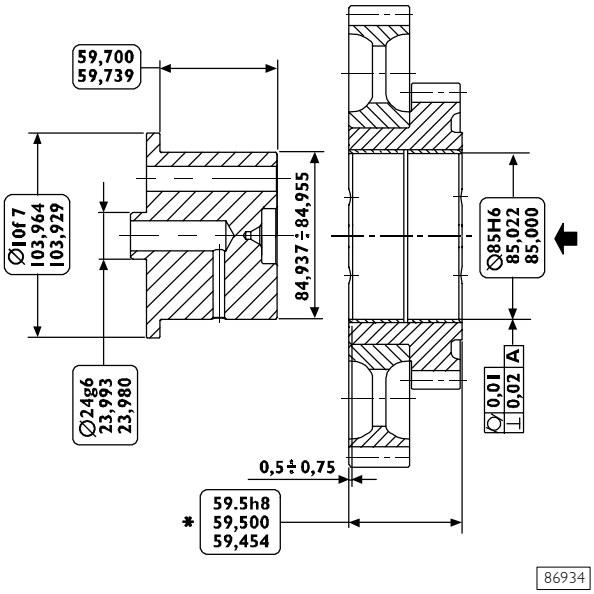
541253 Idler gear pin
541252 Idler gear

Figure 144



541253 Twin intermediate gear pin
541252 Twin idler gear

Figure 145



541254 Replacing the bushings

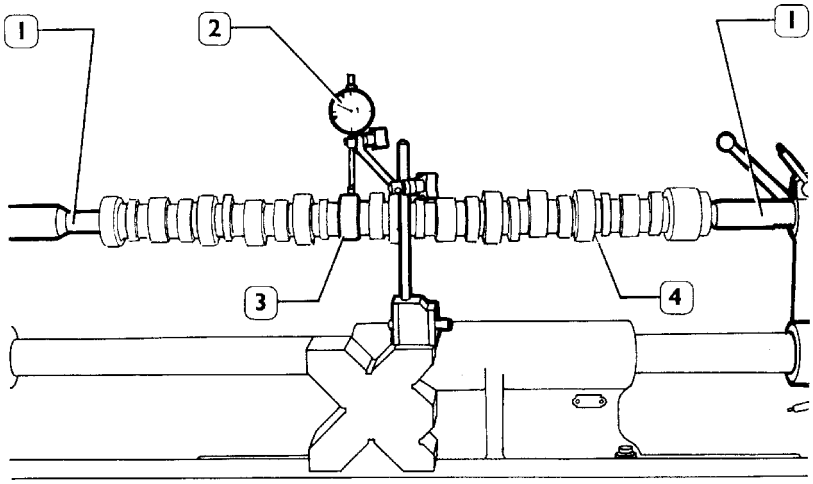
Bushings (2, Figure 144, and 2, Figure 145 can be replaced when they are worn. Put up the bushing, then bore it to obtain the diameter shown on Figure 144 or Figure 145

NOTE The bushing must be driven into the gear by following the direction of the arrow and setting the latter to the dimension shown on Figure 144 or Figure 145

Rated assembling play between gear bushings and pins:
Figure 144 – 0.045 ÷ 0.085 mm
Figure 145 – 0.045 ÷ 0.085 mm.

541210 Timing system
541211 Checking cam lift and pin alignment

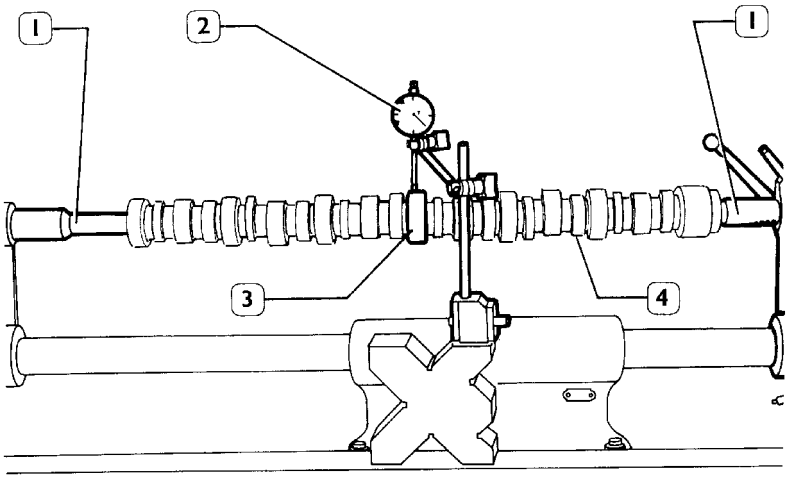
Figure 146



47506

Set the camshaft (4) on the tailstocks (1) and check the lift of the cams (3) with the dial gauge (2); the values are given in the table on page 138.

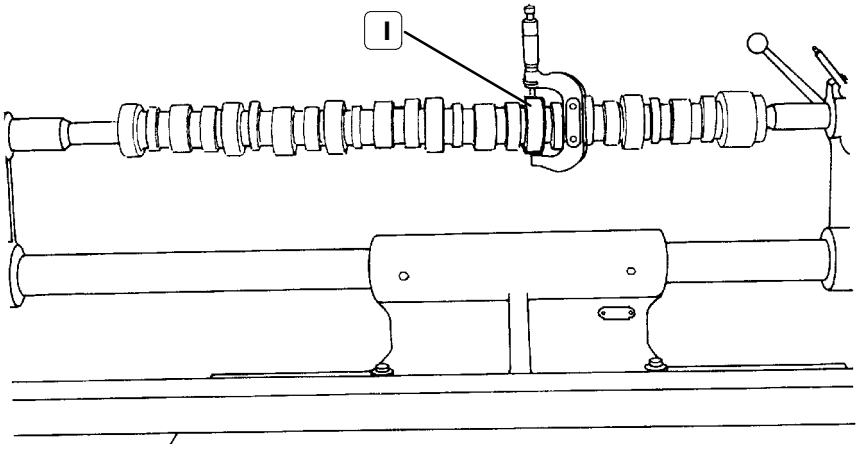
Figure 147



47507

Still with the camshaft (4) set on the tailstocks (1), check the alignment of the supporting pins (3) with the dial gauge (2); it must be no greater than 0.030 mm. If you find a greater misalignment, replace the shaft.

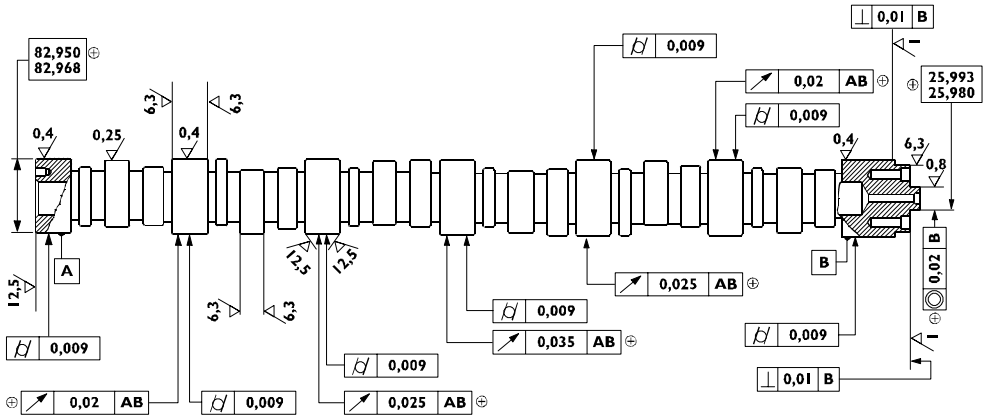
Figure 148



47505

To check the assembly clearance, measure the inside diameter of the bushings and the diameter of the pins (1) of the camshaft: the difference will give the actual clearance.
If you find any clearances over 0.135 mm, replace the bushings and, if necessary, the camshaft as well.

Figure 149



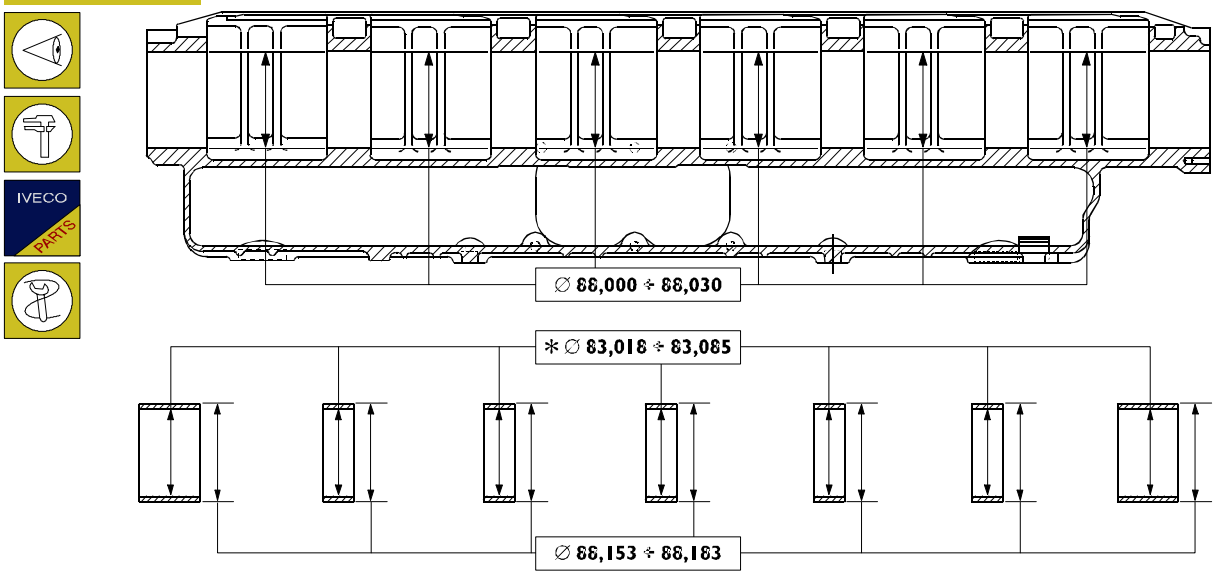
MAIN DATA OF THE CAMSHAFT AND TOLERANCES

The surfaces of the supporting pins of the shaft and those of the cams need to be extra smooth.
Whereas, if they show any signs of seizing or scoring, you should replace the shaft and the relevant bushings.

TOLERANCES	FEATURE SUBJECT OF TOLERANCE	SYMBOL
DIRECTION	Perpendicularity	⊥
POSITION	Concentricity or coaxiality	◎
SWING	Circular oscillation	↗
CLASS OF IMPORTANT ASCRIBED TO PRODUCT CHARACTERISTICS		**SYMBOL**
CRUCIAL		©
IMPORTANT		⊕
SECONDARY		⊖

541213 Bushings

Figure 150



MAIN DATA OF THE BUSHINGS FOR THE CAMSHAFT AND SEATS ON THE CYLINDER HEAD

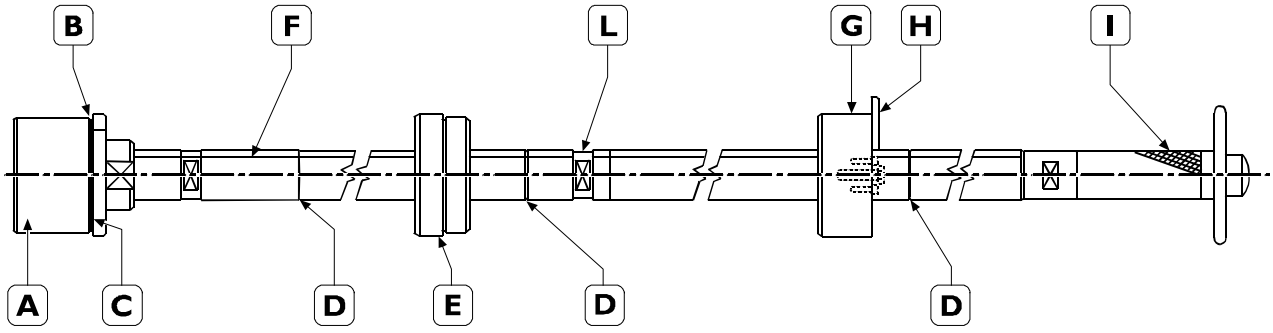
* Bushing inside diameter after driving in

The surface of the bushings must show no sign of seizing or scoring; replace them if they do.
Measure the inside diameter of the bushings with a bore gauge.

If you find a higher value than the tolerance, replace them.
To remove and fit the bushings, use the appropriate drift 99360499.

Replacing camshaft bushings with drift 99360499
Drift

Figure 151

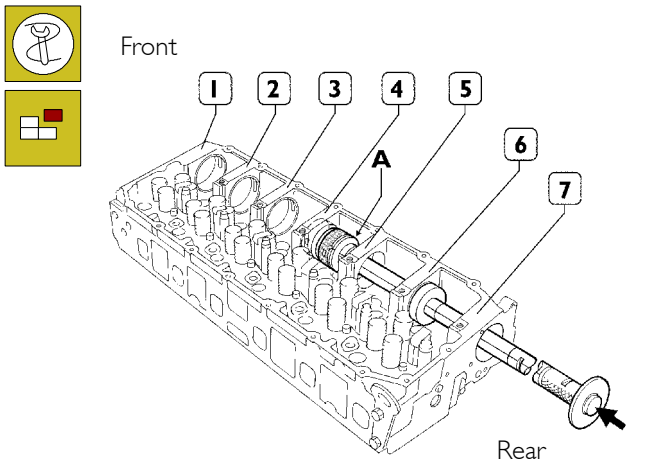


107217

A = Drift with seat for bushings to insert/extract.
B = Grub screw for positioning bushings.
C = Reference mark to insert seventh bushing correctly.
D = Reference mark to insert bushings 1, 2, 3, 4, 5, 6 correctly (yellow marks).
E = Guide bushing.
F = Guide line.
G = Guide bushing to secure to the seventh bushing mount.
H = Plate fixing bushing G to cylinder head.
I = Grip.
L = Extension coupling.

Removal

Figure 152

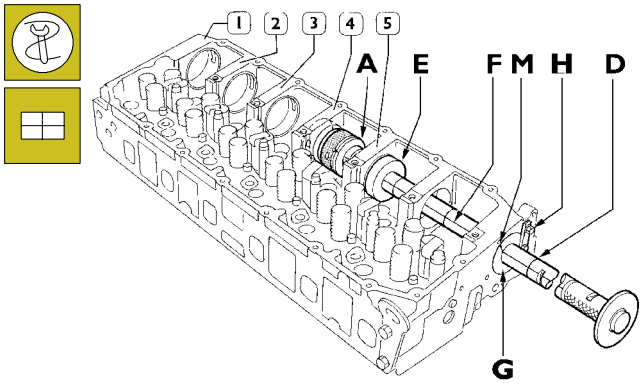


71725

The sequence for removing the bushings is 7, 6, 5, 4, 3, 2, 1.
The bushings are extracted from the front of the single seats.
Removal does not require the drift extension for bushings 5, 6 and 7 and it is not necessary to use the guide bushing.
For bushings 1, 2, 3 and 4 it is necessary to use the extension and the guide bushings.
Position the drift accurately during the phase of removal.

Assembly

Figure 153

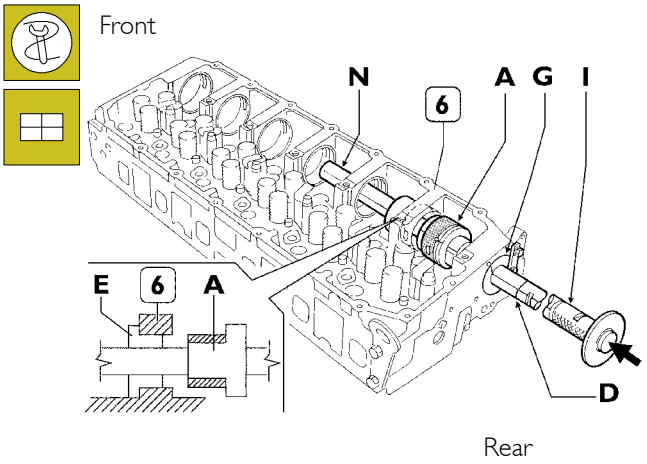


77795

Assemble the drift together with the extension.
To insert bushings 1, 2, 3, 4 and 5, proceed as follows:

1 position the bushing to insert on the drift (A) making the grub screw on it coincide with the seat (B) (Figure 151) on the bushing;
2 position the guide bushing (E) and secure the guide bushing (G) (Figure 151) on the seat of the 7th bushing with the plate (H);
3 while driving in the bushing, make the reference mark (F) match the mark (M). In this way, when it is driven home, the lubrication hole on the bushing will coincide with the oil pipe in its seat.
The bushing is driven home when the 1st yellow reference mark (D) is flush with the guide bushing (G).

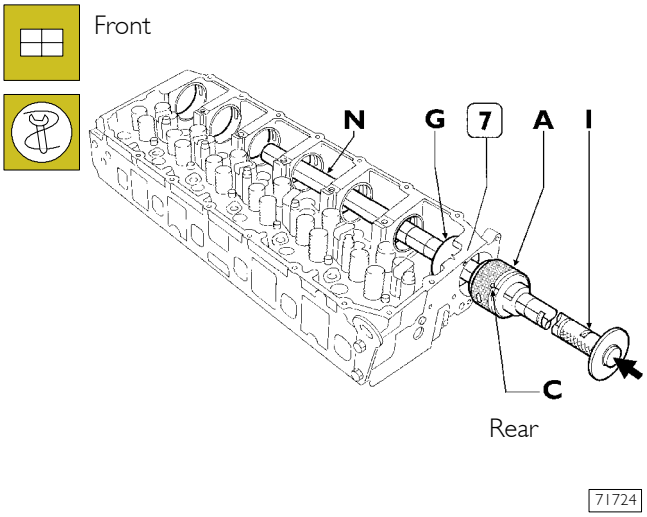
Figure 154



To insert the bushing (6), proceed as follows:

- ❑ Unscrew the grip (I) and the extension (N).
- ❑ Position the extension (N) and the guide bushing E as shown in the figure.
- ❑ Repeat steps 1, 2, 3.

Figure 155

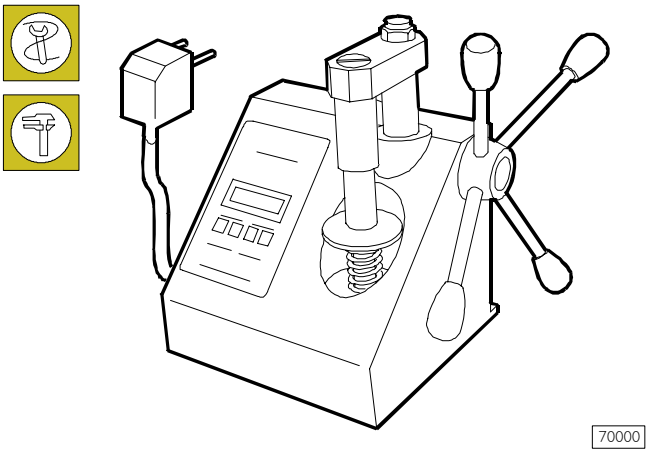


To insert bushing (7), proceed as follows:

- ❑ Unscrew the grip (I) and the extension (N).
- ❑ Refit the guide (G) from the inside as shown in the figure.
- ❑ Position the bushing on the drift (A) and bring it close up to the seat, making the bushing hole match the lubrication hole in the head. Drive it home.
  The 7th bushing is driven in when the reference mark (C) is flush with the bushing seat.

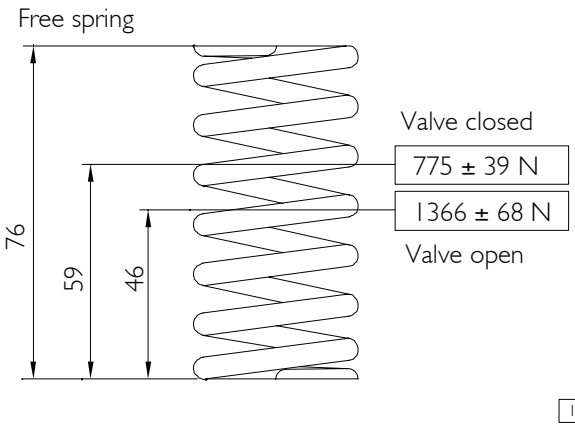
540665 Valve springs

Figure 156 (Demostration)



Prior to assembling, check the valves springs for flexibility using a suitable device.
Compare the load and elastic deformation data with those of the new springs given in the following figure.

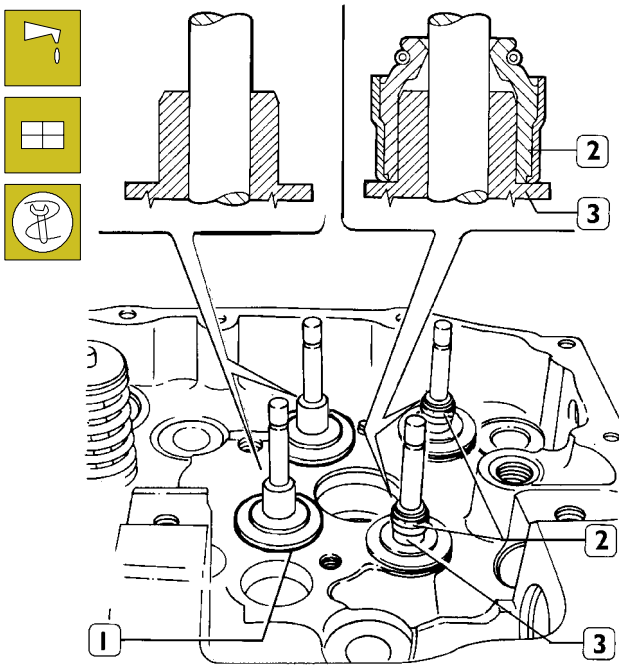
Figure 157



MAIN DATA TO CHECK THE SPRING FOR INTAKE AND EXHAUST VALVES

Fitting valves and oil seal

Figure 158



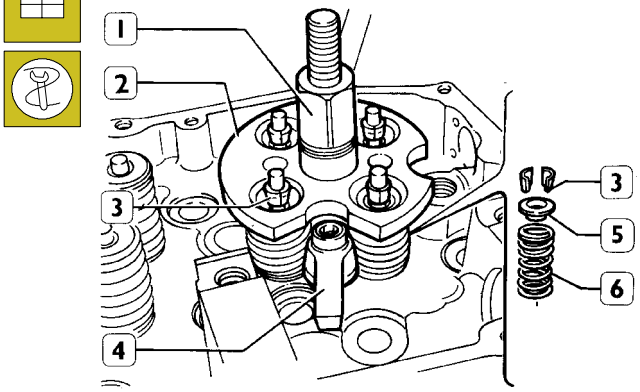
87051

Lubricate the valve stem and insert the valves in the respective valve guides; fit the lower caps (1). Use tool 99360329 to fit the oil seal (2) on the valve guides (3) of the exhaust valves; then, to fit the valves, proceed as follows.

NOTE Should valves not have been overhauled or replaced, remount them according to numbering performed on dismounting.

Intake valves are different form exhaust valves in that they have a notch placed at valve head centre.

Figure 159

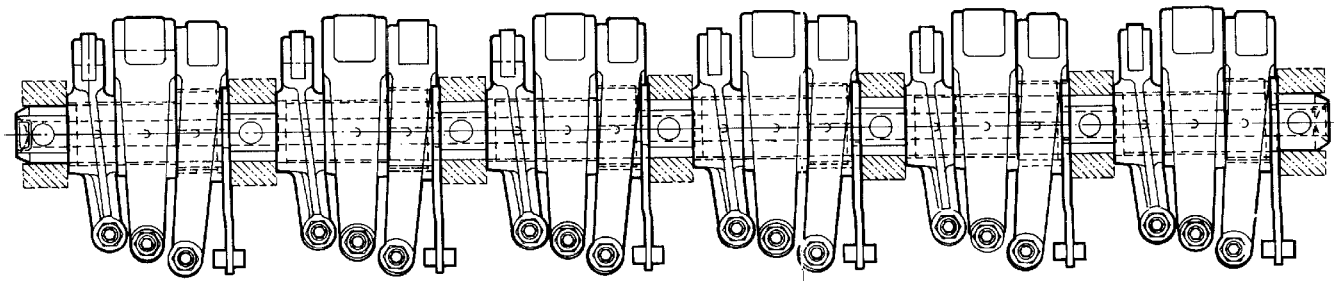


86290

- ❑ Mount the springs (6) and the top plate (5).
- ❑ Fit the tool 99360263 (2) and secure it with the bracket (4). Screw down the lever (1) to be able to fit on the cotters (3). Take off the tool (2).

5412 ROCKER SHAFT

Figure 160



44925

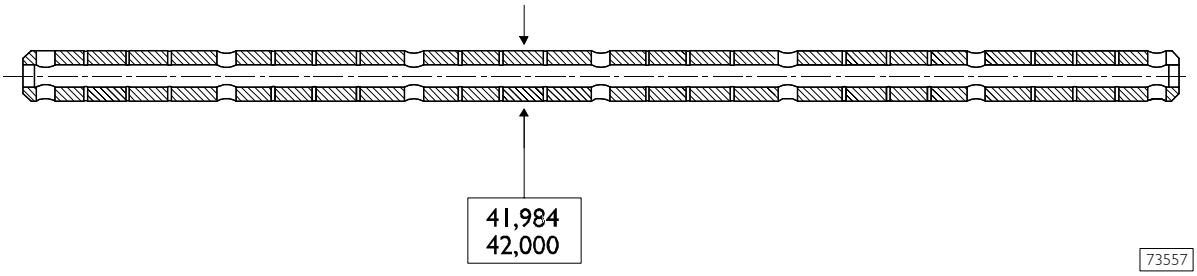
The cams of the camshaft control the rocker arms directly: 6 for the injectors and 12 for the valves.

Injectors and intake valves control rocker arms are keyed on rocker arms shaft directly. Exhaust intake valves control rocker arms are keyed on rocker arms shaft putting in between the levers with engine brake control eccentric pin.

The rocker arms run directly on the profiles of the cams by means of rollers.
The other end acts on a crosspiece that rests on the stem of the two valves.
There is a pad between the rocker arm adjustment screw and the crosspiece.
There are two lubrication ducts inside the rocker arms.
The length of the rocker arm shaft is basically the same as that of the cylinder head. It has to be detached to be able to reach all the parts beneath.

Shaft

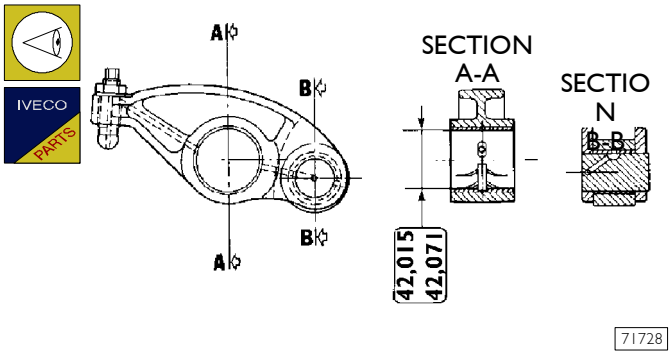
Figure 161



MAIN DATA OF THE ROCKER ARM SHAFT
Check that the surface of the shaft shows no scoring or signs of seizure; if it does, replace it.

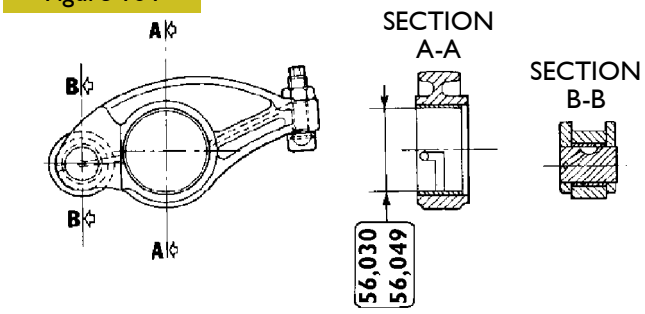
Rocker arms

Figure 162



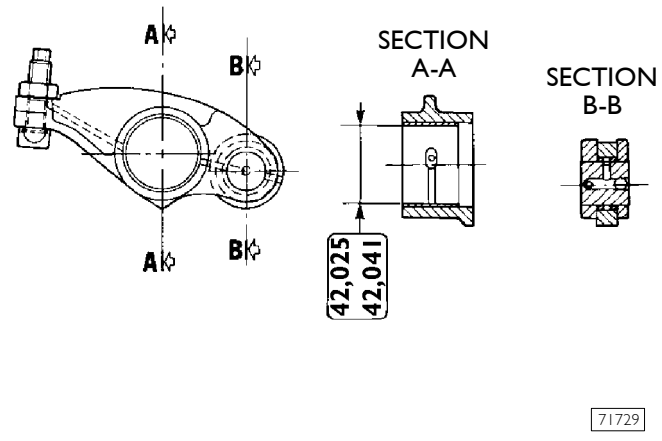
PUMP INJECTOR ROCKER ARMS

Figure 164



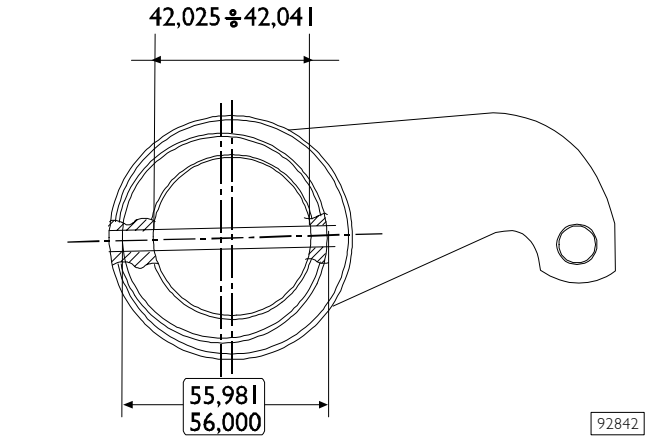
EXHAUST VALVE ROCKER ARMS

Figure 163



INTAKE VALVE ROCKER ARMS

Figure 165



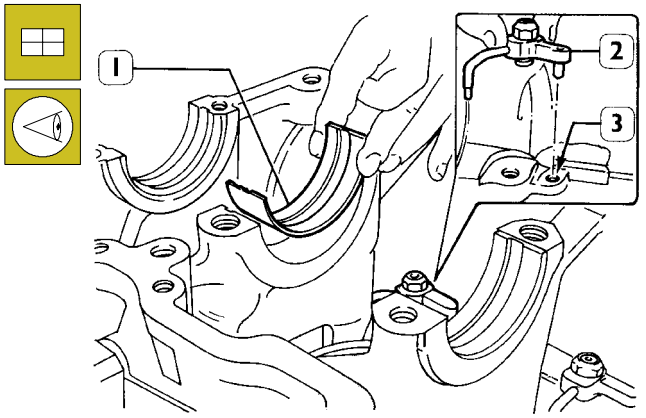
LEVER WITH ENGINE BRAKE CONTROL ECCENTRIC PIN

Check the surfaces of the bushings, which must show no signs of scoring or excessive wear; if they do, replace the rocker arm assembly.

ENGINE ASSEMBLY ON BENCH

Using the brackets 99361036, secure the crankcase to the stand 99322230.
Mount the cylinder liners as described on page 179.

Figure 166



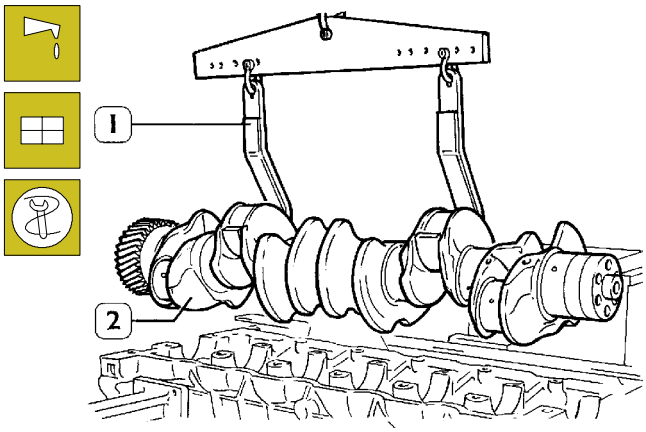
47586

Mount the oil nozzles (2), making the grub screw coincide with the hole (3) in the crankcase.

Arrange the bearing shells (1) on the main bearing housings.

NOTE Not finding it necessary to replace the main bearings, you need to fit them back in exactly the same sequence and position as in removal.
Choose main bearings, if they are to be replaced, based on selection described in chapter "Selecting main and big end bearings".

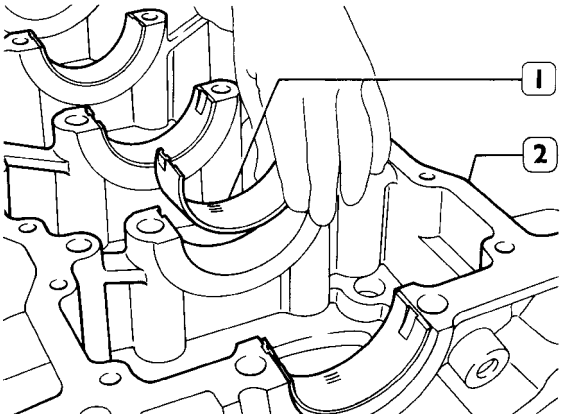
Figure 167



47570

Lubricate the bearing shells then mount the crankshaft (2) using the tackle and hook 99360500 (1).

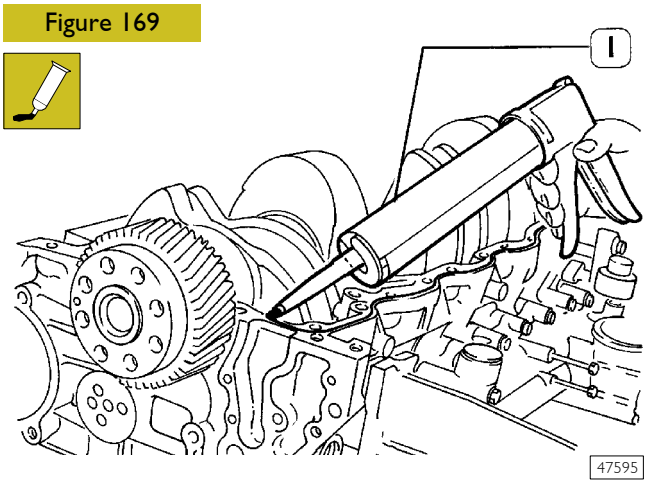
Figure 168



49021

Arrange the bearing shells (1) on the main bearing housings in the crankcase base (2).

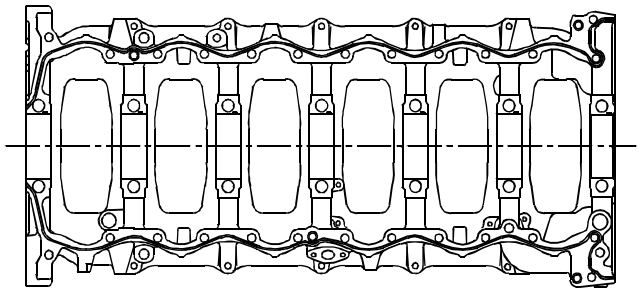
Figure 169



47595

Apply LOCTITE 5970 IVECO No. 2995644 silicone on the crankcase using the appropriate tools (1) as shown in Figure 170.

Figure 170

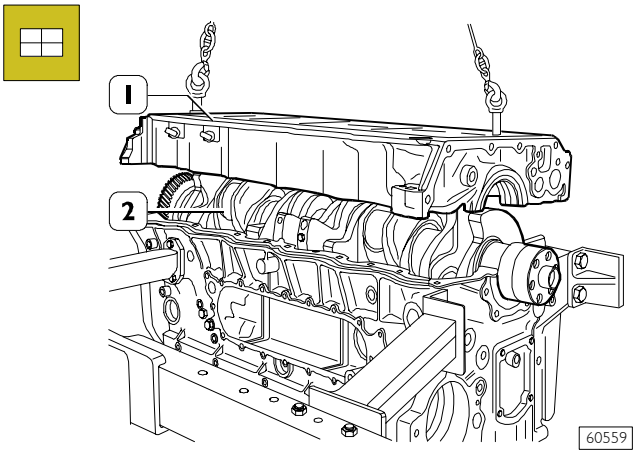


60632

Sealant application diagram.

NOTE Mount the crankcase base within 10 min. of applying the sealant.

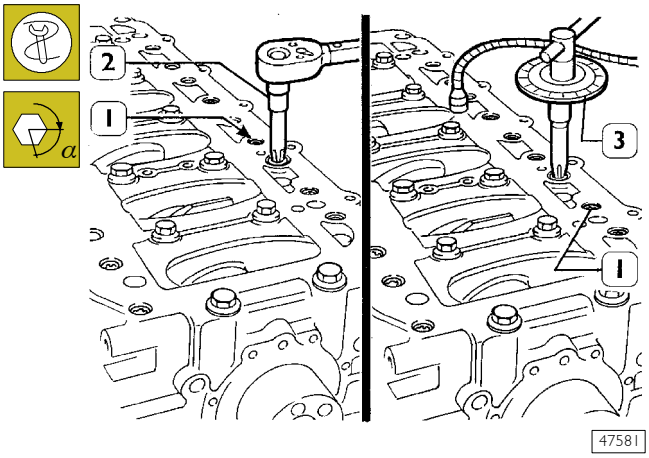
Figure 171



60559

Mount the crankcase base (1) using appropriate tackle and hooks.

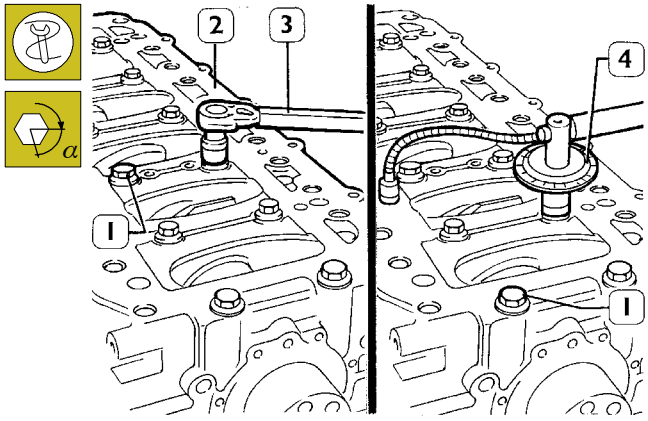
Figure 172



47581

By torque wrench (2), tighten (1) outer Hex splined screws at 30 Nm torque observing the schemes at next page.

Figure 173

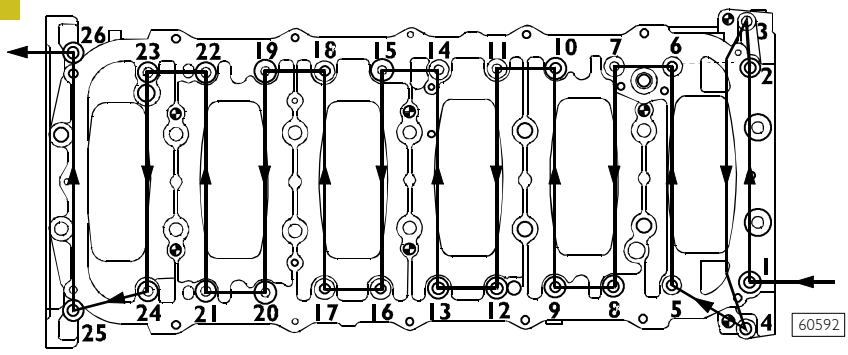


47579

Using a torque wrench (3), tighten the inside screws (1) to a torque of 120 Nm. Then tighten them to an angle of 60° and 55° with tool 99395216 (4) with another two phases. Regrind the outside screws (1, Figure 172) with closure to an angle of 60° using tool 99395216 (4).

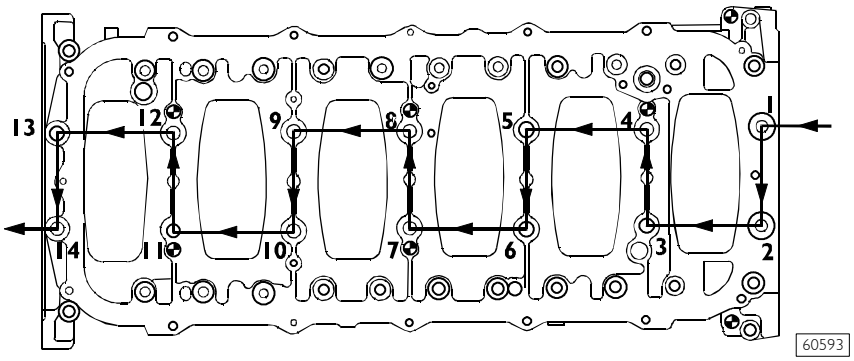
Figure 174

FRONT SIDE



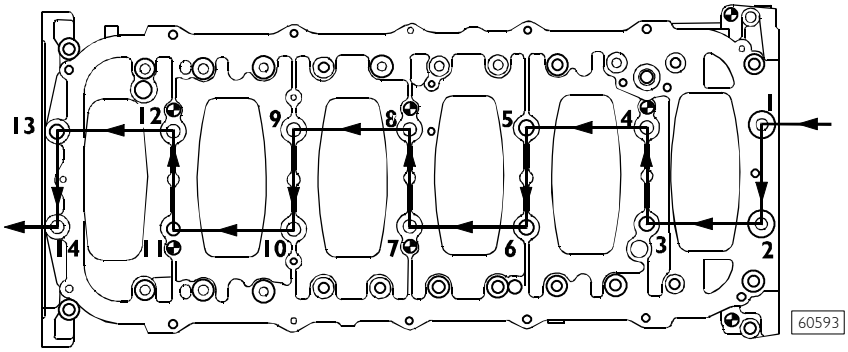
First phase:
pre-tightening
outside screws
30 Nm

FRONT SIDE



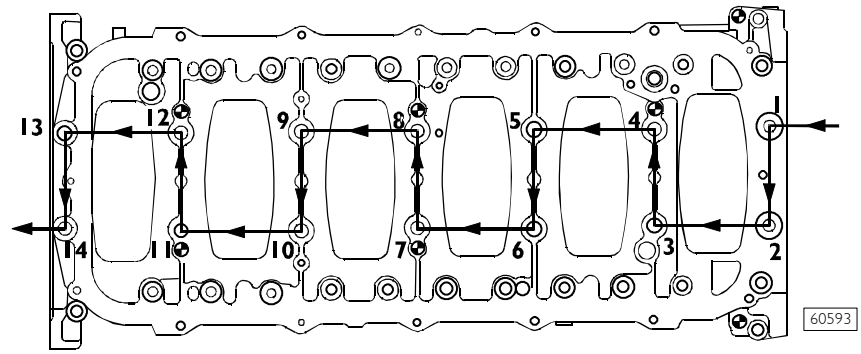
Second phase:
pre-tightening
inside screws
120 Nm

FRONT SIDE



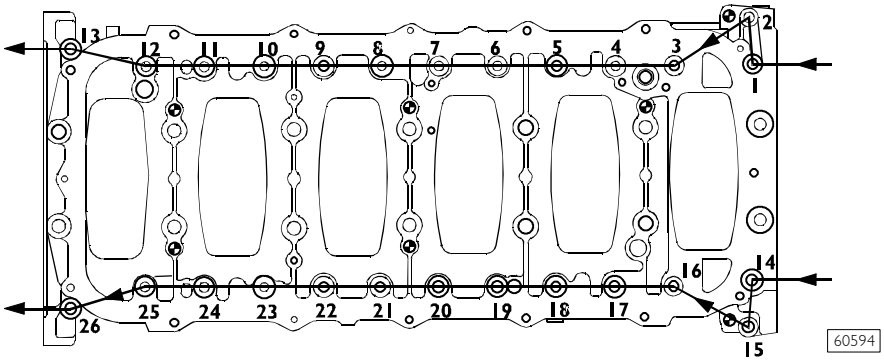
Third phase:
closing inside
screws to angle
60°

FRONT SIDE



Fourth phase:
closing inside
screws to angle
55°

FRONT SIDE

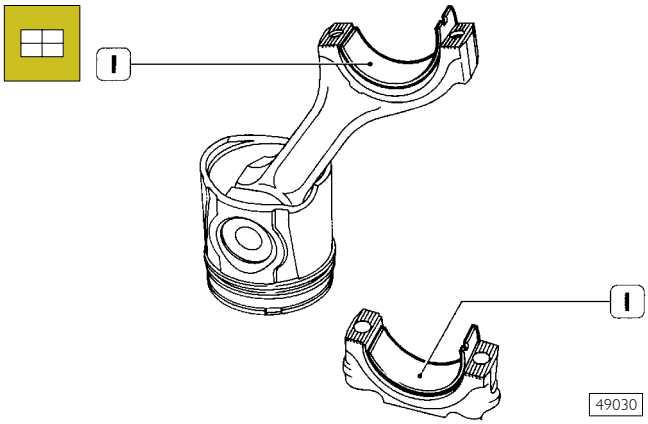


Fifth phase:
closing outside
screws to angle
60°

DIAGRAM OF TIGHTENING SEQUENCE OF CRANKCASE BASE FIXING SCREWS

Fitting connecting rod - piston assemblies in cylinder liners

Figure 175

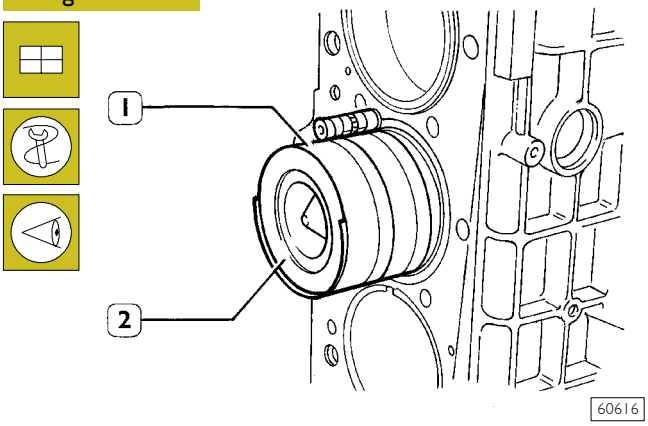


NOTE Not finding it necessary to replace the connecting rod bearings, you need to fit them back in exactly the same sequence and position as in removal.
Choose main bearings, if they are to be replaced, based on selection described in chapter "Selecting main and big end bearings".

Lubricate the bearing shells (1 and 3) and fit them on the connecting rod (2) and on the cap (4).

NOTE Do not make any adjustment on the bearing shells.

Figure 177

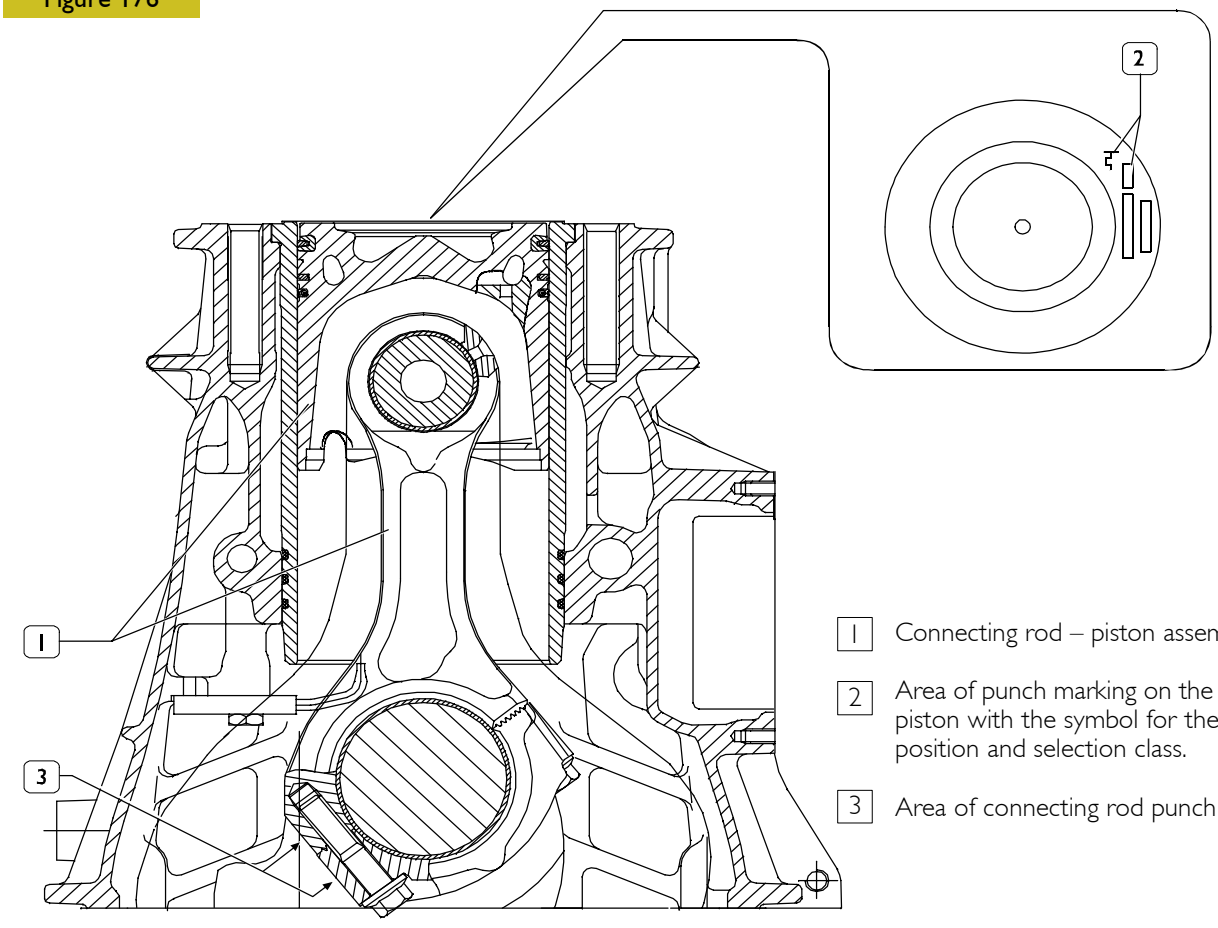


Turn the cylinder block, setting it upright.
Lubricate the pistons, piston rings and inside the cylinder liners. With the aid of the clamp 99360605 (1) mount the connecting rod – piston assemblies (2) in the cylinder liners according to Figure 176. Check that:

- ❑ The number of each connecting rod corresponds to the cap coupling number.
- ❑ The symbol (2, Figure 176) punched on the top of the pistons faces the engine flywheel or the recess in the piston skirt tallies with the position of the oil nozzles.

NOTE The pistons are supplied as spares in class A and can also be fitted in class B cylinder liners.

Figure 176

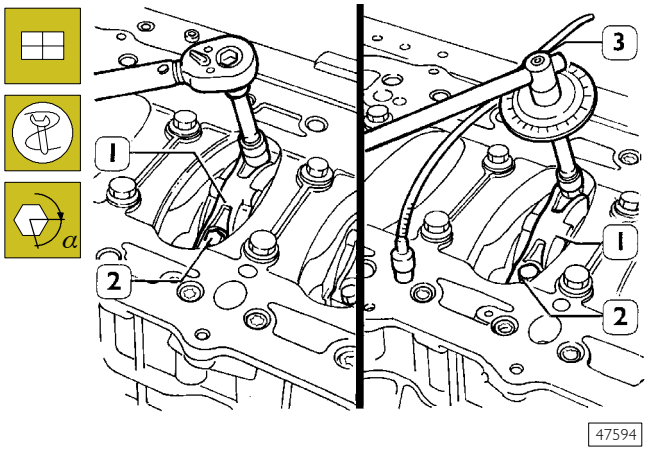


1 Connecting rod – piston assembly

2 Area of punch marking on the top of the piston with the symbol for the mounting position and selection class.

3 Area of connecting rod punch marking

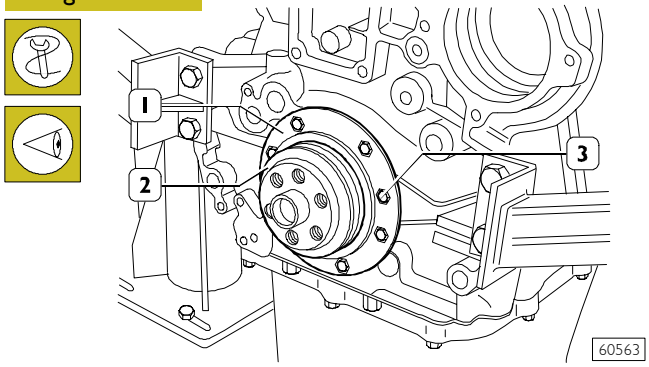
Figure 178



NOTE Before reusing the screws (2), measure the diameter of the thread; it must be no less than 13.4 mm; if it is, change the screw.
Lubricate the thread of the screws with engine oil before assembly.

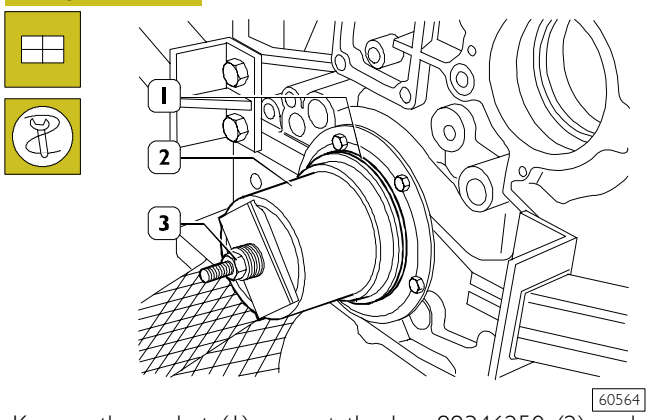
Connect the connecting rods to the relevant pins of the crankshaft, mount the connecting rod caps (1) together with the bearing shells. Tighten the screws (2) fixing the connecting rod caps to a torque of 60 Nm (6 kgm). Using tool 99395216 (3), tighten the screws further with an angle of 60°.

Figure 179



Using the centring ring 99396035 (2), check the exact position of the cover (1). If it is wrong, proceed accordingly and lock the screws (3).

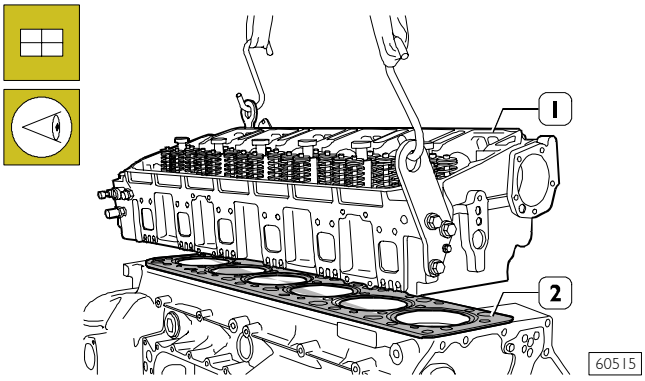
Figure 180



Key on the gasket (1), mount the key 99346250 (2) and, screwing down the nut (3), drive in the gasket (1).

Fitting the cylinder head

Figure 181



Check that the pistons 1-6 are exactly at the T.D.C.
Put the gasket (2) on the crankcase.
Mount the cylinder head (1) and tighten the screws as shown in Figs. 182, 183 and 184.

NOTE Lubricate the thread of the screws with engine oil before assembly.

Figure 182

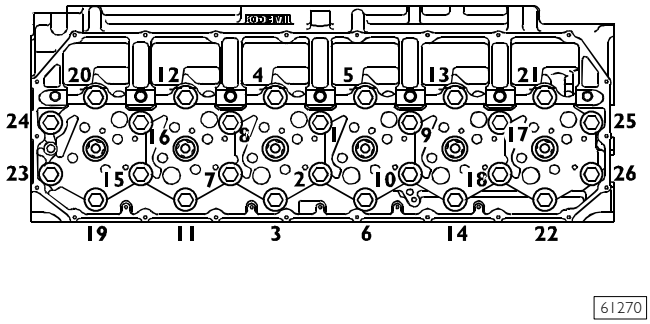
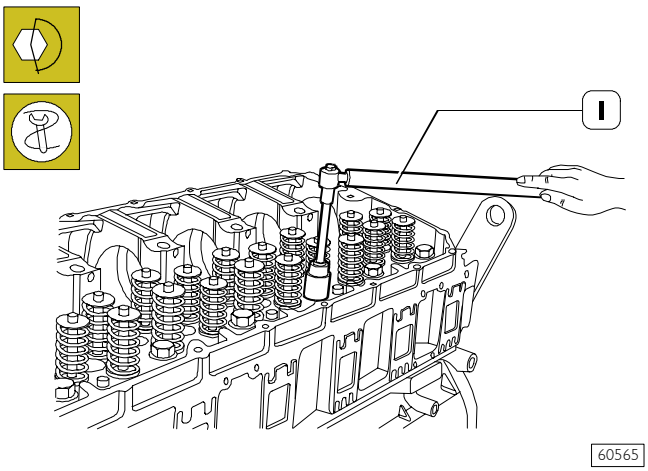


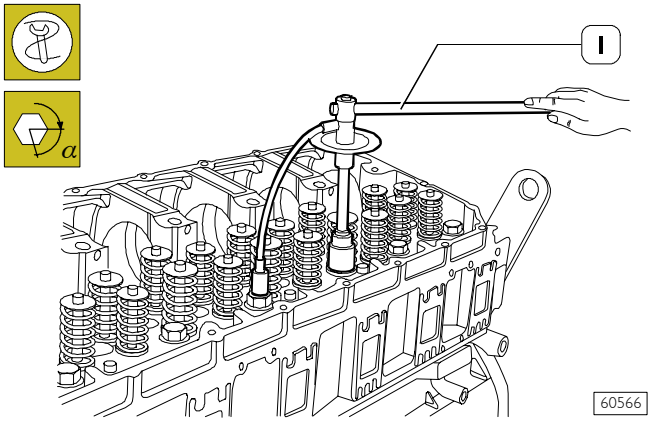
Diagram of the tightening sequence of the screws fixing the cylinder head.

Figure 183



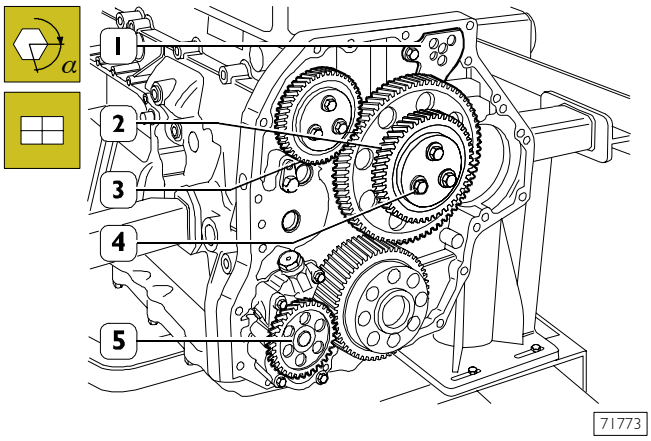
❑ Pre-tightening with the torque wrench (1):
1st phase: 60 Nm (6 kgm).
2nd phase: 120 Nm (12 kgm).

Figure 184



❑ Closing to angle with tool 99395216 (1):
3rd phase: angle of 90°
4th phase: angle of 65°.

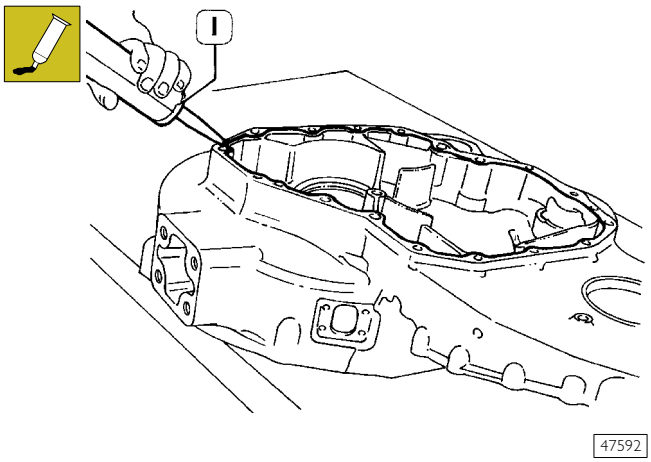
Figure 185



Mount the oil pump (5), the middle gears (2) together with the link rod (1) and the PTO driving gear (3).
Tighten the screws (4) to the required torque.

Fitting flywheel box

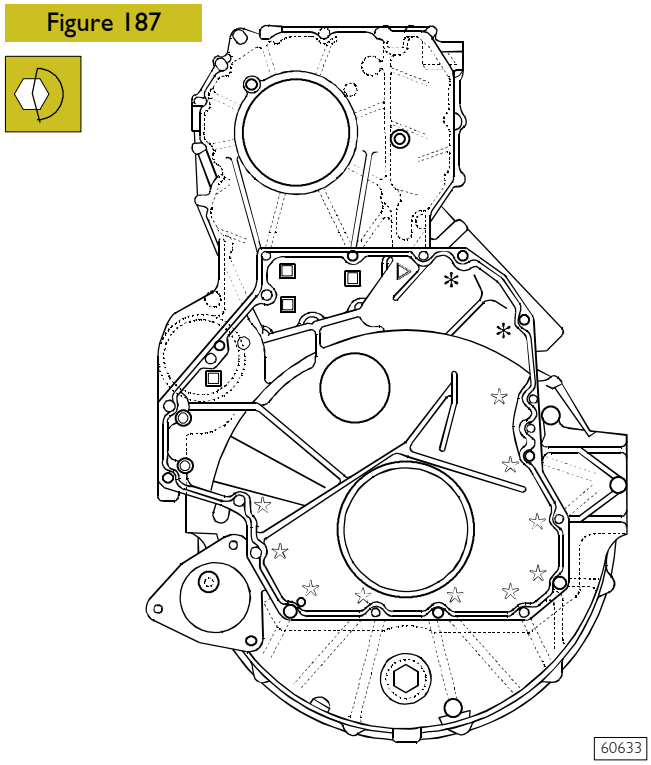
Figure 186



Apply LOCTITE 5970 IVECO No. 2995644 silicone on the gearbox using appropriate tools (1) as shown in the figure.

NOTE Mount the gearbox within 10 min. of applying the sealant.

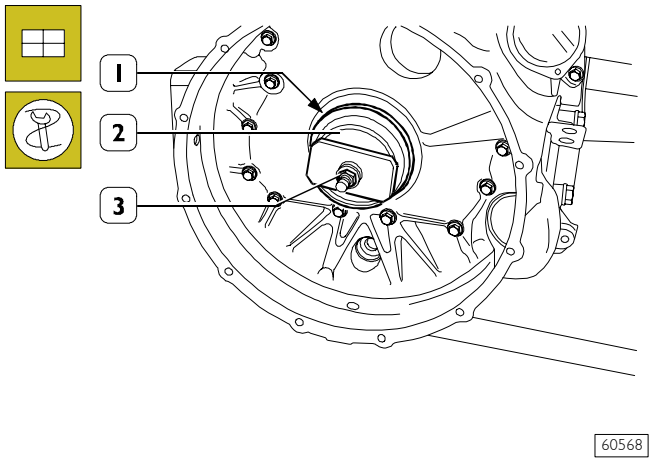
Figure 187



Using a torque wrench, tighten the highlighted screws with the following sequence and torque:

✡	10 screws M12 x 1.75 x 100	56 to 70 Nm
◎	2 screws M12 x 1.75 x 70	56 to 70 Nm
□	4 screws M12 x 1.75 x 35	56 to 70 Nm
△	1 screw M12 x 1.75 x 120	56 to 70 Nm
✳	2 screws M12 x 1.75 x 193	56 to 70 Nm

Figure 188

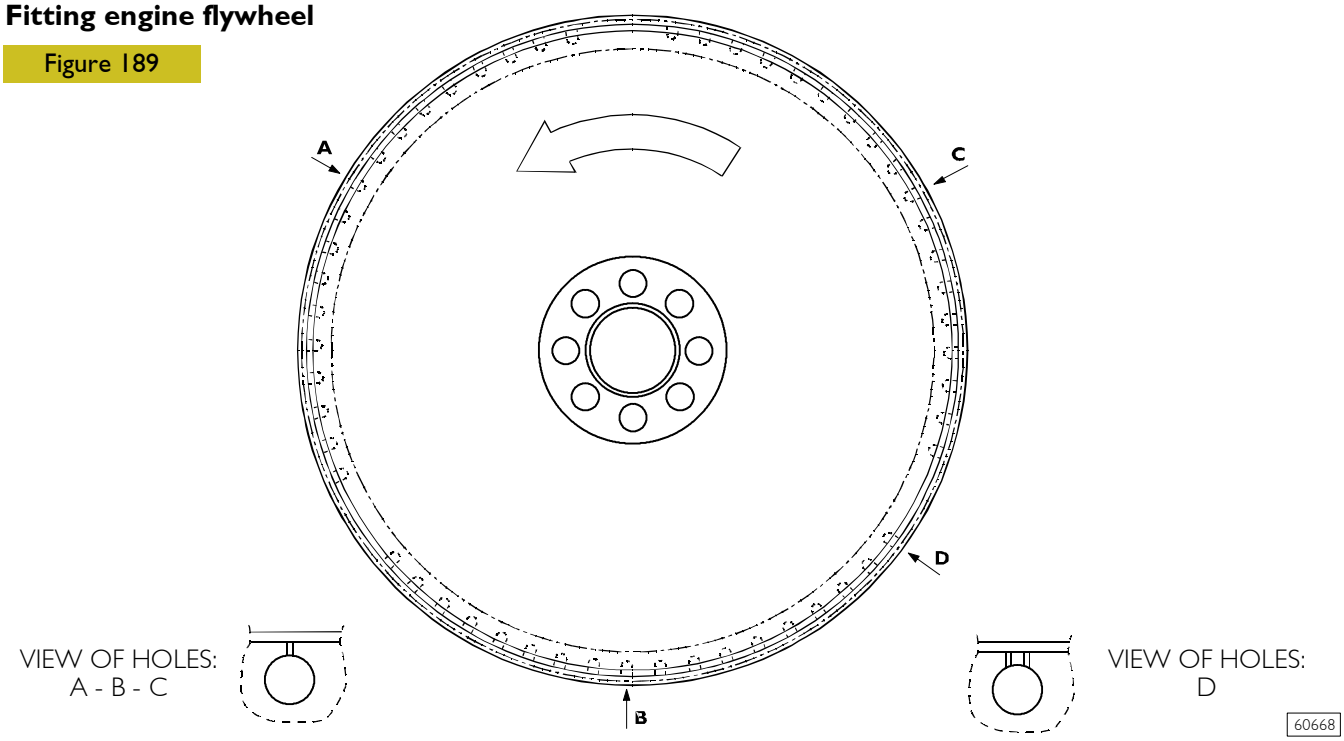


Key on the gasket (1), fit the key 99346251 (2) and, screwing down the nut (3), drive in the gasket.

540850 ENGINE FLYWHEEL

Fitting engine flywheel

Figure 189

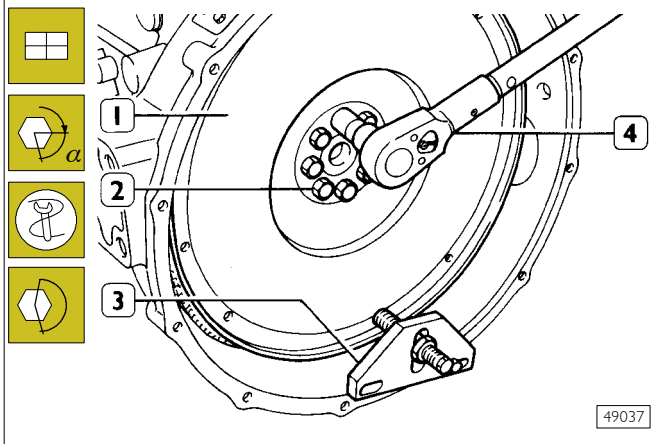


DETAIL OF PUNCH MARKS ON ENGINE FLYWHEEL FOR PISTON POSITIONS

A. Hole on flywheel with one reference mark, corresponding to the TDC of pistons 3-4. - B. Hole on flywheel with one reference mark, corresponding to the TDC of pistons 1-6. - C. Hole on flywheel with one reference mark, corresponding to the TDC of pistons 2-5. - D. Hole on flywheel with two reference marks, position corresponding to 54°.

NOTE If the teeth of the ring gear mounted on the engine flywheel, for starting the engine, are very damaged, replace the ring gear. It must be fitted after heating the ring gear to a temperature of approx. 200°C.

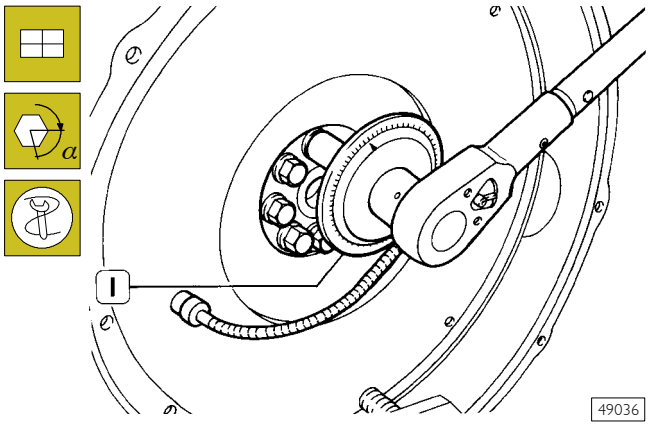
Figure 190



NOTE The crankshaft has a locating peg that has to couple with the relevant seat on the engine flywheel.

Position the flywheel (1) on the crankshaft, lubricate the thread of the screws (2) with engine oil and screw them down. Lock rotation with tool 99360351 (3). Lock the screws (2) in three phases.
First phase: pre-tightening with torque wrench (4) to a torque of 120 Nm (12 kgm).

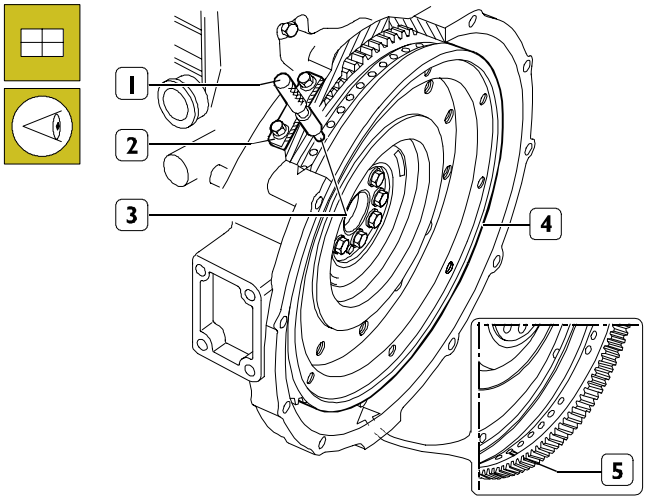
Figure 191



Second phase: closing to angle of 90° with tool 99395216 (1).

Fitting camshaft

Figure 192



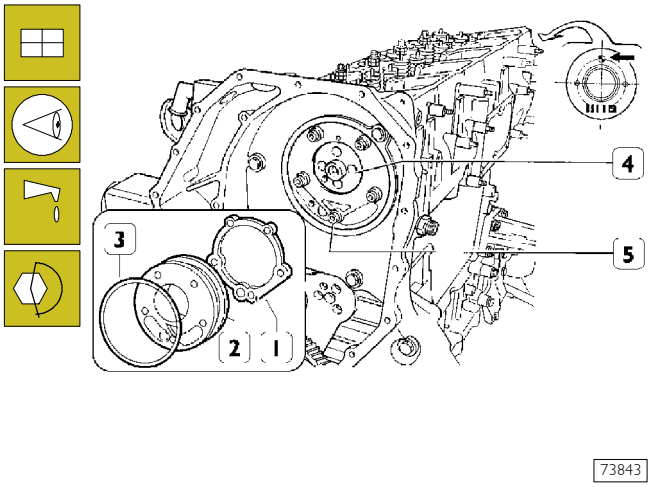
72436

Position the crankshaft with the pistons 1 and 6 at the top dead centre (T.D.C.).
This situation occurs when:

1. The hole with reference mark (5) of the engine flywheel (4) can be seen through the inspection window.
2. The tool 99360612 (1), through the seat (2) of the engine speed sensor, enters the hole (3) in the engine flywheel (4).

If this condition does not occur, turn the engine flywheel (4) appropriately.
Remove the tool 99360612 (1).

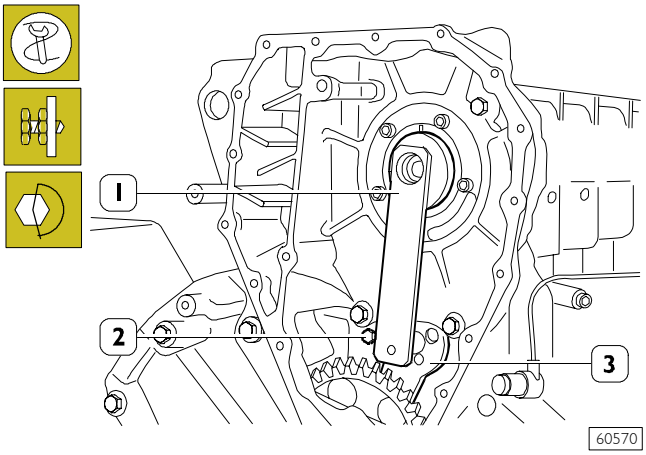
Figure 193



73843

Fit the camshaft (4), positioning it observing the reference marks (→) as shown in the figure.
Lubricate the seal (3) and fit it on the shoulder plate (2).
Mount the shoulder plate (2) with the sheet metal gasket (1) and tighten the screws (5) to the required torque.

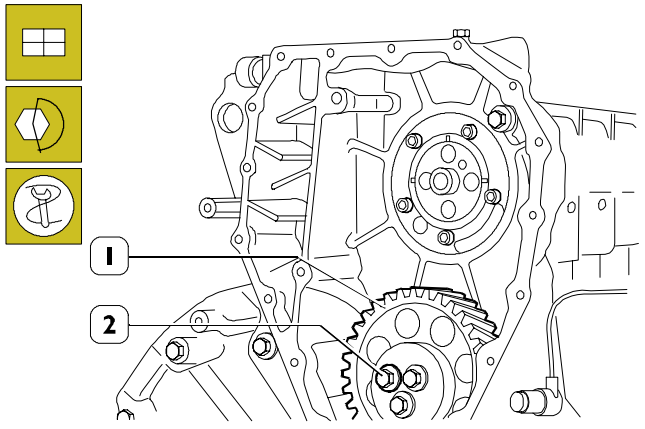
Figure 194



60570

❑ Apply the gauge 99395219 (1). Check and adjust the position of the link rod (3) for the idle gear. Lock the screw (2) to the required torque.

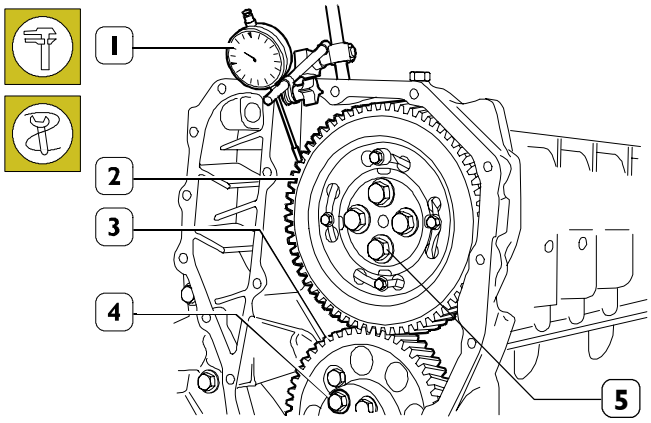
Figure 195



60571

❑ Fit the idle gear (1) back on and lock the screws (2) to the required torque.

Figure 196

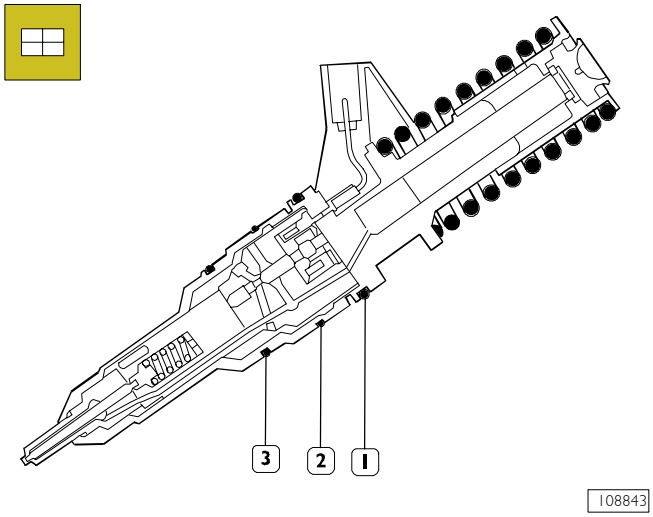


Position the gear (2) on the camshaft so that the 4 slots are centred with the holes for fixing the camshaft, without fully locking the screws (5).
Using the dial gauge with a magnetic base (1), check that the clearance between the gears (2 and 3) is 0.074 – 0.195 mm; if this is not so, adjust the clearance as follows:

- ❑ Loosen the screws (4) fixing the idle gear (3).
- ❑ Loosen the screw (2, Figure 194) fixing the link rod. Shift the link rod (3, Figure 194) to obtain the required clearance.
- ❑ Lock the screw (2, Figure 194) fixing the link rod and screws (4, Figure 196) fixing the idle gear to the required torque.

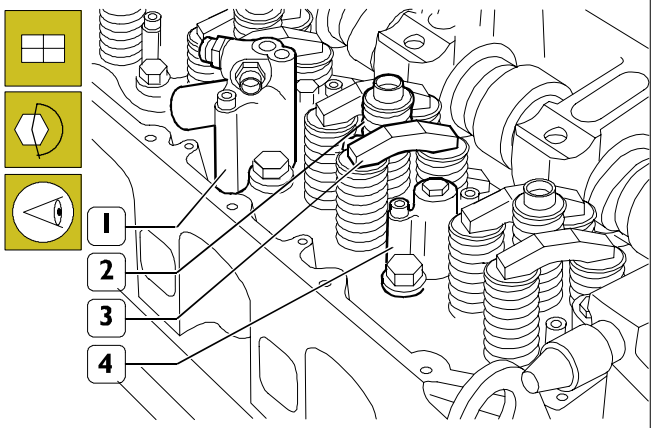
Fitting pump-injectors

Figure 197



Fit the seals (1) (2) (3) on the injectors.

Figure 198



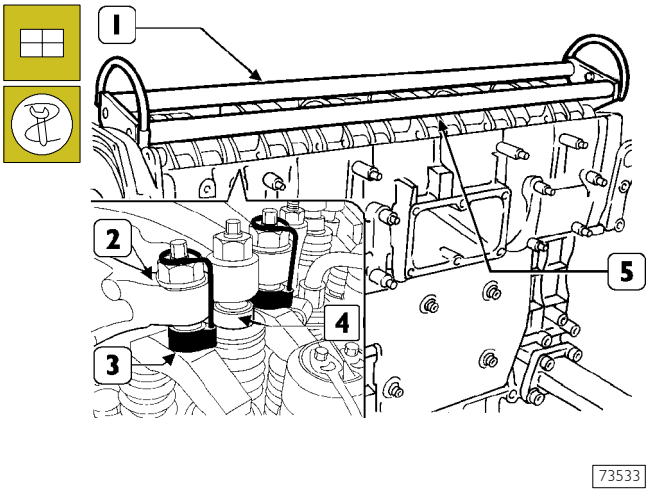
Mount:

- ❑ The injectors (2) and, using a torque wrench, lock the bracket fixing screws to a torque of 26 Nm.
- ❑ The exhaust brake cylinders (1) and (4) and, using a torque wrench, fix them to a torque of 19 Nm.
- ❑ The crosspieces (3) on the valve stem, all with the largest hole on the same side.

Fitting rocker-arm shaft assembly

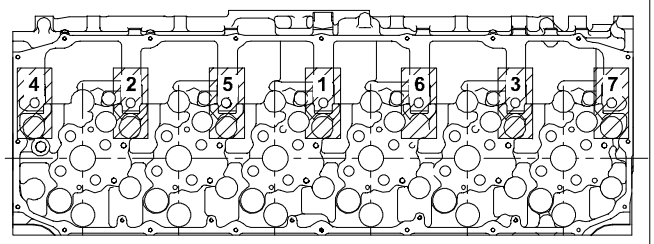
NOTE Before refitting the rocker-arm shaft assembly, make sure that all the adjustment screws have been fully unscrewed.

Figure 199



Using tool 99360144 (3), fasten the blocks (4) to the rocker arms (2).
Apply the tool 99360553 (1) to the rocker arm shaft (5) and mount the shaft on the cylinder head.

Figure 200

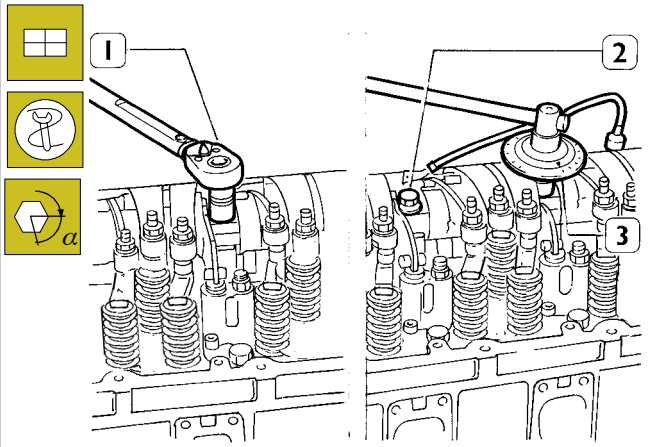


70567A

SCHEME OF SCREW TIGHTENING SEQUENCE SECURING ROCKER ARMS

Screw screws (1 - 2 - 3) until rocker arms are brought to contact relating seats on cylinder head, tighten the screws according to sequence indicated in figure operating in two steps as indicated in successive figure.

Figure 201

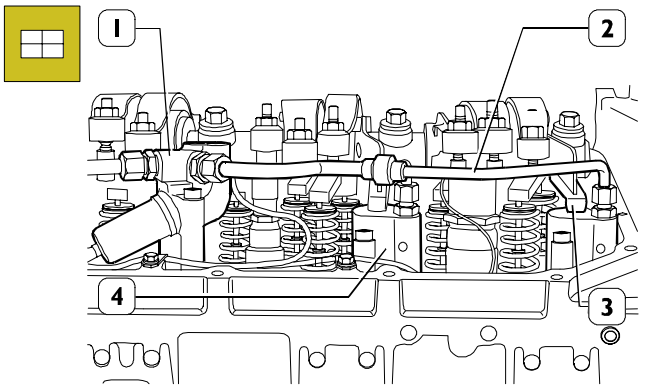


45261

Lock the screws (2) fixing the rocker-arm shaft as follows:

- ❑ 1st phase: tightening to a torque of 80 Nm (8 kgm) with the torque wrench (1).
- ❑ 2nd phase: closing with an angle of 60° using the tool 99395216 (3).

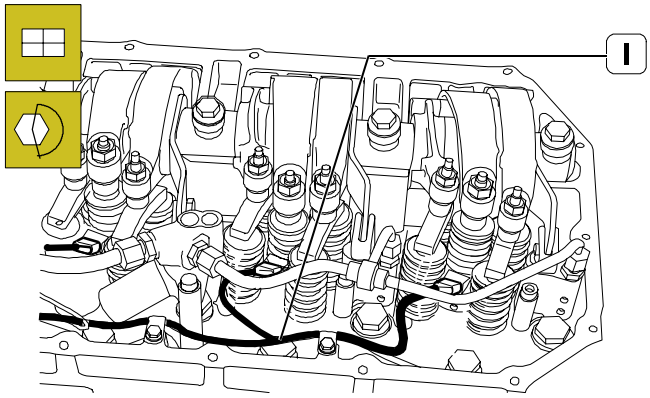
Figure 202



60574

- ❑ Mount the engine brake lever retaining springs (3).
- ❑ Connect the pipe (2) to the engine brake cylinders (4) and to the cylinder with the engine brake solenoid valve (1).

Figure 203

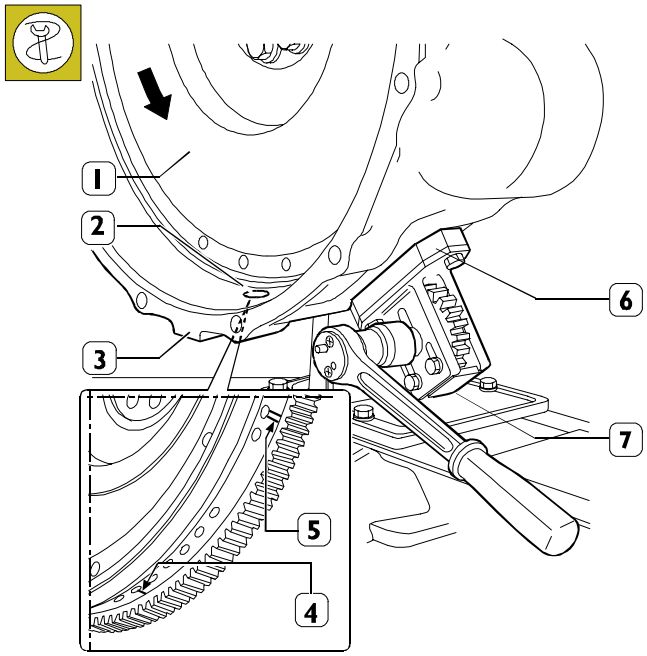


116723

Mount the electric wiring (1).

Camshaft timing

Figure 204

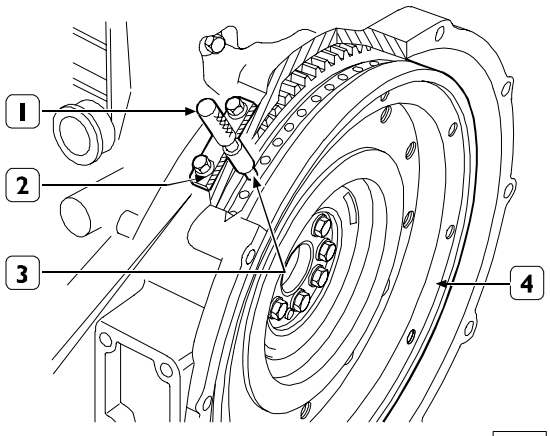


71776

Apply tool 99360321 (7) and spacer (6) to gears box (3).

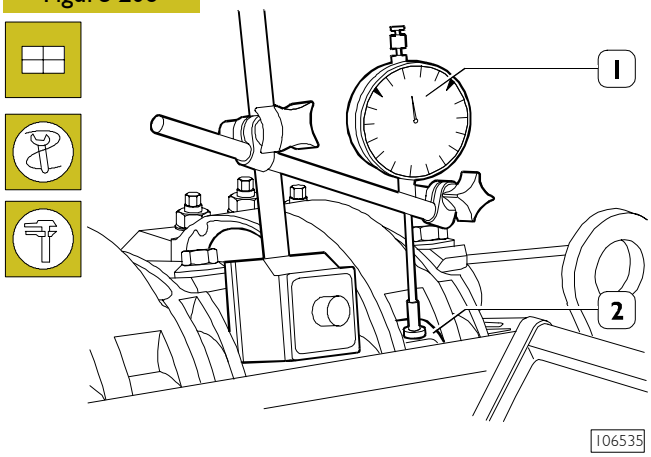
NOTE The arrow shows the direction of rotation of the engine when running.
Using the above-mentioned tool, turn the engine flywheel (1) in the direction of rotation of the engine so as to take the piston of cylinder no.1 to approximately the T.D.C. in the phase of combustion. This condition occurs when the hole with one reference mark (4), after the hole with two reference marks (5) on the engine flywheel (1), can be seen through the inspection window (2).

Figure 205



The exact position of piston no.1 at the T.D.C. is obtained when in the above-described conditions the tool 99360612 (1) goes through the seat (2) of the engine speed sensor into the hole (3) in the engine flywheel (4).
If this is not the case, turn and adjust the engine flywheel (4) appropriately.
Remove the tool 99360612 (1).

Figure 206



Adjust the magnetic comparator (1) with the rod (with flat base) located on the roller (2) of the cocker arm controlling the injector of cylinder no. 1 and preload it by 6 mm.

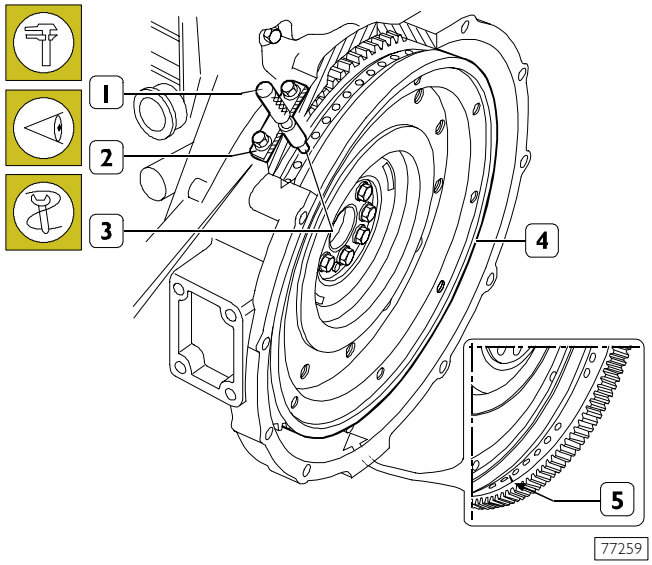
NOTE During measuring, the rod of the comparator must always be perpendicular to the engine axis and NOT to the head surface.

With tool 99360321 (7) Figure 204, turn the crankshaft clockwise until the pointer of the dial gauge reaches the minimum value beyond which it can no longer fall.

Reset the dial gauge.

Turn the engine flywheel anticlockwise until the dial gauge gives a reading for the lift of the cam of the camshaft of 5.33±0.05 mm.

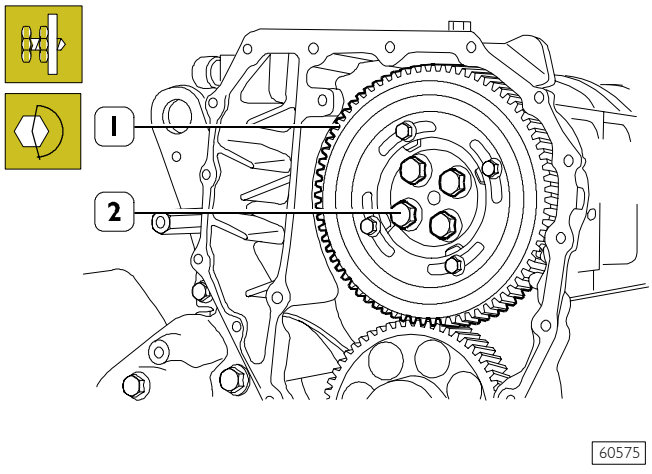
Figure 207



The camshaft is in step if at the cam lift values of 5.33±0.05 mm there are the following conditions:

1) a notch (5) can be seen through the inspection window;
2) the tool 99360612 (1) through the seat (2) of the engine speed sensor goes into the hole (3) in the engine flywheel (4).

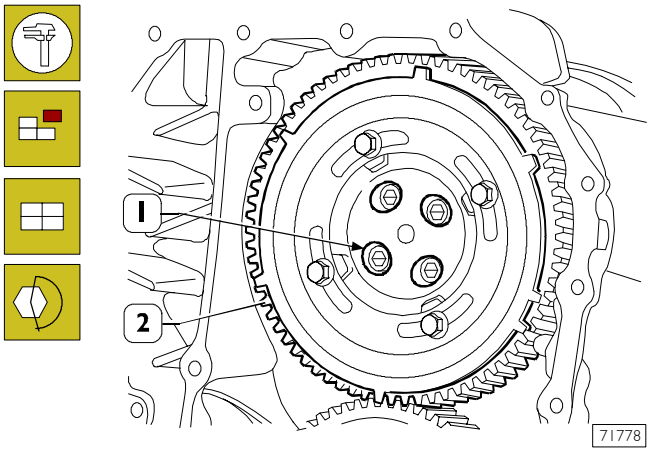
Figure 208



If you do not obtain the conditions illustrated in Figure 207 and described in points 1 and 2, proceed as follows:

1) loosen the screws (2) securing the gear (1) to the camshaft and utilize the slots (1) on the gear (2, Figure 209);
2) turn the engine flywheel appropriately so as to bring about the conditions described in points 1 and 2 Figure 207, it being understood that the cam lift must not change at all;
3) lock the screws (2) and repeat the check as described above;
4) tighten the screws (2) to the required torque.

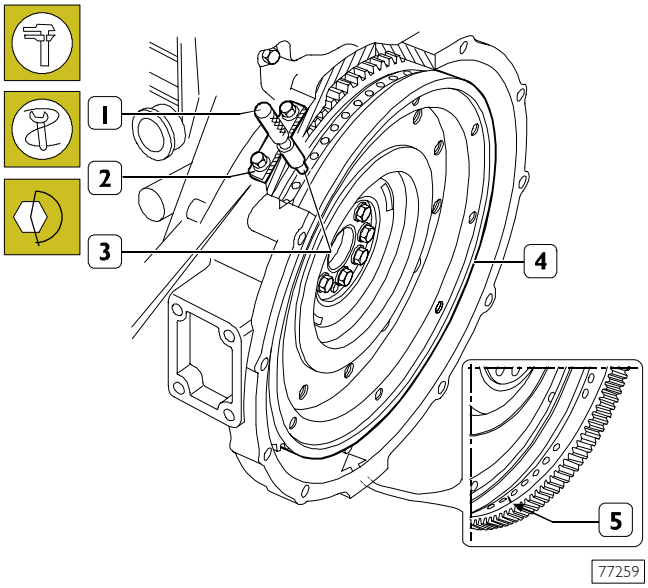
Figure 209



When the adjustment with the slots (1) is not enough to make up the phase difference and the camshaft turns because it becomes integral with the gear (2); as a result, the reference value of the cam lift varies, in this situation it is necessary to proceed as follows:

1) lock the screws (2, Figure 208) and turn the engine flywheel clockwise by approx. 1/2 turn;
2) turn the engine flywheel anticlockwise until the dial gauge gives a reading of the lift of the cam of the camshaft of 5.33 ±0.05 mm;
3) take out the screws (2, Figure 208) and remove the gear (2) from the camshaft.

Figure 210



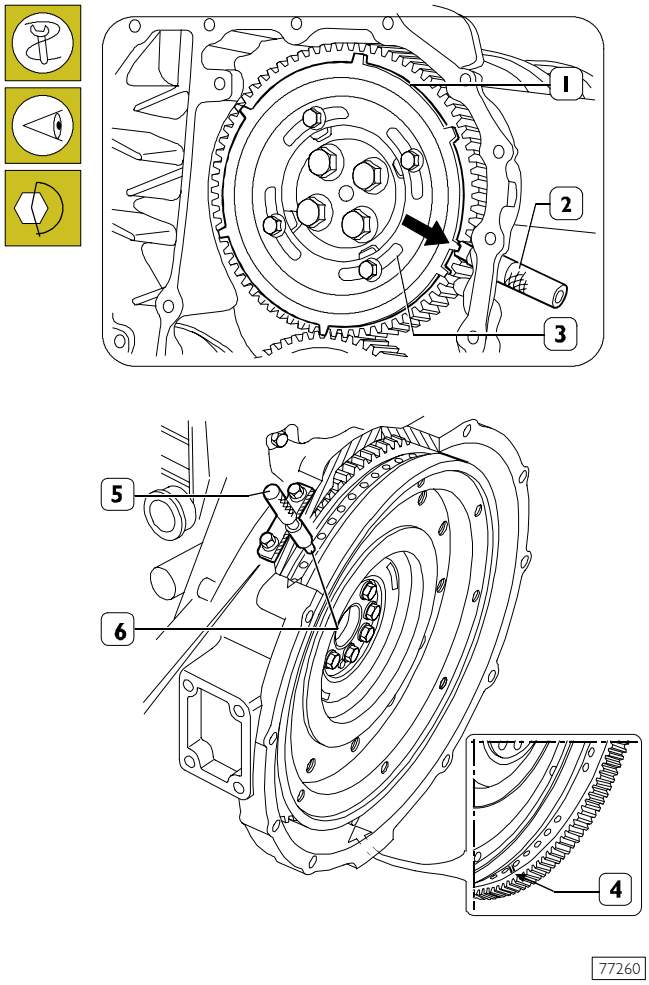
Turn the flywheel (4) again to bring about the following conditions:

- ❑ a notch (5) can be seen through the inspection window;
- ❑ the tool 99360612 (1) inserted in the hole (3) in the engine flywheel (4) through the seat (2) of the engine speed sensor.

Mount the gear (2, Figure 209) with the 4 slots (1, Figure 209) centred with the fixing holes of the camshaft, locking the relevant screws to the required tightening torque. Check the timing of the shaft by first turning the flywheel clockwise to discharge the cam completely and then turn the flywheel anticlockwise until the dial gauge gives a reading of 5.33 ±0.05 mm.
Check the timing conditions described in Figure 207.

Phonic wheel timing

Figure 211



Turn the crankshaft by taking the piston of cylinder no. 1 into the compression phase at T.D.C.; turn the flywheel in the opposite direction to the normal direction of rotation by approximately 1/4 of a turn.

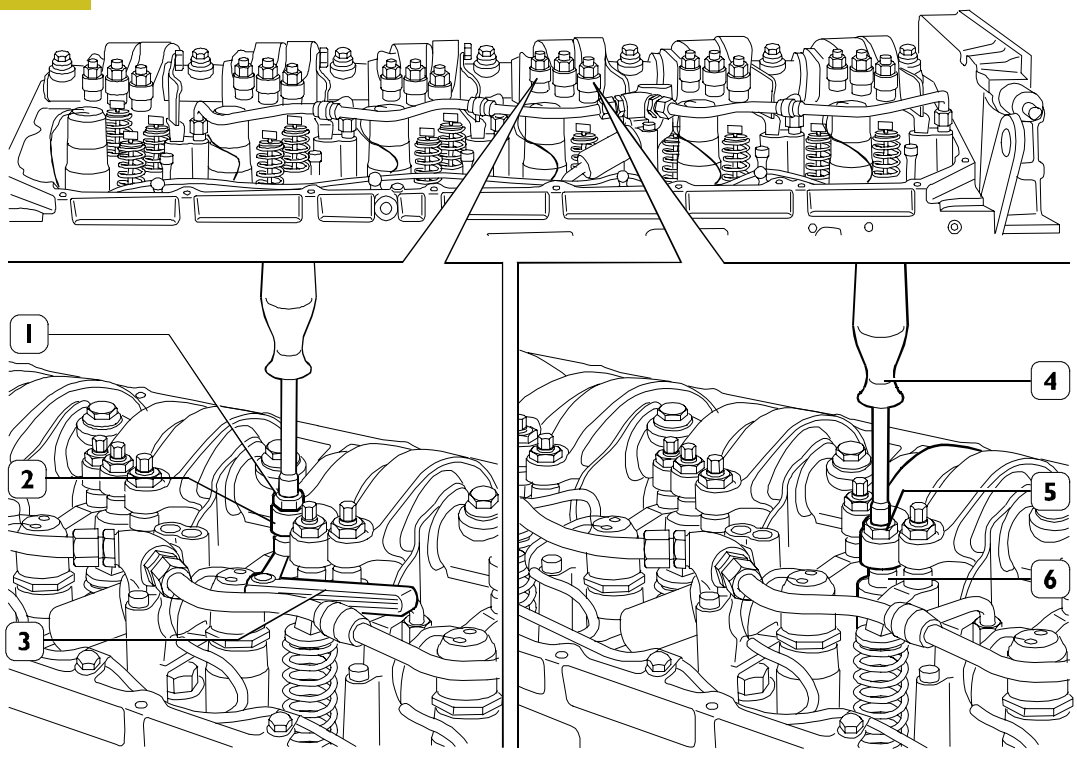
Again turn the flywheel in its normal direction of rotation until you see the hole marked with the double notch (4) through the inspection hole under the flywheel housing. Insert tool 99360612 (5) into the seat of the flywheel sensor (6).

Insert the tool 99360613 (2), via the seat of the phase sensor, onto the tooth (◗) obtained on the phonic wheel.

Should inserting the tool (2) prove difficult, loosen the screws (3) and adjust the phonic wheel (1) appropriately so that the tool (2) gets positioned on the tooth correctly. Go ahead and tighten the screws (3).

Adjusting rocker arm clearance, intake, exhaust and pre-load of pump injector governing rocker arms

Figure 212



ADJUSTING INTAKE, EXHAUST AND INJECTION ROCKER ARMS

The adjustment of the clearance between the rocker arms and the crosspieces governing the intake and exhaust valves and the adjustment of the pre-load of the pump injector governing rocker arms has to be done very conscientiously.

Take the cylinder whose clearance you want to adjust into the combustion phase. The valves of this cylinder are closed while they balance those of the symmetric cylinder.
The symmetric correspondence of the cylinders is 1 - 6, 2 - 5 and 3 - 4.
To perform these operations correctly, proceed as described below and as illustrated in the table.

Adjusting clearance between rocker arms and crosspieces governing the intake and exhaust valves

- ❑ Using a box wrench, loosen the nut (1) locking the adjustment screw.
- ❑ Insert the blade of the feeler gauge (3) corresponding to the operating clearance shown in the specifications and data table.
- ❑ Use a suitable wrench to screw or unscrew rocker arm (2) adjusting screw.
- ❑ Check that the blade of the feeler gauge (3) can slide with a light amount of friction.
- ❑ Lock the nut (1) holding the adjustment screw still.

Pre-load of pump injector governing rocker arms

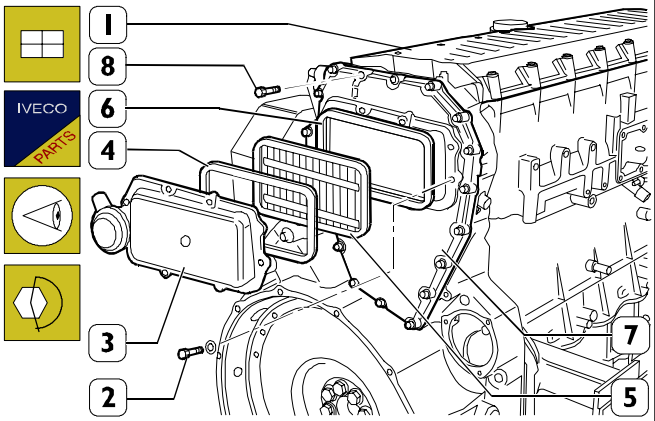
- ❑ Using a box wrench, loosen the nut locking the adjustment screw of the rocker arms (5) governing the pump injector (6).
- ❑ With a suitable wrench (4), screw down the adjustment screw to take the pumping element to its limit.
- ❑ Tighten the adjustment screw with a torque wrench to a torque of 5 Nm (0.5 kgm).
- ❑ Unscrew the adjustment screw by 1/2 ÷ 3/4 of a turn.
- ❑ Tighten the locking nut to a torque of 39 Nm (3.9 kgm).

FIRING SEQUENCE **1 - 4 - 2 - 6 - 3 - 5**

Starting and clockwise rotation	Balance valves of cylinder no.	Adjust clearance of valves of cylinder no.	Adjust pre-load of injectors of cylinder no.
1 and 6 at TDC	6	1	5
120°	3	4	1
120°	5	2	4
120°	1	6	2
120°	4	3	6
120°	2	5	3

NOTE To perform the above adjustments correctly, it is mandatory to follow the sequence given in the table, checking the position at each phase of rotation with the pin 99360612 to be inserted in the 11th hole of each of the three sectors of 18 holes each.

Figure 213



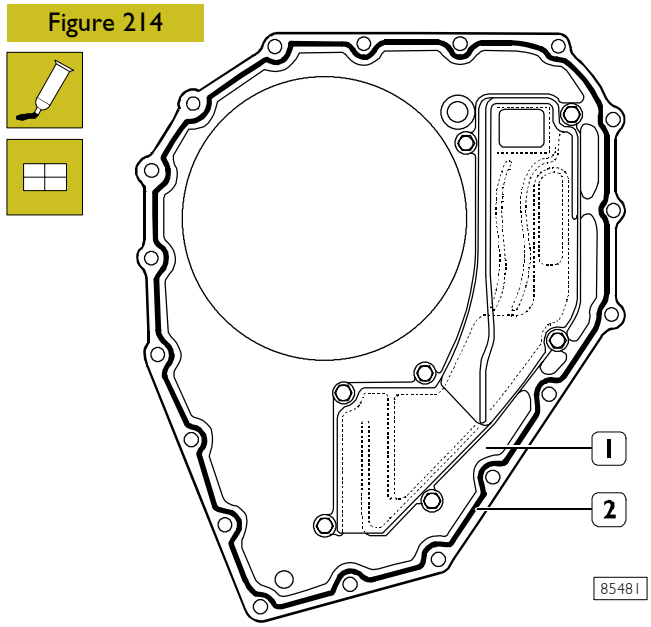
Fit the distribution cover (1).
Fit the blow-by case (7) and its gasket and then tighten the screws (8) to the prescribed torque.
Install the filter (5) and the gaskets (4 and 6).

NOTE The filter (5) operation is unidirectional, therefore it must be assembled with the two sight supports as illustrated in the figure.

Fit the cover (3) and tighten the fastening screws (2) to the prescribed torque.

NOTE Apply silicone LOCTITE 5970 (IVECO No. 2995644) on the blow-by case (7) surface of engines fitted with P.T.O. according to the procedure described in the following figure.

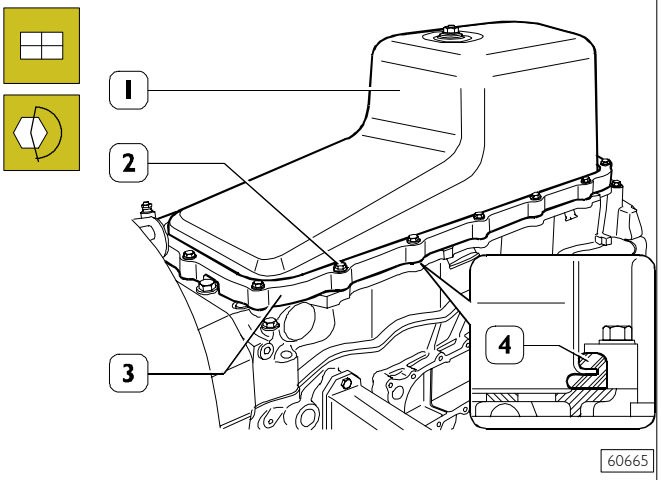
Figure 214



Apply silicone LOCTITE 5970 (IVECO No. 2995644) on the blow-by case and form a string (2) of Ø 1,5 $^{0.5}_{0.2}$ as shown in the figure.

NOTE Fit the blow-by case (1) within 10' from sealer application.

Figure 215



Turn engine and mount oil rose pipe.
Arrange gasket (4) on oil sump (1), position spacer (3) and mount the sump on engine block screwing up screws (2) at prescribed torque:

Completing Engine Assembly

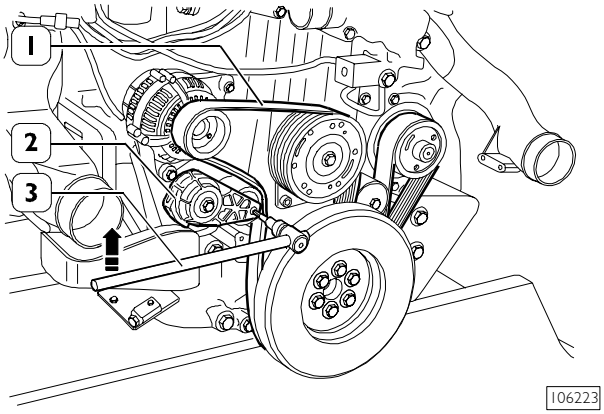
Complete the engine by fitting or hooking up the following parts:

- ❑ power take-off (P.T.O., if present) and relating pipes;
- ❑ fuel pump;
- ❑ support complete with fuel filter and pipes;
- ❑ EDC central unit;
- ❑ intake manifold;
- ❑ preheating resistance;
- ❑ heat exchanger;
- ❑ oil filters, lubricating the gasket;
- ❑ exhaust manifold;
- ❑ turbocompressor and relating water and oil pipes;
- ❑ pulley and damping flywheel;
- ❑ thermostat assembly;
- ❑ belt tensioner, water pump, alternator;
- ❑ electromagnetic joint;
- ❑ belt tensioner, if present, air-conditioner compressor;
- ❑ starter;
- ❑ oil level rod;
- ❑ electrical connections and sensors.

NOTE The fittings of the cooling water and lubricating oil pipes of the turbocharger have to be tightened to a torque of:

- ❑ 35 ±5 Nm, water pipe fittings;
- ❑ 55 ±5 Nm, oil pipe female fitting;
- ❑ 20-25 Nm, oil pipe male fitting.

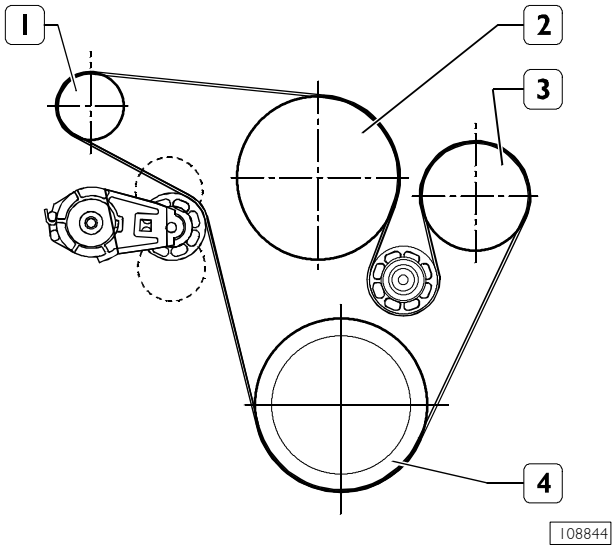
Figure 216



❑ driving belt.

To mount belt (1), belt tensioner (2) has to be operated by proper tooling (3) according to the direction indicated by the arrow in Figure.

Figure 217



ASSEMBLY DIAGRAM OF FAN – WATER PUMP – ALTERNATOR DRIVE BELT

1. Alternator – 2. Electromagnetic coupling – 3. Water pump – 4. Crankshaft

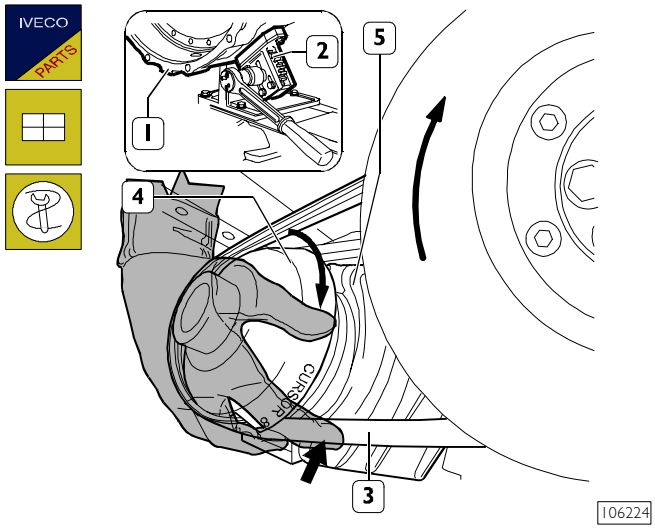
NOTE Belt tensioner is of automatic type; therefore, further adjusting is not provided after mounting.

- ❑ refuel engine with provided oil quantity;
- ❑ dismount engine from rotary stand and take off brackets (99361036) securing the engine.

Mount:

- ❑ oil pressure regulation valve;
- ❑ engine left support;
- ❑ air compressor complete with hydraulic guide pump;
- ❑ sound deadening guard;
- ❑ pipes.
- ❑ if present, climate control system compressor driving belt similarly to belt (1, Figure 216);

Figure 218



NOTE In the case of engines with climate control system compressor spring driving belt, for mounting the belt, tool 99360192 (4) must be used.
Different methods may cause tensions impairing spring belt.

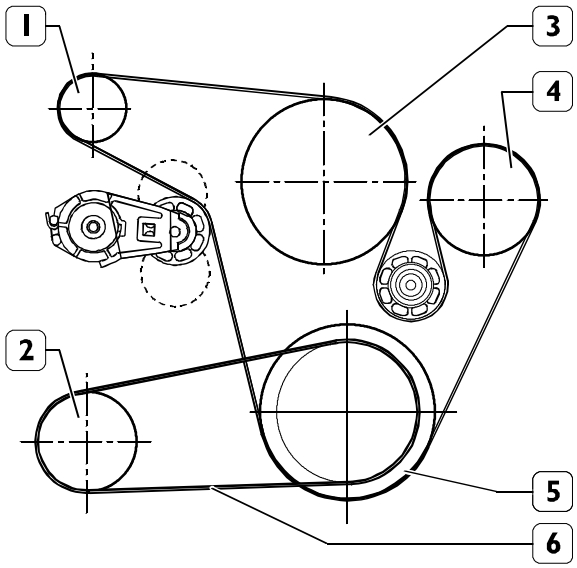
Apply tool 99360321 (2) provided with spacer 99360325 to gears box (1).
Mount spring belt (3) on driving shaft pulley, mount chock 99360192 (4) on compressor pulley (5) for climate control system. Position spring belt (3) in the opening of tool 99360192 marked with "cursor 10/13".
By tool 99360321 (2), rotate driving shaft according to the direction of the arrow (→) until spring belt (3) is correctly positioned on compressor pulley (5).

NOTE While operating, keep tool 99360192 (4) in contact to pulley and at the same time guide spring belt (3) in order to prevent it from twisting.

NOTE Spring belt must be replaced by a new one after every dismounting operation.

NOTE Replacing spring belt with engine on the vehicle is from engine opening after tilting the cab.

Figure 219



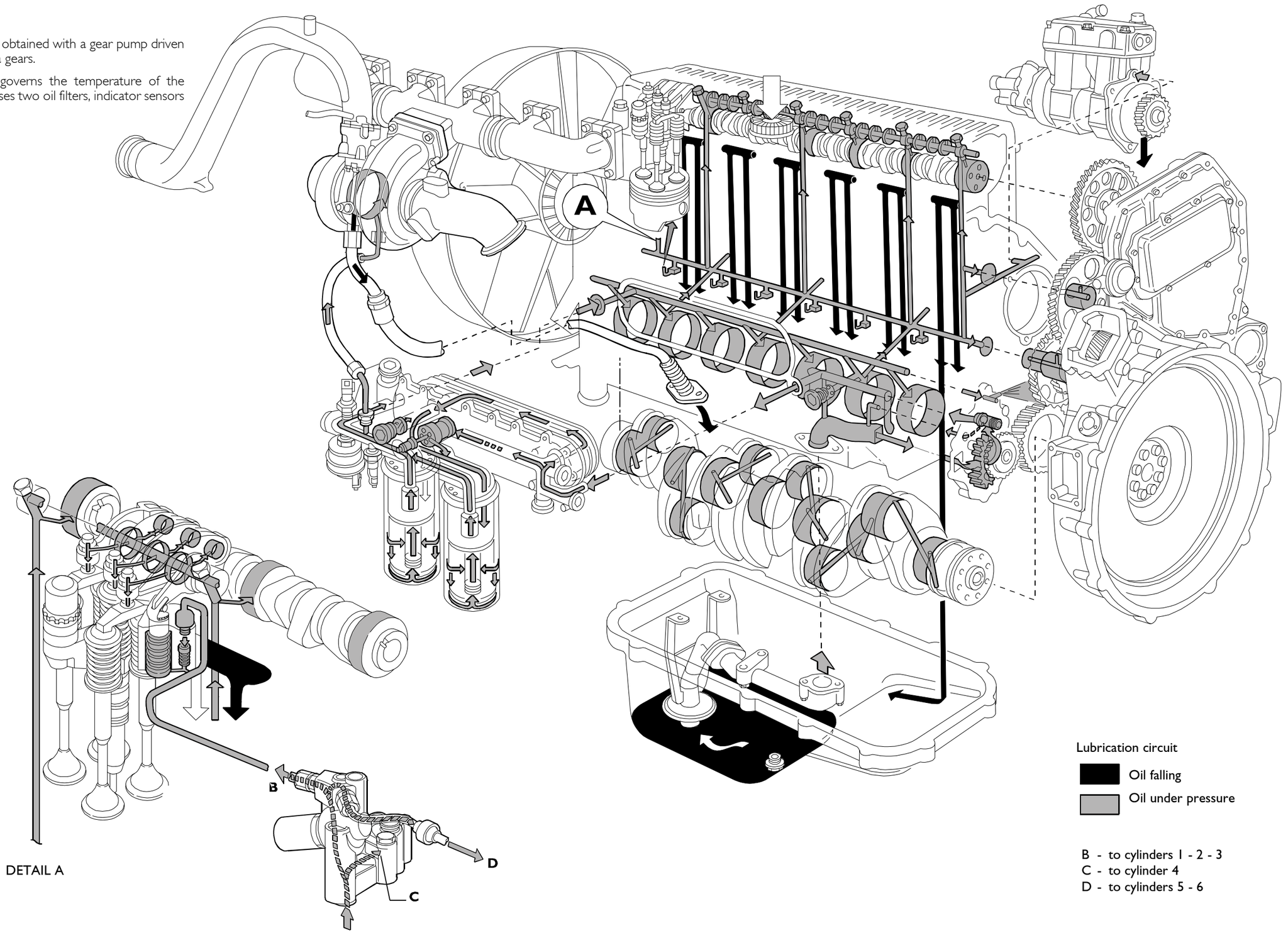
COMPRESSOR CONTROL BELT ASSEMBLY DIAGRAM
1. Alternator – 2. Climate control system compressor – 3. Electromagnetic coupling – 4. Water pump – 5. Crankshaft – 6. Spring belt.

5430 LUBRICATION

Figure 220

Engine lubrication is obtained with a gear pump driven by the crankshaft via gears.

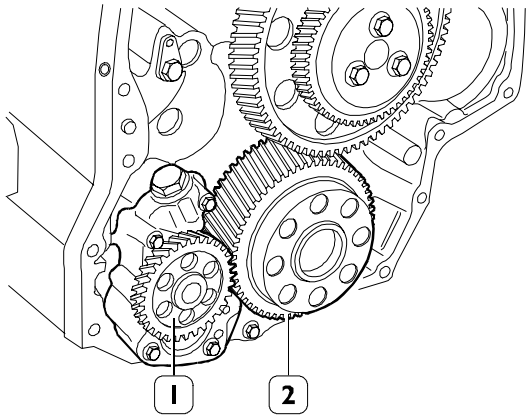
A heat exchanger governs the temperature of the lubricating oil. It houses two oil filters, indicator sensors and safety valves.



Exhaust brake solenoid valve with piston driving the exhaust brake of the 4th cylinder.

543010 Oil pump

Figure 221



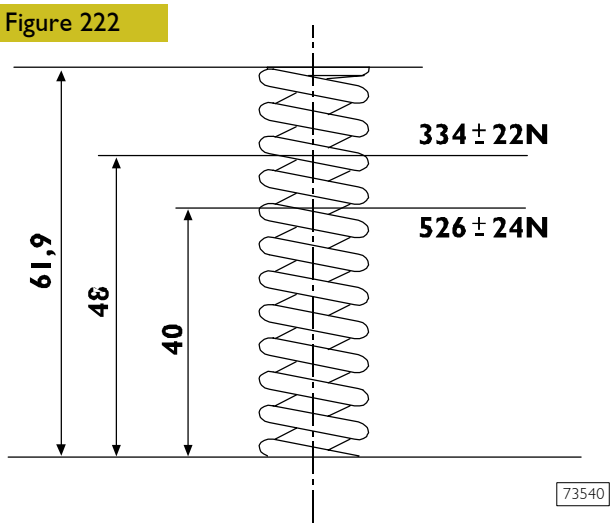
60560

The oil pump (1) cannot be overhauled. On finding any damage, replace the oil pump assembly.

See under the relevant heading for replacing the gear (2) of the crankshaft.

Overpressure valve

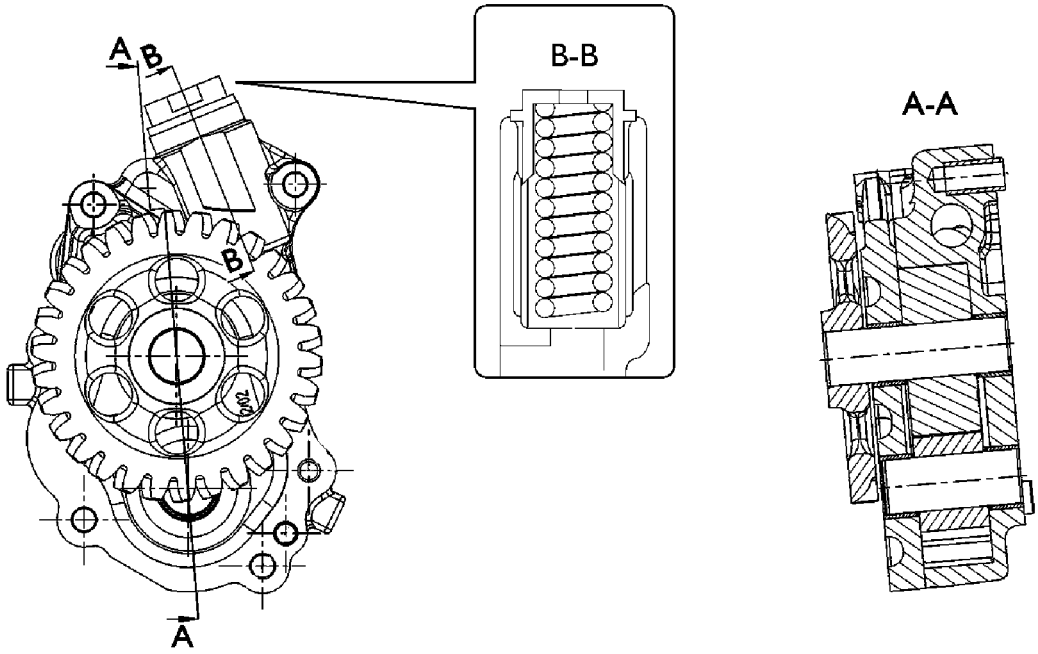
Figure 222



73540

MAIN DATA TO CHECK THE OVERPRESSURE VALVE SPRING

Figure 223

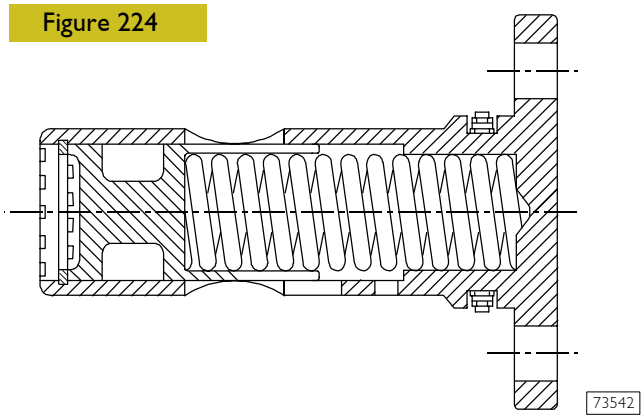


108846

OIL PUMP CROSS-SECTION
Overpressure valve – Start of opening pressure 10 ± 1 bars.

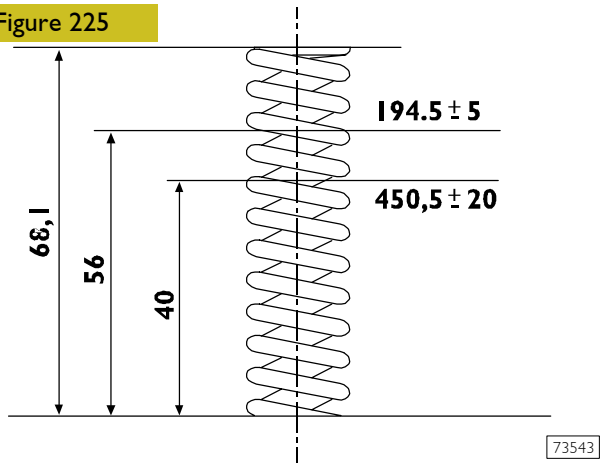
Oil pressure control valve

Figure 224



The oil pressure control valve is located on the left-hand side of the crankcase.
Start of opening pressure 5 bars.

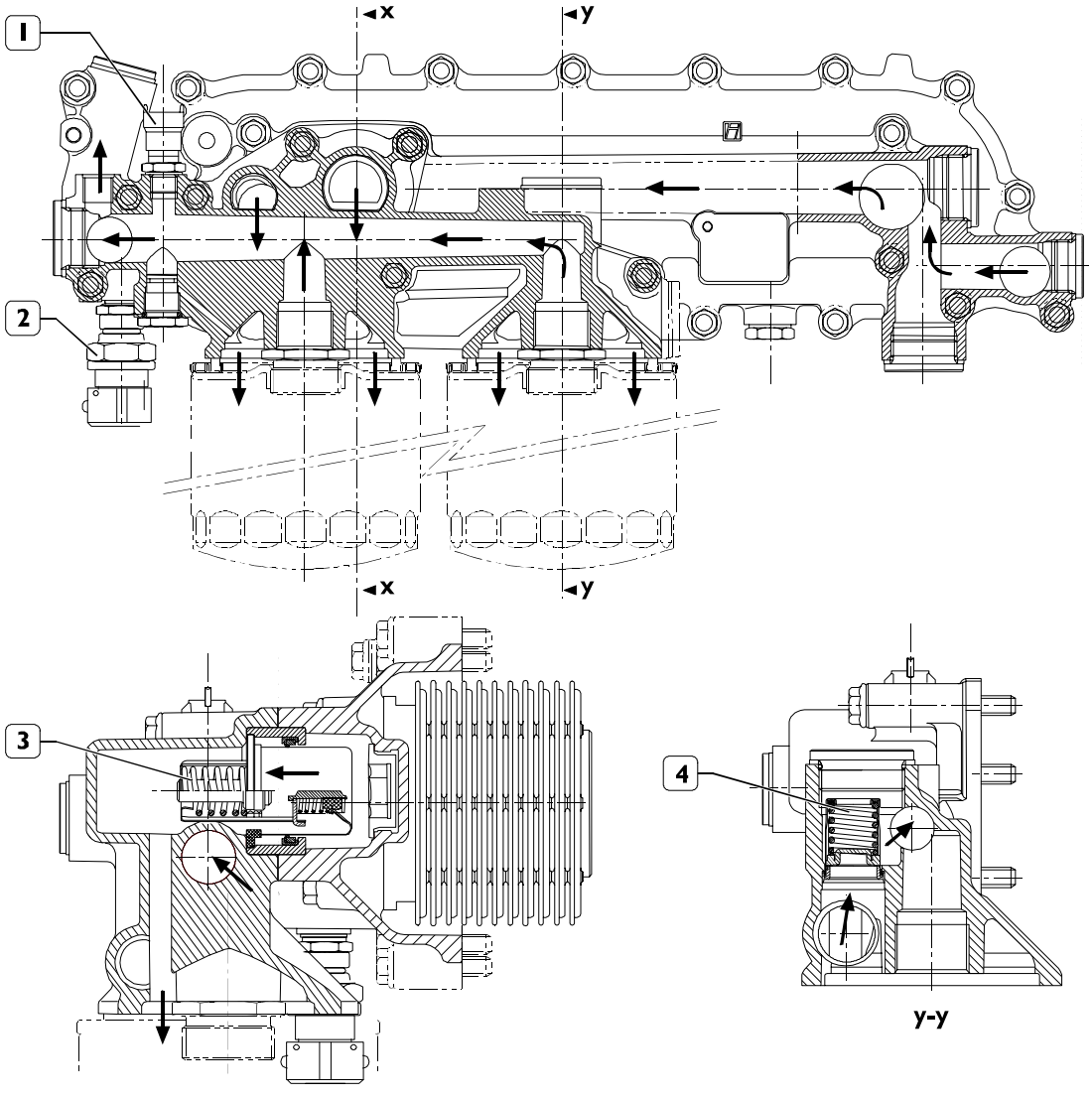
Figure 225



MAIN DATA TO CHECK THE OIL PRESSURE CONTROL VALVE SPRING

543110 Heat exchanger

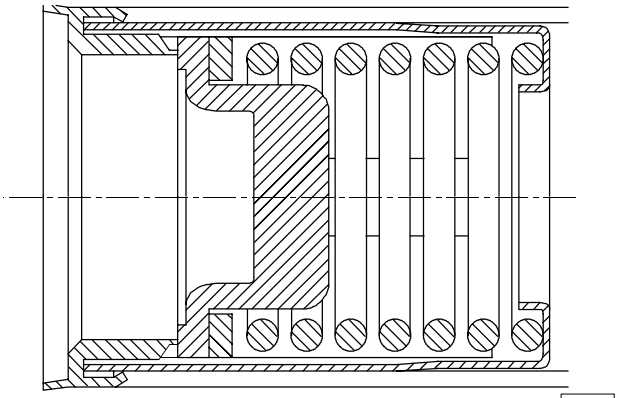
Figure 226



HEAT EXCHANGER
The heat exchanger is fitted with: 1. Oil temperature transmitter – 2. Oil pressure transmitter – 3. Filter bypass valve – 4. Thermostat
Number of heat exchanger elements: 11.

By-pass valve

Figure 227

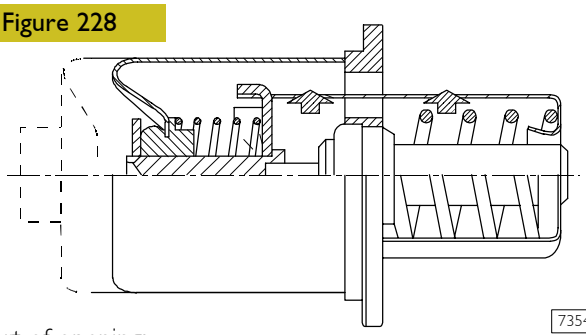


73545

The valve quickly opens at a pressure of: 3 bars.

Thermostatic valve

Figure 228



73546

Start of opening:

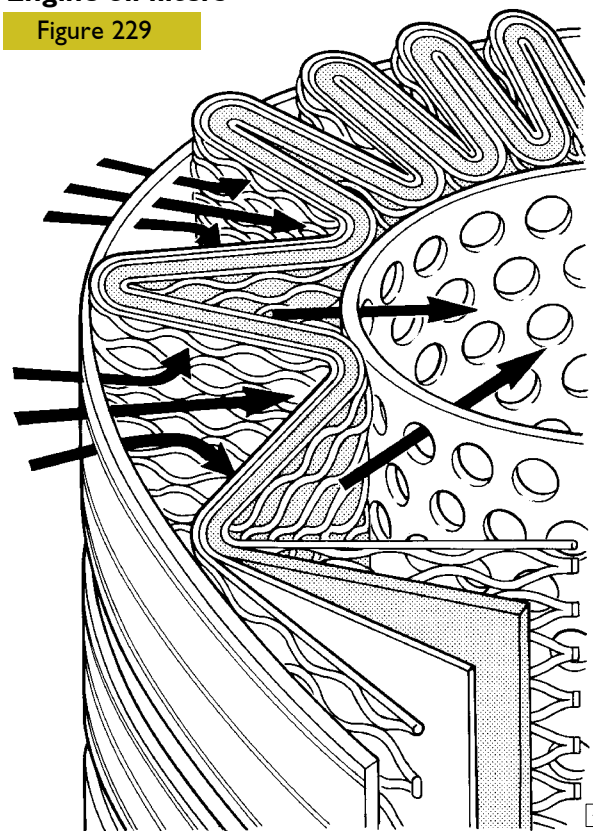
- ❑ travel 0.1 mm at a temperature of 82 ±2°C.

End of opening:

- ❑ travel 8 mm at a temperature of 97°C.

Engine oil filters

Figure 229



47447

This is a new generation of filters that permit much more thorough filtration as they are able to holder back a greater amount of particles of smaller dimensions than those held back by conventional filters with a paper filtering element.

These high-filtration devices, to date used only in industrial processes, make it possible to:

- ❑ reduce the wear of engine components over time;
- ❑ maintain the performance/specifications of the oil and thereby lengthen the time intervals between changes.

External spiral winding

The filtering elements are closely wound by a spiral so that each fold is firmly anchored to the spiral with respect to the others. This produces a uniform use of the element even in the worst conditions such as cold starting with fluids with a high viscosity and peaks of flow. In addition, it ensures uniform distribution of the flow over the entire length of the filtering element, with consequent optimization of the loss of load and of its working life.

Mount upstream

To optimize flow distribution and the rigidity of the filtering element, this has an exclusive mount composed of a strong mesh made of nylon and an extremely strong synthetic material.

Filtering element

Composed of inert inorganic fibres bound with an exclusive resin to a structure with graded holes, the element is manufactured exclusively to precise procedures and strict quality control.

Mount downstream

A mount for the filtering element and a strong nylon mesh make it even stronger, which is especially helpful during cold starts and long periods of use. The performance of the filter remains constant and reliable throughout its working life and from one element to another, irrespective of the changes in working conditions.

Structural parts

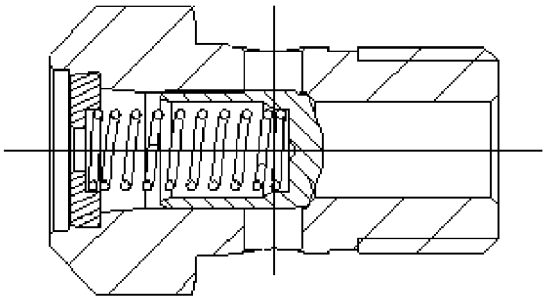
The o-rings equipping the filtering element ensure a perfect seal between it and the container, eliminating by-pass risks and keeping filter performance constant. Strong corrosion-proof bottoms and a sturdy internal metal core complete the structure of the filtering element.

When mounting the filters, keep to the following rules

- ❑ Oil and fit new seals.
- ❑ Screw down the filters to bring the seals into contact with the supporting bases.
- ❑ Tighten the filter to a torque of 35-40 Nm.

Valve integrated in piston cooling nozzle

Figure 230



109080

The valve allows oil to enter only above the threshold pressure of 1.7 ± 0.2 bar. This permits filling the circuit and therefore lubricating the most stressed parts even when working at lower pressures.

5432 COOLING

Description

The engine cooling system works with forced circulation inside closed circuit and can be connected to an additional heater (if any) and to the intarder intercooler.
It consists mainly of the following components:

- ❑ an expansion reservoir whose plug (1) incorporates two valves – discharge and charge – controlling the system pressure.
- ❑ a coolant level sensor placed at the bottom of the expansion reservoir with two coupling points:

  right drive vehicles:
  - coupling point for sensor S1 6.2 litres
  - coupling point for sensor S2 4.7 litres

  left drive vehicles:
  - coupling point for sensor S1 6 litres
  - coupling point for sensor S2 3.7 litres
- ❑ an engine cooling unit to dissipate the heat taken by the coolant from the engine through the intercooler.
- ❑ a heat exchanger to cool down lubrication oil;
- ❑ a water pump with centrifugal system incorporated in the cylinder block;
- ❑ an electric fan consisting of a 2-speed electro-magnetic joint equipped with a neutral wheel shaft hub fitted with a metal plate moving along the axis and where the fan is installed. It is controlled electronically by the vehicle Multiplex system.
- ❑ a 3-way thermostat controlling the coolant circulation.

Operation

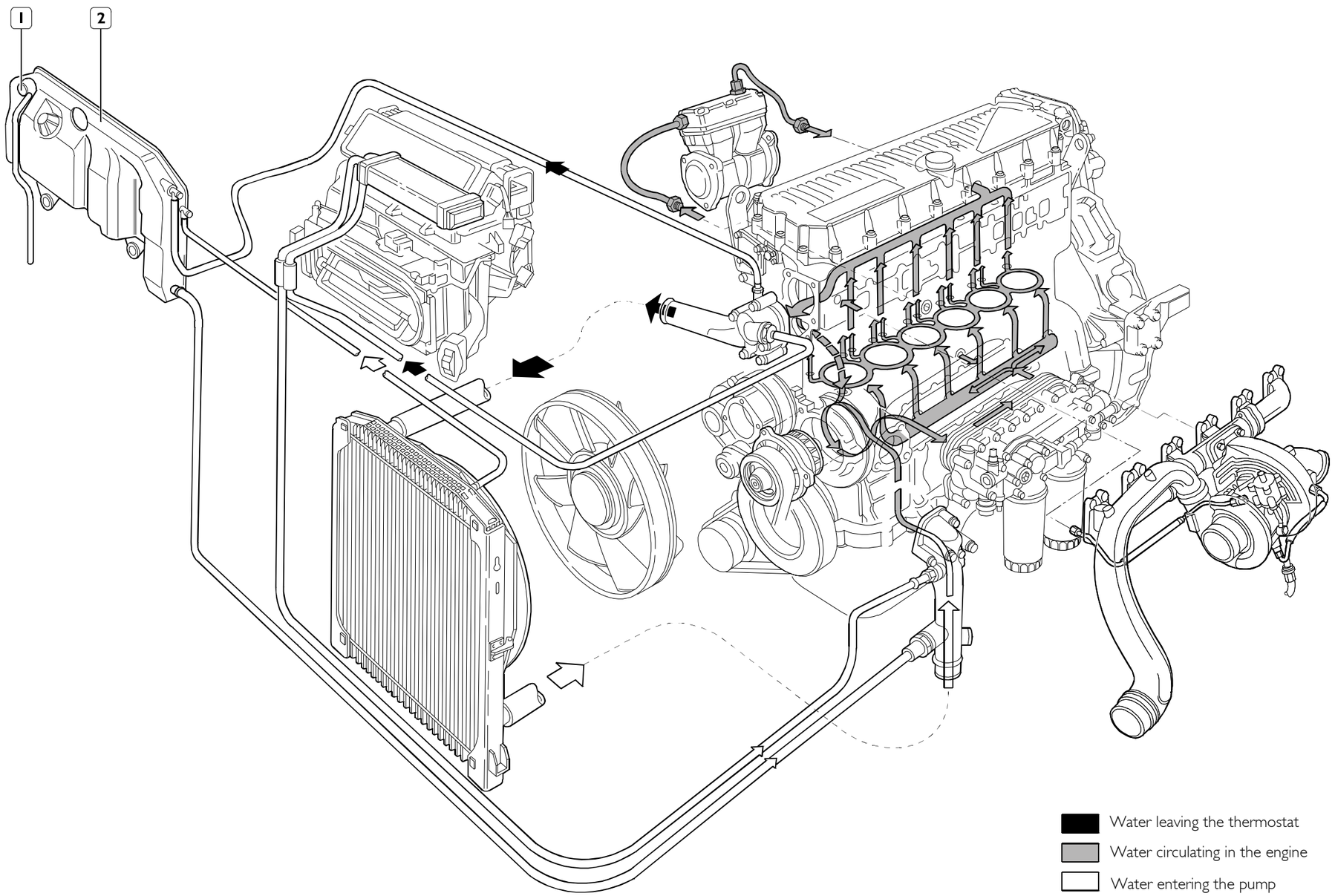
The water pump is actuated by the crankshaft through a poli-V belt and sends coolant to the cylinder block, especially to the cylinder head (bigger quantity). When the coolant temperature reaches and overcomes the operating temperature, the thermostat is opened and from here the coolant flows into the radiator and is cooled down by the fan.
The pressure inside the system depending on the temperature variation is controlled by the discharge and charge valves incorporated in the expansion reservoir filling plug (1).
The discharge valve has a double function:

- ❑ keep the system under light pressure in order to raise the coolant boiling point;
- ❑ discharge the pressure surplus in the atmosphere as a result of the coolant high temperature.

The charge valve makes it possible to transfer the coolant from the expansion reservoir to the radiator when a depression is generated inside the system as a result of the coolant volume reduction depending on the fall in the coolant temperature.
Discharge valve opening:

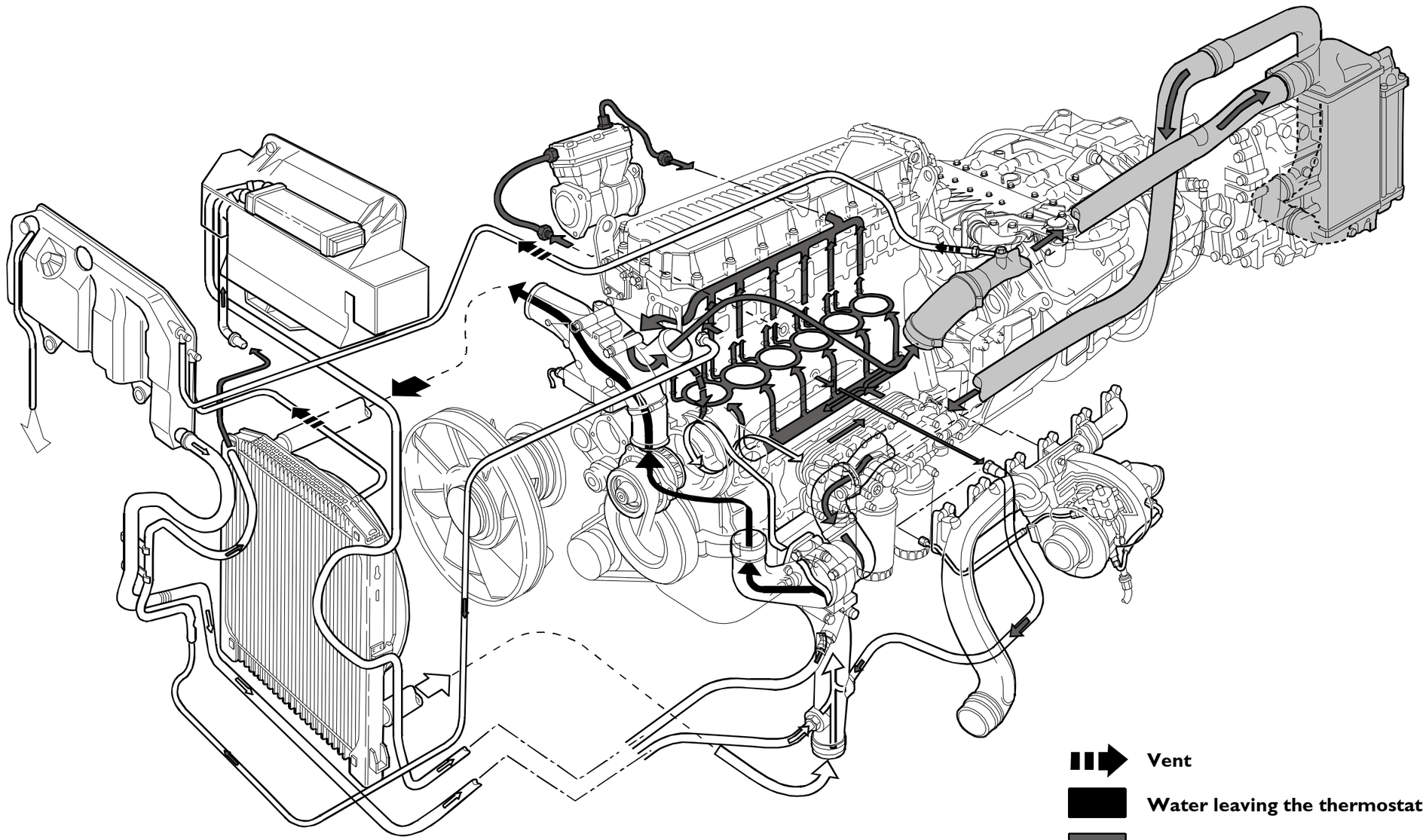
• 1st breather	0.9 $^{+0.2}_{-0.1}$	bar
• 2nd breather	1.2 $^{+0.2}_{-0.1}$	bar
Charge valve opening	-0.03 $^{+0}_{-0.02}$	bar
Plug tightening torque (1):	8 ± 1	Nm

Figure 231



COOLING CIRCUIT VERSION WITHOUT INTARDER

Figure 232



Vent

Water leaving the thermostat

Water circulating in the engine

Water entering the pump

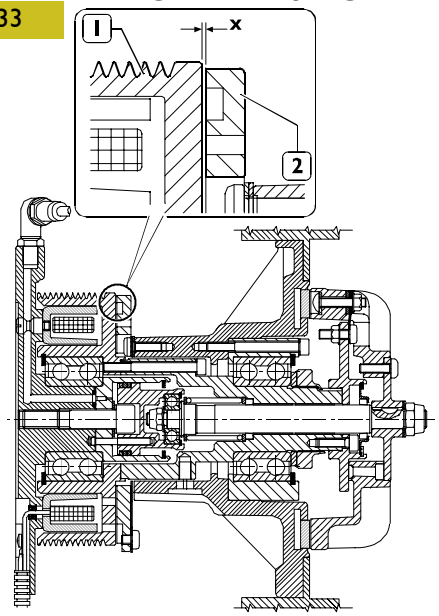
Specific elements of the version with INTARDER

92844

COOLING CIRCUIT VERSION WITH INTARDER

543210 Electromagnetic coupling

Figure 233



ELECTROMAGNETIC COUPLING SECTION

Using a feeler gauge, check the gap between the anchor assembly (2) and the pulley (1), it must be no greater than 2.5 mm.

The electro-magnetic joint action depends on:
- ❑ the coolant temperature;
- ❑ the climate control system fluid pressure (if any);
- ❑ the slowing down action of the intarder on (if any).

Idling condition:
- ❑ water temperature is less than 93°C and both the Intarder and the air-conditioning unit (where available) are OFF;
- ❑ coolant temperature is less than 85°C and the air-conditioning system is ON (pressure inside the circuit is less than 18 bar);
- ❑ coolant temperature is less than 85°C, and the Intarder is ON, with its braking power less than 41% of its maximum power.

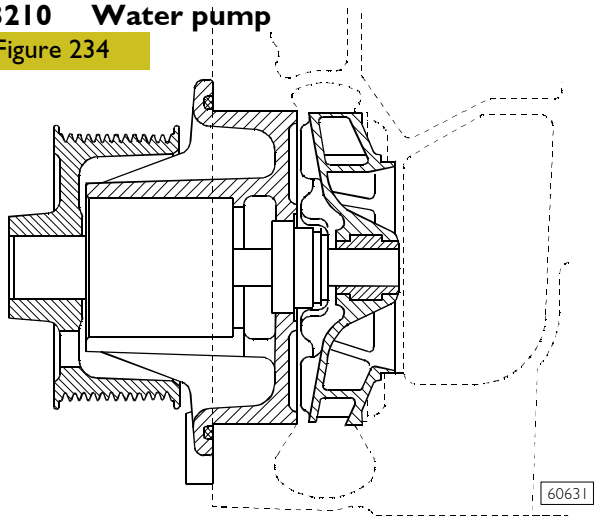
The first speed is actuated when:
- ❑ coolant temperature reaches 85°C, and the Intarder is ON, with its braking power greater than 41% of its maximum power;
- ❑ coolant temperature reaches 85°C and the air-conditioning system is ON (pressure inside the circuit in higher than 18 bar);

The second speed is actuated when:
- ❑ coolant temperature reaches 93°C, and the Intarder is either OFF or ON with its braking power less than 41% (speed is deactuated when temperature falls down to 88°C);
- ❑ coolant temperature reaches 85%, the Intarder is ON (with its braking power greater than 41% of its maximum power), or the air-conditioning system is ON and the pressure inside the circuit is 22 bar.

When second speed actuation is required, the system will drive the fan for 5 seconds at the first speed and then engages the second speed. This will increase belt and fan component wear in time. When the fan first speed is actuated for more than 1 minute, the system actuates the second speed until the control parameters fall under the operation levels.
As to the description of the electro-magnetic joint operation and servicing, see the "Manual for electric/electronic system repairing" - **Volume 3**

543210 Water pump

Figure 234



CROSS-SECTION OF THE WATER PUMP

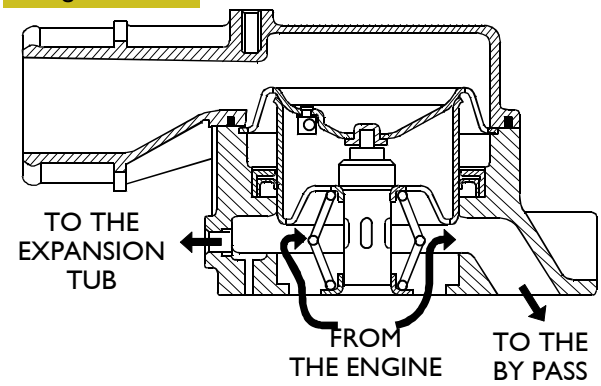
The water pump is composed of: impeller, bearing, seal and driving pulley.

NOTE Check that the pump body has no cracks or water leakage; if it does, replace the entire water pump.

543250 Thermostat

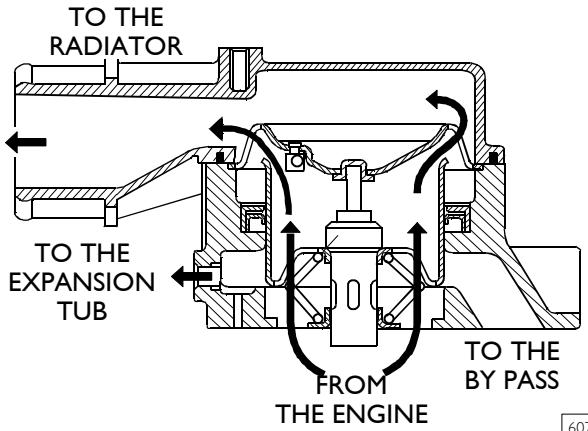
View of thermostat operation

Figure 235



Water circulating in the engine

Figure 236



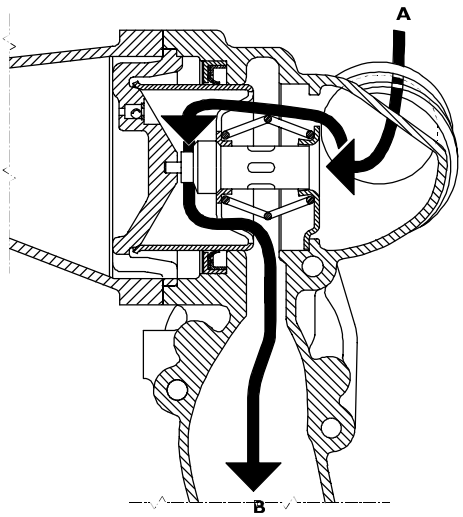
Water leaving the thermostat

Check the thermostat works properly; replace it if in doubt.

Temperature of start of travel 84°C ±2°C.
Minimum travel 15 mm at 94°C ±2°C.

View of thermostat operation for versions with Intarder

Figure 237

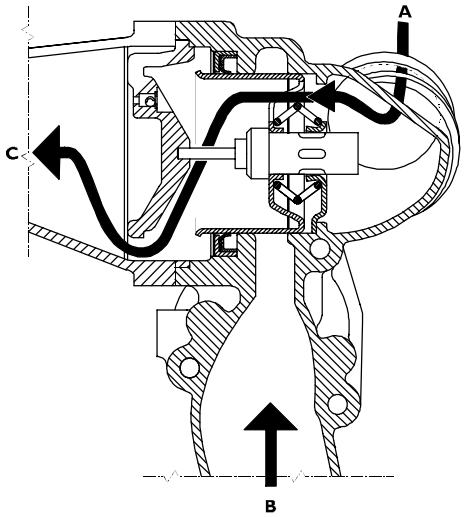


COLD OPERATION WITH CLOSED THERMOSTAT

A - Water circulating in the engine and the intarder.

B - To water pump.

Figure 238



HOT OPERATION WITH OPEN THERMOSTAT

A - Water circulating in the engine and the intarder.

B - From the radiator to the water pump.

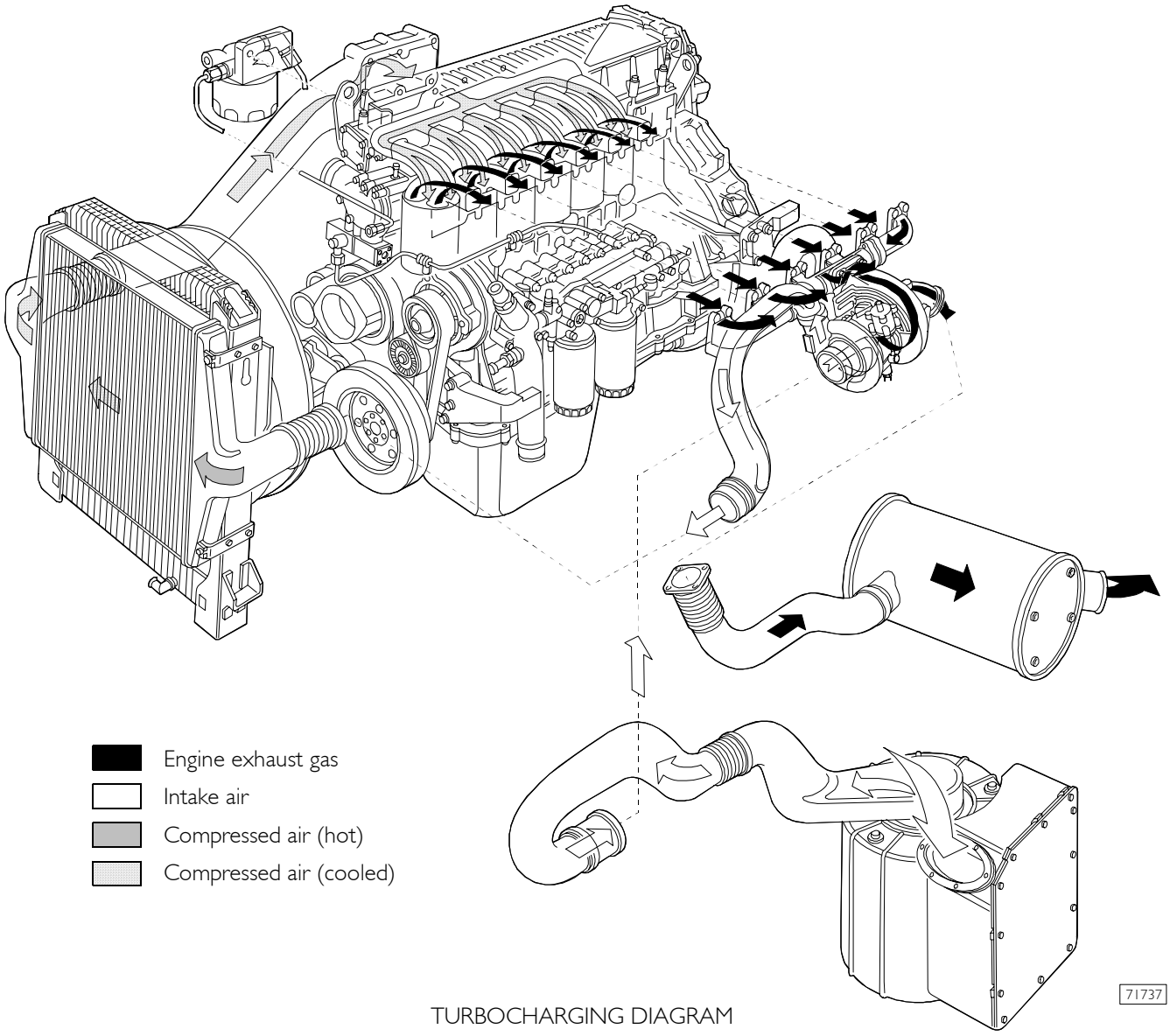
C - To radiator.

5424 TURBOCHARGING

The turbocharging system is composed of:

- an air filter;
- a variable geometry turbocharger;
- an "intercooler" radiator.

Figure 239



TURBOCHARGING DIAGRAM

Turbocharger HOLSET HE 551 V

Working principle

The variable geometry turbocharger (VGT) is composed of a centrifugal compressor and a turbine equipped with a mobile device that, by changing the area of cross-section of the passage of the exhaust gases going to the turbine, governs the speed.

Thanks to this solution, it is possible to keep the speed of the gases and turbine high even when the engine is running at low speed.

By making the gases pass through small cross-sections, they flow faster, so that the turbine turns faster as well.

The movement of the device changing the cross-section of the flow of exhaust gases is accomplished with a mechanism operated by a pneumatic actuator.

This actuator is controlled directly by the electronic control unit via a proportional solenoid valve.

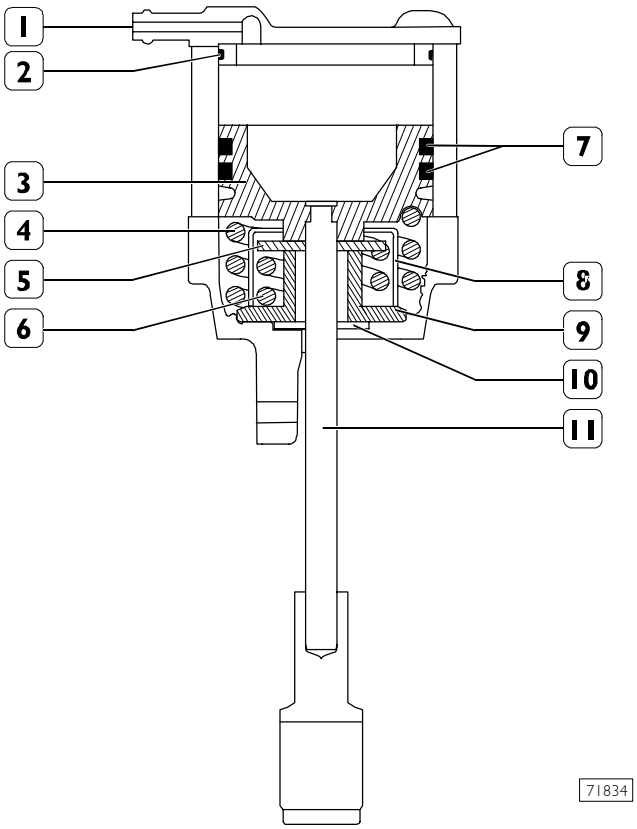
This device is most closed at low speed.

At high engine speeds, the electronic control system increases the cross-section of the passage to permit the incoming gases to flow without increasing their speed too much.

Cast in the central body there is a toroidal chamber for the coolant to pass through.

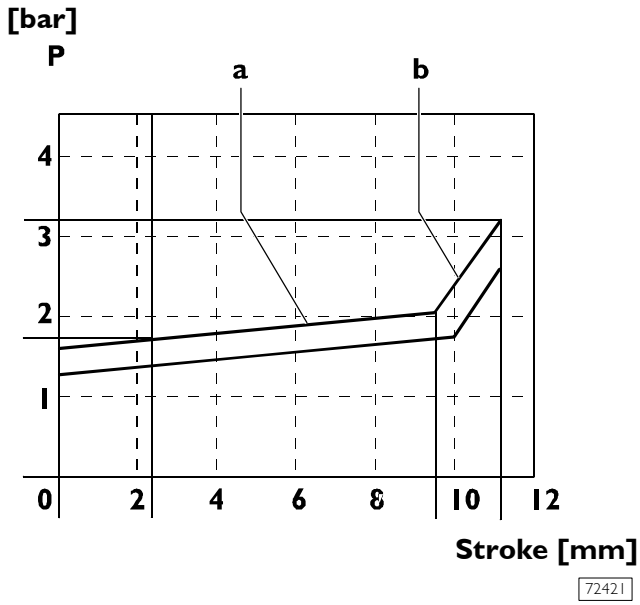
Actuator

Figure 240



1. Air inlet - 2. Gasket - 3. Piston - 4. External spring - 5. Internal spring control disc - 6. Internal spring - 7. O-ring - 8. Spring holder - 9. Limit stop - 10. Dust seal - 11. Control rod

Figure 241



a Gradient characterized by the effect of the external spring (4, Figure 240).

b Gradient characterized by the effect of the external (4, Figure 240) and internal (6, Figure 240) springs.

Working principle (See Figure 240)

The actuator piston, connected to the drive rod, is controlled with the compressed air introduced through the air inlet (1) on the top of the actuator. Modulating the air pressure varies the movement of the piston and turbine control rod. As the piston moves, it progressively compresses the external spring (4) until the base of the piston reaches the disc (5) controlling the internal spring (6). On further increasing the pressure, the piston, via the disc (5), interferes with the bottom limit stop (10). Using two springs makes it possible to vary the ratio between the piston stroke and the pressure. Approximately 85% of the stroke of the rod is opposed by the external spring and 15% by the internal one.

Solenoid valve for VGT control

This N.C. proportional solenoid valve is located on the left-hand side of the crankcase under the turbine. The electronic control unit, via a PWM signal, controls the solenoid valve, governing the supply pressure of the turbine actuator, which, on changing its position, modifies the cross-section of the flow of exhaust gases onto the blades of the impeller and therefore its speed. The VGT solenoid valve is connected to the electronic control unit between pins C1 / C3. The resistance of the coil is approx. 20-30 Ohms.

REPAIR

NOTE If anomalous engine operation is found, which is due to the boosting system, it is advisable that you check the efficiency of seal gaskets and the fastening of connecting sleeves prior to carrying out the checks on the turboblower. Also check for obstructions in the sucking sleeves, air filter. If the turbocharger damage is due to a lack of lubrication, check that the oil circulation pipes are not damaged. If so, change them or eliminate the cause.

After carrying out the above mentioned checks, check the turbocharger operation with an Engine Test by using IVECO diagnosis equipment (Modus - IT 2000 - E.A.SY.) according to the relevant procedure.

NOTE The test must be performed in following conditions:

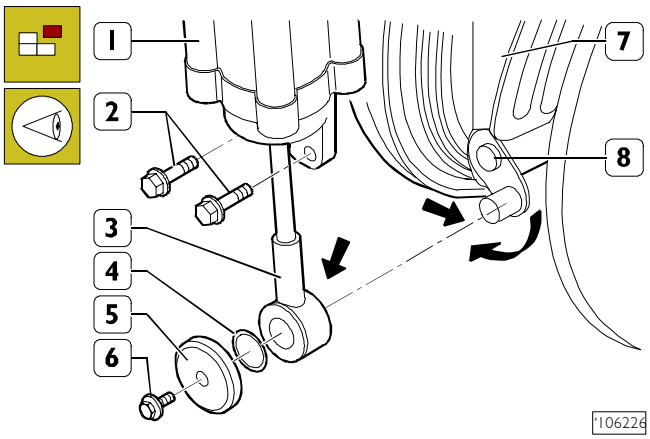
- engine coolant temperature >50 °C;
- battery up (voltage >22V) for compression test;
- efficient recharging system.

If values beyond tolerance are detected, check the efficiency of:

- shut-off valve;
- pressure sensor;
- engine cable pressure sensor connection (if oxidised, clean with a specific product);
- lack of electrical defects in solenoid valve VGT (continuity connection);
- actuator moved by active diagnosis as described in relating chapter, in case of locking, grease bushing with lubricant Kernite (for high temperatures); if the trouble persists, replace the actuator;
- sliding sleeve: it must slide freely when operated manually. If locked and if the bush check is not sufficient or effective, or no faults are detected in the other points, upon authorization of the "Help Desk" market operator, change the turbocharger according to the standard procedures.

Variable geometry movement control

Figure 242



Remove screws (2) and take actuator (1) off turbocompressor (7).
Remove screw (6), underlying disk (5), ring (4) and disconnect tie rod (3) of actuator (1) from the pin of variable geometry driving lever (8).
Accurately clean pin (→) of lever (8) and bushing (→) of tie rod (3) using a cloth made of non abrasive micro fibre.

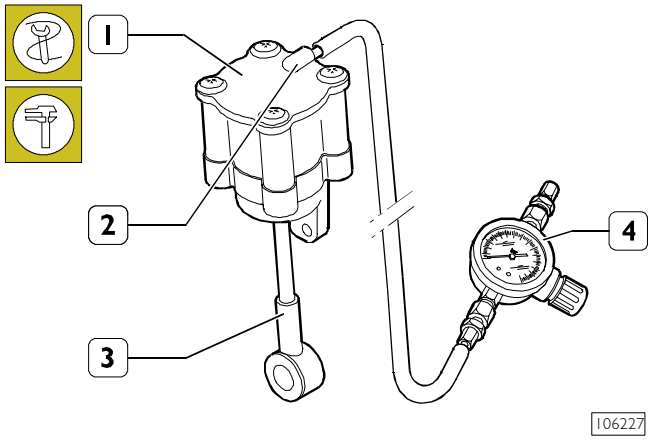
NOTE Do not use abrasive paper of any kind.

Visually check the conditions of bushing (→) of tie rod (3) and pin (→) of lever (8); where they are found to be worn out, replace actuator (1) or turbocompressor (7).

Check variable geometry inner driving mechanism movement by operating on lever (8); jamming must not occur; otherwise, clean turbine body, as described in relating chapter.

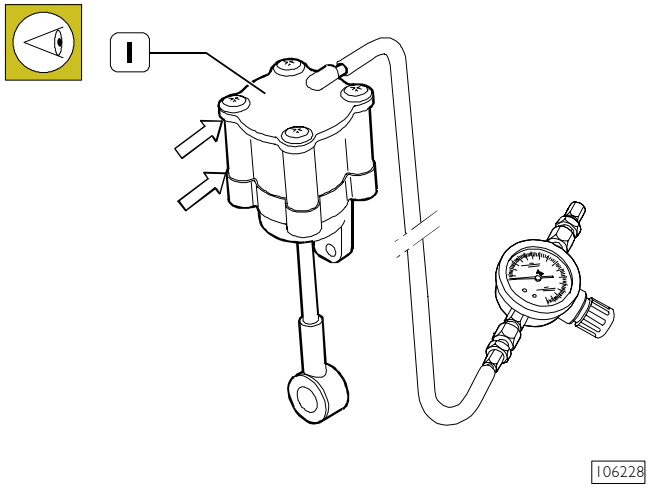
Checking the actuator

Figure 243



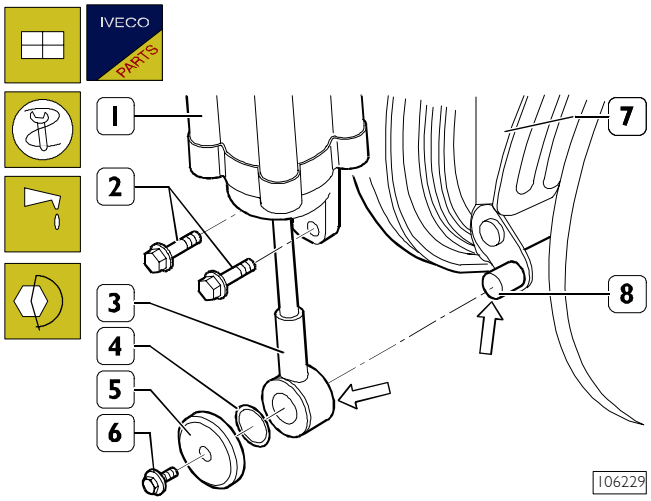
Check actuator efficiency (1) operating as follows.
Apply, to fitting (2) of actuator (1), compressed air feed piping provided with pressure regulator (4). By using the pressure regulator, introduce, into the actuator, compressed air slowly modulating it, from 0÷3.5 bar; tie rod (3) of actuator (1) must move without jamming; otherwise, replace actuator (1).

Figure 244



Check for any actuator leaks at indicated points (→) applying, on these points, a solution of suds.
When actuator (1) is fed with compressed air, no bubbles must be found at indicated points (→); otherwise, replace actuator (1).

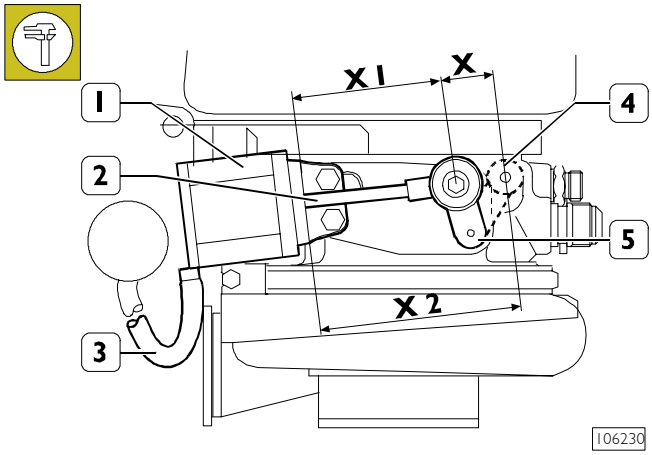
Figure 245



Lubricate bushing (→) of tie rod (3) and pin (→) of lever (8) with lithium-based Castrol LM GREASE type and reconnect actuator (1) to turbocompressor (7) operating as follows.
Connect tie rod (3) to lever (8).
Mount new ring (4), mount disk (5) and screw up screw (6).
Screw up screws (2) securing actuator (1) to turbocompressor (7).
Tighten screws (2 and 6) at 25 Nm torque.

Checking actuator travel

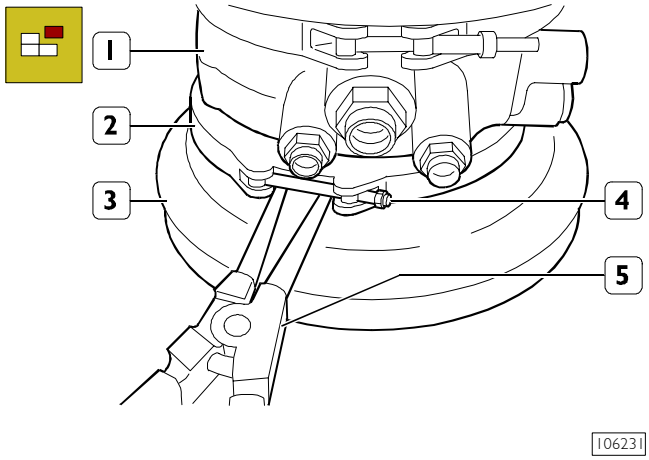
Figure 246



Check travel X of tie rod (2) of actuator (1) operating as follows.
Measure distance X1 between actuator (1) and cross-axis of eyelet (4).
Apply, to fitting of actuator (1), piping (3) for compressed air feed provided with pressure regulator. By using the pressure regulator, introduce, into actuator (1) compressed air slowly modulating it, from 0÷3,5 bar, until lever (5) is taken to its end of travel.
Measure again the distance between actuator (1) and cross-axis of eyelet (4) dimension X2.
Travel X of tie rod (2) of actuator (1) is given by following subtraction X = X2-X1 and must result to be equal to 11.5±0.5 mm.

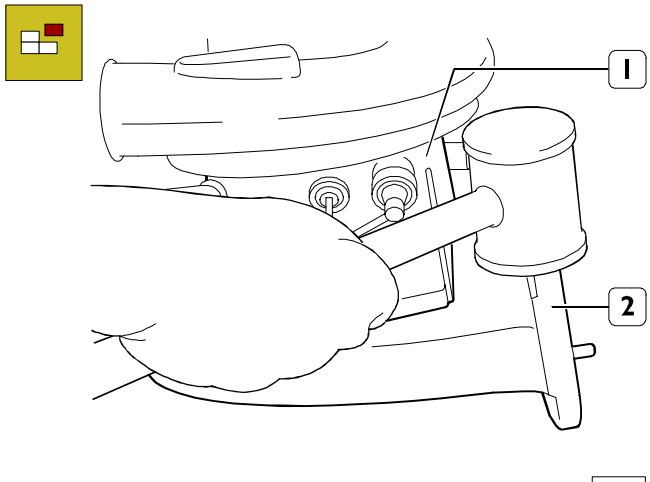
Cleaning turbine body

Figure 247



Mark mounting position of clamp (2) on central body (1).
On threading and nut (4), apply antioxidant spray lubricant and, operating on nut (4), loosen clamp (2).
Slightly rotate clamp (2) using pliers (5).
Mark mounting position of turbine body (3) on central body (1).

Figure 248

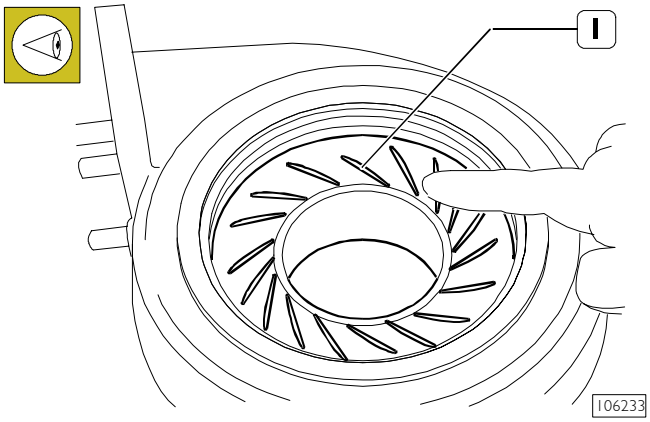


By a copper hammer, beat on two opposite points (~180°) on turbine body (2) to separate turbine body from central body (1).

NOTE In operation, take particular care to avoid damaging turbine rotor.

After dismounting turbine body, check variable geometry movement as described in relating chapter; where improvement in movement is not found with respect to previous check, replace turbocompressor.

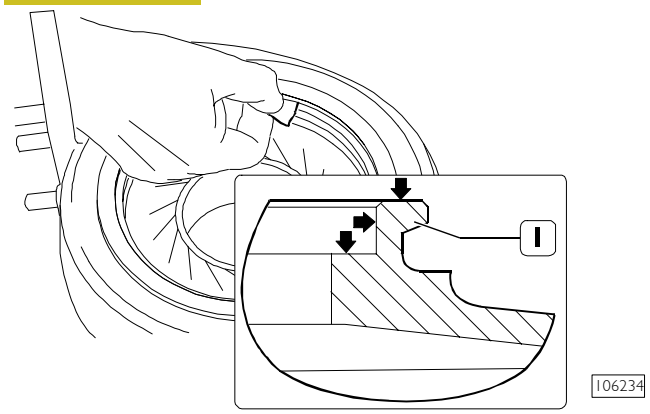
Figure 249



Accurately clean slot ring (1) and area around turbine body from carbonaceous deposits and check that the ring moves freely, otherwise, replace turbocompressor.

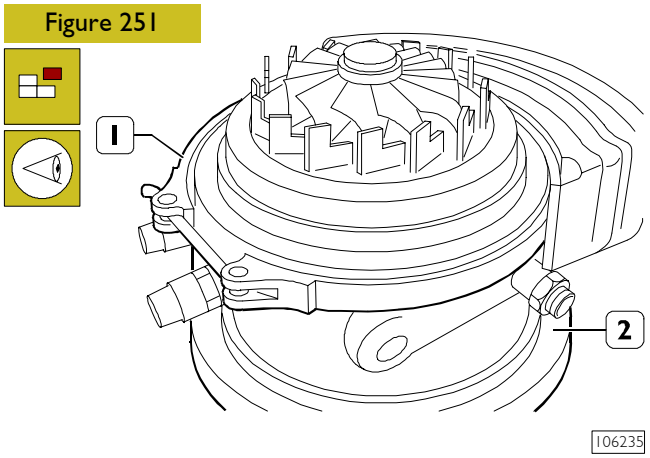
NOTE Any small cracks between slots and ring can be accepted, because they do not impair turbocompressor operation conditions.

Figure 250



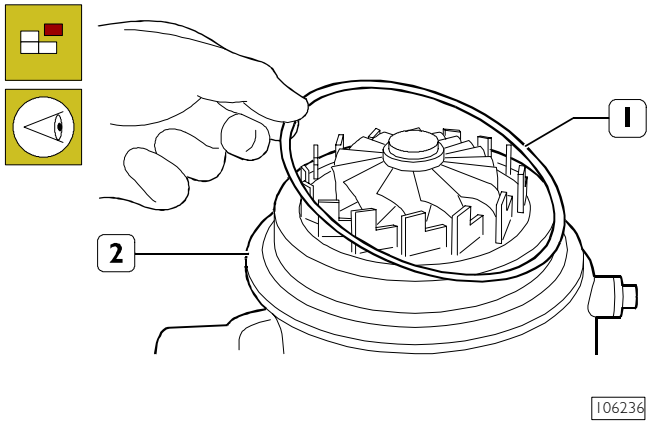
By suitable scraper and abrasive paper, accurately clean surfaces (→) of turbine body (1) from carbonaceous deposits, taking care to avoid damaging the surfaces.

Figure 251



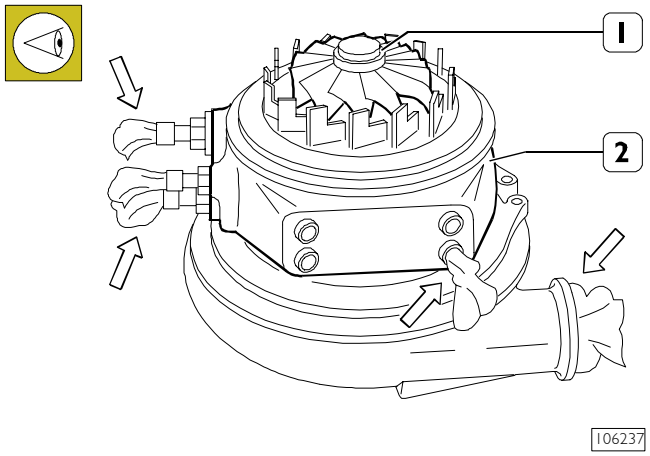
Dismount clamp (1) from central body (2) and check that the clamp does not result to be damaged; otherwise replace the clamp.

Figure 252



Dismount seal ring (1), external with respect to central body (2).
Accurately clean seal ring (1) and check that the ring does not result to be damaged; otherwise replace the ring.

Figure 253

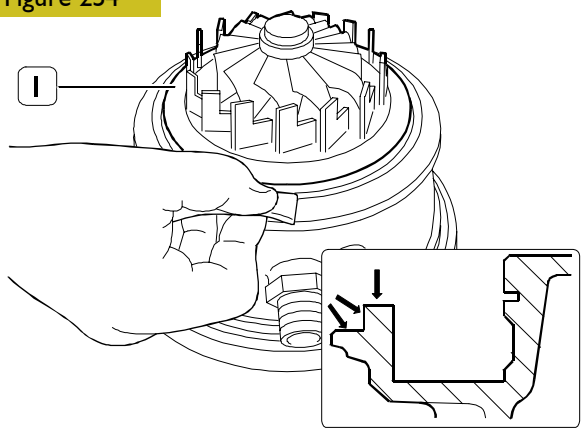


Check turbine rotor (1); there must not be found: carbonaceous deposits, deformation, cracks, blade scoring; also, turbine must turn freely.
By comparator, check clearance of turbine rotor stem (1); clearance must result to be:
- axial clearance: 0.051÷0.152 mm
- radial clearance: 0.381÷0.533 mm.

Where either clearance values over above ones or any one of above mentioned faults are found, replace turbocompressor.

NOTE Before cleaning turbine side central body, properly protect oil, water and air inlets and outlets (→) in order to prevent dirt or foreign bodies from entering turbocompressor.

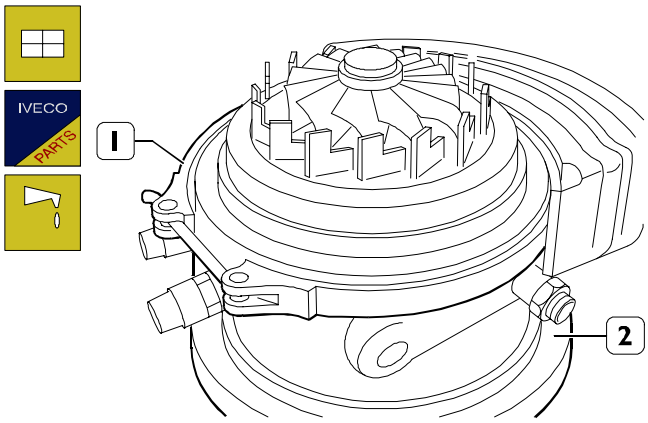
Figure 254



106238

By suitable scraper and abrasive paper, accurately clean surfaces (→) of central body (1) from carbonaceous deposits, taking care to avoid damaging the surfaces and variable geometry ring.
Then, with compressed air, clean variable geometry surfaces and ring from removed residues.
Check again, as described in relating chapters:
- variable geometry movement;
- actuator;
- actuator travel.

Figure 255



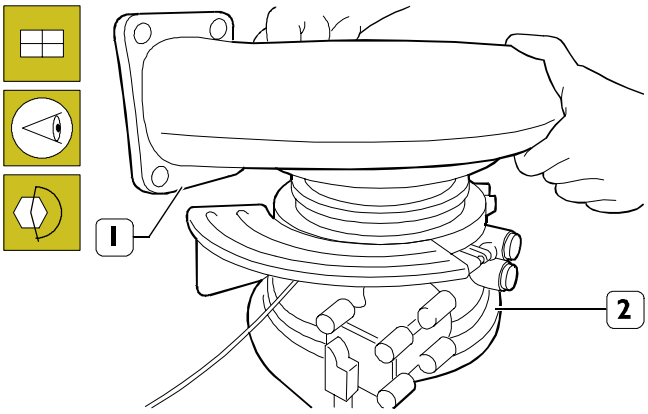
106235

Position clamp (1) on central body (2)

NOTE Should clamp (1) be replaced with an integrated heat guard, a new actuator has to be mounted with an integrated heat guard at the place of existing one.

Position accurately cleaned seal ring on central body.
Apply a thin layer of antiscuff paste on cleaned matching surfaces: central body / turbine body.

Figure 256



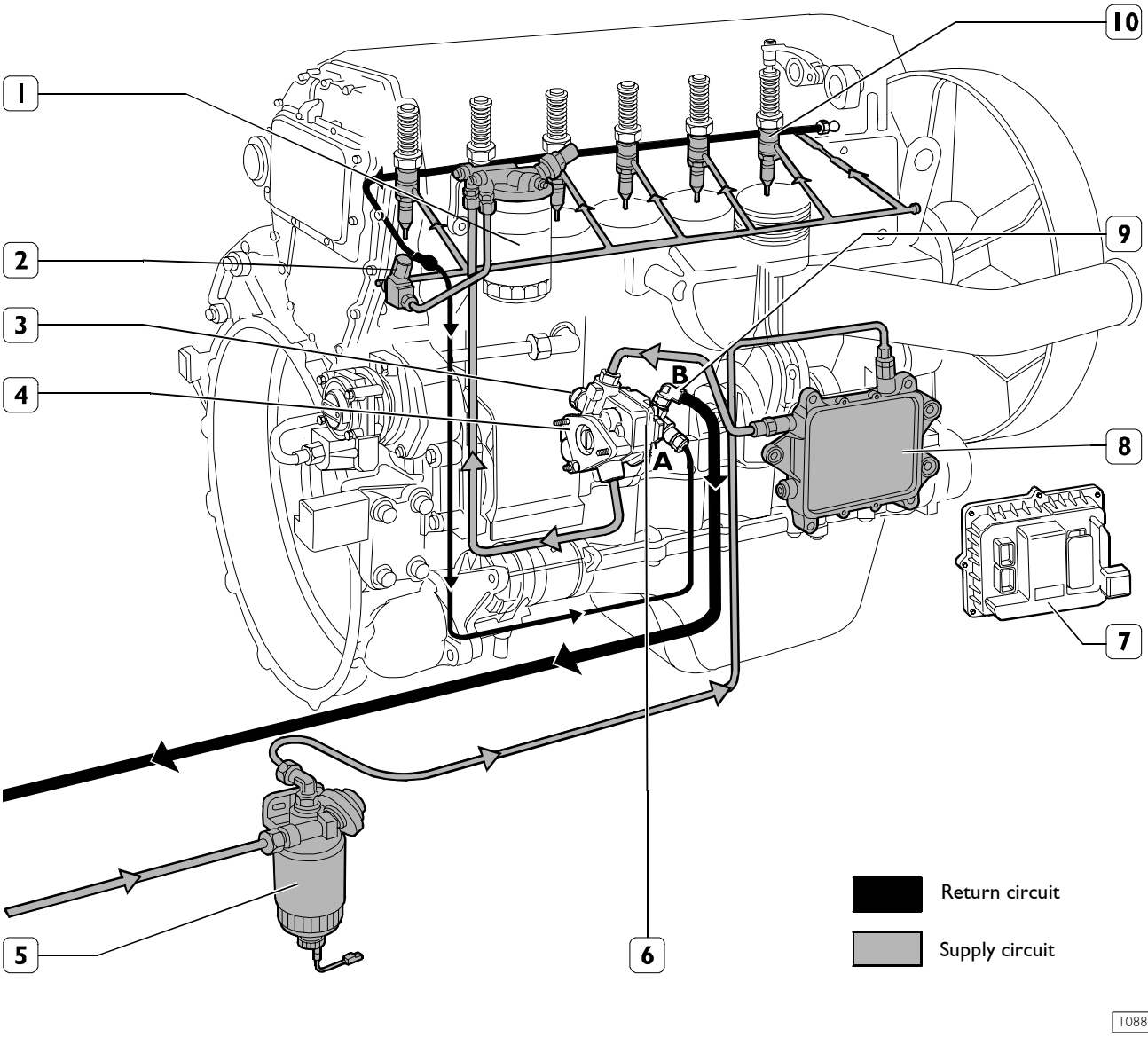
106240

Mount turbine body (1) on central body (2) taking care to avoid damaging turbine rotor and align turbine body variable geometry slot ring. Do not force mounting operation: in case of jamming, it might damage variable geometry with consequent regulation system faulty operation.
Once mounting has been completed, make sure that turbine body results to be matched correctly on central body.
Position turbine body on central body and clamp on central body in such a way that marks, made on dismounting, are matching.
Tighten nut clamping the clamp at 11.3 Nm torque.
Check again, as described in relating chapters:
- actuator;
- actuator travel.

FEEDING

Fuel is supplied via a fuel pump, filter and pre-filter, 6 pump-injectors governed by the camshaft via rocker arms and by the electronic control unit.

Figure 257



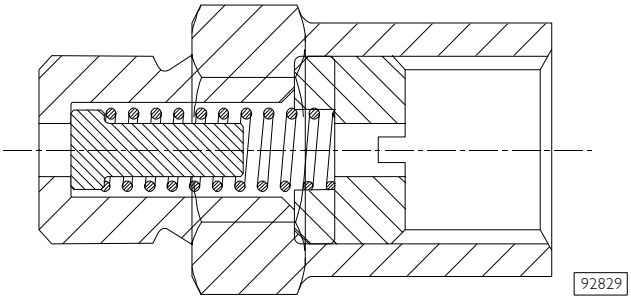
ENGINE FEED SCHEME

1. Fuel filter - 2. Pressure damping device - 3. Pressure control valve (start of opening at 5 bar) - 4. Feed pump - 5. Fuel pre-filter with priming pump - 6. Valve, to recirculate fuel from injectors, integrated in feed pump (start of opening at 3.5 bar) - 7. Central unit - 8. Heat exchanger - 9. Overpressure valve to return fuel to tank (start of opening at 0.2 bar) - 10. Pump injectors

A. Fuel arriving at injectors - B. Fuel returning to tank

Overpressure valve

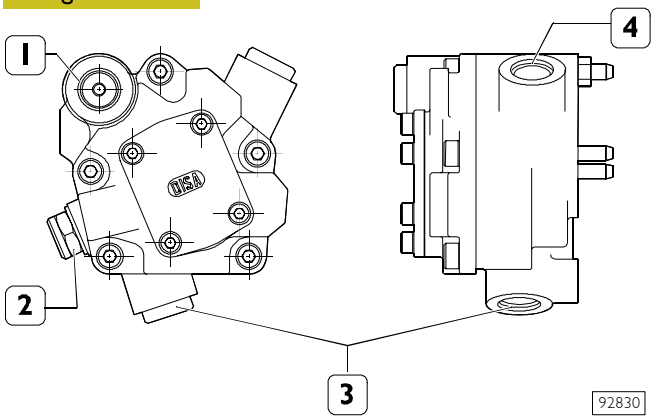
Figure 258



An overpressure valve is a single-acting valve, calibrated to 0.2 ÷ 0.3 bar, placed on the piping that returns fuel to tank. The overpressure valve prevents fuel duct in cylinder head from emptying with engine stopped.

Feed pump

Figure 259



Engine feed pump for vehicles 4x2 - 4x4 - 6x4
1. Overpressure valve - 2. Delivering fuel to injectors - 3. Sucking in fuel - 4. Pressure control valve

Pump performances						
Pump rotation speed		(rpm)	2600	600	170	100
Minimum flow rate		(l/h)	310	45	12	
Test conditions	Negative pressure on aspiration	(bar)	0.5	0.3	0.3	0.3
	Pressure on delivery	(bar)	5	3	0,3	0.3
	Test liquid temperature	(°C)	30	30	30	30
	Test liquid		ISO 4113			

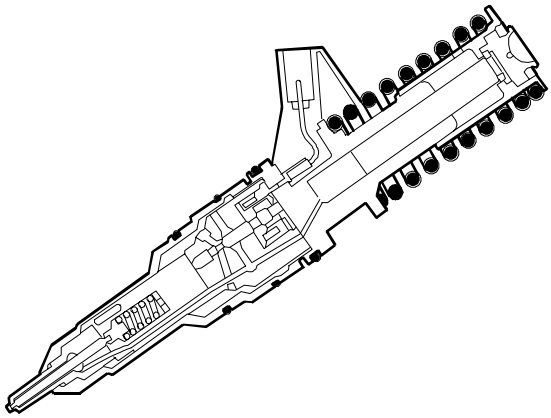
Field of use		
Pump rotation speed	(rpm)	2600
Overrunning rotation speed (max 5 min)	(rpm)	4100 max
Diesel oil temperature	(°C)	-25/+80
Filtering rate on aspiration	(micron)	30
Negative pressure on aspiration	(bar)	0.5 max

Pressure control valve	
Valve calibration	5 ÷ 5.8

Injectors return valve	
Valve calibration	3.4 ÷ 3.8

Injector-pump

Figure 260

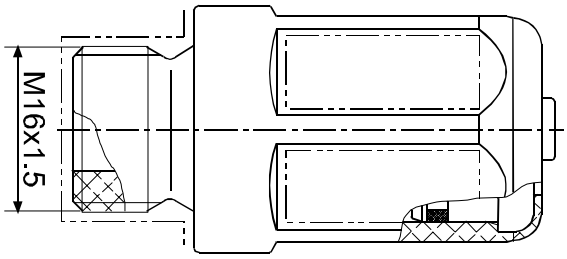


INJECTOR SECTION

The new pump injectors are capable, thanks to the higher injection pressure, of atomizing the fuel in the combustion chamber to a greater extent, thus improving combustion and therefore reducing the polluting exhaust emissions.

Pressure damper

Figure 261



FUEL PRESSURE DAMPER

The function of the fuel pressure damper located on the delivery piping between fuel filter and cylinders head is to dampen the return counter pressures on the delivery piping and on the filter caused by the increase in the injection pressure.

Hydrocar pressure take-off on timing system

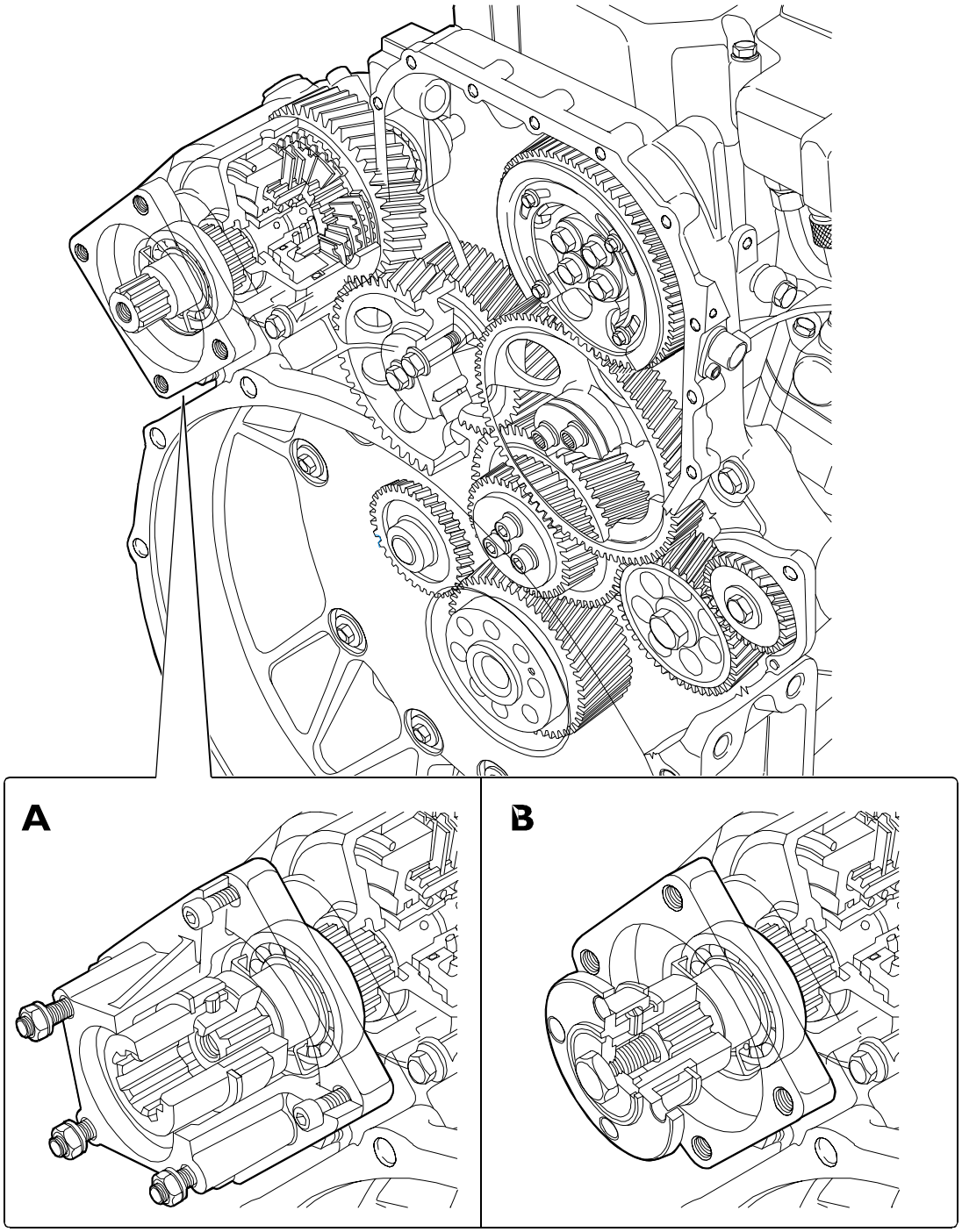
HYDROCAR PRESSURE TAKE-OFF ON TIMING SYSTEM - P.T.O. (OPTIONAL)

Description

This power take-off has one axle, moving by gears and engaging by a clutch that takes the drive from the gears of the timing system irrespective of the vehicle's clutch. It can be used with the vehicle either stationary or running and for continuous use it can be turned on/off with the engine running.

The PTO can be in the version for direct pump connection or with a flange for a universal shaft.

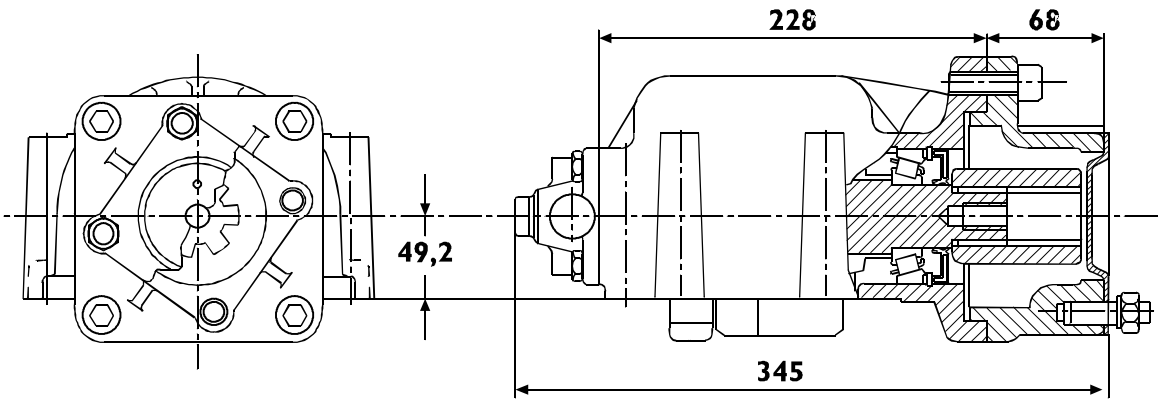
Figure 1



A. ISO pump connection - 4 holes (option 5367) - B. DIN 10 flange connection (option 6366)

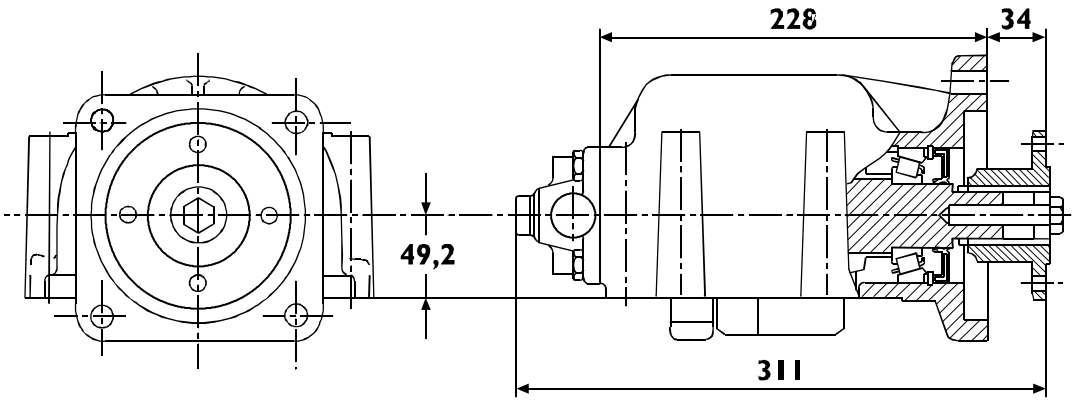
SPECIFICATIONS AND DATA

Figure 2



P.T.O.* with ISO 4-hole pump connection

Figure 3



P.T.O.* with DIN 10-hole flange connection

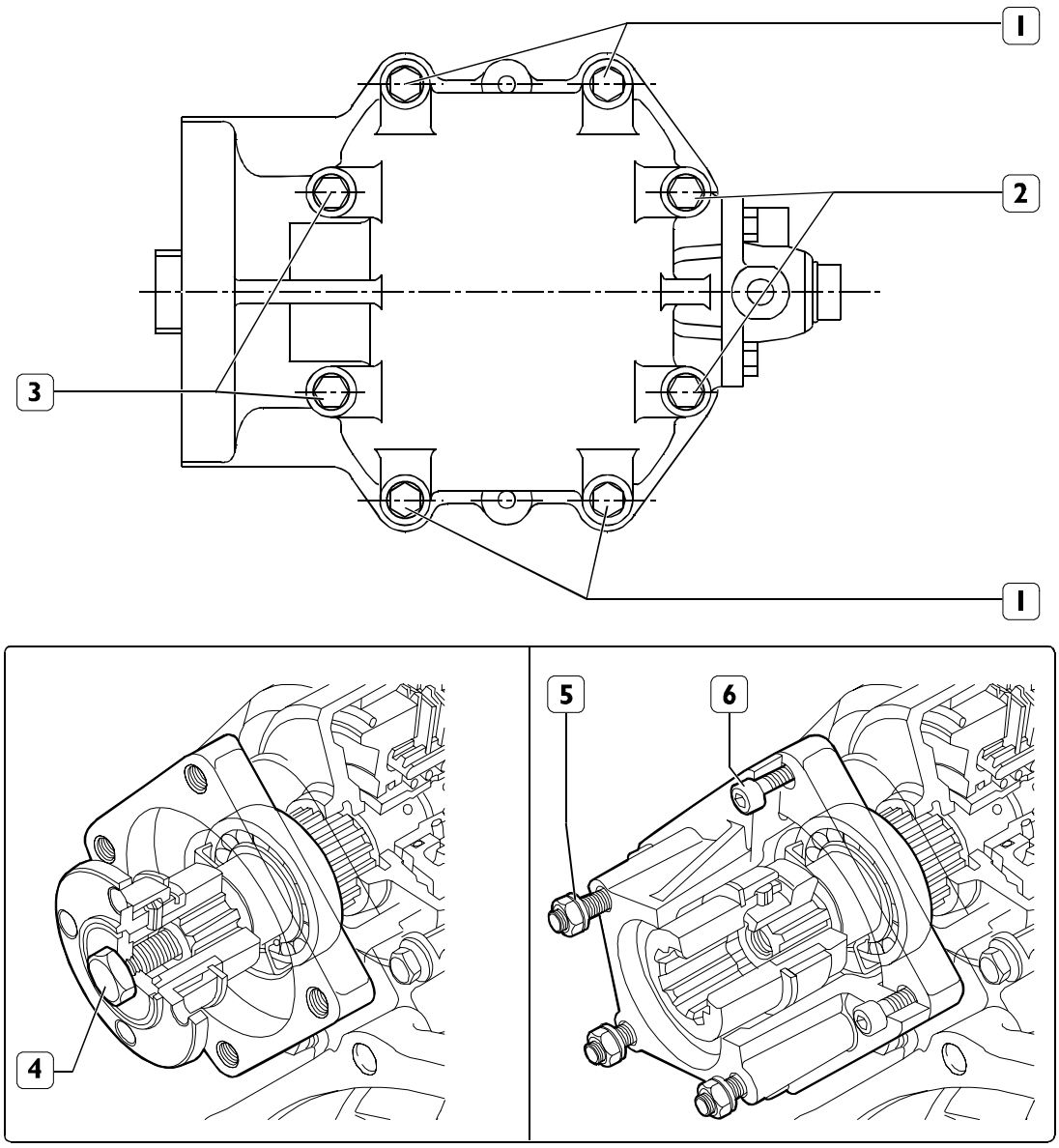
Weight (with flange connection)	kg	13
Weight (with pump connection)	kg	16
Transmission ratio to P.T.O.*		1/1.14
Direction of rotation		opposite to engine
Control		pneumatic
Max. continuous torque available	Nm	600

* P.T.O. = Power Take-Off

The engine speed, when taking off the maximum permissible torque of 600 Nm, must never be less than 1200 rpm.

TIGHTENING TORQUES

Figure 4

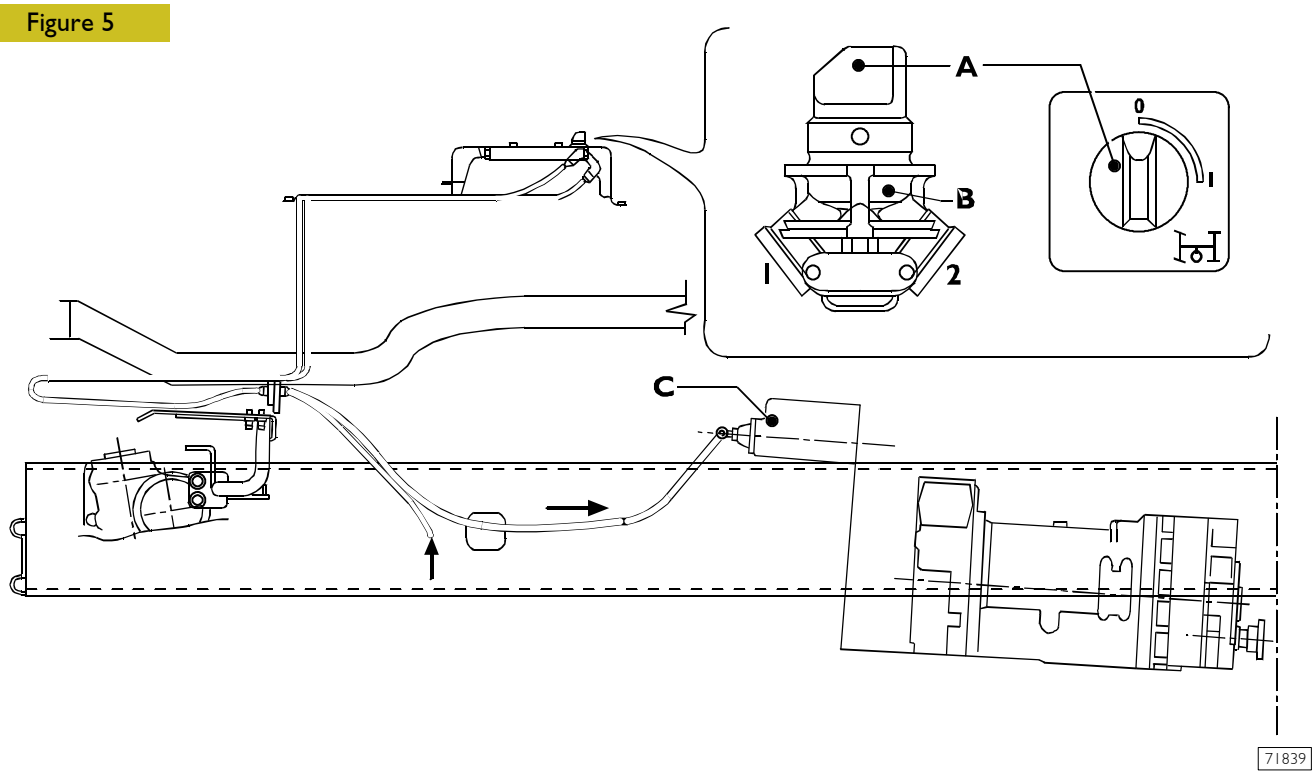


	DESCRIPTION	TORQUE	
		Nm	(kgm)
1	Flanged head screw M10 x 1.5 x 120	53 ± 2.7	(5.3 ± 0.27)
2*	Flanged head screw M10 x 1.5 x 120	53 ± 2.7	(5.3 ± 0.27)
3	Screw M10 X 1.5 x 150	53 ± 2.7	(5.3 ± 0.27)
4	Screw fixing DIN flange	140 ± 5	(14 ± 0.5)
5	Nut fixing pump	85 ± 5	(8.5 ± 0.5)
6	Screw fixing pump flange	115 ± 5	(11.5 ± 0.5)

* Apply LOCTITE 275

ENGAGING POWER TAKE-OFF

Figure 5

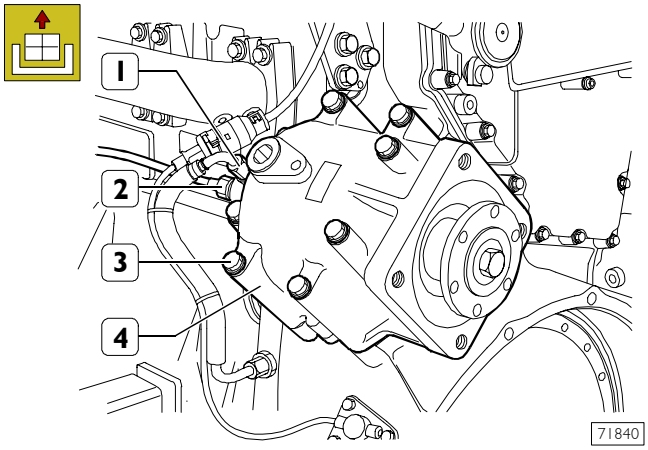


On turning the control knob **A** onto **I**, the air reaching the fitting I passes through the control valve **B** and from the fitting **2** supplies the clutch of the power take-off **C**, thereby making it possible for the drive to pass from the gears of the timing system to the P.T.O.
The control knob **A** is in this phase locked on position **I**.
When turning off the power take-off, turning in the opposite direction, the knob locks and automatically returns onto **0**.

REMOVING-REFITTING POWER TAKE-OFF

Removal

Figure 6

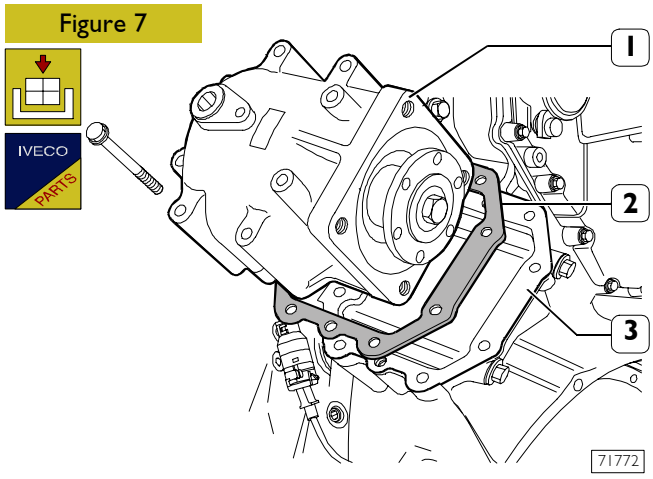


Disconnect the fitting (1) of the oil delivery pipe and the air fitting (2) of the clutch engagement control.
Unscrew the eight fixing screws (3) and take off the power take-off (4).

Refitting

Perform these steps in reverse order, tightening the fixing screws to the required torque.

Figure 7



To refit the PTO, both when replacing it and when reusing the previous one, it is necessary to replace the gasket.
Until the power take-offs are provided with plates stating the necessary dimension to calculate the correct thickness of the gasket, it is necessary to fit the gaskets of 1+0.5 mm provided in kit form and overlap them.
This is to make the gears engage correctly.
In the future the power take-offs will have a plate stating a dimension that, when added to the one punched on the flywheel cover and using a specific table, will make it possible to calculate the type of gasket to fit exactly.

Denox System 2

Page

DeNO$_x$2 SYSTEM

General remarks

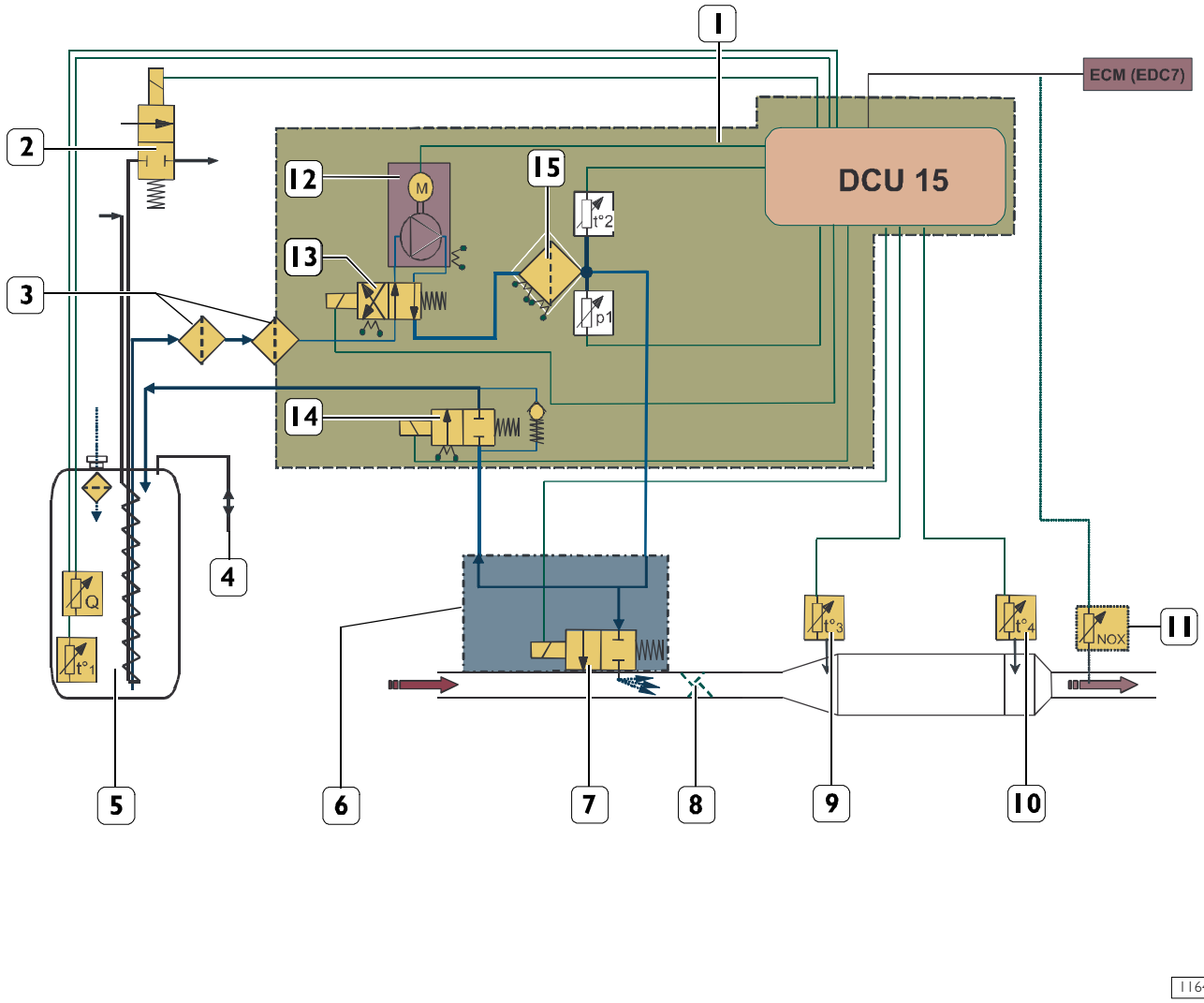
In order to keep the exhaust emission values of nitric oxides (NO_x) within the limits prescribed by the Euro 4 standard, with low fuel consumption, a system for post-processing of the above substances found in exhaust gas has been fitted to the vehicles.

This system essentially consists of an electronic-control oxidizing catalyst.

The system converts, through the SCR (Selective Catalytic Reduction) process, nitric oxides (NO_x) into inert compounds: free nitrogen (N_2) and water vapour (H_2O).

The SCR process is based on a series of chemical reactions, which leads, due to ammonia reacting with exhaust gas oxygen, to a reduction of nitric oxides (NO_x) found in exhaust gas.

Figure 1



1. Pump module - 2. Tank heating valve - 3. Pre-filters - 4. Tank vent pipe - 5. Ad Blue tank - 6. Dosing module - 7. Dosing valve - 8. Mixer - 9/10. Exhaust gases temperature sensors - 11. NOx detection sensors (*) - 12. Diaphragm pump - 13. Multi-ways magnetic valve - 14. Cooling valve - 15. Main filter

* Future application

The system is essentially made up of:

- a tank (9) for reagent solution (water - urea: Ad Blue), equipped with level gauge (8);
- an H_2O diverter valve (1);
- pump module (10);
- a mixing and injection module (2);
- catalyst (4);
- two exhaust gas temperature sensors (3, 6) on catalyst output (4);
- a moisture detection sensor (7) fitted on the engine air intake pipe downstream from the air cleaner.

SCR system is electronically managed by DCU (Dosing Control Unit) incorporated into pump module (10); depending on engine rpm, supplied torque, exhaust gas temperature, quantity of nitrogen oxides and humidity of air sucked in, the control unit regulates the flow rate of Ad Blue solution to be let into the system.

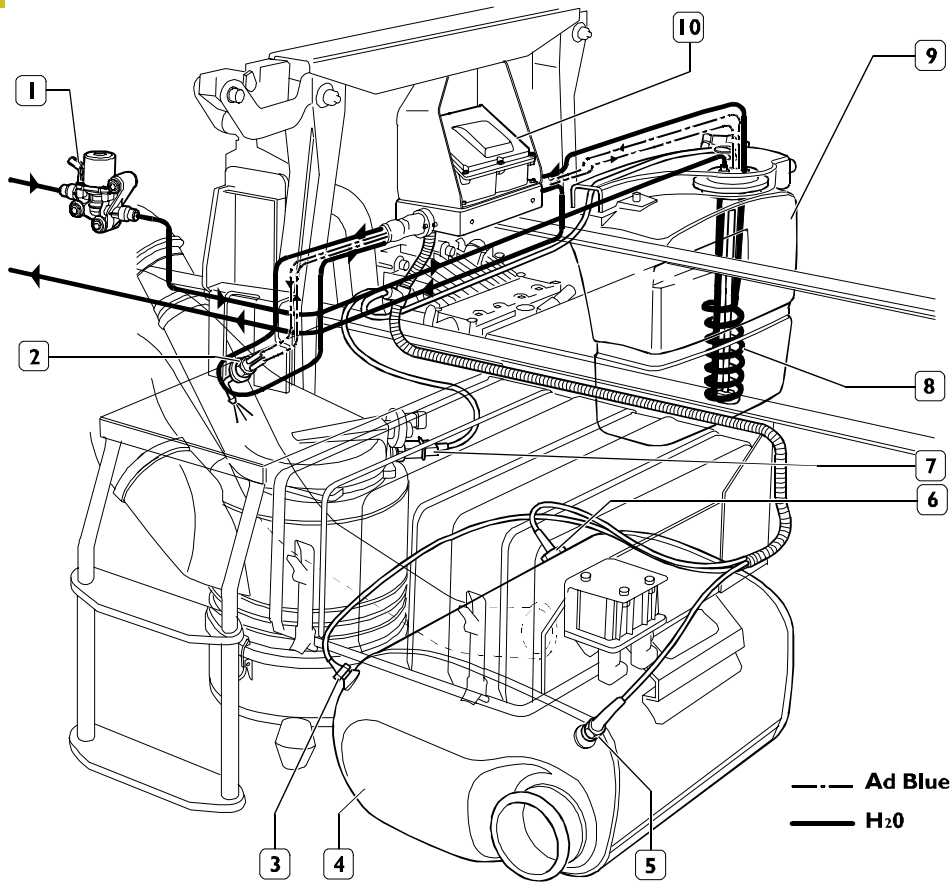
Pump module (10) takes reagent solution out of tank (9), then sends it under pressure into measuring out module (2); finally, the reagent solution is injected into the exhaust pipe upstream of catalyst (4).

The first stage of the process takes place in the first part of the catalytic converter: due to the effect of the exhaust gas temperature, the reagent solution evaporates instantly and is hydrolysed to ammonia ($2NH_3$) and carbon dioxide (CO_2).

At the same time, the solution evaporates to bring down the exhaust gas temperature to levels close to the optimum temperature required for the process.

Exhaust gases containing ammonia at the temperature required for the reaction enter the catalytic converter, where the second stage of the process takes place: the ammonia reacts with the oxygen in the exhaust gases and is converted to free nitrogen (N_2) and steam (H_2O).

Figure 2



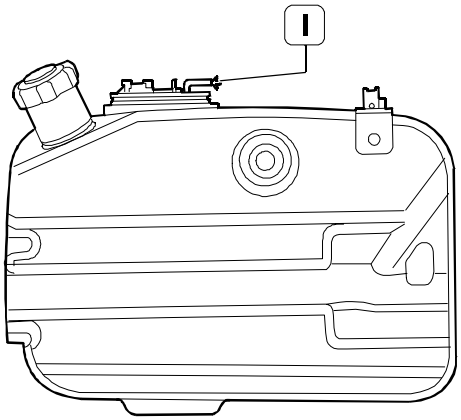
POSITION OF SCR SYSTEM COMPONENTS ON THE VEHICLE

1. H_2O valve - 2. By-pass valve - 3. Outlet temperature sensor - 4. Catalyst - 5. Nitric oxide detecting sensor (*) - 6. Inflow exhaust gas temperature sensor - 7. Sucked air humidity and temperature sensor - 8. Level gauge - 9. Water-urea solution (AD Blue) tank - 10. Pump module

* Future application

Tank

Figure 3

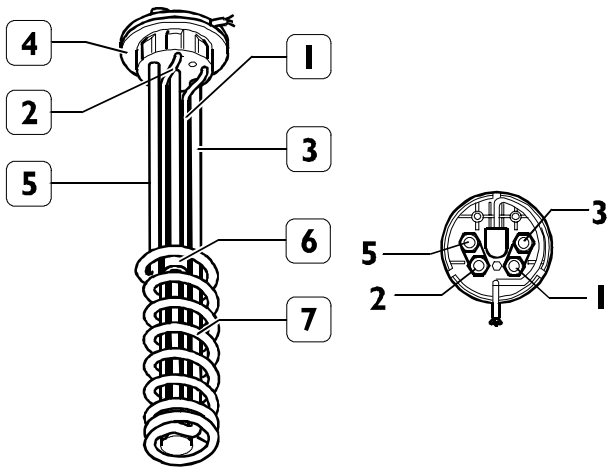


102295

The tank equipped with level gauge control (1) contains the reducing substance required for the SCR process, which consists of a 35%-urea and water solution called Ad Blue.

Ad Blue fluid level gauge control

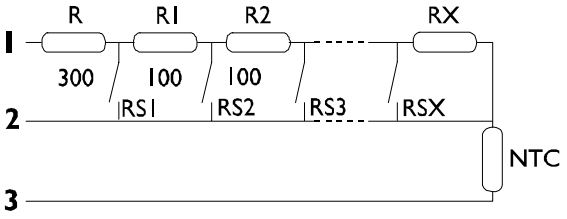
Figure 4



102296

1. Ad Blue fluid suction pipe -
2. Ad Blue fluid return pipe -
3. Engine cooling hot fluid inlet pipe -
4. NTC sensor - 5. Engine cooling hot fluid outlet pipe -
6. Float - 7. Ad Blue fluid heating coil

Figure 5



102308

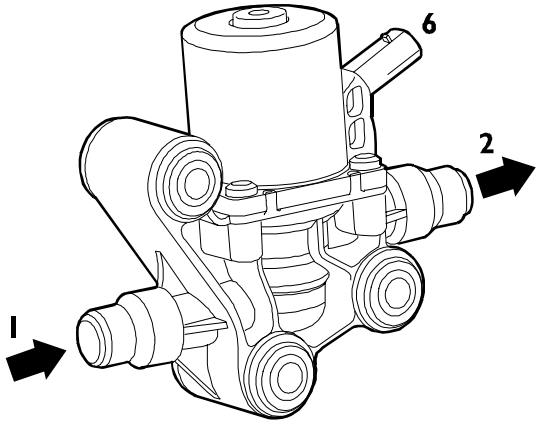
FUNCTIONAL WIRING DIAGRAM

The Ad Blue fluid level gauge control consists of a device made up of a set of resistors, a float, a NTC temperature sensor, and a coil used to heat the fluid under low temperature conditions.

It informs the control unit of any current change due to the resistor determined by the float position with respect to the Ad Blue fluid level.

By-pass valve

Figure 6



108127

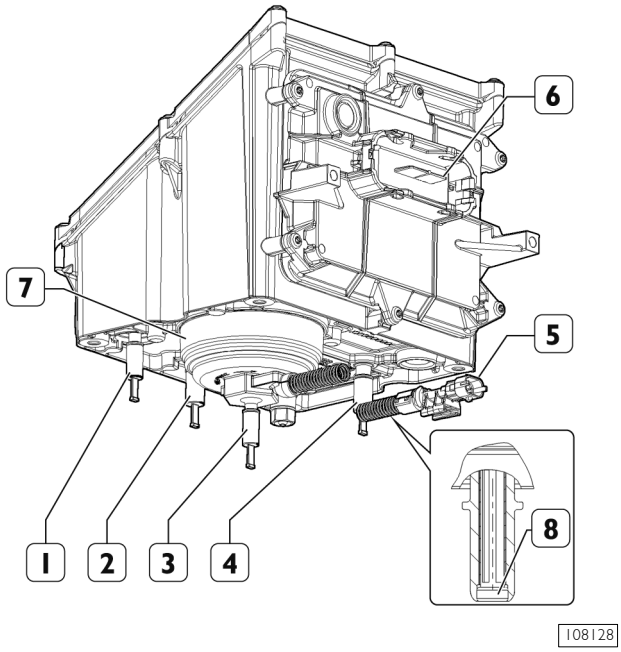
FUNCTIONAL WIRING DIAGRAM

1. Coolant inlet - 2. Coolant outlet - 6. Electrical connection

The valve, which is a Normally Closed type valve, allows Ad Blue tank to be heated by engine coolant.
The NTC (Figure 5) temperature sensor controls the by-pass valve which closes or opens (depending on temperature) the passage of the engine cooling hot fluid into the heating coil.

Pump module

Figure 7

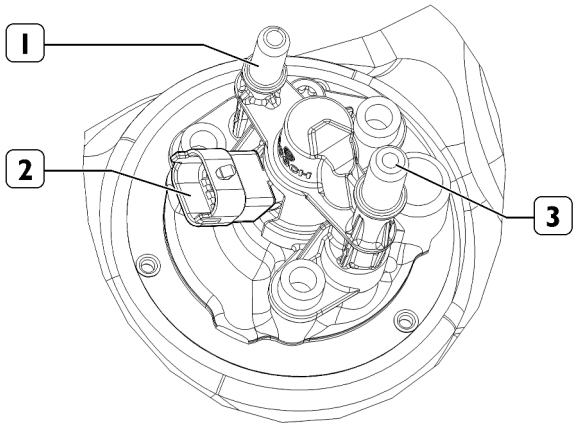


108128

1. Pipe of Ad Blue return to the tank - 2. Pipe of Ad Blue return from measuring out module - 3. Ad Blue solution outlet - 4. Ad Blue solution inlet - 5. Electrical connection - 6. DUC (Dosing Control Unit) connector - 7. Filter - 8. Pre-filter.

Dosing module

Figure 8



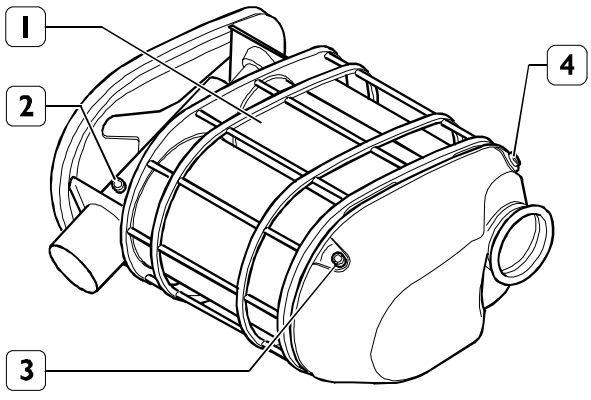
108129

1. Ad Blue inlet - 2. Electrical connection - 3. Ad Blue outlet

Its task is to measure out the Ad Blue solution to be sent to the exhaust pipe upstream of catalyst.

Catalyst

Figure 9



102301

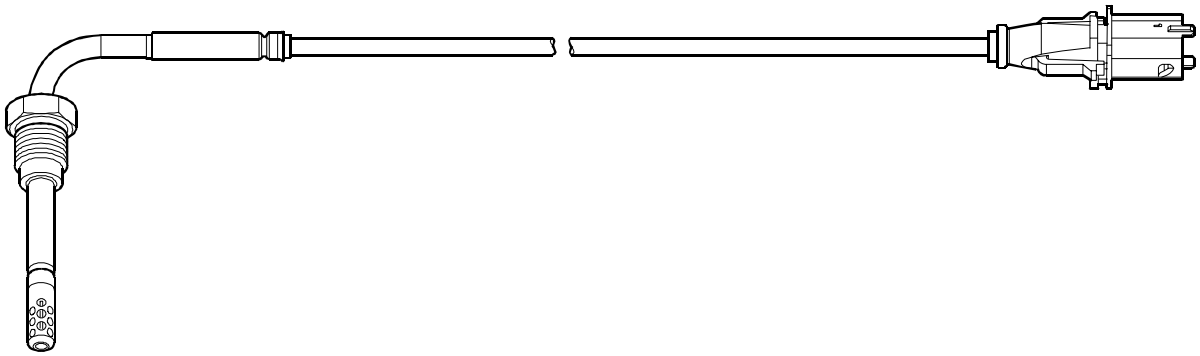
Catalyst (1), equipped with sound-proofing material, replaces the exhaust silencer.

Inside the catalyst, the exhaust gas nitric oxides are, by reacting with ammonia, converted into free nitrogen and water vapour.

Temperature sensors (2 and 3) and nitric oxide detecting sensor (4) are fitted onto catalyst (1).

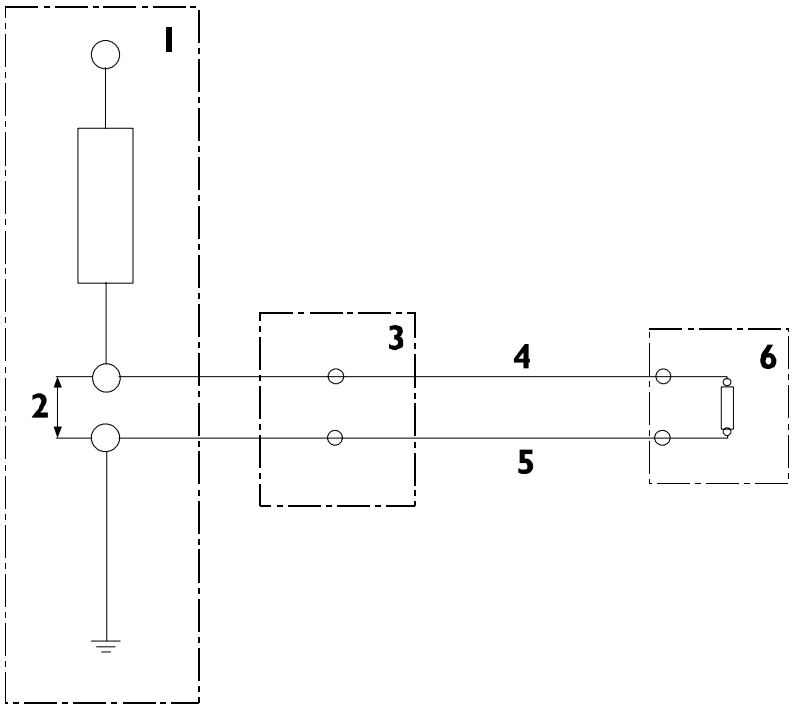
Exhaust gas temperature sensor

Figure 10



102303

Figure 11



102304

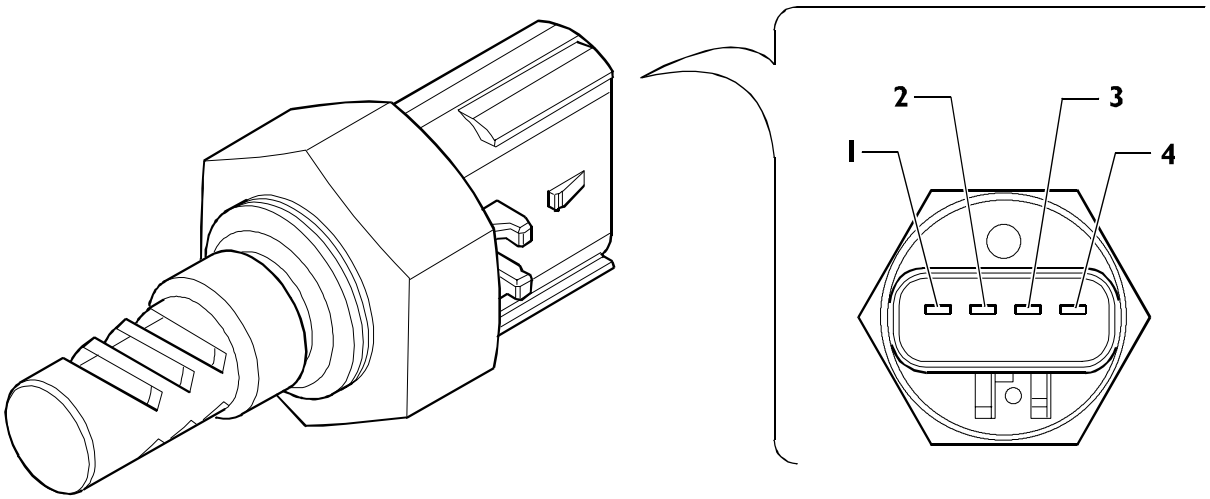
FUNCTIONAL WIRING DIAGRAM

1. Supply voltage - 2. Variable output voltage - 3. Connector - 4. Signal cable (grey) - 5. Earth cable (white) - 6. Sensor.

The function of this sensor is to send the control unit the catalyst inlet and outlet exhaust gas temperature values required to calculate the amount of urea to be injected into the system.

Humidity detecting sensor

Figure 12

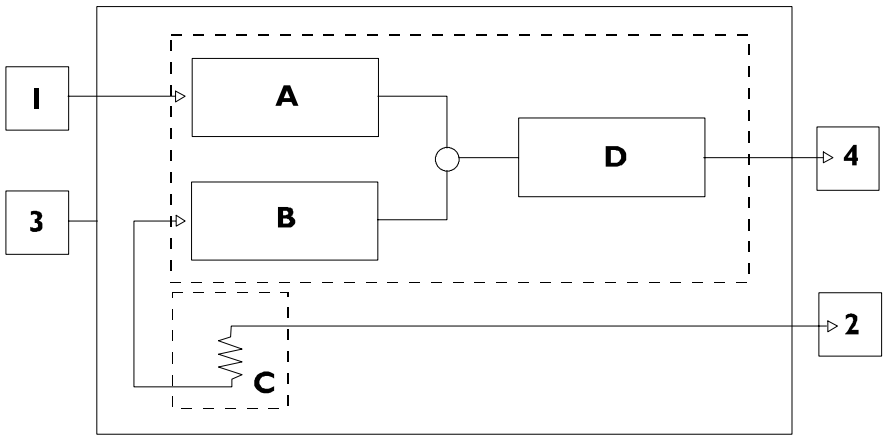


102311

1. Temperature - 2. Earth - 3. Humidity percent value - 4. Power supply.

This sensor is located on the air filter output conveyor, and is used to inform the control unit of the amount (percentage) of humidity found in sucked air, to determine the calculation of nitric oxide emissions.

Figure 13



102312

ELECTRIC BLOCK DIAGRAM

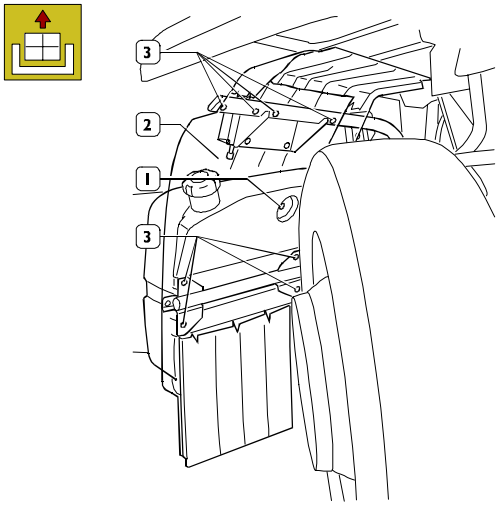
1. Earth - 2. Temperature - 3. Power supply unit - 4. Humidity percent value - A. Sample frequency generator - B. Reference oscillator - C. NTC temperature sensor - D. Amplifier lowpass filter

REPAIR INTERVENTIONS ON DeNo$_x$ SYSTEM

NOTE Whenever liquid Ad Blue pipings are disconnected from their components in S.C.R. system, although liquid Ad Blue is non toxic and non corrosive, it is suggested to clean painted parts from any traces of the liquid, in order to prevent fouling from build-ing up.

507420 Ad Blue tank Disconnection

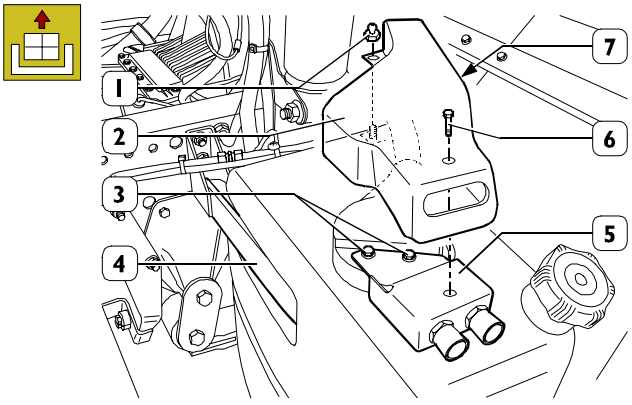
Figure 14



108611

Steer the wheels as in figure.Remove fender (2) operating on the 8 securing screws. Drain engine coolant from radiator. Tilt the cab. Remove screw (1) securing the tank to bracket (4, Figure 15).

Figure 15

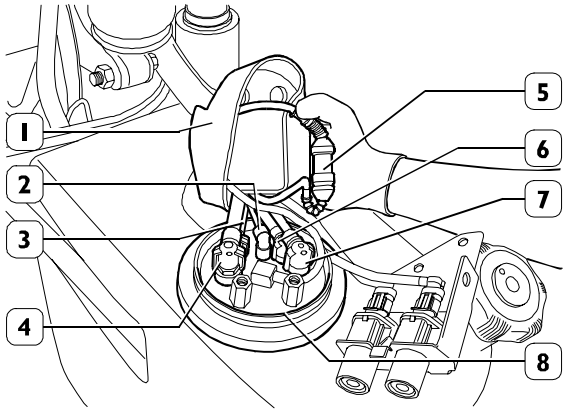


108612

Drain engine coolant from radiator.
Tilt cab.

Remove screws (7 and 6), nut (1) and take off cover (2). Remove screws (3), take off bracket (5) complete with cab tilting switches and draw it near laterally.

Figure 16

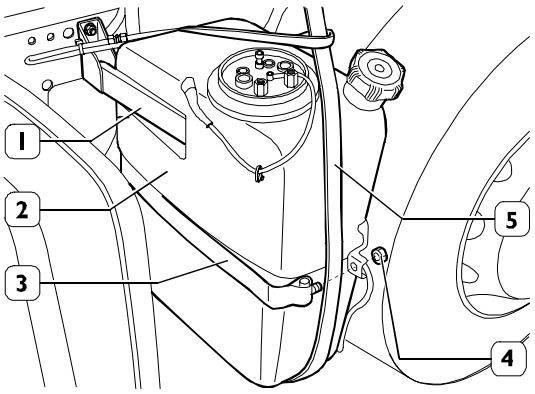


102940

Lift protection cover (1) and disconnect, from level indicator (8):

- ❑ liquid Ad Blue pipings (3 and 6);
- ❑ engine liquid pipings (4 and 7);
- ❑ breather pipe (2);
- ❑ electrical connector (5).

Figure 17



108613

Remove nut (4) and dismantle elastic strap (3) securing tank (2). Sling tank (2) with appropriate cable (5) and hook it to the hoister.

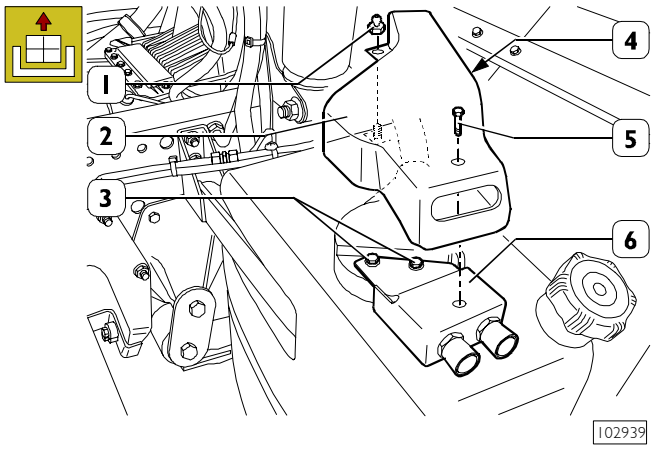
Reconnection

For reconnection, reverse the operations that were described for disconnection, tighten the screws at prescribed torque and ensure correct connection of pipes and electrical connection to level gauge.

Once reconnection has been terminated, fill engine cooling system and Ad Blue tank.

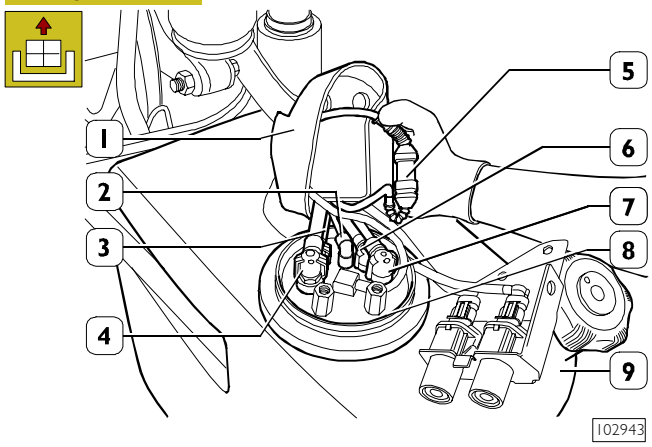
507424 Tank level indicator Disconnection

Figure 18



Drain engine coolant from radiator.
Tilt cab.
Remove screws (4 and 5), nut (1) and take off cover (2).
Remove screws (3), take off bracket (6) complete with cab tilting switches and draw it near laterally.

Figure 19



Lift protection cover (1) and disconnect, from level indicator (8):

- ❑ liquid AD blue pipings (3 and 6);
- ❑ engine liquid pipings (4 and 7);
- ❑ breather pipe (2);
- ❑ electrical connector (5).

With a suitable tool, rotate counterclockwise level indicator (8) and take it off tank (9).

NOTE Level indicator (8) fastening to tank (9) is with a bayonet joint.

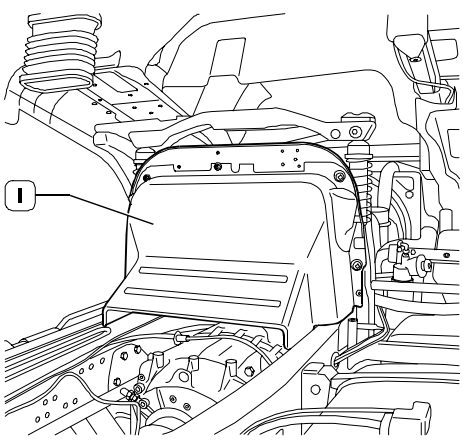
Reconnection

For reconnection, reverse operations described for disconnection tighting the screws at prescribed torque and ensuring correct connection of pipings and electrical connector to level indicator.

Once reconnection has been terminated, fill engine cooling system.

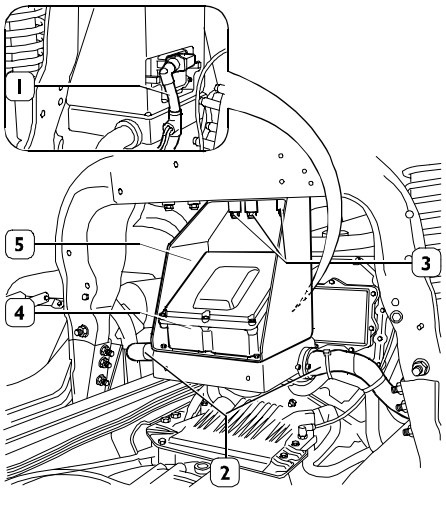
507410 Pump module Disconnection

Figure 20



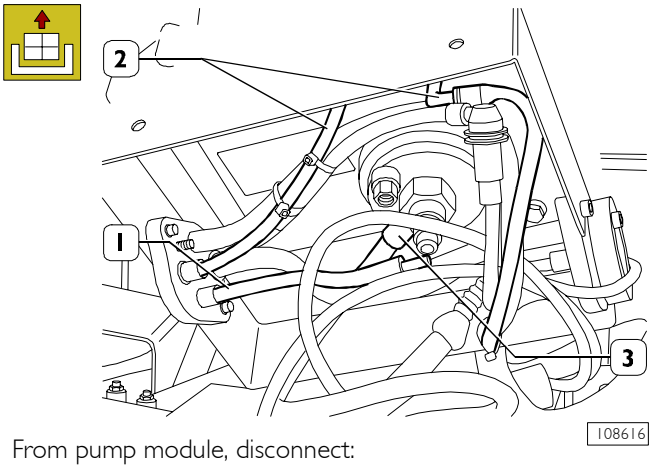
Release the engine coolant from the radiator.
Tilt the cabin.
Remove securing screws and disconnect sound deadening guard (1).

Figure 21



Disconnect Ad Blue liquid pipes (2).Take off central unit connector (1), remove securing screws (3) and take pump module (4) complete with bracket (5) off cab support cross member.

Figure 22



From pump module, disconnect:

- ❑ engine coolant pipes (1);
- ❑ Ad Blue pipes (2);
- ❑ sensor electrical connection (3).

Then, take pump module off the bracket.

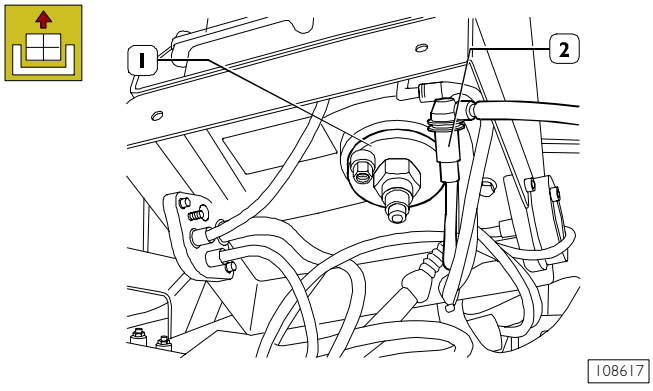
Reconnection

For reconnection, reverse operations de-scribed for disconnection tighting the screws at prescribed torque and ensuring correct connection of pipings and electrical connec-tors.

Once reconnection has been terminated, fill engine cooling system.

507413 Filter + Pre-Filter
Disconnection

Figure 23



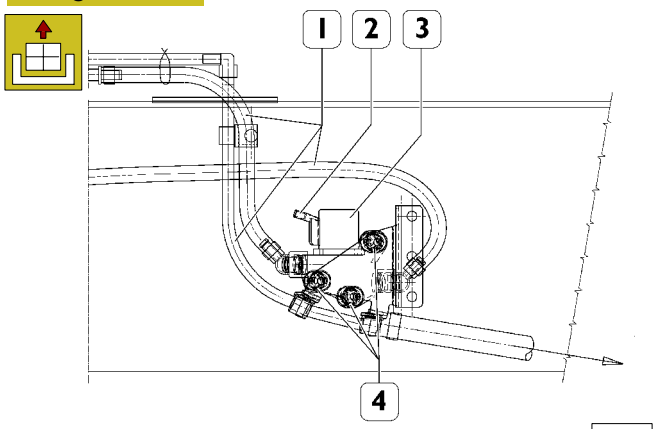
Take off pump module as described in operation 507410.
Operating on the hexagon of cover (1), remove the cover from pump module together with filter and spacer.
Disconnect fitting (2) and remove pre-filter buried inside it.

Reconnection

For reconnection, reverse operations described for disconnection.

507433 Deflecting valve
Disconnection

Figure 24



Drain engine coolant from radiator.
From deflecting valve (3), disconnect:

- ❑ engine coolant pipings (1);
- ❑ electrical connector (2);
- ❑ remove securing screws (4) and take deflecting valve (3) off the chassis.

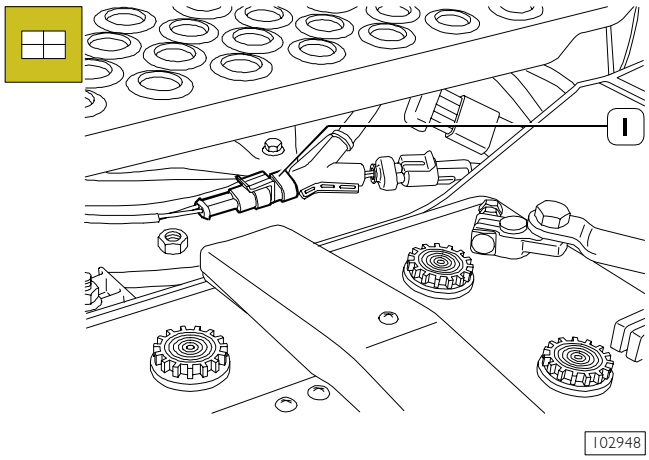
Reconnection

For reconnection, reverse operations described for disconnection tighting the screws at prescribed torque and ensuring correct connection of pipings and electrical connectors.

Once reconnection has been terminated, fill engine cooling system.

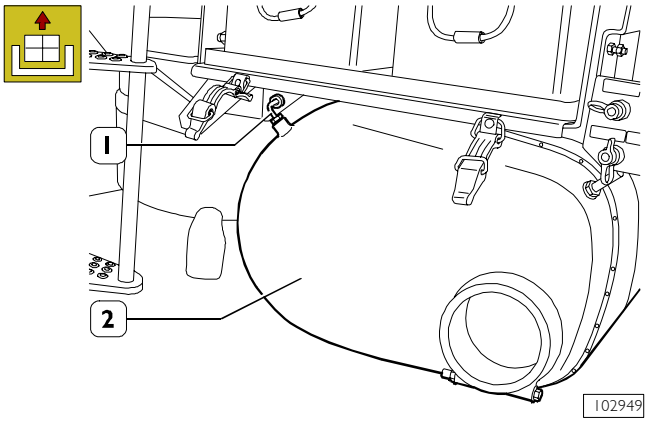
507147 Inlet exhaust gas temperature sensor
Disconnection

Figure 25



Take off battery guard cover.
Disconnect connection (1) of sensor cable and cut off check clamps.

Figure 26



Unscrew temperature sensor (1) and take it off catalyst (2).

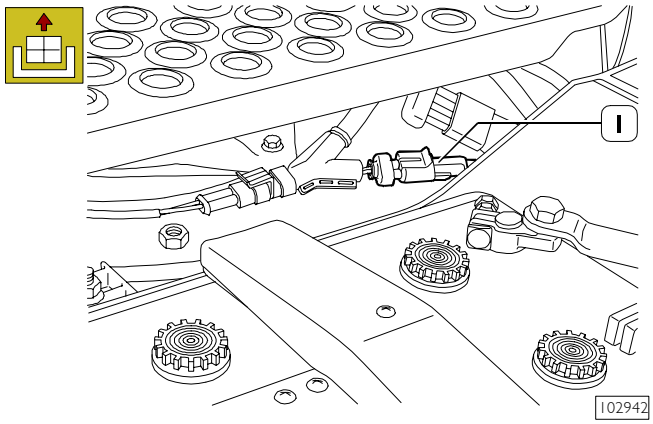
Reconnection

For reconnection, reverse operations described for disconnection tighting the sensor at prescribed torque.

507147 Outlet exhaust gas temperature sensor

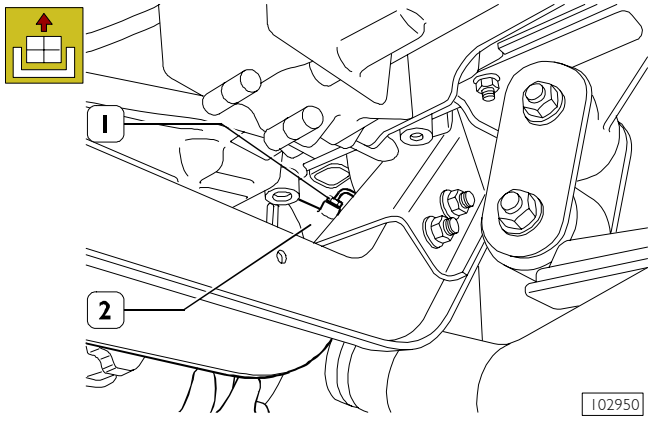
Disconnection

Figure 27



Disconnect connection (1) from sensor cable and cut off check clamp.

Figure 28



Unscrew temperature sensor (1) and take it off catalyst (2).

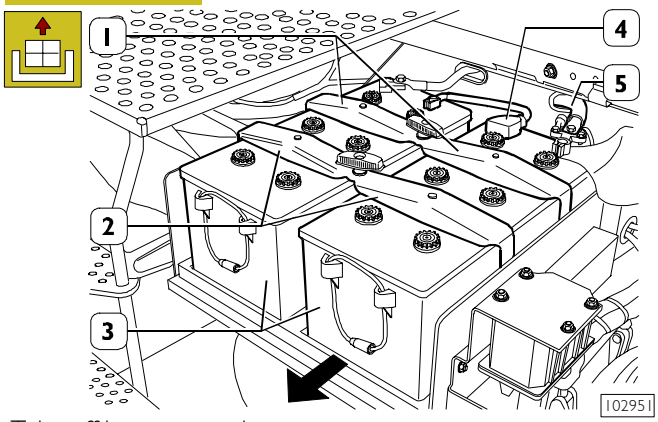
Reconnection

For reconnection, reverse operations described for disconnection tighting the sensor at prescribed torque.

507435 Nitrogen oxides detecting sensor (IF PRESENT)

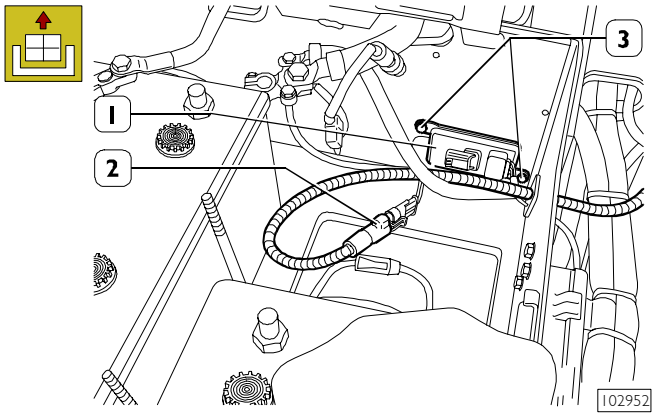
Disconnection

Figure 29



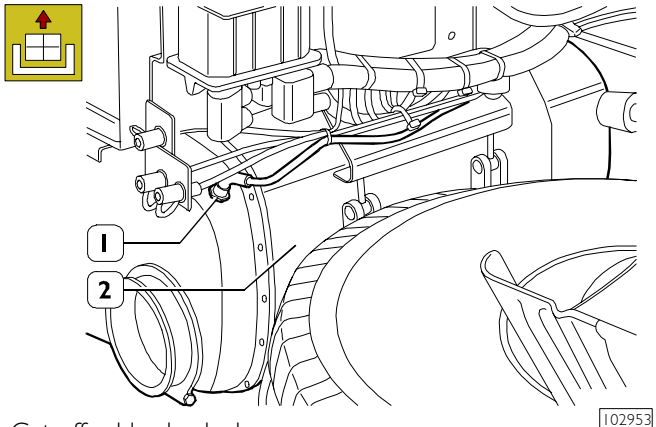
Take off battery guard cover.
Take off brackets (1 and 2) securing batteries. Disconnect cables (4 and 5) from batteries and displace (⇒) battery (3).

Figure 30



Disconnect electrical connector (2).
Remove screws (3) and take off signal amplifier (1) of the

Figure 31



Cut off cable check clamps.
Unscrew sensor (1) and take it off catalyst (2) jointly with signal amplifier (1, Figure 30).

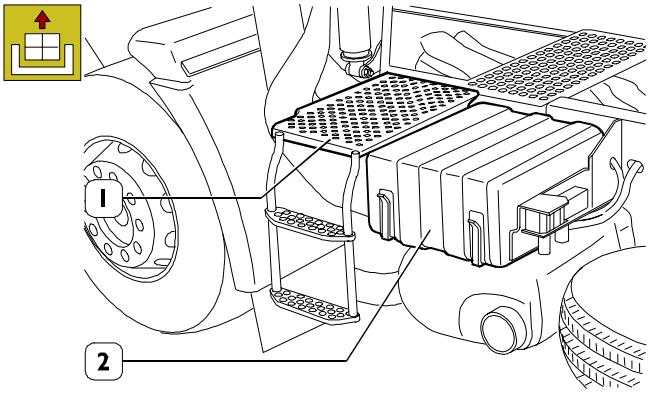
Reconnection

For reconnection, reverse operations described for disconnection tighting the sensor and the screws at prescribed torque.

507436 Sucked air humidity detecting sensor

Disconnection

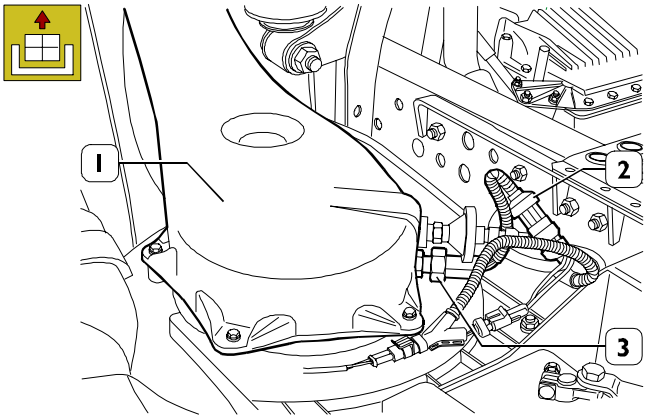
Figure 32



102954

Remove securing screws and take off board (1).
Take off battery guard cover (2).

Figure 33



102955

Cut off sensor electric cable check clamps.
Disconnect electric cable connection (2) from sensor (3).
Unscrew sensor (3) and remove it from air conveyor (1).

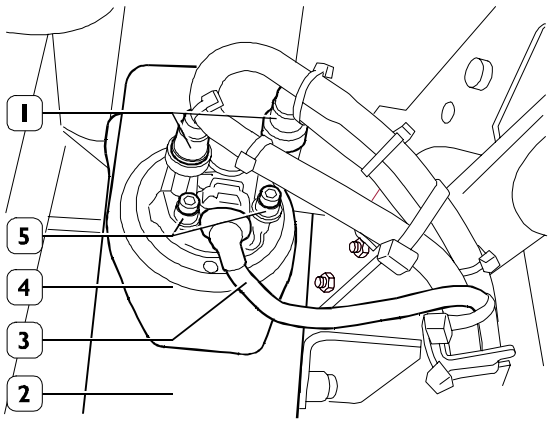
Reconnection

For reconnection, reverse operations described for disconnection tighting the sensor and the screws at prescribed torque.

Measuring out module

Disconnection

Figure 34



108618

Take off electrical connection (1). Disconnect pipes (1) of Ad Blue liquid from module (4). Remove screws (5) and take module (4) off exhaust pipe (2).

Reconnection

For reconnection, reverse operations described for disconnection tighting the screws at prescribed torque and ensuring correct connection of pipings.

Fault Diagnosis

FAULT DIAGNOSIS

EDC troubleshooting can be performed with the Cluster or Modus, IWT and IT 2000 diagnosis instruments.

Diagnosis via cluster makes it possible to estimate the fault situation in the system in advance, while the fault-diagnosis instruments are essential to make a thorough diagnosis and operate correctly on the single faults.

For each single instrument it displays the diagnosis and repair help.

Diagnosis Instruments

MODUS (Maintenance and Diagnostic System)

A computerized fault-diagnosis station dedicated to diagnosing the brake systems, air suspensions, engines and systems controlled electronically.

The station is equipped with auxiliary functions, such as: programming electronic control units, consulting the spare parts catalogue and service time schedules.

The vehicle has a 30-pin diagnosis socket to interface with the instrument.

IT 2000 (IVECO Electronic Tester)

This makes it possible to take immediate action on the vehicle, identifying it with the chassis number.

It saves the results of diagnostics actions performed.

It can be used as a portable Personal Computer, too, being fitted for remote diagnosis.

By using MODUS as the mother station it is possible to update and configure the IT 2000.

IT 2000 interfaces with the vehicle via a 30-pin diagnosis socket.

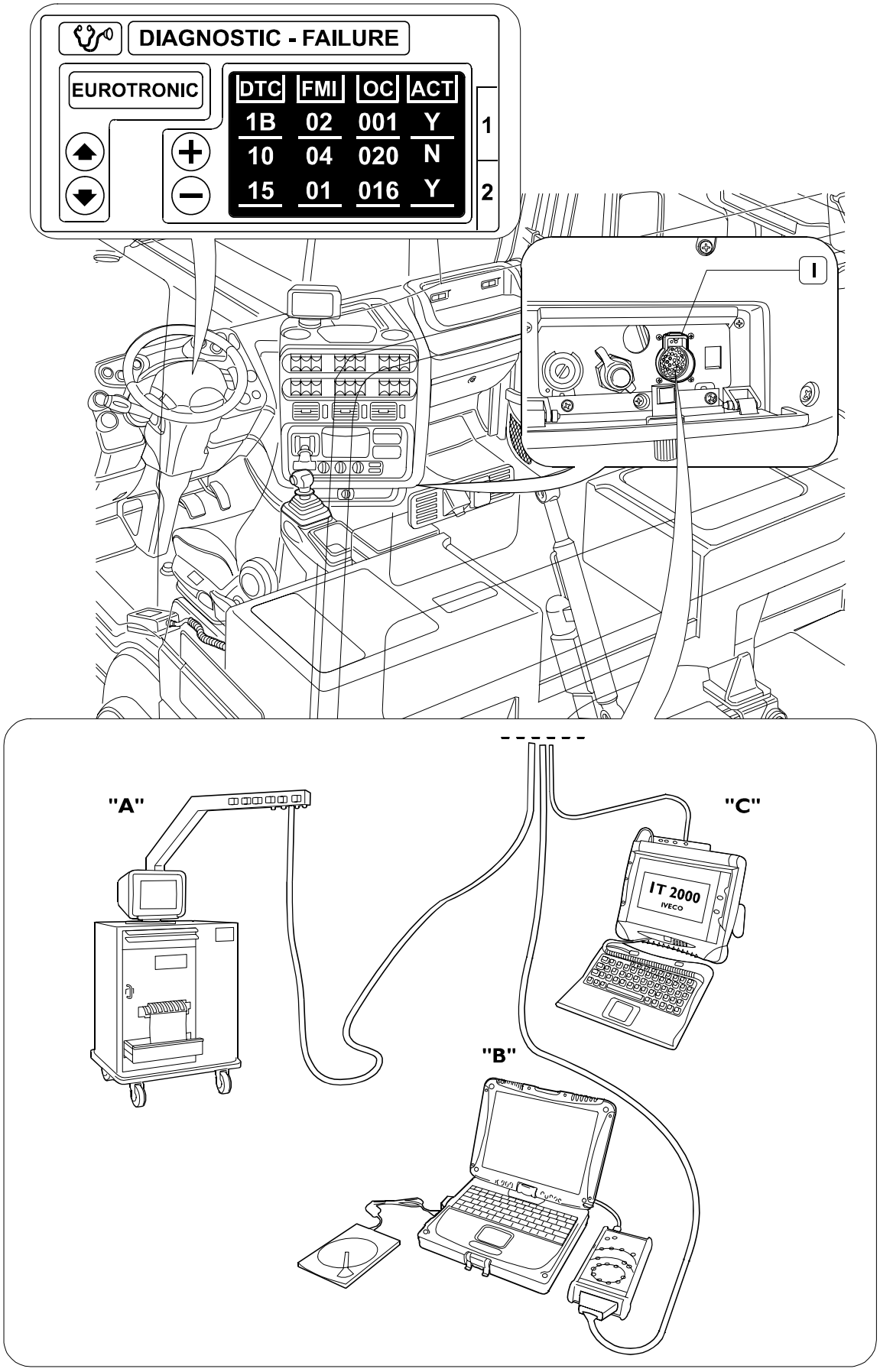
E.A.SY.

E.A.SY. system allows to simply make the diagnosis and programming of the various electronic central units aboard the vehicle.

E.A.SY. system is made up of ECI module communicating with the electronic central units and of a Panasonic PC.

ECI module, exploiting the Panasonic PC, also allows easy on the road interventions: in particular, thanks to Panasonic PC wireless technologies (e.g. GPRS), diagnostic interventions can be assisted by a remote expert centre.

Figure 1



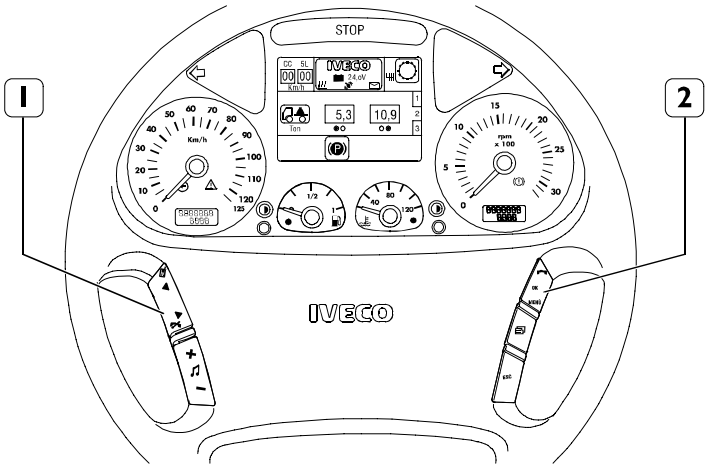
1.Diagnosis socket - A. MODUS - B. E.A.SY. - C. IT 2000

106512

Cluster Diagnosis

It is possible to access the fault memory with the "menu" function key 2 on the steering wheel.

Figure 2



With the ignition key on MAR (+15), press the "menu" function key 2; the display will show a dialogue menu containing a list of the available functions (e.g., Hi-Fi, phone, diagnostics, etc.).

With the ▲ 1 and 1 ▼ function keys, select the diagnosis function and confirm the selection with the "OK" function key 2.

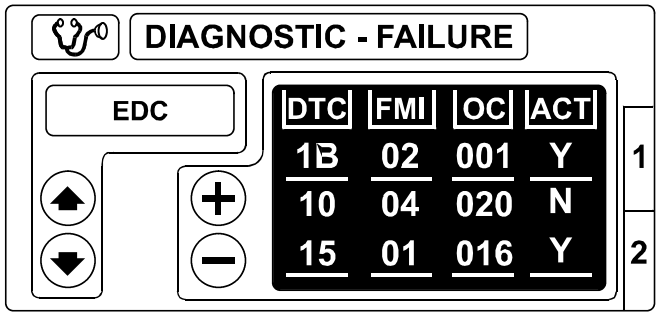
Select the EDC system with the select/confirm keys 1 and 2.

Select the EDC system with the select/confirm keys 1 and 2.

The cluster will display the first diagnostics screen.

After selecting the system, EDC is displayed on a red or green background depending on whether there is any trouble.

Figure 3

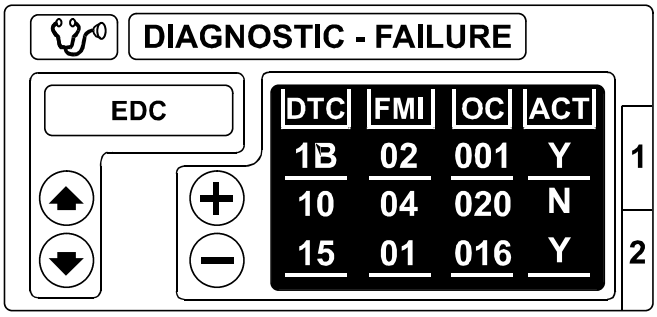


The diagnosis information shown on the cluster is split up on two screens:

- On the first one, it is possible to consult and scroll through all saved/present trouble.
- On the second one, it is possible to delete the intermittent errors (when you have the relevant password).

FIRST SCREEN

Figure 4



The information on the single faults is arranged on four columns with the following content:

DTC	FMI	OC	ACT
Displays the fault code number	Indicates the type of fault	Fault frequency meter	Fault active/not active status
Two digits (hexadecimal)	Two digits (hexadecimal)	Three digits (hexadecimal)	One character (Y = Yes, N = No)

Troubleshooting via DTC-FMI codes described under the relevant section completes the above information. Each pair of DTC-FMI codes is associated with a description of the fault, the possible system reaction and recommended repairs with the relevant checks.

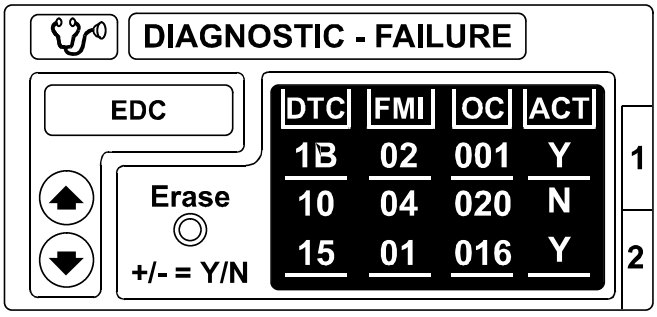
SECOND SCREEN

Deleting Errors

To select the second screen, press "page" on the steering wheel.
The fault display is eliminated as follows:

- ❑ Press "+", on the request to confirm deletion, press OK.
- ❑ Enter the required password (see the ENTERING PASSWORD paragraph).
- ❑ Press OK to confirm.

Figure 5



Entering the Password

Figure 6

Select the first number of the password with the ▲ I and I ▼ keys.
Press OK to confirm each number.
Press ◀ to delete the last number selected.
On completing the password, select the key symbol to confirm.

DTC - FMI error codes

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
113		ACCELERATOR PEDAL/ BRAKE PEDAL SUSPECT		Vehicle acceleration very slow. Engine idle speed: 500 rpm.	Accelerator pedal and brake pressed simultaneously (for too long); Accelerator pedal blocked or faulty; Incorrect use of vehicle.	Check the accelerator pedal signal and pedal mechanical movement.				
116		CLUTCH SIGNAL SUSPECT		The parameter reading shows that the clutch is pressed.	Clutch switch faulty or wiring problems in pedal.	Check clutch pedal switch and wiring.				
117		BRAKE PEDAL SIGNAL ERROR		Slight power reduction	Main and secondary brake switch not synchronised. One of the two brake pedal switches may be stuck.	Check the synchronisation of both switches (signal) and wiring.				
119		PLAUSIBILITY +15			Possible mechanical problem (in pawl) or electrical problem.	Check wiring.				
121		SPEED LIMITER W/ LIGHT		Warning light permanently off.	Short circuit or defective wiring.	Check wiring.				
122		WARNING LIGHT EOBD		Warning light permanently off.	Short circuit or defective wiring.	Check wiring.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
123		EDC LAMP		Warning light permanently off.	Short circuit or defective wiring.	Check wiring.				
124		COLD START LAMP		Warning light permanently off.	Short circuit or defective wiring.	Check wiring.				
125		MAIN RELAY DEFECT		Possible problems during after-run.	Relay short circuit to battery positive or earth.	Check wiring between ECM and battery. Replace relay if necessary.				
126		BATTERY VOLTAGE		Possible problems during after-run.	Alternator or battery defective. Possible wiring problem.	Check wiring. Replace alternator regulator or battery Replace the alternator if necessary.				
127		ENGINE BRAKE ELECTROVALVE		Engine brake not operational.	Relay or wiring short-circuited or interrupted.	Check wiring. Replace relay if necessary.				
128		MAIN RELAY - SHORT CIRCUIT TO BATTERY		Possible problems during after-run.	Relay short circuit to battery positive or earth. Relay may be faulty.	Check wiring between ECM and battery. Replace relay if necessary.				
129		AIR-CONDITIONER COMPRESSOR RELAY		Possible problems during after-run.	Relay short circuit to battery positive or earth. Relay may be faulty.	Check wiring between ECM and battery. Replace relay if necessary.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
12A		RELAIS FOR ENGINE BRAKE VALVE		Possible problems during after-run.	Relay short circuit to battery positive or earth. Relay may be faulty.	Check wiring between ECM and battery. Replace relay if necessary.				
12B		THERMO-STARTER RELAY 1 (HEATER)		Heater not working.	Relay or wiring short-circuited or interrupted.	Check wiring. Replace relay if necessary.				
12C		THERMO-STARTER RELAY 2		Heater not working.	Relay or wiring short-circuited or interrupted.	Check wiring. Replace relay if necessary.				
12E		MANAGEMENT SYSTEM PRE/POST-HEATING (ACTIVE)		Grid heater permanently operating.	Grid heater short circuited to earth.	Check wiring and component.				
131		COOLANT TEMPERATURE SENSOR		No reaction noticeable on behalf of the driver.	Sensor short-circuited or value implausible.	Check the wiring. Replace sensor if necessary.				
132		COOLANT TEMPERATURE SENSOR (TEST)		Slight power reduction.	Operation in extreme environmental conditions or sensor inaccurate.	Ensure the engine is not working in extreme environmental conditions. Check the wiring and the sensor accuracy. Replace sensor if necessary.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
133		AIR TEMPERATURE SENSOR BOOST AIR		Slight power reduction.	Sensor short-circuited or value implausible.	Check the wiring. Replace sensor if necessary.				
134		BOOST PRESSURE SENSOR		No reaction perceivable by the driver. Parameter recovery value: 2700 mbar.	Sensor short-circuited or difference between environmental pressure and turbo pressure implausible.	Check the wiring. Also check the environmental pressure sensor. Replace sensor if necessary.				
135		FUEL TEMPERATURE SENSOR		Slight power reduction.	Sensor short-circuited or value implausible.	Check the wiring. Replace sensor if necessary.				
138		OIL PRESSURE SENSOR		No reaction perceivable by the driver. Parameter recovery value: 3000 mbar.	Sensor short-circuited or value implausible.	Check the wiring and oil level. Replace sensor if necessary.				
13A		OIL TEMPERATURE SENSOR		No reaction perceivable by the driver. Parameter recovery value: coolant temperature value (if intact) otherwise 120°C).	Sensor short-circuited or value implausible.	Check the wiring. Replace sensor if necessary.				
13C		ATMOSPHERIC TEMPERATURE SENSOR(HUMIDTIY?)		No reaction perceivable by the driver. Parameter recovery value: 40°C.	Sensor short-circuited or value implausible.	Check the wiring. Replace sensor if necessary.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
141		CRANK-SHAFT SPEED		No reaction noticeable on behalf of the driver.	Signal interrupted or wiring problem. Sensor installation may not be correct.	Check wiring and installation. Replace sensor if necessary.				
142		ENGINE WORKING ONLY WITH CAM-SHAFT SENSOR		No reaction perceivable by the driver.	Signal interrupted or wiring problem. Sensor installation may not be correct.	Check wiring and installation. Replace sensor if necessary.				
143		CAM-SHAFT SENSOR		No reaction perceivable by the driver.	Signal interrupted or wiring problem. Sensor installation may not be correct.	Check wiring and installation. Replace sensor if necessary.				
144		FAULT BETWEEN FLY-WHEEL SENSOR AND CAM-SHAFT		No reaction noticeable on behalf of the driver.	Signal interrupted or wiring problem. Flywheel and timing sensor installation may be incorrect.	Check wiring and installation of both sensors.				
145		FAN RELAY		No reaction perceivable by the driver. Fan off.	Short circuit or fan actuator faulty.	Check the wiring and the fan actuator. Replace the actuator if necessary.				
148		AIR-CONDITIONER COMPRESSOR RELAY		Air conditioner permanently off.	Wiring or relay short-circuited.	Check the wiring. Replace relay if necessary.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
149		PRE-HEATING RELAY FUEL FILTER		Filter heater not working.	Wiring or filter heater short-circuited.	Check the wiring. Replace the filter heater if necessary.				
151		INJECTOR CYLINDER 1		The engine runs on 5 cylinders.	Injector no.1 electric trouble.	Check correct tightness to torque of the connectors on the solenoid valve of the injector (1.36 - 1.92 Nm). Check the integrity of the injector coil and replace the injector if defective. If the coil is integral, check the wiring between the solenoid valve and EDC connector.				
152		INJECTOR CYLINDER 2		The engine runs on 5 cylinders.	Injector no.2 electric trouble.	Check correct tightness to torque of the connectors on the solenoid valve of the injector (1.36 - 1.92 Nm). Check the integrity of the injector coil and replace the injector if defective. If the coil is integral, check the wiring between the solenoid valve and EDC connector.				
153		INJECTOR CYLINDER 3		The engine runs on 5 cylinders.	Injector no.3 electric trouble	Check correct tightness to torque of the connectors on the solenoid valve of the injector (1.36 - 1.92 Nm). Check the integrity of the injector coil and replace the injector if defective. If the coil is integral, check the wiring between the solenoid valve and EDC connector.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
154		INJECTOR CYLINDER 4		The engine runs on 5 cylinders	Injector no.4 electric trouble	Check correct tightness to torque of the connectors on the solenoid valve of the injector (1.36 - 1.92 Nm). Check the integrity of the injector coil and replace the injector if defective. If the coil is integral, check the wiring between the solenoid valve and EDC connector.				
155		INJECTOR CYLINDER 5		The engine runs on 5 cylinders	Injector no.5 electric trouble	Check correct tightness to torque of the connectors on the solenoid valve of the injector (1.36 - 1.92 Nm). Check the integrity of the injector coil and replace the injector if defective. If the coil is integral, check the wiring between the solenoid valve and EDC connector.				
156		INJECTOR CYLINDER 6		The engine runs on 5 cylinders	Injector no.6 electric trouble	Check correct tightness to torque of the connectors on the solenoid valve of the injector (1.36 - 1.92 Nm). Check the integrity of the injector coil and replace the injector if defective. If the coil is integral, check the wiring between the solenoid valve and EDC connector.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
161		INJECTOR CYLINDER 1 / SHORT CIRCUIT		One or more injectors (bank 1 or bank 2) not operating.	Possible short circuit in connections. Possible problem in injector coil. Possible problem in control unit.	Check wiring. Possible internal problem also in ECM. Replace the injector if necessary.				
162		INJECTOR CYLINDER 2 / SHORT CIRCUIT		One or more injectors (bank 1 or bank 2) not operating.	Possible short circuit in connections. Possible problem in injector coil. Possible problem in control unit.	Check wiring. Possible internal problem also in ECM. Replace the injector if necessary.				
163		INJECTOR CYLINDER 3 / SHORT CIRCUIT		One or more injectors (bank 1 or bank 2) not operating.	Possible short circuit in connections. Possible problem in injector coil. Possible problem in control unit.	Check wiring. Possible internal problem also in ECM. Replace the injector if necessary.				
164		INJECTOR CYLINDER 4 / SHORT CIRCUIT		One or more injectors (bank 1 or bank 2) not operating.	Possible short circuit in connections. Possible problem in injector coil. Possible problem in control unit.	Check wiring. Possible internal problem also in ECM. Replace the injector if necessary.				
165		INJECTOR CYLINDER 5 / SHORT CIRCUIT		One or more injectors (bank 1 or bank 2) not operating.	Possible short circuit in connections. Possible problem in injector coil. Possible problem in control unit.	Check wiring. Possible internal problem also in ECM. Replace the injector if necessary.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
166		INJECTOR CYLINDER 6 / SHORT CIRCUIT		One or more injectors (bank 1 or bank 2) not operating.	Possible short circuit in connections. Possible problem in injector coil. Possible problem in control unit.	Check wiring. Possible internal problem also in ECM. Replace the injector if necessary.				
167		INJECTOR CYLINDER 1 / OPEN CIRCUIT		One or more injectors (bank 1 or bank 2) not operating.	Possible injector connection problem (or disconnected internally). Possible problem in control unit (condenser).	Check wiring. Possible internal problem also in ECM. Replace the injector if necessary.				
168		INJECTOR CYLINDER 2 / OPEN CIRCUIT		One or more injectors (bank 1 or bank 2) not operating.	Possible injector connection problem (or disconnected internally). Possible problem in control unit (condenser).	Check wiring. Possible internal problem also in ECM. Replace the injector if necessary.				
169		INJECTOR CYLINDER 3 / OPEN CIRCUIT		One or more injectors (bank 1 or bank 2) not operating.	Possible injector connection problem (or disconnected internally). Possible problem in control unit (condenser).	Check wiring. Possible internal problem also in ECM. Replace the injector if necessary.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
16A		INJECTOR CYLINDER 4 / OPEN CIRCUIT		One or more injectors (bank 1 or bank 2) not operating.	Possible injector connection problem (or disconnected internally). Possible problem in control unit (condenser).	Check wiring. Possible internal problem also in ECM. Replace the injector if necessary.				
16B		INJECTOR CYLINDER 5 / OPEN CIRCUIT		One or more injectors (bank 1 or bank 2) not operating.	Possible injector connection problem (or disconnected internally). Possible problem in control unit (condenser).	Check wiring. Possible internal problem also in ECM. Replace the injector if necessary.				
16C		INJECTOR CYLINDER 6 / OPEN CIRCUIT		One or more injectors (bank 1 or bank 2) not operating.	Possible injector connection problem (or disconnected internally). Possible problem in control unit (condenser).	Check wiring. Possible internal problem also in ECM. Replace the injector if necessary.				
16D		COMPRESSION TEST IN PROGRESS			Compression Test in progress.	After carrying out the compression test, turn the key OFF (after-run).				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
16E		THE MINIMUM NUMBER OF INJECTIONS WAS NOT REACHED: STOP THE ENGINE		More than 2 injectors not operating.		See individual faults in injectors.				
171		BENCH 1 CC		One or more injectors (bank 1 or bank 2) not operating.	Possible injector connection problem. Injectors short-circuited.	Check wiring. Possible internal problem also in ECM. Replace the injector if necessary.				
173		BENCH 2 CC		One or more injectors (bank 1 or bank 2) not operating.	Possible injector connection problem. Injectors short-circuited.	Check wiring. Possible internal problem also in ECM. Replace the injector if necessary.				
17C		BENCH 1 INJECTORS CHECK (INTERNAL ECU)		One or more injectors (bank 1 or bank 2) may not be operating.	Fault in control unit.	Replace the engine control unit.				
189		EGR POWER ST. SHORT TO BATT.		No fault perceived by the driver. EGR not working.	Short circuit or EGR actuator faulty.	Check wiring. Replace the EGR actuator if necessary.				
191		TURBINE ACTUATOR CONTROL ELECTROVALVE		Poor performance	VGT actuator or wiring defective.	Check VGT wiring and actuator.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
192		TURBINE ACTUATOR CONTROL ELECTROVALVE SHORT CIRCUIT TO POSITIVE		Poor performance	VGT actuator or wiring defective.	Check VGT wiring and actuator.				
193		TURBINE WHEEL REVS SENSOR		Poor performance	Air filter blocked or turbine rpm sensor signal implausible.	Check the air filter and check parameters linked with the turbine by performing a road test (parameter acquisition).				
198		FAULT ON AT LEAST TWO OF THE FOLLOWING SENSORS: TURBINE SPEED, BOOT PRESSURE AND EXHAUST GAS PRESSURE		Poor performance	Sensor signal implausible. Sensor may be faulty.	Determine which turbine component caused the problem.				
199		TURBOCHARGER CONTROL BOOST PRESSURE FAILURE (PCR)		Poor performance	Turbo sensor or actuator may be faulty. Air filter may be blocked.	Check turbine sensors and actuator (parameter acquisition). Check whether air filter is blocked.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
19A		TURBINE SPEED EXCEEDING EVERY PERMITTED RANGE		Poor performance	Turbo sensor or actuator may be faulty. Air filter may be blocked.	Check turbine sensors and actuator (parameter acquisition). Check whether air filter is blocked.				
19B		TURBINE IN OVERSPEED (THE FAULT IS NOT DISPLAYED IF IT IS CAUSED BY A LOW ATMOSPERIC PRESSURE)		Poor performance	Air filter blocked or turbine rpm sensor signal implausible.	Check the air filter and check parameters linked with the turbine by performing a road test (parameter acquisition).				
19F		NOx SENSOR ERROR		No effect perceived by the driver.	Sensor signal implausible. Nox sensor may be faulty.	Check the Nox sensor.				
1A5		TIMEOUT OF CAN MESSAGE DM1DCU		No effect perceived by the driver.	Problems in the Denoxtronic (on the CAN line).	Check wiring. Check and correct any faults in the Denoxtronic control unit.				
1A6		TIMEOUT OF CAN MESSAGE SCR1		No effect perceived by the driver.	CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable.	Check CAN line wiring. Check Denoxtronic control unit wiring and operation.				
1AE		HUMIDITY SENSOR		No effect perceived by the driver.	Sensor short-circuited or faulty.	Check wiring Replace sensor if necessary.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
1AF		SERIOUS EOBD FAULT FROM DE-NOX-TRONIC (EOBD FLASHING LIGHT)		No effect perceived by the driver.	Problems in Ad-Blue dosing system.	Check the faults in the Denoxtronic and consult the control unit troubleshooting guide.				
1B1		ERROR ON CAN CON-TROLLER A		No effect perceived by the driver.	CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable.	Check CAN line wiring. Check terminal resistances.				
1B2		ERROR ON CAN CON-TROLLER B		No effect perceived by the driver.	CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable.	Check CAN line wiring. Check terminal resistances.				
1B3		ERROR ON CAN CON-TROLLER C		No effect perceived by the driver.	CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable.	Check CAN line wiring. Check terminal resistances.				
1B4		TIMEOUT CAN MESSAGE BC2EDC1		No effect perceived by the driver.	CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable.	Check CAN line wiring. Check BC wiring and operation.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
1B5		TIMEOUT CAN MESSAGE VM2EDC		No effect perceived by the driver.	CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable.	Check CAN line wiring. Check VCM wiring and operation.				
1B7		ERROR ON MESSAGES CAN IN TRANSMISSION		No effect perceived by the driver.	CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable.	Check CAN line wiring. Check ECM wiring and operation.				
1B9		ERROR ON THE EOBD LIGHT MANAGED BY THE CLUSTER)		No effect perceived by the driver.	MIL/Body Controller warning light defective.	Consult the Body Controller troubleshooting guide and check the CAN line.				
1BA		TIMEOUT CAN MESSAGE DASH DISPLAY		No effect perceived by the driver.	CAN messages from VCM inconsistent.	Consult the VCM troubleshooting guide and check the CAN line.				
1BC		TIMEOUT CAN MESSAGE AMBCOND		No effect perceived by the driver.	CAN messages from VCM inconsistent.	Consult the VCM troubleshooting guide and check the CAN line.				
1BD		TIMEOUT CAN MESSAGE CCVS		No effect perceived by the driver.	CAN messages from VCM or BC inconsistent.	Consult the VCM/BC troubleshooting guide and check the CAN line.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
1C2		ERROR MESSAGE CAN ETC1		No effect perceived by the driver.	CAN messages from ETC (gearbox) inconsistent.	Check the ETC connection with the CAN line.				
1C3		TIMEOUT IN RECEIVING TC01 CAN MESSAGE		No effect perceived by the driver.	CAN messages from TCO inconsistent.	Check the TCO connection with the CAN line.				
1C6		ERROR MESSAGE CAN TSC1-PE		No effect perceived by the driver.	CAN messages from TCU (Transmission Control Unit) inconsistent.	Check the TCU connection with the CAN line.				
1C8		ERROR MESSAGE CAN TSC1-VE		No effect perceived by the driver.	CAN messages from TCU (Transmission Control Unit) inconsistent.	Check the TCU connection with the CAN line.				
1D1		ECU OVERRUN MONITORING ERROR		No effect perceived by the driver.	Electrical interference or internal control unit problems.	If the error persists to replace ECU.				
1D2		ECU OVERRUN MONITORING ERROR		No effect perceived by the driver.	Poor control unit programming/flash Possible internal fault.	Reprogram the central unit. If the error is repeated, replace the central unit, if needed.				
1D3		ECU OVERRUN MONITORING ERROR		No effect perceived by the driver.	Poor control unit programming/flash Possible internal fault.	Reprogram the central unit. If the error is repeated, replace the central unit, if needed.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
1D4		ECU OVERRUN MONI-TORING ERROR		No effect per-ceived by the driver.	Ecu internal fail-ure.	If the error persists to replace ECU.				
1D5		ECU OVERRUN MONI-TORING ERROR		No effect per-ceived by the driver.	Ecu internal fail-ure.	If the error persists to replace ECU.				
1D6		ECU IN-TERNAL ERROR (TPU)		Control unit deactivation.	Electronic inter-ference or con-trol unit faulty.	If the error persists to replace ECU.				
1D8		ECU OVERRUN MONI-TORING ERROR		No effect per-ceived by the driver.	Ecu internal fail-ure.	If the error persists to replace ECU.				
1E2		IMMOBIL-IZER		The engine fails to start.	Problem in CAN line or immobi-liser control unit.	Check the Immobiliser control unit is correctly connected. Enter the Immobiliser PIN code during the emergency procedure.				
1E3		ERROR FOR ECU INTERNAL MONI-TORING		No effect per-ceived by the driver.	Ecu internal fail-ure.	If the error persists to replace ECU.				
1E4		ERROR FOR ECU INTERNAL MONI-TORING		No effect per-ceived by the driver.	Ecu internal fail-ure.	If the error persists to replace ECU.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
1E5		SENSORS POWER SUPPLY FAULT (12V)		No effect perceived by the driver.	Excessive/insufficient battery voltage or possible internal control unit problem.	Check battery voltage or connections with the ECM. Replace the control unit if necessary.				
1E6		SENSOR POWER SUPPLY 1		No effect perceived by the driver.	Excessive/insufficient battery voltage or possible internal control unit problem.	Check battery voltage or connections with the ECM. Replace the control unit if necessary.				
1E7		SENSOR POWER SUPPLY 2		No effect perceived by the driver.	Excessive/insufficient battery voltage or possible internal control unit problem.	Check battery voltage or connections with the ECM. Replace the control unit if necessary.				
1E8		SENSOR POWER SUPPLY 3		No effect perceived by the driver.	Excessive/insufficient battery voltage or possible internal control unit problem.	Check battery voltage or connections with the ECM. Replace the control unit if necessary.				
1E9		ECU OVERRUN MONITORING ERROR		No effect perceived by the driver.	Excessive/insufficient battery voltage or possible internal control unit problem.	Check battery voltage or connections with the ECM. Replace the control unit if necessary.				
1EA		ECU OVERRUN MONITORING ERROR		No effect perceived by the driver.	Excessive/insufficient battery voltage or possible internal control unit problem.	Check battery voltage or connections with the ECM. Replace the control unit if necessary.				
1EB		ATMOSPHERIC PRESSURE SENSOR		No effect perceived by the driver. Environmental pressure recovery value: 700 mbar.	Fault in sensor inside control unit.	Change ECU.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
1FA		TOO HIGH NUMBER OF REGENERATIONS DEMAND		No reaction perceivable by the driver. Too many filter regenerations carried out.	Particulate filter may be blocked.	Check filter.				
1FB		PERMANENT REGENERATION ON TRAP PARTICLE		No reaction perceivable by the driver.	Catalytic converter not installed or damaged.	Check catalytic converter visually.				
1FC		FIRST SENSOR EXAUSTED GAS TEMPERATURE		No reaction perceivable by the driver.	Temperature sensors damaged or incorrectly fitted.	Check information and condition of sensors.				
21F		TOO HIGH EFFICIENCY OF CATALYST SYSTEM		No reaction noticeable on behalf of the driver.	Actuator coil faulty or not within specified tolerance limits.	Check actuator condition.				
225		INTERRUPTED AFTERRUN		Slight power reduction.	The control unit is turned off by the general switch instead of by the key (k15). Possible problem in main relay or connections.	Check wiring and then replace the main relay.				
228		MAIN RELAY - SHORT CIRCUIT TO GROUND		Slight power reduction.	Short circuit in main relay or relay faulty.	Check wiring between battery and ECM and then replace the main relay.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
232		COOLANT TEMPERATURE SENSOR ABSOLUTE TEST		Slight power reduction	Extreme environmental conditions or sensor incorrectly adjusted.	Ensure the engine is working in non-critical conditions. Check the sensor connections and accuracy. Replace sensor if necessary.				
238		OIL LOW PRESSURE		Slight power reduction	Sensor incorrectly adjusted or faults in lubrication system.	Check the sensor connections and accuracy. Check the lubrication system.				
23A		OIL TEMPERATURE ABOVE NORMAL		Slight power reduction	Sensor incorrectly adjusted or faults in lubrication system.	Check the sensor connections and accuracy. Check the lubrication system.				
27C		BENCH 2 INJECTORS CHECK (INTERNAL ECU)		One or more injectors (bank I or bank 2) may not be operating	Fault in control unit.	Replace the engine control unit.				
292		TURBINE ACTUATOR CONTROL ELECTROVALVE SHORT CIRCUIT TO GROUND		Poor performance	VGT actuator or wiring defective.	Check VGT wiring and actuator.				
2A6		TIMEOUT OF CAN MESSAGE SCR2		No effect perceived by the driver	Problem in the Denoxtronic (on the CAN line).	Check the faults in the Denoxtronic and consult the control unit troubleshooting guide. Check wiring.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
2AF		SERIOUS EOBD FAULT FROM DE-NOX-TRONIC (EOBD FLASHING LIGHT)		No effect perceived by the driver.	Problems in Ad-Blue dosing system.	Check the faults in the Denoxtronic and consult the control unit troubleshooting guide.				
2B4		TIMEOUT CAN MESSAGE BC2EDC2		No effect perceived by the driver.	CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable.	Check CAN line wiring. Check BC wiring and operation.				
2C6		TIMEOUT OF CAN MESSAGE TSC1-PE PASSIVE		No effect perceived by the driver.	CAN messages from TCU (Transmission Control Unit) inconsistent.	Check the TCU connection with the CAN line.				
2C8		ERROR MESSAGE CAN TSC1-VR		No effect perceived by the driver.	CAN messages from TCU (Transmission Control Unit) inconsistent.	Check the TCU connection with the CAN line.				
2C9		ERROR MESSAGE CAN TIME-DATE		No effect perceived by the driver.	CAN messages from TC (tachograph) inconsistent.	Check the tachograph connection with the CAN line.				
2D3		ECU OVERRUN MONI-TORING ERROR		No effect perceived by the driver.	Poor control unit programming/flash Possible internal fault.	Reprogram the central unit. If the error is repeated, replace the central unit, if needed.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
2FF		ERROR CHECK OF CRITICAL TIME FOR OIL DILUTION		Slight power reduction	Oil over-diluted.	Change the engine oil.				
392		TURBINE ACTUATOR CONTROL ELECTROVALVE		Poor performance	Connection damaged. Battery voltage excessive (ECU overheating).	Check VGT connection and actuator.				
3AF		SERIOUS EOBD FAULT FROM DENOXTRONIC (EOBD FLASHING LIGHT)		No effect perceived by the driver.	Problems in AdBlue dosing system.	Check the faults in the Denoxtronic and consult the control unit troubleshooting guide.				
3C8		TIMEOUT OF CAN MESSAGE TSC1-VE PASSIVE		No effect perceived by the driver.	CAN messages from TCU (Transmission Control Unit) inconsistent.	Check the TCU connection with the CAN line.				
3C9		ERROR MESSAGE CAN HRDV		No effect perceived by the driver.	CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable.	Check CAN line wiring. Check BC wiring and operation.				
3D3		ECU OVERRUN MONITORING ERROR		No effect perceived by the driver.	Poor control unit programming/flash Possible internal fault.	Reprogram the central unit. If the error is repeated, replace the central unit, if needed.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3FA		REGENERATION DEMAND NUMBER 2		No effect perceived by the driver.	Too many regenerations carried out.	Check particulate filter and faults in sensors.				
4AF		SERIOUS EOBD FAULT FROM DENOXTRONIC (EOBD FLASHING LIGHT)		No effect perceived by the driver.	Problems in AdBlue dosing system.	Check the faults in the Denoxtronic and consult the control unit troubleshooting guide.				
4C8		TIMEOUT OF CAN MESSAGE TSC1-VR PASSIVE		No effect perceived by the driver.	CAN messages from TCU (Transmission Control Unit) inconsistent.	Check the TCU connection with the CAN line.				
4FA		REGENERATION DEMAND NUMBER 3		No effect perceived by the driver.	Too many regenerations carried out.	Check particulate filter and faults in sensors.				
5AF		DM1DCU SPN5 MESSAGE		No effect perceived by the driver.	Problems in AdBlue dosing system.	Check the faults in the Denoxtronic and consult the control unit troubleshooting guide.				

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SECTION 3

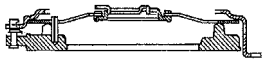
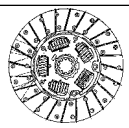
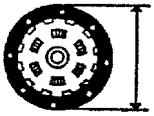
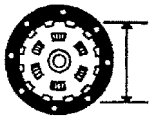
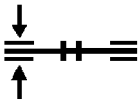
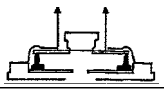
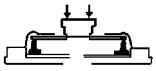
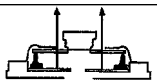
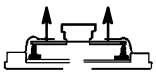
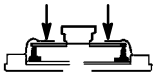
Clutch

DESCRIPTION

Clutch

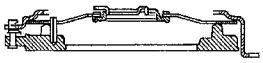
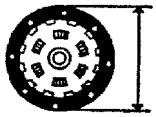
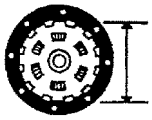
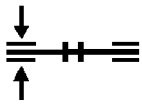
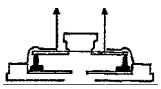
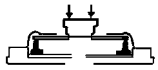
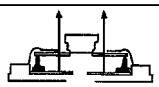
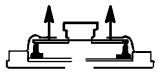
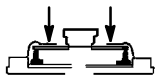
The clutch is the dry single-disc type, with pull engaging mechanism with diaphragm spring. For vehicles with transmission ZF 16S, the control is hydro-pneumatic and includes the main cylinder with incorporated oil reservoir and the clutch actuator. For vehicles with EuroTronic transmission, the clutch control is pneumatic and controlled by the gearshift electronic control unit.

SPECIFICATIONS AND DATA

17" CLUTCH for ENGINES F3A		VALEO *	SACHS **
	Type	Dry single disc	
	Engagement mechanism	Pull with diaphragm spring	
	Driven disc	With friction linings	
	Driven disc hub	With double torsion springs	
	Gasket outside Ø mm	430	430 ± 1
	Gasket inside Ø mm	242	240 + 3
	Disc thickness (new) mm	10 ± 0.3	
	Max. offset driven disc mm	~0.4	~0.40
	Load on pressure plate (new) Minimum N	34000	30900
	Disengagement load N	8200	7000
	Minimum pressure plate lift mm	1.7	
	Disconnection stroke mm	12 + 2	12 + 2
	Consumption stroke max. mm	15.1	15
	Clutch control: - with mechanical gearboxes - with EuroTronic gearboxes	master cylinder with oil reservoir built in, clutch actuator with total wear recovery of driven disc electro-pneumatic actuator controlled by the gearbox control unit	
	Type of oil	**Tutela TRUCK DOT SPECIAL**	

* For manual gearboxes
** For EuroTronic gearboxes

SPECIFICATIONS AND DATA

17" CLUTCH for ENGINES F3B		VALEO *	SACHS **
	Type	Dry single disc	
	Engagement mechanism	Pull with diaphragm spring	
	Driven disc	With friction linings	
	Driven disc hub	With double torsion springs	
	Gasket outside Ø mm	430	430 ± 1
	Gasket inside Ø mm	260	254
	Disc thickness (new) mm	10.6 ± 0.3	
	Max. offset driven disc mm	~0.4	~0.40
	Load on pressure plate (new) Minimum N	35000	34200
	Disengagement load N	8600	7900
	Minimum pressure plate lift mm	1.7	
	Disconnection stroke mm	12 + 2	12 + 2
	Consumption stroke max. mm	16.6	18
	Clutch control - with mechanical gearboxes - with EuroTronic gearboxes	master cylinder with oil reservoir built in clutch actuator with total wear recovery of driven disc electro-pneumatic actuator controlled by the gearbox control unit	
	Type of oil	**Tutela TRUCK DOT SPECIAL**	

* For manual gearboxes
** For EuroTronic gearboxes

DIAGNOSTICS

Main operating faults of a mechanical nature

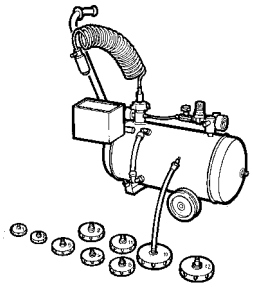
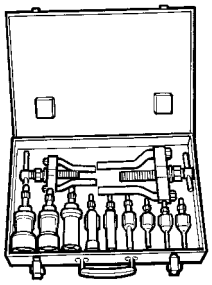
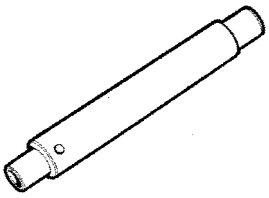
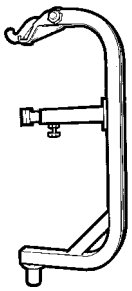
NOTE For all the faults associated with actuator operation on vehicles equipped with the EuroTronic Automated gearbox, see the fault diagnosis for the above-mentioned gearbox.

Visible Failure	Possible cause	Repair action
Noise when the clutch is disengaged	Thrust bearing worn too much, damaged or poorly lubricated.	Replace the thrust bearing.
	Too much clearance between the grooves of the gearbox input shaft and the relevant seat on the driven disc hub.	Replace the shaft and, if necessary, also the driven disc.
Noise when the clutch is engaged	Driven disc springs broken or too weak.	Replace the driven disc.
	Gearbox input shaft worn.	Replace the shaft and, if necessary, the driven disc.
	Thrust bearing with clearance on the engagement sleeve.	Replace the thrust bearing.
The clutch jerks	Oil and grease on the engine flywheel or on the driven disc linings.	Remove the trouble causing the dirt; clean the flywheel thoroughly, then replace the driven disc.
	Clutch plate out of shape.	Replace the clutch.
	Friction linings worn irregularly due to driven disc off centre.	Replace the driven disc.
	Clutch diaphragm spring weak or with broken plates.	Replace the clutch.
The clutch fails to disconnect	Gearbox input shaft grooves deteriorated so as to prevent the driven disc from sliding.	Replace the shaft and, if necessary, also the driven disc.
	Too much travel of the operator cylinder with no load.	Check and adjust the stroke of the operator cylinder with no load.
	Air in the hydraulic circuit.	Bleed the circuit (Excluding vehicles with AUTOMATED Eurotronic gearbox).
The clutch slips	Driven disc linings worn or burnt.	Replace the driven disc.
	Clutch diaphragm spring weak or with broken plates.	Replace the clutch.
	Oil or grease on the driven disc linings.	Remove the trouble causing the dirt; then replace the driven disc.
Abnormal wear on the driven disc linings.	The driver keeps his/her foot on the clutch pedal while driving.	The driver needs to get rid of this bad habit and put his/her foot on the clutch pedal only when needed.
	Pressure plate out of shape.	Change the pressure plate.
	Diaphragm spring with blades yielded or broken.	Replace the clutch.
	Too little travel of the operator cylinder with no load.	Check and adjust the stroke of the operator cylinder with no load.

TIGHTENING TORQUES

PART	TORQUE	
	Nm	(kgm)
Flanged hex screw fixing pressure plate to flywheel	46.5 ± 4.5	(4.65 ± 0.45)
Nut for stud bolt fixing clutch casing to crankcase	46	(4.6)
Stud bolt fixing clutch casing to crankcase	19	(2)

TOOLS

TOOL NO.		DESCRIPTION
99306010		Tool to bleed air from hydraulic clutch circuit
99348004		Universal extractor, internal from 5 to 70 mm
99370264		Guide pin to centre clutch disc
99370547		Mount for removing and refitting clutch assembly (to fit onto the hydraulic jack)

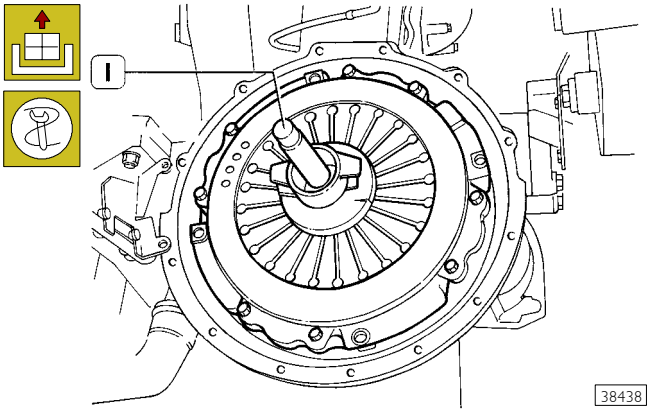
505210 REMOVING AND REFITTING THE CLUTCH

Removal

This operation comprises:

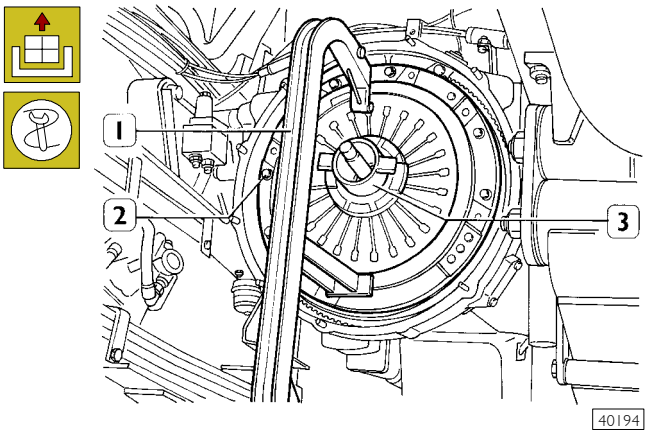
- ❑ Removing-refitting propeller shafts (see relevant section 505620).
- ❑ Removing-refitting gearbox (see relevant section 530210).

Figure 1



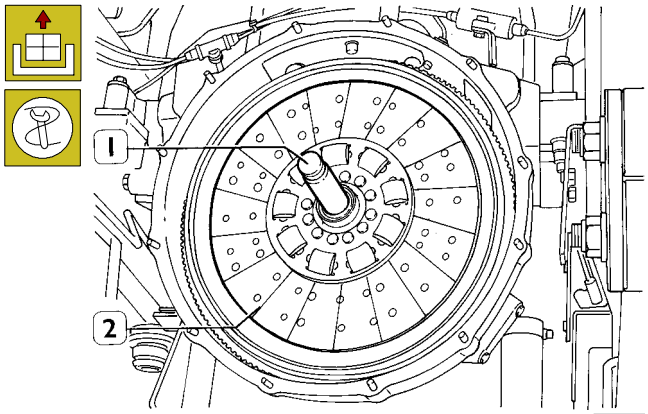
Insert the clutch centring pin 99370264 (1) into the bearing for the gearbox input shaft.

Figure 2



Fit the mount 99370547 (1) on the hydraulic jack and apply the mount to the pressure plate (3). Unscrew the screws (2) and remove the pressure plate from the engine flywheel.

Figure 3



Take out the clutch plate (2) together with the centring pin 99370264 (1).

CHECKS

The checks to make are as follows:

- ❑ The supporting surface of the driven disc, on the engine flywheel, must not be particularly worn or have too much scoring.
- ❑ The toothing of the ring gear of the engine flywheel must be neither deteriorated nor too badly worn.

If this is not the case, remove the engine flywheel (operation 540850).

In addition, check there is not even the slightest leakage of lubricant from the seal of the crankshaft rear cover: in which case, remove the flywheel as described under the relevant heading. Remove the rear cover together with the seal and replace it as described in section 2.

Check that the bearing or bushing supporting the gearbox input shaft mounted on the crankshaft is neither worn nor deteriorated, in which case it should be replaced.

Check the state of the pressure plate, the supporting surface of the driven disc must have no deformation, wear or sign of overheating and its spring or diaphragm must be sound.

Check the state of the driven disc:

- ❑ the friction linings must not be too worn, nor have any sign of overheating, nor be fouled with oil or grease.
- ❑ its hub must not have too much play on the gearbox input shaft.
- ❑ the torsion springs of the hub must not turn in their seats or be broken.

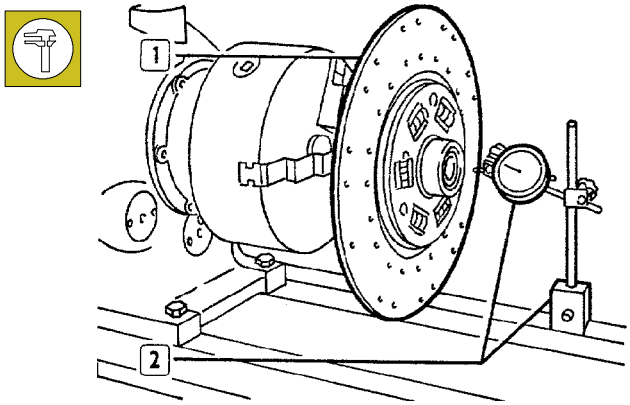
If you find any trouble at all, replace the part concerned. The clutch assembly is supplied as a spare in kit form.

The following are supplied singly:

- ❑ The driven disc and the thrust bearing.

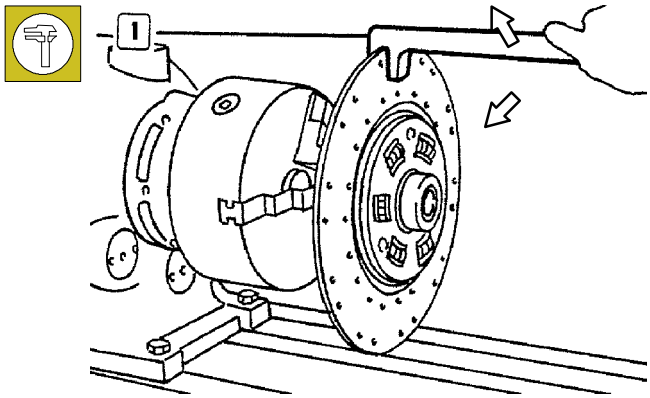
In this case it is necessary to mount the new parts of the same supply as the torsion spring being reused.

Figure 4



Before fitting a new driven disc it is necessary to check its centring as follows:
Position the driven disc (1) on a lathe. Then, with the aid of a dial gauge with a magnetic base (2), check that the surface of the disc is not off centre anywhere.
The maximum permissible eccentricity of the driven disc is 0.20 mm.

Figure 5



If the disc is off centre, use a fork wrench (1) as shown in the figure.

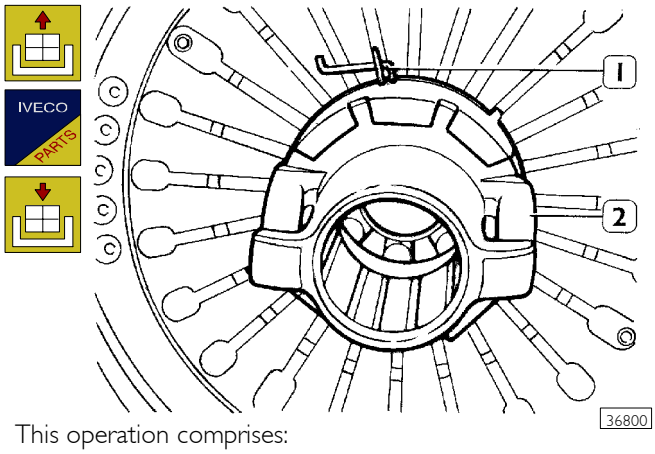
Refitting

Fit the clutch assembly back on by performing the operations described for removal in reverse order and observing the following instructions:

- ❑ Thoroughly clean the supporting surface of the clutch plate of the engine flywheel with spirits or petrol. Any light scoring you find on it can be removed with abrasive cloth.
- ❑ Position the driven disc, always using the guide pin for perfect centring to prevent harmful stresses on the hub when refitting the gearbox.
- ❑ Position the clutch plate by matching the holes for the fixing screws with the ones on the engine flywheel.
- ❑ Mount and lock the fixing screws of the pressure plate to the required torque.
- ❑ Fit the gearbox back on after spreading the splined shaft with Molikote molybdenum disulphide grease.
- ❑ Adjust the push rod of the operator cylinder as described under the relevant heading (operation 505272).

505254 REMOVING-REFITTING THE THRUST BEARING

Figure 6



This operation comprises:

- ❑ Removing-refitting propeller shafts (see relevant section 505620).
- ❑ Removing-refitting gearbox (see relevant section 530210).

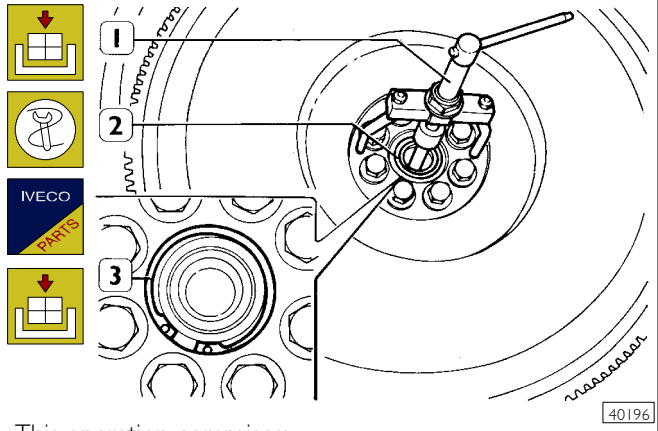
Using suitable pliers, open the snap ring (1), take the thrust bearing (2) out of the pressure plate.

Reverse these steps for fitting.

NOTE The new part has to be of the same supply as the pressure plate being reused.

540852 REPLACING THE SUPPORT BEARING OF THE CLUTCH SHAFT

Figure 7



This operation comprises:

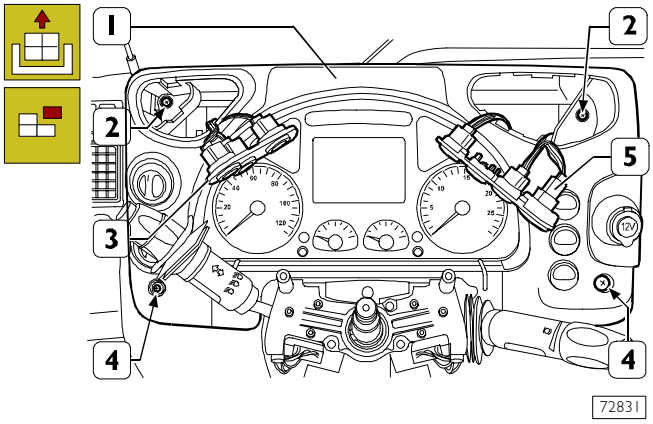
- ❑ Removing-refitting propeller shafts (see relevant section 505620).
- ❑ Removing-refitting gearbox (see relevant section 530210).
- ❑ clutch removal/refitting (operation 505210).

Using the appropriate pliers remove the split ring (3).
Using the universal extractor 99348004 (1) remove the bearing (2).
For refitting, use the appropriate beater.
Refit the split ring.

502601 REMOVING-REFITTING THE PEDAL UNIT SATA

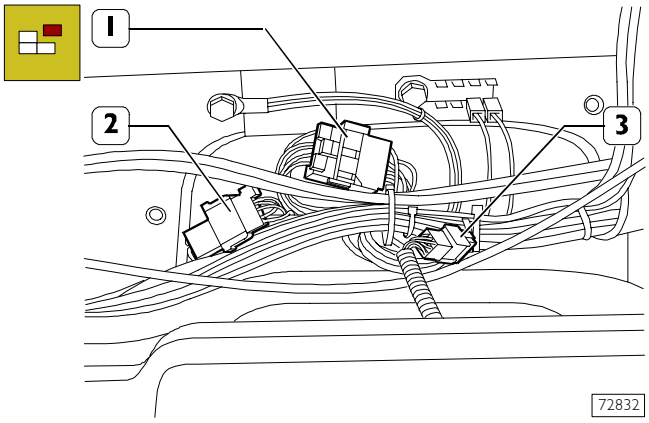
Removal (vehicles with EuroTronic Automated gearbox)

Figure 8



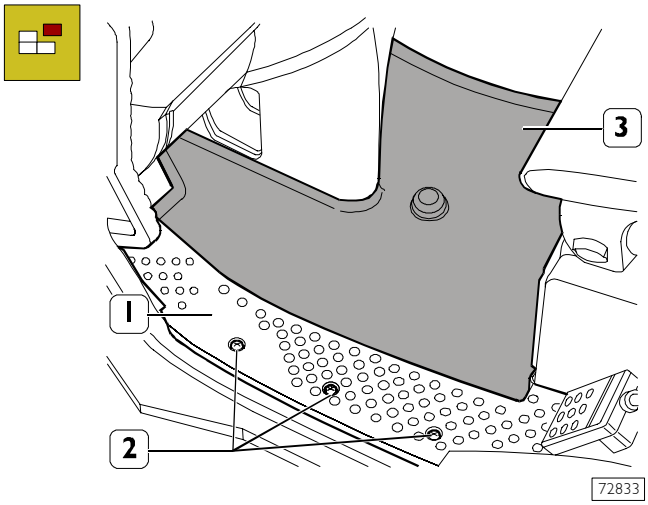
Remove the push-button panels (3 and 5) and the screw caps (4) from the instrument panel (1). Take out the screws (2 and 4), remove the instrument panel (1) and put it aside.

Figure 9



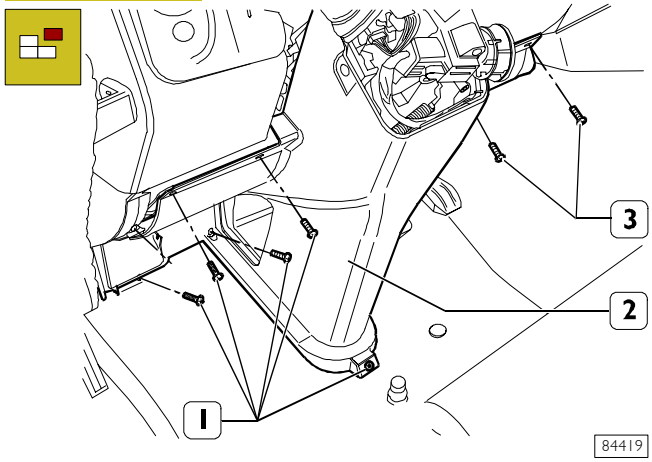
Disconnect the connections (1) of the windscreen wiper, (2) of the drive control system and (3) of the immobilizer.

Figure 10



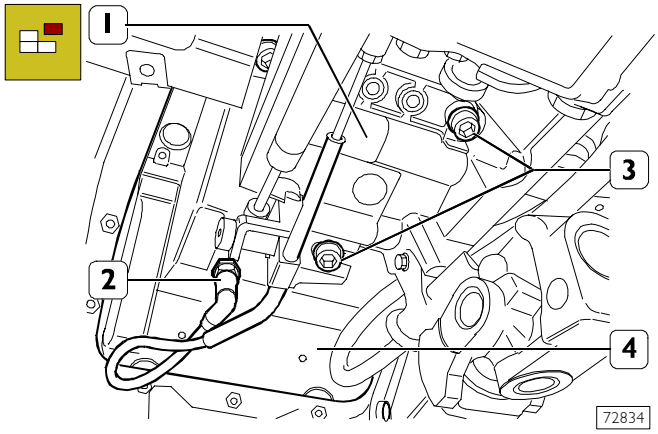
Take out the screws (2), remove the heel rest (1) and lift the mat (3).

Figure 11



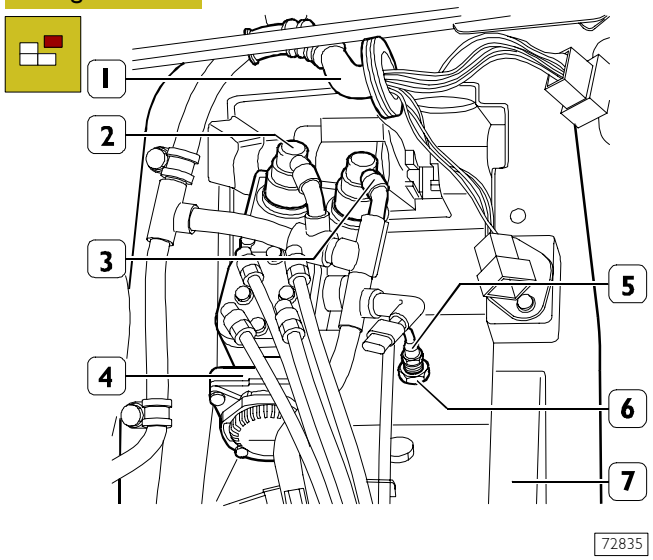
Remove the screws (1 and 3) and the guard (2).

Figure 12



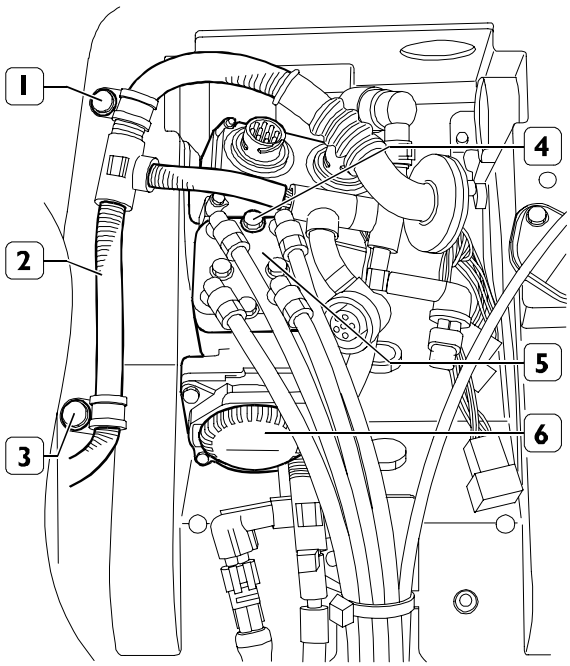
Disconnect the piping (2).
Take out the screws (3) and disconnect the steering control mount (1) from the pedal unit (4).

Figure 13



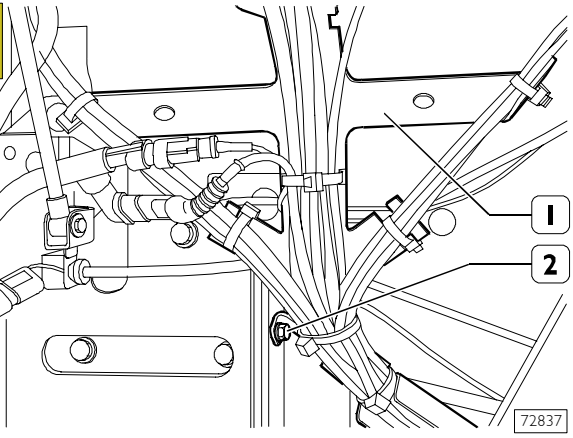
From outside the cab, lift the radiator cowling, extract the grommet (1) with the wiring from the pedal unit (7). Disconnect the piping (5) from the coupling (6). Disconnect the electric connections (2 and 3) from the control valve (4).

Figure 14



Take out the screws (4) fixing the cover (5) of the control valve (6). Gradually lift the cover (5) to discharge the pressurized air in the system.
Take out the screws (1-3) fixing the wiring clamps (2) and pedal unit to the cab.

Figure 15

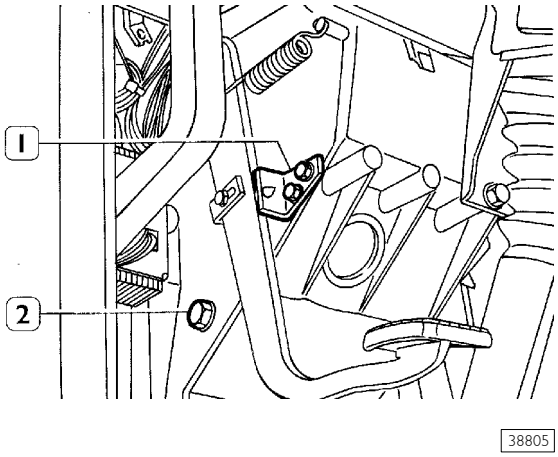


Take out the screw (2) fixing the bracket (1) supporting the piping and wiring and disconnect the pedal unit from the cab.

Removal (vehicles with ZF 16 S... gearbox)

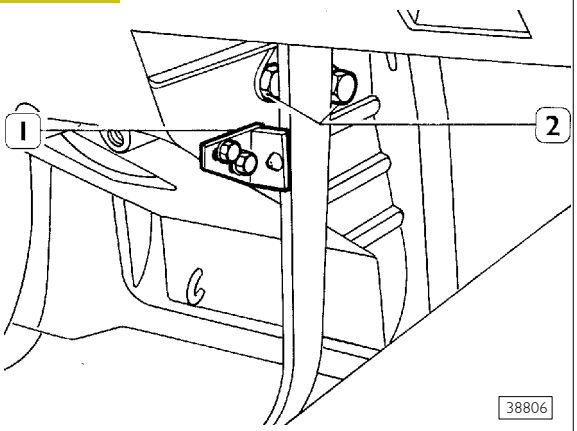
This differs from removing the pedal unit on vehicles with the EuroTronic Automated gearbox in the following.

Figure 16



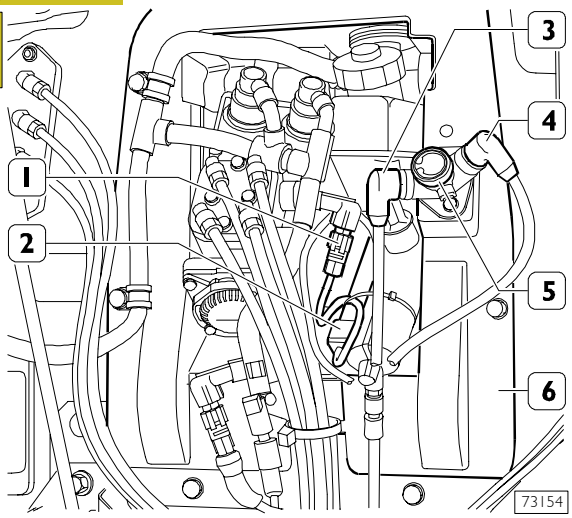
Disconnect the steering control mount as described in figures 8 - 9 - 10 - 11 - 12.
Remove the bracket (1) stopping the clutch pedal. Take out the screws (2) fixing the master cylinder to the pedal unit.

Figure 17



Remove the bracket (1) stopping the brake pedal. Take out the three screws (2) fixing the control valve to the pedal unit.

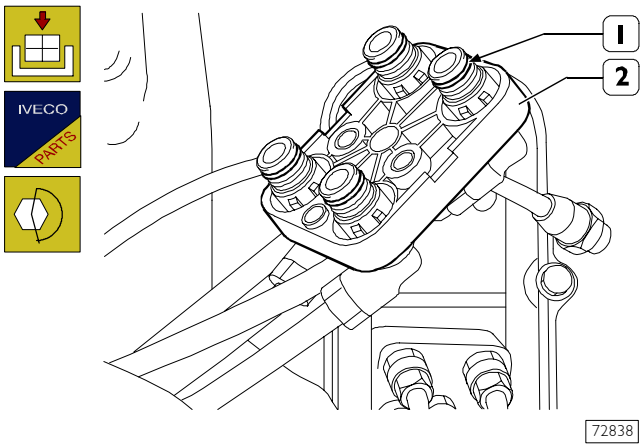
Figure 18



Lift the radiator cowling, disconnect the piping (3-4) from the splitter control button (5). Disconnect the electric connection (1) of the master cylinder (2) and remove this, together with the oil reservoir, from the pedal unit (6). Complete disconnecting the pedal unit as described in figures 13 - 14 - 15.

Refitting

Figure 19



For refitting, carry out the steps described for removal in reverse order. Then adjust the travel of the pedals as described under the relevant heading.

NOTE With each removal, the seals (1) of the coupling of the control valve cover (2) have to be replaced with new ones.

Tighten the screws and nuts to the required torque. After refitting, check and if necessary adjust the travel of the pedal as described under the relevant heading.

PEDAL TYPE SATA (Vehicles with ABS)
Unit removal-assembly

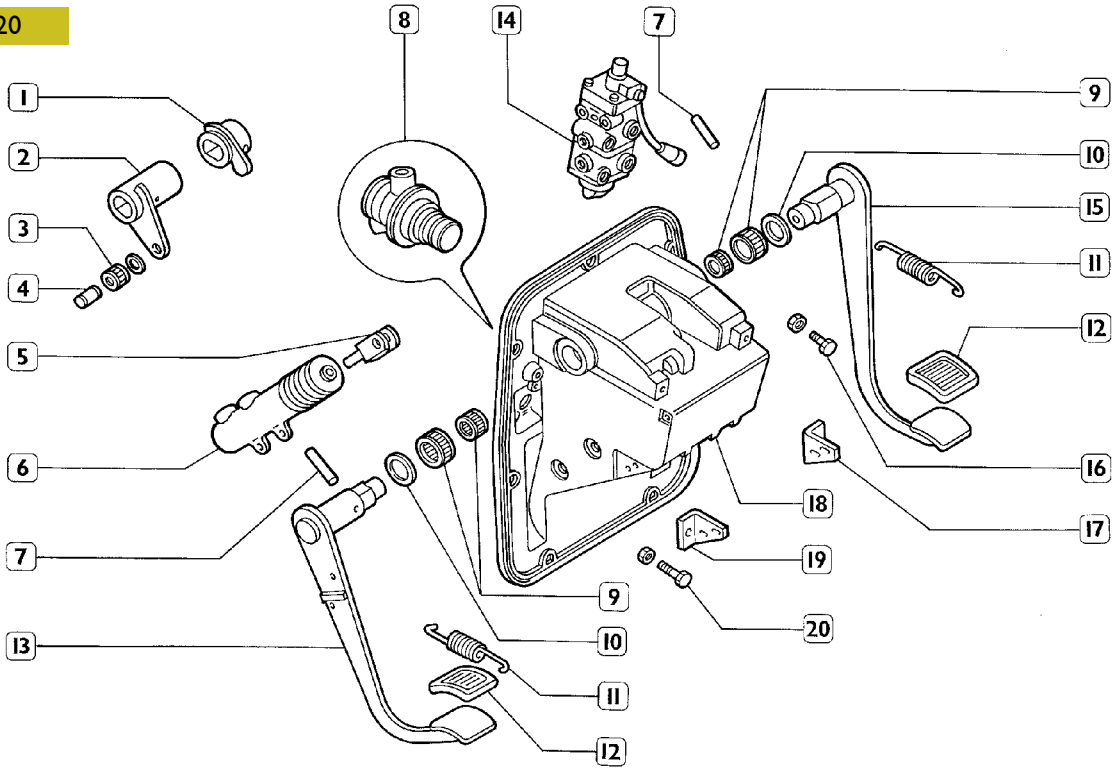
(see Figure 20)

Take out the springs (11) to return the pedals (13*-15). Eject the spring pins (7) so as to free the levers (1* and 2) from the pedals (13* and 15), which you should then extract from the pedal unit mount (18). To replace the roller bearings (9), use:

- ❑ the percussion extractor 99340205 to remove them;
- ❑ a suitable drift to fit them.

NOTE The roller bearings and associated shafts have to be lubricated with TUTELA MR3 grease.
Complete assembly by carrying out the steps performed for removal in reverse order.

Figure 20

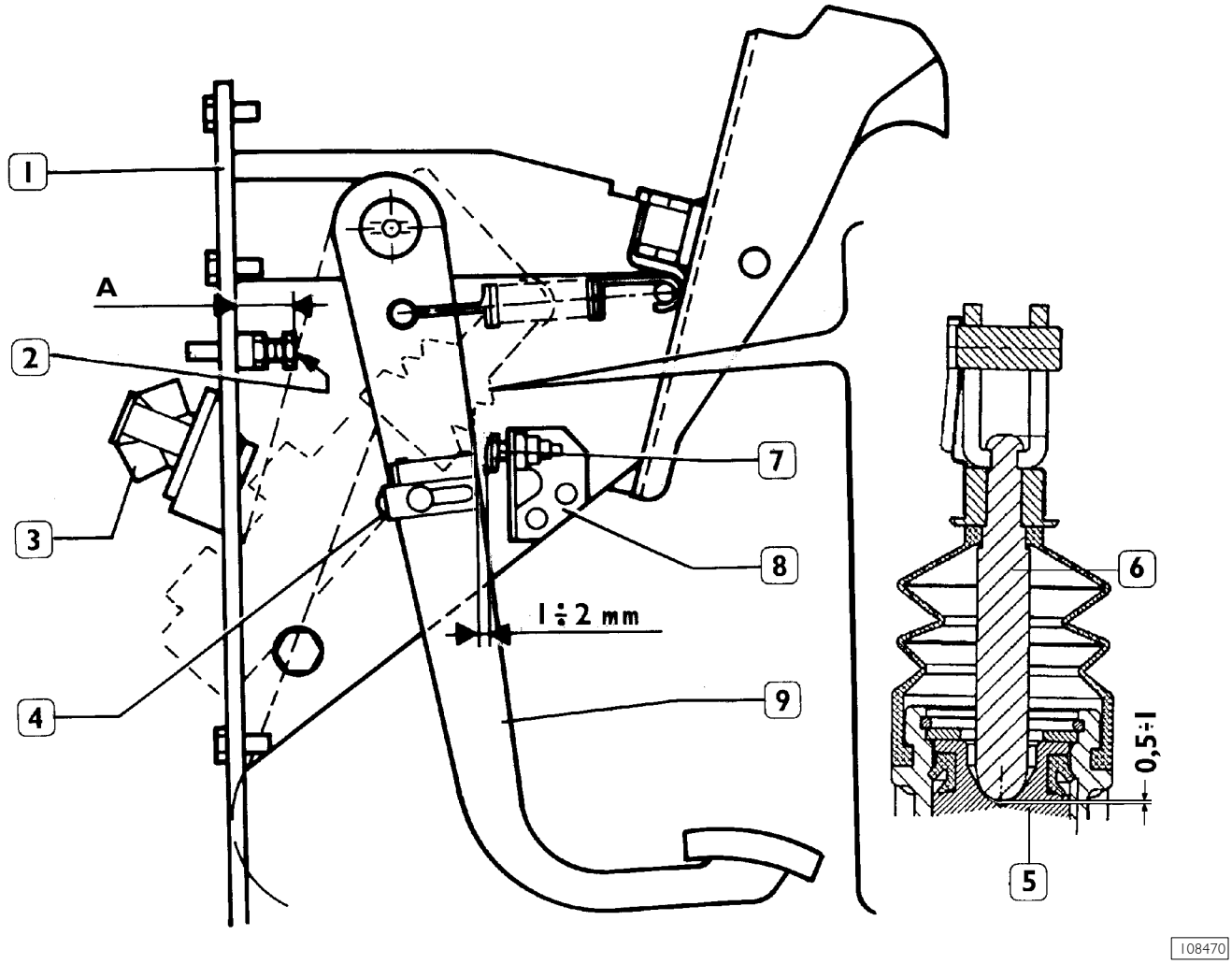


1. Brake control lever – 2. Clutch control lever* - 3. Roller bearings – 4. Pin – 5. Fork – 6. Master cylinder* - 7. Spring pin – 8. Splitter control button* - 9. Roller bearings – 10. Washer – 11. Return spring – 12. Pedal cover – 13. Clutch pedal – 14. Control valve – 15. Brake pedal – 16. Brake pedal limit stop screw – 17. Brake pedal stop bracket – 18. Pedal unit mount – 19. Clutch pedal stop bracket – 20. Clutch pedal limit stop screw*

* Excluding vehicles with the EuroTronic Automated gearbox.

CHECKING AND ADJUSTING STOPS ON CLUTCH PEDAL (vehicles with ABS)

Figure 21



Clutch stop

Check the distance **A** between the pedal unit mount (1) and the end of the screw (2). It has to be 32.5 mm, turn the screw appropriately if it is not.

Idle travel of clutch pedal

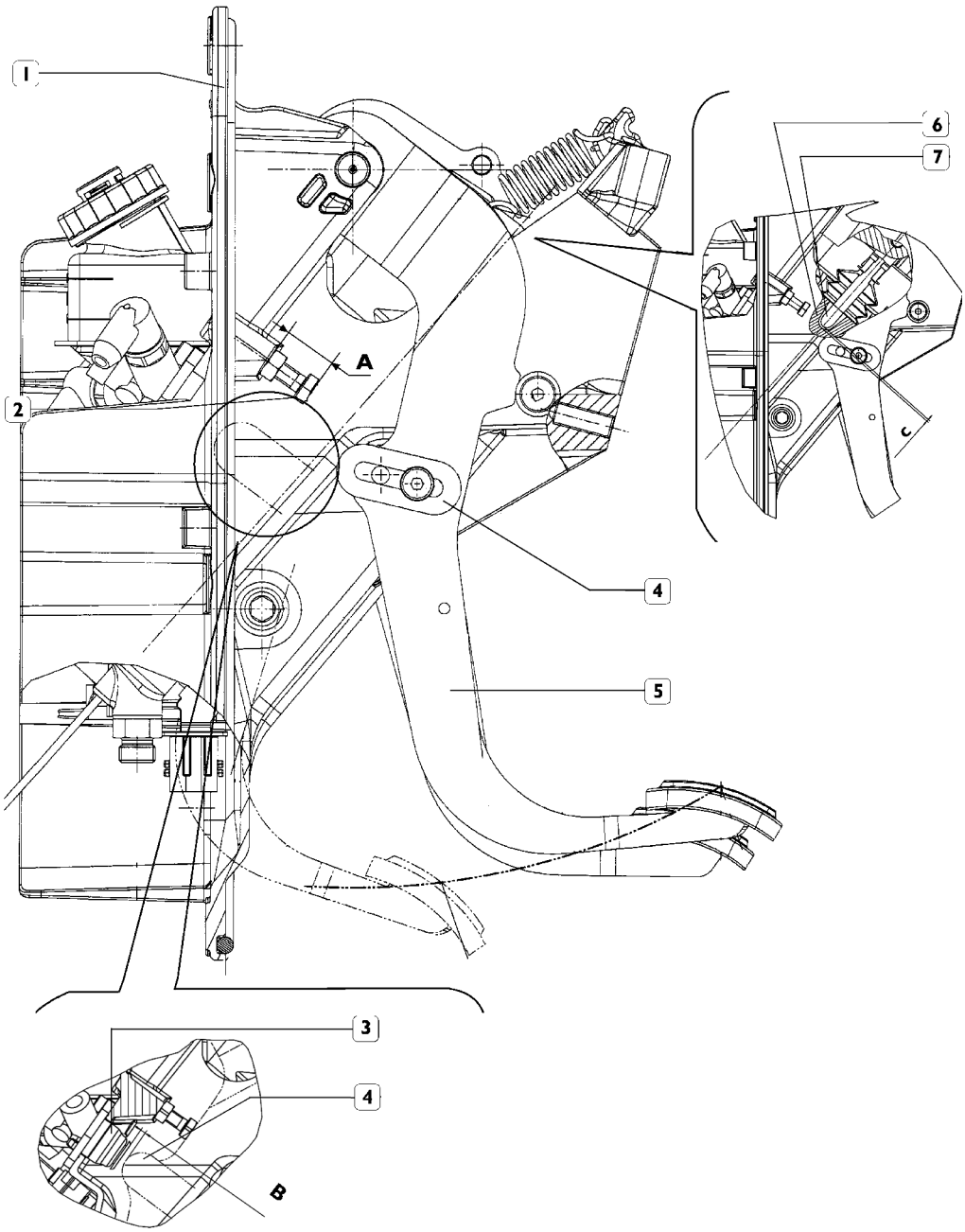
Work the clutch pedal (9) to take the cap (6) into contact with the piston (5) of the master cylinder.
In this condition, check the distance **B** between the clutch pedal (9) and the screw (7) that has to be 1 - 2 mm, turn the screw (7) appropriately if it is not.
The distance **B** corresponds to the clearance of 0.5 - 1 mm between the cap (6) and the piston (5) in the condition of the clutch pedal (9) in contact with the screw (7).

Pedal control valve stroke

After adjusting the position of the bottom and top stop, adjust the travel of the piston of the pedal control valve
Take the clutch pedal (9) into contact with the bottom stop screw (2) and keep it in this position.
Press the button of the control valve (3) fully down and, keeping it pressed, position the angle bracket (4) so that between it and the button there is a distance of 0.5 – 1 mm.
This is to prevent the pedal control valve from stopping the clutch pedal.

PEDAL TYPE WABCO (vehicles with EBS)

Figure 22



Clutch stop

Check the distance **A** between the pedal unit mount (1) and the end of the screw (2). It has to be 24 $^{+0}_{-0,5}$ mm, turn the screw appropriately if it is not.

Clutch pedal idle travel

Operate on clutch pedal (4) in such a way that spring pin (7) is taken to distance **C** from plunger (6) that is equal to 1.99 ± 0.25.In such condition, check that distance **B** results to be equal to 3.34 ± 0.25 mm.

Pedal control valve stroke

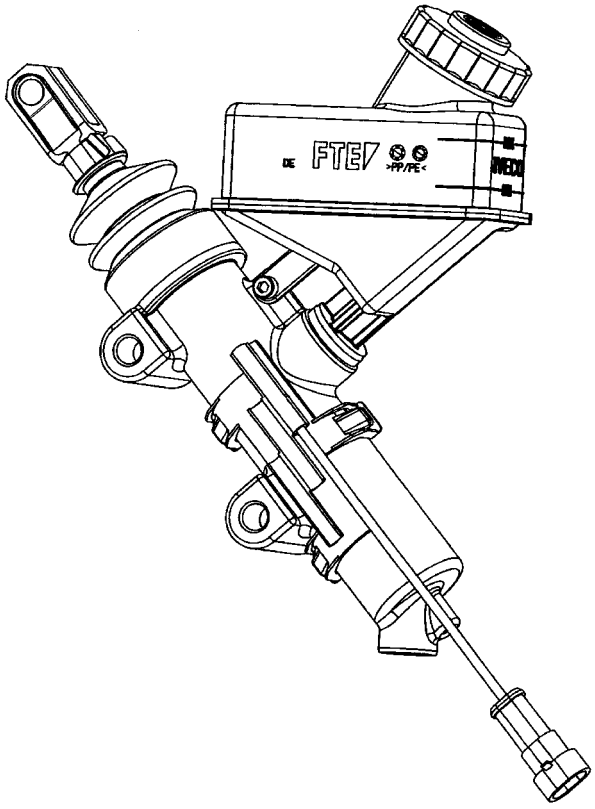
Press the button of the control valve (3) fully down and, keeping it pressed, position the angle bracket (5) so that between it and the button there is a distance of **B** di 3.34 ± 0.25 mm.
This is done to prevent pedal distributor from stopping clutch pedal.

HYDRAULIC CONTROL
(vehicles with ZF 16 S... gearboxes)

The hydraulic control is composed of:

- master cylinder with oil reservoir built in;
- clutch actuator with full recovery of driven disc wear.

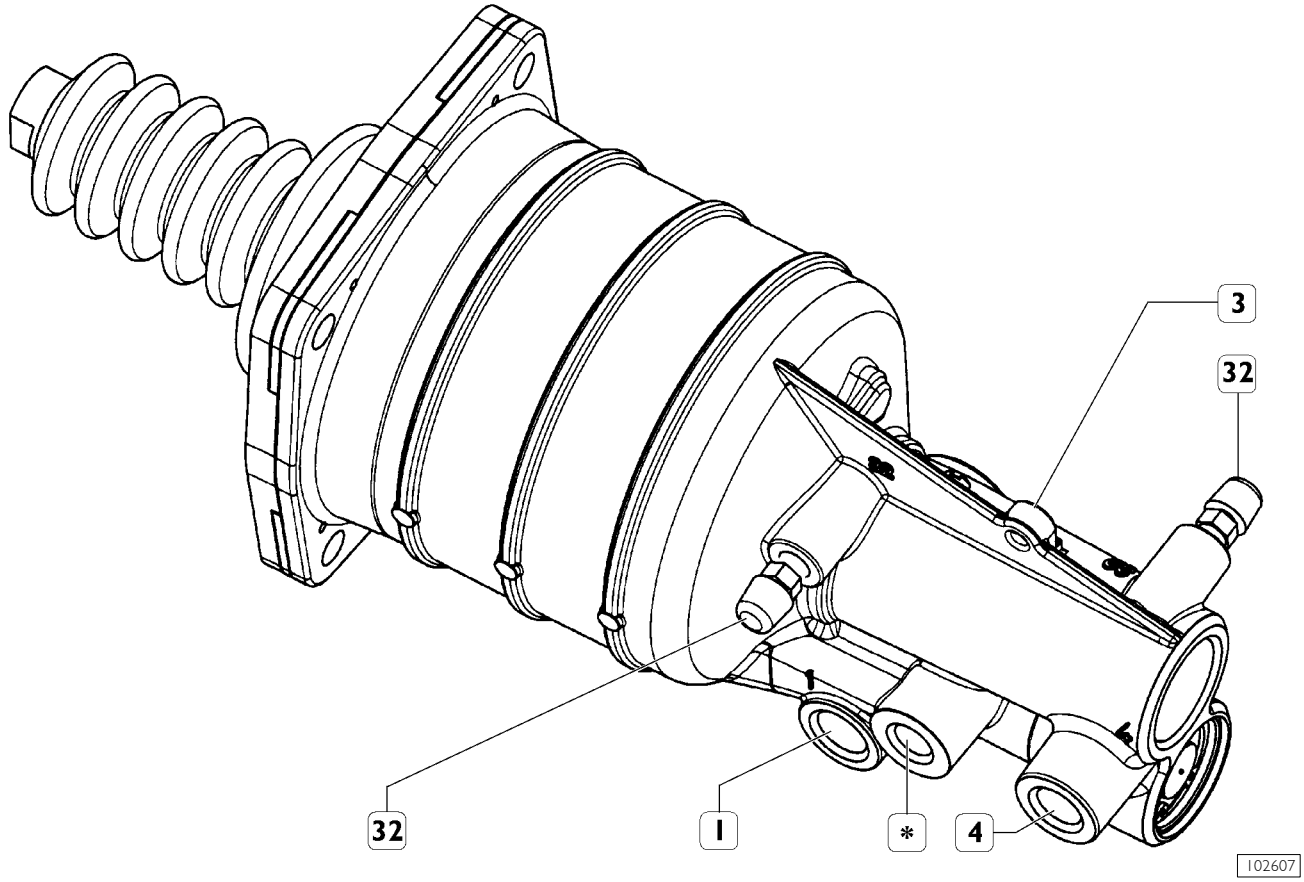
Figure 23



VIEW OF THE MASTER CYLINDER

5052 Clutch actuator

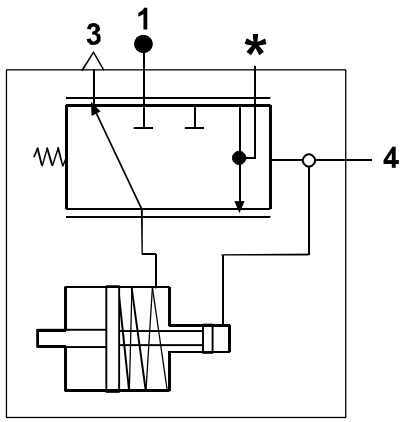
Figure 24



1. Feed (compressed air)
3. Bleed (compressed air)
4. Drive (clutch liquid)
32. Bleed screw
* Fitting for valve drive

NOTE Clutch actuator can only be driven after mounting.

Figure 25



Functional scheme

1. Feed (compressed air)
3. Bleed (compressed air)
4. Drive (clutch liquid)

Service pressure:

- ❑ clutch liquid (P4) 40 bar
- ❑ air (P1) 11.5 bar

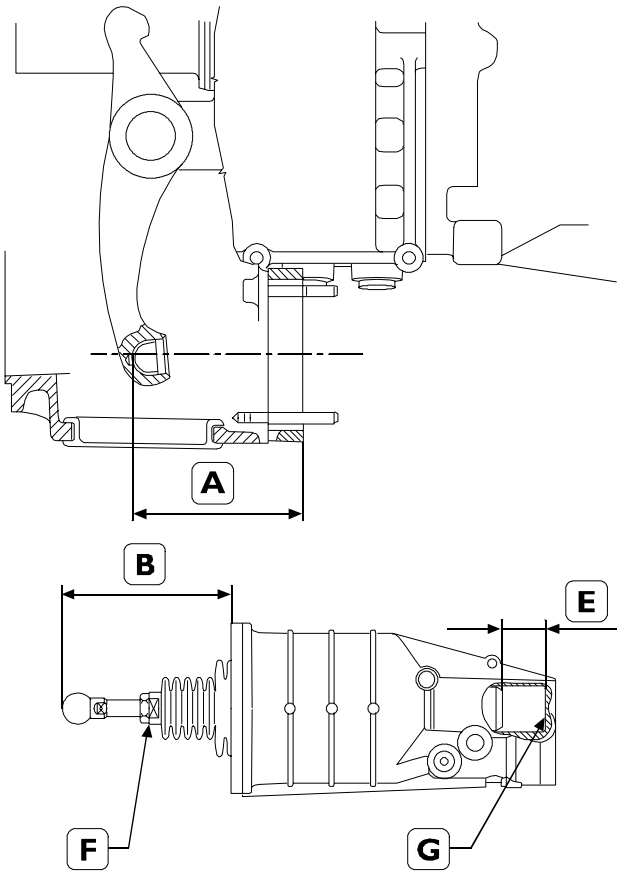
Max pressure:

- ❑ clutch liquid (P4) 120 bar
- ❑ air (P1) 13 bar

SPECIFICATIONS FOR MANUAL GEARBOX PREASSEMBLY

505272 Spring pin adjustment

Figure 26



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Perform following operations:

- ❑ measure dimension (**A**) between clutch lever spherical cavity and actuator fixing plane; Disengagement lever must rest against thrust bearing.
- ❑ push ball spring pin up to stop (**G**); screw, or unscrew, spring pin (**F**) until dimension (**B**) is obtained.
  B = **A** - **E** (See values shown in below table).

Engine	Clutch E (mm)
F3A	30
F3B	35

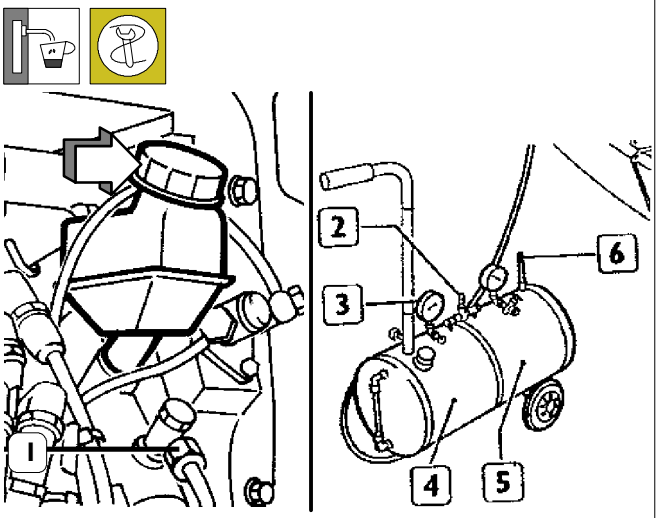
NOTE It is necessary to observe this adjustment to make the worn plate indicator trip, which is located in the operator cylinder, close to the complete wear of the friction linings.
The plate wear (90% of the friction material) is indicated by a significant increase in load on the pedal when disengaging the clutch.

NOTE Should any oil leaks from the main cylinder and/or the clutch actuator be detected, replace the involved component and bleed the hydraulic system.

Clutch liquid is poisonous and corrosive: in case of accidental contact, immediately wash with water and neuter soap.

BLEEDING CLUTCH CIRCUIT

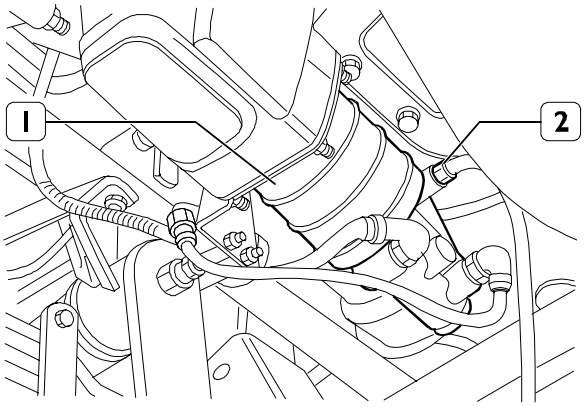
Figure 27



Bleed air from clutch hydraulic circuit after repairing clutch assembly or following periodic oil changes. Use air remover 99306010 for this purpose as follows:

- ❑ introduce compressed air into reservoir (5);
- ❑ fill reservoir (4) with Tutela TRUCK DOT SPECIAL fluid;
- ❑ replace clutch reservoir cover (⇒) with one of those provided with device 99306010 and connect device line to cover.

Figure 28



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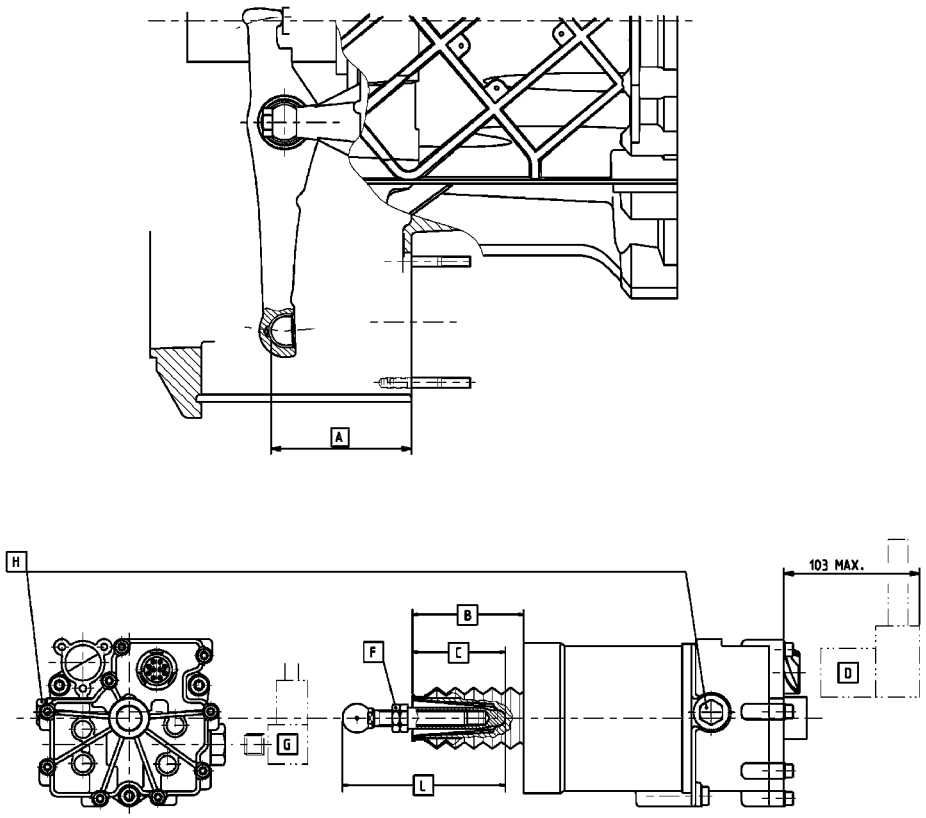
- ❑ apply a plastic pipe to bleed screw (2) of slave cylinder (1) and immerse the opposite end of the pipe in a recipient containing Tutela TRUCK DOT SPECIAL fluid. Undo bleed screw (1) by one turn, open (see Figure 27) crock (2) until pressure gauge (3) shows a reading of 1 ÷ 1,2 bars;
- ❑ when clutch fluid emerging from circuit is free of bubbles, tighten bleed screw and drain air from device reservoir (5) through valve (6).

NOTE When clutch fluid is changed, bleed master cylinder by loosening fitting (1, Figure 27) before bleeing clutch servo.

SPECIFICATIONS FOR AUTOMATIC TRANSMISSION ASSEMBLY

Figure 29



A) Specifications for adjusting the clutch servo, when new and when the clutch is replaced:

1. Measure distance "**A**" between the clutch lever ball socket base and the clutch servo fastening surface. The lever should be resting on the thrust bearing.
2. Adjust the rod using the following equation: **L=A-(B-C)**+33 and secure with locknut "**F**". Tightening torque 52 Nm.

NOTE Measure dimension "**B**" with the clutch servo at the end of its travel (screw plug "**H**" open). The clutch wear travel to the clutch servo, set using software, is standardised at 30 mm, corresponding to clutch plate wear of 3 mm (minimum guaranteed clutch plate wear).

B) Fitting the clutch servo to the clutch casing:

1. Unscrew the screw plug "**H**" on the inspection hole to allow air to emerge from the inner chamber.
2. Move the clutch servo piston back by hand to overcome the resistance of the internal spring.
3. Retighten plug "**H**" by hand to hold the piston back.
4. Fit the pushrod in the lever ball socket.
5. Fit the clutch servo and secure using the four hex-headed bolts. Tightening torque 23 Nm.
6. Unscrew screw plug "**H**" and then retighten when the piston is forward. Tightening torque 25 Nm.
7. Connect electrical connector "**D**" and air delivery pipe "**G**".

C) Replacing the clutch servo:

If replacing the clutch servo alone, proceed as described under point B, leaving pushrod adjustment setting "**L**" unchanged.

Before connecting the air pipe, ensure that the clutch servo is correctly fastened to the clutch casing.

SECTION 4

5302 Gearboxes

Gearboxes:
ZF 16 S 1920 T.D.
ZF 16 S 2220 T.D./T.O.
ZF 16 S 2320 T.D.
ZF 16 S 2520 T.O.

Page

DESCRIPTION

The ZF 16 S 1920 / 2220 / 2320 / 2520 gearboxes in the T.D. (direct drive) or T.O. (geared up) versions are composed of:

- A central box containing the main shaft, drive input shaft, transmission shaft and the gears for the four forward speeds and one reverse gear.
- A rear box containing the Epicyclic Reduction Gear Unit (ERG). Its function is to double the number of forward speeds by using epicyclic gears with helical toothing.
  This produces a range of gears that, starting with the four incoming speeds, makes it possible to have eight different ratios at the output (four normal speeds plus four reduced speeds).
- A front box containing the step-up gearing, called the "splitter", that makes it possible for each of the eight forward speeds and for the reverse gear to obtain an additional double selection.
  The "splitter" therefore halves the stagger between two successive ratios and each gear is divided into a slow ratio (L = slow ratio) and a fast ratio (S = fast ratio).

These gearboxes therefore have sixteen forward speeds with finely staggered ratios that can be engaged in succession and two reverse gears.

The synchronizing devices are the single-cone type.

Lubrication is made with a gear pump.

The double-H speed control is fitted with an air-operated "servoshift" device to improve speed selection and engagement.

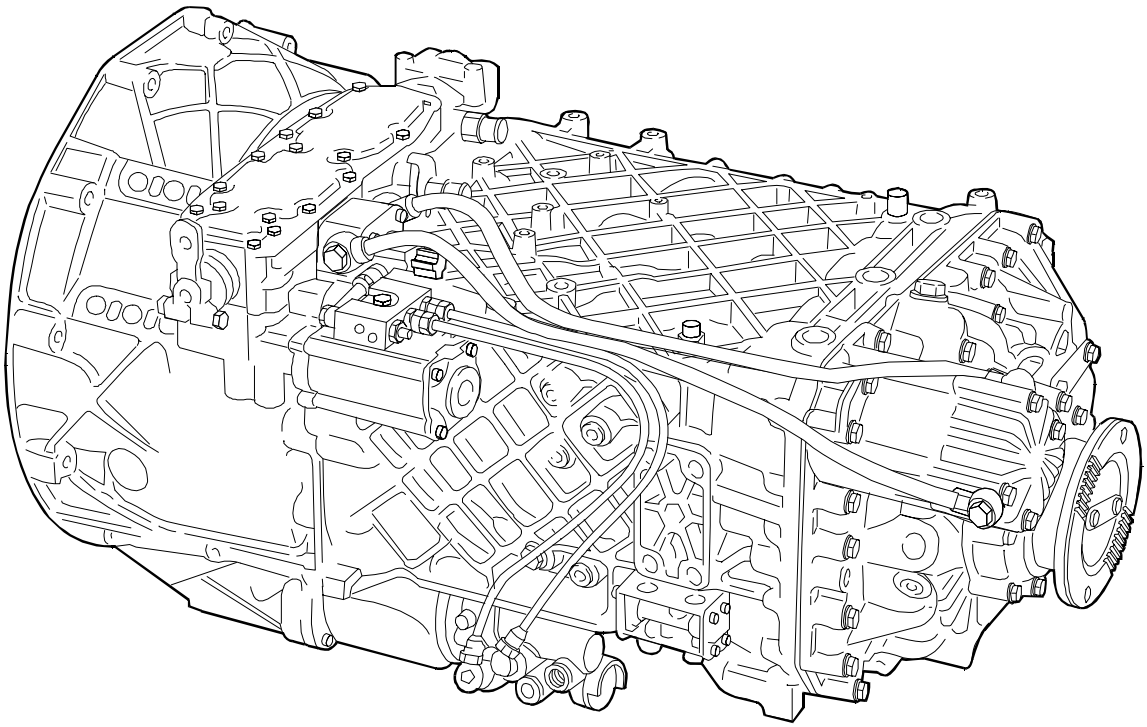
The servoshift is a device comprising a mechanical/pneumatic module and a double-acting cylinder.

The advantages of this device are:

- Faster speed selection and engagement with less effort.
- It cushions the vibrations of the control linkage, reducing noise.
- Less synchronizing device stress.

The device works mechanically if the pneumatic system breaks down.

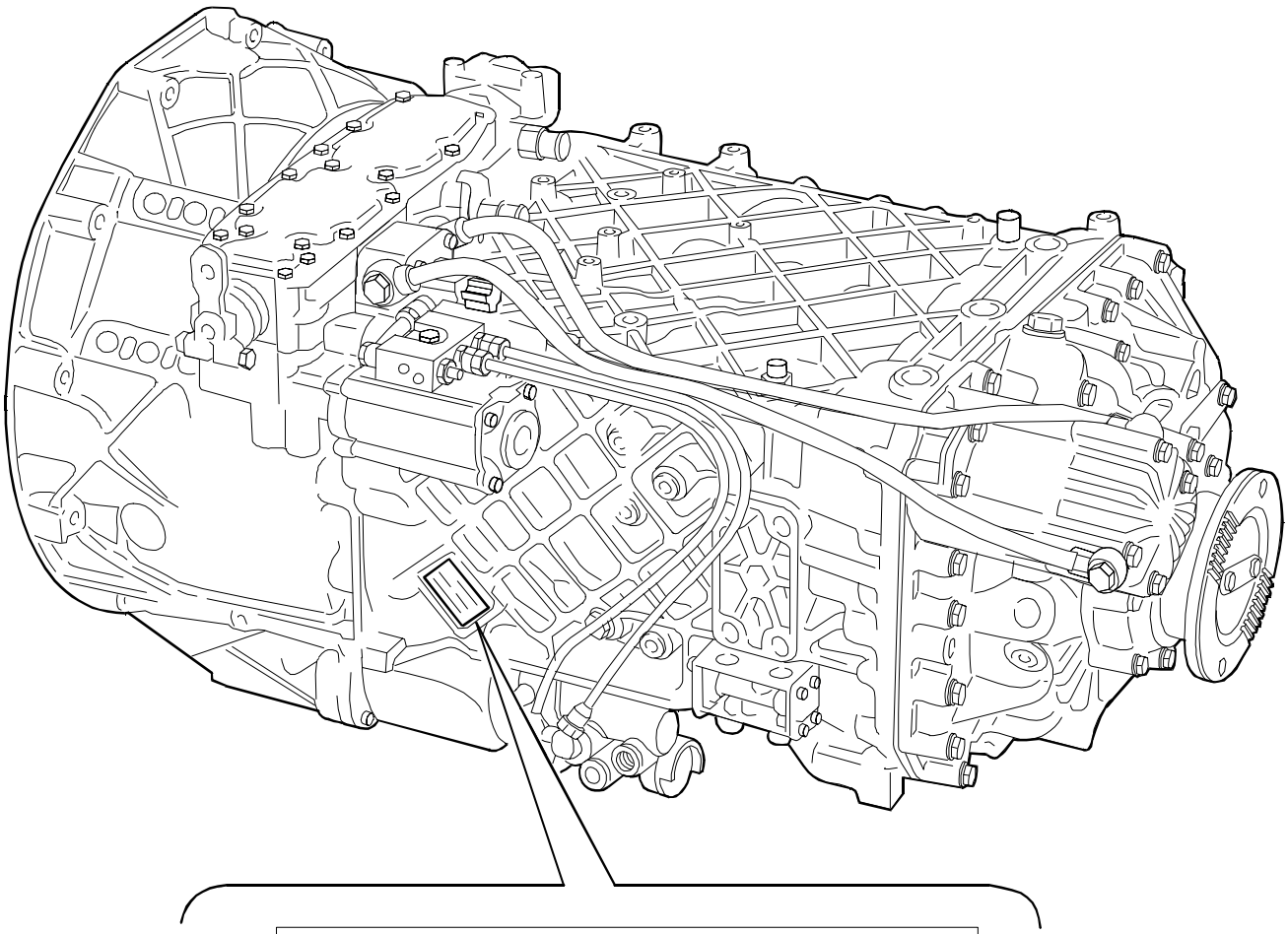
Figure 1

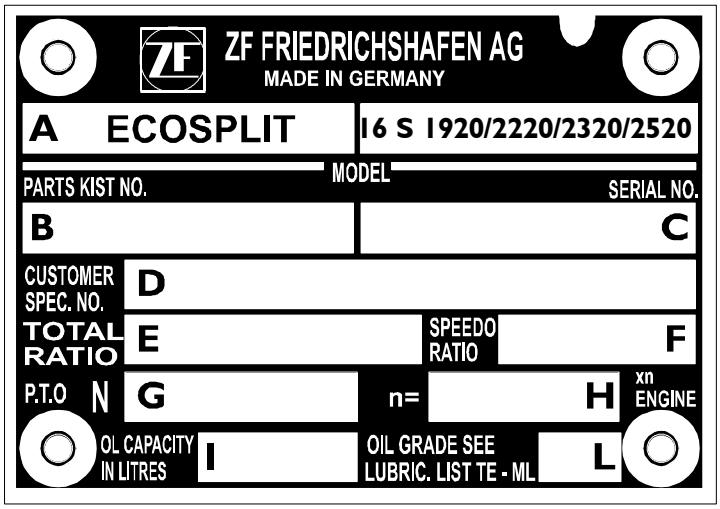


71107

LOCATION OF GEARBOX DESCRIPTION PLATE

Figure 2





16=Number of forward gears

S=Synchronized

1920/2220/2320/2520 input torque

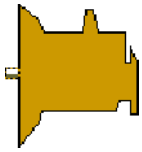
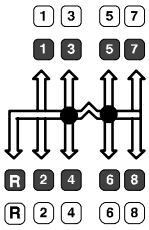
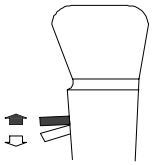
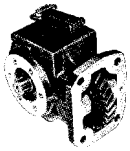
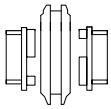
112202

A = Type of transmission
B = ZF drawing no.
C = Production sequence number
D = Spare part IVECO drawing no.
E = Transmission gear ratio

P.T.O. = Power take-off

F = Tachometer gear ratio
G = Type of power take-off
H = Power take-off gear ratio
I = Replacement oil amount
L = ZF lubricant list name

SPECIFICATIONS AND DATA

GEARBOXES		
	Type	Mechanical
	Torque at input ZF 16 S 1920 T.D. ZF 16 S 2220 T.D./T.O. ZF 16 S 2320 T.D. ZF 16 S 2520 T.O.	 1900 2200 2350 2500
	Speeds	16 forward speeds 2 reverse speeds
	Control of the four main speeds ERG control * Splitter control	Mechanical Pneumatic Pneumatic
	Power take-off	On request
	Gear engagement: Forward speeds Reverse gear Gear anti-disengagement	 Free ring synchronizer Bk-type single cone 1st-2nd-3rd-4th-5th-6th speed Quick engagement Sliding sleeves held by pawls and springs.
	Gear wheels	Helical-toothed

* ERG = Epicyclic reduction gear unit

T.D. = Truck Direct Drive (direct mesh)
T.O. = Truck Over Drive (Split)

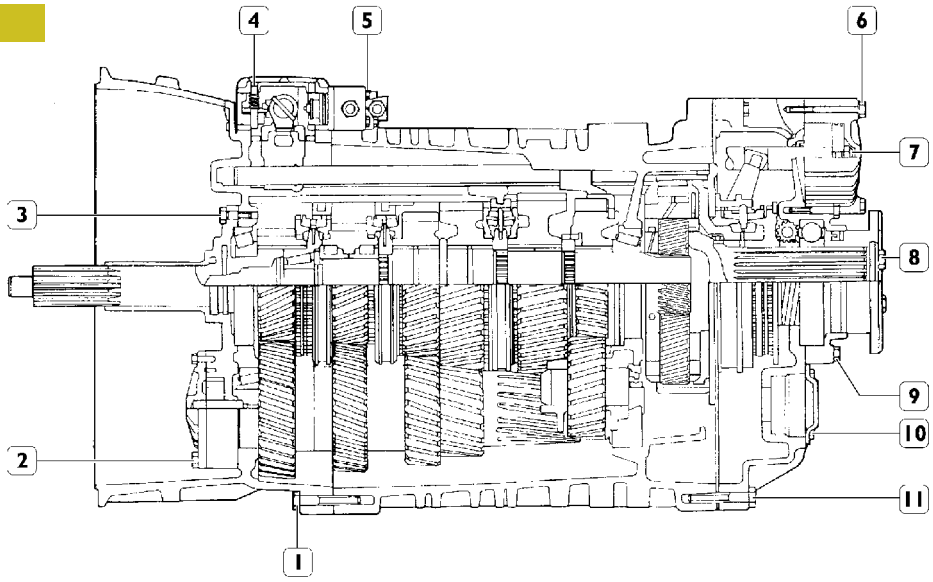
SPECIFICATIONS AND DATA

GEARBOXES		ZF 16 S 1920 T.D. ZF 16 S 2220 T.D. ZF 16 S 2320 T.D.	ZF 16 S 2220 T.O. ZF 16 S 2520 T.O.
	Gear ratio		
	1ª	16.41	13.80
	2ª	13.80	11.54
	3ª	11.28	9.49
	4ª	9.49	7.93
	5ª	7.76	6.53
	6ª	6.53	5.46
	7ª	5.43	4.57
	8ª	4.57	3.82
	9ª	3.59	3.02
	10ª	3.02	2.53
	11ª	2.47	2.08
	12ª	2.08	1.74
	13ª	1.70	1.43
	14ª	1.43	1.20
	15ª	1.19	1.00
	16ª	1.00	0.84
	1ª RM	15.36	12.92
	2ª RM	12.92	10.80
	Type of oil	**Tutela Truck FE-Gear Tutela ZC 90**	
	Quantity	Dry change	
	ZF 16 S 1920 T.D. ZF 16 S 2220 T.D./T.O. ZF 16 S 2320 T.D Kg ZF 16 S 2520 T.O. Litres	12 13	

T.D. = Truck Direct Drive (direct mesh)
T.O. = Truck Over Drive (Split)

TIGHTENING TORQUES

Figure 3

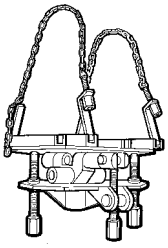


	DESCRIPTION	TORQUE Nm	TORQUE kgm
1	Screws fixing splitter box	50	5
2	Screws fixing oil pump	46	4.6
3	Screws fixing drive input shaft cover	46	4.6
4	Screws fixing gearbox	43	4.3
5	Screws fixing valve to gearbox	23	2.3
6	Screws fixing ERG* cylinder to the box	50	5.0
7	Self-locking nuts fixing splitter control rods and ERG to pistons	150	15.0
8	Screws fixing drive output flange	120	12
9	Screws fixing rear cover	50	5
10	Screws fixing PTO fitting cover	79	7.9
11	Screws fixing ERG* box	50	5
	Fixing screws		
	- M18 x 1.5	35	3.5
	- M22 x 1.5	50	5
	- M24 x 1.5	60	6
	Clutch disengagement bearing drive fork support fastening screws	150	15
	Screws fixing RM gearbox bottom cover	49	4.9
	Screws fixing gearbox side cover	23	2.3
	Socket-head screws fixing pipes	35	3.5
	Oil drain plugs	80	8.0
	Oil drain plugs M38 x 1.5 with magnetic filter	140	14.0
	Pressure switches / pulse transmitters	50	5.0
	Screws fixing oil pump cover	46	4.6
	Switches on gearbox	35	3.5
	Screws fixing splitter control valve	9,5	0.9
	Nut for screw fixing lever to gearbox control rod	5	4.9
	Threaded pins for articulation of ERG* control fork	250 ◆	25 ◆
	Oil vapour breather pipe	10	1
	Push rods for positioning rods	50	5
	Screw for reverse gear shaft retaining plate (if applicable)	86	8.6
	Screws fixing fork on splitter control shaft	60	6

ERG* = Epicyclic Reduction Gear unit

◆ = Apply LOCTITE 241 on the thread

TOOLS

TOOL NO.		DESCRIPTION
99370629		Mount to support gearbox when removing and refitting it on the vehicle

530210 REMOVING-REFITTING THE GEARBOX

Removal

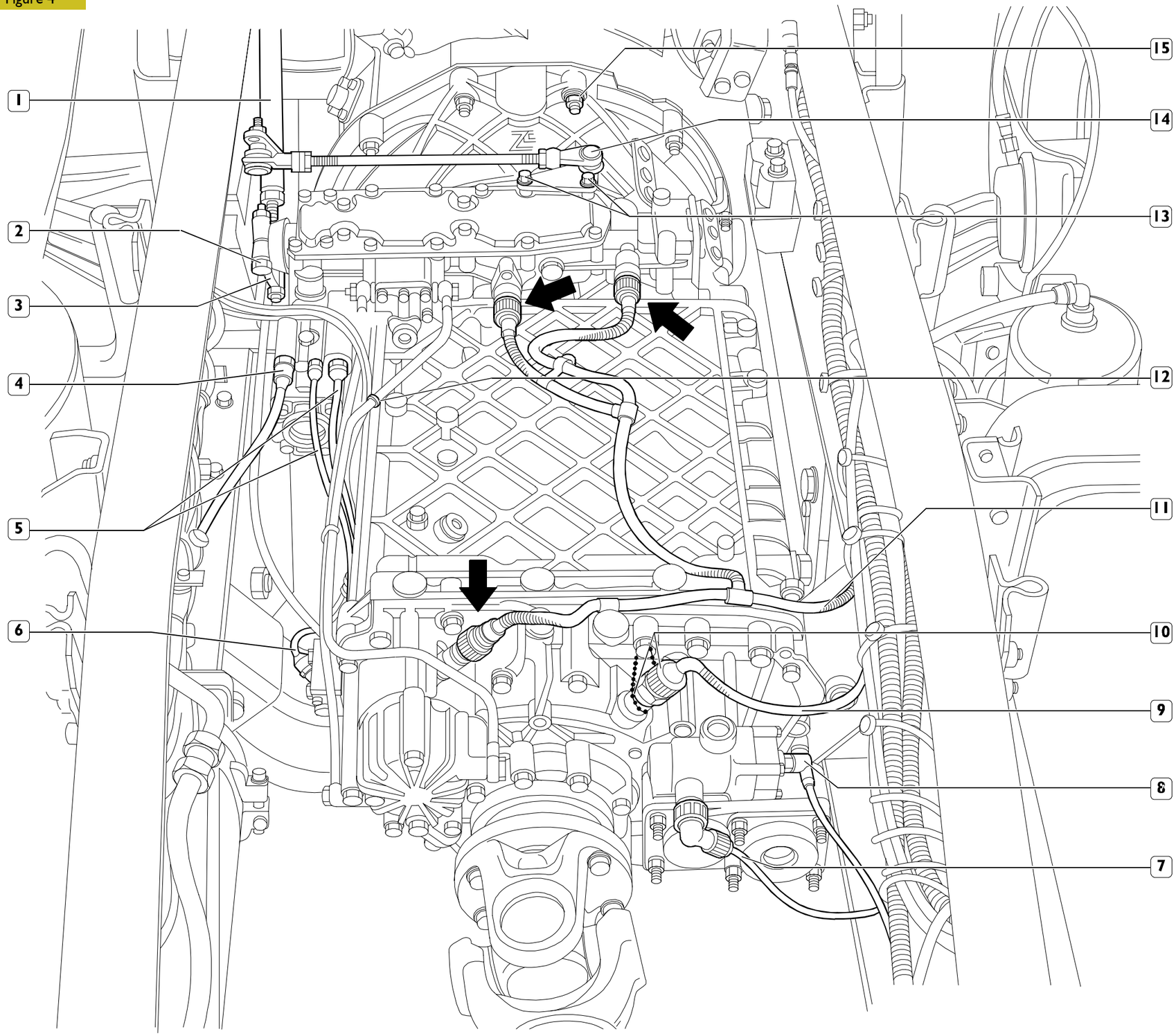
To remove the gearbox, proceed as follows:

- ❑ Set the vehicle over a pit or on a lift.
- ❑ Disconnect the battery cables to prevent any short-circuiting.
- ❑ Disconnect the cable (11) using the connectors (→) and breaking the safety lead off the screw (10).
- ❑ Disconnect the connector (7) and the pipe (8) from the power take-off (if applicable).
- ❑ Disconnect the air pipes (4) and (5).
- ❑ Free the pipes (6) from the clamps (12).
- ❑ Undoing the fasteners (13), disconnect the tie rod (14) from the gearbox.
- ❑ Loosen the screw (2) and extract the lever (3) together with the tie rod (1) from the gearbox after marking its position for reassembly.
- ❑ Remove the fasteners (15) of the gearbox bell, accessible from above.

NOTE For gearboxes with the intarder, proceed as follows:

- ❑ Drain off the engine coolant and disconnect the pipes from the heat exchanger.
- ❑ If the cross member of the chassis frame prevents you from removing the gearbox, you need to drain off the oil from the intarder; take out the nuts and screws fixing the heat exchanger to the intarder, remove the stud bolts and detach the heat exchanger.

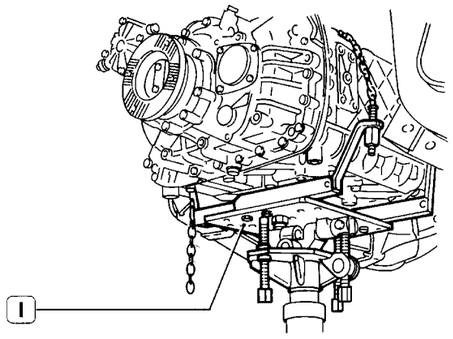
Figure 4



Working from under the vehicle:

- ❑ Disconnect the pipes (1) and (2), previously freed from the clamps.
- ❑ Unscrew the nuts (5) and tie the clutch cylinder (6) to the vehicle's chassis frame appropriately.
- ❑ Undoing the side fasteners (8), take off the cross member (7).
- ❑ Place a hydraulic jack equipped with the mount 99370629 (1, Figure 5) under the gearbox.
- ❑ Disconnect the propeller shaft (10) by undoing the screws (9) and tie it to the vehicle's chassis frame appropriately so it will not interfere with the removal of the gearbox.
- ❑ Complete removing the gearbox bell fasteners (4).
- ❑ Afterwards, extract the gearbox from the engine by bringing it suitably back out of the space occupied by the exhaust pipe (3). Then lower the jack and take out the gearbox.

Figure 6



45369

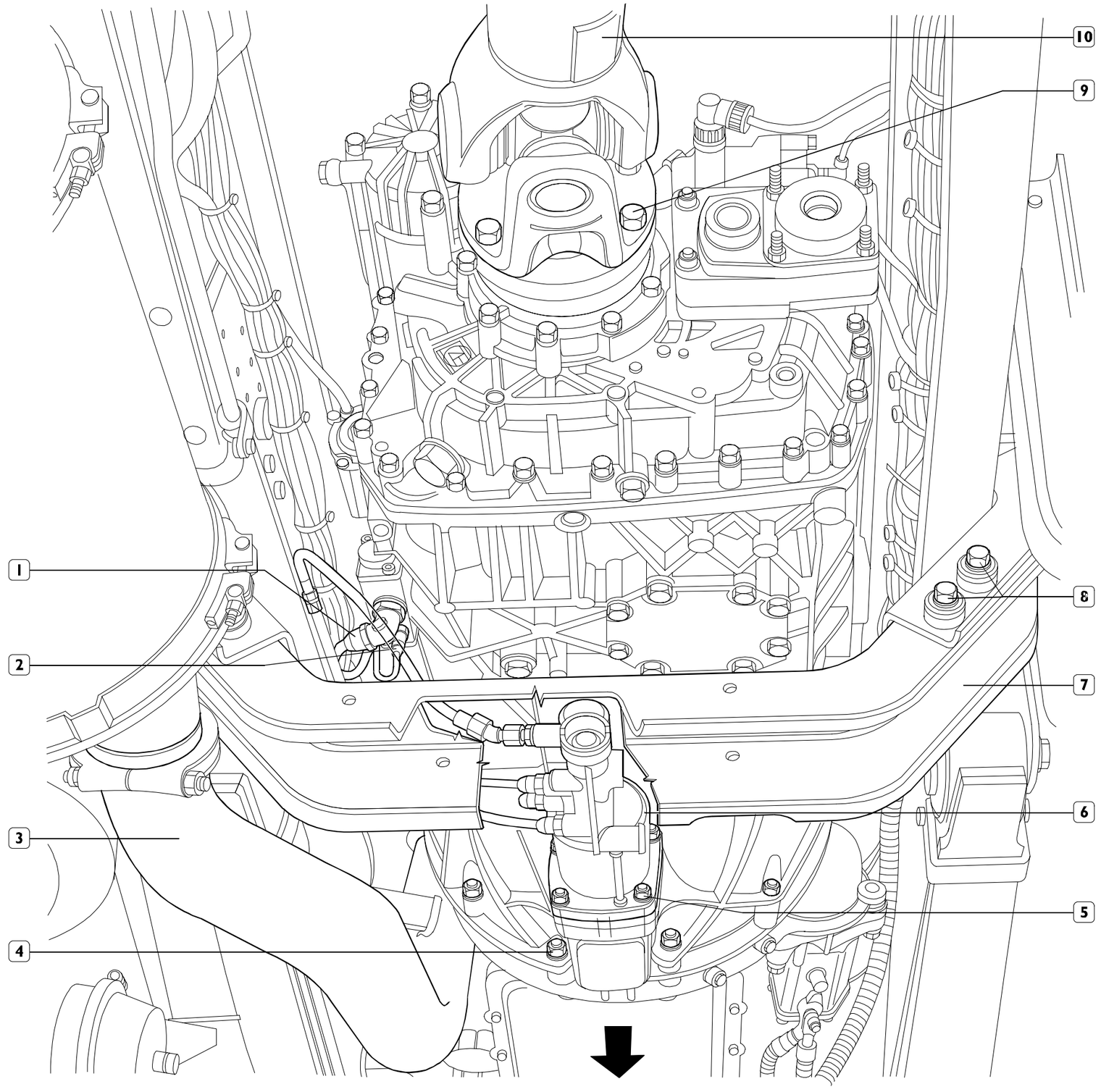
Refitting

Carry out the operations performed for removal in reverse order and tighten the fixing nuts and screws to the required torque.

NOTE For gearboxes with the intarder, proceed as follows:

- ❑ Refit the heat exchanger to the intarder, inserting new seals; fit the stud bolts and tighten the fixing screw and nuts to the required torque.
- ❑ Connect the coolant pipes to the heat exchanger and replenish the gearbox with the required amount of oil.
- ❑ Fill the engine cooling system as described in Section 2 Engine.

Figure 5



71752

ZF gearboxes with Intarder (IT), hydraulic retarder, types: ZF 16 S 1921 T.D. ZF 16 S 2221 T.D./T.O. ZF 16 S 2321 T.D. ZF 16 S 2521 T.O.

NOTE This sub-section gives the main topics that differ from the ones covered for the similar types of gearbox without the Intarder.

NOTE The technical data, tightening torques and procedure for overhauling the gearboxes differ from the 16 S 1920 T.D. - 2220 T.D./T.O. - 2320 T.D. - 2520 T.O. gearboxes in the following.

SPECIFICATIONS AND DATA

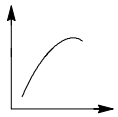
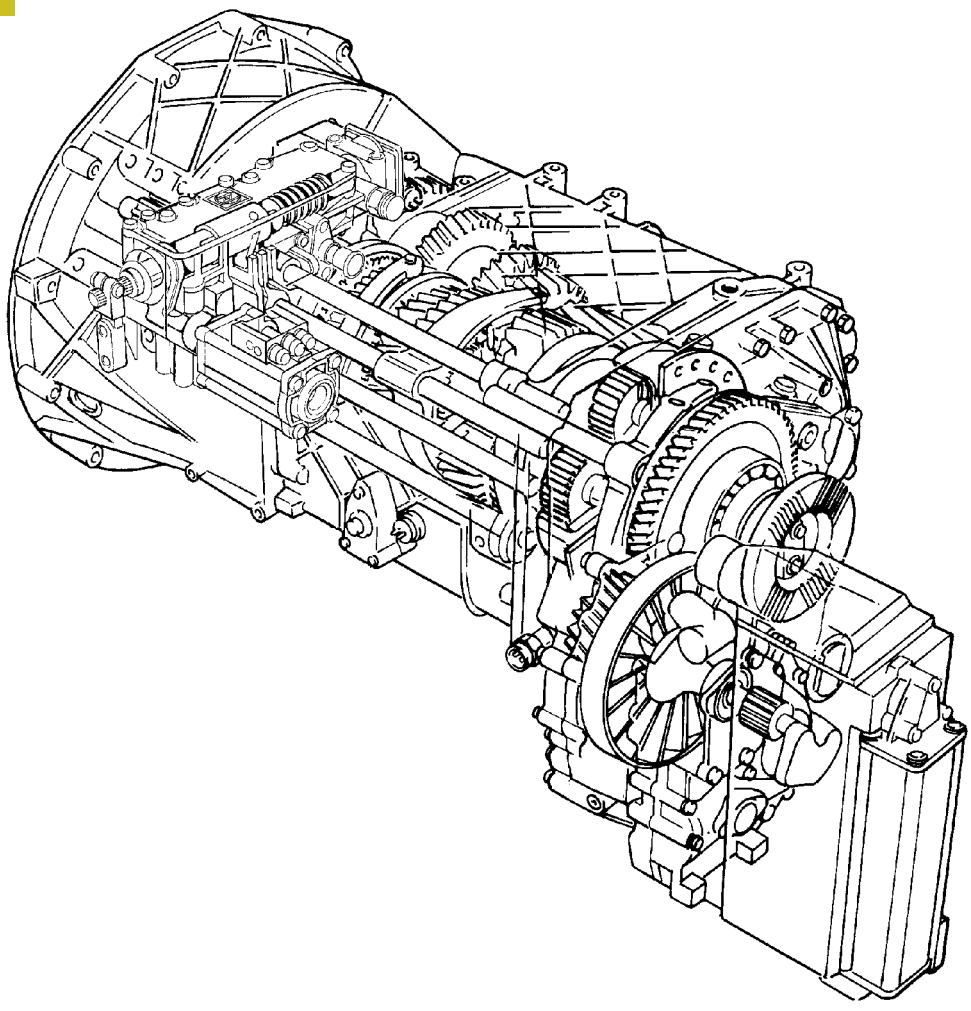
GEARBOXES WITH INTARDER			
	Maximum braking torque	Nm	3200
	Braking capacity	kW	500
	Type of oil		Tutela Truck Fe-Gear Tutela ZC 90
	Quantity after overhauling gearbox and retarder drained completely	l kg	21.5 19.5

Figure 1



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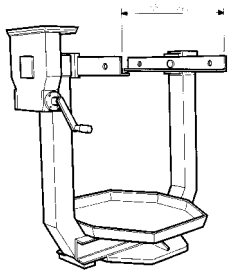
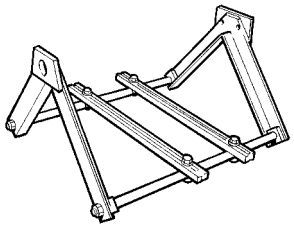
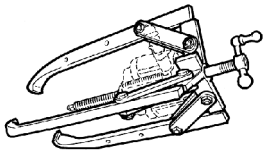
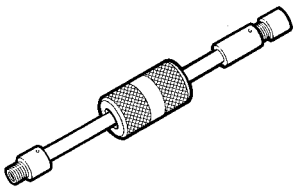
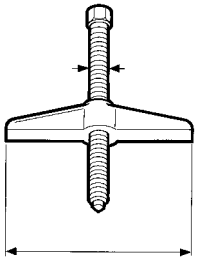
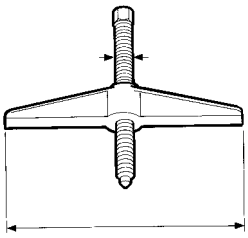
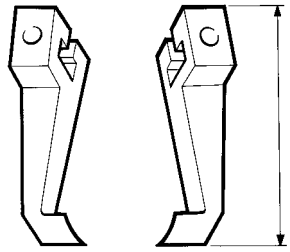
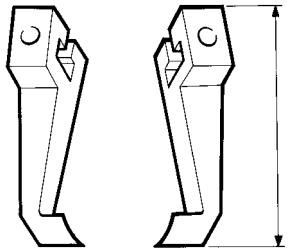
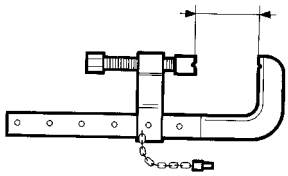
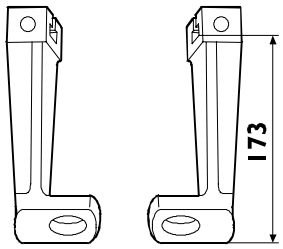
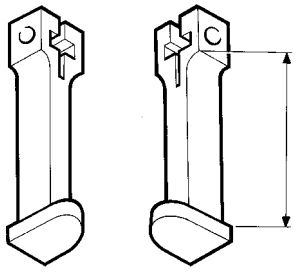
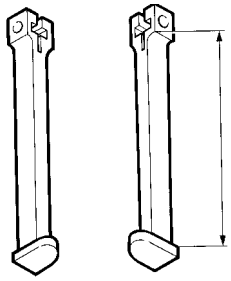
GEARBOX ASSEMBLY WITH RETARDER

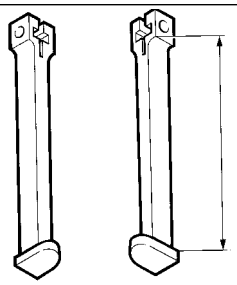
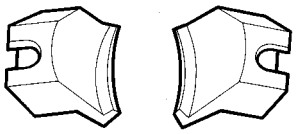
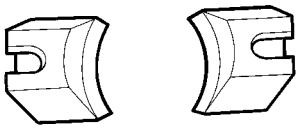
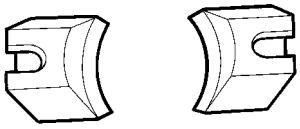
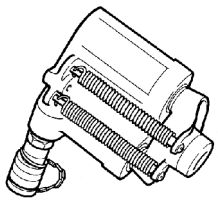
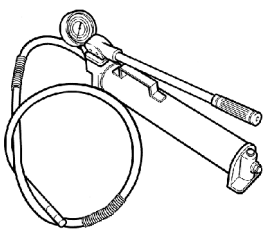
TOOLS

TOOL NO.		DESCRIPTION
99322205		Rotary stand for overhauling assemblies
99322225		Stand for supporting assemblies (to be fitted on stand 99322205)
99340030		Extractor fitted for hydraulic operation (use with 99341033 - 99341034)
99340205		Percussion extractor
99341003		Single-acting bridge
99341004		Single-acting bridge

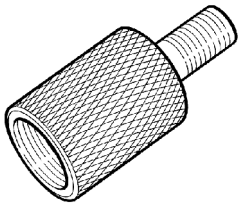
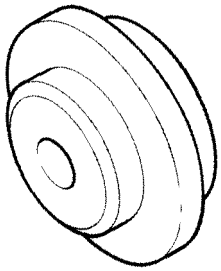
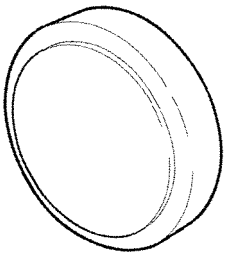
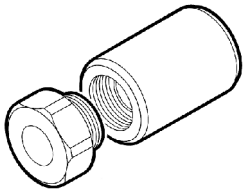
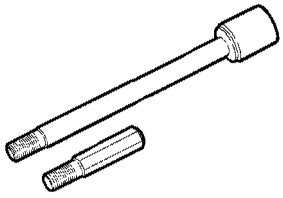
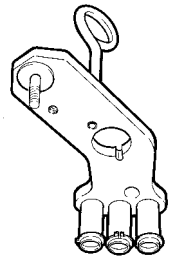
TOOLS

TOOL NO.		DESCRIPTION
99341009		Pair of brackets
99341012		Pair of brackets
99341015		Clamp
99341018		Pair of brackets with hole
99341019		Pair of tie rods with grips
99341020		Pair of tie rods with grips

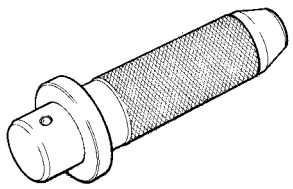
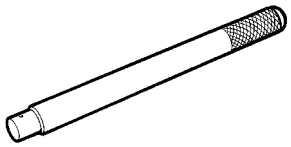
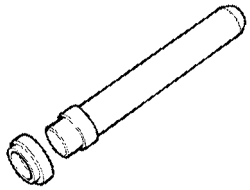
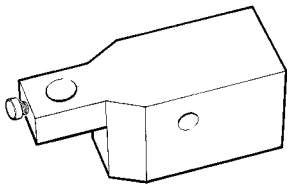
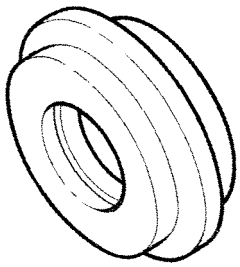
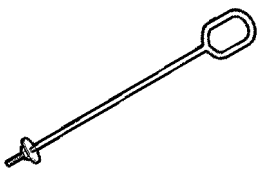
TOOLS

TOOL NO.		DESCRIPTION
99341021		Pair of tie rods with grips
99341022		Grips
99341024		Grips
99341025		Grips
99341033		17.5 t hydraulic unit for extractor
99341034		50 t hydraulic pump

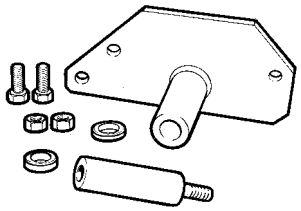
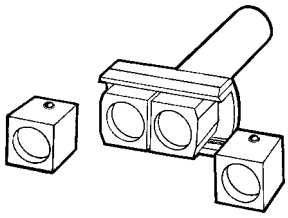
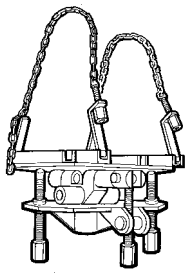
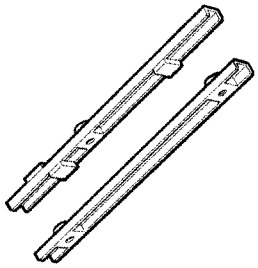
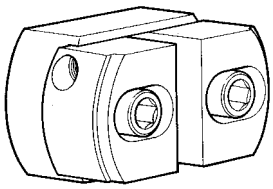
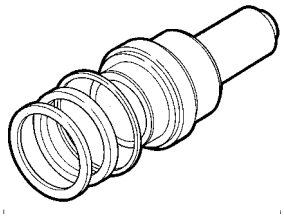
TOOLS

TOOL NO.		DESCRIPTION
99342143		Pin to extract reverse gear shaft (use with 99340205)
99345058		Extractor reaction block
99345092		Extractor reaction block
99345097		Reaction tool to extract sun gear and drive in main shaft oil pipe
99347092		Pin to extract gearbox front and rear centring pins
99360515		Tool to extract and insert main shaft, transmission shaft and fork assembly

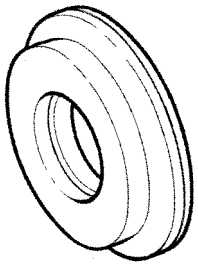
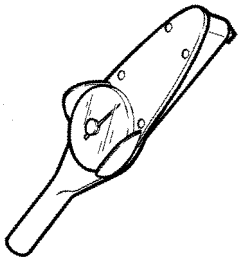
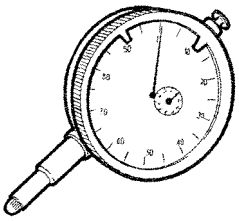
TOOLS

TOOL NO.		DESCRIPTION
99370006		Grip for interchangeable drifts
99370007		Grip for interchangeable drifts
99370113		Drift to mount seal and/or bushings on gearbox
99370415		Dial gauge base to adjust transmission shaft bearing end float (use with 99395604)
99370420		Key for fitting gasket on gearbox front cover (use with 99370006)
99370449		Hook to lift main shaft

TOOLS

TOOL NO.		DESCRIPTION
99370450		Tool to adjust splitter control fork
99370465		Tool to notch safety plates
99370629		Mount to support gearbox when removing and refitting it on the vehicle
99371050		Brackets to support gearbox when overhauling (use with 99322205 - 99322225)
99374093		Drift to mount external bearing races (Ø 91 ÷ 134 mm) (use with 99370007)
99374221		Key to fit gaskets on rear cover

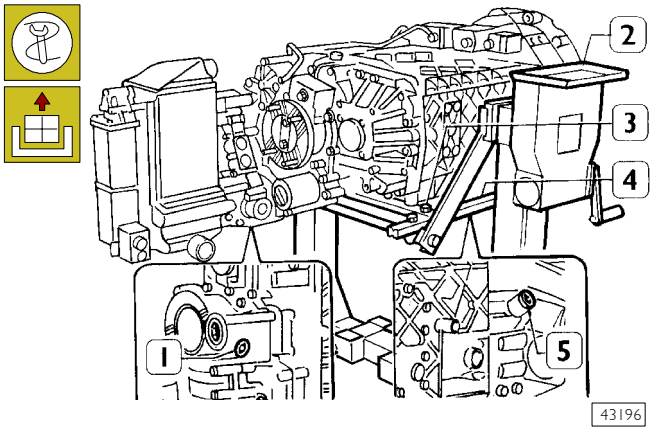
TOOLS

TOOL NO.		DESCRIPTION
99374370		Key to fit oil deflector on direct drive shaft (use with 99370006)
99389819		Torque wrench (0 ÷ 10 Nm) with square 1/4" connection
99395604		Dial gauge (0÷10 mm)

530210 OVERHAULING THE GEARBOX

Removing the hydraulic retarder from the gearbox on the stand

Figure 2



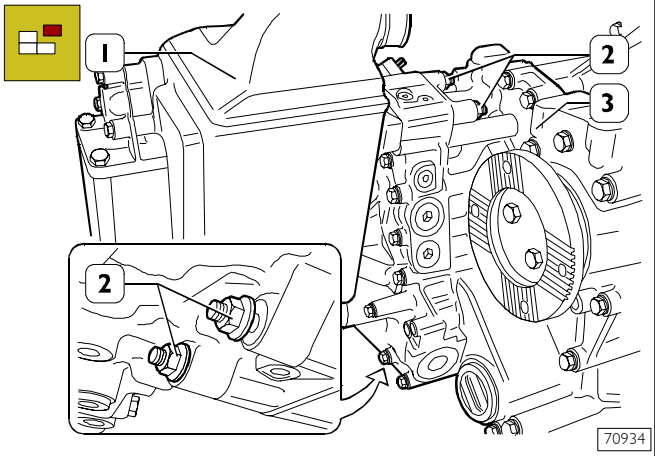
Fit the brackets 99371050 (3) onto the assembly.

Using ropes with hooks and a movable lift, put the assembly on the rotary stand 99322205 (2) together with the mount 99322225 (4).

Take off the plug (5) and drain the lubricating oil from the gearbox.

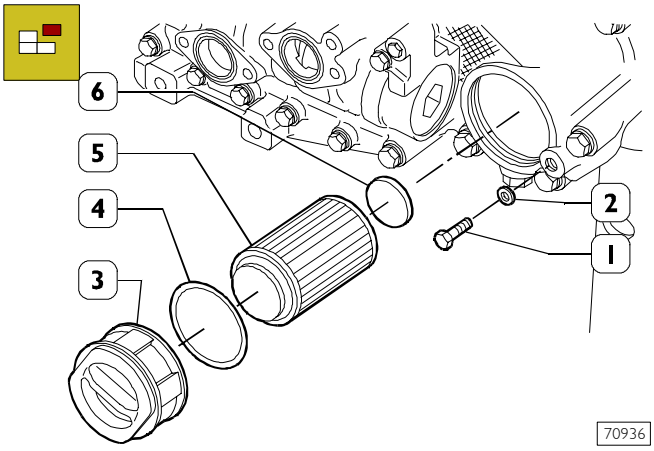
Take off the plug (1) and drain the lubricating oil from the hydraulic retarder.

Figure 3



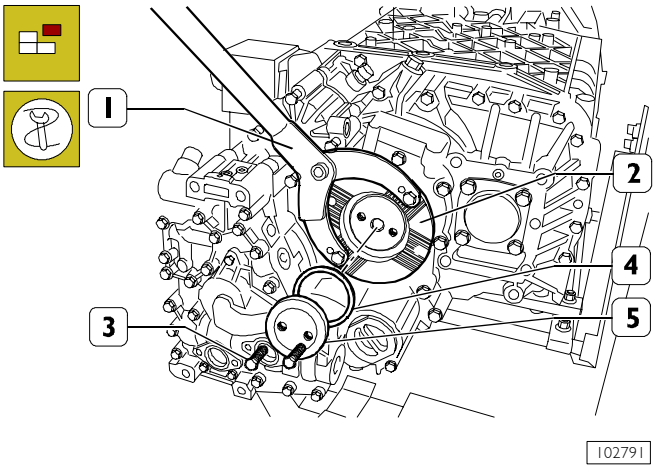
If applicable, remove the four nuts (2) fixing the heat exchanger (1) to the hydraulic retarder (3) and detach the heat exchanger (1).

Figure 4



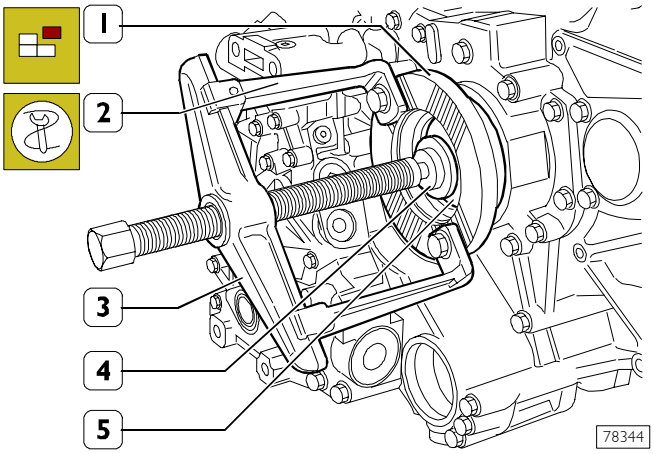
Remove the screw (1) and the washer (2) beneath. Extract the plug (3) with the seal (4), oil filter (5) and magnet (6).

Figure 5



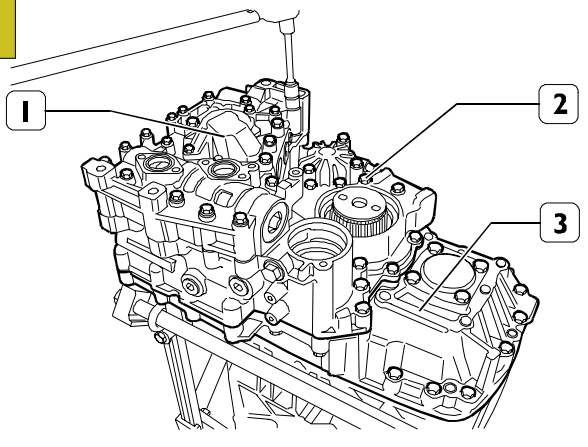
Block rotation of the sleeve (2) by applying the lever 99370317 (1) to it and remove the screws (3), disc (5) and underlying seal (4).

Figure 6



Using an extractor composed of the bridge 99341003 (3), brackets 99341018 (2) and reaction block 99345058 (4), remove the sleeve (1) from the shaft (5).

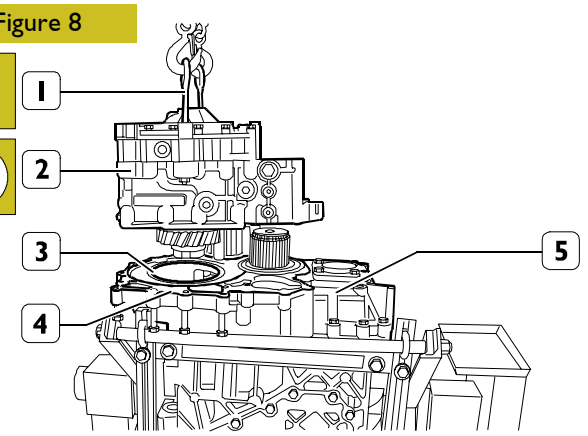
Figure 7



102792

Remove the screws (2) fixing the hydraulic retarder (1) to the rear box (3).

Figure 8



102793

Fit the eyebolt 99370565 (1) to the hydraulic retarder (2). With special ropes and lifter, detach the hydraulic retarder (2) from the rear box (5).

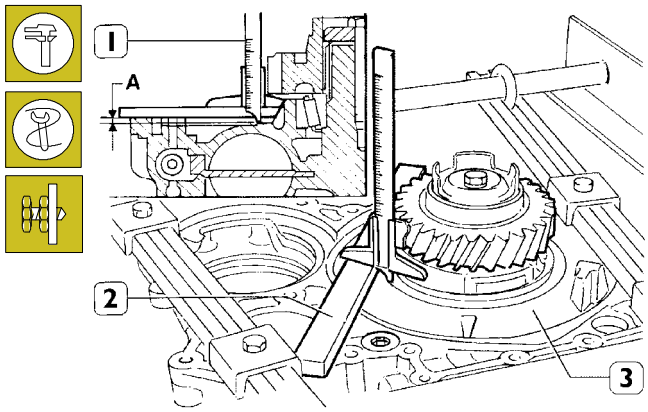
Remove the adjustment ring (3) and the gasket (4).

Refitting the hydraulic retarder

Before refitting, determine the thickness of the adjustment ring (3, Figure 8) as follows:

Adjusting stator end float

Figure 9



70946

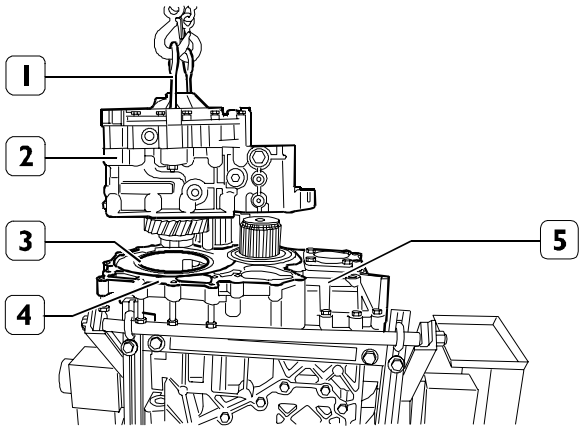
Determine the thickness **S** of the stator end float adjustment ring:

- using a depth gauge (1) and calibrated rule (2), measure the distance between the sealing surface of the half boxes and the supporting surface of the stator (3): distance **A**;
- measure the thickness of the gasket between the retarder and gearbox: distance **B**.

The thickness S of the stator end float adjustment ring is given by the following sum: **S = A+B+C**

- **A** and **B** = measurements
- **C** = 0.05 mm: stator end float adjustment ring pre-load. (- 0.05 ÷ 0.05 mm)

Figure 10



102793

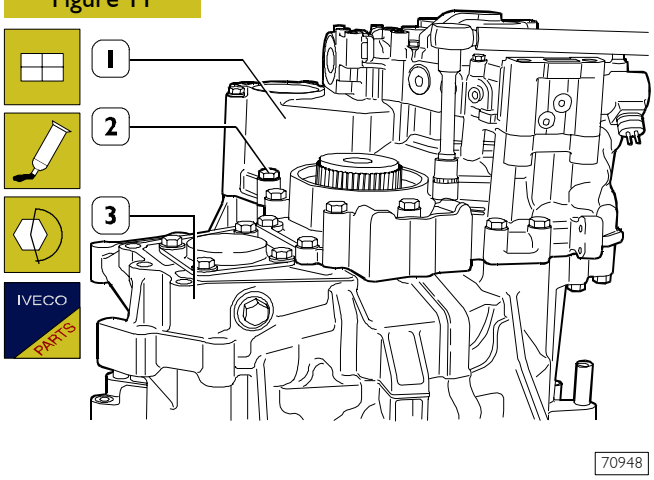
Fit the eyebolt 99370565 (1) to the hydraulic retarder (2) and lift it with a hoist.

Position adjusting ring (3) by thickness determined in previous measurement, on stator seat.

Fit a new gasket (4) on the rear box (5).

Mount the hydraulic retarder (2) on the rear box (5) making sure that the gasket (4) gets positioned correctly.

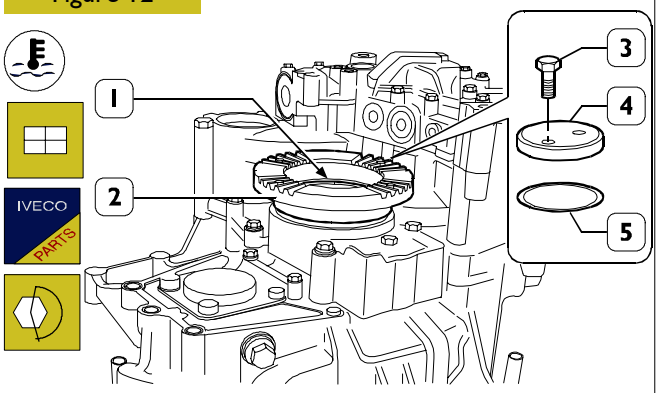
Figure 11



70948

Screw down the screws (2) fixing the hydraulic retarder (1) to the rear box (3) and tighten them to the prescribed torque.

Figure 12

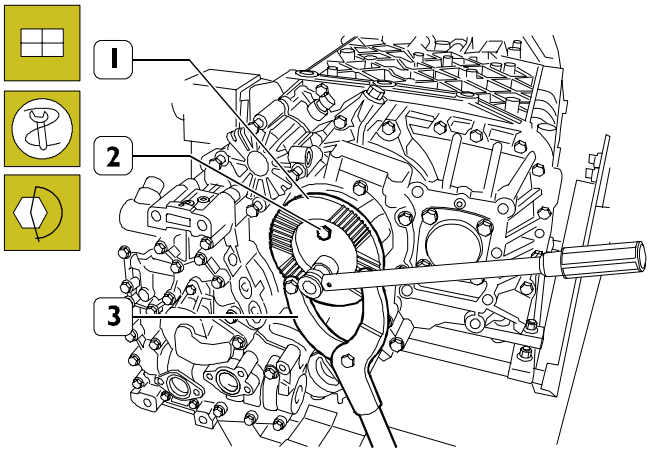


70949

Heat the flange (2) to approx. 80°C and fit it onto the spider shaft (1).

Fit on a new seal (5), the disc (4), screw down the screws (3) and tighten them to the prescribed torque.

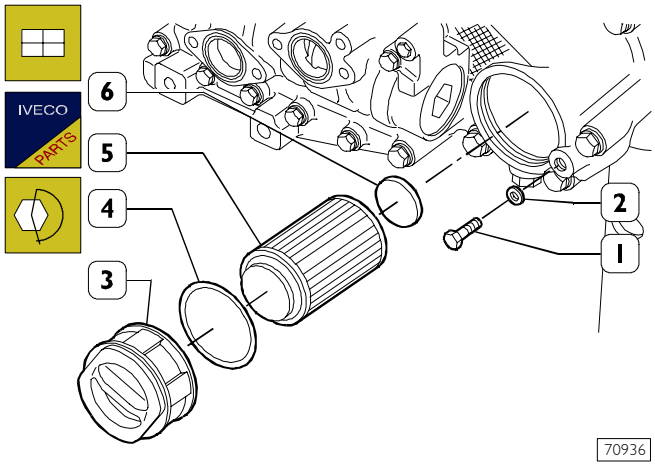
Figure 13



102794

Block rotation of the sleeve (1) by applying the lever 99370317 (3) and tighten the fixing screws (2) to the prescribed torque.

Figure 14

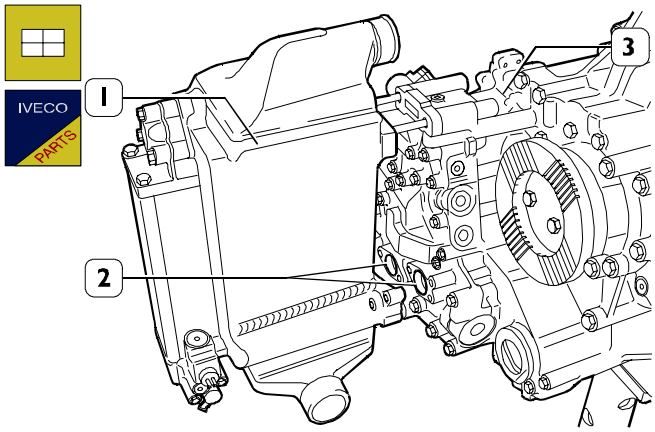


70936

Position the magnet (6) on the filter (5) and insert this into the hydraulic retarder. Fit the plug (3) with a new seal (4).

Screw down the fastening screw (1) with the washer (2).

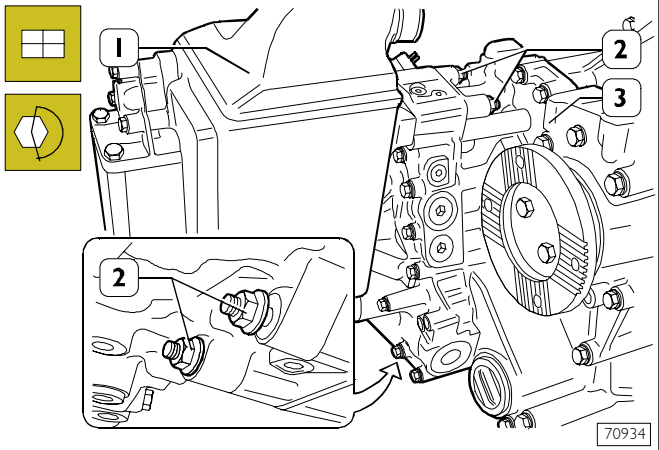
Figure 15



70955

Fit two new seals (2) on the hydraulic retarder (3) and mount the heat exchanger (1) (if applicable).

Figure 16

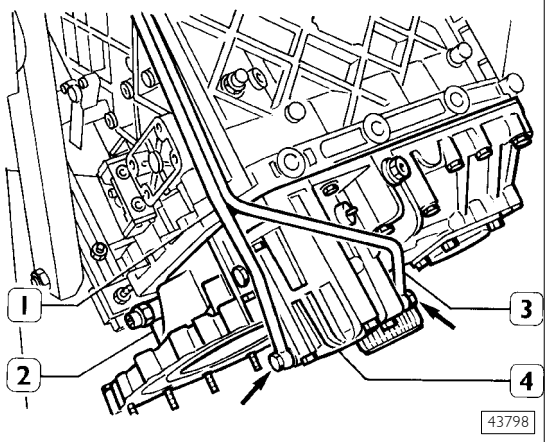


70934

Screw down the four nuts (2) fixing the heat exchanger (1) to the hydraulic retarder (3) and tighten them to the prescribed torque.

Removing the epicyclic reduction gear unit (ERG) rear box

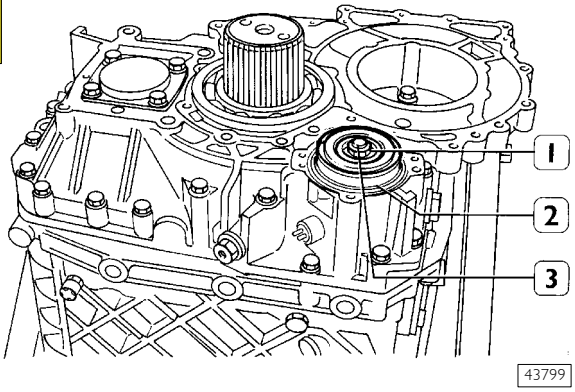
Figure 17



Remove the hydraulic retarder as described under the relevant heading.

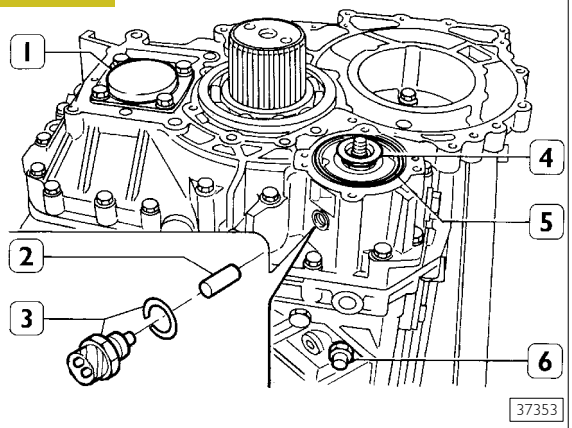
Take off the fittings (→) and disconnect the pipes (1 and 3) from the cylinder (4). Remove the cylinder (4) from the ERG rear box (2).

Figure 18



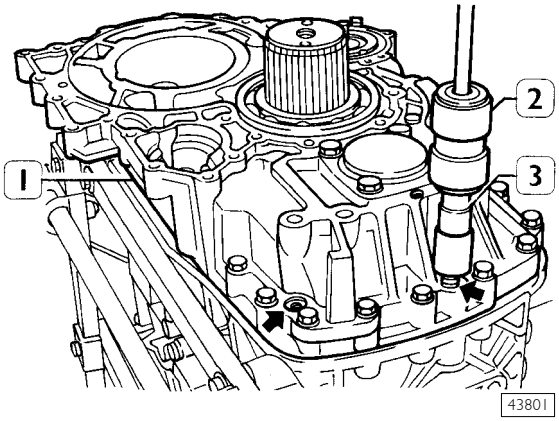
Remove the nut (1) and extract the piston (2) from the rod (3).

Figure 19



Remove the seal (5), gasket (4), switch (3), push rod (2) and retaining push rod (6) from the ERG rear box (1).

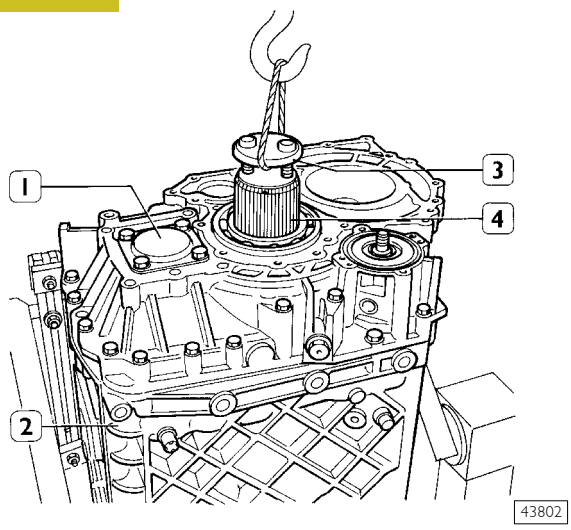
Figure 20



Using the percussion extractor 99340205 (2) and part 99342143 (3), extract two of the three centring pins from the ERG rear box (1).

The arrows show the outside pins to extract; there is a third pin inside.

Figure 21

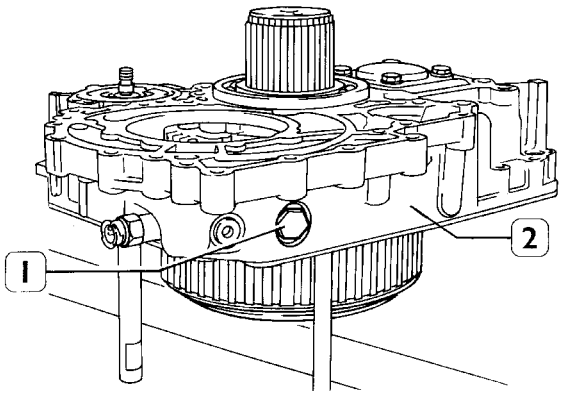


Take out the screws fixing the ERG rear box (1) to the gearbox (2). Fasten the retaining plate (3) to the shaft (4) with two screws. Using a rope and hydraulic lift, remove the ERG box (1) from the gearbox (2).

Removing the epicyclic reduction gear unit (ERG)

NOTE Here we describe the steps to remove and fit the ERG epicyclic reduction gear unit that differ from the ones given for gearboxes without the Intarder.

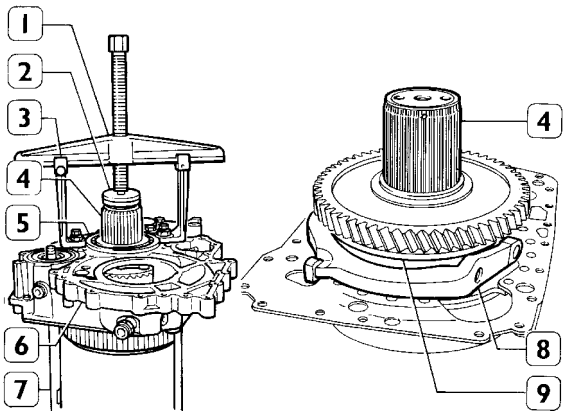
Figure 22



43803

Place the epicyclic reduction gear unit (2) on the workbench and remove the pins (1) for the articulation of the fork (8, Figure 12) controlling the ERG.

Figure 23



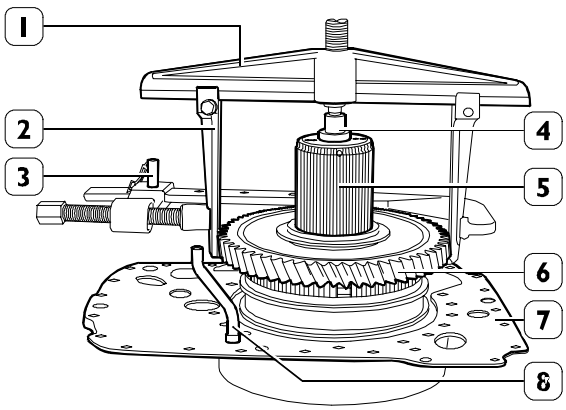
36804

Using the extractor composed of bridge 99341003(1), tie rods 99341018 (3) and block 99345092 (2) fitted onto the ERG box, as shown in the figure, extract the bearing (5) and the box (6) from the ERG shaft (4).

NOTE While extracting them, hold back the rod (7) to then take it out of the box (6) when it is freed from the fork (8).

Take the fork (8) with its blocks out of the sliding sleeve (9).

Figure 24

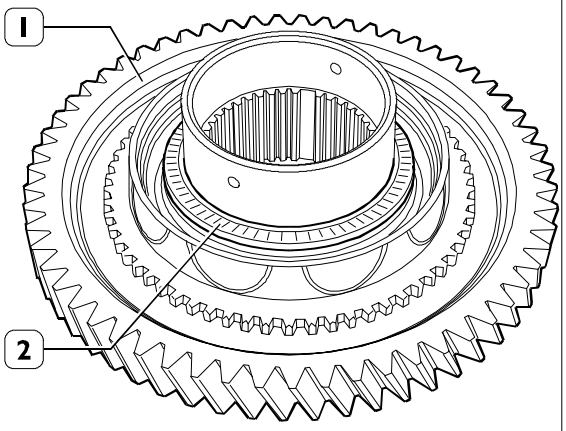


61216

Using the extractor composed of bridge 99341004(1), brackets 99341012 (2), part 99345092 (4) and clamp 99341015 (3), extract the gear (6) from the ERG shaft (5).

Take off the plate (7) with the tube (8) for lubrication.

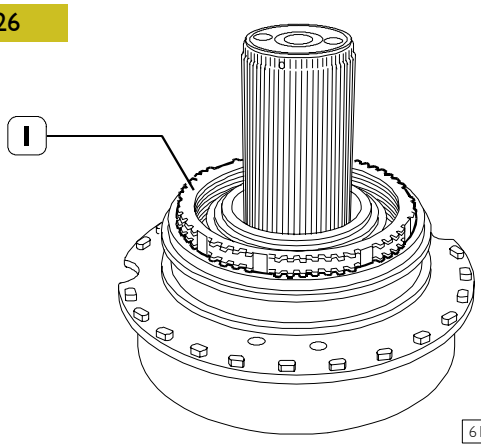
Figure 25



61217

Remove the fifth wheel bearing (2) from the gear (1).

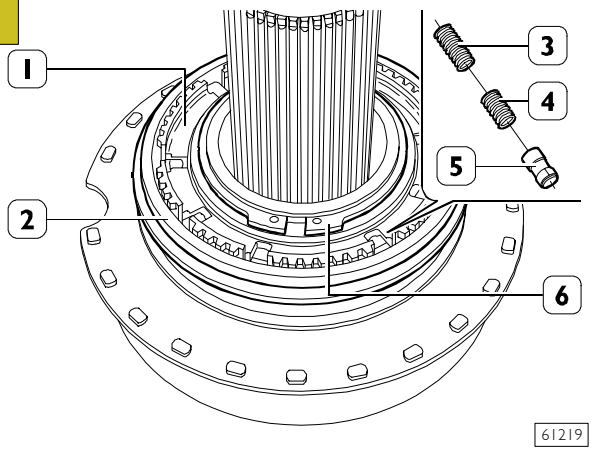
Figure 26



61218

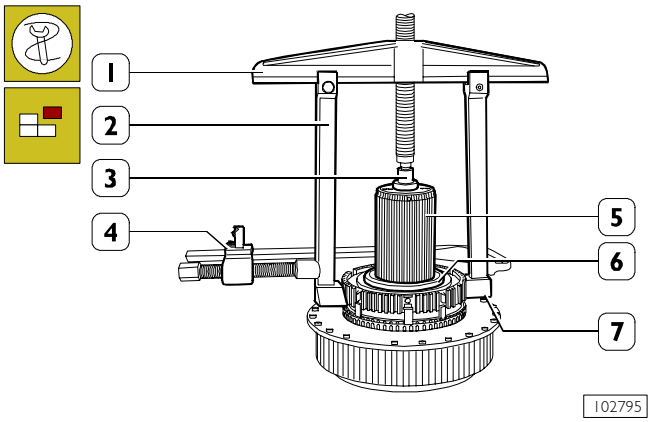
Take the synchronizer ring (1) out of the sliding sleeve hub.

Figure 27



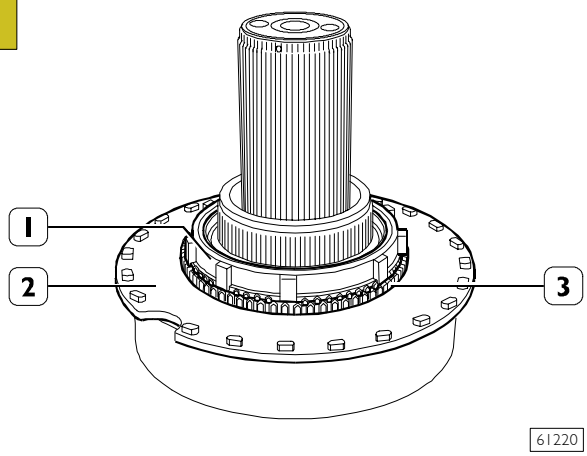
Taking care over the blocks (5) and springs (3 and 4) coming out of the hub (1), extract the sliding sleeve (2) from the hub and remove the seal (6).

Figure 28



Extract hub (6) for sliding sleeve from epicyclic reduction unit shaft (5) with extractor made up of bridge 99341003 (1), brackets 99341021 (2), counter-part 99341058 (3) and grips 99341025 (7) clamp 99341015 (4).

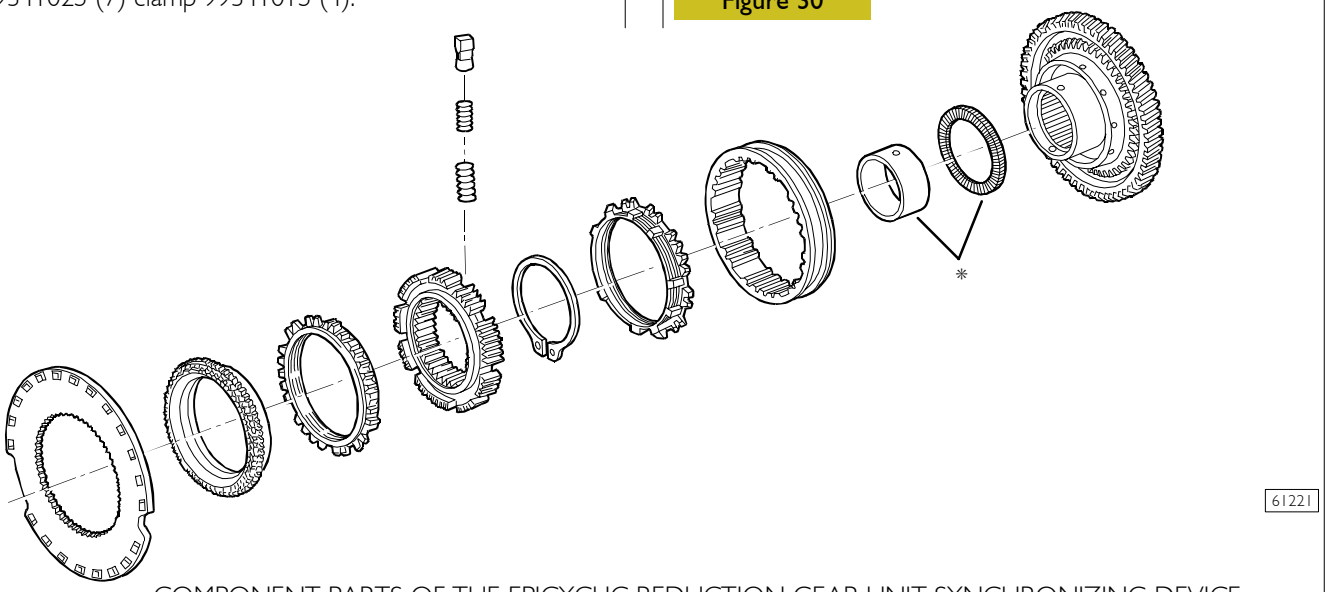
Figure 29



Take off the synchronizer ring (1) and the coupling body (3) together with the plate (2).

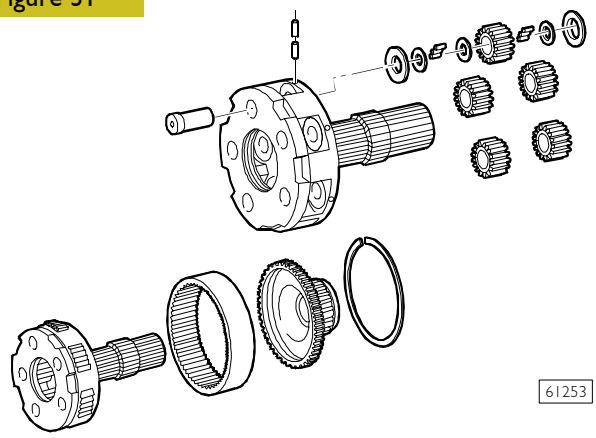
Levering under the coupling body (3), extract it from the plate (2).

Figure 30



COMPONENT PARTS OF THE EPICYCLIC REDUCTION GEAR UNIT SYNCHRONIZING DEVICE

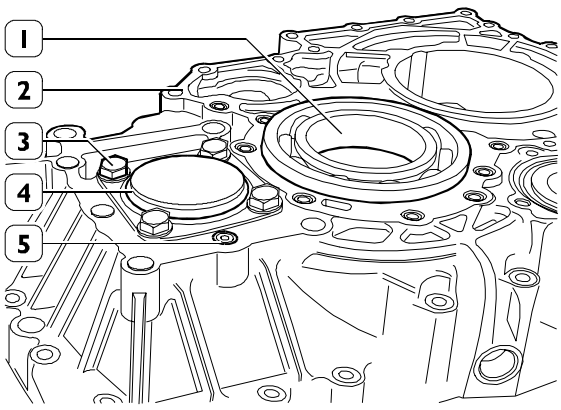
Figure 31



COMPONENT PARTS OF THE EPICYCLIC REDUCTION GEAR UNIT

Remove the epicyclic reduction gear unit as described for gearboxes with no Intarder.

Figure 33

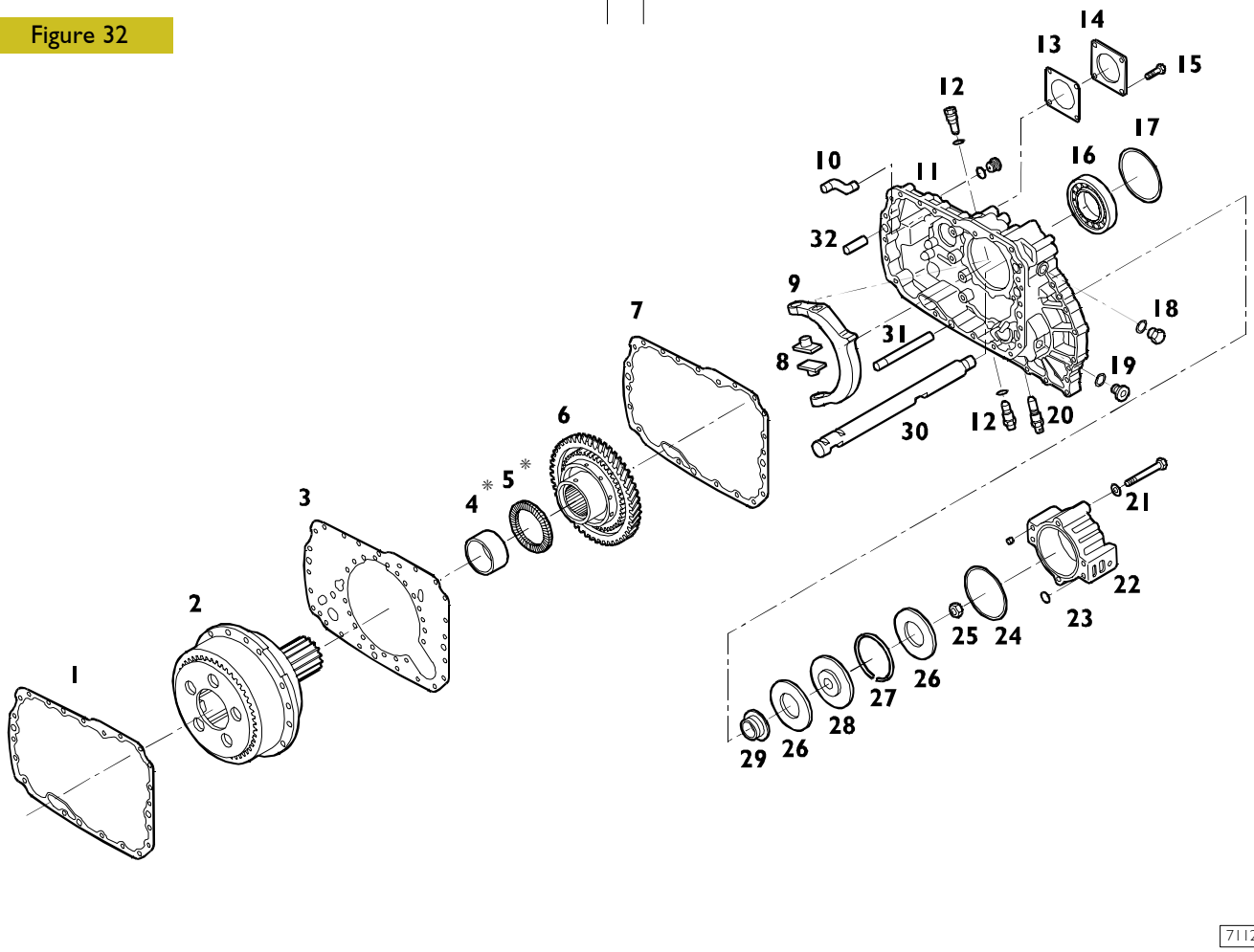


Remove the ball bearing (1) from the ERG box (2).

Unscrew the screws (3) and remove the cover (4).

Unscrew the screw (5).

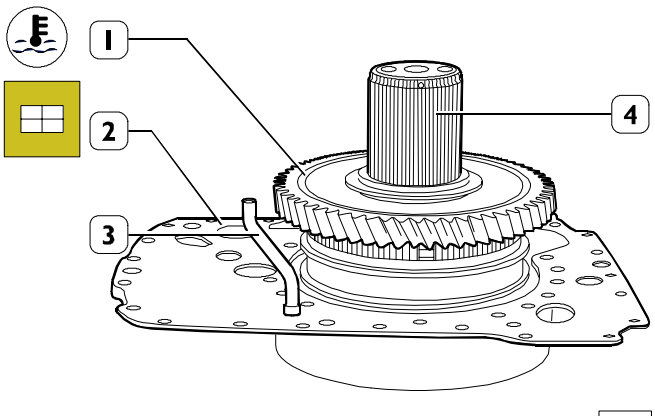
Figure 32



COMPONENT PARTS OF THE ERG CONTROL AND BOX

1. Gasket - 2. ERG - 3. Plate - 4. Bushing - 5. Fifth wheel bearing - 6. Gear - 7. Gasket - 8. Sliding blocks - 9. Fork - 10. Nozzle tube - 11. ERG box - 12. Pin for fork articulation with washer - 13. Gasket - 14. Cover - 15. Screw - 16. Ball bearing - 17. Adjustment ring - 18. Plug with seal - 19. Plug with seal - 20. Sensor - 21. Screw with washer - 22. Cylinder - 23. Seal - 24. Seal - 25. Nut - 26. Seal - 27. Spacer ring - 28. Piston - 29. Seal - 30. Rod - 31. Tube - 32. Pin.

Figure 34

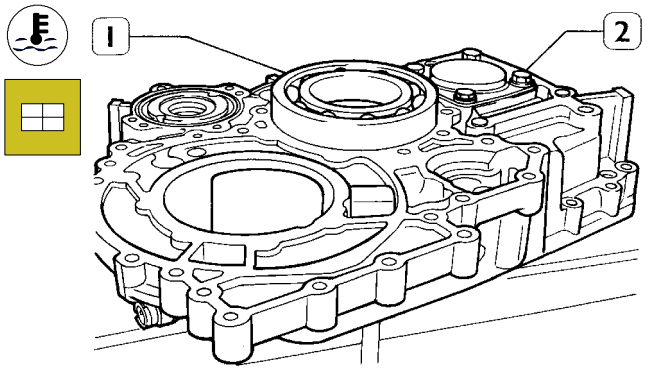


61254

Position the plate (2) together with the tube (3) on the ERG (4).

NOTE Heat the gear (1) to a temperature of 160°C for no longer than 10 sec.
Fit the gear (1) on the ERG shaft (3).

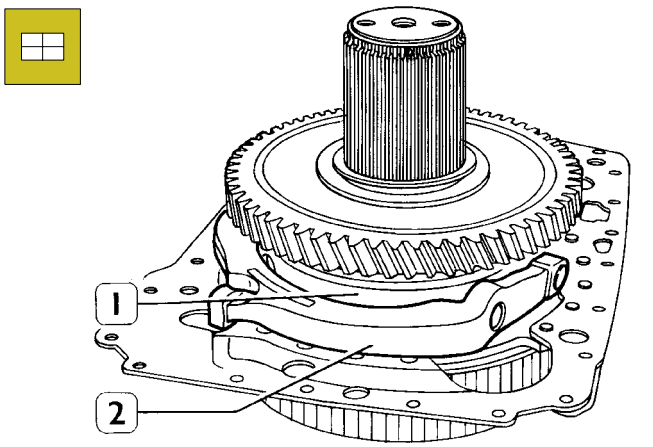
Figure 35



43806

Heat the seat of the ball bearing (1) on the ERG rear box (2) to approx. 60°C and mount the ball bearing (1).

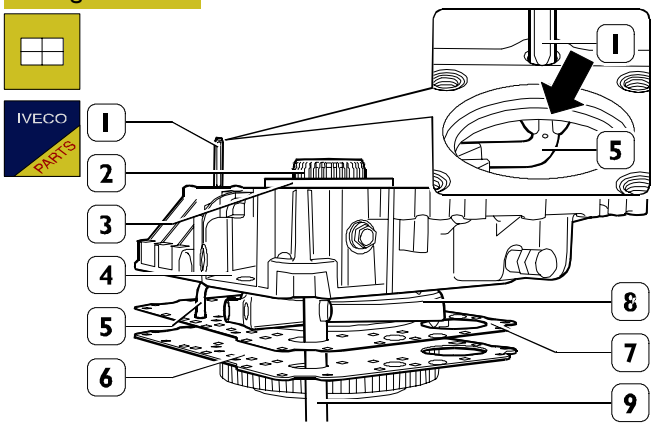
Figure 36



43812

Set the fork (2) with its blocks on the sliding sleeve (1).

Figure 37



61223

Place a new gasket (7) on the plate (6).

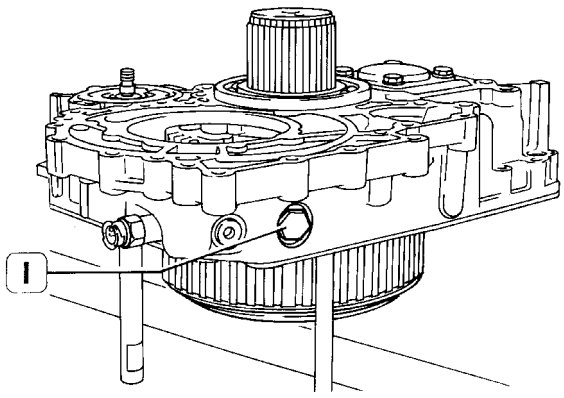
Partially fit the ball bearing (3) with the box (4) on the ERG shaft (2).

Insert the rod (9) into its seat in the box (4).

Position the fork (8) in the slot in the rod (9) and, keeping it in this position, complete the assembly of the ball bearing (3) on the shaft (2).

NOTE When fitting the bearing (3), guide the tube (5) with a punch (1) so it goes into its seat (→) in the box (4).

Figure 38

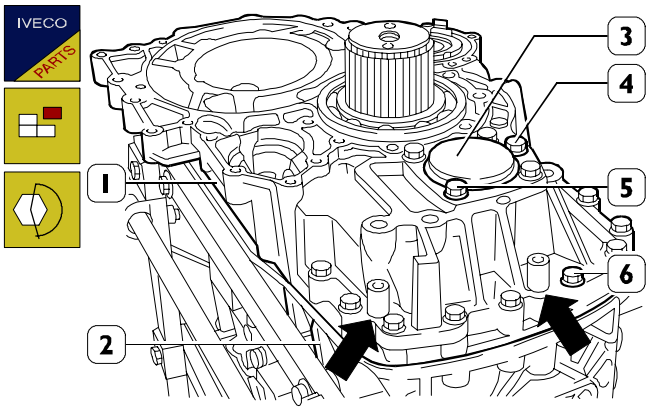


43803

Fasten the fork (2, Figure 36) to the box with the articulation pins (1) and tighten them to the required torque.

Refitting the epicyclic reduction gear unit (ERG) rear box

Figure 39



61224

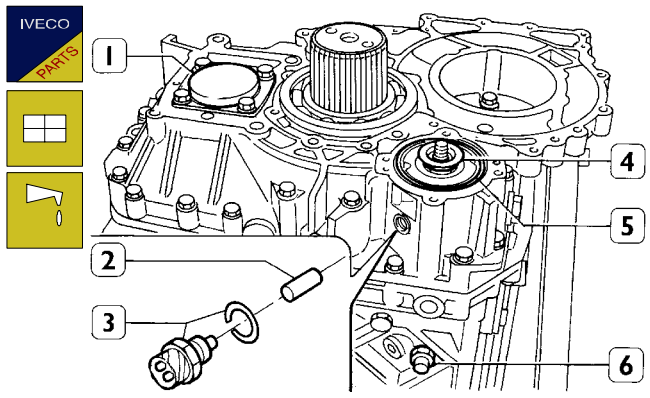
Put a new gasket on the gearbox (2) and refit the ERG rear box (1).

Fit the two centring pins (→) and tighten the fixing screws (6) to the required torque.

Mount the cover (3) with a new gasket and tighten the screws (5) to the required torque.

Screw down the plug (4).

Figure 40

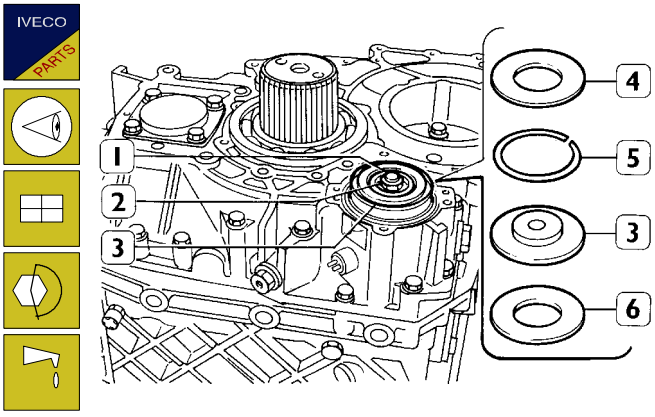


37353

Insert the push rod (2) into the gearbox and fit the switch (3) with the washer. Mount the retaining push rod (6).

Lubricate the seal (5), gasket (4) and mount them on the box (1).

Figure 41

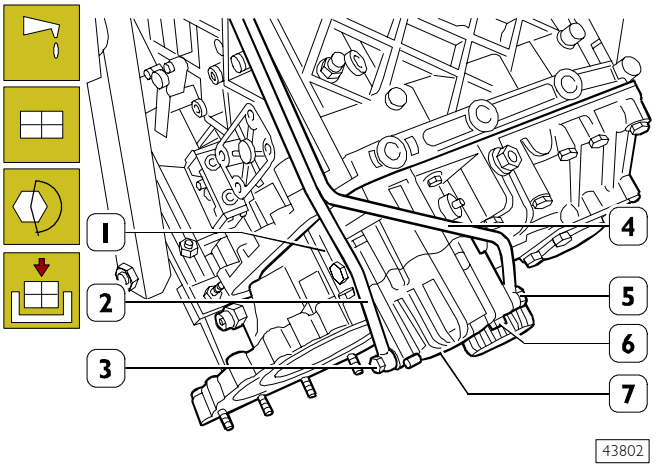


43815

Change the seals (4 and 6), spacer ring (5) of the piston (3) and lubricate them.

Fit the piston (3) on the rod (1) and tighten the nut (2) to the required torque.

Figure 42



43802

Lubricate the inside of the cylinder (7), fit it on the box (1) and tighten the fixing screws (6) to the required torque.

Connect the pipes (2 and 4) to the cylinder (7), screwing down the fittings (3 and 5) with new washers and tightening them to the required torque.

Reconnect hydraulic decelerator as described in relating chapter and fill the unit with oil by prescribed quantity and quality.

Gearboxes EuroTronic Automated: - 12 AS 1930 T.D. - 12 AS 2330 T.D./T.O. - 12 AS 2530 T.O.

DESCRIPTION

Eurotronic Automated gearbox is an electrical-pneumatic drive mechanical type gearbox electronically managed by central unit. It has twelve forward gears and two reverse gears.

Gears selection and engagement functions are actuated by the help of an electronic central unit controlling clutch handling and engine rpm's during gear shift. A pneumatic device inside the gearbox decreases secondary shaft rpm's facilitating gear engagement.

All gearbox functions are managed by an electronic central unit, which receives signals from various electrical and electronic systems aboard via CAN line and controls various components optimising manoeuvres and managing manoeuvres safety.

The driver can choose whether to actuate gear selection manually or in semiautomatic mode, or to use completely automatic management.

With semiautomatic operation, the driver engages the various gears very easily by driving the selector lever, without needing to release accelerator pedal.

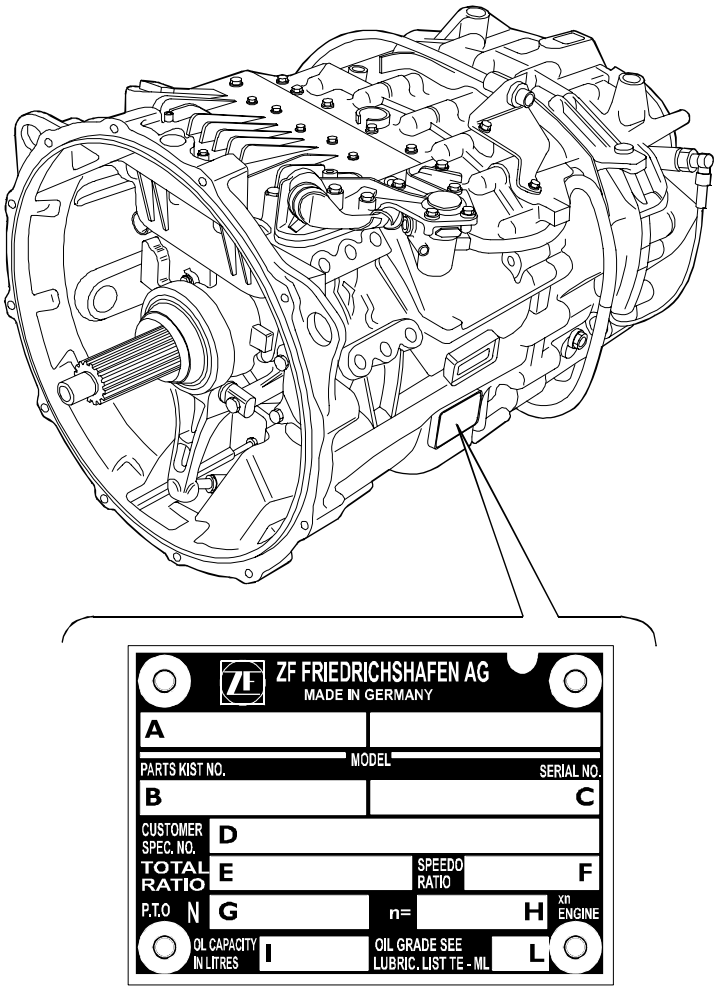
With automatic operation, the driver only drives accelerator or brake pedal; the gears are engaged automatically.

The gears are selected with finely shifted ratios and can be entered successively. Positioned in gearbox rear side is G.R.E. (Epicycloidal Reducer), that can be inserted by a sliding sleeve shift. The sliding sleeve allows to double front box ratios number. Such number can be further multiplied via "Splitter" engagement. Each single ratio consequently results to be split into an either slow or fast ratio. The engagements of G.R.E. and "Splitter" are synchronised.

A display unit on instrument panel warns about each system operation, as well as any operation faults.

LOCATION OF GEARBOX DESCRIPTION PLATE

Figure 1



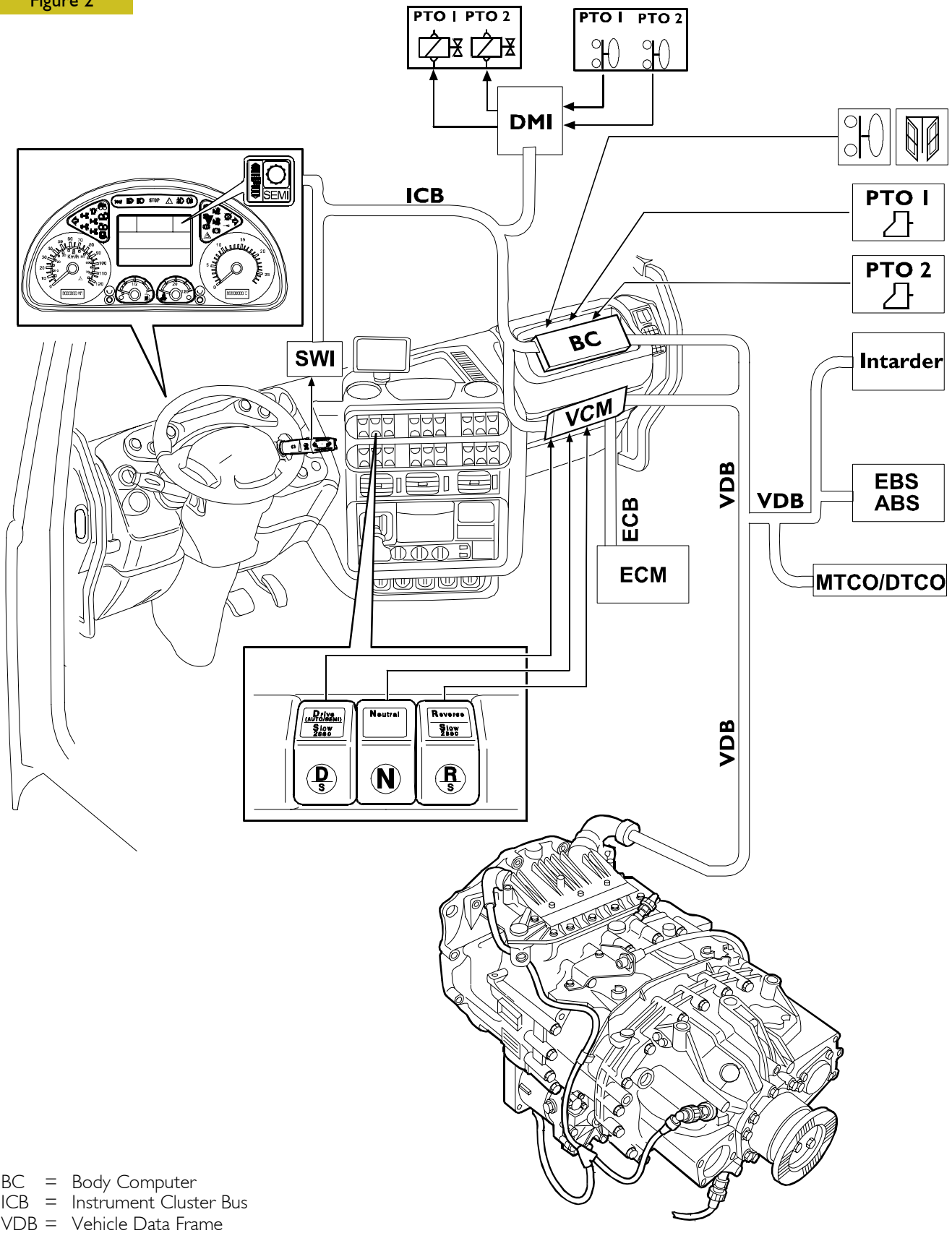
112203

A = Type of transmission
B = ZF drawing no.
C = Production sequence number
D = Spare part IVECO drawing no.
E = Transmission gear ratio
F = Tachometer gear ratio
G = Type of power take-off
H = Power take-off gear ratio
I = Replacement oil amount
L = ZF lubricant list name

P.T.O. = Power take-off

GEARBOX ELECTRONIC MANAGEMENT
Theoretical scheme

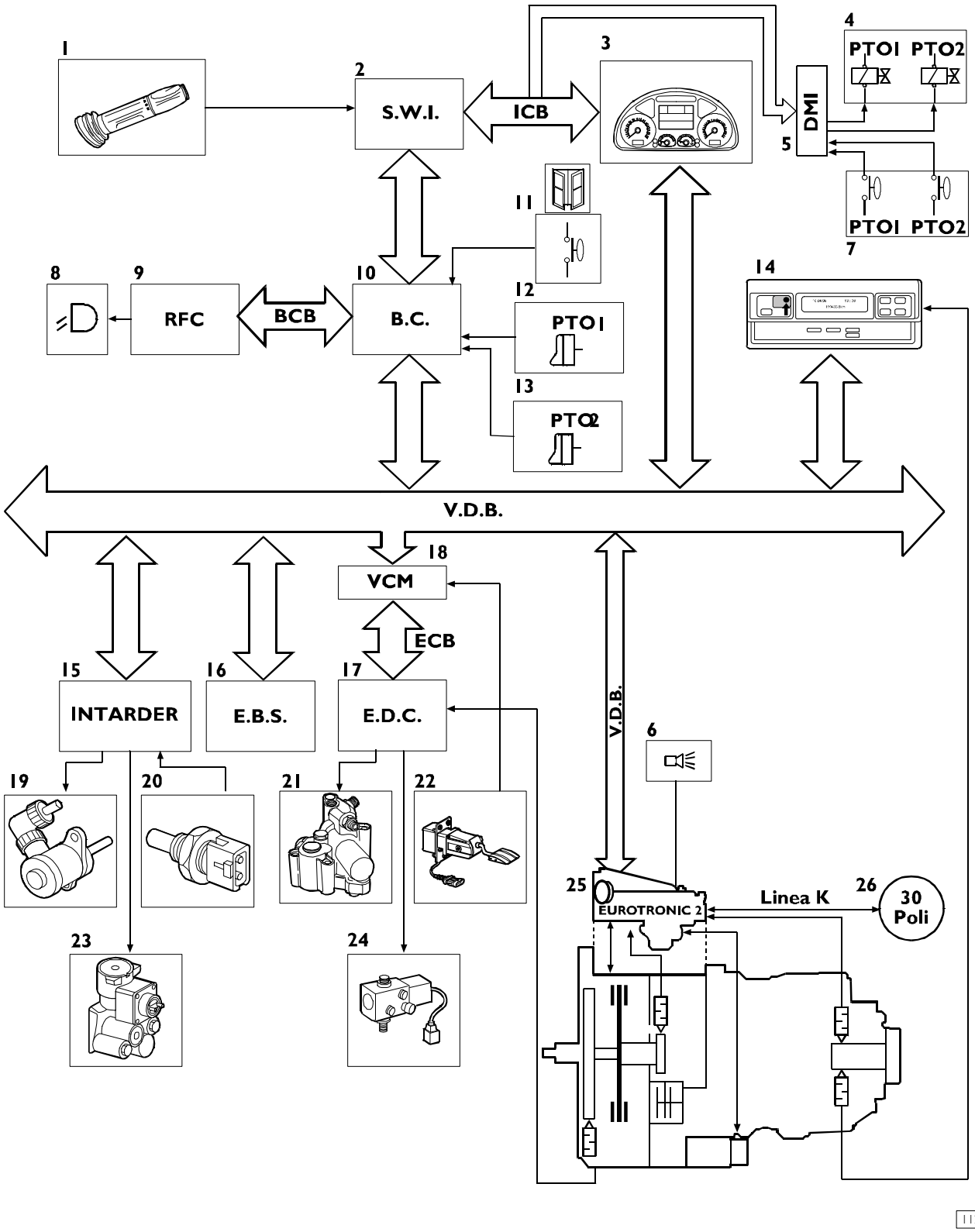
Figure 2



BC = Body Computer
ICB = Instrument Cluster Bus
VDB = Vehicle Data Frame
ECM = Engine Control Module
DMI = Data Management Interface
ECB = Engine Control Bus

112204

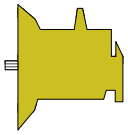
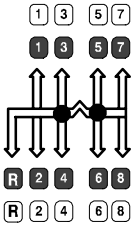
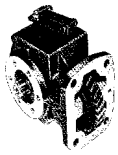
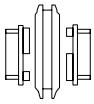
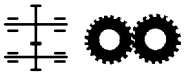
Figure 3



OPERATION SCHEME

1. Multifunction lever - 2. Steering Wheel Interface - 3. Instrument Cluster - 4. PTO solenoid valve - 5. DMI - 6. External buzzer - 7. PTO engaged signalling switches - 8. Reversing lights - 9. Rear Frame Computer - 10. Body Computer - 11. Door open switch - 12. Switches to request PTO1 engagement - 13. Switches to request PTO2 engagement - 14. Tachograph - 15. Intarder control unit - 16. EBS control unit - 17. EDC control unit - 18. VCM - 19. Proportional solenoid valve - 20. Coolant temperature sensor - 21. Exhaust-brake solenoid valve - 22. Accelerator pedal - 23. ON/OFF solenoid valve - 24. VGT solenoid valve - 25. Gearbox control unit / actuator - 26. Diagnosis connector

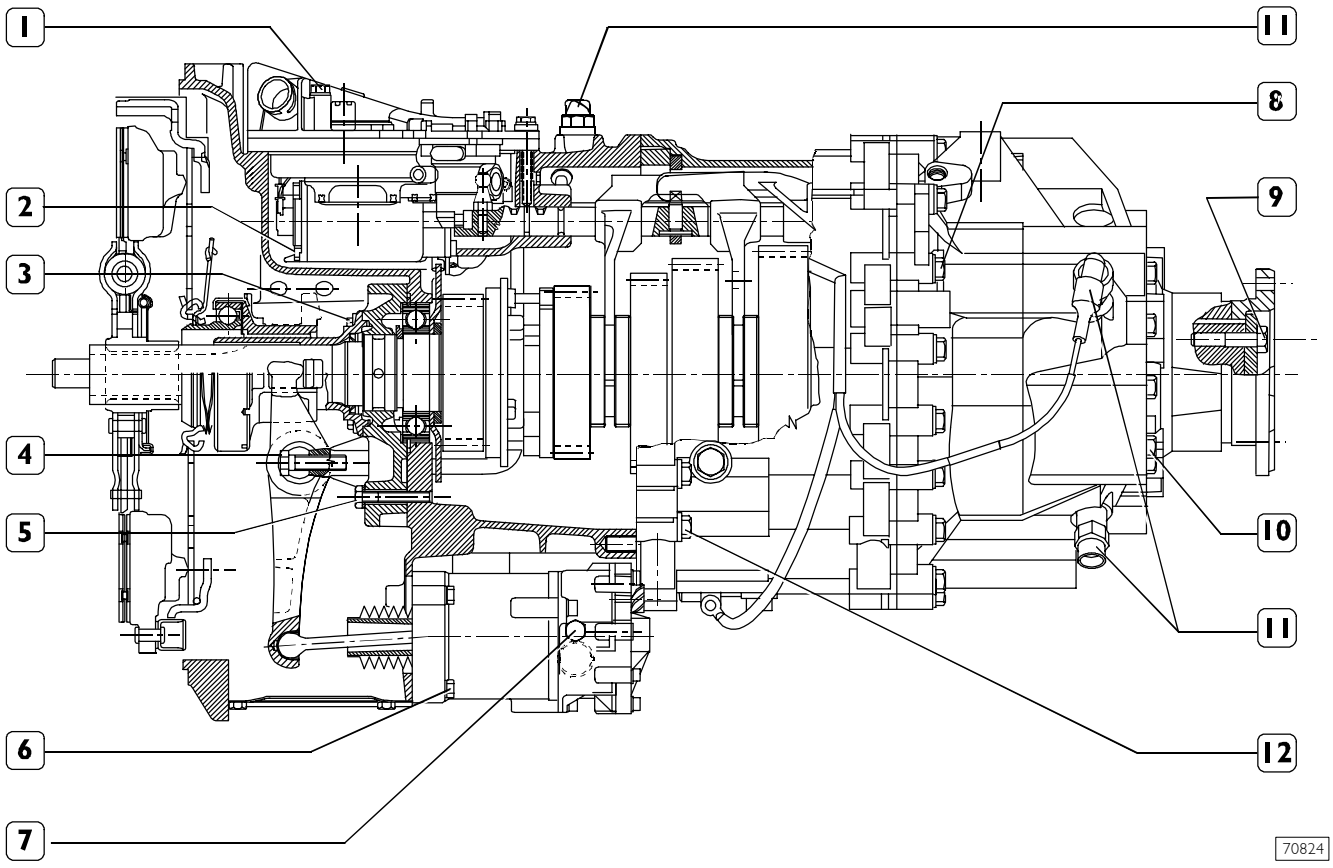
SPECIFICATIONS AND DATA

	GEARBOXES	EuroTronic			
		12 AS 1930 TD	12 AS 2330 TD	12 AS 2330 TO	12 AS 2530 TO
	Type	Mechanical			
	Torque activated Nm	1900	2300	2300	2500
	Forward gears	12		12	
	Reverse gears	2		2	
	Type of running control	semiautomatic/automatic with electronic management			
	Side and/or rear power take-off	optional			
	Gear clutch : Splitter and G.R.E clutch.*	through synchroniser frontal clutch sleeves with free ring			
	Gears	with epicyclic teeth constantly meshing			
	Gear ratios				
	1st	15.86		12.33	
	2nd	12.33		9.59	
	3rd	9.57		7.44	
	4th	7.44		5.78	
	5th	5.87		4.57	
	6th	4.57		3.55	
	7th	3.47		2.70	
	8th	2.70		2.10	
	9th	2.10		1.63	
	10th	1.63		1.27	
	11th	1.29		1.00	
	1st reverse gear	1.00		0.78	
	2nd reverse gear	14.68		11.41	
		11.41		8.88	
	Oil type	Tutela Truck Fe-Gear Tutela ZC 90			
	- 1st filling Litres	12			
	kg	11			

* ERG = Epicyclic reduction gear unit
T.D. = Truck Direct Drive
T.O. = Truck Over Drive (Multiplied)

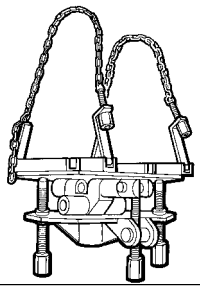
TIGHTENING TORQUES

Figure 4



DESCRIPTION		TORQUE	
		Nm	kgm
1	Screws fixing gearbox actuator	23	2.3
2	Screw fixing oil pump	10	1
3	Screws fixing drive input shaft cover	23	2.3
4	Screw fixing clutch uncoupling lever control pin: - M 12 8.8 - M 12 10.9	 79 115	 7.9 11.5
5	Screws fixing cover (spread LOCTITE 241 on the thread)	79	7.9
6	Screws fixing clutch actuator	23	2.3
7	Screw cap to discharge air from clutch actuator	22	2.2
8	Screws fixing rear box to middle box	46	4.6
9	Screws fixing flange retaining plate	120	12
10	Screws fixing rear cover	5	4.6
11	Speed sensor	45	4.5
12	Screws fixing middle box to front box	50	5
	Pin on rod (spread LOCTITE 262 on the thread)	23	2.3
	Oil vapour vent	10	1
	Screw plug M 10x1 on rear box	15	1.5
	Screw plug M 24x1 on rear box	60	6
	Screw M12 fixing power take-off bay cover	79	7.9
	Screw plug M 24x1.5 on middle box	60	6
	Screw fixing plates retaining fork joint pins on rear box	23	2.3

TOOLS

TOOL NO.		DESCRIPTION
99370629		Mount to support gearbox when removing and fitting it back on the vehicle

530210 REMOVING-REFITTING GEARBOX

Removal

NOTE There follows a description of the operations for removing-refitting a gearbox with Intarder that, barring the asterisked operations, hold for the gearbox without intarder too.

To remove the gearbox, proceed as follows:

- ❑ set the vehicle over a pit or on a lift;
- ❑ disconnect the battery cables to avoid any possible short-circuiting;
- ❑ remove any sound-proofing guards that may be fitted on the engine and the entry boards;
- ❑ drain engine coolant;
- ❑ disconnect the wiring via the connectors (→) and disengage it from any clamps;
- ❑ disconnect the electrical connections (3) and (18) on the electronic control unit;
- ❑ disconnect the air supply pipe (19);
- ❑ * disengage the water delivery and return pipes (4 and 12) from the sleeves (1) on the engine;
- ❑ * disconnect the water delivery pipe (4) via the sleeve (13) and disengage it from any clamps on the gearbox;
- ❑ * disconnect the water return pipe (12) via the sleeve (16) (det. C) and disengage it from any clamps on the gearbox; remove the air pipe (17) too;
- ❑ disconnect the air pipe (7) of the servo-clutch cylinder (8) (det. A);
- ❑ remove the fasteners (9) (det. A) of the servo-clutch cylinder and extract it from the gearbox;
- ❑ disconnect the drier air discharge pipe (10) from the discharge pipe (11) (det. B);
- ❑ remove the outlet pipe (11) disconnecting it from the associated collars on the silencer and turbine and disengaging it from the fastener on the chassis frame;
- ❑ put a hydraulic jack fitted with the mount 99370629 under the gearbox and sling the gearbox mount;
- ❑ remove the screws (6) (det. A) fixing the crosspiece (5) to the chassis frame and remove the crosspiece;
- ❑ disconnect the propeller shaft (15) using the screws (14) and fasten it to the vehicle's chassis frame so it won't interfere with the removal of the gearbox;
- ❑ take out the screws (2) fixing the gearbox to the engine;
- ❑ take the gearbox out of its seat.

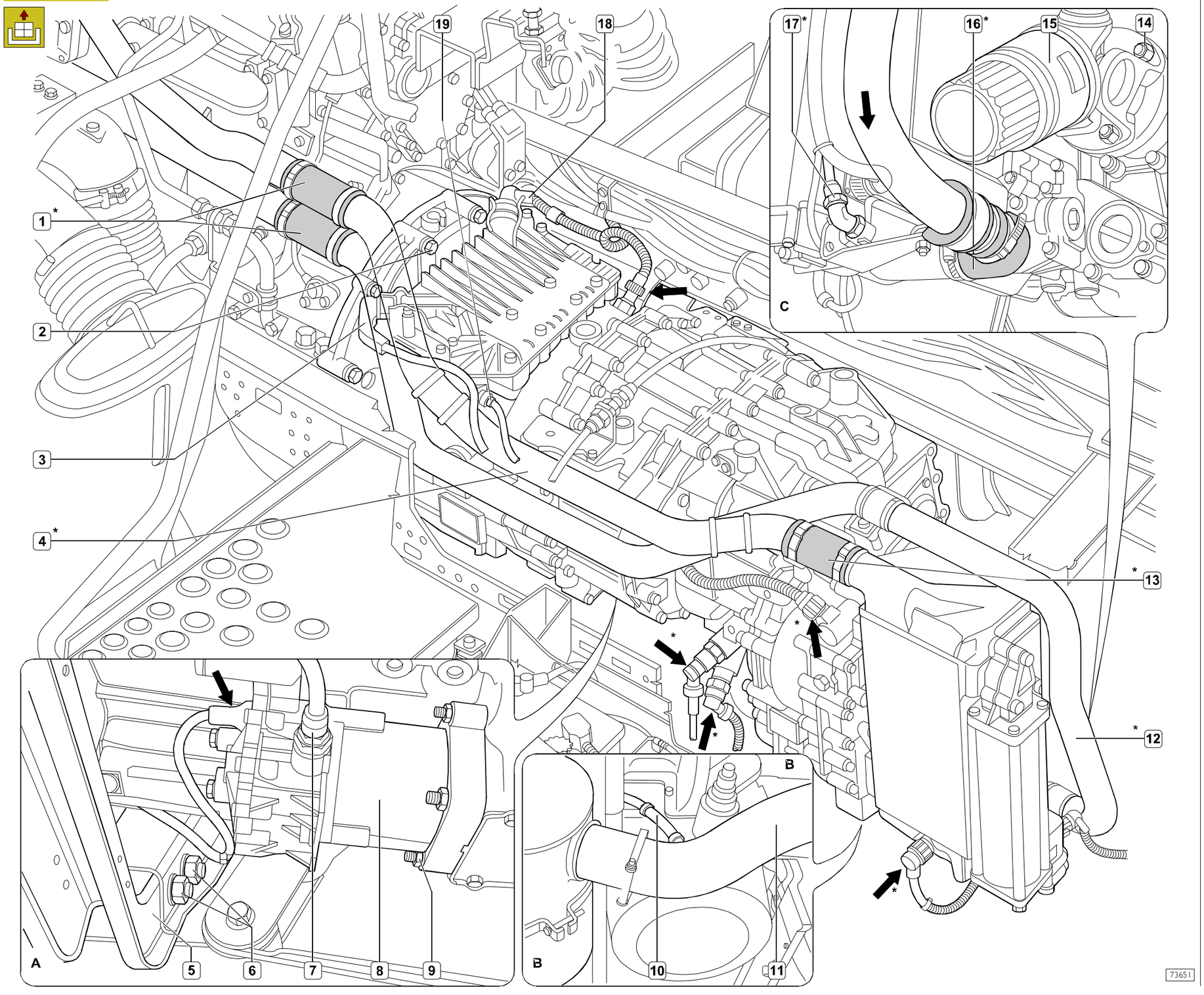
NOTE If the cross member of the chassis frame prevents you from removing the gearbox, you need to drain off the oil from the intarder; take out the nuts and screws fixing the heat exchanger to the intarder, remove the stud bolts and detach the heat exchanger.

Refitting

Carry out the operations described for removal in reverse order and tighten the fixing nuts and screws to the required torque.

NOTE For gearboxes with intarder, proceed as follows: apply LOCTITE 510 onto the thread of the stud bolts fixing the heat exchanger and screw then onto the gearbox; connect the refrigerant fluid pipes to the heat exchanger and replenish the gearbox with the required amount of oil; fill the engine cooling system as described in Section 2 Engine.

Figure 5



Gearboxes
EuroTronic Automated with Intarder:
- 12 AS 1931 T.D.
- 12 AS 2331 T.D./T.O.
- 12 AS 2531 T.O.

NOTE This differs from the 12 AS 1930 T.D. - 12 AS 2330 T.D./T.O. - 12 AS 2530 T.O. gearbox in the following:

SPECIFICATIONS AND DATA

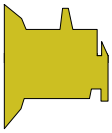
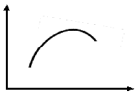
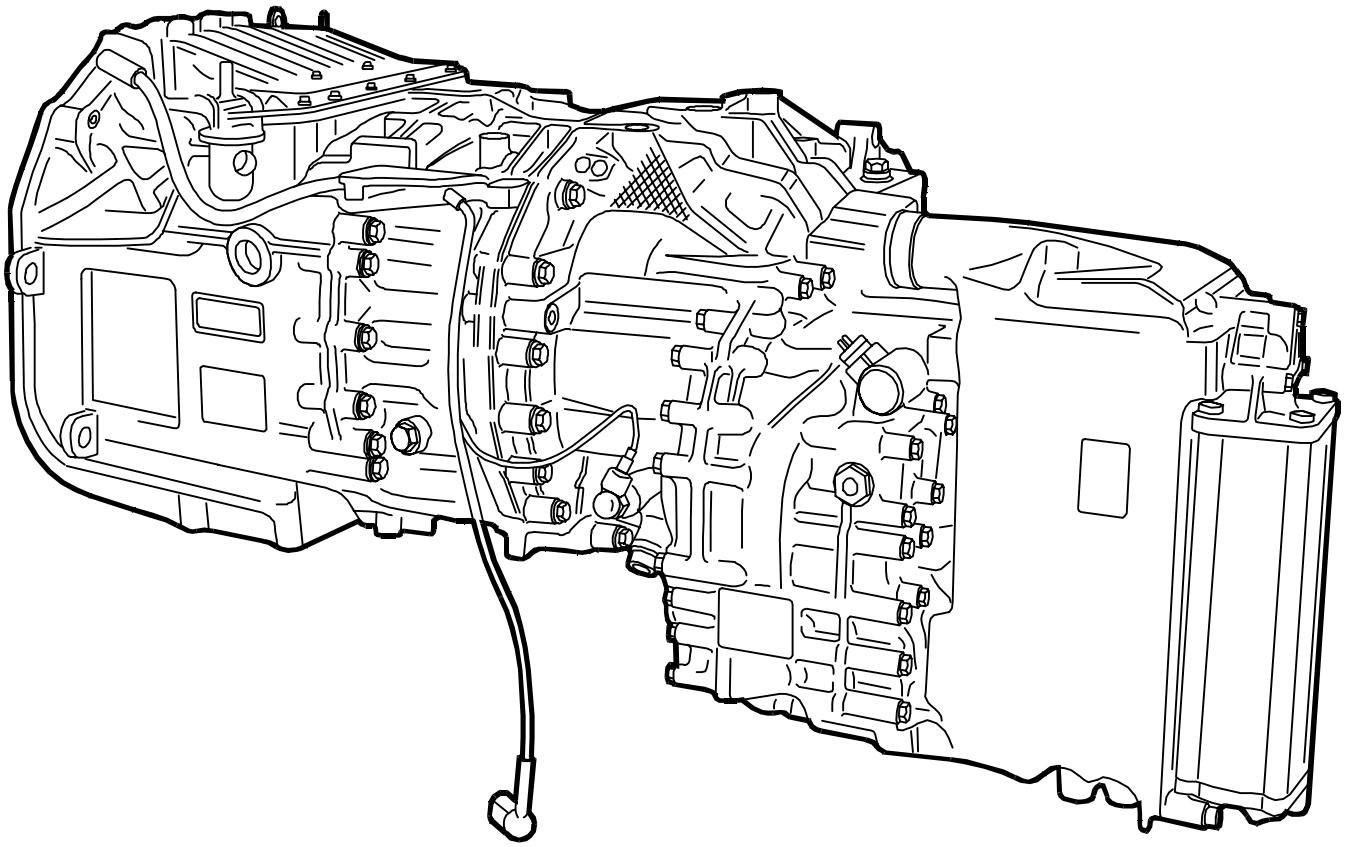
	GEARBOXES	12 AS 1931 T.D. 12 AS 2331 T.D./T.O. 12 AS 2531 T.O.
	Maximum braking torque Nm Braking capacity Kw	3200 500
	Type of oil Quantity after overhauling gearbox and retarder drained completely litres kg	Tutela Truck Fe - Gear Tutela ZC 90 21 18.9

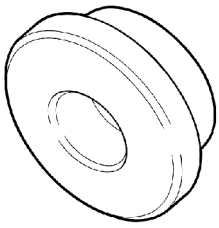
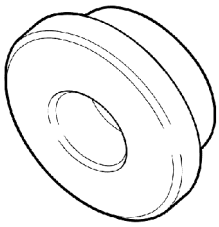
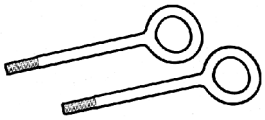
Figure 1



T.D. = Truck Direct Drive
T.O. = Truck Over Drive (Multiplied)

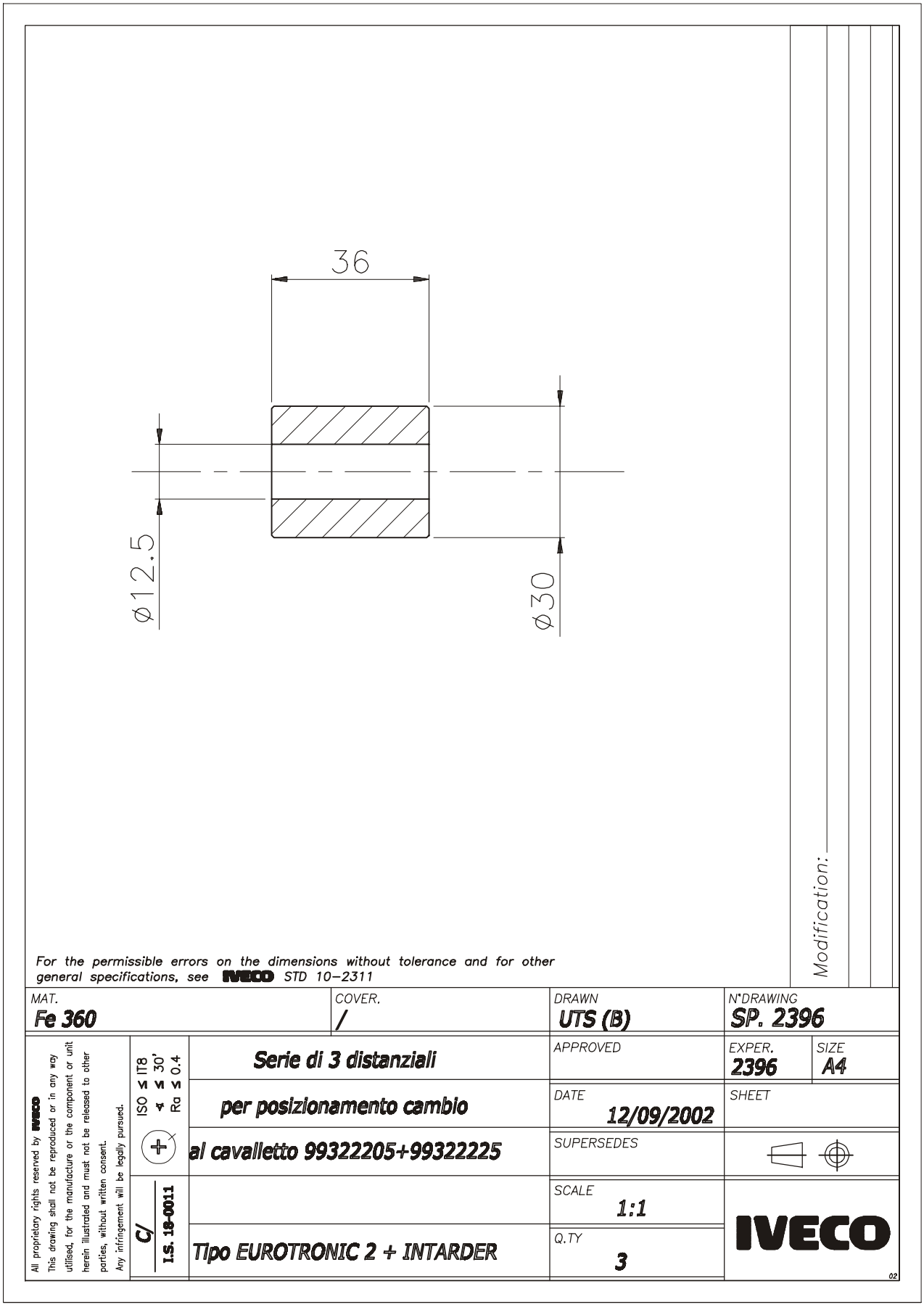
70831

TOOLS

TOOL NO.		DESCRIPTION
99345056		Reaction block for extractors
99345058		Reaction block for extractors
99370565		M10 eyebolts (2) for lifting various assemblies

EXPERIMENTAL TOOLS

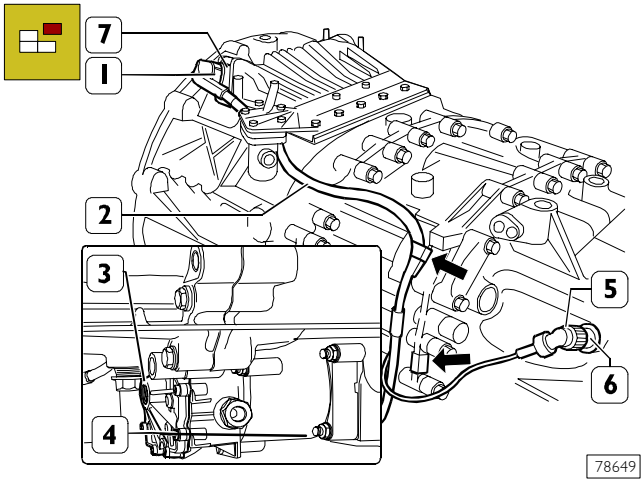
This heading covers the working drawing for the experimental tool (S.P. 2396) used when overhauling the gearbox described in this section, which can be made by the repair shop.



530210 OVERHAULING THE GEARBOX

Removing the hydraulic retarder

Figure 2

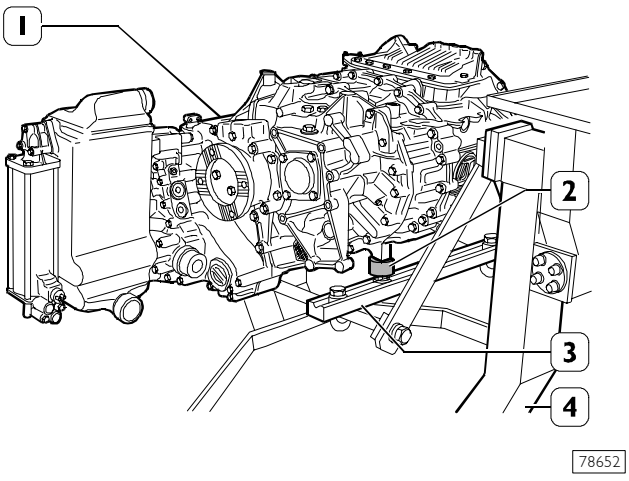


Unscrew the ring nut (1 and 5) and disconnect the electric wiring (2) from the speed sensor (6 and 7).

Detach the wiring (2) from the clips (→) securing it to the middle box.

Remove the nuts (4) and detach the actuator (3) from the front box.

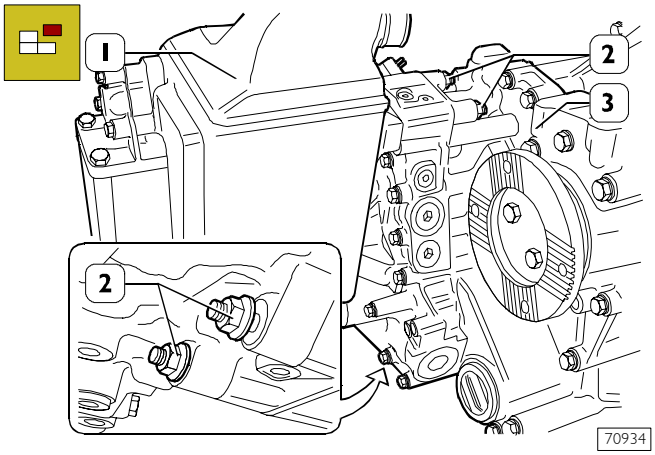
Figure 3



Fir spacers SP. 2396 (2) and fasten the gearbox (1) to brackets 99322225 (3) on the rotating stand 99322205 (4).

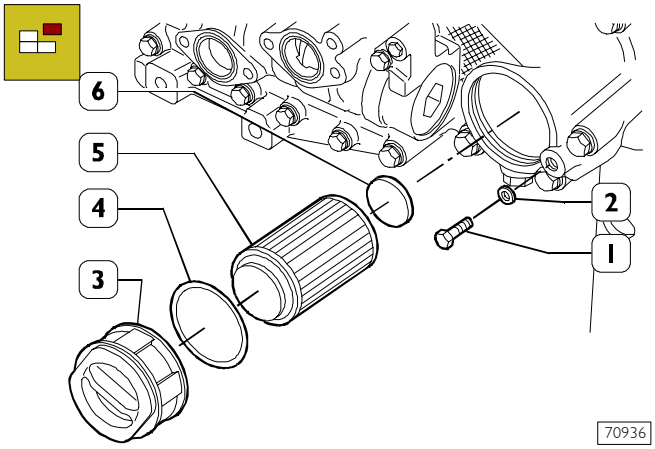
Drain off the lubricating oil by removing the plugs from the Intarder and from the gearbox.

Figure 4



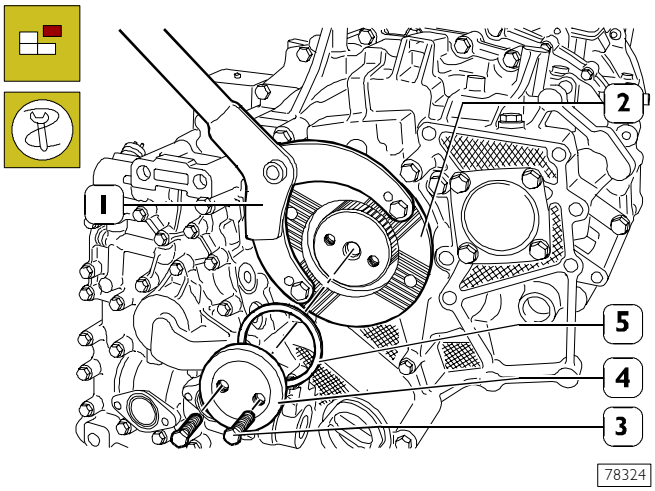
If applicable, remove the four nuts (2) fixing the heat exchanger (1) to the hydraulic retarder (3) and detach the heat exchanger (1).

Figure 5



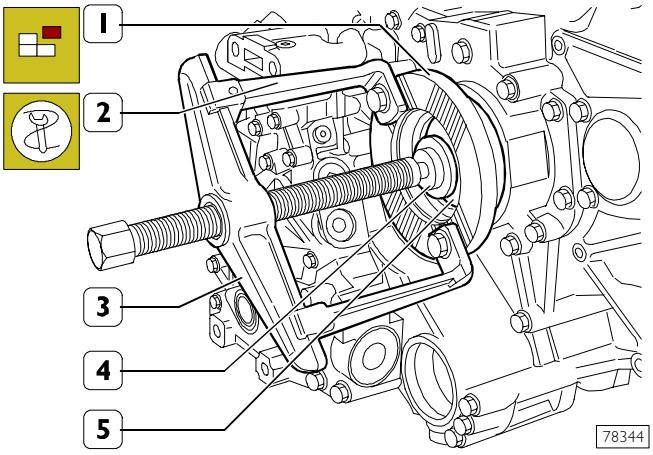
Remove the screw (1) and the washer (2) beneath. Extract the plug (3) with the seal (4), oil filter (5) and magnet (6).

Figure 6



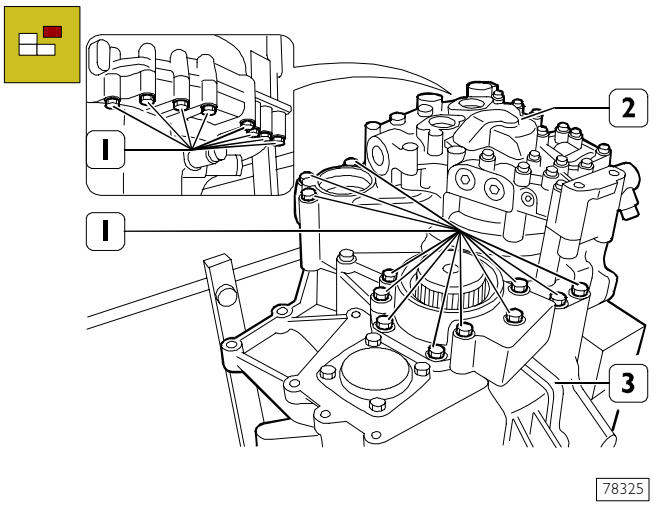
Block rotation of the sleeve (2) by applying the lever 99370317 (1) to it and remove the screws (3), disc (4) and underlying seal (5).

Figure 7



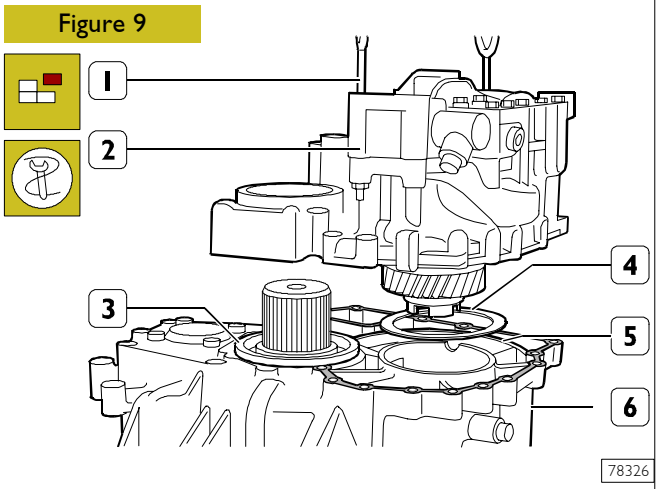
Using an extractor composed of the bridge 99341003 (3), brackets 99341018 (2) and reaction block 993410134 (4), remove the sleeve (1) from the shaft (5).

Figure 8



Remove the screws (1) fixing the hydraulic retarder (2) to the rear box (3).

Figure 9



Fit the eyebolt 99370565 (1) to the hydraulic retarder (2). With special ropes and lifter, detach the hydraulic retarder (2) from the rear box (5).

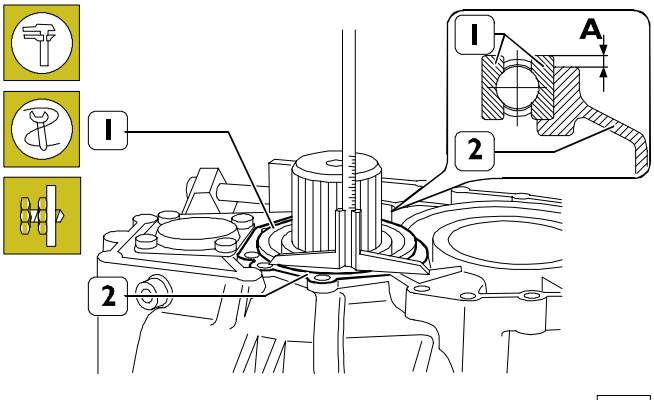
Remove the adjustment rings (3 and 4) and the gasket (6).

Refitting the hydraulic retarder

Before refitting, determine the thickness of the adjustment rings (3 and 4, Figure 9) as follows:

Adjusting epicyclic reduction gear train bearing end float

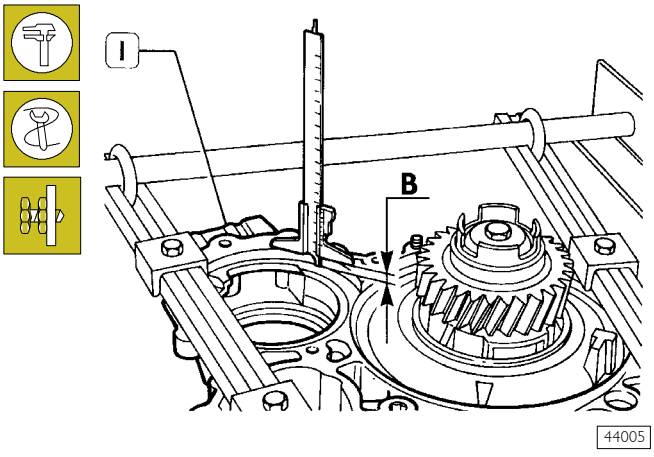
Figure 10



Determine the ball bearing end float adjustment thickness (1) by proceeding as follows:

- ❑ measure the protrusion of the bearing (1) from the surface of the rear box (2): distance **A;**

Figure 11



- ❑ measure the distance between the sealing surface (1) of the half box of the retarder and the supporting surface of the bearing (1, Figure 10): distance **B;**
- ❑ measure the thickness of the gasket between the retarder and gearbox: distance **C.**

The thickness S of the adjustment ring is given by the following equation:

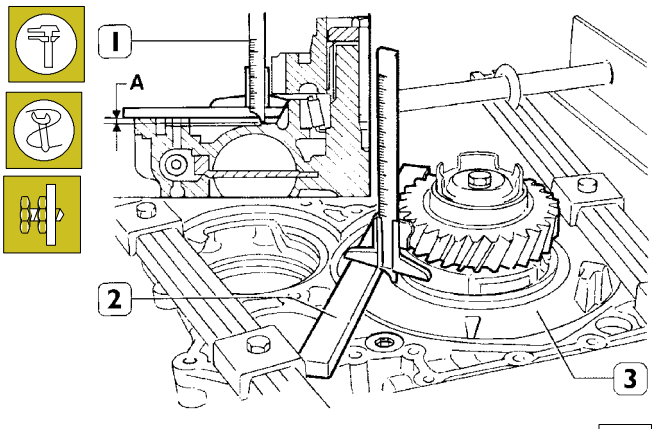
$$S = [B + C - A] - G$$

where:

- ❑ B - C - A = measurements
- ❑ G = 0.1 mm: end float of the ball bearing (1 Figure 10) (0 ÷ 0.1 mm)

Adjusting stator end float

Figure 12

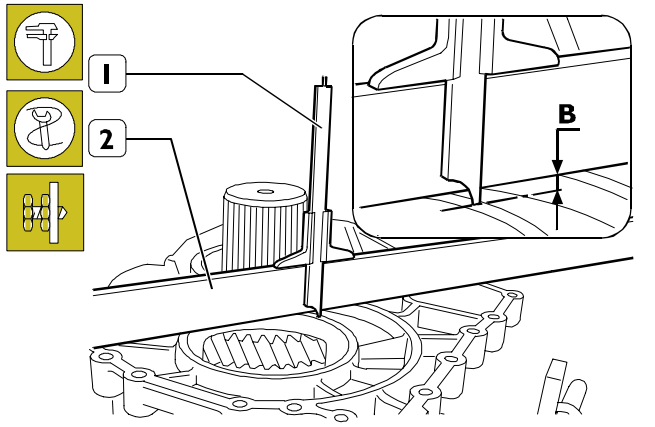


70946

Determine the thickness **S** of the stator end float adjustment ring:

- using a depth gauge (1) and calibrated rule (2), measure the distance between the sealing surface of the half boxes and the supporting surface of the stator (3): distance **A**;

Figure 13



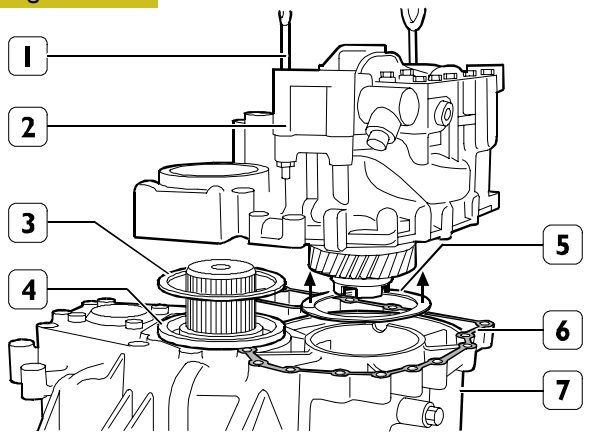
106403

- with depth gauge (1) and calibrated ruler (2), measure distance **B** between adjusting ring (5,) rest surface and hydraulic decelerator rest surface;
- measure the thickness of the gasket between the retarder and gearbox: distance **C**.

The thickness S of the stator end float adjustment ring is given by the following sum: **S = A+B+C+D**

- **A, B** and **C** = measurements
- **D** = 0.05 mm: stator end float adjustment ring pre-load. (- 0.05 ÷ 0.05 mm)

Figure 14



78327

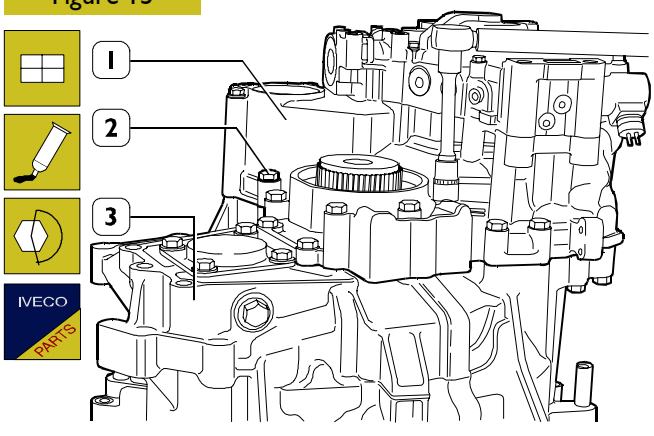
Fit the eyebolt 99370565 (1) to the hydraulic retarder (2) and lift it with a hoist.

Position the adjustment rings (3 and 5) of the thickness determined in the preceding measurements on the bearing (4) and on the seat (→) of the stator.

Fit a new gasket (6) on the rear box.

Mount the hydraulic retarder (2) on the rear box (7) making sure that the gasket (6) gets positioned correctly.

Figure 15



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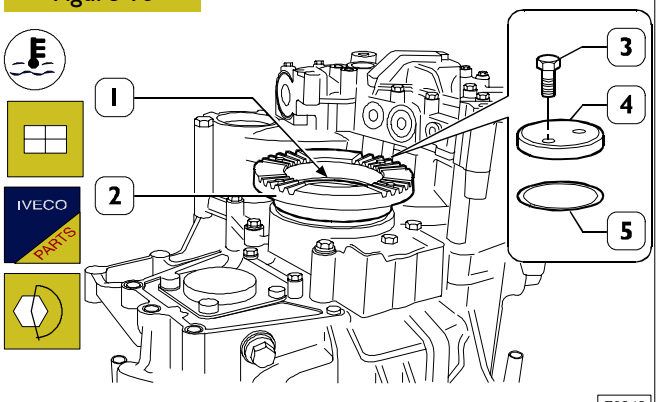
Screw down the screws (2) fixing the hydraulic retarder (1) to the rear box (3) and tighten them to the prescribed torque.

Adjusting stator end float

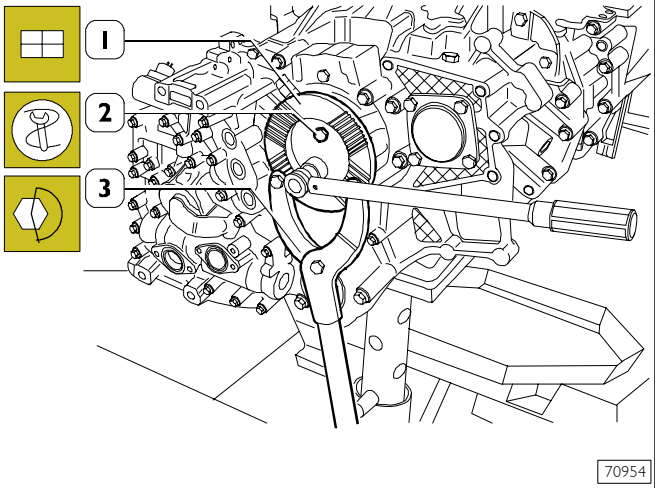
Figure 16



Heat the flange (2) to approx. 80°C and fit it onto the spider shaft (1).

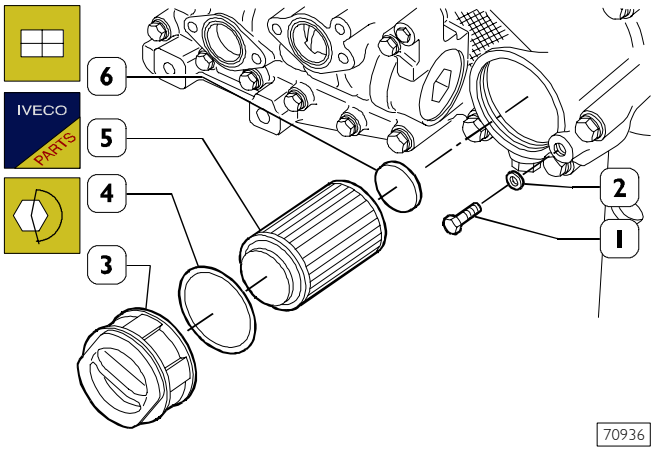
Fit on a new seal (5), the disc (4), screw down the screws (3) and tighten them to the prescribed torque.

Figure 17



Block rotation of the sleeve (1) by applying the lever 99370317 (3) and tighten the fixing screws (2) to the prescribed torque.

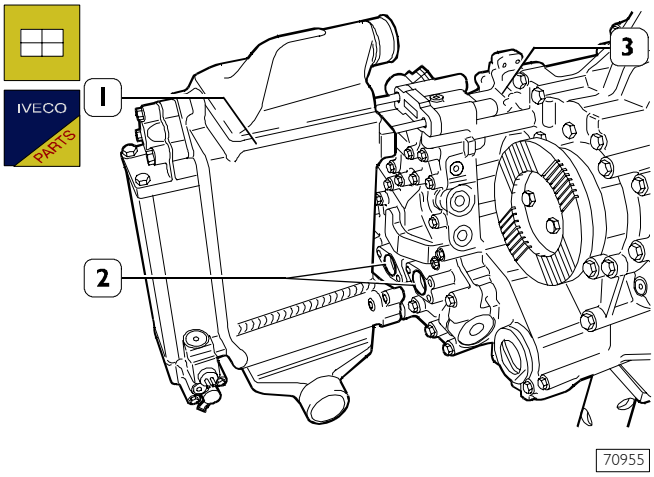
Figure 18



Position the magnet (6) on the filter (5) and insert this into the hydraulic retarder. Fit the plug (3) with a new seal (4).

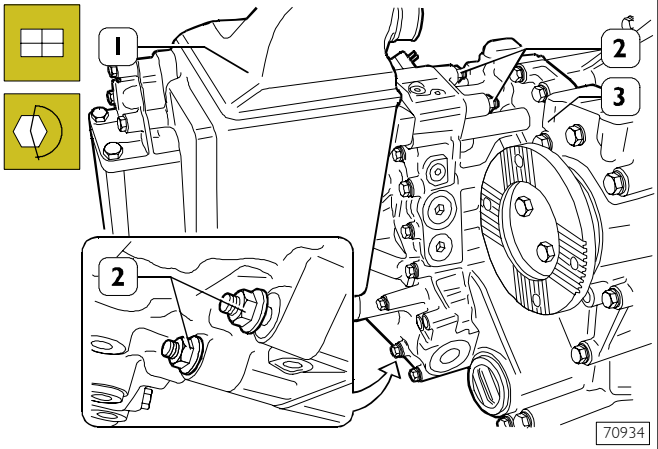
Screw down the fastening screw (1) with the washer (2).

Figure 19



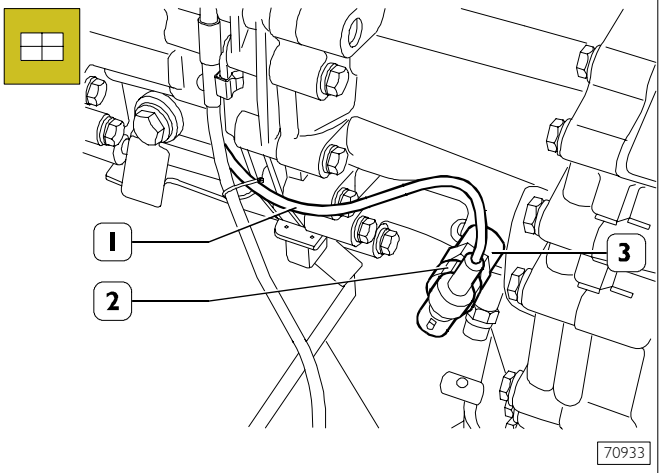
Fit two new seals (2) on the hydraulic retarder (3) and mount the heat exchanger (1) (if applicable).

Figure 20



Screw down the four nuts (2) fixing the heat exchanger (1) to the hydraulic retarder (3) and tighten them to the prescribed torque.

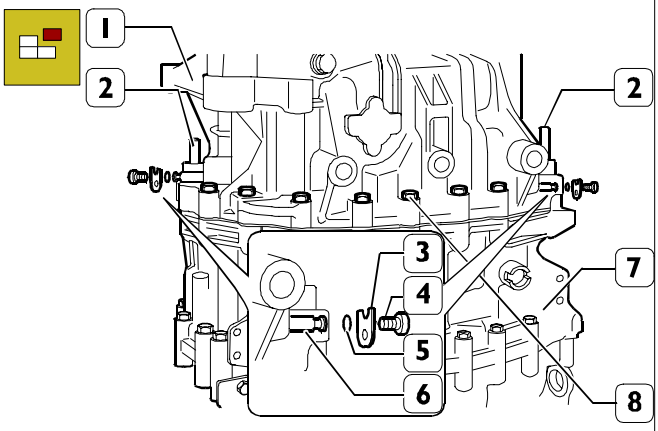
Figure 21



Connect the electric wiring (1) to the speed sensor (3) and tighten the ring nut (2).
Replenish the gearbox with the prescribed grade and quantity of lubricating oil.

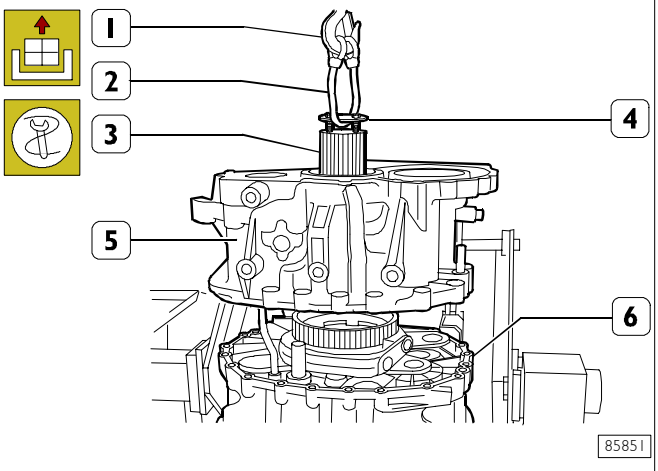
Removing the rear box

Figure 22



Disconnect the gear actuator, as described in the respective chapter.
Remove the hydraulic retarder as described under the relevant heading.
Remove the fastening screws (4) of the plates (3) retaining the pins (6) and remove the pins with the O-rings (5) from the central case (7).
Take off the locating pins (2) and remove the rear case (1) fastening screws (8).

Figure 23

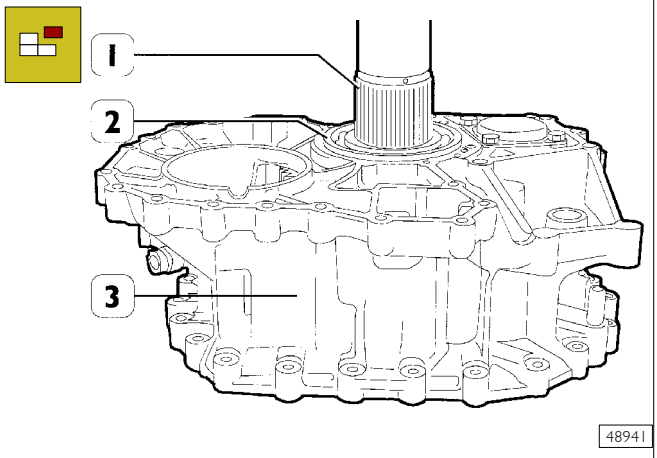


Apply the flange fastening plate (4) on the planetary gear shaft (3) and leave enough clearance to let the rope (2) pass through.

Hook the rope to a hoist (1) and remove the rear case (5) from the central case (6).

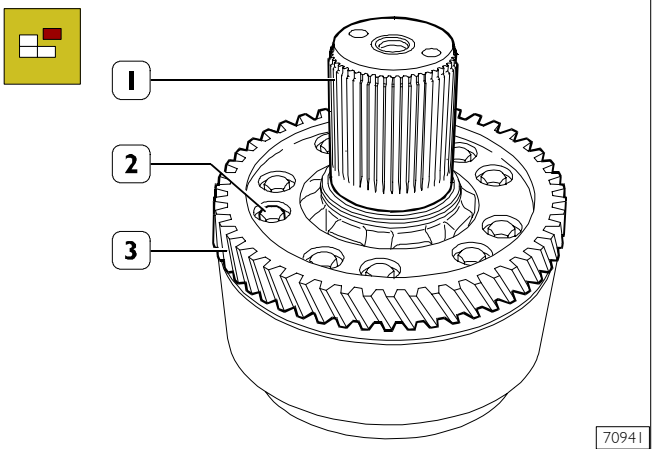
Disassembling the E.R.G.

Figure 24



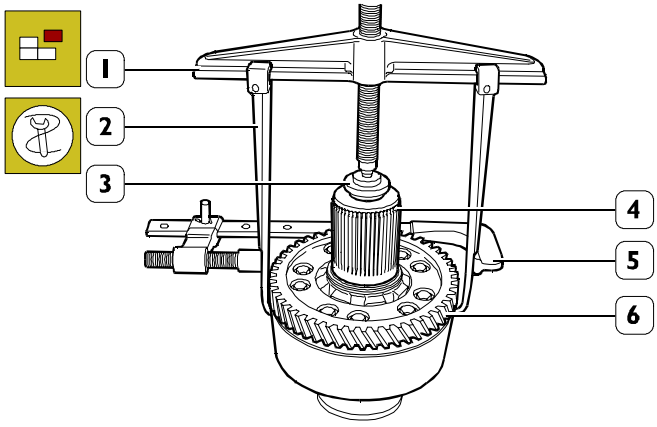
Using a press, extract the E.R.G. spider shaft (1) from the supporting ball bearing (2). Turn the rear box (3) upside-down and extract the ball bearing (2).

Figure 25



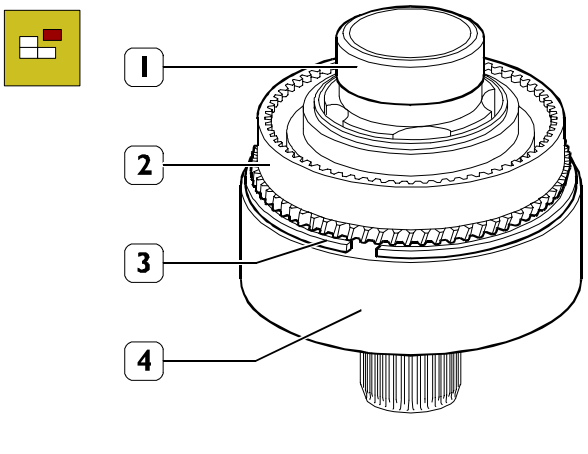
Remove the screws (2) securing the gear (3) to the spider shaft (1).

Figure 26



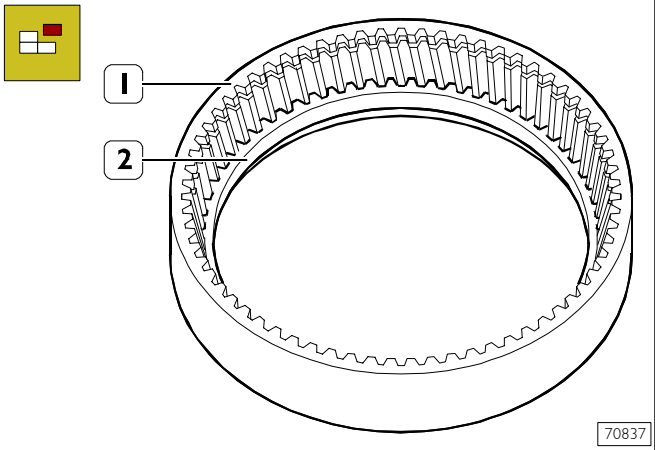
Using an extractor composed of: bridge 99341004 (1), stays 99341012 (2), reaction block 99345056 (3) and clamp 99341015 (5), extract the gear (6) from the spider shaft (4).

Figure 27



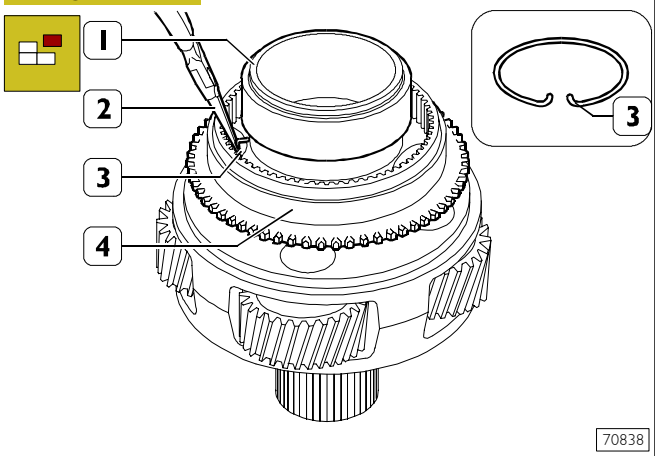
Using a screwdriver, remove the circlip (3) fastening the ring gear with internal toothing (4) to the ring gear with external toothing (2) and remove them from the E.R.G. (1).

Figure 28



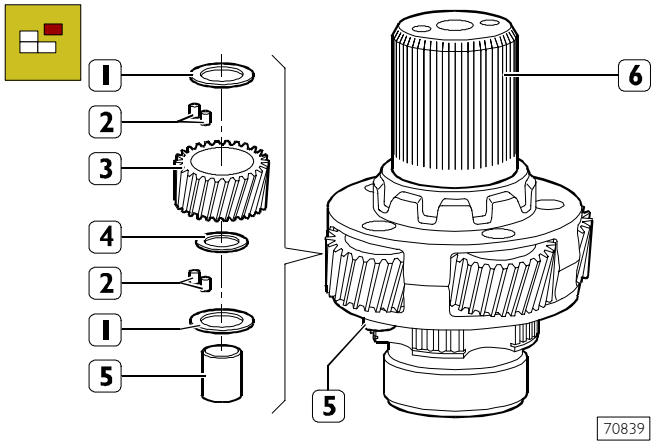
Extract the toothed ring (2) from the ring gear with internal toothing (1).

Figure 29



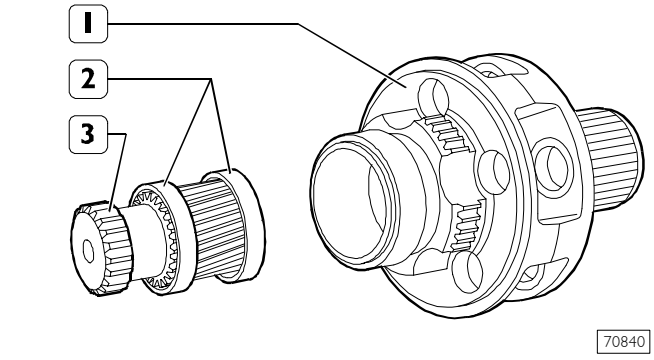
Using pliers (2), tighten the ends of the circlip (3) and remove the coupling body (4) from the E.R.G. shaft (1).

Figure 30



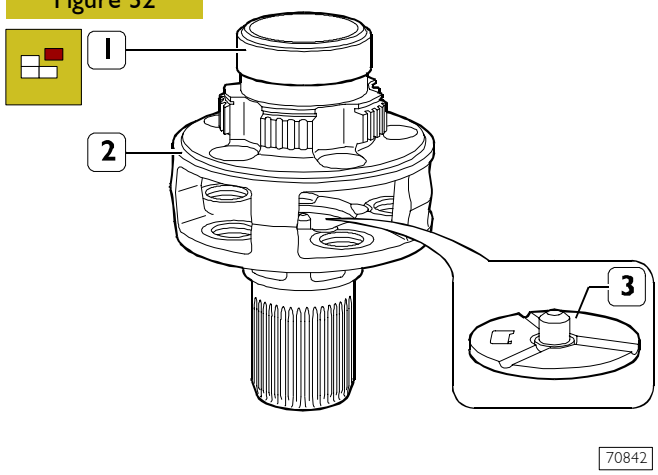
Using a punch, extract the pins (5) from the spider shaft (6). Remove the planetary gears (3) from the spider shaft (6), together with the rollers (2) and shim adjustment rings (1 and 4).

Figure 31



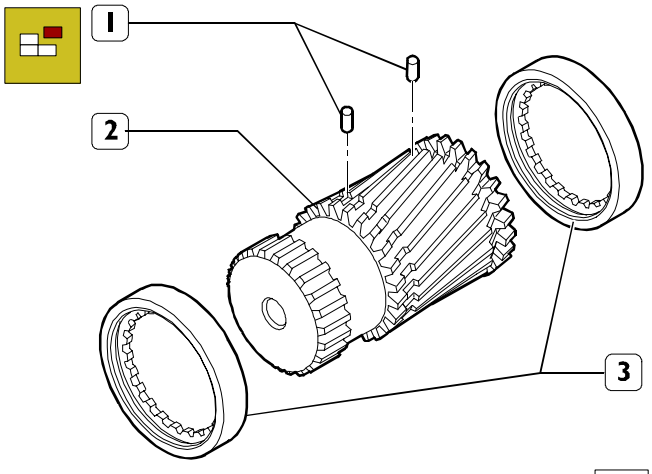
Extract the toothed spindle (3) from the spider shaft (1) together with the rings (2).

Figure 32



Using a suitable extractor, remove the roller bearing ring (1) from the spider shaft (2). Using a punch, extract the disc (3) from the inside of the spider shaft (2).

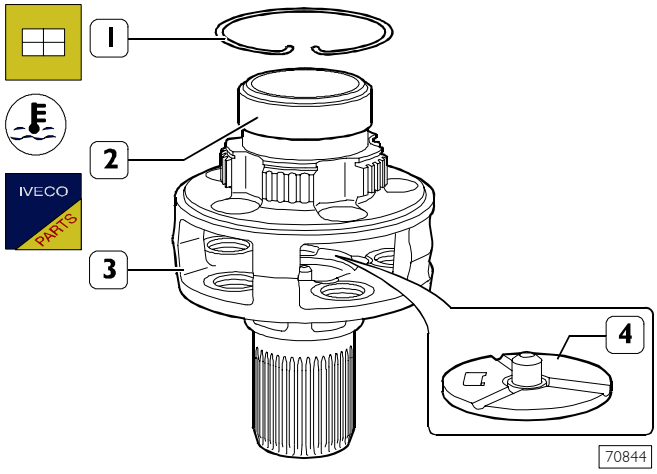
Figure 33



Extract one of the pins (1) from the toothed spindle (2) and extract the rings (3) from this.

Assembling the E.R.G.

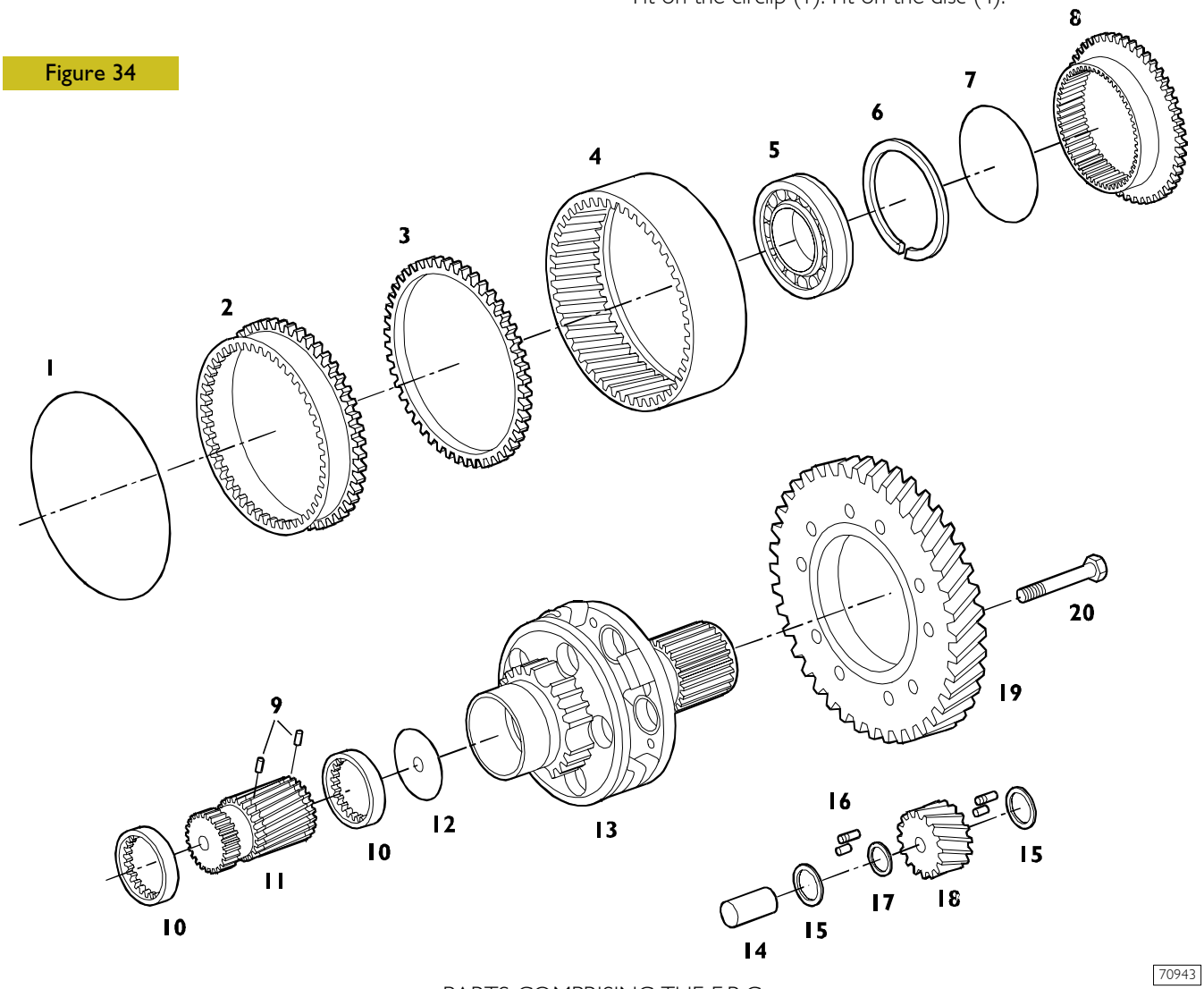
Figure 35



Heat the inside ring (2) of the roller bearing to and fit it on the spider shaft (3).

Fit on the circlip (1). Fit on the disc (4).

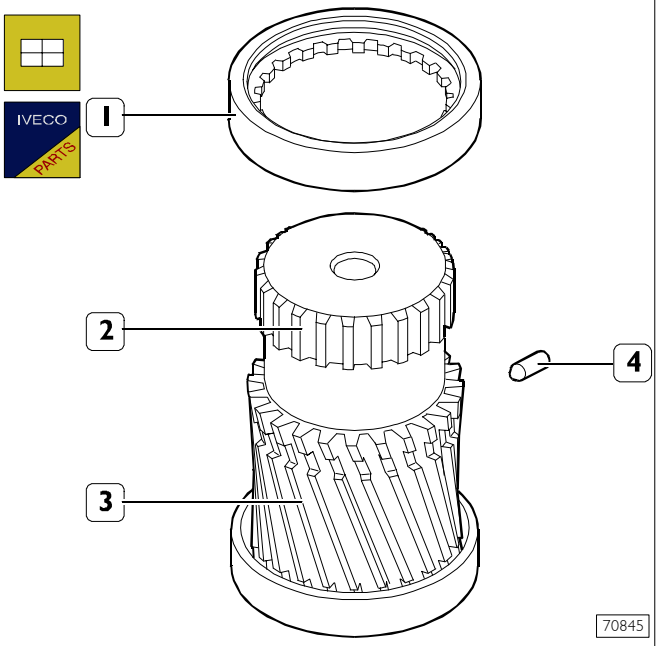
Figure 34



PARTS COMPRISING THE E.R.G.

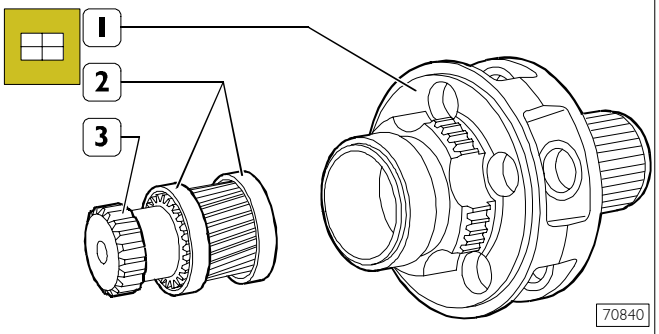
1. Circlip - 2. Ring gear with external toothing - 3. Toothed ring - 4. Ring gear with internal toothing - 5. Bearing - 6. Circlip - 7. Circlip - 8. Coupling body - 9. Pins - 10. Ring - 11. Toothed spindle - 12. Disc - 13. Spider shaft - 14. Pin - 15. Shim adjustment ring - 16. Rollers - 17. Shim adjustment ring - 18. Planetary gear - 19. Gear - 20. Screw.

Figure 36



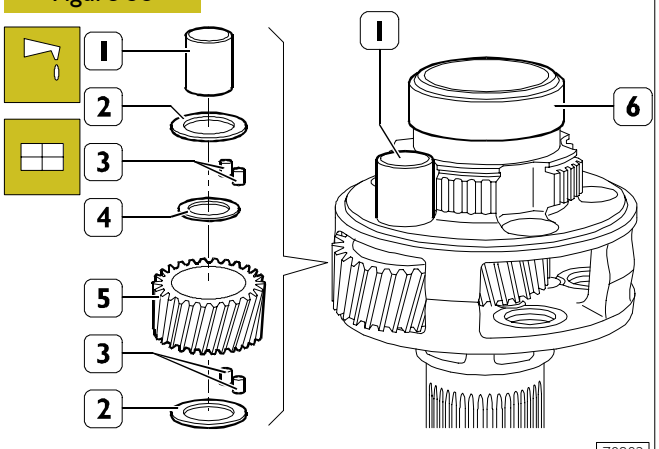
Drive the rings (1 and 3) onto the toothed spindle (2) and fit on the pin (4).

Figure 37



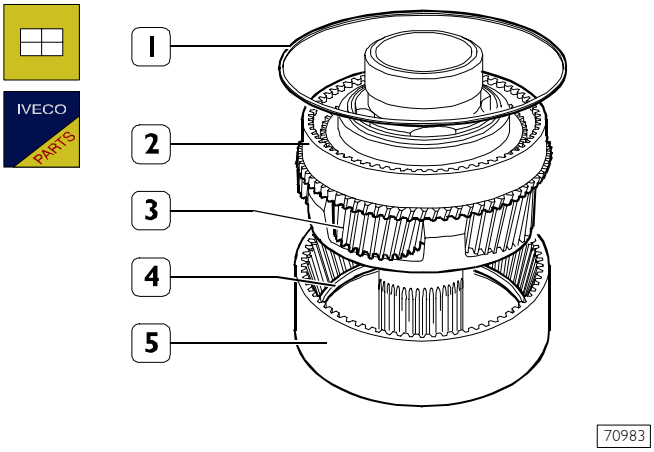
Insert the spindle (3) together with the rings (2) onto the spider shaft (1).

Figure 38



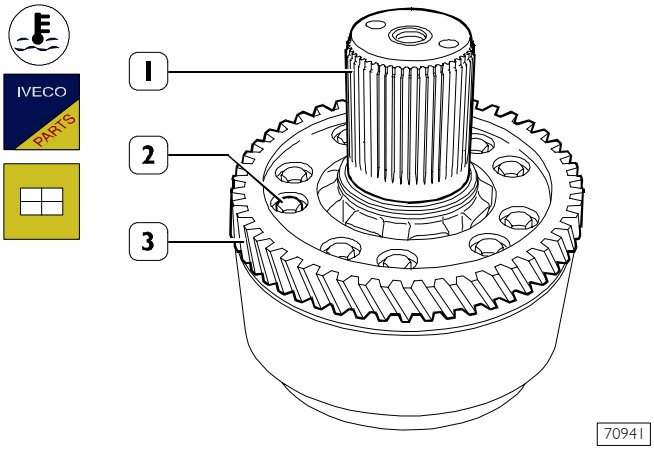
Smear grease into the hole of the planetary gear (5) and insert the rollers (3) with the associated shim adjustment rings (2 and 4).
Fit the planetary gears (5) onto the spider shaft (6), fastening them to it with the pins (1).

Figure 39



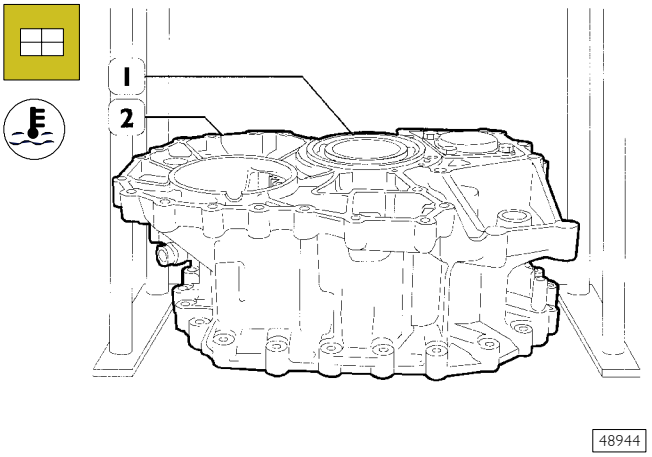
On the spider shaft (3), fit: the ring gear with internal toothing (5) together with the toothed ring (4), and the ring gear with external toothing (2) and fasten the two ring gears with the circlip (1).

Figure 40



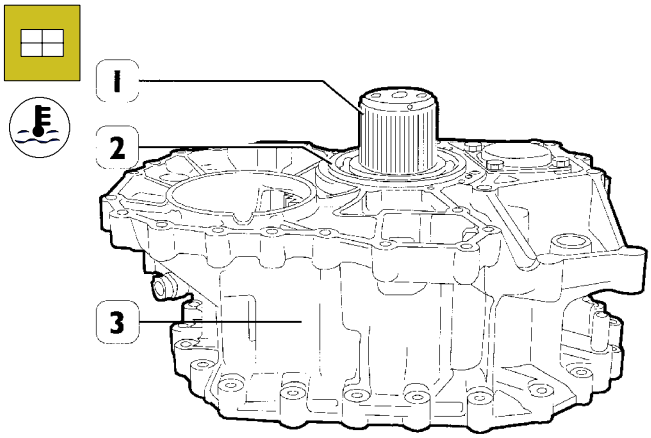
Heat the gear (3) to 120°C ÷ 130°C and fit it onto the spider shaft (1). Screw down the fixing screws (2) and tighten them to the prescribed torque.

Figure 41



Heat the seat of the bearing (1) of the rear box (2) to 90°C and mount the bearing (1).

Figure 42



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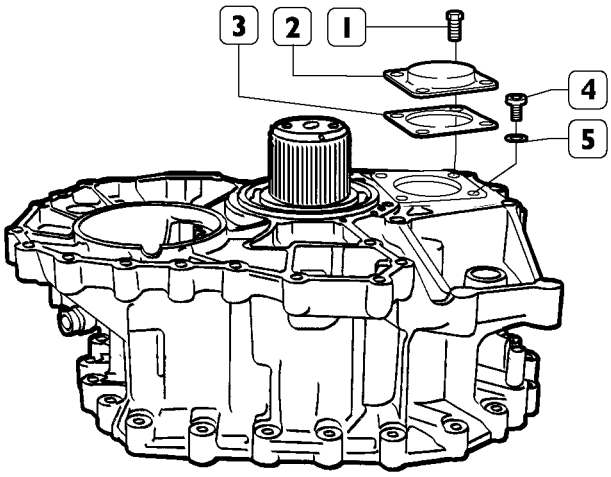
Rest the spider shaft (1) on an appropriate spacer. Heat the inside ring of the bearing (2) to approx. 100°C and drive it together with the rear box (3) onto the spider shaft (1).

Figure 43



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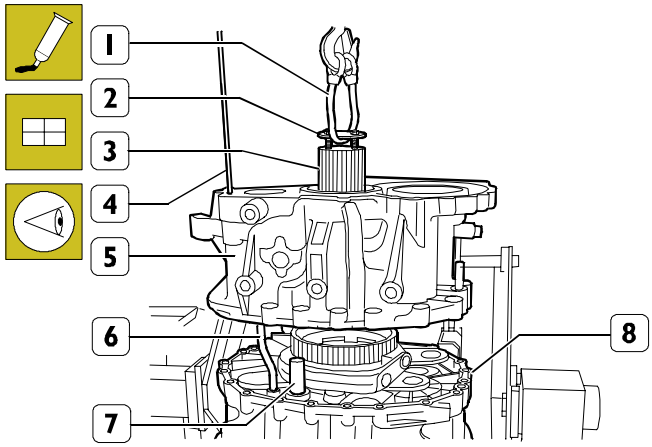
Take out the screws (1) and remove the cover (2) with its seal (3). Remove the screw (4) with the washer (5).

Figure 44



85852

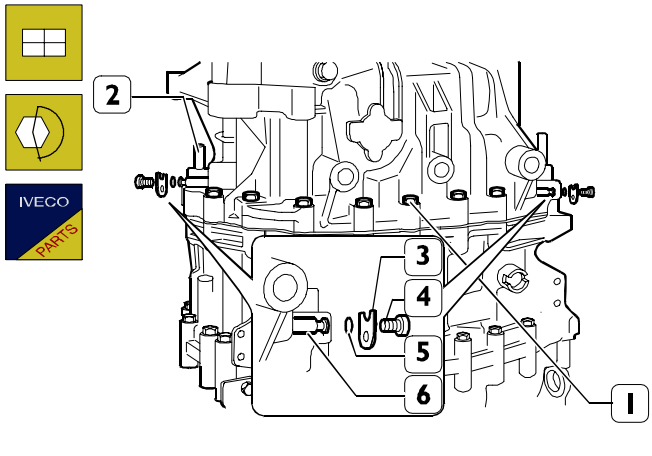
Apply sealer IVECO 1905685 on the central case (8) mating surface. Apply the shaft (3), the planetary gear shaft (3) fastening plate (2) leaving enough clearance to let the rope (1) pass through.

Hook the rope to a hoist and position the rear case (5) coaxially compared to the central case (8).

Fit a reinforcement (4) having the suitable diameter in the screw hole (1, Figure 45) and in the oil pipe (6) in order to lead the pipe into its seat when the rear case is lowered.

Lower the rear case (5) and make sure the planetary gear shaft, the oil pipe (6) and the bar (7) are fitted correctly in the respective seats.

Figure 45

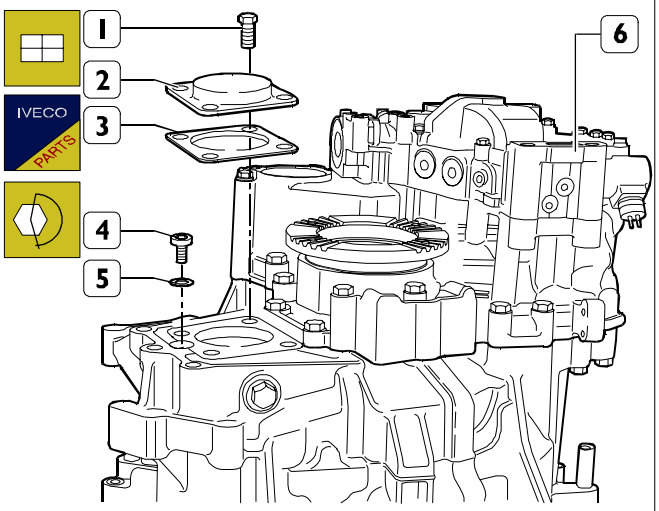


70937

Screw down the screws (1) without tightening them; insert the centring pins (2) and tighten the screws (1) to the prescribed torque.

Fit the fork joint pins (6) with fresh seals (5) and tighten the screws (4) fixing the fastening plates (3) to the prescribed torque.

Figure 46



Fit: the screw (4) with a new washer (5) and tighten it to the prescribed torque.

Fit the cover (2) with a fresh seal (3) and tighten the fixing screws (1) to the prescribed torque.

Then refit the hydraulic retarder (6) as described under the relevant heading.

EuroTronic gearboxes diagnostics

DIAGNOSTICS

EUROTRONIC troubleshooting can be performed with the Cluster or Modus, IWT and IT 2000 diagnosis instruments.

Diagnosis via cluster makes it possible to estimate the fault situation in the system in advance, while the fault-diagnosis instruments are essential to make a thorough diagnosis and operate correctly on the single faults.

For each single instrument it displays the diagnosis and repair help.

Diagnosis Instruments

MODUS (Maintenance and Diagnostic System)

A computerized fault-diagnosis station dedicated to diagnosing the brake systems, air suspensions, engines and systems controlled electronically.

The station is equipped with auxiliary functions, such as: programming electronic control units, consulting the spare parts catalogue and service time schedules.

The vehicle has a 30-pin diagnosis socket to interface with the instrument.

IT 2000 (IVECO Electronic Tester)

This makes it possible to take immediate action on the vehicle, identifying it with the chassis number.

It saves the results of diagnostics actions performed.

It can be used as a portable Personal Computer, too, being fitted for remote diagnosis.

By using MODUS as the mother station it is possible to update and configure the IT 2000.

IT 2000 interfaces with the vehicle via a 30-pin diagnosis socket.

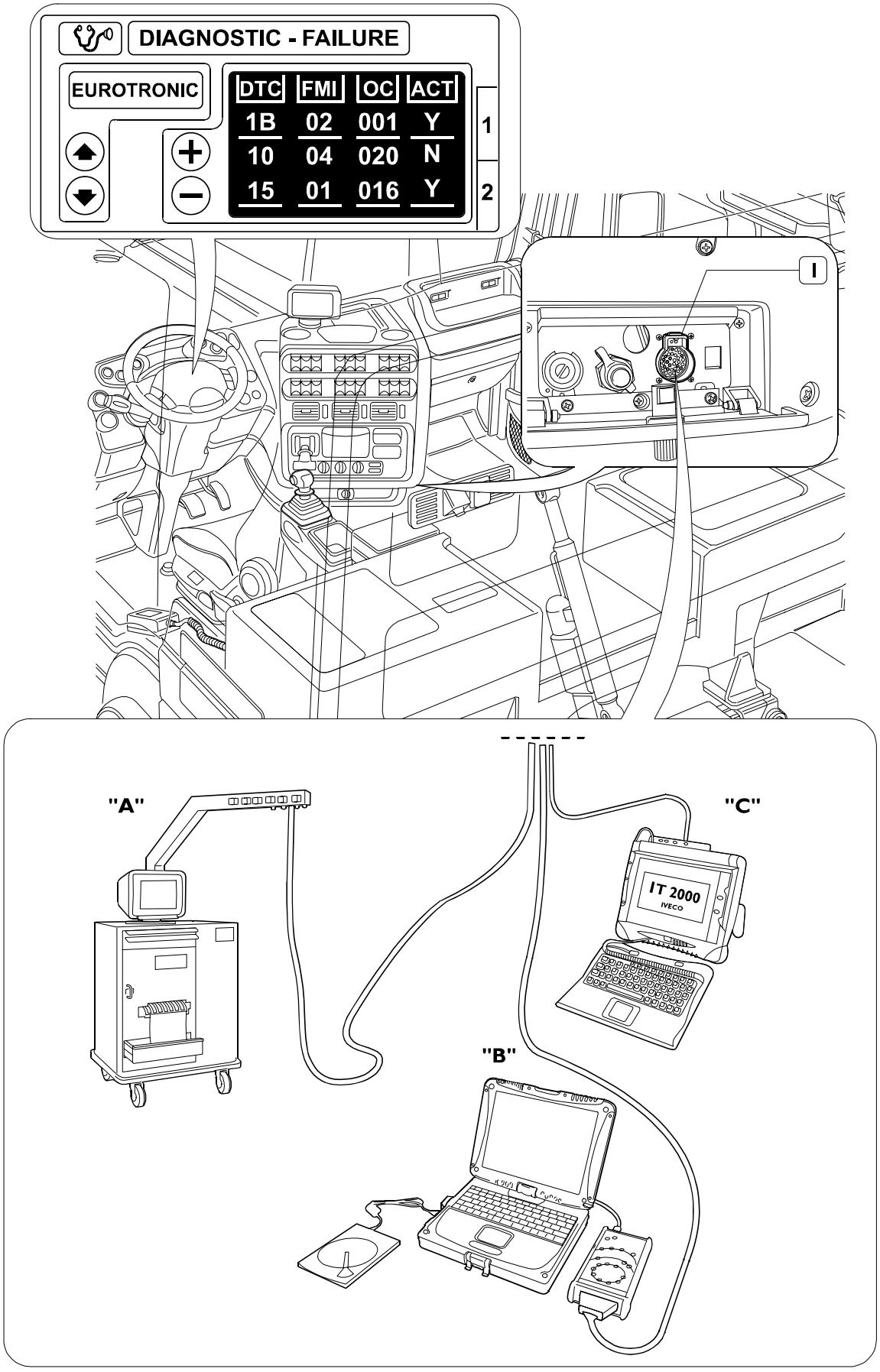
E.A.SY.

E.A.SY. system allows to simply make the diagnosis and programming of the various electronic central units aboard the vehicle.

E.A.SY. system is made up of ECI module communicating with the electronic central units and of a Panasonic PC.

ECI module, exploiting the Panasonic PC, also allows easy on the road interventions: in particular, thanks to Panasonic PC wireless technologies (e.g. GPRS), diagnostic interventions can be assisted by a remote expert centre.

Figure 1



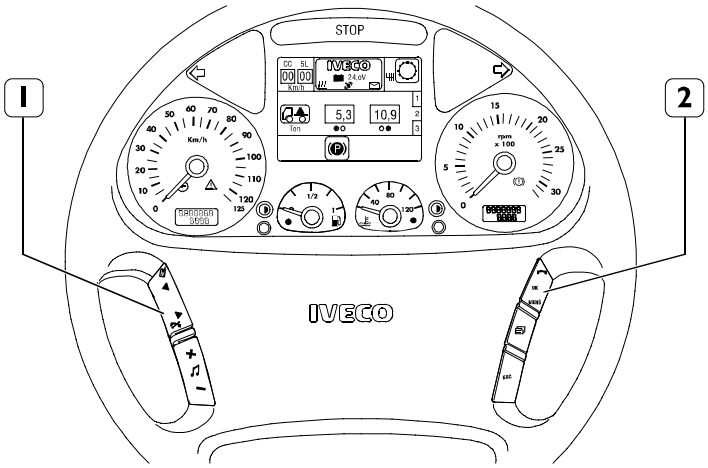
1.Diagnosis socket - A. MODUS - B. E.A.SY. - C. IT 2000

106512

Cluster Diagnosis

It is possible to access the fault memory with the "menu" function key 2 on the steering wheel.

Figure 2



74375

With the ignition key on MAR (+15), press the "menu" function key 2; the display will show a dialogue menu containing a list of the available functions (e.g., Hi-Fi, phone, diagnostics, etc.).

With the ▲ 1 and 1 ▼ function keys, select the diagnosis function and confirm the selection with the "OK" function key 2.

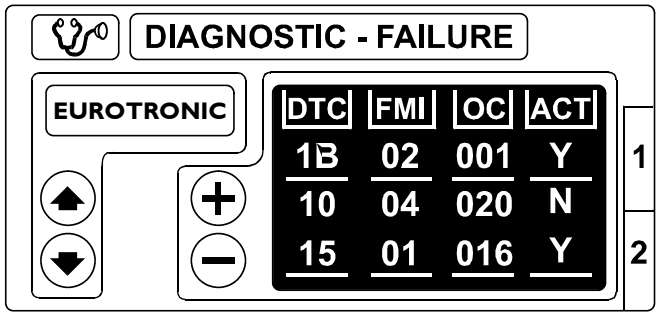
Select the EUROTRONIC system with the select/confirm keys 1 and 2.

Select the EUROTRONIC system with the select/confirm keys 1 and 2.

The cluster will display the first diagnostics screen.

After selecting the system, EUROTRONIC is displayed on a red or green background depending on whether there is any trouble.

Figure 3



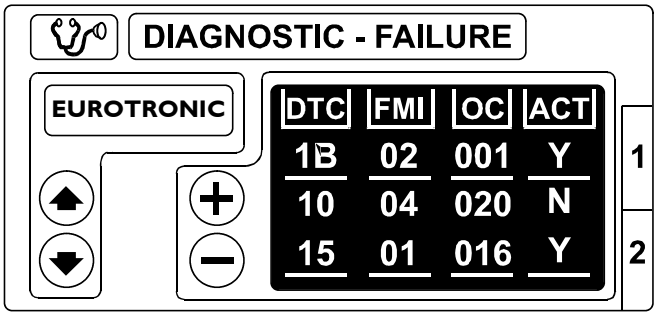
74377

The diagnosis information shown on the cluster is split up on two screens:

- On the first one, it is possible to consult and scroll through all saved/present trouble.
- On the second one, it is possible to delete the intermittent errors (when you have the relevant password).

FIRST SCREEN

Figure 4



The information on the single faults is arranged on four columns with the following content:

DTC	FMI	OC	ACT
Displays the fault code number	Indicates the type of fault	Fault frequency meter	Fault active/not active status
Two digits (hexadecimal)	Two digits (hexadecimal)	Three digits (hexadecimal)	One character (Y = Yes, N = No)

Troubleshooting via DTC-FMI codes described under the relevant section completes the above information. Each pair of DTC-FMI codes is associated with a description of the fault, the possible system reaction and recommended repairs with the relevant checks.

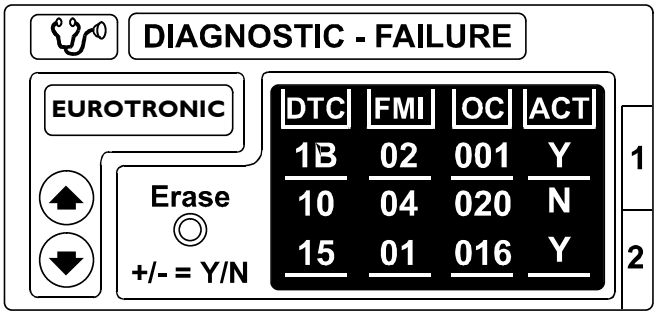
SECOND SCREEN

Deleting Errors

To select the second screen, press "page" on the steering wheel.
The fault display is eliminated as follows:

- ❑ Press "+", on the request to confirm deletion, press OK.
- ❑ Enter the required password (see the ENTERING PASSWORD paragraph).
- ❑ Press OK to confirm.

Figure 5



Entering the Password

Figure 6

Select the first number of the password with the ▲ I and I ▼ keys.
Press OK to confirm each number.
Press ◀ to delete the last number selected.
On completing the password, select the key symbol to confirm.

Troubleshooting via DTC-FMI codes

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
		SENSORS -TRANS-MISSION OUTPUT SPEED	WRONG SIGNAL			Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit)				Gear actuator replacement (control unit)
		SIGNALS - SENSOR - TACHO-GRAPH SENSOR	WRONG SIGNAL	Other errors 91,100,177 present.	Short circuit to ground to pin 8 - CAN H possible.	Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	
		SIGNALS - SENSOR - TACHO-GRAPH+OUTPUT SHAFT SPEED SENSOR	BOTH SPEED SENSORS FAULTY	If the output speed signal 1 is available, there are no restrictions on the system.		Check vehicle-end wiring. Check and replace defective output sensor.				Error 99,101 set; Output speed > 2500 rpm; Vehicle speed too high.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
		CAN LINE - ENGINE - REQUESTED ENGINE TORQUE	WRONG SIGNAL	Vehicle moving: No calculation of vehicle weight and gear resistance possible. Impossible to calculate starting gear. The driver's request will be substituted by the information on the throttle pedal position. Once coupling is over, an amount of fuel equivalent to the throttle pedal value will be released. The clutch coupling quality could be reduced. During cruise control operation it is not possible to release any amount of fuel because the throttle pedal value is 0. After the clutch has engaged, the amount of fuel will be released by the EDC. Poor coupling quality after changing gear. Vehicle stationary: Starting is possible. On reaching the stop, the average starting gear will be engaged. No additional functional restrictions.		Check accelerator/accelerator wiring. Replace/repair accelerator/periphery.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
		CAN LINE - ENGINE - LOW IDLE SWITCH	WRONG SIGNAL	Further errors saved in EDC.		Please make also a diagnosis check on EDC system.				
		CAN LINE - ENGINE - CONTROL MESSAGE	TIMEOUT			Check fuse box fuses.				
		CAN LINE - ENGINE - CONTROL MESSAGE	TIMEOUT		In the EEC1 message time-out at the following signals: - Idling switch - Kickdown switch - Accelerator pedal position - Engine torque ratio calculation	Please make also a diagnosis check on EDC system.				
		CAN LINE - ENGINE - NUMBER OF ENGINE REVS.	WRONG SIGNAL			Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
02	05	SHIFTING ACTUATOR - SOLENOID VALVE (Y2) SPLITTER	SHORT CIRCUIT TO GROUND	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
03	05	SHIFTING ACTUATOR - SOLENOID VALVE (Y3) SPLITTER	SHORT CIRCUIT TO GROUND	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
04	05	SHIFTING ACTUATOR - (Y4) SOLENOID VALVE GEAR SELECTION	SHORT CIRCUIT TO GROUND	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
05	05	SHIFTING ACTUATOR - (Y5) SOLENOID VALVE GEAR SELECTION	SHORT CIRCUIT TO GROUND	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
06	05	SHIFTING ACTUATOR - (Y6) SOLENOID VALVE GEAR ENGAGEMENT	SHORT CIRCUIT TO GROUND	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
07	05	SHIFTING ACTUATOR - (Y7) SOLENOID VALVE GEAR ENGAGEMENT	SHORT CIRCUIT TO GROUND	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
08	05	SHIFTING ACTUATOR - (Y8) SOLENOID VALVE RANGE LOW	SHORT CIRCUIT TO GROUND	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
09	05	SHIFTING ACTUATOR - (Y9) SOLENOID VALVE RANGE HIGH	SHORT CIRCUIT TO GROUND	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
0A	05	SHIFTING ACTUA-TOR - (Y10) MAIN VALVE	SHORT CIRCUIT TO GROUND	Impossible to change gear, not even in neutral. The selected gear stays engaged. The vehicle can only set off again in par-ticular conditions (gear selected =< the 8th gear).		Replacing the gearbox actuator (control unit)				
0B	05	DEVICE - WARNING LAMP/ BUZZER	SHORT CIRCUIT TO GROUND	Possible short circuit.		Check wiring	1- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 11 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 16 2- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 11 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 17	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; 2- Min. value: 22 V; Max. value: 28 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
0D	05	DEVICE - REAR PTO - REAR ENGINE PTO EN-GAGED	SHORT CIRCUIT TO GROUND	PTO 1 not available. No additional system restrictions.		Check wiring, control contactor, connections with the MUX system and gear lever				
0D	05	DEVICE - REAR PTO - REAR ENGINE PTO EN-GAGED	SHORT CIRCUIT TO GROUND			For STRALIS please check either for a possible short be-tween 9131 and 0131 cables or check for a possible wiring inver-sion on ST67 con-nector (PIN 4 of 0131 cable could be in-verted with PIN 2 of 9131 cable).				
0E	05	DEVICE - PTO 2 - LATERAL ENGINE PTO EN-GAGED	SHORT CIRCUIT TO GROUND	PTO2 not available. No additional system restrictions		Check wiring, control contactor, connections with the MUX system and gear lever				
0E	05	DEVICE - PTO 2 - LATERAL ENGINE PTO EN-GAGED	SHORT CIRCUIT TO GROUND			For STRALIS please check either for a possible short be-tween 9131 and 0131 cables or check for a possible wiring inver-sion on ST67 con-nector (PIN 4 of 0131 cable could be in-verted with PIN 2 of 9131 cable).				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
11	05	SHIFTING ACTUATOR - SOLENOID VALVE (Y1)	SHORT CIRCUIT TO GROUND	Vehicle moving: The speed increases are managed as the changes. The speed increases are not possible when the engine is at low speed. The engagement time increases. Vehicle stationary: The engagement time is longer.		Replacing the gearbox actuator (control unit)				
12	05	CLUTCH ACTUATOR - (Y17) SOLENOID VALVE CLUTCH DISENGAGEMENT SLOW	SHORT CIRCUIT TO GROUND	Clutch control is implemented via the fast clutch uncoupling solenoid valve. It decreases comfort when manoeuvring.		Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit)	Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 9 Measure point 2: Connector for clutch actuator - gearbox side Pin: 16	Connector Not connected; Key +15 OFF;	Min. value: 14 Ohm; Max. value: 20 Ohm;	
13	05	CLUTCH ACTUATOR - (Y15) SOLENOID VALVE CLUTCH ENGAGEMENT SLOW	SHORT CIRCUIT TO GROUND	Clutch control is implemented via the fast clutch uncoupling solenoid valve. It decreases comfort when manoeuvring.		Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit)	Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 7 Measure point 2: Connector for clutch actuator - gearbox side Pin: 16	Connector Not connected; Key +15 OFF;	Min. value: 14 Ohm; Max. value: 20 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
14	05	CLUTCH ACTUATOR - (Y16) SOLENOID VALVE CLUTCH DISENGAGEMENT FAST	SHORT CIRCUIT TO GROUND	Clutch control is implemented via the fast clutch uncoupling solenoid valve. It decreases comfort when manoeuvring.		Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit)	Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 12 Measure point 2: Connector for clutch actuator - gearbox side Pin: 17	Connector Not connected; Key +15 OFF;	Min. value: 14 Ohm; Max. value: 20 Ohm;	
15	05	CLUTCH ACTUATOR - (Y14) SOLENOID VALVE CLUTCH ENGAGEMENT FAST	SHORT CIRCUIT TO GROUND	Clutch control is implemented via the fast clutch uncoupling solenoid valve. It decreases comfort when manoeuvring.		Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit)	Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 8 Measure point 2: Connector for clutch actuator - gearbox side Pin: 17	Connector Not connected; Key +15 OFF;	Min. value: 14 Ohm; Max. value: 20 Ohm;	
16	05	SUPPLY VOLTAGE - DEVICE	SHORT CIRCUIT TO GROUND	ECU output deactivated. No information from the gear lever, from the buzzer. Vehicle moving: Gearbox locked. Vehicle stationary: Gearbox automatically in neutral. System not available		Control unit - gear lever wiring control				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
1A	04	CAN LINE - ENGINE - CONFIGURATION MESSAGE	TIMEOUT	The system adopts substitutive parameters. Reduced functionality for the automatic mode and to calculate the starting gear, if there is a large difference between the parameters utilized and the actual values. The quality of clutch uncoupling may decrease.		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	Reprogram the electronic control unit to rewrite the parameters.
1A	04	CAN LINE - ENGINE - CONFIGURATION MESSAGE	TIMEOUT			Please make also a diagnosis check on EDC system.				
1B	08	CAN LINE - ENGINE - CONFIGURATION MESSAGE	WRONG SIGNAL	The system adopts substitutive parameters. Reduced functionality for the automatic mode and to calculate the starting gear, if there is a large difference between the parameters utilized and the actual values. The quality of clutch uncoupling may decrease.		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	Reprogram the electronic control unit to rewrite the parameters.
1B	08	CAN LINE - ENGINE - CONFIGURATION MESSAGE	WRONG SIGNAL			Please make also a diagnosis check on EDC system.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
1C	08	CAN LINE RE-TARDER - INTARDER - BRAKING TORQUE	WRONG SIGNAL	Impossible to calculate the gear resistance. No automatic calculation of the starting gear. The average starting gear is engaged at the stop. No additional system restrictions.		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	Further CAN errors present (183, 184, etc.).
1C	08	CAN LINE -RE-TARDER - INTARDER - BRAKING TORQUE	WRONG SIGNAL	Further Intarder errors (e.g. 27, 29).		Check/Replace Intarder electronics.				
1D	08	CAN LINE -RE-TARDER - INTARDER - WATER TEMPERATURE INCREASE	WRONG SIGNAL	There are no requests to engage lower gears, from the retarder, to increase the engine speed to improve the cooling capacity.		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	Further CAN errors present (183, 184, etc.).
1D	08	CAN LINE -RE-TARDER - INTARDER - WATER TEMPERATURE INCREASE	WRONG SIGNAL	Further Intarder errors (e.g. 27, 28).		Check/Replace Intarder electronics.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
1E	08	CAN LINE -RE-TARDER - INTARDER -CON-FIGUR-ATION MESSAGE	WRONG SIGNAL	Further Intarder errors (e.g. 27, 28).		Check/Replace Intarder electronics.				
1E	08	CAN LINE -RE-TARDER - INTARDER -CON-FIGUR-ATION MESSAGE	WRONG SIGNAL	Impossible to calculate the gear resistance. No automatic calculation of the starting gear. The average starting gear is engaged at the stop. No additional system restrictions.		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	Further CAN errors present (183, 184, etc.).
1F	08	CAN LINE -RE-TARDER - ENGINE BRAKE - BRAKING TORQUE	WRONG SIGNAL	Further Intarder errors (e.g. 27, 28).		Check/Replace Intarder electronics.				
1F	08	CAN LINE -RE-TARDER - ENGINE BRAKE - BRAKING TORQUE	WRONG SIGNAL	Impossible to calculate the gear resistance. No automatic calculation of the starting gear. The average starting gear is engaged at the stop. No additional system restrictions.		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	Further CAN errors present (183, 184, etc.).

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
20	08	CAN LINE -RE-TARDER - ENGINE BRAKE - CON-FIGUR-ATION MESSAGE	WRONG SIGNAL	Impossible to calcu-late the gear resis-tance. No automatic cal-culation of the start-ing gear. The average starting gear is engaged at the stop. No additional system restrictions.		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8 Measure point 2: Connector (ve-hicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	Further CAN errors present (183, 184, etc.).
20	08	CAN LINE -RE-TARDER - ENGINE BRAKE - CON-FIGUR-ATION MESSAGE	WRONG SIGNAL	Further Intarder er-rors (e.g. 27, 28).		Check/Replace Intar-der electronics.				
21	04	CAN LINE -RE-TARDER - ENGINE BRAKE - CON-FIGUR-ATION MESSAGE	TIMEOUT	Impossible to calcu-late the gear resis-tance. No automatic cal-culation of the start-ing gear. The average starting gear is engaged at the stop. No additional system restrictions.		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8 Measure point 2: Connector (ve-hicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	Further CAN errors present (26, 178, 183, 184, etc.).

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
21	04	CAN LINE -RE-TARDER - ENGINE BRAKE - CON-FIGUR-ATION MESSAGE	TIMEOUT	Further Intarder errors (e.g. 27, 28).		Check/Replace Intarder electronics.				
21	04	CAN LINE -RE-TARDER - ENGINE BRAKE - CON-FIGUR-ATION MESSAGE	TIMEOUT			Check fuse box fuses.				
22	0A	SHIFTING ACTUA-TOR - SO-LENOID VALVE (Y2) SPLITTER	INTER-RUPTION	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
23	0A	SHIFTING ACTUA-TOR - SO-LENOID VALVE (Y3) SPLITTER	INTER-RUPTION	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
24	0A	SHIFTING ACTUATOR - (Y4) SOLENOID VALVE GEAR SELECTION	INTERRUPTION	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
25	0A	SHIFTING ACTUATOR - (Y5) SOLENOID VALVE GEAR SELECTION	INTERRUPTION	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
26	0A	SHIFTING ACTUATOR - (Y6) SOLENOID VALVE GEAR ENGAGEMENT	INTERRUPTION	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
27	0A	SHIFTING ACTUATOR - (Y7) SOLENOID VALVE GEAR ENGAGEMENT	INTERRUPTION	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
28	0A	SHIFTING ACTUATOR - (Y8) SOLENOID VALVE RANGE LOW	INTERRUPTION	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
29	0A	SHIFTING ACTUATOR - (Y9) SOLENOID VALVE RANGE HIGH	INTERRUPTION	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
2A	0A	SHIFTING ACTUATOR - (Y10) MAIN VALVE	INTERRUPTION	Impossible to change gear, not even in neutral. The selected gear stays engaged. The vehicle can only set off again in particular conditions (gear selected =< the 8th gear).		Replacing the gearbox actuator (control unit)				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
2B	0A	DEVICE - WARN-ING LAMP/ BUZZER	INTER-RUPTION	Possible wiring inter-ruption.		Check wiring	1- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 11 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 16 2- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 11 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 17	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; 2- Min. value: 22 V; Max. value: 28 V;	
2D	0A	DEVICE - REAR PTO - REAR ENGINE PTO EN-GAGED	INTER-RUPTION			For STRALIS please check either for a possible short between 9131 and 0131 cables or check for a possible wiring inversion on ST67 connector (PIN 4 of 0131 cable could be inverted with PIN 2 of 9131 cable).				
2D	0A	DEVICE - REAR PTO - REAR ENGINE PTO EN-GAGED	INTER-RUPTION	PTO 1 not available. No additional system restrictions.		Check wiring, control contactor, connections with the MUX system and gear lever				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
2E	0A	DEVICE - PTO 2 - LATERAL ENGINE PTO ENGAGED	INTERRUPTION	PTO2 not available. No additional system restrictions		Check wiring, control contactor, connections with the MUX system and gear lever				
2E	0A	DEVICE - PTO 2 - LATERAL ENGINE PTO ENGAGED	INTERRUPTION			For STRALIS please check either for a possible short between 9131 and 0131 cables or check for a possible wiring inversion on ST67 connector (PIN 4 of 0131 cable could be inverted with PIN 2 of 9131 cable).				
31	0A	SHIFTING ACTUATOR - SOLENOID VALVE (Y1)	INTERRUPTION	Vehicle moving: The speed increases are managed as the changes. The speed increases are not possible when the engine is at low speed. The engagement time increases. Vehicle stationary: The engagement time is longer.		Replacing the gearbox actuator (control unit)				
32	0A	CLUTCH ACTUATOR - (Y17) SOLENOID VALVE CLUTCH DISENGAGEMENT SLOW	INTERRUPTION	Comfort decreased when starting and manoeuvring; the clutch is controlled by the fast uncoupling valve.		Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit)	Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 9 Measure point 2: Connector for clutch actuator - gearbox side Pin: 16	Connector Not connected; Key +15 OFF;	Min. value: 14 Ohm; Max. value: 20 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
33	0A	CLUTCH ACTUATOR - (Y15) SOLENOID VALVE CLUTCH ENGAGEMENT SLOW	INTERRUPTION	Comfort decreased when starting and manoeuvring; the clutch is controlled by the fast uncoupling valve.		Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit)	Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 7 Measure point 2: Connector for clutch actuator - gearbox side Pin: 16	Connector Not connected; Key +15 OFF;	Min. value: 14 Ohm; Max. value: 20 Ohm;	
34	0A	CLUTCH ACTUATOR - (Y16) SOLENOID VALVE CLUTCH DISENGAGEMENT FAST	INTERRUPTION	Comfort decreased when starting and manoeuvring; the clutch is controlled by the fast uncoupling valve.		Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit)	Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 12 Measure point 2: Connector for clutch actuator - gearbox side Pin: 17	Connector Not connected; Key +15 OFF;	Min. value: 14 Ohm; Max. value: 20 Ohm;	
35	0A	CLUTCH ACTUATOR - (Y14) SOLENOID VALVE CLUTCH ENGAGEMENT FAST	INTERRUPTION	Comfort decreased when starting and manoeuvring; the clutch is controlled by the fast uncoupling valve.		Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit)	Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 8 Measure point 2: Connector for clutch actuator - gearbox side Pin: 17	Connector Not connected; Key +15 OFF;	Min. value: 14 Ohm; Max. value: 20 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
36	0A	SUPPLY VOLTAGE - DEVICE	INTER-RUPTION	ECU output deacti-vated. No information from the gear lever, from the buzzer. Vehicle moving: Gearbox locked. Ve-hicle stationary: Gear-box automatically in neutral. System not available		Control unit - gear lever wiring control				
3B	06	DEVICE - REAR PTO - SWITCH SIGNAL-LING PTO 1 EN-GAGE-MENT	SIGNAL NOT PLAUSIBLE			For STRALIS please check either for a possible short be-tween 9131 and 0131 cables or check for a possible wiring inver-sion on ST67 con-nector (PIN 4 of 0131 cable could be in-verted with PIN 2 of 9131 cable).				
3B	08	DEVICE - REAR PTO - SWITCH SIGNAL-LING PTO 1 EN-GAGE-MENT	SIGNAL NOT PLAUSIBLE	PTO1 not available. No additional system restrictions		Check wiring between the PTO1 check and control switches				
3C	08	DEVICE - PTO 2 - SWITCH SIGNAL-LING PTO 2 EN-GAGE-MENT	SIGNAL NOT PLAUSIBLE	PTO2 not available. No additional system restrictions		Check wiring between the PTO2 check and control switches				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3C	08	DEVICE - PTO 2 - SWITCH SIGNAL-LING PTO 2 EN-GAGE-MENT	SIGNAL NOT PLAUSIBLE			For STRALIS please check either for a possible short be-tween 9131 and 0131 cables or check for a possible wiring inver-sion on ST67 con-nector (PIN 4 of 0131 cable could be in-verted with PIN 2 of 9131 cable).				
3D	08	DEVICE - REAR PTO - SWITCH SIGNAL-LING PTO 1 EN-GAGE-MENT	PERMA-NENT SIG-NAL	Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving.		Check wiring between the PTO1 check and control switches				
3E	08	DEVICE - PTO 2 - SWITCH SIGNAL-LING PTO 2 EN-GAGE-MENT	PERMA-NENT SIG-NAL	Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving.		Check wiring between the PTO2 check and control switches				
3F	08	DEVICE - REAR PTO - SWITCH SIGNAL-LING PTO 1 EN-GAGE-MENT	NO SIG-NAL	PTO1 not available. No additional system restrictions		Check wiring between the PTO1 check and control switches				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3F	08	DEVICE - REAR PTO - SWITCH SIGNAL-LING PTO 1 EN-GAGE-MENT	NO SIG-NAL			For STRALIS please check either for a poss-ible short between 9131 and 0131 cables or check for a possible wiring inversion on ST67 connector (PIN 4 of 0131 cable could be inverted with PIN 2 of 9131 cable).				
40	08	DEVICE - PTO 2 - SWITCH SIGNAL-LING PTO 2 EN-GAGE-MENT	NO SIG-NAL	PTO2 not available. No additional system restrictions		Check wiring between the PTO2 check and control switches				
40	08	DEVICE - PTO 2 - SWITCH SIGNAL-LING PTO 2 EN-GAGE-MENT	NO SIG-NAL			For STRALIS please check either for a poss-ible short between 9131 and 0131 cables or check for a possible wiring inversion on ST67 connector (PIN 4 of 0131 cable could be inverted with PIN 2 of 9131 cable).				
42	06	SHIFTING ACTUA-TOR - SO-LENOID VALVE (Y2) SPLITTER	SHORT CIRCUIT TO POSI-TIVE	Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
43	06	SHIFTING ACTUATOR - SOLENOID VALVE (Y3) SPLITTER	SHORT CIRCUIT TO POSITIVE	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
44	06	SHIFTING ACTUATOR - (Y4) SOLENOID VALVE GEAR SELECTION	SHORT CIRCUIT TO POSITIVE	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
45	06	SHIFTING ACTUATOR - (Y5) SOLENOID VALVE GEAR SELECTION	SHORT CIRCUIT TO POSITIVE	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
46	06	SHIFTING ACTUATOR - (Y6) SOLENOID VALVE GEAR ENGAGEMENT	SHORT CIRCUIT TO POSITIVE	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
47	06	SHIFTING ACTUATOR - (Y7) SOLENOID VALVE GEAR ENGAGEMENT	SHORT CIRCUIT TO POSITIVE	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
48	06	SHIFTING ACTUATOR - (Y8) SOLENOID VALVE RANGE LOW	SHORT CIRCUIT TO POSITIVE	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
49	06	SHIFTING ACTUATOR - (Y9) SOLENOID VALVE RANGE HIGH	SHORT CIRCUIT TO POSITIVE	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Replacing the gearbox actuator (control unit)				
4A	06	SHIFTING ACTUATOR - (Y10) MAIN VALVE	SHORT CIRCUIT TO POSITIVE	Vehicle moving: Gearbox locked. Vehicle stationary: The reduced gears can be engaged.		Replacing the gearbox actuator (control unit)				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
4B	06	DEVICE - WARNING LAMP/ BUZZER	SHORT CIRCUIT TO POSITIVE	Possible short circuit.		Check wiring	1- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 11 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 16 2- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 11 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 17	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; 2- Min. value: 22 V; Max. value: 28 V;	
4D	06	DEVICE - REAR PTO - REAR ENGINE PTO ENGAGED	SHORT CIRCUIT TO POSITIVE	PTO 1 not available. No additional system restrictions.		Check wiring, control contactor, connections with the MUX system and gear lever				
4D	06	DEVICE - REAR PTO - REAR ENGINE PTO ENGAGED	SHORT CIRCUIT TO POSITIVE			For STRALIS please check either for a possible short between 9131 and 0131 cables or check for a possible wiring inversion on ST67 connector (PIN 4 of 0131 cable could be inverted with PIN 2 of 9131 cable).				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
4E	06	DEVICE - PTO 2 - LATERAL ENGINE PTO ENGAGED	SHORT CIRCUIT TO POSITIVE	PTO2 not available. No additional system restrictions		Check wiring, control contactor, connections with the MUX system and gear lever				
4E	06	DEVICE - PTO 2 - LATERAL ENGINE PTO ENGAGED	SHORT CIRCUIT TO POSITIVE			For STRALIS please check either for a possible short between 9131 and 0131 cables or check for a possible wiring inversion on ST67 connector (PIN 4 of 0131 cable could be inverted with PIN 2 of 9131 cable).				
51	06	SHIFTING ACTUATOR - SOLENOID VALVE (Y1)	SHORT CIRCUIT TO POSITIVE	Vehicle moving: Gearbox locked. Vehicle stationary: It is possible to engage the starting gear. The main valve is only activated in the coupling phase if the clutch is open.		Replacing the gearbox actuator (control unit)				
52	06	CLUTCH ACTUATOR - (Y17) SOLENOID VALVE CLUTCH DISENGAGEMENT SLOW	SHORT CIRCUIT TO POSITIVE	Generally, gearbox locked, system not available. Vehicle stationary: The coupling valve is de-energized; the gearbox is in neutral when the clutch opens.		Replacing the gearbox actuator (control unit)	Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 9 Measure point 2: Connector for clutch actuator - gearbox side Pin: 16	Connector Not connected; Key +15 OFF;	Min. value: 14 Ohm; Max. value: 20 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
53	06	CLUTCH ACTUATOR - (Y15) SOLENOID VALVE CLUTCH ENGAGEMENT SLOW	SHORT CIRCUIT TO POSITIVE	Generally, gearbox locked, system not available. Vehicle stationary: The coupling valve is de-energized; the gearbox is in neutral when the clutch opens.		Replacing the gearbox actuator (control unit)	Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 7 Measure point 2: Connector for clutch actuator - gearbox side Pin: 16	Connector Not connected; Key +15 OFF;	Min. value: 14 Ohm; Max. value: 20 Ohm;	
54	06	CLUTCH ACTUATOR - (Y16) SOLENOID VALVE CLUTCH DISENGAGEMENT FAST	SHORT CIRCUIT TO POSITIVE	Generally, gearbox locked, system not available. Vehicle moving: The clutch is kept in the position required by the uncoupling valve. Vehicle stationary: After a certain length of time the gearbox goes into neutral.		Replacing the gearbox actuator (control unit)	Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 12 Measure point 2: Connector for clutch actuator - gearbox side Pin: 17	Connector Not connected; Key +15 OFF;	Min. value: 14 Ohm; Max. value: 20 Ohm;	
55	06	CLUTCH ACTUATOR - (Y14) SOLENOID VALVE CLUTCH ENGAGEMENT FAST	SHORT CIRCUIT TO POSITIVE	Generally, gearbox locked, system not available. Vehicle stationary: The coupling valve is de-energized; the gearbox is in neutral when the clutch opens.		Replacing the gearbox actuator (control unit)	Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 8 Measure point 2: Connector for clutch actuator - gearbox side Pin: 17	Connector Not connected; Key +15 OFF;	Min. value: 14 Ohm; Max. value: 20 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
56	06	SUPPLY VOLTAGE - DEVICE	SHORT CIRCUIT TO POSI-TIVE	After switching over the key (Off-On) the fault is recognized during system set-up and the display does not go out. Turning the key onto Off the display shows code EE. No additional system restrictions.		Control unit - gear lever wiring control				
5A	09	SHIFTING ACTUA-TOR - ELEC-TRONIC CON-TROL UNIT - IN-TENAL FAILURE	INTERNAL COM-MUNICA-TION ERROR	Vehicle moving: Gear-box locked, the clutch opens when the ve-hicle stops. Vehicle stationary: Gearbox automatically in neu-tral. Gearbox locked; the system is not available.		Replacing the gearbox actuator				
5B	04	CAN LINE - BRAKING SYSTEM - CON-TROL MESSAGE	TIMEOUT	Other CAN errors 180,181,182,183,184 and/or 177 present.	Short circuit to ground to pin 8 - CAN H poss-ible.	Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8 Measure point 2: Connector (ve-hicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	
5B	04	CAN LINE - BRAKING SYSTEM - CON-TROL MESSAGE	TIMEOUT	Impossible to calculate the gear resistance. No automatic calcula-tion of the starting gear. The average starting gear is engaged at the stop. No additional system restrictions.		Check fuse box fuses.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
5B	04	CAN LINE - BRAKING SYSTEM - CONTROL MESSAGE	TIMEOUT		Message issued by ASR / ABS / EBS electronics.	Check ABS/ASR/EBS signal travel.				The message contains the following signals: z_ABS: ABS operation. z_ASR_EDC: Signal ASR-EDC-Eingriffz_ASR_BR : Status ASR-Bremsbetriebz_EBS: Status EBS
5C	08	CAN LINE - BRAKING SYSTEM - ABS ACTIVATED	WRONG SIGNAL	Impossible to calculate the gear resistance. No automatic calculation of the starting gear. The average starting gear is engaged at the stop. No additional system restrictions.	Error 91 present "EBC1 timeout" message issued by ABS / ASR / EBS electronics.	Check ABS / ASR / EBS signal travel.				No z_ABS signal (signal contained in EBC1 message).
5C	08	CAN LINE - BRAKING SYSTEM - ABS ACTIVATED	WRONG SIGNAL			Check CAN line. Check ECU correct programmino.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	
5D	08	CAN LINE - BRAKING SYSTEM - ASR ACTIVATED (ENGINE)	WRONG SIGNAL			Check CAN line. Check ECU correct programmino.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
5D	08	CAN LINE - BRAKING SYSTEM - ASR ACTIVATED (ENGINE)	WRONG SIGNAL	Impossible to calculate the gear resistance. No automatic calculation of the starting gear. The average starting gear is engaged at the stop. No additional system restrictions.	Error 91 present "EBC1 timeout" message issued by ABS / ASR / EBS electronics.	Check ABS/ASR/EBS signal travel.				No z_ABS signal (signal contained in EBC1 message).
5E	08	CAN LINE - BRAKING SYSTEM - ASR ACTIVATED (BRAKE)	WRONG SIGNAL	Impossible to calculate the gear resistance. No automatic calculation of the starting gear. The average starting gear is engaged at the stop. No additional system restrictions.	Error 91 present "EBC1 timeout" message issued by ABS / ASR / EBS electronics.	Check ABS / ASR / EBS signal travel.				No z_ABS signal (signal contained in EBC1 message).
5E	08	CAN LINE - BRAKING SYSTEM - ASR ACTIVATED (BRAKE)	WRONG SIGNAL			Check CAN line. Check ECU correct programmino.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
5F	08	CAN LINE - CRUISE CONTROL / VEHICLE SPEED - CRUISE CONTROL OFF	WRONG SIGNAL	No additional system restrictions.		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	No z_cc_status signal (signal contained in CCVS message).
5F	08	CAN LINE - CRUISE CONTROL / VEHICLE SPEED - CRUISE CONTROL OFF	WRONG SIGNAL	Error 182 present "CCVS timeout" message issued by EDC.		Check signal travel EDC.				
60	08	CAN LINE - CRUISE CONTROL / VEHICLE SPEED - PROGRAMMED SPEED	WRONG SIGNAL	No additional system restrictions.		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	No z_cc_status signal (signal contained in CCVS message).

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
60	08	CAN LINE - CRUISE CONTROL / VEHICLE SPEED - PROGRAMMED SPEED	WRONG SIGNAL	Error 182 present "CCVS timeout" message issued by EDC.		Check signal travel EDC.				
61	08	CAN LINE - ENGINE - NUMBER OF ENGINE REVS.	WRONG SIGNAL	Vehicle moving: Clutch control is governed by the time interval set by the control unit. Reduction in driving comfort. The clutch opens under the threshold fixed by the system; the speed of the engine is not checked during gear increases. Vehicle stationary: Clutch control is governed by the time interval set by the control unit; reduction in manoeuvring comfort.		Check engine speed in error memory under environmental conditions.				
61	08	CAN LINE - ENGINE - NUMBER OF ENGINE REVS.	WRONG SIGNAL			Please make also a diagnosis check on EDC system.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
62	08	SHIFTING ACTUATOR - SENSORS - INPUT SHAFT SPEED	WRONG SIGNAL	Vehicle moving: The time interval increases by which gear changes are governed. When changing gear the clutch may be partly closed. If the gear is engaged, the input speed is replaced with the output speed. Vehicle stationary: The time interval increases by which gear changes are governed. Reduction in driving and manoeuvring comfort.		Check connector status and sensor efficiency. Otherwise check: - correct mounting of the sensor. - correct mounting and play of phonic wheel.				
63	08	SENSORS - TRANSMISSION OUTPUT SPEED	WRONG SIGNAL	The output speed is calculated via redundant signals, such as the tachograph signal, via the CAN line. All the gears can be engaged manually. Reduction in clutch performance due to the time needed to acquire the information from the CAN line.		Check wiring and connections. Replace sensor if required.	1- Measure type: Voltage (V) Measure point 1: Connector for clutch actuator - gearbox side Pin: 18 Measure point 2: Connector for clutch actuator - gearbox side Pin: 6 2- Measure type: Voltage (V) Measure point 1: Connector for clutch actuator - gearbox side Pin: 11 Measure point 2: Connector for clutch actuator - gearbox side Pin: 6	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;		

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
64	08	SIGNALS - SENSOR - TACHO-GRAPH SENSOR	WRONG SIGNAL	If the output speed signal 1 is available, there are no restrictions on the system.		Check vehicle-end wiring. Check and replace defective output sensor.				Error 99,101 set; Output speed > 2500 rpm; Vehicle speed too high.
64	08	SIGNALS - SENSOR - TACHO-GRAPH SENSOR	WRONG SIGNAL			Verify the correct working of the tachograph.				
64	08	SIGNALS - SENSOR - TACHO-GRAPH SENSOR	WRONG SIGNAL			Or alternatevely check that the stored value in the ECU for the axle ratio correct is (Diagnosis: Idendification Code Reading). If the value is not correct, carry out again the programming (Programming: Configuration Change).				
65	08	SIGNALS - SENSOR - TACHO-GRAPH+OUTPUT SHAFT SPEED SENSOR	BOTH SPEED SENSORS FAULTY	Vehicle moving: The speed increases are managed as the changes. The speed increases are not possible when the engine is at low speed. The engagement time increases. Vehicle stationary: The engagement time is longer.	Wear of selector fork.	Check signal travel as with error 99 and 100. Wear of selector fork. Disassemble/replace transmission.				Gear selected and displayed -> no power transmission.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
66	03	SIGNALS - SENSOR - INPUT AND OUTPUT SPEED SENSOR	PLAUSIBILITY	Vehicle moving: The speed increases are managed as the changes. The speed increases are not possible when the engine is at low speed. The engagement time increases. Vehicle stationary: The engagement time is longer.		Check if the position of the sensors is correct. Check the mechanical efficiency of the transmission. Check that the vehicle is not equipped with an electronic control unit programmed for the retarder, if the transmission does not require it.				
67	08	CAN LINE - CRUISE CONTROL / VEHICLE SPEED - VEHICLE SPEED	WRONG SIGNAL	The system adopts substitutive parameters. Reduced functionality for the automatic mode and to calculate the starting gear, if there is a large difference between the parameters utilized and the actual values. The quality of clutch uncoupling may decrease.	Other CAN errors 26,180,181,182.	Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	Reprogram the electronic control unit to rewrite the parameters.
67	08	CAN LINE - CRUISE CONTROL / VEHICLE SPEED - VEHICLE SPEED	WRONG SIGNAL			Please make also a diagnosis check on EDC system.				
67	08	CAN LINE - CRUISE CONTROL / VEHICLE SPEED - VEHICLE SPEED	WRONG SIGNAL	Further errors saved in EDC.	EDC deactivation relay defective.	Replace deactivation relay.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
68	01	SUPPLY VOLTAGE - ELEC-TRONIC CON-TROL UNIT	VOLTAGE TOO HIGH	Defective supply.		Check for a fault in the 10A fuses (fuses holder no. 70602).	1- Measure type: Voltage (V) Measure point 1: Connector for ECU power sup-ply - vehicle side. Pin: 4 Measure point 2: Con-nector for ECU power supply - vehicle side. Pin: 16 - 2- Measure type: Voltage (V) Measure point 1: Connector for ECU power sup-ply - vehicle side. Pin: 5 Measure point 2: Con-nector for ECU power supply - vehicle side. Pin: 16 - 3- Measure type: Voltage (V) Measure point 1: Connector for ECU power sup-ply - vehicle side. Pin: 4 Measure point 2: Con-nector for ECU power supply - vehicle side. Pin: 17 - 4- Measure type: Voltage (V) Measure point 1: Con-nector for ECU power supply - vehicle side. Pin: 5 Measure point 2: Con-nector for ECU power supply - vehicle side. Pin: 17	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON; 3- Connector Connected; Key +15 ON; 4- Connector Connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; 2- Min. value: 22 V; Max. value: 28 V; 3- Min. value: 22 V; Max. value: 28 V; 4- Min. value: 22 V; Max. value: 28 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
69	02	SUPPLY VOLTAGE - ELEC-TRONIC CON-TROL UNIT	VOLTAGE TOO LOW	Defective supply.		Check for a fault in the 10A fuses (fuses holder no. 70602).	1- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 4 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 16 - 2- Measure type: Voltage (V) - Measure point 1: Connector for ECU power supply - vehicle side. Pin: 5 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 16 - 3- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 4 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 17 - 4- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 5 - Measure point 2: Connector for ECU power supply - vehicle side. Pin: 17	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON; 3- Connector Connected; Key +15 ON; 4- Connector Connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; 2- Min. value: 22 V; Max. value: 28 V; 3- Min. value: 22 V; Max. value: 28 V; 4- Min. value: 22 V; Max. value: 28 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
6B	02	CLUTCH ACTUATOR - POSITION SENSOR	SUPPLY OUT OF RANGE	Vehicle moving: The clutch is disengaged via time control. Vehicle stationary: Impossible to perform manoeuvres. If the vehicle has not started within a set time, neutral is engaged. A fresh gear has to be selected with the gear lever to start the vehicle. Comfort is diminished on starting.		Check the sensor voltage supply.	Measure type: Voltage (V) Measure point 1: Connector for clutch actuator - gearbox side Pin: 15 Measure point 2: Connector for clutch actuator - gearbox side Pin: 20	Connector Connected; Key +15 ON;	Min. value: 4.5 V; Max. value: 5.5 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
6C		SIGNALS - GEAR SHIFT LEVER	WRONG SIGNAL	Control lever: No shifting possible during travel. At standstill the "last-starting gear" is selected in the manual mode (half-automatic mode), theautomatic starting gear in automatic mode. If neutral is activated or existingat standstill, the starting gear is not engaged. Neutral switch: No shifting possible during travel. At standstill a startinggear can be selected and the vehicle can be driven with a starting gearselected. R gear selector signals: If there is a fault (no signal) in one of the two. Reverse gear switches at a standstill and if the tip-action speed rangeselector is pulled backwards (-/--), the low-ratio Reverse gear (RL) isengaged.	New shift lever: if there is any shifting request signal transmitted in the VCM_TC message.	Check wiring and connections between gear lever and Ecu: nominal value supply voltage gear selector 24 Volt. Check CAN line between gear lever and Ecu: nominal value resistance CAN H - CAN L 60 Ohm. Replace CAN bus wiring and/or CAN modules. Check and/or replace range selector.	1- Measure type: Voltage (V) Measure point 1: Connector (vehicle side) Pin: 11 Measure point 2: Connector (vehicle side) Pin: 16 2- Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 3 Measure point 2: Connector (vehicle side) Pin: 6 3- Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	1- Connector Connected; Key +15 OFF; 2- Connector Connected; Key +15 OFF; 3- Connector Connected; Key +15 OFF;	1- Max. value: 19,5 V; 2- Typical Value: 60 Ohm; 3- Typical Value: 60 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
6C	00	SIGNALS - GEAR SHIFT LEVER	WRONG SIGNAL	The gearbox may have lower performance or be locked. It depends on the conditions generating it.		Select PARAMETER READ environment. Move the shift lever and verify the value changes. Check cabling, if failure persists, the lever is worn.				
6E	04	CAN LINE - COMMUNICATION LINES - GEAR SHIFT LEVER	COMMUNICATION ERROR	After switching over the key (Off-On) the fault is recognized during system set-up and the display shows the error code; the system is not available. Vehicle moving: gearbox locked, the system automatically engages the last gear used to start the vehicle. If the gearbox has the reverse gear engaged t/m is automatically put into neutral. No information on the gear lever is available. The display shows alternately the error code and the information on the gear.		Check vehicle CAN.	1- Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 3 Measure point 2: Connector (vehicle side) Pin: 6 2- Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	1- Connector Connected; Key +15 OFF; 2- Connector Connected; Key +15 OFF;	1- Typical Value: 60 Ohm; 2- Typical Value: 60 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
6E	04	CAN LINE - COMMUNICATION LINES - GEAR SHIFT LEVER	COMMUNICATION ERROR			Check wiring and connections between gear lever and Ecu.	Measure type: Voltage (V) Measure point 1: Connector (vehicle side) Pin: 11 Measure point 2: Gear lever connector Pin: 15	Connector Connected; Key +15 ON;	Max. value: 24 V;	Replace CAN gear selector switch. Conduct a test drive with function check. Check transmission for leaks.
71	04	CAN LINE -RETARDER - INTARDER -CONFIGURATION MESSAGE	TIMEOUT	Impossible to calculate the gear resistance. No automatic calculation of the starting gear. The average starting gear is engaged at the stop. No additional system restrictions.		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	
71	04	CAN LINE -RETARDER - INTARDER -CONFIGURATION MESSAGE	TIMEOUT			Check/Replace Intarder electronics.				
72	00	CLUTCH ACTUATOR - CLUTCH	ENGAGEMENT NOT REQUESTED, ENGAGED GEAR AND STATIONARY VEHICLE	Standstill: shift to neutral, after neutral system available.		Check the mechanical operation of the clutch unit and the pneumatic circuit.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
75	00	CLUTCH ACTUATOR - CLUTCH	SELF-ADJUSTMENT ERROR	System not available.		Check the mechanical system of the clutch engage/disengage unit.				
76	00	CLUTCH ACTUATOR - CLUTCH	DOES NOT DISENGAGE	Vehicle moving: Try engaging the gear. If the gear is engaged, the clutch stays engaged. The gearbox stays locked. Vehicle stationary: If the clutch fails to disengage, the engine remains locked. The system selects neutral automatically.		Check the mechanical operation of the clutch unit and the pneumatic circuit.				
77	00	CLUTCH ACTUATOR - CLUTCH	DOES NOT ENGAGE	Vehicle moving: If the gearbox has a gear engaged, the clutch tries to close with the highest speed. Gearbox locked. Vehicle stationary: Automatic engagement of neutral after time lag governed by the system. System not available.		Check the mechanical operation of the clutch unit and the pneumatic circuit.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
78	00	CLUTCH ACTUATOR - (Y17) SOLENOID VALVE CLUTCH DISENGAGEMENT SLOW	MECHANICAL FAILURE	Reduction in clutch performance. The function performed by a damaged valve is performed by another valve following this scheme:mechanical fault of the Y17 valve >> function performed by valve Y16 mechanical fault of the Y16 valve >> function performed by valve Y17 mechanical fault of the Y15 valve >> function performed by valve Y14 mechanical fault of the Y14 valve >> function performed by valve Y15		Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit)				
79	00	CLUTCH ACTUATOR - (Y16) SOLENOID VALVE CLUTCH DISENGAGEMENT FAST	MECHANICAL FAILURE	Reduction in clutch performance. The function performed by a damaged valve is performed by another valve following this scheme:mechanical fault of the Y17 valve >> function performed by valve Y16 mechanical fault of the Y16 valve >> function performed by valve Y17 mechanical fault of the Y15 valve >> function performed by valve Y14 mechanical fault of the Y14 valve >> function performed by valve Y15		Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit)				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
7A	00	CLUTCH ACTUATOR - (Y15) SOLENOID VALVE CLUTCH ENGAGEMENT SLOW	MECHANICAL FAILURE	Reduction in clutch performance. The function performed by a damaged valve is performed by another valve following this scheme:mechanical fault of the Y17 valve >> function performed by valve Y16 mechanical fault of the Y16 valve >> function performed by valve Y17 mechanical fault of the Y15 valve >> function performed by valve Y14 mechanical fault of the Y14 valve >> function performed by valve Y15		Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit)				
7B	00	CLUTCH ACTUATOR - (Y14) SOLENOID VALVE CLUTCH ENGAGEMENT FAST	MECHANICAL FAILURE	Reduction in clutch performance. The function performed by a damaged valve is performed by another valve following this scheme:mechanical fault of the Y17 valve >> function performed by valve Y16 mechanical fault of the Y16 valve >> function performed by valve Y17 mechanical fault of the Y15 valve >> function performed by valve Y14 mechanical fault of the Y14 valve >> function performed by valve Y15		Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit)				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
7C	00	CLUTCH ACTUATOR - POSITION SENSOR	SIGNAL OUT OF RANGE	Vehicle moving: The clutch is engaged - disengaged via time lag signal. Vehicle stationary: Manoeuvring impossible. If the vehicle fails to start within a certain length of time set by the control unit, the gearbox automatically goes into neutral; starting is again possible after engaging the gear with the gear lever. Reduction in clutch performance.		Check the sensor voltage supply.	Measure type: Voltage (V) Measure point 1: Connector for clutch actuator - gearbox side Pin: 10 Measure point 2: Connector for clutch actuator - gearbox side Pin: 20	Connector Connected; Key +15 ON;	Min. value: 0.5 V; Max. value: 4.5 V;	
7D	00	SHIFTING ACTUATOR - PRESSURE REDUCTION VALVE	PRESSURE TOO HIGH AT ALTITUDE	No system restriction.		Check system supply air pressure 7 bars.				
7E	03	SHIFTING ACTUATOR - SENSORS - PRESSURE SENSOR	SIGNAL OUT OF RANGE	No system restriction if there is enough air in the system. The Cluster fails to display the AL code if the air system does not have the right pressure. The clutch is controlled with a time interval; the control times may turn out longer.		Gear actuator replacement (control unit)				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
7F	03	SHIFTING ACTUATOR - SENSORS - ECU TEMPERATURE	SIGNAL OUT OF RANGE	No system restriction.		Replacing the gearbox actuator (control unit)				
80	00	SENSORS - OIL TEMPERATURE SIGNAL	SIGNAL OUT OF RANGE	No system restriction; the system takes the control unit temperature signal as reference.		Reprogram and in case replace the gearbox actuator (control unit).				
81	06	SHIFTING ACTUATOR - SENSORS - GEAR ENGAGED	SHORT CIRCUIT TO POSITIVE	Vehicle moving: When the trouble occurs while changing gear, the coupling signal is substituted by the time check signal. The gearbox is then locked; it is possible to engage neutral. Vehicle stationary: it is possible to select the starting gear. The main valve and the gear coupling valve remain active until the clutch, on closing, exceeds the reference threshold or the start conditions occur.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
81	06	SHIFTING ACTUATOR - SENSORS - GEAR ENGAGED	SHORT CIRCUIT TO POSITIVE			Check VDB CAN-line integrity.				
82	05	SHIFTING ACTUATOR - SENSORS - GEAR ENGAGED	SHORT CIRCUIT TO GROUND	Vehicle moving: When the trouble occurs while changing gear, the coupling signal is substituted by the time check signal. The gearbox is then locked; it is possible to engage neutral. Vehicle stationary: it is possible to select the starting gear. The main valve and the gear coupling valve remain active until the clutch, on closing, exceeds the reference threshold or the start conditions occur.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
82	05	SHIFTING ACTUATOR - SENSORS - GEAR ENGAGED	SHORT CIRCUIT TO GROUND			Check VDB CAN-line integrity.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
83	0A	SHIFTING ACTUATOR - SENSORS - GEAR ENGAGED	INTERRUPTION	Vehicle moving: When the trouble occurs while changing gear, the coupling signal is substituted by the time check signal. The gearbox is then locked; it is possible to engage neutral. Vehicle stationary: it is possible to select the starting gear. The main valve and the gear coupling valve remain active until the clutch, on closing, exceeds the reference threshold or the start conditions occur.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
83	0A	SHIFTING ACTUATOR - SENSORS - GEAR ENGAGED	INTERRUPTION			Check VDB CAN-line integrity.				
84	00	SHIFTING ACTUATOR - SENSORS - GEAR ENGAGED	SELF-ADJUSTMENT ERROR	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
85	06	SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR	SHORT CIRCUIT TO POSITIVE	Vehicle moving: Only some gears can be selected. Vehicle stationary: All the gears can be selected; the reverse gears cannot be selected.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
85	06	SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR	SHORT CIRCUIT TO POSITIVE			Check VDB CAN-line integrity.				
85	06	SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR	SHORT CIRCUIT TO POSITIVE			Replace ECU. If replacing the ECU corrects the problem, reinstall the original ECU to confirm that the problem is in the ECU.				
86	05	SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR	SHORT CIRCUIT TO GROUND			Check VDB CAN-line integrity.				
86	05	SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR	SHORT CIRCUIT TO GROUND			Replace ECU. If replacing the ECU corrects the problem, reinstall the original ECU to confirm that the problem is in the ECU.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
86	05	SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR	SHORT CIRCUIT TO GROUND	Vehicle moving: Only some gears can be selected. Vehicle stationary: All the gears can be selected; the reverse gears cannot be selected.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
87	0A	SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR	INTERRUPTION	Vehicle moving: Only some gears can be selected. Vehicle stationary: All the gears can be selected; the reverse gears cannot be selected.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
87	0A	SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR	INTERRUPTION			Check VDB CAN-line integrity.				
87	0A	SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR	INTERRUPTION			Replace ECU. If replacing the ECU corrects the problem, reinstall the original ECU to confirm that the problem is in the ECU.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
88	00	SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR	SELF-ADJUSTMENT ERROR	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
89	06	SHIFTING ACTUATOR - SENSORS - RANGE UNIT	SHORT CIRCUIT TO POSITIVE	Vehicle moving: Locking engaged gear range assembly. Only the gears of the current gear assembly can be changed by time control. Vehicle stationary: All the starting gears can be selected; the low range gear assembly can be selected by the time control. The main valve and the range valve remain active until the clutch coupling exceeds a pre-arranged threshold or the running condition is detected.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
89	06	SHIFTING ACTUATOR - SENSORS - RANGE UNIT	SHORT CIRCUIT TO POSITIVE			Check VDB CAN-line integrity.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
8A	05	SHIFTING ACTUATOR - SENSORS - RANGE UNIT	SHORT CIRCUIT TO GROUND	Vehicle moving: Locking engaged gear range assembly. Only the gears of the current gear assembly can be changed by time control. Vehicle stationary: All the starting gears can be selected; the low range gear assembly can be selected by the time control. The main valve and the range valve remain active until the clutch coupling exceeds a pre-arranged threshold or the running condition is detected.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
8A	05	SHIFTING ACTUATOR - SENSORS - RANGE UNIT	SHORT CIRCUIT TO GROUND			Check VDB CAN-line integrity.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
8B	0A	SHIFTING ACTUATOR - SENSORS - RANGE UNIT	INTERRUPTION	Vehicle moving: Locking engaged gear range assembly. Only the gears of the current gear assembly can be changed by time control. Vehicle stationary: All the starting gears can be selected; the low range gear assembly can be selected by the time control. The main valve and the range valve remain active until the clutch coupling exceeds a pre-arranged threshold or the running condition is detected.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
8B	0A	SHIFTING ACTUATOR - SENSORS - RANGE UNIT	INTERRUPTION			Check VDB CAN-line integrity.				
8C	00	SHIFTING ACTUATOR - SENSORS - RANGE UNIT	SELF-ADJUSTMENT ERROR	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
8D	06	SHIFTING ACTUATOR - SENSORS - SPLITTER UNIT	SHORT CIRCUIT TO POSITIVE	Splitter assembly locked. Driving is possible only with the last gear assembly selected by the splitter. If the required gear cannot be engaged, the highest available gear is engaged. If the trouble occurs a gear change the splitter control is made by the time control.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
8E	05	SHIFTING ACTUATOR - SENSORS - SPLITTER UNIT	SHORT CIRCUIT TO GROUND	Splitter assembly locked. Driving is possible only with the last gear assembly selected by the splitter. If the required gear cannot be engaged, the highest available gear is engaged. If the trouble occurs a gear change the splitter control is made by the time control.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
8F	0A	SHIFTING ACTUATOR - SENSORS - SPLITTER UNIT	INTERRUPTION	Splitter assembly locked. Driving is possible only with the last gear assembly selected by the splitter. If the required gear cannot be engaged, the highest available gear is engaged. If the trouble occurs a gear change the splitter control is made by the time control.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
90	00	SHIFTING ACTUATOR - SENSORS - SPLITTER UNIT	SELF-ADJUSTMENT ERROR	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Verify that sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
91	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT	DOES NOT DISENGAGE	Vehicle moving: When selecting the change from the lower gear assembly to the higher one, the highest gear of the lower gear assembly is selected. When selecting the change from the higher gear assembly to the lower one, the lowest gear of the higher gear assembly is selected. Vehicle stationary: If it is not possible to select the lower gear assembly, the lowest gear of the higher gear assembly is used for picking up. It is not possible to engage the reverse gear of the higher gear assembly.		First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves				
91	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT	DOES NOT DISENGAGE			Try to engage gears with the vehicle at rest and check if the failure is still present.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
91	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT	DOES NOT DISENGAGE			Check the mechanical system of the range unit.				
92	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT	SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION	If the selected gear assembly cannot be engaged, the relevant actuator tries to repeat engagement for three times. When the attempts fail, the system can have the following reactions: 1) When the selection from the lower to the higher gear assembly fails, the highest gear of the lower assembly is engaged. 2) When the selection from the higher to the lower gear assembly fails, the lowest gear of the higher gear assembly is engaged. Vehicle stationary: if the lower gear assembly cannot be selected, the lowest gear of the higher gear assembly is selected for picking up.		First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
92	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT	SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION			Try to engage gears with the vehicle at rest and check if the failure is still present.				
92	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT	SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION			Check the mechanical system of the range unit.				
93	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT	DOES NOT ENGAGE	If the selected gear assembly cannot be engaged, the relevant actuator tries to repeat engagement for three times. If it is not possible to engage the fresh gear assembly the system tries to go back to the previous one; if this attempt fails after a certain length of time the system goes into neutral.		First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves				
93	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT		DOES NOT ENGAGE		Try to engage gears with the vehicle at rest and check if the failure is still present.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
93	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT	DOES NOT ENGAGE			Check the mechanical system of the range unit.				
94	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	DOES NOT DISENGAGE	Vehicle moving: The highest-lowest gear that can be selected is the highest-lowest one available on the gear assembly selected previously with the splitter. Vehicle stationary: The highest-lowest gear that can be selected corresponds to the highest-lowest pick-up gear on the gear assembly previously engaged by the splitter.		First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves				
94	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	DOES NOT DISENGAGE			Verify that B7 sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
94	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	DOES NOT DISENGAGE			Try to engage gears with the vehicle at rest and check if the failure is still present.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
94	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	DOES NOT DISENGAGE			Check the mechanical system of the splitter unit (eventually replace the gears/splitter shaft).				
95	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION	Vehicle moving: The highest-lowest gear that can be selected is the highest-lowest one available on the gear assembly selected previously with the splitter. Vehicle stationary: The highest-lowest gear that can be selected corresponds to the highest-lowest pick-up gear on the gear assembly previously engaged by the splitter.		First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves				
95	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION			Verify that B7 sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
95	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION			Try to engage gears with the vehicle at rest and check if the failure is still present.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
95	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION			Check the mechanical system of the splitter unit (eventually replace the gears/splitter shaft).				
96	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	DOES NOT ENGAGE	System not available.		First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves				
96	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	DOES NOT ENGAGE			Verify that B7 sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
96	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	DOES NOT ENGAGE			Try to engage gears with the vehicle at rest and check if the failure is still present.				
96	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	DOES NOT ENGAGE			Check the mechanical system of the splitter unit.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
97	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR	DOES NOT DISENGAGE			Check the mechanical system of the gear engagement unit.				
97	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR	DOES NOT DISENGAGE	Vehicle moving: T/m engages on the previous gear. If the previous gear cannot be engaged due to the vehicle's speed, the system selects the gear that can be selected as close as possible to the previous gear. When the attempt is not successful the T/m is in neutral. Vehicle stationary: If the previous gear cannot be engaged the T/m goes into neutral.		First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves				
97	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR	DOES NOT DISENGAGE			Try to engage gears with the vehicle at rest and check if the failure is still present.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
98	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR	SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION	Vehicle moving: T/m engages on the previous gear. If the previous gear cannot be engaged due to the vehicle's speed, the system selects the gear that can be selected as close as possible to the previous gear. When the attempt is not successful the T/m is in neutral. Vehicle stationary: If the previous gear cannot be engaged the T/m goes into neutral.		First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves				
98	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR	SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION			Try to engage gears with the vehicle at rest and check if the failure is still present.				
98	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR	SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION			Check the mechanical system of the gear engagement unit.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
99	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR	DOES NOT ENGAGE	Vehicle moving: T/m engages on neutral. It is necessary to start engaging another gear with the gear lever; if the system is not able to engage the gear it shuts down and is no longer available.		First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves				
99	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR	DOES NOT ENGAGE			Try to engage gears with the vehicle at rest and check if the failure is still present.				
99	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR	DOES NOT ENGAGE			Check the mechanical system of the gear engagement unit.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
9A	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED	DOES NOT DISENGAGE	Vehicle moving: The clutch is engaged in the previous gear. The next attempt at engaging will have to start with the selector switch. Vehicle stationary: gear change permitted only after the neutral signal has been received. Starting and driving can be attempted with the gear engaged, if the gear is equal to or lower than the lowest gear of the selected range.		First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves				
9A	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED	DOES NOT DISENGAGE			Try to engage gears with the vehicle at rest and check if the failure is still present.				
9A	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED	DOES NOT DISENGAGE			Check the mechanical system of the gear engagement unit.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
9B	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED	DOES NOT ENGAGE	Vehicle moving: T/m stays on neutral. Another gear selection can be set with the selector lever; if the system comes out of the neutral position, but the gear is not engaged within a certain time, the system goes back into neutral. Vehicle stationary: T/m stays on neutral. When a gear is engaged the clutch is engaged. If the clutch travel is too long, T/m goes back into the neutral position. Another gear selection can be set with the selector lever.		First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves				
9B	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED	DOES NOT ENGAGE			Try to engage gears with the vehicle at rest and check if the failure is still present.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
9B	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED	DOES NOT ENGAGE			Check the mechanical system of the gear engagement unit.				
9C	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED	WRONG GEAR SHIFTING	The gearbox automatically goes into neutral and the clutch stays open. Another gear selection can be set with the selector lever.		First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves				
9C	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED	WRONG GEAR SHIFTING			Try to engage gears with the vehicle at rest and check if the failure is still present.				
9C	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED	WRONG GEAR SHIFTING			Check the mechanical system of the gear engagement unit.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
9E	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED	DISENGAGEMENT NOT REQUESTED			Try to engage gears with the vehicle at rest and check if the failure is still present.				
9E	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED	DISENGAGEMENT NOT REQUESTED			Check the mechanical system of the gear engagement unit.				
9E	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED	DISENGAGEMENT NOT REQUESTED	The main valve will be automatically operated together with the gear valves to couple in the final position. If the gear has uncoupled completely, a suitable gear will be automatically engaged according to the speed conditions.		First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves				
9E	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED	DISENGAGEMENT NOT REQUESTED			Verify that B4 sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
9F	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT	DISENGAGEMENT NOT REQUESTED	The main valve will be automatically operated together with the gear valves to couple in the final position. If the gear has uncoupled completely, a suitable gear will be automatically engaged according to the speed conditions.		First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves				
9F	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT	DISENGAGEMENT NOT REQUESTED			Verify that B4 sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
9F	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT	DISENGAGEMENT NOT REQUESTED			Try to engage gears with the vehicle at rest and check if the failure is still present.				
9F	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT	DISENGAGEMENT NOT REQUESTED			Check the mechanical system of the gear engagement unit.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
A0	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	DISENGAGEMENT NOT REQUESTED			Verify that B7 sensor resistance should be between 60 and 90 Ohms.	Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 69 Ohm;	
A0	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	DISENGAGEMENT NOT REQUESTED			Try to engage gears with the vehicle at rest and check if the failure is still present.				
A0	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	DISENGAGEMENT NOT REQUESTED	The main valve will be automatically operated together with the gear valves to couple in the final position. If the gear has uncoupled completely, a suitable gear will be automatically engaged according to the speed conditions.		First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves				
A0	00	SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT	DISENGAGEMENT NOT REQUESTED			Check the mechanical system of the range splitter (in case replace the sleeves and the gears shaft).				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
A3	00	CAN LINE - ENGINE - TORQUE REQUEST	NO AVAIL-ABLE SYMPTOM	Speed cannot be in-creased (during downshifts).	Transmission end possibilities.	Check/assemble the gear shift rail with det-ent for gate.				Gear change shaft: - Old: 1327 306 005 - New: 1327 306 008 Introduction ex trans-mission number into production: 12 AS 2301 No. 141912 AS 2301 IT No. 203583
A3	00	CAN LINE - ENGINE - TORQUE REQUEST	NO AVAIL-ABLE SYMPTOM	Vehicle moving: Gear change not syn-chronized. Vehicle stationary: Starting permitted. Decrease in function-ality and clutch com-fort.		Check the following function vehicle com-ponents: - Injection pump - Diesel filter- Fuel conduct and circuit Wiring (signal travel) - Mechanics engine brake flaps				
A4	08	CAN LINE - ENGINE - RE-QUESTED ENGINE TORQUE	WRONG SIGNAL	Further errors saved in EDC.		Please make also a di-agnosis check on EDC system.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
A5	08	CAN LINE - ENGINE - ACCELERATOR PEDAL POSITION	WRONG SIGNAL	Further errors saved in EDC.		Please make also a diagnosis check on EDC system.				
A5	08	CAN LINE - ENGINE - ACCELERATOR PEDAL POSITION	WRONG SIGNAL	Vehicle moving: No calculation of vehicle weight and gear resistance possible. Impossible to calculate starting gear. Throttle pedal position will be replaced by request for information from the driver. The coupling quality could be reduced. Vehicle stationary: Starting is possible. On reaching the stop, the average starting gear will be engaged. The manoeuvring and starting quality could be reduced.		Check accelerator/accelerator wiring.Replace/repair accelerator/periphery.				
A6	00	CAN LINE - ENGINE - IDLE SWITCH / ACCELERATOR PEDAL	PLAUSIBILITY	Vehicle moving: Gear changing possible Vehicle stationary: Impossible to start the vehicle. System not available.		Check accelerator/accelerator wiring/idling switch. Replace/repair/teach-in accelerator/periphery.				Error is set with idling signal 1 and accelerator pedal position > 20%.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
A6	00	CAN LINE - ENGINE - IDLE SWITCH / ACCELERATOR PEDAL	PLAUSIBILITY	Further errors saved in EDC.		Please make also a diagnosis check on EDC system.				
A7	08	CAN LINE - ENGINE - ENGINE TORQUE	WRONG SIGNAL	System not available.		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	
A7	08	CAN LINE - ENGINE - ENGINE TORQUE	WRONG SIGNAL			Intermittent or incorrect signal.	Please make also a diagnosis check on EDC system.			

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
A8	08	CAN LINE - ENGINE - LOW IDLE SWITCH	WRONG SIGNAL	Vehicle moving: No system restriction present while driving. Vehicle stationary: After RESETTING the display shows codes AP or FP until the throttle pedal is pressed and the idling signal is off. If the idling signal fails to arrive within a certain length of time, the display will show the error with code AC or will no longer show code FP. Starting is possible if the control unit detects a throttle potentiometer value > the threshold and the engine idling speed + a predefined threshold.		Check accelerator / accelerator wiring / idling switch. Replace / repair / teach-in accelerator / periphery.				Error is set with idling signal 0 and accelerator pedal position > 0%.
A9	00	SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - ECU RELAY CUT-OFF	DOES NOT SWITCH OFF	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		The relay is located within the E.C.U. Before replacing the E.C.U., check that the voltage supplied is correct.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
AA	00	SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - ECU RELAY CUT-OFF	DOES NOT SWITCH ON	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		The relay is located within the E.C.U. Before replacing the E.C.U., check that the voltage supplied is correct.				
AB	08	CAN LINE - ENGINE - ENGINE TORQUE	WRONG SIGNAL	Vehicle moving: No calculation of vehicle weight and gear resistance possible. Impossible to calculate starting gear. The information on the torque percentage is obtained from the driver's controls (throttle pedal). Vehicle stationary: Starting possible. When the vehicle stops the system selects the average starting gear. Attention to possible overloads on the clutch.	EDC deactivation relay defective.	Replace deactivation relay.				No error saved in EDC.
AB	08	CAN LINE - ENGINE - ENGINE TORQUE	WRONG SIGNAL			Intermittent or incorrect signal.	Please make also a diagnosis check on EDC system.			

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
AE	08	CAN LINE - ENGINE - KICK-DOWN SWITCH	WRONG SIGNAL	The kickdown function is not available. No additional functional restrictions.		Check the following components: - EDC-Accelerator pedal (teach-in) - Wiring (signal travel) - Kickdown switch				Error on the signal from the throttle pedal
AF	04	SUPPLY VOLTAGE - ELECTRONIC CONTROL UNIT	SIGNAL KEY (+15) NOT PRESENT	Defective supply (+ 15).		Check for a fault in the 10A fuses (fuses holder no. 70602).	1- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 1 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 16 2- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 1 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 17	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; 2- Min. value: 22 V; Max. value: 28 V;	
B0	00	SIGNALS - GEAR SHIFT LEVER	SHIFT LEVER POSITION NOT DEFINED	The gearbox may have lower performance or be locked. It depends on the conditions generating it.		Select PARAMETER READ environment. Move the shift lever and verify the value changes. Check cabling, if failure persists, the lever is worn.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
B1	04	CAN LINE -COM-MUNICA-TION LINES - VEHICLE	COM-MUNICA-TION ERROR	Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving.		Verify CAN line (for a possible disconnection of ST11 connector).	Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8 Measure point 2: Connector (ve-hicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	
B1	04	CAN LINE -COM-MUNICA-TION LINES - VEHICLE	COM-MUNICA-TION ERROR			Check wiring				
B2	04	CAN LINE -COM-MUNICA-TION LINES - VEHICLE	COM-MUNICA-TION ERROR (WARN-ING)	Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving.		Verify CAN line (for a possible disconnection of ST11 connector).	Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8 Measure point 2: Connector (ve-hicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	
B2	04	CAN LINE -COM-MUNICA-TION LINES - VEHICLE	COM-MUNICA-TION ERROR (WARN-ING)			Check wiring				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
B3	00	CAN LINE -COM-MUNICA-TION LINES - VEHICLE	QUEUE OVERRUN	Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving.		Verify CAN line (for a possible disconnection of ST11 connector).	Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8 Measure point 2: Connector (ve-hicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	
B3	00	CAN LINE -COM-MUNICA-TION LINES - VEHICLE	QUEUE OVERRUN			Check wiring				
B4	04	CAN LINE - ENGINE - CONTROL MESSAGE	TIMEOUT	Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving.		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8 Measure point 2: Connector (ve-hicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	
B4	04	CAN LINE - ENGINE - CONTROL MESSAGE	TIMEOUT	In the EEC1 message timeout at the fol-lowing signals: - theoretical injection volume EDC - current injected vol-ume EDC - output speed of en-gine		Please make also a di-agnosis check on EDC system.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
B4	04	CAN LINE - ENGINE - CONTROL MESSAGE	TIMEOUT			Check fuse box fuses.				
B5	04	CAN LINE - ENGINE - CON-TROL MESSAGE	TIMEOUT	Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving.		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8 Measure point 2: Connector (ve-hicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
B6	04	CAN LINE - CRUISE CONTROL / VEHICLE SPEED - CONTROL MESSAGE	TIMEOUT	No vehicle speed based on wheels (redundant 2 output speed information, if output speed is not detected on 2nd output speed sensor of CAN tachograph). No service brake signal. When running by inertia, the service brake signal is considered active. No Cruise Control active information. No calculation of vehicle weight and gear resistance possible. Impossible to calculate starting gear. The ensuing variable single fault message is deleted. The clutch always disengages at the associated brake pedal engine speed (higher engine revs).		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	The following signals are in CCVS:-Veh. speed v_fzg (km/h)-Brake switch z_fbr (1 active/0 not active)-Cruise control target speed v_cc_set (km/h)-Cruise control status v cc status
B6	04	CAN LINE - CRUISE CONTROL / VEHICLE SPEED - CONTROL MESSAGE	TIMEOUT			Please make also a diagnosis check on EDC system.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
B6	04	CAN LINE - CRUISE CONTROL / VEHICLE SPEED - CONTROL MESSAGE	TIMEOUT			Check fuse box fuses.				
B7	04	CAN LINE - RETARDER - ENGINE BRAKE - CONTROL MESSAGE	TIMEOUT	No calculation of vehicle weight and gear resistance possible. Impossible to calculate starting gear. No information on exhaust brake torque. If the exhaust brake is activated, the coupling quality can turn out poor at the start of coupling. The exhaust brake is considered as not activated. No additional functional restrictions.		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	ERC1_ER contains the current engine brake torque.
B7	04	CAN LINE - RETARDER - ENGINE BRAKE - CONTROL MESSAGE	TIMEOUT			Please make also a diagnosis check on Intarder.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
B7	04	CAN LINE - RETARDER - ENGINE BRAKE - CONTROL MESSAGE	TIMEOUT			Check fuse box fuses.				
B8	04	CAN LINE - RETARDER - INTARDER - CONTROL MESSAGE	TIMEOUT	No calculation of vehicle weight and gear resistance possible. Impossible to calculate the starting gear. The average starting gear will be engaged. No additional functional restrictions		Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	Message ERC1_DR contains: -Secondary retarder brake torque -Request, increase in engine speed
B8	04	CAN LINE - RETARDER - INTARDER - CONTROL MESSAGE	TIMEOUT			Please make also a diagnosis check on Intarder.				
B8	04	CAN LINE - RETARDER - INTARDER - CONTROL MESSAGE	TIMEOUT			Check fuse box fuses.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
BC	00	SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - INTENAL FAILURE	INCORRET WORKING	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Delete the fault memory: if the error remains, call the Help Desk and follow their instructions to reprogram or replace the control unit if necessary.				
BD	00	SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - INTENAL FAILURE	INCORRET WORKING	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Delete the fault memory: if the error remains, call the Help Desk and follow their instructions to reprogram or replace the control unit if necessary.				
BE	00	SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - INTENAL FAILURE	PROGRAMMING DATA NOT VALID	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Reprogram the electronic control unit to rewrite the parameters.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
BF	00	SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - INTENAL FAILURE	PROGRAMMING DATA NOT VALID	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Reprogram the electronic control unit to rewrite the parameters.				
C0	00	SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - INTENAL FAILURE	EEPROM ACCESS FAILURE	No calculation of vehicle weight and gear resistance possible. Impossible to calculate the starting gear. The average starting gear will be engaged. No additional functional restrictions		Erase the failure memory and retry.If the problem persists, contact the Help Desk and follow the instructions for the possible replacement of the gearcase.				
C1	01	SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - ECU TEMPERATURE	TOO HIGH	Vehicle moving: Gear changing blocked. The clutch opens when the vehicle stops and neutral is engaged. Impossible to keep on driving. The display alternately shows the too high temperature and the information on the gear. System not available.		Verify fluid level.				ECU temperature on electronics circuit board greater than 125 °C and oiltemperature greater than 130 °C.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
C2	08	CAN LINE - BRAKING SYSTEM - FRONT WHEELS SPEED	NO SIGNAL	The automatic shift unit is deactivated. No further system restrictions.		Check / Replace speed sensor.				Error entered in other electronic units as well (EDC, ABS, etc.)
C2	08	CAN LINE - BRAKING SYSTEM - FRONT WHEELS SPEED	NO SIGNAL	Error stored only in transmission electronic unit.		Last time of error storage on the reading out environmental conditions. Cancel Faults Memory				
C2	08	CAN LINE - BRAKING SYSTEM - FRONT WHEELS SPEED	NO SIGNAL	Error still active.	Vehicle speed sensor disconnected or failed.	Check / Replace wiring speed sensor. Check signal travel.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
C2	08	CAN LINE - BRAKING SYSTEM - FRONT WHEELS SPEED	NO SIGNAL		Signal out of tolerance.	Gear actuator replacement (control unit)				Alternative solution: disassemble transmission actuator and replace transmission actuator lower section.
C5	08	CAN LINE - BRAKING SYSTEM - AVERAGE FRONT WHEEL SPEED	WRONG SIGNAL	No calculation of vehicle weight and gear resistance possible. Impossible to calculate the starting gear. The average starting gear will be engaged. No additional functional restrictions		Check fuse box fuses.				Signal is contained in CAN message "SWI".
C5	08	CAN LINE - BRAKING SYSTEM - AVERAGE FRONT WHEEL SPEED	WRONG SIGNAL		Message is generated in the ABS electronics.	Check ABS.				
C5	08	CAN LINE - BRAKING SYSTEM - AVERAGE FRONT WHEEL SPEED	WRONG SIGNAL	The automatic shift unit is deactivated. No further system restrictions.	Check / Replace speed sensor.					Error entered in other electronic units as well (EDC, ABS, etc.)

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
C5	08	CAN LINE - BRAKING SYSTEM - AVERAGE FRONT WHEEL SPEED	WRONG SIGNAL	Error stored only in transmission electronic unit.		Last time of error storage on the reading out environmental conditions. Cancel Faults Memory				
C5	08	CAN LINE - BRAKING SYSTEM - AVERAGE FRONT WHEEL SPEED	WRONG SIGNAL	Error still active.	Vehicle speed sensor disconnected or failed.	Check/Replace wiring speed sensor. Check signal travel.				
C5	08	CAN LINE - BRAKING SYSTEM - AVERAGE FRONT WHEEL SPEED	WRONG SIGNAL	Signal out of tolerance.	Gear actuator replacement (control unit)	Alternative solution: disassemble transmission actuator and replace transmission actuator lower section.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
C7	04	CAN LINE - BRAKING SYSTEM - SPEED WHEELS MESSAGE	TIMEOUT	No calculation of vehicle weight and gear resistance possible. Impossible to calculate the starting gear. The average starting gear will be engaged. No additional functional restrictions		Check fuse box fuses.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	
C7	04	CAN LINE - BRAKING SYSTEM - SPEED WHEELS MESSAGE	TIMEOUT		Message issued by ASR / ABS / EBS electronics.	Check ABS / ASR / EBS signal travel.				
C7	04	CAN LINE - BRAKING SYSTEM - SPEED WHEELS MESSAGE	TIMEOUT	Other errors 91,100,177 present.	Short circuit to ground to pin 8 - CAN H possible.	Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	
E2	04	CAN LINE - MUX	TIMEOUT	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Check the CAN line and the working of the other ECU's connected.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	After replacing any ECU's connected to CAN line, carry out the Cancel Faults Memory.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
E3	00	SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - INTENAL FAILURE	APPLICATION ERROR FOR CAN COMMUNICATION	Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving.		Check the CAN line and the working of the other ECU's connected.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	After replacing any ECU's connected to CAN line, carry out the Cancel Faults Memory.
E7	00	CAN LINE - COMMUNICATION LINES - VCM	EEC3 TIMEOUT ERROR	In initialization phase: default config. (current lever/no addit. Manoeuvring mode/ normal mode). After initialization phase: no functional limitation.	The message VCM_TC is not received for approx. 150 ms or is ignored because it is not valid always for the same time.	Verify presence and recognition VCM ECU.Verify CAN line.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	The error passes intermittent in phase of initialization when it receives the corrected message, but only the shift lever configuration is updated. After the initialization after a reset of the system.

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
F1	08	CAN LINE - COMMUNICATION LINES - GEAR SHIFT LEVER	VCM_TC CAN MESSAGE MISSING	In initialization phase: default config. (current lever/no addit. Manoeuvring mode/ normal mode). After initialization phase: no functional limitation.	The message VCM_TC is not received for approx. 150 ms or is ignored because it is not valid always for the same time.	Verify presence and recognition VCM ECU. Verify CAN line.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	The error passes intermittent in phase of initialization when it receives the corrected message, but only the shift lever configuration is updated. After the initialization after a reset of the system.
F6	00	CAN LINE - COMMUNICATION LINES - VCM	PTI (Power takeoff Information) MESSAGE TIMEOUT ERROR	In initialization phase: default config. (current lever/no addit. Manoeuvring mode/ normal mode). After initialization phase: no functional limitation.	The message VCM_TC is not received for approx. 150 ms or is ignored because it is not valid always for the same time.	Verify presence and recognition VCM ECU. Verify CAN line.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	The error passes intermittent in phase of initialization when it receives the corrected message, but only the shift lever configuration is updated. After the initialization after a reset of the system.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
F7	00	CAN LINE - COMMUNICATION LINES - VCM	PTI (Power takeoff Information) MESSAGE SIGNAL FAILURE			For STRALIS please check either for a possible short between 9131 and 0131 cables or check for a possible wiring inversion on ST67 connector (PIN 4 of 0131 cable could be inverted with PIN 2 of 9131 cable).				
F7	00	CAN LINE - COMMUNICATION LINES - VCM	PTI (Power takeoff Information) MESSAGE SIGNAL FAILURE			Check vehicle CAN.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	

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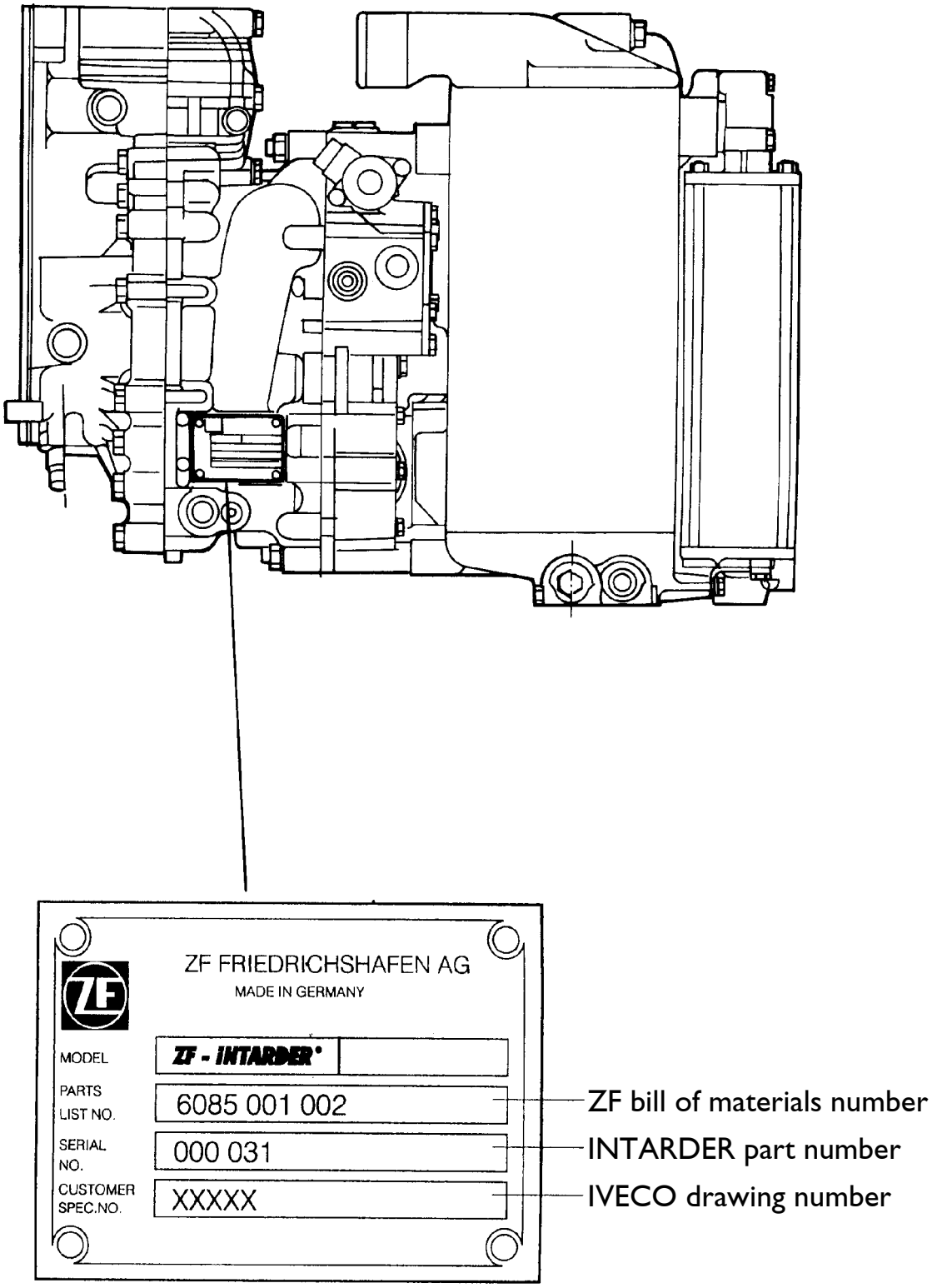
DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
FD	04	CAN LINE - COMMUNICATION LINES - VEHICLE	EM_CMD CAN MESSAGE TIMEOUT	No system restriction.	The message EM_CMD CAN is not received for approx. 150 ms or is ignored because it is not valid always for the same time.	Verify presence and recognition EM (Expansion Module) ECU. Verify CAN line.	Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	

SECTION 5

5342 Intarder - ZF hydraulic retarder

LOCATION OF INTARDER HYDRAULIC RETARDER DESCRIPTION PLATE

Figure 1

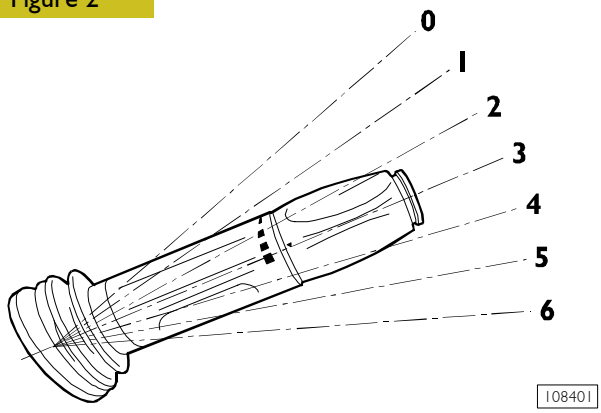


When requesting information, orders or repairs, you need to provide the above information.

GENERAL INFORMATION

The ZF Intarder is an auxiliary hydrodynamic brake integrated with the gearbox.
The braking effect is obtained via the oil contained in the retarder. It is operated by a seven-position lever mounted on the instrument panel. Depending on the position of the lever, the amount of oil necessary to obtain the required braking torque is sent between the rotor and stator.
The rotor increases the speed of the oil coming into the retarder that is slowed down as it hits the stator. This causes the temperature of the oil to increase.
It is cooled via an oil/water heat exchanger that is connected to the vehicle's cooling system. The resulting braking torque acts on the kinematic chain of the vehicle, slowing it down.

Figure 2



OPERATION

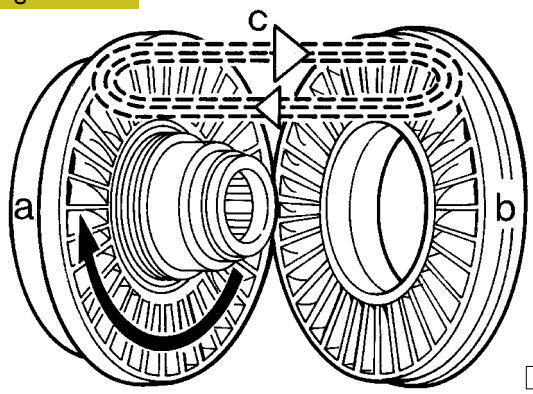
Decelerator drive is through (⇒) 6-position steering column stalk (5) located at steering wheel right side. A warning lamp on instrument Cluster shows steering column stalk being inserted

Position 0 – disengaged
Position 1 - F.M. 100%
Position 2 - F.M. 100% + Intarder 25% (20% *)
Position 3 - F.M. 100% + Intarder 50% (40% *)
Position 4 - F.M. 100% + Intarder 75% (60% *)
Position 5 - F.M. 100% + Intarder 100% (80% *)
Position 6 - F.M. 100% + Intarder 100%
* vehicle with mechanical gearbox .
FM - Engine brake

The oil contained in the sump is sent by the pump into the hydraulic circuit of the retarder passing through a filter at a pressure of 12 bars. The supply circuit is protected by a relief valve at 14.5 bars. On operating the lever, the electronic control unit receives an electric signal that it processes and sends to the solenoid valve controlling the accumulator and to the proportional solenoid valve. The accumulator solenoid valve switches over, lets pressurized air pass that acts on the piston of the hydraulic accumulator, which sends the oil to the hydraulic circuit, shortening the retarder response time.
The proportional solenoid valve acts on the control valve, determining the control pressure.

The adjustment valve is controlled by the pressure of the oil from the control valve. Depending on the control pressure (max. 5.4 bars), they let the oil pass under pressure (max. 9.5 bars) to supply the rotor.

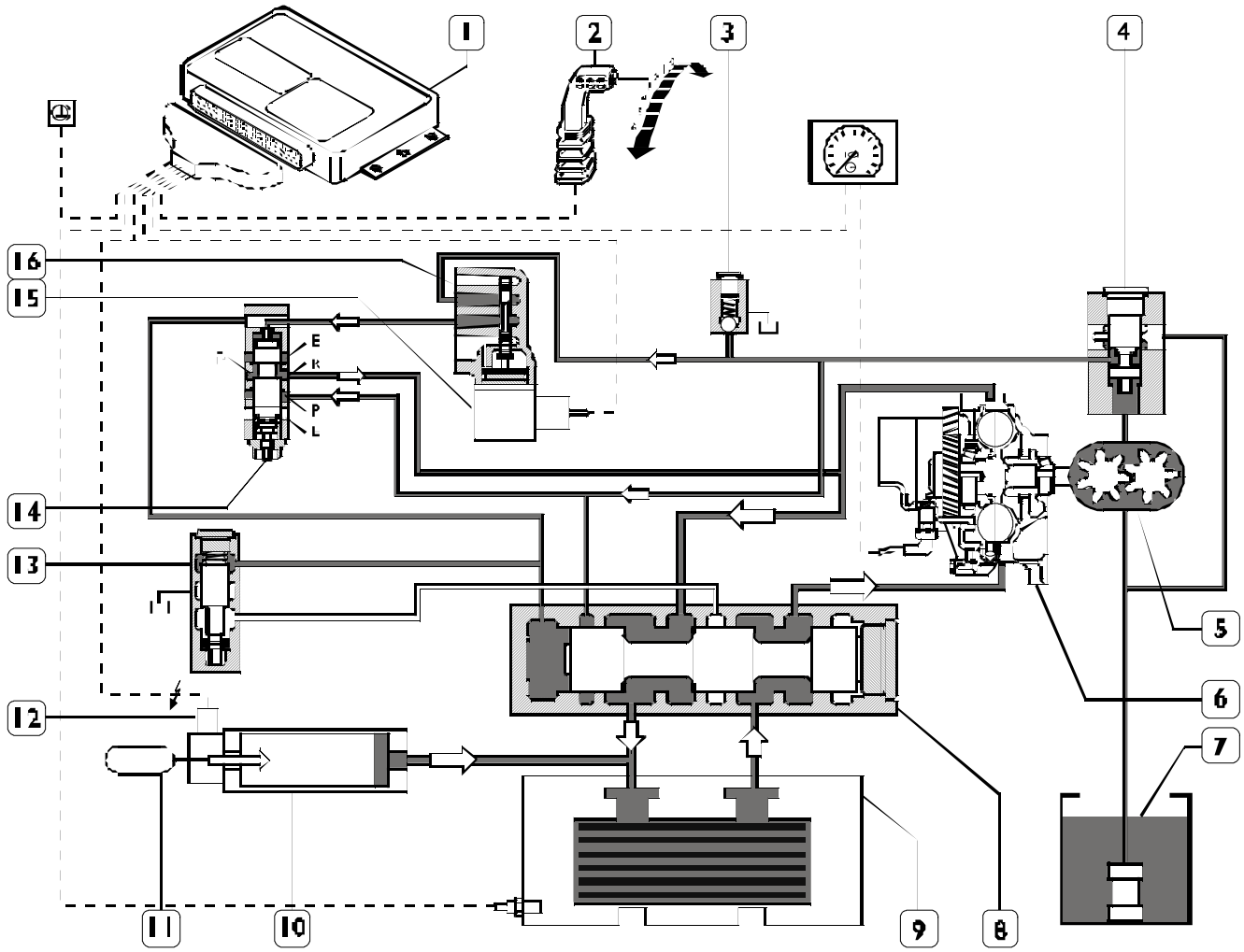
Figure 3



a. Rotor - **b.** Stator - **c.** Oil flow

The rotor is connected to the rear axle via the propeller shaft and the stator is connected to the chassis frame via the retarder box.
The oil in the compartments between the rotor and stator is set moving by the blades of the rotor, creating a flow of oil in a closed circuit between the movable and fixed parts of the retarder.
The oil, on hitting the blades of the stator, is slowed down, causing the rotor and therefore the vehicle to slow down.
The decrease in speed of the flow of oil between the rotor and stator causes the kinetic energy to transform into heat energy.
To dissipate the heat, the oil passes through an oil/water heat exchanger.
In the exchanger, the heat of the oil is transferred to the cooling water and dissipated through the vehicle's cooling system.
A temperature sensor is fitted on the water outlet pipe of the heat exchanger. This sensor constantly sends the cooling water temperature to the electronic control unit, thereby ensuring the maximum permissible temperature needed for the engine to work properly is not exceeded.
If, for whatever reason, the temperature of the water rises and reaches the value set in the control unit, this will adjust the air pressure in the sump and decrease the braking torque, falling to the highest level of braking still permissible.
In addition, the electronic control unit receives the signal from the ABS system, when it comes into operation, that causes the retarder to disengage and the signal of the electronic transmitter of the turns of the retarder that makes it possible to use the constant speed function.
Setting the lever onto "0", the retarder turns itself off. The accumulator solenoid valve and the proportional solenoid valve de-energize. The control valve switches over, producing a control pressure of 0 bars so the adjustment valve and the pressure increase valve are set to discharge with just the action of the spring.
The switchover valve switches over under the action of the spring, discharging the supply circuit into the sump.
The oil circuit, via the pressure holding valve, takes on a pressure of approximately 1.5 bars. At the same time, the oil accumulator is again filled.

Figure 4



HYDRAULIC SYSTEM WORKING DIAGRAM

Retarder engaged

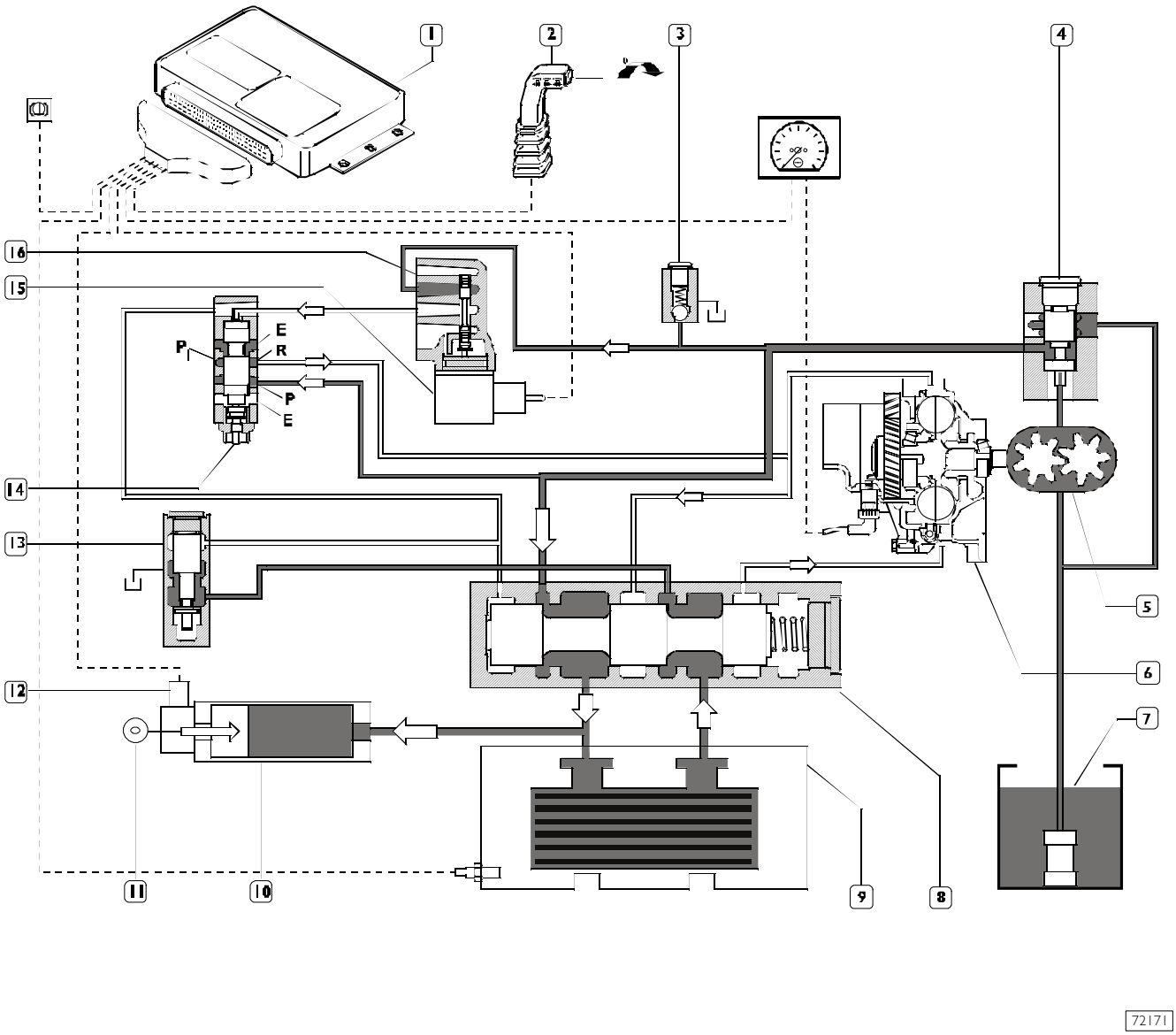
On operating the lever (2), the electronic control unit (1) receives an ON electrical signal that it processes and sends to the solenoid valve (12) controlling the accumulator (10) that, by energizing, lets the air from the services reservoir (11) pass at a pressure of 9.5 bars, which acting on the piston of the hydraulic accumulator (10) sends the oil into the circuit, shortening the retarder response time.

The proportional solenoid valve (15), on energizing, acts on the valve (16), shifting the hydraulic slide valve, determining the control pressure in relation to the braking level.

This pressure, acting on the adjustment valve (14), sets the inlet pipe P in communication with the outlet pipes PI - R.
As a result, the oil from the pressure relief valve (4) will shift the hydraulic slide of the valve (8), setting the pipe RI in communication with the rotor/stator via the heat exchanger (9).

The pressure holding valve (13), not being affected by the oil pressure, shuts off the oil outlet into the sump (7).

Figure 5



Retarder disengaged

Setting the lever (2) in the rest position 0, the electronic control unit (1) receives no electric signal; therefore, it de-energizes both the solenoid valve (12) controlling the accumulator and the proportional solenoid valve (16).

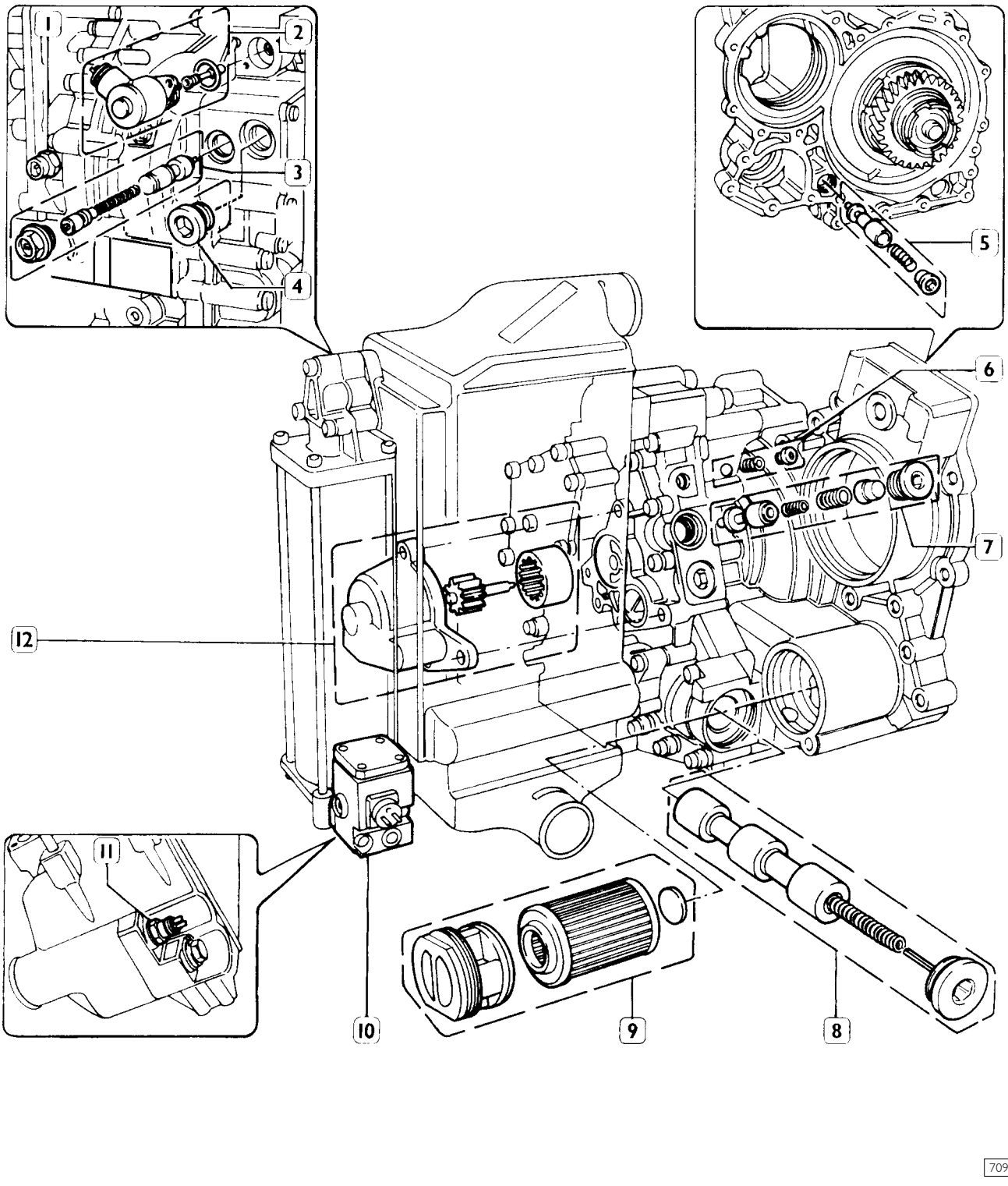
The control valve (16) switches over, thereby causing the pressure to drop to 0 bars, so the adjustment valve (14) is made to discharge with just the action of the springs.

No longer being able to send the pressure P to the switchover valve (8), the spring switches over the slide valve, discharging the pressure of the Rotor - Stator circuit (6) into the sump (7) and thereby freeing the exchanger changeover circuit.

Through the holding valve (13) the oil circuit between the pump and heat exchanger (9) maintains a pressure of 1.5 bars, at the same time the oil accumulator fills up.

LAYOUT OF MAIN SYSTEM COMPONENTS ON THE RETARDER

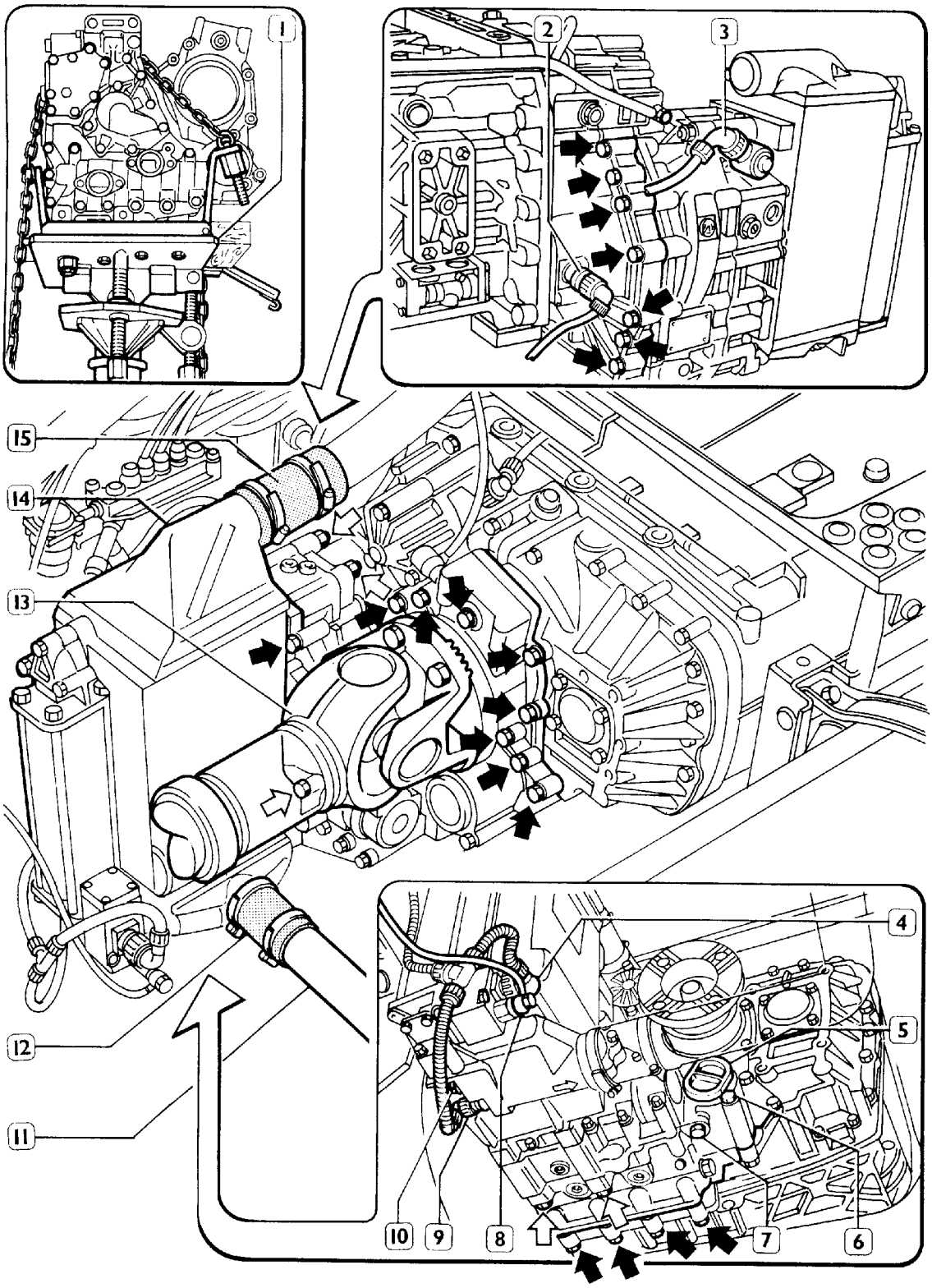
Figure 6



1. Electronic speed transmitter - 2. Proportional solenoid valve with control valve - 3. Adjustment valve - 4. Plug - 5. Pressure holding valve - 6. Safety valve - 7. Pressure relief valve - 8. Switchover valve - 9. Oil filter - 10. Electropneumatic valve - 11. Water temperature sensor - 12. Oil pump

REMOVING AND REFITTING THE RETARDER ON THE ZF 16 S 1621/1921/2221 GEARBOX

Figure 7



Removal

Set the vehicle over the pit and carry out the following operations:

- ❑ Drain the coolant from the radiator through the plug (10).
- ❑ Drain off the oil by taking out the plug (7) on the retarder and the plug on the gearbox (oil passes between the retarder and the gearbox).

- ❑ Disconnect the pneumatic connection (8).
- ❑ Disconnect the electrical connections (2 - 3 - 4 - 9).
- ❑ Disconnect the sleeves (12 and 15) and remove the pipe (11).
- ❑ Disconnect the propeller shaft (13) from the drive output flange of the retarder.
- ❑ Remove the drive output flange.
- ❑ Unscrew the screw (6) and take out the plug (5) together with the oil filter.
- ❑ Unscrew the screw and nuts (⇒) and remove the heat exchanger (14).

After refitting:

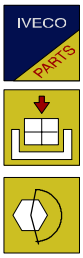
- ❑ Replenish the lubricating oil as described under the relevant heading.
- ❑ Replenish the engine coolant as described under the relevant heading.

NOTE If the cross member of the chassis frame prevents you from removing the retarder, you need to take out the stud bolts for the nuts fixing the heat exchanger.

- ❑ Set the bracket 99370629 (1) on the hydraulic lift and fit the retarder on it.
- ❑ Take out the screws (⇒) fixing the retarder to the gearbox and remove it.

NOTE Recover the adjustment rings from the stator and from the epicyclic unit shaft bearing.

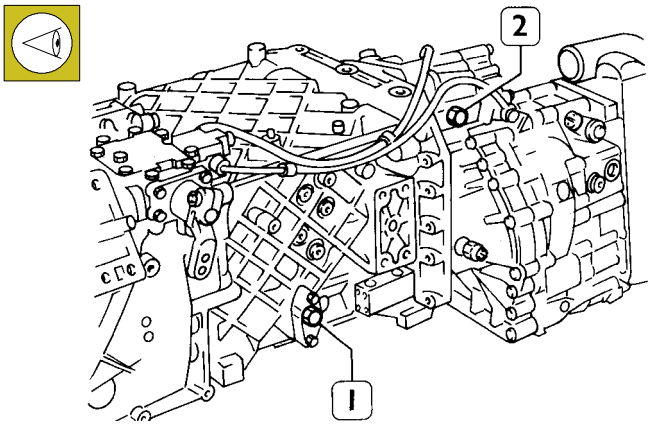
Refitting



Replace the sealing elements with new parts.
For refitting, carry out the steps performed for removal in reverse order and keep to the required tightening torques.
If the stud bolts for the nuts fixing the heat exchanger were removed, for assembly it is necessary to apply LOCTITE 510 on their thread and tighten them to a torque of 18 Nm (1.8 kgm).

Filling with oil

Figure 8

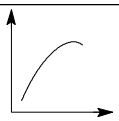


Keep to the following procedure:

- ❑ Unscrew the screw of the oil filler hole (2).
- ❑ Add the amount of oil stated in the specifications and data table.
- ❑ Screw the filler hole screw back on.
- ❑ Have a test run on the road (at least 1 minute at a speed of at least 10 km/h). At the start of the run, briefly press the Intarder once (level 6) and then disengage it (level 0). In this way the gearbox oil gets distributed.
- ❑ After the road test, stop the vehicle **without operating the Intarder**.
- ❑ Stop the engine.
- ❑ Unscrew the overflow plug (1).
- ❑ Check the oil level again and, if necessary, add oil until it spills over.

NOTE The oil level of the gearbox with the ZF-Intarder has to be checked with the vehicle horizontal, the engine switched off and after the oil has cooled. Hot oil gives faulty readings and causes thermal expansion.

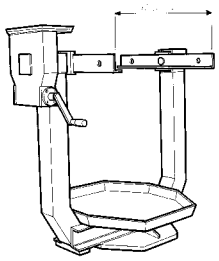
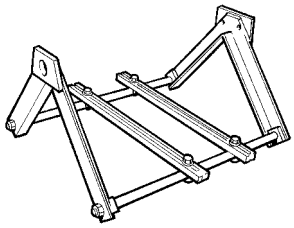
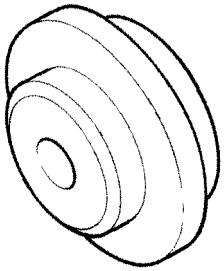
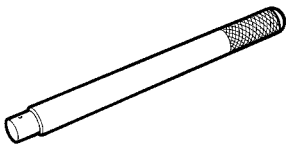
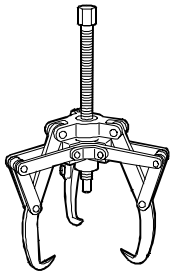
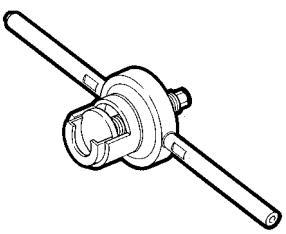
SPECIFICATIONS AND DATA

INTARDER		
 Maximum braking torque	Nm	3200
Braking capacity:	kW	500
Air pressure	bar	6.3 ÷ 10.0
Weight	kg	69
Control		Electrohydraulic
Voltage	V	24

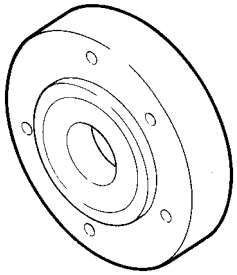
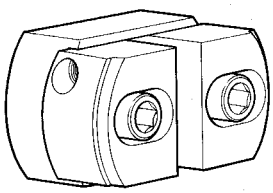
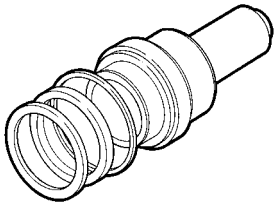
TIGHTENING TORQUES

DESCRIPTION	TORQUE	
	Nm	Kgm
Screws fixing hydraulic accumulator to exchanger (M8 x 18 - M8 x 60)	23	2.3
Coolant drain plug (M18 x 1.5)	35	3.5
Coolant temperature sensor (M18 x 1.5)	40	4
Screws fixing solenoid valve (proportional) (M8 x 22)	23	2.3
Screws fixing electropneumatic valve controlling hydraulic accumulator (M8 x 60)	23	2.3
Oil drain plug (M24 x 1.5)	60	6
Screws closing pressure test points (M12 x 1.5)	25	2.5
Screw fixing safety valve (M12 x 1.5)	25	2.5
Screw fixing pressure relief valve (26 x 1.5)	70	7
Screw fixing switchover valve (M48 x 1.5)	150	15
Screw fixing adjustment valve (M26 x 1.5)	70	7
Screw fixing pressure increase valve (M30 x 1.5)	100	10
Screw fixing rotor driving gear (M12 x 80)	95	9.5
Screws fixing oil pump casing (M8 x 80) (M8 x 30)	23	2.3
Nuts fixing heat exchanger to rear half box	62	6.2
Screw fixing heat exchanger to rear half box (M8)	23	2.3

TOOLS

TOOL No.		DESCRIPTION
99322205		Rotary stand for overhauling assemblies
99322225		Stand for supporting assemblies (to be fitted on stand 99322205)
99345058		Extractor reaction block
99370007		Grip for interchangeable drifts
99348002		Extractor
99370047		Tool pre-loading Intarder rotor shaft bearing to measure adjustment thickness

TOOLS

TOOL No.		DESCRIPTION
99370048		Centring plate to fit rotor shaft on Intarder box
99374093		Drift to mount external bearing races (91-134) (use with 99370007)
99374221		Key to fit gaskets on rear cover

DIAGNOSTICS
Main operating faults of a mechanical nature

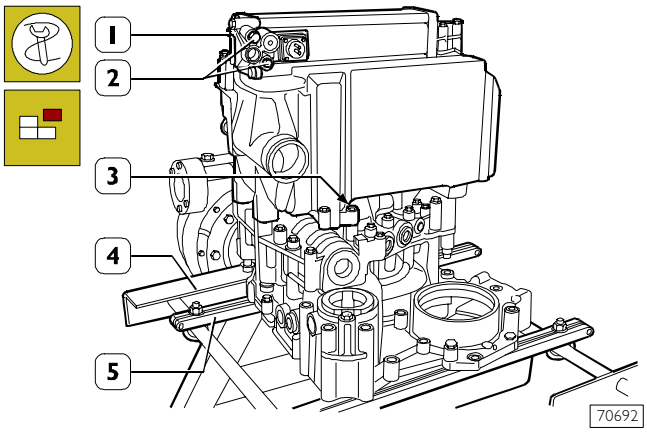
Visible Failure	Possible cause	Repair action
No braking effect	Inefficient lever operation.	Replace the lever.
	Inefficient electronic control unit operation.	Check and if necessary replace the control unit.
	Inefficient electric system operation.	Determine the trouble and restore the system.
Poor braking effect	Incorrect use of the retarder.	Use the retarder properly, keeping to the instructions given in the operation and maintenance handbook.
	Low oil level.	Top up the oil level.
	Air system pipes leaking or burst.	Close the loose fittings. Replace the broken or damaged pipes.
	Inefficient operation of the electropneumatic valve controlling the hydraulic accumulator.	Replace the electropneumatic valve.
	Inefficient operation of the proportional solenoid valve with the control valve.	Replace the worn or inefficient parts.
	Inefficient operation of the temperature sensor.	Replace the temperature sensor.
	Internal defect of the retarder.	Overhaul the retarder.
Irregular braking effect	Moisture from the heat exchanger in the retarder.	Check the seal of the exchanger and replace it if necessary.
	Inefficient operation of the proportional solenoid valve with the control valve.	Replace the worn or inefficient parts.
	Internal defect of the retarder.	Overhaul the retarder.
Poor or no retarder disengagement	Inefficient operation of the electropneumatic valve controlling the hydraulic accumulator.	Replace the electropneumatic valve.
	Internal defect of the retarder.	Overhaul the retarder.

(Continued)

Visible Failure	Possible cause	Repair action
Indicator light comes on intermittently (lever on 1-6)	Temperature control trips due to low engine speed.	Keep a higher engine speed with an ensuing increase in the flow rate of cooling water.
	Inefficient operation of the temperature sensor.	Replace the temperature sensor.
	Low coolant level.	Top up the level of coolant.
	Inefficient operation of the electronic control unit.	Check and if necessary replace the electronic control unit.
	Inefficient operation of the electric system.	Determine the trouble and restore the system.
Temperature control trips early	Inefficient operation of the cooling system.	Restore correct cooling system operation.
	Inefficient operation of the electronic control unit.	Check and if necessary replace the electronic control unit.

534230 OVERHAULING THE INTARDER HYDRAULIC RETARDER

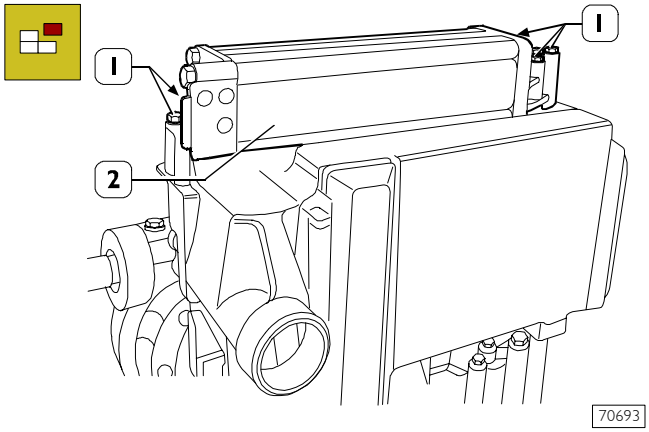
Figure 9



Using a rope and the movable lift, put the retarder (3) on the rotary stand 99322205 (4) together with the mount 99322225 (5). Unscrew the screws (2) and remove the electropneumatic valve (1).

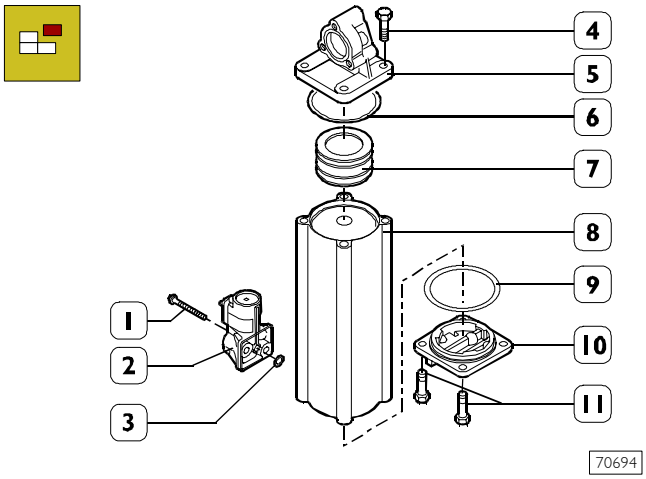
Hydraulic accumulator Removal

Figure 10



Take out the screws (1) and disconnect the hydraulic accumulator (2).

Figure 11



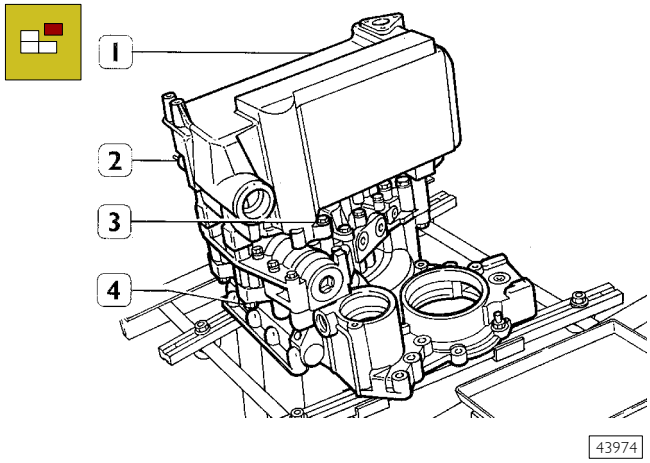
Take out the screws (1) and remove the solenoid valve (2). Take out the screws (4 and 11) and remove the side covers (5 and 10). Extract the piston (7) from the body (8).

Fitting

For fitting, carry out the steps described for removal in reverse order with the precaution to fit new seals (3 - 6 - 9) and tighten the screws (1 - 4 - 11) to the required torque.

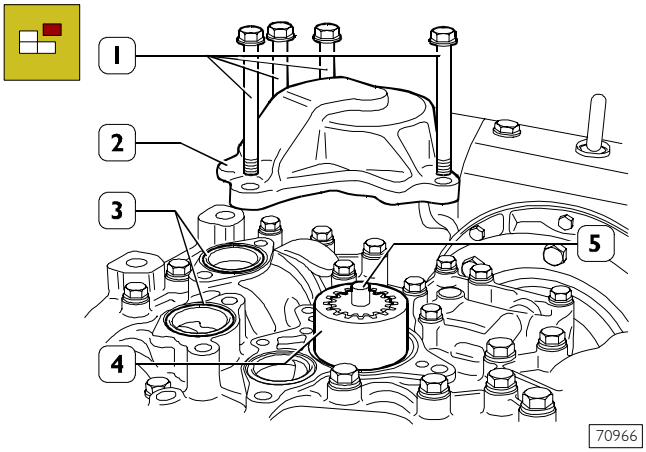
Removing hydraulic retarder

Figure 12



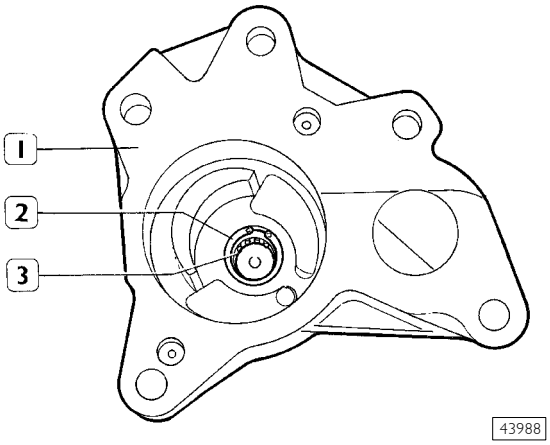
Take out the water temperature sensor (2). Take out the nuts (3 and 4) and remove the heat exchanger (1).

Figure 13



Take off the seals (3). Take out the screws (1) and remove the pump casing (2).
Remove the rotor (5) and the ring (4) of the oil pump.

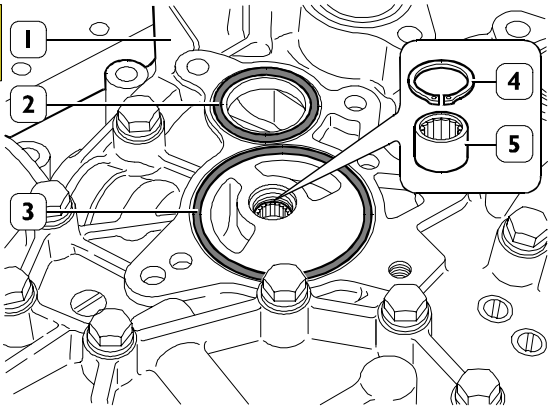
Figure 14



43988

Take the circlip (2) and the roller bearing (3) out of the pump casing (1).

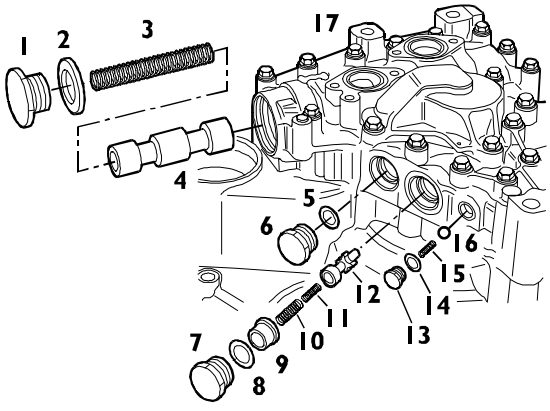
Figure 15



70967

Take the seals (2 and 3) out of the rear box (1). Remove the circlip (4) and extract the roller bearing (5).

Figure 16

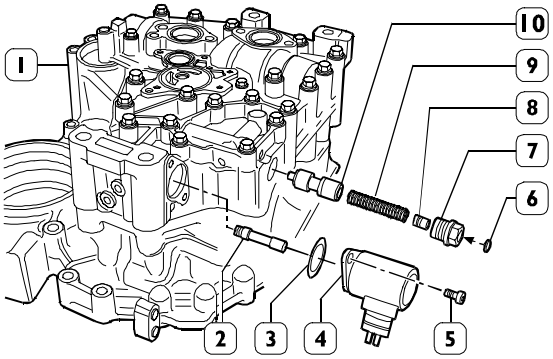


70968

From the rear half box (17):

- ❑ Take out the plug (1) with the washer (2) and extract the spring (3) and switchover valve (4).
- ❑ Take out the plug (6) with the washer (5).
- ❑ Take out the plug (7) with the washer (8) and extract the cup (9), springs (10 and 11) and the pressure relief valve (12).
- ❑ Take out the plug (13) with the washer (14) and extract the spring (15) and safety ball valve (16).

Figure 17



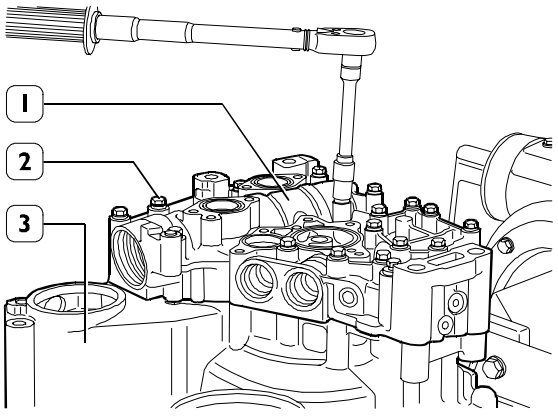
70969

From the rear half box (1):

- ❑ Take out the screw (5) and remove the proportional solenoid valve (4) with the seal (3) and the pressure control valve (2).
- ❑ The adjustment device (7) and extract the cup (8), spring (9) and pressure adjustment valve (10).

NOTE Do not take off the cover (6) so as not to tamper with the adjustment device (7).

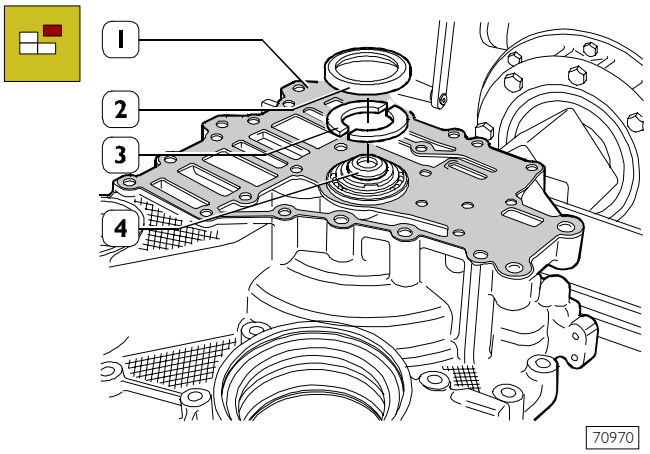
Figure 18



70971

Take out the screws (2) and remove the rear half box (1) from the front half box (3).

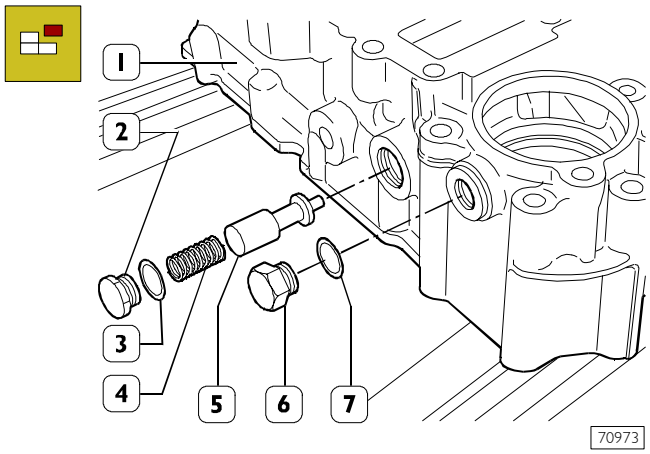
Figure 19



Take off the gasket (1).

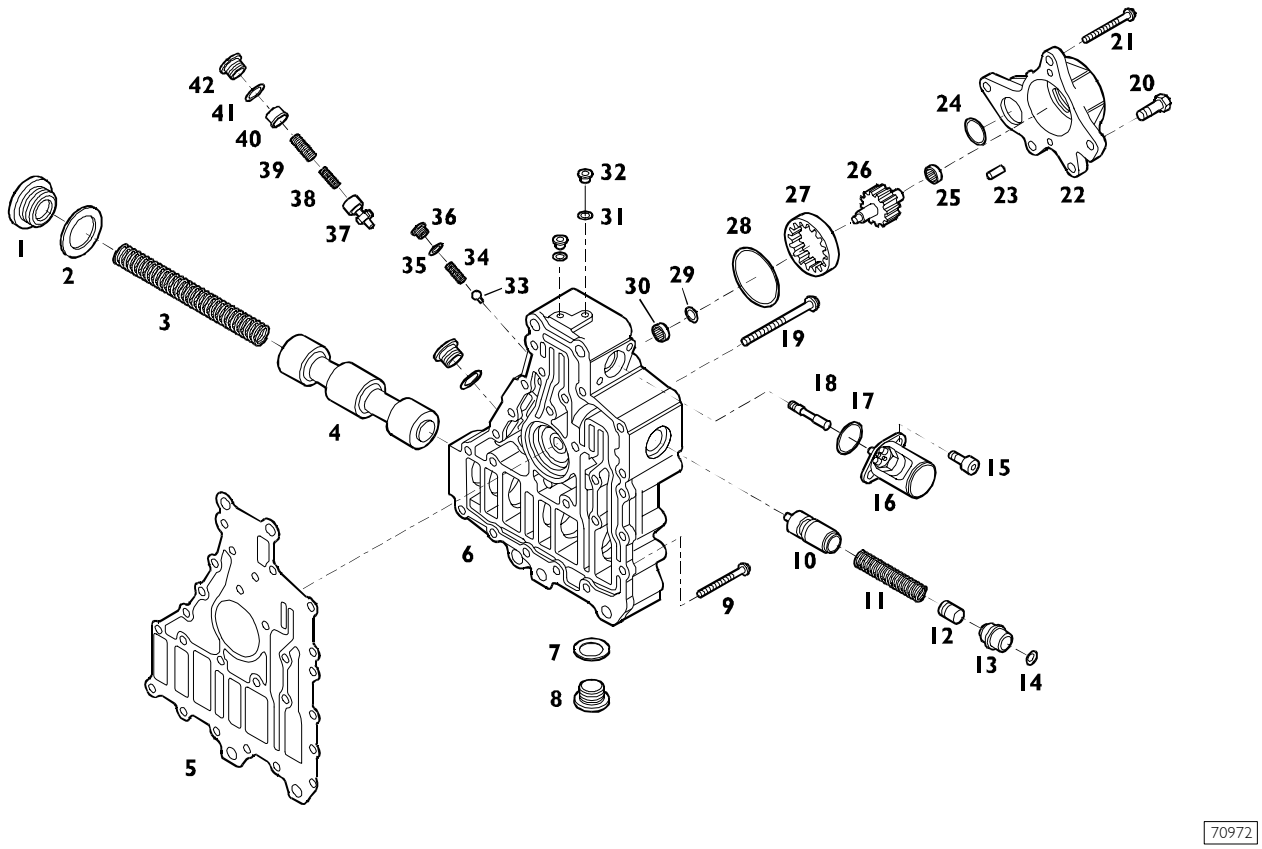
Lift the notches in the safety cover (2) and remove the half rings (3) from the shaft of the rotor (4).

Figure 20



Take the plug (2) with the washer (3) out of the front box (1); extract the spring (4) and the valve (5).
Take out the plug (6) with the washer (7).

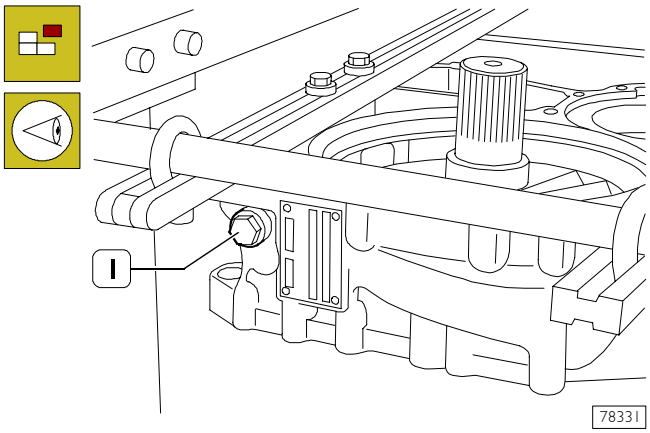
Figure 21



COMPONENT PARTS OF THE REAR BOX

1. Plug - 2. Washer - 3. Spring - 4. Switchover valve - 5. Gasket - 6. Rear half box - 7. Washer - 8. Plug - 9. Screw - 10. Pressure adjustment valve - 11. Spring - 12. Cup - 13. Adjustment device - 14. Cover - 15. Screw - 16. Proportional solenoid valve - 17. Seal - 18. Pressure control valve - 19. Screw - 20. Screw - 21. Screw - 22. Oil pump cover - 23. Grub screw - 24. Seal - 25. Roller bearing - 26. Rotor - 27. Ring gear - 28. Seal - 29. Split ring - 30. Roller bearing - 31. Washer - 32. Plug - 33. Safety ball valve - 34. Spring - 35. Washer - 36. Plug - 37. Pressure relief valve - 38. Spring - 39. Spring - 40. Cup - 41. Washer - 42. Plug

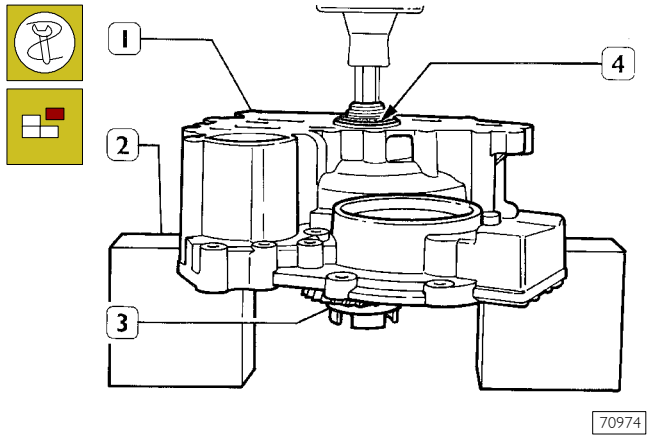
Figure 22



Remove the plug (1) and check that the spring (24, Figure 34) of the friction reducing valve is present.

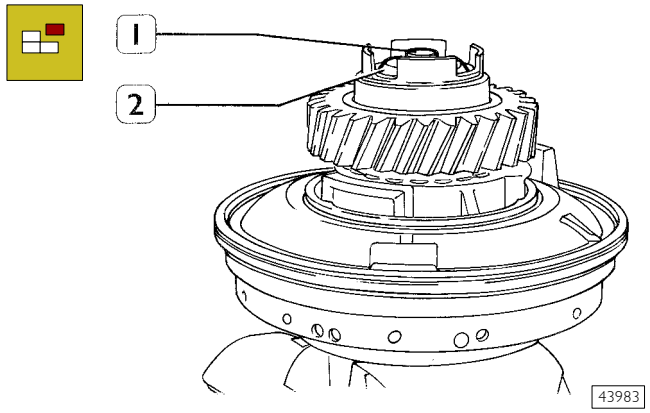
NOTE For hydraulic retarders without friction reducing valves, proceed as follows.

Figure 23



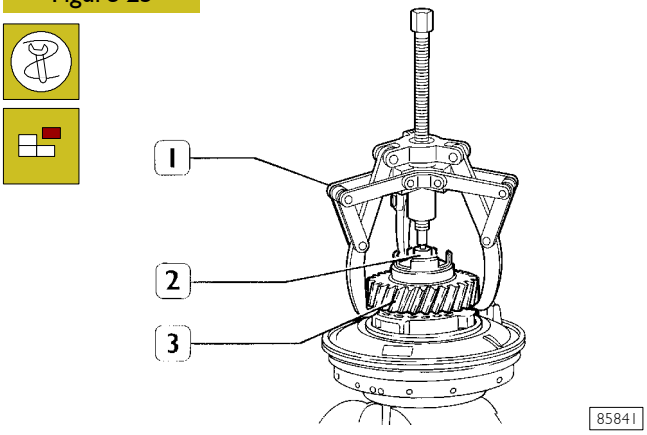
Transfer the front half box (1) together with the rotor and stator to the press. Put the half box on mounts (2) and take the rotor shaft together with the stator (3) out of the internal ring (4) of the tapered roller bearing and extract this from the half box (1).

Figure 24



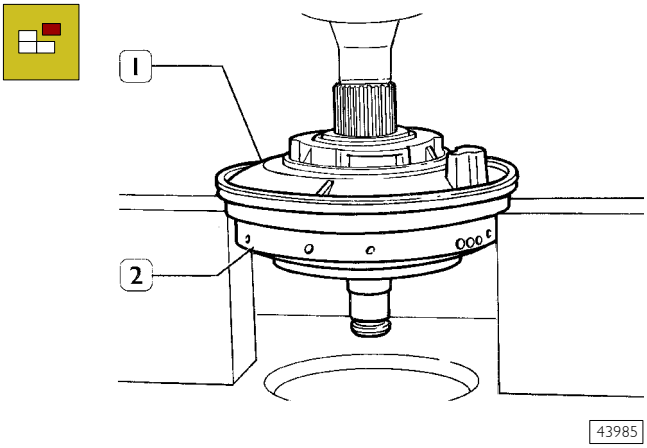
Unscrew the screw (1) and take off the washer (2).

Figure 25



Transfer the rotor and stator assembly to the bench and lock it in the vice. Using the bridge 99341002 (1) and reaction block 99345058 (2), extract the gear (3).

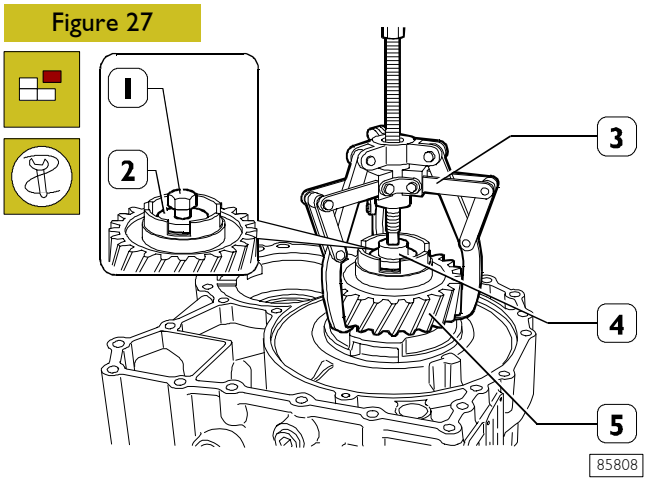
Figure 26



Transfer the rotor and stator assembly to the press. Put the stator (1) on the mounts and extract the rotor (2).

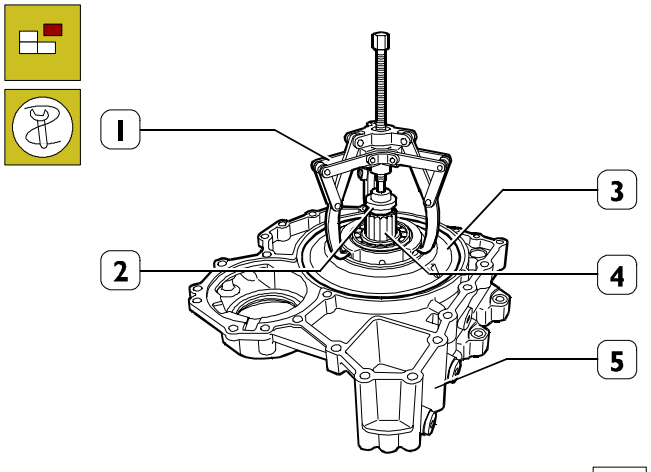
NOTE For hydraulic retarders equipped with a friction reducing valve, proceed as follows.

Figure 27



Remove the bolt (1) and the washer (2); using yoke 99341003 (3), and block 99345058 (4), extract the gear (5).

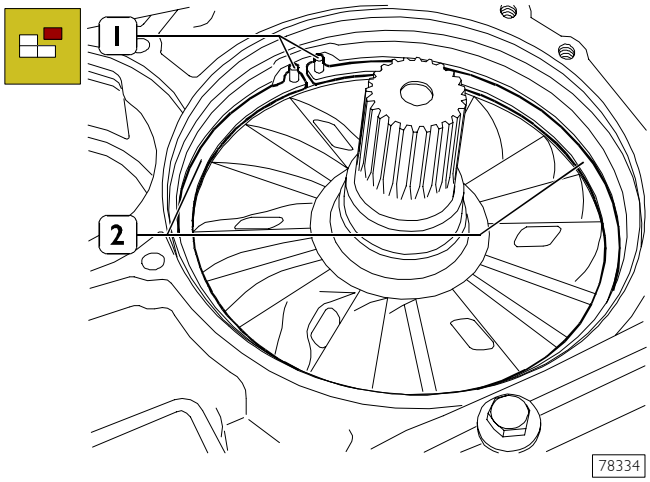
Figure 28



85809

Using the yoke (1), rods (2) and block (3), withdraw the stator (4) from the rotor (5) and from the half casing (6).

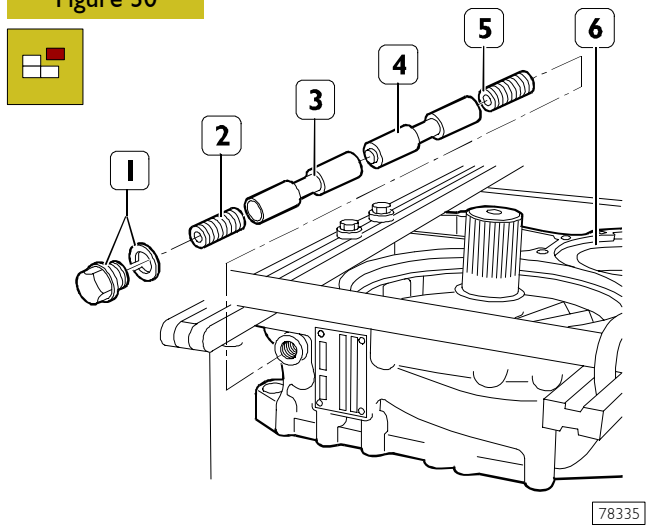
Figure 29



78334

Withdraw the pins (1) and remove the half rings (2).

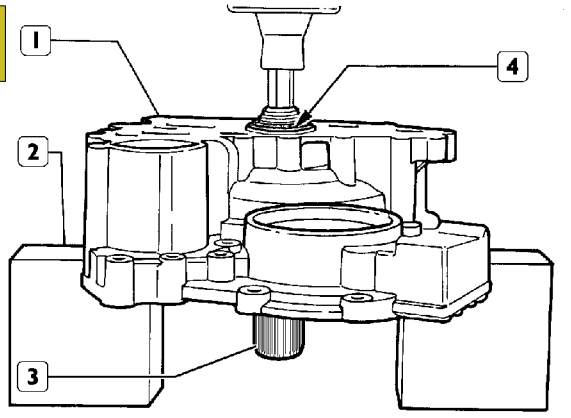
Figure 30



78335

Remove the plug (1) and withdraw from the half casing (6): the spring (2), the pistons (3 and 4) and the spring (5).

Figure 31

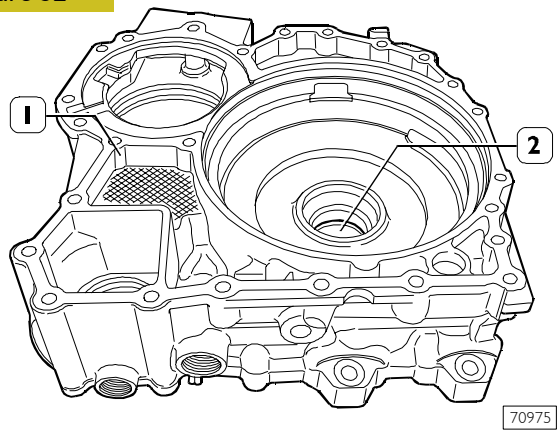


78336

Take the front half-casing (1), complete with the rotor, to a press. Position the half casing on the supports (2) and (3) and withdraw the rotor shaft (3) from the inner race (4) of the taper roller bearing and remove the latter from the half-casing (1).

For all types of retarder, proceed as follows.

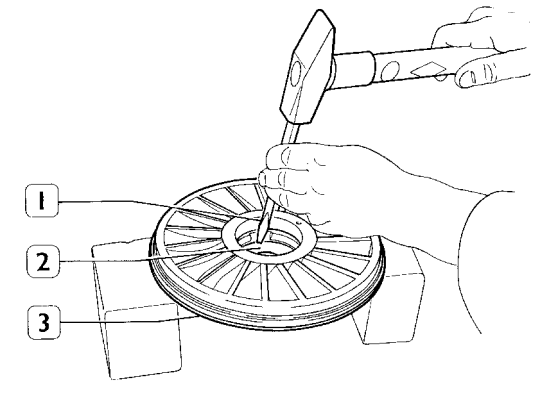
Figure 32



70975

Using a punch, extract the external ring (2) of the bearing from the front half box (1).

Figure 33



43986

Using a punch (1), extract the external race (2) of the bearing from the stator (3).

Checking the component parts of the hydraulic retarder

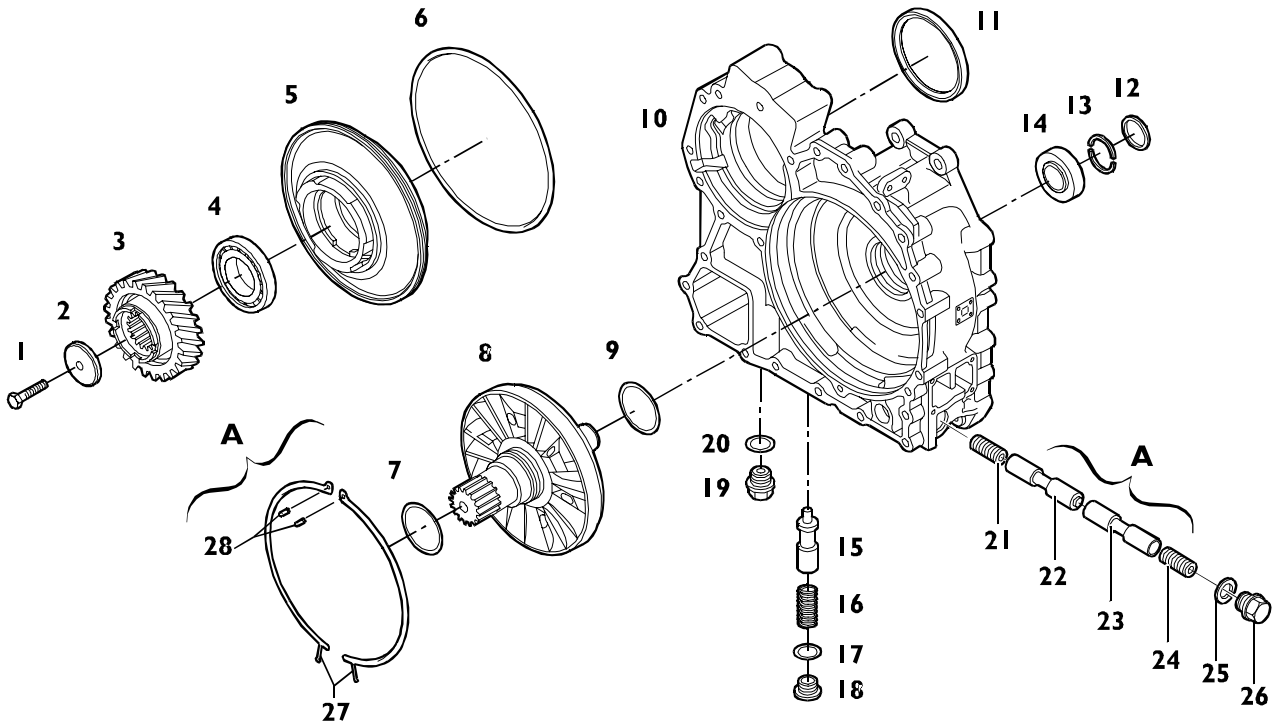
Carefully clean the single parts comprising the retarder and check their state of wear for them to be reused.

Clean the threads of the plugs and their seats of remains of sealant.

Check the mating surfaces are not deformed and moisten the sliding surfaces.

Replace all the sealing and safety elements and the valve springs with new parts.

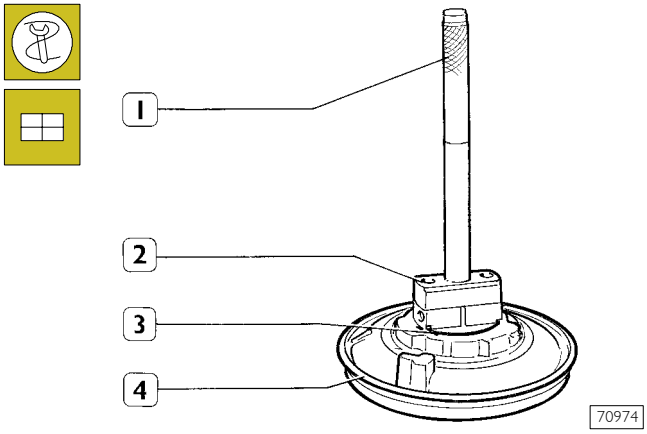
Figure 34



1. Screw - 2. Washer - 3. Gear - 4. Tapered roller bearing - 5. Stator - 6. Seal - 7. Split ring - 8. Rotor - 9. Split ring - 10. Front box - 11. Seal - 12. Safety cover - 13. Half rings - 14. Tapered roller bearing - 15. Valve - 16. Spring - 17. Washer - 18. Plug - 19. Plug - 20. Washer
A = Components of the friction reducing valve: (if present)
21. Pins - 22. Half rings - 23. Spring - 24. Piston - 25. Piston - 26. Spring - 27. Washer - 28. Plug.

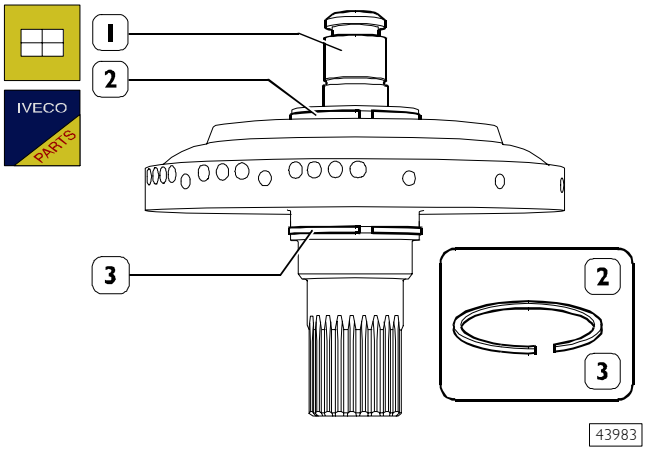
Fitting the hydraulic retarder

Figure 35



Heat the hole of the stator (4) to approximately 80°C. Using the keying device 99374093 (2) and grip 99370007 (1), mount the external race (3) of the tapered roller bearing.

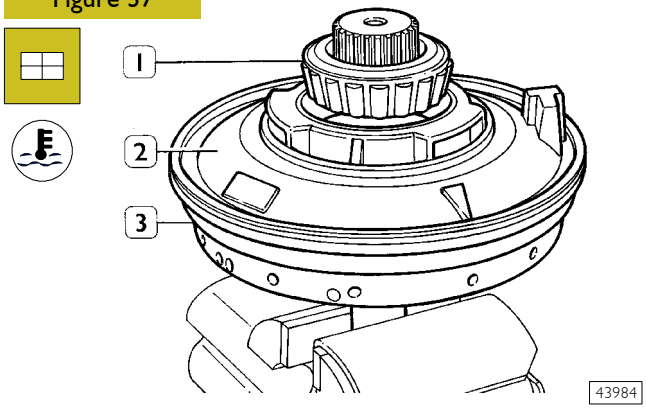
Figure 36



Fit the new split rings (2 and 3) on the shaft (1) of the rotor.

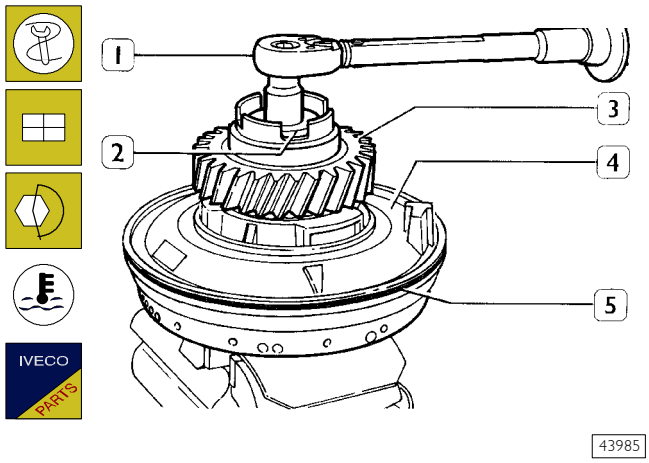
For hydraulic retarders without friction reducing valves only.

Figure 37



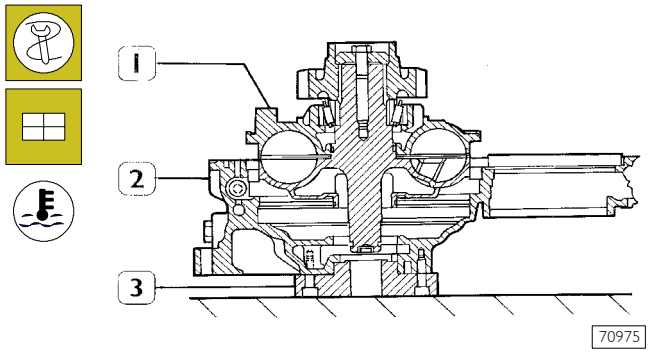
Lock the rotor (3) in the vice as shown in the figure. Mount the stator (2).
Heat the internal ring of the bearing (1) to approximately 100°C and mount it in its seat.

Figure 38



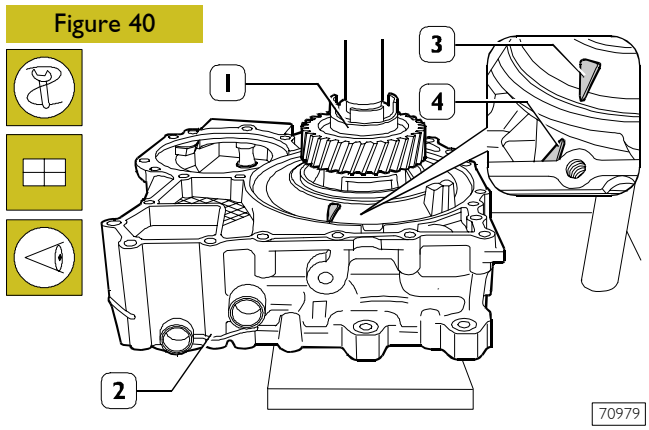
Heat the gear (3) to approximately 85°C and fit it on the shaft of the rotor (4). Fit the washer (2) and provisionally tighten the check screw. After cooling, lock the check screw to the required torque with a torque wrench (1). Fit a new seal (5) on the stator (4).

Figure 39



Fit the rotor shaft centring plate 99370048 (3) to the front half box (2). Heat the half box (2) to 90 ÷ 100°C and position the rotor and stator assembly (1) on the half box (2) as shown in the figure.

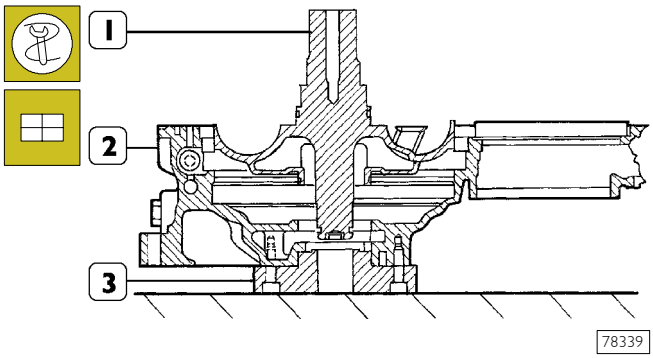
Figure 40



Using a press, drive the rotor and stator assembly (1) down to the stop in the front half box (4) so that the arrows (3 and 4) are aligned. A misalignment of 1 mm is permissible. Keep the assembly (2) under the action of the press for 5 minutes to ensure it gets bedded.
Remove the centring plate (3, Figure 39).

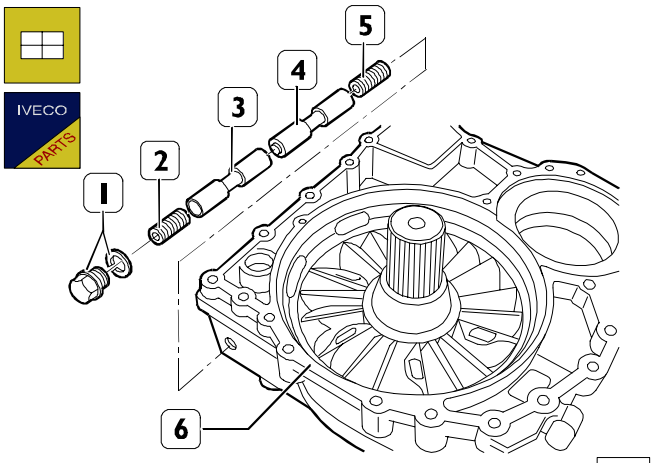
For hydraulic retarders with friction reducing valves, proceed as follows.

Figure 41



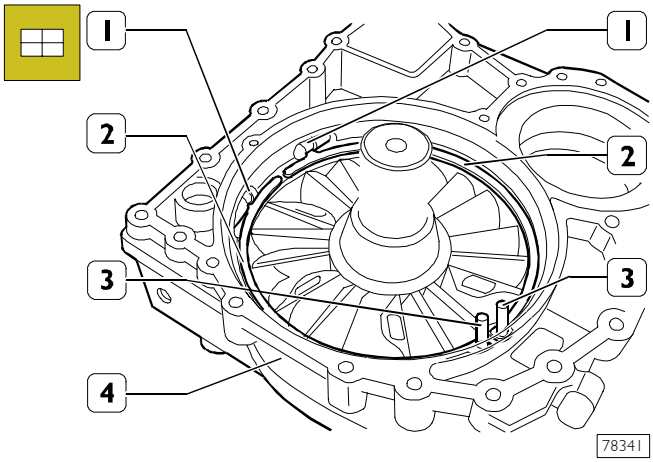
Attach the rotor shaft locating plate 99370048 (3) to the front half-casing (2). Position the rotor assembly (1) complete with circlips in the half casing (2).

Figure 42



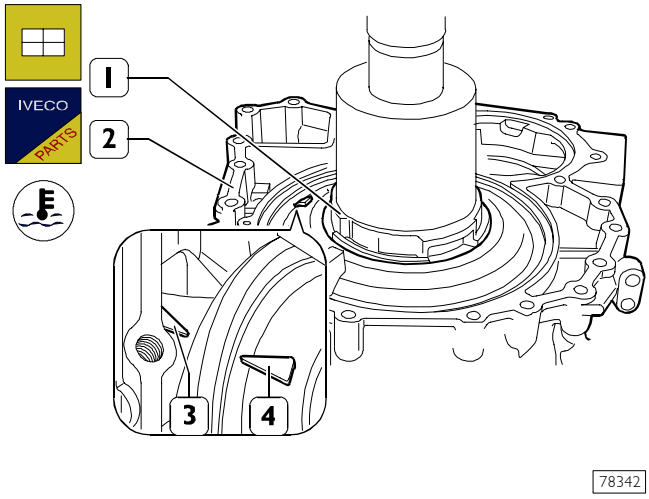
Install in the half casing (6) the spring (5), the pistons (3 and 4) and the spring (2); fit a new gasket to the plug (1) and tighten to a torque of 50 Nm.

Figure 43



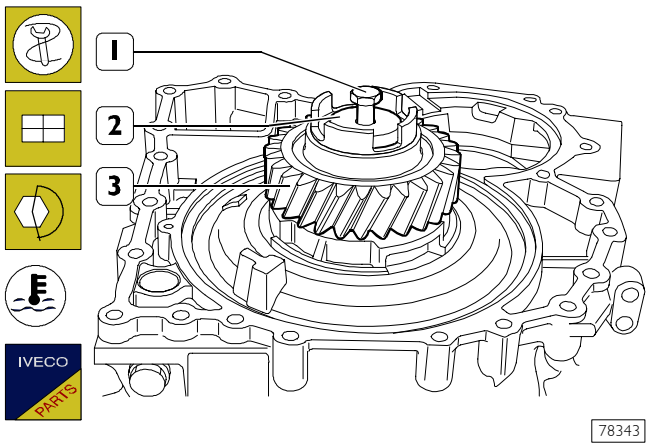
Position the half rings (2) in the half casing (4) so that the projecting parts engage the grooves in the pistons (1) and fix them to the half casing with the pins (3).

Figure 44



Position the assembled half casing (2) in the press. Heat the seating of the stator (1) to 80 °C. Fit the stator (1) with a new oil seal in the front half casing (2), making sure that the arrows (3 and 4) are aligned. An alignment error of up to 1 mm is permissible. Keep the stator (2) under the press for 5 minutes to ensure it is fully bedded down.
Remove the locating plate (3, Figure 41).

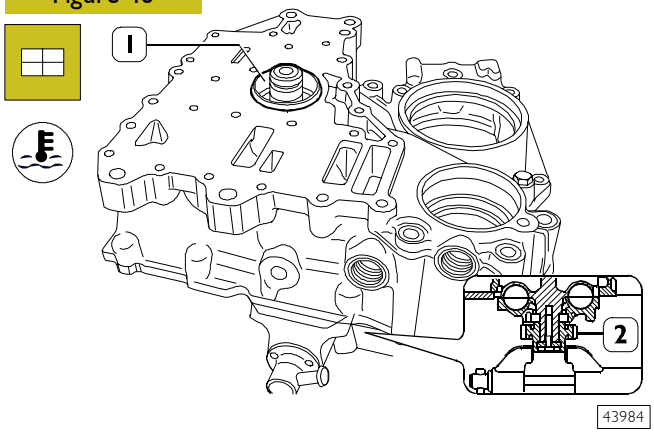
Figure 45



Heat the gear (3) to approx. 85°C and fit it on the rotor shaft. Fit the washer (2) and provisionally tighten the retaining bolt (1). Once the gear (3) has cooled, tighten the retaining bolt to the prescribed torque.

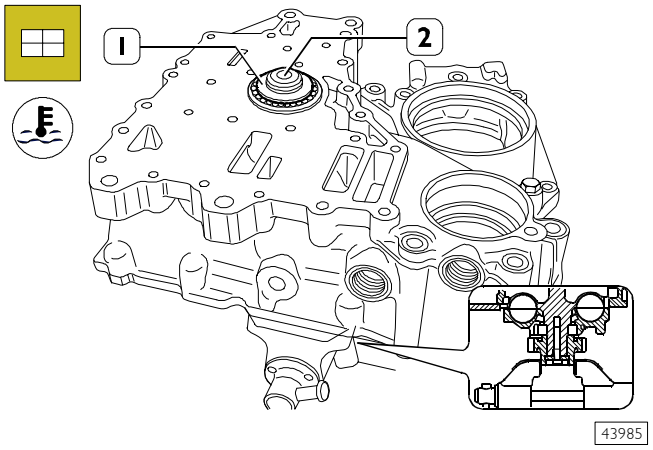
For both types of hydraulic retarder

Figure 46



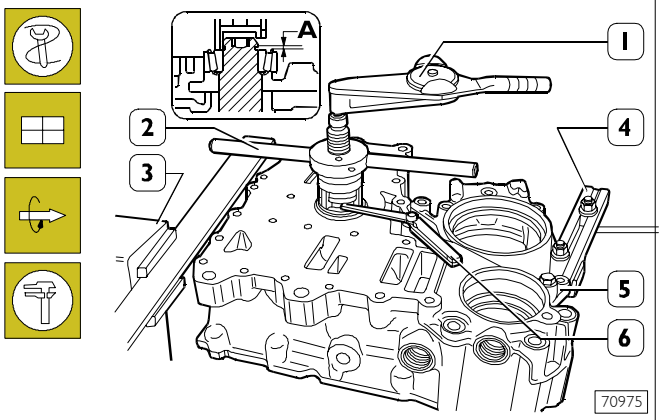
Transfer the assembly to the bench and lock (2) the gear mounted on the rotor shaft in a vice so as to support the assembly.
Heat the seating of the outer race (1) of the taper roller bearing and install the outer race.

Figure 47



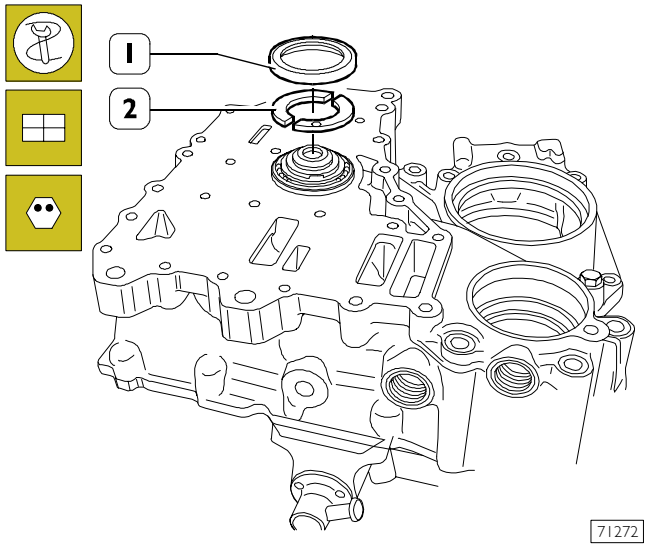
Heat the internal ring of the bearing (1) to approximately 85°C and mount it on the shaft of the rotor (2).

Figure 48



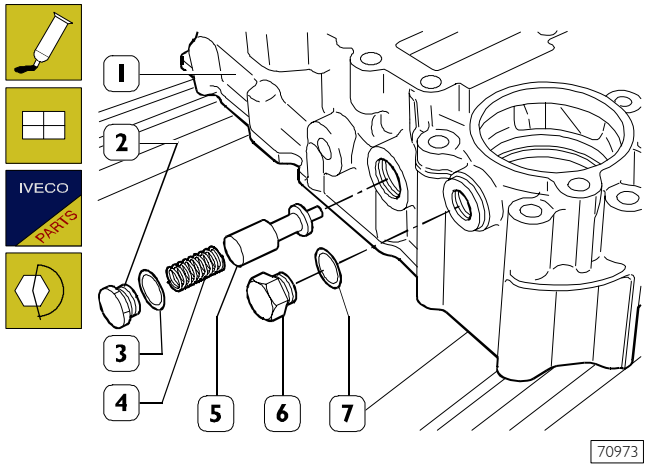
Leave the bearing to cool and fit the front half box (5) on the rotary stand 99322205 (3) together with the mount 99322225 (4).
Fit the tool 99370047 (2) for pre-loading the bearing.
Pre-load the bearing so that the rolling torque that can be measured with the torque wrench (1) is 2 ±0.5 Nm.
Using a feeler gauge (6) measure the thickness of the half rings (2, Figure 49): distance A.

Figure 49



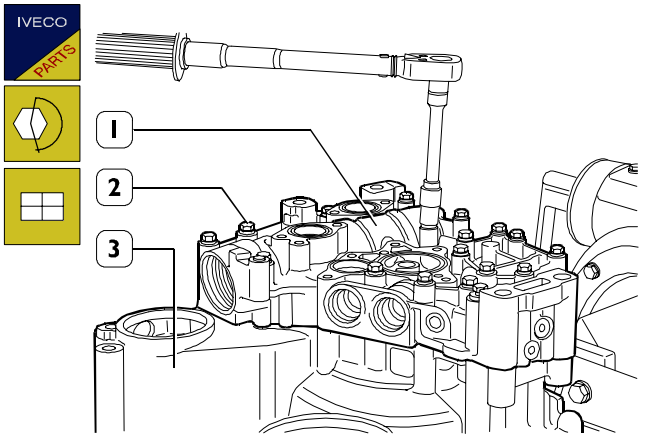
Insert the half rings (2) of the thickness measured beforehand.
Mount the cover (1).
Dent cap (1) using a suitable tool.

Figure 50



Apply sealant on the thread of the plug (6) and screw it down with a new washer (7) and tighten it to the required torque.
Insert the valve (5) and the spring (4) into the front box (1).
Apply sealant on the thread of the plug (2), screw it down with a new gasket (3) and tighten it to the required torque.

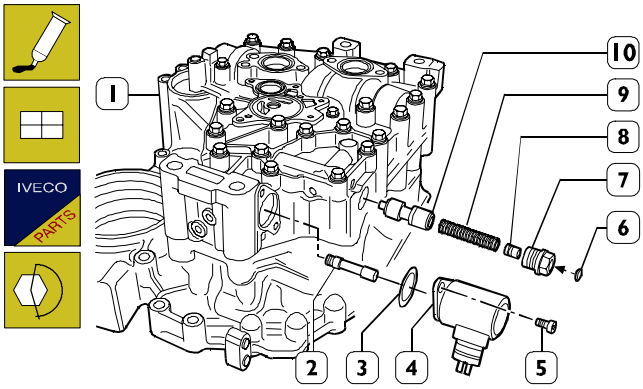
Figure 51



70971

Put a new gasket on the front box (3).
Mount the rear box (1), screw down the screws (2) and tighten them to the required torque.

Figure 52



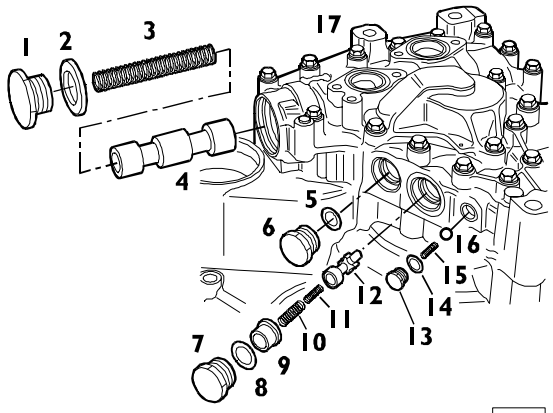
70969

In the rear box (1), insert:

- ❑ Pressure adjustment valve (10), spring (9) and cup (8). Apply sealant on the thread of the adjustment device (7), screw it down with a new washer, tightening it to the required torque.
- ❑ Pressure control valve (2) and mount the proportional solenoid valve (4) with a new seal (3). Screw down the screws (5) and tighten them to the required torque.

NOTE Do not take off the cover (6) so as not to tamper with the adjustment device (7).

Figure 53



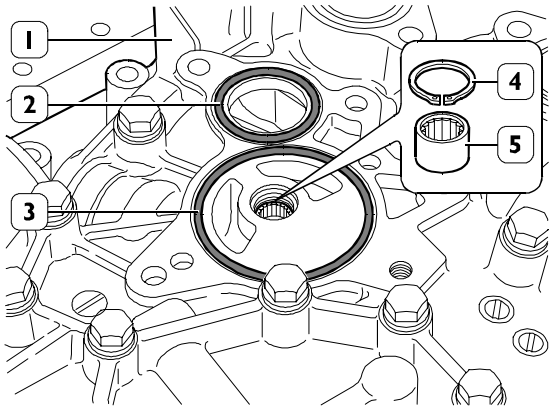
70698

In the rear box (17), insert:

- ❑ Safety ball valve (16), spring (15) and plug (13) with washer (14).
- ❑ Pressure relief valve (12), springs (10-11), cup (9) and screw down the plug (7) with the washer (8).
- ❑ Screw down the plug (6) with the washer (5).
- ❑ Switchover valve (4), spring (3) and screw down the plug (1) with the washer (2).

NOTE Before mounting the plugs (13-7-5 and 1), apply sealants on their threads.
The plugs have to be tightened to the required torque.

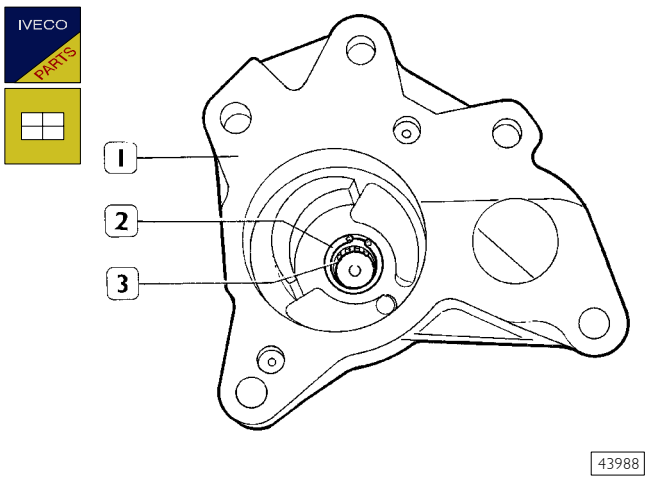
Figure 54



70967

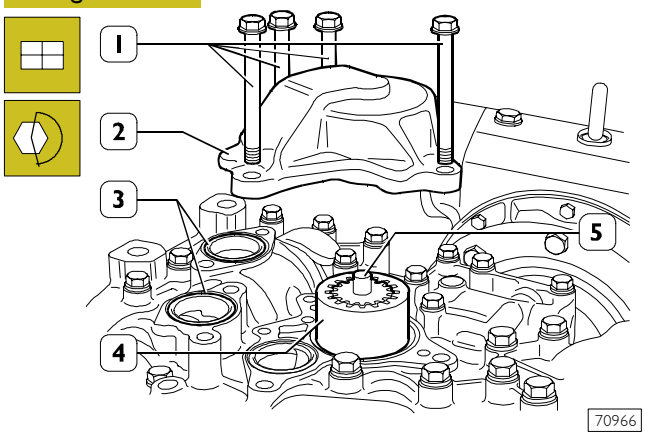
Fit the roller bearing (5) and circlip (4) in the rear half box (1).
Position the seals (2 and 3) on it.

Figure 55



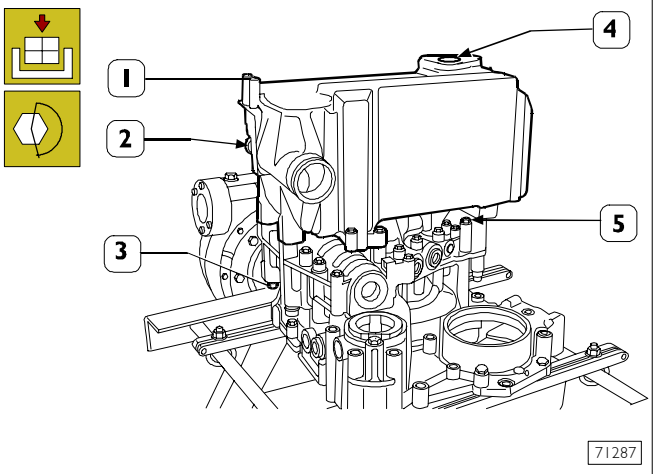
Mount the roller bearing (3) in the pump casing (1) and secure it with the circlip (2).

Figure 56



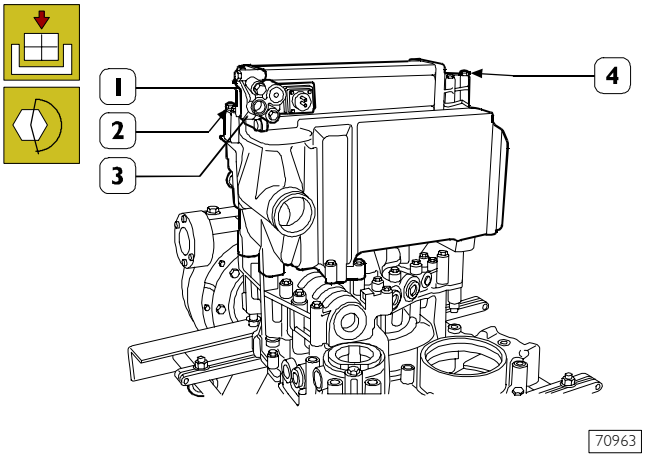
Mount the ring gear (4), the rotor (5) and the pump casing (2).
Screw down the screws (1) and tighten them to the required torque.
Position the seals (3).

Figure 57



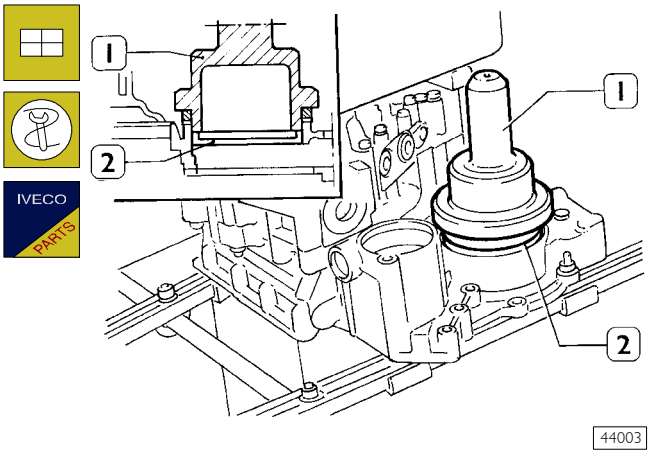
Refit the heat exchanger (1) to the hydraulic retarder and tighten the fixing nuts (3 and 5).
Mount the temperature sensor (2). Mount the seal (4).

Figure 58



Refit the hydraulic accumulator (1) together with the electropneumatic valve (3).
Screw down the screws (2 and 4) and tighten them to the required torque.

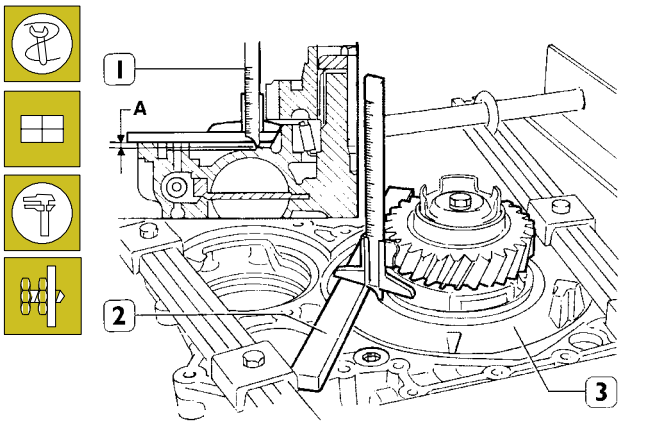
Figure 59



Using installation tool 99374221 (1), install a new oil seal (2) in the hydraulic retarder casing.

Stator end float adjustment

Figure 60



70946

Determine the thickness **S** of the stator end float adjustment ring.

- ❑ With a depth gauge (1) and calibrated rule (2), measure the distance between the supporting surface of the stator (3) (distance **A**).
- ❑ Measure the thickness of the gasket between the retarder and the gearbox (distance **B**).

The thickness S of the stator end float adjustment ring is given by the following equation:

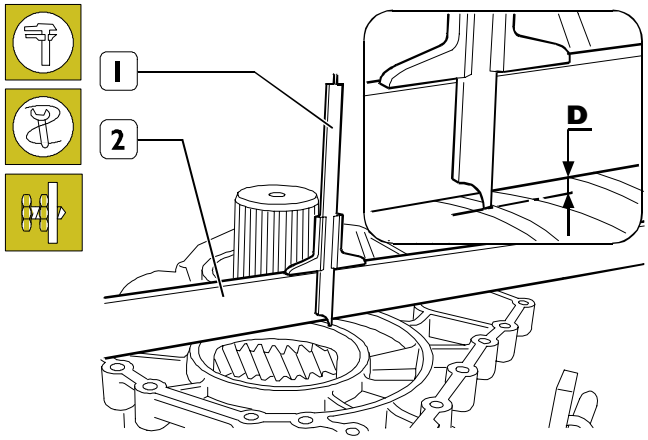
$$S = A + B + C$$

Where,

- ❑ **A** and **B** = measurements made
- ❑ **C** = 0.05 mm: pre-load of stator end float adjustment ring (-0.05 - +0.05 mm).

Only for EuroTronic Automated gearboxes, operate as below

Figure 61



106403

- ❑ With depth gauge (1) and calibrated ruler (2), measure distance **B** between stator adjusting ring rest surface and hydraulic decelerator rest surface.
- ❑ Measure the thickness of the gasket between the retarder and the gearbox (distance **B**).

The thickness **S** of the stator end float adjustment ring is given by the following equation: **S = A + B + C + D**

- ❑ **A**, fig. 60 **B** and **D** = detected values
- ❑ **C** = 0.05 mm: pre-load of stator end float adjustment ring (-0.05 - +0.05 mm).

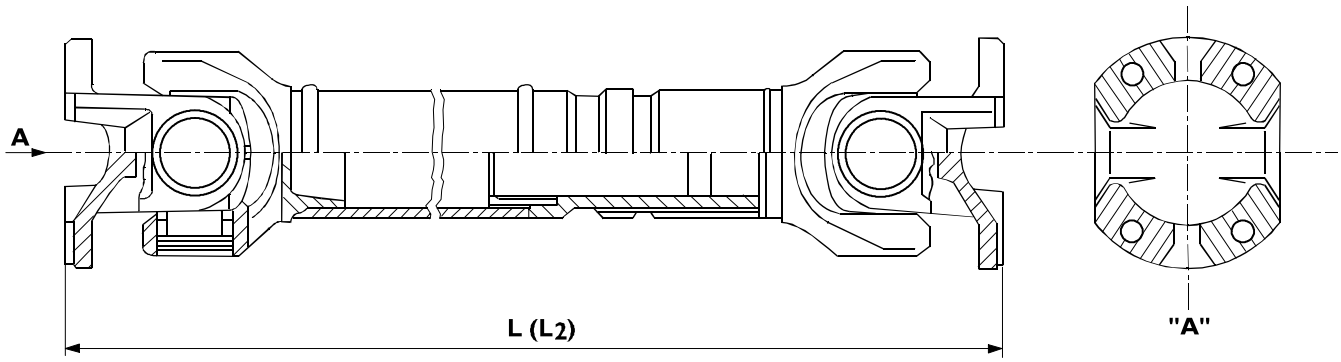
Refit the hydraulic retarder as described under the relevant heading of gearbox overhauling.

SECTION 6

Propeller shafts

CHARACTERISTICS AND DATA

Figure 1

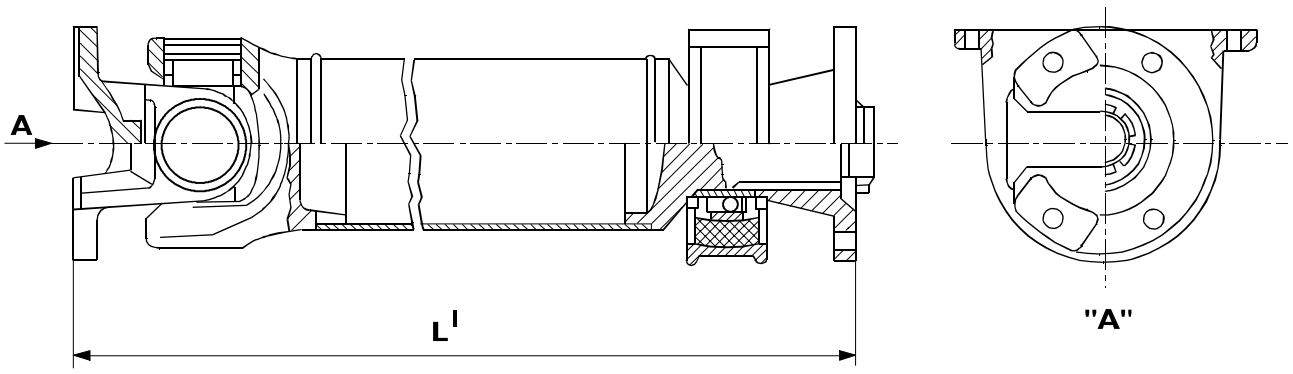


85482

SLIDING TRANSMISSION SHAFT

L = sliding shaft length shift
L_2 = minimum length between flanges

Figure 2



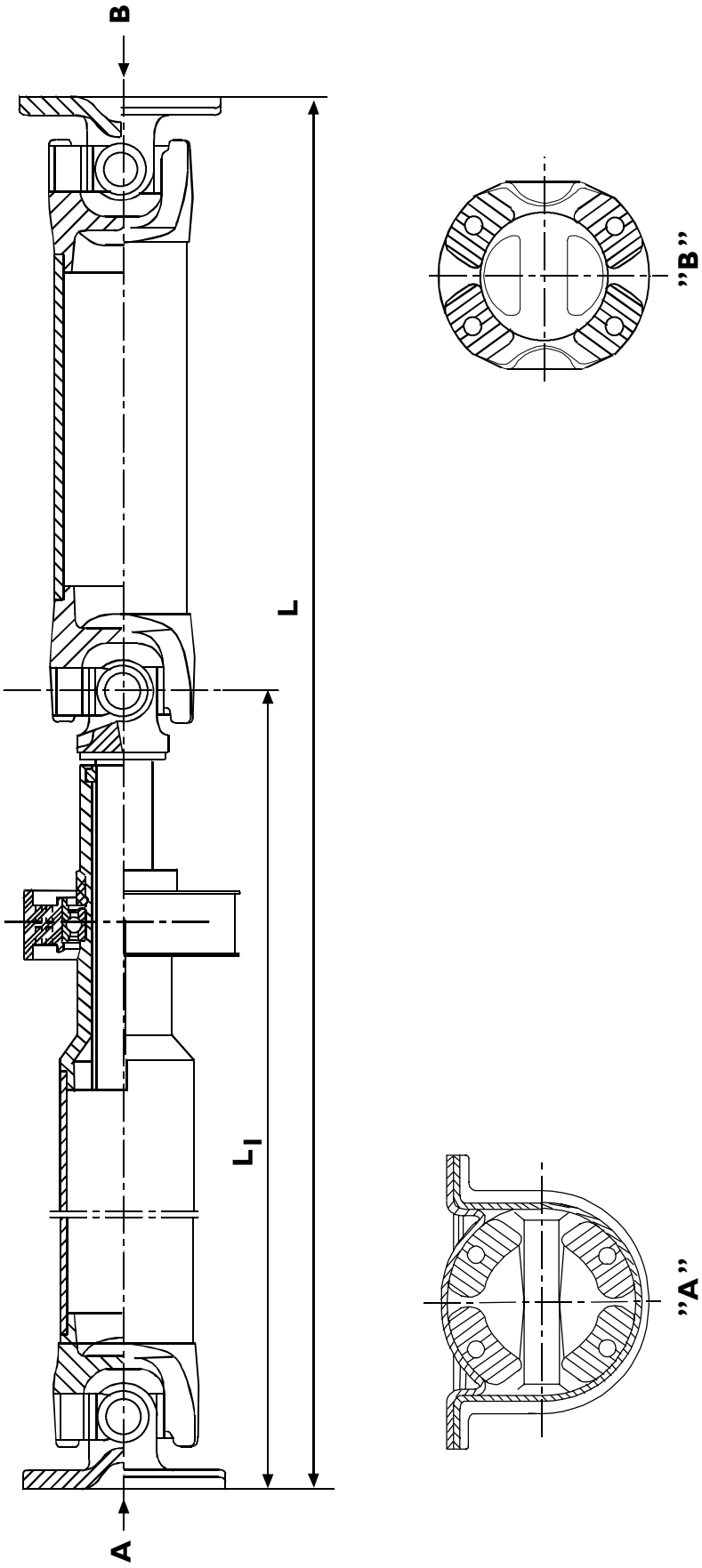
85483

TRANSMISSION SHAFT FOR CONNECTION TO ELASTIC SUPPORT

L_1 = length of connection transmission shaft

Universal joint working angle 25°

Figure 3



SINGLE SECTION TRANSMISSION SHAFT
L = minimum length between flanges
L_I = fixed length between flange and supportge and support

STRALIS (Tractors)

CHARACTERISTICS AND DATA (vehicles 4x2/6x2C/6x4/6x2p)

TRACTORS 4x2		WHEELBASE					
		2800		3200		3650	3800
Gearbox type	Shaft type	L mm min. max.	L mm min. max.	L mm min. max.	L mm min. max.	L mm min. max.	L mm min. max.
ZF 16 S 2220 TD ZF 16 S 1920 TD	KLEIN GKN	-	-	-	-	1700 ÷ 1810	1875 ÷ 1985
ZF 16 S 2220 TO	KLEIN GKN	-	-	-	-	1800 ÷ 1910	1975 ÷ 2085
ZF 16 S 2520 TO ZF 16 S 2330 TD	KLEIN GKN	-	-	-	-	1700 ÷ 1810	1775 ÷ 1885
12 AS 2330 TO	KLEIN GKN	-	-	-	-	1875 ÷ 1985	2050 ÷ 2160
12 AS 2530 TO 12 AS 2330 TD	KLEIN GKN	-	-	-	-	1700 ÷ 1810	1875 ÷ 1985
12 AS 2330 TO 12 AS 2530 TO	KLEIN GKN	-	-	-	-	1875 ÷ 1985	1975 ÷ 2085
ZF 16 S 2520 TO	KLEIN GKN	-	-	-	-	1700 ÷ 1810	1875 ÷ 1985
12 AS 1930 TD 12 AS 2530 TD	KLEIN GKN	-	-	-	-	1800 ÷ 1910	1975 ÷ 2085

TRACTORS 6x2 C		WHEELBASE					
		2800		3200		3650	3800
Gearbox type	Shaft type	L mm min. max.	L mm min. max.	L mm min. max.	L mm min. max.	L mm min. max.	L mm min. max.
ZF 16 S 2220 TD ZF 16 S 1920 TD	KLEIN GKN	-	-	-	-	-	1875 ÷ 1985
ZF 16 S 2520 TO ZF 16 S 2330 TD	KLEIN GKN	-	-	-	-	-	1775 ÷ 1885
12 AS 2530 TO 12 AS 2330 TD	KLEIN GKN	-	-	-	-	-	1875 ÷ 1985
12 AS 1930 TD 12 AS 2530 TD	KLEIN GKN	-	-	-	-	-	1975 ÷ 2085

TRACTORS 6x2 P		WHEELBASE					
		2800		3200		3650	3800
Gearbox type	Shaft type	L mm min. max.	L mm min. max.	L mm min. max.	L mm min. max.	L mm min. max.	L mm min. max.
ZF 16 S 2520 TO ZF 16 S 2330 TD	KLEIN GKN	-	-	-	1200 ÷ 1310	-	-
12 AS 2330 TD 12 AS 2530 TO	KLEIN GKN	-	-	-	1325 ÷ 1435	-	-

TRACTORS 6x4		WHEELBASE					
		2800		3200		3650	3800
Gearbox type	Shaft type	L mm min. max.	L mm min. max.	L mm min. max.	L mm min. max.	L mm min. max.	L mm min. max.
ZF 16 S 2520 TO ZF 16 S 2330 TD	KLEIN GKN	670 ÷ 830	700 ÷ 810	670 ÷ 830	1100 ÷ 1210	-	-
12 AS 2330 TD 12 AS 2530 TO	KLEIN GKN	670 ÷ 830	825 ÷ 935	670 ÷ 830	1225 ÷ 1335	-	-

STRALIS AS (Cabs)
CHARACTERISTICS AND DATA (vehicles 4x2/6x2P/6x4)

CABS 4x2		WHEELBASE																								
		3800		4200	4500			4800			5100			5500			5700			6300			6700		
Gearbox type	Shaft type	L mm min. max.	L2 mm	L mm min. max.	L' mm	L2 mm	L mm min. max.	L' mm	L2 mm	L mm min. max.	L' mm	L2 mm	L mm min. max.	L' mm	L2 mm	L mm min. max.	L' mm	L2 mm	L mm min. max.	L' mm	L2 mm	L mm min. max.	L' mm	L2 mm	L mm min. max.
ZF 16 S 2320 TD	KLEIN GKN	-	-	-	-	-	2470 ÷ 2580	-	-	-	-	-	3080 ÷ 3190	-	-	-	-	-	3650 ÷ 3760	-	1645	2600 ÷ 2710	-	-	-
ZF 16 S 2220 TD	KLEIN GKN	1875 ÷ 1985	-	2275 ÷ 2385	1510	-	1050 ÷ 1160	1735	-	1125 ÷ 1235	1735	-	1450 ÷ 1560	1735	-	1850 ÷ 1960	1735	-	2025 ÷ 2135	1215	-	1400 ÷ 1510	1735	-	3000 ÷ 3110
ZF 16 S 1920 TD		-	-	-	-	-	2555 ÷ 2665	-	-	2870 ÷ 2980	-	-	3170 ÷ 3280	-	-	3590 ÷ 3700	-	-	3740 ÷ 3850	1735	-	1400 ÷ 1510	-	-	-
																				1735	-	2600 ÷ 2710			
ZF 12 AS 1930 TD	KLEIN GKN	1975 ÷ 2085	-	2375 ÷ 2485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1840	-	2600 ÷ 2710	1840	-	3000 ÷ 3110
ZF 12 AS 2330 TD		-	-	-	-	-	2660 ÷ 2770	-	-	2970 ÷ 3080	-	-	3280 ÷ 3390	-	-	3700 ÷ 3810	-	-	3850 ÷ 3960	1815	1135	2645 ÷ 2755	-	-	-
ZF 12 AS 2330 TD	KLEIN GKN	-	-	-	-	-	2570 ÷ 2680	-	-	-	-	-	3190 ÷ 3300	-	-	-	-	-	3760 ÷ 3870	-	1750	2600 ÷ 2710	-	-	-

CABS 6x2P		WHEELBASE																		
		3800	4200		4500			4800			5100			5700			6050			
Gearbox type	Shaft type	L mm min. max.	L2 mm	L mm min. max.	L' mm	L2 mm	L mm min. max.	L' mm	L2 mm	L mm min. max.	L' mm	L2 mm	L mm min. max.	L' mm	L2 mm	L mm min. max.	L' mm	L2 mm	L mm min. max.
ZF 16 S 2320 TD	KLEIN GKN	1950 ÷ 2060	-	2200 ÷ 2310	-	-	2660 ÷ 2770	-	-	2975 ÷ 3085	-	-	3290 ÷ 3400	-	1720	3850 ÷ 3960	1800	1135	2420 ÷ 2530
ZF 16 S 2520 TO		1755 ÷ 1885	-	2390 ÷ 2500	-	-	2485 ÷ 2595	-	-	2795 ÷ 2905	-	-	3100 ÷ 3210	-	-	3690 ÷ 3800	-	-	4050 ÷ 4160
ZF 16 S 2220 TD	KLEIN GKN	1875 ÷ 1985	-	2300 ÷ 2410	1510	-	1065 ÷ 1175	1735	-	1150 ÷ 1260	1735	-	1450 ÷ 1560	1735	-	2025 ÷ 2135	1215	-	1200 ÷ 1310
ZF 16 S 1920 TD			-		-	-	2575 ÷ 2685	-	-	2885 ÷ 2995	-	-	3200 ÷ 3310	-	-	3780 ÷ 3890	1735 -	- -	1200 ÷ 1310 4140 ÷ 4250
ZF 12 AS 1930 TD ZF 12 AS 2330 TD	KLEIN GKN	1975 ÷ 2085	-	2400 ÷ 2510	-	-	2680 ÷ 2790	-	-	2990 ÷ 3100	-	-	3300 ÷ 3410	-	-	3890 ÷ 4000	-	-	4250 ÷ 4360
ZF 12 AS 2330 TD ZF 12 AS 2530 TO	KLEIN GKN	-	-	2300 ÷ 2410	-	-	2590 ÷ 2700	-	-	2900 ÷ 3010	-	-	3210 ÷ 3320	-	-	3790 ÷ 3900	-	-	4150 ÷ 4260

CABS 6x2C		WHEELBASE					
		3800		4200		4500	
Gearbox type	Shaft type	L2 mm	L mm min. max.	L2 mm	L mm min. max.	L2 mm	L mm min. max.
ZF 16 S 2320 TD	KLEIN GKN	670 ÷ 830	1700 ÷ 1810	670 ÷ 830	2100 ÷ 2210	670 ÷ 830	2375 ÷ 2485
ZF 12 AS 2330 TD	KLEIN GKN	670 ÷ 830	1800 ÷ 1910	670 ÷ 830	2200 ÷ 2310	670 ÷ 830	2450 ÷ 2560

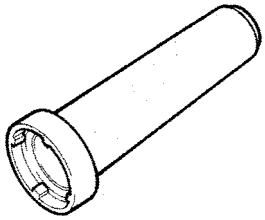
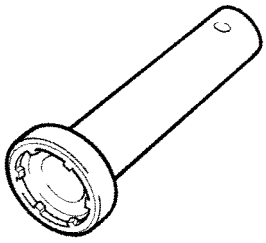
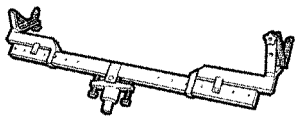
DIAGNOSTIC
Main operating faults of a mechanical nature

Visible Failure	Possible cause	Repair action
Noisy and vibrating transmission	Shaft distorted.	Replace the shaft.
	Shaft not balanced.	Check the balance and ascertain where to weld the balancing patches.
	Excessive play between splined sections.	Replace the shaft.
	Screws and nuts loosened where shaft is attached to sleeves on transmission and rear axle.	After careful checking, take steps to tighten the loose screws and nuts fully, replacing damaged parts if necessary.
	Drive shaft universal joints seized or excessively worn.	Overhaul or replace the universal joints.
	Flexible support fixing screws loose.	Tighten the screws to the required torque.
	Central support flexible insert worn.	Replace the support.
	Flexible support bearing worn or with too much slack.	Replace the support.
	Loose screws or ring nuts fastening the flange to the propeller shaft hold.	Tighten the screws or ring nuts to the required torque.

TIGHTENING TORQUES

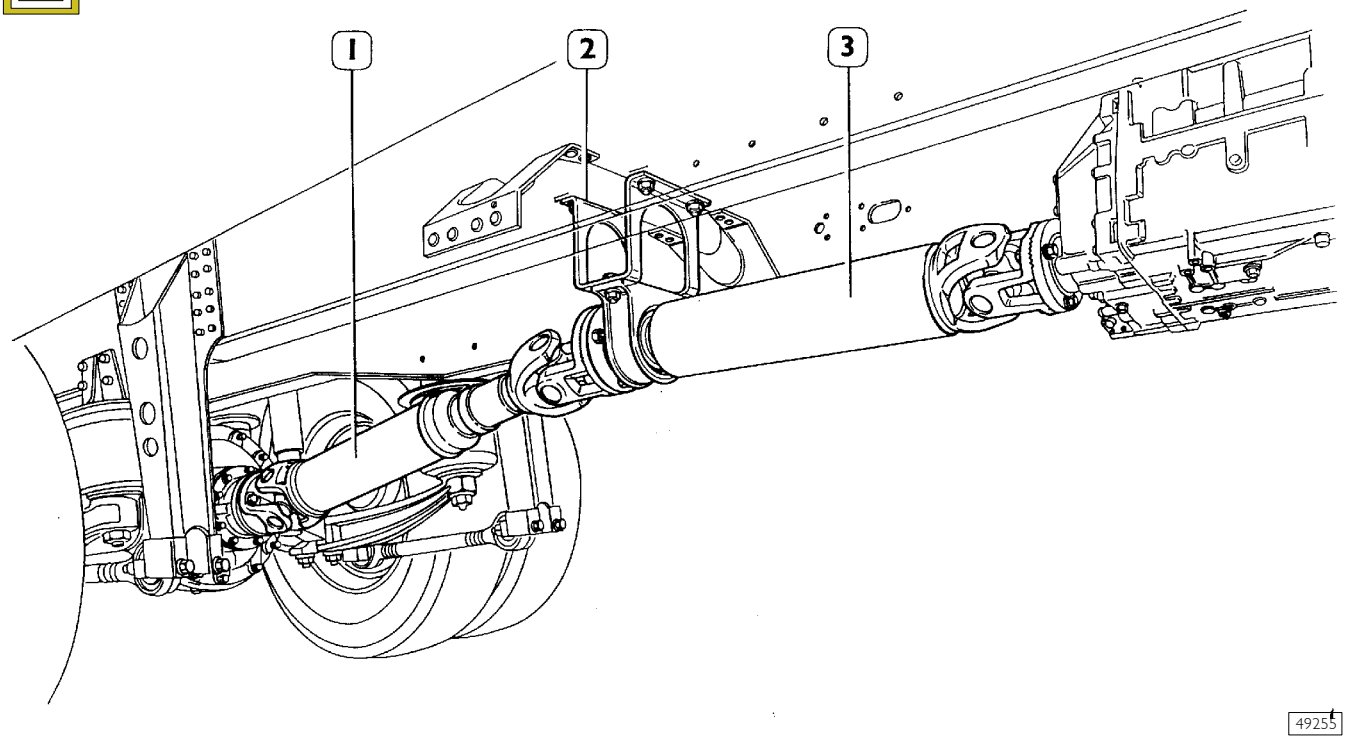
COMPONENT	TORQUE	
	Nm	kgm
Ring nut to fasten the flange to the propeller shaft: M 40X1.5 M 55X1.5	 350 + 50 380 + 70	 35 + 5 38 + 7
Screw fastening the flange to the propeller shaft: M 20X160	450 ± 34	45 ± 3.4
Nut for screw fastening propeller shaft flanges	133.5 ± 13.5	13.3 ± 1.3
Nut for M12 screw fastening flexible support bracket to chassis	92 ± 9	9.2 ± 1

TOOLS

TOOL NO.		DESCRIPTION
99355124		Ring nut wrench
99355172		Ring nut wrench
99370618		Support to remove-fit back the propeller shaft

505620 REMOVING AND REASSEMBLING THE PROPELLER SHAFT

Figure 4



LAY-OUT OF A TRANSMISSION COMPOSED OF:
Front propeller shaft (3) - Support (2) - Sliding rear shaft (1)

Removal

NOTE Always remove the rear propeller shaft first before overhauling a transmission.

Place a hydraulic jack, fitted with support 99370618, underneath the rear propeller shaft.
Remove the nuts fastening the flanges and disconnect the propeller shaft; as for the front propeller shaft, also remove the support fastening the shaft to the chassis.

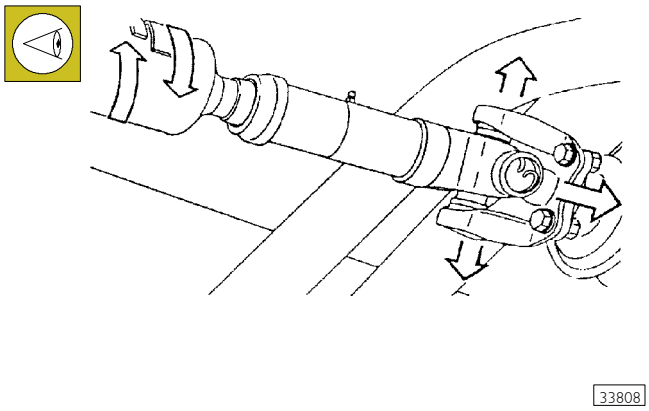
Reassembly

Follow the above mentioned procedure backwards, checking for the following:

- ❑ Rear propeller shaft
  - make sure the arrows on the sliding sleeve and shaft are aligned;
- ❑ Front propeller shaft
  - make sure the holes in the front flange match those in the rear flange;
  - do not re-use the nuts of the flange fastening screws; replace them;
  - make sure the flange fastening screws match the flange holes on the universal joint end;
  - make sure nuts and screws are tightened to the required torque;
  - make sure the sliding propeller shaft flange is connected to the input shaft flange.

CHECKING THE PROPELLER SHAFT ON THE VEHICLE

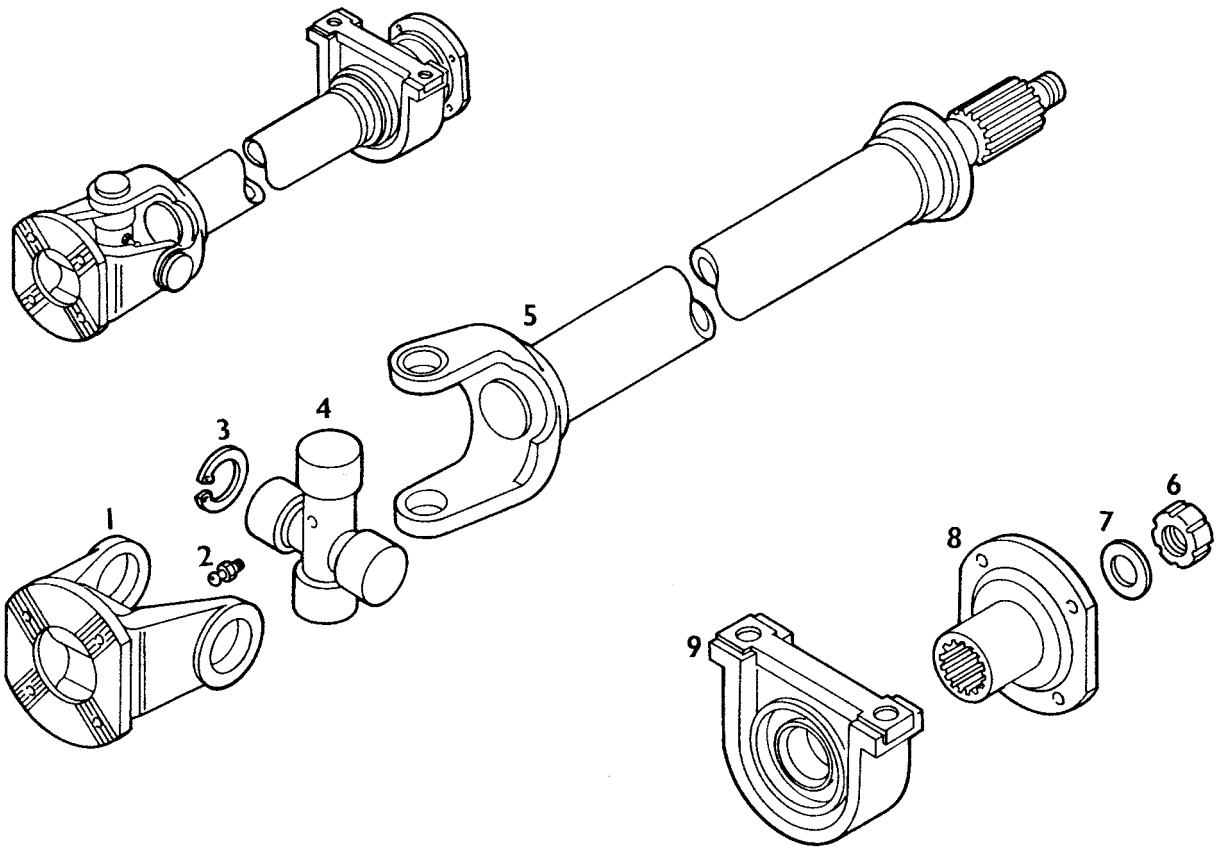
Figure 5



33808

The propeller shafts are supplied by the supplier as assemblies ready to be mounted.
They are statically and dynamically balanced.
The plates welded to the transmission shafts are balancing plates.
If the plates are missing, it will be necessary to re-balance the shaft.
Working on the transmission shaft and, at the same time, but in the opposite direction, on the sliding sleeve (arrows) check that there is no clearance between the grooves.
Working on the forks of the sleeves (arrows) check that the spiders are not worn. If they are, replace them as described previously.

Figure 6



38824

FRONT PROPELLER SHAFT COMPONENTS
1. Front fork flange - 2. Grease nipple - 3. Split ring - 4. Spider - 5. Propeller shaft - 6. Ring nut
7. Washer - 8. Rear flange - 9. Support

REMOVING AND FITTING BACK THE UNIVERSAL JOINTS

Using suitable pliers, remove the split ring (3, Figure 7).
Beat the fork flange (1) with a hammer until the bearing starts coming out of its housing, i.e. Until the spider (4) interferes with the fork. Turn the component upside down and repeat the above operations.
Manually remove one of the two bearings. Remove the fork (1) and use a punch to remove the other bearing.
Repeat this procedure to remove bearings from the other fork and free the spider (4).
To reassemble, repeat the above mentioned procedure backwards.

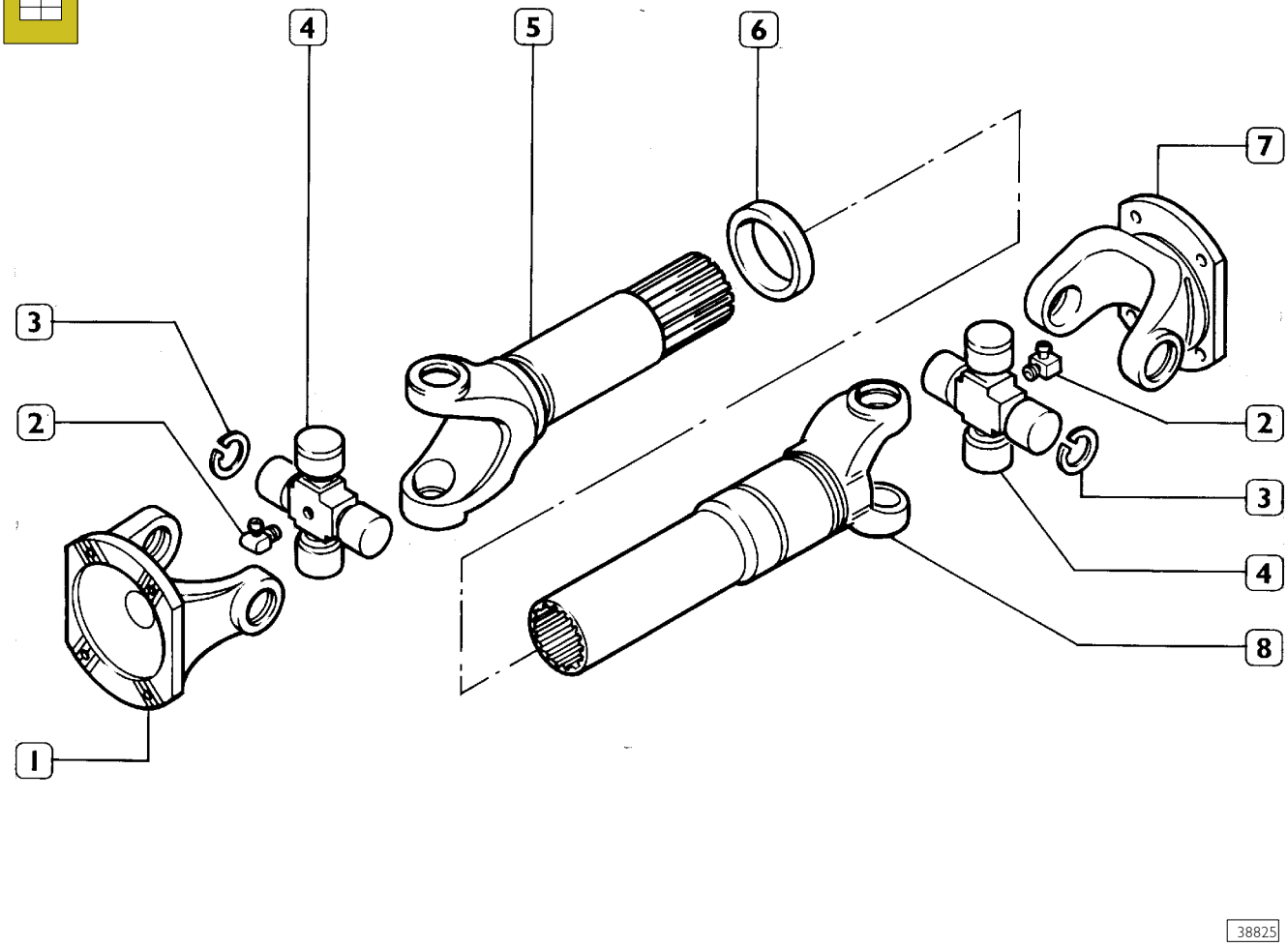
REMOVING AND REASSEMBLING THE SUPPORT

Using a suitable wrench, remove the ring nut (6, Figure 6) and the following components from the propeller shaft:

- ❑ washer (7);
- ❑ rear flange (8);
- ❑ support (9).

To reassemble, repeat the above mentioned procedure backwards.

Figure 7



FRONT PROPELLER SHAFT COMPONENTS
1. Front fork flange - 2. Grease nipple - 3. Split ring - 4. Spider - 5. Front half-propeller shaft - 6. Ring nut (for KLEIN supply only) - 7. Rear fork flange - 8. Rear half-propeller shaft

SECTION 7

5250 Rear axles

DIAGNOSTICS
Main operating faults of a mechanical nature

Visible Failure	Possible cause	Repair action
Wheel hub noise	Insufficient lubrication.	Check there are no leaks from gaskets or the rear axle casing and top up oil to correct level.
	Inefficient wheel hub bearings.	Dismantle the hub and replace the required parts.
	Incorrectly adjusted wheel hub bearings.	Adjust the bearings.
	Drive shaft splines to fit the epicycloid gear unit gearing worn.	Overhaul the assembly and replace worn or damaged parts.
Noise	Lubricating oil level low.	Check there are no leaks from gaskets or the rear axle casing and top up oil to correct level.
	Drive shaft splines to fit the differential crown wheels damaged.	Overhaul the rear axle and replace worn or damaged parts.
	Incorrectly adjusted wheel hub bearings.	Adjust the clearance on the bearings.
	Bad adjustment or wear on differential gears or bearings.	Locate the trouble and overhaul the assembly.
Noise on release	Incorrect fitting clearance between pinion and ring bevel gear.	Remove the gear housing inspection cover and adjust clearance between pinion and ring bevel gear.
Noise during acceleration	Insufficient lubrication.	Check there are no leaks from gaskets or the housing and top up to level.
	Gear housing bearings badly set or deteriorated.	Overhaul the assembly.
	Bad tooth contact between pinion and ring bevel gear.	Adjust the contact.
Cornering noise	Inexact clearance between side pinion crown wheels.	Overhaul or replace the assembly.

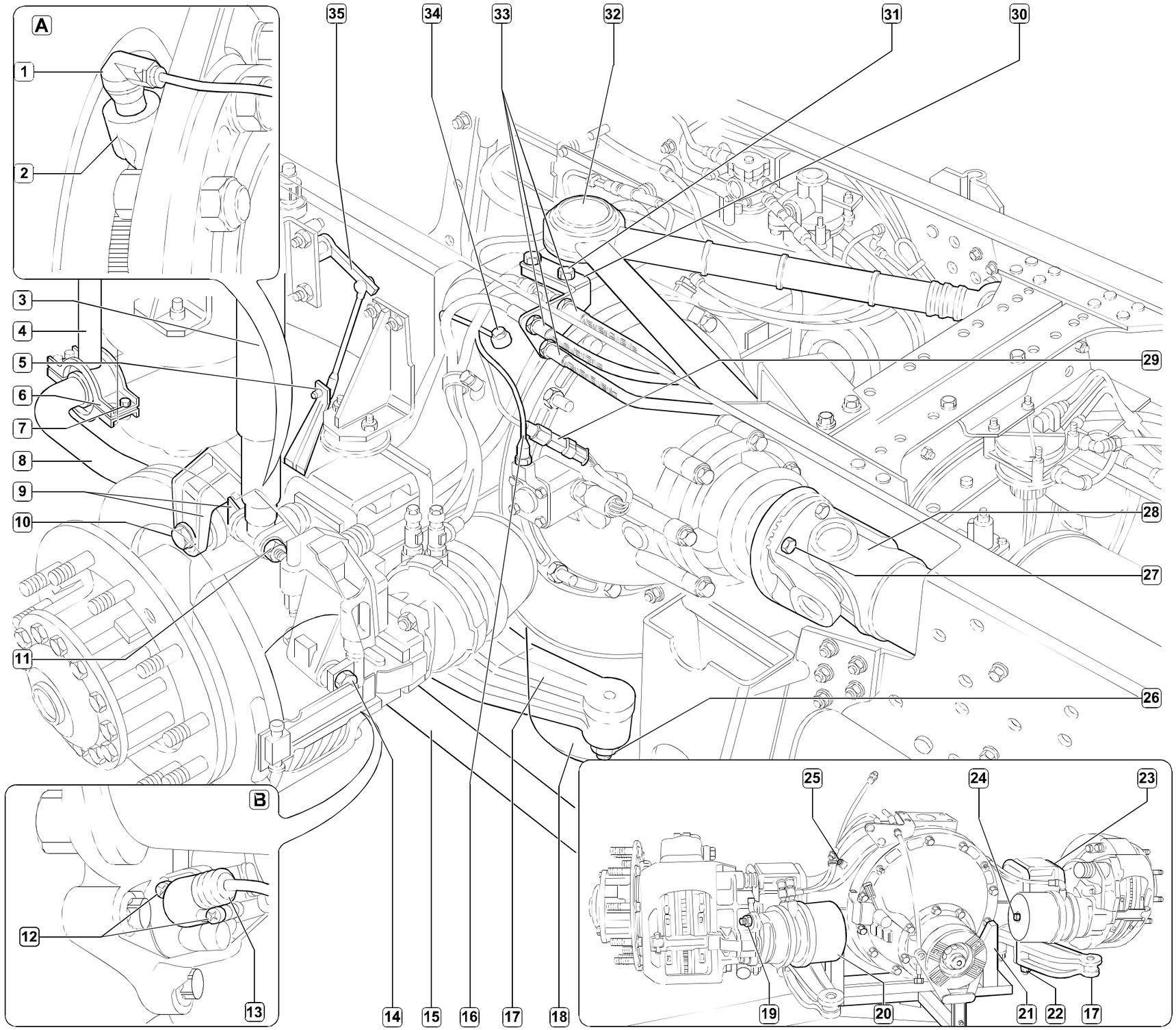
REMOVING-REFITTING THE REAR AXLE

Removal

There follows a description of the operations for removing and refitting the rear axle with disc brakes that, by analogy, can be considered good for the rear axle with drum brakes too.

- ❑ Set the vehicle on level ground and lock the front wheels.
- ❑ Loosen the nuts fixing the wheels.
- ❑ Lift the vehicle at the rear and put the chassis frame on two stands.
- ❑ Put the hydraulic trolley 99321024 under the wheels, take out the nuts fixing the wheels and remove them.
- ❑ Cut the clamps holding the wiring and air piping to the reaction triangle.
- ❑ Disconnect the three brake air pipes (33) from the bracket (30).
- ❑ Take out the screws (31) and disconnect the reaction triangle (32) from the axle housing.
- ❑ Extract the speed sensors (1) from the brake calliper supporting flange (2) (det. A).
- ❑ Take out the screws (12) and extract the brake lining wear sensor (13) (det. B).
- ❑ Disconnect the air pipe (16) and the electrical connection (29) from the differential locking control device.
- ❑ Take out the screws (27) fixing the propeller shaft flange (28).
- ❑ With an appropriate rope, secure the propeller shaft to the vehicle's chassis frame.
- ❑ Disconnect the brackets (5) for the levelling valve tie rods (35) from the mounts (17).
- ❑ Using a hydraulic lift, apply the mount 99370617 (21) to the axle housing.
- ❑ Take out the fixing screws (10) and disconnect the stabilizer bar (8) from the mounts (9).
- ❑ Loosen the screws (7) fixing the cap (6) retaining the stabilizer bar (8) to the anchor bar (4).
- ❑ Turn the stabilizer bar and secure it with a suitable rope to the chassis frame so as not to obstruct removing the rear axle.
- ❑ Take out the nuts (14) and disconnect the longitudinal tie rods (15).
- ❑ Take out the nuts (11) and disconnect the shock absorbers (3) from the axle mount (17).
- ❑ Disconnect the air vent pipe (34) from the axle.
- ❑ Take out the nuts (26) and disconnect the air springs (18) from the mounts (17).
- ❑ Lower the hydraulic lift and extract the rear axle from the vehicle.
- ❑ Disconnect the mounts (17) from the axle housing, removing the nuts (22) for the fixing brackets (23).
- ❑ Take out the screws (25) and disconnect the wiring and air pipes of the differential case.
- ❑ Fully unscrew the screws (24) to release the brake cylinder (20).
- ❑ Remove the nuts (19) and disconnect the brake cylinder (20) from the axle housing.

Figure 1



Refitting

For refitting, carry out the operations described for removal in reverse order, keeping to the required tightening torques for the screws and/or nuts.
Afterwards, check that:

- ❑ There is no air leakage from the air pipes.
- ❑ The lubricating oil of the axle housing is at the right level.
- ❑ The differential locking indicator lamp works properly; if it does not, proceed as described under the relevant heading.

REMOVING-REFITTING THE DIFFERENTIAL FROM THE REAR AXLE ON THE VEHICLE

Removal

- ❑ Set the vehicle on level ground and lock the front wheels.
- ❑ Drain the oil from the axle housing through the drain plug.
- ❑ Take out the screws (7) and disconnect the propeller shaft (8) from the differential flange.
- ❑ Secure the propeller shaft to the vehicle's chassis frame with an appropriate rope.
- ❑ Disconnect the electrical connection (4) for the switch (5) signalling differential locking and the air pipe (3) from the differential locking control device.
- ❑ Disconnect the screws (1) fixing the drive shafts (2) and extract them from the axle housing.
- ❑ Using the hydraulic jack, put the mount 993770616 (10, det. B) under the differential and constrain the brackets (11) of this mount to the flange (12) of the differential sleeve (det. B).
- ❑ Unscrew the screws (6) and nuts (9) fixing the differential assembly to the axle housing.
- ❑ Remove the plugs (➧ det. B) from the threaded holes and screw appropriate screws into them so as to extract the differential from the axle housing.

Refitting

For refitting, carry out the operations described for removal in reverse order, keeping to the following instructions:

- ❑ The self-locking nuts have to be replaced with new parts for each removal.
- ❑ After thoroughly cleaning the parts, apply sealant paste onto the threads of the screws fixing the differential case and the drive shafts.
- ❑ Tightening sequence diagram (differential case to axle housing) (det. A)
  1 – 2 – 3 – 4 nuts;
  10 – 9 – 14 – 5 – 7 – 11 – 13 – 6 – 8 – 12 screws.
- ❑ Tighten the screws and nuts fixing the differential case to the rear axle at the required torque and in the sequence indicated in the diagram.

After refitting:

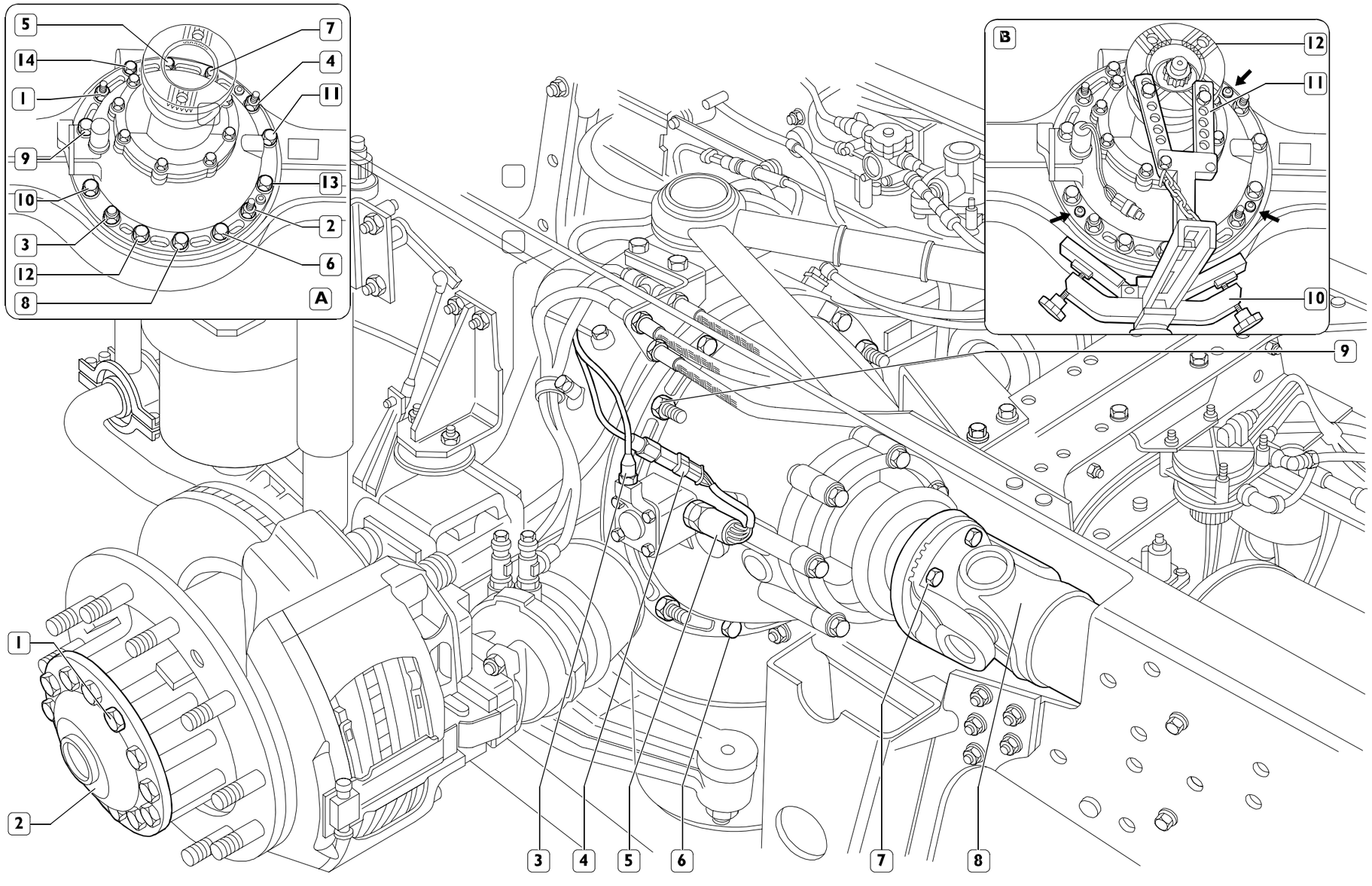
- ❑ Screw the drain plug on and restore the level of oil with the required quantity and grade.
- ❑ Check there is no leakage from the air pipe of the differential locking device and that it engages.
- ❑ Check that the differential locking indicator light in the cab works correctly; if it does not, keep to the instructions described in the relevant section.

Instructions to adjust and check the operation of the transmitter controlling differential locking and divider engagement.

The operation of the transmitter (two-function type) to control differential and divider engagement is adjusted and checked with the axle mounted on the vehicle and proceeding as described below:

- ❑ With differential locking, screw down the transmitter to close the contacts and check the indicator light in the cab comes on.
- ❑ The moment the indicator light in the cab comes on, screw down the transmitter one more turn.
- ❑ Tighten the lock nut to lock the transmitter at a torque of 40 Nm (4 kgm).
- ❑ Release the divider and differential locking engagement control and check that the contacts are closed (in this condition, the indicator light in the cab must be off).

Figure 2



72797

5250 Rear Axle ARVINMERITOR MS 13-175 with disc brakes

LOCATION OF DIFFERENTIAL UNIT PLATES - REAR AXLE

The plates contain all information and details relating to either DIFFERENTIAL UNIT and REAR AXLE.

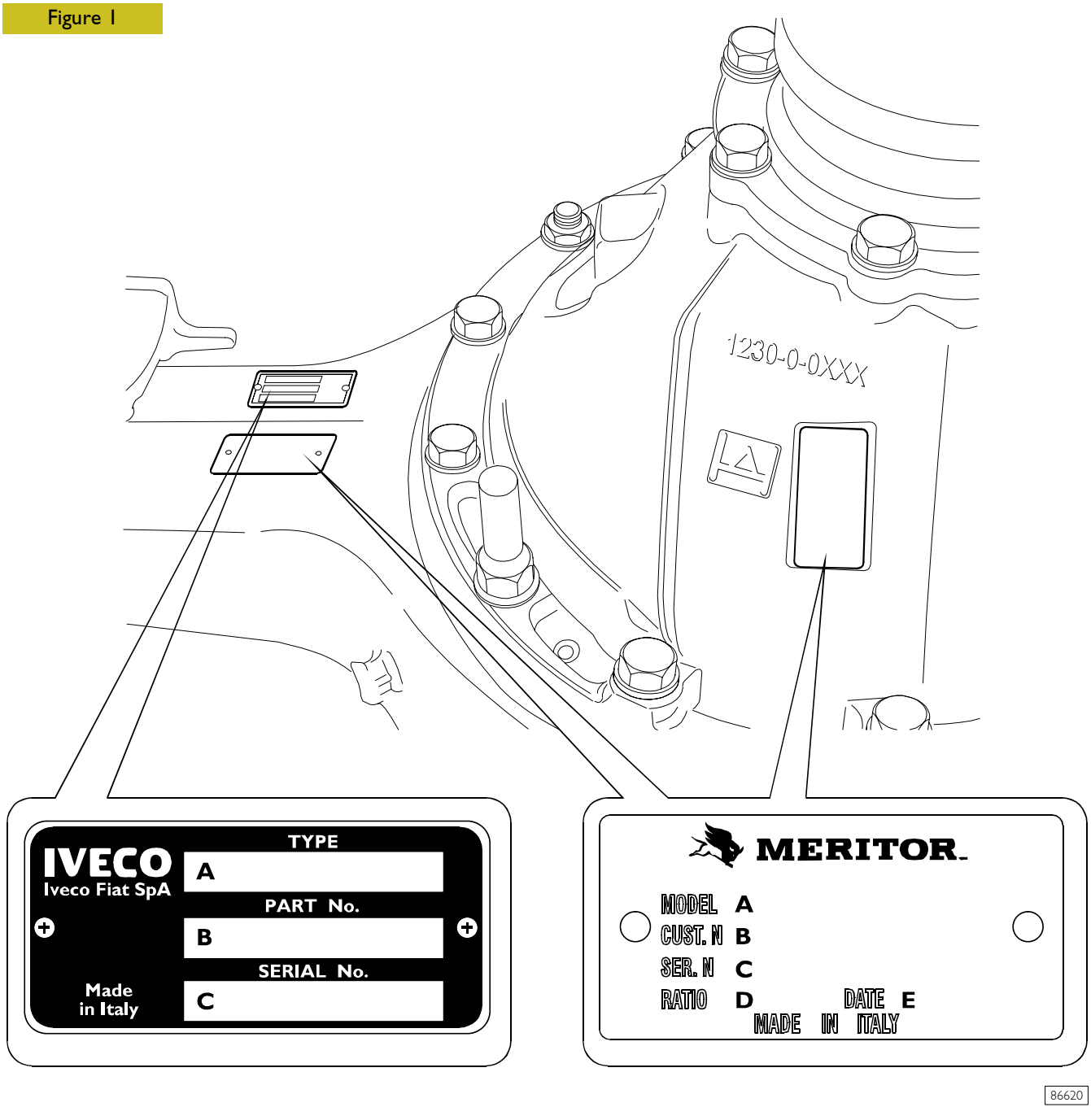
On real axle, two plates are present: one on the differential unit and one in same position on rear axle box.

On the notifications of interventions under guarantee, rear axle box and differential unit plate data must always be shown.

It is suggested always to read and copy out shown data before any repair so as to order correct spare parts and transmit correct information to either IVECO Service Network.

Plate is never to be removed from the unit.

Figure 1



IVECO identification plate

A = identifies rear axle type
B = drawing number
C = production progressive number

ARVINMERITOR identification plate

A = identifies the family the item is belonging to / the model
B = drawing number
C = ArvinMeritor series number
D = rear axle ratio
E = production date

DESCRIPTION

The rear axle is the load bearing type with a single reduction. It is composed of a pressed sheet steel box appropriately strengthened.

The differential consists of a group of hypoid gears of coarse pitch type.

The pinion is supported by two tapered roller bearings (pinion unit) and by a third cylindrical roller bearing.

The position of the bevel pinion, in relation to the ring bevel gear, is adjusted by changing the thickness of the pack of rings between the differential case and the bevel pinion mount.

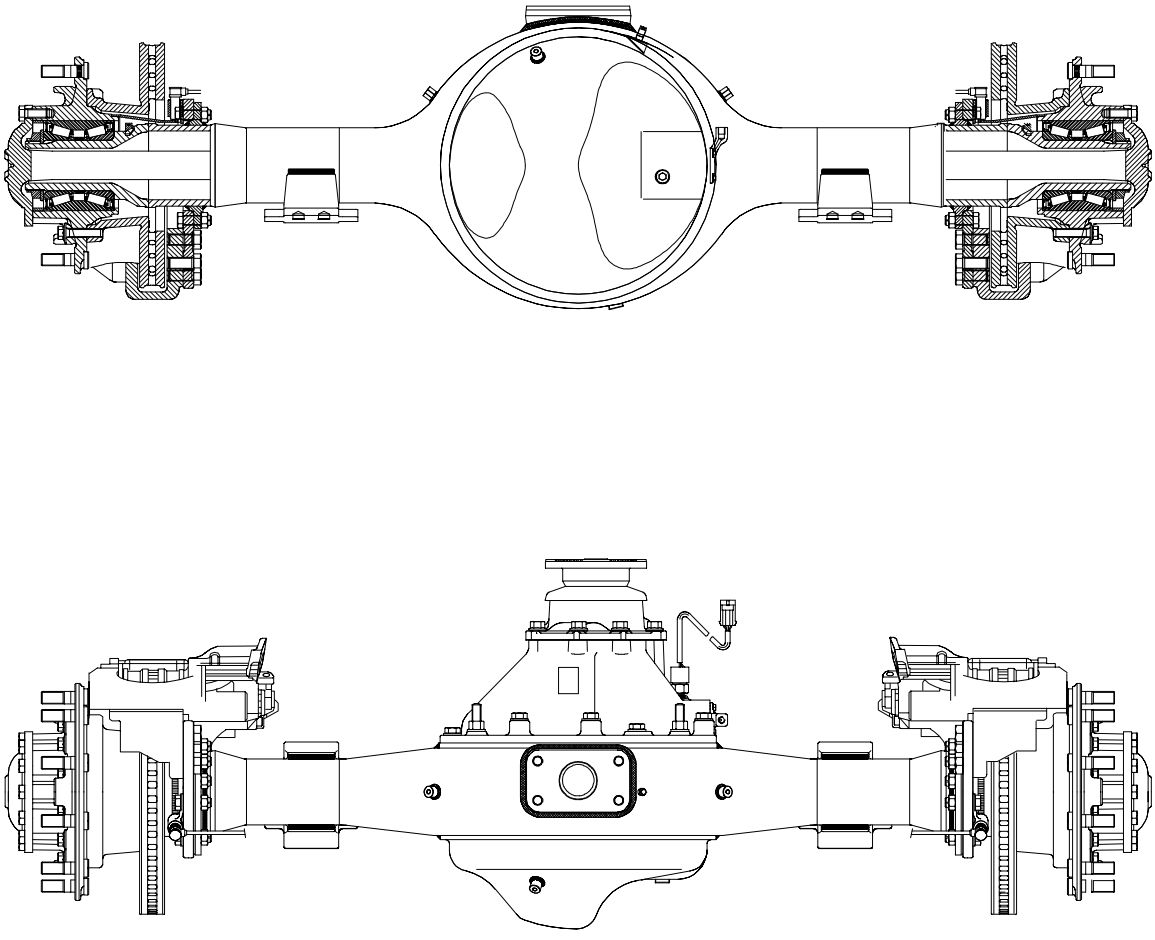
The gearing box is supported by two tapered roller bearings and can be adjusted axially with two threaded ring nuts.

The rear axle is equipped with a differential locking device.

The bearings of the wheel hubs are the UNIT-BEARING type with permanent lubrication and need no adjustment.

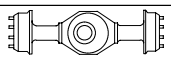
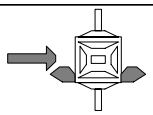
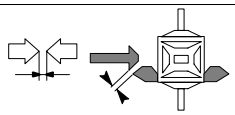
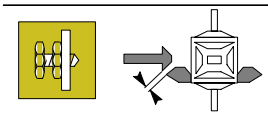
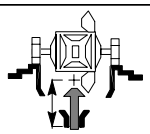
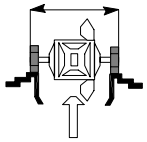
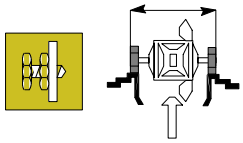
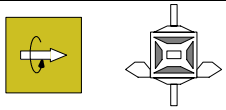
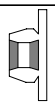
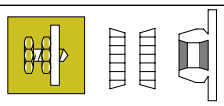
The brakes are of disc type with KNORR float calipers.

Figure 2



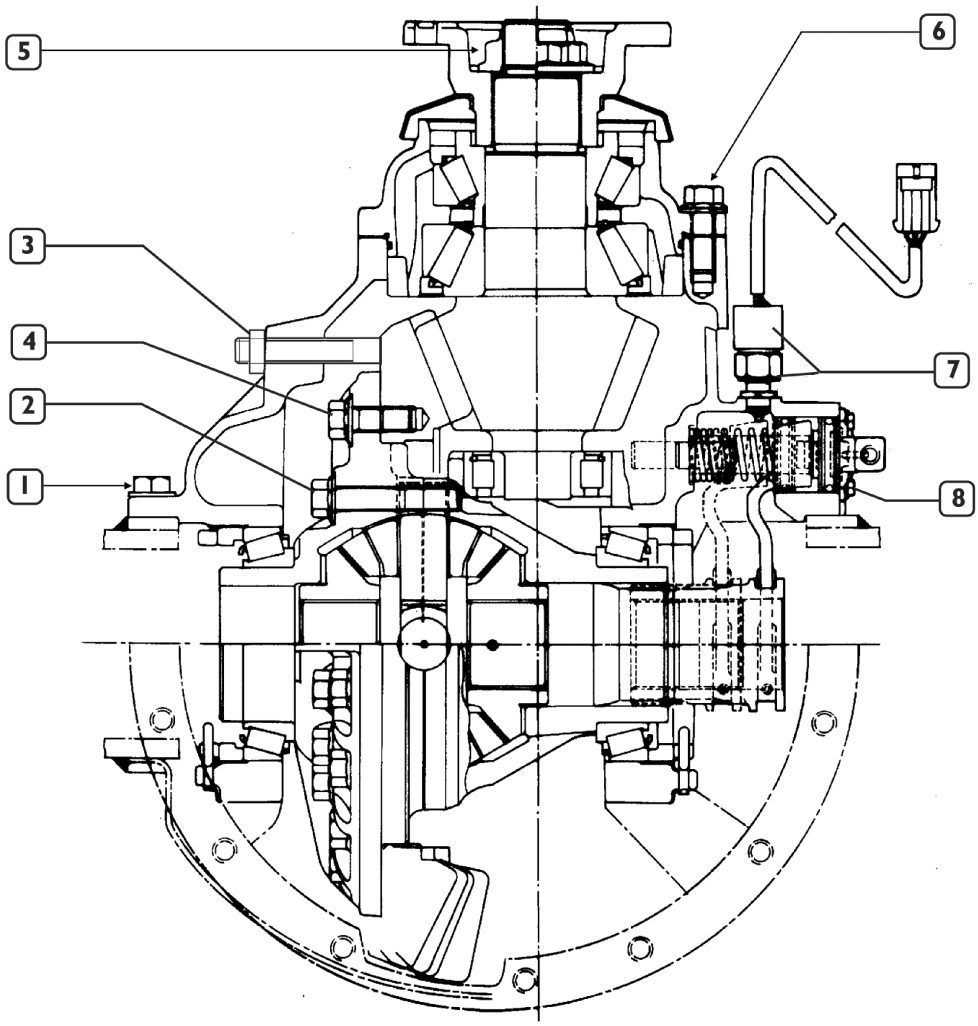
VIEW OF THE ARVINMERITOR MS 13-175 REAR AXLE ASSEMBLY

CHARACTERISTICS AND DATA

 Rear axle Type	Load bearing with single reduction ARVINMERITOR MS 13-175
 Bevel pinion bearings	2 with tapered rollers and 1 with cylindrical rollers
 DIFFERENTIAL ASSEMBLY Bevel gear pair reduction ratio	2.64 (14/37) - 2.85 (13/37) - 3.08 (12/37) - 3.36 (11/37) 3.70 (10/37) - 4.11 (9/37) - 4.63 (8/37)
 Clearance between pinion and ring gear mm	0.26 to 0.50
 Adjustment of clearance between pinion and ring gear	With adjustment rings
 Bevel pinion position in relation to ring gear	With adjustment shims
 Cap gap mm	0.15 to 0.33
 Cap gap adjustment	With adjustment rings
 Rolling torque between planetary gears and crown wheels Nm kgm	68 max. 6.8 max.
 Thicknesses of adjustment rings between bevel pinion mount and differential case mm	0.125 - 0.200 - 0.500
Wobble of ring gear supporting surface on half box mm	0.13 max.
 **WHEEL HUBS**	
 Wheel hub bearings	Two Unit Bearing type
 Wheel hub bearing end float adjustment	Not adjustable Tightening to torque with threaded nut
 Axle oil Quantity Litres (kg)	TUTELA W 140/MDA (•) 18.5 (16.5)
Dry weight kg Maximum capacity GRW kg	- 13000

(•) For vehicles with F3A engine (CURSOR10) TUTELA TRUCK FE AXLE oil can be alternatively used.

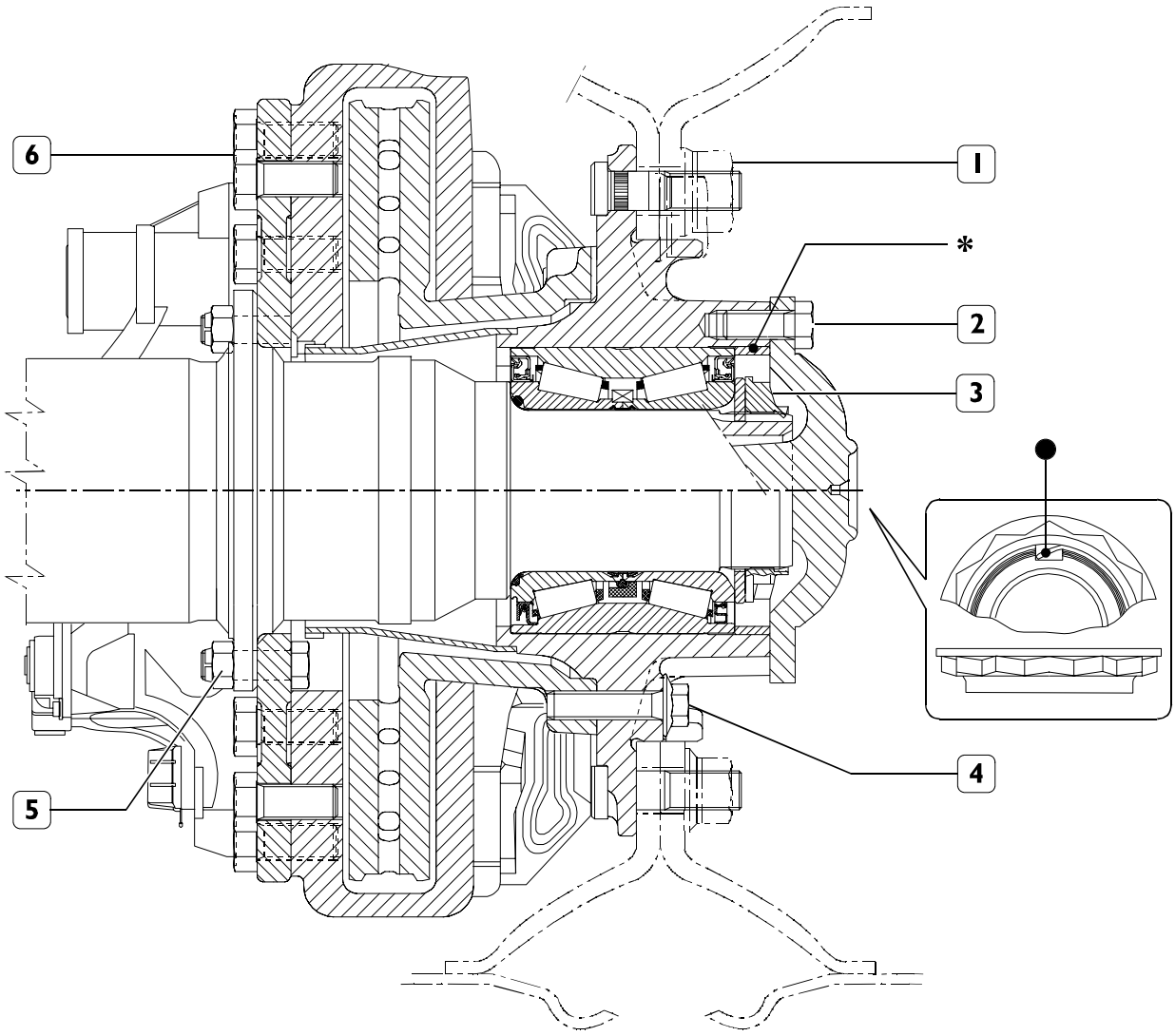
Figure 3



TIGHTENING TORQUES

	PART		TORQUE	
			Nm	kgm
1	Screw fixing differential case to axle housing	1st phase torque 2nd phase angle	100 ± 5 80° to 90°	10 ± 0.5
2	Screw fixing differential half boxes	1st phase torque 2nd phase angle	100 ± 5 110° to 120°	10 ± 0.5
3	Pressure bolt nut		270 to 335	27 to 33.5
4	Screw fixing bevel ring gear to half box	1st phase torque 2nd phase angle	100 ± 5 80° to 90°	10 ± 0.5
5	Nut locking bevel pinion		1350 to 1670	135 to 167
6	Screw fixing bevel pinion mount	1st phase torque 2nd phase angle	100 ± 5 60° to 70°	10 ± 0.5
7	Nut locking sensor		35 to 45	3.5 to 4.5
	Screw fixing caps to differential case		650 to 810	65 to 81
	Oil level and draining plugs		45 ÷ 55	4.5 ÷ 5.5
8	Cover bolts		10 to 12	1 to 2

Figure 4



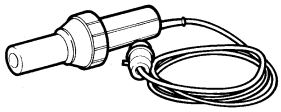
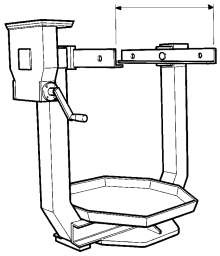
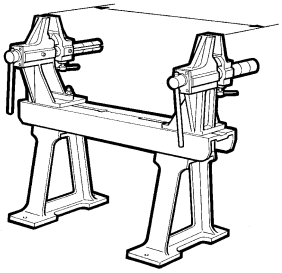
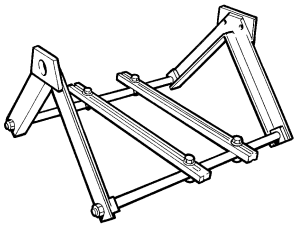
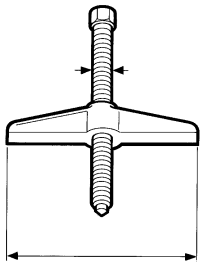
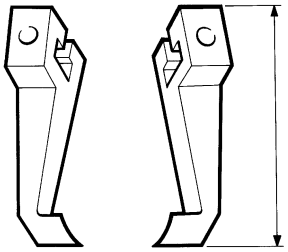
TIGHTENING TORQUES

	PART	TORQUE	
		Nm	Kgm
1	Nut fixing wheels	732 to 599	73.2 to 59.9
2	Screw fixing drive shaft flange	235 to 289	23.5 to 28.9
3	Ring nut retaining wheel hub bearing	834 to 1030	83.4 to 103
4	Screw fixing brake disc to wheel hub	268 to 295	26.8 to 29.5
5	Nut for screw fixing brake calliper mount	275 to 304	27.5 to 30.4
6	Screw fixing brake calliper to mount	554 to 677	55.4 to 67.7

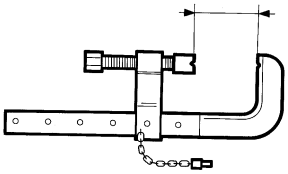
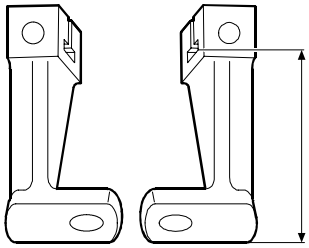
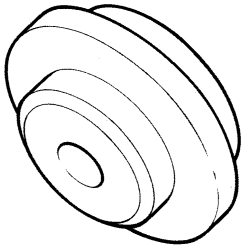
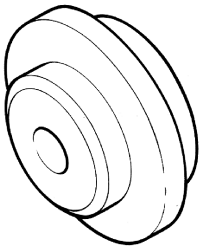
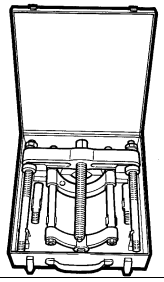
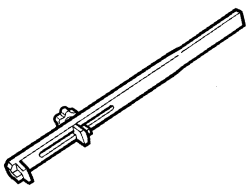
* When fitting the spacer ensure a clearance equal to 0-0.145 mm between the outer edge to the wheel hub and the spacer, carrying out two checks at 1805.

• Notch as close as possible to the side of the milling as shown in the drawing (after tightening to the specified torque).

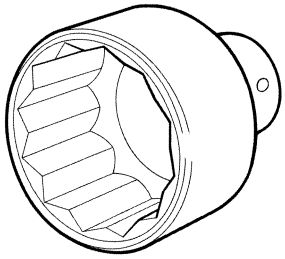
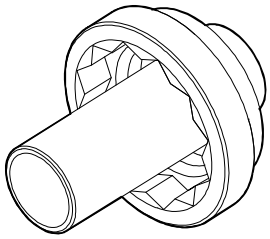
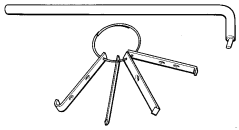
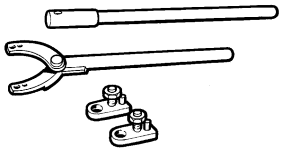
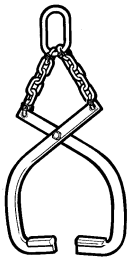
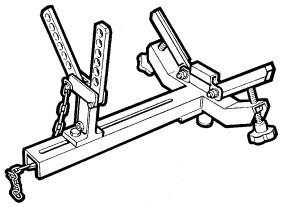
TOOLS

TOOL NO.		DESCRIPTION
99305121		Heater
99322205		Rotary stand for unit overhauling
99322215		Stand for axle overhauling
99322225		Unit holder (to be mounted on stand 99322205)
99341003		Single-acting lift
99341009		Pair of brackets

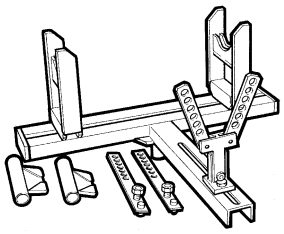
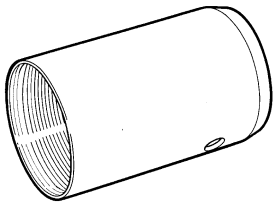
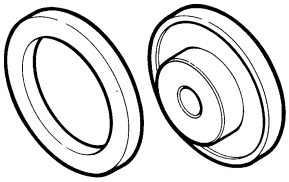
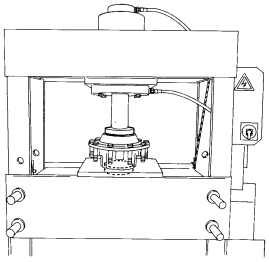
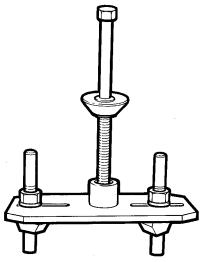
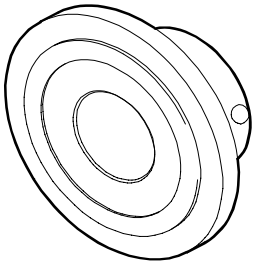
TOOLS

TOOL NO.		DESCRIPTION
99341015		Clamp
99341017		Pair of brackets with holes
99345049		Reaction block for puller tools
99345053		Reaction block for puller tools
99348001		Puller tool with clamping device
99355025		Wrench for differential gearcase bearing adjustment ring nuts

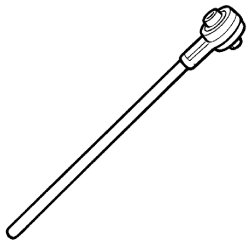
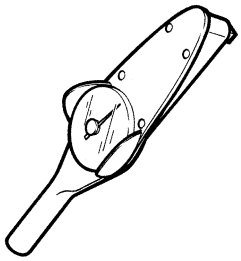
TOOLS

TOOL NO.		DESCRIPTION
99355088		Wrench (60 mm) for differential bevel pinion nut (to be used with 99370317)
99355180		Wrench (105 mm) for wheel hub bearing adjustment nut
99363204		Tool to extract gaskets
99370317		Reaction lever and extension for flange lock
99370509		Hook to remove differential gearcase half-housing
99370616		Support to remove-fit back differential

TOOLS

TOOL NO.		DESCRIPTION
99370617		Universal support to remove-fit back rear axles
99370700		Guide to assemble wheel hub
99370706		Tool to fit wheel hub bearing
99370708		Tool for removing wheel hub bearing
99371047		Stand to hold differential half-housing when tightening crown wheel screws (to be used with 99322205 - 993222225)
99374244		Installing tool for assembling bevel pinion seal ring

TOOLS

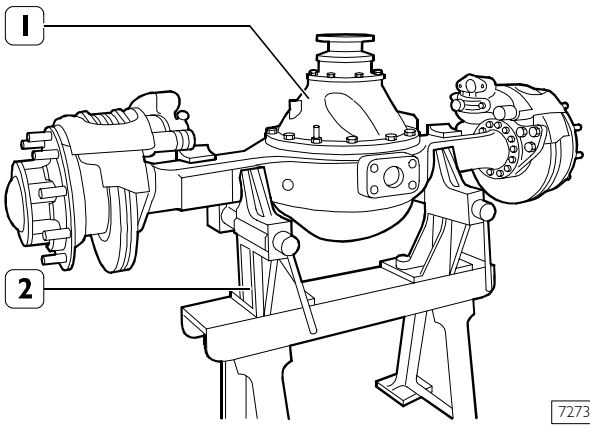
TOOL NO.		DESCRIPTION
99389816		4 x torque multiplier, with square connection, 3/4" in, 1" out (maximum torque 2745 Nm)
99389819		Torque wrench (0 - 10 Nm) with 1/4" square fitting

525010 OVERHAULING THE REAR AXLE ASSEMBLY

NOTE Following operations can also be performed with the assembly mounted on the vehicle: half shafts disconnection and reconnection - disks disconnection and reconnection - differential disconnection and reconnection.

Before putting the rear axle assembly on the stand for overhauling, drain off the oil by unscrewing the bottom plug of the differential case.

Figure 5

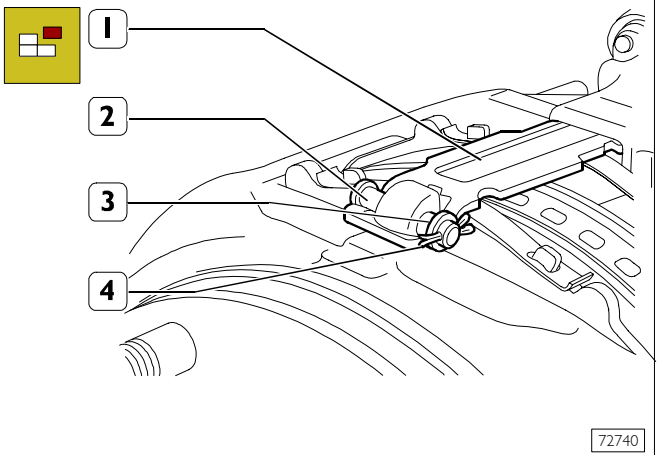


Put the rear axle (1) on the overhaul stand 99322215 (2).

525030 OVERHAULING THE WHEEL HUBS

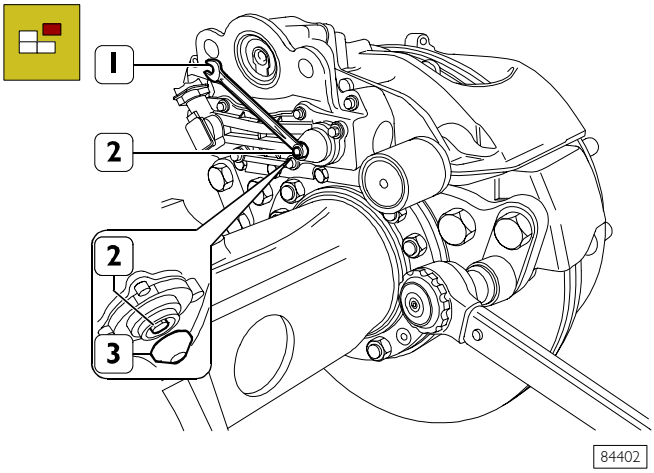
Removal

Figure 6



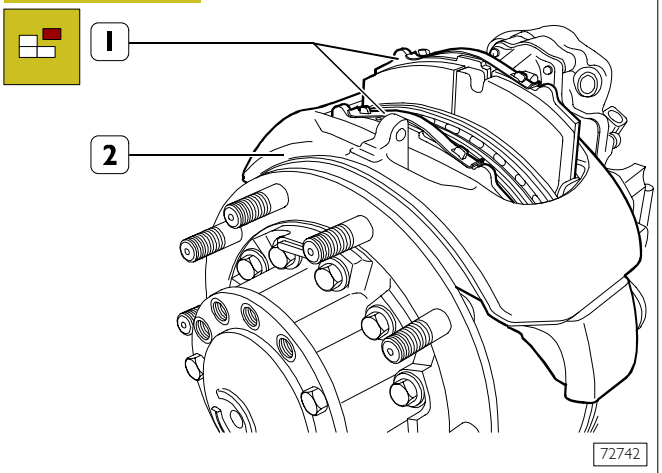
Remove the split pin (4), washer (3), pin (2) and plate (1) holding the brake linings.

Figure 7



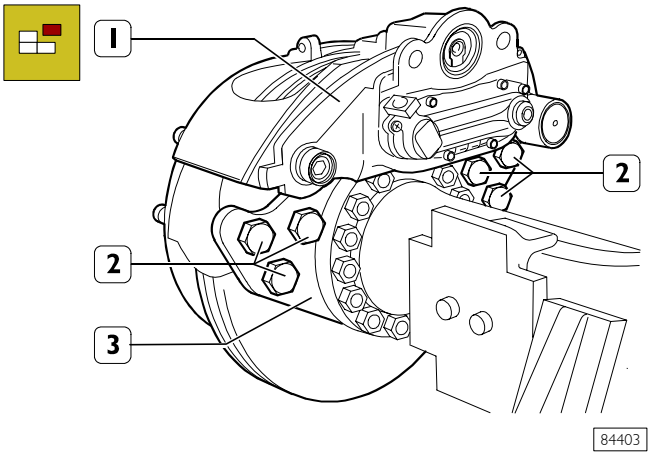
Remove the plug (3), turn the adjustment unit (2) anticlockwise, with a spanner, to make the pistons move back into the calliper body.

Figure 8



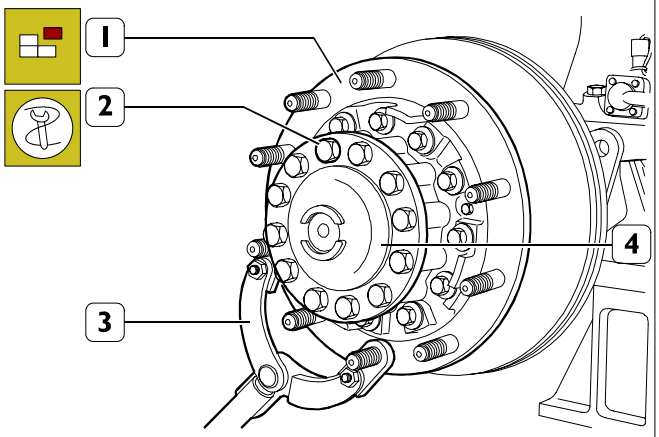
Remove the brake linings (1) making the calliper body (2) float appropriately.

Figure 9



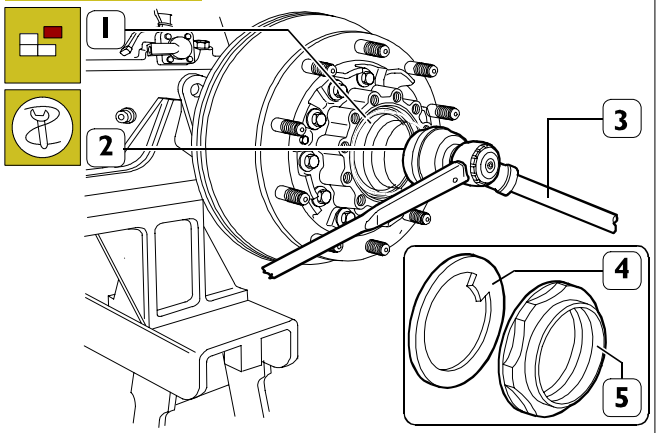
Take out the screws (2) and remove the brake calliper (1) from the supporting flange (3).

Figure 10



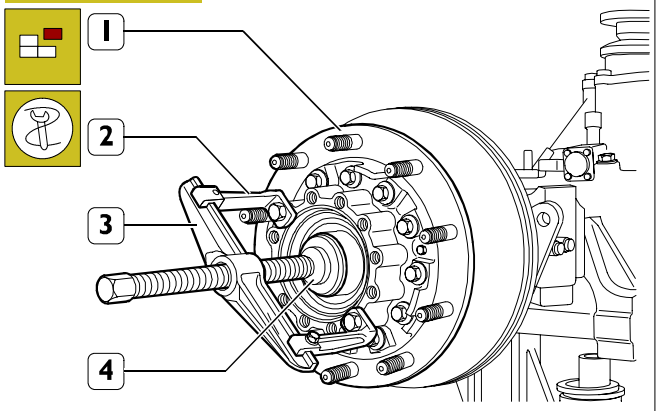
Put a container under the wheel hub to collect the oil. Lock rotation of the wheel hub (1) with the retaining tool 99370317 (3). Take out the screws (2) and extract the drive shaft (4).

Figure 11



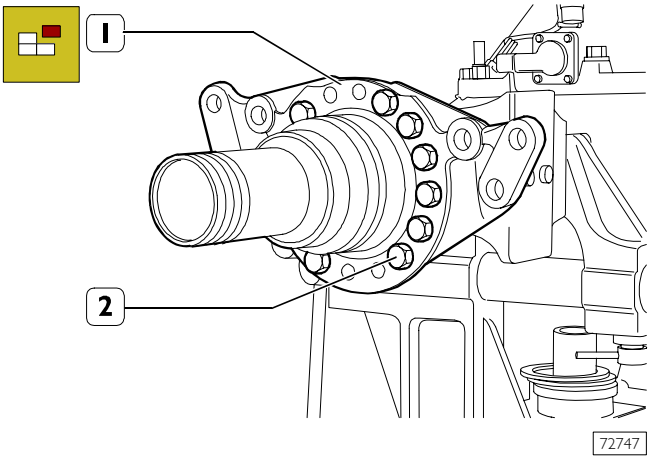
Lift the notching of the ring nut (5). Using the wrench 99355180 (1) and multiplier 99389816 (2), remove the ring nut (5) holding the wheel hub bearing. Take out the retaining ring (4).

Figure 12



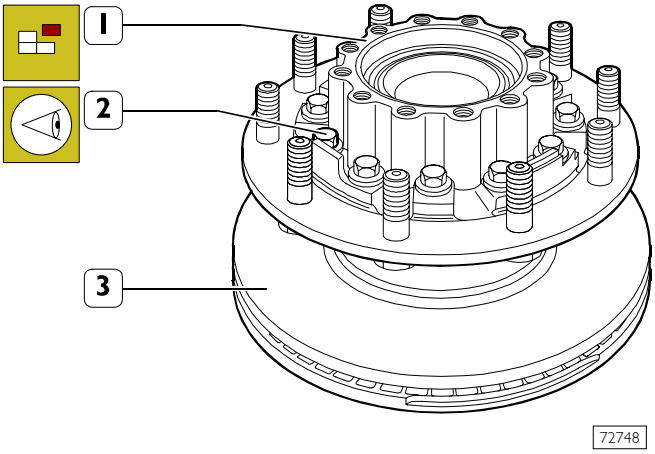
Imbragare il disco freno (1) con fune, agganciare quest'ultima ad un sollevatore. Remove the wheel hub (1). If this proves difficult, use the extractor comprising: brackets 99341017 (2), bridge 99341003 (3), block 99345053 (4), applied as shown in the figure.

Figure 13



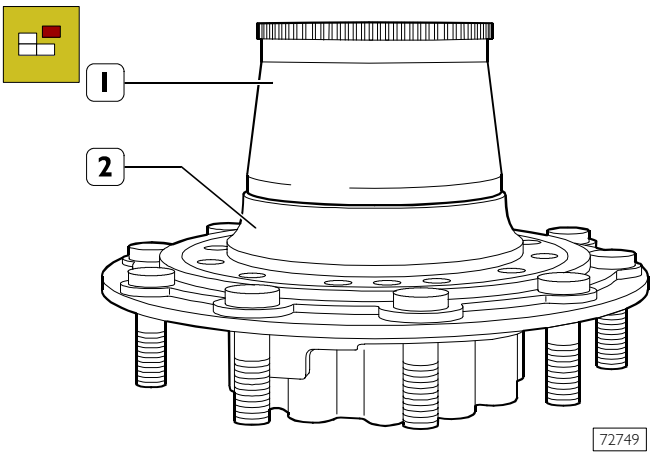
If the brake calliper supporting plate (1) is damaged, remove it from the axle housing by taking out the bolts (2).

Figure 14



Take out the screws (2) and remove the wheel hub (1) from the brake disc (3).
Examine the state of wear of the brake disc (3) as described in the "BRAKE AIR SYSTEM" section.

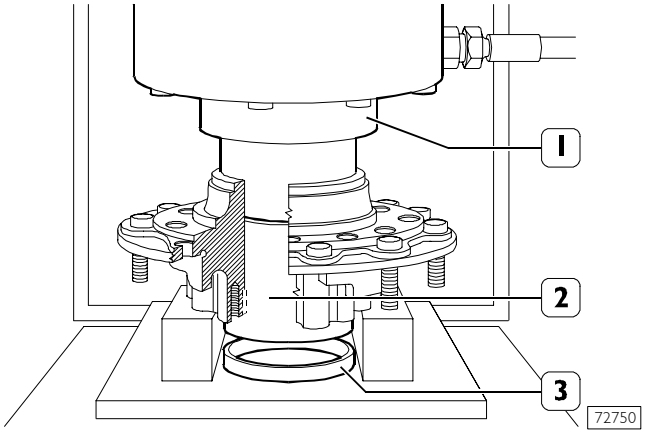
Figure 15



The phonic wheel (1) is removed from the wheel hub (2) with general tools.

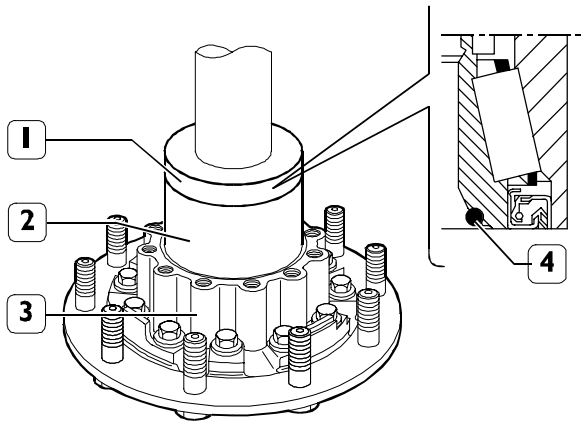
529621 Replacing wheel hub bearings

Figure 16



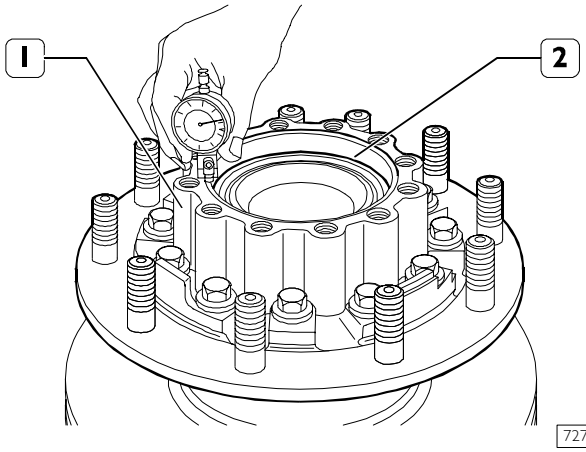
Using a hydraulic press and tool 99370708 (1) take out the wheel hub, spacer (3) and bearing (2).

Figure 17



Position the bearing (2) with the seal (4) turned as shown in the figure on the wheel hub (3).
Using the press and tool 99370706 (1) mount the bearing (2): bearing drive-in load 40.000 ÷ 100.000 N.

Figure 18



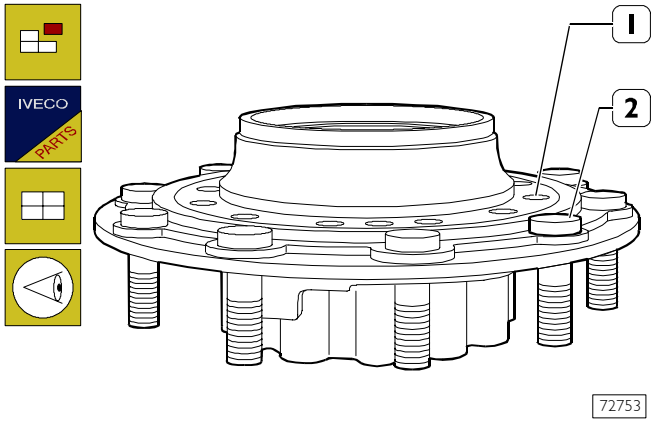
Fit the spacer ring (2) in the wheel hub (1) and check on two diametrically opposite points that, after assembly, the ring (2) is sunk below the face of the wheel hub by 0.0 to 0.145 mm.

Checking the parts forming the wheel hubs

Thoroughly clean the single parts comprising the wheel hub. Examine the drive shafts and check there is no deformation.
Check the wheel fixing pins: if there is any deformation or damage to the thread, replace them, using a press to extract them.
Check the threads of the nuts to adjust the hub bearings and the threads on the ends of the axle housing; change the nuts if necessary.
Replace all the sealing elements with new parts.

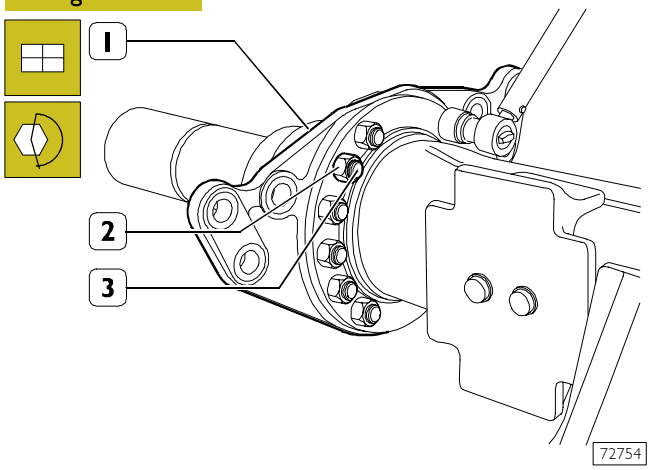
525035 Replacing the wheel fixing pins

Figure 19



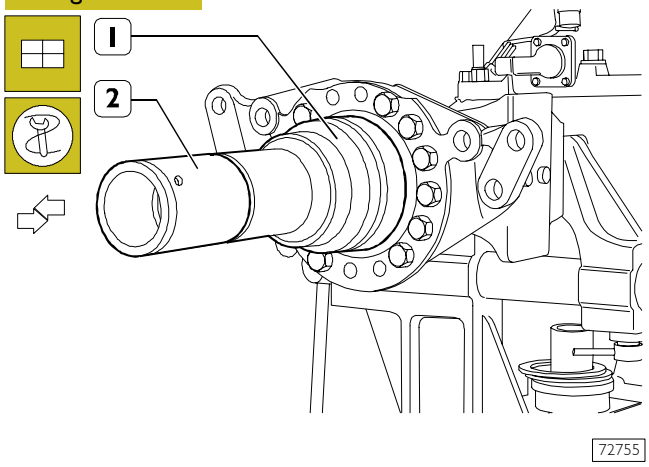
Using general tools, drive the pins (2) out of the hub (1).
Make sure the supporting surface for the heads of the pins has no burrs.
Carefully drive in the pins, applying a load no greater than 2500 kg on their heads.
Afterwards, check that the obliquity is no greater than 0.3 mm.

Figure 20



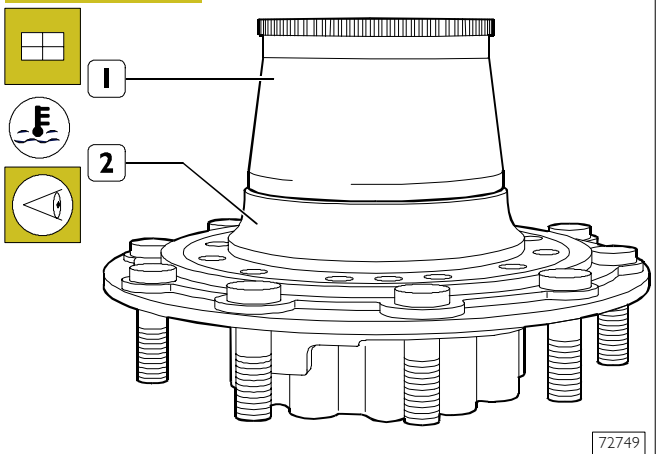
If the plate (1) were disassembled, fit it back on the axle housing and tighten the nuts (2) for the fixing screws (3) to the required torque.

Figure 21



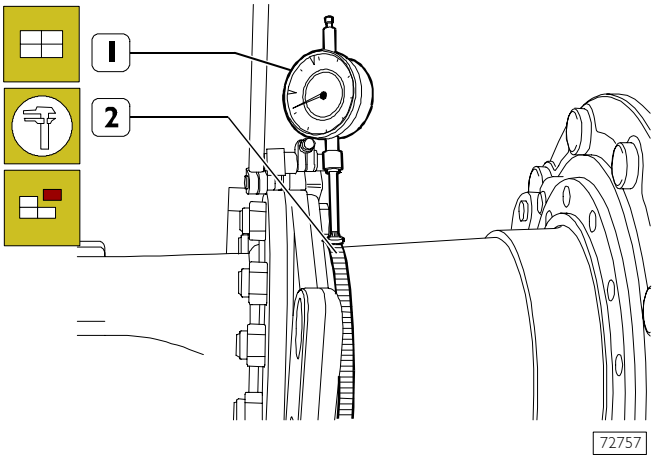
Screw the tool 99370700 (2) onto the sleeve (1) of the axle housing. Lubricate the tool external surface (1) with the oil prescribed for the wheel hubs.

Figure 22



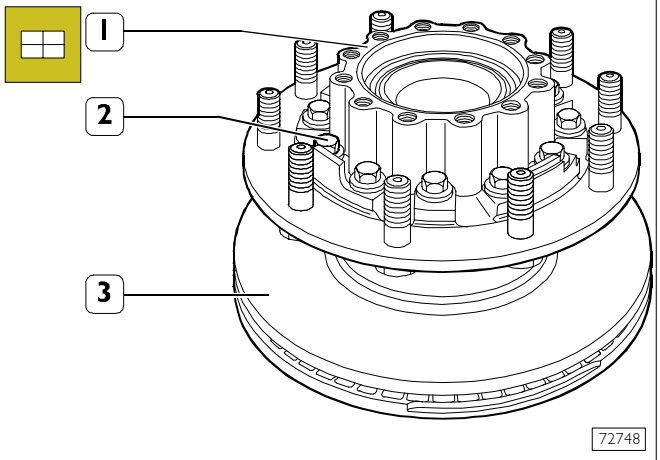
Heat the phonic wheel (1) to approx. 150°C and fit it on the wheel hub (2).
On completing assembly, make sure the phonic wheel (1) rests correctly in the seat of the hub.

Figure 23



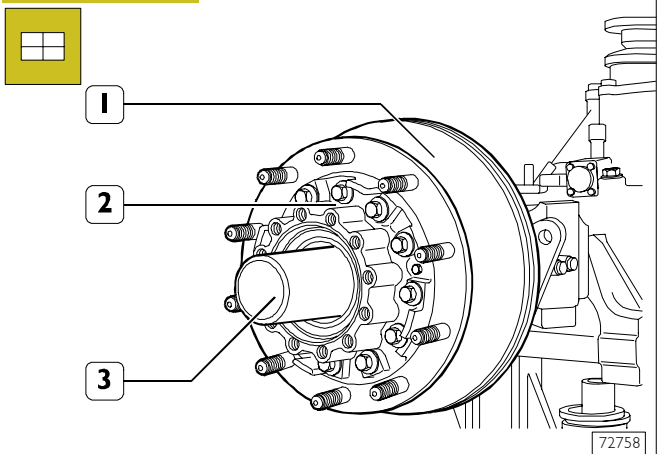
Fit the wheel hub on the sleeve of the axle housing and, using a dial gauge (1) with a magnetic base, check that the radial runout of the phonic wheel (2) is no greater than 0.2 mm. Remove the wheel hub.

Figure 24



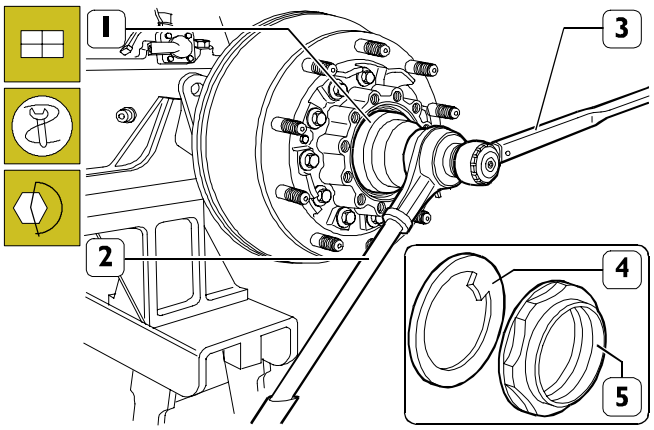
Mount the brake disc (3) on the wheel hub (1) and screw down the screws (2).

Figure 25



Sling the brake disc (1) with a rope, hook this onto a lift and fit the wheel hub (2) on the sleeve of the axle housing. Remove the tool 99370700 (3).

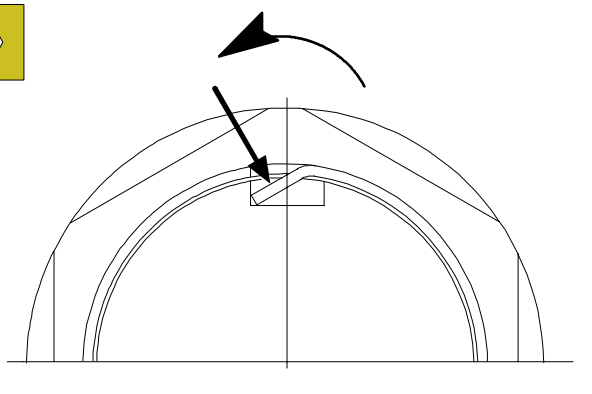
Figure 26



72759

Position the retaining ring (4) so as to insert the tab into the groove of the sleeve, then screw on the ring nut (5). Using the wrench 99355180 (1), multiplier 99389816 (2) and the torque wrench (3), tighten the ring nut (5) to the required torque.

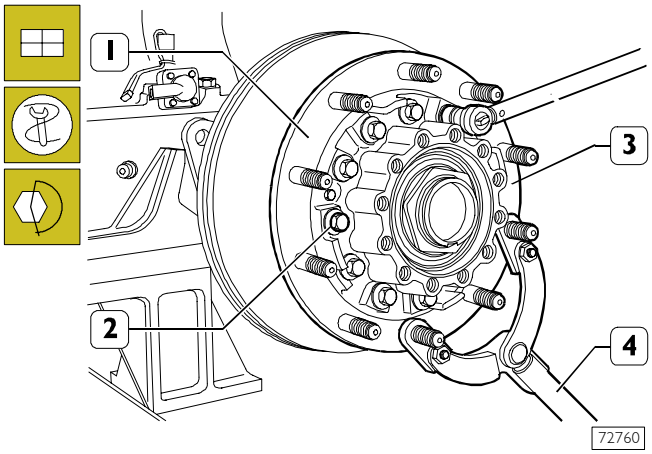
Figure 27



49213A

After tightening, using an appropriate tool, notch and bend the ring nut as shown in the figure so it cannot be unscrewed. The arrow shows the direction of unscrewing the ring nut.

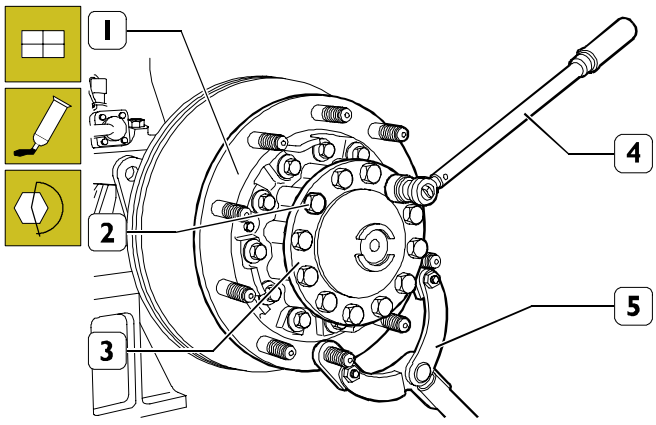
Figure 28



72760

Lock rotation of the wheel hub (3) with the tool 99370317 (4) and tighten the screws (2) fixing the brake disc (1) to the wheel hub to the required torque.

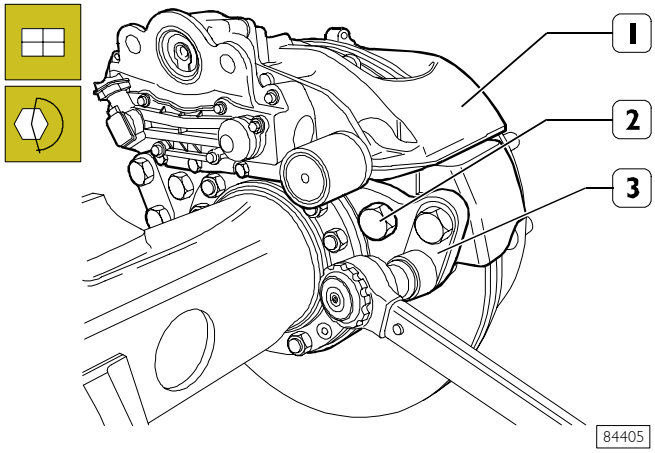
Figure 29



72761

Spread IVECO 1905685 (LOCTITE 14780) sealant onto the flange contact surfaces of the drive shaft – wheel hub and insert the drive shaft into the axle housing. Screw down the screws (2) fixing the drive shaft (3) to the wheel hub (1) and tighten them with the torque wrench (4) to the required torque. Remove the tool 99370317 (5).

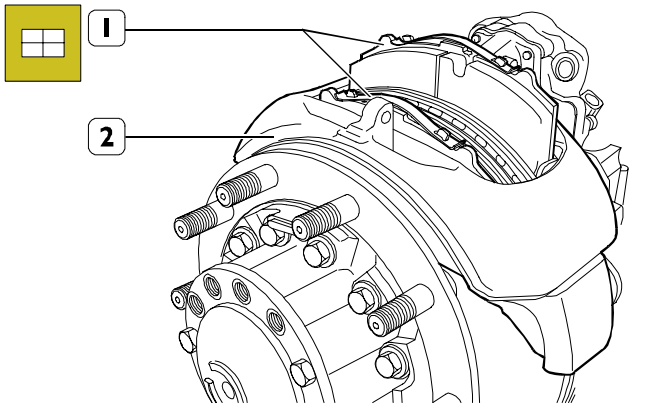
Figure 30



84405

Position the brake calliper (1) on the flange (3) and tighten the fixing screws (2) to the required torque.

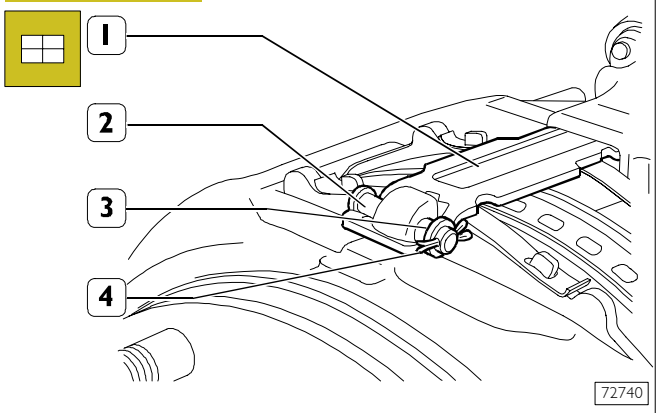
Figure 31



72742

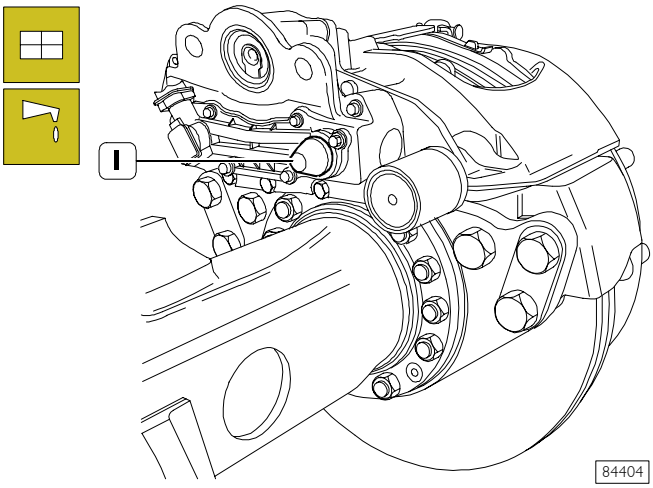
Mount the brake linings (1) in the brake calliper (2).

Figure 32



Mount the brake lining retaining plate (1).
Mount the pin (2), washer (3) and secure them with the split pin (4).

Figure 34

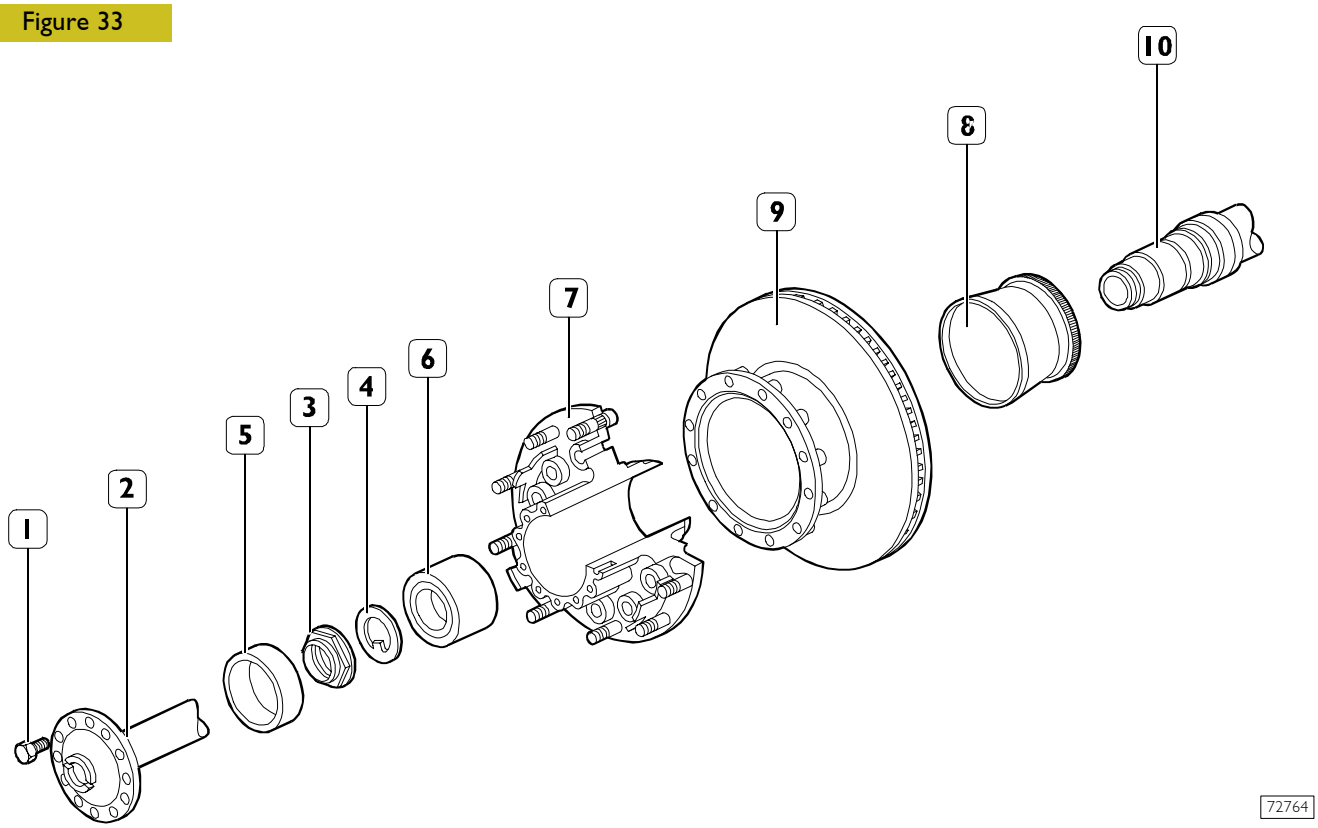


Provisionally mount the plug (1) for the brake lining wear adjustment screw.

NOTE After refitting the rear axle on the vehicle, check the efficiency of the brake lining wear recovery device, as described in the relevant section and replace the plug (1) with a new one.

On completing assembly, fill the axle housing with the required quantity and grade of lubricating oil.

Figure 33

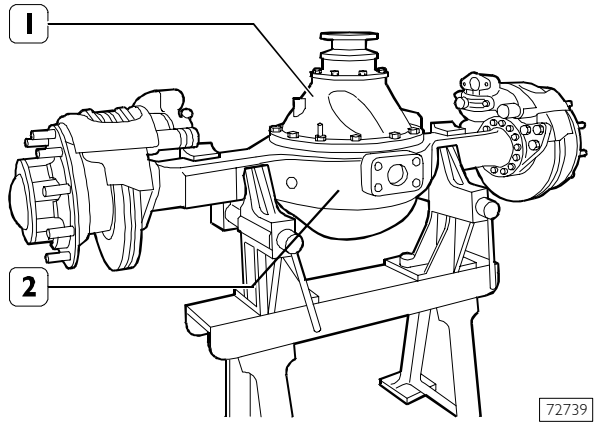


WHEEL HUB COMPONENT PARTS

1. Screw – 2. Drive shaft – 3. Ring nut – 4. Retaining ring – 5. Spacer ring – 6. Bearing – 7. Wheel hub – 8. Phonic wheel – 9. Brake disc – 10. Axle sleeve

526210 REMOVING AND REFITTING THE DIFFERENTIAL (with axle on stand 99322215)

Figure 35

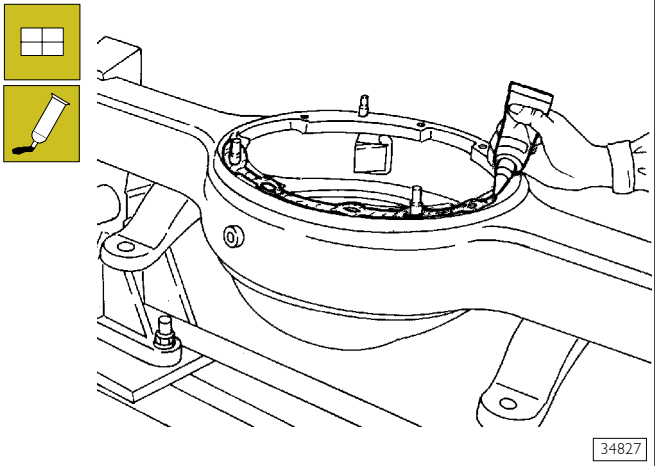


Removal

Extract the drive shafts as described on page 19, unscrew the screws and nuts fixing the differential case (1); screw three screws, which in this case act as extractors, into the threaded holes and extract the differential from the axle housing (2).

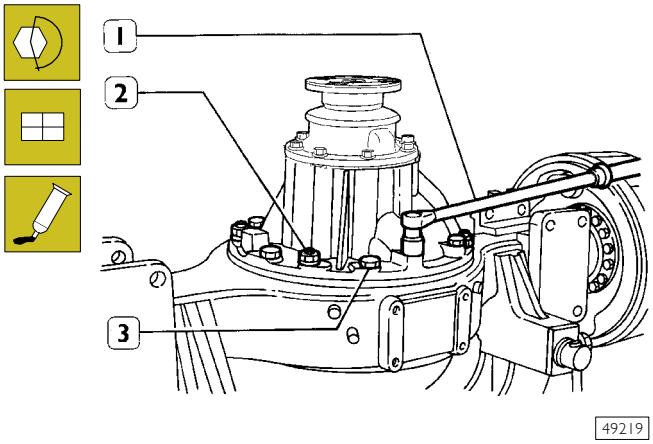
Refitting

Figure 36



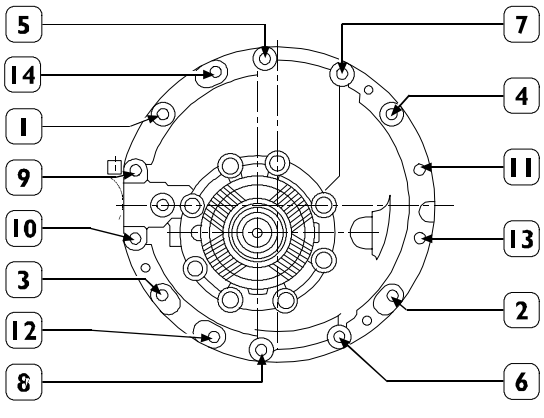
Spread the contact surface of the axle housing with IVECO 1905685 (LOCTITE 14780) sealant, after cleaning the contact surface.

Figure 37



Insert the differential into the axle housing, screw down the nuts (2) and screws (3) together with the safety washers and tighten them, with a torque wrench (1), to the required torque and in the sequence shown in Figure 38.
Mount the drive shafts as described on page 23.
Pour the required amount of oil into the axle housing.

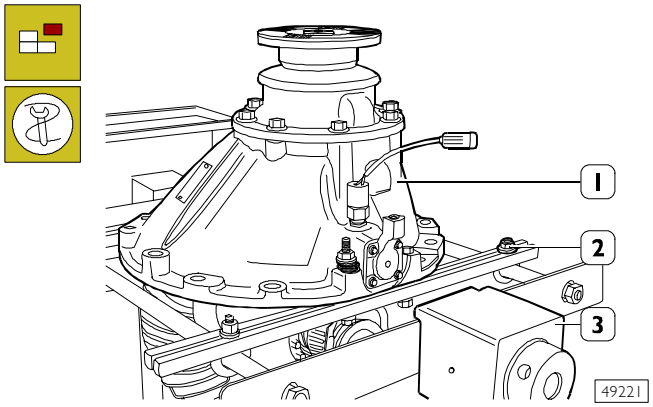
Figure 38



Tightening sequence diagram (differential case to axle housing)
(1 – 2 – 3 – 4 – Nuts)
(10 – 9 – 14 – 5 – 7 – 11 – 13 – 6 – 8 – 12 – Screws)

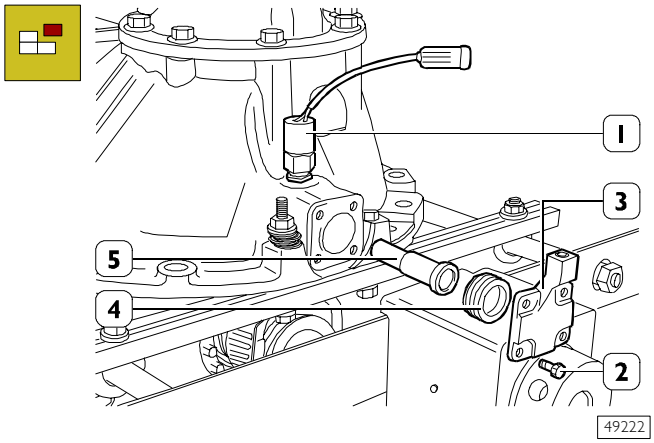
526210 REPAIRING THE DIFFERENTIAL
Removing the differential

Figure 39



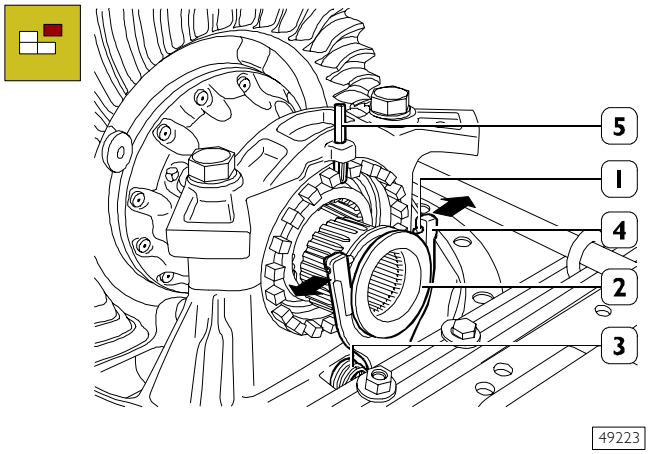
Remove the differential (1) as described in Figure 34.
Secure it to the stand 99322205 (3) with the mount 99322225 (2).

Figure 40



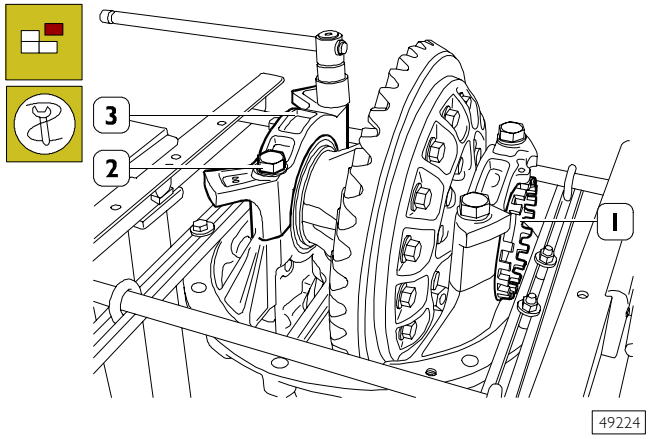
Unscrew the transmitter (1); unscrew the screws (2) and remove the parts 3 – 4 – 5.

Figure 41



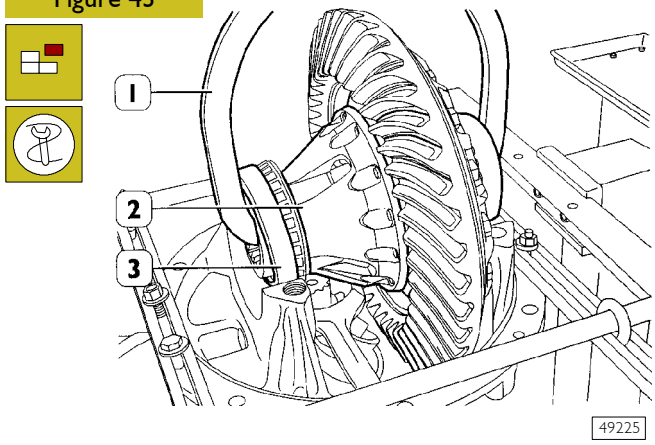
Push the split pins (1 →) outwards and extract the sliding sleeve (2).
Take out the spring (3), fork (4) and split pin (5).

Figure 42



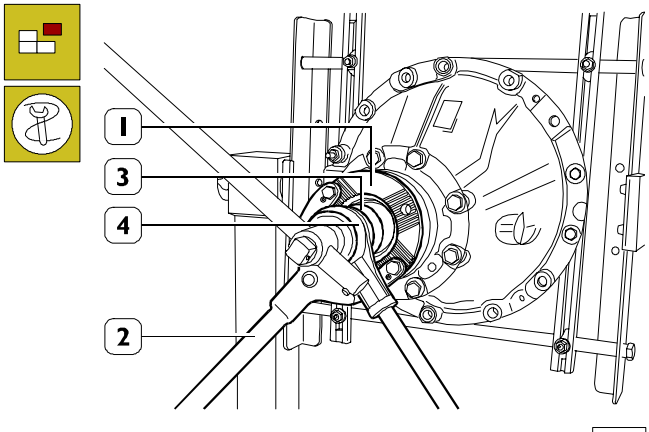
Unscrew the ring nut (1) for adjusting the bearing. Using an appropriate wrench, unscrew and remove the screws (2) with their washers; repeat this process on the opposite side. Remove the supporting bearing caps (3).

Figure 43



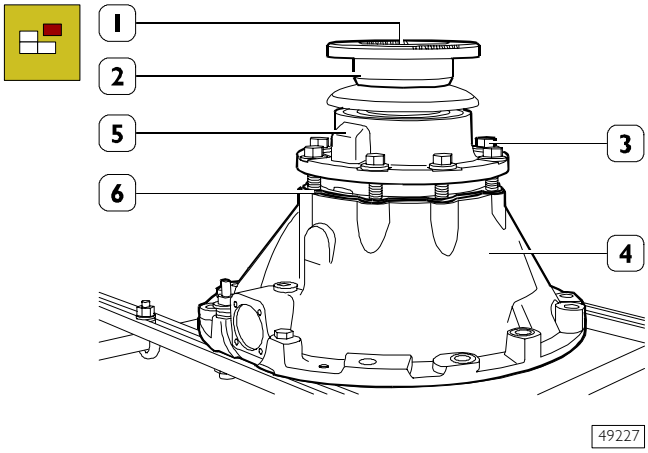
Using the hook 99370509 (1) extract the gearing housing (2) together with the ring bevel gear and outer rings (3).

Figure 44



Using tool 99370317 (2), lock the flange (1).
Using wrench 9955088 (3) and multiplier (4), loosen the bevel pinion nut.

Figure 45

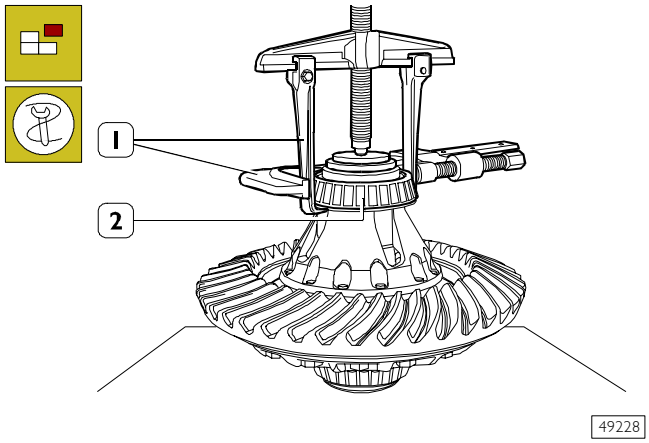


Remove the nut (1) and extract the flange (2).
Remove the screws (3) fastening the bevel pinion support to the differential housing (4).
Remove the complete bevel pinion support (5) from the differential carrier. Remove the shims (6) for adjusting the pinion position in relation to the crown wheel and use a micrometer to measure the overall thickness.

NOTE Check that the seal ring is intact (O-ring), change it if damaged.

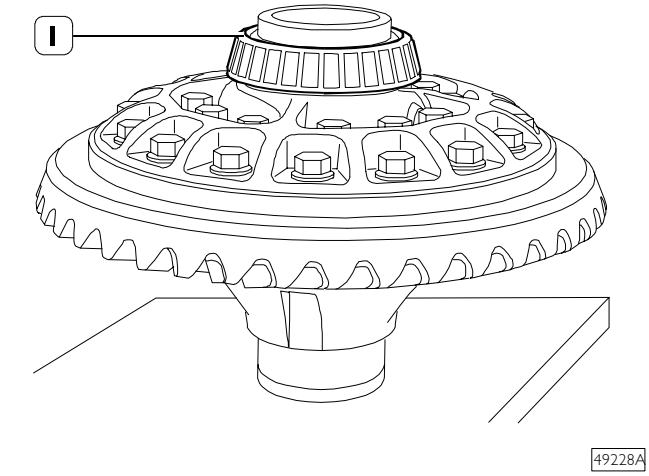
Removing the gearcase

Figure 46



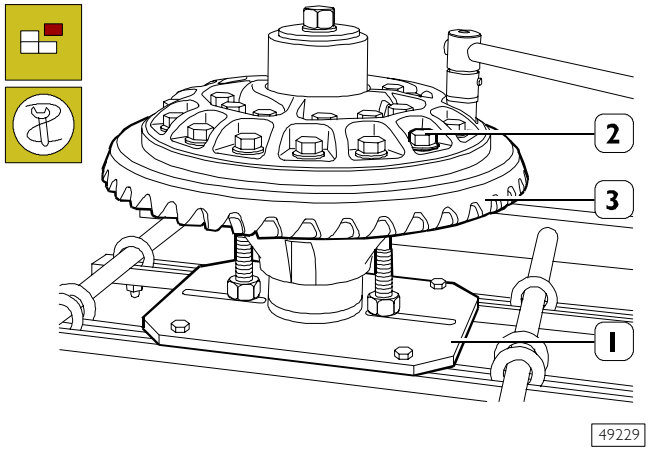
Using a suitable puller (1), extract the bearing (2).

Figure 47



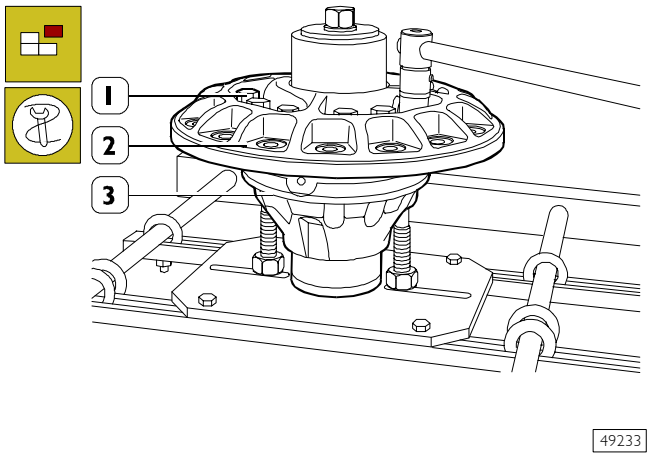
Turn the gearcase upside down and remove the bearing (1). (This is a destructive operation).

Figure 48



Place the gearcase on tool 9971047 (1).
Remove the locknuts (2) fastening the ring bevel gear (3) to the gearcase.
Using a bronze beater, remove the ring bevel gear.

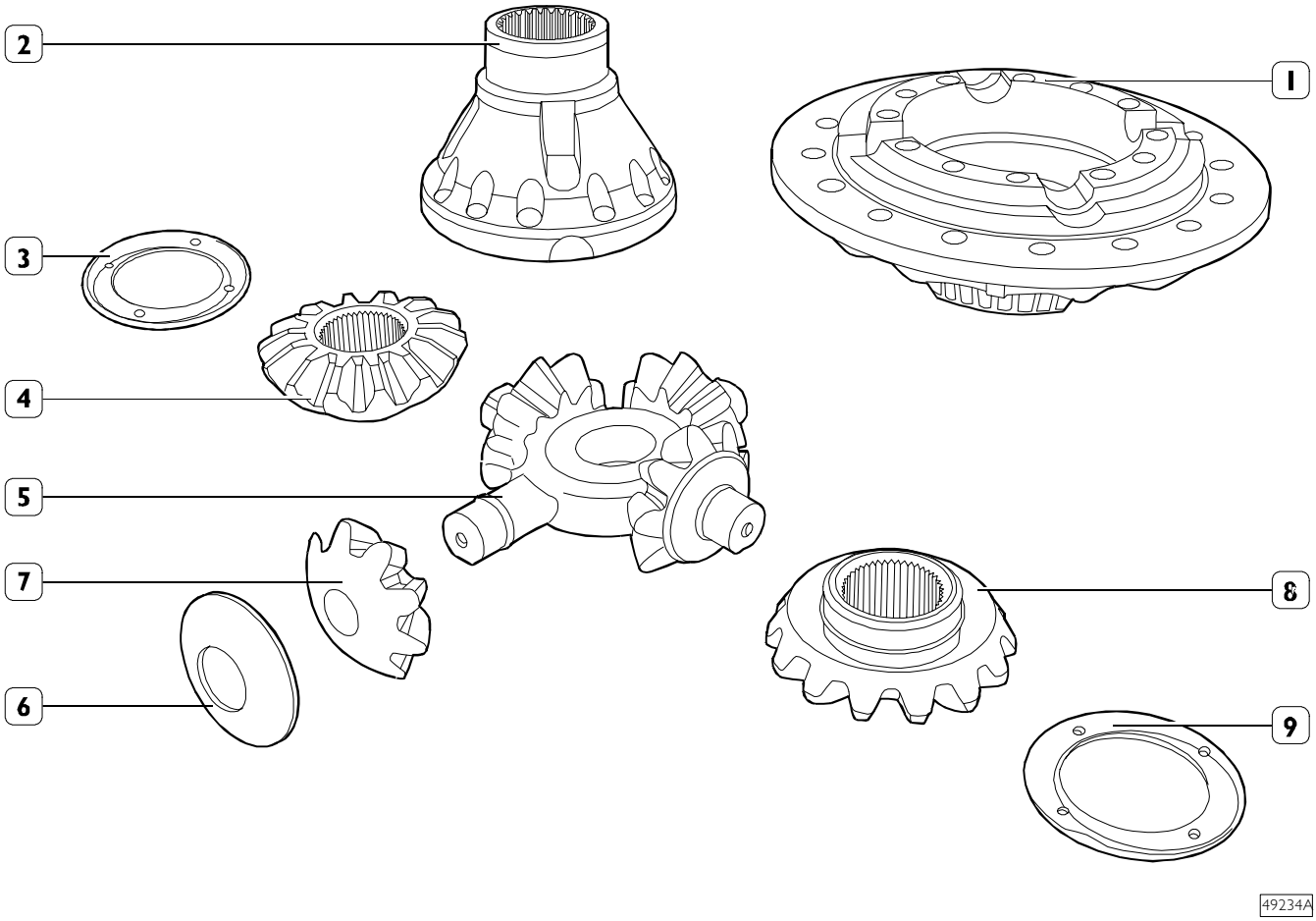
Figure 49



Mark the mounting positions of the two half casings (2 and 3) and spider.
Remove the screws (1) and lift the half casing (2) off the unit.

Figure 50

Remove components (2 - 3 - 4 - 5 - 6 - 7 - 8 - 9) from the half casing (1).

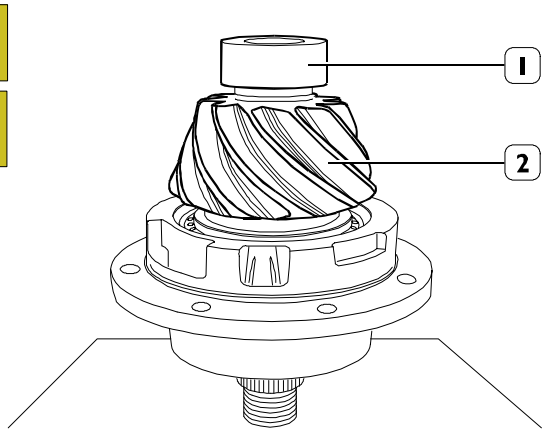


GEARCASE COMPONENTS

1. Half casing - 2. Half casing - 3. Crown wheel - 4. Planetary gear - 5. Spider - 6. Shoulder washer - 7. Planetary gears - 8 Crown wheel - 9 Shoulder washer

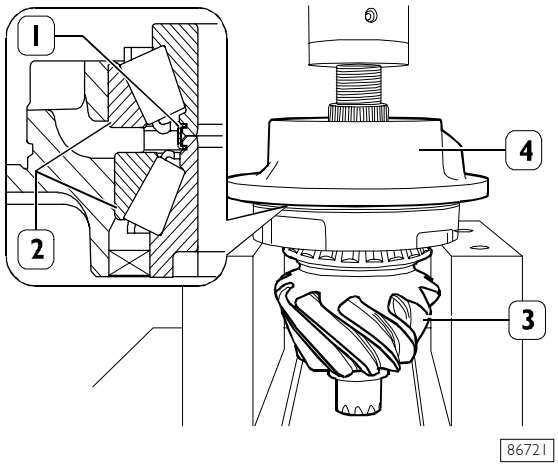
526249 REMOVING THE BEVEL PINION FROM THE SUPPORT

Figure 51



Using tool 99348001, extract the bearing (1) from the bevel pinion (2).

Figure 52

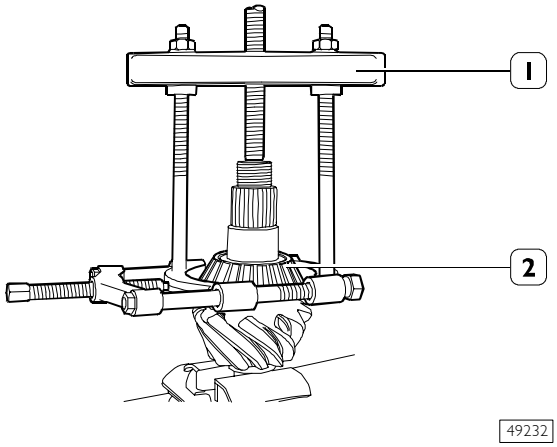


Take off the bevel pinion (3) (under a press) from the support (4).

The mounting (4) is supplied as a spare part together with preassembled tapered roller bearings and seals.

Due to production requirements, the two bearings (2) of pinion (3) are kept assembled by means of a special metal ring (1) that is normally left in place, owing to its being unimportant. During the pinion disassembling phase, the ring is partially taken out, if still present.
If not taken out, the ring could be dangerous, since it could subsequently interfere with the bearings.
Prior to reassembling the pinion, it is therefore essential that you check for the presence of the ring and take it out fully.

Figure 53



Using a suitable tool (1), extract the bearing (2).

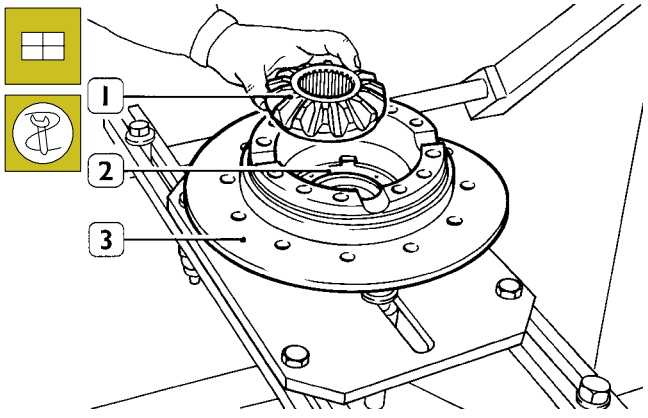
Differential component check

Carefully clean all differential components.
Lubricate the bearings and rotate the roller cage; it should rotate freely and smoothly.

Inspect the ring bevel gear and half casing contact surfaces, making sure the ring bevel gear perfectly adheres. Warped surfaces may cause ring bevel gear fastening screw vibration, thus undermining the unit operation.
Make sure the slotted section fastening the flange to the pinion is not worn. If it is, replace the pinion.

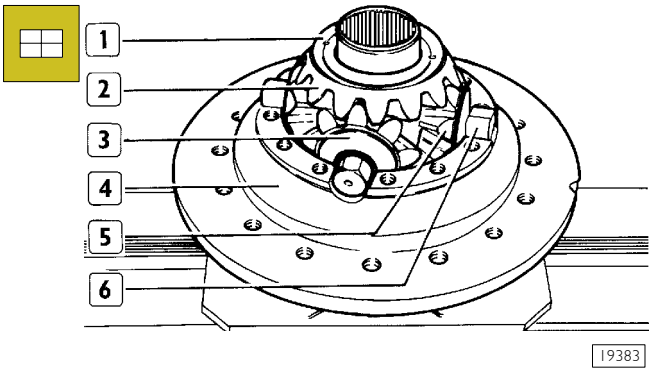
Fitting the gear housing

Figure 54



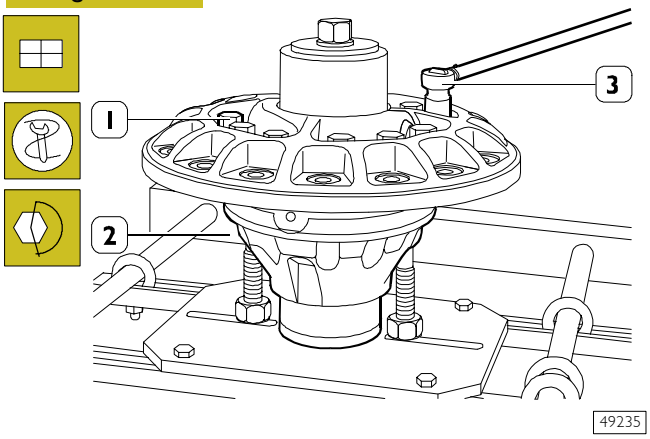
Place the half casing (3) on tool 99371047.
Insert the crown wheel shoulder washer (2) into the half casing, then fit the crown wheel (1).

Figure 55



Fit the spider (6), complete with planetary gears (5) and shoulder washers (3), to the half casing (4).
If the spider has not been replaced, make sure the marks made on removal match.
Fit the second crown wheel (2) complete with shoulder washer (1).

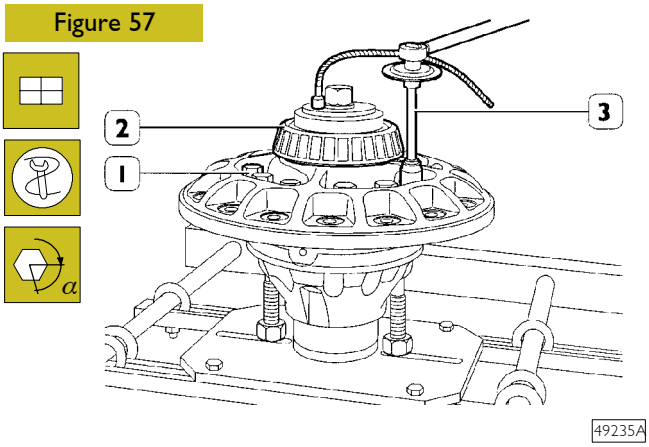
Figure 56



Fit the half casing (2).
Make sure the marks made on removal match. Insert the screws (1) and tighten as follows:

- ❑ 1st phase: tightening with a torque wrench (3) to a torque of 100 Nm (10 kgm).

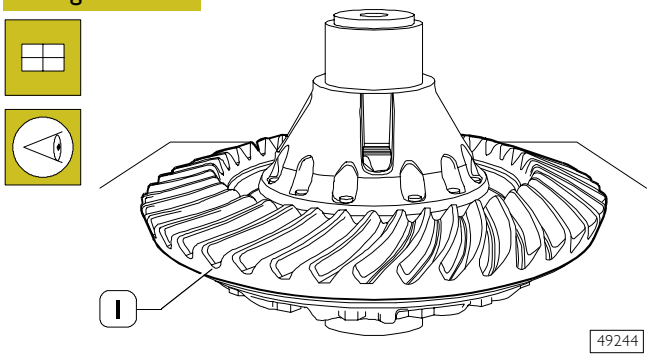
Figure 57



- ❑ 2nd stage: tighten the screws (1) by means of tool 99395216 (3) at 110° to 120° angle.

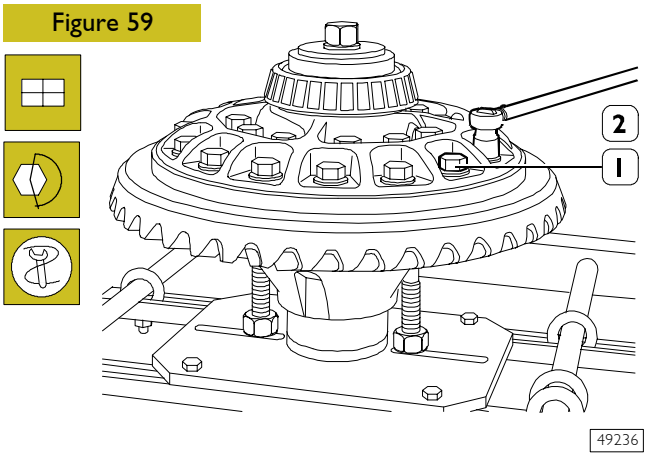
Heat the bearing (2) at 100°C for approx. 15 min. in a convection furnace and fit it, using a suitable beater.

Figure 58



Heat the ring bevel gear (1) to a temperature of 100°C ÷ 150°C in an air circulation oven and position it in its seat, in the gear housing, checking it turns freely and making the holes coincide for the screws fixing the ring bevel gear-gear housing by fitting the 4 manoeuvring screws.

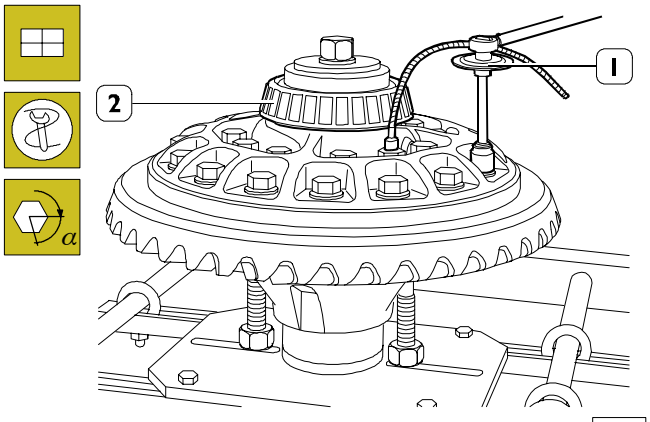
Figure 59



Let the ring bevel gear cool, then place the gearcase upside down on the tool.
Insert the screws (1) and tighten as follows:

- ❑ 1st stage: tighten to 100 Nm (10 kgm) torque by means of a torque wrench (2);
- ❑ replace the 4 manoeuvre screws with new ones and apply the same specified torque.

Figure 60

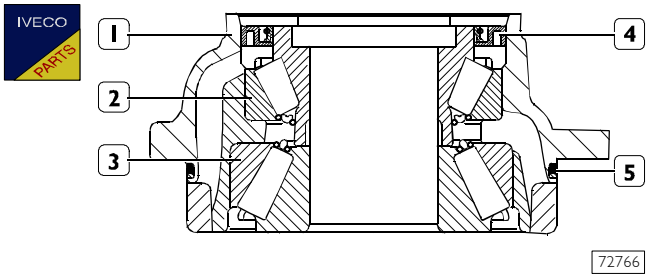


❑ 2nd phase: closing, with tool 99395216 (1) with an angle of 80 to 90°.

Heat the bearing (2) to a temperature of 100°C for approx. 15 min. in an air circulation oven and drive it in with an appropriate drift.

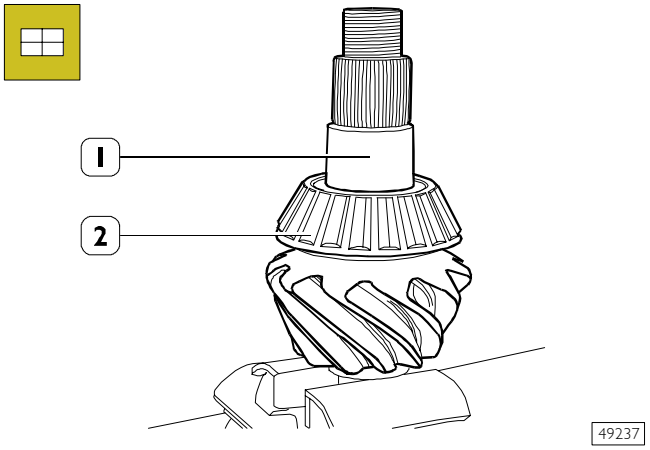
526249 FITTING THE MOUNT ON THE BEVEL PINION

Figure 61



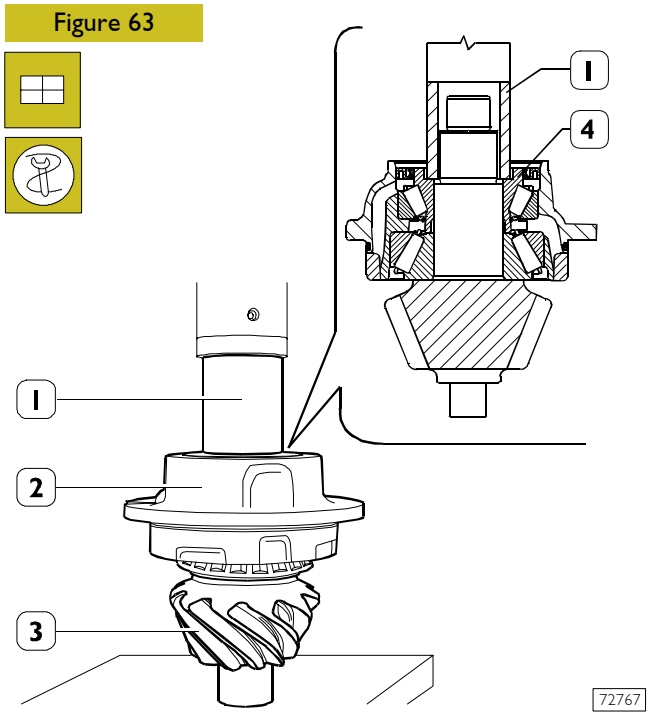
The bevel pinion mount (1) is supplied as a spare together with the tapered roller bearings (2 and 3) and the seals (4 and 5).

Figure 62



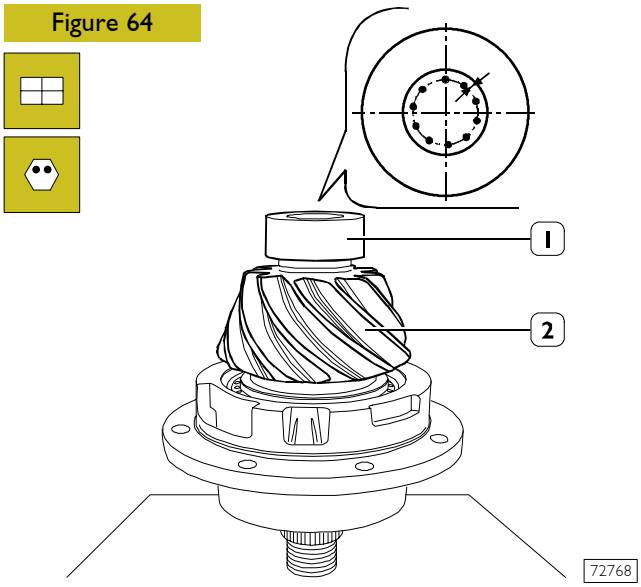
Heat the bearing (2) to a temperature of 100°C for 15 min. in an air circulation oven and mount it on the bevel pinion (1).

Figure 63



Using a press and a suitable tube (1) positioned on the inner ring of the roller bearing (4), fit the mount (2) on the bevel pinion (3).

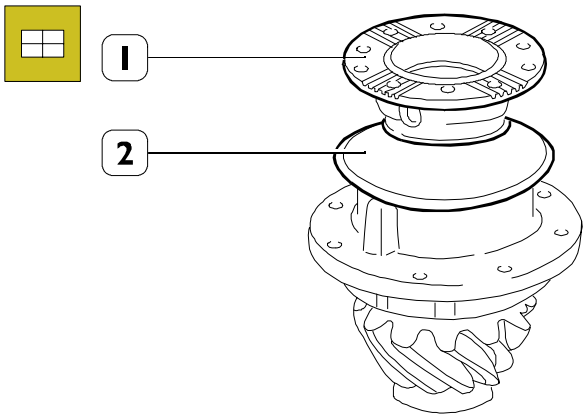
Figure 64



Heat the bearing (1) to a temperature of 100°C for 15 min. in an air circulation oven and mount it on the bevel pinion (2).
Lock the bearing by notching the bevel pinion at 10 equidistant points as shown in the figure. This should be done conscientiously with a suitable punch.

NOTE The diameter of the impression has to be between 3.40 to 4.10 mm, corresponding to a depth of 0.30 to 0.44 mm respectively, using a load of 4000 kg with a ball with a 10 mm diameter.

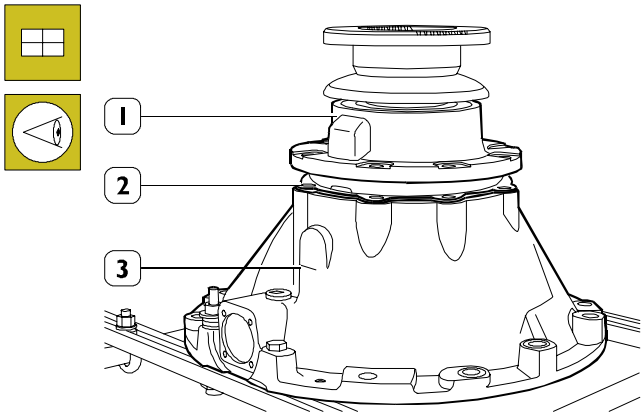
Figure 65



49239

Place the transmission fitting flange (1), complete with baffle (2), and fit it using a suitable beater. The use of a vice is recommended. Temporarily tighten the lock nut.

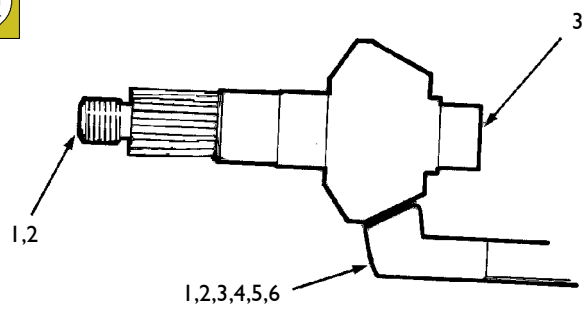
Figure 66



49240

If the same pinion-crown wheel unit previously removed is reinstalled, fit the relative adjusting shims (2) and bevel pinion support with the seal ring (O-ring) (1) to the differential housing (3). Make sure the lubrication oil slot is properly aligned.

Figure 67



19416

Before assembling a new pinion-crown wheel unit, it is mandatory to understand the meaning of the marks stamped on both pinion and crown wheel, in order to find out the proper pinion position.

1. Part number
2. Tooth play number
3. Pinion-crown wheel unit coupling number
4. Adjustment number, to define the thickness of the shims to be fitted between pinion support and differential housing (this number is called CP in the following examples)
5. Pinion-crown wheel unit date of manufacturing and testing (month and year)
6. Pinion-crown wheel unit rated backlash.

Part and tooth play numbers are marked on the pinion threaded end.
On crown wheels, the same numbers are generally marked on the front face.
As an alternative, they may be found on the crown wheel outer diameter.
For any pinion-crown wheel unit, the crown wheel part number shall always be even (for instance, 36786), whereas the corresponding pinion part number shall be odd (for instance, 36787).
The tooth play number (for example, 10-41) means the pinion features 10 teeth and crown wheel 41, corresponding to 4.10 : 1 transmission ratio.

Never use pinion-crown wheel units bearing different numbers.

Each crown wheel has an adjustment number specifying the rated mounting clearance.
Use this number to calculate the thickness of the adjusting shims to be fitted between pinion support and differential housing.
This number (for example, C.P. +0.1, or C.P. -0.1 mm), is stamped on the crown wheel outer diameter.

To calculate the thickness of the adjusting shims to be fitted between pinion support and differential housing, proceed as follows:

1. Measure the thickness of the shims fitted on the pinion-crown wheel unit to be replaced. Use a micrometer or gauge and note the measurement.
2. Read the C.P. stamped on the crown wheel to be replaced. If positive (+), subtract this number from the previously taken measurement (see "1"). If the number represents a negative value (-) add it to the measurement taken (see "1").

Note the result.

NOTE The measurement obtained at "2" shall be used to calculate the thickness of the adjusting shims to be fitted between pinion support and differential housing, in relation to the new pinion-crown wheel unit to be installed.

3. Read the C.P. stamped on the new crown wheel. Add or subtract this value (add if +, subtract if -) to/from the previously taken measurement (see item "2").

The obtained value indicates the thickness of the new shims to be fitted.

Refer to the following examples, covering all possible combinations.

Examples of calculation

Example 1:

Original shim thickness	mm 0.75
Crown wheel C.P. + 0.05	- 0.05
Result	mm 0.70
New crown wheel C.P. + 0.10	+ 0.10
New shim thickness to be used	mm 0.80

Example 2:

Original shim thickness	mm 0.65
Crown wheel C.P. - 0.05	+ 0.05
Result	mm 0.70
New crown wheel C.P. + 0.15	+ 0.15
New shim thickness to be used	mm 0.85

Example 3:

Original shim thickness	mm 0.70
Crown wheel C.P. + 0.05	- 0.05
Result	mm 0.65
New crown wheel C.P. - 0.05	- 0.05
New shim thickness to be used	mm 0.60

Example 4:

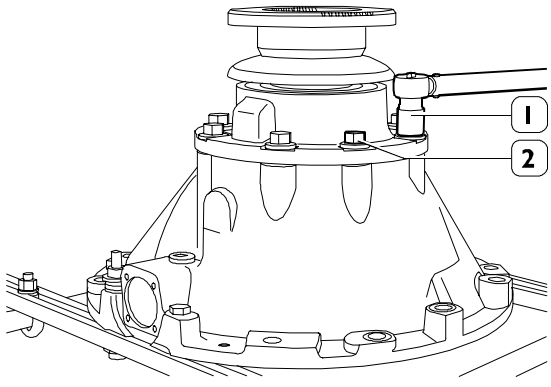
Original shim thickness	mm 0.85
Crown wheel C.P. - 0.10	+ 0.10
Result	mm 0.70
New crown wheel C.P. - 0.15	- 0.15
New shim thickness to be used	mm 0.80

NOTE Spare parts shims, to be fitted between pinion support and differential housing, are provided with the following thickness: 0.125 - 0.200 - 0.500 mm.

A number, specifying the rated backlash between pinion and crown wheel after manufacturing, is stamped on all units.
This number is found on the crown wheel outer diameter.

Reassembling the differential housing

Figure 68

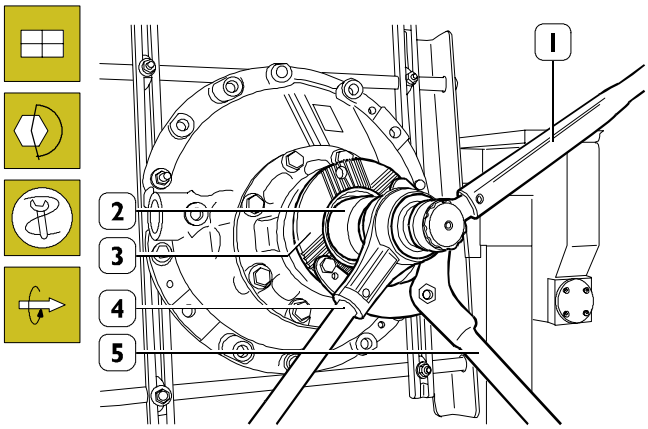


49241

Insert the screws (2) and tighten to the prescribed torque, using a torque wrench (1).

- ❑ 1st step: tighten using the torque wrench (1) to a torque of 100 Nm (10 kgm);
- ❑ 2nd step: tighten the screw (2) using tool 9935216 with an angle of 60° ÷ 70°.

Figure 69

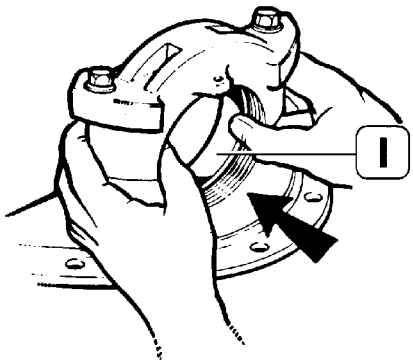


49242

Turn the unit by 90°.
Using tool 99370317 (5), lock the flange (3). Using wrench 99355088 (2), multiplier (4) and torque wrench (1), tighten the pinion lock nut to the prescribed torque (1350 to 1370 Nm). Place the caps, making sure reference tabs match. Tighten the screws, complete with washers, to the prescribed torque by means of a torque wrench.

NOTE Check that the multiplication factor of the multiplier (4) is correct.

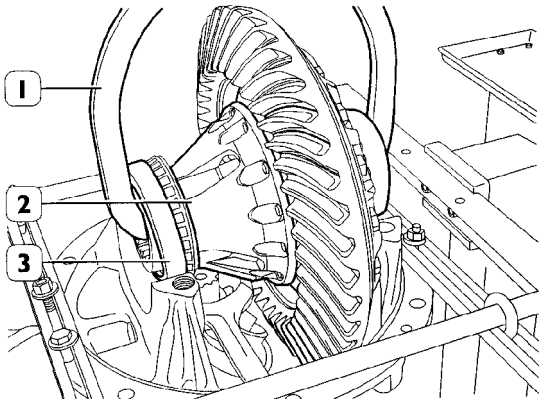
Figure 70



20670

Then, slightly push the bearing outer rings (1), to make sure they slide smoothly within their housings.
Remove the screws, complete with washers, and caps.

Figure 71

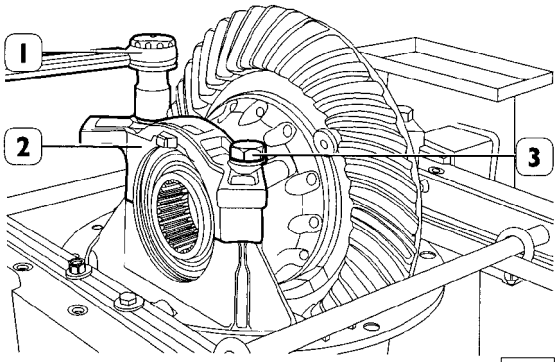


49225

Position the external rings (3) of the bearings

Using hook 99370509 (1), lift the previously assembled gearcase (2) and place it onto the differential housing.

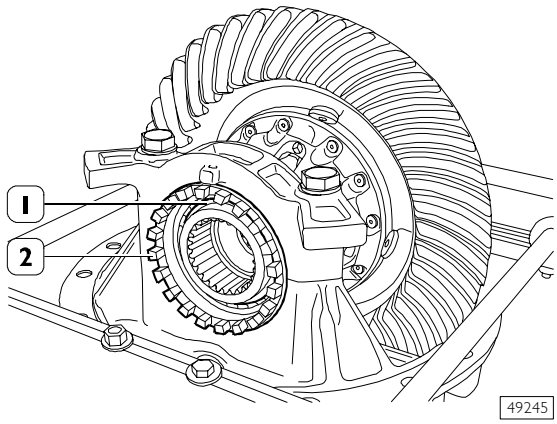
Figure 72



49244

Position the caps (2), suitably settle them using a hammer and insert the screws (3), complete with washers. Tighten the screws to the prescribed torque, using a torque wrench (1).

Figure 73



49245

Lubricate the conical roller bearings (1), manually tighten the ring nuts (2) until they touch the external bearing rings; tighten the screws (3, Figure 72) to the prescribed torque.

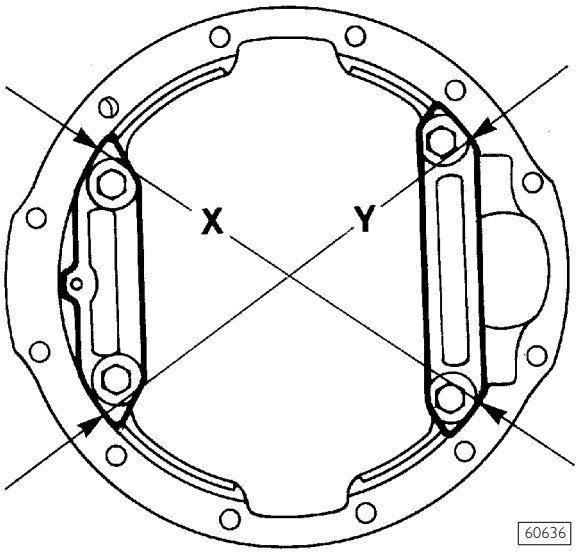
ADJUSTING THE CAP GAP

Adjusting and checking retraction of the caps can be done with two methods:

1st METHOD

1. Use wrench 99355025 (3, Figure 75) to tighten the adjustment lock rings (4) of the bearings until eliminating the pinion-crown wheel clearance and end float. At the same time check that the crown wheel does not force on the pinion;
2. using a suitable micrometer positioned diagonally and centrally in points (X-Y-arrows, Figure 74);
   measure and note the distance of the caps;

Figure 74

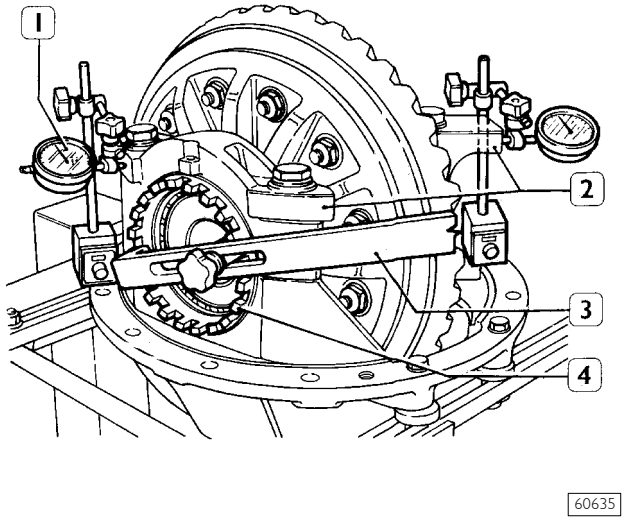


3. further tighten the two adjustment lock rings (4, Figure 75) to obtain a retraction of the caps (2, Figure 75), measured on Axis X or on axis Y as described in point "2" of: 0.15 to 0.33 mm which corresponds to a preload on the bearings of 1.7 to 3.9 Nm (0.17 to 0.39 kgm).

2nd METHOD

A. Diagonally and centrally on the outer machined seats of both caps (2, Figure 75) position two dial gauges (1) with magnetic base as shown in Figure 75;

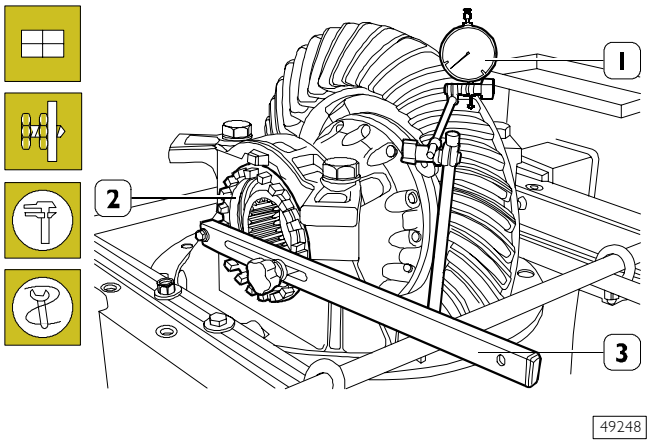
Figure 75



B. proceed as described in point "1";

C. after eliminating the end float further tighten the two adjustment lock rings (4, Figure 75) to obtain a retraction of the caps (2) of 0.15 to 0.33 mm, which corresponds to the sum of the readings on the dial gauges (1).

Figure 76



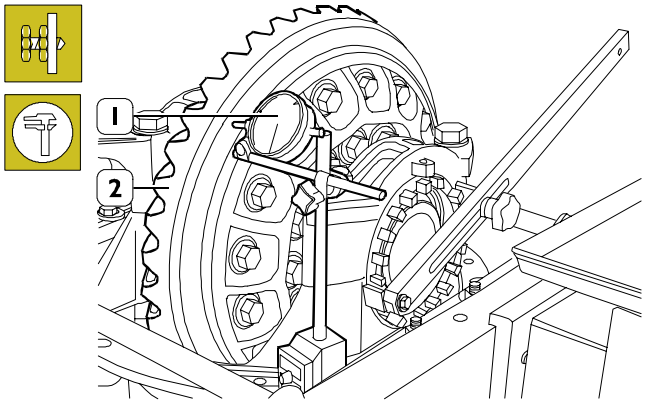
49248

Adjust the axial clearance between the teeth of the pinion - crown wheel unit which must be 0.26 to 0.50 mm proceeding as follows:

- ❑ stop the bevel pinion from turning using tool 99370317;
- ❑ position the magnetic-based dial gauge (1) as illustrated;
- ❑ using wrench 99355025 (3) slacken the adjustment lock ring on the crown wheel side and tighten, to the same extent, the adjustment lock ring (2) of the opposite side. The purpose of this is to leave the previously-adjusted cap retraction unchanged;
- ❑ proceed as described until obtaining the specified clearance.

The clearance should be checked on 4 points the same distance apart.

Figure 77

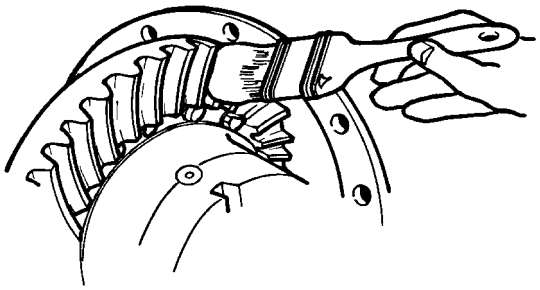


49246

Use a magnetic-based dial gauge (1) to check that the crown wheel (2) does not have any upper wobble above 0.20 mm. If it does, disassemble the differential unit and find the cause.

Refit and repeat the adjustment operations described previously.

Figure 78



19451

Apply a light layer of Prussian blue on the crown wheel. Turn the pinion and measure the impression of the contact of the pinion teeth on the crown wheel teeth.
The following figures show possible contacts and how to correct any errors.

Figure 79

19452

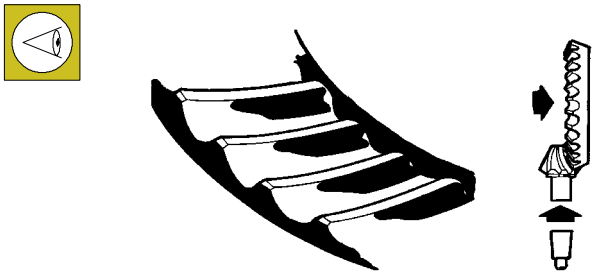
Contacts too much on crown wheel teeth bottom land

Conditions C-D. Indicates that the pinion is fastened too deeply and needs further adjustment.
To adjust the exact position of the pinion shims should be added under the pinion support to obtain the exact contact.

Condition C. Measure the clearance and restore it after adding shims.

Condition D. After adding shims, take the clearance towards minimum.

Figure 80



19453

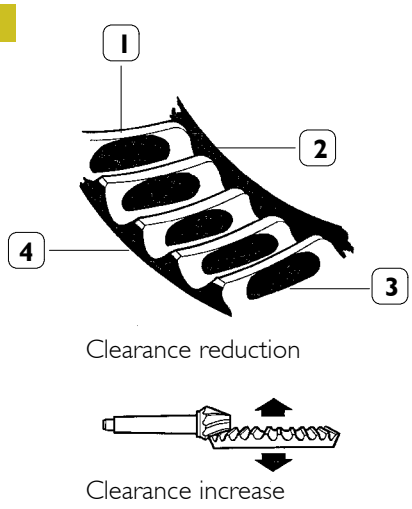
Contacts too much towards the crown wheel teeth top land

Conditions A-B. Indicates that the pinion is fastened to much towards the outside and therefore needs further adjustment.
To adjust the exact position of the pinion, remove shims under the pinion support to obtain the exact contact.

Condition A. After removing the shims, take the clearance towards maximum.

Condition B. Measure the clearance and restore it after removing shims.

Figure 81



19454

THEORETICAL CONTACT AREA

1. Release, concave side of tooth
2. Top land
3. Pulling, convex side of tooth
4. Heel

PULLING. Central tending towards the top land on the tooth face and central on the tooth profile.

RELEASE. Central tending to the heel on the tooth face and central on the tooth profile.

Indicates that the pinion is fastened correctly.

The contact position can be further changed by changing the pinion-crown wheel clearance.

Condition E. Lower the clearance.

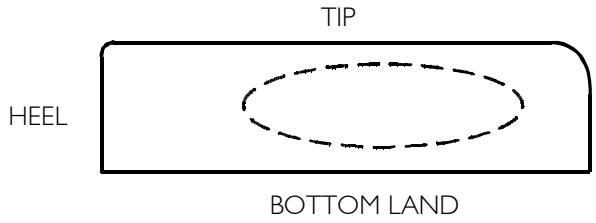
Condition F. Increase the clearance.

CORRECTING THE CROWN WHEEL AND PINION CONTACTS (AFTER ASSEMBLY)

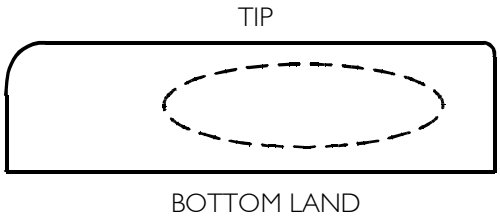
Figure 82

THEORETICAL CONTACTS

PULLING
(CONVEX SIDE OF RING GEAR)



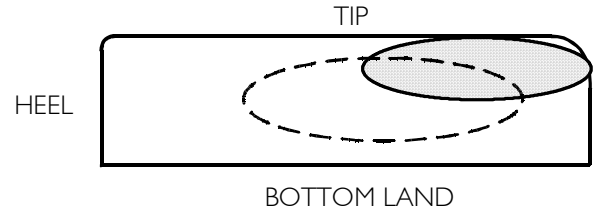
RELEASE
(CONCAVE SIDE OF RING GEAR)



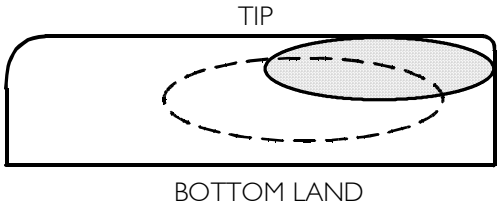
- PULLING : CENTRAL TENDING TOWARDS THE TOP LAND ON THE TOOTH FACE AND CENTRAL ON THE TOOTH PROFILE
- RELEASE : CENTRAL TENDING TOWARDS THE HEEL ON THE TOOTH FACE AND CENTRAL ON THE TOOTH PROFILE

CONDITION "A"

PULLING

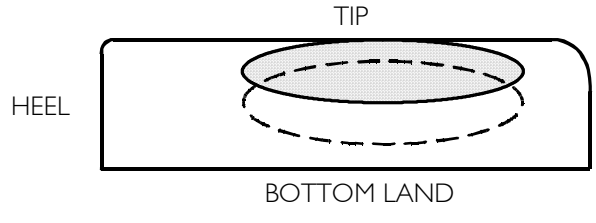


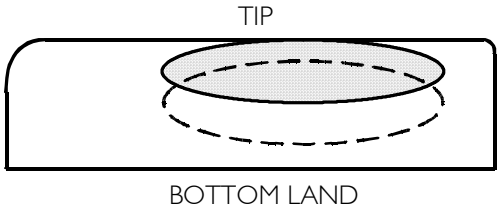
RELEASE



- PULLING RELEASE : CONTACTS TOO MUCH AT TIP
- PULLING : CONTACT TOO MUCH AT TOP LAND
- RELEASE : CONTACT TOO MUCH AT HEEL
- CORRECTIVE ACTION : REMOVE SHIMS AND INCREASE CLEARANCE TO MAXIMUM

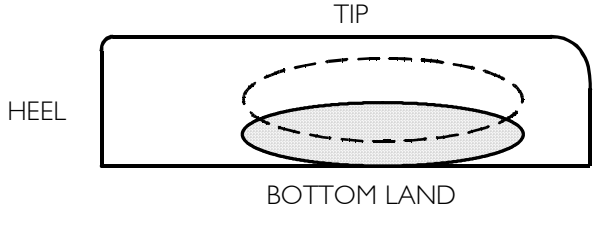
CONDITION "B"

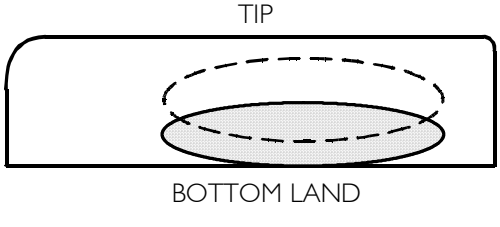




- PULLING - RELEASE : CONTACTS TOO MUCH AT TIP
- CORRECTIVE ACTION : MEASURE THE CLEARANCE AND RESTORE THE CLEARANCE

CONDITION "C"



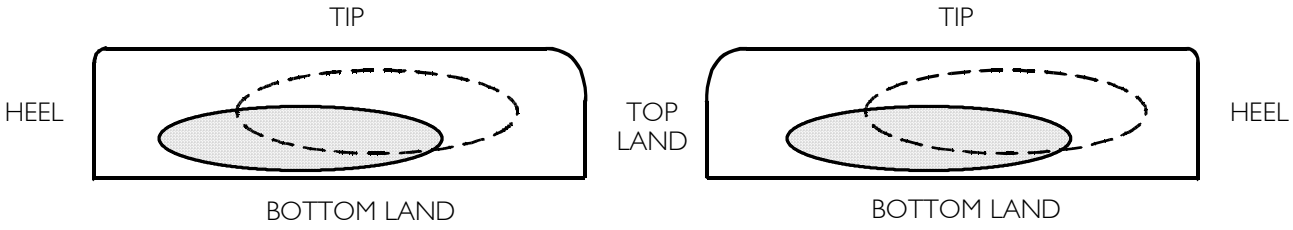


- PULLING - RELEASE : CONTACTS TOO MUCH ON BOTTOM LAND
- CORRECTIVE ACTION : MEASURE THE CLEARANCE, ADD SHIMS AND RESTORE CLEARANCE

60676

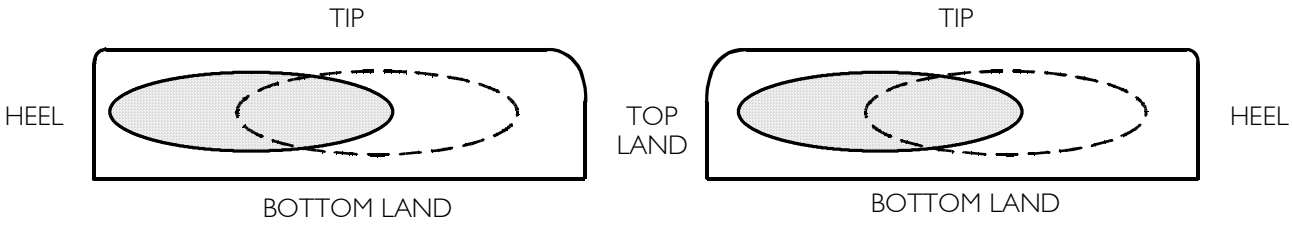
Figure 83

CONDITION "D"



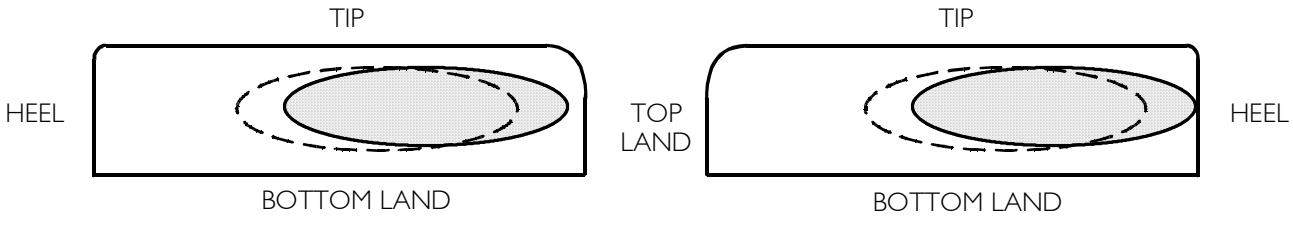
- PULLING - RELEASE : CONTACTS TOO MUCH ON BOTTOM LAND
- PULLING: : CONTACT TOO MUCH AT HEEL
- RELEASE : CONTACT TOO MUCH AT TOP LAND
- CORRECTIVE ACTION : ADD SHIMS AND REDUCE CLEARANCE TO MINIMUM

CONDITION "E"



- PULLING : CONTACT TOO MUCH AT HEEL
- RELEASE : CONTACT TOO MUCH AT TOP LAND
- CORRECTIVE ACTION : REDUCE CLEARANCE

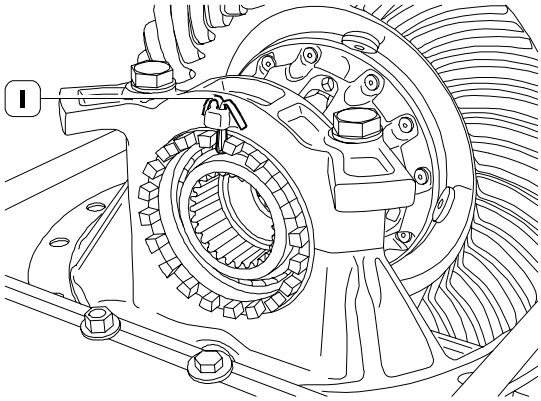
CONDITION "F"



- PULLING : CONTACT TOO MUCH AT TOP LAND
- RELEASE : CONTACT TOO MUCH AT HEEL
- CORRECTIVE ACTION : INCREASE CLEARANCE

60677

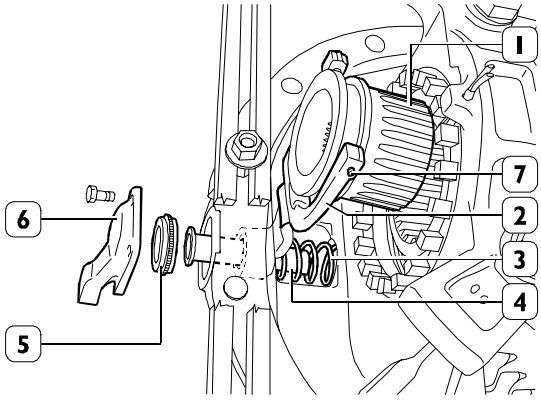
Figure 84



49249

Replace the safety split pin (1) and fold it; repeat this operation on the opposite side.

Figure 85



49250

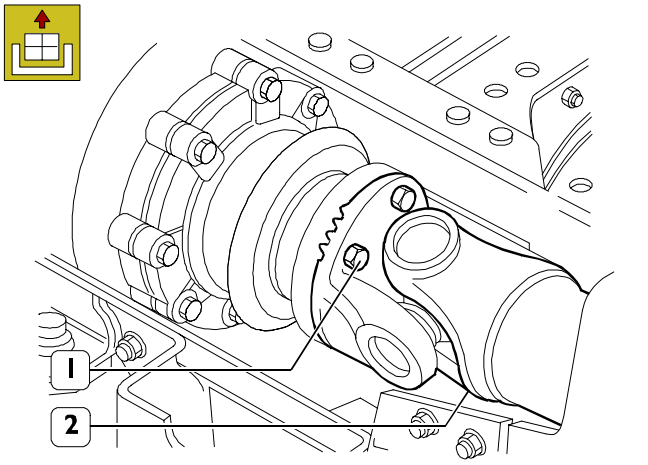
Place the pin (4) into its housing.
Fit the fork (2) and spring (3) to the pin (4) and push it in all the way. Fit the piston (5), complete with ring and cover (6), then fit the sliding sleeve (1) and spring plugs (7).

WORK ON THE VEHICLE

REPLACING THE BEVEL PINION MOUNT SEAL

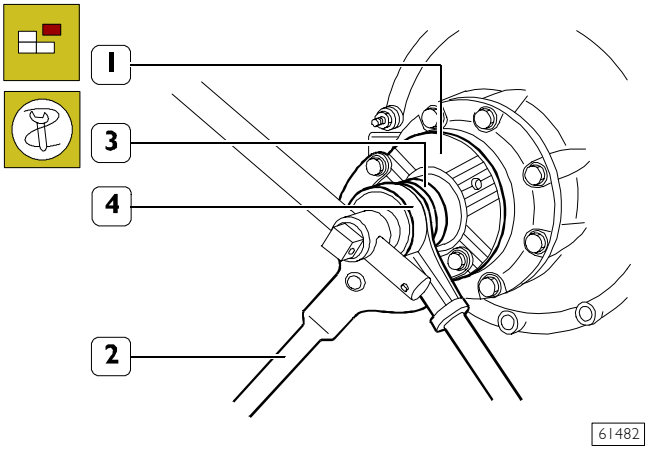
Disassembly

Figure 86



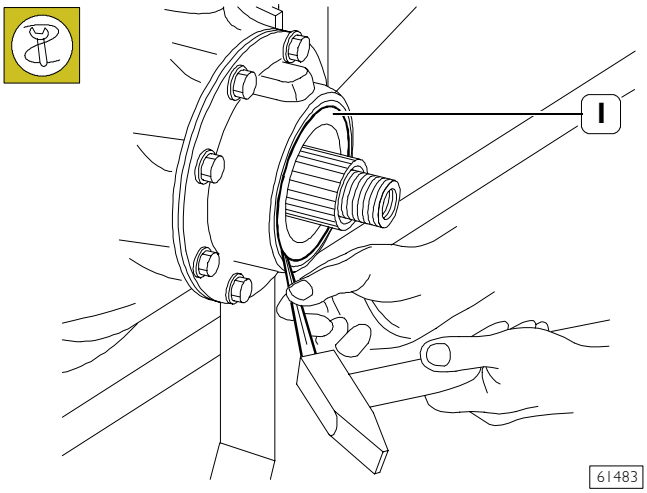
Slacken the nuts (1) fastening the flange. Disconnect the transmission shaft (2), fastening it to the frame.

Figure 87



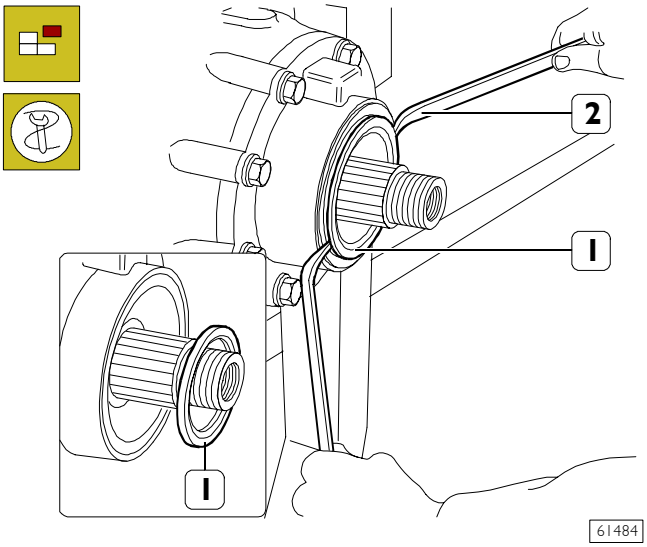
Prevent the flange (1) from turning using retainer tool 99370317 (2).
Using wrench 99355088 (3) and the multiplier (4) slacken the nut for the bevel pinion and withdraw the flange (4).

Figure 88



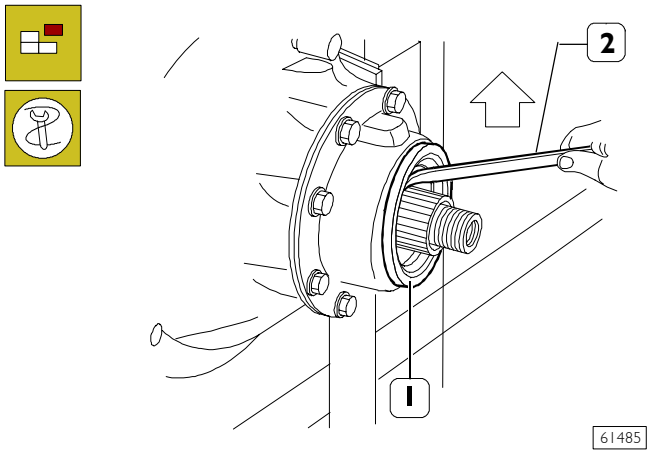
Using a suitable tool raise the outer edge of the ring (1) in two opposed points

Figure 89



Using the two levers (2) remove the inner ring (1).

Figure 90

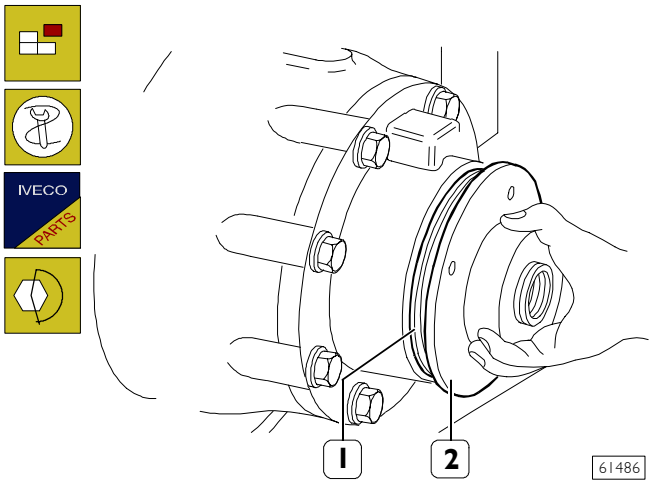


With tool 99363204 (2) positioned as shown in the figure, remove the seal (1) from the bevel pinion mount.

Assembly

Thoroughly clean the seat of the seal of all debris and traces of oil.

Figure 91



Position the new seal (1).
Apply the keying device 99374244 (2), screw a manoeuvring nut onto the bevel pinion and mount the seal down to the stop.

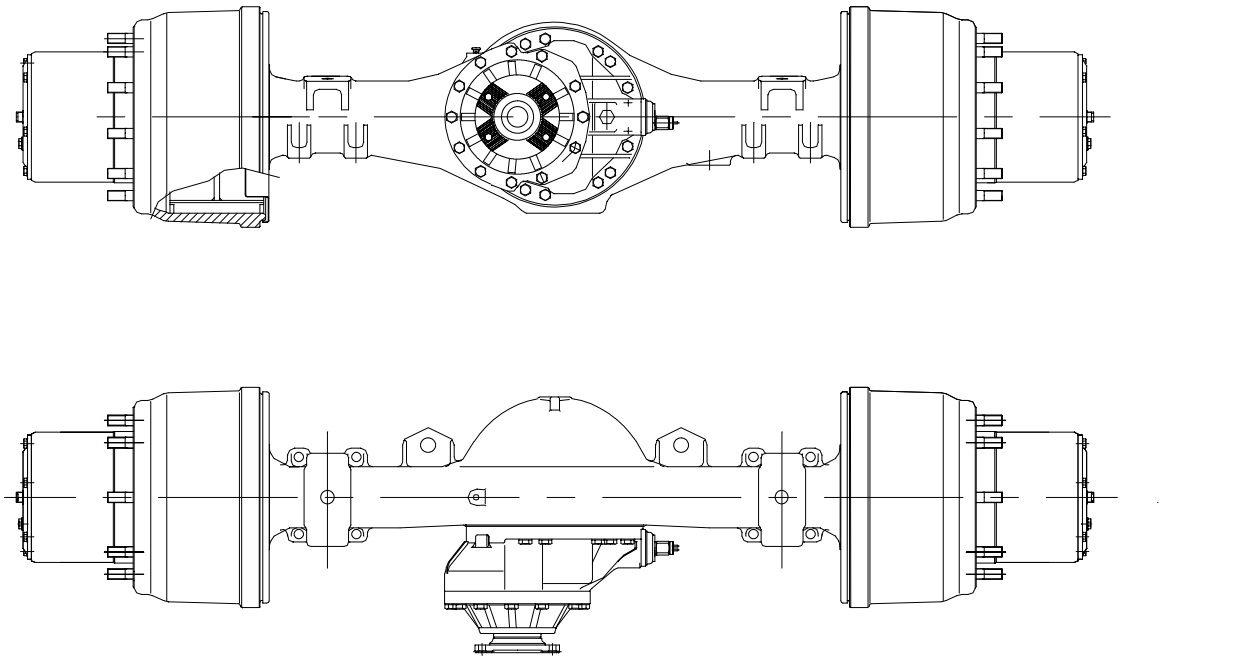
Unscrew the manoeuvring nut, take out the keying device 99374244 (2), fit the flange back on and screw down a new nut, locking it with a torque wrench and multiplier to the required torque.
Fit the propeller shaft back on and tighten the fixing nuts to the required torque.

5250 Rear axle 451391

DESCRIPTION

The rear axle is of the double reduction type; the first reduction is provided by the bevel pinion/ring bevel gear, whereas the second reduction is by means of an epicycloid unit on the wheel hubs.
The differential housing (with ring bevel gear) is supported by taper roller bearings, which can be adjusted by means of two threaded ring nuts.
The bevel pinion is supported by two taper roller bearings and a third straight roller bearing.
The bevel pinion can be adjusted by means of adjustment rings located between the two taper roller bearings.
The axle is provided with a pneumatic device for differential locking.
The axle shafts start from the differential and transmit drive to the epicycloid reduction units.
The drum brake is of the Simplex type.

Figure 1



71548

REAR AXLE 451391/1

SPECIFICATIONS AND DATA

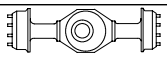
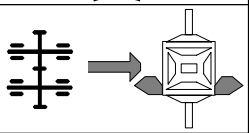
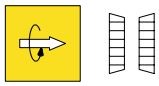
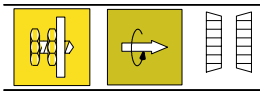
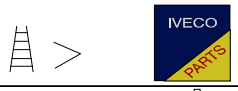
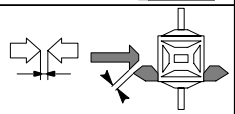
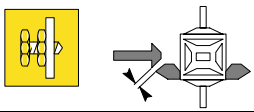
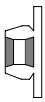
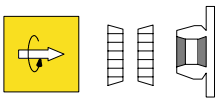
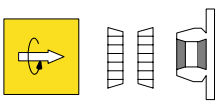
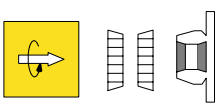
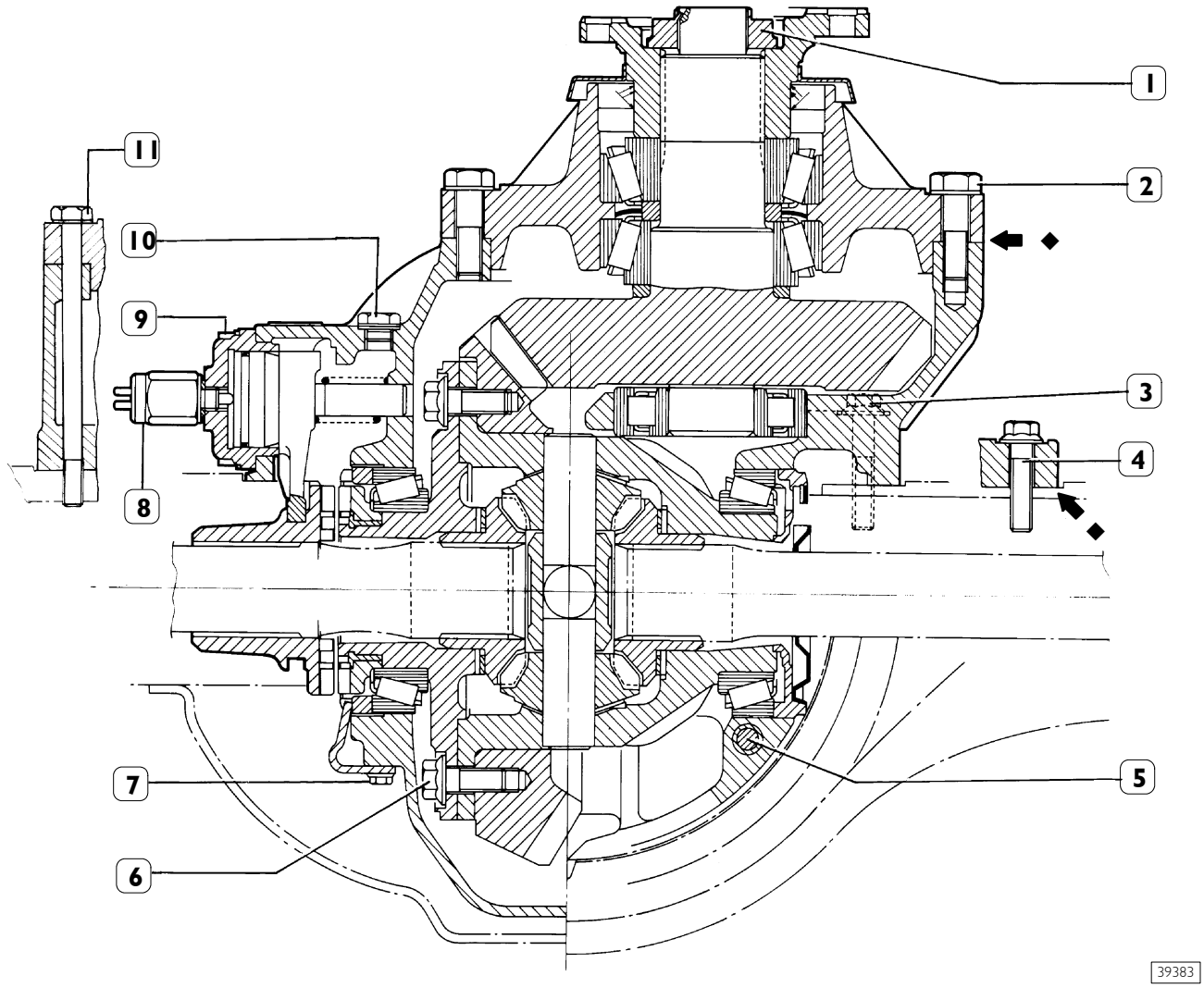
	Type of axle: Load-bearing, double reduction with pneumatically controlled differential locking	**451391/1**
	Bevel pinion bearings	2 taper rollers and 1 straight roller
	Bevel gear reduction unit ratio	27/32 (1.185) - 29/37 (1.276) - 27/37 (1.370) - 28/37 (1.321) - 24/35 (1.458) - 23/36 (1.565) - 21/34 (1.619) - 19/33 (1.737) - 21/40 (1.905) - 17/35 (2.059) - 19/37 (0.513) - 19/39 (0.487)
	Epicycloid reduction unit/wheels ratio	3.2
	Bevel pinion bearing rolling torque without seal Nm	1.5 ÷ 3.5
	Bevel pinion bearing rolling torque adjustment	with adjustment rings
	Thickness of bevel pinion bearing rolling torque adjustment rings mm	10 - 10.02 - 10.04 - 10.06 - 10.08 - 10.10 - 10.12 - 10.14 - 10.16 - 10.18 - 10.20 - 10.22 - 10.24 - 10.26 - 10.28 - 10.30 - 10.32 - 10.34 - 10.36 - 10.38 - 10.40 - 10.42 - 10.44 - 10.46 - 10.48 - 10.50
	Thickness of bevel pinion/ring bevel gear position adjustment rings mm	3.3 - 3.4 - 3.5 - 3.6 - 3.7 - 3.8 - 3.9 - 4.0 - 4.1 - 4.2 - 4.3 - 4.4 - 4.5 - 4.6 - 4.7
	Clearance between pinion and ring bevel gear mm	0.20 ÷ 0.33
	Adjustment of clearance between pinion and ring bevel gear	with ring nuts
	**WHEEL HUBS**	
	Wheel hub bearings	2 taper rollers
	Wheel hub bearings rolling torque: new bearings with surface protection Nm	6 ÷ 7 + (12 ÷ 16)
	Wheel hub bearings rolling torque: run in bearings and new, lubricated seals Nm	6 ÷ 7 + (5 ÷ 7)
	Wheel hub bearings rolling torque: run in bearings and seals Nm	6 ÷ 7 Nm + (2.5 ÷ 4.5 Nm)
	Drive shaft end float mm	0.5 ÷ 1
	Axle oil	**TUTELA W140/MDA** 16 14.5
	G.R.W. maximum load kg	13.000

Figure 2

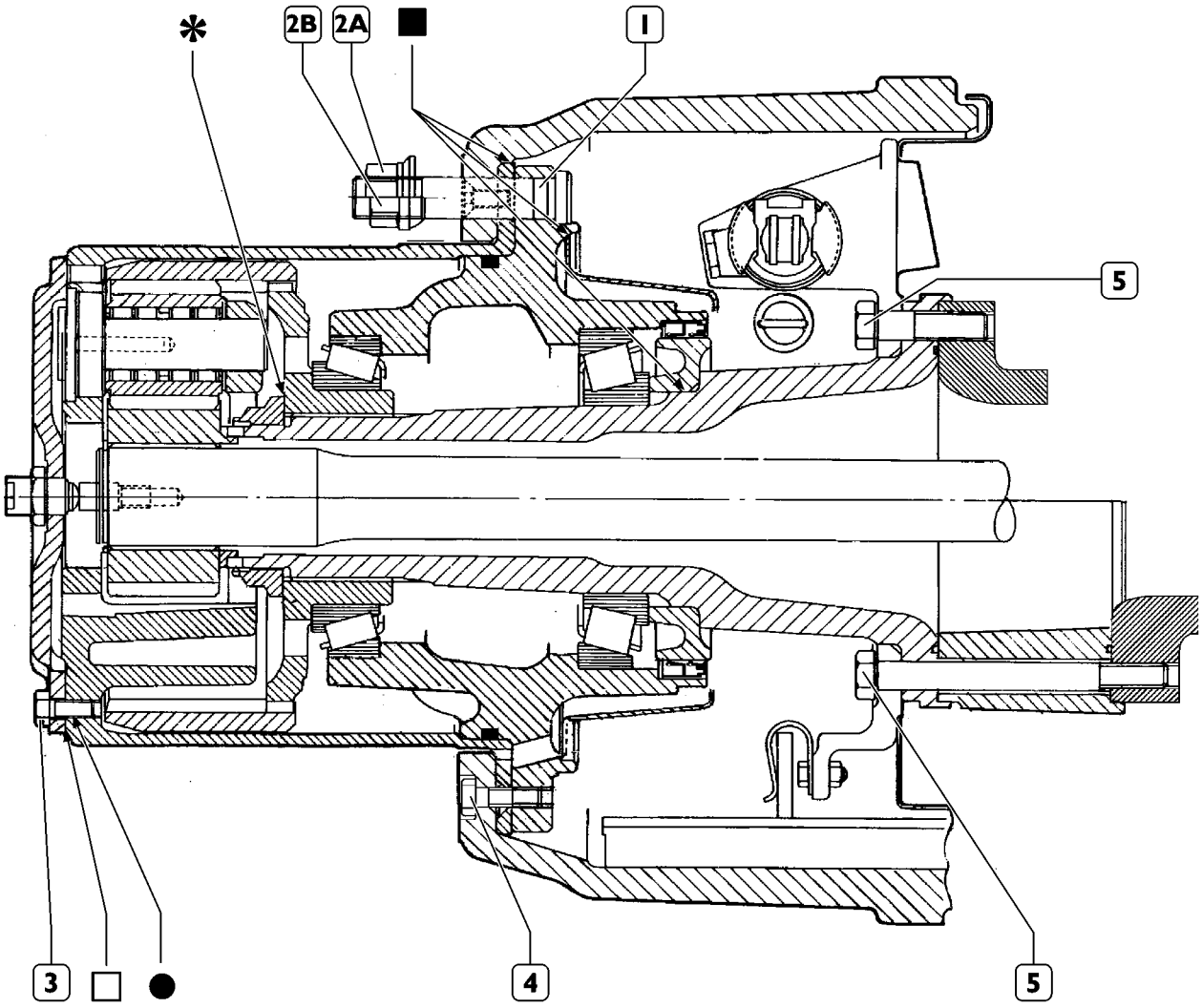


TIGHTENING TORQUES

	PART	TORQUE	
		Nm	kgm
1	Nut fixing bevel pinion	700 ± 50	70 ± 5
2	Screw fixing bevel pinion support to differential housing	165 ± 15	16.5 ± 1.5
3	Screw fixing differential housing to axle housing	160 ± 10	16 ± 1
4	Screw fixing differential housing to axle housing ♦	160 ± 10	16 ± 1
5	Screw fixing bevel pinion support to differential housing •	280 ± 15	28 ± 1.5
6	Screw fixing ring bevel gear to gear housing	300 ± 10	30 ± 1
7	Screw fixing safety plate to gear housing cover	60 ± 6	6 ± 0.6
8	Pressure switch	61 ± 6	6.1 ± 0.6
9	Cheese headed screw fixing control cylinder	25 ± 2	2.5 ± 0.2
10	Oil filler cap	-	-
11	Self-locking screw	120 ± 10	12 ± 1

● apply LOCTITE AVX
♦ apply LOCTITE 573

Figure 3

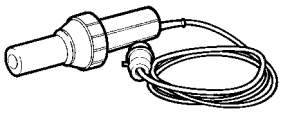
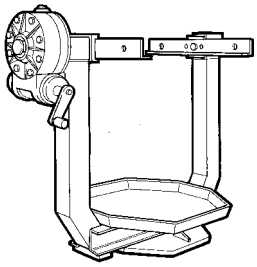
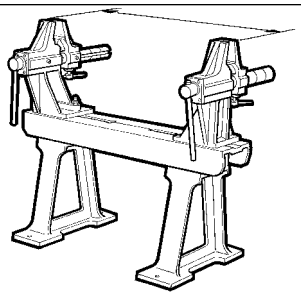
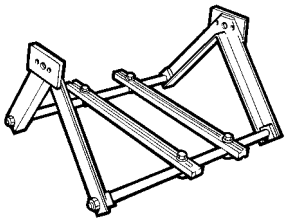
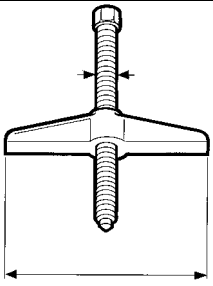
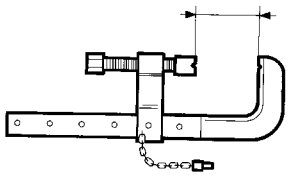


TIGHTENING TORQUES

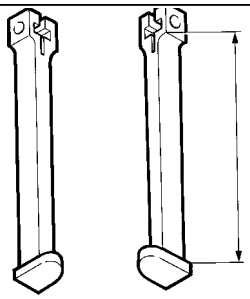
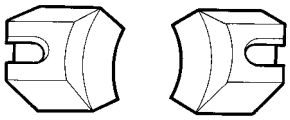
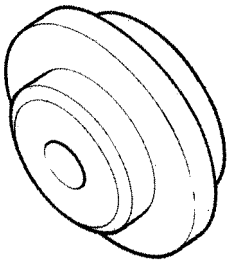
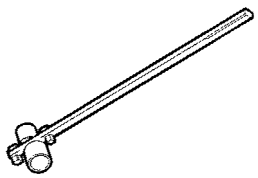
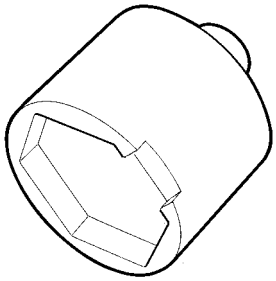
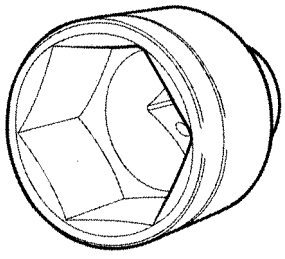
PART			TORQUE Nm	TORQUE kgm
1	Countersunk screw fixing drum		25 ± 3	2.5 ± 0.3
2	Nut fixing wheel	A	600 $^{+50}_{-20}$	60 $^{+5}_{-2}$
		B	400 $^{+50}_{-20}$	40 $^{+5}_{-2}$
3	Screw fixing cover to side pinion support □		50 ± 5	5 ± 0.5
4	Countersunk screw		50 ± 5	5 ± 0.5
5	Screw fixing load bearing sleeve		295 ± 30	29.5 ± 3

- • apply LOCTITE 573 on the contact surface
- ■ apply LOCTITE 573 on mating surface
- ✳ apply MOLYKOTE on the nut contact surface
- □ Apply LOCTITE 5970

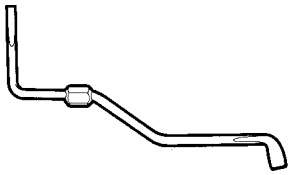
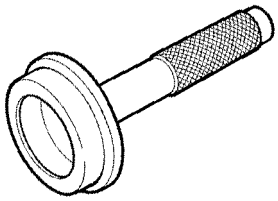
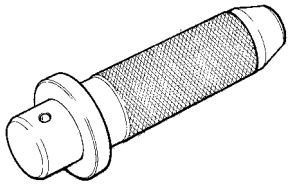
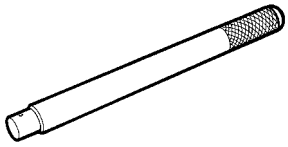
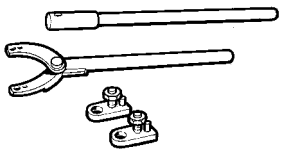
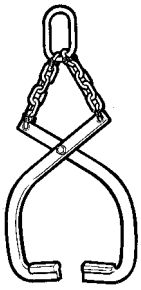
TOOLS

TOOL No.		DESCRIPTION
99305121		Hot air device
99322205		Rotating stand for assembly overhaul
99322215		Stand for axles overhaul
99322225		Support for assemblies (to be fitted onto stand 99322205)
99341003		Single-acting bridge
99341015		Press

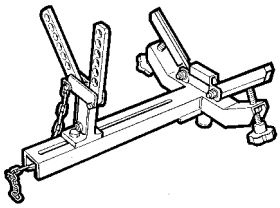
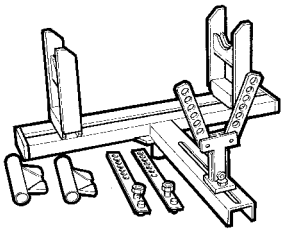
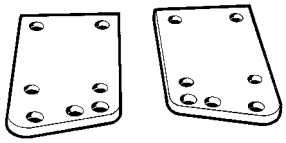
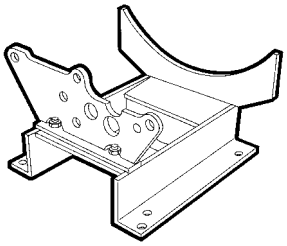
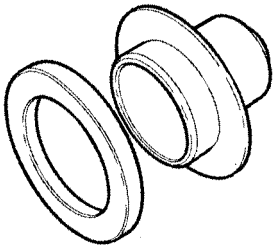
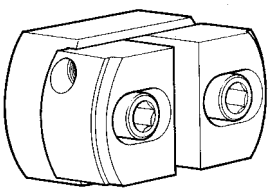
TOOLS

TOOL No.		DESCRIPTION
99341020		Pair of tie rods for grips
99341023		Grips
99345055		Reaction block for extractors
99354001		Wrench for differential gear housing bearing adjustment ring nuts
99354207		Wrench (94.5 mm) for wheel hub bearings adjusting nut
99355081		Wrench (60 mm) for differential bevel pinion nut (use with 99370317)

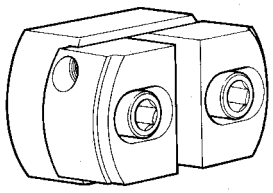
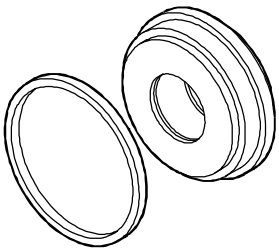
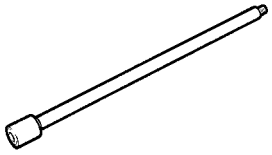
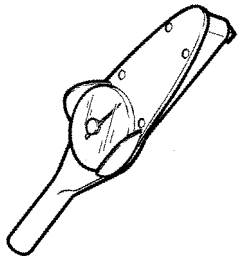
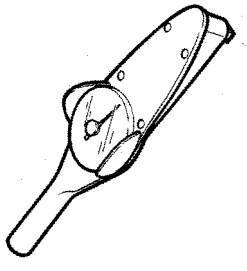
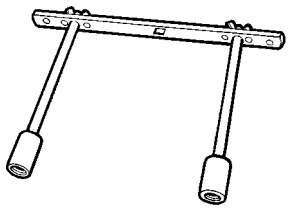
TOOLS

TOOL No.		DESCRIPTION
99356001		Wrench for adjusting wheel brake jaws
99370005		Grip for interchangeable punches
99370006		Interchangeable grip for punches
99370007		Interchangeable grip for punches
99370317		Reaction lever with extension for flange retaining
99370509		Hook to extract differential gear half-housing

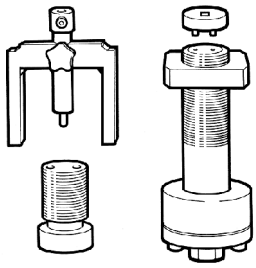
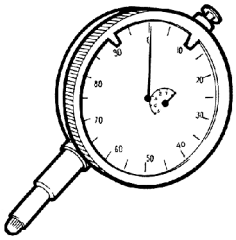
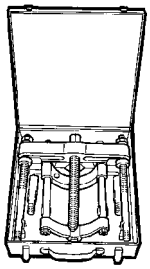
TOOLS

TOOL No.		DESCRIPTION
99370616		Mounting for removal and refitting of differential
99370617		Universal mounting to support axles during removal and refitting
99371022		Pair of differential support brackets for use during overhaul (use with 99322205-99322225)
99372211		Tool for removal and refitting of brake jaws retaining springs
99374013		Key to fit flow divider drive infeed shaft seal (use with 99370006)
99374093		Punch to fit external races of bearings (use with 99370007)

TOOLS

TOOL No.		DESCRIPTION
99374094		Punch to fit external races of bearings (diameter 134 - 215 mm use with 99370007)
99374161		Key for assembly of wheel hub internal seals
99374451		Tool for axle shaft disassembly-assembly
99389819		Torque wrench from 0 to 10 Nm with 1/4" square connection
99389821		Torque wrench from 0 to 70 Nm with 3/8" square connection
99395026		Tool to check rolling torque of hubs (use with torque wrench)

TOOLS

TOOL No.		DESCRIPTION
99395027		Tool for differential bevel pinion shim measurement (to be used with 99395603)
99395603		Dial gauge (0÷5 mm)
99348001		Extractor with locking device.

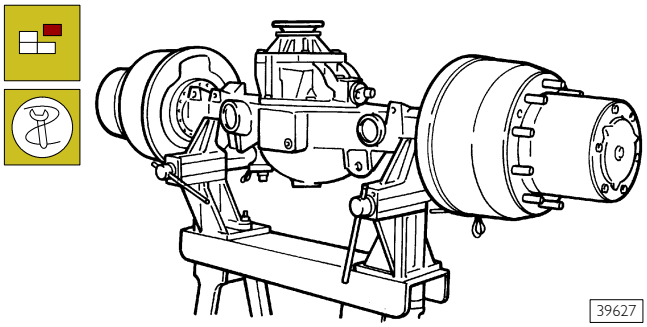
525010 REAR AXLES ASSEMBLY OVERHAUL

Disassembly

NOTE The drive shafts - brake drums and jaws - air breather - wheel hubs differential and epicycloid reduction units removal-refitting operations, can all be carried out with the units fitted on the vehicle.

Before positioning the axle assembly on the overhaul stand, drain off the oil by unscrewing the lower plug on the axle housing.

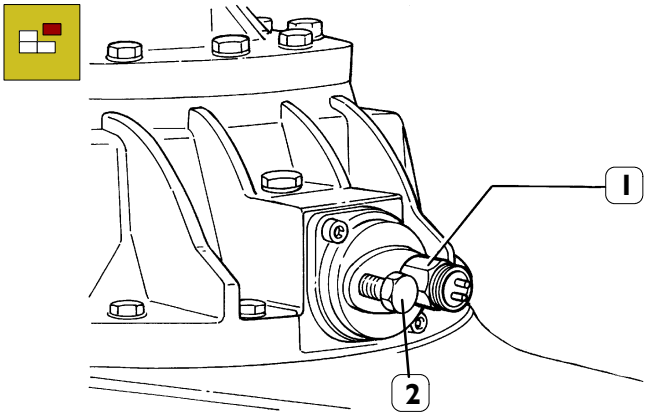
Figure 4



39627

Position the axle assembly on stand 99322215.

Figure 5



39628

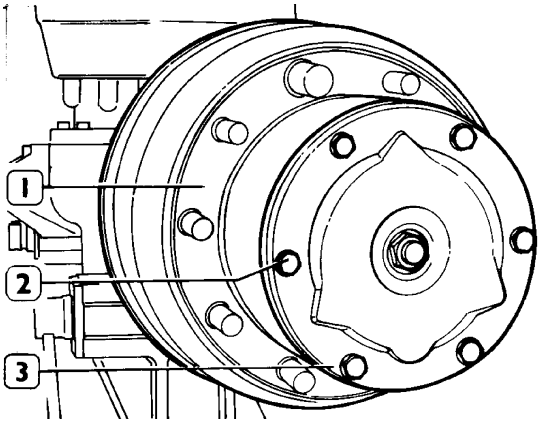
Block the differential locking device sliding sleeve with a screw. Remove the control cylinder threaded coupling (2) and replace with a screw (1) (M 14 x 1.5).
Rotate the axle mechanism to facilitate engagement between the sliding sleeve and the engagement sleeve; this will avoid involuntary sleeve movement whilst the drive shaft is being extracted.

NOTE Position a container under the wheel hub to recover the oil.

Before extracting the axle shaft make sure that the screw has been tightened (2, Figure 5).

Epicycloid reduction gear disassembly

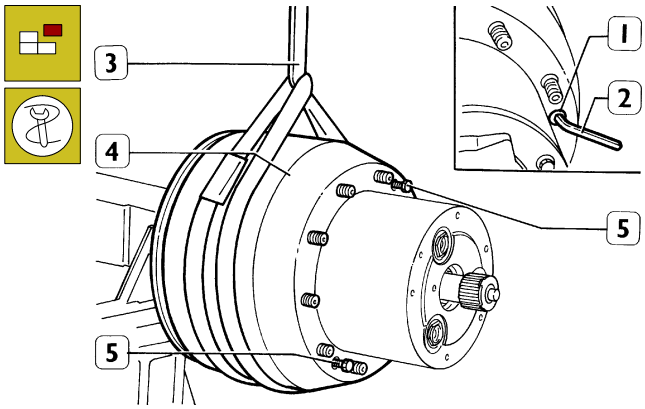
Figure 6



71534

Unscrew the screws (1), remove the cover (3) and drain off the oil into the container.

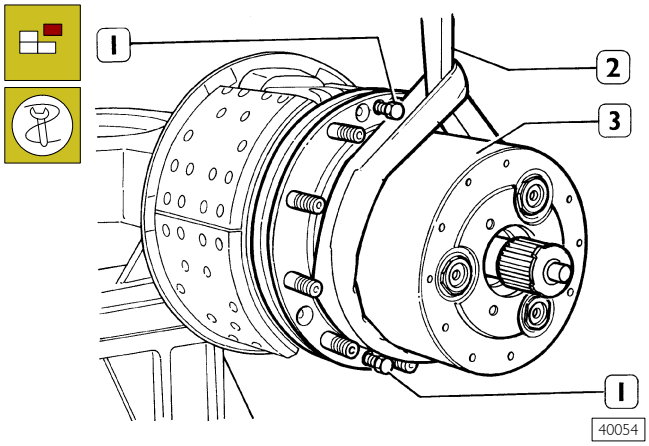
Figure 7



40338

Using an Allen wrench (2) unscrew the two screws (1) fixing the drum; replace with the reaction screws (5). Tighten the reaction screws and remove the drum (4) from the hub and, using a sling (3), raise and remove.

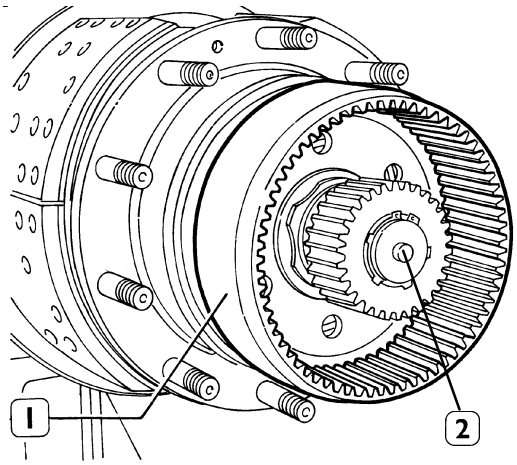
Figure 8



40054

Unscrew the 3 side pinion (3) fixing screws; tighten the reaction screws (1) and, using a sling (2), remove the support (3).

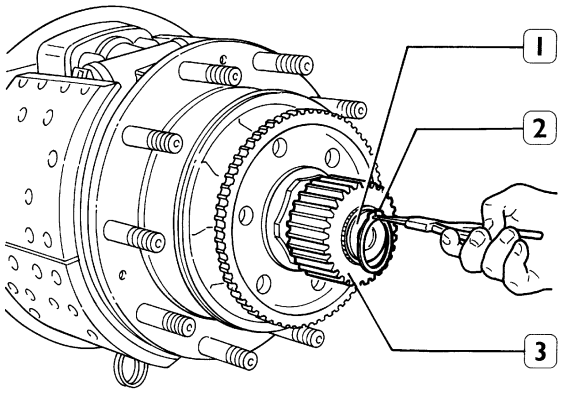
Figure 9



40055

Remove the bevel gear (1) from the mounting.
Remove the shoulder pin (2).

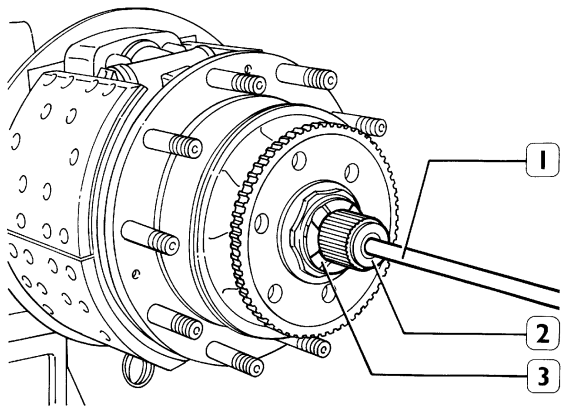
Figure 10



39635

Using suitable pliers, remove the safety ring (2), extract the gear unit (3) from the drive shaft.

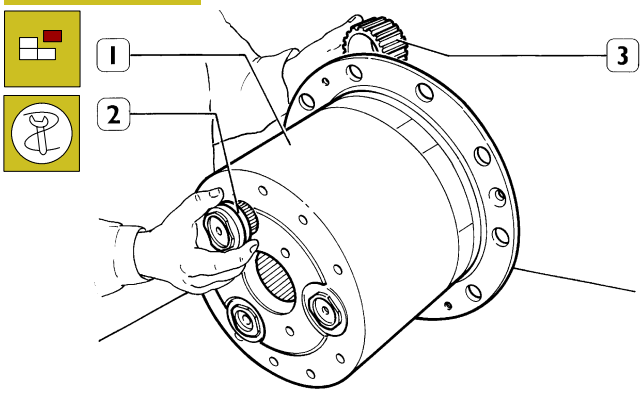
Figure 11



39636

Fit tool 99374451 (1) in the shoulder pin seat and extract the drive shaft (2) from the load bearing sleeve.
Remove the spacer ring (3).

Figure 12

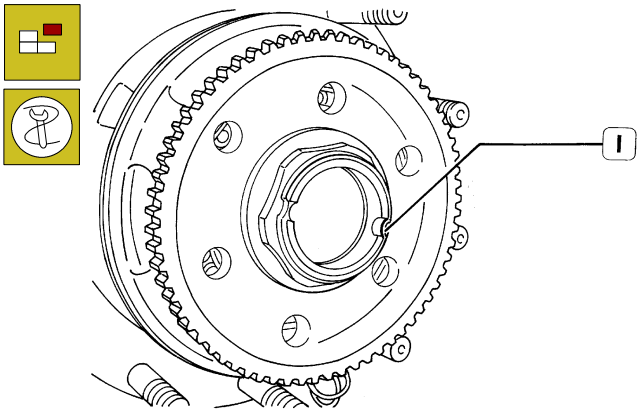


40056

Extract the support pins (2) from the side pinion support (1).
Remove the side pinions (3) from the support (1) and recover the rollers and the spacer rings.

525130 Wheel hub disassembly

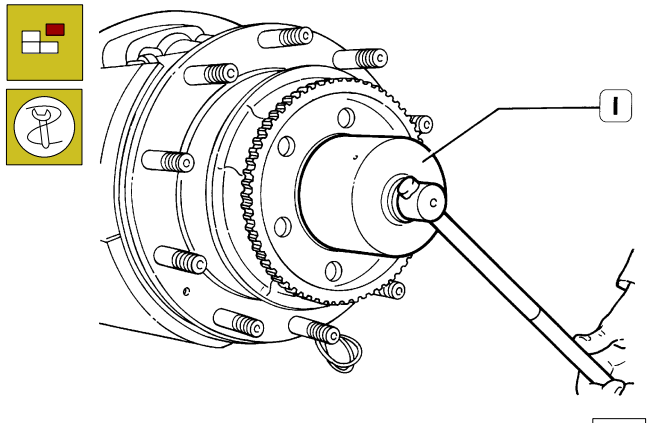
Figure 13



39637

Using a punch, remove the notch (1) on the adjusting nut.

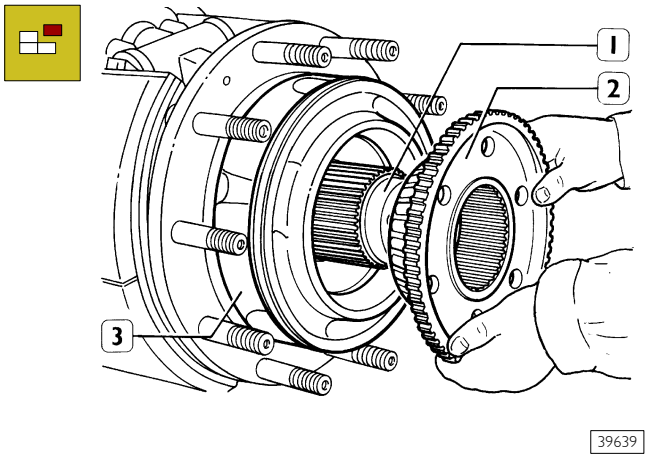
Figure 14



39638

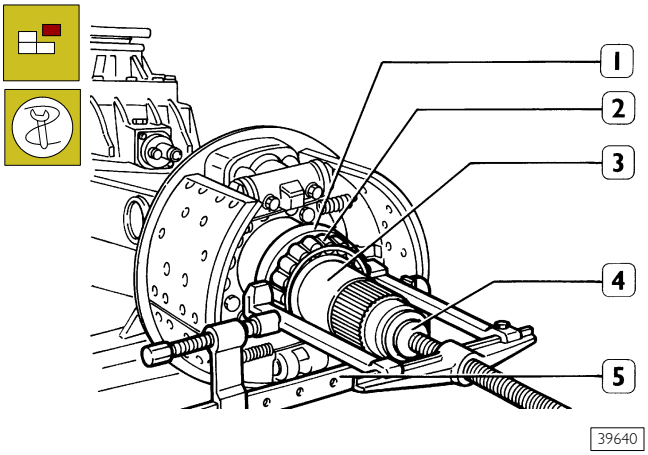
Using Allen wrench 99354207 (1), unscrew the adjusting nut.

Figure 15



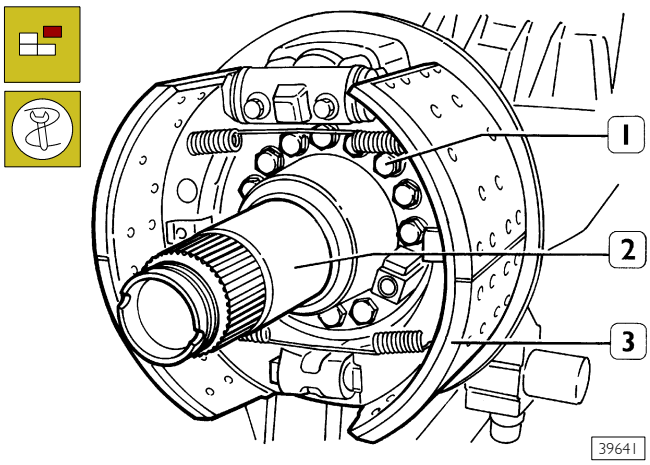
Extract the bevel gear mounting (2), together with the bearing and wheel hub (3), from the load bearing sleeve (1).

Figure 16



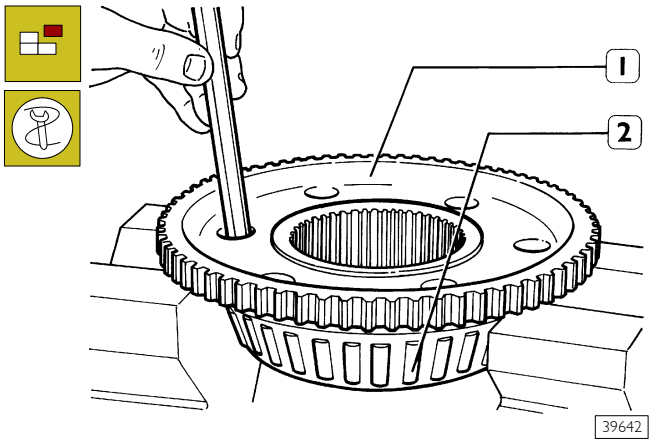
Check the surface of the ring (1), on which the hub seal ring rotates, is not damaged or worn, if necessary, replace the ring (1).
Using the extractor [comprising bridge 99341003, grips 99341023, tie rods 99341020, press 99341015 (5) and reaction block 99345055 (4)], extract the ring (replacing if necessary) and/or the internal ring (2) of the sleeve (3) taper bearing.

Figure 17



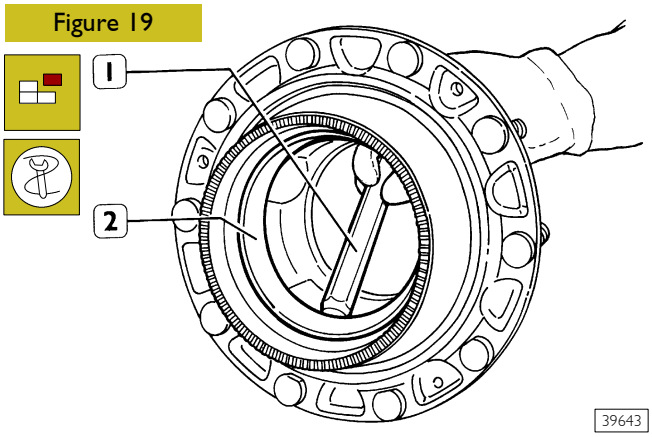
Check the load bearing sleeve (2). If damaged, replace as follows.
Unscrew the screws (1), remove the brake support plate (3) and the axle casing sleeve (2).

Figure 18



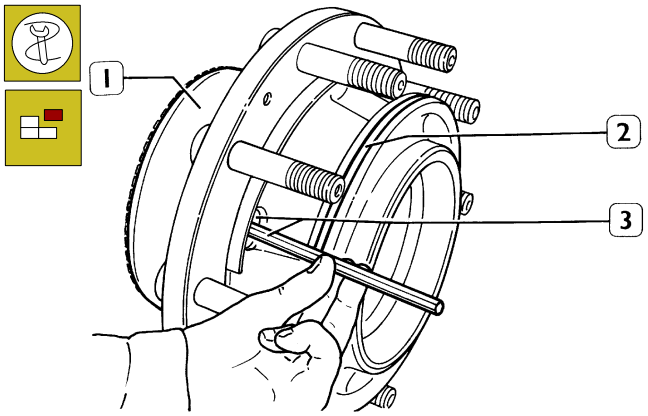
Using a punch inserted through the holes on the bevel gear support, extract the external taper roller bearing (2) from the bevel gear support (1).

Figure 19



Using a universal bronze punch (1), extract the external ring (2) for the internal bearing. The seal ring will also be extracted.
Proceed in the same way to extract the external bearing external ring. If necessary, disassemble the phonic wheel.

Figure 20

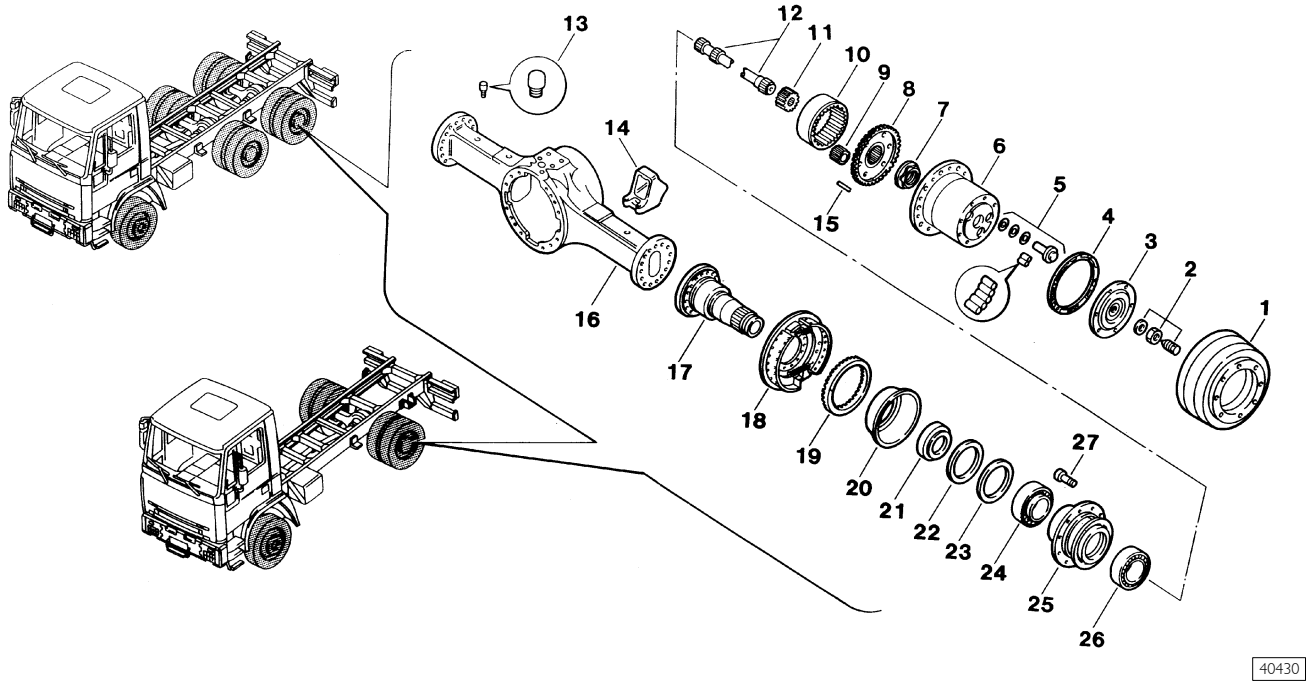


Check the oil manifold (1) and replace if damaged. Extract with a punch inserted in the slots on the hub (3). Remove the seal ring (2).

CHECKING THE WHEEL HUB AND EPICYCLOID REDUCTION GEAR UNIT PARTS

Carefully clean the wheel hub parts. Check the drive shafts for deformation. If necessary, straighten the drive shafts using a hydraulic press; if this does not provide satisfactory results, replace the drive shafts.
Check the studs fixing the wheel: if the threads are damaged or deformed they must be replaced. Work under a press to extract and re-assemble the studs.
On completion of assembly operations, check that the orthogonal deviation is no greater than 0.3 mm.
Lubricate the bearings and make sure that the roller support cage rotates freely, rotation should be smooth, without hardening.
Check the threads on the hub bearings adjustment nuts and on the load bearing sleeves; replace the nuts if necessary. Check the oil manifold and replace if damaged.
Replace all seals with new parts.
Carefully clean all the epicycloid gear unit parts. Visually check the toothing on the bevel gear support, the bevel gear, the crown wheel gears and the open gear unit.
Check the spacer rings, distance ring, bearing rollers and support pins.
Replace any damaged or worn parts.

Figure 21

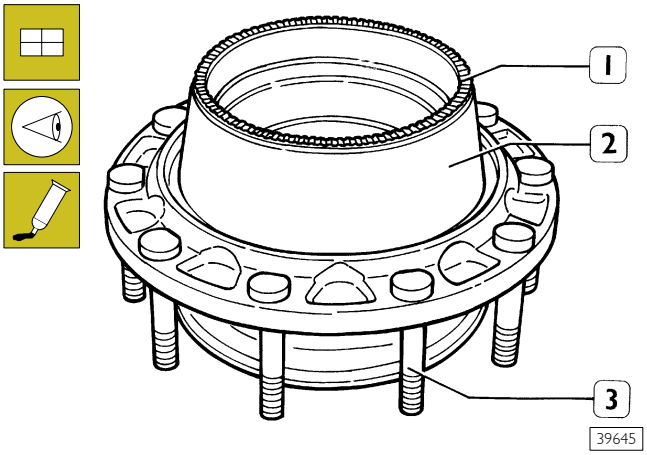


WHEEL HUB PARTS

1. Brake drum - 2. Adjusting nut and screw - 3. Cover - 4. Seal - 5. Pin and roller for side pinions - 6. Side pinion support - 7. Adjusting nut - 8. Ring bevel gear support - 9. Side pinion - 10. Shoulder pin - 11. Ring bevel gear - 12. Drive shaft - 13. Breather - 14. Bracket - 15. Shoulder pin - 16. Axle housing - 17. Load bearing sleeve - 18. Brake unit - 19. Phonic wheel - 20. Oil sump - 21. Support ring - 22. Seal ring - 23. Seal ring - 24. Bearing - 25. Wheel hub - 26. Bearing - 27. Stud

525030 WHEEL HUB ASSEMBLY

Figure 22



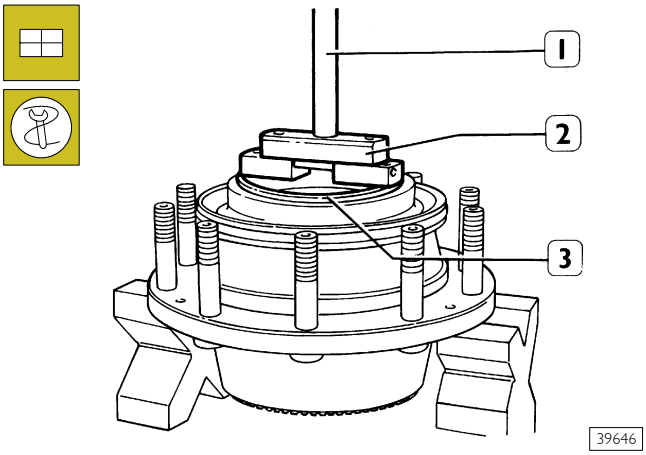
If the studs (3) need to be replaced, before fitting new studs, make sure that the contact surface on the head is free of slag, burr, blisters.

After fitting, check that the studs are fully inserted on the hub and that the right angle error does not exceed 0.3 mm.

If the oil collecting sump (2) needs to be replaced, before assembly, smear the contact surface on the hub/sump and hub/hub seat with LOCTITE 573 sealing compound.

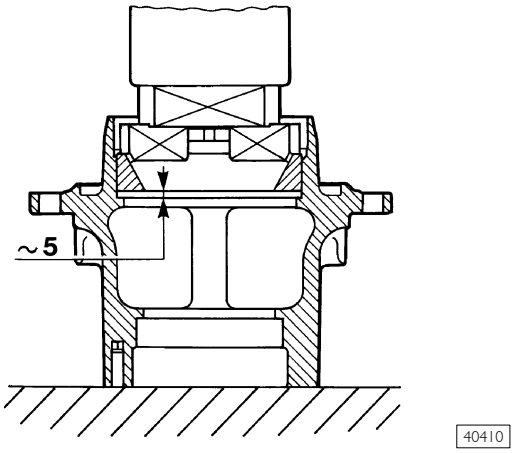
Refit the phonic wheel (1) and, on completion, make sure that phonic wheel is positioned perfectly in the hub seat.
Using a 1/100ths feeler gauge, check that the right angle error does not exceed 0.2 mm.

Figure 23



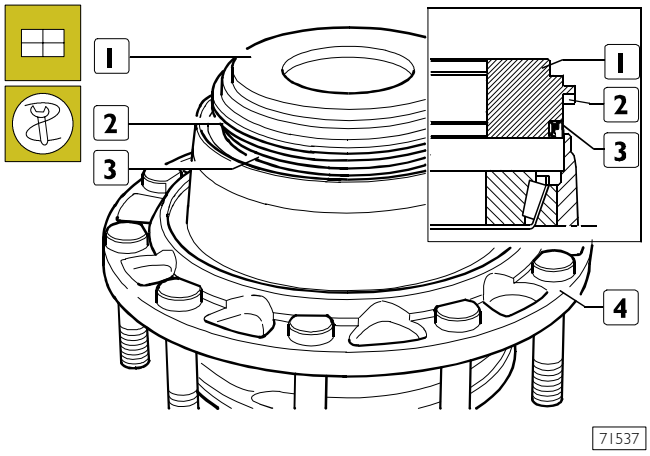
Using punch 99374093 (2) and a press, fit the external ring on the external bearing (3), stopping approx. 5 mm from the fully fitted position; complete fitting operations manually, using grip 99370007 (1).

Figure 24



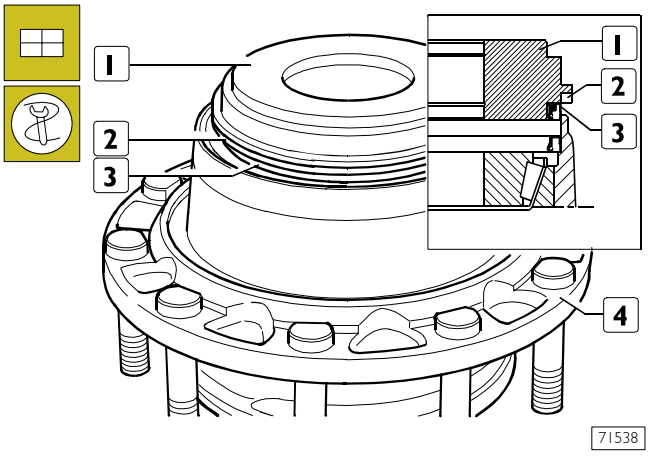
Complete fitting operations manually, using grip 99370007, then turn the hub over and carry out the same operation with the external ring of the internal bearing.

Figure 25



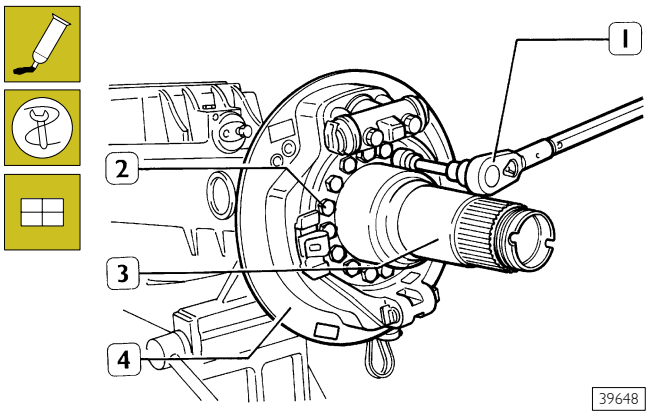
Using a hydraulic press and key 99374161 (1), with the ring (2) positioned as shown in the drawing, fit the brown internal seal ring (3) on the wheel hub (4).

Figure 26



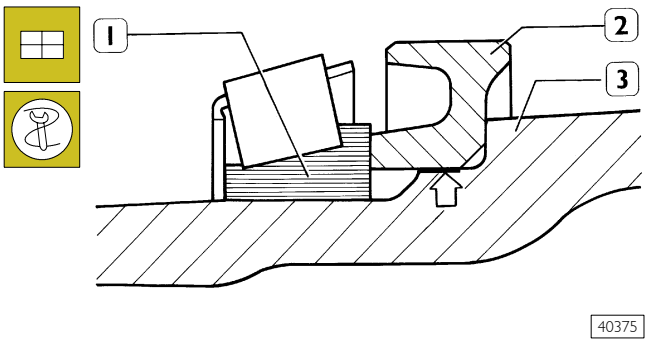
Using a hydraulic press and key 99374161 (1), with the ring (2) positioned as shown in the drawing, fit the blue seal ring (3) on the wheel hub (4).

Figure 27



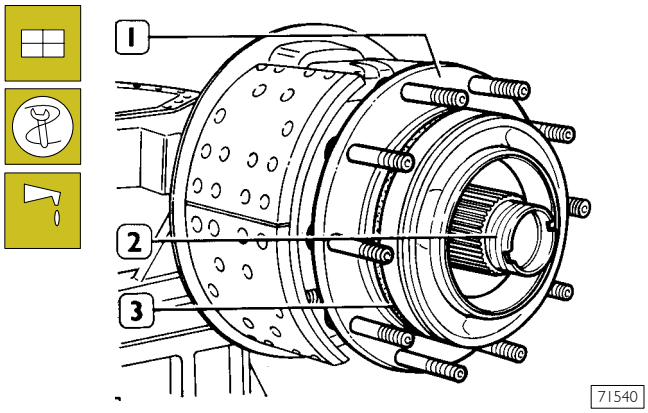
Position the seal ring on the load bearing sleeve. Fit the load bearing sleeve (3), the brake support plate (4) and dust seal disk. Smear the screws (2) and tighten to the correct value with a torque wrench (1).

Figure 28



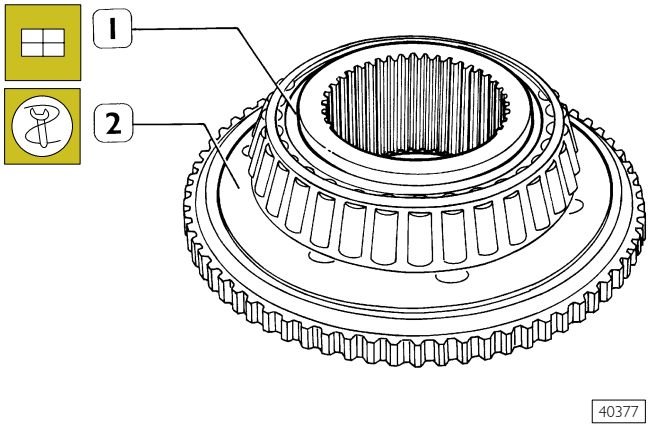
Smear LOCTITE 573 on the seat (⇒) of the load bearing sleeve (3) on the seal rings support ring (2). Heat the ring (2) with an electric drier and key on the load bearing sleeve (3). Heat the taper bearing internal ring (1) to 100°C and fit on the load bearing sleeve.

Figure 29



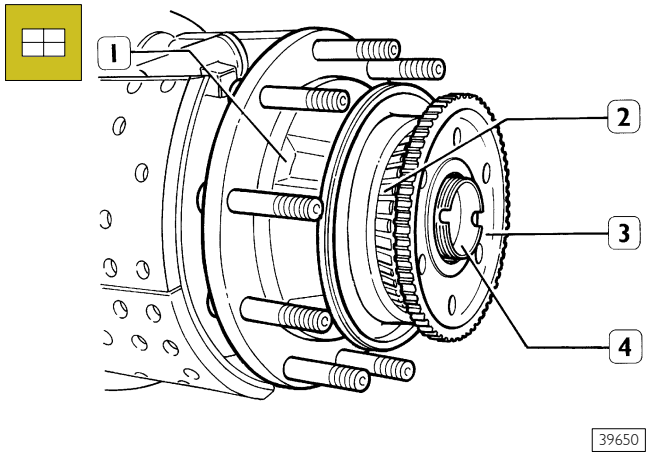
Fit the brake shoes as described in the brake air system section.
Lubricate the lip of the seal rings and sleeve.
Fit the hub (1) on the load bearing sleeve (2).
Lubricate the seal ring (3) and fit on the wheel hub.

Figure 30



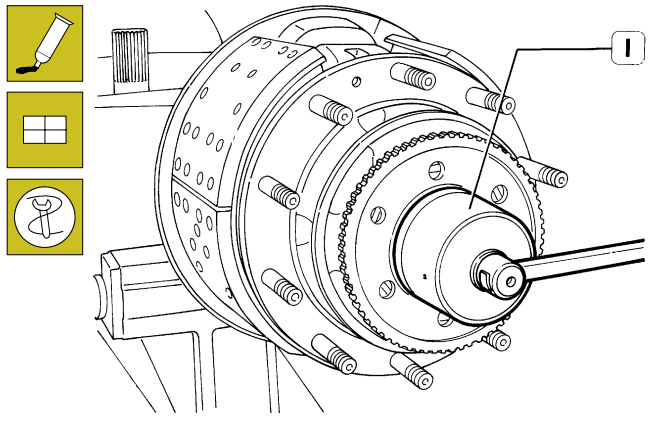
Using an electric drier, heat the taper roller bearing (1) to 100°C and fit on the bevel gear support (2) with a punch.

Figure 31



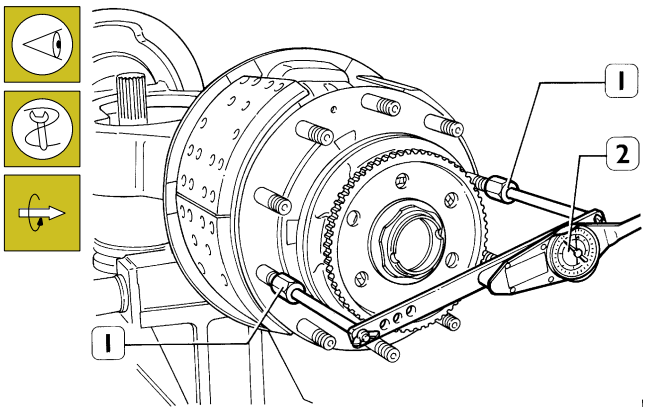
Fit the bevel gear support (3) and the taper roller bearing (2) on the load bearing sleeve (4).

Figure 32



Apply a thin layer of MOLYKOTE on the contact surface of the adjusting nut and tighten with wrench 99354207 (1) until the hub rotates with difficulty. Release the hub with a few blows from a hammer in the direction of the axis and in both directions.

Figure 33



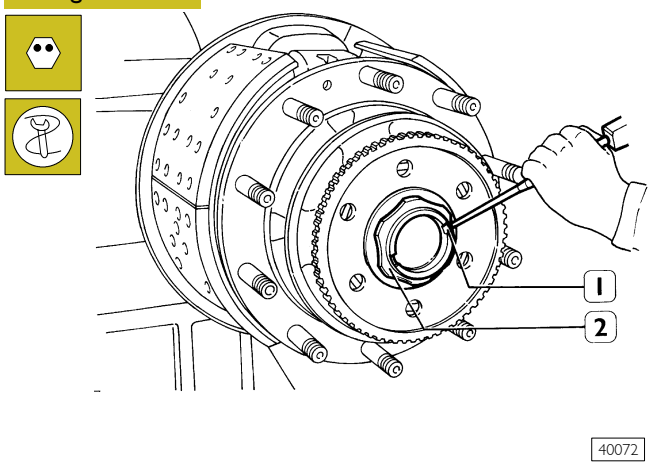
Position tool 99395026 (1) and, using a torque wrench (2), read the wheel hub rolling torque.

NOTE Whilst reading the wheel hub rolling torque, hub rotation must not exceed 40 rpm.

Wheel hub rolling torque values vary according to the following conditions:

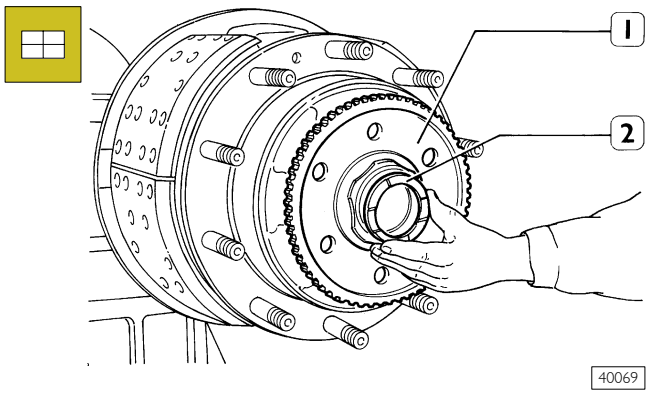
- ❑ new bearings with surface protection — 6 ÷ 7 + (12 ÷ 16) Nm
- ❑ run in bearings and new, lubricated seals — 6 ÷ 7 + (5 ÷ 7) Nm
- ❑ run in bearings and seals — 6 ÷ 7 + (2.5 ÷ 4.5) Nm

Figure 34



Once the required rolling torque has been achieved, secure the adjusting nut (2) with a punch in the two grooves on the load bearing sleeve (1).

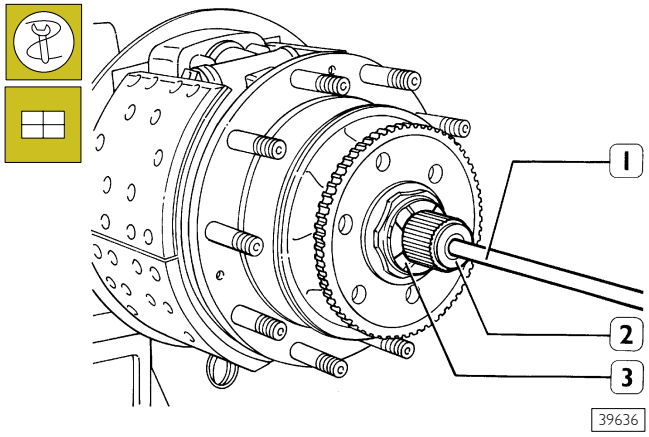
Figure 35



Position the spacer ring (2) on the load bearing sleeve.

525140 Assembling the epicycloid reduction gear

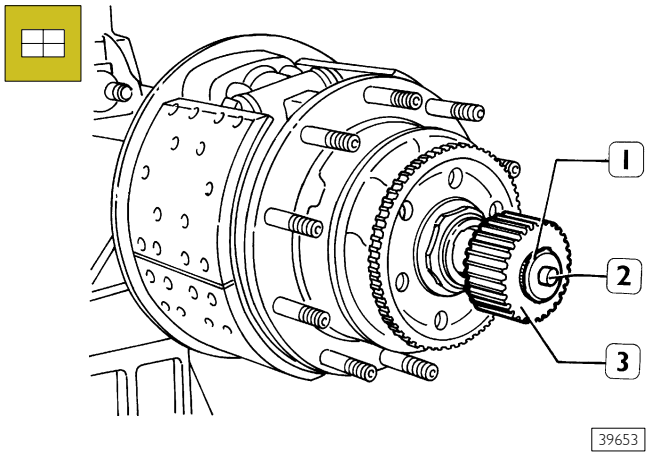
Figure 36



Using tool 99374451 (1) introduce the drive shaft (2) on the load bearing sleeve (3).

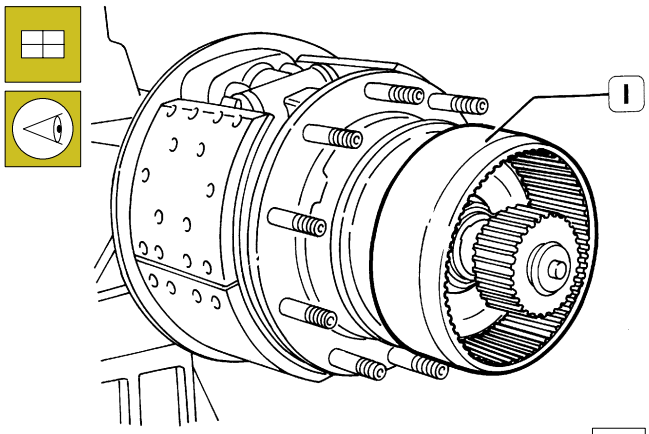
NOTE The double toothed short half shaft is to be fitted in the bearing shaft on the differential locking side.

Figure 37



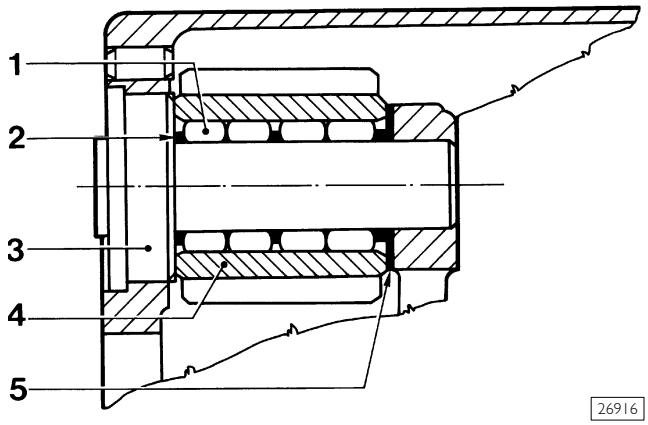
Position the gear unit (3) on the grooved section of the drive shaft and the safety ring (1) in the seat. Drive the shoulder pin (2) into the seat on the drive shaft.

Figure 38



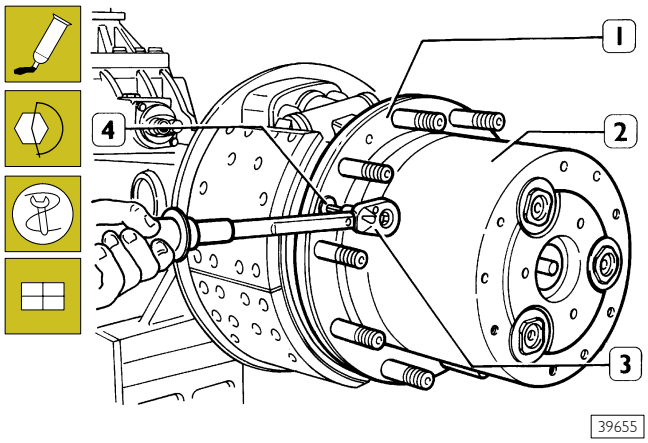
Position the bevel gear (1) with the external bevel facing outwards and then fit on the bevel gear support.

Figure 39



Smear the rollers (1) with grease and position, together with the three spacer rings (2) on the side pinion (4), as shown in the drawing.
Position the side pinion (4) and the spacer washer (5) in the side pinion support.
Introduce the support pin (3) from the cover side, pushing it fully into position.
Repeat the same operation for the remaining two side pinion units.

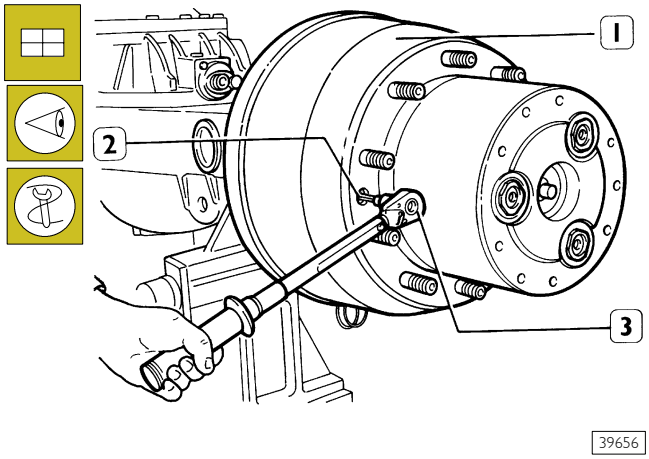
Figure 40



Smear a thin layer of LOCTITE 573, or Reinzoplast, on the contact surfaces of the side pinion support (2) and the wheel hub (1).

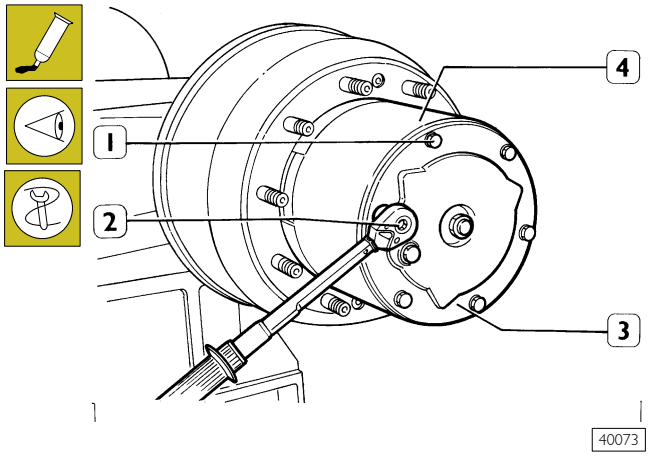
Push the side pinion support (2) onto the hub by moving the drive coupling flange in both directions to facilitate toothing engagement. Make sure that the fixing holes on the side pinion support and the hub coincide.
Position the three cheese-headed screws (4) and tighten to a torque of 50 ± 5 Nm with a torque wrench (3).

Figure 41



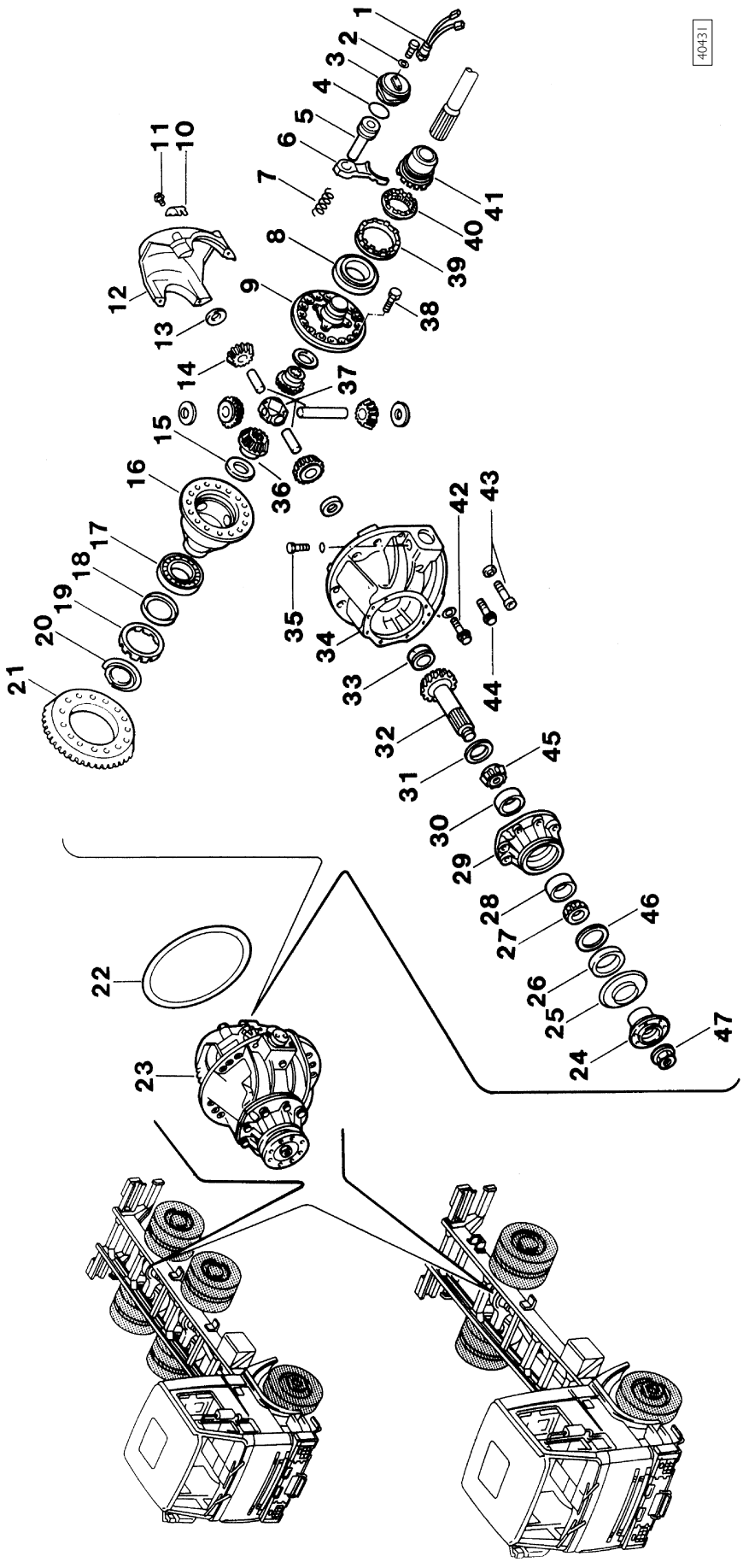
Fit the brake drum (1) on the side pinion support. Secure the brake drum with the two cheese-headed screws (2) and tighten to a torque of 50 ± 5 Nm with a torque wrench (3).

Figure 42



Smear a thin layer of LOCTITE 510 on the cover (3) and side pinion support (4) contact surfaces.
Position the cover so that the bevels of the support pins coincide with the holes on the cover.
Smear LOCTITE 573 sealing compound on the screw (1) thread and tighten to a torque of 50 ± 5 Nm with a torque wrench (2).

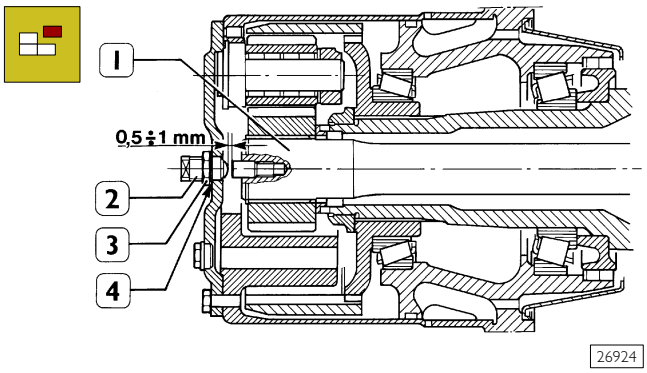
Figure 43



DIFFERENTIAL UNIT PARTS

1. Electric transmitter - 2. Seal and coupling ring - 3. Cover - 4. Seal ring - 5. Piston - 6. Fork - 7. Springs - 8. Bearing - 9. Cover - 10. Plate - 11. Screw - 12. Cover - 13. Washer - 14. Side pinion - 15. Shoulder washer - 16. Half-housing - 17. Bearing - 18. Ring - 19. Ring nut - 20. Oil baffle - 21. Ring bevel gear - 22. Seal ring - 23. Differential unit - 24. Flange - 25. Dust seal - 26. Seal ring - 27. Bearing - 28. Bearing - 29. Pinion support - 30. Bearing - 31. Adjusting ring - 32. Pinion - 33. Bearing - 34. Housing - 35. Screw - 36. Crown wheel - 37. Cross pins - 38. Screw - 39. Ring nut - 40. Sleeve - 41. Sliding sleeve - 42. Screw - 43. Screw - 44. Screw - 45. Bearing - 46. Ring - 47. Nut

Figure 44



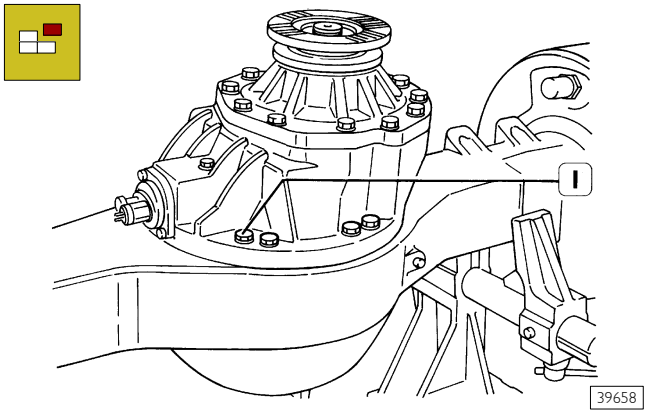
26924

The end float on the drive shaft (1) must be between 0.5 and 1 mm. To carry out this adjustment fully tighten the adjusting screw (2), then unscrew by half a turn and secure with the hex nut (3).

NOTE The flat face of the hex nut must be positioned towards the seal ring (4).

526210 REMOVING-REFITTING THE DIFFERENTIAL

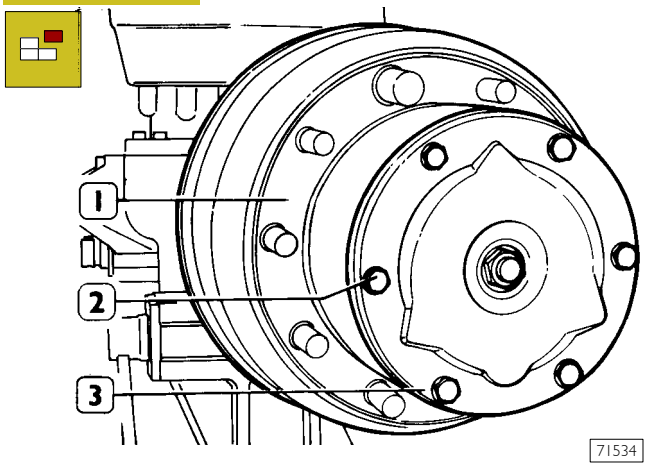
Figure 45



39658

Remove the screws (1) fixing the differential housing to the axle housing.

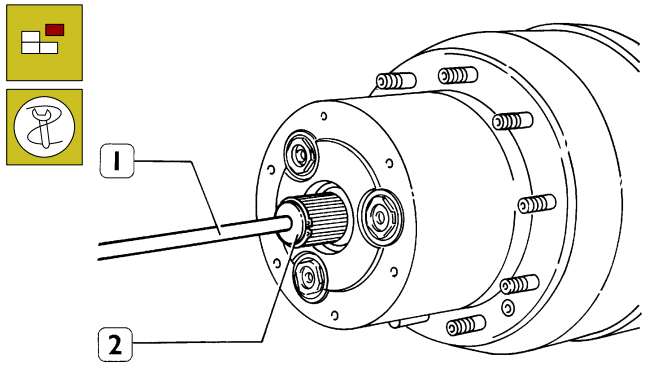
Figure 46



71534

Position a container under the wheel hub (1); unscrew the screws (2), remove the cover (3) and drain off the oil.

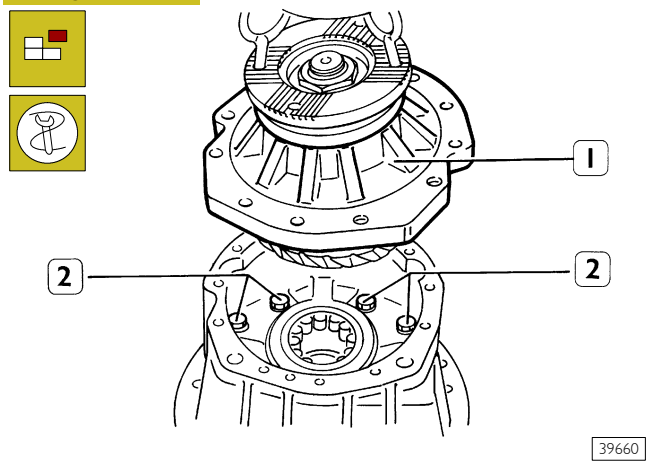
Figure 47



39659

Fit tool 99374451 (1) in the shoulder pin seat thread, then extract the drive shaft (2) from the load bearing sleeve.

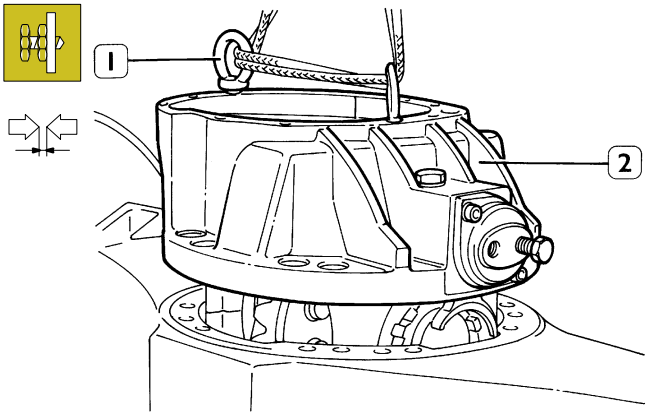
Figure 48



39660

Using eyebolts, raise the pinion support (1) with a sling and unscrew the four screws (2) fixing the differential housing.

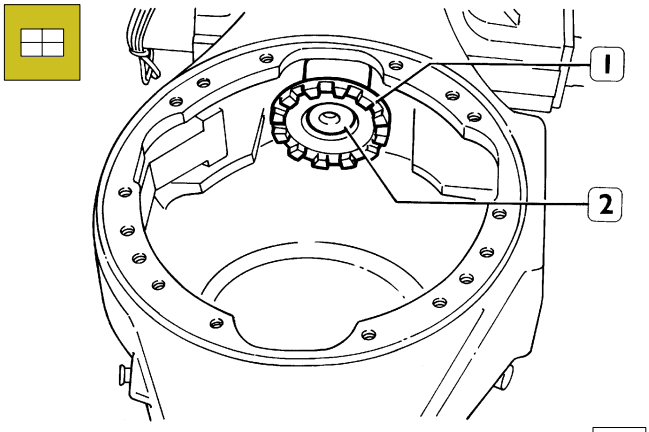
Figure 49



39661

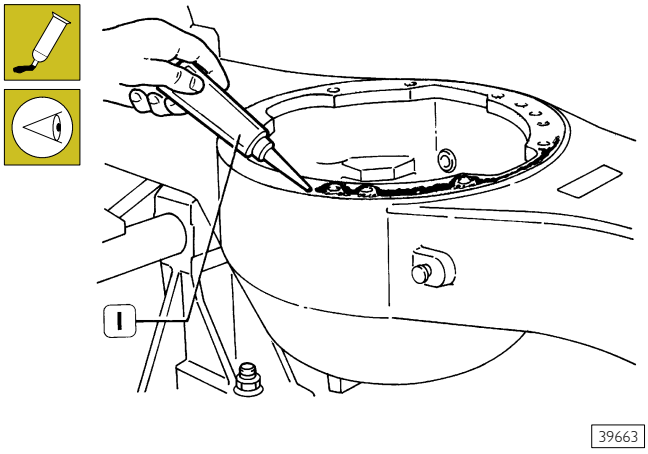
Using eyebolts (1) and a sling, raise the differential housing (2).

Figure 50



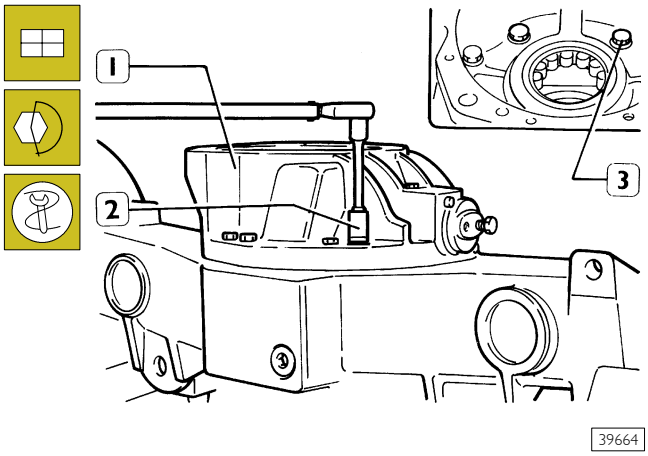
Fit the sliding sleeve (1) on the drive shaft (2) with double toothing.

Figure 51



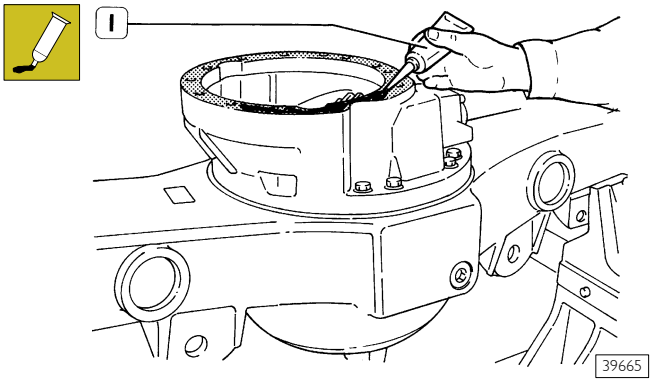
Smear LOCTITE 573 (1) sealing compound on the contact surface. When assembling the differential housing, make sure that the differential lock engagement fork is correctly introduced on the sliding sleeve.

Figure 52



Position the seal ring and assemble the differential housing (1). Apply LOCTITE 573 on the threads of the external screws (2). Using a torque wrench, tighten the external (2) and internal (3) screws to the correct torque.

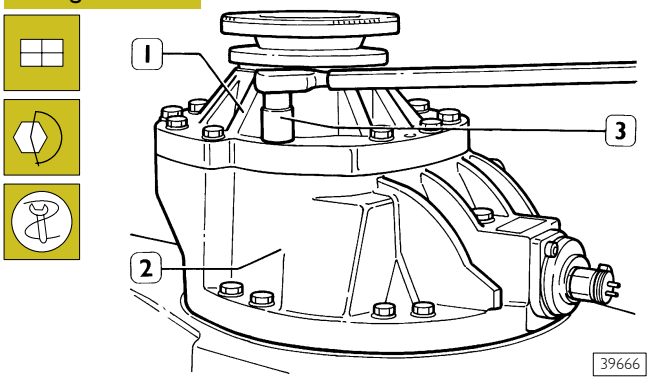
Figure 53



Smear LOCTITE 573 (1) sealing compound on the contact surface.

Apply a bead of LOCTITE 510 around the oil passage holes.

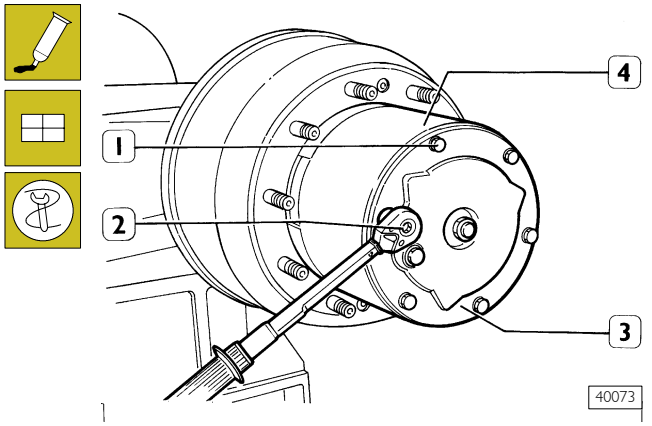
Figure 54



Position the bevel pinion support (1) on the differential housing (2). Using a torque wrench, tighten the screws (3) to the correct torque.

Apply LOCTITE 573 on the threads of the screws (3) that pass through the holes.

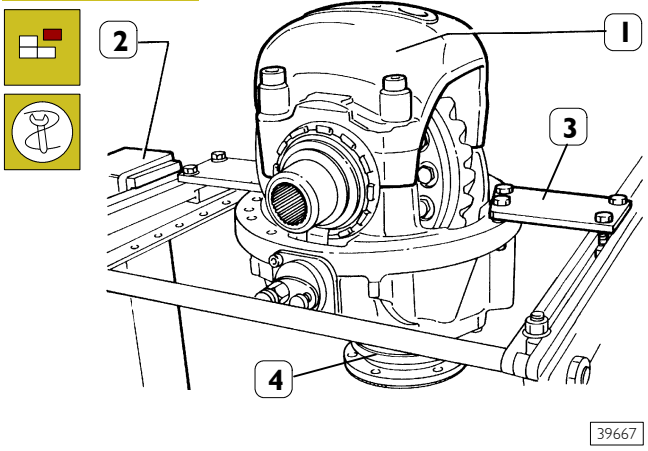
Figure 55



Smear a thin layer of LOCTITE 510 on the cover (3) and crown wheel support (4) contact surfaces. Position the cover so that the bevels of the support pins coincide with the holes on the cover. Smear LOCTITE 573 sealing compound on the screw (1) thread and tighten to the correct torque with a torque wrench (2).

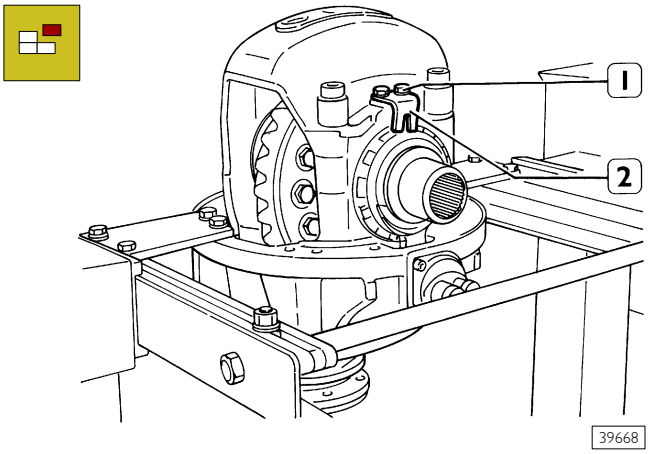
REPAIRING THE DIFFERENTIAL
Disassembly

Figure 56



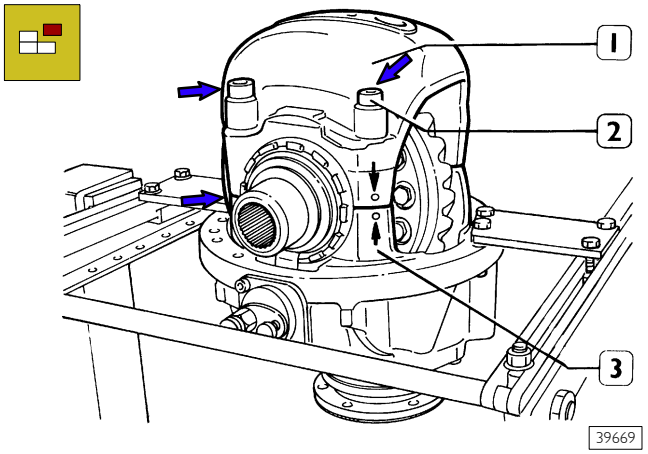
Position the differential housing with the gear housing cover (1) facing upwards, on rotating stand 99322205 (2), together with support 99322225 and pair of brackets 99371022 (3). Provisionally fit the bevel pinion support (4).

Figure 57



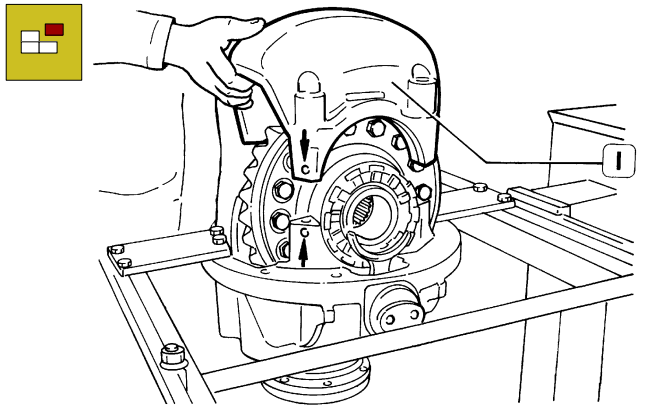
Unscrew the screws (1) and remove the safety plate (2). Repeat the same operation on the opposite side.

Figure 58



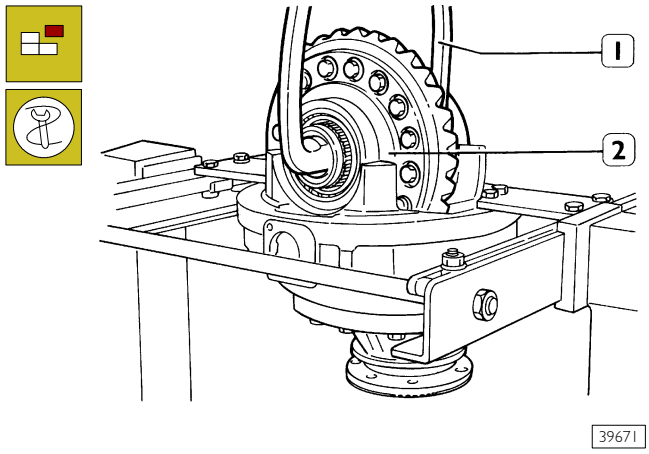
Heat the points indicated by the arrows with drier 99305121 and unscrew the screws (2) fixing the cover (secured with LOCTITE).

Figure 59



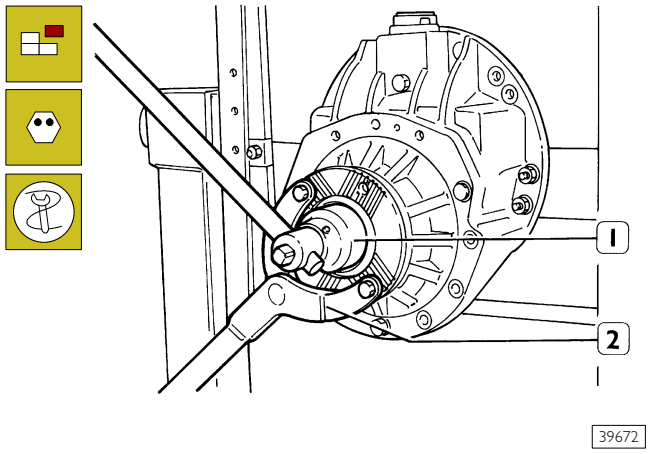
Raise the gear housing cover (1).

Figure 60



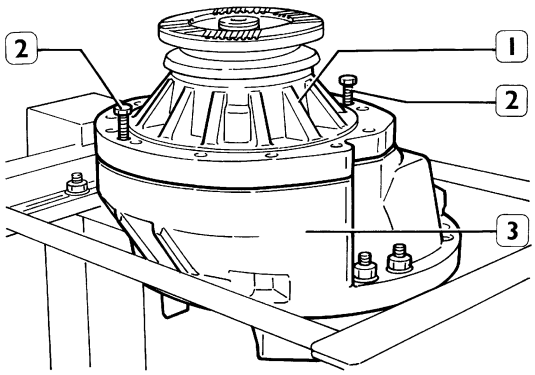
Using hook 99370509 (1), raise the gear housing (2), together with the taper roller bearings and bearing external rings.

Figure 61



Rotate the differential housing through 90°.
Remove the safety notch on the fixing nut.
Apply reaction lever 99370131 7 (2) to the drive coupling flange and, using Allen wrench 99355081 (1), loosen the fixing nut.

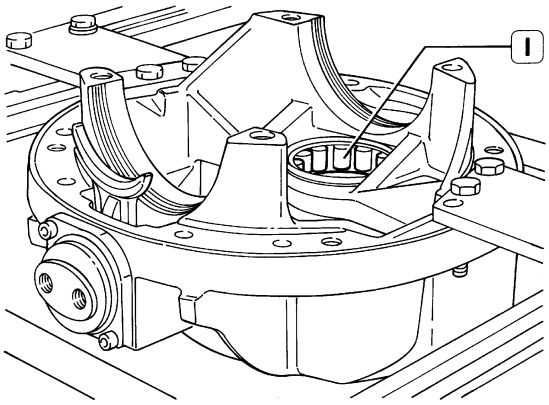
Figure 62



39673

Unscrew the screws and washers of the differential housing (3) bevel pinion support (1). Fit the reaction screws (2) and extract the differential housing support.

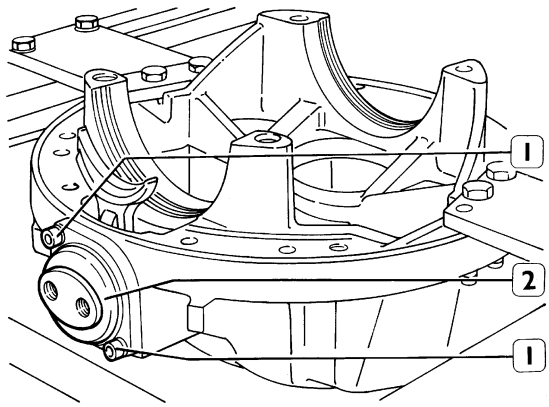
Figure 63



39674

Using a universal punch, extract the bevel pinion taper roller bearing (1) from the seat on the differential housing.

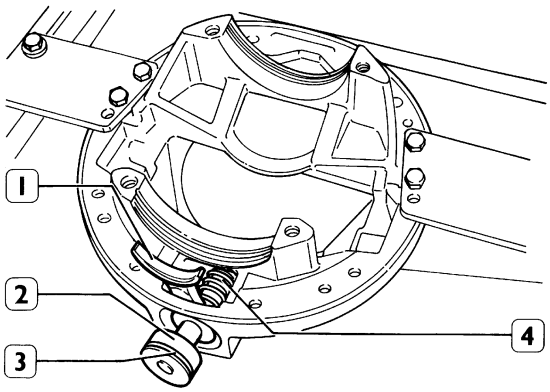
Figure 64



39675

Unscrew the 2 sunken hex screws (1) and remove the differential locking device control cylinder (2).

Figure 65

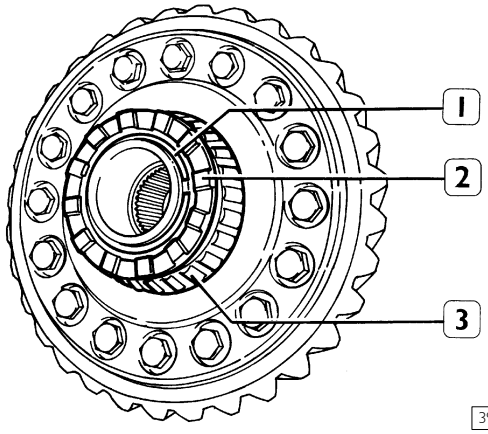


39676

Extract the piston (2), together with the seal ring (3), the engaging fork (1) and the compression spring (4).

Gear housing disassembly

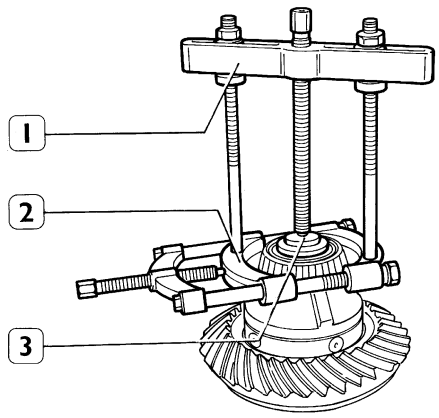
Figure 66



39677

Remove the circlip (1) and extract the differential lock engaging sleeve (3) from the gear housing cover (2).

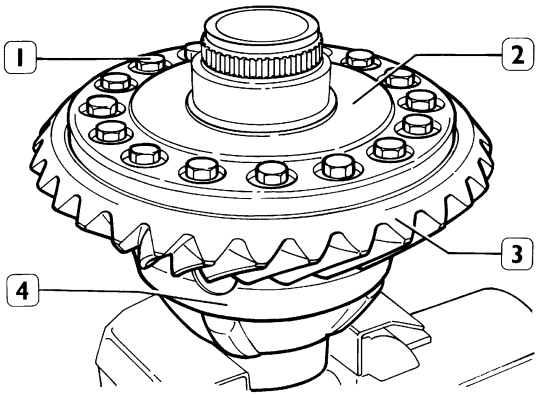
Figure 67



40086

Using extractor 99348001 (1-2) and reaction block 99345055 (3), extract the taper roller bearing from the gear housing. Repeat the same operation on the opposite side.

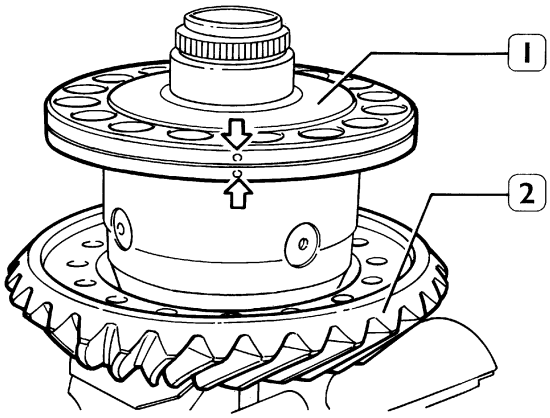
Figure 68



39679

Loosen and extract the screws (1) fixing the ring bevel gear (3) and cover (2) to the half-housing (4).

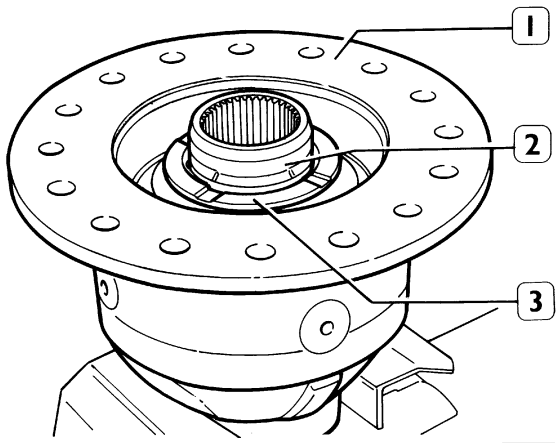
Figure 69



39680

Counter-mark the cover and gear housing (⇒ ⇐).
Remove the gear housing cover (1) and release the ring bevel gear (2).

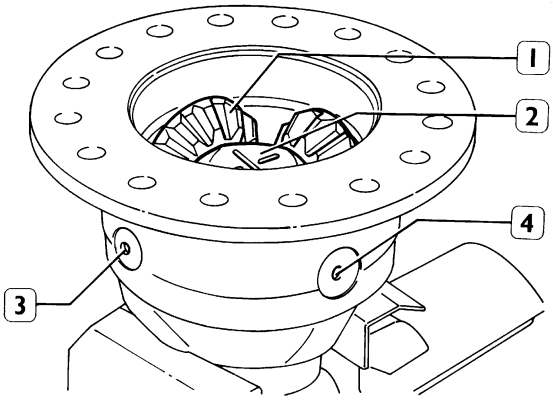
Figure 70



39681

Remove the crown wheel (2), together with the shoulder washer (3), from the gear housing (1).

Figure 71



39682

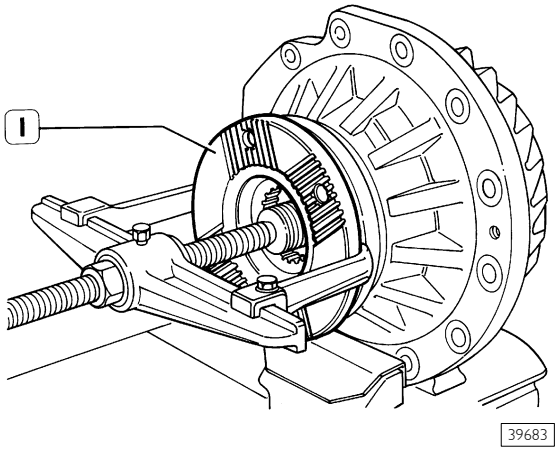
Using a punch, first extract the long pin (4) and then the two short pins (3).

NOTE The exact position of the pins is marked on the spider body (2) by a long stripe for the long pin, and by two short stripes for the short pins.

Remove the spider (2) and the four side pinions (1) with the relative shoulder washers.
Remove the crown wheel and the shoulder washer.

Removing the bevel pinion from the support

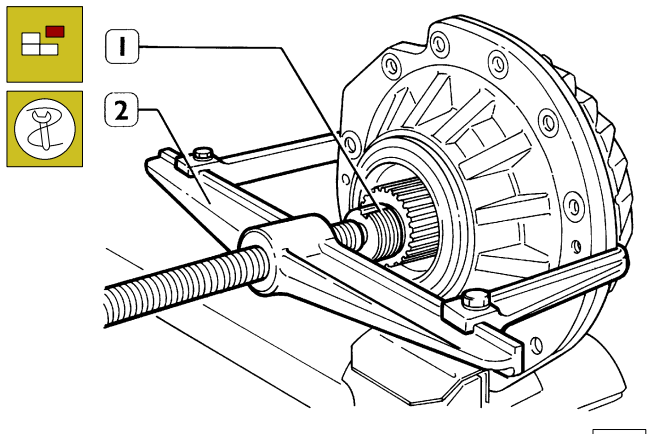
Figure 72



39683

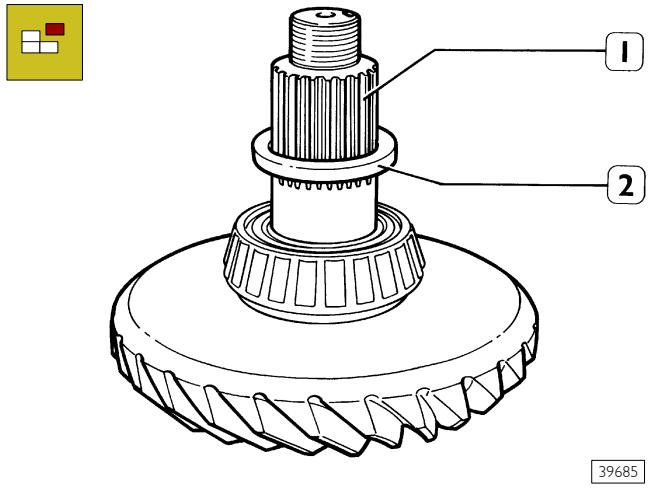
Remove the fixing nut and the drive coupling flange (1).
If flange extraction proves difficult, use a universal extractor.

Figure 73



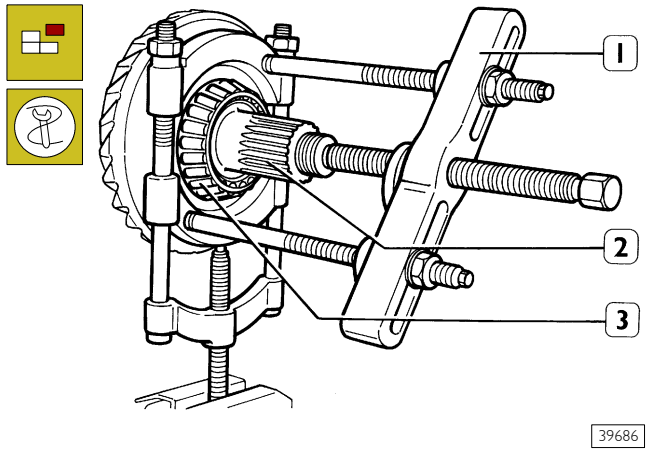
Remove the bevel pinion (1), intermediate bearing and adjusting rings from the support. This operation should be carried out under a press; if not, use an extractor (2).

Figure 74



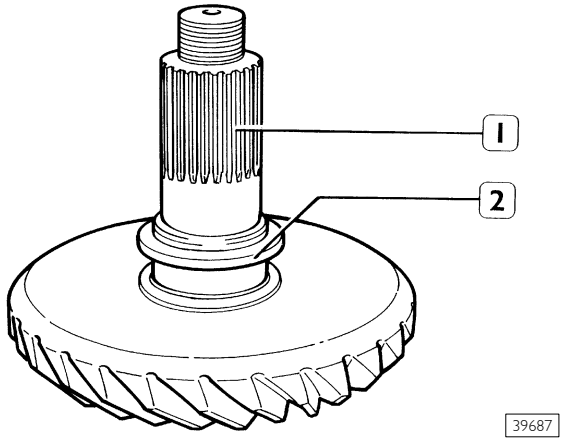
Remove the bearing adjustment ring (2) from the bevel pinion (1).

Figure 75



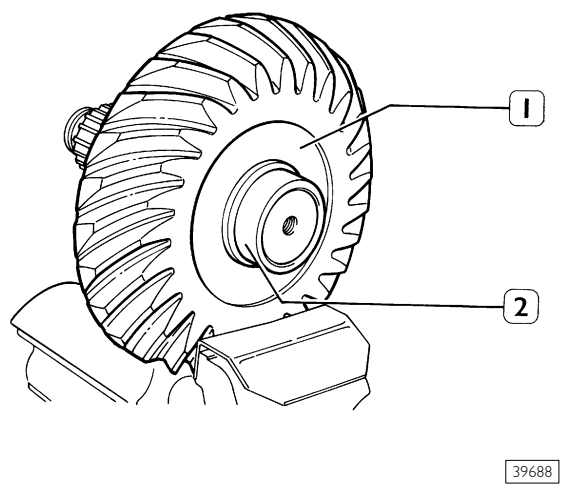
Using universal extractor 99348001 (1), extract the intermediate taper roller bearing (3) from the bevel pinion (2).

Figure 76



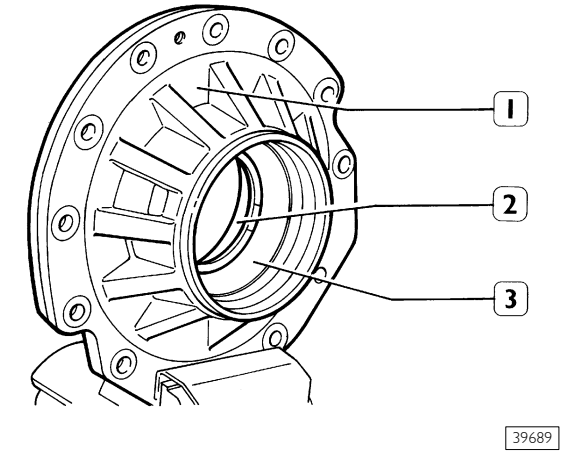
Extract the pinion position adjusting ring (2) from the bevel pinion (1).

Figure 77



Extract the rear straight roller bearing internal ring (2) from the bevel pinion (1). This is a destructive operation.

Figure 78



Using a punch, extract the external rings (3 and 2) for the front and intermediate bearings from the support (1).

CHECKING THE DIFFERENTIAL COMPONENTS

Carefully clean all of the individual differential components. Lubricate the bearings and make sure that the roller support cage rotates freely, rotation should be smooth, without hardening.

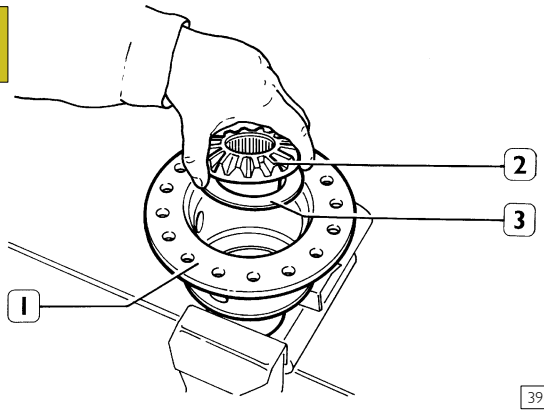
NOTE Carefully clean all the threads to ensure exact adjustments and precise tightening torque values.

Check that the grooved section on the pinion flange is not excessively worn. Replace the pinion if necessary.

If either the bevel gear or pinion need to be changed, both parts must be replaced as they are provided as coupled spare parts.

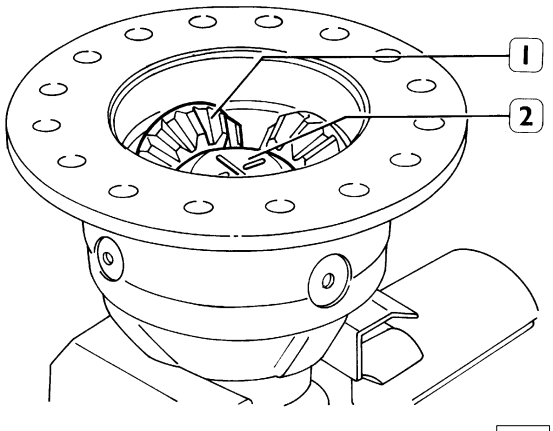
Gear housing assembly

Figure 79



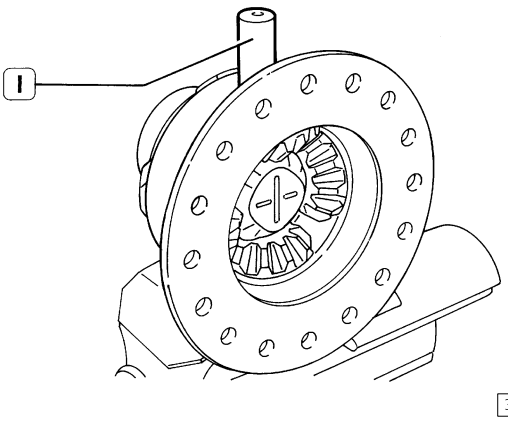
Secure the gear housing (1) in a vice and position the crown wheel (2) in its seat, together with the shoulder washer (3).

Figure 80



Assemble the four side pinions (1) with the shoulder washers and insert the spider (2).

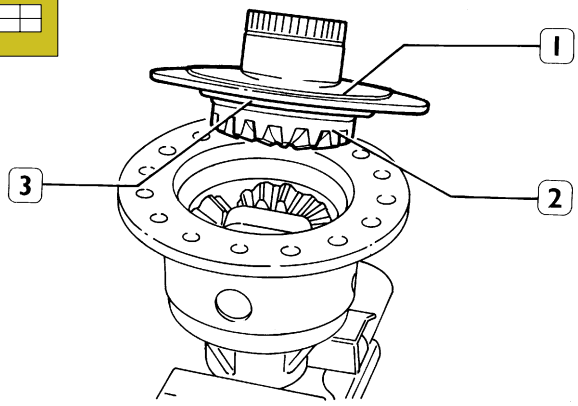
Figure 81



Insert the long pin (1) and the two short pins.

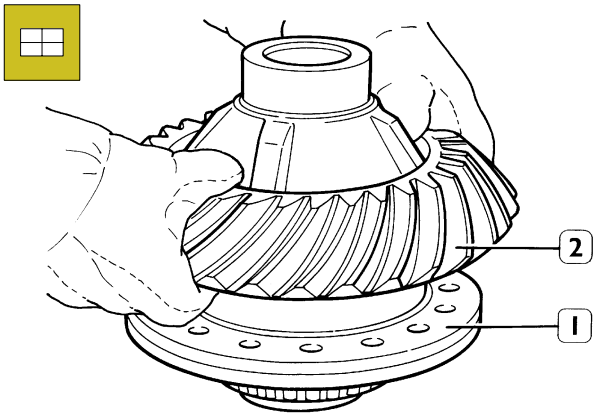
NOTE First insert the long (through) pin. The exact position of the pins is marked on the spider body by a long stripe for the long pin, and by two short stripes for the short pins.

Figure 82



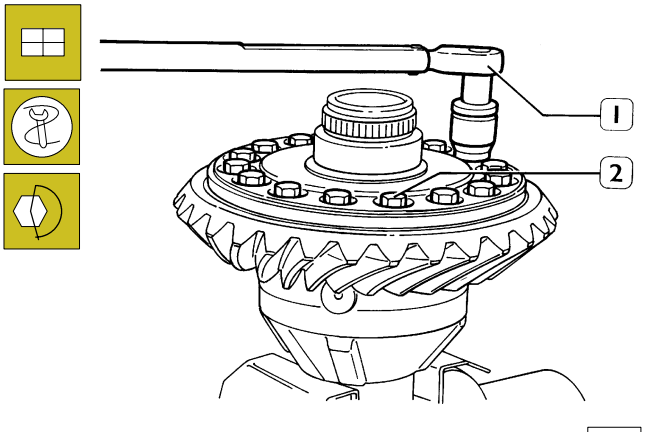
Position the crown wheel (2) and shoulder washer (3) on the side pinion gear unit.
Fit the cover (1) on the gear housing by making the marks (made during disassembly operations) coincide.

Figure 83



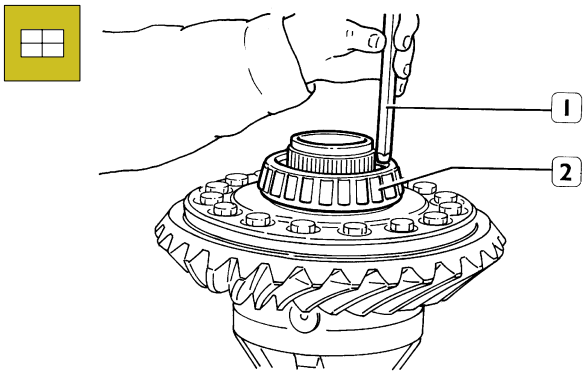
Heat the ring bevel gear (2) to approx. 80°C, fit in position in the gear housing (1) and secure with two fixing screws.

Figure 84



Fit the remaining screws (2) and tighten with a torque wrench (1) to 300 ± 10 Nm (30 ± 1).

Figure 85

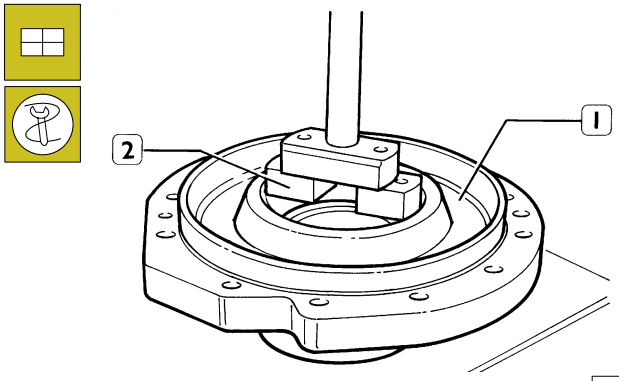


39696

Using an electric heater, heat the support bearing (2) for 15' at a temperature of 100°C and fit on the gear housing cover using a punch (1). Repeat the same operation on the other bearing.

Assembling the bevel pinion support

Figure 86

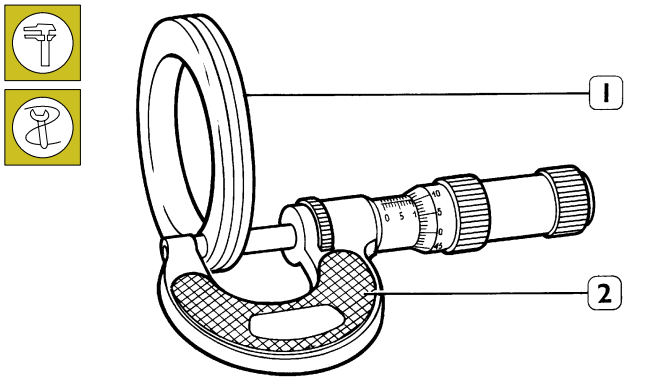


39697

Fit a new oil baffle on the pinion support (1) Using punch 99374093 (2), fit the intermediate bearing external ring and the front bearing external ring in the support in their respective seats.

Procedure to follow to determine the thickness of the bevel pinion rolling torque adjusting ring

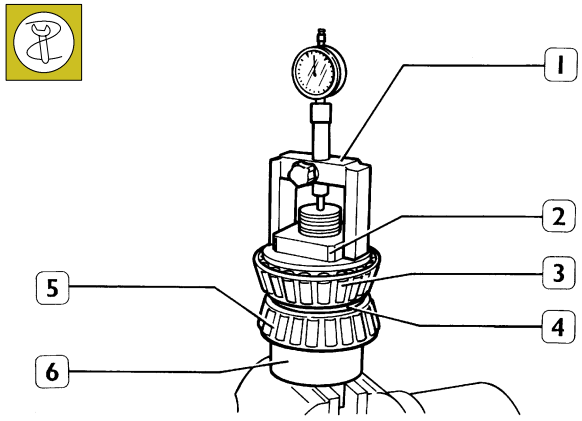
Figure 87



39572

Using a feeler gauge (1) measure and note the thickness of the adjusting ring on disassembly (value A).

Figure 88



39698

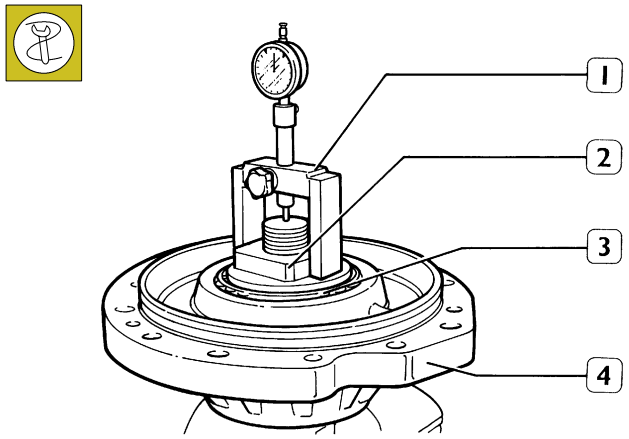
Secure tool 99395027 (6) in a vice and fit the following parts:

- ❑ the bearing (5) on the pinion-side;
- ❑ the previously measured adjusting ring (4) and the bearing (3).

Fully tighten the ring nut (2).
Position part (1) of tool 99395027 (6) on the bearing (3), fitted with a zero-set dial gauge on the end of the tool (6).
Then remove:

- ❑ the part (1),
- ❑ the ring nut (2),
- ❑ the bearing (3),
- ❑ the adjusting ring (4) on the tool (6).

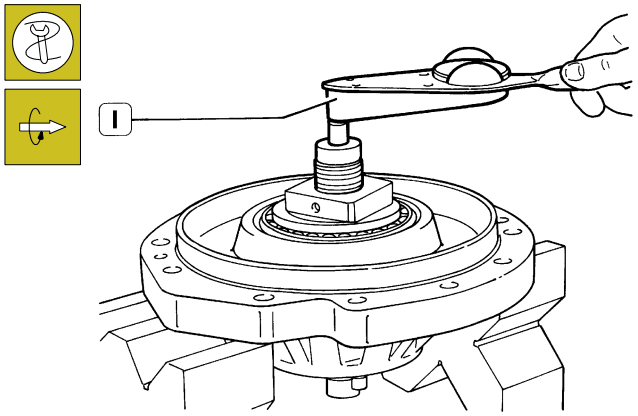
Figure 89



39699

Position the support (4) on the bearing (5, Figure 88) and the bearing (3) on the support. Tighten the ring nut (2) by hand and check the rolling torque, as indicated in Figure 90.

Figure 90



Position the complete support on two parallel blocks; using the torque wrench (1) applied on tool 99395027 and read the rolling torque. This value should be 1.5 to 3.5 Nm; if not, adjust by means of the ring nut (2, Figure 87).
Position the part (1, Figure 79), with the dial gauge zero-set, on the bearing (3) and read the eventual deviation (value B).

Thickness **S** on the adjusting ring is provided by the following formula:

Where:

A = thickness of the adjusting ring assembled for dial gauge zero-setting;

B = deviation value read;

C = 0.05 mm coefficient which takes into account the expansion of the bearings as a result of the assembly negative allowance on the bevel pinion.

First example:

A = 10.12 mm
B = + 0.13 mm
C = 0.05 mm

S = 10.12 - (+ 0.13) + 0.05 =
S = 10.12 - 0.13 + 0.05 = 10.04 mm.

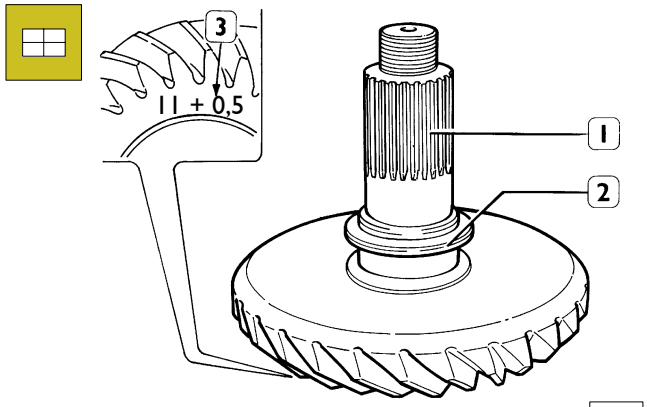
Second example:

A = 10.12 mm
B = - 0.13 mm
C = 0.05 mm

S = 10.12 - (- 0.13) + 0.05 =
S = 10.12 + 0.13 + 0.05 = 10.35 mm.

On completion of the operation, remove the parts of tool 99395027.

Figure 91



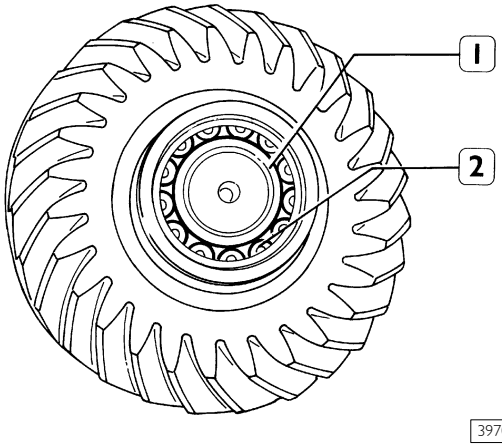
Fit the adjusting ring (2), in order to position the pinion in relation to the bevel gear, on the bevel pinion (1). The thickness of the adjusting ring is determined by the reference value (3) marked on the bevel pinion.
See the table in Figure 92.

Figure 92

Value marked on the bevel pinion	Total thickness of adjusting ring
0	4.6
0.1	4.5
0.2	4.4
0.3	4.3
0.4	4.2
0.5	4.1
0.6	4.0
0.7	3.9
0.8	3.8
0.9	3.7
1.0	3.6

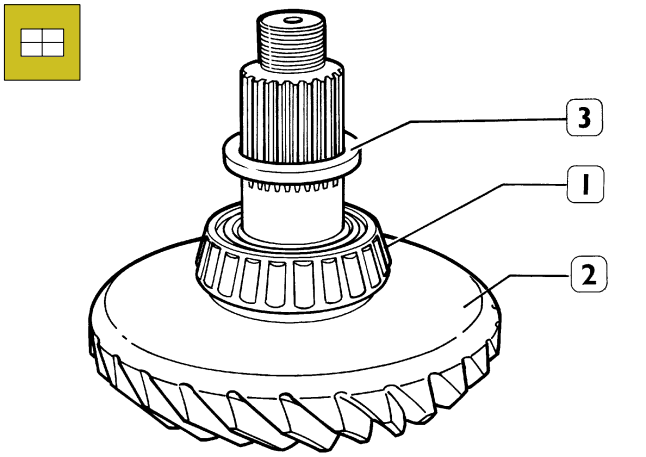
Summary table to determine the thickness of the bevel pinion position adjusting ring.

Figure 93



Heat with an electric drier to 100°C and insert the rear straight rollers bearing internal ring (1) on the bevel pinion (2).

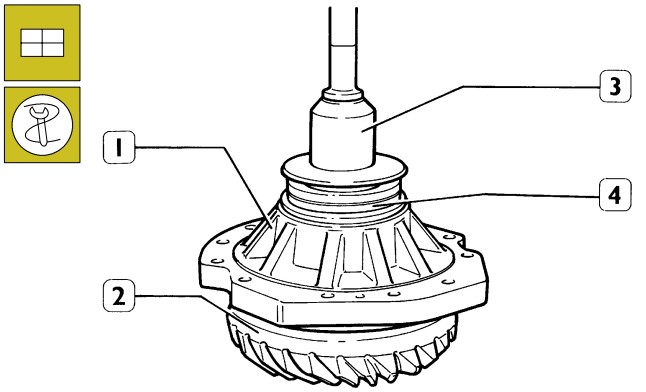
Figure 94



39703

Heat the intermediate bearing (1) for approx. 15' at a temperature of 100°C and fit on the bevel pinion (2); fit the adjusting ring (3) with the same thickness as previously noted (page 29-30).

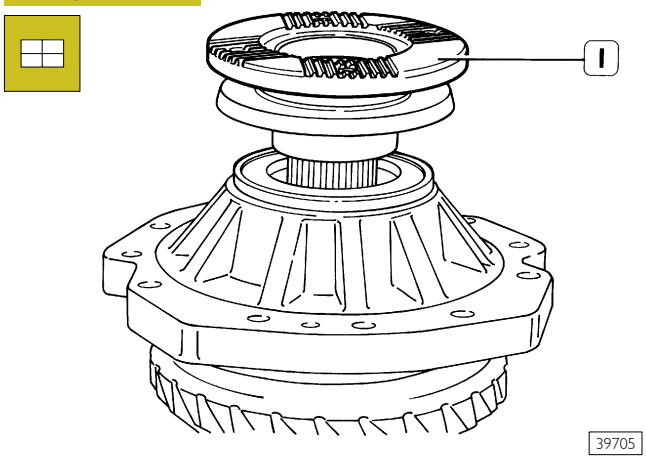
Figure 95



39704

Fit the previously assembled support (1) on the bevel pinion (2), fitting the front bearing. Using key 99374013 (3) and grip 99370006, insert the oil seal ring (4).

Figure 96

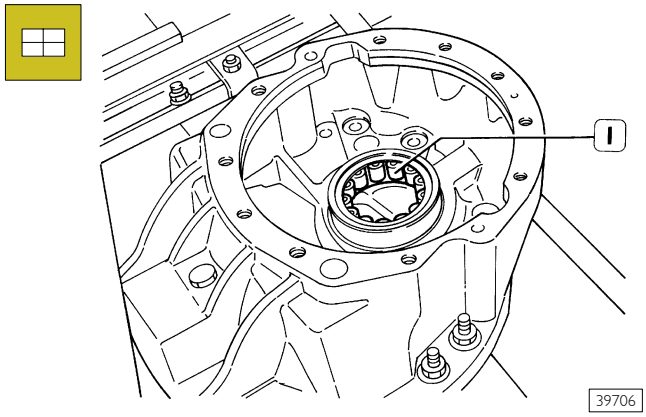


39705

Assemble the drive coupling flange (1) with a punch and tighten the fixing nut by hand.

Differential housing assembly

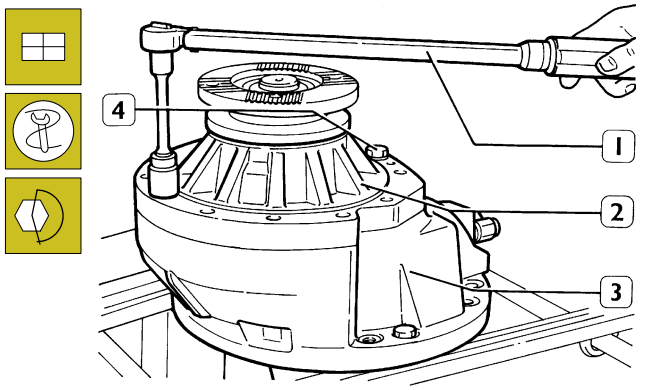
Figure 97



39706

Using a punch, fit the rear straight rollers bearing (1) in position on the differential housing.

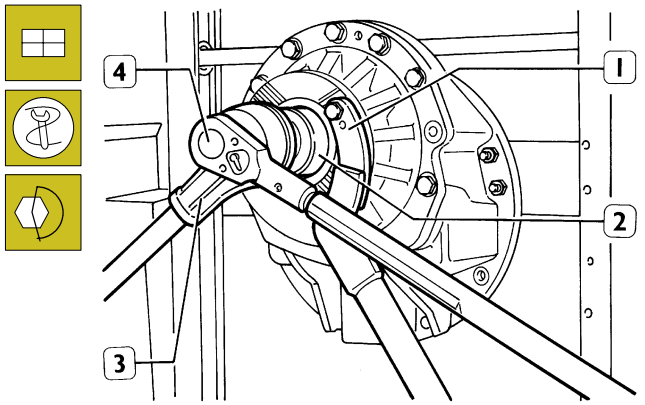
Figure 98



39707

Provisionally assemble the bevel pinion support (2) on the differential housing (3), insert 2 screws (4) and washers in diametrically opposing positions. Using a torque wrench (1), tighten to a torque of 160 ± 10 Nm (16 ± 1 kgm).

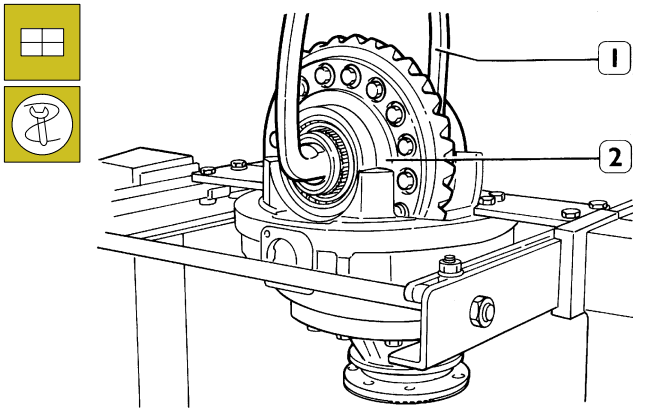
Figure 99



39708

Block the drive coupling flange rotation using reaction lever 99370317 (1) and, using Allen wrench 99355081 (2), the multiplier (3) and a torque wrench (4) tighten the fixing nut to a torque value of 700 ± 50 Nm (70 ± 5 kgm).

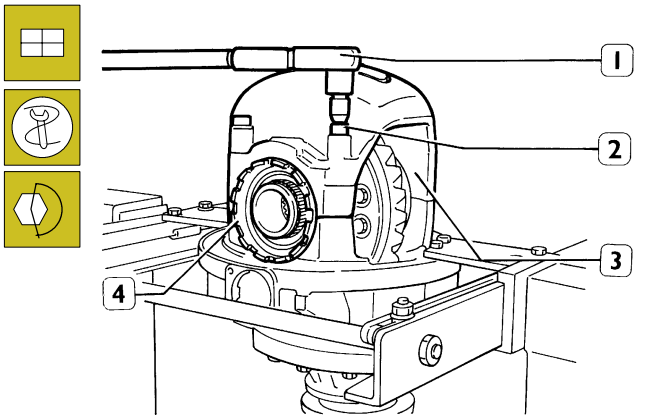
Figure 100



39671

Using hook 99370509 (1), position the gear housing (2) together with the roller bearings on the differential housing.

Figure 101



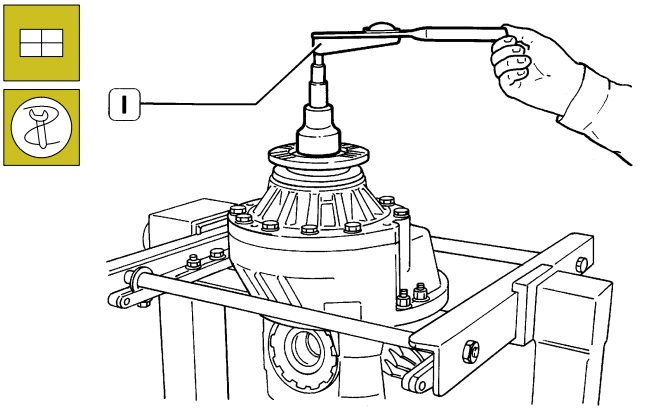
39709

Correctly fit the cover (3) making the marks (made during disassembly operations) coincide. Provisionally tighten the screws (2) and check that the adjusting ring nuts (4) screw-in easily.
Remove the screws (2), smear the threads with LOCTITE AVX and then re-tighten with a torque wrench (1) to a torque of 280 ± 15 Nm.

Gear housing bearings rolling torque adjustment

The rolling torque reading is carried out when there is a clearance between the teeth on the bevel gear pair. However, the total rolling torque value varies according to the reduction bevel gear pair ratio (see table in Figure 103).

Figure 102



39712

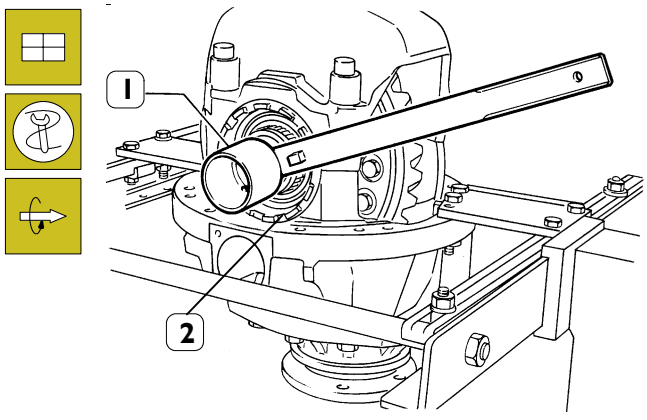
Using torque wrench 99389819 (1) and the appropriate Allen wrench, check that the total rolling torque value corresponds with the value indicated in Figure 103.

Figure 103

No. of teeth	Ratio	Total rolling torque (Nm)
17/35	2.059	a + (1.5 - 2.4)
19/33	1.737	a + (1.6 - 2.6)
21/34	1.619	a + (1.9 - 3.1)
23/36	1.565	a + (1.9 - 3.2)
24/35	1.458	a + (2.1 - 3.4)
28/37	1.321	a + (2.3 - 3.8)
27/32	1.185	a + (2.5 - 4.2)
21/40	1.905	a + (1.6 - 2.6)
27/37	1.370	a + (2.2 - 3.6)
29/37	1.276	a + (2.4 - 3.9)

a = 7.5 ÷ 9.5 Nm

Figure 104



39711

If the torque value is different from that indicated in Figure 104, adjust the adjustment ring nuts (2) with wrench 99354001 (1) until the required torque is obtained.

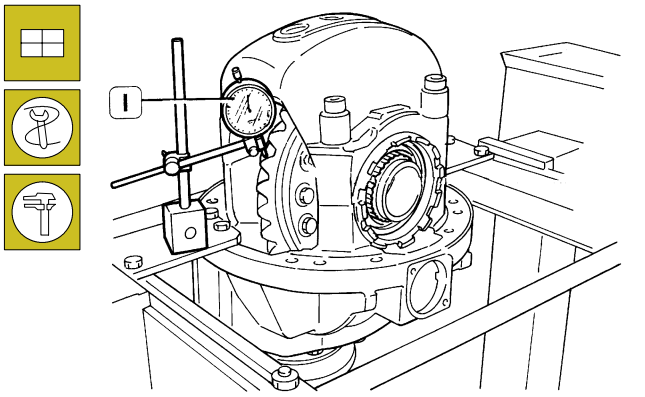
Adjust the end float between the teeth on the bevel gear pair as follows:

- ❑ Read the clearance value between the teeth in Figure 105.

Figure 105

No. of teeth	Ratio	Clearance between teeth
17/35	2.059	0.2 ÷ 0.33
19/33	1.737	0.2 ÷ 0.33
21/34	1.619	0.2 ÷ 0.33
23/36	1.565	0.2 ÷ 0.33
24/35	1.458	0.2 ÷ 0.33
28/37	1.321	0.2 ÷ 0.33
27/32	1.185	0.2 ÷ 0.33
21/40	1.905	0.2 ÷ 0.33
27/37	1.370	0.2 ÷ 0.33
29/37	1.276	0.2 ÷ 0.33

Figure 106

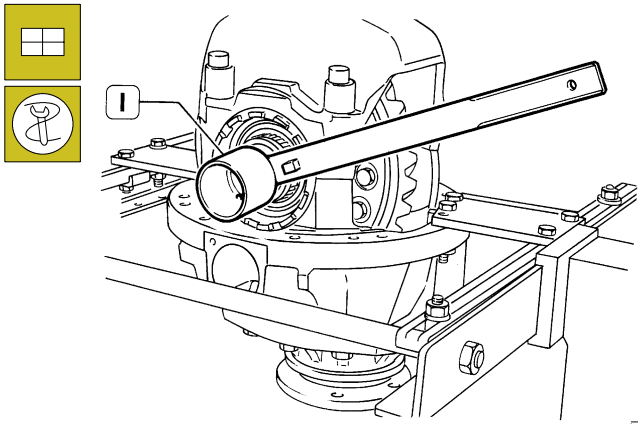


39710

- ❑ Position a magnetic dial gauge (1) as shown in the drawing.
- ❑ Prevent the bevel pinion from rotating with reaction lever 99370317, reverse the direction of rotation of the bevel gear and, using a gauge (1), read the clearance between the teeth on the two gear units.

If not, using the wrench 99354001 (1, Figure 107), adjust the adjusting ring nut.

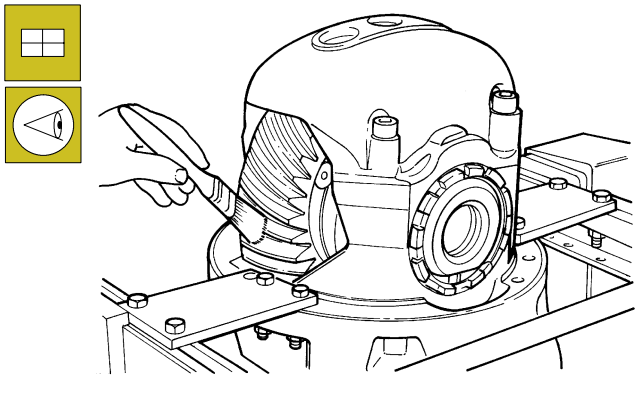
Figure 107



39711

In order to prevent the previously measured rolling torque from varying, during adjustments of the coupling clearance between the pinion and the bevel gear teething, tighten the ring nut with the wrench 99354001 (1) by the same amount as the ring nut on the opposite is loosened.
On completion of operations, check that the two adjusting ring nuts are suitably positioned to allow the safety plate to be fitted.

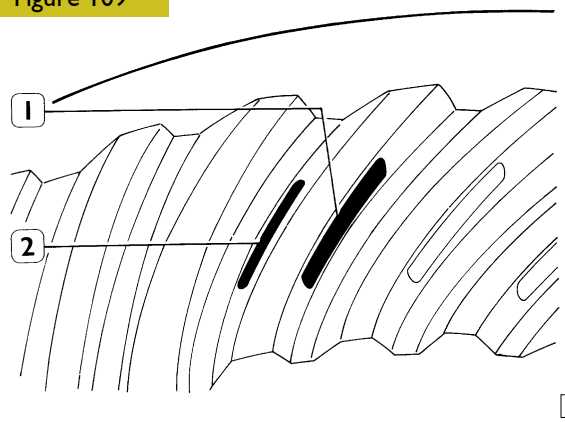
Figure 108



39704

Using a brush, apply a light covering of Prussian blue on the teeth of the bevel gear.
Rotate the pinion and check the coloured contact marks that the pinion teeth have made on the bevel gear teeth.
The following drawings illustrate possible contact marks and the operations required in order to correct the faults.

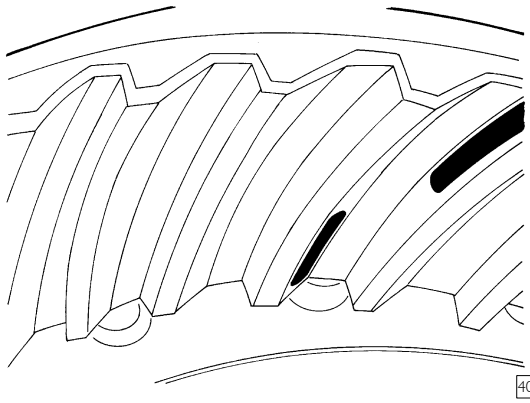
Figure 109



40160

The contact marks should be on both the leading face (1) and the pushing face (2), more or less in the centre between the teeth. When working without a load, both contact zones should be slightly out of position in relation to the external diameter of the bevel gear.

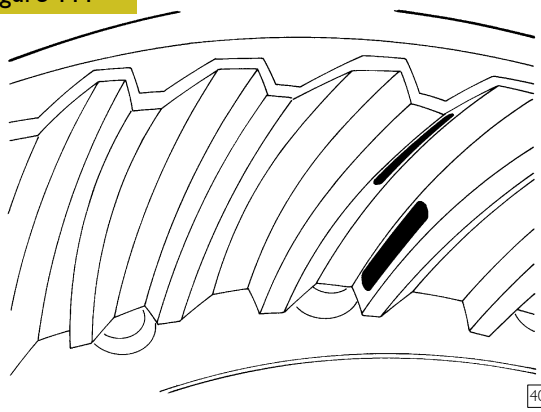
Figure 110



40161A

If the mark on the leading face (towards the external diameter) and on the pushing face (towards the internal diameter) is out of position, the pinion is located too close to the bevel gear.
- Solution: decrease the thickness of the adjusting ring (2, Figure 91) between the intermediate bearing and the bevel pinion.

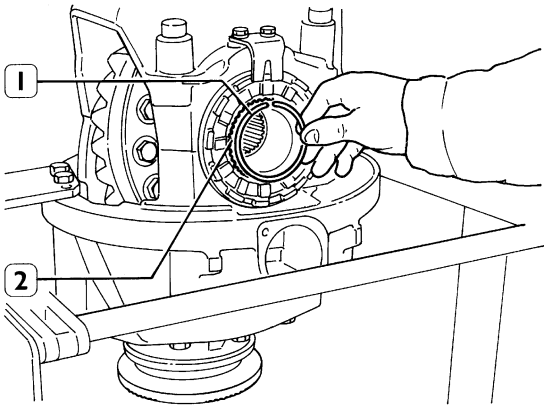
Figure 111



40161B

If the mark on the leading face is positioned towards the internal diameter, and on the pushing face it is located towards the external diameter of the bevel gear, the pinion is located too far away from the bevel gear axis.
- Solution: increase the thickness of the adjusting ring (2, Figure 91) between the intermediate bearing and the bevel pinion.

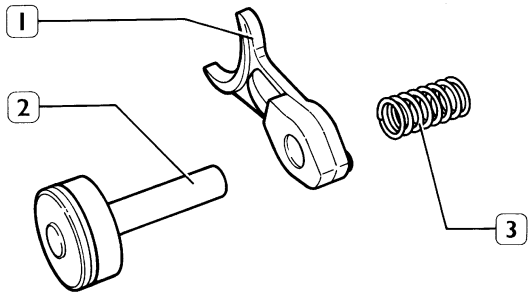
Figure 112



39713

Assemble the engaging sleeve (1) on the gear housing toothing and, with a screwdriver, position the circlip (2) in the groove.

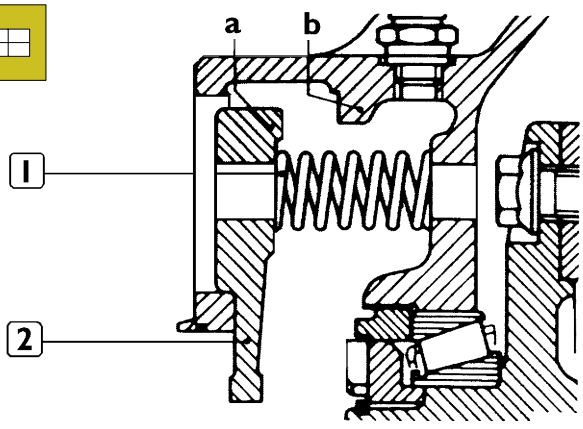
Figure 113



39714

Fit the differential lock engagement assembly comprising: the control cylinder, the piston (2), the engaging fork (1) and the compression spring (3).

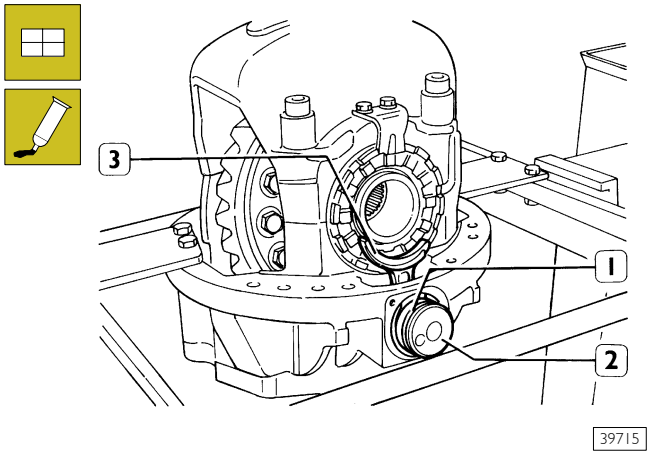
Figure 114



26609

Introduce the compression spring (1) in the differential housing. Fit the engaging fork (2) so that fork (a) travel limit corresponds with travel limit (b) on the differential housing.

Figure 115



Fit a new seal ring (1) on the control piston (2) and smear with grease.
Introduce the control piston (2) on the engaging fork (3) in the compression spring, then fit the assembly in the gap on the differential housing.
Disassemble the bevel pinion support.
Fitting the differential on the axle housing.

1. Fit the sliding sleeve on the drive shaft.
2. Fit the gear housing assembly, taking care that the fork engages in the groove on the sliding sleeve.
3. Tighten the screw whilst pushing the drive shaft so that the sliding sleeve engages on the differential engaging sleeve.
4. Apply LOCTITE 573 on the threads and under the heads of the screws and tighten to the correct torque with a torque wrench.
5. Apply LOCTITE 573 on the contact surface, refit the pinion support and tighten the screws to the correct torque.

Axles in tandem
ARVINMERITOR MT23-155/2D

Page

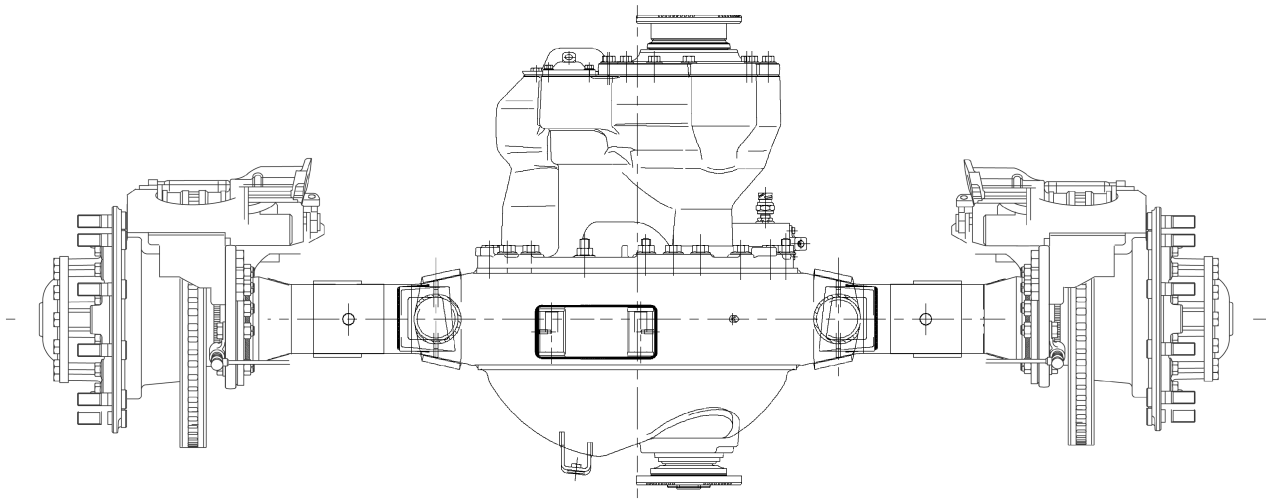
Axles Intermediate
ARVINMERITOR MD11-155/2D

DESCRIPTION

The intermediate axle is of the full-floating, single-reduction type and consists of a steel case housing the inter-axle differential and the main differential.
Drive is transmitted from the inter-axle differential to the main differential by means of two helical gears.

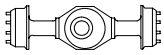
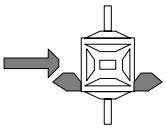
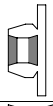
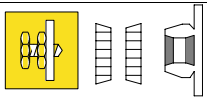
The rear axle is fitted with an air-controlled differential lock device.
Wheel hubs are mounted on two taper roller bearings floating on the sleeve and adjusted by means of a threaded nut.
The brakes are KNORR-type disc brakes.

Figure 1



109090

SPECIFICATIONS ANDA DATA

	Axle type: Full-floating, single reduction with air-controlled differential lock device	**MT23-155/D**
DIFFERENTIAL		
	Final bevel gear ratio (number of teeth: pinion/crown wheel) Standard on models:	4.50 (8/36) - 4.13 (8/33) - 3.78 (9/34) - 3.40 (10/34)
	**WHEEL HUBS**	
	Wheel hub bearings	Two UNIT - BEARING
	Wheel hub bearing end play adjustment	Non-adjustable Tightening to torque with threaded nut
	Rear axle oil Quantity: air suspension litres (kg)	TUTELA W140/M-DA 20 (18)

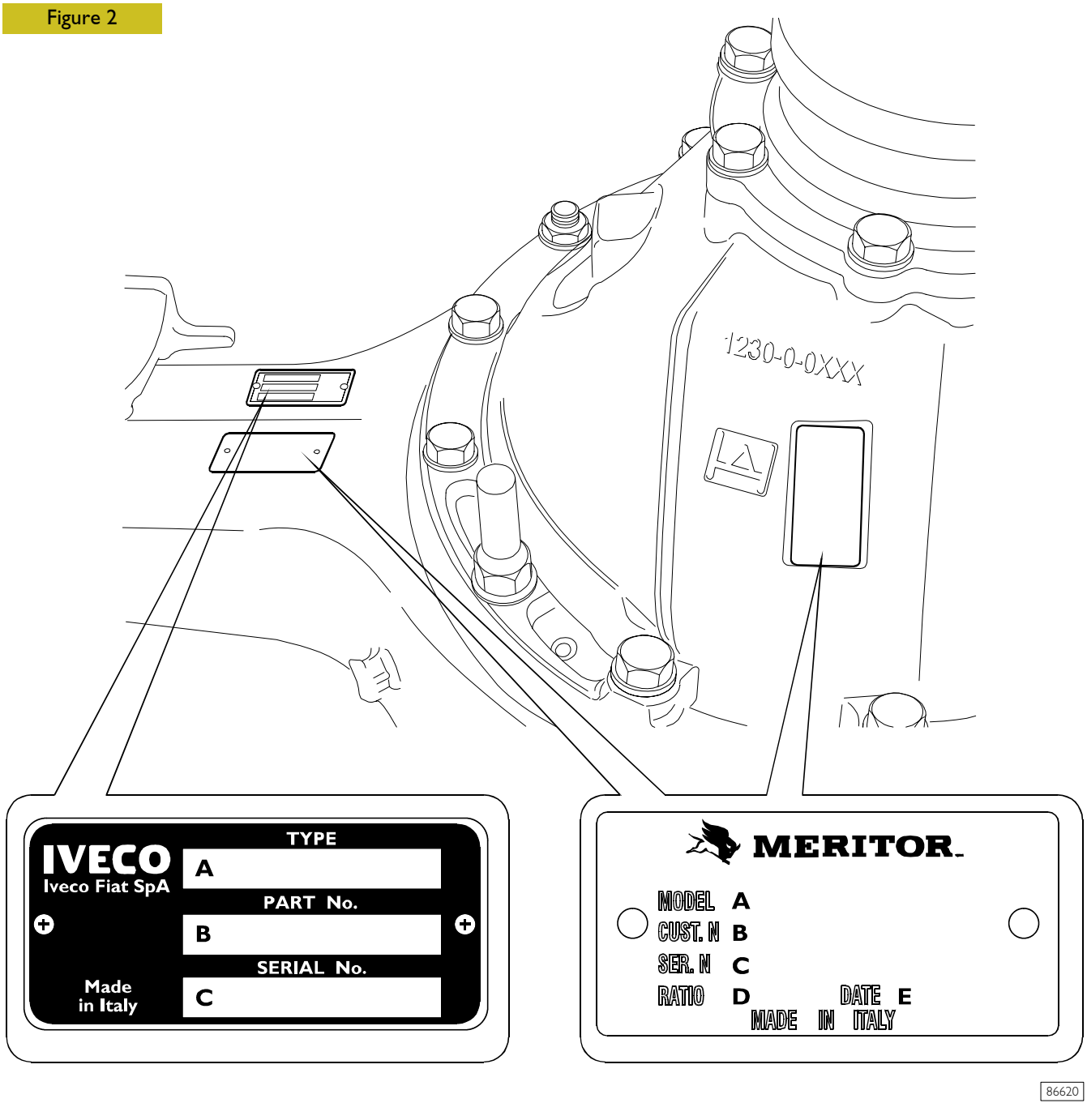
LOCATION OF DIFFERENTIAL UNIT PLATES - REAR AXLE

The plates contain all information and details relating to either DIFFERENTIAL UNIT and REAR AXLE.

On real axle, two plates are present: one on the differential unit and one in same position on rear axle box. On the notifications of interventions under guarantee, rear axle box and differential unit plate data must always be shown. It is suggested always to read and copy out shown data before any repair so as to order correct spare parts and transmit correct information to either IVECO Service Network.

Plate is never to be removed from the unit.

Figure 2



IVECO identification plate

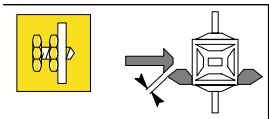
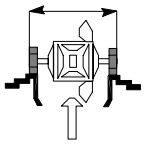
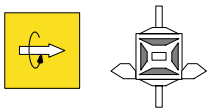
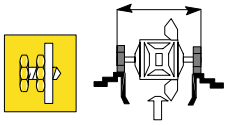
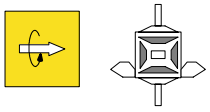
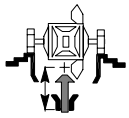
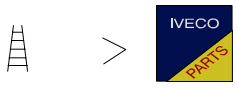
A = identifies rear axle type
B = drawing number
C = production progressive number

ARVINMERITOR identification plate

A = identifies the family the item is belonging to / the model
B = drawing number
C = ArvinMeritor series number
D = rear axle ratio
E = production date

SPECIFICATIONS AND DATA

Axle type: Full-floating, single reduction with air-controlled differential lock device	**MT23-155/D**
DIFFERENTIAL	
Final bevel gear ratio (number of teeth: pinion/crown wheel) Standard on models:	4.50 (8/36) - 4.13 (8/33) - 3.78 (9/34) - 3.40 (10/34)
Bevel drive pinion bearings	2 taper roller
Bevel drive pinion bearing rolling torque	
New bearings — Nm	2.30 ÷ 7.40
New bearings — kgm	0.23 ÷ 0.74
Used bearings — Nm	3.00 ÷ 5.30
Used bearings — kgm	0.30 ÷ 0.53
Bearing drive pinion preloading adjustment	by shims
Shim thickness range or bevel pinion bearing preloading adjustment	-
Bevel drive pinion bearing rolling torque — New bearings — mm	0.20 ÷ 0.46
Bevel drive pinion bearing rolling torque — Used bearings — mm	0.30

	Bevel pinion to crown wheel end play adjustment	By ring nuts
	Cap divergency	0.05 ÷ 0.23
	Differential carrier bearing rolling torque Nm kgm	1.7 ÷ 3.9 0.17 ÷ 0.39
	Cap divergency adjustment	By ring nuts
	Rolling torque between planetary gear and differential gears Nm kgm	-
	Bevel drive pinion setting as to differential carrier	By shims
	Thickness range for shims located between intermediate bearing ring and differential carrier	-

INTER-AXLE DIFFERENTIAL UNIT

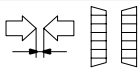
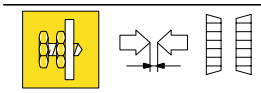
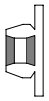
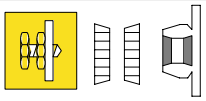
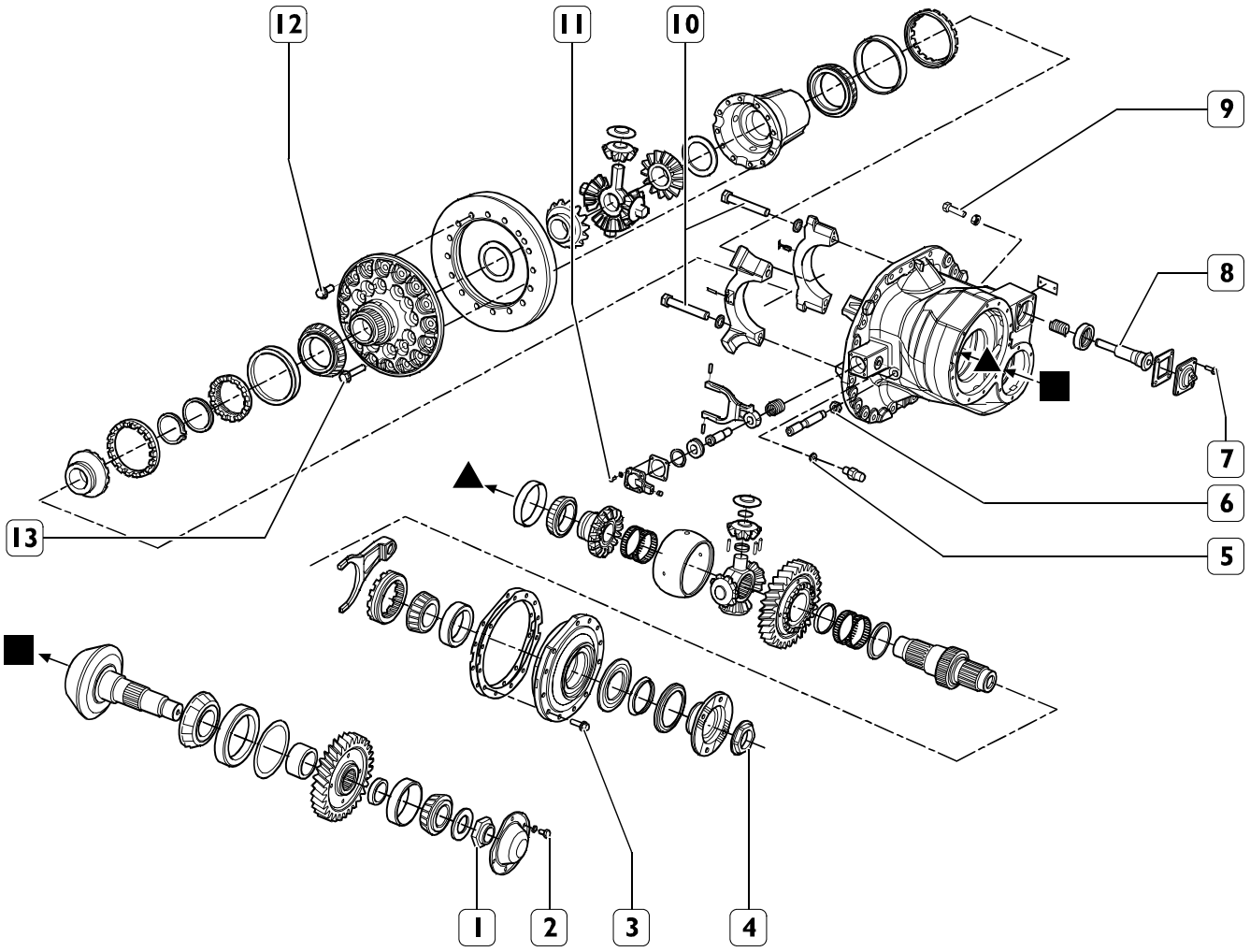
	Inter-axle differential bearings	2, taper roller
	Inter-axle differential bearing end play mm	0.05 ÷ 0.20
	End play adjustment	By shims
	Inter-axle differential bearing shim thickness range mm	-
	**WHEEL HUBS**	
	Wheel hub bearings	Two of type UNIT - BEARING
	Wheel hub bearing end play adjustment	Not adjustable Torque tightening by threaded nut
	Rear axle oil Quantity: air suspension litres (kg)	TUTELA W140/M-DA 20 (18)

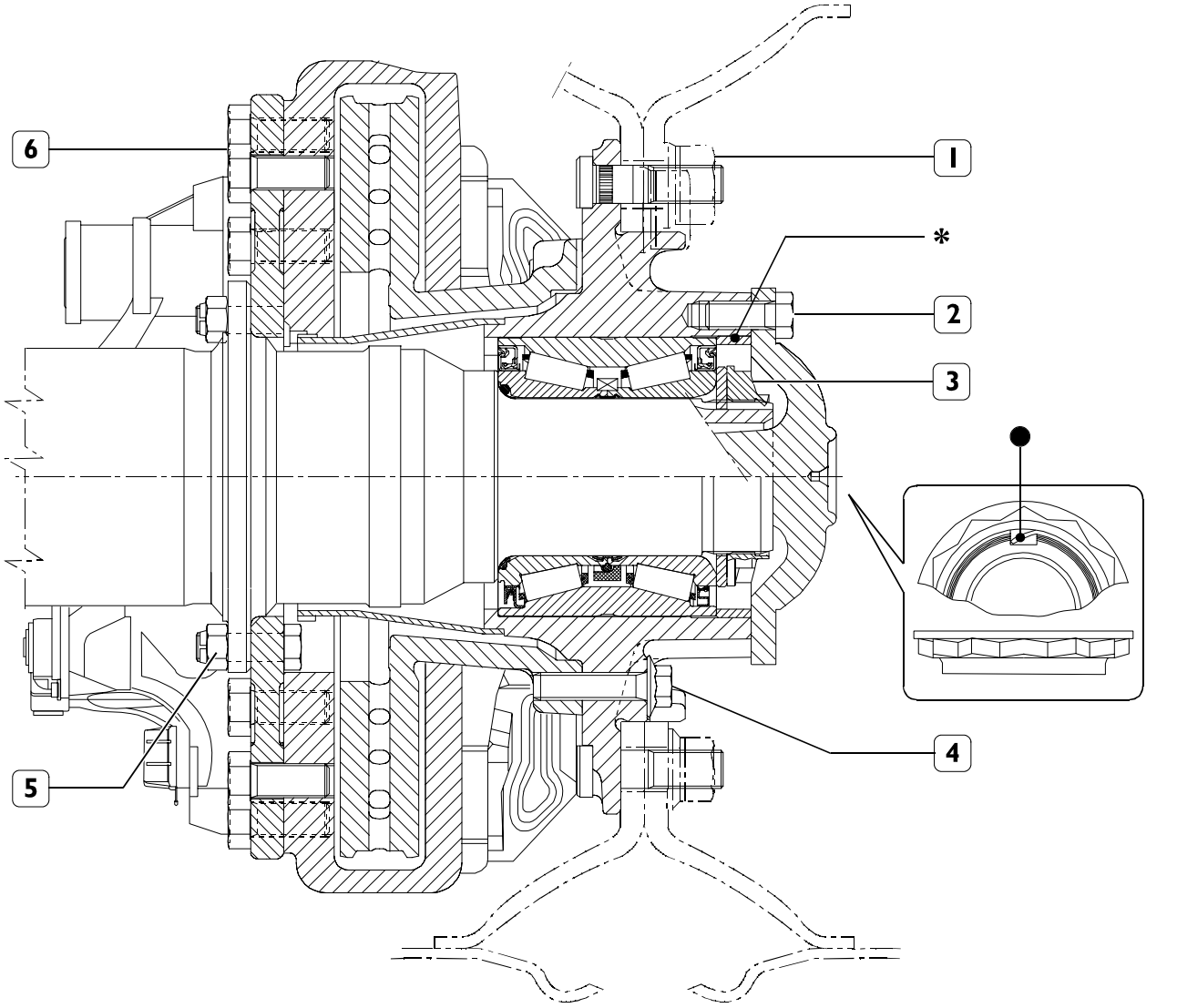
Figure 3



TIGHTENING TORQUES

PART		TORQUE	
		Nm	kgm
1	Pinion nut	1220 ÷ 2035	122 ÷ 203
2	Pinion cover cheese-headed screw	40 ÷ 70	4 ÷ 7
3	Drive input shaft cover cylindrical-headed bolt	75 ÷ 95	7.5 ÷ 9.5
4	Motion input shaft nut	1200 ÷ 1400	120 ÷ 140
5	Sensor switch lock nut	35 ÷ 45	3.5 ÷ 4.5
6	Pressure screw nut	210 ÷ 270	21 ÷ 27
7	Longitudinal clamp cover cheese-headed screw	15 ÷ 25	1.5 ÷ 2.5
8	Differential longitudinal clamp piston	180 ÷ 220	18 ÷ 22
9	Adjusting screw	55 ÷ 75	5.5 ÷ 7.5
10	Half-cap fastening cheese-headed screw	650 ÷ 810	65 ÷ 81
11	Differential cover cheese-headed screw	15 ÷ 25	1.5 ÷ 2.5
12	Cover cheese-headed screw	520 ÷ 540	52 ÷ 54
13	Differential casing cheese-headed screw	460 ÷ 480	46 ÷ 48
-	Differential lock switch	30 ÷ 50	3 ÷ 5

Figure 4



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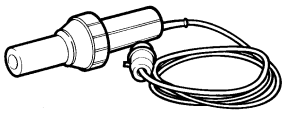
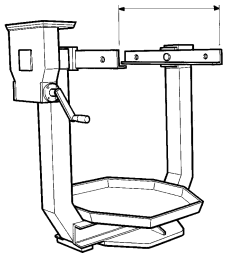
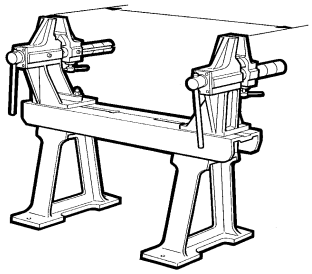
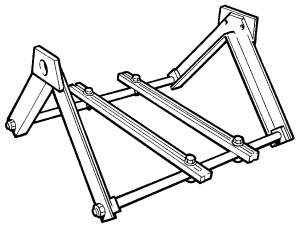
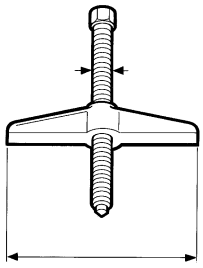
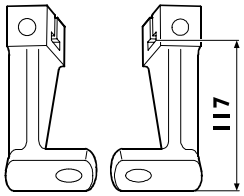
TIGHTENING TORQUES

	PART	TORQUE	
		Nm	Kgm
1	Nut fixing wheels	732 to 599	73.2 to 59.9
2	Screw fixing drive shaft flange	235 to 289	23.5 to 28.9
3	Ring nut retaining wheel hub bearing	834 to 1030	83.4 to 103
4	Screw fixing brake disc to wheel hub	268 to 295	26.8 to 29.5
5	Nut for screw fixing brake calliper mount	275 to 304	27.5 to 30.4
6	Screw fixing brake calliper to mount	554 to 677	55.4 to 67.7

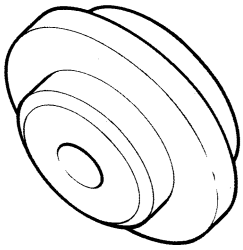
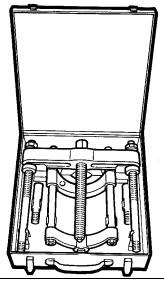
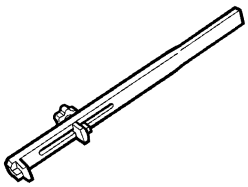
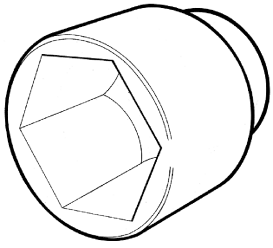
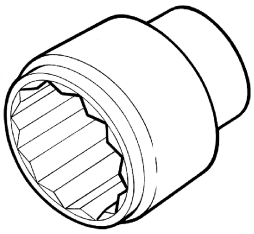
* When fitting the spacer ensure a clearance equal to 0-0.145 mm between the outer edge to the wheel hub and the spacer, carrying out two checks at 1805.

• Notch as close as possible to the side of the milling as shown in the drawing (after tightening to the specified torque).

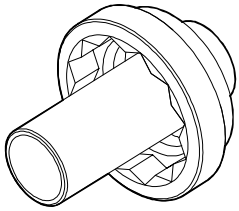
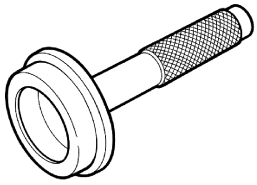
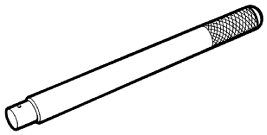
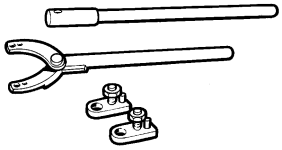
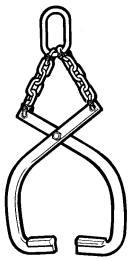
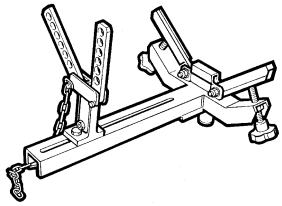
TOOLS

TOOL NO.		DESCRIPTION
99305121		Heater
99322205		Rotary stand for overhauling assemblies (capacity 1000 daN, torque 120 daN/m)
99322215		Stand for axle overhauling
99322225		Unit holder (to be mounted on stand 99322205)
99341003		Single-acting lift
99341017		Pair of brackets with holes

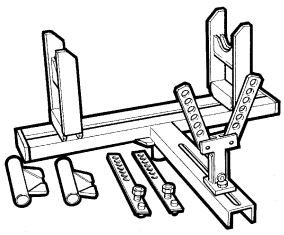
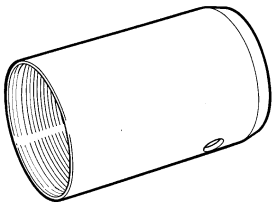
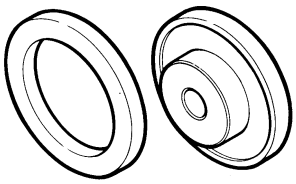
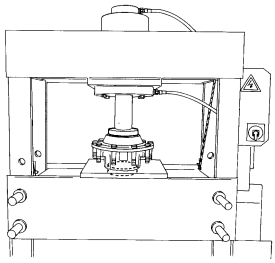
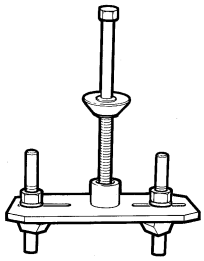
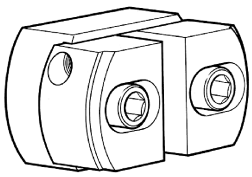
TOOLS

TOOL NO.		DESCRIPTION
99345053		Reaction block for puller tools
99345055		Reaction block for puller tools
99348001		Puller tool with clamping device
99355025		Wrench for differential gearcase bearing adjustment ring nuts
99355069		Wrench (75 mm) for differential bevel pinion nut (to be used with 99370317)
99355131		Wrench (55 mm) for the nut of the drive input flange of the transfer box (use with 99370317)

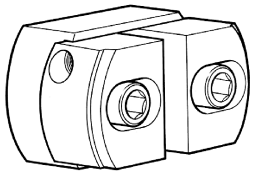
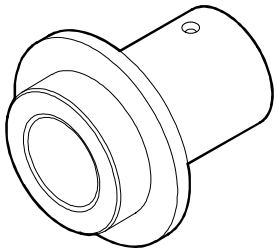
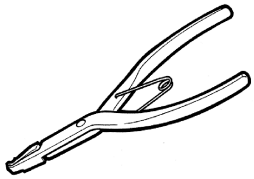
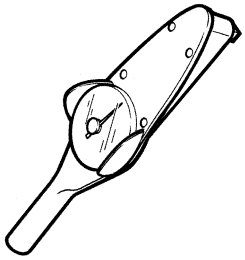
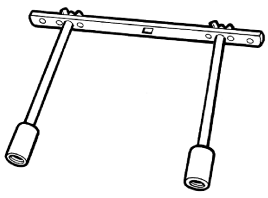
TOOLS

TOOL NO.		DESCRIPTION
99355180		Wrench (105 mm) for wheel hub bearing adjustment nut
99370005		Hand-grip for interchangeable drift punches
99370007		Hand-grip for interchangeable drift punches
99370317		Reaction lever and extension for flange lock
99370509		Hook to remove differential gearcase half-housing
99370616		Support to remove-fit back differential

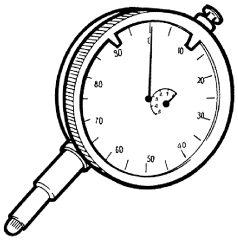
TOOLS

TOOL NO.		DESCRIPTION
99370617		Universal support to remove-fit back rear axles
99370700		Guide to assemble wheel hub
99370706		Tool to fit wheel hub bearing
99370708		Tool for removing wheel hub bearing
99371047		Stand to hold differential half-housing when tightening crown wheel screws (to be used with 99322205 - 993222225)
99374093		Drift punch for installation of bearing outer races (91 ÷ 134) (use with 99370007)

TOOLS

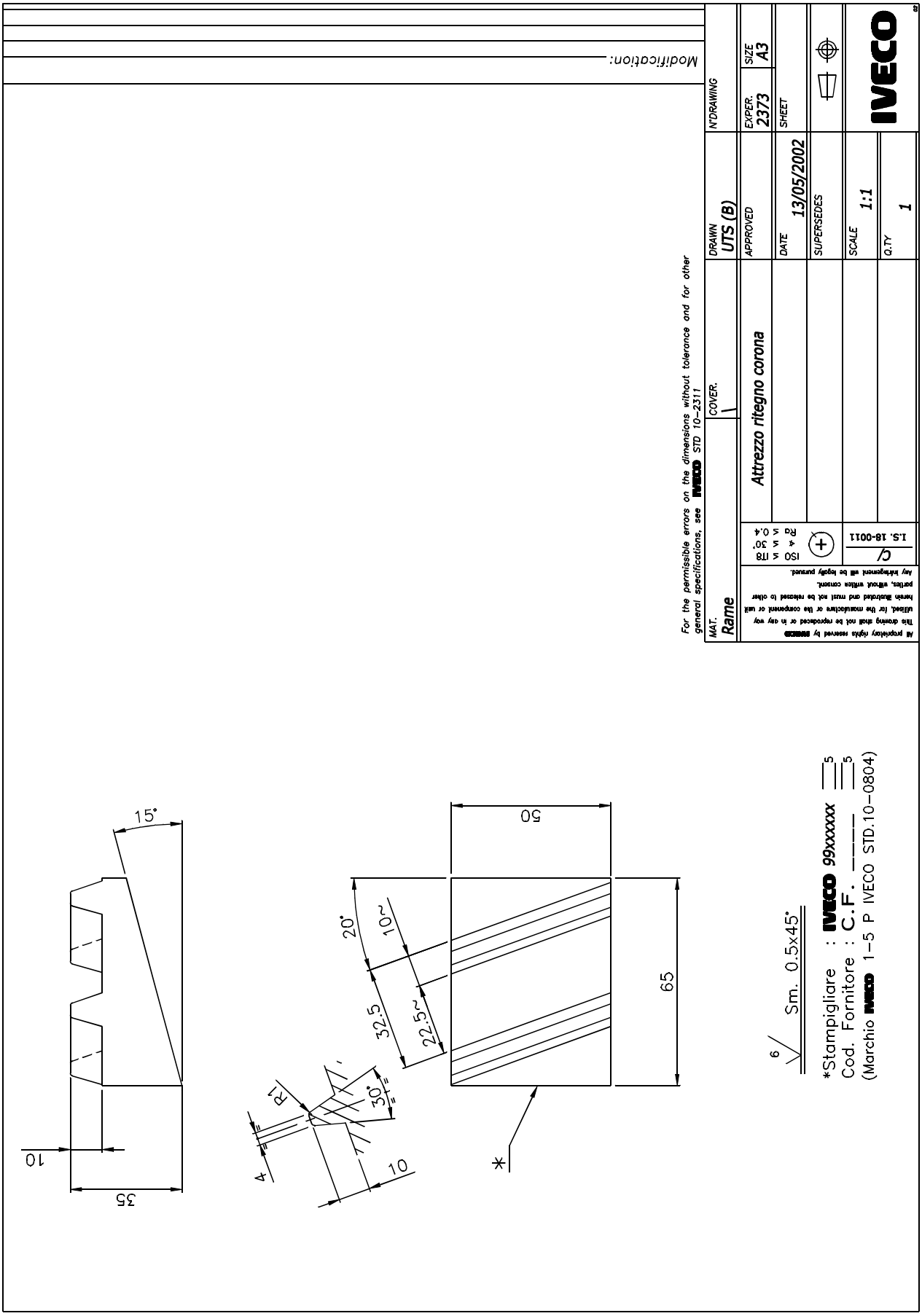
TOOL NO.		DESCRIPTION
99374094		Drift punch for installation of bearing outer races (134 ÷ 215) (use with 99370007)
99374163		Installer, transfer case output shaft seal
99381125		Pliers for removal of circlips on transfer box shaft
99389816		4 x torque multiplier, with square connection, 3/4" in, 1" out (maximum torque 2745 Nm).
99389819		Torque wrench (0 - 10 Nm) with 1/4" square fitting
99395026		Tool for measuring hub rolling drag torque (use with torque wrench)

TOOLS

TOOL NO.		DESCRIPTION
99395603		Dial gauge (0÷5 mm)

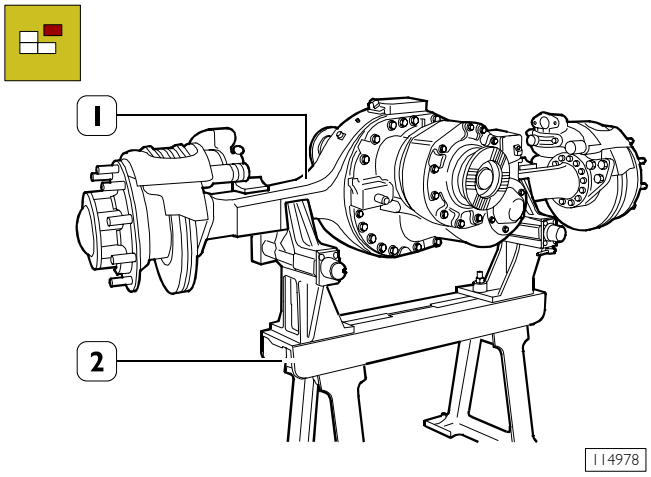
SPECIAL PURPOSE TOOLS

This chapter shows technical construction drawings of the special purpose tools (S.P. 2373) used to service the rear axle described in this section. These may be built by the repair workshops.



525010 INTERMEDIATE REAR AXLE ASSEMBLY OVERHAUL

Figure 5

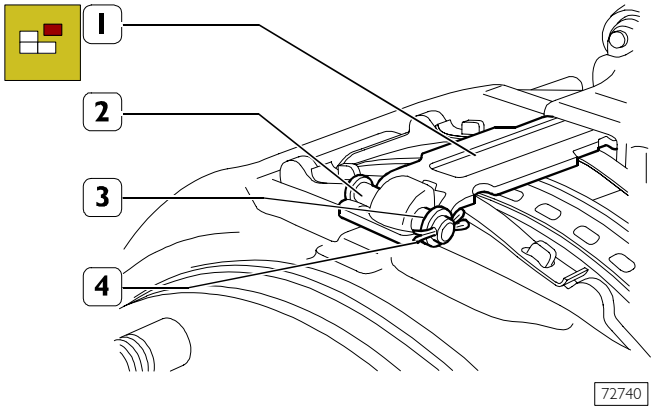


Put the rear axle (1) on the overhaul stand 99322215 (2).

525030 OVERHAULING THE WHEEL HUBS

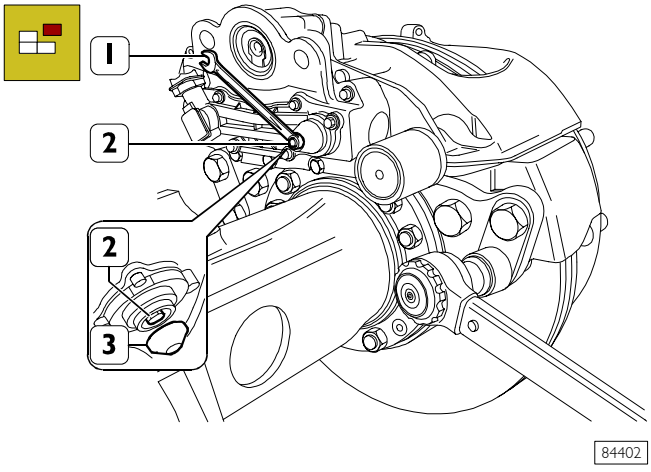
Removal

Figure 6



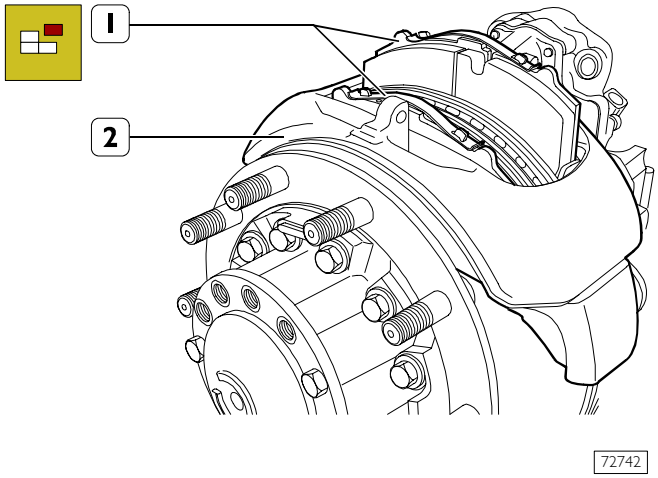
Remove the split pin (4), washer (3), pin (2) and plate (1) holding the brake linings.

Figure 7



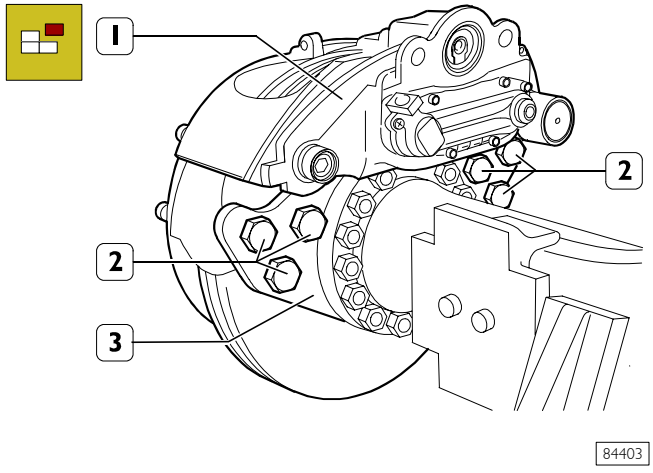
Remove the plug (3), turn the adjustment unit (2) anticlockwise, with a spanner, to make the pistons move back into the calliper body.

Figure 8



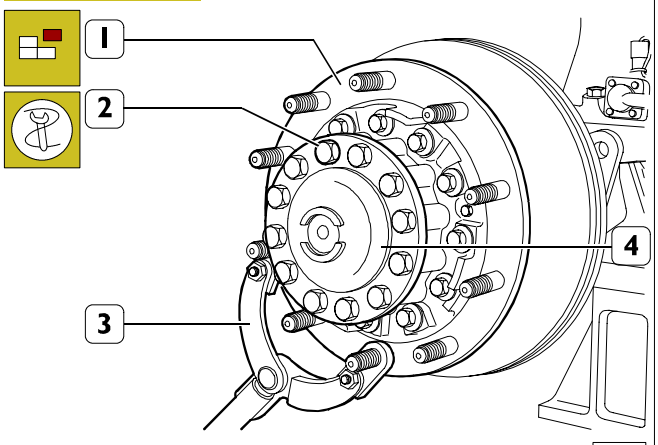
Remove the brake linings (1) making the calliper body (2) float appropriately.

Figure 9



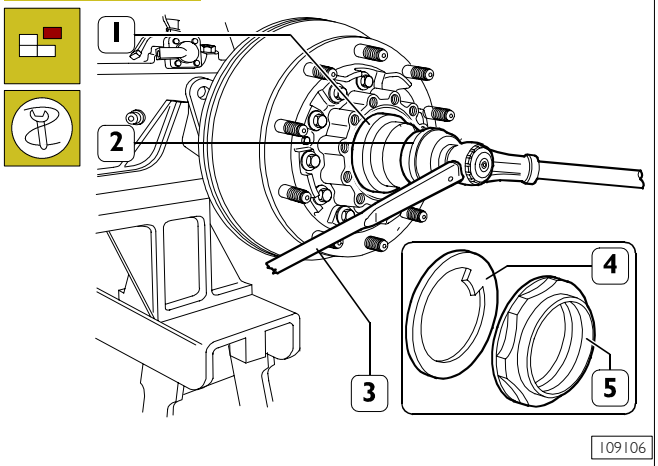
Take out the screws (2) and remove the brake calliper (1) from the supporting flange (3).

Figure 10



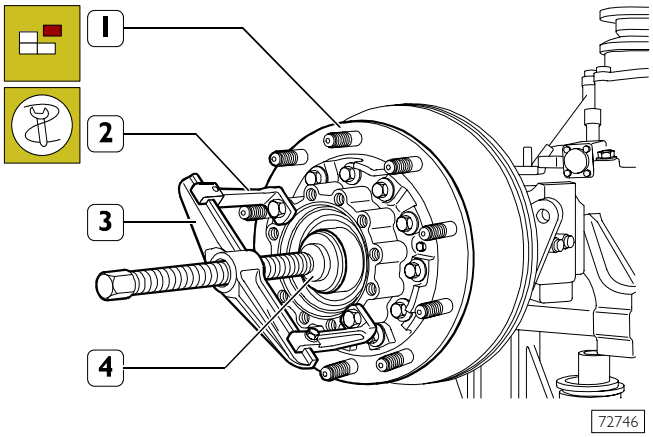
Put a container under the wheel hub to collect the oil. Lock rotation of the wheel hub (1) with the retaining tool 99370317 (3). Take out the screws (2) and extract the drive shaft (4).

Figure 11



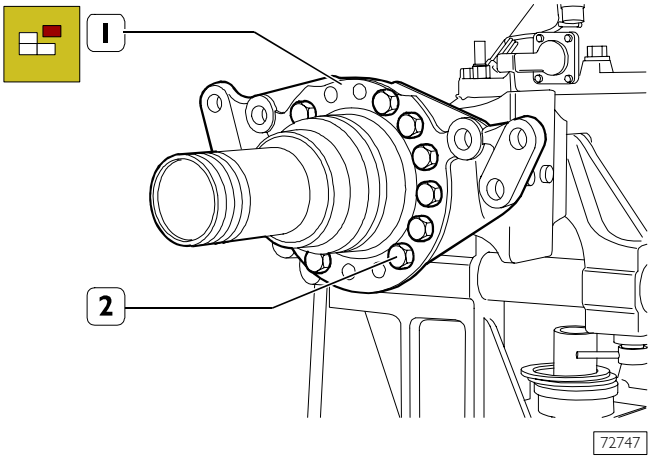
Lift the notching of the ring nut (5). Using the wrench 99355180 (1) and multiplier 99389816 (2), remove the ring nut (5) holding the wheel hub bearing. Take out the retaining ring (4).

Figure 12



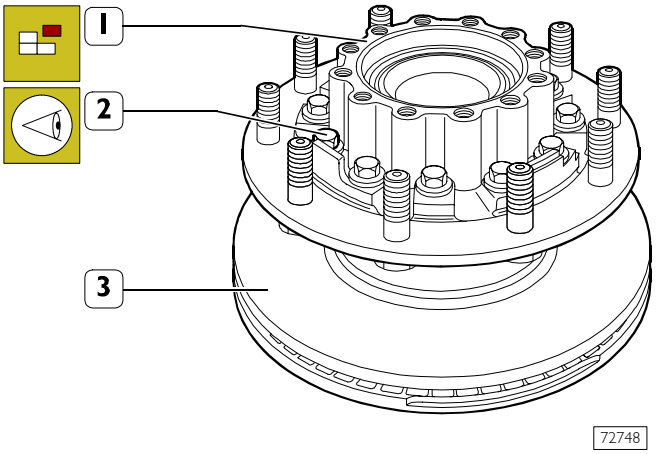
Sling the brake disc (1) with a rope and hook this onto a hoist. Remove the wheel hub (1). If this proves difficult, use the extractor comprising: brackets 99341017 (2), bridge 99341003 (3), block 99345053 (4), applied as shown in the figure.

Figure 13



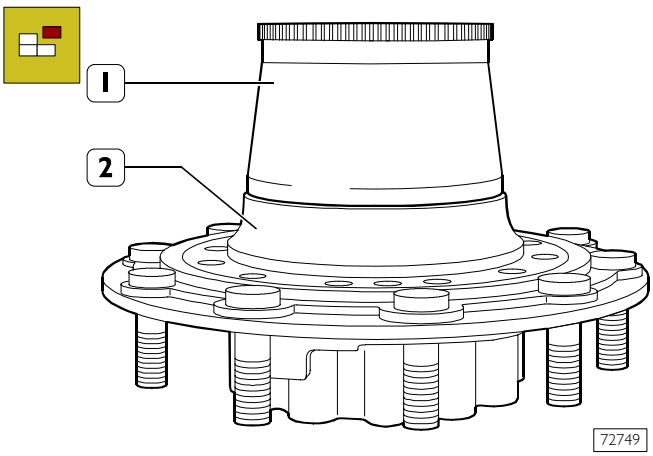
If the brake calliper supporting plate (1) is damaged, remove it from the axle housing by taking out the bolts (2).

Figure 14



Take out the screws (2) and remove the wheel hub (1) from the brake disc (3).
Examine the state of wear of the brake disc (3) as described in the "BRAKE AIR SYSTEM" section.

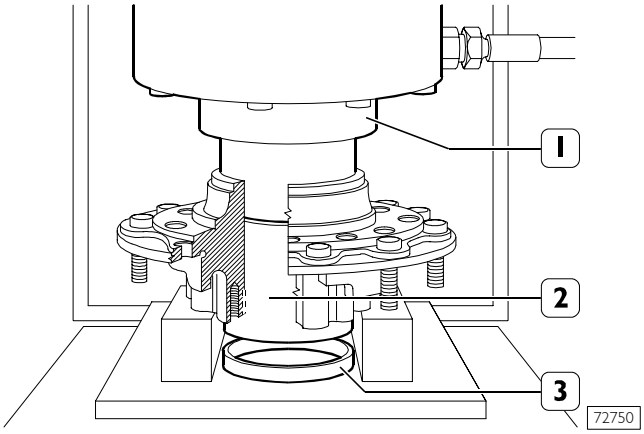
Figure 15



The phonic wheel (1) is removed from the wheel hub (2) with general tools.

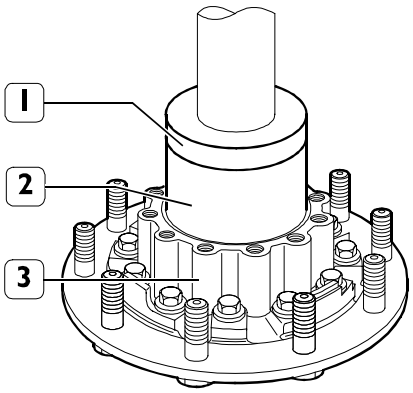
529621 Replacing wheel hub bearings

Figure 16



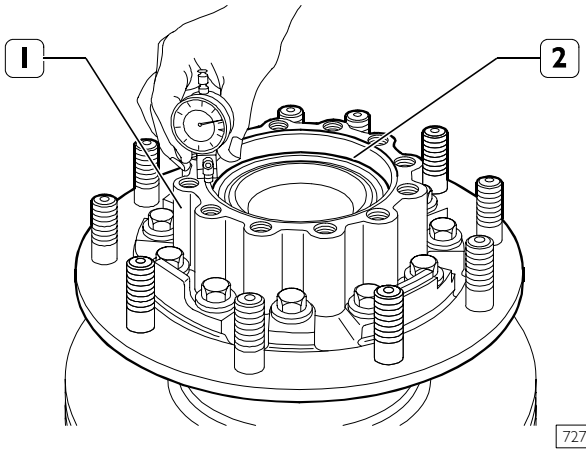
Using a hydraulic press and tool 99370708 (1) take out the wheel hub, spacer (3) and bearing (2).

Figure 17



Place the bearing (2) on the wheel hub (3).
Using the press and tool 99370706 (1) mount the bearing (2): bearing drive-in load 40.000 ÷ 100.000 N.

Figure 18



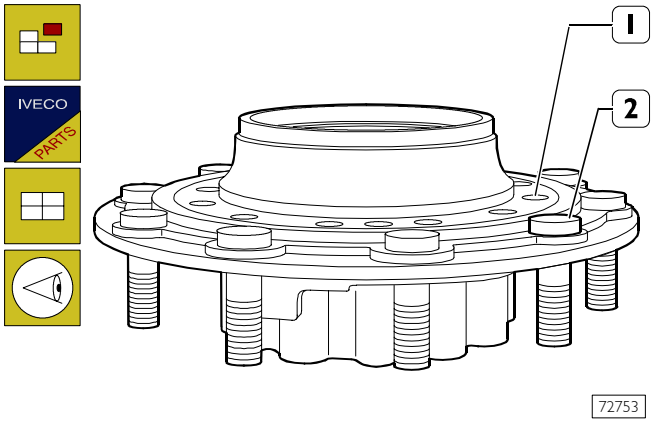
Fit the spacer ring (2) in the wheel hub (1) and check on two diametrically opposite points that, after assembly, the ring (2) is sunk below the face of the wheel hub by 0.0 to 0.145 mm.

Checking the parts forming the wheel hubs

Thoroughly clean the single parts comprising the wheel hub. Examine the drive shafts and check there is no deformation.
Check the wheel fixing pins: if there is any deformation or damage to the thread, replace them, using a press to extract them.
Check the threads of the nuts to adjust the hub bearings and the threads on the ends of the axle housing; change the nuts if necessary.
Replace all the sealing elements with new parts.

525035 Replacing the wheel fixing pins

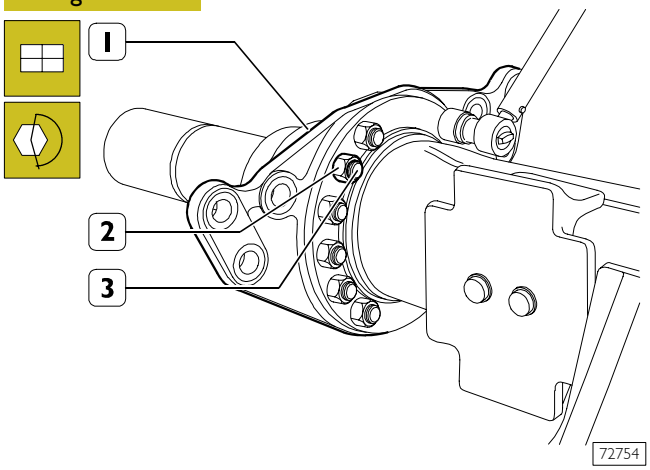
Figure 19



Using general tools, drive the pins (2) out of the hub (1).
Make sure the supporting surface for the heads of the pins has no burrs.
Carefully drive in the pins, applying a load no greater than 2500 kg on their heads.
Afterwards, check that the obliquity is no greater than 0.3 mm.

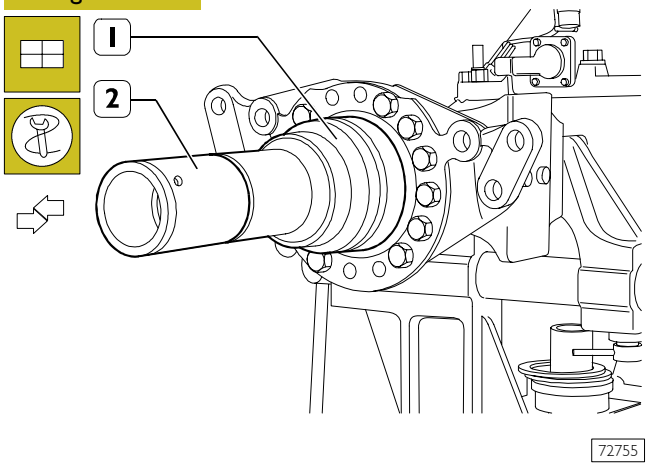
Wheel hub reassembly

Figure 20



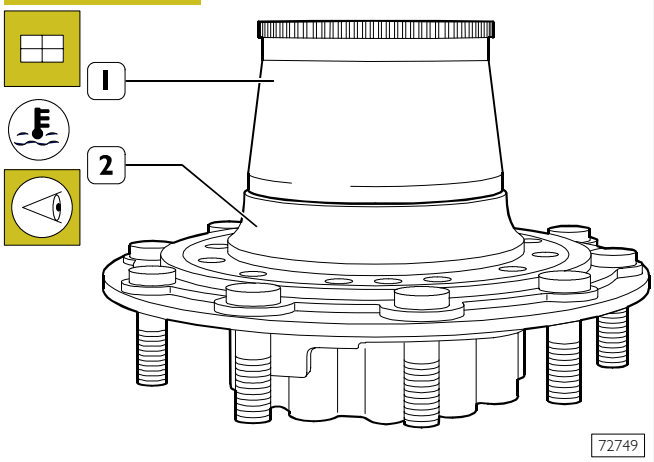
If the plate (1) were disassembled, fit it back on the axle housing and tighten the nuts (2) for the fixing screws (3) to the required torque.

Figure 21



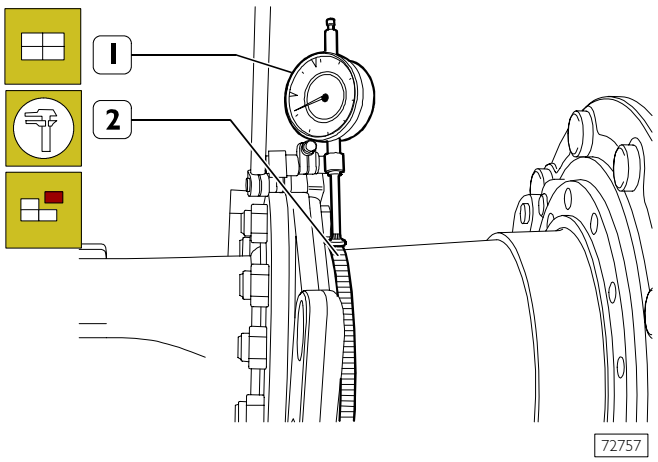
Screw the tool 99370700 (2) onto the sleeve (1) of the axle housing. Lubricate the tool external surface (1) with the oil prescribed for the wheel hubs.

Figure 22



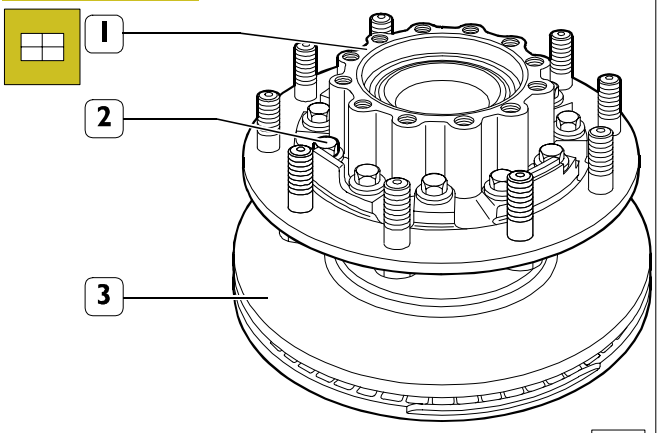
Heat the phonic wheel (1) to approx. 150°C and fit it on the wheel hub (2).
On completing assembly, make sure the phonic wheel (1) rests correctly in the seat of the hub.

Figure 23



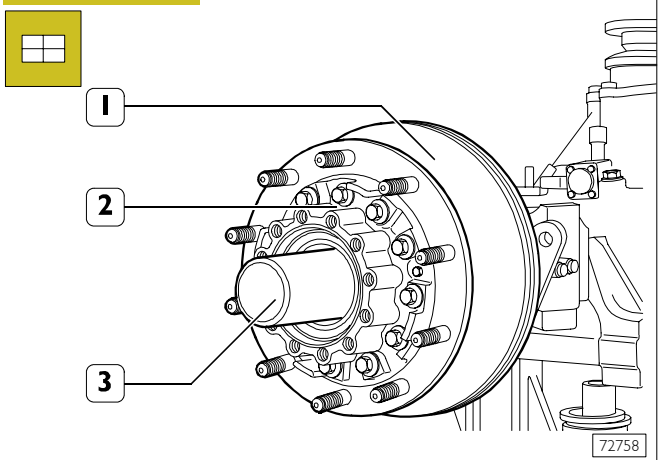
Fit the wheel hub on the sleeve of the axle housing and, using a dial gauge (1) with a magnetic base, check that the radial runout of the phonic wheel (2) is no greater than 0.2 mm. Remove the wheel hub.

Figure 24



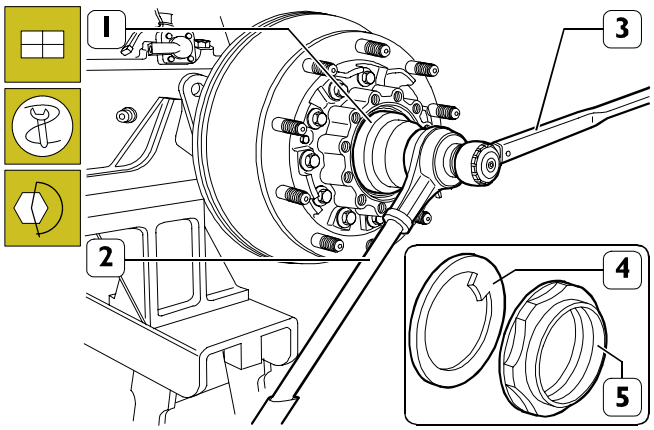
Mount the brake disc (3) on the wheel hub (1) and screw down the screws (2).

Figure 25



Sling the brake disc (1) with a rope, hook this onto a lift and fit the wheel hub (2) on the sleeve of the axle housing. Remove the tool 99370700 (3).

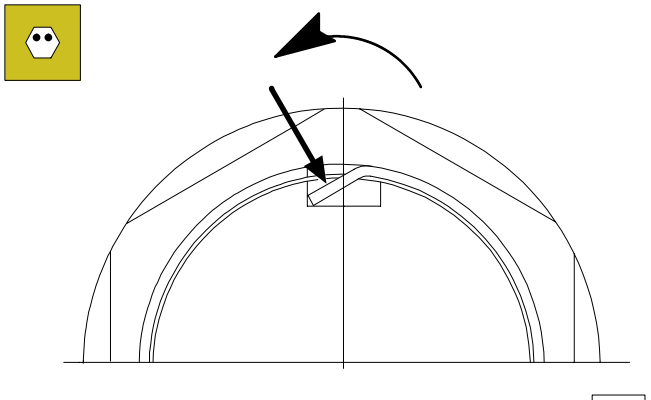
Figure 26



72759

Position the retaining ring (4) so as to insert the tab into the groove of the sleeve, then screw on the ring nut (5). Using the wrench 99355180 (1), multiplier 99389816 (2) and the torque wrench (3), tighten the ring nut (5) to the required torque.

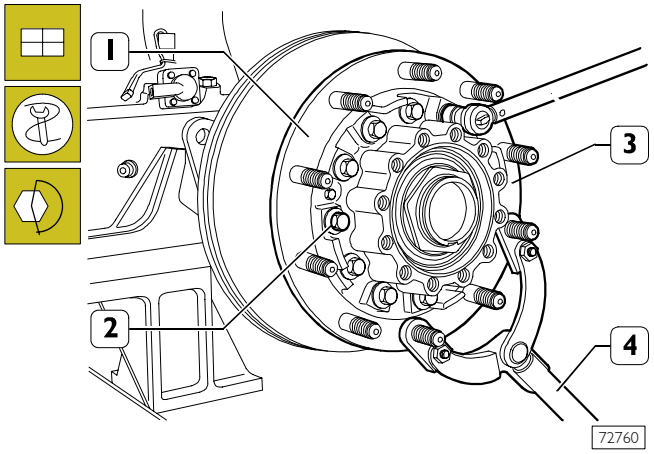
Figure 27



49213A

After tightening, using an appropriate tool, notch and bend the ring nut as shown in the figure so it cannot be unscrewed. The arrow shows the direction of unscrewing the ring nut.

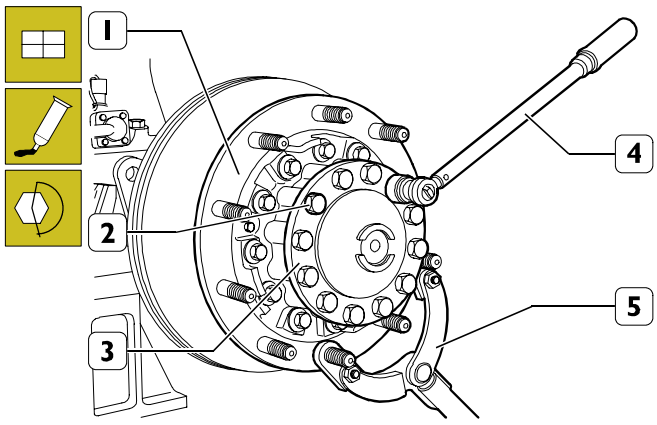
Figure 28



72760

Lock rotation of the wheel hub (3) with the tool 99370317 (4) and tighten the screws (2) fixing the brake disc (1) to the wheel hub to the required torque.

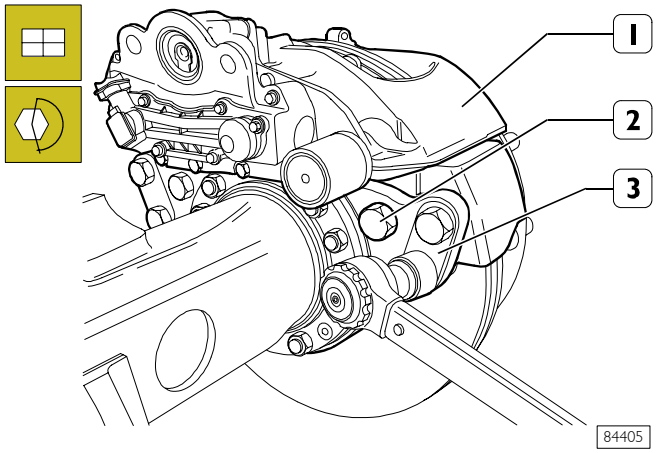
Figure 29



72761

Spread IVECO 1905685 (LOCTITE 14780) sealant onto the flange contact surfaces of the drive shaft – wheel hub and insert the drive shaft into the axle housing. Screw down the screws (2) fixing the drive shaft (3) to the wheel hub (1) and tighten them with the torque wrench (4) to the required torque. Remove the tool 99370317 (5).

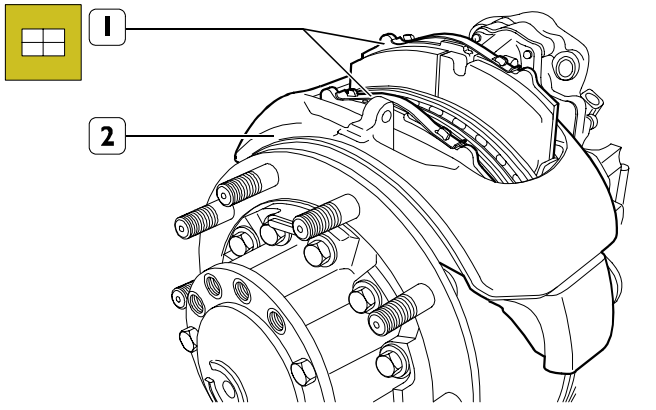
Figure 30



84405

Position the brake calliper (1) on the flange (3) and tighten the fixing screws (2) to the required torque.

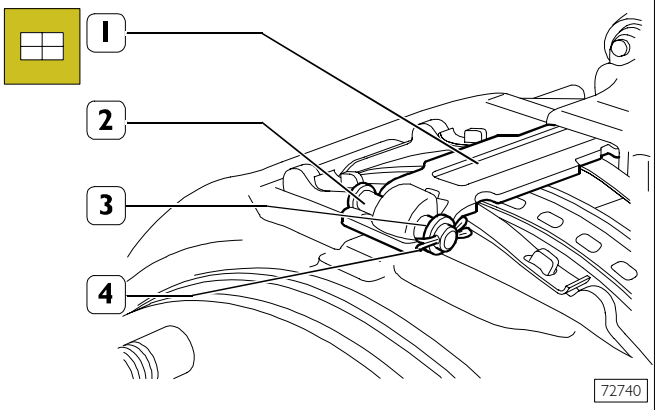
Figure 31



72742

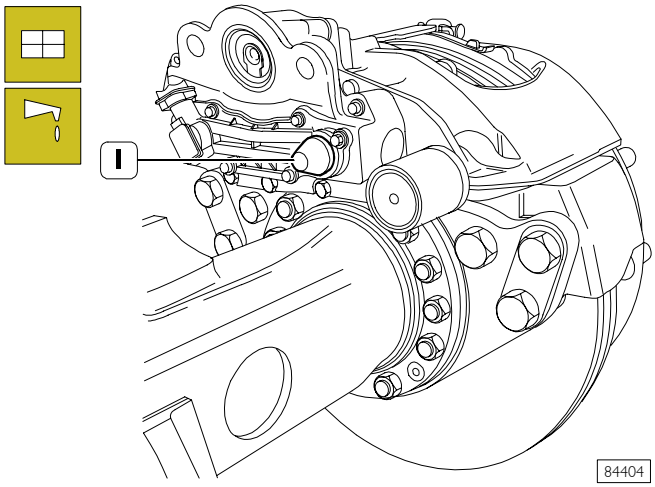
Mount the brake linings (1) in the brake calliper (2).

Figure 32



Mount the brake lining retaining plate (1).
Mount the pin (2), washer (3) and secure them with the split pin (4).

Figure 34

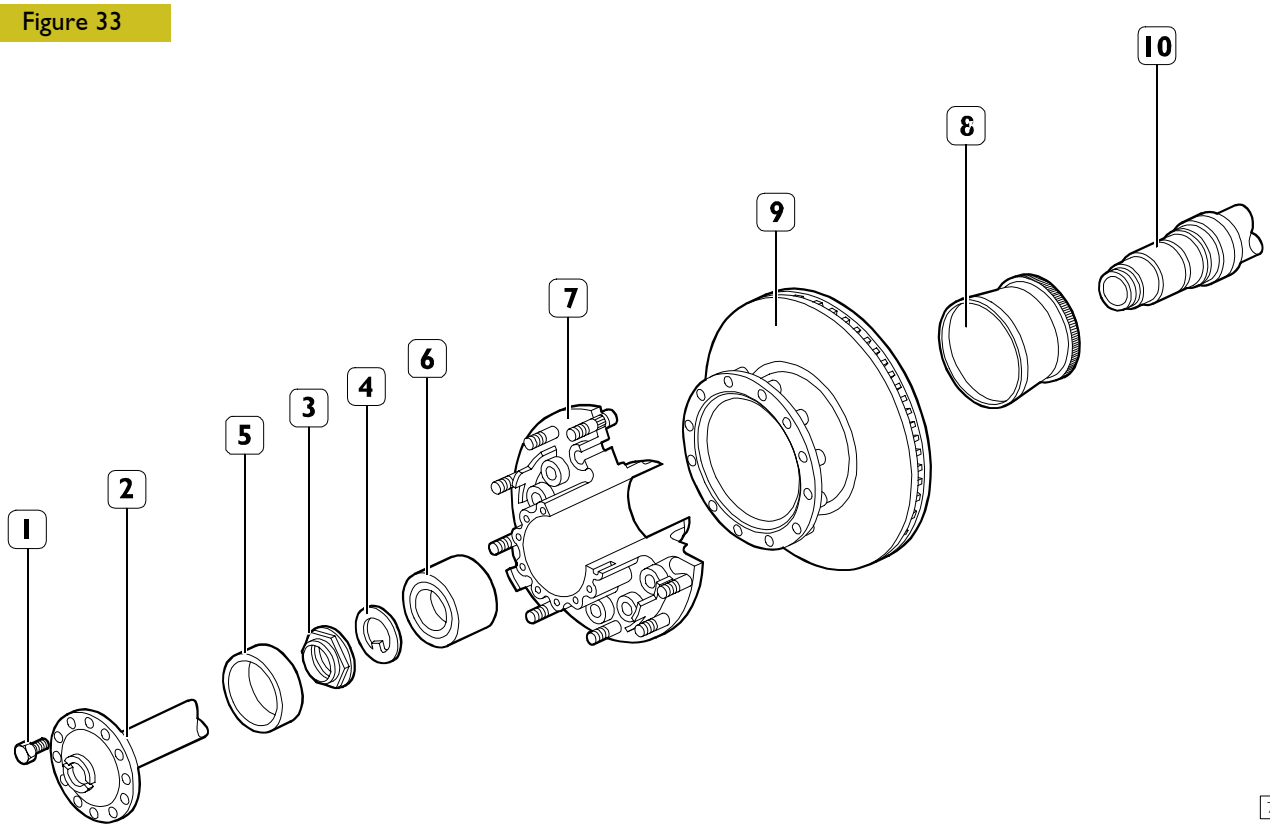


Provisionally mount the plug (1) for the brake lining wear adjustment screw.

NOTE After refitting the rear axle on the vehicle, check the efficiency of the brake lining wear recovery device, as described in the relevant section and replace the plug (1) with a new one.

On completing assembly, fill the axle housing with the required quantity and grade of lubricating oil.

Figure 33



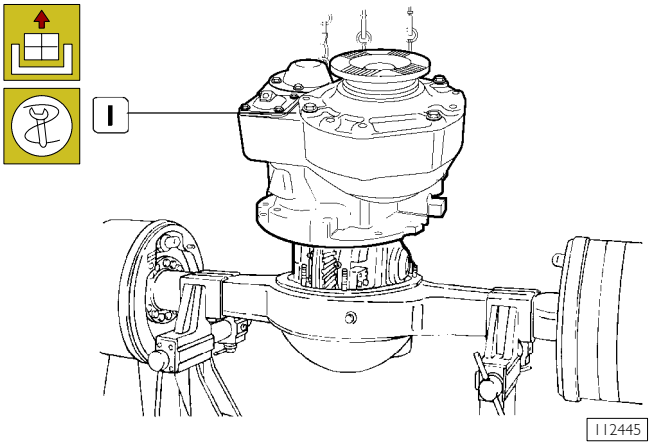
WHEEL HUB COMPONENT PARTS

1. Screw – 2. Drive shaft – 3. Ring nut – 4. Retaining ring – 5. Spacer ring – 6. Bearing – 7. Wheel hub – 8. Phonic wheel – 9. Brake disc – 10. Axle sleeve

526210 DIFFERENTIAL CASE REMOVAL

Case removal

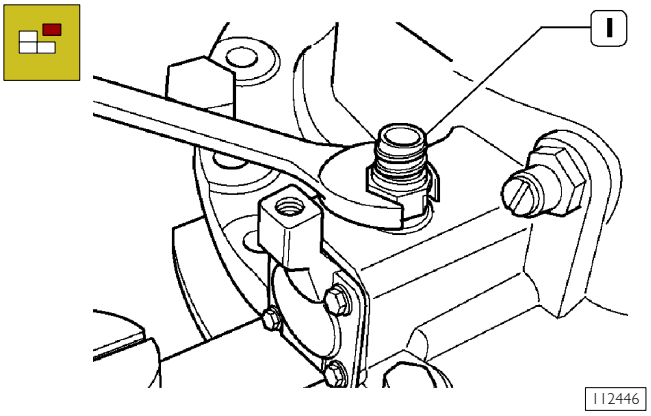
Figure 35



Withdraw the casing from the rear axle using metal eyelets and cables.

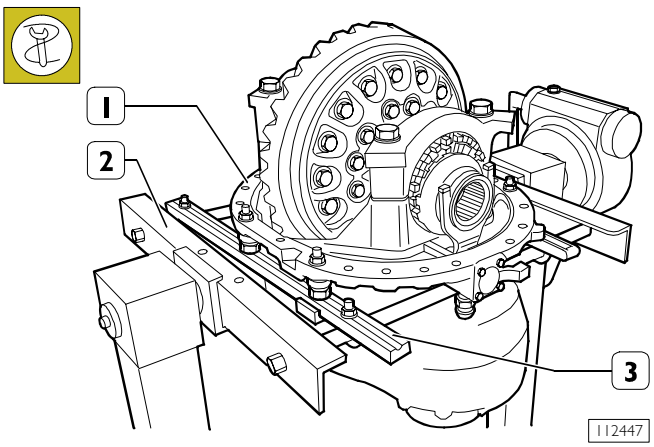
NOTE To remove the differential case with the rear axle fitted on the vehicle, use support 99370616.

Figure 36



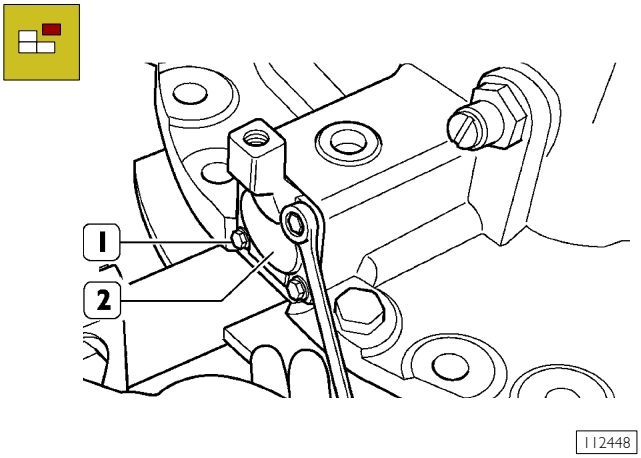
Remove the differential clamp warning switch (1) to fit the case on the stand.

Figure 37



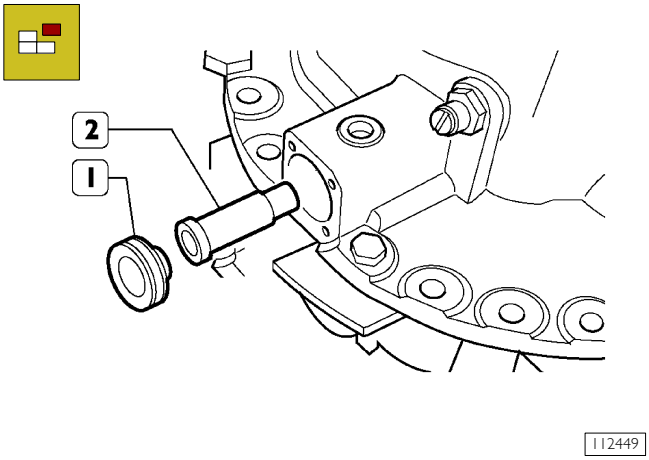
Put the differential case (1) on the rotating stand 99322205 (2) together with the support 99322225 (3).

Figure 38



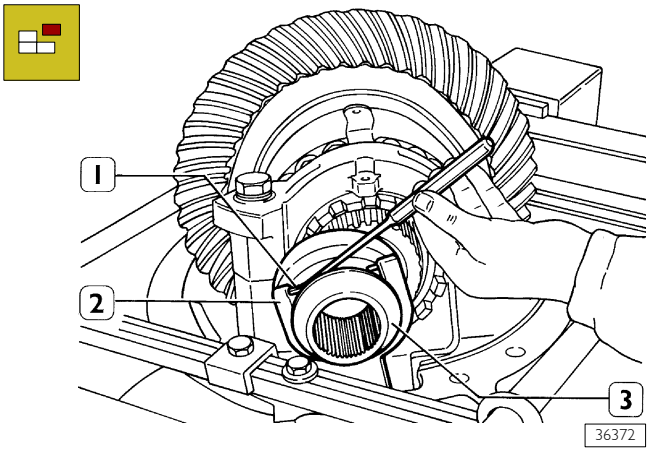
Remove the differential clamp cover (2) fastening screws (1). Take off the cover and the gasket.

Figure 39



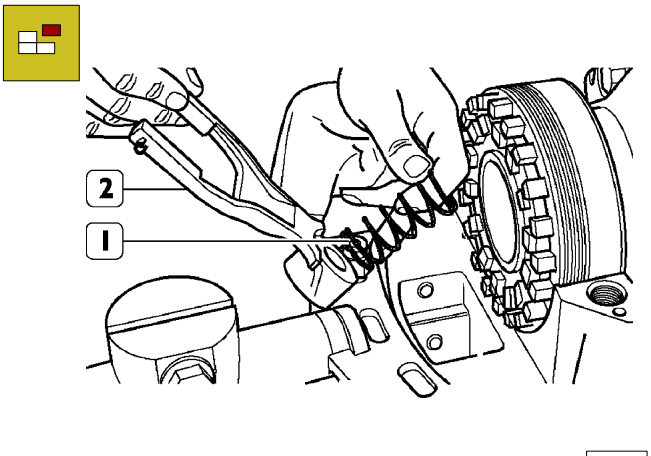
Remove the piston (1) and the stem (2).

Figure 40



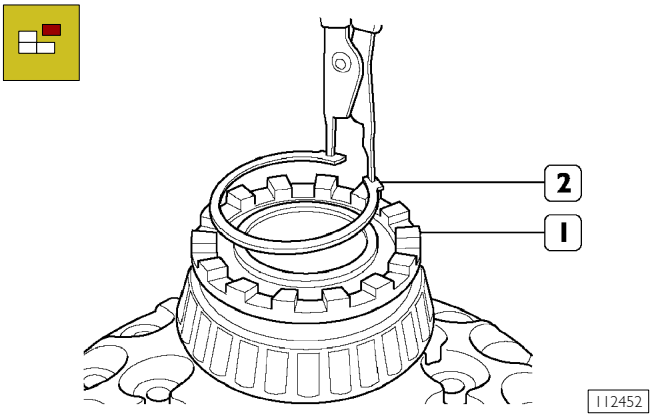
Use a punch to take back the fork (2) elastic pins (1) so that the fork can be released from the sleeve (3).
Remove the sleeve (3) from the case.

Figure 41



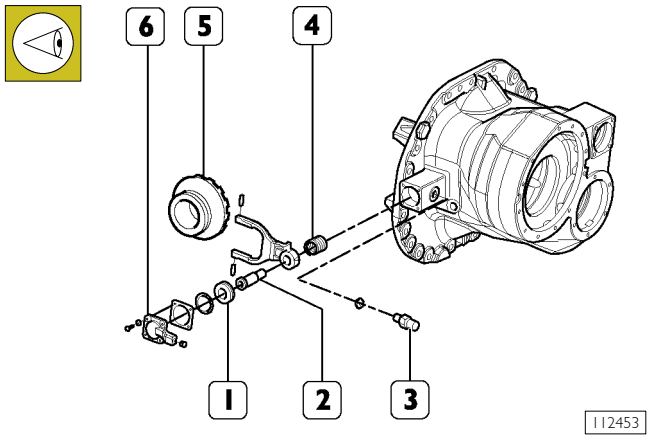
Press and remove the spring (1), then take off the fork (2).

Figure 42



Remove the seal ring (2), the spacer fitted below and the collar (1).

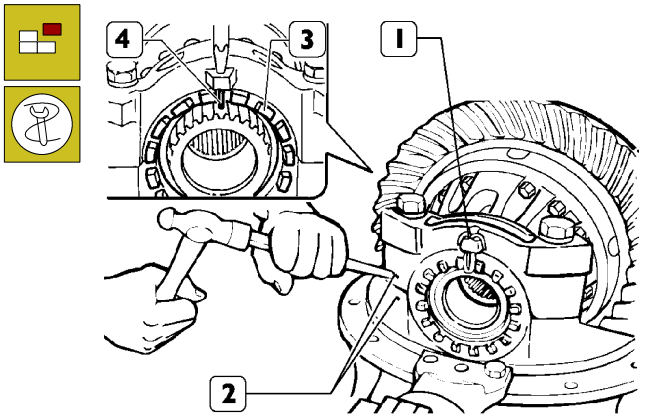
Figure 43



1. Plunger - 2. Stem - 3. Differential locking switch - 4. Spring - 5. Sleeve - 6. Cover

Clean and check the status of all differential lock assembly parts.

Figure 44



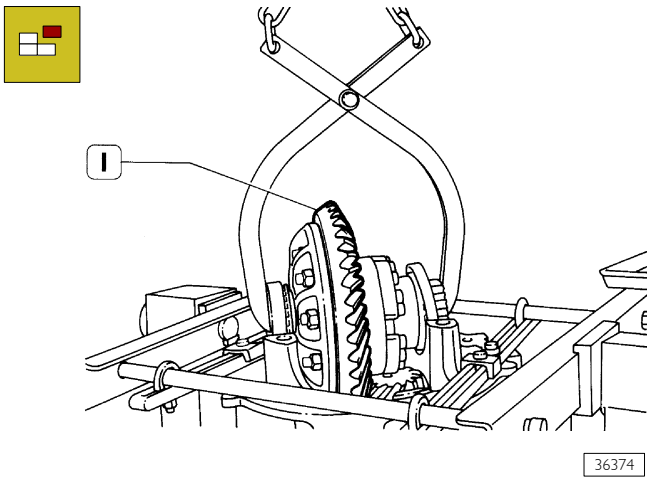
Remove the split pin (1) and the elastic pin (4).

Mark with a punch the caps (2) and the case to facilitate the assembly.

Slacken the ring nuts (3) with tool 99355025.

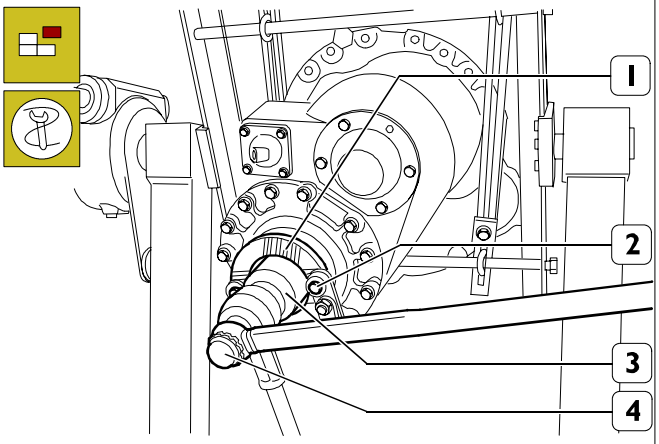
Remove the caps (2) and the ring nuts (5).

Figure 45



Use the suitable hook to remove the gearing case (1) with the ring bevel gear and the support bearings.

Figure 46



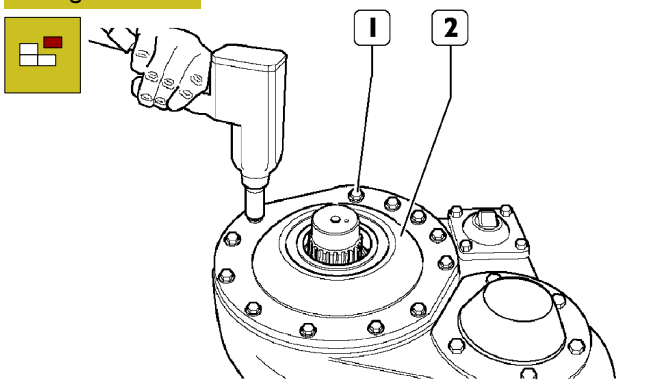
112456

Remove denting of nut checking flange (1).

Stop the flange rotation (1) through tool 99370317 (2); use wrench 99355069 (3) and the multiplier (4) to slacken the flange retaining nut (1).

Remove the motion input shaft flange (1).

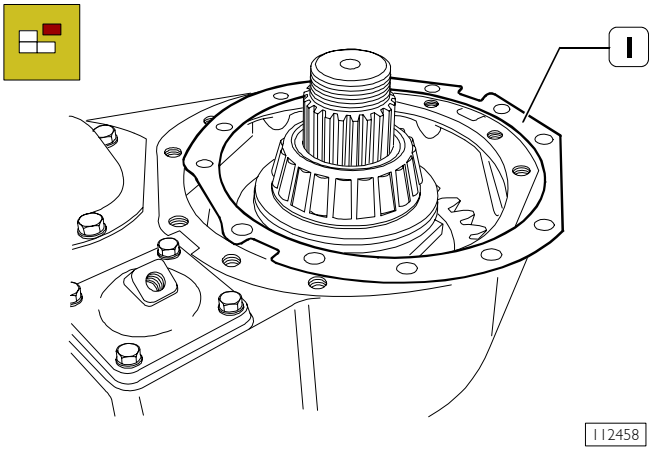
Figure 47



112457

Take off the screws (1) and remove the motion input shaft cover (2).

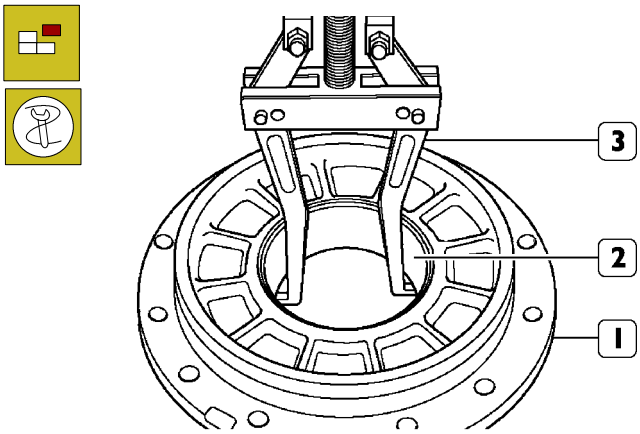
Figure 48



112458

Remove the shims (1).

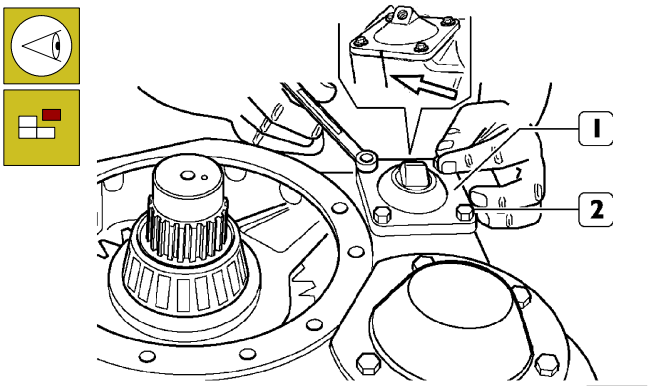
Figure 49



112459

Remove the bearing (2) outer ring from the cover (1) of the motion input shaft through the puller (3), if needed.

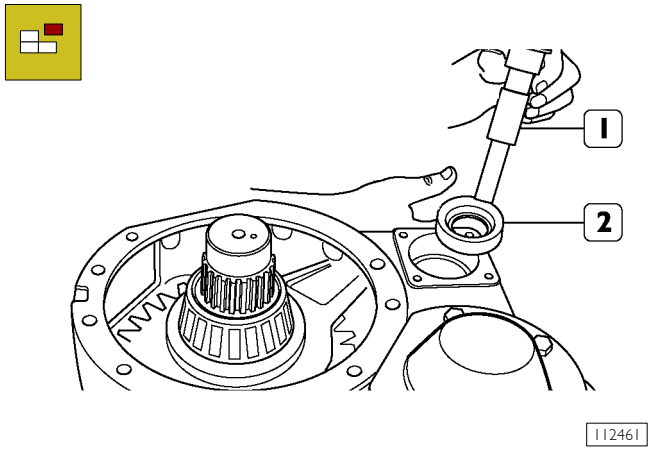
Figure 50



112460

Mark the longitudinal clamp cover (1) assembly position and take it off by slackening the fastening screws (2).

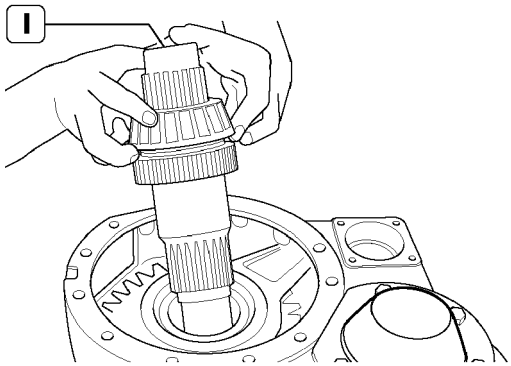
Figure 51



112461

Remove the control piston (1), the diaphragm seat (2) and the spring below it.

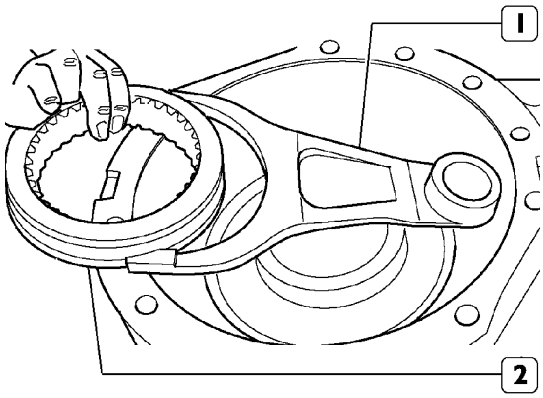
Figure 52



112462

Carefully remove the motion input shaft assembly (1).

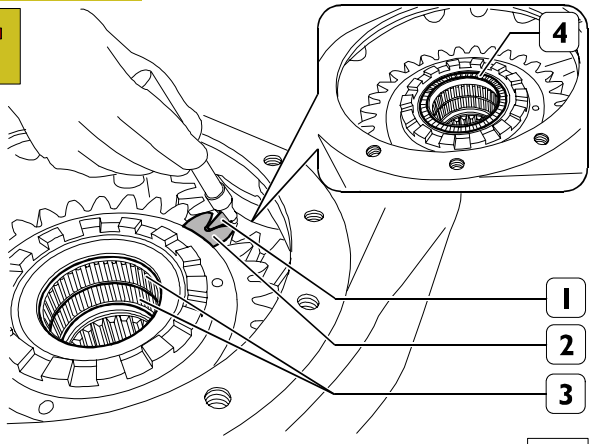
Figure 53



112463

Take off the fork (1) and the sleeve (2).

Figure 54



112464

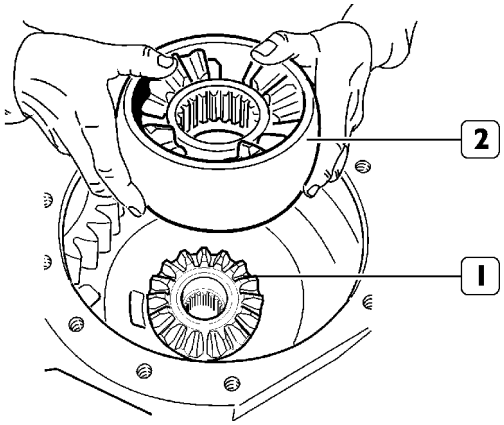
Remove the bearing (4).

Mark the gear (1,2) assembly position.

Remove the two roller cages (3) from the gear (2).

Remove the helical-tooth gear (2).

Figure 55

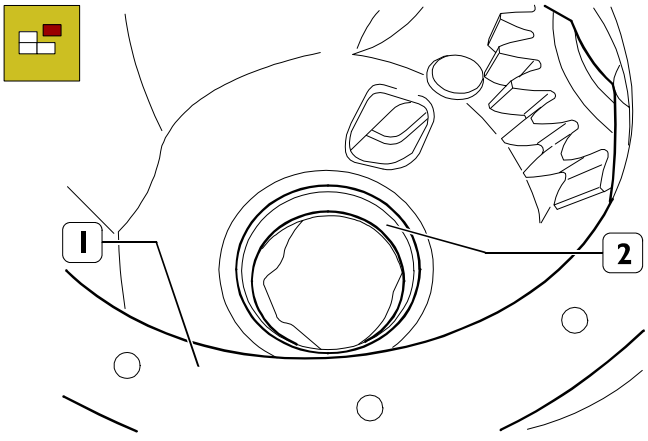


112466

Remove the crown wheel and planetary gear unit (2).

Remove the rear gear (1) with the bearing.

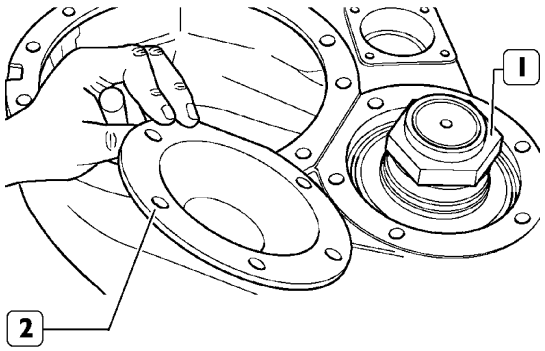
Figure 56



112467

Turn the differential case (1) and use a beater to remove the rear bearing outer ring (2), if needed.

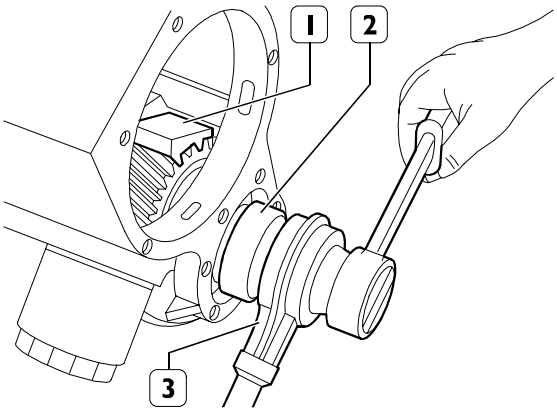
Figure 57



112468

Remove the cover (2) of the conic pinion.

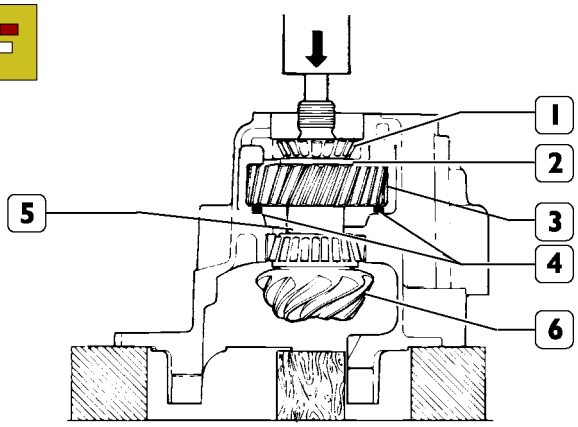
Figure 58



77237

Stop the conic pinion rotation with tool S.P.2373 (1); use wrench 99355069 (2) and the multiplier (3) to remove the bearing retaining nut (1, Figure 57) on the conic pinion and the washer below.

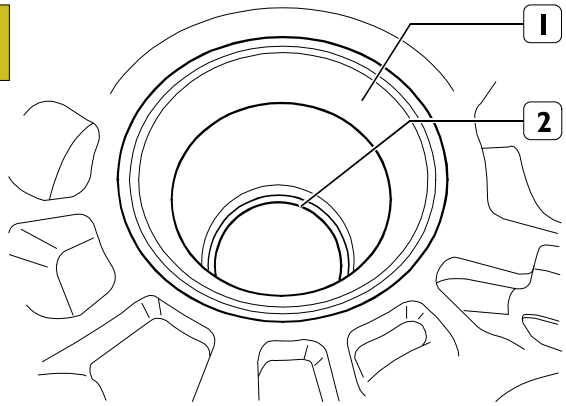
Figure 59



112470

Fit the two spacers (4) below the gear (3).
Under the press, pull out the conic pinion (6) and take off the bearing (1), the adjusting ring (2), the gear (3) and the spacer (5) from the conic pinion.

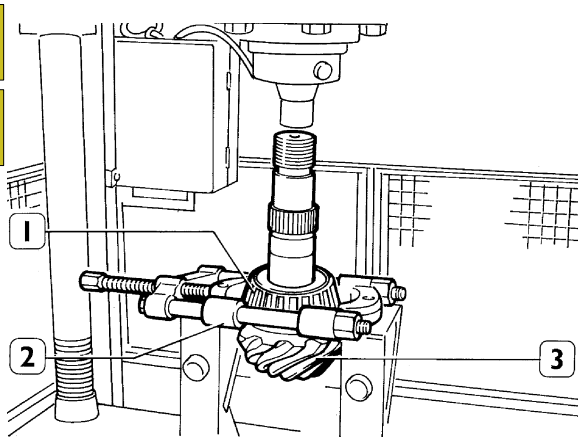
Figure 60



112471

Use a drift to remove outer races (1) and (2) with their shims.

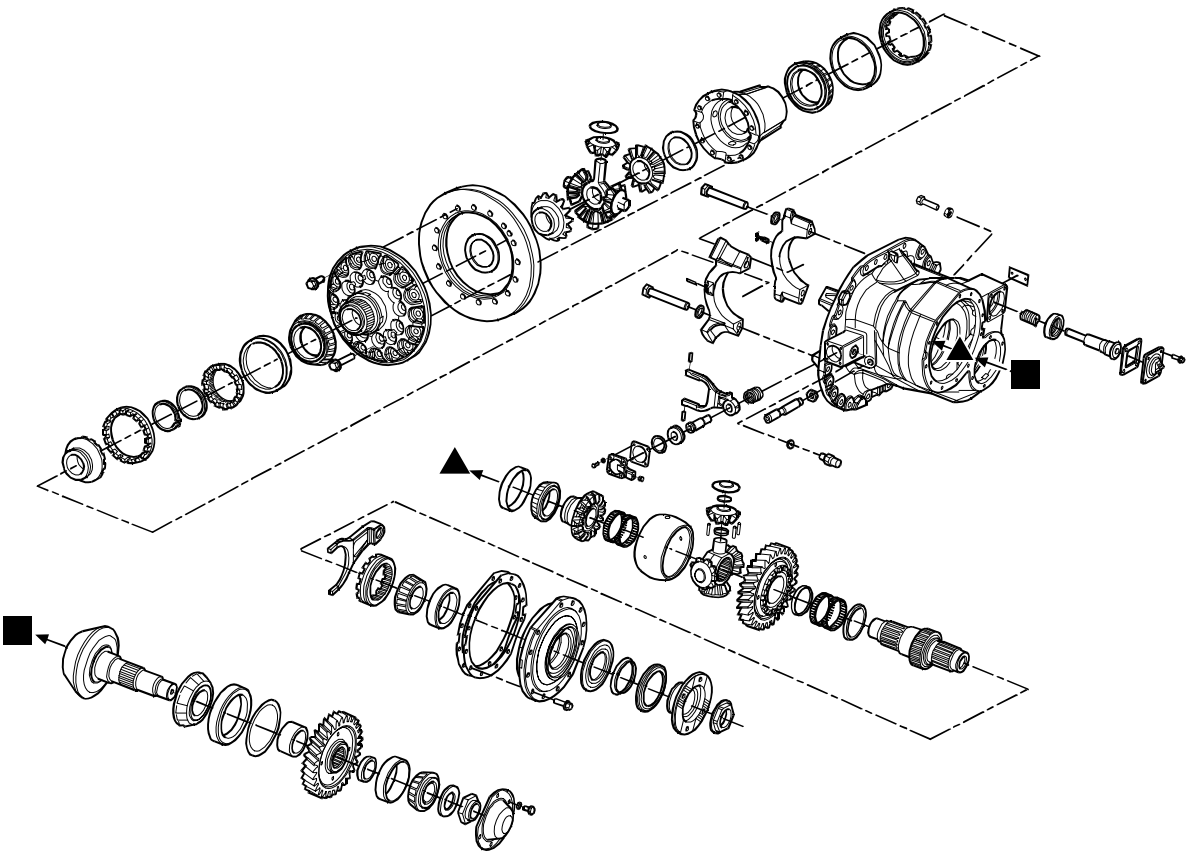
Figure 61



36381

Place tool 99348001 (2) under the taper roller bearing (1) and pull it off the bevel pinion (3) using a press.

Figure 62

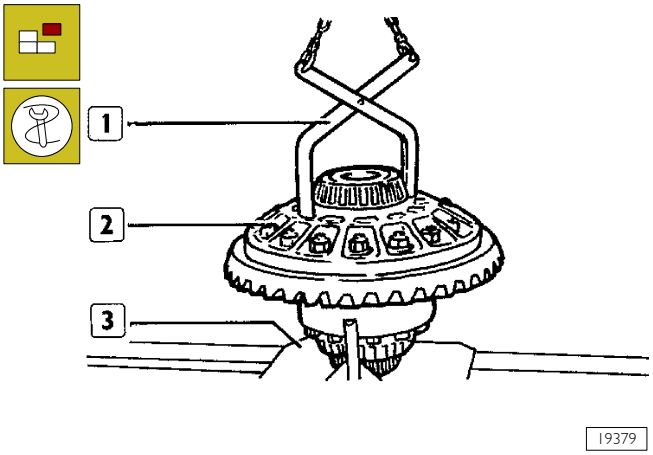


112472

INTER-AXLE DIFFERENTIAL COMPONENTS - EXPLODED VIEW

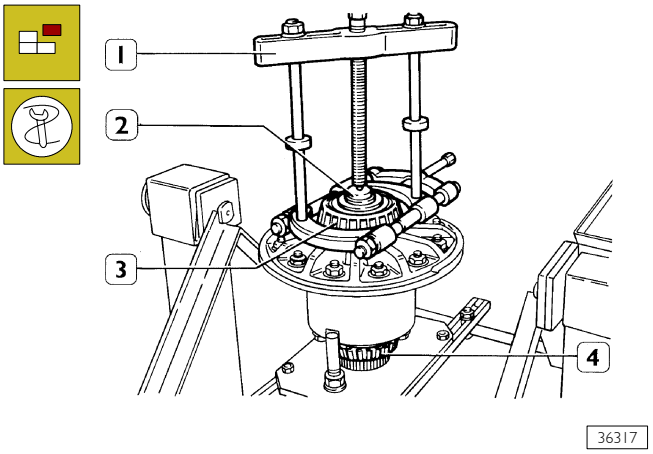
Gearing case removal

Figure 63



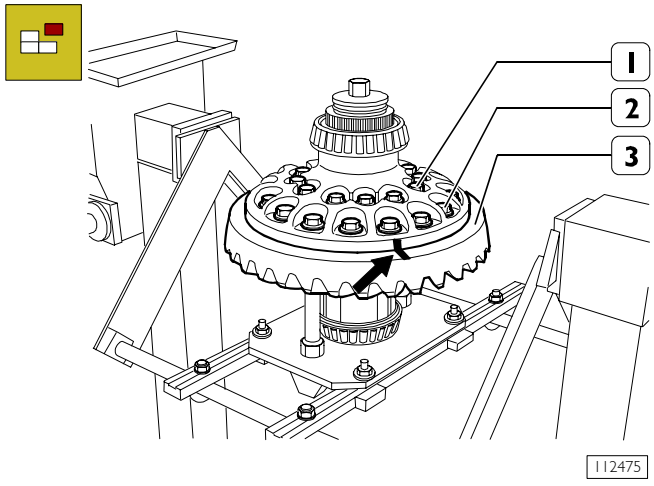
Use the suitable hook (1); lift the whole gearing case (2) and put it on the supporting base 99371047 (3).

Figure 64



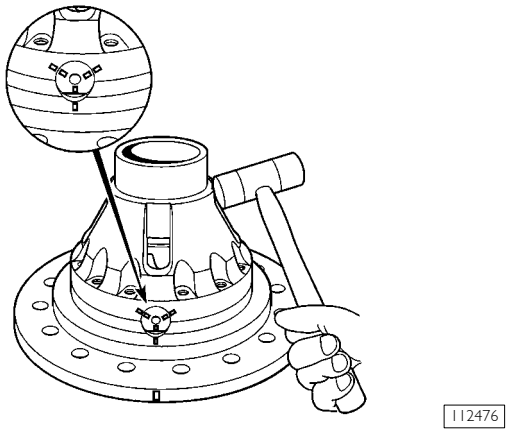
Use tool 99348001 (1) and the reaction block 99345055 (2) to pull out bearing (3) and bearing (4).

Figure 65



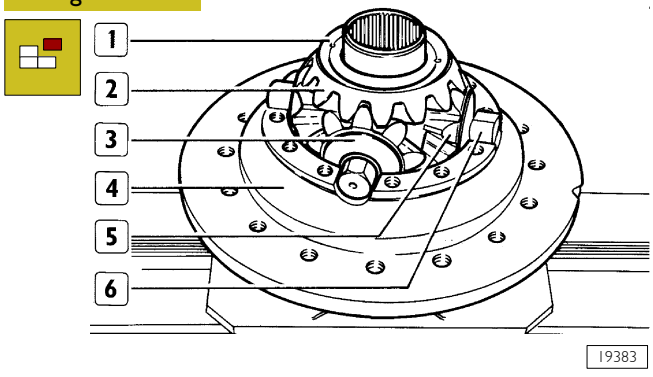
Mark the ring gear and the gearing case position as shown in the figure.
Remove the ring gear (3) fastening screws (2).
Turn the case and remove the ring gear (3).
Remove the half-case fastening screws (1).
Turn the case.

Figure 66



Mark the two half-cases and the cross as shown in the figure.
Split the half-cases.

Figure 67



Remove the crown wheel (2) and the offsetting washer (1).
Remove the cross (6) with the four planetary gears (5) and the shoulder washer (3); strip the cross-planetary gear unit.
Remove the other planetary gear and the shoulder washer from the half-case (4).

Checking the differential components

Carefully clean the differential components.
Lubricate the bearings and rotate the roller cage freely: the rotation must be regular with no stiffness.
Check the contact surfaces of the bevel gear and the stop plate of the half-box to ensure that the crown wheel adheres properly. Any deformation of these surfaces will cause the vibration of the fastening screws jeopardising the unit functioning.

NOTE Carefully clean screw, stud and ring nut threads to ensure proper adjustments and exact tightening torque.

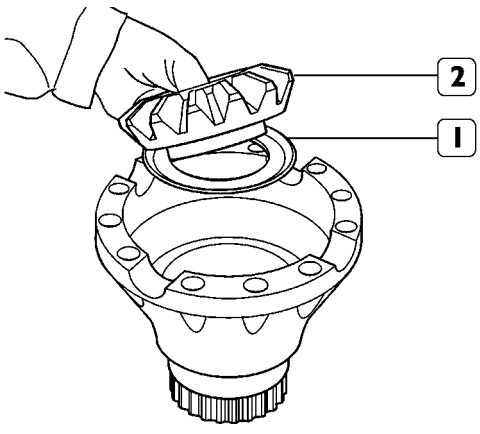
Check that the splined section for the flange connection onto the pinion is not worn. If it is replace the pinion.

Check the planetary gears and their shoulder washers, the spider and the crown wheels with their shoulder washers.
All sealing elements, the adjustment ring nut clip and safety washers must be replaced with new ones.

NOTE If it is necessary to replace the crown or the pinion, both elements must be changed as they are supplied in pairs.

Gearing case refitting

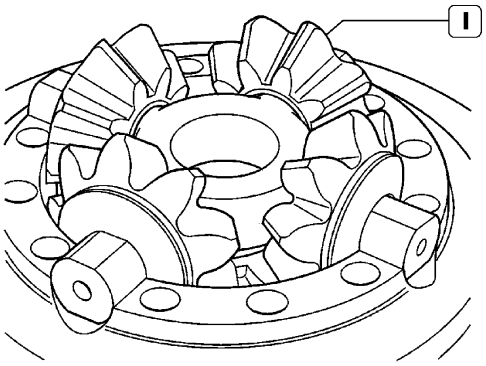
Figure 68



112478

Fit the shoulder washer (1) and the planetary gear (2) in the half-case.

Figure 69

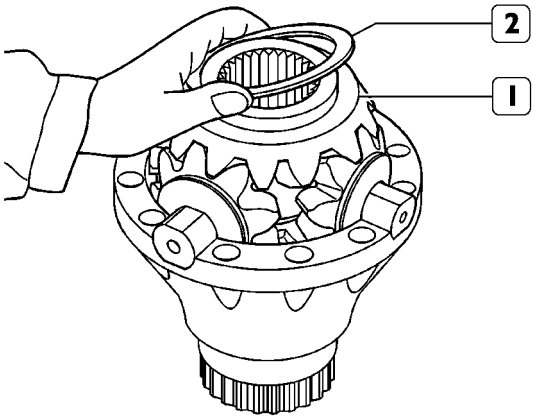


112479

Assemble the pinions (1) and the fit the assembly in the half-case.

NOTE If the assembly has not been previously mounted, make sure that the pinions are installed correctly.

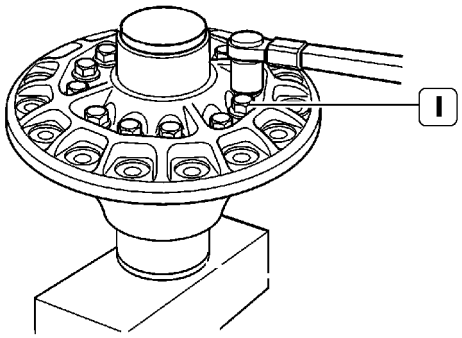
Figure 70



112480

Fit the shoulder washer (2) and the planetary gear (1) on the differential case.

Figure 71



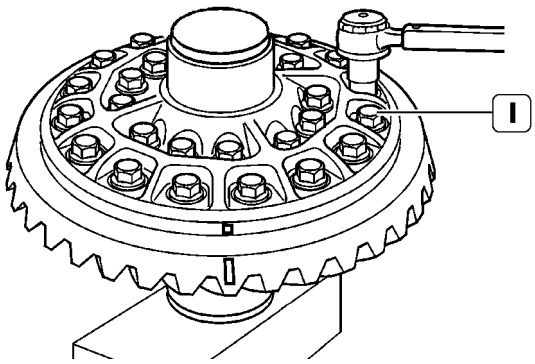
112481

Lock the differential with the suitable tool; then fit it in the half-case. Make sure that the marks made at removal match. Apply some drops of "LOCTITE 270" on the screw threading (1). Tighten the screws (1) to the prescribed torque.

NOTE It is advisable to replace the screws (1) with new ones.

Heat the ring gear inside an air-circulation oven at 100°C for 15' and fit it in the seat on the gearing case, making sure that the holes for the fastening screws of the ring gear-gearing case coincide.

Figure 72

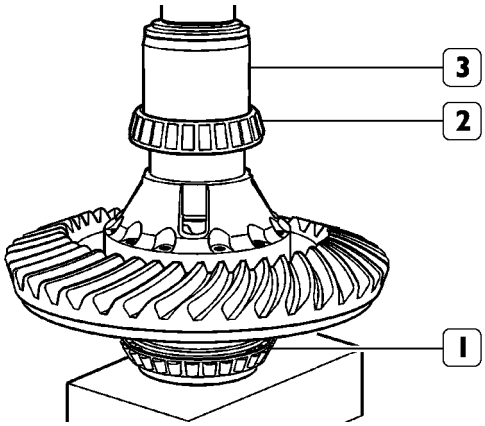


112482

After the ring gear has cooled down, fit the screws and tighten the self-locking nuts (1) with the dynamometric wrench to the prescribed torque.

NOTE It is advisable to replace the screws (1) with new ones.

Figure 73



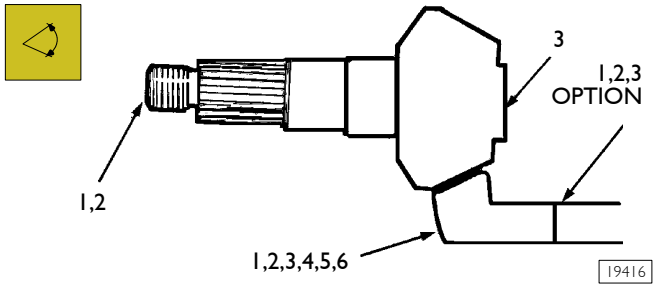
112483

Heat the bearings (1,3) inside an air-circulation oven at 100°C for 15' and fit them in the gearing case by means of the suitable beater (3).

ASSEMBLING DIFFERENTIAL CASING

Calculating bevel pinion position in differential casing

Figure 74



If a new final drive set is installed, it will be necessary to know the meaning of the markings on pinion and crown wheel in order to position the pinion correctly.

1. Part number
2. Tooth combination number.
   This number (example: 12/41) indicates that the pinion has 12 teeth and the crown wheel 41.
3. Pinion/crown wheel pair set number.
   All final drive sets are available as pairs: therefore pinion and crown wheel bear the same number which is stamped on head end for pinions and the outer face for crown wheels.

Never use a pinion and crown wheel set unless both components have the same number.

4. Variation number needed to determine the thickness of the shim pack interposed between pinion bearing cage and differential carrier (in the example below, this number is identified as CP).

Every crown wheel is marked with a variation number which indicates the nominal assembly distance. Use this number to calculate the thickness of the shim pack that is interposed between pinion bearing cage and differential carrier.
This number, expressed in mm, (e.g. P.C. + 0.1 or P.C. - 0.1) is marked on the external part of the ring gear.

5. Pinion/crown wheel set manufacturing and inspection month and year.
6. Specified pinion/crown wheel set clearance.

Part number and tooth combination number are stamped on threaded end of all pinions. Number may alternatively be located on outer diameter of crown wheel. On any pinion/crown wheel set, crown wheel will always bear an even stamped category number (e.g. 36786), whereas corresponding pinion will bear an odd number (e.g. 36787).

To determine the thickness of the shim pack to be interposed between bearing cage and differential carrier proceed as follows

1. Measure the thickness of the shim pack removed with the old final drive gear set. Use a micrometer or other suitable gauge and record the value found.
2. Read the CP marked on pinion to be replaced: if it is a plus (+) number or a minus (-) number respectively subtract or add it from the value obtained under 1. above.
   Take note of the result

NOTE The value obtained in 2. will be used to calculate the thickness of the shim to be interposed between pinion bearing cage and differential carrier for correct new final drive assembly.

3. Read the CP marked on the new pinion.
   Either add or subtract this value - depending on whether the sign is a plus or a minus - to or from the value noted under 2. above.
   The result indicates the thickness which the new shim pack should have.

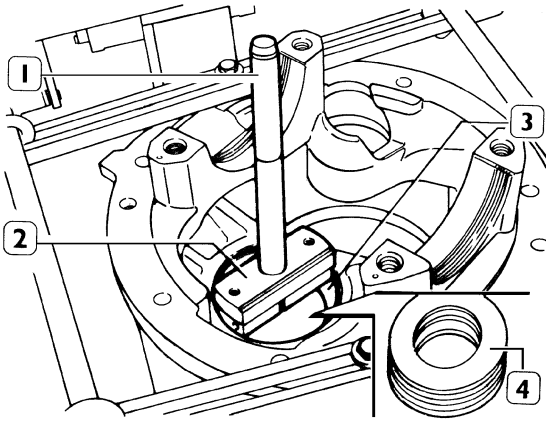
Refer to the following examples which cover all the possible calculation cases

EXAMPLES

	mm
Case 1:	
Original shim pack thickness	0.76
CP marked on pinion + 0.05	+ 0.05
Resulting value	0,81
CP marked on new pinion +0.12	- 0.12
Thickness for new shim pack	0.69
Case 2:	
Original shim pack thickness	0.76
CP marked on pinion - 0.05	- 0.05
Resulting value	0.71
CP marked on new pinion + 0.12	- 0.12
Thickness for new shim pack	0.59
Case 3:	
Original shim pack thickness	0.76
CP marked on pinion + 0.05	+ 0.05
Resulting value	0.81
CP marked on new pinion - 0.12	+ 0.12
Thickness for new shim pack	0.93
Case 4:	
Original shim pack thickness	0.76
CP marked on pinion - 0.05	- 0.05
Resulting value	0.71
CP marked on new pinion - 0.12	+ 0.12
Thickness for new shim pack	0.83

NOTE The difference between old pack and new pack thickness values must be added or subtracted - depending on cases - to or from the adjusting ring thickness (4, Figure 75).

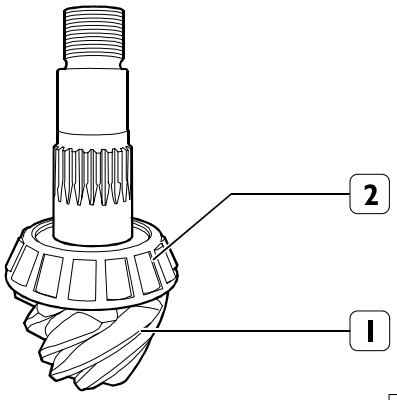
Figure 75



36383

Arrange shim pack (4) for adjusting bevel pinion position in carrier; then fit bevel pinion bearing cup (3) using handle 99370007 (1) and drift 99374093 (2).
Fit the remaining outer rings using beaters 99374093/94.

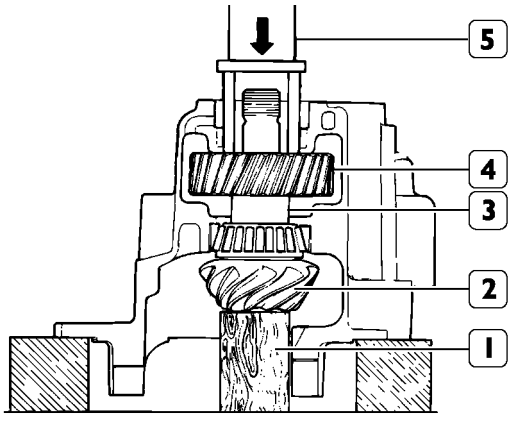
Figure 76



112485

Heat the bearing (2) to 100°C for 15 minutes and install it on bevel pinion (1) using a drift.

Figure 77

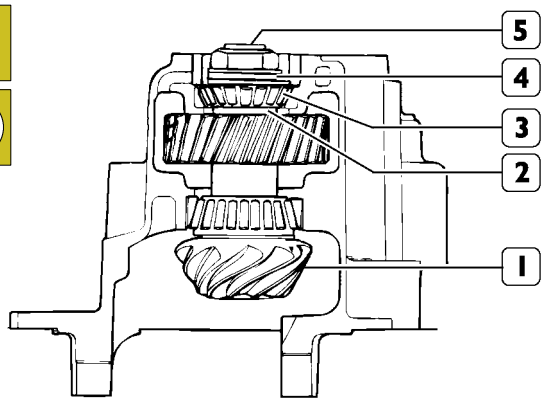


112486

Insert bevel pinion (2) in carrier and spline spacer (3) and gear (4) on it at the same time.
Mount reaction block (1) under pinion.

Drive gear (4) under press (5)

Figure 78



112487

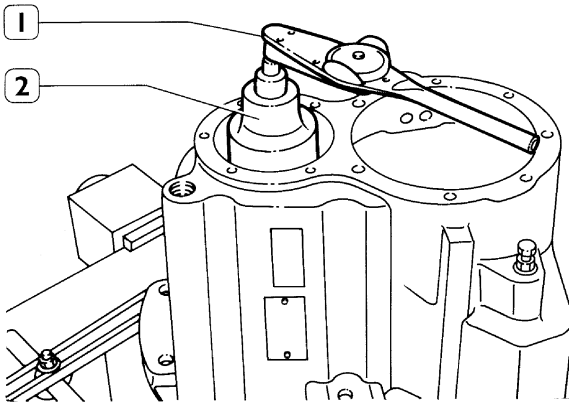
Block the rear axle position with tools 99341004 and 99341008.

Fit the adjusting ring (2).

Heat the bearing (3) at 100°C for 15' and fit it on the pinion.

Insert the washer (4) and the retaining nut (5).

Figure 79



36387

Tighten retaining nut bevel pinion using wrench 99355069 (2).

Remove tools 99341004 and 99341008.

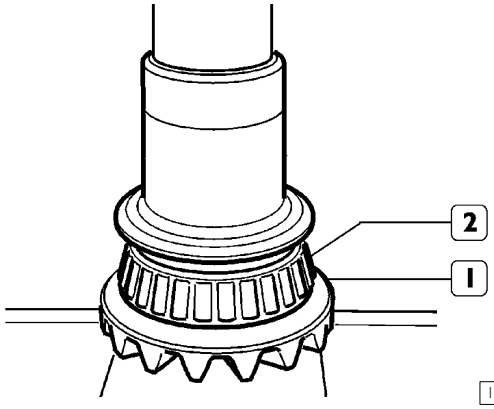
Apply torque wrench (1) to bevel pinion retaining nut and check that rolling torque is:

- 2.30 ÷ 7.40 Nm with new bearings,
- 3.00 ÷ 5.30 Nm with used bearing.

In case of a different reading, replace adjusting ring (2, Figure 78) with a thinner one if reading is higher than the specified figure and with a thicker one if the reading is lower than the specified figure.

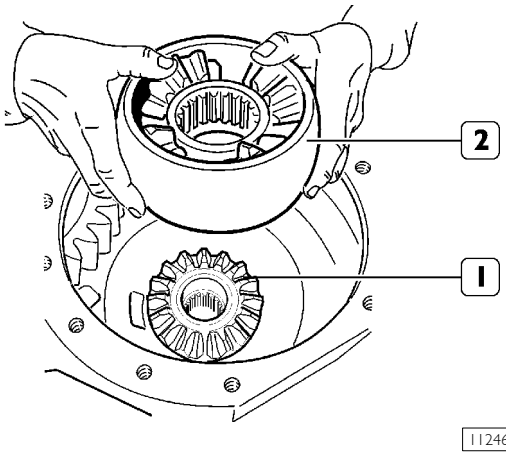
Apply a layer of sealer on the pinion cover and the screws. Fasten the cover by tightening the screws to the prescribed torque.

Figure 80



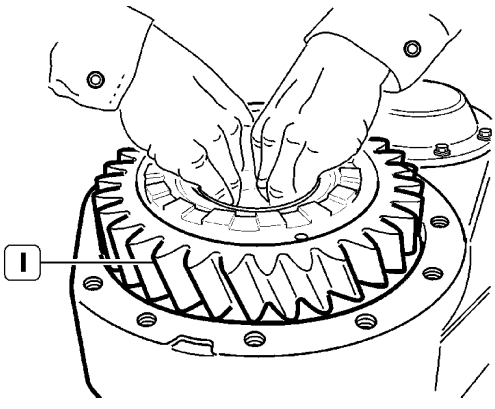
If previously removed, heat the bearing (2) at 100°C for 15' and fit it with the suitable beater on the rear gear (1).

Figure 81



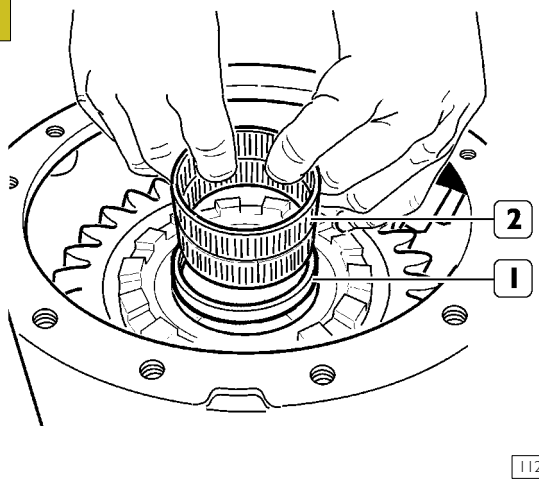
Fit the rear gear (1) and the crown wheel and planetary gear unit (2) in the case.

Figure 82



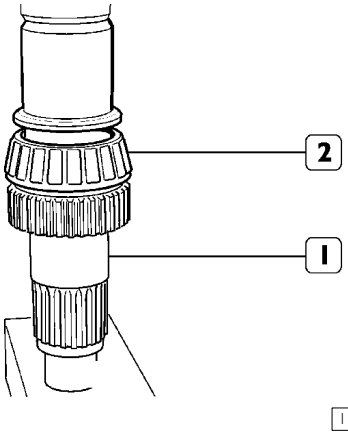
Fit the gear (1) making sure that it matches with the marks made at removal.

Figure 83



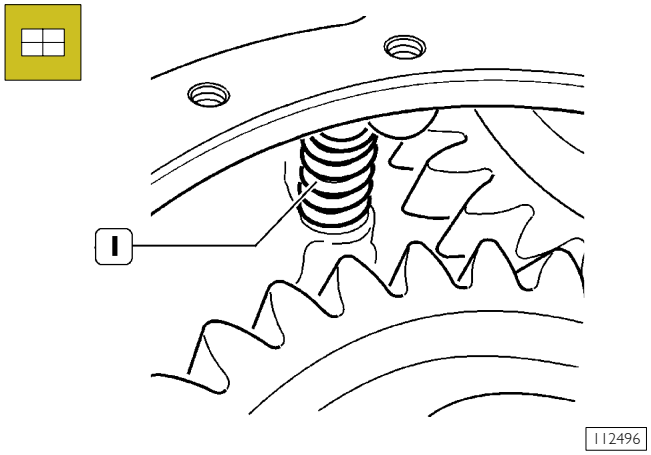
Fit the spacer (1) and the roller cages (2).

Figure 84



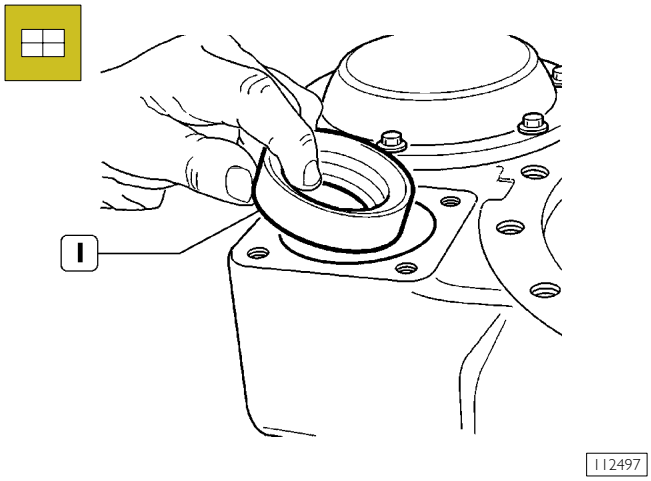
Heat the bearing (2) at 100°C for 15' and fit it with the suitable beater on the motion input shaft (1).

Figure 85



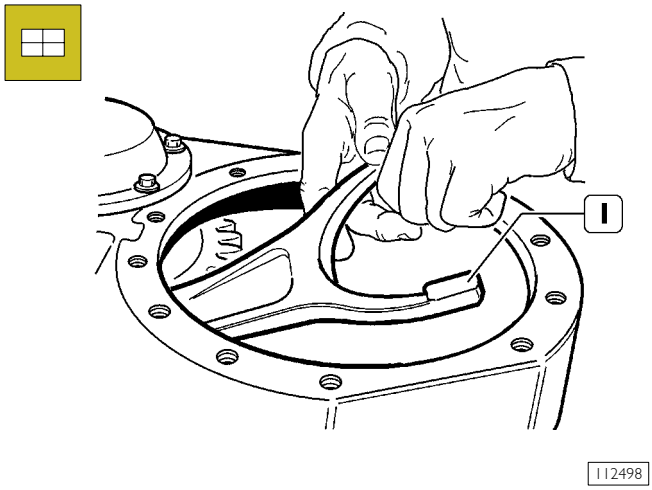
Fit the compression spring (1).

Figure 86



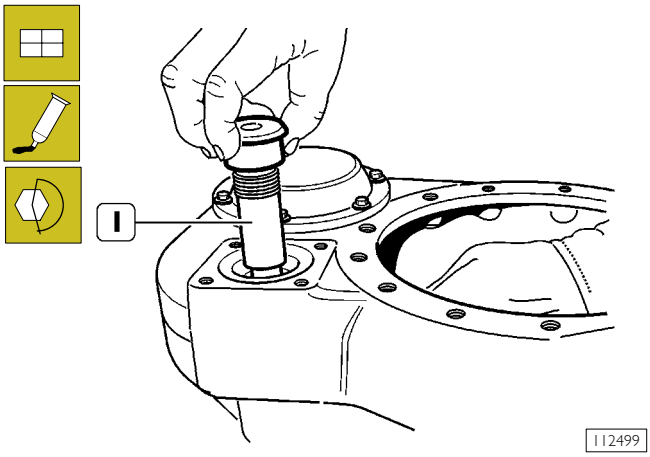
Fit the membrane seat (1).

Figure 87



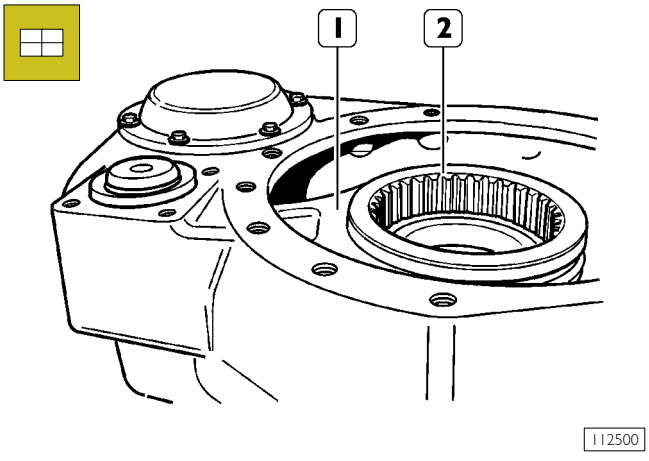
Fit the fork (1).

Figure 88



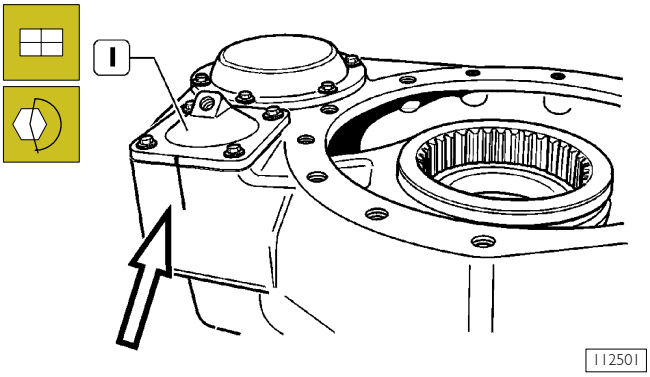
Apply some sealer on the piston threading (1). Insert the piston through the fork and the compression spring. Tighten to the prescribed torque.

Figure 89



Insert the sleeve (2) in the fork (1).

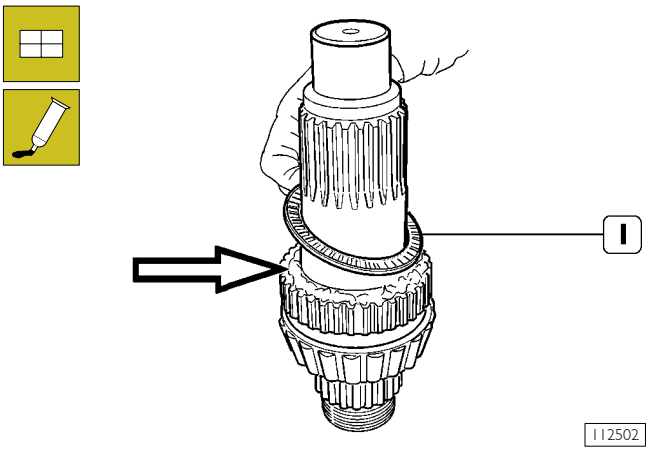
Figure 90



Fit the cover (1) and the membrane located below. Tighten to the prescribed torque.

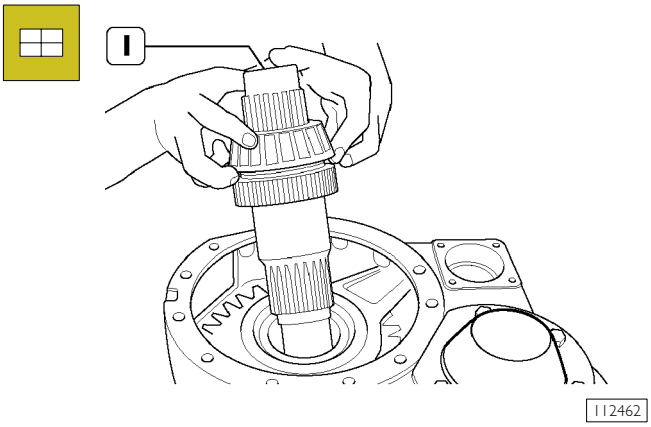
NOTE Fit the cover making sure that it matches with the marks made at removal.

Figure 91



Spread some vaseline as shown in the figure.
Fit the roller bearing (1).

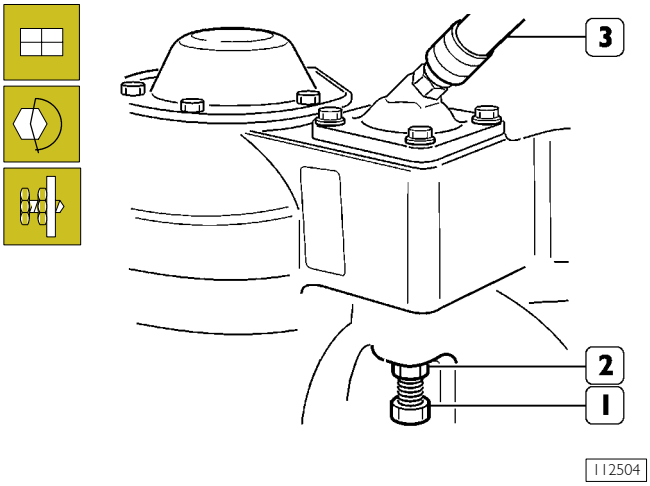
Figure 92



Fit the motion input shaft assembly (1) in the case.

Adjust the limit switch of the differential - distributor lock control pin

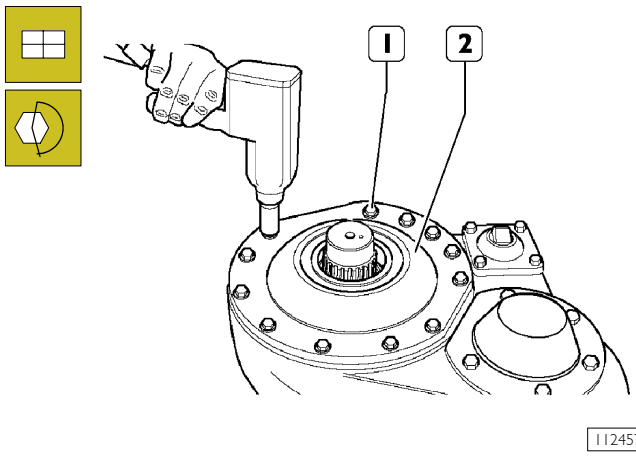
Figure 93



Adjust the limit switch of the control pin as follows:

- ❑ fill the cylinder (3) with 8-bar compressed air;
- ❑ tighten the screw (1) until it comes into contact with the control pin;
- ❑ further tighten the screw (1) by 1/4 ÷ 1/2 turn and lock the stop nut (2) to the prescribed torque.

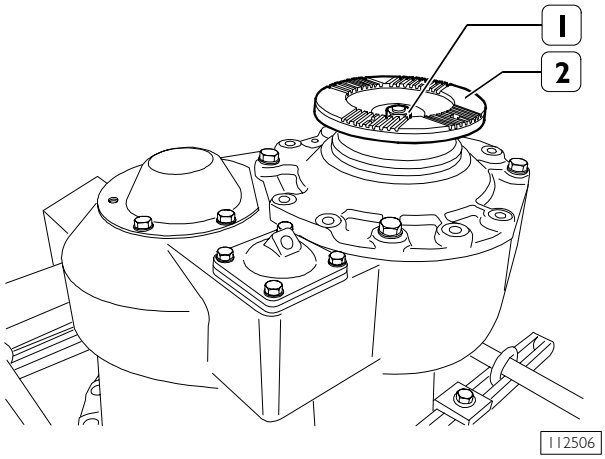
Figure 94



Fit the spacers (1, Figure 48) taken off at removal.

Fit the cover (2) tightening only 4 screws (1) to the prescribed torque.

Figure 95

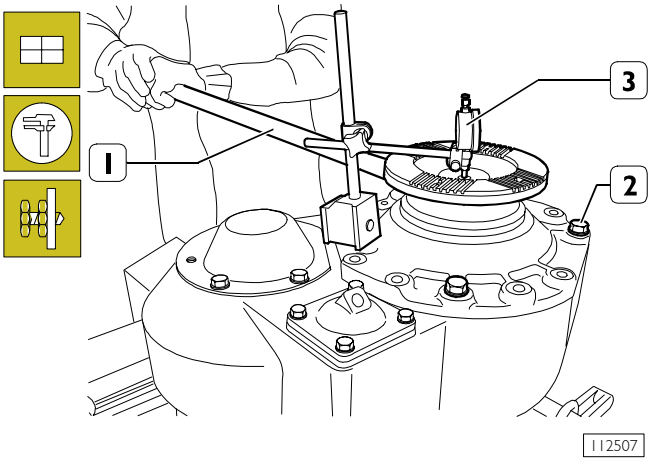


Fit the flange (2).

Tighten the retaining nut (1) to the prescribed torque.

Adjusting drive input shaft bearing end float

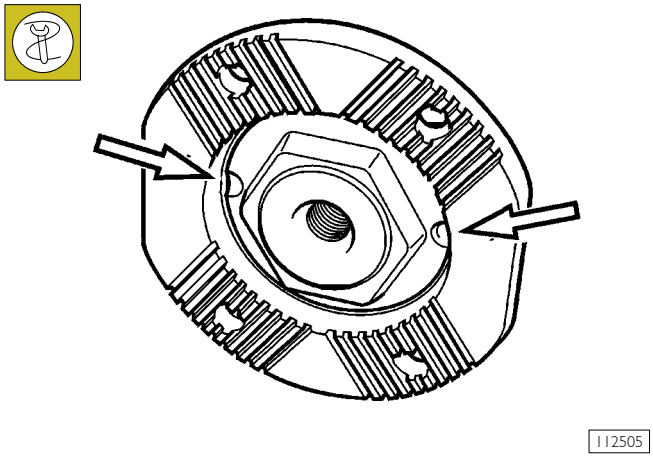
Figure 96



Proceed as follows to adjust shaft bearing end play;

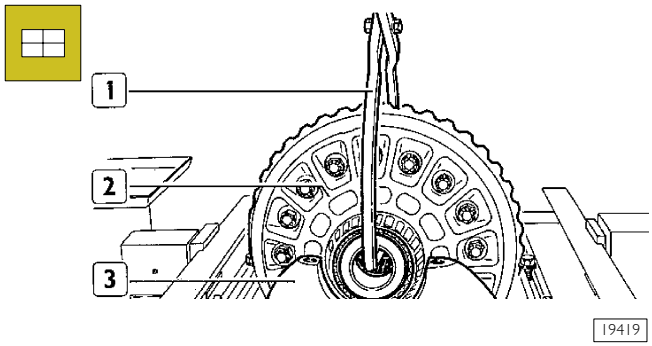
- ❑ turn the motion input shaft in the two directions to adjust the bearing;
- ❑ fit a dial gauge (3) and set to zero on the motion input shaft end;
- ❑ use a bar (1) and a support, if needed, to lever and check that the end play of the input shaft is between 0.01 ÷ 0.09 mm. If the end play is not included in this range, add or remove the shims (1 Figure 32) from the package previously inserted to obtain the required play;
- ❑ Tighten all the cover screws (2) to the prescribed torque.

Figure 97



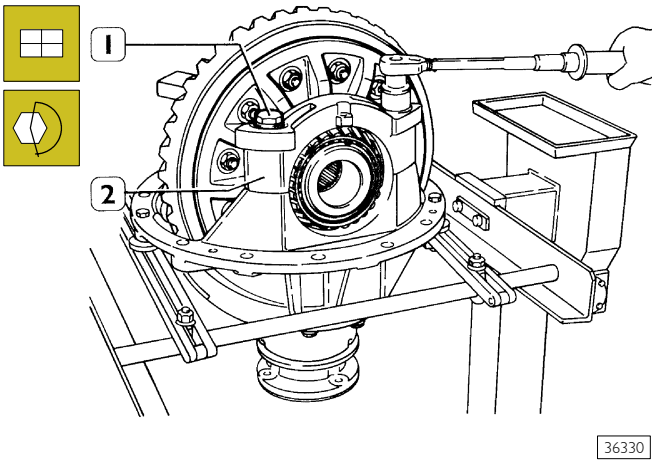
Bruise the retaining nut (1) as shown in the figure.

Figure 98



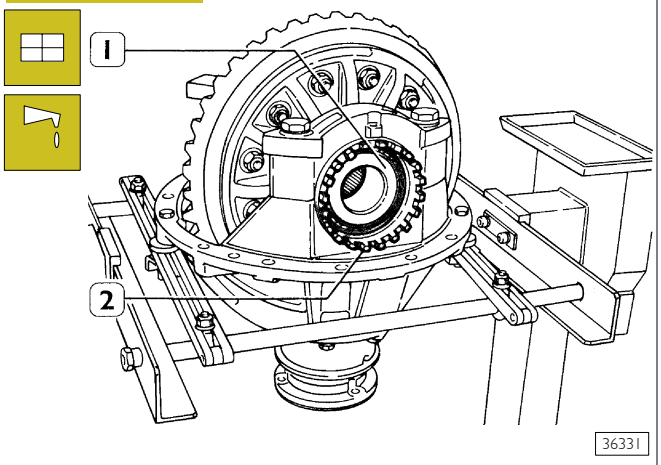
Using the proper hook (1) lift the previously assembled gear housing (2) and set it on the differential carrier (3).

Figure 99



Fit the caps (2), tighten the screws (1) and the washers to the prescribed torque.

Figure 100



Grease the taper roller bearings (1) and set the outer rings on them.
Screw the adjustment ring nuts (2).

ADJUSTING THE CAP ANGLE

Cap angle adjustment and check can be performed with two methods:

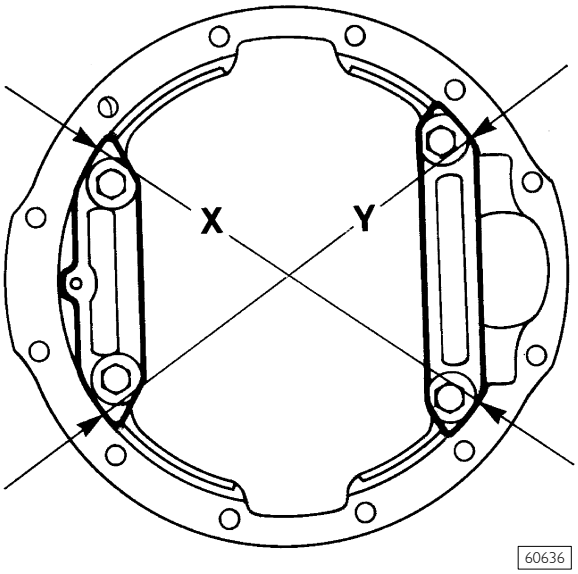
1st METHOD

1. Tighten bearing adjusting ring nuts (4) by wrench 99355025 (3, Figure 102) until removing the gap between pinion-crown and axle, ensure also that the crown is not forcing on pinion;
2. use a proper micrometer, set diagonally and centred on points (X-Y-arrows, Figure 101), to measure and mark cap distance;

2nd METHOD

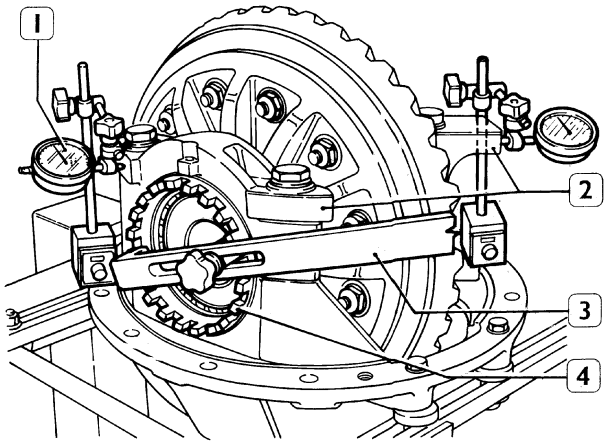
A. Set diagonally and centred on the external machined seats of both caps (2, Figure 102), two magnetic base gauges (1) as shown in Figure 102.

Figure 101



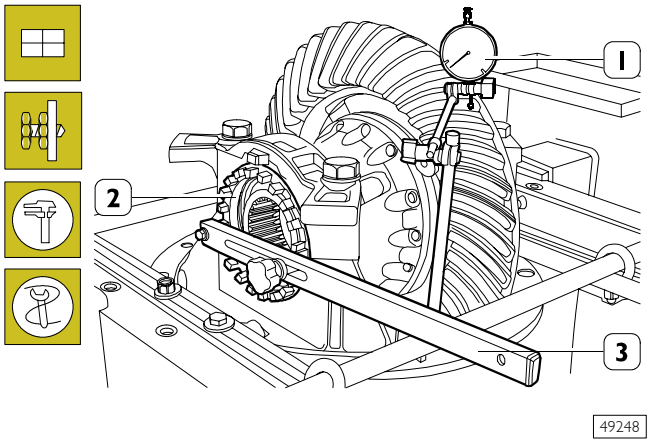
3. retighten the two adjusting ring nuts (4, Figure 102) to obtain a cap angle (2, Figure 102), measured as described in point 2, of 0.15 - 0 33 mm which corresponds to a bearing preload of 1.7 - 3.9 Nm (0.17 - 0.39 kgm).

Figure 102



B. proceed as described in point 1;
C. remove the end play, retighten the two adjusting ring nuts (4, Figure 102) to obtain a cap angle (2) of 0.05 - 0.23 mm which corresponds to sum of the values read on the gauges (1)

Figure 103



Adjust the end play between pinion-crown wheel teeth to obtain:

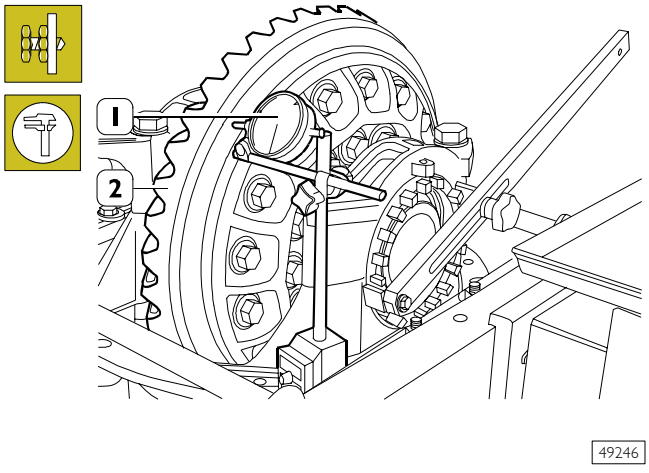
- 0.20 to 0.46 mm for already used units;
- 0.3 mm for new units

and proceed as follows:

- lock bevel pinion rotation using tool 99370317;
- position the gauge with magnetic base (1) as shown in the figure;
- using wrench 99355025 (3), loosen the adjusting ring nut on the crown side and tighten by the same amount the adjusting ring nut (2) on the opposite side. Taking this precaution the cap angle that has been previously adjusted is maintained;
- proceed as described until obtaining the prescribed value.

The end play value shall be checked on 4 equidistant points.

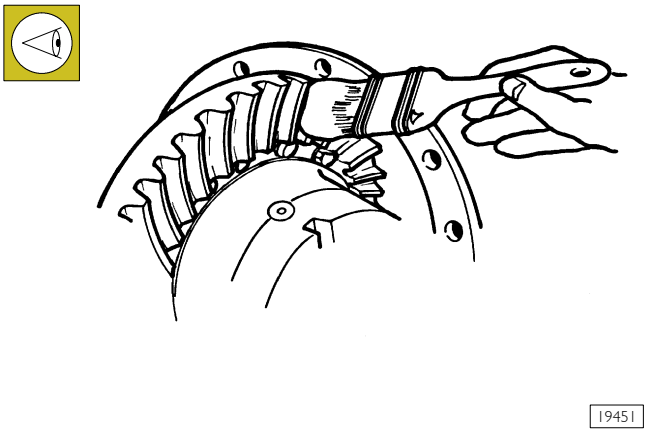
Figure 104



Using a gauge with magnetic base (1) check whether crown surging is not exceeding 0.20 mm, otherwise remove the differential unit and find the cause.

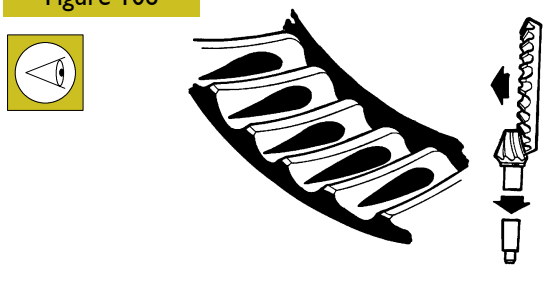
Re-assemble and repeat previously described adjustment operations.

Figure 105



Using a brush apply a thin coating of Prussian blue on the crown wheel.
Turn the pinion and find the contact mark between the pinion teeth and the crown wheel teeth.
The following figures show the possible contact points and how to correct any errors.

Figure 106



19452

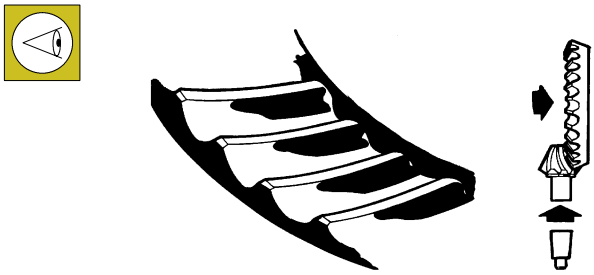
Contacts are excessively set on crown wheel teeth bottom land.

Conditions C-D. The pinion is too deeply set and therefore it requires further adjustment.
To adjust the exact pinion position, shims must be added under the pinion support to obtain an exact contact.

Condition C. Measure the end play and restore after adding the shims.

Condition D. After adding the shims take end play to the minimum value.

Figure 107



19453

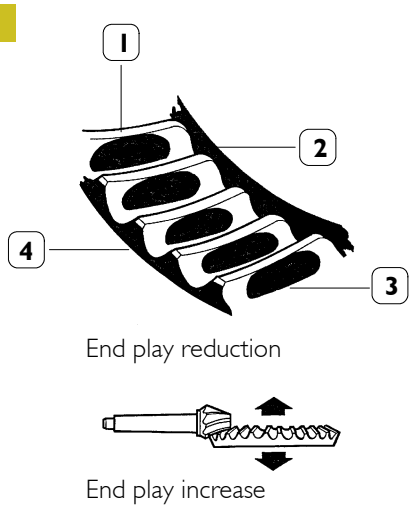
Contacts are excessively set towards crown wheel teeth crest.

Conditions A-B. The pinion is too far out and therefore it requires further adjustment.
To adjust the exact pinion position, shims must be removed from under the pinion support to obtain an exact contact.

Condition A. After removing the shims take end play to the maximum value

Condition B. Measure the end play and restore after removing the shims.

Figure 108



19454

THEORETICAL CONTACT AREA

1 Release, tooth concave side

2 Tip

3 Driving, tooth convex side

4 Heel

Condition E-F.

DRIVING. Central, tending towards the tip on tooth face and central on tooth contour.

RELEASE. Central, tending towards the heel on tooth face and central on tooth contour.

The pinion is positioned exactly.

Contact position can be modified by changing the pinion-crown end play.

Condition E. Reduce the end play.

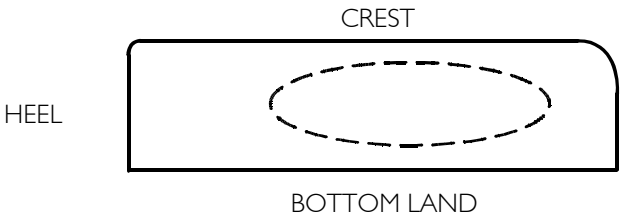
Condition F. Increase the end play.

CORRECTING THE BEVEL GEAR PAIR CONTACTS (AFTER FITTING IN PLACE)

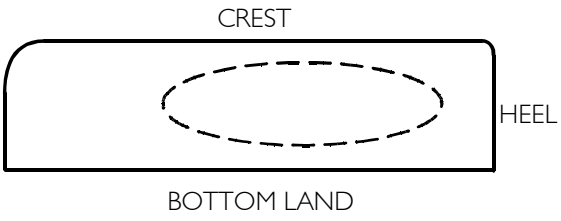
Figure 109

THEORETICAL CONTACTS

DRIVING
(CROWN WHEEL CONVEX SIDE)



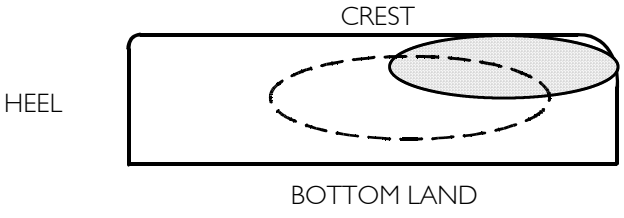
RELEASE
(CROWN WHEEL CONCAVE SIDE)



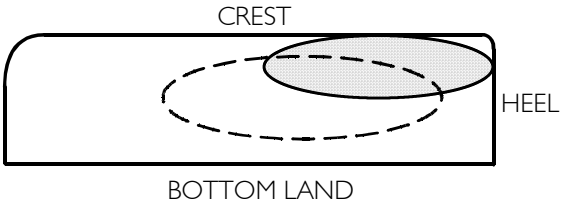
- DRIVING : CENTRAL, TENDING TOWARDS THE TIP ON TOOTH FACE AND CENTRAL ON TOOTH CONTOUR.
- RELEASE : CENTRAL, TENDING TOWARDS THE HEEL ON TOOTH FACE AND CENTRAL ON TOOTH CONTOUR.

CONDITION "A"

DRIVING

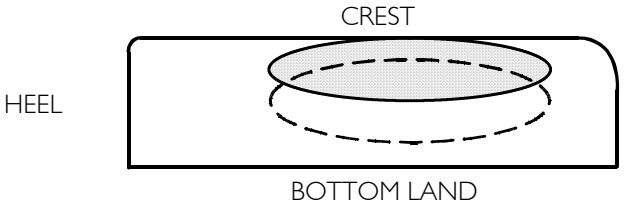


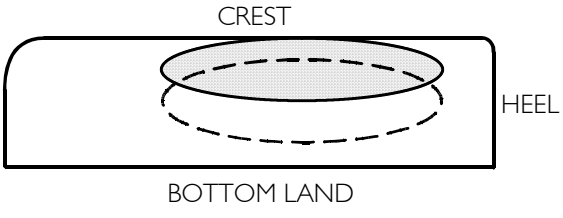
RELEASE



- DRIVING - RELEASE : EXCESSIVE CONTACTS TO CREST
- DRIVING : EXCESSIVE CONTACT TO TIP
- RELEASE: EXCESSIVE : CONTACT TO HEEL
- CORRECTIVE ACTIONS : REMOVE SHIMS AND INCREASE END PLAY TO MAX.

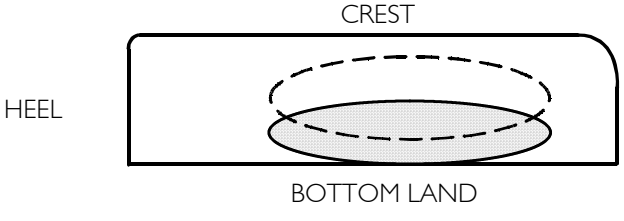
CONDITION "B"

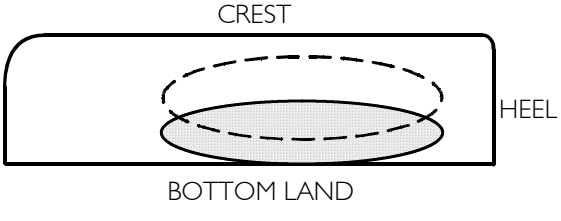




- DRIVING - RELEASE : EXCESSIVE CONTACTS TO CREST
- CORRECTIVE ACTIONS : MEASURE THE END PLAY, REMOVE SHIMS AND RESTORE END PLAY

CONDITION "C"



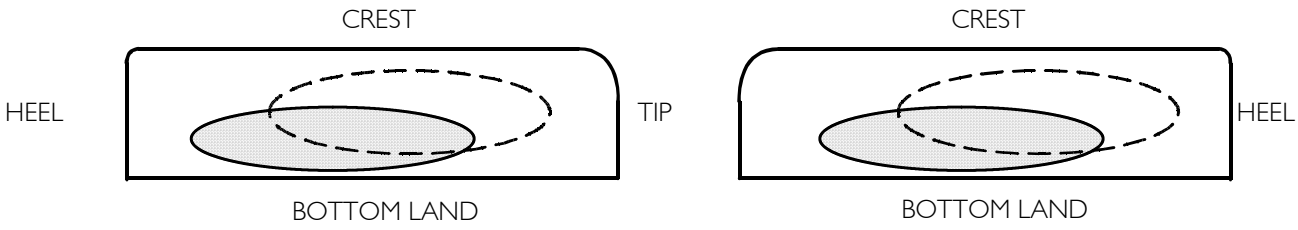


- DRIVING - RELEASE : EXCESSIVE CONTACTS TO BOTTOM LAND
- CORRECTIVE ACTIONS : MEASURE THE END PLAY, ADD SHIMS AND RESTORE END PLAY

60676

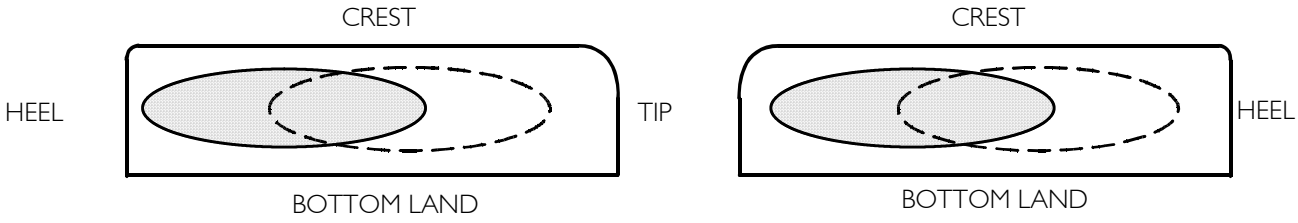
Figure 110

CONDITION "D"



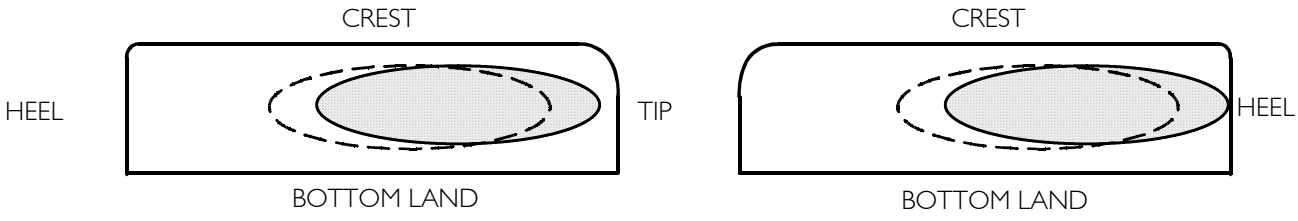
- DRIVING - RELEASE : EXCESSIVE CONTACTS TO BOTTOM LAND
- DRIVING : EXCESSIVE CONTACT TO HEEL
- RELEASE : EXCESSIVE CONTACT TO TIP
- CORRECTIVE ACTIONS : ADD SHIMS AND REDUCE END PLAY TO MIN.

CONDITION "E"



- DRIVING : EXCESSIVE CONTACT TO HEEL
- RELEASE : EXCESSIVE CONTACT TO TIP
- CORRECTIVE ACTIONS : REDUCE END PLAY

CONDITION "F"

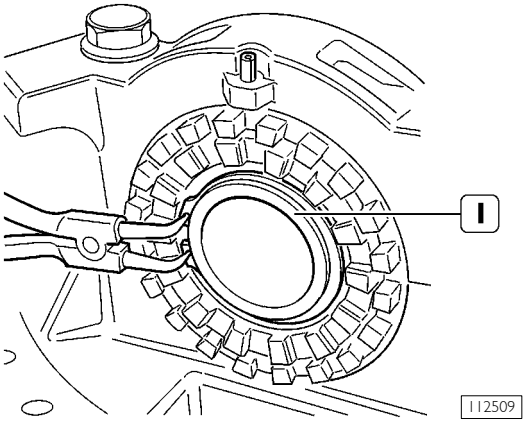


- DRIVING : EXCESSIVE CONTACT TO TIP
- RELEASE : EXCESSIVE CONTACT TO HEEL
- CORRECTIVE ACTIONS : INCREASE END PLAY

60677

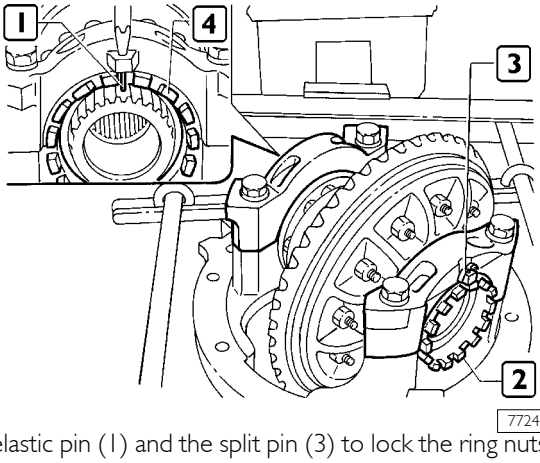
Note: In case of pinions fitted without pilot bearing instead of "removing shims" it will be necessary to "add shims" and vice versa.
For the end play, the same conditions shown stand valid.
Contact marks are always referred to crown wheel teeth.

Figure 111



Fit the seal ring (1) and the spacer below.

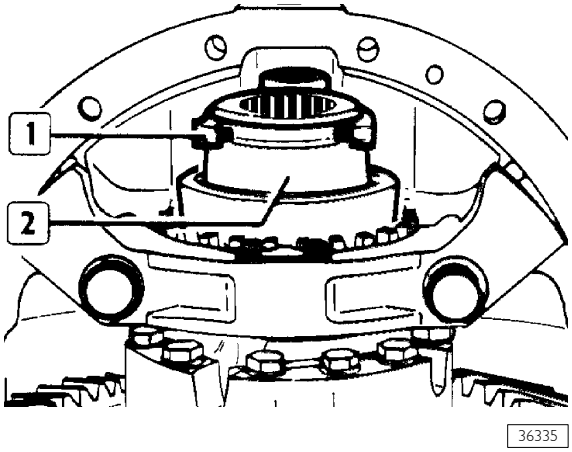
Figure 112



Fit the elastic pin (1) and the split pin (3) to lock the ring nuts (2-4).

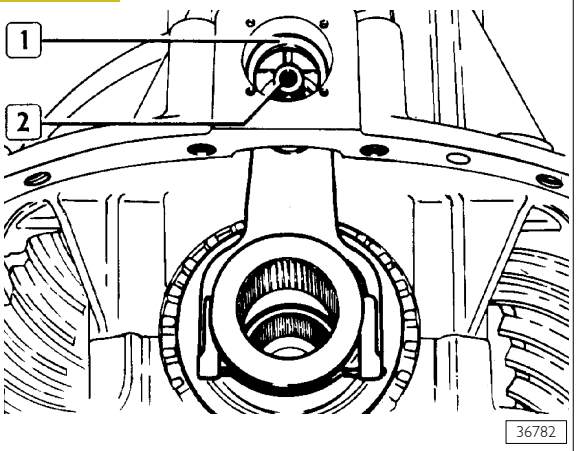
NOTE If the elastic pin or the split pin do not coincide with the respective seats on the ring nuts, slightly turn the ring nuts so that the elastic pin or the split pin can be fitted.

Figure 113



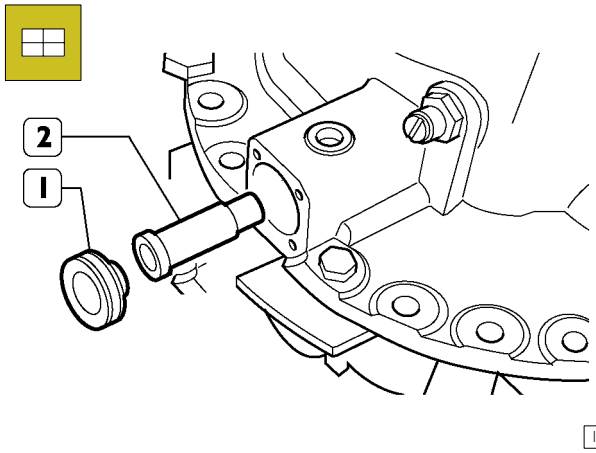
Fit the sliding sleeve (2) on the fork (1) and drive in the two spring pins.
Position the fork including the sliding sleeve into its seat.

Figure 114



Insert the return spring (2) and the plain washer (1).

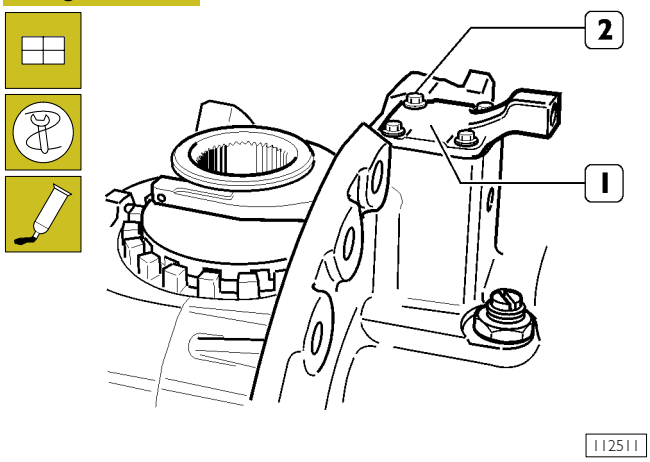
Figure 115



Fit the stem (2) and the piston (1).

NOTE Use a new o-ring.

Figure 116

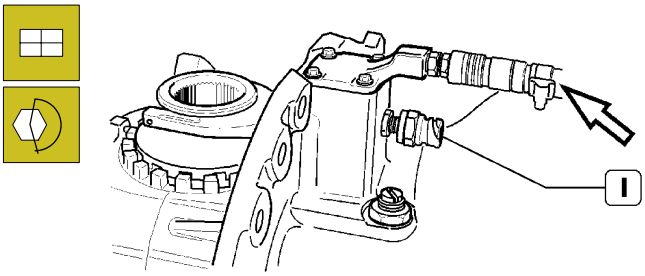


Fit the cover (1) as shown in the figure with a new gasket.

Tighten the screws (2) to the prescribed torque.

Remove the differential case from the stand and refit it on the rear axle case.

Figure 117



112512

Fill the cylinder (see arrow) with 8-bar pressure.

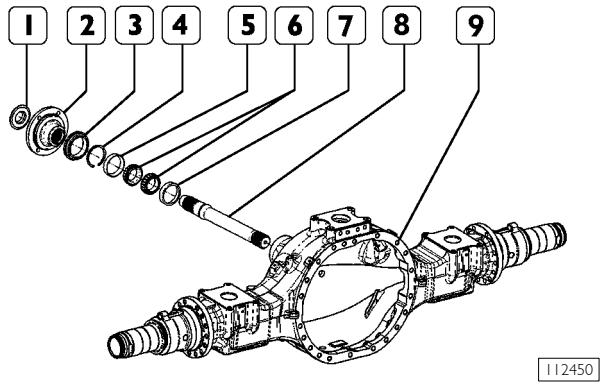
Apply some sealer on the differential clamping switch (1) and fit it in its seat.

Connect a multimetre to the differential clamping switch and tighten the switch until they touch.

Further tighten it by one turn and close with the lock nut to the prescribed torque.

526082 REMOVAL-OVERHAUL-REFITTING OF DISTRIBUTOR OUTPUT SHAFT

Figure 118

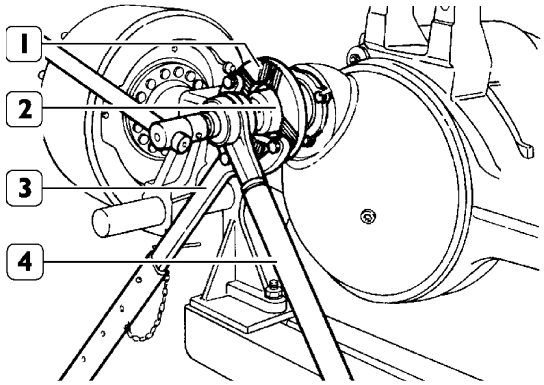


112450

MOTION OUTPUT SHAFT COMPONENTS

1. Nut - 2. Flange - 3. Seal ring - 4. Spacer ring - 5. Bearing outer ring - 6. Motion output shaft bearings - 7. Bearing outer ring - 8. Motion output shaft - 9. Rear axle case

Figure 119



112455

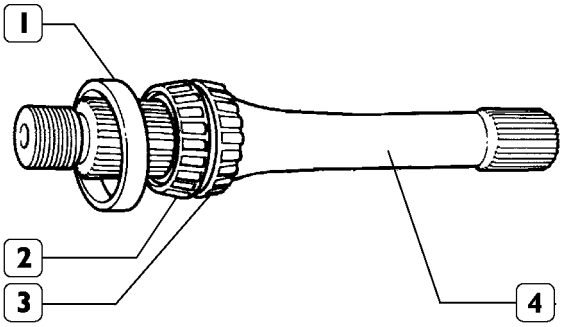
Stop rotation of flange (1) with retainer 99370317 (3). With wrench 99355131 (2) and torque adaptor (4) loosen shaft flange (1) retaining nut.

Use a lever and the suitable beater to remove the flange (1).

Remove and throw away the seal ring (3, Figure 120).

Remove the snap ring from the motion output shaft (4, Figure 120).

Figure 120

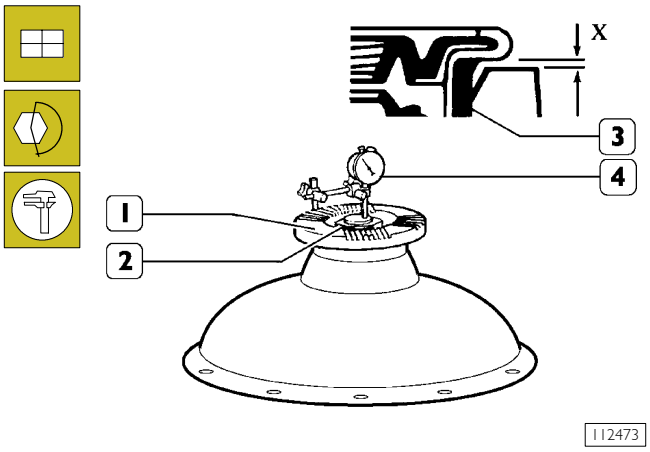


112469

Pull out the motion output shaft (4) together with the bearings (2 and 3) and the outer ring (1).
Use a suitable extractor to remove bearings (2 and 3) from drive output shaft (4).

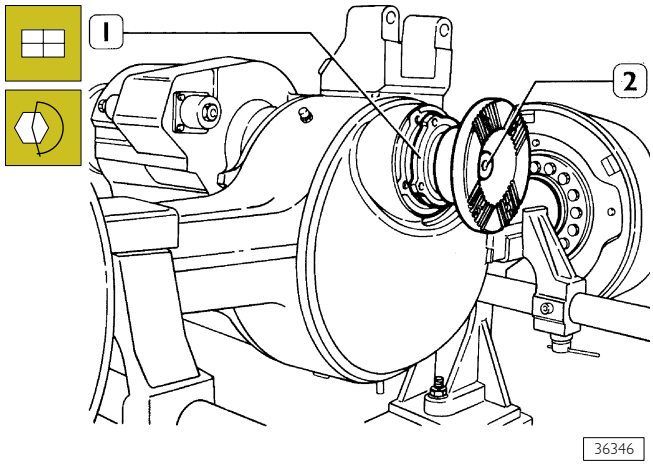
Adjustment of motion output shaft bearing end play

Figure 121



Reverse the removal operation sequence to reassemble the output shaft unit.
After fitting sealing ring (3), use a feeler gauge to check distance X between sealing ring (3) and mounting at four equi-distant points. Distance X must be between 0.38 ÷ 0.76 mm.
Tighten nut (2) fastening flange (1) to the drive output shaft to the specified torque. Then check that end play is between 0.025 and 0.127 mm using a magnetic base dial gauge (4) positioned on shaft.
If reading is other than specified, replace the snap ring (4, Figure 119) with one of the correct thickness.

Figure 122



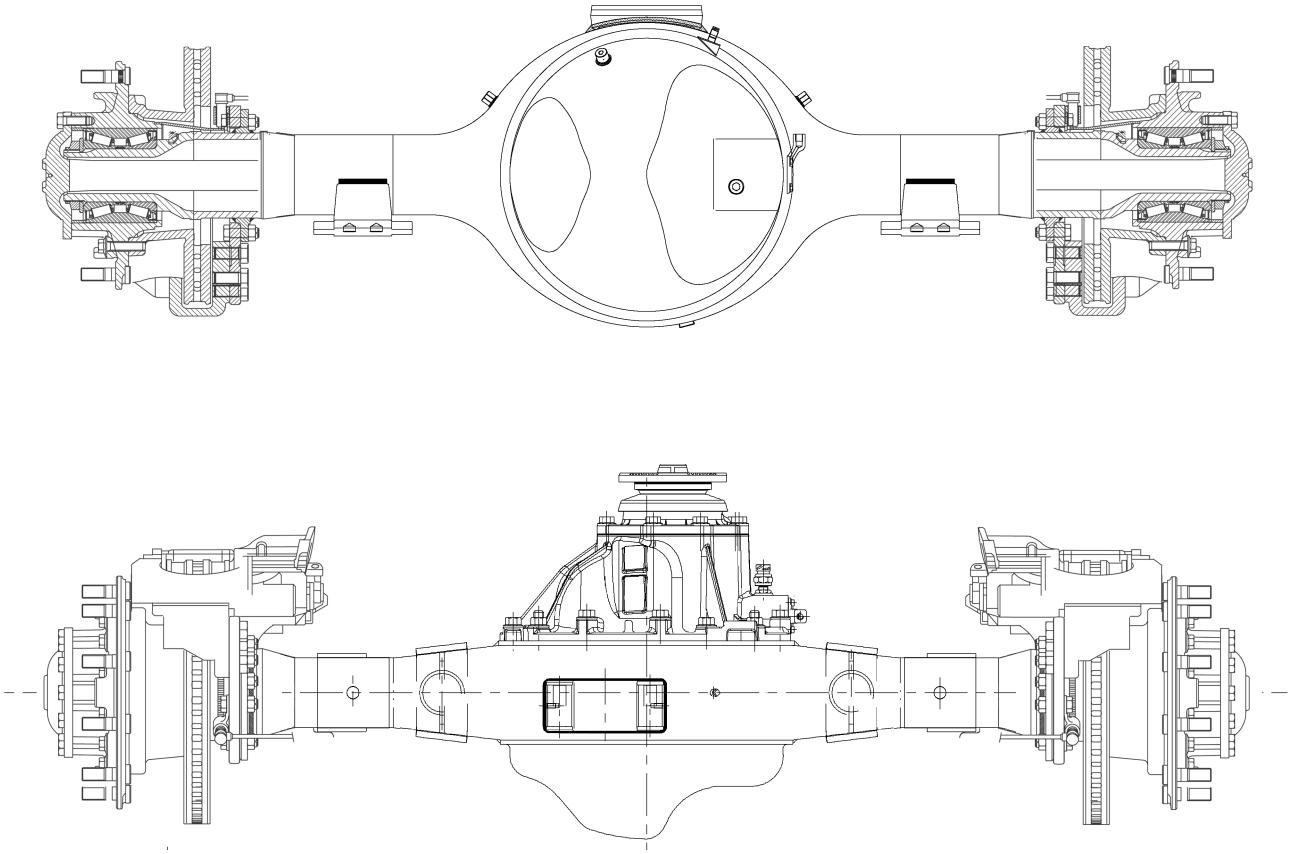
Turn by 90° axle casing.
Set support (1) into axle casing comprising motion output shaft (2) and tighten fixing nuts to the required torque.

5250 Rear axles ARVINMERITOR MR11-155/D

DESCRIPTION

The rear axle is the load bearing type with a single reduction. It is composed of a pressed sheet steel box appropriately strengthened.
The differential is characterized by a hypoid-toothed gear train.
The pinion is supported by two tapered roller bearings and by a third cylindrical roller bearing.
The position of the bevel pinion, in relation to the ring bevel gear, is adjusted by changing the thickness of the pack of rings between the differential case and the bevel pinion mount.
The gearing box is supported by two tapered roller bearings and can be adjusted axially with two threaded ring nuts.
The rear axle is equipped with a differential locking device.
The bearings of the wheel hubs are the UNIT-BEARING type with permanent lubrication and need no adjustment.
The brakes are KNORR-type disc brakes.

Figure 1



109091

VIEWS OF THE ARVINMERITOR MT23-155 AXLE IN TANDEM ASSEMBLY WITH DISC BRAKES

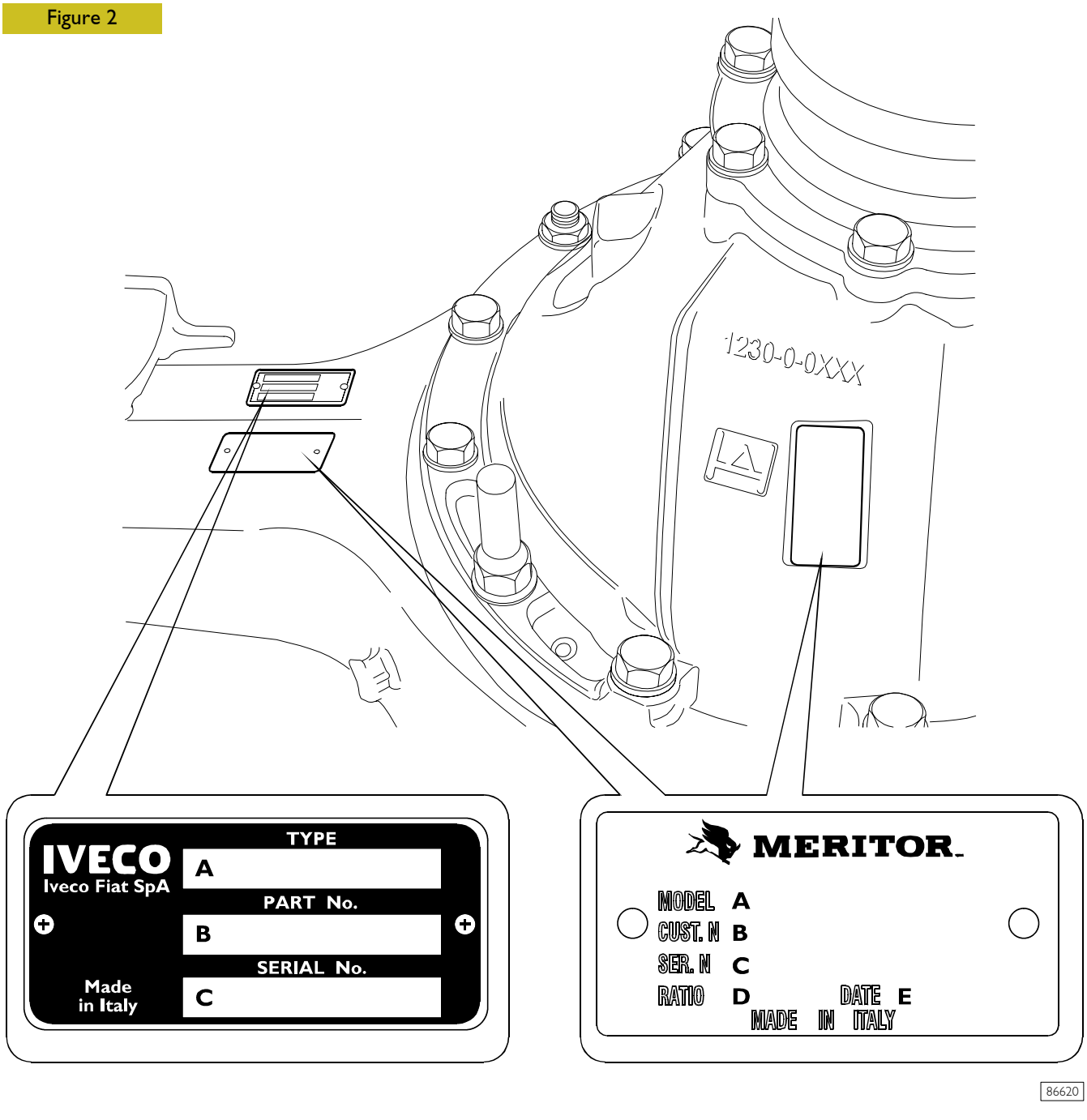
LOCATION OF DIFFERENTIAL UNIT PLATES - REAR AXLE

The plates contain all information and details relating to either DIFFERENTIAL UNIT and REAR AXLE.

On real axle, two plates are present: one on the differential unit and one in same position on rear axle box. On the notifications of interventions under guarantee, rear axle box and differential unit plate data must always be shown. It is suggested always to read and copy out shown data before any repair so as to order correct spare parts and transmit correct information to either IVECO Service Network.

Plate is never to be removed from the unit.

Figure 2



IVECO identification plate

A = identifies rear axle type
B = drawing number
C = production progressive number

ARVINMERITOR identification plate

A = identifies the family the item is belonging to / the model
B = drawing number
C = ArvinMeritor series number
D = rear axle ratio
E = production date

CHARACTERISTICS AND DATA

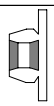
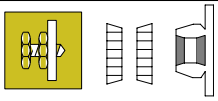
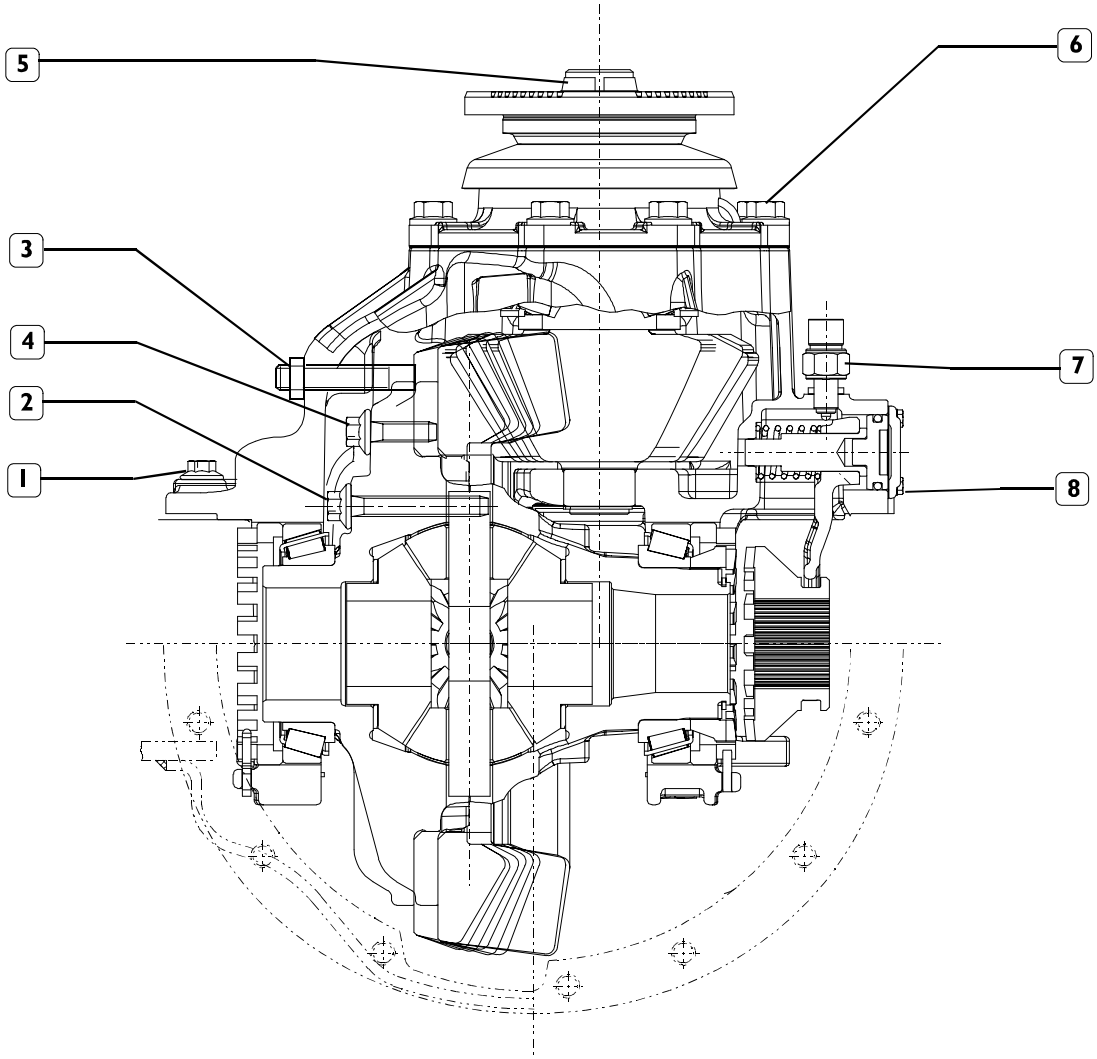
	**WHEEL HUBS**	
	Wheel hub bearings	Two UNIT - BEARING
	Wheel hub bearing end float adjustment	Non-adjustable Tightening to torque with threaded nut
	Axle oil	TUTELA W140/M-DA
	Quantity Litres (kg)	18.5 (16.5)
	Dry weight (Mechanical suspension) kg (Pneumatic suspension) kg	586 591
	Maximum capacity GRW kg	11500

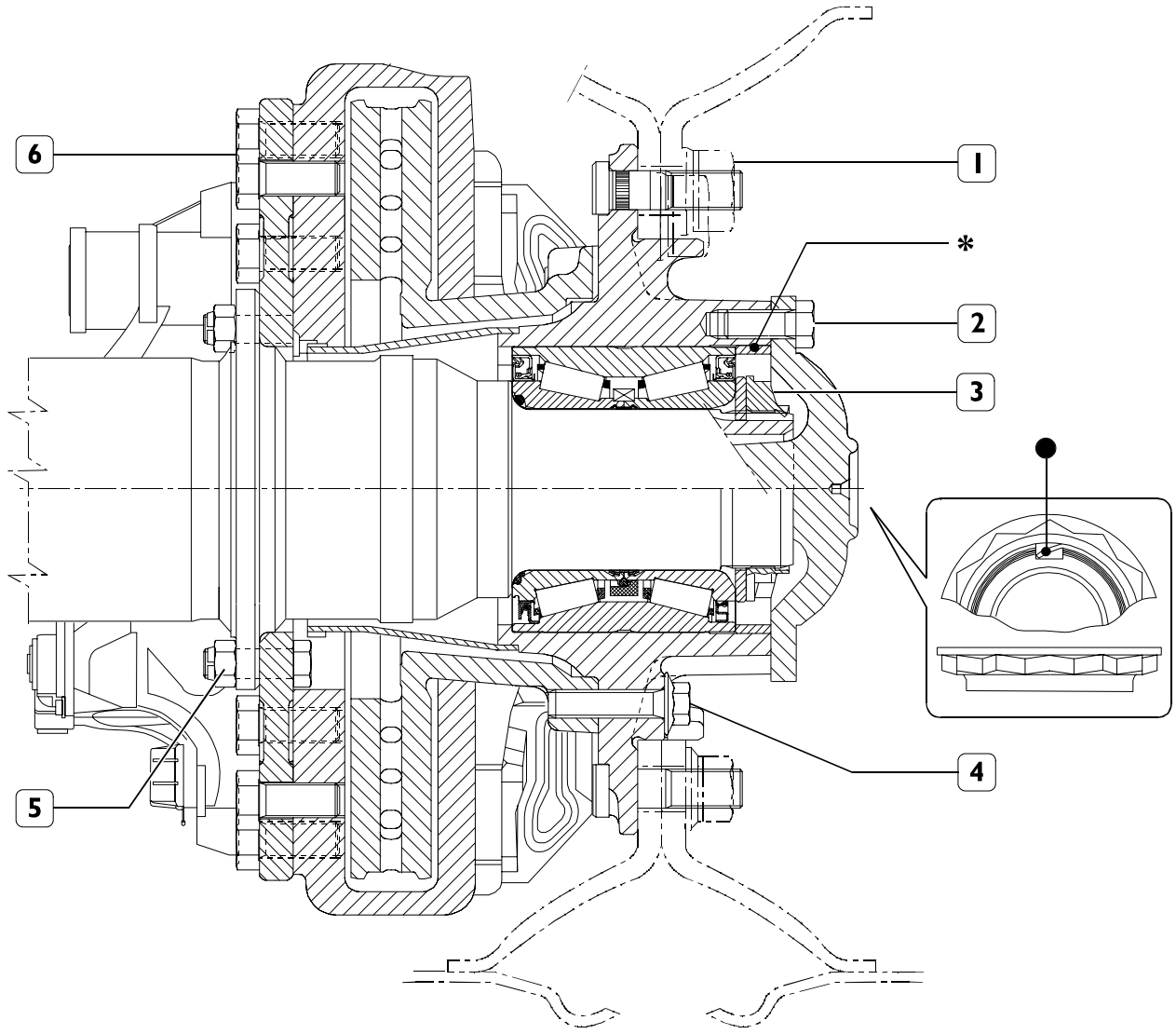
Figure 3



TIGHTENING TORQUES

	PART		TORQUE	
			Nm	kgm
1	Screw fixing differential case to axle housing	1st phase torque 2nd phase angle	100 ± 5 80° to 90°	10 ± 0.5
2	Screw fixing differential half boxes	1st phase torque 2nd phase angle	100 ± 5 110° to 120°	10 ± 0.5
3	Nut locking bevel pinion		1350 to 1670	135 to 167
4	Screw fixing bevel ring gear to half box	1st phase torque 2nd phase angle	100 ± 5 80° to 90°	10 ± 0.5
5	Nut locking bevel pinion		1350 to 1670	135 to 167
6	Screw fixing bevel pinion mount	1st phase torque 2nd phase angle	100 ± 5 60° to 70°	10 ± 0.5
7	Nut locking sensor		35 to 45	3.5 to 4.5
	Screw fixing caps to differential case		650 to 810	65 to 81
	Oil level and draining plugs		45 to 55	4.5 to 5.5
8	Nut locking bevel pinion		1350 to 1670	135 to 167

Figure 4



114976

TIGHTENING TORQUES

	PART	TORQUE	
		Nm	kgm
1	Nut fixing wheels	732 to 599	73.2 to 59.9
2	Screw fixing drive shaft flange	235 to 289	23.5 to 28.9
3	Ring nut retaining wheel hub bearing	834 to 1030	83.4 to 103
4	Screw fixing brake disc to wheel hub	268 to 295	26.8 to 29.5
5	Nut for screw fixing brake calliper mount	275 to 304	27.5 to 30.4
6	Screw fixing brake calliper to mount	554 to 677	55.4 to 67.7

* When fitting the spacer ensure a clearance equal to 0-0.145 mm between the outer edge to the wheel hub and the spacer, carrying out two checks at 1805.

• Notch as close as possible to the side of the milling as shown in the drawing (after tightening to the specified torque).

REPAIR OPERATIONS

Since the wheel hub servicing procedure is similar to that described for middle axle MD 11-155/D, please refer to this.
The axle adjustment data, tools and service procedure are similar to those described for axle MS 13-175.

SECTION 8

5206 Axles

In this section

5206 Front axles

5258 Additional rear axle

Front axle
5876
5876/4
5876/5
Steering central added axle
5876/4

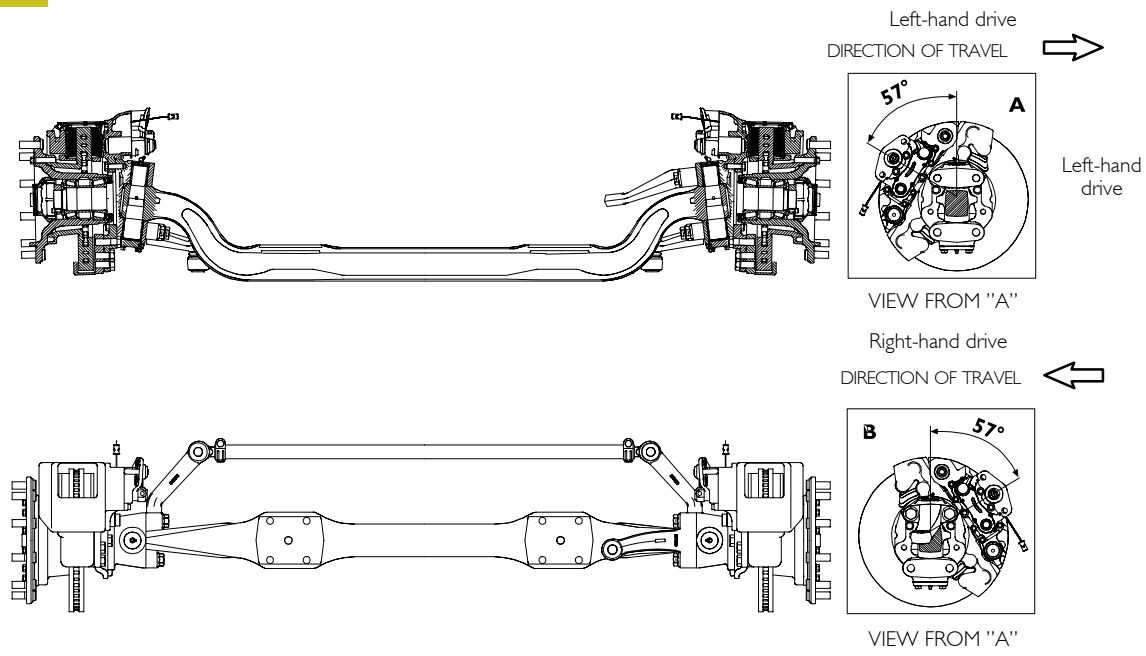
DESCRIPTION

The front axle is a steel structure with a double-T cross-section at the end of which the stub axles are articulated.
The stub axle articulation is made with tapered pins integral with the axle body and by means of four bearings with rollers driven in with interference in the holes of the stub axle overhangs.
The wheel hubs are supported by two tapered roller bearings, set right, lubricated with oil, mounted on the shank of the stub axle.

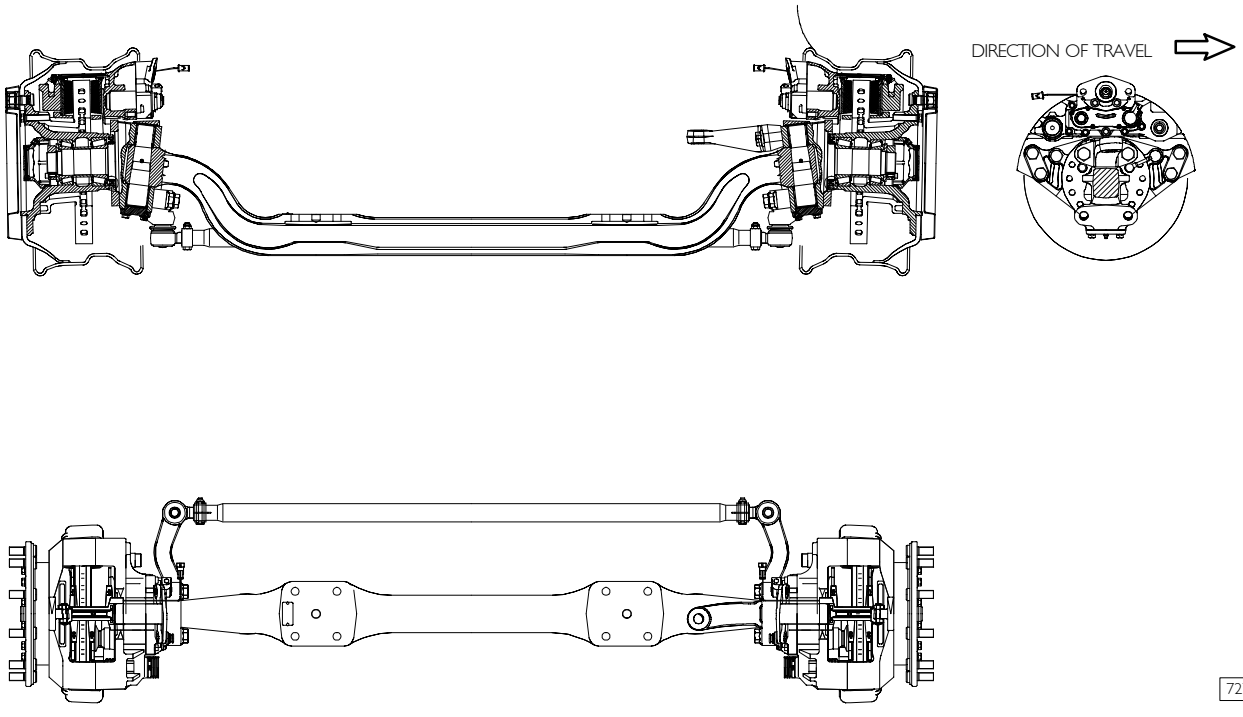
The bearings need no adjustment; their end float is obtained by tightening the retaining ring nut to torque.
The disc brake is the "KNORR" type.
The brake calliper is fitted with:

- an angle of 57° on axles 5876, 5876/4 without parking brake;
- an angle of 0° on axle 5876/5 with parking brake.

Figure 1

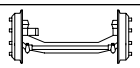
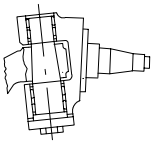
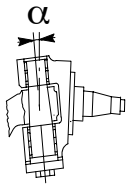
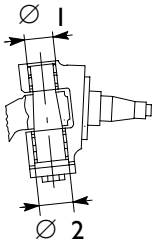
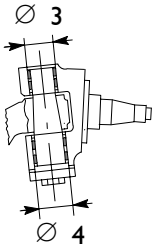
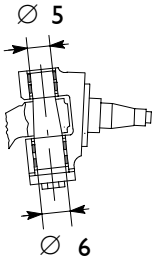
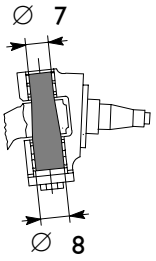
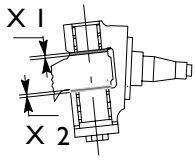


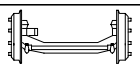
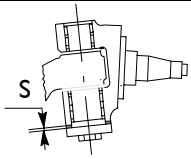
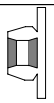
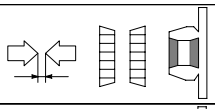
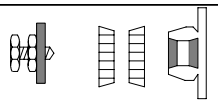
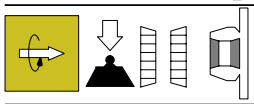
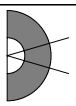
VIEWS OF FRONT AXLES AND STEERING CENTRAL ADDED AXLE 5876/4

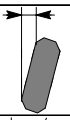
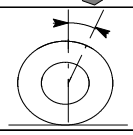
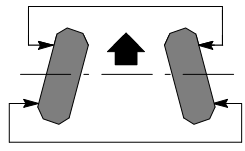


VIEW OF FRONT AXLE 5876/5

SPECIFICATIONS AND DATA

	Type of axle	5876 - 5876/4 - 5876/5
	**KINGPINS**	
	Kingpin angle	7°
	Diameter of roller bearing seats on the stub axle: - top seat Ø 1 mm - bottom seat Ø 2 mm	51.967 to 51.986 59.967 to 59.986
	Outside diameter of roller bearings for stub axle: - top bearings Ø 3 mm - bottom bearings Ø 4 mm	52 60
	Stub axle bearings mm	0.014 to 0.033
	Inside diameter of roller bearings for stub axle: - top bearings Ø 5 mm - bottom bearings Ø 6 mm	43 53
	Diameter of pin for stub axle - top Ø 7 mm - bottom Ø 8 mm	42.984 to 43.000 52.981 to 53.000
	Top bearings - pin mm	0 to 0.016
	Bottom bearings - pin mm	0 to 0.019
	Clearance between axle and stub axle top shim adjustment X1 mm Gap between axle and stub axle bottom shim adjustment X2 mm	0.10 to 0.35 0.25

	Type of axle	5876 - 5876/4 - 5876/5
	Adjustment plates X1; X2	
	0.25 mm > S mm	0.25 to 1.75
	**WHEEL HUBS**	
	Wheel hub bearings	2 with tapered rollers
	Hub bearing axle clearance mm	max 0.16
	Wheel hub clearance	by tightening retaining ring nut to torque
	Bearing pre-load rolling torque daNm	0.50 max.
	Oil for wheel hub bearings Quantity per hub Litres (kg)	Tutela W 140/M DA ~0.35 (0.32)
	**WHEEL GEOMETRY**	

	Wheel toe-in (unloaded vehicle)	4x2 - 6x2 - 6x4 vehicles: 1° / 6x2 C vehicles: 0,8°
	Wheel toe-in (unloaded vehicle)	4x2 - 6x2 - 6x4 vehicles: 1°24" / 6x2 C vehicles: 1st axle 3°, 2nd axle 2,3°
	Wheel toe-in (unloaded vehicle) mm Adjusting tolerance mm Checking tolerance mm	4x2 - 6x2 - 6x4 vehicles: + 1 / ± 0.75 / ± 2 6x2 C vehicles 1st axle: 1 / ± 0.75 / ± 2 6x2 C vehicles 2nd axle: 0 / ± 0.75 / ± 2

Steering angle:	4x2 - 6x2P vehicles 5876/4/5		6x4 vehicles 5876/4		6x2 C vehicles 5876/4			
					Internal α		External β	
	Internal α	External β	Internal α	External β	1st axle	2nd axle	1st axle	2nd axle
Vehicles with mechanical front suspension	52°	36°	52°	36°	52°	21°	36°	14.5°
Vehicles with pneumatic front suspension and longitudinal bars	50°	35°	50°	35°	-	-	-	-
Vehicles with pneumatic front suspension and leaf springs	47°	33°	47°	33°	-	-	-	-

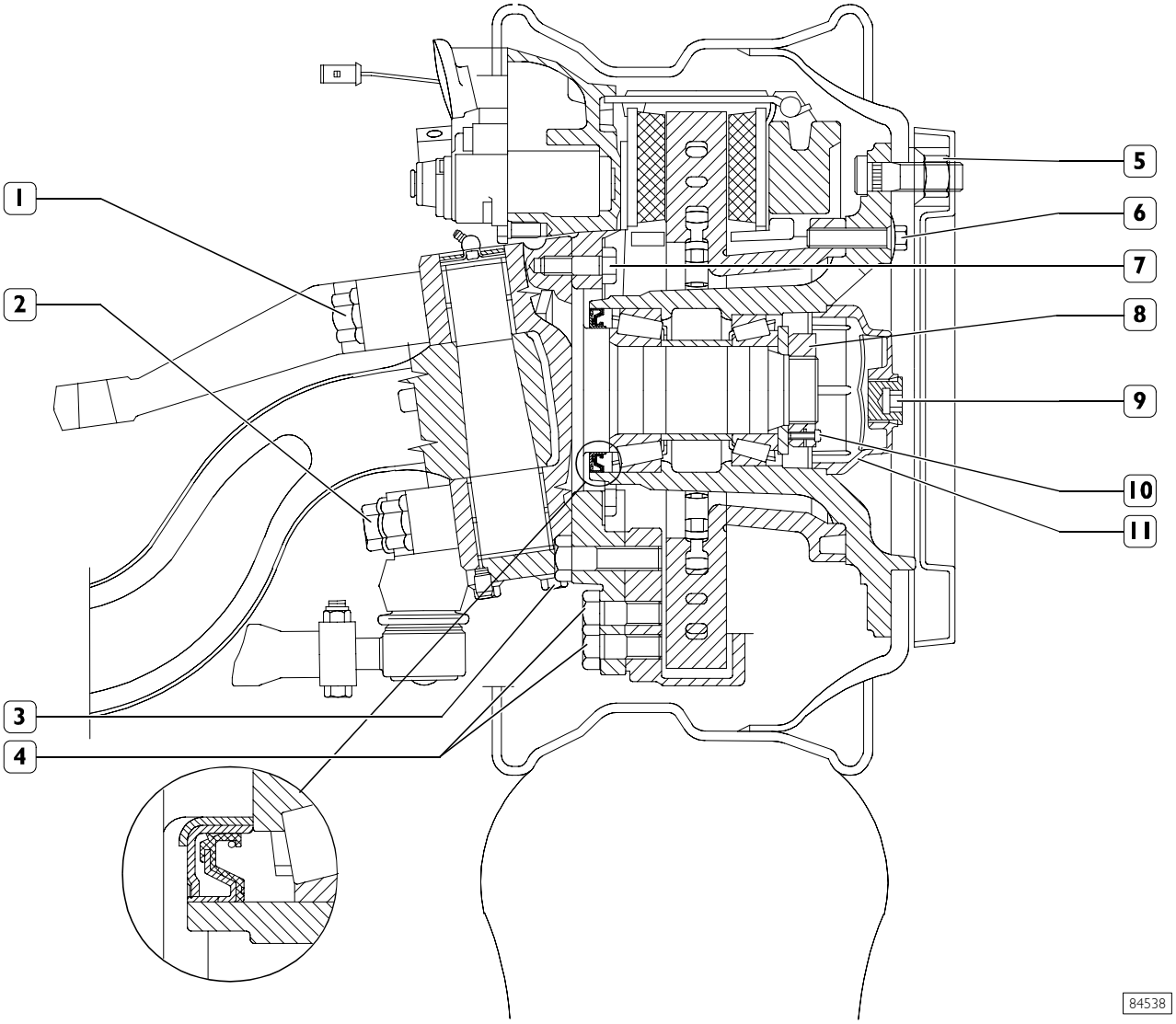
Axle weight	kg	-
Maximum load capacity	kg	7500

DIAGNOSTICS
Main operating faults of a mechanical nature

Visible Failure	Possible cause	Repair action
Steering hardness	Front axle misaligned.	Restore the alignment and tighten the fixing nuts of the leaf spring brackets to torque.
	Wheel toe-in abnormal.	Adjust the toe-in of the front wheels correctly.
	Tyre pressure abnormal.	Inflate the tyres to the required pressure.
	Insufficient lubrication of joints.	Lubricate the joints thoroughly.
	Adjustment between stub axle and front axle incorrect.	Carefully adjust the play between the stub axle and front axle.
	Elements involved in the rotation of the stub axle on the pin are inefficient.	Check and replace any deteriorated parts.
Wobbling	Caster abnormal.	Check the assembly of the axle, repair or replace any deformed parts.
	Front axle misaligned.	Restore the alignment and tighten to torque the nuts of the brackets fixing the leaf springs on the axle.
	Wheel toe-in abnormal.	Adjust the toe-in correctly.
	Ball joints of the steering tie rods inefficient.	Replace the defective parts.
	Wheel hub bearing clearance abnormal.	Adjust the end float after making any necessary replacements.
	Wheels off centre: rim centred, buckled tyre fitted on rim incorrectly.	Replace the faulty rim. Deflate and centre the tyre on the rim.
	Wheels unbalanced.	Balance the wheels.
Noise	Lubrication of the wheel hub bearings insufficient.	Restore the level of oil in the wheel hubs.
	Wheel hub bearings worn.	Replace the worn bearings and adjust the end float.
	Clearance between pin for stub axle and roller bearings too great.	Check and replace the worn parts.

TIGHTENING TORQUES

Figure 2



WHEELS SIDE SECTION OF FRONT AXLES: 5876 - 5876/4

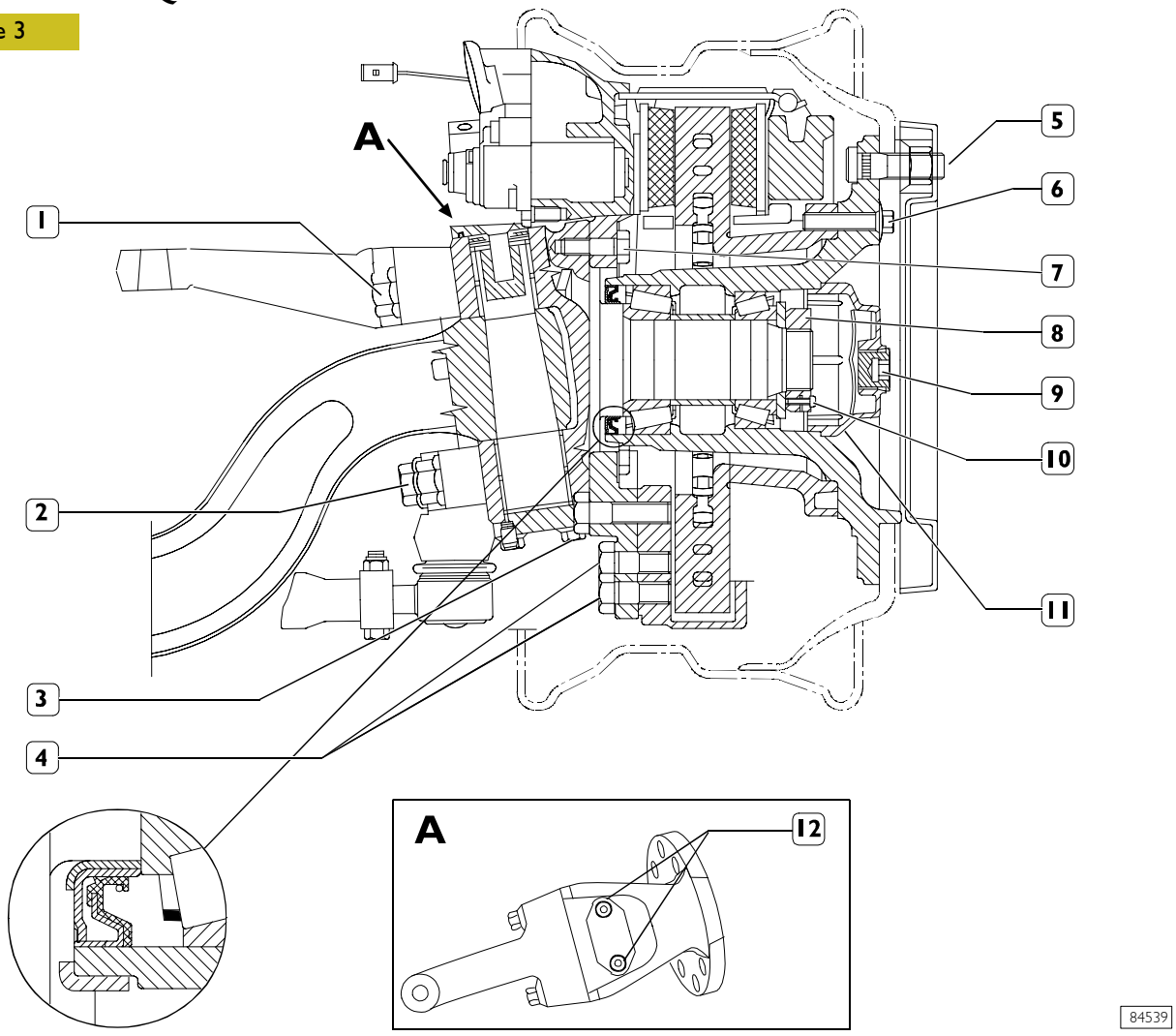
PART		TORQUE	
		Nm	kgm
1	Flanged screw fixing transverse tie rod lever onto stub axle	1325 ± 75	(135 ± 7.6)
2	Flanged screw fixing longitudinal lever onto stub axle	953.5 ± 75	(135 ± 7.6)
3	Flanged hex screw fixing bottom fifth wheel cover onto stub axle	117 ± 6	(11.7 ± 0.6)
4	Self-locking hex screw M20x1.5 fixing brake callipers	615.5 ± 61.5	(61.5 ± 6.1)
5	Nut fixing wheels	665.5 ± 66.5	(66.6 ± 6.6)
6	Hex screw fixing brake disc to wheel hub	281.5 ± 13.5	(28.1 ± 1.3)
7	Self-locking hex screw M16x1.5 fixing brake calliper mount to stub axle	313.5 ± 15.5	(31.3 ± 1.5)
8	Ring nut fixing wheel bearing	515.5 ± 24.5	(51.5 ± 2.4)
9	Tapered threaded plug for wheel hub cover	57.5 ± 2.5	(5.8 ± 0.2)
10	Cylindrical screw with recessed hex locking ring nut adjusting wheel bearings	27.5 ± 2.5	(2.7 ± 0.2)
11	Cover for wheel hub •	130 ± 10	(13 ± 1)
-	Castellated nut for kingpin*	300	(30)

• Apply LOCTITE 574 sealer

* Minimum torque - Maximum torque, tighten to the first notch corresponding to the split pin hole

TIGHTENING TORQUES

Figure 3



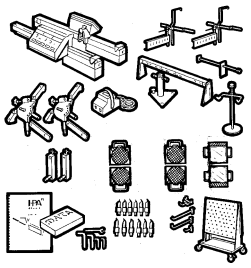
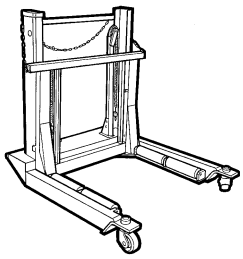
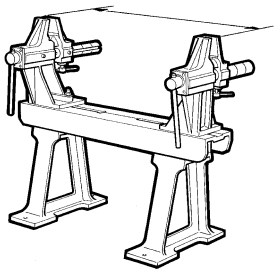
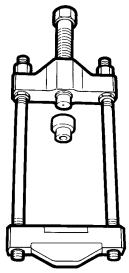
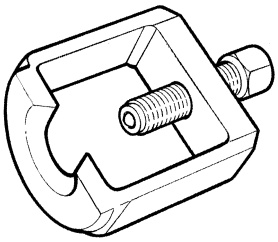
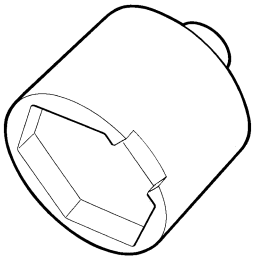
WHEELS SIDE SECTION OF FRONT AXLE 5876/5

PART		TORQUE	
		Nm	(kgm)
1	Flanged screw fixing transverse tie rod lever onto stub axle	1325 ± 75	(135 ± 7.6)
2	Flanged screw fixing longitudinal lever onto stub axle	1325 ± 75	(135 ± 7.6)
3	Flanged hex screw fixing bottom fifth wheel cover onto stub axle	117 ± 6	(11.7 ± 0.6)
4	Self-locking hex screw M20x1.5 fixing brake callipers	615.5 ± 61.5	(61.5 ± 6.1)
5	Nut fixing wheels	665.5 ± 66.5	(66.6 ± 6.6)
6	Hex screw fixing brake disc to wheel hub	281.5 ± 13.5	(28.1 ± 1.3)
7	Self-locking hex screw M16x1.5 fixing brake calliper mount to stub axle	313.5 ± 15.5	(31.3 ± 1.5)
8	Ring nut fixing wheel bearing	515.5 ± 24.5	(51.5 ± 2.4)
9	Tapered threaded plug for wheel hub cover	57.5 ± 2.5	(5.8 ± 0.2)
10	Cylindrical screw with recessed hex locking ring nut adjusting wheel bearings	27.5 ± 2.5	(2.8 ± 0.2)
11	Cover for wheel hub •	130 ± 10	(13 ± 1)
12	Screw fixing top cover to stub axle	11.1 ± 2	(1.1 ± 0.2)
-	Castellated nut for kingpin*	300	(30)

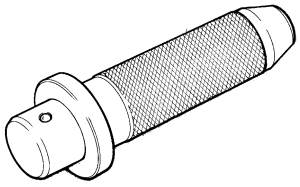
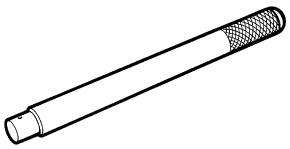
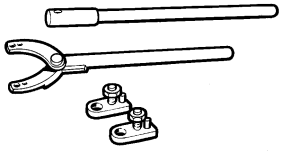
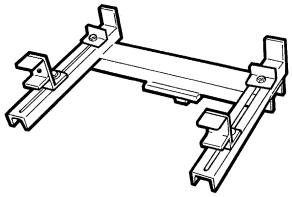
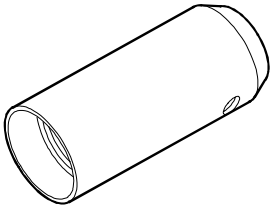
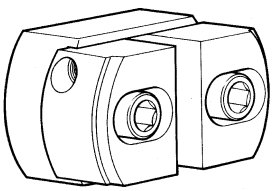
• Apply LOCTITE 574 sealer

* Minimum torque - Maximum torque, tighten to the first notch corresponding to the split pin hole

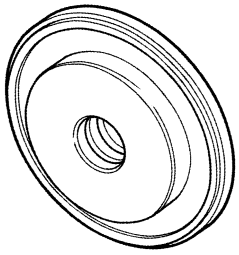
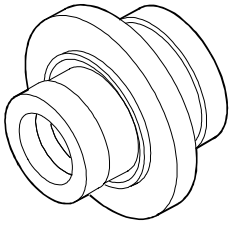
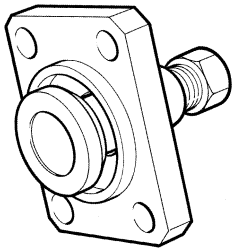
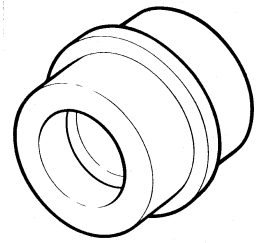
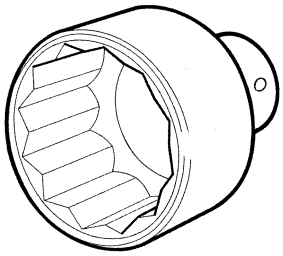
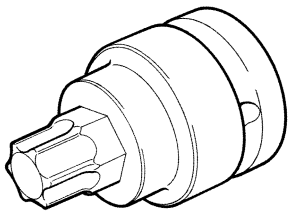
TOOLS

TOOL No.		DESCRIPTION
99305354		Portable optical equipment to check wheel geometry
99321024		Hydraulic trolley to remove and refit wheels
99322215		Stand for overhaul
99347047		Tool to remove kingpin
99347068		Extractor for steering tie-rod head pins
99354207		Wrench for wheel hub cover

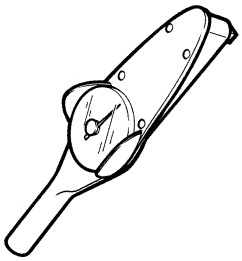
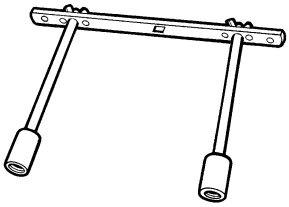
TOOLS

TOOL No.		DESCRIPTION
99370006		Grip for interchangeable drifts
99370007		Grip for interchangeable drifts
99370317		Reaction lever with extension
99370628		Mount to remove and refit front axle
99370715		Guide for mounting wheel hub
99374093		Drift to mount outer bearing races (use with 99370007)

TOOLS

TOOL No.		DESCRIPTION
99374132		Key to mount internal wheel hub gasket (use with 99370006)
99374173		Parts to mount kingpin gaskets (use with 99370007)
99374405		Tool to drive in kingpin
99374530		Drift to remove and refit kingpin bearings (use with 99370007)
99388001		Wrench (80 mm) for wheel hub bearing adjustment nut
99388002		Wrench for screws securing longitudinal tie-rod and transverse tie-rod bar lever on stub axle

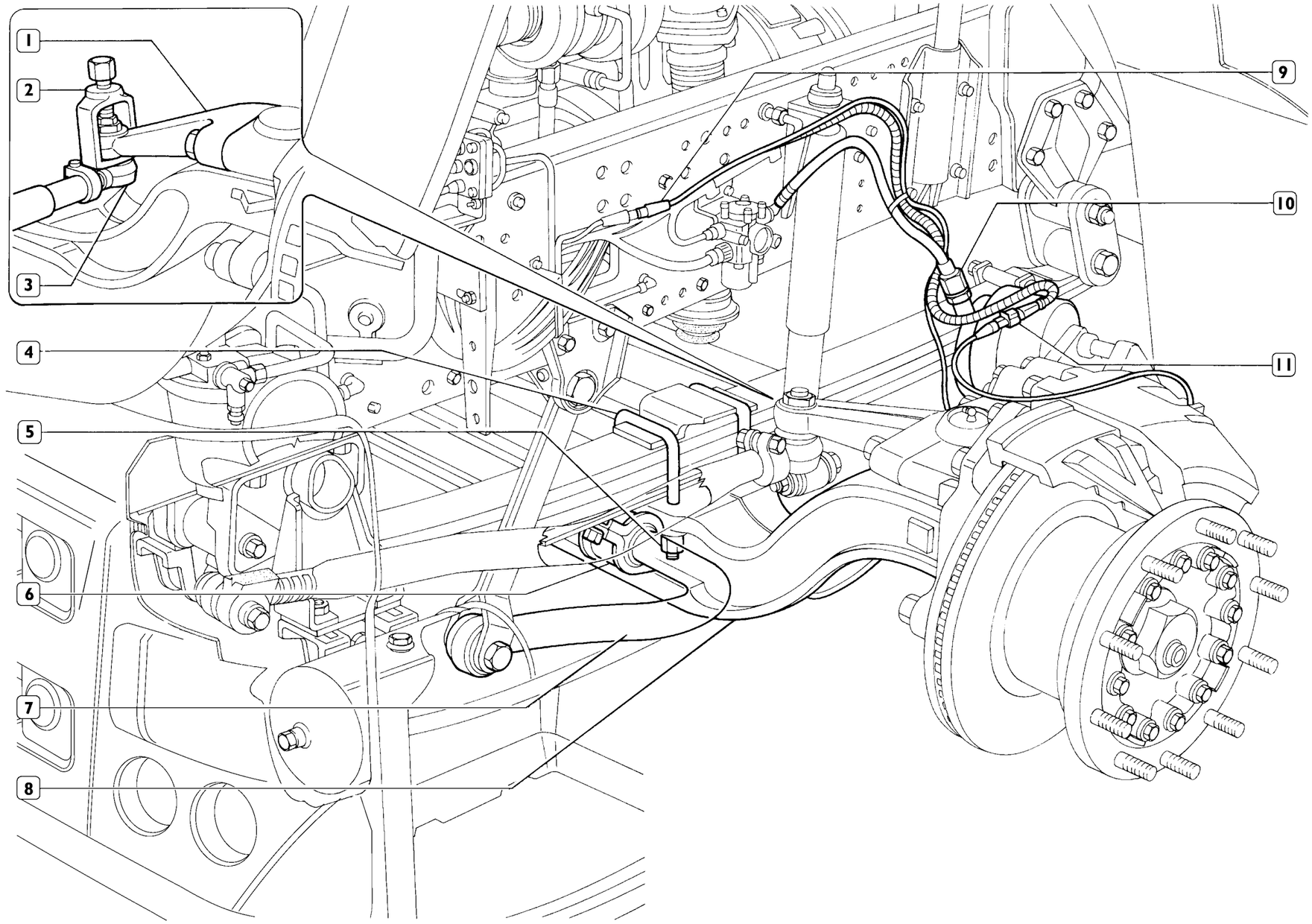
TOOLS

TOOL No.		DESCRIPTION
99389805		Torque multiplier x 4 with square attachment input 1/2" output 3/4" (max 1350 Nm)
99389819		Torque wrench (0-10 Nm) with square connection 1/4"
99395026		Tool to check rolling torque of hubs (use with torque wrench)

520610 REMOVING AND REFITTING AXLE

Vehicles with mechanical front suspension

Figure 4



90321

Removal

Position the vehicle on level ground and lock the rear wheels.
Loosen the fixing nuts of the front wheels.
Using a hydraulic jack, lift the vehicle at the front and rest it on two stands.
Unscrew the wheel fixing nuts and, using the hydraulic trolley 99321024, take off the wheels.

Using the extractor 99347068 (2) disconnect the swivel head of the tie rod (3) of the lever (1).

Disconnect:

- ❑ The diaphragm brake cylinder air delivery pipes (10);
- ❑ The electric cable (9) of the ABS transmitters;
- ❑ For vehicles without one, the electric cable (11) for the brake lining wear indicator.

Put a hydraulic jack fitted with the mount 99370628 under the axle (8).
Unscrew the nuts (5) and extract the leaf spring mating brackets (4) and the mounts (6) fixing the stabilizer bar (7) to the axle.
Turn the stabilizer bar (7) so it does not interfere with the following operation.
Lower the hydraulic jack and extract the axle (8).

Refitting

For refitting, carry out the steps described for removal in reverse order while observing the following:

- ❑ Check the thread of the leaf spring mating brackets; if there are any problems, rectify the thread (operation 500412) or change the brackets.
- ❑ Tighten the nuts or the screws to the required torque.
- ❑ The self-locking nuts must not be reused.
- ❑ Check the state of the flexible pads, and change them if they have deteriorated (operation 500417).
- ❑ Using a hydraulic jack fitted with the mount 99370628, lift the axle so that the leaf spring mating pins go into the holes made on the leaf supporting surfaces on the axle.
- ❑ Check and if necessary adjust the geometry of the front wheels.

520610 REMOVING AND REFITTING AXLE

Vehicles with pneumatic front suspension and longitudinal bars

Removal

Position the vehicle on level ground and lock the rear wheels.

Loosen the fixing nuts of the front wheels. Put a hydraulic jack fitted with mount 99370628 under the axle (34).

Lift the vehicle at the front and rest it on two stands. Again using the hydraulic jack and mount 9937628, support the axle so that the longitudinal bars (3) and (5) are parallel with the chassis frame.

Unscrew the wheel fixing nuts and, using the hydraulic trolley 99321024, take off the wheels.

Remove the cabin accessing platform, if needed. Take out the bolts (7) and detach the board mount (8).

Disconnect the steering tie rod (9) as follows: Take out the split pin (22) and the nut (21) (det. A).

Using the extractor 99347068 (23) disconnect the swivel head of the tie rod (19) of the lever (20).

Disconnect:

- ❑ The diaphragm brake cylinder air delivery pipes(28);
- ❑ Extract the speed sensor (17) from the brake calliper supporting flange (18);
- ❑ Take out the screws (30) and extract the brake lining wear sensor (31) (det. B);
- ❑ Take out the fixing screws (13) and remove the bracket (14) anchoring the levelling valve tie rod (27);
- ❑ Take out the screw (24) and remove the shock absorber (29) from the mount (16);
- ❑ Take out the screws (15) and remove the air spring (26) from the mount;
- ❑ Remove the screw (11) and disconnect the stabilizer bar (12) from the connecting rod (10);
- ❑ Take out the screws (6) and disconnect the bottom rod (5) from the mounts (4). Repeat these operations for the top rod (3);
- ❑ Repeat the above operations for the opposite side;
- ❑ Take out the screws (25) and disconnect the transverse bar (1) from the mounts (2);
- ❑ Lower the hydraulic jack and take the axle out from under the vehicle;
- ❑ Take out the screws (33) and disconnect the stabilizer bar (32) from the axle (34) (det. C);
- ❑ Take out the screws (35) and disconnect the mounts (36) from the axle (34) (det. C).

Figure 5

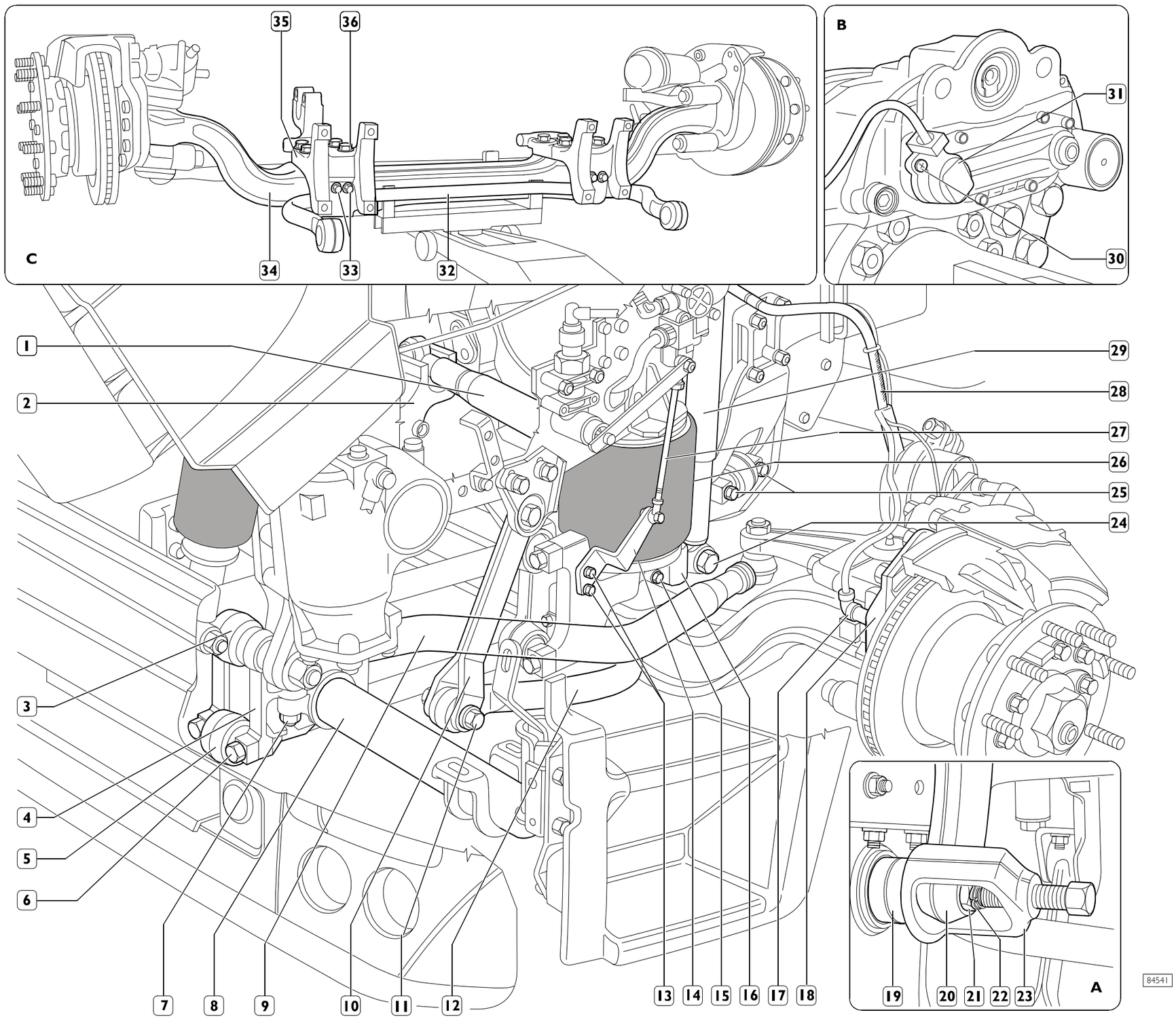
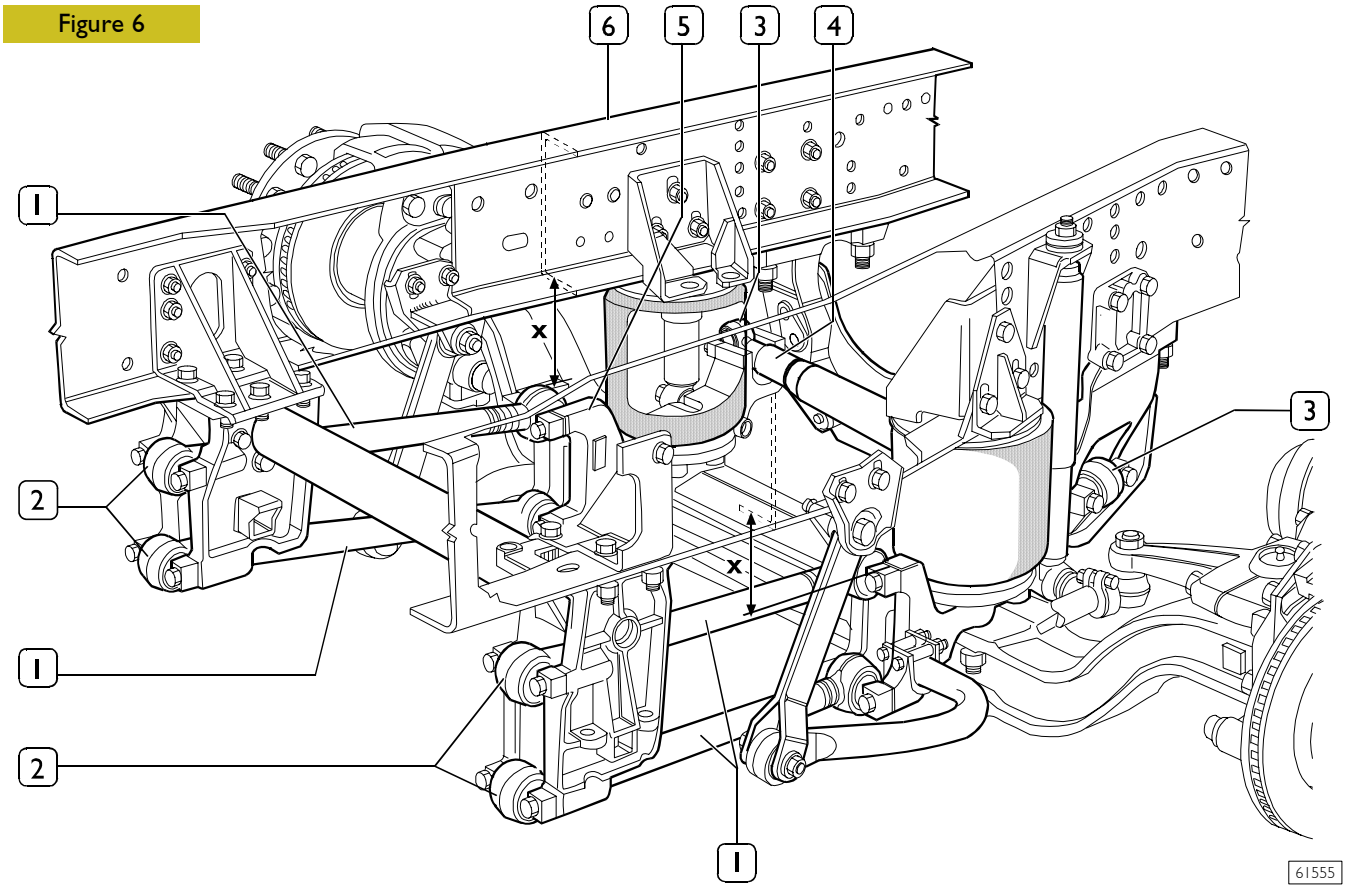


Figure 6



Refitting

For refitting, carry out the steps described for removal in reverse order while observing the following:

The connection of the swivel head shanks (2) of the longitudinal rods (1) to the mounts of the chassis frame and of the axle has to be made when there is a distance X between the mounts (5) and structural members (6) of X = 154 mm.

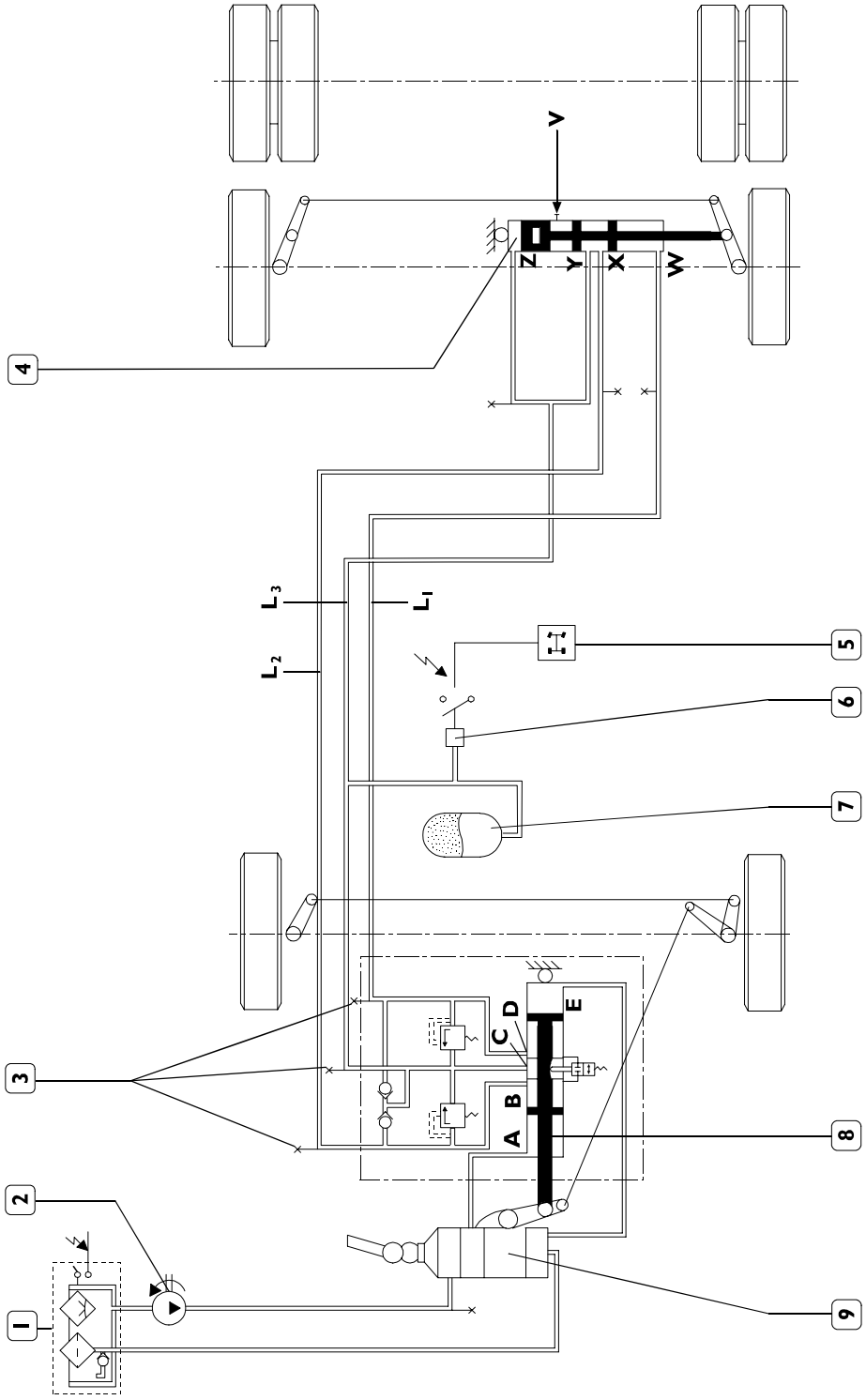
The connection of the swivel head shanks (3) of the Panhard bar (4) has to be made when there is a distance X between the mounts (5) and structural members (6) of X = 224.5 mm.

- ❑ Tighten the nuts or the screws to the required torque.
- ❑ The self-locking nuts must not be reused.
- ❑ Check the state of the flexible pads, and change them if they have deteriorated (operation 500417).
- ❑ Using a hydraulic jack fitted with the mount 99370628, lift the axle so that the leaf spring mating pins go into the holes made on the leaf supporting surfaces on the axle.
- ❑ Check and if necessary adjust the geometry of the front wheels.

HYDRAULIC SYSTEM FOR CENTRAL ADDED AXLE STEERING (vehicles 6X2C)

Hydraulic system working diagram

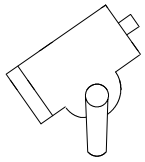
Figure 7

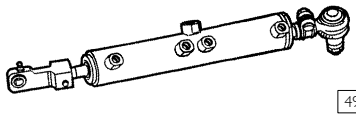
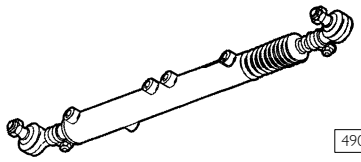
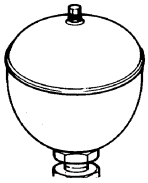


1. Oil tank with low oil level switch - 2. Hydraulic pump - 3. Pressure test points - 4. Centring cylinder - 5. Additional axle steering warning light - 6. Pressure gauge (2 bar) - 7. Hydraulic accumulator - 8. Slave cylinder - 9. Power steering system - V. Cap

Connections between slave cylinder and centring cylinder			
LH drive vehicles (as shown in the figure)	B - L2 - X C - L3 - Y/Z D - L1 - W	RH drive vehicles	B - L2 - W C - L3 - Y/Z D - L1 - X

CHARACTERISTICS AND DATA

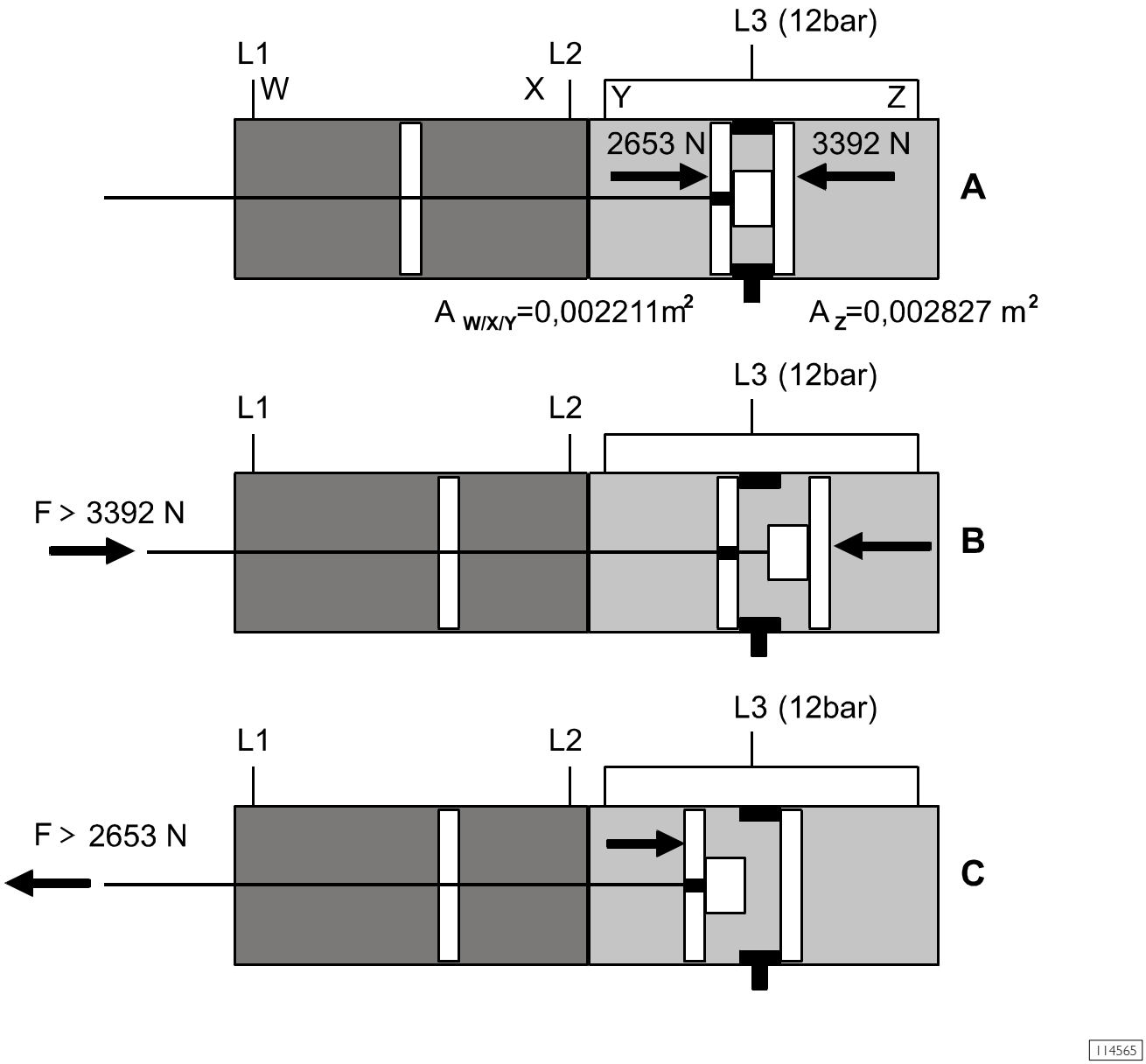
Power steering system 	Ball-circulation ZF 8098 with built-in pressure relief valve		
	Operating pressure variable		150 + 15 bar
	Reduction ratio variable: steering centre		22.2:1
	Reduction ratio variable: maximum steering		26.2:1
Power steering pump 	Type		ZF
	Minimum no. of revolutions	rpm	~ 500
	Maximum no. of revolutions	rpm	~ 3500
	Maximum pressure (without pressure relief valve)	bar	165
	Delivery (controlled)	dm^3/min	20

Slave cylinder  49086	Useful stroke	180 mm
	Length between wheel bases in straight running position	786 mm
Centring cylinder  49086	Useful stroke	180 mm
	Length between wheel bases in straight running position	1000 mm
Hydraulic accumulator  38948	Nitrogen pre-load pressure	8.5 ± 1 bar
Oil Tutela GI/A	Quantity	4 to 5 litres
	Circuit pressure (during straight running)	12 +1 bar

CENTRING CYLINDER OPERATING DIAGRAM

Added central axle

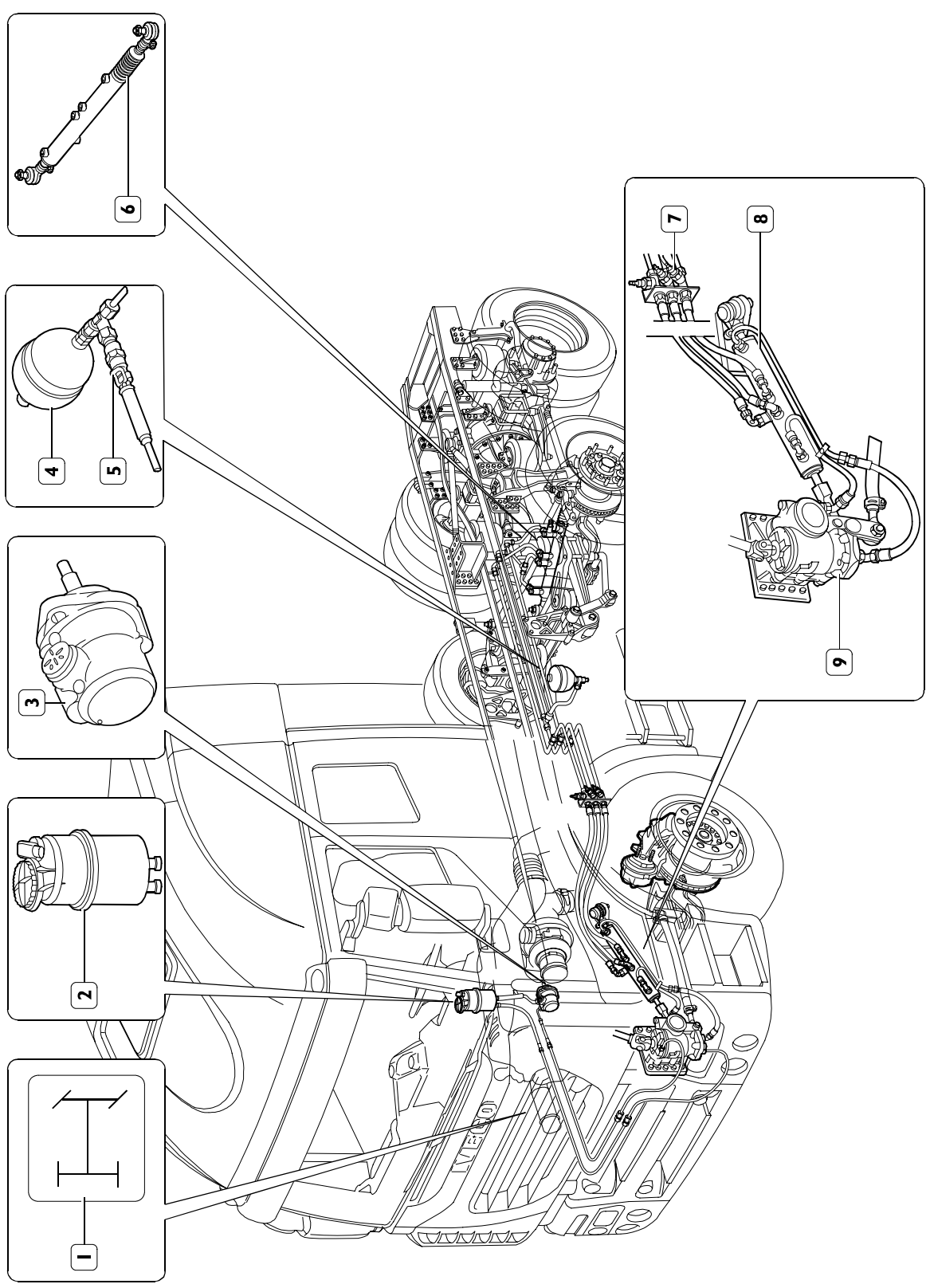
Figure 8



A. Operation in straight line motion - B. Operation when steering to left - C. Operation when steering to right

Location on the vehicle of the main components of the hydraulic system

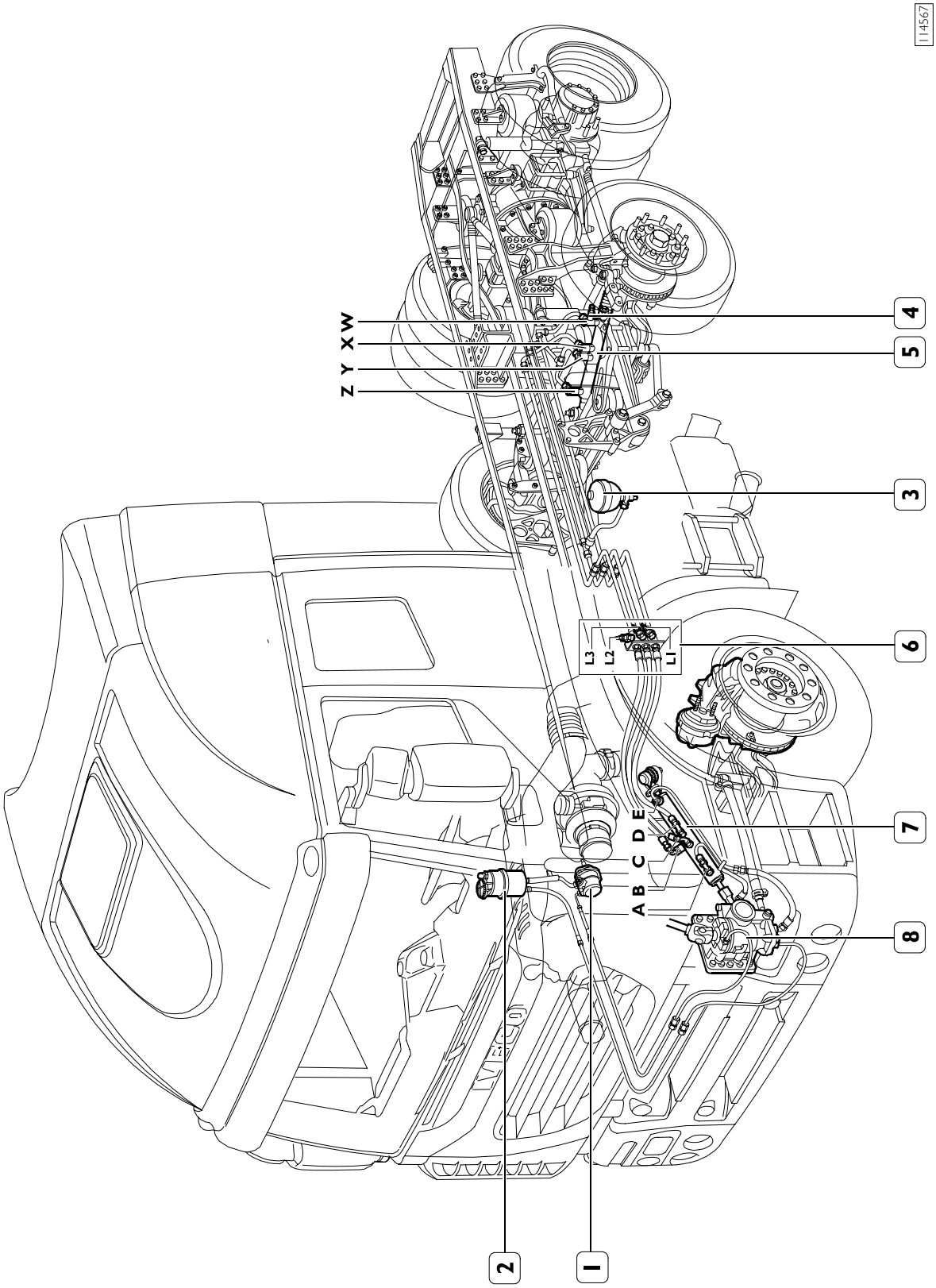
Figure 9



1. Lamp - 2. Oil tank - 3. Oil pump - 4. Hydraulic accumulator - 5. Pressure gauge - 6. Centring cylinder - 7. Pressure control intakes - 8. Slave cylinder - 9. Power steering system

Hydraulic system

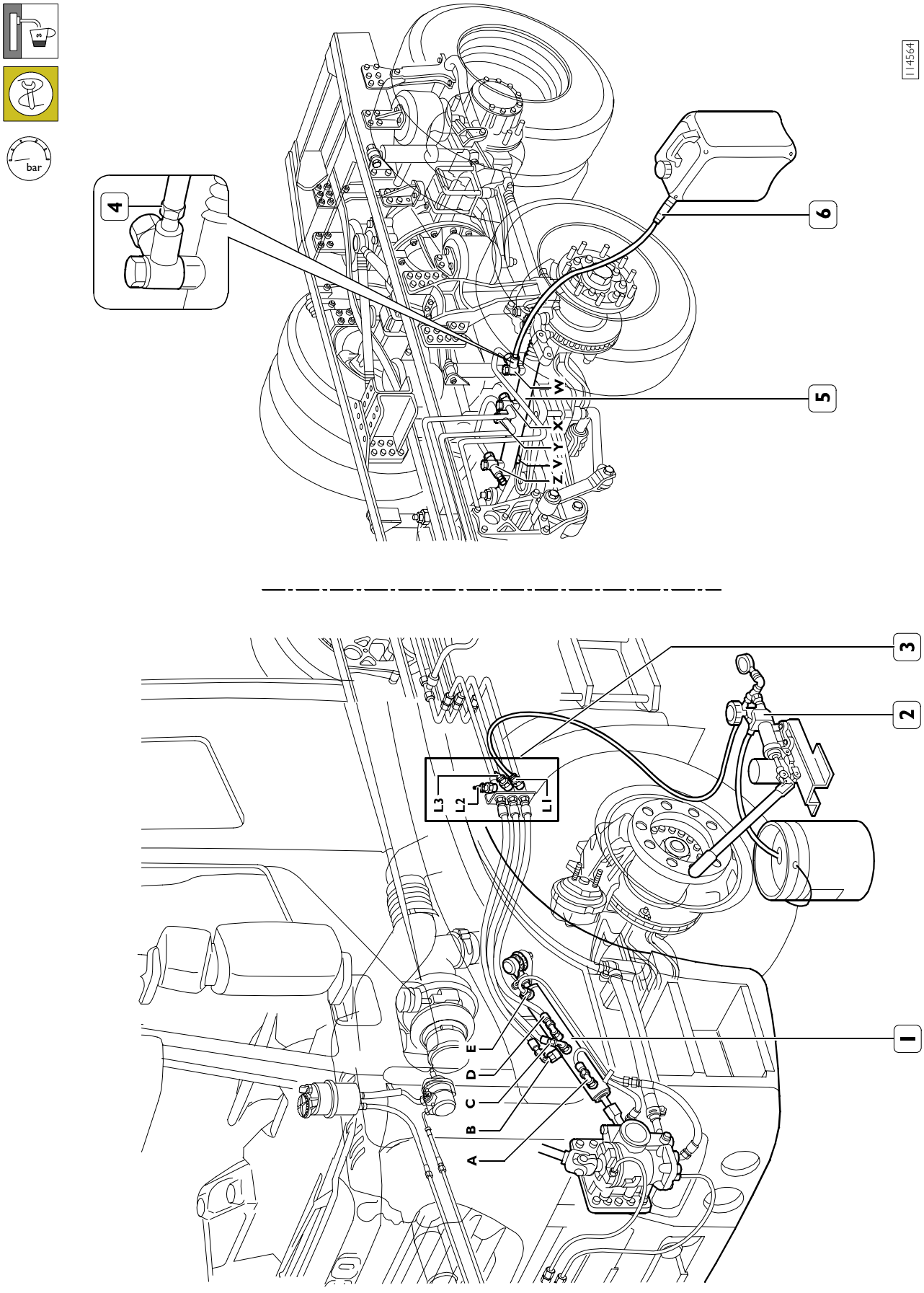
Figure 10 (Illustrative)



1. Hydraulic pump - 2. Oil tank with low oil level switch - 3. Hydraulic accumulator - 4. Pressure control intakes - 5. Centring cylinder - 6. Pressure control intakes - 7. Slave cylinder - 8. Power steering system

5014 AIR BLEEDING FROM THE HYDRAULIC CIRCUIT

Figure 11



501430 Filling up and bleeding the power steering hydraulic circuit (circuit 1)

NOTE Before assembly, check that the various parts are free of burrs and that the pipes are clean inside to prevent foreign bodies entering the circuit because this could cause the valves to block or the slave cylinder to seize.

Then connect the power steering, pump and reservoir as shown in the drawing.

The lever on the steering box must be connected to the steering link and the steering must be adjusted. These operations are required to ensure the adjustment bushes are correctly positioned.

- ❑ With the engine off, remove the oil reservoir cover and add AG2 "GI/A" hydraulic fluid to IVECO STD 18-1807 to the power steering circuit through a filter (30 mm mesh) until the oil level is constant.
  If a siphon effect is observed, unscrew the filter fastening on the reservoir to facilitate the filling operation.
- ❑ Before running the engine, the hydraulic fluid must be added as instructed to prevent it running dry and damaging the hydraulic pump.
- ❑ With the engine running, turn the steering wheel several times in both directions (to the end of its travel) until no more air emerges from the hydraulic fluid reservoir.
  During this operation, the fluid level must be maintained between the max/min values by topping up with fluid.
- ❑ Start the engine and idle for a short time.
  Simultaneously check the fluid level and add fluid if the level drops.
  Continue starting the engine until the fluid level no longer changes. The fluid filling operation is now complete.
  After turning off the engine, the fluid level may rise by 2 cm - 2 cm.
- ❑ Close the fluid reservoir cover.

501475 Filling up and bleeding the power steering hydraulic circuit (circuit 2)

Set the vehicle in steering centre position. Take down the ABS valve and the operator cylinder (1) from the frame and hang up the cylinder vertically.

Connect hydraulic pump 99305446 (2, Figure 11) by means of fittings 99305450 to line L_1 as shown in Figure 11; connect a pipe (6, Figure 11) to fitting w (L_1) on the centring cylinder (5) and introduce it into a special container.

By means of hydraulic pump (2) introduce oil into the system up to a pressure of ca 20 bar.

Open the bleeder valve (4) and empty out the oil mixed with air while keeping the pressure at ca 15 bar.

Let the oil flow out until you can seen there is no air left.

Repeat this step on fittings Z and X of the centring cylinder (5).

Repeat the same step on the control taps (3, Figure 11) with the following bleeding order: L_3 - L_2. connecting the bleeding piping to the pressure intakes by means of one of 99305450 unions. set the system to 12 + 1 bar and fit back the slave cylinder (1, Figure 11) and the ABS valve.

REPAIRS

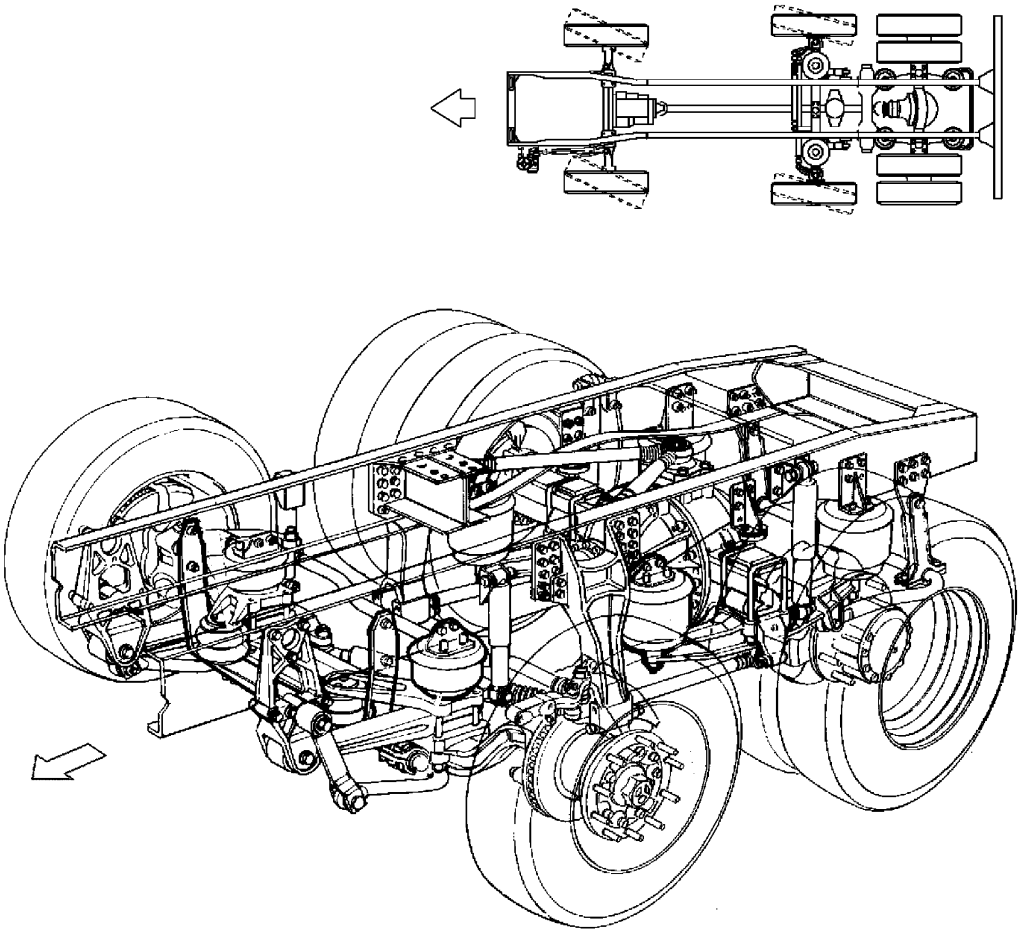
Keep to the procedure described in the chapter AXLE 55080/D as for wheel hub overhauling.

Adjustment data, tightening torques and tools are the one shown in this chapter.

CENTRAL ADDED AXLE AIR LIFT, 6X2C VEHICLES

GENERAL

Figure 12



114980

This system enables the driver to lift the additional axle when the vehicle operating conditions require it and to move the load to the driving axle during pickup in condition of poor grip of the vehicle (assistance during pickup).

All the above operations, however, are bound to specific conditions of operation and relevant system safety connected to it.

Lifting, lowering and assistance during pickup are controlled from a button strip in the cabin, located on the central dashboard.

Axle lifting prevents tire sliding on ground, during vehicle manoueuvres.

The device for assistance during pickup allows to totally or partially transfer the load o the additional axle to the driving axle so that, in the above describe grip conditions and in compliance with local laws, friction on the ground is increased.

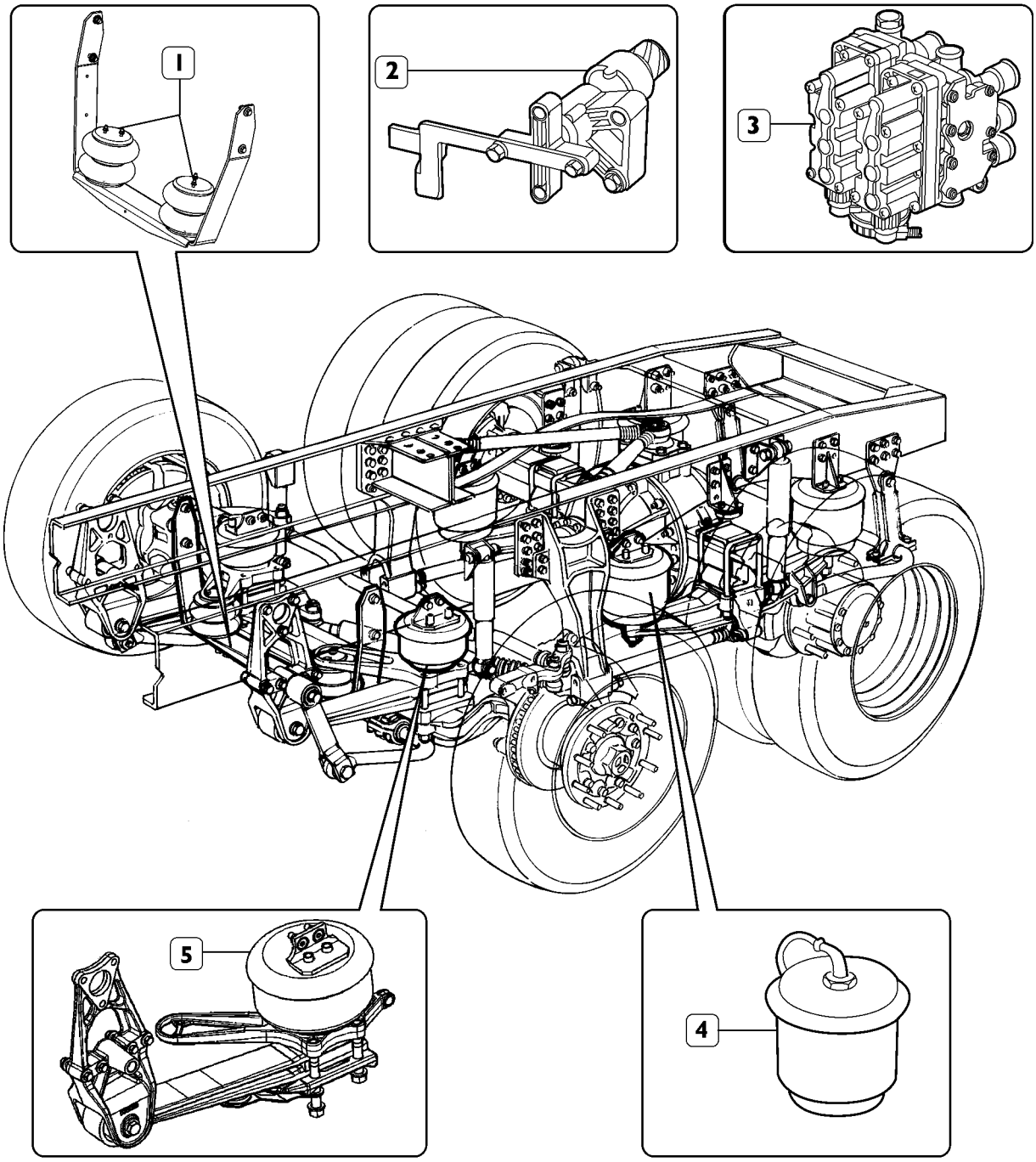
The functions of lifting and aid in the pickup phase can be performed at speeds under 30 km/h with a load on the driving axle of under 11.5 tonnes, otherwise the system will automatically lower the added axle.

To ensure the vehicle is safer when driven straight ahead, the central axle steering is activated after the front axle wheels have overcome a steering angle of 5°.

The transmission of steering power from the front axle to the additional rear axle is hydrostatic, thanks to a slave cylinder fitted on the front and to a centring cylinder fitted on the additional rear axle. A hydraulic accumulator stores and keeps the oil in the system, depending on the centring cylinder movements, without volume losses.

Location on the vehicle of the main components

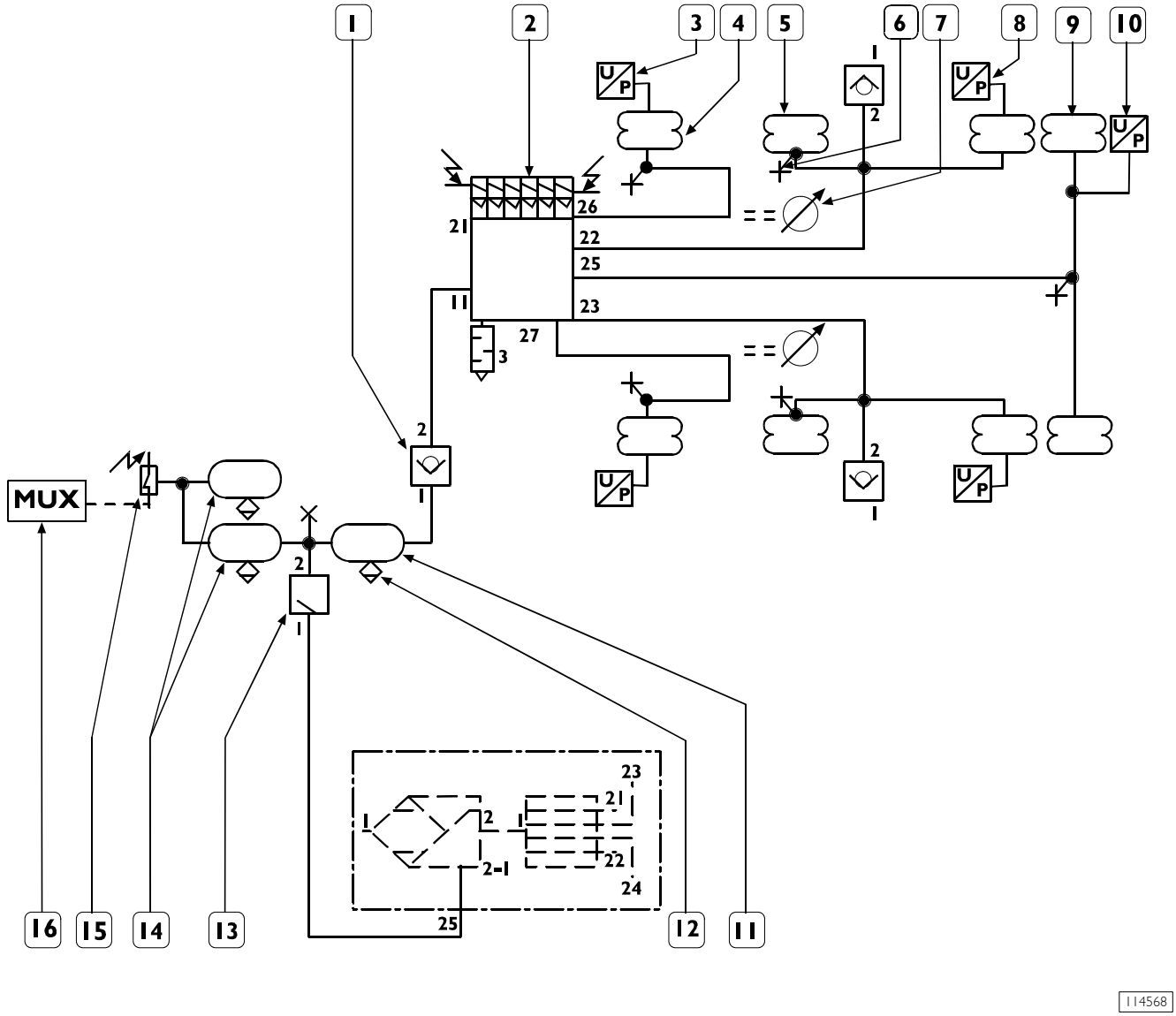
Figure 13



1. Air springs for lifting additional axle - 2. Level sensor - 3. Electropneumatic distributor - 4. Rear axle air spring - 5. Additional axle air spring

Pneumatic principle scheme, rear pneumatic suspensions and pneumatic lifting device for central added axle with single wheels

Figure 14



1. Check valve - 2. Second steering axle and rear axle electropneumatic control valve - 3. Additional central axle suspension pressure sensor - 4. Second steering axle air spring - 5. Rear axle air spring - 6. Pressure check point - 7. Rear level sensor - 8. Pressure sensor - 9. Additional central axle lift air spring - 10. Additional central axle lift pressure sensor - 11. 15 litre air reservoir - 12. Manual condensate bleed valves - 13. Controlled pressure valve with limited return (opening pressure 8.5 bars) - 14. 20 litre air reservoir - 15. Pressure switch (8 bar opening pressure) - 16 MUX electrical system.

Additional axle lift pressure = 7.5 + 0.4 bar

VEHICLE CHECKS

Tie rods

Check bolts and nuts retaining clamps to track rods and drag links are not damaged and are tightened to specified torque.
Track rods and drag links should not be damaged or worn. The threaded part should be in good condition.

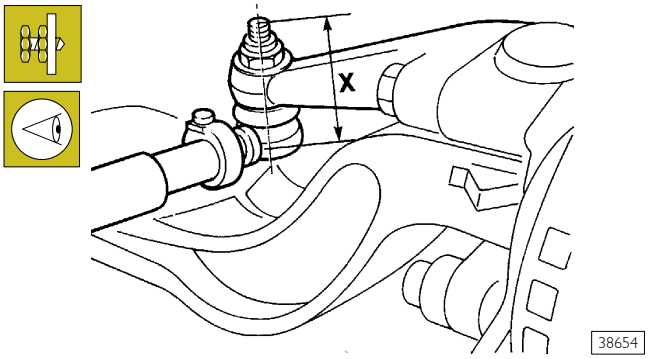
Swivel heads

Clean the swivel heads of the tie rods: transverse and longitudinal.
This needs to be done with dry canvas or raw cotton, never use solvents.
Check that the various components of the swivel head have no points of corrosion deeper than 1 mm; in particular, check the sheet metal cover near the roller.
Check the protective cover:

- ❑ It needs to be secured to the body and to the pin of the articulation with split rings and it must not turn.
- ❑ It must be neither deteriorated nor damaged.
- ❑ Press on the protective cover and check that grease comes out.
- ❑ Check that the nut and split pin have not deteriorated.

CHECKING SWIVEL HEAD PLAY

Figure 15



Put the vehicle on the lift or over the pit and do not lift the wheels.
Using a gauge, measure the distance between the body of the swivel head and the end of the pin, making three measurements in the following conditions:

- ❑ wheels straight **measurement X;**
- ❑ wheels turned lef **measurement X_1;**
- ❑ wheels turned (fully to the right) **measurement X_2.**

Calculate the play **A** according to the following formula:

A = B - X

where **B** is the larger of the measurements X_1 and X_2.
This play must be no greater than 2 mm.
If you find the play to be greater or any of the problems listed in the checks, replace the part concerned as described under the relevant section heading.

520610 FRONT AXLE ASSEMBLY OVERHAUL

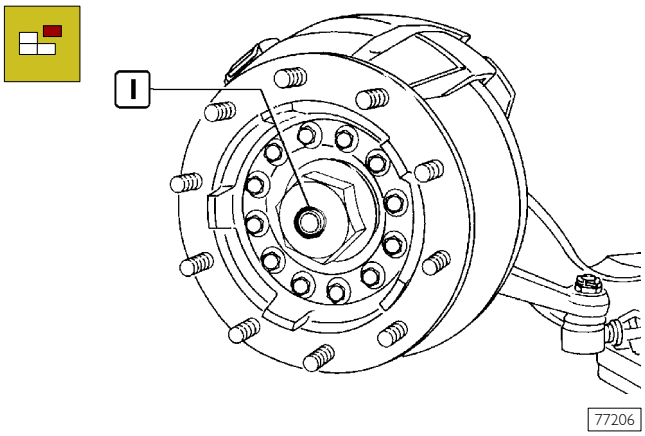
NOTE There follows a description of the operations to overhaul the axle 5876/4 that, unless stated otherwise, hold for the axles 5876/5 - 5886/5.

Using a lift, position and secure the axle assembly on the stand 99322215 for overhaul.

520620 REMOVING - REFITTING WHEEL HUBS

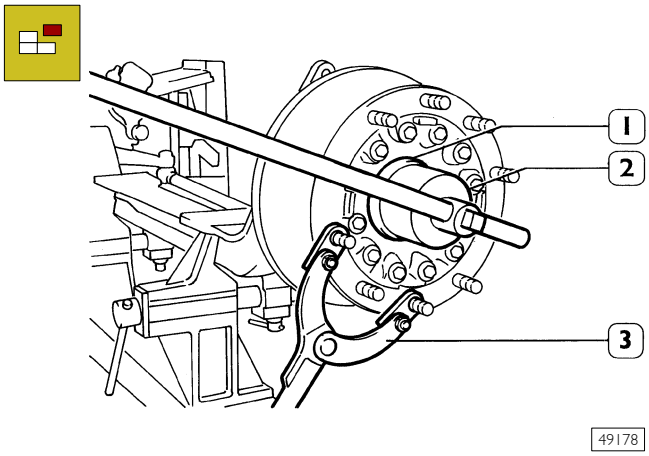
Removal

Figure 16



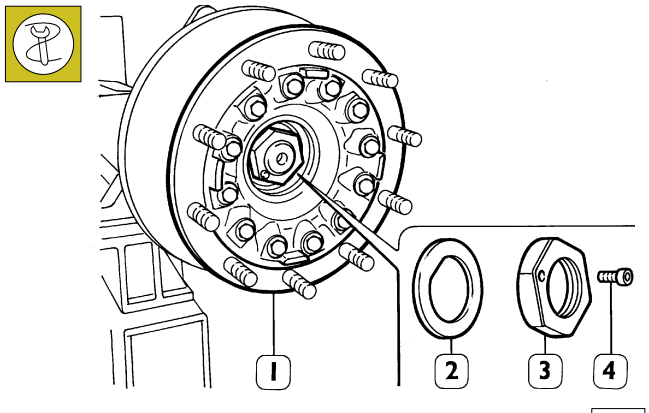
Remove the brake pliers as described in the "BRAKE AIR SYSTEM" Section.
Turn the wheel hub so that the screw plug (1) goes down, unscrew the plug (1).

Figure 17



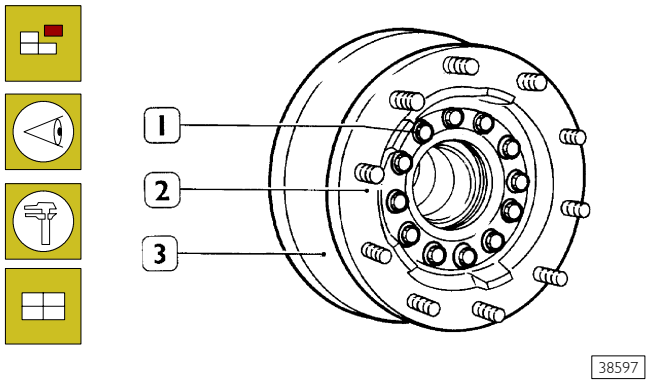
Using the reaction lever 99370317 (3), lock the rotation of the wheel hub and, using wrench 99354207 (2), unscrew the oil cover (1). Bleed oil completely.

Figure 18



Undo the screw (4), take out the adjustment nut (3) with the wrench 99388001, extract the washer (2), the outer bearing and remove the wheel hub (1) together with the spacer and internal bearing.

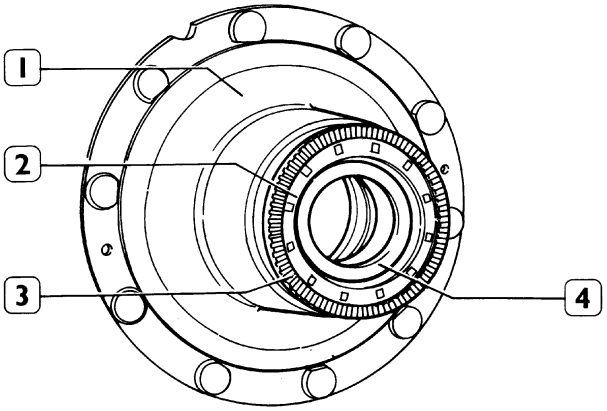
Figure 19



Examine the state of wear of the brake disc (3) as described in the "BRAKE AIR SYSTEM" section.
To remove the brake disc (3), take out the screws (1) and disconnect it from the wheel hub (2).

520621 Replacing wheel hub bearings

Figure 20



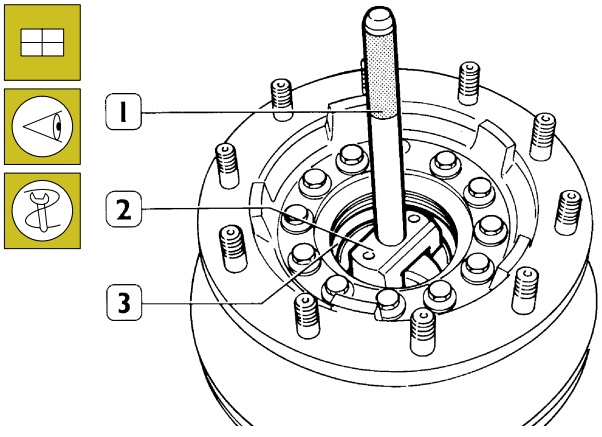
40362

Using general tools, remove the following from the wheel hub (1): seal (2), phonic wheel (3) and bearing (4).

Using a specific drift, drive the outer rings of the bearings out of the wheel hub.

NOTE Check that the seats of the outer rings of the bearings in the wheel hub are not dented after driving them out.

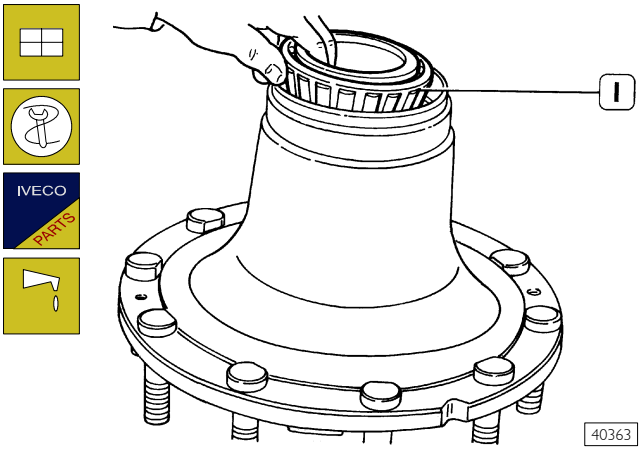
Figure 21



71553

Using the drift 99374093 (2), under a press, drive the outer ring of the front bearing into the hub without going right down to the bottom. Repeat this operation on the opposite side for the outer ring of the rear bearing.
Complete driving home the outer rings of the bearings manually with the drift 99374093 (2) and grip 99370007 (1).

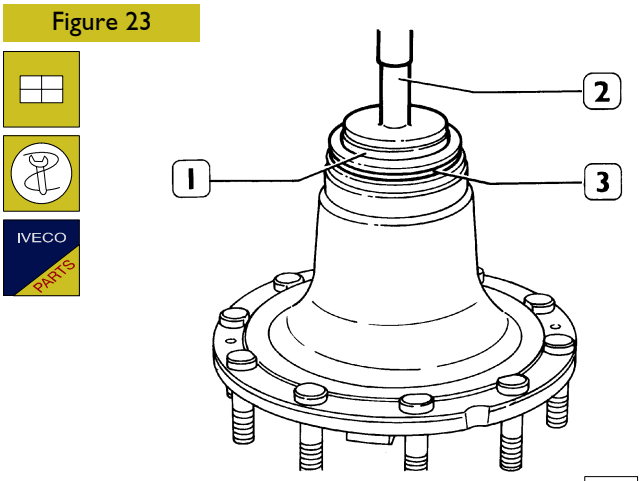
Figure 22



40363

Lubricate the inner bearing with the oil prescribed for wheel hubs (1) and place it on the wheel hub.

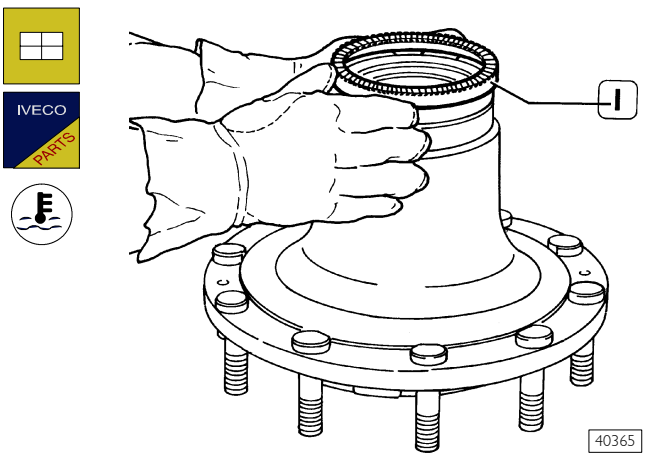
Figure 23



40364

Using the drift 99374132 (1) and grip 99370006 (2), mount the seal (3).

Figure 24



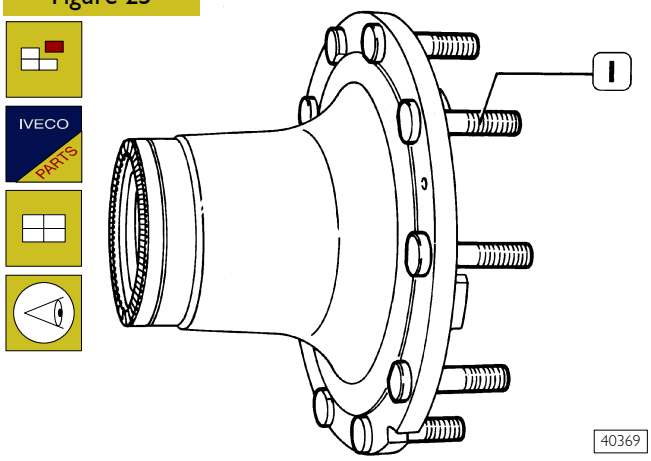
40365

The phonic wheel (1) needs to be mounted after heating it to a temperature of approx. 150°C, checking after assembly that the "phonic" wheel rests on the seat of the hub properly.

Using a dial gauge, check that the inclination of the phonic wheel is no greater than 0.2 mm.

Replacing wheel fixing pins

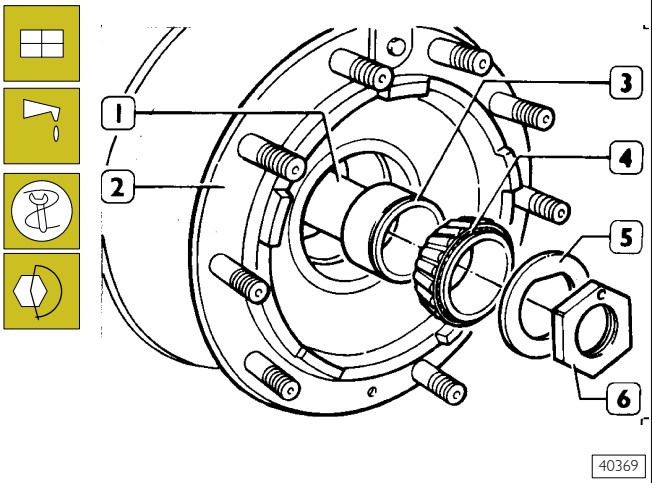
Figure 25



Using general tools, drive the pins (1) out of the hub (2).
Make sure that the surface supporting the heads of the pins has no burrs.
Drive in the pins carefully, apply a load no greater than 2500 kg on their head.
Afterwards, check that the inclination error is no greater than 0.3 mm.

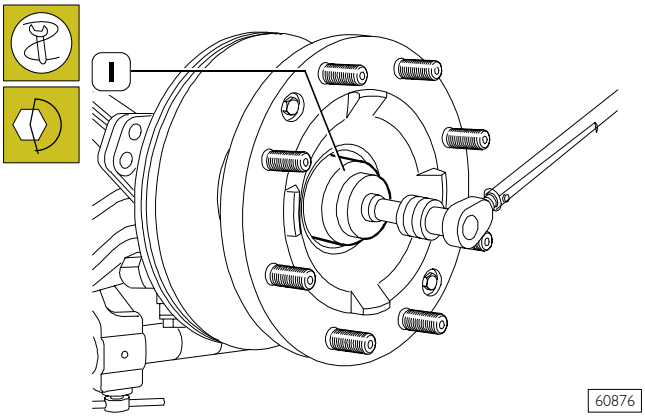
Refitting wheel hubs

Figure 26



Screw tool 99370715 (1) to the steering knuckle pin and lubricate its outer surface with the oil prescribed for wheel hubs.
Carefully key the wheel hub (2) onto the kingpin so as not to damage the seal (3, Figure 23).
Fit on the spacer (3), inner ring (4) of the tapered roller bearing.
Unscrew the tool 99370715 (1).
Key on the washer (5) and screw down the stop nut (6).

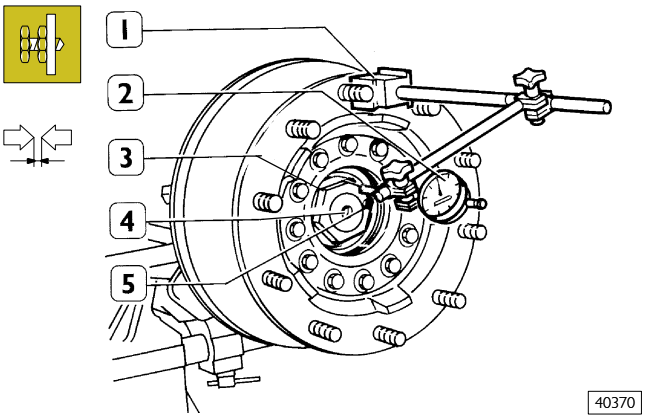
Figure 27



Using the wrench 99388001 (1) tighten the nut (6, Figure 26) to the required torque.

Checking wheel hub bearing end float

Figure 28



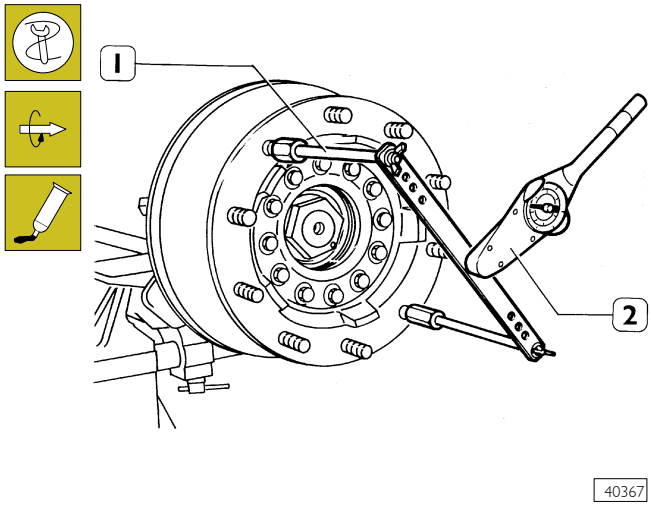
Strike the wheel hub axially a few times with a mallet and turn it in both directions to free the rollers of the bearings.
Apply the magnetic base (1) with the dial gauge (2) onto the wheel hub.
Set the pointer of the dial gauge (2) at right angles to the shank of the stub axle (4).
Reset the dial gauge with a pre-load of 1.5-2 mm.
With the aid of a lever, move the wheel hub axially and measure the end float that has to be 0.16 mm (maximum value).

NOTE If the end float is not as required, replace the bearing assembly and repeat the check.

Check the required end float, lock the screw (5) holding the adjustment ring nut (3) to the required torque.

Measuring rolling torque

Figure 29

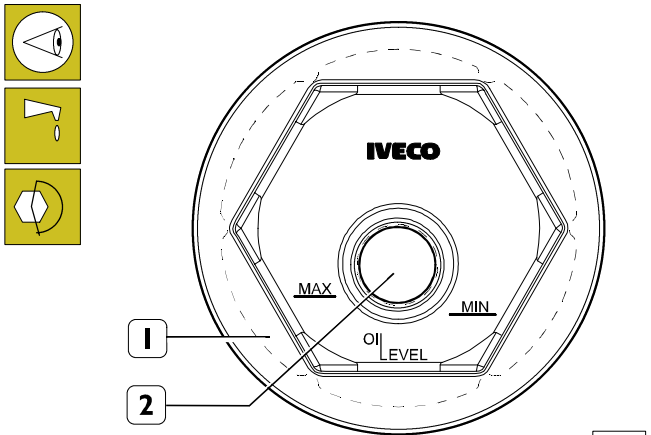


Fit the tool (1) 99395026 onto the pins of the wheel hub and using the torque wrench (2) 99389819 check that the rolling torque of the wheel hub is 5 Nm.

Deposit a sealing bead (Loctite type 574) exclusively on the hub cover ledge surface and protect the threaded part.

Tighten to torque the hub cover (1, Figure 30).

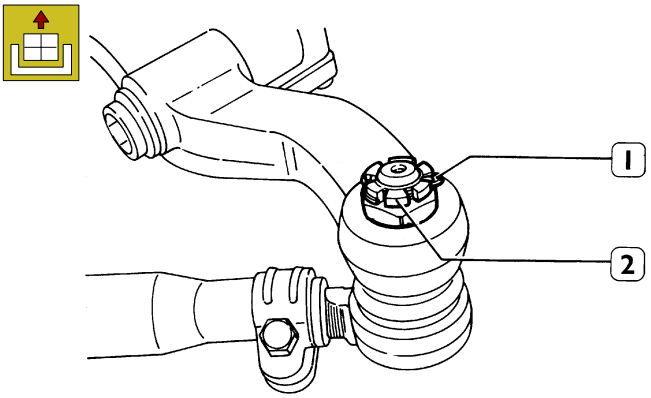
Figure 30



Rotate the wheel hub until when hub cover (1) is positioned as shown in the figure. Restore the prescribed quantity of oil into the hub cover (1) through filling hole (2). Tighten the plug on the hub cover (1) to the set torque.

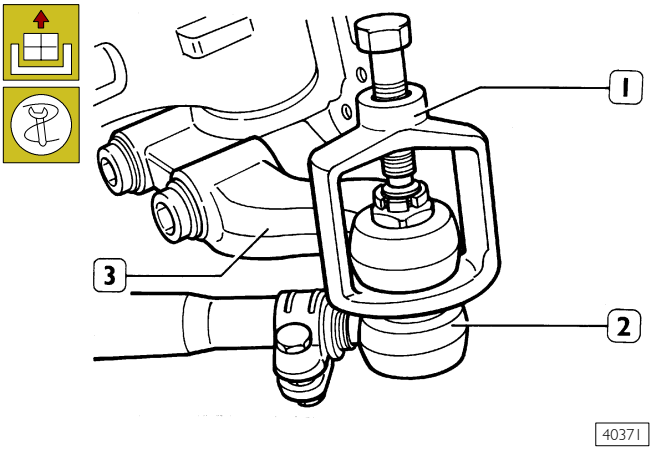
520635 REMOVING AND REFITTING TRANSVERSE TIE ROD

Figure 31



Straighten out and take off the split pin (1).
Free the nut (2) and partly unscrew it so as to prevent the tie rod falling when it is freed.

Figure 32



Using the extractor (1) 99347068, free the swivel head (3) from the lever (2). Repeat this operation on the opposite side; fully unscrew the nuts and disconnect the transverse tie rod.

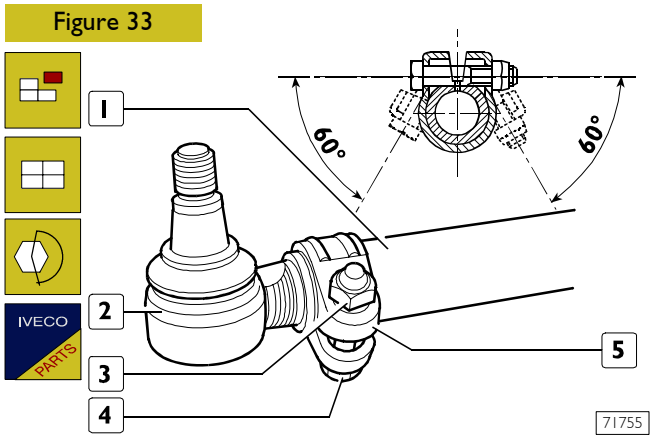
For refitting, carry out the operations performed for removal in reverse order.

Tighten the nuts fixing the tapered pins to the required torque.

NOTE Check that the position of the notches on the nuts coincide with the transverse holes of the tapered pins. If the split pins will not go in, progressively increase the tightening torque of the nuts till they go in properly (angle less than 60°).

520635 REPLACING TRANSVERSE TIE ROD SWIVEL HEADS

Figure 33



Lock the screw (4), loosen the nut (3) and unscrew the articulation (2) from the transverse tie rod (1).

NOTE To make it easier to refit the transverse tie rod and then adjust the wheel toe-in, note down the number of turns needed to unscrew each single articulation so as to screw the new ones on with the same number of turns.

Screw the new articulation into the tie rod and lock it in position by tightening the locking nut (3) to the required torque.

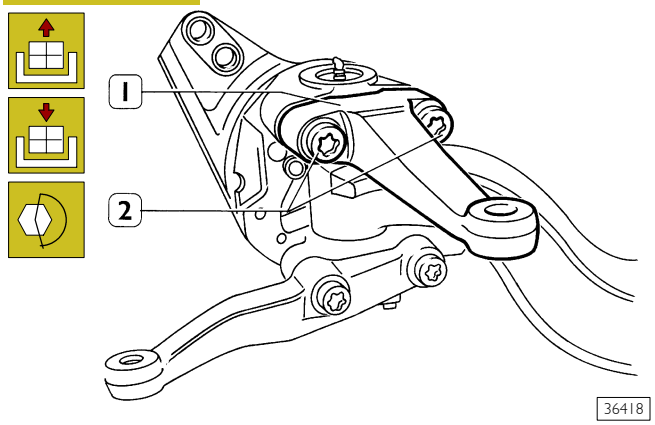
NOTE The nut (3) has to be tightened with the clamp (5) positioned in one of the set-ups shown in the figure.

Refit the transverse tie rod.

Check and if necessary adjust the toe-in of the front wheels as described under the section heading "Wheel Geometry".

520631 LONGITUDINAL TIE ROD LEVER REMOVAL/REFITTING

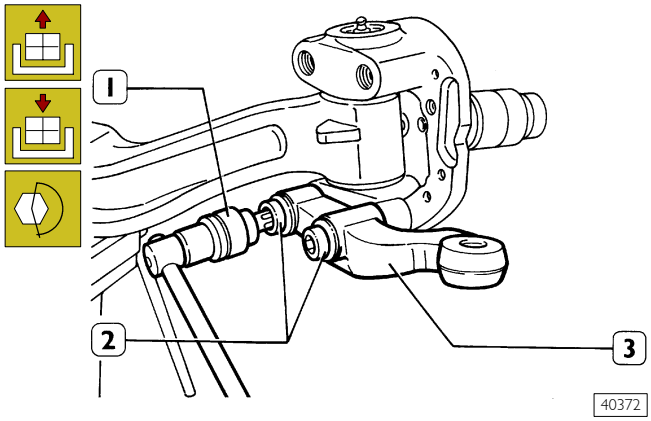
Figure 34



Using wrench 99388002 (1, Figure 35) unscrew the screws (2) and remove the lever (1). To refit it, carry out the operations in reverse order, locking the fixing screws to the required torque.

520632 CROSS TIE ROD LEVER REMOVAL/REFITTING

Figure 35

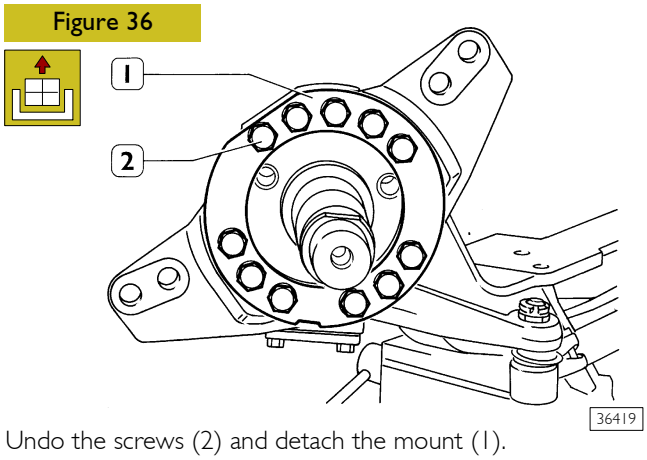


Using wrench 99388002 (1), unscrew the screws (2) and remove the lever (1). To refit it, carry out the operations in reverse order, locking the screws to the required torque.

520611 REMOVING AND REFITTING PIN FOR STUB AXLE

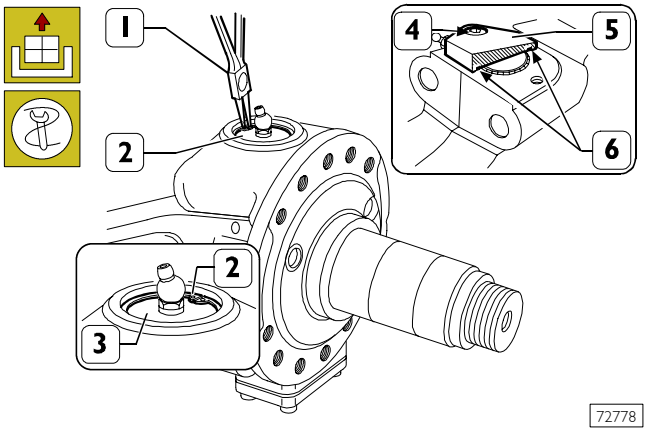
Removal

Figure 36



Undo the screws (2) and detach the mount (1).

Figure 37



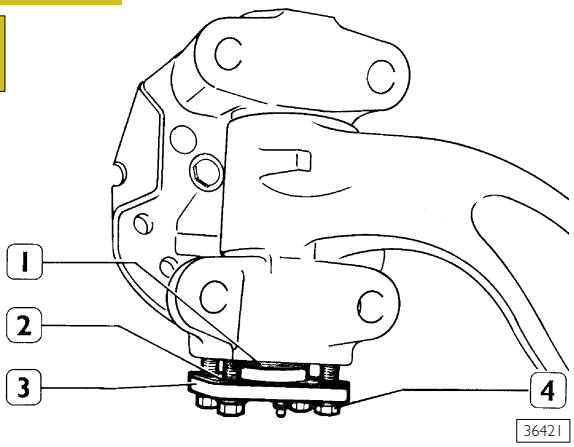
For axles 5876/4 only

Using specific pliers (1) take out the retaining ring (2) and remove the cover (3) with the grease nipple.

For axles 5876/5 - 5886/5 only

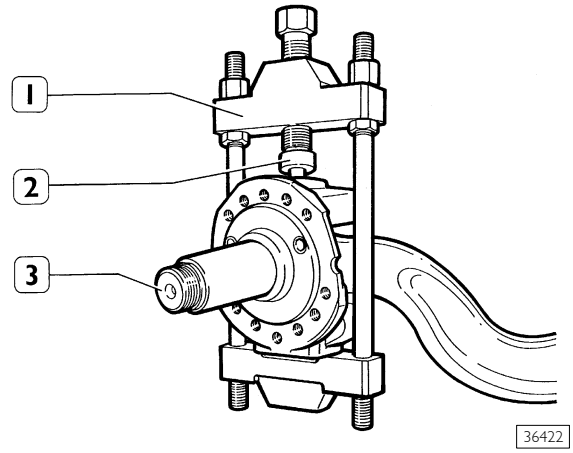
Take out the screws (4) and remove the top cover (5) and seal (6).

Figure 38



Undo the screws (4) and remove the bottom cover (3), adjustment plates (2) and fifth wheel (1).

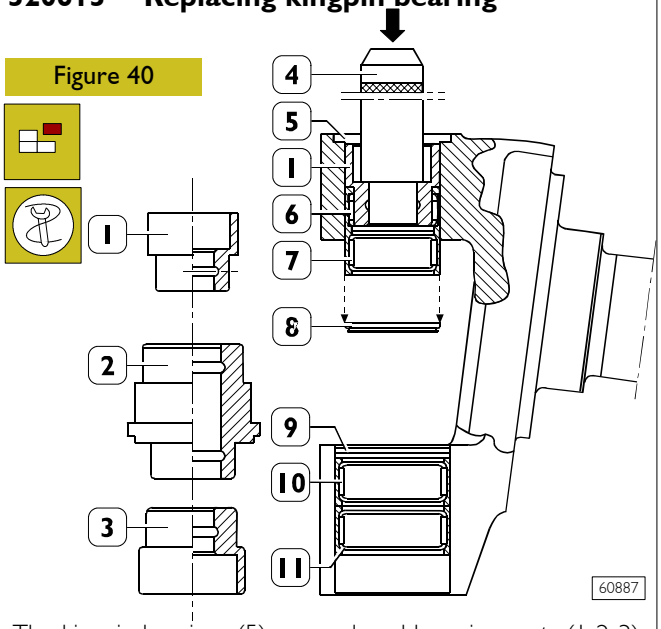
Figure 39



Using the tool 99347047 (1) and part (2), free the kingpin (3); remove the tool and take out the pin.

520615 Replacing kingpin bearing

Figure 40

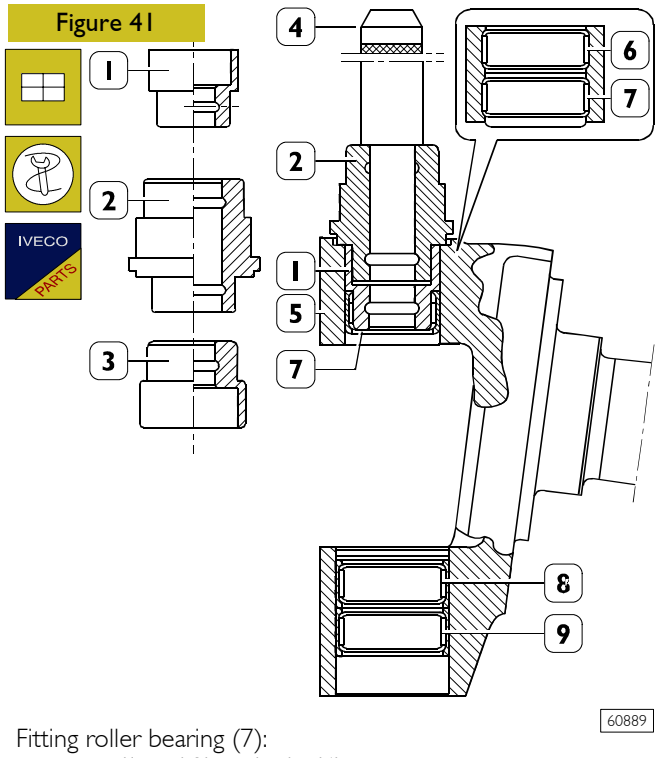


The kingpin bearings (5) are replaced by using parts (1-2-3) of drift 99374530 and grip 99370007 (4) to disassemble and assemble them.

NOTE The parts mentioned in the following text are shown in Figure 40.

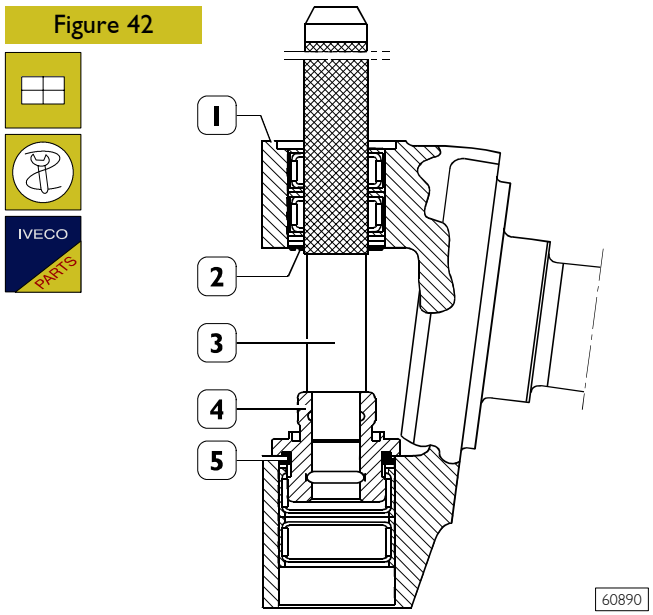
Use part (1) and grip (4) to remove the seal (8) and roller bearings (6-7) on the top side.
Use part (3) and grip (4) to remove the seal (9) and roller bearings (10-11) on the bottom side.

Figure 41



Fitting roller bearing (7):
use parts (1 and 2) and grip (4).
Fitting roller bearing (6):
use part (2) and grip (4).
Fitting roller bearing (8):
use parts (3 and 2) and grip (4).
Fitting roller bearing (9):
use part (2) and grip (4).

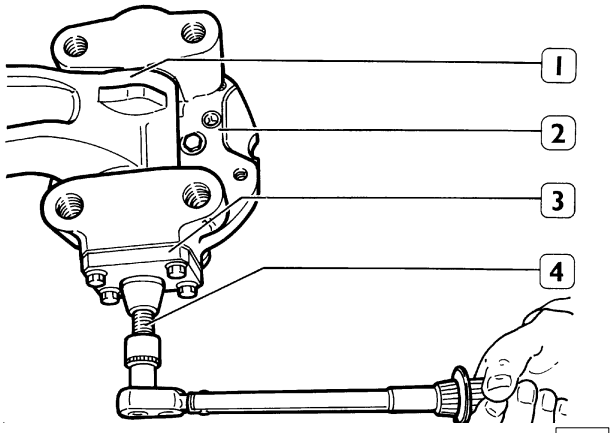
Figure 42



Using the drift 99374173 (4) and grip 99370007 (3), fit the seals (2 and 5) in the stub axle (1).

NOTE Before driving in the pin, you need to make sure the tapered seat on the axle and the surface of the pin are thoroughly clean and dry to avoid films of oil that would make it easier for the pin to turn in its seat while driving it home.

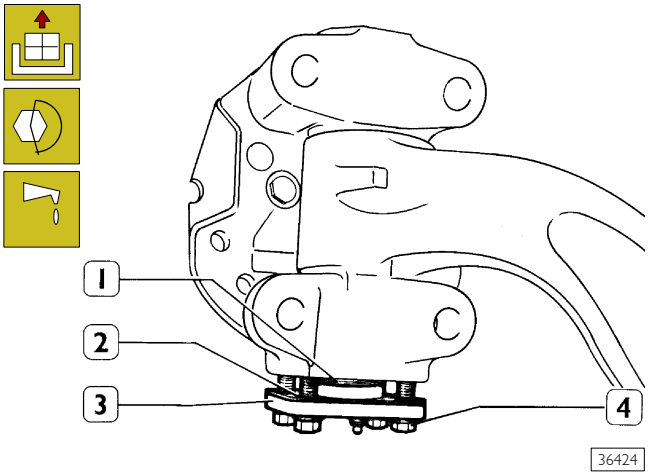
Figure 43



40374

Position the stub axle (2) on the axle (1) and insert the pin into its seat. Fit the tool 99374405 (3) onto the stub axle and secure it with the same fixing screws as the bottom cover, locking them to an adequate torque.
Drive the pin into the tapered seat of the axle, screwing down the pressure screw (4) to a torque of 15 to 16 daNm.
Remove the tool 99374505 (3) from the stub axle.

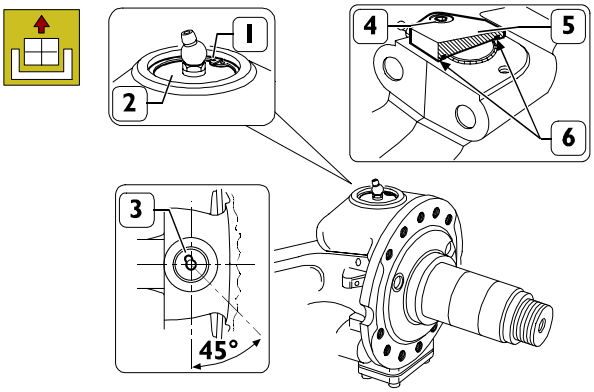
Figure 44



36424

Lubricate the fifth wheel (1) with TUTELA MR2 grease.
Position the bottom cover (3) together with the fifth wheel (1) and adjustment shims (2). Tighten the fixing screws (4) to the required torque.
Repeat the same operations for the opposite stub axle.

Figure 45



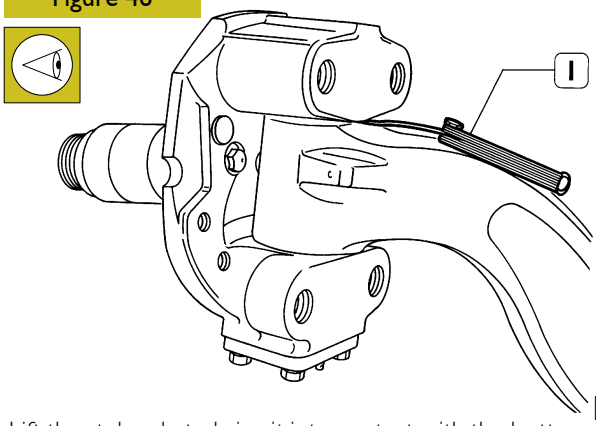
72779

For axles 5876/4 only
Insert the top cover (2) in its seat together with the relevant gasket. Position the grease nipple (3) as shown in the figure; then, insert the retaining ring (1) making sure the ring expands correctly.

For axles 5876/5 - 5886/5 only
Fit the top cover (5) with a new seal (6) and tighten the fixing screw (4) to the required torque.

Checking and adjusting clearance between stub axle and axle

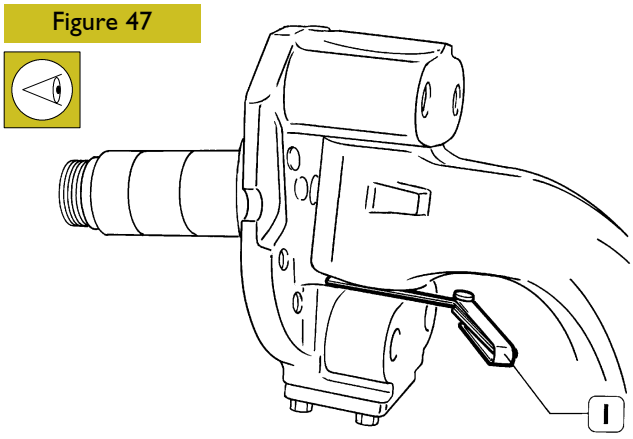
Figure 46



36425

Lift the stub axle to bring it into contact with the bottom shim adjustment of the axle and, using a feeler gauge (1), check the clearance between the top shim adjustment of the stub axle and the axle that needs to be between 0.10 and 0.35 mm.

Figure 47



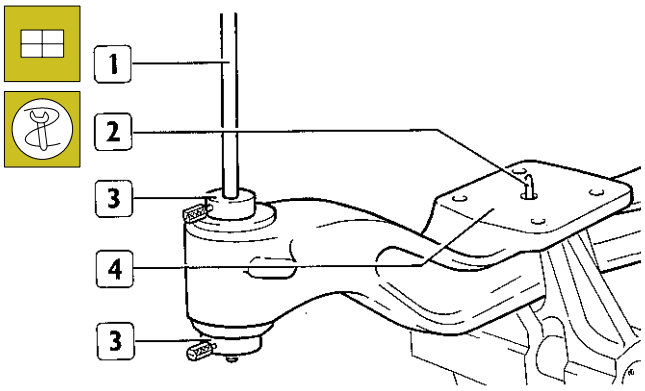
36426

Check the clearance between the top shim adjustment of the stub axle and the axle. Check with a feeler gauge (1) that there is a gap between the bottom shim adjustment of the stub axle and that of the axle of no less than 0.25 mm.

520618 CHECKING AND MEASURING THE AXLE BODY

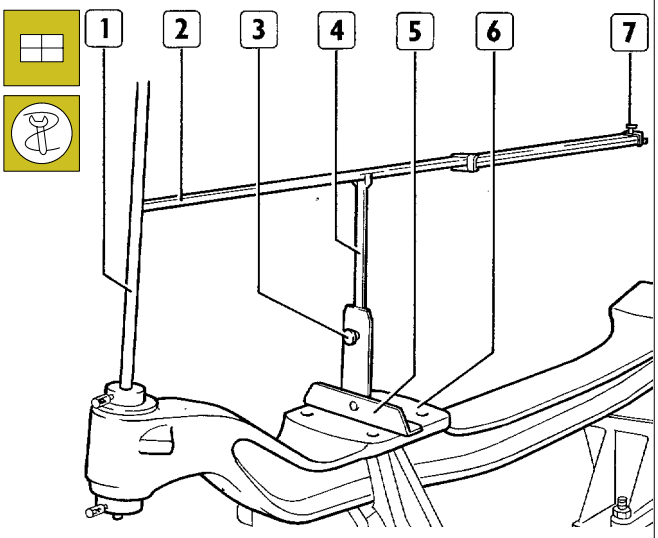
Checking levelness of leaf spring supporting surfaces with respect to the holes for the kingpins

Figure 48



Fit the two rods (1) with the cones (3) into the kingpin holes.
Press on the cones and lock them in position with the screws on the rods.
Insert the two centring grub screws (2) into the seats of the leaf spring supporting surface (4).

Figure 49

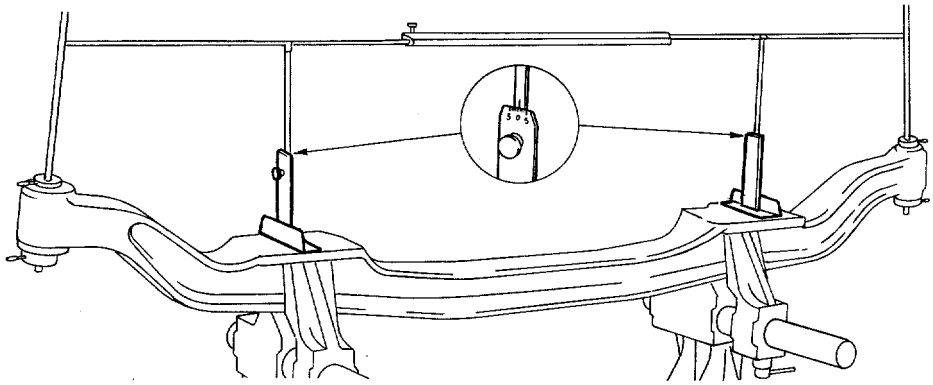


Fit the sliding bar (2) on the rods (4) of the goniometers, adjusting the length so that the shaped ends are inserted in contact with the rods (1).
Lock the screw of the clamp (7) and the screws (3) fixing the goniometers to the rods (4).

Fit the bases (5) with goniometers on the surfaces (6), inserting them in the centring grub screws.

NOTE Before fitting the bases with goniometers, check that the supporting surfaces have no sign of paint or roughness.

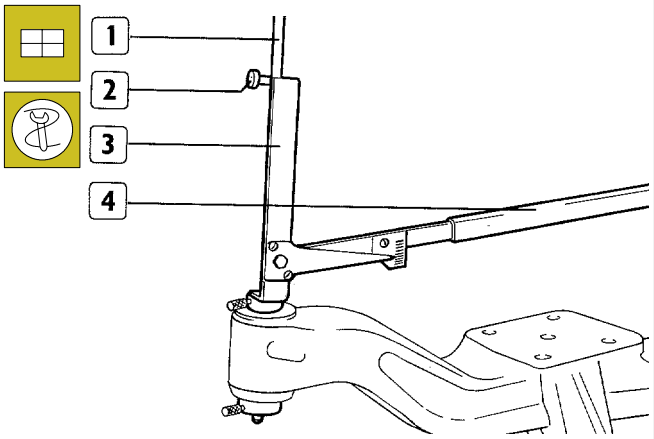
Figure 50



Check the angle of deformation, if any, on the graduated sectors of the goniometers shown by the arrows.
Clearly, the pointers of the goniometers detect no angular movement when the levelness of the supporting surfaces of the leaf springs with respect to the holes of the kingpins is correct.
Remove the sliding bar and the bases with goniometers used for the test.

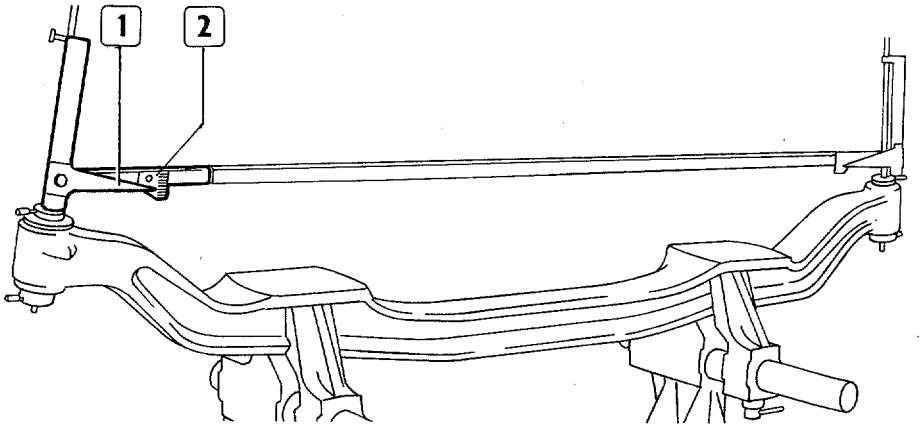
Checking angle of holes for kingpins

Figure 51



Fit the mounts (3) with goniometers onto the rods (1) and screw down the screws (2) without locking them.
Insert the transverse tie rod (4) and fully screw down the screws (2) fixing the mounts in contact with the rods (1).

Figure 52



Read off the angle of the holes for kingpins on the relevant graduated sectors (2), shown by the pointers (1).

The angle of the holes for kingpins has to be 7° ± 0°3'.

Rigid rear added axle 55080/DI

DESCRIPTION

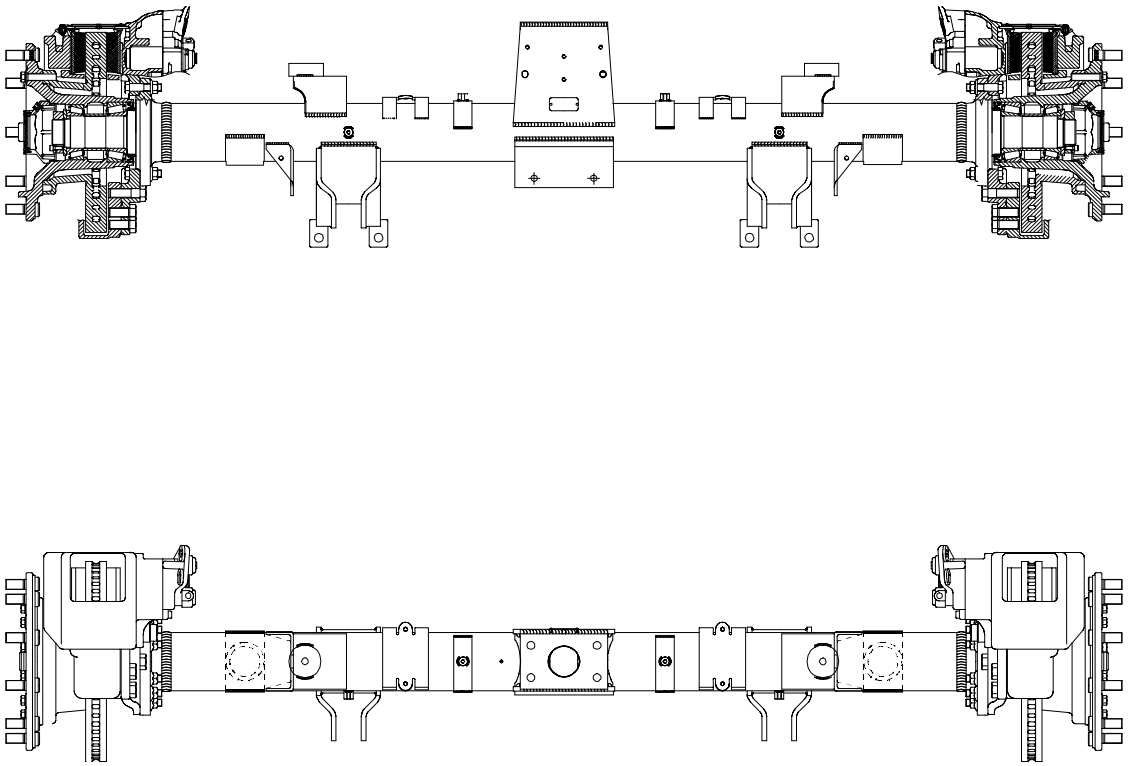
The front axle is a steel structure with a tubular cross-section at the end of which the wheel hubs are keyed.

The wheel hubs are supported by two tapered roller bearings, set right, lubricated with oil.

The bearings need no adjustment; their end float is obtained by tightening the retaining ring nut to torque.

The disc brake is the "KNORR" type. The brake calliper is mounted on the axle with an angle of 57°.

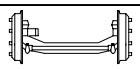
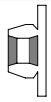
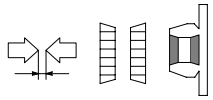
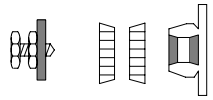
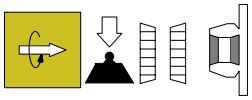
Figure 1



72781

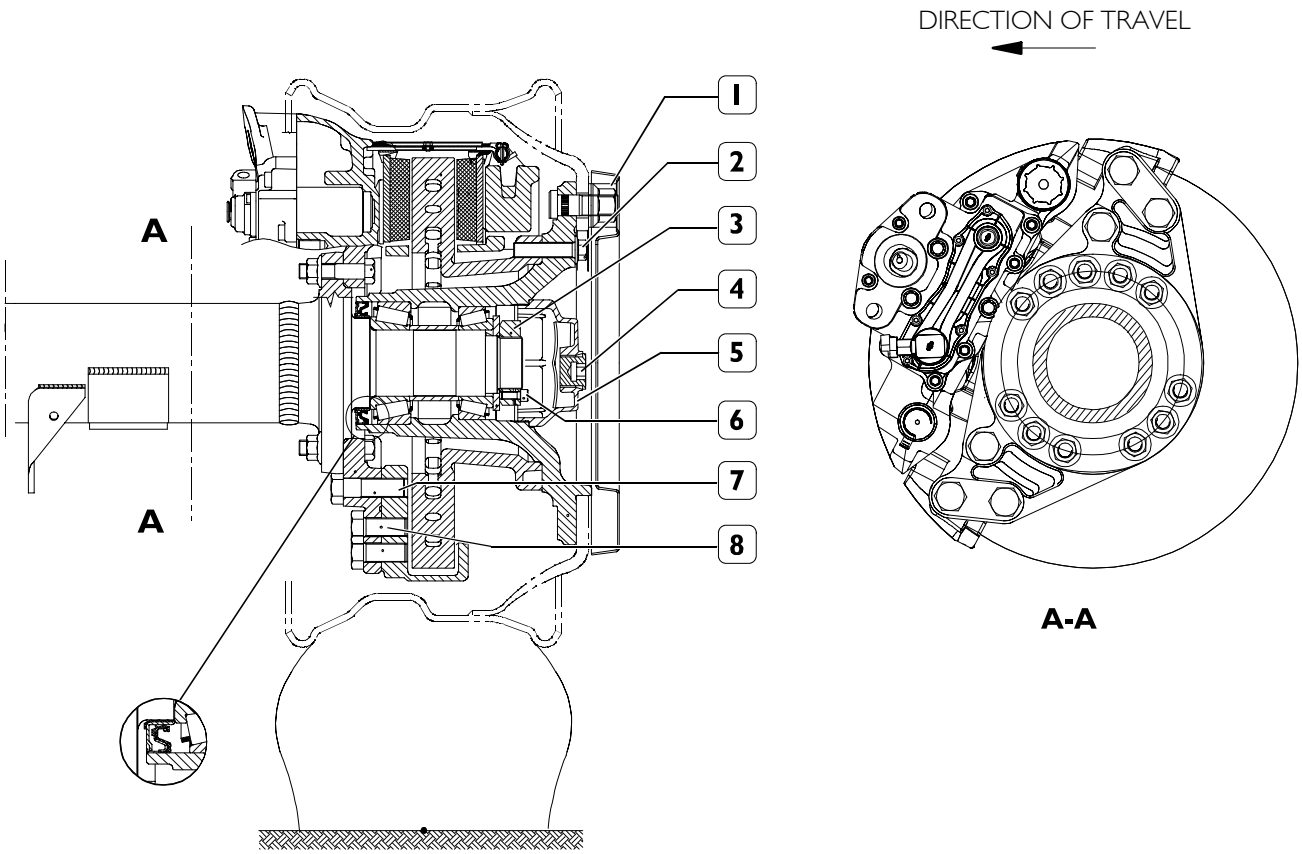
VIEW OF FRONT AXLE 55080/DI

CHARACTERISTICS AND DATA

	Axle type	Rigid, 8 tonnes, can be lifted, with single wheels 55080/DI (N 8071)
	**WHEEL HUBS**	
	Wheel hub bearings	2 with tapered rollers
	Hub bearing axle clearance mm	max 0.16
	Wheel hub clearance	by tightening retaining ring nut to torque
	Bearing pre-load rolling torque daNm	max 0.50
	Oil for wheel hub bearings Quantity of oil per hub Litres	Tutela W 140/MDA 0.35 (0.32 kg)
G.A.W. permissible maximum capacity kg		8000

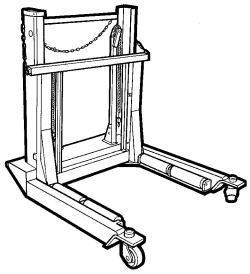
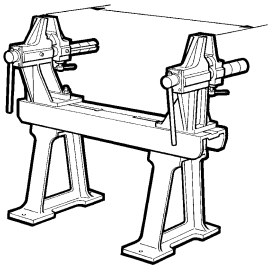
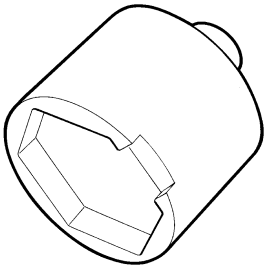
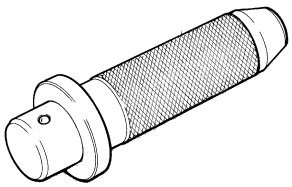
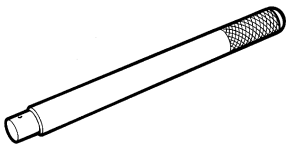
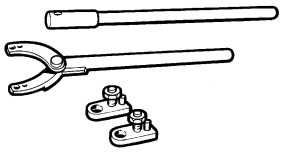
TIGHTENING TORQUE

Figure 2

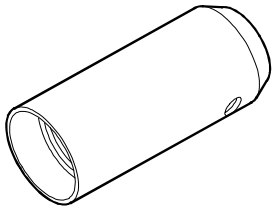
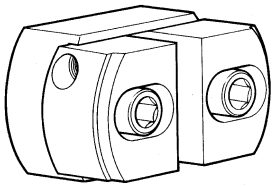
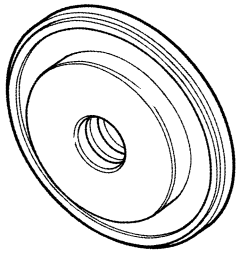
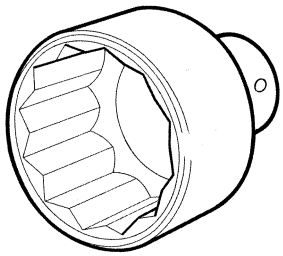
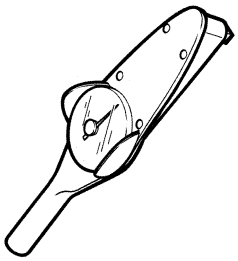
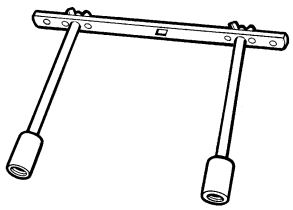


	PART	TORQUE	
		Nm	(kgm)
1	Wheel fixing nut	600 +50 -20	(60 +5 -2)
2	Hex screw fixing brake disc to wheel hub	281.5 ± 13.5	(28.1 ± 1.3)
3	Ring nut fixing wheel bearings	515 ± 30	(51.5 ± 3)
4	Tapered threaded plug for wheel hub cover	57.5 ± 7.5	(5.8 ± 0.7)
5	Cover for wheel hub	130 ± 10	(13.3 ± 1)
6	Screw fixing nut (3)	27.5	(2.75)
7	Screw fixing brake calliper mount	275 to 304	(27.5 to 30.4)
8	Screw fixing brake calliper	615 ± 61	(61.5 ± 6.1)

TOOLS

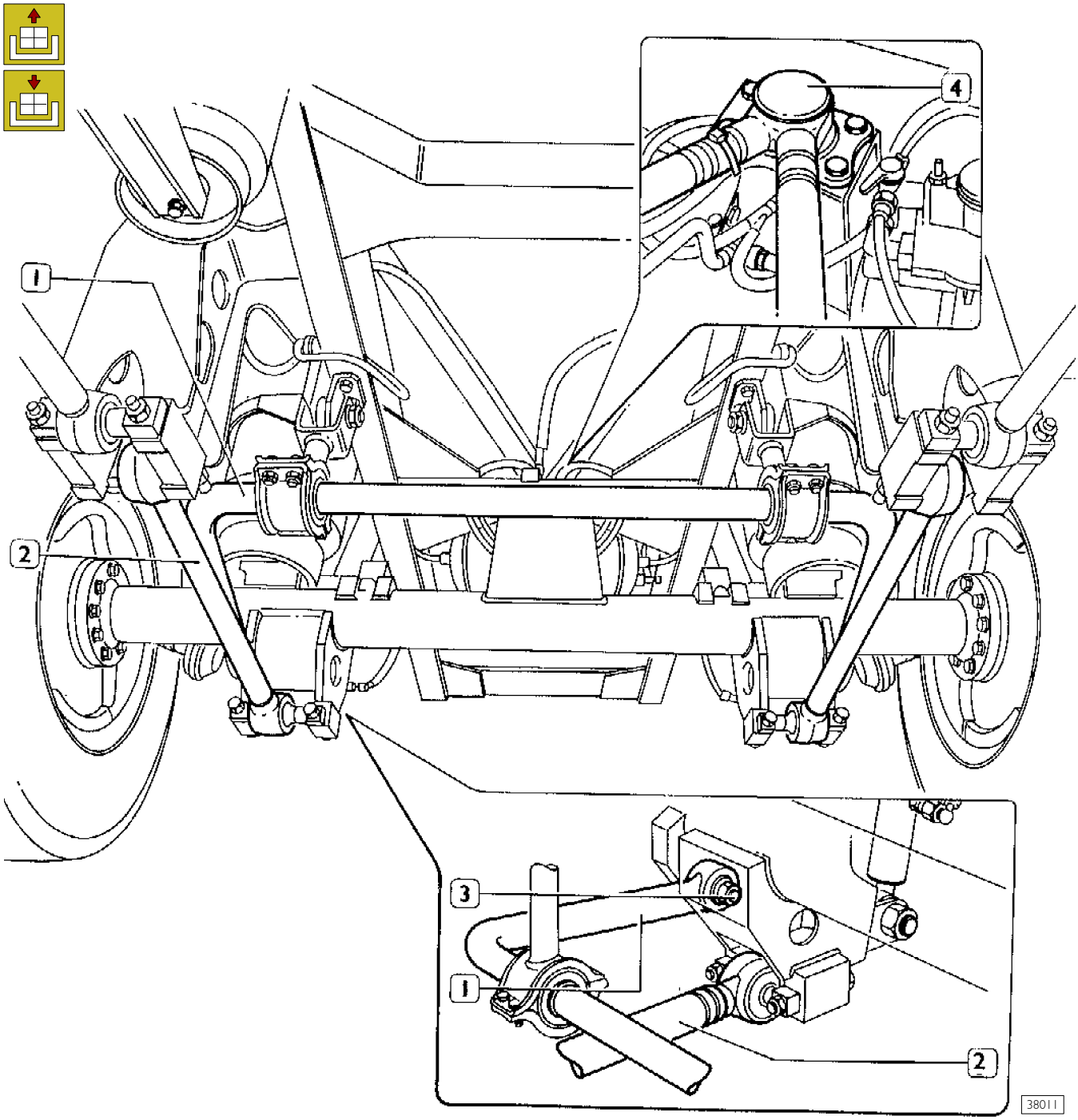
TOOL NO.		DESCRIPTION
99321024		Hydraulic jack for wheel removal and refitting
99322215		Overhauling stand
99354207		Wrench for wheel hub cover
99370006		Handle for interchangeable beaters
99370007		Handle for interchangeable beaters
99370317		Reaction lever with extension to retain flanges

TOOLS

TOOL NO.		DESCRIPTION
99370715		Guide for mounting wheel hub
99374093		Beater to fit back bearing outer races (91-134) (to be used with 99370007)
99374132		Installer to fit back wheel hub internal gasket (to be used with 99370006)
99388001		Wrench (80 mm) for wheel hub bearing adjustment nut
99389819		Torque wrench (0 -10 Nm) with square socket 1/4"
99395026		Tool for testing hubs rolling torque (to be used with torque wrench)

520710 REMOVING-REFITTING

Figure 3

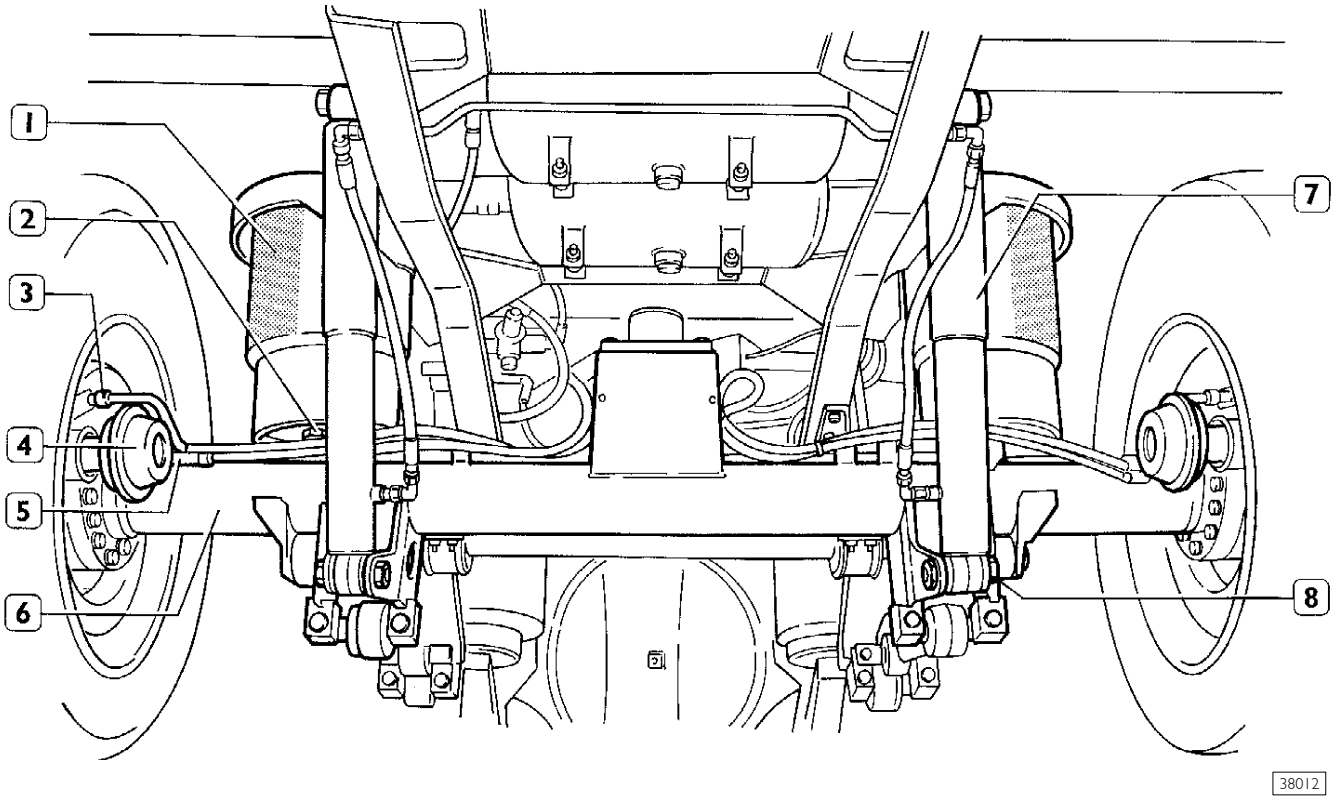


Removal

Place vehicle on flat ground and chock front wheels.
Loosen rear wheel retaining bolts.
Use hydraulic jack to raise vehicle at rear and support by resting rear axle on stands.
Unscrew wheel retaining bolts and remove wheels using hydraulic trolley 99321024.
Support additional rear axle using stand 99370628 and hydraulic lift.

Remove jointed mount (5) of additional axle wishbone.
Remove nut (3) and take out bolt.
Disconnect stabiliser bar (1) and turn so that it does not foul during removal of vehicle axle.
Remove wishbone (2).

Figure 4



Disconnect: the air delivery pipes (5) from the diaphragm brake cylinders (4), the electric cable (3) for the brake lining wear indicator.
Remove the nut (8) and take out the bottom fixing screw of the shock absorber (7).
Remove the nuts (2) fixing the air springs (1) to the axle.
Lower the hydraulic jack and take the axle (6) out from under the vehicle.

Refitting

Reverse operations described for removal to refit. Tighten bolts and/or nuts to specified torque.
After fitting, check that:
- ❑ there is no air leakage from the air pipes.
- ❑ the lubricating oil in the wheel hubs is at the right level.

REPAIRS

The wheel hub overhaul procedure is similar to the one described for the axle 5876/4 (F 8021) to which you should refer.

The adjustment data, tightening torques and equipment are as stated in this section.

Rigid rear added axle with hydraulic lifting 56082/D1 (N 9171)

DESCRIPTION

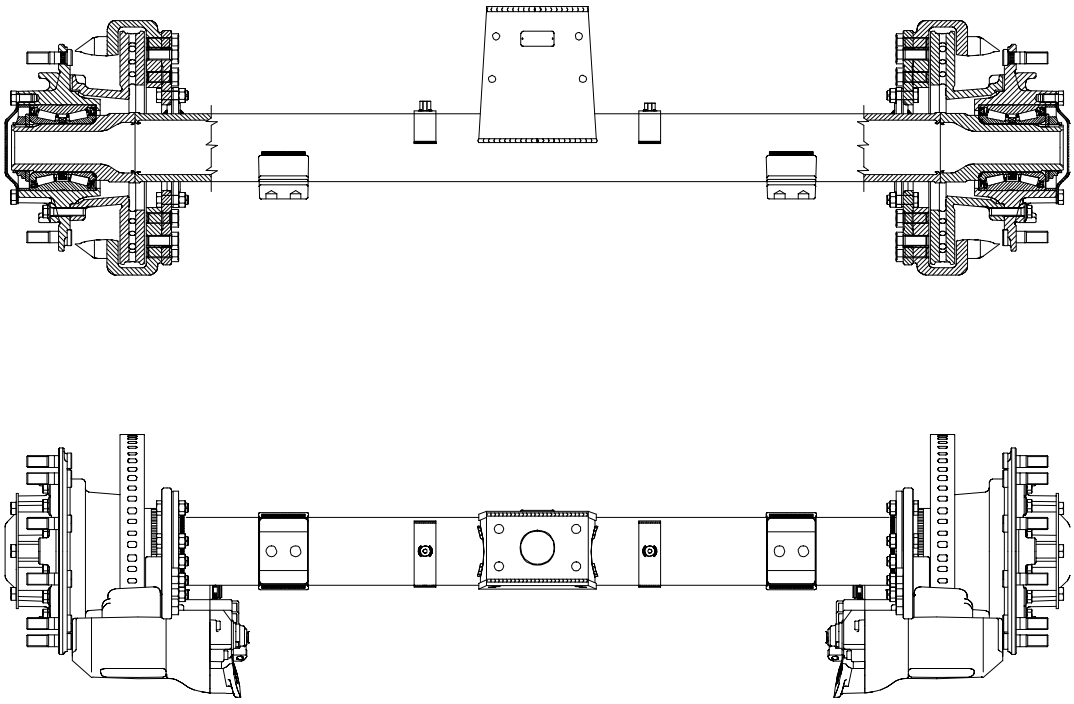
The front axle is a steel structure with a tubular cross-section at the end of which the wheel hubs are keyed.

The wheel hubs are supported by two tapered roller bearings, the Unit Bearing type with permanent lubrication.

The bearings need no adjustment; their end float is obtained by tightening the retaining ring nut to torque.

The disc brake is the "KNORR" type. The brake calliper is mounted on the axle with an angle of 57°.

Figure 1



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VIEW OF FRONT AXLE 56082/D1

CHARACTERISTICS AND DATA

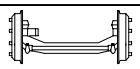
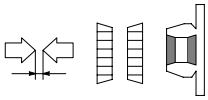
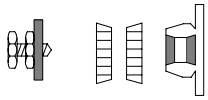
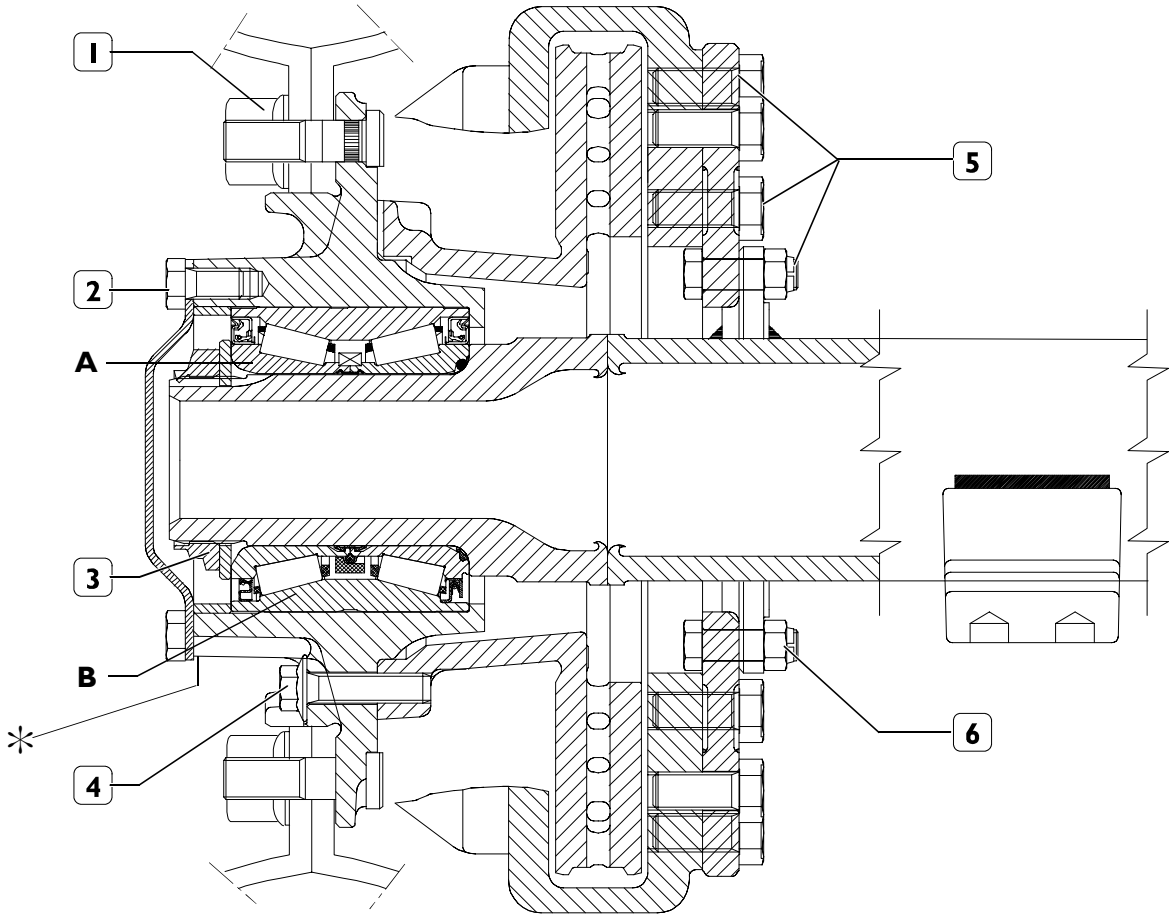
	Axle type	Rigid, 10 tonnes, can be lifted, with twin wheels 56082/D1 (N 9171)
	**WHEEL HUBS**	
	Wheel hub bearings	2, Unit-Bearing type
	Hub bearing axle clearance mm	max 0.16
	Wheel hub clearance	by tightening retaining ring nut to torque
	Oil for wheel hub bearings Quantity of oil per hub Litres	Tutela W 140/MDA 0.35 (0.32 kg)
G.A.W. permissible maximum capacity kg		10.000

Figure 2



TIGHTENING TORQUE

	PART	TORQUE	
		Nm	kgm
1	Wheel fixing nut	600 $^{+50}_{-20}$	(60 $^{+5}_{-2}$)
2	Screw fixing drive shaft flange ●	80 to 100	8 to 10
3	Ring nut retaining wheel hub bearing	834 to 1030	83.4 to 103
4	Screw fixing brake disc to wheel hub	268 to 295	26.8 to 29.5
5	Nut for screw fixing brake calliper to mount	554 to 677	55.4 to 67.7
6	Nut for screw fixing brake calliper mount	275 to 304	27.5 to 30.4

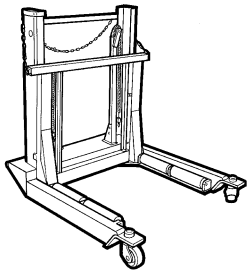
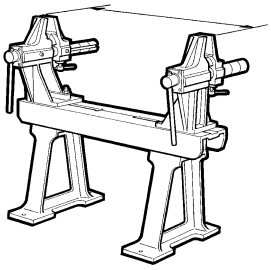
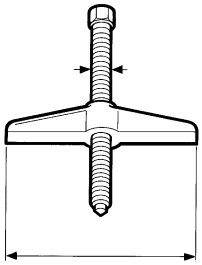
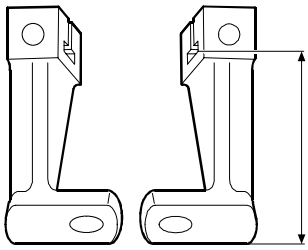
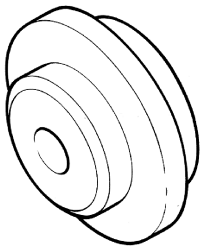
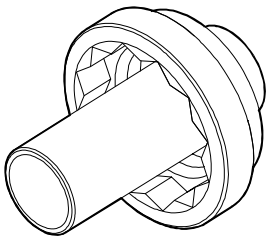
✳ Spread with sealant type IVECO 1905685 (LOCTITE 14780)

● Apply LOCTITE 243 sealant on the thread

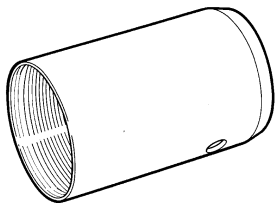
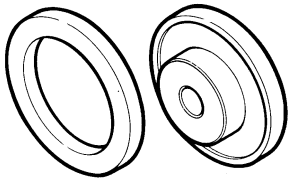
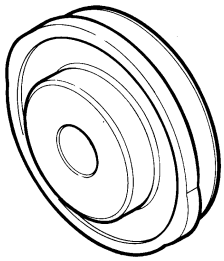
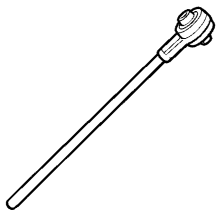
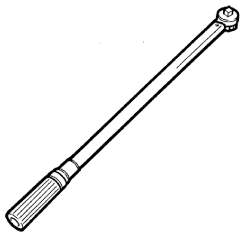
A = TIMKEN bearing

B = SKF bearing

TOOLS

TOOL NO.		DESCRIPTION
99321024		Hydraulic trolley to remove and refit wheels
99322215		Stand for overhauling
99341003		Single-acting lift
99341017		Pair of brackets with holes
99345053		Reaction block for puller tools
99355180		Wrench (105 mm) for wheel hub bearing adjustment nut

TOOLS

TOOL NO.		DESCRIPTION
99370700		Guide to assemble wheel hub
99370706		Tool to fit wheel hub bearing
99370708		Tool to drive out wheel hub bearing
99389816		4 x torque multiplier, with square connection, 3/4" in, 1" out (maximum torque 2745 Nm).
99389818		Dynamometric wrench (150 - 800 Nm) with square 3/4" coupling

REMOVING-REFITTING

By analogy, follow the descriptions already given for the rear added axle type 55080

REPAIRS

The wheel hub overhaul procedure is very similar to that described for rear axle MS 13-175 with disc brakes, that you are strongly recommended to observe.
The adjusting values, the tightening torques and the tools used are those shown in the section.

Steering rear added axle with pneumatic lifting 57080/DI

Page

DESCRIPTION

The front axle is a steel structure with a tubular cross-section at the end of which the stub axles are articulated.

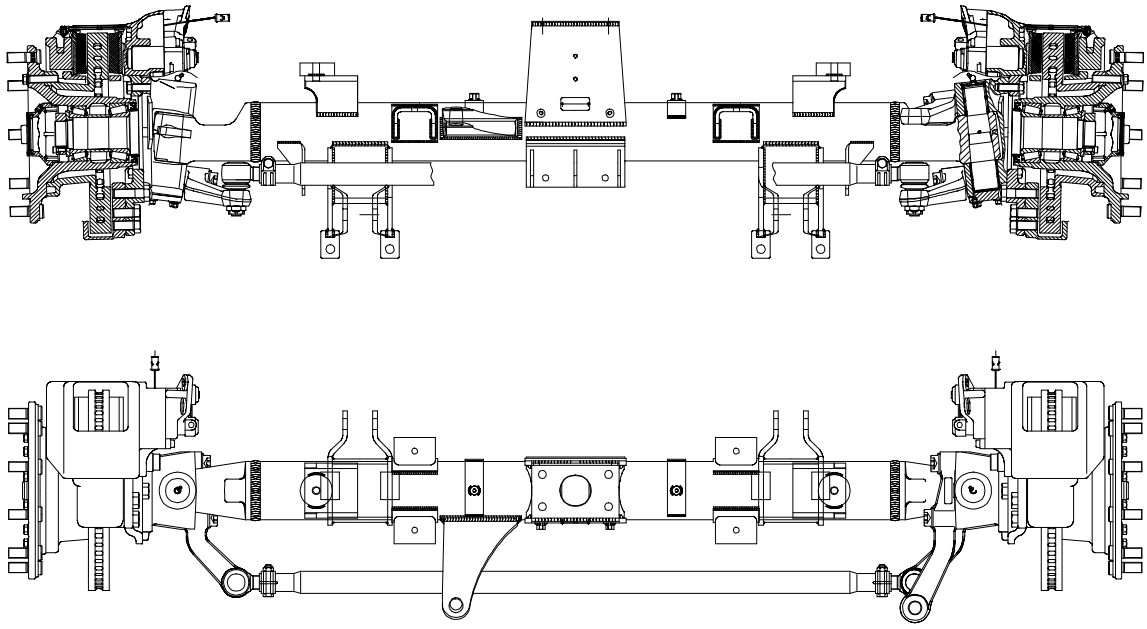
The stub axle articulation is made with tapered pins integral with the axle body and by means of four bearings with rollers driven in with interference in the holes of the stub axle overhangs.

The wheel hubs are supported by two tapered roller bearings, set right, lubricated with oil, mounted on the shank of the stub axle.

The bearings need no adjustment; their end float is obtained by tightening the retaining ring nut to torque.

The disc brake is the "KNORR" type. The brake calliper is mounted on the axle with an angle of 57°.

Figure 1



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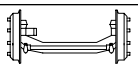
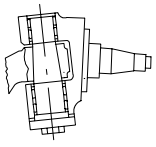
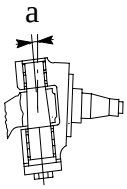
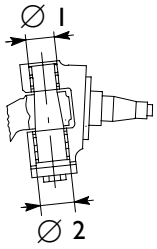
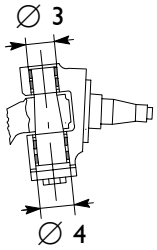
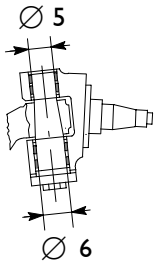
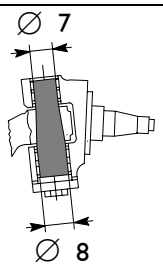
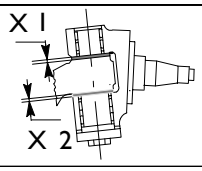
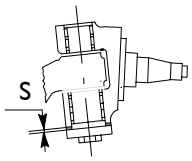
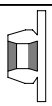
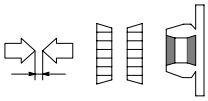
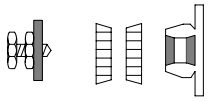
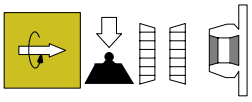
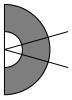
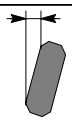
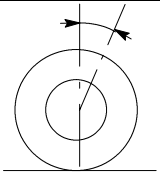
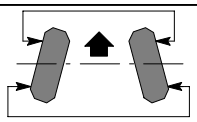
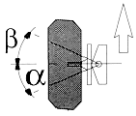
VIEW OF STEERING REAR AXLE 57080/D1

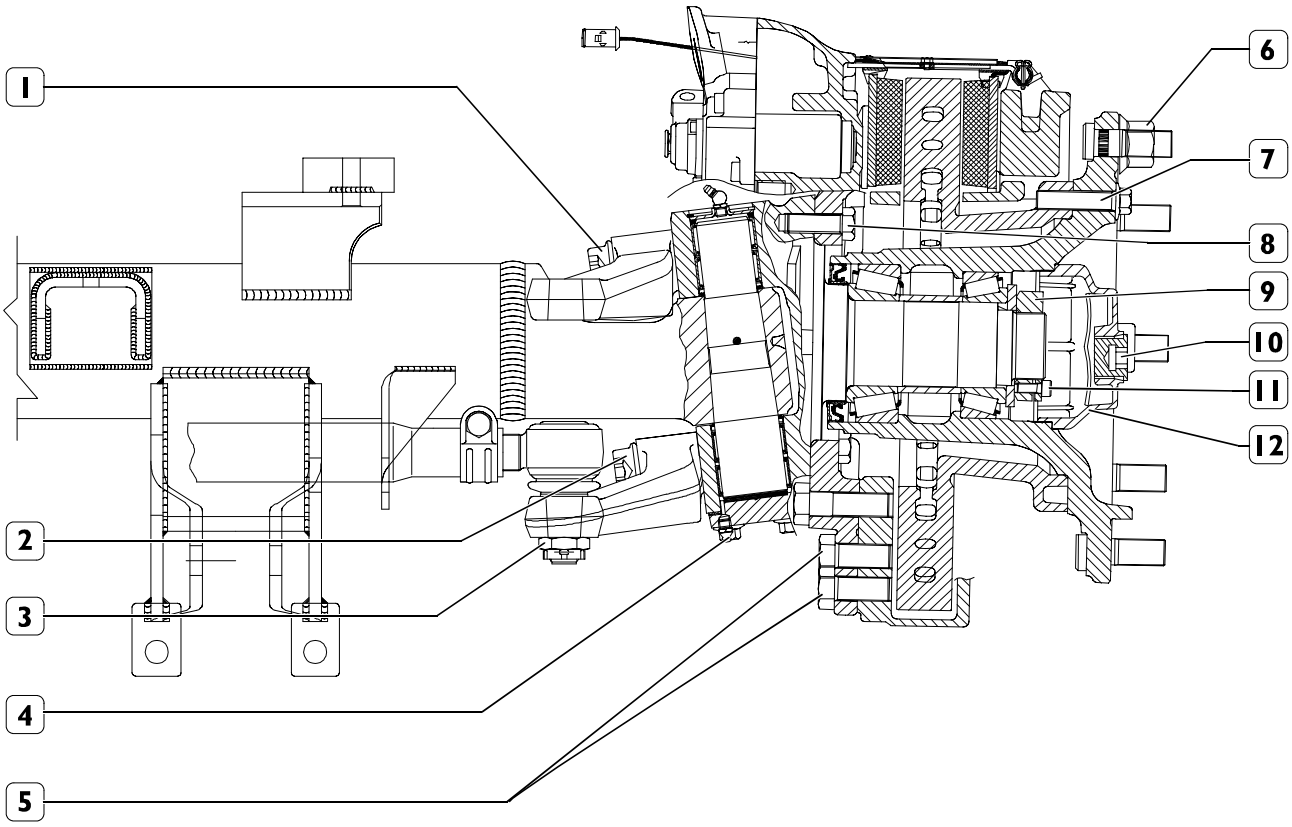
CHARACTERISTICS AND DATA

	Type of axle	Steering liftable single wheels	
	**STUB AXLE PINS**		
	Inclination of kingpin	7°	7°48'
	Diameter of roller bearing housings on the stub axle: - upper housing Ø 1 mm - lower housing Ø 2 mm	51.967 to 51.986 59.967 to 59.986	
	Outside diameter of roller bearings for stub axle: - upper bearings Ø 3 mm - lower bearings Ø 4 mm	52 60	
	Stub axle bearings mm	0.014 to 0.033	
	Inside diameter of roller bearings for stub axle: - upper bearings Ø 5 mm - lower bearings Ø 6 mm	43 53	
	Diameter of king pin - top end Ø 7 mm - bottom end Ø 8 mm	42.984 to 43.000 52.981 to 53.000	
	Upper bearings/pin mm	0 to 0.016	
	Lower bearings/pin mm	0 to 0.019	
	Play between axle and upper facing of stub axle X1 mm Clearance between axle and lower facing of stub axle X2 mm	0.10 to 0.15 0.25	

  	Shims to adjust X1, X2 0.25 mm S mm	0.25 to 1.75
	**WHEEL HUBS**	
	Wheel hub bearings	2, taper rollers
	Wheel hub bearing end play mm	max 0.16
	Wheel hub play adjustment	by tightening retaining ring nut to torque
	Rolling torque Bearing preloading daNm	0.50
	Oil for wheel hub bearings Litre	Tutela W 140/MDA 0.33 (0.30 kg)
	**WHEEL GEOMETRY**	
	Wheel camber (vehicle with static load)	1°
	Wheel caster (vehicle with static load)	0°
	Wheel toe-in (vehicle unladen) mm	LEFT WHEEL 0 / RIGHT WHEEL - 2
	Adjustment tolerance mm Check tolerance mm	± 0.75 ± 2
	Steering angle: Inner α Outer β	 20° 13°
	Axle weight kg Maximum capacity (GRW) kg	- 8000

TIGHTENING TORQUES

Figure 2

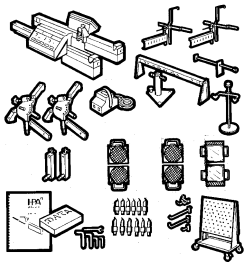
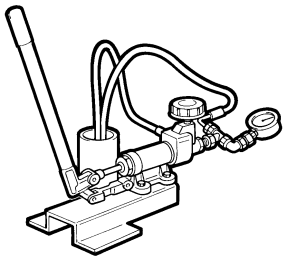
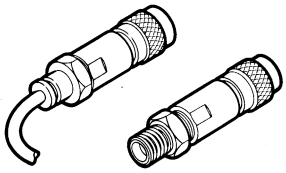
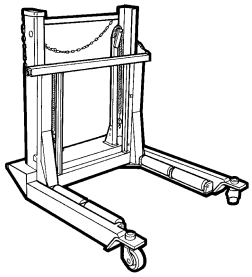
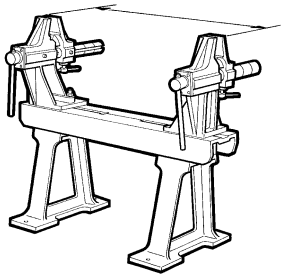
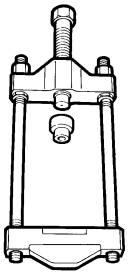


	PART	TORQUE	
		Nm	(kgm)
1	Flanged screw fixing transverse tie rod lever onto stub axle	1325 ± 75	(135 ± 7.6)
2	Flanged screw fixing longitudinal lever onto stub axle	1325 ± 75	(135 ± 7.6)
3	Castellated nut for kingpin	300 *	30 *
4	Flanged hex screw fixing bottom fifth wheel cover onto stub axle	117 ± 6	(11.7 ± 0.6)
5	Self-locking hex screw M20x1.5 fixing brake callipers	615.5 ± 61.5	(61.5 ± 6.1)
6	Nut fixing wheels	665.5 ± 66.5	(66.6 ± 6.6)
7	Hex screw fixing brake disc to wheel hub	281.5 ± 13.5	(28.1 ± 1.5)
8	Self-locking hex screw M16x1.5 fixing brake calliper mount to stub axle	313.5 ± 15.5	(313.5 ± 15.5)
9	Ring nut fixing wheel bearing	515.5 ± 24.5	(51.5 ± 2.4)
10	Threaded plug for wheel hub cover	57.5 ± 7.5	(5.8 ± 0.2)
11	Cylindrical screw with recessed hex locking ring nut adjusting wheel bearings	27.5 ± 2.5	(2.7 ± 0.2)
12	Cover for wheel hub •	130 ± 10	(132 ± 0.1)

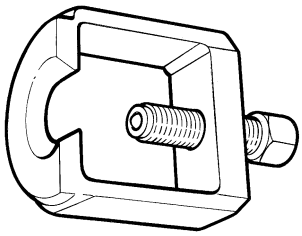
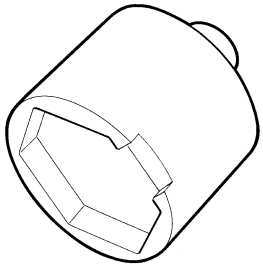
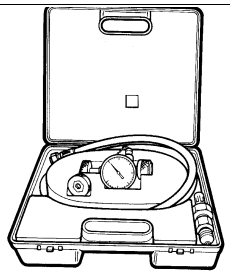
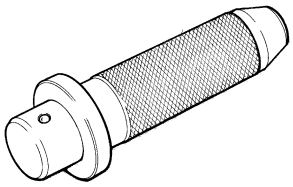
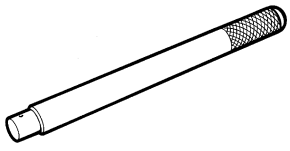
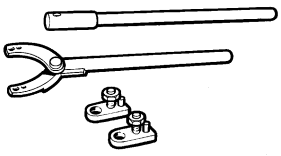
* Minimum torque – peak torque, tighten to the first cut coinciding with the hole for the split pin

• Apply Loctite 574 on the wheel hub/cover contact surface

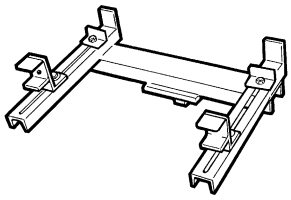
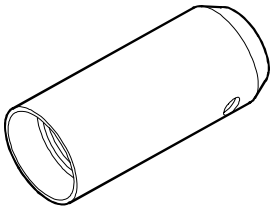
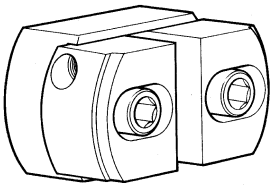
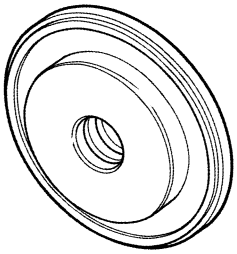
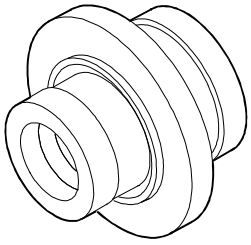
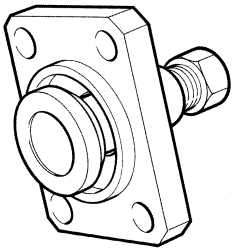
TOOLS

TOOL NO.		DESCRIPTION
99305354		Wheel geometry portable optical testing equipment
99305446		Hand pump for filling and bleeding hydraulic system
99305450		Set of couplings (2) for hydraulic pump 99305446
99321024		Hydraulic truck to remove and fit back the wheels
99322215		Overhauling stand
99347047		Puller for king pin

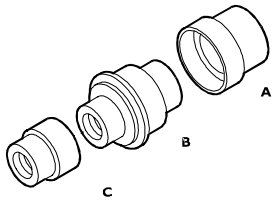
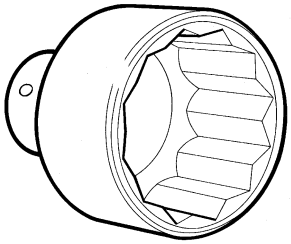
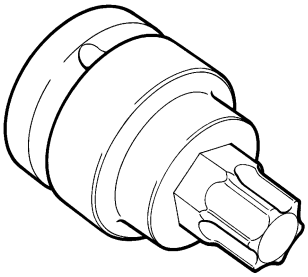
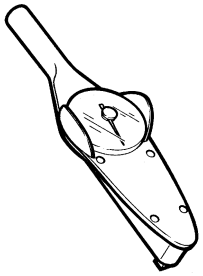
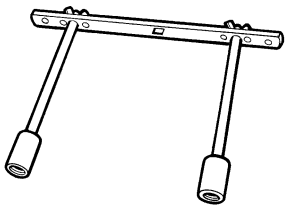
TOOLS

TOOL NO.		DESCRIPTION
99347068		Puller for steering rod ball joints
99354207		Wrench for wheel hub cap
99366918		Equipment for hydraulic accumulator check and charging
99370006		Handle for interchangeable beaters
99370007		Handle for interchangeable beaters
99370317		Reaction lever with extension to retain flanges

TOOLS

TOOL NO.		DESCRIPTION
99370628		Stand for axle removal and installation
99370715		Guide for fitting wheel hub
99374093		Beater to fit back bearing outer races (to be used with 99370007)
99374132		Installer to fit back wheel hub internal gasket (to be used with 99370006)
99374173		Elements to fit kingpin gasket (to be used with 9937007)
99374405		Tool to fit kingpin

TOOLS

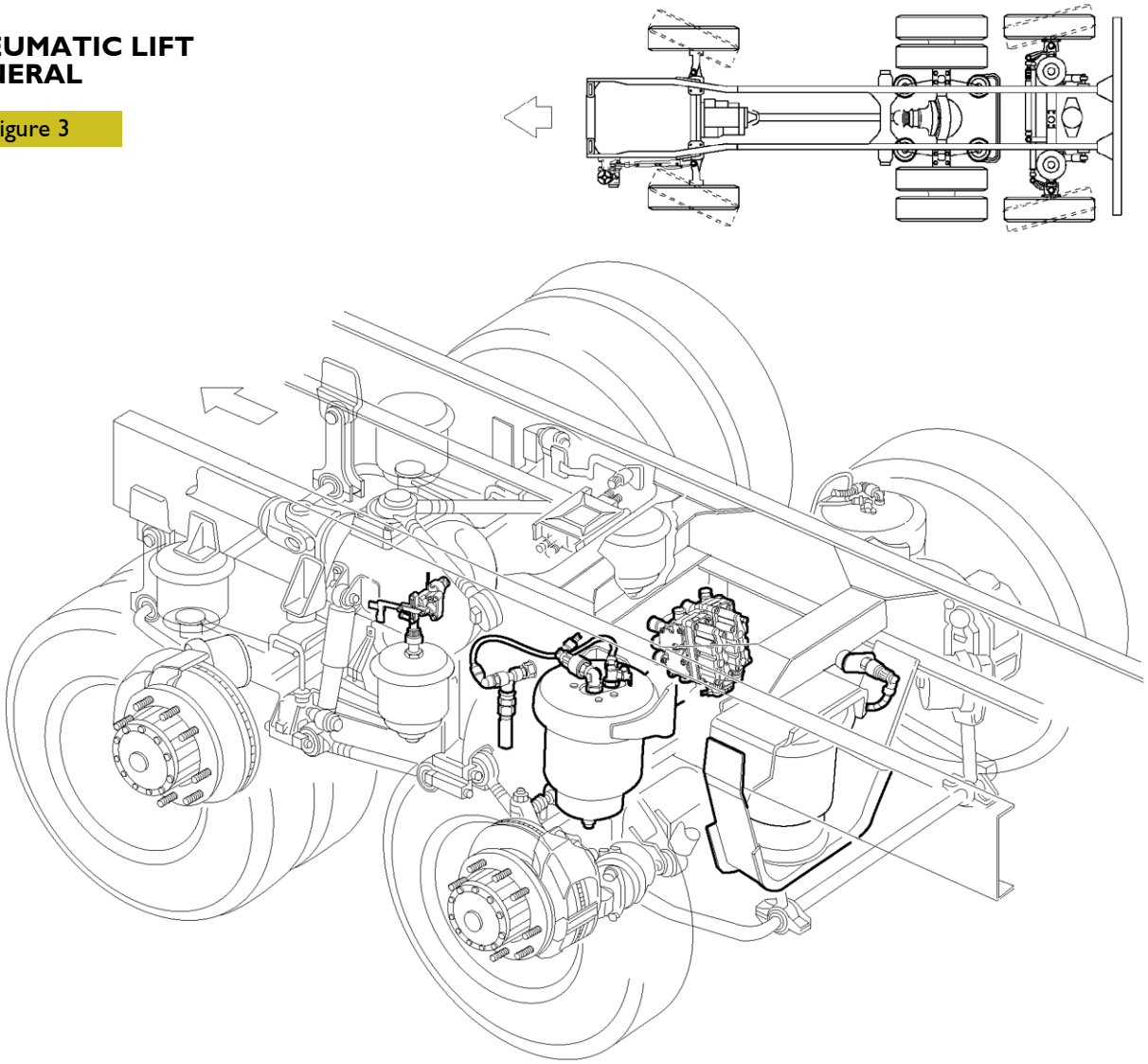
TOOL NO.		DESCRIPTION
99374530		Drift to remove and refit kingpin bearings (use with 99370007)
99388001		Wrench (80 mm) for wheel hub bearing adjustment ring nut
99388002		Wrench for screws fastening the track rod arm and the drag link arm to the stub axle
99389819		Torque wrench (0-10 Nm) with 1/4" square fitting
99395026		Tool for testing hubs rolling torque (to be used with torque wrench)

REPAIRS

Keep to the procedure described in the chapter AXLE 55080/D as for wheel hub overhauling.
Adjustment data, tightening torques and tools are the one shown in this chapter.

PNEUMATIC LIFT GENERAL

Figure 3



73040

This system enables the driver to lift the additional axle when the vehicle operating conditions require it and to move the load to the driving axle during pickup in condition of poor grip of the vehicle (assistance during pickup).

All the above operations, however, are bound to specific conditions of operation and relevant system safety connected to it.

Lifting, lowering and assistance during pickup are controlled from a button strip in the cabin, located on the central dashboard.

Axle lifting prevents tire sliding on ground, during vehicle manoueuvres.

The device for assistance during pickup allows to totally or partially transfer the load o the additional axle to the driving axle so that, in the above describe grip conditions and in compliance with local laws, friction on the ground is increased.

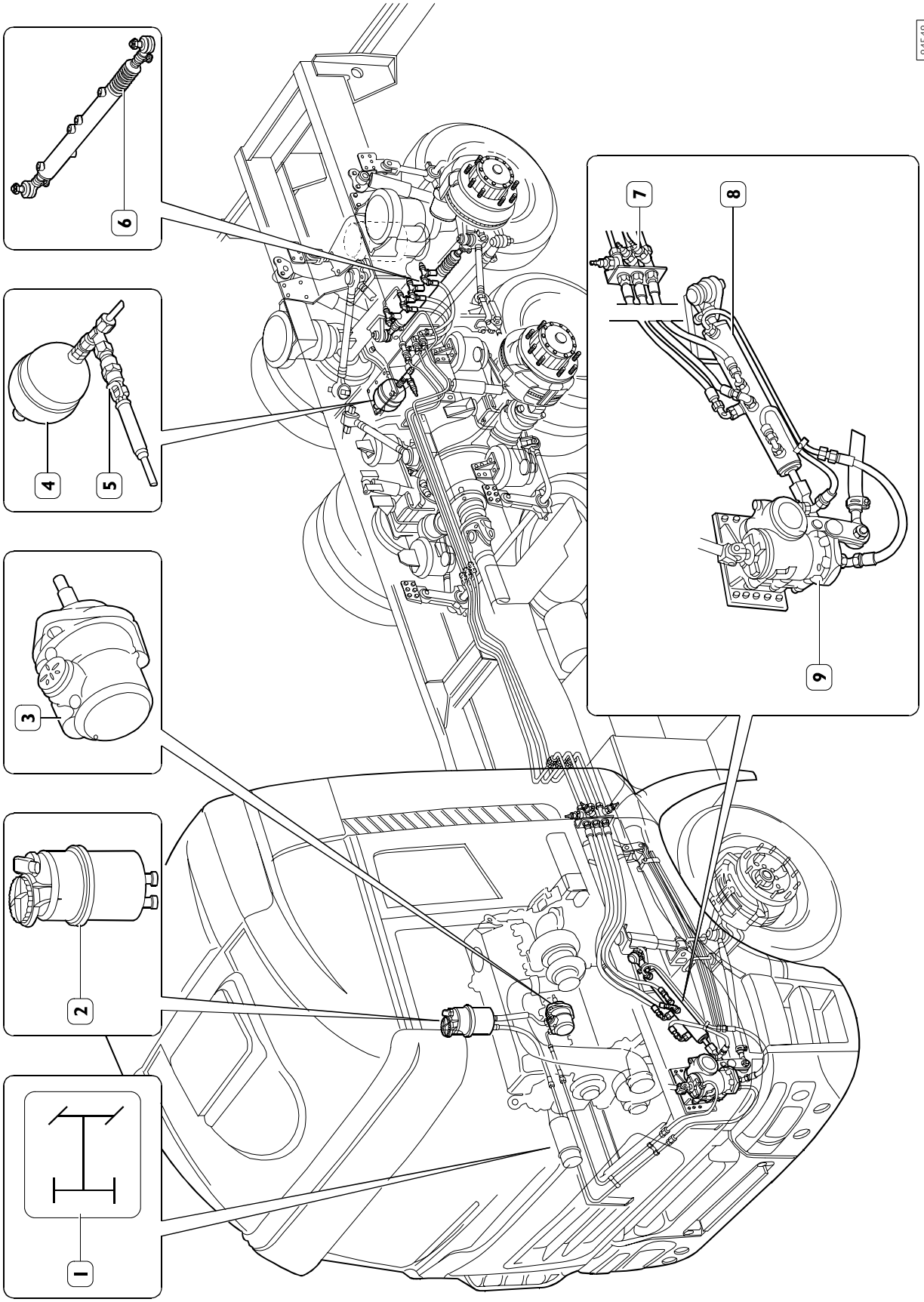
The functions of lifting and aid in the pickup phase can be performed at speeds under 30 km/h with a load on the driving axle of under 11.5 tonnes, otherwise the system will automatically lower the added axle.

In order to ensure a greater safety during straight running, rear axle steering starts when the wheels of the front axle have exceeded a steering angle of 5° only.

The transmission of steering power from the front axle to the additional rear axle is hydrostatic, thanks to a slave cylinder fitted on the front and to a centring cylinder fitted on the additional rear axle. A hydraulic accumulator stores and keeps the oil in the system, depending on the centring cylinder movements, without volume losses.

LOCATION ON THE VEHICLE OF THE MAIN COMPONENTS OF THE HYDRAULIC SYSTEM

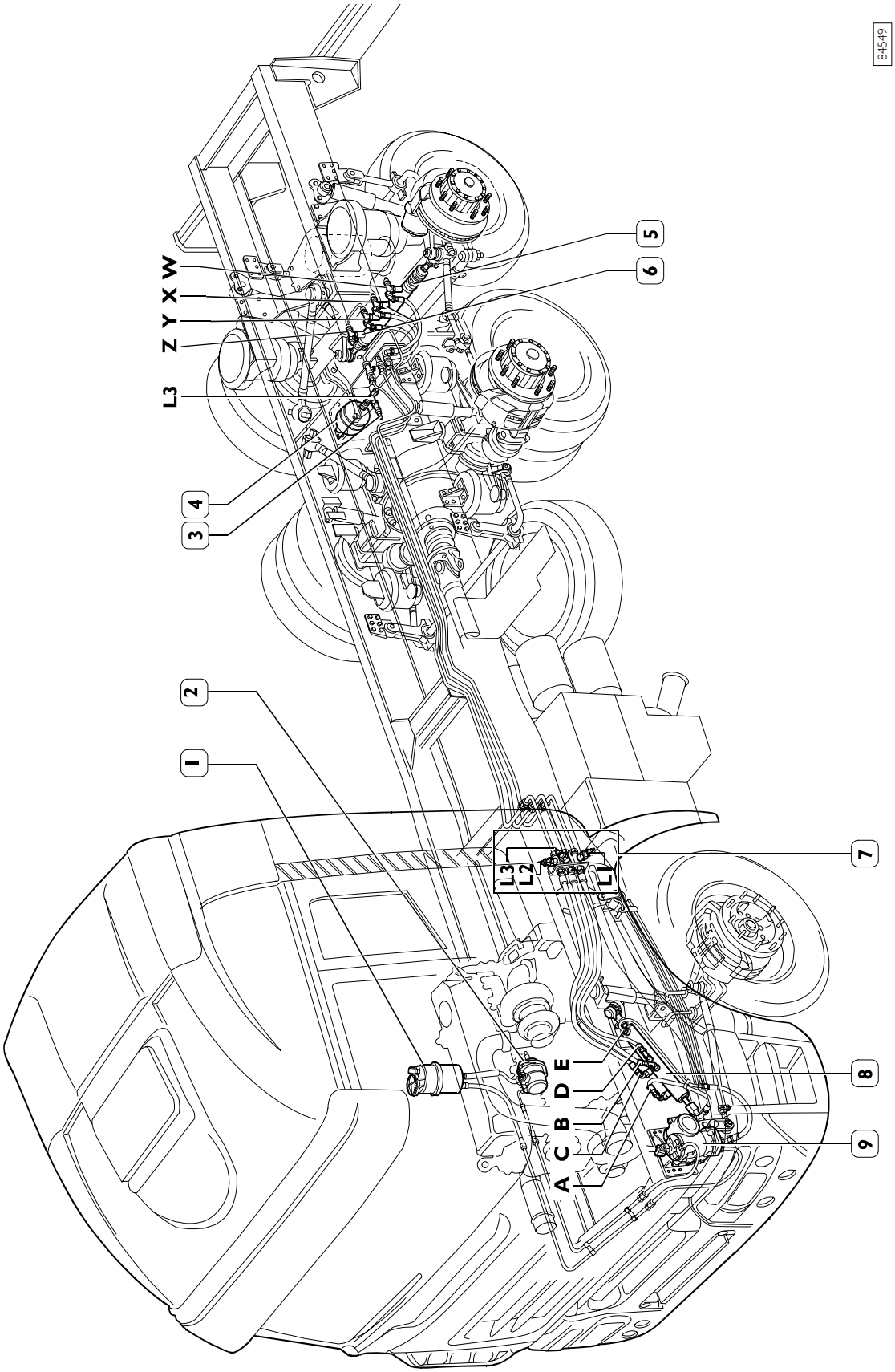
Figure 4



1. Lamp - 2. Oil tank - 3. Oil pump - 4. Hydraulic accumulator - 5. Pressure gauge - 6. Centring cylinder - 7. Pressure control intakes - 8. Slave cylinder - 9. Power steering system

HYDRAULIC SYSTEM

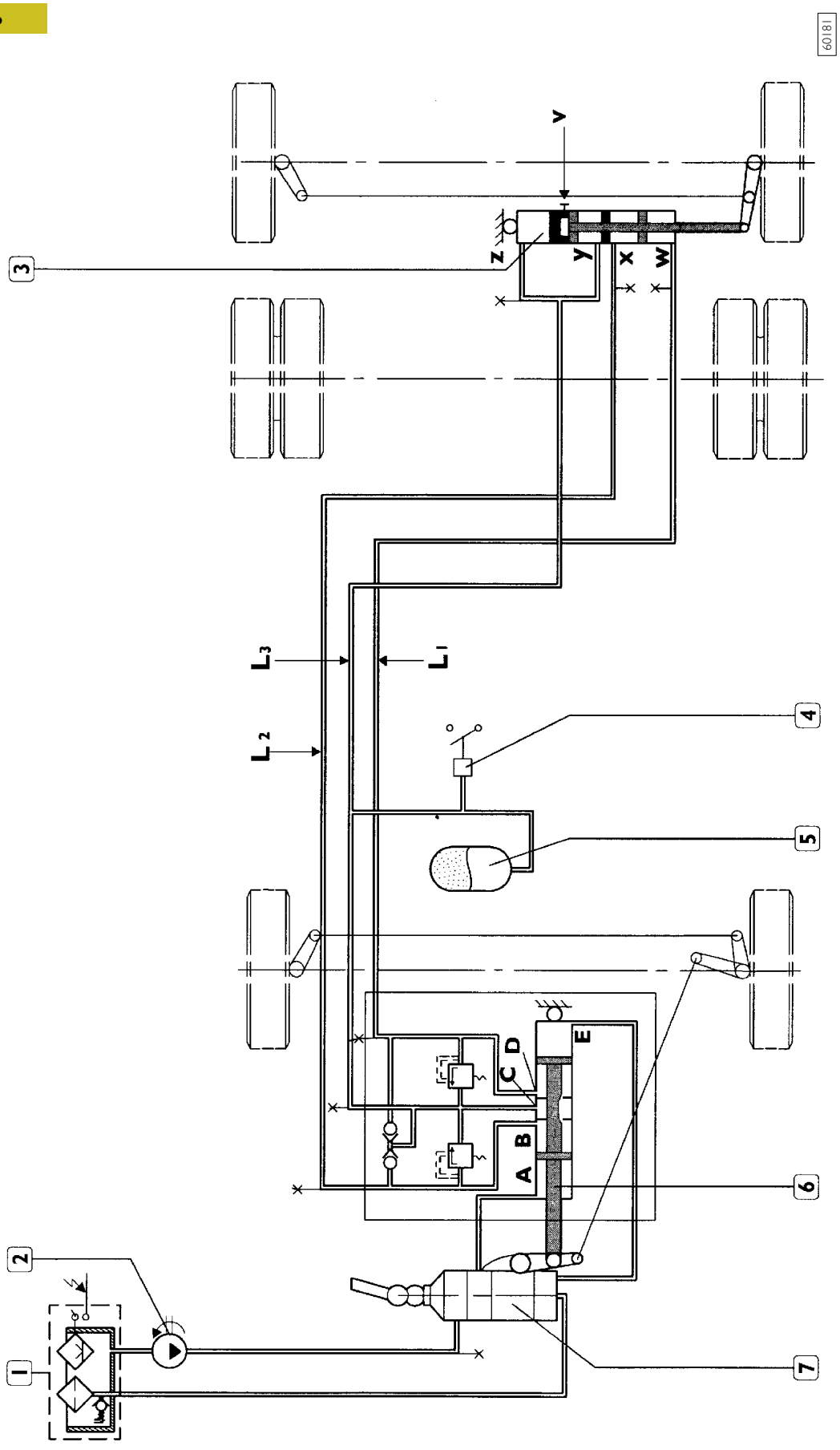
Figure 5 (Illustrative)



1. Oil tank with low oil level switch - 2. Hydraulic pump - 3. Pressure gauge - 4. Hydraulic accumulator - 5. Centring cylinder - 6. Pressure control intakes - 7. Pressure control intakes - 8. Slave cylinder - 9. Power steering system

HYDRAULIC SYSTEM WORKING DIAGRAM

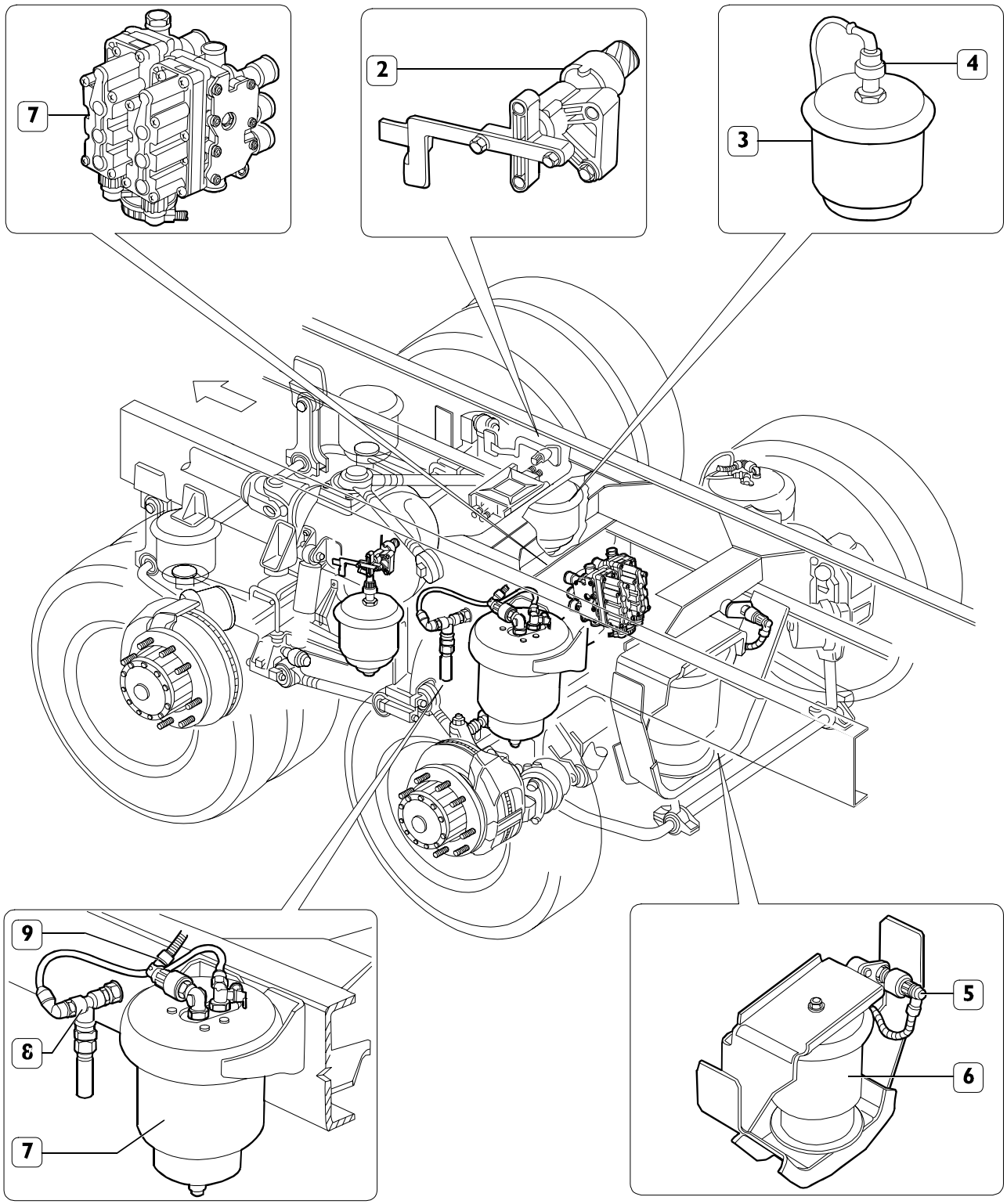
Figure 6



1. Oil tank with low oil level switch - 2. Hydraulic pump - 3. Centring cylinder - 4. Pressure gauge (2 bar) - 5. Hydraulic accumulator - 6. Slave cylinder - 7. Power steering system - V. Cap

VEHICLES WITH PNEUMATIC REAR SUSPENSIONS AND PNEUMATIC LIFTING
Location on the vehicle of the main components

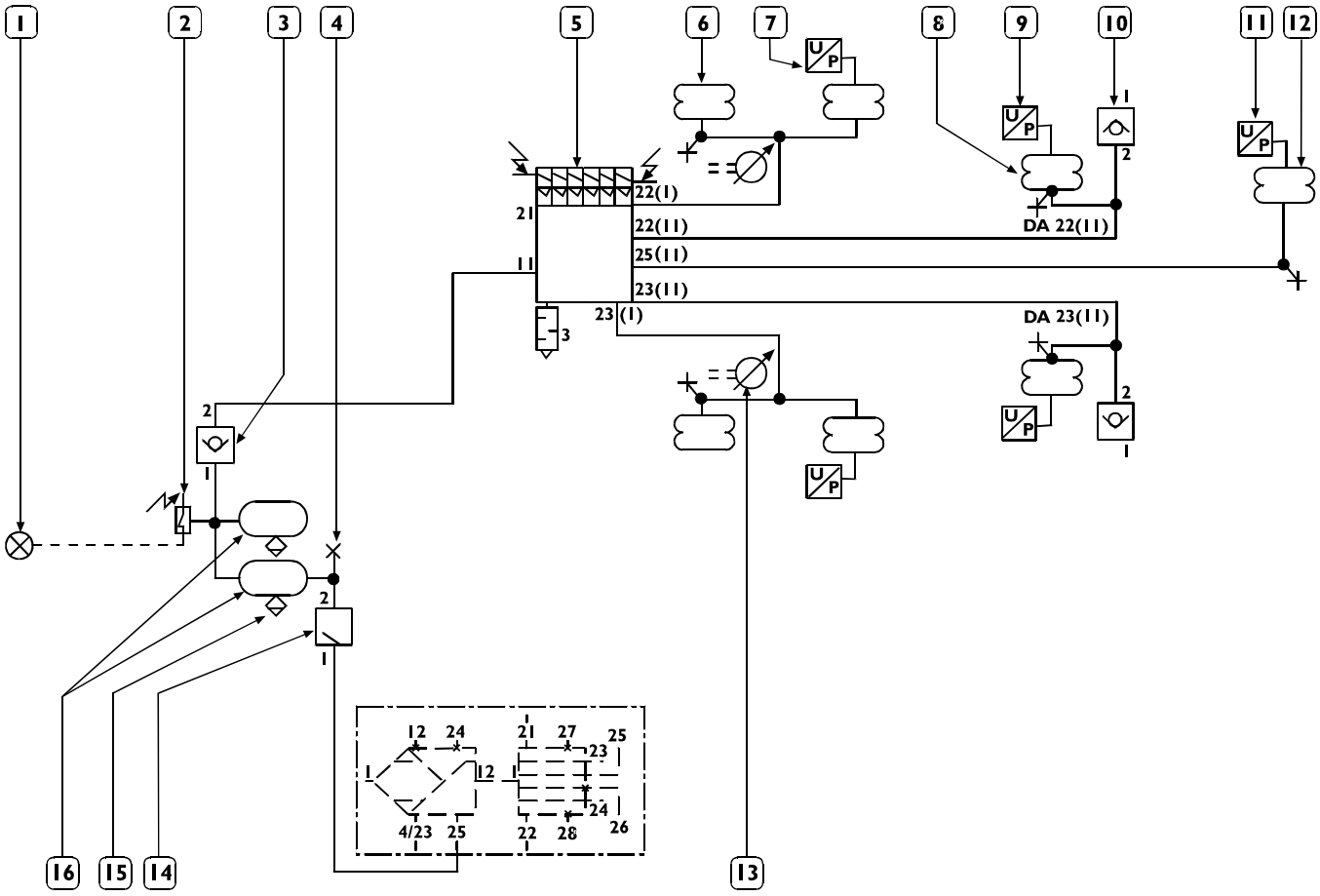
Figure 7



1. Electropneumatic distributor - 2. Level sensor - 3. Rear axle air spring - 4. Pressure sensor - 5. Sensor pressure - 6. Air spring for additional axle lifting - 7. Additional axle air spring - 8. Check valve - 9. Pressure sensor

Pneumatic principle scheme, rear pneumatic suspensions and pneumatic lifting device for rear added axle with single wheels

Figure 8



1. Light indicator (air spring suspension low pressure) - 2. Pressure gauge (opening pressure 8 bar) - 3. Check valve - 4. Pressure control intake - 5. Axle electropneumatic distributor - 6. Rear axle air spring - 7. Axle suspension pressure gauge - 8. Air spring for additional rear axle - 9. Pressure gauge for additional rear axle suspension - 10. Check valve* - 11. Pressure gauge for additional rear axle lift - 12. Air spring for additional rear axle lift - 13. Level sensor - 14. Controlled pressure valve - 15. Manual condense bleeder - 16. 30 litres air tank

* Both must be fitted on the vehicle with connection 1 downward.

DIAGNOSTICS
Main operating faults of a mechanical nature

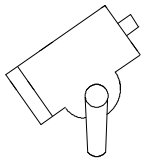
Visible Failure	Possible cause	Repair action
Partial or total reduction of the third axle steering	Inefficient operation of mechanical components (Visual inspection).	Overhaul or replace worn or damaged mechanical components.
	Leakage or breaking in the hydraulic system piping.	Close or replace loosened or damaged connections. Replace broken or damaged pipes.
	Oil leakage inside the rear cylinder.	Replace the cylinder.
	Oil leakage inside the front cylinder.	Replace the cylinder.
Total or partial lack of realignment of the third axle	Air in the hydraulic system.	Bleed and refill the system.
	System oil low pressure.	Refill the system.
	Low nitrogen pressure in the hydraulic accumulator.	Refill nitrogen.
	Steering centre an cylinder positioning adjustment incorrect.	Adjust where necessary.
	Oil leakage inside the rear cylinder.	Replace the cylinder.
	Oil leakage inside the front cylinder.	Replace the cylinder.
Irregular wear of the third axle tyres	Third axle wheel balancing incorrect.	Balance wheels.
Power steering system oil lamp lighted	Third axle circuit oil low pressure.	Refill the system.
	Transmitter irregular operation.	Check wiring and replace transmitter if necessary.
	Oil leakage inside the rear cylinder.	Replace the cylinder.
Third axle hydraulic system low oil pressure lamp lighted	Third axle circuit oil low pressure.	Refill the system.
	Pressure gauge irregular operation.	Check wiring and replace the pressure gauge if necessary.
	Oil leakage inside the rear cylinder.	Replace the rear cylinder.
Third axle hydraulic system low oil pressure lamp off in presence of fault	Lamp burnt (Check with "lamp test").	Replace the lamp.
	Transmitter irregular operation.	Replace the transmitter.
	Wiring irregular operation.	Check wiring and replace faulty components.

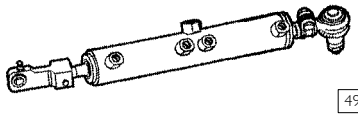
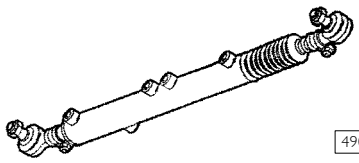
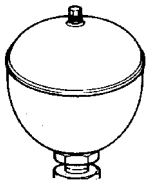
Visible Failure	Possible cause	Repair action
The third axle does not lift or lower or does not assist at pickup	Leakage or breaking in the hydraulic system piping.	Close or replace loosened or damaged connections. Replace broken or damaged pipes.
	Lift air spring damaged.	Replace air spring.
	Fault of mechanical components.	Replace faulty mechanical components.
	Fault on the electric system.	❑ Fault memory reading ❑ Pressure sensor parameter reading ❑ Check the wiring ❑ Replace faulty components

TIGHTENING TORQUES (Steering and lifting device linkage)

PART	TORQUE	
	Nm	(kgm)
Nut fastening slave cylinder and centring cylinder ball joint	300	(30)
Steering linkage castellated nut	250	(25)
Nut for screw fastening air spring	92 ± 9	(9.2 ± 0.9)
Nut fastening spring supporting sheet to chassis	146.5 ± 14.5	(14.7 ± 1.5)
Nut for screw fastening rear axle support	92 ± 9	(9.2 ± 0.9)
Nut for screw fastening plate to support	92 ± 9	(9.2 ± 0.9)

CHARACTERISTICS AND DATA
Steering and third axle hydraulic system

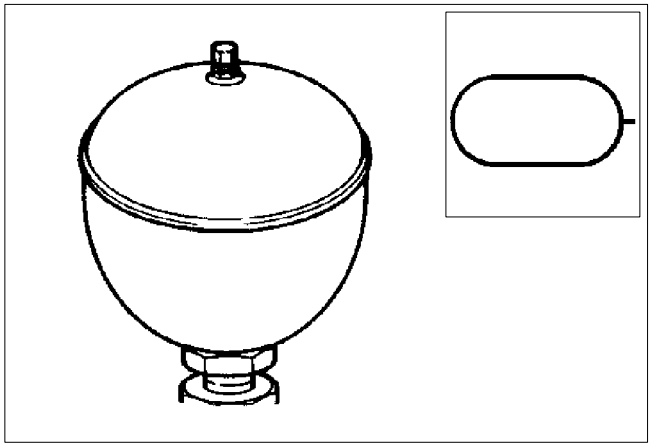
Power steering system 	Ball-circulation ZF 8098 with built-in pressure relief valve	
	Operating pressure variable	150 + 15 bar
	Reduction ratio variable — steering centre	22.2:1
	Reduction ratio variable — maximum steering	26.2:1
Power steering pump 	Type	ZF8696955107
	Minimum no. of revolutions rpm	~ 500
	Maximum no. of revolutions rpm	~ 3500
	Maximum pressure (without pressure relief valve) bar	165
	Delivery (controlled) dm^3/min	20

Slave cylinder  49086	Useful stroke	90 mm
	Length between wheel bases in straight running position	786 mm
Centring cylinder  49086	Useful stroke	180 mm
	Length between wheel bases in straight running position	1000 mm
Hydraulic accumulator  38948	Nitrogen pre-load pressure	8.5 ± 1 bar
Oil Tutela GI/A	Quantity	4 to 5 litres
	Circuit pressure (during straight running)	12 +1 bar

MAIN HYDRAULIC SYSTEM COMPONENTS

501476 HYDRAULIC ACCUMULATOR

Figure 9

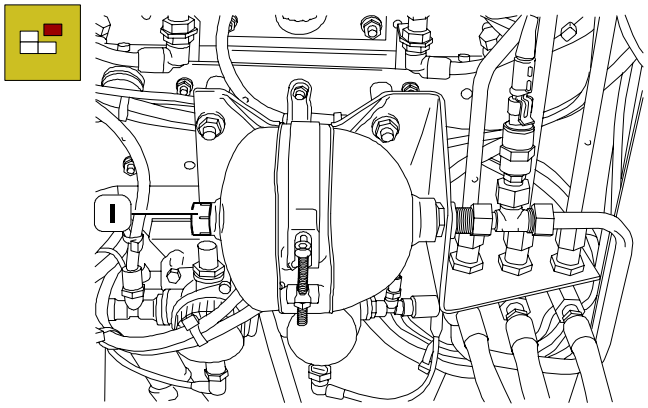


38948

This component supplies the hydraulic pressure necessary to keep the third axle wheels aligned on a straight.

Nitrogen pressure checking and recharging

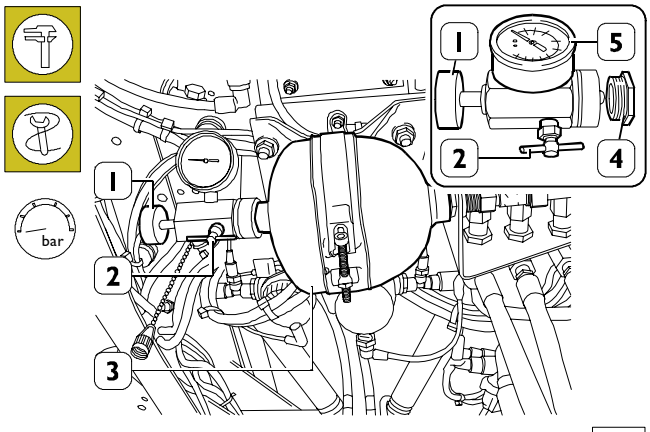
Figure 10



50724

Discharge the oil pressure from the circuit, working as described on page 78, Figure 18.
Remove the protective lid (1).

Figure 11

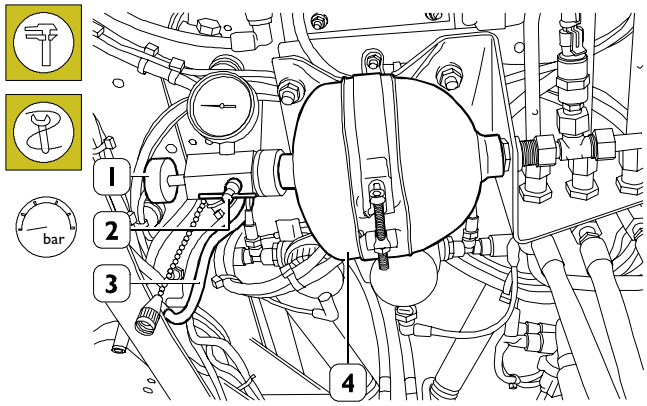


50725

Fit the adapter (4) to tool 99366918 (5). Fit tool (5) complete with adapter (4) onto the accumulator (3).

Make sure that discharge valve (2) is closed.
Open the hydraulic accumulator nitrogen pressure checking and recharge valve (3) by working on the knob (1) and read the pressure on the pressure gauge.
Close the checking and recharge valve.
Discharge the nitrogen pressure from tool (5) by opening valve (2).

Figure 12



50726

If the reading on the pressure gauge is lower than 8.5 bar, connect the tool to the nitrogen cylinder piping (3).

Make sure that the discharge valve (2) is closed, open the checking and recharge valve by working on the knob (1). Open the nitrogen cylinder and charge the hydraulic accumulator (4) up to the required value of 8.5 ±1.

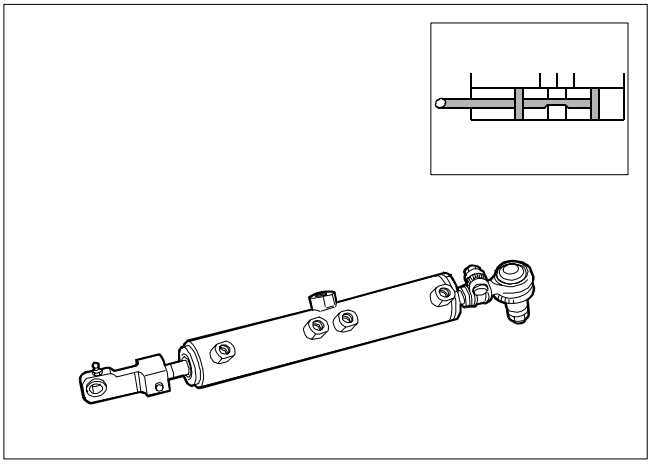
Having charge the accumulator, close the nitrogen cylinder and the checking and recharge valve.

Open the discharge valve (2) to release the nitrogen pressure from the tool.

Finally, disconnect the tool, fit back the plug and the protective lid.

501471 OPERATOR CYLINDER

Figure 13

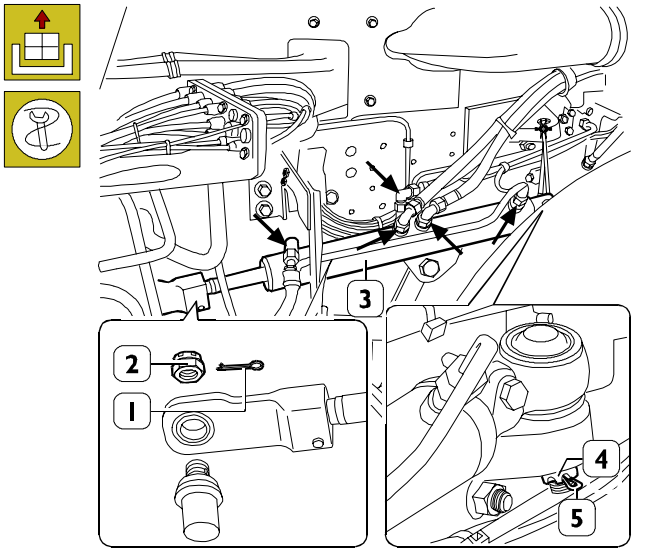


60182

Controls the operation of the centring cylinder as a function of front axle steering.

Disassembly

Figure 14

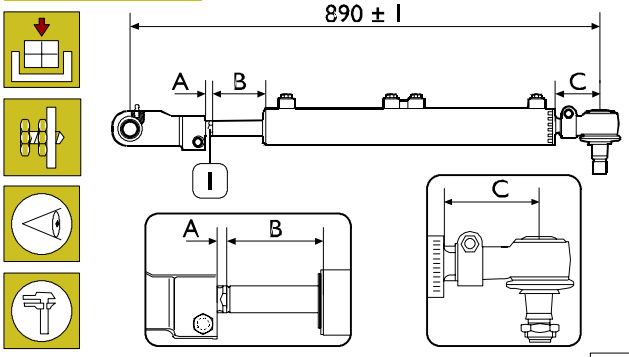


50728

First of all discharge the pressure and then the oil from the third axle control circuit as described on page 78, Figure 18.
Empty out the oil from the front axle circuit by disconnecting the delivery pipe to the power steering system.
Disconnect the pipes (→) from the cylinder (3).
Disconnect the pipes from the ABS solenoid valve.
Remove the cotter pins (1 and 5) the nuts (2 and 4) and take down the cylinder (3).

Assembly

Figure 15



50729

A = 12 to 15 mm
B = 98 mm
C = 82 to 89 mm

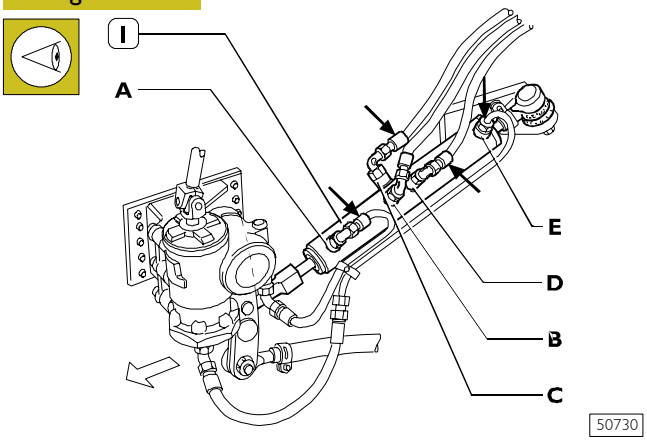
NOTE In recent production vehicles, the length between axle bases is 786 mm under straight ride.

Adjust dimensions A and C on the cylinder.
Fit back the cylinder to the vehicle by reversing the order of the disassembly operations described above.
Recharge and bleed the power steering circuit according to the procedure described on page 81 (circuit 1), with the third axle control circuit discharged and making sure that the measurements given in the figure are respected; if they are not, adjust them.
To change dimensions A and B you can work on the ground part (1) after releasing the retaining screw.
Recharge and bleed the third axle hydraulic control system as described on page 81 (circuit 2).

To ensure flawless system operation, measurement **B** must be absolutely complied with the vehicle in straight travelling conditions.

Checking cylinder oil sealing on the vehicle

Figure 16



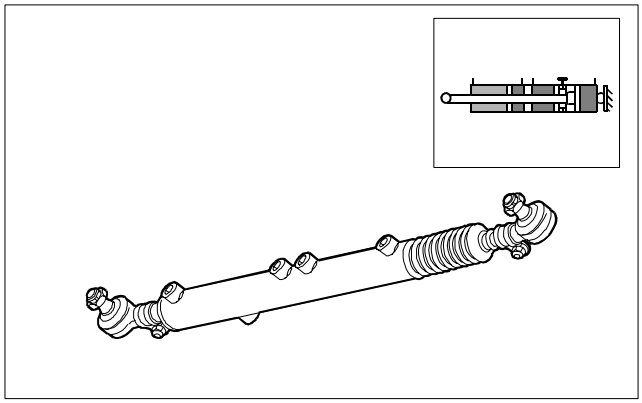
50730

Steer to nearly full lock in one direction. Lock the wheels in this position.
Discharge the hydraulic pressure from the 3rd axle system as described on page 78, Figure 18.
Discharge the oil from the power steering hydraulic system.
Disconnect the pipes (→) from the cylinder (1). Introduce oil into fitting B, on the cylinder, at a pressure of ca 10 bar, and make sure that no oil comes out from fittings A and D.
Introduce oil into fitting D, on the cylinder, at a pressure of ca 10 bar, and make sure that no oil comes out from fittings E, C and B (4).
Having completed these checks, restore travelling conditions and recharge and bleed the hydraulic system as described on page 80.

NOTE The letters appearing in the figure are stamped on the cylinder.

501475 CENTRING CYLINDER

Figure 17

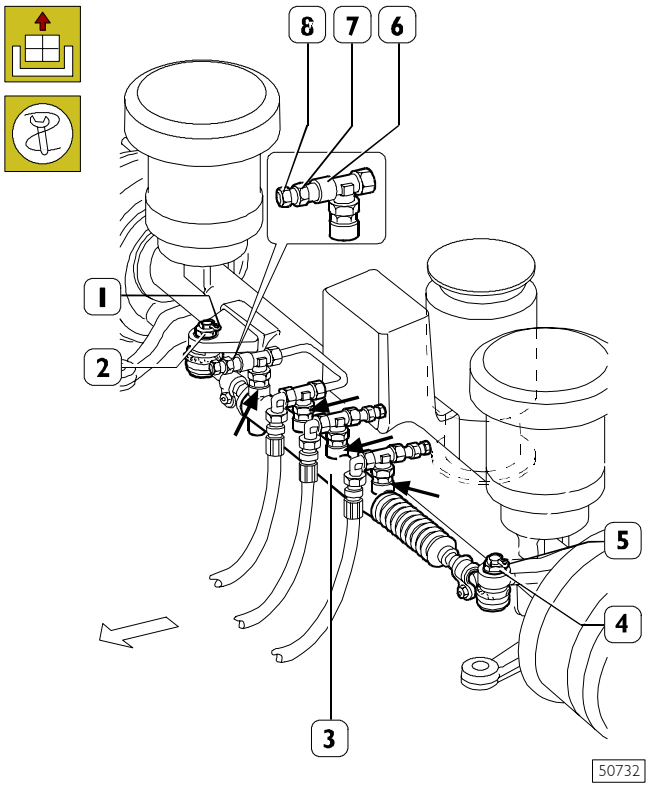


50731

Controls third axle steering as a function of vehicle travelling conditions and front axle steering.

Disassembly

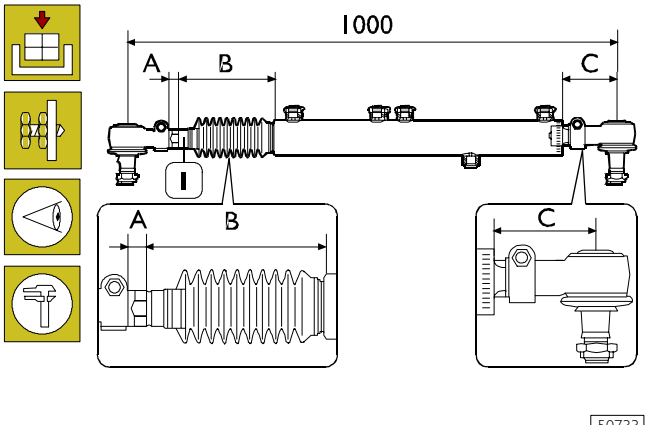
Figure 18



Remove the plug (8).
Connect a pipe to fitting (6) as shown in Figure 22; discharge the hydraulic pressure by working on fitting (7).
Disconnect the pipes (→) from the cylinder (3) and empty out the oil.
Remove the cotter pins (1 and 5) the nuts (2 and 4) and take down the cylinder (3).

Assembly

Figure 19



A = 16 to 22 mm
B = 186 mm
C = 102 to 109 mm

Adjust dimensions A and C on the cylinder.
Fit back the cylinder to the vehicle by reversing the order of the disassembly operations described above.
Arrange the vehicle in straight travelling position and make sure that the measurements given in the figure are respected; if they are not, adjust them.
To change dimensions A and B you can work on the ground part (1) after releasing the retaining screw.

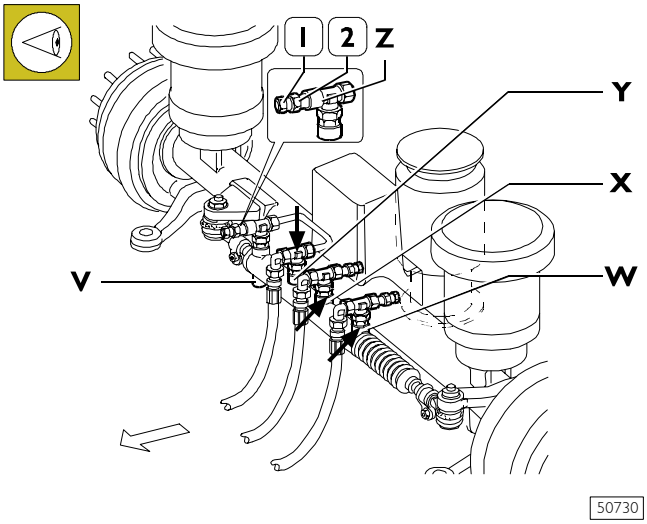
To ensure flawless system operation, measurement **B** must be absolutely complied with the vehicle in straight travelling conditions.

Recharge and bleed the third axle hydraulic control system as described on page 80.

Do the wheel geometry as described under the relevant heading.

Checking cylinder oil sealing on the vehicle

Figure 20



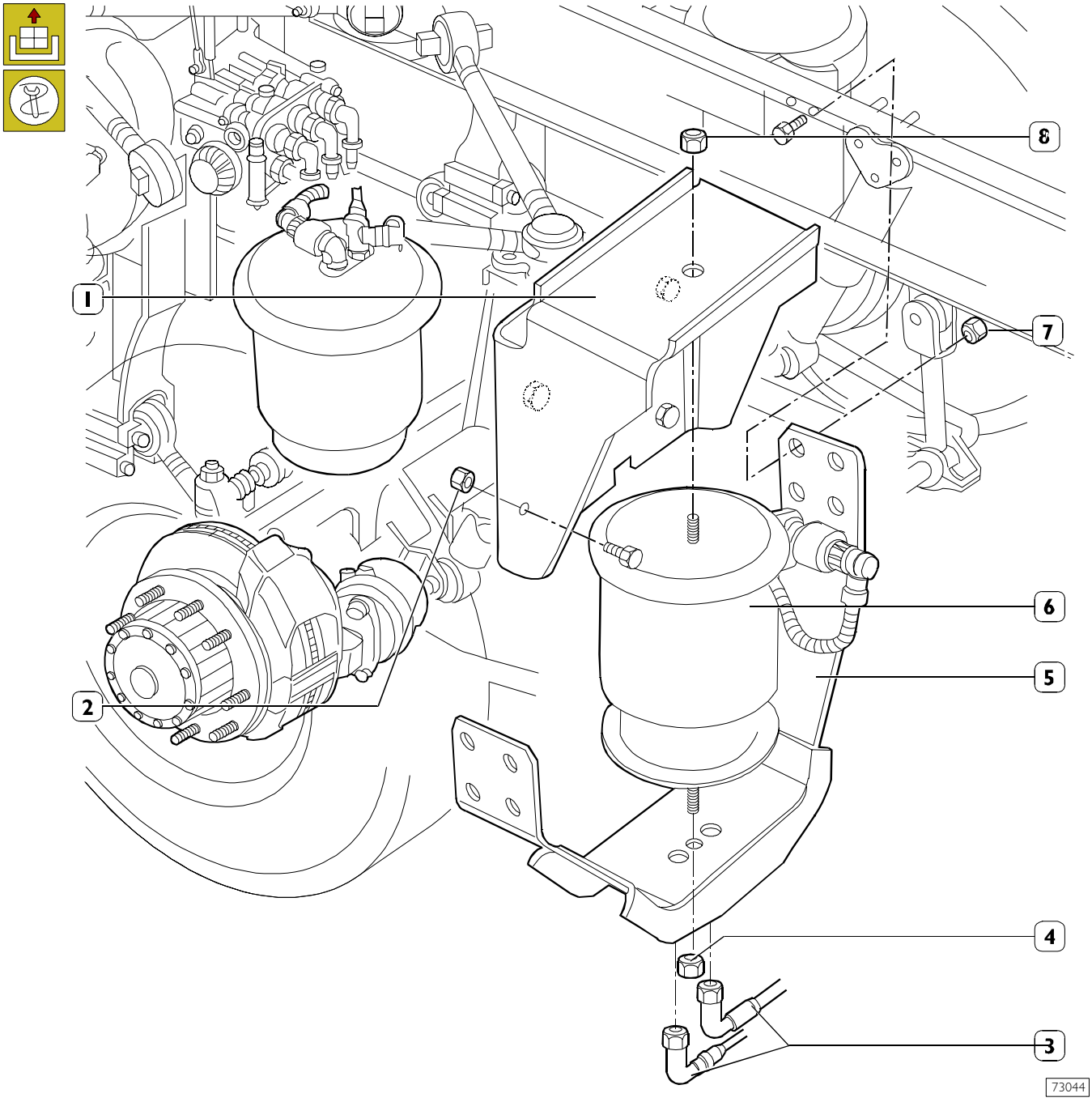
Arrange the vehicle in straight travelling conditions and lock the 3rd axle wheels in this position.
Open plug V and make sure no oil comes out.
Remove the plug (1)
Connect a pipe to fitting (Z) as shown in Figure 22, discharge the hydraulic pressure by means of fitting (2).
Disconnect the pipes (→).
Introduce oil into fitting X, on the cylinder, at a pressure of ca 10 bar, and make sure that no oil comes out from fittings Y and W.
Having completed these checks, restore travelling conditions and recharge and bleed the hydraulic system as described on page 76.

NOTE The letters appearing in the figure are stamped on the cylinder.

ADDITIONAL AXLE PNEUMATIC LIFTING DEVICE REMOVAL AND REFITTING

Removal

Figure 21



NOTE The operations described below have been carried out on a vehicle fitted with additional steering rear axle, but also apply to vehicles with single and twin wheel additional non-steering axle.

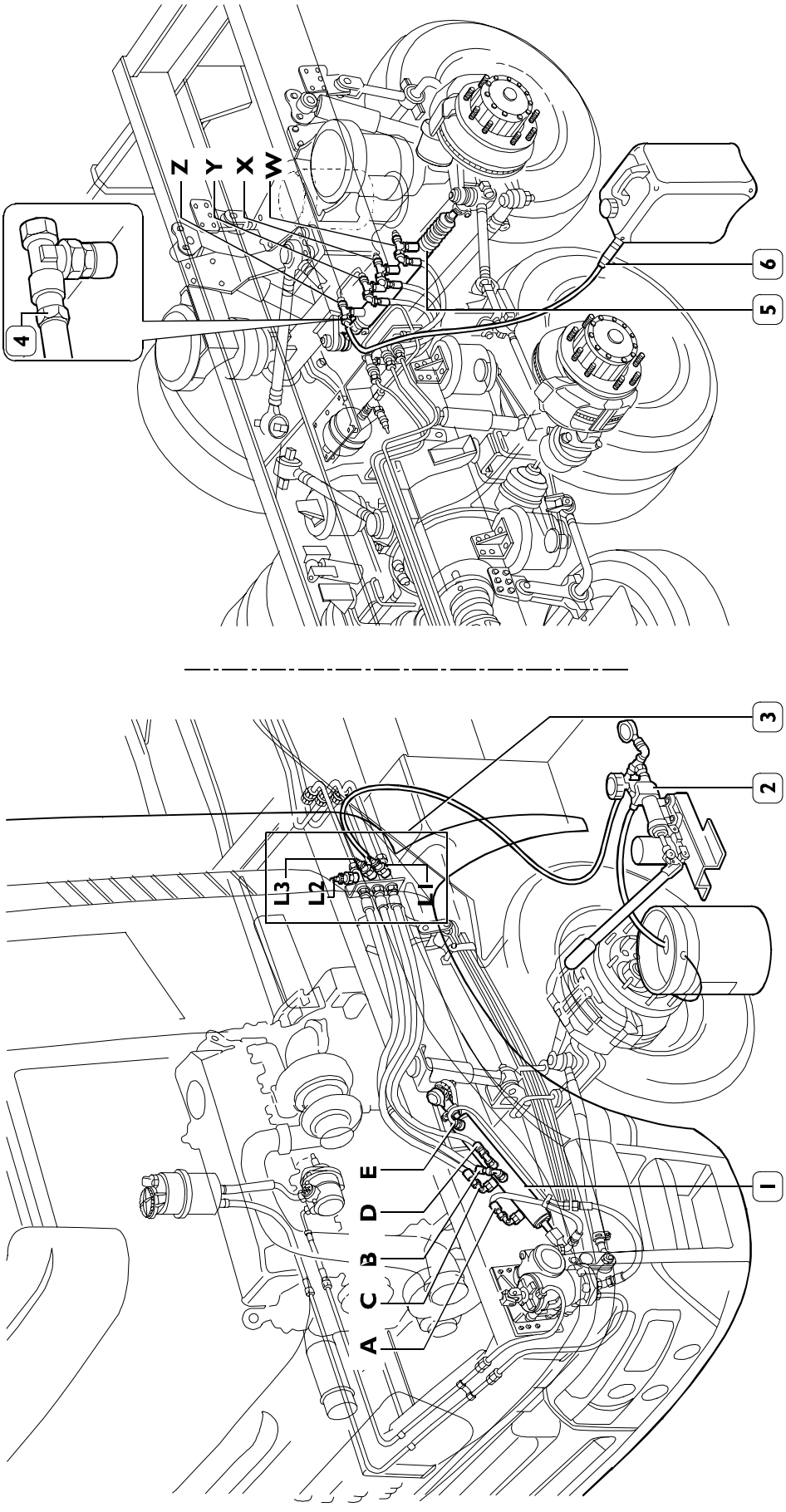
Position the vehicle on an even surface.
Lift the vehicle from the rear and position two supporting stands under the chassis.
Discharge air pressure and disconnect air spring feeding piping (3).
Remove the nuts (4 and 8) and the air spring (6).
Remove the nuts (7) and the supporting sheet (5).
Remove the nuts (2) and the support (1).

Refitting

Carry out the operations described for removal in the reverse order to refit and comply with prescribed tightening torques.

5014 AIR BLEEDING FROM THE HYDRAULIC CIRCUIT

Figure 22



501430 Filling up and bleeding the power steering hydraulic circuit (circuit 1)

Bleed the air from the power steering circuit, working as follows:

- ❑ fill up the circuit tank with the required oil type;
- ❑ rotate the engine with the starter motor and top up with oil continuously, to prevent the pump from taking in air;
- ❑ top up the oil until the level is not below the upper mark of the dipstick;
- ❑ start the engine and have it run at idling speed while checking that the oil does not drop below the upper mark of the dipstick;
- ❑ rotate the steering wheel several times from the lock to lock so as enable the air to come out from the power steering cylinder, until no air bubbles can be seen in the oil flowing into the tank;
- ❑ accelerate the engine as much as possible, stop it and make sure that the oil level in the reservoir does not rise by more than 1 to 3 cm.

501475 Filling up and bleeding the power steering hydraulic circuit (circuit 2)

Set the vehicle in steering centre position. Take down the ABS valve and the operator cylinder (1) from the frame and hang up the cylinder vertically.
Connect hydraulic pump 99305446 (2, Figure 22) by means of fittings 99305450 to line L_3 as shown in Figure 22; connect a pipe (6, Figure 22) to fitting z (L_3) on the centring cylinder (5) and introduce it into a special container.
By means of hydraulic pump (2) introduce oil into the system up to a pressure of ca 20 bar.
Open the bleeder valve (4) and empty out the oil mixed with air while keeping the pressure at ca 15 bar.
Let the oil flow out until you can seen there is no air left.
Repeat this step on fittings X and W of the centring cylinder (5).
Repeat the same step on the control taps (3, Figure 22) with the following bleeding order: L_1 - L_2. connecting the bleeding piping to the pressure intakes by means of one of 99305450 unions. set the system to 12 + 1 bar and fit back the slave cylinder (1, Figure 22) and the ABS valve.

Wheel geometry

GENERAL INFORMATION

Steering wheel angles

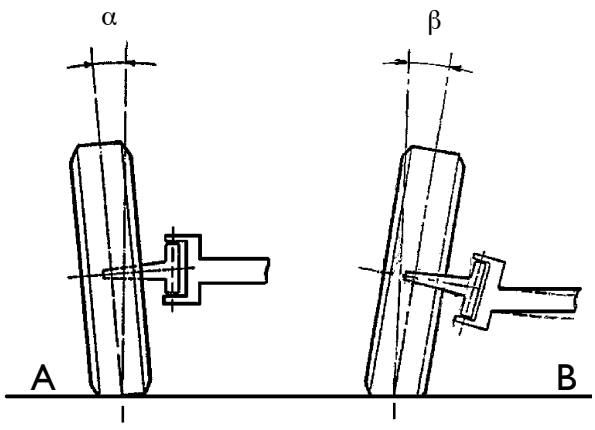
To ensure satisfactory road holding performance, low tyre wear and to allow driving wheels in the steering stage to return spontaneously to straight ahead running position, front wheels are given the following fitting angles:

- camber;
- kingpin angle;
- caster;
- toe-in.

These angles, suitably calculated, produce the right balance of the forces created when the vehicle is moving, in different load conditions, which tend to alter the position of the wheels on the ground.

Figure 1

Camber

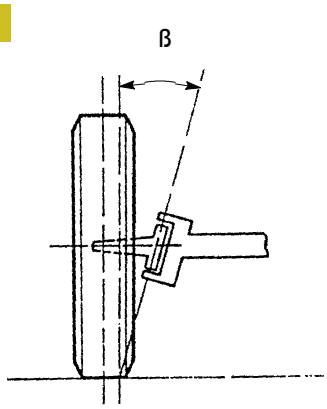


32956

The camber (α) is the angle formed by the axis passing through the centre line of the wheel and the vertical to the ground when observing the vehicle from the front.
The angle is positive (A) when the top of the wheel tilts outwards, negative (B) when the top of the wheel tilts inwards.

Kingpin angle

Figure 2

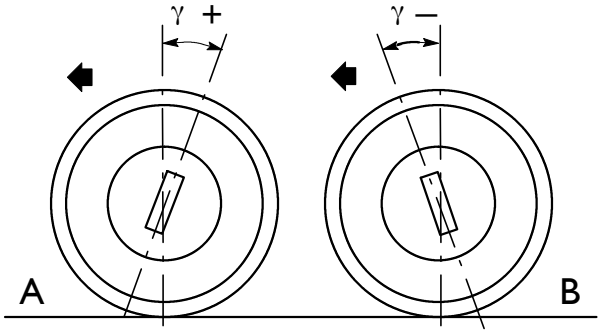


32957

The kingpin angle (ß) is the angle formed by the axis passing through the kingpin and the vertical to the ground when observing the vehicle from the front.
When the extension of the kingpin axis approaches the wheel at its point of contact with the ground (opposite to the camber), the angle is positive; it is extremely difficult, if not impossible, to have a negative kingpin angle.
The camber (α) and kingpin angle (ß) make it possible for the axes of the wheel and kingpin to come as close as possible to the centre of support of the tyre on the ground.
This produces low tyre consumption and a low steering torque.

Caster

Figure 3

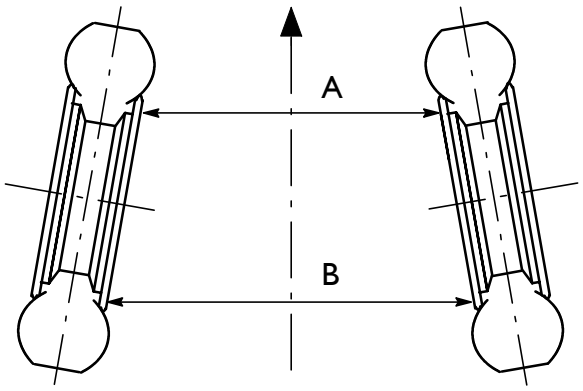


32958

The caster (γ) is the angle formed by the kingpin axis with the vertical to the ground when observing the vehicle from the side.
If the extension of the kingpin axis falls forwards to the point where the wheel rests on the ground, in the direction of travel of the vehicle, the caster is by convention positive (A); it is negative (B) if it falls behind the point where the wheels rest on the ground, and zero if it is exactly vertical to the point where the wheels rest on the ground.
This angle makes it possible to keep the front wheels straight when the vehicle is travelling in a straight line and for them to return straight on their own after the position they take in a bend as soon as the driver lets go of the steering wheel.

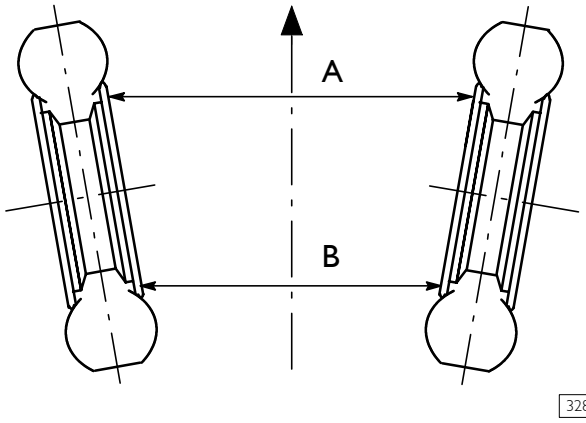
Wheel toe-in

Figure 4



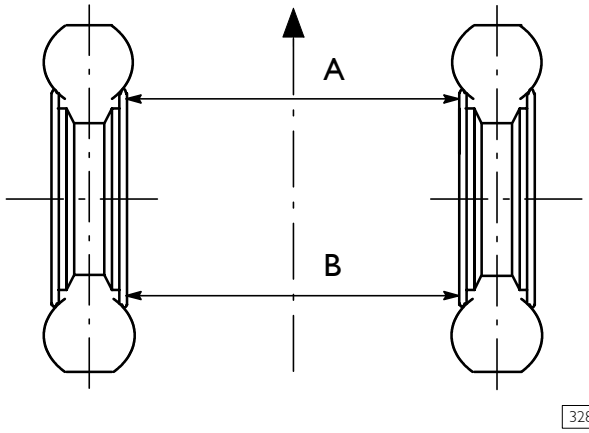
The toe-in is the result of the difference between the distances A and B (in mm) measured on the horizontal axis of the rims, when observing the vehicle from above.
This produces light driving and low tyre consumption.
Toe-in is positive if B is greater than A.

Figure 5



Toe-in is negative if B is less than A.

Figure 6



Toe-in will be zero if B is equal to A.

FRONT WHEEL GEOMETRY (4X2 vehicles)

Before moving on to the checks, it is necessary to make a preliminary inspection of some parts of the vehicle that may affect wheel geometry. If any trouble is found, it will have to be rectified in order to avoid incorrect measurements. The checks to make are the following:

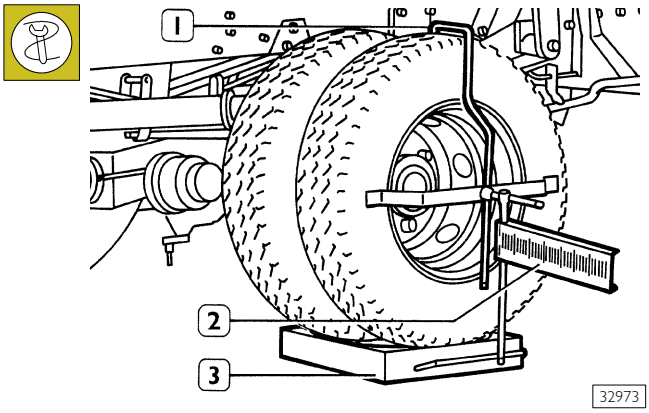
- ❑ tyre pressure;
- ❑ wheel hub bearing clearance;
- ❑ clearance between steering tie-rod pins and levers on stub axles;
- ❑ efficiency of shock absorbers;
- ❑ wheel rims, which must have no buckling out of tolerance.

Check the wheel geometry with the instrument 99305354.

NOTE The checks and any work on the wheel geometry must be done with the vehicle with a static load. Periodically make sure the light clusters are set correctly.

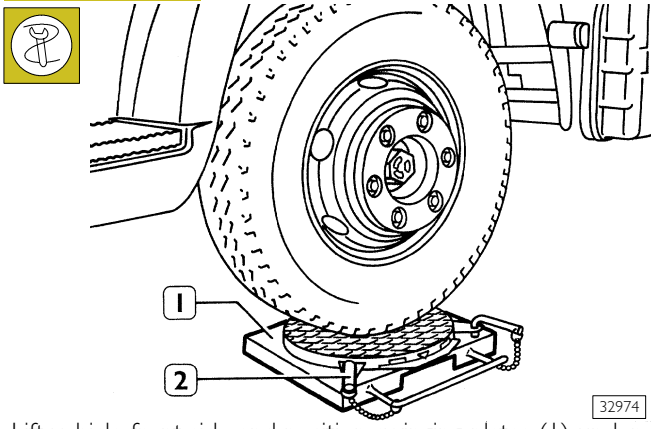
Positioning clips and headlights

Figure 7



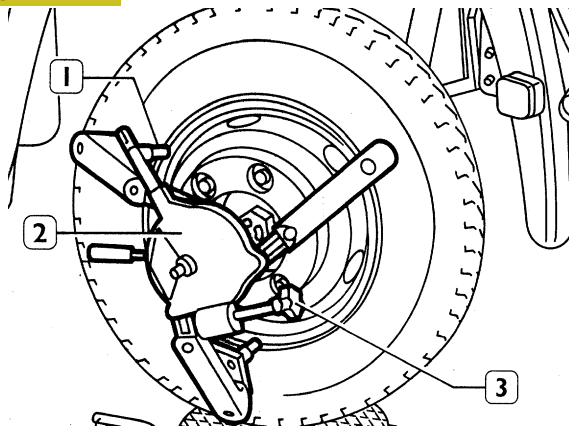
Set the vehicle with its wheels in the position of straight-line travel on a flat surface. Lift the rear of the vehicle and place the boards (3) under the wheels. Lower the vehicle, brake the rear wheels and fit on the hook (1) with the rule (2).

Figure 8



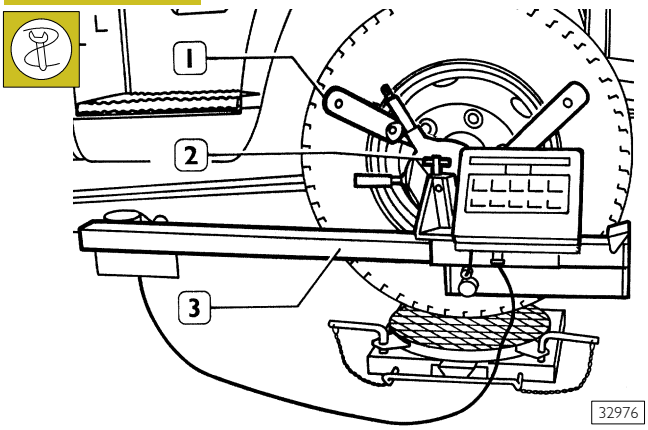
Lift vehicle front side and position swinging plates (1) under the wheels, clamping the plates by special retainers (2).

Figure 9



Position the self-centring clip (2), fitted with appropriate fixing pins (1), on the rim of the wheel. Using the knob (3), lock the clip on the wheel, checking it is properly anchored.

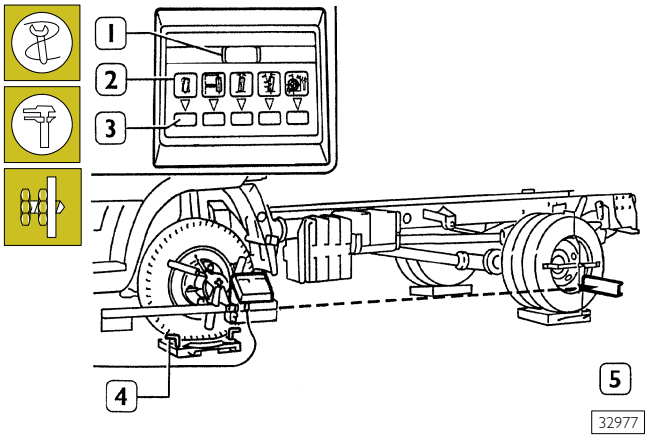
Figure 10



Fit the measuring unit (3) on the clips (1) and fasten it with the screw (2). Repeat these steps on the other wheel.

Electronic compensation of rim eccentricity

Figure 11



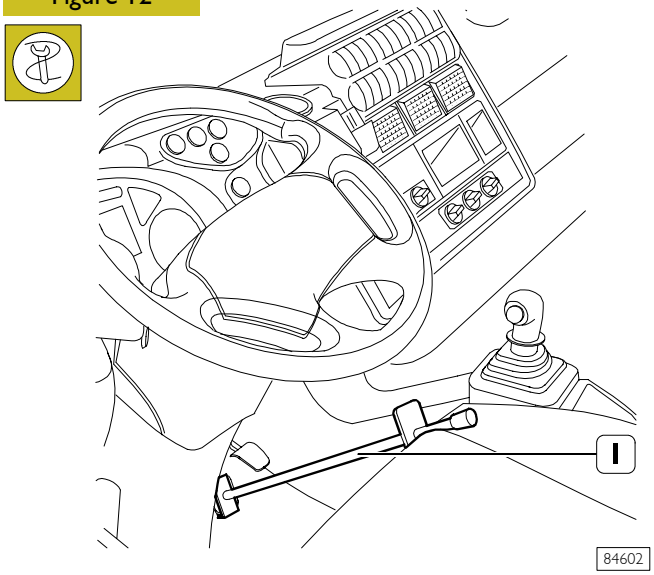
Connect the plugs of the measuring unit to the transformer and turn on the switch. Loosen the locking screw of the measuring unit and lift the lens shield. Press the "off centre" button (3) for at least two seconds, five lines will appear on the display (1).

Turn the wheel slowly by hand and project the light signal onto the corresponding scale of the rule (5).
Measure and note down the minimum and maximum travel of the light signal: e.g., 12 and 8.
Calculate the mean travel: 12+8 = 20:2 = 10 and position the wheel on the mean value calculated, marking its position.
Press the "off centre" button (3) again till the wheel toe-in LED (2) comes on and the digital indicator (1) shows an artificial value.
Repeat these steps on the other wheel.

Take care the laser beam does not hit anyone's eyes: it would severely damage their sight.

Lower the vehicle so that the wheels, in the marked position, rest completely in the middle of the oscillating plates, and free these from their bases, taking out the pins (4).

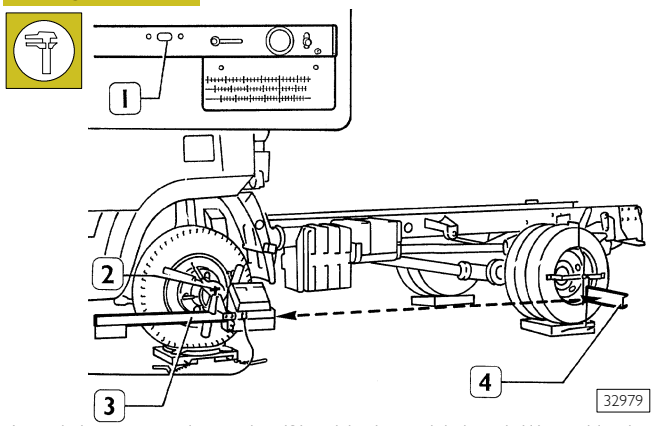
Figure 12



Press the brake pedal and lock it in position with the tool (1) positioned against the seat, thereby keeping the vehicle braked for the entire cycle of measurement.

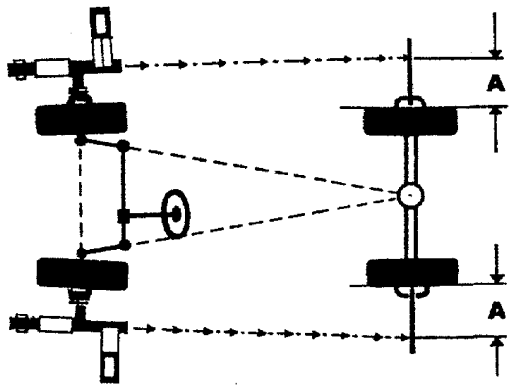
Wheel alignment

Figure 13



Level the measuring units (3) with the spirit level (1) and lock them in position with the screw (2).
Move the rules (4) until they are centred by the light signal emitted by the measuring unit and note down the values given.

Figure 14

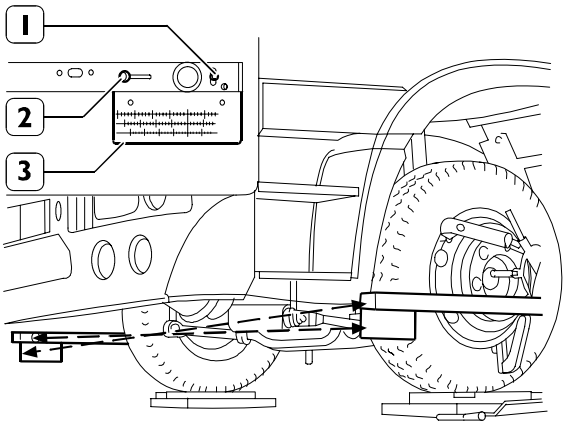


13952

If the values are not the same, turn the wheels until the pointers of the light signals are on two equal values (A), exactly the mean value of the two readings made beforehand. This produces perfect wheel alignment.

Checking wheel toe-in

Figure 15



73038

With the measuring units still level and the wheels perfectly aligned, using the lever (1), move the lens shield.
Using the lever (2), direct the pointer of the light signal onto the millimetre scale of the rule (3) corresponding to the diameter of the rim.
Repeat these steps on the opposite measuring unit and read off the value of the toe-ins given in mm on the millimetre scales.
The algebraic sum of these two measurements must give the required value.

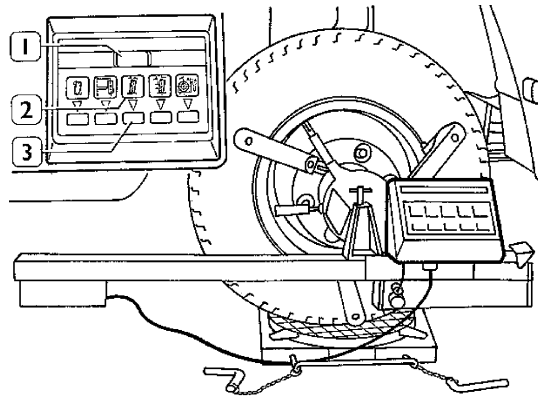
The toe-in is adjusted with the transverse tie rod so as, for each wheel, to have a toe-in equal to half the required value.

Checking wheel deviation

The deviation is checked while reading the toe-in.
The partial value of the toe-in measured on the rule (3) has to be equal to the value measured on the rule on the other wheel.
If, however, there is a difference in these values, e.g. -2 and +3, the total toe-in is +1 and is therefore correct, but at the same time it indicates a deviation between the wheels (one wheel further forward than the other) of 5 lines.
This number of lines is calculated with the algebraic sum of the values measured: +3-(-2) = 5, or more simply by counting the lines between the two values.
Each line corresponds to a deviation of 2 mm.
When the deviation is greater than 10 lines (20 mm), it is necessary to make additional checks, to verify the state of the leaf springs (whether one of these has given way, or whether the chassis or axle are out of shape).

Checking camber

Figure 16



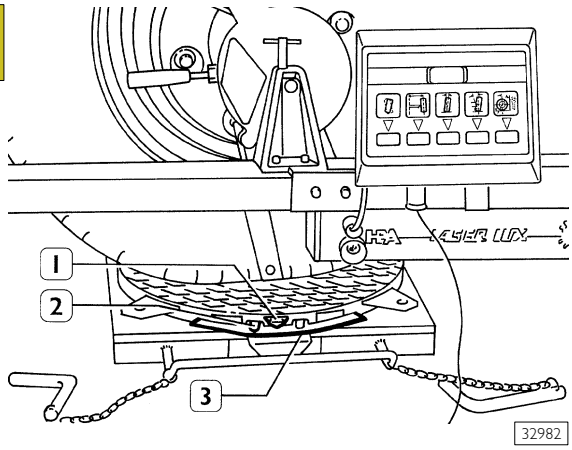
32981

With the front wheels aligned with the rear ones and the measuring units level, press the camber button (3); the LED (2) will come on and the display (1) will show the value of the camber, that has to be 1°.

The camber is a fixed value that cannot be adjusted. Therefore, if you find the value is not as required, detach and remove the axle to make the relevant checks and replacements if necessary.

Checking kingpin angle and caster

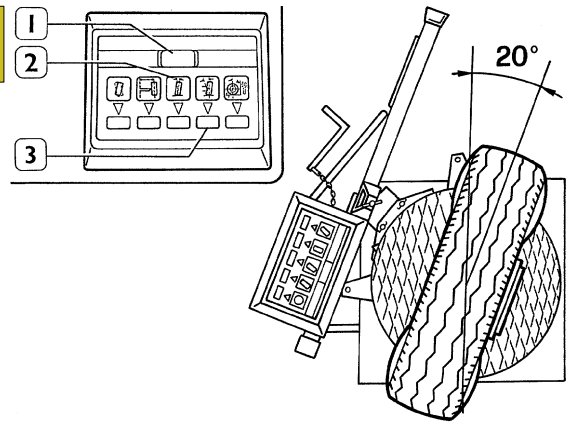
Figure 17



32982

Still with the front wheels aligned with the rear ones, loosen the knurled knobs (2) and reset the graduated sector (3) on the pointer (1) of the oscillating plate.

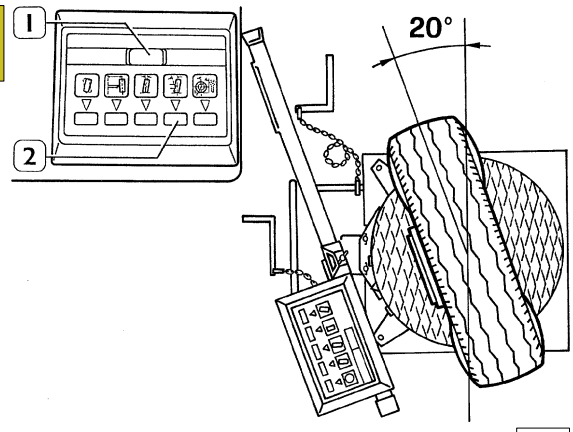
Figure 18



32983

Turn the wheels 20° inwards and press the kingpin angle button (3) twice; the LED (2) will come on and the display (1) will show nine horizontal lines.

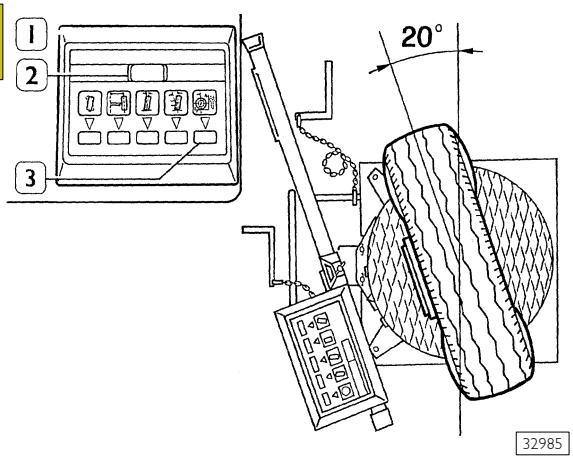
Figure 19



32984

Turn the wheels 20° outwards and press the kingpin angle button (2) again; the display (1) will show the value of the kingpin angle that has to be 7°.

Figure 20

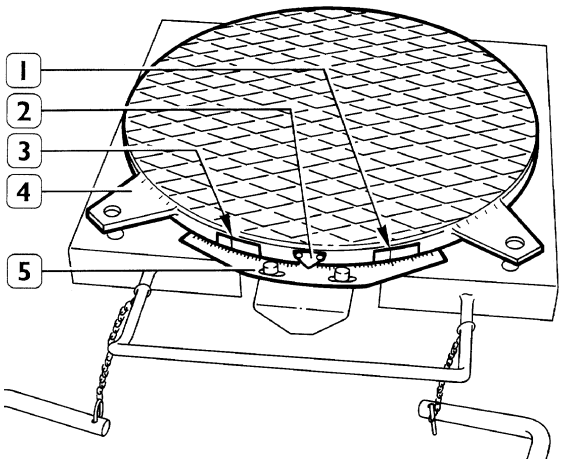


32985

Without moving the wheel, press the caster button (3). The LED (1) will come on and the display (2) will show the value of the caster, which has to be the required value.

The caster and kingpin angle are fixed values that cannot be adjusted.
Therefore, if you find the values are not as required, detach and remove the axle to make the relevant checks and replacements if necessary.

Figure 21

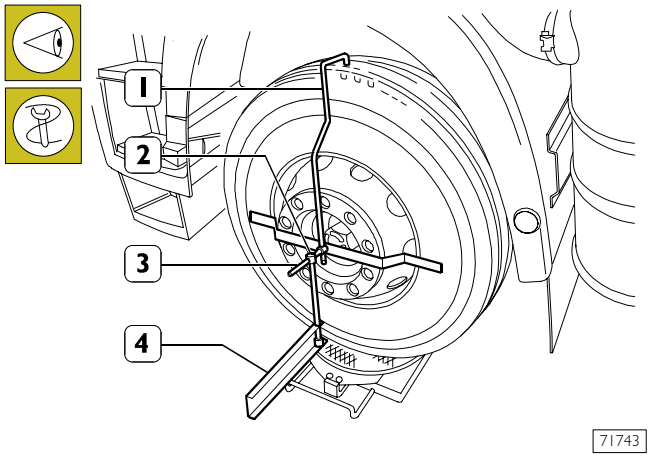


32986

With the wheels turned straight, reset the graduated sectors (5) on the pointer (2) of the oscillating plates (4).
If the steering angles to be measured are greater than 30°, it is necessary to use the 20° mark (1) on the oscillating plate and the corresponding one of the graduated sector as "0°" reference indices.
Turn the wheels to reach a required angle (internal or external wheel angle).
Then check that the steering angle (external or internal wheel angle) of the opposite wheel corresponds to the required value, remembering to use the corresponding scale with the sign shown on the oscillating plate to read off the angle.

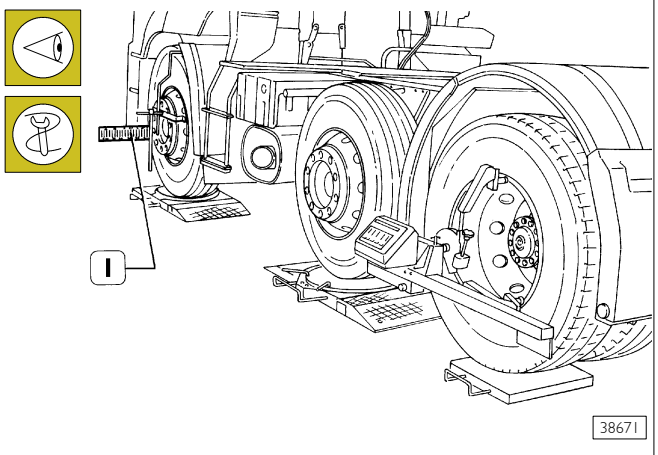
Checking rear axle alignment

Figure 22



Fit the rule (4) on the front wheels, checking the slide (2) is exactly in the middle of the two annular grooves of the shaft (3).
Fit the measuring units on the rear wheels as described above for the wheels of the front axle.

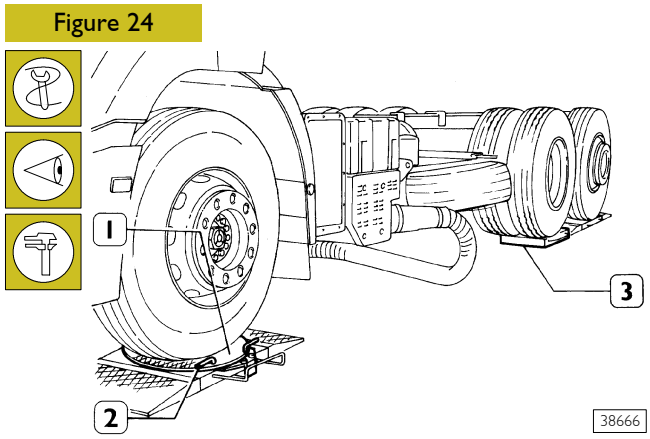
Figure 23



Project the light signal on the rule (1) and note down the value shown.
Repeat this measurement on the other wheel and check that the value shown is the same as the one noted down; if it is not, thoroughly check over the assembly of the rear axle on the vehicle: if you find no trouble, check the chassis has not lost its shape, following the procedures described in the "Bodywork - Chassis" section.

Vehicle wheel geometry with steering rear added axle and pneumatic lifting

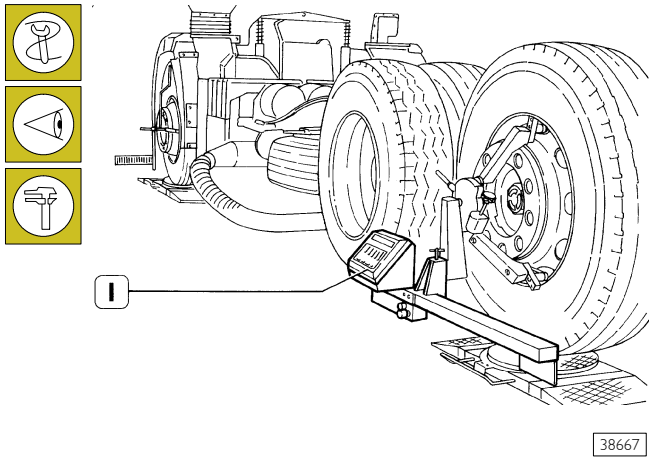
Figure 24



Lift the vehicle, position the oscillating plates (1) of appliance 99305354 under the wheels of the steering axles, locking the plates with the clamps (2) and place the boards (3) under the wheels of the rear axle.
Check the wheel geometry of the front axle with appliance 99305354 according to the procedure described and illustrated for 4x2 vehicles.
After making the check and any adjustment of the toe-in, set the wheels straight.

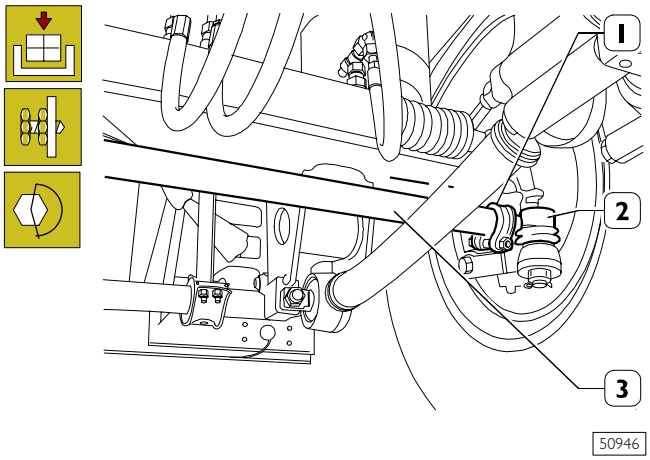
NOTE With the steering box in the driving centre position, the operating and centering cylinder measurements can be checked and reset (if necessary), by following the procedure described in this chapter, pages 76 to 78.

Figure 25



With the steering housing in the "drive centre" position, apply the optical assembly of the appliance 99305354 to the wheels of the rear added axle.
Lift the added axle and adjust the wheel rims; lower the added axle.
Check the wheel toe-in of the third axle as described for the front axle of the 4x2 vehicles.
Finding a different value to the one given in the characteristics and data table, adjust the toe-in as follows.

Figure 26



Loosen the collars (1) fixing the swivel heads (2) at the ends of the transverse tie rod (3) and turn this to accomplish the required wheel toe-in.
Continue checking the camber, kingpin angle, caster and steering angle as described for the 4x2 vehicles.

Wheel setup for vehicles with additional centralsteering axle and pneumatic lift

NOTE Please refer to the procedure described for the additional rear steering axles because it is similar.

SECTION 9

5004 Suspensions

5004 SUSPENSIONS

DESCRIPTION

The vehicle's suspension, depending on the version, may be:

- ❑ pneumatic
- ❑ mixed (front mechanical and rear pneumatic).

Mechanical front suspension

The front suspension comprises:

- double-acting hydraulic shock absorbers;
- stabilizer bar;
- parabolic leaf springs

Pneumatic front suspension

The front suspension comprises:

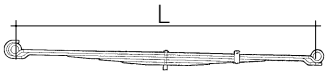
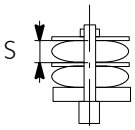
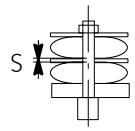
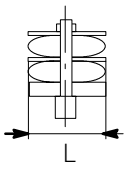
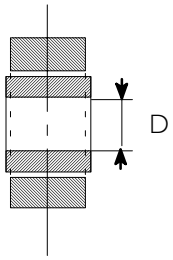
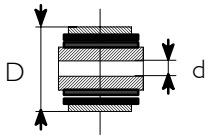
- double-acting hydraulic shock absorbers;
- stabilizer bar;
- parabolic leaf-springs and air springs of vehicles:
  - 4x2 T/FP-LT (Full Pneumatic tractors with lowered chassis).
  - 6x2c T/XP (central added axle).
  - 6x2p /FP-GV (large volume Cab-equipped Full Pneumatic vehicles).
- air springs with longitudinal bars (only for vehicles with mobile box CM).

Pneumatic rear suspension

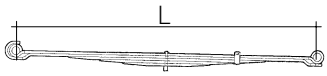
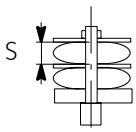
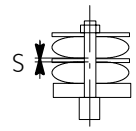
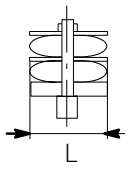
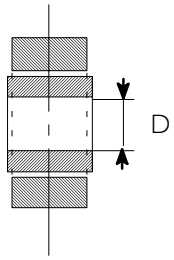
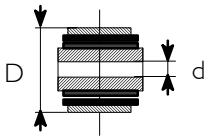
The rear suspension comprises:

- stabilizer bars;
- double-acting hydraulic shock absorbers;
- air springs.

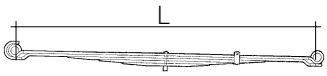
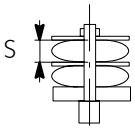
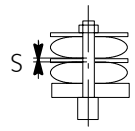
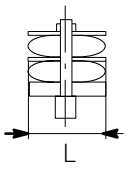
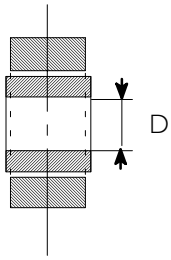
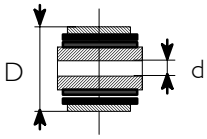
SPECIFICATIONS AND DATA
Models front suspension:
4x2 (tractors)

		mm
	**7.5 tonnes parabolic leaf springs**	No. 2
	Spring length (measured at eye centres)	1900 $^{+0}_{-5}$
	Leaf thickness (measured at centre)	39
	Distance between leaves	-
	Leaf width	90
	Inside diameter of master leaf eye (bushing seat)	60.1 ÷ 60.2
	D = outside diameter of bushing d = inside diameter of bushing	62.0 ÷ 62.8 20.2 ÷ 20.5
NEW LEAF SPRING CHECK DATA		
	Flexibility mm/kN	3.8

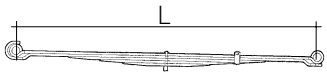
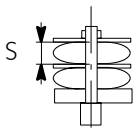
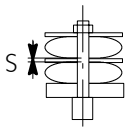
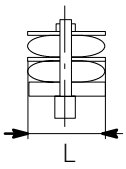
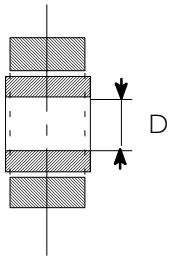
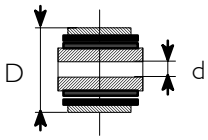
Models front suspension:
4x2 (tractors) - 6x4 (tractors and cab-equipped vehicles)

		mm
	**7.5 tonnes parabolic leaf springs**	No. 2
	Spring length (measured at eye centres)	1900 $^{+0}_{-6}$
	Leaf thickness (measured at centre)	25
	Distance between leaves	3
	Leaf width	90
	Inside diameter of master leaf eye (bushing seat)	60.1 ÷ 60.2
	D = outside diameter of bushing d = inside diameter of bushing	62.0 ÷ 62.8 20.2 ÷ 20.5
NEW LEAF SPRING CHECK DATA		
	Flexibility mm/kN	5.2

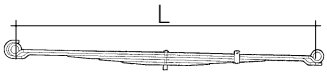
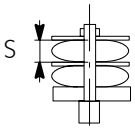
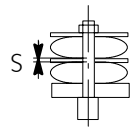
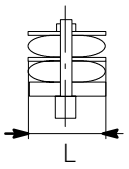
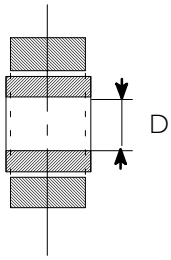
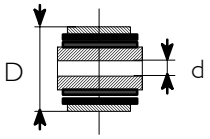
Models front suspension:
4x2 (tractors) - 6x4 (tractors and cab-equipped vehicles)

		mm
	**8 tonnes parabolic leaf springs**	No. 2
	Spring length (measured at eye centres)	1894 ± 3
	Leaf thickness (measured at centre)	30
	Distance between leaves	-
	Leaf width	90
	Inside diameter of master leaf eye (bushing seat)	60.1 ÷ 60.2
	D = outside diameter of bushing d = inside diameter of bushing	62.0 ÷ 62.8 20.2 ÷ 20.5
NEW LEAF SPRING CHECK DATA		
	Flexibility mm/kN	4.2

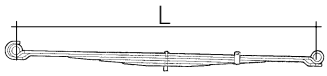
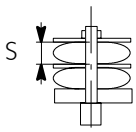
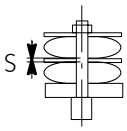
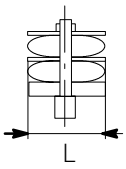
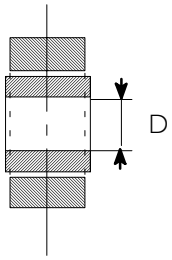
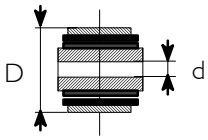
Models front suspension:
4x2 (cab-equipped vehicles) - 6x2C (tractors) - 6x2P (tractors and cab-equipped vehicles)

		mm
	**7.5 tonnes parabolic leaf springs**	No. 2
	Spring length (measured at eye centres)	1895^{+0}_{-5}
	Leaf thickness (measured at centre) (1st and 2nd leaf)	30
	Distance between leaves	3
	Leaf width	90
	Inside diameter of master leaf eye (bushing seat)	60.1 ÷ 60.2
	D = outside diameter of bushing d = inside diameter of bushing	62.0 ÷ 62.8 20.2 ÷ 20.5
NEW LEAF SPRING CHECK DATA		
	Flexibility mm/kN	4.98

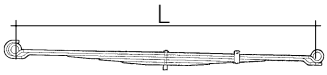
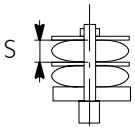
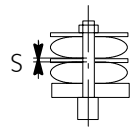
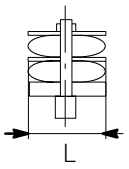
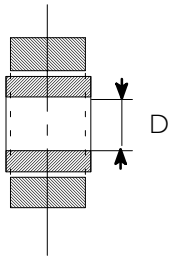
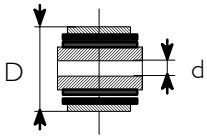
Models front suspension:
4x2 (cab-equipped vehicles) - 6x2C (tractors) - 6x2P (tractors and cab-equipped vehicles)

		mm
	**8 tonnes parabolic leaf springs**	No. 2
	Spring length (measured at eye centres)	1895 $^{+0}_{-5}$
	Leaf thickness (measured at centre) (1st and 2nd leaf)	30
	Distance between leaves	3
	Leaf width	90
	Inside diameter of master leaf eye (bushing seat)	60.1 ÷ 60.2
	D = outside diameter of bushing d = inside diameter of bushing	62.0 ÷ 62.8 20.2 ÷ 20.5
NEW LEAF SPRING CHECK DATA		
	Flexibility mm/KN	4.7

Models front suspension:
4x2 (tractors and lorries) - 6x2P (tractors and lorries)

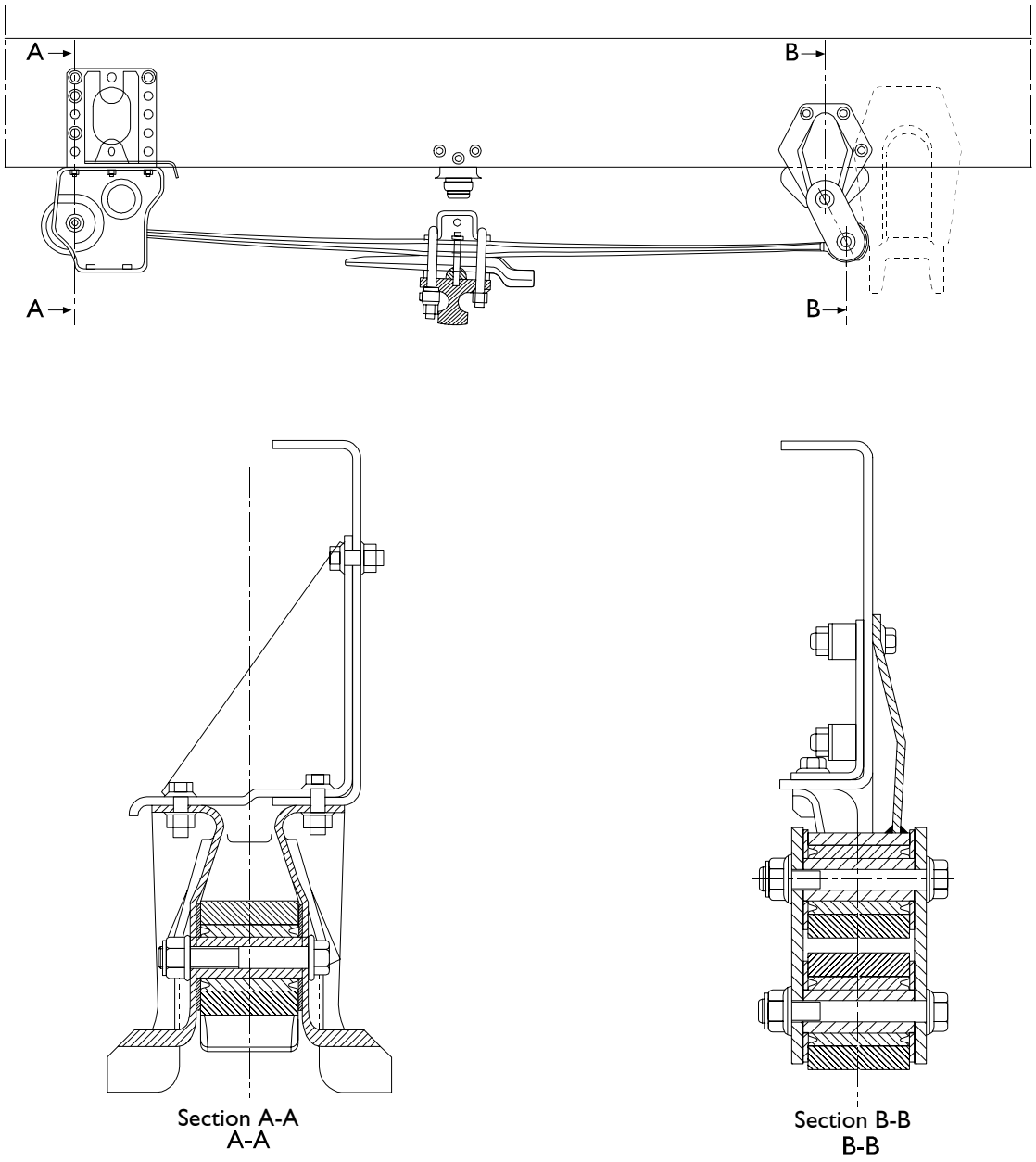
		mm
	8 tonnes parabolic leaf springs	No. 2
	Spring length (measured at eye centres)	1900 $^{+0}_{-6}$
	Leaf thickness (measured at centre) ❑ master leaf ❑ 2nd - 3rd leaf	 25 26
	Distance between leaves	3
	Leaf width	90
	Inside diameter of master leaf eye (bushing seat)	60.1 ÷ 60.2
	D = outside diameter of bushing d = inside diameter of bushing	62.0 ÷ 62.8 20.2 ÷ 20.5
NEW LEAF SPRING CHECK DATA		
	Flexibility mm/kN	4.41

Models front suspension:
4x2 (tractors and cab-equipped vehicles) - 6x2P (cab-equipped) vehicles with pneumatic front suspension

		mm
	7.5 tonnes parabolic leaf springs	No. 2
	Spring length (measured at eye centres)	1875 $^{+2}_{-4}$
	Leaf thickness (measured at centre) 1st leaf 2nd leaf	 40 25
	Distance between leaves	3
	Leaf width	90
	Inside diameter of master leaf eye (bushing seat)	60.1 ÷ 60.2
	D = outside diameter of bushing d = inside diameter of bushing	62.0 ÷ 62.8 20.2 ÷ 20.5
NEW LEAF SPRING CHECK DATA		
	Flexibility mm/kN	9.8

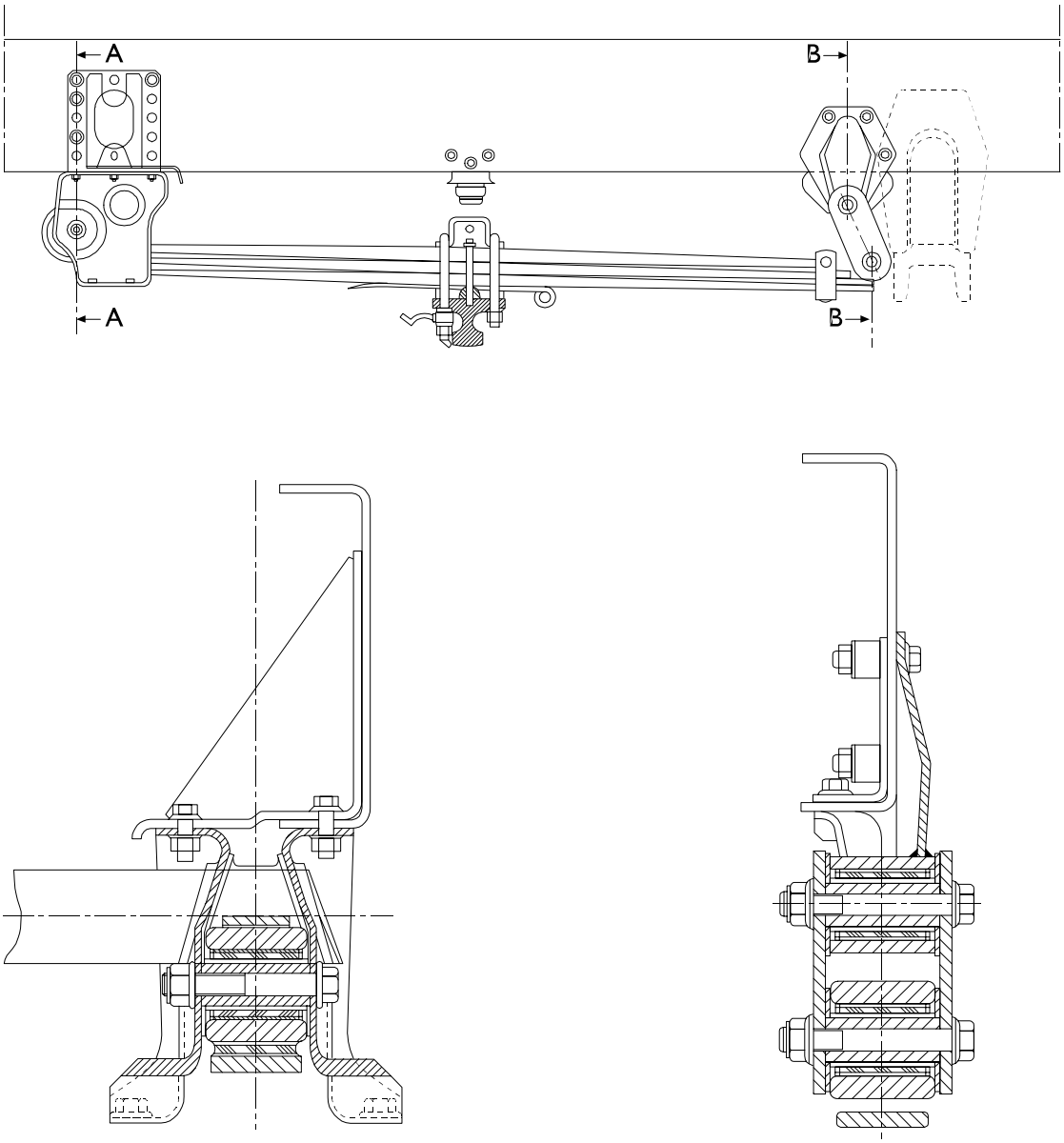
MECHANICAL FRONT SUSPENSION ASSEMBLY DRAWING

Figure 1



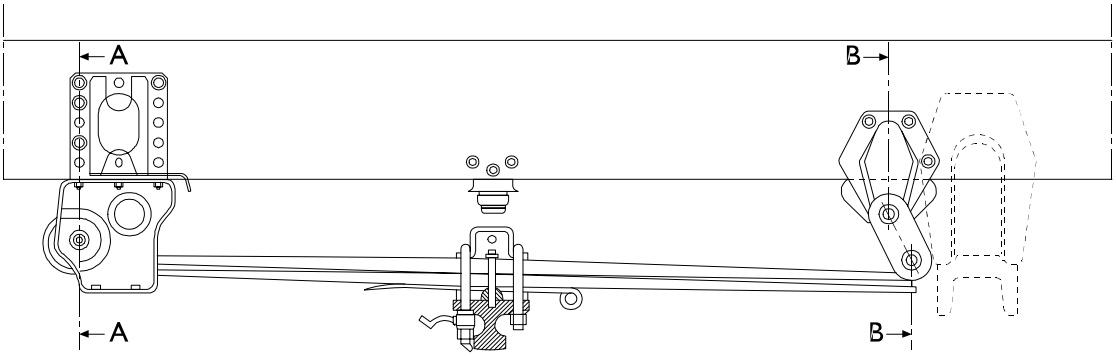
FRONT SUSPENSION WITH PARABOLIC LEAF SPRING: 4x2 (tractors)

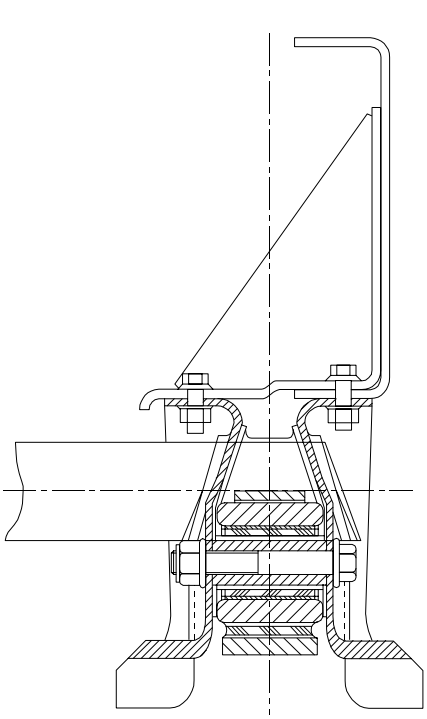
Figure 2



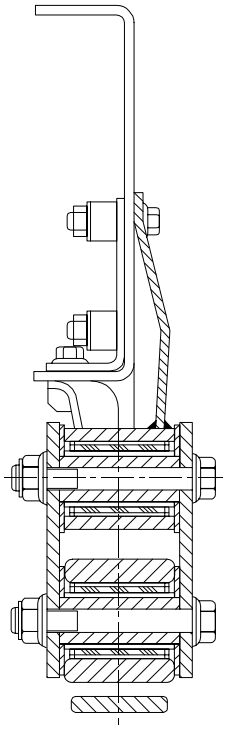
FRONT SUSPENSION WITH PARABOLIC LEAF SPRING: 4x2 – 6x2P – 6x4 VEHICLES

Figure 3





Section A-A



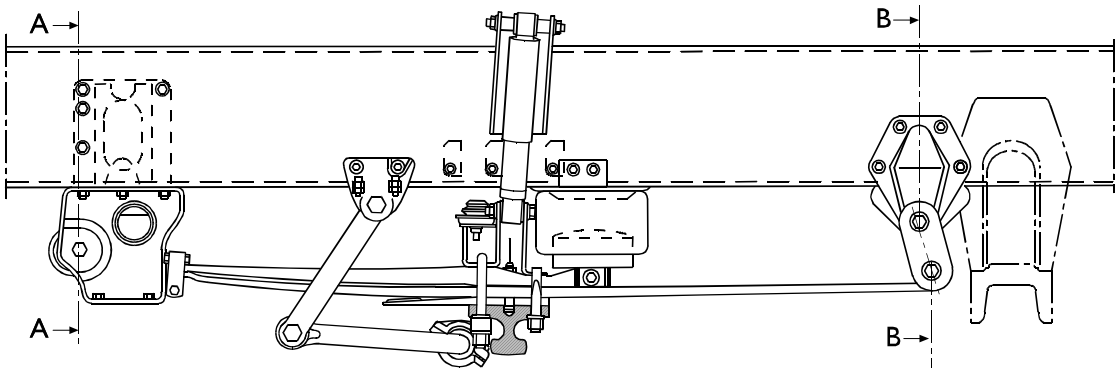
Section B-B

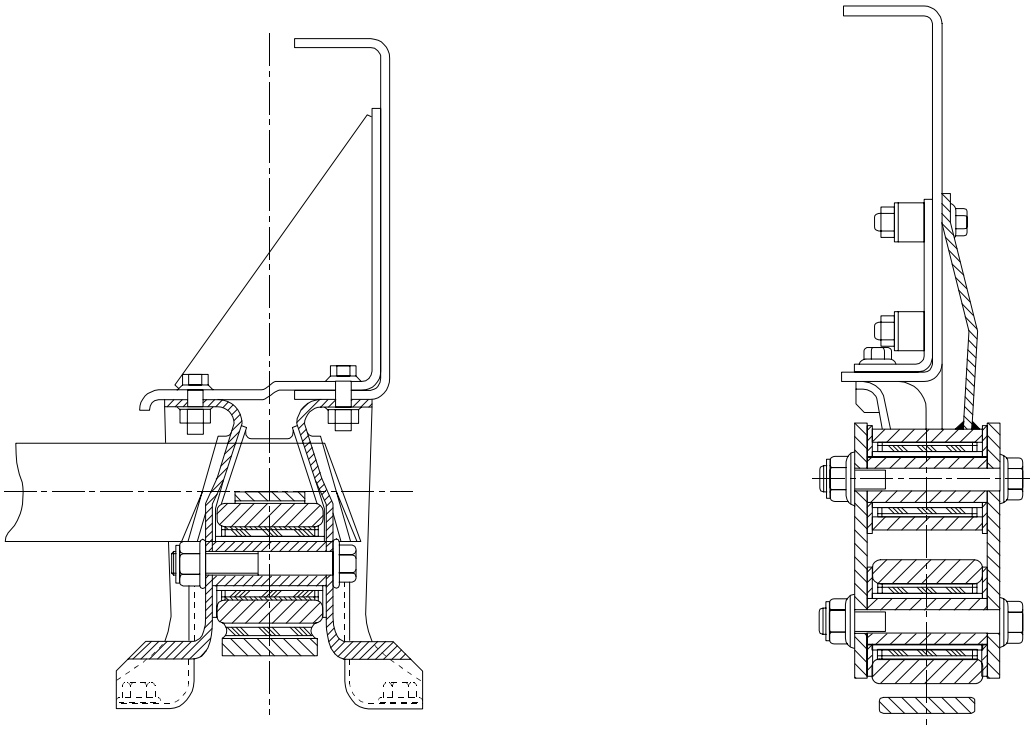
49253

FRONT SUSPENSION WITH PARABOLIC LEAF SPRING: 4x2 – 6x2P – 6x2C VEHICLES

PNEUMATIC FRONT SUSPENSION ASSEMBLY

Figure 4





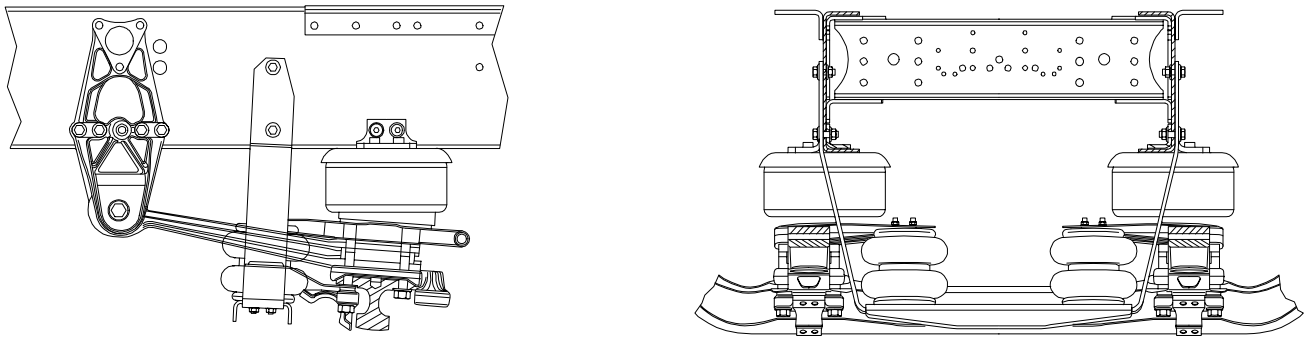
SECTION A-A **SECTION B-B**

72859

FRONT AIR SUSPENSION WITH PARABOLIC LEAF SPRING:
Vehicles 4X2 with lowered chassis and Large Volume vehicles 6x2p

CENTRAL ADDED AXLE SUSPENSION ASSEMBLY

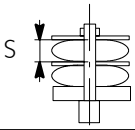
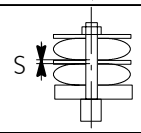
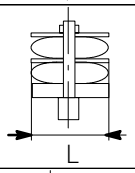
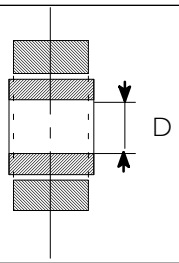
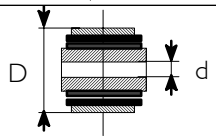
Figure 5



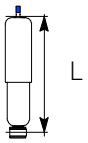
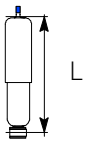
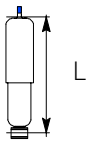
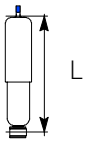
108526

CENTRAL ADDED AXLE SUSPENSION
Vehicles 6X2C

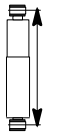
Leaf spring for central added axle (vehicles with air suspension) 6x2C vehicles

		mm
	**Parabolic leaf springs**	N° 2
	Spring length (measured to eye centres)	665
	Leaf thickness (measured at centre) 1st leaf 2nd leaf	 25 30
	Distance between leaves	-
	Leaf width	90
	Inside diameter of master leaf eye (bushing seat)	60.2 ÷ 60.1
	D = outside diameter of bushing d = inside diameter of bushing	62.0 ÷ 62.8 20.2 ÷ 20.5
NEW LEAF SPRING CHECK DATA		
	Flexibility mm/kN	2.252

Front shock absorbers

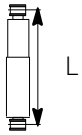
SHOCK ABSORBERS  Modelli: 4x2 . . . T/P 6x2P . . T/P 6x2C . . TX/P 6x4 . . . TZ 6x4 . . . Z/P	Length between the eye centres: Open Closed Stroke	FICHTEL & SACHS 754 ± 3 434 ± 3 320	ARVIN 753 ± 3 436 ± 3 317
SHOCK ABSORBERS  Modelli: 4x2 . . . T/P 4x2 . . . /P 6x2P . . T/P 6x2P . . /P 6x4 . . . TZ/P	Length between the eye centres: Open Closed Stroke	MANNESMANN SACHS 754 ± 3 434 ± 3 320	ARVIN 754 ± 3 432 ± 3 317
SHOCK ABSORBERS  Modelli: 4x2 . . . T/P 4x2 . . . /P 4x2 . . . T/FP 4x2 . . . /FP 6x2P . . T/P 6x2P . . /P 6x2P . . T/FP 6x2P . . /FP	Length between the eye centres: Open Closed Stroke	MANNESMANN SACHS 492 ± 3 322 ± 3 170	WAY-ASSAUTO 495 ± 3 325 ± 3 170
SHOCK ABSORBERS  Modelli: 4x2 . . . T/FP 6x2P . . T/FP	Length between the eye centres: Open Closed Stroke	SACHS 580 ± 3 365 ± 3 215	

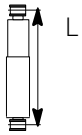
Additional axle shock absorbers

SHOCK ABSORBERS REAR ADDED AXLE  L Veicoli: 6x2P . . ./P 6x2P . . FP	Length between the eye centres: Open Closed Stroke	MANNESMANN SACHS 820 ± 3 500 ± 3 320	ARVIN 820 ± 3 520 ± 3 300
SHOCK ABSORBERS REAR ADDED AXLE  L Veicoli: 6x2P . . /FP	Length between the eye centres: Open Closed Stroke	MANNESMANN SACHS 930 ± 3 550 ± 3 380	ARVIN 922 ± 3 553 ± 3 369
SHOCK ABSORBERS REAR ADDED AXLE  L Veicoli: 6x2P . . T/P	Length between the eye centres: Open Closed Stroke	MANNESMANN SACHS 729 ± 3 439 ± 3 290	
SHOCK ABSORBERS CENTRAL ADDED AXLE  Veicoli: 6x2C . . TX/P	Length between the eye centres: Open Closed Stroke	MANNESMANN SACHS 580 ± 3 365 ± 3 215	

Rear shock absorbers

SHOCK ABSORBERS		MANNESMANN SACHS	ARVIN
 L Modelli: 4x2 . . . T/P 4x2 . . . T/FP 4x2 . . . /P 4x2 . . . /FP 6x2C . . TX/P 6x2P . . T/P 6x2P . . /P 6x4 . . . T/P 6x4 . . . /P	Length between the eye centres: Open Closed Stroke	 652 ± 3 402 ± 3 250	 652 ± 3 404 ± 3 248

SHOCK ABSORBERS		MANNESMANN SACHS
 L Modelli: 6x2 . . . /FP	Length between the eye centres: Open Closed Stroke	 729 ± 3 439 ± 3 310

SHOCK ABSORBERS		MANNESMANN SACHS	WAY-ASSAUTO
 L Modelli: 4x2 . . . /FP 6x2 . . . /FP	Length between the eye centres: Open Closed Stroke	 776 ± 3 466 ± 3 310	 776 ± 3 469 ± 3 307

PNEUMATIC SUSPENSION

The air suspensions are highly flexible; they have a considerable vibration-damping capacity and, above all, irrespective of the load on the vehicle, due to the system's self-adjustment, the "chassis frame – road surface" distance stays constant. By simply pressing a push-button the air suspensions can change the "chassis frame – road surface" distance and therefore the height of the vehicle's loading deck.
Besides the well-known benefits provided by the air suspension, the ECAS system provides:

- ❑ considerable reduction in air consumption;
- ❑ ready response to the various adjustment processes;
- ❑ simplified systems;
- ❑ wide safety margins;
- ❑ full system diagnosis.

The **ECAS (Electronically Controlled Air Suspension)** system automatically controls the nominal level of the vehicle's air suspensions.

All the above operations anyhow have the constraint of specific operating conditions and the associated safety devices of the systems connected to them.

The ECAS electronic control unit automatically controls the level (distance off the road surface) of the chassis frame with the actual values supplied by the sensors, comparing them with the nominal values saved in memory.

In the event of moving away or the attitude changing, the electronic control unit governs the electro-pneumatic assemblies with which the actual level is corrected compared to the nominal one set or saved previously by the driver.

The system has a remote control for lifting/lowering and levelling the chassis frame and it is possible to work with the vehicle either stationary or moving.

Besides lifting, lowering and self-levelling, the remote control makes it possible to save other chassis frame attitude levels and call them up when required.

Chassis frame lifting, lowering and self-levelling with remote control

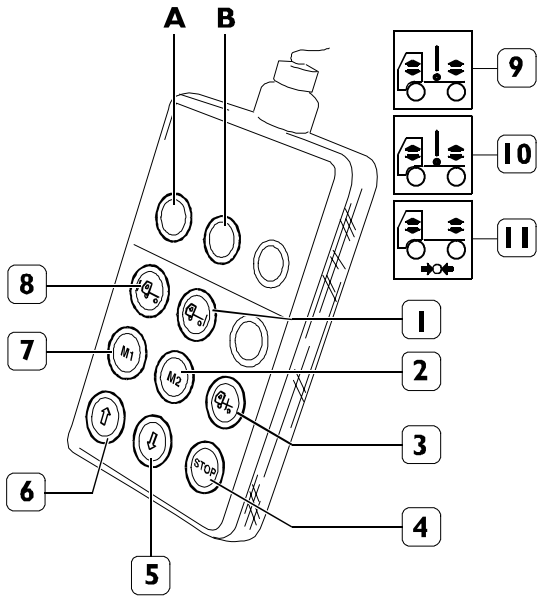
Lifting, lowering and levelling the vehicle before loading and unloading it is done with the remote control located next to the driver's seat.

The remote control can be removed from its mounting so these manoeuvres can be done from the ground too.

When unloading heavy loads or containers (with a crane), lower the chassis frame completely.

Do not stop the engine if the indicator light (10) comes on. If the indicator light (9) comes on while driving, stop the vehicle and turn the ignition key onto "STOP"; after approximately (7) seconds, turn the key onto MAR (start). If after approximately two seconds the indicator light (9) does not go out, call the Service Network.

Figure 6



Lift/lower the chassis frame as described below:

- ❑ Turn the ignition switch onto MAR (start). The yellow and red indicator lights (9) and (10) will come on for approximately 3 seconds.
- ❑ Press the push-button (1 and 8) to select the rear axle. The indicator light A-B comes on to show the selection made (to cancel the selection, press the button again).
- ❑ Pressing the buttons (5 and 6) and keeping them pressed lifts or lowers the chassis frame.

Briefly press the push-button (3), the chassis frame will go back into its normal self-levelling position.

The indicator light (9) goes out as soon as the normal level is reached.

The "STOP" push-button (4) stops any action the system is performing.

After loading/unloading and before starting off again, you must bring the vehicle back into its normal self-levelling position by pressing the button (3).

Saving Levels

With buttons (2) and (7), it is possible to save and call up two chassis-frame positions:

- ❑ Take the chassis frame to the required height by following the above instructions.
- ❑ Press the STOP button (4) and keep it pressed while pressing one of the buttons (2) or (7).
- ❑ Release the button (4). The chassis-frame position has been saved.

To call up a saved position, press the associated button (2) or (7).

AXLE LOAD METER

NOTE Axle load indication is available on the instrument panel display unit of vehicles with pneumatic suspension axles.

By using this functionality, vehicle pneumatic suspension axle weights are shown.
The system provides for up to 4 axles indication.
Measure indicated for information purposes is only consistent with the vehicle stopped. Any values indicated with the vehicle moving are not real.

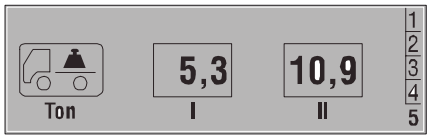
NOTE Loads indicated are for information purposes only. Indications are not utilisable by official authorities (police, etc.).

Activating function

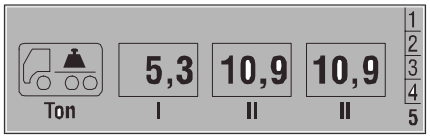
- ❑ Turn ignition key to position MAR [ride] with engine off.
- ❑ Choose trip menu pressing key Page on steering wheel (page 23, reference 4) and choose page 5.

In connection with vehicle configuration, there will appear on the menu one of following indications:

Figure 7



2-axle vehicle



3-axle vehicle

106260

NOTE In presence of an axle without a pneumatic suspension, matching symbol is shaded.

Indication tolerance is +2%.
In case of lifted axle there appears measure = 0.0.

Indication disappears in following cases:

- ❑ during chassis level adjustment through suspension ECAS system;
- ❑ during chassis lifting/lowering operations through ECAS remote control.

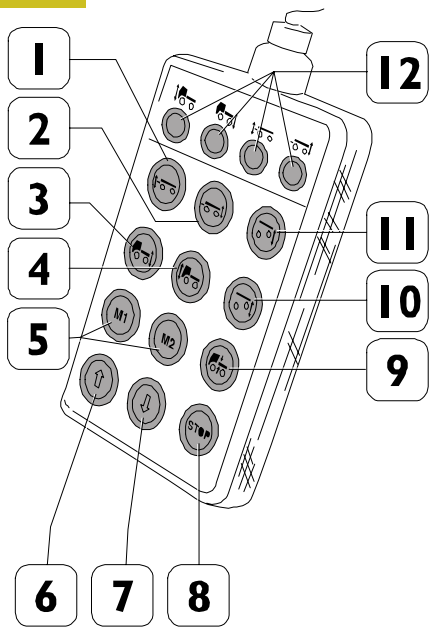
CALIBRATION (indication on display unit)

Calibration is requested:

- ❑ in case of indications out of tolerance in connection to a calibrated system;
- ❑ in case of significant modifications to either pneumatic suspension or axles suspension typology.

Calibration can be carried out by ECAS remote control.

Figure 8



106261

1. Trailer front axle - 2. Trailer rear axle - 3. Vehicle front axle - 4. Vehicle rear axle - 5. Storing - 6. Lifting - 7. Lowering - 8. Stopping - 9. Self-levelling - 10. Vehicle liftable axle - 11. Trailer liftable axle - 12. Warning lights

1. Activating calibration

Press key(10).
The two warning lights at the left on top are blinking.
Then, press key (8) and keep it pressed for at least 5 seconds: calibration mode activation is confirmed through the four warning lights (12) being blinking.

NOTE Keys 1, 2 and 11 are only active for trailer on following combination: vehicle prepared with EBS, vehicle manufactured after 01.05.2005 and trailer prepared with EBS and TCE electronic module with specific calibration.

2. Selecting the axle to be calibrated

Axles are numbered starting from front axle according to standard SAE 1939.

- ❑ Key no. 3 activates I. axle (Front axle).
- ❑ Key no. 4 activates II. axle (Central or rear axle).
- ❑ Key no. 1 activates III. axle (added rear axle; rear axle on vehicles 6x2C or second rear axle on vehicles 6x4).
- ❑ Key no. 2 activates IV. axle.

3. Indication of the axle selected for calibration through corresponding warning light

Starting from left (Figure 8) there is following situation:

- ❑ the first warning light warns about I. axle possible calibration;
- ❑ the second warning light warns about II. axle possible calibration;
- ❑ the third warning light warns about III. axle possible calibration;
- ❑ the fourth warning light warns about IV. axle possible calibration.

4. Calibration of axle load indication

Pressing lifting key (6) or lowering key (7), the value is modified by 100 kg intervals. It is suggested to always round the value up.

5. Storing modification / calibration

Press key (8) together with key (5) and keep them pressed for a short time.

- ❑ Calibration values are stored.
- ❑ To confirm that the storing has occurred, all the four warning lights blink in sequence (one after the other).

6. Deactivating calibration function

It can be achieved:

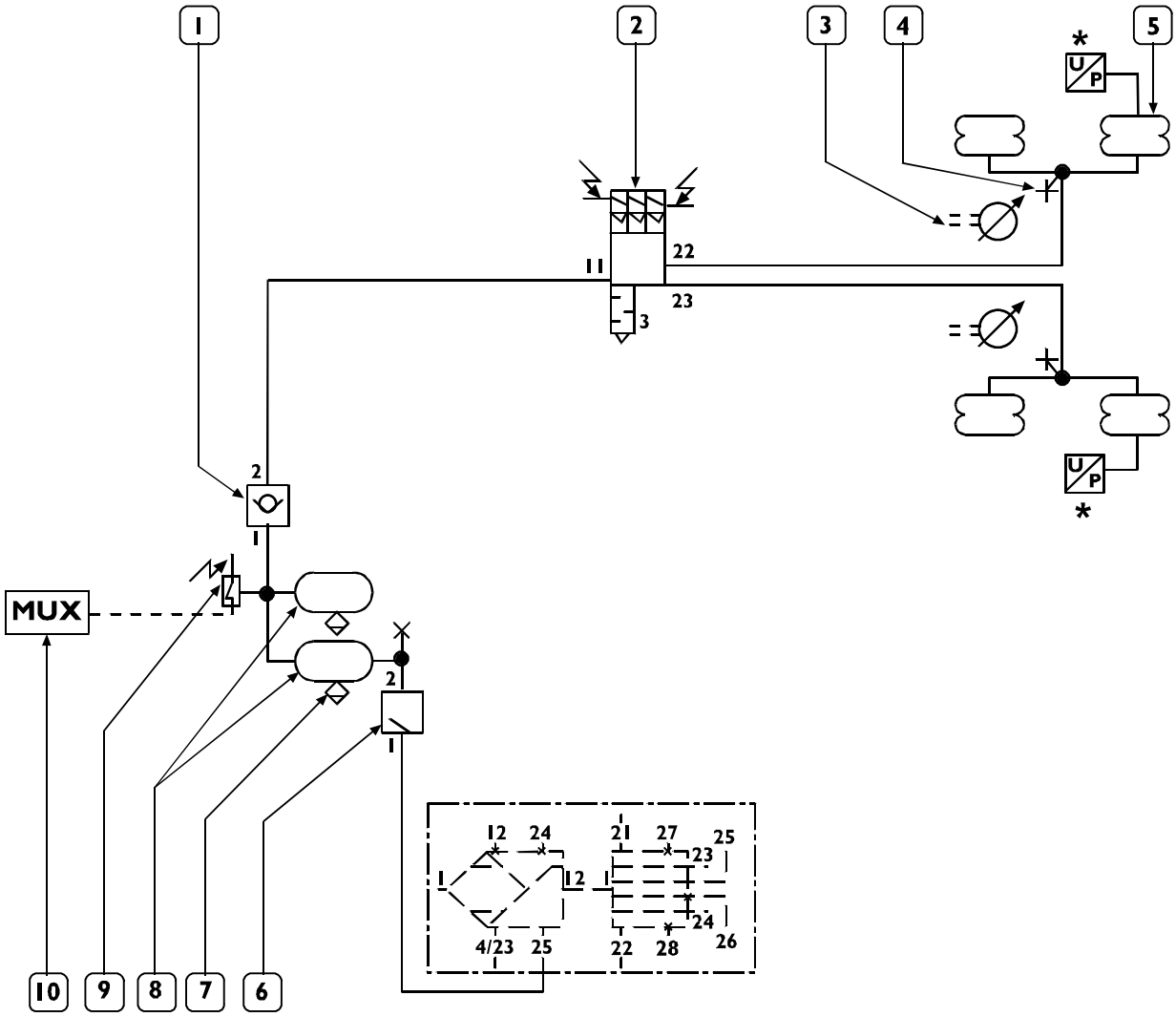
- ❑ manually, by pressing key (8) and keeping it pressed for at least 5 seconds;
- ❑ automatically, after a certain time from last pressing of a key (e.g. 20 seconds);
- ❑ activating a new axle for calibration.

With the function deactivated, all the four warning lights are off.

SCHEMES OF AIR SPRING SUSPENSIONS SYSTEMS

Principle scheme of rear air spring suspensions for lorries 4x2/P

Figure 9

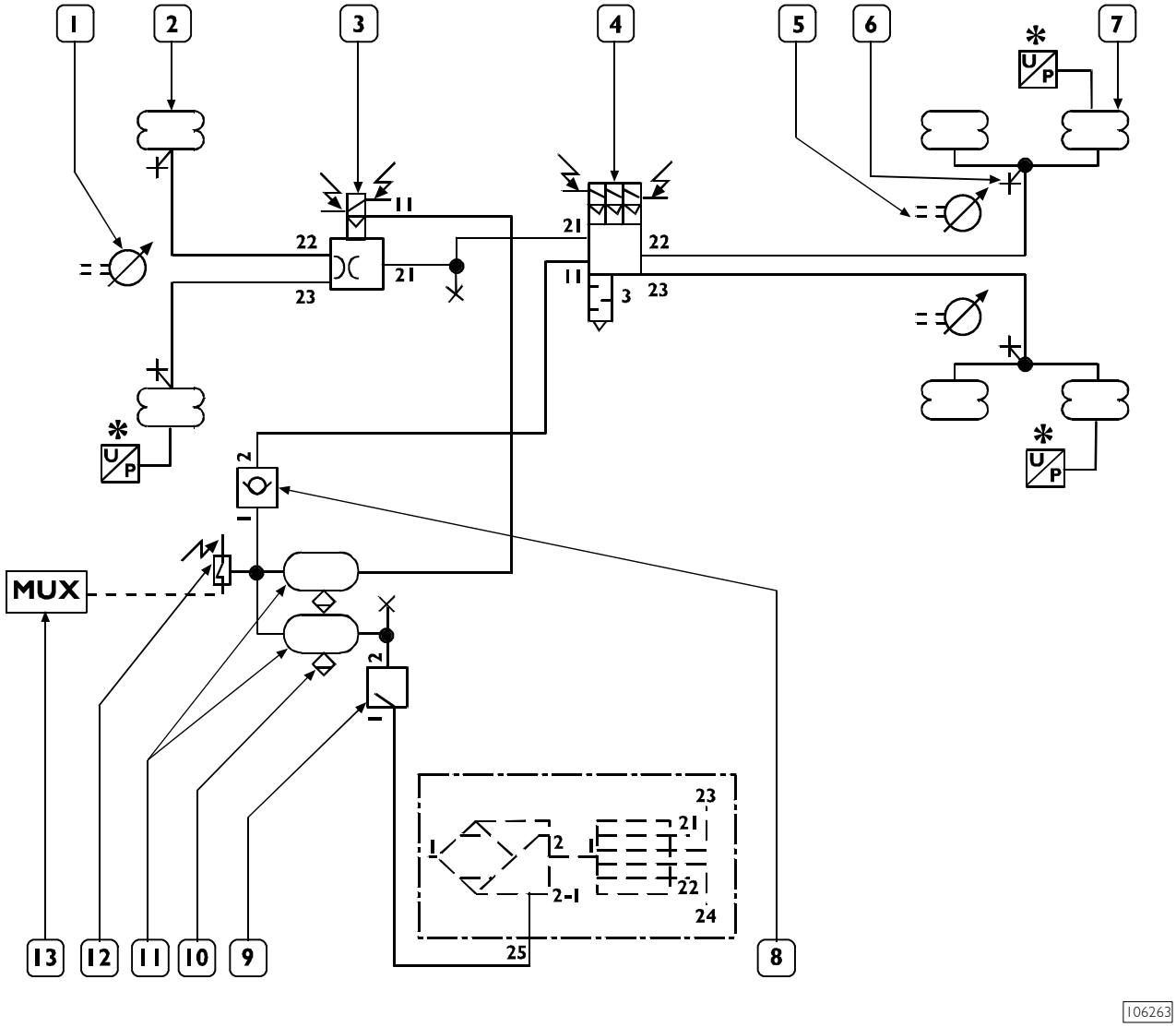


1. Check valve - 2. Rear axle electropneumatic distributor - 3. Rear level sensor - 4. Pressure control intake - 5. Rear axle air spring - 6. Pressure relief valve with limited return - 7. Condensate hand bleeder - 8. 20 lt. air reservoirs - 9. Pressure gauge (opening pressure 8 bar) - 10. MUX electric system.

* pressure sensor only present in vehicles with optional "Axles Load Measurement" (ECAS CAN 2)

Principle scheme of suspensions for lorries 4x2/FP

Figure 10

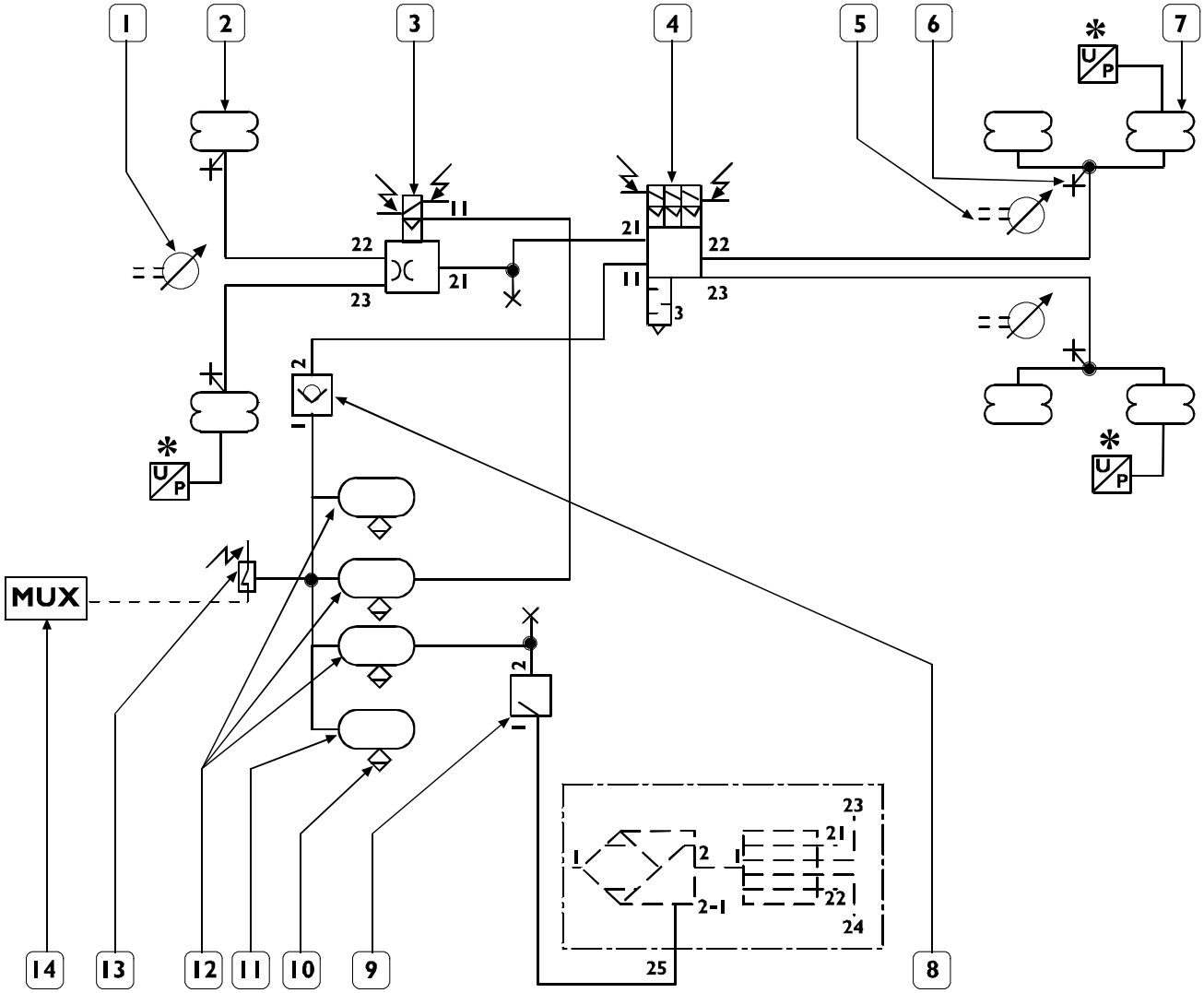


1. Front level sensor – 2. Front axle air spring – 3. Front electro-pneumatic control valve – 4. Rear electro-pneumatic control valve– 5. Rear level sensor – 6. Pressure test point– 7. Rear axle air spring – 8. Check valve– 9. Controlled pressure valve with limited return (opening pressure 8.5 bars)– 10. Manual condensate bleed valve– 11. 20-litre air tanks – 12. Pressure switch (opening pressure 8 bars) – 13. MUX electric system.

* pressure sensor only present in vehicles with optional "Axles Load Measurement" (ECAS CAN 2)

Principle scheme of air spring suspensions for lorries 4x2FP-CM

Figure 11

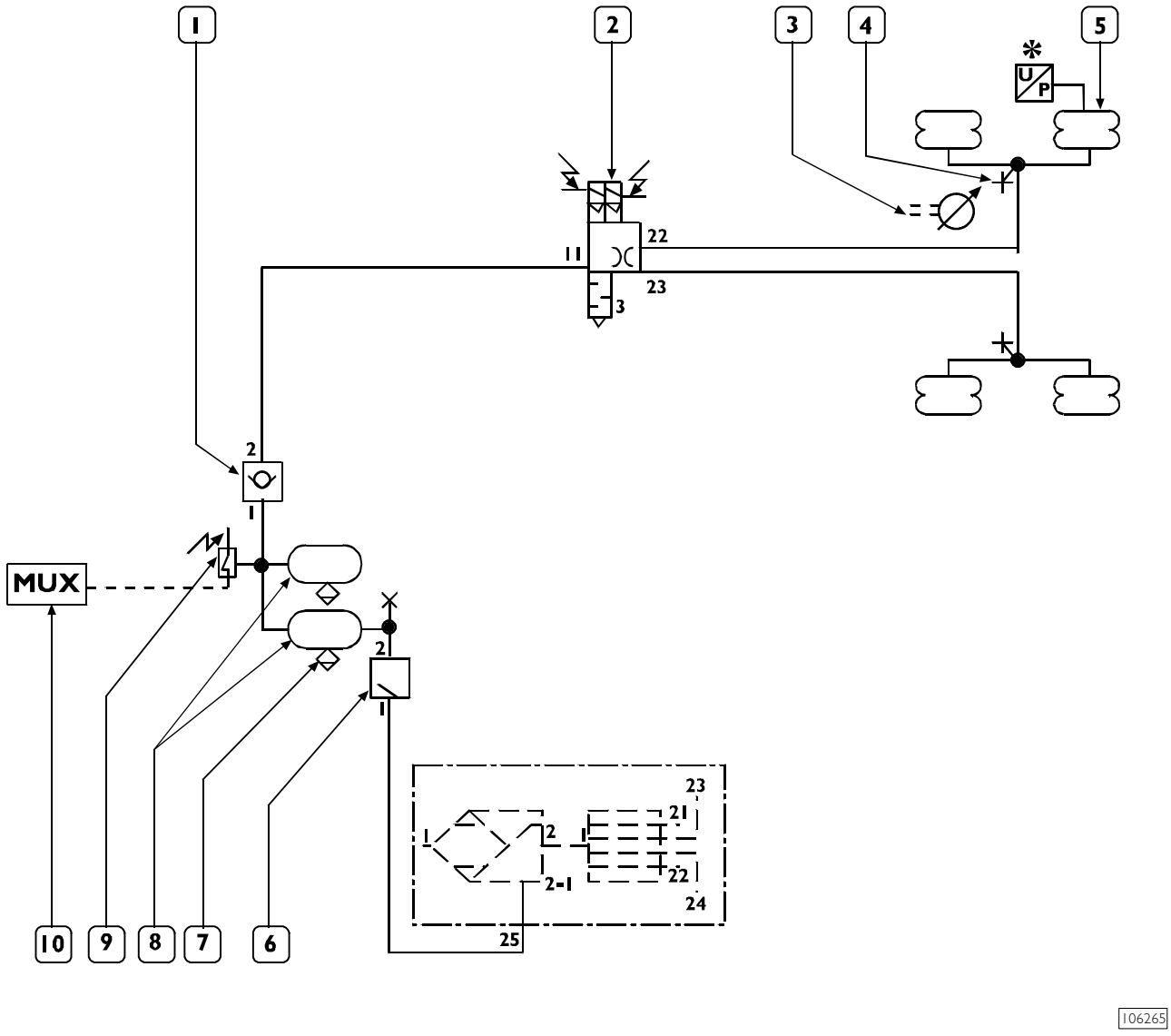


1. Front level sensor – 2. Front axle air spring – 3. Front electro-pneumatic control valve – 4. Rear electro-pneumatic control valve– 5. Rear level sensor – 6. Pressure test point– 7. Rear axle air spring – 8. Check valve– 9. Controlled pressure valve with limited return (opening pressure 8.5 bars)– 10. Manual condensate bleed valve– 11. 30-litre air tank – 12. 20-litre air tanks – 13. Pressure switch (opening pressure 8 bars) – 14. MUX electric system

* pressure sensor only present in vehicles with optional "Axles Load Measurement" (ECAS CAN 2)

Working diagram of pneumatic rear suspensions for 4x2T/P tractors

Figure 12

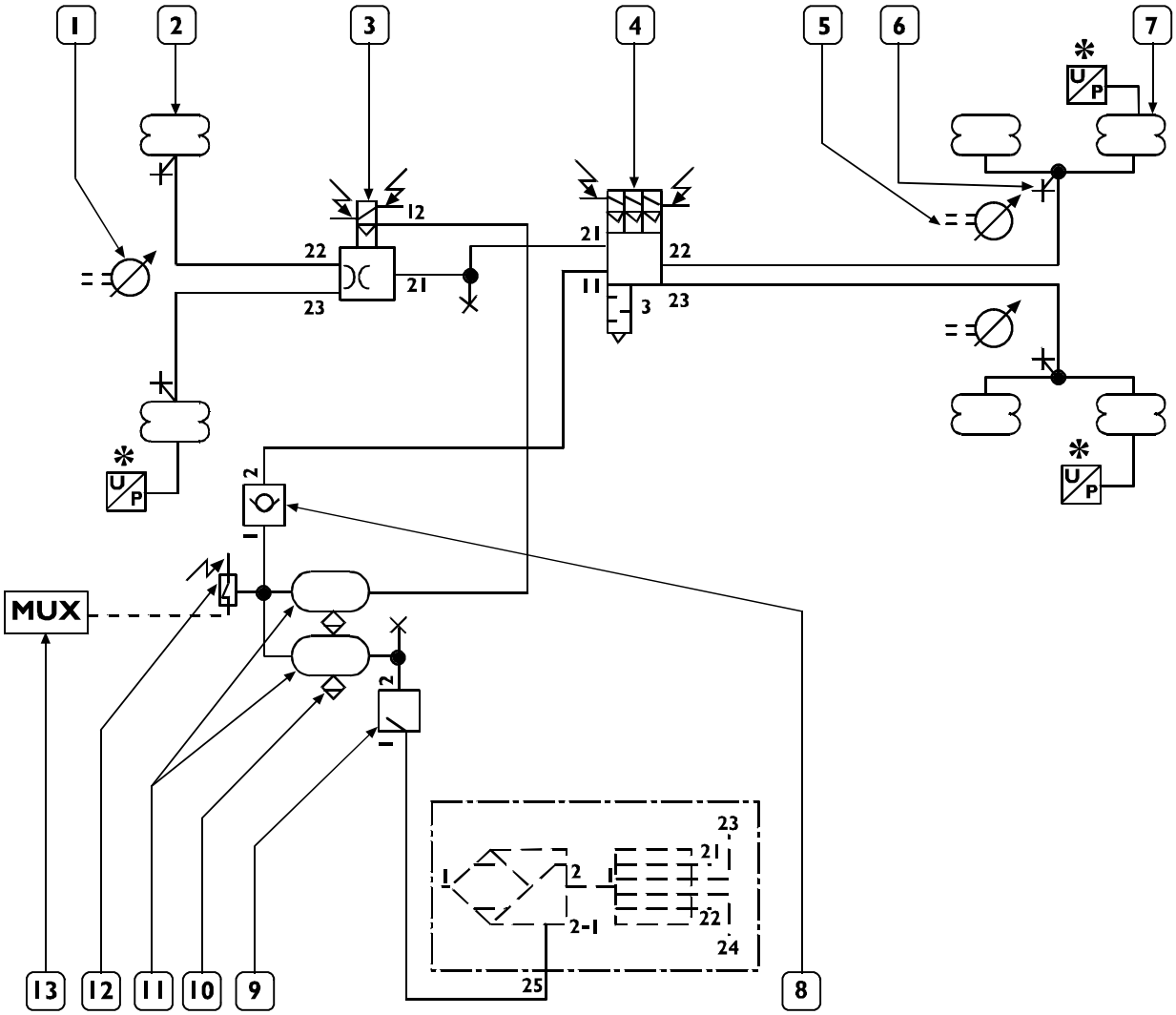


1. Check valve – 2. Rear axle electro-pneumatic control valve – 3. Rear level sensor – 4. Pressure test point – 5. Rear axle air spring – 6. Controlled pressure valve with limited return (opening pressure 8.5 bars) – 7. Manual condensate bleed valve 8. 20-litre air tanks – 9. Pressure switch (opening pressure 8 bars) – 10. MUX electric system

* pressure sensor only present in vehicles with optional "Axles Load Measurement" (ECAS CAN 2)

Working diagram of suspensions for 4x2T/FP-LT

Figure 13

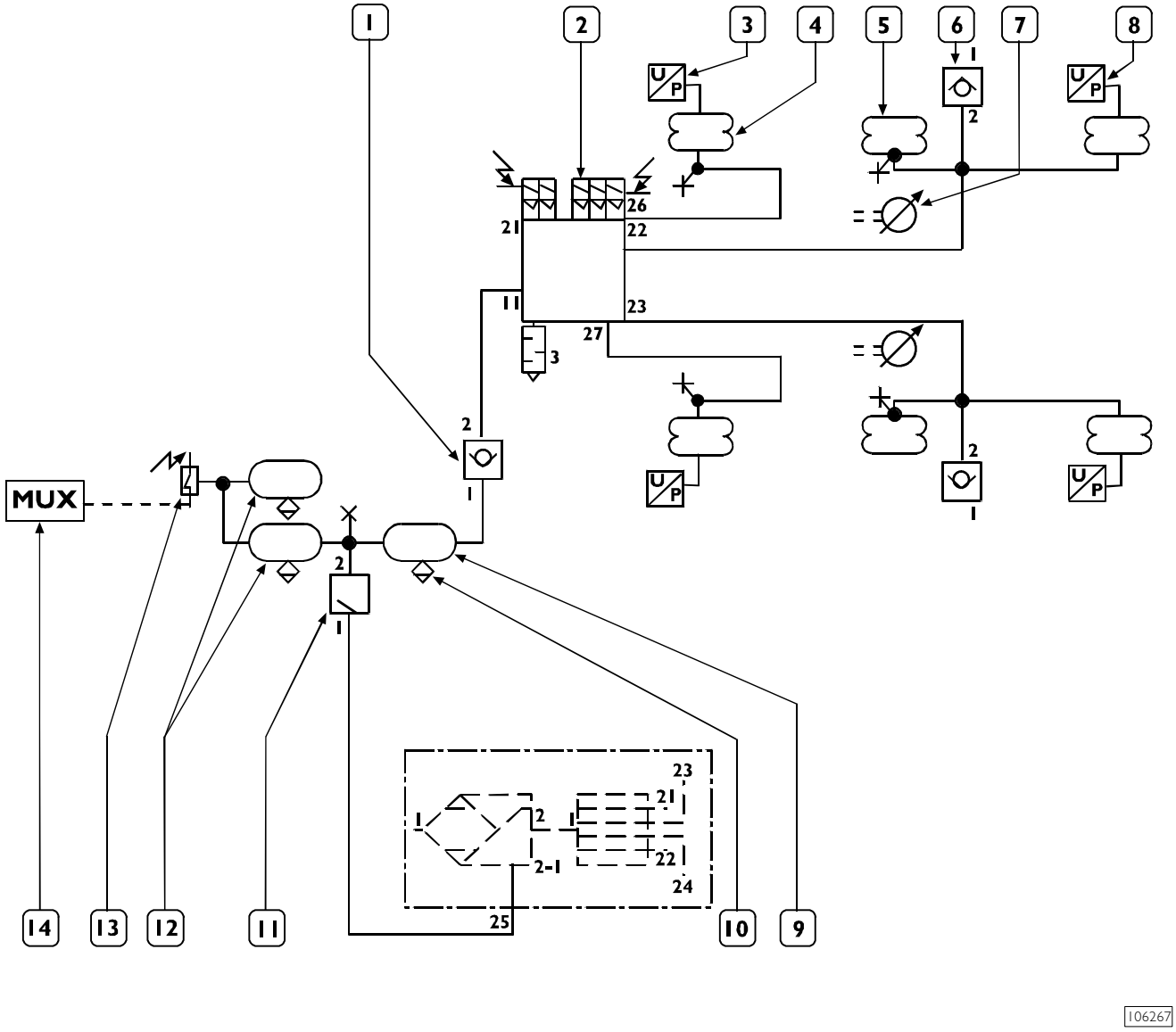


1. Front level sensor – 2. Front axle air spring – 3. Front electro-pneumatic control valve – 4. Rear electro-pneumatic control valve – 5. Rear level sensor – 6. Pressure test point – 7. Rear axle air spring – 8. Check valve – 9. Controlled pressure valve with limited return (opening pressure 8.5 bars) – 10. Manual condensate bleed valve – 11. 20-litre air tanks – 12. Pressure switch (opening pressure 8 bars) – 13. MUX electric system

* pressure sensor only present in vehicles with optional "Axles Load Measurement" (ECAS CAN 2)

Working diagram of pneumatic suspensions for tractors 6x2TX/P (without added axle lifter)

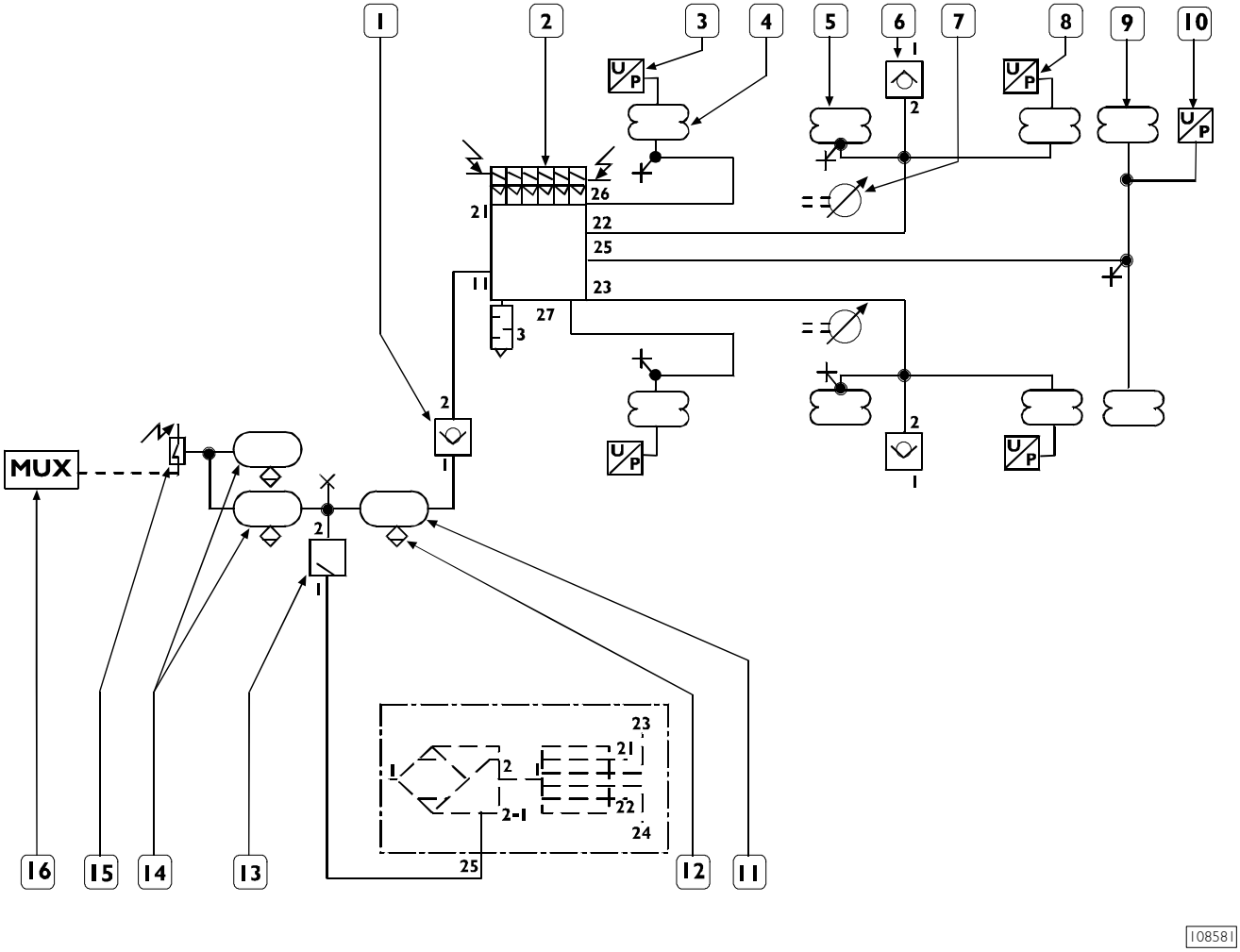
Figure 14



1. Check valve – 2. Rear and second steering axle electro-pneumatic control valve – 3. Central added axle suspension pressure switch – 4. Second steering axle air spring – 5. Pressure test point – 6. Rear axle air spring – 7. Rear level sensor 8. Pressure sensor – 9. 15-litre air tank – 10. Manual condensate bleed valve – 11. Controlled pressure valve with limited return (opening pressure 8.5 bars) – 12. 20-litre air tanks – 13. Pressure switch (opening pressure 8 bars) – 14. MUX electric system.

Working diagram of pneumatic suspensions for tractors 6x2TX/P (with added axle lifter)

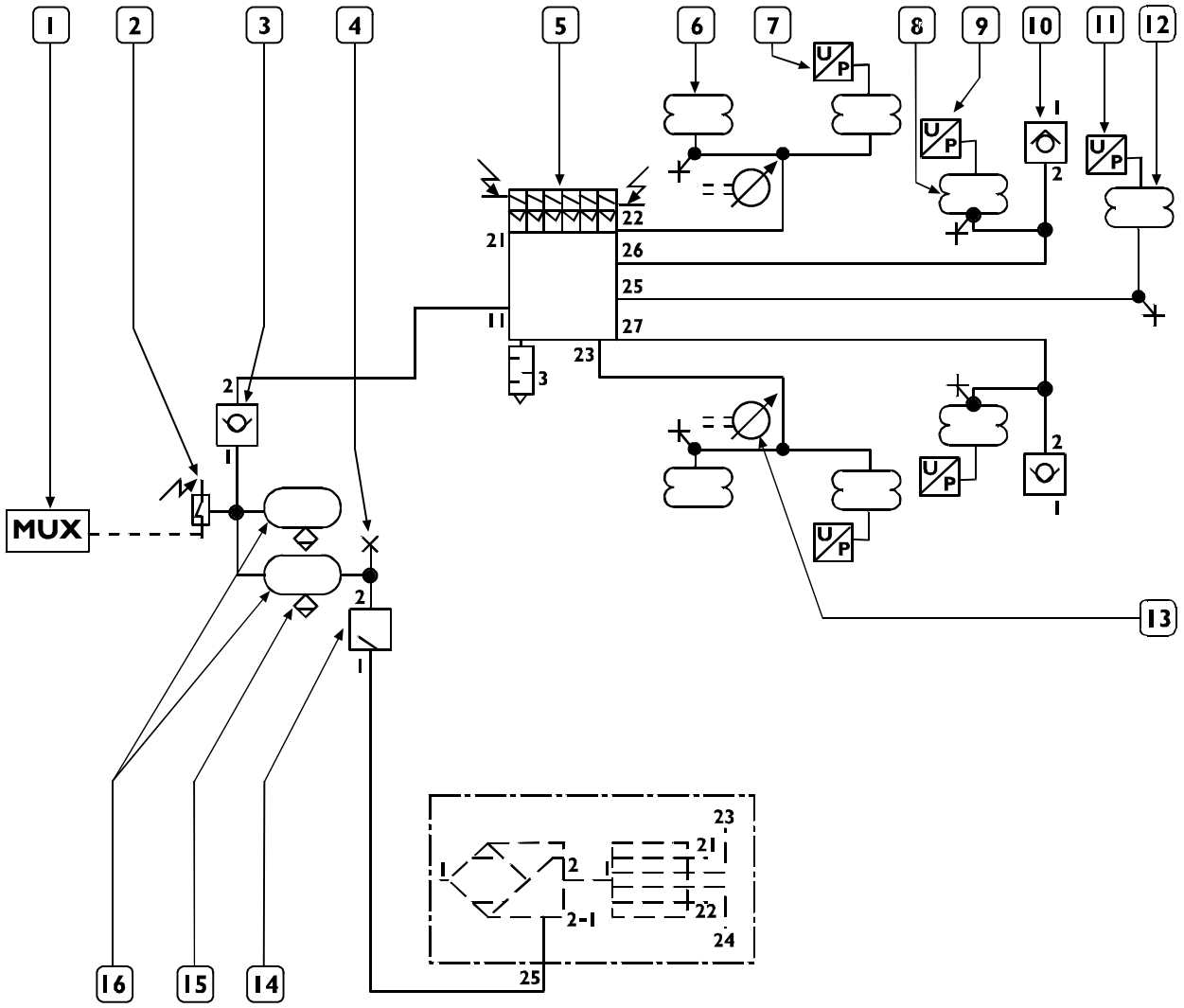
Figure 15



1. Check valve – 2. Rear and second steering axle electro-pneumatic control valve – 3. Central added axle suspension pressure switch – 4. Second steering axle air spring – 5. Pressure test point – 6. Rear axle air spring – 7. Rear level sensor 8. Pressure sensor – 9. Central added axle lifter air spring - 10. Central added axle lifter pressure switch 11. 15-litre air tank – 12. Manual condensate bleed valve – 13. Controlled pressure valve with limited return (opening pressure 8.5 bars) – 14. 20-litre air tanks – 15. Pressure switch (opening pressure 8 bars) – 16. MUX electric system.

Principle scheme of rear air spring suspensions for lorries 6x2Y/PS (with added axle lifter)

Figure 16

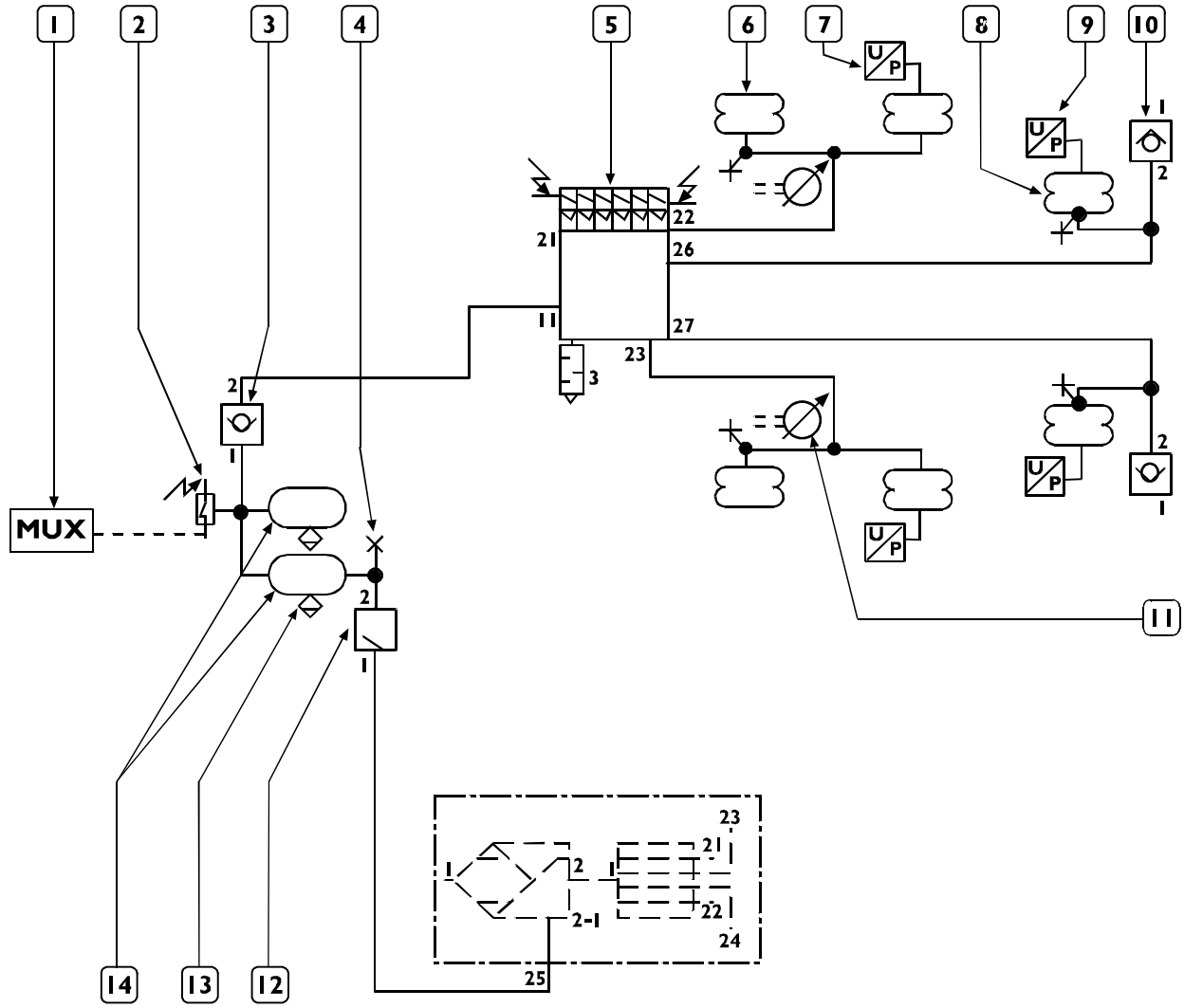


1. MUX electric system – 2. Pressure switch (opening pressure 8 bars) – 3. Check valve – 4. Pressure test point – 5. Rear axle electro-pneumatic control valve – 6. Rear axle air spring – 7. Rear axle suspension pressure switch – 8. Rear added axle air spring – 9. Rear added axle suspension pressure switch – 10. Check valve * - 11. Rear added axle lift pressure switch 12. Rear added axle lift air spring – 13. Level sensor – 14. Controlled pressure valve with limited return (opening pressure 8.5 bars) – 15. Manual condensate bleed valve – 16. 30-litre air tanks

* (Both need to be fitted on the vehicle with the connection 1 facing downwards.)

Principle scheme of rear air spring suspensions for lorries 6x2Y/PS (without added axle lifter)

Figure 17

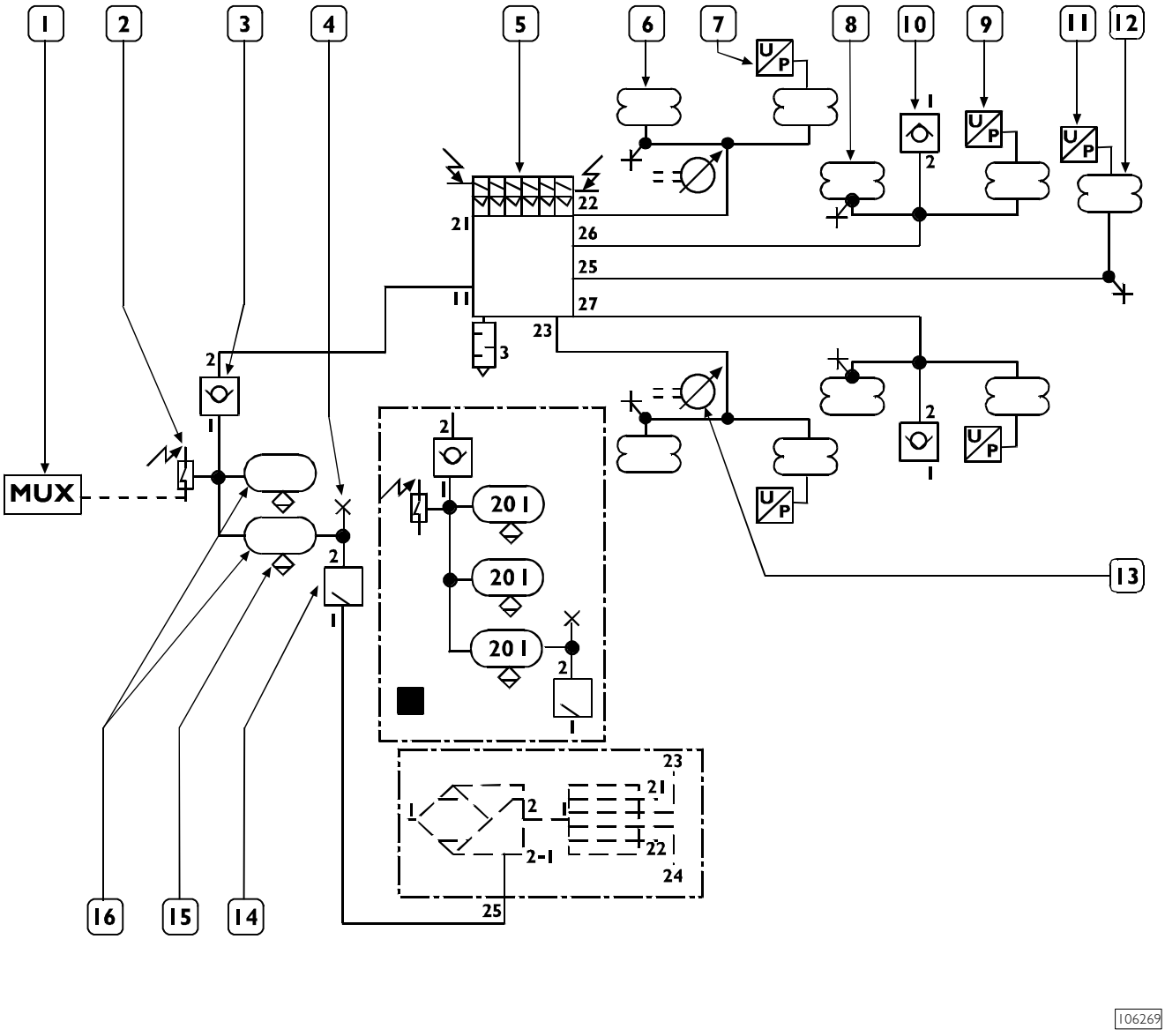


1. MUX electric system – 2. Pressure switch (opening pressure 8 bars) – 3. Check valve – 4. Pressure test point – 5. Rear axle electro-pneumatic control valve – 6. Rear axle air spring – 7. Rear axle suspension pressure switch – 8. Rear added axle air spring – 9. Rear added axle suspension pressure switch – 10. Check valve * - 11. Level sensor – 12. Controlled pressure valve with limited return – 13. Manual condensate bleed valve – 14. 30-litre air tanks

* (Both need to be fitted on the vehicle with the connection 1 facing downwards.)

Principle scheme of rear air spring suspensions for lorries 6x2Y/PT and tractors 6x2TY/PT (with added axle lifter)

Figure 18



106269

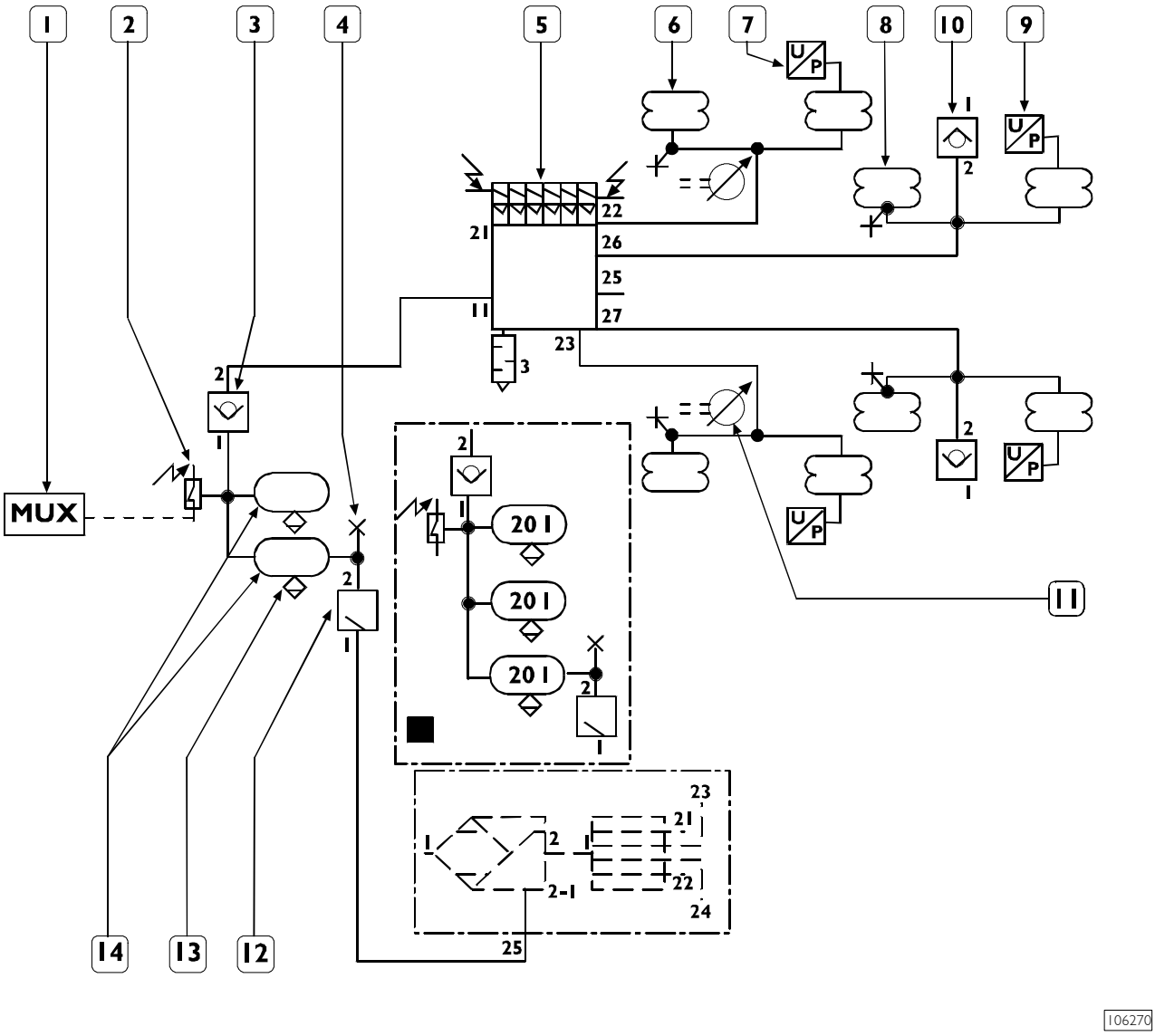
1. MUX electric system – 2. Pressure switch (opening pressure 8 bars) – 3. Check valve – 4. Pressure test point – 5. Rear axle electro-pneumatic control valve – 6. Rear axle air spring – 7. Rear axle suspension pressure switch – 8. Rear added axle air spring – 9. Rear added axle suspension pressure switch – 10. Check valve * - 11. Rear added axle lift pressure switch - 12. Rear added axle lift air spring – 13. Level sensor – 14. Controlled pressure valve with limited return – 15. Manual condensate bleed valve – 16. 30-litre air tanks

* Both need to be fitted on the vehicle with the connection 1 facing downwards.

■ Version: system for tractors (440 S.. TY/PT)

Principle scheme of rear air spring suspensions for lorries 6x2Y/PT and tractors 6x2TY/PT (without added axle lifter)

Figure 19



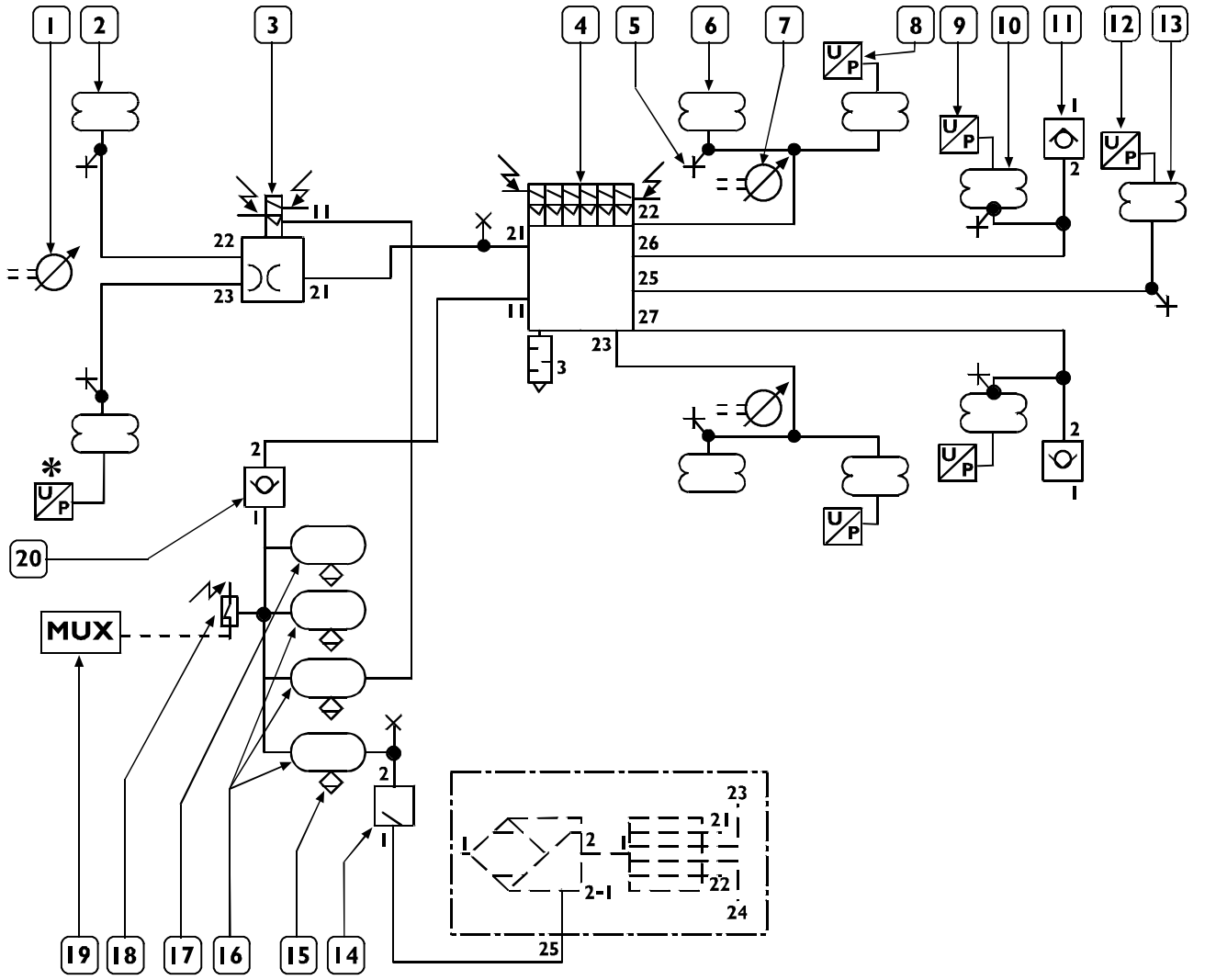
1. MUX electric system – 2. Pressure switch (opening pressure 8 bars) – 3. Check valve – 4. Pressure test point – 5. Rear axle electro-pneumatic control valve – 6. Rear axle air spring – 7. Rear axle suspension pressure switch – 8. Rear added axle air spring – 9. Rear added axle suspension pressure switch – 10. Check valve * – 11. Level sensor – 12. Controlled pressure valve with limited return – 13. Manual condensate bleed valve – 14. 30-litre air tanks

* Both need to be fitted on the vehicle with the connection 1 facing downwards.

■ Version system for tractors (440 S.. TY/PT)

Principle scheme of air spring suspensions for lorries 6x2Y/FP/FS-CM (with added axle lifter)

Figure 20

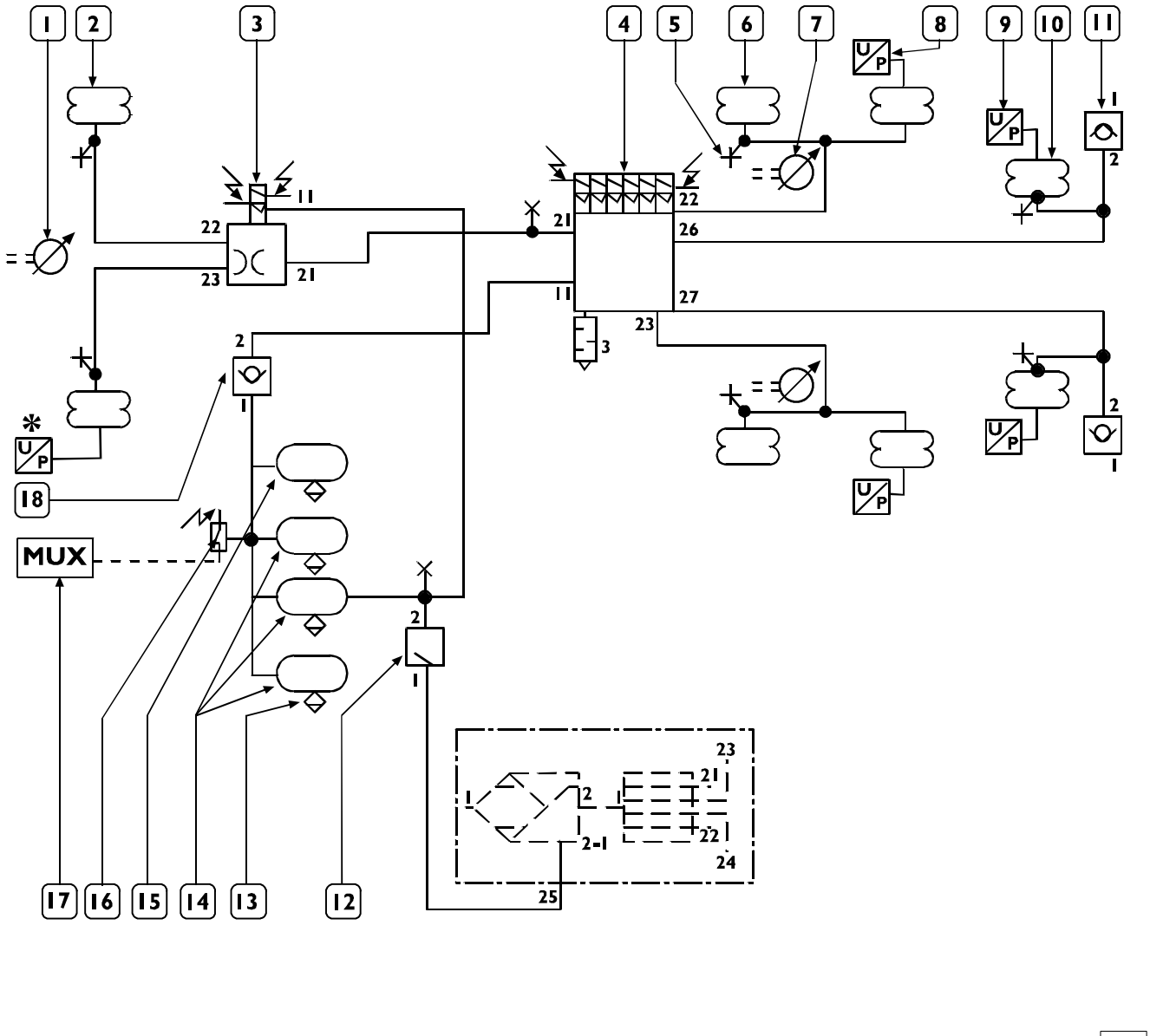


1. Front level sensor – 2. Front axle air spring – 3. Front axle electro-pneumatic control valve – 4. Rear and added third axle electro-pneumatic control valve– 5. Pressure test point – 6. Rear axle air spring – 7. Rear level sensor– 8. Rear axle suspension pressure switch – 9. Rear added axle suspension pressure switch – 10. Rear added axle air spring – 11. Check valve– 12. Rear added axle lift pressure switch – 13. Rear added axle lift air spring –14. Controlled pressure valve with limited return (opening pressure 8.5 bars)– 15. Manual condensate bleed valve – 16. 30-litre air tank – 17. 80-litre air tank 18. Pressure switch (opening pressure 8 bars) 19. MUX electric system – 20. Check valve

* pressure sensor only present in vehicles with optional "Axles Load Measurement" (ECAS CAN 2)

Principle scheme of air spring suspensions for lorries 6x2Y/FP/FS-CM (without added axle lifter)

Figure 21

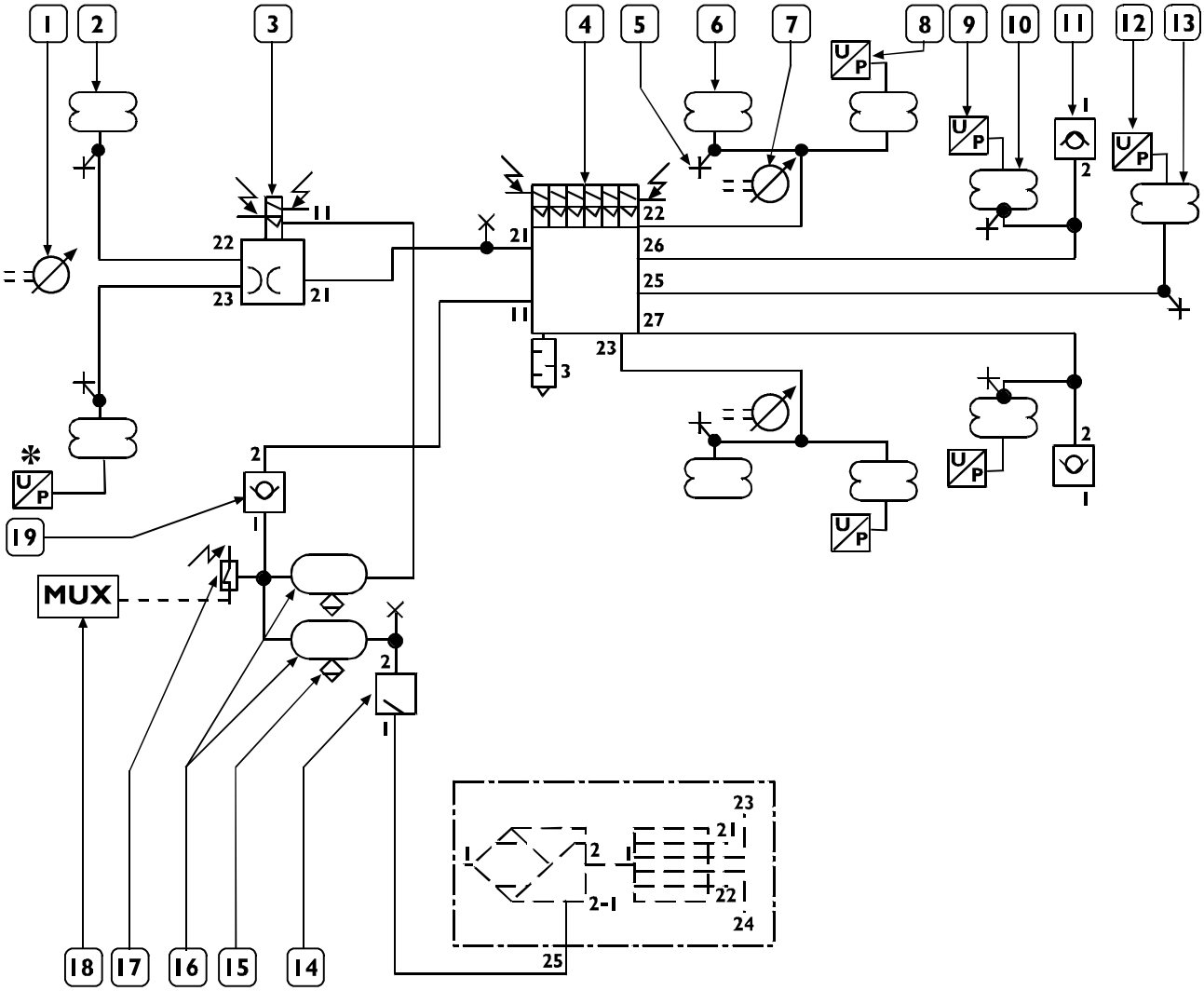


1. Front level sensor – 2. Front axle air spring – 3. Front axle electro-pneumatic control valve – 4. Rear and added third axle electro-pneumatic control valve– 5. Pressure test point – 6. Rear axle air spring – 7. Rear level sensor– 8. Rear axle suspension pressure switch – 9. Rear added axle suspension pressure switch – 10. Rear added axle air spring – 11. Check valve– 12. Controlled pressure valve with limited return (opening pressure 8.5 bars) – 13. Manual condensate bleed valve –14. 30-litre air tank – 15. 80-litre air tank – 16. Pressure switch (opening pressure 8 bars) – 17. MUX electric system 18. Check valve

* pressure sensor only present in vehicles with optional "Axles Load Measurement" (ECAS CAN 2)

Principle scheme of air spring suspensions for lorries 6x2Y/FP/FS-GV (with added axle lifter)

Figure 22

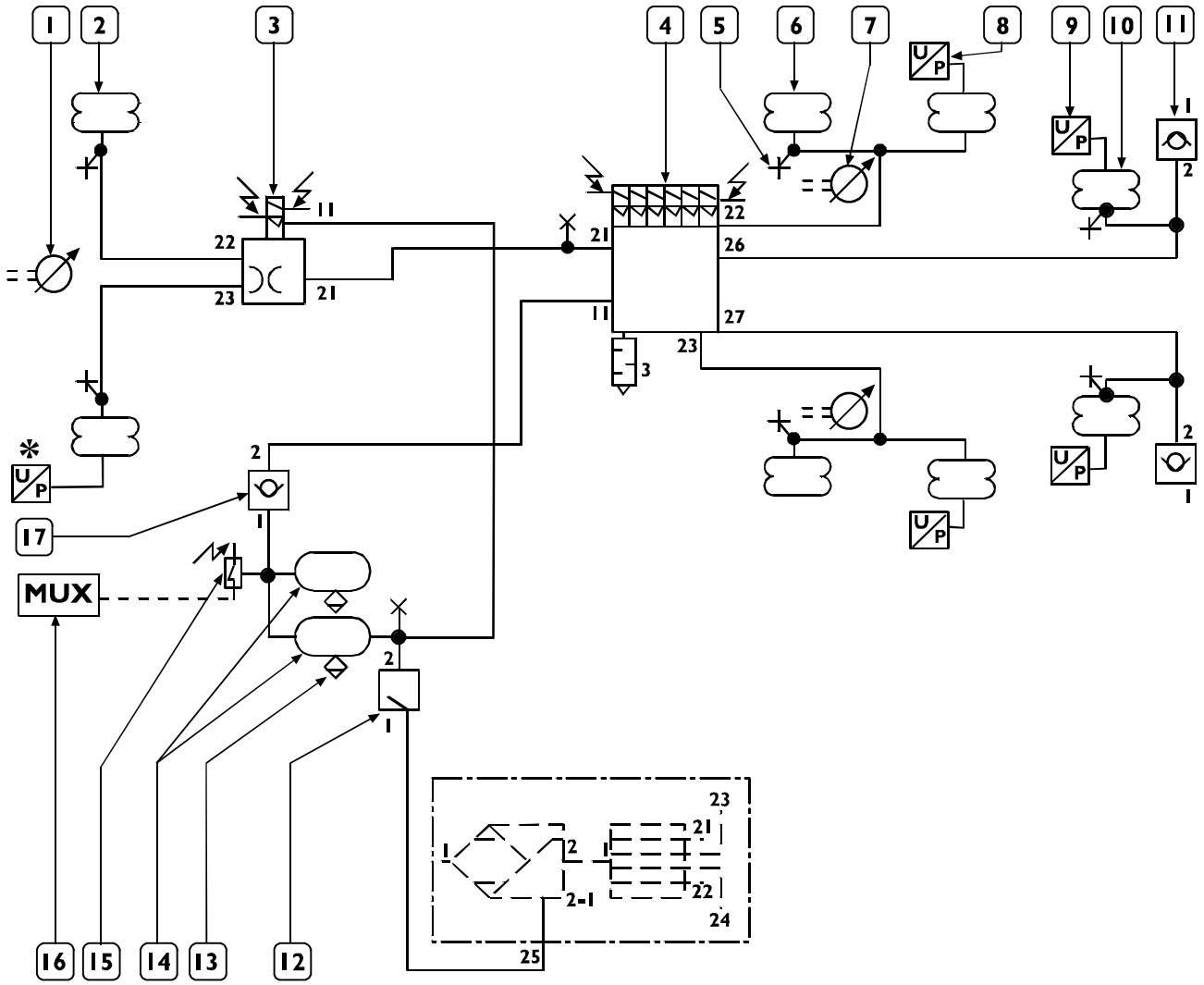


1. Front level sensor – 2. Front axle air spring – 3. Front axle electro-pneumatic control valve – 4. Rear and added third axle electro-pneumatic control valve– 5. Pressure test point – 6. Rear axle air spring – 7. Rear level sensor– 8. Rear axle suspension pressure switch – 9. Rear added axle suspension pressure switch – 10. Rear added axle air spring – 11. Check valve– 12. Rear added axle lift pressure switch – 13. Rear added axle lift air spring –14. Controlled pressure valve with limited return (opening pressure 8.5 bars)– 15. Manual condensate bleed valve – 16. 30-litre air tank – 17. Pressure switch (opening pressure 8 bars) 18. MUX electric system – 19. Check valve

* pressure sensor only present in vehicles with optional "Axles Load Measurement" (ECAS CAN 2)

Principle scheme of air spring suspensions for lorries 6x2Y/FP/FS-GV (without added axle lifter)

Figure 23

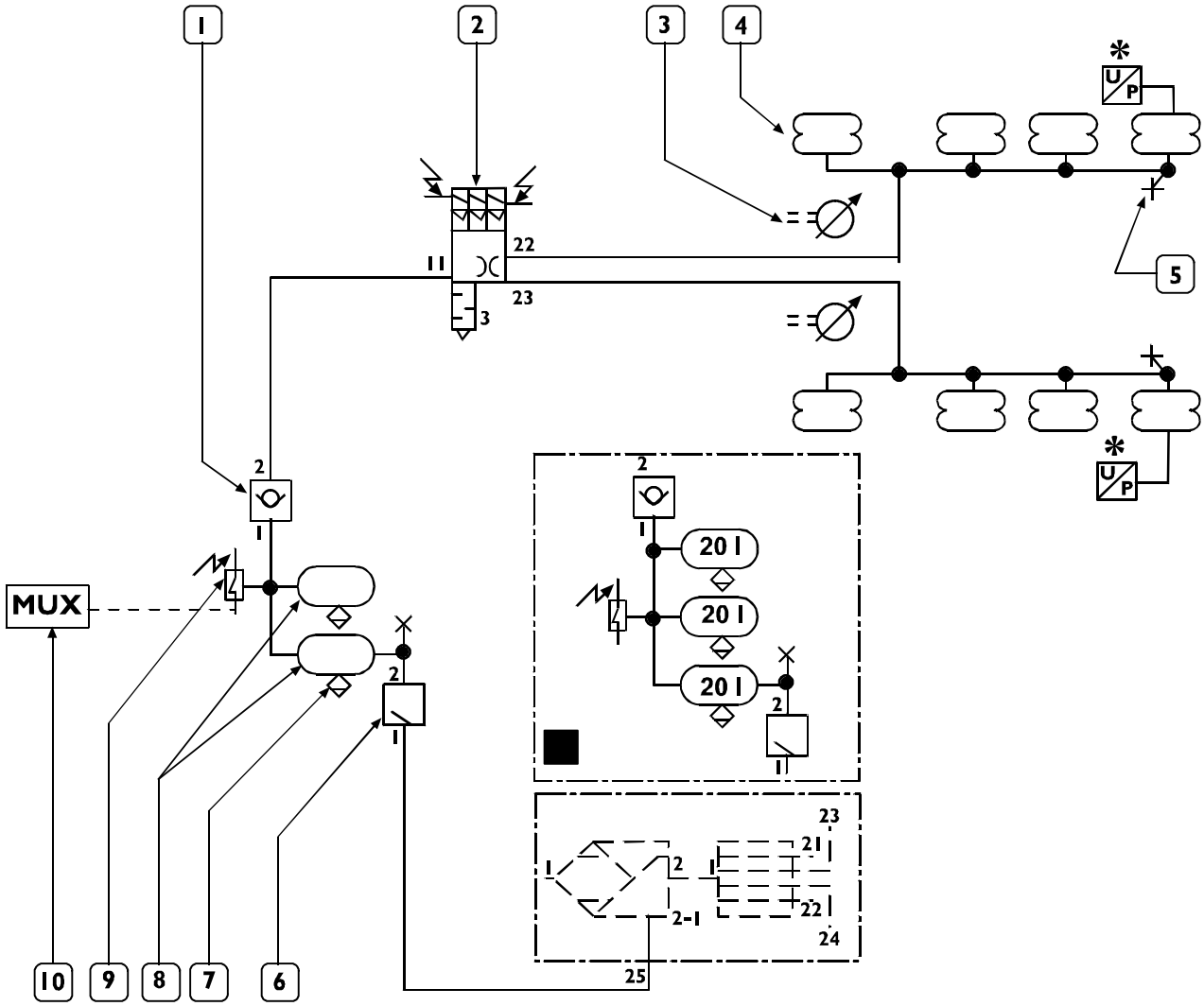


1. Front level sensor – 2. Front axle air spring – 3. Front electro-pneumatic control valve – 4. Rear and added third axle electro-pneumatic control valve– 5. Pressure test point – 6. Rear axle air spring – 7. Rear level sensor– 8. Rear axle suspension pressure switch – 9. Rear added axle suspension pressure switch – 10. Rear added axle air spring – 11. Check valve– 12. Controlled pressure valve with limited return (opening pressure 8.5 bars) – 13. Manual condensate bleed valve –14. 30-litre air tank – 15. Pressure switch (opening pressure 8 bars) – 16. MUX electric system – 17. Check valve

* pressure sensor only present in vehicles with optional "Axles Load Measurement" (ECAS CAN 2)

Working diagram of pneumatic rear suspensions for 6x4 tractors and lorries

Figure 24



1. Check valve – 2. Rear axle electro-pneumatic control valve – 3. Rear level sensor – 4. Rear axle air spring – 5. Pressure test point – 6. Controlled pressure valve with limited return (opening pressure 8.5 bars) – 7. Manual condensate bleed valve – 8. 30-litre air tanks – 9. Pressure switch (opening pressure 8 bars) – 10. MUX electric system

■ System version for tractors with 3200 wheel base

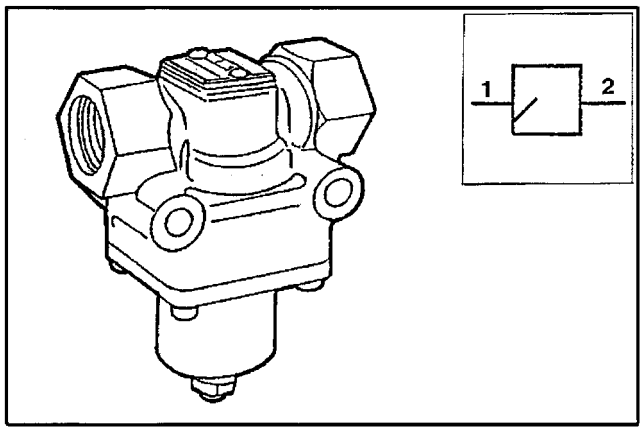
* pressure sensor only present in vehicles with optional "Axles Load Measurement" (ECAS CAN 2)

CHARACTERISTICS AND DATA
Pneumatic System

DESCRIPTION	
Controlled pressure valve	
❑ Type: KNORR-BREMSE DR 4248 - WABCO 434 100 299	
Opening pressure	8,5 $^{+0}_{-0,3}$ bar
Electro-pneumatic control valves	
❑ Type: WABCO: • 472 880 020 – cab-equipped vehicles:4x2 F/P - 6x2p/FP;tractors: 4x2 T/FP • 472 880 030 – tractors: 4x2 T/P • 472 880 001 – cab-equipped vehicles: 4x2 P/FP - 6x4/P;tractors: 4x2 T/FP - 6x4 T/P • 472 880 103 – cab-equipped vehicles: 6x2p/P/FP;tractors: 6x2pT/P • 472 880 100 – tractors: 6x2cT/P	
Supply voltage	24V
Nominal current	0.34A
Working pressure	5 ÷ 13 bar
Level sensors	
❑ Type: WABCO 441 050 120	
Supply voltage	Pulse 5 to 16 V
Measuring principle	Inductive
Current input	Max 90 mA
Working range of lever	Max 100°
Check valve	
❑ Type: VOSS 56900209	
Maximum working pressure	12 bar
Suspension pressure switch	
❑ Type: WABCO 441 044 002	
Supply voltage	8 ÷ 32 V
Current input	≤ 15 mA
Measuring range	0 ÷ 10 bar
Permissible overpressure	16 bar
Tightening torque	27 ± 2 Nm
Low air pressure switch	
❑ Type: TDS F13046 S	
Working voltage	12/24 V
Permissible electric load	0.01 ÷ 1 A
Maximum working pressure	12 bar
Maximum tightening torque	30Nm
Calibration with decreasing pressure	6.6 + 0.3 bar
Hysteresis with increasing pressure	0.1 + 0.5 bar
Manual condensate bleed valve	
❑ Type: VOSS 52089975	
Maximum working pressure	13 bar
Air tanks	
Tanks	80 Litres
Tanks	30 Litres
Tanks	20 Litres
Tanks	15 Litres
Electronic control unit	
❑ WABCO 446170211 (vehicles 4x2 - 6x4 without axle load measuring options)	
❑ WABCO 446170212 (vehicles 4x2 - 6x4 with axle load measuring options and vehicles 6x2 with and without axle load measuring options)	
Supply voltage	24 Volt

MAIN COMPONENTS OF THE PNEUMATIC SYSTEM

Figure 25



793824 Controlled pressure valve

This limited return valve fulfils two functions:

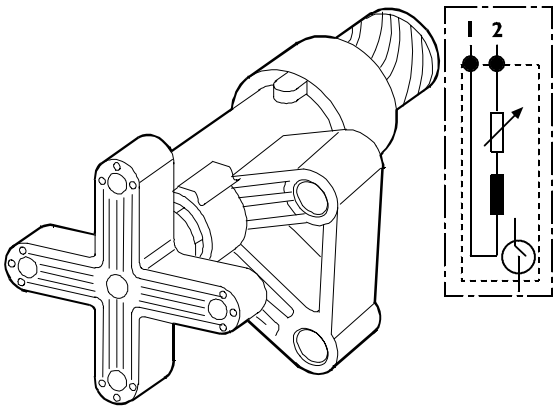
- It cuts off the flow of compressed air supplying the tanks when the pressure in the tanks falls under a certain level (setting) after a breakdown or due to excessive drawing;
- It supplies these tanks as soon as the braking system reaches a value ensuring fully efficiency for the brakes.

Fault Diagnosis

TROUBLE	POSSIBLE CAUSE	REMEDY
Exhaust leak	Leakage from diaphragm	Overhaul the appliance, replacing worn parts
Air leak from joint of half-bodies	Leakage from the diaphragm fitting	
Delivery leak (into the atmosphere) with supply at a lower pressure than the setting	Leakage from the inlet valve or its seat	Overhaul the appliance, replacing worn parts.

Level sensor

Figure 26



The level sensor constantly informs the electronic control unit on the change in attitude of the chassis frame with the road surface.

The sensor comprises a coil, secured on the chassis frame, in which a piston moves that is connected via a cam to the lever, which is anchored to the vehicle axle.

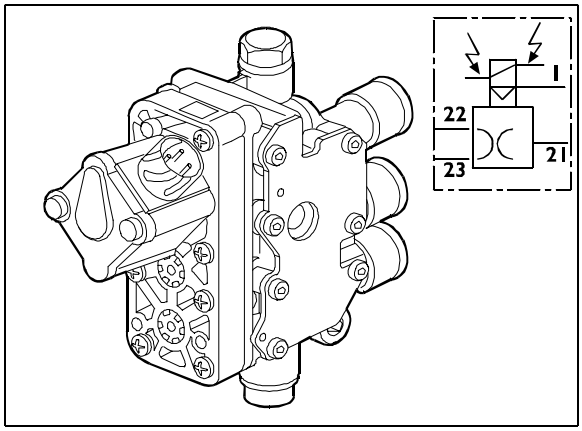
With a change in height between the chassis frame and vehicle axis, the lever turns, moving the piston that accordingly changes the inductance of the coil wired to the electronic control unit.

Electro-Pneumatic Control Valve

The electro-pneumatic control valve comprises a set of electromagnetic valves whose concentration reduces both the volume of the structure and the use of connections.

The solenoid valves are controlled directly by the electronic control unit and make it possible to increase, decrease or hold the volume of air in the pneumatic cells.

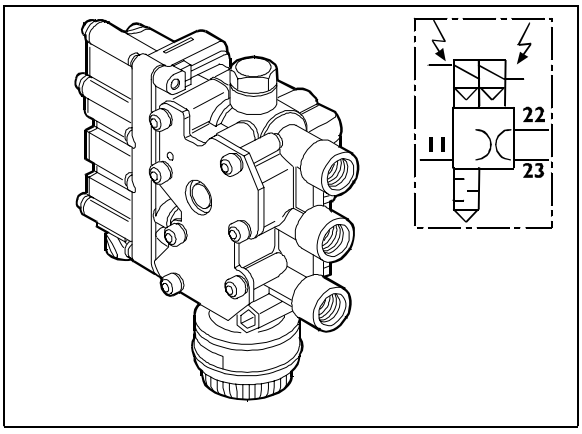
Figure 27



73808

FRONT AXLE ELECTRO-PNEUMATIC CONTROL VALVE
for tractors 4x2 FP and cab-equipped vehicles 4x2 FP - 6x2 FP

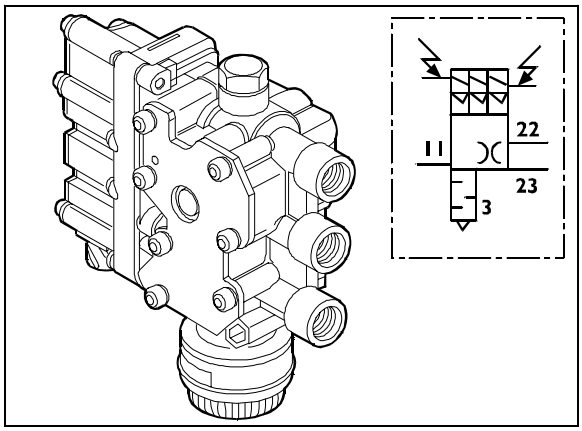
Figure 28



73809

REAR AXLE ELECTRO-PNEUMATIC CONTROL VALVE
for 4x2 P tractors

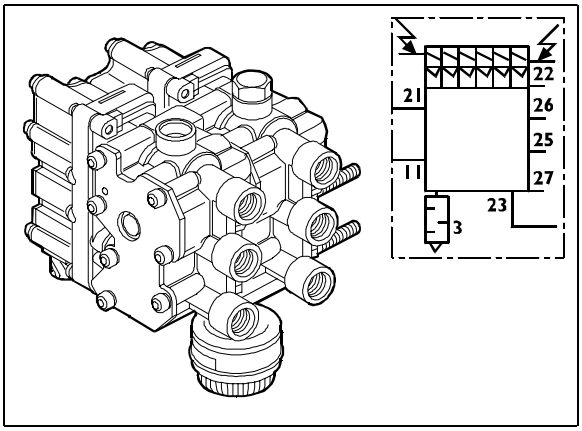
Figure 29



73810

REAR AXLE ELECTRO-PNEUMATIC DISTRIBUTOR
for tractors 4x2 FP - 6x4 P and cab-equipped vehicles 4x2 P/FP - 6x4 P

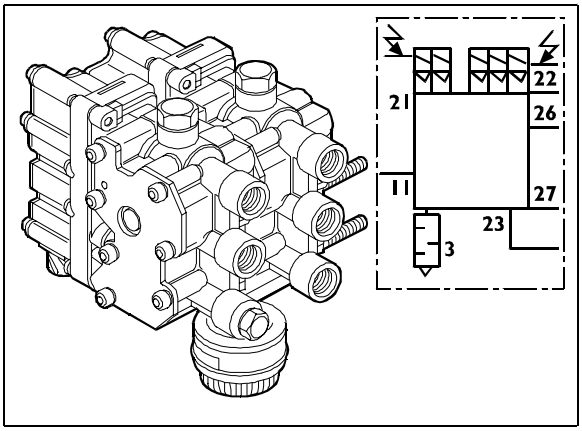
Figure 30



73811

REAR AXLE ELECTRO-PNEUMATIC CONTROL VALVE
for 6x2 P/FP chassis cabs and tractors 6x2 P

Figure 31

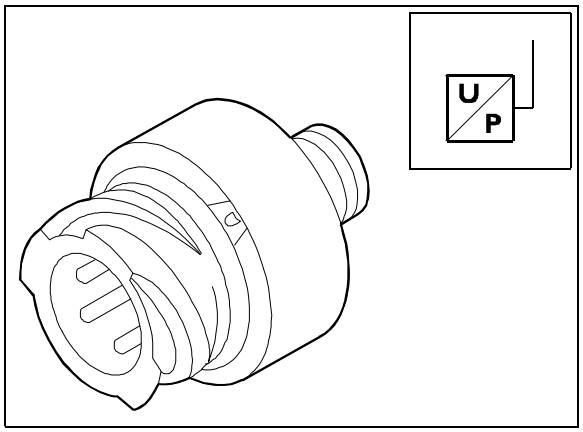


73813

REAR AXLE ELECTRO-PNEUMATIC CONTROL VALVE
for 6x2 TxP tractors

Load detector pressure sensor

Figure 32

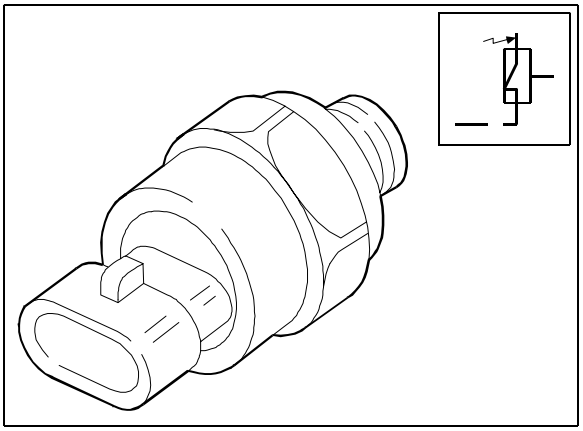


52722

Suspensions pressure switches are located on pneumatic cells. Pressure switches transduce pressure into an electrical signal in order to acquaint central unit about the conditions of load on affected axles so as to enable possible automatic lifting and lowering, as well as help means during vehicle take-off step.
In vehicles with ECAS CAN 2 system, additional measurement of the load on the axles, and display of this information directly on the Cluster are available.

Low air pressure switch

Figure 33



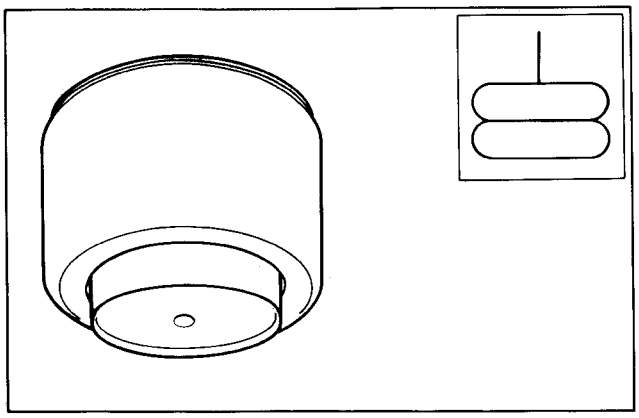
52723

The pressure switch is located near the service air tank on the delivery pipe for the air suspensions.

Its function is to signal a low supply pressure (< 8 bars) via the optical indicator on the instrument panel.

5007 Air spring

Figure 34

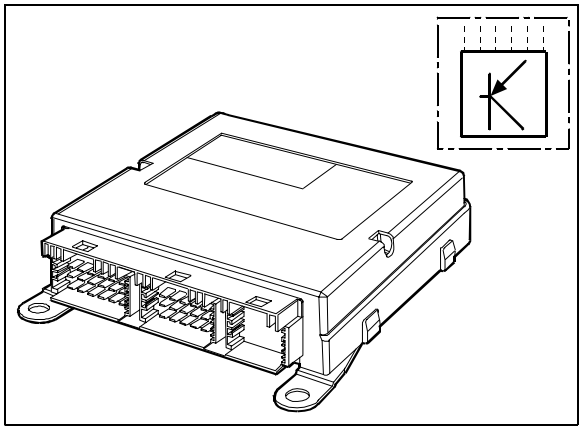


30106

This flexible element is designed to contain pressurized air and is capable of changing its extension irrespective of the load applied.

ECAS Control Unit

Figure 35



73819

The electronic control unit keeps the vehicle's chassis frame at a constant height off the ground according to the data stored in it or set by the driver.

DIAGNOSTICS

Fault diagnosis comprises two sections:

- The first one, organized by error codes (DTC-FMI), concerns faults that may be identified by the ECAS control unit directly. These faults are mainly of an electric – electronic – pneumatic nature.
- The second one, organized by symptoms, describes the possible faults the electronic control unit cannot identify directly. These faults are mainly of a mechanical nature.

SECTION 1

ECAS system troubleshooting can be performed with the Cluster or with the diagnosis instruments Modus, E.A.SY. and IT 2000.

Diagnosis with the cluster makes it possible to estimate the situation of faults in the system in advance, while the diagnosis instruments are essential to perform thorough diagnosis and operate on the single faults correctly.

Each single instrument displays the diagnosis and repair help.

Diagnosis Instruments

MODUS (Maintenance and Diagnostic System)

A computerized fault-diagnosis station dedicated to diagnosing the brake systems, air suspensions, engines and systems controlled electronically.

The station is equipped with auxiliary functions, such as: programming electronic control units, consulting the spare parts catalogue and service time schedules.

The vehicle has a 30-pin diagnosis socket to interface with the instrument.

IT 2000 (IVECO Electronic Tester)

This makes it possible to take immediate action on the vehicle, identifying it with the chassis number.

It saves the results of diagnostics actions performed.

It can be used as a portable Personal Computer, too, being fitted for remote diagnosis.

By using MODUS as the mother station it is possible to update and configure the IT 2000.

IT 2000 interfaces with the vehicle via a 30-pin diagnosis socket.

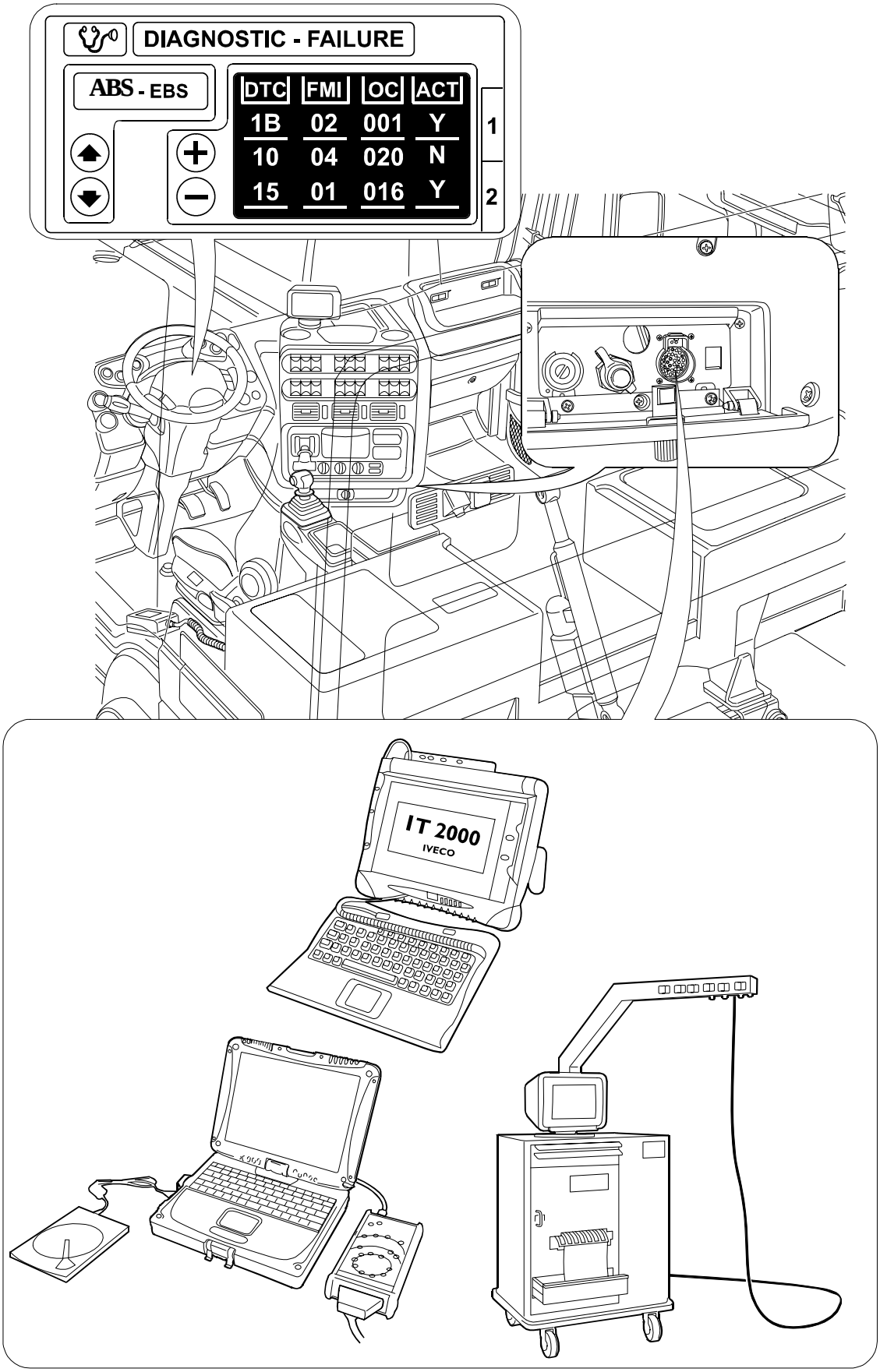
E.A.SY.

E.A.SY. system allows to simply make the diagnosis and programming of the various electronic central units aboard the vehicle.

E.A.SY. system is made up of ECI module communicating with the electronic central units and of a Panasonic PC.

ECI module, exploiting the Panasonic PC, also allows easy on the road interventions: in particular, thanks to Panasonic PC wireless technologies (e.g. GPRS), diagnostic interventions can be assisted by a remote expert centre.

Figure 36

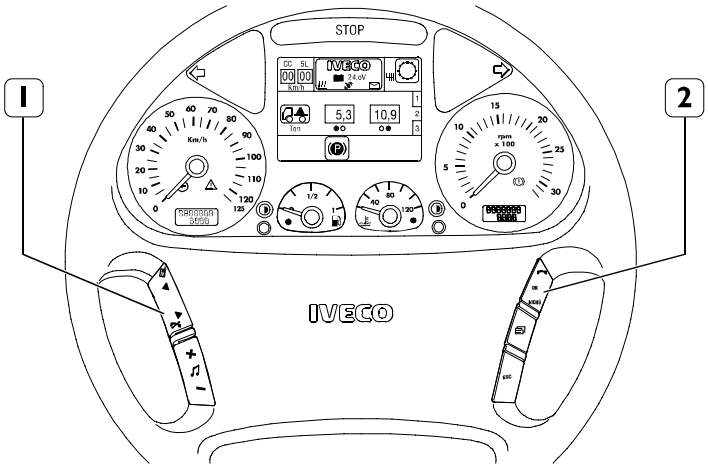


106212

Cluster Diagnosis

It is possible to access the fault memory with the "menu" function key 2 on the steering wheel.

Figure 37



With the ignition key on MAR (+15), press the "menu" function key 2; the display will show a dialogue menu containing a list of the available functions (e.g., Hi-Fi, phone, diagnostics, etc.).

With the ▲ 1 and 1 ▼ function keys, select the diagnosis function and confirm the selection with the "OK" function key 2.

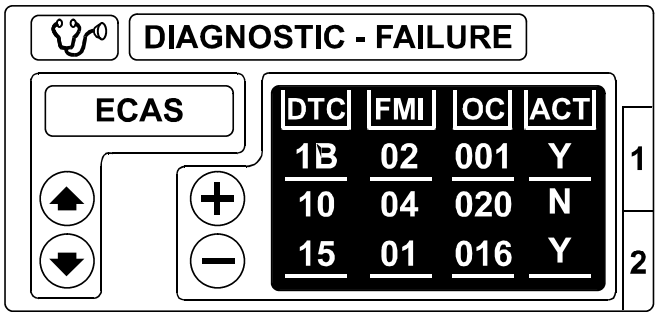
Select the ECAS system with the select/confirm keys 1 and 2.

Select the ECAS system with the select/confirm keys 1 and 2.

The cluster will display the first diagnostics screen.

After selecting the system, ECAS is displayed on a red or green background depending on whether there is any trouble.

Figure 38

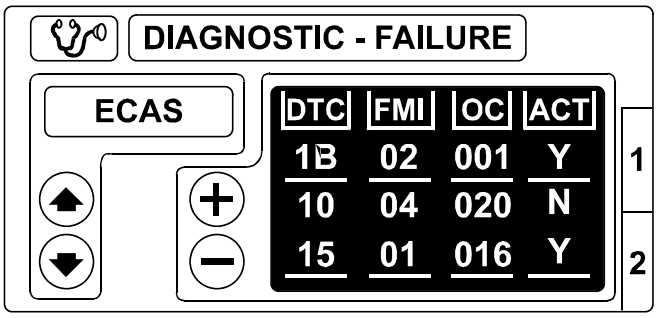


The diagnosis information shown on the cluster is split up on two screens:

- On the first one, it is possible to consult and scroll through all saved/present trouble.
- On the second one, it is possible to delete the intermittent errors (when you have the relevant password).

FIRST SCREEN

Figure 39



The information on the single faults is arranged on four columns with the following content:

DTC	FMI	OC	ACT
Displays the fault code number	Indicates the type of fault	Fault frequency meter	Fault active/not active status
Two digits (hexadecimal)	Two digits (hexadecimal)	Three digits (hexadecimal)	One character (Y = Yes, N = No)

Troubleshooting via DTC-FMI codes described under the relevant section completes the above information. Each pair of DTC-FMI codes is associated with a description of the fault, the possible system reaction and recommended repairs with the relevant checks.

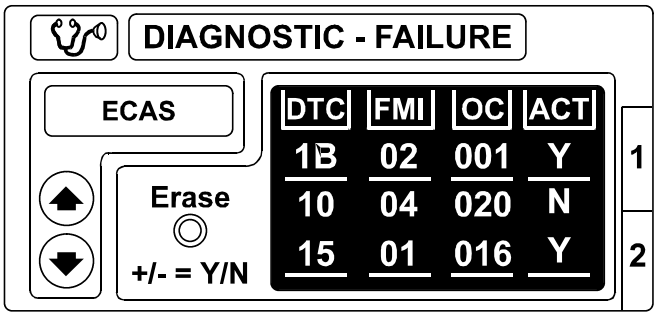
SECOND SCREEN

Deleting Errors

To select the second screen, press "page" on the steering wheel.
The fault display is eliminated as follows:

- ❑ Press "+", on the request to confirm deletion, press OK.
- ❑ Enter the required password (see the ENTERING PASSWORD paragraph).
- ❑ Press OK to confirm.

Figure 40



Entering the Password

Figure 41

Select the first number of the password with the ▲ I and I ▼ keys.
Press OK to confirm each number.
Press ◀ to delete the last number selected.
On completing the password, select the key symbol to confirm.

Troubleshooting via DTC-FMI codes

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
		ELECTRO-VALVES - ADDI-TIONAL AXLE LIFT-ING	SHORT CIRCUIT TO POSI-TIVE	Additional axle control deacti-vated.	Additional axle lifting solenoid valve locked closed.	Check wiring and con-nectors on additional axle control solenoid valve. Check: Check isolation from - battery pin 1 - X3 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				
		ELECTRO-VALVES - ADDI-TIONAL AXLE LIFT-ING	OPEN CIR-CUIT	Additional axle control deacti-vated.	Additional axle lifting solenoid valve locked closed.	Check wiring and con-nectors on additional axle control solenoid valve. Check: Check continu-ity between pins 4 - X2 / 1 - X3 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 70 - 90 Ohm				
		ELECTRO-VALVES - ADDI-TIONAL AXLE LIFT-ING	SHORT CIRCUIT TO GROUND	Additional axle automatically lowered.	Additional axle lifting solenoid valve locked open.	Check wiring and con-nectors on additional axle control solenoid valve. Check: Check isolation from - battery pin 1 X3 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: > 1 Mohm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
01	03	ELECTRO-VALVES - FRONT SOLE-NOID VALVE	SHORT CIRCUIT TO POSI-TIVE	Front and rear axles automatic controls deacti-vated. Front axle manual controls deactivated.	Front axle sole-noid valve locked closed.	Check wiring and con-nectors on front frame control solenoid valve. Check: Check isolation from + battery pin 15 - X2 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				
01	05	ELECTRO-VALVES - FRONT SOLE-NOID VALVE	OPEN CIR-CUIT	Front and rear axles automatic controls deacti-vated. Front axle manual controls deactivated.	Front axle sole-noid valve locked closed.	Check wiring and con-nectors on front frame control solenoid valve. Check: Check continu-ity pins 4 - 15 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 70 - 90 Ohm				
01	06	ELECTRO-VALVES - FRONT SOLE-NOID VALVE	SHORT CIRCUIT TO GROUND	Front axle auto-matically lowered.	Front axle sole-noid valve locked open.	Check wiring and con-nectors on front frame control solenoid valve. Check: Check isolation from - battery pin 15 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: > 1 Mohm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
03	03	ELECTRO-VALVES - REAR RIGHT	SHORT CIRCUIT TO POSI-TIVE	Rear axles auto-matic controls deactivated.	RH engine axle solenoid valve locked closed.	Check wiring and con-nectors on RH engine axle frame control solenoid valve. Check: Check isolation from - battery pin 13 - X2 / 7 -10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				
03	05	ELECTRO-VALVES - REAR RIGHT	OPEN CIR-CUIT	Rear axles auto-matic controls deactivated.	RH engine axle solenoid valve locked closed.	Check wiring and con-nectors on RH engine axle frame control solenoid valve. Check: Check continu-ity pins 4 - 13 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 70 - 90 Ohm				
03	06	ELECTRO-VALVES - REAR RIGHT	SHORT CIRCUIT TO GROUND	RH side engine axle automatically lowered.	RH engine axle solenoid valve locked open.	Check wiring and con-nectors on RH engine axle frame control solenoid valve. Check: Check isolation from - battery pin 13 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: > 1 Mohm				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
04	03	ELECTRO-VALVES - REAR LEFT	SHORT CIRCUIT TO POSI-TIVE	Rear axles auto-matic controls deactivated.	LH engine axle solenoid valve locked closed.	Check wiring and con-nectors on LH engine axle frame control solenoid valve. Check: Check isolation from - battery pin 10 - X2 /7 - 10 X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				
04	05	ELECTRO-VALVES - REAR LEFT	OPEN CIR-CUIT	Rear axles auto-matic controls deactivated.	LH engine axle solenoid valve locked closed.	Check wiring and con-nectors on LH engine axle frame control solenoid valve. Check: Check continu-ity between pins 4 - 10 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 70 - 90 Ohm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
04	06	ELECTRO-VALVES - REAR LEFT	SHORT CIRCUIT TO GROUND	LH side engine axle automatically lowered.	LH engine axle solenoid valve locked open.	Check wiring and connectors on LH engine axle frame control solenoid valve. Check: Check isolation from - battery pin 10 - X2 /12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: > 1 Mohm				
05	03	ELECTRO-VALVES - REAR RIGHT (THIRD AXLE)	SHORT CIRCUIT TO POSI-TIVE	Rear axles automatic controls deactivated. Raise and auxiliary deactivated at additional axle peak.	RH additional axle solenoid valve locked closed.	Check wiring and connectors on RH additional axle frame control solenoid valve. Check: Check isolation from + battery pin 12 - X2 /7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				
05	05	ELECTRO-VALVES - REAR RIGHT (THIRD AXLE)	OPEN CIR-CUIT	Rear axles automatic controls deactivated. Raise and auxiliary deactivated at additional axle peak.	RH additional axle solenoid valve locked closed.	Check wiring and connectors on RH additional axle frame control solenoid valve. Check: Check continuity between pins 4 - 12 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 70 - 90 Ohm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
05	06	ELECTRO-VALVES - REAR RIGHT (THIRD AXLE)	SHORT CIRCUIT TO GROUND	RH side additional axle automatically lowered.	RH additional axle solenoid valve locked open.	Check wiring and connectors on RH additional axle frame control solenoid valve. Check: Check isolation from - battery pin 12 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: > 1 Mohm				
06	03	ELECTRO-VALVES - REAR LEFT (THIRD AXLE)	SHORT CIRCUIT TO POSITIVE	Rear axles automatic controls deactivated. Raise and auxiliary deactivated at additional axle peak.	LH additional axle solenoid valve locked closed.	Check wiring and connectors on LH additional axle frame control solenoid valve. Check: Check isolation from - battery pin 14 - X2 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				
06	05	ELECTRO-VALVES - REAR LEFT (THIRD AXLE)	OPEN CIRCUIT	Rear axles automatic controls deactivated. Raise and auxiliary deactivated at additional axle peak.	LH additional axle solenoid valve locked closed.	Check wiring and connectors on LH additional axle frame control solenoid valve. Check: Check continuity between pins 4 - 14 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 70 - 90 Ohm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
06	06	ELECTRO-VALVES - REAR LEFT (THIRD AXLE)	SHORT CIRCUIT TO GROUND	LH side additional axle automatically lowered.	LH additional axle solenoid valve locked open.	Check wiring and connectors on LH additional axle frame control solenoid valve. Check: Check isolation from - battery pin 14 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: > 1 Mohm				
07	03	ELECTRO-VALVES - AIR INLET/ OUTLET VALVE	SHORT CIRCUIT TO POSITIVE	Front and rear axles automatic controls deactivated. Raise and auxiliary deactivated at additional axle peak.	Power supply solenoid valve locked closed.	Check wiring and connectors on power supply solenoid valve. Check: Check isolation from - battery pin 11 - X2 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				
07	05	ELECTRO-VALVES - AIR INLET/ OUTLET VALVE	OPEN CIRCUIT	Front and rear axles automatic controls deactivated. Raise and auxiliary deactivated at additional axle peak.	Power supply solenoid valve locked closed.	Check wiring and connectors on power supply solenoid valve. Check: Check continuity between pins 4 - 11 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 70 - 90 Ohm				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
07	06	ELECTRO-VALVES - AIR INLET/ OUTLET VALVE	SHORT CIRCUIT TO GROUND	Front and rear axles automatic controls deactivated. Raise and auxiliary deactivated at additional axle peak.	Power supply solenoid valve locked open.	Check wiring and connectors on power supply solenoid valve. Check: Check isolation from - battery pin 11 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: > 1 Mohm				
10	02	SENSORS - FRONT LEVEL SENSOR	INCORRECT PARAMETERS	No front axle leveling.	Front axle level automatic controls disabled.	Electronic control unit configuration check. Check calibration levels. Check sensor installation and eventual mechanical connection faults.				
10	03	SENSORS - FRONT LEVEL SENSOR	SHORT CIRCUIT TO POSITIVE	No front axle leveling.	Front axle level automatic controls disabled.	Check sensor wiring and connectors. Check: Check isolation from - battery pin 9 - X2 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
10	05	SENSORS - FRONT LEVEL SENSOR	OPEN CIRCUIT	No front axle leveling.	Front axle level automatic controls disabled.	Check sensor wiring and connectors. Check: Check continuity between pins 7 - 9 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 4 - 5 Kohm				
10	06	SENSORS - FRONT LEVEL SENSOR	SHORT CIRCUIT TO GROUND	No front axle leveling.	Front axle level automatic controls disabled.	Check sensor wiring and connectors. Check: Check isolation from - battery pin 9 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: > 1 Mohm				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
12	02	SENSORS - REAR RIGHT LEVEL SENSOR	INCORRECT PARAMETERS	On "4x2 Tractor" - No rear axle leveling. On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous LH sensor fault - No rear axle leveling and auxiliary function deactivated at peak.	1 sensor axle "4x2 Tractors" Deactivation of rear axle level automatic controls. 2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous LH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak.	Electronic control unit configuration check. Check calibration levels. Check sensor installation and eventual mechanical connection faults.				
12	03	SENSORS - REAR RIGHT LEVEL SENSOR	SHORT CIRCUIT TO POSITIVE	On "4x2 Tractor" - No rear axle leveling. On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous LH sensor fault - No rear axle leveling and auxiliary function deactivated at peak.	1 sensor axle "4x2 Tractors" Deactivation of rear axle level automatic controls. 2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous LH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak.	Check sensor wiring and connectors. Check: Check isolation from + battery pin 8 - X2 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
12	05	SENSORS - REAR RIGHT LEVEL SENSOR	OPEN CIRCUIT	On "4x2 Tractor" - No rear axle leveling. On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous LH sensor fault - No rear axle leveling and auxiliary function deactivated at peak.	1 sensor axle "4x2 Tractors" Deactivation of rear axle level automatic controls. 2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous LH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak.	Check sensor wiring and connectors. Check: Check continuity between pins 7 - 8 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 80 - 90 Ohm				
12	06	SENSORS - REAR RIGHT LEVEL SENSOR	SHORT CIRCUIT TO GROUND	On "4x2 Tractor" - No rear axle leveling. On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous LH sensor fault - No rear axle leveling and auxiliary function deactivated at peak.	1 sensor axle "4x2 Tractors" Deactivation of rear axle level automatic controls. 2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous LH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak.	Check sensor wiring and connectors. Check: Check isolation from + battery pin 8 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: > 1 Mohm				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
13	02	SENSORS - REAR LEFT LEVEL SENSOR	INCORRECT PARAMETERS	On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous RH sensor fault - No rear axle leveling and auxiliary function deactivated at peak.	2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous RH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak.	Electronic control unit configuration check. Check calibration levels. Check sensor installation and eventual mechanical connection faults.				
13	03	SENSORS - REAR LEFT LEVEL SENSOR	SHORT CIRCUIT TO POSITIVE	On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous RH sensor fault - No rear axle leveling and auxiliary function deactivated at peak.	2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous RH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak.	Check sensor wiring and connectors. Check: Check isolation from + battery pin 5 - X2 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
13	05	SENSORS - REAR LEFT LEVEL SENSOR	OPEN CIRCUIT	On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous RH sensor fault - No rear axle leveling and auxiliary function deactivated at peak.	2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous RH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak.	Check sensor wiring and connectors. Check: Check continuity between pins 7 - 5 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 80 - 90 Ohm				
13	06	SENSORS - REAR LEFT LEVEL SENSOR	SHORT CIRCUIT TO GROUND	On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous RH sensor fault - No rear axle leveling and auxiliary function deactivated at peak.	2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous RH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak.	Check sensor wiring and connectors. Check: Check isolation from - battery pin 5 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: > 1 Mohm				
16	03	SENSORS - FRONT PRESSURE SENSOR	SHORT CIRCUIT TO POSITIVE	Possible front axle overload.	FAILURE INDICATOR TURNS ON.LOAD INDICATION IS MISSING OR DOES NOT RESULT.	Check connector wiring and components.	Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 10 Measure point 2: Connector X2 Pin: 3	Key +15 ON;	Typical Value: 22-26 V;	INSERT ADAPTER BETWEEN THE UNIT AND CABLING

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
16	05	SENSORS - FRONT PRESSURE SENSOR	OPEN CIRCUIT	Possible front axle overload.	FAILURE INDICATOR TURNS ON.LOAD INDICATION IS MISSING OR DOES NOT RESULT.	Check connector wiring and components.	Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 1 Measure point 2: Connector X2 Pin: 3	Key +15 OFF;	Typical Value: 41 KOhm;	INSERT ADAPTER BETWEEN THE UNIT AND CABLING
16	06	SENSORS - FRONT PRESSURE SENSOR	SHORT CIRCUIT TO GROUND	Possible front axle overload.	FAILURE INDICATOR TURNS ON.LOAD INDICATION IS MISSING OR DOES NOT RESULT.	CHECK INSULATION FROM BATTERY.CHECK COMPONENT AND CONNECTOR CABLING INTEGRITY.	Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 3 Measure point 2: Connector X1 Pin: 12	Key +15 OFF;	Typical Value: 1-1.5 KOhm;	INSERT ADAPTER BETWEEN THE UNIT AND CABLING
18	03	SENSORS - RIGHT PRESSURE SENSOR (AXLE)	SHORT CIRCUIT TO POSITIVE	Fault light ON. Axle load signal missing or incorrect.	Possible engine axle overload.	Check connector wiring and components. Check: Check isolation from + battery pin 2 - X2 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
18	05	SENSORS - RIGHT PRESSURE SENSOR (AXLE)	OPEN CIRCUIT	Fault light ON. Axle load signal missing or incorrect.	Possible engine axle overload.	Check connector wiring and components. Check: Check continuity between pins 1 - 2 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 35 - 45 Kohm				
18	06	SENSORS - RIGHT PRESSURE SENSOR (AXLE)	SHORT CIRCUIT TO GROUND	Fault light ON. Axle load signal missing or incorrect.	Possible engine axle overload.	Check connector wiring and components. Check: Check isolation from - battery pin 2 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 1 - 1.5 Kohm				
19	03	SENSORS - LEFT PRESSURE SENSOR (AXLE)	SHORT CIRCUIT TO POSITIVE	Fault light ON. Axle load signal missing or incorrect.	Possible engine axle overload.	Check connector wiring and components. Check: Check isolation from + battery pin 6 - X2 /7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
19	05	SENSORS - LEFT PRESSURE SENSOR (AXLE)	OPEN CIRCUIT	Fault light ON. Axle load signal missing or incorrect.	Possible engine axle overload.	Check connector wiring and components. Check: Check continuity between pins 1 - 6 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 35 - 45 Kohm				
19	06	SENSORS - LEFT PRESSURE SENSOR (AXLE)	SHORT CIRCUIT TO GROUND	Fault light ON. Axle load signal missing or incorrect.	Possible engine axle overload.	Check connector wiring and components. Check: Check isolation from - battery pin 6 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 1 - 1.5 Kohm				
1A	03	SENSORS - RIGHT PRESSURE SENSOR 3RD AXLE	SHORT CIRCUIT TO POSITIVE	Fault light ON. Axle load signal missing or incorrect.	Possible additional axle overload.	Check connector wiring and components. Check: Check isolation from + battery pin 4 - X3 /7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
1A	05	SENSORS - RIGHT PRESSURE SENSOR 3RD AXLE	OPEN CIRCUIT	Fault light ON. Axle load signal missing or incorrect.	Possible additional axle overload.	Check connector wiring and components. Check: Check continuity between pins 1 - X2 / 4 - X3 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 35 - 45 Kohm				
1A	06	SENSORS - RIGHT PRESSURE SENSOR 3RD AXLE	SHORT CIRCUIT TO GROUND	Fault light ON. Axle load signal missing or incorrect.	Possible additional axle overload.	Check connector wiring and components. Check: Check isolation from - battery pin 4 - X3 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 1 - 1.5 Kohm				
1B	03	SENSORS - LEFT PRESSURE SENSOR 3RD AXLE	SHORT CIRCUIT TO POSITIVE	Fault light ON. Axle load signal missing or incorrect.	Possible additional axle overload.	Check connector wiring and components. Check: Check isolation from + battery pin 3 - X3 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
1B	05	SENSORS - LEFT PRESSURE SENSOR 3RD AXLE	OPEN CIRCUIT	Fault light ON. Axle load signal missing or incorrect.	Possible additional axle overload.	Check connector wiring and components. Check: Check continuity between pins 1 - X2 / 3 - X3 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 35 - 45 Kohm				
1B	06	SENSORS - LEFT PRESSURE SENSOR 3RD AXLE	SHORT CIRCUIT TO GROUND	Fault light ON. Axle load signal missing or incorrect.	Possible additional axle overload.	Check connector wiring and components. Check: Check isolation from - battery pin 3 - X3 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 1 - 1.5 Kohm				
1C	03	SENSORS - PRESSURE SENSOR RAISER	SHORT CIRCUIT TO POSITIVE	Additional axle cannot be raised. Auxiliary function deactivated at peak.	Additional axle control disabled.	Check connector wiring and components. Check: Check isolation from + battery pin 5 - X3 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
1C	05	SENSORS - PRESSURE SENSOR RAISER	OPEN CIRCUIT	Additional axle cannot be raised. Auxiliary function deactivated at peak.	Additional axle control disabled.	Check connector wiring and components. Check: Check continuity between pins 1 - X2 / 5 - X3 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 35 - 45 Kohm				
1C	06	SENSORS - PRESSURE SENSOR RAISER	SHORT CIRCUIT TO GROUND	Additional axle cannot be raised. Auxiliary function deactivated at peak.	Additional axle control disabled.	Check connector wiring and components. Check: Check isolation from - battery pin 5 - X3 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 1 - 1.5 Kohm				
21	0B	REMOTE CONTROL - REMOTE CONTROL 1	IT IS NOT POSSIBLE TO DETECT THE FAULT	Deactivation remote control 1.	Level manual controls disabled.	Check correct operation of remote control on Modus instrument status parameters.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
22	03	POWER SUPPLY - SUPPLY VOLTAGE FOR ELECTRO-VALVES	SHORT CIRCUIT TO POSITIVE	Fault light ON.	Load distribution on axles control disabled.	Check wiring and connectors on frame control solenoid valves. Check: Check isolation from + battery pin 4 - X2 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				
22	05	POWER SUPPLY - SUPPLY VOLTAGE FOR ELECTRO-VALVES	OPEN CIRCUIT	Pneumatic suspension locked. Manual trim variations cannot be carried out. Auxiliary function deactivated at peak.	ECAS totally disabled.	Check wiring and connectors on frame control solenoid valves. Check: Check continuity between pins 4 - X2 / 6.1 or 61.1 solenoids Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 70 - 90 Ohm				
22	06	POWER SUPPLY - SUPPLY VOLTAGE FOR ELECTRO-VALVES	SHORT CIRCUIT TO GROUND	Pneumatic suspension locked. Manual trim variations cannot be carried out. Auxiliary function deactivated at peak.	ECAS totally disabled.	Check wiring and connectors on frame control solenoid valves. Check: Check isolation from - battery pin 4 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: > 1 Mohm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
26	02	ELEC-TRONIC CON-TROL UNIT - MEMORY CHECK-SUM	SPECIFIC DATA NOT CORRECT	No frame auto-matic adjustment. Additional axle cannot be raised. Auxiliary function deactivated at peak.	Additional axle control and level automatic controls dis-abled.	Electronic control unit configuration check. Check calibration le-vels. Check: Reprogram Electronic control unit. Recalibrate frame level. Measuring conditions: Comparable values:				
27	02	ELEC-TRONIC CON-TROL UNIT - PARA-METER CHECK-SUM	INCOR-RECT PARA-METERS	No frame auto-matic adjustment. Additional axle cannot be raised. Auxiliary function deactivated at peak.	Additional axle control and level automatic controls dis-abled.	Electronic control unit configuration check. Check calibration le-vels. Check: Reprogram Electronic control unit. Recalibrate frame level. Measuring conditions: Comparable values:				
28	02	ELEC-TRONIC CON-TROL UNIT - HEIGHT SENSOR CALIBRA-TION DATA CHECK-SUM FAULT	INCOR-RECT PARA-METERS	No frame auto-matic adjustment. Additional axle cannot be raised. Auxiliary function deactivated at peak.	Additional axle control and level automatic controls dis-abled.	Electronic control unit configuration check. Check calibration le-vels. Check: Reprogram Electronic control unit. Recalibrate frame level. Measuring conditions: Comparable values:				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
2E	03	POWER SUPPLY - PRESSURE SENSORS VOLTAGE SUPPLY	SHORT CIRCUIT TO POSITIVE	Fault light ON. Axles load signal missing or incorrect.	Possible axles overload.	Check connector wiring and components. Check: Check isolation from + battery pin 1 - X2 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 0.5 - 4.5 V				
2E	06	POWER SUPPLY - PRESSURE SENSORS VOLTAGE SUPPLY	SHORT CIRCUIT TO GROUND	Fault light ON. Axles load signal missing or incorrect. Additional axle cannot be raised. Auxiliary function deactivated at peak.	Possible axles overload. Additional axle control disabled.	Check connector wiring and components. Check: Check isolation from - battery pin 1 - X2 / 7 - 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 30 - 50 Kohm				
2E	0B	POWER SUPPLY - PRESSURE SENSORS VOLTAGE SUPPLY	IT IS NOT POSSIBLE TO DETECT THE FAULT	Fault light ON. Axles load signal missing or incorrect. Additional axle cannot be raised. Auxiliary function deactivated at peak.	Possible axles overload. Additional axle control disabled.	Check connector wiring and components. Check: A) Check isolation from + battery pin 1 - X2 / 7 - 10 - X1 B) Check isolation from - battery pin 1 - X2 / 12 - X1 Measuring conditions: A) Connectors connected to control unit. Key on START. B) Connectors connected to control unit. Key on STOP. Comparable values: A) 0.5 - 4.5 V B) 30 - 50 Kohm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
2F	03	POWER SUPPLY - SUPPLY VOLTAGE FOR ECAS REMOTE CON-TROL	SHORT CIRCUIT TO POSI-TIVE	Remote controls deactivated.	Level manual controls dis-abled.	Check connector wir-ing and components. Check: Check isolation from + battery pin 13 - X1 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 1 - 1.5 V				
2F	06	POWER SUPPLY - SUPPLY VOLTAGE FOR ECAS REMOTE CON-TROL	SHORT CIRCUIT TO GROUND	Remote controls deactivated.	Level manual controls dis-abled.	Check connector wir-ing and components. Check: Check isolation from - battery pin 13 - X1 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 30 - 40 Kohm				
30	03	REMOTE CON-TROL - REMOTE CON-TROL 1	SHORT CIRCUIT TO POSI-TIVE - DATA LINE	Deactivation re-mote control 1.	Level manual controls dis-abled.	Check connectors wir-ing and components. Check: Check isolation from + battery pin 11 - X1 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
30	06	REMOTE CONTROL - REMOTE CONTROL 1	SHORT CIRCUIT TO GROUND - DATA LINE	Deactivation remote control 1.	Level manual controls disabled.	Check connectors wiring and components. Check: Check isolation from - battery pin 11 - X1 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 6 - 7 Kohm				
31	03	REMOTE CONTROL - REMOTE CONTROL 1	SHORT CIRCUIT TO POSITIVE - CLOCK LEITUNG	Deactivation remote control 1.	Level manual controls disabled.	Check connectors wiring and components. Check: Check isolation from + battery pin 8 - X1 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 4 - 4.5 V				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
31	06	REMOTE CONTROL - REMOTE CONTROL 1	SHORT CIRCUIT TO GROUND - CLOCK LINE	Deactivation remote control 1.	Level manual controls disabled.	Check connectors wiring and components. Check: Check isolation from - battery pin 8 - X1 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 8.5 - 9.5 Kohm				
3C	09	CAN LINE - CAN COMMUNICATION ERROR	ABNORMAL UPDATE RATE	Level adjustment delayed or advanced.	Delayed level adjustment time. Incorrect braking adjustment.	Check vehicle CAN line and relative connections on the relevant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connector.Measuring conditions: Connectors connected to control unit. Key on STOP.Comparable values: 60 ohm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3D	09	CAN LINE - MESSAGE VSC1 (CCVS) FROM ENGINE	FAULTY SIGNAL	Level adjustment delayed or advanced.	Delayed level adjustment time. Incorrect braking adjustment.	Check vehicle CAN line and relative connections on the relevant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connector.Measuring conditions: Connectors connected to control unit. Key on STOP.Comparable values: 60 ohm				
3E	09	CAN LINE - MESSAGE EEC1 FROM ENGINE	FAULTY SIGNAL	Level adjustment delayed or advanced.	Delayed level adjustment time. Incorrect braking adjustment.	Check vehicle CAN line and relative connections on the relevant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connector.Measuring conditions: Connectors connected to control unit. Key on STOP.Comparable values: 60 ohm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
44	09	CAN LINE - MESSAGE TCO1 FROM TACHO-GRAPH	FAULTY SIGNAL	Level adjustment delayed or advanced.	Delayed level adjustment time. Incorrect braking adjustment.	Check vehicle CAN line and relative connections on the relevant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connector.Measuring conditions: Connectors connected to control unit. Key on STOP.Comparable values: 60 ohm				
45	09	CAN LINE - MESSAGE TIME AND DATE FROM TACHO-GRAPH	FAULTY SIGNAL	Level adjustment delayed or advanced.	Delayed level adjustment time. Incorrect braking adjustment.	Check vehicle CAN line and relative connections on the relevant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connector.Measuring conditions: Connectors connected to control unit. Key on STOP.Comparable values: 60 ohm				

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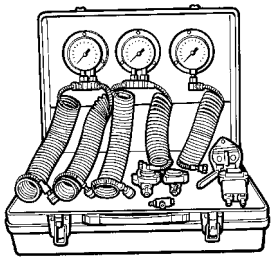
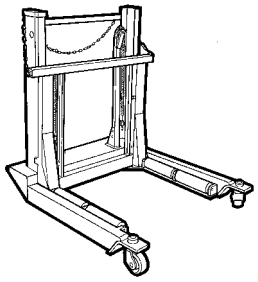
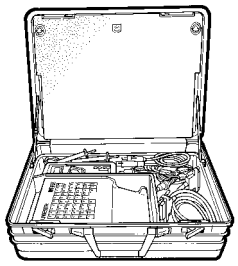
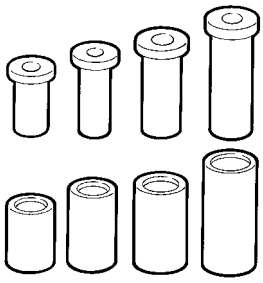
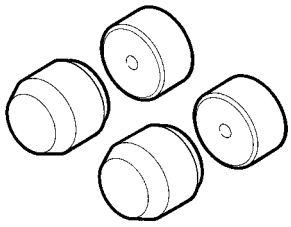
DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
E7	09	CAN LINE - DATA UPDATING FREQUENCY	FAULTY SIGNAL	Level adjustment delayed or advanced.	Delayed level adjustment time. Incorrect braking adjustment.	Check vehicle CAN line and relative connections on the relevant control units.				
FE	02	ELECTRONIC CONTROL UNIT - ELECTRONIC CONTROL UNIT	SPECIFIC DATA NOT CORRECT	Pneumatic suspension locked. Manual trim variations cannot be carried out. Auxiliary function deactivated at peak.	ECAS totally disabled.	Electronic control unit configuration check. Check: Reprogram Electronic control unit, if fault persists, replace. Measuring conditions: Comparable values:				

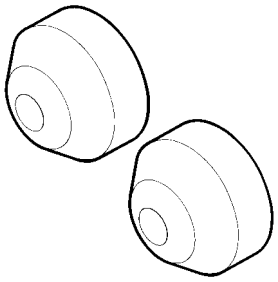
SECTION 2 Main operating faults of a mechanical nature

Visible Failure	Possible cause	Repair action
Noisy suspension	Insufficient lubrication.	Lubricate thoroughly.
	Shock absorbers noisy or inefficient.	Check and if necessary replace shock absorbers.
	Wheel bearings worn with excessive play.	Renew bearings or adjust play.
	Leaf spring hangers loose.	Check hanger fixings and if necessary re-place any loose pins or bolts.
	Leaf spring pack loose due to broken centre bolt.	Overhaul the leaf springs and renew the centre bolt and self-locking nut.
	Leaf spring pack loose due to breakage of pins securing the spring clamps.	Check leaf spring clamps and renew the pins..
Vehicle pulls to one side	Tyre pressures incorrect.	Check and inflate to specified pressure.
	Front wheel alignment incorrect.	Check and adjust front wheel alignment.
	Hydraulic shock absorbers inefficient.	Fit new shock absorbers.
	Broken leaf spring.	Overhaul leaf spring and renew compo-nents as required.
	Incorrect load distribution.	Distribute load evenly over loading deck.
Excessive flexibility of suspension	Leaf spring centre bolt broken.	Fit new bolt.
	Spring leaves over-stressed or broken.	Overhaul the leaf spring and renew damaged parts or the complete spring as necessary.
Squeaking, knocking, excessive noise in general	Leaf spring mountings loose.	Check mountings and if necessary renew loose shackle pins.
	Leaf spring pack loose due to broken centre bolt.	Overhaul the leaf springs and renew the centre bolt and self-locking nut.
	Leaf spring pack loose due to breakage of pins securing the spring clamps.	Check leaf spring clamps and renew the pins..
	Wheel bearings worn.	Renew bearings, if necessary.
	Excessive wear or play of bearings at central pivot of cantilever suspension.	Renew bearings and/or adjust axial clearances of bearings.

TOOLS

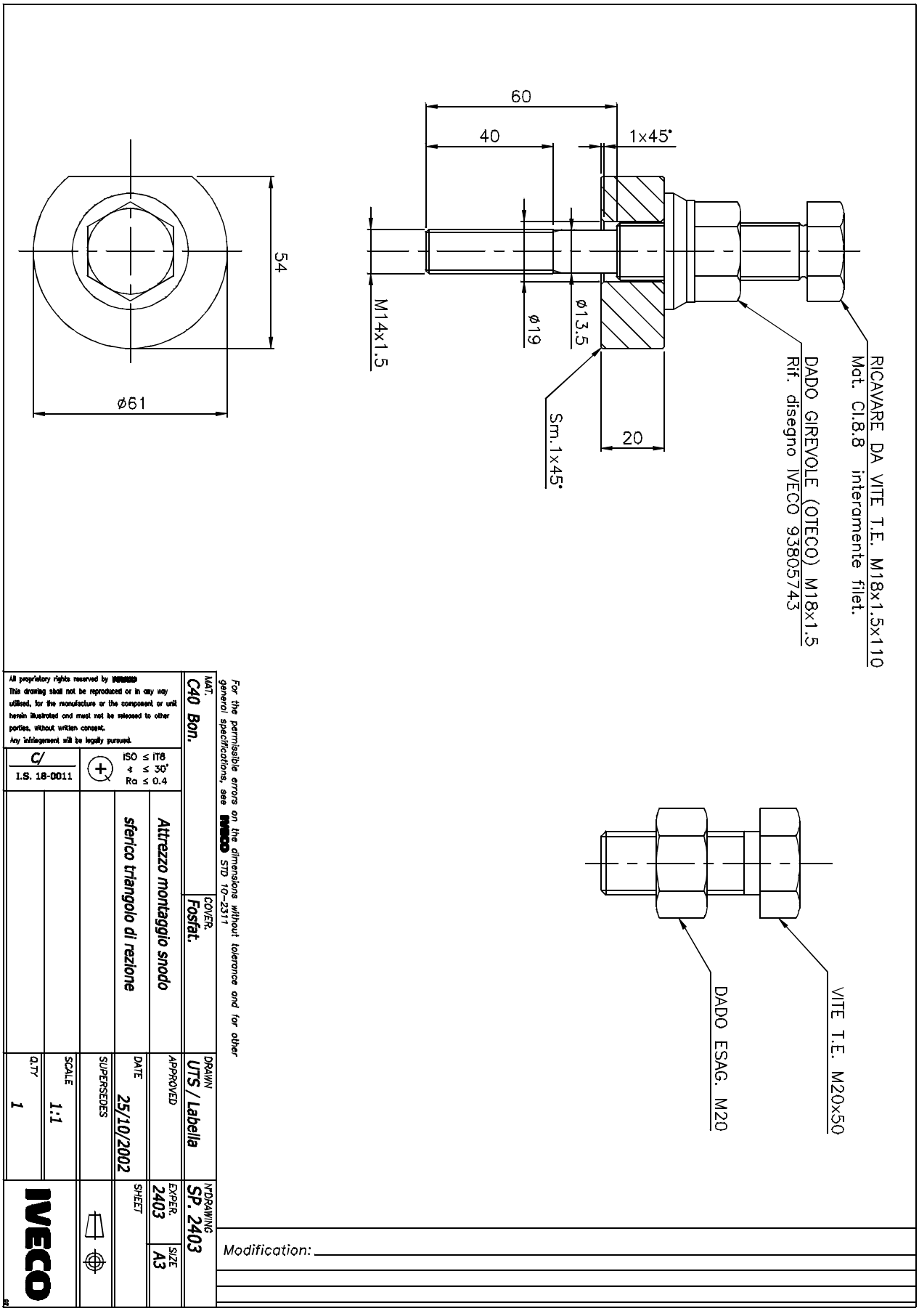
TOOL NO.		DESCRIPTION
99305117		Instrumentation to check pneumatic circuits
99321024		Hydraulic trolley to remove and refit wheels
99327010		E.A.SY.
99331016		Unitester case with multimeter and current pincers
99346049		Tool for removal and fitting of rubber bushings on stabilizer bar and leaf spring
99346247		Reference pads for ECAS suspension calibration

TOOLS

TOOL NO.		DESCRIPTION
99346248		Reference pads for ECAS suspension calibration (Low Tractor only). Use with 99346247 for rear axles.

SPECIAL PURPOSE TOOLS

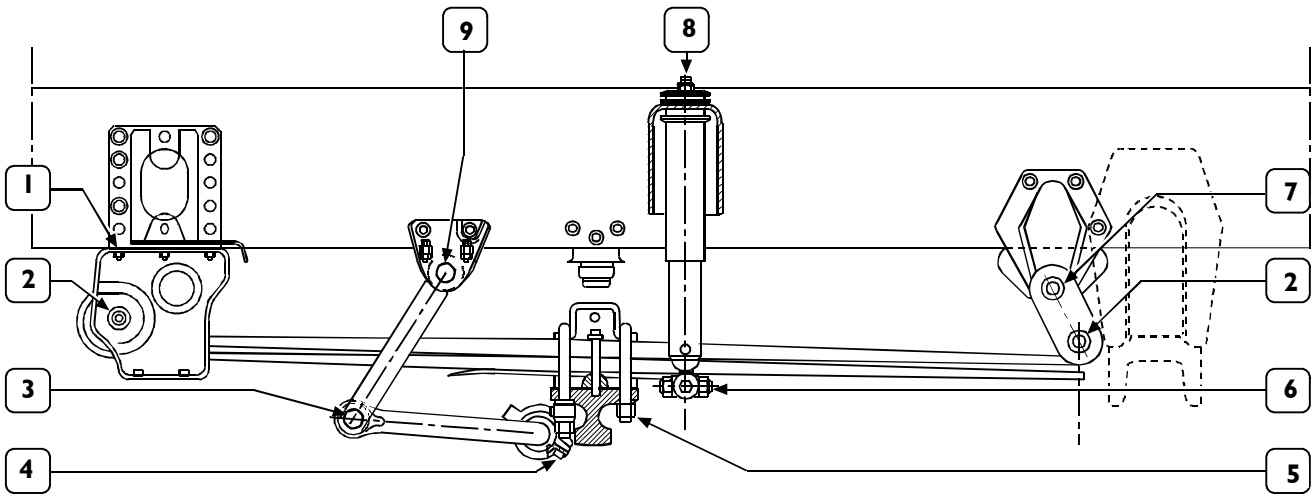
This chapter shows technical construction drawings of the special purpose tool (SPs 2403), used in servicing the wishbone described in this section. This may be built by the repair workshops.



TIGHTENING TORQUES

Mechanical front suspension

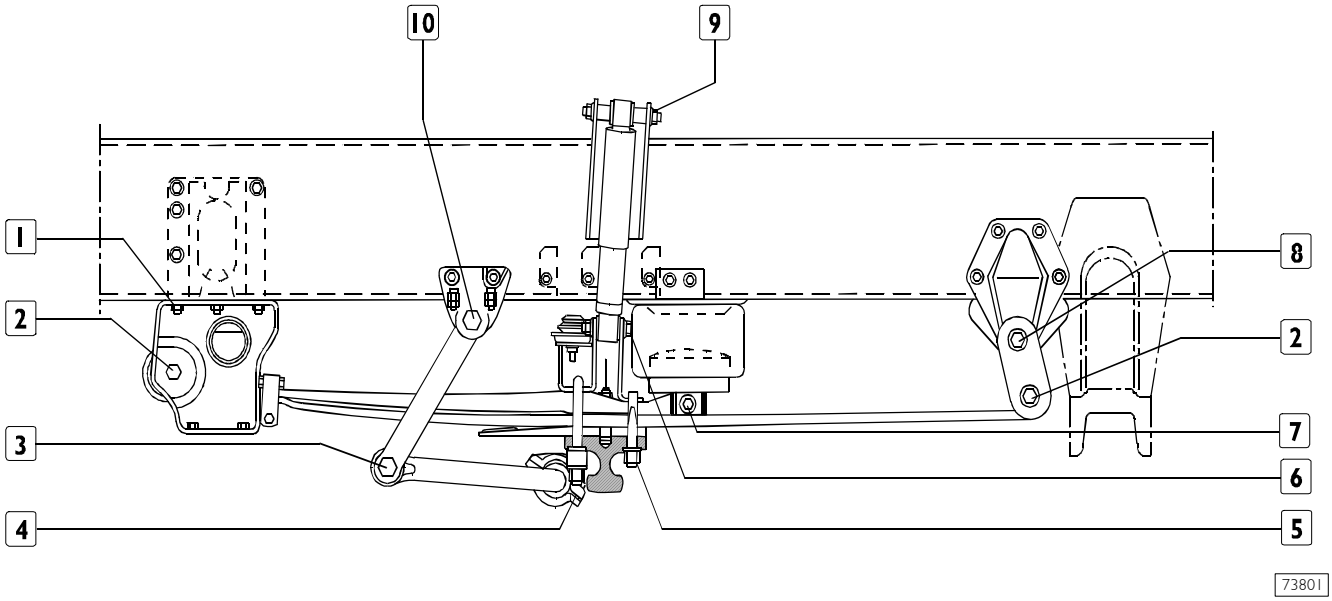
Figure 42



PART		TORQUE	
		Nm	kgm
1	M14 flanged nut for bolt securing front mounting to chassis frame	200 to 160	20 to 16
2	M20 x 1.5 flanged nut for bolt fixing front and rear leaf spring	780 to 640	78 to 64
3	M18 screw fixing stabilizer bar to link rod	715 to 585	71.5 to 58.5
4	M12 socket-head screw fixing flexible connection to axle	122 to 100	12.2 to 10
5	M20 x 1.5 nut with collar for brackets: fixing leaf spring to axle	510 to 410	51 to 41
6	M16 flanged nut for bolt fixing bottom shock absorber	165 to 135	16.5 to 13.5
7	M20 x 1.5 flanged nut for bolt fixing shackle to rear mounting	780 to 640	78 to 64
8	M14 x 1.5 nut fixing top shock absorber	70 to 57	7 to 5.7
9	M20 flanged nut for bolt fixing stabilizer bar to mounting	480 to 395	48 to 39.5

Pneumatic front suspension

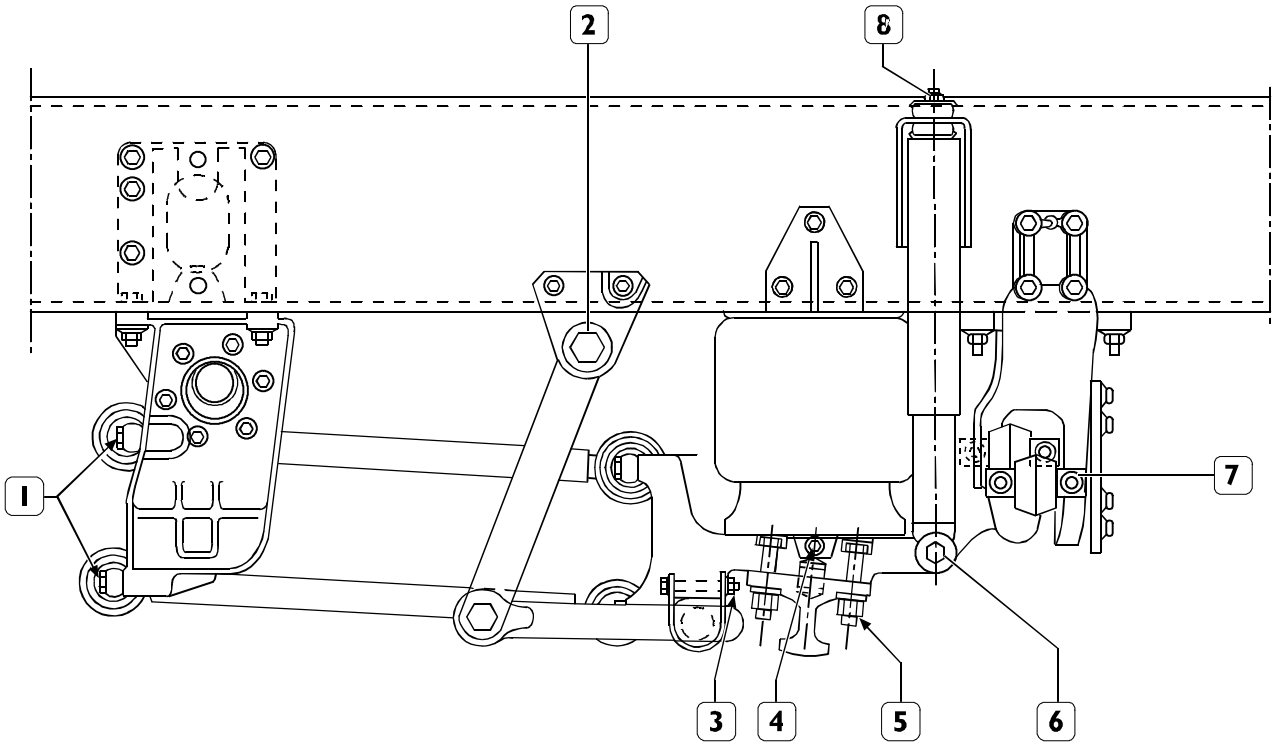
Figure 43



PART		TORQUE	
		Nm	kgm
1	M14 flanged nut for bolt securing front mounting to chassis frame	200 to 160	20 to 16
2	M20 x 1.5 flanged nut for bolt fixing front and rear leaf spring	780 to 640	78 to 64
3	M18 screw fixing stabilizer bar to link rod	715 to 585	71.5 to 58.5
4	M12 socket-head screw fixing flexible connection to axle	122 to 100	12.2 to 10
5	M20 X 1.5 flanged nut for brackets: fastening of leaf spring to axle	510 to 410	51 to 41
6	M16 flanged nut for bolt fixing bottom shock absorber	165 to 135	16.5 to 13.5
7	M16 screw fixing air spring	249 to 204	24.9 to 20.4
8	M20 x 1.5 flanged nut for bolt fixing shackle to rear mounting	780 to 640	78 to 64
9	M14 x 1.5 flanged nut fixing top shock absorber for bolt fixing top shock absorber M16 flanged nut for bolt fixing top shock absorber	70 to 57 165 to 135	7 to 5.7 16.5 to 13.5
10	M20 flanged nut for bolt fixing stabilizer bar to mounting	480 to 395	48 to 39.5

Pneumatic front suspension with bars

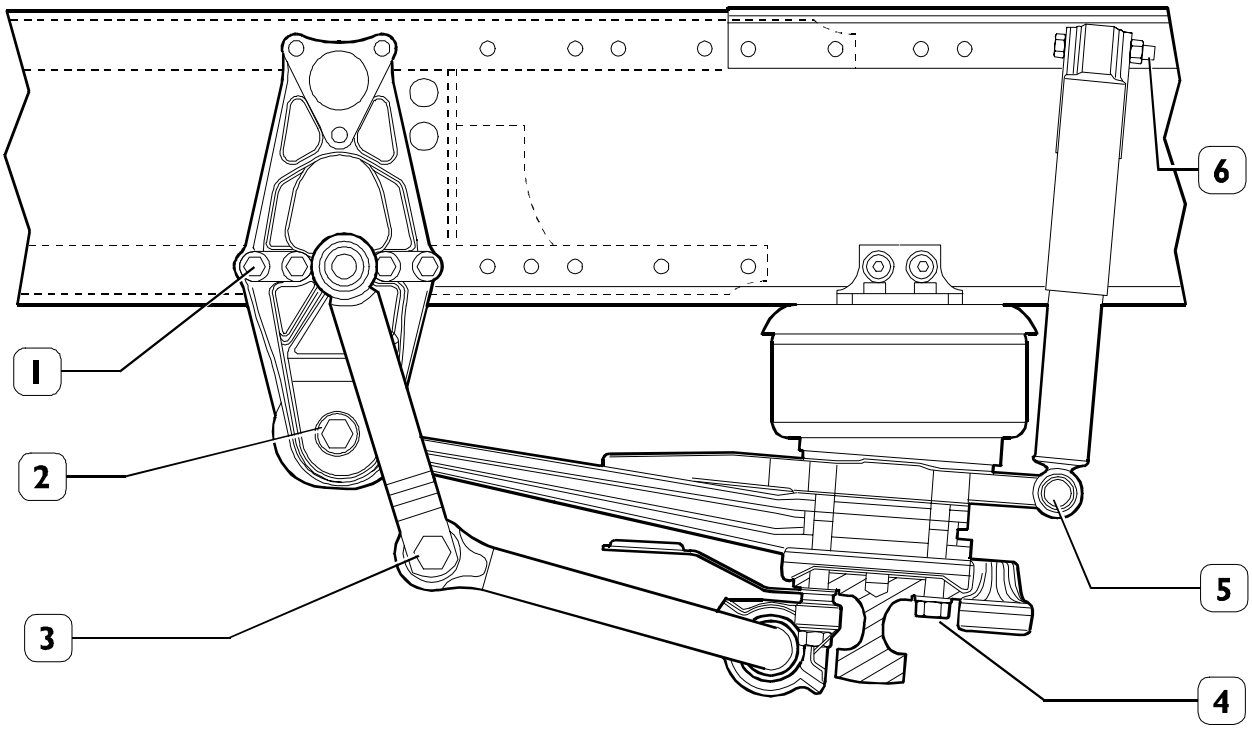
Figure 44



PART		TORQUE	
		Nm	kgm
1	M18 screw fixing longitudinal rods to mountings	200 to 160	20 to 16
2	M20 nut for pin fixing link rod to chassis frame and to stabilizer bar	780 to 640	78 to 64
3	M14 screw fixing flexible anchor to axle	715 to 585	71.5 to 58.5
4	M12 screw fixing air spring to mounting	122 to 100	12.2 to 10
5	M20 x 1.5 nut for bolt fixing anchoring mount to axle	510 to 410	51 to 41
6	M20 screw fixing shock absorber to axle	165 to 135	16.5 to 13.5
7	M16 nut for bolt fixing Panhard bar to mountings	780 to 640	78 to 64
8	M14 x 1.5 nut fixing shock absorber to chassis frame	70 to 57	7 to 5.7

Central added axle pneumatic suspensions 6x2 C vehicles

Figure 45



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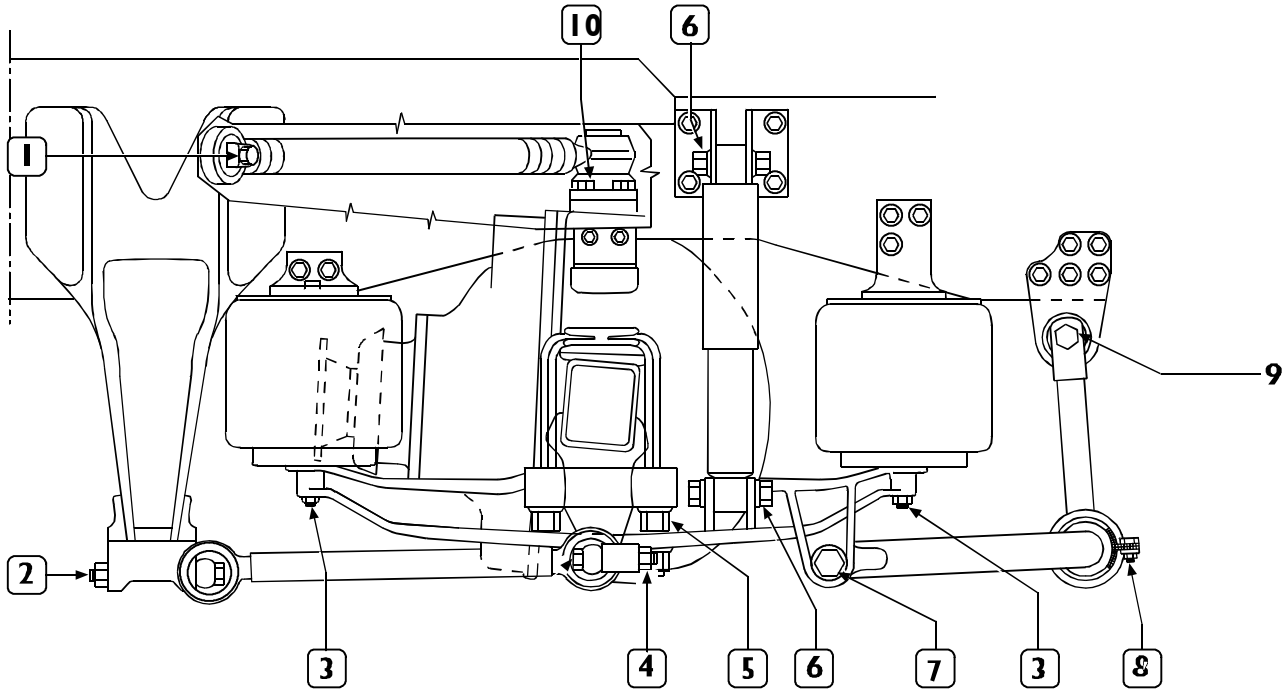
PART		TORQUE	
		Nm	kgm
1	M14 flanged nut for bolt fixing front mounting to chassis frame	200 to 160	20 to 16
2	M20 x 1.5 flanged nut for bolt fixing front leaf spring	780 to 640	78 to 64
3	M18 screw fixing stabilizer bar to link rod	715 to 585	71.5 to 58.5
4	M20 x 1.5 nut with collar for brackets: fixing leaf spring to axle	660 to 600	66 to 60
5	Screw fixing shock absorber to axle	420 to 340	42 to 34
6	Screw fixing shock absorber to axle	208 to 170	20.8 to 17

Pneumatic rear suspension
4x2 – 6x2 C vehicles

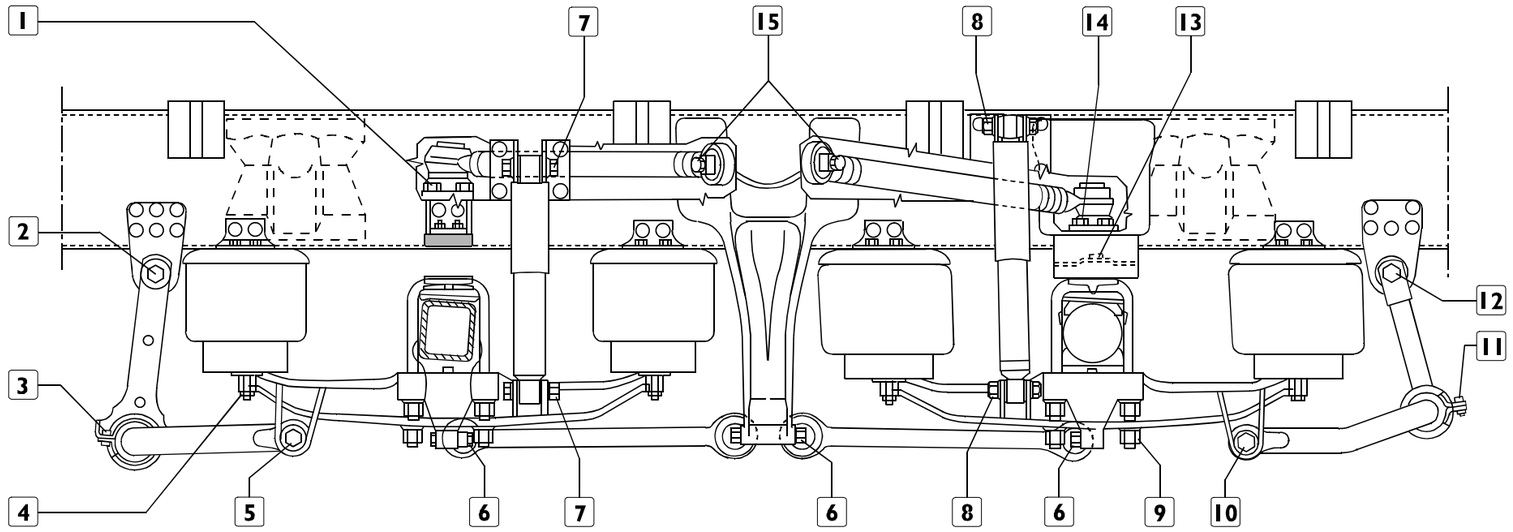
Figure 46



PART		TORQUE	
		Nm	kgm
1	M18 x 1.5 screw fixing triangular arm to bracket	385 to 320	38.5 to 32
2	M18 x 1.5 nut for bolt fixing longitudinal rod to bracket	460 to 375	46 to 37.5
3	Nut fixing air springs to the mounting	101 to 83	10.1 to 8.3
4	M18 x 1.5 nut for screw fixing longitudinal rod	460 to 375	46 to 37.5
5	M24 x 2 nut with collar for brackets fixing rear axle to rear mounting	900 to 750	90 to 75
6	M20 nut for screw fixing top and bottom shock absorber	250 to 210	25 to 21
7	M20 nut for pin fixing stabilizer bar to mounting: - 16750725 - 16984735 - 8161193	 480 to 395 685 to 560 777 to 636	 48 to 39,5 68,5 to 56 77,7 to 63,6
8	M12 nut for bolt fixing stabilizer bar to link rod	200 to 165	20 to 16.5
9	M20 nut for pin fixing link rod to mounting: - 16750725 - 16984735 - 8161193	 480 to 395 685 to 560 777 to 636	 48 to 39,5 685 to 56 77,7 to 63,6
10	M16 x 1.5 screw fixing triangular arm to rear axle housing	320 to 260	32 to 26

Pneumatic rear suspension 6x2 P/PT vehicles

Figure 47



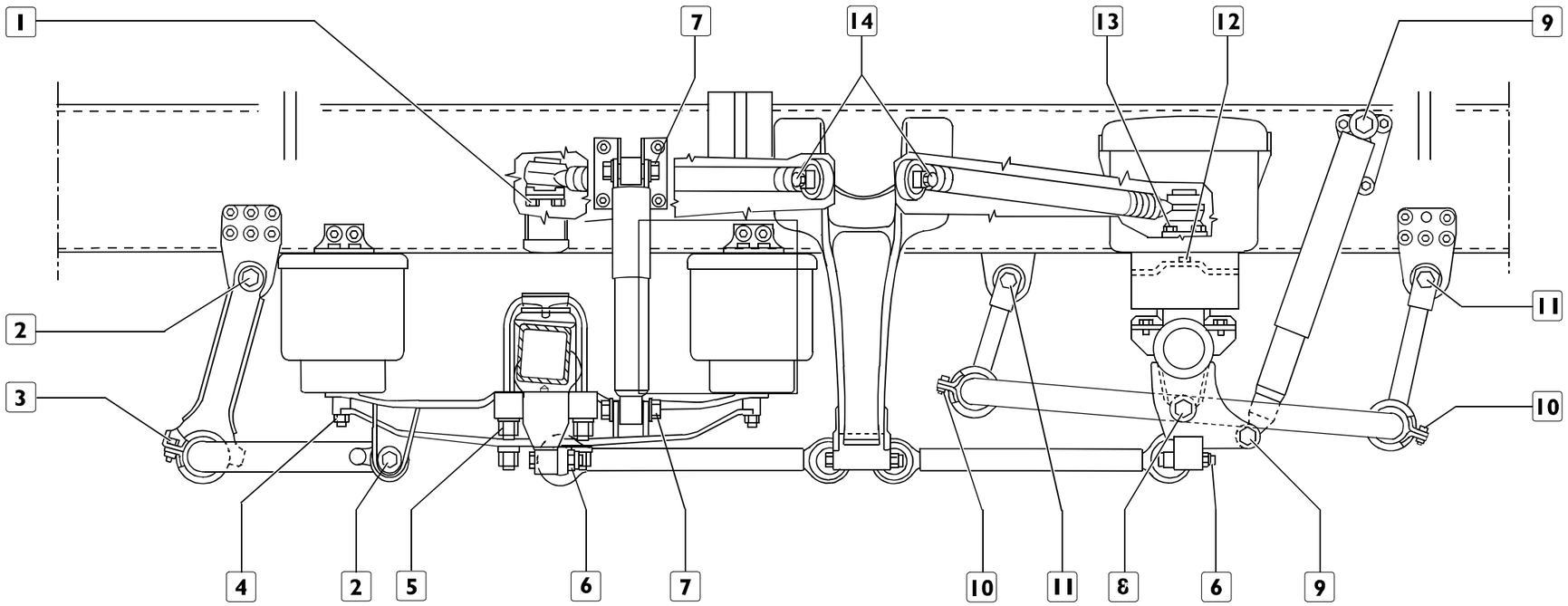
REAR SUSPENSION ASSEMBLY DRAWING

73803

PART		TORQUE	
		Nm	kgm
1	M18 screw fixing triangular arm to rear axle housing	320 to 260	32 to 26
2	M20 flanged nut fixing stabilizer bar on air spring mounting and fixing link rod on chassis frame bracket	777 to 636	77.7 to 63.6
3	Nut for bolt fixing flexible anchoring to link rod	200 to 165	20 to 16.5
4	Nut fixing air spring to mounting	101 to 83	10.1 to 8.3
5	M24 nut with collar for brackets fixing rear axle to suspension mounting	900 to 750	90 to 75
6	M18 x 1.5 nut fixing longitudinal rods	460 to 375	46 to 37.5
7	M20 nut fixing top and bottom shock absorber for rear axle	250 to 210	25 to 21
8	M20 nut fixing top and bottom shock absorber for added axle	250 to 210	25 to 21
9	M20 nut with collar for brackets fixing added axle and rear axle to suspension mounting	510 to 410	51 to 41
10	M20 nut for pin fixing stabilizer bar to added axle	480 to 395	48 to 39.5
11	Nut for bolt fixing stabilizer bar flexible anchoring to link rod	200 to 165	20 to 16.5
12	M20 nut for pin fixing link rod to chassis frame bracket	480 to 395	48 to 39.5
13	Nut fixing air spring	101 to 83	10.1 to 8.3
14	M16 self-locking nut fixing triangular arm to added axle	310 to 250	31 to 25
15	M18 screw fixing triangular arm to bracket	385 to 320	38.5 to 32

Pneumatic rear suspension 6x2 P/PS vehicles

Figure 48

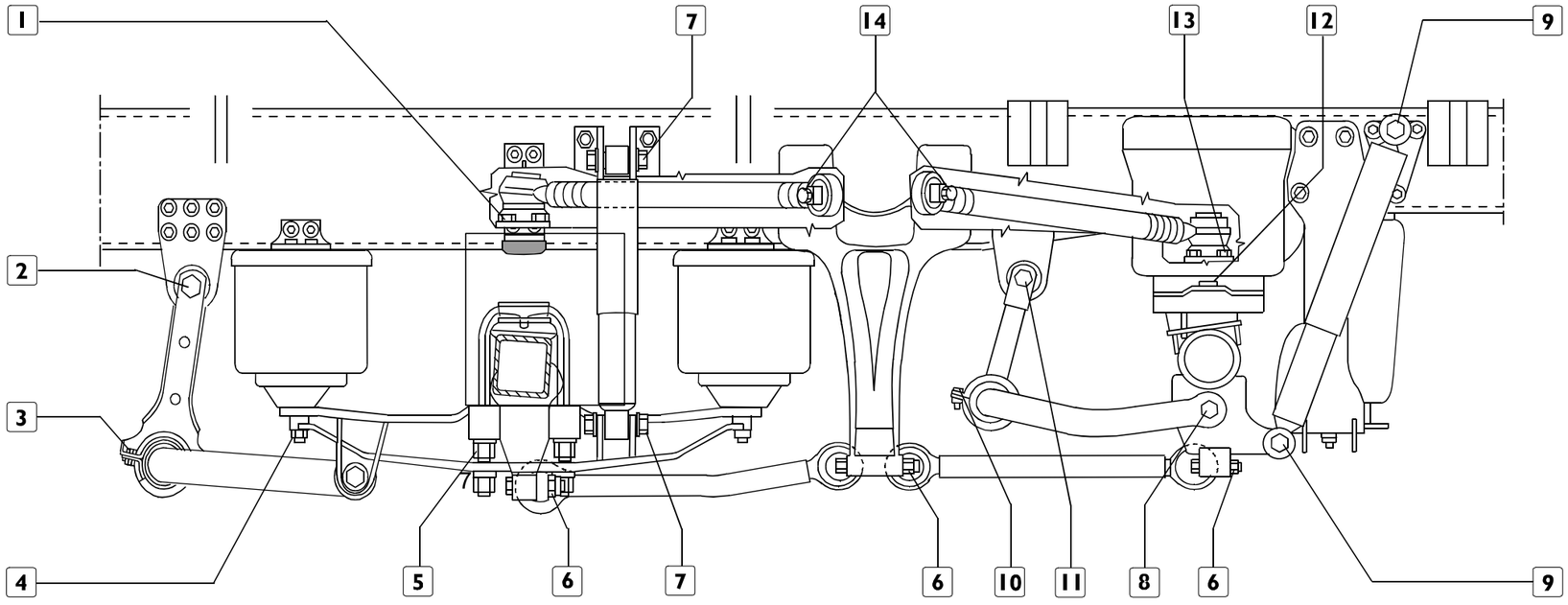


REAR SUSPENSION ASSEMBLY DRAWING

PART		TORQUE	
		Nm	kgm
1	M16 screw fixing triangular arm to rear axle housing	320 to 260	32 to 26
2	M20 flanged nut fixing stabilizer bar on air spring mounting and fixing link rod on chassis frame bracket	685 to 580	68.5 to 58
3	Nut for bolt fixing flexible anchoring to link rod	200 to 165	20 to 16.5
4	Nut fixing air spring to mounting	101 to 83	10.1 to 8.3
5	M24 nut with collar for brackets fixing rear axle to suspension mounting	900 to 750	90 to 75
6	M18 x 1.5 nut fixing longitudinal rods	460 to 375	46 to 37.5
7	M20 nut fixing top and bottom shock absorber for rear axle	250 to 210	25 to 21
8	M20 nut for pin fixing stabilizer bar to added axle	480 to 395	48 to 39.5
9	M24 nut fixing top and bottom shock absorber for added axle	440 to 360	44 to 36
10	Nut for bolt fixing stabilizer bar flexible anchoring to link rod	200 to 165	20 to 16.5
11	M20 nut for pin fixing link rod to chassis frame bracket	480 to 395	48 to 39.5
12	Nut fixing air spring	101 to 83	10.1 to 8.3
13	M16 self-locking nut fixing triangular arm to added axle	310 to 250	31 to 25
14	M18 screw fixing triangular arm to bracket	385 to 320	38.5 to 32

Pneumatic rear suspension
6x2 P/FP/FS vehicles (version for 3800 to 5500 wheel bases)

Figure 49

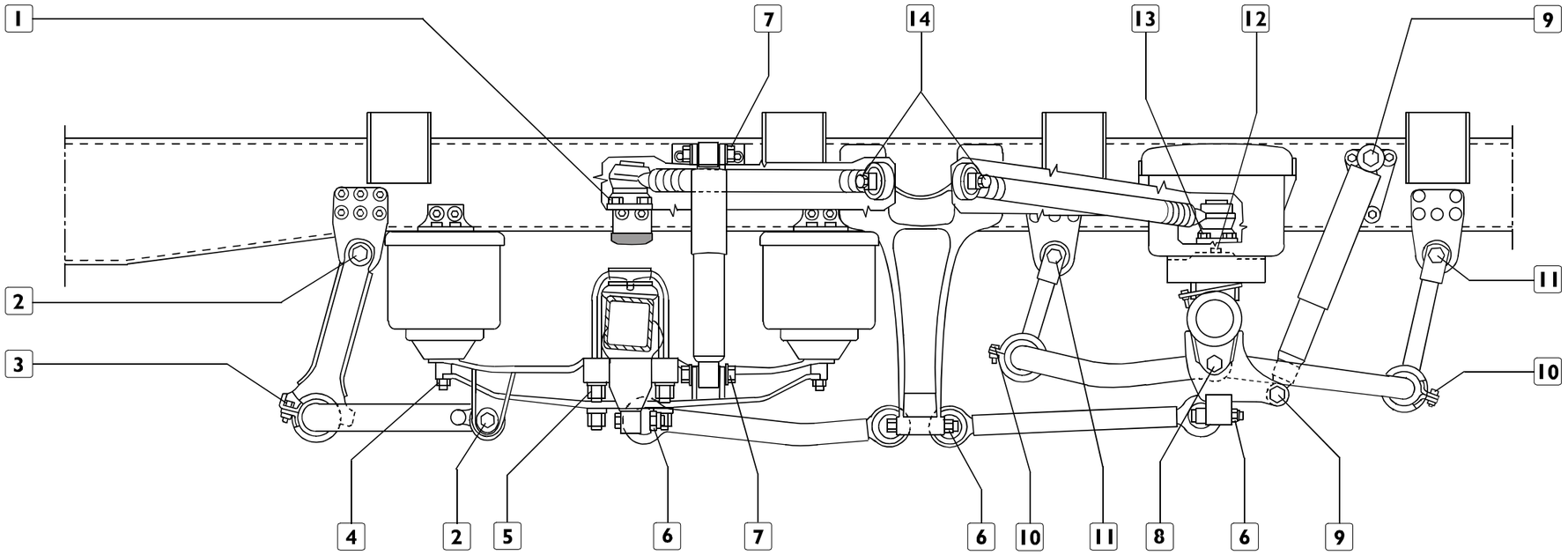


REAR SUSPENSION ASSEMBLY DRAWING

PART		TORQUE	
		Nm	kgm
1	M16 screw fixing triangular arm to rear axle housing	320 to 260	32 to 26
2	M20 flanged nut fixing stabilizer bar on air spring mounting and fixing link rod on chassis frame bracket	685 to 580	68.5 to 58
3	Nut for bolt fixing flexible anchoring to link rod	200 to 165	20 to 16.5
4	Nut fixing air spring to mounting	101 to 83	10.1 to 8.3
5	M24 nut with collar for brackets fixing rear axle to suspension mounting	900 to 750	90 to 75
6	M18 x 1.5 nut fixing longitudinal rods	460 to 375	46 to 37.5
7	M20 nut fixing top and bottom shock absorber for rear axle	250 to 210	25 to 21
8	M20 nut for pin fixing stabilizer bar to added axle	480 to 395	48 to 39.5
9	M24 nut fixing top and bottom shock absorber for added axle	440 to 360	44 to 36
10	Nut for bolt fixing stabilizer bar flexible anchoring to link rod	200 to 165	20 to 16.5
11	M20 nut for pin fixing link rod to chassis frame bracket	480 to 395	48 to 39.5
12	Nut fixing air spring	101 to 83	10.1 to 8.3
13	M16 self-locking nut fixing triangular arm to added axle	310 to 250	31 to 25
14	M18 screw fixing triangular arm to bracket	385 to 320	38.5 to 32

Pneumatic rear suspension
6x2 P/FP/FS vehicles (version for 5700 to 6050 wheel bases)

Figure 50

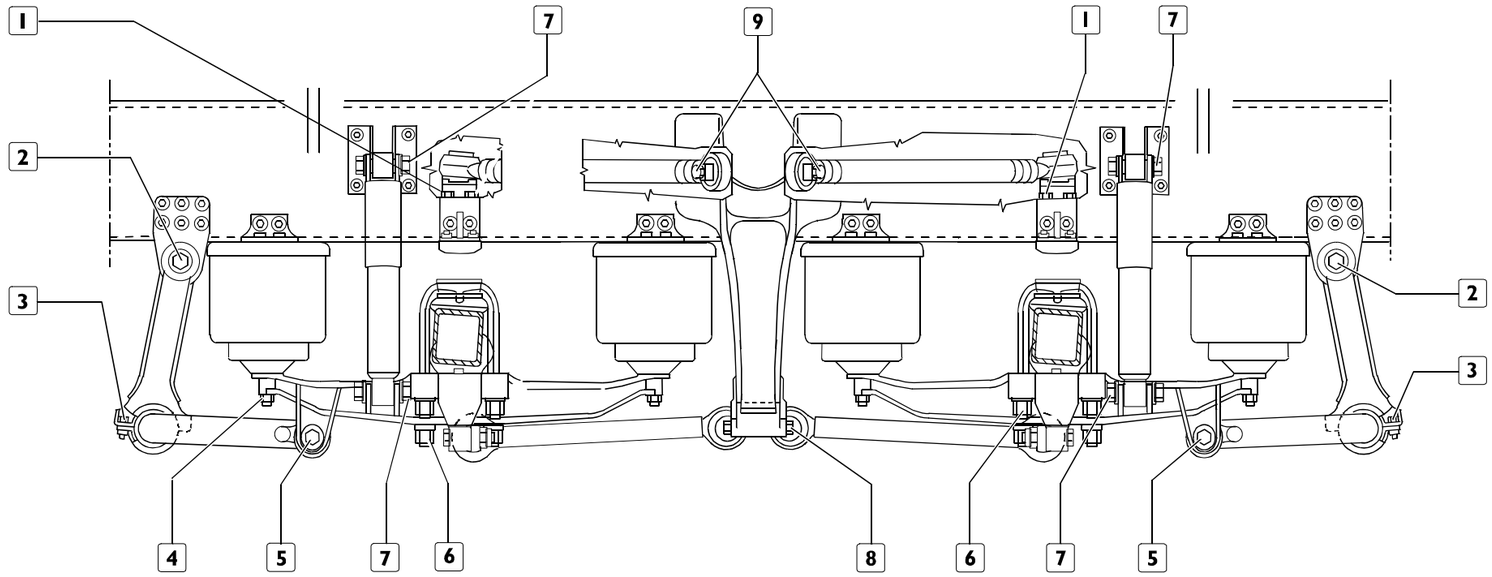


REAR SUSPENSION ASSEMBLY DRAWING

PART		TORQUE	
		Nm	kgm
1	M16 screw fixing triangular arm to rear axle housing	320 to 260	32 to 26
2	M20 flanged nut fixing stabilizer bar on air spring mounting and fixing link rod on chassis frame bracket	685 to 580	68.5 to 58
3	Nut for bolt fixing flexible anchoring to link rod	200 to 165	20 to 16.5
4	Nut fixing air spring to mounting	101 to 83	10.1 to 8.3
5	M24 nut with collar for brackets fixing rear axle to suspension mounting	900 to 750	90 to 75
6	M18 x 1.5 nut fixing longitudinal rods	460 to 375	46 to 37.5
7	M20 nut fixing top and bottom shock absorber for rear axle	250 to 210	25 to 21
8	M20 nut for pin fixing stabilizer bar to added axle	480 to 395	48 to 39.5
9	M24 nut fixing top and bottom shock absorber for added axle	440 to 360	44 to 36
10	Nut for bolt fixing stabilizer bar flexible anchoring to link rod	200 to 165	20 to 16.5
11	M20 nut for pin fixing link rod to chassis frame bracket	480 to 395	48 to 39.5
12	Nut fixing air spring	101 to 83	10.1 to 8.3
13	M16 self-locking nut fixing triangular arm to added axle	310 to 250	31 to 25
14	M18 screw fixing triangular arm to bracket	385 to 320	38.5 to 32

Pneumatic rear suspension 6x4 P vehicles

Figure 51



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PART		TORQUE	
		Nm	kgm
1	M18 screw fixing triangular arm to rear axle housing	330 to 270	33 to 27
2	M20 flanged nut fixing stabilizer bar on air spring mounting and fixing link rod on chassis frame bracket	685 to 560	68.5 to 56
3	Nut for bolt fixing flexible anchoring to link rod	200 to 165	20 to 16.5
4	Nut fixing air spring to mounting	101 to 83	10.1 to 8.3
5	M20 nut with collar	900 to 750	90 to 75
6	M24 nut with collar for brackets fixing rear axle to suspension mounting	704 to 576	70.4 to 57.6
7	M20 nut fixing top and bottom shock absorber for rear axle	250 to 210	25 to 21
8	M18 x 1.5 nut fixing longitudinal rods	460 to 375	46 to 37.5
9	M18 screw fixing triangular arm to bracket	385 to 320	38.5 to 32

500410 REMOVAL-REFITTING OF FRONT LEAF SPRING

Removal

Park the vehicle on level ground and chock the rear wheels.
Loosen the front wheel nuts.
Using a hydraulic jack, raise the front of the vehicle and support it on two stands.
Unscrew the wheel nuts and using hydraulic trolley 99321024, remove the wheels.

Position a hydraulic jack to support the axle when the leaf spring is detached.
Then, lower the hydraulic jack supporting the axle until the tension on the leaf spring is relieved.
Remove the lower access step (15) as follows:
Working from underneath the vehicle, remove the bolts (12) securing the U-bolts (13) to the bracket.
At the side, remove the screw and the nut (16) with the front bumper and extract the access step assembly (15).
Take out the screw (21) fixing the leaf spring (20) to the rear shackle (22).

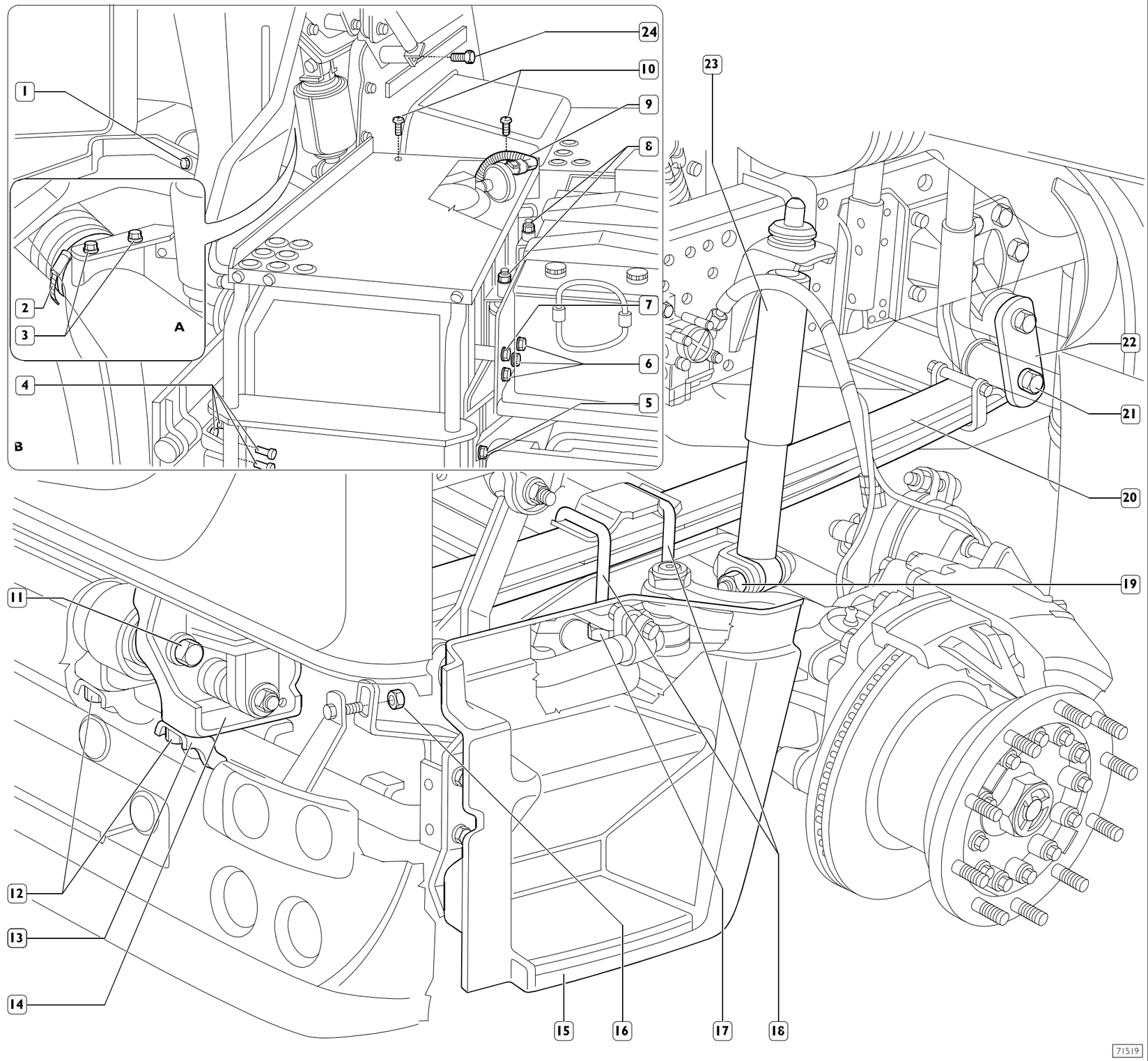
If the screw (21) is fitted with its head on the outer side of the vehicle, it will first be necessary to remove the side access step – air filter assembly (detail B) used to help remove the front suspension.
Proceed as described below:
Remove the bolts (6) and (7) located inside the battery compartment.
Take out the screws (24) fixing the handrail and the bottom (4) and top (10) screws fixing the handrail and the steps to the vehicle.
Remove the access steps and the handrail.
Disconnect the batteries and remove them from the battery compartment.
Remove the bolt (5) and nuts (8).
Take out the screw (1) fixing the air pipe.
Disconnect the air sensor (9).
Remove the bracket bolts (3) and loosen the air hose retaining strap (2) (detail A).
Remove the air cleaner complete with its hoses.
Remove the fastening (11) from the front mounting (14).
Unscrew the four nuts (17) and extract the U-bolts (18).
Disengage the shock absorber (23) front the suspension via the fastening (19).
Remove the leaf spring (20).

Refitting

Carry out the removal operations in reverse order, observing the prescribed torque settings.

To secure the leaf spring on two connections to the chassis frame it is necessary to load it so as to stretch it to align the holes, using appropriate tools and with the opposition of the load of the vehicle and the hydraulic lifts.

Figure 52



REMOVING-REFITTING FRONT SUSPENSION BARS

Removing longitudinal bars

Park the vehicle on level ground and chock the rear wheels.
Loosen the front wheel nuts.
Put a hydraulic jack equipped with mount 99370628 under the axle.
Lift the vehicle at the front, rest it on two stands and, with the hydraulic jack and mount 9937628, support the axle so that the longitudinal bars (3) and (8) are parallel to the chassis frame.
Remove the cab access steps. Take out the bolts (6) and remove the access step mount (7).
Take out the screws (5) and disconnect the bottom bar (8) from the mount (4). Repeat these operations for the top bar (3).
Repeat the above for the opposite side.

Removing transverse bar

Take out the screws (9) and remove the transverse bar (1) from the mounts (2) and (10).

Refitting

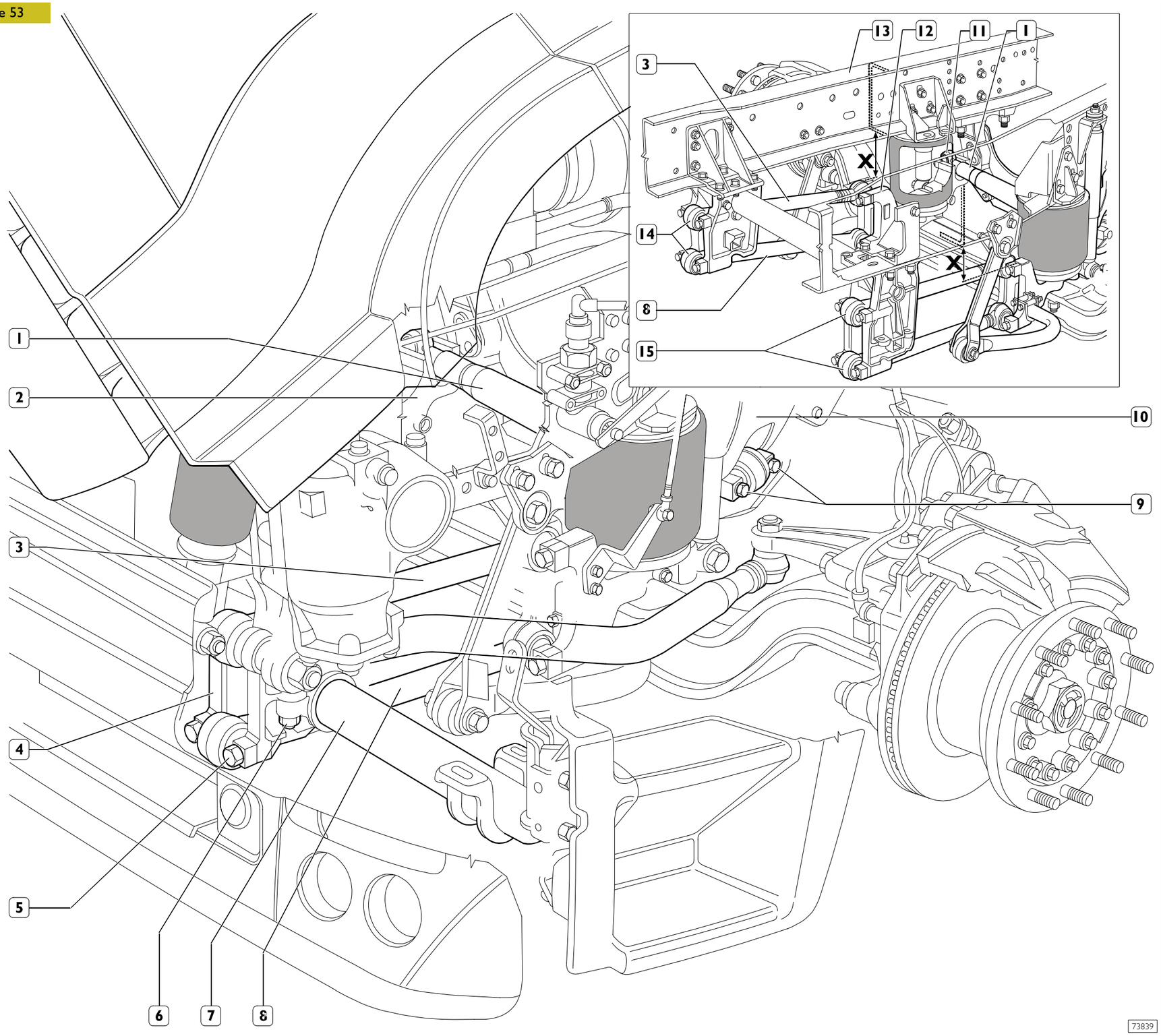
For refitting, perform the operations described for removal in reverse order, keeping to the following instructions:

the swivel head shanks (14) and (15) of the longitudinal bars (3) and (8) need to be connected to the mountings (4) and (12) when there is a distance X = 154 mm between the mountings (12) and the structural members (13);

the swivel head shanks (11) of the transverse bar (1) need to be connected when there is a distance X = 224.5 mm between the mountings (12) and structural members (11);

- ❑ tighten the nuts or screws to the required tightening torque;
- ❑ the self-locking nuts must not be reused;
- ❑ check the state of the flexible pads and replace them if deteriorated (operation 500417).

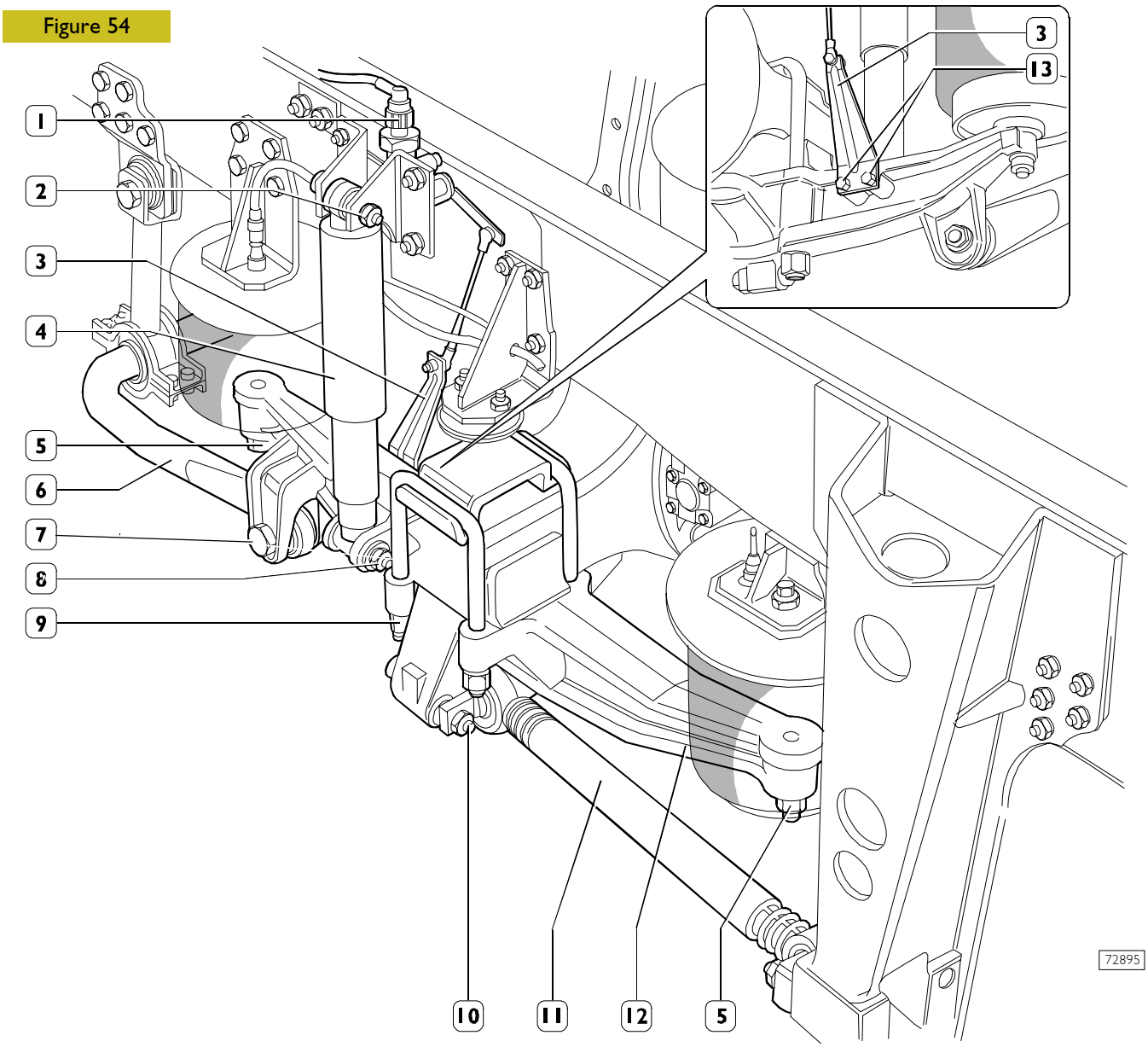
Figure 53



500730 REAR SUSPENSIONS

Removal

Figure 54



NOTE The following operations have been performed on a 4x2 T/P vehicle, but they are to be considered good for the other vehicles too.

Park the vehicle on level ground.
Raise the vehicle at the rear and place two stands under the chassis frame.
Remove the wheels, unscrew the screws (13) and disconnect the linkage (3) of the level sensor (1).
Unscrew the nuts (10) and disconnect the reaction bar (11).
Unscrew the nuts (2) and (8) and remove the shock absorber (4).
Unscrew the nuts (5) fastening the air springs.
Unscrew the nuts (9), take out the associated U-bolts and remove the arm (12) supporting the air springs.

Unscrew the screw (7) and remove the stabilizer bar (6) from the air spring mounting (12).

Refitting

For refitting, perform the operations described for removal in reverse order, keeping to the following instructions:

- ❑ Tighten the nuts or the screws to the required torque.
- ❑ The self-locking nuts must not be reused.
- ❑ Check the state of the flexible pads, and change them if they have deteriorated (operation 500417).

528913 REMOVING-REFITTING THE REAR AXLE LONGITUDINAL SUSPENSION ARM
528914 REMOVING-REFITTING THE REAR ADDED AXLE LONGITUDINAL SUSPENSION ARM
528918 REMOVING-REFITTING THE REAR AXLE TRIANGULAR SUSPENSION ARM
528919 REMOVING-REFITTING THE REAR ADDED AXLE TRIANGULAR SUSPENSION ARM

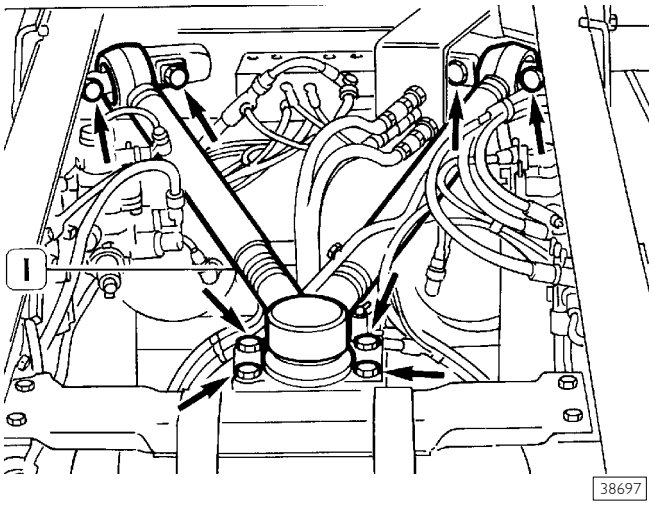
Removal

Take out the nuts or screws (⇒) fixing the longitudinal (2, Figure 56) or triangular (1, Figures 55-56) suspension arms and remove them.

Refitting

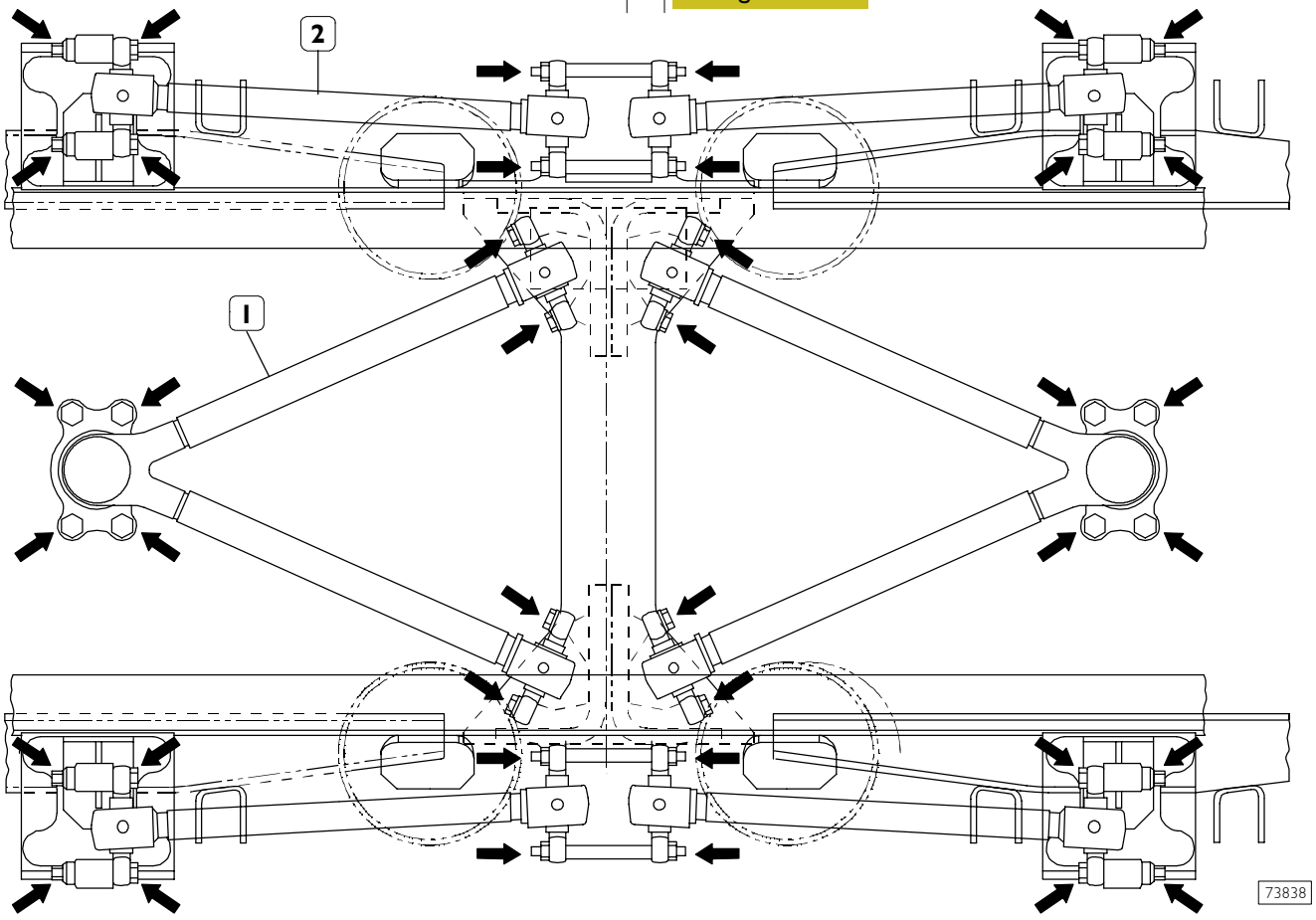
For refitting, carry out the steps described for removal in reverse order, tightening the nuts or screws to the required torque.

Figure 55



TRIANGULAR SUSPENSION ARM FITTED ON 6x2 C VEHICLES

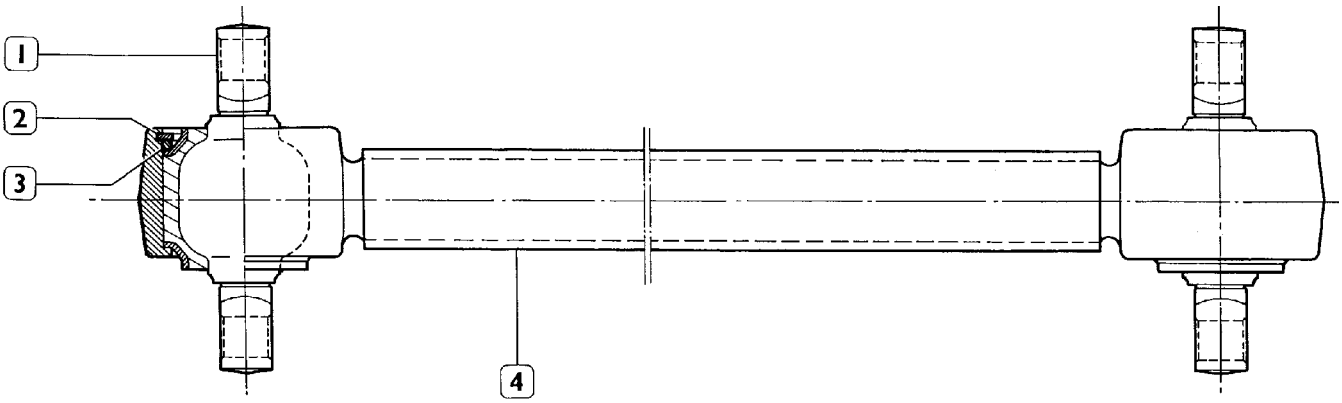
Figure 56



LONGITUDINAL AND TRIANGULAR SUSPENSION ARMS FITTED ON 6x2 P VEHICLES

REPLACING THE SUSPENSION ARM FLEXIBLE PIN

Figure 57



LONGITUDINAL SUSPENSION ARM

Dismounting

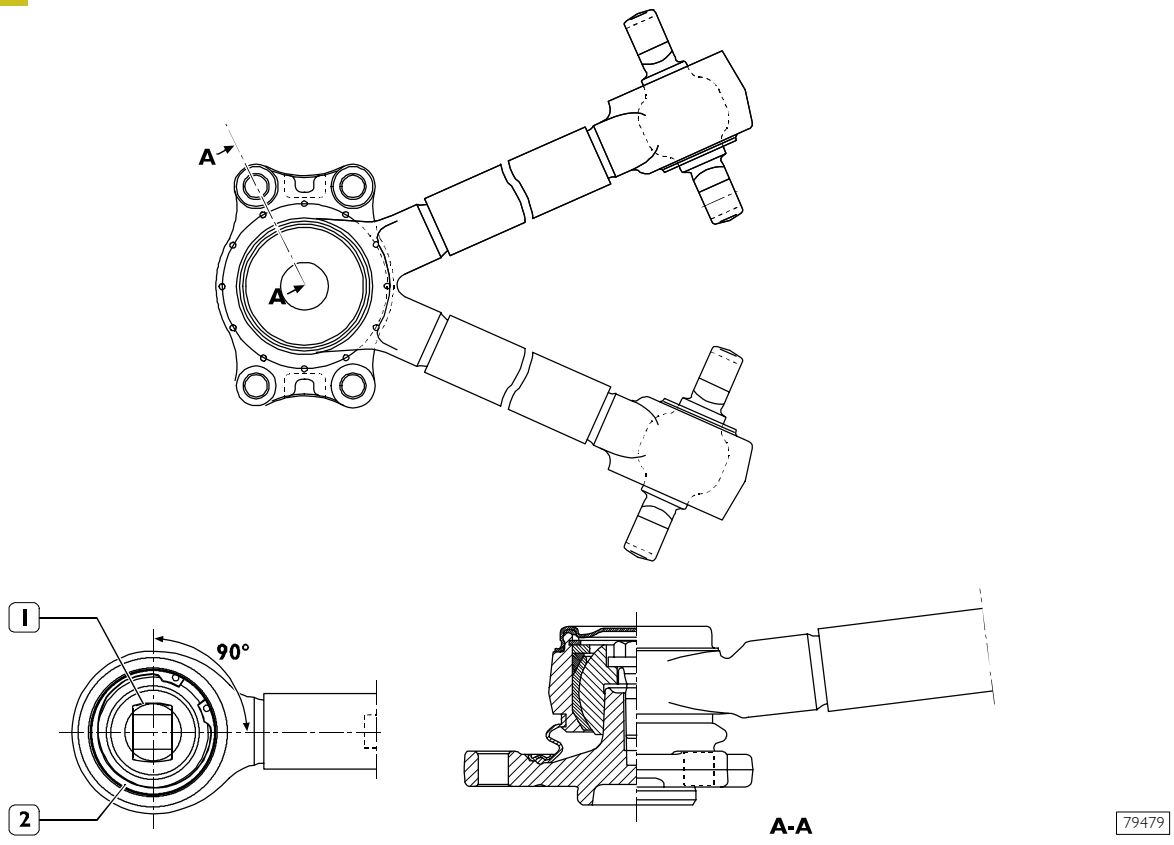
Using a suitable press and drift, compress the flexible part of the pin (1) in order to remove the circlip (2) and the underlying ring (3) with pincers.
Withdraw the pin (1) from the suspension arm (4).

Mounting

Carry out the removal operations in reverse order, bearing in mind that the pin mounting face must be positioned at 90° to the longitudinal axis of the suspension arm. The circlip opening must be oriented as shown in the detail in the figure.

REPLACING TRIANGULAR SWINGING ARM BALL ARTICULATED JOINT

Figure 58



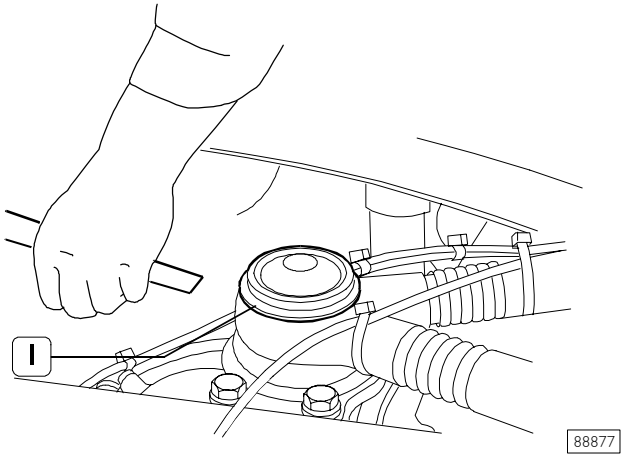
TRIANGULAR SUSPENSION ARM

Dismounting

Replacing the ball articulated joint directly on the vehicle can only be performed on tractors. For boxed trucks, the operation is carried out at the bench after detaching the reaction triangle (see procedure described at page 96).

Before replacing the articulated joint, a stand has to be arranged under the axle in order to avoid dangerous oscillations of it once dismounting has been performed.

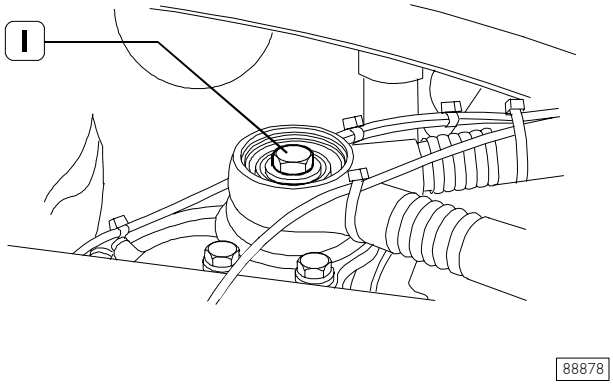
Figure 59



Dismount cover (1).

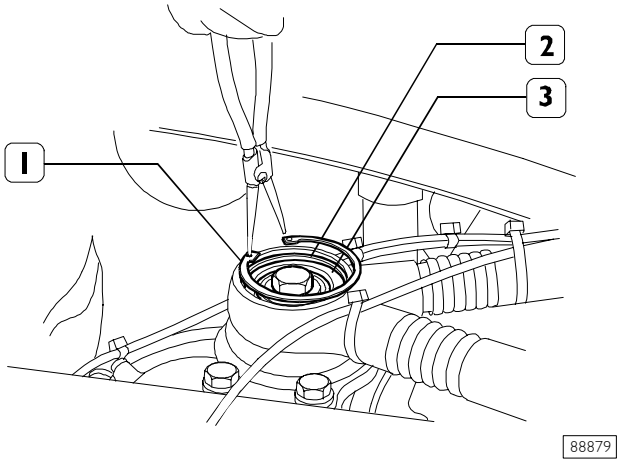
NOTE Once it has been removed, the cover is to be replaced by a new one.

Figure 60



Unscrew screw (1).

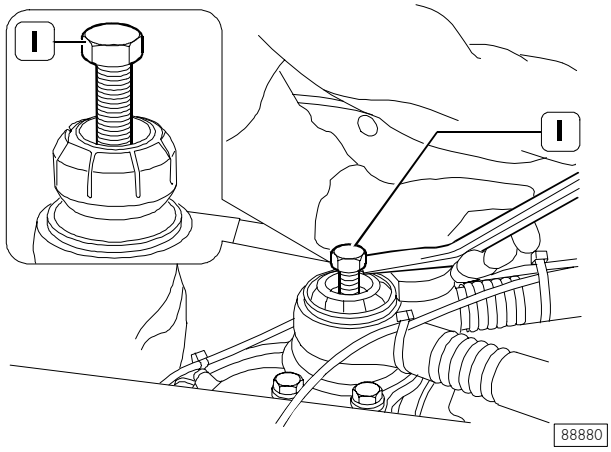
Figure 61



Remove spring ring (1) by pliers.

Remove underlying check rings (2, 3).

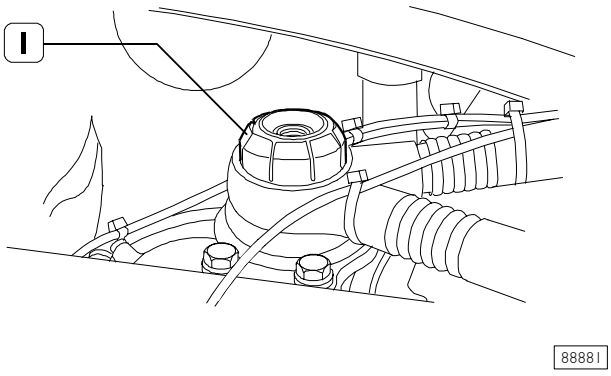
Figure 62



Dismount the ball articulated joint with M20 X 1,5 screw (1) and suitable tools.

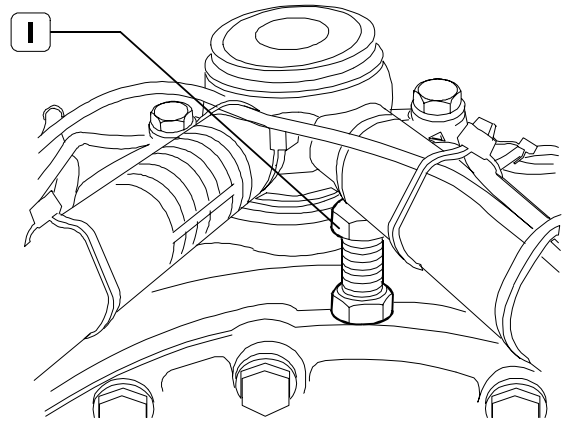
Mounting

Figure 63



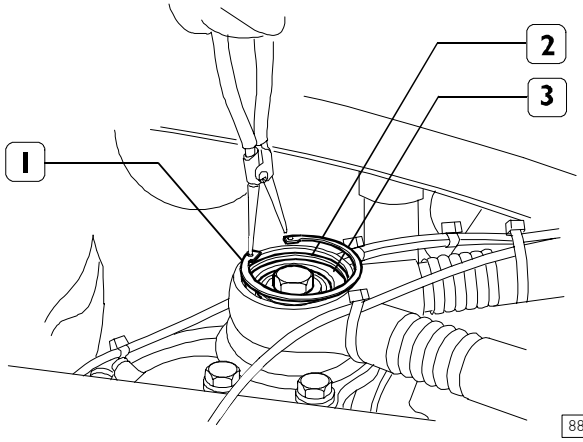
Mount ball articulated joint (1) into seat by provided beater

Figure 64



Arrange part (1) of the tool of Sp. 2403 under one of reaction triangle arms to the purpose of making upper seal ring mounting easier.

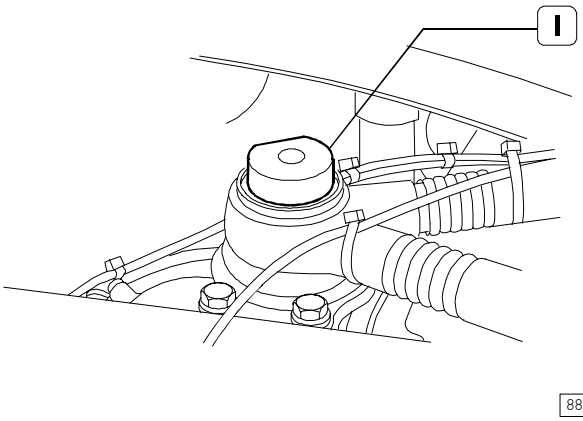
Figure 65



Mount seal rings (1, 2, 3).

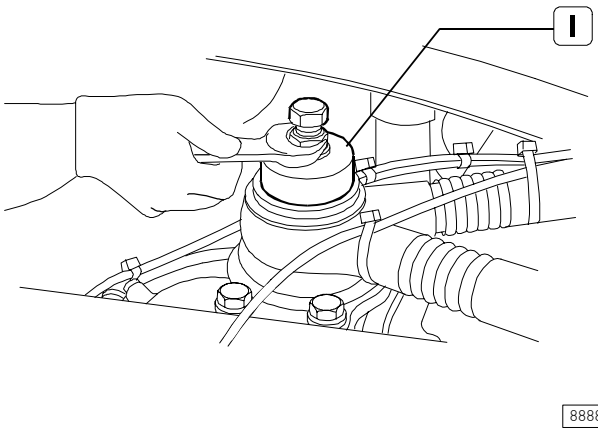
Remove the part of tool (1) of Sp. 2403 (see previous figure).

Figure 66



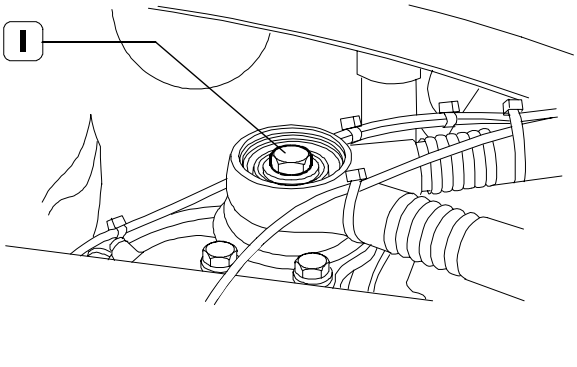
Position spacer (1) of the tool of Sp. 2403 as in figure.

Figure 67



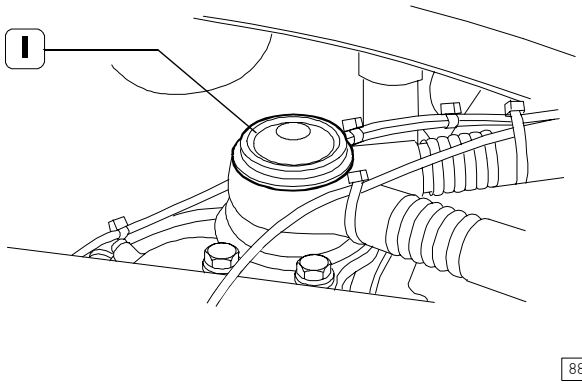
By tool (1) of Sp. 2403, draw the ball articulated joint and seal ring.

Figure 68



Tighten screw (1) with a proper torque (135 Nm).

Figure 69



Mount cover (1).

5289 STABILIZER BAR
528930 FRONT STABILIZER BAR
528940 CENTRAL ADDED AXLE STABILIZER BAR (6x2 C vehicles)
528960 REAR STABILIZER BAR
528970 REAR ADDED AXLE STABILIZER BAR (6x2P vehicles)

Removal

Remove the stabilizer bar by removing the nuts or screws securing the fixing pins and the cap retaining bolts.

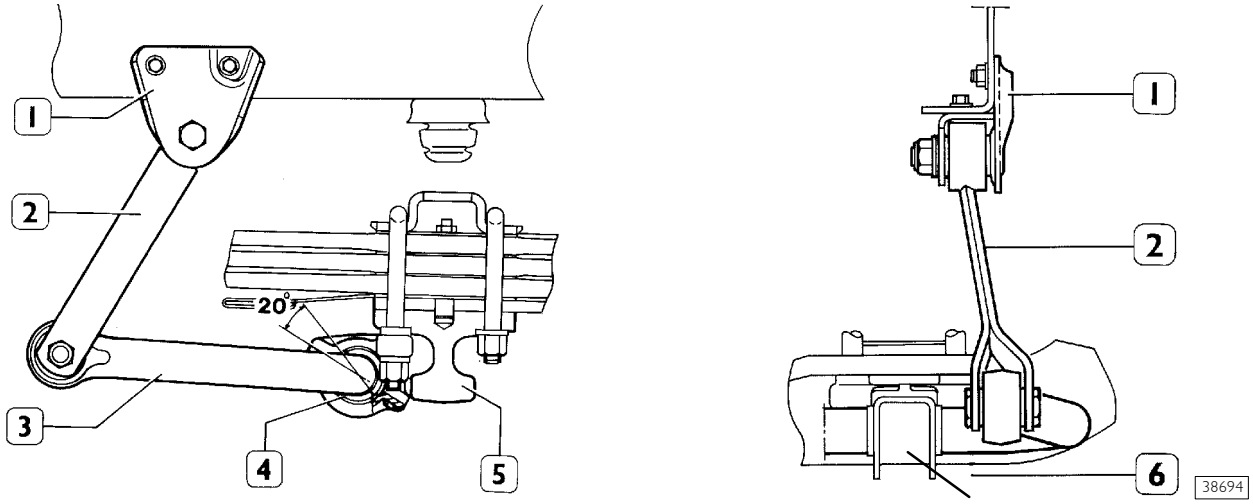
Check the bushings and/or rubber mountings and renew them if they show signs of wear or deterioration.

Refitting

Refit by carrying out the removal operations in reverse order; tighten nuts/bolts to the specified torques.

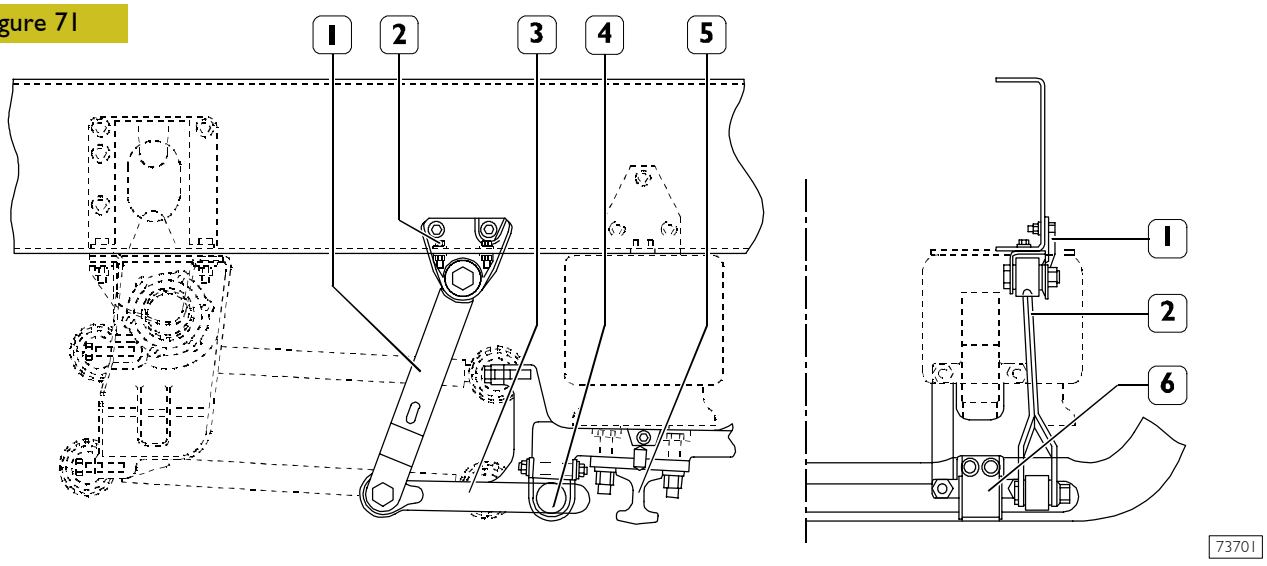
NOTE Position the half bushings (4) so that the joint is located as shown in the figure.

Figure 70



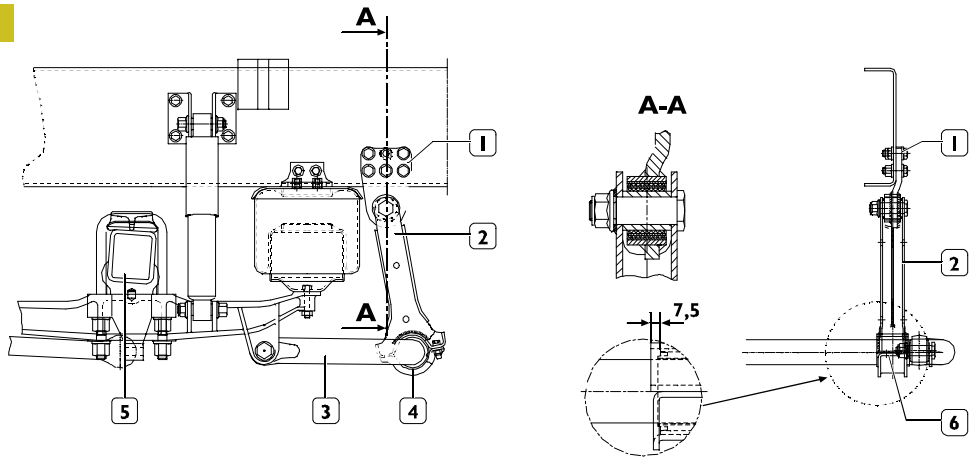
ASSEMBLY DRAWING FOR FRONT STABILIZER BAR
1. Upper hanger bracket - 2. Link rod - 3. Stabilizer bar - 4. Rubber bushing (in two halves) - 5. Front axle - 6. Cap.

Figure 71



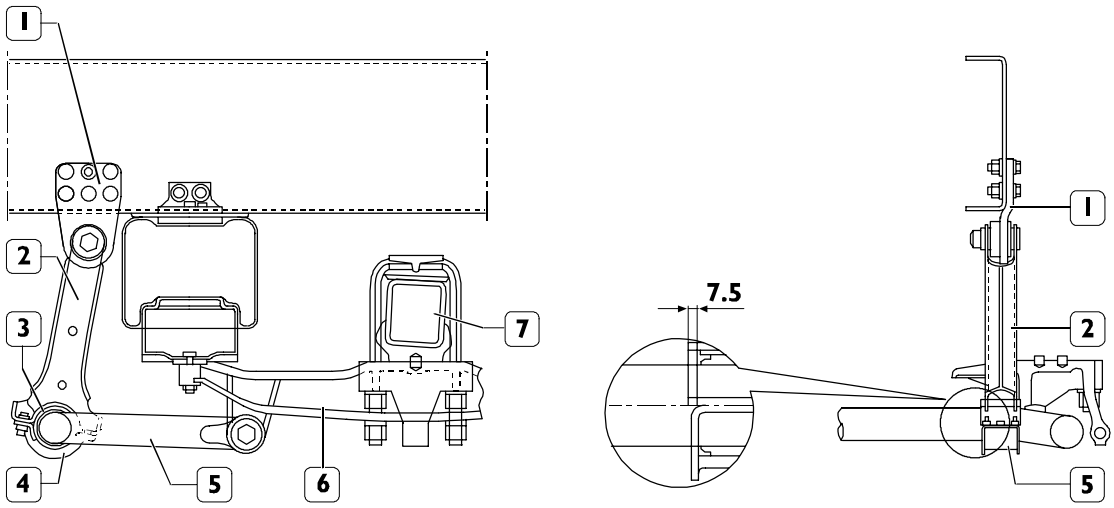
ASSEMBLY DRAWING FOR FRONT STABILIZER BAR: 4x2 – 6x2P VEHICLES WITH AIR SUSPENSION AND LONGITUDINAL BARS
1. Link rod - 2. Upper hanger bracket - 3. Stabilizer bar - 4. Rubber bushing (in two halves) - 5. Front axle - 6. Cap.

Figure 72



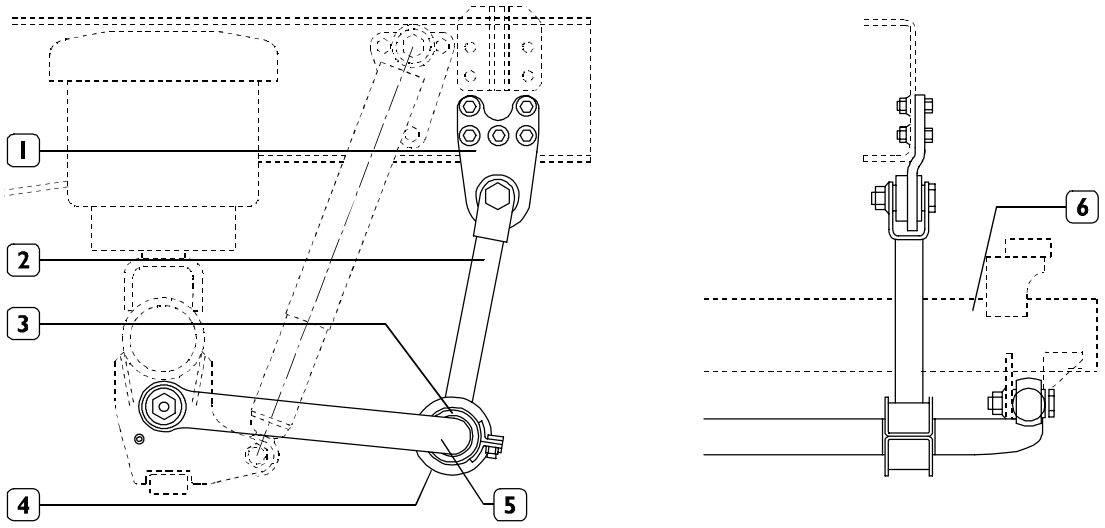
ASSEMBLY DRAWING FOR REAR STABILIZER BAR: 4x2 – 6x2C – 6x4 VEHICLES
1. Upper hanger bracket - 2. Link rod - 3. Stabilizer bar - 4. Rubber bushing (in two halves) - 5. Rear axle - 6. Cap.

Figure 73



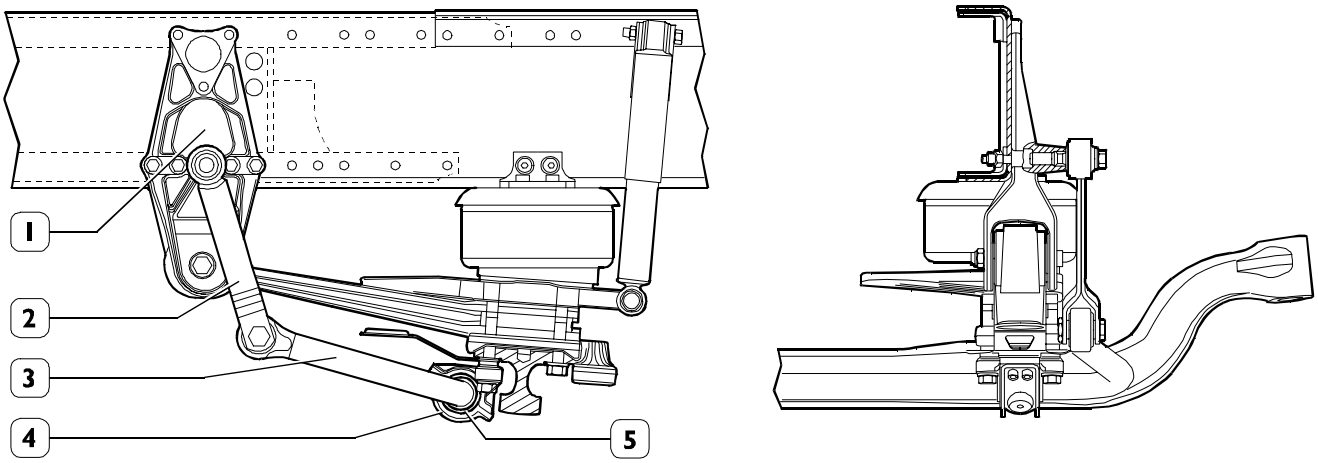
ASSEMBLY DRAWING OF REAR STABILIZER BAR FOR 6x2P VEHICLES
AND INTERMEDIATE STABILIZER BAR FOR 6x4 VEHICLES
1. Upper hanger bracket - 2. Link rod - 3. Rubber bushing (in two halves) - 4. Cap - 5. Stabilizer bar – 6. Mounting – 7. Rear axle.

Figure 74



ASSEMBLY DRAWING OF REAR STABILIZER BAR FOR REAR STEERING ADDED AXLE: 6x2P VEHICLES
1. Upper hanger bracket - 2. Link rod - 3. Rubber bushing (in two halves) - 4. Cap - 5. Stabilizer bar - 6. Added axle.

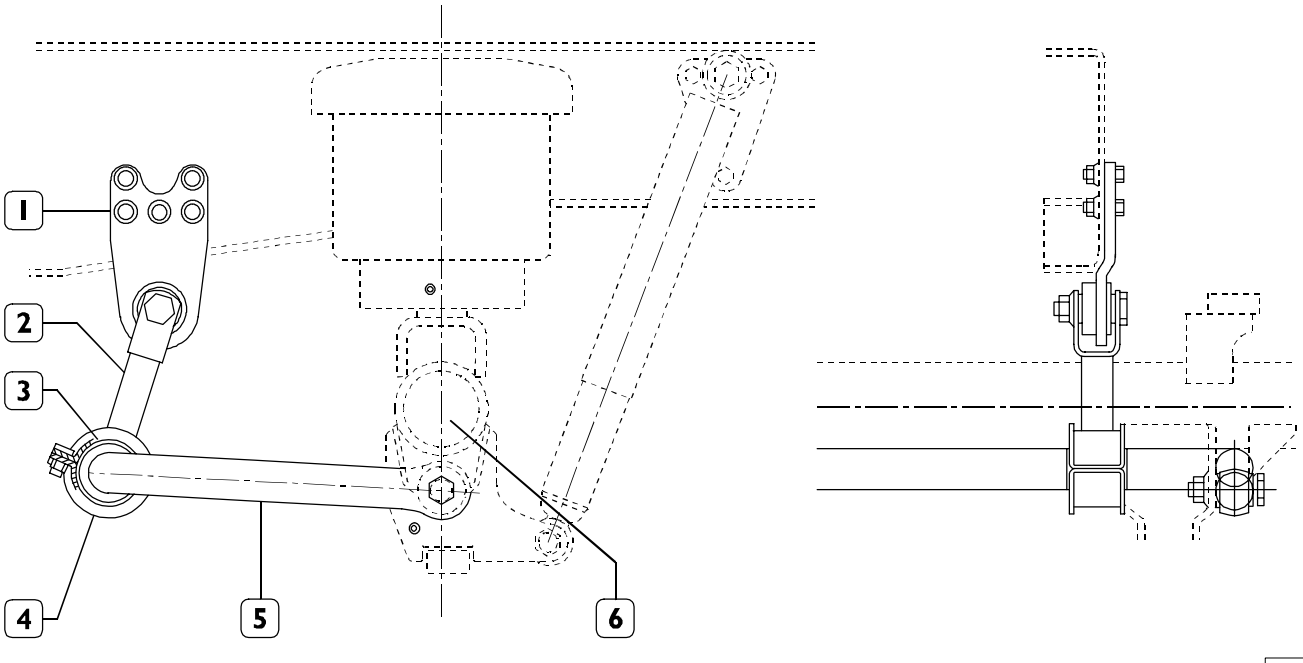
Figure 75



108529

MOUNTING SCHEME OF CENTRAL STEERING ADDED AXLE STABILISING BAR
VEHICLES 6x2 WITH AIR SPRING SUSPENSION
1. Upper hanger bracket - 2. Link rod - 3. Rubber bushing (in two halves) - 4. Cap - 5. Stabilizer bar.

Figure 76



73702

ASSEMBLY DRAWING OF STABILIZER BAR FOR REAR RIGID ADDED AXLE: 6x2P VEHICLES
WITH AIR SUSPENSION
1. Upper hanger bracket - 2. Link rod - 3. Rubber bushing (in two halves) - 4. Cap - 5. Stabilizer bar - 6. Added axle.

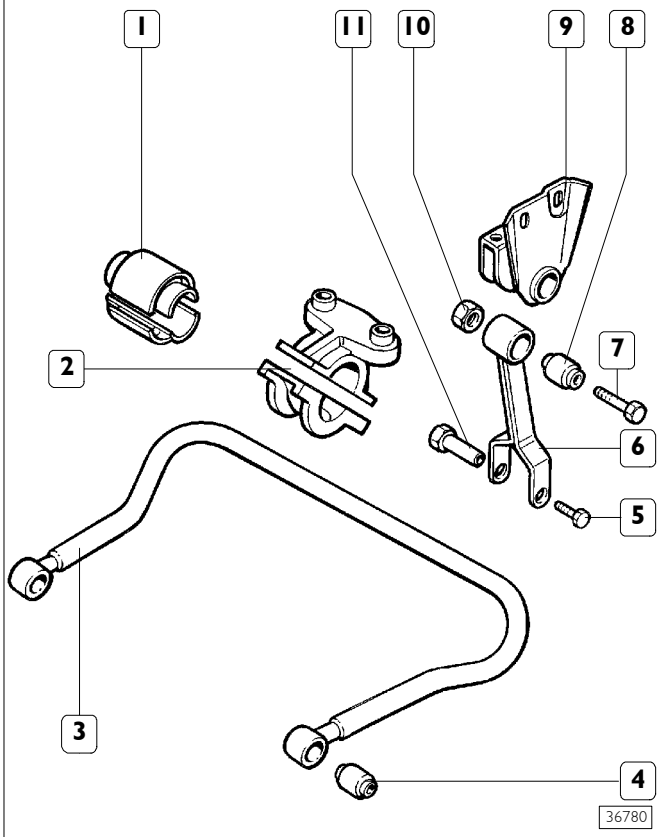
RUBBER BUSHINGS

528933 Replacing front stabilizer bar rubber bushings

528933 Replacing rear stabilizer bar rubber bushings

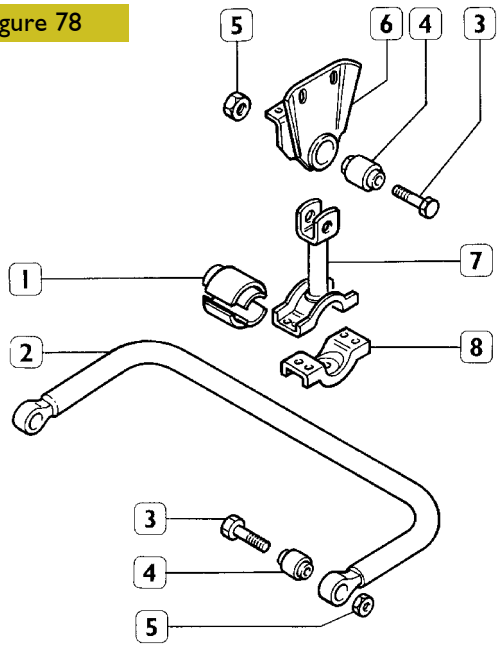
The rubber bushings (4 and 8, Figure 77), (4, Figure 78) and (6, Figure 79) are changed by using tool 99346049 to remove and fit them.

Figure 77



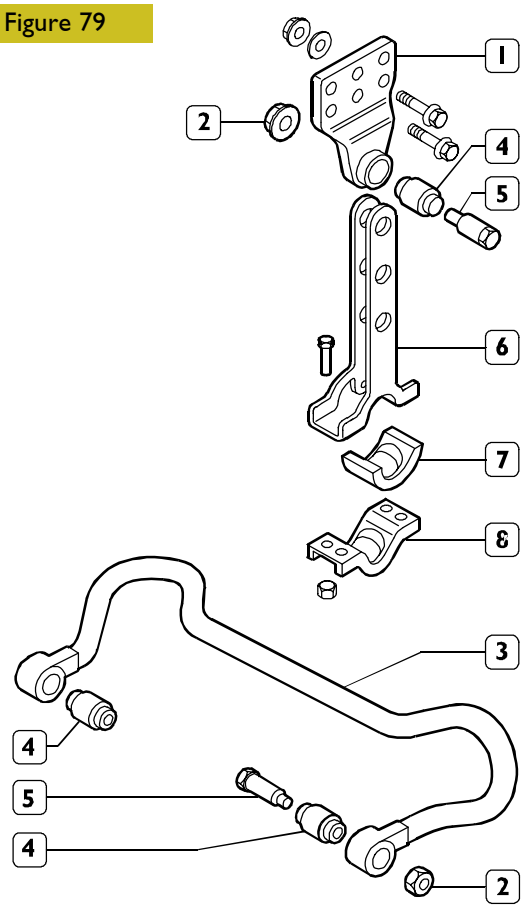
FRONT STABILIZER BAR COMPONENT PARTS
1. Bushing – 2. Mounting – 3. Stabilizer bar – 4. Rubber bushing – 5. Screw – 6. Link rod – 7. Bolt – 8. Rubber bushing – 9. Mounting – 10. Nut – 11. Screw

Figure 78



REAR STABILIZER BAR COMPONENT PARTS
1. Half bushing – 2. Stabilizer bar – 3. Bolt – 4. Rubber bushing – 5. Nut – 6. Mounting – 7. Suspension arm 8. Suspension arm cap

Figure 79



REAR STABILIZER BAR COMPONENT PARTS
1. Mounting – 2. Nut – 3. Stabilizer bar – 4. Bushing 5. Pin – 6. Suspension arm – 7. Half bushing 8. Suspension arm cap

5009 SHOCK ABSORBERS

Removal-refitting
500920 Central added axle shock absorbers
500940 Rear axle shock absorbers
500950 Rear added axle shock absorbers (6x2 P vehicles)

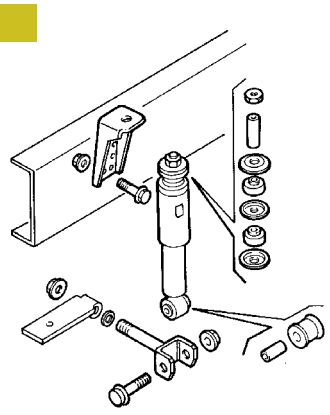
Removal

Remove the shock absorber by removing the upper and lower mounting nuts or screws.
Inspect the rubber bushings; if worn or deteriorated, renew them.
Check shock absorber efficiency using suitable test equipment.

Refitting

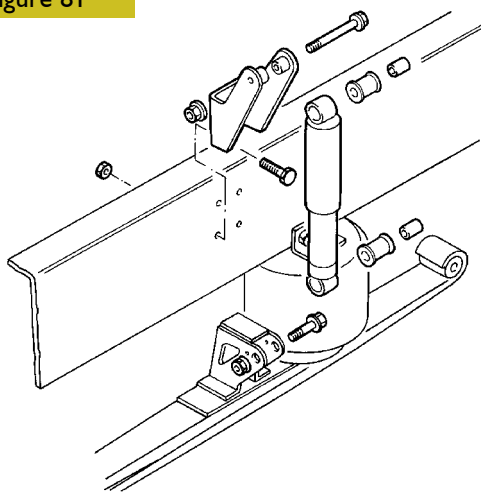
Carry out the removal operations in reverse order; tighten bolts and nuts to specified torques.

Figure 80



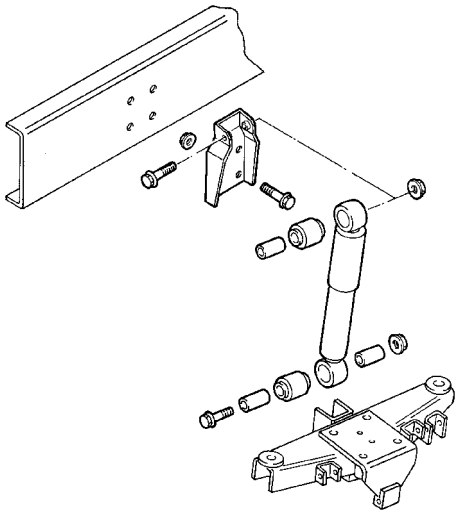
FRONT AXLE SHOCK ABSORBER WITH MECHANICAL SUSPENSION

Figure 81



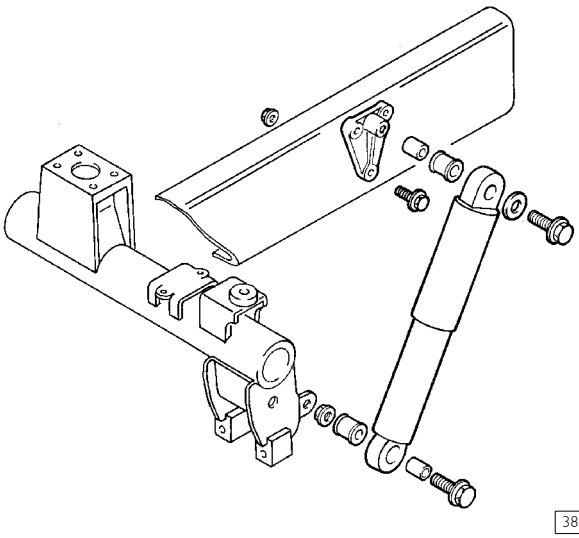
FRONT AXLE ADDED AXLE SHOCK ABSORBER WITH AIR SUSPENSION

Figure 82



REAR AXLE SHOCK ABSORBER WITH AIR SUSPENSION

Figure 83



REAR ADDED AXLE SHOCK ABSORBER

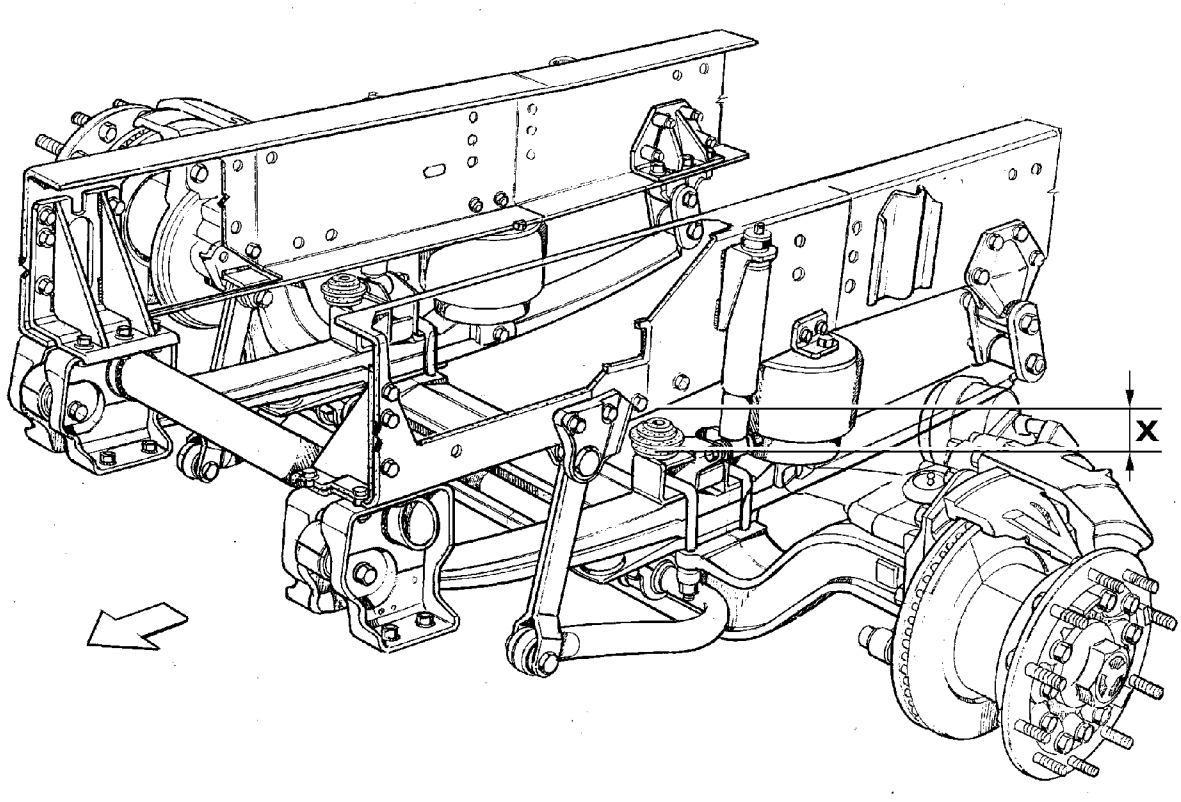
CHASSIS FRAME ADJUSTMENT

The chassis frame is adjusted using tools:

- ❑ 99346247, if the vehicle is a standard one;
- ❑ 99346248, if the vehicle has a lowered chassis frame.

And by adjusting the tie rods of the levelling valves to get the distances X shown in the figures.

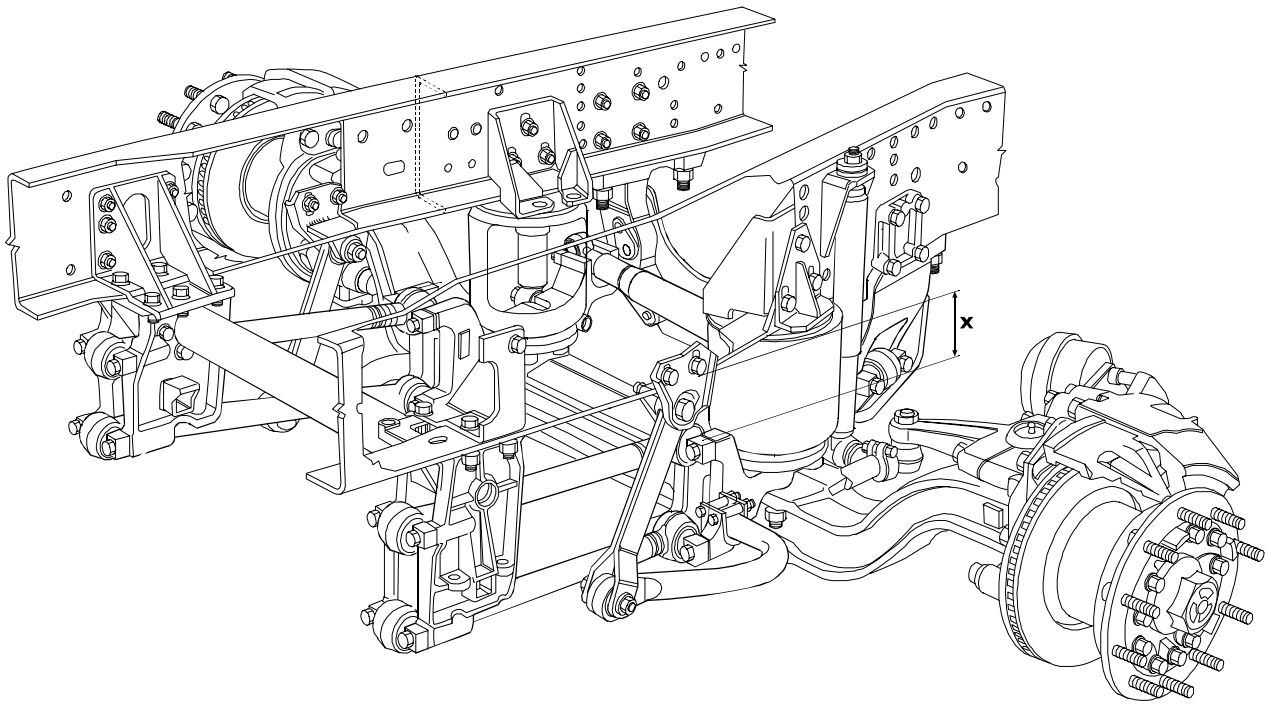
Figure 84



FRONT AIR SUSPENSION

X = 65 mm, standard version
X = 55 mm, lowered version

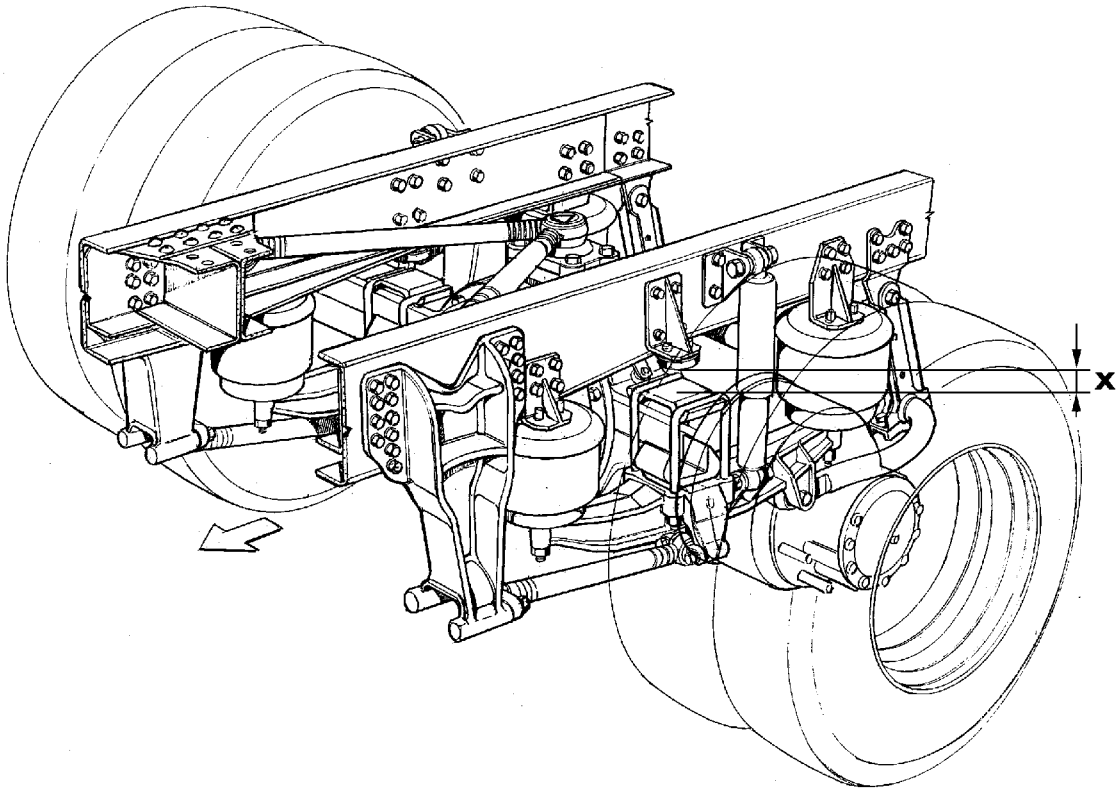
Figure 85



FRONT AIR SUSPENSION WITH LONGITUDINAL BARS: 4x2 – 6x2 P VEHICLES

X = 195 mm

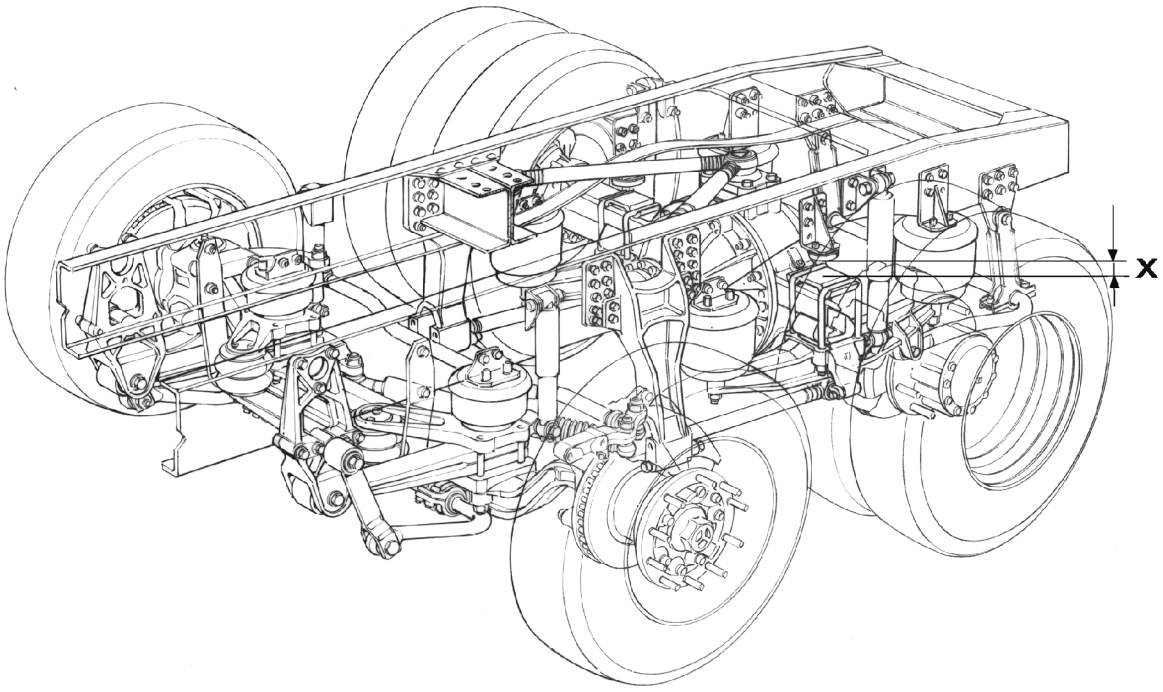
Figure 86



REAR AIR SUSPENSION: 4x2 VEHICLES

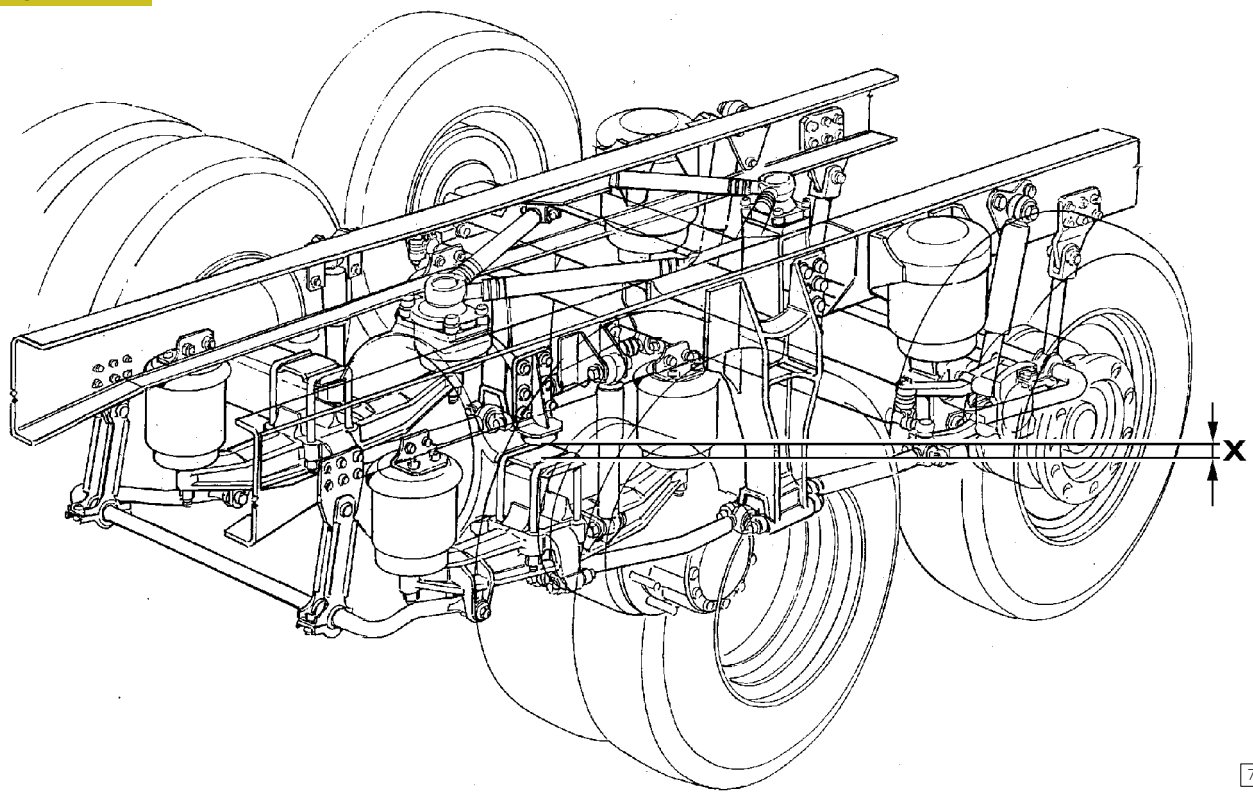
X = 60 mm

Figure 87



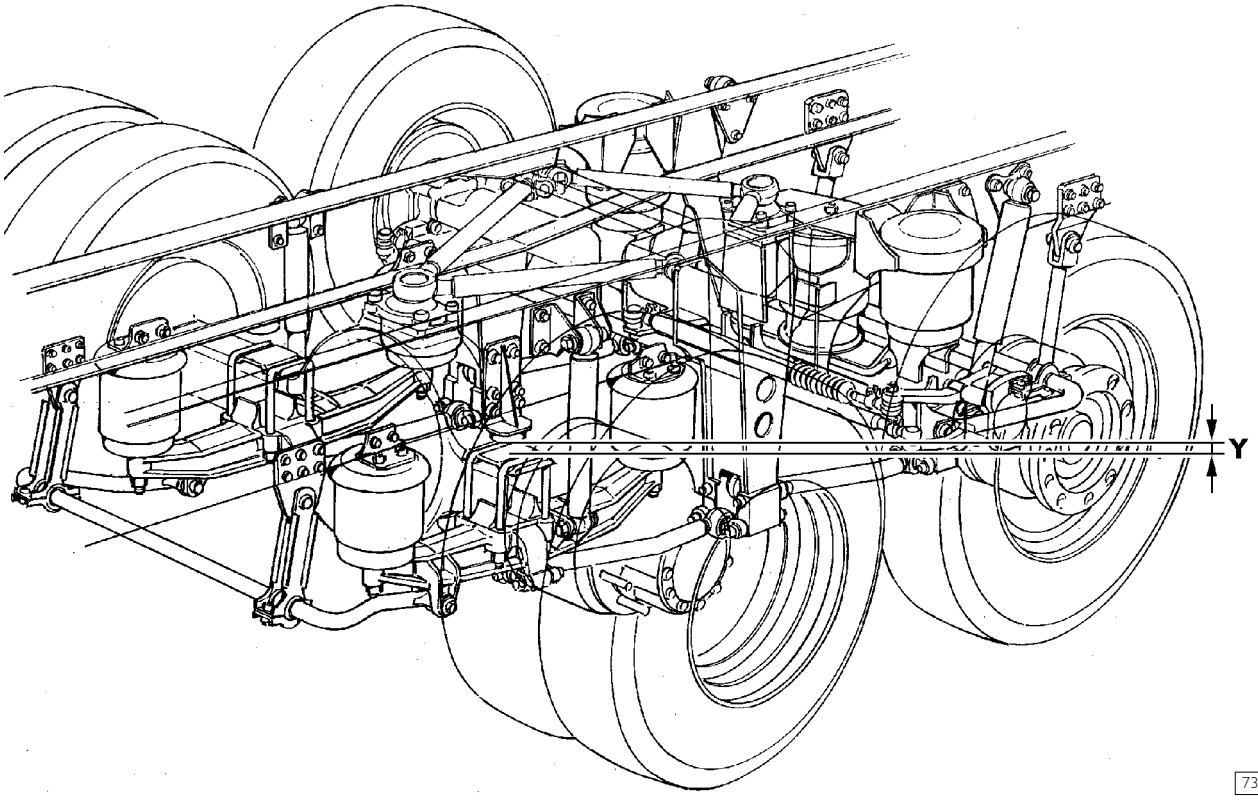
PNEUMATIC STEERING CENTRAL ADDED AXLE SUSPENSION
WITH PARABOLIC LEAF SPRINGS, REAR AIR SUSPENSION: 6x2 C VEHICLES
X = 60 mm

Figure 88



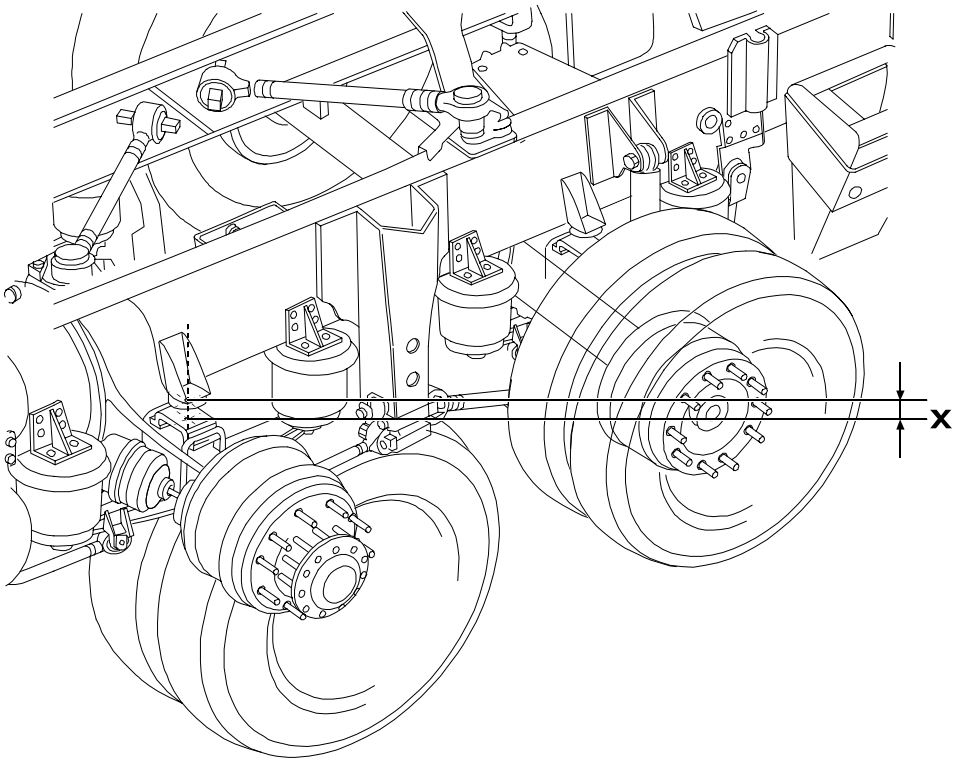
REAR AIR SUSPENSION: 6x2 P/FP VEHICLES
FIXED ADDED AXLE THAT CAN BE LIFTED WITH SINGLE WHEELS
X = 60 mm

Figure 89



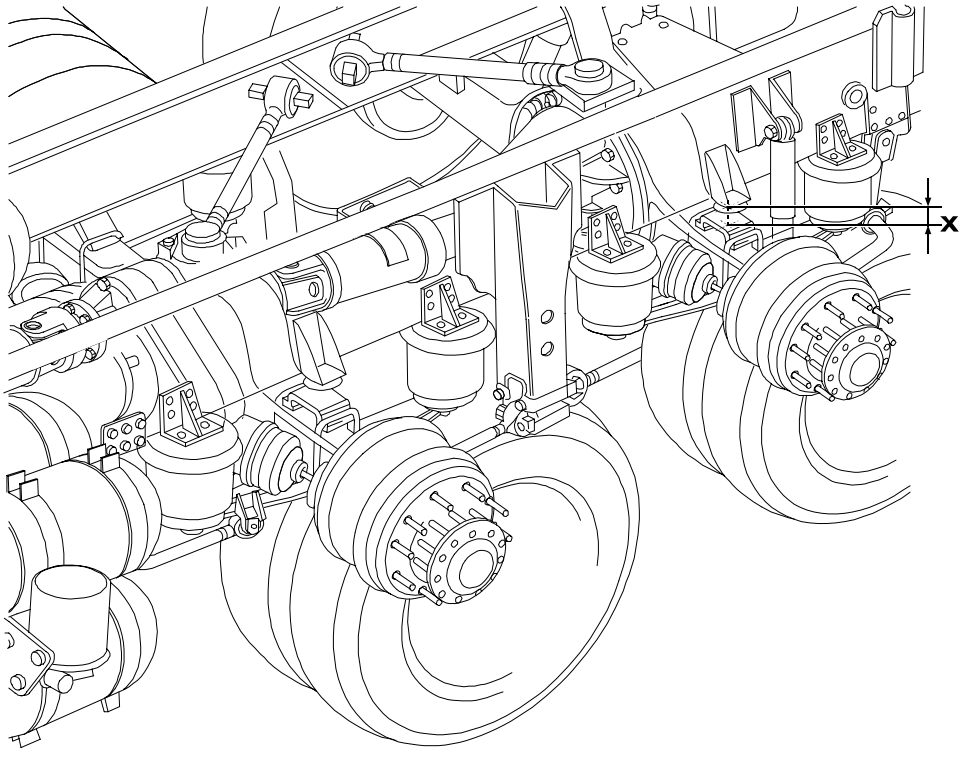
REAR AIR SUSPENSION: 6x2 PS-FS VEHICLES,
STEERING ADDED AXLE THAT CAN BE LIFTED WITH SINGLE WHEELS
Y = 60 mm

Figure 90



REAR AIR SUSPENSIONS: 6x2 PT VEHICLES
X = 55 mm

Figure 91



REAR AIR SUSPENSIONS: 6x4 VEHICLES
X = 60 mm

SECTION 10

5025 Wheels and tyres

DESCRIPTION

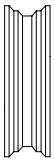
The wheel rim represents the rigid structure of the wheel and is identified by the following dimensions:

- ❑ diameter of the rim, measured at the base of the circumferential groove (that is, on the surface on which the air chamber rests);
- ❑ width of the circumferential groove in the wheel rim (that is, the distance between the surfaces on which the cover rests);

The tyre has the following functions:

- ❑ to absorb the greater part of the jolts caused by roughness of the road surface by exploiting the elasticity of air;
- ❑ to generate on the ground the motive force supplied by the engine necessary for the vehicle to move;
- ❑ to ensure the maximum grip and stability of contact between the tyre and the road, with satisfactory life;
- ❑ to withstand the forces generated by sudden braking, hard acceleration and by the thrust of centrifugal force on bends;
- ❑ to ensure the stability of the vehicle even at high speeds; to ensure the steerability of the vehicle.

CHARACTERISTICS AND DATA

WHEELS		
	Disc type, with specific continuous rims.	22.5" x 8.25 22.5" x 9 22.5 x 11.75

Tyre inflation pressures

NOTE When checking tyre pressures, adhere to the values given in the booklet "Use and Maintenance".

NOTE As regards the vehicles equipped with ESP, it is recommended that the same type of tyres are used both with the front and rear axle. Therefore, it is recommended that traction tyres of the winter type on the rear axle and leading tyres of the summer type on the front axle are used.

TOOLS

TOOL	DESCRIPTION
99305037	Electronic unit for balancing the front wheels on the vehicle/GSL

DIAGNOSTICS

Main operating faults of a mechanical nature

Visible Failure	Possible cause	Repair action
Excessive wear	Excessive speed on particularly uneven ground.	Reduce speed.
	Sudden variations in speed, violent or harsh braking.	Avoid all unnecessary acceleration or braking.
	Excessive speed with tyre pressures too low.	Check tyre pressures cold.
	Tyre pressures too high.	Reduce pressures.
	Truck overloaded.	Consult data on loads permitted.
Irregular wear	Difference in tyre pressures between one pair of wheels and the other.	Check pressure.
	Tyre pressures too low; wear more accentuated on the outside surfaces of the tread than in the middle.	Increase tyre pressures.
	Tyre pressures too high, with excessive wear in the middle of the tread.	Reduce pressure.
	Insufficient toe-in of front wheels; substantial wear on the inside surfaces of the tread.	Check and adjust toe-in.
	Front wheel geometry incorrect.	Restore normal wheel geometry.
	Distortion of wheel rims causing imbalance.	If possible, repair the rims or replace; then balance the wheels.
	Tyres incorrectly fitted to rims.	Fit the tyre correctly and balance the wheel.
	Rear axle out of parallel due to breakage of the leaf spring centre pin, or springs of different lengths, or bent springs.	Overhaul the suspension.
	Excessive toe-in of front wheels; excessive wear of the outside surfaces of the tread.	Check and adjust toe-in.

(Continued)

Visible Failure	Possible cause	Repair action
Vehicle pulls to one side	Front wheels out of balance.	Balance the wheels.
	Front tyres at different pressures.	Check pressures ensuring that both are at the correct value.
	Excessive difference in wear between a pair of tyres.	Replace excessively worn tyre.

502511 STATIC BALANCING OF THE WHEELS

Figure 1

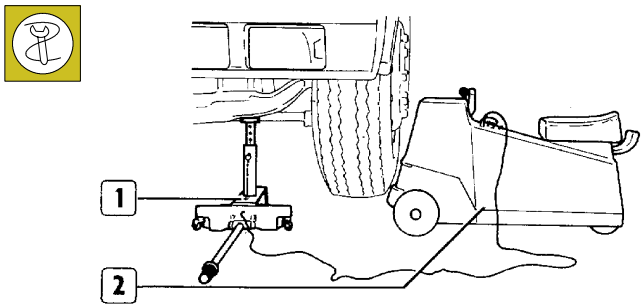
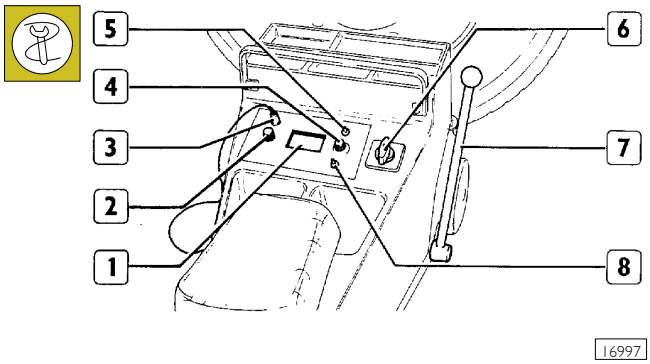


Figure 2



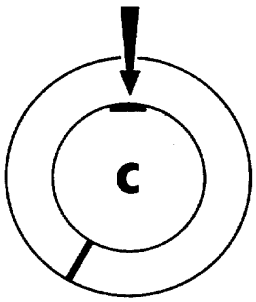
The front wheels can be balanced on the vehicle using the electronic unit 99305037; this has the great advantage of balancing the wheel together with the other rotating masses.

The operation must be carried out as follows :

- ❑ Raise the front of the vehicle and make sure that the wheels rotate freely
- ❑ Position the imbalance detector (1) under the axle close to the wheel being examined, arranging the height so that the spin-up wheel of unit 99305037 (2) is in contact with the tyre; position a support stand under the opposite side of the axle and lower the hydraulic jack
- ❑ Connect the cable (3) of the imbalance detector to unit 99305037
- ❑ Make a reference mark on the tyre by drawing a radial mark with chalk or using a strip of gummed paper
- ❑ Turn switch (2) to static balancing position and sensitivity switch (4) to notch no. 5 on the graduated scale
- ❑ Turn on switch (5) for instrument light (1) and strobe lamp switch (8).
- ❑ Turn the spin-up switch (6) of unit 99305037 to the first speed position so as to make the wheel rotate.

Turn up the spin switch (6) to second speed and place the balancing machine against the tyre.
While the wheel is being spun, it will be found that the stroboscopic effect on the wheel will make the reference mark appear stationary; the pointer of the instrument (1), moving from the value zero, reaches a maximum value on the scale and then returns to zero.
When the pointer has begun to fall back, withdraw the balancing machine, turn off the spin-up switch (6) completely and brake the motor by means of the brake lever (7). The wheel continues to revolve due to inertia and the reference mark made on the tyre moves; the point to which the reference mark has moved should therefore be noted.
Read off from the instrument (1) the value shown by the pointer, multiply it by 10, to obtain the value of the balance weight to be fitted to the rim.

Figure 3



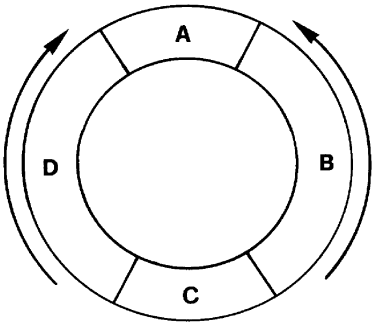
16998

Fit the balance weight calculated in this way as shown in the figure. If during the test, the pointer of the instrument (1, Figure 2) remains in the green area of the box, the wheel is balanced.

NOTE If the weight required to balance the wheel is more than 600 to 800 grams, divide the weight in half and position the two parts so formed with one half on the inside and one half on the outside of the rim, making sure that they are in the same position.

CORRECTING RESIDUAL STATIC IMBALANCE

Figure 4



23885

To correct the residual imbalance, repeat the operations already carried out above; depending to the new reading on the instrument (1, Figure 2), refer to the diagram in Figure 4 and proceed as follows to adjust:

- If the weight is in the zone marked with letter A, this means that it is too light, and in that case weight must be added as indicated by the instrument (1, Figure 2).
- If the weight is in the bottom zone marked with letter C, this means that it is too heavy and in that case the weight must be reduced as shown by the measuring instrument.
- If the weight is found to be in the zones marked with letters B or D, do not remove or add any weight but instead move it 5 cm upwards in the direction of the arrows, see Figure 4.

502510 TYRE PRESSURE

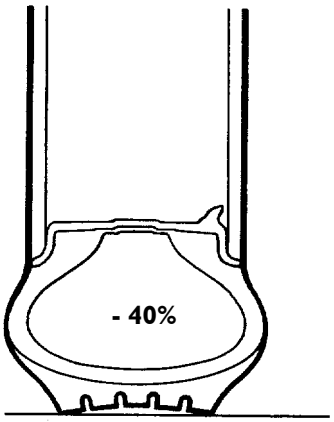
Tyre pressures must be checked with the tyres cold.
Carefullly make sure that the pressure is correct since, if it is higher than required, a harsh ride and excessive wear of the centre of the tread will result, while if it is lower, the load is not distributed over the whole tread but is concentrated at either side, causing premature wear of these areas and also damaging the internal structure of the tyre.
Unequal pressures between tyres affects the driving stability of the vehicle and impairs operating safety.
Abnormal wear of the tyres may appear in various areas of the tyre treads.

HOW TYRE BEHAVIOUR DEPENDS ON PRESSURE

Schematic views to demonstrate how tyre behaviour and performance depends on pressure.

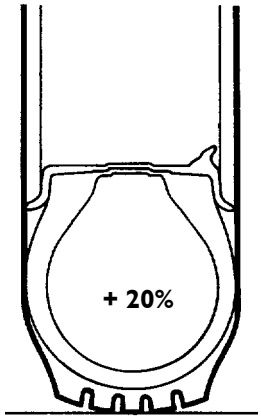
NOTE (The value shown inside each figure indicates the tyre pressure, whereas the performance refers to the tyre life).

Figure 5



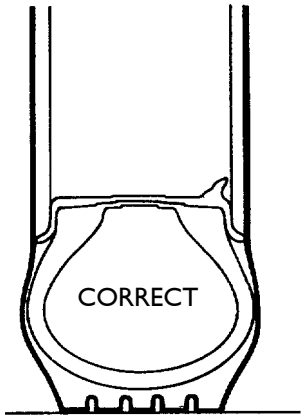
EFFICIENCY 40%

Figure 6



EFFICIENCY 90%

Figure 7



EFFICIENCY 100%

NOTE If anomalous wear of front tyres is found (either inside or outside the tread), have front wheel toe-in checked. Never exceed the maximum weight per axle (the vehicle's gross weight being unchanged).
The pair of tyres mounted on an axle is properly replaced when, owing to blocks worn out, continuous bands result apparent extending to displayed tyre full length.
Tyres are provided with wear indicators. Replacement is compulsory when such indicators are reached.

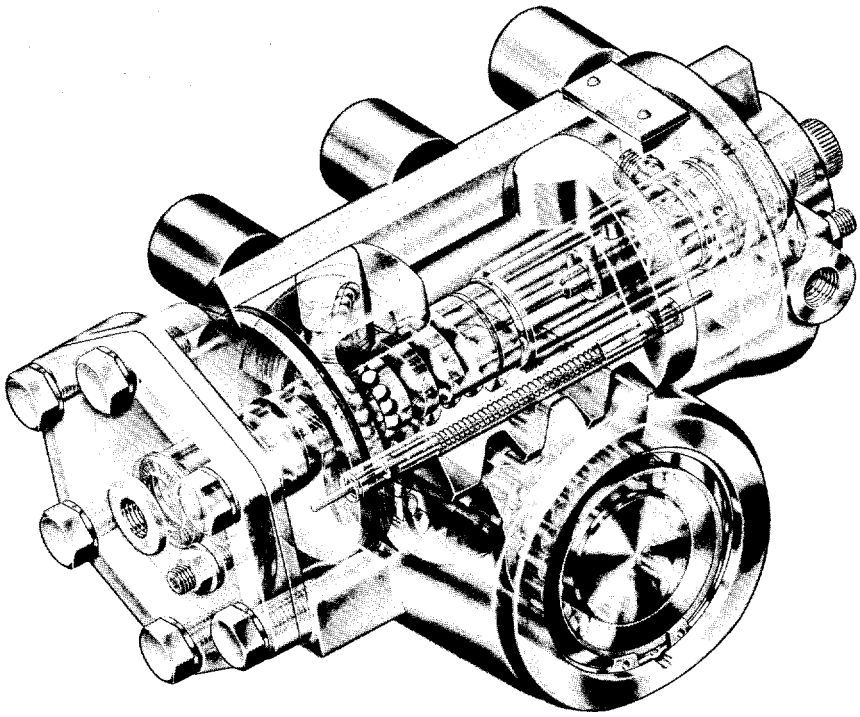
SECTION 11

5014 Steering

DESCRIPTION

The ZF 8098 power steering box is a recirculating ball unit; it is essentially comprised of a housing, the integral mechanical steering linkage, the control valve and the power cylinder.

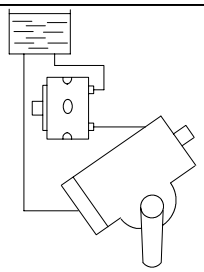
Figure 1



27199

ZF 8098 POWER STEERING BOX

SPECIFICATIONS AND DATA

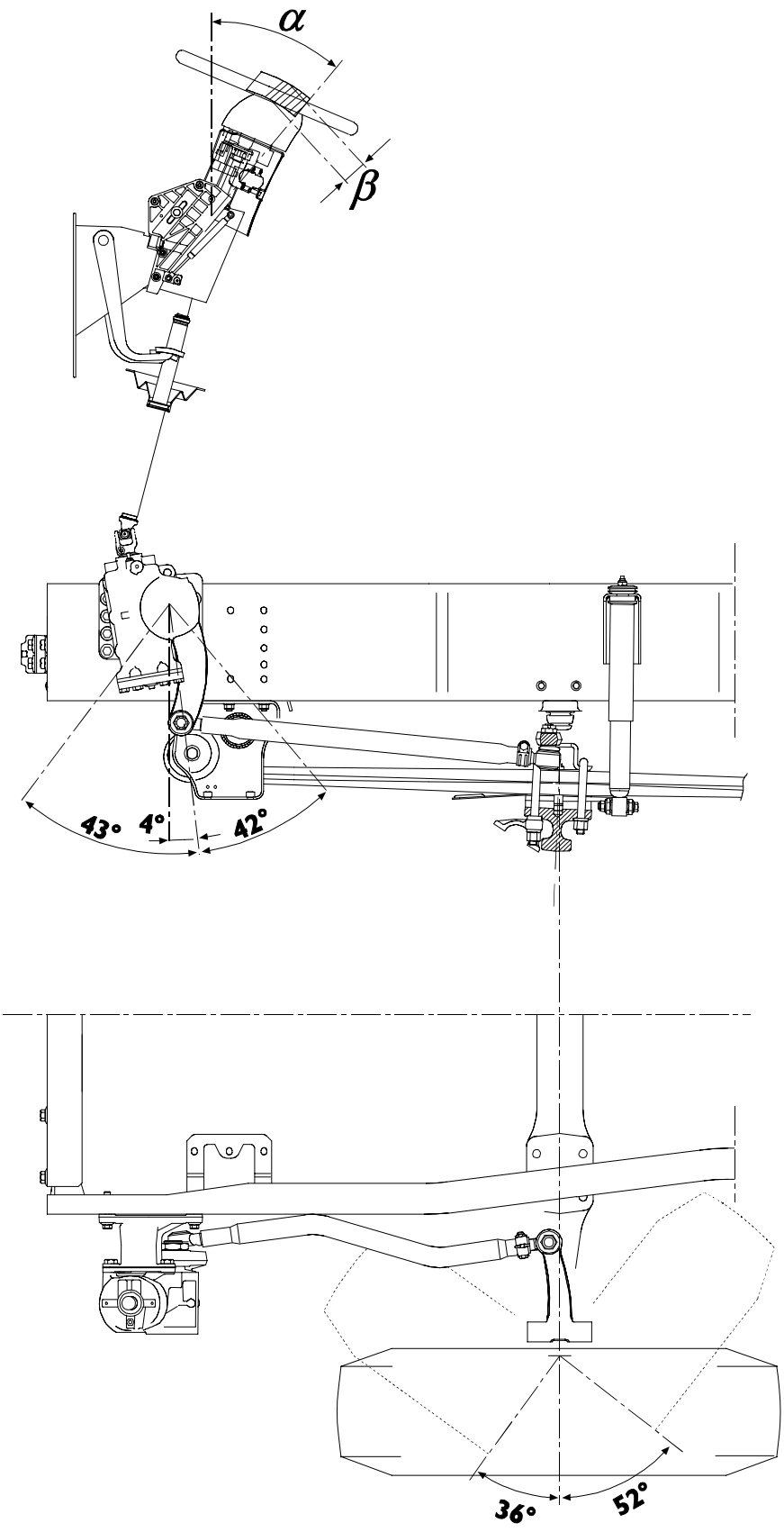


	Steering system	Hydraulic	
	Power steering	ZF8098 recirculating ball type with integral pressure limiting valve and hydraulic device with automatic adjustment to limit the steering angle	
	Variable working pressure	150+ 15 bar	
	Variable reduction ratio	vehicles	
		Chassis cab and tractor 6x2 C	Excluding tractors 6x2 C
	straight ahead	22.2 : 1	17 : 1
	full lock	26.2 : 1	20 : 1
	no. of turns of steering wheel from straight ahead to full lock	3.1	2.4
	Power steering pump	ZF	
	Minimum rpm	500	
	Maximum rpm	3500	
	Maximum pressure (without limiting valve) bar	180	165*
	Capacity dm^3/min	16	20*

* vehicles 6x2 p /FS - PS - vehicles 6x2 c

Scheme of the steering control of vehicles with mechanical front suspension

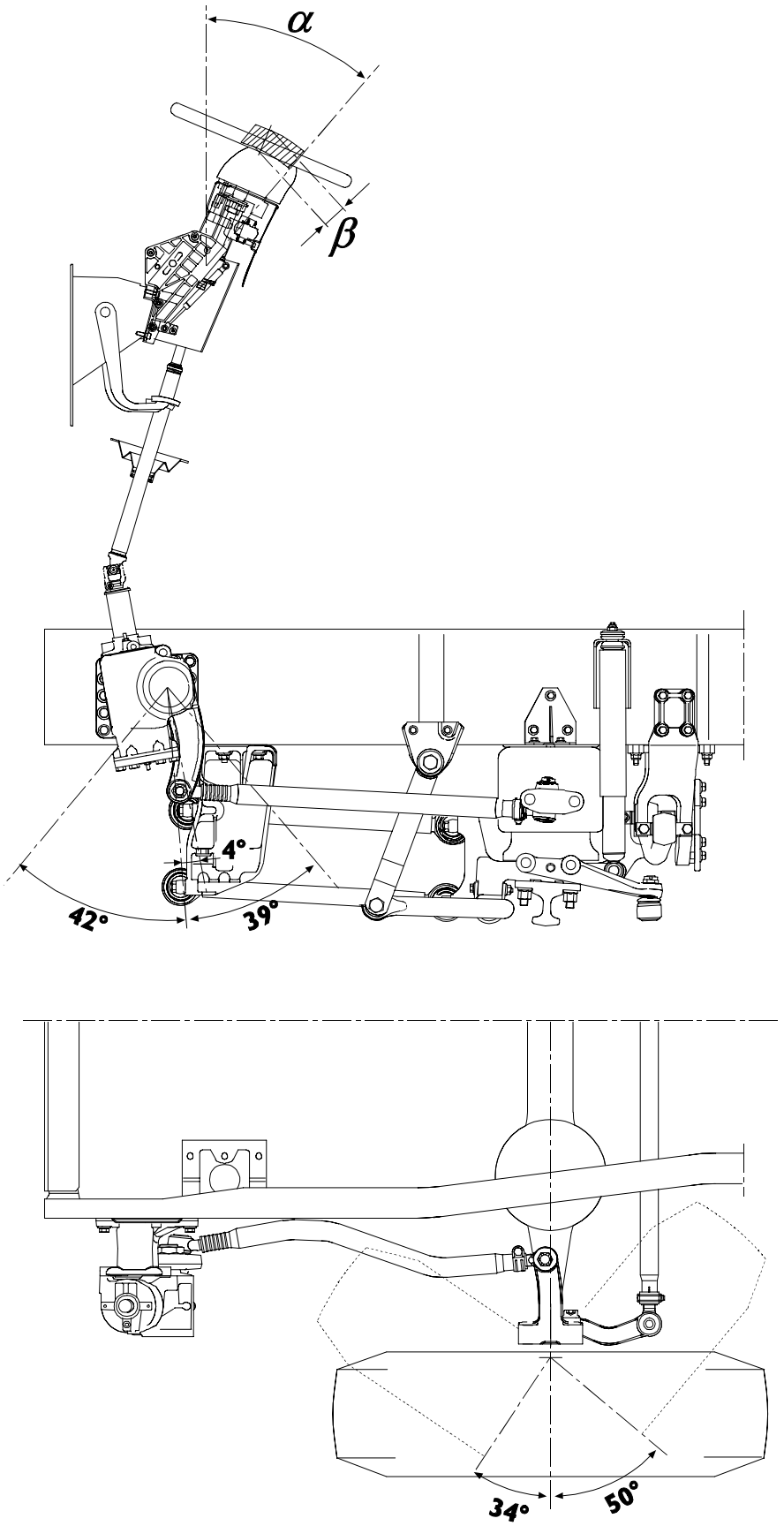
Figure 2



α = range of angular adjustment: 40°
β = range of axial adjustment: 60 mm

Vehicle steering control diagram with front air suspension and longitudinal bars

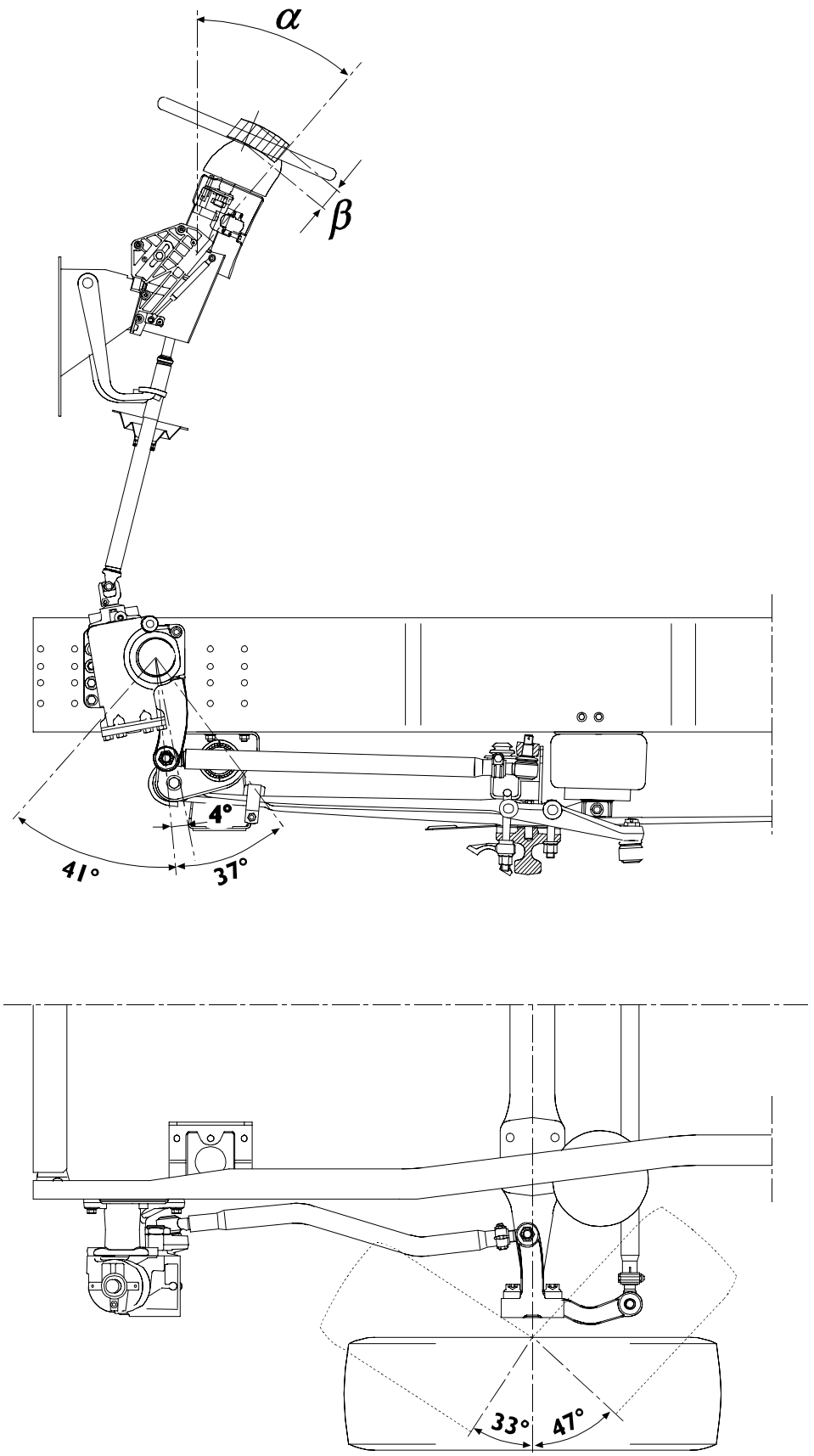
Figure 3



α = range of angular adjustment: 40°
β = range of axial adjustment: 60 mm

Vehicle steering control diagram with front air suspension and leaf springs

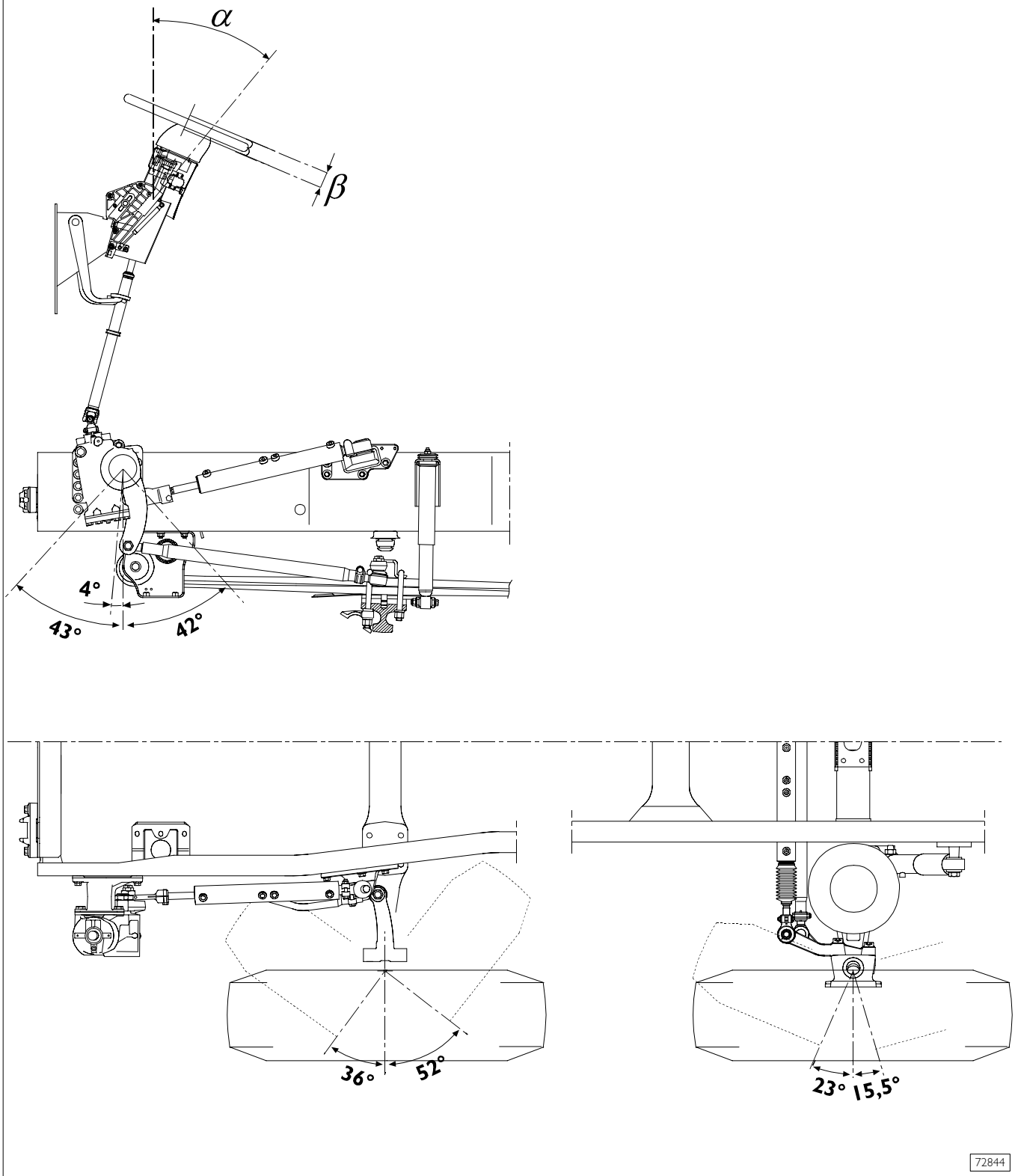
Figure 4



α = range of angular adjustment: 40°
β = range of axial adjustment: 60 mm

Scheme of the steering control of 6x2 p vehicles - having a steering rear axle - with mechanical front suspension

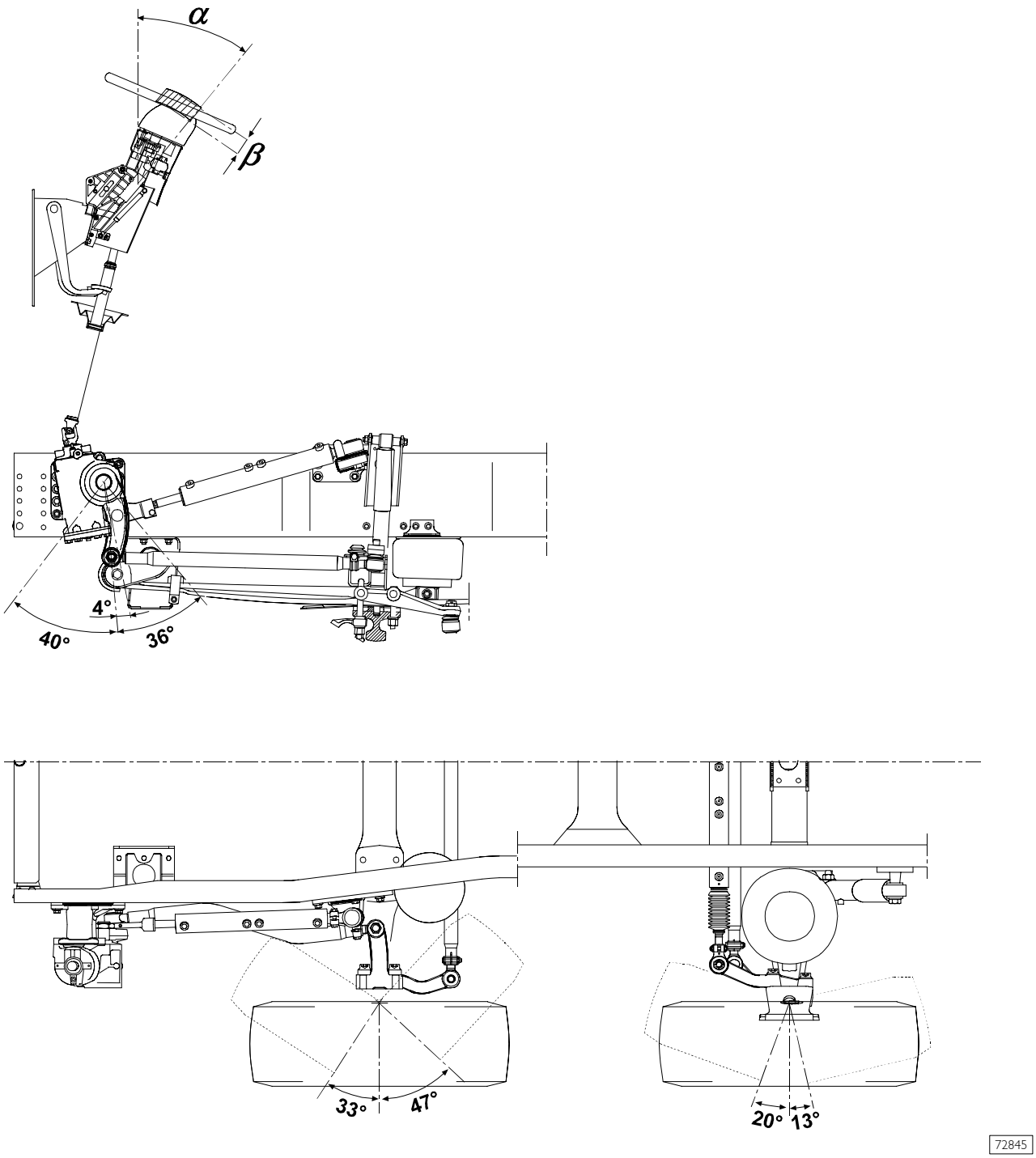
Figure 5



α = range of angular adjustment: 40°
β = range of axial adjustment: 60 mm

Scheme of the steering control of 6x2 p vehicles - having a steering rear axle - with pneumatic front suspension

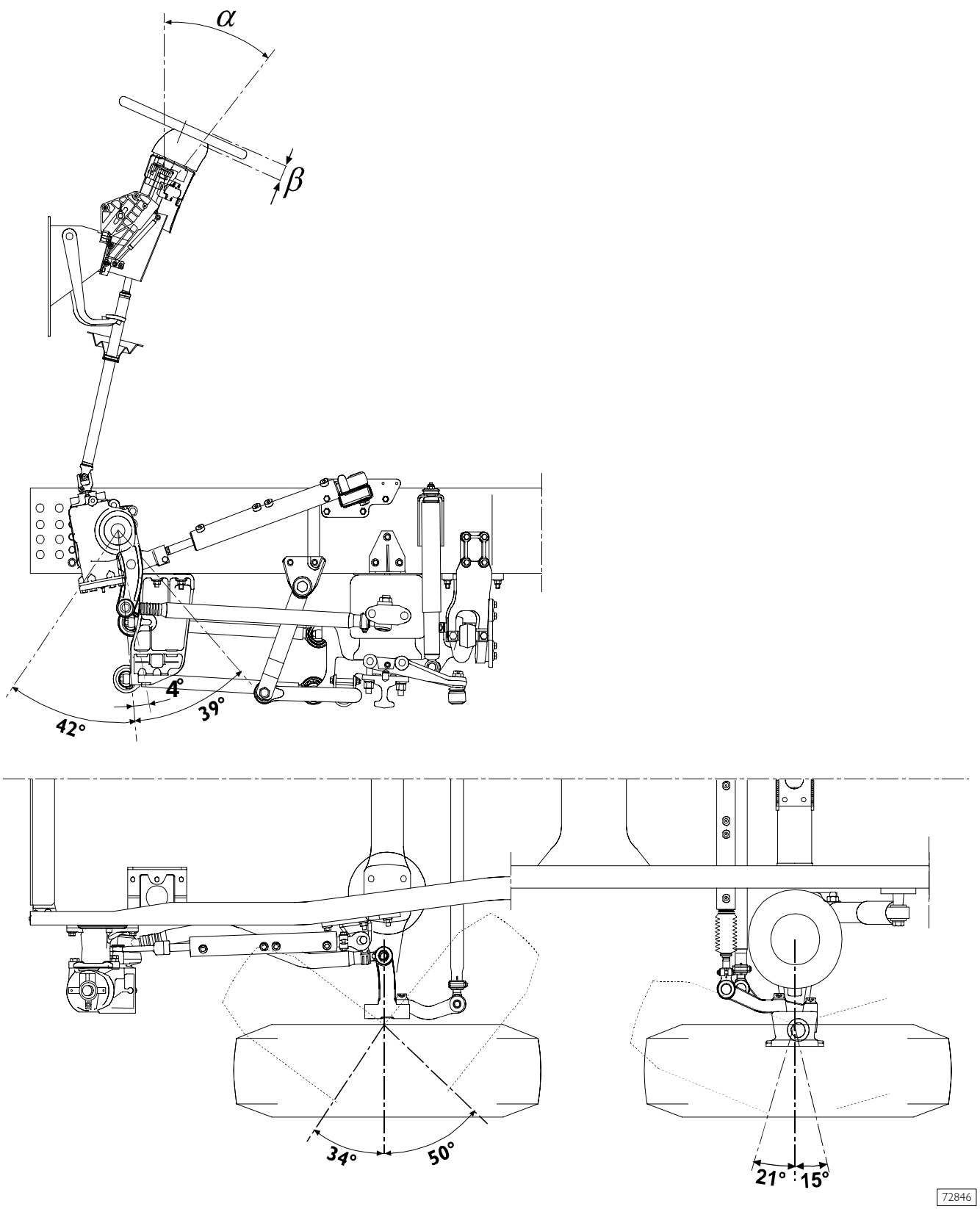
Figure 6



α = range of angular adjustment: 40°
β = range of axial adjustment: 60 mm

Scheme of the steering control of 6x2 p vehicles - having a steering rear axle - with pneumatic front suspension and longitudinal bars

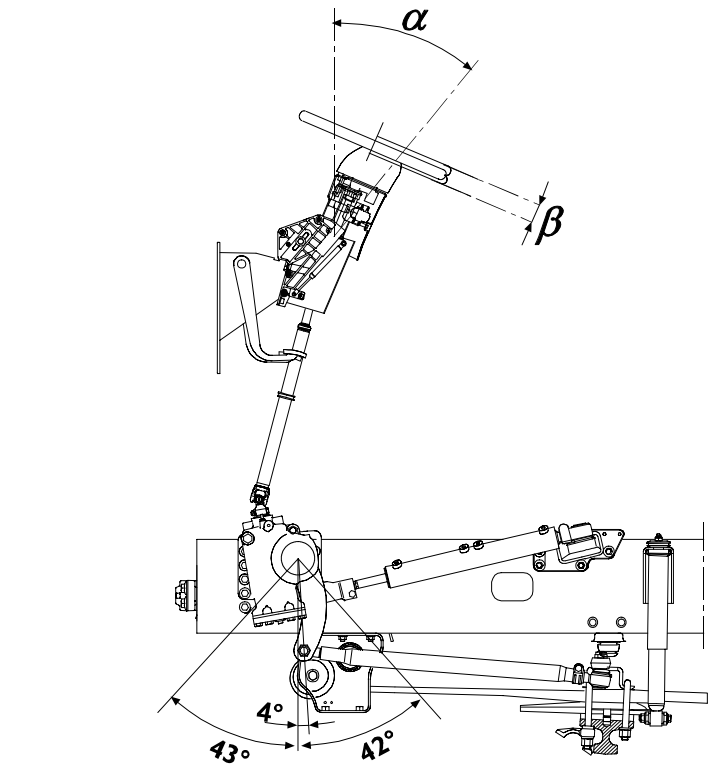
Figure 7



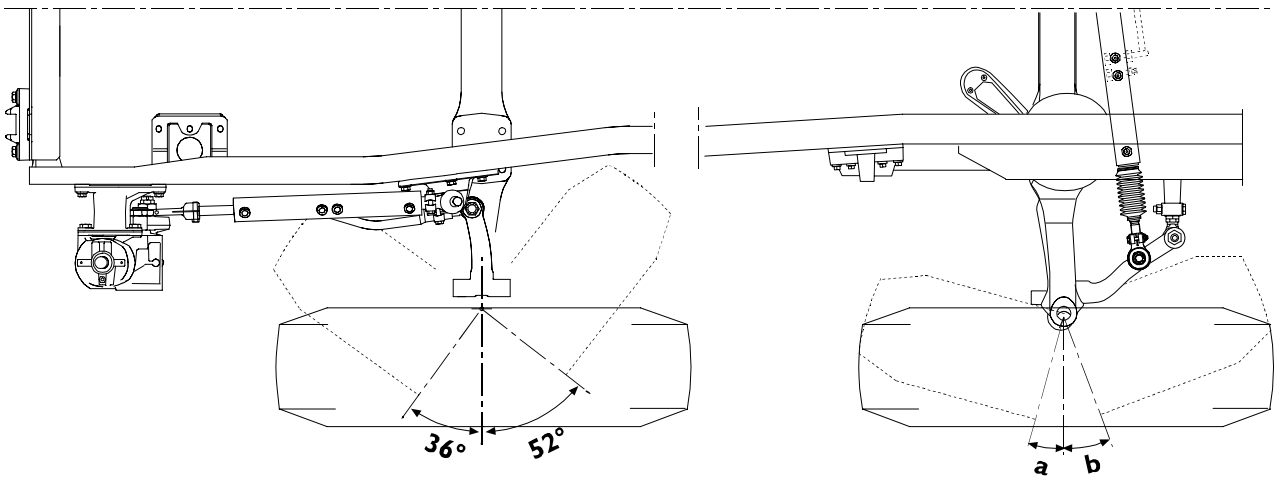
α = range of angular adjustment: 40°
β = range of axial adjustment: 60 mm

Scheme of the steering control of 6x2 c vehicles - having a steering central axle - with mechanical front suspension

Figure 8



Wheels	Drive	a	b
RH	LH	14.5°	21°
	RH	13.3°	25°
LH	LH	14.5°	21°
	RH	16.5°	18°



114981

α = range of angular adjustment: 40°
β = range of axial adjustment: 60 mm

DIAGNOSTICS

Main operating faults of a mechanical nature

Visible Failure	Possible cause	Repair action
Steering stiff when turning right and left	Insufficient fluid in system.	With motor running, check fluid level; top up fluid to upper mark on dipstick and bleed system.
	Air in hydraulic circuit.	Check intake tube and pump shaft seal for leaks and top up the fluid. Bleed system.
	Pump regulating valve jammed or blocked.	Take down valve, wash and check. Throttling orifice must not be blocked.
	Insufficient oil pump flow.	Replace pump.
	Universal joint not serviceable.	Make joint free to slide by moving it to and fro several times so that it tilts under its own weight.
	Lubrication of the transmission lever bearings insufficient (for vehicles with steering third axle).	Grease the transmission lever bearings.
	Bearings for internal transmission levers worn (for vehicles with steering third axle).	Overhaul the transmission levers and replace worn parts.
	Hydraulic cylinders not working (for vehicles with steering third axle).	Replace the cylinders.
Steering stiff only when turning left or right	Internal seals not serviceable.	Send steering gear to a ZF service centre.
	Incorrect position of hydraulic centre (when wheel is released, the steering does not return to one end of travel by itself).	Have valve adjusted by a ZF service centre.
Steering stiff when the wheel is turned quickly	Regulating valve in pump clogged.	Dismantle valve, rinse and clean.
	Insufficient hydraulic pump flow.	Overhaul or replace the hydraulic pump.
	Air in steering circuit.	Check intake tube and pump shaft seal for leaks and top up fluid. Bleed system.

(Continued)

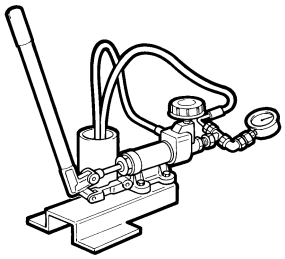
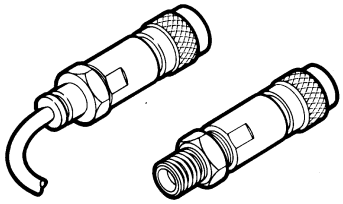
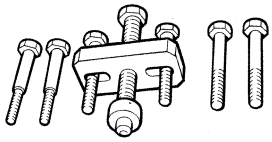
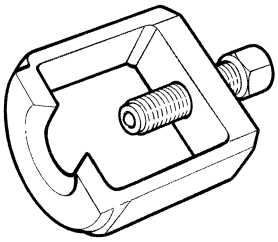
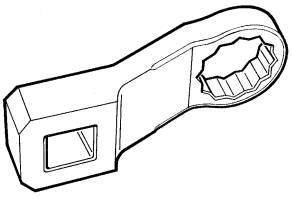
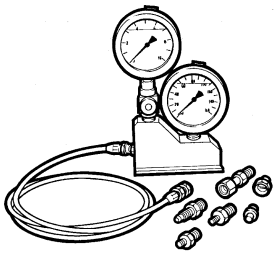
Visible Failure	Possible cause	Repair action
When steering, heavy jolts are felt at the wheel	Play in universal joint.	Replace the universal joint.
	Internal failure of steering unit.	Send steering unit to a ZF service centre.
	Insufficient fluid in system.	Top up fluid and bleed system.
	Wheel geometry incorrect.	Check and adjust according to the characteristic data given in the "AXLE" section.
	Wheels out of balance.	Balance in accordance with instructions given in the section "Wheels and tyres".
	Steering rod joints loose on the arms.	Replace any worn parts.
	Irregular pump operation.	Replace pump.
	Leakage of fluid from power steering circuit couplings.	Check coupling seals for serviceability, and replace any which are worn.
Torsional vibration of the steering wheel	Wheels out of balance.	Balance in accordance with instructions given in the section "Wheels and tyres".
	Front wheel toe-in incorrect.	Check and adjust in accordance with characteristic data given in the "AXLE" section.
	Air in hydraulic system.	Check intake pipe and pump shaft seal for leaks and top up fluid. Bleed the system.
Excessive play at the steering wheel	Play in ball joints and/or elastic supports loosened.	Fix the supports. Replace ball joints.
	Play in universal joint.	Replace universal joint.
	Internal failure of steering system.	Send steering unit to a ZF service centre.
Loss of fluid	Tank cover not secured.	Secure cover.
	Deterioration of gaskets and seals.	Replace worn gaskets and seals, top up fluid and bleed.
	In every case it is necessary to establish where and why hydraulic fluid is being lost, eliminate the cause and, with the engine running, top up fluid to upper mark on dipstick..	
Insufficient pressure in the circuit	Pump not operating correctly.	Overhaul or replace the hydraulic pump.
	Fluid leaking from couplings in power steering circuit.	Check coupling and seals for serviceability, replacing any which are worn.
	Insufficient oil level in the tank.	Top up oil level and bleed circuit.

TIGHTENING TORQUES

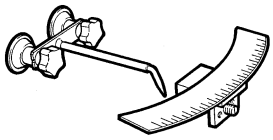
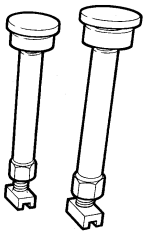
	PART	TORQUE Nm	(kgm)
	Flanged hexagonal nut for steering support + pitman arm	226.5±22.5	(22.6±2.3)
	Flanged hexagonal head screw for fixing steering gear stand	278±28	(27.8±2.8)
	Hexagonal head screw for steering box	527.5±52.5	(52.7±5.3)
	Calibrated hexagonal head screw for steering box		
	Castellated nut for steering linkage and hydraulic circuit (*)	300	(30)
	Self-locking nut for universal joint	55±5	(5.5±0.5)
	Calibrated screw for universal joint	55±5	(5.5±0.5)
	Fixing flange for track rod and drag link arm	80±10	(8±1)
	Hexagonal nut for lever on the steering box	575±55	(57.5±5.5)
	Nut for screw fastening steering support	146.5±14.5	(14.6±1.5)
▲	Self-braking flanged hexagonal nut for steering gear stand	226.5±22.5	(22.6±2.3)
▲	Hexagonal head screw for fixing the steering gear stand	248±25	(24.8±2.5)
□	Hexagonal nut with flange for pitman's arm	226.5±22.5	(22.6±2.3)
□	Hexagonal head flanged screw for pitman's arm	278±28	(27.8±2.8)
□	Castellated nut for hydraulic cylinder (*)	400	(40)
□	Castellated nut for steering linkage (*)	250	25
□	Fixing flange for track rod and drag link arm	170±10	(17±1)
□	Fixing flange for drag link bar	80±10	(8±1)
(*)	If at the prescribed torque the notch does not correspond to the hole, keep tightening until the split pin can be inserted.		

▲ 4x2 vehicles - 6x2 vehicles with additional rear lifting axle -
□ 6x2 vehicle with third steering axle - 6x2C vehicles

TOOLS

TOOL NO.		DESCRIPTION
99305446		Hand pump for hydraulic system filling and drain
99305450		Series of connections (2) for 99305446 hydraulic pump
99347042		Steering wheel puller
99347068		Puller for steering rod ball joints
99355032		Wrench for power steering fixing screws
99374393		Tool with pressure gauges for checking the power steering hydraulic pressure

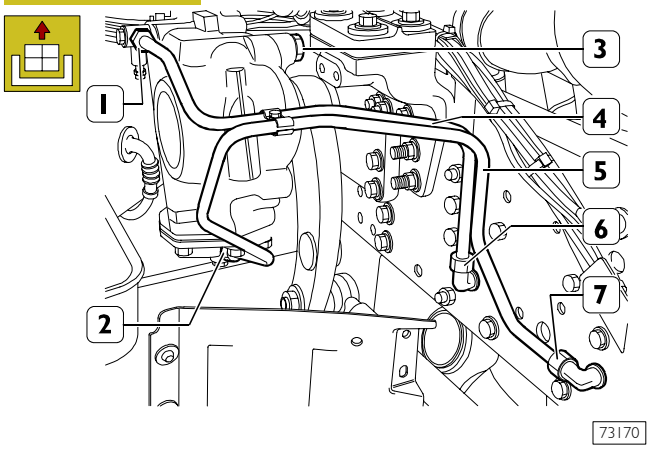
TOOLS

TOOL NO.		DESCRIPTION
99374398		Graduated sector and scale steering wheel play control (to be used with 99374393)
99374399		Couple of expanders for locking the wheels (to be used with 99374393-99374398)

541430 REMOVING-REFITTING THE POWER STEERING SYSTEM

Removal

Figure 9

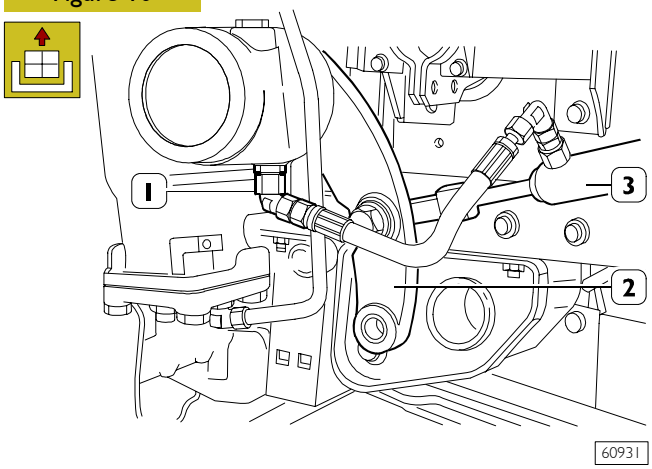


Set the vehicle with its wheels straight. Tilt the cab.
Put a container under the power steering box and take the cover off the fluid reservoir.
Unscrew the fittings (1-2-6-7), detach the pipes (4 and 5) and drain off the oil. Take out the screw (3) fixing the power steering box to the mounting.

For vehicles with a steering rear added axle only.

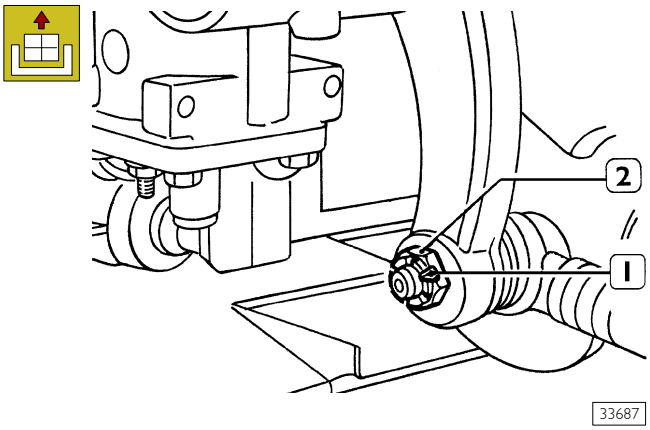
NOTE For vehicles with a steering added rear axle, before disconnecting the pipes, it is necessary to discharge the pressure from the system as described under the relevant heading.

Figure 10



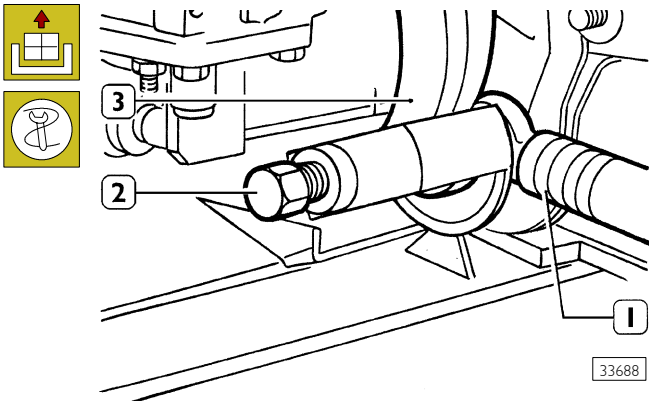
Disconnect the oil pipe (1).
Disconnect the operating cylinder (3) from the lever (2), removing the split pin and the connecting nut.

Figure 11



Remove the split pin (1) and unscrew the nut (2).

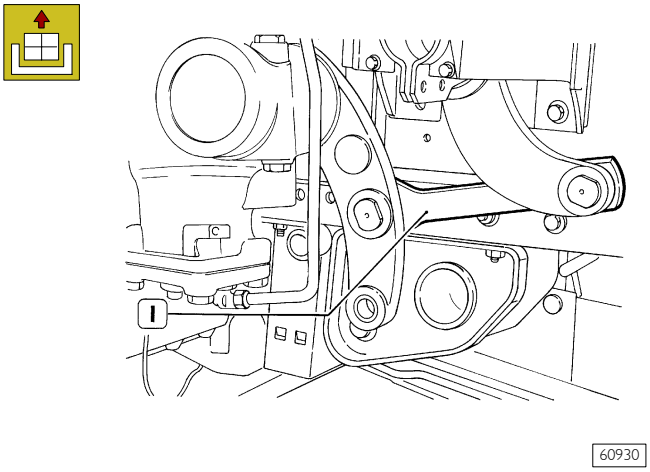
Figure 12



Using an extractor 99347068 (2), disconnect the tie rod (1) from the lever (3).

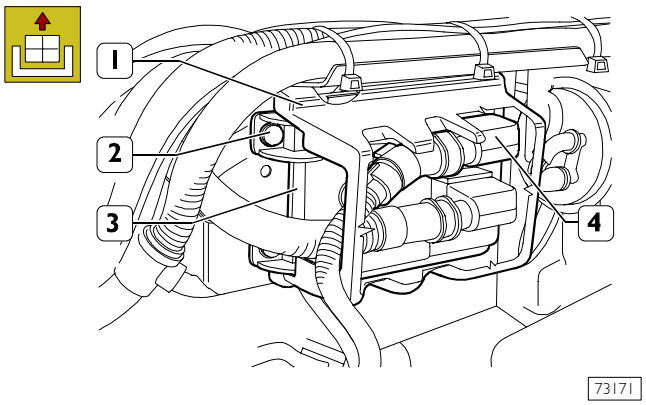
For vehicles with a central added axle only.

Figure 13



Take out the split pins; unscrew the retaining nuts and remove the relay lever (1).

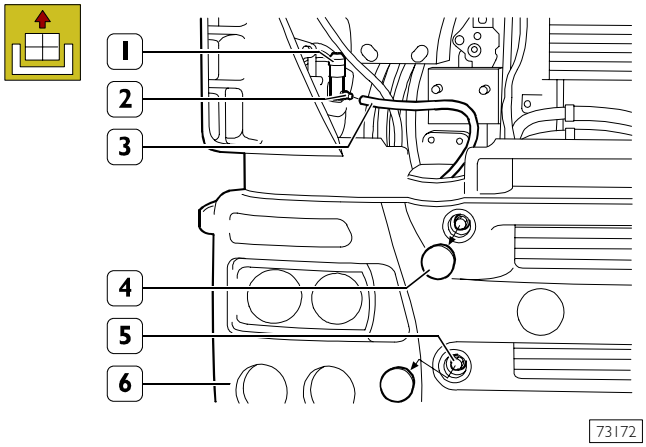
Figure 14



If the vehicle is fitted with a cabin tilting electro-hydraulic control, proceed as follows.
Take out the screws (2), disconnect the F.F.C. (Front Frame Computer) control unit (3) from the chassis frame; take off the cover (1) and reconnect the control unit (3) to the chassis frame. Lower the cab.
Disconnect the corrector (4) from the F.F.C. control unit (3).

After disconnecting the connector (4) it is no longer possible to lift the cab.

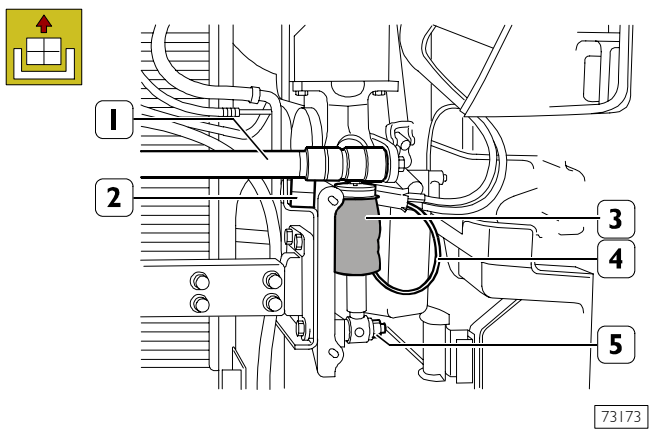
Figure 15



Disconnect the pipe (3) from the motor pump (1) for the headlight washer and put a plug (2) into its fitting to prevent the fluid from draining out of the reservoir. Take off the covers (4). Remove the four nuts (5) fixing the bumpers (6) to the cab.
Support the bumper (6) appropriately and detach it from the cab by removing the nuts securing it to the side brackets.

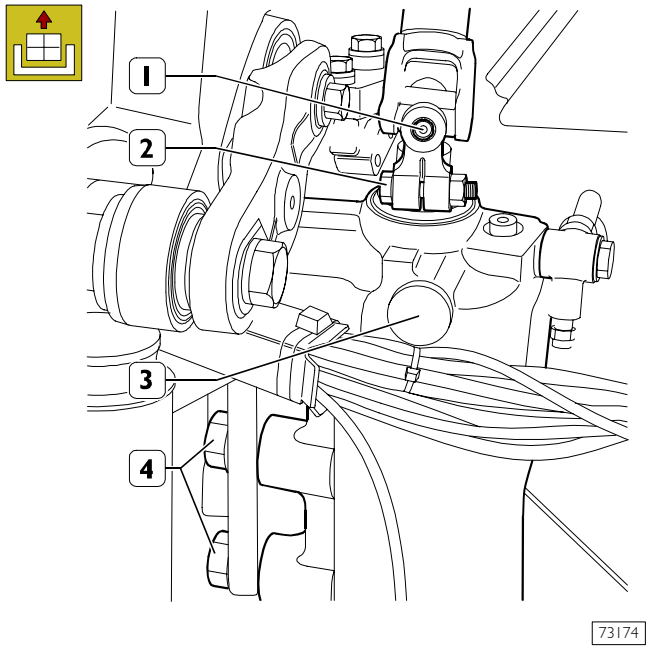
With the bumper moved away from the cab, take out the screw fixing the earth cable to the chassis frame.

Figure 16



Put a wooden plug (2) between the bar (1) and the structural member of the chassis frame. Disconnect the pipe (4) from the air spring (3).
Disconnect the air spring (3) from the chassis frame by taking out the bolt (5).
Engage the steering lock by taking the ignition key out.

Figure 17



Mark the assembly position of the universal joint (1) on the power steering box. Take out the bolt (2) and disconnect the universal joint (1) from the shaft of the power steering system (3).
Support the power steering box (3) appropriately, take out the screws (4) and detach it from the chassis frame.

NOTE So as not to change the setting of the automatic hydraulic steering limit, do not turn the shaft of the power steering box with a torque greater than 25 Nm.

Refitting

Carry out the steps performed for removal in reverse order.

Lubricate the screws fixing the power steering box to the mounting with oil.

Tighten the screws to the required tightening torques.

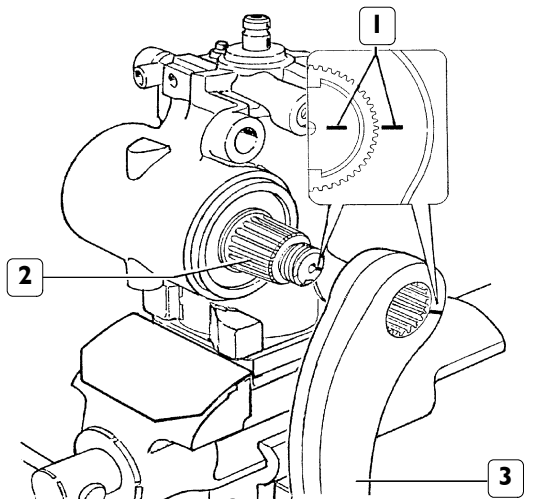
Bleed the air from the circuit as described on page 27 of this section.

NOTE Where the hydraulic guide is replaced, after reconnecting the hydraulic guide on the vehicle, it is needed to set the automatic regulation of steering hydraulic limitation as described in relating chapter.

Removing-Fitting the Steering Lever

NOTE If it is necessary to replace the power steering system with a new one, before fitting it on the mounting, carry out the following operations.

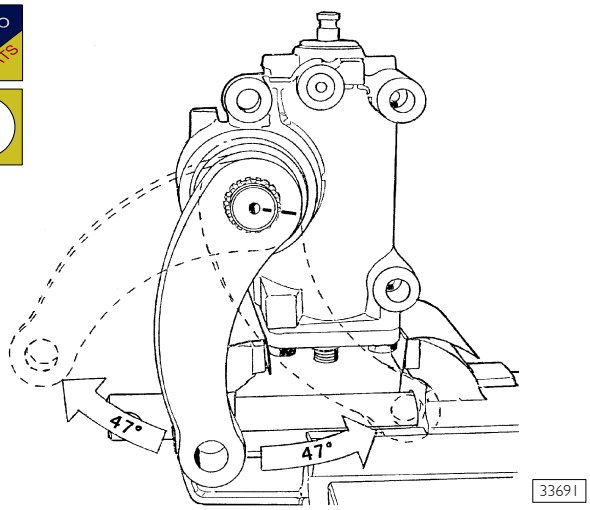
Figure 18



Secure the power steering box in a vice.
Fit the steering lever (3), making the reference marks (1) cut on the driving shaft (2) and on the lever (3) tally.

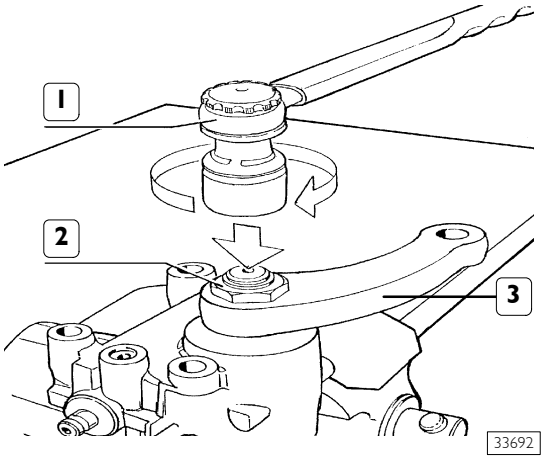
NOTE So as not to change the setting of the automatic hydraulic steering limit, do not turn the shaft (2) of the power steering box with a torque greater than 25 Nm.

Figure 19



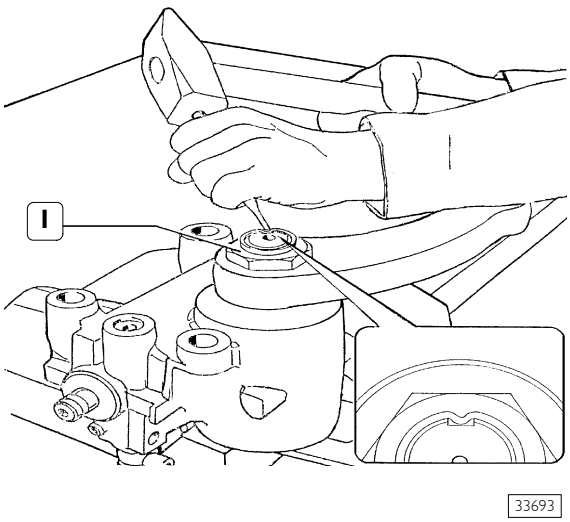
Check the angular travel of the lever that has to be 47° in both directions.

Figure 20



Keeping the lever (3) stationary to prevent turning the power steering shaft, lock the nut (2) fixing the lever with a torque wrench (1) to a torque of 575 Nm.

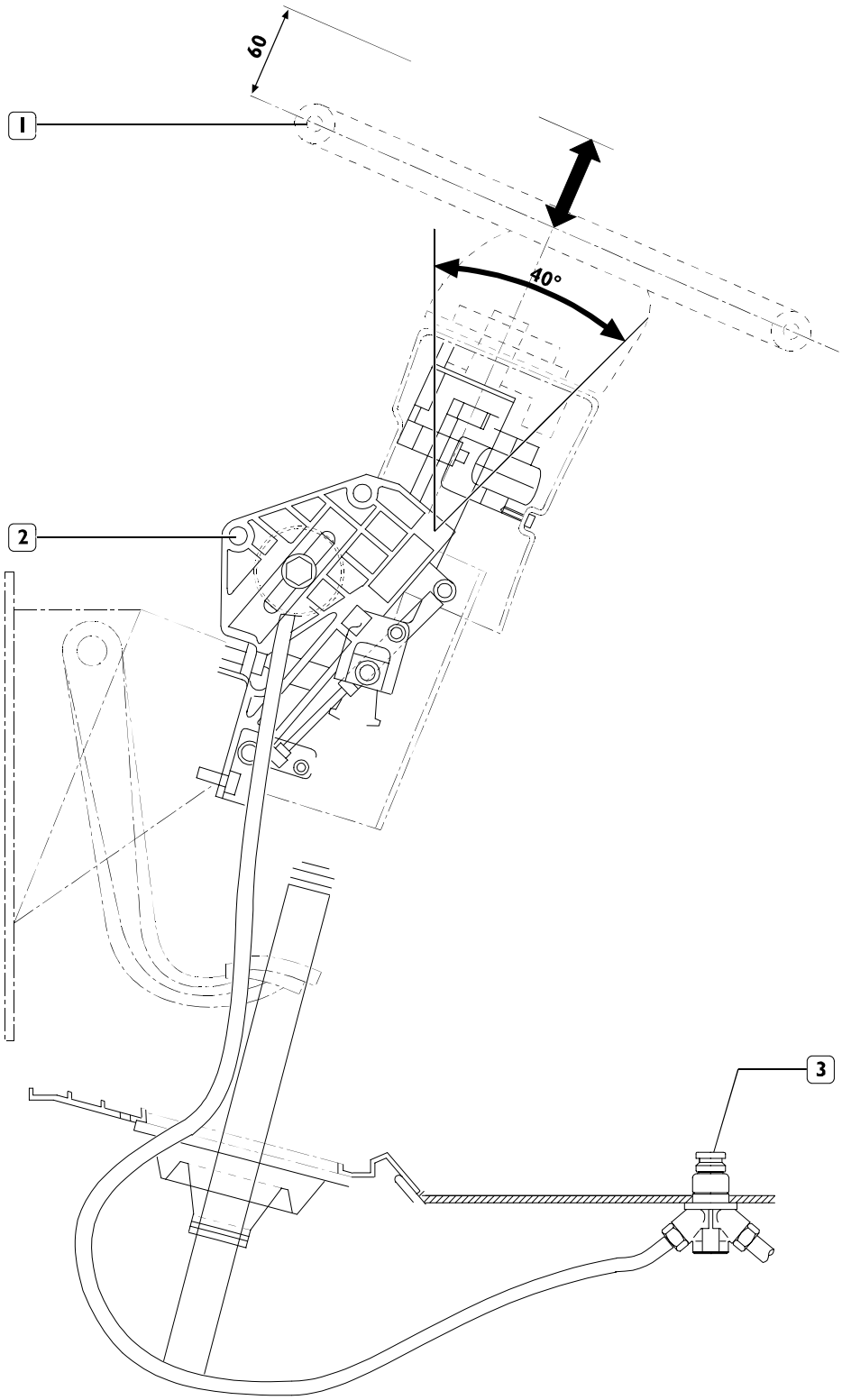
Figure 21



Using a suitable punch, notch the collar of the nut (1).

50140 STEERING CONTROL

Figure 22



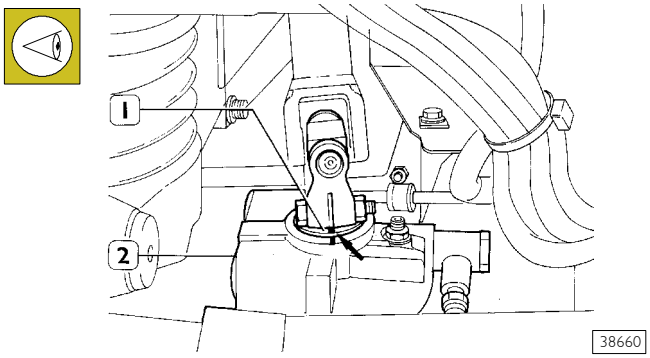
The steering control is equipped with a pneumatic device to adjust the angle and height of the steering wheel.
The position of the steering wheel is adjusted by pressing the push-button on the floor of the cab:

- ❑ Press the button (3) on the floor: the pressurized air of the services system is sent to the steering wheel adjustment assembly (2) releasing it.
- ❑ Manoeuvre the steering wheel (1) into the required position (longitudinal travel along the axis of the steering column 60 mm, angular travel to the vertical 40°).
- ❑ Release the button on the floor.

501410 REMOVING-REFITTING THE STEERING CONTROL ASSEMBLY

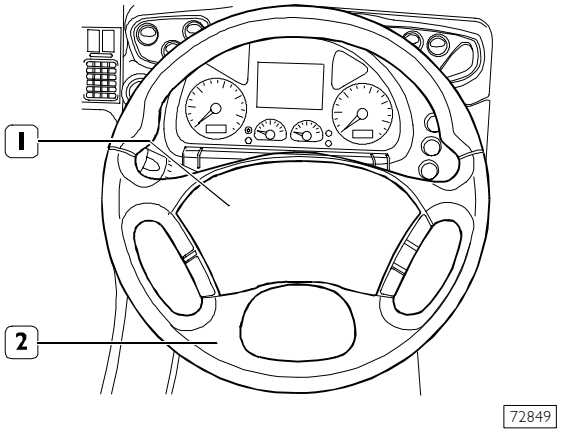
Removal

Figure 23



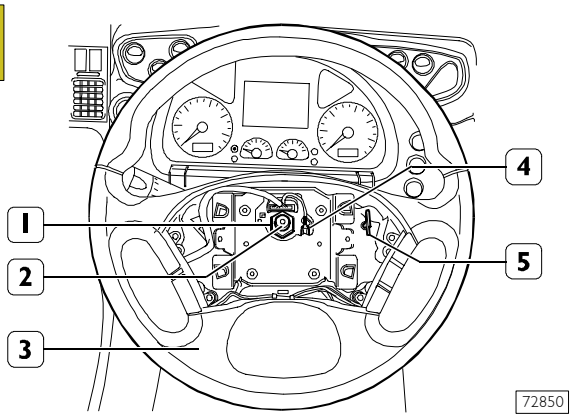
Lift the cowling of the cab. Set the wheels straight and check that the steering box is in the "straight ahead" position, so the reference mark ⇐ of the shaft (1) coincides with the reference mark ⇒ of the steering box (2).

Figure 24



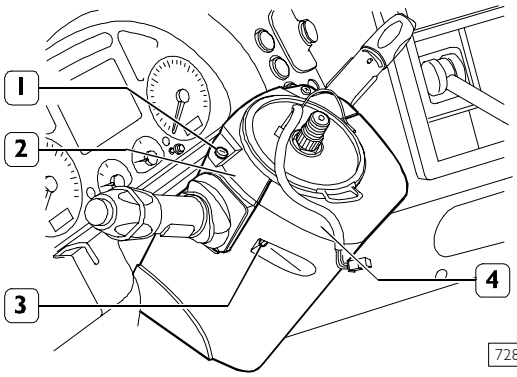
Engage the steering lock by taking the ignition key out.
Take the cover (1) off the steering wheel (2).

Figure 25



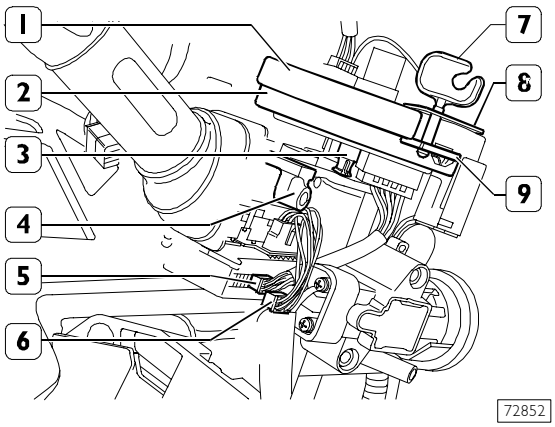
Disconnect the connection (4) of the earth cable.
Remove the nut (1), mark the assembly position of the steering wheel (3) on the shaft (2) and remove the steering wheel (3).

Figure 26



Take out the screws (1 and 3) and take off the side guards (2.4).

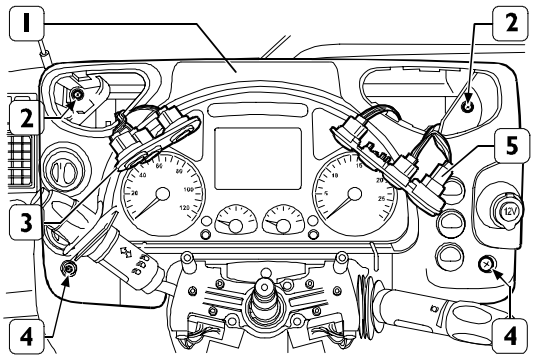
Figure 27



Remove the interconnecting box (2) from the steering control mounting (4), keeping strictly to the procedures described hereunder. This is to prevent damaging the spiralled cable in the box, during assembly, and to avoid a wrong reading of the steering wheel angle.

Disconnect the electric connections (5 and 6). Take the key (5, Figure 25) out of the steering wheel (3, Figure 25). Fasten the cover (1) of the interconnecting box (2) to the box by inserting the key (7) in the slots (8 and 9). This prevents the cover (1) and the box (2) from turning on each during disassembly and this condition is maintained until assembly. If there is no key (7), use a screw and nut of suitable length and diameter.
Take hold of the interconnecting box (2), lift it carefully so that the retaining spring pins (3) come out of the mounting (4) and put it aside.

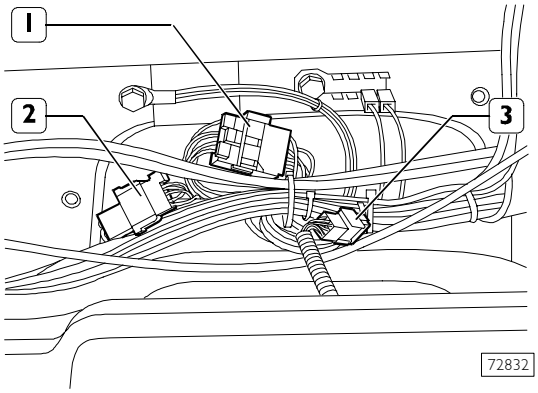
Figure 28



72831

Remove the push-button panels (3 and 5) and the caps for the screws (4) from the instrument panel (1).
Take out the screws (2 and 4), remove the instrument panel (1) and put it aside.

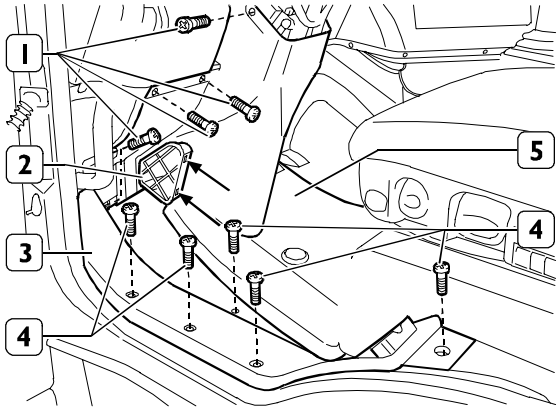
Figure 29



72832

Disconnect the connections (1) of the windscreen wiper, (2) of the drive control system, (3) of the immobilizer.

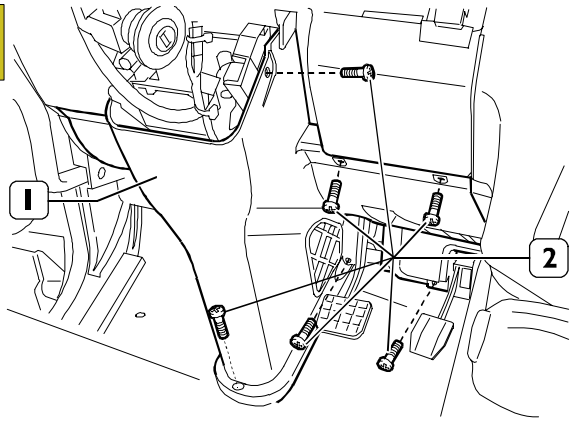
Figure 30



77108

- ❑ Remove mat (5).
- ❑ Unscrew screws (4) securing sill board (3).
- ❑ Detach the sill (3) from the vehicle.
- ❑ Undo the fasteners (←) and take out the air opening (2) in the floor.
- ❑ Unscrew the side screws (1) fixing the steering column guard.

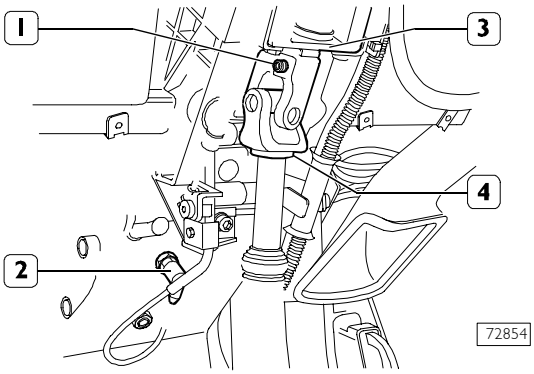
Figure 31



90002

- ❑ Unscrew the screws (2) fixing the steering column guard in the area of the pedal board.
- ❑ Detach the steering column guard (1) from the vehicle.

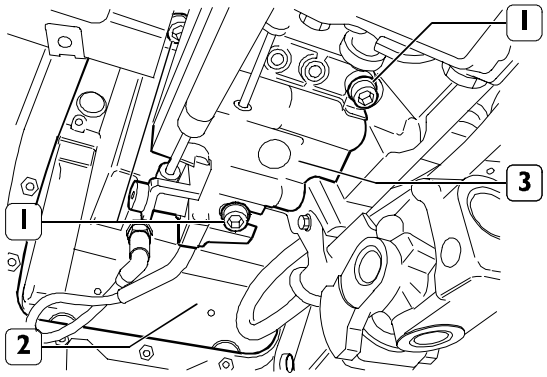
Figure 32



72854

Mark the assembly position of the shaft (2, Figure 25) on the mounting (3) and on the universal joint (4). Loosen the screw (1) and extract the universal joint (4) from the top shaft.
Disconnect the pipe (2).

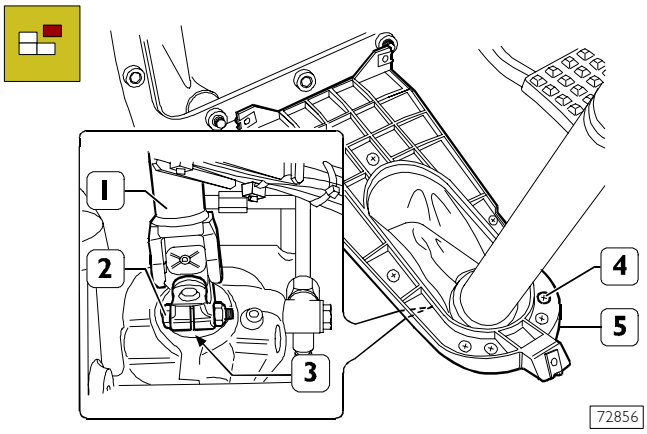
Figure 33



72855

Take out the 3 screws (1) and remove the steering control mounting (3) from the pedal board (2).

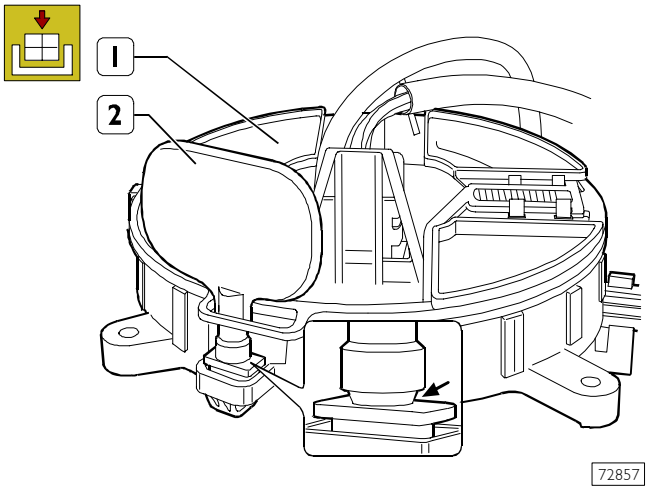
Figure 34



From outside the cab, loosen the screw (2) and disconnect the bottom shaft (1) from the power steering (3) shaft. Take out the screws (4) and remove the bottom shaft (1) together with the guard (5).

Refitting

Figure 35

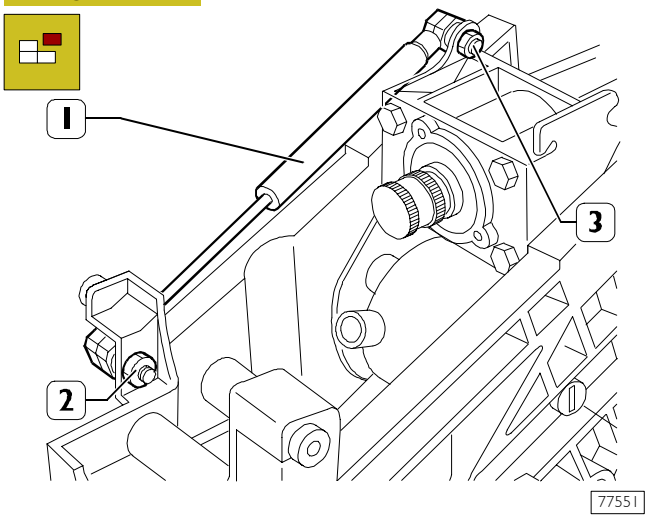


To refit, carry out the operations described for removal in reverse order, tightening the screws and/or nuts to the required torque.

The interconnecting box (1) is supplied as a spare with the stop key assembled as illustrated in the figure.
After fitting it on the steering control mounting, it is necessary to turn the key (2) so as to cause it to break at the point shown by the arrow and put the key in the steering wheel housing, see Figure 25.

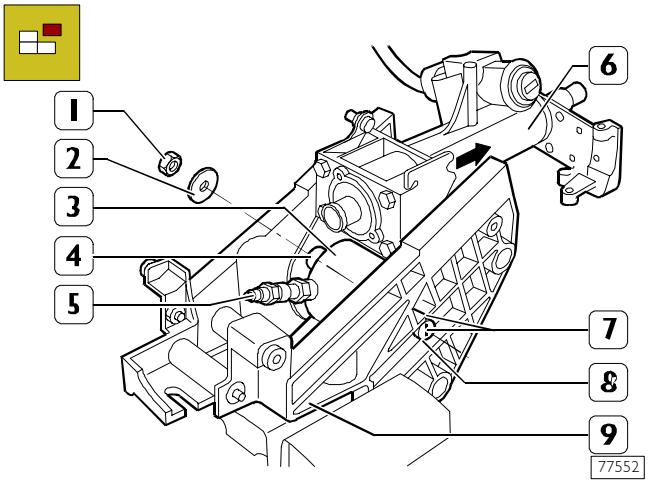
Changing the pneumatic cylinder Removal

Figure 36



Remove the steering gear assembly as described under the relevant heading (operation 501410).
Remove the damper (1) by taking out the fixing nuts (2 and 3).

Figure 37



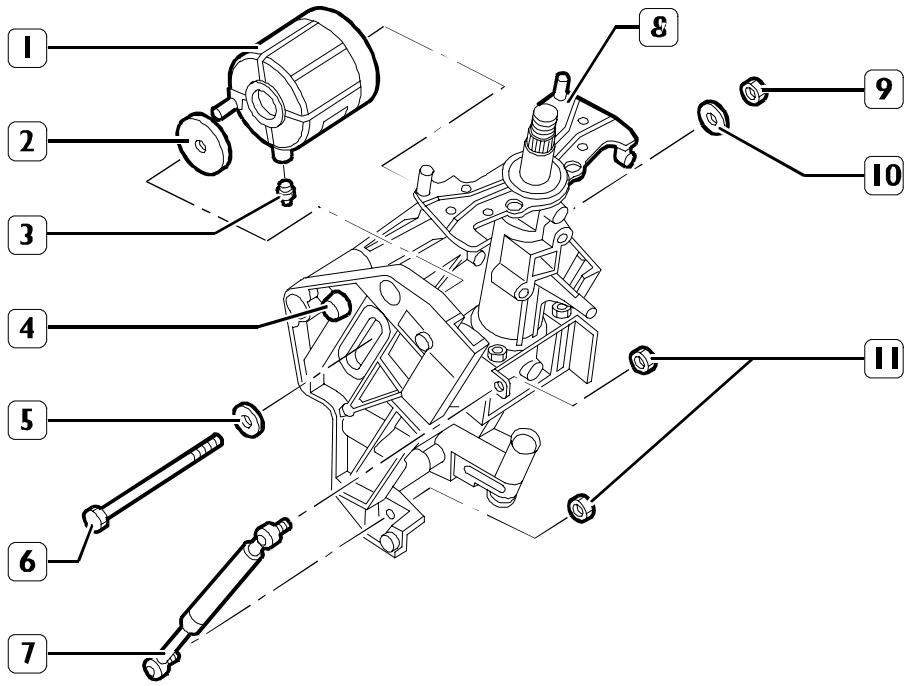
Screw a suitable coupling (5) into the air supply hole of the cylinder (3) and introduce air at a pressure of 8 ÷ 12 bars.

The air pressure must be maintained throughout removal: this is a necessary condition to make sure the pneumatic cylinder (3) gets released.

Shift the steering gear shaft-assembly (6) completely outwards (→).
Mark the assembly position of the screw (7) on the mount (9). Remove the nut (1), extract the screw (7) with the washers (2 and 8) and remove from the mount (9) the pneumatic cylinder (3) the adjustment washer (4) and the steering gear shaft assembly (6).

Refitting

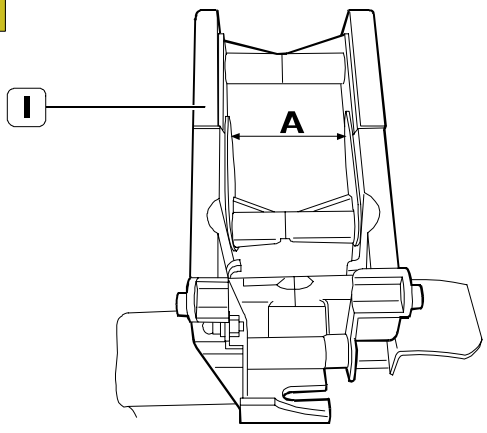
Figure 38



77554

PARTS COMPRISING THE STEERING GEAR ASSEMBLY
1. Pneumatic cylinder - 2. Adjustment washer - 3. Coupling - 4. Mount - 5. Washer - 6. Screw - 7. Damper - 8. Steering gear shaft assembly - 9. Nut - 10. Washer - 11. Nut.

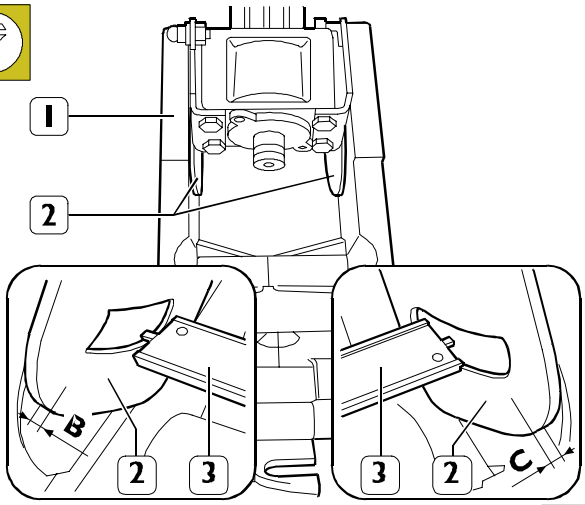
Figure 39



77553

Determine the thickness of the adjustment washer (2, Figure 38) as follows.
Measure the distance A between the sliding surfaces of the mount (1) with a suitable instrument (precision class 0.05 mm).

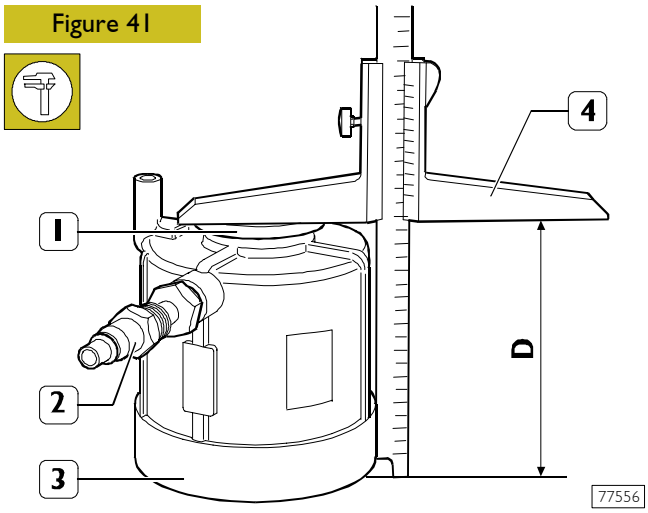
Figure 40



77555

Position the steering gear shaft mount (2) in the mount (1). Measure the distances B and C between the internal surface of the mount (2) and the sliding surface (of the above) of the mount (1) with a suitable instrument (3) (precision class 0.05 mm).

Figure 41



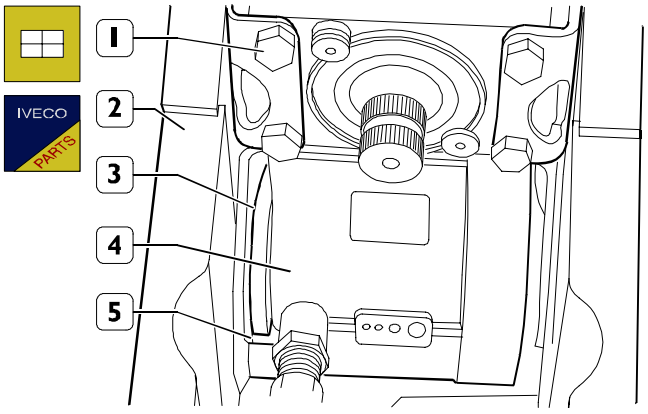
Screw a suitable coupling (2) into the air supply hole of the new cylinder (3) and introduce air at a pressure of 8 ÷ 12 bars.

The air pressure must be maintained throughout the following measurement and assembly.

Place the pneumatic cylinder (3) on the plane and put the adjustment washer (1) on its piston; measure the distance (D) with a suitable instrument (4, precision class 0.05 mm).

S = A - (B + C + D + 0.2), where A - B - C - D are the distances measured and 0.2 is the clearance.

Figure 42

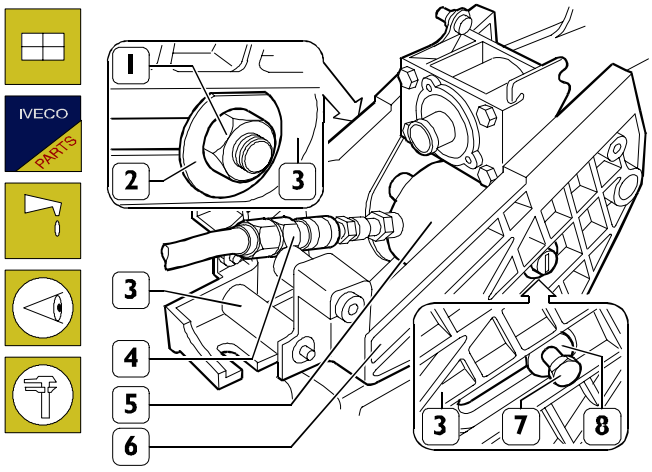


Put mount (2) in mount (1) and fit on the cylinder (4 supplied with air at a pressure of 8 ÷ 12 bars) positioning it with the pin (5) in the guiding groove of the mount (2).
Choose the adjustment washer (3) from the ones supplied as spares, with the thickness calculated in the preceding measurement.

NOTE Washer thickness: 4.6 – 4.7 – 4.8 – 4.9 - 5-5 – 5.2 – 5.4 mm.

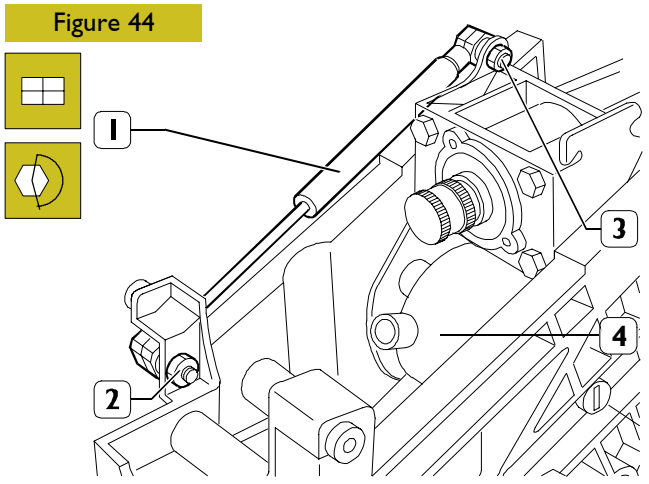
Lubricate the washer (3) with grease and insert it between the cylinder (4) and the mount (1).

Figure 43



Fit on a new screw (7) with the washer (8) positioning it at the point marked during removal.
From the opposite side, fit on the washer (2). Apply Loctite 270 on the thread of the new nut (1) and screw it onto the screw (3) to determine a clearance of 0.1 ÷ 0.2 mm between the washer (2) and the mount (3).
Check the travel of the mount (8) of the steering gear shaft on the mount (3) in all directions.
Set the steering gear shaft mount (6) in the position of the start of travel (minimum height of the steering wheel).
Remove the air coupling (4) from the pneumatic cylinder (5).

Figure 44

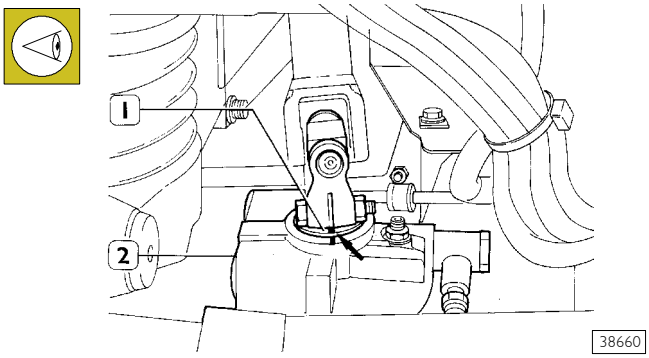


Fit on the damper (1), screw down the fixing nuts (2 and 3) tightening them to a torque of 23 Nm.
Check the locking of the cylinder (4): applying a tractive force of 300 N (30 kg) to the steering gear shaft, in the direction of the driver, this must not move in relation to the mount (3).
Then refit the steering gear assembly to the vehicle as described under the relevant heading.

Replacing direction indicator switch

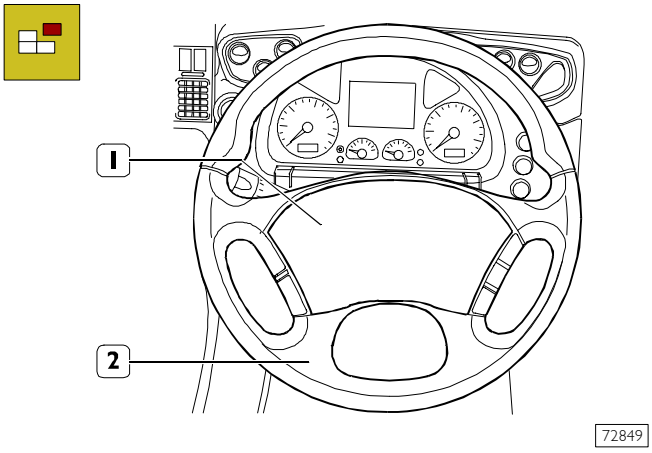
Removal

Figure 45



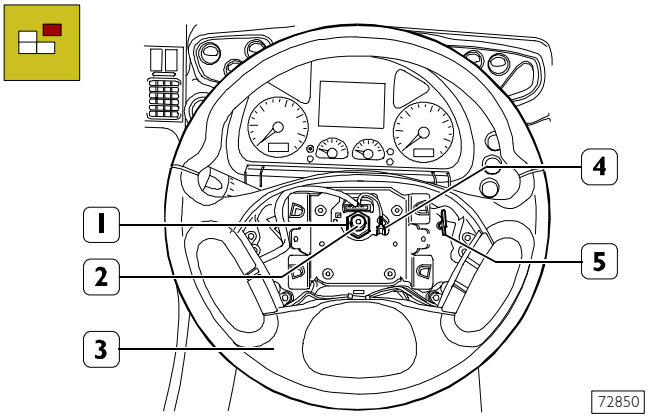
Lift the cowling of the cab. Set the wheels straight and check that the steering box is in the "straight ahead" position, so the reference mark ⇐ of the shaft (1) coincides with the reference mark ⇒ of the steering box (2).

Figure 46



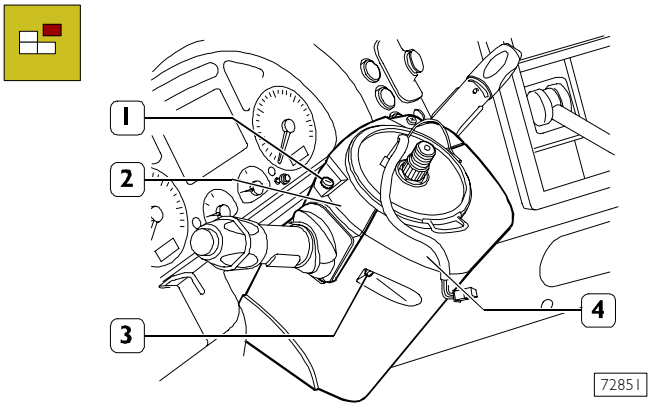
Engage the steering lock by taking the ignition key out.
Take the cover (1) off the steering wheel (2).

Figure 47



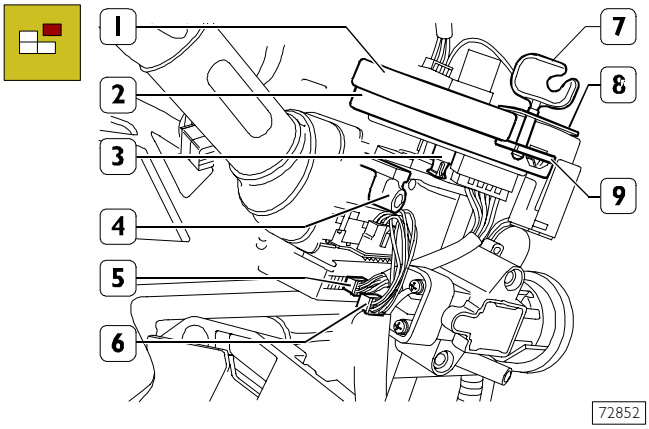
Disconnect the connection (4) of the earth cable.
Remove the nut (1), mark the assembly position of the steering wheel (3) on the shaft (2) and remove the steering wheel (3).

Figure 48



Take out the screws (1 and 3) and take off the side guards (2.4).

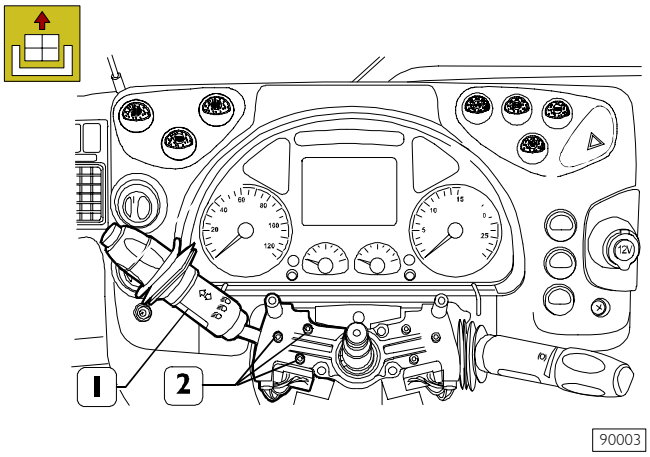
Figure 49



Remove the interconnecting box (2) from the steering control mounting (4), keeping strictly to the procedures described hereunder. This is to prevent damaging the spiralled cable in the box, during assembly, and to avoid a wrong reading of the steering wheel angle.

Disconnect the electric connections (5 and 6). Take the key (5, Figure 25) out of the steering wheel (3, Figure 25). Fasten the cover (1) of the interconnecting box (2) to the box by inserting the key (7) in the slots (8 and 9). This prevents the cover (1) and the box (2) from turning on each during disassembly and this condition is maintained until assembly. If there is no key (7), use a screw and nut of suitable length and diameter.
Take hold of the interconnecting box (2), lift it carefully so that the retaining spring pins (3) come out of the mounting (4) and put it aside.

Figure 50



Disconnect securing screws (2) of steering column stalk (1). Remove electric connection and disconnect steering column stalk (1).

Mounting

For mounting, invert operations described for dismounting, tightening screws and/or nuts at prescribed torque.

Steering column stalks supplied as spares have no threading on securing plate. Never thread on holes because this operation might damage the components within the steering column stalk. As the plate is made of aluminium, it allows self-threading to be performed on its fastening through screws.

501430 BLEEDING THE POWER STEERING SYSTEM

For all vehicles

To bleed the power steering system, proceed as follows.

Fill the power steering fluid reservoir with the prescribed fluid (Tutela GI/A)

Turn the engine over with the starter motor and top up the fluid continually to prevent air being drawn into the pump.

Top up the fluid until the level remains constant above the minimum mark on the dipstick.

Start the engine and run it idling, checking that the level of the fluid does not fall under the minimum level marked on the dipstick.

Turn the steering wheel from lock to lock several times to force any air out of the power steering cylinder until no more bubbles appear in the fluid in the reservoir.

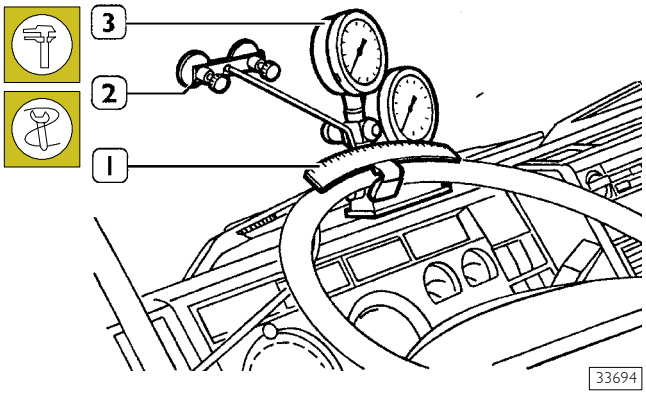
Accelerate to maximum rpm, then stop the engine and check that the fluid level does not rise more than 1 to 3 cm.

For pneumatic lifting vehicles with central or rear steering added axle, see what described in section 8 of this manual.

501430 MEASURING STEERING BOX PLAY AT THE STEERING WHEEL

Check there is no mechanical play in the steering linkage.
Lock the left-hand wheel in the straight-ahead position using the expanders 99374399; raise the axle.

Figure 51



Attach the fixed pointer (2) to the windscreen with suction cups, and attach the graduated scale 99374398 (1) to the steering wheel.
Position the pressure tester 99374393 (3) (0 to 10 bar and 0 to 160 bar, pressure gauges connected by a shunt valve).
Connect the pipe of the pressure tester to the fitting on the power steering delivery pipe.
Top up the fluid level if necessary.
Start the engine and run at idle speed. Record the pressure reading shown on the 0 to 10 bar gauge. Slowly turn the steering wheel to the left until the previous pressure reading is increased by 1 bar. Hold the steering wheel in this position and record the value in mm reached on the graduated scale 99374398. Now turn the steering wheel to the right until the pressure reading is again increased by 1 bar, and note the value in mm on the graduated scale 99374398.

Add together the two values in mm obtained for left and right steering: the total should not exceed 40 mm.
Lower the axle.

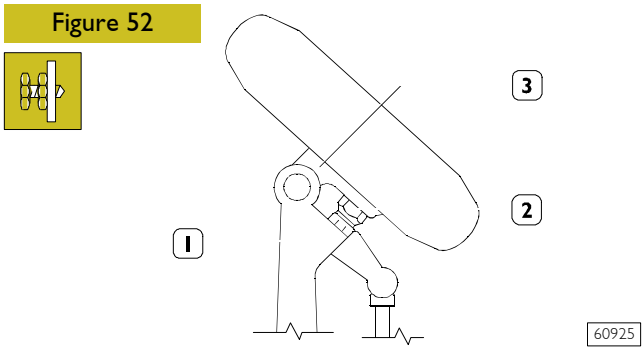
CHECKING THE MAXIMUM PRESSURE OF THE POWER STEERING SYSTEM

Using the pressure tester 99374393, connected as described above, and the driver's side wheel locked, start the engine and run at idle. Apply a steering force of 10÷20 kg to the steering wheel and record the pressure reading on the 0÷160 bar gauge. Repeat the operation applying the same steering force in the opposite direction; if the readings obtained are lower than specified, locate the source of the problem.

NOTE The maximum pressure is given on the data plate attached to the ZF steering box.

Setting the automatic hydraulic steering limit

Figure 52



This adjustment is made after fitting the power steering system on the vehicle, with the vehicle unloaded and the front wheels raised or set on revolving platforms. In addition, it is necessary to steer both right and left as follows.
Make sure the gearbox is in neutral.
Start the engine and run at a speed of ≤ 1500 rpm.
Turn the steering wheel in one direction to bring the stop screw (2) on the stub axle (3) into contact with the axle (1).

In this position, apply an additional force on the steering wheel to determine the automatic setting. Repeat this procedure steering in the opposite direction.

If there is a reduction in the travel of the steering control lever, it is necessary to replace the steering limiting screw concerned with a new one, or both screws if the trouble involves the opposite travel as well.

The screws are located on the top and bottom sides of the power steering box. Make the adjustment as described above.

Check

Connect a pressure gauge (minimum full-scale value 200 bar) to the pressure test fitting on the delivery line from the pump to the power steering and apply a steering force at the steering wheel of 50 ± 20 Nm (corresponding to 200 ± 80 N on a 500 mm diameter steering wheel), turning the wheel to the full lock position. The pressure reading should be within the range of 35 to 70 bar. If the pressure is too high, replace the adjustment screws with new ones and repeat the adjustment procedure. If the pressure is too low, check that the hydraulic system is operating properly and that there are no leaks.

ESP (Electronic Stability Program) CALIBRATION

NOTE Operation only valid for vehicles having ESP (Electronic Stability Program) option.

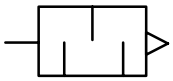
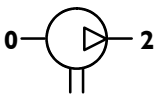
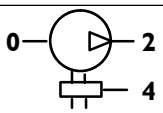
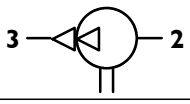
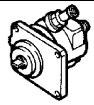
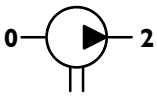
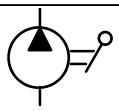
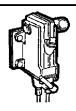
Works on drive system, such as replacing, modifying or repairing linkage, i.e. all interventions where sensor path is discontinued from steering angle sensor up to wheel and possible steering adjustment requires ESP system calibration

Such procedure is described in section BRAKES of this manual.

SECTION 12

Air system - Brakes

SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (TANKS AND ACCUMULATORS)

DESCRIPTION	SYMBOL	
HYDRAULIC FLOW		
AIR FLOW		
ELECTRICAL LINE		
ABLE TO ROTATE		
CROSSOVER OF CONNECTED LINES		
PRESSURE TEST POINT		
QUICK-CONNECTION COUPLING		
COCK		
COCK WITH OUTLET		
SILENCER		
COMPRESSOR		
ENERGY SAVING COMPRESSOR		
VACUUM PUMP		
HYDRAULIC PUMP		
HYDRAULIC HAND PUMP		

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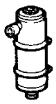
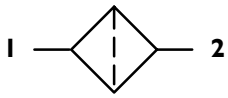
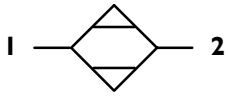
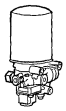
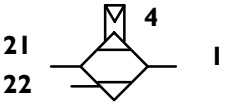
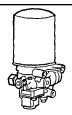
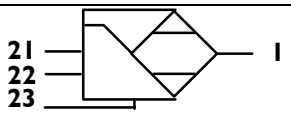
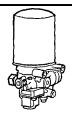
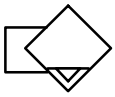
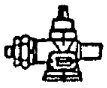
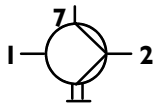
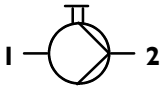
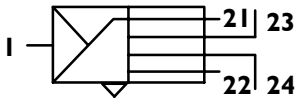
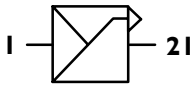
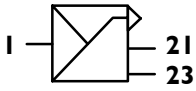
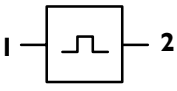
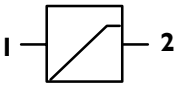
SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

DESCRIPTION	SYMBOL	
CONDENSATE SEPARATOR		
FILTER		
DEHUMIDIFIER		
DEHUMIDIFIER		
DEHUMIDIFIER WITH BUILT-IN REGULATOR		
AUTOMATIC CONDENSATE DRAIN VALVE		
CONTROLLED CONDENSATE DRAIN VALVE		
HAND CONDENSATE DRAIN VALVE		
CONTROLLED ANTI-ICING UNIT		
AUTOMATIC ANTI-ICING UNIT		
PRESSURE REGULATOR WITH INDEPENDENT CIRCUIT		
PRESSURE CONTROLLER		
PRESSURE CONTROLLER		
PRESSURE CONTROLLER (GOVERNOR)		
PRESSURE LIMITING VALVE		

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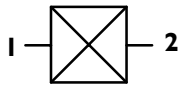
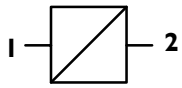
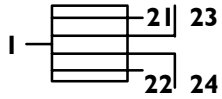
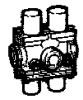
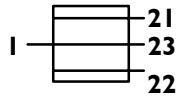
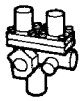
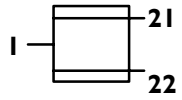
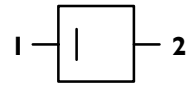
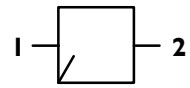
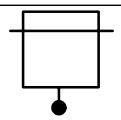
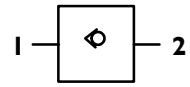
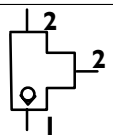
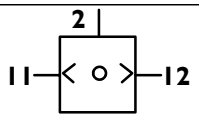
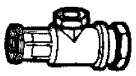
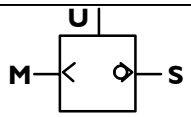
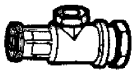
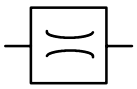
SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

DESCRIPTION	SYMBOL	
PROPORTIONAL REDUCING VALVE		
MATCHING VALVE		
FOUR CIRCUIT PROTECTION VALVE		
THREE CIRCUIT PROTECTION VALVE		
TWO CIRCUIT PROTECTION VALVE		
NON-RETURN AIR INLET VALVE		
LIMITED RETURN AIR INLET VALVE		
SAFETY VALVE		
CHECK VALVE		
CHECK VALVE		
DOUBLE SHUT-OFF VALVE		
DIFFERENTIAL DOUBLE SHUT-OFF VALVE		
THROTTLE VALVE WITH QUICK RETURN		
THROTTLE VALVE		

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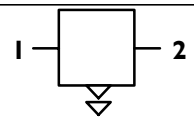
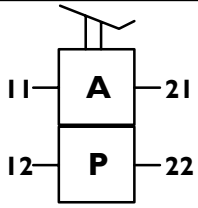
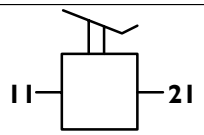
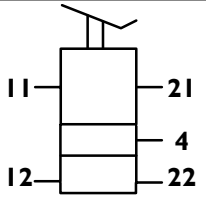
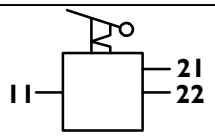
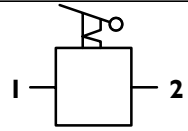
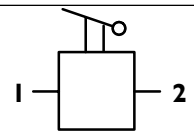
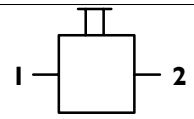
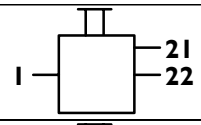
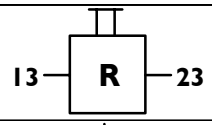
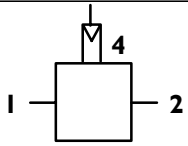
SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

DESCRIPTION	SYMBOL	
DUMP VALVE		
BRAKE CONTROL VALVE		
BRAKE CONTROL VALVE		
BRAKE CONTROL VALVE		
PARKING BRAKE CONTROL VALVE		
PARKING BRAKE CONTROL VALVE		
BRAKE VALVE		
CONTROL VALVE		
CONTROL VALVE		
RETARDER CONTROL VALVE		
SERVO CONTROL VALVE		

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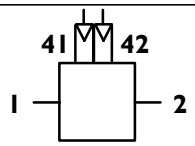
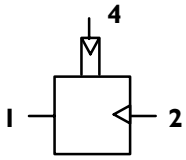
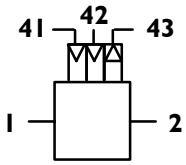
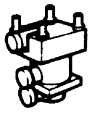
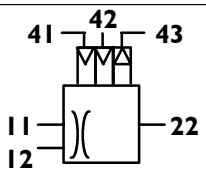
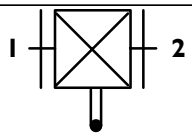
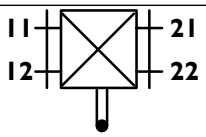
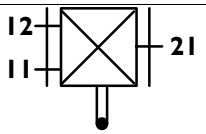
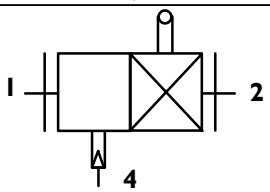
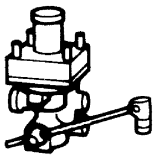
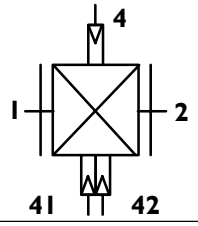
SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

DESCRIPTION	SYMBOL	
SERVO CONTROL VALVE		
SERVO CONTROL VALVE FOR SINGLE LINE		
TRAILER BRAKING TRIPLE CONTROL VALVE		
TRAILER BRAKING TRIPLE CONTROL VALVE WITH BUILT-IN SERVO SWITCHING		
LOAD PROPORTIONING VALVE		
DUAL LOAD PROPORTIONING VALVE		
LOAD PROPORTIONING VALVE WITH BY-PASS		
LOAD PROPORTIONING VALVE WITH BUILT-IN RELAY		
LOAD PROPORTIONING VALVE WITH BUILT-IN RELAY WITH AIR CONTROL		

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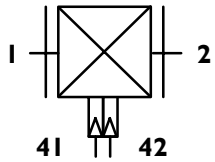
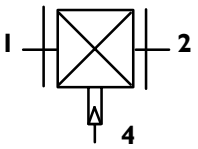
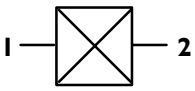
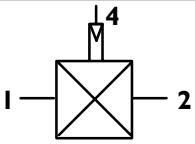
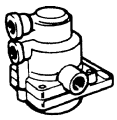
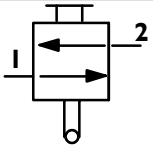
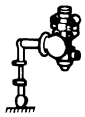
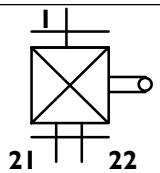
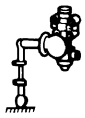
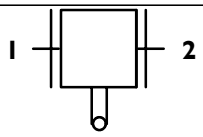
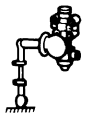
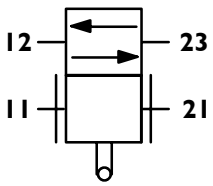
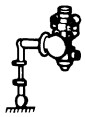
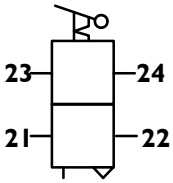
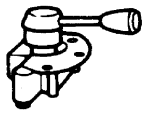
SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

DESCRIPTION	SYMBOL	
LOAD PROPORTIONING VALVE WITH AIR CONTROL		
LOAD PROPORTIONING VALVE WITH AIR CONTROL		
PROPORTIONAL REDUCING VALVE		
SLAVED PROPORTIONAL REDUCING VALVE		
STROKE LIMITING VALVE		
LEVELLING VALVE		
LEVELLING VALVE		
LEVELLING VALVE WITH BUILT-IN TRAVEL LIMITER		
HAND OPERATED SUSPENSION RAISING CONTROL VALVE		

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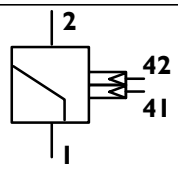
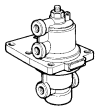
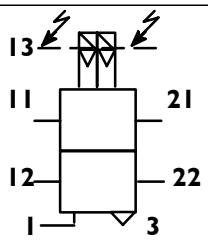
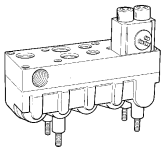
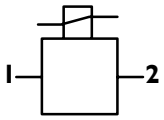
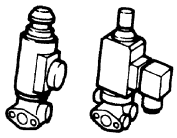
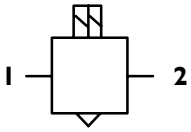
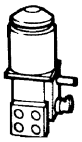
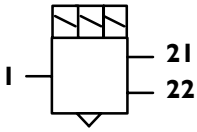
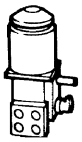
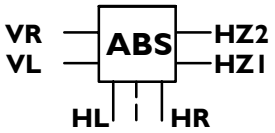
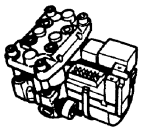
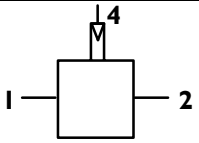
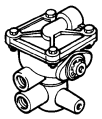
SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

DESCRIPTION	SYMBOL	
PROPORTIONAL CONTROL VALVE		
HAND OPERATED SUSPENSION CONTROL VALVE WITH ELECTRICAL MONITORING		
ELECTROPNEUMATIC VALVE		
ELECTROPNEUMATIC VALVE		
ELECTROPNEUMATIC VALVE		
HYDRAULIC MODULATOR FOR ABS		
AUGMENTER VALVE		

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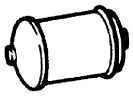
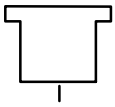
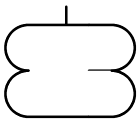
SYMBOLS FOR AIR-HYDRAULIC SYSTEM DIAGRAMS (TANKS AND ACCUMULATORS)

DESCRIPTION	SYMBOL	
COMPRESSED AIR TANK		
BRAKE FLUID RESERVOIR		
AIR SPRING		

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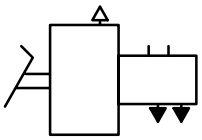
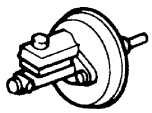
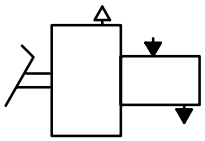
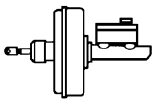
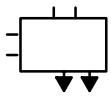
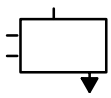
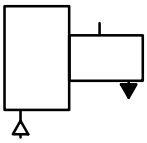
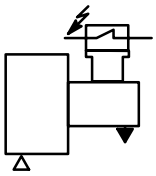
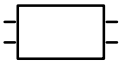
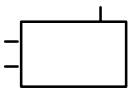
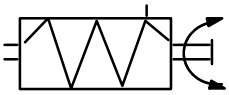
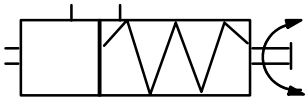
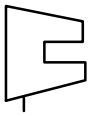
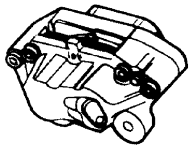
SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (CONVERTERS, CYLINDERS AND CALLIPERS)

DESCRIPTION	SYMBOL	
VACUUM BRAKE SERVO		
VACUUM BRAKE SERVO		
DUAL CIRCUIT MASTER CYLINDER		
SINGLE CIRCUIT MASTER CYLINDER		
AIR/HYDRAULIC CONVERTER		
AIR/HYDRAULIC CONVERTER		
HYDRAULIC BRAKE CYLINDER		
SLAVE CYLINDER		
BRAKE CYLINDER		
SPRING CYLINDER		
COMBINED BRAKE CYLINDER		
FIXED DISC BRAKE CALLIPER		

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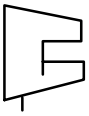
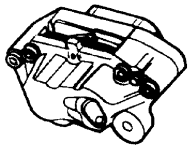
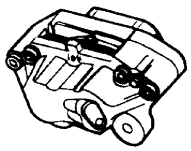
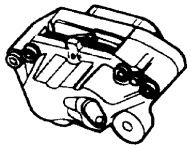
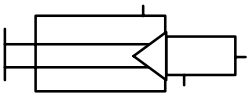
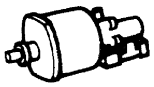
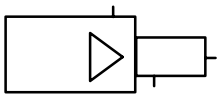
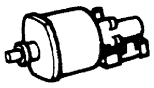
SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (CALLIPERS AND CYLINDERS)

DESCRIPTION	SYMBOL	
FLOATING DISC BRAKE CALLIPER		
FLOATING DISC BRAKE CALLIPER WITH PARKING		
MECHANICAL FLOATING DISC BRAKE CALLIPER		
SERVO CLUTCH		
SERVO CLUTCH		

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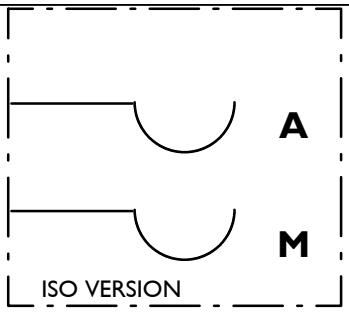
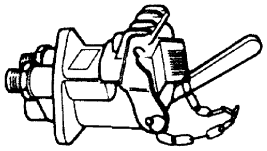
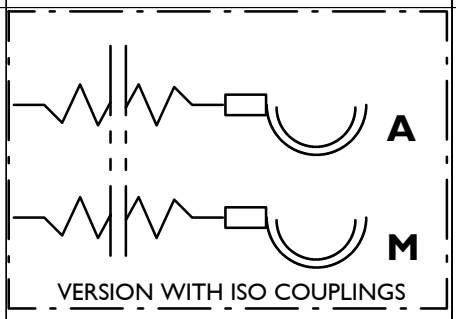
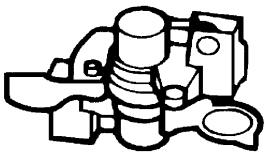
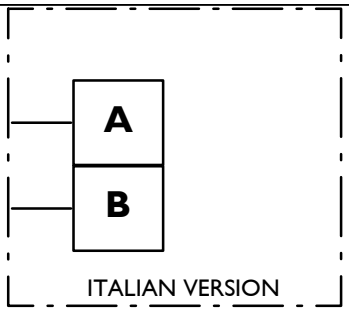
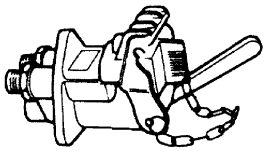
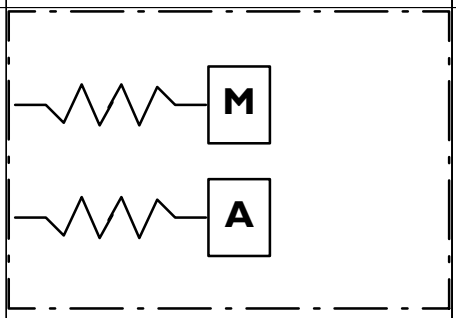
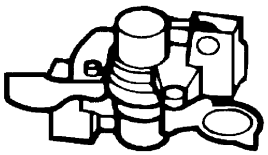
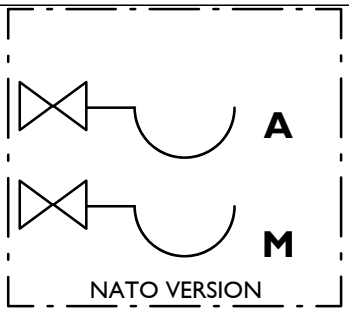
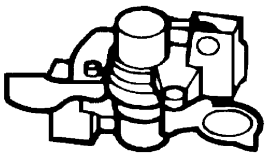
SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (SEMI-COUPLINGS AND COUPLING CONNECTORS)

DESCRIPTION	SYMBOL	
"ISO" SEMI-COUPLING		
"ISO" SEMI-COUPLING		
"CUNA" SEMI-COUPLING		
"CUNA" SEMI-COUPLING		
"NATO" SEMI-COUPLING		

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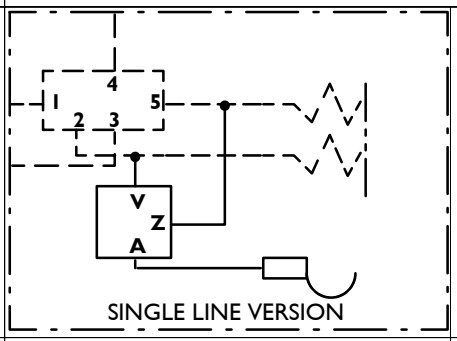
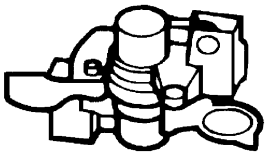
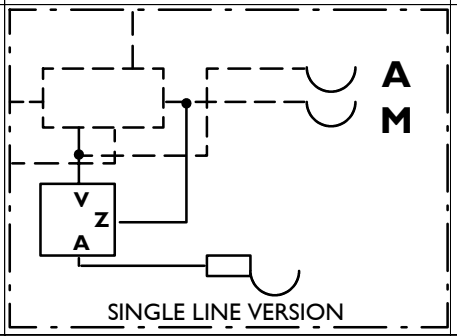
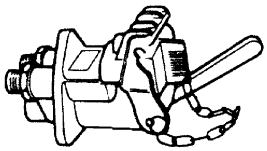
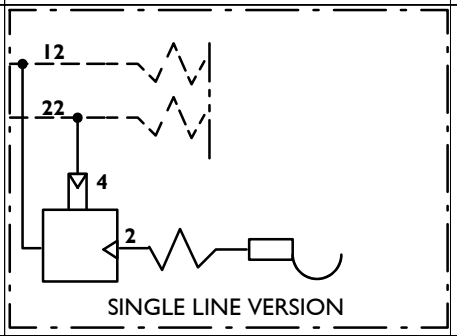
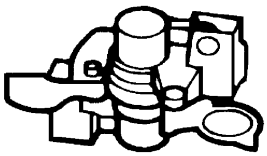
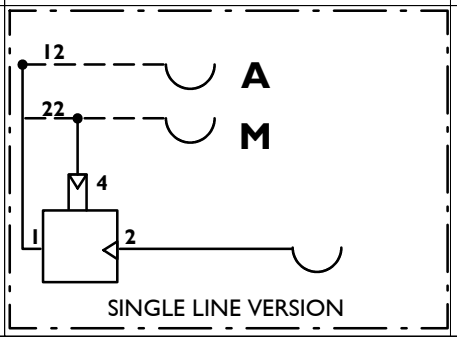
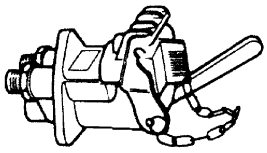
SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (SEMI-COUPLINGS AND COUPLING CONNECTORS)

DESCRIPTION	SYMBOL	
		
SEMI-COUPLING		
SEMI-COUPLING		
SEMI-COUPLING		

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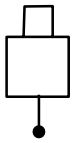
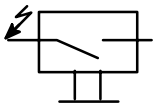
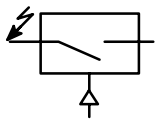
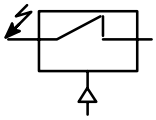
SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (INDICATORS AND SWITCHES)

DESCRIPTION	SYMBOL	
PRESSURE GAUGE		
PRESSURE GAUGE		
PRESSURE SENDING UNIT		
LAMP		
MECHANICAL SWITCH		
PRESSURE SWITCH		
LOW PRESSURE SWITCH		
AUDIBLE WARNING		
SENSOR		

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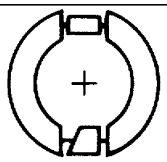
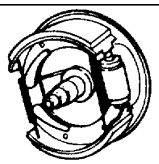
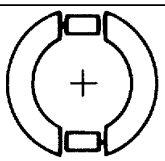
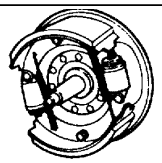
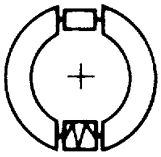
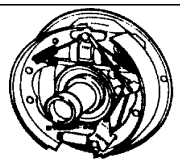
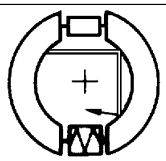
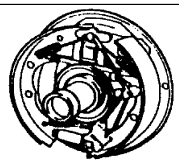
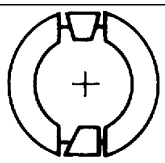
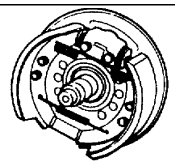
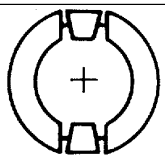
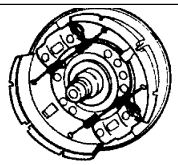
SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (BRAKES)

DESCRIPTION	SYMBOL	
SINGLE CYLINDER HYDRAULIC BRAKE		
TWIN CYLINDER HYDRAULIC BRAKE		
DUAL SERVO HYDRAULIC BRAKE		
DUAL SERVO HYDRAULIC BRAKE WITH PARKING BRAKE		
SINGLE CAM OPERATED BRAKE		
TWIN DUAL CAM OPERATED BRAKE		

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799512 PIPINGS AND FITTINGS

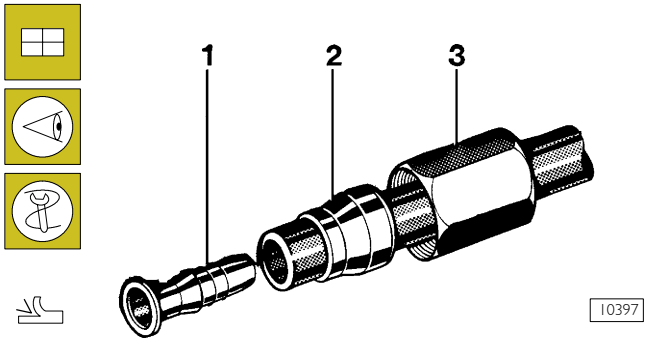
In general

Hydraulic system pipings for industrial vehicles are flexible ones made of polyamide with single-layered or double-layered structure and in the following diameters (Ø 6-8-10-12-16 mm) equipped with spares in meters.

Flexible pipings replacement with traditional fittings

Strictly comply with the following instructions:

Figure 1

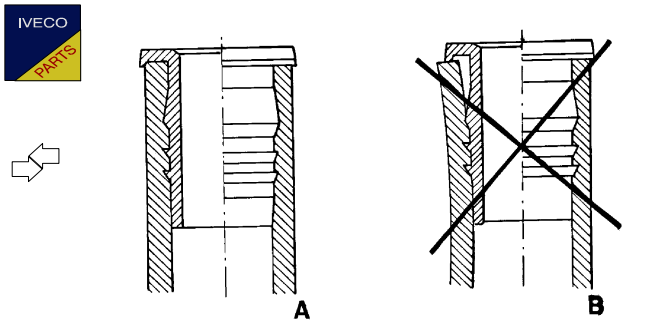


- ❑ Use homologated pipes only;
- ❑ Check the spare pipe status, on which no cracks, cuts or nickings must be detected;
- ❑ Cut the pipe at 90° with respect to the axis through a suitable pipe-cutting pliers 99387050 at the necessary length;

Insert on the pipe in the following order:

- ❑ nut (3), pressure ring (2) (its greater thickness must be facing nut (3) and reinforcement bush (1));
- ❑ the bush must be in perfect conditions (it must not have either distortions or hammering traces).

Figure 2



REINFORCEMENT BUSH ASSEMBLY
A = CORRECT ASSEMBLY
B = WRONG ASSEMBLY

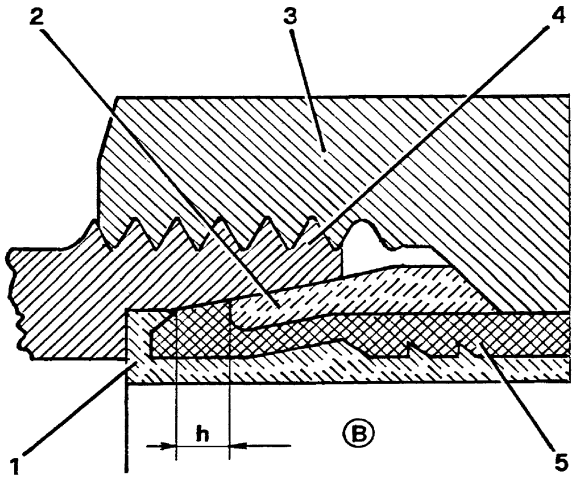
- ❑ Key the reinforcement bush with tool 99372219 guaranteeing the contact between its flange and the pipe end;
- ❑ make sure that the pipe end penetrates into the suitable rake groove obtained in the flange.
- ❑ Carry out abutment ring reflanging upon assembly on the vehicle or work bench on a fitting.
- ❑ The exerted pressure and the final distance from front pressure ring edge to reinforcement bush edge must be those mentioned in the table below.

NOTE In case of a bad assembly, never use the pipe after having extracted bush and abutment ring.

	Pipe mm	Distance between bush edge and ring mm (*)	Assembling pressure N/mm^2
Double-layered	6 x 1	from 1 to 1.5	0.040
	8 x 1	from 2 to 2.5	0.050
Single-layered	10 x 1.5	from 2 to 2.5	0.050
	12 x 1.6	from 2 to 2.5	0.060
	16 x 2.34	from 3 to 3.5	0.060

(*) See reference h, Figure 3.

Figure 3



1. Reinforcement bush - 2. Pressure ring - 3. Nut - 4. Fitting - 5. Pipe - h. Distance between bush edge and ring edge (see table).

Insert the thereby-prepared piping end into the fitting body till the reinforcement bush flange rests within the suitable seat:

- ❑ For closing the nut on the fitting, initially screw it manually and then complete the tightening with a suitable box wrench (complete series 99372221) inserted into the dynamometric wrench, to be calibrated according to the required tightening torque.

Assembly of piping on vehicle is carried out by taking into account some important solutions:

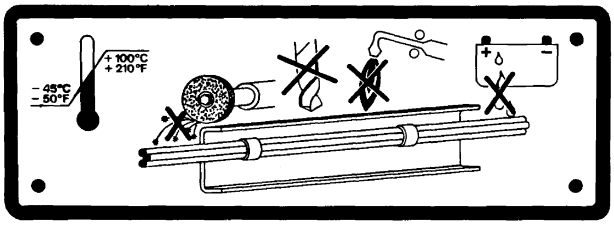
- ❑ Bendings must comply with minimum radiusses, in order to avoid throttlings.

Pipings diameter mm	Minimum bending radius mm
6 x 1	approx. 40
8 x 1	approx. 50
10 x 1.5	approx. 60
12 x 1.6	approx. 75
16 x 2.34	approx. 100

NOTE Make sure that pipings are not in contact with sharp edges or with cutting metallic parts or with heat sources, but that are distant therefrom by a minimum safety distance of 15 mm.

- ❑ Moreover, when crossing chassis longitudinal members or metallic parts, check that passage holes are coated with rubber fairlead rings and that these latter ones are in good conditions;
- ❑ Avoid that the pipe slides along cutting edges that would risk to create nickings;
- ❑ Having to fix the piping onto already existing ducts, take into account the supplementary heat to which it can be subjected (hydraulic power steering duct): in such case, the piping must be protected with guards;
- ❑ At the end of the connection, verify that the piping, between keying and securing, is not stretched, but must be slightly loosened to recover higher temperature variations, particularly for short lengths;
- ❑ Before assembling, accurately clean the pipings by blowing compressed air in order to guarantee system operation.

Figure 4



13132

- ❑ Protect the pipes in case of grinding or welding operations on the vehicle; for such purpose, an adhesive plate is applied in the cabin and shows the precautions to be observed with utmost care to avoid damages.

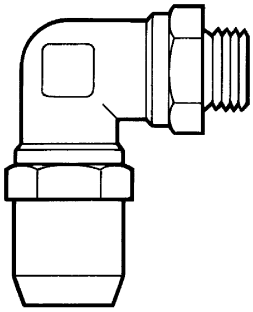
NOTE For better safety and work comfortability, it is advisable to detach the pipings during such operations.

At the end of the assembly, check the perfect seal of all gaskets (unions, fittings, etc.).

Flexible pipings replacement with quick connection fittings

Rotating fittings

Figure 5



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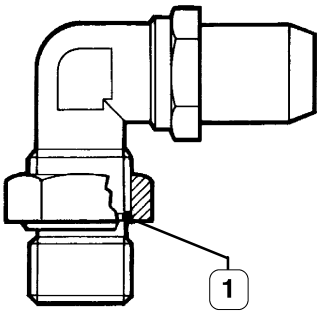
Screw the fitting in the threaded seat provided on the pneumatic valve and lock it at the tightening torque shown in the table.

Swinging fittings

Figure 6



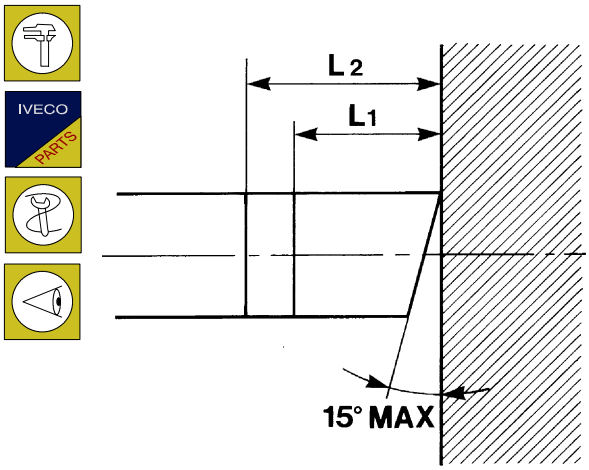
39307

- ❑ Check that the sealing ring (1) is into its suitable seat;
- ❑ screw the fitting till it is felt that the sealing gasket abuts onto the valve;
- ❑ adequately swing the fitting and keeping the swingable part still, lock the hexagonal nut at the tightening torque mentioned in the table.

Rotating and swinging fittings

FITTING THREADING	TIGHTENIG TORQUE (Nm ± 10%)
M 10 x 1.0 mm	22
M 12 x 1.5 mm	24
M 14 x 1.5 mm	28
M 16 x 1.5 mm	35
M 22 x 1.5 mm	40

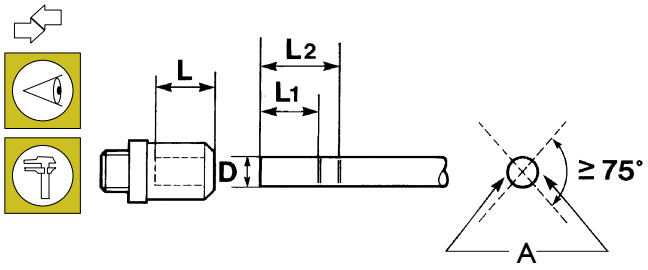
Figure 7



33977

- ❑ Use homogated pipes only;
- ❑ Check the spare pipe status, on which no cracks, cuts or nicking must be detected;
- ❑ Cut the pipe at 90° with a max 15° error with respect to the axis through the suitable pipe-cutting pliers 99387050 at the necessary length;

Figure 8



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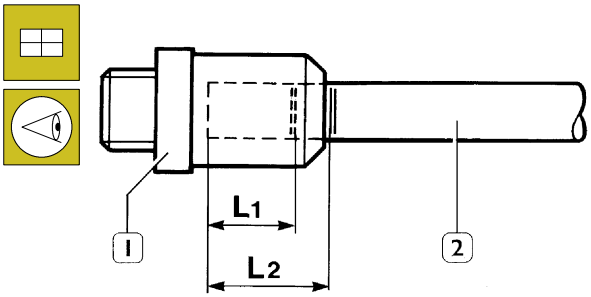
A = Marking to identify pipe end-of-stroke

- ❑ Strongly and indelibly mark with ink two reference notches on both diametrically-opposed pipe faces for an angle ≥ 75°, placed at the distances of L_1 and L_2 to guarantee a correct assembly.

NOTE Dimensions L_1 and L_2 change depending on the pipe diameter and must be measured from the longest pipe part (see Figure 7).

D (mm)	$L\ ^{0}_{+0.5}$ (mm)	$L_1\ ^{-0.5}_{+1}$ (mm)	$L_2\ ^{-0.5}_{+1}$ (mm)
6	19.8	17	22
8	20.5	18	23
12	25	22	28
16	27.1	24	30

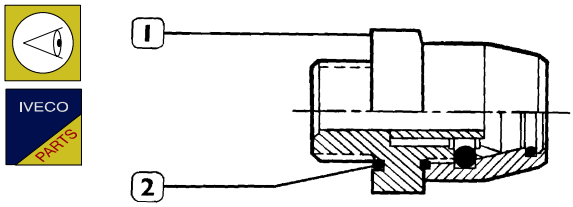
Figure 9



39308

- ❑ Manually insert pipe (2) into fitting (1), with a force varying from 30 to 120 N depending on pipe diameter, so that the notch L_1 is placed inside the fitting while the notch L_2 is visible.

Figure 10



33978

In case of disassembling of fittings (1) from pneumatic components, check the sealing ring (2) status, and if necessary replace it.

FITTING THREADING	SEALING RINGS DIMENSIONS
M 10 x 1.0	10.1 x 1.6
M 12 x 1.5	11.0 x 2.0
M 14 x 1.5	-
M 16 x 1.5	15.0 x 2.0
M 22 x 1.5	-

NOTE Every time a piping is detached from a quick connection fitting, it is necessary to replace the fitting itself. Quick connection fittings are supplied complete as spares.

NOTE Quick connection and threaded fittings, as well as flexible pipings used with quick connection fittings and flexible pipings used with threaded fittings, are not interchangeable.

EBS (ELECTRONIC BRAKE SYSTEM)

The increase in competition in the transport sector has had the effect, among others, of constantly increasing the basic requirements of braking systems.

The introduction of the EBS electronic brake system is the logical answer to these new needs.

It is an integrated and permanent electronic control system for the brake system of the tractor and trailer.

It supplements the ABS, ASR and EBL functions.

The system is composed of a pneumatic system and an electric system containing the following components:

- CBU, Central Brake Unit integrating duplex distributor with electrical transmitter, electronic central unit, proportional relay valve and ABS valve for front axle.
- Rear axle electrical-pneumatic modulator.
- Trailer drive power-assisted distributor and electronic central unit.

The EBS systems dialogue with the control units of the other assemblies:

Engine, Ecas, retarder and gearbox via the CAN line (VDB, Vehicle Data Bus).

EBS Benefits

Lower servicing costs.

The EBS combines many functions. The aim is to cut maintenance costs while maximizing braking safety – that is minimizing brake lining wear.

An individual control according to the lining wear parameters on both the front and rear axles harmonizes lining wear. Distributing the load homogeneously between all the brakes of the wheels reduces total consumption. In addition, the frequency of servicing and changing the linings coincide. The costs of inactivity are drastically reduced.

Depending on the servicing a vehicle needs along with other factors, the owner may be able to make considerable savings. A comparison of the maintenance costs, for the brake system, of a vehicle with EBS and one with a conventional brake system highlights significant savings.

Tractor and trailer compatibility at any time

Harmonizing the braking processes of the entire tractor-trailer combination, especially if the combinations are frequently changed, often with conventional means, is not satisfactory.

An inadequate balance, such as with a trailer whose braking is not sufficiently effective, will cause uneven wear of the brake linings.

The EBS will recognize all the incompatibilities between tractor and trailer, harmonizing braking automatically. When the brakes work in the best conditions, not only are brake maintenance costs optimized, but safety and comfort are optimum too.

Complete fault-diagnosis structures

The EBS provides the owner of the vehicle with constantly updated information on the state of the brake system and the basic brakes. This makes it possible to schedule servicing in advance. The EBS monitors all the fundamental components and functions of the brake system.

Any defect recognized by the system is accurately highlighted. The maintenance specialist can therefore rectify the error at issue.

The high degree of safety ensured by the EBS is due to several factors:

- Lower pressure accumulation and response times for the brakes on the front, rear and trailer axles.
- Better ABS function.
- Tractor/trailer always balanced in every moment.
- Constant monitoring of the service brake system. In the event of reduced brake performance, the EBS will be able to warn the driver.
- The integrated ASR function permits optimum vehicle stability and drive optimization.

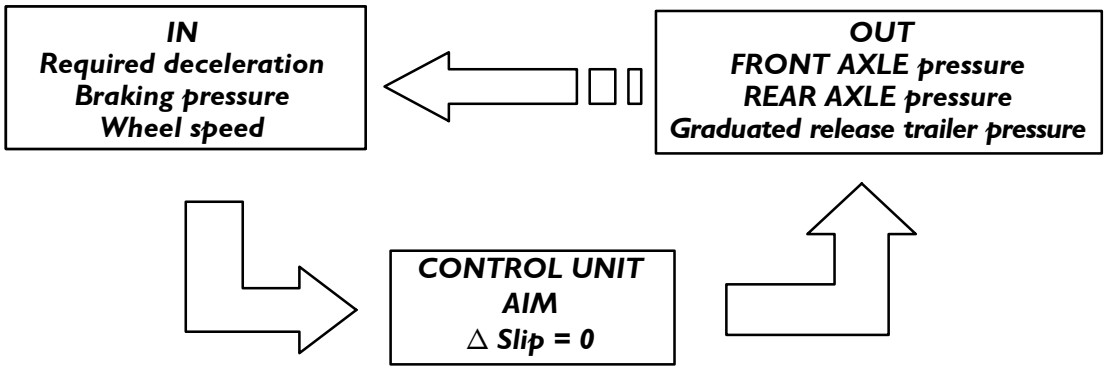
OPERATING LOGIC

The purpose of the electronic control unit is to slow down the vehicle as quickly as possible, ensuring its stability and avoiding the tendency for the wheels to lock.

To achieve this aim, while braking, the electronic control unit will be informed of the:

- ❑ required deceleration via the sensors inside the duplex control valve;
- ❑ pressures made available via the pressure sensors in the components;
- ❑ reaction on slowing down due to the pressures made available via the speed sensor signals.

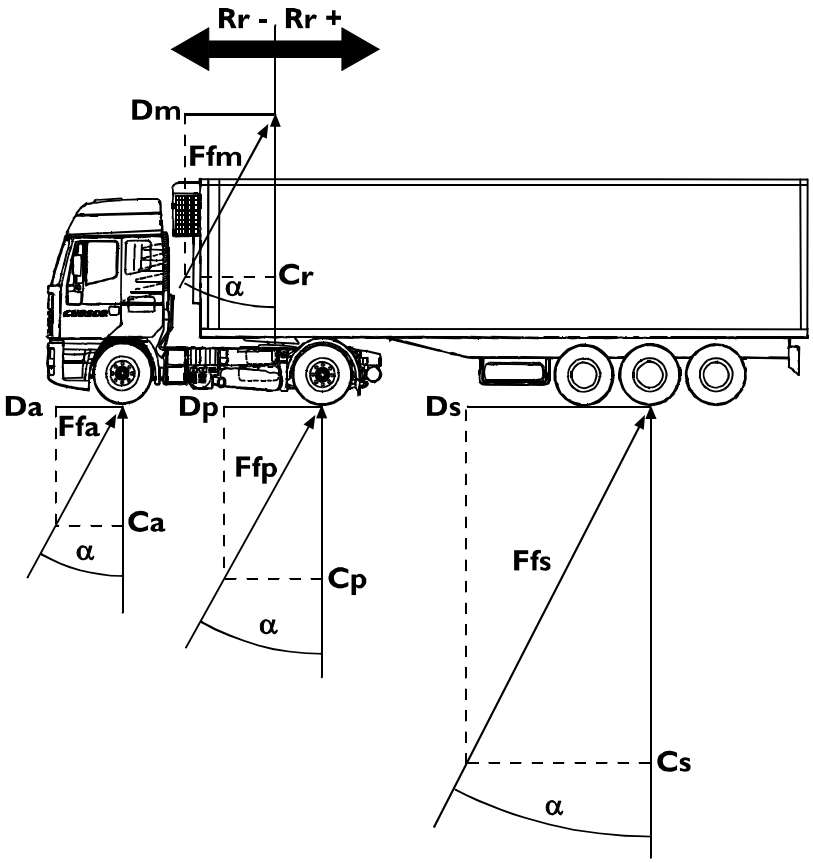
The continuous monitoring and processing of this information, in relation to the set aim, will cause the modulating valves to activate appropriately and optimize the braking action accordingly.



BRAKE SYSTEM

In a dynamic situation the effect on the vehicle will be managed in this way:

Figure 11



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Ca. Front axle load – Cp. Rear axle load – Cr. Load on fifth wheel – Da. Front axle braking force – Dp. Rear axle braking force – Dm. Braking force at graduated release – Ds. Semitrailer braking force – Ffa. Resultant of braking/front axle load – Ffp. Resultant of braking/rear axle load – Ffm. Resultant of braking/load at graduated release – Ffs. Resultant of braking/semitrailer load – a. Braking angle – Rr. Reaction on the fifth wheel – Dec. Required deceleration – g. Acceleration due to gravity – z. Braking ratio

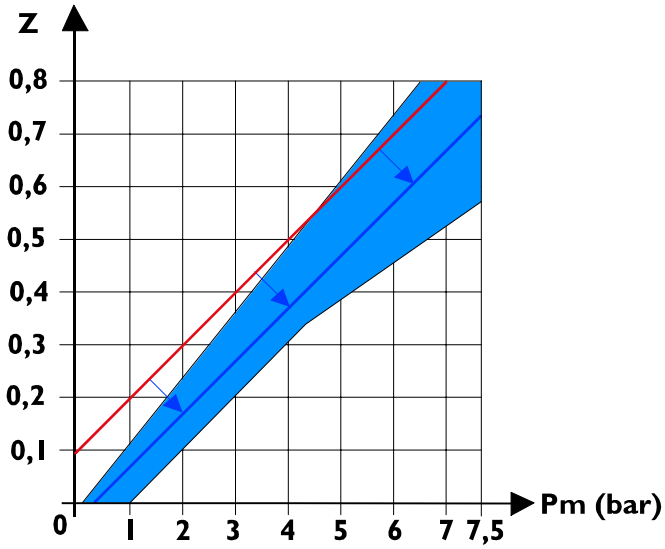
Generally, the EBS will tend to apply a braking force in proportion to the load on the axles, that is to maintain the same angle "á" for all the axles:

$$\frac{Da}{Ca} = \frac{Dp}{Cp} = \frac{Ds\ (Dm)}{Cs\ (Cr)} = Tag\ \alpha \cong \alpha = \frac{dec}{g} = z$$

This, as may be seen, also holds for the semitrailer control.

If the reaction on the fifth wheel "Rr" is not as expected, the system automatically increases or decreases the predominance at the graduated release and "Ffm" accordingly so as to ensure the best compatibility between the tractor and semitrailer in compliance with current type-approval standards, as may be seen in the following compatibility diagram.

Figure 12



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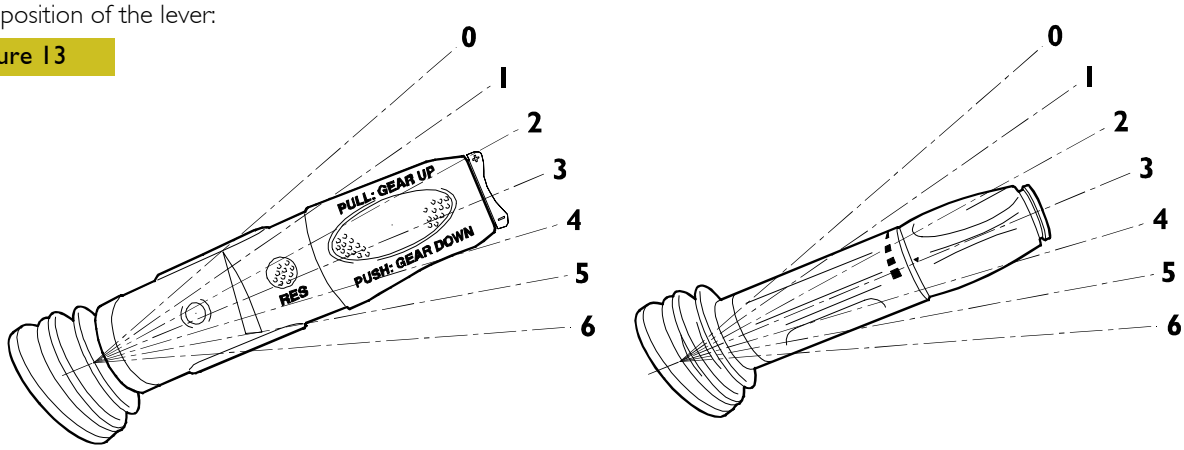
AUXILIARY BRAKE INTEGRATION

Commercial vehicles are normally fitted with auxiliary brakes for slowing down without causing wear, such as the exhaust brake and intarder.

On vehicles equipped with the EBS, these devices can be integrated to ensure the vehicle slows down sooner and more effectively. The exhaust brake/intarder action percentage is set by the driver with the lever.

The exhaust brake will be applied up to a speed of 1000 rpm, while the action of the retarder will cause the following action depending on the position of the lever:

Figure 13



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Lever with Eurotronic gearboxes

Lever with mechanical gearboxes

Position 0 – disengaged

Position 1 – E.B. 100%

Position 2 – E.B. 100% + Intarder 25% (20% *)

Position 3 – E.B. 100% + Intarder 50% (40% *)

Position 4 – E.B. 100% + Intarder 75% (60% *)

Position 5 – E.B. 100% + Intarder 100% (80% *)

Position 6 – E.B. 100% + Intarder 100%

These applications, always possible, will be signalled to the driver by the relevant indicator lights coming on.

* Vehicles with mechanic gearbox.

NOTE On vehicles without the optional Intarder, the auxiliary brake lever has just three positions: off, E.B. 50%, E.B. 100%.

On vehicles fitted with a EuroTronic gearbox, with the auxiliary brake lever on position 6, slowing down will be more effective with the automatic gear shift down.

Switching the engine off for longer than one minute involving a change in load, tyres or ratios at the rear axle causes the adjustment data to be lost and so a fresh period of data acquisition will be necessary for the system to be able to reactivate auxiliary brake integration if no vehicle parameter is changed the integration will be immediately available.

If manually activating the auxiliary brakes, the next time the brake pedal is pressed will implement integration.

On releasing the brake pedal, if the manual action is compatible with the calculated action it will be kept active.

If activating the auxiliary brakes, both manual and integrated, causes the rear axle to slow down too much and a tendency for it to lock, the EBS control unit, on detecting this situation via the speed sensors, will immediately disengage them or turn on the auxiliary brake Slip Control.

ESP (ELECTRONIC STABILITY PROGRAM)

ESP function, joined to EBS abilities, controls vehicle lateral dynamics.

The main objectives of this function are:

- Improving stability, mainly on understeering and oversteering
- Reducing braking spaces on changes of line on slippery roads.

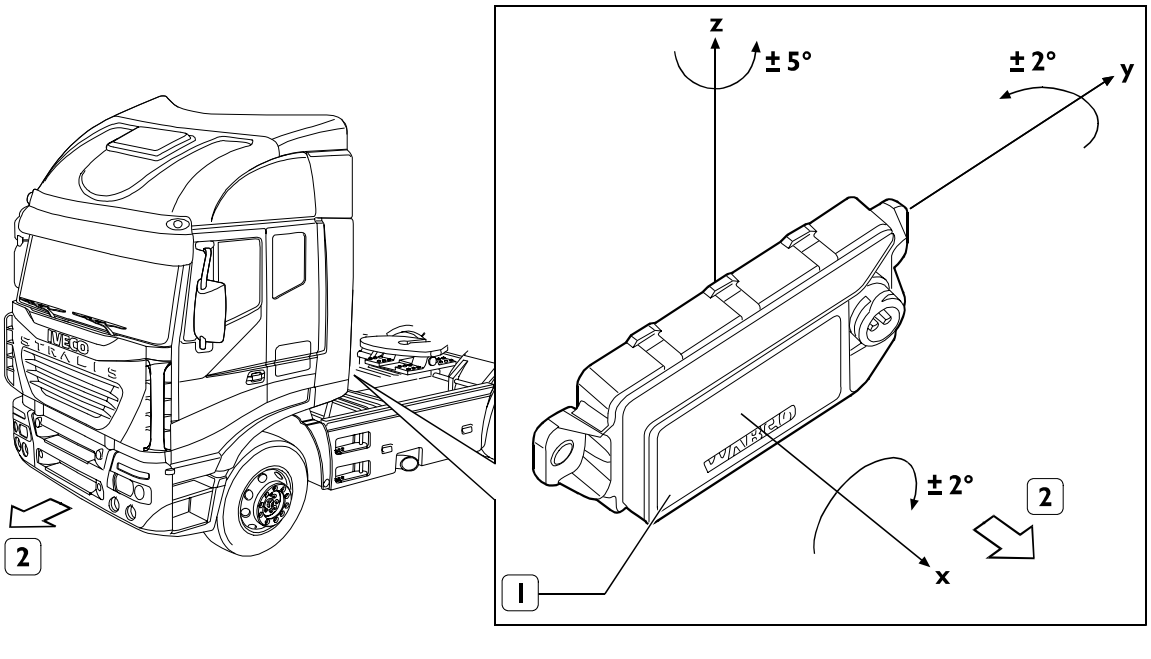
Central unit input main data to achieve following objectives are:

- the signal of steering angle sensor (mounted on the steering wheel)
- the signals of yaw speed and lateral acceleration sensors (integrated into ESP (1) module mounted on the chassis, also containing a part of ESP software).

To avoid loss of control, ESP will automatically activate the brakes of one wheel per axle trying to take back the vehicle to correct direction. In this case, ESP controls the skidding angle of the towing body and its inclination, as well as the shift between driver's request and vehicle actual yaw speed. To the purpose of withstanding vehicle deceleration, the driving torque will be decreased. In yaw control mode, ESP very carefully controls driver's reactions and always tries to provide relating support.

NOTE The ESP function is available as an option only on vehicles with an EBS braking system.

Figure 14



1. ESP module - 2. Ride direction

NOTE The components of ESP system, including calibration and self-learning procedures, are described on pages 190 and 191 of this section.

"ABS-EBL" SYSTEM (ANTI-LOCK BRAKE SYSTEM – ELECTRONIC BRAKE LIMITER)

EBL function controls rear axle wheel "skidding" by comparing it to front axle wheel speed.
On the basis of wheel r.p.m.'s and braking pressure (detected by the sensor upstream from rear axle ABS modulators), the central unit calculates vehicle speed, rear axle wheel "skidding" and minimum acceleration expected.

"ABS" (Anti-Lock Brake System)

The braking of a moving vehicle and the according deceleration and stopping distances depend above all on the grip between the surfaces of the tyres and the road.

With a fully efficient braking system, a further improvement in braking can only be achieved by acting on the friction of the tyres or on the grade of the road surface.

Even in these optimum conditions, absolute braking safety is anyhow not guaranteed when faced with especially tricky situations, such as poor grip due to a wet or icy road surface: the driver is forced to moderate use of the brakes in order to avoid partially locking one or more wheels, with the risk of skidding dangerously.

The function of the "ABS" is therefore to ensure vehicle stability (in all braking conditions), preventing the wheels from locking irrespective of the state of the road surface, so as to ensure the available grip is made full use of.

Even in the case of emergency braking, the system makes it possible to keep direction, that is to turn the steering wheel to avoid obstacles with no risk of skidding.

In short, the anti-lock brake system (ABS):

- ❑ Prevents the wheels locking when the vehicle is braking, no matter what grip is available on the road.
- ❑ Shortens stopping distances.
- ❑ Provides safety for the driver who can keep the vehicle's stability and direction.

EBL (Electronic Brakes Limiter)

The EBL function checks the rear axle wheel "slip", comparing it with the speed of the wheels of the front axle.

The control unit input data are the wheel speed and braking pressure measured by the pressure sensor installed upstream from the rear axle ABS modulators.

On the basis of these values, the control unit calculates the speed of the vehicle, the vehicle's deceleration, the rear axle wheel "slip" and the minimum deceleration contemplated.

The EBL function is activated (the rear ABS modulators maintain the set pressure) when the driver applies an excessive braking force for the conditions of load on the vehicle, in short when the rear axle slip and vehicle deceleration thresholds are exceeded.

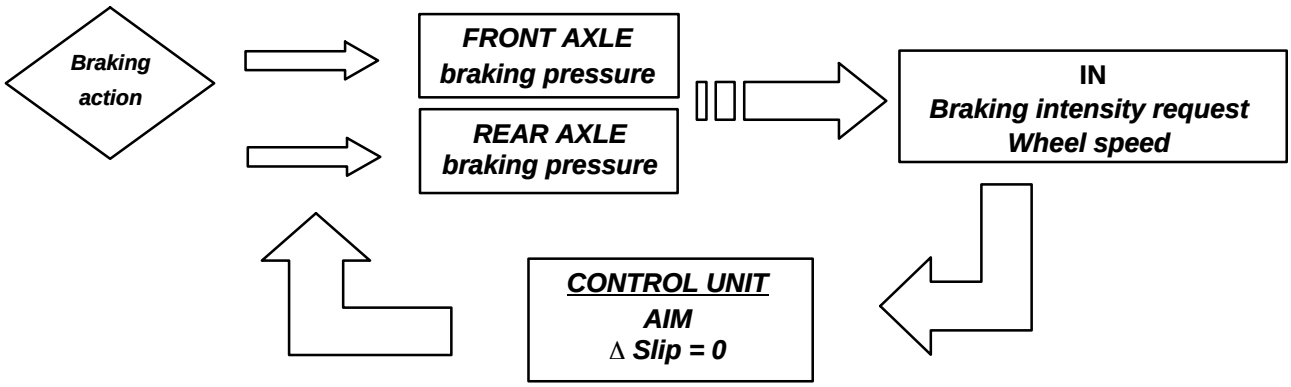
Operating Logic

The purpose of the electronic control unit is to slow down the vehicle as quickly as possible, ensuring its stability and avoiding the tendency for the wheels to lock.
To achieve this aim, while braking, the electronic control unit will be informed of the:

- braking intensity required by the driver via the rear axle pressure sensor,
- reaction on slowing down due to the pressures made available via the speed sensor signals.

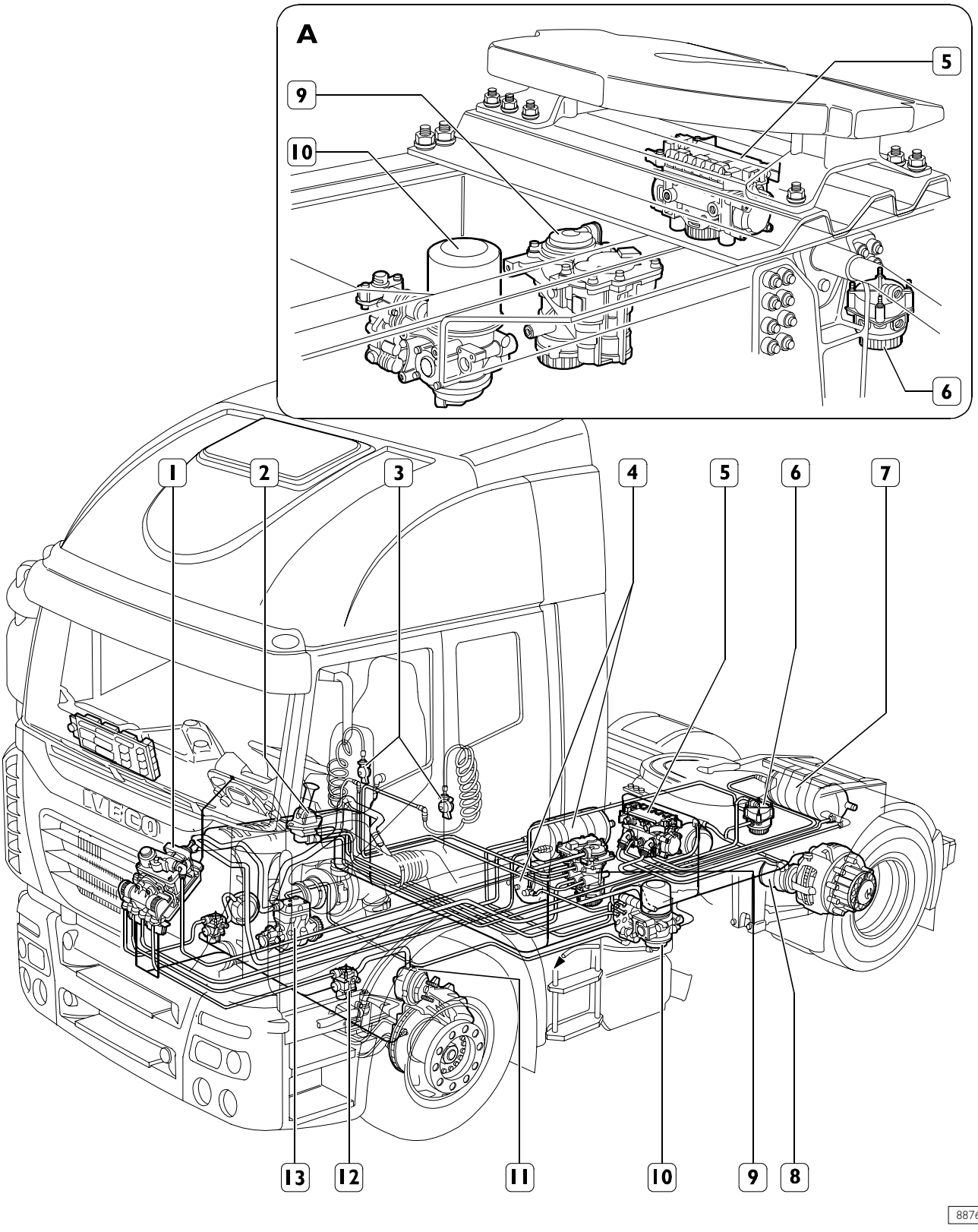
The continuous monitoring and processing of this information, in relation to the set aim, will cause the rear axle modulating valves to activate appropriately and optimize the braking action accordingly.

Figure 15



EBS SYSTEM COMPONENTS LOCATION ON VEHICLE (TRACTORS VARIANT)

Figure 16

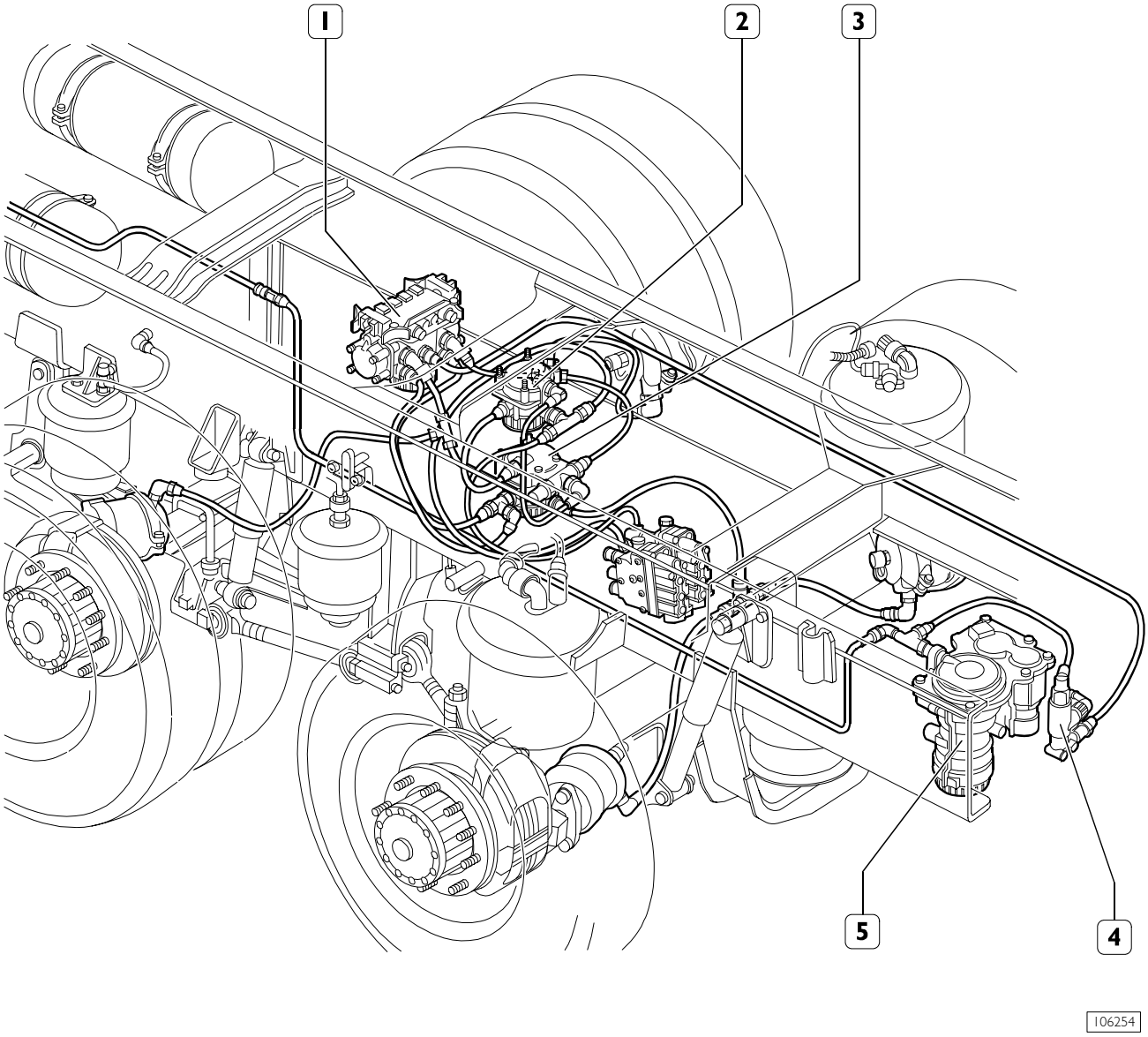


1. CBU (Central Brake Unit) - 2. Hand distributor for parking - 3. Coupling half joints - 4. Air tanks - 5. Axle electropneumatic modulator - 6. Relay valve for parking - 7. Air tank - 8. Spring brake cylinder - 9. Trailer drive servo-assisted distributor - 10. APU - 11. Membrane brake cylinder - 12. ABS solenoid valve - 13. Compressor

A. Real component location 5, 6, 9 and 10.

LOCATION OF EBS SYSTEM COMPONENTS ON THE VEHICLE (TRUCKS VARIANT)

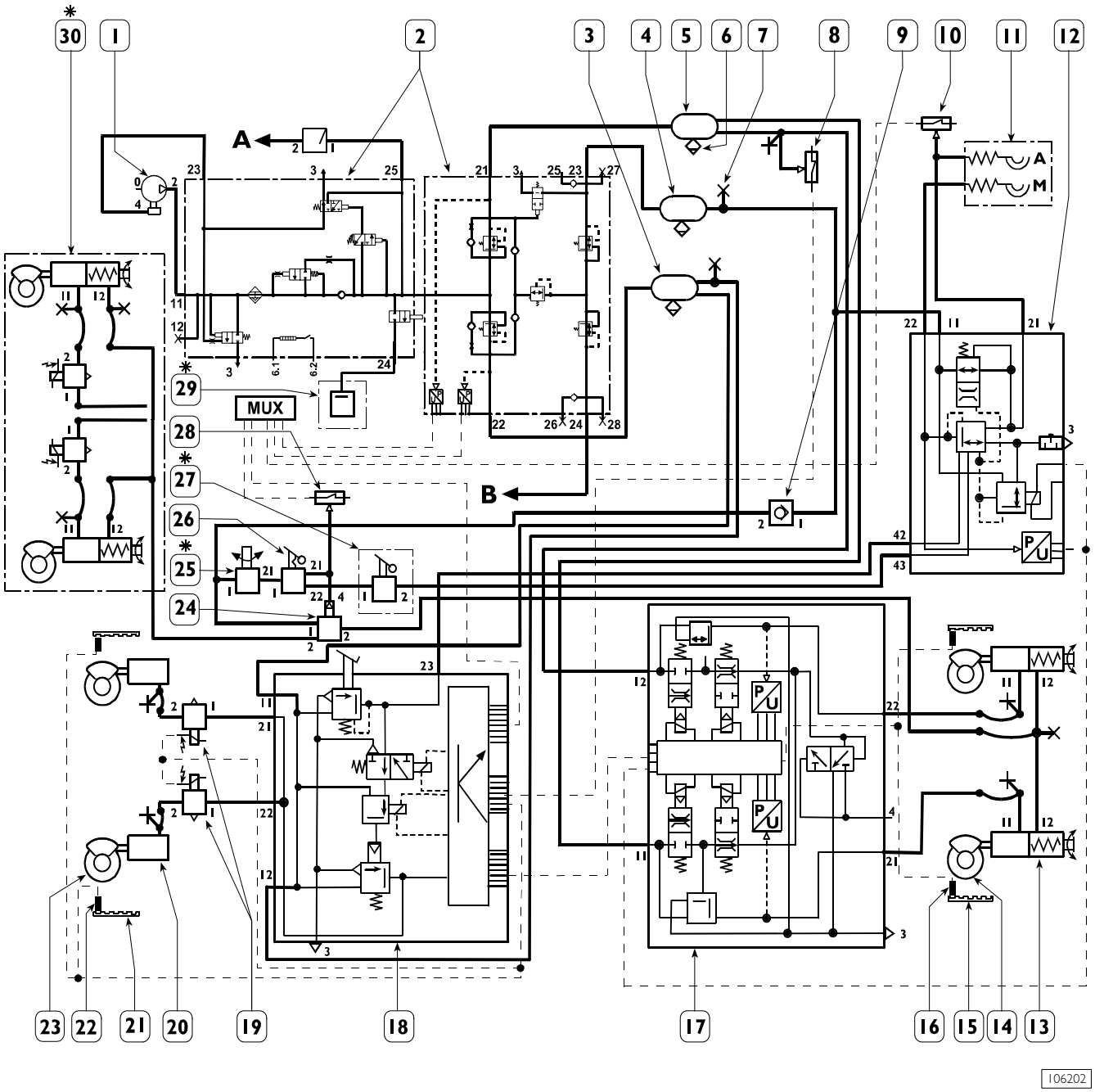
Figure 17



1. Rear axle modulator - 2. 3. Relay valve - 4. Redundant valve - 5. Trailer drive power-assisted distributor.

BRAKING SCHEMES OF EBS SYSTEMS
Theoretical scheme of EBS system for 4x2 vehicles (tractors)

Figure 18



1. Compressor - 2. Air processing unit 10.5 bars - 3. Front axle air tank 20 l. - 4. Parking air tank 20 l. - 5. Rear axle air tank 30 l. - 6. Manual discharge valve - 7. Air test point - 8. Rear axle low pressure switch for ASR - 6.6 bars - 9. Parking system one-way valve - 10. Trailer system low pressure switch - 5.5 bars - 11. ISO coupling half joints - 12. Trailer brake servo control valve - 13. Redundant solenoid valve - 14. Rear axle combined cylinder - 15. Rear axle disc brake assembly - 16. Rear axle phonic wheel - 17. Rear axle speed sensor - 18. Rear axle brake control electro-pneumatic modulator - 19. CBU - 20. Front axle ABS solenoid valves - 21. Front axle diaphragm brake cylinder - 22. Front axle phonic wheel - 23. Front axle speed sensor - 24. Front axle disc brake assembly - 25. Parking control relay valve - 26. On-off valve - 27. Parking manual control valve - 28. Trailer slowing manual control valve - 29. Handbrake low pressure switch turned on - 6.6 bars - 30. 14 bar safety valve - 31. Front axle parking brake - A. To the air suspension system - B. To the service system - * Optional extra

EBS working diagram for 6x2p vehicles (tractors)

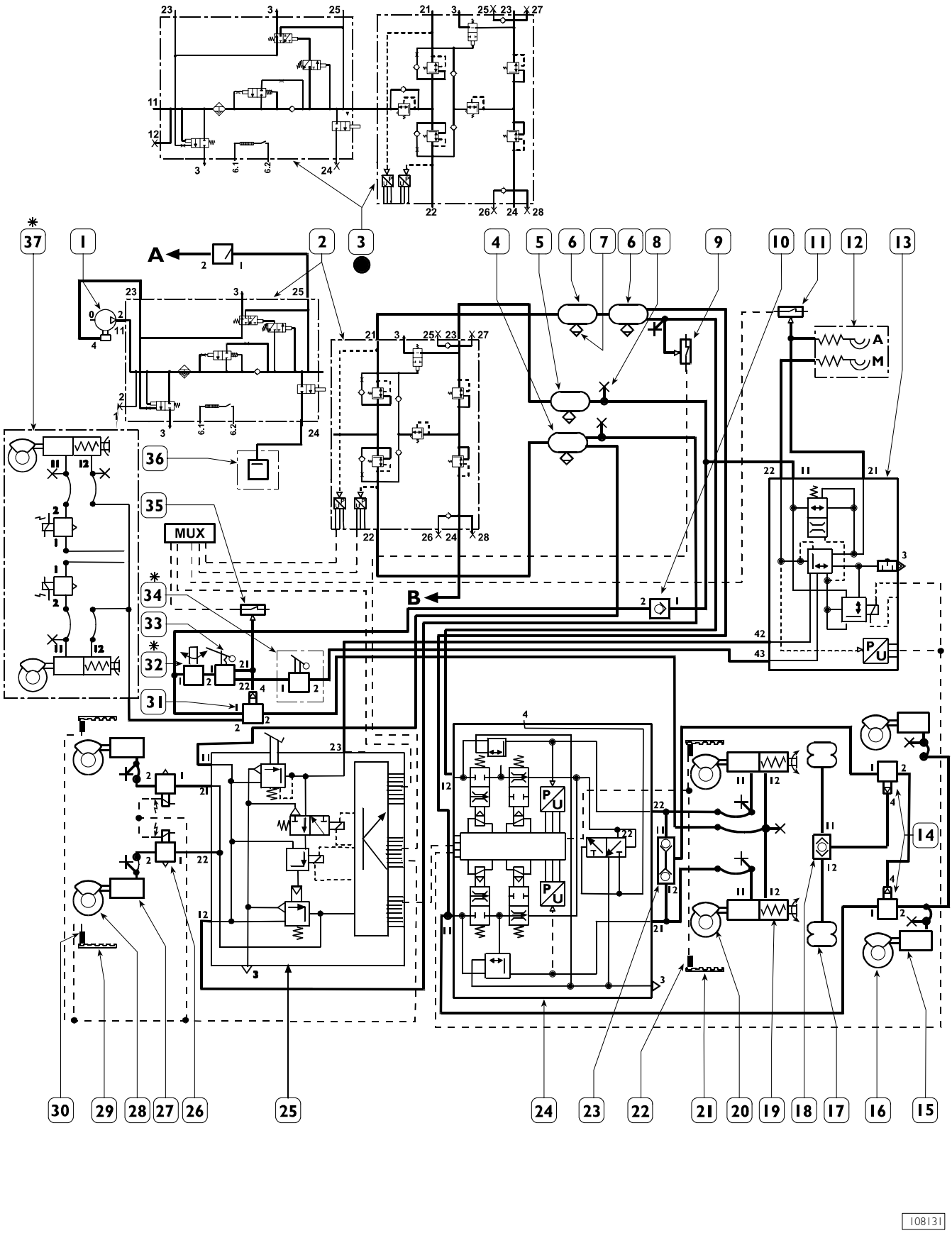
Legend

1. Compressor
2. Air processing unit - 10.5 bars
3. Air processing unit - 12.5 bars
4. Front axle air tank - 20 l.
5. Parking air tank - 20 l.
6. Rear axle air tank - 30 l. + 20 l.
7. Manual discharge valve
8. Pneumatic control connector
9. Rear axle low pressure switch for ASR – 6.6 bars
10. Parking system one-way valve
11. Trailer system low pressure switch – 5.5 bars
12. Semitrailer half-couplings
13. Trailer brake servo control valve
14. Load ratio relay valve for added axle braking
15. Added axle diaphragm brake cylinder
16. Overview of additional axis disk brakes
17. Added axle suspension air springs
18. Added axle load ratio dual stop valve
19. Rear axle combined cylinder
20. Rear axle disc brake assembly
21. Rear axle phonic wheel
22. Rear axle speed sensor
23. Selector
24. Rear axle brake control electro-pneumatic modulator
25. CBU
26. Front axle ABS solenoid valves
27. Front axle diaphragm brake cylinder
28. Front axle disc brake assembly
29. Front axle phonic wheel
30. Front axle speed sensor
31. Parking control relay valve
32. On-off valve
33. Parking manual control valve
34. Trailer slowing manual control valve
35. Handbrake low pressure switch turned on – 6.6 bars
36. 14 bar safety valve
37. Front axle parking brake

A. To the air suspension system
B. To the service system
* Optional extra
• Only for vehicles CM

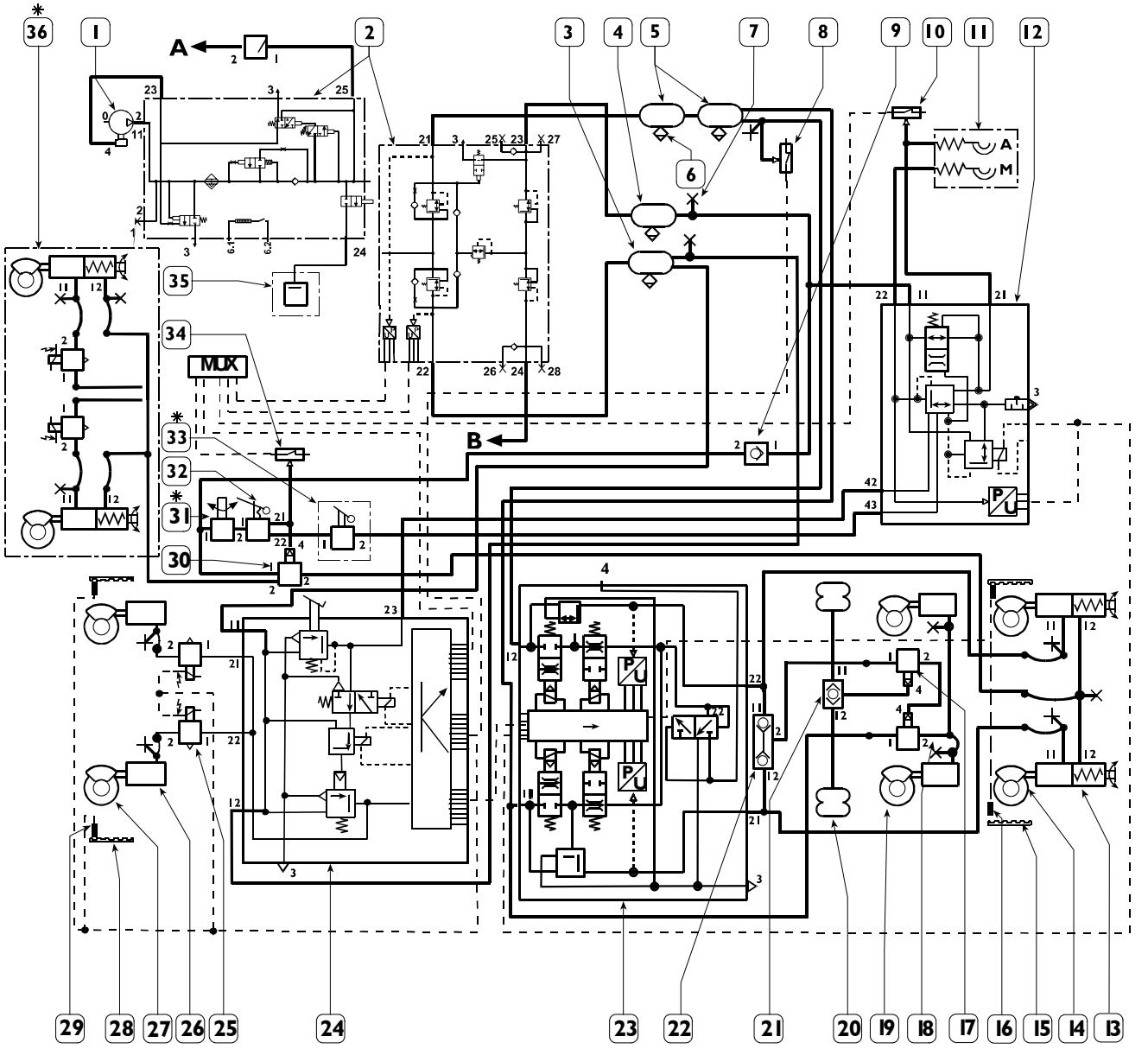
Theoretical scheme of EBS system for 6x2p vehicles (tractors)

Figure 19



Theoretical scheme of EBS system for 6x2 C vehicles (tractors)

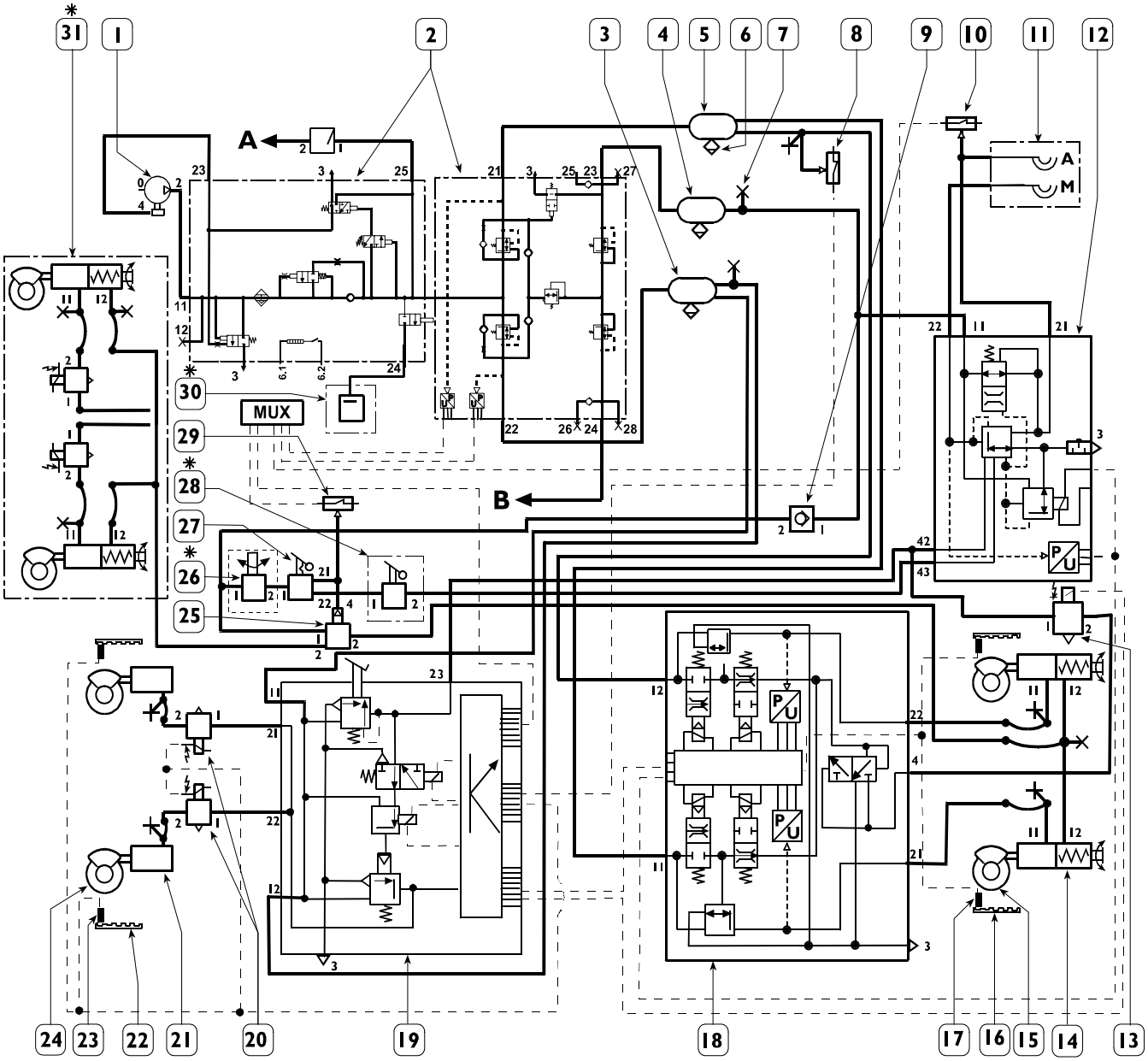
Figure 20



1. Compressor - 2. Air processing unit 10.5 bars - 3. Front axle air tank 20 l. - 4. Parking air tank 20 l. - 5. Rear axle air tank 30 l. + 15 l. - 6. Manual discharge valve - 7. Air test point - 8. Rear axle low pressure switch for ASR - 6.6 bars - 9. Parking system one-way valve - 10. Trailer system low pressure switch - 5.5 bars - 11. Semitrailer half-couplings - 12. Trailer brake servo control valve - 13. Rear axle combined cylinder - 14. Rear axle disc brake assembly - 15. Rear axle phonic wheel - 16. Rear axle speed sensor - 17. Relay valves - 18. Intermediate axle diaphragm cylinder - 19. Intermediate axle disc brake assembly - 20. Intermediate axle suspension air springs - 21. Intermediate axle load ratio dual stop valve - 22. Selector - 23. Rear axle braking control electro-pneumatic modulator - 24. CBU - 25. Front axle ABS solenoid valves - 26. Front axle diaphragm brake cylinder - 27. Front axle disc brake assembly - 28. Front axle phonic wheel - 29. Front axle speed sensor - 30. Parking control relay valve - 31. On-off valve - 32. Parking manual control valve - 33. Trailer slowing manual control valve - 34. Handbrake low pressure switch turned on - 6.6 bars - 35. 14 bar safety valve - 36. Front axle parking brake - A. To the air suspension system - B. To the service system - * Optional extra.

Theoretical scheme of EBS system for 4x2 vehicles (trucks)

Figure 21



1. Compressor - 2. Air processing unit 10.5 bars - 3. Front axle air tank 20 l. - 4. Parking air tank 20 l. - 5. Rear axle air tank 30 l. - 6. Manual discharge valve - 7. Air test point - 8. Rear axle low pressure switch for ASR - 6.6 bars - 9. Parking system one-way valve - 10. Trailer system low pressure switch - 5.5 bars - 11. ISO coupling half joints - 12. Trailer brake servo control valve - 13. Redundant solenoid valve - 14. Rear axle combined cylinder - 15. Rear axle disc brake assembly - 16. Rear axle phonic wheel - 17. Rear axle speed sensor - 18. Rear axle brake control electro-pneumatic modulator - 19. CBU - 20. Front axle ABS solenoid valves - 21. Front axle diaphragm brake cylinder - 22. Front axle phonic wheel - 23. Front axle speed sensor - 24. Front axle disc brake assembly - 25. Parking control relay valve - 26. On-off valve - 27. Parking manual control valve - 28. Trailer slowing manual control valve - 29. Handbrake low pressure switch turned on - 6.6 bars - 30. 14 bar safety valve - 31. Front axle parking brake - A. To the air suspension system - B. To the service system - * Optional extra

EBS working diagram for 6x2p vehicles (trucks)

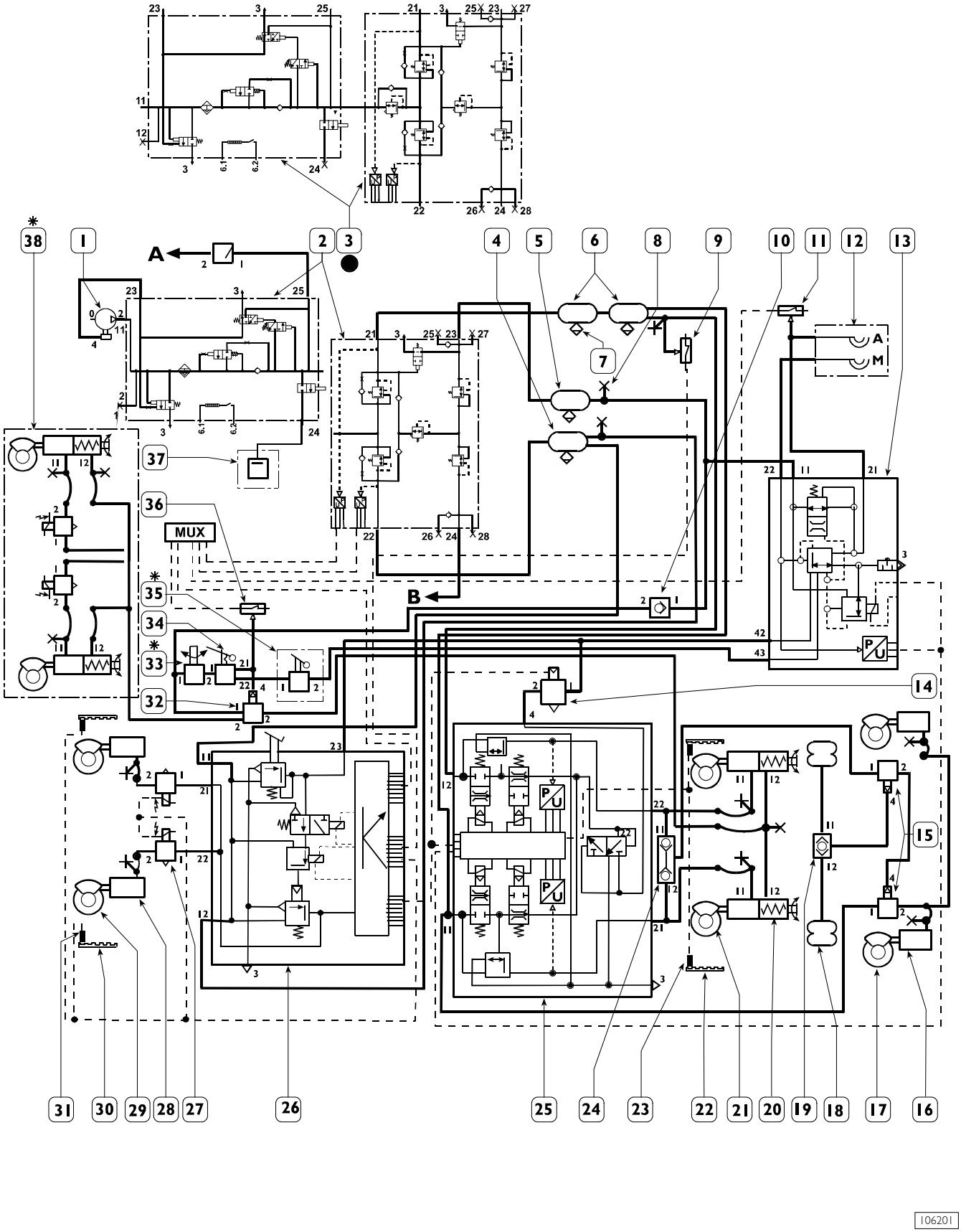
Legend

1. Compressor
2. Air processing unit - 10.5 bars
3. Air processing unit - 12.5 bars
4. Front axle air tank - 20 l.
5. Parking air tank - 20 l.
6. Rear axle air tank - 30 l. + 20 l.
7. Manual discharge valve
8. Air test point
9. Rear axle low pressure switch for ASR – 6.6 bars
10. Parking system one-way valve
11. Trailer system low pressure switch – 5.5 bars
12. Semitrailer half-couplings
13. Trailer brake servo control valve
14. Rear axle braking redundancy valve
15. Load ratio relay valve for added axle braking
16. Added axle diaphragm brake cylinder
17. Added axle ASR exclusion solenoid valve
18. Added axle suspension air springs
19. Added axle load ratio dual stop valve
20. Rear axle combined cylinder
21. Rear axle disc brake assembly
22. Rear axle phonic wheel
23. Rear axle speed sensor
24. Selector
25. Rear axle brake control electro-pneumatic modulator
26. CBU
27. Front axle ABS solenoid valves
28. Front axle diaphragm brake cylinder
29. Front axle disc brake assembly
30. Front axle phonic wheel
31. Front axle speed sensor
32. Parking control relay valve
33. On-off valve
34. Parking manual control valve
35. Trailer slowing manual control valve
36. Handbrake low pressure switch turned on – 6.6 bars
37. 14 bar safety valve
38. Front axle parking brake

A. To the air suspension system
B. To the service system
* Optional extra
• For CM vehicles only

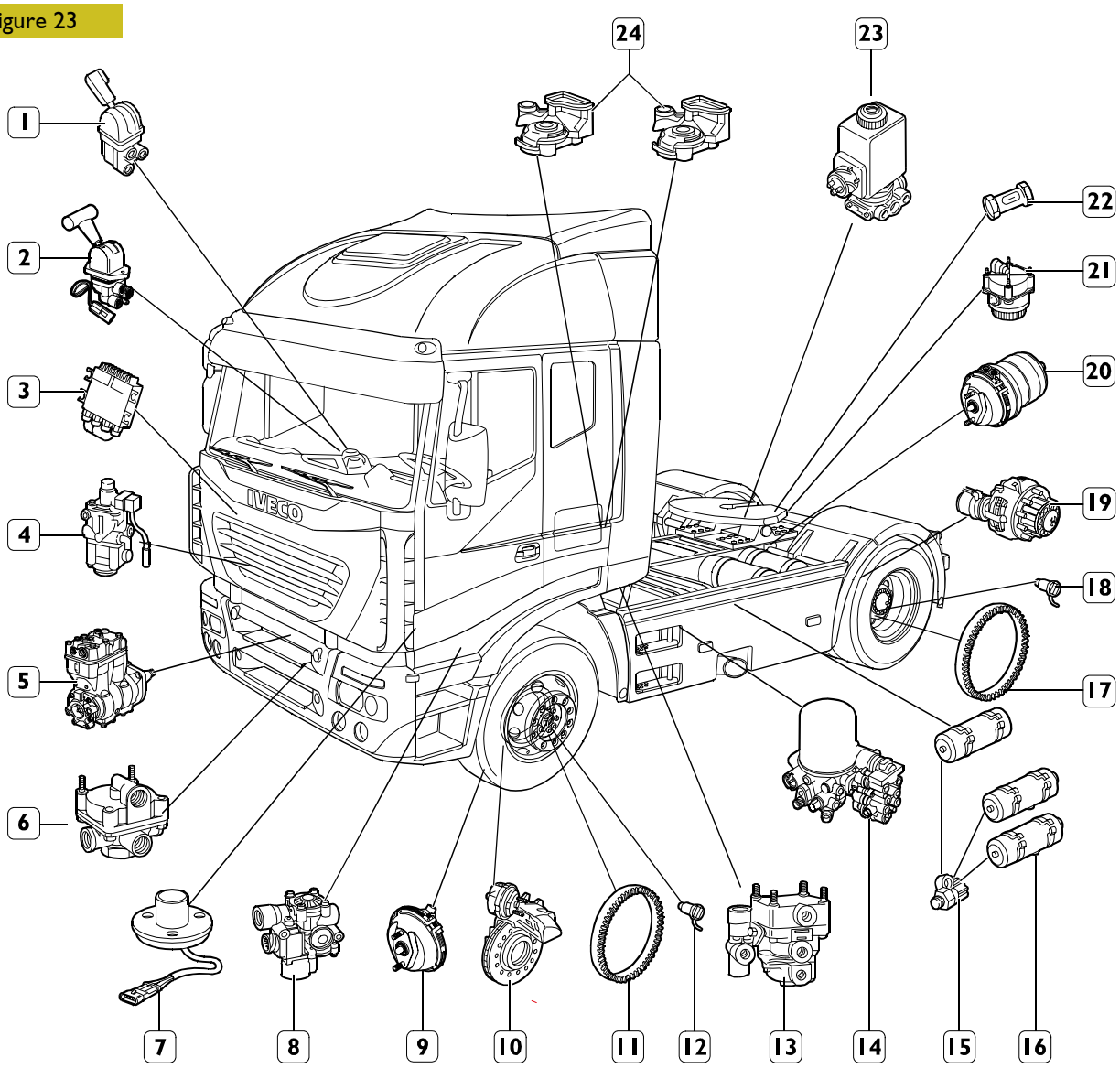
Working diagram of EBS system for 6x2p vehicles (trucks)

Figure 22



LOCATION OF ABS - EBL SYSTEM COMPONENTS (TRACTOR VARIANT)

Figure 23

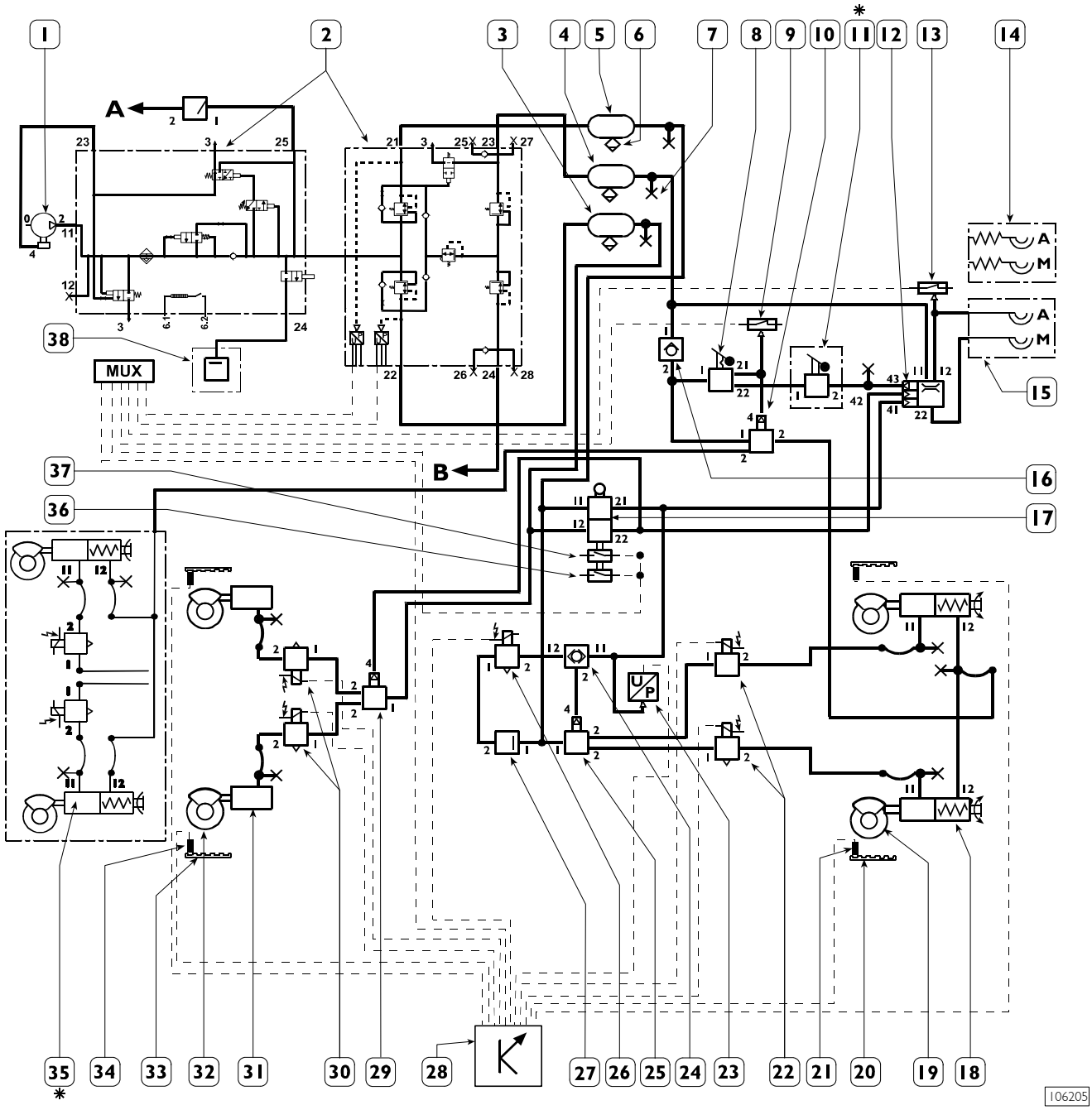


1. Trailer only brakes drive manual distributor - 2. Parking brake drive manual distributor - 3. Duplex central unit - 4. Duplex distributor - 5. Compressor - 6. Relay valve - 7. Engine brake drive pedal switch - 8. ABS solenoid valve - 9. Membrane brake cylinder - 10. Front disk brake assembly - 11. "Phonic" wheel - 12. Wheel rpm sensor - 13. Trailer drive power-assisted distributor - 14. A.P.U. - 15. Pressure control take-off - 16. Air tanks - 17. "Phonic" wheel - 18. Wheel rpm sensor - 19. Rear disk brake assembly - 20. Combined brake cylinder - 21. Relay valve - 22. Non return valve - 23. ASR electrical-pneumatic valve - 24. Half-coupling

BRAKING SCHEMES OF ABS - EBL - ASR SYSTEMS

Working diagram of ABS-EBL-ASR system for 4x2 vehicles (trucks and tractors)

Figure 24



1. Compressor - 2. Air processing unit - 10.5 bars - 3. Front axle air tank - 20 l. - 4. Parking air tank - 20 l. - 5. Rear axle air tank - 30 l. - 6. Manual discharge valve - 7. Air test point - 8. Parking manual control valve - 9. Handbrake low pressure switch turned on – 6.4 bars - 10. Parking control relay valve - 11. Trailer slowing manual control valve - 12. Trailer brake servo control valve - 13. Trailer system low pressure switch – 6.4 bars - 14. Trailer half couplings for tractors - 15. Trailer coupling half joints for FP-CT trucks and tractors - 16. Parking system one-way valve - 17. Duplex control valve - 18. Rear axle combined cylinder - 19. Rear axle disk brake assembly (■) - 20. Rear axle phonic wheel - 21. Rear axle speed sensor - 22. Rear axle ABS solenoid valves - 23. EBL pressure sensor - 24. Dual stop valve - 25. Rear axle brake control relay valve - 26. ASR control solenoid valve - 27. Controlled pressure valve with no return for ASR – 7.5 bars - 28. ABS electronic control unit - 29. Front axle brake control relay valve - 30. Front axle ABS solenoid valve - 31. Front axle diaphragm brake cylinder - 32. Front axle disc brake assembly - 33. Front axle phonic wheel - 34. Front axle speed sensor - 35. Front axle parking brake - 36. Brake light control microswitch - 37. Microswitch for EDC control unit - 38. 14 bar safety valve - A. To the air suspension system - B. To the service system - * Optional extra.

(■) On vehicles with rear axle HR, rear drum brakes are mounted.

Working diagram of ABS-EBL-ASR system for 6x2p vehicles (trucks)

Legend

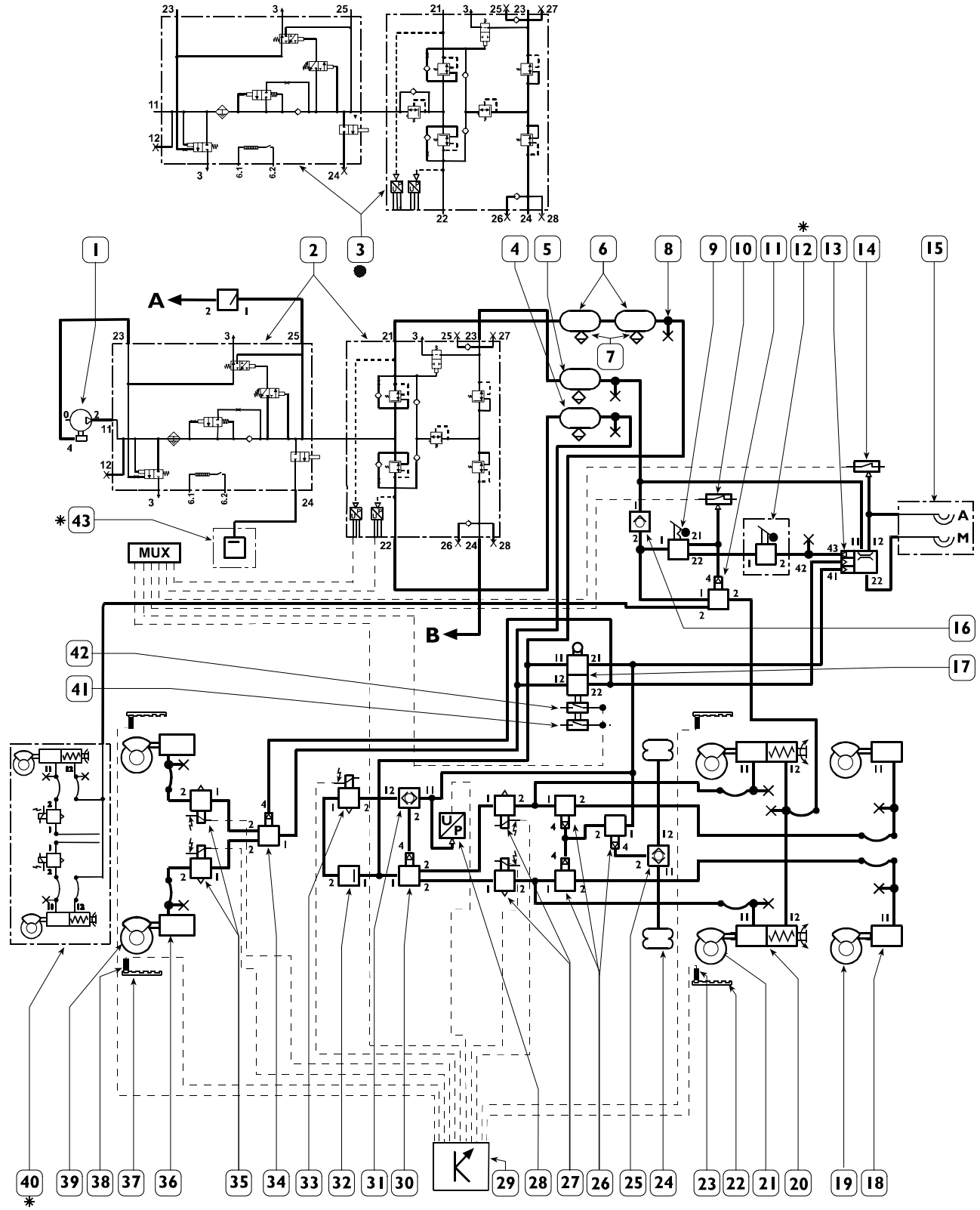
1. Compressor
2. Air processing unit - 10.5 bars
3. Air processing unit - 12.5 bars
4. Front axle air tank - 20 l.
5. Parking air tank - 20 l.
6. Rear axle air tank – 30 l. + 20 l.
7. Manual discharge valve
8. Air test point
9. Parking manual control valve
10. Handbrake low pressure switch turned on – 6.4 bars
11. Parking control relay valve
12. Trailer slowing manual control valve
13. Trailer brake servo control valve
14. Trailer system low pressure switch – 6.4 bars
15. Trailer half-couplings
16. Parking system one-way valve
17. Duplex control valve
18. Diaphragm cylinder
19. Additional axle disk brake assembly
20. Rear axle combined cylinder
21. Rear axle disk brake assembly
22. Rear axle phonic wheel
23. Rear axle speed sensor
24. Added axle suspension air springs
25. Added axle load ratio dual stop valve
26. Load ratio relay valve for added axle braking
27. Rear axle ABS solenoid valves
28. EBL pressure sensor
29. ABS electronic control unit
30. Rear axle brake control relay valve
31. Dual stop valve
32. Controlled pressure valve with no return for ASR – 7 bars
33. ASR control solenoid valve
34. Front axle brake control relay valve
35. Front axle ABS solenoid valve
36. Front axle diaphragm brake cylinder
37. Front axle phonic wheel
38. Front axle speed sensor
39. Front axle disc brake assembly
40. Front axle parking brake
41. Brake light control microswitch
42. Microswitch for EDC control unit
43. 14 bar safety valve (optional)

A. To the air suspension system
B. To the service system

* Optional extra
• For CM vehicles only

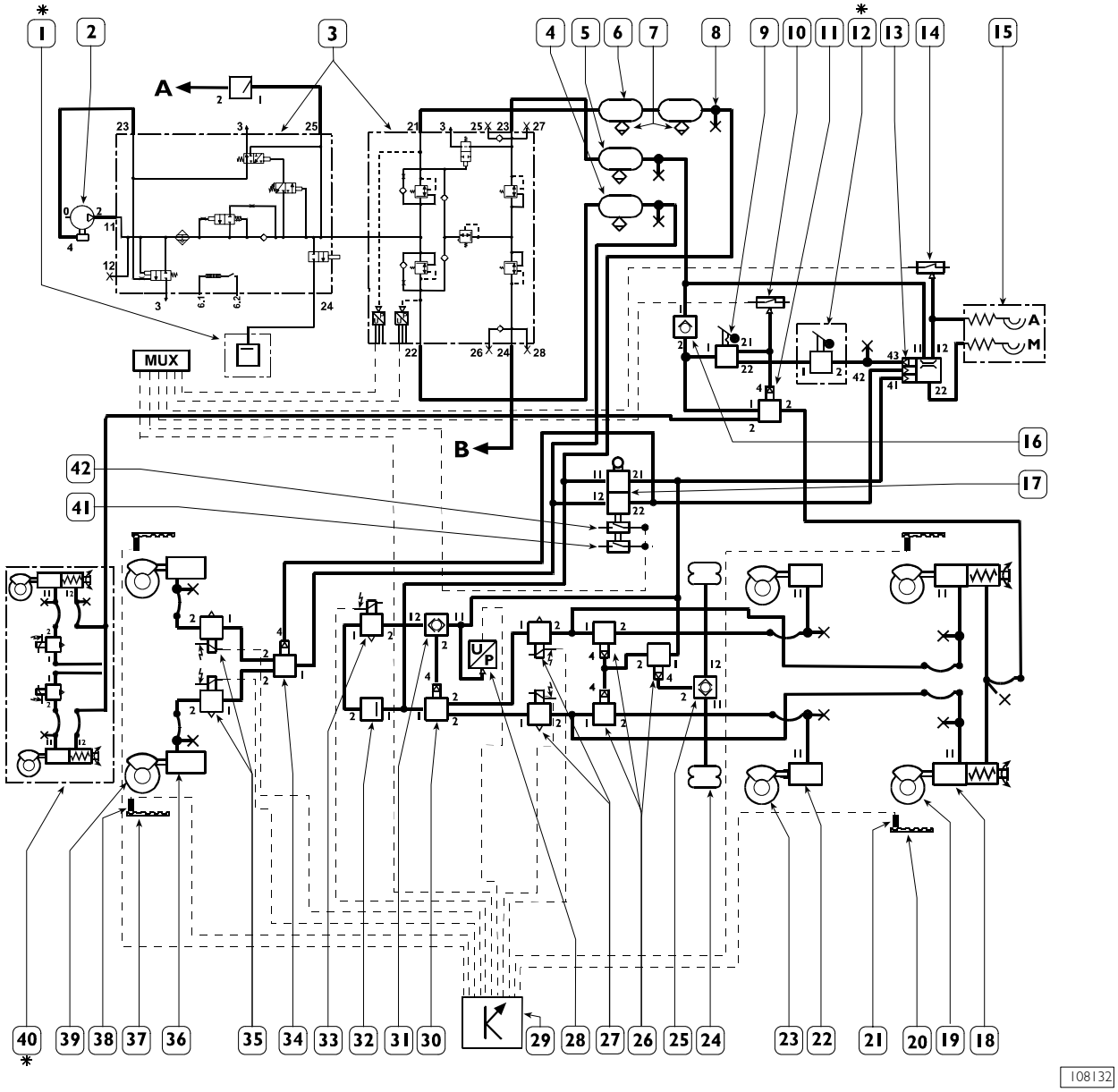
Working diagram of ABS-EBL-ASR system for 6x2p vehicles (trucks)

Figure 25



Working diagram of ABS-EBL-ASR system for 6x2C vehicles (tractors)

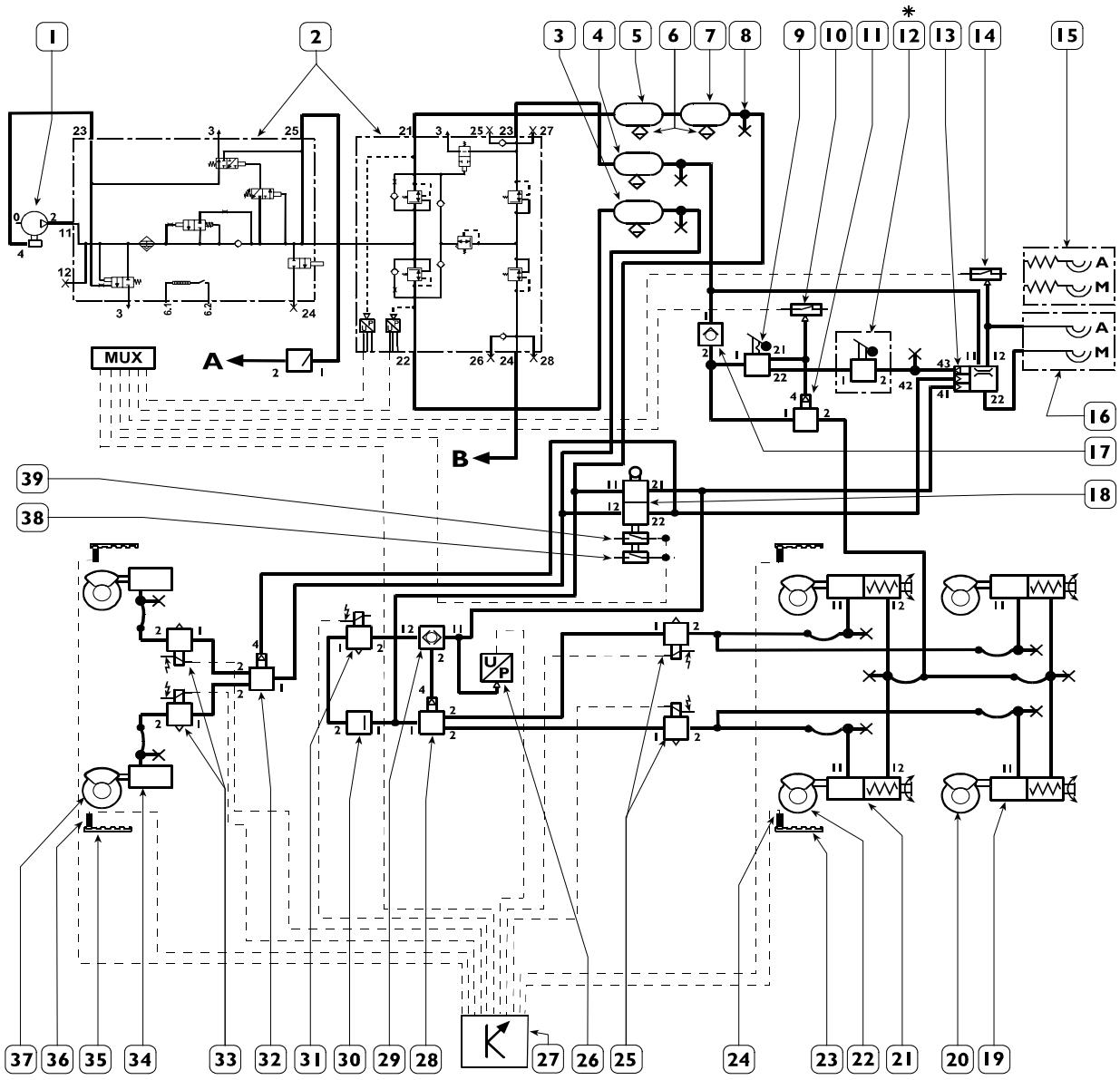
Figure 26



1. Safety valve (14 bar) - 2. Compressor - 3. Air processing unit - 4. Front axle air tank - 20 l -
5. Parking air tank - 20 l - 6. Rear axle air tank - 30 l + 20 l - 7. Manual discharge valve -
8. Air test point - 9. Parking manual control valve -
10. Handbrake low pressure switch turned on - 6.4 bars - 11. Parking control relay valve -
12. Trailer slowing manual control valve - 13. Trailer brake servo control valve -
14. Trailer system low pressure switch - 6.4 bars - 15. Trailer half-couplings -
16. Parking system one-way valve - 17. Duplex control valve - 18. Rear axle combined cylinder -
19. Rear axle disk brake assembly - 20. Rear axle phonic wheel - 21. Rear axle speed sensor -
22. Diaphragm cylinder - 23. Additional axle disk brake assembly - 24. Added axle suspension air springs -
25. Added axle load ratio dual stop valve - 26. Load ratio relay valve for added axle braking -
27. Rear axle ABS solenoid valves - 28. EBL pressure sensor - 29. ABS electronic control unit -
30. Rear axle brake control relay valve - 31. Dual stop valve -
32. Controlled pressure valve with no return for ASR - 7 bars - 33. ASR control solenoid valve -
34. Front axle brake control relay valve G - 35. Front axle ABS solenoid valve - 36. Front axle diaphragm brake cylinder -
37. Front axle phonic wheel - 38. Front axle speed sensor - 39. Front axle disc brake assembly -
40. Front axle parking brake - 41. Brake light control microswitch -
42. Microswitch for EDC control unit - A. To the air suspension system -
B. To the service system - * Optional extra

Working diagram of ABS-EBL-ASR system for 6x4 vehicles (trucks and tractors)

Figure 27

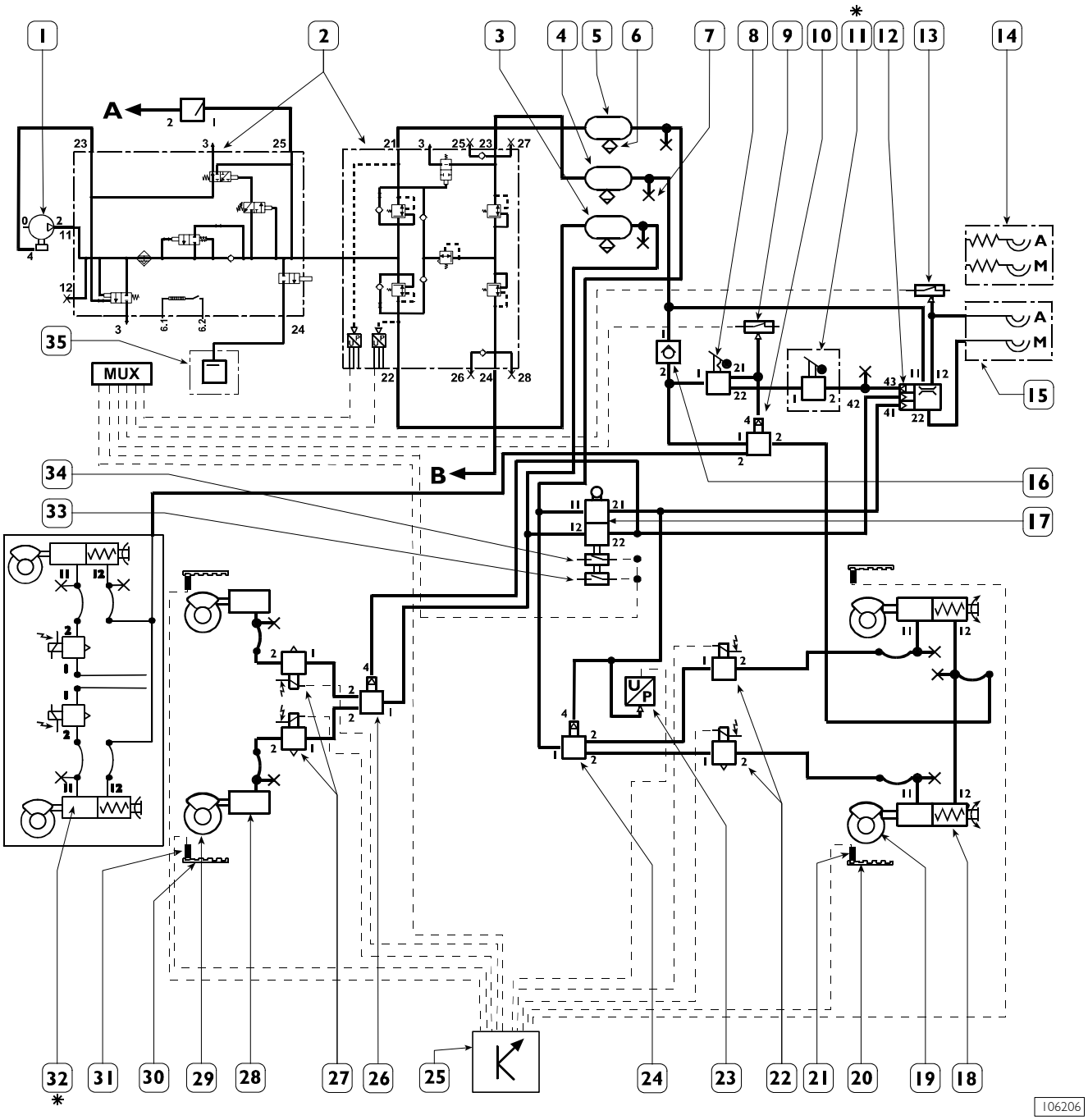


1. Twin cylinder compressor ES - 460 cc / 630 cc - 2. Air Processing Unit - 10.5 bar -
3. Front axle air tank - 20 l - Parking air tank - 20 l - 5. Rear axle air tank - 30 l -
6. Manual discharge valve - 7. Rear axle air tank - 20 l - 8. Air test point -
9. Parking manual control valve - 10. Handbrake low-pressure switch on - 6.4 bar -
11. Parking control relay valve - 12. Trailer slowing manual control valve -
13. Trailer braking servo control valve - 14. Trailer system low-pressure switch - 6.4 bar -
15. Trailer half-couplings for tractors - 16. Trailer half-couplings for trucks -
17. Parking system one-way valve - 18. Duplex control valve -
19. Rear axle combined cylinder - 20. Rear axle disk brake assembly -
21. Front axle combined cylinder - 22. Front axle disk brake assembly -
23. Rear axle phonic wheel - 24. Rear axle speed sensor - 25. Rear axle ABS solenoid valves -
26. EBL pressure sensor - 27. ABS electronic control unit - 28. Rear axle braking control relay valve -
29. Twin stop valve - 30. Pressure valve tested with no return for ASR - 7 bar -
31. Solenoid valve governing ASR - 32. Front axle braking control relay valve -
33. Front axle ABS solenoid valve - 34. Front axle diaphragm brake cylinder- 35. Front axle phonic wheel -
36. Front axle speed sensor - 37. Front axle disc brake assembly - 38. Brake light control microswitch -
39. EDC control unit microswitch - A. To the air suspension system -
B. To the services system - * Optional

BRAKING SCHEMES OF ABS - EBL SYSTEMS

Working diagram of ABS-EBL system for 4x2 vehicles (trucks and tractors)

Figure 28

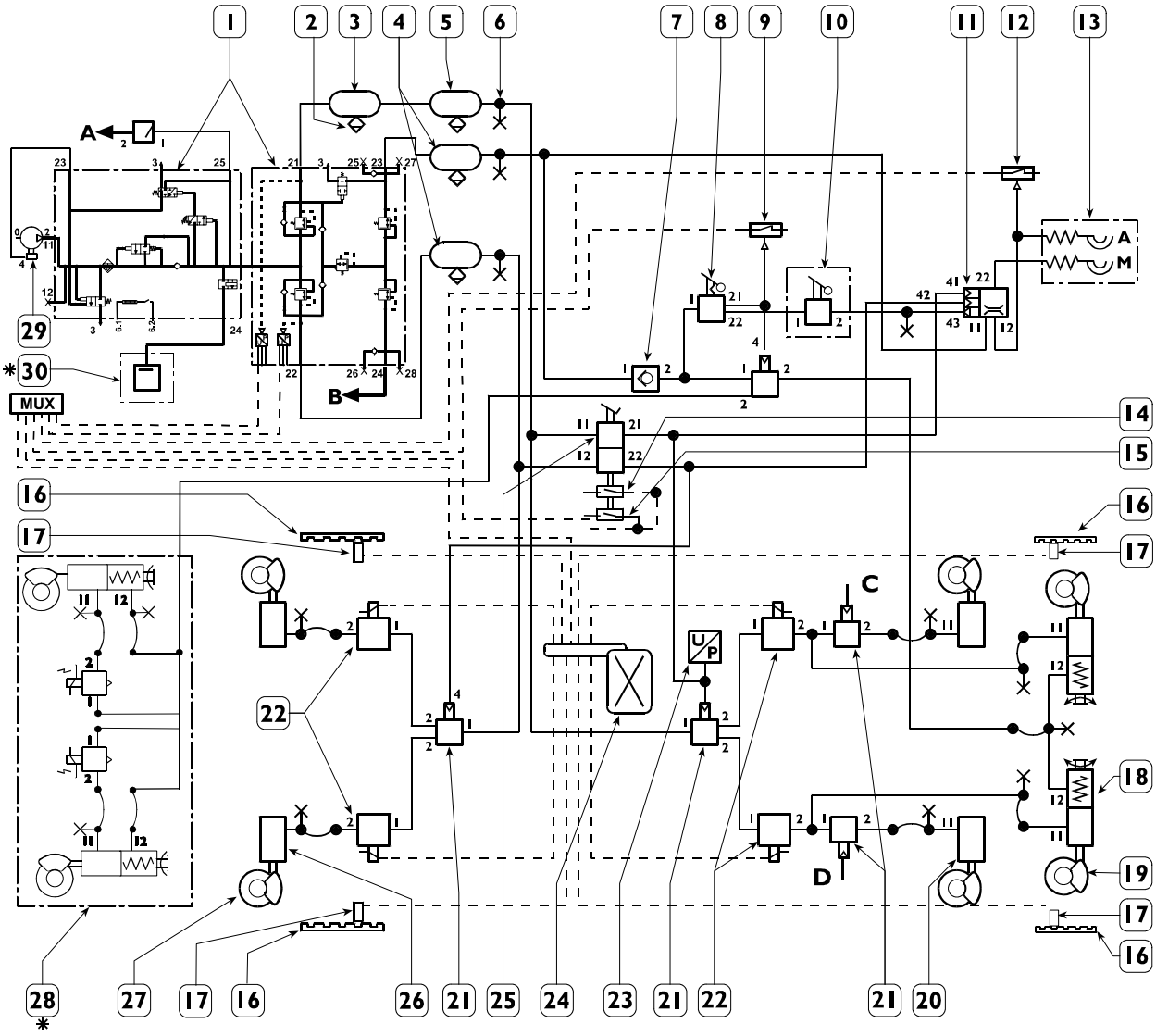


1. Compressor - 2. Air processing unit - 10.5 bars - 3. Front axle air tank - 20 l. - 4. Parking air tank - 20 l. - 5. Rear axle air tank - 30 l. - 6. Manual discharge valve - 7. Air test point - 8. Parking manual control valve - 9. Handbrake low pressure switch turned on – 6.4 bars - 10. Parking control relay valve - 11. Trailer slowing manual control valve - 12. Trailer brake servo control valve - 13. Trailer system low pressure switch – 6.4 bars - 14. Trailer half couplings for tractors - 15. Trailer coupling half joints for FP-CT trucks and tractors - 16. Parking system one-way valve - 17. Duplex control valve - 18. Rear axle combined cylinder - 19. Rear axle disk brake assembly (■) - 20. Rear axle phonic wheel - 21. Rear axle speed sensor - 22. Rear axle ABS solenoid valves - 23. EBL pressure sensor - 24. Rear axle brake control relay valve - 25. ABS electronic control unit - 26. Front axle brake control relay valve - 27. Front axle ABS solenoid valve - 28. Front axle diaphragm brake cylinder - 29. Front axle disc brake assembly - 30. Front axle phonic wheel - 31. Front axle speed sensor - 32. Front axle parking brake - 33. Brake light control microswitch - 34. Microswitch for EDC control unit - 35. 14 bar safety valve - A. To the air suspension system - B. To the service system - * Optional extra.

(■) On vehicles with rear axle HR, rear drum brakes are mounted.

Working diagram of ABS-EBL system for 6x2C vehicles (tractors)

Figure 29



1. A.P.U. unit - 2. Manual condensate bleeding valve - 3. 30-litre air reservoir - 4. 20 -litre air reservoir - 5. 15-litre air reservoir - 6. Pressure check socket - 7. Retaining valve - 8. Manual control distributor for parking brake - 9. Low pressure switch - 10. Manual control distributor for trailer brake (optional) - 11. Three-control servo-distributor - 12. Low pressure switch - 13. Half-coupling "ISO" - 14. Stop light control microswitch - 15. EDC control unit microswitch - 16. Phonic wheel - 17. Rev sensor - 18. Combined brake cylinder - 19. Disk brake assembly - 20. Membrane brake cylinder - 21. Relay valve - 22. ABS solenoid valve - 23. Pressure sensor - 24. Electronic control unit - 25. Duplex distributor - 26. Membrane cylinder - 27. Disc brake assembly - 28. Parking brake on front axle - 29. Compressor - 30. 14 bar safety valve - A. To air suspensions - B. To services - C. Right central axle suspension air spring - D. Right central axle suspension air spring

Working diagram of ABS-EBL system for 6x2p vehicles (trucks)

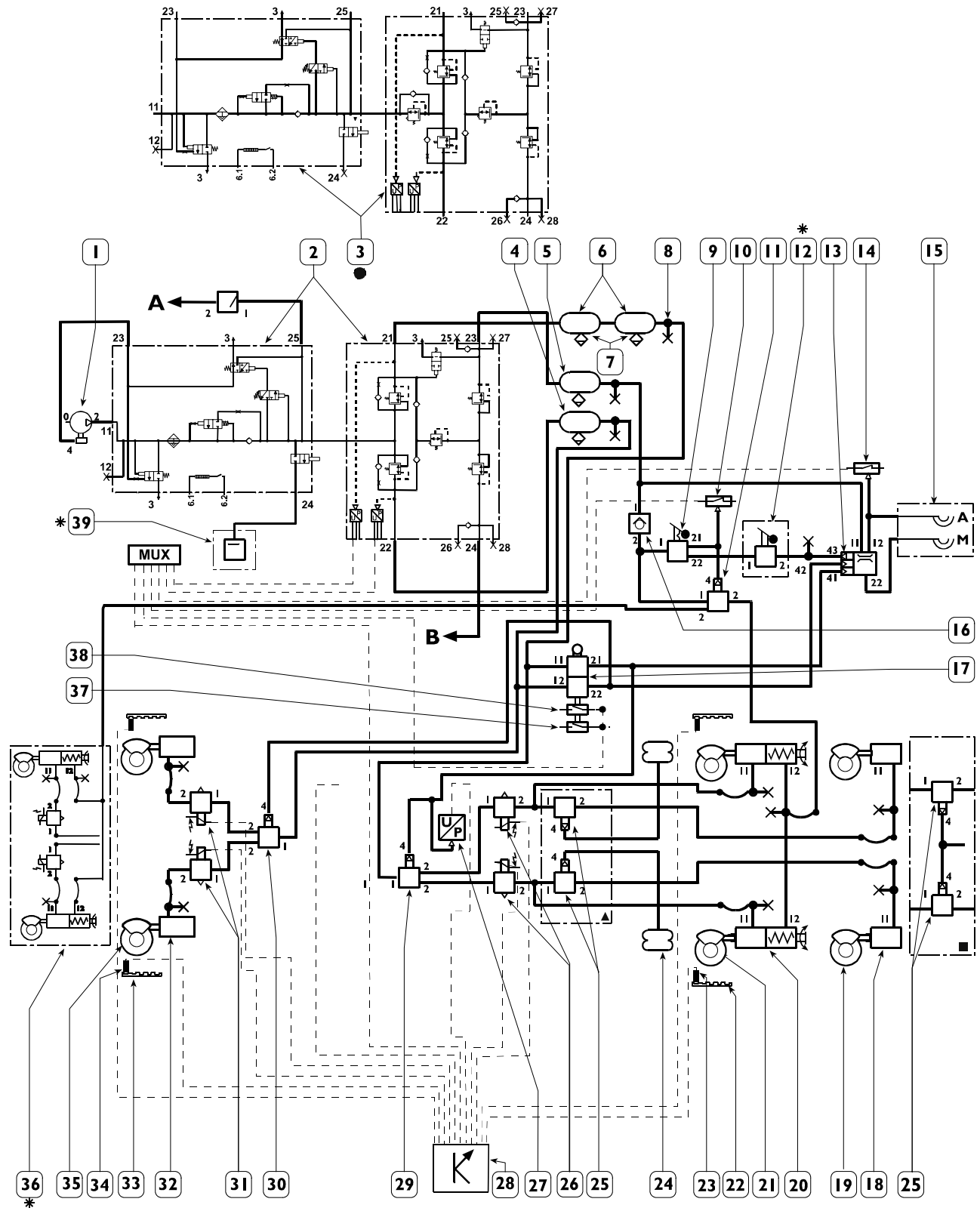
Legend

1. Compressor
2. Air processing unit - 10.5 bars
3. Air processing unit - 12.5 bars
4. Front axle air tank - 20 l.
5. Parking air tank - 20 l.
6. Rear axle air tank – 30 l. + 20 l.
7. Manual discharge valve
8. Air test point
9. Parking manual control valve
10. Handbrake low pressure switch turned on – 6.4 bars
11. Parking control relay valve
12. Trailer slowing manual control valve
13. Trailer brake servo control valve
14. Trailer system low pressure switch – 6.4 bars
15. Trailer half-couplings
16. Parking system one-way valve
17. Duplex control valve
18. Diaphragm cylinder
19. Additional axle disk brake assembly
20. Rear axle combined cylinder
21. Rear axle disk brake assembly
22. Rear axle phonic wheel
23. Rear axle speed sensor
24. Added axle suspension air springs
25. Load ratio relay valve for added axle braking
26. Rear axle ABS solenoid valves
27. EBL pressure sensor
28. ABS electronic control unit
29. Rear axle brake control relay valve
30. Front axle brake control relay valve
31. Front axle ABS solenoid valve
32. Front axle diaphragm brake cylinder
33. Front axle phonic wheel
34. Front axle speed sensor
35. Front axle disc brake assembly
36. Front axle parking brake
37. Brake light control microswitch
38. Microswitch for EDC control unit
39. 14 bar safety valve (optional)

A. To the air suspension system
B. To the service system
* Optional extra
• For CM vehicles only
■ Only for vehicles YTN
▲ Not including vehicles YTN

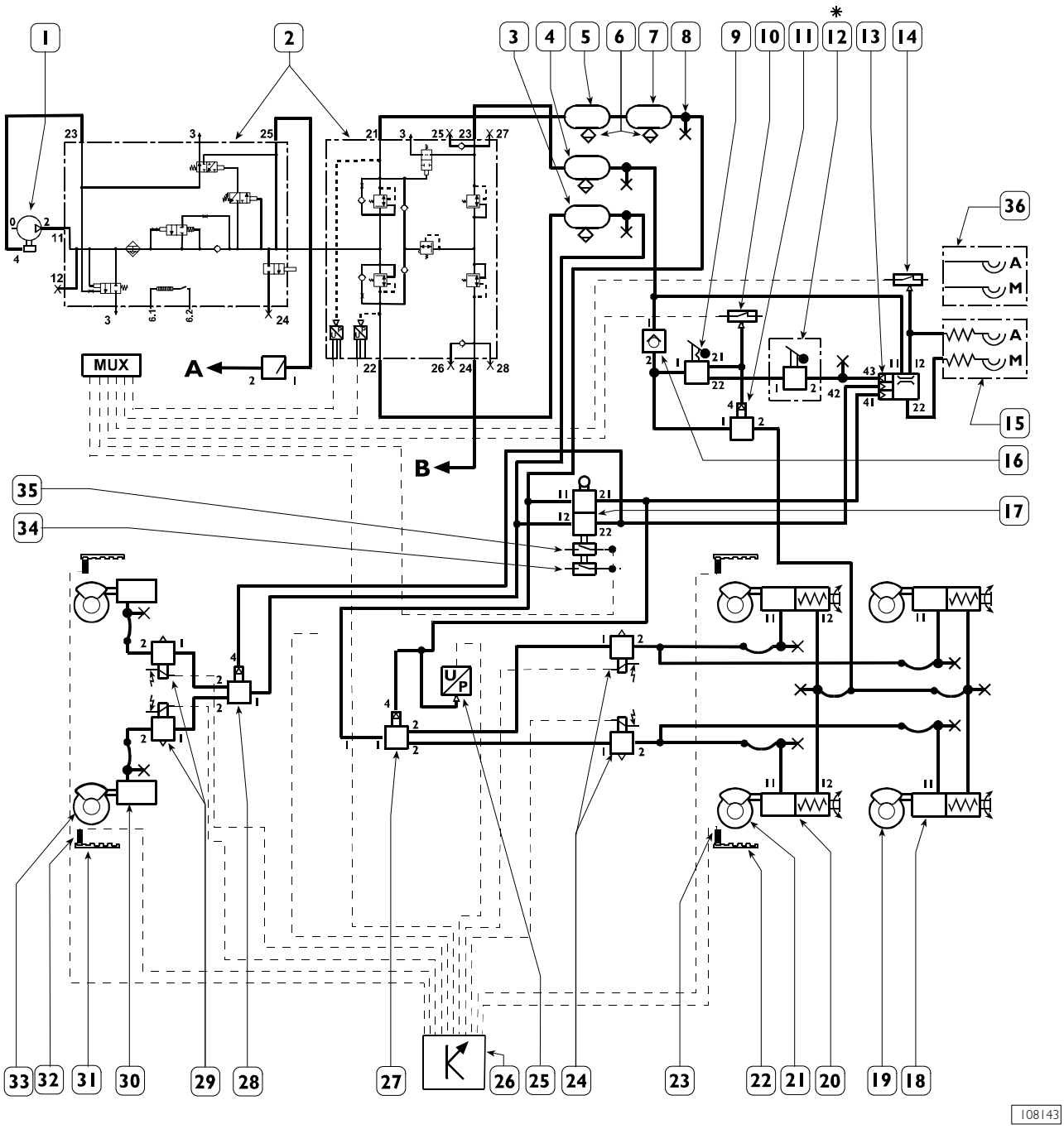
Working diagram of ABS-EBL system for 6x2p vehicles (trucks)

Figure 30



Working diagram of ABS-EBL system for 6x4 vehicles (trucks and tractors)

Figure 31



1. Compressor - 2. Air Processing Unit – 10.5 bar - 3. Front axle air tank – 20 l - 4. Parking air tank – 20 l - 5. Rear axle air tank – 30 l - 6. Manual exhaust valve - 7. Rear axle air tank - 20 l - 8. Pneumatic control drive - 9. Parking control manual distributor - 10. Low pressure switch for hand brake in – 6.4 bar - 11. Parking control relay valve - 12. Manual distributor for slowing down trailer - 13. Servo distributor to control trailer braking - 14. Trailer system low pressure switch – 6.4 bar - 15. Trailer half couplings for tractors - 16. Parking system single-acting valve - 17. Duplex distributor - 18. Combined rear axle cylinder - 19. Rear axle disk brake assembly - 20. Combined front axle cylinder - 21. Front axle disk brake assembly - 22. Rear axle phonic wheel - 23. Rear axle speed sensor - 24. Rear axle ABS solenoid valves - 25. EBL pressure sensor - 26. ABS electronic central unit - 27. Rear axle braking control relay valve - 28. . Front axle braking control relay valve - 29. Front axle ABS solenoid valve - 30. Front axle membrane brake cylinder - 31. Front axle phonic wheel - 32. Front axle speed sensor - 33. Front axle disk brake assembly - 34. Stop lights control micro switch - 35. EDC central unit micro switch - 36. Lorry trailer half couplings
A. To pneumatic suspension system - B. To services system - * Optional.

DESCRIPTION

Service braking

Pedal-operated, pneumatic, with electric control acting on all the wheels and on the trailer.

It is composed of two independent sections, one for activating the braking elements of the front axle, the other for activating the braking elements of the rear axle.

The division of the air system, if one section breaks down, permits the other to remain efficient.

Emergency braking

Emergency braking makes it possible to slow down the vehicle and stop it within a safety distance, even if the braking system has broken down.

It should be interpreted as a partial service brake that, thanks to the dual circuit, anyhow acts on one of the two axles.

Exhaust brake

The "exhaust brake" function is controlled by the EDC control unit that, depending on the required braking capacity, governs this function in combination with the EBS and Intarder systems (where applicable).

Parking brake

This comprises the pneumatic control of the manual control valve, a spring cylinder acting on the rear wheel brakes, locking them (on some versions the parking brake acts on the front brakes too).

In the event of the supply failing, this system automatically brakes the vehicle.

BRAKES

Front brakes are all of disk type, rear brakes vary depending on system type and can be of either disk or drum type.

Disc Brakes

For the disc brakes, the discs are keyed onto the wheel hubs and equipped with ventilation fins that permit lowering the high temperature generated under the braking action.
The brake linings are fitted with a wear indicator connected to an indicator light on the dashboard to signal brake lining wear.
The phonic wheels of the ABS device are keyed onto the wheel hubs.
The versions with disc brakes are equipped with:

- ❑ brake calipers type KNORR SN7;
- ❑ disc brakes Ø 432 x 45 mm.

Drum Brakes

For the drum brakes, each braking assembly is composed of a body housing the adjustment pins, control pins and wedge units. The wedge units are operated by the stem of the cylinders that in their turn are operated by compressed air.
The wedge unit rollers, as they travel, cause the control pins to expand that, overcoming the resistance of the shoe return springs, bring the shoes up to the drum to actuate braking. The adjustment and control pins are made integral with the brake body by two pins that fit into a side slot. When the braking action ends, there is no air pressure in the diaphragm section of the combined brake cylinders and so the action of the wedge unit return and shoe return springs take the wedge units back into the starting position.
The brake linings are fitted with a wear indicator.
The phonic wheels of the ABS device are keyed onto the wheel hubs.
The versions with drum brakes are the SIMPLEX type, model:

- ❑ ROCKWELL Ø 410 x 200 mm.

DIAGNOSTICS

Troubleshooting consists of two sections:

- stage one, organised by error code (DTC-FMI), concerns faults that may be directly recognised by the ABS-EBS control unit. These faults are mainly electrical - electronic - pneumatic in nature.
- the second, organised by symptom, describes possible faults not directly recognisable by the electronic control unit. These faults are mainly mechanical - pneumatic in nature.

SECTION 1

ABS-EBS system troubleshooting can be performed with the Cluster or with the diagnosis instruments Modus, IT 2000 and E.A.SY.

Diagnosis with the cluster makes it possible to estimate the situation of faults in the system in advance, while the diagnosis instruments are essential to perform thorough diagnosis and operate on the single faults correctly.

Each single instrument displays the diagnosis and repair help.

Diagnosis Instruments

MODUS (Maintenance and Diagnostic System)

A computerized fault-diagnosis station dedicated to diagnosing the brake systems, air suspensions, engines and systems controlled electronically.

The station is equipped with auxiliary functions, such as: programming electronic control units, consulting the spare parts catalogue and service time schedules.

The vehicle has a 30-pin diagnosis socket to interface with the instrument.

E.A.SY.

E.A.SY. system allows to simply make the diagnosis and programming of the various electronic central units aboard the vehicle.

E.A.SY. system is made up of ECI module communicating with the electronic central units and of a Panasonic PC.

ECI module, exploiting the Panasonic PC, also allows easy on the road interventions: in particular, thanks to Panasonic PC wireless technologies (e.g. GPRS), diagnostic interventions can be assisted by a remote expert centre.

IT 2000 (IVECO Electronic Tester)

This makes it possible to take immediate action on the vehicle, identifying it with the chassis number.

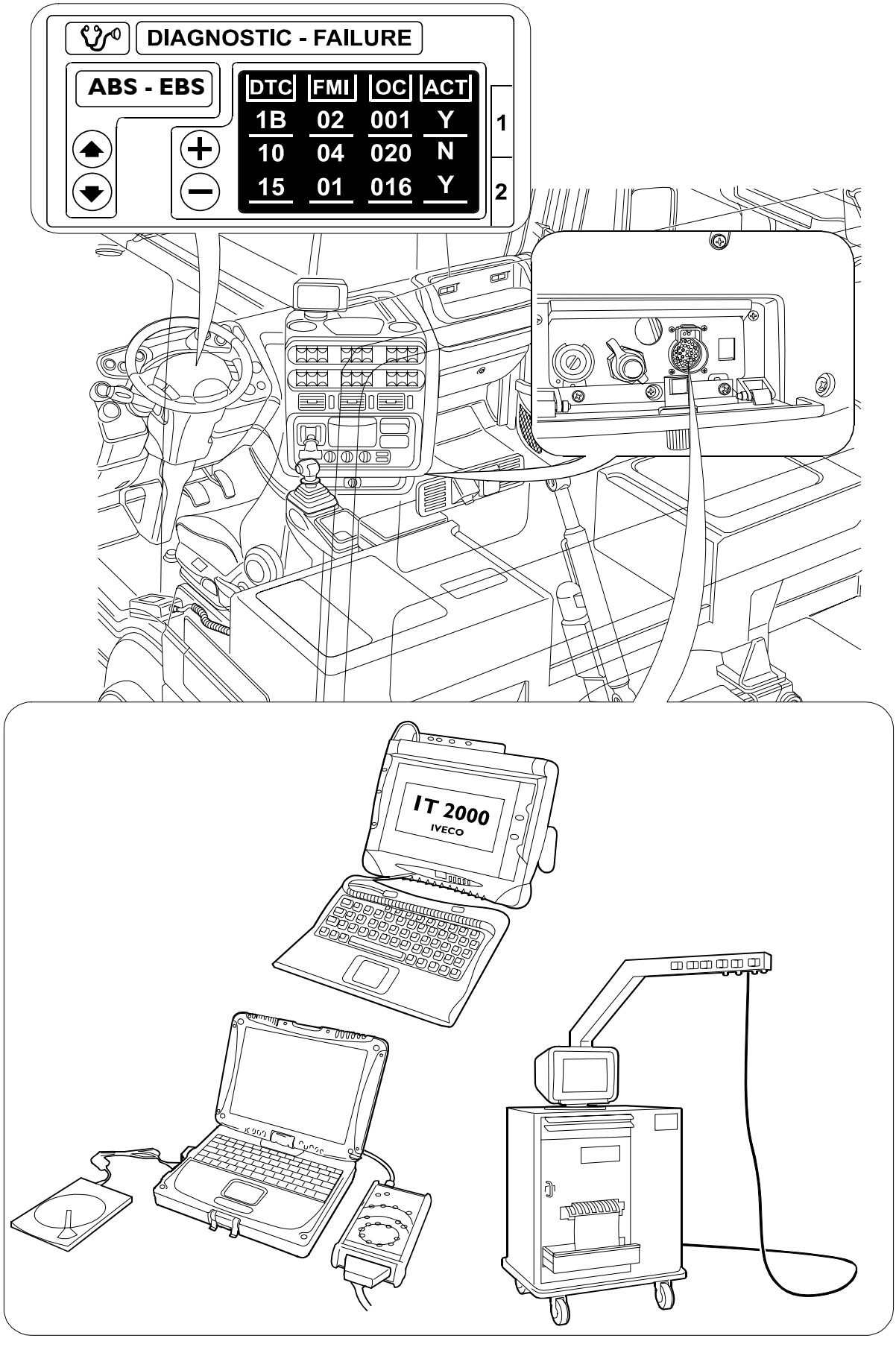
It saves the results of diagnostics actions performed.

It can be used as a portable Personal Computer, too, being fitted for remote diagnosis.

By using MODUS as the mother station it is possible to update and configure the IT 2000.

IT 2000 interfaces with the vehicle via a 30-pin diagnosis socket.

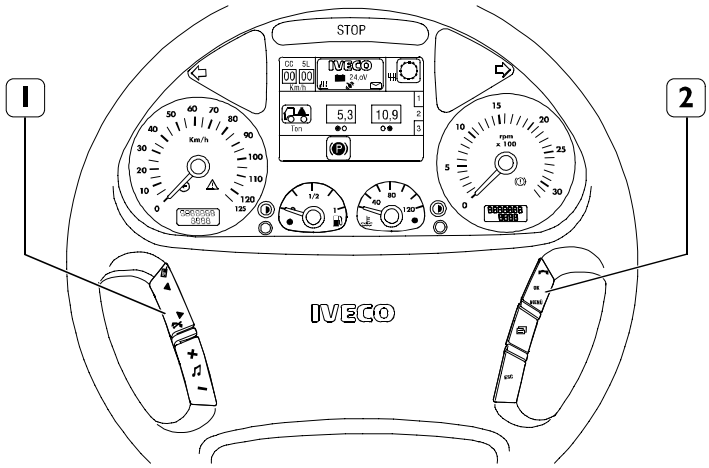
Figure 32


DIAGNOSTIC - FAILURE
ABS - EBS
DTC FMI OC ACT
1B 02 001 Y
10 04 020 N
15 01 016 Y
1
2
IT 2000
IVECO
106212

Cluster Diagnosis

It is possible to access the fault memory with the "menu" function key 2 on the steering wheel.

Figure 33



With the ignition key on MAR (+15), press the "menu" function key 2; the display will show a dialogue menu containing a list of the available functions (e.g., Hi-Fi, phone, diagnostics, etc.).

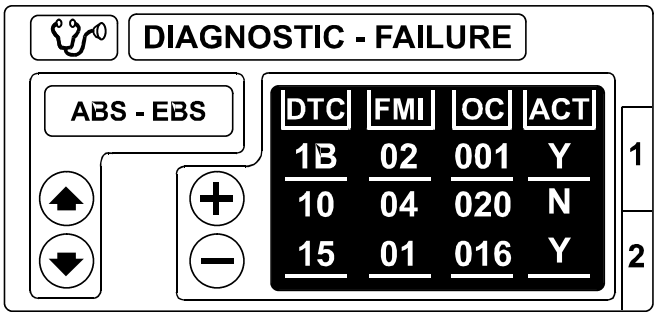
With the ▲ 1 and 1 ▼ function keys, select the diagnosis function and confirm the selection with the "OK" function key 2.

Select the ABS-EBS system with the select/confirm keys 1 and 2.

The cluster will display the first diagnostics screen.

After selecting the system, ABS-EBS is displayed on a red or green background depending on whether there is any trouble.

Figure 34

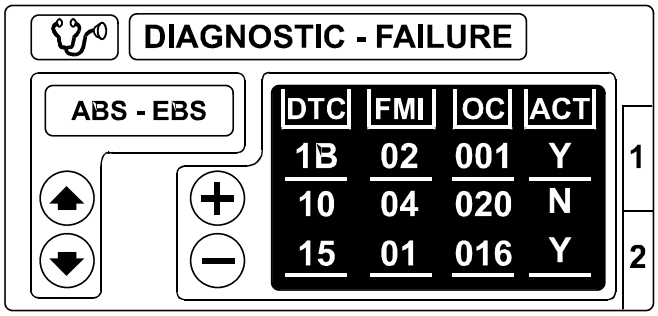


The diagnosis information shown on the cluster is split up on two screens:

- On the first one, it is possible to consult and scroll through all saved/present trouble.
- On the second one, it is possible to delete the intermittent errors (when you have the relevant password).

FIRST SCREEN

Figure 35



The information on the single faults is arranged on four columns with the following content:

DTC	FMI	OC	ACT
Displays the fault code number	Indicates the type of fault	Fault frequency meter	Fault active/not active status
Two digits (hexadecimal)	Two digits (hexadecimal)	Three digits (hexadecimal)	One character (Y = Yes, N = No)

Troubleshooting via DTC-FMI codes described under the relevant section completes the above information. Each pair of DTC-FMI codes is associated with a description of the fault, the possible system reaction and recommended repairs with the relevant checks.

SECOND SCREEN

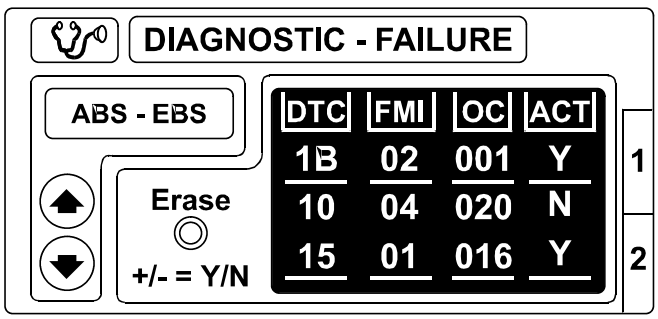
Deleting Errors

To select the second screen, press "page" on the steering wheel.
The fault display is eliminated as follows:

- ❑ Press "+", on the request to confirm deletion, press OK.
- ❑ Enter the required password (see the ENTERING PASSWORD paragraph).
- ❑ Press OK to confirm.

SECTION 2

Figure 36



Entering the Password

Figure 37

Select the first number of the password with the ▲ I and I ▼ keys.
Press OK to confirm each number.
Press ◀ to delete the last number selected.
On completing the password, select the key symbol to confirm.

Troubleshooting via DTC-FMI codes
EBS system

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
00	0B	ELEC-TRONIC CON-TROL UNIT	PRESENCE OF A COM-PONENT NOT PLAUSIBLE WITH THE ECU CON-FIGU-RATION		Presence of component which was not included in this configuration.	Check compatibility between vehicle system and E.C.U. configuration.				
01	01	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT LEFT SEN-SOR	EXCESSIVE AIR GAP	Incorrect braking of the LH front wheel. LH front wheel tends to block. Rear axle tends to skid.	LH front axle ABS disabled. ASR totally disabled.	Check and restore clearance between sensor and phonic wheel. Check: Restore clearance between sensor and phonic wheel. Measuring conditions: Connectors disconnected from control unit Key on MARCIA (START) Comparable values: 0,7 ± 0,05 mm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
01	03	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT LEFT SENSOR	SHORT CIRCUIT TO POSITIVE	Incorrect braking of the LH front wheel. LH front wheel tends to block. Rear axle tends to skid.	LH front axle ABS disabled. ASR totally disabled.	Check sensor wiring. Replace sensor if damaged. Check: Check isolation from + battery.	1- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 14 Measure point 2: Connector X1 Pin: 2 2- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 16 Measure point 2: Connector X1 Pin: 2 3- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 16 Measure point 2: Connector X1 Pin: 3 4- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 14 Measure point 2: Connector X1 Pin: 3 5- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 14 Measure point 2: Connector X1 Pin: 4 6- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 16 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON; 4- Connector Not connected; Key +15 ON; 5- Connector Not connected; Key +15 ON; 6- Connector Not connected; Key +15 ON;	1- Min. value: 500 KOhm; 2- Min. value: 500 KOhm; 3- Min. value: 500 KOhm; 4- Min. value: 500 KOhm; 5- Min. value: 500 KOhm; 6- Min. value: 500 KOhm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
01	04	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT LEFT SENSOR	SHORT CIRCUIT TO GROUND	Incorrect braking of the LH front wheel. LH front wheel tends to block. Rear axle tends to skid.	LH front axle ABS disabled. ASR totally disabled.	Check sensor wiring. Replace sensor if damaged. Check: Check isolation from - battery.	1- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 14 Measure point 2: Connector X1 Pin: 1 2- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 16 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 500 KOhm; 2- Min. value: 500 KOhm;	
01	05	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT LEFT SENSOR	OPEN CIRCUIT	Incorrect braking of the LH front wheel. LH front wheel tends to block. Rear axle tends to skid.	LH front axle ABS disabled. ASR totally disabled.	Check sensor wiring. Replace sensor if damaged.	Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 14 Measure point 2: Connection on both wiring harness sides Pin: 16	Connector Not connected; Key +15 OFF;	Min. value: 0.9 KOhm; Max. value: 2 KOhm;	
01	06	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT LEFT SENSOR	INTERNAL SHORT CIRCUIT	Incorrect braking of the LH front wheel. LH front wheel tends to block. Rear axle tends to skid.	LH front axle ABS disabled. ASR totally disabled.	Check sensor wiring. Replace sensor if damaged.	Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 14 Measure point 2: Connection on both wiring harness sides Pin: 16	Connector Not connected; Key +15 OFF;	Min. value: 0.9 KOhm; Max. value: 2 KOhm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
01	07	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT LEFT PHONIC WHEEL	MECHANICAL FAILURE	Incorrect braking of the LH front wheel. LH front wheel tends to block. Rear axle tends to skid.	LH front axle ABS disabled. ASR totally disabled.	Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm				
01	0B	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT LEFT SENSOR	IT IS NOT POSSIBLE TO DETECT THE FAULT	Incorrect braking of the LH front wheel. LH front wheel tends to block. Rear axle tends to skid.	LH front axle ABS disabled. ASR totally disabled.	Check speed sensor fastening. Check for any vibration of the complete wheel assembly. Check: Check the integrity of the LH front sensor fastening. Check the brake caliper assembly clearances and the LH front wheel side fastenings.				
01	0C	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT LEFT SENSOR	ECU INTERNAL COMPONENT FAULTY	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. C) No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled. C) Electronic control of the rear axle braking pressure disabled.	Check control unit configuration. Replace EBS (CBU) control unit. Check: Verify correct control unit configuration.				If the error persists to contact the help desk for the eventual substitution of the CBU.

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
01	0E	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT LEFT PHONIC WHEEL	WOBBLE	Incorrect braking of the LH front wheel. LH front wheel tends to block.	LH front axle ABS disabled. ASR totally disabled.	Check wobble of phonic wheel. Check bearing clearance.				
02	01	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT RIGHT SENSOR	EXCESSIVE AIR GAP	Incorrect braking of the RH front wheel. RH front wheel tends to block. Rear axle tends to skid.	RH front axle ABS disabled. ASR totally disabled.	Check and restore clearance between sensor and phonic wheel. Check: Restore clearance between sensor and phonic wheel. Measuring conditions: Connectors disconnected from control unit. Key on MARCIA (START). Comparable values: 0,7 ± 0,05 mm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
02	03	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT RIGHT SENSOR	SHORT CIRCUIT TO POSITIVE	Incorrect braking of the RH front wheel. RH front wheel tends to block. Rear axle tends to skid.	RH front axle ABS disabled. ASR totally disabled.	Check sensor wiring. Replace sensor if damaged. Check: Check isolation from + battery	1- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 10 Measure point 2: Connector X1 Pin: 2 2- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 12 Measure point 2: Connector X1 Pin: 2 3- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 12 Measure point 2: Connector X1 Pin: 3 4- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 10 Measure point 2: Connector X1 Pin: 3 5- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 10 Measure point 2: Connector X1 Pin: 4 6- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 12 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON; 4- Connector Not connected; Key +15 ON; 5- Connector Not connected; Key +15 ON; 6- Connector Not connected; Key +15 ON;	1- Min. value: 500 KOhm; 2- Min. value: 500 KOhm; 3- Min. value: 500 KOhm; 4- Min. value: 500 KOhm; 5- Min. value: 500 KOhm; 6- Min. value: 500 KOhm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
02	04	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT RIGHT SENSOR	SHORT CIRCUIT TO GROUND	Incorrect braking of the RH front wheel. RH front wheel tends to block. Rear axle tends to skid.	RH front axle ABS disabled. ASR totally disabled.	Check sensor wiring. Replace sensor if damaged. Check: Check isolation from - battery.	1- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 10 Measure point 2: Connector X1 Pin: 1 2- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 12 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 500 KOhm; 2- Min. value: 500 KOhm;	
02	05	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT RIGHT SENSOR	OPEN CIRCUIT	Incorrect braking of the RH front wheel. RH front wheel tends to block. Rear axle tends to skid.	RH front axle ABS disabled. ASR totally disabled.	Check sensor wiring. Replace sensor if damaged.	Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 10 Measure point 2:Connection on both wiring harness sides Pin: 12	Connector Not connected; Key +15 OFF;	Min. value: 0.9 KOhm; Max. value: 2 KOhm;	
02	06	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT RIGHT SENSOR	INTERNAL SHORT CIRCUIT	Incorrect braking of the RH front wheel. RH front wheel tends to block. Rear axle tends to skid.	RH front axle ABS disabled. ASR totally disabled.	Check sensor wiring. Replace sensor if damaged.	Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 10 Measure point 2: Connection on both wiring harness sides Pin: 12	Connector Not connected; Key +15 OFF;	Min. value: 0.9 KOhm; Max. value: 2 KOhm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
02	07	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT RIGHT PHONIC WHEEL	MECHANICAL FAILURE	Incorrect braking of the RH front wheel. RH front wheel tends to block. Rear axle tends to skid.	RH front axle ABS disabled. ASR totally disabled.	Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm				
02	0B	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT RIGHT SENSOR	IT IS NOT POSSIBLE TO DETECT THE FAULT	Incorrect braking of the RH front wheel. RH front wheel tends to block. Rear axle tends to skid.	RH front axle ABS disabled. ASR totally disabled.	Check speed sensor fastening. Check for any vibration of the complete wheel assembly. Check: Check the integrity of the RH front sensor fastening. Check the brake caliper assembly clearances and the RH front wheel side fastenings.				
02	0C	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT RIGHT SENSOR	ECU INTERNAL COMPONENT FAULTY	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. C) No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled. C) Electronic control of the rear axle braking pressure disabled.	Check control unit configuration. Replace EBS (CBU) control unit. Check: Verify correct control unit configuration.				If the error persists to contact the help desk for the eventual substitution of the CBU.

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
02	0E	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - FRONT RIGHT PHONIC WHEEL	WOBBLE	Incorrect braking of the RH front wheel. RH front wheel tends to block.	RH front axle ABS disabled. ASR totally disabled.	Check wobble of phonic wheel. Check bearing clearance.				
03	05	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - REAR LEFT SENSOR	OPEN CIRCUIT	Incorrect braking of the LH rear wheel. LH rear wheel tends to block. Rear axle tends to skid.	LH rear axle ABS disabled. ASR totally disabled.	Check sensor wiring. Replace sensor if damaged.	Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 1 Measure point 2 Connection on both wiring harness sides Pin: 2	Connector Not connected; Key +15 OFF;	Min. value: 0.9 KOhm; Max. value: 2 KOhm;	
03	06	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - REAR LEFT SENSOR	INTERNAL SHORT CIRCUIT	Incorrect braking of the LH rear wheel. LH rear wheel tends to block. Rear axle tends to skid.	LH rear axle ABS disabled. ASR totally disabled.	Check sensor wiring. Replace sensor if damaged.	Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 1 Measure point 2: Connection on both wiring harness sides Pin: 2	Connector Not connected; Key +15 OFF;	Min. value: 0.9 KOhm; Max. value: 2 KOhm;	
03	0B	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - REAR LEFT SENSOR	IT IS NOT POSSIBLE TO DETECT THE FAULT	Incorrect braking of the LH rear wheel. LH rear wheel tends to block. Rear axle tends to skid.	LH rear axle ABS disabled. ASR totally disabled.	Check speed sensor fastening. Check for any vibration of the complete wheel assembly.Check: Verify the integrity of the LH rear sensor fastening. Check the brake caliper assembly clearances and the LH rear wheel side fastenings.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
03	0C	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - REAR LEFT SENSOR	ECU INTERNAL COMPONENT FAULTY	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. C) No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled. C) Electronic control of the rear axle braking pressure disabled.	Check control unit configuration. Replace EBS (CBU) control unit. Check: Verify correct control unit configuration.				If the error persists to contact the help desk for the eventual substitution of the CBU.
03	0E	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - REAR LEFT PHONIC WHEEL	WOBBLE	Incorrect braking of the LH rear wheel. LH rear wheel tends to block.	LH rear axle ABS disabled. ASR totally disabled.	Check wobble of phonic wheel. Check bearing clearance.				
04	01	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - REAR RIGHT SENSOR	EXCESSIVE AIR GAP	Incorrect braking of the RH rear wheel. Rear axle tends to skid.	RH rear axle ABS disabled. ASR totally disabled.	Check and restore clearance between sensor and phonic wheel. Check: Restore clearance between sensor and phonic wheel. Measuring conditions: Connectors disconnected from control unit. Key on MARCIA (START). Comparable values: 0,7 ± 0,05 mm				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
04	03	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - REAR RIGHT SENSOR	SHORT CIRCUIT TO POS-ITIVE	Incorrect braking of the RH rear wheel. Rear axle tends to skid.	RH rear axle ABS disabled. ASR totally disabled.	Check sensor wiring. Replace sensor if damaged. Check: Check isolation from + battery pin rear axle electro-pneumatic modulator.	1- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 1 Measure point 2:Connector 61 Pin: 1 2- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 2 Measure point 2 Connector 61 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON;	1- Min. value: 500 KOhm; 2- Min. value: 500 KOhm;	
04	04	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - REAR RIGHT SENSOR	SHORT CIRCUIT TO GROUND	Incorrect braking of the RH rear wheel. Rear axle tends to skid.	RH rear axle ABS disabled. ASR totally disabled.	Check sensor wiring. Replace sensor if damaged. Check: Check isolation from - battery pin rear axle electro-pneumatic modulator.	1- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 1 Measure point 2 Connector 61 Pin: 2 2- Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 2 Measure point 2: Connector 61 Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 500 KOhm; 2- Min. value: 500 KOhm;	
04	05	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - REAR RIGHT SENSOR	OPEN CIR-CUIT	Incorrect braking of the RH rear wheel. Rear axle tends to skid.	RH rear axle ABS disabled. ASR totally disabled.	Check sensor wiring. Replace sensor if damaged.	Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 1 Measure point 2: Connection on both wiring harness sides Pin: 2	Connector Not connected; Key +15 OFF;	Min. value: 0.9 KOhm; Max. value: 2 KOhm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
04	06	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - REAR RIGHT SENSOR	INTERNAL SHORT CIRCUIT	Incorrect braking of the RH rear wheel. Rear axle tends to skid.	RH rear axle ABS disabled. ASR totally disabled.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	Measure type: Resistance (KOhm) Measure point 1: Connection on both wiring harness sides Pin: 1 Measure point 2: Connection on both wiring harness sides Pin: 2	Connector Not connected; Key +15 OFF;	Min. value: 0.9 KOhm; Max. value: 2 KOhm;	
04	07	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - REAR RIGHT PHONIC WHEEL	MECHANICAL FAILURE	Incorrect braking of the RH rear wheel. Rear axle tends to skid.	RH rear axle ABS disabled. ASR totally disabled.	Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm				
04	0B	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - REAR RIGHT SENSOR	IT IS NOT POSSIBLE TO DETECT THE FAULT	Incorrect braking of the RH rear wheel. Rear axle tends to skid.	RH rear axle ABS disabled. ASR totally disabled.	Check speed sensor fastening. Check for any vibration of the complete wheel assembly. Check: Verify the integrity of the RH rear sensor fastening. Check the brake caliper assembly clearances and the RH rear wheel side fastenings.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
04	0C	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - REAR RIGHT SENSOR	ECU INTERNAL COMPONENT FAULTY	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. C) No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled. C) Electronic control of the rear axle braking pressure disabled.	Check control unit configuration. Replace EBS (CBU) control unit. Check: Verify correct control unit configuration.				If the error persists to contact the help desk for the eventual substitution of the CBU.
04	0E	SPEED SENSORS OFF WHEEL / PHONIC WHEELS - REAR RIGHT PHONIC WHEEL	WOBBLE	Incorrect braking of the RH rear wheel. RH rear wheel tends to block.	RH rear axle ABS disabled. ASR totally disabled.	Check wobble of phonic wheel. Check bearing clearance.				
07	03	ABS ELECTRO-VALVES - FRONT LEFT	SHORT CIRCUIT TO POSITIVE	Front axle wheels tend to lock.	RH/LH front axle ABS disabled.	Check connector wiring and components.	1- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 9 Measure point 2 Connector X2 Pin: 15 2- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X2 Pin: 15	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON;	1- Max. value: 1 V; 2- Max. value: 1 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
07	05	ABS ELECTRO-VALVES - FRONT LEFT	OPEN CIRCUIT	LH front wheel tends to block.	LH front axle ABS disabled.	Check connector wiring and components.	1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 9 Measure point 2:Connector X2 Pin: 15 2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X2 Pin: 15	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 14 Ohm; Max. value: 21 Ohm; 2- Min. value: 14 Ohm; Max. value: 21 Ohm;	
07	06	ABS ELECTRO-VALVES - FRONT LEFT	SHORT CIRCUIT TO GROUND	LH front wheel tends to block.	LH front axle ABS disabled.	Check connector wiring and components.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 9 Measure point 2: Connector X2 Pin: 15 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X2 Pin: 15	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 500 KOhm; 2- Min. value: 500 KOhm;	
07	0E	ABS ELECTRO-VALVES - FRONT LEFT	ALWAYS ON			Before replacing the E.C.U. execute some operations directly on the electric valve connector:	1- Measure type: Voltage (V) Measure point 1: Solenoid valve connector Pin: 3 Measure point 2: Solenoid valve connector Pin: 2 2- Measure type: Voltage (V) Measure point 1: Solenoid valve connector Pin: 1 Measure point 2 Solenoid valve connector Pin: 2	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON;	1- Max. value: 24 V; 2- Max. value: 24 V;	Check wiring. After that, replace the ECU.

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
07	0E	ABS ELECTRO-VALVES - FRONT LEFT	ALWAYS ON	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled.	Before replacing the E.C.U., execute some operations directly on the E.C.U.	1- Measure type: Voltage (V) Measure point 1: X2 connector - ECU Pin: 9 Measure point 2: X2 connector - ECU Pin: 15 2- Measure type: Voltage (V) Measure point 1: X2 connector - ECU Pin: 11 Measure point 2: X2 connector - ECU Pin: 15	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON;	1- Max. value: 1 V; 2- Max. value: 1 V;	
08	03	ABS ELECTRO-VALVES - FRONT RIGHT	SHORT CIRCUIT TO POSITIVE	Front axle wheels tend to lock.	RH/LH front axle ABS disabled.	Check connector wiring and components.	1- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 5 Measure point 2: Connector X2 Pin: 13 2- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 7 Measure point 2: Connector X2 Pin: 13	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON;	1- Max. value: 1 V; 2- Max. value: 1 V;	
08	05	ABS ELECTRO-VALVES - FRONT RIGHT	OPEN CIRCUIT	RH front wheel tends to block.	RH front axle ABS disabled.	Check connector wiring and components.	1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 5 Measure point 2: Connector X2 Pin: 13 2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 7 Measure point 2: Connector X2 Pin: 13	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 14 Ohm; Max. value: 21 Ohm; 2- Min. value: 14 Ohm; Max. value: 21 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
08	06	ABS ELECTRO-VALVES - FRONT RIGHT	SHORT CIRCUIT TO GROUND	RH front wheel tends to block.	RH front axle ABS disabled.	Check connector wiring and components.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 5 Measure point 2:Connector X2 Pin: 13 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 7 Measure point 2:Connector X2 Pin: 13	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 500 KOhm; 2- Min. value: 500 KOhm;	
08	0E	ABS ELECTRO-VALVES - FRONT RIGHT	ALWAYS ON	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled.	Before replacing the E.C.U., execute some operations directly on the E.C.U.	1- Measure type: Voltage (V) Measure point 1: X2 connector - ECU Pin: 5 Measure point 2: X2 connector - ECU Pin: 13 2- Measure type: Voltage (V) Measure point 1: X2 connector - ECU Pin: 7 Measure point 2 X2 connector - ECU Pin: 13	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON;	1- Max. value: 24 V; 2- Max. value: 24 V;	1-2
08	0E	ABS ELECTRO-VALVES - FRONT RIGHT	ALWAYS ON			Before replacing the E.C.U. execute some operations directly on the electric valve connector:	1- Measure type: Voltage (V) Measure point 1: Solenoid valve connector Pin: 3 Measure point 2 Solenoid valve connector Pin: 2 2- Measure type: Voltage (V) Measure point 1: Solenoid valve connector Pin: 1 Measure point 2: Solenoid valve connector Pin: 2	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON;	1- Max. value: 24 V; 2- Max. value: 24 V;	3-4

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
08	0E	ABS ELECTRO-VALVES - FRONT RIGHT	ALWAYS ON			Check wiring and after that, replace the ECU.				
0D	03	RELAY - THIRD BRAKE RELAY	SHORT CIRCUIT TO POSITIVE	Yellow warning light comes on.	No functional trouble.	Check connector wiring and components. Check: Check isolation from + battery.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X1 Pin: 17 Measure point 2: Connector X1 Pin: 2 2- Measure type: Resistance (KOhm) Measure point 1: Connector X1 Pin: 17 Measure point 2: Connector X1 Pin: 3 3- Measure type: Resistance (KOhm) Measure point 1: Connector X1 Pin: 17 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 500 KOhm; 2- Min. value: 500 KOhm; 3- Min. value: 500 KOhm;	Only vehicles with Retarder that cannot be configured
0D	05	RELAY - THIRD BRAKE RELAY	OPEN CIRCUIT	Yellow warning light comes on.	No functional trouble.	Check correct electronic control unit configuration. Check the integrity of the wiring, connectors and component. Check: Check continuity between pins 17/X1 and relay.	1- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 17 Measure point 2: Relay Pin: 85 2- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 17 Measure point 2: Relay Pin: 86	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 0 Ohm; Max. value: 5 Ohm; 2- Min. value: 200 Ohm; Max. value: 350 Ohm;	Only vehicles with Retarder that cannot be configured

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
0D	06	RELAY - THIRD BRAKE RELAY	SHORT CIRCUIT TO GROUND	Yellow warning light comes on.	No functional trouble.	Check connector wiring and components. Check: Check isolation from - battery.	Measure type: Resistance (KOhm) Measure point 1: Connector X1 Pin: 17 Measure point 2: Connector X1 Pin: 1	Connector Not connected; Key +15 OFF;	Min. value: 500 KOhm;	Only vehicles with Retarder that cannot be configured
0D	0D	RELAY - THIRD BRAKE RELAY	CONFIGURATION PARAMETERS NOT CORRECT	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. C) No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled. C) Electronic control of the rear axle braking pressure disabled.	Check correct configuration and electronic control unit connections. Check: Program electronic control unit correctly.				Only vehicles with Retarder that cannot be configured
0E	03	ELECTRONIC CONTROL UNIT - INTERNAL RELAY TO CONTROL EBS ELECTROVALVES GROUND	SHORT CIRCUIT TO POSITIVE	Front axle wheels tend to lock.	RH/LH front axle ABS disabled.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
0E	06	ELEC-TRONIC CON-TROL UNIT - IN-TERNAL RELAY TO CON-TROL EBS ELECTRO-VALVES GROUND	INTERNAL SHORT CIRCUIT	Yellow warning light comes on.	No functional trouble.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
16	02	SPEED SIGNAL TO TA-CHO-GRAPH	INTERMIT-TENT OR NOT CORRECT SIGNAL FOR THE SENSOR			Check CAN line. Check tachograph cor-rect programmino.				
16	09	SPEED SIGNAL TO TA-CHO-GRAPH	NOT CORRECT REFRESH FREQUEN-CY FOR CAN LINE DATA			Check CAN line. Check tachograph cor-rect programmino.				
16	0D	SPEED SIGNAL TO TA-CHO-GRAPH	CONFIGU-RATION PARAME-TERS NOT CORRECT			Check CAN line. Check tachograph cor-rect programmino.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
37	05	DUPLEX DISTRIBUTOR - BRAKE PEDAL 2 SIGNAL	OPEN CIRCUIT	Yellow warning light comes on.	No functional trouble.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
37	06	DUPLEX DISTRIBUTOR - BRAKE PEDAL 2 SIGNAL	SHORT CIRCUIT TO GROUND	Yellow warning light comes on.	No functional trouble.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
38	05	DUPLEX DISTRIBUTOR - BRAKE PEDAL 1 SIGNAL	OPEN CIRCUIT	Yellow warning light comes on.	No functional trouble.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
38	06	DUPLEX DISTRIBUTOR - BRAKE PEDAL 1 SIGNAL	SHORT CIRCUIT TO GROUND	Yellow warning light comes on. Brake lights constantly on.	No functional trouble.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
39	03	PROPORTIONAL VALVE RELAY - ELECTROVALVE	SHORT CIRCUIT TO POSITIVE	Front axle slowing delayed and not optimized.	Electronic control of the front axle pressure disabled.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
39	05	PROPORTIONAL VALVE RELAY - ELECTROVALVE	OPEN CIRCUIT	Front axle slowing delayed and not optimized.	Electronic control of the front axle pressure disabled.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
39	06	PROPORTIONAL VALVE RELAY - ELECTRO-VALVE	SHORT CIRCUIT TO GROUND	Front axle slowing delayed and not optimized.	Electronic control of the front axle pressure disabled.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
39	07	PROPORTIONAL VALVE RELAY	MECHANICAL FAILURE	Front axle slowing delayed and not optimized.	Electronic control of the front axle pressure disabled.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
39	0B	PROPORTIONAL VALVE RELAY	IT IS NOT POSSIBLE TO DETECT THE FAULT	Front axle slowing delayed and not optimized.	Electronic control of the front axle pressure disabled.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
39	0E	PROPORTIONAL VALVE RELAY - ELECTROVALVE	ALWAYS ON	The vehicle remains braked on the front axle.	No functional trouble.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3A	03	SAFETY ELECTRO-VALVE FOR THE FRONT AXLE	SHORT CIRCUIT TO POS-ITIVE			Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
3A	04	SAFETY ELECTRO-VALVE FOR THE FRONT AXLE	SHORT CIRCUIT TO GROUND			Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3A	05	SAFETY ELECTRO-VALVE FOR THE FRONT AXLE	OPEN CIR-CUIT			Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
3A	07	SAFETY ELECTRO-VALVE FOR THE FRONT AXLE	MECHANI-CAL FAIL-URE			Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3A	0E	SAFETY ELECTRO-VALVE FOR THE FRONT AXLE	ALWAYS ON			Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
3B	03	PROPORTIONAL VALVE RELAY - PRESSURE SENSOR	SHORT CIRCUIT TO POSITIVE	Front axle slowing delayed and not optimized.	Electronic control of the front axle pressure deteriorated.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3B	04	PROPORTIONAL VALVE RELAY - PRESSURE SENSOR	OPEN CIRCUIT OR SHORT CIRCUIT TO GROUND	Front axle slowing delayed and not optimized.	Electronic control of the front axle pressure deteriorated.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
3C	02	CAN LINE -COMUNICATION WITH ELECTROPNEUMATIC REAR AXLE MODULATOR	INCORRECT OR INTERMITTENT DATA	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. C) No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled. C) Electronic control of rear axle braking pressure disabled.	Check control and supply pressure. Replace rear axle electropneumatic modulator. Check: A) Check component supply pressures at connections 11 - 12. B) Check outlet pressure connections 21 - 22. Measuring conditions: A) Vehicle stationary system at governor rating. B) Vehicle stationary system at rating with governor pedal pressed fully down. Comparable values: Max 10,5 bar				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3C	07	ELECTRO-PNEU-MATIC REAR AXLE MOD-ULATOR	MECHANI-CAL FAIL-URE	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no en-gine limitation. B) No rear axle braking.	A) ABS/ASR to-tally disabled. B) Electronic control of rear axle braking pressure dis-abled.	Check supply pressure, integrity of control / supply pipes and rear axle electro-pneumatic modulator operation. Check: A) Check component supply pressures at connections 11 - 12. B) Check outlet pres-sure connections 21 - 22. Measuring conditions: A) Vehicle stationary system at governor rating. B) Vehicle stationary system at rating with governor pedal pressed fully down. Comparable values: Max 10.5 bar				
3C	09	CAN LINE -COM-UNICA-TION WITH ELECTRO-PNEU-MATIC REAR AXLE MOD-ULATOR	UPDATE SPEED NOT CORRECT	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no en-gine limitation. B) No rear axle braking.	A) ABS/ASR to-tally disabled. B) Electronic control of rear axle braking pressure dis-abled.	Check the integrity of the wiring, connectors and CAN line opera-tion between rear axle modulator and elec-tronic control unit. Check: Check continuity.	1- Measure type: Re-sistance (Ohm) Mea-sure point 1: Connec-tor X3 Pin: 11 Mea-sure point 2: Connec-tor X3 Pin: 15 2- Measure type: Resist-ance (Ohm) Measure point 1: Connector 61 Pin: 3 Measure point 2: Connector 61 Pin: 4	1- Connector Connected; Key +15 OFF; 2- Connector Connected; Key +15 OFF;	1- Typical Val-ue: 60 Ohm; 2- Typical Value: 60 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3C	0A	CAN LINE -COM-UNICA-TION WITH ELECTRO-PNEU-MATIC REAR AXLE MOD-ULATOR	CHANGE SPEED NOT CORRECT			Check the integrity of the wiring, connectors and CAN line operation between rear axle modulator and electronic control unit. Check: Check continuity.	1- Measure type: Resistance (Ohm) Measure point 1: Connector X3 Pin: 11 Measure point 2: Connector X3 Pin: 15 2- Measure type: Resistance (Ohm) Measure point 1: Connector 61 Pin: 3 Measure point 2: Connector 61 Pin: 4	1- Connector Connected; Key +15 OFF; 2- Connector Connected; Key +15 OFF;	1- Typical Value: 60 Ohm; 2- Typical Value: 60 Ohm;	
3C	0B	ELECTRO-PNEU-MATIC REAR AXLE MOD-ULATOR	IT IS NOT POSSIBLE TO DE-TECT THE FAULT	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. C) No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled. C) Electronic control of trailer and rear axle braking pressure disabled.	Check correct electric power supply. Replace rear axle electropneumatic modulator. Check: Check correct power supply.	Measure type: Voltage (V) Measure point 1: Connector 61 Pin: 1 Measure point 2: Connector 61 Pin: 2	Connector Connected; Key +15 ON;	Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
3C	0C	ELECTRO-PNEU-MATIC REAR AXLE MOD-ULATOR	TOTAL FAILURE	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of rear axle braking pressure disabled.	Check correct electric power supply. Replace rear axle electropneumatic modulator. Check: Check correct power supply.	Measure type: Voltage (V) Measure point 1: Connector 61 Pin: 1 Measure point 2: Connector 61 Pin: 2	Connector Connected; Key +15 ON;	Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3C	0D	ELECTRO-PNEU-MATIC REAR AXLE MOD-ULATOR	CONFIGU-RATION PARAME-TERS NOT CORRECT	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. C) No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled. C) Electronic control of the rear axle braking pressure disabled.	Check correct electronic control unit configuration. Replace rear axle electropneumatic modulator. Check: Verify correct EBS control unit configuration.				
3C	0E	ELECTRO-PNEU-MATIC REAR AXLE MOD-ULATOR	SUPPLY VOLTAGE	Yellow warning light comes on.	No functional trouble.	Check correct electric power supply of the component.	Measure type: Voltage (V) Measure point 1: Connector 61 Pin: 1 Measure point 2: Connector 61 Pin: 2	Connector Connected; Key +15 ON;	Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3C	0F	ELECTRO-PNEU-MATIC REAR AXLE MOD-ULATOR	INTERNAL FAULT	Electronic regulation of pressure on rear axle and for trailer de-activated. ABS / ASR completely de-activated. ESP de-activated.	Late and non optimum braking of the trailer. Late and non optimum braking of the driving axle (trucks). Missing braking of driving axle (tractors). Blocking of the front and/or rear wheels. Skidding of driving axle and missing engine limitation. Missing stability control.	Check correct electric power supply. Replace rear axle electropneumatic modulator. Check: Check correct power supply.	Measure type: Voltage (V) Measure point 1: Connector 61 Pin: 1 Measure point 2: Connector 61 Pin: 2	Connector Connected; Key +15 ON;	Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
3D	00	SAFETY ELECTRO-VALVE FOR REAR AXLE	SIGNAL OUT OF RANGE	Front axle wheels tend to lock.	RH/LH front axle ABS disabled.	Check back-up valve and rear axle electropneumatic modulator work properly. Check: A) Check continuity.	Measure type: Resistance (Ohm) Measure point 1: Connector X3 Pin: 12 Measure point 2: Connector X3 Pin: 14	Connector Not connected; Key +15 OFF;	Min. value: 55 Ohm; Max. value: 90 Ohm;	
3D	00	SAFETY ELECTRO-VALVE FOR REAR AXLE	SIGNAL OUT OF RANGE	Front axle wheels tend to lock.	RH/LH front axle ABS disabled.	Check back-up valve and rear axle electropneumatic modulator work properly. Check: B) Check correct power supply.	Measure type: Voltage (V) Measure point 1: Connector 61 Pin: 1 Measure point 2: Connector 61 Pin: 2	Connector Connected; Key +15 ON;	Min. value: 22 V; Max. value: 28 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3D	03	SAFETY ELECTRO-VALVE FOR REAR AXLE	SHORT CIRCUIT TO POS-ITIVE	Front axle wheels tend to lock.	RH/LH front axle ABS dis-abled.	Check connector wir-ing and components. Check: Check isolation from + battery.	Measure type: Volt-age (V) Measure point 1: Connector X3 Pin: 14 Measure point 2: Connector X1 Pin: 1	Connector Not connected; Key +15 ON;	Max. value: 1 V;	
3D	05	SAFETY ELECTRO-VALVE FOR REAR AXLE	OPEN CIR-CUIT	A) Front and/or rear axle wheels tend to lock. B) Rear axle wheels skid and no engine limita-tion.	ABS/ASR totally disabled.	A) Check correct elec-tronic control unit configuration. B) Check the integrity of the wiring, connec-tors and component. Check: A) Check correct EBS (CBU) control unit configuration. B) Check continuity between pins (14/X3 - 12/X3). Measuring conditions: Connectors discon-nected from control unit Key on STOP.				
3D	06	SAFETY ELECTRO-VALVE FOR REAR AXLE	SHORT CIRCUIT TO GROUND	No rear axle braking.	Electronic con-trol of rear axle braking pressure disabled.	Check connector wir-ing and components. Check: Check isolation from - battery.	Measure type: Resist-ance (KOhm) Mea-sure point 1: Connec-tor X3 Pin: 14 Measure point 2: Connector X1 Pin: 1	Connector Not connected; Key +15 OFF;	Min. value: 500 KOhm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3D	07	SAFETY ELECTRO-VALVE FOR REAR AXLE	MECHANI-CAL FAIL-URE	No functional trouble.	Yellow warning light comes on.	Check the supply pressure of the axle-modulator (insufficient ?). Check the pneumatic supply lines of the axle-modulator (blocked ? kinked ?). Check the pneumatic brake lines of the axle-modulator (broken ? leaky ?). Check the backup relay valve and the pneumatic lines. Is the supply monitoring (RA) correct ? Replace the axle-modulator.				
3D	0D	SAFETY ELECTRO-VALVE FOR REAR AXLE	CONFIGU-RATION PARAME-TERS NOT CORRECT	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. C) No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled. C) Electronic control of the rear axle braking pressure disabled.	Check correct configuration and electronic control unit connections. Check: A) Verify correct EBS (CBU) control unit configuration. B) Check correct connection to pins 14/X3 - 12/X3.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3E	02	ELECTRO-PNEU-MATIC REAR AXLE MOD-ULATOR - PRESSURE SENSOR	SIGNAL FAULT	Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limita-tion.	ABS/ASR totally disabled.	Check integrity of con-trol / supply pipes and rear axle electro-pneu-matic modulator op-eration. Check: Check component supply pressures at connections 11 - 12. Check outlet pressure connections 21 - 22. Measuring conditions: Vehicle stationary sys-tem at governor rating. Vehicle stationary sys-tem at rating with gov-ernor pedal pressed fully down. Comparable values: Max 10.5 bar				
42	03	TRAILER CON-TROL SERVO-DISTRIBU-TOR - ELECTRO-VALVE	SHORT CIRCUIT TO POS-ITIVE	Trailer slowing delayed and not optimized.	Electronic con-trol of trailer braking pressure disabled.	Check connector wir-ing and components.	1- Measure type: Voltage (V) Mea-sure point 1: Connec-tor 68 Pin: 4 Mea-sure point 2: Connec-tor 61 Pin: 2 2- Mea-sure type: Voltage (V) Measure point 1: Connector 68 Pin: 5 Measure point 2: Connector 61 Pin: 2	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON;	1- Max. value: 1 V; 2- Max. value: 1 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
42	05	TRAILER CONTROL SERVO-DISTRIBUTOR - ELECTRO-VALVE	OPEN CIRCUIT	Trailer slowing delayed and not optimized.	Electronic control of trailer braking pressure disabled.	Check correct electronic control unit configuration. Check the integrity of the wiring, connectors and component. Check: Verify correct EBS (CBU) control unit configuration.	Measure type: Resistance (Ohm) Measure point 1: Connector 68 Pin: 4 Measure point 2: Connector 68 Pin: 5	Connector Not connected; Key +15 OFF;	Min. value: 4 Ohm; Max. value: 7 Ohm;	
42	06	TRAILER CONTROL SERVO-DISTRIBUTOR - ELECTRO-VALVE	SHORT CIRCUIT TO GROUND	Trailer slowing delayed and not optimized.	Electronic control of trailer braking pressure disabled.	Check connector wiring and components. Check: Check isolation from - battery.	1- Measure type: Resistance (Ohm) Measure point 1: Connector 68 Pin: 4 Measure point 2: Connector 61 Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: Connector 68 Pin: 5 Measure point 2: Connector 61 Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 500 Ohm; 2- Min. value: 500 Ohm;	
42	07	TRAILER CONTROL SERVO-DISTRIBUTOR	MECHANICAL FAILURE	Trailer slowing delayed and not optimized.	Electronic control of trailer braking pressure disabled.	Check supply pressure, integrity of control / supply pipes and trailer servo control valve operation. Check: Check component supply pressures at connections 11 and 12. Check outlet pressure connection 21 and 22. Measuring conditions: Vehicle stationary system at rating with governor pedal pressed fully down. Comparable values: Max 8.5 bar				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
42	0B	TRAILER CONTROL SERVO-DISTRIBUTOR	IT IS NOT POSSIBLE TO DETECT THE FAULT	Trailer slowing delayed and not optimized.	Electronic control of trailer braking pressure disabled.	Check the integrity of the wiring, connectors and component. Check: Check correct connection at pins 1/68 - 2/68 - 3/68 - 4/68 end 5/68.				
42	0D	TRAILER CONTROL SERVO-DISTRIBUTOR	CONFIGURATION PARAMETERS NOT CORRECT	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. C) No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled. C) Electronic control of the rear axle braking pressure disabled.	Check correct configuration and electronic control unit connections. Check: Verify correct EBS control unit configuration. Check correct connection at pins 1/68 - 2/68 - 3/68 - 4/68 and 5/68.				
42	0E	TRAILER CONTROL SERVO-DISTRIBUTOR - ELECTROVALVE	ALWAYS ON	The trailer remains braked.	No functional trouble.	Check connector wiring and components. Check: Check isolation from + battery.	1- Measure type: Voltage (V) Measure point 1: Connector 68 Pin: 4 Measure point 2: Connector 61 Pin: 2 2- Measure type: Voltage (V) Measure point 1: Connector 68 Pin: 5 Measure point 2: Connector 61 Pin: 2	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON;	1- Max. value: 1 V; 2- Max. value: 1 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
44	00	TRAILER CONTROL SERVO-DISTRIBUTOR - PRESSURE SENSOR	SIGNAL OUT OF RANGE	Imperfect trailer slowing.	Electronic control of trailer braking pressure deteriorated.	A) Check integrity of control / supply pipes. Check the integrity of the wiring, connectors and component. / B) Check the front axle pressure sensor works properly. Check: A) Check supply pressures at connection 11. Check outlet pressure connection 22. B) Check sensor range between pins (3/68 - 2/68). Measuring conditions: A) Vehicle stationary system at rating with governor pedal pressed fully down. B) Connectors connected to control unit. Key on MARCIA (START). Comparable values: A) Max 8,5 bar B) 0,5 - 3,7 Volt				
44	03	TRAILER CONTROL SERVO-DISTRIBUTOR - PRESSURE SENSOR	SHORT CIRCUIT TO POSITIVE	Imperfect trailer slowing.	Electronic control of trailer braking pressure deteriorated.	Check connector wiring and components. Check: Check isolation from + battery.	Measure type: Voltage (V) Measure point 1: Connector 68 Pin: 3 Measure point 2: Connector 68 Pin: 2	Connector Connected; Key +15 ON;	Min. value: 0.5 V; Max. value: 3.7 V;	

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
44	04	TRAILER CONTROL SERVO-DISTRIBUTOR - PRESSURE SENSOR	OPEN CIRCUIT OR SHORT CIRCUIT TO GROUND	Imperfect trailer slowing.	Electronic control of trailer braking pressure deteriorated.	Check connector wiring and components. Check: Check isolation from - battery.	Measure type: Voltage (V) Measure point 1: Connector 68 Pin: 3 Measure point 2: Connector 68 Pin: 2	Connector Connected; Key +15 ON;	Min. value: 0.5 V; Max. value: 3.7 V;	
46	00	PAD WEAR SENSORS - FRONT LEFT SENSOR	SIGNAL OUT OF RANGE/ WORN PADS	Excessive wear signal from cluster.	No functional trouble.	A) Check and replace brake linings. B) Check the integrity of the wiring, connectors and component. Check: A) Check thickness of brake linings (min. 2 mm). 1) Check supply between. 2) Check sensor range.	1- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 4 Measure point 2: Connector X2 Pin: 3 2- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 8 Measure point 2: Connector X2 Pin: 3	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Min. value: 4.9 V; Max. value: 5.1 V; 2- Min. value: 1 V; Max. value: 4 V;	Carry out the recommended measurements.
46	03	PAD WEAR SENSORS - FRONT LEFT SENSOR	SHORT CIRCUIT TO POSITIVE	Yellow warning light comes on.	No functional trouble.	Check connector wiring and components. Check: Check isolation from + battery.	Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 8 Measure point 2: Connector X2 Pin: 3	Connector Connected; Key +15 ON;	Min. value: 1 V; Max. value: 4 V;	
46	04	PAD WEAR SENSORS - FRONT LEFT SENSOR	OPEN CIRCUIT OR SHORT CIRCUIT TO GROUND	Yellow warning light comes on.	No functional trouble.	Check connector wiring and components. Check: Check isolation from - battery.	Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 8 Measure point 2: Connector X2 Pin: 3	Connector Connected; Key +15 ON;	Min. value: 1 V; Max. value: 4 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
47	00	PAD WEAR SENSORS - FRONT RIGHT SENSOR	SIGNAL OUT OF RANGE/ WORN PADS	Excessive wear signal from cluster.	No functional trouble.	A) Check and replace brake linings. B) Check the integrity of the wiring, connectors and component. Check: A) Check thickness of brake linings (min. 2 mm). 1) Check supply between. 2) Check sensor range.	1- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 2 Measure point 2: Connector X2 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 6 Measure point 2: Connector X2 Pin: 1	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Min. value: 4.9 V; Max. value: 5.1 V; 2- Min. value: 1 V; Max. value: 4 V;	
47	03	PAD WEAR SENSORS - FRONT RIGHT SENSOR	SHORT CIRCUIT TO POSITIVE	Yellow warning light comes on.	No functional trouble.	Check connector wiring and components. Check: Check isolation from + battery.	Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 6 Measure point 2: Connector X2 Pin: 1	Connector Connected; Key +15 ON;	Min. value: 1 V; Max. value: 4 V;	
47	04	PAD WEAR SENSORS - FRONT RIGHT SENSOR	OPEN CIRCUIT OR SHORT CIRCUIT TO GROUND	Yellow warning light comes on.	No functional trouble.	Check connector wiring and components. Check: Check isolation from - battery.	Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 6 Measure point 2: Connector X2 Pin: 1	Connector Connected; Key +15 ON;	Min. value: 1 V; Max. value: 4 V;	

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
48	00	PAD WEAR SENSORS - REAR LEFT SENSOR	SIGNAL OUT OF RANGE/ WORN PADS	Excessive wear signal from cluster.	No functional trouble.	A) Check and replace brake linings. B) Check the integrity of the wiring, connectors and component. Check: A) Check thickness of brake linings (min. 2 mm). 1) Check supply between. 2) Check sensor range.	1- Measure type: Voltage (V) Measure point 1: Connector 67 Pin: 1 Measure point 2: Connector 67 Pin: 3 2- Measure type: Voltage (V) Measure point 1: Connector 67 Pin: 2 Measure point 2: Connector 67 Pin: 3	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Min. value: 1 V; Max. value: 4 V; 2- Min. value: 4.9 V; Max. value: 5.1 V;	
48	03	PAD WEAR SENSORS - REAR LEFT SENSOR	SHORT CIRCUIT TO POSITIVE	Yellow warning light comes on.	No functional trouble.	Check connector wiring and components. Check: Check isolation from + battery.	Measure type: Voltage (V) Measure point 1: Connector 67 Pin: 1 Measure point 2: Connector 67 Pin: 3	Connector Connected; Key +15 ON;	Min. value: 1 V; Max. value: 4 V;	
48	04	PAD WEAR SENSORS - REAR LEFT SENSOR	OPEN CIRCUIT OR SHORT CIRCUIT TO GROUND	Yellow warning light comes on.	No functional trouble.	Check connector wiring and components. Check: Check isolation from - battery.	Measure type: Voltage (V) Measure point 1: Connector 67 Pin: 1 Measure point 2: Connector 67 Pin: 3	Connector Connected; Key +15 ON;	Min. value: 1 V; Max. value: 4 V;	
49	00	PAD WEAR SENSORS - REAR RIGHT SENSOR	SIGNAL OUT OF RANGE/ WORN PADS	Excessive wear signal from cluster.	No functional trouble.	A) Check and replace brake linings. B) Check the integrity of the wiring, connectors and component. Check: A) Check thickness of brake linings (min. 2 mm). 1) Check supply between. 2) Check sensor range.	1- Measure type: Voltage (V) Measure point 1: Connector 66 Pin: 1 Measure point 2: Connector 66 Pin: 3 2- Measure type: Voltage (V) Measure point 1: Connector 66 Pin: 2 Measure point 2: Connector 66 Pin: 3	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Min. value: 1 V; Max. value: 4 V; 2- Min. value: 4.9 V; Max. value: 5.6 V;	Carry out the recommended measurements.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
49	03	PAD WEAR SENSORS - REAR RIGHT SENSOR	SHORT CIRCUIT TO POSITIVE	Yellow warning light comes on.	No functional trouble.	Check connector wiring and components. Check: Check isolation from + battery.	Measure type: Voltage (V) Measure point 1: Connector 66 Pin: 1 Measure point 2: Connector 66 Pin: 3	Connector Connected; Key +15 ON;	Min. value: 1 V; Max. value: 4 V;	
49	04	PAD WEAR SENSORS - REAR RIGHT SENSOR	OPEN CIRCUIT OR SHORT CIRCUIT TO GROUND	Yellow warning light comes on.	No functional trouble.	Check connector wiring and components. Check: Check isolation from - battery.	Measure type: Voltage (V) Measure point 1: Connector 66 Pin: 1 Measure point 2: Connector 66 Pin: 3	Connector Connected; Key +15 ON;	Min. value: 1 V; Max. value: 4 V;	
4C	02	DUPLEX DISTRIBUTOR - BRAKE SIGNAL	INTERMITTENT / NOT CORRECT SENSOR SIGNAL	Yellow warning light comes on.	No functional trouble.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
4C	0C	DUPLEX DISTRIBUTOR - BRAKE SIGNAL	INTERMITTENT / NOT CORRECT SIGNAL OF TWO BRAKING OR SENSORS SWITCHES	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. C) No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled. C) Electronic control of the rear axle braking pressure disabled.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
4C	0E	DUPLEX DISTRIBUTOR - BRAKE SIGNAL	BRAKE AND ACCELERATOR PEDAL PRESSED AT THE SAME TIME > 5 min.			Check accelerator foot pedal switch.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
4D	02	DUPLEX DISTRIBUTOR - POSITION SENSOR 2	NO SENSOR SIGNAL/SIGNAL TOO LOW	Yellow warning light comes on.	No functional trouble.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
4D	04	DUPLEX DISTRIBUTOR - POSITION SENSOR 2	SHORT CIRCUIT TO GROUND	Yellow warning light comes on.	No functional trouble.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
4E	02	DUPLEX DISTRIBUTOR - POSITION SENSOR 1	NO SENSOR SIGNAL/SIGNAL TOO LOW	Yellow warning light comes on.	No functional trouble.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
4E	04	DUPLEX DISTRIBUTOR - POSITION SENSOR 1	SHORT CIRCUIT TO GROUND	Yellow warning light comes on.	No functional trouble.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	
4F	0B	ELECTRONIC CONTROL UNIT	WRONG TYRE SIZE	Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation.	ABS/ASR totally disabled.	Check control unit configuration and reprogram it with the right tyre dimensions. Check the inflation pressure is right.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
58	02	ESP MODULE	NOT CORRECT OR INTERMITTENT DATA - INCOMPATIBILITY WITH EBS	ESP de-activated.	Missing stability control.	A right combination of CBU, axle modulator and ESP-module must be assembled in the vehicle.				
58	03	ESP MODULE	IT IS NOT POSSIBLE TO DETECT THE FAULT	Electronic regulation of pressure on the front axle, rear axle and for trailer de-activated. ABS / ASR completely de-activated. ESP de-activated.	Late and non optimum braking of the front axle and trailer. Late and non optimum braking of the driving axle (trucks). Missing braking of driving axle (tractors). Blocking of the front and/or rear wheels. Skidding of driving axle and missing engine limitation. Missing stability control.	Check / replace the ESP-module. Check / replace the CBU.				If the error persists to replace module ESP, to contact the help desk for the eventual substitution of the CBU. (therefore to execute one new calibration)
58	04	ESP MODULE	SHORT CIRCUIT TO GROUND	ESP de-activated.	Missing stability control.	Check wiring and connectors ESP.	Measure type: Voltage (V) Measure point 1: Connector X3 Pin: 8 Measure point 2: Connector X1 Pin: 1	Connector Connected; Key +15 ON;	Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	Check and replace the ESP-module.

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
58	07	ESP MODULE	MECHANICAL FAILURE	ESP de-activated.	Missing stability control.	Check the CBU concerning correct ESP specific EOL parameters (e.g. wrong sign of lateral acceleration). Check the assembly position of ESP module. Check the assembly position of steering wheel sensor (wrong sign).				
58	08	ESP MODULE	EBS CONFIGURATION WRONG	ESP de-activated.	Missing stability control.	In the programming environment, perform - OTHER - ESP module calibration. Then perform the ESP module on-the-road manual recalibration and self-learn procedure. Drive along a straight section of road approximately 250 m in length, during which you should turn the steering wheel at least once to the left and once to the right (the error will automatically be deleted at the end of the procedure).				If the error persists to replace module ESP, to contact the help desk for the eventual substitution of the CBU. (therefore to execute one new calibration)

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
58	09	ESP MODULE	UPDATE SPEED NOT CORRECT	ESP de-activated.	Missing stability control.	Check the wiring and connectors between EBS-centralmodule and ESP-module. Check the wiring and connectors between EBS-axlemodulator and ESP-module. Check and replace the ESP-module. Check and replace the EBS-axlemodulator or EBS-centralmodule.				If the error persists to replace module ESP, to contact the help desk for the eventual substitution of the CBU. (therefore to execute one new calibration)
58	0A	ESP MODULE	CHANGE SPEED NOT CORRECT	ESP de-activated.	Missing stability control.	Check CBU for correct EOL-configuration (ESP yes/no). Check the wiring between CBU and ESP-module. Check the ESP-module / replace ESP-module (correct assembly position of ESP-module is important). Check the CBU / replace CBU.				If the error persists to replace module ESP, to contact the help desk for the eventual substitution of the CBU. (therefore to execute one new calibration)

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
58	0B	ESP MODULE	IT IS NOT POSSIBLE TO DETECT THE FAULT	ESP de-activated.	Missing stability control.	Check the CBU concerning correct ESP specific EOL parameters e.g. ESP-type).				
58	0C	ESP MODULE	TOTAL FAILURE	ESP de-activated.	Missing stability control.	Check the assembly position, the lateral inclination and correct fixing of the ESP-module. Check and replace the ESP module (correct assembly position is important).				
58	0D	ESP MODULE	CONFIGURATION PARAMETERS NOT CORRECT	ESP de-activated.	Missing stability control.	Check the CBU concerning correct ESP specific EOL parameters.				If required reprogram EBS (CBU) central unit with correct configuration.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
58	0E	ESP MODULE	THE CALIBRATION MAY BE INCORRECT	ESP de-activated. Missing stability control.	Be carried out one of the following operations:-vehicle specific parameters have been changed;-substitution of the CBU;-substitution of module ESP.Faulty wiring,or possible false contact.	Perform the ESP module on-the-road manual recalibration and self-learn procedure. Drive along a straight section of road approximately 250 m in length, during which you should turn the steering wheel at least once to the left and once to the right. In this way the ESP reference values will be updated, and the ESP will calculate and store a new series of data relating to the vehicle (the error will automatically be deleted at the end of the procedure).				Check wiring and connections.
58	0F	ESP MODULE	FAULTY CPU CHECK - NOT FORESEEN CODE	ESP de-activated.	Missing stability control.	Check / replace the ESP-module (the correct assembly position is important).				
59	02	STEERING ANGLE SENSOR	INCORRECT OR INTERMITTENT DATA	ESP de-activated.	Missing stability control.	Check / replace the steering wheel sensor.				
59	04	STEERING ANGLE SENSOR	SHORT CIRCUIT TO GROUND	ESP de-activated.	Missing stability control.	Check the wiring and connectors (voltage supply) to the steering wheel sensor.	Measure type: Voltage (V) Measure point 1: Connector X3 Pin: 6 Measure point 2: Connector X1 Pin: 1	Connector Connected; Key +15 ON;	Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
59	07	STEERING ANGLE SENSOR	MECHANICAL FAILURE	ESP de-activated.	Missing stability control.	Check the CBU concerning correct ESP specific EOL parameters (e.g. wheel base, ...). Check / replace the ESP module. Check / replace the steering wheel sensor.				
59	09	STEERING ANGLE SENSOR	UPDATE SPEED NOT CORRECT	ESP de-activated.	Missing stability control.	Check the wiring (CAN) between CBU and the steering wheel sensor. Failure is detected by the steering wheel sensor. Check / replace the steering wheel sensor.	Measure type: Resistance (Ohm) Measure point 1: Connector X3 Pin: 5 Measure point 2: Connector X3 Pin: 1	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	
59	0A	STEERING ANGLE SENSOR	CHANGE SPEED NOT CORRECT	ESP de-activated.	Missing stability control.	Check the wiring (voltage supply and CAN) and the relating electric connectors between CBU and axle modulator (interruption ?, short circuit ?). Check the wiring of the rear-axle backup valve concening short circuit to UBatt. Replace axle modulator. Replace centralmodule.				If the error persists to contact the help desk for the eventual substitution of the CBU. (therefore to execute one new calibration)

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
59	0A	STEERING ANGLE SENSOR	CHANGE SPEED NOT CORRECT	ESP de-activated.	Missing stability control.	Check the wiring (CAN) between CBU and the steering wheel sensor. Failure is detected by the steering wheel sensor. Check / replace the steering wheel sensor.				If the error persists to contact the help desk for the eventual substitution of the CBU. (therefore to execute one new calibration)
59	0B	STEERING ANGLE SENSOR	IT IS NOT POSSIBLE TO DETECT THE FAULT	Electronic regulation of pressure on the front axle, rear axle and for trailer de-activated. ABS / ASR completely de-activated.ESP de-activated.	Late and non optimum braking of the front axle and trailer.Late and non optimum braking of the driving axle (trucks).Missing braking of driving axle (tractors). Blocking of the front and/or rear wheels.Skidding of driving axle and missing engine limitation. Missing stability control.	Replace CBU control unit.				If the error persists to contact the help desk for the eventual substitution of the CBU. (therefore to execute one new calibration)
59	0C	STEERING ANGLE SENSOR	TOTAL FAILURE	ESP de-activated.	Missing stability control.	Check / replace the steering wheel sensor.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
59	0D	STEERING ANGLE SENSOR	CONFIGURATION PARAMETERS NOT CORRECT	ESP de-activated.	Missing stability control.	Check the CBU concerning correct EOL parameters. Check the specific parameters of the steering wheel sensor.				
59	0E	STEERING ANGLE SENSOR	NOT ADJUSTED	ESP de-activated.	Missing stability control.	Check the position of the steering-wheel, when the front wheels are in straight-on position. Check the steering-geometry (wheel toe, wheel camber) or the assembly of the steering-column. Check and replace the steering wheel sensor.				
59	0F	STEERING ANGLE SENSOR	NOT CORRECT OR INTERMITTENT DATA - INCOMPATIBILITY WITH EBS	ESP de-activated.	Missing stability control.	A steering wheel sensor with a correct version-number must be assembled in the vehicle.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
5A	03	ESP MODULE - SUPPLY VOLTAGE	OVER-VOLTAGE	ESP de-activated.	Missing stability control.	Check the wiring between CBU and ESP-module. Check the wiring between CBU and steering wheel sensor: measure 1 and 2.	1- Measure type: Voltage (V) Measure point 1: Connector X3 Pin: 8 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X3 Pin: 6 Measure point 2: Connector X1 Pin: 1	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	If the error persists to contact the help desk for the eventual substitution of the CBU. (therefore to execute one new calibration)
5A	04	ESP MODULE - SUPPLY VOLTAGE	LOW VOLTAGE	ESP de-activated.	Missing stability control.	Check the wiring between CBU and ESP-module. Check the wiring between CBU and steering wheel sensor.	Measure type: Voltage (V) Measure point 1: Connector X3 Pin: 8 Measure point 2: Connector X1 Pin: 1	Connector Connected; Key +15 ON;	Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	Check and replace the ESP-module.
5A	04	ESP MODULE - SUPPLY VOLTAGE	LOW VOLTAGE	ESP de-activated.	Missing stability control.	Check the steering wheel sensor / replace the steering wheel sensor.	Measure type: Voltage (V) Measure point 1: Connector X3 Pin: 6 Measure point 2: Connector X1 Pin: 1	Connector Connected; Key +15 ON;	Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	If the error persists to contact the help desk for the eventual substitution of the CBU. (therefore to execute one new calibration)
5F	03	PAD WEAR SENSORS - FRONT SENSOR FEED LINE	SHORT CIRCUIT TO POSITIVE	Yellow warning light comes on.	No functional trouble.	Check connector wiring and components. Check: Check isolation from + battery.	Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 2 Measure point 2: Connector X2 Pin: 1	Connector Connected; Key +15 ON;	Min. value: 4.9 V; Max. value: 5.1 V;	1) RH front axle brake pad wear sensor.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
5F	03	PAD WEAR SENSORS - FRONT SENSOR FEED LINE	SHORT CIRCUIT TO POSITIVE	Yellow warning light comes on.	No functional trouble.	Check connector wiring and components. Check: Check isolation from + battery.	Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 4 Measure point 2: Connector X2 Pin: 3	Connector Connected; Key +15 ON;	Min. value: 4.9 V; Max. value: 5.1 V;	2) LH front axle brake pad wear sensor.
5F	04	PAD WEAR SENSORS - FRONT SENSOR FEED LINE	SHORT CIRCUIT TO GROUND	No indication on cluster.	No functional trouble.	Check sensor wiring. Replace sensor if damaged. Check: Check isolation from - battery.	Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 4 Measure point 2: Connector X2 Pin: 3	Connector Connected; Key +15 ON;	Min. value: 4.9 V; Max. value: 5.1 V;	2) LH front axle brake pad wear sensor.
5F	04	PAD WEAR SENSORS - FRONT SENSOR FEED LINE	SHORT CIRCUIT TO GROUND	No indication on cluster.	No functional trouble.	Check sensor wiring. Replace sensor if damaged. Check: Check isolation from - battery.	Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 2 Measure point 2: Connector X2 Pin: 1	Connector Connected; Key +15 ON;	Min. value: 4.9 V; Max. value: 5.1 V;	1) RH front axle brake pad wear sensor.
60	03	PAD WEAR SENSORS - REAR SENSOR FEED LINE	SHORT CIRCUIT TO POSITIVE	Yellow warning light comes on. No indication on cluster.	No functional trouble.	Check connector wiring and components. Check: Check isolation from + battery.	Measure type: Voltage (V) Measure point 1: Connector 66 Pin: 2 Measure point 2: Connector 66 Pin: 3	Connector Connected; Key +15 ON;	Min. value: 4.9 V; Max. value: 5.1 V;	1) RH rear axle brake pad wear sensor.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
60	03	PAD WEAR SENSORS - REAR SENSOR FEED LINE	SHORT CIRCUIT TO POSITIVE			Check connector wiring and components. Check: Check isolation from + battery.	Measure type: Voltage (V) Measure point 1: Connector 67 Pin: 2 Measure point 2: Connector 67 Pin: 3	Connector Connected; Key +15 ON;	Min. value: 4.9 V; Max. value: 5.1 V;	2) LH rear axle brake pad wear sensor.
60	04	PAD WEAR SENSORS - REAR SENSOR FEED LINE	SHORT CIRCUIT TO GROUND	Yellow warning light comes on. No indication on cluster.	No functional trouble.	Check sensor wiring. Replace sensor if damaged. Check: Check isolation from - battery.	Measure type: Voltage (V) Measure point 1: Connector 66 Pin: 2 Measure point 2: Connector 66 Pin: 3	Connector Connected; Key +15 ON;	Min. value: 4.9 V; Max. value: 5.1 V;	1) RH rear axle brake pad wear sensor.
60	04	PAD WEAR SENSORS - REAR SENSOR FEED LINE	SHORT CIRCUIT TO GROUND			Check sensor wiring. Replace sensor if damaged. Check: Check isolation from - battery.	Measure type: Voltage (V) Measure point 1: Connector 67 Pin: 2 Measure point 2: Connector 67 Pin: 3	Connector Connected; Key +15 ON;	Min. value: 4.9 V; Max. value: 5.1 V;	2) LH rear axle brake pad wear sensor.

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
DC	09	CAN LINE -COMMU-NICA-TION WITH SEMI-TRAILER	UPDATE SPEED NOT CORRECT	Incorrect or no integration in trailer braking.	No functional trouble.	Check wiring integrity between electronic control unit and trailer ISO connector, check integrity of trailer system. Check: Check integrity between pins 6 and 7 of the trailer coupling. Check the wiring of the trailer coupling is correct. Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 60 ohm				
DC	0B	CAN LINE -COMMU-NICA-TION WITH SEMI-TRAILER	IT IS NOT POSSIBLE TO DE-TECT THE FAULT	Incorrect or no integration in trailer braking.	No functional trouble.	Check wiring integrity between electronic control unit and trailer ISO connector, check integrity of trailer system. Check: Check integrity between pins 6 and 7 of the trailer coupling. Check the wiring of the trailer coupling is correct. Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 60 ohm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
DC	0C	CAN LINE -COMMU-NICA-TION WITH SEMI-TRAILER	TOTAL FAILURE	Incorrect or no integration in trailer braking.	No functional trouble.	Check wiring integrity between electronic control unit and trailer ISO connector, check integrity of trailer system. Check: Check integrity between pins 6 and 7 of the trailer coupling. Check the wiring of the trailer coupling is correct. Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 60 ohm				
DC	0E	CAN LINE -COMMU-NICA-TION WITH SEMI-TRAILER	FAULT ON CAN (H) OR CAN (L)	Incorrect or no integration in trailer braking.	No functional trouble.	Check wiring integrity between electronic control unit and trailer ISO connector, check integrity of trailer system. Check: Check integrity between pins 6 and 7 of the trailer coupling. Check the wiring of the trailer coupling is correct. Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 60 ohm				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
DD	03	ELEC-TRONIC CON-TROL UNIT - PRESSURE SENSORS VOLTAGE SUPPLY	SHORT CIRCUIT TO POS-ITIVE	Imperfect trailer and front axle slowing-down braking.	Electronic con-trol of the trail-er and front axle pressure deteriorated.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Mea-sure point 1: Connec-tor X1 Pin: 2 Mea-sure point 2: Connec-tor X1 Pin: 1 2- Mea-sure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Mea-sure point 1: Connec-tor X1 Pin: 4 Mea-sure point 2: Connec-tor X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. val-ue: 28 V; Typi-cal Value: 24 V; 2- Min. value: 22 V; Max. val-ue: 28 V; Typi-cal Value: 24 V; 3- Min. value: 22 V; Max. val-ue: 28 V; Typi-cal Value: 24 V;	
DD	04	ELEC-TRONIC CON-TROL UNIT - PRESSURE SENSORS VOLTAGE SUPPLY	SHORT CIRCUIT TO GROUND	Imperfect trailer and front axle slowing-down braking.	Electronic con-trol of the trail-er and front axle pressure deteriorated.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Mea-sure point 1: Connec-tor X1 Pin: 2 Mea-sure point 2: Connec-tor X1 Pin: 1 2- Mea-sure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Mea-sure point 1: Connec-tor X1 Pin: 4 Mea-sure point 2: Connec-tor X1 Pin: 1 4- Mea-sure type: Voltage (V) Measure point 1: Connector 68 Pin: 1 Measure point 2: Connector 68 Pin: 2	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON; 4- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. val-ue: 28 V; Typi-cal Value: 24 V; 2- Min. value: 22 V; Max. val-ue: 28 V; Typi-cal Value: 24 V; 3- Min. value: 22 V; Max. val-ue: 28 V; Typi-cal Value: 24 V; 4- Min. value: 22 V; Max. val-ue: 28 V; Typi-cal Value: 24 V;	Check cor-rect electric power sup-ply of the compo-nent:Trailer servo con-trol valve - Proportional valve to control EBS trailer air pressure (78058).

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
E7	00	CAN LINE - COMMUNICATION WITH OTHER E.C.U.s	DELAY IN THE COMMUNICATION WITH THE EDC E.C.U. (ENGINE BRAKE)			Check the integrity of the vehicle's CAN line and the relevant connections of the associated electronic control units.				
E7	01	CAN LINE - COMMUNICATION WITH OTHER E.C.U.s	TIMEOUT WITH THE RETARDER			Check the integrity of the vehicle's CAN line and the relevant connections of the associated electronic control units.				
E7	02	CAN LINE -COMMUNICATION WITH OTHER E.C.U.s	TIMEOUT WITH THE GEARBOX	Rear axle wheels skid and no engine limitation.	ASR totally disabled.	Check the integrity of the vehicle's CAN line and the relevant connections of the associated electronic control units.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
E7	03	CAN LINE -COMMU-NICA-TION WITH OTHER E.C.U.s	TIMEOUT WITH THE CRUICE CON-TROL	Rear axle wheels skid and no en-gine limitation.	ASR totally dis-abled.	Check the integrity of the vehicle's CAN line and the relevant con-nections of the associ-ated electronic control units.				
E7	04	CAN LINE -COMMU-NICA-TION WITH OTHER E.C.U.s	DELAY IN THE COM-MUNICA-TION WITH THE TACHOM-ETER	Rear axle wheels skid and no en-gine limitation.	ASR totally dis-abled.	Check the integrity of the vehicle's CAN line and the relevant con-nections of the associ-ated electronic control units.				
E7	05	CAN LINE -COM-UNICA-TION WITH ELECTRO-PNEU-MATIC REAR AXLE MOD-ULATOR	TIMEOUT	Rear axle wheels skid and no en-gine limitation.	ASR totally dis-abled.	Check the integrity of the vehicle's CAN line and the relevant con-nections of the associ-ated electronic control units. Check: Check integrity be-tween pins 21 and 22 of the 30-pin fault-diagnosis connector.	Measure type: Resist-ance (Ohm) Mea-sure point 1: 30-pole connector Pin: 21 Measure point 2: 30-pole connector Pin: 22	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm;	
E7	06	CAN LINE -COMMU-NICA-TION WITH OTHER E.C.U.s	DELAY / NO MES-SAGE FOR AIR PRES-SURE OF SYSTEM BRAKE			Check vehicle CAN line and relative con-nections on the rele-vant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connec-tor.Measuring condi-tions: Connectors con-nected to control unit. Key on STOP.Compar-able values: 60 ohm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
E7	07	CANLINE -COMMU-NICA-TION WITH OTHER E.C.U.s	TIMEOUT WITH THE RETARD-ER	Rear axle wheels skid and no en-gine limitation.	ASR totally dis-abled.	Check the integrity of the vehicle's CAN line and the relevant con-nections of the associ-ated electronic control units.				
E7	08	CAN LINE -COMMU-NICA-TION WITH OTHER E.C.U.s	TIMEOUT WITH THE RETARD-ER			Check vehicle CAN line and relative con-nections on the rele-vant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connec-tor.Measuring condi-tions: Connectors con-nected to control unit. Key on STOP.Compar-able values: 60 ohm				
E7	09	CAN LINE -COMMU-NICA-TION WITH OTHER E.C.U.s	TIMEOUT WITH THE EDC E.C.U.	Rear axle wheels skid and no en-gine limitation.	ASR totally dis-abled.	Check vehicle CAN line and relative con-nections on the rele-vant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connec-tor.Measuring condi-tions: Connectors con-nected to control unit. Key on STOP.Compar-able values: 60 ohm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
E7	0A	CAN LINE -COMMU-NICA-TION WITH OTHER E.C.U.s	INTER-RUPTION	Rear axle wheels skid and no en-gine limitation.	ASR totally dis-abled.	Check vehicle CAN line and relative con-nections on the rele-vant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connec-tor.Measuring condi-tions: Connectors con-nected to control unit. Key on STOP.Compar-able values: 60 ohm				
E7	0C	CAN LINE -COMMU-NICA-TION WITH OTHER E.C.U.s	CONNEC-TION DIS-ABLED	Rear axle wheels skid and no en-gine limitation.	ASR totally dis-abled.	Check vehicle CAN line and relative con-nections on the rele-vant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connec-tor.Measuring condi-tions: Connectors con-nected to control unit. Key on STOP.Compar-able values: 60 ohm				
E7	0E	CAN LINE -COMMU-NICA-TION WITH OTHER E.C.U.s	TIMEOUT WITH THE EDC E.C.U.			Check vehicle CAN line and relative con-nections on the rele-vant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connec-tor.Measuring condi-tions: Connectors con-nected to control unit. Key on STOP.Compar-able values: 60 ohm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
F8	00	CAN LINE -COMMU-NICA-TION WITH OTHER E.C.U.s	CAN EEC2 MESSAGE DELAY			Check vehicle CAN line and relative con-nections on the rele-vant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connec-tor.Measuring condi-tions: Connectors con-nected to control unit. Key on STOP.Compar-able values: 60 ohm				
F8	01	CAN LINE -COMMU-NICA-TION WITH OTHER E.C.U.s	CAN EEC3 MESSAGE DELAY			Check vehicle CAN line and relative con-nections on the rele-vant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connec-tor.Measuring condi-tions: Connectors con-nected to control unit. Key on STOP.Compar-able values: 60 ohm				
F8	02	CAN LINE -COMMU-NICA-TION WITH OTHER E.C.U.s	CAN EET1 MESSAGE DELAY			Check vehicle CAN line and relative con-nections on the rele-vant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connec-tor.Measuring condi-tions: Connectors con-nected to control unit. Key on STOP.Compar-able values: 60 ohm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
F8	03	CAN LINE -COMMU-NICA-TION WITH OTHER E.C.U.s	DELAY WHEN RE-CEIVING THE CAN ETC2 MES-SAGE			Check vehicle CAN line and relative con-nections on the rele-vant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connec-tor.Measuring condi-tions: Connectors con-nected to control unit. Key on STOP.Compar-able values: 60 ohm				
F8	04	CAN LINE -COMMU-NICA-TION WITH OTHER E.C.U.s	DELAY IN THE COM-MUNICA-TION WITH THE TACHOM-ETER			Check vehicle CAN line and relative con-nections on the rele-vant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connec-tor.Measuring condi-tions: Connectors con-nected to control unit. Key on STOP.Compar-able values: 60 ohm				
F8	05	CAN LINE -COMMU-NICA-TION WITH OTHER E.C.U.s	DELAY IN THE COM-MUNICA-TION WITH THE TACHOM-ETER			Check vehicle CAN line and relative con-nections on the rele-vant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connec-tor.Measuring condi-tions: Connectors con-nected to control unit. Key on STOP.Compar-able values: 60 ohm				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
FB	00	VOLTAGE	OVER-VOLTAGE	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. C) No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled. C) Electronic control of the rear axle braking pressure disabled.	Check the vehicle's supply voltage. Check the efficiency of the batteries and alternator voltage regulator.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON; 3- Connector Connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; 2- Min. value: 22 V; Max. value: 28 V; 3- Min. value: 22 V; Max. value: 28 V;	
FB	01	VOLTAGE	LOW VOLTAGE	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. C) No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled. C) Electronic control of the rear axle braking pressure disabled.	Check the vehicle's supply voltage. Check the efficiency of the batteries and alternator voltage regulator.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON; 3- Connector Connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; 2- Min. value: 22 V; Max. value: 28 V; 3- Min. value: 22 V; Max. value: 28 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
FB	04	VOLTAGE - POWER SUPPLY (+30) PIN 3 (X1)	LOW VOLTAGE	A) Front axle wheels tend to lock. B) Rear axle wheels skid on starting. C) No trailer and front axle braking optimization.	A) RH/LH front axle ABS disabled. B) Brake controlling ASR disabled. C) Electronic control of trailer and front axle braking pressure disabled.	Check voltage, integrity of fuse and wiring on + 30a. Check the efficiency of the batteries and alternator voltage regulator.	Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1	Connector Connected; Key +15 ON;	Min. value: 22 V; Max. value: 28 V;	
FB	05	VOLTAGE - POWER SUPPLY (+30) PIN 2 (X1)	LOW VOLTAGE	Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation.	ABS/ASR totally disabled. Electronic control of rear axle braking pressure disabled.	Check voltage, integrity of fuse and wiring on + 30b. Check rear axle modulator. Check the efficiency of the batteries and alternator voltage regulator.	Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1	Connector Connected; Key +15 ON;	Min. value: 22 V; Max. value: 28 V;	
FB	0E	VOLTAGE -BATTERY VOLTAGE (+15)	FAULTY CIRCUIT	Yellow warning light comes on.	No functional trouble.	Check integrity of fuse and wiring on + 15, key switch, relay 25213 A Check the efficiency of the batteries and alternator voltage regulator.	Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	Connector Connected; Key +15 ON;	Min. value: 22 V; Max. value: 28 V;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
FD	0C	ELEC-TRONIC CON-TROL UNIT	EEPROM FAULTY	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled. C) Electronic control of the rear axle braking pressure disabled.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	If the error persists to contact the help desk for the eventual substitution of the CBU. (therefore to execute one new calibration)

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
FE	0C	ELEC-TRONIC CON-TROL UNIT	INTERNAL FAULT	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. No rear axle braking.	A) ABS/ASR totally disabled. B1) Electronic control of trailer and front axle braking pressure disabled. B2) Electronic control of rear axle braking pressure disabled.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 1 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 3 Measure point 2: Connector X1 Pin: 1 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: Connector X1 Pin: 1	1- Connector Not connected; Key +15 ON; 2- Connector Not connected; Key +15 ON; 3- Connector Not connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 2- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V; 3- Min. value: 22 V; Max. value: 28 V; Typical Value: 24 V;	If the error persists to contact the help desk for the eventual substitution of the CBU. (therefore to execute one new calibration)
FE	0D	ELEC-TRONIC CON-TROL UNIT	CONFIGU-RATION PARAME-TERS NOT CORRECT	A) Front and/or rear axle wheels tend to lock. Rear axle wheels skid and no engine limitation. B) No trailer and front axle braking optimization. C) No rear axle braking.	A) ABS/ASR totally disabled. B) Electronic control of trailer and front axle braking pressure disabled. C) Electronic control of the rear axle braking pressure disabled.	Check control unit configuration. Replace EBS control unit.				If the error persists to contact the help desk for the eventual substitution of the CBU. (therefore to execute one new calibration)

ABS System

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
001	01	SENSORS - FRONT LEFT SENSOR	EXCESSIVE AIR GAP			Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm				
001	02	SENSORS - FRONT LEFT SENSOR	INCORRECT TYRE			Check that: - the phonic wheels are not faulty; - teeths are not damaged or missing; - the tyres have equal measure (measures released by constructor), tyres pressure . Verify the axle ratio.				Check correct tyre circumference.
001	03	SENSORS - FRONT LEFT SENSOR	SHORT CIRCUIT TO POSITIVE		Possible short circuit.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X2 Pin: 12 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
001	04	SENSORS - FRONT LEFT SENSOR	SHORT CIRCUIT TO GROUND		Possible short circuit.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X2 Pin: 12 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements
001	05	SENSORS - FRONT LEFT SENSOR	OPEN CIRCUIT		Possible open circuit or interrupted cable between.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X2 Pin: 12 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
001	06	SENSORS - FRONT LEFT SENSOR	SHORT CIRCUIT		Possible short circuit.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X2 Pin: 12 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements
001	07	SENSORS - FRONT LEFT SENSOR	PHONIC WHEEL			Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
001	08	SENSORS - FRONT LEFT SENSOR	SLIPPING		Mechanical problems in the ASR -System (pneumatic pipes, the ASR electrovalve, ABS-electrovalves, ASR disabling switch).	Check that: - the phonic wheels are not faulty; - teeths are not damaged or missing.				Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm
001	09	SENSORS - FRONT LEFT SENSOR	INVERTED WIRING			Using the MEASURABLE PARAMETERS read the velocity of the wheel in question.				
001	0A	SENSORS - FRONT LEFT SENSOR	IRREGULAR SIGNAL			Position of the sensor incorrect; high air gap; false contacts in the connector.				
001	0B	SENSORS - FRONT LEFT SENSOR	SIGNAL NOT PLAUSIBLE			Position of the sensor incorrect; high air gap; false contacts in the connector.				

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
001	0C	SENSORS - FRONT LEFT SENSOR	WRONG SIGNAL			Position of the sensor incorrect; high air gap; false contacts in the connector.				If necessary, replace the ECU.
002	01	SENSORS - FRONT RIGHT SENSOR	EXCESSIVE AIR GAP			Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm				
002	02	SENSORS - FRONT RIGHT SENSOR	INCORRECT TYRE			Check that: - the phonic wheels are not faulty; - teeths are not damaged or missing; - the tyres have equal measure (measures released by constructor), tyres pressure . Verify the axle ratio.				Check correct tyre circumference.

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
002	03	SENSORS - FRONT RIGHT SENSOR	SHORT CIRCUIT TO POSITIVE		Possible short circuit.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 13 Measure point 2: Connector X2 Pin: 10 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 13 Measure point 2: Connector X1 Pin: 8 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 13 Measure point 2: Connector X1 Pin: 8	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements
002	04	SENSORS - FRONT RIGHT SENSOR	SHORT CIRCUIT TO GROUND		Possible short circuit.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 13 Measure point 2: Connector X2 Pin: 10 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 10 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 10 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
002	05	SENSORS - FRONT RIGHT SENSOR	OPEN CIRCUIT		Possible open circuit or interrupted cable between.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 13 Measure point 2: Connector X2 Pin: 10 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 10 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 10 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements
002	06	SENSORS - FRONT RIGHT SENSOR	SHORT CIRCUIT		Possible short circuit.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 13 Measure point 2: Connector X2 Pin: 10 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 10 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 10 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
002	07	SENSORS - FRONT RIGHT SENSOR	PHONIC WHEEL			Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm				
002	08	SENSORS - FRONT RIGHT SENSOR	SLIPPING		Mechanical problems in the ASR -System (pneumatic pipes, the ASR electrovalve, ABS-electrovalves, ASR disabling switch).	Check that: - the phonic wheels are not faulty; - teeths are not damaged or missing.				Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm
002	09	SENSORS - FRONT RIGHT SENSOR	INVERTED WIRING			Using the MEASURABLE PARAMETERS read the velocity of the wheel in question.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
002	0A	SENSORS - FRONT RIGHT SENSOR	IRREGULAR SIGNAL			Position of the sensor incorrect; high air gap; false contacts in the connector.				
002	0B	SENSORS - FRONT RIGHT SENSOR	SIGNAL NOT PLAUSIBLE			Position of the sensor incorrect; high air gap; false contacts in the connector.				
002	0C	SENSORS - FRONT RIGHT SENSOR	WRONG SIGNAL			Position of the sensor incorrect; high air gap; false contacts in the connector.				If necessary, replace the ECU.
003	01	SENSORS - REAR LEFT SENSOR	EXCESSIVE AIR GAP			Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
003	02	SENSORS - REAR LEFT SENSOR	INCORRECT TYRE			Check that: - the phonic wheels are not faulty; - teeths are not damaged or missing; - the tyres have equal measure (measures released by constructor), tyres pressure . Verify the axle ratio.				Check correct tyre circumference.
003	03	SENSORS - REAR LEFT SENSOR	SHORT CIRCUIT TO POSITIVE		Possible short circuit.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 14 Measure point 2: Connector X2 Pin: 11 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
003	04	SENSORS - REAR LEFT SENSOR	SHORT CIRCUIT TO GROUND		Possible short circuit.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 14 Measure point 2: Connector X2 Pin: 11 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements
003	05	SENSORS - REAR LEFT SENSOR	OPEN CIRCUIT		Possible open circuit or interrupted cable between.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 14 Measure point 2: Connector X2 Pin: 11 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
003	06	SENSORS - REAR LEFT SENSOR	SHORT CIRCUIT		Possible short circuit.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 14 Measure point 2: Connector X2 Pin: 11 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements
003	07	SENSORS - REAR LEFT SENSOR	PHONIC WHEEL			Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm				
003	08	SENSORS - REAR LEFT SENSOR	INVERTED WIRING			Using the MEASURABLE PARAMETERS read the velocity of the wheel in question.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
003	09	SENSORS - REAR LEFT SENSOR	SLIPPING		Mechanical problems in the ASR -System (pneumatic pipes, the ASR electrovalve, ABS-electro-valves, ASR disabling switch).	Check that: - the phonic wheels are not faulty; - teeths are not damaged or missing.				Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm
003	0A	SENSORS - REAR LEFT SENSOR	IRREGULAR SIGNAL			Position of the sensor incorrect; high air gap; false contacts in the connector.				
003	0B	SENSORS - REAR LEFT SENSOR	SIGNAL NOT PLAUSIBLE			Position of the sensor incorrect; high air gap; false contacts in the connector.				
003	0C	SENSORS - REAR LEFT SENSOR	WRONG SIGNAL			Position of the sensor incorrect; high air gap; false contacts in the connector.				If necessary, replace the ECU.

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
004	01	SENSORS - REAR RIGHT SENSOR	EXCESSIVE AIR GAP			Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm				
004	02	SENSORS - REAR RIGHT SENSOR	INCORRECT TYRE			Check that: - the phonic wheels are not faulty; - teeths are not damaged or missing; - the tyres have equal measure (measures released by constructor), tyres pressure . Verify the axle ratio.				Check correct tyre circumference.
004	03	SENSORS - REAR RIGHT SENSOR	SHORT CIRCUIT TO POSITIVE		Possible short circuit.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 18 Measure point 2: Connector X2 Pin: 17 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
004	04	SENSORS - REAR RIGHT SENSOR	SHORT CIRCUIT TO GROUND		Possible short circuit.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 18 Measure point 2: Connector X2 Pin: 17 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements
004	05	SENSORS - REAR RIGHT SENSOR	OPEN CIRCUIT		Possible open circuit or interrupted cable between.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 18 Measure point 2: Connector X2 Pin: 17 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
004	06	SENSORS - REAR RIGHT SENSOR	SHORT CIRCUIT		Possible short circuit.	Check sensor wiring. Check sensor efficiency, replace it if damaged.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 18 Measure point 2: Connector X2 Pin: 17 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON;	1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V;	Carry out the indicated measurements
004	07	SENSORS - REAR RIGHT SENSOR	PHONIC WHEEL			Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
004	08	SENSORS - REAR RIGHT SENSOR	SLIPPING		Mechanical problems in the ASR -System (pneumatic pipes, the ASR electrovalve, ABS-electro-valves, ASR disabling switch).	Check that: - the phonic wheels are not faulty; - teeths are not damaged or missing.				Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm
004	09	SENSORS - REAR RIGHT SENSOR	INVERTED WIRING			Using the MEASURABLE PARAMETERS read the velocity of the wheel in question.				
004	0A	SENSORS - REAR RIGHT SENSOR	IRREGULAR SIGNAL			Position of the sensor incorrect; high air gap; false contacts in the connector.				
004	0B	SENSORS - REAR RIGHT SENSOR	SIGNAL NOT PLAUSIBLE			Position of the sensor incorrect; high air gap; false contacts in the connector.				
004	0C	SENSORS - REAR RIGHT SENSOR	WRONG SIGNAL			Position of the sensor incorrect; high air gap; false contacts in the connector.				If necessary, replace the ECU.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
007	03	ELECTRO-VALVES - FRONT LEFT ABS ELECTRO-VALVE	SHORT CIRCUIT TO POS-ITIVE		Possible short circuit.	Check wiring and connectors.	1- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 3 Measure point 2: Connector X1 Pin: 4 2- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 6 Measure point 2: Connector X1 Pin: 4	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Max. value: 1 V; 2- Max. value: 1 V;	Carry out the recommended measurements.
007	05	ELECTRO-VALVES - FRONT LEFT ABS ELECTRO-VALVE	OPEN CIR-CUIT		Possible open circuit or interrupted cable between.	Check wiring and connectors.	1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 3 Measure point 2: Connector X1 Pin: 4 2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 6 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 14 Ohm; Max. value: 21 Ohm; 2- Min. value: 14 Ohm; Max. value: 21 Ohm;	Carry out the recommended measurements.
007	06	ELECTRO-VALVES - FRONT LEFT ABS ELECTRO-VALVE	SHORT CIRCUIT TO GROUND		Possible short circuit.	Check wiring and connectors.	1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 3 Measure point 2: Connector X1 Pin: 4 2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 6 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 14 Ohm; Max. value: 21 Ohm; 2- Min. value: 14 Ohm; Max. value: 21 Ohm;	Carry out the recommended measurements.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
008	03	ELECTRO-VALVES - FRONT RIGHT ABS ELECTRO-VALVE	SHORT CIRCUIT TO POS-ITIVE		Possible short circuit.	Check wiring and con-nectors.	1- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 1 Measure point 2: Connector X1 Pin: 4 2- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 4 Measure point 2: Connector X1 Pin: 4	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Max. value: 1 V; 2- Max. value: 1 V;	Carry out the recom-mended measure-ments.
008	05	ELECTRO-VALVES - FRONT RIGHT ABS ELECTRO-VALVE	OPEN CIR-CUIT		Possible open circuit or inter-rupted cable be-tween.	Check wiring and con-nectors.	1- Measure type: Re-sistance (Ohm) Measure point 1: Connector X2 Pin: 1 Measure point 2: Connector X1 Pin: 4 2- Measure type: Re-sistance (Ohm) Measure point 1: Connector X2 Pin: 4 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 14 Ohm; Max. val-ue: 21 Ohm; 2- Min. value: 14 Ohm; Max. val-ue: 21 Ohm;	Carry out the recom-mended measure-ments.
008	06	ELECTRO-VALVES - FRONT RIGHT ABS ELECTRO-VALVE	SHORT CIRCUIT TO GROUND		Possible short circuit.	Check wiring and con-nectors.	1- Measure type: Re-sistance (Ohm) Measure point 1: Connector X2 Pin: 1 Measure point 2: Connector X1 Pin: 4 2- Measure type: Re-sistance (Ohm) Measure point 1: Connector X2 Pin: 4 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 14 Ohm; Max. val-ue: 21 Ohm; 2- Min. value: 14 Ohm; Max. val-ue: 21 Ohm;	Carry out the recom-mended measure-ments.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
009	03	ELECTRO-VALVES - REAR LEFT ABS ELECTRO-VALVE	SHORT CIRCUIT TO POSITIVE		Possible short circuit.	Check wiring and connectors.	1- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 2 Measure point 2: Connector X1 Pin: 4 2- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 5 Measure point 2: Connector X1 Pin: 4	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Max. value: 1 V; 2- Max. value: 1 V;	Carry out the recommended measurements.
009	05	ELECTRO-VALVES - REAR LEFT ABS ELECTRO-VALVE	OPEN CIRCUIT		Possible open circuit or interrupted cable between.	Check wiring and connectors.	1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 2 Measure point 2: Connector X1 Pin: 4 2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 5 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 14 Ohm; Max. value: 21 Ohm; 2- Min. value: 14 Ohm; Max. value: 21 Ohm;	Carry out the recommended measurements.
009	06	ELECTRO-VALVES - REAR LEFT ABS ELECTRO-VALVE	SHORT CIRCUIT TO GROUND		Possible short circuit.	Check wiring and connectors.	1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 2 Measure point 2: Connector X1 Pin: 4 2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 5 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 14 Ohm; Max. value: 21 Ohm; 2- Min. value: 14 Ohm; Max. value: 21 Ohm;	Carry out the recommended measurements.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
00A	03	ELECTRO-VALVES - REAR RIGHT ABS ELECTRO-VALVE	SHORT CIRCUIT TO POS-ITIVE		Possible short circuit.	Check wiring and connectors.	1- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 8 Measure point 2: Connector X1 Pin: 4 2- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 9 Measure point 2: Connector X1 Pin: 4	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Max. value: 1 V; 2- Max. value: 1 V;	Carry out the recommended measurements.
00A	05	ELECTRO-VALVES - REAR RIGHT ABS ELECTRO-VALVE	OPEN CIR-CUIT		Possible open circuit or interrupted cable between.	Check wiring and connectors.	1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 8 Measure point 2: Connector X1 Pin: 4 2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 9 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 14 Ohm; Max. value: 21 Ohm; 2- Min. value: 14 Ohm; Max. value: 21 Ohm;	Carry out the recommended measurements.
00A	06	ELECTRO-VALVES - REAR RIGHT ABS ELECTRO-VALVE	SHORT CIRCUIT TO GROUND		Possible short circuit.	Check wiring and connectors.	1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 8 Measure point 2: Connector X1 Pin: 4 2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 9 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Min. value: 14 Ohm; Max. value: 21 Ohm; 2- Min. value: 14 Ohm; Max. value: 21 Ohm;	Carry out the recommended measurements.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
00D	03	THIRD BRAKE RELAY - THIRD BRAKE RELAY	SHORT CIRCUIT TO POSITIVE		Possible short circuit.	Check for a fault in the fuse 70601 / 5. Check for a fault in the connector ST93 Check that the relay 25104 (E) is working correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 14 Measure point 2: Connector X1 Pin: 4 2- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 14 Measure point 2: Connector X1 Pin: 7	1- Connector Connected; Key +15 ON; 2- Connector Not connected; Key +15 OFF;	1- Max. value: 1 V; 2- Min. value: 14 Ohm; Max. value: 21 Ohm;	Carry out the recommended measurements.
00D	05	THIRD BRAKE RELAY - THIRD BRAKE RELAY	OPEN CIRCUIT		Possible open circuit or interrupted cable between.	Check for a fault in the fuse 70601 / 5. Check for a fault in the connector ST93 Check that the relay 25104 (E) is working correctly. Reset the ECU: 1- With ignition key on "ON" short-circuit Pin 13 (connector X1) to ground for a time between 3 and 6 sec. 2- Wait for 2 sec. 3- Short-circuir again the Pin 13 connector X1 to ground and repeat the procedure for three times; each short-circuit should last at least 0,5 sec. If the procedure has been correctly carried out the ASR indicator switches on (four short pulses). When the ignition key is switched ON again, it is possible to delete the faults memory. If the fault persists, replace the E.C.U.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 14 Measure point 2: Connector X1 Pin: 4 2- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 14 Measure point 2: Connector X1 Pin: 7	1- Connector Connected; Key +15 ON; 2- Connector Not connected; Key +15 OFF;	1- Max. value: 1 V; 2- Min. value: 14 Ohm; Max. value: 21 Ohm;	Carry out the recommended measurements.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
00D	06	THIRD BRAKE RELAY - THIRD BRAKE RELAY	SHORT CIRCUIT TO GROUND		Possible short circuit.	Check for a fault in the fuse 70601 / 5. Check for a fault in the connector ST93 Check that the relay 25104 (E) is working correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 14 Measure point 2: Connector X1 Pin: 4 2- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 14 Measure point 2: Connector X1 Pin: 7	1- Connector Connected; Key +15 ON; 2- Connector Not connected; Key +15 OFF;	1- Max. value: 1 V; 2- Min. value: 14 Ohm; Max. value: 21 Ohm;	Carry out the recommended measurements.
00E	04	VOLTAGE	LOW TENSION/ OPEN CIRCUIT		Possible open circuit or interrupted cable between.	Check for a fault in the fuse 70601 / 4 (Stralis 70602 / 5). Check for a fault in the fuse 70601 / 6 (Stralis 70602 / 6). Check for a fault in the supply wiring. Check the ignition key and voltage stability. Check correct pin location on Electronic control unit, if fault persists, replace.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 7 Measure point 2: Connector X1 Pin: 4 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 8 Measure point 2: Connector X1 Pin: 4	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; 2- Min. value: 22 V; Max. value: 28 V;	Carry out the recommended measurements.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
00E	05	VOLTAGE	GROUND FAULTY OR NOT PRESENT (pin 9 connector X1)		Possible open circuit or interrupted cable between.	Check wiring and connectors. Check: Check correct pin location on Electronic control unit, if fault persists, replace. Comparable values:	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: GND Pin: GND 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 9 Measure point 2: GND Pin: GND 3- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 9 Measure point 2: GND Pin: GND 4- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 4 Measure point 2: GND Pin: GND	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON; 3- Connector Not connected; Key +15 OFF; 4- Connector Not connected; Key +15 OFF;	1- Max. value: 1 V; 2- Max. value: 1 V; 3- Max. value: 3 Ohm; 4- Max. value: 3 Ohm;	Carry out the recommended measurements.
00E	07	THIRD BRAKE RELAY - SUPPLY RELAY (INSIDE THE ELECTRONIC CONTROL UNIT)	FAULT		Ecu internal failure.	Before replacing the control unit make sure that the control unit is powered correctly.	(V)			Carry out the recommended measurements.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
010		PRESSURE SENSOR	SHORT CIRCUIT		Short-circuit, faulty sensor.	Check sensor wiring. Replace sensor if damaged.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 4 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 7 Measure point 2: Connector X1 Pin: 4	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Min. value: 0.5 V; Max. value: 4.5 V; 2- Min. value: 22 V; Max. value: 28 V;	Carry out the recommended measurements.
010	03	PRESSURE SENSOR	SHORT CIRCUIT TO POSITIVE		Shorted to high source	Check sensor wiring. Replace sensor if damaged.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 4 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 7 Measure point 2: Connector X1 Pin: 4	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Min. value: 0.5 V; Max. value: 4.5 V; 2- Min. value: 22 V; Max. value: 28 V;	Carry out the recommended measurements.
010	05	PRESSURE SENSOR	OPEN CIRCUIT OR SHORT CIRCUIT TO GROUND		Open circuit or short-circuiting to negative.	Check sensor wiring. Replace sensor if damaged.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 4 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 7 Measure point 2: Connector X1 Pin: 4	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Min. value: 0.5 V; Max. value: 4.5 V; 2- Min. value: 22 V; Max. value: 28 V;	Carry out the recommended measurements.
012	03	ELECTRO-VALVES - ASR ELECTRO-VALVE	SHORT CIRCUIT TO POSITIVE		Possible short circuit.	Check wiring and connectors.	Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 16 Measure point 2: Connector X1 Pin: 4	Connector Connected; Key +15 ON;	Max. value: 1 V;	Carry out the recommended measurements.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
012	05	ELECTRO-VALVES - ASR ELECTRO-VALVE	OPEN CIRCUIT		Possible open circuit or interrupted cable between.	Check wiring and connectors.Check for a fault in the component. Reset the ECU: 1- With ignition key on "ON" short-circuit Pin 13 (connector X1) to ground for a time between 3 and 6 sec. 2- Wait for 2 seconds. 3-Short-circuir again the Pin 13 connector X1 to ground and repeat the procedure for three times; each short-circuit should last at least 0,5 sec. If the procedure has been correctly carried out the ASR indicator switches on (four short pulses). When the ignition key is switched ON again, it is possible to delete the faults memory. If the fault persists, replace the E.C.U.	Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 7 Measure point 2: Connector X2 Pin: 16	Connector Not connected; Key +15 OFF;	Min. value: 30 Ohm; Max. value: 40 Ohm;	Carry out the recommended measurements.
012	06	ELECTRO-VALVES - ASR ELECTRO-VALVE	SHORT CIRCUIT TO GROUND		Possible short circuit.	Check wiring and connectors.	Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 7 Measure point 2: Connector X2 Pin: 16	Connector Not connected; Key +15 OFF;	Min. value: 30 Ohm; Max. value: 40 Ohm;	Carry out the recommended measurements.
017	05	ABS INDICATOR	SHORT CIRCUIT TO GROUND		Possible causes: blink code activation > 16 sec. by means of switch (pin 15 ecu).	Check for a fault in the fuse 14 and connector ST18, pin 5.	Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 15 Measure point 2: Connector X1 Pin: 4	Connector Connected; Key +15 ON;	Max. value: 1 V;	Carry out the recommended measurements.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
0E7	02	CAN LINE	INPLAUSIBLE VEHICLE SPEED			Check that: - the phonic wheels are not faulty; - teeths are not damaged or missing; - the tyres have equal measure (measures released by constructor), tyres pressure . Verify the axle ratio.				
0E7	05	CAN LINE	OPEN CIRCUIT OR SHORT CIRCUIT TO GROUND OR POSITIVE		Possible open circuit or interrupted cable between.	Check wiring and connectors. Check for reversal of CAN line cables.	1- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 1 (CAN H) Measure point 2: Connector X1 Pin: 3 (CAN L) 2- Measure type: Resistance (KOhm) Measure point 1: Connector X1 ECU Pin: 1 (CAN H) Measure point 2: Connector X1 ECU Pin: 3 (CAN L)	1- Connector Connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Typical Value: 60 Ohm; 2- Min. value: 29 KOhm; Max. value: 33 KOhm;	Carry out the recommended measurements.
0E7	06	CAN LINE	CONNECTION DISABLED		Possible open circuit or interrupted cable between.	Check wiring and connectors.	1- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 1 (CAN H) Measure point 2: Connector X1 Pin: 3 (CAN L) 2- Measure type: Resistance (KOhm) Measure point 1: Connector X1 ECU Pin: 1 (CAN H) Measure point 2: Connector X1 ECU Pin: 3 (CAN L)	1- Connector Connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF;	1- Typical Value: 60 Ohm; 2- Min. value: 29 KOhm; Max. value: 33 KOhm;	Carry out the recommended measurements.

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DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
0E7	07	CAN LINE	TIMEOUT WITH THE RETARDER			Check for correct operation/connection of the control units that are interfaced with each other (e.g.: EDC, GEARBOXES, EBS, ABS, INTARDER, SUSPENSIONS, IMMOBILIZER, others...)				
0E7	08	CAN LINE	DELAY IN THE COMMUNICATION WITH THE EDC E.C.U. (ENGINE BRAKE)			Check for correct operation/connection of the control units that are interfaced with each other (e.g.: EDC, GEARBOXES, EBS, ABS, INTARDER, SUSPENSIONS, IMMOBILIZER, others...)				
0E7	09	CAN LINE	DELAY IN THE COMMUNICATION WITH THE EDC E.C.U. (TORQUE)			Check that the CAN LINE is correctly connected to the other control units. Check for CAN presence on the diagnostic connector.	1- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 1 (CAN H) Measure point 2: Connector X1 Pin: 3 (CAN L) 2- Measure type: Resistance (KOhm) Measure point 1: Connector X1 ECU Pin: 1 (CAN H) Measure point 2: Connector X1 ECU Pin: 3 (CAN L) 3- Measure type: Resistance (Ohm) Measure point 1: 30-pole connector Pin: 21 Measure point 2: 30-pole connector Pin: 22	1- Connector Connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 OFF;	1- Typical Value: 60 Ohm; 2- Min. value: 29 KOhm; Max. value: 33 KOhm; 3- Typical Value: 60 Ohm;	Carry out the recommended measurements.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
0E7	0A	CAN LINE	DELAY IN THE COMMUNICATION WITH THE EDC E.C.U. (ENGINE BRAKE/RETARDER)			Check that the CAN LINE is correctly connected to the other control units. Check for CAN presence on the diagnostic connector.	1- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 1 (CAN H) Measure point 2: Connector X1 Pin: 3 (CAN L) 2- Measure type: Resistance (KOhm) Measure point 1: Connector X1 ECU Pin: 1 (CAN H) Measure point 2: Connector X1 ECU Pin: 3 (CAN L) 3- Measure type: Resistance (Ohm) Measure point 1: 30-pole connector Pin: 21 Measure point 2: 30-pole connector Pin: 22	1- Connector Connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 OFF;	1- Typical Value: 60 Ohm; 2- Min. value: 29 KOhm; Max. value: 33 KOhm; 3- Typical Value: 60 Ohm;	Carry out the recommended measurements.
0E7	0C	CAN LINE	INTERNAL FAULT		Ecu internal failure.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Resistance (KOhm) Measure point 1: Connector X1 ECU Pin: 1 (CAN H) Measure point 2: Connector X1 ECU Pin: 3 (CAN L) 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 7 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 8 Measure point 2: Connector X1 Pin: 4	1- Connector Not connected; Key +15 OFF; 2- Connector Connected; Key +15 ON; 3- Connector Connected; Key +15 ON;	1- Min. value: 29 KOhm; Max. value: 33 KOhm; 2- Min. value: 22 V; Max. value: 28 V; 3- Min. value: 22 V; Max. value: 28 V;	Carry out the recommended measurements.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
0FB	03	VOLTAGE	OVER-VOLTAGE		The alternator charge may be excessive.	Check battery and alternator supply. Check supply voltage.				Check the Tension Regulator or any false contacts on the earth or positive points.
0FD	02	ELEC-TRONIC CON-TROL UNIT	INCOR-RECT WHEEL PARAME-TERS			Reprogram ABS central unit with correct configuration.				If the error persists to replace ECU.
0FD	0C	ELEC-TRONIC CON-TROL UNIT	EEPROM PARAME-TERS NOT CORRECT			Reprogram ABS central unit with correct configuration.				If the error persists to replace ECU.
0FE	05	ELEC-TRONIC CON-TROL UNIT	ASR FUNC-TION DIS-ABLED	Brake controlling ASR disabled.	ECU connector X2 not connected or absence of ground on PIN 2 of each ABS electrovalve.	Check compatibility between vehicle system and E.C.U. configuration.				Check that the ABS ECU programming is convenient for the vehicle system. Check the CAN line with EDC. Check that the EDC ECU is properly programmed.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
0FE	05	ELEC-TRONIC CON-TROL UNIT	ABS-ASR FUNC-TION DIS-ABLED	ABS / ASR dis-abled.	ECU connector X2 not con-nected or ab-sence of ground on PIN 2 of each ABS electro-valve.	Check compatibility be-tween vehicle system and E.C.U. configura-tion.				Check that the ABS ECU pro-gramming is convenient for the ve-hicle system. Check the CAN line with EDC. Check that the EDC ECU is prop-erly pro-grammed.
0FE	08	ELEC-TRONIC CON-TROL UNIT	EXCESSIVE SLIPPING		Mechanical problems in the ASR -System (pneumatic pipes, the ASR electrovalve, ABS-electro-valves, ASR dis-abling switch).	Check phonic wheel and replace it if dam-aged. Check and re-store clearance be-tween sensor and pho-nic wheel. Check: Check the in-tegrity and cleanliness of the phonic wheel. Restore clearance be-tween sensor and pho-nic wheel. Comparable values: 0,7 ± 0,05 mm				
0FE	09	ELECTRO-VALVES - ABS ELEC-TRO-VALVES	ACTIVA-TION TIMES NOT CORRECT		ABS valve enab-ling time incor-rect.	Check that the solenoid connectors in the elec-trical system and the pipes in the pneumatic system have not been inverted.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
0FE	0C	ELEC-TRONIC CON-TROL UNIT	INTERNAL FAULT		Ecu internal fail-ure.	Before replacing the control unit make sure that the control unit is powered correctly.	1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 7 Measure point 2: Connector X1 Pin: 4 2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 8 Measure point 2: Connector X1 Pin: 4	1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON;	1- Min. value: 22 V; Max. value: 28 V; 2- Min. value: 22 V; Max. value: 28 V;	Carry out the recom-mended measure-ments.

SECTION 2 - Main operating faults of a mechanical nature

Visible Failure	Possible cause	Repair action
Poor or abnormal system charge	Air system pipes leak or burst.	Close or replace the worn or damaged fittings. Replace the burst or damaged pipes.
	Inefficient air compressor operation.	Overhaul or replace the air compressor.
	Inefficient A.P.U. operation.	Overhaul or replace the A.P.U..
Poor or abnormal service braking of the rear axle	Air system pipes leak or burst	Close or replace the worn or damaged fittings. Replace the burst or damaged pipes.
	Brake linings worn and/or vitrified.	Overhaul or replace the brake linings.
	Inefficient operation of the rear brakes.	Overhaul the rear brakes.
	Inefficient operation of the Duplex control valve.	Overhaul or replace the Duplex control valve.
	Inefficient operation of the brake cylinders.	Overhaul or replace the brake cylinders.
	Inefficient operation of the ABS solenoid valve	❑ Check the electric wiring. ❑ Replace the ABS solenoid valve.
	Inefficient operation of the electro-pneumatic modulator of the rear axle (vehicles with EBS).	❑ Check the wiring. ❑ Replace the electro-pneumatic modulator.
	Inefficient operation of the automatic clearance recovery device.	Replace the complete brake calliper.
Poor or abnormal service braking of the front axle	Air system pipes leak or burst.	Close or replace the worn or damaged fittings. Replace the burst or damaged pipes.
	Inefficient operation of the Duplex control valve.	Overhaul or replace the Duplex control valve.
	Brake linings worn and/or vitrified.	Overhaul or replace the brake linings.
	Inefficient operation of the front brakes.	Overhaul the front brakes.
	Inefficient operation of the relay valve.	Overhaul ore replace the relay valve.
	Inefficient operation of the diaphragm brake cylinders.	Overhaul or replace the diaphragm brake cylinders.
	Inefficient operation of the automatic clearance recovery device.	Replace the complete brake calliper.
	Inefficient operation of the ABS solenoid valve.	❑ Check the electric wiring. ❑ Replace the ABS solenoid valve.

(continues)

Visible Failure	Possible cause	Repair action
Poor or abnormal trailer service braking	Air system pipes leak or burst.	Close or replace the worn or damaged fittings. Replace the burst or damaged pipes.
	Inefficient operation of the triple control servo control valve.	Overhaul or replace the triple control servo control valve.
	Inefficient operation of the Duplex control valve.	Overhaul or replace the Duplex control valve.
	Inefficient operation of the A.P.U..	Overhaul or replace the A.P.U..
	Brake linings worn and/or vitrified.	Overhaul or replace the brake linings.
	Inefficient operation of the trailer brakes.	Overhaul the trailer brakes.
	Inefficient operation of the electro-pneumatic modulator of the rear axle (vehicles with EBS).	❑ Check the wiring ❑ Replace the electro-pneumatic modulator
Poor or no parking braking	Air system pipes leak or burst.	Close or replace the worn or damaged fittings. Replace the burst or damaged pipes.
	Inefficient operation of the combined brake cylinders.	Overhaul or replace the combined brake cylinders.
	Inefficient operation of the parking brake manual control valve (lever).	Overhaul or replace the lever.
	Brake linings worn and/or vitrified.	Overhaul or replace the brake linings.
	Inefficient operation of the relay valve.	Overhaul or replace the relay valve.
	Inefficient operation of the rear brakes.	Overhaul the rear brakes.
Poor or no trailer parking braking	Air system pipes leak or burst.	Close or replace the worn or damaged fittings. Replace the burst or damaged pipes.
	Inefficient operation of the triple control servo control valve.	Overhaul or replace the triple control servo control valve.
	Inefficient operation of the parking brake manual control valve (lever).	Overhaul or replace the lever.
	Trailer brake linings worn and/or vitrified.	Overhaul or replace the trailer brake linings.
	Inefficient operation of the trailer brakes.	Overhaul the trailer brakes.
	Inefficient operation of the trailer control servo control valve.	❑ Check the electric wiring. ❑ Replace the trailer control servo control valve.

(continues)

Visible Failure	Possible cause	Repair action
Parking brake release delayed	Air system pipes leak or burst.	Close or replace the worn or damaged fittings. Replace the burst or damaged pipes.
	Inefficient operation of the relay valve.	Overhaul or replace the relay valve.
	Inefficient operation of the combined brake cylinders.	Overhaul or replace the combined brake cylinders.
	Inefficient operation of the parking brake manual control valve (lever).	Overhaul or replace the lever.
	Inefficient operation of the rear brakes.	Overhaul the rear brakes.
Trailer parking brake release delayed	Air system pipes leak or burst.	Close or replace the worn or damaged fittings. Replace the burst or damaged pipes.
	Inefficient operation of the triple control servo control valve.	Overhaul or replace the triple control servo control valve.
	Inefficient operation of the parking brake manual control valve (lever).	Overhaul or replace the lever.
	Inefficient operation of the trailer brakes.	Overhaul the trailer brakes.
The vehicle skids when braking	Air system pipes leak or burst.	Close or replace the worn or damaged fittings. Replace the burst or damaged pipes.
	Inefficient operation of the Duplex control valve.	Overhaul or replace the Duplex control valve.
	Inefficient operation of the front brakes.	Overhaul the front brakes.
	Inefficient operation of the rear brakes.	Overhaul the rear brakes.
	Inefficient operation of the triple control servo control.	Overhaul or replace the triple control servo control.
Insufficient trailer retarder braking	Air system pipes leak or burst.	Close or replace the worn or damaged fittings. Replace the burst or damaged pipes.
	Inefficient operation of the A.P.U..	Overhaul or replace the A.P.U..
	Inefficient operation of the triple control servo control valve.	Overhaul or replace the triple control servo control valve.
	Inefficient operation of the parking brake manual control valve (lever).	Overhaul or replace the lever.

(continues)

Visible Failure	Possible cause	Repair action
Early wear of the brake linings	Inefficient operation of the Duplex control valve.	Overhaul or replace the Duplex control valve.
	Inefficient operation of the brakes.	Overhaul the brakes.
	Inefficient operation of the triple control servo control valve.	Overhaul or replace the triple control servo control valve.
	Inefficient operation of the relay valve.	Overhaul or replace the relay valve.
Brake system warning light on	Air system pipes leak or burst.	Close or replace the worn or damaged fittings. Replace the burst or damaged pipes.
	Inefficient operation of the A.P.U.	Overhaul or replace the A.P.U..
	Wrong wiring of the electric circuit of the indicator light.	Find the wrong connection and restore the wiring.
Parking brake indicator light on with lever in driving position	Wrong wiring of the electric circuit of the indicator light.	Find the wrong connection and restore the wiring.
	Inefficient operation of the parking brake manual control valve (lever).	Overhaul or replace the lever.
	Inefficient operation of the A.P.U..	Overhaul or replace the A.P.U..
Noisy brakes	Worn brake linings.	Replace the brake linings.
	Foreign bodies between the brake linings and discs (disc brakes).	Remove the foreign bodies between the brake linings and discs.
	Brake discs off centre (disc brakes).	Grind or replace the brake discs.
	Inefficient shoe return springs (drum brakes).	Overhaul the rear brakes.
	Excessive ovalization of the brake drums (drum brakes).	Turn or if necessary replace the drums.

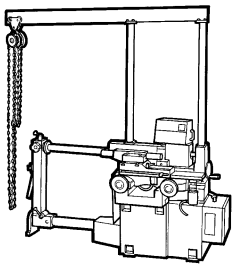
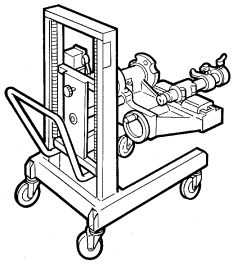
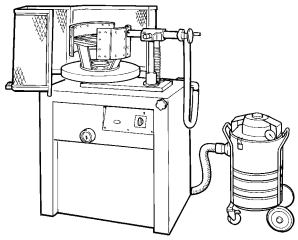
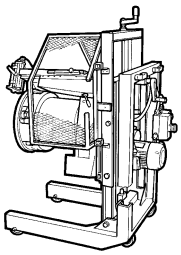
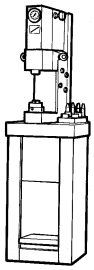
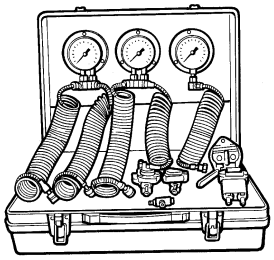
TIGHTENING TORQUES

PART	TORQUE	
	Nm	(kgm)
Compressor		
Nut fixing pulley	200	(20.4)
Combined brake cylinder (for disc brakes)		
Nuts for bolts fixing cylinder to brake calliper	180 + 30	(18.3 + 0.3)
Manual brake release screw (type 14 – front disc brakes)	max 35	(max 3.6)
Manual brake release screw (type 20/27 – rear disc brakes)	max 70	(max 7.1)
Fixing fittings	40 ± 5	(4 ± 0.5)
Combined brake cylinder (for drum brakes)		
Manual brake release screw	315 ± 15	(32.1 ± 1.5)
Ring nut fixing brake cylinder	30 ± 1	(3 ± 0.1)
Fixing fittings	40 ± 5	(4 ± 0.5)
Diaphragm brake cylinder (for disc brakes)		
Nut for fixing cylinder to brake calliper	180 + 30	(18 + 3)
Fixing fittings	40 ± 5	(4 ± 0.5)
Front axle disc brakes 5876-57080/DI		
Self-locking hex screw M20 x 1.5 fixing brake callipers	615.5 ± 61.5	(62.7 ± 6.2)
Nut fixing wheels	665.5 ± 66.5	(67.8 ± 6.7)
Self-locking hex screw to fix brake disc to wheel hub	281.5 ± 13.5	(28.7 ± 1.3)
Self-locking hex screw M16 x 1.5 to fix brake calliper mount to stub axle	313.5 ± 15.5	(32 ± 1.6)
Threaded plug for wheel hub cover	55 ± 5	(5.5 ± 0.5)
Ring nut fixing wheel bearings	515.5 ± 24.5	(52.6 ± 2.5)
Cylindrical head screw with hex socket to lock wheel bearing adjustment clamp	27.5 ± 2.5	(2.8 ± 0.2)
Cover for wheel hub ♦	130 ± 10	(13 ± 1)
Front axle disc brakes 55080/DI		
Nut fixing wheel	$600\ ^{+50}_{-20}$	$(61.2\ ^{+5}_{-2})$
Hex screw to fix brake disc to wheel hub	281.5 ± 13.5	(28.7 ± 1.3)
Threaded plug for wheel hub cover	55 ± 5	(5.5 ± 0.5)
Nut fixing wheel bearings	515.5 ± 24.5	(52.6 ± 2.5)
Cover for wheel hub ♦	130 ± 10	(13 ± 1)
Screw fixing nut	27.5	(2.8)
Screw fixing mount	289.5 ± 14.5	(29.5 ± 1.5)
Screw fixing brake calliper	615 ± 61	(62.7 ± 6.2)

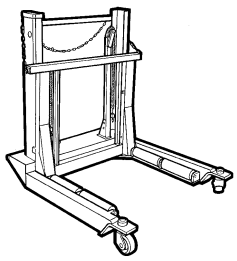
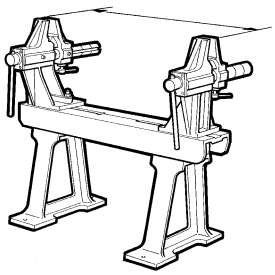
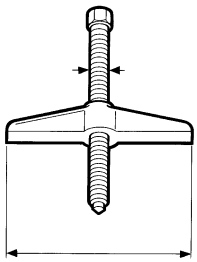
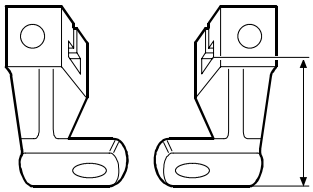
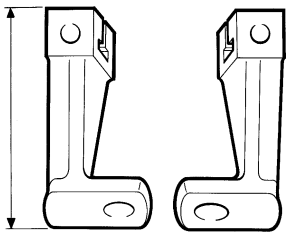
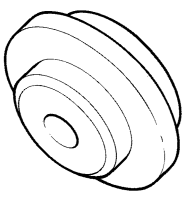
♦ Spread a bead of sealant solely on the mating surface of the hub cover, using the specific metering device. Protect the threaded part. Use LOCTITE sealant type 574.

PART	TORQUE	
	Nm	(kgm)
Added rear axle disc brakes 56082/1		
Nut fixing wheels	665 ± 61.5	(67.8 ± 6.2)
Screw fixing drive shaft flange • *	90 ± 10	(9.2 ± 1)
Ring nut fastening wheel hub bearing	932 ± 98	(95 ± 10)
Screw fixing brake disc to wheel hub	281.5 ± 13.5	(28.7 ± 1.3)
Nut for screw fixing brake calliper to mount	615.5 ± 61.5	(62.7 ± 6.2)
Nut for screw fixing brake calliper mount	289.5 ± 14.5	(29.5 ± 1.5)
• Apply LOCTITE 243 sealant onto the thread * Spread the drive shaft / wheel hub contact surface with sealant type IVECO 1905685 (LOCTITE 14780)		
MS 13-175 - MT 23-155 rear axle disc brakes		
Nut fixing wheels	665.5 ± 61.5	(67.8 ± 6.2)
Screw fixing drive shaft flange *	262 ± 27	(26.7 ± 2.7)
Ring nut fastening wheel hub	932 ± 98	(95 ± 10)
Screw fixing brake disc to wheel hub	281.5 ± 13.5	(28.7 ± 1.3)
Screw fixing brake calliper to mount	615.5 ± 61.5	(62.7 ± 6.2)
Nut for screw fixing brake calliper mount	289.5 ± 14.5	(29.5 ± 1.5)
* Spread the flange / wheel hub contact surface with sealant type IVECO 1905685 (LOCTITE 14780)		
Rear axle drum brakes 451391/1		
Screw fixing drum	50 ± 5	(5 ± 0.5)
Screw fixing drive shaft flange *	50 ± 5	(5 ± 0.5)
Brake support clamping screw	295 ± 30	(29.5 ± 3)
Nut fixing wheels	600^{+50}_{-20}	$^{+5}_{-2}$
* Apply LOCTITE 573 sealant onto the thread		

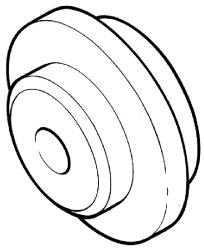
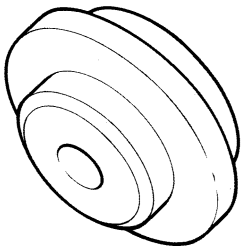
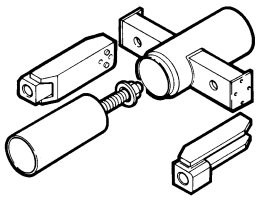
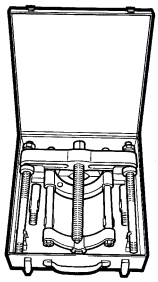
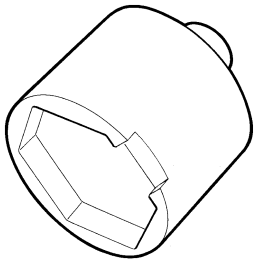
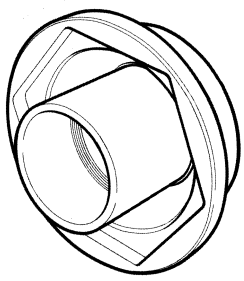
TOOLS

TOOL NO.		DESCRIPTION
99301001		Grinding and turning machine for brake discs and drums
99301005		Brake disc turning device
99301006		Brake shoe turning device
99305079		Brake shoe turning device
99305087		Rivet press
99305117		Instrument to check air circuits

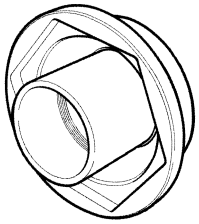
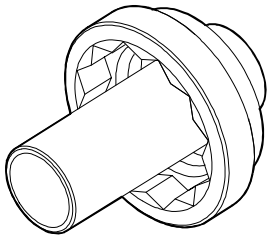
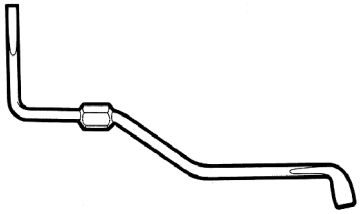
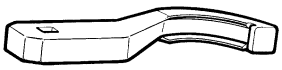
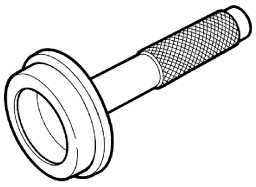
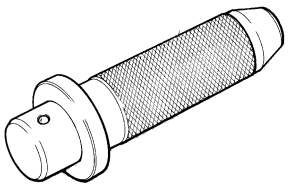
TOOLS

TOOL NO.		DESCRIPTION
99321024		Hydraulic trolley to remove and refit wheels
99322215		Stand for overhauling front and rear axles
99341003		Single-acting bridge
99341016		Pair of brackets with hole
99341017		Pair of brackets with hole
99345049		Reaction block for extractors

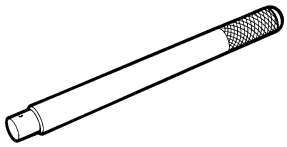
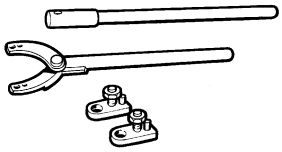
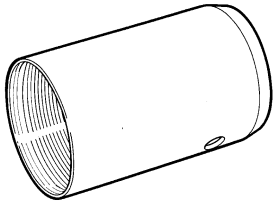
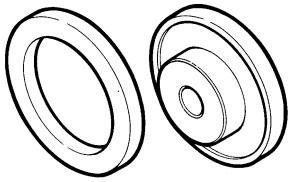
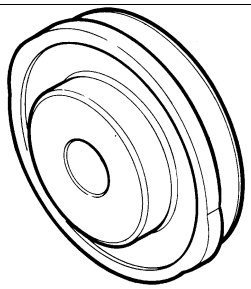
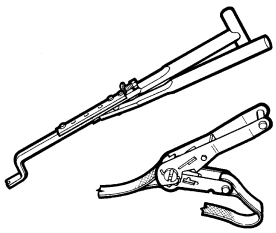
TOOLS

TOOL NO.		DESCRIPTION
99345053		Reaction block for puller tools
99345055		Reaction block for puller tools
99345103		Wheel hub fitting tool
99348001		Extractor with locking device
99354207		Wrench for wheel hub sumps
99355167		Wrench (114 mm) for wheel hub bearing adjustment nut

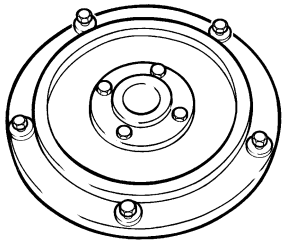
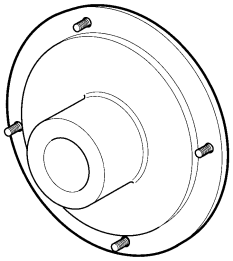
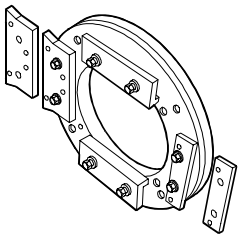
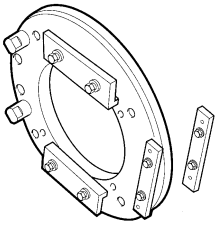
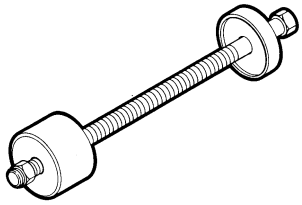
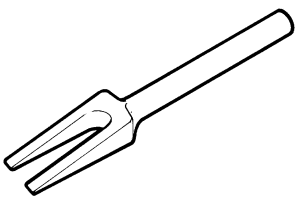
TOOLS

TOOL NO.		DESCRIPTION
99355175		Wrench (105 mm) for wheel hub bearing adjustment nut
99355180		Wrench (105 mm) for wheel hub bearing adjustment nut
99356001		Wheel brake shoes adjusting wrench
99356006		Wrench to remove and refit brake cylinder ring nut (use with 99389817)
99370005		Grip for interchangeable drifts
99370006		Grip for interchangeable drifts

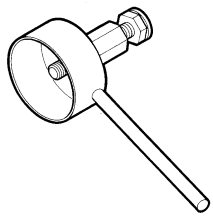
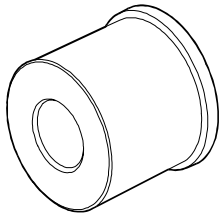
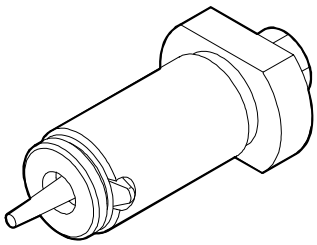
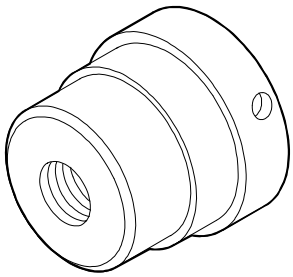
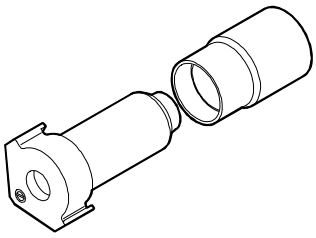
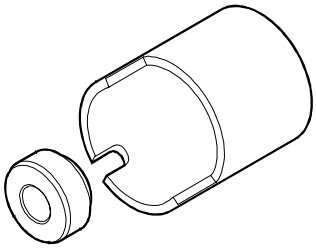
TOOLS

TOOL NO.		DESCRIPTION
99370007		Grip for interchangeable drifts
99370317		Reaction lever with extension to fasten flanges
99370700		Guide to fit wheel hub
99370706		Tool to drive in wheel hub bearing
99370708		Tool to drive out wheel hub bearing
99372211		Tool to remove and refit brake shoe retainer springs

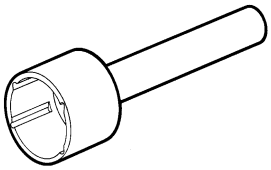
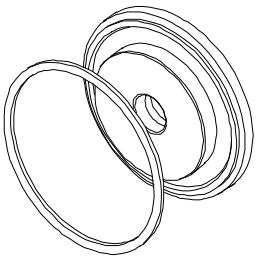
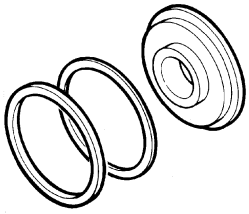
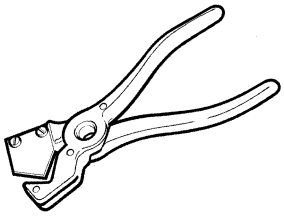
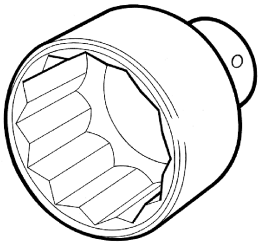
TOOLS

TOOL NO.		DESCRIPTION
99372213		Tool for turning brake drum (use with 99301001)
99372228		Hub for positioning dismantled floating shoe turning tools on lathe 99301001
99372230		Tool for turning dismantled floating shoes (Rockwell 410) (use with 99301001 – 99372228)
99372231		Tool for turning dismantled floating shoes (Perrot 410) (use with 99301001 – 99372228)
99372237		Tool to mount brake caliper sliding bush guard
99372238		Tool to extract brake caliper thrust units

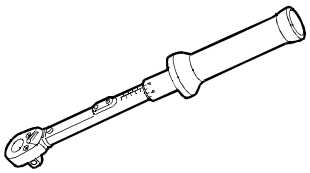
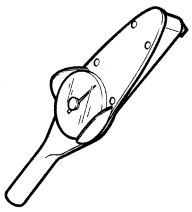
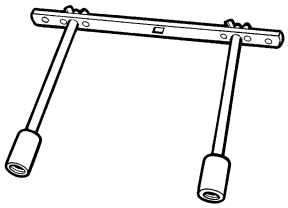
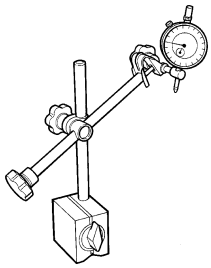
TOOLS

TOOL NO.		DESCRIPTION
99372239		Tool to mount thrust units with brake caliper guard
99372240		Tool to remove and refit brake caliper sliding bush guide bushings (use with 99372237)
99372242		Tool for notching brake caliper sliding bush guide bushing
99372243		Tool for mounting thrust pressure inner seals (use with 99372239) and for mounting the brass bush of brake caliper guide pin (use with 99372240 and with the screw of 99372237)
99372244		Tool for mounting the rubber bush of brake caliper guide pin (use with the screw of 99372237)
99372245		Tool for dismounting the rubber bush of brake caliper guide pin (use with the screw of 99372237)

TOOLS

TOOL NO.		DESCRIPTION
99373004		Key to remove brake cylinder gasket (Rockwell)
99374132		Installer, wheel hub inner seal (use with 99370006)
99374134		Installer, wheel hub inner seal
99387050		Cutters for polyamide pipes
99388001		Wrench (80 mm) for wheel hub bearing adjustment nut
99389816		Torque multiplier x 4, with square fitting, 3/4" in, 1" out (maximum torque 2745 Nm)

TOOLS

TOOL NO.		DESCRIPTION
99389817		Torque wrench (60-32 Nm) with 1/2" square fitting
99389819		Torque wrench from 0 to 0.9 kgm with 1/4" square fitting
99395026		Tool to check rolling torque of wheel hubs (use with torque wrench)
99395684		Dial gauge with magnetic base

SPECIFICATIONS AND DATA - PNEUMATIC SYSTEM

DESCRIPTION	
Compressor	
❑ **WABCO 412 352 008**	Single cylinder
Capacity	352 cm^3
Bore	85 mm
Stroke	62 mm
Head cooling	Water
Max. continuous rpm	3000 r.p.m.
Max. working pressure	14 bar
❑ **KNORR-BREMSE Z006051 (2W630R)**	Twin cylinder
Capacity	628 cm^3
Bore	86 mm
Stroke	54 mm
Head cooling	Water
Max. continuous rpm	3060 r.p.m.
Max. working pressure	14 bar

A.P.U. (Air Processing Unit)

❑ **KNORR Z 007036**

Max. working pressure	bar	13 bar					
Safety valve opening pressure	bar	14.5 + 4					
Circuit		1	2	3	4	3	4
Fitting for second		21	22	23	24		26
Opening pressure (The circuit 1+2 are filled first)	bar	$7.5^{+0.2}_{0}$		$8.0^{-0}_{0.2}$			
Opening pressure of the integrated safety valve	bar	≥ 11		> = 9.2			
Static closing pressure. (Without compensation, with 0 bars in the circuit out of service)	bar	6.5 ± 0.25		6.5 ± 0.25			
Working pressure	bar	$10.4_{-0.4}$		8.5 - 0.3		8.5 - 0.5	
Pressure limiter on/off pressure difference	bar	< = 0.8		< = 0.65			
Switch off pressure	bar	12.5 + 0.2					
On/off pressure difference	bar	1 + 0.6					
Working temperature		-40 to +80°C					

❑ **KNORR Z 007035**

Max. working pressure	bar	13					
Safety valve opening pressure	bar	13 + 4					
Circuit		1	2	3	4	3	4
Fitting for second		21	22	23	24		26
Opening pressure (The circuits 1+2 are filled first)	bar	$7.5^{+0.2}_{0}$		$8.0^{0}_{-0.2}$			

DESCRIPTION								
Union for second one:			21	22	23	24		26
Opening pressure of the integrated safety valve	bar		> = 9.2					
Opening pressure of the integrated safety valve	bar		> = 9.2					
Static closing pressure (Without compensation, with 0 bars in the circuit out of service)	bar	6.5 ± 0.25	6.5 ± 0.25					
Limiting pressure	bar				8.5 - 0.3		8.5 - 0.5	
Pressure limiter on / off pressure difference	bar		< = 0.65					
Switch-off pressure	bar	10.5 + 0.2						
On / off pressure difference	bar	0.8 + 0.5						
Working temperature		-40°C to +80°C						

Air tanks

4 x 2 vehicles	Tank capacity				Total capacity	Working pressure
	15l	20l	30l	80l		
190 E.. P / FP-GV		2	1		40	10.5
190 E.. FP-CM		2	1		90	12.5
440 E.. TP / TFP		2	1		40	10.5
6 x 2 p vehicles 260 E.. YP / YPS / YPT / YFP / YFS / YFP - CM 440 E.. TY/PT		3	1		60	10.5/12.5
6 x 4 vehicles 260 E.. ZP / 260 E.. TZP		3	1		60	10.5
6 x 2 c vehicles 440 E.. TXP	1	2	1		55	10.5

Manual discharge valve

❑ VOSS 520 899 750 0 - TECHNOMATIK TP 1609.00.00 - SIRIT VSM2215

Maximum working pressure 13 bar

ABS duplex control valve

❑ KNORR - BREMSE DX 60 A

Supply pressure 10.5 bar

Working pressure 10.5 bar

Relay valve

❑ KNORR - BREMSE AC574AXY

Working pressure 10.2 bar

ABS-EBS solenoid valve

❑ WABCO 472 195 055 0

Maximum working pressure 13 bar

Voltage 24 V

❑ KNORR BREMSE Z 012356

Maximum working pressure 10.2 bar

Voltage 24 V

Dual stop valve (for vehicles with EBS)

❑ WABCO 434 500 003

Working pressure 10 bar (max)

Dual stop valve (for vehicles with ASR or EBS)

❑ WABCO 434 208 029

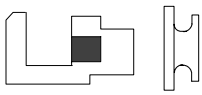
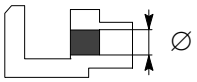
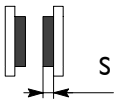
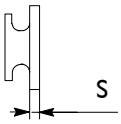
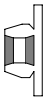
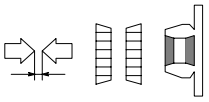
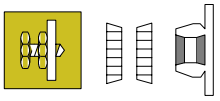
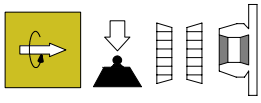
Supply pressure 10 bar (max)

DESCRIPTION	
ABS trailer triple servo control valve	
❑ WABCO 973 009 0130 - KNORR - BREMSE AC 597 B	
Supply pressure	8.5 bar
Predominance	0.2 bar
Differential control pressure (pipes 42 and 22)	$2.5^{+0.3}_{-0.5}$ bar
Parking brake control valve (vehicles suited for towing)	
❑ KNORR - BREMSE DPM 90 EY	
Supply and working pressure	8.5 bar
Travel of control lever (discharge) with start of emergency braking (point of resistance)	67°
Parking braking	73°
Test braking to check supply to triple control valve	86°
Pressure sensor (for vehicles with ABS/EBL)	
❑ WABCO 441 044 002 0	
Supply voltage	8 - 32 V
Field of measurement	0 - 10 bar
Controlled pressure valve	
❑ WABCO 434 100 199 - KNORR - BREMSE 1B 435 47 - BENDIX VPC 4M	
Opening pressure	$7^{+0.1}_{-0.3}$ bar
One-way valve	
❑ PEL 50 473 - C	
Working pressure	12 bar
Backpressure	0.2 bar
Low-pressure switch	
❑ F 130 46 S - F 130 47 S	
Trip pressure	6.6 ± 0.2 bar
ASR control normally-closed solenoid valve	
❑ WABCO 472 170 606 0	
Working pressure	5.5 ÷ 11 bar
Maximum supply pressure	13 bar
Voltage	24 V
Current	0.69 A
Rear axle braking redundant valve (EBS)	
❑ WABCO 472 173 226 0	
Working pressure	0 ÷ 11 bar
Maximum supply pressure	13 bar
Voltage	$24^{+8}_{-6.5}$ V
Current	0.69 A
ABS electronic control unit	
❑ BOSCH 446 004 606 0	
Supply voltage	24 V

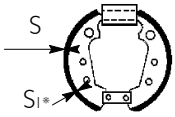
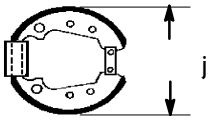
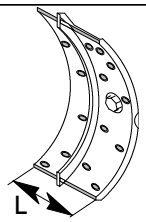
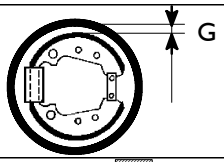
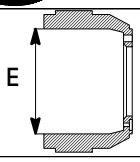
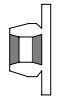
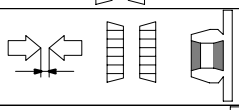
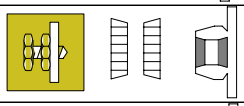
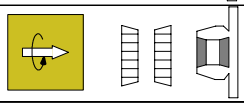
DESCRIPTION	
CBU (Central Brake Unit) (for vehicle with EBS system)	
❑ WABCO 480 020 010 0	
Feed pressure	12.7 bar
Maximum working pressure	13 bar
Terminal voltage	24+8 V
Current absorption	0.5 - 11 A
ESP electronic central unit (option for tractors only)	
❑ WABCO 446 065 020 0	
Supply voltage	8 to 32 V
EBS system rear axle electropneumatic modulator	
❑ WABCO 480 104 000 0	
Maximum working pressure	15 bar
Terminal voltage	$24^{+6}_{-9,5}$ V
Terminal max current	10 A/10 bar
EBS trailer servo control valve	
❑ WABCO 480 204 002 0	
Supply pressure	8.5 bar
Max. working pressure	13 bar
Voltage	$24^{+8}_{-6,5}$ V
Max. permanent voltage between orifice 6.4 and 6.5	8 V
Max. current	1.4A / 8 bar
Outlet pressure (p 22)	8.5 bar
On-off valve (For Sweden only)	
❑ WABCO 434 205 061	
Maximum working pressure	10 bar
Diaphragm brake cylinder (for front disc brake)	
❑ Type 20: KNORR - BREMSE Z 011564	
Maximum working pressure	10.7 bar
Minimum stroke	64 mm
❑ Type 22: KNORR - BREMSE Z 011553	
Maximum working pressure	10.7 bar
Minimum stroke	64 mm
❑ Type 24: KNORR - BREMSE Z 010464	
Maximum working pressure	10.7 bar
Minimum stroke	64 mm

DESCRIPTION	
Diaphragm brake cylinder (for added axle disc brake)	
❑ Type 12: KNORR - BREMSE Z 017212	
Maximum working pressure	10.2 bar
Minimum stroke	57 mm
❑ Type 14: KNORR - BREMSE Z 018285	
Maximum working pressure	10.7 bar
Minimum stroke	57 mm
Combined brake cylinder (for front disk brake)	
❑ Type 14: KNORR - BREMSE Z 003479	
❑ Type 14: KNORR - BREMSE Z 003480	
Maximum working pressure	
- fitting 11	10.7 bar
- fitting 12	8.5 bar
Minimum stroke	64 mm
Combined brake cylinder (for rear disc brake)	
❑ Type 20/27 KNORR - BREMSE Z 018049	
Maximum working pressure	
- fitting 11	13 bar
- fitting 12	11 bar
Minimum stroke	64 mm
Combined brake cylinder (for rear drum brake)	
❑ Type 18/24 HF KNORR - BREMSE IC 559 76	
Maximum working pressure	8.5 bar
Minimum stroke	53 mm
❑ Type 20/24 HF KNORR - BREMSE IC 559 78	
Maximum working pressure	8.5 bar
Minimum stroke	53 mm

SPECIFICATIONS AND DATA - BRAKES

	**DISC BRAKES:** **FRONT AXLE** **CENTRAL ADDED AXLE** **REAR AXLE** **REAR ADDED AXLE**		**5876** **5876/4/5** **5876/4** **MS13-175 / MT23-155** **55080/DI - 57080/DI** **56082/DI**	
	Brake calliper cylinders: - number - diameter	 Ø mm	 2 68	
	Brake lining thickness: - normal - minimum permissible	 S mm S mm	 21 2	
	Brake disc diameter	Ø mm	432	
	Brake disc thickness: - normal - minimum permissible	 S mm S mm	 45 37 (4 mm each side)	
	Operating clearance	G mm	0.5 ÷ 1	
	**WHEEL HUBS**		FRONT AXLES 5876/4/5 - 55080/DI-57080/DI	56082/DI
	Wheel hub bearings		2 with tapered rollers	2 with tapered rollers Unit-Bearing
	Hub bearing end float	mm	max 0.16	-
	Hub bearing end float adjustment		Not adjustable Tightening ring nut to torque	
	Rolling torque	da Nm	0.50 max.	
	Tutela W140/M - DA Quantity of oil for each hub	Litres kg	0.33 (•) 0.30 (•)	- -

(•) For rear axles MS 13-175 and MT 23-155, see section Rear Axles.

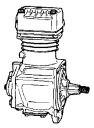
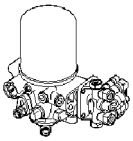
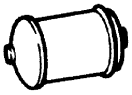
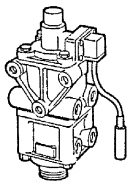
ROCKWELL DRUM BRAKES	REAR AXLE 451391
 Drum diameter: - Nominal Ø mm - 1st uprating Ø mm - 2nd uprating Ø mm	 410 to 410.4 412 414
 Brake lining thickness: - Nominal S mm - 1st uprating S mm - 2nd uprating S mm - minimum permissible S_{1*} mm	 22.1 23.1 24.1 5
* In correspondence with the last rivet, on the opposite side of the pin, of the shoe with wear sensor.	
 Diameter of brake linings: - Nominal S mm - 1st uprating S mm - 2nd uprating S mm	 407.5 to 409 409.5 to 411 411.5 to 413
 Width of brake linings: L mm	200
 Clearance between brake linings and drum G mm	1 to 1.125
 Maximum error of concentricity in the drum diameter after turning E mm	0.04
 **WHEEL HUBS**	
 Wheel hub bearings	2 with tapered rollers (Unit Bedring)
 Hub bearing end float mm	Not adjustable
 Hub bearing end float adjustment	Tightening to torque with ring nut
 Wheel hub bearing rolling torque	-
 Oil for wheel hub bearings Tutela W 140/M DA Litres Quantity of oil for each hub kg	(•) (•)

(•) See section Rear Axle

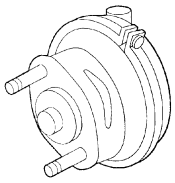
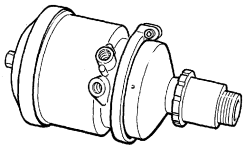
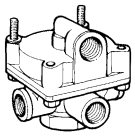
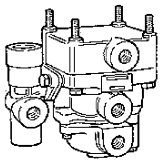
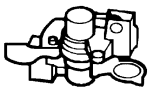
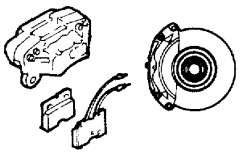
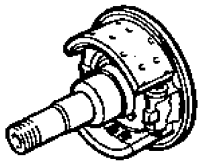
CHECKS ON MAIN COMPONENTS OF BRAKE SYSTEM

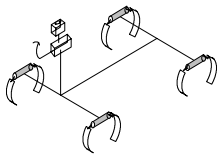
Since the vehicle system is type approved to European code standards, it is vital to periodically check its efficiency and that of the relevant components with the device 99305117.
These checks should be carried out with the vehicle stationary, using the compressed air of the tanks filled by the compressor, with the engine started.

NOTE Always lock the vehicle before doing any work. Periodically check the pressure gauges, comparing them with a sample pressure gauge.

DEVICE	DESCRIPTION	TASK
	Compressor	Check the tightness of fittings and compressor fixing; make sure the cooling fins are not dirty.
	A.P.U. (Air Processing Unit)	Using a bleed valve or loosening a screw plug (with integrated bleed hole), check whether the air drier works properly. In this case, the air needs to come out of the tank without there being any trace of condensation water.
	Air tanks for: ❑ Front axle ❑ Rear axle ❑ Parking + trailer ❑ Services ❑ For regeneration	Check the seal and corrosion protection. Drain the condensate off from the tanks via the drain valve.
	Duplex control valve	Check that the pedal gasket is not worn, that the brake control linkage is properly tightened and lubricated, not out of shape. Check that the lever housings are neither worn nor oxidized.
	Pneumatic pressure test points	Check the safety caps are on
	Parking brake control valve	Apply the parking brake control valve till it trips; the pressure gauge on the test point has to show pressure discharge down to 0 bar in 1 sec.
	Parking brake control valve (with check position)	At the same time, at the automatic coupling pipe, the pressure gauge has to show a pressure of 7.5 bars.

(continued)

	**Diaphragm cylinder**	Check its fixing, integrity and seal. The bleed hole must be facing downwards and must not be clogged.
	**Combined cylinder**	Check its fixing, integrity and seal. The bleed hole must be facing downwards and must not be clogged.
	**Relay valve**	Check its operation and seal, evaluating how fast the brake cylinders act.
	**Servo control valve with triple control for trailer braking, with modulated servo diverter incorporated**	Fill the tank. Connect one pressure gauge to the automatic coupling head and one to the graduated coupling head. A pressure of 1 bar, sent by the twin control valve, must at the graduated coupling head correspond to a pressure of from 0.8 to 1.5 bars. Make a full braking (vehicle stationary). The coupling head must have available the required braking pressure or a pressure decreased by 0.5 bars. Apply the parking brake; at the graduated coupling head, the pressure must stay unchanged or decreased by 0.5 bars.
	**Coupling heads**	Check there is no dirt or damage in the coupling guides. After coupling is made, press the brake pedal and check the seal and stability between the coupling heads introducing air at 8.5 bars. Check there is no air leakage from the coupling gaskets.
	**Disc brake calliper** **Brake disc** **Brake linings**	Check the wear of the brake linings, scoring and wear of the brake disc, efficiency of the pistons, wear of the dust caps.
	**Drum brakes**	When the pressure on the pedal stops, the shoes need to return to the rest position quickly and evenly on all the wheels. Check the clearance between shoes and drum. Check the thickness of the brake linings.

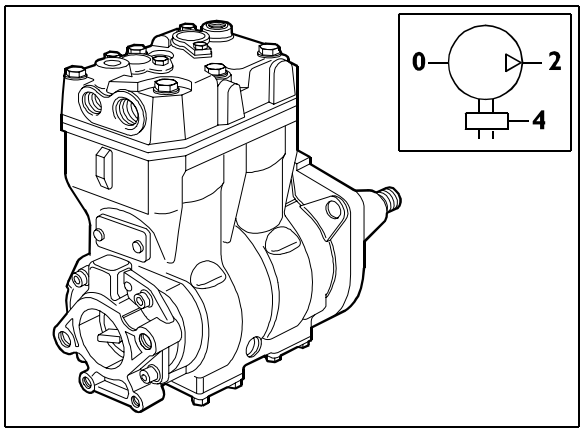


Pipes and fittings	Check the metal pipes are in a perfect state, with no dents or cranks; the polyamide pipes must have no cracking or cuts. Check moreover they are far from sharp edges of the bodywork and chassis that could damage them. Check that all the pipe brackets are firmly secured, their slackening causes vibration with the ensuing risk of breakage. Check that the polyamide pipes have not come into contact with oil or mineral grease, rubber solvents. Press forcefully on the brake pedal and check the pipes do not swell. Check there is no leakage from the various fittings or it will be necessary to tighten them fully, but taking care not to cause any abnormal torsion on the pipes. In all the above cases it is necessary to replace the relevant parts if there is even the slightest doubt about their efficiency. Apart from their conditions, it is advisable to replace the flexible hoses after considerable mileage or after a lengthy period of using the vehicle in order to prevent sudden bursting due to ageing and fatigue.
Seal of pneumatic system with engine off and under activation pressure	This check is carried out by introducing air pressure into the system of no less than 5 bars, spreading fairly dense soapy water over the couplings and fittings with a soft brush and seeing there is no leakage. Air leakage corresponding to a soap bubble of Ø 25 mm in 5 seconds is tolerated, or anyhow a max. fall in pressure within 10 min. of 2% of the disengagement pressure = 0.22 + 0.02 bars.
Seal of pneumatic system in the partial braking range with 3 bars	For 3 min. the pressure has to remain stable in the pneumatic system. This check should be made with the parking brake disengaged.

MAIN COMPONENTS OF THE BRAKING SYSTEM

790510 Compressor

Figure 38

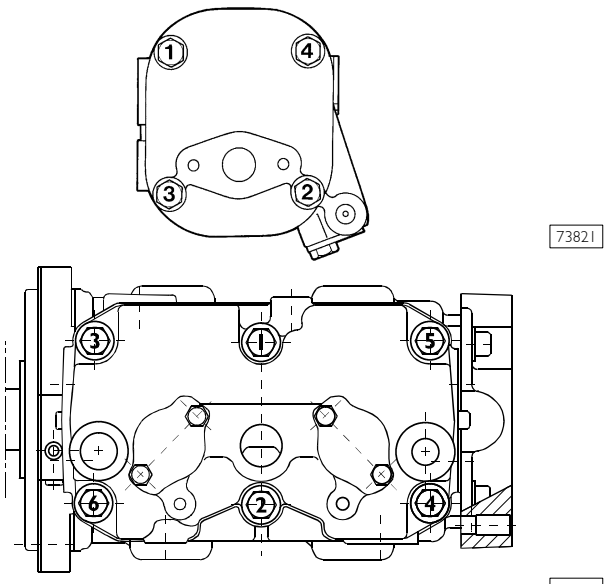


73820

It produces compressed air needed to supply the pneumatic system. Depending on the version, it may be a single- or twin-cylinder compressor.

Head locking screw tightness

Figure 39



73821

60732

A = single-cylinder compressor
B = twin-cylinder compressor

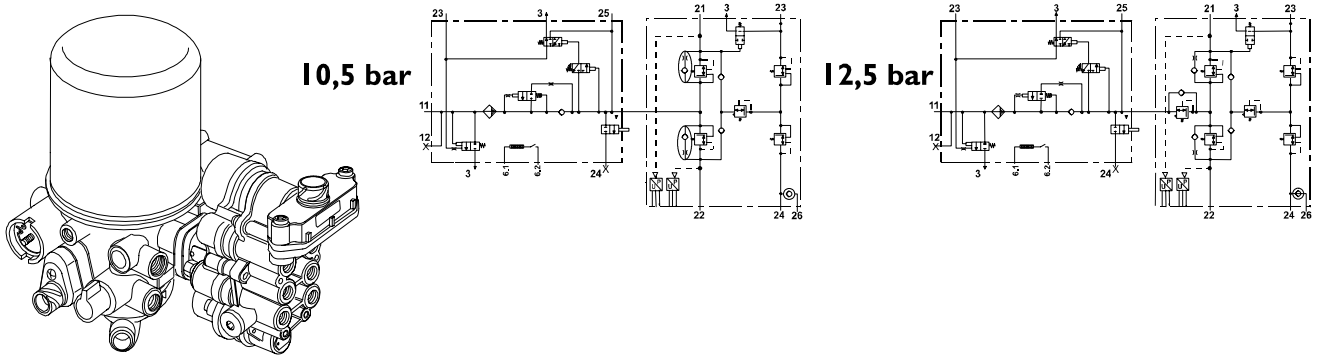
Following the order shown in the figure, tighten the screws fixing the cylinder head to the required torque.

Fault diagnosis

TROUBLE	POSSIBLE CAUSE	REMEDY
Oil leakage from the flange on the outside	Incorrect tightening torque	Lock the screws to the required values.
	Flange seal surfaces not perfectly flat.	Check the sealing surfaces, replace any defective parts or make them level.
	Gasket broken.	Change the gasket.
	Shaft gasket damaged.	Change the gasket.
Oil leakage from the head	Scraper ring worn (noted because the seal seat is shiny).	Replace the piston assembly.
	Defective assembly of the scraper ring.	It should be fitted with the word TOP facing the head of the compressor.
	Scraper ring and piston rings all on the same vertical line.	Fit at 120° to each other.
	Cylinder scored or ovalized.	Grind the cylinder and mount an uprated piston.
Total lack of compression	Compression or intake valve deteriorated.	Replace deteriorated parts.
	Piston rings all on the same vertical line.	Mount rings at 120° to each other.
	Perforation of the piston or breakage of parts connected to the piston.	Replace the piston assembly.
	Gaskets damaged.	Replace the gaskets.
	Energy-saving device in open position during intake.	Replace the cylinder head.
Poor efficiency	Piston rings worn.	Replace the piston (together with piston rings).
	Air leakage between cylinder and head.	Replace the gasket and lock the screws with the required torque.
	Energy-saving device, intake or compression valves deteriorated.	Replace the deteriorated parts.
	Excessive clearance between piston and cylinder.	Grind the cylinder and mount an uprated piston.
	Particles of carbonized oil between the intake and compression valves.	Clean the valves.
Mechanical noise	Too much clearance between the small end and pin, between the pin and hole in the piston, between the shaft and big end, between the shaft and bushings and between the piston and cylinder.	Check the tolerance of the couplings at issue.
	To much clearance between the piston and cylinder.	Grind the cylinder and mount an uprated piston.
	Too much incrustation between the piston and cylinder head caused by burnt oil.	Clean the incrusted parts and replace the valves.
Water blow-by	Head gasket or coupling faces scored and uneven.	Replace the damaged parts.

A.P.U. (Air Processing Unit)

Figure 40

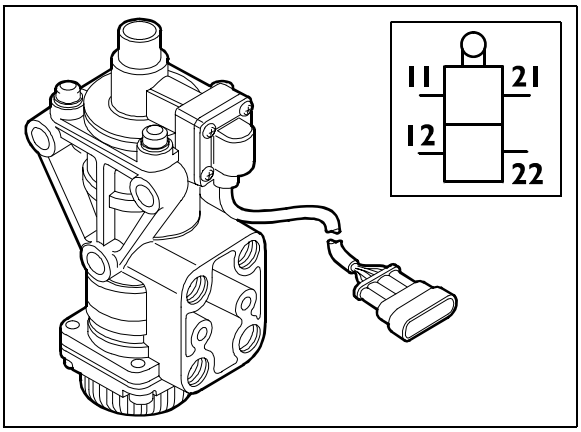


108402

Its function is to keep the air clean and at the right moisture level in the system.
In addition, it has to distribute and keep the pressure needed for the operation of the connected systems at the outlet.
On vehicles CM (mobile boxes), the component is used with 12.5 bar calibration, whereas on the remaining models, 10.5 bar calibration is used.
The A.P.U. contains two pressure sensors connected with the MUX system to display the front/rear axle pressure on the Cluster.

793110 Duplex control valve (vehicles without EBS)

Figure 41



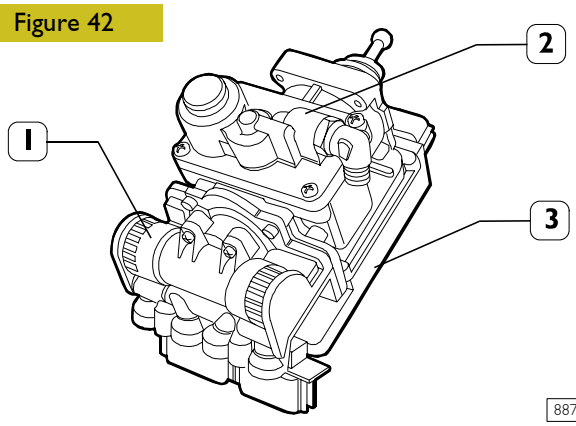
73914

It takes air from the tanks and distributes it to the braking elements.
It is self-limited, that is it limits the delivery of air at a set maximum pressure, the outcome of which is a greater availability of energy and a constant maximum braking pressure irrespective of the pressure swings in the tanks.

In most recent EBS systems, this component is integrated into CBU (Central Brake Unit).

CBU - Central Brake Unit (vehicles with EBS)

Figure 42



88761

This component integrates the functions of following components:

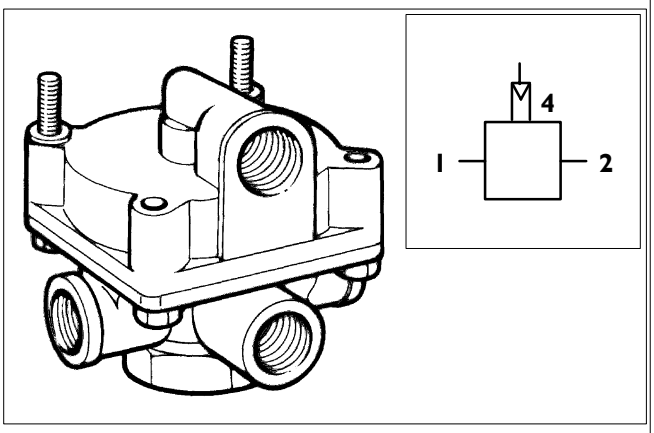
- Duplex distributor (2), generating electric signals to increase or decrease braking system pressure;
- electronic central unit (3), having the task of managing the braking system determining deceleration values as a function of parameters detected by various components;
- proportional relay valve (1), modulating pressure at front axle
- back up valve, assuring braking also in case of electric failure.

Fault Diagnosis (vehicles without EBS)

TROUBLE	POSSIBLE CAUSE	REMEDY
Air leaks from the outlet hole	Leaks from the outlet pipes due to wear of the gaskets	Overhaul the device, replacing the worn parts.
Control valve with abnormal self-limitation	Self-limitation higher or lower than as required	Set the device using the specific screw.
Vibration during braking	Spring wear Air leakage due to piston gaskets in the two sections	Overhaul the device, replacing the worn parts. Overhaul the device, replacing the worn parts.
Abnormal operation of the brake light switch	It fails to close the electric circuit It fails to open the electric circuit	Replace the switch. Replace the switch.

793331 Relay valve (vehicles without EBS)

Figure 43

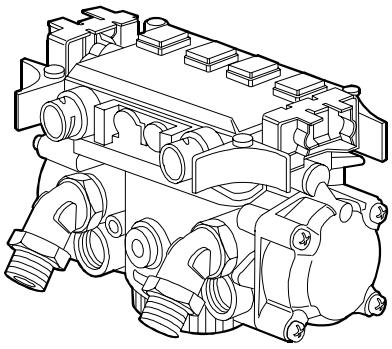


36743

This device makes it possible to accelerate the discharge of compressed air from the section of the combined cylinder, thereby shortening braking times.

Proportional relay valve for front axle (vehicles with EBS)

Figure 44



88763

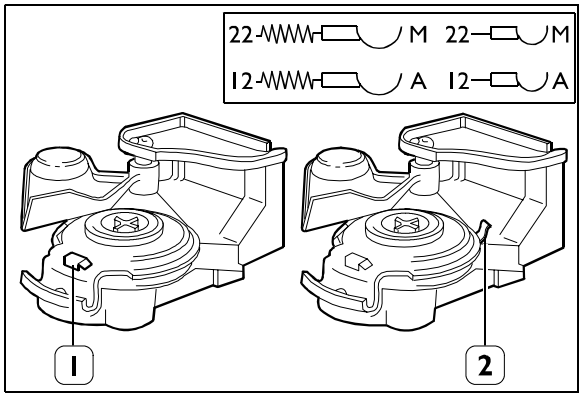
Its task is to modulate the pressure to the brake cylinders of the rear axle.
It has an electronic control unit that controls the rear speed sensors and the wear of the brake linings of the rear axle.
This electronic central unit communicates via CAN network with E.B.S. central unit integrated into CBU.

Fault Diagnosis (vehicles without EBS)

TROUBLE	POSSIBLE CAUSE	REMEDY
Air leaks from the outlet with the control pipe exhausting	Leakage from the introduction or from the seals.	Overhaul the device, replacing any defective parts.
Air leaks from the outlet with supply in the control pipe	Leakage from the piston gasket or from the exhaust valve.	Overhaul the device, replacing any defective parts.

798510 Coupling heads

Figure 45

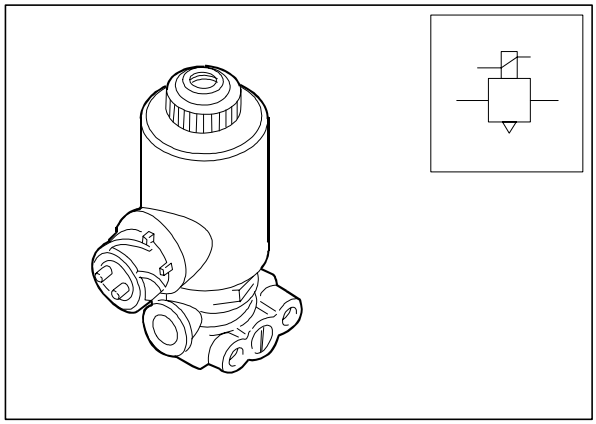


52871

The version for the "Graduated" pipe is equipped with a yellow cover and a safety projection (1), while the version for the "Automatic" pipe is equipped with a yellow cover and a side safety projection (2). The safety projections are used to avoid coupling errors.

Redundancy valve (for 4x2 and 6x2 trucks)

Figure 46

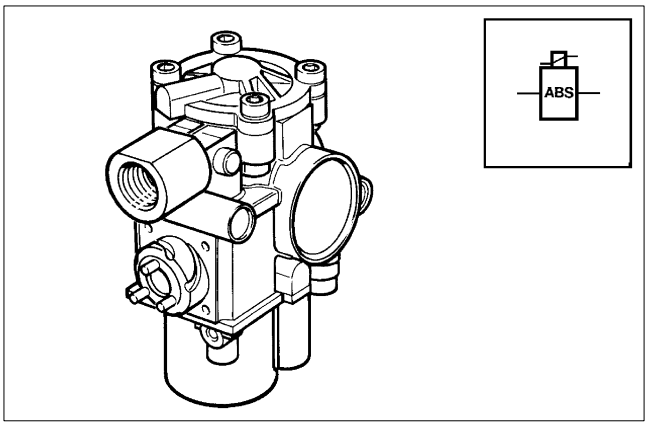


90143

This component has the task of ensuring the rear axles brake even if the EBS is entirely out of service.

ABS-EBS solenoid valve

Figure 47

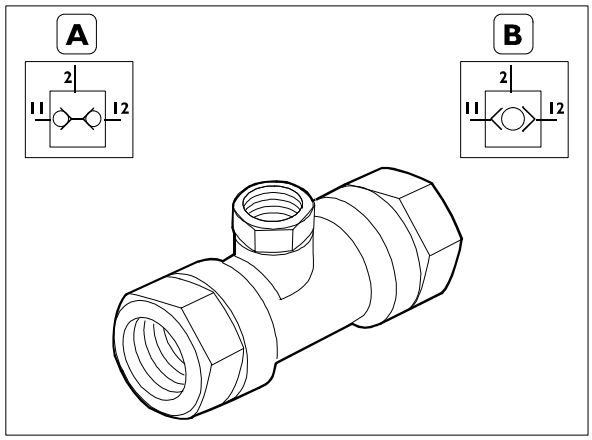


35805

This component modulates the air pressure in the brake circuits. When the electronic control unit detects a tendency for one of the wheels to lock, the valve shuts off the supply to the brake cylinder, preventing the wheel from locking.

Dual stop valve

Figure 48

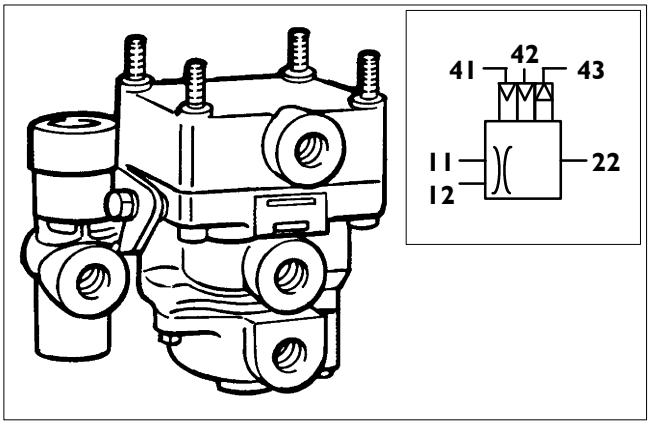


108403

On vehicles with an ABS/EBL system, this component has the task of sending the rear axle braking control relay valve the control pressure from the duplex control valve (normal working function). With the ASR function active, this component will send the activation pressure from the ASR solenoid valve. In addition, it is used on 6x2 vehicles to transmit the pressure in the air springs, to the added axle braking control relay valve, according to the load. (TYPE A)
It is used on lorries with EBS systems, where it performs the function of cutting out ASR added axle. It releases added axle relay valves control in order to prevent differential braking, which, in this way, will only be able to intervene on driving axle wheels so optimising traction.
To the output coming in is only the lowest of the control pressures. (TYPE B)

793332 Triple servo control valve (vehicles without EBS)

Figure 49



33986

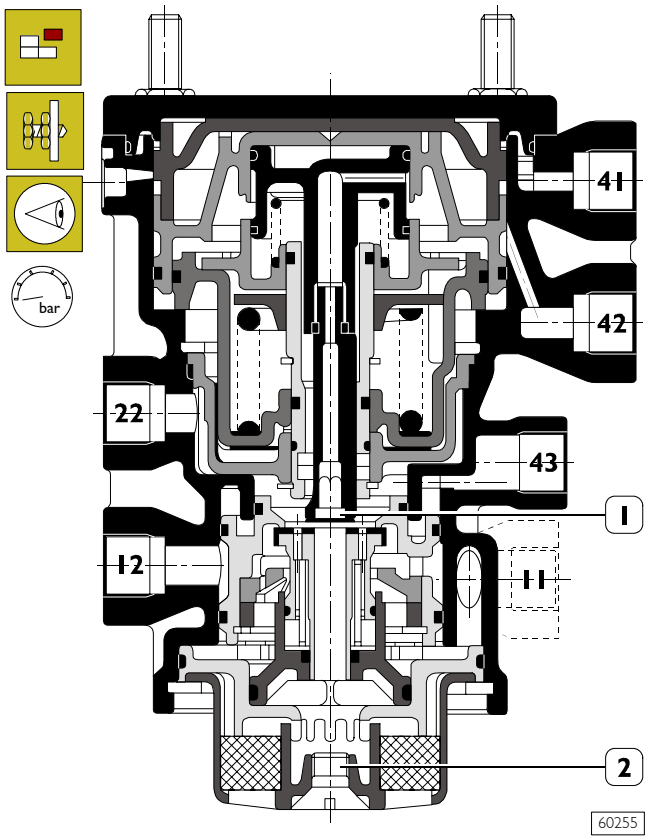
The device controlled by the two independent circuits of the duplex control valve and the spring brake circuit of the tractor controls trailer braking.
It incorporates a device making it possible to brake the trailer even in the event of control pipe failure.

Predominance control

It is equipped with a predominance adjustment device.

KNORR - BREMSE AC 597 B

Figure 50

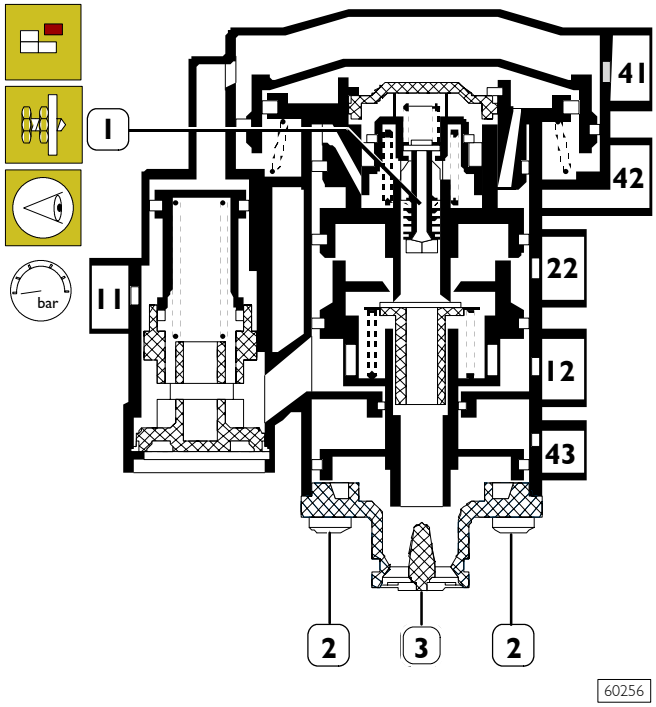


The operations to carry out to adjust the predominance of the servo control valve type KNORR – BREMSE AC 597 B are performed in the following order:

- ❑ undo the screw (2) from the silencer body;
- ❑ insert an Allen wrench into the hole through the silencer body and turn the hexagonal hole of the body (1);
- ❑ turning it CLOCKWISE increases the predominance;
- ❑ turning it ANTICLOCKWISE decreases the predominance.

WABCO 9730090130

Figure 51



The operations to carry out to adjust the predominance of the servo control valve type WABCO 973 009013 are performed in the following order:

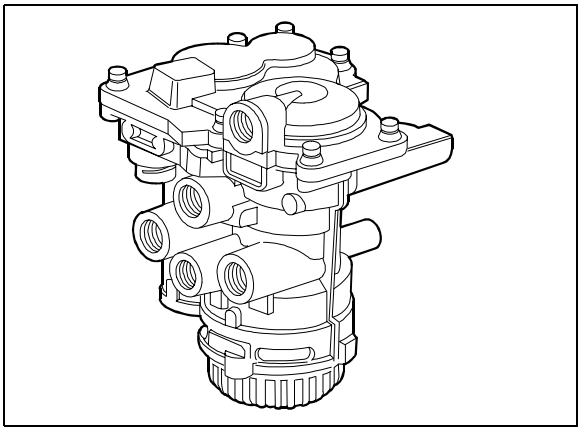
- ❑ Remove the screws (2) and take off the cover (3).
- ❑ Turn the screw (1) to adjust the predominance.
- ❑ Turning it CLOCKWISE decreases the predominance.
- ❑ Turning it ANTICLOCKWISE increases the predominance.

Fault Diagnosis

TROUBLE	POSSIBLE CAUSE	REMEDY
Air leaks from the outlet when at rest	Leaks from the gaskets.	Overhaul the device, replacing the worn parts.
	Exhaust valve and seat defective	Overhaul the device, replacing the worn parts.
Outlet pressures not as required	Air leaks from the gaskets.	Overhaul the device, replacing the worn parts.
	Pistons and seats worn or defective.	Overhaul the device, replacing the worn parts.
	Springs yielded.	Overhaul the device, replacing the worn parts.

Trailer servo control valve (vehicles with EBS)

Figure 52

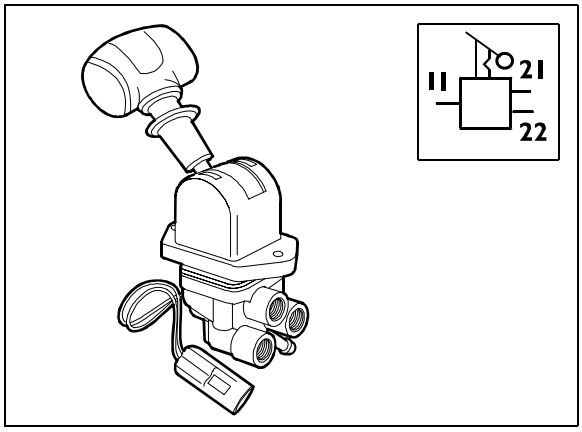


88769

This valve has the job of ensuring all braking levels (service, parking, emergency) and adjusting trailer predominance.

794310 Parking brake hand control valve (vehicles suited to towing)

Figure 53

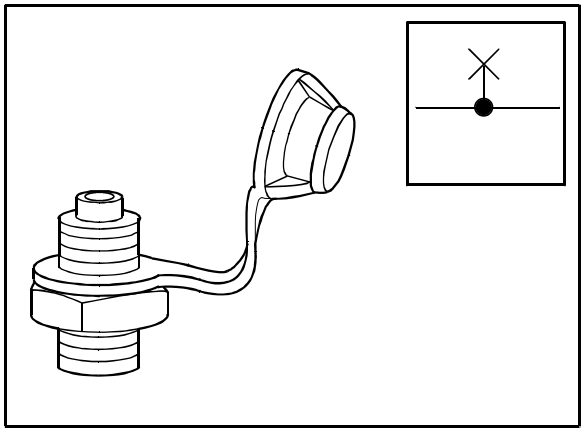


73921

This device provides emergency and parking braking for the tractor and trailer.
Additionally, it makes it possible to check the braking effect of the tractor. This is vital when the vehicle is parked on a steep slope.

Pressure test point valve

Figure 54

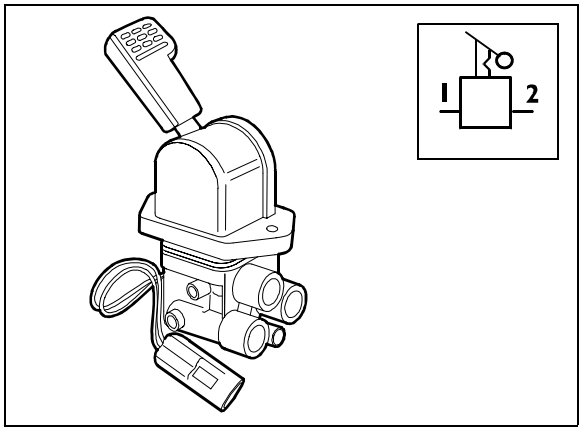


71953

The pressure test points are in the pipes or tanks of the pneumatic system in order to make it easier to hook up pressure gauges for fault diagnosis.

Manual control valve to slow down the trailer (optional extra)

Figure 55



73922

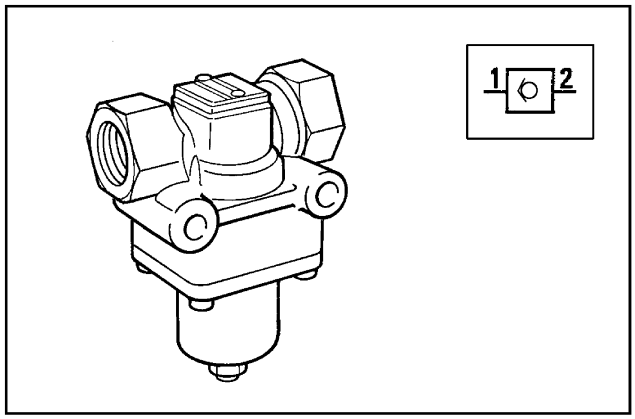
This component, in the parking circuit between the manual control valve and the trailer servo control valve, makes it possible to activate braking to slow down just the semitrailer according to the control given by the driver. It is an optional fitting and is anyhow bound by the current type-approval regulations in the various countries.

Fault Diagnosis (parking brake control valve)

TROUBLE	POSSIBLE CAUSE	REMEDY
Air leaks from the outlet with the control lever:		
in the release position	Exhaust valve, seat or seal defective	Check and overhaul the device, replacing any defective parts
in the braking position	Control valve, seals and valve to control component worn	Thoroughly clean the various parts comprising it
Difficulty in turning the control lever	Interference in the control valve	Overhaul the device and moisten all the sliding parts

Controlled pressure valve

Figure 56



73923

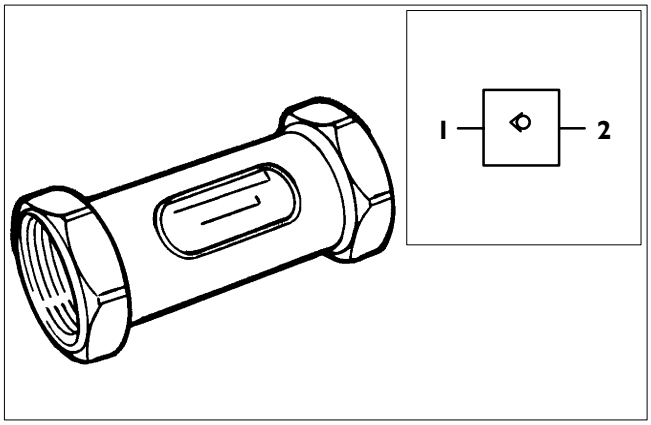
Its job is to break off the flow of air to the ASR solenoid valve when the pressure of the rear axle system falls under 7.5 bars after a breakdown or too much air being drawn off.

Fault Diagnosis

TROUBLE	POSSIBLE CAUSE	REMEDY
Vent at outlet	Diaphragm leaks	Overhaul the device, replacing any worn parts
Air leaks from the join between the two half-bodies	Leakage from the diaphragm fitting	
Vent on delivery (into the atmosphere) with supply at a lower pressure than the setting	Leakage from inlet valve or its seat	Overhaul the device, replacing any worn parts

793319 Check valve (vehicles suited to towing)

Figure 57

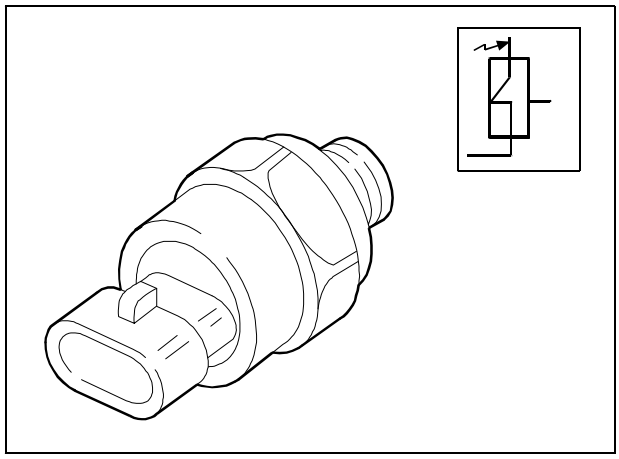


33987

This permits compressed air to pass in the direction shown by the arrow on the valve body, preventing its backflow.

Low-pressure switch

Figure 58

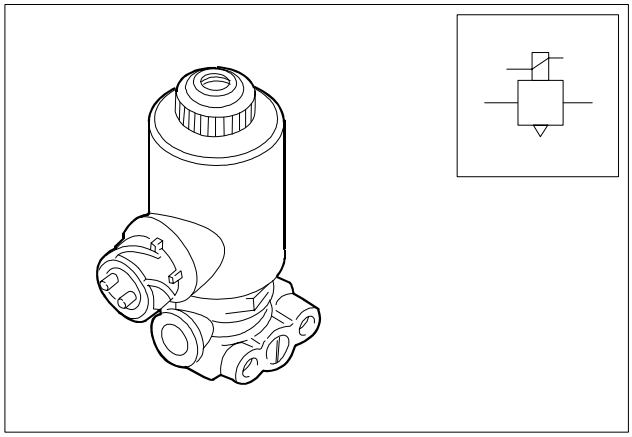


73924

The purpose of this component is to warn the driver, with indicator lights on the CLUSTER, and the electronic control unit of low pressure in the system.

526724 Electro-pneumatic valve for ASR

Figure 59

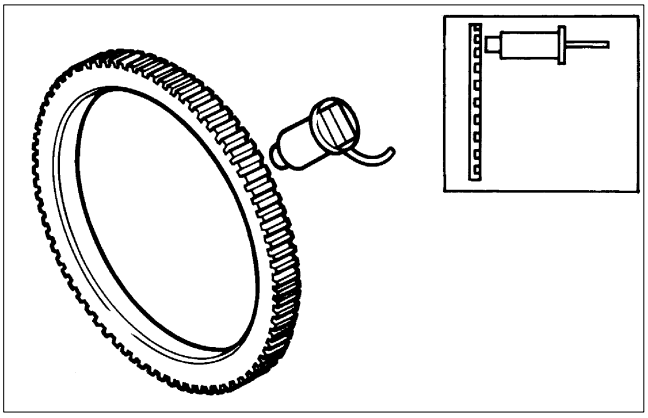


90143

This device brakes the driving wheels, via the brake anti-lock modulator, whenever a tendency for one or more driving wheels to skid is detected.
The valve is normally closed. When the electronic control unit detects a tendency to skid of one or more driving wheels, it sends a signal to the solenoid valve, which energizes and lets air pass to the brake anti-lock modulators that brake the wheels. The solenoid valve de-energizes when the wheels have reached the right degree of friction on the road surface.

526713 Speed sensor
566712 Phonic wheels

Figure 60

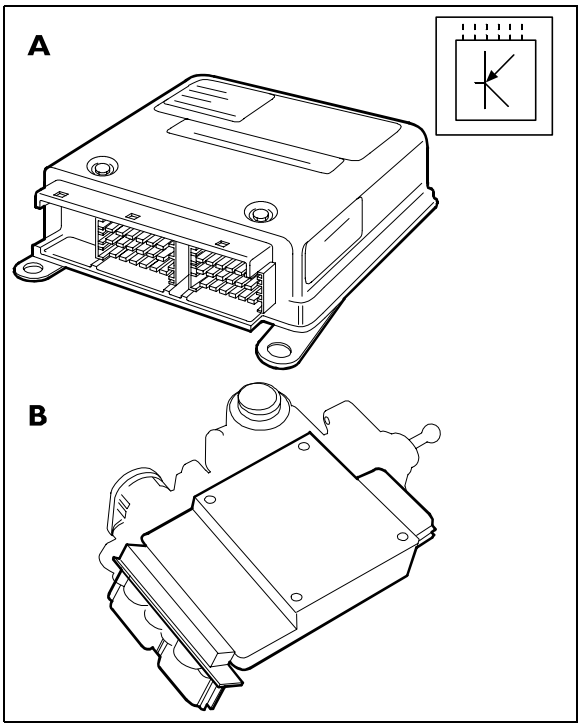


35383

The speed sensors and phonic wheels have the job of detecting the speeds of the respective wheels.
The phonic wheel is housed on the wheel hub and turns at the same speed as the wheel. It generates alternating voltages in the sensors by induction. The frequency of these voltages is in proportion to the speed of rotation of the respective wheel. These voltage signals are transmitted to the control unit to be suitably processed. A sensor and a phonic wheel are fitted for each wheel. This arrangement makes it possible to control an individual braking pressure for each wheel during adjustment, optimizing travelling stability and braking distance.

526711 Electronic control unit

Figure 61



106255

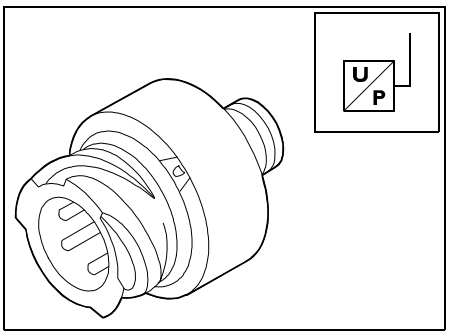
A = ABS – EBL electronic control unit
B = EBS (CBU) electronic control unit

Its purpose is to control the brake system, producing deceleration in relation to the parameters detected by the various system components.
The electronic control unit is equipped with a highly advanced self-diagnosis system and it is able to identify and save any trouble, even of an intermittent nature, occurring to the system during operation, in relation to the environmental conditions, ensuring the most correct and reliable repairs.

Compared to the ABS control unit, the EBS (integrated into CBU), control unit is able to govern auxiliary deceleration systems (exhaust brake and Retarder), optimizing the action so as to ensure better system operation and moreover reduce brake lining wear.

Pressure sensor

Figure 62

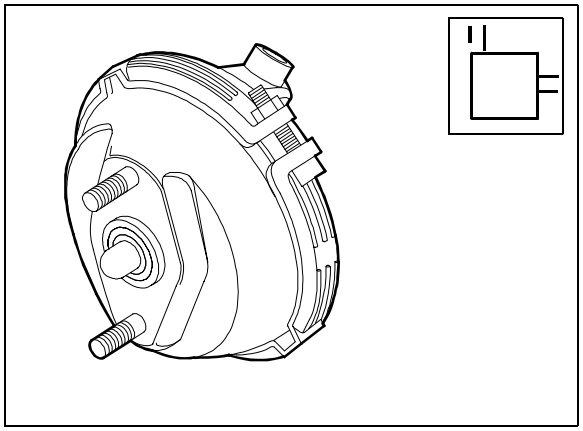


52722

In ABS/EBL systems, its job is to inform the electronic control unit of the extent of action required by the driver.
In EBS systems, this component is integrated in the front axle, rear axle and trailer control valves.

794911 Diaphragm brake cylinder (for front and added front axle disc brake)

Figure 63

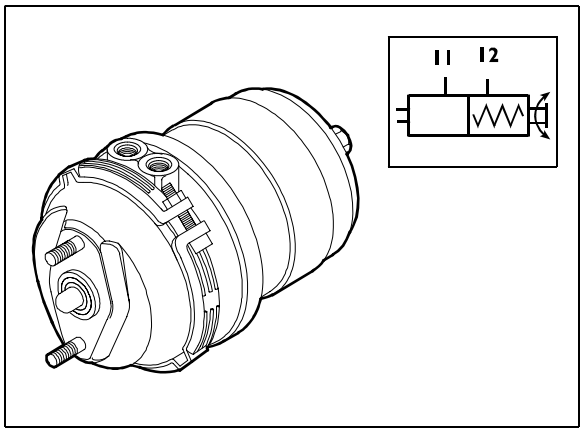


73926

This device transmits the force given by the compressed air, as the brake pedal is pressed, to the mechanical service braking device. If there is any trouble, it is necessary to replace the entire cylinder.

794922 Combined brake cylinder (for front and rear disc brake)

Figure 64

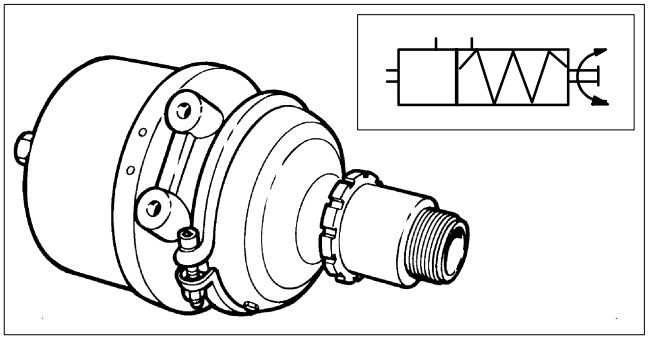


73927

This device is composed of two parts: a diaphragm brake for service braking and a spring brake for parking and emergency braking if the braking system fails.

Combined brake cylinder (for front and rear drum brake)

Figure 65



36744

This device is composed of two parts: a diaphragm brake for service braking and a spring brake for parking and emergency braking if the braking system fails.

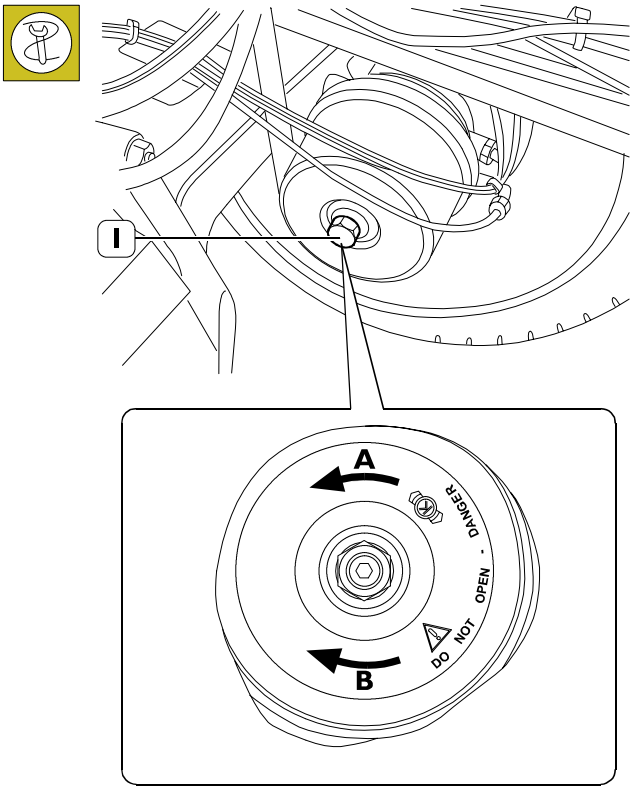
NOTE Should the component have to be replaced, follow the PIC instructions of the relevant vehicle to identify the actual sizing.

Combined cylinder emergency brake release device

If it is not possible to supply the combination cylinder spring section with compressed air, the vehicle brake may be released by hand to allow towing.

For rear disc or drum brakes

Figure 66



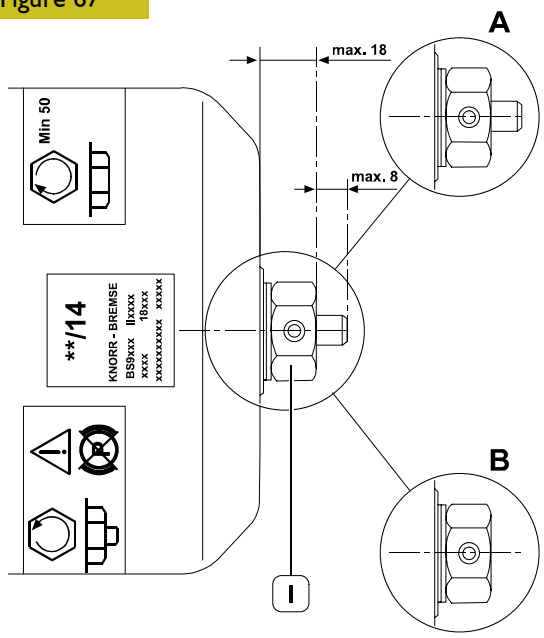
114979

A. To release the vehicle brake, turn bolt (1) anticlockwise to the end of its travel (maximum torque 35 Nm).

B. To brake the vehicle, turn bolt (1) anticlockwise to a torque of 20 - 70 Nm.

For front disc brakes

Figure 67



114982

A. To release the vehicle brake, turn nut (1) anticlockwise to the end of its travel (maximum torque 35 Nm).

B. To brake the vehicle, turn nut (1) clockwise (minimum of 50 turns).

Repair operations

Before removing the combination cylinder from the vehicle, carry out the combined cylinder brake release operation as described above, depending on the model.

NOTE Before removal, it is advisable to clean the exterior parts of earth and other impurities that could enter the cylinder and cause damage.

If the cylinder spring section is faulty, do not remove the part because the above operation could be dangerous.

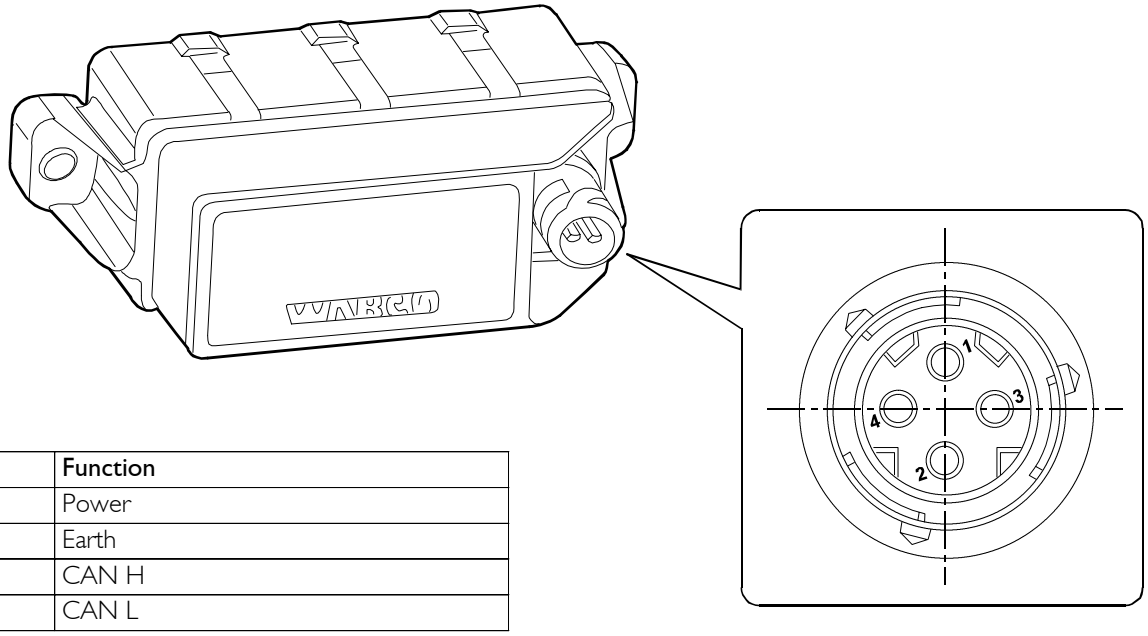
Fault diagnosis

TROUBLE	POSSIBLE CAUSE	REMEDY
Air leaks from the exhaust or retaining band	Diaphragm perforated or failed.	Replace the diaphragm.
	Membrane lip failed.	
	Retaining collar bolts loose.	Tighten the bolt.
Air leaks from the diaphragm section supply	Deterioration of spring section components.	Service the device, repairing worn parts and replacing the cylinder assembly if necessary.

ESP SYSTEM COMPONENTS

ESP module

Figure 68

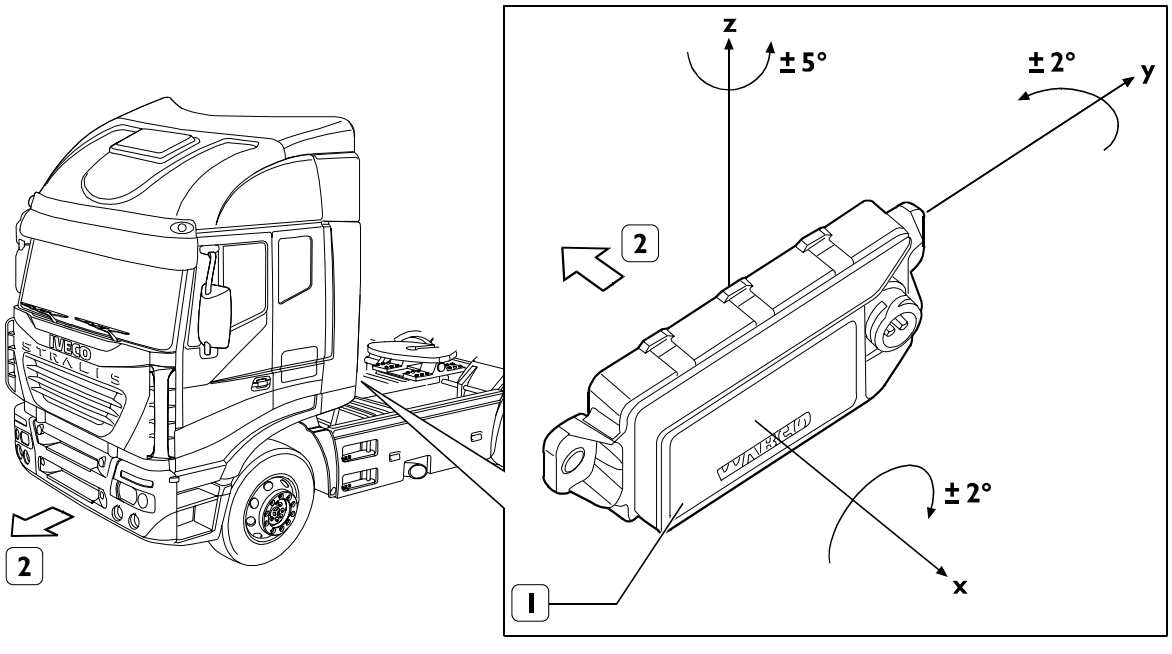


Pin	Function
	Power
2	Earth
3	CAN H
4	CAN L

114983

Installation

Figure 69

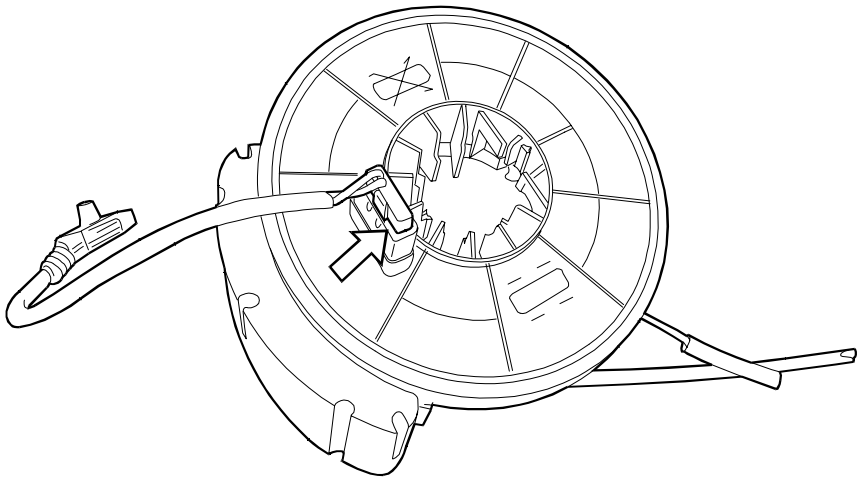


108400

1. ESP module - 2. Ride direction

Steering angle sensor

Figure 70



106257

ESP SYSTEM SELF-LEARNING AND CALIBRATION

After assistance works, several check steps are needed to assure ESP system perfect operation and prevent non specified adjusting interventions from being activated during vehicle ride.
Data base detection for system check and adaptation, carried out by the system in a self-standing way, can only be during ride.
In determined marginal conditions, it is necessary to run a short straight section, a right bend and a left bend.
In below detail there are highlighted repair interventions requiring calibration and/or self-learning.

The sole On Road Calibration is carried out in case of:

- ❑ Works on drive system (replacing, modifying or repairing gearbox, rods, adjusting the wheel base...), i.e. in general all the works where either the travel is cut off from steering angle sensor up to the wheel or steering is adjusted.
- ❑ Replacing system CBU (Central Brake Unit);
- ❑ Replacing steering angle sensor.

Self-learning by diagnosis tool (specific of ESP module) with successive on road calibration are carried out in case of:

- ❑ Replacing ESP module.

Performing calibration procedure.

Calibration is carried out on road by below described path.
Before running the path:

- ❑ Check correct mounting of all steering system components (rods and mechanical members from wheels side assembly to steering wheel);
- ❑ Position the vehicle with straight wheels and the steering wheel in drive center position.

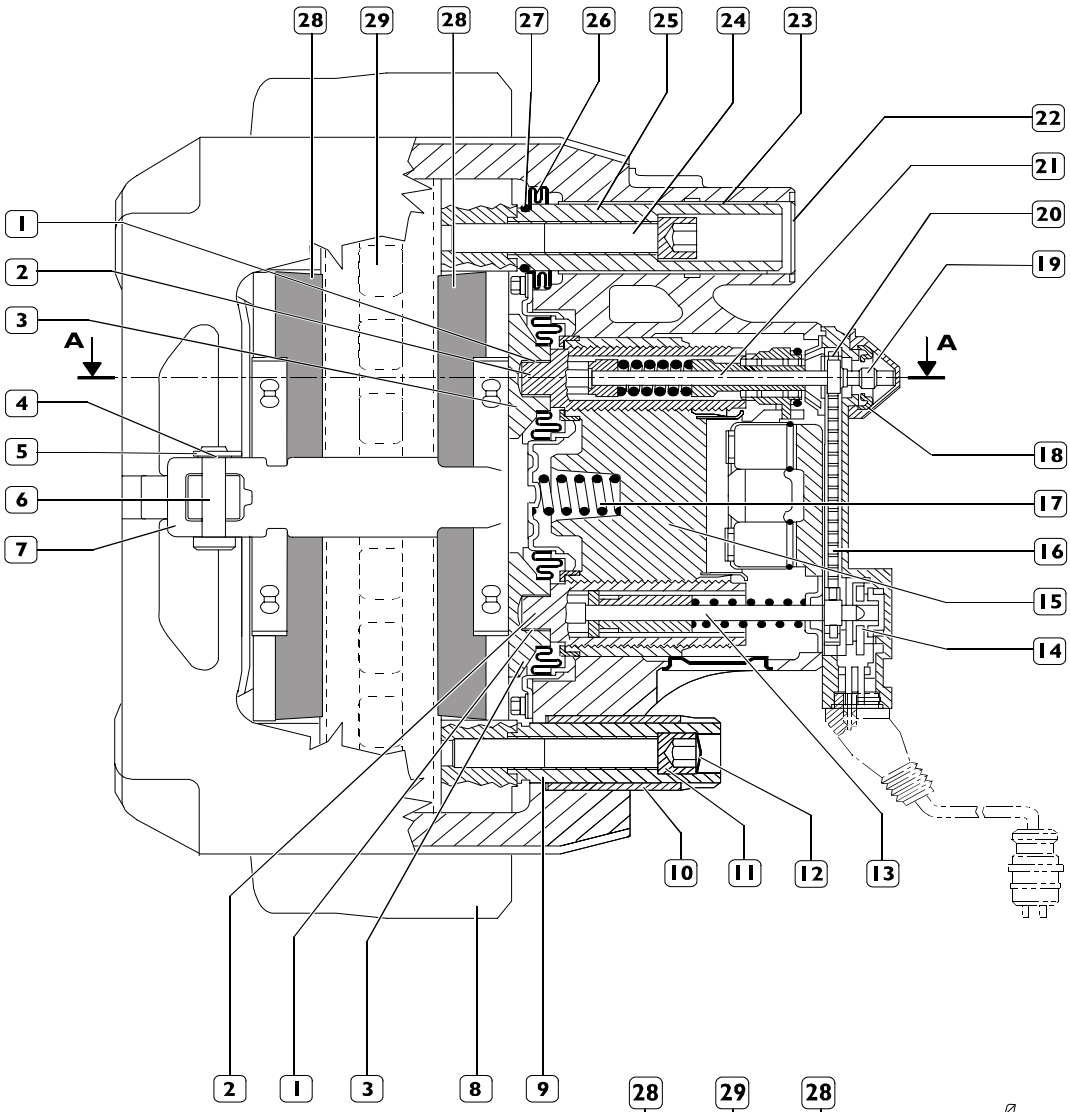
NOTE Replacing an ESP component causing error yellow warning light to go on associated to code 5808 on Cluster display;

Drive in a straight line for at least 250 m followed by a left bend and a right bend to activate the calibration function.

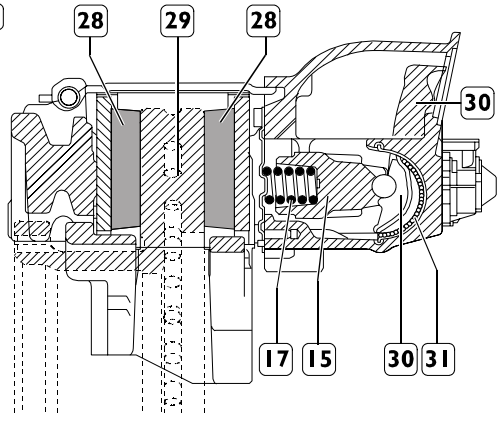
ESP system calibration taking place is visually checked by yellow warning light going off on Cluster display.

5274 DISC BRAKES KNORR TYPE (CALIPER SN7)

Figure 71



78397



78396

SEC. AA

1. Dry bush - 2. Threaded hose - 3. Piston - 4. Washer - 5. Spring split pin - 6. Pin - 7. Retaining plate - 8. Supporting plate - 9. Guide pin - 10. Guide bush - 11. Sliding pin - 12. Plug - 13. Dragging device - 14. Wear sensor - 15. Rear axle - 16. Chain - 17. Spring -18. Cover - 19. Adapter - 20. Chain gear - 21. Adjusting device -22. Cover - 23. Brass bush - 24. Sliding pin - 25. Sliding bush - 26. Inner protection - 27. Ring - 28. Brake lining - 29. Brake disc body - 30. Lever - 31. Cam bearing.

Operation (See previous figure)

Braking stage

During braking, the diaphragm cylinder rod presses down on the lever (30).
The force is transferred to the axle (15) by the bearing in an off - centered position (31)
Through the threaded sleeves (2) and pistons (3), the force is conveyed to the inner braking lining (28).
Once the play between brake linings (28) and brake disc (29) has been recovered, the force is conveyed to the outer brake lining (28), due to brake caliper displacement.
The brake linings (28) pressing on the brake disc (29) produce the braking power.

Releasing stage

As soon as the pressure on the brake is reduced, the pressure spring (17), the rear axle (15) along with threaded sleeves (2) and lever (32) go back to their original positions.

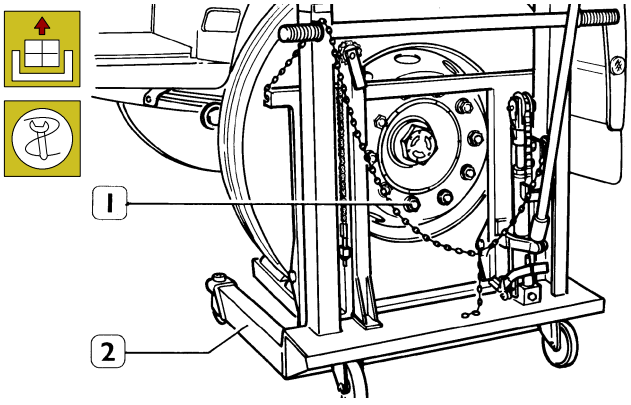
Automatic play recovery

The brake is equipped with automatic adjustment device, which keeps the operating play between brake linings and brake disc constant.
Every time the brake is operated, the adjustment device (21), which is integral with the lever (32), is automatically started.
If worn brake linings and brake discs increase the operating play, the adjustment device (21) and drag link (13) turn the threaded sleeves (2) so to recover said increase in play.
The operating clearance should be between 0.6 and 1.1 mm; lower clearances might cause overheating problems.

CHECKS

Checking the automatic play recovery system efficiency

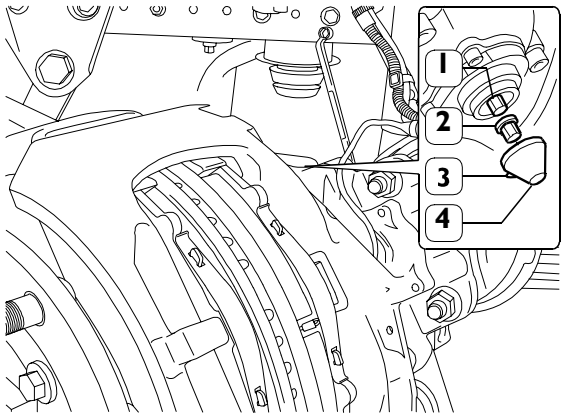
Figure 72



40570

Remove the lock nuts and wheels, using hydraulic stand 99321024 (1).

Figure 73

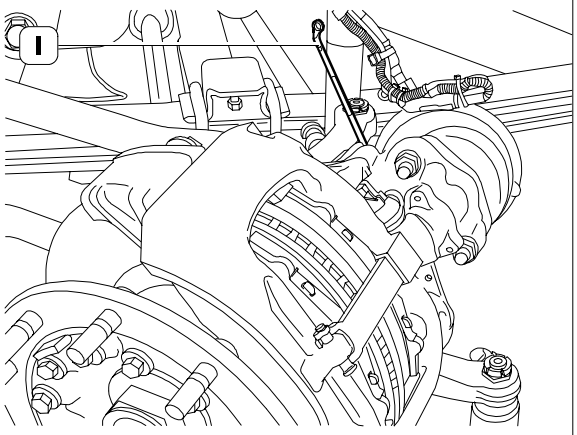


78622

Remove the plug (4) using the tab (3) and make sure the adapter (2) is not lost.

NOTE Never turn the adjusting pinion (1) without fitting the adapter (2) first. If the adapter cut torque is overcome, the adapter gets broken.
Try again with a new adapter and if also in this case it gets broken, the caliper should be replaced because there is an inner damage.

Figure 74



60759

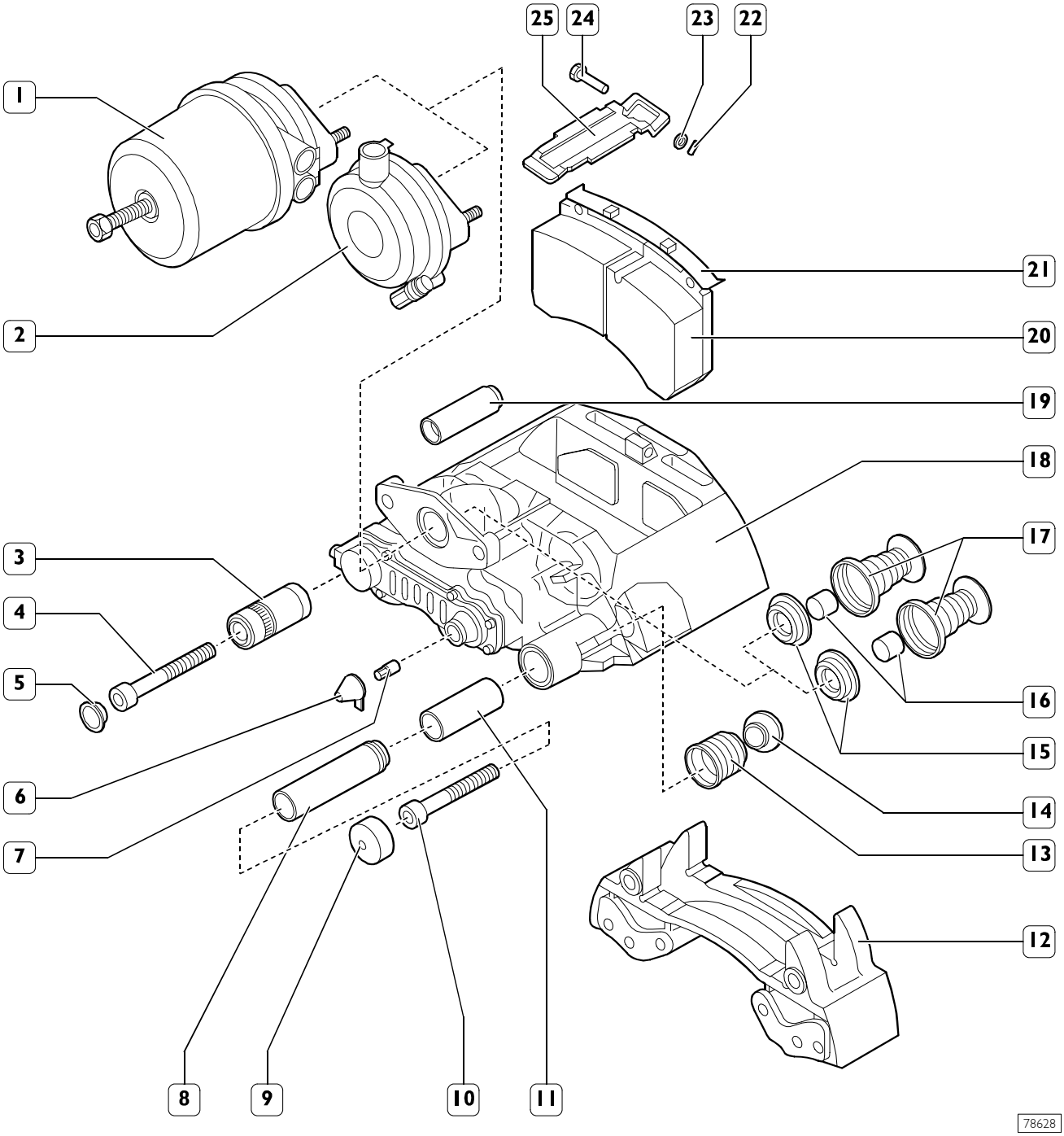
Using a suitable wrench (1), rotate the adjustment pinion counterclockwise by 2-3 with the adapter (2, Figure 73) installed turns, thus increasing the play between brake linings and brake disc.

Operate the brakes for about 5-10 times and make sure the wrench (1) moves clockwise with small increments, up to complete recover of play between braking linings and brake disc.

Otherwise, i.e. if the wrench does not turn, turns just once or turns in both directions, this means the automatic play recovery system is faulty. Replace the caliper, following the procedure given subsequently, then fit back the wheels.

Brake caliper components

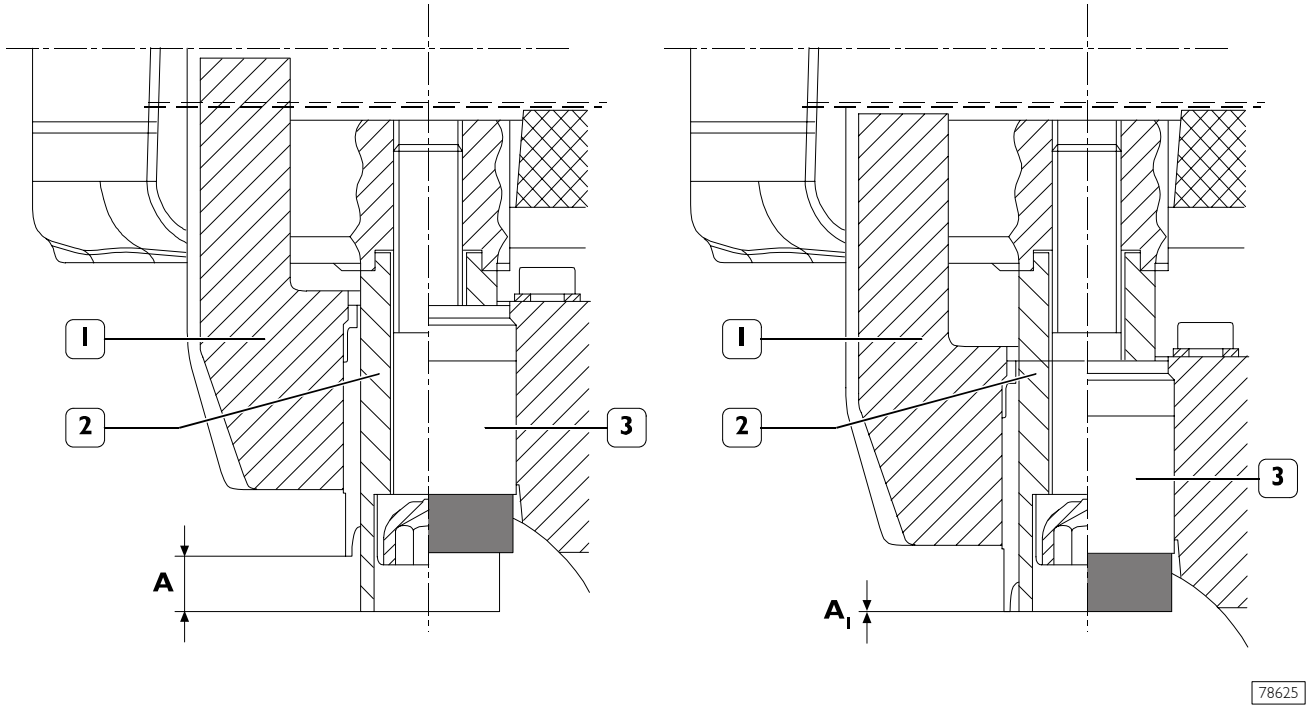
Figure 75



1. Combined brake cylinder - 2. Membrane brake cylinder - 3. Rubber bushes - 4. Sliding pins - 5. Plug - 6. Adjusting unit cover - 7. Adapter - 8. Guide pin - 9. Cover - 10. Sliding pin - 11. Brass bushes - 12. Carrying plate - 13. Protection cowling - 14. Ring - 15. Inner seals - 16. Bushes - 17. Plungers - 18. Brake caliper - 19. Guide pin - 20. Braking seal - 21. Spring - 22. Split pin - 23. Washer - 24. Pintle - 25. Check plate.

Check of braking seals thickness

Figure 76



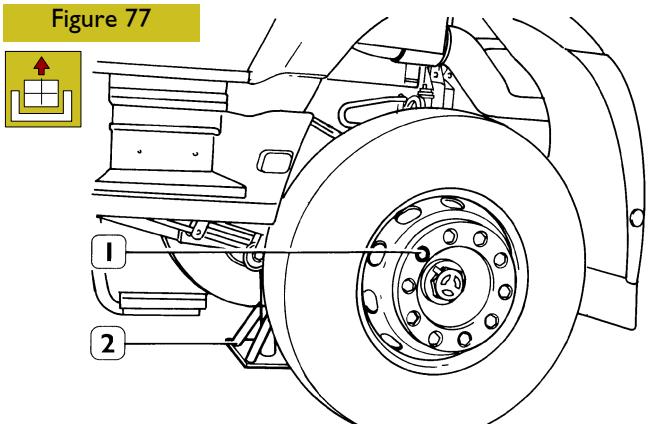
1. Brake caliper - 2. Sliding bush - 3. Rubber bush - A. Bush position with new seals - A_1. Bush position with worn out braking seals (perform an accurate check with wheels dismounted).

The condition of braking seals can be visually determined without dismounting wheels, by checking that A > 1 mm. Otherwise, it is needed to dismount the wheels and perform an accurate check as described below.

5274 OVERHAULING FRONT DISC BRAKES

527417 Replacing brake linings

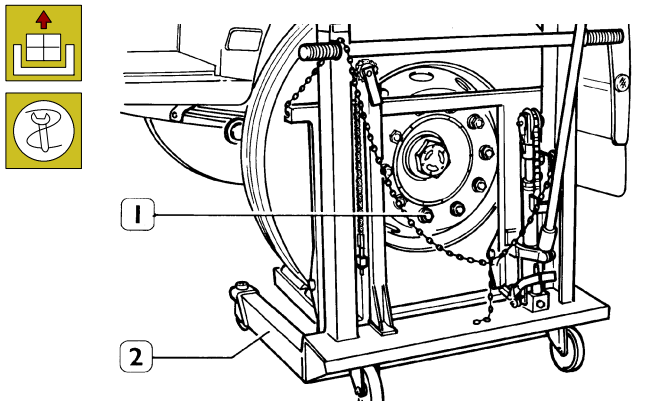
Figure 77



40569

Set the vehicle on flat ground and lock the rear wheels. Loosen the nuts (1) fixing the front wheels.
Lift the vehicle at the front with a hydraulic lift and set it on two stands (2).

Figure 78

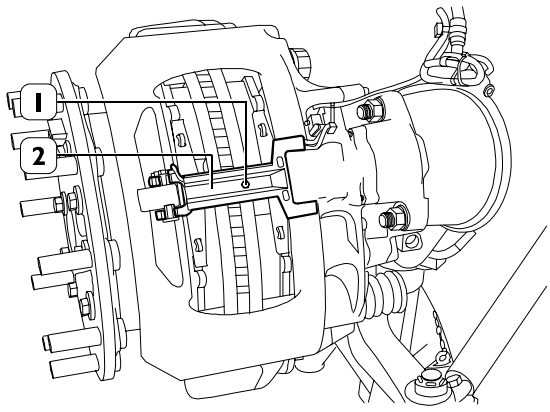


40570

Unscrew the fixing nuts and with the aid of the hydraulic trolley 99321024 (1) remove the wheels.

For vehicles without EBS

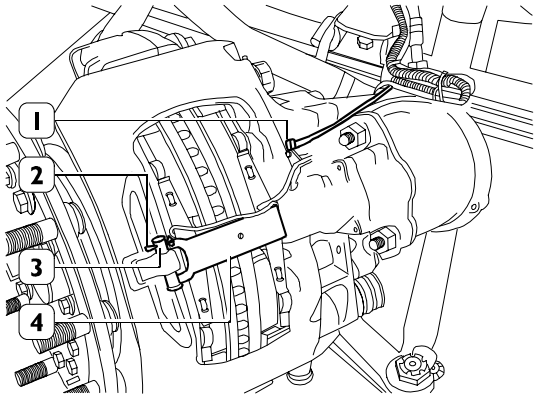
Figure 79



49157

Remove the screw (1) and the wear sensor cable retaining plate (2).

Figure 80



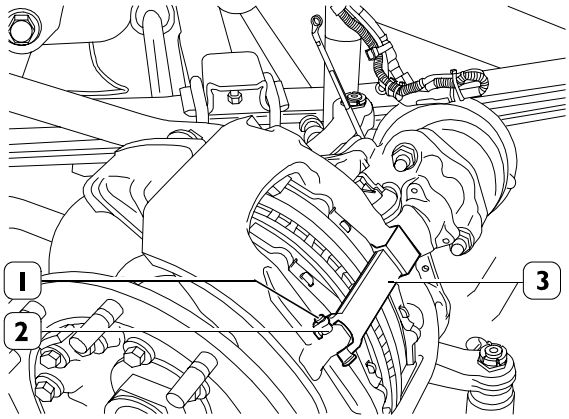
49158

Disconnect the electrical connection (1) from the calliper body.
Remove the split pin (2), pin (3) and brake lining retaining plate (4).

No lifting devices are to be fixed to plate (4).

For vehicles with EBS

Figure 81

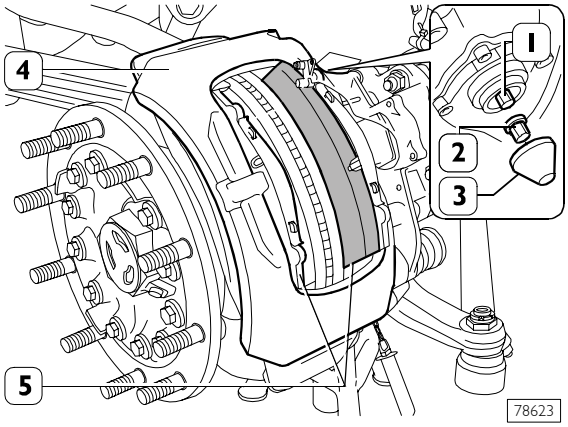


60860

Remove the split pin (1), pin (2) and brake lining retaining plate (3).

If plate (3) is damaged or worn out, it must be replaced.
No lifting devices are to be fixed on plate (3).

Figure 82

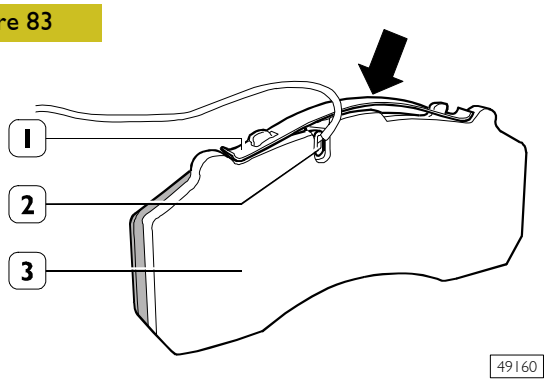


Remove the plug (3). Turn the adjustment device (1) operating on the adapter counterclockwise with a wrench, to insert the pistons within the caliper body and extract brake linings (4), suitably moving the caliper body (3).

Never operate directly on the registration pinion (1) without having first of all fitted the adapter (2). If the cutting torque of the adapter is exceeded, this will break.
Test with a new adapter. If this also breaks, the caliper must be replaced because it is damaged.

For vehicles without EBS

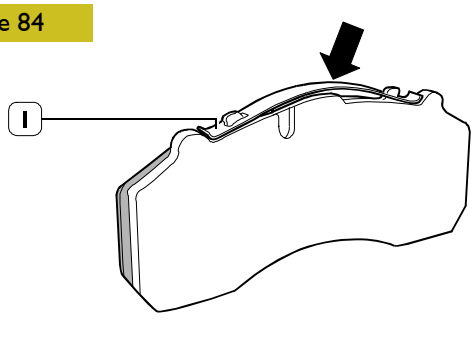
Figure 83



Press (→) on the spring (1) and remove it. Remove the wear sensors (2) from the brake linings (3).

For vehicles with EBS

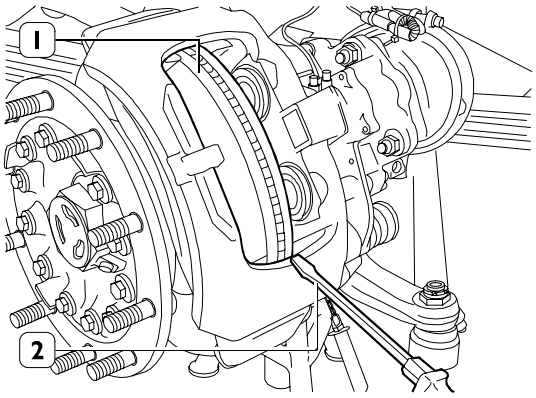
Figure 84



Press (→) on the spring (1) and remove it. If necessary, replace it with a new one.

For all vehicles

Figure 85



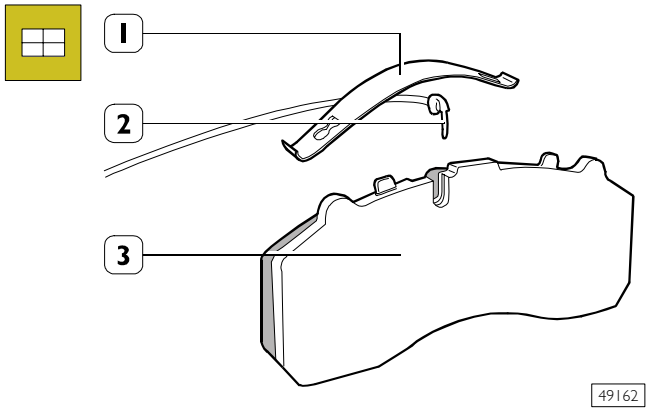
Remove dirt and rust from around the edge of the brake disc with a scraper or an old screwdriver (2) resting on the calliper body, turning the disc (1).
Finish the job with abrasive cloth. Remove the remains with the aid of an aspirator, or rags and a brush.
Do not use petrol or other petroleum products that could cause trouble for the brakes.
Use only methylated spirit or isopropyl alcohol.
Carefully clean the surfaces of the braking area of the brake disc.

NOTE Visually check the conditions of the dust caps, if deformed or broken it is necessary to replace them. This requires removing the brake calliper, so it is recommended to remove the brake calliper body together with the bearing plate for a thorough overhaul.

Check that the calliper slides freely on its guides.
If you find any trouble on a single brake calliper it is wise to overhaul both brake callipers completely.
Remove the dirt from the brake calliper with a wire brush, without damaging the dust caps.
Clean the sliding surfaces of the brake linings.
Check the conditions of the brake disc and make sure it is not corroded, scored or grooved. Light surface cracks are acceptable, but it is necessary to grind the brake disc as described under the relevant section heading. On the contrary, if it is worn, replace the brake disc.
If one needs to be replaced, it is recommended to replace both brake discs.
Check the state of the springs and wear sensors, replace them if necessary.

For vehicles without EBS

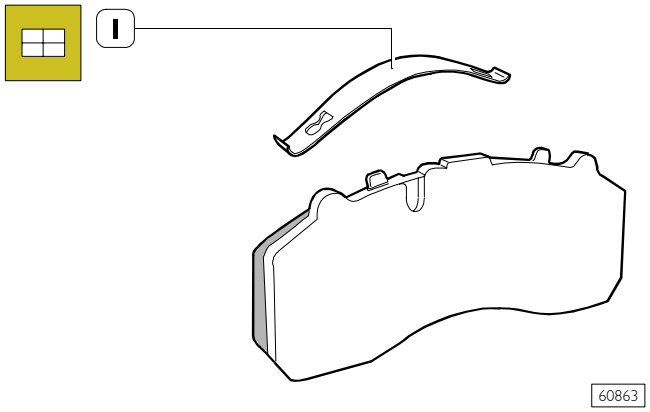
Figure 86



Insert the wear sensor (2) into its seat on the brake lining (3). Mount the spring (1) in the opposite sequence to that for disassembly.

For vehicles with EBS

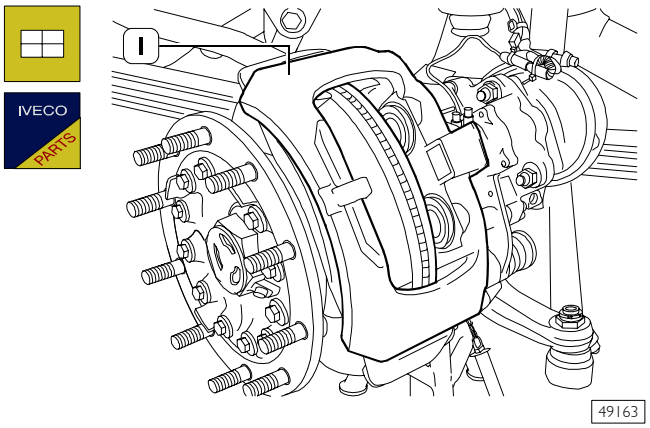
Figure 87



Mount the spring (1) in the opposite sequence to that for disassembly.

For all vehicles

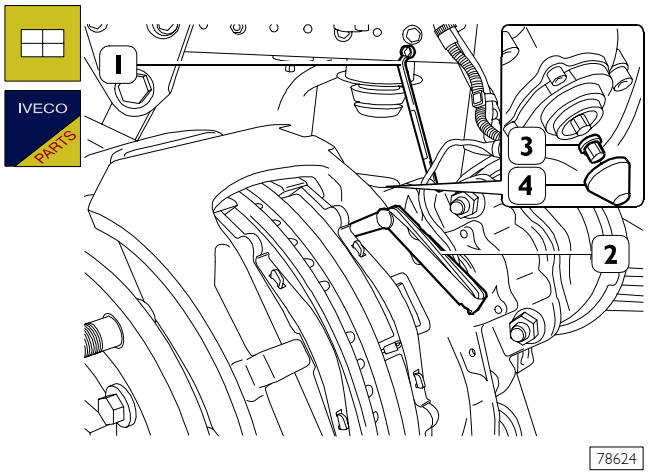
Figure 88



Insert the new linings in the brake calliper (1) and check they slide freely in their seats.

If you find it necessary to replace the pair of brake linings, always replace them with a full set for each axle.

Figure 89

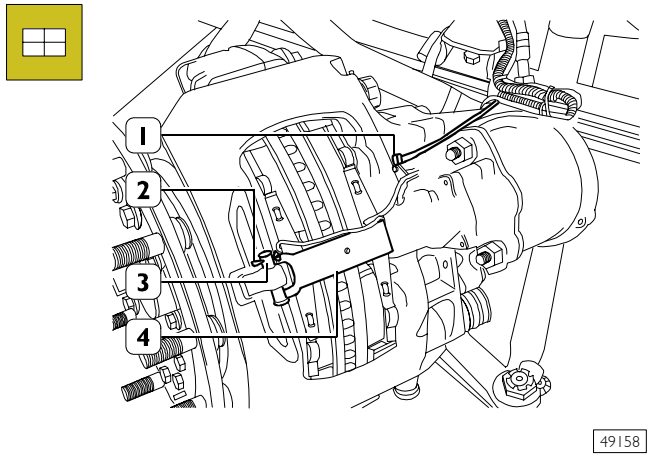


Using the wrench (1), act on the adaptator retriever pin to get a play not lower than 0.7 mm between brake lining and brake disk, which can be measured using the thickness gauge (2). Replace the cover (4) and lubricate it with white grease RENOLIT HLT2.

NOTE Make sure that the outer protecting plug and the seal ring are correctly fitted, in order to prevent water leaks inside the play automatic retriever.

For vehicles without EBS

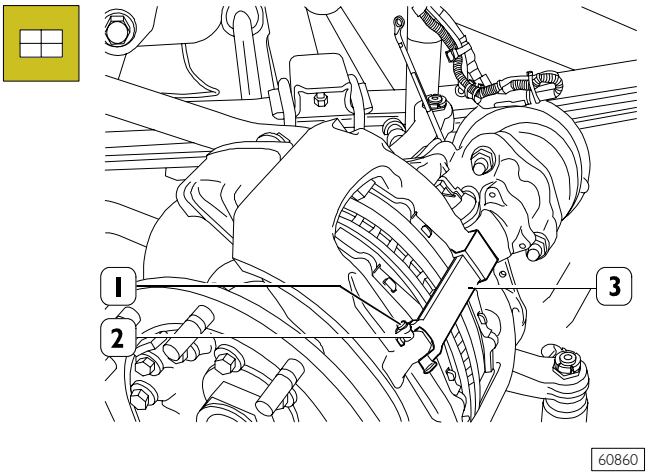
Figure 90



Make the electrical connection (1) and secure it to the calliper body.
Mount the plate (4), pin (3) and split pin (2).

For vehicles with EBS

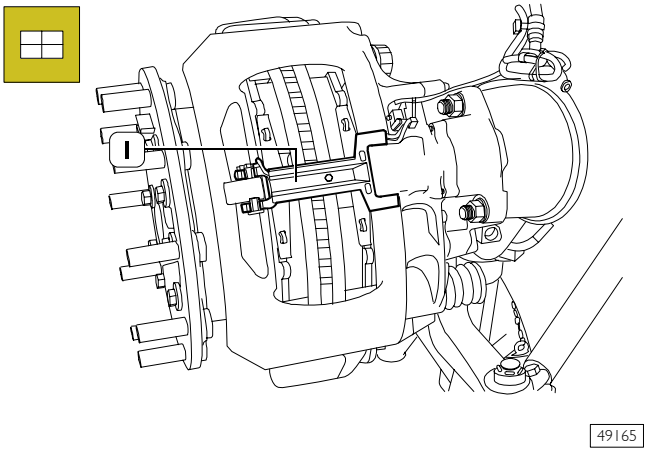
Figure 91



Mount the plate (3), pin (2) and split pin (1).

For vehicles without EBS

Figure 92



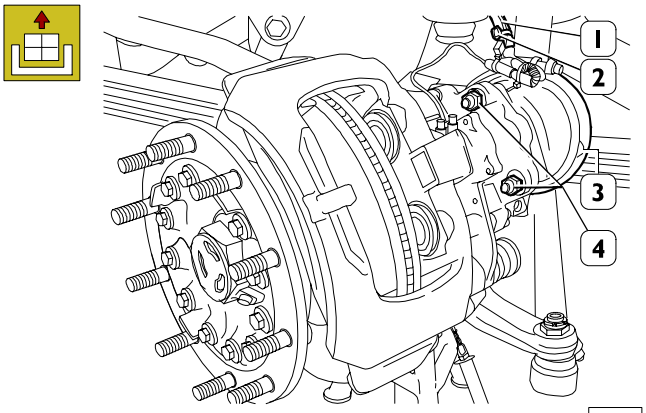
Mount the wear sensor cable retaining plate (1).
Using the hydraulic trolley 99321024, fit on the wheels. Lower the vehicle. Lock the nuts fixing the wheels to the required torque.
Fit the safety cap onto the wheel hubs.
Proceed as described on the opposite side.
After repairing the vehicle brakes, press the brake pedal repeatedly, while the vehicle is moving, in both directions, in order to wear in the brake linings.

527413 Removing and refitting brake callipers

Removal

For vehicles without EBS

Figure 93

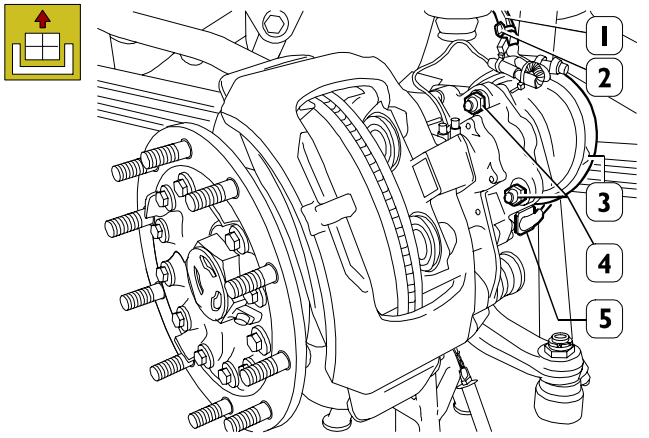


To remove the brake linings, keep to the above description in the paragraph for replacing brake linings. Remove the clamps (2). Disconnect the diaphragm cylinder supply pipe (1). Unscrew the nuts (4) and remove the diaphragm cylinder (3).

NOTE Nuts (4) are to be replaced once they have been dismounted.

For vehicles with EBS

Figure 94

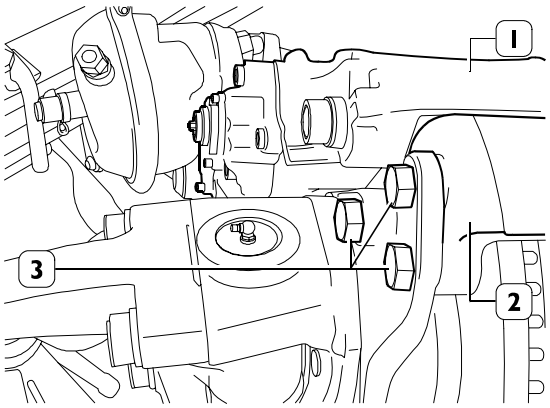


To remove the brake linings, keep to the above description in the paragraph for replacing brake linings. Remove the clamps (2). Disconnect the diaphragm cylinder supply pipe (1). Unscrew the nuts (4) and remove the diaphragm cylinder (3). Disconnect the electrical connection (5) of the calliper body.

NOTE Nuts (4) are to be replaced once they have been dismounted.

For all vehicles

Figure 95



49167

Remove the screws (3) and disconnect the brake calliper (1) together with the bearing plate (2).

Be very careful in removing and carrying the calliper (1) as it is heavy and floating on the support plate (2). Keep the caliper only on the outer side. Never put your fingers between the caliper (1) and the supporting plate (2).

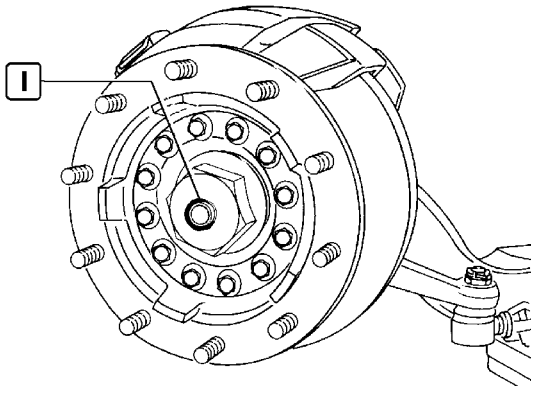
Refitting

For refitting, carry out the steps described for removal in reverse order, keeping to the required tightening torques.

520620 Removing and refitting wheel hubs

Removal

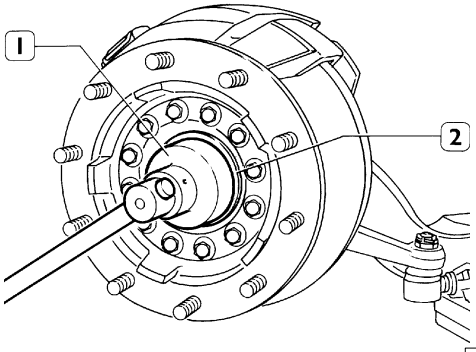
Figure 96



77206

Rotate wheel hub in order to take screw plug (1) downwards; unscrew the plug and drain oil into a suitable tank.

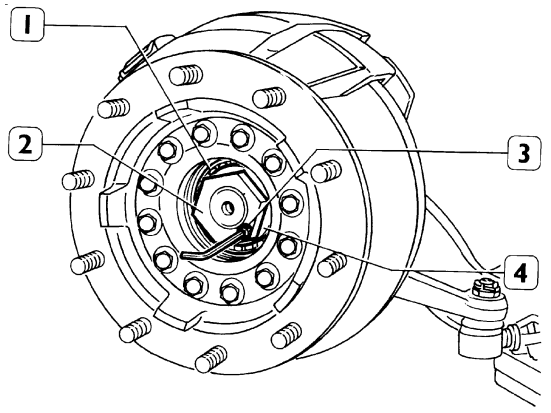
Figure 97



36407

Block rotation of the wheel hub appropriately and, using the wrench 99354207 (1), unscrew the oil cover (2).
Drain off all the oil.

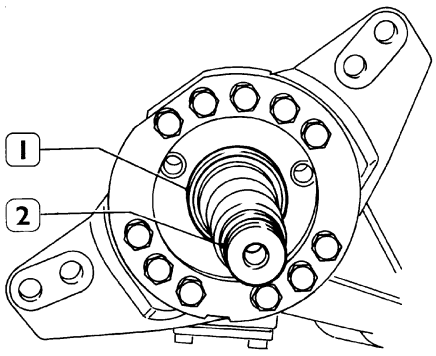
Figure 98



36408

Undo the safety screw (3). With the wrench 99388001, unscrew the adjustment ring nut (2), remove the washer (4), outer bearing (1) and remove the brake disc together with the wheel hub, spacer and internal bearing.

Figure 99



38596

Visually check the diameter of the gasket ring (1) has no accidental dents or scratches.
Replace the internal gaskets of the wheel hubs and, if necessary, the ring (1), keeping to the description given in the "Front axle" section.
Using the adjustment ring nut, check that the thread (2) has no stiffness. If it has, use appropriate means to get rid of the stiffness.
Remove the opposite brake assembly, keeping the components separate.

Refitting

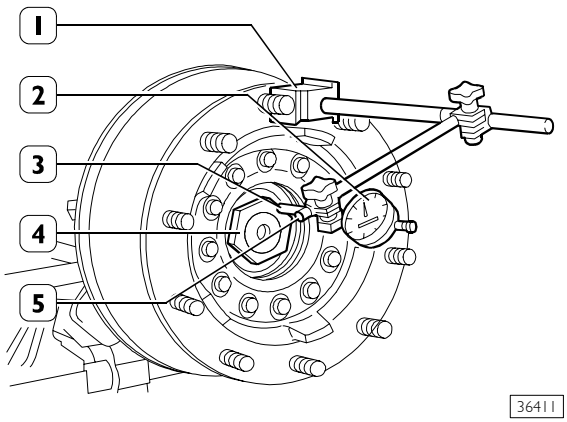
Make sure the surfaces of all the parts inside the hub are thoroughly clean, with no waste or burrs.

Lubricate the bearings with Tutela W 140/M-DA oil.

Key the wheel hub on the stub axle together with the brake disc. Insert the internal spacer onto the stub axle then position the external bearing and thrust washer.

Screw down and lock the adjustment ring nut to the required torque.

Figure 100

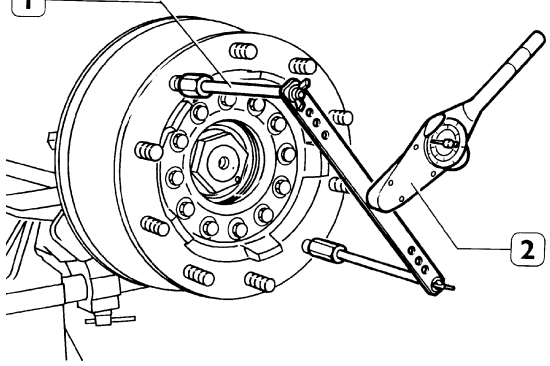


36411

Strike the wheel hub a few times with a mallet in an axial direction, turn it in both directions to free the bearing rollers. Fit the magnetic base (1) together with the dial gauge (2) on the wheel hub. Set the pointer of the dial gauge (3) at right angles to the shank of the stub axle.

Reset the dial gauge with a pre-load of 1.5 ÷ 2 mm.
With the aid of a lever, move the wheel hub axially and measure the end float, which must be 0.16 mm (maximum value).
On obtaining the required end float, lock the screw (5) retaining the adjustment ring nut (4) to the required torque.

Figure 101



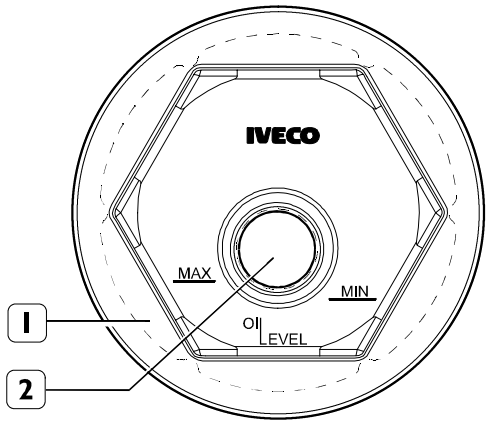
36412

Apply tool (1) 99395026 on wheel hub stud bolts and use torque meter 99389819 (2) to check whether the wheel hub rolling torque is at the set value.

Deposit a sealing bead (Loctite type 574) exclusively on the hub cover ledge surface and protect the threaded part.

Tighten to torque the hub cover (1, Figure 102).

Figure 102

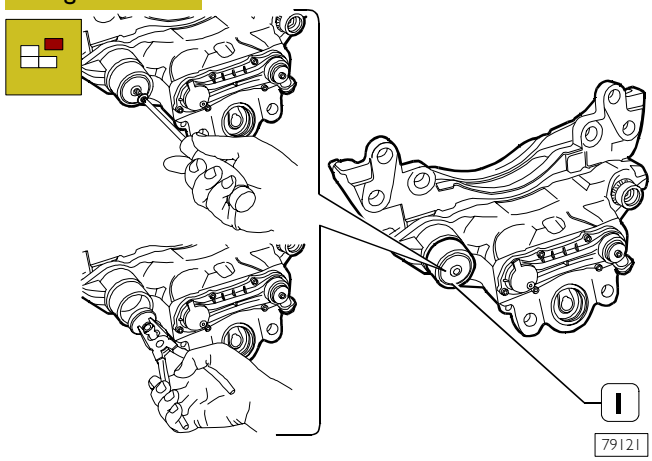


79068

Rotate the wheel hub until when hub cover (1) is positioned as shown in the figure. Restore the prescribed quantity of oil into the hub cover (1) through filling hole (2). Tighten the plug on the hub cover (1) to the set torque.

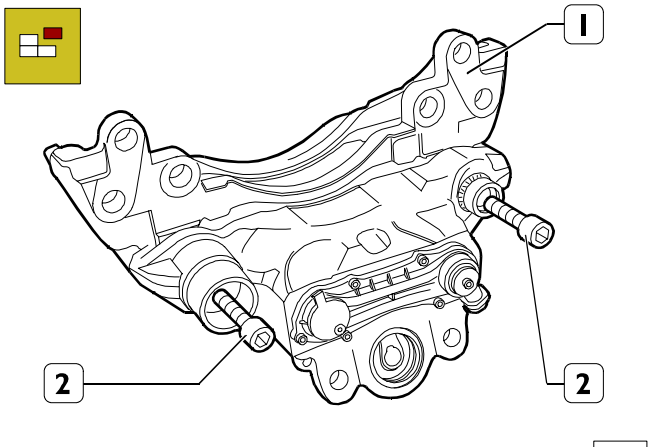
BRAKE CALIPER OVERHAUL
Disassembly

Figure 103



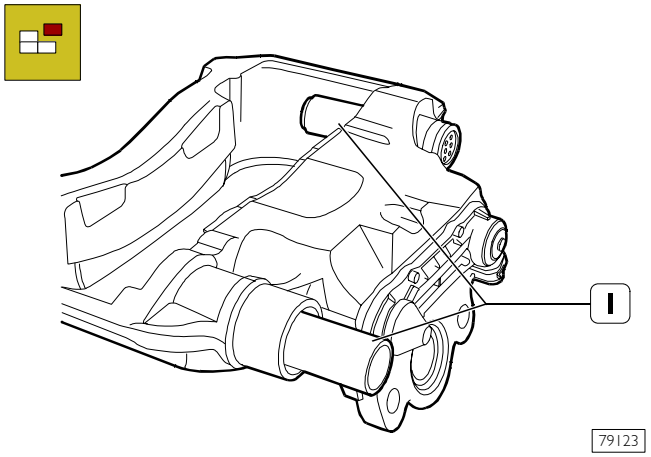
Place the brake caliper on the bench and block it in a vice. Remove the cover (1) and make a hole in it with a Parker screw.

Figure 104



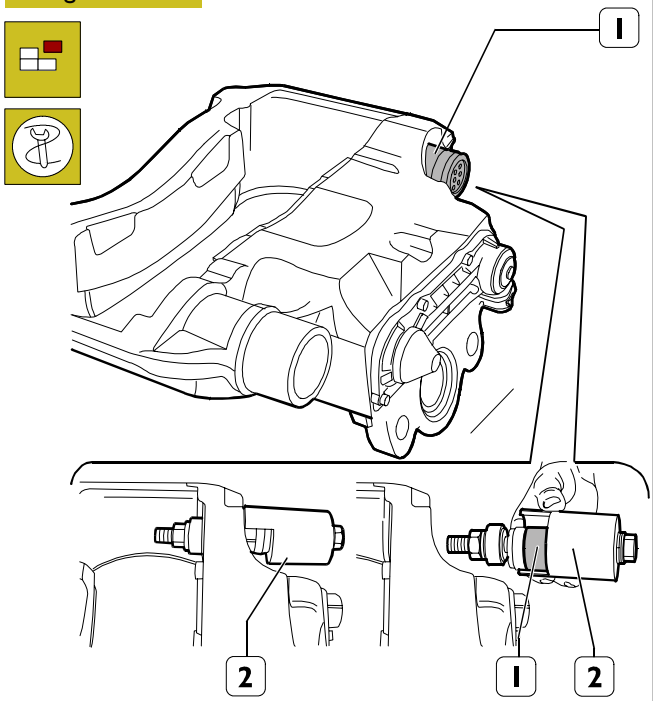
Refit the supporting plate (1) and remove the fastening screws (2).

Figure 105



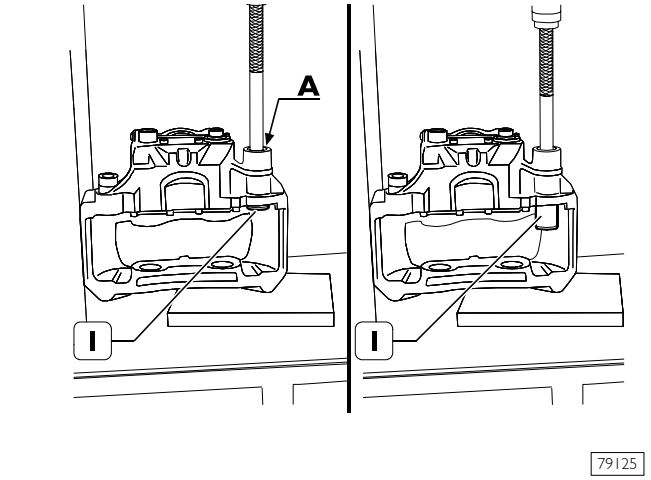
Remove the sliding bushes (1).

Figure 106



Use tool 99372245 (2) (to be used with screw in tool 99372237) to disassemble the rubber sleeve (1).

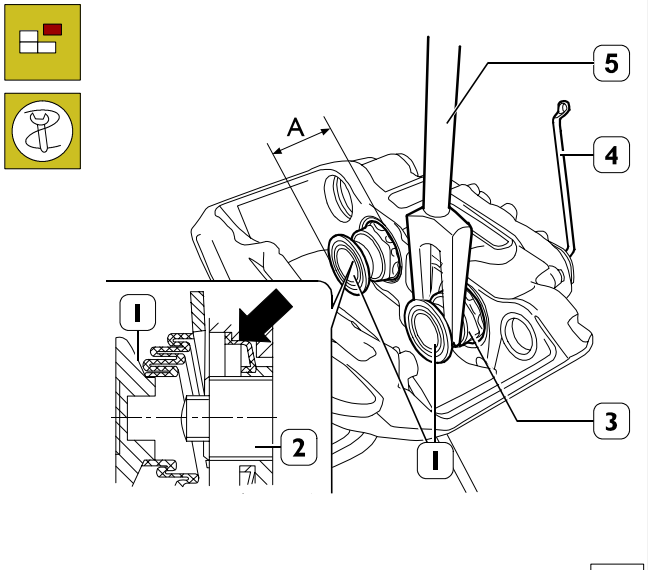
Figure 107



Take the caliper to the press.

Insert the appropriate beater in the brass bush housing (1) (See arrow A). Use the press to remove the bush (1).

Figure 108



Place the caliper on the bench and block it in a vice. Use the wrench (4) to operate the clearance recovery device so that the piston (1) comes out of the caliper body for a maximum of 30 mm (value A).
Take off the dust-guard from the caliper body and use tool 99372238 (5) to remove the thrust pressing devices (1) of the caliper together with the protection casings (3).

Value A must not be overcome because threaded hoses (2) are synchronised. If the threaded hoses (2) reach their over-travel, they loose synchronism and the brake caliper must be replaced. The brake caliper inner parts must never be removed.
For this reason you are recommended non to slacken or to remove the cover retaining screws..

Component part cleaning and check

To wash metal parts, use a solution of hot water with Fiat LCD detergent. Use a metal brush to remove dirt from the caliper body and then a little brush to remove the residuals and to clear accurately the guide pin and the sliding bush housings.

Use a synthetic brush with the right dimensions to remove the grease left on the sliding bush housings.

Clean the caliper body accurately with compressed air.

Use a piece of cloth soaked with isopropyl alcohol or similar to clean the sliding bushes accurately.

Check the wear conditions of the sliding bushes and their housings on the brake caliper body. Make sure they are not damaged or worn, especially the sliding surfaces. Fit the bushes in their housings and check they slide regularly.

Fit the bushes in their housings, check they slide correctly, otherwise replace or restore their housings on the caliper body, if needed.

NOTE Regular braking depends mainly on the brake caliper sliding on the guide pins.

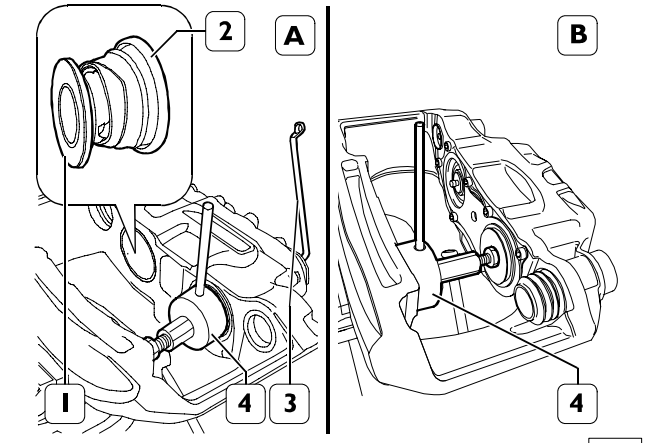
Check the wear conditions of the brake lining retaining pins and the related safety pins. If they are worn or damaged, replace the worn parts.

It is advisable to replace all rubber and plastic parts and the brass bush even if they do not seem damaged or worn at sight.

Assembly

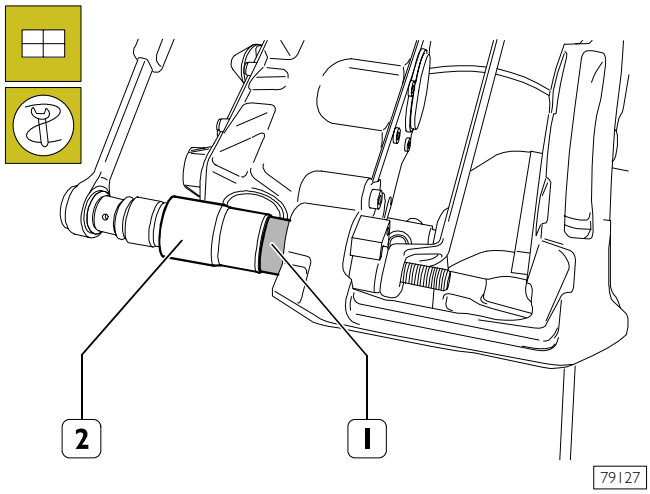
Make sure all the brake caliper components are perfectly clean. Possible abrasive residuals should be removed with a cloth soaked in isopropyl alcohol or similar.

Figure 109



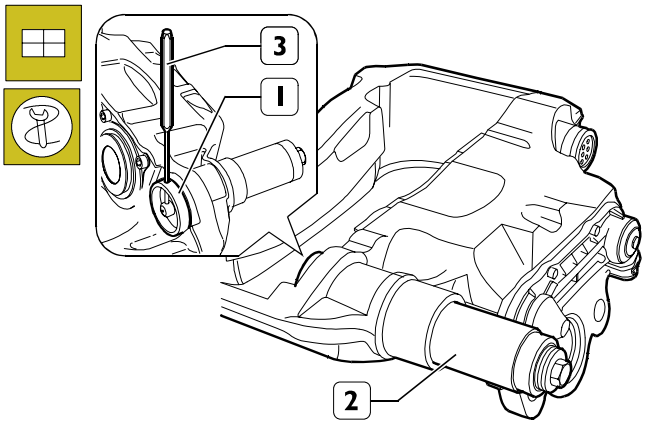
Use tool 99372239 (4) (see figure A) to fit the protection casings (2). Use the same tool 99372239 (4) fitted on the other side (see figure B) to insert the pistons (1). Use the wrench (3) to operate the clearance recovery device and ad just the pistons (1).

Figure 110



Use tool 99372244 (2) (to be used with the screw in tool 99372237) to assemble the rubber sleeve (1).

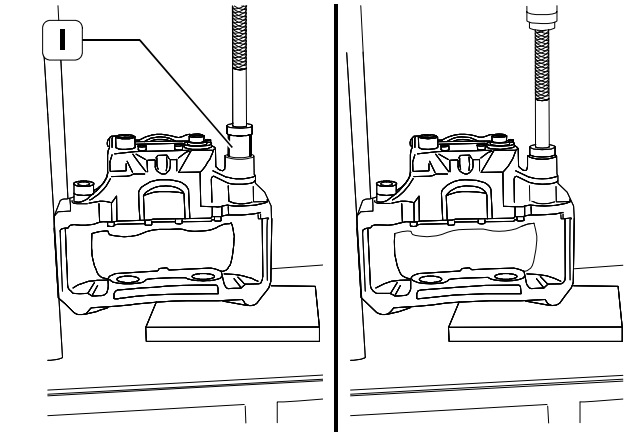
Figure 111



79128

Use tool 99372243 (1) (to be used with tool 99372240 and use screw in tool 99372237) to assemble the brass bush (2) in its seat, by blocking its rotation by means of a suitable tool (3) (punch or screwdriver).

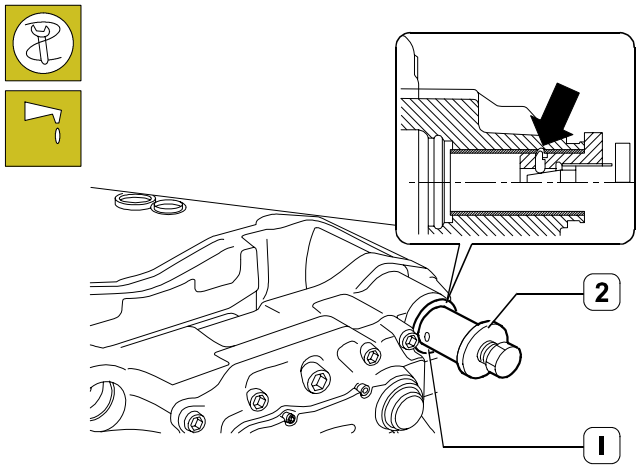
Figure 112



79129

Place the caliper under the press. Use the press to fit the brass bush (1) in its housing until is comes out of the lower side by 1 mm.

Figure 113

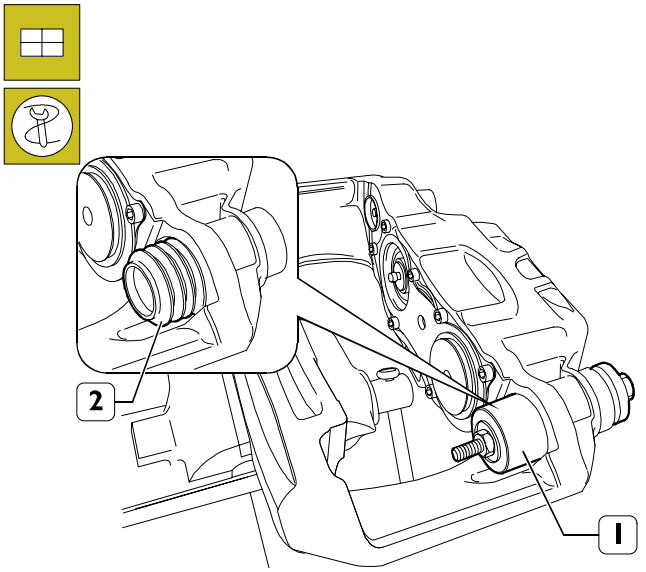


60745

Use the appropriate tool 99372242 (2) to carry out bruising in the point (→) next to the caliper body groove, in order to prevent the brass bush (1) from moving.

Make sure there are no burrs in the bush housing, otherwise remove them. Apply white grease RENOLIT HLT2 on the bush.

Figure 114



79130

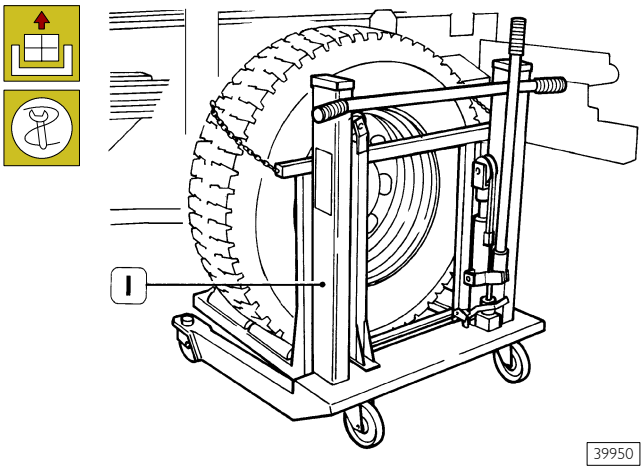
Place the caliper on the bench and block it in the vice. Fit the protection casing (2) by means of tool (1) 99372237.

NOTE Reverse the removal order to fit the sliding bushes and the supporting plate.

5274 OVERHAULING REAR DISC BRAKES

527417 Replacing brake linings

Figure 115



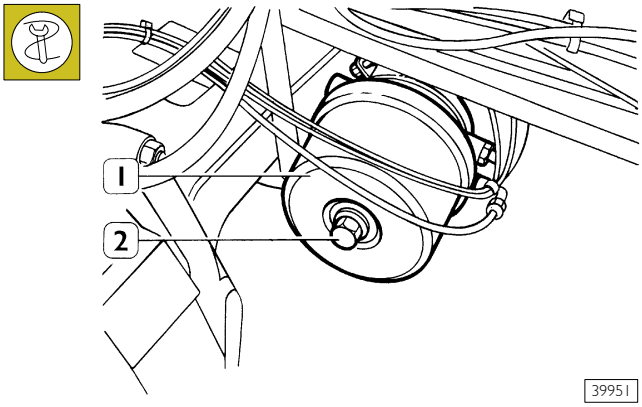
39950

Park the vehicle on level ground. Put the parking brake lever into the off position and loosen the nuts fixing the rear wheels. Using a hydraulic jack, lift the vehicle at the rear and rest it on the special stands. Using the hydraulic trolley 99321024 (1), take off the wheels.

NOTE Overhaul braking unit, observing – in dismounting and overhauling the brake caliper – the procedure described for front disk brakes, since it is similar.

Examine the state of wear of the brake disc surfaces. If you find different values to the ones given in the characteristics and data table, remove it as follows.

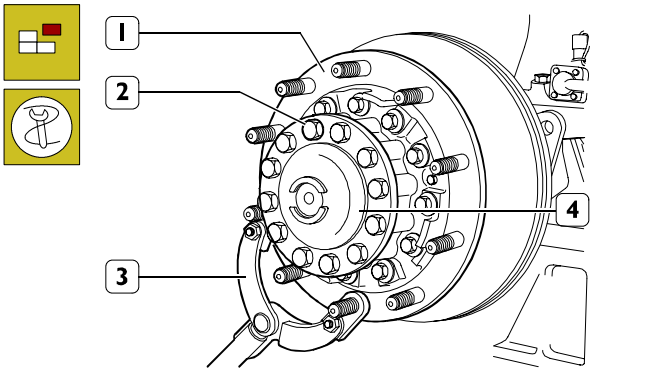
Figure 116



39951

Fully unscrew the screw (2) to manually release the combined cylinder (1) and detach it from the brake calliper.

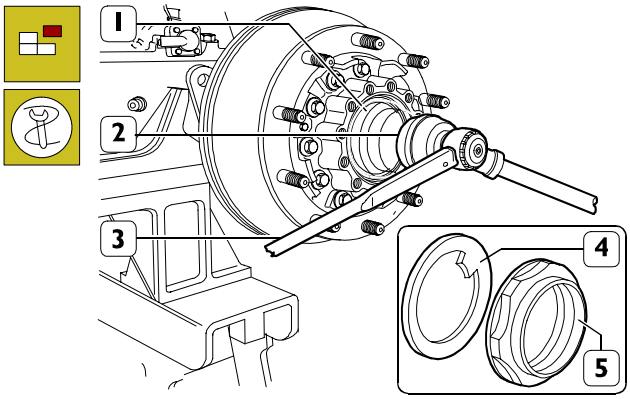
Figure 117



72744

Place a container under the wheel hub to collect the oil. Block wheel hub (1) rotation with the retaining tool 99370317 (3).
Take out the screws (2) and extract the drive shaft (4).

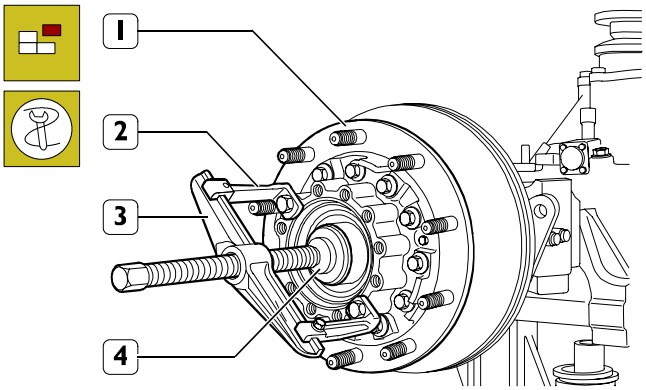
Figure 118



72745

Lift the notch on the ring nut (5). With wrench 99355175 (1) and multiplier 99389816 (2), take off the ring nut (5) holding the wheel hub bearing. Remove the retaining ring (4).

Figure 119

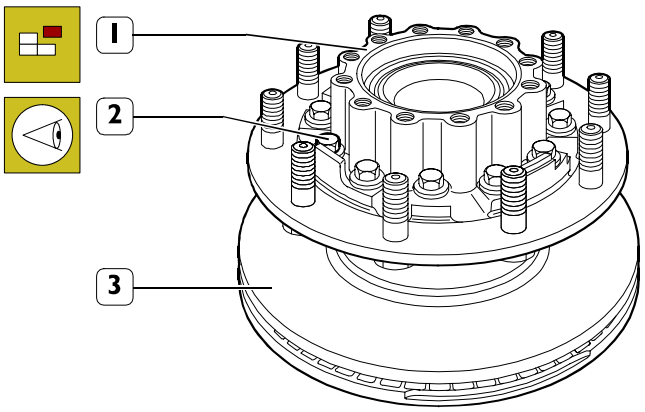


72746

Remove the wheel hub (1). Should this prove difficult, use the extractor comprising the brackets 99341017 (2), bridge 99341003 (3) and block 99345049 (4) fitted as shown in the figure.

Check the state of the wheel hub bearing, rear axle housing sleeve and calliper mounting plate. Replace any worn or damaged parts as described under "Overhauling the wheel hubs" of rear axle MS 13-175 with disc brakes.

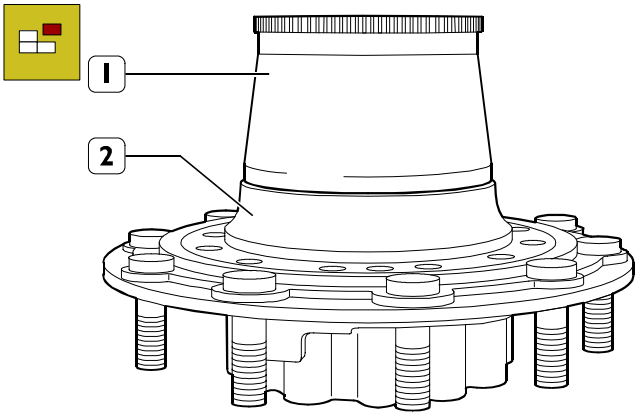
Figure 120



72748

Take out the screws (2) and remove the wheel hub (1) from the brake disc (3). Turn and grind the brake disc as described in the section or replace it if necessary.

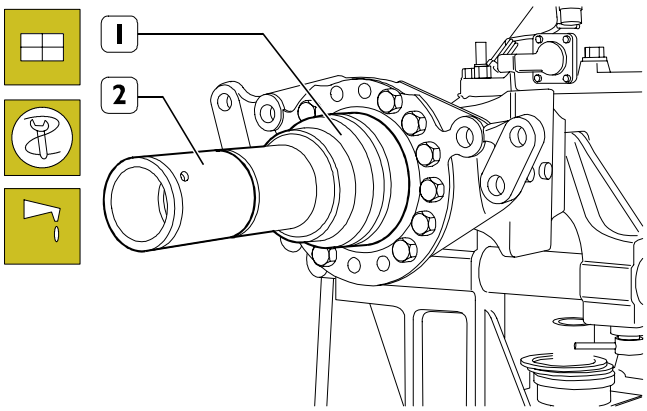
Figure 121



72749

The phonic wheel (1) is removed from the wheel hub (2) with general tools.
To assemble the phonic wheel, heat it to approx. 150°C and fit it on the wheel hub (2).
On completing assembly, make sure the phonic wheel (1) rests correctly on the hub seat.

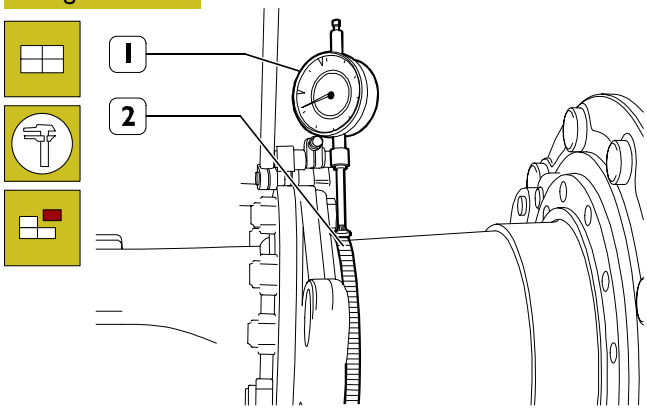
Figure 122



72755

Screw the tool 99370700 (2) onto the sleeve (1) of the rear axle housing.
Lubricate the outside of the tool (1) with Tutela Truck Fe-Axle.

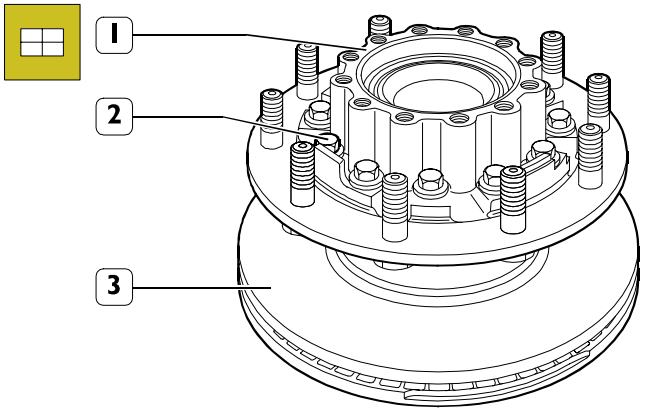
Figure 123



72757

Fit the wheel hub (3) on the sleeve of the rear axle housing and with the dial gauge (1) with a magnetic base check that the error of concentricity of the phonic wheel (2) is no greater than 0.2 mm. Remove the wheel hub (3).

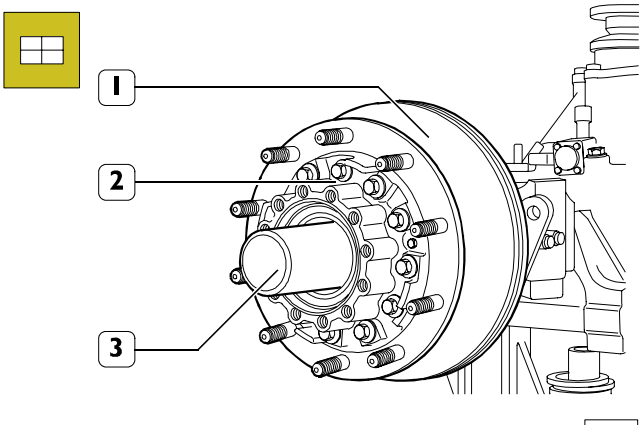
Figure 124



72748

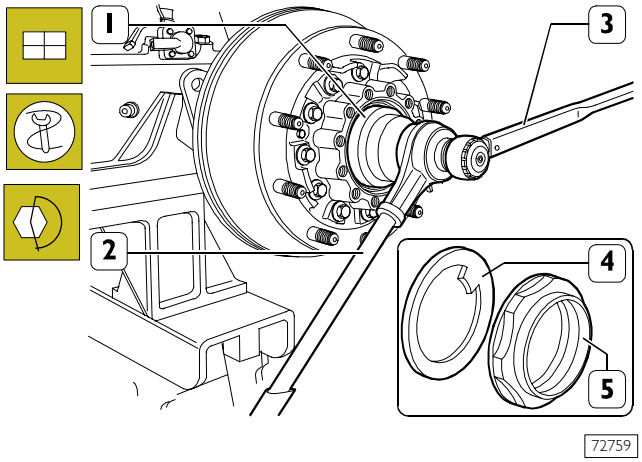
Fit the brake disc (3) onto the wheel hub (1) and screw down the screws (2).

Figure 125



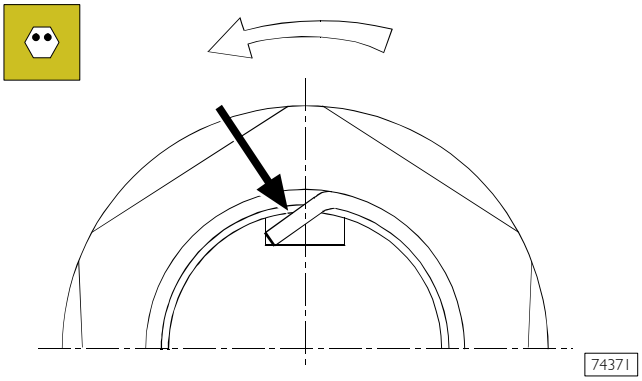
Sling the brake disc (1) with a rope and hook this onto a lift. Fit the wheel hub (2) onto the sleeve of the rear axle housing. Remove the tool 99370700 (3).

Figure 126



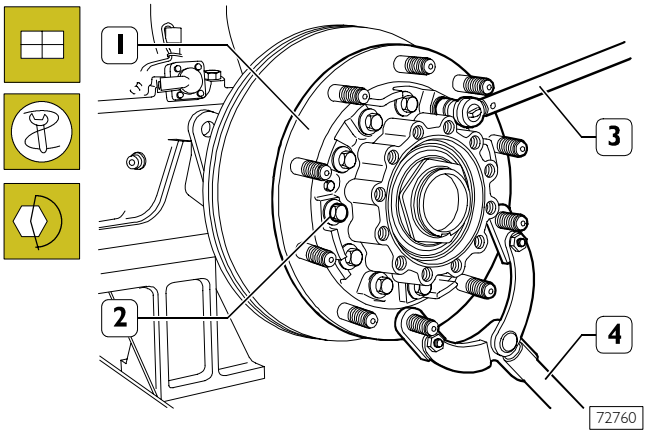
Position the retaining ring (4) so as to insert the tab into the groove in the sleeve. Lastly, screw down the ring nut (5). Using wrench 99355175 (1), the multiplier 99389816 (2) and the torque wrench (3), tighten the ring nut (5) to the required torque.

Figure 127



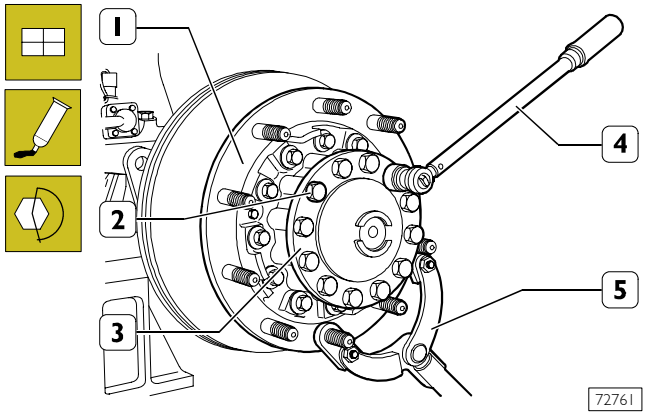
After tightening with a specific tool, make the cut and bend to prevent the ring nut unscrewing, as shown in the figure. The arrow shows the direction of unscrewing the ring nut.

Figure 128



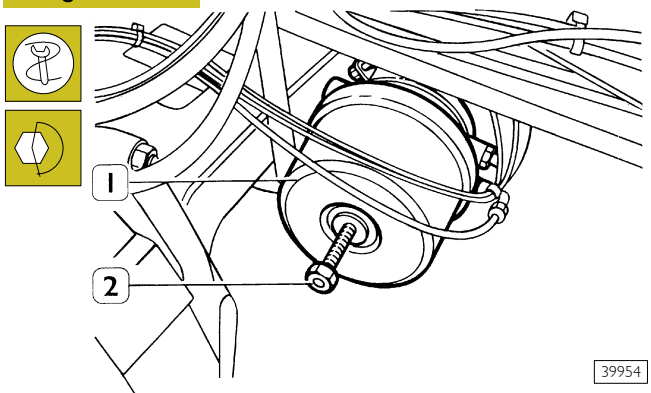
Block rotation of the wheel hub (2) with tool 99370317 (4) and tighten the screws (3) fixing the brake disc (1) to the wheel hub to the required torque.

Figure 129



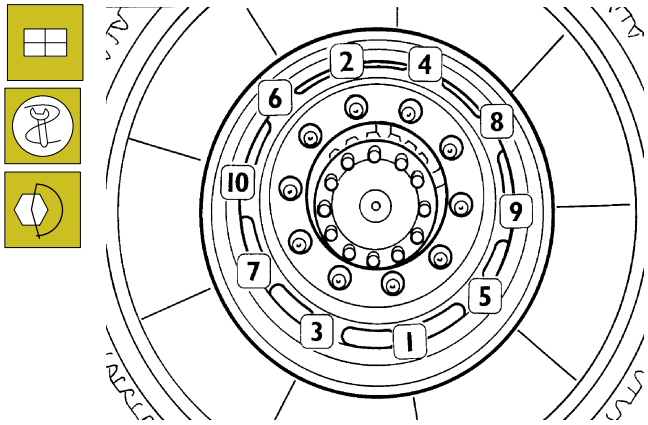
Spread IVECO 1905685 sealant (LOCTITE 14780) onto the contact surfaces, drive shaft flange and wheel hub and insert the drive shaft into the rear axle housing.
Screw down the screws (2) fixing the drive shaft (3) to the wheel hub and tighten with the torque wrench (4) to the required torque. Remove the tool 99370317 (5).

Figure 130



After overhauling and refitting the braking assembly, fit the cylinder (1) following the procedure described for the front brake cylinder.
Supply the cylinder (1) by pressing the service brake and tighten the fixing ring nut to the required torque with the wrench 99356006. Restore operation of the cylinders (1) governing the parking brake by fully screwing down the screw (2).

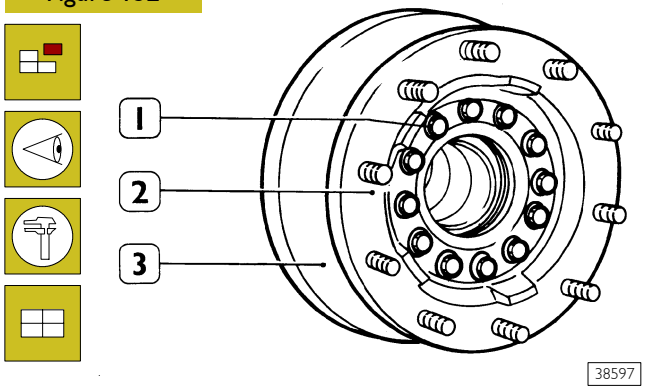
Figure 131



Using the hydraulic trolley 99321024 fit on the wheels. Lower the vehicle. Lock the nuts fixing the rims to the required tightening torque according to the diagram shown in the figure Proceed as described on the opposite side.
On completing this process, start the engine to recharge the pneumatic system.
Drive the vehicle in both directions, press the brake pedal repeatedly, to let the brake linings settle in.

527411 OVERHAULING BRAKE DISCS

Figure 132

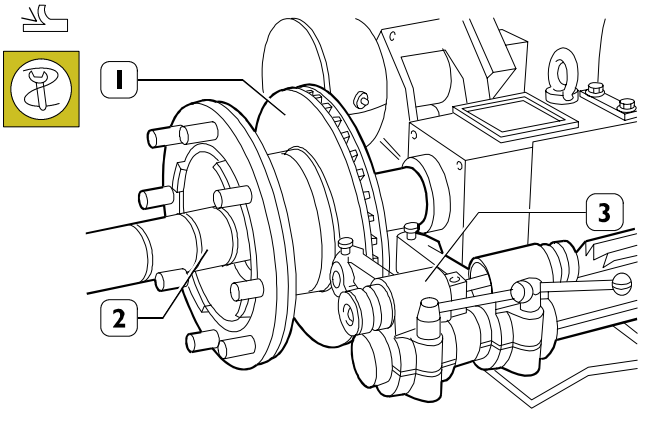


Examine the state of wear of the surfaces of the brake discs. Finding other values to the ones given in the characteristics and data, turn and grind the brake discs or, if necessary, replace them. Remove the screws (1) and detach the hub (2) from the disc (3). Replace the disc (3) and refit it following the reverse procedure to the one described above.

NOTE For regular braking, always replace a complete set of disks per axle.

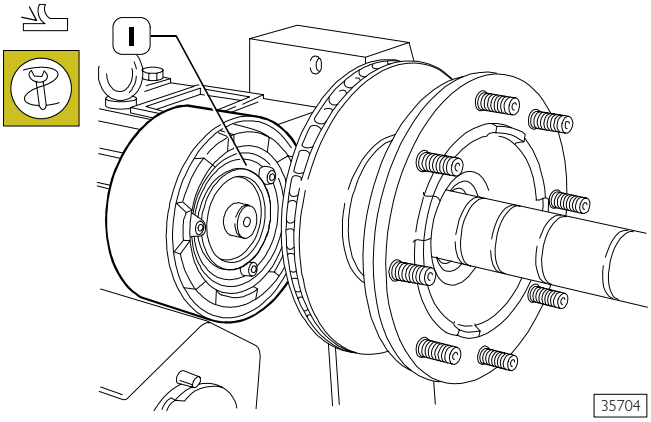
527411 TURNING AND GRINDING BRAKE DISCS

Figure 133



- ❑ Key onto the shaft of the lathe 99301001 (2) the brake disc (1) together with the hub.
- ❑ Key onto the shaft a set of spacers that eliminate the end float of the assembly; screw on the locking nut and fit the mount of the lathe shaft.
- ❑ Position the tool holder (3) in line with the brake disc (1), then adjust the depth of the tools.
- ❑ Proceed with turning and grinding the brake disc (1), operating with one or more passes to remove material depending on the scoring found.

Figure 134

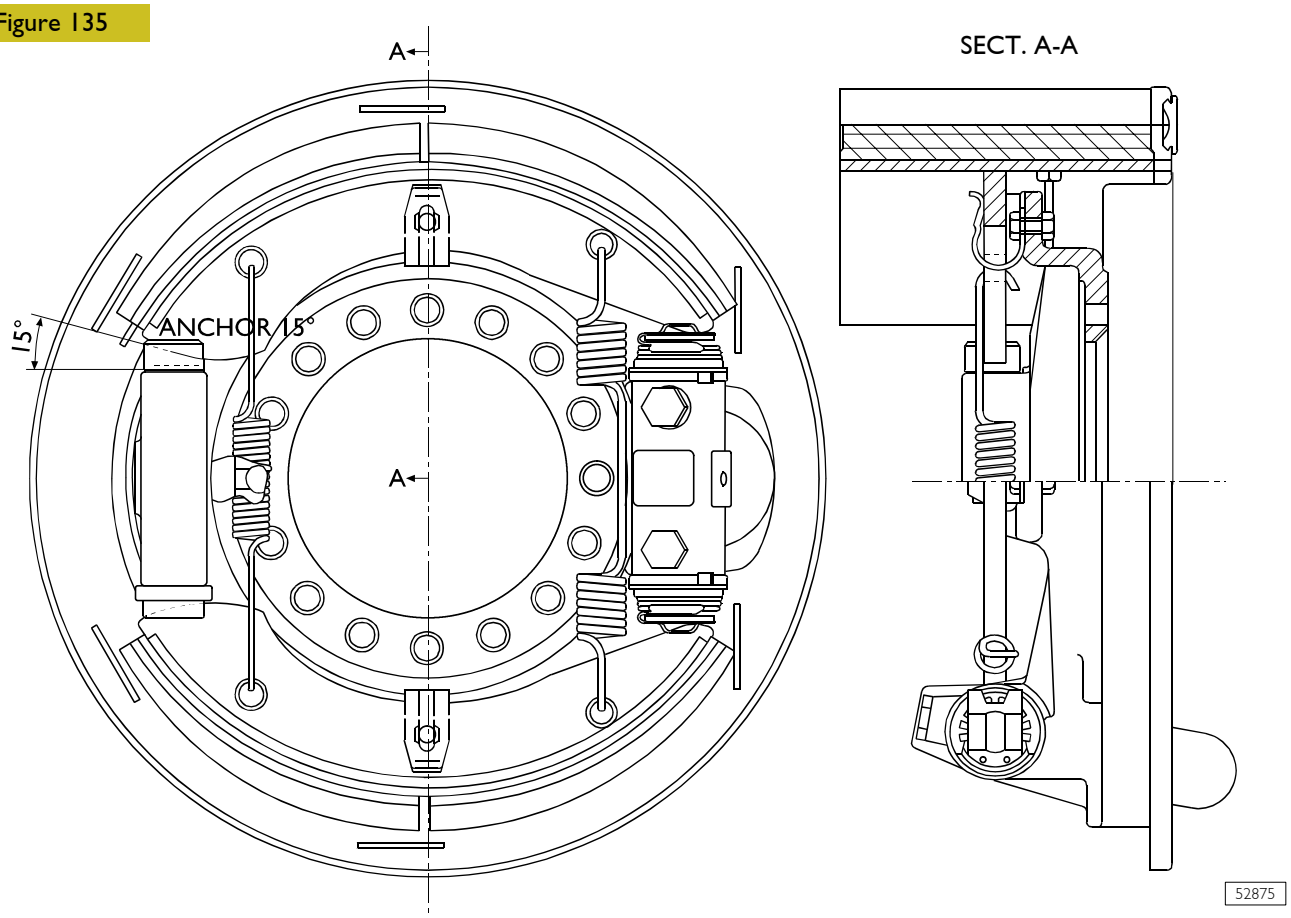


Using the specific grinding tool 99301001 (1) fitted to the lathe 99301001, grind both working surfaces of the brake disc.

NOTE When grinding, move the sector wheel forwards gradually, to remove all remains of turning.

DRUM BRAKES

Figure 135

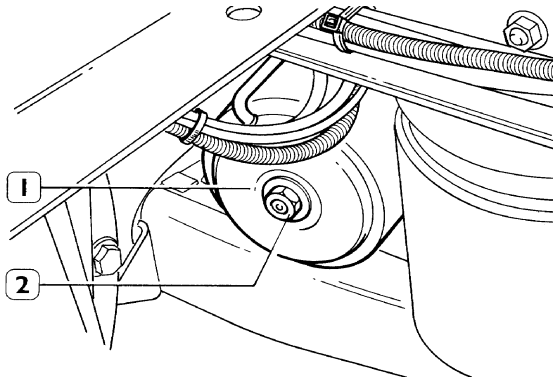


VIEW OF SIMPLEX TYPE DRUM BRAKES (ROCKWELL)

OVERHAULING THE DRUM BRAKES

527230 Removing the rear drum brakes

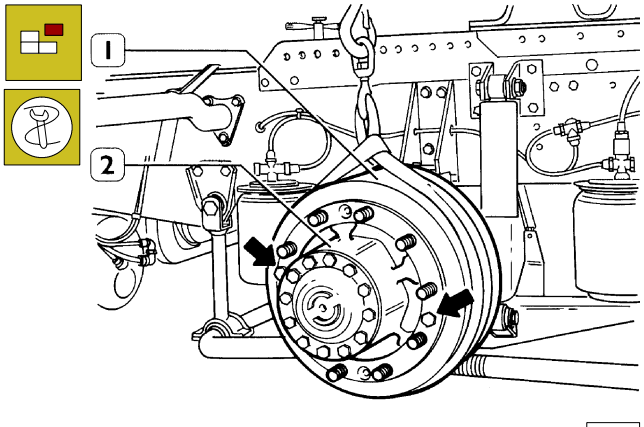
Figure 136



40511

Set the vehicle on level ground. Take the covers off the nuts fixing the wheel and loosen the nuts.
Lift the vehicle at the rear and put it on stands.
Position the hydraulic trolley 99321024 under the wheels.
Take out the nuts fixing the wheels and take them off.
Fully unscrew the manual brake release screw (2) of the combined cylinder (1).

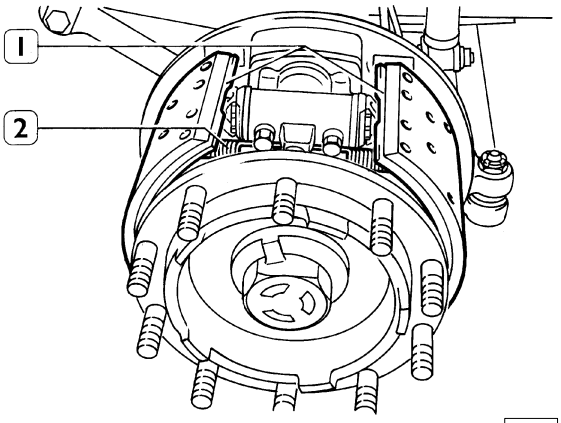
Figure 137



40867

Take out the screws fixing the brake drum (1) to the wheel hub (2). Screw two appropriate screws (⇒) into the holes in the drum and take this out of the wheel hub.

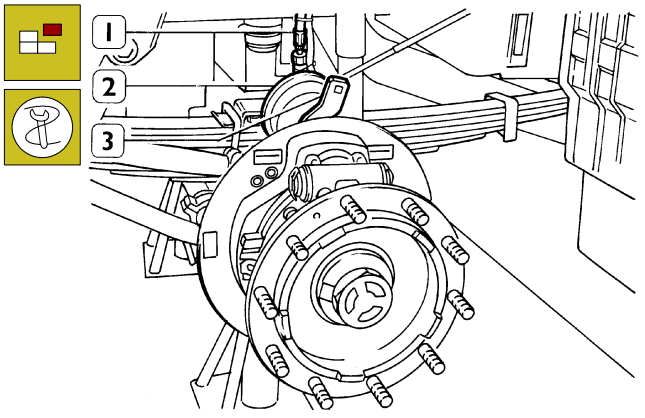
Figure 138



40512

Unlock shoe (1) return springs (2) using pliers 9935711. Remove shoe (1) and disconnect the electrical connection by unscrewing brake lining wear indicator cable fastening nut set on it.

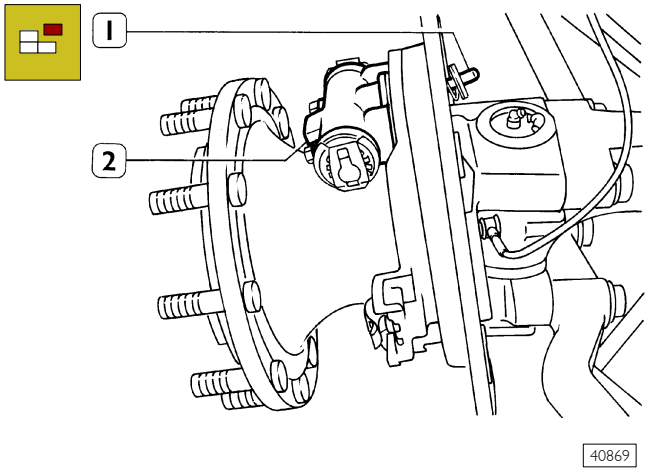
Figure 139



40868

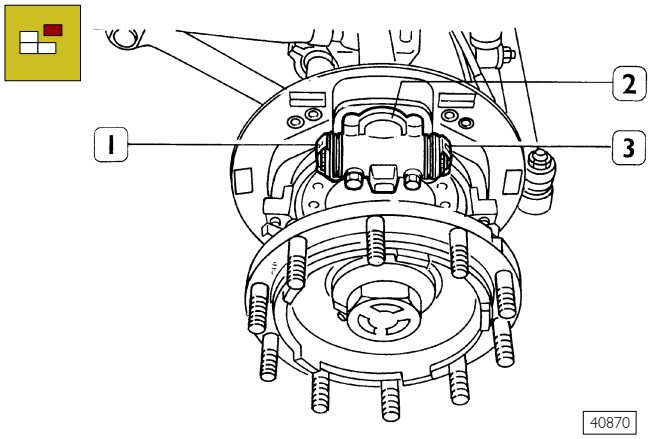
Disconnect the brake cylinder (2) feeding pipes (1). Using wrench 99356006 (3) loosen the ring nuts and remove the brake cylinder (2).

Figure 140



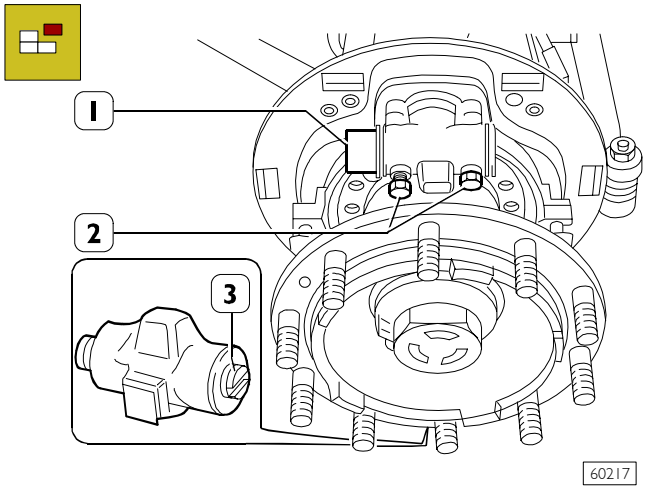
Take away the wedge units (1) controlling the brake housing (2).

Figure 141



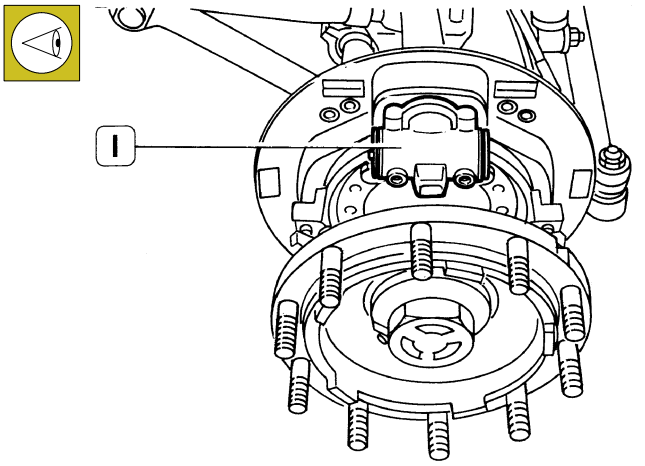
Take away the adjusting units (1 and 3) from the brake housing (2).

Figure 142



Remove the guide screws (2) and remove the thrust pins (1) with the adjustment bushes and relevant springs.
Remove thrust pins (3).
Remove the wheel and the whole braking unit on the opposite side. Keep components separate.

Figure 143



Check the wear on the pin seats of the brake housing (1), if they are scored or very worn replace the faulty brake housings.

Controls

Check the wear on the drums to decide whether they can be re- used.

Measure the drum diameters with a gauge without bending the arms.

Measure the diameter in several points to establish the ovality and wear, also taking into consideration the depth of scores on the braking surface.

Allowed tolerance for ovality and/or eccentricity is 0.25 mm

If the braking surface scoring or wear cannot be repaired by turning, or if there are evident signs of overheating, replace the drum (see Specifications and data table).

Check the conditions of the brake shoes, if they are cracked replace them.

If the brake lining surfaces show signs of grease, find the cause and remove it.

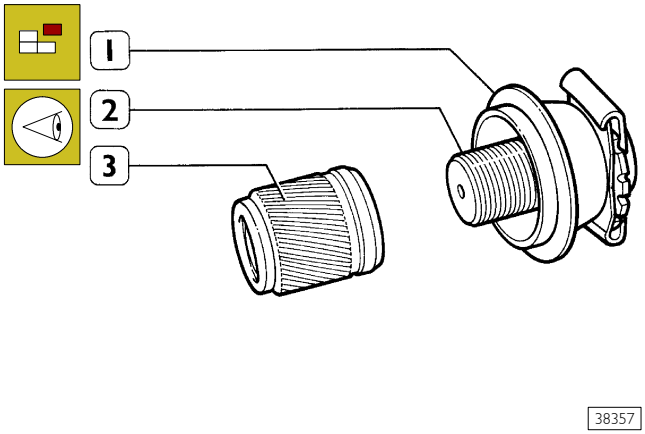
The minimum thickness admitted for the brake linings is 4.7 mm, measured at the last rivet of the shoe with the wear sensor on the side opposite the cylinder.

If a value that is under, or only just over the specified thickness, replace.

Check the integrity and/or efficiency of the brake lining wear indicator cable.

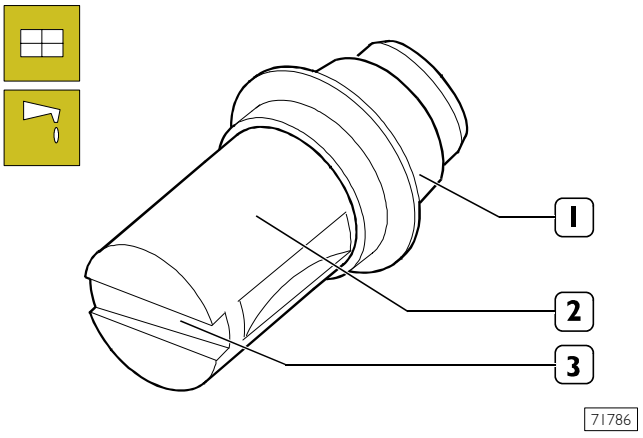
Check the integrity and/or efficiency of the shoe return springs.

Figure 144



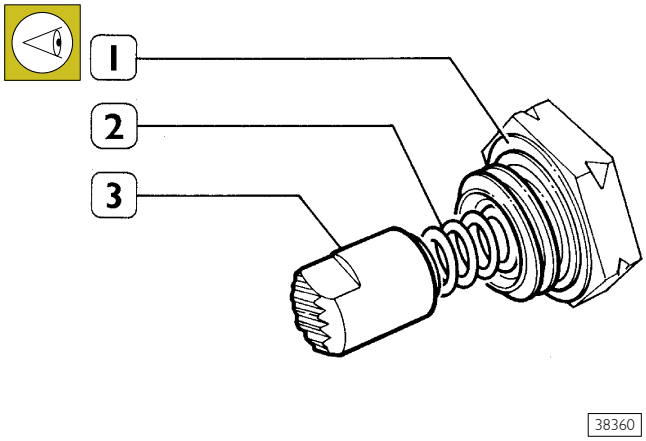
Disassemble the automatic adjustment unit.
Unscrew the adjustment bushes (3) from the adjustment pins (2) and then remove the seals (1).
Check the wear condition of the adjustment bush outer helical toothing and check whether bushes are sliding freely on the relevant adjustment pins when screwing.

Figure 145



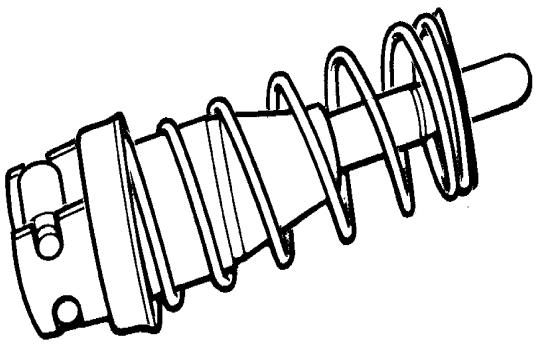
Take seal (1) off thrust pin (2). Check wear conditions for thrust pin (2) and surfaces of sloping planes (3) subjected to the operation of shoe opening drive rollers.

Figure 146



Check the condition of the pressure pin teeth (3), of the relevant compression springs (2) and of the copper washers (1).

Figure 147



35713

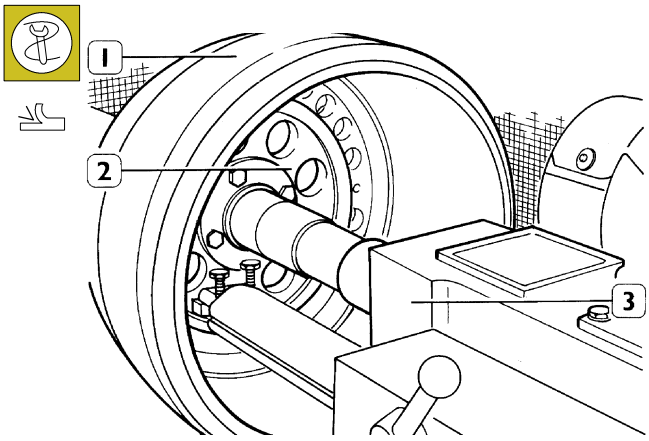
Check that the wedge assemblies run smoothly and the parts are not scratched.

NOTE If the parts forming the wedge units are worn, you need to replace the entire wedge unit.

527231 Turning drums

Measure the diameter of the drums with a sliding gauge without angling the arms. Measure the diameter at several points to determine the roundness and state of wear.

Figure 148



40520

Fit the tool 99372213 (2) in the brake drum (1).
Key this assembly onto the shaft of the lathe 99301001 (3).
Fit a set of spacers onto the shaft eliminating the end float of the assembly. Screw down the locking nut and fit on the lathe mount.
Fit the anti-vibration band onto the brake drum.
Turn the drums, removing the necessary amount of material in several stages to eliminate the flaws found.

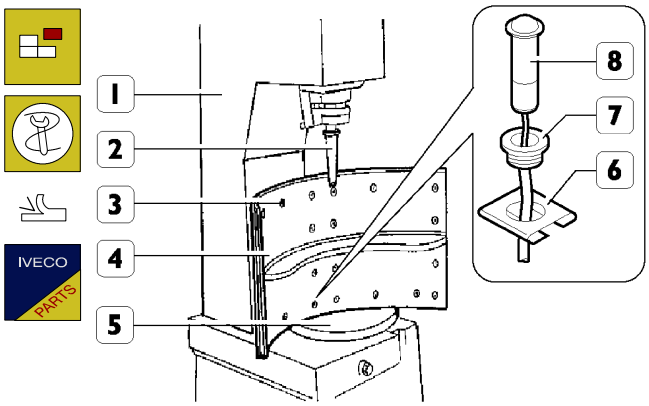
After turning, remove the brake drum from the lathe and clean it carefully.

The highest permitted diameter for the drums is given on the drum itself.
This limit must never be exceeded as this would impair the braking effect and the strength of the drums.

Couple the appropriate brake linings for each single drum according to the oversize.
Each of the vehicle's axles must be equipped with linings of the same type.

527233 Replacing brake linings

Figure 149

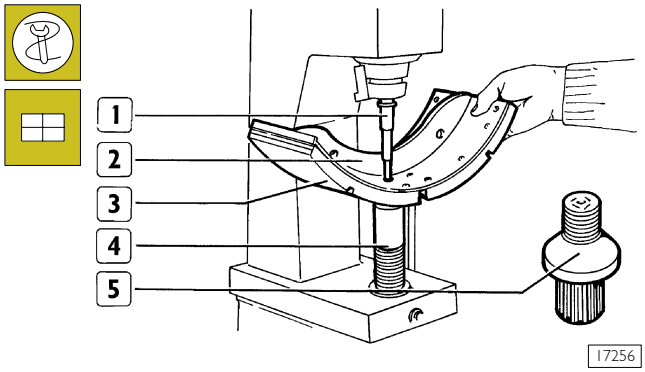


Remove the worn brake linings from the shoes with the compressed air press 99305087 (1).

NOTE From the bottom shoes or the tongues of the clip (6) freeing the bushing (7). Now remove the lining wear gauge (8) with the associated cable.

Put the entire shoes (4) on the adjustable plate (5).
With the chisel (2) in the operating head of the press (1), cut off the heads of the rivets (3).
Eject the rivets from the shoes.
Thoroughly clean the shoes by washing and blowing.

Figure 150



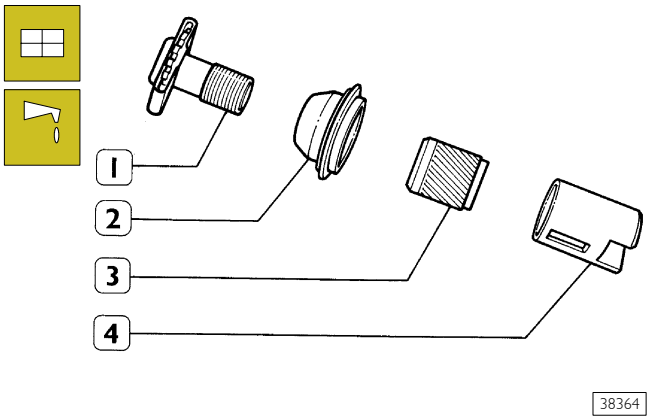
Fit the supporting pin (5) on the mobile mount (4) of the press. Rivet the brake linings (3) onto the shoes (2) using the drift (1) inserted in the operating head of the press.

NOTE The right way to rivet the brake linings is to start from the middle and gradually move towards the outside of the braking sectors.

Fit on the lining wear cable by carrying out the procedures described for removal in reverse order.

Assembly

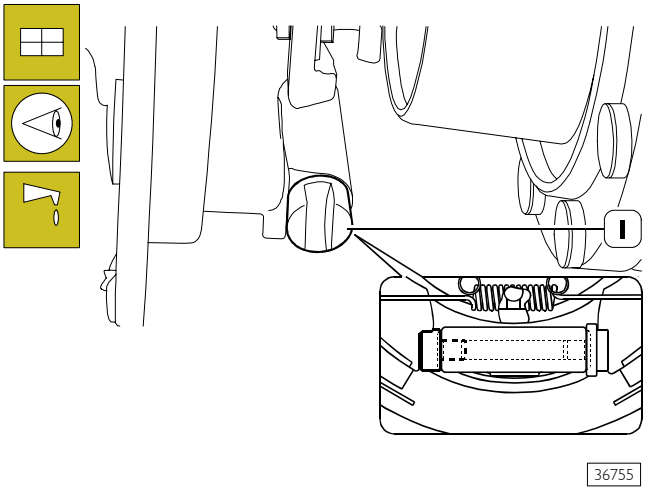
Figure 151



Fit the seals (2) on the units of the adjustment pins (1). Grease the thread of the pins (1).
Fully screw down the adjustment bushings (3) and grease them thoroughly on the outside diameter.
Grease the inside diameter of the thrust pins (4).

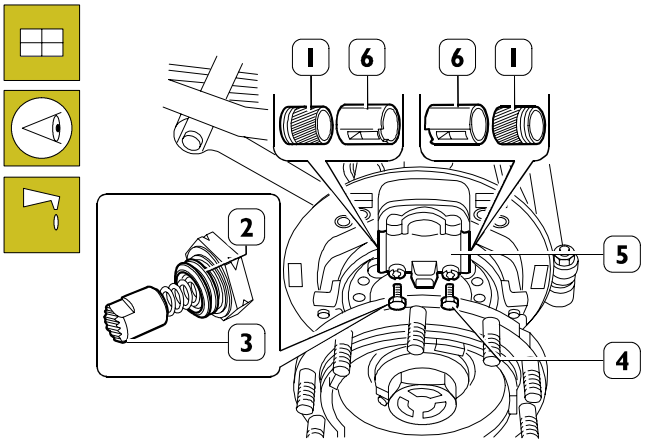
When repairing the brakes, replace the seals of the reaction and thrust pins.
To lubricate the components, use Rockwell RBSK 0253 grease.

Figure 152



Fit thrust pins (1) inclined by 15° towards the main shoe and thoroughly grease inside support diameters.

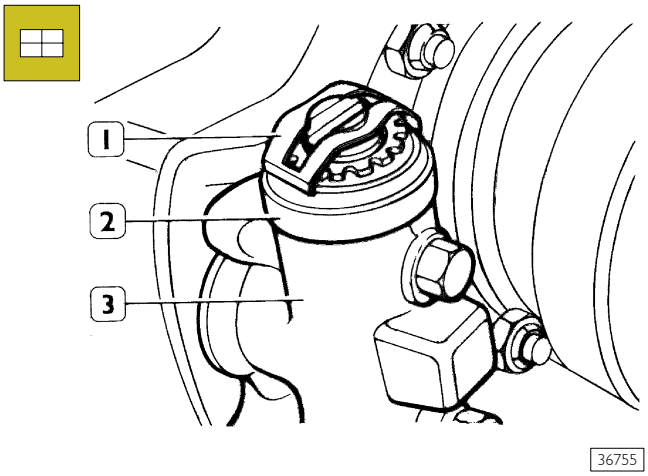
Figure 153



Screw component (1) and fit it in the thrust pin (6). Grease the interior of the brake body (5) and fit thrust pins (6) so that the slot is facing the guide pins (4).
Grease and fit complete guide pins (4) in brake body seats (5); check whether washers (2) are fitted and screw some turns.

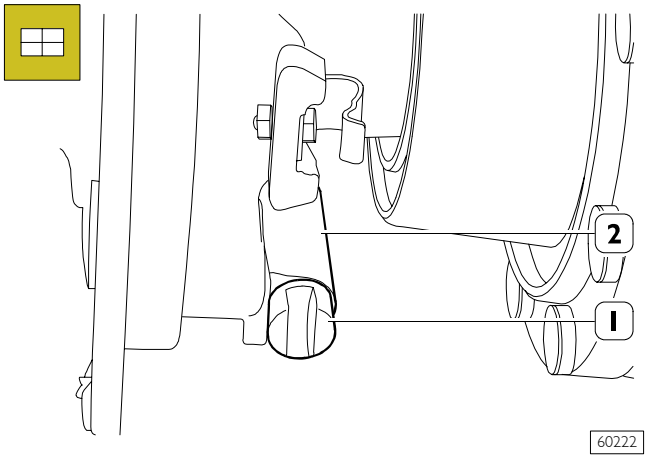
NOTE Guide pins (4) shall be fitted so that prongs (3) can slide in the proper brake body hole seats (5).

Figure 154



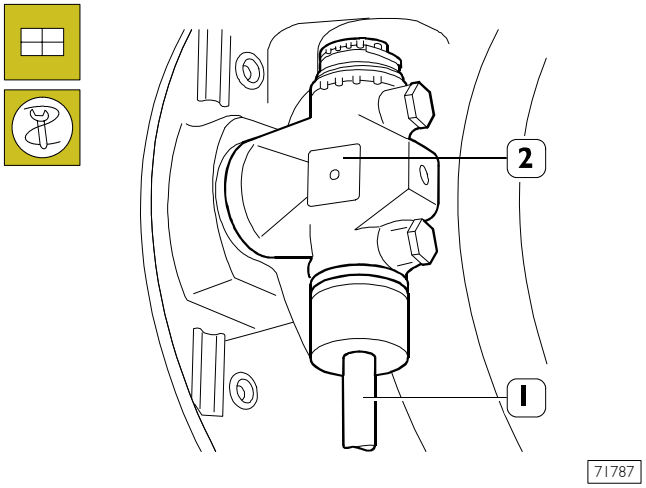
Inset the adjustment units (1) into the brake body (3), facing the clip as shown in the figure.
Fit the protective cap (2) into the groove of the brake body (3).

Figure 155



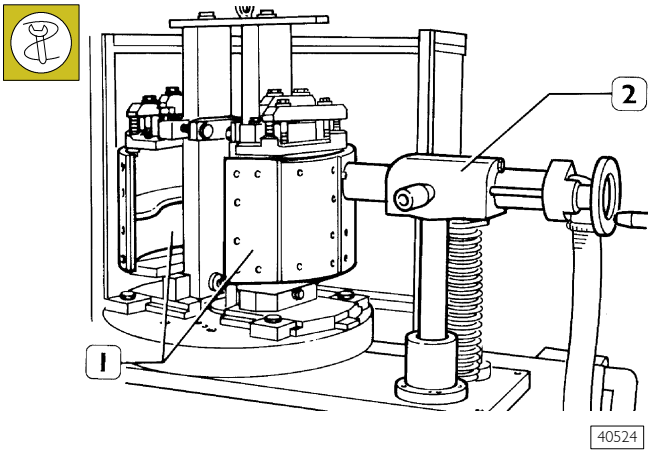
Fit thrust pins (1) into brake body (2).

Figure 156



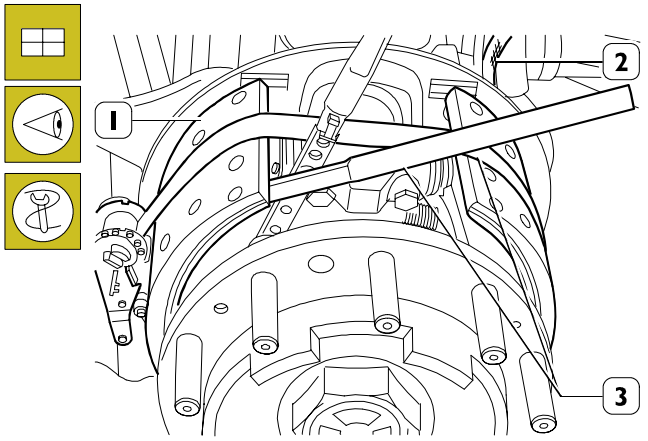
Using the key 99373002 (1), drive the metal rings of the seals onto the brake assembly (2).

Figure 157



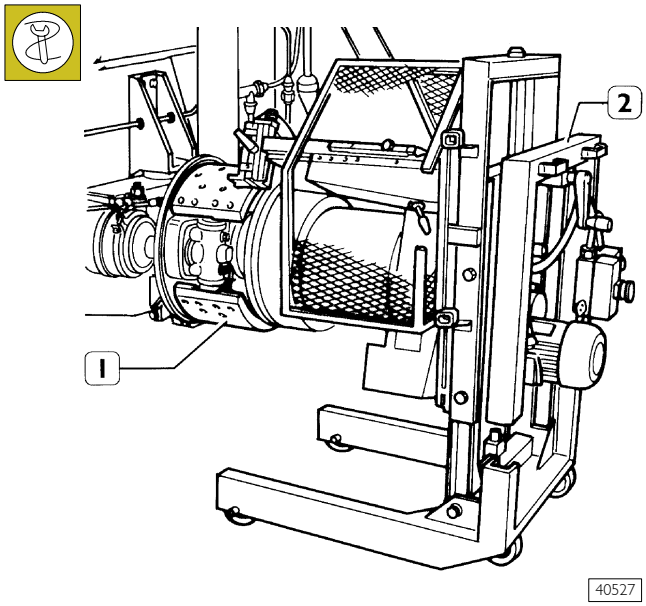
Using device 99301006 (2), turn the brake linings (1).

Figure 158



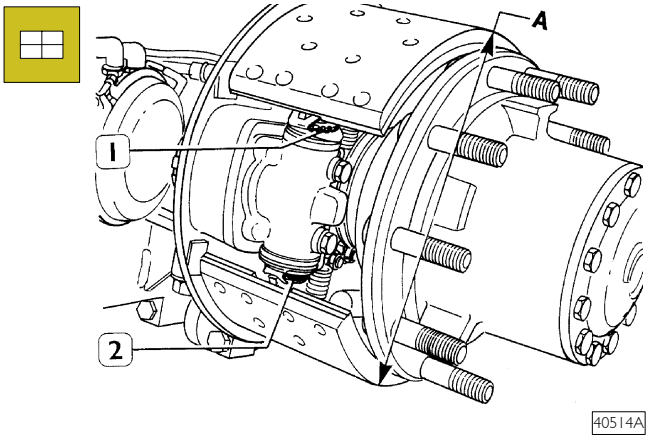
Electrically connect brake lining wear indicator cable (2), aiding the fastening nut on the shoe. Fit shoes (1) into the proper seat, "Anchor" writing marked on the shoe shall be set near the thrust pins and be faced towards the operator.
Hook shoe return springs by tool 99372211 (3).

Figure 159



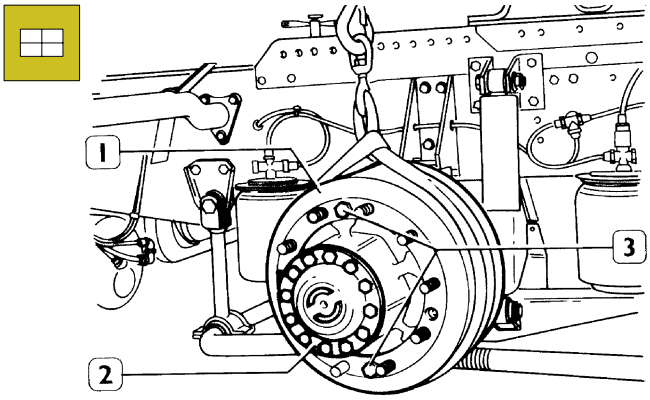
If you have device 99305079 (2) instead of 99301006 (2, Figure 157), turn the brake linings (1).

Figure 160



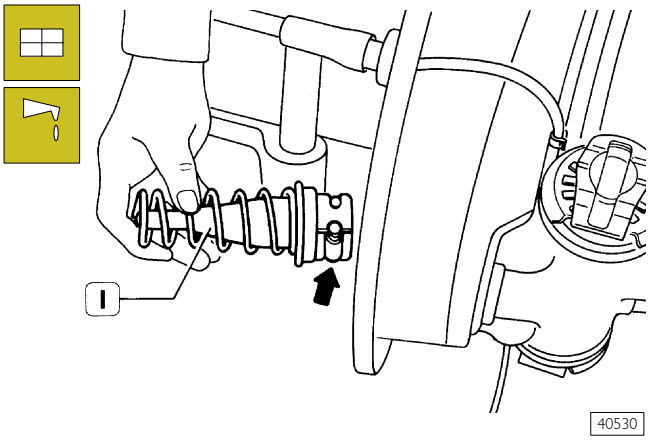
Unscrew the adjustment units (1 and 2) to the same extent to obtain the diameter A, 2 mm less than the diameter of the brake drum to mount.

Figure 161



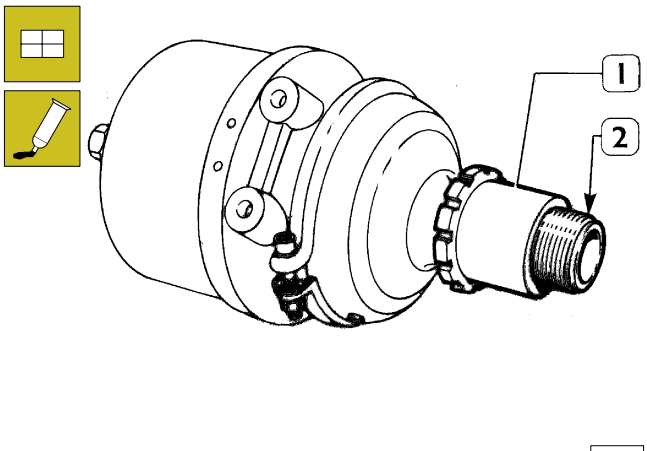
Fit the brake drum (1) and secure it to the wheel hub (2) with the screws (3).

Figure 162



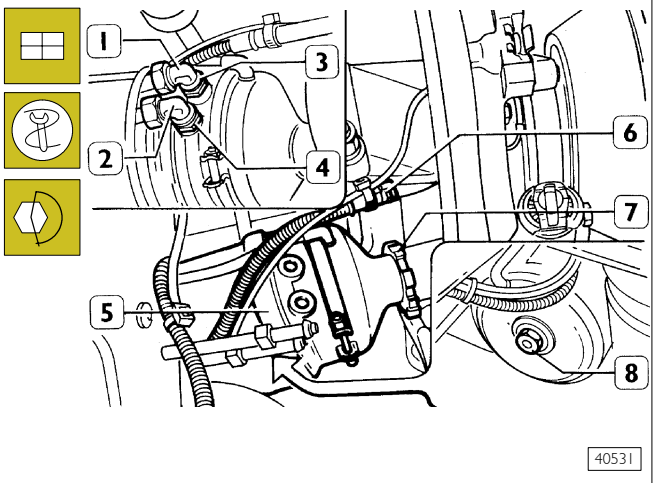
Grease the wedge-shaped control unit (1). Insert it in its seat, taking care that the rollers (⇒) are positioned in the sliding race.

Figure 163



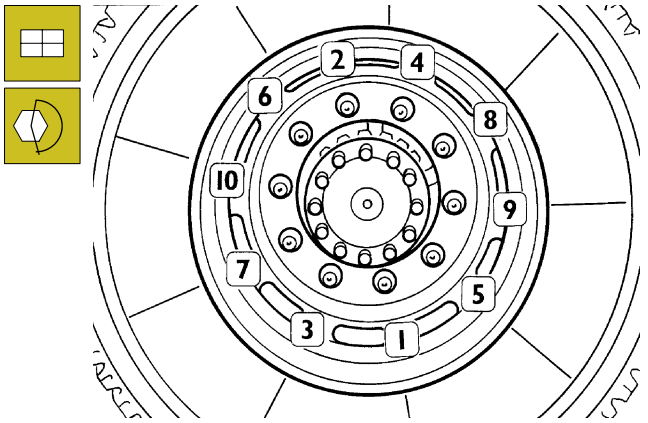
Screw the ring nut (1) by hand onto the sleeve (2) as far as it will go.
Apply non-hardening sealant type LOCTITE 573 on the first few threads of the sleeve.

Figure 164



Screw the combined cylinder (5) fully down into its seat.
Check that the holes for the supply fittings are in the same position found on removal; if they are not, unscrew the combined cylinder appropriately.
Mount the fittings (3 and 4) and connect the supply pipes (1 and 2).
Supply the diaphragm sections of the combined cylinder by applying the service brake.
With the wrench 99356006, tighten the ring nut (7) to the required torque. Connect the brake lining wear indicator cable electrical connection (6).
Restore the operation of the combined cylinder (5) screwing down the screw (8) fully.

Figure 165



Mount the wheels and tighten the fixing nuts to the required torque according to the diagram shown in the figure.

On completing this process, start the engine to recharge the pneumatic system.
Drive the vehicle in both directions, press the brake pedal repeatedly, to let the brake linings settle in and recover the clearance between the brake linings and the drum.

SECTION 13

5501 Bodywork
5001 Chassis frame

5501 CAB
General information

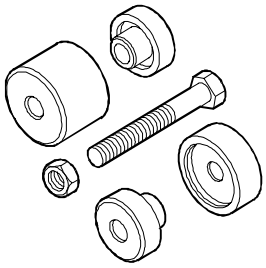
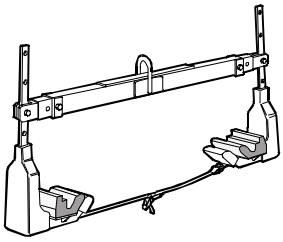
The cab is of advanced type, hydraulically tiltable by electrical drive, or, on request, by manual drive.
Tilting angle 60°.
Pressed, weld steel frame.
Anticorrosion protection for boxed structure spaces.
Outer panel inner side and door frame with electrogalvanized sheet,
Application of polyurethane foam sheets on perimeter walls and foamed polyethylene sheet on doors, to reduce thermal dispersion and improve passenger compartment sound-proofing.

Likewise, the boxed structure inside making up the cabin frame is filled with polyurethane elements to eliminate air circulation with resulting hiss, by reducing thermal dispersion, and also improve sound-proofing.
Cabin dimensions: 2,480 x 2,115 mm.
High roof with electrically controlled trapdoor.
Built-in, manually controlled spoiler (on request).
Flat floor.Pneumatic cabin suspension.

FEATURES AND DATA

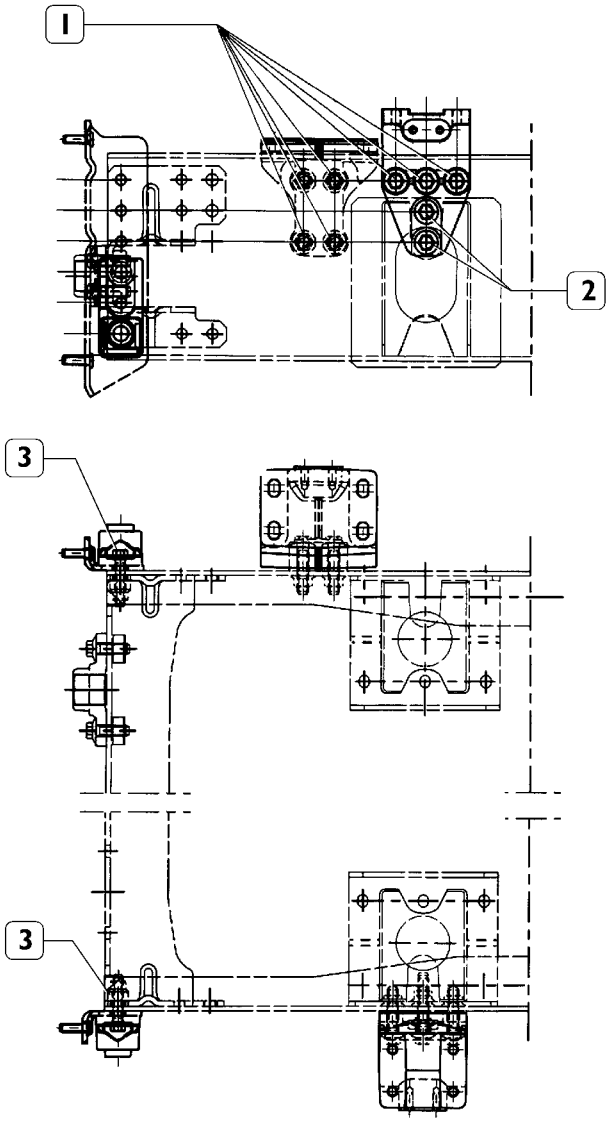
DESIGNATION		
Cabin with pneumatic suspension, made up of:*		
- shock absorber with coaxial air spring		
- levelling valve	2	
- levelling valve	1	
Rear suspension made up of:		
- shock absorber with coaxial air spring	2	
- levelling valve	1	
Levelling valve		
❑ KNORR-BREMSE SV 1490-K000264 (front and rear)		
Maximum working pressure	8,5 bar	
Minimum guaranteed pressure	$0.5^{+0.8}_{-0.2}$	bar
Maximum lever working range	± 20°	
Control lever maximum stroke (upwards and downwards starting from horizontal position)	70 mm	

TOOLS

TOOL NO.		DESCRIPTION
99346051		Cabin front suspension bracket rubber bush disassembling/assembling tool
99378039		Cabin detachment/reattachment swing bar

TIGHTENING TORQUES

Figure 1



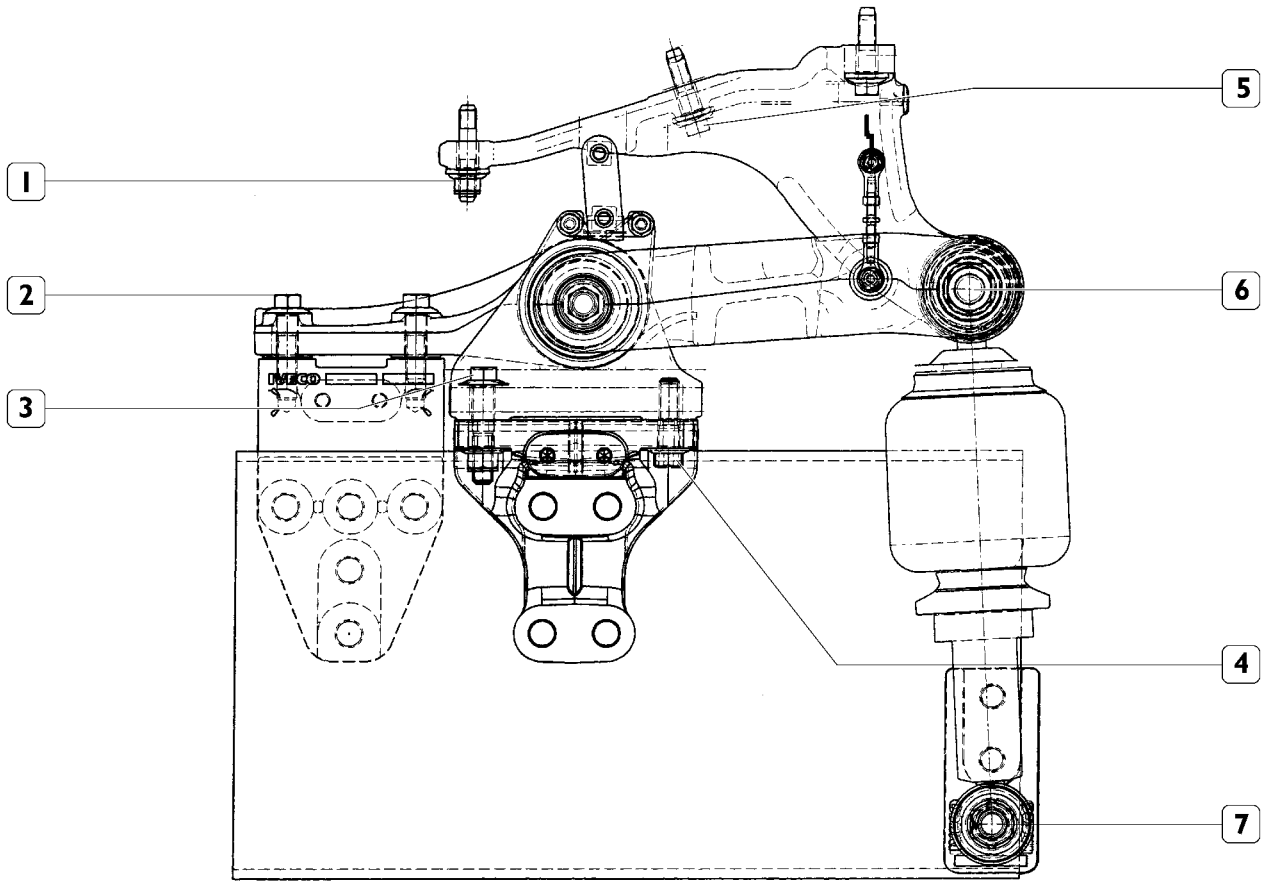
LEFT HAND DRIVE VEHICLES CAB SUPPORTS

	DESCRIPTION	TORQUE	
		Nm	Kgm
1	Nut M16	226.5 ± 22.5	22.6 ± 2.2
	Screw M16	278 ± 28	27.8 ± 2.8
2	Screw M16	226.5 ± 22.5	22.6 ± 2.2
3	Nut M14	179 ± 18	17.9 ± 1.8
	Screw M14	146.5 ± 14.5	14.6 ± 1.4

NOTE The cab supports of left hand drive vehicles are mounted in changed over position with respect to the ones shown in figure.

TIGHTENING TORQUE

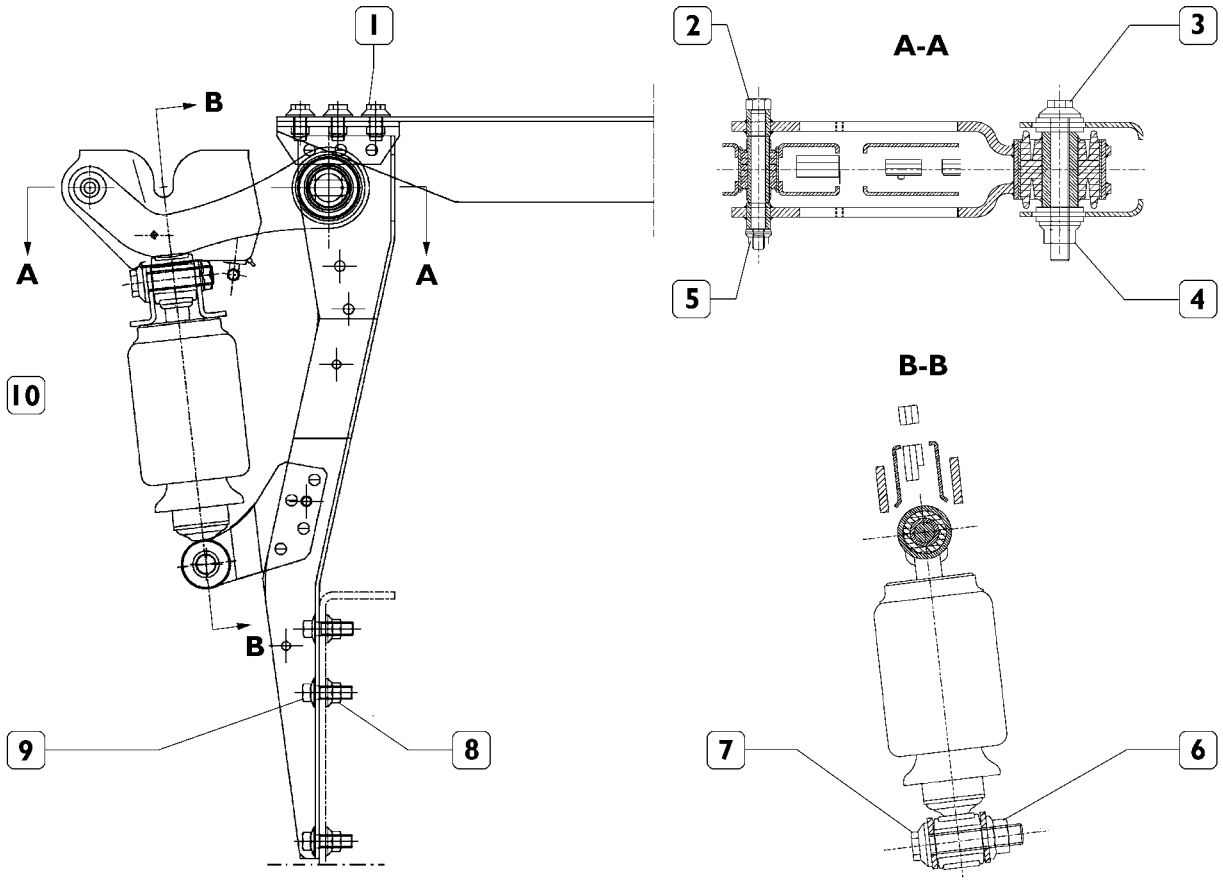
Figure 2



CABIN FRONT SUSPENSION

	DESCRIPTION	TORQUE	
		Nm	Kgm
1	Cabin front support fastening nut	83 ÷ 101	8.3 ÷ 10
2	Front left support fastening screw	173 ÷ 212	17.3 ÷ 21.2
3	Front right support fastening screw	161 ÷ 197	16 ÷ 19.7
4	Front right support fastening screw	173 ÷ 212	17.3 ÷ 21.2
5	Cabin front support fastening screw	109 ÷ 133	10.9 ÷ 13.3
6	Air spring/shock absober upper fastening screw	400	40
7	Air spring/shock absober upper fastening screw Air spring/shock absorber upper fastening nut	490 ÷ 600 398 ÷ 487	49 ÷ 60 39.8 ÷ 48.7

Figure 3



TIGHTENING TORQUE

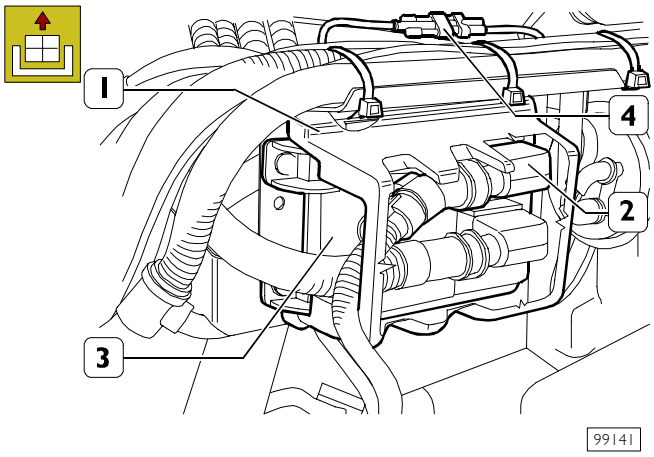
DESCRIPTION		TORQUE	
		Nm	Kgm
Rear cabin suspension			
1	Flanged, hexagonal screw for fastening	120 ÷ 145	12 ± 14.5
2	Flanged, hexagonal screw for bracket/lock fastening	57 ÷ 70	5.7 ± 7
3	Flanged, hexagonal screw for bracket/bolster fastening	250 ÷ 305	25 ± 30.5
4	Flanged, hexagonal nut for bracket/bolster fastening	205 ÷ 250	25 ± 20.5
5	Flanged, hexagonal nut for bracket/lock fastening	47 ÷ 58	4.7 ± 5.8
6	Flanged, hexagonal nut for shock absorber lower fastening	165 ÷ 200	16.5 ÷ 20
7	Flanged, hexagonal screw for shock absorber lower fastening	205 ÷ 250	20.5 ± 25
8	Flanged, hexagonal nut for bolster/chassis fastening	47 ÷ 58	47 ± 5.8
9	Flanged, hexagonal screw for bolster/chassis fastening	255 ÷ 310	25.5 ÷ 31
10	Hexagonal screw and nuts for shock absorber/lock upper fastening	255 ÷ 310	25.5 ÷ 31
	GAS PIPE ADAPTERS		
	5/8" - 18 UNF	15.9	1.6
	3/4" - 18 UNF	15.9	1.6
	1" - 14 UNF	29.8	3

REPAIR WORK

500210 BUMPER

Removal

Figure 4



Operating on main switch, take current off the electric system.

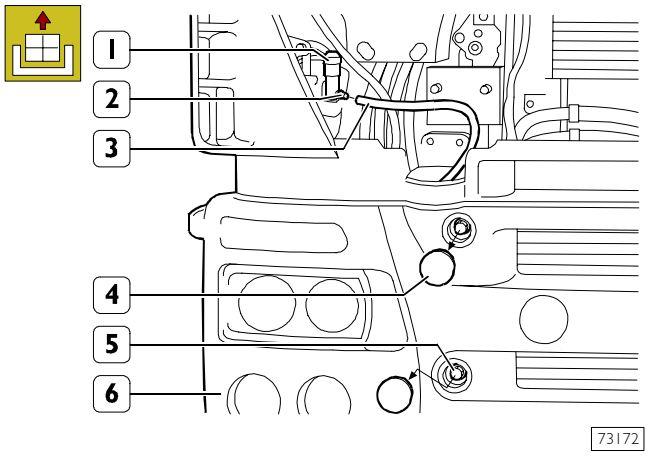
Tilt the cab.

Remove cover (1). Disconnect the connector (2) from the F.F.C. control unit (3).

Cut wiring harness retaining clamps and disconnect connection (4).

NOTE After disconnecting connector (2), the cab cannot be lowered any more.

Figure 5



Disconnect the pipe (3) from the motor pump (1) for the headlight washer and attach its fitting; fit on a plug (2) to prevent the liquid draining out of the tank. Take off the covers (4) and unscrew the four nuts (5) fixing the bumpers (6) to the cab.
Support the bumper (6) appropriately and detach it from the cab by removing the nuts securing it to the side brackets.

NOTE With the bumper moved away from the cab, take out the screws fixing the earth cable to the chassis frame.

Fully remove the bumper, then store it with the greatest care so as not to damage it.

NOTE Should after taking off the bumper be necessary to lower the cab, connector (4, fig.4) has to be fed with battery positive.

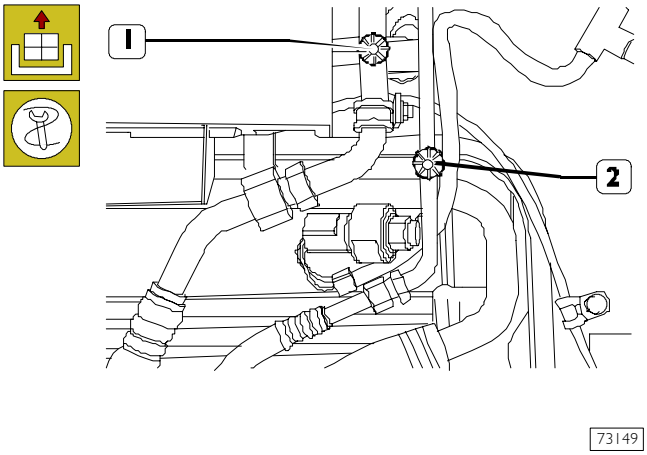
Refitting

Reattachment is carried out by properly reversing the detachment operations and tightening the nuts and screws to the specified torque
When reattachment operations have been completed, check correct operation of the lights or units affected by detachment.

55005 CABIN

Removal

Figure 6

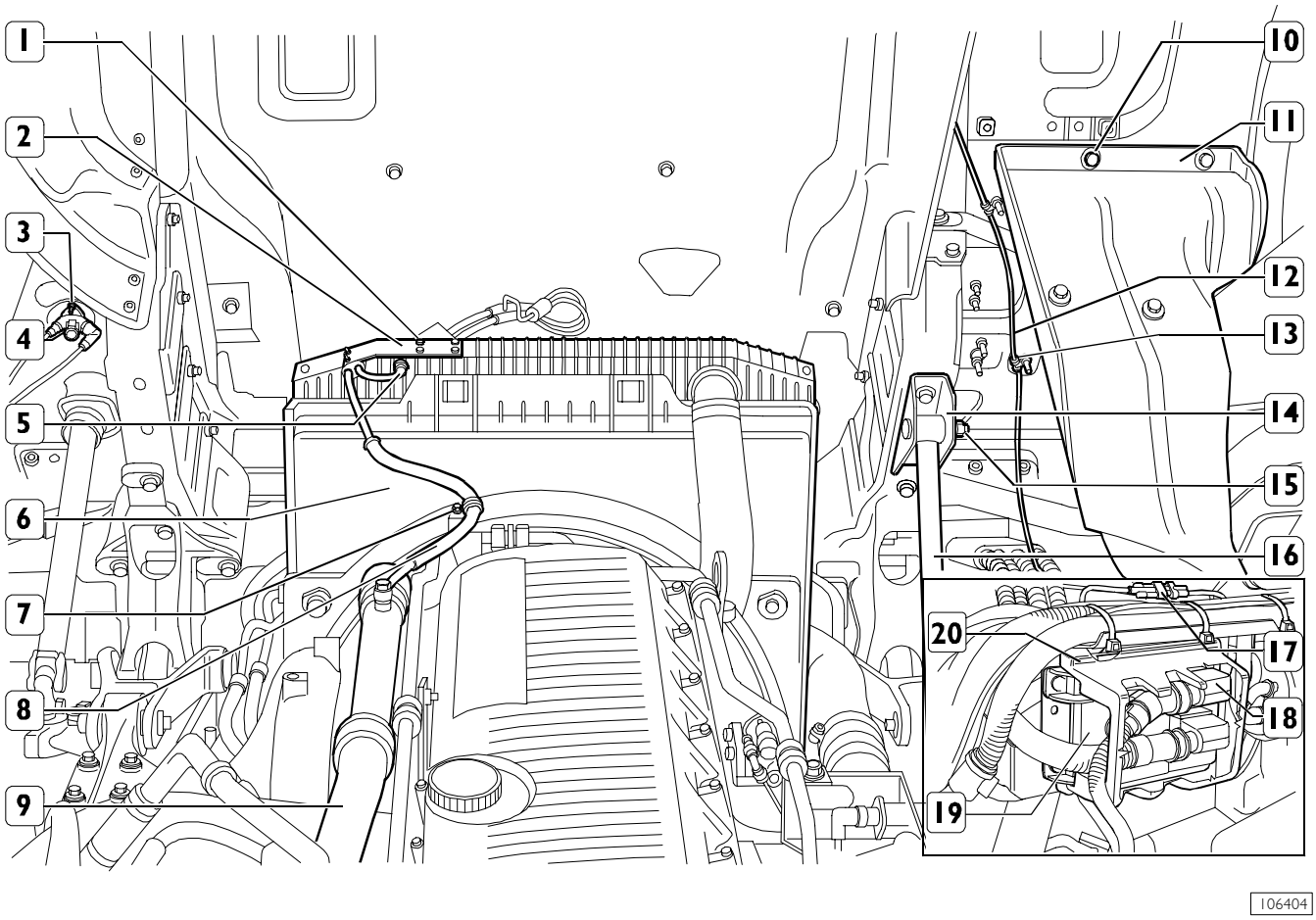


Set the vehicle with its front wheels pointing straight ahead. Lift the front radiator cowling. Take the cap off the expansion tank and partially drain off the coolant from the engine cooling system.
Remove plugs (1) and (2), apply pipes of equipment 99305146 to underlying fittings and bleed gas from cab air-conditioning system as described in relating chapter.

NOTE This operation must be carried out only by authorized, qualified skilled personnel.

Drain the pneumatic system.

Figure 7



Take out the screws (10) and remove the mudflaps (11) from the cab. Disconnect the coolant pipes (8) from the duct (9) and (5) from the radiator (6). Take out the screw (7) fixing the pipe clamp (8). Take out the screws (1) fixing the bracket (2) supporting the pipes on the radiator (6).
Remove the nuts (3) and detach the pedal control valve (4) for the steering assembly.
Disconnect the heater fuel pipe (12) from the fitting (13).
Loosen the nut (15) fixing the cylinder (16) for tilting the cab to the mounting (14).

Only for vehicles equipped with mechanic gearbox.

Mark the assembly position of the telescopic tie-rod Cardan joint on gearbox control rod, then remove nut with its respective screw and disconnect Cardan joint from rod.

Properly secure the telescopic tie-rod to the cabin.

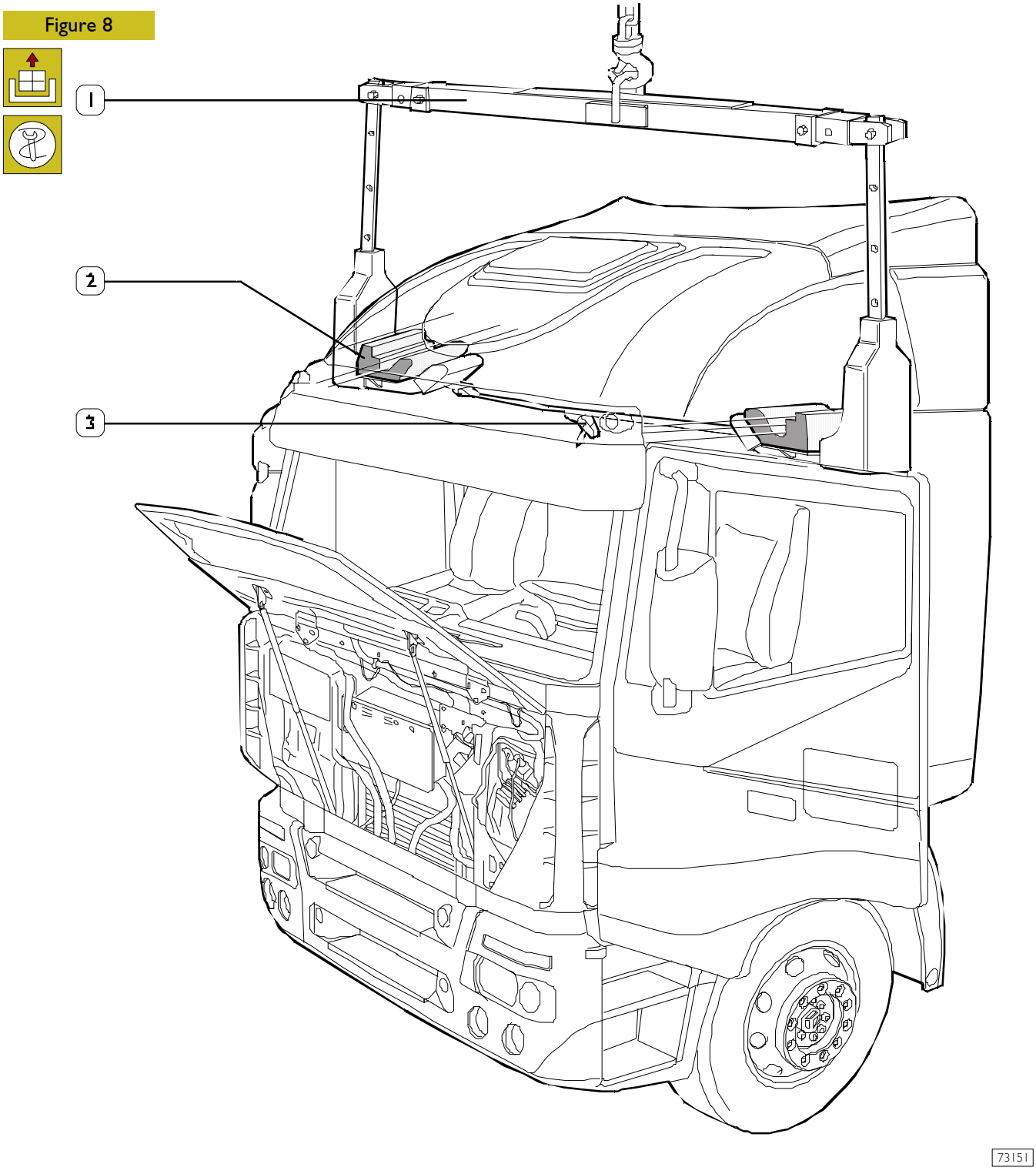
Remove cover (20). Disconnect the connector (18) from the F.F.C. control unit (19).

Cut wiring harness retaining clamps and disconnect connection (17).

Feed connector (17) with battery positive.

Position the two wooden dowels of suitable thickness onto the cabin supporting rear crossbar, to avoid cabin lock engagement after the cabin has been lowered.
Lower the cabin.

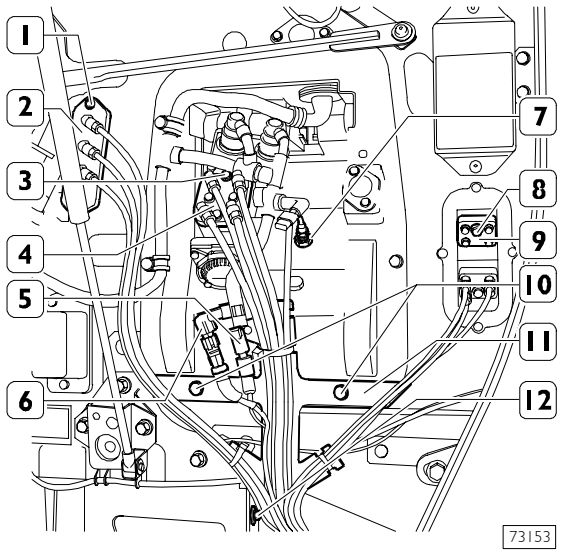
Figure 8



Take off the bumper as described in relating chapter (operation 500210). Remove gasket from door openings upper side.
Using an overhead travelling crane or a suitable lift, sling the cab with the arm 99378039 (1). The hooks (2) of the arm (1) need to be positioned approximately on the centre line of the door bays and fastened to them with the tensioner (3).

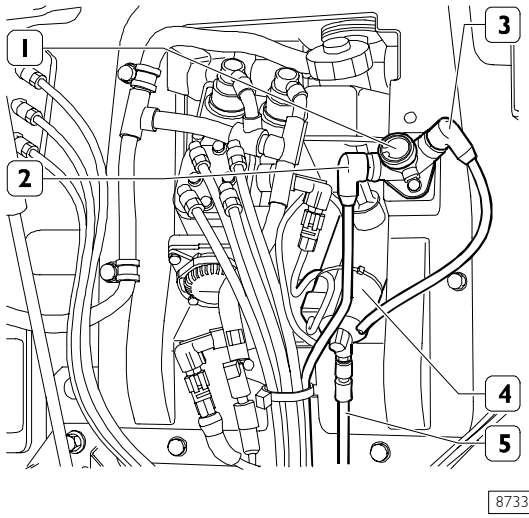
Engage the steering lock by taking the ignition key out.
Place a vessel under cab tilt cylinder in order to recover oil from the cylinder, disconnect oil piping.

Figure 9



Remove the nuts (1) and detach the cover (2) together with the pipes from the bulkhead connector.
Take out the screws (3) and detach the cover (4) together with the pipe from the control valve.
Take out the screws (8) and detach the cover (9) from the bulkhead connector.
Disconnect the electric connections (5) and (6).
Take out the screws (10) and (12) and detach the bracket (11) to support the cables and pipes from the cab.
Disconnect the pipe (7) of the steering assembly control device.

Figure 10

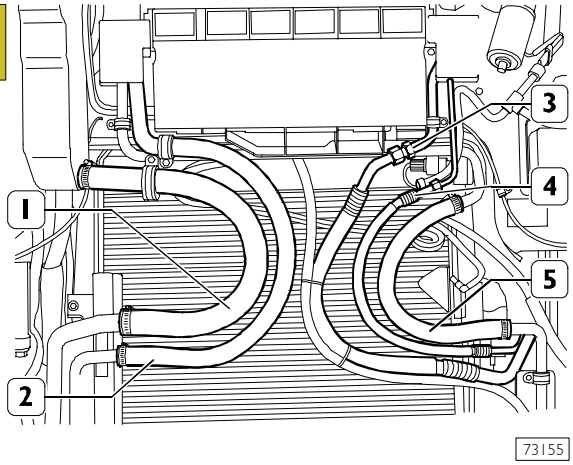


Only for vehicles equipped with automatic gearbox:

- ❑ from distributor (1), disconnect pipes (2 and 3).
- ❑ place a container below master cylinder (4), disconnect piping (5) from the same, then drain the clutch fluid.

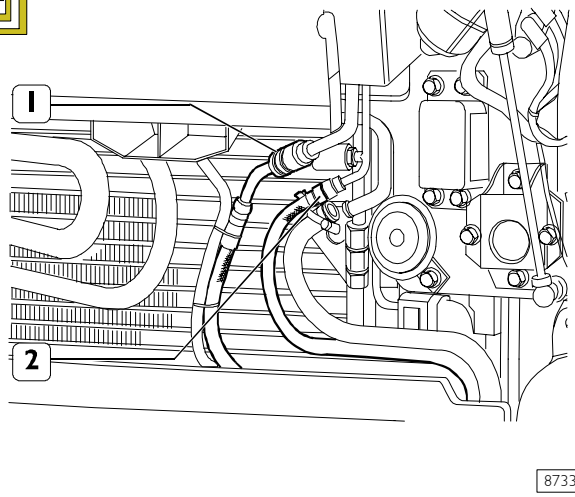
Properly plug the piping (5) and master cylinder (4) adapter, to prevent the clutch fluid from damaging painted parts. The clutch fluid is poisonous and corrosive: in case of contact, wash immediately with water and mild soap.

Figure 11



Disconnect engine coolant pipes (1 - 2 and 5). Disconnect air-conditioning system gas pipes (3 and 4) (where available).
Cut the pipe-electric cable joining straps.
ect the air-conditioning system gas pipes (3) and (4).

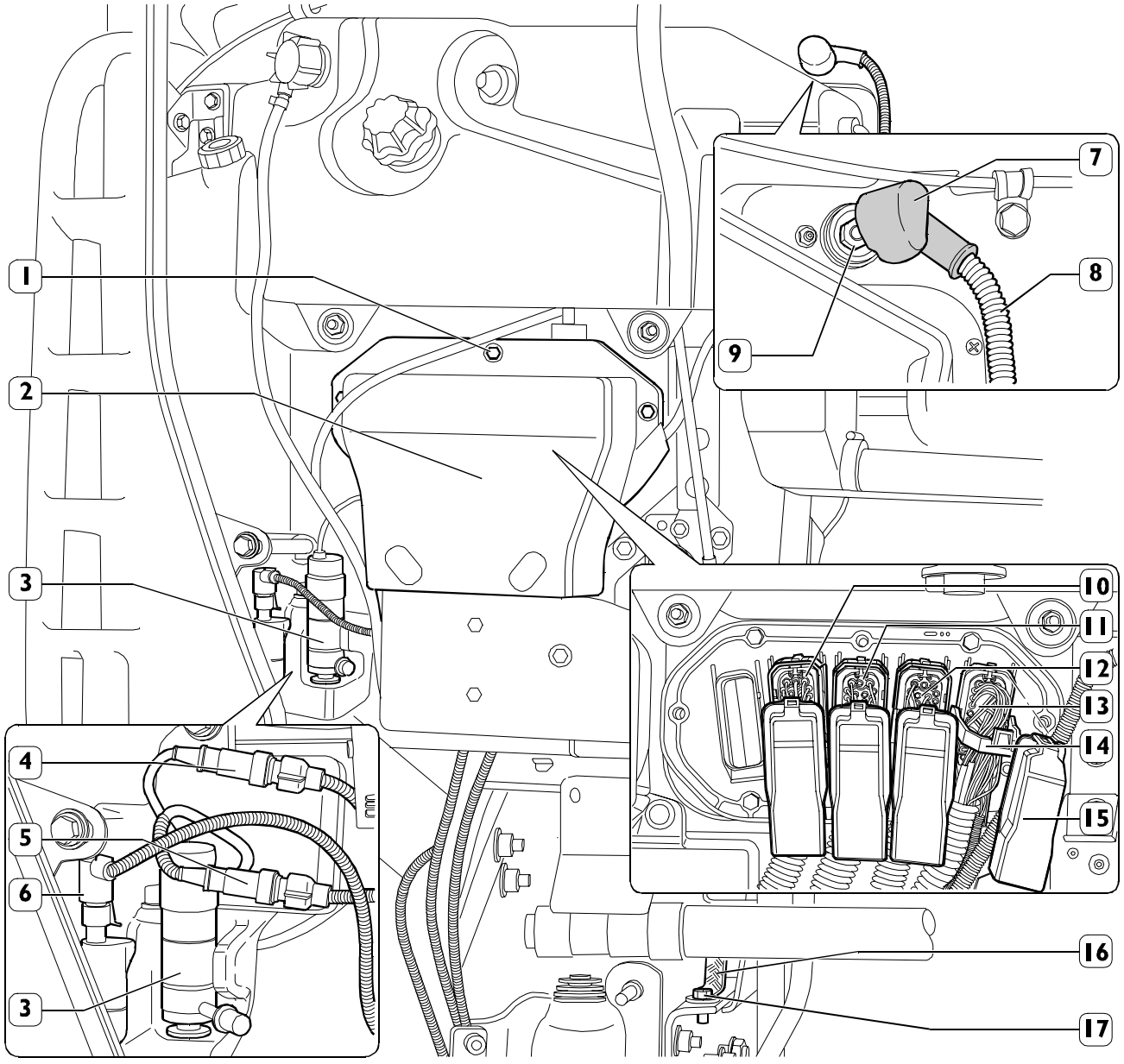
Figure 12



Air-conditioning system pipes equipped with quick-connect couplings (1 and 2) shall, where available, be disconnected by pressing the couplings axially.

NOTE Seal the air-conditioning system pipes so as to prevent moisture or impurities getting into the system.

Figure 13

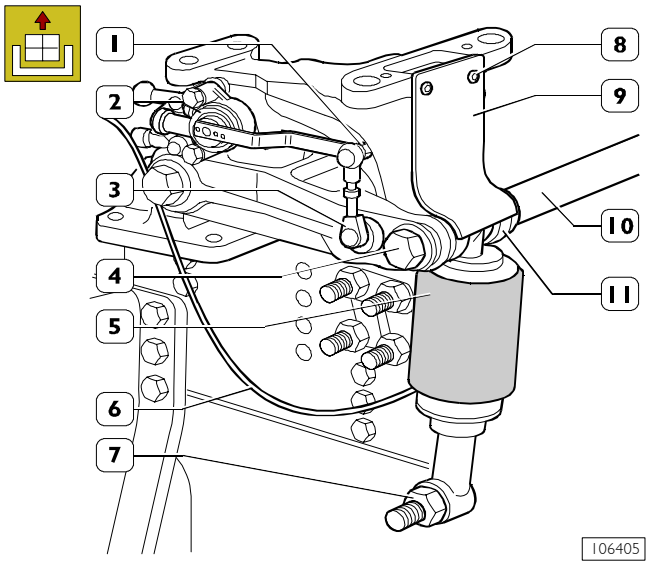


Remove nuts (1) and take off cover (2).
Remove covers (15), release safety levers (14) and disconnect connections (10 - 11 - 12 and 13).

Disconnect the electric connections (4) and (5) of the motor pump (3) for the windscreen-headlight washer fluid.

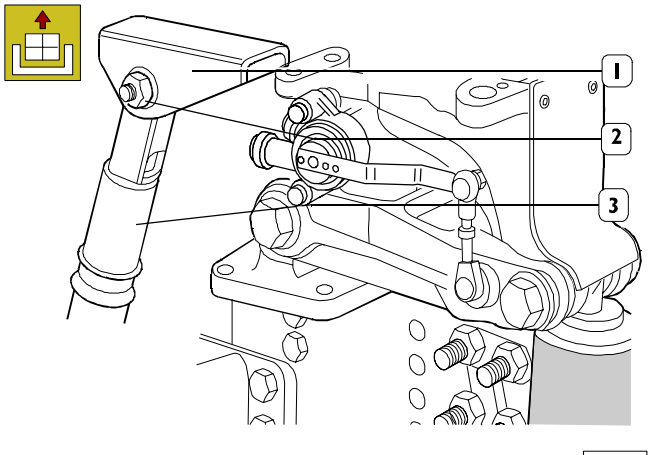
Disconnect the electric connection (6) for the tank fluid level gauge.
Lift the protective cap (7), remove the nut (9) and disconnect the cable (8) from the cab.
Remove the nut (17) and disconnect the earth cable (16) from the chassis frame.

Figure 14



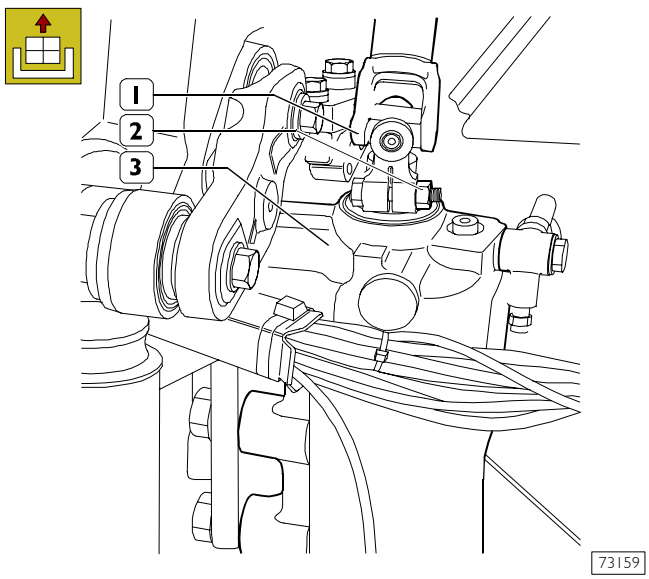
Take out the screws (8) and remove the guard (9).
Take out the screw (4) fixing the air spring mating pin (5), bar (10) and mount (11).
Disconnect the pipe (6) from the shock absorber.
Remove bolt (7) securing the air spring (5) or shock absorber with coaxial spring to the chassis.
Repeat these steps on the opposite side.
Remove the nut (1) and disconnect the tie rod (3) from the levelling valve (2).

Figure 15



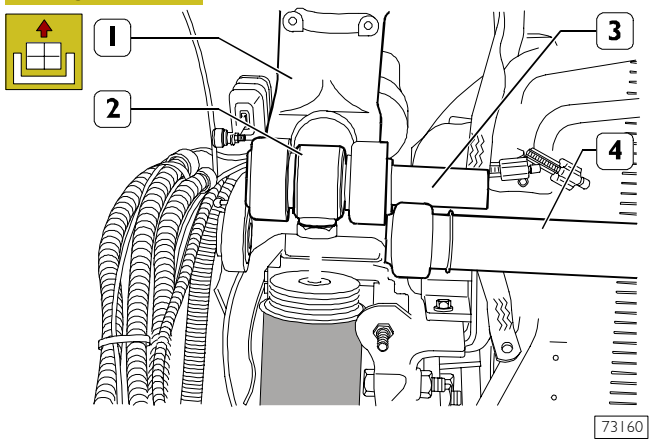
Remove the bolt (2) fixing the cylinder (3) for tilting the cab from the cab mounting (1).

Figure 16



Mark the assembly position of the universal joint (1) on the power steering shaft (3). Remove the bolt (2) and disconnect the universal joint (1) from the power steering shaft (3).

Figure 17



Lift the cab and extract the mating pin (3) of the shock absorber (2), bar (4) and front cab mounting (1). Carefully lift the cab to detach it from the chassis frame and put it aside appropriately.

Refitting

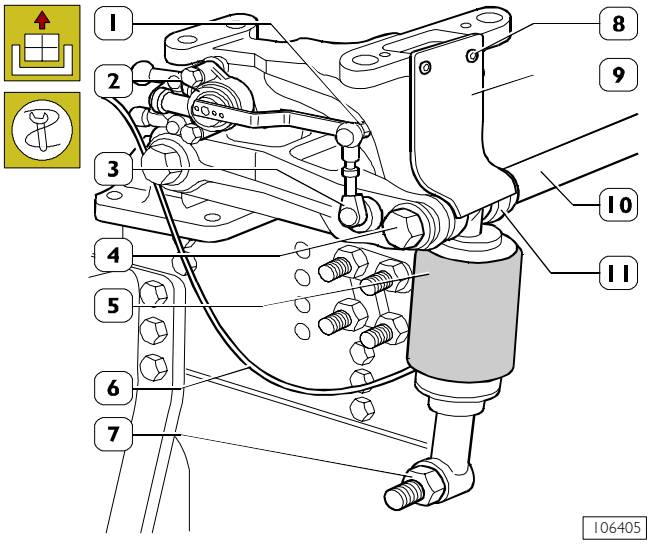
Reattachment is carried out by reversing the order of detachment operations and by taking the following precautions:

- ❑ tighten the nuts or screws to the specified torque;
- ❑ the pneumatic piping adapter seal rings (O-rings) must not be reused; they must be replaced with new ones upon every reassembling operation;
- ❑ seal up the tachometer electric cable ring with proper sealing medium;
- ❑ check correct operation of instrument board warning lamps;
- ❑ in case of vehicles equipped with mechanic gearbox, restore the clutch hydraulic system oil tank level, then blow off air as described in the relevant chapter;
- ❑ restore the engine coolant level;
- ❑ fill up the air-conditioning system as described in the respective chapter.

554243 REPLACING THE FRONT SHOCK ABSORBER

Removal

Figure 18

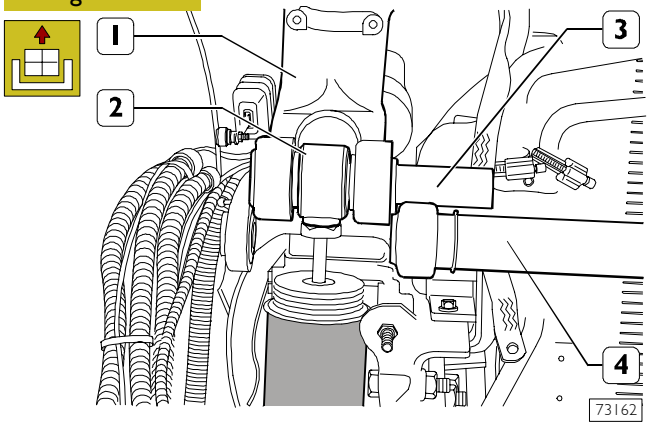


Using the arm 99378039, sling the cab as described under the heading "Cab Removal-Refitting" and proceed as follows:
Remove the front bumper (operation 500210) as described under the relevant heading.
Take out the screws (8) and remove the guards (9).
Remove the bolt (7) fixing the shock absorber (5) to the chassis frame.
Disconnect the pipe (6) from the shock absorber (5).
Take out the screw (4) fixing the shock absorber mating pin (5), bar (10) and mounting (11).
Repeat these steps on the opposite side.

For the right-hand air spring only

Remove the nut (1) and disconnect the tie rod (3) from the levelling valve (2).

Figure 19



Lift the cab and extract the mating pin (3) of the shock absorber (2), bar (4), front cab mounting (1) and remove the shock absorber (2).

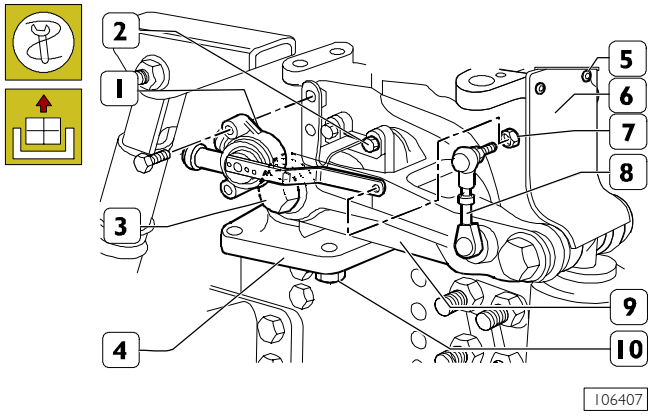
Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

REPLACING THE CAB SUSPENSION FRONT MOUNTING RUBBER-TYPE BUSHINGS

Removal

Figure 20



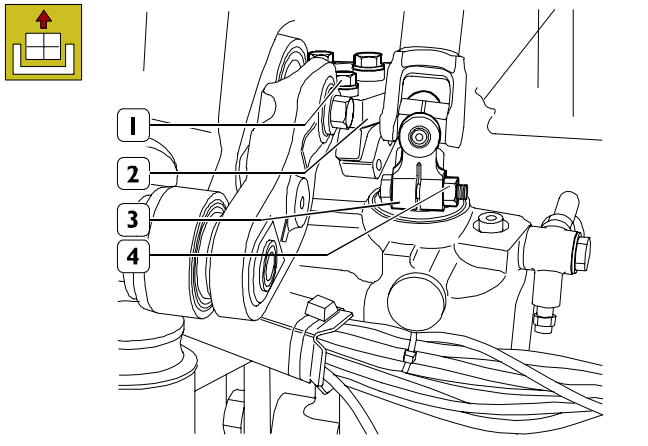
Using the arm 99378039, sling the cab as described under the heading "Cab Removal-Refitting" and proceed as follows:
Remove the front bumper (operation 500210) as described under the same heading.
Take out the screws (5) and remove the guard (6).

Removing the right-hand front suspension mounting

Remove the nut (7) and disconnect the tie rod (8) from the levelling valve (1).
Take out the screws (2) and remove the bracket together with the levelling valve (1).
Disconnect the air pipe (6, Figure 18) from the shock absorber (5, Figure 19).
Take out the screw (3) joining the bar (9) to the mounting (4).
Remove the bolt (7, Figure 18) fixing the shock absorber (5, Figure 19) to the chassis frame.
Take out the screws (10) and remove the mounting (4) from the chassis frame.

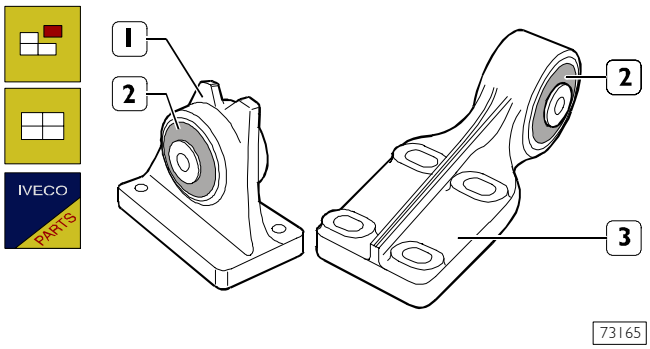
Removing the left-hand front suspension mounting

Figure 21



Remove the bolt (4) and disconnect the universal joint (3) from the power steering shaft.
Repeat the steps described for removing the right-hand front mounting. Take out the screws (1) and remove the mounting (2) from the chassis frame.

Figure 22



The bushings (2) in the right-hand (1) and left-hand (3) front suspension mountings are replaced with the aid of a press and a suitable drift.

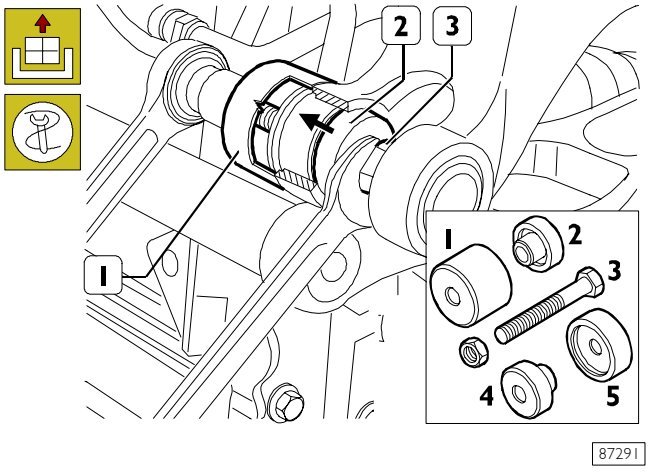
Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

REPLACING THE CAB FRONT MOUNT BUSHINGS

Removal

Figure 23

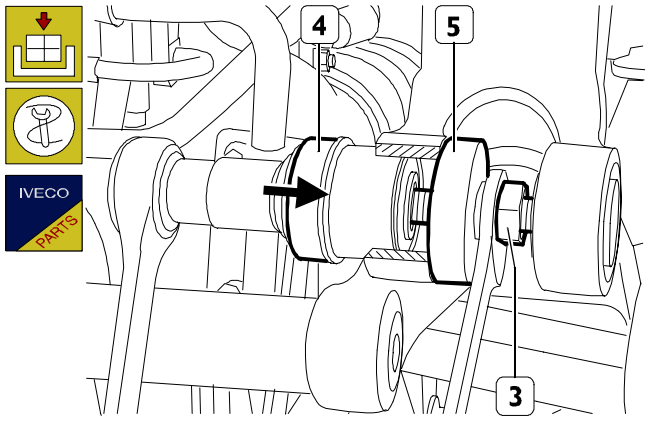


Remove the shock absorbers as described in the "Front shock absorber replacement" chapter.

Extract the bush with elements (1, 2 and 3) of tool 99346051 and remove the bush.

Refitting

Figure 24

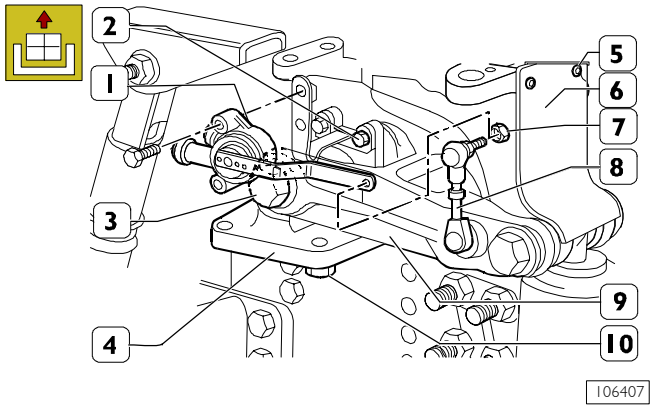


Use elements (3, 4 and 5) of tool 99346051 to fit the bush in its seat.

REMOVING – REFITTING THE STABILIZER BAR

Removal

Figure 25

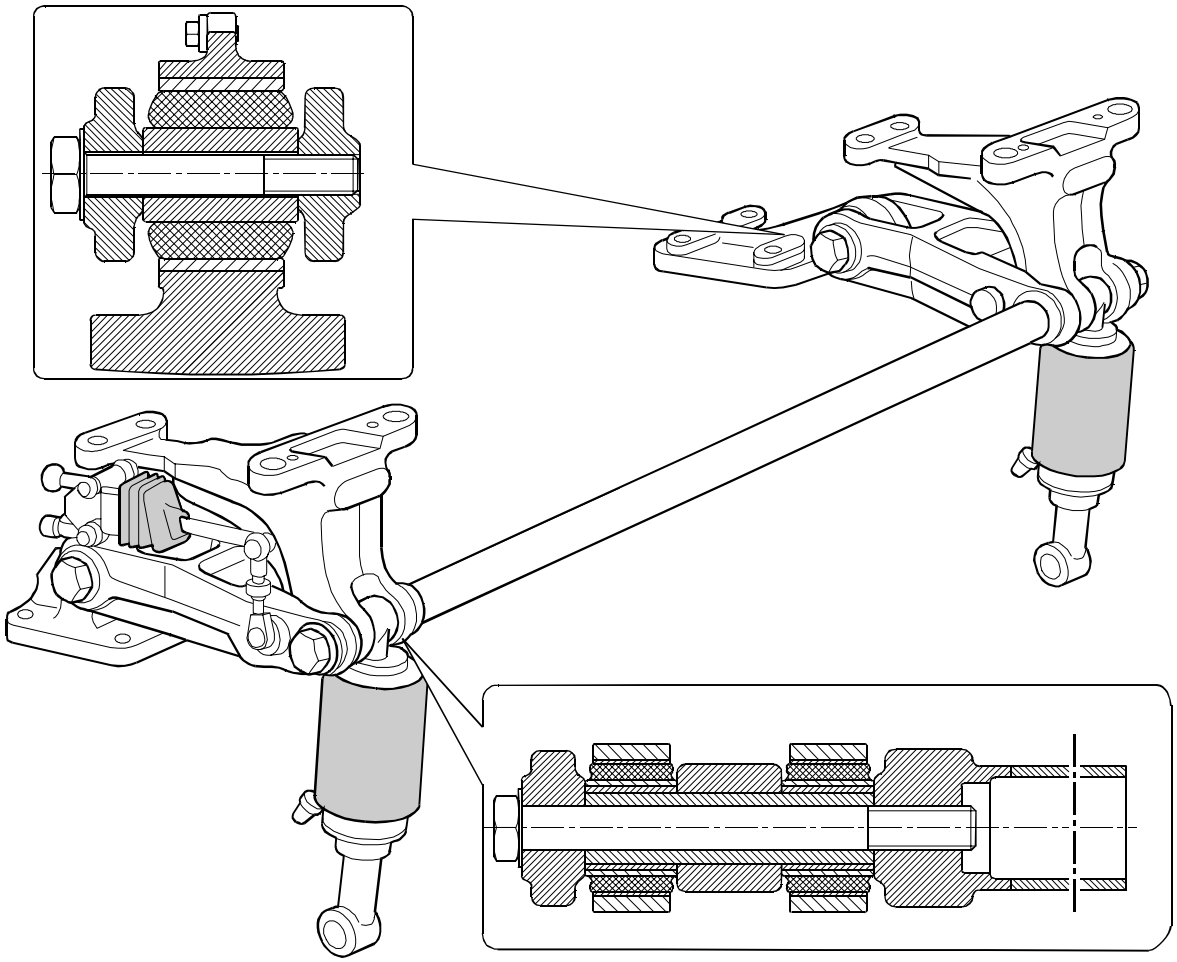


Using the arm 99378039, sling the cab as described under the heading "Cab Removal-Refitting" and proceed as follows. Remove the front bumper, operation 500210 as described under the same heading. Take out the screws (5) and take off the guards (6). Remove the nut (7) and disconnect the tie rod (8) from the levelling valve (1). Take out the screws (2) and remove the bracket together with the levelling valve (1). Remove the bolt (4, Figure 21) and disconnect the universal joint (3) from the power steering shaft. Remove the shock absorbers as described under the relevant heading. Take out the screw (3) and remove the stabilizer bar (9) from the mounting (4).

Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

Figure 26



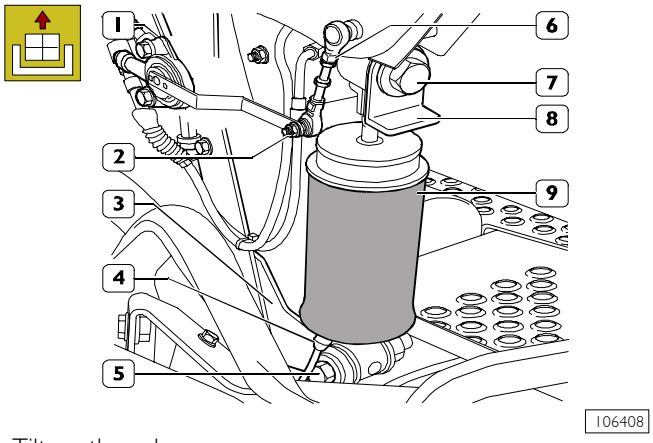
73169

CAB FRONT ANCHORING COMPONENTS

CHANGING THE REAR SHOCK ABSORBER

Removal

Figure 27



Tilt up the cab.
Remove the nut (2) and disconnect the tie rod (6) from the levelling valve (1).
Disconnect the pipe (4) from the shock absorber (9).
Remove the bolts (5) and (7) and disconnect the shock absorber from the brackets (3) and (8).

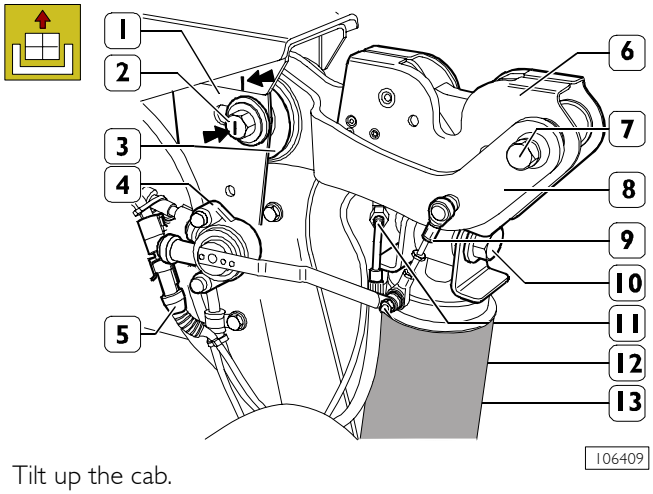
Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

CHANGING THE CAB LOCK

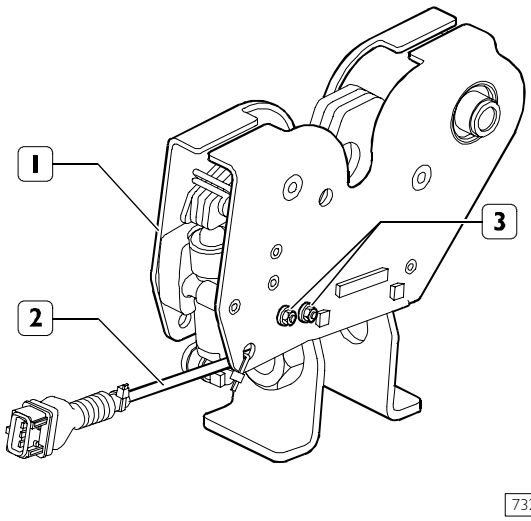
Removal

Figure 28



Tilt up the cab.
Remove the nut (12) and disconnect the tie rod (9) from the levelling valve (4). Disconnect the pipe (11) from the lock (6) and collect the oil in a specific container.
Disconnect the electric connection (5) of the inductive proximity switch.
Disconnect the pipe (4, Figure 27) from the shock absorber (13). Remove the bolt (10) fixing the shock absorber (13) to the lock (6).
Remove the bolt (7) and disconnect the lock (6) from the bracket (8).

Figure 29



Remove the nuts (3) and disconnect the inductive proximity switch (2) from the lock (1).

NOTE An alphanumeric code is stamped on the lock specifying the month and year of manatacture. The letter indicates the month and the figure the year, for example:
B0 = February 2000
C1 = March 2001
D2 = April 2002, etc.

Refitting

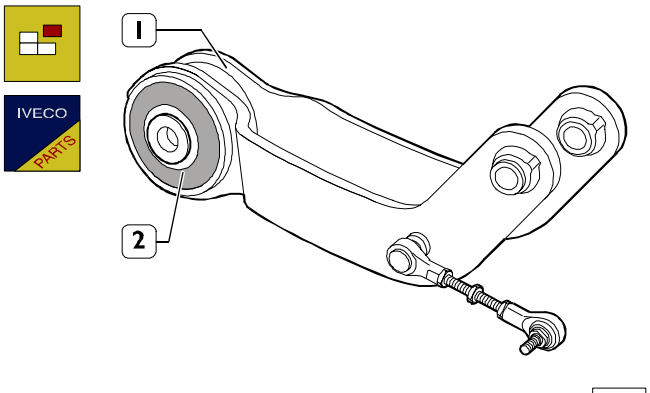
Carry out the steps performed for removal in reverse order, observing the required tightening torques.
The tightening torque of the nuts (3) fixing the inductive proximity switch is 0.5 daNm.
After refitting, check the oil level of the cab tilting unit as described under the relevant heading.

CHANGING THE SWINGING BRACKET BUSHING

Removal

Remove the lock (6, Figure 28) as described under the relevant heading "Changing the cab lock."
Mark the position of the centre line of the bolt (2, Figure 28) and detach the swinging bracket (8) with the washers (3) from the bracket (1).

Figure 30

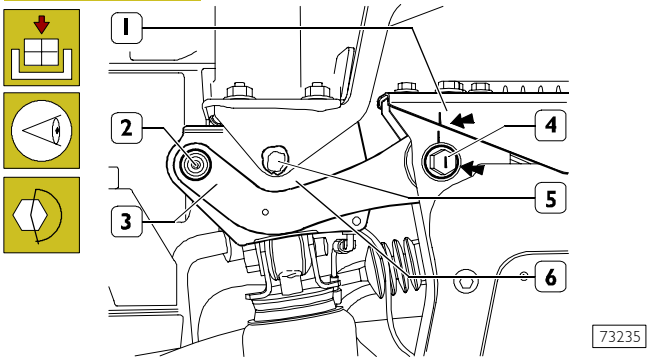


The bushing (2) of the swinging bracket (1) is changed using a press and a suitable drift.

Refitting

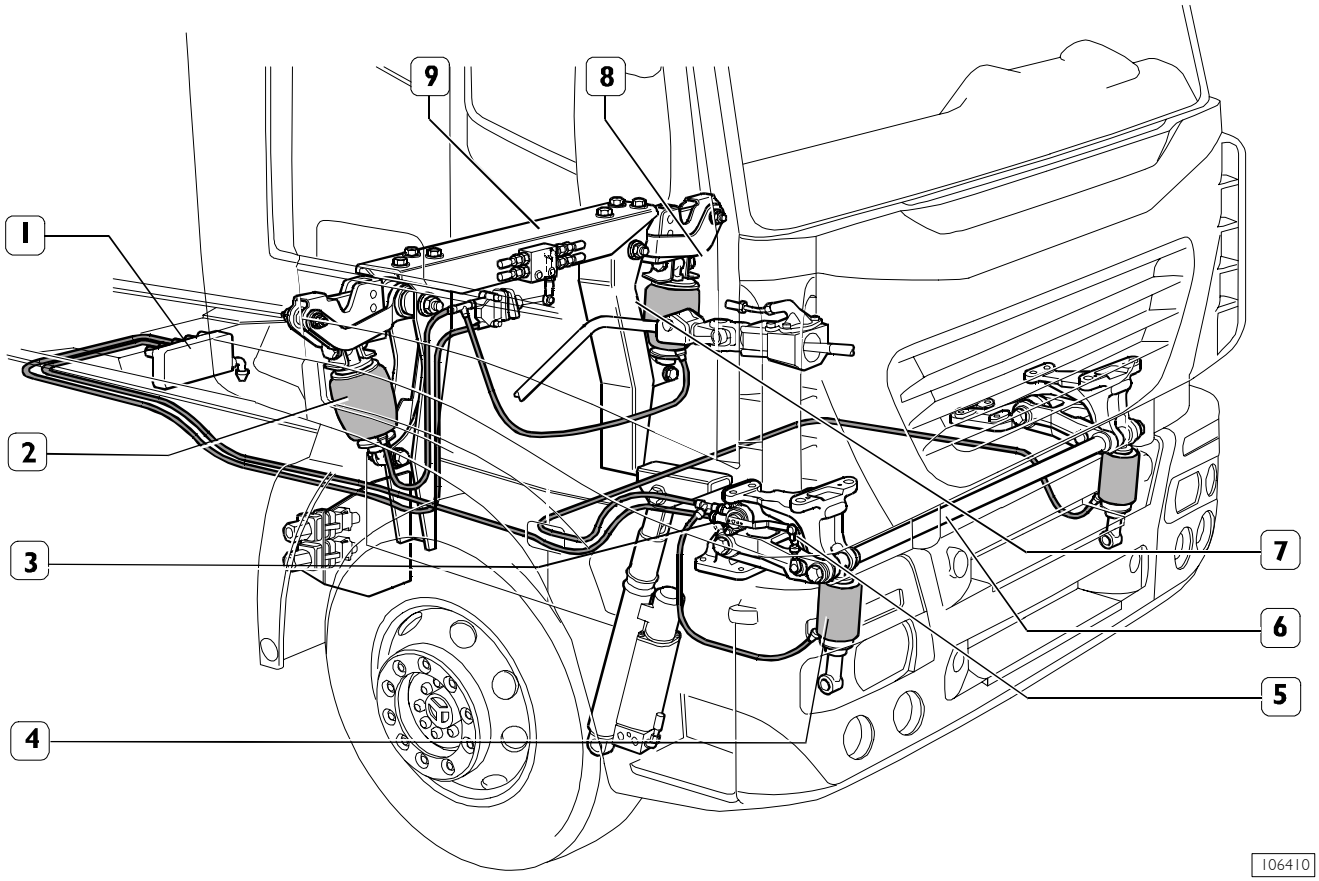
Carry out the steps performed for removal in reverse order, observing the following instructions.

Figure 31



Position the bracket (3) on the crosspiece (1) so that the centre distance of the fixing screw coincides with the mark on the crosspiece (1). Screw down the nut (4) without locking it. Lower the cab till the anchoring pins are locked by the locks (6). Tighten the nuts for the screws fixing the remounted components to the required torque.
On completing this phase, top up the cab tilting hydraulic system.

Figure 32

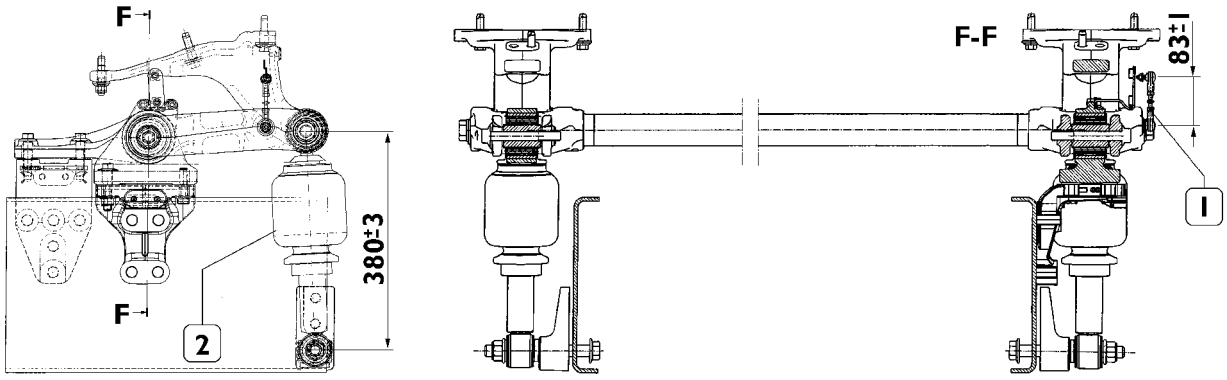


LOCATION OF CAB SUSPENSION COMPONENTS

1. Service supply – 2. Rear shock absorber – 3. Front levelling valve – 4. Front shock absorber – 5. Tie rod for valve (3) 6. Cab anchoring – 7. Rear levelling valve – 8. Tie rod for valve (7) – 9. Stabilizer bar.

554275 Adjusting the front levelling valve linkwork

Figure 33

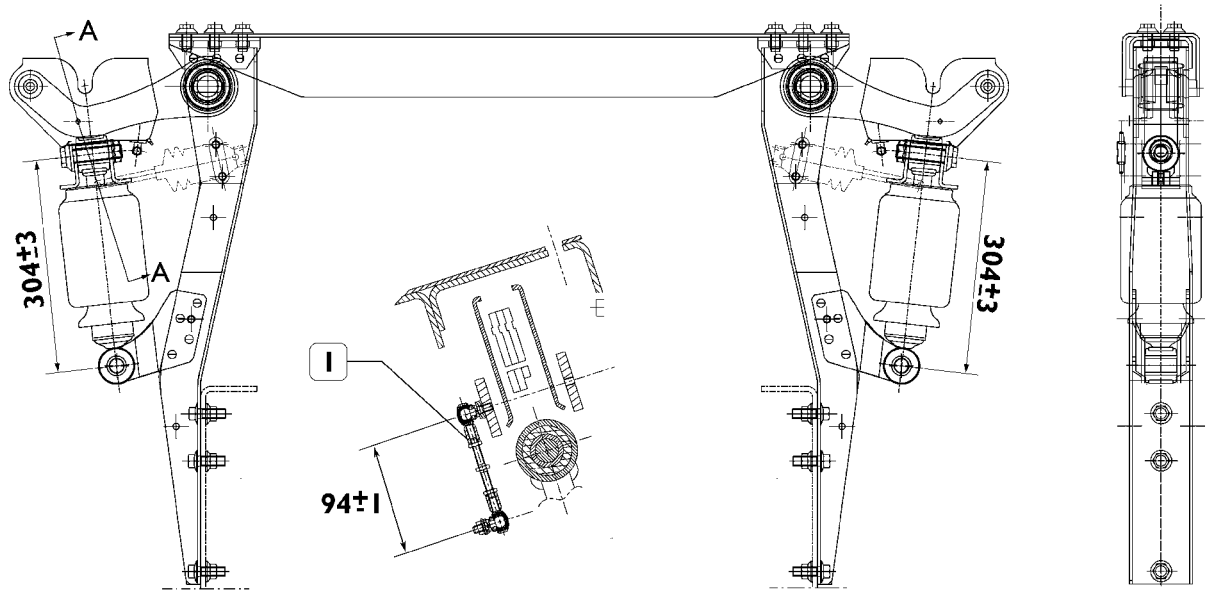


87338

CABIN PNEUMATIC FRONT SUSPENSION AND ANCHORING

Verify that the distance between the shock absorber hook (2) centre distances is 380 ± 3 mm (under static conditions).
In the above conditions, check and/or adjust the distance between the centre lines of tie-rod (1) kingpins, which must be 83 ± 1 mm. Otherwise, properly act on the same.

Figure 34

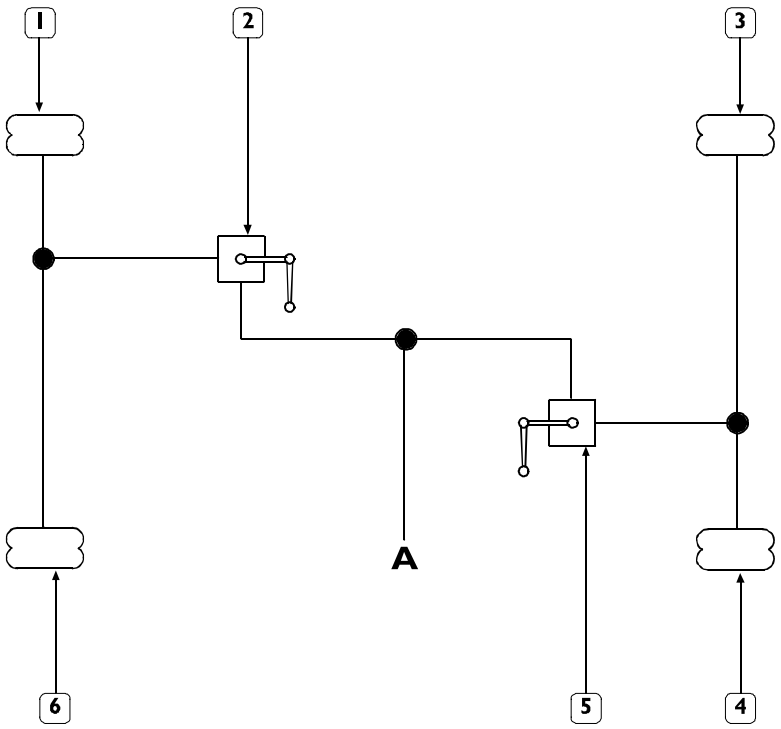


87339

CABIN PNEUMATIC REAR SUSPENSION AND ANCHORING

Verify that the distance between the shock absorber hook (2) centre distances is 304 ± 3 mm (under static conditions).
In the above conditions, check and/or adjust the distance between the centre lines of tie-rod (1) kingpins, which must be 94 ± 1 mm. Otherwise, properly act on the same.

Figure 35

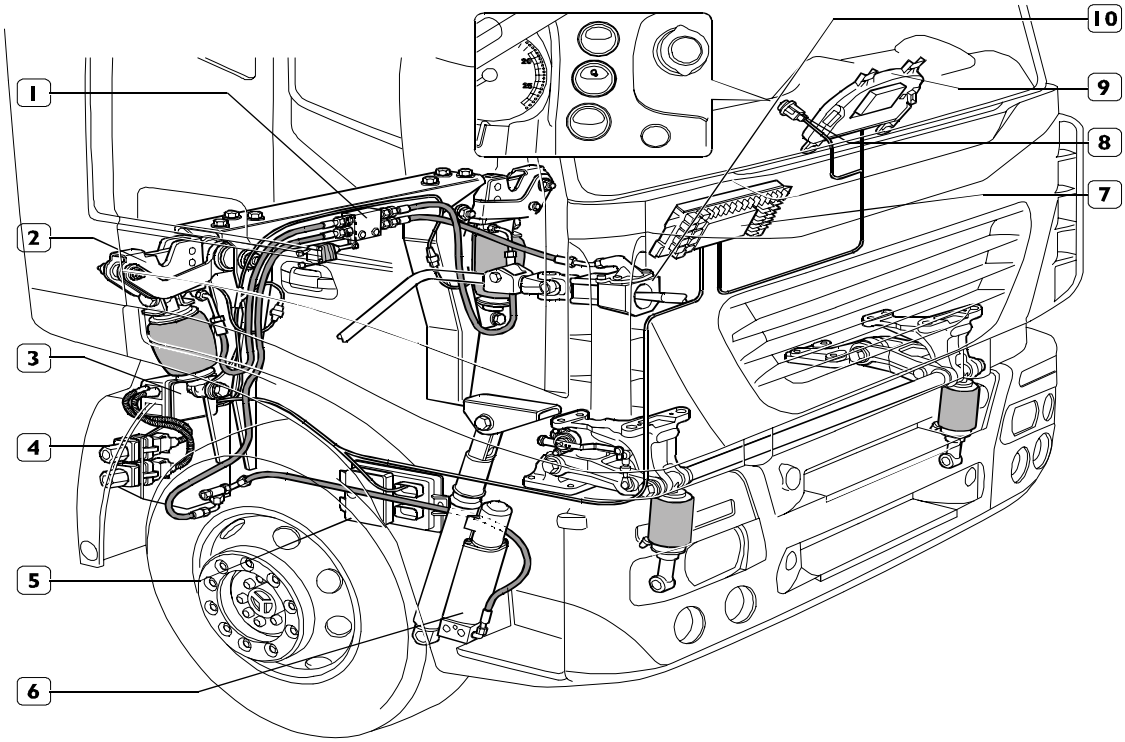


CAB SUSPENSION PNEUMATIC SYSTEM WORKING DIAGRAM

1. Right-hand front air spring – 2. Front levelling valve – 3. Right-hand rear air spring – 4. Left-hand rear air spring
5. Rear levelling valve – 6. Left-hand front air spring – A. Service supply (8.5 bars)

ELECTRICALLY DRIVEN CAB TILT

Figure 36



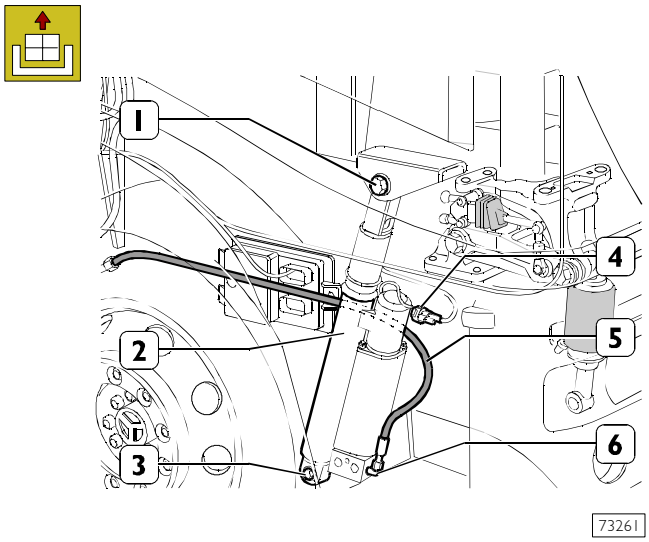
ELECTRICALLY DRIVEN CAB TILTING SYSTEM COMPONENT PARTS

1. Hydraulic control valve – 2. Cab coupling lock with hydraulic control – 3. Box with control contactors – 4. Control buttons
5. Front Frame Computer (F.F.C.) – 6. Cab tilting unit – 7. Body Computer (B.D.) – 8. Cab tilting signal switch
9. Instrument Cluster (I.C.) – 10. Hydraulic actuator to release gearbox telescopic piston (ZF 16 S... gearbox only).

554255 MANUALLY DRIVEN CAB TILT

Removal

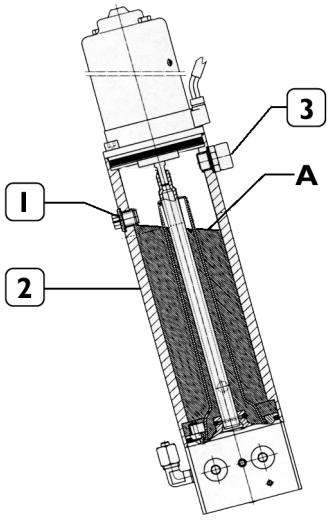
Figure 37



Start up the vehicle and steer the wheels to the right.
Disconnect the positive cable of the battery.
Detach the front mudflaps from the cab.
Disconnect the electric connection (4).
Place a container under the fitting (6) and disconnect the pipe (5).
Put plugs on the fitting (6) and pipe (5) to prevent oil coming out.
Remove the bolts (1) and (3) and disconnect the cab tilting unit (2).

Refitting

Figure 38



The cab tilting unit (2) is supplied as a spare part with no hydraulic fluid. If there is any oil, this is due to the remains of oil used to test the assembly.
In this case, as in the case of the cab tilting unit already assembled and with the fluid drained from it, you need to replenish the fluid as follows:

- ❑ Position the cab tilting unit horizontally with the plug (1) facing upwards.
- ❑ Take out the plug (1) and screw a fitting (M12 x 1.5) in its place; then fit a suitable drain pipe to it.
- ❑ Add approx. 500 cm3 of the required type through the pipe. If the cab locks have been replaced or drained, add approx. 88 cm3 of oil.
- ❑ Keeping the pipe with the end facing upwards to prevent the fluid coming out, connect the oil pipe (5, Figure 37) to the fitting (6) and complete refitting by carrying out the steps for removal in reverse order.

NOTE The self-locking nuts removed must not be reused. After refitting, check the level of the fluid as described under the relevant heading.

Checking the oil level

1. Check that the cab pneumatic suspension is ready for the road.
2. Perform 2 full cab-tilting cycles.

NOTE If the cab locks have been replaced or their oil drained off, perform 5 full cab-tilting cycles to deaerate the system through the vent (3).

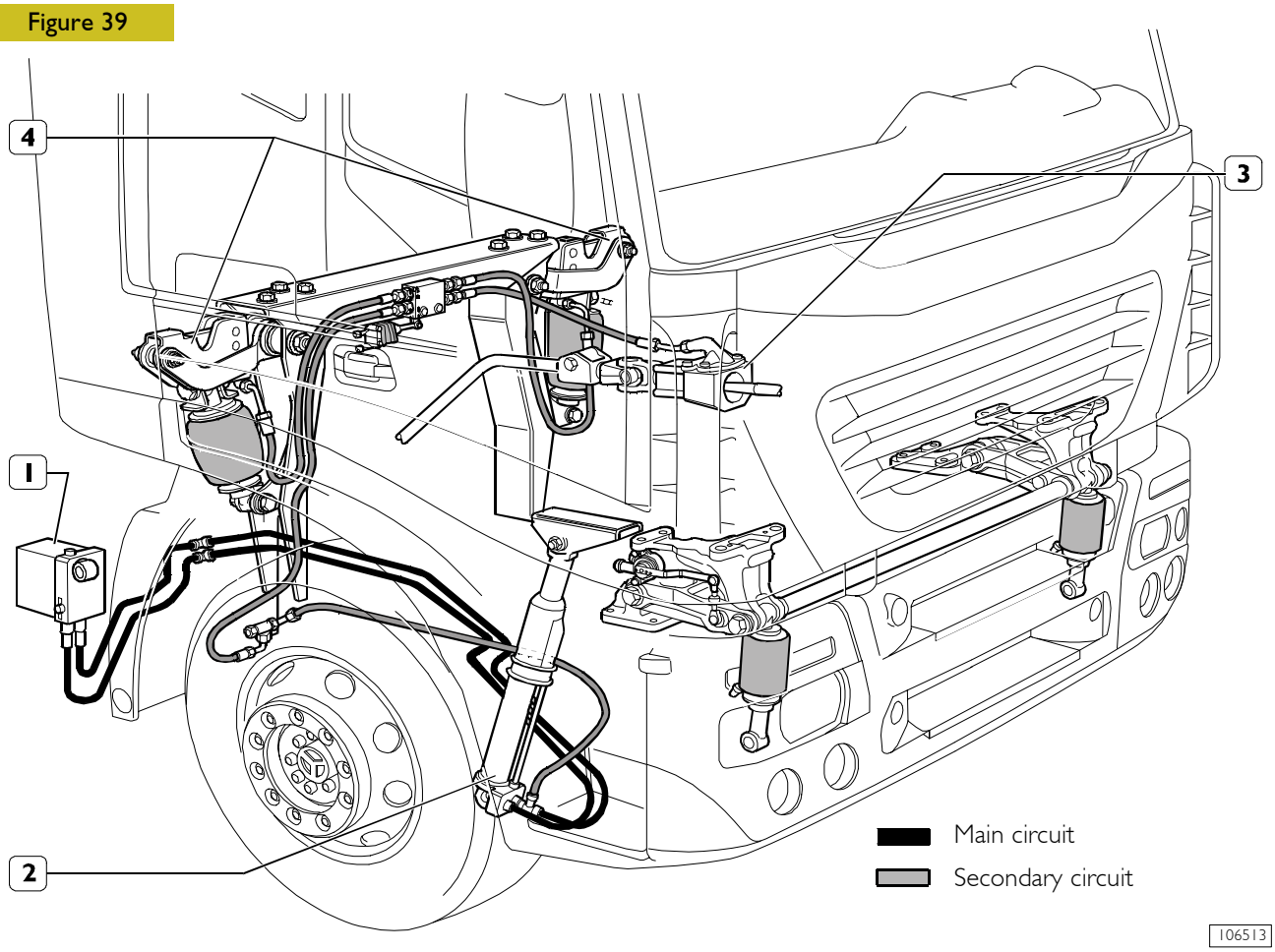
3. Wait for the cab level to settle. The tilting cylinder is thus at the set length.
4. Briefly operate the tilting cylinder till you see a clear upward movement of the cab.
   The tilting cylinder is thus fully filled with oil.
5. Lower the oil level with the drain pipe.
6. Remove the fitting with the drain pipe and screw on the closing plug (1).
   If no oil comes out, restore the level **A** by adding oil through the hole for plug (1) till oil spills out of it.

Periodic level check

Perform the operations described in points 1 – 2 – 3 – 4.
Remove the plug (1) and check the level **A** of the oil. Top it up as described above if it is too low.

MANUALLY DRIVEN CAB TILT

Figure 39



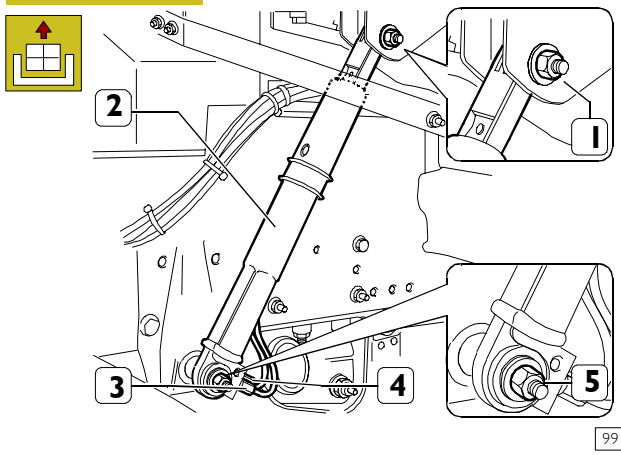
CAB TILTING SYSTEM COMPONENT PARTS

1. Hand driven pump - 2. Cab tilting cylinder -
3. Hydraulic actuator to release gearbox control telescopic tie rod - 4. Cab hitching up lock

554255 REPLACING HYDRAULIC CAB TILT CYLINDER

Removal

Figure 40



Place a container under oil piping (3 and 4) to recover the oil from the system. Disconnect oil piping (3 and 4) from cabin tilting cylinder (2) adapter. Remove bolt (1) and nut (5), then take off cylinder (2).

This operation must be carried out with the cab lowered.

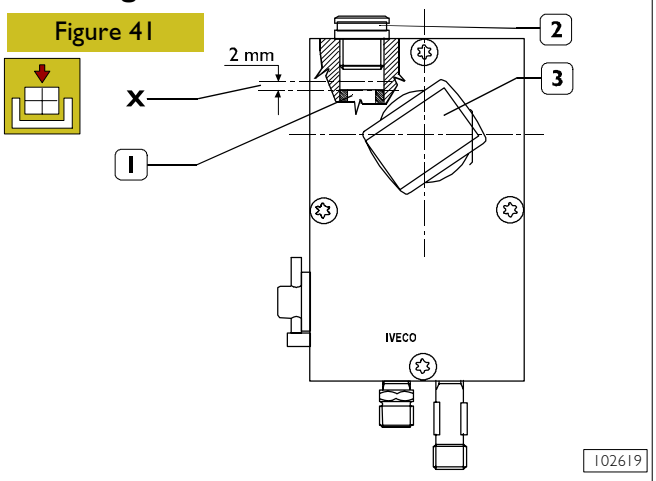
Refitting

Reattachment is carried out by reversing the order of detachment operations, by tightening the nuts to the specified torque.

After reattachment has been completed, fill up and blow air off the hydraulic system, as described in the relevant chapter.

Checking oil level

Figure 41



NOTE Cab must be lowered in ride condition.

Position pump drive lever (3) as indicated in figure.
Remove plug (2) and check that oil level X results to be above plunger (1) by some 2 mm; otherwise, top up.

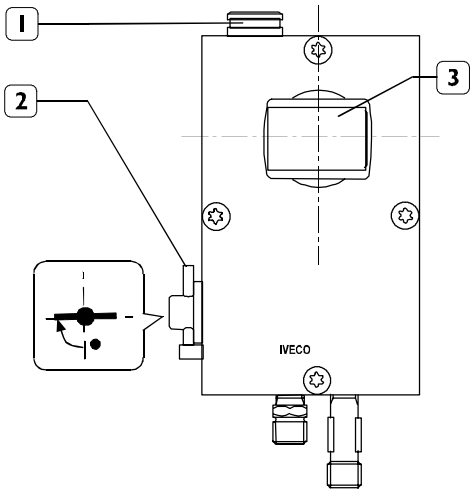
Bleeding cab tilt system

NOTE Bleed the air in the event of general tilt system malfunctioning and for the following operations (see Figure 39).

1) Replacing manual drive pump (1);
2) replacing cab tilting cylinder (2) and main circuit pipings;
3) replacing lock (4) and secondary circuit pipings;
4) replacing all components of tilting system.

Bleeding air from manual drive pump (point 1)

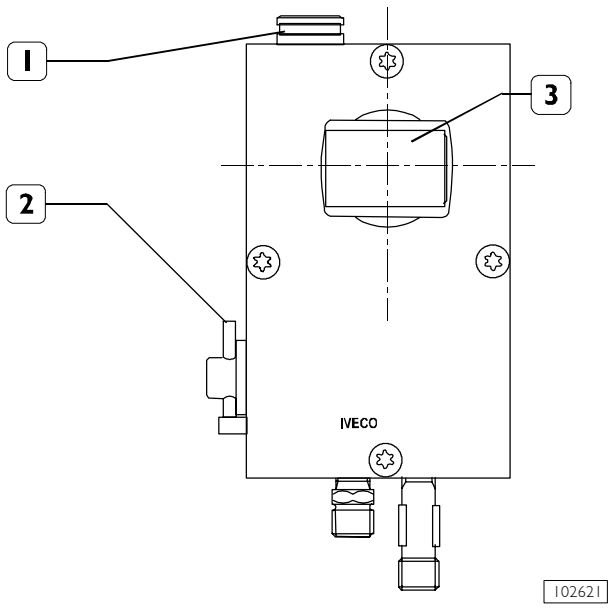
Figure 42



- ❑ Rotate tap (2) to the position shown in figure;
- ❑ take off plug (1);
- ❑ slowly drive lever (3) five times, (through full range);
- ❑ check the level as described in relating chapter.

Bleeding air from cab tilting cylinder (point 2)

Figure 43



- ❑ Cab lowered to drive position
- ❑ take off plug (1) and check oil level as described in relating chapter, topping up, if required;
- ❑ rotate tap (2) to cab lowered position;
- ❑ slowly drive lever (3) at least forty times (through full range);
- ❑ check oil level as described in relating chapter

Bleeding air from secondary circuit (point 3)

- ❑ Disconnect piping from lock (4, Figure 39) and hydraulic actuator (3, Figure 39);
- ❑ drive lever (3) until oil is drained away into special container;
- ❑ check oil level as described in relating chapter.

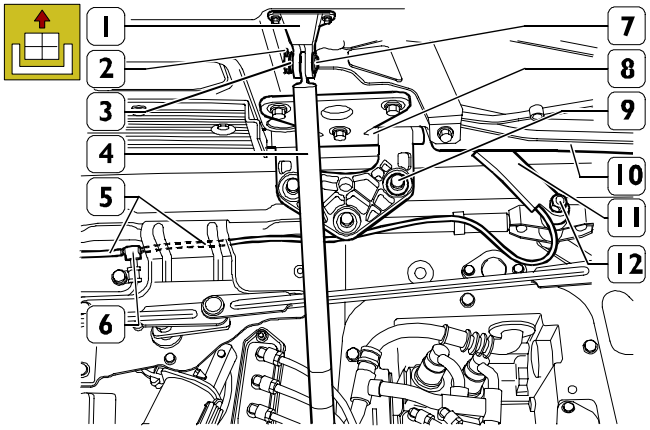
Bleeding air fully

In case all cab tilting system components are replaced, bleed air as described on points 1-2-3.

552410 REPLACING THE WINDSHIELD

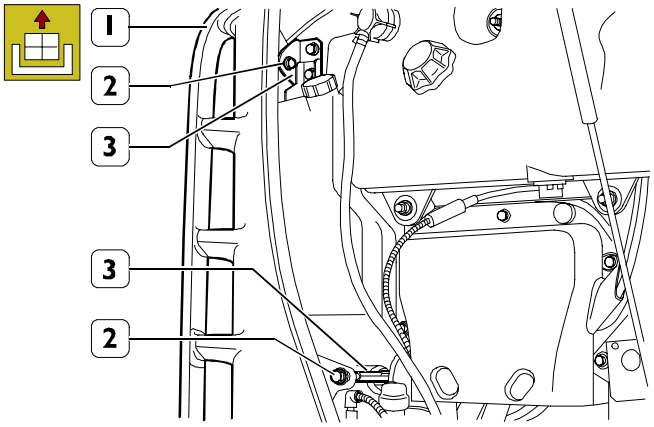
Removal

Figure 44



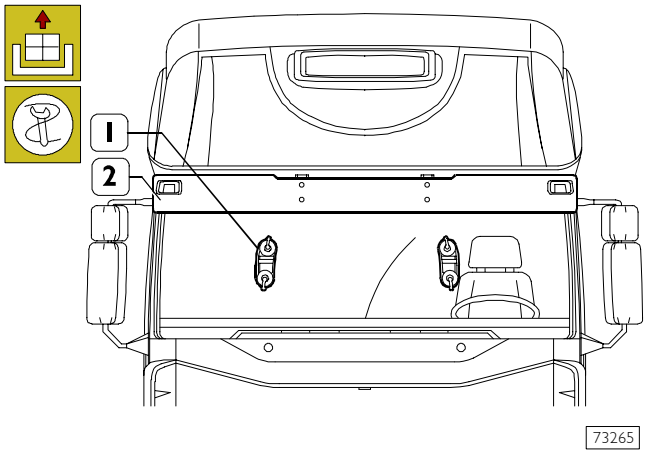
Lift the radiator cowling (10). Take out the split pin (2), extract the pin (7) with the thrust washers (3) and disconnect the shock absorber (4) from the mount (1).
Repeat these steps for the other shock absorber.
Take out the screws (9) fixing the hinges (8) and remove the radiator cowling (10) from the cab.
Disconnect the pipes (5) for the window-washer liquid from the fitting (6).
Remove the nuts (12) and disconnect the windscreen wiper (11).

Figure 45



Take out the screws (2) and detach the deflectors (1) from the mounts (3).

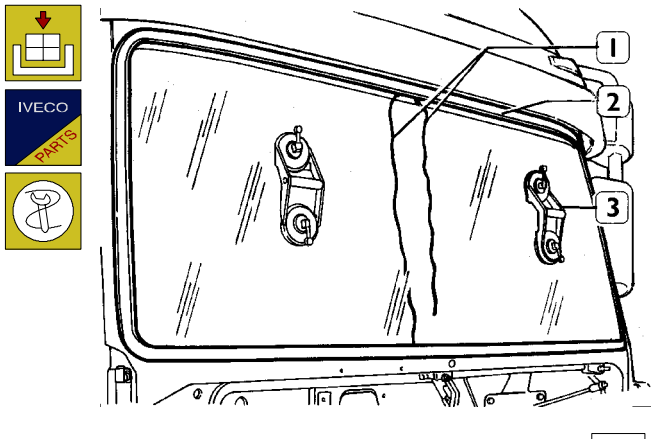
Figure 46



Take out the fixing screws. Remove the visor.
Put the pair of suction cups 99378031 (1) on the windscreen and with two operators, one inside the cab who, using the right tool, removes the seal while applying pressure on the top corners of the windscreen, while the other, on the outside, pulling on the handles of the suction cups 99378031, removes the windscreen from its housing.

Refitting

Figure 47



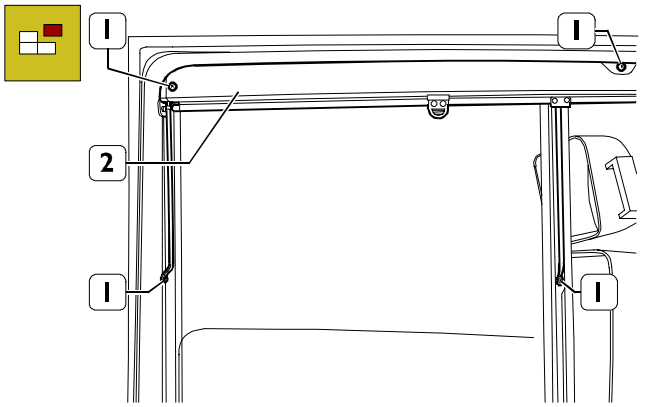
To refit the windscreen, carry out the following operations:

- ❑ Fit the rubber seal on the windscreen, insert a cord (1) in the seal (2).
- ❑ Put the suction cups of tool 99378031 on the windscreen.
- ❑ Position it against the cab flanging.
- ❑ Press firmly on the suction cups while pulling both ends of the cord (1) from the inside so that the seal fits onto the flanging of the bodywork.
- ❑ Finish fitting the parts taken down during removal.

550740 REPLACING THE WINDING WINDOW

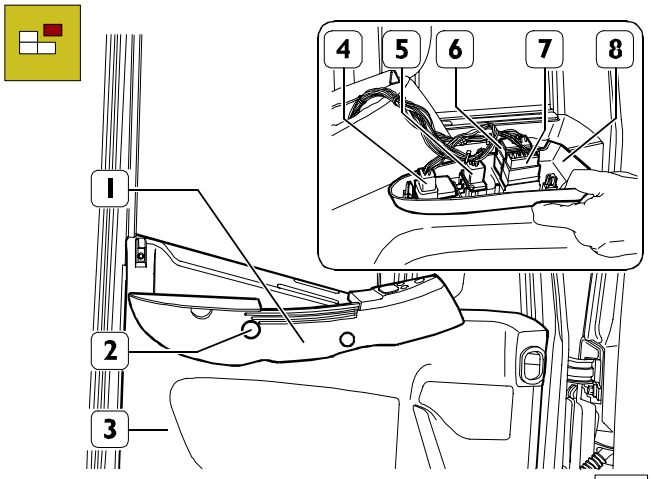
Removal

Figure 48



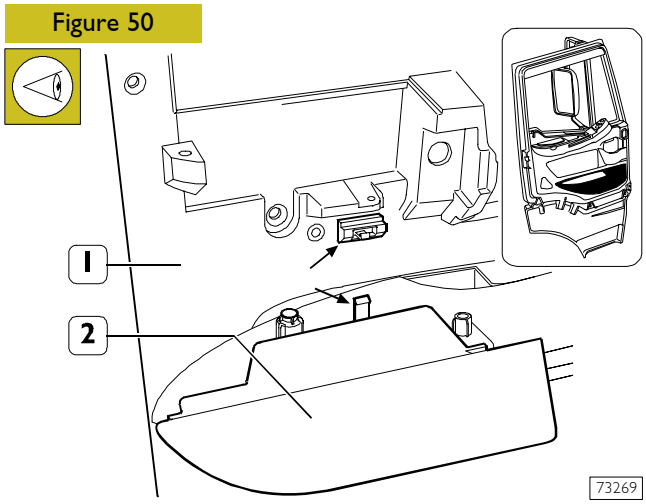
Lower the window.
Take out the screws (1) and remove the sunblind assembly (2) from the door.

Figure 49



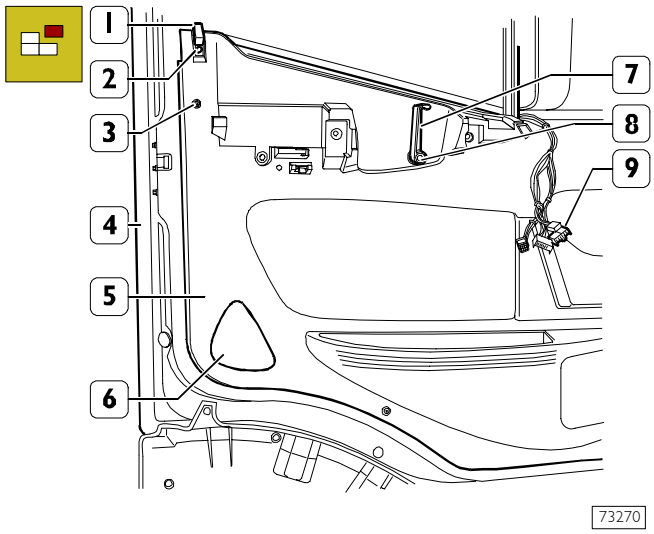
Remove the push-button panel (8) from the armrest (1).
Disconnect the electric connections (4), (5), (6) and (7) from the push-button panel (8). Remove the covers (2), take out the screws fixing the armrest (1) to the door trim (3).

Figure 50



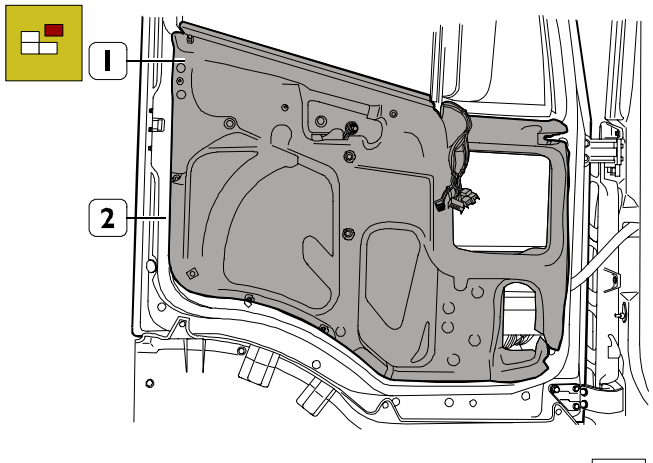
Tip up the armrest (2) so as to free it from the door trim (1).
The arrows show the hooking points.

Figure 51



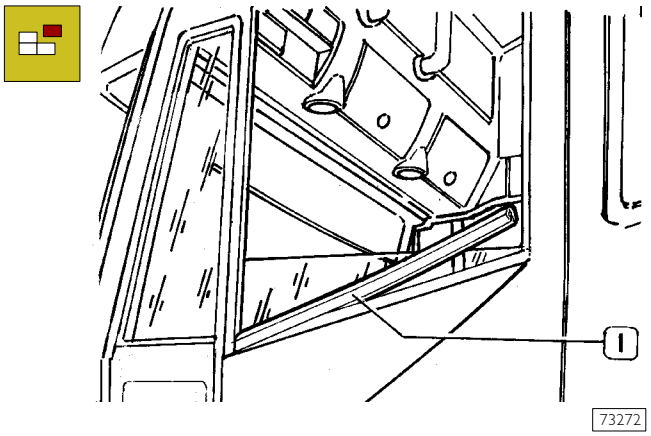
Take out the screw (2) and extract the push-button (1) from the door lock tie rod.
Extract the handle (7) from the pin (8). Remove the reflector (6) to access the panel fixing screw beneath.
Take out the screws (3) and remove the panel (5) from the door (4) taking care when extracting the wiring (9) from the panel (5).

Figure 52



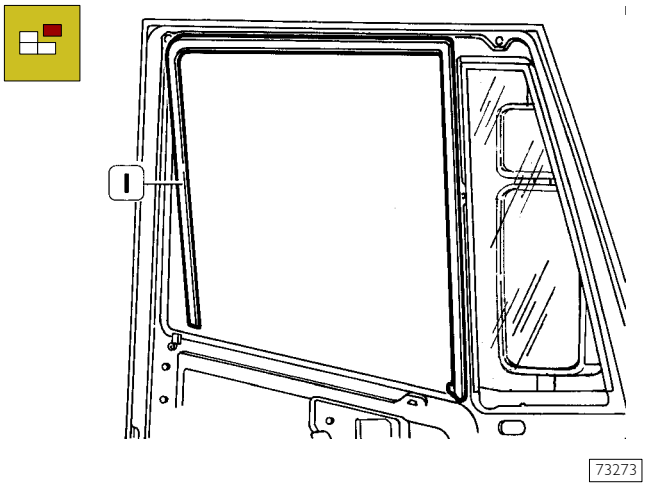
Remove the soundproofing guard (1) from the door (2).

Figure 53



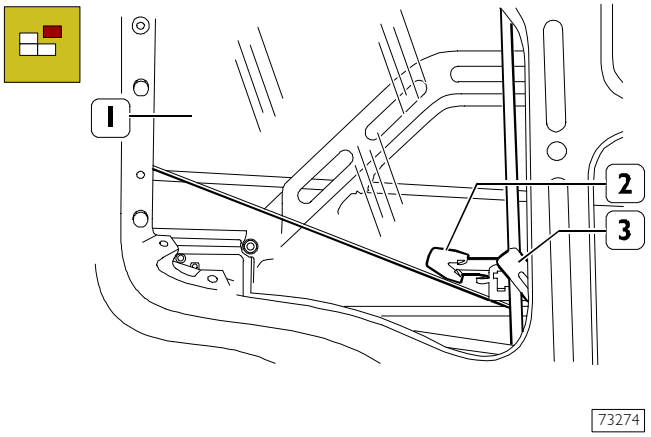
Extract the outside and inside bottom seals (1) from the window compartment.

Figure 54



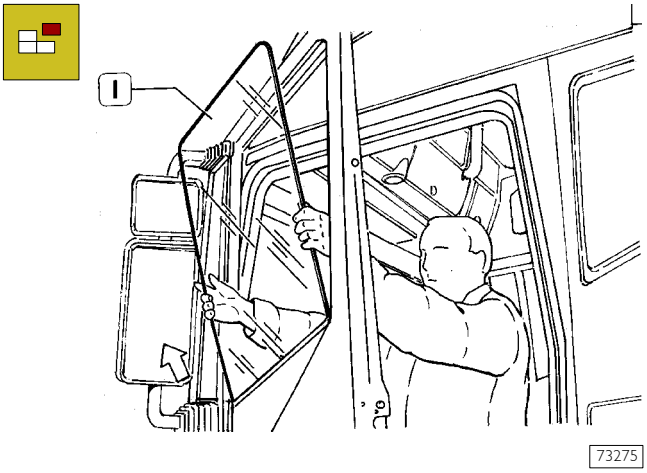
Extract the window guide seal (1).

Figure 55



Disconnect the electric window device (2) from the window (1) by removing the clamp (1).

Figure 56



Lift the window (1) and extract it from the top (arrow).

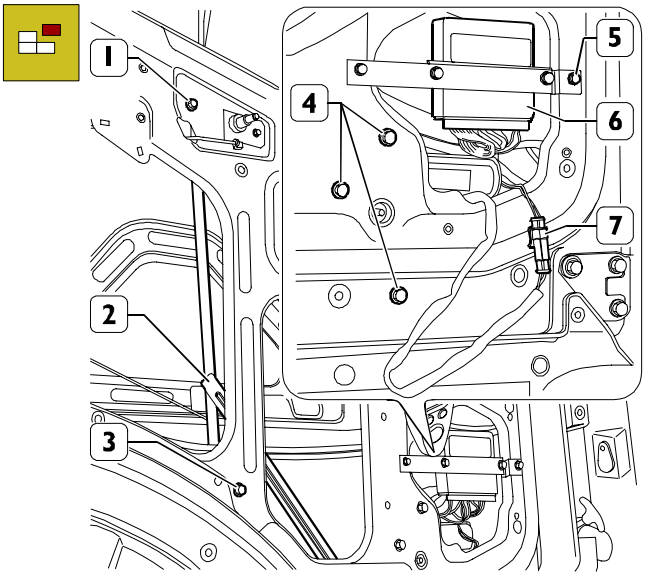
Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

550730 REPLACING THE WINDOW WINDER

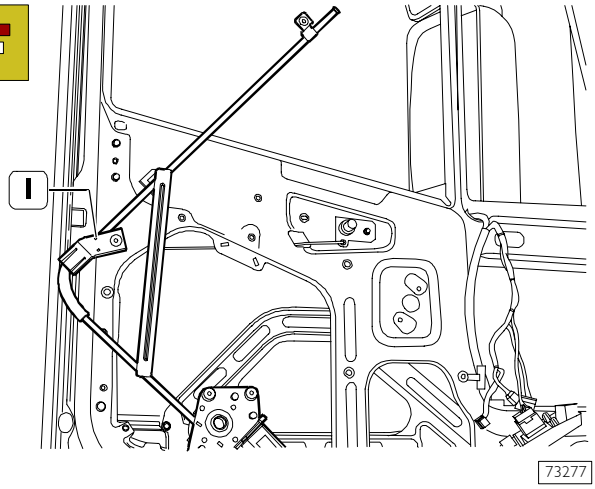
Removal

Figure 57



Remove the window as described in operation 550740.
Disconnect the electric connection (7).
Take out the screws (5) and disconnect the control unit (6) from the door.
Take out the screws (1), (3) and (4) fixing the electric window device (2) on the door.

Figure 58



Extract the electric window device (1) from the door.

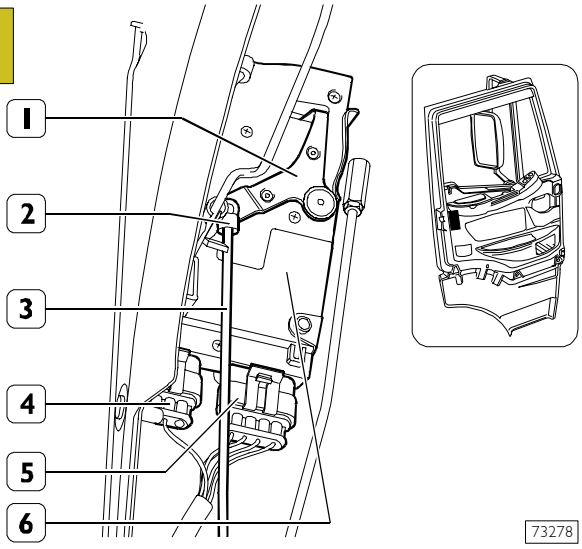
Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

550714 REPLACING THE DOOR LOCK

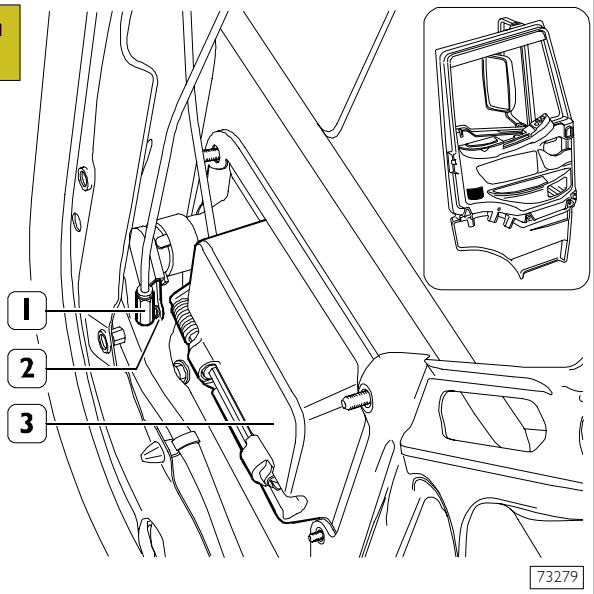
Removal

Figure 59



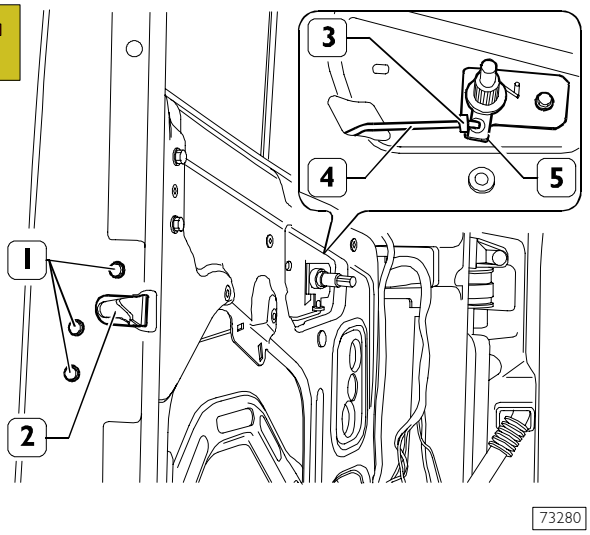
Remove the door trim as described in operation 550740.
Unhook the clip (2) from the tie rod (3) and disconnect this from the idler (1).
Disconnect the electric connections (4) and (5) from the lock (6).

Figure 60



Disconnect the tie rod (1) from the lever (2) of the outside handle (3).

Figure 61



Unhook the clip (3) from the tie rod (4) and disconnect this from the lever (5) of the internal handle.
Take out the screws (1) and remove the lock (2) from the door.

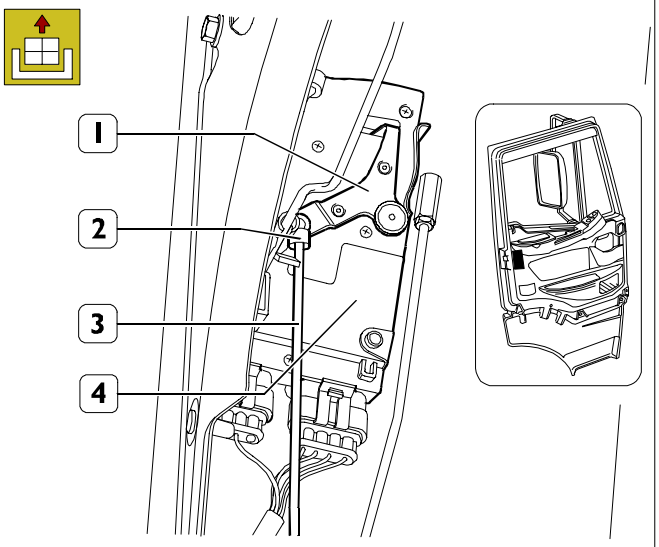
Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

550717 REPLACING THE OUTSIDE HANDLE OF THE DOOR

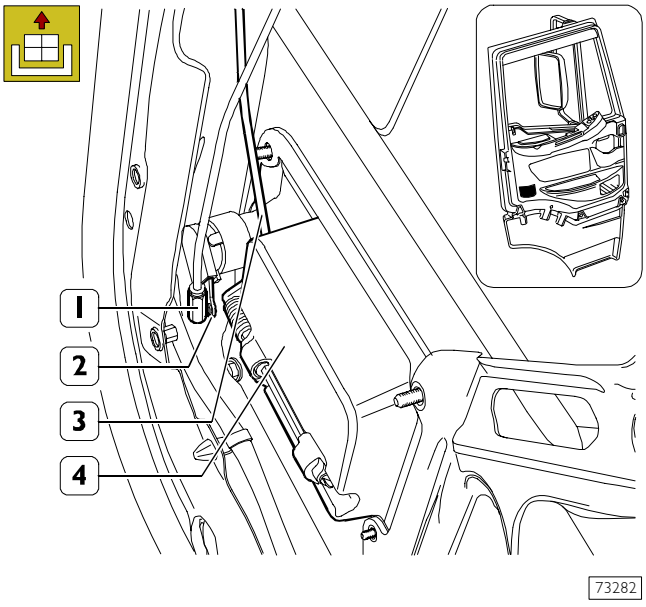
Removal

Figure 62



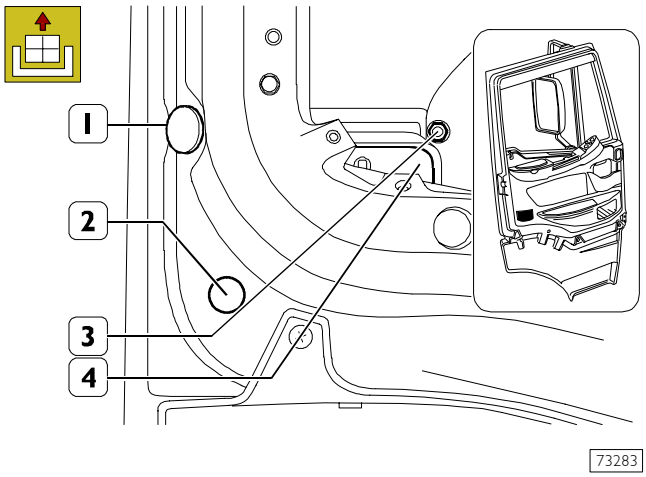
Remove the door trim as described in operation 550740.
Unhook the clip (2) from the tie rod (3) and disconnect this from the idler (1) of the lock (4).

Figure 63



Disconnect the tie rod (1) from the lever (2) of the external handle (3).

Figure 64



Take off the covers (1) and (2) and the nuts (3) fixing the external handle (4) and detach this from the door.
Remove the tie rod (3, Figure 63) from the handle (4).

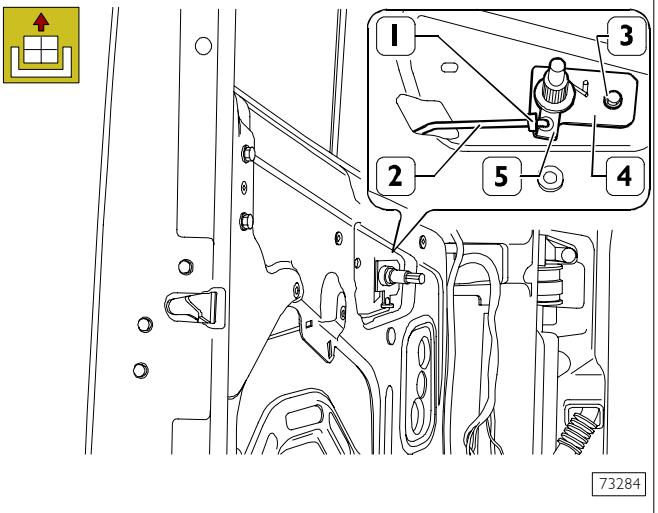
Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

CHANGING THE INSIDE HANDLE

Removal

Figure 65



Take off the trim as described in operation 550740.
Unhook the clip (1) from the tie rod (2) and disconnect this from the lever (5) of the inside handle (4).
Take out the screws (3) and remove the handle (4) from the door.

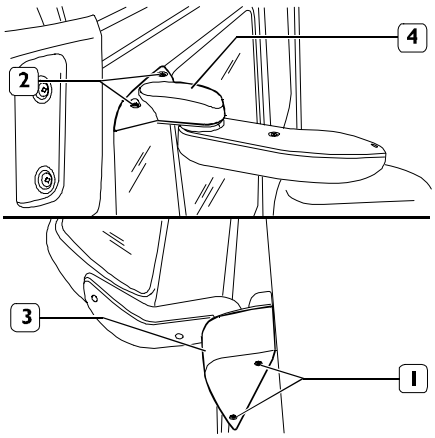
Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

CHANGING THE SIDE MIRRORS

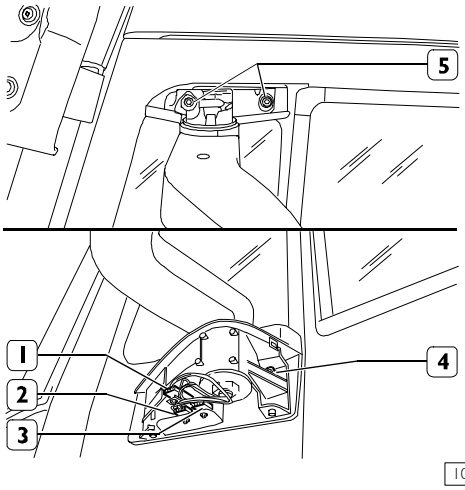
Removal

Figure 66



Undo the screws (1) and (2) and remove the plastic guards (3) and (4).

Figure 67



Disconnect the electrical connections (1), (2) and (3). Take out the screws (4) and (5) and remove the assembly from the vehicle.

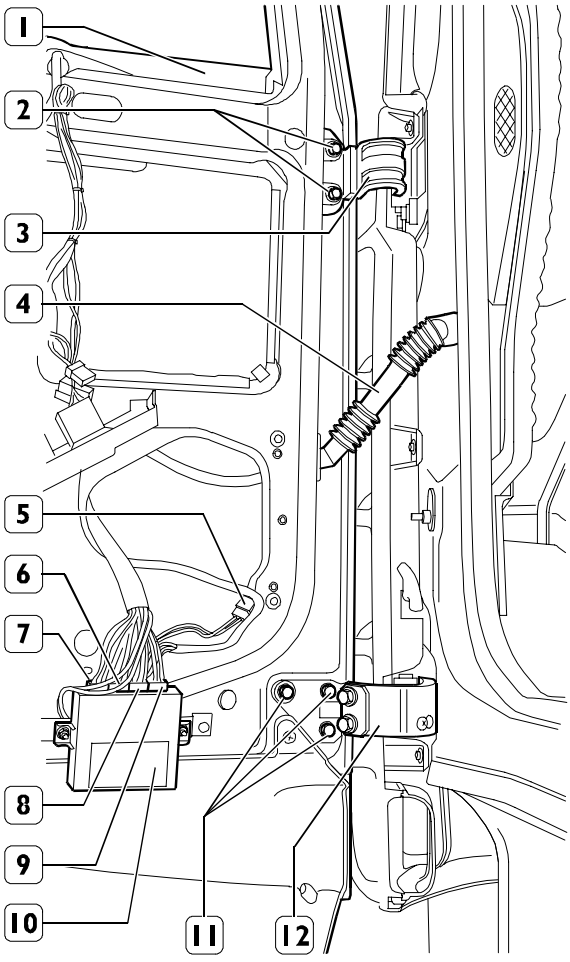
Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

CHANGING THE DOOR

Removal

Figure 68



Take off the side mirror mounting as described in the previous operation.
Detach the inside door trim as described in operation 550740.
Remove the electric window device as described in operation 550730.
Disconnect the electric connections (5), (6), (7), (8) and (9) from the control unit and take this out (10).
Support the door (1), take out the screws (2) and (11) and take the door (1) off its hinges (3) and (12).

NOTE When taking off the door (1), extract the wiring (4) from it with great care.

Refitting

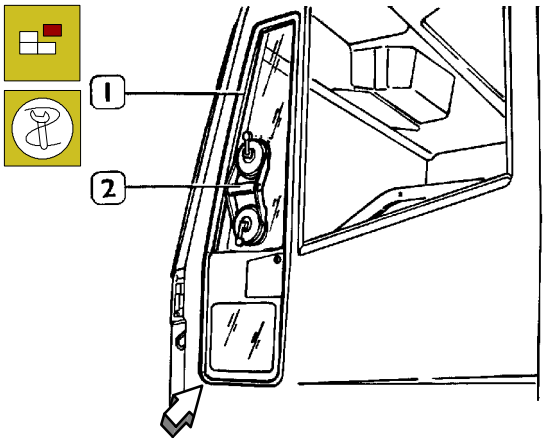
Carry out the steps performed for removal in reverse order, observing the required tightening torques.

550748 REPLACING THE FIXED WINDOW

Removal

Take off the side mirror mounting as described in the related operation.
Detach the inside door trim as described in operation 550740.

Figure 69



Extract the outside seal (1), apply the suction cup 99378031 (2).

NOTE Before starting to cut, you need to protect the paintwork with adhesive tape to prevent any damage.

Insert a suitable tool through the sealant by a corner (arrow) of the window.
Make the cut all along the perimeter. Remove the window with a suction cup handle (2).

NOTE Do not use any lubricant during cutting.
The blades must always be sharp.

Preparing the window bay

Using an appropriate knife, cut and level the sealant of the window bay so as to leave a thickness of between 0.25 and 1 mm to prevent chipping the paintwork.
Get rid of the remaining dust and degrease the window bay with the BETACLEAN 3300 detergent towelette contained in the BETASEAL 1703 Sprint kit (IVECO PARTS 93162553).

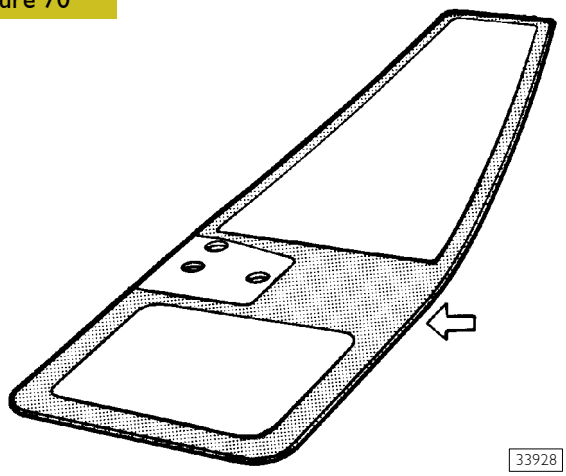
NOTE The film of sealant remaining on the windscreen will be a support for subsequent gluing.

NOTE If the window bay has been painted after repair work, treat it with the COMBI primer 5061 contained in the kit and wait for 15 minutes.

Preparing the window

Using an appropriate knife, cut and level the sealant of the window bay so as to leave a thickness of between 0.25 and 1 mm to prevent chipping the paintwork.
Get rid of the remaining dust and degrease the window bay with the BETACLEAN 3300 detergent towelette contained in the BETASEAL 1703 Sprint kit (IVECO PARTS 93162553).

Figure 70



❑ Degrease the screen-printed portion of the windscreen with the BETACLEAN 3300 detergent towelette contained in the kit.

NOTE If using a new window, it is still necessary to degrease the screen-printed portion with the BETACLEAN 3300 detergent towelette.

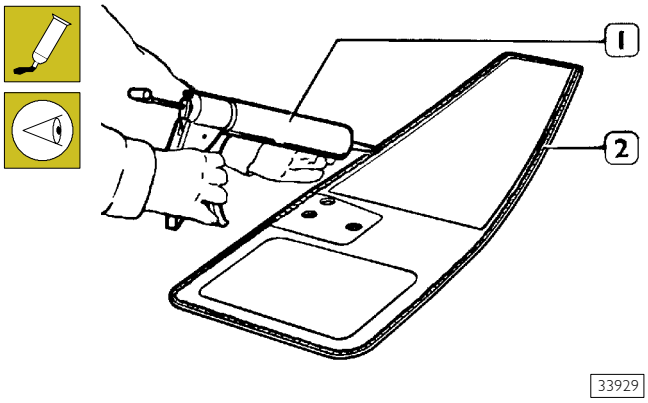
❑ Using the applicator contained in the kit, spread the glass adhesion promoter (COMBI primer 5061) on the screen-printed portion. It is not necessary to use it on the remaining sealant.

❑ Wait for 15 minutes before going ahead with the operations so as to allow the solvent of the adhesion promoter (COMBI primer 5061) to evaporate.

Refitting

Mount the seals on the inside of the door, without touching the area where the adhesion promoter (primer) has been applied.
Mount the rubber seal on the window.
Perform a trial assembly and centre the window exactly.
After centring the window, mark the reciprocal position between the window and its seat with strips of adhesive tape (1).
Cut the strips of adhesive tape and remove the window.

Figure 71

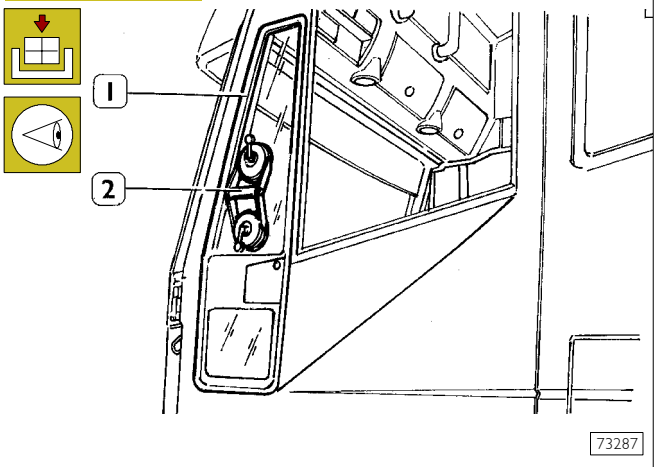


Using an air gun, apply a bead of BETASEAL 1703 SPRINT polyurethane adhesive along the perimeter of the window as evenly as possible.

Start this process from the middle of the bottom side and proceed without stopping all around the perimeter of the window.

Cut off the tip of the adhesive cartridge so that the cross-section of the adhesive bead is triangular in shape with a base of 5-7 mm and a height of 12 mm.

Figure 72

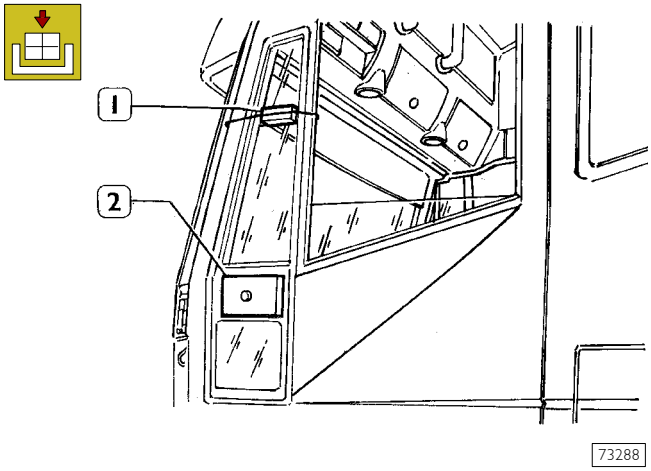


Place the windscreen in its seat with the suction cup handle (2).

❑ Align the window with its housing bay, using the adhesive tape applied beforehand as a reference.

NOTE The window must be positioned within 15 minutes of applying the adhesive.

Figure 73



Keep the window under pressure with two wooden plugs (1) and (2) positioned as shown in the figure.

NOTE Keep the window under pressure for at least 1 hour.

Before refitting the parts that had been removed beforehand, check there are no points of infiltration.

Apply soapy water with a sponge along the outer perimeter and blow compressed air from the inside so as to see whether there is any infiltration.

If bubbles form, degrease the relevant part and fill it with adhesive.

Any sealant spilling over on the inside can be removed once it has hardened by cutting it with a knife and detaching it with tweezers.

NOTE Take care not to damage the screen-printing on the window with the knife.

Fit the parts that had been removed back on and clean the window.

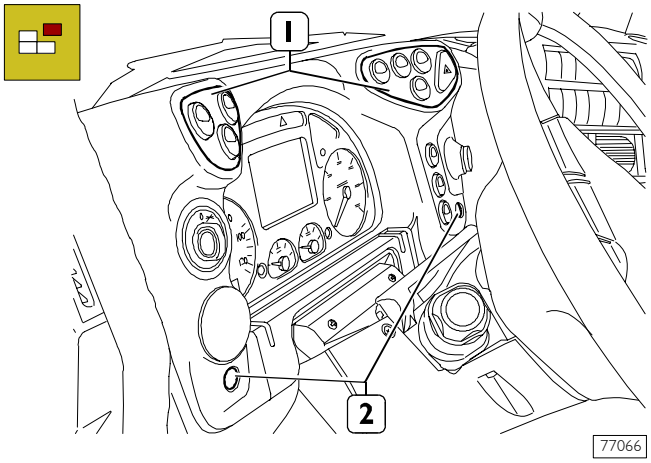
NOTE Do not move or deliver the vehicle until one hour and thirty minutes have passed at a temperature of 23°C and relative humidity (RH) of 50%.
If the temperature or humidity are lower you need to increase the waiting time.

Before all else, disconnect the batteries and observe the safety standards.

553710 INSTRUMENT PANEL

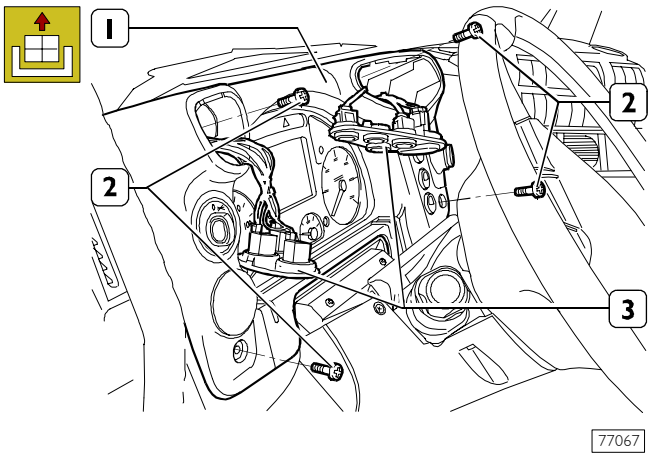
Removal

Figure 74



- ❑ Take the plugs (2) out of their seat.
- ❑ Undo the fasteners and remove the light switch assemblies (1) from their compartment.

Figure 75



- ❑ Disconnect the electric connectors and remove the light switch assemblies (3).
- ❑ Unscrew the screws (2) fixing the instrument panel (1).
- ❑ Remove the instrument panel (1) from its seat, then disconnect the associated electrical connections.

NOTE Mark the wirings to facilitate reconnection.

Remove the instrument panel (1) from its seat.

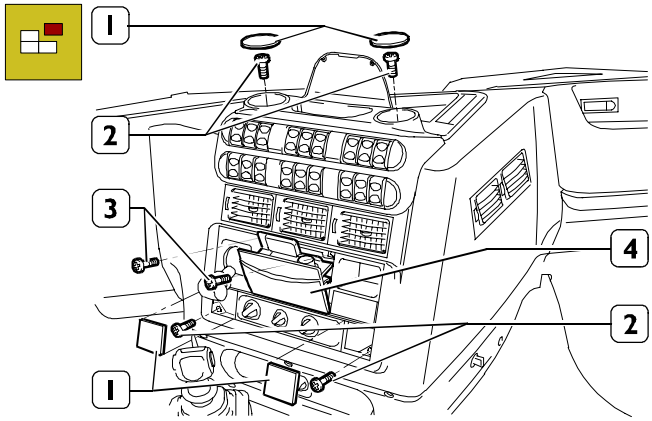
Refitting

Refit by carrying out the procedures described for removal in reverse order.

553710 CENTRAL INSTRUMENT PANEL

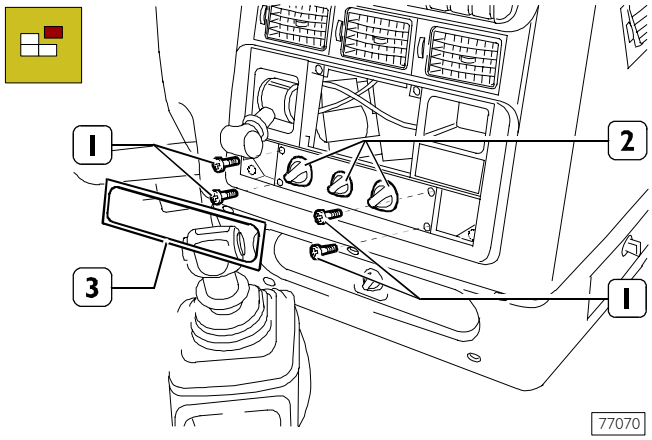
Removal

Figure 76



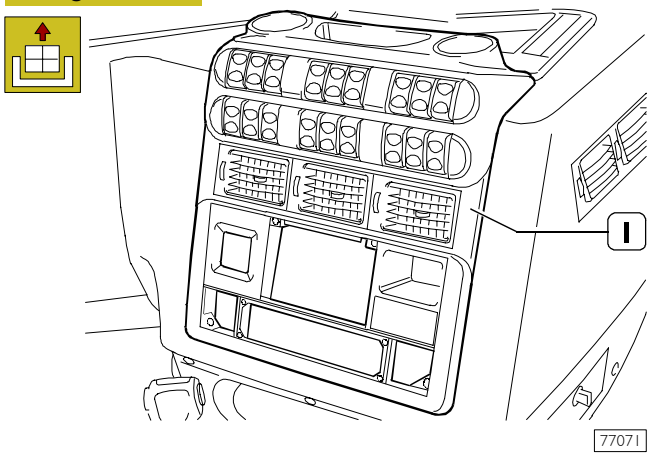
- ❑ Take off the plastic coverings (1).
- ❑ Unscrew the fixing screws (2) beneath.
- ❑ Unscrew the screws (3) fixing the ashtray and disconnect the cigar lighter connection.
- ❑ Remove the ashtray (4).

Figure 77



- ❑ Take off the climate control frame (3).
- ❑ Remove the climate control knobs (2).
- ❑ Unscrew the screws (1).

Figure 78



- ❑ Take off the central instrument panel (1).
- ❑ Disconnect the electrical connections and mark them.
- ❑ Remove the central instrument panel (1) from the vehicle.

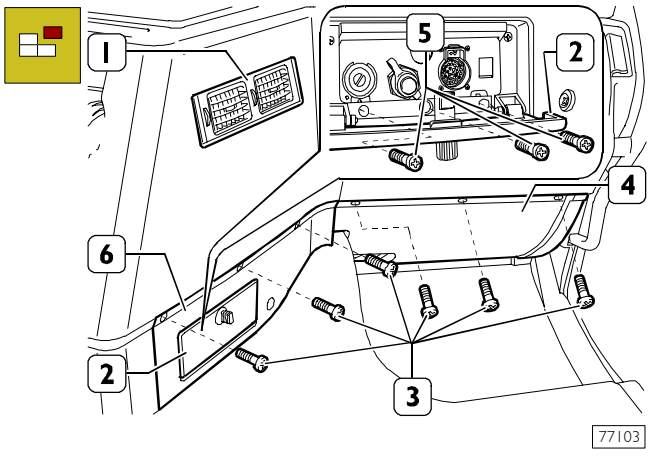
Refitting

Refit by carrying out the procedures described for removal in reverse order,

552211 FASCIA COVERING

Removal

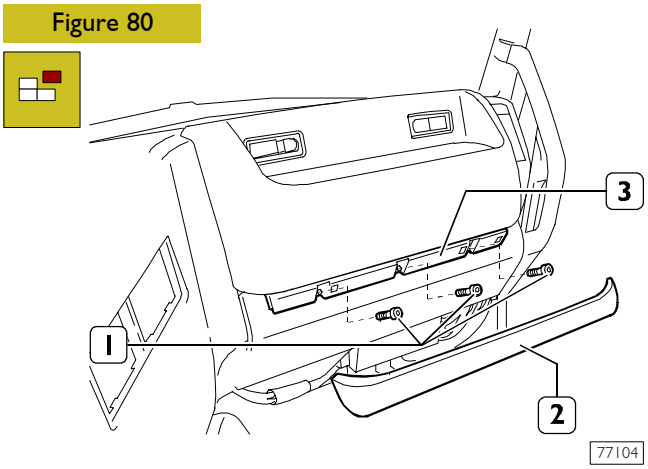
Figure 79



Perform the removal procedure.

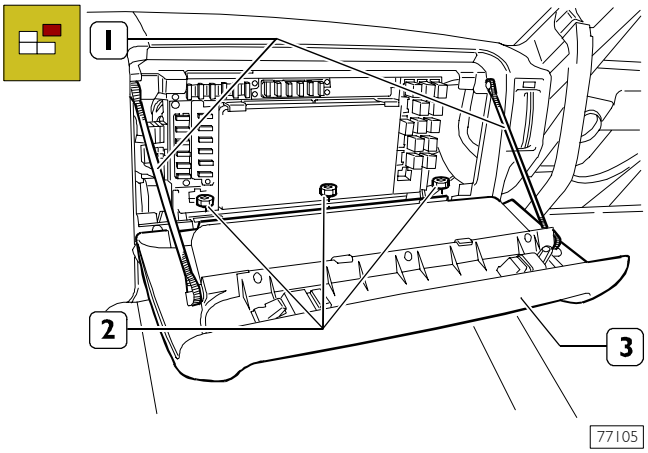
- ❑ Instrument panel (OP. 553710) and central instrument panel (OP. 553710) as described on the previous page, then proceed as described below:
- ❑ undo the fasteners and remove the air openings (1);
- ❑ unscrew the screws and the plugs (3) fixing the bottom instrument panel covering on the passenger side;
- ❑ detach the bottom instrument panel covering (4) on the passenger side;
- ❑ open the diagnosis socket door (2);
- ❑ unscrew the fixing screws (5) and remove the diagnosis socket door (2);
- ❑ detach the bottom instrument panel covering (6) of the diagnosis socket.

Figure 80



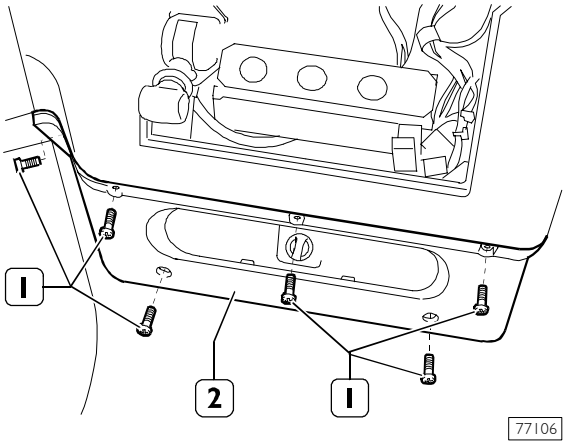
- ❑ Undo the fasteners and take off the moulding (2) to get to the underlying screws.
- ❑ Unscrew the fixing screws (1) and remove the connection (3) of the moulding (2).

Figure 81



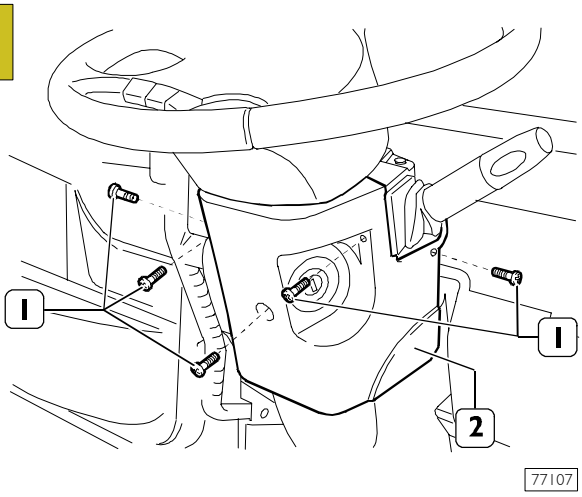
- ❑ Open the glove compartment (3).
- ❑ Detach the tie rods (1).
- ❑ Unscrew the nut (2) and detach the glove compartment (3).

Figure 82



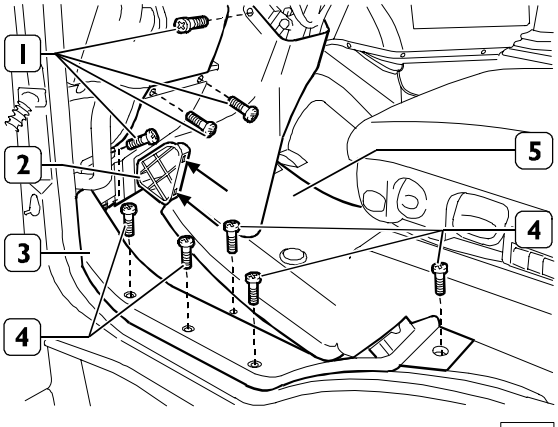
❑ Unscrew the fixing screws (1) and remove the bottom covering (4) of the central instrument panel.

Figure 83



❑ Unscrew the fixing screws (1) and remove the indicator switch covering (2).

Figure 84



❑ Unscrew the screws (4) fixing the sill (3).

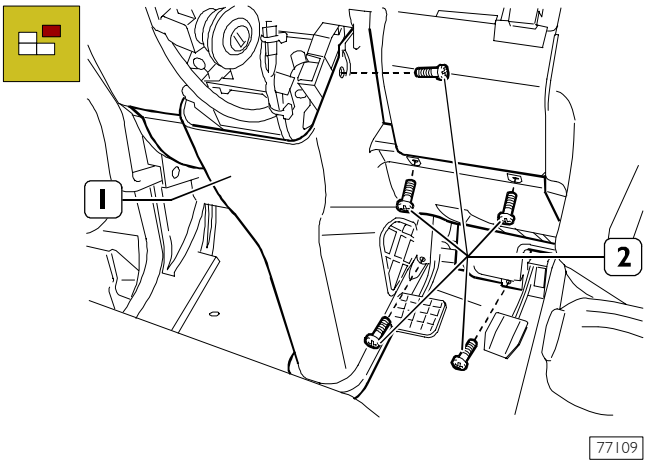
❑ Lift the mat (5) to get to one of the fasteners of the sill (3).

❑ Detach the sill (3) from the vehicle.

❑ Undo the fasteners (←) and take out the air opening (2) in the floor.

❑ Unscrew the side screws (1) fixing the steering column guard.

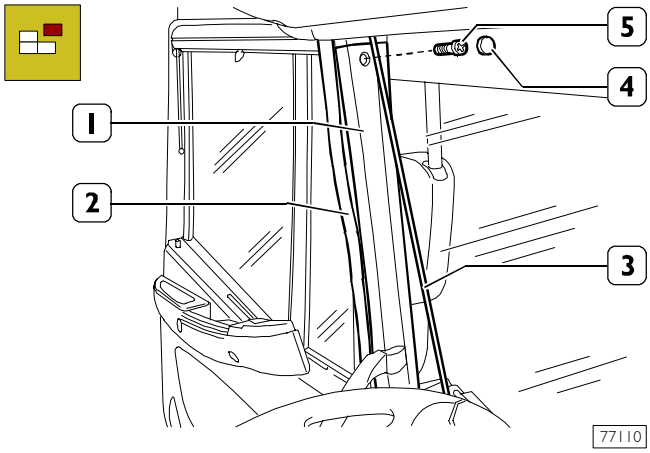
Figure 85



❑ Unscrew the screws (2) fixing the steering column guard in the area of the pedal board.

❑ Detach the steering column guard (1) from the vehicle.

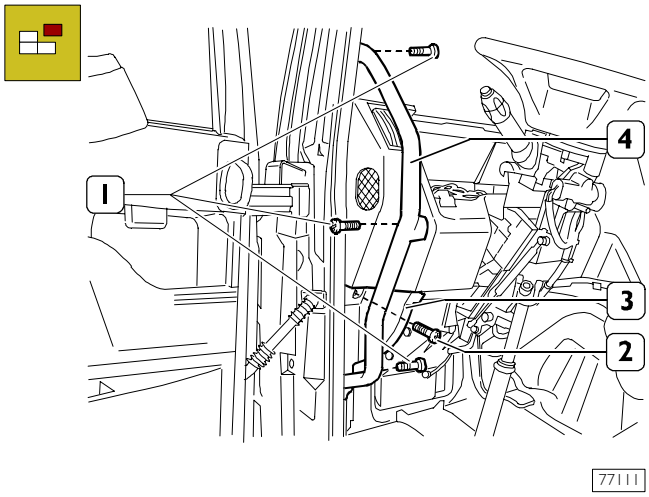
Figure 86



- ❑ Partly take off the door seal (2).
- ❑ Remove the sunblind rod (3).
- ❑ Take off the press-on plug (4) to access the screws beneath.
- ❑ Unscrew the fixing screw (5) and remove the windshield upright covering (1).

NOTE Perform the operations on both sides.

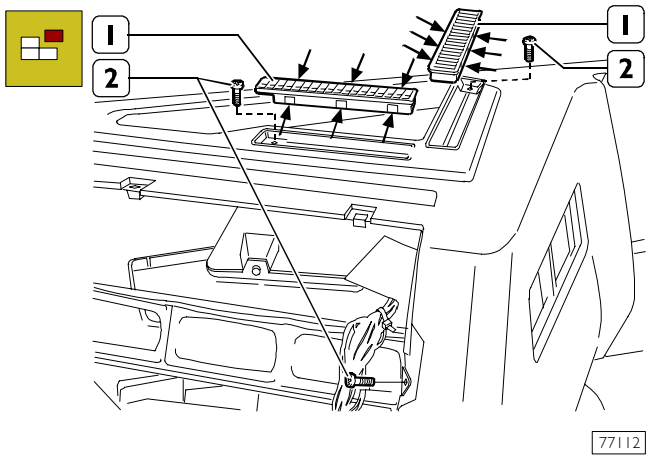
Figure 87



- ❑ Unscrew the fixing screw (2) and remove the covering (3).
- ❑ Unscrew the fixing screws (1) and remove the up handle (4).

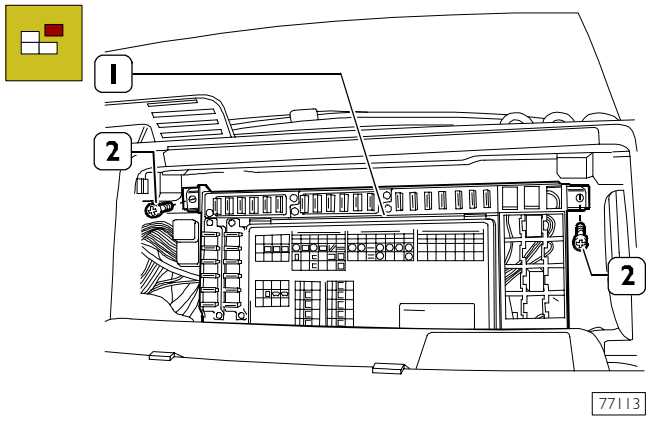
NOTE Perform the operations on both sides.

Figure 88



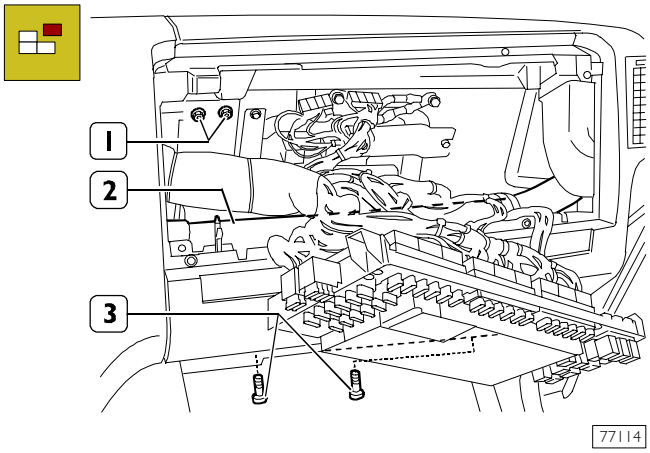
- ❑ Undo the fasteners (←) and take out the air openings (1) to get to the screws beneath.
- ❑ Unscrew the screws (2) fixing the fascia covering to the heater.

Figure 89



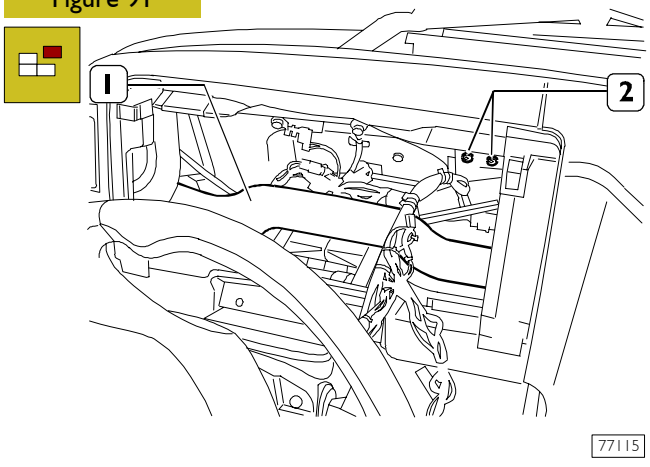
- ❑ Unscrew the screws (2) fixing the Body Control.
- ❑ Remove the Body Control (1) and to set it aside in order to get to the fasteners beneath.

Figure 90



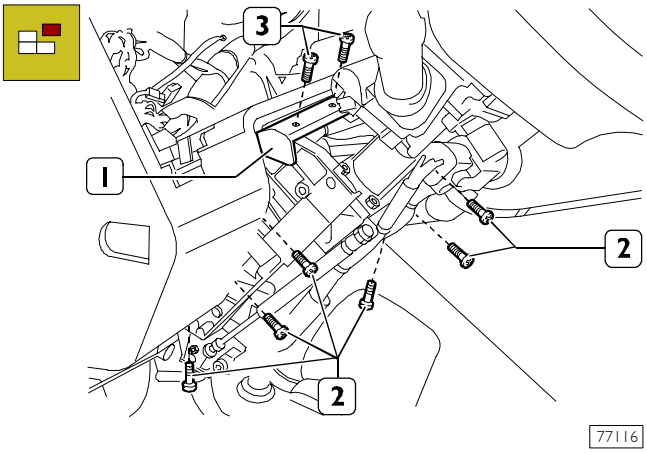
- ❑ Operate from the passenger side (Body Control compartment) unscrew the nuts (1) fixing the fascia covering to the body.
- ❑ Free the right-hand air delivery pipe (2) from the retaining clamps and disconnect it from the fan body and right-hand door air opening.
- ❑ Unscrew the bottom screws (3) fixing the fascia covering.

Figure 91



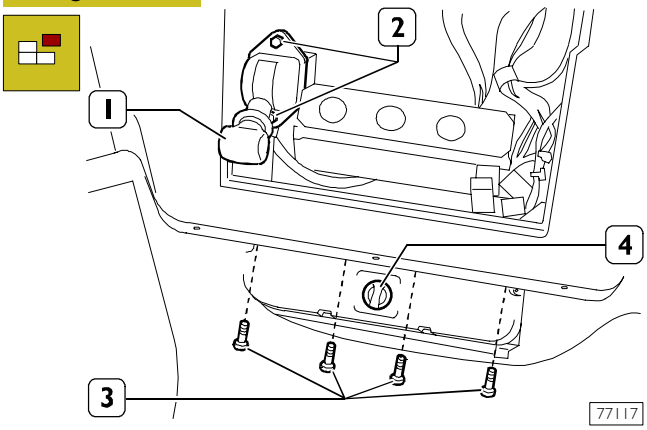
- ❑ Operate from the instrument panel compartment and unscrew the nuts (2) fixing the fascia covering to the body.
- ❑ Free the left-hand air delivery pipe (1) from the retaining clamps and disconnect it from the fan body and left-hand door air opening.

Figure 92



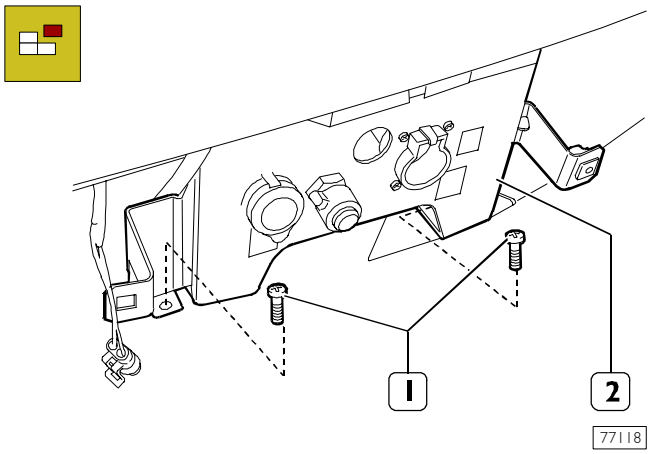
- ❑ Unscrew the screws (3) fixing the blind guard (1) on the steering column.
- ❑ Unscrew the screws (2) fixing the fascia covering to the steering column and to the body.

Figure 93



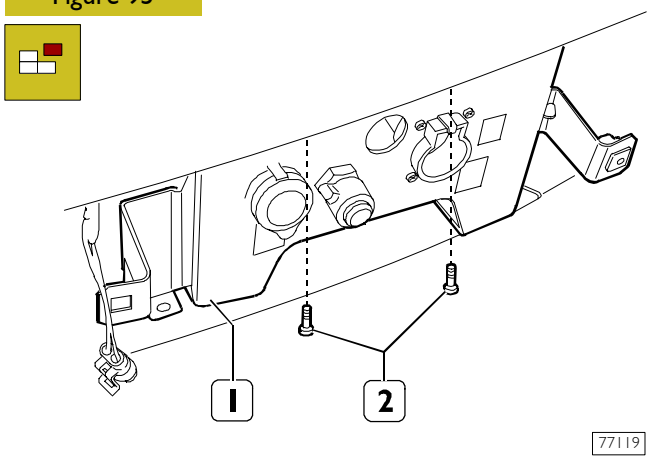
- ❑ Unscrew the screws (3) fixing the fascia covering to the bracket supporting differential locking (4).
- ❑ Unscrew the fixing screws (2) and set aside the lever (1).

Figure 94



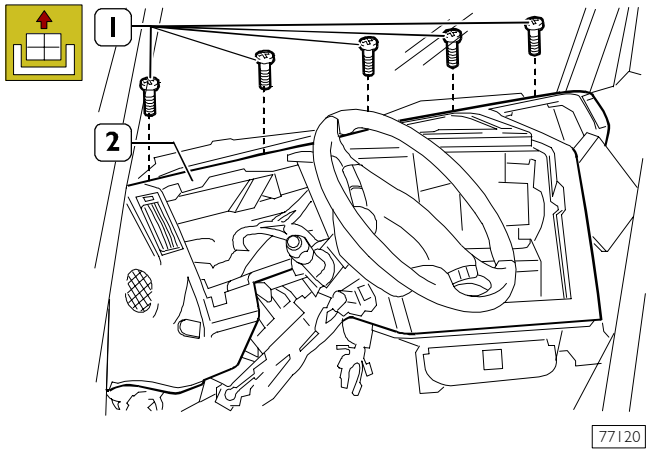
- ❑ Unscrew the screws (1) fixing the diagnosis socket mount (2) from the floor, to access the underlying screws.

Figure 95



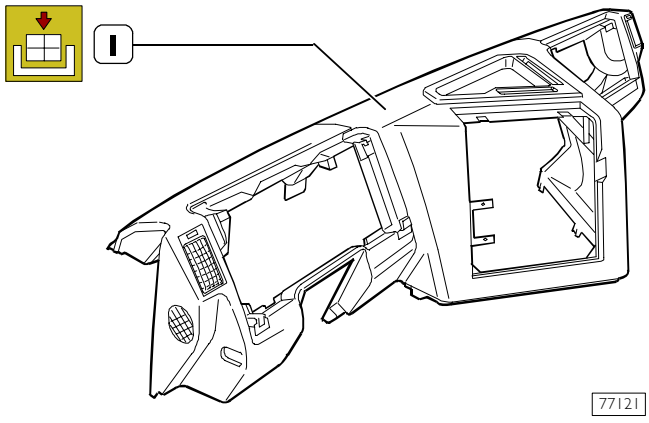
- ❑ Move aside the diagnosis socket mount (1) and unscrew the screws (2) fixing the fascia covering.

Figure 96



- ❑ Unscrew the top screws (1) fixing the fascia covering (2) along the perimeter of the windshield.
- ❑ With the help of an assistant, detach and rotate the panel trim as required.
- ❑ Pay attention to the fasteners and extract the fascia covering (2) from the vehicle.

Figure 97



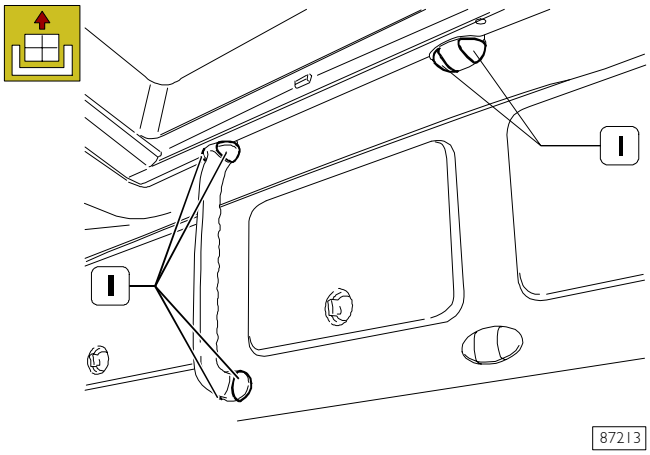
Refitting

Refit the fascia covering (1) by performing the operations described for removal in reverse order, paying attention to the fasteners.

AIR INTAKE LID REMOVAL AND REFITTING

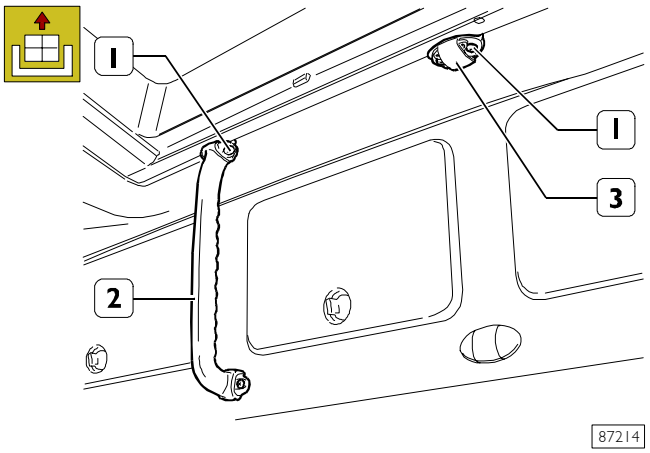
Removal

Figure 98



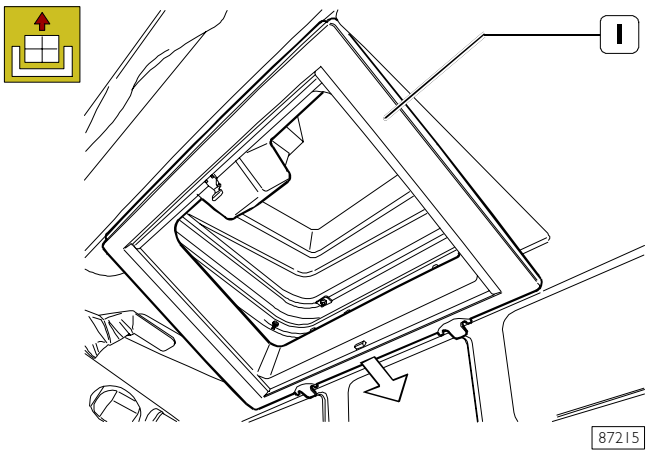
Extract the screw covering trims (1).

Figure 99



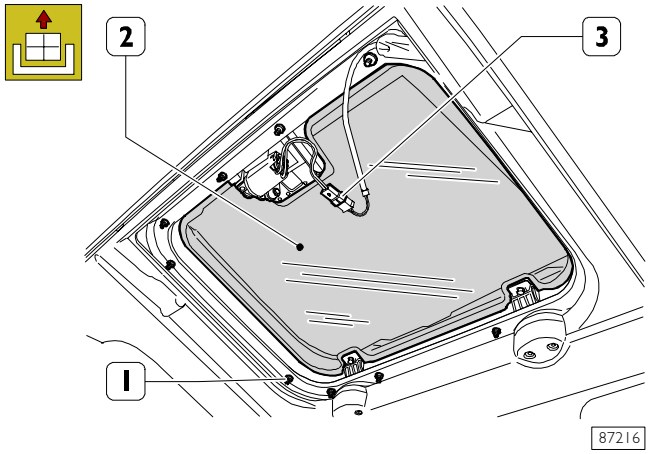
Slacken the fastening screws (1) and remove the handle (2) and the support (3).

Figure 100



Remove the rim (1).

Figure 101



Disconnect the connection (3), slacken the 12 fastening nuts (1) and remove the air intake lid assembly (2).

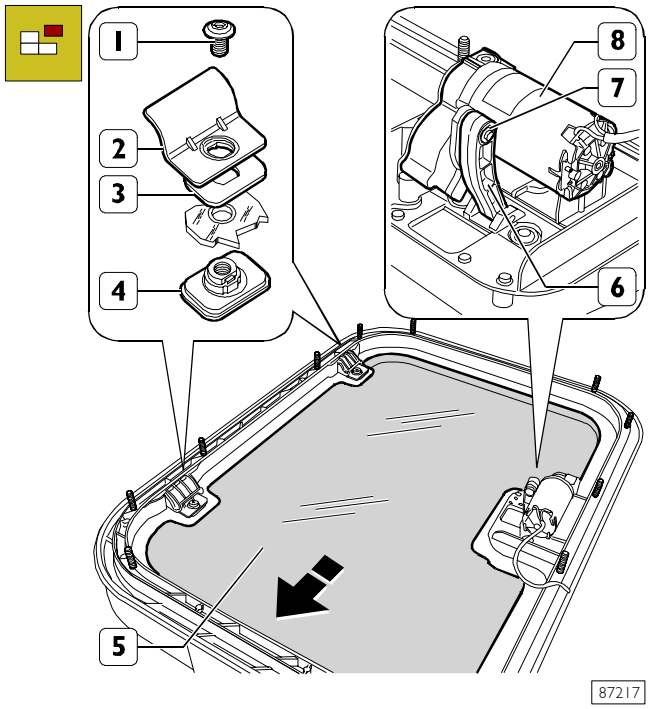
Refitting

Reverse the removal procedure.

AIR INTAKE LID MOTOR REPLACEMENT

Removing

Figure 102

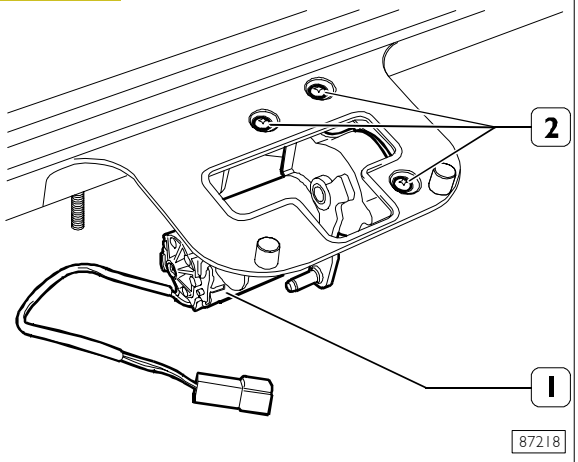


Disconnect the lid as described above and put it on the working stand.

Slacken the screws (1), recover the hinges (2), the gaskets (3) and the bosses (4).

Remove the safety ring (7) and make the window (5) slide in the direction shown by the arrow to release the motor (8) lever (6).

Figure 103

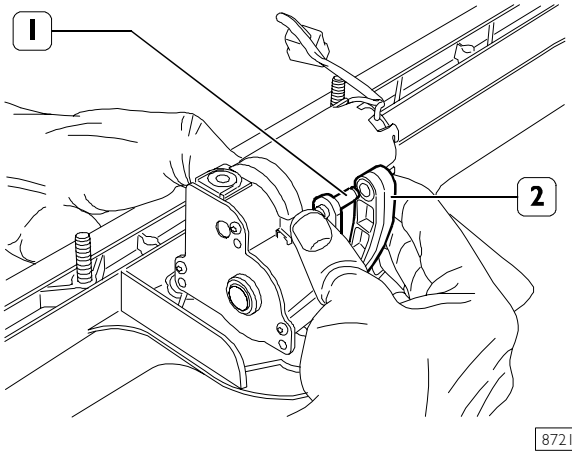


Slacken the screws (2) and remove the motor (1).

Refitting

Reverse the removal procedure except for the following operations.

Figure 104

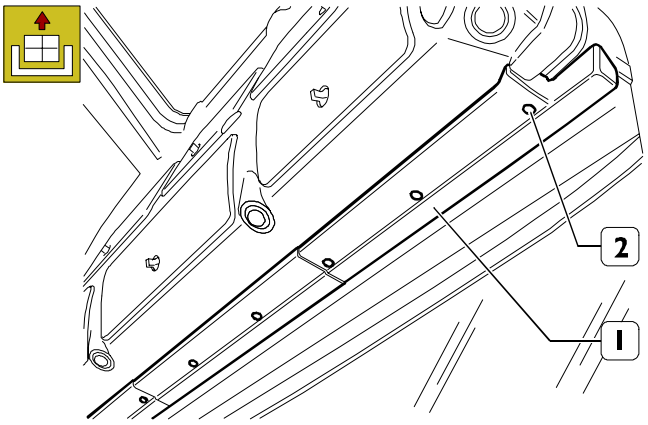


At refitting, press the rim in contact with the window to obtain alignment between the motor lever pin (1) and the window lever hole (2). Make the parts slide until the lever coupling is obtained.

WINDSCREEN SUN VISOR REEL REMOVAL/REFITTING

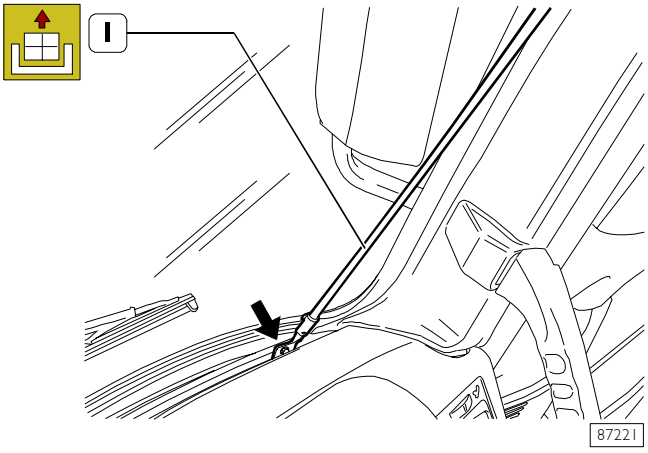
Removal

Figure 105



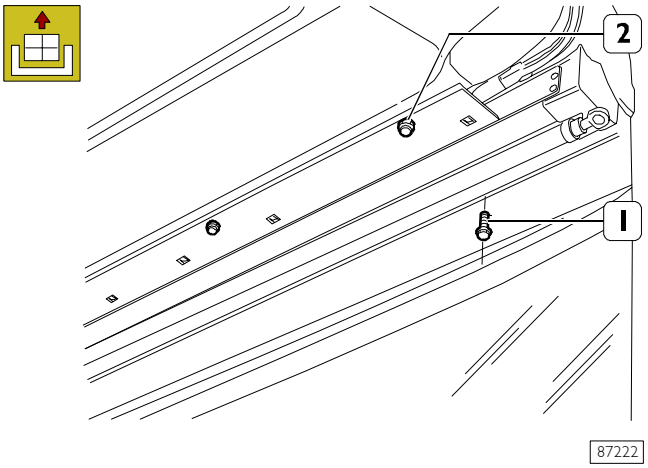
Extract the eight screw plugs (2), slacken the fastening screws and remove the mouldings (1).

Figure 106



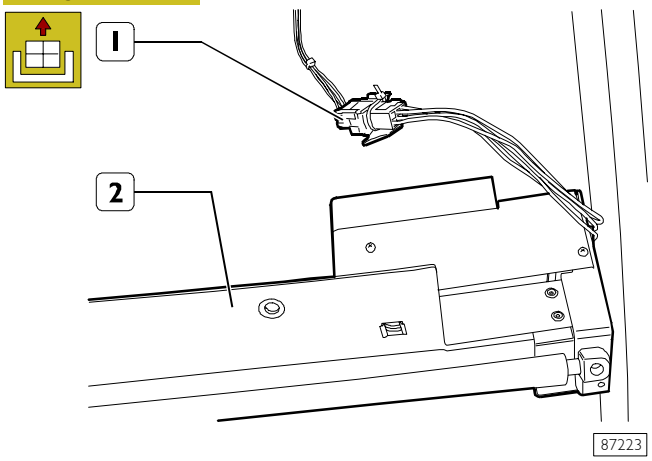
Extract the base (→) and remove the sun visor guide rod (1) on both sides.

Figure 107



Slacken the four screws (1), the seven screws (2) and lower the reel unit with great care.

Figure 108



Disconnect the connection (1) and remove the reel unit (2).

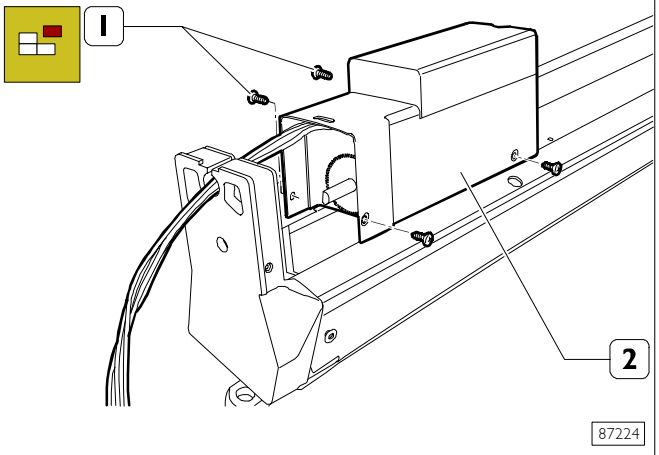
Refitting

Reverse the removal procedure.

WINDSCREEN SUN VISOR REEL MOTOR REPLACEMENT

Removing

Figure 109



Slacken the four fastening screws (1) and remove the motor (2).

Refitting

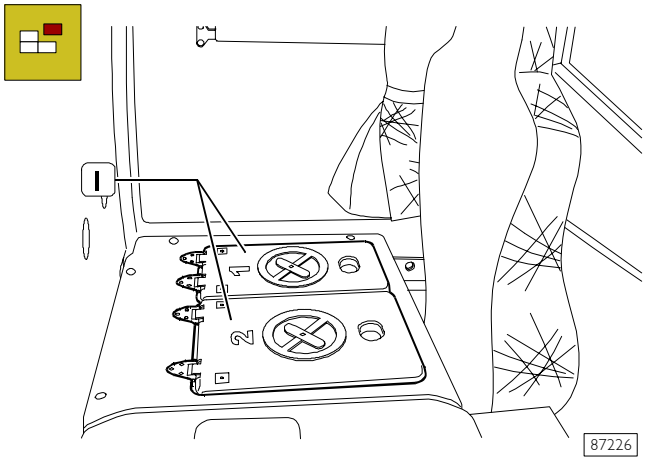
Reverse the removal procedure.

551644 REPLACING SIDE DOOR OPENING CONTROL CABLE

NOTE Should the lid opening control cable be broken, you can gain access to the glove compartment from the cabin inside behind the driver's seat.

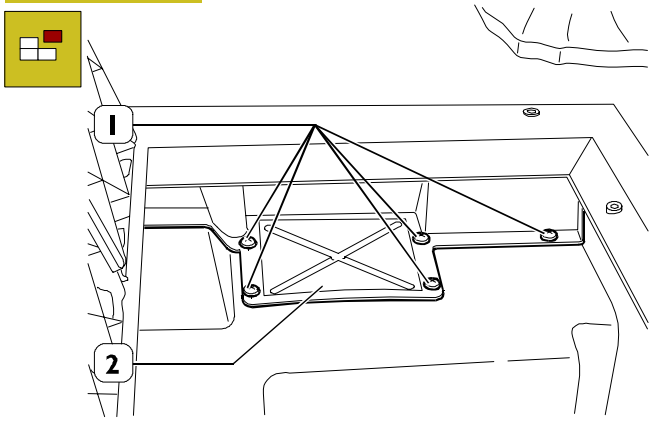
Removing

Figure 110



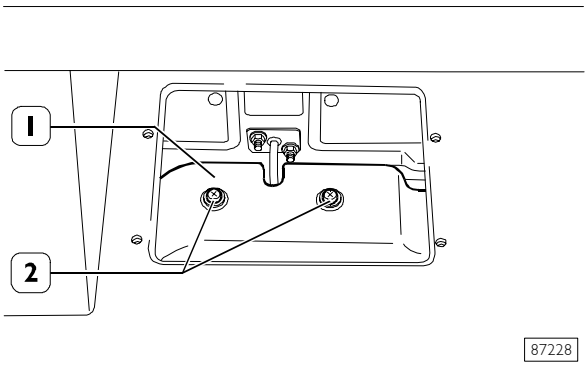
Remove the mattress behind the driver's seat and raise the lids (1).

Figure 111



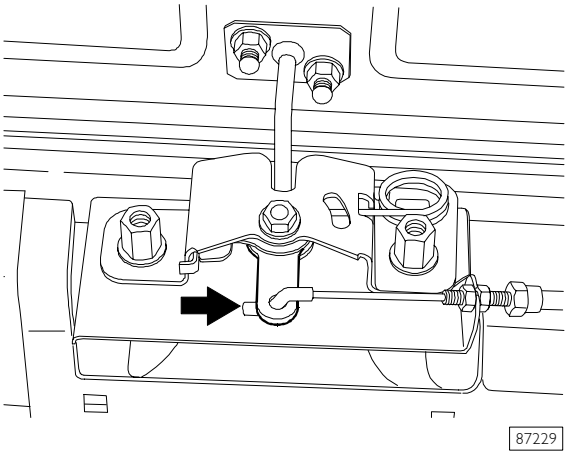
Slacken the screws (1) and remove the cover (2).

Figure 112



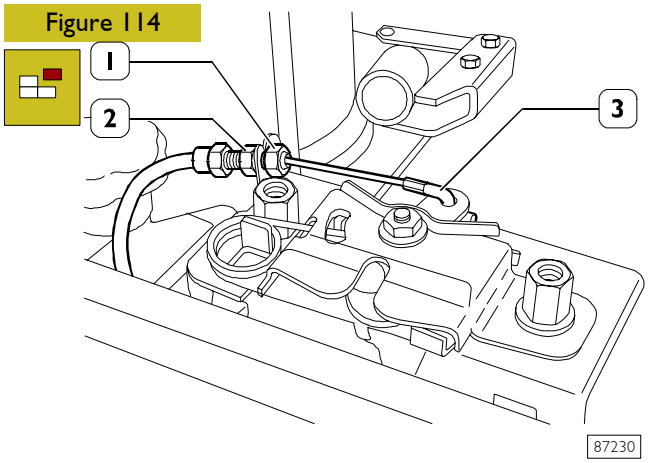
Slacken the screws (2), recover the washers and remove the covering (1).

Figure 113



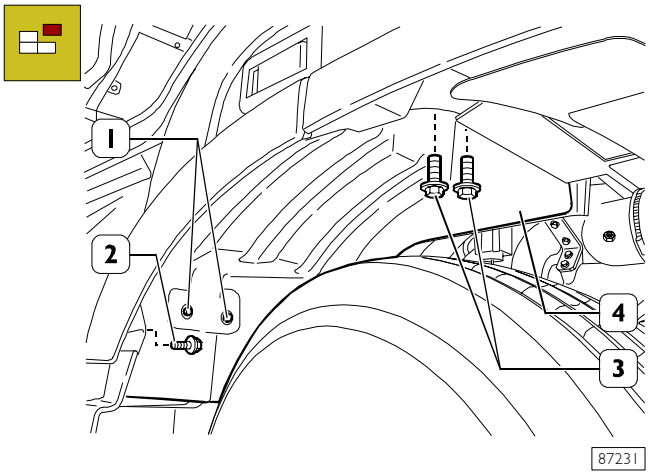
Operate the lever (→) to open the lid.

Figure 114



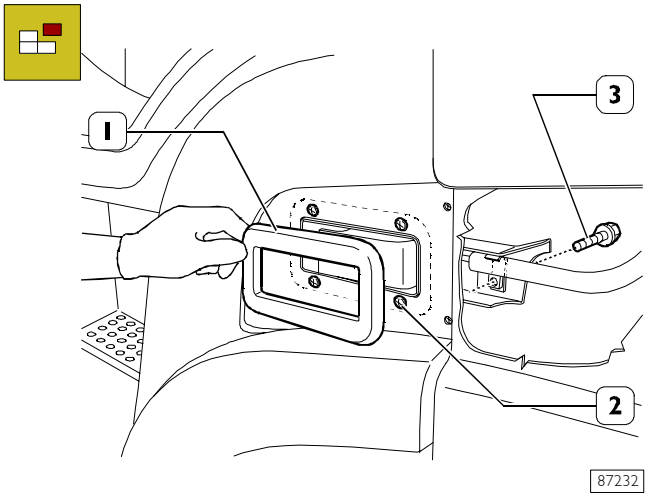
Slacken the lock nut (1) and remove the adjusting terminal (2) from the lock, then release the terminal from the lever cable (3).

Figure 115



Slacken the screws (1), the self-threading screw (2) and the screws (3), then remove the wheelhouse (4).

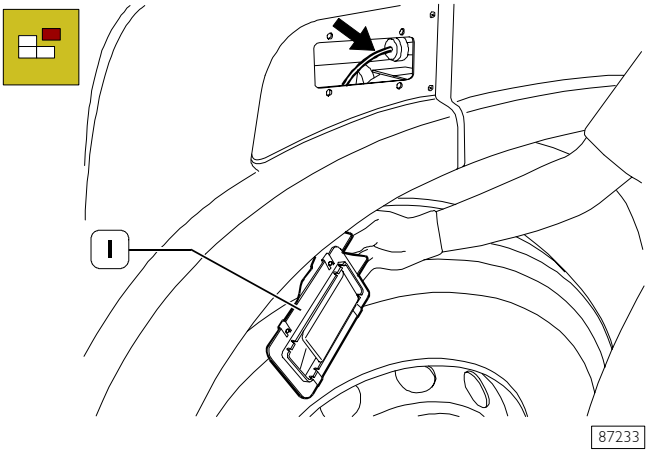
Figure 116



Take off the rim (1) and remove it.

Slacken the outer screws (2) and the inner screw (3).

Figure 117



Remove the control lever (1) underneath the bumper by taking off the protection pipe cable (→).

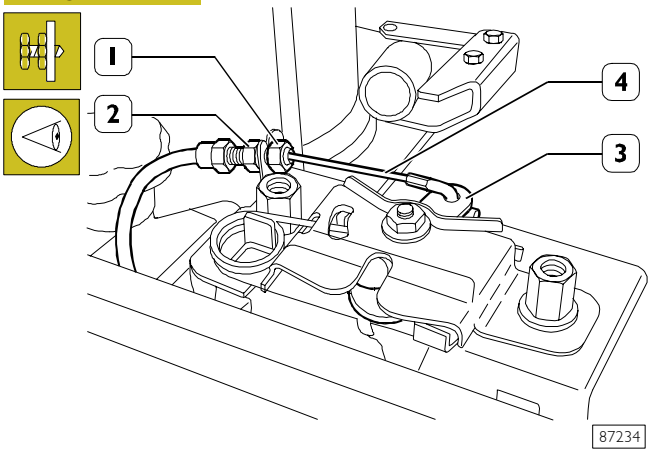
Fitting

Reverse the removal procedure.

NOTE Before refitting the covering (1, Figure 112) carry out the lid opening control adjustment.

Lid opening control adjustment

Figure 118



Operate the nut (2) to tension the cable (4) with the lever (3) free and without clearance.

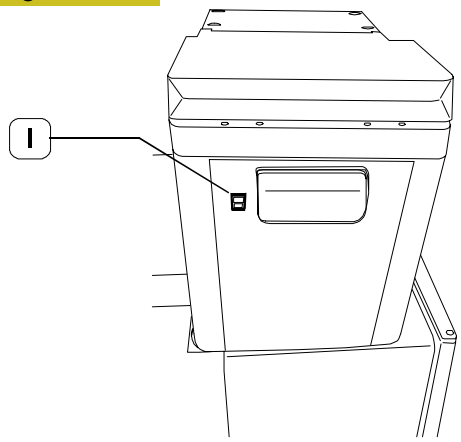
After adjustment, tighten the lock nut (1).

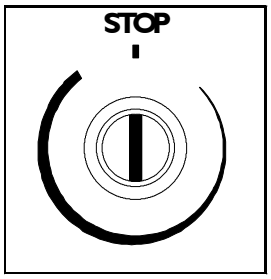
CABIN REFRIGERATOR

Preliminary checks

If the fridge does not work or its inner temperature is not enough, check the following conditions prior to making any replacement or maintenance work:

Figure 119





OFF position

- ❑ control unit supply voltage equal to 24.1 V;
- ❑ switch (1) ON (orange warning lamp ON);
- ❑ the thermostat must be not in OFF position (see figure);
- ❑ the protection fuse available on the dashboard electric panel must not be blown;
- ❑ the space around the refrigerator must be free enough to ensure ventilation.

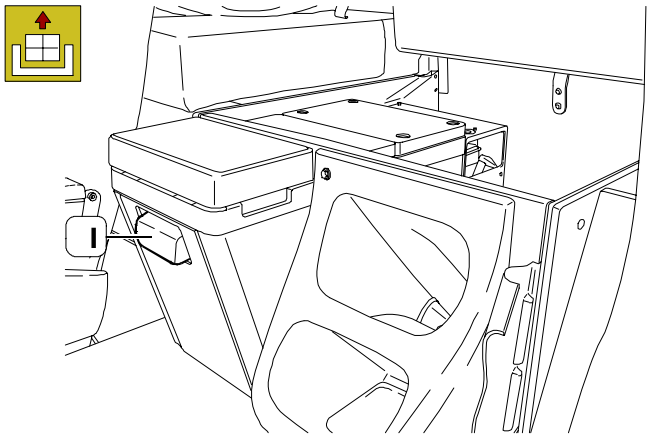
NOTE A compressor protection device is available for cabin tilting, whereby the installed refrigerator stops working, for safety reasons, if the vehicle (either stationary or running) is tilted by more than 15°.

NOTE The refrigerator may run down the battery when the engine is not working. When the battery level falls too low, the refrigerator will switch off automatically. Correct refrigerator operation is ensured only when the engine is running.

Removal

❑ Detachment is accomplished by tilting over the cabin, removing the sound-proofing panel below, and taking off the two refrigerator fastening screws.

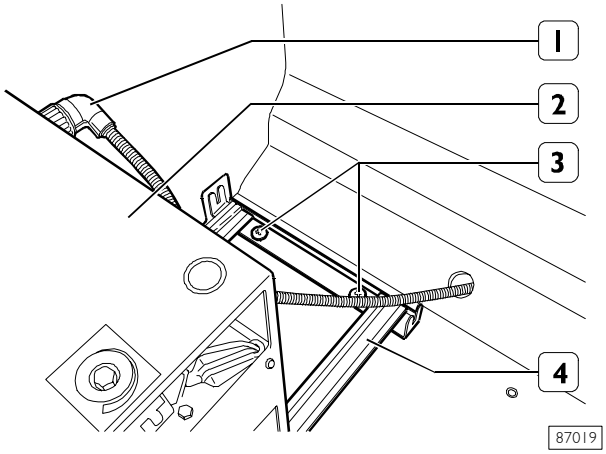
Figure 120



87018

❑ When the cabin has been lowered, make the refrigerator slide forward by acting on handle (1).

Figure 121



87019

❑ Disconnect electric connection (1).

❑ Remove screws (3).

❑ Take off refrigerator (2) with its respective guide (4).

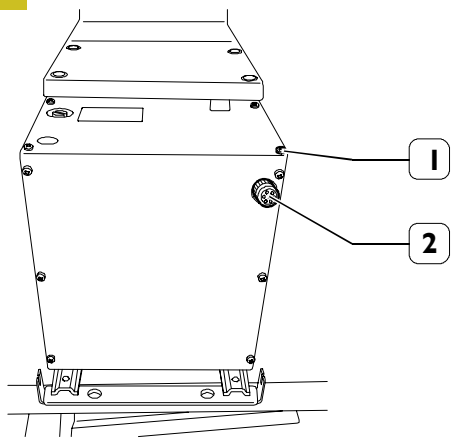
Refitting

Refitting is carried out by reversing the order of removing operations.

OVERHAULING

Removing

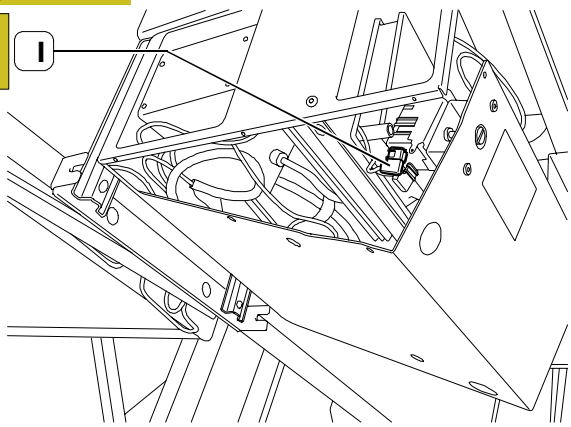
Figure 122



86982

Remove screws (1). Take threaded ring (2) out of the connector.

Figure 123

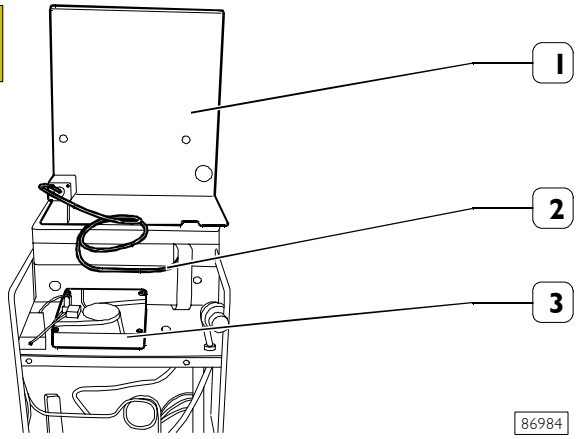


86983

Remove connection (1) from the thermostat.

Fan disassembling

Figure 124

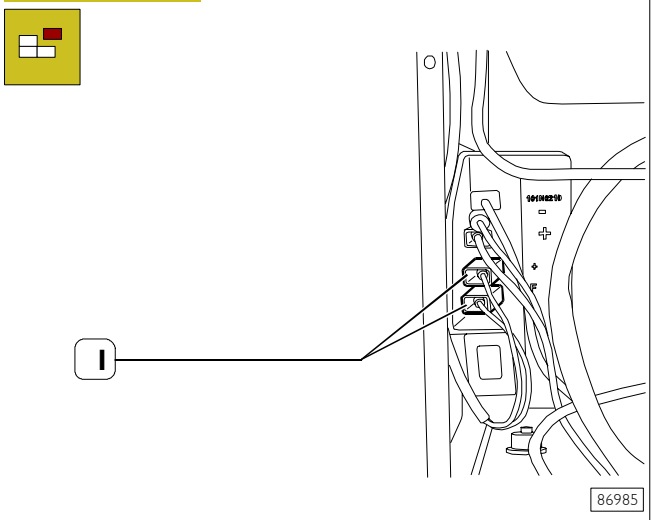


86984

Overturn rear protection (1) as shown on the figure, taking care not to apply tensile stress to the thermostat probe (2).

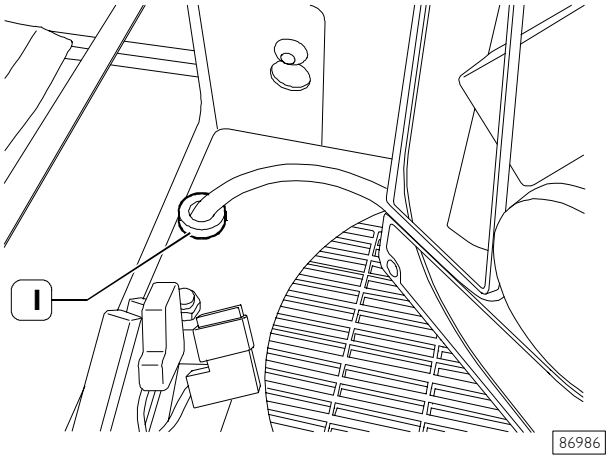
The fan can be removed by taking out screws (3).

Figure 125



Remove electric connection (1) from the control unit, taking care not to pull the cables.

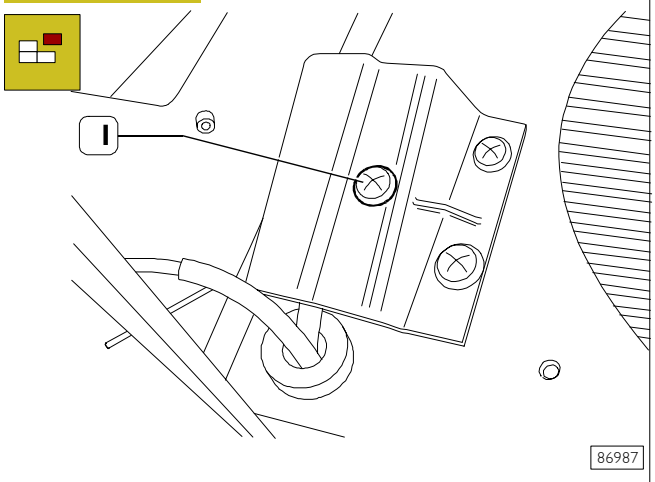
Figure 126



Use a screwdriver to take out core hitch (1), then take out the cables one at a time.

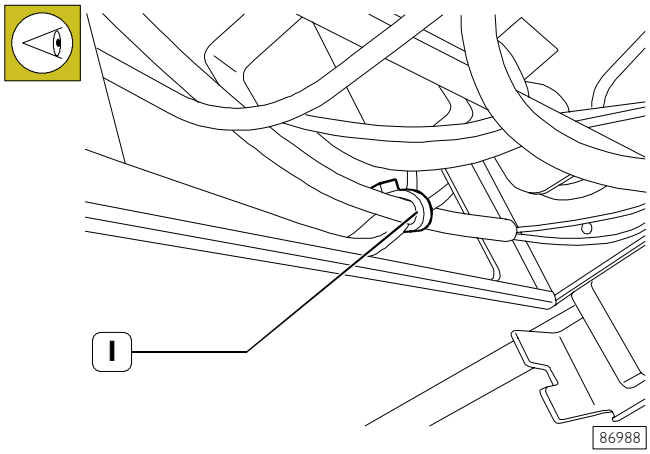
Disassembling the anti-tipping probe with electronic circuit on the control unit

Figure 127



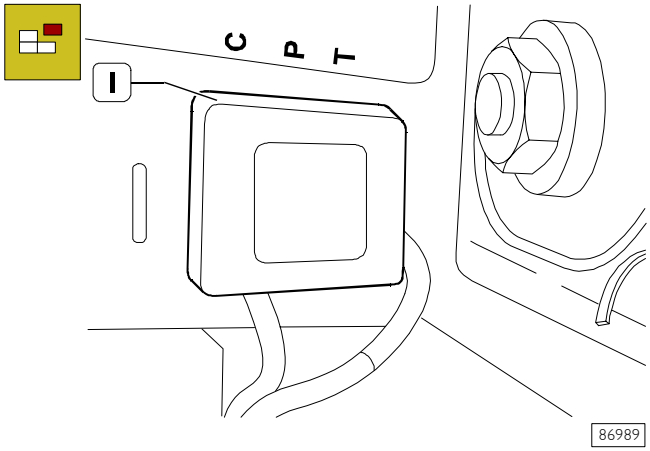
Remove screw (1).

Figure 128



Cut the plastic strap (1) joining the wiring on the electronic control unit front part.

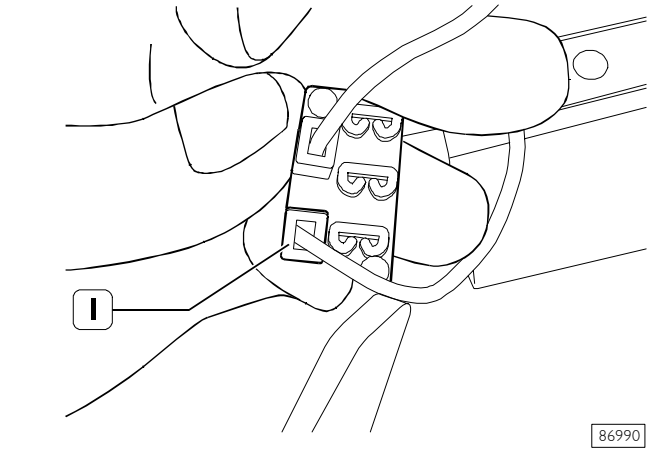
Figure 129



Take non-tilting probe circuit (1) out of the compressor's electronic control unit.

NOTE Do not use blunt tools which could damage the circuit inner face.

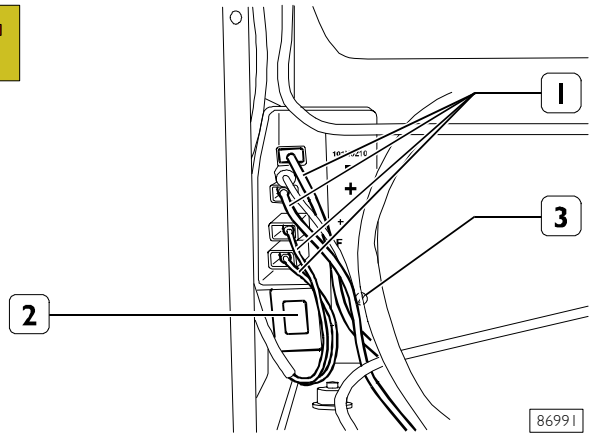
Figure 130



Take off the connector (1) to which the probe cable is secured. Now, the probe can be taken out through the core hitch, thus avoiding connector crawling.

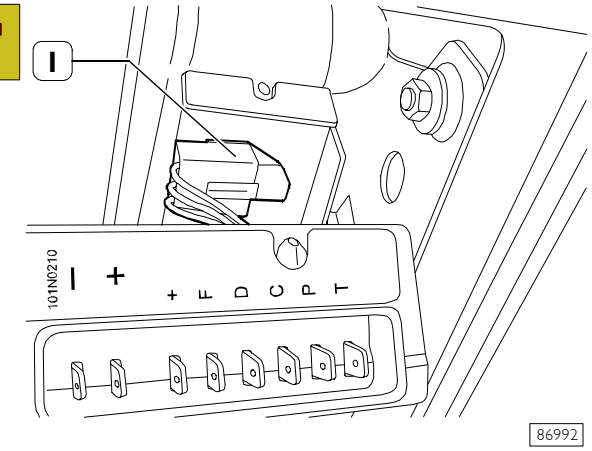
Electronic control unit disassembling

Figure 131



Disconnect all electric cables (1) from the control unit. Take out electronic circuit (2). Remove screw (3).

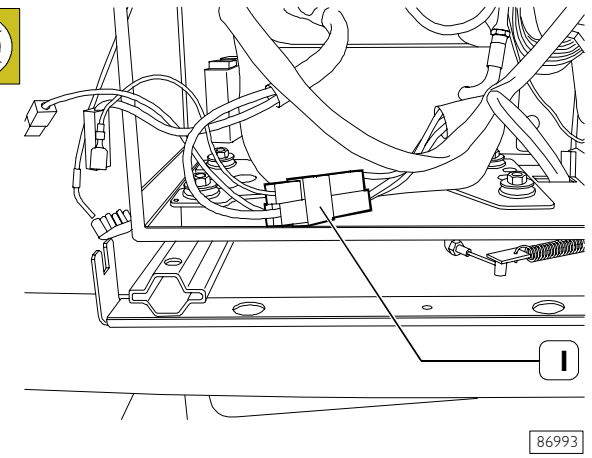
Figure 132



Move the control unit aside, then take connector (1) out of the compressor.

Checks

Figure 133



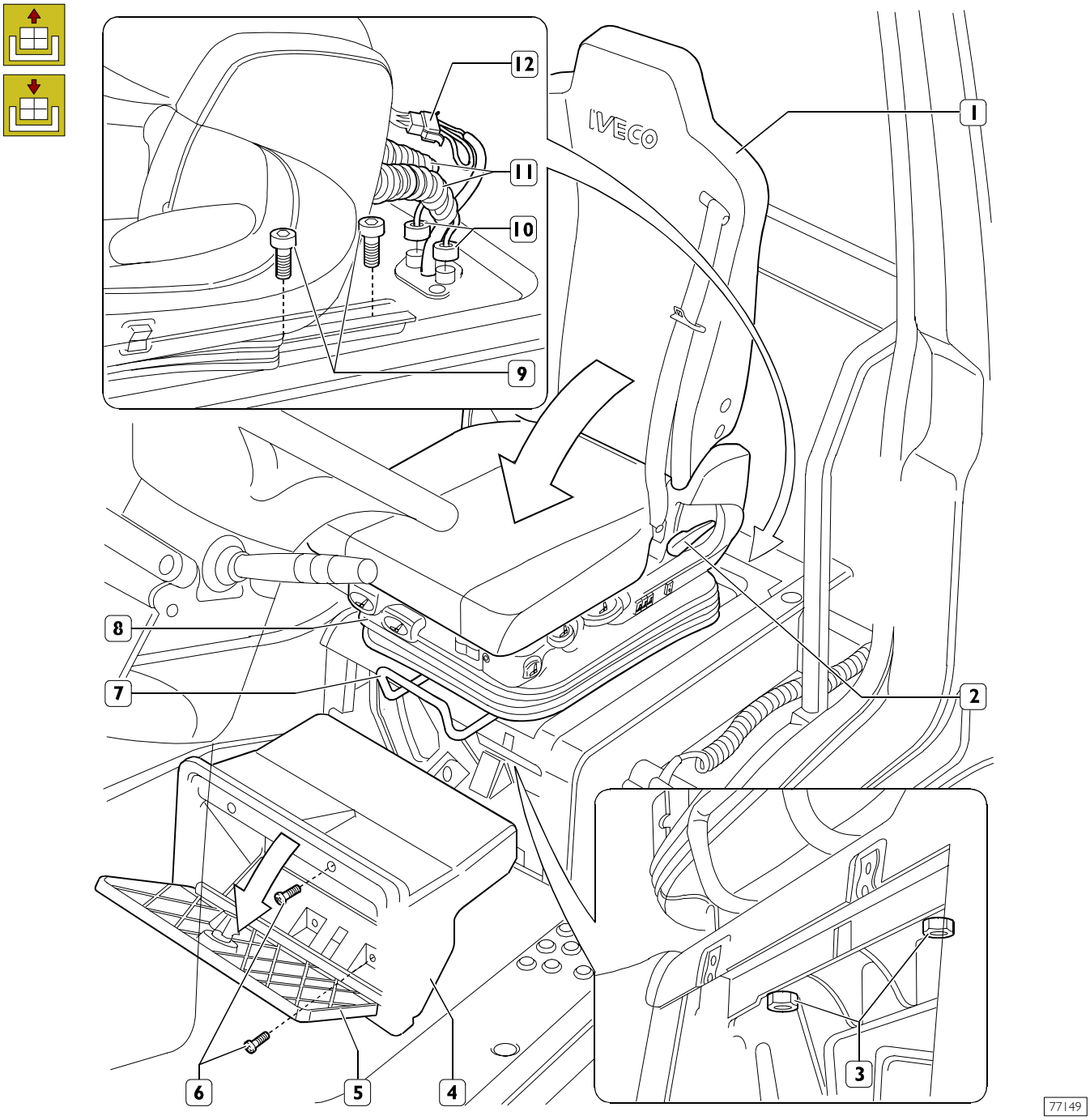
Check proper tightening of connector (1) for connection with the front switch.

Fitting

Assembling is carried out by reversing the order of disassembling operations.

DRIVER'S SEAT

Figure 134



Removal

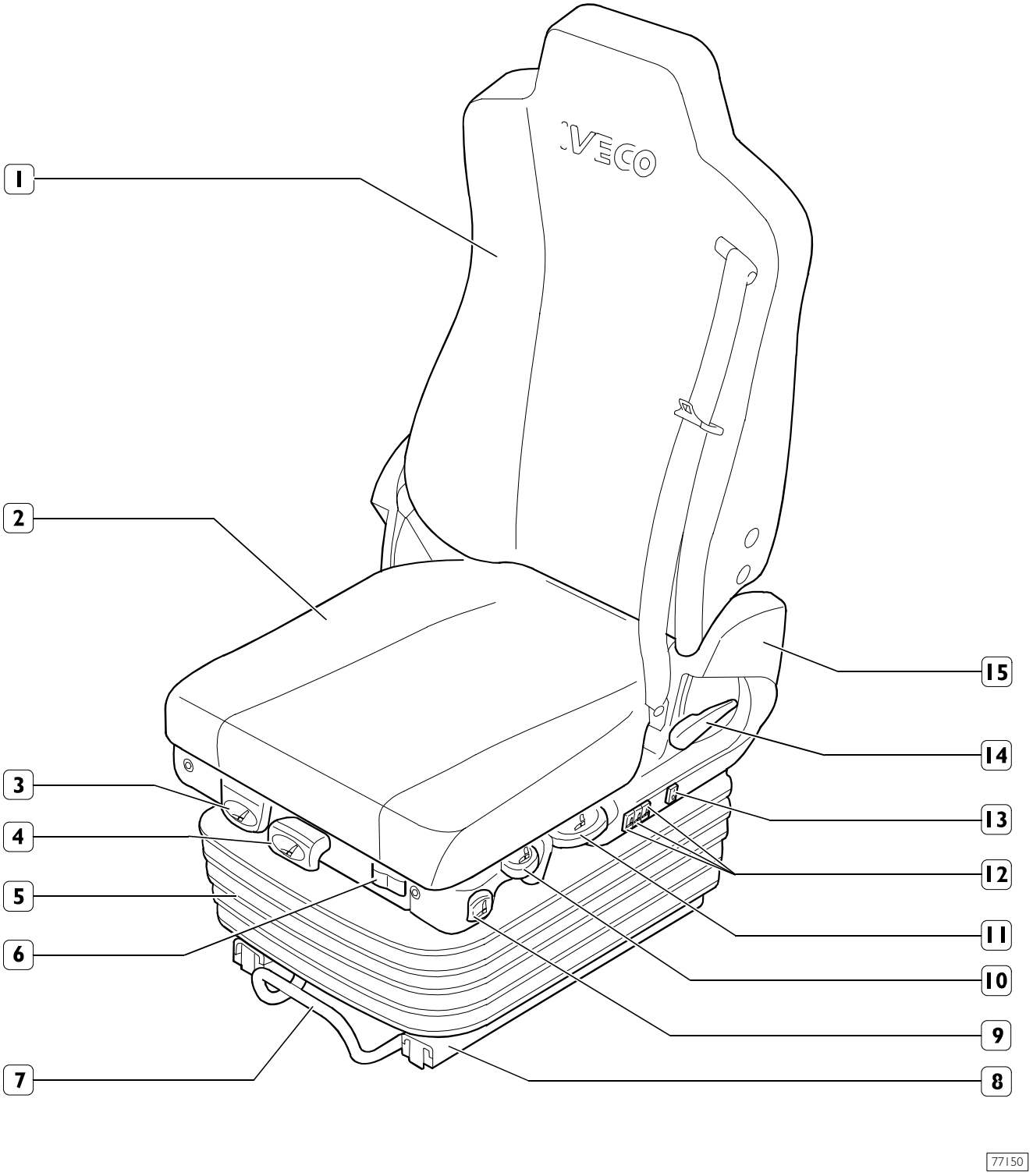
Open the door (5) of the glove compartment (4).
Unscrew the fixing screws (6) and remove the glove compartment (4) from the vehicle.
Operate the lever (7) and bring the seat (8) into the "all forward" position.
Operate the lever (2) and tilt the back (1).
Undo the quick couplings (10) and detach the air pipes (11).
Disconnect the electric system connector (12).
Unscrew the fixing nuts (3) and screws (9) and remove the seat (8) from the vehicle.

Refitting

Refit by carrying out the procedures described for removal in reverse order.

Component layout

Figure 135

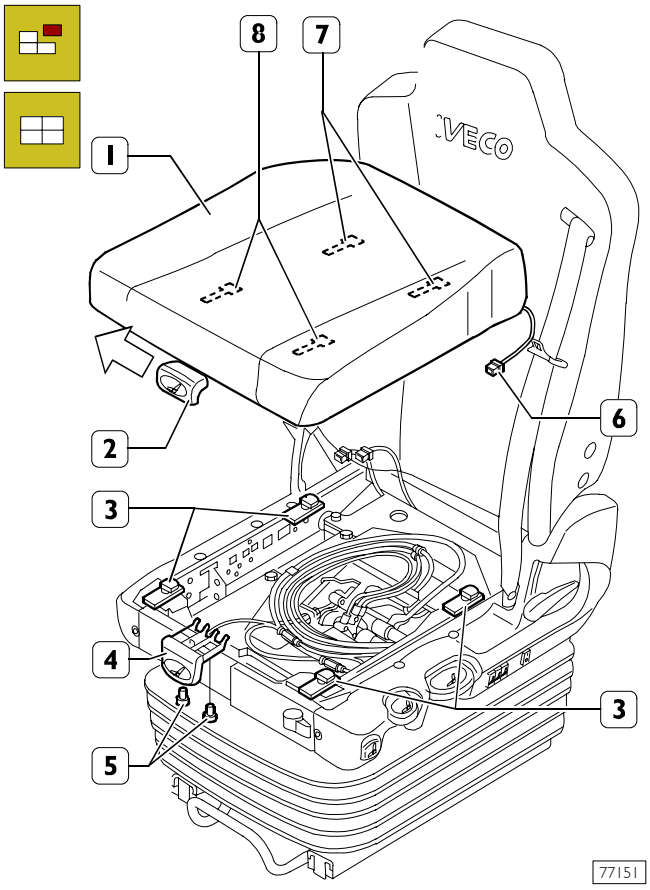


1. Back - 2. Cushion - 3. Seat tilt adjustment - 4. Cushion depth adjustment - 5. Bellows - 6. Horizontal spring - 7. Horizontal adjustment - 8. Guides - 9. Lowering seat - 10. Adjusting the vertical shock absorber - 11. Adjusting the seat height - 12. IPS pneumatic lumbar support - 13. Seat heating - 14. Back adjustment - 15. Upholstery.

REMOVING THE DRIVER'S SEAT

Removing-fitting the cushion

Figure 136



Removal

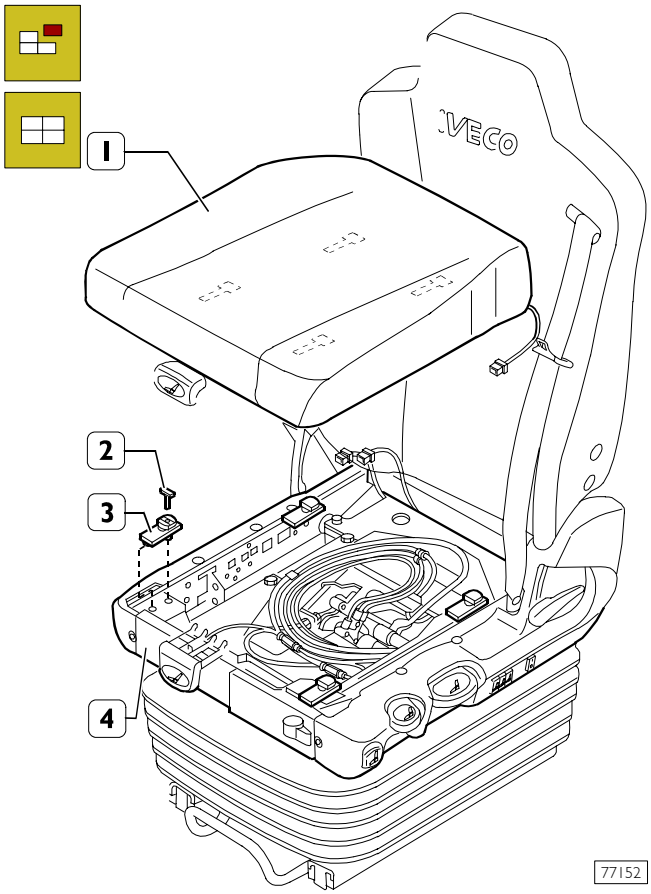
- ❑ Lift the lever (1) for adjusting the cushion depth.
- ❑ Arrange the cushion (1) in its head position.
- ❑ Keep the lever (2) in the top position and push in the direction of the arrow.
- ❑ Move the cushion (1) of the seat forward and lift it.
- ❑ Disconnect the electrical connection (6) of the seat.
- ❑ Unscrew the screws (5) fixing the seat tilt adjustment lever (4).
- ❑ Detach the cushion (1) from the seat.

Fitting

- ❑ Push the lever (2) in the direction of the arrow.
- ❑ Position the cushion (1) on the sliders (3) at the rear, grooves (7), push the seat cushion (1) downwards, grooves (8).
- ❑ Push the cushion (1) in the direction of the back.

Removing-fitting the cushion slider

Figure 137



Removal

Remove the cushion as shown alongside.

Extract the plastic pin (2) and push out the slider (3).

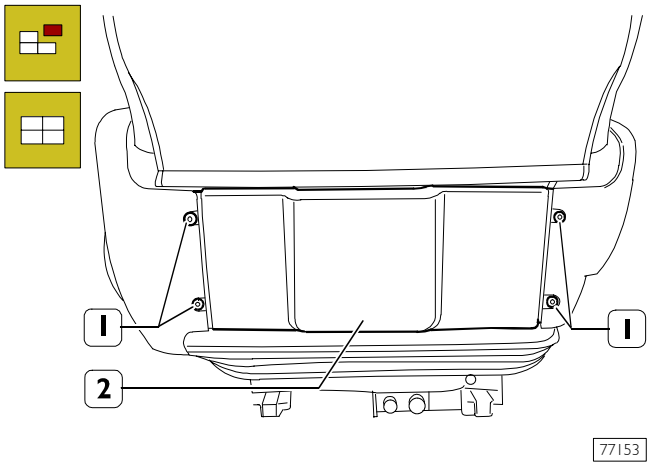
Fitting

Fit the slider (3) onto the frame (4) of the seat

Insert the pin (2) in the seat of the slider (3).

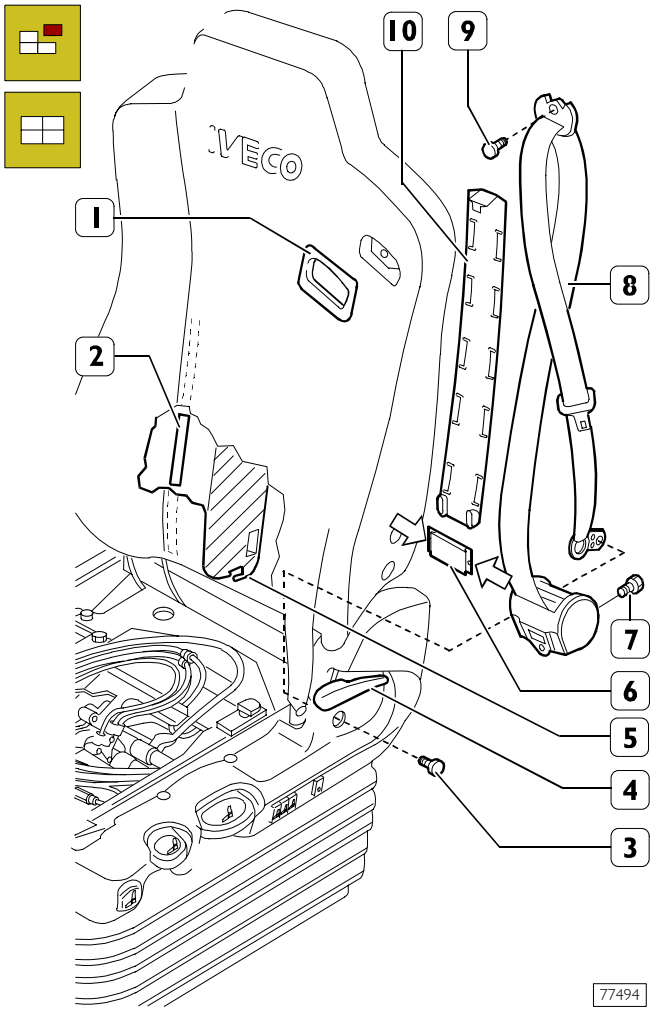
Removing-fitting the seatbelt

Figure 138



- ❑ Detach the seat cushion as described above.
- ❑ Unscrew the fasteners (1) and remove the rear upholstery (2) of the back.

Figure 139



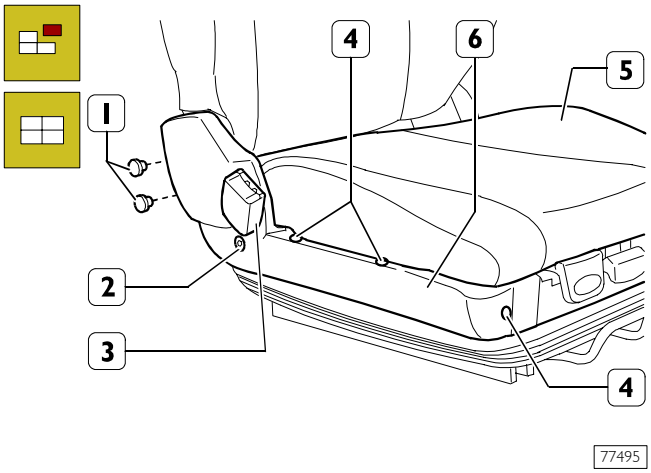
- ❑ Lift the back adjustment lever (4) and unscrew the screw (3) fixing the seatbelt hook.
- ❑ Unscrew the screw (9) fixing the top of the seatbelt and take off the facing (1).
- ❑ Unhook the sections (5) and lift the back upholstery off the fixing tapes (2) (Velcro),
- ❑ Remove the retainer (6) of the plastic guide (10) acting in the direction of the arrows.
- ❑ Unscrew the screw (7) fixing the reel and remove the seatbelt (8) from the seat.

Fitting

- ❑ For fitting, carry out the steps performed for removal in reverse order.

Removing-fitting seatbelt connection and right-hand side upholstery

Figure 140



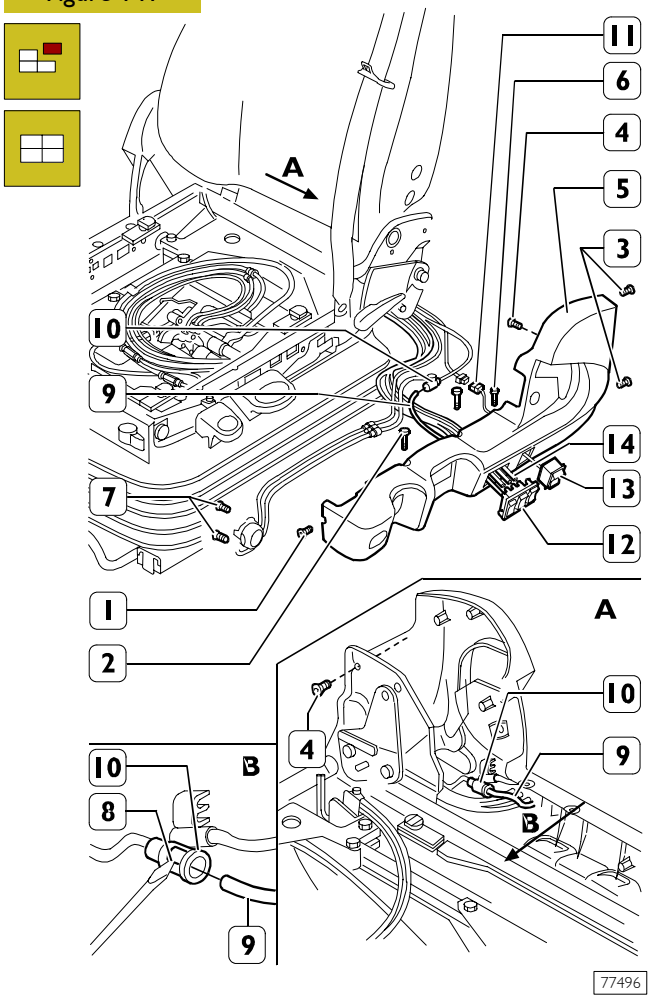
- ❑ Position the cushion (5) forwards.
- ❑ Unscrew the screws (4) fixing the upholstery (6) and the press-on caps (1).
- ❑ Unscrew the screw (2) and remove the belt connection (3) and the side upholstery (6).

Fitting

- ❑ For fitting, carry out the steps performed for removal in reverse order.

Removing - fitting the left-hand side upholstery, IPS valve and heating switch

Figure 141



Removal

- ❑ Remove the seat cushion as described above.
- ❑ Unscrew a screw (1), two screws (2) and two pins (3).
- ❑ Fold the back fully forwards and unscrew the screw (4).
- ❑ Remove the side upholstery (5) from the seat framework.
- ❑ Unscrew a screw (6) and two screws (7).
- ❑ Lift the fixing hook (8) safely and fit the air pipe (9) from the connector (10) (see detail A, B).
- ❑ Separate the electric connector (11).
- ❑ Push the valve (12) and the switch (13) outside the upholstery (5).
- ❑ Disconnect the hoses (14) from the valve (12).

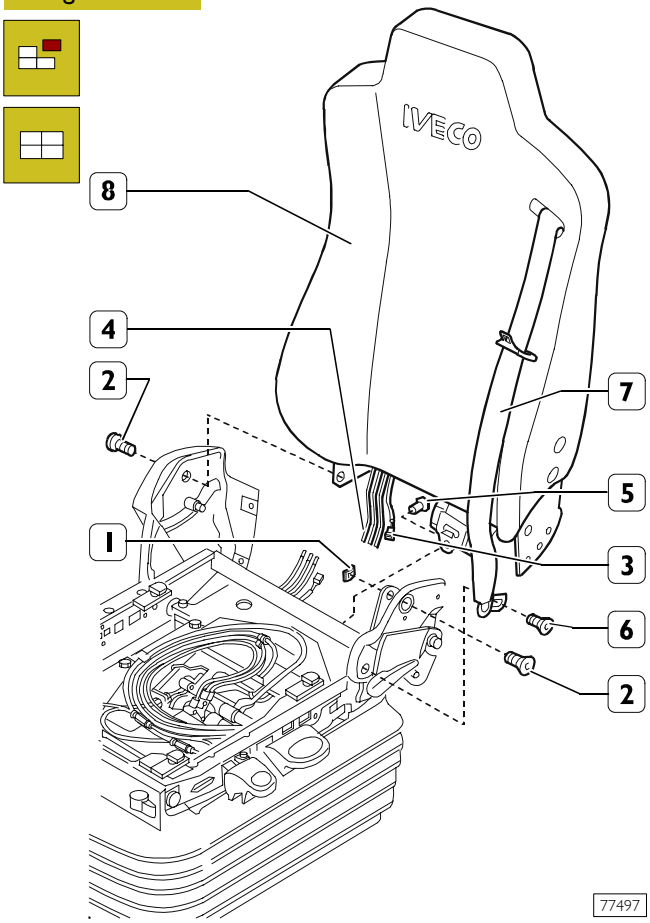
NOTE Mark the hoses to facilitate assembly.

Fitting

- ❑ For fitting, carry out the steps performed for removal in reverse order.

Removing - fitting the back

Figure 142



Removal

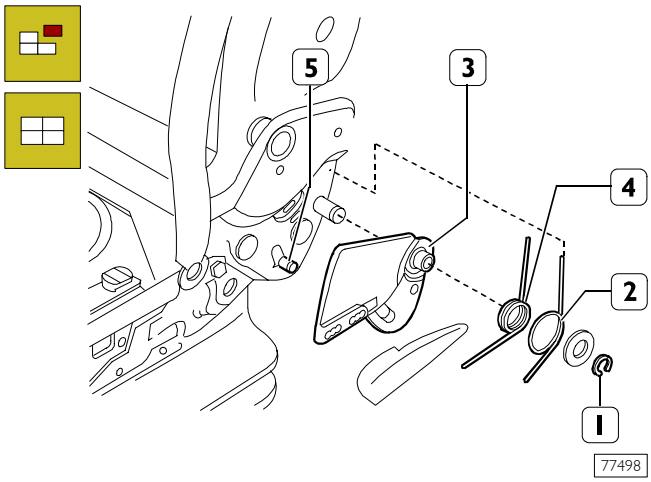
- ❑ Remove the seat cushion as described above.
- ❑ Take off the side upholstery.
- ❑ Remove the safety lock (1).
- ❑ Unscrew the screws (2) fixing the back (8).
- ❑ Disconnect the connector (3) and three air hoses (4) if applicable.
- ❑ Unscrew the screw (5) fixing the seatbelt reel and the screw (6) fixing the seatbelt (7).
- ❑ Remove the back (8) from the seat,

Fitting

- ❑ For fitting, carry out the steps performed for removal in reverse order.

Removing - fitting the back adjustment lever

Figure 143



Removal

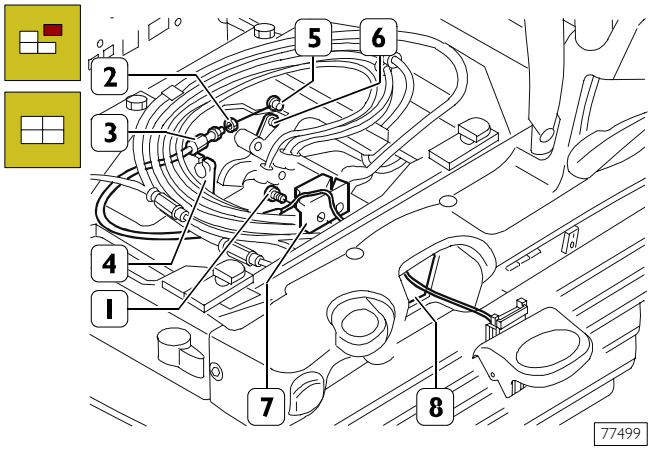
- ❑ Remove the seat cushion and the left-hand side upholstery as described above.
- ❑ Remove the safety washer (1).
- ❑ Remove the spring (2) at the lever (3).
- ❑ Remove the spring (4) from the pin (5).
- ❑ Remove the lever (3).

Fitting

- ❑ For fitting, carry out the steps performed for removal in reverse order.

Removing - fitting the height adjustment device

Figure 144



Removal

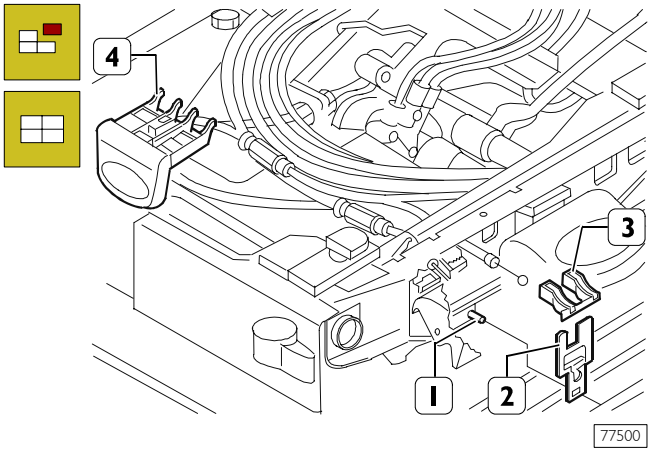
- ❑ Remove the seat cushion as described above.
- ❑ Unscrew the fixing screws (1), loosen the nut (2) and remove the flexible cable (3) from the fixing (4).
- ❑ Free the threaded coupling of the cable (5) from the lever (6).
- ❑ Push the flexible cable out of the mount (7) and extract through the opening (8).

Fitting

- ❑ For fitting, carry out the steps performed for removal in reverse order.

Removing - fitting the seat angle adjustment device

Figure 145



Removal

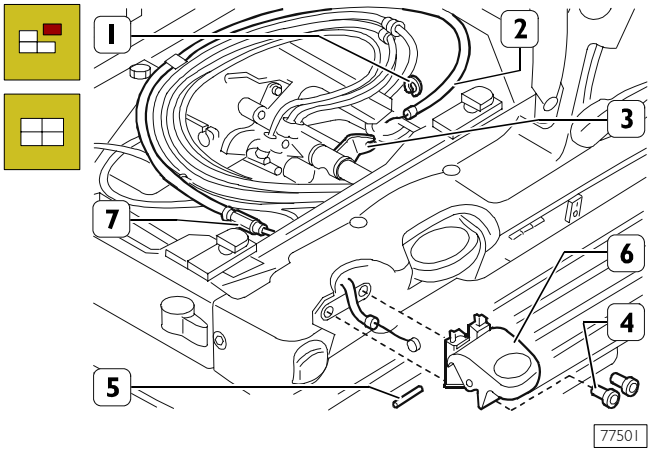
- ❑ Remove the seat cushion and the left-hand side upholstery as described above.
- ❑ Free the pin (1) from the lever (2).
- ❑ Remove the lever mount (3) from the seat framework.
- ❑ Loosen the flexible cable from the lever (2).
- ❑ Remove the seat adjustment device (4) from the seat.

Fitting

- ❑ For fitting, carry out the steps performed for removal in reverse order.

Removing - fitting the flexible cable of the shock absorber adjustment device

Figure 146



Removal

- ❑ Remove the seat cushion as described above.
- ❑ Remove the supporting washer (1) and the flexible cable (2) of the lever from the fixing system (3).
- ❑ Unscrew the screws (4).
- ❑ Extract the pin (5) from the lever (6).
- ❑ Extract the flexible cable (2) from the seat framework.

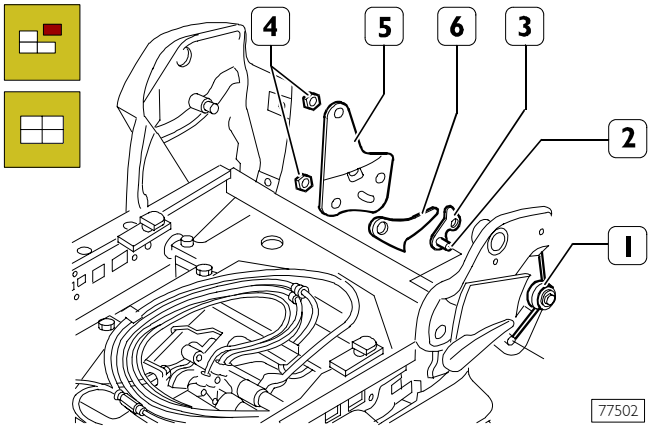
Fitting

NOTE Before fitting the seat cushion, loosen the locking nut (7), adjust the flexible cable (2) so that in the lowest position of the adjustment lever, the stiffest vertical damping is reached, then retighten the locking nut.

❑ For fitting, carry out the steps performed for removal in reverse order.

Removing – fitting the back adjustment lever segment

Figure 147



Removal

❑ Remove the seat cushion, left-hand side upholstery and the back as described above.

❑ Loosen the spring (1) at the pin (2) of the lever (3).

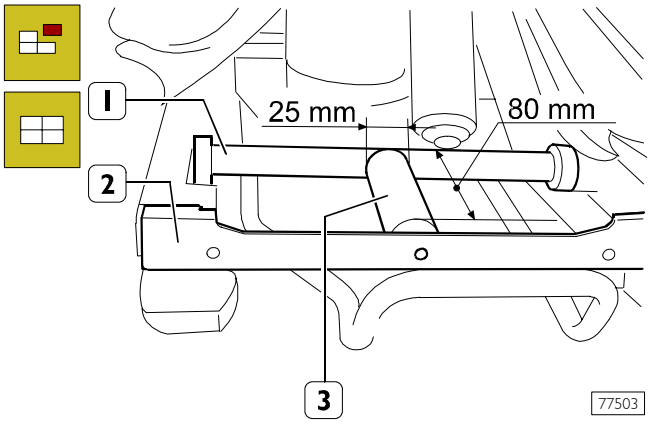
❑ Unscrew the nuts (4) and remove the plate (5), the toothed segment (6) and the lever (3).

Fitting

❑ For fitting, carry out the steps performed for removal in reverse order.

Removing - fitting the air spring

Figure 148



Removal

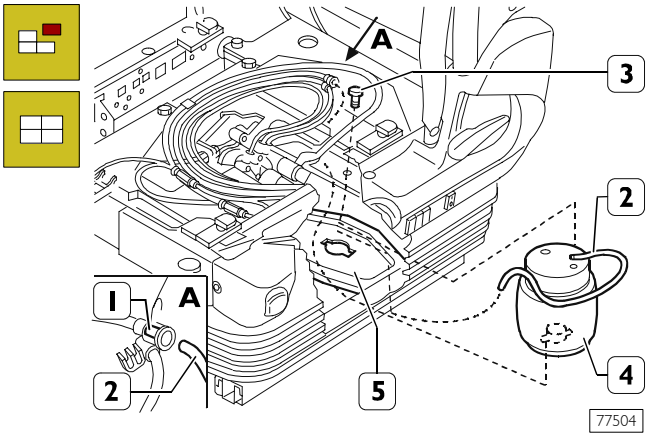
❑ Remove the seat cushion as described above.

❑ Take out the bottom bellows fastener.

❑ Fix the suspension assembly (1) in the highest position, use a special tool (3) of the dimensions shown in the figure.

❑ Insert the tool (3) between the frame (2) and the suspension (1) of the seat.

Figure 149



❑ Lift the fixing hook (1) safely and remove the air pipe (2) as shown in the box.

❑ Unscrew the screw (3) and loosen the shock-absorber fixing and move the air spring toward the front.

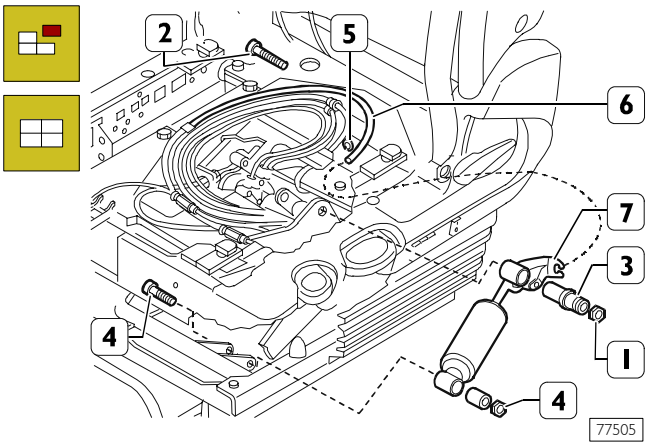
❑ Turn the air spring (4) by 90 degrees and remove it from the bottom mount (5).

Fitting

For fitting, carry out the steps performed for removal in reverse order.

Removing - fitting the shock absorber

Figure 150



Removal

❑ Remove the seat cushion as described above.

❑ Take out the bottom bellows fastener.

❑ Move the suspension assembly into its lowest position.

❑ Unscrew the nut (1), take out the screw (2) and remove the socket (3).

❑ Position the suspension assembly in its highest position (use tool (3), Figure 148).

- ❑ Unscrew the bottom shock absorber fastener (4).
- ❑ Remove the supporting washer (5) and the flexible cable of the lever (6) out of the fastener (7).

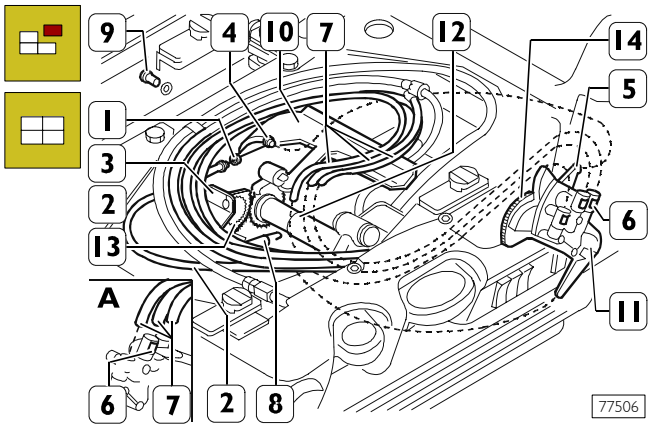
Fitting

NOTE Before fitting the seat cushion, loosen the locking nut (8), adjust the flexible cable (6) so that in the lowest position of the adjustment lever, the stiffest vertical damping is reached, then retighten the locking nut. (8).

- ❑ For fitting, carry out the steps performed for removal in reverse order.

Removing - fitting the height adjustment valve

Figure 151



Removal

- ❑ Remove the seat cushion, as described above.
- ❑ Unscrew the nut (1), remove the flexible cable (2) from the fixing (3) and pull the cable with the threaded coupling (4) out of the valve lever (5).
- ❑ Lift the fixing hooks (6) safely and remove the air pipes (7) (see box A).
- ❑ Unhook the spring (8), extract the bottom bellow fastener, unscrew the screw (9) and turn the bracket (10) upward.
- ❑ Turn the valve (11) on the supporting pipe and pull it above the end of the supporting pipe (12).

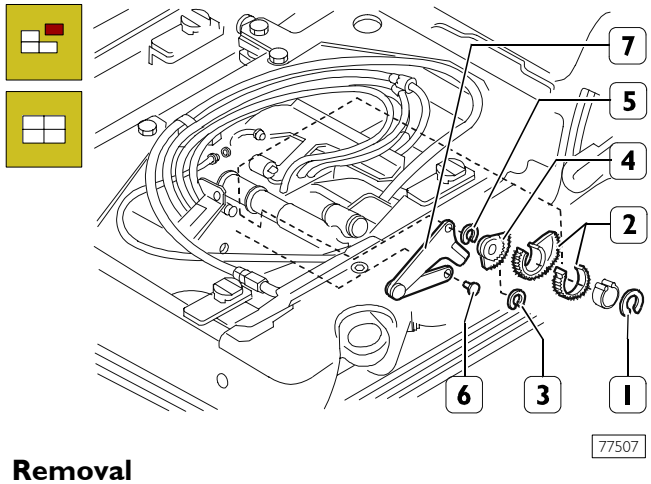
Fitting

- ❑ For fitting, carry out the steps performed for removal in reverse order.

NOTE After fitting the new valve, the highest tooth of the toothed segment (13) must adapt to the width of the highest space of the toothed segment of the valve (14).

Removing - fitting the height locking system

Figure 152



Removal

- ❑ Remove the seat cushion, as described above.
- ❑ Remove the height adjustment valve.
- ❑ Unscrew the supporting washer (1) and remove the toothed segments (2).
- ❑ Unscrew the supporting washer (3) and remove the toothed segments (4).
- ❑ Unscrew the supporting washer (5) and unscrew the screw (6) and remove the lever (7).

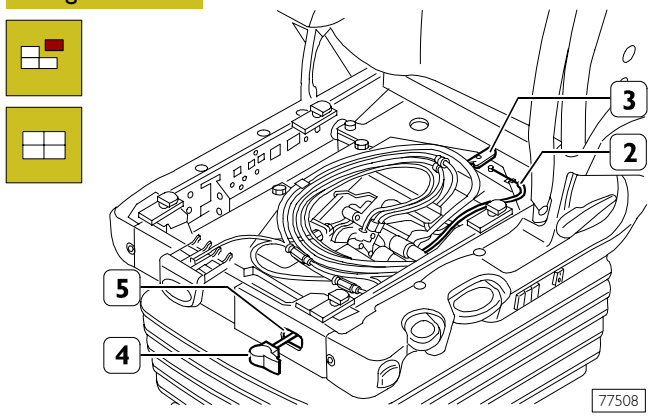
Fitting

- ❑ For fitting, carry out the steps performed for removal in reverse order.

NOTE After fitting the new parts, the highest tooth of the toothed segment (2) must adapt to the width of the highest space of the toothed segment of the valve (4).

Removing - fitting the flexible cable of the horizontal lever suspension

Figure 153



Removal

- ❑ Remove the seat cushion, as described above.

❑ Unhook the cable (2) from the lever (3).

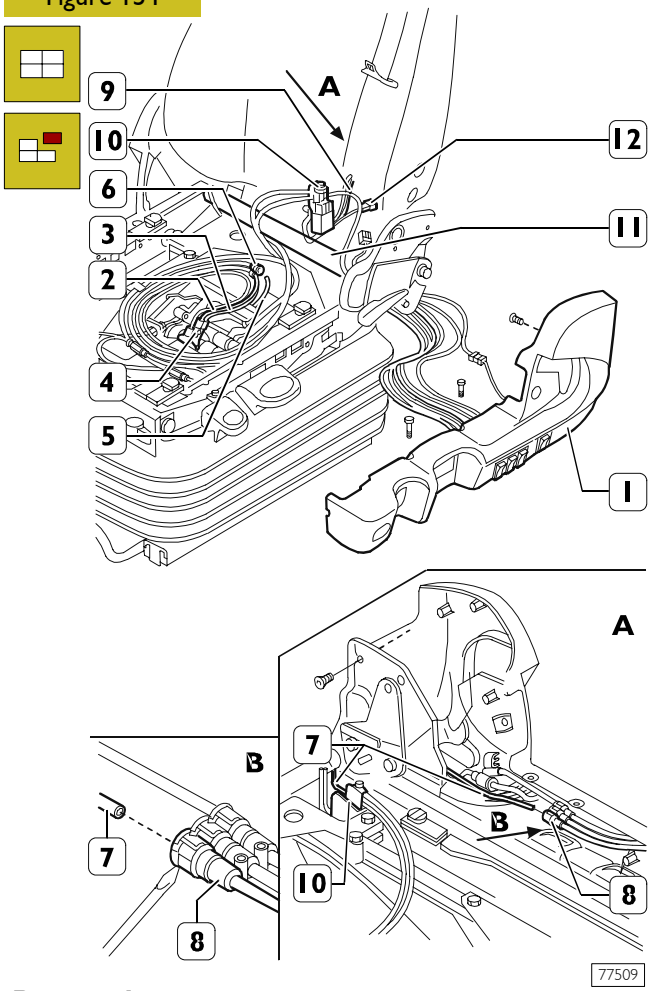
❑ Extract the flexible cable (2) comprehensive of the lever (4) from the opening (5).

Fitting

❑ For fitting, carry out the steps performed for removal in reverse order.

Removing - fitting the fast lowering magnetic valve

Figure 154



Removal

❑ Remove the seat cushion, as described above.

❑ Loosen the plastic covering (1) as described above.

❑ Disconnect the hoses (2) and (3) from the valve (4), the hose (5) from the coupling (6) and the hose (7) from the coupling (8) inside the plastic covering (1) (box A/B).

❑ Extract the fixing arm (9) of the magnetic valve (10) from the transverse pipe (11) and lift the valve (10).

❑ Disconnect the electric connector (12).

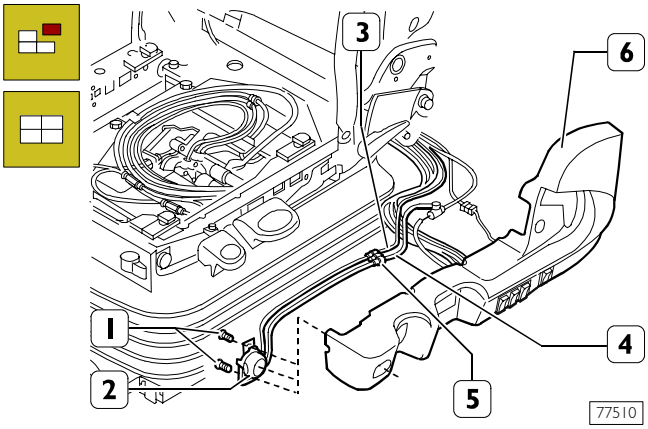
❑ Remove the magnetic valve (10) for fast lowering from its seat.

Fitting

❑ For fitting, carry out the steps performed for removal in reverse order.

Removing - fitting the fast lowering switch

Figure 155



Removal

❑ Remove the seat cushion, as described above.

❑ Loosen the plastic covering (6) as described above.

❑ Disconnect the hoses (3) (4) from the coupling (5).

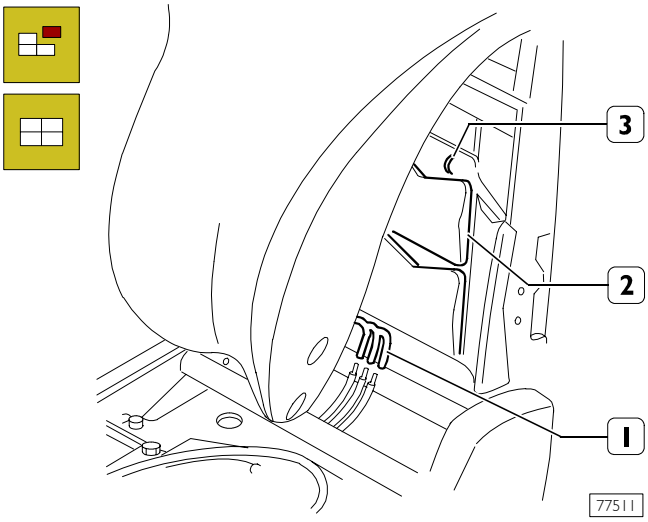
❑ Unscrew the fixing screws (1) and disconnect the switch (2) for fast lowering from its seat.

Fitting

❑ For fitting, carry out the steps performed for removal in reverse order.

Removing - fitting the lumbar support device

Figure 156



Removal

❑ Partially remove the back upholstery.

❑ Loosen the foam part from the frame.

❑ Disconnect the hoses (1).

❑ Detach the retaining clamps (3).

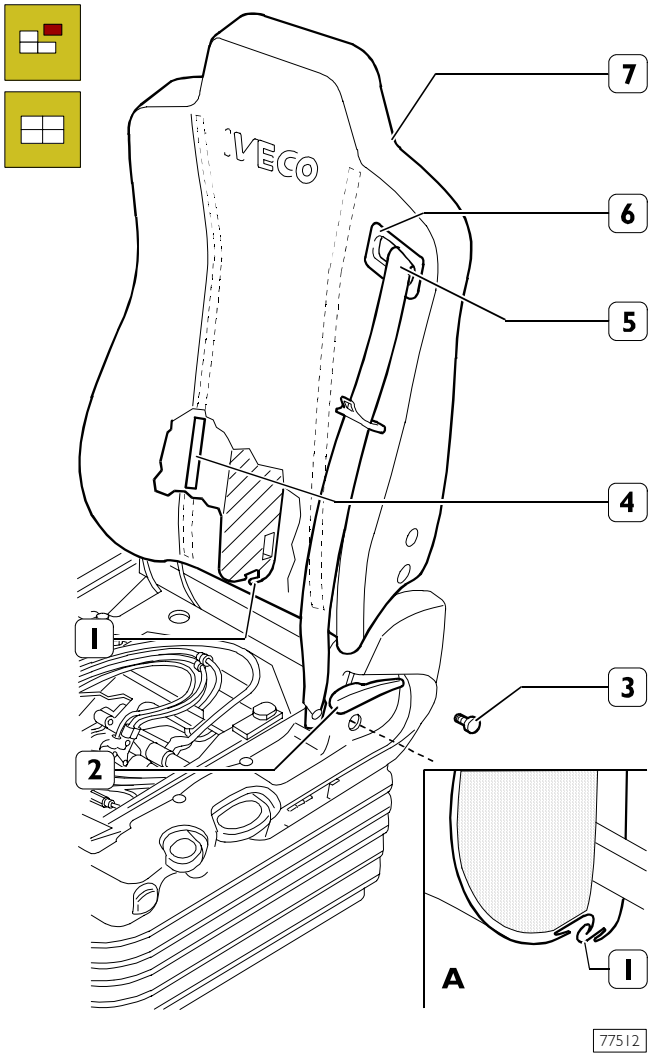
❑ Remove the lumbar support device (2).

Fitting

❑ For fitting, carry out the steps performed for removal in reverse order.

Removing - fitting the back upholstery

Figure 157



Removal

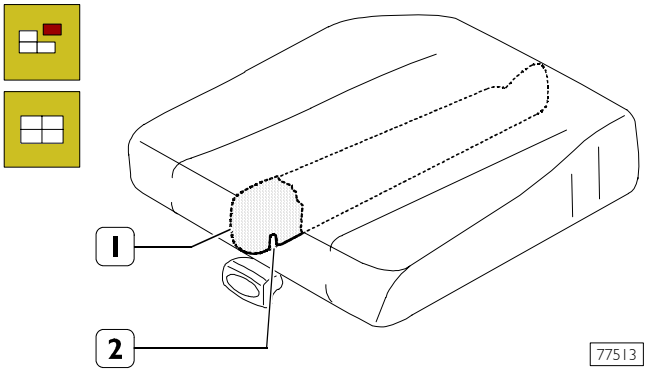
- ❑ Remove the seat cushion, as described above.
- ❑ Unhook the C-sections (1) (box A).
- ❑ Lift the lever (2) and unscrew the screw (3) fixing the seatbelt.
- ❑ Take off the facing (6).
- ❑ Lift the back upholstery (7) upwards off the fixing tapes (4) (Velcro),
- ❑ Extract the seatbelt through the opening (5).
- ❑ Remove the upholstery (7) from the seat.

Fitting

- ❑ For fitting, carry out the steps performed for removal in reverse order.

Removing - fitting the cushion upholstery

Figure 158



Removal

- ❑ Remove the seat cushion, as described above.
- ❑ Free the upholstery of the cushion of the seat (1) from the edging (2) passing along the perimeter of the seat bottom.

Fitting

- ❑ For fitting, carry out the steps performed for removal in reverse order.

CAB AIR-CONDITIONING

General

The purpose of the air-conditioning system is to make the cab comfortable as regards the following parameters:

- temperature and relative humidity of outside air;
- temperature and relative humidity in the cab.

The system subjects the air to thermodynamic transformations that affect its temperature, relative humidity and purity. This is accomplished by:

- **ventilation**, or introducing air taken from the outside (therefore with the temperature and humidity of the surrounding environment) into the cab;
- **air-conditioning**, or cooling and de-humidifying the air, with the possibility of heating it afterwards as preferred so as to change the temperature and humidity in the cab.

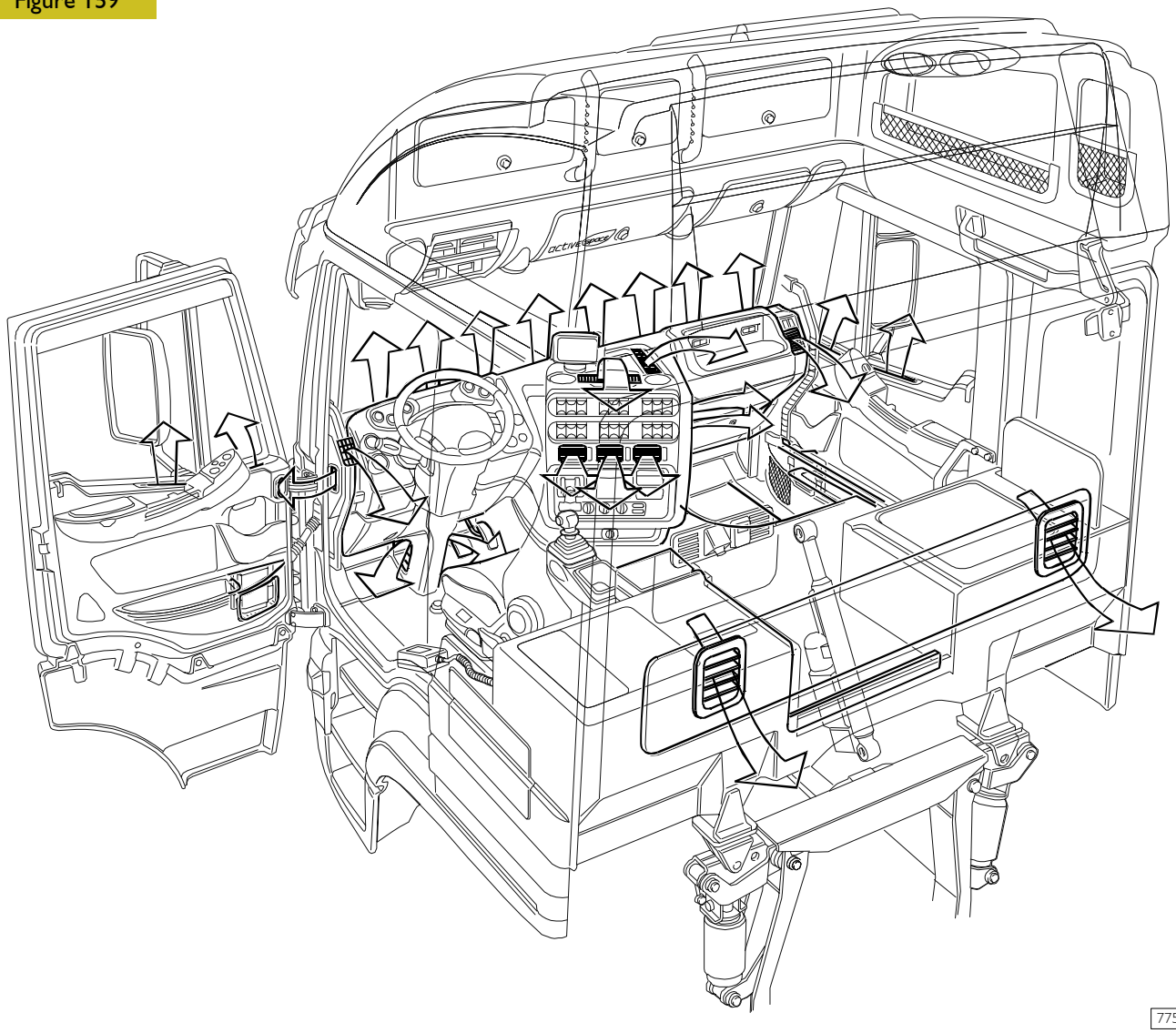
VENTILATION

Description

Ventilation is the function of drawing in fresh air from the outside, cleaned of pollen and dust by a special filter, or recycling the air in the cab.

This system is composed of a shell, designed to house the electric fan unit, air ducts, fresh air intake and recycled air intake. The electric fan has several speeds to draw in and circulate large masses of air.

Figure 159



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CAB INTERNAL VENTILATION DIAGRAM

AIR-CONDITIONING AND HEATING
Description

This is accomplished by integrating an air-conditioning and a heating system.

This integration makes it possible to change the temperature and humidity in the cab.

Air-conditioning

Air-conditioning is accomplished by taking advantage of the high capacity of some gases to lower temperature considerably in their phase of expansion, thereby making it possible to absorb heat from the cab.

This condition is obtained by two different levels of pressure (high, when the refrigerant fluid is in its liquid state, and low, when the fluid is in its gaseous state) that are established and maintained during operation of the system.

Heating

Heating is accomplished by a radiator, in the heater unit, in which the engine coolant circulates.

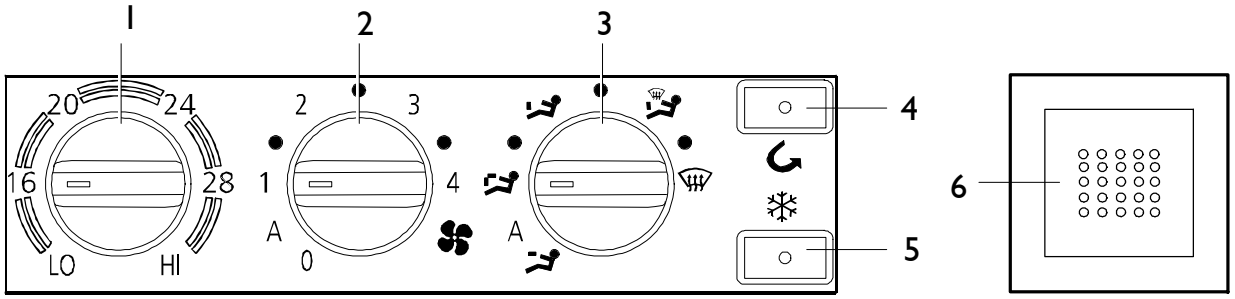
Special doors allow air to pass through the radiator only when the heating function is activated.

The main components of the air-conditioning and heating system comprise:

- ❑ compressor;
- ❑ condenser;
- ❑ the dehumidifier filter (incorporated in the condenser);
- ❑ three-level pressure switch;
- ❑ expansion valve;
- ❑ evaporator;
- ❑ heater/fan unit;
- ❑ pollen filter.

Air-conditioning controls assembly

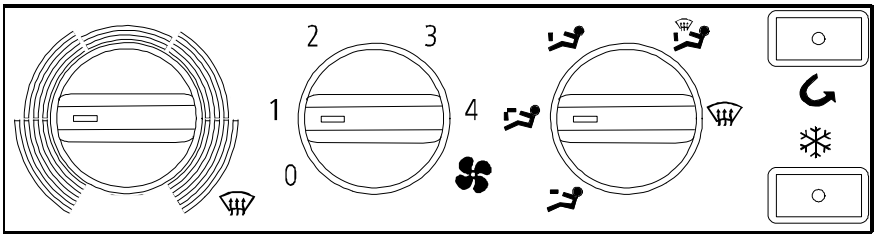
Figure 160



73668b

Automatic

Figure 161



73668c

Manual
Heating and ventilation

1. Air temperature control knob, with extreme positions to cut in the HI and LO functions (max and min air temperature / turn to the left for fresh air – turn to the right for warm air).
2. Electric fan knob with relative working speeds and operation selection;

- off (0);
- automatic operation (A);
- manual operation (1-2-3-4).

3. Air inlet control knob:

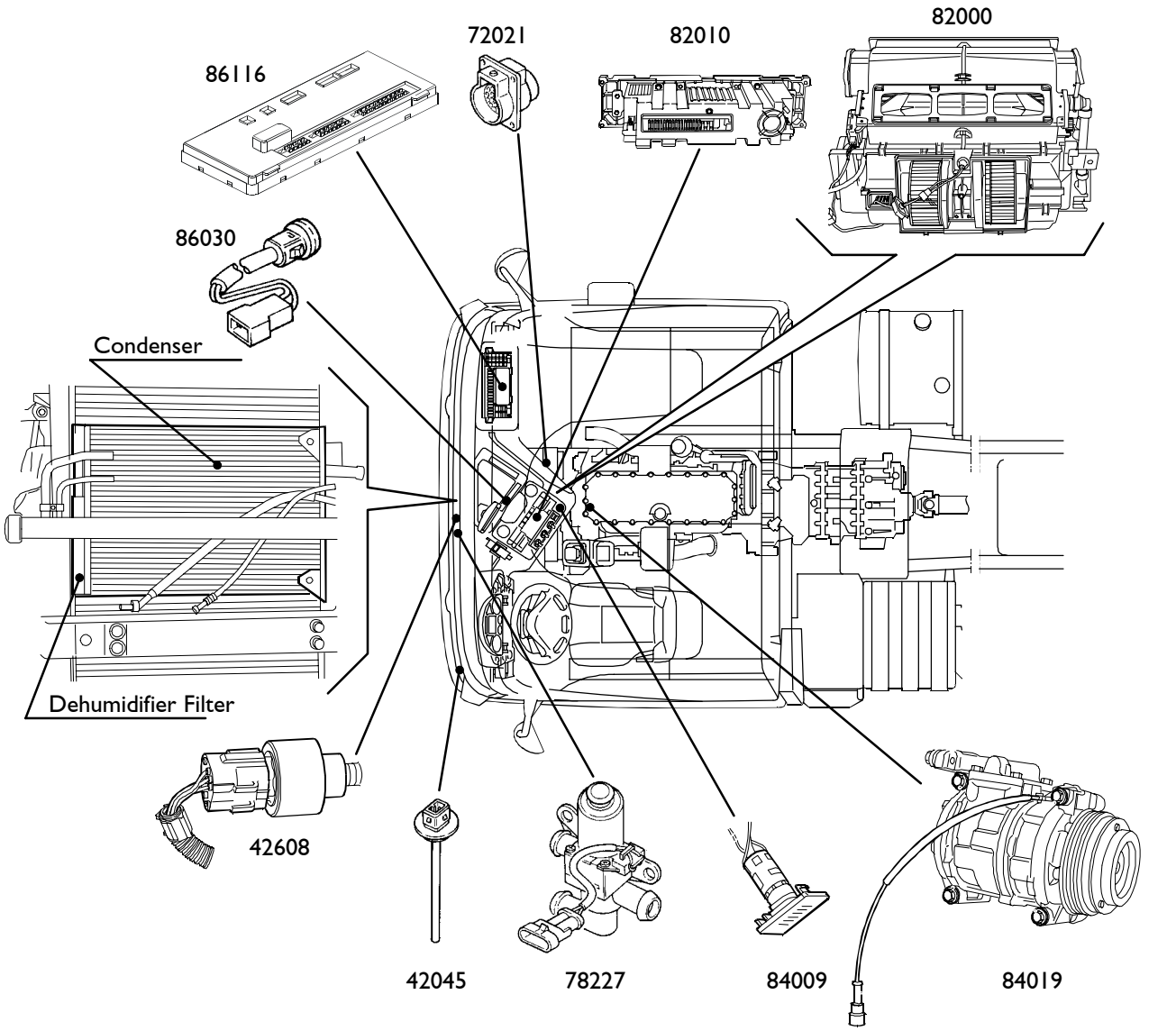
A automatic operation;

- ❑ face zone air;
- ❑ face and feet zone air;
- ❑ feet zone air;
- ❑ feet and windshield zone air;
- ❑ windshield zone air.

4. Switch to turn on air recirculation: it prevents air flowing in from outside.
5. Switch to turn on the air-conditioner.
6. Inside temperature sensor.

COMPONENT LAYOUT (WEBASTO AIR CONDITIONER)

Figure 162

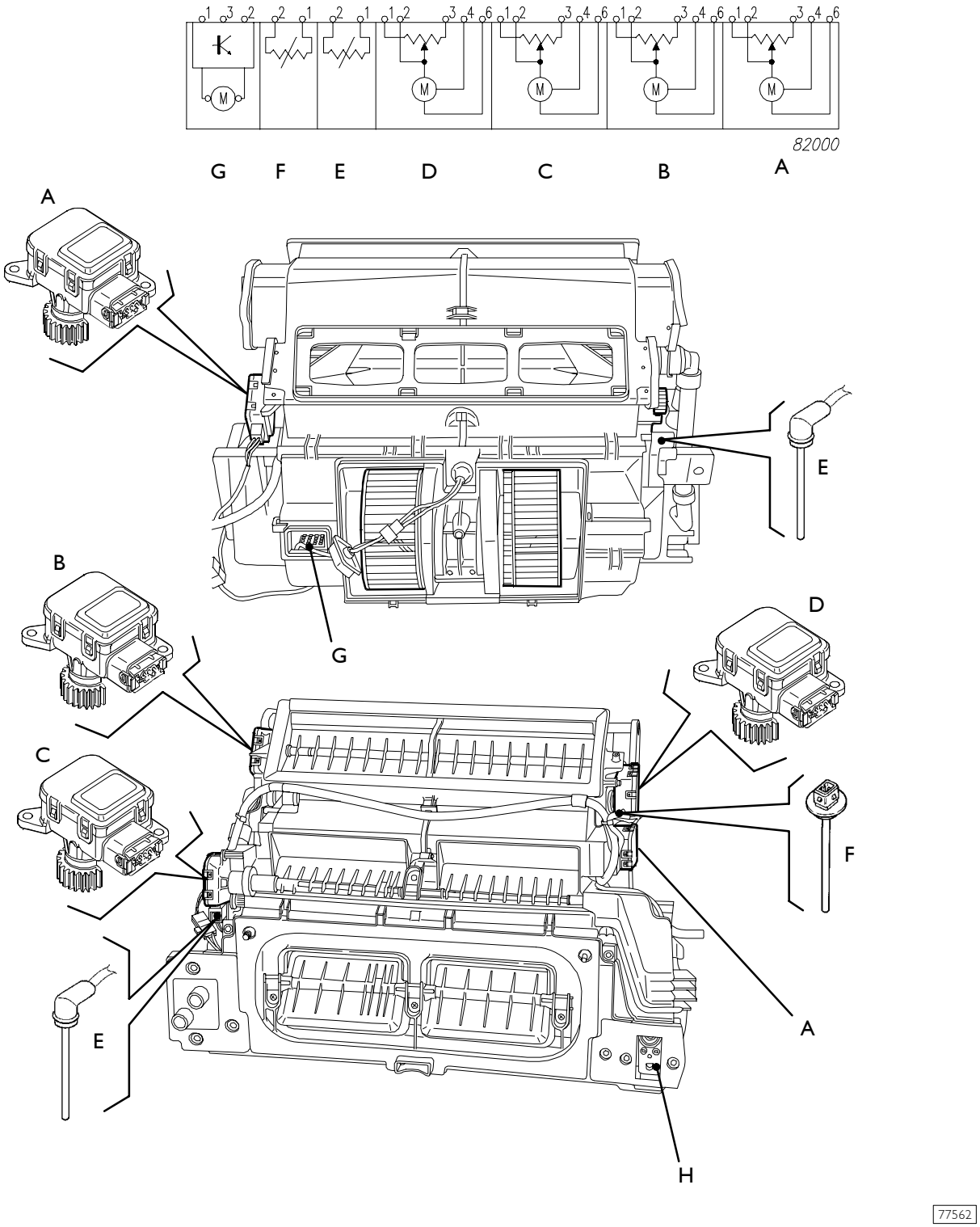


Legend

42045 Outside temperature transmitter
82000 Heater assembly
82010 Electronic air-conditioner control unit
86030 Solar radiation sensor
84009 Inside temperature sensor
42608 Coolant pressure switches
78227 Radiator water recirculation solenoid valve
84019 Compressor
86116 Body Computer
72021 30-pin diagnosis connector

HEATER ASSEMBLY COMPONENT LAYOUT (WEBASTO)

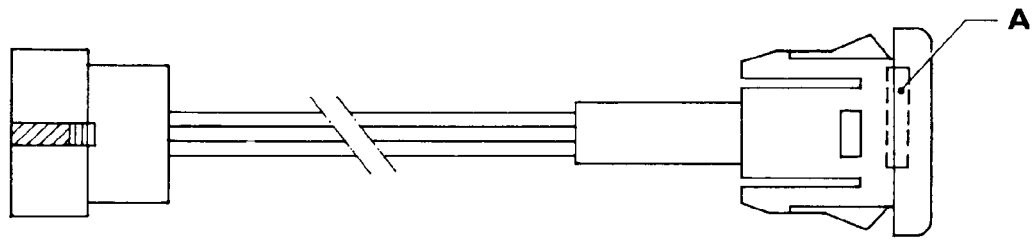
Figure 163



A. Floor geared motor (Floor) - B. Windshield defrosting geared motor (Defrost) - C. Recirculation geared motor (Ric) - D. Mixing geared motor (Mix) - E. Blown air temperature sensor - F. Evaporator temperature sensor - G. Modulates blower control - H. Expansion valve.

MAIN COMPONENTS OF AIR CONDITIONER AND HEATER (WEBASTO)

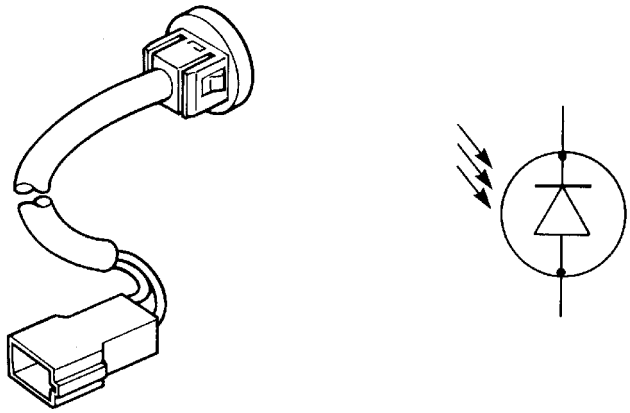
Figure 164



77563

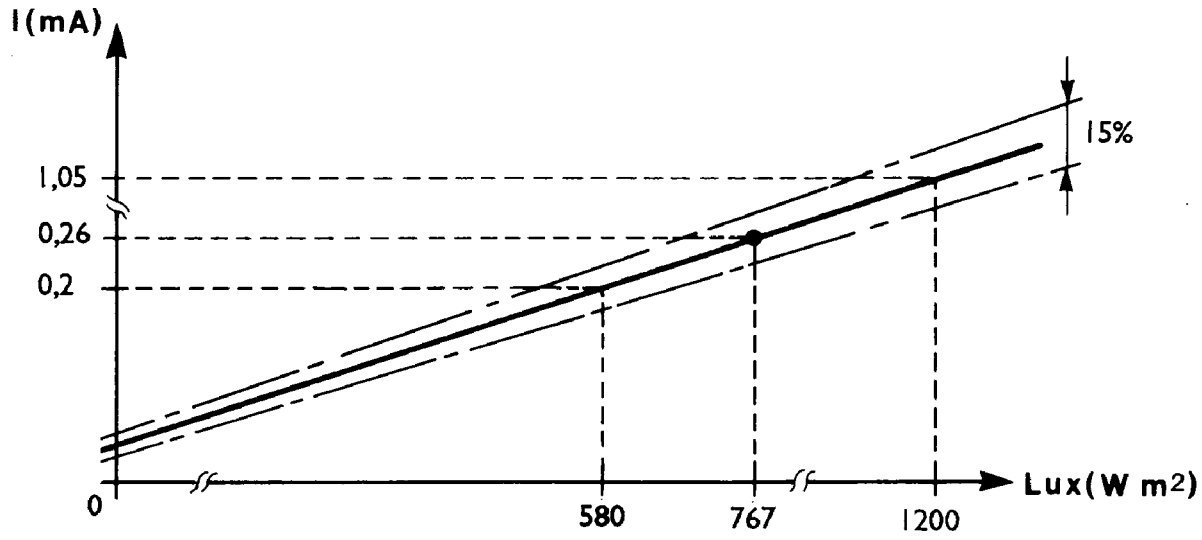
A) Sensor

Figure 165



77564

Figure 166



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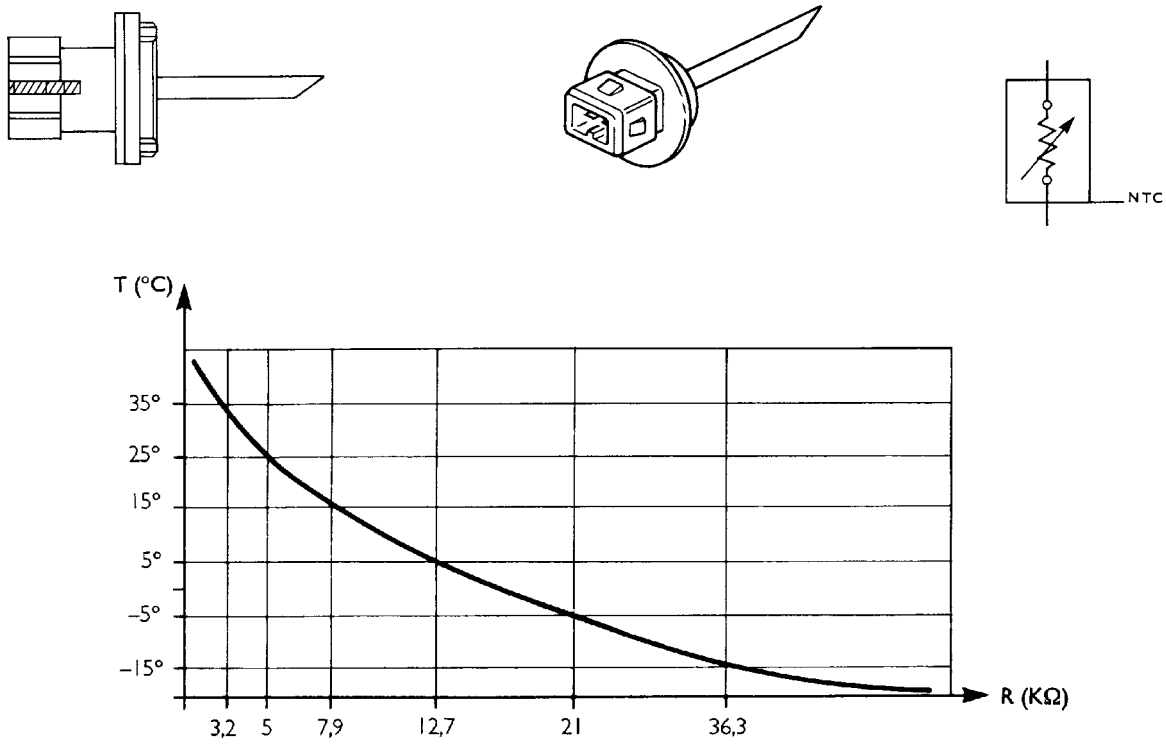
Solar radiation sensor

This sensor is located on the vehicle's dashboard to indicate the intensity of the light the cab receives from the outside.

Outside temperature sensor

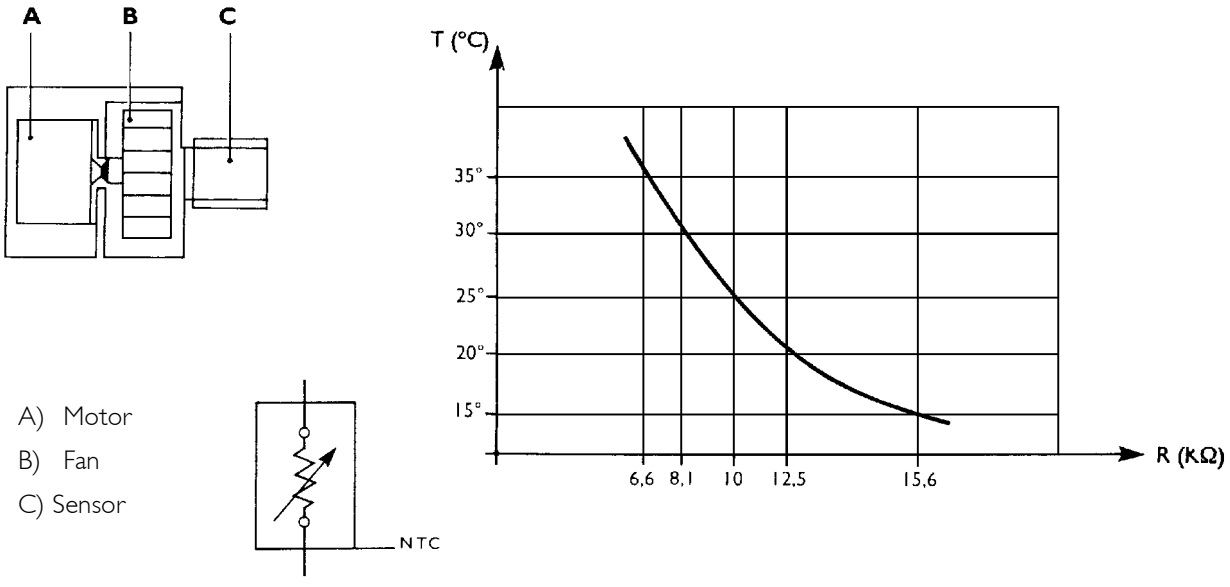
Figure 167



Positioned on the front of the vehicle (driver's side) so as to be affected by a temperature closer to reality.

Inside temperature sensor

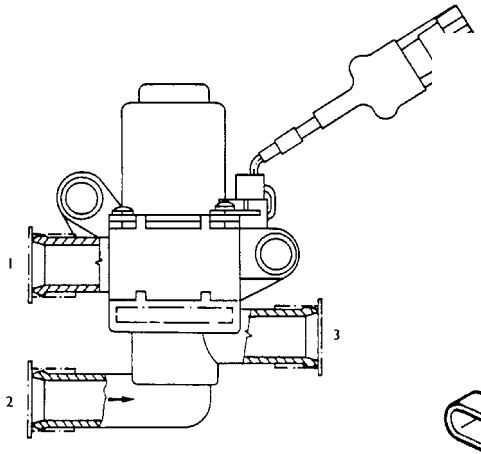
Figure 168



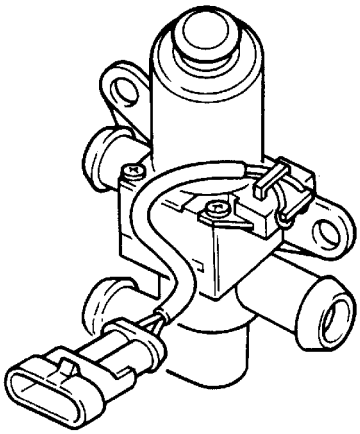
Situated inside the control module (right side) for Valeo and on the side for Webasto, it is ventilated by a motor that lets the air circulate, avoiding wrong temperature measurements between the measured value and that of the cab.

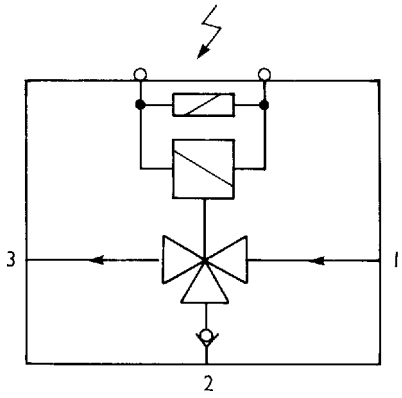
Three-way solenoid valve (WEBASTO)

Figure 169



77568


77569



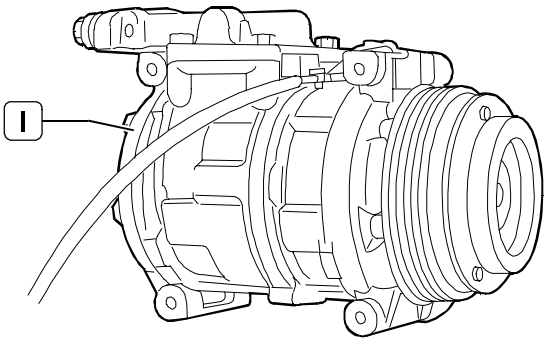
77570

In the WEBASTO air-conditioning system there is only one three-way valve that performs both functions, metering and bypass.

It is supplied by a direct positive from the battery and is governed by the negative supplied by the control unit that controls the work cycle.

Compressor

Figure 170



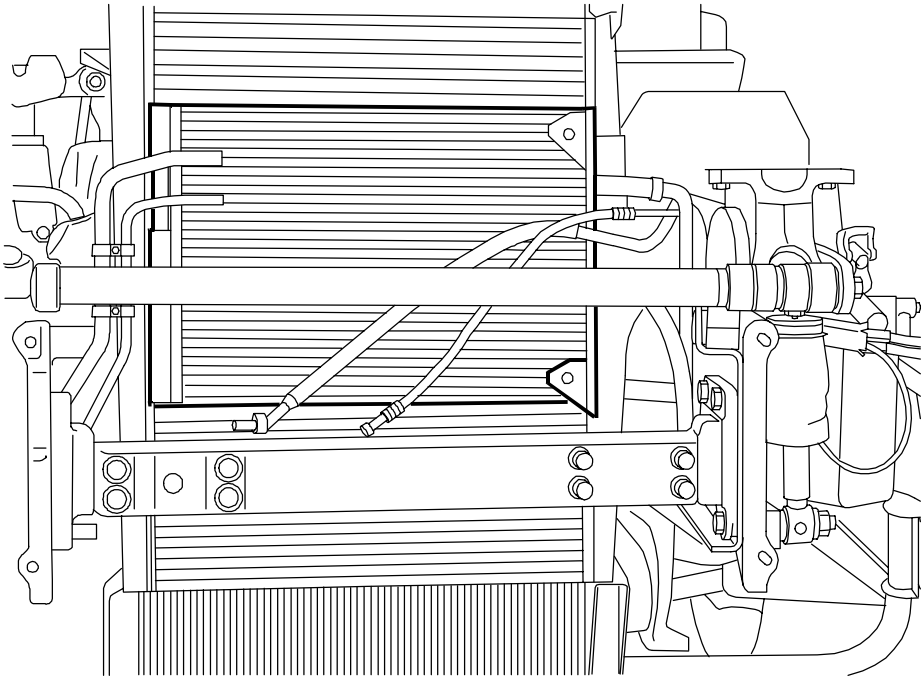
77145

	NIPPONDENSO ND10 PA 17
Fluid refrigerant	R134A
Oil lubricant	ND80
Quantity fluid refrigerant	700g
Quantity oil	40 g.

The compressor is situated in the engine bay between the radiator fan and the alternator.

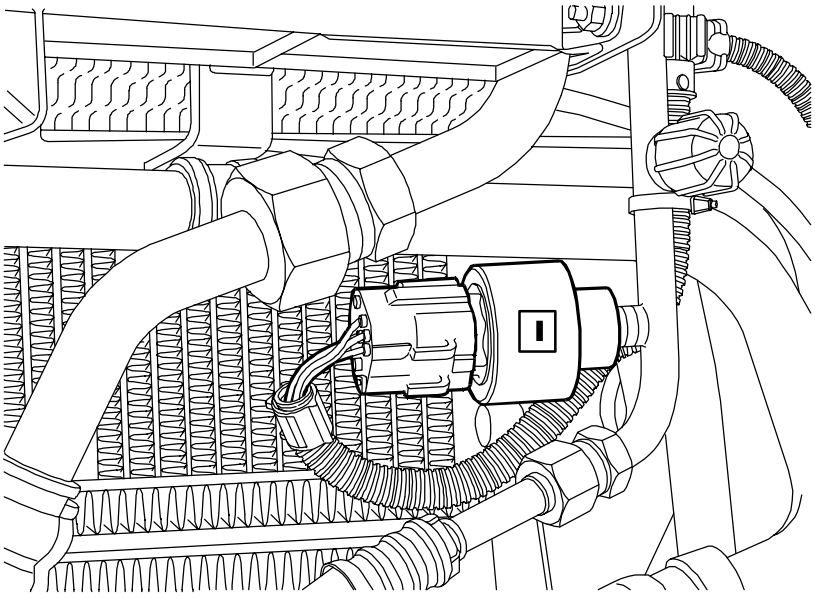
Dehumidifier filter and safety pressure switches

Figure 171

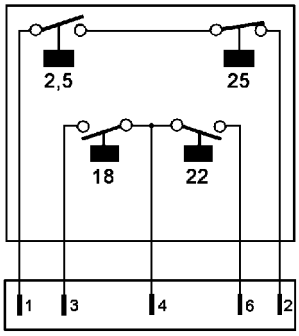


77245

Figure 172



74247



77560

The dehumidifier filter is integrated in the condenser that is found on the front of the vehicle.

The refrigeration system uses R134a fluid highlighted on the plate on its casing.

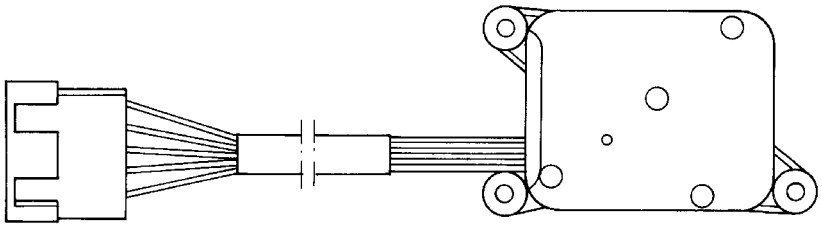
The safety pressure switch assembly with four levels (1) is fitted on the condenser outlet pipe.

The two pressure switches, which are of the N/C and N/O type, make it possible to keep the pressure in the system constant from a minimum of 2.5 (N/O) to a maximum of 25 bars (N/C); with values outside this range the system is deactivated.

Whereas, the two pressure switches of the N/O type are used to disconnect the engine cooling fan coil when the system pressure is in the interval 18 ÷ 22 bars. This is accomplished by an earth signal that the two pressure switches supply to the Body Computer control unit.

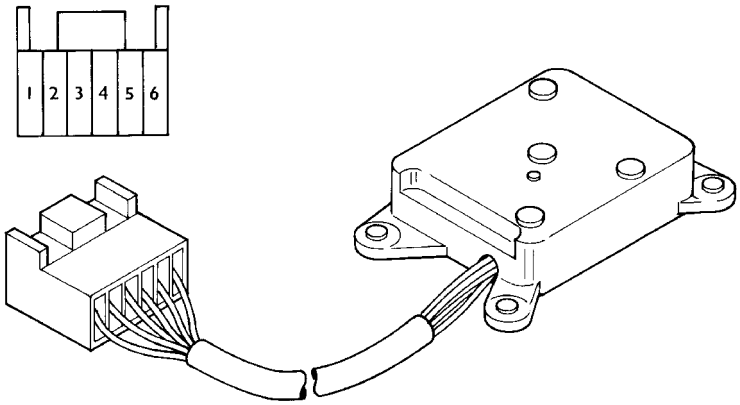
Geared motors

Figure 173

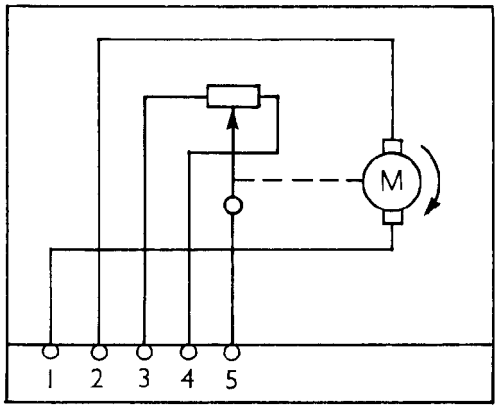


77571

Figure 174



77572



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Pin-out

PIN	CABLE COLOUR	SIGNAL
1	White	+/- 24V
2	Purple	+/- 24V
3	Blue	0V
4	Orange	0 ÷ 5V
5	Green	+ 5V
6	---	Free

The location of the four geared motors in the automatic system, as mentioned above, is on the Heater/Air-conditioner assembly in the cab according to the function they have to perform.

The electrical characteristics of the four geared motors are the same.

They are activated directly by the electronic control unit with the nominal voltage (24 V) and they have a current draw of from 20 to 40 mA.

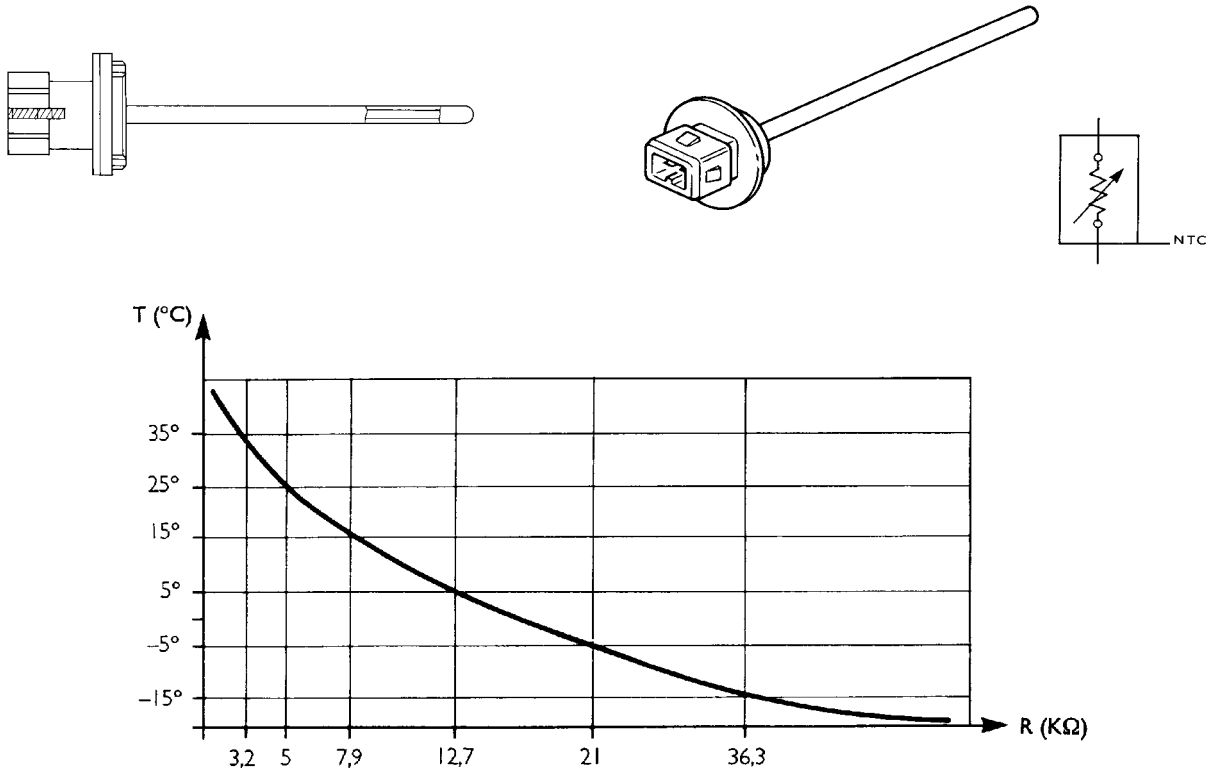
The maximum input, at the end of the travel, reaches 200 mA when the control unit cuts off the power supply.

The potentiometer with which they are equipped is used as a feedback signal and at the time of the first ignition, the control unit measures and saves the values of the end of the travel used to divide the field of operation.

N.B.If a geared motor is changed, it is VITAL to RESET the system.

Evaporator temperature sensor

Figure 175

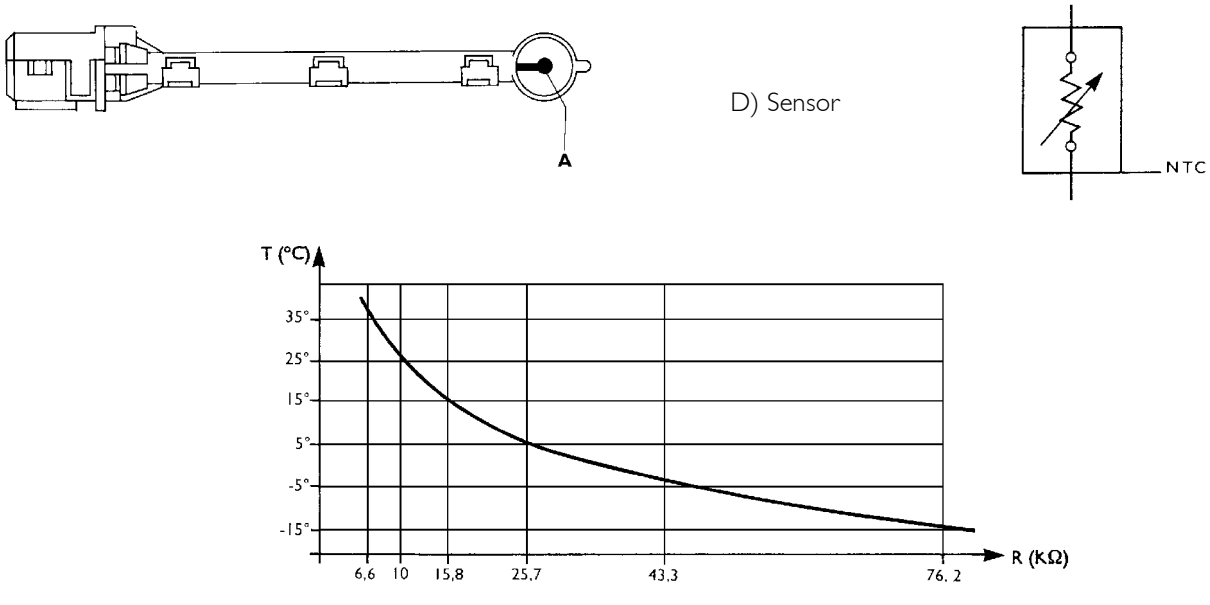


The sensor inside the evaporator causes the compressor to turn on and off, allowing temperatures from 2°C (off) to 3.5°C (on) for VALEO and from 5°C (off) to 10°C (on) for WEBASTO.

The figure shows the same characteristics of the outside temperature sensor except for the connection.

Blown air temperature sensor

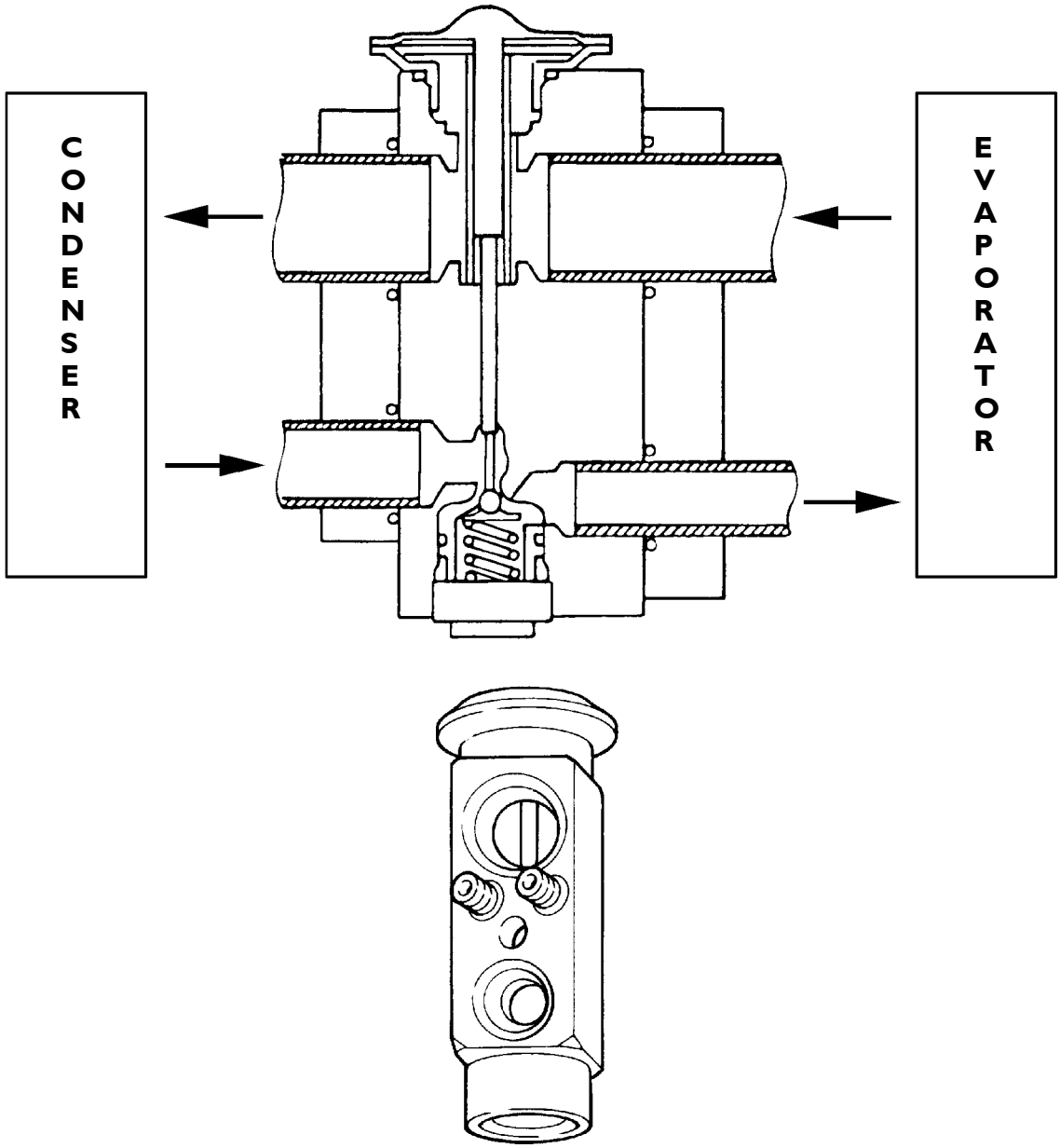
Figure 176



Located downstream from the heat exchanger, it indicates the temperature of the air introduced into the cab, permitting the control unit to operate for more suitable regulation.

Expansion valve

Figure 177



The expansion valve is the type with a block, its job is to lower the pressure of the fluid at the outlet of the condenser (and therefore of the filter) to a pre-set value so that the same fluid, circulating in the evaporator, can be drawn up by the compressor in a totally gaseous form.

It is therefore possible to state that the expansion valve fulfils three basic functions:

- METERING
- MODULATING
- CHECKING

This is fitted on the Heater/Air-conditioner assembly near the blower control module.

ADDITIONAL AIR HEATER SYSTEM (on request)

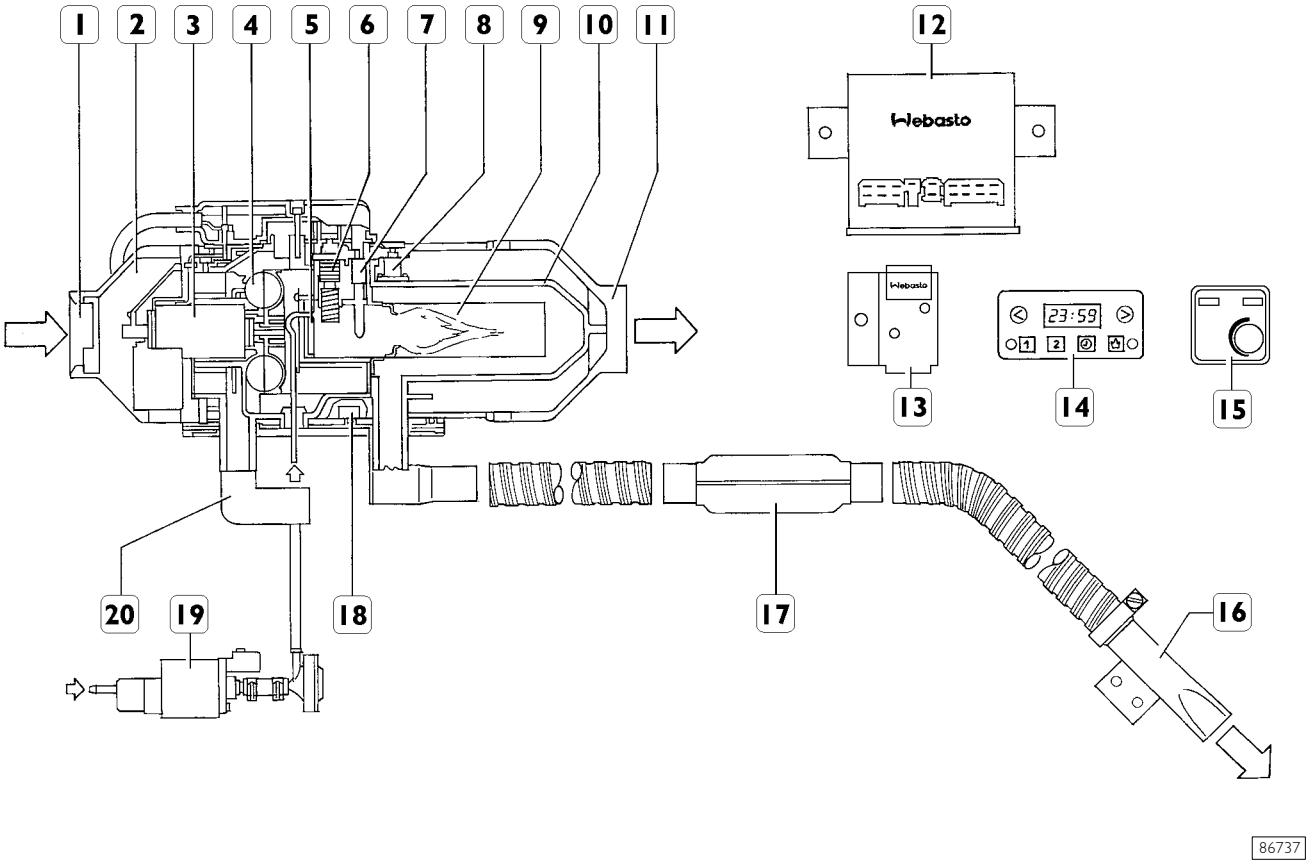
Description

The auxiliary heater works independently of the engine.
Its function is to heat the cabin only.
The heater is connected to the vehicle fuel tank and electric system, and is located in the cabin.

Operation

Switch-on and switch-off can be done by means of digital timer (4) or ambient thermostat (5).
Upon switching on, the warning lamp lights up and combustion chamber (9) preheating is started.
After approximately 30 seconds, pump (19) sucks the fuel from the tank and sends it to felt (5) which acts as an evaporator.
At the same time, fan (4) sucks, through pipe (20), the external air and sends it, through passage (18), to felt (5), where air is mixed with the fuel.
Heating plug (6) triggers mix burning.
During combustion, the flame licks exchanger (10). Fan (2) sucks cold air from intake (1) and sends it to exchanger (1) which heats, by yielding heat, the air sent to the cabin.
When combustion is over, photoresistor (7) cuts off heating plug (6) by means of control unit (12).
When the temperature exceeds the required value, a signal sent by ambient thermostat (15) causes reduced-power resistor (13) to come into operation: such resistor acts on the heater by reducing the revs number of engine (3) and the fuel pump rate.
Burnt gas are finally eliminated through silencer (17) and exhaust pipe (16).

Figure 178



PARTS MAKING UP THE AUXILIARY AIR-TYPE HEATER

DIAGNOSTICS

Troubleshooting
Introduction

Diagnosis, i.e. locating the troubles that cause operation faults in the system, makes it possible to identify, by analyzing the fault found, the causes and, therefore, ensure prompt and safe repair so as to restore the system to full efficiency.
Below is the troubleshooting guide for faults mainly of mechanic and hydraulic nature which cannot be recognized by the electronic control unit.
As regards the fault mainly of electric and electronic nature, use the electronic diagnosis instruments "Modus - IT 2000 - E.A.SY", by connecting the instrument to the diagnosis takeoff and following the instructions step by step, as displayed by the instrument itself.

Visible Failure	Possible cause	Repair action
System does not work	Inefficient electric system.	Check the electric system.
	Compressor pulling belt not in normal working conditions and inefficient.	Check the belt: if it is too loose or stretched, adjust it or, if necessary, replace it.
	Inefficient electromagnetic clutch coil.	Check whether the coil receives current. Replace the coil, if necessary.
	Inefficient system fittings and pipes.	Check and replace, if necessary, defective parts.
	Incorrect distance (play) between the front disc and the electromagnetic clutch.	Check the distance (play). Disconnect the compressor and adjust the distance, if necessary.
	Inefficient compressor.	Drain the system as described in the relevant chapter; disconnect the compressor and replace it.
Noisy system	Low compressor oil level.	Drain and refill the system as described in the relevant chapter.
	Lack of cooling fluid in the system.	Drain and refill the system as described in the relevant chapter.
	Incorrect distance (play) between the front disc and the electromagnetic clutch.	Check the distance (play). Disconnect the compressor and adjust the distance, if necessary.
	Low amount of coolant in the system (green sight glass).	Drain and refill the system as described in the relevant chapter.
	System is not leak-proof.	Use leak-detector 99051147 to check the system and the compressor; remedy the cooling fluid leaks (if any).
	Electromagnetic clutch does not work properly.	Check the clutch electric connections. Replace the electromagnetic clutch, if necessary.
	Humidity in the system.	Drain and refill the system as described in the relevant chapter.

(continues)

Visible Failure	Possible cause	Repair action
Unusual noise with clutch engaged	Loose compressor fastenings.	Check and tighten to torque the screws and bolts fastening the compressor.
	Inefficient electromagnetic clutch.	Check whether the fault is due to mechanic or electric causes, then act accordingly.
	Low compressor oil level.	Drain and refill the system as described in the relevant chapter.
	Inefficient compressor.	Drain the system and refill the compressor.
Unusual noise with clutch disengaged	Incorrect distance (play) between the front disc and the electromagnetic clutch pulley.	Check the distance (play). Disconnect the compressor and adjust the distance, if necessary.
	Inefficient electromagnetic clutch supply electric system.	Check the electric system.
Poor cooling	Humidity in the system.	Drain and refill the system as described in the relevant chapter.
	High discharge pressure and normal sucking pressure due to the presence of air in the system.	Drain the cooling fluid, replace the drying filter, deaerate the system, then refill, as described in the relevant chapter.
	High discharge pressure and low sucking pressure with presence of water or ice on the drying filter or on the pipes from the condenser outlet to the expansion valve.	Drain the cooling fluid, eliminate the throttling or replace the faulty component, deaerate the system, then refill, as described in the relevant chapter.
	Normal discharge pressure and low/high sucking pressure due to incorrect electromagnetic clutch engagement/disengagement.	Change the trinary pressure gauge.
Heater gets stuck	Inefficient electric system.	Check the electric system and replace defective parts.
	Irregular electric voltage.	(Operating voltage 19.5V ± 5%). Charge the battery.
	Incorrect operation of the heating plug.	Check the electric connections, the control unit and the plug, then act on faulty parts.
	Incorrect operation of the metering pump after 30 seconds' preheating.	Check the electric system, the control unit and the metering pump, then act on faulty parts.
	Incorrect operation of the burning unit.	Check the burning unit and the electric system.
	The heating plug is switched off within the safety time.	Check and replace, if necessary, the photoresistor.
	Efficient thermal limiter.	Check the thermal limiter.

(continues)

Visible Failure	Possible cause	Repair action
Fume exhaust pipe gets hot (heater combustion)	Incorrect operation of the metering pump.	Check and replace, if necessary, the pump.
	Poor fuel pipe seal.	Verify that the fuel pipe does not leak or is not throttled.
	Incorrect fuel connection.	Check the connection.
Heater gets stuck after brief combustion	Incorrect operation of the metering pump.	Check the pump rate.
	Incorrect CO_2 value.	Check the CO_2 value and replace the burner, if necessary.
	Inefficient, reduced power resistor.	Inefficient electric system.
Incorrect operation of feeding pump (after 30 seconds' pre-glow)	Inefficient photoresistor.	Check the electric cables and verify whether short-circuit occurs.
	Incorrect operation of the metering pump.	Check and replace if necessary.
	Inefficient thermal limiter.	Check and replace if necessary.
	Inefficient safety switch.	Check current flow and replace, if necessary.
Glow plug won't ignite	Inefficient electric system.	Check for breaks in electric cables and fittings.
	Inefficient heating plug.	Check and replace, if necessary, the plug. Check the ambient thermostat.
	Inefficient control unit.	Check the control unit.
Heater does not provide enough heat	Heater not running at full capacity.	Switch set to "reduced power" position.
	Ambient thermostat not set to the desired temperature.	Adjust the ambient thermostat.
	Inefficient electric system.	Check the electric system.
Incorrect CO_2 (carbon dioxide) value.	Incorrect assembly of fuel pump.	Verify that the fuel pump is positioned on the chassis with an inclination of 30° relative to the horizontal plane and with the power cables facing upwards.
	Inefficient silencer and fume exhaust pipe.	Clean and verify that they are not clogged. Replace them, if necessary.
	Dirty heat exchanger.	Check and clean the heat exchanger.
	Inefficient evaporating felt.	Check and replace, if necessary, the felt.
	Incorrect metering pump rate.	Check the pump rate and adjust the CO_2 value.

(continues)

Visible Failure	Possible cause	Repair action
Heater is switched off due to a fault during operation	Inefficient safety switch.	Check the safety switch.
	Inefficient photoresistor.	Check and replace, if necessary, the photoresistor.
	Incorrect heater operating temperature.	Check the ambient thermostat and the combustion air circuit.
	Incorrect fastening of heater to the support.	Check the fastening bolts and tighten them to torque.
	Incorrect combustion.	Check and troubleshoot..
	Incorrect operation of the metering pump.	Check and replace, if necessary, the pump.
	Inefficient combustion air circuit.	Check the combustion air circuit.

CHARACTERISTICS AND DATA

Cooling fluid			Type		R 134 A
Amount of the system cooling fluid					
VEHICLE	COMPRESSOR	R134 COULANT QUANTITY PROVIDED FOR IN SYSTEM	COULANT QUANTITY CONTAINED IN THE PIPINGS (150 cm length) THAT ARE USED FOR RECHARGING	COULANT TOTAL QUANTITY TO BE SET ON CHARGING TOOL	OIL QUANTITY TO BE ADDED INTO SYSTEM AT EACH ND 8 TYPE CHARGING
STRALIS AS	DENSO 10 PA 17	700 g	300 g for low pressure pipe, 200 g for high pressure pipe	1000 g	40 g

COMPRESSOR		NIPPONDENSO
Type		10 PA 17
Number of cylinders		10
Bore	mm	29.5
Stroke	mm	6
Revs number: max. min.	 rpm rpm	9000
Coolant		R 134 a (ecology)
Type of oil		ND 8
ELECTROMAGNETIC CLUTCH		
Revs number: max. min.	 rpm rpm	9000
Disengaging torque	kgm	4
Rated voltage	V	24
Minimum engagement voltage	V	7.5
Play between front disc and pulley	mm	0.4 ÷ 0.8

AUXILIARY HEATER

Air-type heater with burner		Eberspächer
Type		D3L
Rated voltage		24V
Calorific yield: full capacity reduced capacity	 KW (Kcal/h) KW (Kcal/h)	 3.2 1.0
Permitted max. temperature at heater air inlet		+ 40°C
Heating air flow rate at 0.5 mbar: full capacity reduced capacity	 m^3 /h m^3 /h	 160 65

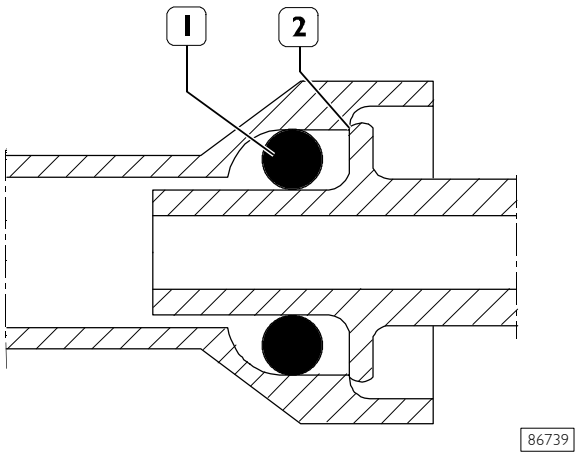
GENERAL WARNINGS

Make sure that replacement parts (filter, condenser, evaporator, pipes and fittings) are supplied complete with the protection caps against dirt and moisture.
These caps must be removed only when the part is ready to be installed.

Compressors – and, sometimes, exchangers and filters, too – are delivered with slight internal pressurization, to prevent moisture penetration.
Verify that gas escapes when the protection cap is opened: this will prove that the component has been stored correctly.

Make sure that the pipe connections, both to one another and to other components, are made so as to ensure perfect tightness of the system. Cooling fluid leaks do not only cause system stoppage, but also fast compressor wear.
Therefore, you should check the presence of the seal ring on the fitting male portion: moisten with oil, the same used for the system (bear in mind, in any case, that it differs according to the type of coolant), and avoid, when assembling, making cuts or burrs between the coupling surfaces, which cause gas leaks.
Follow the instructions below.

Figure 179



Manually and carefully insert the male portion into the fitting female drill until collar (2) comes into contact with the corresponding metal seat in the female.
Such contact ensures mechanic support to the pipe: seal ring (1) pressed between the internal cylindrical portion and the drill provides hydraulic seal.
Do not use oversized-diameter or twin seal rings: they temporarily perform hydraulic seal, yet prevent the contact between the metal seats, causing, after a short period, fitting loosening and gas leaks.

NOTE When disconnecting the system pipes, plug the pipes and the coolant passages (if any), so as to avoid possible moisture or dirt penetration inside the system. This can badly affect correct operation of the system.

TIGHTENING TORQUES

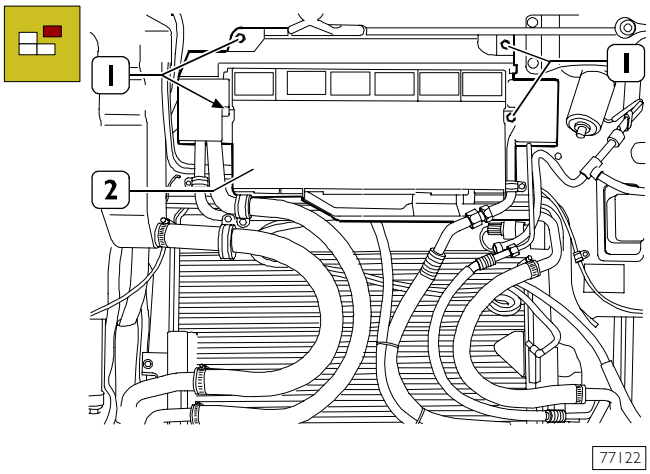
PART	TORQUE	
	Nm	(kgm)
GAS PIPES FITTINGS		
5/8" - 18 UNF	15.9	1.6
3/4" - 18 UNF	15.9	1.6
1" - 14 UNF	29.8	3

REPAIR OPERATIONS

553210 HEATER

Removal

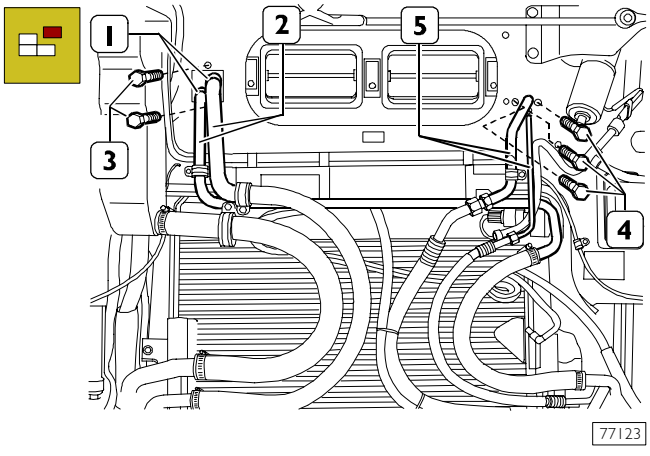
Figure 180



For disconnecting heater assembly, it is needed to:

- ❑ Position the key of ignition block to"Key On" position and switch air temperature to "LOW".
- ❑ Partially drain engine coolant.
- ❑ Detach the fascia covering (552211).
- ❑ Lift the radiator cowling.
- ❑ Unscrew the fixing screws (1) and separate the pollen filter cover (2) to access the underlying fasteners.

Figure 181



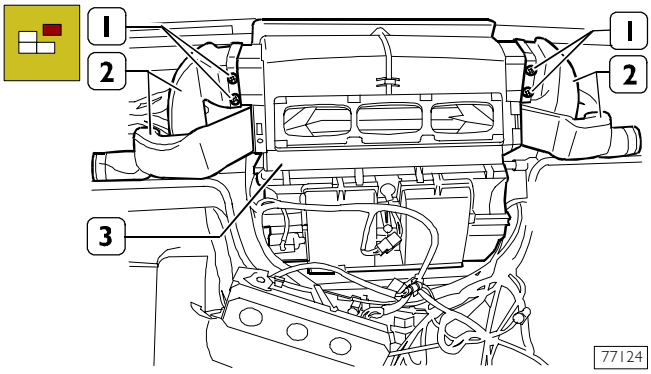
Blow gas off cab air conditioning system, as described in relating chapter.

NOTE This operation must be carried out only by authorized, qualified skilled personnel.

NOTE Seal air conditioning system pipings to prevent moisture or impurities from entering the system.

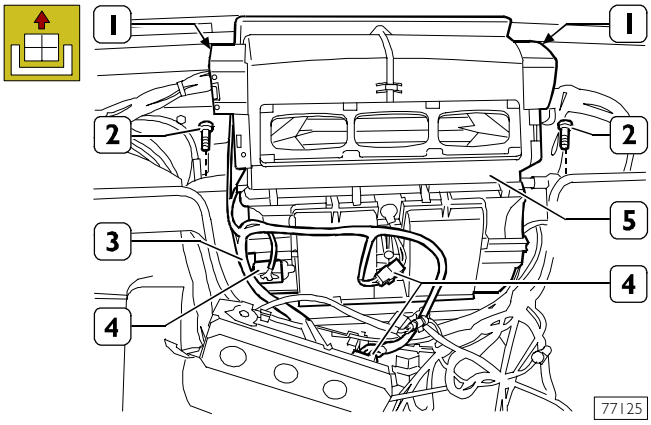
- ❑ Unscrew screws (4) securing low and high pressure piping (5).
- ❑ Remove screws (3) near water pipings.
- ❑ Screws (3) near the water pipes.
- ❑ Apply special plugs on the high and low pressure pipes and on the expansion valve.

Figure 182



- ❑ Working from inside the cab, unscrew the screws (1) fixing the air ducts (2) to the heater (3).
- ❑ Disconnect the air ducts (2) from the heater (3).

Figure 183



- ❑ Unscrew the screws (2) fixing the heater (5) to the cross member on the cab.
- ❑ Detach the clamps (1) of the wiring bundles.
- ❑ Disconnect the connectors (4) and detach the relative electric wiring (3).
- ❑ Detach the heater (5) from the vehicle.

Refitting

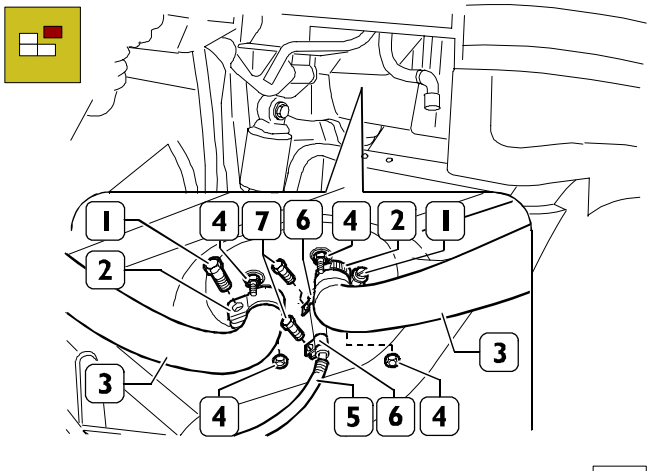
For reconnection, invert operations described for disconnection, observing following warnings:

- ❑ tighten nuts or screws at prescribed torque;
- ❑ the engine coolant is at the right level;
- ❑ the system and components involved in the described procedure work properly.
- ❑ if present, fill air conditioner system as described in relating chapter

507570 ADDITIONAL AIR HEATER SYSTEM

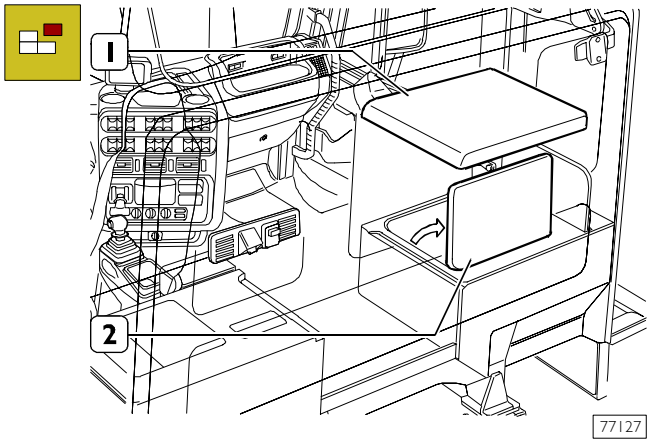
Removal

Figure 184



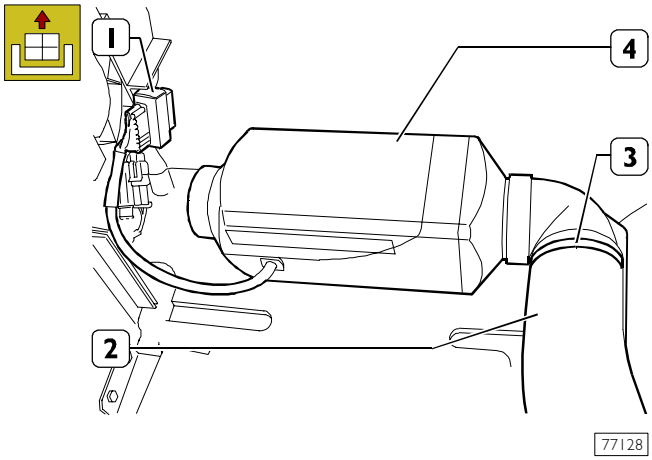
- ❑ Lift the radiator cowling.
- ❑ Tilt up the cab.
- ❑ Unscrew the screws (7) of the clamps (6) and disconnect the fuel pipe (5).
- ❑ Unscrew the screws (1).
- ❑ Disconnect the clamps (2) and detach the inlet and outlet pipes (3).
- ❑ Unscrew the nuts (4) fixing the additional heater to the floor of the cab.

Figure 185



- ❑ Lower the cab.
- ❑ Close the radiator cowling.
- ❑ Working from inside the cab, detach the cushion (1) and lift the door (2) of the additional heater compartment.

Figure 186



- ❑ Disconnect the electrical connection (1).
- ❑ Detach the clamp (3) and free the pipe (2) from the heater (4).
- ❑ Detach the additional heater (4) from the vehicle.

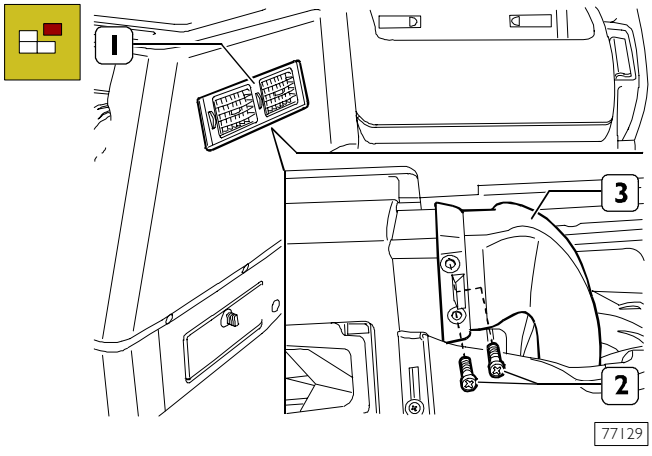
Refitting

Refit by carrying out the procedures described for removal in reverse order.

553254 DEFROST CONTROL MOTOR

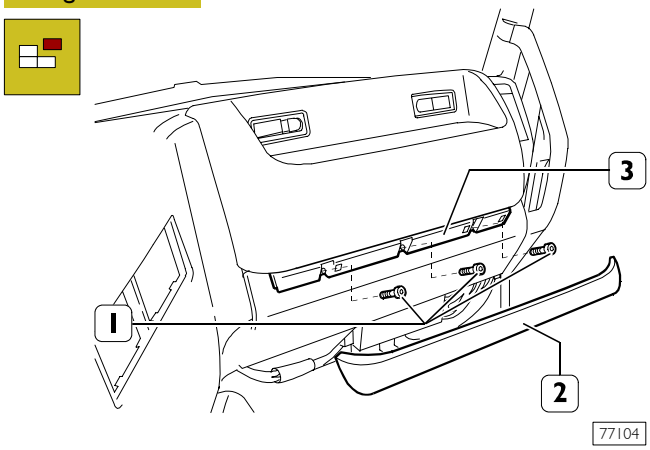
Removal

Figure 187



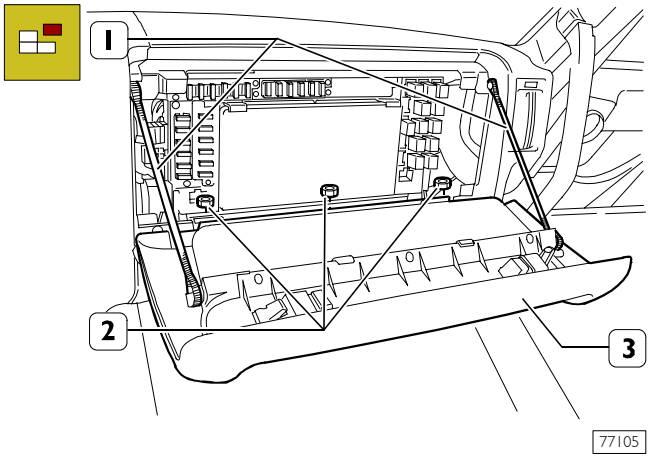
- ❑ Undo the fasteners and detach the air diffuser openings (1).
- ❑ Working through the seat of the air diffuser openings, unscrew the screws (2) fixing the air pipe (3).
- ❑ Remove the bottom covering of the instrument panel as described in operation (552211).

Figure 188



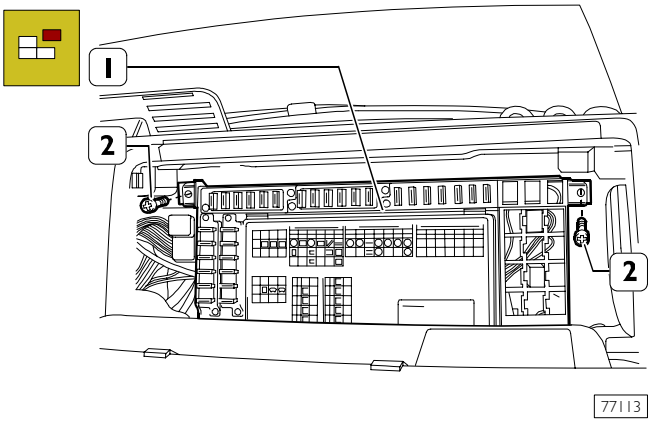
- ❑ Undo the fasteners and take off the moulding (2) to get to the underlying screws.
- ❑ Unscrew the fixing screws (1) and remove the connection (3) of the moulding (2).

Figure 189



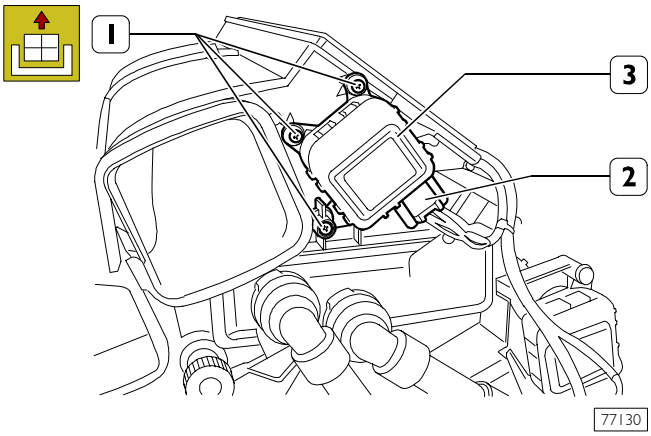
- ❑ Open the glove compartment (3).
- ❑ Detach the tie rods (1).
- ❑ Unscrew the nuts (2) and detach the glove compartment.

Figure 190



- ❑ Unscrew the screws (2) fixing the Body Control (1).
- ❑ Remove the Body control (1) and set it aside.

Figure 191



- ❑ Take off the press-on plugs fixing the air pipe to the cross member under the fascia.
- ❑ Unscrew the fixing screw and take out the air pipe.
- ❑ Disconnect the power supply connector (2).
- ❑ Unscrew the fixing screws (1).
- ❑ Detach the DEFROST control motor (3) from the vehicle.

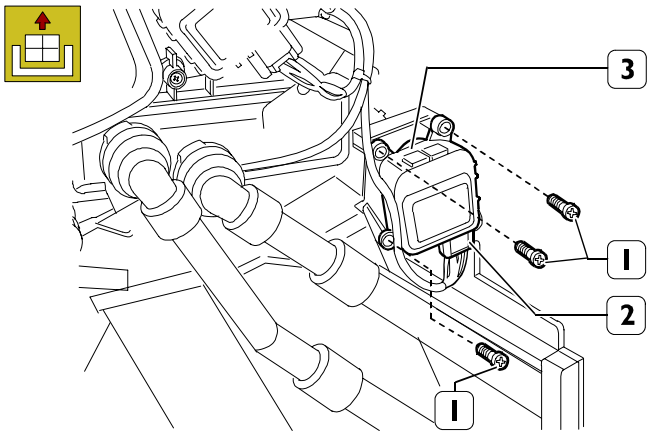
Refitting

Refit by carrying out the procedures described for removal in reverse order.

553153 AIR RECIRCULATION DOOR CONTROL MOTOR

Removal

Figure 192



- ❑ Detach the glove compartment, unscrew the fixing screws, remove the Body Control and set it aside as described in removing the "DEFROST CONTROL MOTOR."
- ❑ Disconnect the power supply connector (2).
- ❑ Unscrew the fixing screws (1).
- ❑ Detach the air recirculation door control motor (3).

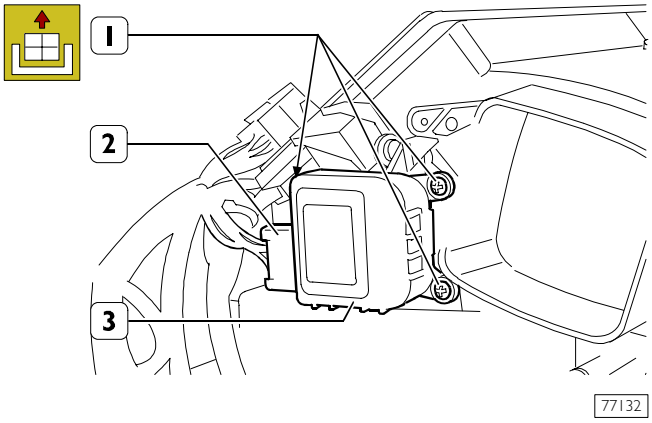
Refitting

Refit by carrying out the procedures described for removal in reverse order.

553254 AIR MIXING DOOR CONTROL MOTOR

Removal

Figure 193



- ❑ Perform the removal procedure:
- ❑ Instrument panel (OP. 553710).
- ❑ Central instrument panel (OP. 553710).
- ❑ Detach the air diffuser openings (Figure 79).
- ❑ Detach the air diffuser openings and the screws fixing the fascia covering to the heater (Figure 88).
- ❑ Detach the lever (Figure 93) and the associated bracket.
- ❑ Extract the side window air delivery duct.
- ❑ Disconnect the power supply connector (2).
- ❑ Unscrew the fixing screws (1).
- ❑ Detach the air mixing door control motor (3).

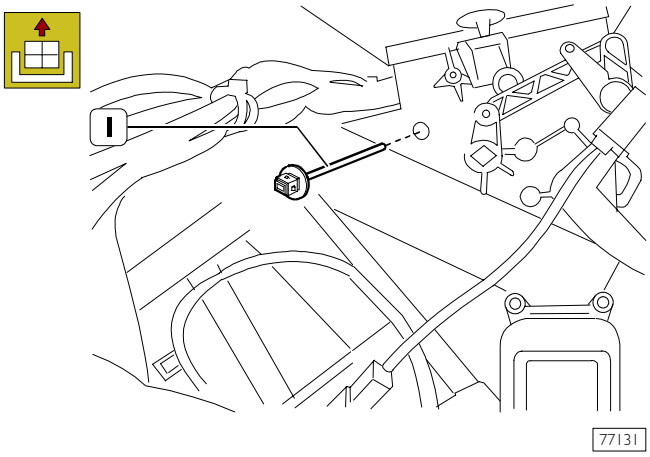
Refitting

Refit by carrying out the procedures described for removal in reverse order.

553245 HEATER RADIATOR TEMPERATURE SENSOR

Removal

Figure 194



Perform the removal procedure:

- ❑ door control motor;
- ❑ air mixing (553252).
- ❑ Disconnect the electrical connection and extract the heater radiator temperature sensor (1).

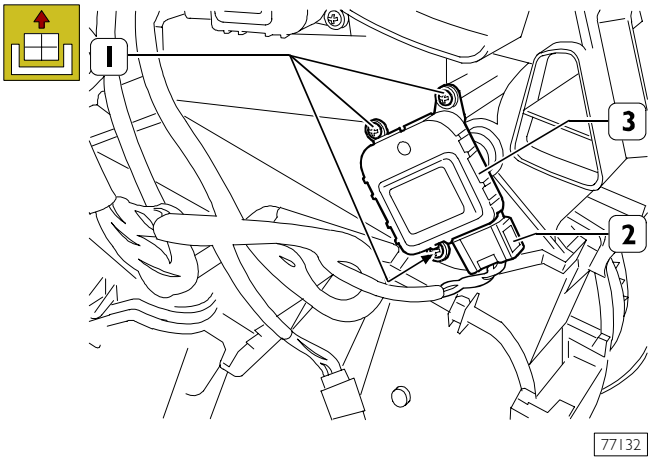
Refitting

Refit by carrying out the procedures described for removal in reverse order.

553255 FLOOR AIR DOOR CONTROL MOTOR

Removal

Figure 195



- ❑ Perform the removal procedure:
- ❑ Central instrument panel (OP. 553710).
- ❑ Detach the air diffuser openings (Figure 79).
- ❑ Detach the air diffuser openings and the screws fixing the fascia to the heater (Figure 88).
- ❑ Detach the lever (Figure 93) and the associated bracket.
- ❑ Extract the side window air delivery duct.
- ❑ Disconnect the connection (2), unscrew the fixing screws (1) and remove the floor air motor (3).

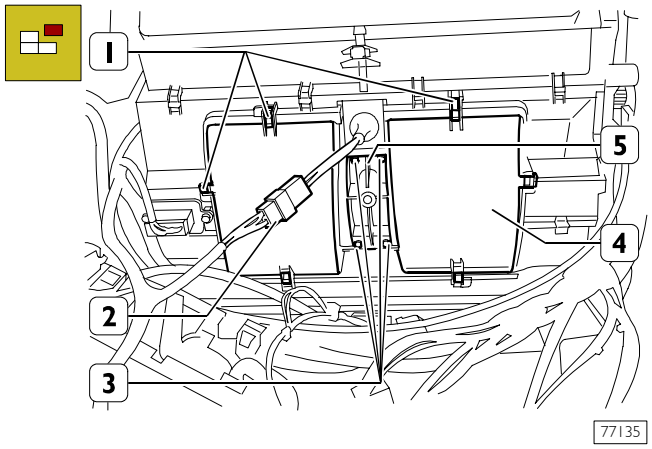
Refitting

Refit by carrying out the procedures described for removal in reverse order.

553212 ELECTRIC FAN

Removal

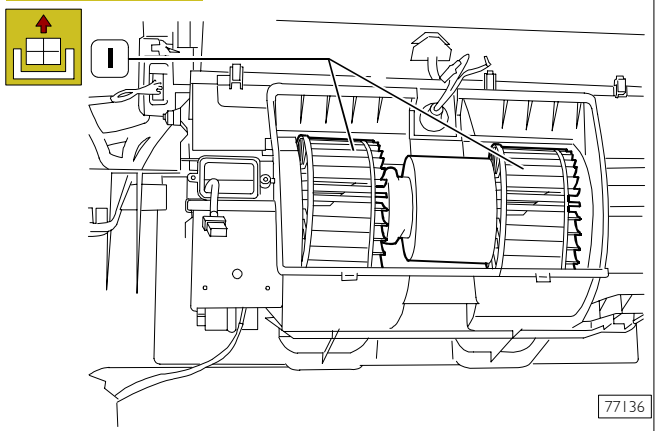
Figure 196



Perform the removal procedure:

- ❑ Central instrument panel (OP. 553710).
- ❑ Disconnect the connector (2).
- ❑ Take off the fixing clips (1), unscrew the screws (3) and detach the covers (4) and (5).

Figure 197



- ❑ Detach the electric fan (1) from its seat.

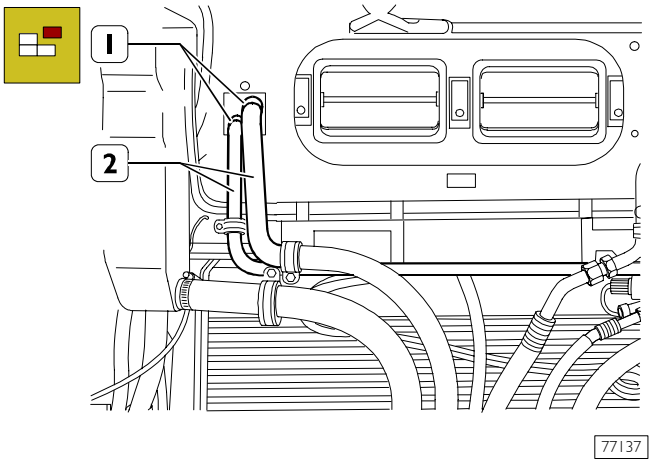
Refitting

Refit by carrying out the procedures described for removal in reverse order.

553215 HEATER RADIATOR

Removal

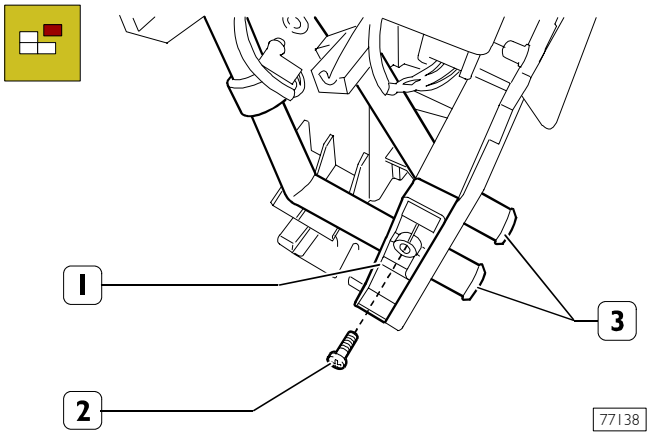
Figure 198



Before proceeding to detach the heater radiator, it is necessary to:

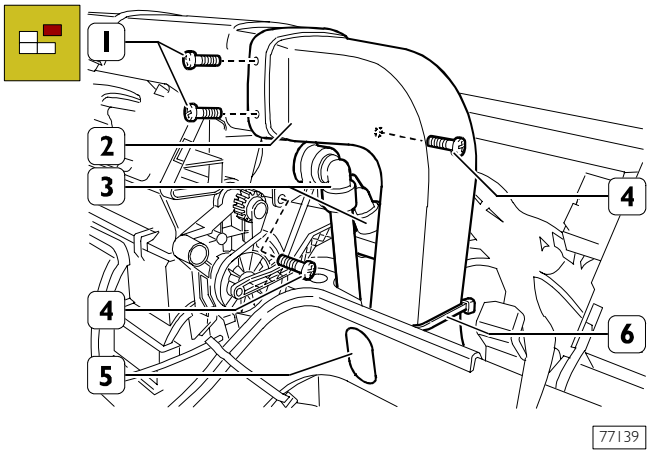
- ❑ Position the key of ignition block toKey On" position and switch air temperature to "LOW".
- ❑ Partially drain engine coolant.
- ❑ Detach the pollen filter and cover (Figure 207).
- ❑ Detach the Body Control.
- ❑ Detach the bottom covering of the fascia on the passenger side.
- ❑ Detach two passenger air openings.
- ❑ Detach the air delivery pipe from the central body to the rh door opening.
- ❑ Disconnect the retaining clamps (1) and separate the water pipes (2).

Figure 199



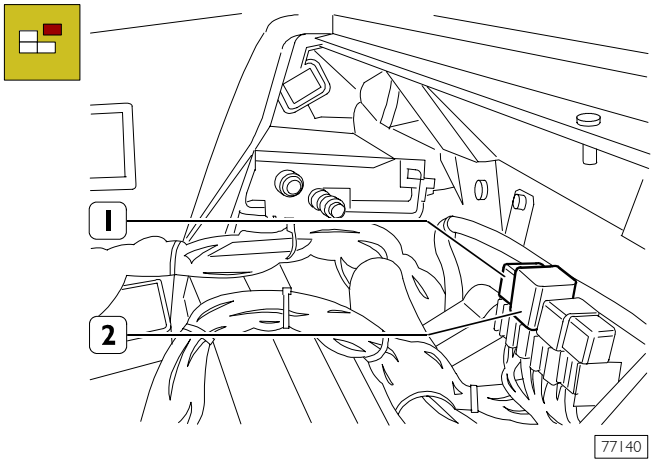
- ❑ Operating through the control unit compartment at the bottom of the fascia covering, unscrew the screw (2) fixing the clevis (1) and free the heater water pipes (3).

Figure 200



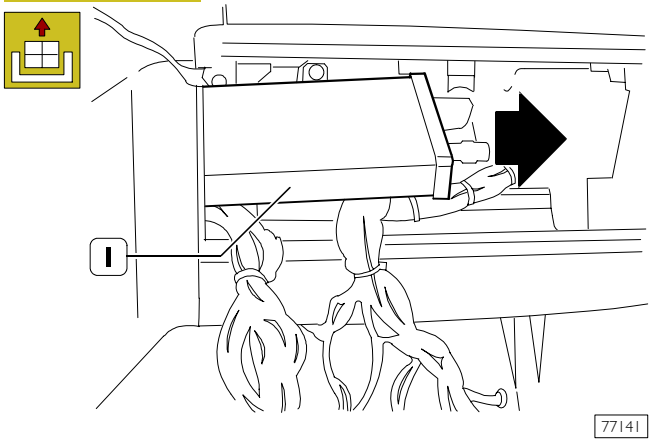
- ❑ Detach the connectors (1), (2) indicated to facilitate the outflow from the heater radiator.
- ❑ Take off the clips and detach the pipe (3).
- ❑ Unscrew the screws (4) fixing the radiator to the heater.

Figure 201



- ❑ Detach the connectors (1), (2) indicated to facilitate the outflow from the heater radiator.

Figure 202



- ❑ Extract the heater radiator (1) with due caution from the glove compartment bay.

Refitting

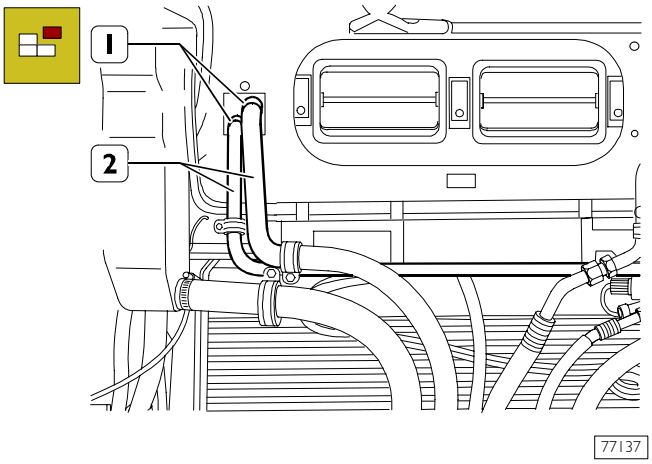
For reconnection, invert operations described for disconnection, observing following warnings:

- ❑ tighten nuts or screws at prescribed torque;
- ❑ the engine coolant is at the right level;
- ❑ the system and components involved in the described procedure work properly.

553216 TAP

Removal

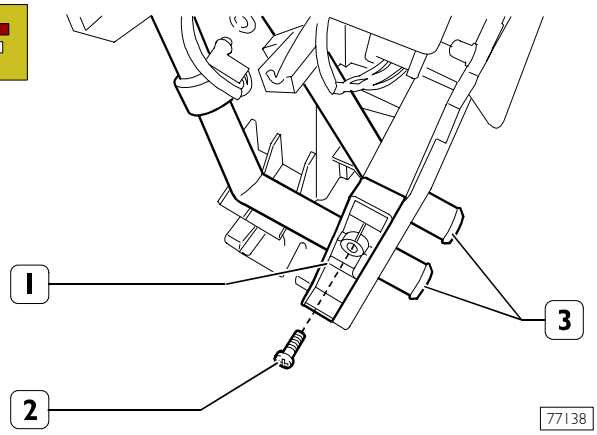
Figure 203



Before proceeding to detach the heater radiator, it is necessary to:

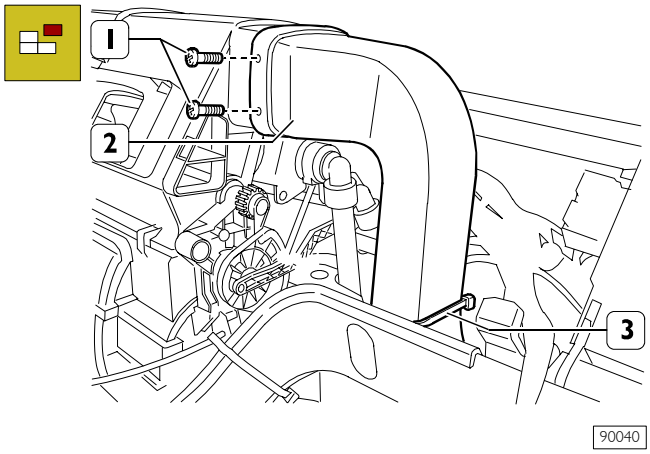
- ❑ Position the key of ignition block toKey On" position and switch air temperature to "LOW".
- ❑ Partially drain engine coolant.
- ❑ Detach the pollen filter and cover (Figure 207).
- ❑ Detach the Body Control.
- ❑ Detach the bottom covering of the fascia on the passenger side.
- ❑ Detach two passenger air openings.
- ❑ Detach the air delivery pipe from the central body to the rh door opening.
- ❑ Disconnect the retaining clamps (1) and separate the water pipes (2).

Figure 204



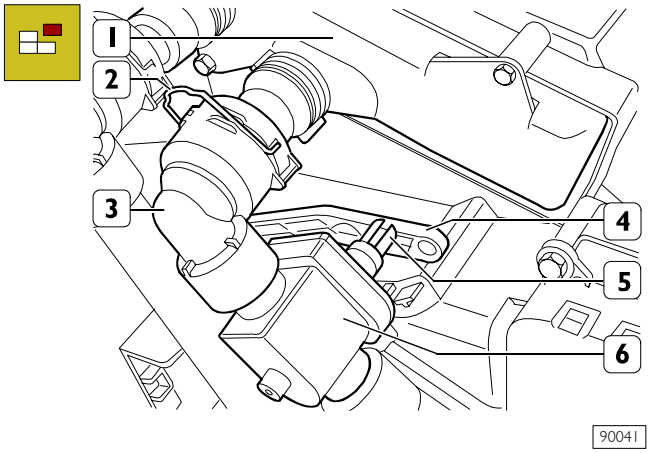
❑ Operating through the control unit compartment at the bottom of the fascia covering, unscrew the screw (2) fixing the clevis (1) and free the heater water pipes (3).

Figure 205



❑ Unscrew screws (1), take off pressure button, and cut check strap (3) and take off the piping for air duct (2).

Figure 206



❑ Lift fastener (2) and disconnect piping (3) from radiator (1). By special pliers, press fins (5) and disconnect tie rod (4). Remove screws and take tap (6) off the heater.

Refitting

Refit by carrying out the procedures described for removal in reverse order.

❑ tighten nuts or screws at prescribed torque;

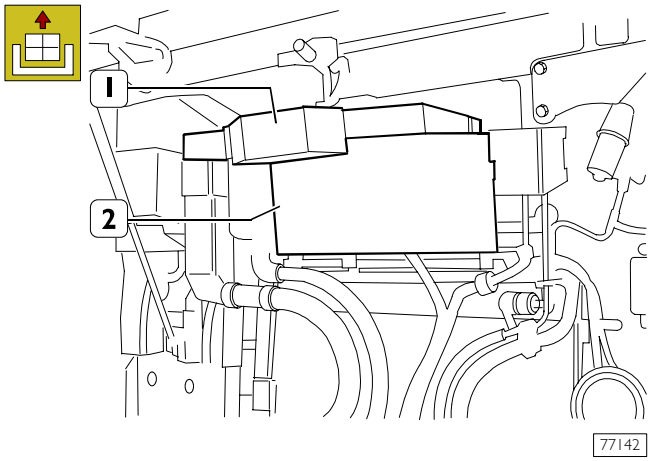
❑ the engine coolant is at the right level;

❑ the system and components involved in the described procedure work properly.

553261 POLLEN FILTER

Removal

Figure 207



Lift the radiator cowling, take off the cover (1) and remove the pollen filter (2).

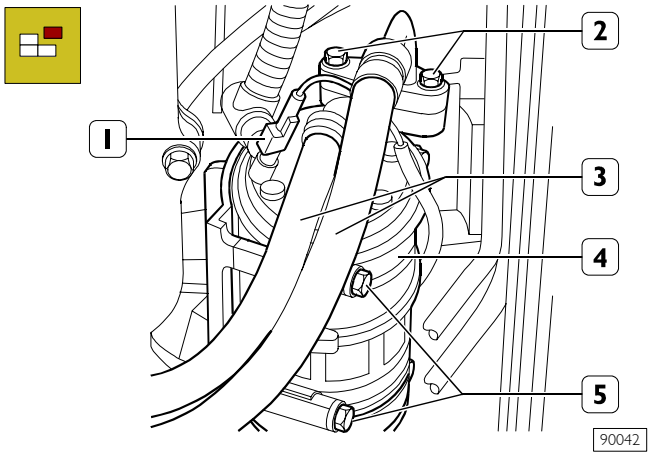
Refitting

Refit by carrying out the procedures described for removal in reverse order.

553239 AIR-CONDITIONER COMPRESSOR

Removal

Figure 208



❑ Discharge the air-conditioning system by following the procedure described under the relevant heading.

❑ Working from under the vehicle, unscrew the fixing screws (2) and remove the inlet and outlet pipes (3) from the compressor.

NOTE Seal air conditioning system pipings to prevent moisture or impurities from entering the system.

- ❑ Loosen the automatic tightener and take off the compressor belt.
- ❑ Disconnect the power supply connector (1, Figure 208).
- ❑ Unscrew the fixing screws (5, Figure 208).
- ❑ Take compressor (4, Figure 208) off the engine.

Refitting

Replace the sealing gasket.

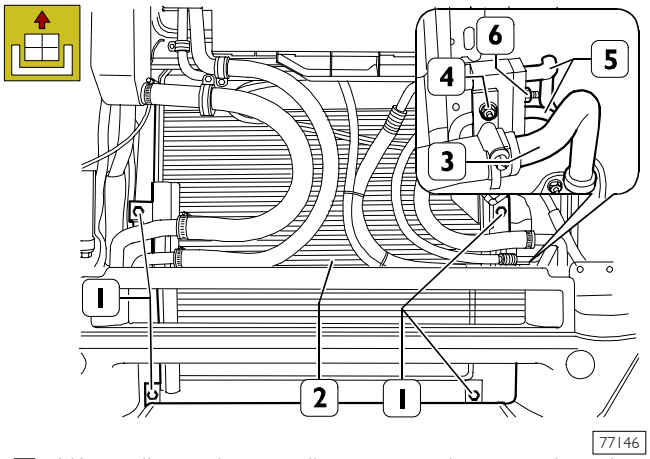
Tighten the fastening screws and the adapters to the specified torque.

Fill air conditioner system as described in relating chapter.

553232 AIR-CONDITIONER CONDENSER

Removal

Figure 209



77146

- ❑ Lift cowling and purge climate control system observing the procedure described in relating chapter.
- ❑ Unscrew the nut (6) and detach the condenser pipes (5).
- ❑ Unscrew the nut (4) fixing the pipe bracket (3).
- ❑ Unscrew the fixing screws (1) and remove the condenser (2) from the vehicle.

Refitting

Replace the sealing gasket.

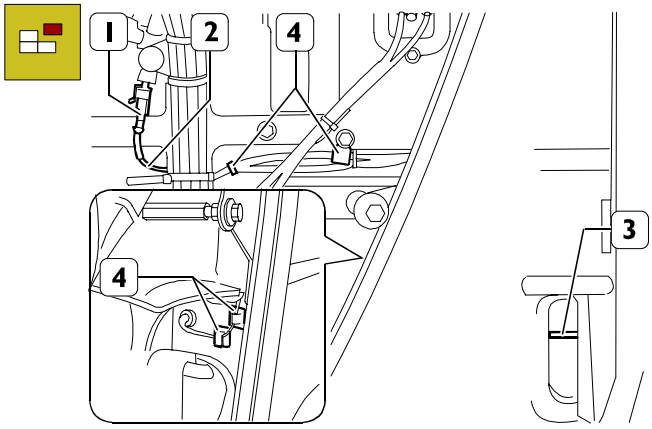
Tighten the fastening screws and the adapters to the specified torque.

Fill air conditioner system as described in relating chapter.

553242 OUTSIDE AIR TEMPERATURE SENSOR

Removal

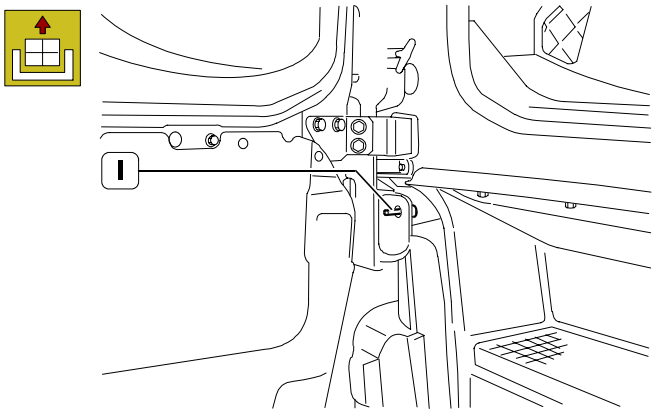
Figure 210



77147

- ❑ Lift the radiator cowling and disconnect the connector (1) and free the wiring (2) of the sensor (3) from the retaining clamps (4).

Figure 211



77148

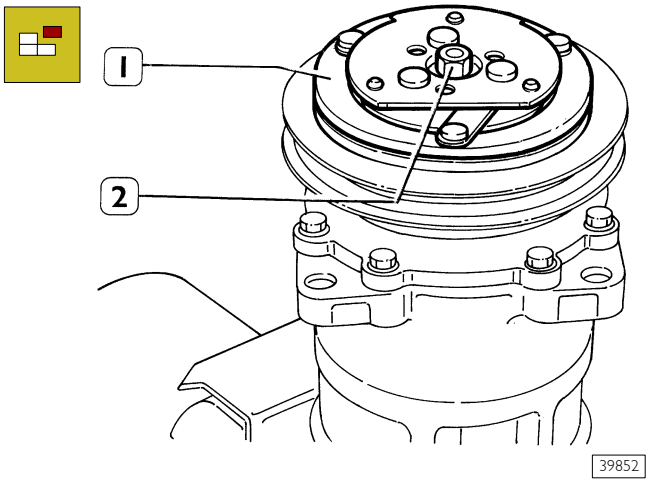
- ❑ Detach the outside air temperature sensor (1) from its seat.

Refitting

Refit by carrying out the procedures described for removal in reverse order.

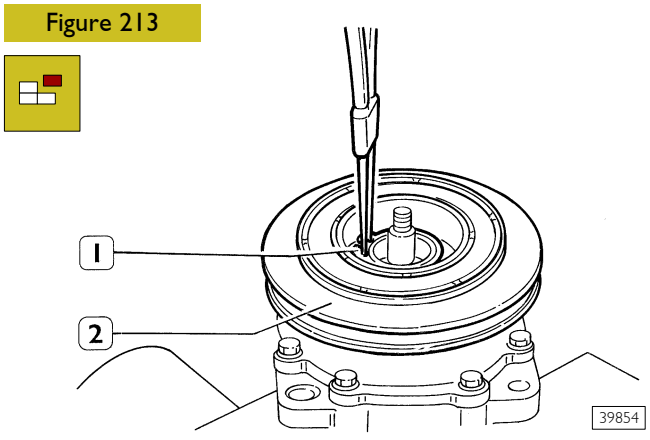
543921 REPLACING THE ELECTROMAGNETIC CLUTCH

Figure 212



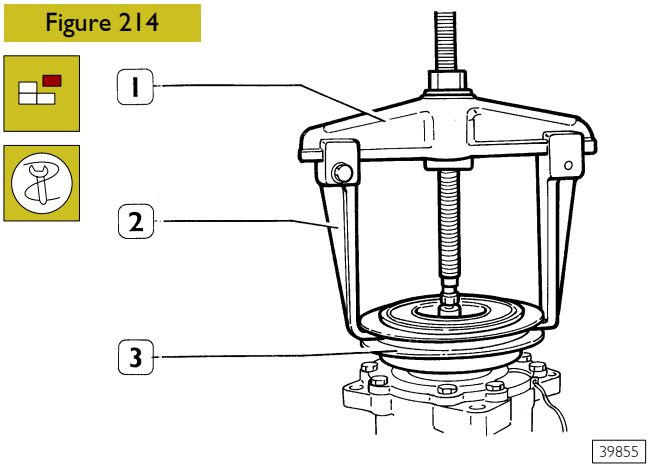
Stop front disc (1) rotation, then unscrew retaining nut (2) and remove the spacer below.

Figure 213



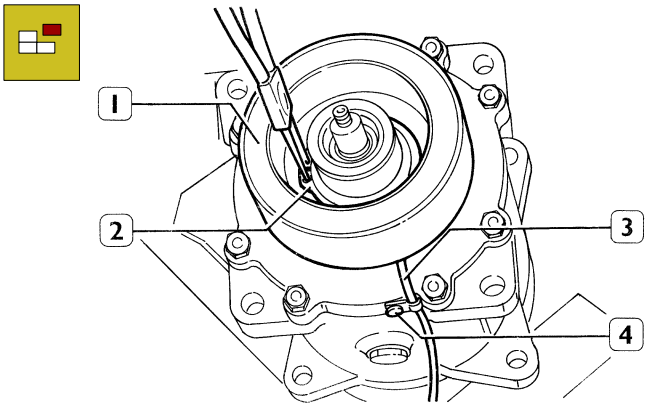
Use special rounded-tip pliers to remove pulley (2) retaining snap ring (1).

Figure 214



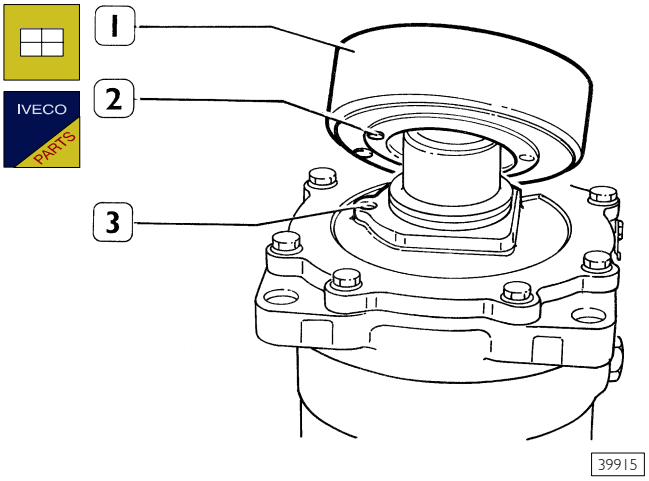
Use extractor 99341001 (1), equipped with brackets 99341009 (2), to take out pulley (3).
Remove the plate fastening screw with the envelope from the compressor.

Figure 215



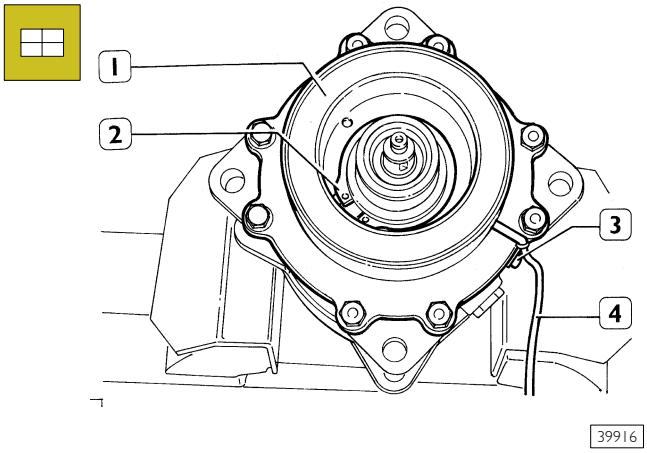
Loosen screw (4), thus releasing magnetic coil (1) supply electric cable (3).
Use special rounded-tip pliers to remove retaining snap ring (2) and take off magnetic coil (1).

Figure 216



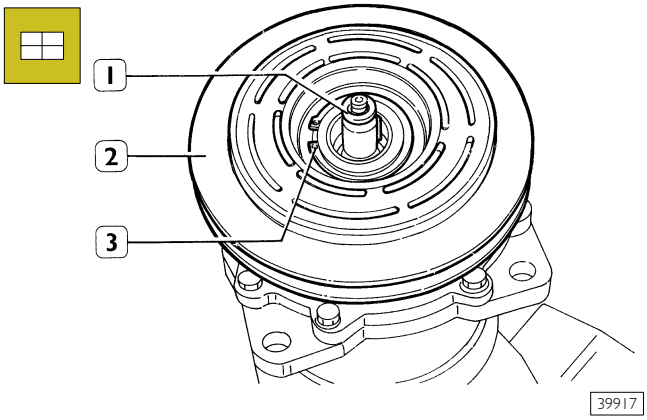
Place the new magnetic coil (1) in position, so that centering pin (2) engages into the respective hole (3).

Figure 217



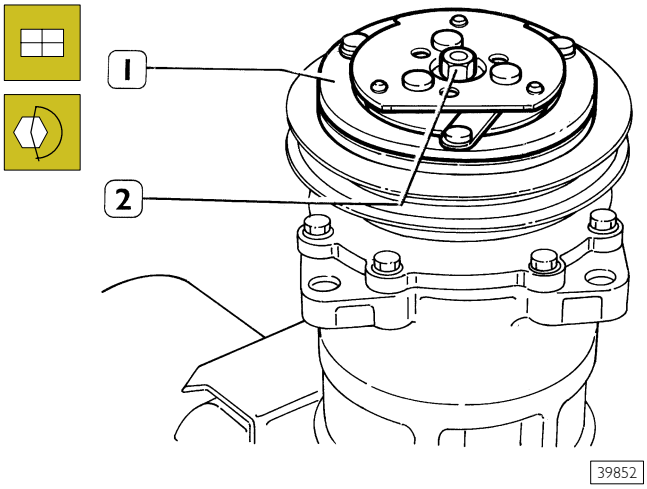
Fit retaining snap ring (2). Tighten screw (3), then secure coil (1) supply electric cable (4) to the compressor body.

Figure 218



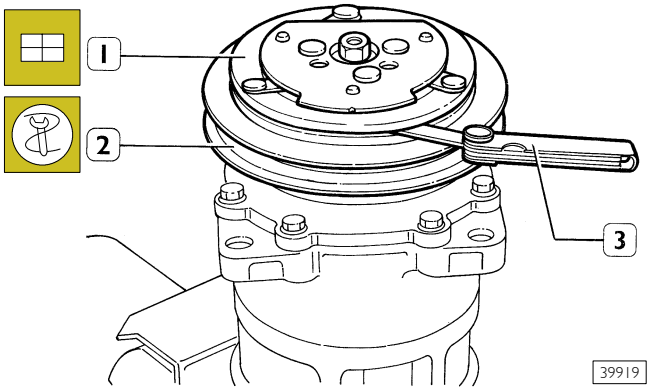
Mount pulley (2), then retaining snap ring (3) and adjusting shim (1).

Figure 219



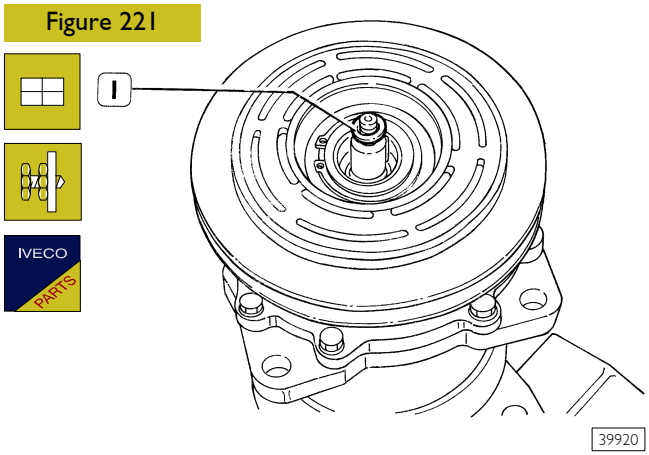
Mount front disc (1), stop rotation, then tighten retaining nut (2) to a torque of 35 ÷ 40 Nm (3,5 ÷ 4 Kgm).

Figure 220



Check, by means of a thickness gauge (3), that the play between front disc (1) and pulley (2) is 0.4 ÷ 0.8 mm.

Figure 221



If the clearance between the front disc and the pulley does not correspond to the prescribed value, remove the front disc and replace the adjusting ring (1) with one having the suitable thickness.

PROCEDURE FOR DRAINING AND RECHARGING AIR CONDITIONING SYSTEMS WITH RECHARGING STATION 99305146 AND RECOVERY OF R134A COOLANT

This station has been made to be used on all air-conditioning/ heating systems for motor vehicles using R134A gas.

By connecting the station to a refrigerating system the gas it contains can be recovered, cleaned and made ready to be reloaded into the system or be transferred to an external container. In addition, it is possible to see the amount of oil taken from the system, restore it and "empty" the system.

To be operative, the station needs to absorb approximately 3 kg of refrigerant.

For prompt use it is advised to have at least 2 kg of refrigerant in the filler cylinders and to keep the station as level as possible.

NOTE This procedure does not describe the phases of loading and unloading refrigerant to and from external and internal containers or maintenance. Therefore, please refer to the operating and maintenance manual of the appliance.

The station is composed of:

1 control panel;

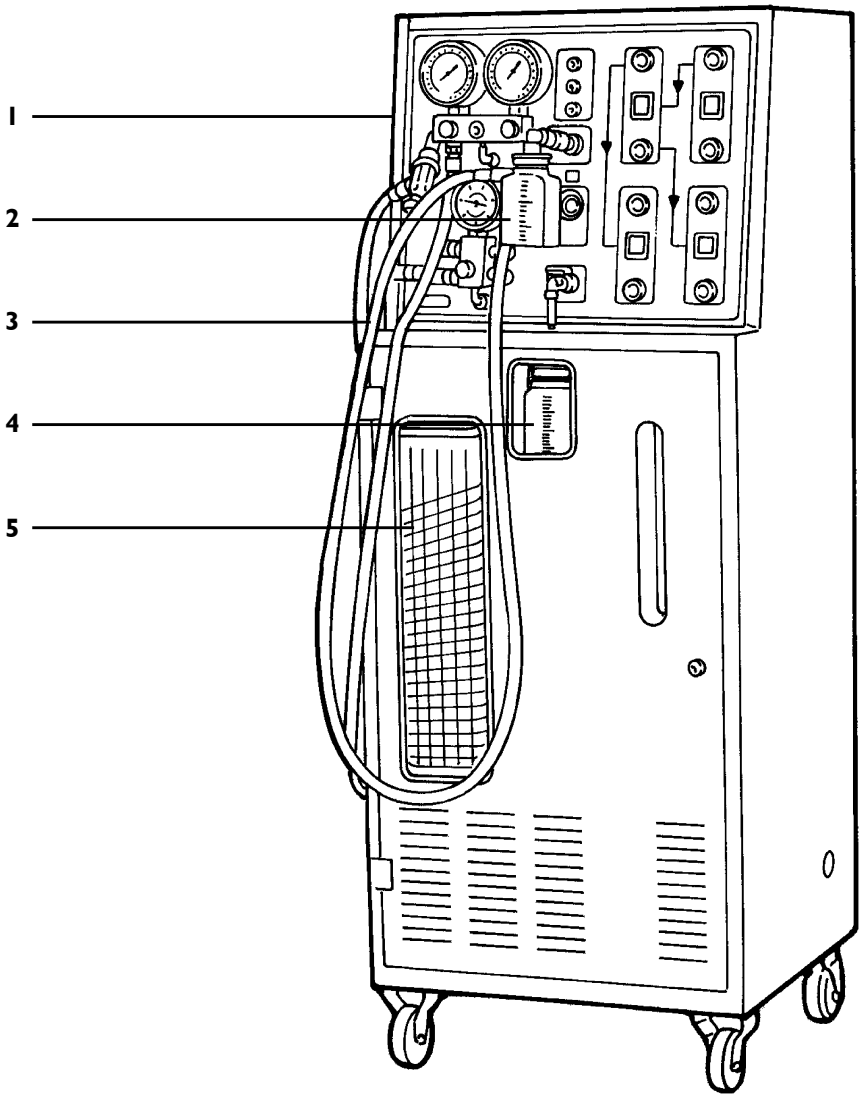
2 container to restore any oil recovered when unloading;

3 flexible hoses;

4 container to collect any oil recovered from the system;

5 filler cylinder with graduated scale revolving.

Figure 222



SAFETY STANDARDS

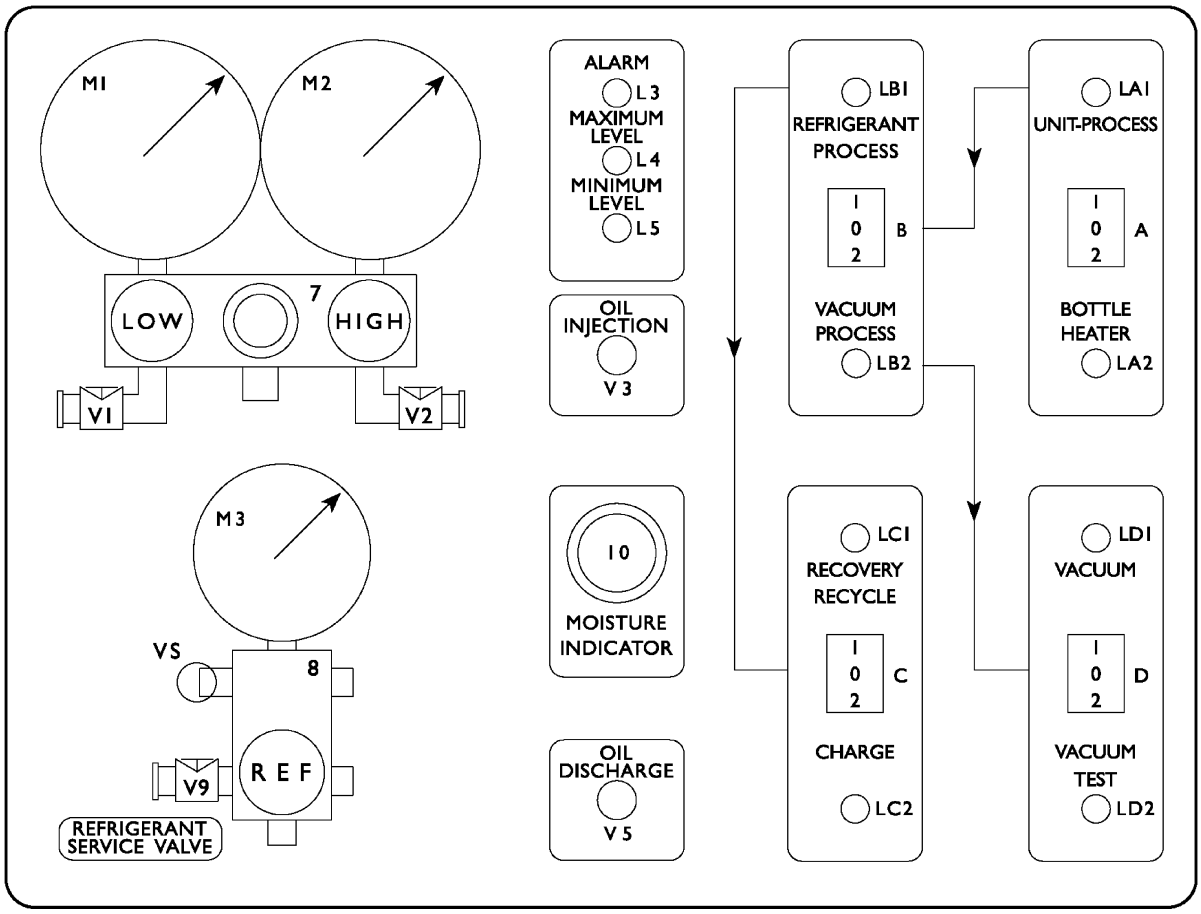
This station is exclusively for professionally trained operators who must be familiar with refrigerating systems, refrigerant gases and the damage pressurized equipment can cause, therefore:

- ❑ always wear gloves and goggles when working with refrigerant gases. Contact of refrigerant liquid with the eyes can cause blindness;
- ❑ avoid all contact with skin (low boiling point -30°C can cause frostbite);
- ❑ never inhale the vapours of refrigerant gases;
- ❑ before connecting the station with a system or external container, check that all the valves are closed;
- ❑ before disconnecting the station, check that the cycle is over and all the valves are closed. This will prevent dispersing refrigerant gas into the atmosphere;
- ❑ never expose the unit or operate it in acidic or wet environments or close to open containers of inflammable substances;
- ❑ the unit must operate in places with good ventilation;
- ❑ never alter the settings of the safety valves and control systems;
- ❑ never use bottles or other storage containers that are not approved and are not fitted with safety valves;
- ❑ never load any container over 80% of its maximum capacity;
- ❑ never leave the unit powered if it is not to be used immediately. Cut off the mains power supply when it is not planned to use the equipment.

The station is equipped with special fittings to avoid contamination with systems using R12. Do not attempt to adapt this unit for use with R12.

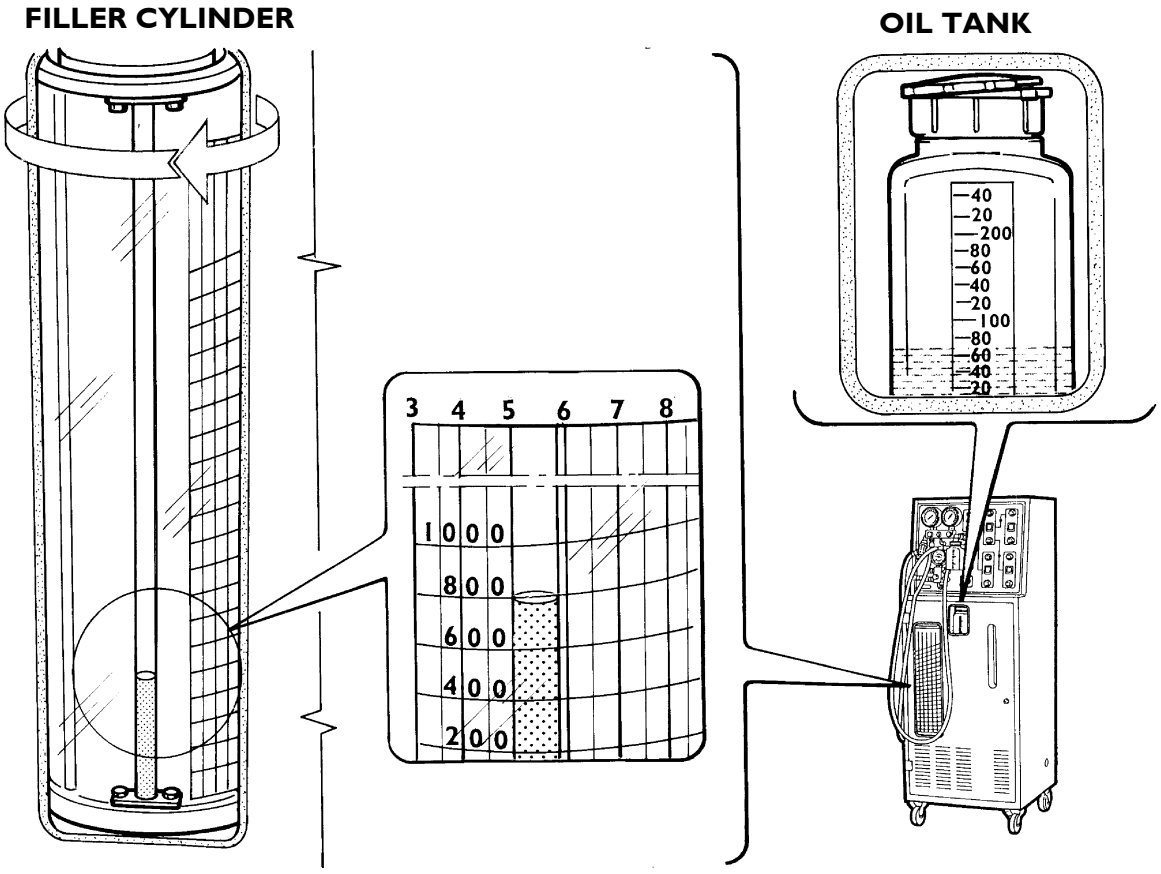
CONTROL FASCIA

Figure 223



50634

Figure 224



50632

Control fascia diagram legend

M1	Low pressure gauge
M2	High pressure gauge
M3	Filler cylinder pressure gauge
LOW	Low-pressure valve
HIGH	High-pressure valve
REF	Refrigerant filler and drain valve
V1	Valve on low-pressure pipe
V2	Valve on high-pressure pipe
V3	Oil injection valve for A/C system
V5	Oil drainage valve
V9	A/C system washing refrigerant service valve
10	Moisture indicator
VS	Safety and drainage valve
L3	Alarm warning light
L4	Maximum level warning light
L5	Minimum level warning light
A	Unit process / bottle heater switch
LA1	Unit process indicator light
LA2	Bottle heater indicator light
B	Refrigerant process / vacuum process switch
LB1	Refrigerant process indicator light
LB2	Vacuum process indicator light
C	Recovery recycle cycle / Filling switch
LC1	Recovery recycle cycle indicator light
LC2	Filling indicator light
D	Vacuum / vacuum test switch
LD1	Vacuum indicator light
LD2	Vacuum test indicator light

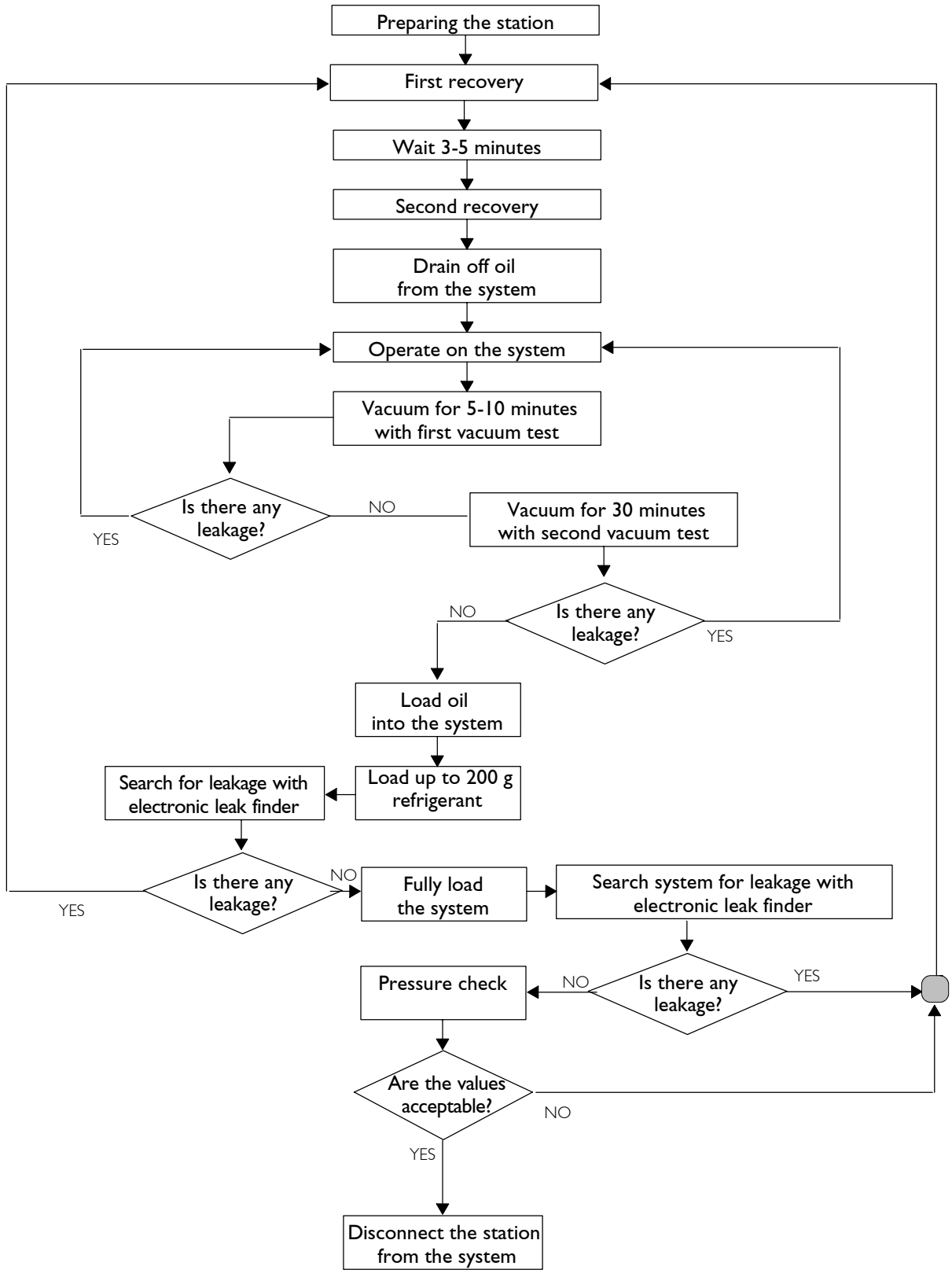
Filler cylinder legend

1 Pressure values in bar (vertical lines, revolving top cylinder).

2 Weight of load in grams (oblique lines, revolving top cylinder) 50 g division between lines.

3 Tank level viewer (internal cylinder).

OPERATION FLOW CHART



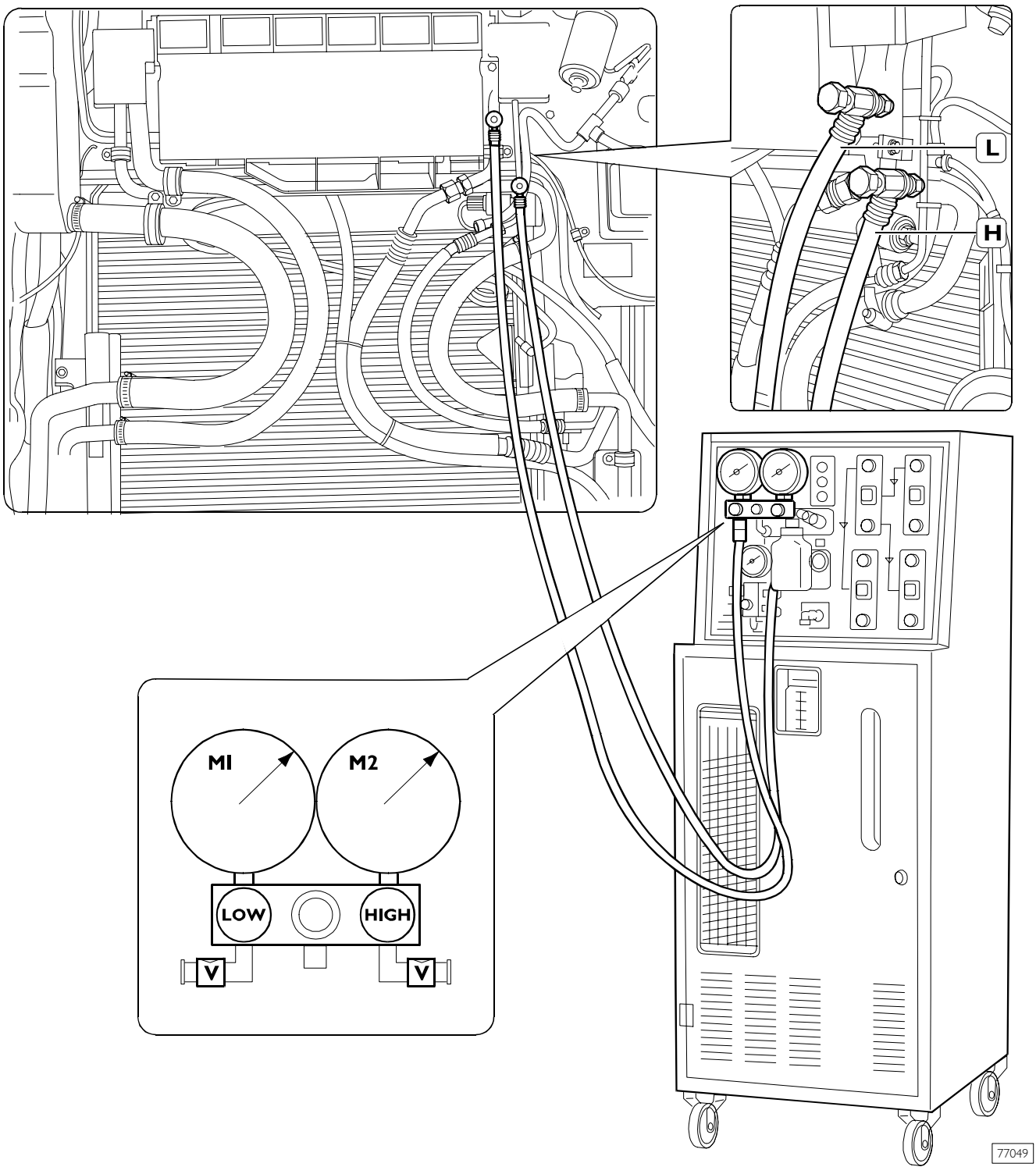
RECOVERING REFRIGERANT FROM THE VEHICLE SYSTEM

Before starting to disconnect the pipes from the air-conditioner, check whether it is possible to do the repairs without discharging the gas.

If this is not possible, the following operations must be carried out:

- ❑ connect the pipe marked **HIGH** under the pressure gauge to the evaporator inlet (the inlet is the one on the pipe with a smaller diameter (H) connecting the drier filter with the evaporator);
- ❑ connect the pipe marked **LOW** under the pressure gauge to the evaporator outlet (the outlet is the one on the pipe with a larger diameter (L) connecting the evaporator with the drier);
- ❑ open the valves **V1** and **V2**;
- ❑ open the **LOW** and **HIGH** cocks;

Figure 225

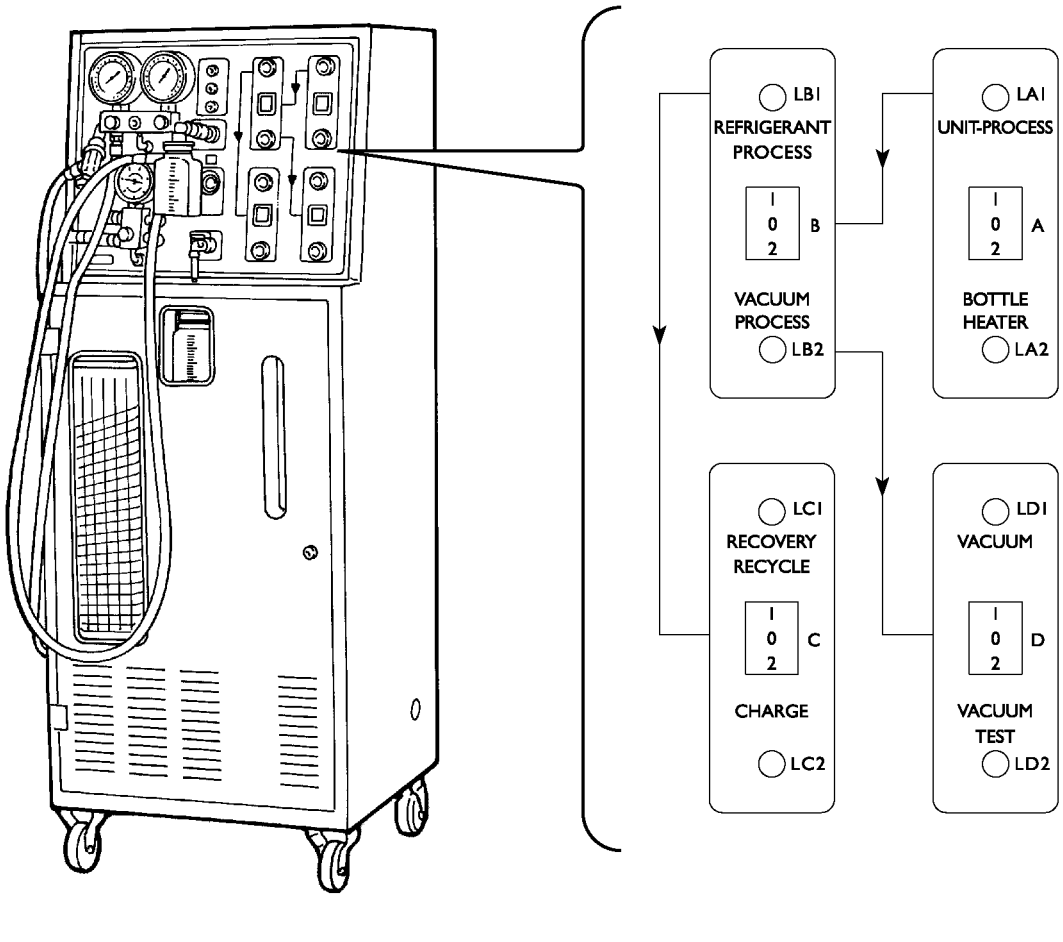


- ❑ connect the station to the electricity mains (220 V - 50 Hz);
- ❑ press the switch **A** (Process Unit) onto position 1. The respective indicator light **LA1** will come on;
- ❑ press the switch **B** (Refrigerant Process) onto position 1;
- ❑ the respective indicator light **LB1** will come on;
- ❑ press the switch **C** (Recovery Recycle) onto position 1. The recovery and recycling operation will start automatically. The respective indicator light LC1 will come on to signal the operation in progress.
  On completing this operation the unit will automatically stop and the indicator light **LC1** go out. Wait for a few minutes so that any pockets of refrigerant at low pressure remaining in the system can increase their pressure, by absorbing heat, and be able to be recovered. The station will automatically repeat the recovery cycle if the above conditions occur;
- ❑ put the switches A, B and C back onto position 0;
- ❑ close the **V1**, **V2**, **LOW** and **HIGH** valves.

If the refrigerant reaches the maximum level (maximum level indicator light L4 on), the recovery cycle must be stopped immediately by pressing switch C onto position 0 and transferring the refrigerant from the filler cylinder to a suitable external bottle.

- ❑ Continue the operations following the instructions given on the following pages.

Figure 226



CREATING A VACUUM IN THE SYSTEM

This operation should be carried out if all the repairs have been performed and the system components have been properly refitted. This operation is the phase prior to refilling, therefore proceed as follows:

Do not run the vacuum cycle when there is even minimal pressure in the station or system.

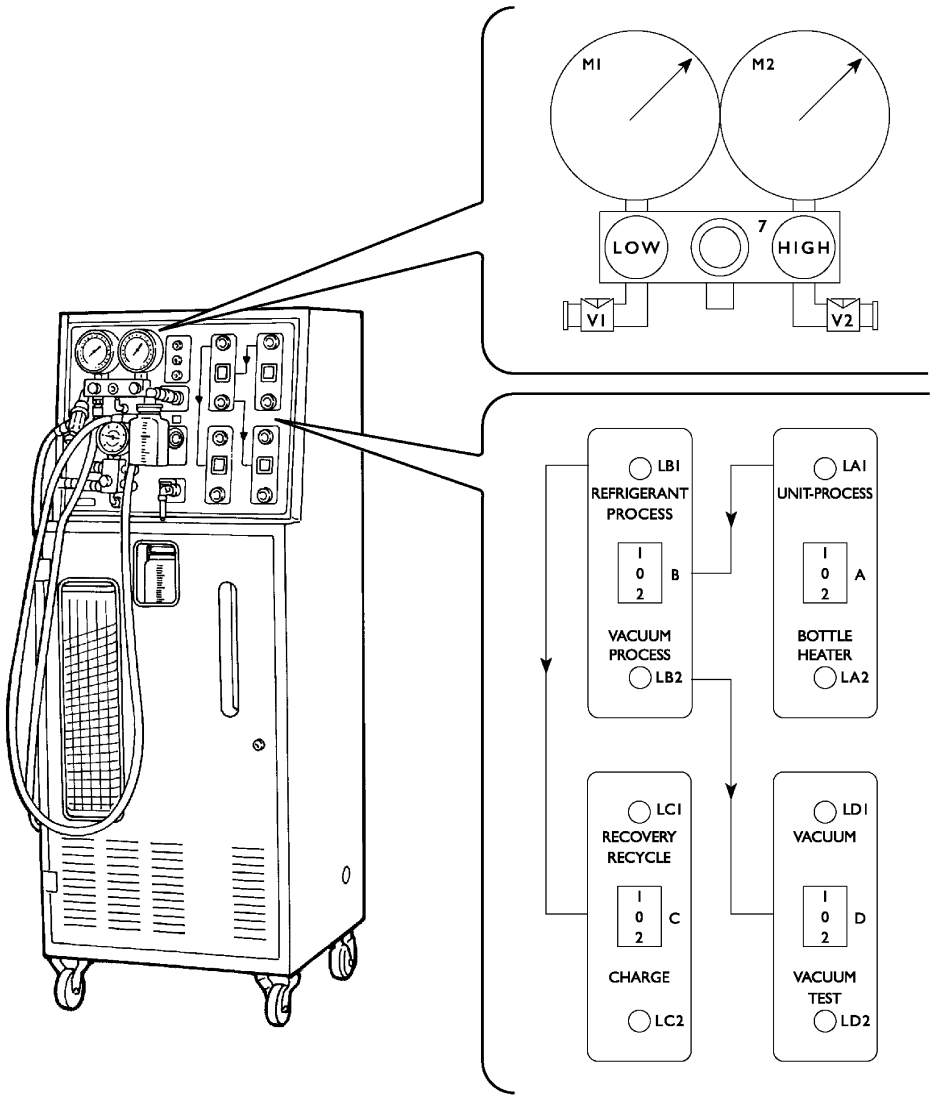
- ❑ connect the pipes to the specific system connections and open the **V1-V2/LOW** and **HIGH** valves;
- ❑ press the switch **A** (Process Unit) onto position 1. The respective indicator light **LA1** will come on;
- ❑ press the switch **B** (Vacuum Process) onto position 2. The respective indicator light **LB2** will come on;
- ❑ press the switch **D** (Vacuum) onto position 1. The system will automatically start being evacuated and the respective indicator light **LD1** will come on to signal the operation in progress.

After a few minutes of operation (10 at most) if the system has no leaks the indicator light LD2 VACUUM TEST will also come on. From this time on, evacuation should be continued for at least two hours to obtain a good evacuation;

The indicator light LD2 vacuum test fails to come on if there is a leak. Stop evacuation, eliminate the leak and repeat the evacuation procedure.

- ❑ at the end of the time programmed for evacuation, press the switch **D** (vacuum test) onto position 2 and leave the system in this state for 3-5 minutes. The indicator light **LD2** VACUUM TEST is on if the system has a good seal. The indicator light **LD2** VACUUM TEST goes out if there is a leak. Eliminate the leak and repeat the evacuation cycle;
- ❑ put the switches **D** and **B** back onto position 0 and proceed with the following phase.

Figure 227



It is possible that at the end of each recovery cycle the station may have recovered lubrication oil from the compressor, which should be drained off into a specific graduated container (1).

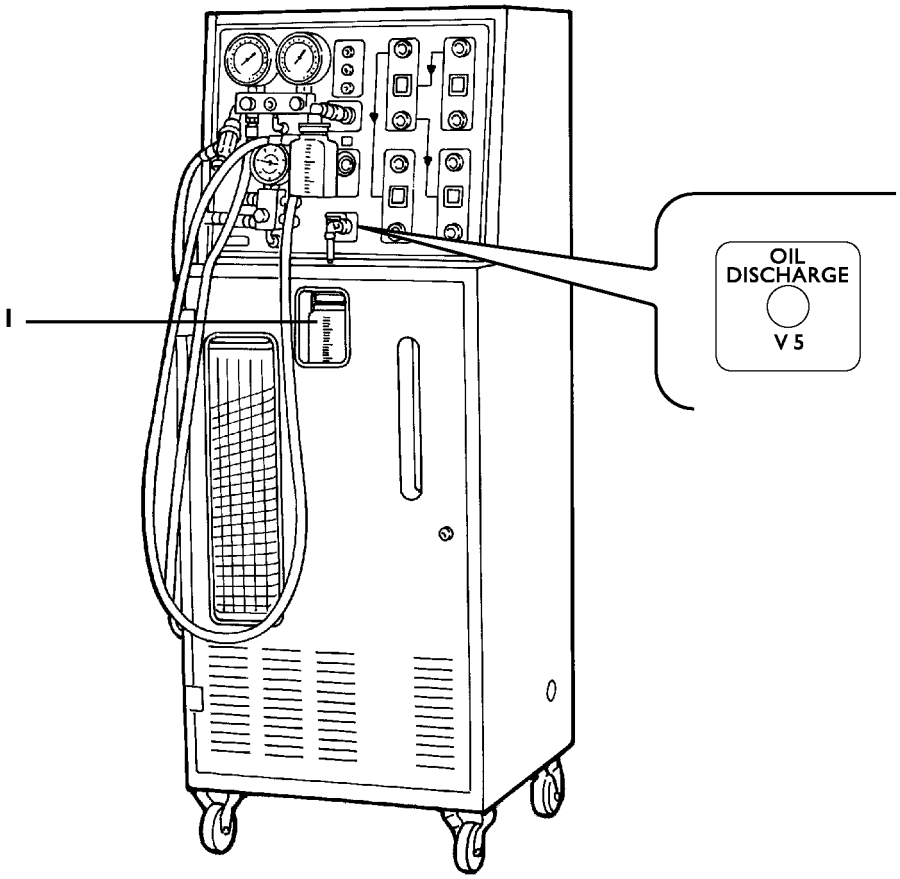
1 Slowly open the valve **V5** (Oil Discharge).

2 When all the oil has been discharged into the container (1) close the valve **V5**.

3 Quantify and **record** the amount of oil discharged.

4 Eliminate the recovered oil correctly.
This oil cannot be reused.
The same amount of new oil as has been removed must be added to the system.

Figure 228



RESTORING OIL IN THE SYSTEM

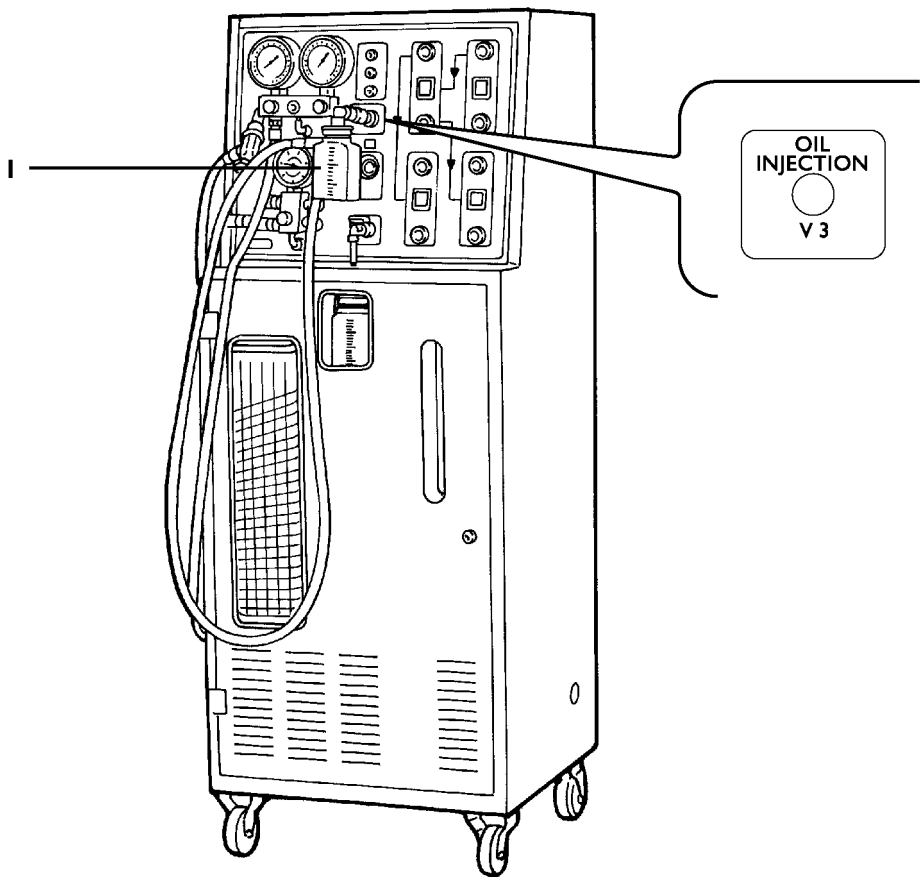
If during the recovery and recycle phase, oil from the system has been removed, it must now be replenished:

- ❑ take the metering device supplied with the right amount of lubricant for the system concerned, or previously measured;
- ❑ connect the metering device (1) to the lubricant injection valve **V3**;
- ❑ open the valve **V3** and then carry out the system vacuum phase for a few moments;
- ❑ open the valve mounted on the metering device container (1). The oil will be drawn into the system;
- ❑ close the valve **V3** and the valve on the metering device container when the required quantity of lubricant has been drawn in;
- ❑ disconnect the metering device (1) from the injection valve **V3** and fit the protective cap back on;

NOTE Keep the oil containers well sealed in order to avoid contamination. In particular, remember that oil is extremely hygroscopic:

- ❑ never open the oil injection valve **V3** if the system has positive pressure;
- ❑ oil should only be injected with a vacuum in the system;
- ❑ the oil level must never fall under the suction pipe (air would get into the system).

Figure 229



FILLING THE SYSTEM WITH REFRIGERANT

Before refilling, it is wise to be aware of some important rules:

- ❑ know the quantity of refrigerant to use (it is normally written on an adhesive plate affixed on the vehicle);
- ❑ the filler cylinder is equipped with a minimum level check that prevents introducing incondensable gas into the system.
  This is why the last approx. 600 g of refrigerant it contains cannot be used;
- ❑ therefore, before filling, check that the cylinder contains a sufficient quantity for filling (maximum quantity that can be used 3800 g);
- ❑ if the pressure inside the filler cylinder indicated on the pressure gauge (2) is greater than as required, which can be seen on the filler cylinder window approx. 10 bar max, discharge the excess pressure through the valve (1) on the pressure gauge assembly to bring it down to the right level, reading the value on the pressure gauge.

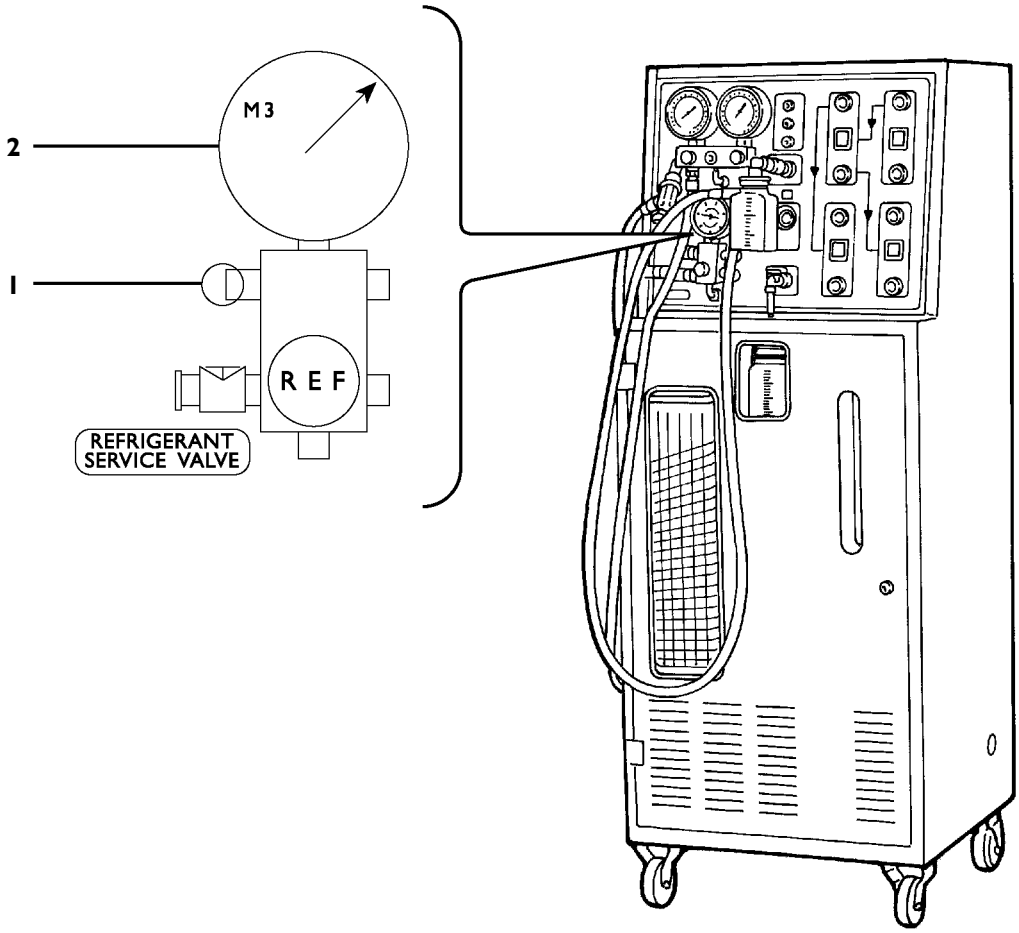
NOTE To transfer refrigerant from an external bottle to the filler cylinder and vice versa, refer to the equipment manual.

Considering that the amount of refrigerant depends on its pressure, to know the actual weight it is necessary to turn the outside of the filler cylinder so the line of the diagram matches the level viewer. In this way we can know the exact quantity of refrigerant in the cylinder (starting weight).

When calculating the weight of the refrigerant, in addition to the 600 g that cannot be used, remember to increase the load by approximately 100 g (this is the weight of refrigerant contained in the station-system connecting pipes). The right quantity of refrigerant to introduce into the system will therefore be given by: 600 g + 100 g + (quantity referred to the system capacity).

Always check before filling that the indicator on the "console" shows the refrigerant contains no moisture, in which case the indicator will be bright green. If this is not so, replace the filters in the station as instructed in the equipment manual.

Figure 230



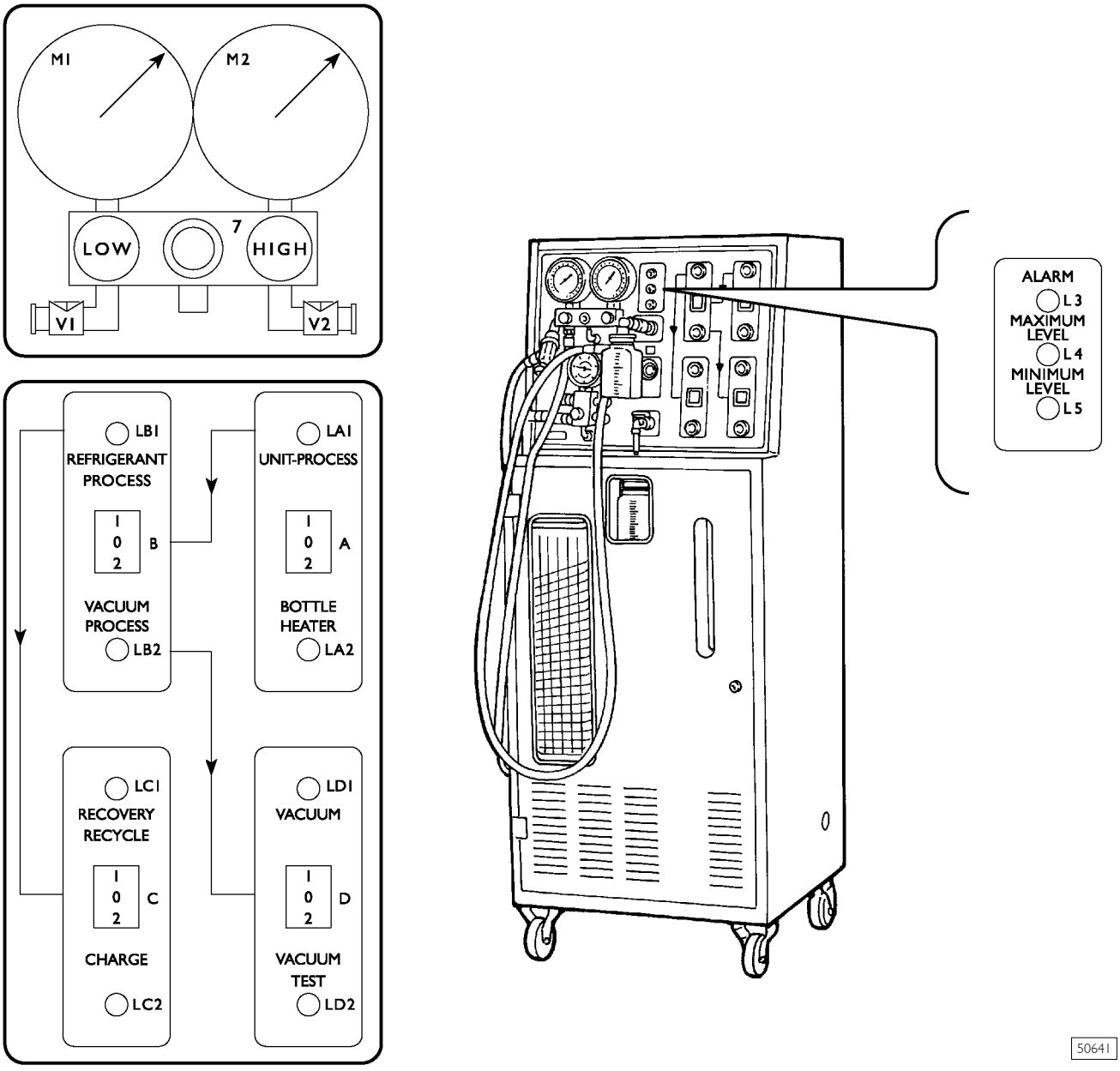
When the cylinder contains the necessary quantity for filling (both pipes must already be connected to the system connectors since the vacuum operation has already been performed), proceed as follows:

- close the **LOW** valve, keep the **HIGH** and **V1 - V2** valves open;
- press the switch **B** (Refrigerant process) onto position 1, the indicator light **LB1** will come on;
- press the switch **C** (Charge) onto position 2, the respective indicator light **LC2** will come on and refrigerant will flow from the station into the system;

NOTE When filling, if the level of refrigerant in the cylinder falls under the required quantity the system will stop and the Minimum Level indicator light (L5) will come on.

- having loaded 200 ÷ 500 g of refrigerant, depending on the size of the system, stop filling by moving the switch **C** (Charge) onto position 0;
- check the system is properly sealed with the electronic leak finder;
- complete filling the system until the **pre-calculated residual weight** in the cylinder is reached;
  (Residual weight = Total weight - System capacity weight)
- complete filling, move the switches **C - B** and **A** onto position 0 (A had been moved for the vacuum).
  Check again there is no leakage;
- close the **HIGH** valve.

Figure 231



CHECKING THE PRESSURES IN THE SYSTEM

After filling, leave the pipes connected and carry out the following check:

- ❑ close the **HIGH** and **LOW** valves, **V1** and **V2** open;
- ❑ turn on the engine, switch on the air-conditioner and check on the pressure gauges **M1** and **M2** that the pressures correspond, normally: low pressure no less than 1 bar, high pressure 15 ÷ 18 bar, depending on the system specifications.

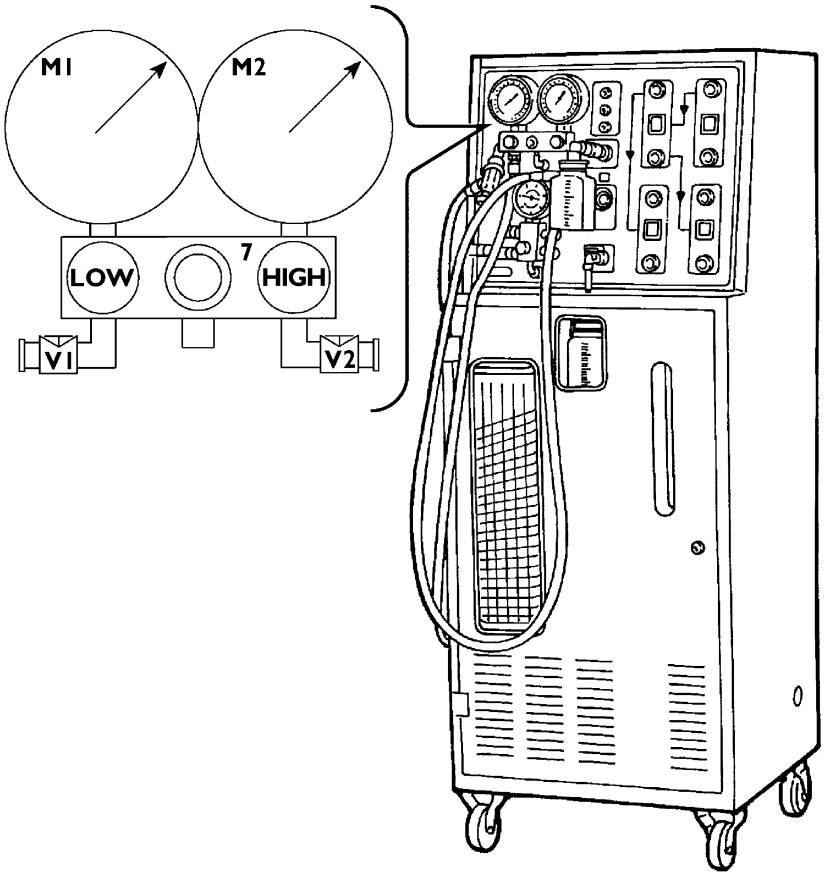
OPERATIONS PRIOR TO DISCONNECTING THE STATION FROM THE SYSTEM

Always observing the above safety rules, carry out the following operations:

- ❑ check that all the valves are closed: **LOW - HIGH**, **V1 - V2**;
- ❑ disconnect the pipes of valves **V1 - V2** and put the caps back onto the system valves;
- ❑ Check the system again with the leak finder.

NOTE Normally, with the air-conditioner switched on, air should come out of the vents at a temperature lower than 5°C and after a period of operation to stabilize the temperature of the ducts.

Figure 232



50642

PROCEDURE FOR DRAINING AND RECHARGING AIR CONDITIONING SYSTEMS WITH RECHARGING STATION 99305148 AND RECOVERY OF R134A COOLANT

This station has been made to be used on all air-conditioning/ heating systems for motor vehicles using R134A gas.

By connecting the station to a refrigerating system the gas it contains can be recovered, cleaned and made ready to be reloaded into the system or be transferred to an external container. In addition, it is possible to see the amount of oil taken from the system, restore it and "empty" the system.

Main components

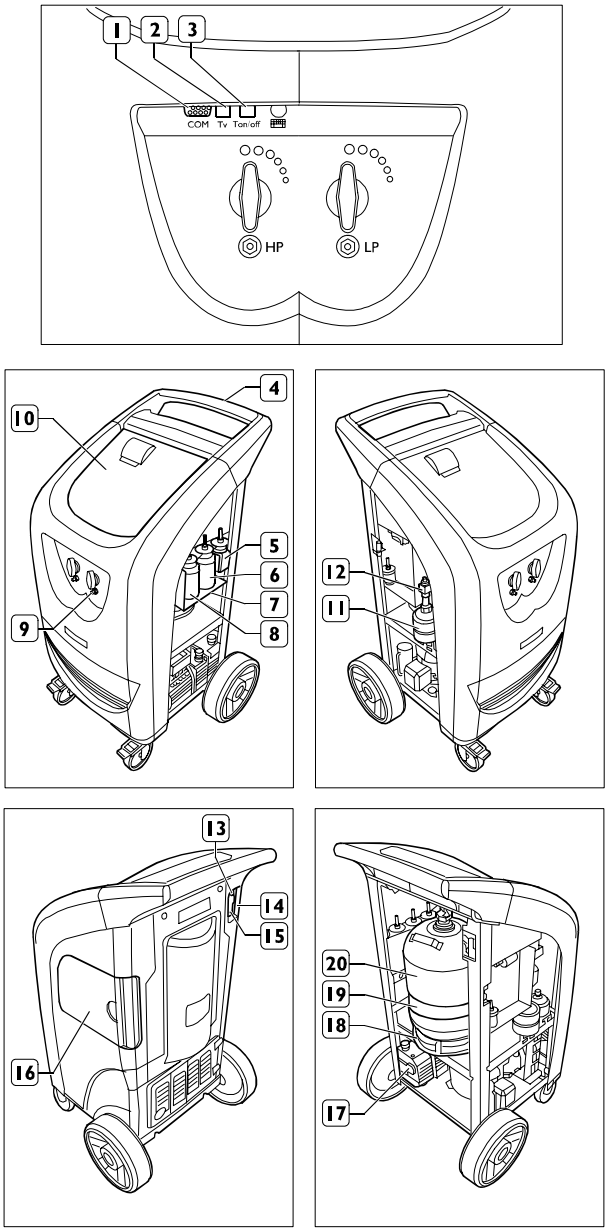
To be operative, the station needs to absorb approximately 3 kg of refrigerant.

For prompt use it is advised to have at least 2 kg of refrigerant in the filler cylinders and to keep the station as level as possible.

NOTE This procedure does not describe the charge/drain phases of coolant from internal/external tanks an dit does not provide indications on maiintenance interventions required.

For these operations, please refer to the equipment supplier use and maintenance manual.

Figure 233



115615

1.Serial port - 2. TV temperature probe connector - 3. Electrical probe connector - 4. Handle - 5. Tracer container - 6. New fluid container - 7. Fluid scales - 8. Used fluid container - 9. Taps - 10. Control console - 11. Dehydrating filters - 12. Moisture gauge - 13. Master switch - 14. Fuse - 15. Electric plug socket - 16. Fluid container flap - 17. Vacuum pump - 18. Electronic scale - 19. Heater coil - 20. Cylinder

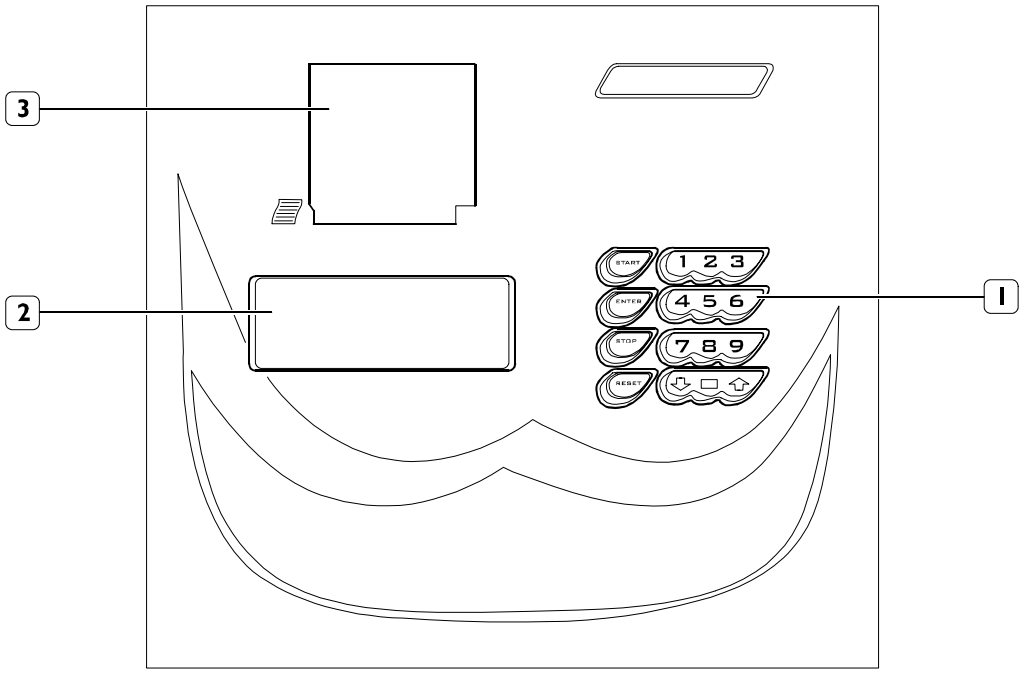
SAFETY STANDARDS

This station is exclusively for professionally trained operators who must be familiar with refrigerating systems, refrigerant gases and the damage pressurized equipment can cause, therefore:

- ❑ always wear gloves and goggles when working with refrigerant gases. Contact of refrigerant liquid with the eyes can cause blindness;
- ❑ avoid all contact with skin (low boiling point -30°C can cause frostbite);
- ❑ never inhale the vapours of refrigerant gases;
- ❑ before connecting the station with a system or external container, check that all the valves are closed;
- ❑ before disconnecting the station, check that the cycle is over and all the valves are closed. This will prevent dispersing refrigerant gas into the atmosphere;
- ❑ never expose the unit or operate it in acidic or wet environments or close to open containers of inflammable substances;
- ❑ the unit must operate in places with good ventilation;
- ❑ never alter the settings of the safety valves and control systems;
- ❑ never use bottles or other storage containers that are not approved and are not fitted with safety valves;
- ❑ never load any container over 80% of its maximum capacity;
- ❑ never leave the unit powered if it is not to be used immediately.
  Cut off the mains power supply when it is not planned to use the equipment;
- ❑ always connect the pipe with the RED machine quick coupling to the A/C system high pressure branch.
  Always connect the pipe with the BLUE machine quick coupling to the A/C system low pressure branch.
  Keep the connection pipes far away from moving or rotating objects or parts (cooling fan, alternator etc.).
  Keep the connection pipes far away from hot items or parts (engine exhaust pipes, radiator etc.);
- ❑ always fill the A/C system with the amount of fluid recommended by the manufacturer.
  Never exceed this amount. Always check the fluid level before each operation.
  Always add the correct amount of fluid.
  Check the electric mains is 220-240V/50Hz before connecting the machine to the mains;
- ❑ the cylinder must be filled to 80% of maximum capacity to leave a gas reserve to absorb any pressure increases.
  Never touch the internal cylinder taps.
  Dispose of fluid extracted from the A/C system and vacuum pump in special waste fluid containers.
  Change the filters at the required intervals using only filters recommended by the manufacturer.
  Only use fluids recommended by the manufacturer.
  Never swap the vacuum pump fluid with air conditioning system fluid.
  Any guarantees on the machine will be null and void if the above safety rules are not complied with.

CONTROL PANEL

Figure 234



114767

1. Keypad - 2. Alphanumeric LCD - 3. Printer

Keypad functions

STOP: Use this key to stop the current operation (recovery - drain fluid - empty - add fluid - fill).
Press the START key again to start again from the previous point.
The horn is switched off if the STOP key is pressed during an alarm, an error or at the end of an operation.
ENTER: This key confirms the procedure or operation flashing on the LCD.

↓: This key is used to move from one procedure to another or from one operation to another, from top to bottom.

↑: This key is used to move from one procedure to another or from one operation to another, from bottom to top.

START: This key activates the confirmed procedure or operation.

NOTE Press START only when requested to by the LCD).

Emergency warning light panel

HIGH PRESSURE ALARM: is displayed and emits an acoustic signal when fluid pressure in the circuit exceeds 17.5 bars.
The recovery operation is automatically halted.

CYLINDER FULL ALARM: displayed and emits an acoustic alarm when more than 80% of the maximum capacity is present in the cylinder, i.e. 9.5 kg.
RECOVERY operation is automatically halted (to cancel this alarm, one or more A/C systems must be charged before recovering more coolant).

CYLINDER EMPTY ALARM: displayed and emits an acoustic alarm when too little coolant is present inside the cylinder.

NEW FLUID CONTAINER ALARM: displayed and emits an acoustic alarm when the volume of new fluid drops below approximately 50 cm^3.

USED FLUID CONTAINER FULL ALARM: displayed and emits an acoustic alarm when the volume of used fluid drops exceeds approximately 200 cm^3.

LEAKS IN A/C SYSTEM ALARM: displayed and emits an acoustic alarm after the first 10 minutes of vacuum if there are leaks in the A/C system.

NOTE Detection of micro-leaks cannot be guaranteed.

SERVICE ALARM: displayed and emits an acoustic alarm when 150 kg of coolant are recovered.
To deactivate, replace the filters and vacuum pump fluid.
Together with the filters, a code will be sent to eliminate the alarm.

PRELIMINARY CHECKS

Check that the switch (13, Figure 233) is in position 0.
Check that all the machine taps are closed.
Connect the machine to the mains and turn on.
Check that the pump fluid level gauge indicates at least half full.
If the level is low, fuel must be added.

Check the additional fluid container (6, Figure 233) contains at least 100 cm^3 of fluid.
Check the machine LCD to ensure the cylinder contains at least 3 kg of coolant.
If not, refill the internal cylinder using an external cylinder with appropriate coolant.

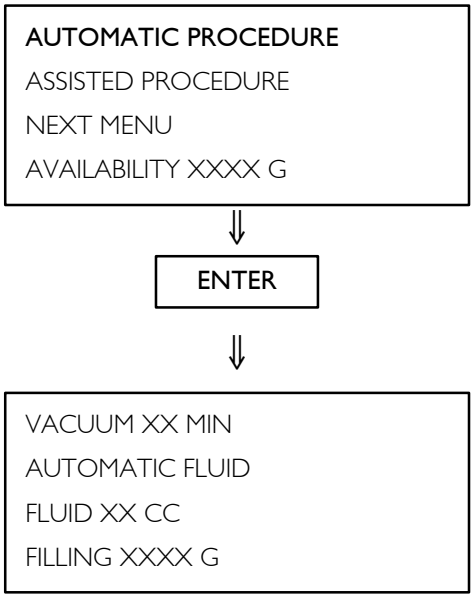
AUTOMATIC PROCEDURE

All the operations are carried out automatically in the automatic procedure: recovery and recycling, fluid drain, vacuum, addition of new fluid and refilling.
The amount of gas recovered, recovered fluid, vacuum time, fluid added and the amount of gas injected are printed automatically at the end of each individual operation.

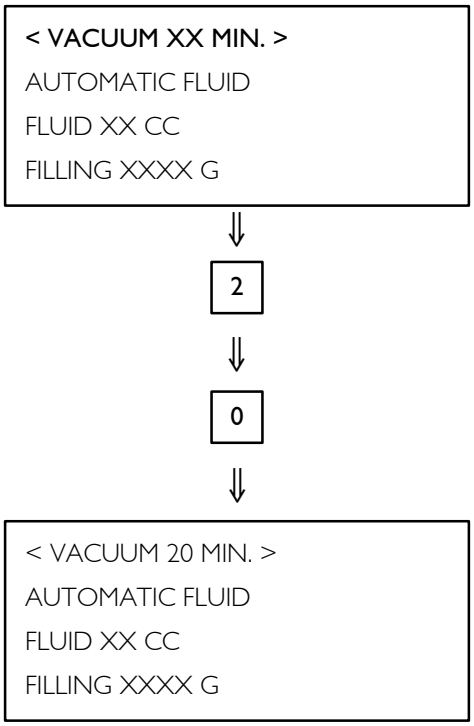
Connect the hoses to the A/C system using the quick couplings, taking care to connect the BLUE hose to the low pressure branch and the RED hose to the high pressure branch.
If the system is equipped with a single high or low pressure quick coupling, only connect the relevant quick coupling.

Check that the high and low taps are closed.
Turn on the vehicle engine and air conditioner for 5-10 minutes, keeping the passenger compartment fan running at maximum speed.
Turn off the vehicle engine.

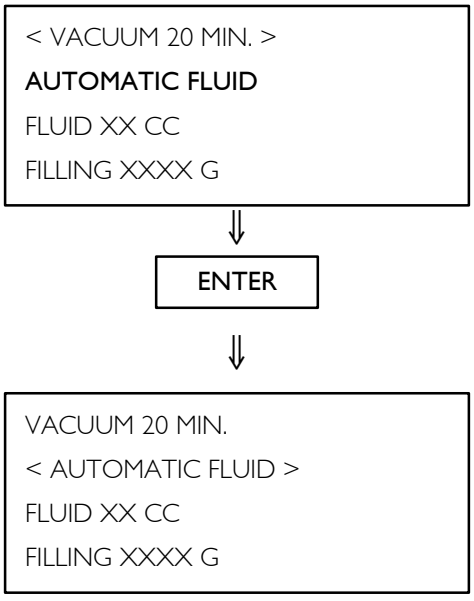
The instrument has a four-row display with up to 20 characters per row.
The selected item flashes on the option menus.
It is indicated between inverted commas in this manual.



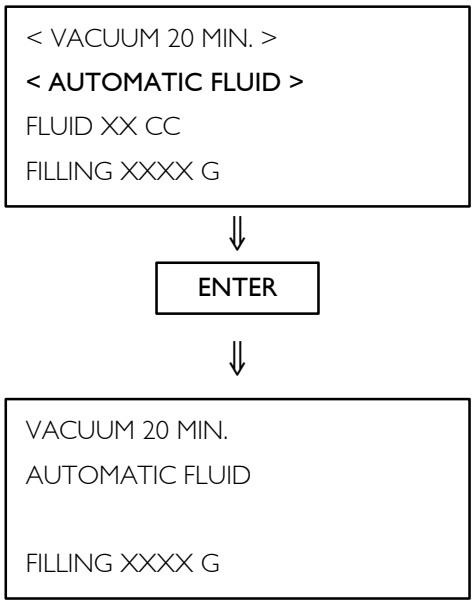
Follow the automatic procedure, i.e. press ENTER when the message "Automatic procedure" flashes on the LCD.



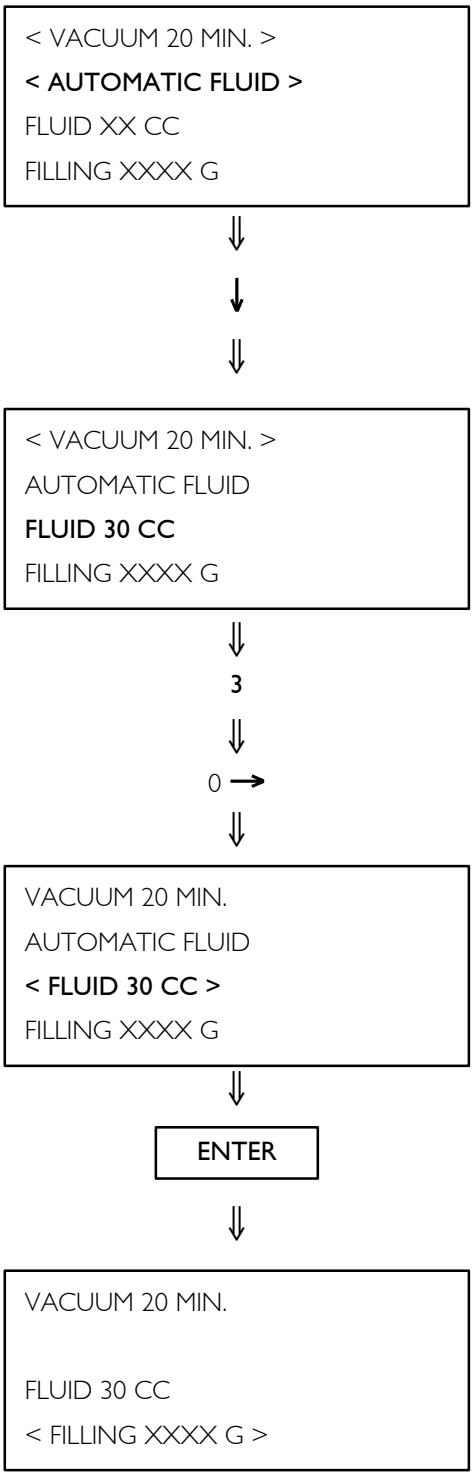
Enter the vacuum time or confirm the previous time. Simply press ENTER to confirm the previous time. Use keys 0-...-9 to set a new time.



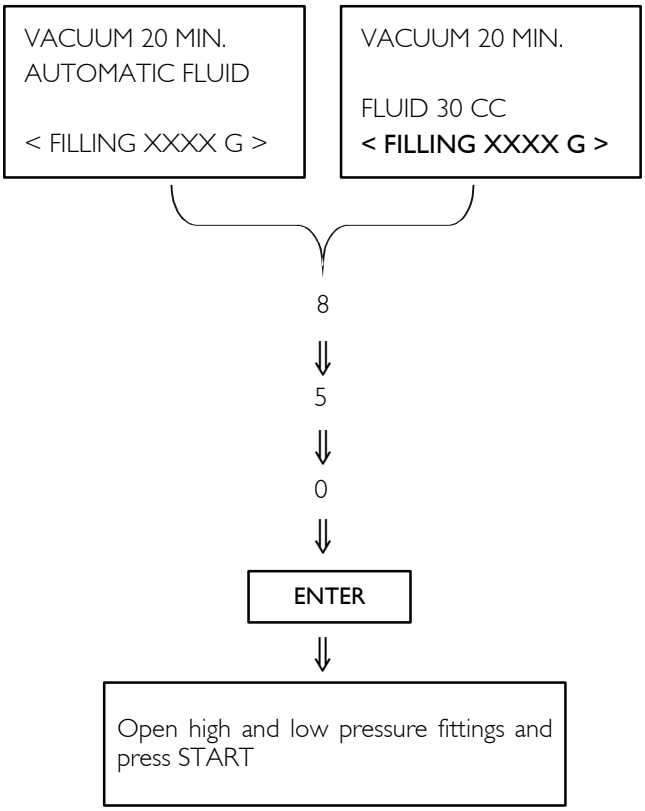
Once the vacuum time has been confirmed, the message "Automatic fluid" begins to flash.
Press ENTER to confirm.



If the automatic fluid is confirmed, the system automatically adds the amount of fluid removed during recovery after the vacuum stage.



If you need to add a quantity of fluid other than the quantity drained after recovery, set as follows: once the vacuum time has been confirmed, the message "Automatic fluid" begins to flash.
Press the ↓ key to move to the message "Fluid xx cc", enter the volume of fluid you wish to be added automatically after the vacuum using the keys 0-... 9 and press ENTER.



Once the fluid has been confirmed, the message "Filling xxxx g" begins to flash. Set the quantity of coolant in g you wish to add to the A/C system.
For example, if the quantity is 850 g, press the keys 8, 5 and 0 "Filling 850 g".
After setting the quantity, confirm with ENTER.

Open the machine high and low pressure fittings and press the START key.

If a gas analyser is installed, the machine tests the purity of the air conditioning system coolant.
If the coolant is sufficiently pure, recovery begins.
If the A/C system does not achieve the required level of purity, the machine runs a second test.
If the second test fails, the machine displays the alarm message "A/C system contains contaminated coolant".

Contaminated coolant cannot be recovered because it would contaminate the coolant inside the machine cylinder.

During the recovery stage, the system displays the amount of coolant recovered in g.
Once recovery is complete, the machine stops draining and automatically displays the spent fluid removed from the A/C system during recovery.

The fluid drain operation lasts 3 minutes. If some pockets of coolant remaining in the A/C system after this operation cause the pressure to increase, the machine automatically begins to recover the coolant.
After draining, the vacuum operation begins automatically for the preset time. After the first 10 minutes, a check is run for A/C system leaks (attention: if vacuum time is < 10 minutes, the machine will not check for leaks in the A/C system).
If leaks are found in the A/C system, the machine automatically stops and displays the "leaks in A/C system" alarm (detection of microleaks is not guaranteed).

If the A/C system seal is effective, the machine will continue with the vacuum operation.
Once the vacuum stage is complete, new fluid is added automatically according to the amount of fluid drained or according to the volume set by the operator.
At the end, the system automatically switches to refilling and adds the set amount.

Once the refilling operation is complete, close the machine high and low pressure fittings and turn on the A/C system to check the pressures.
During the pressure check, the machine displays "Press ENTER to print a pressure graph".
To obtain a print-out, press ENTER. A pressure graph may be printed for other checks by pressing the START key.
After the pressure check, the machine displays the message "Disconnect the HP fitting and open HP-BP".
Now disconnect the quick coupling only from the A/C system (turn the engine off if necessary) and open the high and low pressure taps with the A/C system running so that the A/C system drains off the coolant in the pipes.

After approximately one minute, remove the machine low pressure fitting from the vehicle A/C system and turn off the engine.
Set the master switch (13, Figure 233) to 0.

NOTE The automatic procedure may be run even if the A/C system is empty. In this case, the system begins directly from the vacuum operation.

If the A/C system only has one high pressure quick coupling, set the filling quantity to +150g.

ASSISTED PROCEDURE

In the assisted procedure, each operation may be carried out individually apart from the recycling recovery stage, which is followed automatically by the spent fuel drain stage and the vacuum for the set time.

The amount of gas recovered, recovered oil, vacuum time, oil added and the amount of gas injected are printed automatically at the end of each individual operation.

Recycling recovery

Connect the hoses to the A/C system using the quick couplings, taking care to connect the BLUE hose to the low pressure branch and the RED hose to the high pressure branch.
If the system is equipped with a single high or low pressure quick coupling, only connect the relevant quick coupling.
Turn on the vehicle engine and air conditioner for 5-10 minutes, keeping the passenger compartment fan running at maximum speed.
Turn off the vehicle engine.
Follow the assisted procedure, i.e. press ENTER when the message "Assisted procedure" flashes on the LCD.

If following the assisted procedure, press ENTER when the message "Recycling recovery" flashes on the LCD.
Open the machine high and low pressure fittings and press the START key.

If a gas analyser is installed, the machine tests the purity of the air conditioning system coolant.
If the coolant is sufficiently pure, recovery begins. If the A/C system does not achieve the required level of purity, the machine runs a second test.
If the second test fails, the machine displays the alarm message "A/C system contains contaminated coolant".

Contaminated coolant cannot be recovered because it would contaminate the coolant inside the machine cylinder.

During the recovery stage, the system displays the amount of coolant recovered in g.
Once recovery is complete, the machine stops draining and automatically displays the spent fluid removed from the A/C system during recovery.
The fluid drain operation lasts 3 minutes.
If some pockets of coolant remaining in the A/C system after this operation cause the pressure to increase, the machine automatically begins to recover the coolant.

Vacuum

Connect the hoses to the A/C system using the quick couplings, taking care to connect the BLUE hose to the low pressure branch and the RED hose to the high pressure branch.
If the system is equipped with a single high or low pressure quick coupling, only connect the relevant quick coupling.
Follow the assisted procedure, i.e. press ENTER when the message "Assisted procedure" flashes on the LCD.
To select vacuum, press ENTER when the message "Vacuum xx min" flashes on the LCD.

Set the vacuum time only if you wish to change the previously set time.
Press ENTER to confirm.
Open the machine high and low pressure fittings and press START.
At this point, the vacuum operation begins for the preset time.
After the first 10 minutes, a check is run for A/C system leaks (attention: if vacuum time is < 10 minutes, the machine will not check for leaks in the A/C system). Leaks are found in the A/C system, the machine automatically stops and displays the "leaks in A/C system" alarm (detection of microleaks is not guaranteed); in this event, use leak detector 99305147.
If the A/C system seal is effective, the machine will continue with the vacuum operation.

Adding new fluid

This operation may be carried out exclusively following a vacuum operation and before refilling.
Follow the assisted procedure, i.e. press ENTER when the message "Assisted procedure" flashes on the LCD.
Select the fluid, i.e. when the message "Fluid xx cc" flashes on the LCD.
Set the volume of new fluid to be added in cm^3.
Press ENTER to confirm.
Open at least one of the two machine high or low pressure valves and press START.

Filling A/C systems

Follow the assisted procedure, i.e. press ENTER when the message "Assisted procedure" flashes on the LCD.
Select refilling, i.e. when the message "Refilling xxxx g" flashes on the LCD.
Set the amount you wish to add to the A/C system in grams (if an A/C system contains 740g press keys 7, 4 and 0.
To check, ensure the message "Filling 740g" is displayed).
Press ENTER to confirm.

Press the START key and open the machine high pressure tap (if the A/C system only has one low pressure fitting, open the machine low pressure tap).
Once the refilling operation is complete, close the machine high and low pressure fittings and turn on the A/C system to check the pressures.
During the pressure check, the machine displays "Press ENTER to print a pressure graph".
To obtain a print-out, press ENTER.
A pressure graph may be printed for other checks by pressing the START key.
After the pressure check, the machine displays the message "Disconnect the HP fitting and open HP-BP".
Now disconnect the quick coupling only from the A/C system (turn the engine off if necessary) and open the high and low pressure taps with the A/C system running so that the A/C system drains off the coolant in the pipes.

After approximately one minute, remove the machine low pressure fitting from the vehicle A/C system and turn off the engine.
Set the master switch (13, Figure 233) to 0.
If the A/C system only has one high pressure quick coupling, set the filling quantity to +150g (this is the amount that may remain in the high pressure pipe).

LEAK FINDER FOR AIR-CONDITIONING SYSTEMS WITH HFC R134A (99305147)

Tool L-780A makes it possible to identify leakage of HFC 134A gas from the system extremely accurately in the order of 3.3 g a year with the switch on maximum sensitivity.

This instrument requires no settings, the operator only needs to select the desired sensitivity.

The instrument warns the operator of any gas leakage with a buzzer and a LED that flashes in proportion to the concentration of gas.

In addition, the LED indicates the battery is flat if it goes out.

Operating temperature is between 0 C and 50°C.

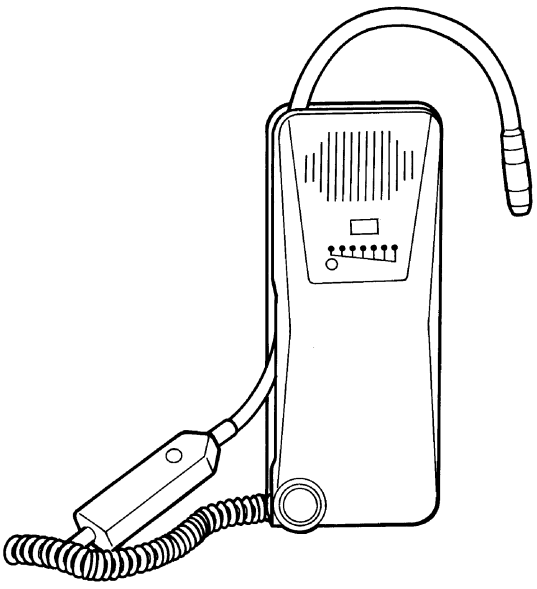
The instrument is equipped with a flexible probe to reach particularly difficult fittings or parts.

The two levels of sensitivity are:

- low sensitivity = 16.5 g/year;
- high sensitivity = 3.3 g/year.

NOTE Before checking vehicles, wait for the engine to cool, the hot parts can falsify the test.

Figure 235



50643

DIAGNOSTICS INSTRUMENTS

Currently the available instrumentation comprises:

MODUS - IT 2000 - E.A.SY.

These are diagnostic tools that permit making a complete diagnosis on the different systems on the vehicles in the IVECO range.

MODUS

A computerized diagnosis station dedicated to diagnosis of the braking systems, air suspensions, engines and electronically controlled systems.
The station is equipped with auxiliary functions such as: programming electronic control units, referring to the spare parts catalogue, service time schedules.
The vehicle is equipped with the 30-pin diagnosis socket.

IT 2000

IT 2000 is a diagnosis tool for all the electronic systems of IVECO vehicles.
It enables immediate action on the vehicle by identifying it with its chassis number.
It saves the results of the diagnostics carried out.
It can also be used as a portable Personal Computer and is fitted for remote diagnosis.
By using MODUS as the parent station it is possible to update and configure the IT 2000.
IT 2000 interfaces with the vehicle via a 30-pin diagnosis socket.
Observe the screens on the single instruments to make the necessary repairs.

E.A.SY.

E.A.SY. system allows to simply make the diagnosis and programming of the various electronic central units aboard the vehicle.

E.A.SY. system is made up of ECI module communicating with the electronic central units and of a Panasonic PC.

ECI module, exploiting the Panasonic PC, also allows easy on the road interventions: in particular, thanks to Panasonic PC wireless technologies (e.g. GPRS), diagnostic interventions can be assisted by a remote expert centre.

CHASSIS

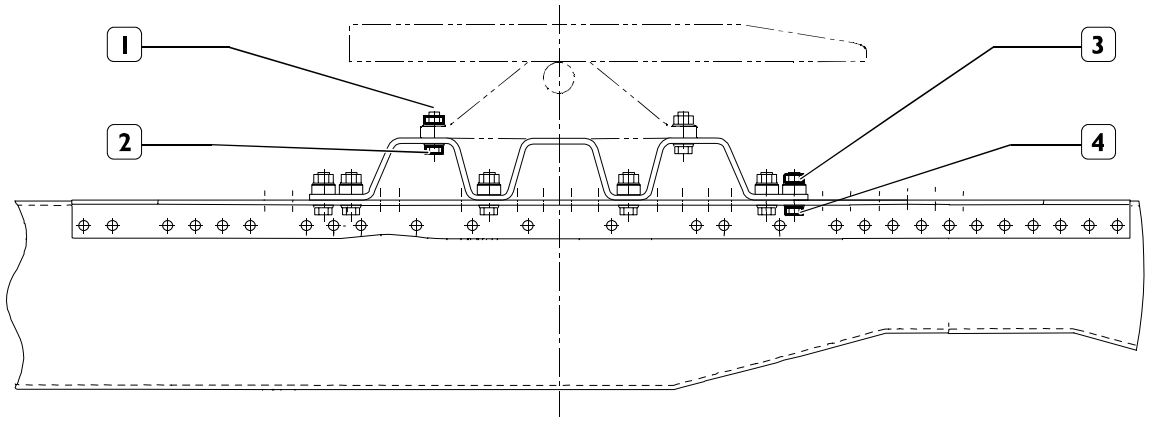
Double bottle neck high resistance steel chassis.

Dimensions

Inner distance between side members:		1016 mm (front) 836 (middle) 756 mm (rear)
Note: Indicated distances are independent of thickness.		
Side member section inner height		289 mm (front) 199 mm (rear)
Side member thickness:	6.7 mm	Standard models
	7.7 mm	HM (Heavy Mission) Models and 6x2 FP / FS - GV Models

TIGHTENING TORQUES

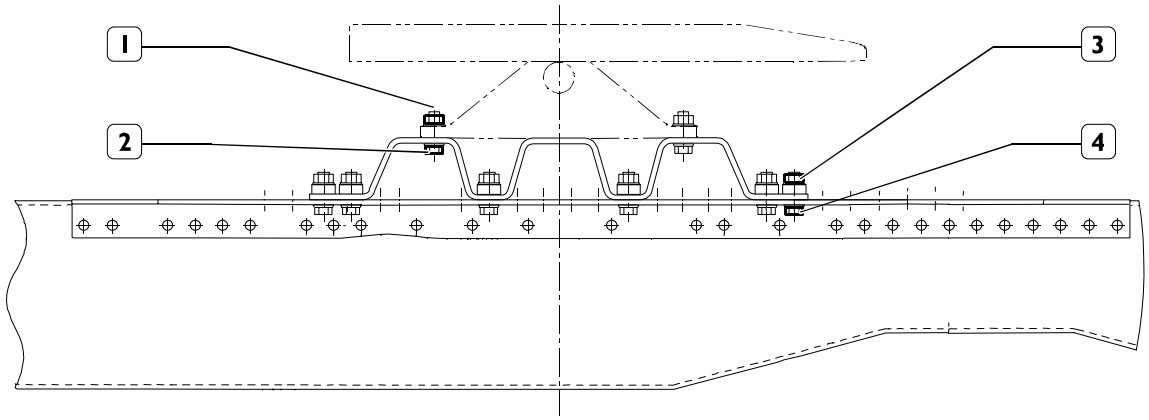
Figure 236



90317

SEMITRAILER FIFTH WHEEL MOUNTING SCHEME

Figure 237



90318

SEMITRAILER PLATE AND FIFTH WHEEL MOUNTING SCHEME

PART	TORQUE	
	Nm	Kgm
Screw with M16x1.5 flange securing fifth wheel to chassis or plate	310.5 ± 33.5	31 ± 3.3
Nut with M16x1.5 flange securing fifth wheel to chassis or plate	310.5 ± 33.5	31 ± 3.3
Nut with M16x1.5 flange securing plate to chassis	310.5 ± 33.5	31 ± 3.3
Screw with M16x1.5 flange securing plate to chassis	310.5 ± 33.5	31 ± 3.3

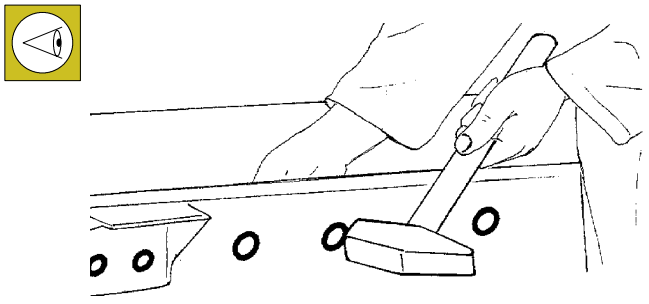
5001 CHASSIS FRAME

REPAIRS

CHECKS

Inspect the chassis frame, checking its alignment.
If even at this stage you detect any deformation you then need to free the relevant part of the chassis frame to help make an exact measurement.
Before the test you need to check all the parts that, with their imperfections, affect the exact measurements (for example, tyre pressure, weak or broken leaf springs, etc.).

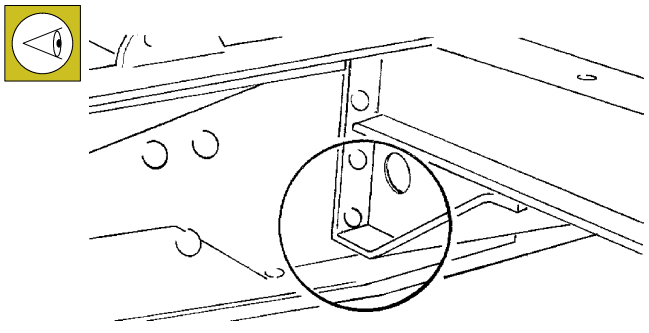
Figure 238



17344

Check the rivets by striking their heads with a mallet and touching the opposite side with your fingers.
Mark any loose rivets with paint to help identify them during the repair work.

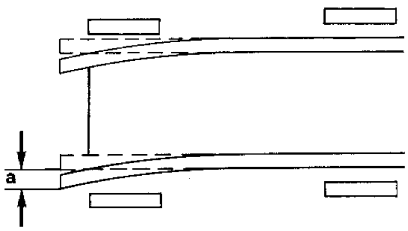
Figure 239



17345

Carefully check for any peeling or cracking all over the chassis frame, paying special attention to joints under great strain, such as: chassis frame cross members, brackets, mounts of leaf springs and chassis frame structural members.
Mark any peeled or cracked points straight away.

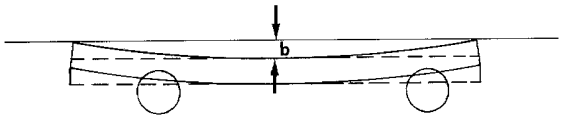
Figure 240



17347

Laterally permissible curvature of chassis frame
"a" = 3 mm/m.

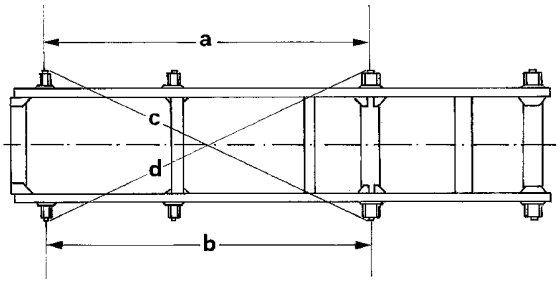
Figure 241



17348

Permissible curvature of chassis frame
"b" = 1 mm/m
Maximum 10 mm.

Figure 242

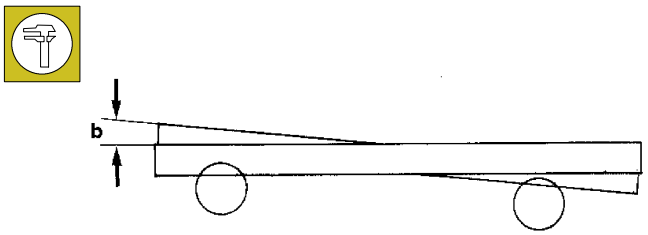


17349

Permissible difference between "a" and "b" = 3 mm.
With diagonal measurement between "c" and "d" = 6 mm.

Measuring the bend of the chassis frame downwards or upwards

Figure 243

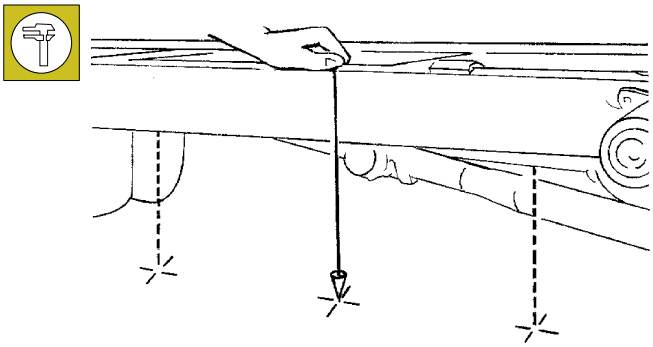


17350

Permissible torsion on the chassis frame
"b" = 1 mm each side.

Measuring the side bend of the chassis frame

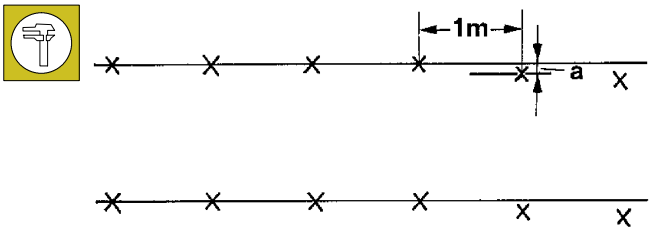
Figure 244



17351

To measure the side bend of the chassis frame you need to plumb the supporting surfaces starting with the two structural members at an interval of approximately 1 m.
The points obtained in this way need to be marked accurately on the floor.

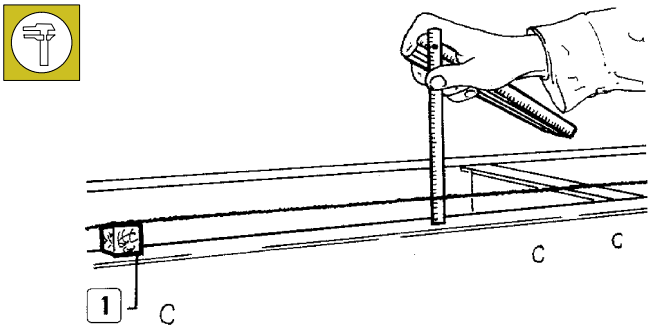
Figure 245



17352

To use the plumbed points you need to stretch out a string passing through the marked points in a line.
The points outside the line indicate the start and extent of the actual deformation (a).

Figure 246

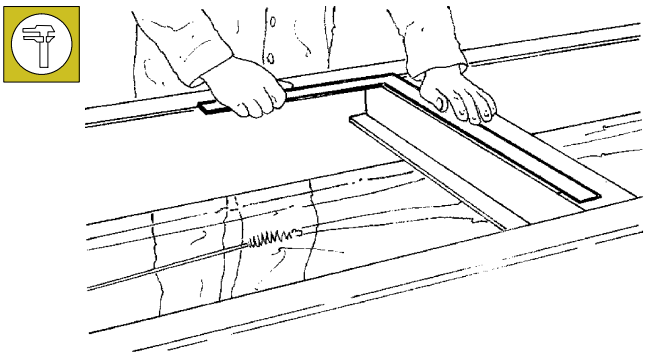


17353

Take two shims (1) of such a size that a string can be stretched along the full length from the straight portion of the bottom or top waist on the structural member of the chassis frame.
Measure the distance of the structural member from the string at 1-metre intervals. A different string distance indicates the position and extent of an actual bend in the structural member.

Measuring the movement of the chassis frame

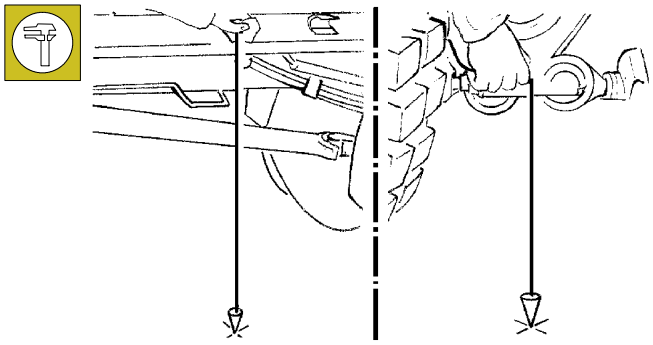
Figure 247



17354

A movement of the chassis frame can be measured by means of a set square.
To do this, place the set square at 90° to the structural member of the chassis frame and check the squareness of the cross members of the chassis frame.

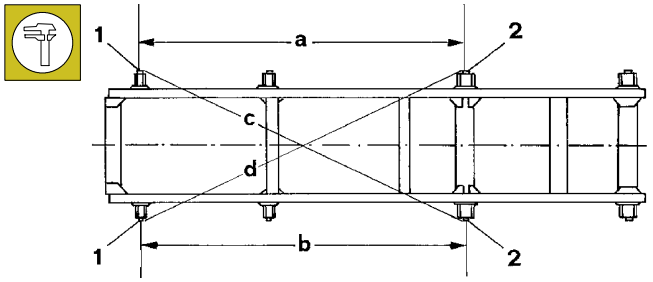
Figure 248



17355

A movement in the position of the axes can be checked by making a diagonal measurement. To do this, plumb the centre of the front mount of the front suspension and the centre of the front support of the rear leaf spring on the flat supporting surface, on both sides.

Figure 249

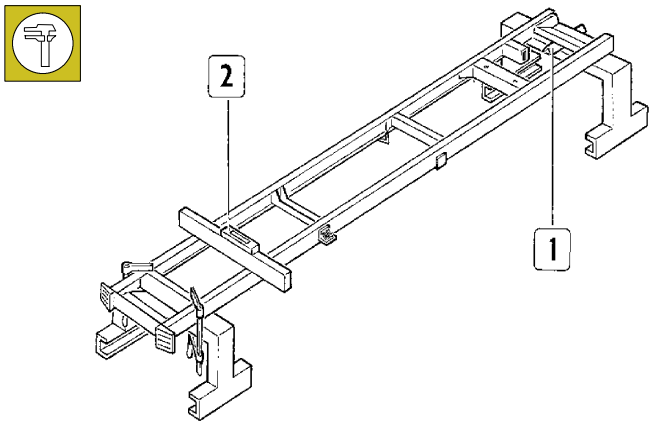


17356

Firstly compare the distance of the points "a" and "b". Then make the diagonal measurement (distance "c" and "d") from point (2) in front to the right to point (2) behind to the left and the opposite.

Measuring the torsion of the chassis frame

Figure 250



17357

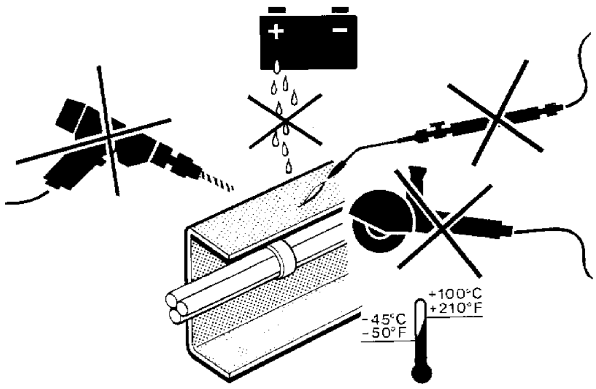
A slight torsion can only be measured with the chassis frame freed of the cab and mechanical assemblies.
To do this check, proceed as follows:

- ❑ Set the chassis frame on two stands.
- ❑ Using two clamps, secure one side of the chassis frame to the stand.
- ❑ Position the other side of the chassis frame, in a central position under the rear cross member, on the knee of an L-shaped iron (1).
- ❑ Set a rule crosswise and put a spirit level (2) on this, checking the reading.

At each check point you will need to have the same reading or the chassis frame is out of shape.

PRECAUTIONS

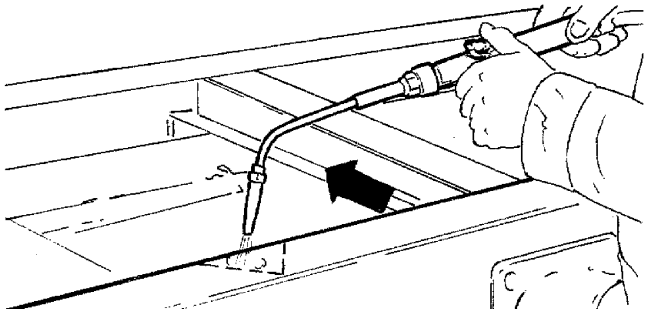
Figure 251



17358

During the work of welding, drilling, grinding, cutting near brake system piping, especially if this is made of plastic, and electric cables, take the appropriate precautions to protect them, contemplating their removal if required. All the parts of the chassis frame subject to reconditioning will need to be protected against oxidation and corrosion.
This protection and painting will need to be done carefully on all the parts concerned, as per any relevant instructions, methods and precautions of the paint manufacturers.

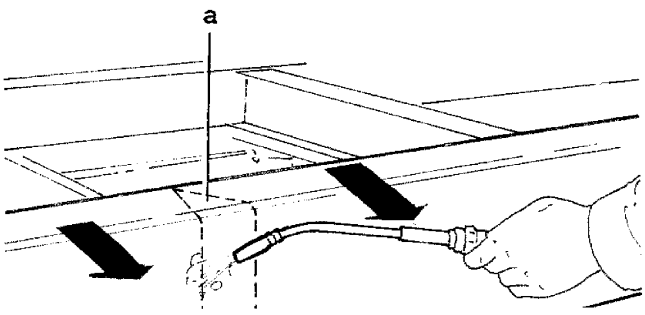
Figure 252



17359

The chassis frame is reconditioned by wedge heating the relevant part with a blowpipe.
During this operation the metal needs to turn cherry red, which corresponds to a temperature of 600 - 680°C.
The heated points must undergo no further heating.
Let the treated parts cool slowly without using any water, compressed air or the like.

Figure 253

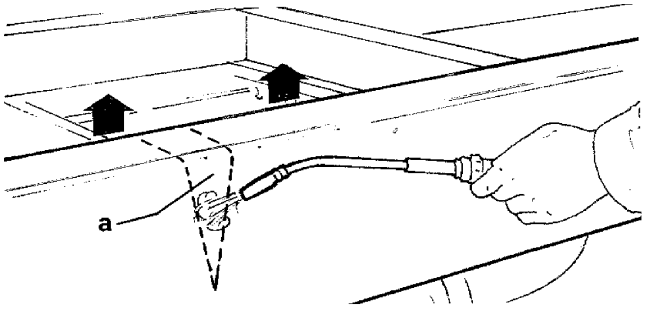


17360

Straighten the side bend of the chassis frame with wedge heating on the top and bottom waist of the part concerning the chassis frame.
The tip of the heating wedge has to lie in the direction of the required bend.

If the base (a, Figure 44) of the two heating wedges is in the top plate of the structural member, then the plate also needs to be heated, but last.

Figure 254

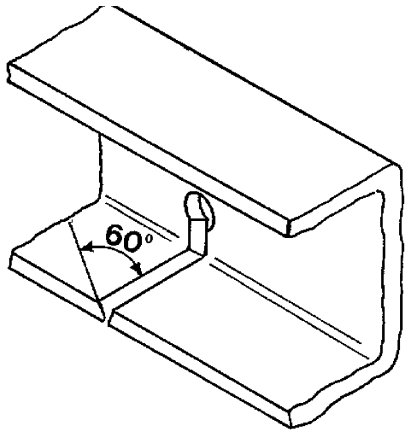


17361

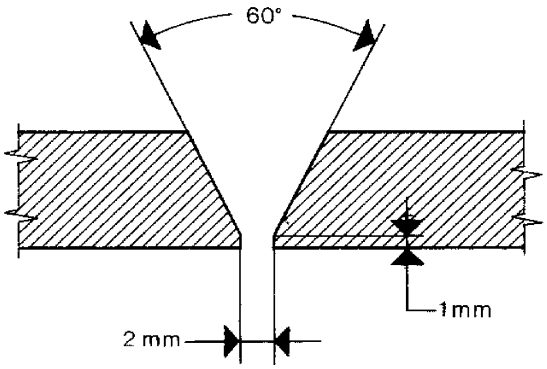
Straighten the sag in the chassis frame downwards or upwards with wedge heating on the top plate of the structural member.
In the case of downward bending, the base (a) of the heating wedge is at the bottom. In the case of upward bending, do the opposite.
The relevant bottom or top waist of the structural member has to be heated last in the area of the base of the heating wedge.

Welds on the chassis frame

Figure 255



17362

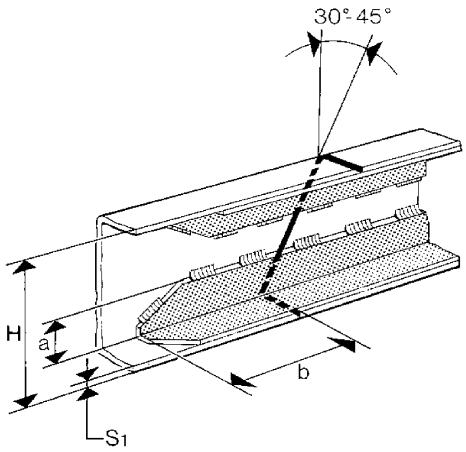


17363

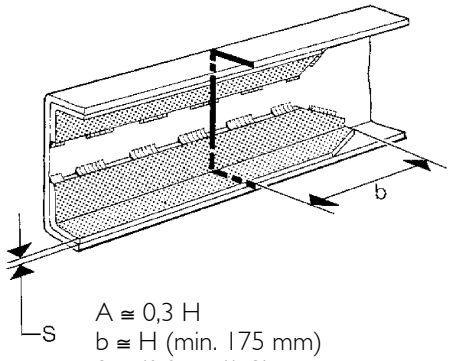
Before starting work, disconnect the negative battery terminal and connect the earth of the welding machine straight onto the piece to weld. Plastic pipes will need to be protected or removed.
Welds will have to be made solely by skilled, trained personnel, with suitable equipment and in workmanlike fashion.
Strip and deoxidize the parts to weld. At the point of breakage, on the inside of the structural member and along the full length of the relevant section, make a V bevel of 60°.

No cuts are permitted on the structural members at areas of changes in profile or at points with a high concentration of stresses; additionally, the line of separation must not concern the holes already in the structural member.

Figure 256



17364



A ≅ 0,3 H
b ≅ H (min. 175 mm)
S ≅ (0.8 ÷ 1) SI

17365

Here we give the operating instructions for proper welding:

a) Heat all around the area to weld (except for QST E 420 material). Do the arc welding with several passes, using thoroughly dried basic electrodes, or MIG-MAG procedures with suitable filler material. Do not overcharge with current. The weld must have no edge cuts or dross.

b) Start back welding as specified in point (a).

c) Leave the structural members to cool slowly and evenly. It is not permissible to use jets of air or other means.

d) Grind off the excess material.

e) Apply steel corner strengthening, with the same specifications as the steel used in the chassis frame. The approximate minimum dimensions are given in the above illustrations. They are to be fixed solely on the vertical rib of the structural member and it is possible to use bead welding, dummy spots, screws or rivets. The cross section and length of the weld bead, the number and distribution of the dummy spots, screws or rivets must be suited to transmit the bending and cutting moments of the section. On completing the work, the part involved in welding must be effectively protected with rust proofing.

SECTION 14

Scheduled maintenance

MAINTENANCE SERVICES CHART

The Extra Plan operations (designated with the letters EP) are complementary to standard services.
They are maintenance operations to be carried out at regular time or mileage intervals and concern optional components that are not present on all models.
Important! The correlation between kilometres and months only applies in cases where the distance travelled by the vehicle corresponds roughly to the specified average annual mileage. This is indicated only in order to suggest a hypothetical maintenance programme,. Note that the time intervals specified for Extra Plan operations are to be adhered to regardless of the actual mileage covered.

The kilometre frequency for engine lubrication is in relation to a percentage of sulphur in diesel of under 0.5%.

NOTE: If using diesel with a percentage of sulphur above 0.5%, the oil-change frequency has to be halved.

Use engine oil: **ACEA E4 (URANIA FE 5 W 30) - ACEA E7 (URANIA LD7)**

- ❑ The ACEA E4 lubricants also classed as ACEA E6 must not be used with the change frequency contemplated for class ACEA E4. Their use must include changing the oil at the contemplated mileage for ACEA E2 lubricants and that is every 50,000 km.
- ❑ If class ACEA E7 (URANIA LD7) engine oil is used, the engine oil and filters must be changed every 100,000 km.
- ❑ If class ACEA E2 (URANIA LD7) engine oil is used, the engine oil and filters must be changed every 50,000 km.
- ❑ In the case of very low annual mileage of less than 150,000 km/year, the engine oil and filters must be changed every 12 months.
- ❑ If mineral oil is used in the gearbox, the interval between gearbox oil changes is to be reduced to 150,000 km.
- ❑ In the case of very low annual mileage of less than 150,000 km/year, the engine oil and filters must be changed at least every 2 years.
- ❑ If mineral oil is used in the axle with disc brakes, the interval between oil changes is to be reduced to 200,000 km as for the axle with drum brakes.
- ❑ In the case of very low annual mileage of less than 150,000 km/year, the oil in axles with disc brakes must be changed at least every 3 years.
- ❑ In the case of very low annual mileage of less than 150,000 km/year, the oil in axles with drum brakes must be changed at least once every 2 years.
- ❑ The filter dryer of the pneumatic system must in any case be renewed every year.
- ❑ In the case of very low annual mileage, general greasing must be carried out at least once a year.

To schedule the work, keep to the following chart:

OILS	SERVICES		EXTRA PLAN				PROGRAMMED OPERATIONS			
Engine (1) Urania FE5W30	**M1**	**M2**	**EP1**	**EP2**	**EP3**	**EP4**	**T1**	**T2**	**T3**	**T4**
Gearbox (1) Tutela Truck FE-Gear			**Fuel filter renewal**	**Check and adjust valve clearances and injectors**	**Change axle oil**	**Changing gearboxes oil**				
Axle with disc brakes (1) Tutela Truck FE-Axle	Every 150,000 km	Every 300,000 km	Every 100,000 km	After the first 150,000 km and subsequently every 300,000 km	Axle with disc brakes every 45,000 km (1) Axle with drum brakes every 200,000 km (2)	Every 540,000 km	Every 6 months	Every year	Every 2 years	Every 3 years
Axle with drum brakes (2) Tutela W140 / MDA										

(1) IVECO recommends using these oils to obtain benefits in terms of "fuel economy". IVECO already equips new vehicles with these types of lubricants, suited for cold climates too (minimum temperature down to - 30°C). The lubricant change frequency is related to using these types of oil.
(2) In this case, new vehicles are supplied by IVECO with mineral oil in the axle.

The extra plan and scheduled operations must preferably be performed at the same time as a maintenance service and specifically:

- ❑ EP1, every 100,000 km;
- ❑ EP2, at the end of the first 150,000 km and subsequently every 300,000 km;
- ❑ EP3(1):
  - every 200,000 km, vehicles with rear axle with drum brakes
  - every 450,000 km, vehicles with rear axle with disc brakes;
- ❑ EP4, every 540,000 km;
- ❑ T1, every 6 months, particularly every start of spring;
- ❑ T2, every year before the winter season;
- ❑ T3, every two years;
- ❑ T4, every three years.

(1) Axles with drum brakes are supplied with mineral oil; those with disc brakes are supplied with synthetic oil.

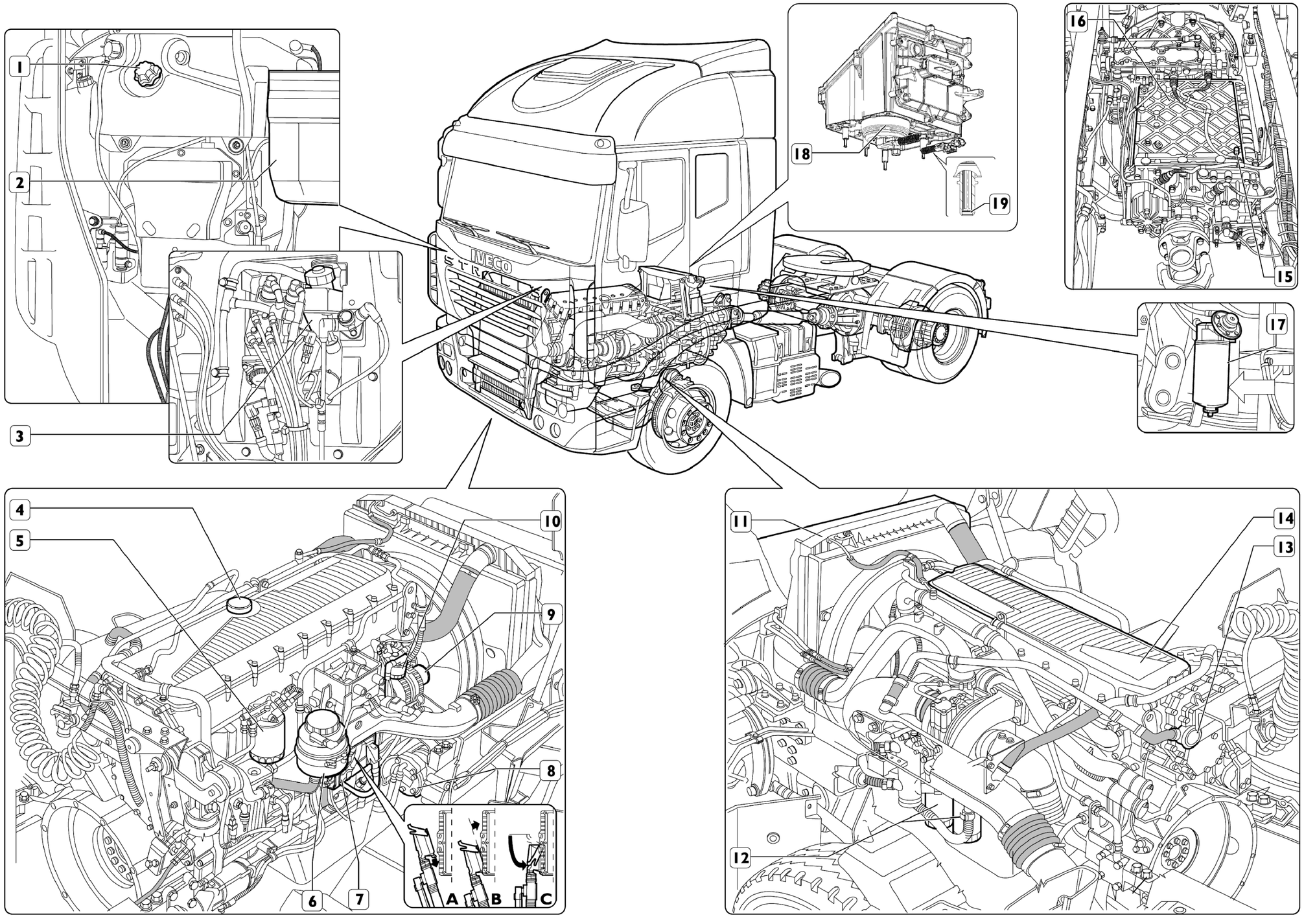
CHECKS AND/OR MAINTENANCE WORK

Type of operation		M1	M2	EP1	EP2	EP3	EP4	T1	T2	T3	T4
Engine											
4	Change engine oil	•	•								
12	Change engine oil filters	•	•								
5	Change fuel filter			•							
8	Check electromagnetic coupling clutch wear	•	•								
9	Check auxiliary drivebelt condition	•									
6	Change or clean hydraulic steering system filter	•	•								
10	Change VGT variable geometry turbocharger valve air filter		•								
7	Check-up on engine EDC system with MODUS or IT2000 or E.A.SY.	•	•								
14	Valve/injector play check and adjustment (if necessary)				•						
9	Change miscellaneous drive belts		•								
11	Change engine coolant									•	
13	Replacing the blow-by filter	•	•								
•	Grease the VGT control lever	•									
	Chassis and mechanical assemblies										
17	Change fuel pre-filter	•	•								
15	Check manual gearbox oil vent efficiency and clean	•	•								
3	Check clutch fluid level	•	•								
•	Change gearbox oil						•				
2	Change pollen filters (2)							•			
1	Check percentage of antifreeze in engine coolant								•		
3	Change clutch hydraulic fluid and bleed air										•
18-19	Changing filter and Ad Blue pre-filter	•	•								
7	Check Ad Blue system using E.A.S.Y. MODUS or IT2000	•	•								

2) If the mileage is low, replace the filters once yearly.

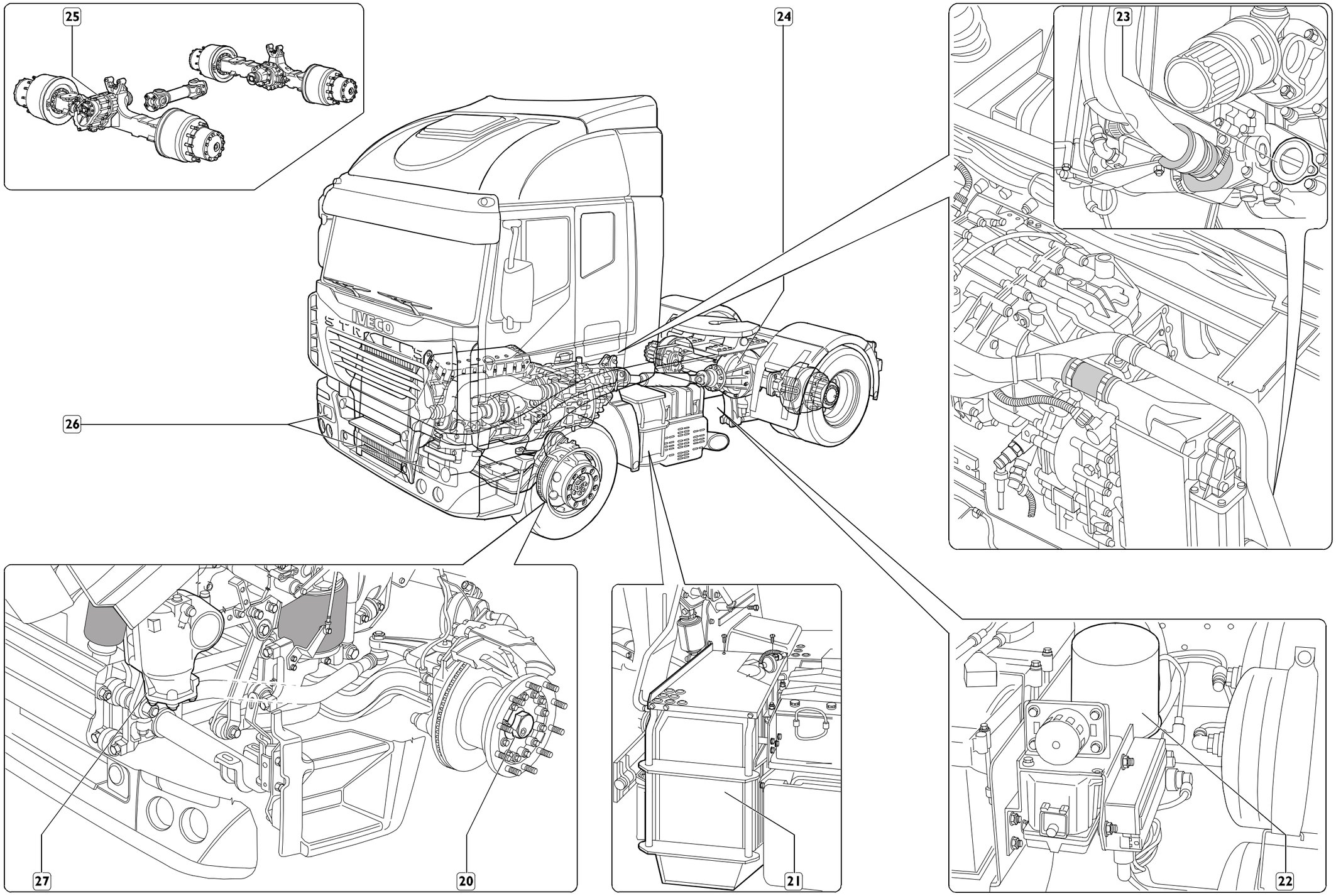
DIAGRAM OF POINTS FOR CHECKS AND/OR MAINTENANCE WORK

Figure 1



114984

Figure 2



MAINTENANCE WORK

CHECKS AND/OR MAINTENANCE WORK

Type of operation		M1	M2	EP1	EP2	EP3	EP4	T1	T2	T3	T4
Chassis and mechanical assemblies											
22	Change pneumatic system drier filter (anyhow every year)	•	•								
•	General greasing of the chassis (anyhow every year)	•	•								
23	Changing oil of ZF gearbox + Intarder						•				
24	Change rear axle oil (anyhow every two years)					•					
24-25	Check the efficiency of the rear axle oil vent and clean	•	•								
25	Change the intermediate axle oil and filter (for 6x4 versions)					•					
20	Change front axle wheel hub oil:(2) front, middle or rear (where applicable)	•	•								
27	Check steering box and mounting	•	•								
26	Check headlight adjustment	•	•								
•	Change the fuel filter of the additional heater (where applicable)								•		
21	Change the cartridge of the dry air filter (1)	•	•								
•	Wash radiator grille							•			
	Miscellaneous										
•	Manoeuvring (3)	•	•								
•	Road test	•	•								

(1) Early clogging of the air cleaner is generally due to environmental conditions. For this reason it needs to be replaced when signalled by the sensor irrespective of the guidelines that anyhow have to be observed if there are no specific instructions otherwise.

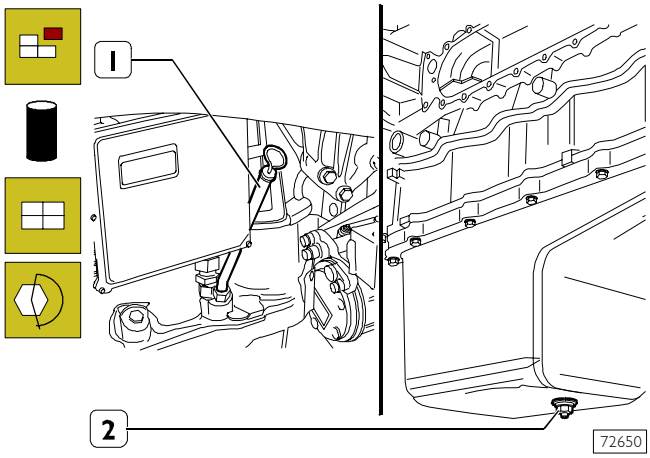
(2) The oil used in the hubs of the front axles, in the hubs of the second axles and in those of the added third axles is a mineral based oil (see fluid table in Section 1 General).

(3) Vehicle and equipment handling activity, in workshop.

M1 SERVICE

4. Change engine oil

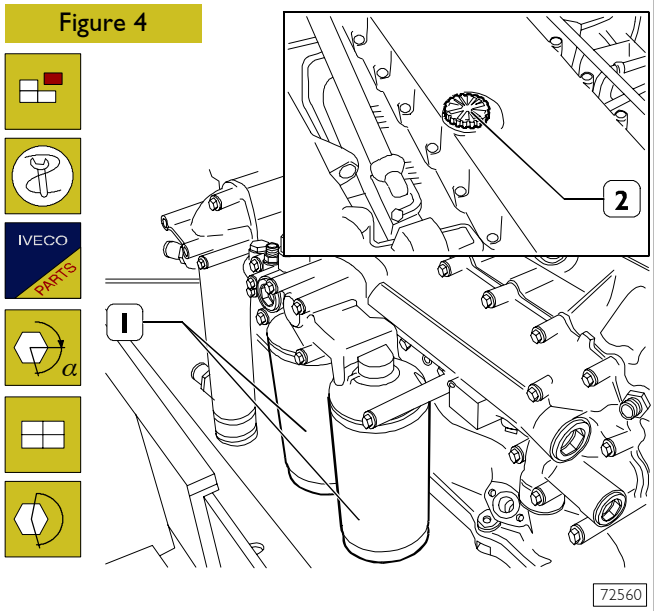
Figure 3



Take out the oil level dipstick (1).
From underneath the vehicle, remove the soundproofing guard.
Unscrew the plug (2) from the oil sump and drain the engine oil off into a specific container.
Screw the plug back on under the sump and tighten it to the required torque.
Pour oil into the engine through the filling-pipe (2) of the required grade and quantity (see FLUIDS table in the GENERAL section).

12. Change engine oil filters

Figure 4



Drain the oil as described in point 4. "Changing engine oil."

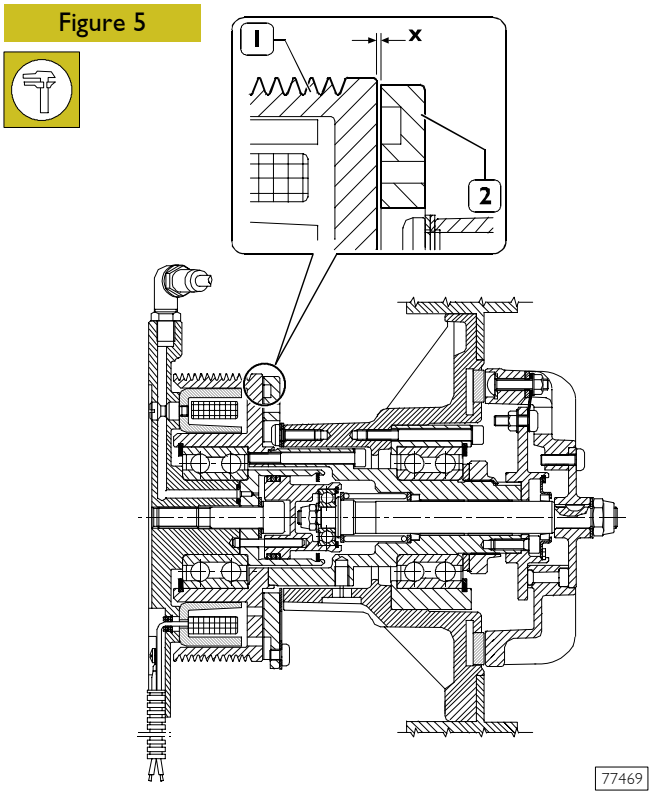
Remove the oil filter (1) with tool 99360314.

NOTE Before refitting the new cartridges, moisten the seal with engine oil.

Screw the oil filters (1) on by hand to bring them into contact with the mount and then tighten by 3/4 of a turn to the prescribed torque and proceed as described in point 4. "Changing engine oil."

8. Check electromagnetic coupling clutch wear

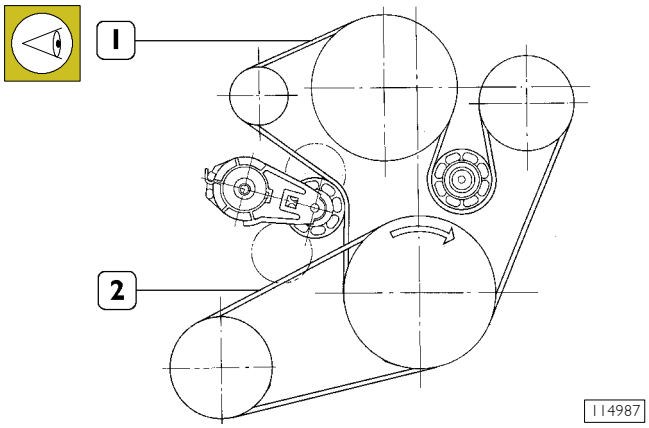
Figure 5



Using a feeler gauge, check the gap between the anchor assembly (2) and the pulley (1), it must be no greater than 2.5 mm.

9. Check miscellaneous drive belts

Figure 6

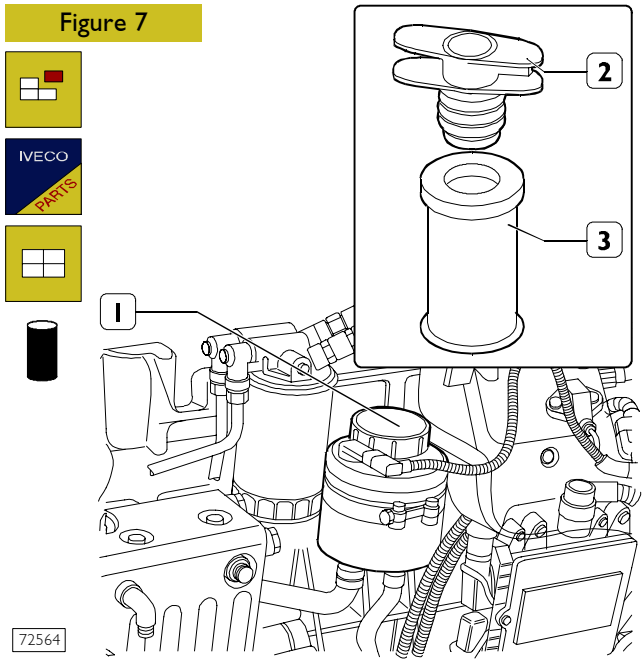


Check by sight that belts (1) and (2) are not worn or deteriorated.

In this case, replace as described in service M2.

6. Change or clean hydraulic steering system filter

Figure 7



Before taking off the cover (1), thoroughly clean the tank.

This will prevent foreign impurities from coming into contact with the oil of the hydraulic system.

Take the cover (1) off the tank and take out the oil filter (3).

Remove the coupling device (2) from the oil filter (3) and replace the filter.

Take off the plug (1) (after unhooking the transmitter) of the hydraulic power steering tank and check that with the engine running and the wheels travelling in a straight line, the oil level reaches the top reference mark on the dipstick.

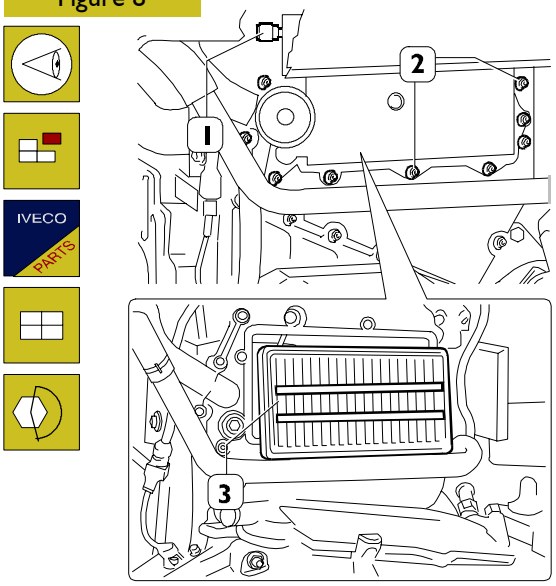
With the engine stationary and wheels in a straight line, the oil level has to exceed the top reference mark of the dipstick by 1 or 2 cm; if necessary, top up the level by taking off the cover (1).

7. Check-up on EDC system with MODUS, IT2000 or E.A.SY.

- **Grease the VGT control lever**

13. Check state of blow-by filter with clogging indicator

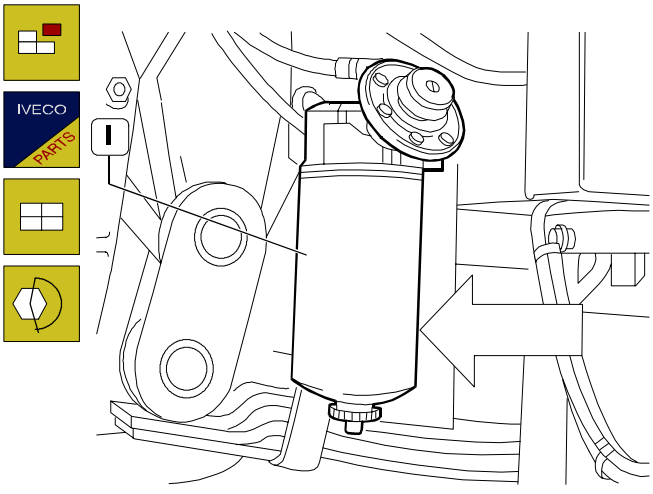
Figure 8



To renew the blow-by filter, remove the screws and the cover, withdraw the filter (3) along with its gaskets. Carefully clean the seating of the filter and the cover. Fit a new filter with new gaskets. Refit the cover and tighten the fixing screws (2) to the prescribed torque. The filter only operates in one flow direction and therefore must be installed with the reinforcing bars visible as shown in the figure.

17. Change fuel pre-filter

Figure 9

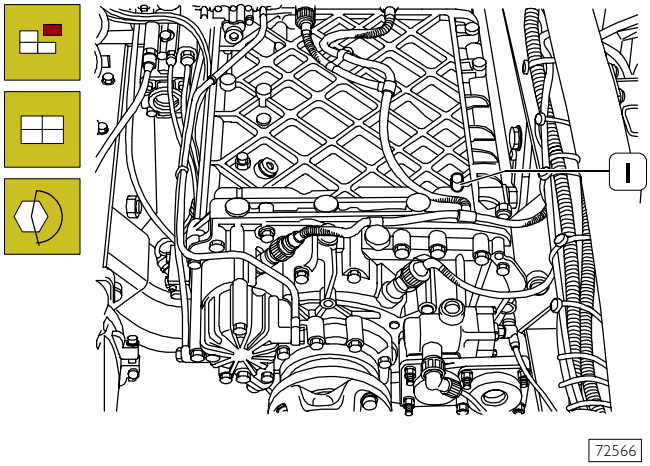


Unscrew the pre-filter (1) and replace it.
Before refitting the new cartridge, moisten the seal with diesel or engine oil. Screw the cartridge on by hand until it is in contact with the mounting and then tighten by 3/4 of a turn to the required tightening torque.

NOTE When replacing the cartridge, it must not have been pre-filled. This is to prevent impurities getting into circulation that could damage the injector/pump system components.
Bleed the air from the fuel circuit as described on the previous pages.

15. Clean gearboxes oil bleed

Figure 10

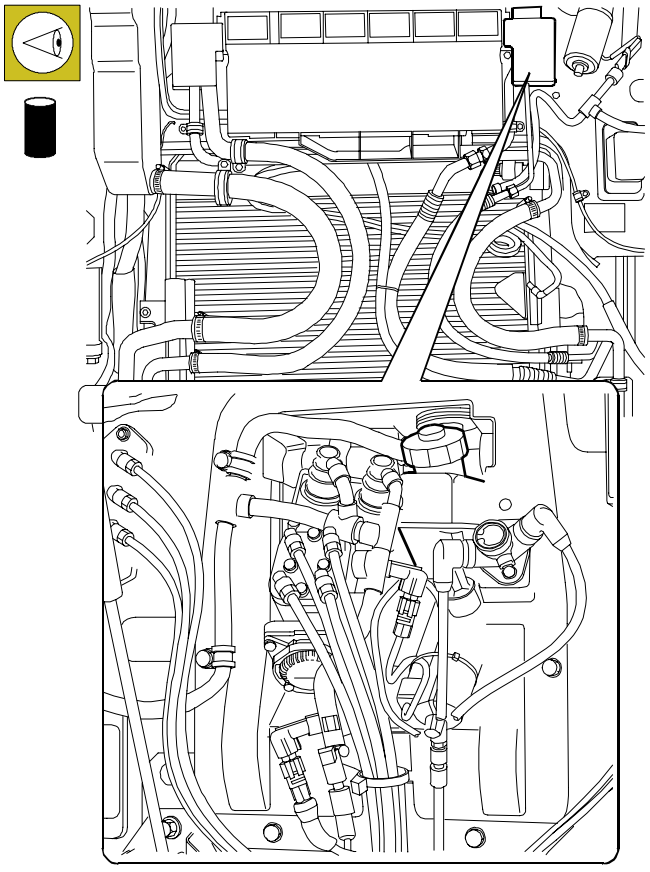


72566

Remove the oil vapour breather (1) and clean it thoroughly. Then fit it back on, checking it is in the right position, and tighten it to the required torque.

3. Check clutch fluid level (only on vehicles with manual ZF gearbox)

Figure 11



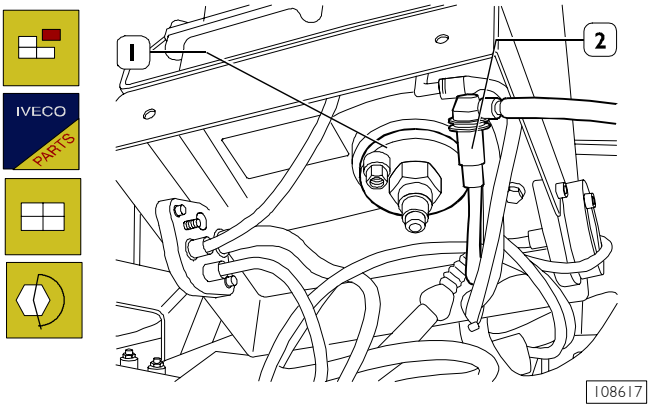
74089

Check the level of the clutch fluid. Top it up if it is too low (see the FLUIDS table in the GENERAL section).

The clutch fluid is poisonous and corrosive: if you accidentally come into contact with it, wash immediately with water and a neutral soap.

18-19. Change Ad Blue filter and prefilter

Figure 12



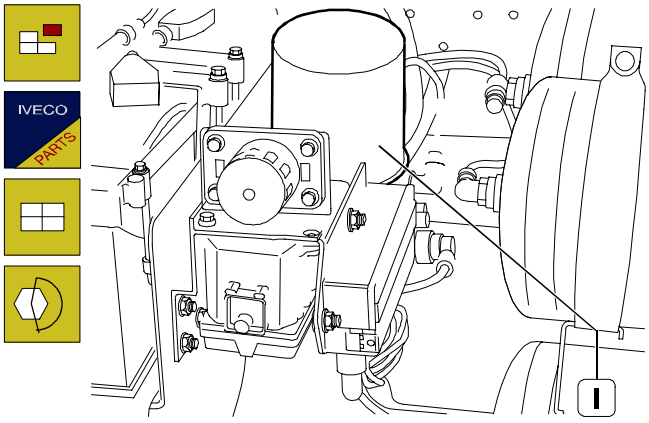
108617

Remove the pump module as described in operation 507410. Undo the hex-headed bolt securing cover (1) and remove from the pump module together with the filter. Disconnect fitting (2) and remove the prefilter embedded inside. Remove the filter and prefilter, reversing the disassembly operations.

7. Testing the Ad Blue system using Modus - IT2000

22. Change pneumatic system drier filter

Figure 13



74091

Discharge the pressure from the compressed air system.

With the right tool, remove the drier filter (1) from its mounting and fit the new part.

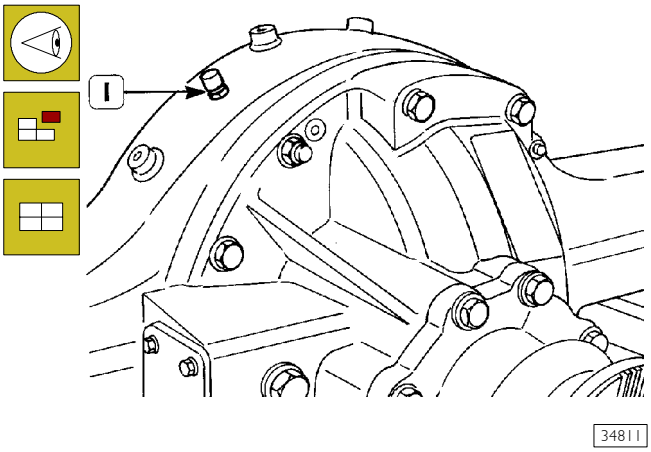
Screw on by hand until there is contact with the mounting and then tighten by 3/4 of a turn to the required torque.

NOTE If on removal you find there is too much oil in the drier or in the intake pipe, check the conditions of the compressed air as described under the relevant heading.

- **General chassis greasing**

24. 25. Clean rear axle oil vent

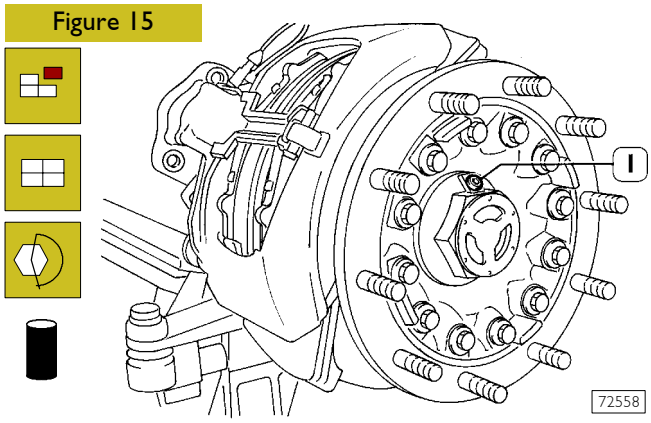
Figure 14



Check that the air breather (1) is not clogged; if it is, remove it, clean it carefully and fit it back on.

20. Change front, middle or rear axle wheel hub oil (where applicable)

Figure 15

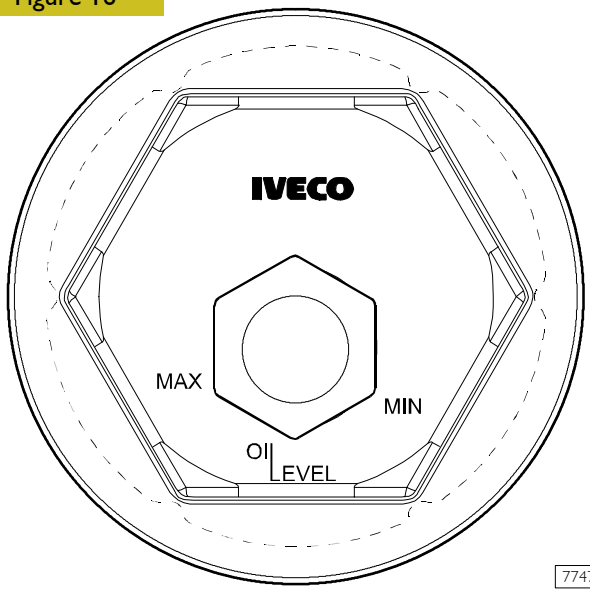


For the wheel hubs with the cover illustrated in the figure, proceed as follows:

- ❑ turn the wheel hub so as to bring the plug (1) downward; unscrew the plug and drain off the oil into an appropriate container;
- ❑ then turn the hub and take the hole closed by the plug (1) back upward and replenish with fresh oil; for the quantity, see CHARACTERISTICS AND DATA in the "AXLES" section;
- ❑ screw the plug down to the prescribed torque.

NOTE Use no chlorothene based solvents to clean the cover.

Figure 16



For the wheel hub with the cover illustrated in the figure, proceed as follows:

- ❑ remove the plug (1) and draw up the oil with a suitable string;
- ❑ fill the wheel hub with new oil (for the quantity and type of oil, see CHARACTERISTICS AND DATA in the "AXLES" section.

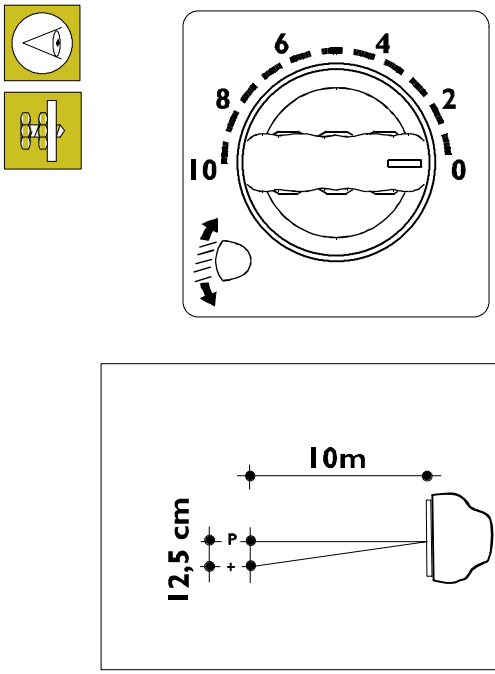
The oil level is checked through the window in the plug (1) with max. and min. on the cover in a horizontal position.

27. Check steering box fixing and mounting

Check that the fastenings of the steering box and mounting are tightened to the required torque.

26. Check headlight adjustment

Figure 17

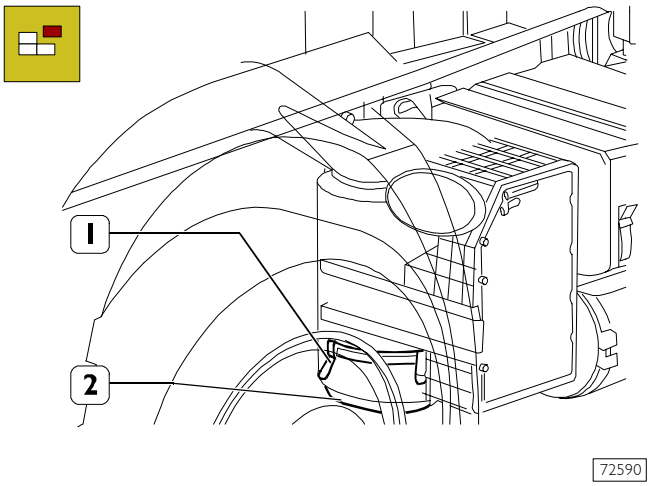


- ❑ Set the vehicle unladen with its tyres at the required pressure on level ground facing a light wall.
- ❑ Mark two crosses on the wall corresponding to the centres of the two headlights.
- ❑ Turn the switch onto 0.
- ❑ Set the vehicle at 10 metres and turn on the low beam. The distance between the crosses and the points P, which correspond to the angle of the headlights, has to be 12.5 cm.

1. Light beam adjustment screw in horizontal direction.
2. Light beam adjustment screw in vertical direction.

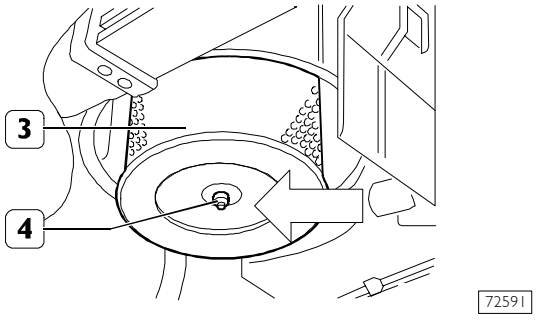
21. Change the cartridge of the dry air filter and clean its container

Figure 18



- ❑ Unhook the clamps (1) (or, depending on the version, unscrew the nut) and take off the bottom cover (2).

Figure 19



- ❑ Unscrew the nut (4) and take out the cartridge of the filter (3).

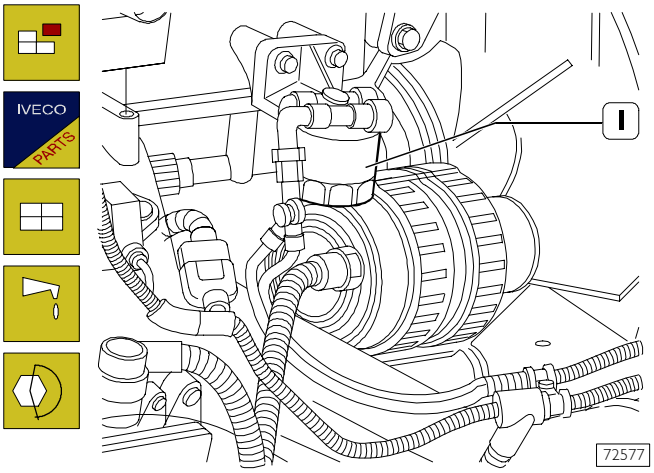
Before fitting the new cartridge, clean its housing thoroughly.

M2 SERVICE

NOTE Service M2 includes service M1 operations excluding point 9. "checking auxiliary drivebelt condition" and 13. to which the following operations must be added.

10. Change variable geometry turbocharger (VGT) valve air filter

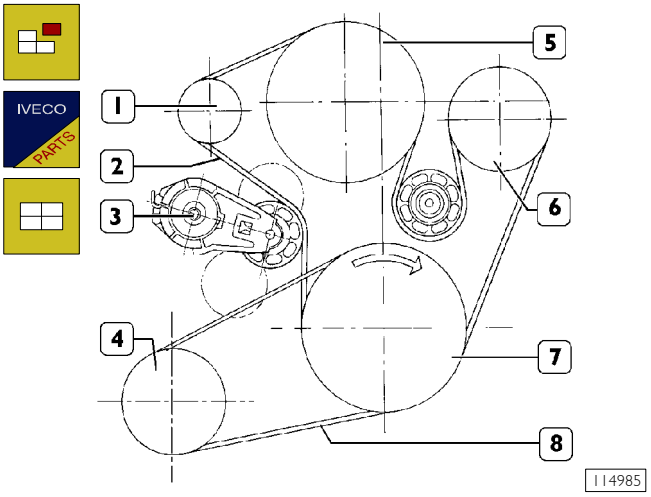
Figure 20



Using a suitable tool, unscrew the filter (1) and replace it.
Before fitting the new cartridge, moisten the seal with diesel or engine oil. Screw it on by hand until it is in contact with the mounting and then tighten by 3/4 of a turn to the required tightening torque.

9. Change miscellaneous drive belts

Figure 21



ASSEMBLY DIAGRAM OF BELTS FOR FAN – WATER PUMP – ALTERNATOR AND AIR-CONDITIONER COMPRESSOR

1. Alternator - 2. Water/alternator pump drivebelt - 3. Automatic belt tensioner - 4. Air-conditioner compressor - 5. Fan - 6. Water pump - 7. Crankshaft - 8. Compressor drive belt

To remove and refit belts (2-8), follow the instructions in section 2 "Engine".

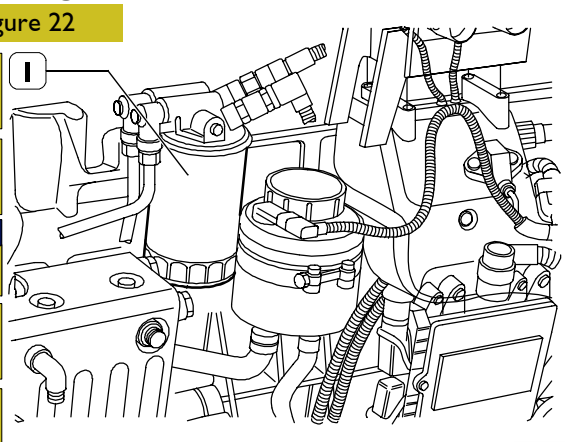
NOTE Belt tensioner (3) is automatic and does not require adjustment after fitting.

EXTRA PLAN MAINTENANCE

EP1 SERVICE

5. Change fuel filter

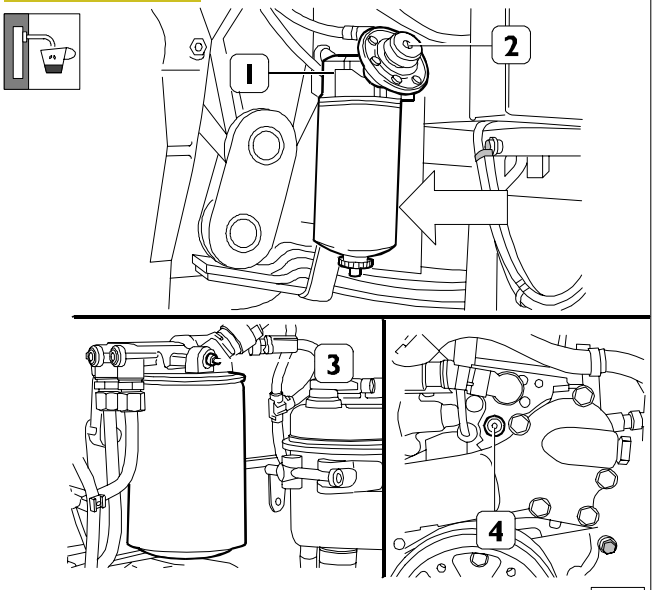
Figure 22



Remove the fuel filter (1) with tool 99360314.
Before refitting the new cartridge, moisten the seal with diesel or engine oil.
Screw the new one on by hand, taking care to check that the rubber seal and the mating surface are clean and in a perfect state of repair. Screw the cartridge on by hand until it is in contact with the mounting and then tighten by 3/4 of a turn to the required tightening torque.
Bleed the air from the supply system as described in the following paragraph.

Bleeding air from the fuel circuit

Figure 23



❑ Open the bleed screws, connecting them with tubes to run off the bled fluid into suitable containers to prevent dirtiness:
1 = located on the pre-filter mount (on the chassis frame);
3 = located on the filter mount (on the engine);
4 = located on the front of the cylinder head.

❑ Work the hand pump (2) on the pre-filter till you see fuel with no air in it coming out of the bleed screw (1) (retighten the screw when the operation is over).
Keep on pumping until you see fuel with no air in it come out of the bleed screw (3) on the filter as well (then retighten the screw) and from the screw (4) on the front of the cylinder head (retighten the screw when the operation is over) and tighten them to the required torque.

The circuit has now been bled. Start up the engine and run it for a few minutes at idling speed to get rid of all remaining air.

NOTE Never let the fuel soil the drive belt: alternator, pump, water, etc.

EP2 SERVICE

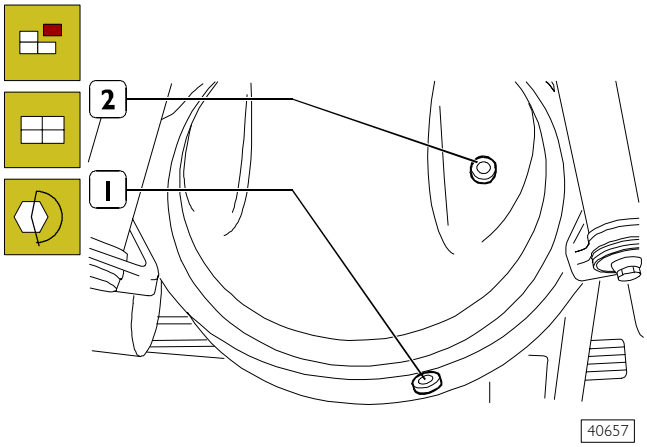
14. Check valve clearance and adjust if necessary

To carry out these operations correctly, refer to the procedures described in the relative chapter of the "ENGINE" section.

EP3 SERVICE

24. Change rear axle oil

Figure 24

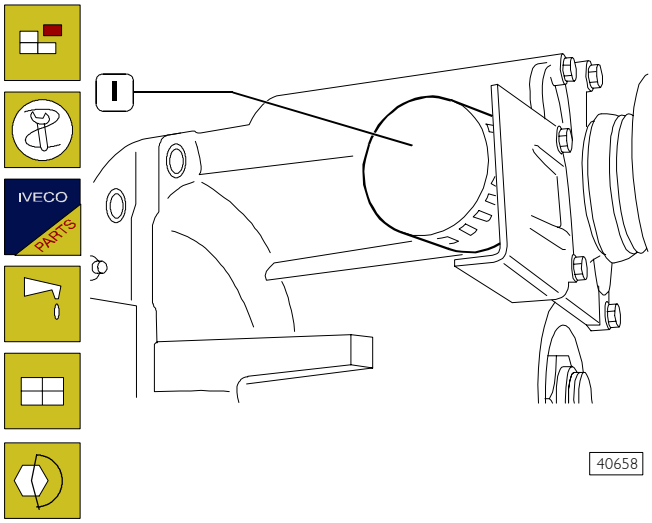


The lubricating oil has to be drained with the oil warm.
Place a container under the plug (1), remove the plug and drain off the oil.

Fit the plug (1) back on, remove the plug (2) and pour the required grade and quantity of lubricating oil in through the hole. Remove the oil vapour bleed and clean it thoroughly.

25. Change intermediate axle oil filter (6x4 vehicles)

Figure 25

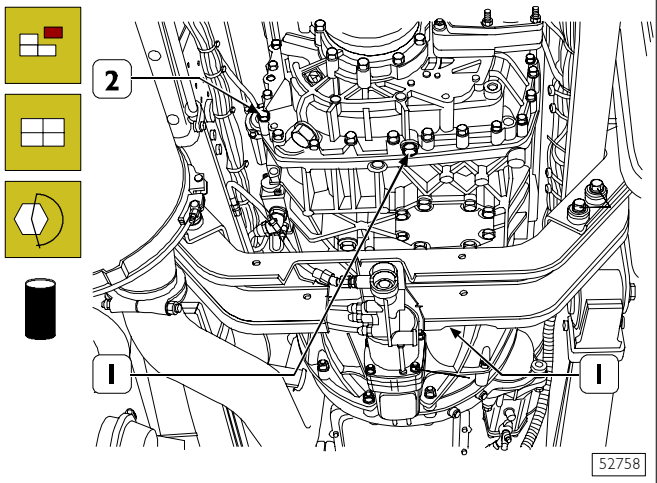


Using tool 99360314, remove the oil filter (1) from the differential of the intermediate axle.
Before fitting the new oil filter on, moisten the seal with lubricating oil.
Screw the filter on by hand until it is in contact with the mounting and then tighten it by 3/4 of a turn.

EP4 SERVICE

Changing manual ZF gearbox oil

Figure 26



❑ With the gearbox warm, take off the plug(s) (1) and drain the oil into a specific container.

❑ The oil should be drained off taking care not to soil the cross member beneath as it is near the outlet on some types of gearbox.

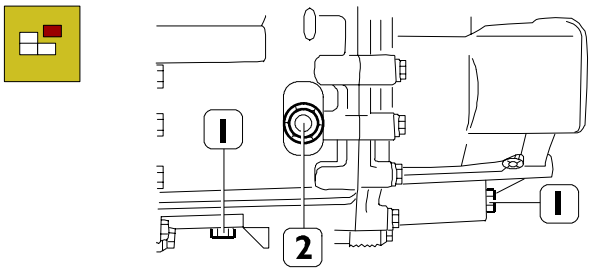
❑ It is therefore wise to use a tool to convey the oil away.

❑ Pour in fresh oil through the hole closed by the plug (2) (for the quantity, see under the FLUIDS heading of the GENERAL section).

❑ Tighten the plugs to the required torque.

- **Changing ZF Eurotronic Automated gearbox oil**

Figure 27



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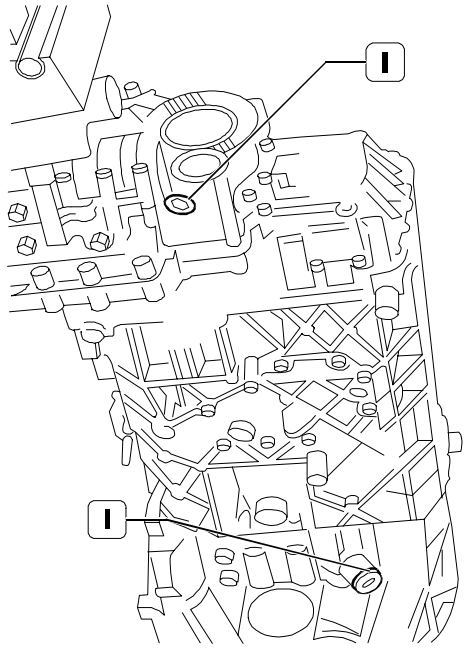
- ❑ With the gearbox warm, take off the plug(s) (1) and drain the oil into a specific container.
- ❑ The oil should be drained off taking care not to soil the cross member beneath as it is near the outlet on some types of gearbox.

23. Changing gearbox oil and filterfor ZF manual gearbox with Intarder

Figure 28



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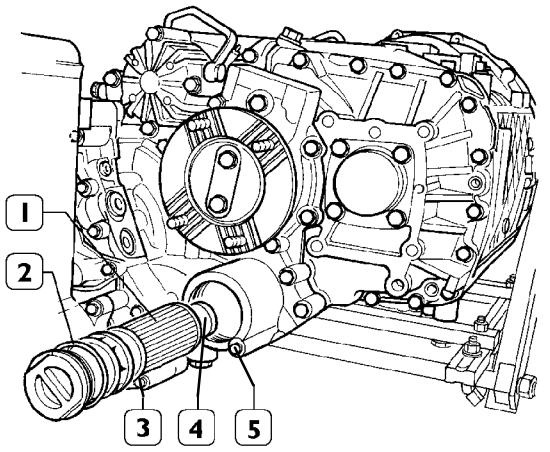
- ❑ With the gearbox warm, take off the plugs (1) and drain the oil into a specific container.

Figure 29



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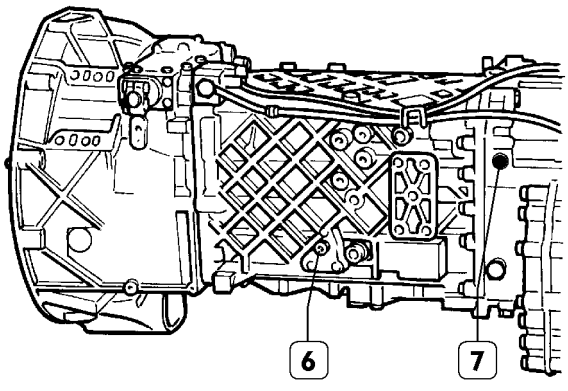
Remove the oil filter as follows:

- ❑ unscrew the screw (5) fixing the filter;
- ❑ take off the cover and filter (1);
- ❑ remove the cover from the filter and replace it. Take care not to lose the magnetic pad (4) on the outer edge of the filter, as it has to be repositioned on the new filter;
- ❑ check the state of the o-ring (2) and replace it, if necessary;
- ❑ grease the o-ring (3) inserted in the assembly opening of the new filter;
- ❑ couple the new filter with its cover and insert it into its seat as far as it will go. Secure the screw (5).

Figure 30



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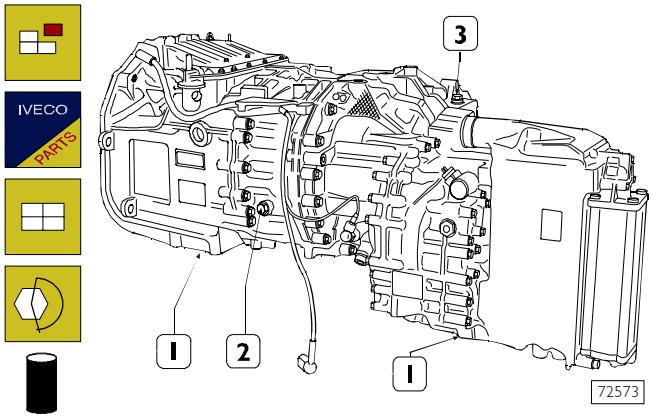
- ❑ Screw the plugs back on and tighten them to the required torque.
- ❑ Pour in fresh oil through the hole closed by the plug (7) until oil comes out of the hole of plug (6) and screw the plugs back on to the required torque.
  (The filling quantity is given under the FLUIDS heading of the GENERAL section.)
- ❑ Clean the gearbox oil vapour breather.

23. Change oil and filter of ZF Eurotronic Automated gearbox with Intarder

Figure 31



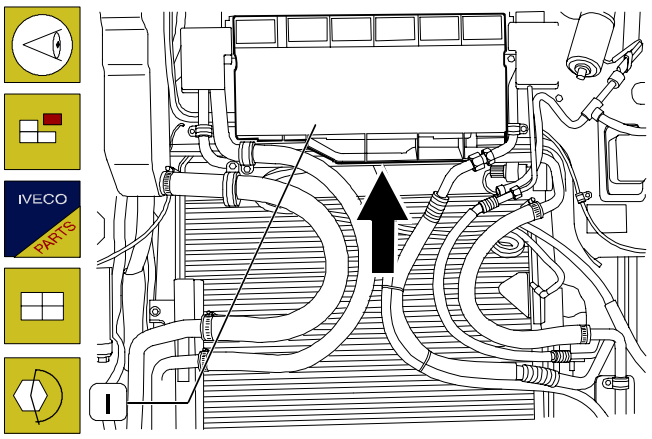
- ❑ With the gearbox warm, take off the plugs (1) and drain the oil into a specific container.
- ❑ Remove the Intarder filter following the procedure described in the above paragraph.
- ❑ Screw the plugs (1) back on and tighten them to the required torque. Pour in fresh oil through the hole of plug (3) until oil comes out of the hole of plug (2). (See the FLUIDS table in the GENERAL section.)
- ❑ Screw the plugs back on to the required torque.
- ❑ Clean the gearbox oil vapour breather.

NOTE Have a short test run on the roads (at least one minute at least 10 km/h), briefly operating the Intarder just once (level 6) and then disengage it (level 0). At the end of the test, stop the vehicle without operating the Intarder. Stop the engine, check the level again (plug 2) and top up, if necessary.

T1 SERVICE

2. Change pollen filter

Figure 32



Check the state of clogging of the pollen filter (1).

It is reached by lifting the front radiator cowling and unscrewing the six supporting screws.

NOTE Excessive clogging of the pollen filters can cause a reduction in the flow rate of air into the cab and therefore less ventilation.

This will be highlighted especially by a significant reduction in the efficiency of the windscreen defrosting function.

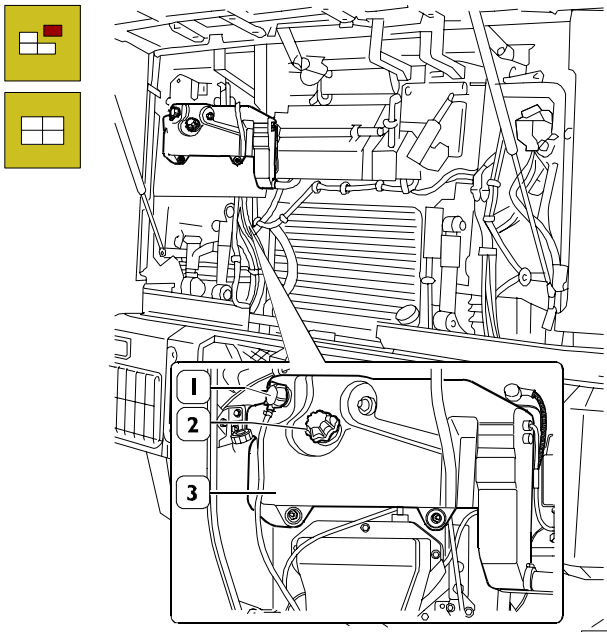
- **Wash radiator grille**

Lift the cab radiator cowling and carefully clean the radiator grille.

T2 SERVICE

1. Check percentage of antifreeze in the engine coolant

Figure 33



The plug (1) must never be taken out for any reason whatsoever.

With the engine warm, the cooling system is in overpressure, therefore take care when taking off the cap (2).

Take off the cap (2) and draw off a sample of the coolant from the expansion tank (3) with the densimeter 99395858.

Depending on the temperature of the liquid, check the percentage of antifreeze in the liquid on the scale of the instrument. The percentage has to be higher than 40% and must not exceed 50%.

If necessary, restore the percentage of antifreeze, bearing in mind that the liquid needs to be replaced every 2 years.

For vehicles fitted with an additional heater, the percentage of antifreeze must never exceed 50%.

- **Renewal of the fuel filter of the additional heater (if present)**

T3 SERVICE

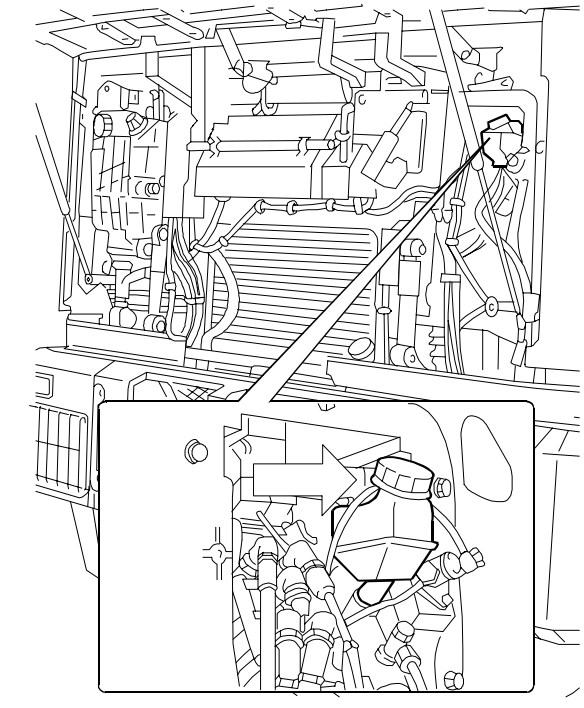
11. Change engine coolant

Carry out the procedure described under the relevant subheading of the "ENGINE" section.

T4 SERVICE

3. Changing the clutch fluid and bleeding the hydraulic clutch control system (only versions with ZF manual gearbox)

Figure 34



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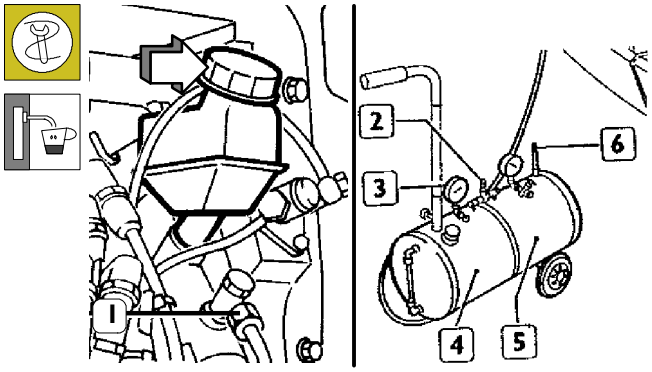
Drain off the clutch control fluid and change it (see Fluids table in GENERAL section).

The clutch fluid is poisonous and corrosive: if you accidentally come into contact with it, wash immediately with water and a neutral soap.

Figure 35

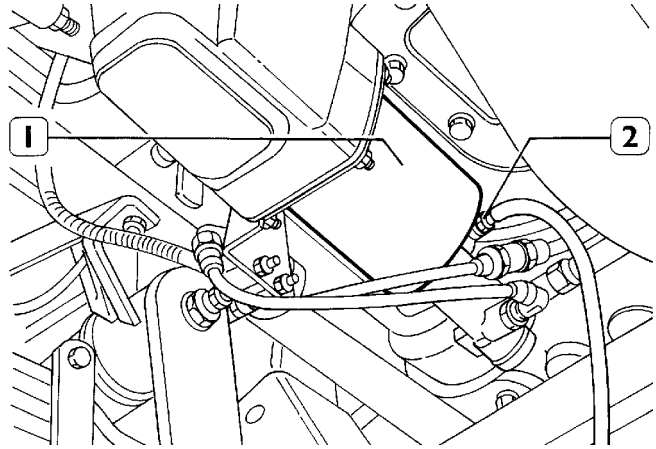


After changing the fluid, bleed the hydraulic clutch control system.

Use the air bleeding tool 99306010 as follows:

- ❑ charge reservoir (5) with compressed air;
- ❑ fill reservoir (4) with Tutela TRUCK DOT SPECIAL fluid
- ❑ replace the cap (⇒) of the clutch fluid reservoir with one of the caps supplied with the tool 99306010 and connect the pipe to the cap.

Figure 36



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- ❑ Attach a plastic tube to the bleed screw (2) on the slave cylinder (1) and immerse the opposite end of the tube in a container containing Tutela TRUCK DOT SPECIAL fluid, unscrew the bleed screw (2) by one full turn, open the valve (2) (see Figure 35) until a pressure reading of 1 to 1.2 bar is obtained on the pressure gauge (3);
- ❑ when the clutch fluid flowing through the tube is uniform and free of air bubbles, close the bleed screw and discharge the air from the reservoir (5) through valve (6).

NOTE Whenever the clutch fluid is changed, it will also be necessary to bleed the clutch master cylinder by loosening the fitting (1, Figure 35) before bleeding the clutch servo.

SECTION 15

Electric/Electronic system

GENERAL WARNINGS FOR ELECTRICAL/ELECTRONIC COMPONENTS

Do not ever disconnect the batteries from the system with the engine running.
Do not start the engine without first having connected the batteries in a permanent manner.

- ❑ Before working on the vehicle, immobilise the wheels with chocks.
- ❑ Do not use fast chargers to start the engine. Engine starting can be performed either by means of separate batteries or by means of a special truck.
- ❑ Incorrect polarisation of the power supply voltage for the electronic control units (e.g. erroneous battery polarisation) may damage the components irreversibly.
- ❑ If you have to disconnect the batteries from the system, always disconnect the frame ground cable from the negative terminal of the batteries first.
- ❑ Before connecting the batteries to the system, make sure that the system is suitably insulated.
- ❑ Disconnect the batteries from the system before recharging them by means of an external unit.
- ❑ Disconnect the external recharging unit from the power mains before removing the unit's pliers from the battery terminals.
- ❑ At temperatures of over 80 °C (drier ovens), take down the ECU's.
- ❑ At the connection stage, tighten the flanged nuts of the connectors (temperature and pressure sensors, etc.) to he required torque. Check the exact polarity of the battery terminals when starting the engine by means of the auxiliary truck.
- ❑ Before working on the vehicle's electrical/electronic system disconnect the positive pole of the battery.
- ❑ Before disconnecting the connector from an electronic control unit, isolate the system.
- ❑ Do not cause sparks to check whether a circuit is live.
- ❑ Do not use a test bulb to check the continuity of a circuit. Only use the appropriate testing devices.
- ❑ Do not directly power the components associated with electronic control units with the nominal power rating of the vehicle.
- ❑ Make sure that the wirings of electronic devices (length, type of cable, location, grouping, connection of screen braiding, earthing, etc.) conform with the IVECO system and that they are carefully restored after repair or maintenance work. To avoid the possible malfunctioning of the electronic systems on board, the wirings of additional devices must follow a different path than that of the above-mentioned systems.
- ❑ Do not connect the negative terminals of additional systems to the negative terminals of electronic systems.
- ❑ In the event of electric welding on the vehicle, disconnect all the electronic control units and/or disconnect the power cable from the battery positive terminal and connect it to the frame earth.
- ❑ Connectors are viewed from the cable side.

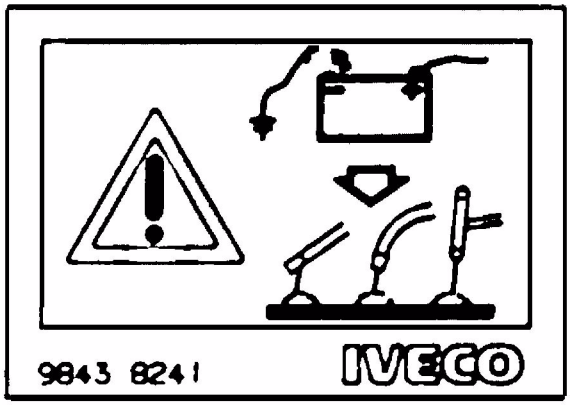
Key storage procedures are affected by electromagnetic disturbances such as cell phones and the like.
Therefore, during key memorization:
1. Ensure there are no sources of disturbance in the cab or close to the keys.
2. Keys not inserted in the panel must be at a distance of at least 1 meter.

When working on electronic control units, plug connections and electrical connections to the components, measurements can be made only on suitable testing lines, by means of special plugs and plug-type bushes. Do not under any circumstances make use of improper devices such as metal wires, screwdrivers, clips and the like. In addition to the risk of causing a short circuit, this might damage plug-type connections and this would then give rise to contact problems.

NOTE Connectors present must be seen from cable side. Connectors views contained in the manual are representative of cable side.

In order to prevent damage or short-circuiting of the on-board electronic control units, the following operations must be always carried out before starting any welding operation on the chassis.

❑ If electric welding has to be done on the vehicle,



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isolate the electric system as follows:

a) disconnect the power lead from the battery positive terminal and connect it to the chassis earth;

b) disconnect the power lead from the battery negative terminal;

c) disconnect the electronic control unit connectors, taking care to avoid touching the control unit connector pins.

❑ Moreover:

a) should it be necessary to carry out welding operations close to the control unit, remove it from its location.

b) whenever possible, earth the welding machine directly to the piece that has to be welded.

In the case of vehicles equippedwith a DTCO digital tachograph, do not disconnect the battery leads and then connect them by jumpers to reset the electronic systems.

This operation should be avoided, as it could cause permanent damage to the DTCO tachograph CARD or other on-board electronic systems.

To reset the electronic system without running risks, disconnect the vehicle battery and wait for 10 minutes.

It is strictly forbidden to carry out any modifications or connections to the electronic control unitwiring; in particular, the line interconnecting data between the control units (CAN line) must be considered as untouchable.

Diagnostic and maintenance operations can only be carried out by authorised personnel with IVECO approved equipment.

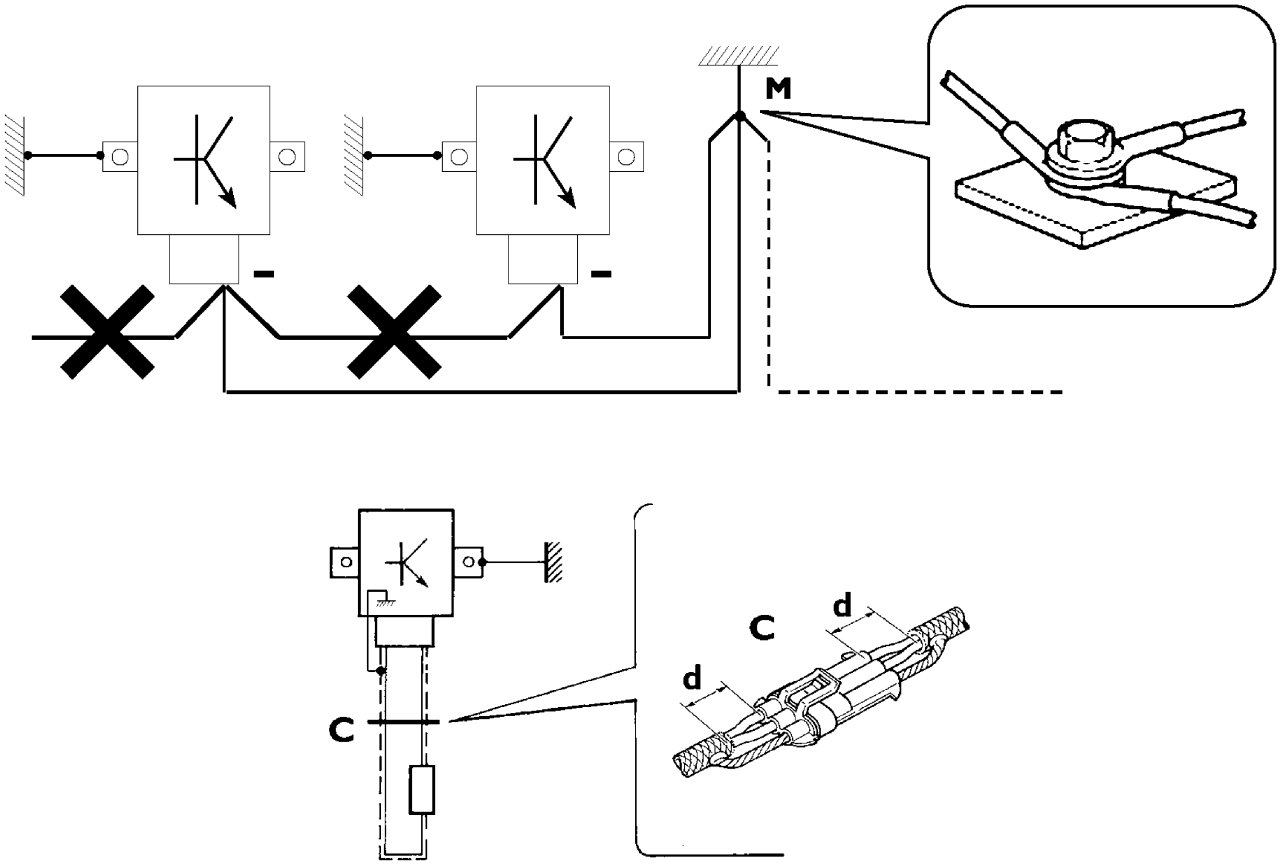
Practical tips

The negative leads connected to a system grounding point must be as short as possible and connected to one another in "star" configuration; make sure that they are tightened in an orderly and adequate manner (Figure 1, ref. M).

Furthermore, for electronic components, the instructions to be followed very carefully are:

- ECU's must be connected to the system ground if they are provided with a case.
- ECU negative cables must be connected both to a system grounding point, such as for instance the dash compartment ground (with no "serial" or "chain" connections) and to the negative terminal(s) of the battery/batteries.
- Even though they are not connected to the system ground/battery negative terminals, analogue ground elements (sensors) must have excellent insulation. As a result, special care must be devoted to the eddy resistances of the cable terminals: oxidation, seam-folding defects, etc.
- The metal braid of shielded circuits must be in electrical contact at either end with system components.
- Only one end of the shielding braid must be connected to the system ground.
- In the presence of jointing connectors, the non-shielded portion, **d**, must be as short as possible in the proximity of the connectors (Figure 1).
- The cables must be arranged so as to run parallel to the reference plane, i.e., as close as possible to the frame/body structure.
- Additional electromechanical systems must be connected with the greatest care to the system ground and must not be placed alongside the cables of electronic components.

Figure 1



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SHIELDING BY MEANS OF A METAL BRAID OF A CABLE LEADING TO AN ELECTRONIC COMPONENT - C. CONNECTOR - d. DISTANCE → 0.

COMPONENT CODE

03000	Self-rectifying alternator with built in voltage regulator
08000	Starter Motor
12015	Motor for outside air intake door
12023	Window shade motor
12032	Cab hydraulic release pump motor
20000	Starter battery
22000	Horn
25200	Relay for starter
25201	Relay, preheating
25202	Relay, G.C.R. energizing
25203	Relay, G.C.R. opening
25204	Relay, remote starting enablement, cab unlatched
25205	Relay, engine stopping
25206	Relay, rich mixture control
25207	Relay, alternator D+ earthing
25208	Relay, remote start enablement, gear engaged
25209	Relay for cutting off various components during starting stage
25210	Relay, starting enablement with transmission in neutral
25211	Relay with delayed opening contact for keeping G.C.R energized
25212	Relay with delayed closing contact for keeping RTE energized
25213	Relay for supply of users connected to ignition switch through battery positive
25222	Relay for allowing connection of thermal starter
25310	Relay for allowing connection of internal heating with power load inhibiting relay
25322	Relay for connection of auxiliary heater (1st speed)
25327	Relay for connection of air-conditioning system
25332	Relay for connection of air-conditioning system
25544	Topflap engine polarity reverse contactor for LD
25545	Topflap open/close comand contactor for LD
25722	Cab hydraulic release pump switch (lowering)
25723	Cab hydraulic release pump switch (raising)
25866	Relay for terminal 58
25874	Relay for connection of power loads with engine running
25897	Relay for connection of side transmission power takeoff
25898	Relay for connection of rear transmission power takeoff
25900	General current relay
25924	EDC connecting relay "Main Relay"
30001	Dipped and main beam headlamp with side light
30011	Fog light
32002	Front direction indicator
33001	Side direction indicator
34000	Multifunctional rear light
34011	Trailer light
35000	Number plate light
37000	Front/rear dimensions light
37001	Front dimensions light
39003	Courtesy light for steps
39009	Courtesy light for reading lights
39017	Courtesy light for adjustable cabin interior light
39030	Cab side opening lighting lamp
39034	White and red internal light unit
40011	Electronic Tachograph
40032	Sender unit for tachometer and tachograph
40046	Inductive type chassis height sensor (rear axle)
40047	Inductive type chassis height sensor (front axle)
42030	Sender unit for engine oil pressure gauge
42045	Sender unit for outdoor temperature gauge
42102	Switch signalling handbrake applied

42108	Switch for trailer retarder signal
42111	Switch signalling trailer braking system failure
42116	Switch for low air pressure indicator in EBS system
42200	Switch signalling pneumatic suspension system failure
42351	Switch signalling air filter blocked
42374	EDC clutch switch
42381/A	Drive axle RH pressure sensor (ECAS)
42382/a	Lift axle RH pressure sensor (ECAS)
42389	Air pressure sensor on third axle pneumatic lifting system
42551	Switch signalling oil filter blocked
42608	Coolant pressure signalling 3-switch assembly
42700	Fuel filter clogged indicator switch
44031	Fuel level gauge sender unit with reserver warning light contact
44035	Insufficient windscreen washer fluid level gauge control
44036	Insufficient radiator coolant level gauge control
44037	Insufficient power assisted steering fluid level gauge control
44043	Engine oil level gauge sender unit
47032	Sender unit for engine oil temperature thermometer
47041	Water temperature sender for retarder control unit
47042	Fuel temperature sensor
47043	Engine fan temperature sensor
48035	Engine rpm sensor
48042	Engine rpm sensor (on timing gear)
48043	Turbocharger speed sensor
50005	Multiplex instruments unit module
52005	Switch with built in w/l for heated rear view mirrors
52009	Switch with built in w/l for trailer light
52024	Switch with built in w/l for additional headlamps
52056	Switch with built-in w/lamp for ASR cutout
52059	Automatic transmission speed selector
52070	Switch for engaging side power takeoff
52071	Switch for engaging rear power takeoff
52090	Suspension levelling switch (ECAS)
52092	Switch for engine or cab heater
52093	Switch for tail hatch locking safety
52093	Switch for tail hatch locking safety
52094	Switch for spot light
52200	Switch for electric or pneumatic horns
52302	Switch with built in w/l for hazard warning lights
52304	Switch for fog lights and rear fog lights inhibitor
52307	Switch for exterior lights
52312	Switch controlling headlamp alignment adjustment
52324	Engine brake connecting switch
52326	White and red internal lights switch
52502	Ignition switch for services with starting
53006	Switch for starting from engine compartment
53007	Switch for stopping engine from engine compartment
53030	Switch for controlling starting assistance
53061	Cab hydraulic release consensus switch
53062	Cab hydraulic release pump switch (lowering)
53063	Cab hydraulic release pump switch (raising)
53300	Switch for driver's side electric window
53302	Switch for passenger side electric window
53053	Test pushbutton coupling, automatic transmission
53054	Limit switch button on side doors
53055	Unstable switch for interior lights
53306	Switch controlling sun roof motor
53309	Switch for 3rd axle raising system
53311	Switch for controlling window blind

53315	Switch with built in telltale to turn on foglights
53316	Current general contactor switch
53501	Switch signalling vehicle stopped
53503	Switch signalling reversing lights
53507	Switch signalling reduced gears engaged
53508	Switch for antistarting with reduced gears
53509	Switch for switching on interior lights
53510	Switch for switching on step lights
53511	Switch signalling cabin unlatched
53512	Switch for antistarting engine device with handbrake off
53521	Switch for signalling longitudinal differential lock
53547	Switch for secondary signal from brake pedal to EDC control unit
53567	Switch for signalling side power takeoff engaged
53568	Switch for signalling rear power takeoff engaged
53591	Switch for signalling failure of the hydraulic circuit with auxiliary steering third axle
53593	Switch to light cab side opening lamp
53593	Tool compartment light switch
53602	Switch indicating incomplete sunshade closing
53801	Switch signalling Rockwell axle differential lock engaged
53802	Switch signalling Rockwell axle differential lock engaged (3rd axle)
54030	4 function steering column switch unit
54033	6 function steering column switch unit
61011	3A 1-diode holder container
61104	Air braking system drier resistor
61121	Resistance for engine preheating
61126	Termination resistor for CAN bus
64000	Electric windscreen washer pump
68000	Radio equipment
68001	Speaker
68003	Preamplifier
68005	Feeder 24 V 12 V
68007	City Band (C.B.)
70000	6 fuse carrier
70058	1-way 20A fuse carrier
70601	6-fuse holder
70602	6-fuse holder
70603	6-fuse holder
70604	6-fuse holder
70605	6-fuse holder
72006	Coupling with 7 poles for electrical connection of trailer ABS
72010	15-pole coupling for electrical connection to trailer
72021	30-pole connector for the electrical connection to the diagnostic equipment located outside the vehicle
72025	2-pole 12 V connection for general power supply
72026	2-pole 12 V connection for telephone
78016	Engine fan solenoid valve
78050	Engine brake solenoid valve
78052	ABS/EBS solenoid valve
78053	ASR solenoid valve
78054	Solenoid valve for engaging retarder
78055	Solenoid valve for retarder oil accumulator
78057	EBS front axle air pressure control proportional valve
78058	EBS trailer air pressure control proportional valve
78059	Duplex valve for EBS
78060	Solenoid valve to exclude third-axle braking with ASR
78061	Redundant solenoid valve for rear-axle braking in the event of EBS control unit failure
78203	Solenoid valve for pneumatic horns
78227	Solenoid valve for radiator water recirculation
78238	Rear axle solenoid valve assembly for chassis alignment
78239	Front axle solenoid valve assembly for chassis alignment

78243	Rear axle electropneumatic distributor
78247	Solenoid valve for electronic injection
78248	Solenoid valve for variable geometry turbine order
72049	3-pole coupling for rear-view mirror motor
72050	Unipolar current outlet
78251	Solenoid valve for engaging transmission side power takeoff
78252	Solenoid valve for engaging transmission rear power takeoff
80000	Motor for right electric window
80001	Motor for left electric window
82000	Windscreen defrosting control unit
82005	Auxiliary air heater
82010	Air-conditioning system electronic control unit
84000	Water boiler
84009	Internal temperature sensor
84010	Metering device
84019	Electromagnetic pulley
85000	Cigar lighter
85001	Cigar lighter outlet
85003	Heated rearview mirror (trailer)
85004	Heated rearview mirrot (wheel)
85005	Heated rearview mirror
85006	Electrically adjustable heated rear view mirror
85007	Wheel electrically adjustable heated rear view mirror
85008	Trailer electrically adjustable heated rear view mirror
85010	Rear view mirror control
85023	Electric latch
85065	Remote control for aligning suspensions and raising 3rd axle
85150	EDC MS6 control unit
85152	Accelerator load sensor (EDC)
85153	Coolant temperature sensor (EDC)
85154	Turbofan air temperature sensor (EDC)
85155	Turbofan air temperature sensor (EDC)
85158	Turbofan air temperature sensor (EDC)
85159	Temperature and ambient air pessure sensor for E.D.C.
86002	Sensors for front brake shoe wear
86003	Sensors for rear brake shoe wear
86004	Automatic transmission electronic control unit
86013	Sensor for signalling water in fuel filter
86015	Retarder electronic control unit
86023	Vehicle raising/lowering control unit Ecas
86030	Sensor detecting heat irradiation
86053	Multiplex control and signal unit from bed positions
86116	Multiplex body computer control unit
86117	Multiplex front frame computer control unit
86118	Multiplex rear frame computer control unit
86119	Multiplex Driver Door Module Control Unit
86120	Multiplex Passenger Door Module Control Unit
86123	Multiplex control unit for interface with steering control shaft
86124	Cab with multiplex function electronic control unit
88000	ABS system electronic control unit
88001	ABS system sensor
88005	Electronic control unit for EBS system
88006	EBS rear axle air pressure control modulator
88007	Potentiometric sensor for front wheel shoe position indicator
88008	Potentiometric sensor for rear wheel shoe position indicator
88010	Rear axle brake application pressure sensor

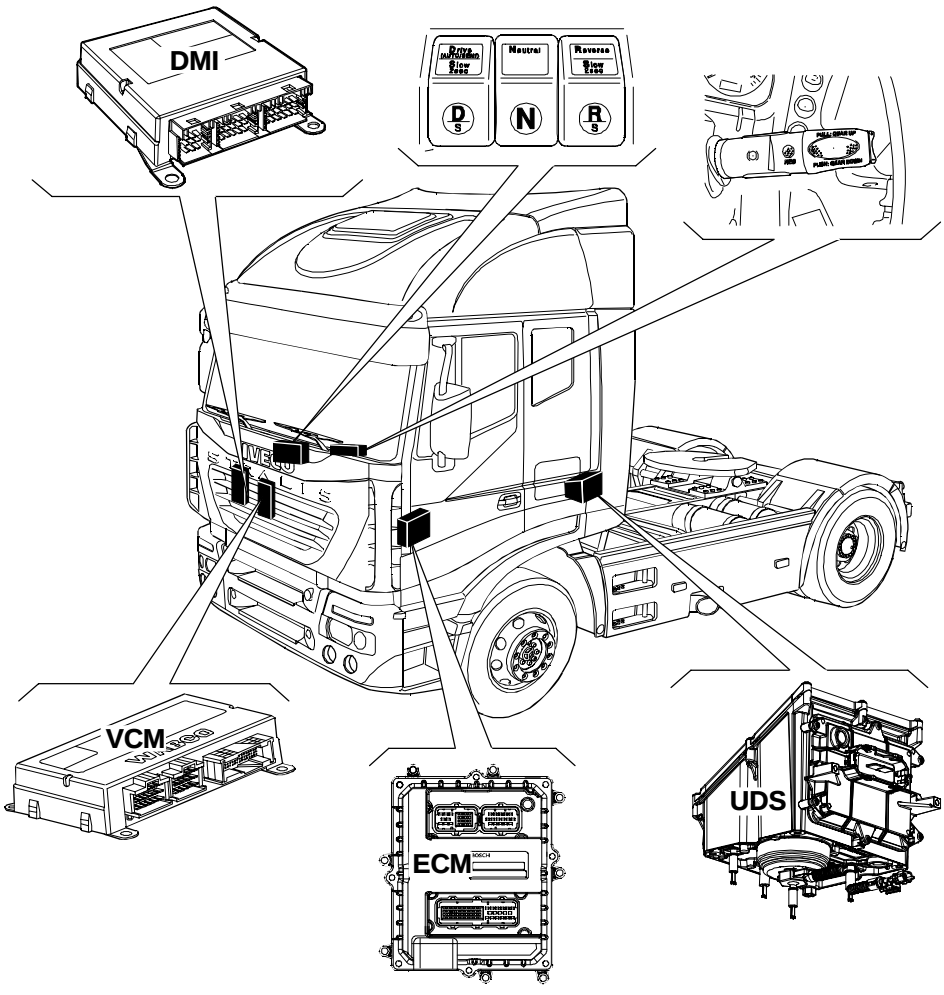
MAIN CHANGES

For vehicles with Euro 4 engine the electric/electronic system is subject to important variations.
In order to handle the increased complexity of Euro 4 operations demanded to the engine control system extra hardware and software resources, the VCM (Vehicle Computer Module) has been added so that vehicle functions can be reallocated on it, which up to Euro 3 had been carried out by the EDC engine control unit, therefore more development flexibility is available for vehicle functions.
The immobilizer function has been also integrated on this unit.For the automated transmission on the new Euro 4 vehicle range the gear selector has been removed. Its functions are carried out from the control pushbuttons located on the dashboard center panel combined with the power steering lever. The DMI (Data Management Interface) unit controls power take off and is connected to the other units by the CAN ICB line.
The SCR (Selective Catalytic Reduction) - Denox 2 is on the entire Average/Heavy Euro 4 Range with the Urea Dosing System (UDS) positioned on the lower side of the frame.
The ENGINE ECM (Engine Control Module) replaces EDC MS 6.2.

The introduction of the new units and the change of the previous ones require changes of the vehicle system structure.
The following CAN lines are on the VCM unit:

- VDB - Vehicle Data Bus
- ECB - Engine Control Bus
- ICB - Instruments Cluster Bus
- FMB - Fuhrpark Management Bus

Figure 2



CAN LINES

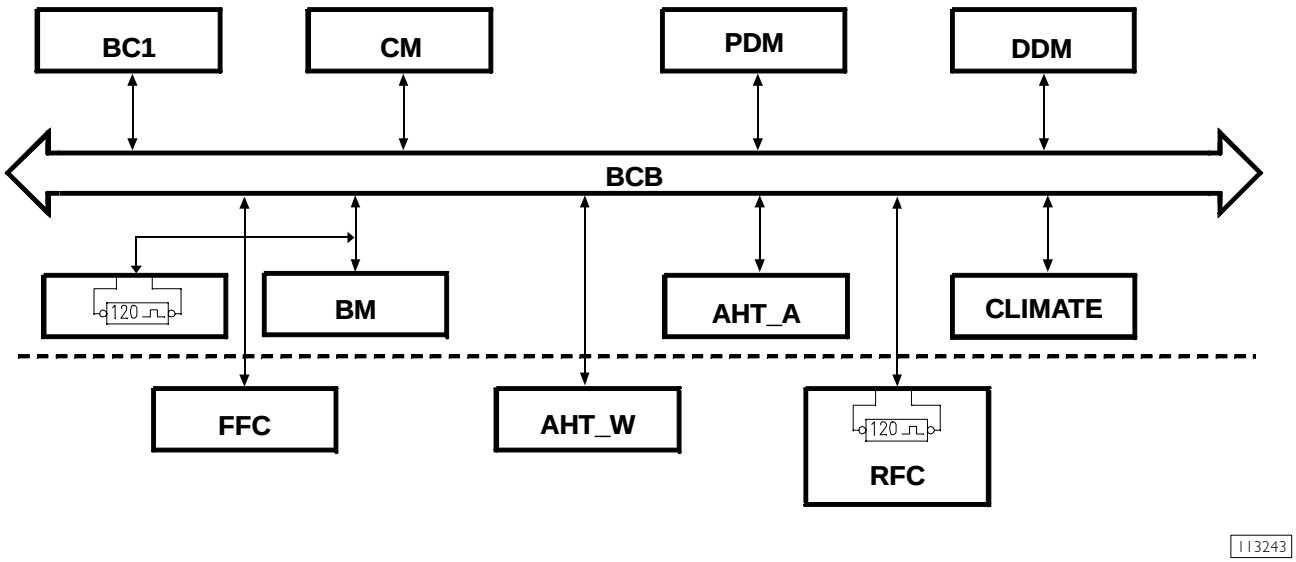
Dialogue between the Multiplex system, vehicle systems, engine control unit, SCR system, radio and various setters is carried out by means of the CAN lines:

- BCB - Body Control Bus
- VDB - Vehicle Data Bus
- ECB - Engine Control Bus
- ICB - Instruments Cluster Bus
- IDB - Infotainment Data Bus
- FMB - Fuhrpark Management Bus

BCB (Body Control Bus) communication line

Allows communication between the different electronic systems on the vehicle. This line does not regard directly the units on the VDB line but the units that carry out different onboard services.

Figure 3



Technical features

Data transmission speed	62.500 (BIT/SEC)
Color of the wire	Gray

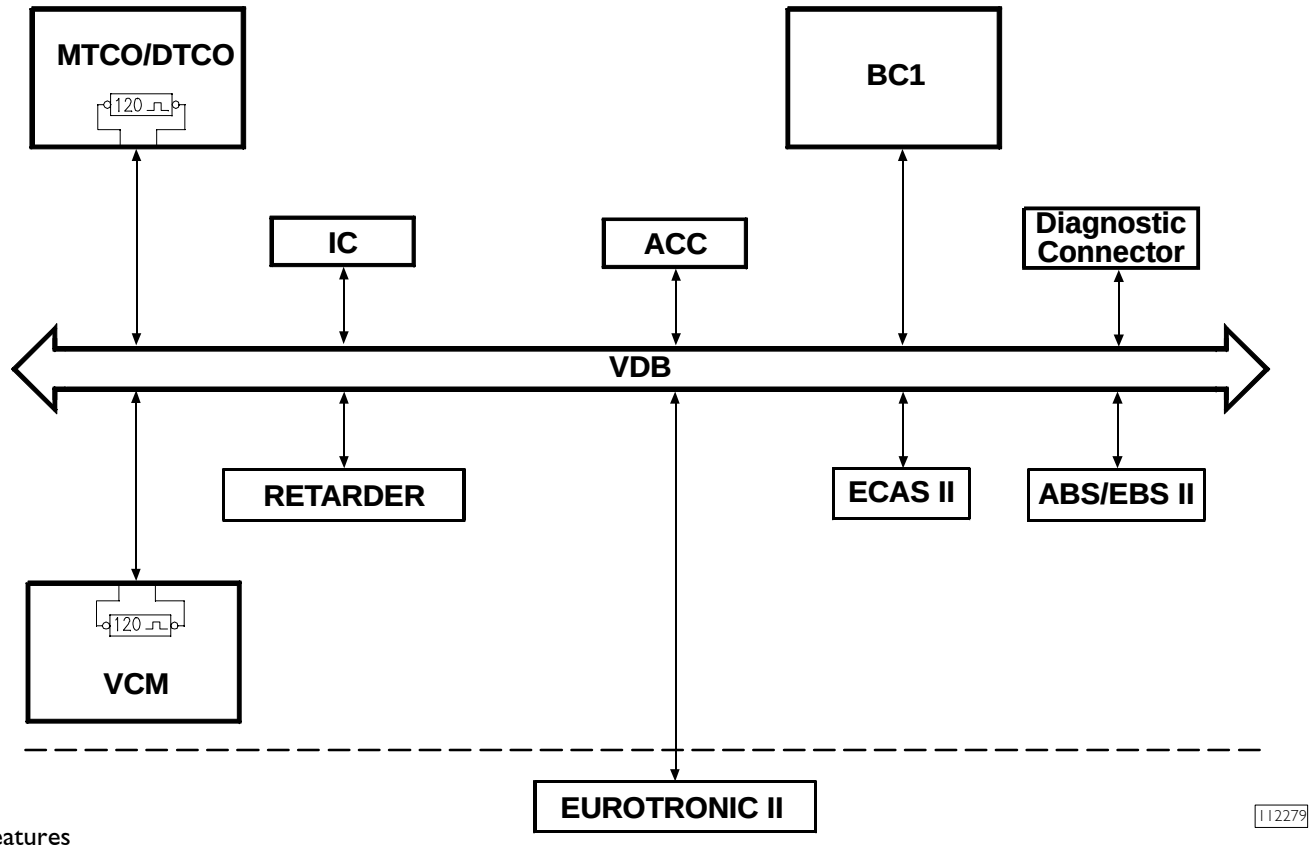
List of Units

Ref.	Description
BC1	Body Computer
DDM	Driver Door Module Unit
PDM	Passenger Door Module Unit
BM	Bed Modul
CLIMATE	Air Conditioning
FFC	Front Frame Computer Unit
RFC	Rear Frame Computer Unit
AHT-A	Air type heater, located on the rear right part of the cab
AHT-W	Water type heater, located on the front right wheel house, next to the FFC
CM	Cabin Module

VDB (Vehicle Data Bus) Communication Line

Allows the electronic systems on the vehicle to dialogue. The units connected to it are: Eurotronic Transmission, Retarder, EBS, Ecas, Diagnosis connector, VCM, Tachograph, ACC.
This line also dialogues with the Cluster and the Body Computer.

Figure 4



Features

❑ Data transmission speed	250.000 (BIT/SEC)
❑ Color of the wire	Black

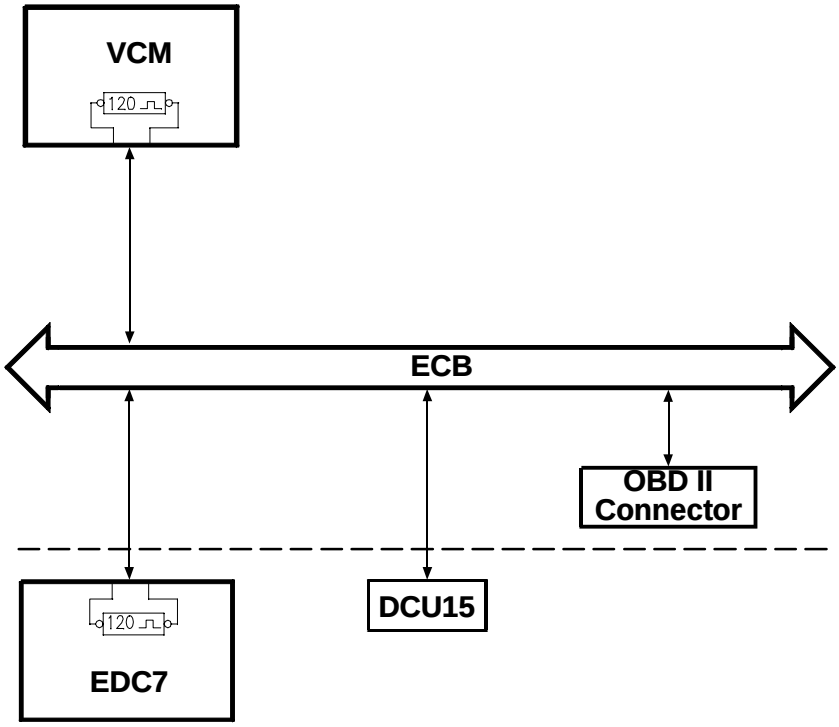
List of Units

Ref.	Description
MTCO	Tachograph
DTCO	Digital Tachograph
VCM	Vehicle Control Module Unit
IC	Cluster
BC1	Body Computer
Diagnostic Connector	30 pole diagnosis connector
ABS	ABS Unit
EBS II	EBS II Unit
RETARDER	Intarder Unit
ECAS II	Pnuematic suspension unit
EUROTRONIC II	Eurotronic II automatic transmission unit
ACC	ACC (Adaptive Cruise Control) Unit

ECB (Engine Control Bus) communication line

Allows the units and the engine control sensors to dialogue together. The units connected to it are:: EDC, VCM, DCU15 and the OBD connector.

Figure 5



112280

Features

❑ Data transmission speed	250.000 (BIT/SEC)
❑ Color of the wire	Yellow

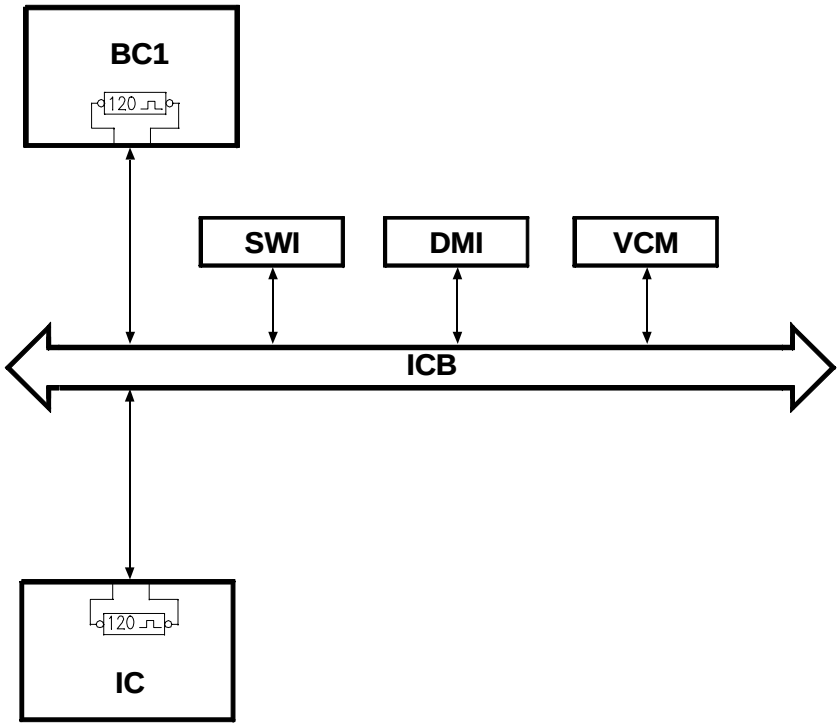
List of Units

Ref.	Description
VCM	Vehicle Control Module Unit
EDC7	Engine control unit
DCU15	SCR pumping module unit
OBD II Connector	16 pole connector for OBD (onbord diagnose)

I.C.B. (Instruments Cluster Bus) communication line

Allows dialogue between the unit located on the steering column (SWI), BODY COMPUTER, CLUSTER, VCM, and DMI. In this way all information coming from the steering wheel and the power steering can reach their respective users i.

Figure 6



Technical features

- ❑ Data transmission speed 250.000 (BIT/SEC)
- ❑ Color of the wire Green

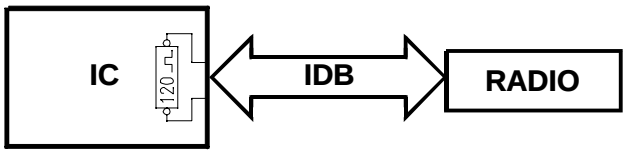
List of Units

Ref.	Description
IC	Cluster
BC1	Body Computer
VCM	Vehicle Control Module Unit
SWI	Steering Wheel Interface Unit
DMI	Data Management Interface Unit

I.D.B. (Infotainment Data Bus) communication line

Allows communication between the Cluster and the Radio. The messages sent are shown on the CLUSTER.

Figure 7



112282

Technical features

- ❑ Data transmission speed 100.000 (BIT/SEC)
- ❑ Color of the wire Blue

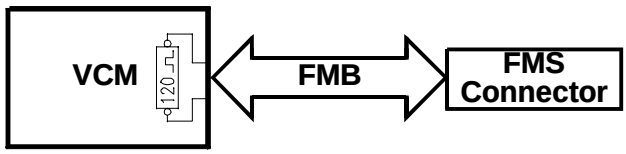
List of Units

Ref.	Description
Radio	Radio
IC	Cluster

F.M.B. (Fuhrpark Managemant Bus) communication line

Allows communication between the different electronic systems (accessories) on the vehicle, , FMS (Telephone) connector and VCM unit.

Figure 8



112283

Technical features

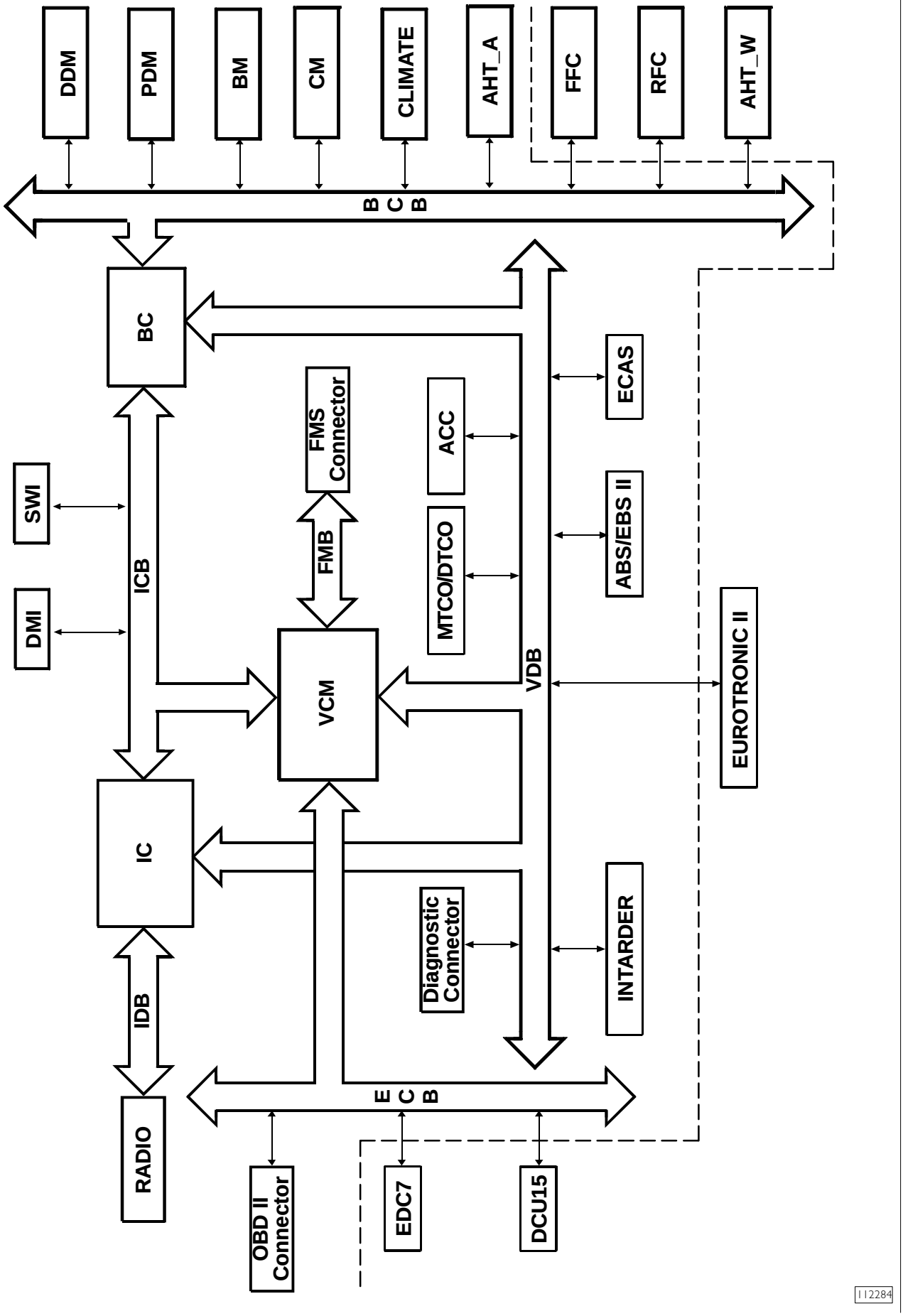
- Data transmission speed 250.000 (BIT/SEC)
- Color of the wire White

List of Units

Ref.	Description
VCM	Vehicle Control Module Unit
FMS	Connector FMS

CAN LINE ASSEMBLY DRAWING

Figure 9



POWER NETWORK

Never disconnect the batteries from the system with the engine running.
Before connecting the batteries to the system, make sure that the system is well insulated.
Disconnect the batteries from the system when charging them.

The purpose of the electric system is to generate, regulate, store and distribute the energy needed to make the vehicle components work.

For this reason the supply of the base electric system is ensured by a generator (28V - 60A -90A alternator) and two batteries, each with 12 V 170 Ah (opt 220 Ah) connected in series.

A mobile fuse holder containing a 20 Amp fuse is located close to the batteries. This fuse supplies:

- ❑ Fuse holder 70601/C
- ❑ Body Computer (J1-8)
- ❑ Cluster (B20)
- ❑ Bed Module
- ❑ Tachograph (A1)
- ❑ Diagnosis connector (Pin 27)
- ❑ Refrigerator

This fuse is not present on the ADR version.

Power cable section:

- ❑ battery direct cable = 16 mm^2
- ❑ fuse cables = 4 mm^2

Attain to what detected on the vehicle for the remaining sections.

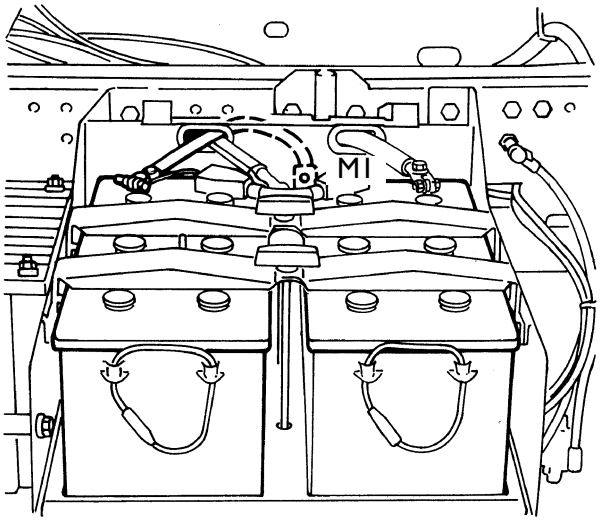
Negative network

The batteries are connected to the frame earth with a brown 70 mm^2 cable, at earth point M1 on the left sidemember (Figure 10).

The starter motor is connected to the frame earth (M2/1) through a 70 mm^2 cable, fastened on the right sidemember near the actual motor.

The same cable serves for connecting the whole engine unit to the frame earth.

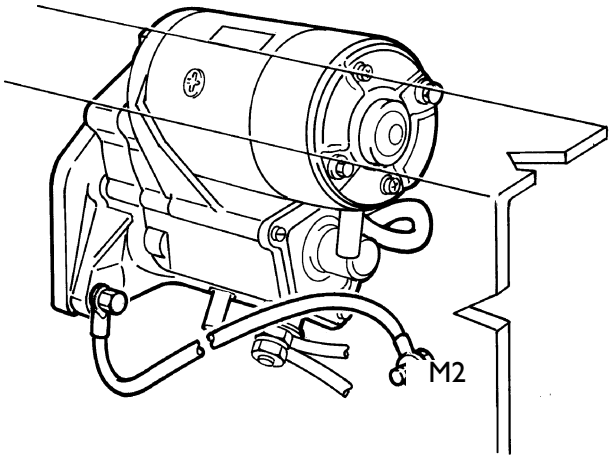
Figure 10



6633

EARTH POINT OF BATTERIES ON LEFT SIDEMEMBER

Figure 11

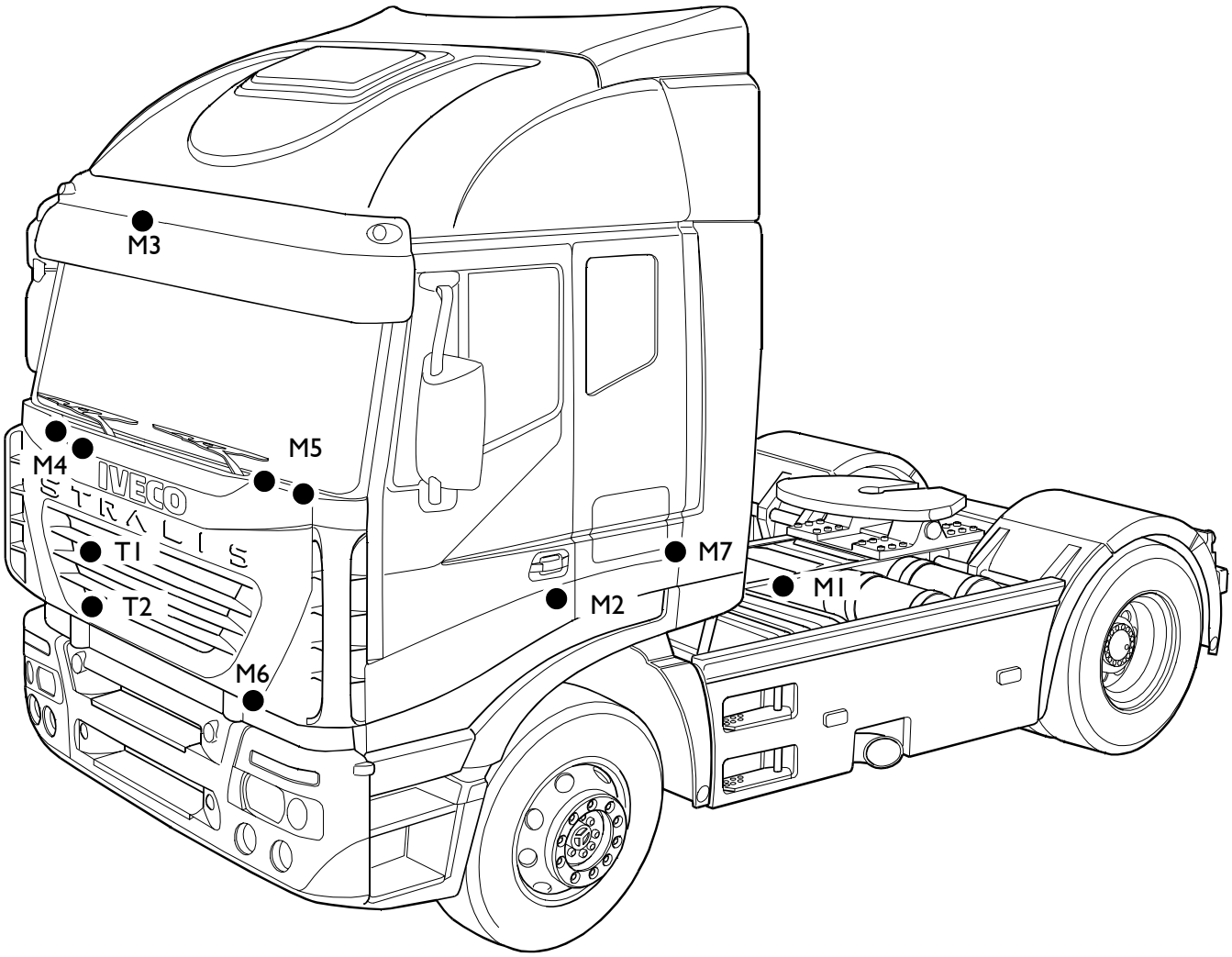


6632

STARTER MOTOR AND ENGINE EARTH POINT

MASS POINTS

Figure 12



M1. Battery mass - M2. Starter motor mass - M3. Upper cab mass - M4. Right inner cab mass - M5. Left inner cab mass - M6. Front right frame mass - M7. Engine mass - T1 - T2. Equipotential braid

ELECTRICAL EQUIPOTENTIAL BRAID

Though generally protected against the influence of on-board equipment voltage, electronic components nevertheless remain particularly sensitive electromagnetic compatibility issues, of different nature such as:

- ❑ generated by the vehicles
- ❑ external.

A suitable size flexible electrolytic copper braid has been provided on the vehicles to minimize these phenomena and return main cab and frame structures to the equipotential state.

Check that the braid is properly attached to the frame and the cab, in the event of defective cab grounding.

Figure 13

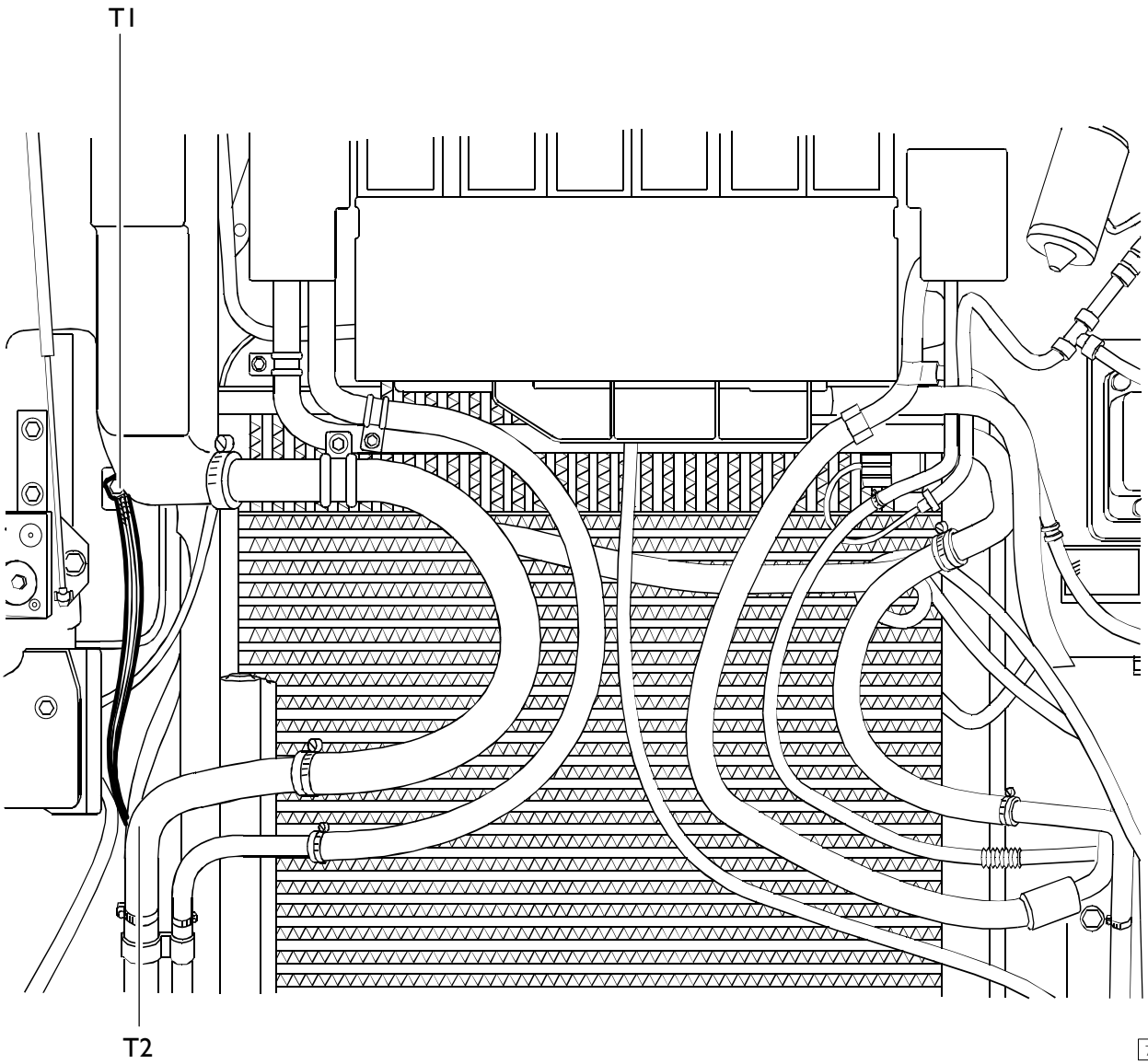
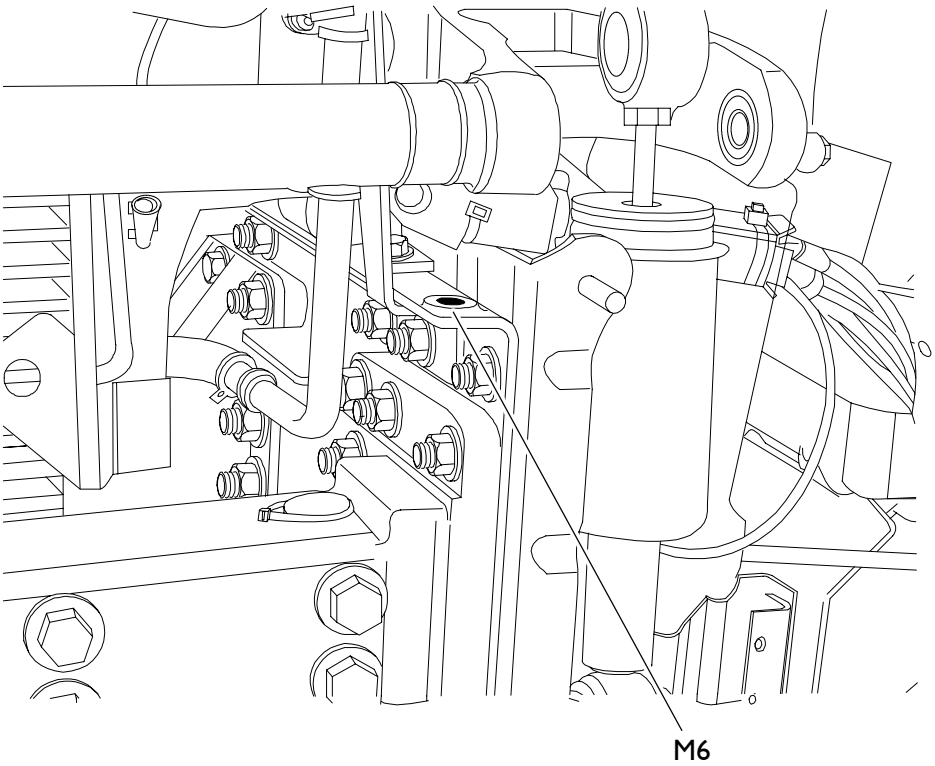
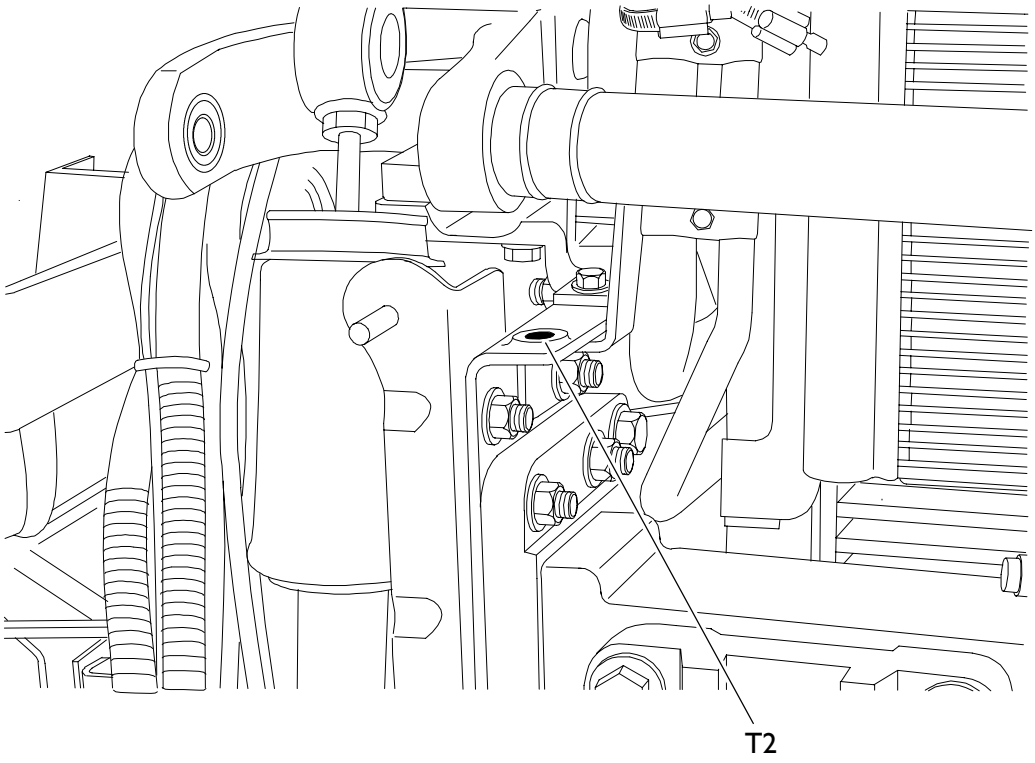


Figure 14



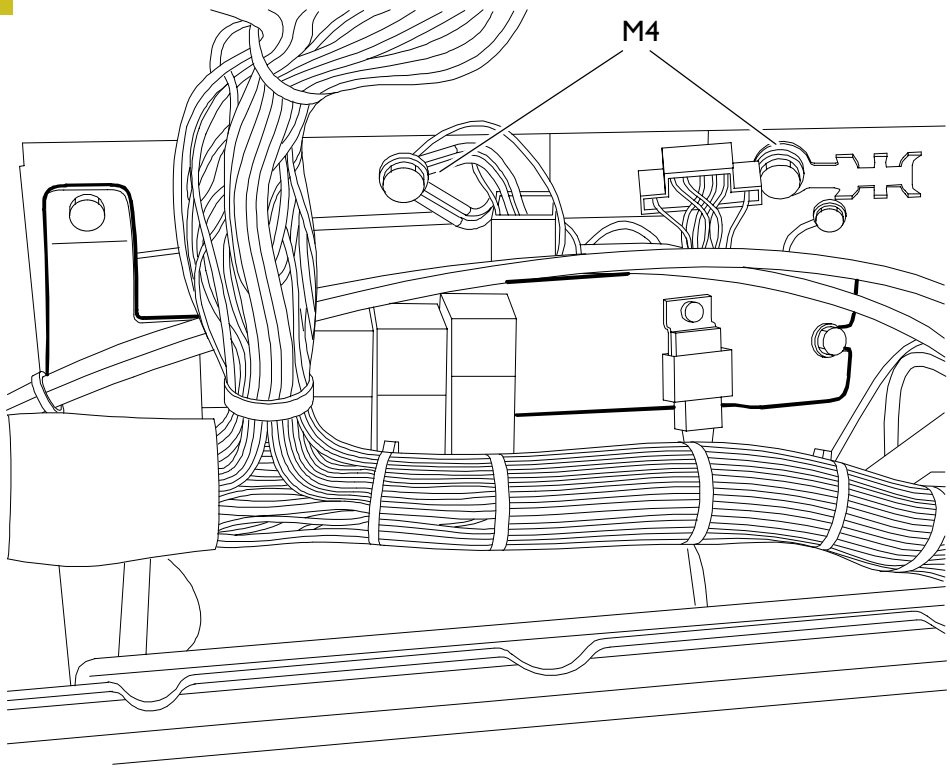
MASS POINT ON THE LEFT FRONT FRAME

Figure 15



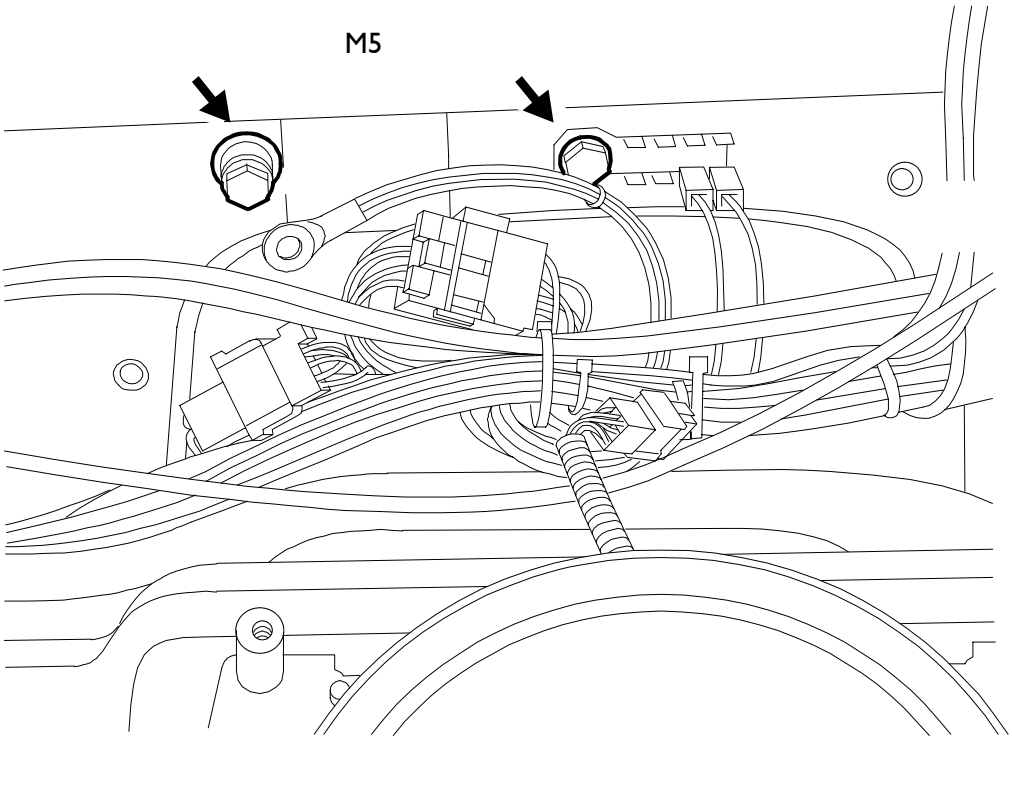
MASS POINT ON THE RIGHT FRONT FRAME

Figure 16



MASS POINT BEHIND THE BODY COMPUTER

Figure 17

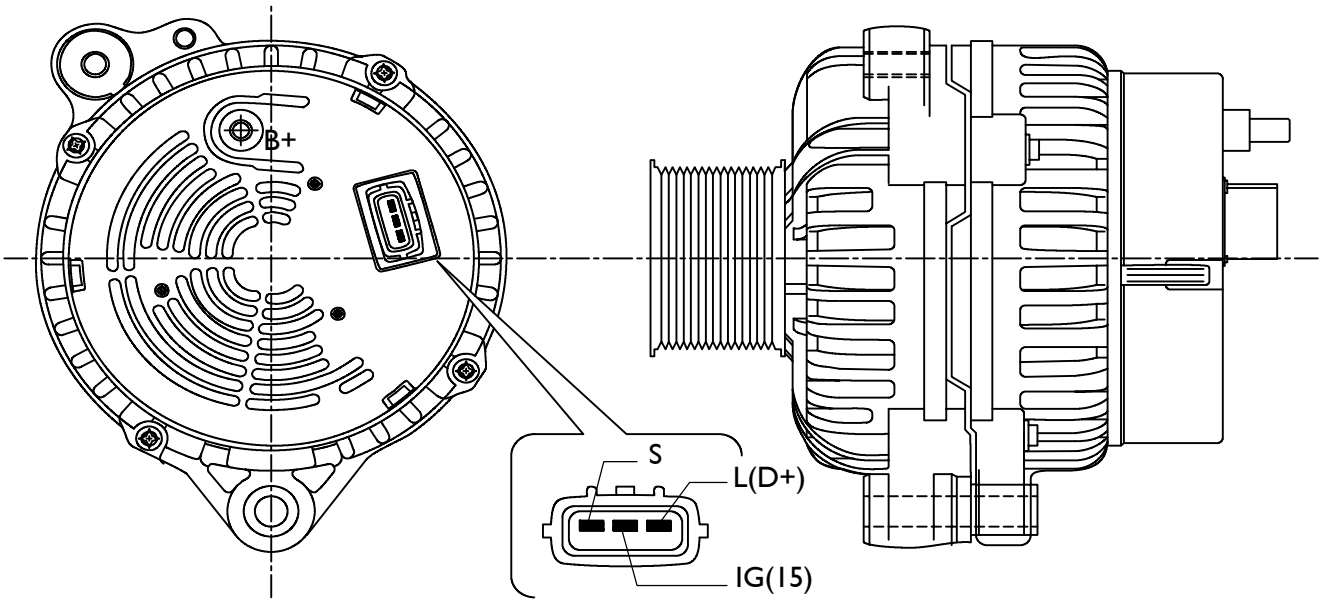


MASS POINT BEHIND THE CLUSTER

28 V - 40 A ÷ 90 A "BOSCH"ALTERNATOR

Figure 18

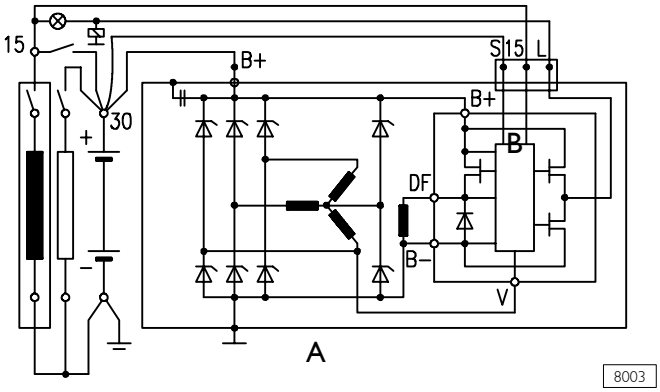
03000



TECHNICAL VIEW

7998

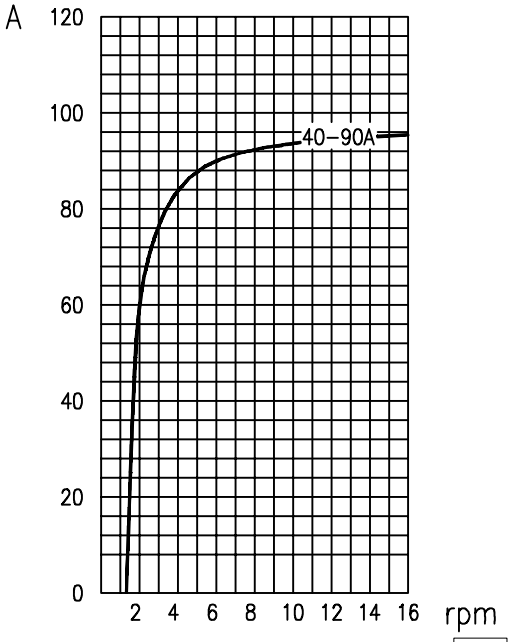
Figure 19



8003

WIRING DIAGRAM
A. Alternator B. Voltage regulator

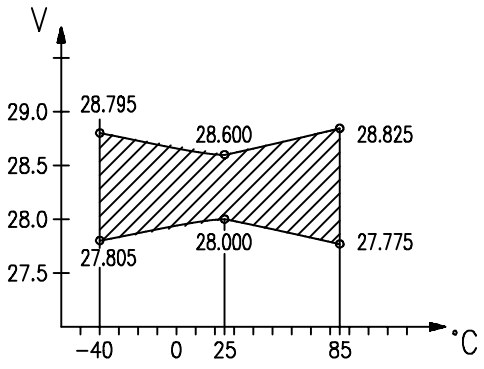
Figure 20



8002

ALTERNATOR CURRENT DELIVERY CURVE

Figure 21



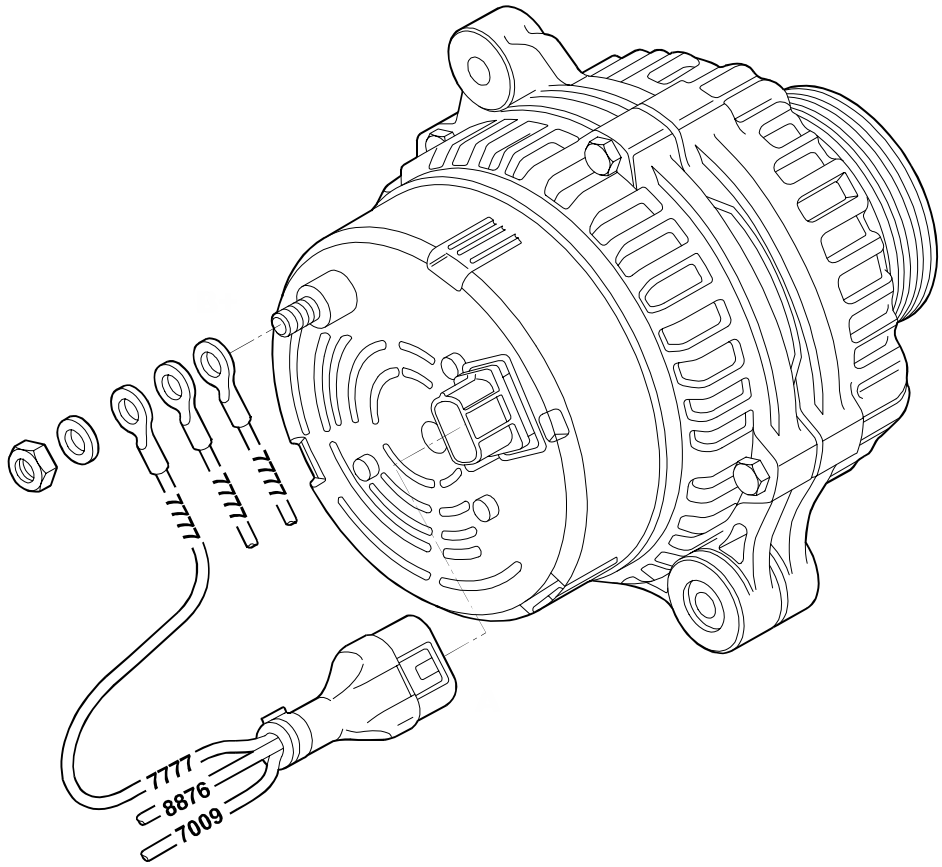
8000

VOLTAGE REGULATOR TEMPERATURE CHARACTERISTICS (6000 RPM)

Characteristics

Rated voltage	28 V
Rated power	90 A
Current at environment temperature	1800 RPM/40 A
At 25 °C and rated voltage	6000 RPM/90 A
Direction of rotation	clockwise, seen from pulley
Weight	7.8 kg

Figure 22



8535

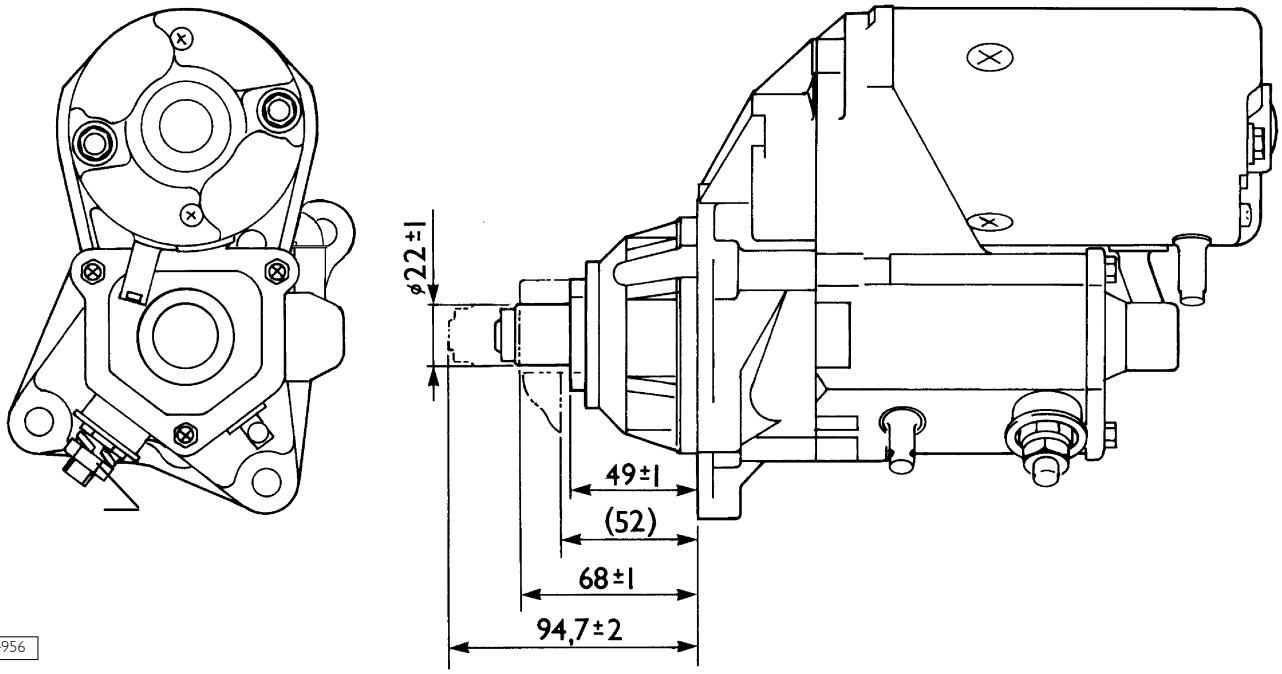
PERSPECTIVE VIEW WITH CORRESPONDING ELECTRICAL CONNECTIONS

Ref.	Function	Cable colour code
L 15 (IG) S	To F.F.C. center clamp J2/B24 To remote switch 25213 clamp 87 (via fuse F6-70601) Positive (+30)	**7009** **8876** **7777**
B+	Clamp S alternator Positive +30 power positive +30 positive to starter motor Positive +30	**7777** **7777** **7777**

24V - 5,5 KW "NIPPONDENSO" STARTER MOTOR

08000

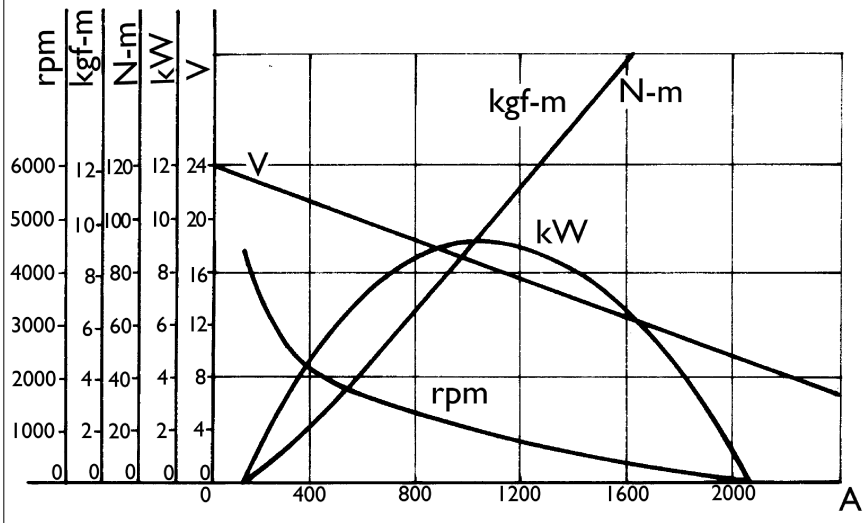
Figure 23



4956

TECHNICAL VIEW

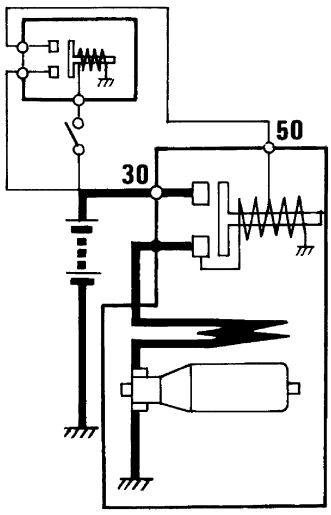
Figure 24



4957

CHARACTERISTIC CURVES

Figure 25

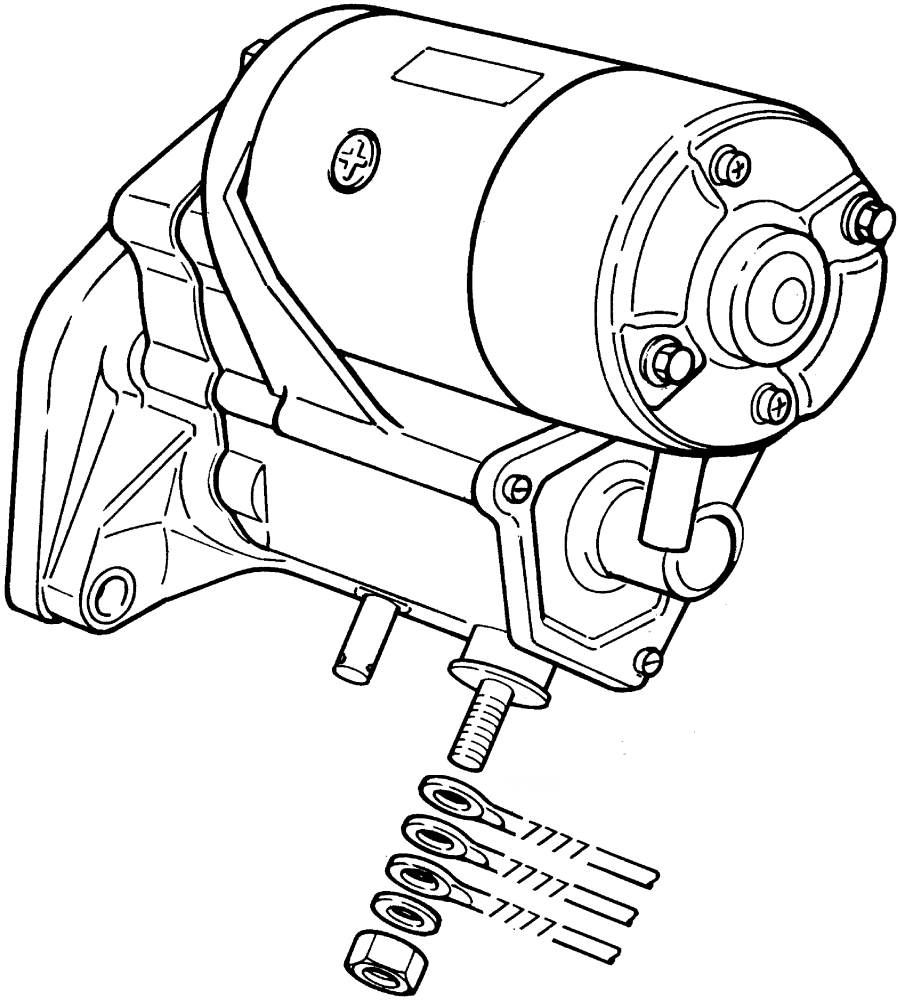


4958

WIRING DIAGRAM

Characteristics		Specific Power (20 °C)	Test cond.	Characteristics
Rated power	5,5 kW	Loadless	23V	120A MAX (3800rpm MIN.)
System voltage	24V	Load	16V (49 N-m)	690A MAX. (900rpm MIN.)
Engagement system	Positive approach control	Stall	6V	1260A MAX. (73.5 N-m MIN.)
Adjusted time	30 sec.			
Direction of rotation	clockwise, seen from end of pinion			
Weight	approx. 10.5 kg			
Operating voltage	16V MAX. (20°C)			
Water resistance	Water spray test to JIS D0203' SI'			

Figure 26



6658

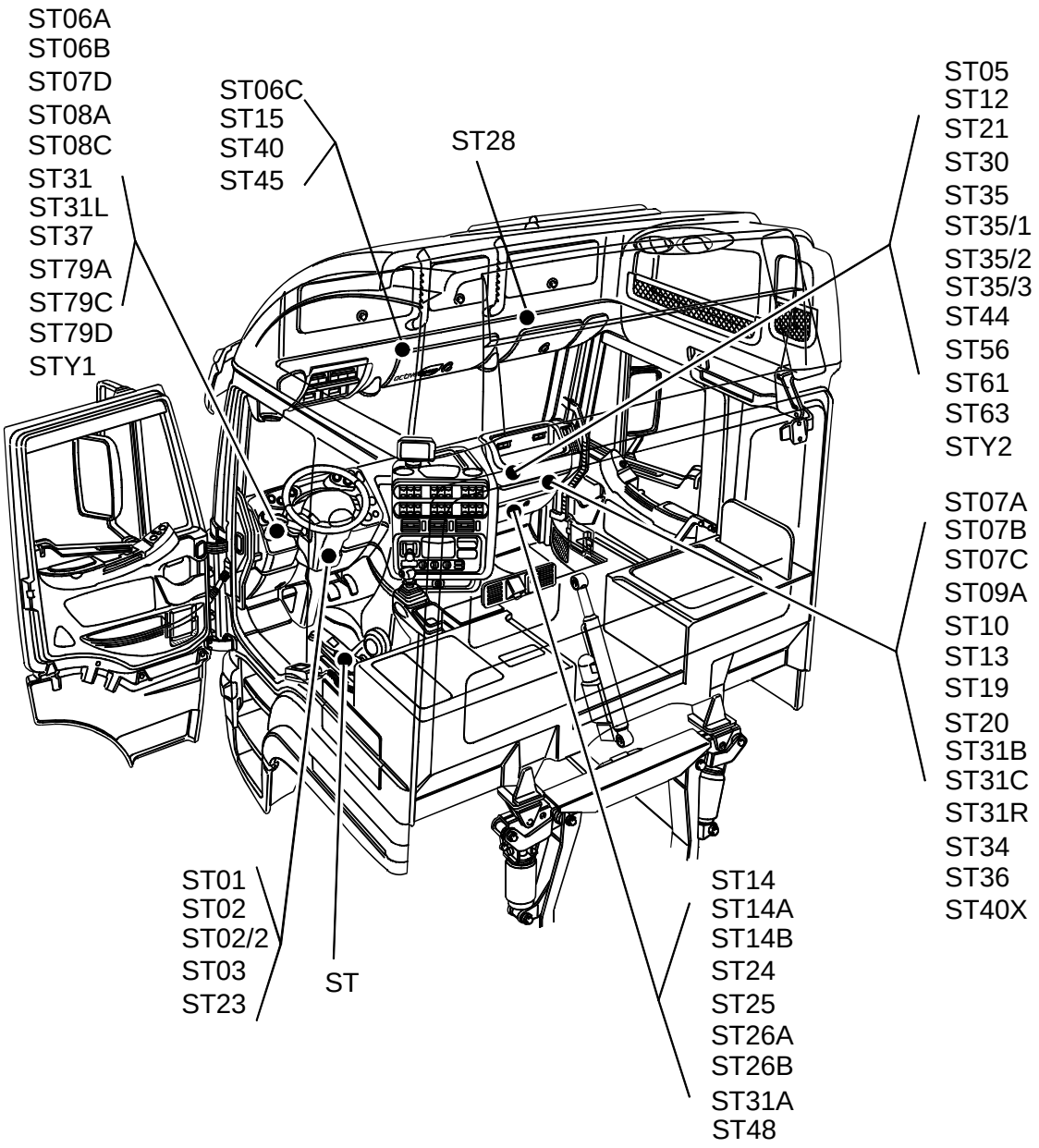
PERSPECTIVE VIEW WITH ASSOCIATED ELECTRICAL CONNECTIONS

Connector	Function	Cable colour code
+30	+30 positive for starter motor power from battery positive clamp (via the T.G.C.)	**7777**
+30	+30 positive to the alternator	**7777**
+30	+30 positive to remote switch for engine preheat on consent	**7777**
+50	+50 positive for key switch	**8888**

JUNCTION CONNECTORS

Location of the junction connectors - cab

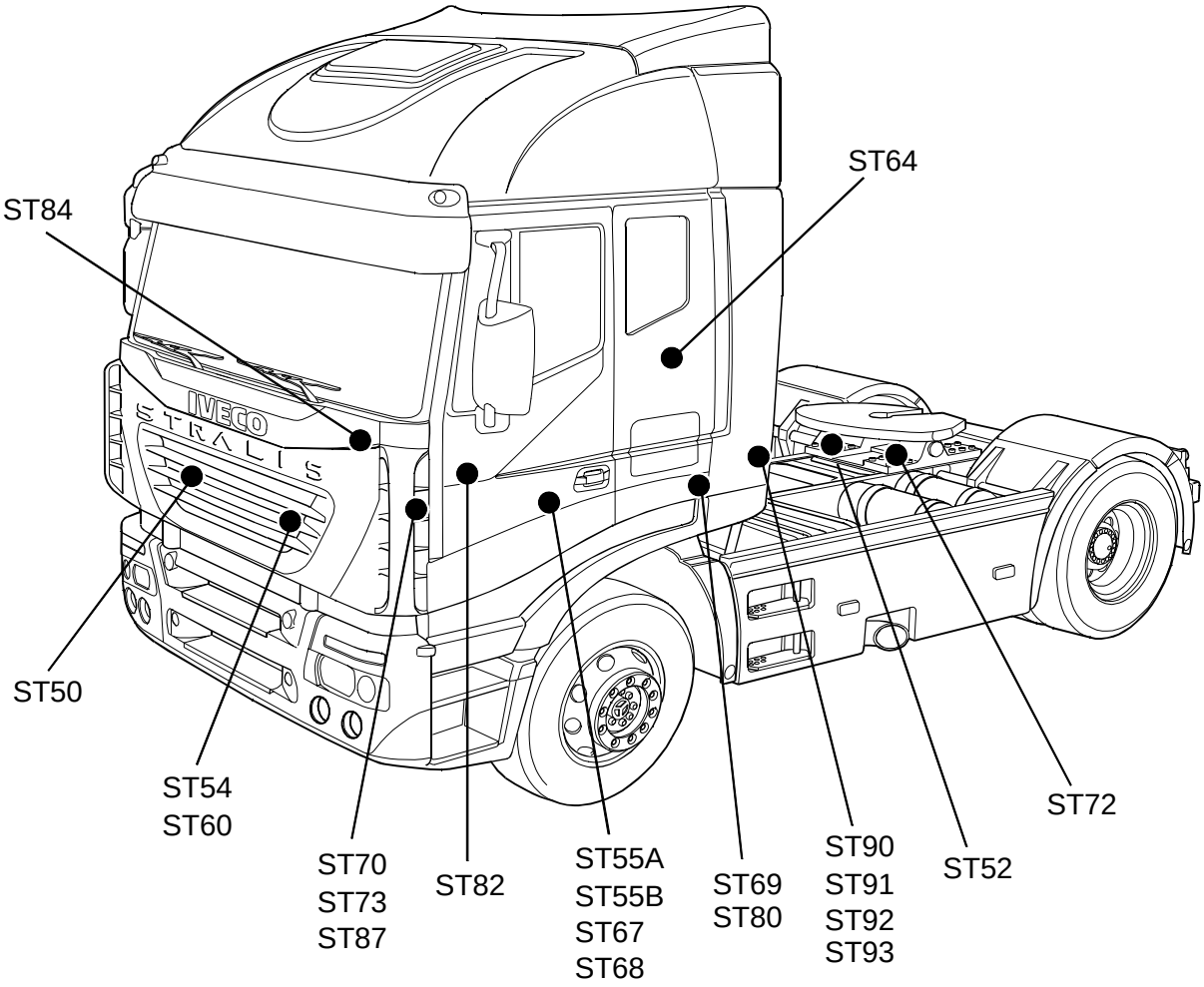
Figure 27



The location of the connectors (cab - chassis) could change to suit wiring needs.

Location of the junction connectors - chassis

Figure 28



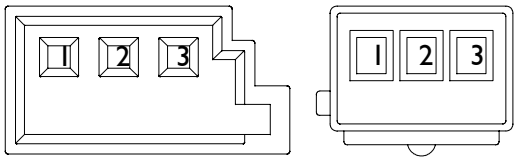
113254

Name	Description
ST 01	Start up commutator
ST 02	Connection for steering column
ST 02/2	Connection for steering angle sensor
ST 03	Connection for speed limiter / Cruise control set
ST 05	Connection for Eurotronic
ST 06A	Connection for roof panel wings devices on the driver side
ST 06B	Connection for tachograph
ST 06C	Connection for Toll Collect
ST 07A	Connection for roof panel wings devices on the passenger side
ST 07B	Connection for navigation and for IT tools
ST 07C	Connection for heatable windscreen
ST 07D	Connection for rotating headlights
ST 08A	Connection for DDM control unit
ST 08C	Connection for front rear-view mirror
ST 09A	Connection for PDM control unit
ST 10	Connection for tools lighting
ST 12	Connection for ABS/EBS tractor and trailer electrical connection
ST 13	Connection for auxiliary air heater CAN line
ST 14	Connection for Ecas bodybuilders (cab)
ST 14A	Connection for bodybuilders (cab)
ST 14B	Connection for bodybuilders (cab)
ST 15	Connection for couplings in the high roof
ST 19	Connection for heater
ST 20	Connection for air- conditioner
ST 21	Connection for radiator water recirculation solenoid valve
ST 23	Connection for Immobilizer antenna
ST 24	Connection for air conditioning system control unit CAN line
ST 25	Connection for Intarder
ST 26A	Connection for Ecas
ST 26B	Connection for ABS/EBS
ST 28	Connection for rotating headlights
ST 30	Connection for ADR (tachograph) provision
ST 31	Connection for ECAS remote control
ST 31A	Connection for cab rear
ST 31B	Connection for auxiliary air heating
ST 31C	Connection for auxiliary air heating temperature sensor
ST 31L	Connection for pneumatic heated seat
ST 31R	Connection for pneumatic heated seat
ST 34	Connection for ACC provision / simple "H" gearbox control
ST 32/2	Connection for gears selector
ST 35	Connection for air conditioner with automatic control
ST 35/1	Connection for air conditioner with manual control
ST 35/2	Connection for air conditioning with manual control
ST 35/3	Connection for air conditioning with manual control
ST 36	Connection for T.G.C. / I.G.C.
ST 37	Connection for Toll Collect
ST 40	Connection for navigation and for IT tools
ST 40X	Connection for FMS (Management system for vehicle fleet)
ST 44	Connection for centralized closing with remote control

Name	Description
ST 45	Connection for 24 V radio
ST 48	Connection for DMI / EM control unit for PTO
ST 50	Connection for FFC control Unit power supply
ST 52	Connection for bodybuilders (chassis)
ST 54	Connection for ACC provision
ST 55A	Connection for SCR system (Urea)
ST 55B	Connection for SCR system (Urea)
ST 56	Connection for ADR (15) Alternator
ST 60	Connection for ECAS axle
ST 61	Connection for steering angle sensor
ST 62	Connection for trailer CAN line (EBS2)
ST 63	Connection for auxiliary water heater CAN line (BCB)
ST 64	Connection for 15-poles current output free pins
ST 67	Connection for urea dosing module solenoid valve
ST 68	Connection for Urea temperature sensor
ST 69	Connection for Intarder
ST 70	Connection for ASR solenoid valve
ST 71/1	Connection for 3° axle left brake pads wear and tear
ST 71/2	Connection for 3° axle right brake pads wear and tear
ST 72	Connection for 3° axles for shoes wear and tear / transverse differential blocking
ST 73	Connection for front shoes wear signalling
ST 77	Connection for right hand side SML indicator lamp (Side Marker Lamp)
ST 78	Connection for left hand side SML indicator lamp (Side Marker Lamp)
ST 79A	Connection for external cab front
ST 79C	Connection for steering angle sensor (EBS2)
ST79D	Connection for brake pedal switch (ABS)
ST 80	Connection for mechanic gearbox
ST 82	Connection for components on the engine
ST 84	Connection for cab tilt system
ST 85L	Connection for left hand side plate light
ST 85R	Connection for right hand side plate light
ST 86	Connection for T.G.C. / I.G.C.
ST 87	Connection for projectors position controller / cab tilting consent
ST 90	Connection for PTO (without DMI)
ST 91	Connection for PTO1 (DMI)
ST 92	Connection for PTO2 (DMI)
ST 93	Connection for PTO3 (DMI)
ST	Connection for ECAS
STY/1	Connection for switch on clutch
STY/2	Connection for Economy Power
STY/3	Connection for ECAS axle (only axle 3° not liftable)

Junction connector ST01 (black) - turn on key

Figure 29



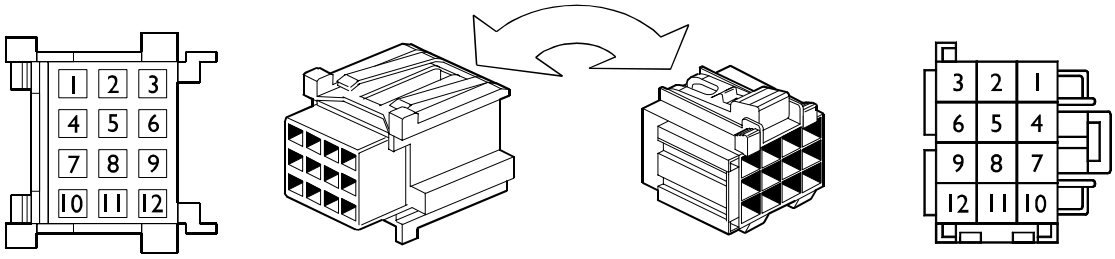
107169

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Commutator ground	0000
2	Terminal 15 key switch	0987
3	Terminal 50 key switch	0900

ST02 (green) - connection for steering column

Figure 30



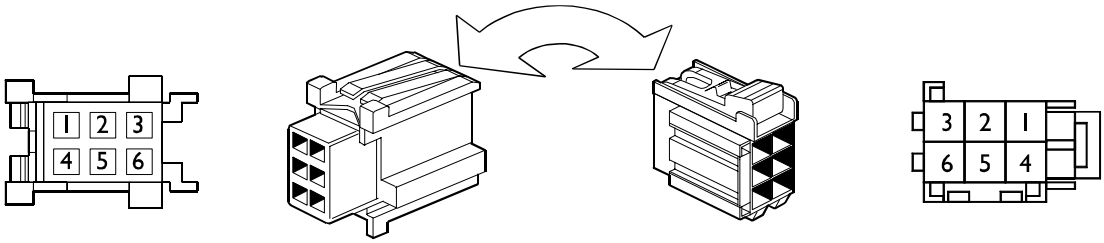
107538

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	CAN L line (ICB)	Green
2	CAN H line (ICB)	White
3	Earth	0000
4	Negative for warning horn	1116
5	Negative from the key switch (15) - ST 1/2	0987
6	Positive for steering column switch unit symbols lighting	4442
7	Positive (+30)	7906
8	Negative from the key switch (50) - ST 1/3	0900
9	Speed limiter signal	9968
10	Earth	0000
11	-	-
12	-	-

ST02/2 junction connector (yellow) - steering angle sensor

Figure 31



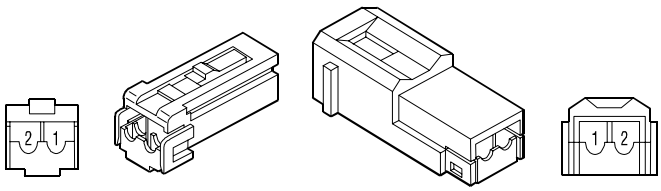
107188

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	CAN SB Line (L)	Green
2	CAN SB Line (H)	White
3	Positive for steering angle sensor	8275
4	Earth	0000
5	-	-
6	-	-

ST03 junction connector - speed limiter signal / Cruise Control Set

Figure 32



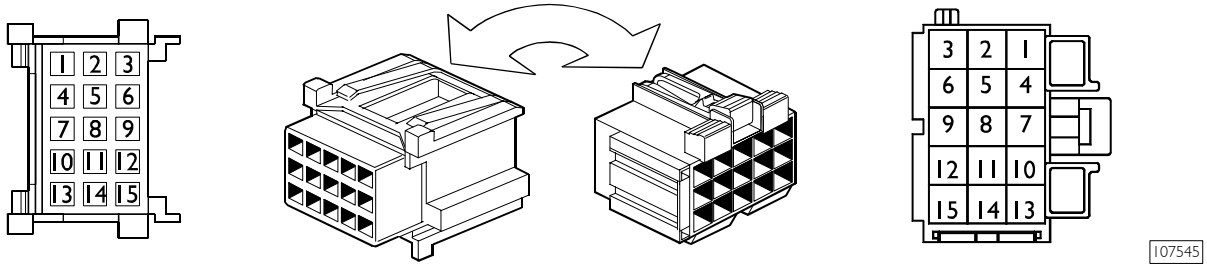
101525

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Speed limiter signal	9968
2	-	-

ST05 junction connector (green) - Eurotronic II

Figure 33

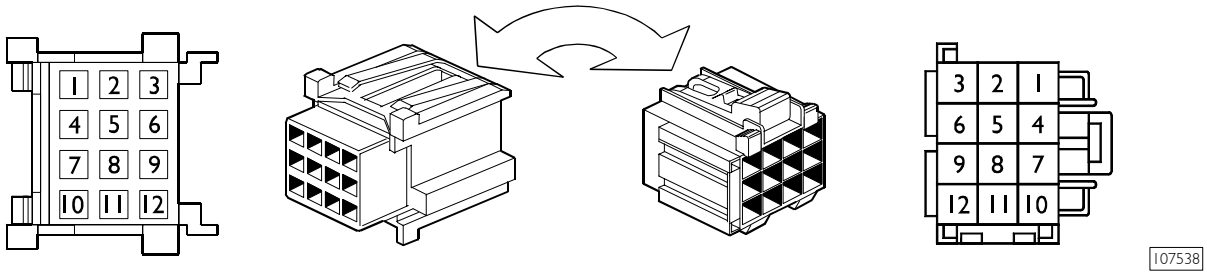


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	CAN VDB Line (L)	Green
2	CAN VDB Line (H)	White
3	CAN VDB Line (L)	Green
4	CAN VDB Line (H)	White
5	K line automatic gearbox	2297
6	Automatic gearbox system power supply (Positive +15)	8102
7	Positive symbols lighting	4442
8	Negative signal forward gear with automatic gearbox	0127
9	VCM control unit pin - X3/24	0125
10	Negative signal from neutral position of the automatic gearbox	0147
11	Negative signal reverse gear with automatic gearbox	0128
12	VCM control unit pin - X3/41	0126
13	Automatic gearbox system power supply (Positive +30)	7101
14	Earth	0000
15	Speed limiter signal	9968

ST06A junction connector (yellow) - roof panel wings devices on the driver side

Figure 34

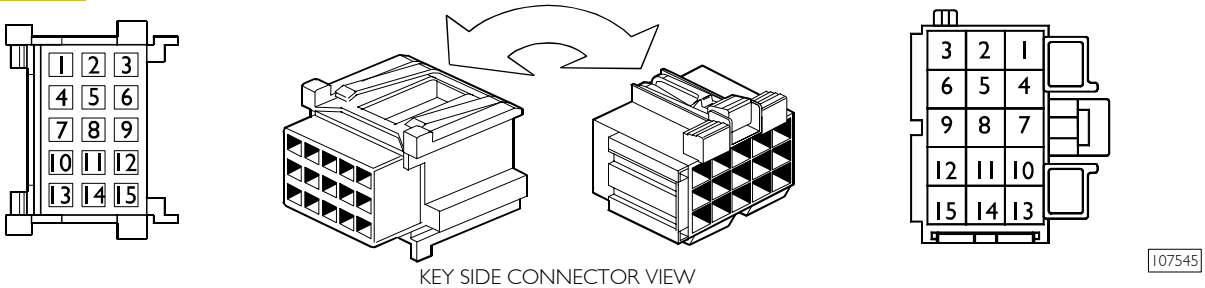


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive left loudspeaker (preamplifier)	1188
2	Negative left loudspeaker (preamplifier)	1186
3	Sliding roof closing control power supply	7011
4	Sliding roof opening control power supply	7010
5	Positive for warning horn solenoid valve	1133
6	CAN line (IDB) H	White
7	CAN line (IDB) L	Green
8	Positive symbols lighting	4442
9	Positive +15	8871
10	-	-
11	-	-
12	-	-

ST06B junction connector (yellow) - tachograph

Figure 35

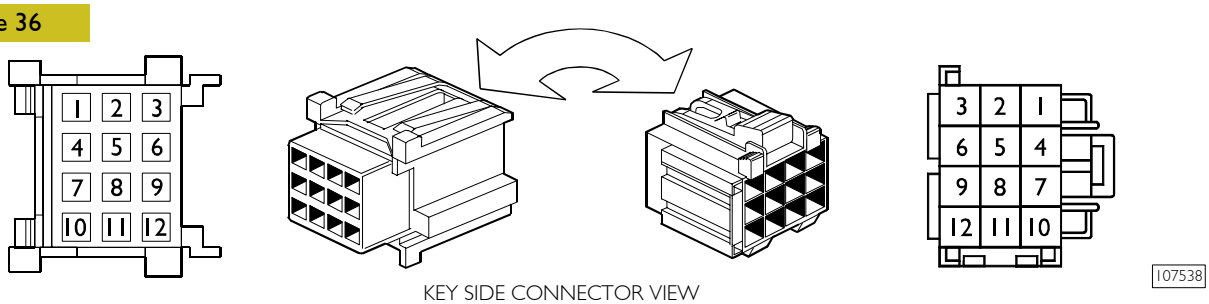


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Isolated negative tachograph transmitter	0058
2	Speed signal tachograph transmitter	5517
3	Inverted signal tachograph transmitter	5516
4	Tachograph transmitter power supply	5514
5	Speed pulse for EDC	5155
6	CAN VDB Line (H)	White
7	CAN VDB Line (L)	Green
8	-	-
9	Earth	0000
10	Tachograph power supply (Positive +15)	8871
11	Positive symbols lighting	4442
12	Tachograph power supply (battery positive +Batt) after fuse 70058	7768
13	K line	2997
14	Tachograph signal distance - travelled for Cluster	5518
15	-	-

ST06C junction connector (yellow) - Toll Collect

Figure 36

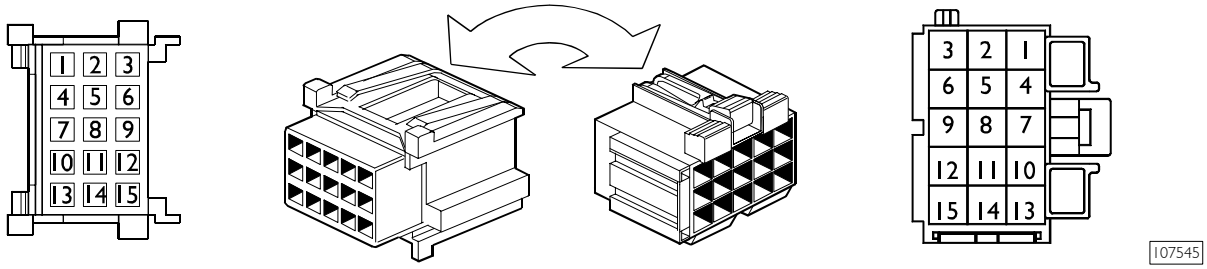


KEY SIDE CONNECTOR VIEW

	Function	Cable colour coding
1	Positive +30	7772
2	Positive symbols lighting	4442
3	Positive +15	8871
4	Speed signal (tachograph)	5541
5	Earth	0000
6	Positive symbols lighting	4444
7	-	2222
8	CAN line	Yellow
9	CAN line	Red
10	-	6666
11	Positive +30	7777
12	Earth	0000

ST07A junction connector (yellow) - roof panel wings devices on the passenger side

Figure 37

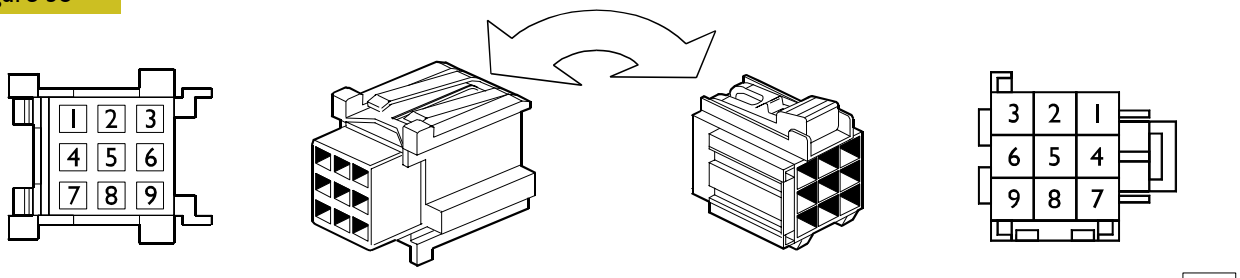


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive for front end-outline marker lamps	3339
2	Positive for voltage reducer	7772
3	Loudspeaker signal (preamplifier)	1184
4	Loudspeaker signal (preamplifier)	1183
5	Positive for reading lights (12V)	7712
6	Positive 12V	7712
7	Positive for overhead light (white light)	4423
8	Positive step lighting	4445
9	Positive for overhead light (blue lights)	4410
10	Positive for overhead light (red lights)	4422
11	Negative for sunshade curtain	0974
12	Sunshade curtain closing signal	8065
13	Positive for sunshade curtain motor	8063
14	Positive for sunshade curtain motor	8064
15	-	-

ST07B junction connector (yellow) - navigation and it tools

Figure 38

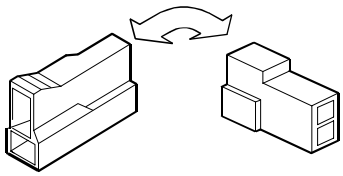


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive +30 after TGC	7772
2	Positive +15	8871
3	Speed signal for navigator	5541
4	-	-
5	CAN L line (FMB)	Green
6	CAN H line (FMB)	White
7	Positive for instruments lighting	4442
8	Reverse gear signal	2268
9	-	-

ST07C junction connector (black) - heatable windshield

Figure 39



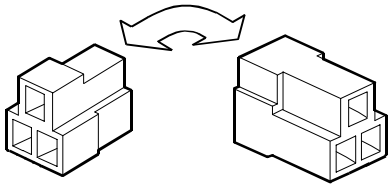
101529

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Power supply to heatable windshield	8020
2	Power supply to heatable windshield	8020

ST07D junction connector- rotating headlights

Figure 40



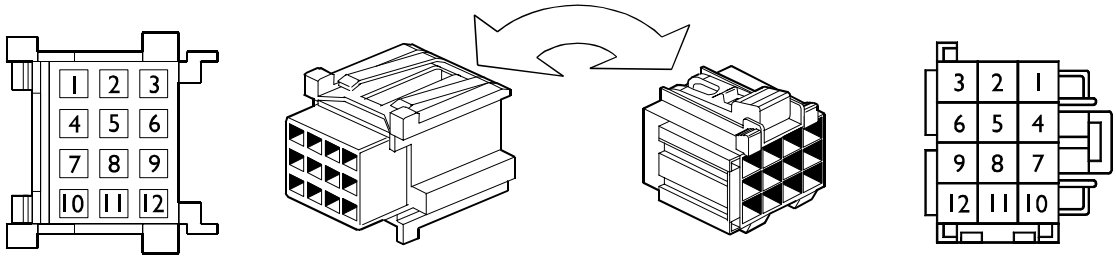
105228

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive for left hand side rotating headlight	1108
2	Ground for rotating headlight	0000
3	Positive for right hand side rotating headlight	1115

ST08A junction connector (blue) - DDM control unit

Figure 41



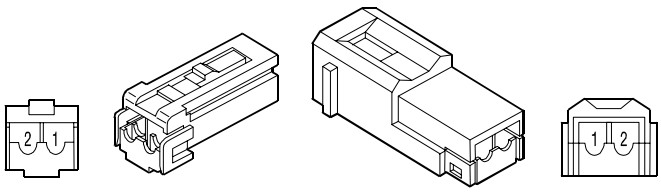
107538

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive (+30) for control unit power supply	7991
2	Earth	0000
3	Signal for loudspeaker (roof panel)	1188
4	Signal for loudspeaker (roof panel)	1186
5	K line for diagnosis	2991
6	CAN H line (BCB)	White
7	CAN L line (BCB)	Green
8	Centralised locking control signal - opening	0064
9	Centralised locking control signal - closing	0065
10	Signal (+) external temperature sensor	7573
11	Driver side electrical lock bolt	0003
12	External temperature sensor ground	0550

ST08C junction connector - front rear-view mirror

Figure 42



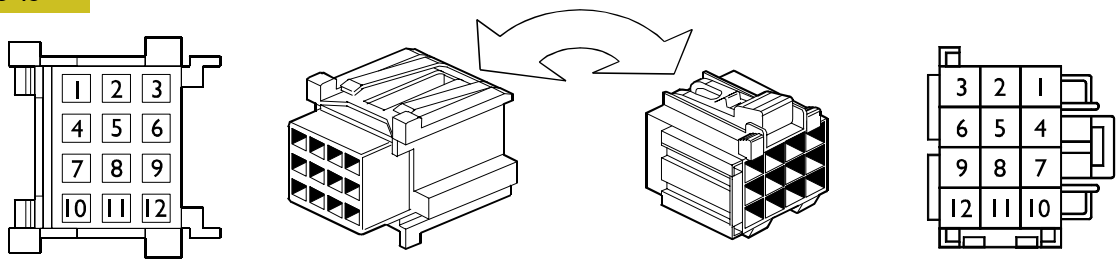
101525

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Front rear-view mirror heating positive	8830
2	-	-

ST09A junction connector (blue) - PDM control unit

Figure 43

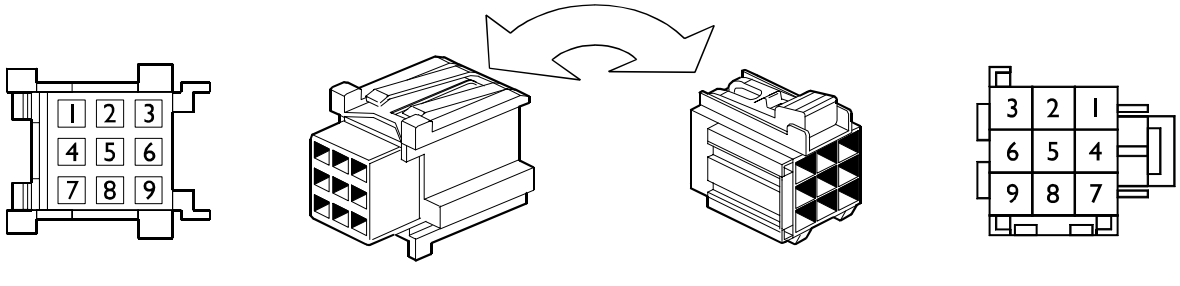


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive (+30) control unit power supply	7990
2	Earth	0000
3	Positive right hand side loudspeaker	1184
4	Negative right hand side loudspeaker	1183
5	K line for diagnosis	2290
6	CAN H line (BCB)	White
7	CAN L line (BCB)	Green
8	Centralised locking control signal - opening	0064
9	Centralised locking control signal - closing	0065
10	-	-
11	Passenger side electrical lock bolt	0003
12	Free	-

ST10 junction connector (green) - Instruments lighting

Figure 44

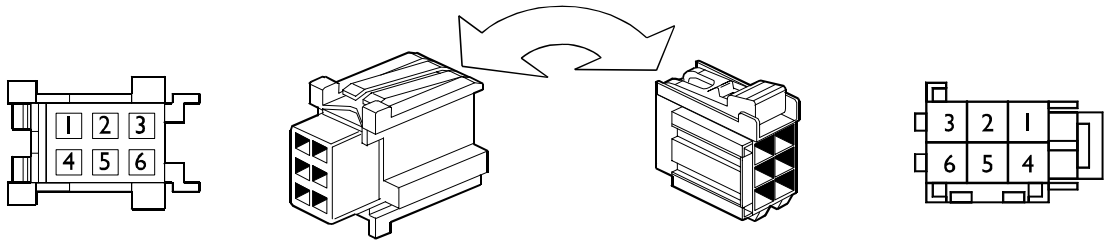


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive for instruments lighting	4442
2	Positive for instruments lighting	4442
3	Positive for commutator for third axle lifting	4442
4	Positive for switch with incorporated warning light for heatable windshield enabling	4442
5	Positive for switch with incorporated warning light for heated rear view mirrors	4442
6	Positive for switch with incorporated warning light for A.S.R. disabling	4442
7	Positive for instruments lighting	4442
8	Positive for instruments lighting	4442
9	Positive for instruments lighting	4442

ST12 junction connector (green) - tractor and trailer ABS/EBS

Figure 45

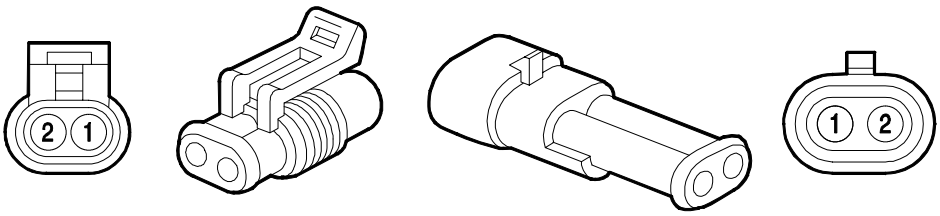


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	–	-
2	-	-
3	Trailer ABS/EBS fault signal	6671
4	Positive (+15) ABS/EBS trailer	8847
5	Positive pressed pedal signal (ABS)	8153
6	Positive for stop lights (ABS)	8158

ST13 junction connector (black) - auxilliary air heater

Figure 46

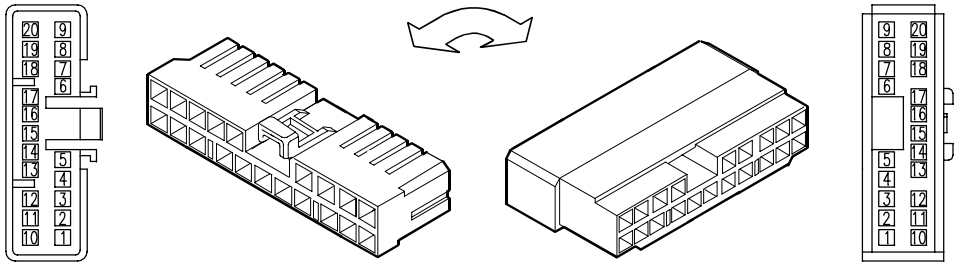


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	CAN BCB Line (L)	Green
2	CAN BCB Line (H)	White

ST14A JUNCTION CONNECTOR (BLUE) - FOR BODYBUILDERS (CAB)

Figure 47



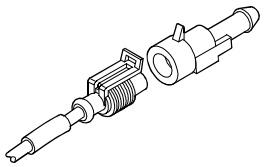
101564

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Engine start-up signal input	8892
2	Engine turning off signal input	0151
3	Stop lights signal for bodybuilders	1165
4	Vehicle not in operation signal output	5515
5	Parking brake engaged signal output	6656
6	Positive +30	7772
7	Tail lights signal for bodybuilders	3333
8	Engine condition (output signal) 0 V engine not in operation / 24 V engine in operation	7778
9	Gearbox in neutral position signal	8050
10	Reverse gear signal	2268
11	Positive +15	8871
12	Provision for Cruise Control SET +	8156
13	Provision for Cruise Control SET -	8157
14	Provision for Cruise Control OFF	8154
15	Provision for Cruise Control RESUME	8155
16	Provision Cruise Control (internal /external choice)	0158
17	Earth	0000
18	Provision for P.T.O. 1 control signal	0131
19	Provision for P.T.O. 2 control signal	0132
20	Provision for P.T.O. 3 control signal	0333/0123

ST14 junction connector - ECAS bodybuilders (cab)

Figure 48



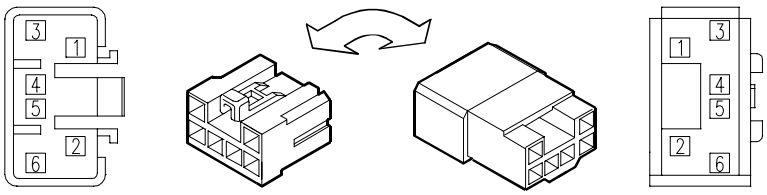
101523

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Power supply to liftable axle lowering or lifting switch	8445

ST14B junction connector (blue) - for bodybuilders (cab)

Figure 49



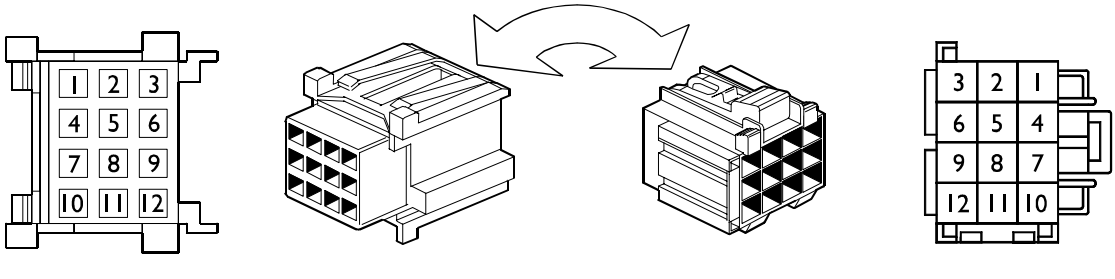
101545

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Signal for the second speed limiter	0172
2	Signal for Economy Power	0166
3	-	-
4	-	-
5	-	-
6	-	-

ST15 - ST19 junction connector

Figure 50



KEY SIDE CONNECTOR VIEW

ST15 (yellow) - Connection for couplings in the high roof

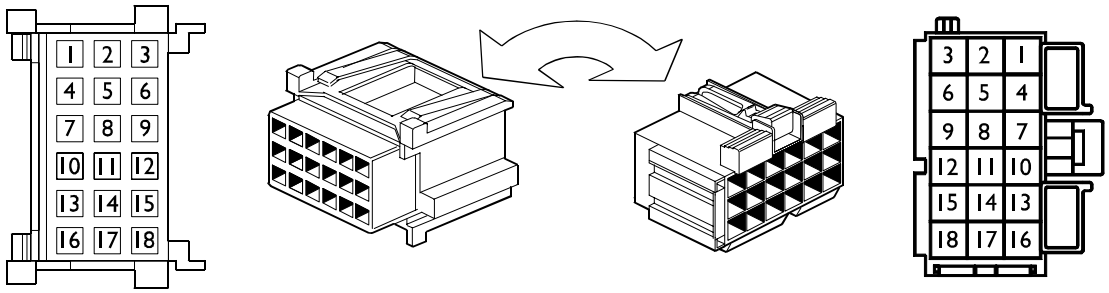
Pin	Function	Cable colour coding
1	Earth	0000
2	Positive for sliding roof closing	7011
3	Positive for sliding roof opening	7010
4	Positive for reading light	4412
5	Positive for overhead lights (white light)	4423
6	Positive for overhead lights (red lights)	4422
7	-	-
8	Left hand side loudspeaker	1186
9	Left hand side loudspeaker	1188
10	Right hand side loudspeaker	1183
11	Right hand side loudspeaker	1184
12	-	-

ST19 (green) - connection for heating

Pin	Function	Cable colour coding
1	K line	2295
2	Positive symbols lighting	4442
3	with ST 20 - 3	0506
4	with ST 20 - 4	8087
5	Positive for 1st speed auxiliary heating enabling (remote control switch)	8884
6	Positive for heater motor water recirculation enabling (remote control switch)	7778
7	Locked positive	8871
8	-	-
9	Earth	0000
10	Negative for auxiliary heater enabling	0501
11	Positive with starter up engine	7786
12	-	-

ST20 junction connector (green) - air conditioning system

Figure 51

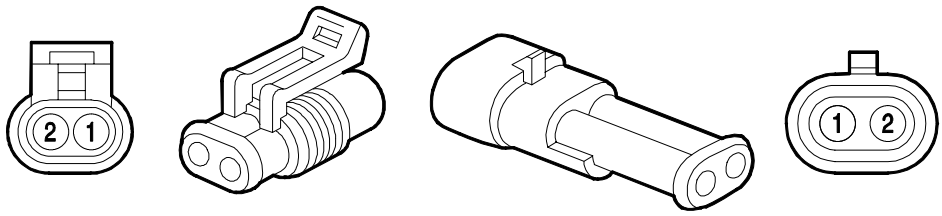


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	K line	2296/2295
2	Positive instruments lighting	4442
3	with ST 19 - 3	0506
4	with ST 19 - 4	8087
5	Positive for 1st speed heater enabling (remote control switch)	8884
6	Remote control switch signal for compressor enabling (from pressure switches)	9933
7	Remote control switch signal for compressor enabling (from control unit)	9933
8	Positive with starter up engine	7778
9	Earth	0000
10	Positive compressor control	9993
11	Positive +15	8871
12	Positive after TGC	7551
13	Positive after TGC	7551
14	-	-
15	Negative (from control unit) for solenoid valve radiator water recirculation	9552
16	Positive for solenoid valve radiator water recirculation	7550
17	-	-
18	-	-

ST21 junction connector (black) - solenoid valve for radiator water recirculation

Figure 52



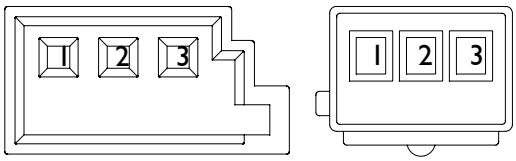
101531

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive for solenoid valve radiator water recirculation	7550
2	Negative for solenoid valve for radiator water recirculation	9552

ST23 junction connector - immobilizer antenna

Figure 53



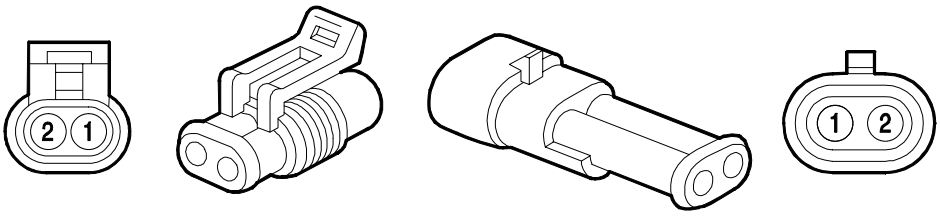
107169

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Immobilizer antenna signal (VCM pin - X1/1)	-
2	Immobilizer antenna signal (VCM pin - X1/3)	-
3	-	-

ST24 junction connector (black) - CAN line for air conditioning system

Figure 54



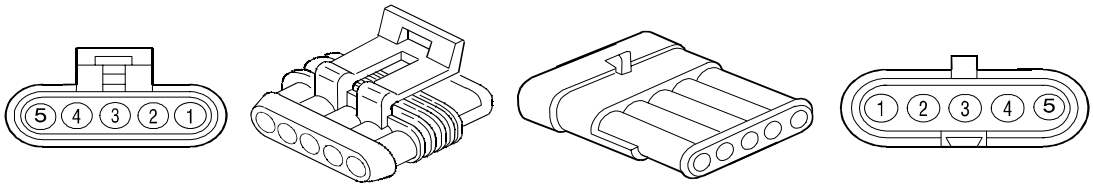
101531

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	CAN L line (BCB)	Green
2	CAN H line (BCB)	White

ST25 junction connector (black) - Intarder

Figure 55



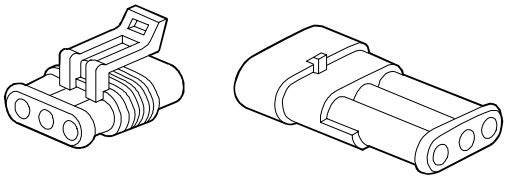
101542

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	CAN VDB Line (L)	Green
2	CAN VDB Line (H)	White
3	Speed signal for Intarder	5541
4	EOL data entry line for Intarder control unit	3393
5	K line	2293

ST26A - ST26B junction connector

Figure 56



101536

KEY SIDE CONNECTOR VIEW

ST26A (black) - Ecas (CAN)

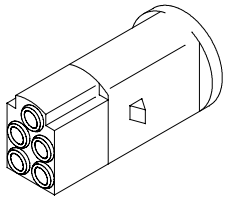
Pin	Function	Cable colour coding
1	CAN VDB Line (L)	Green
2	CAN VDB Line (H)	White
3	K line	2294

ST26B (black) - ABS/EBS (CAN)

Pin	Function	Cable colour coding
1	CAN VDB Line (L)	Green
2	CAN VDB Line (H)	White
3	K line	2299

ST28 junction connector- rotating headlights

Figure 57



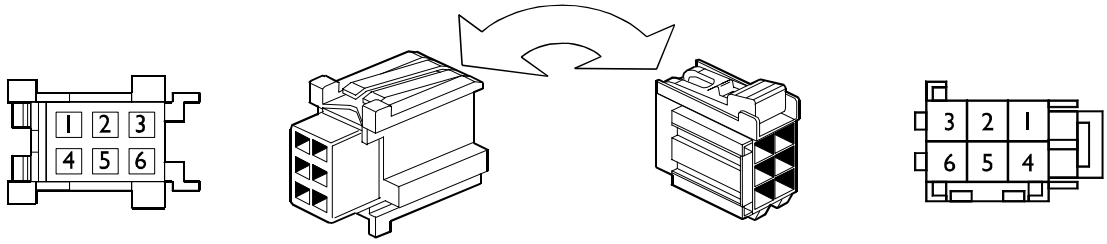
107183

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Ground for left hand side rotating headlight	0000
2	Positive for left hand side rotating headlight	1108
3	Free	-
4	Positive for right hand side rotating headlight	1115
5	Ground for right hand side rotating headlight	0000

ST30 - ST31 junction connector

Figure 58



KEY SIDE CONNECTOR VIEW

ST30 (blue) - provision for ADR (tachograph)

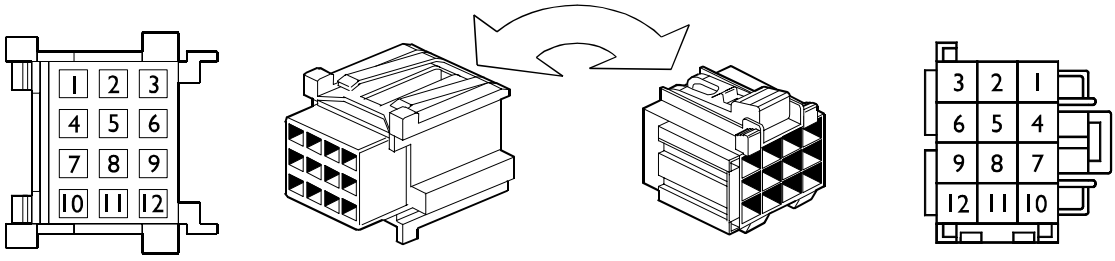
Pin	Function	Cable colour coding
1	Positive (+Batt) tachograph (pin/AI)	7768
2	-	-
3	Positive (+Batt) fuse 70601/3	7768
4	Earth	0000
5	Battery direct positive (+Batt) after fuse 70058 (20A)	7972
6	Positive (+Batt)	7972

ST31 (green) - connection for ECAS (remote control)

Pin	Function	Cable colour coding
1	Power supply to equalization adjustment system (+15)	8810
2	Earth	0000
3	Clock line on ECAS suspensions control keyboard	6402
4	Clock line on ECAS suspensions control keyboard	6403
5	-	-
6	-	-

ST31A junction connector (green) - Cab rear

Figure 59



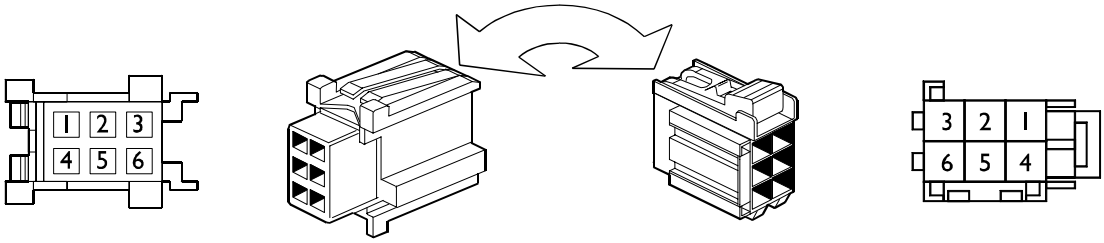
107538

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive for tool compartment lighting switch	4448
2	Positive for reading over head light	4412
3	Earth	0000
4	Ground for refrigerator	0000
5	Positive for refrigerator (24 V)	7735
6	Positive power supply for Bed Module	7906
7	Earth	0000
8	CAN (H) Line BCB	White
9	CAN Line (L) BCB	Green
10	Positive for telephone plug (12 V)	7712
11	Telephone plug ground	0000
12	Positive for lamp	7772

ST31B junction connector (blue) - auxiliary air heating

Figure 60



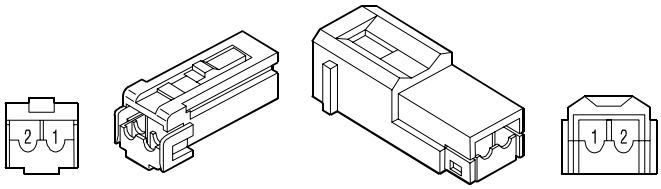
107188

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Auxiliary air heater warning light	6655
2	Positive +30	7708
3	Earth	0000
4	Power supply to auxiliary fuel pump for air heater	7783
5	Auxiliary heater K line	2295
6	Power supply to ambient temperature sensor for auxiliary sensor	7512

ST31C junction connector (white) - water heating temperature sensor

Figure 61



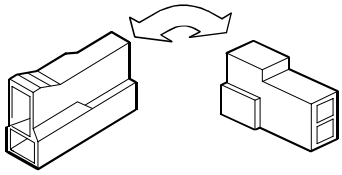
101525

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive for internal temperature detection probe	7520
2	Negative for internal temperature detection probe	0000

ST31L - ST31R junction connector

Figure 62



101529

KEY SIDE CONNECTOR VIEW

ST31L - connection for pneumatic heated seat

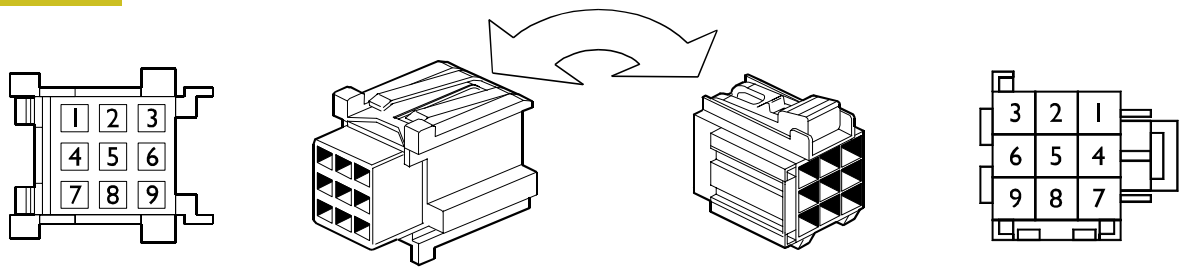
Pin	Function	Cable colour coding
1	Earth	0000
2	Positive for driver side heated pneumatic seat	8031

ST31R - connection for pneumatic heated seat

Pin	Function	Cable colour coding
1	Earth	0000
2	Positive for passenger side heated pneumatic seat	8031

ST34 (blue) junction connector- provision for ACC / simple gearbox control "H"

Figure 63

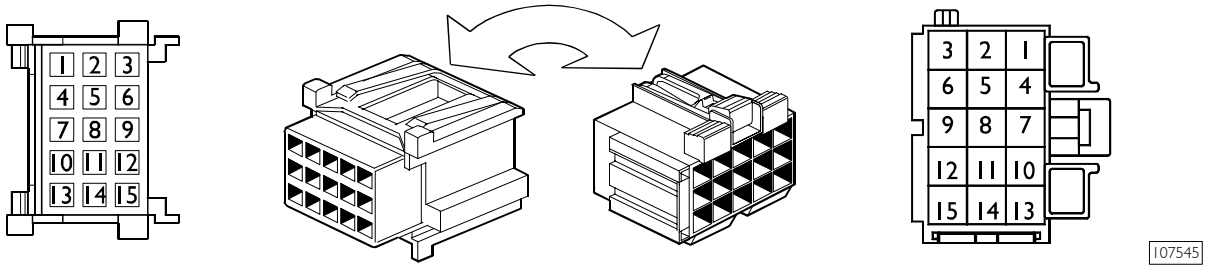


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	VCM control unit pin X3/7	0179
2	Power supply to warning light for ACC (Adaptive Cruise Control) distance rule signalling / Power supply to splitter control solenoid valve (gear reducer) mechanical gearbox	6179/9973
3	Positive 5 V for distance control with ACC (Adaptive Cruise Control) great distance	8179
4	VCM control unit pin X2/9	0139
5	Return from distance selector with ACC (Adaptive Cruise Control)	6178
6	Power supply to distance alarm buzzer with ACC (Adaptive Cruise Control) / Power supply to splitter control solenoid valve (mechanical gearbox)	1166/9974
7	Positive +15	8871
8	Positive for instruments lighting	4442
9	-	-

ST35 junction connector (yellow) - automatic control air conditioning system

Figure 64

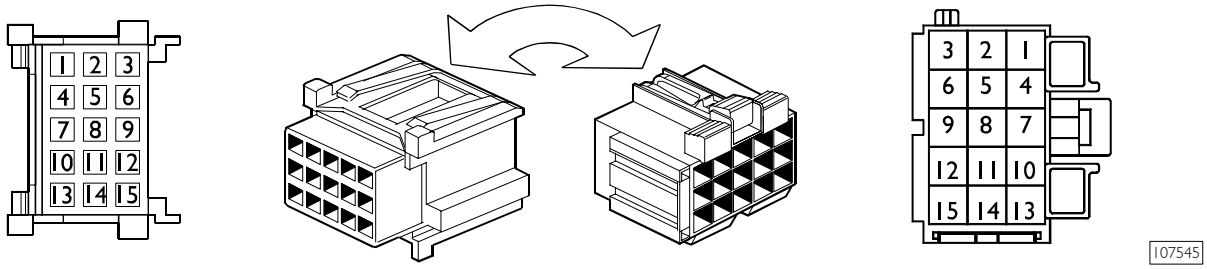


KEY SIDE CONNECTOR VIEW

Ref.	Function	Cable colour coding
1	"BCB" CAN Line (L)	Green
2	"BCB" CAN Line (H)	White
3	K line	2296
4	Positive +30	7551
5	-	-
6	Positive for heating unit solenoid valve	7551
7	Negative for radiator water recirculation solenoid valve	9552
8	Air conditioning system pressure switch signal	9933
9	Earth	0000
10	-	-
11	-	-
12	Signal from internal temperature probe	7575
13	-	-
14	-	-
15	Signal from internal temperature probe	0550

ST35/1 junction connector (yellow) - manual control air conditioning system

Figure 65

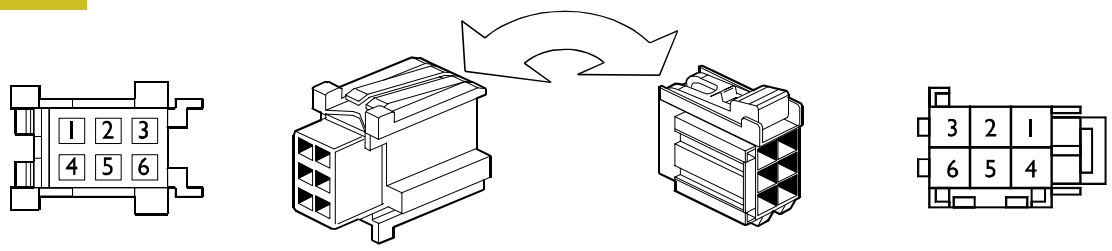


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	-	-
2	-	-
3	-	-
4	Positive +30	7550
5	-	-
6	-	-
7	-	-
8	Ambient thermostat signal	9993
9	Negative remote control switches air conditioning enabling command	0555
10	Positive symbols lighting	4442
11	Positive from remote control switch internal heating enabling consent	8004
12	Positive remote control switch air conditioner enabling command	8097
13	Contact of the remote control switch (87) for auxiliary heater 1st speed enabling	8884
14	Positive for Topflap commanding remote switch control	8801
15	-	-

ST35/2 junction connector (yellow) - manual control air conditioning system

Figure 66

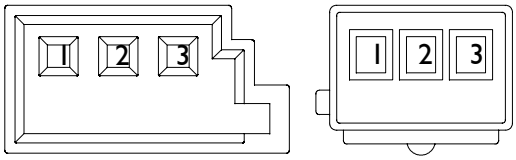


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive for windshield electric defroster command unit	8884
2	-	-
3	K line	2296
4	Positive +30 from Body Computer	7786
5	-	-
6	-	-

ST35/3 junction connector (yellow) - manual control air conditioning system

Figure 67



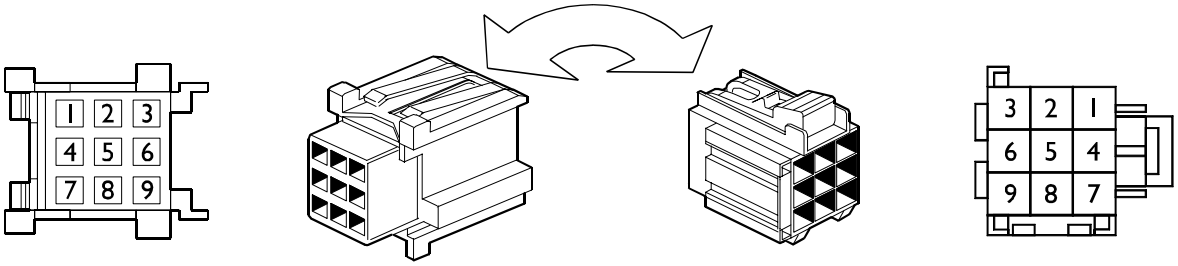
107169

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	-	-
2	Positive for polarity inversion remote control switch topflap engine	9570
3	Negative for remote control switch for topflap open/closed command	0550

ST36 junction connector (grey) - T.G.C. / I.G.C.

Figure 68



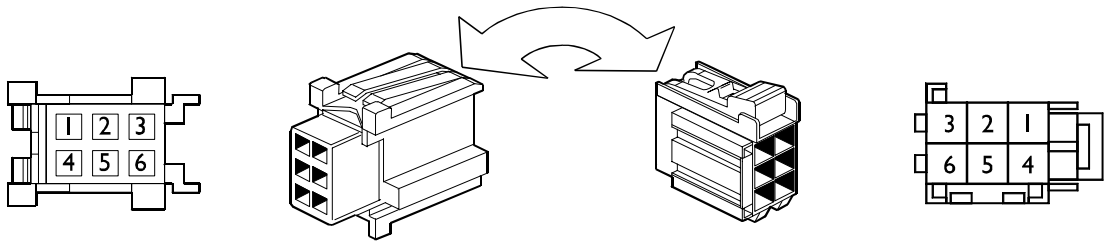
107531

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Alternator power supply terminal 15	8876
2	Alternator power supply terminal 15	8876
3	Signal for TGC closing	8035
4	Signal for TGC closing	8035
5	Battery positive (+Batt)	7972
6	Battery positive (+Batt) for tachograph and IC	7768
7	Battery positive (+Batt) for B.C. / B.M. / diagnosis /refrigerator connector	7972
8	-	-
9	-	-

ST37C junction connector (yellow) - Toll Collect

Figure 69



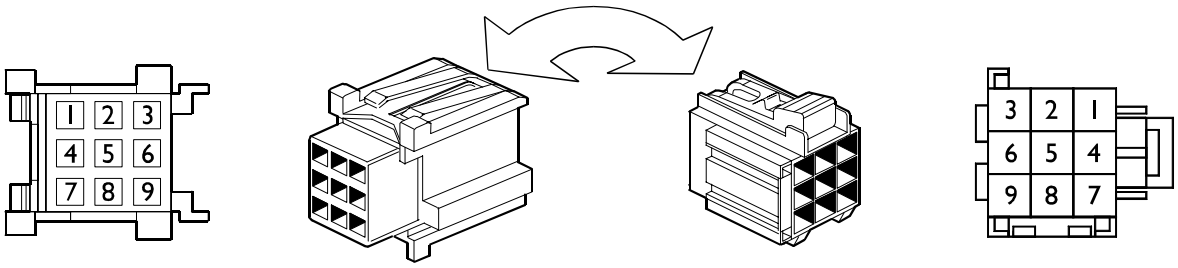
107188

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive +30 after TGC	7772
2	Positive symbols lighting	4442
3	Positive +15	8871
4	Speed signal (tachograph)	5541
5	Earth	0000
6	-	-

ST40 junction connector - navigation and it tools

Figure 70



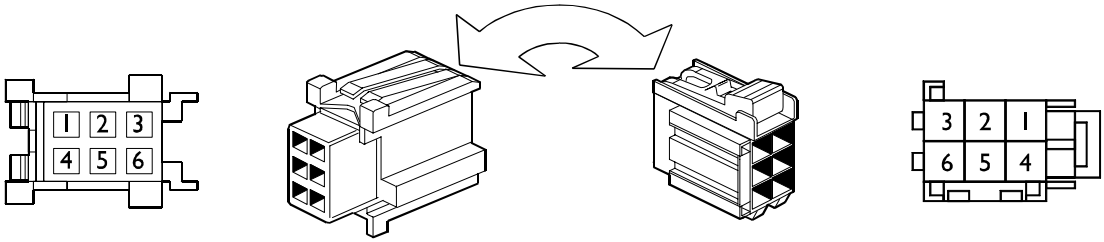
107531

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive +30 after TGC	7772
2	Positive +15	8871
3	Speed signal for navigator	5541
4	Positive 12V	7712
5	CAN L line (ICB)	Green
6	CAN H line (ICB)	White
7	Positive for instruments lighting	4442
8	Reverse gear signal	2268
9	Earth	0000

ST40X junction connector (blue) - FMS (Vehicle fleet management system)

Figure 71



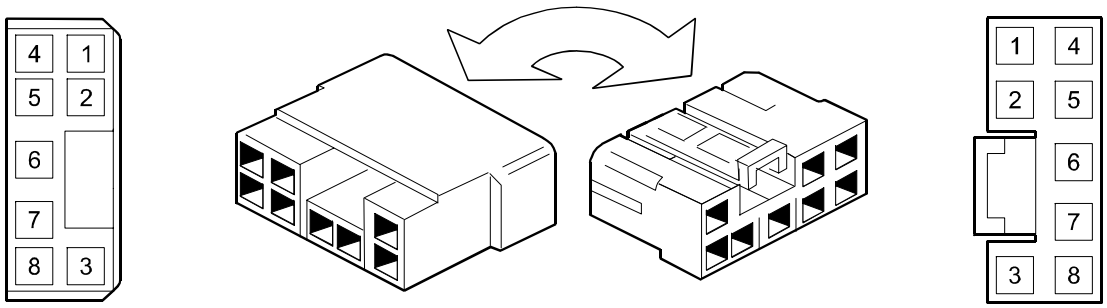
107188

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	-	-
2	CAN L line (FMB)	Green
3	CAN H line (FMB)	White
4	-	-
5	Earth	0000
6	Positive +30 after TGC	7797

ST44 junction connector - centralized locking with remote control

Figure 72



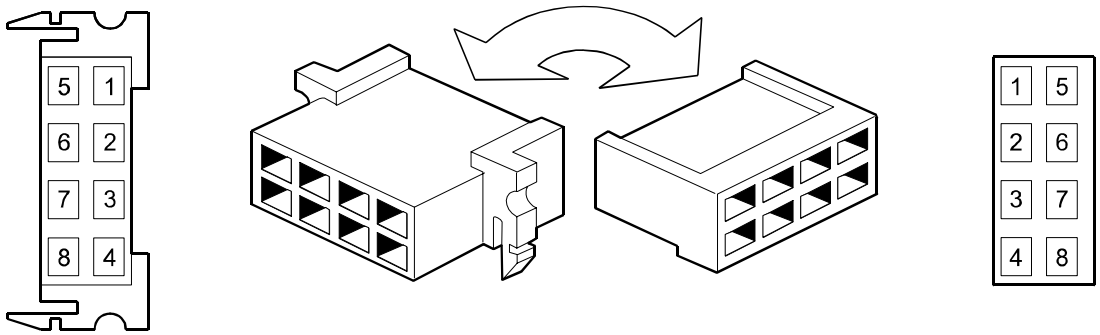
113250

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Blinker control	1113
2	-	-
3	Battery positive (+Batt)	7772
4	Earth	0000
5	Control for centralized locking to Body Computer (door opening)	0064
6	Control for centralized locking to Body Computer (door closing)	0065
7	Power supply +15	8871
8	-	-

ST45 junction connector- 24V connection for radio

Figure 73

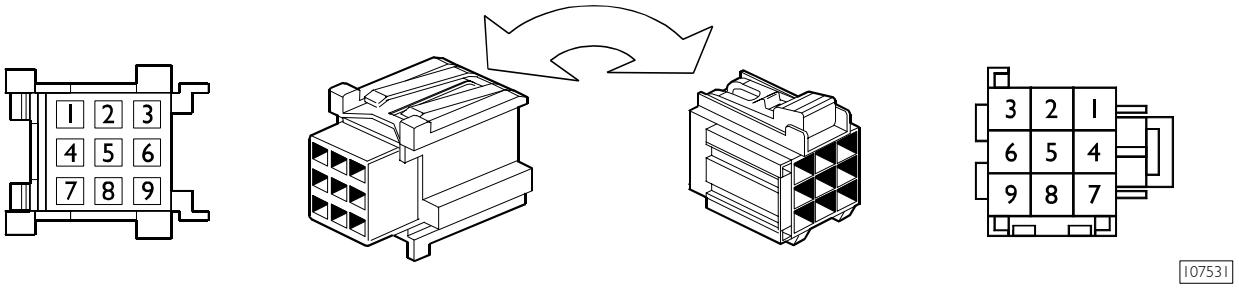


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive +30 for preamplifier	7772
2	Positive +15 for radio receiver	8871
3	Earth	0000
4	Positive symbols lighting	4442
5	CAN line L (IDB)	Green
6	CAN line H (IDB)	White
7	Positive +30 for radio receiver	7770
8	-	-

ST48 junction connector (yellow) - DMI / EM control unit for PTO

Figure 74

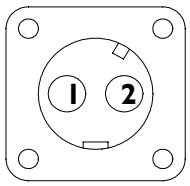


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	CAN L line (ICB)	Green
2	CAN H line (ICB)	White
3	K line	Green
4	Positive +30 after TGC	7772
5	Positive +30	7166
6	Positive +15	8166
7	Earth	0000
8	-	-
9	-	-

ST50 junction connector (black) - FFC control unit power supply

Figure 75



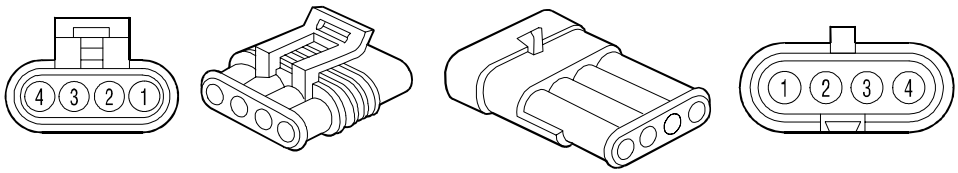
107163

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Battery direct positive (+Batt) FFC control unit power supply	7904
2	Battery direct positive (+Batt) FFC control unit power supply	7903

ST52 JUNCTION CONNECTOR (BLACK) - BODYBUILDERS (CHASSIS)

Figure 76



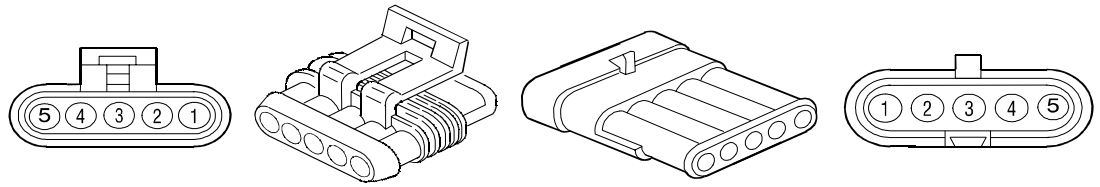
101538

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive +15 for bodybuilders	8871
2	Earth	0000
3	Positive for external lights (body builders)	3333
4	Negative from the speed limiter secondary switch	0172

ST54 junction connector- provision for ACC

Figure 77

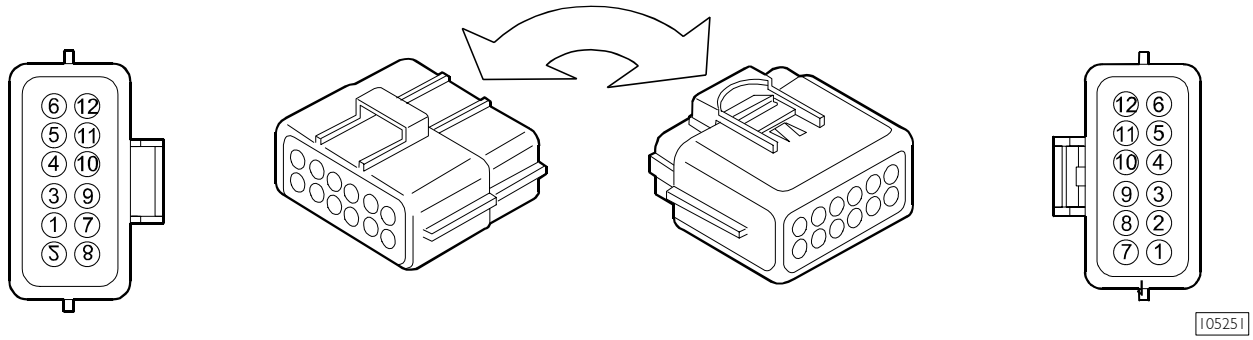


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	CAN line L (VDB)	Green
2	CAN line H (VDB)	White
3	CAN line L (VDB)	Green
4	CAN line H (VDB)	White
5	Positive +15	8176

ST55A junction connector- SCR system (urea)

Figure 78

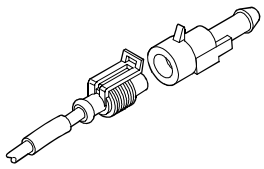


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	CAN line L (ECB)	Green
2	CAN line H (ECB)	White
3	CAN line L (ECB)	Green
4	CAN line H (ECB)	White
5	K line	2257
6	Positive +15	8540
7	Power supply to combustion air relative humidity and temperature sensor	8173
8	Signal for combustion air relative humidity sensor	5173
9	Combustion air relative humidity and temperature sensor ground	0173
10	Combustion air temperature sensor signal	5174
11	Power supply to engine brake solenoid valve	9966
12	Engine brake solenoid valve ground	0043

ST55B - ST56 junction connector

Figure 79



101523

KEY SIDE CONNECTOR VIEW

ST55B - SCR system power supply (urea)

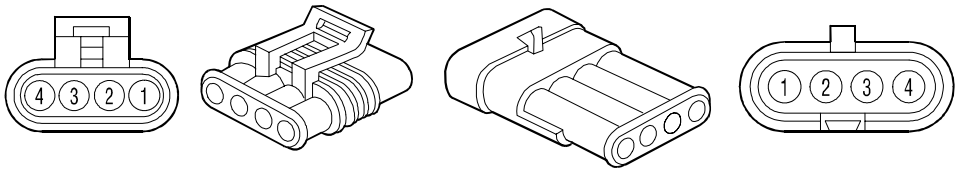
Pin	Function	Cable colour coding
1	Battery positive (+Batt) SCR System	7540

ST56 (black) - Connection for ADR cut generator

Pin	Function	Cable colour coding
1	Alternator power supply terminal 15	8876

ST60 junction connector- ECAS axle

Figure 80



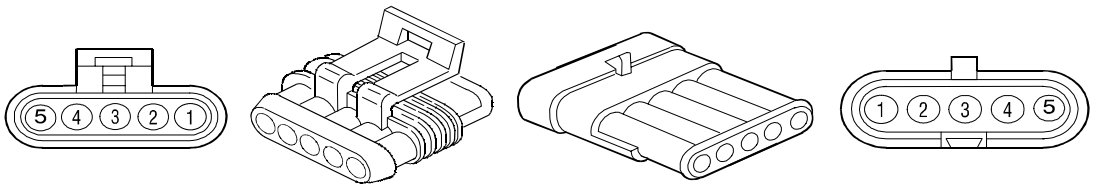
101538

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Chassis height sensors ground	0400
2	Front axle inductive chassis height sensor (ECAS)	5410
3	Front axle electro-pneumatic distributor (ECAS)	9413
4	Power supply to ECAS solenoid valves after control unit	9400

ST61 junction connector - steering angle sensor

Figure 81



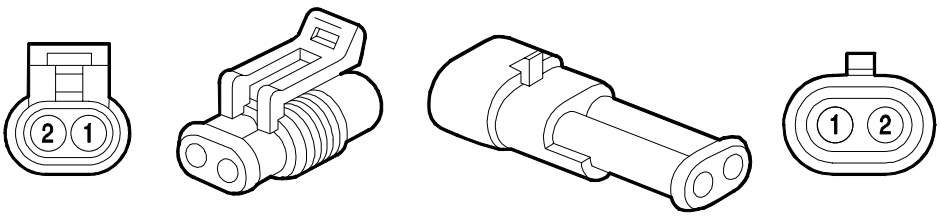
101542

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	CAN SB Line (L)	Green
2	CAN SB Line (H)	White
3	Positive for steering angle sensor	8275
4	-	-
5	Earth	0000

ST62 junction connector- CAN for trailer (EBS2)

Figure 82



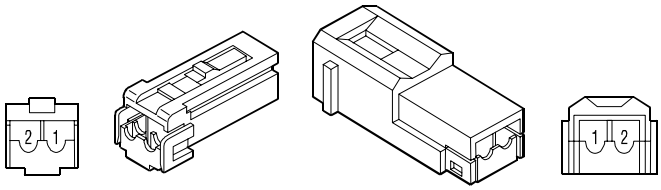
101531

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	CAN SB line (L) (trailer connector EBS2)	Green
2	CAN SB line (H) (trailer connector EBS2)	White

ST63 junction connector- auxiliary water heater CAN

Figure 83



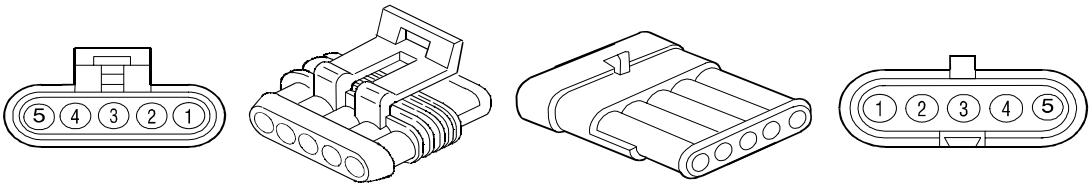
101525

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	CAN Line (L) BCB	Green
2	CAN Line (H) BCB	White

ST64 junction connector (black) - 15-poles current outlet free pins

Figure 84



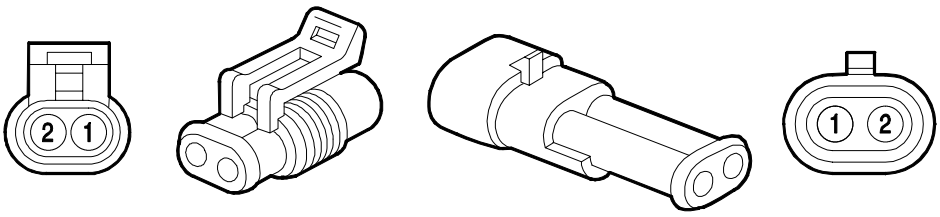
101542

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Power supply to current outlet	8021
2	Power supply to current outlet	7021
3	Transverse differential blocking signal	6621
4	Power supply to positive trailer interlocking +15	8075
5	Power supply to positive trailer interlocking +15	8075

ST67 junction connector- UREA dosing module solenoid valve

Figure 85



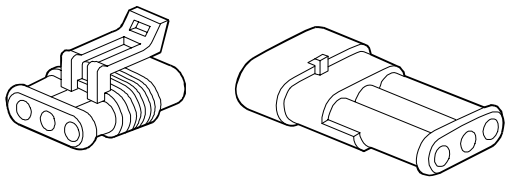
101531

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Power supply to dosing module solenoid valve with SCR	7541
2	Urea electric dosing unit (-) control	9541

ST68 junction connector- UREA temperature sensor

Figure 86



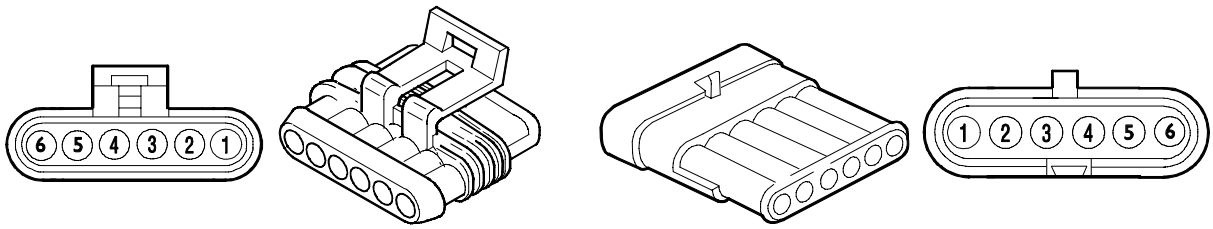
101536

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Signal cable to urea tank level sensor with SCR	6543
2	Urea tank with SCR level and temperature sensor ground	0543
3	Signal cable to urea tank temperature sensor with SCR	6542

ST69 junction connector- Intarder

Figure 87



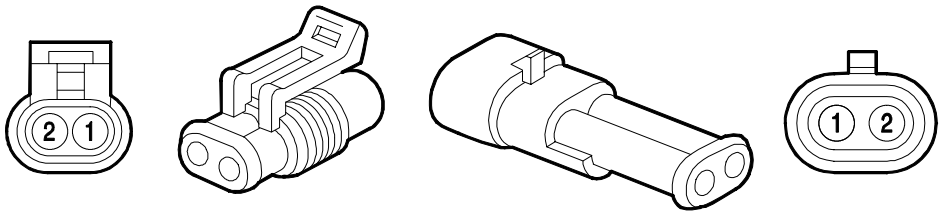
105334

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Solenoid valve for retarder oil accumulator	0311
2	Solenoid valve for retarder oil accumulator	9311
3	Water temperature transmitter for retarder	5309
4	Water temperature transmitter for retarder	0309
5	Solenoid valve for retarder enabling	0310
6	Solenoid valve for retarder enabling	9310

ST70 junction connector (black) - ASR solenoid valve

Figure 88



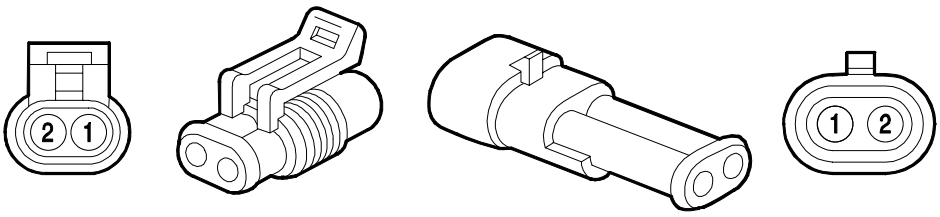
101531

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	ASR solenoid valve (-) control	0260
2	ASR solenoid valve power supply	9260

ST70 junction connector (black) - ASR solenoid valve

Figure 89



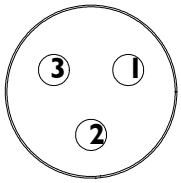
101531

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	ASR solenoid valve (-) control	0260
2	ASR solenoid valve power supply	9260

ST71/1 - ST71/2 junction connector

Figure 90



107172

KEY SIDE CONNECTOR VIEW

ST71/1 (black) - 3rd axle brake pads wear

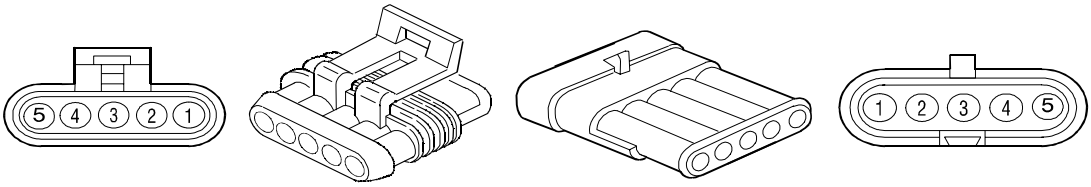
Pin	Function	Cable colour coding
1	Potentiometric sensor for 3rd axle wheel pads wear signalling	6037
2	Potentiometric sensor for 3rd axle wheel pads wear signalling	5560
3	Potentiometric sensor for 3rd axle wheel pads wear signalling	0000

ST71/2 (orange) - 3rd axle right hand side brake pads wear

Pin	Function	Cable colour coding
1	Potentiometric sensor for 3rd axle wheel pads wear signalling	6035
2	Potentiometric sensor for 3rd axle wheel pads wear signalling	5560
3	Potentiometric sensor for 3rd axle wheel pads wear signalling	0000

ST72 (black) - 3rd axle shoes wear / transverse differential blocking

Figure 91



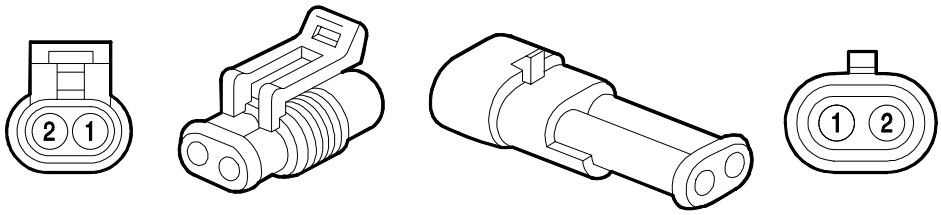
101542

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	To the deviator for signalling of transverse differential blocking of Rockwell rear axles for the third axle	0041
2	To the deviator for signalling of transverse differential blocking of Rockwell rear axles for the third axle	0000
3	To the deviator for signalling of transverse differential blocking of Rockwell rear axles for the third axle	0040
4	To the sensor for circuit signalling of rear wheel shoes wear	6667
5	To the sensor for circuit signalling of rear wheel shoes wear	6664

ST73 junction connector (black) - Front shoes wear signalling

Figure 92



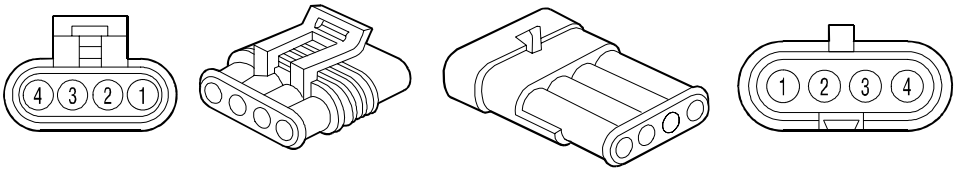
101531

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	To the sensor for circuit signalling of rear wheel shoes wear	6664
2	To the sensor for circuit signalling of rear wheel shoes wear	0000

ST77 - ST78 JUNCTION CONNECTOR - BODYBUILDERS (CHASSIS-TRUCK)

Figure 93



101538

KEY SIDE CONNECTOR VIEW

ST77 (black) - Right hand side SML indicator light (Side Marker Lamp)

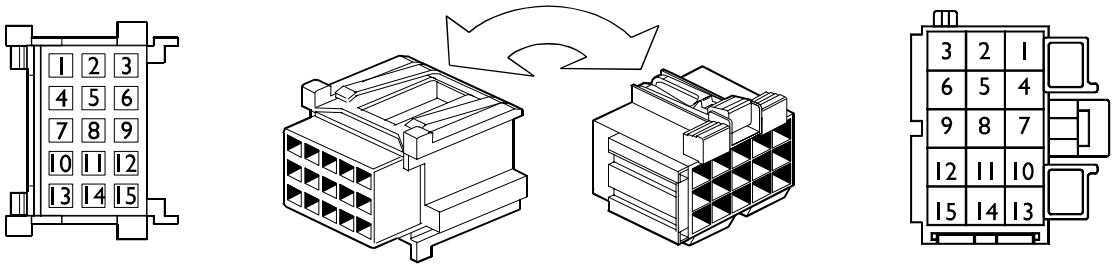
Pin	Function	Cable colour coding
1	Signal for side lamps	3330
2	Ground for side lamps	0000
3	Signal for side lamps	3330
4	Ground for side lamps	0000

ST78 (black) - Left hand side SML indicator lamp (Side Marker Lamp)

Pin	Function	Cable colour coding
1	Signal for side lamps	3339
2	Ground for side lamps	0000
3	Signal for side lamps	3339
4	Ground for side lamps	0000

ST79A junction connector (yellow) - external cab front

Figure 94

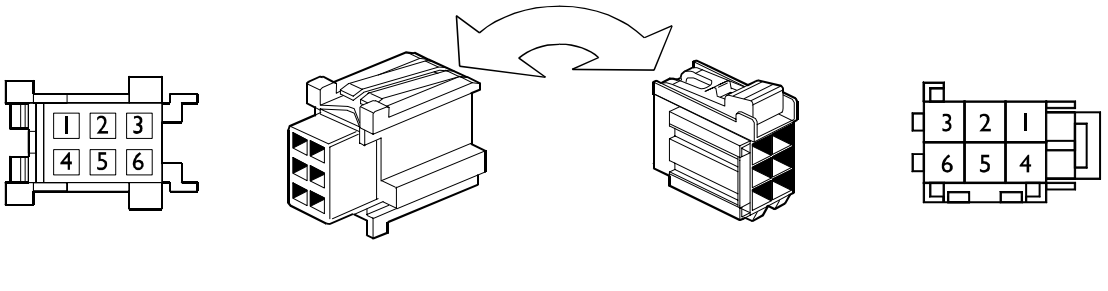


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Earth	0000
2	Positive to refrigerating fluid pressure signalling switch (air conditioner)	9993
3	Positive from refrigerating fluid pressure signalling switch (air conditioner)	9993
4	Positive for solenoid valve radiator water recirculation	7550
5	Signal from switch on clutch for VCM	0160
6	Signal for warning horns	1116
7	Positive for windscreen unit (high speed)	8881
8	Positive for windscreen unit (low speed)	8882
9	Positive for windscreen unit	8880
10	Positive for windscreen unit	8873
11	Radiator water recirculation solenoid valve command	9552
12	Negative from refrigerating fluid pressure signalling switch (engine cooling)	0583
13	Negative from refrigerating fluid pressure signalling switch (engine cooling)	0582
14	-	-
15	-	-

ST79C junction connector (yellow) - steering angle sensor

Figure 95

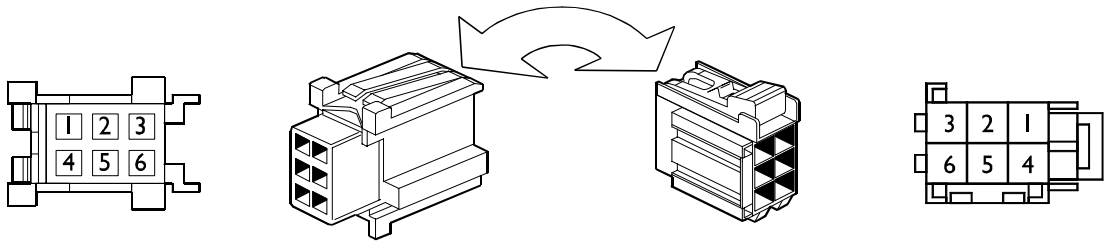


KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	CAN SB Line (L)	Green
2	CAN SB Line (H)	White
3	Positive for steering angle sensor	8275
4	Earth	0000
5	Free	-
6	Free	-

ST79D junction connector (green) - brake pedal switch (ABS)

Figure 96



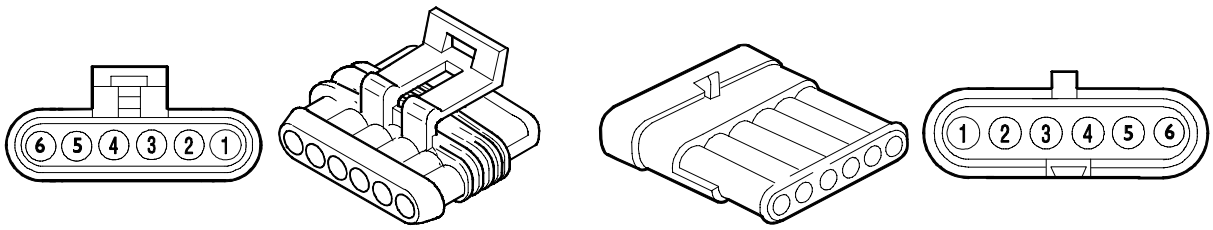
101545

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive +30	7150
2	Positive for stop lights	8158
3	Positive pressed pedal signal	8153
4	Positive +30	7150
5	-	-
6	-	-

ST80 junction connector (black) - mechanical gearbox

Figure 97



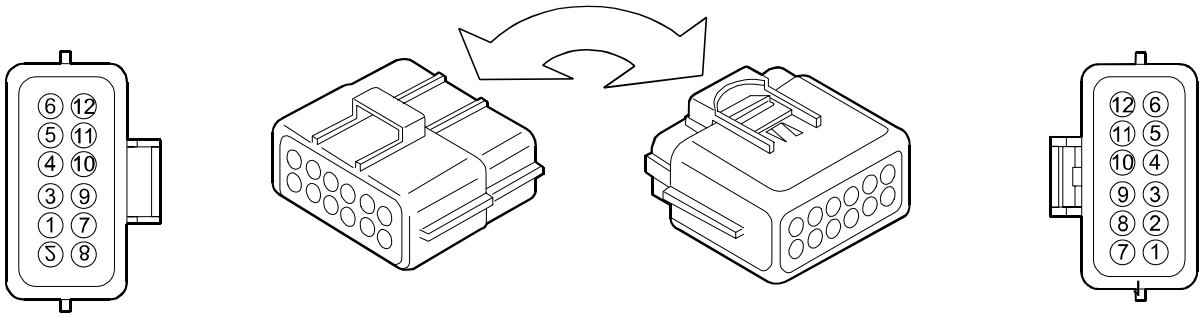
105334

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Signal for reverse lights light up switch	2268
2	Ground for reverse lights lighting up switch	0000
3	Ground for anti-start system with gears engaged switch and for reverse light light up switch	0000
4	Ground for anti-start system with gears engaged switch and for reverse light light up switch	8050
5	Signal for reduced gears engaged signalling switch	9992
6	Ground for reduced gears engaged signalling switch	0000

ST82 junction connector (black) - components on engine

Figure 98



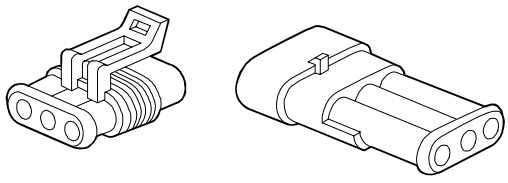
105251

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	-	-
2	-	-
3	Signal for engine ventilation temperature sensor	5166
4	-	-
5	-	-
6	-	-
7	-	-
8	-	-
9	Signal for engine oil level thermometer transmitter	5505
10	Signal for engine oil level thermometer transmitter	5506
11	Ground for fuel filter clogged signalling switch	0000
12	Signal for fuel filter clogged signalling switch	5531

ST84 junction connector (black) - cab tilting

Figure 99



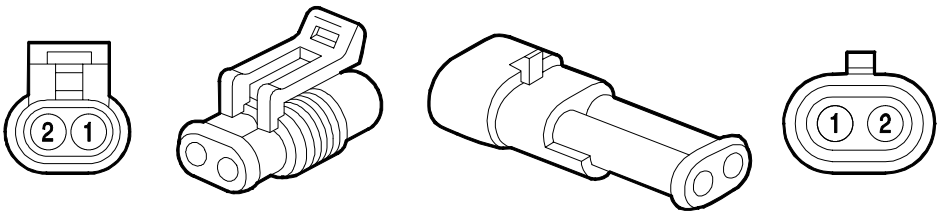
101536

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive +15 unhooked cab signalling switch	8871
2	Unhooked cab signalling switch	0096
3	Earth	0000

ST85R - ST85L - ST86 - ST87 junction connector

Figure 100



101531

KEY SIDE CONNECTOR VIEW

ST85L (black) - left hand side plate light connection

Pin	Function	Cable colour coding
1	Earth	0000
2	Positive for plate lighting left hand side lamp	3307

ST85R (black) - Right hand side plate light connection

Pin	Function	Cable colour coding
1	Earth	0000
2	Positive for plate lighting left hand side lamp	3307

ST86 (black) - T.G.C. connection

Pin	Function	Cable colour coding
1	TGC Off relay excitation	8845
2	TGC On relay excitation	8835

ST86 (black) - I.G.C. connection

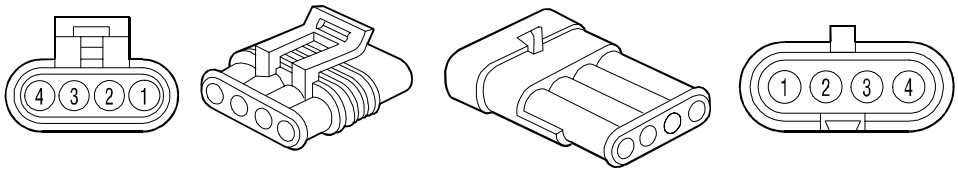
Pin	Function	Cable colour coding
1	Provision	8045
2	TGC On relay excitation	8035

ST87 (black) - Connection for projectors position controller / cab tilting consent

Pin	Function	Cable colour coding
1	Signal for projector positioning actuator	9936
2	Cab tilting consent control	8129

ST90 - ST91 - ST92 - ST93 junction connector

Figure 101



101538

KEY SIDE CONNECTOR VIEW

ST90 (black) - PTO (without DMI)

Pin	Function	Cable colour coding
1	Signal for rear power take-off enabled signalling switch	0131
2	Signal for solenoid valve for total power take-off on enabling on gearbox	9954
3	Signal for side power take-off enabled signalling switch	0132
4	Earth	0000

ST91 (black) - PTO1 (DMI)

Pin	Function	Cable colour coding
1	PTO 1 power take-off return signal	6131
2	PTO 1 solenoid valve power supply	9131
3	Negative consent for power take-off PTO 1	0391
4	Earth	0000

ST92 (black) - PTO2 (DMI)

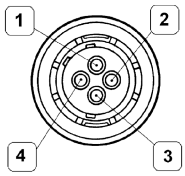
Pin	Function	Cable colour coding
1	PTO 2 power take-off return signal	6132
2	PTO 2 solenoid valve power supply	9132
3	Negative consent for power take-off PTO 2	0392
4	Earth	0000

ST93 (black) - PTO3 (DMI)

Pin	Function	Cable colour coding
1	PTO 3 power take-off return signal	6133
2	PTO 3 solenoid valve power supply	9133
3	Negative consent for power take-off PTO 3	0393
4	Earth	0000

ST junction connector- ECAS remote control

Figure 102



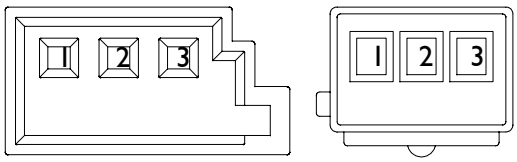
107178

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Positive for remote control power supply (pin 1)	7777
2	Negative for remote control (pin 2)	0000
3	Communication line with remote control (pin 3)	3333
4	Communication line with remote control (pin 4)	8888

STY/1 junction connector (black) - switch on clutch

Figure 103



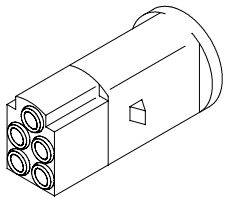
107169

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Earth	0000
2	Signal from switch on clutch for VCM	0160
3	-	-

STY/2 junction connector (black) - Economy power

Figure 104



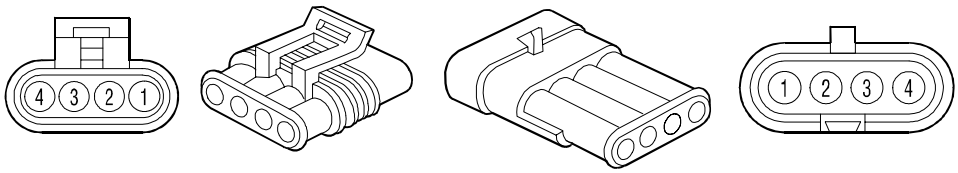
107183

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Earth	0000
2	Provision for Economy Power	-
3	-	-
4	Provision for Economy Power	-
5	Command from Economy Power switch	0166

STY/3 junction connector- ECAS axle 6x2 (only for 3° axle not liftable)

Figure 105



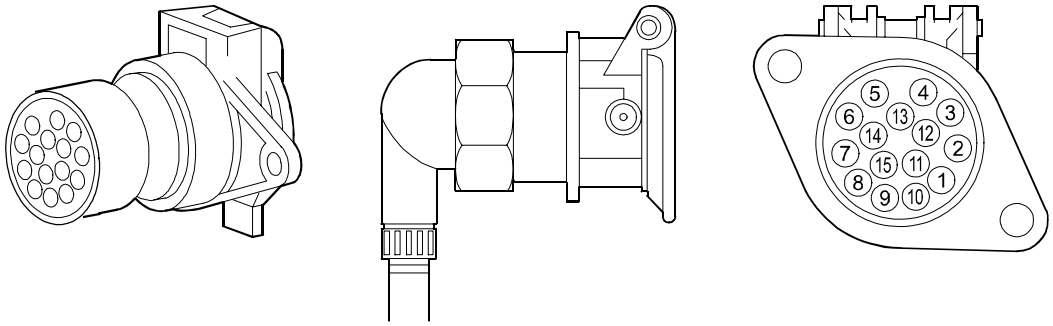
101538

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Provision for rear axle electro-pneumatic distributor (ECAS)	9442
2	Rear axle electro-pneumatic distributor (ECAS)	9446
3	Rear axle electro-pneumatic distributor (ECAS)	9447
4	Power supply to ECAS solenoid valves after control unit	9400

15-poles current outlet for trailer electric connection (72010)

Figure 106



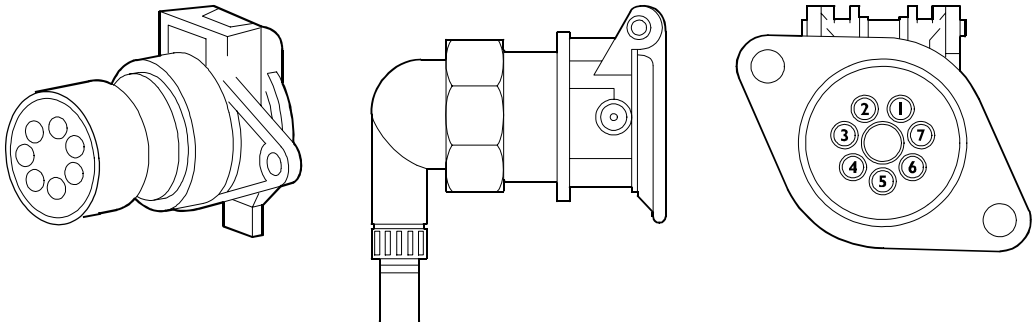
113251

KEY SIDE CONNECTOR VIEW

Pin	Function	Cable colour coding
1	Left hand side trailer direction indicators	1180
2	Right hand side trailer direction indicators	1185
3	Trailer back fog light	2283
4	Earth	0000
5	Left trailer end-outline marker	3339
6	Right trailer end-outline marker	3330
7	Trailer stop lights	1179
8	Trailer reverse light	2226
9	Power supply to trailer outlet after fuse for T.M.P. devices	7790
10	Transverse differential blocking signal	6621
11	Power supply to positive trailer interlockings +15	8075
12	Warning light signalling trailer axle lifted	6442
13	Earth	0000
14	Power supply to current outlet	7021
15	Power supply to current outlet	8021

7-poles current outlet for trailer electric connection

Figure 107



113252

KEY SIDE CONNECTOR VIEW

72000 - normal 7-poles current outlet for trailer electric connection

Pin	Function	Cable colour coding
1	Earth	0000
2	Left trailer end-outline marker	3339
3	Left hand side trailer direction indicators	1180
4	Trailer stop lights	1179
5	Right hand side trailer direction indicators	1185
6	Trailer end-outline marker	3330
7	Free	-

72001 - auxiliary 7-poles current outlet for trailer electric connection

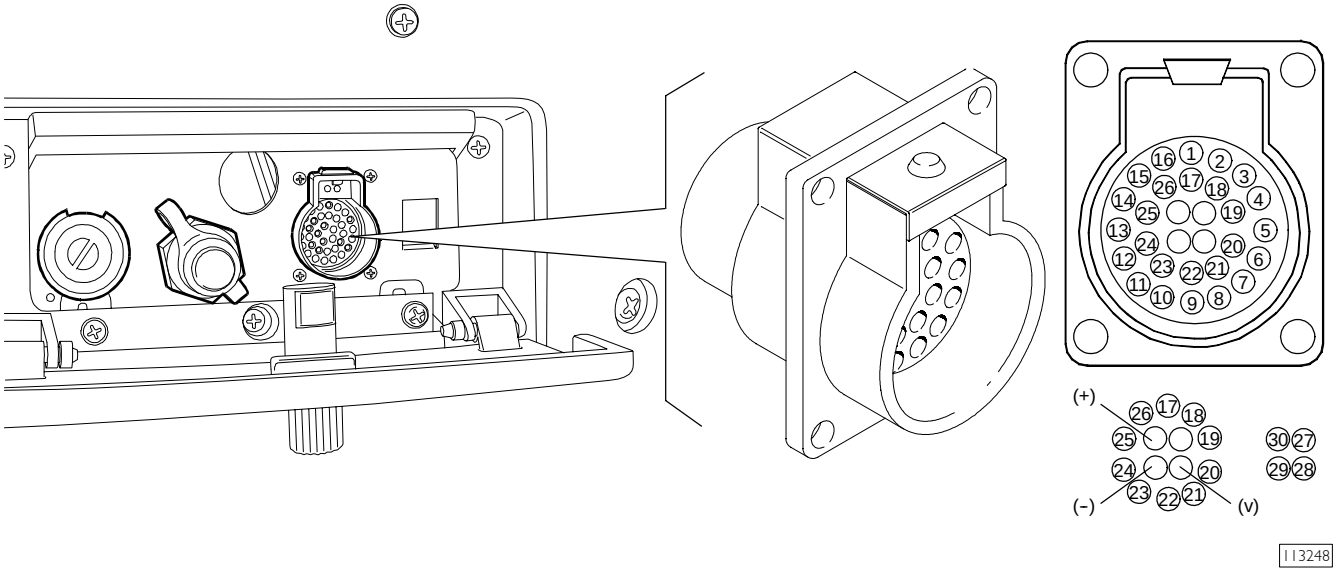
Pin	Function	Cable colour coding
1	Earth	0000
2	Trailer interlockings power supply with terminal +15	8075
3	Trailer reverse light	2226
4	Free	-
5	Warning light signalling trailer axle lifted	6442
6	Power supply to trailer outlet after fuse for T.M.P. devices	7790
7	Trailer back fog light	2283

72006 - -poles current outlet for trailer ABS electric connection

Pin	Function	Cable colour coding
1	Positive after fuse for trailer ABS	7772
2	Power supply after fuse for ABS / speed limiter	8847
3	Earth	0000
4	Earth	0000
5	Trailer ABS fault warning light	6671
6	CAN "H" line (SB)	WS/BI
7	CAN "L" line (SB)	GN/VE

DIAGNOSIS OUTLET
Diagnosis connector - 72021

Figure 108



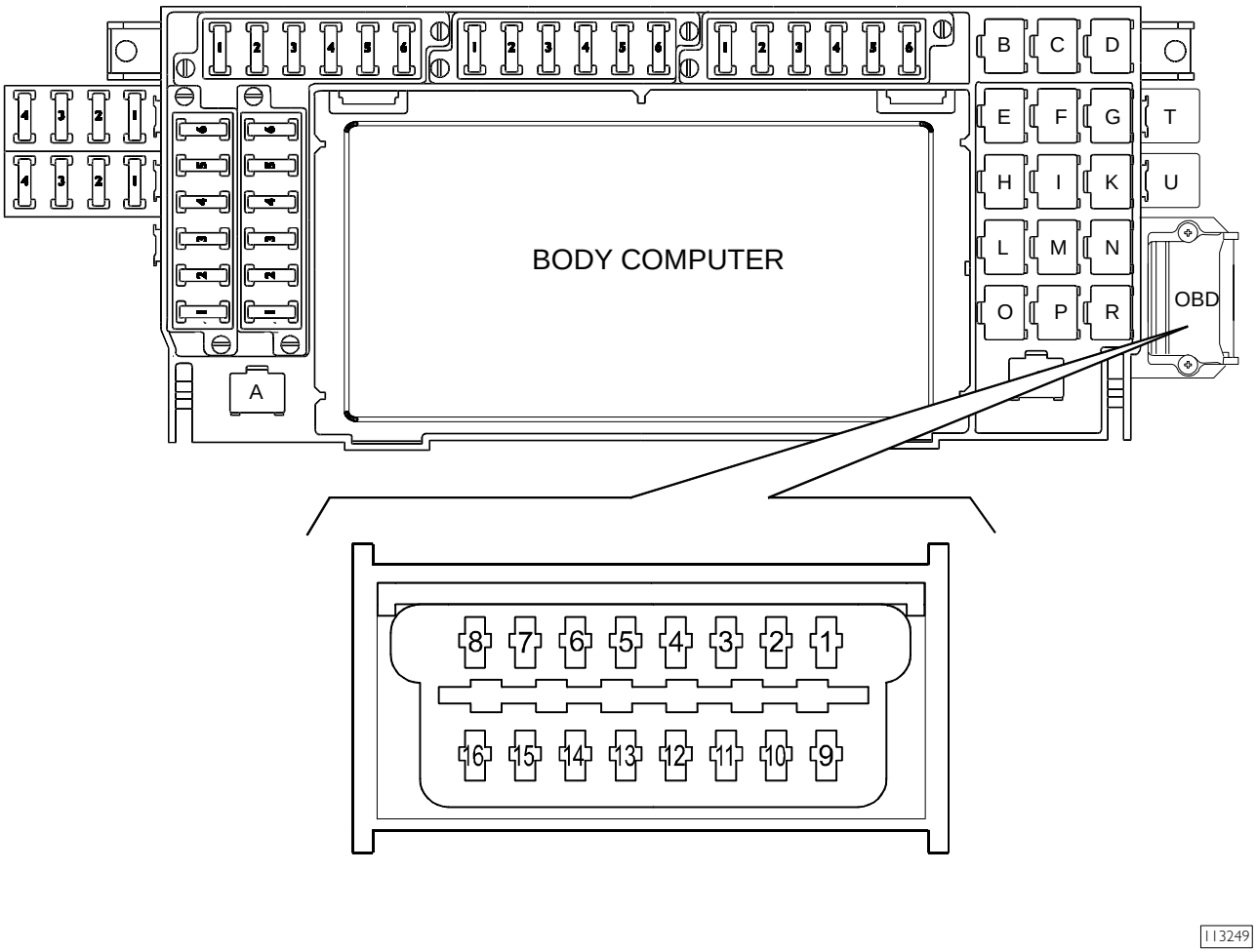
DIAGNOSIS CONNECTOR (FRONT VIEW)

Pins 27,28,29,30 might be printed with different positions from those reported in this picture.

Pin		Function	Cable colour coding
1	Free	-	-
2	EDC (ECM)	K	2298
3	Free	-	-
4	ABS / EBS + ECAS	K	2299
5	Free	-	-
6	Decelerator / OMI	K	2293
7	Free	-	-
8	Multiplex units	K	2295
9	Free	-	-
10	Air conditioner / Heater	K	2296
11	Service actuation Key to "MAR"	+ 15	8802
12	VCM	K	2292
13	Free	-	-
14	Tachograph / IC	K	2994
15	Free	-	-
16	UREA (SCR system)	K	2257
17	Free	-	-
18	EUROTRONIC	K	2297
19	Free	-	-
20	Programming retarder EOL	-	3393
21	CAN H (VDB)	H	Ws/Bi
22	CAN L (VDB)	L	Gn/Ve
23	Free	-	-
24	Free	-	-
25	Engine start signal	-	8050
26	Signal earth (engine start signal)	-	0050
27	Free	-	-
28	Speed signal (B7)	v	5542
29	Signal earth	31	0050
30	Positive	+ 30	7772

OBD diagnosis connector (blue)

Figure 109



KEY SIDE CONNECTOR VIEW

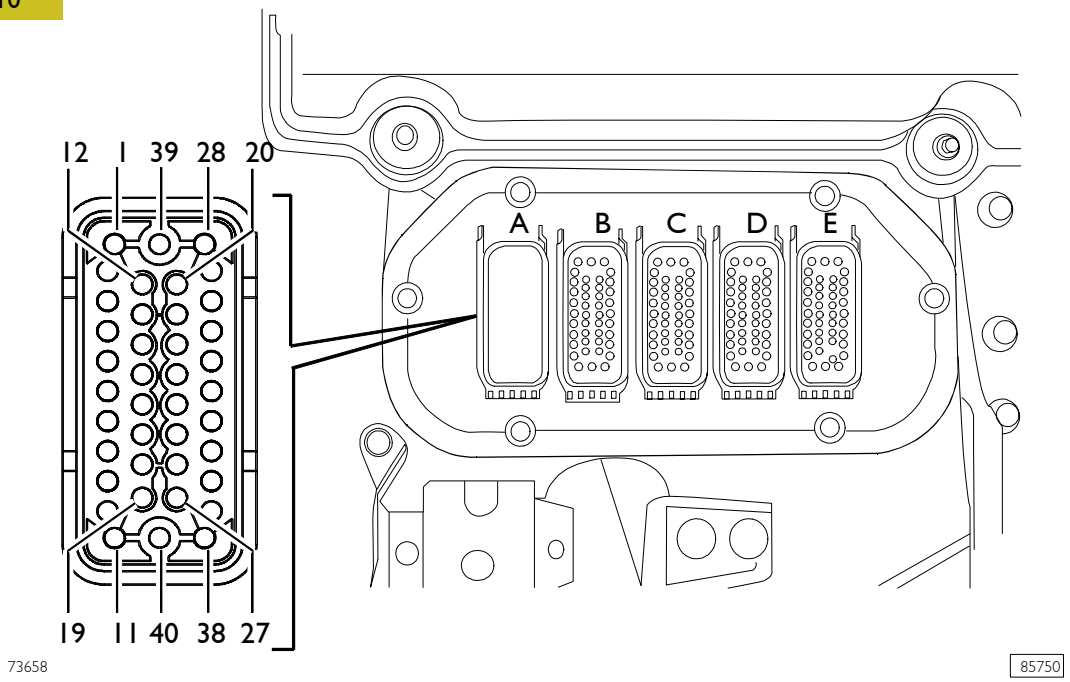
Pin	Function	Cable colour coding
1	-	-
2	-	-
3	-	-
4	Earth	0000
5	Signal ground	0050
6	CAN line H (ECB)	White
7	-	-
8	-	-
9	-	-
10	-	-
11	-	-
12	-	-
13	-	-
14	CAN line L (ECB)	White
15	-	-
16	Battery direct positive (+Batt)	7721

RECEPTACLE CONNECTOR

LEFT HAND DRIVE

A connector - White (free)
B connector - Brown (ECAS)
C Connector - Yellow (EBS/ABS/ASR)
D connector - Blue (EuroTronic/PTO/Intarder)
E connector - Green (EDC/ADR)

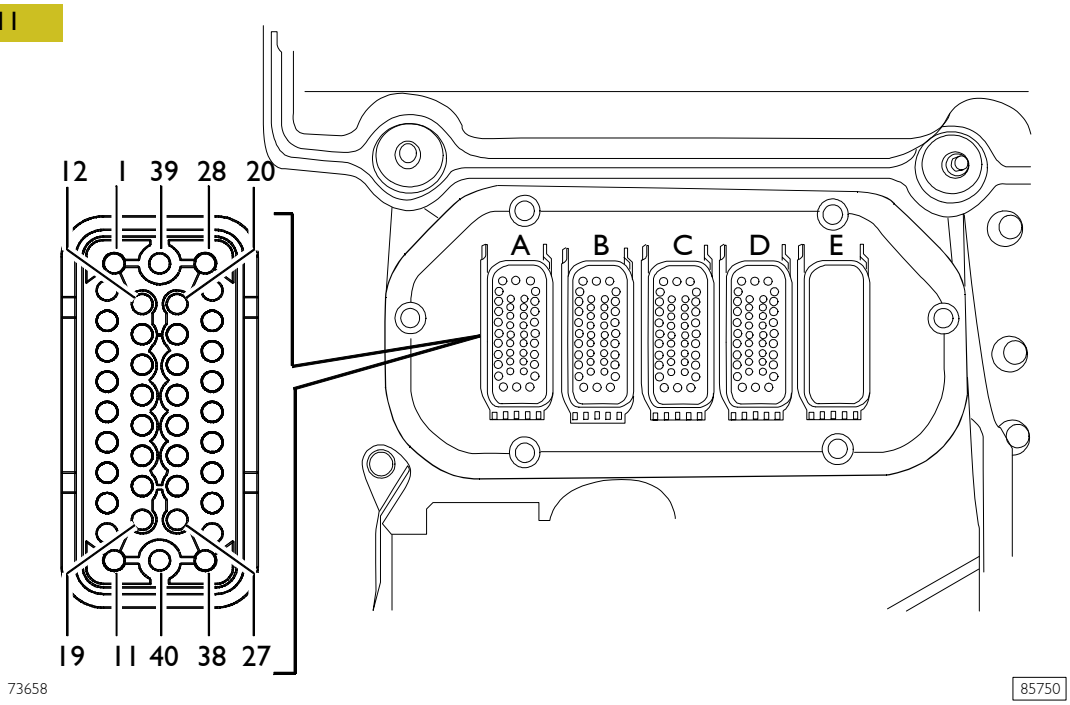
Figure 110



RIGHT HAND DRIVE

A connector - White (EDC/ADR)
B connector - Brown (EuroTronic/PTO/Intarder)
C Connector - Yellow (EBS/ABS/ASR)
D connector - Blue (ECAS)
E connector - Green (free)

Figure 111



Thanks to the new bayonet connectors the continuity of the various signals is much more reliable than with the previous system.

Brown bulkhead "B"

Pin	Function	Cable colour code
1	Chassis height sensor ground	0400
2	Inductive rear axle chassis height sensor (Ecas)	5421
3	Inductive rear axle chassis height sensor (Ecas)	5422
4	Electro-pneumatic rear axle distributor (Ecas)	9442
5	Electro-pneumatic front axle distributor (Ecas)	9413
6	Inductive front axle chassis height sensor (Ecas)	5410
7	Power supply to electro-pneumatic distributors (Ecas)	9400
8	Electro-pneumatic distributor	9423
9	Electro-pneumatic rear axle distributor (Ecas)	9425
10	Electro-pneumatic rear axle distributor (Ecas)	9424
11	Electro-pneumatic rear axle distributor (Ecas)	5445
12	Electro-pneumatic rear axle distributor (Ecas)	9447
13	Electro-pneumatic rear axle distributor (Ecas)	9446
14	Third axle lifting/lowering switch (Ecas)	5441
15	Third axle lifting/lowering switch (Ecas)	5443
16	Third axle lifting/lowering switch (Ecas)	5444
17	Third axle lifting/lowering switch (Ecas)	5442
18	Air pressure sensor on the pneumatic third axle lifting device (Ecas)	8403
19	Trailer axle lifted warning light signal	6442
20	CAN - L line (BCB)	GN/VE
21	CAN - H line (BCB)	WS/BI
22	Engine fan solenoid valve control	9166
23	Tachograph speed sensor power supply	5514
24	Signal from the tachograph speed sensor	5516
25	Signal from the tachograph speed sensor	5517
26	Tachograph speed sensor ground (speed signal)	0058
27	VGT turbine piping air block solenoid valve +15 power supply (shut-off)	8360
28	Negativo from key switch for R.F.C.	0987
29	Drier/heater power supply / Trailer current tap terminal 15	8840
30	Relay excitation for TGC ON maintenance (closing)	8035
31	Relay excitation for TGC OFF maintenance (opening)	8045
32	Cabin unhooked signal	0096
33	Diagnosis K line for R.F.C.	2999
34	Power take-off ON signal (sensor)	0132
35	Signal for second speed limiter (for body builders)	0172
36	Dimmers (for body builders)	3333
37	Trailer ABS/EBS failure signal	6671
38	Electrical power supply socket for trailer ABS/EBS clamp 2	8847
39	Clamp 30 for 15 pins coupler for trailer electrical connection	7790
40	Positive for tachograph, Body Computer, Cluster, Bed Module, Refrigerator	7972

Yellow wall pass "C"

Pin	Function	Cable colour code
1	PTO 1 power take-off return signal	6131
2	Rear axle braking detection pressure sensor signal	6245
3	Locked power supply positive	8847
4	Front right ABS sensor	5571
5	Diagnosis K line for SCR control unit	5571
6	Positive for front right ABS power supply solenoid valve	9920
7	PTO 1 solenoid valve power supply	9131
8	Positive for front right ABS release solenoid valve	9918
9	Centralized smearing system ground	0000
10	Central lubrication system supply	8898
11	Rear right ABS sensor	5573
12	CAN - H line (ECB)	5573
13	Positive for rear right hand side ABS power supply solenoid valve	9930
14	Consent for power take-off 1 (PTO1)	0391
15	Positive for rear right hand side ABS release solenoid valve	9928
16	Power take-off 2 (PTO2) return signal	6132
17	Power take-off 2 (PTO2) solenoid valve power supply	9132
18	Enabling signal for power take-off 2 (PTO2)	0392
19	Power take-off 3 (PTO3) return signal	6133
20	Free	-
21	Negative for hydraulic cab release control in the lifting phase	0923
22	Negative for hydraulic cab release control in the lowering phase	0922
23	Power take-off 3 solenoid valve power supply	9123
24	Negative for rear axle ASR solenoid valve	0260
25	Positive for rear axle ASR solenoid valve	9260
26	Negative enabling signal for power take-off 3	0393
27	Free	-
28	Chassis height sensor ground	0400
29	Positive for rear left hand side ABS release solenoid valve	9929
30	Inductive rear axle chassis height sensor (Ecas)	8403
31	Positive for rear left hand side ABS power supply solenoid valve	9931
32	Positive for front left hand side ABS drain solenoid valve	9919
33	Air pressure sensor on front axle	5440
34	Positive for front left hand side ABS power supply solenoid valve	9921
35	Front left hand side ABS sensor	5570
36	Solenoid valve supply for engine fan	5570
37	Rear left hand side ABS sensor	5572
38	Rear left hand side ABS sensor	5572
39	Free	-
40	ABS solenoid valve ground	0000

Blue wall pass "D"

Pin	Function	Cable colour code
1	TGC opening signal	8101
2	Eurotronic ground	0000
3	Electric selector with automatic transmission (power supply from the control unit)	6100
4	Transmission warning horn earthing	1101
5	Free	-
6	Eurotronic power supply (+30)	7101
7	Eurotronic diagnosis K line	2297
8	Automatic transmission electronic control unit CAN - L line (VDB)	GN/VE
9	Automatic transmission electronic control unit CAN - H line (VDB)	WS/BI
10	Automatic transmission electronic control unit CAN - L line (VDB)	GN/VE
11	Automatic transmission electronic control unit CAN - H line (VDB)	WS/BI
12	Free	-
13	Free	-
14	Water temperature transmitter for decelerator	0309
15	Water temperature transmitter for decelerator	5309
16	Decelerator oil accumulator solenoid valve	9311
17	Decelerator oil accumulator solenoid valve	0311
18	Decelerator deactivation solenoid valve (proportional solenoid valve)	9310
19	Decelerator actuation solenoid valve (proportional solenoid valve)	0310
20	"K" line for auxiliary water heater control unit diagnostic / Power supply to auxiliary water heater dosing pump	2295 / 7783
21	Auxiliary heater power supply by means of switch	7775
22	Auxiliary heater control with passage for microswitch on heating tap control lever	7506
23	Windscreen heating, control and defrosting motor power supply	7711
24	Auxiliary heater power supply	7708
25	Free	-
26	Auxiliary water heater	GN/VE
27	CAN - H line (BCB)	WS/BI
28	CAN - L line (BCB)	GN/VE
29	CAN - H line (BCB)	WS/BI
30	Solenoid valve power supply for water circulation block in the engine circuit or cabin with auxiliary heater	9506
31	Auxiliary heater ON optical indicator power supply	6605
32	Free	-
33	ADR dynamic control	8876
34	+30 power supply	8876
35	Ground (TGC ADR)	0000
36	Free	-
37	TGC opening signal from the switch	0176
38	TGC closing signal from the switch	0178
39	Power supply to heated fuel pre-filter	7753
40	Free	-

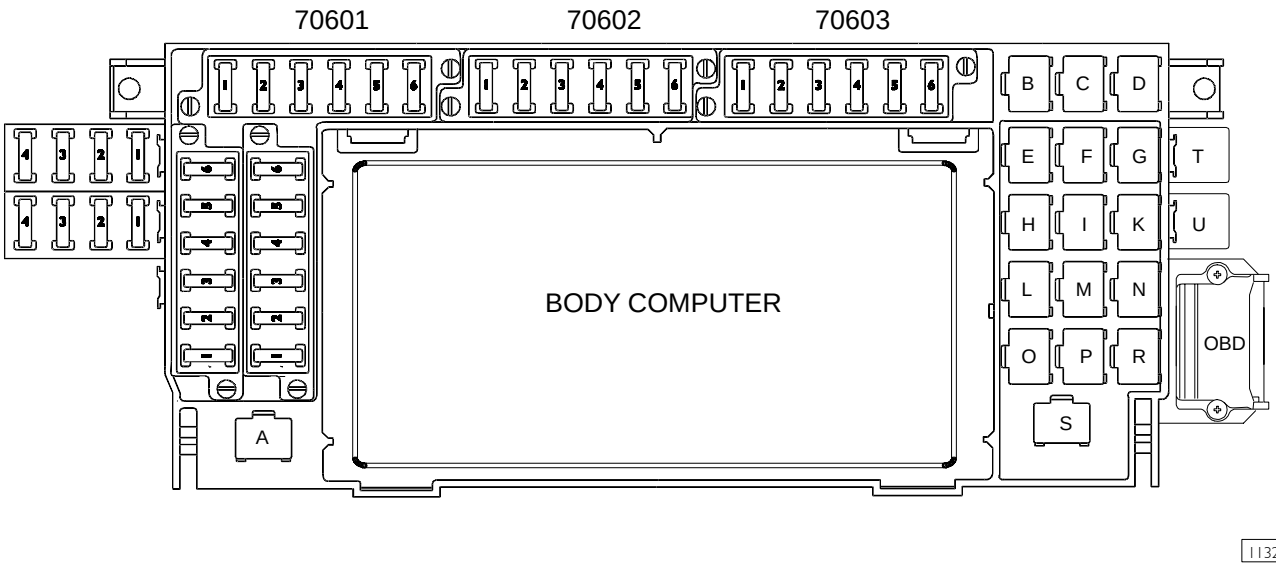
Green wall pass "E"

Pin	Function	Cable colour code
1	CAN - L line (ECB)	GN/VE
2	CAN - H line (ECB)	WS/BI
3	CAN - L line (BCB)	GN/VE
4	CAN - H line (BCB)	WS/BI
5	K line - F.F.C. diagnosis	2998
6	Terminal 15 ignition switch (F.F.C.)	0987
7	Terminal 15 generator power supply	8876
8	EDC system diagnostic switch power supply (presetting)	0163
9	EDC system diagnosis inciting switch power supply (presetting)	5163
10	ACC supply	8176
11	Ground for positive for front rear view mirror heating	0000
12	Front rear-view mirror heating positive	8830
13	EDC control unit terminal 15 power supply	8015
14	Servo-assisted tilting hydraulic pump power supply	7730
15	Hydraulic cabin uncoupling (+ lowering) pump motor power supply	9029
16	CAN - L line (VDB)	GN/VE
17	CAN - H line (VDB)	WS/BI
18	CAN - L line (VDB)	GN/VE
19	CAN - H line (VDB)	WN/VE
20	CAN - L line (BCB)	GN/VE
21	CAN - H line (BCB)	WS/BI
22	K line - EDC diagnosis	2298
23	Starting motor (terminal 50)	8888
24	Compressor electromagnet (Valeo)	9993
25	SCR system supply	7540
26	SCR system supply	8540
27	Fault diagnosis line for SCR	2257
28	Signal for windscreen washer tank low water level	5521
29	Electric pump power supply headlamp wipers	8821
30	Cooling water level optical indicator	5520
31	Engine start signal from the EDC control units	8892
32	Low cooling water level signal	5527
33	Horn positive	1116
34	Free	-
35	Windscreen washer control signal	8886
36	Engine fan solenoid valve positive	9166
37	Cab release enabling signal	8129
38	Headlight angle load apportioning valve	9936
39	+30 positive	7151
40	+30 positive	7151

REMOTE-CONTROL SWITCH / FUSE HOLDER CONTROL UNIT

FUSES

Figure 112

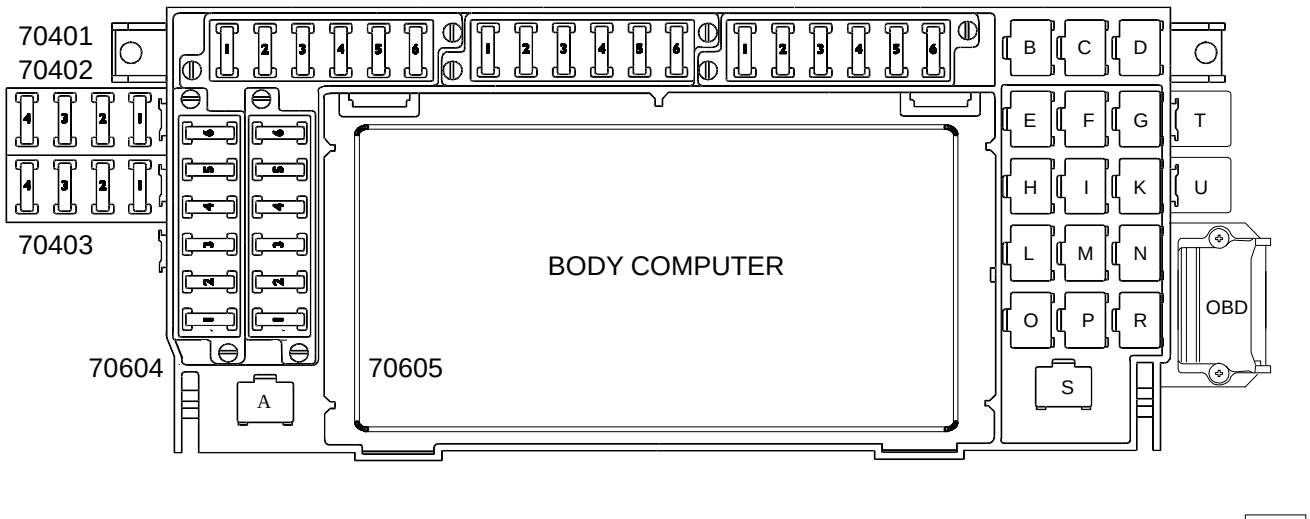


Black color fuse holder (70601) Position		Delivery (A)
1	- Terminal 15 for air conditioning / Heated prefilter / Radio 24V	5
2	- Food warmer + Fridge / BM / Diagnosis connector / OBD connector	10
3	- Tachograph / IC / Centralized locking (remote control)	5
4	- SWI	3
5	- Cigar lighter - 24V/12V voltage reducer / Radio 24V	20
6	- Tilted cab / Drier / Water presence in fuel filter / "Shut off" solenoid valve/ Projectors positioning	10

Red color fuse holder (70602) Position		Delivery (A)
1	- ACC	10
2	- Eurotronic II	10
3	- Internal lighting / FMS connector	5
4	- EBS / ABS - D BASIC	5
5	- EBS	15
6	- EBS / ABS - D BASIC	15

Natural color fuse holder (70603) Position		Delivery (A)
1	- Driver door module (DDM)	20
2	- Passenger door module (PDM)	20
3	- IC	10
4	- EDC (ECM)	30
5	- Body Computer	25
6	- Body Computer	25

Figure 113



Black color fuse holder (70604) Position		Delivery (A)
1	- Free	15
2	- Air-conditioning system	15
3	- Air-conditioning system / IT / navigation	5
4	- Auxiliary heating	15
5	- Auxiliary heating	5
6	- CM (Cabin Module) / VCM (Vehicle Control Module)	20

Natural color fuse holder (70605) Position		Delivery (A)
1	- Presetting	5
2	- Vehicle levelling	5
3	- Chassis level adjustment	7.5
4	- Decelerator with CAN	10
5	- Decelerator with CAN	10
6	- Heated seat / Central lubrication / IT / navigation / Centralized locking	7.5

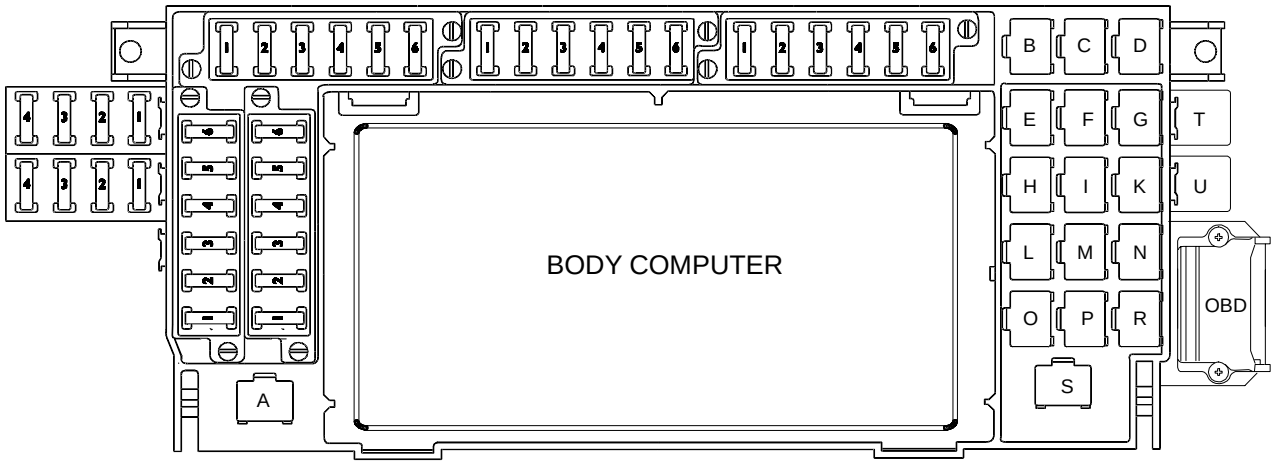
Black color fuse holder (70401) Position		Delivery (A)
1	- Cabin tilting	25
2	- Cabin tilting	5
3	- Body builders / DMI (provision for)	7.5
4	- 12V internal lighting / 12V Reading lights	5

Black color fuse holder (70402) Position		Delivery (A)
1	- Heated windscreen	30
2	- Heated windscreen	30
3	- Heated prefilter	20
4	- K15 for alternator	3

Black color fuse holder (70402) Position		Delivery (A)
1	- Presetting	5
2	- EBS / Trailer EBS	10
3	- Urea (SCR system) / DMI / ACC	5
4	- Urea (SCR system)	15

SUPPLEMENTARY REMOTE SWITCHES

Figure 114

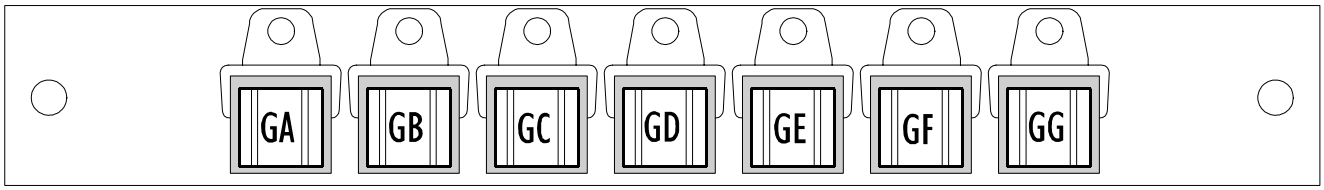


Ref.	Description	Component code
A	-	-
B	Water heater remote control switch	25337
C	-	-
D	Manual air conditioner remote-control switch	25545
E	Water heater remote-control switch	25325
F	-	-
G	Manual air conditioning remote-control switch	25544
H	Cabin tilting diodes	61004
I	Manual air conditioning remote-control switch	25874
K	Manual air conditioning remote-control switch	25310
L	Remote control switch for IGC	25903
M	Manual air conditioning remote-control switch	25322
N	Manual air conditioning remote-control switch	25332B
O	Diodes for cab tilt system	61000
P	Manual air conditioning remote-control switch	25327
R	Manual air conditioning remote-control switch	25332A
S	-	25314
T	Heated windscreen remote-control switch	25818A
U	Heated windscreen remote-control switch	25818B

Remote-control switches

Positioned behind the BODY COMPUTER.

Figure 115



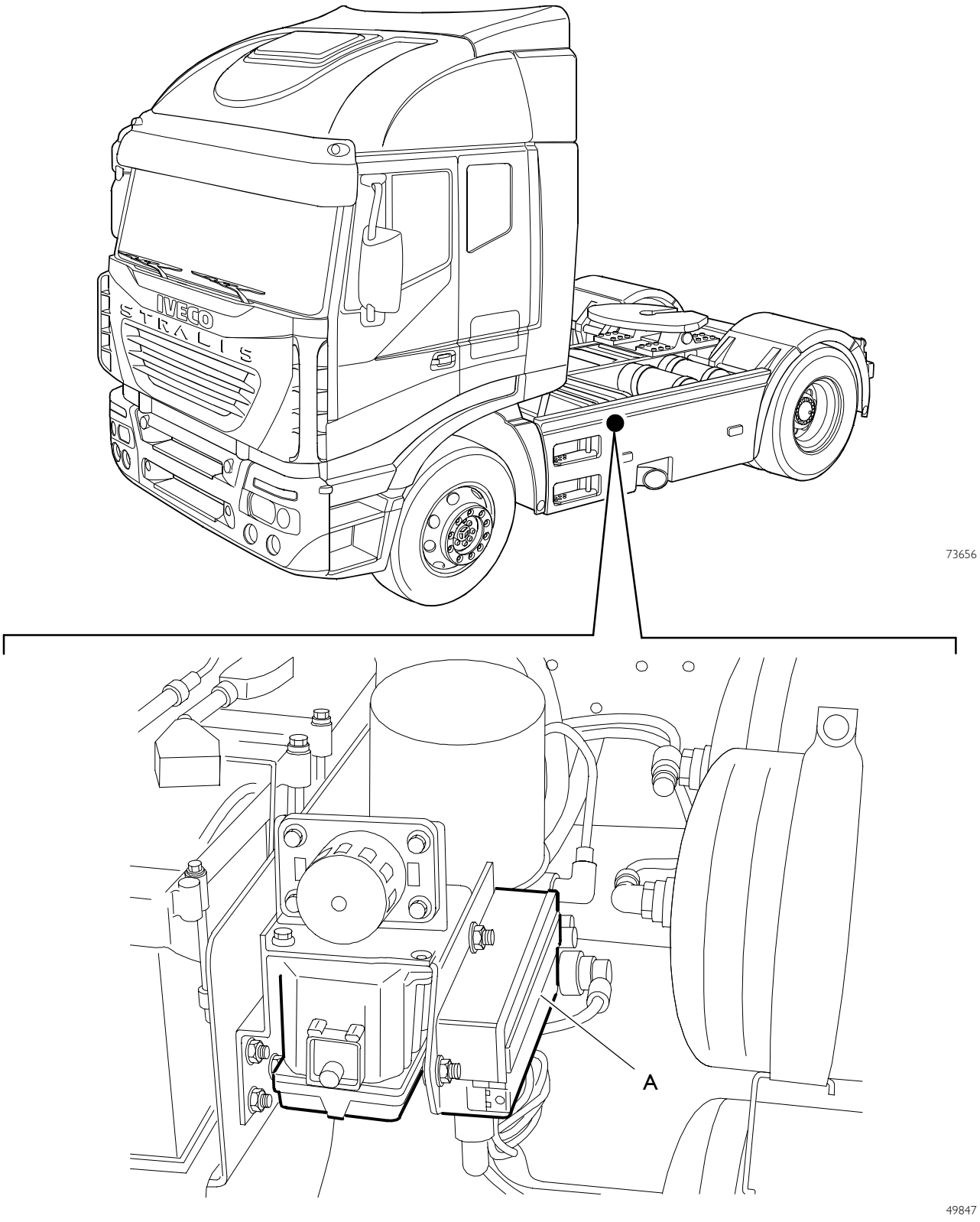
73672

Ref.	Description	Component code
GA	Heated prefilter remote-control switch	25825
GB	Remote-control switch (terminal 15), 50A	25213
GC	Starting remote-control switch (50), 40A	25200
GD	-	-
GE	Cabin tilting remote-control switch	25906
GF	Cabin tilting remote-control switch	25722
GG	Cabin tilting remote-control switch	25723

SUPPLEMENTARY FUSES (70000)

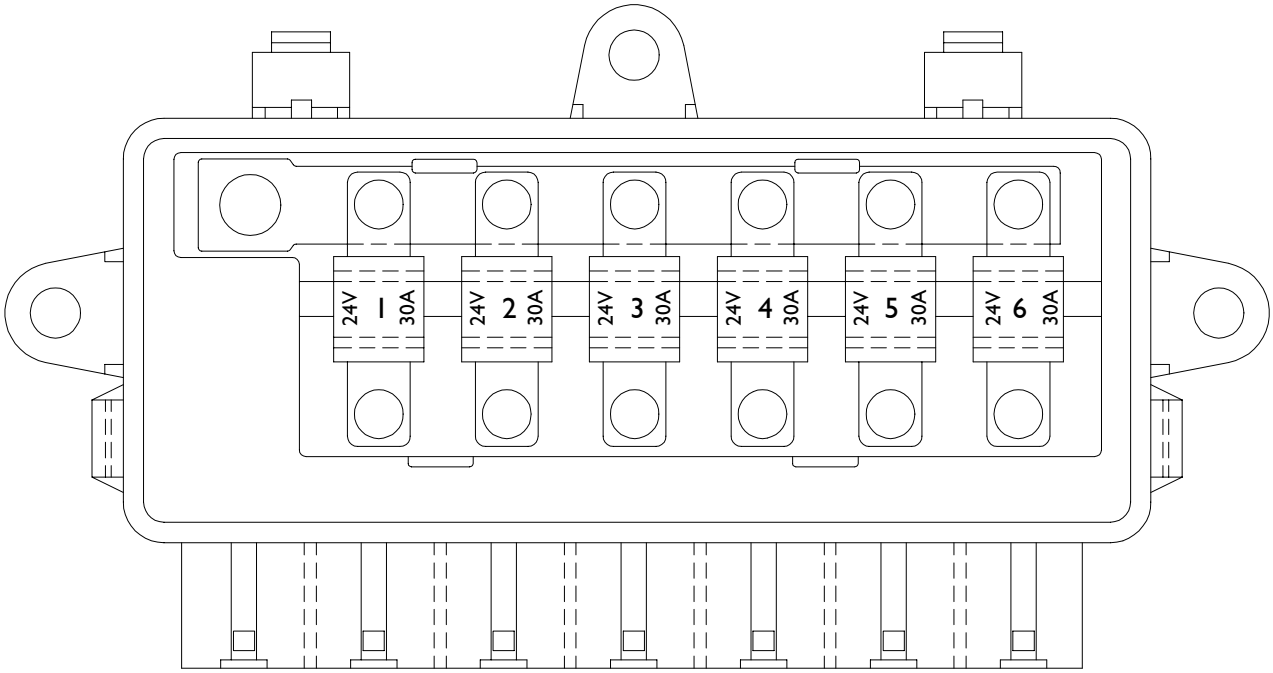
They are located on the left side of the vehicle, next to the batteries and the TGC. The fuse compartment can be accessed by levering on the two springs available on cover (A).

Figure 116



A. Auxiliary fuse holder

Figure 117

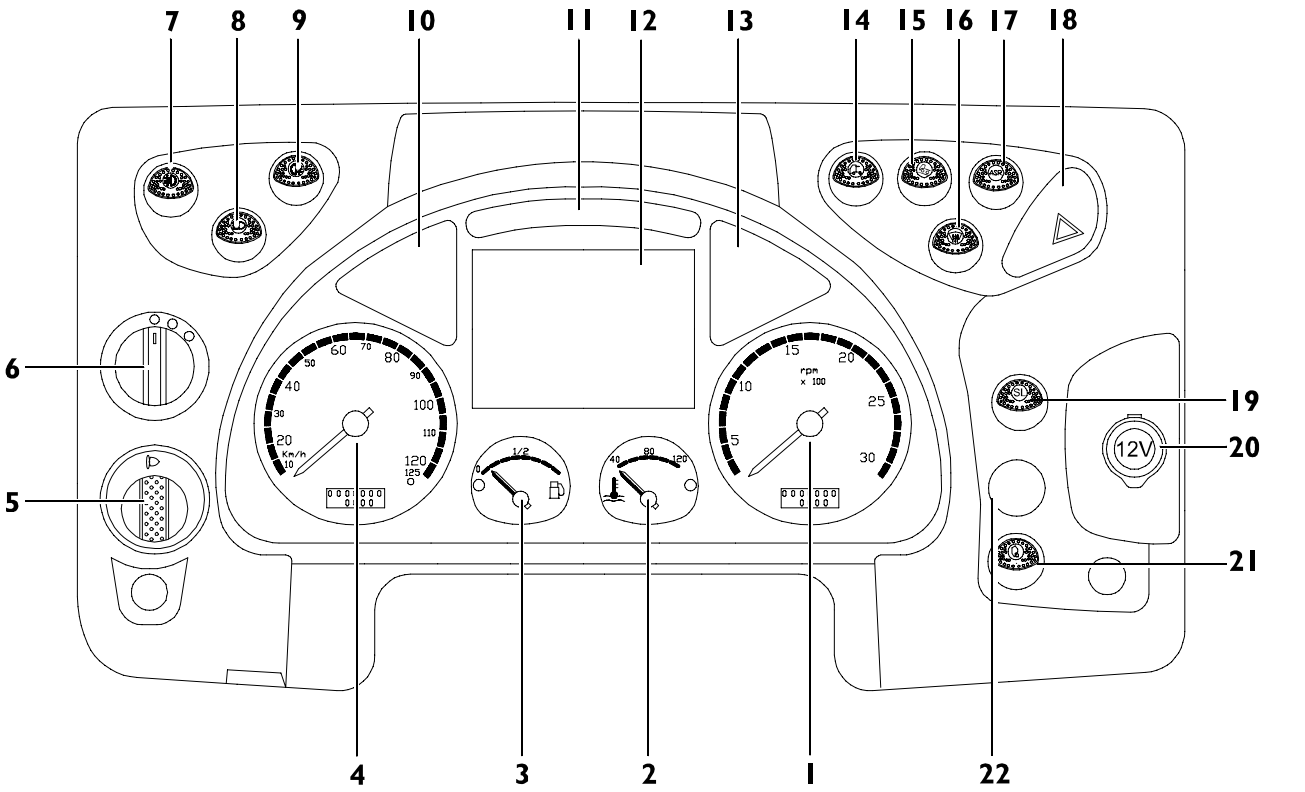


49731

Ref.	Function	Delivery A
1	R.F.C. (rear right light power supply)	30
2	R.F.C. (rear left light power supply)	30
3	F.F.C. (front right light power supply)	30
4	F.F.C. (front left light power supply)	30
5	Current tap - ABS/EBS	30
6	Presetting	30

INSTRUMENT BOARD

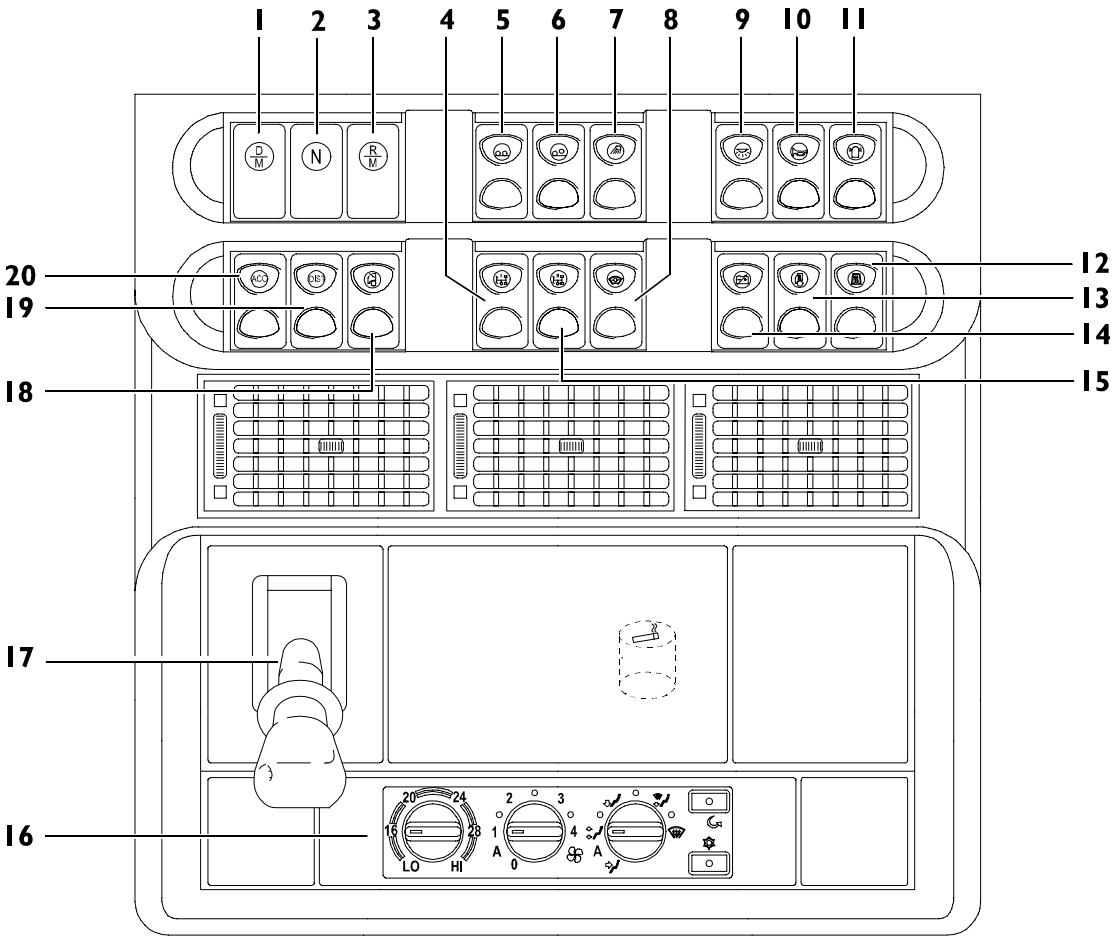
Figure 118



Ref.	Description
1	Revs counter
2	Coolant thermometer
3	Fuel level gauge
4	Speedometer
5	Headlamp trim control
6	External light switch
7	Fog light actuation switch
8	Auxiliary headlamp actuation switch
9	Rear fog light actuation switch
10	Optical indicator cluster
11	Optical indicator cluster
12	Display
13	Optical indicator cluster
14	Loading platform light actuation switch
15	ARB - Anti Roll Back enabling switch (if present)
16	Heated windscreen actuation switch (OPT)
17	ASR actuation switch (if available)
18	Emergency light actuation switch
19	Speed limiter cut-in switch
20	12 V current tap
21	Cabin tilting enable switch
22	Free

CONTROLS ON THE CENTRAL BOARD

Figure 119

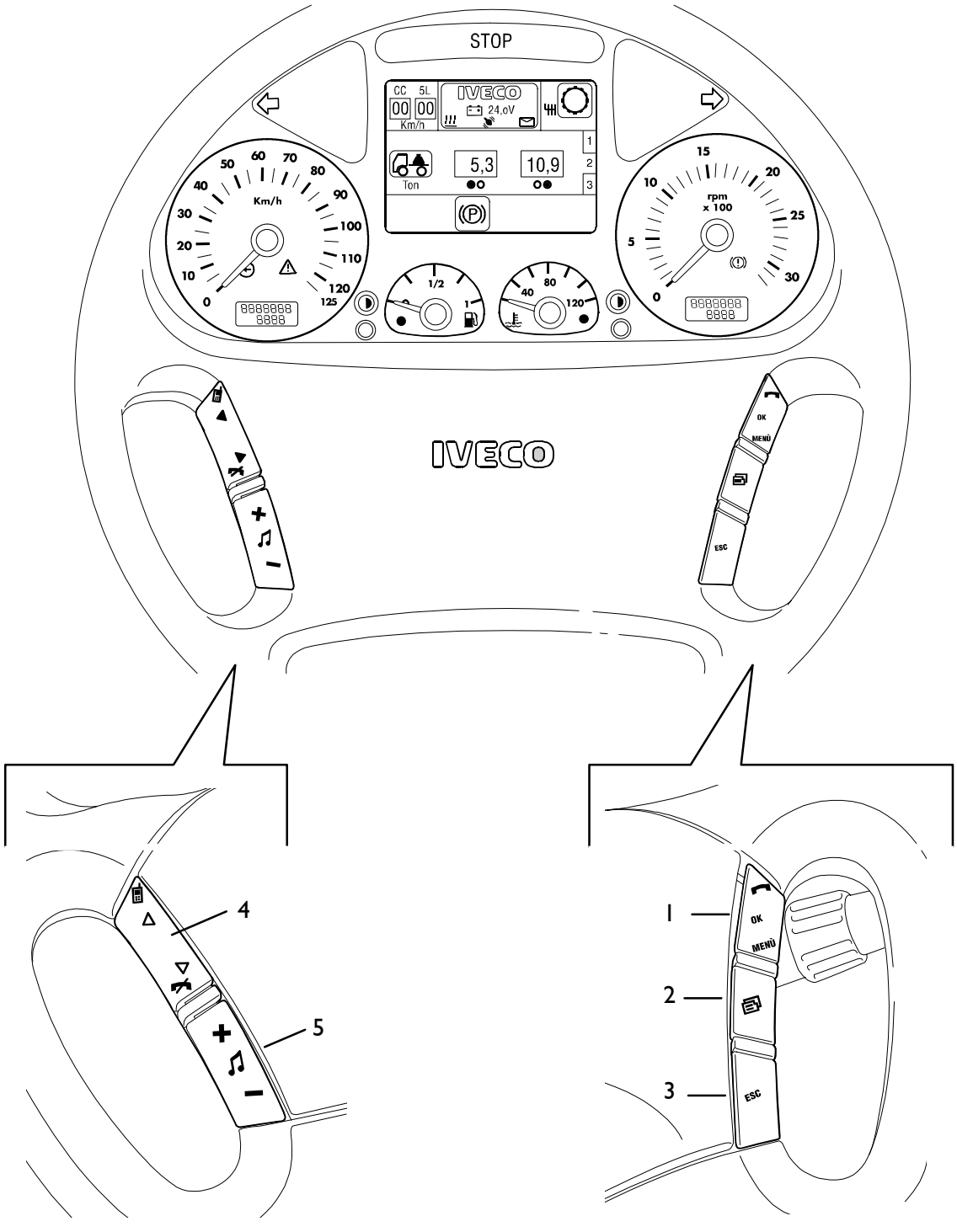


Ref.	Description
1	Eurotronic "Drive"
2	Eurotronic "Neutral"
3	Eurotronic "Reverse"
4	Power take-off 1 (OPT)
5	Pick-up assist provision (OPT)
6	Third axle lifting/lowering (OPT)
7	Spotlights on tie (central) (OPT)
8	Sun visors (OPT)
9	Cabin lights (ceiling lights)
10	Pneumatic horns
11	Rotary lamps (OPT)
12	Auxiliary water heater (OPT)
13	Cabin/engine preheating (OPT)
14	Master current remote-control switch
15	Power take-off 2 (OPT)
16	Air conditioner heating/ventilation or controls (OPT)
17	Hand brake
18	Electric trap door (OPT)
19	DIST
20	ACC

CONTROLS ON THE STEERING WHEEL

The steering wheel features some keys that enable selecting and controlling certain functions.

Figure 120



Left hand side:

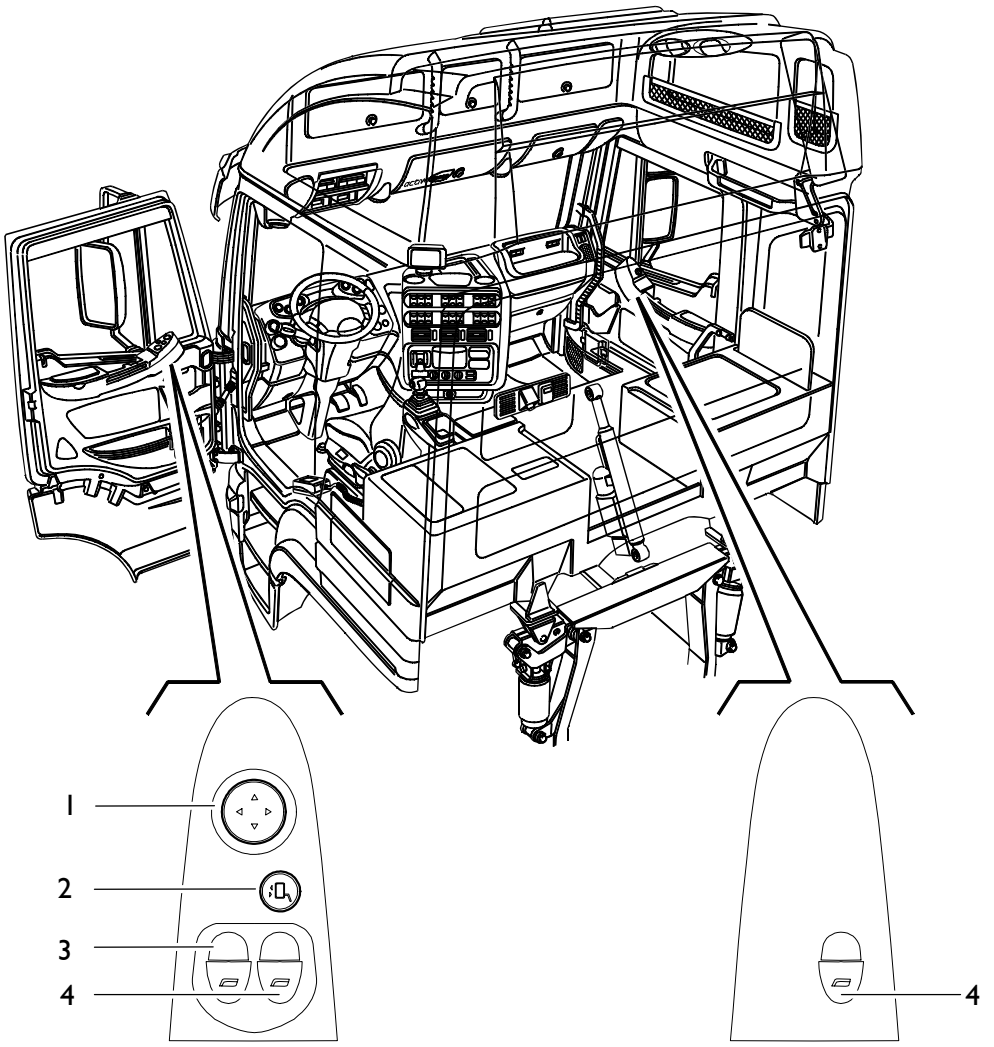
4. KEY ▲
   KEY ▼
5. KEY +
   KEY -

Right hand side:

1. MEBU KEY/OK
2. PAGE PUSH BUTTON
3. ESCAPE KEY

REARVIEW MIRRORS AND WINDOW REGULATOR CONTROL ADJUSTMENT

Figure 121



Ref.	Description
1	Rearview mirror orientation control
2	Mirror selector control
3	Driver window regulator
4	Passenger window regulator

Key 2 on AS was placed on the left and in its place there was the mirror heating key that on AT/AD is placed on central dashboard as series.

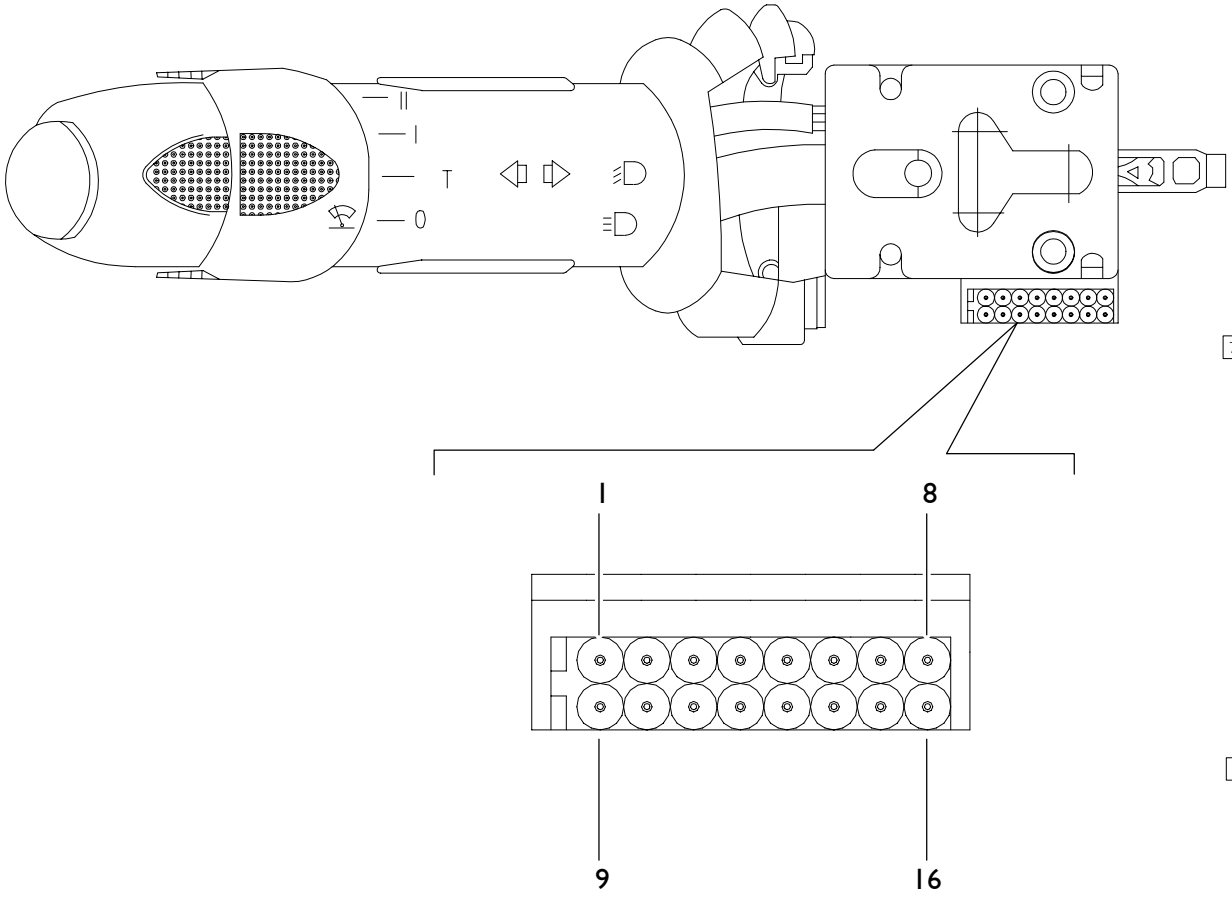
Adjustment functions for rearview mirrors and window regulator control are managed by DDM and FDM units, and consequently they are present as optionals.

EXTERNAL REARVIEW MIRRORS HEATING

By pressing the related button, the rearview mirrors heating is activated and the related icon is displayed on the display. To deactivate such function, press the button again. The icon will not be displayed any more. It is possible to select this function also with moving vehicle. Heating has a maximum length of 30 minutes.

LEFT LIGHT CONTROL 54033

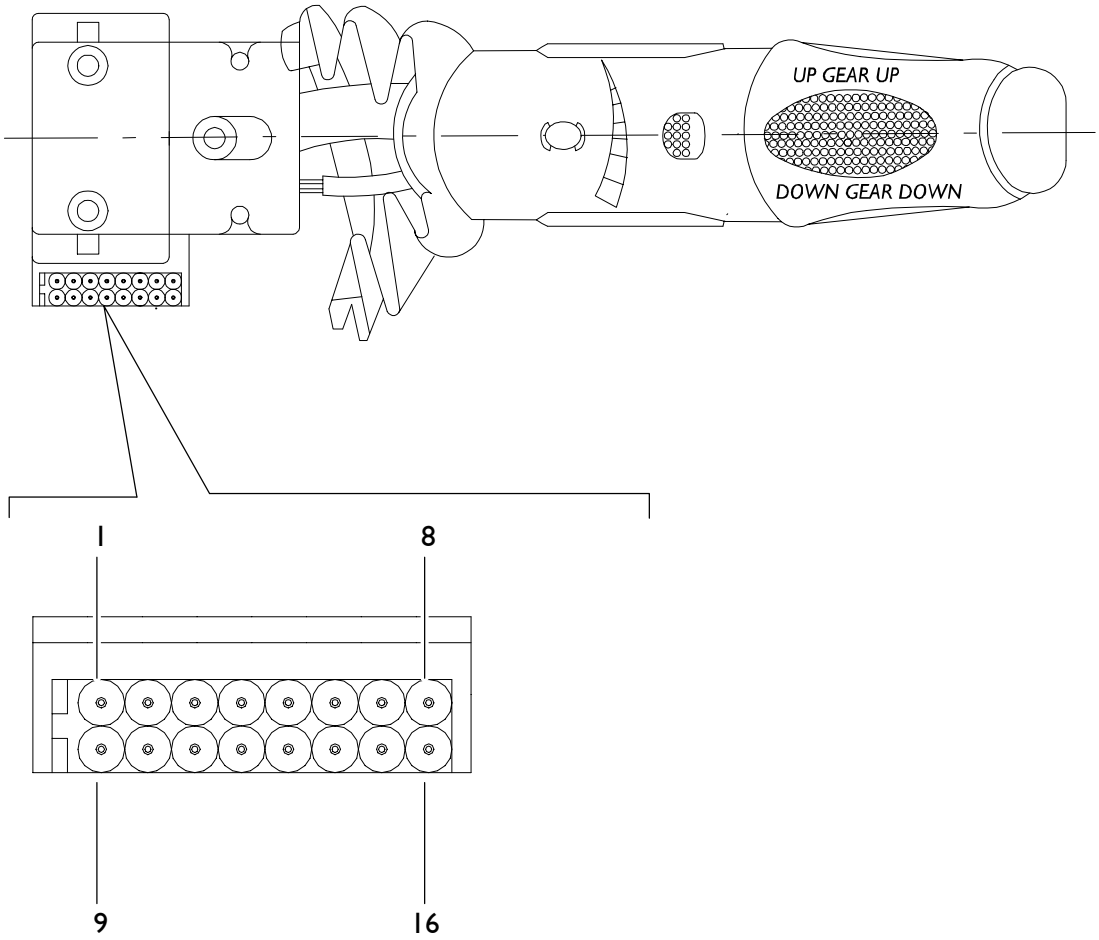
Figure 122



Ref.	Description
1	Windshield wiper (top speed)
2	Windshield wiper (slow speed)
3	Windshield wiper (intermittent)
4	Windshield wiper (one stroke)
5	-
6	Dipped lights on
7	Light flashes
8	Mass
9	Washer electrical pump control
10	-
11	-
12	-
13	-
14	-
15	Right direction indicator
16	Left direction indicator

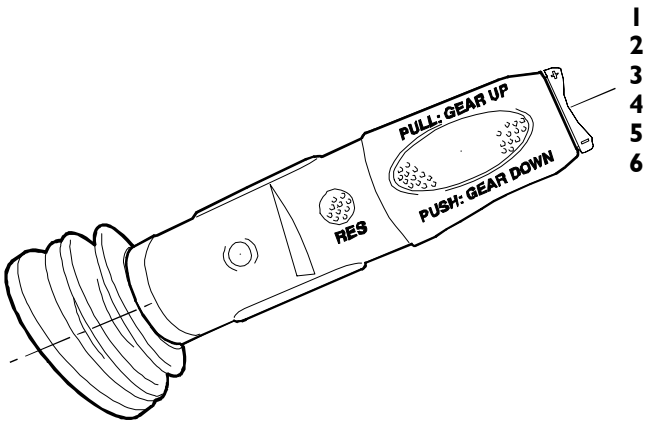
RIGHT LIGHT CONTROL 54030

Figure 123



Ref.	Description
1	Intarder (Position 4)
2	Change gear (down)
3	Cruise Control (set/acceleration)
4	Cruise Control (Resume)
5	Intarder (Position 1)
6	Intarder (Position 3)
7	Intarder (Position 2)
8	-
9	Intarder (Position 5)
10	Intarder (Position 6)
11	Cruise Control (deceleration)
12	-
13	-
14	-
15	Change gear (up)
16	Earth (from the SWI)

Figure 124



108920

RIGHT MULTIFUNCTION LEVER

The multifunction lever, located on the right-hand side of the steering column, permits engaging the engine brake function of the intarder when applicable and selecting gears with the automatic transmission.

The former is selected by moving the lever to positions 1 and 2 and remains o even when the same lever is used to selected the intarder function at positions 3, 4, 5 and 6 related to available braking power ratings.

When the engine brake function is selected the control lever signal is transmitted to the (Steering Wheel Interface) S.W.I. center.

Which activates the engine brake on warning light on Instrument Cluster IC, and via Body Computer B.C. sends the request fro engine rake to the EDC, EBS and automated EuroTronic center (when present).

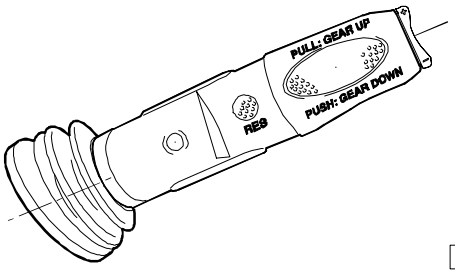
When the operator selects the engine brake manually, selection is displayed in the Cluster with a blinking warning light, which goes to steady when the engine brake is turned on. In the manual mode, engine brake action is also conditioned by accelerator pedal release. In the automatic mode, the engine brake is activated by the VCM center on receipt of a request from the EBS center.

In this condition, the EDC center pilots the engine brake electro valve and the VGT actuator to the fully closed position.

ENGINE BRAKE CONTROL AND INTARDER

Vehicles with Intarder mechanical gearshift

Figure 125



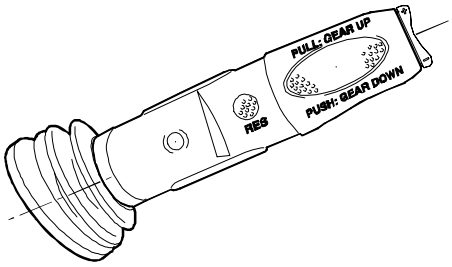
108920

1
2
3
4
5
6

Position 0 = disenabled
Position 1 = 50% engine brake
Position 2 = 100% engine brake + 20% Intarder
Position 3 = 100% engine brake + 40% Intarder
Position 4 = 100% engine brake + 60% Intarder
Position 5 = 100% engine brake + 80% Intarder
Position 6 = 100% engine brake + 100% Intarder

Vehicles with Intarder EuroTronic transmission

Figure 126



108920

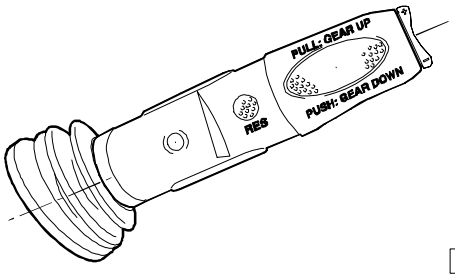
1
2
3
4
5
6

Position 0 = disenabled
Position 1 = 50% engine brake
Position 2 = 100% engine brake
Position 3 = 100% engine brake + 50% Intarder
Position 4 = 100% engine brake + 75% Intarder
Position 5 = 100% engine brake + 100% Intarder
Position 6 = 100% engine brake + 100% Intarder *

(*) The intarder can be more effective with automatic downshifting managed by the transmission electronic control centre.

Vehicles with mechanical gearshift or Eurotronic transmission in the manual mode without Intarder

Figure 127



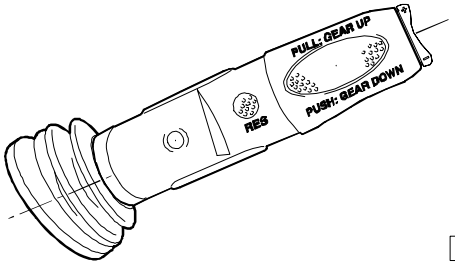
108920

0
1
2

Position 0 = disenabled
Position 1 = 50% engine brake <EV. Engine brake >
Position 2 = 100% engine brake <EV. Engine brake + VGT>

Vehicles with Eurotronic transmission in the automatic mode without Intarder

Figure 128



108920

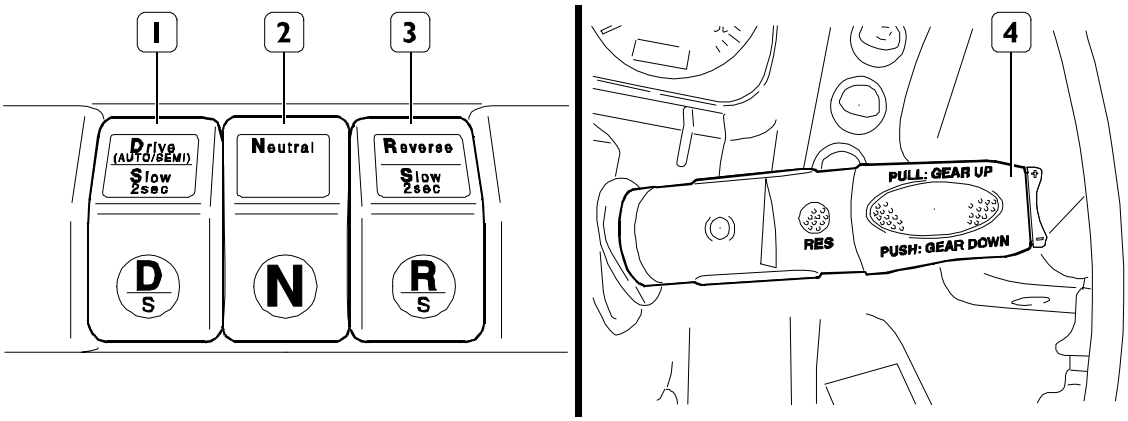
0
1
2

Position 0 = disenabled
Position 1 = 100% engine brake
Position 2 = 100% engine brake + downshifting in the automatic mode

GEAR SELECTION FUNCTION

On the new range of Euro 4 vehicles the gear selector has been eliminated. Its functions are performed by the control pushbutton panel on the central panel of the dashboard, in combination with the drive control system lever.

Figure 129



1. Pushbutton D - AUTO/SEMI mode
2. Pushbutton N - neutral
3. Pushbutton N - neutral
4. Drive control system - gear selection

Driving in manual mode (semi)

1) Parking brake engaged.
2) Start the engine
3) Gearbox in neutral (position N).
4) Briefly press pushbutton "D" (1). The automatic system is activated and the calculated pick-up gear is engaged.The display shows the pick-up gear together with "AUTO".
5) Turn off the automatic system by again pressing button "D". The display passes from showing "AUTO" to "SEMI".
6) The pick-up gear can be corrected with the following operations on the drive control system (4): By slightly moving the drive control system upwards (pulling it) the gearbox shifts one ratio up.By slightly moving the drive control system downwards (pressing it) the gearbox shifts one ratio down.By keeping the drive control system in the desired position (pulling / pressing it) the gearbox shifts two ratios up or down respectively.

NOTE The following pick-up gears are available: 1st, 2nd, 3rd, 4th, 5th.

7) Press the accelerator pedal releasing the parking brake. The vehicle starts (the clutch engages automatically).

Changing ratio while driving the vehicle

Shifting up to a higher ratio

- By slightly moving the drive control system (4) downwards (pressing it) the gearbox shifts one ratio up.
- By keeping the drive control system (4) in this position the gearbox shifts two ratios up.

Shifting down to a lower ratio

- By slightly moving the drive control system (4) downwards (pressing it) the gearbox shifts one ratio down.
- By keeping the drive control system (4) in this position the gearbox shifts two ratios down.

Driving in automatic mode (Auto)

1) Parking brake engaged.
2) Start the engine
3) Gearbox in neutral (position N).
4) Briefly press pushbutton "D" (1). The automatic system is activated and the calculated pick-up gear is engaged.The display shows the pick-up gear together with "AUTO".
5) After entering AUTO mode, the same guidelines given for the SEMI mode apply (points 6 and 7) for selecting the pick-up gear.

Changing ratio while driving the vehicle

While driving the vehicle the display shows the engaged ratio. All the ratio changing operations are automatic and depend on the situation of driving the vehicle, the load, the position of the accelerator pedal, the speed and number of revolutions of the engine. The gear can always be changed manually with the drive control system (4), without having to leave automatic mode.

Keeping the engaged ratio

If in automatic mode you want to keep the engaged ratio, you need to briefly press pushbutton "D" (1). The gearbox will pass on to manual mode (SEMI). Later operations on the gearbox are possible only by pulling or pressing the drive control system (4) (as described for driving in manual mode). To pass back into automatic mode, you need to briefly press pushbutton "D" (1).

Pass into neutral (Position N)

Press pushbutton "N" (2). The display shows N.Positioning in neutral "N" has priority over the other operations of changing ratio. It is always possible to pass into neutral starting from any ratio.When the vehicle is driving forwards, from the neutral position (N) it is always possible to engage a gearbox ratio. For this you need to briefly press pushbutton "D" (1).

NOTE So as not to wear out the mechanical parts of the clutch control, if stopping the vehicle for longer than 1 - 2 minutes (for instance, in a queue, at a level crossing, etc.), the gearbox must be put into neutral (N).
This closes the clutch and the control system is lightened.

Reverse gear

- With the vehicle stationary, briefly press pushbutton "R" (3). The slow reverse gear ratio (RL) is engaged.
- Press the accelerator pedal. The vehicle starts (the clutch engages automatically).

NOTE With the vehicle stationary and in reverse gear it is possible to change between the two reverse gear ratios RL (slow) and RH (fast) by using the drive control system (4)

By slightly moving the drive control system upwards (pulling it) % RH
By slightly moving the drive control system downwards (pressing it) % RL

Operations in slow mode

For manoeuvring in harsh driving conditions (off-road, for instance) there is a supplementary operating mode, with the aid of which the driver can fine tune the clutch according to the travel of the accelerator pedal (up to 100%). In this way the engine speed is limited and rapid vehicle acceleration is prevented.

Turning on

- The vehicle must be stationary

Forward drive manoeuvres
- Press and hold pushbutton "D" (1) (> 2 sec.) The forward drive manoeuvre mode is turned on. The display shows "SLOW"

Reverse drive manoeuvres
- Press and hold pushbutton "R" (> 2 sec.) The reverse drive manoeuvre mode is turned on. The display shows "RL SLOW"

Turning off

With the vehicle stationary

- Briefly press pushbutton "D" (1). The calculated pick-up gear is engaged and automatic mode turned on or briefly press pushbutton "R" (3). The slow reverse gear ratio (RL) is engaged.

During the forward drive manoeuvre:

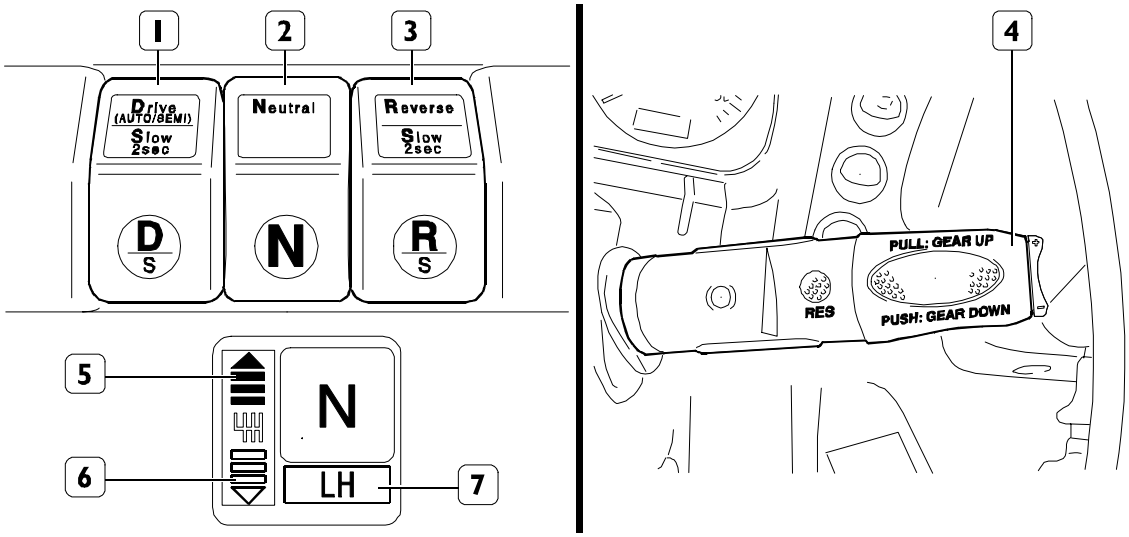
- Briefly press pushbutton "D" (1). The automatic system is activated or operate the kick-down.

During the reverse drive manoeuvre:

- Briefly press pushbutton "R" (3). or operate the kick-down.

FUNCTION ENGAGING EMERGENCY MODE (LIMP HOME)

Figure 130



This is an emergency function in which the normal system of automatic control is put out of service.

1) Engagement

Indicator (Display): LH = engage emergency mode (when changing ratio).

2) Activation by the driver

Ignition turned off (until the indicator is turned off).
Ignition turned on, within 5 seconds:
Press pushbutton N (2) for at least 5 seconds.

3) Indicator LH

After turning on emergency mode (when changing ratio).
Gearbox in neutral.
Clutch released (open).

4) "Clutch status" indicator

Bar with arrow tip pointing upwards (5) (blinking) = clutch released.

Bar with arrow tip pointing downwards (6) = the clutch is about to engage or is engaged.

NOTE When changing ratio, blinking stops: (as soon as a new ratio is engaged it starts blinking again!)

5) Operations to perform

After turning on the emergency mode (see point 3), start up the engine.
When the engine is running, press and then release again the brake pedal.
Engage the required pick-up gear.

Forwards:

- By slightly moving the drive control system (4) upwards (pulling it) the gearbox shifts one ratio up.
- By slightly moving the drive control system (4) downwards (pressing it) the gearbox shifts one ratio down.

In reverse gear:

- Briefly press pushbutton "R" (3). (the slow reverse gear ratio "RL" is engaged).
- By slightly moving the drive control system (4) upwards (pulling it) the gearbox passes to the fast reverse gear ratio RH.

Engage the clutch: press pushbutton D (1) until the bars stop blinking with the arrow tip pointing upwards and when the bars appear with the arrow tip pointing downwards (5 / 6).

The clutch can be engaged slowly or even suddenly.

NOTE If the vehicle accidentally moves on a slope with a gear engaged, the clutch will automatically engage

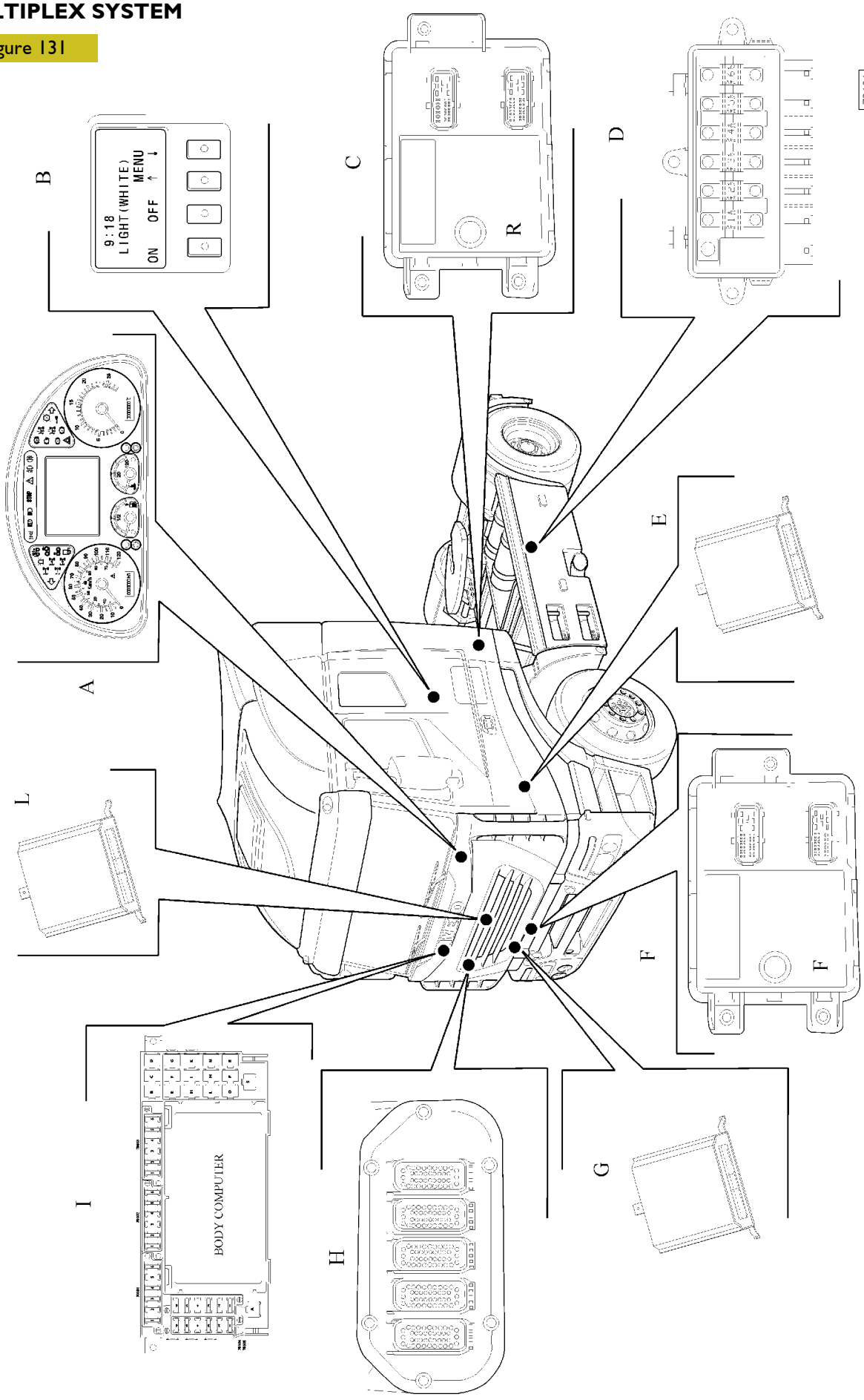
Disengage the clutch: briefly press pushbutton "D" (1) or alternatively press the brake pedal.

If on pressing the brake pedal the clutch is engaged with the pushbutton "D" (1) (for example vehicle pick-up uphill), in order to be able to release the clutch again with the brake pedal, it will be necessary to first briefly take your foot off the brake pedal: a ratio shift will only be possible with the vehicle stationary.

Leaving emergency mode.
Turn off the ignition and wait for the indicator to disappear.
When next starting up the system will be in normal mode.

MULTIPLEX SYSTEM

Figure 131



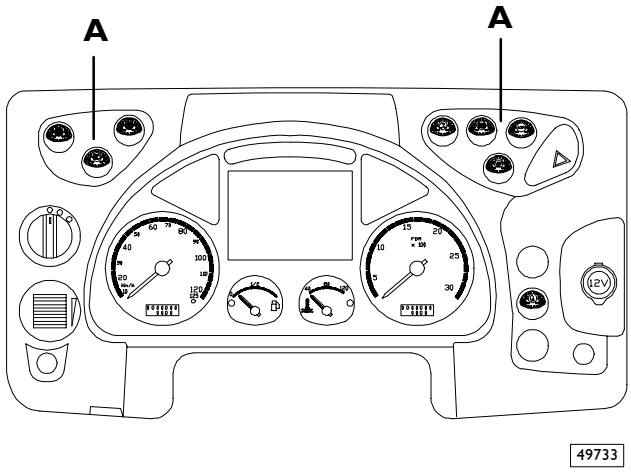
A. Cluster - B. Bed Module - C. R.F.C. center - D. Fuse holder on frame - E. Operator door center (D.D.M.) - F. F.F.C. center - G. Cab Module - H. Wall pass - I. Body Computer - L. Passenger door center (PDM) - * OPT

Cluster

Proceed as follows to remove the Cluster:

– Use a screwdriver for leverage inside the two slots in the two groups of switches (A) located in the upper panel.

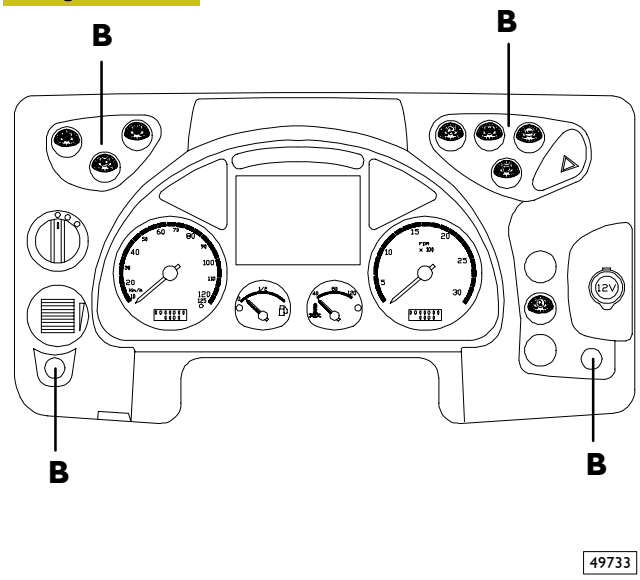
Figure 132



– Remove the two protection caps.

– Loose the four panel retainer screws (B).

Figure 133

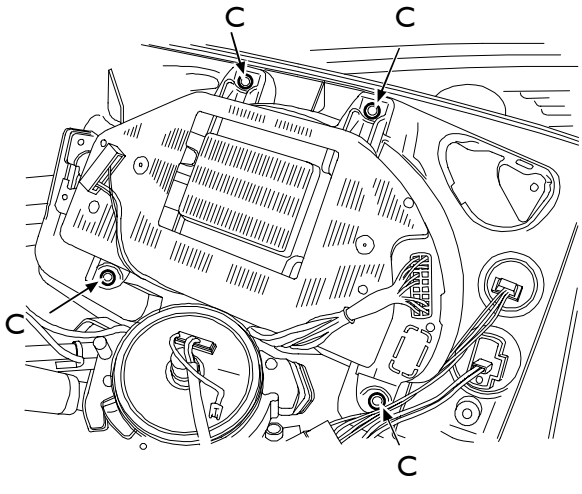


– Move the panel as far outwards as possible after relocating the steering wheel far from the panel.

– Disconnect the two Cluster attaching screws.

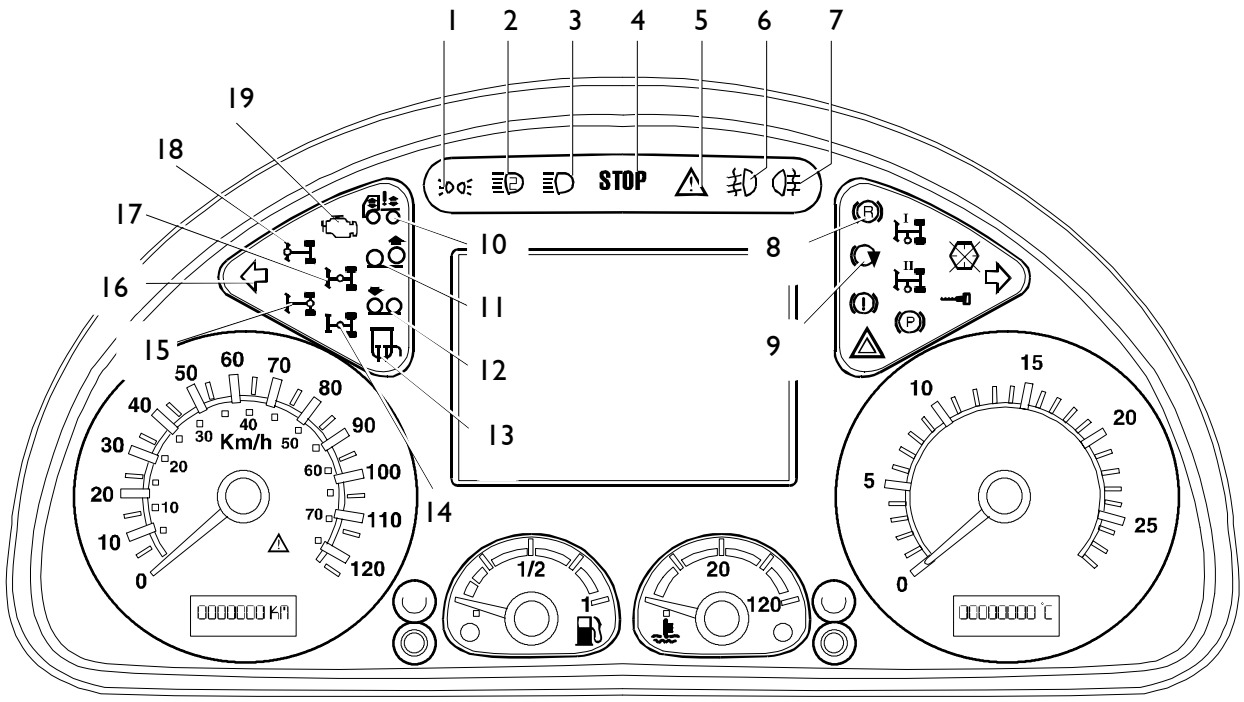
– Loosen the four retainer screws (C).

Figure 134



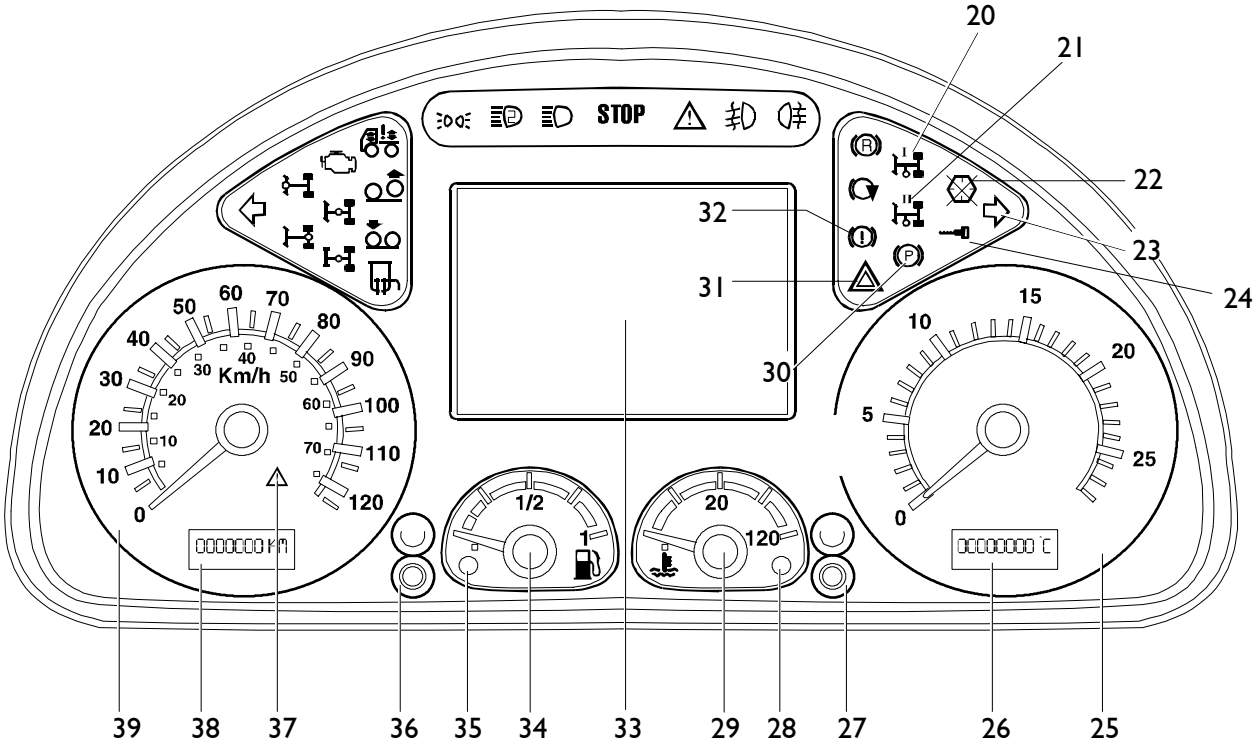
Cluster (optical indicators)

Figure 135



Ref.	Description
1	External lights
2	Auxiliary headlamps
3	High-beam headlamps
4	Generic anomaly/failure signal
5	Generic alarm
6	Fog headlamps
7	Rear fog lights
8	* Decelerator
9	* Exhaust brake
10	Vehicle suspensions not in running trim
11	Third axle lifted
12	Pick-up assist provision
13	Mirror heating
14	Longitudinal tandem differential locking
15	Longitudinal/transverse rear differential locking
16	Left indicator light
17	Longitudinal differential locking
18	Longitudinal/transverse front differential locking
19	OBDII anomaly
*	Warning light: blinking with the function requested by the driver; ON steady with the function actuated

Figure 136



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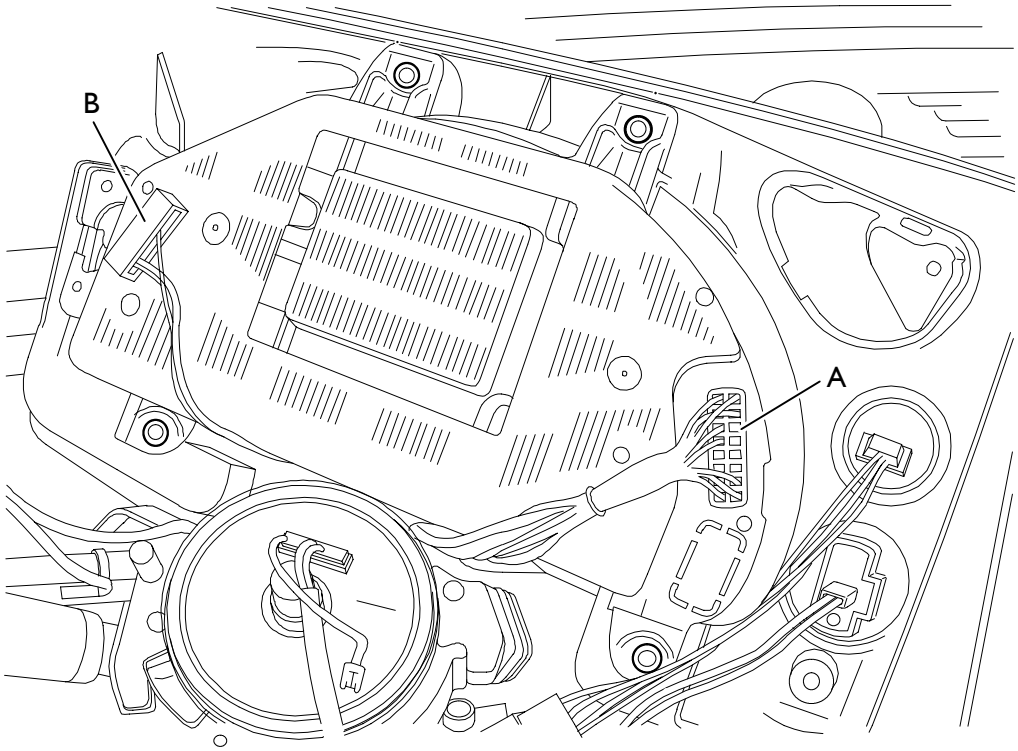
Ref.	Description
20	Power take-off 1 (PTO 1)
21	Power take-off 2 (PTO 2)
22	Instrument panel failure (Cluster)
23	Right indicator light
24	Immobilizer
25	Analog revs counter
26	Temperature/time display
27	Instrument illumination itensity/temperature/time display button
28	Coolant temperature (high temperature warning light)
29	Full/trip odometer display button
30	Hand brake ON
31	Emergency lights
32	Braking system failure
33	Display
34	Fuel level
35	Fuel level (low level warning light)
36	Odometer/mileage indicator display button
37	Tachograph anomaly
38	Full/trip odometer/mileage indicator display
39	Analog speedometer

Pin-out connectors

Figure 137



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Ref.	A - Black	Cable code	Compo-nent code	B - Blue	Cable code	Compo-nent code
1	K line - Diagnosis	2994	72021	-	72021	-
2	-	-	-	-	-	-
3	CAN H line (VDB)	White	-	-	-	-
4	CAN L line (VDB)	Green	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	CAN H line (ICB)	White	-	-	-	-
11	CAN L line (ICB)	Green	-	EDC failure signal (ECM)	6150	86132
12	-	-	-	-	-	-
13	CAN H line (IDB)	White	-	-	-	-
14	CAN L line (IDB)	Green	-	-	-	-
15	-	-	-	-	-	-
16	Covered distance acc. to tachograph	5518	40011	-	-	-
17	Vehicle speed acc. to tachograph	5540	40011	-	-	-
18	Signal from Intarder	5541	86015	K15 power supply	8871	70603/3
19	-	-	-	Ground	0000	-
20	Vehicle speed (Body builders)	5541	ST14/7	K30 power supply	7606	70603/3

Display operation

Display varies subject to the following:

- Key on MAR with engine off
- Key on MAR with engine started and vehicle stationary
- Key on MAR at vehicle speed over 15 Km/h
- Key out

Key in MAR with engine off

Turning the key to MAR displays control of main vehicle systems.
Their presence is indicated in green, if all is OK, or yellow in case of a light anomaly/breakdown, or red in case of a serious anomaly/breakdown, with activation of a buzzer.

The list of systems present on the vehicle and their status can be displayed with the Multiplex system during Start-Up, by receiving the diagnostic message from the various centers.
System Check Ok or System Check Failed information is provided at Start-Up Test end.
The defective system then sends its diagnostic message that is displayed with the icon of the defect under review.

The Multiplex system can indicate vehicle and electronic system errors. In case of an error detected by the Body Computer, it sends the Instrument Cluster a message containing the following information, via the CAN line:

- the status of the light associated to the defect (red for a serious and yellow for a slight anomaly)
- the error code

At receipt of the error message, the Instrument Cluster displays the following in the central display area:

- the colored icon related to the defective component or center
- the related error code

It also advises the operator by activating the Buzzer. After recognizing the error, the operator presses key "OK" and the central display area returns showing the previous information (virtual tool or menu).
The icon related to the error detected is stored in the lower layer of the display or with a specific warning.

No options such as to distract attention or options not related to an operation useful for vehicle operation are available during operation, which is why the Menus available in case of a moving vehicle are reduced to the base essential and scanning of the various displays is obtained simply with the "Menu" key (without reading the list of options).
With the vehicle stationary, scanning of the complete set of menus available is enabled with keys "Arrow up" and "Arrow down".

Breakdown

After acknowledging the error, the operator presses key OK on the steering wheel and the icon appears in the lower display layer.

Yellow color (light anomaly/breakdown):

Proceed with caution and contact a Service Network workshop as soon as possible.

Red color (serious anomaly/breakdown):

Park the vehicle on the roadside in a non-dangerous area or contact the Dealer or the 24 hour Client Center number in unusual hours or in a decentralized area.

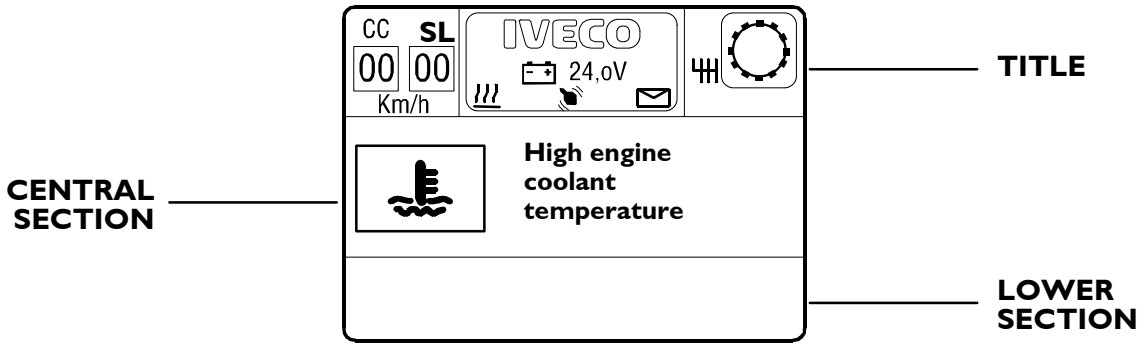
Two menus are available:

- TRAVEL MENU
- DIALOG MENU

External mirrors and lights can also be adjusted.
When the key is inserted, the present electronic systems perform a test by activating the related lights, enabling the operator to check their efficiency (and learn of the existence of vehicle systems).

Display structure

Figure 138



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TITLE

- ❑ Speed set by Cruise Control
- ❑ Speed Limiter set
- ❑ Supplementary heater enabled
- ❑ Battery voltage
- ❑ Radio/RDS information
- ❑ Telephone/ EMS message information
- ❑ Gears (downshifted/normal gears), suggested gears, auto/manual mode.

CENTRAL SECTION

- ❑ Engine oil pressure
- ❑ Engine oil level
- ❑ Consumption indicator
- ❑ Turbo pressure
- ❑ Engine oil temperature
- ❑ Reservoir, trailer, service air pressure
- ❑ Front / rear / trailer brake wear (vehicles with EBS)
- ❑ Light setting adjustment
- ❑ Mirror positioning
- ❑ Failure messages
- ❑ Load on the axles (OPT)

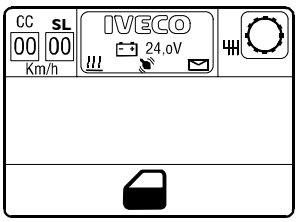
LOWER SECTION

- ❑ Alarms
- ❑ Active functions indications (intarder, etc.)

Optical status indicators on display

The corresponding icon appears at activation of the following functions of occurence of the following anomalies.

Figure 139



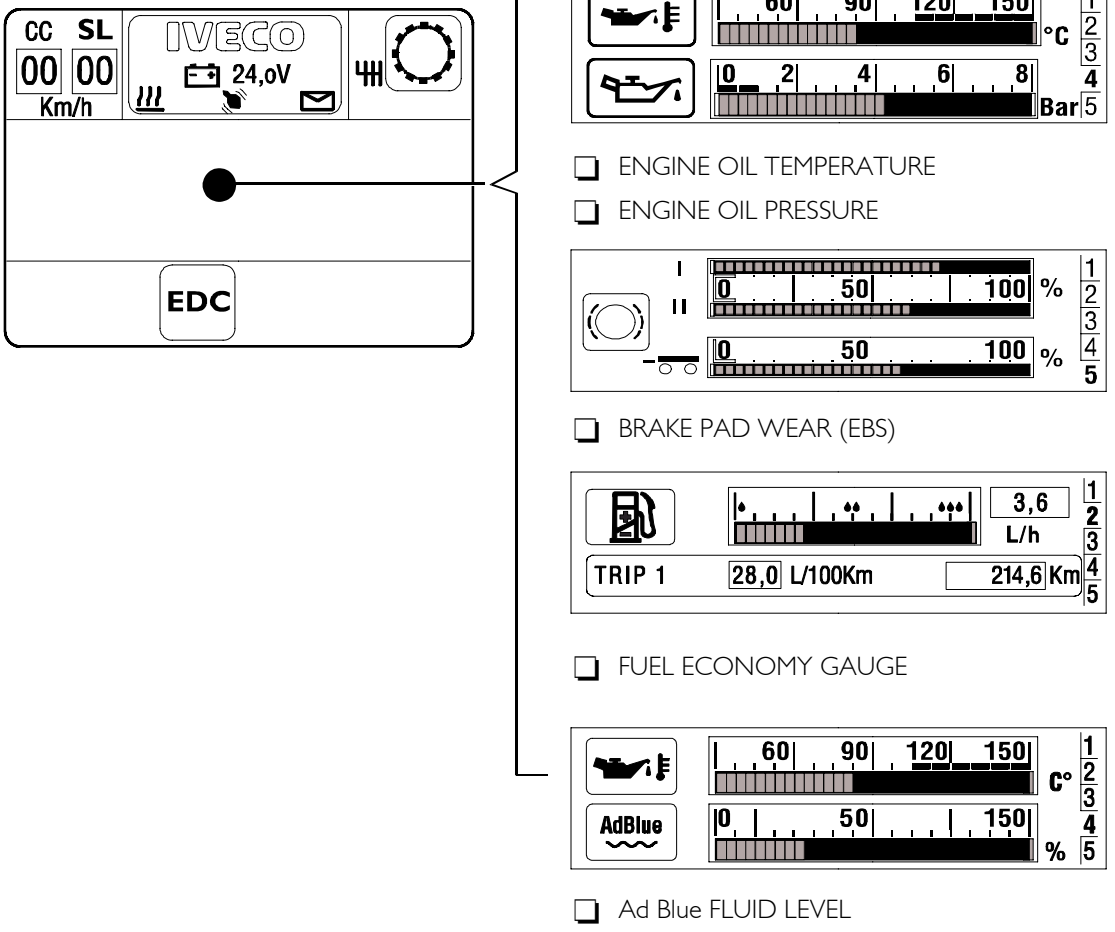
Meaning	Symbol	Colour	Meaning	Symbol	Colour
Pre-heating		yellow	ASR on	ASR	yellow
Cab unhooked Unhooked cab enable		red yellow	ASR off	ASR	yellow
Door open		red	Reduced ABS operation	ABS	yellow
Low front axle brake air pressure		red	Automatic chains		yellow
Low rear axle brake air pressure		red	Trailer without EBS/ABS	ABS	yellow
Low trailer brake air pressure		red	Tipper body		yellow
Loading deck light (tractor only)		yellow	Instrument Cluster trouble	IC	red
Windscreen defroster		yellow	Low hydraulic pressure of third steering axle		red
Minimum engine coolant level		yellow	Low engine coolant level		red
High engine coolant temperature		yellow	Very high engine coolant temperature		red
Low windscreen washer reservoir level		yellow	Low fuel level Ad Blue		yellow
Front axle brake wear		red	Rear axle brake wear		red
Rear second axle brake worn		red	Trailer ABS/EBS fault		red
Power steering low fuel level		yellow	Low level second power steering circuit		yellow
Oil filter clogged		yellow	Air filter clogged		yellow
Fuel filter clogged		yellow	Water in fuel filter		yellow
Low engine oil level		red	Engine oil level too high		red
Low engine oil pressure		red	High engine oil temperature		red
Low parking brake air pressure	P	red	Low air suspension pressure		yellow
Low trailer brake air pressure		red	Brake wear on a specific wheel		yellow/red

After recognizing the error, the operator must press OK on the steering wheel and the icon appears in the lower display section.

Meaning	Symbol	Colour	Meaning	Symbol	Colour
Low/poor generator charge	TCO	red	CDM ECU failure	BM	red
TCO ECU failure		red	BM ECU failure	CM	red
Parking brake failure		yellow	CM ECU failure		red
Second importance light failure	BC	yellow/red	Air conditioning system failure		red
BC ECU failure	ECM	yellow/red	Additional heater failure	SWI	red
EDC failure		red	SWI ECU failure	RFC	yellow/red
EuroTronic failure		red	RFC ECU trouble/fault		red
EBS failure		red	First importance light failure		red
ABS failure		red	Right turn indicator fault		yellow
Intarder failure	FFC	yellow/red	Left turn indicator fault		yellow
FFC ECU trouble/fault	DDM	red	EAC defect	EAC	yellow
Distance alarm signalling		yellow	EAC failure	EAC	red
ACC sensor defect		yellow	a Trailer EBS failure		red
ACC sensor dirty		yellow	Reduced power and engine		yellow
ARB enabled		yellow	Rotating headlights		yellow
TPM steering axle low tire pressure		yellow	VCM failure	VCM	yellow/red
TPM engine axle low tire pressure		yellow	SCR failure	SCR	yellow/red
Trailer: attention thresholds reached		yellow	ASR / ESP disabled	ASR ESR	yellow
Trailer: anti-theft enabled		yellow	ESP enabled		yellow
Airbag default/defect		red	Power steering failure		red
EM defect	EM	yellow	Power steering liquid low pressure		yellow
EM failure	EM	red			
CDM ECU failure	CDM	red			

Display instruments

Figure 140



- AXLE LOAD GAUGE (2/3 AXLES)
- OIL PRESSURE
- AIR PRESSURE (BRIDGE - AXLE)
- ENGINE OIL TEMPERATURE
- ENGINE OIL PRESSURE
- BRAKE PAD WEAR (EBS)
- FUEL ECONOMY GAUGE
- Ad Blue FLUID LEVEL

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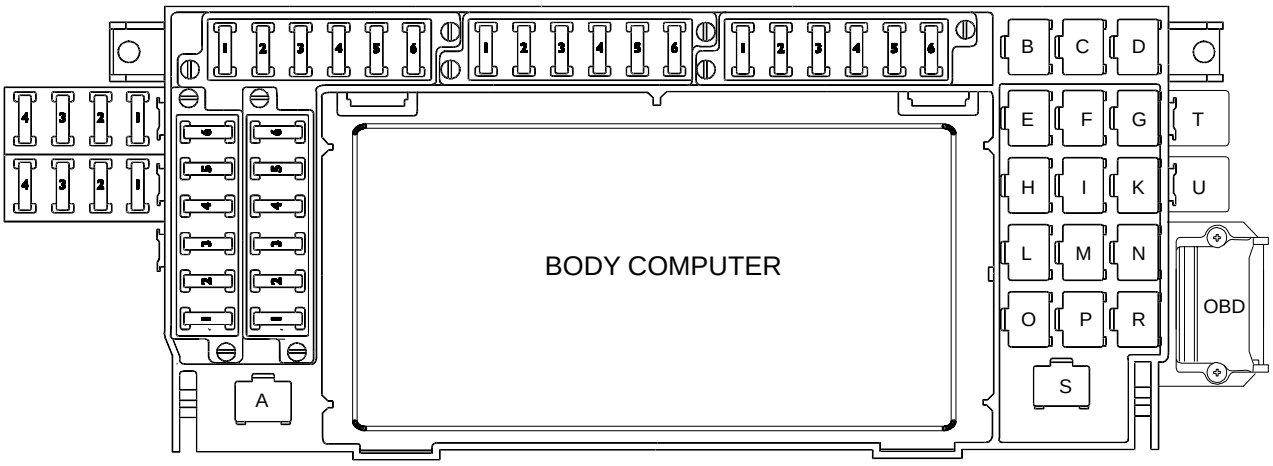
Body computer

The Body Computer is the Multiplex system central unit. Its function is to manage the peripheral units present and is located inside the instrument panel on the passenger side in the interconnection center.

Figure 141



113246

Input signals

- vehicle external lighting
- interior compartment lighting
- horn
- windshield wiper
- engine start
- coolant level
- automatic snow chains
- parking brake
- tilted cab
- PTO
- electrical cavity
- external temperature sensor
- windshield heating
- vehicle external lighting

Output signals

- interior compartment lighting
- horn
- windshield wiper
- starter motor
- windshield heating
- battery sectioning
- electrical cavity
- equipper outputs

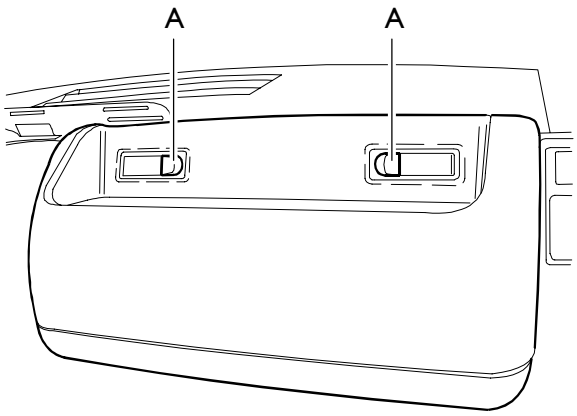
BC replacement operation sequence:

1. Turn key OFF
2. Press instrument panel button TGC OFF
3. Wait for about 15seconds for the TGC to open – check that the TGC does not work when actuating the windshield wiper to be sure the TGC is open.
4. Disconnect J1
5. Disconnect other connectors in any order
6. Complete necessary operations
7. Reconnect connectors other than J1 in any order
8. Reconnect J1
9. Turn key ON

Proceed as follows to remove the Body Computer:

– Press the two release push buttons (A) on the passenger side object holder drawer.

Figure 142



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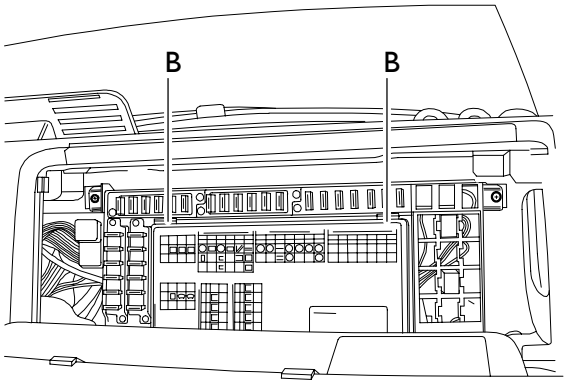
– Lift the two Body Computer (B) lock straps.

Figure 143



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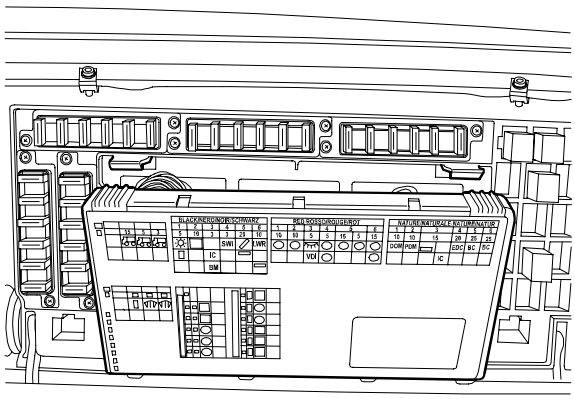
– Draw the center carefully forward to avoid removing the connection cables.

– Disconnect the connectors on the back.

Figure 144



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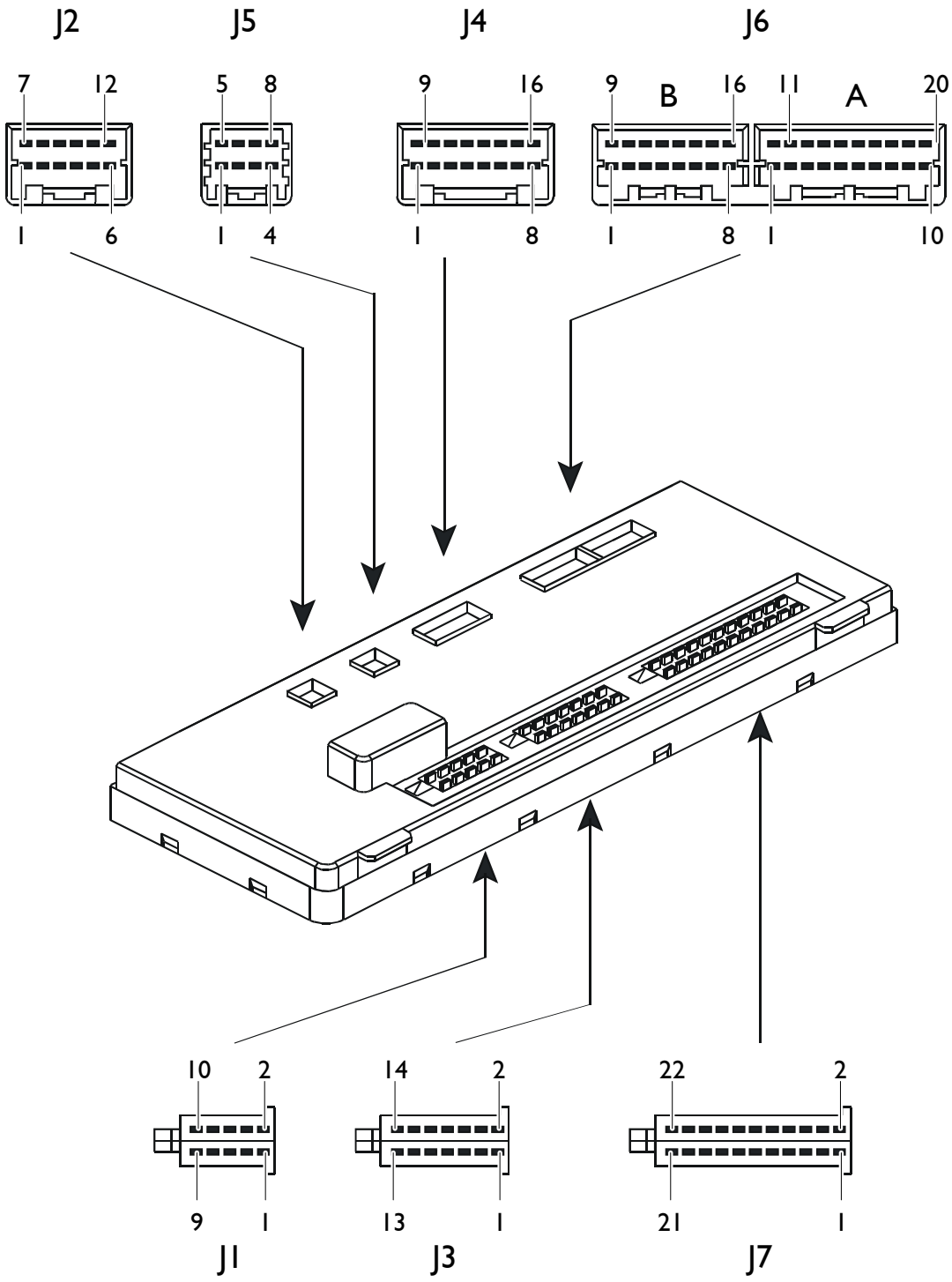
Body Computer perspective view

Figure 145



The connector pin-out is viewed from the cabling side.

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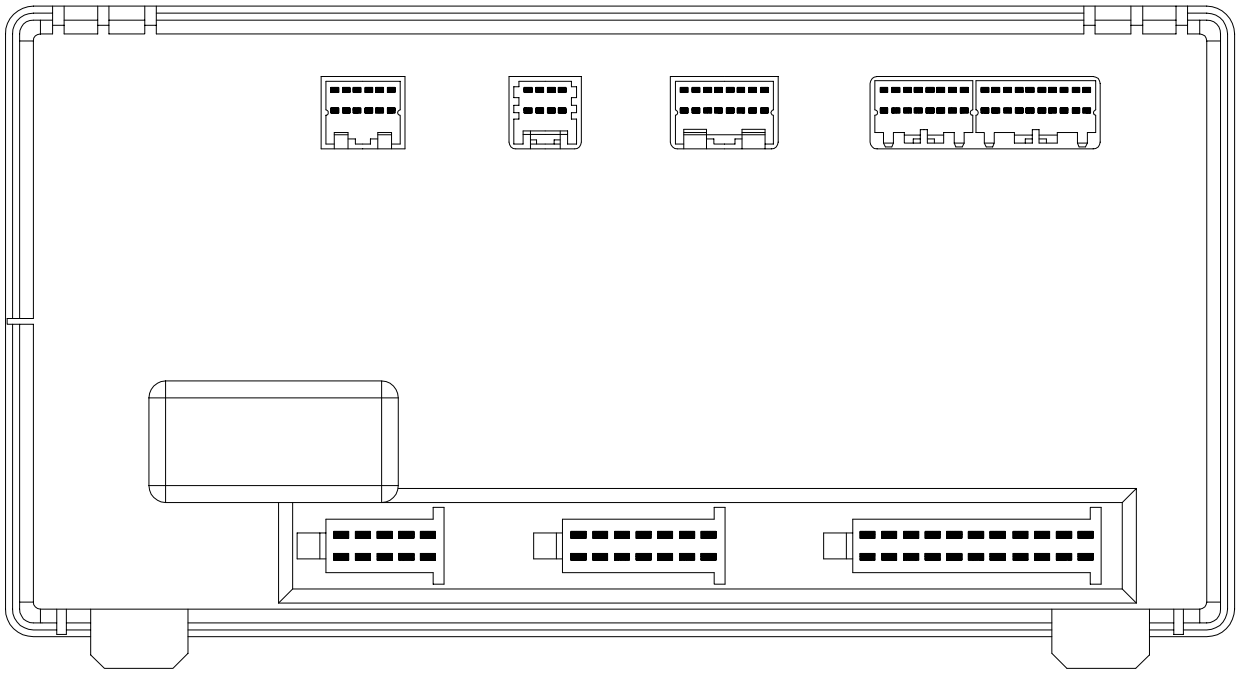
Connector "J1"

Figure 146



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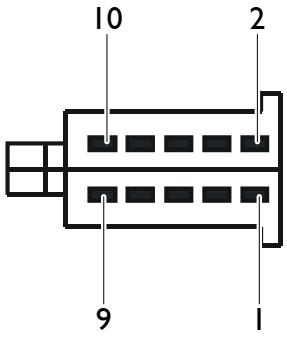
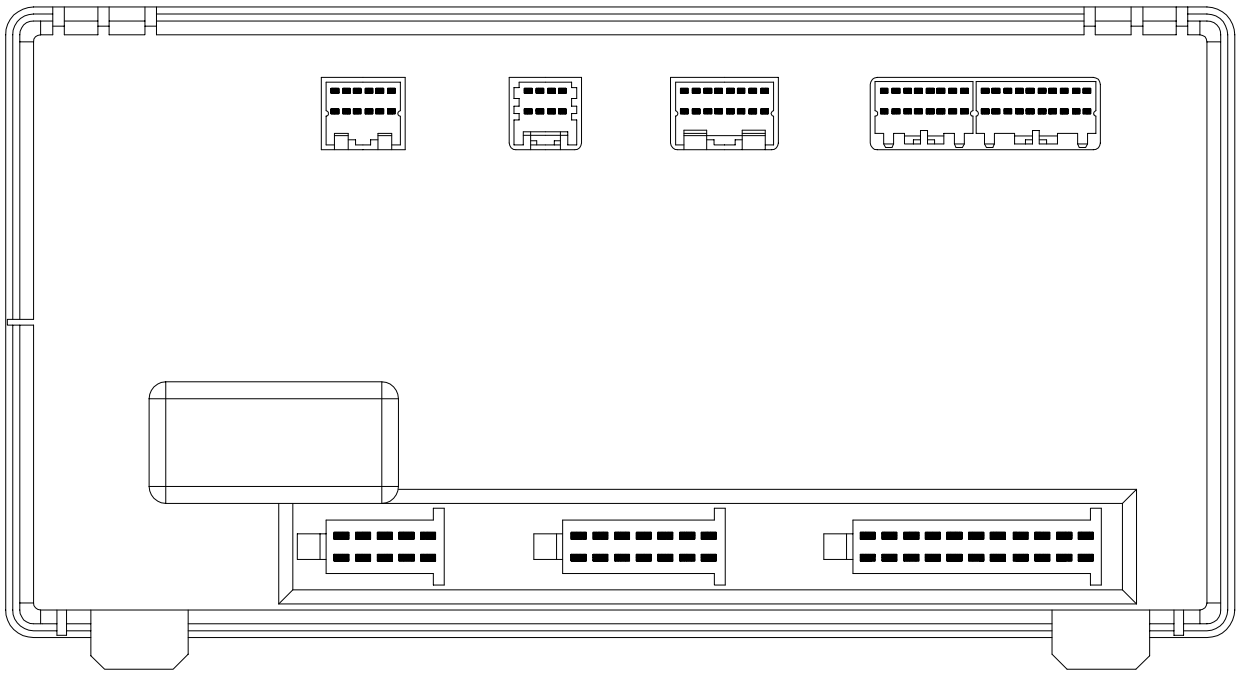


Ref.	Description	Component code	Cable color code
1	Positive from the fuse (after TGC)	70603/6	7905
2	Positive from the fuse (after TGC)	70603/6	7905
3	Positive from the fuse (after TGC)	70603/5	7905
4	Positive from the fuse (after TGC)	70603/5	7905
5	Earth	-	0000
6	Earth	-	0000
7	Earth	-	0000
8	Positive from the fuse (to the battery)	70058	7972
9	Starting motor remote-control switch control ground	25200	0008
10	TGC closing signal	25900	8035

Connector "J2"

Figure 147



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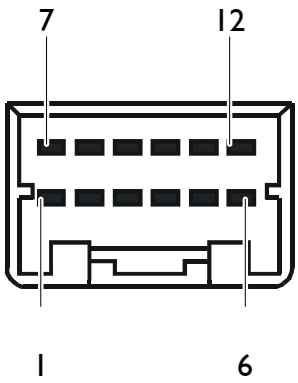
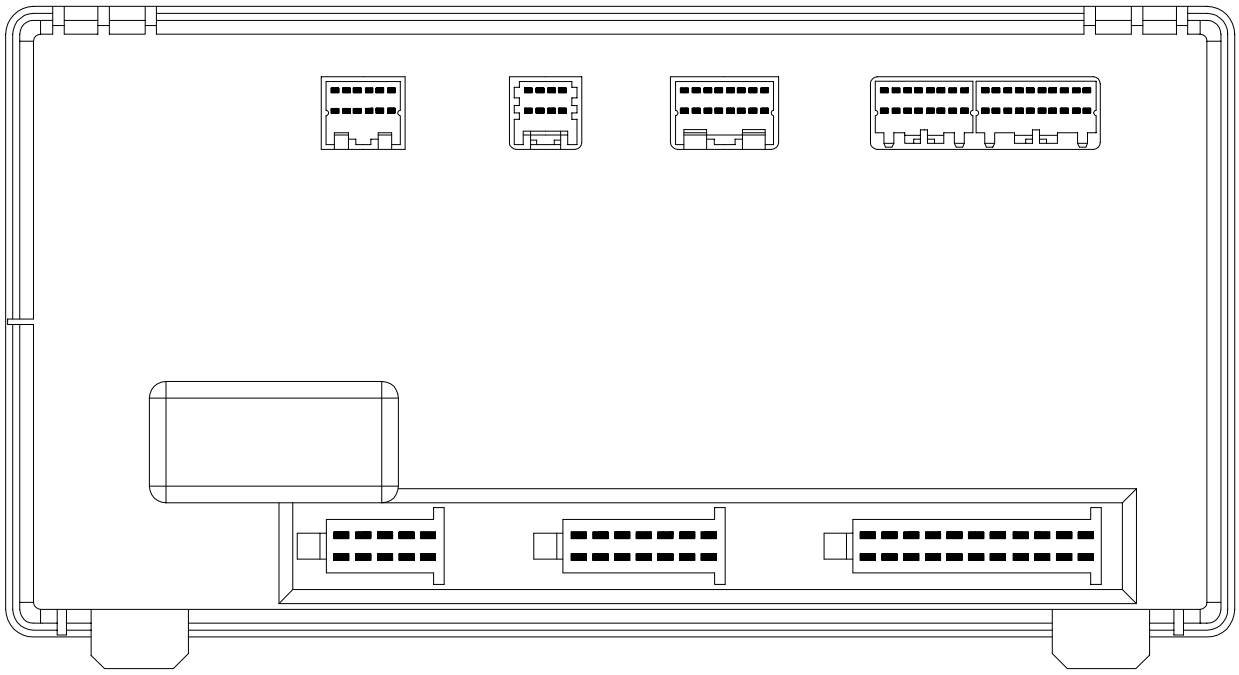


Ref.	Description	Component code	Cable color code
1	CAN - H line (ICB)	-	Ws/Bi
2	CAN - L line (ICB)	-	Gn/Ve
3	CAN - H line (VDB)	-	Ws/Bi
4	CAN - L line (VDB)	-	Gn/Ve
5	Diagnosis K line	72021	2995
6	Negative from the coolant pressure signalling switch	42608	0583
7	Free	-	-
8	Free	-	-
9	Free	-	-
10	CAN - H line (BCB)	-	Ws/Bi
11	Free	-	-
12	CAN - L line (BCB)	-	Gn/Ve

Connector "J3"

Figure 148



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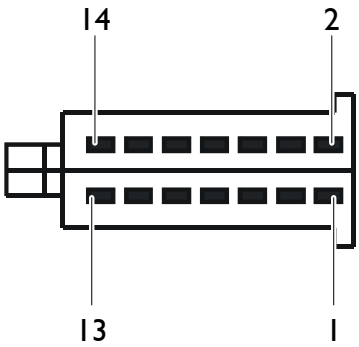
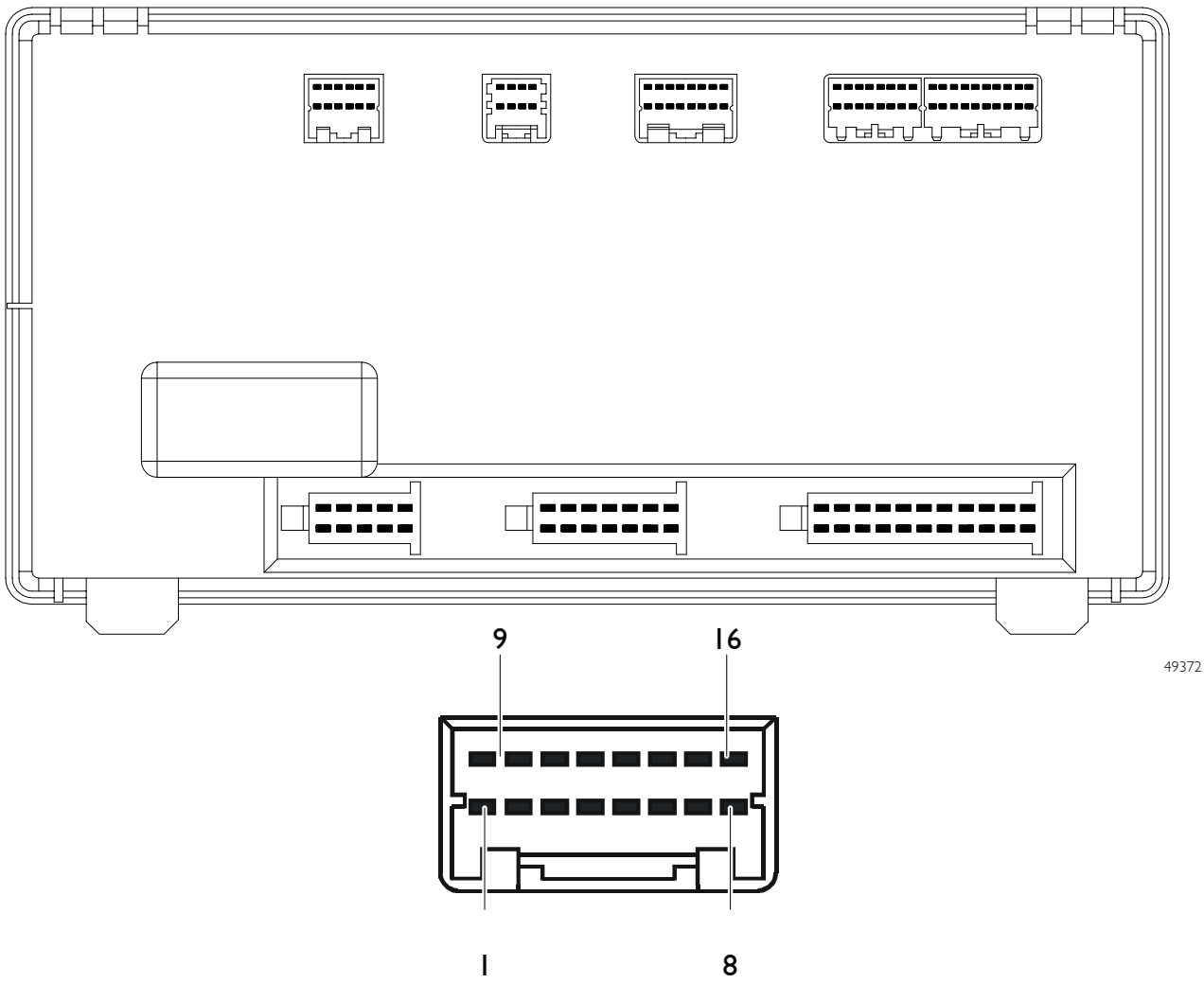


Ref.	Description	Component code	Cable color code
1	Signal from the external light switch	52307	2237
2	Positive for internal light ceiling light fixture	39034	4423
3	Negative from the internal light switch	52326	0941
4	Free	-	-
5	Negative from the external air temperature sensor	42045	0550
6	TGC opening signal (OPT)	25900	8045
7	Free	-	-
8	Positive from the external air temperature sensor	42045	7573
9	Negative from the TGC opening switch (OPT)	53316	0946
10	Positive for pneumatic horn solenoid valve	78203	1133
11	Positive for front clearance lamps	37001	3339
12	Sunroof opening signal (OPT)	12015	7010
13	Rotary lamp signals (OPT)	32010	1115
14	Sunroof closing signal (OPT)	12015	7011

Connector "J4"

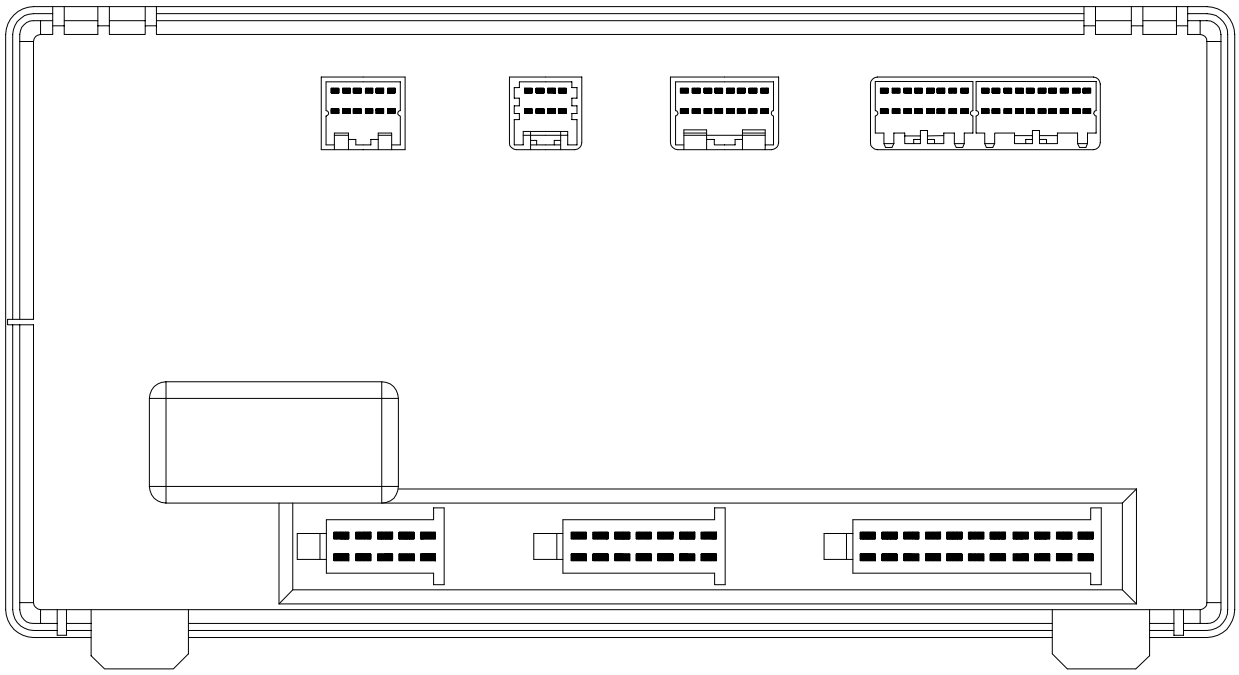
Figure 149



Ref.	Description	Component code	Cable color code
1	Positive for step illumination light fixture	39003	4445
2	Negative from the TGC closing switch (ON)	53316	0945
3	Negative from the exhaust brake presetting switch	52324	0082
4	Free	-	-
5	Auxiliary heater actuation presetting	(ST19/10)	0501
6	Horn control	54033	1116
7	Door closing negative (passenger's side)	85023	0065
8	Door closing negative (driver's side)	85023	0065
9	Positive for starting remote-control switch	25200	8888
10	Negative for the switch for starting from the engine compartment	53006	8892
11	Negative from the engine radiator low fluid level sensor	44036	5527
12	Negative from the engine radiator lacking fluid sensor	44036	5520
13	Auxiliary heater water pump consent	ST9/11	7786
14	Negative from the switch for cabin uncoupled during lowering	53062	0922
15	Door opening negative (passenger's side)	85023	0064
16	Rotary lamp control (OPT)	52035	0901

Connector "J5"

Figure 150



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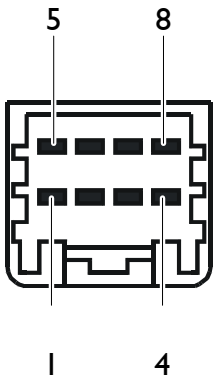
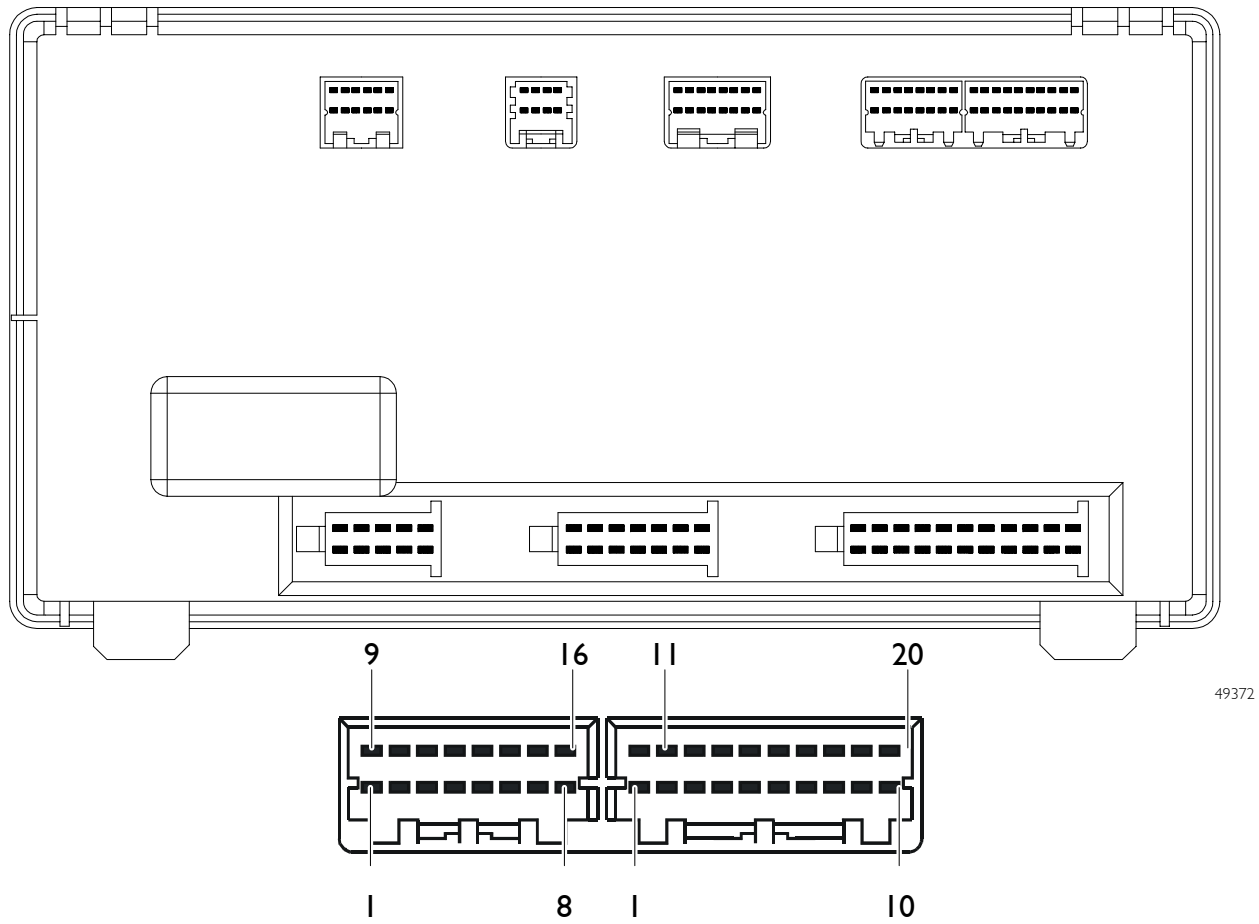


Ref.	Description	Component code	Cable color code
1	Engine start-up signal from diagnosis connector	72021	0900
2	Negative from the handbrake ON switch	42102	6662
3	Negative from the handbrake ON start-prevent switch	53512	8892
4	Control for internal red light	52326	0942
5	Reverse gear signal	ST14 - 10	2268
6	Gearbox idling signal	ST14 - 9	8050
7	Negative from the cabin uncoupled signalling switch	53511	0096
8	Rotary lamp signal (OPT)	32010	1108

Connector "J6A"

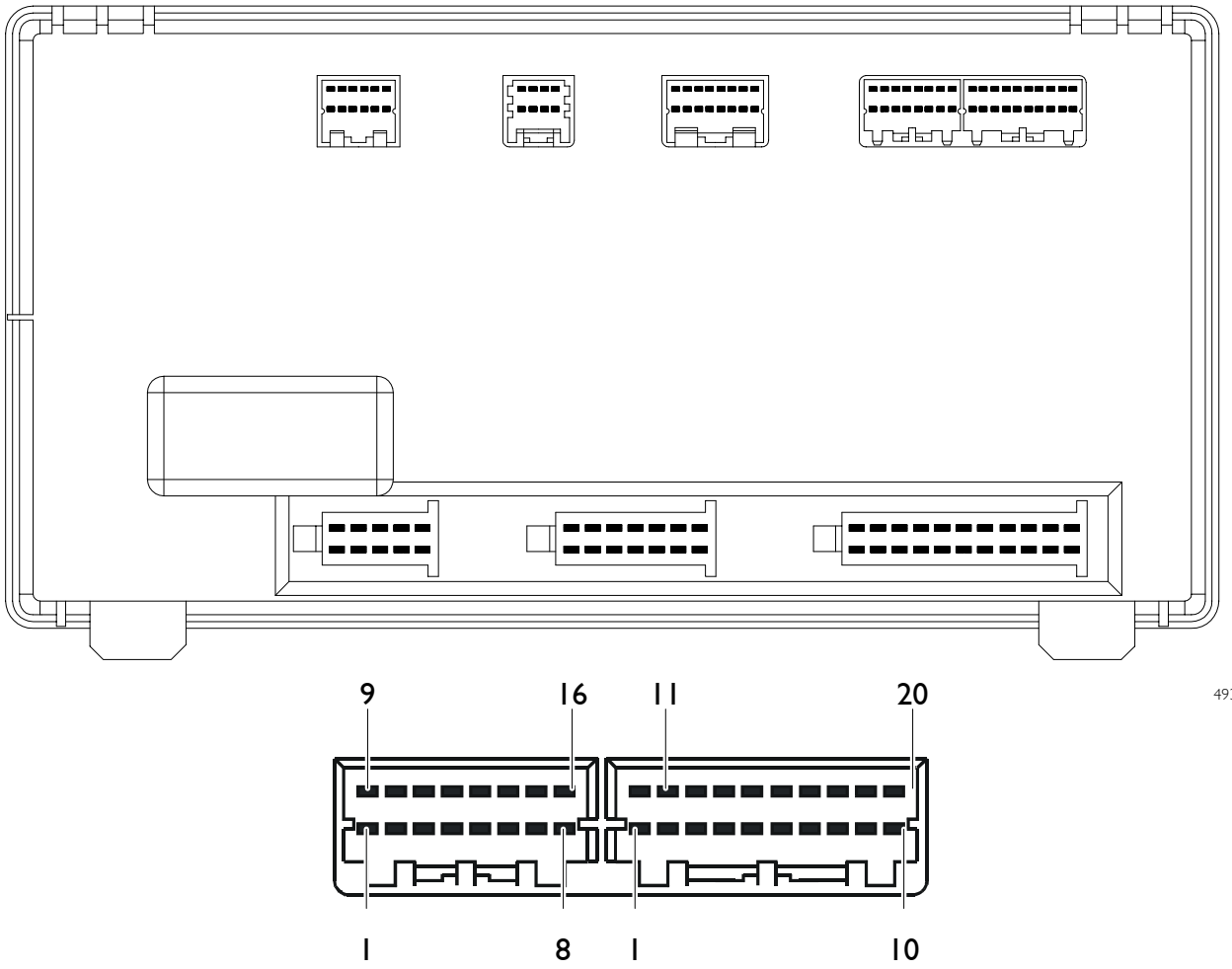
Figure 151



Ref.		Description	Component code	Cable color code
	1	Negative from the sunroof switch (closing)	53306	0971
	2	Negative from the coolant pressure (18 bar) signalling switch	42608	0582
	3	Windscreen heating control negative	52036	-
	4	P.T.O. 2 command signal	ST18-19 (52070)	0132
	5	P.T.O. 3 command signal	ST14-20 (52220)	0123
	6	P.T.O. 1 command signal	ST14-18 (52071)	0131
	7	Chains fitted pressure gauge negative	-	-
	8	Negative from the electric or pneumatic horn switch	52200	1119
A	9	Presetting for signal from the switch used to stop the engine from the cabin (body builders)	ST14-2	0151
	10	Free	-	-
	11	Free	-	-
	12	Free	-	-
	13	Signal from headlamp trim control	52312	9936
	14	Free	-	-
	15	Free	-	-
	16	Free	-	-
	17	Positive for starting remote-control switch (jumper connection with pin J4_9)	25200	8888
	18	Free	-	-
	19	Starting motor remote-control switch control ground (jumper connection with pin J1_9)	25200	0008
	20	Free	-	-

Connector "J6B"

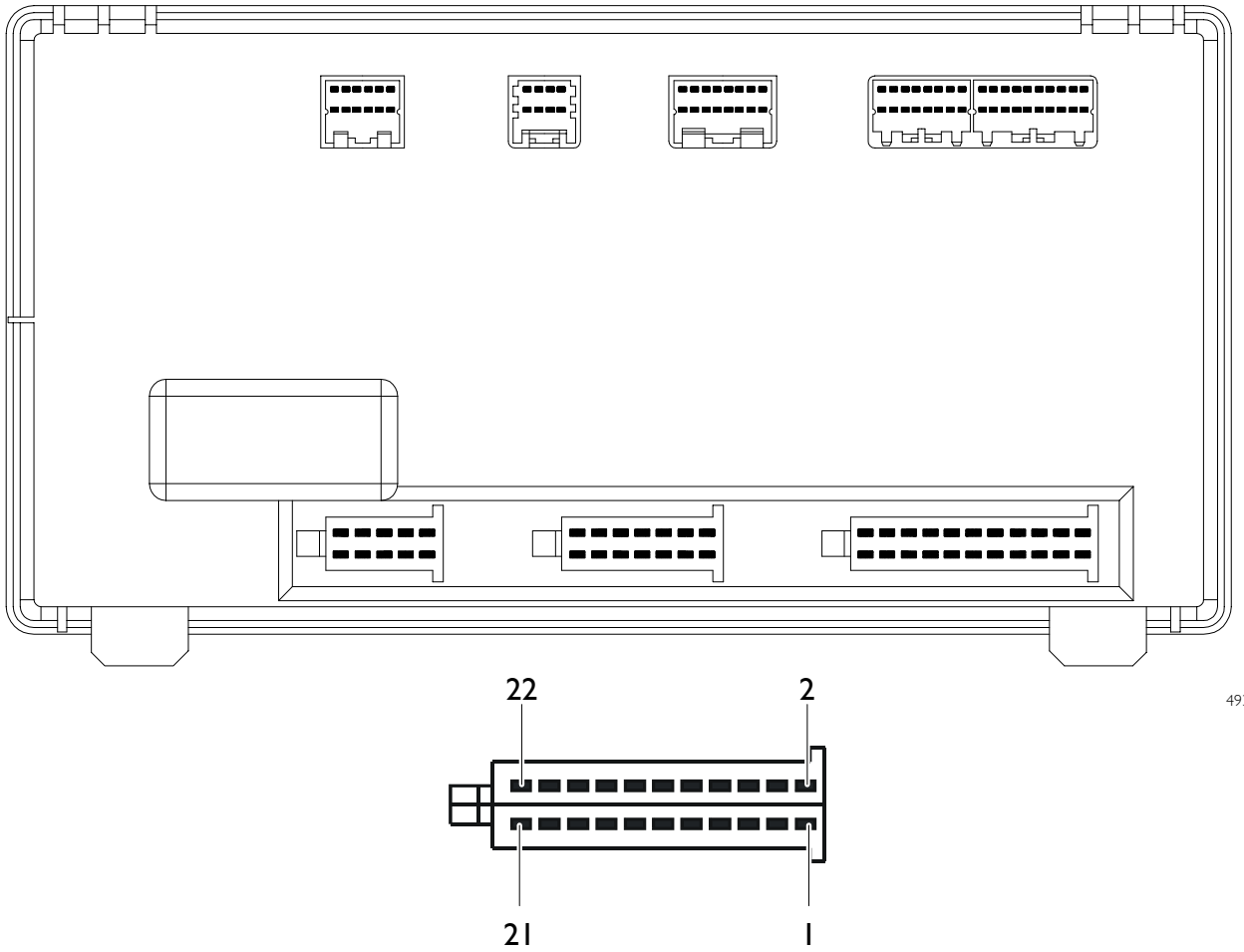
Figure 152



Ref.		Description	Component code	Cable color code
B	1	Presetting for signal for engine start from the cabin (body builders)	ST14-1	8892
	2	Negative from the trailer brake pressure gauge	42108	-
	3	Free	-	-
	4	Free	-	-
	5	Negative from the P.T.O. ON signalling switch	53567	0132
	6	Free	-	-
	7	Free	-	-
	8	Negative from the cabin uncoupling enable switch	53061	8129
	9	Free	-	-
	10	Trailer EBS/ABS failure signal	72006	6671
	11	Free	-	-
	12	Free	-	-
	13	Heated windscreen remote-control switch positive	25818	8020
	14	Free	-	-
	15	Free	-	-
	16	Negative from the sunroof control switch (opening)	53306	0970

Connector "J7"

Figure 153



Ref.	Description	Component code	Cable color code
1	User positive under key (+15)	25213	8802
2	-	-	-
3	Positive (+15) for bodybuilders	ST14 - 11	8871
4	Engine started signal	ST14 - 8	7778
5	Negative from the parking light switch	52307	3333
6	Negative from front fog light switch	52304	2228
7	Free	-	-
8	Negative from rear fog light switch	53315	2284
9	Positive 30-pole	72021	8802
10	Negative from circle light switch	52009	2224
11	Negative for operator side door opening	85023	0064
12	Negative from supplementary light switch	52024	2229
13	Negative from the passenger's side door switch	53509	0003
14	Negative from key switch (15)	52502	0987
15	Negative from the driver's side door switch	53509	0003
16	Positive from windshield wiper unit	65000	8880
17	Negative from emergency light control switch	52302	1113
18	Negative from key switch (50)	52502	0900
19	Positive for instrument lighting	-	4442
20	Positive from windshield wiper unit	65000	8873
21	Positive for windshield wiper unit (low speed)	65000	8882
22	Positive for windshield wiper unit (high speed)	65000	8881

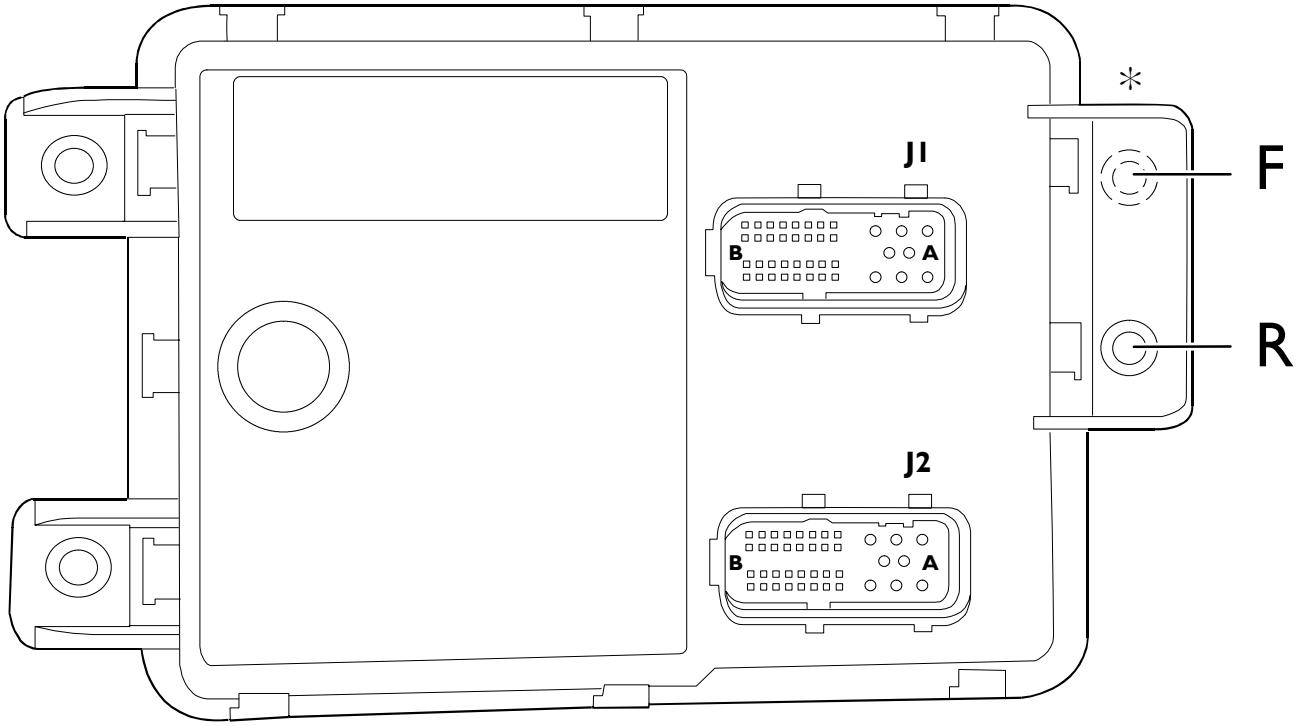
F.F.C. - R.F.C. (Front Frame Computer - Rear Frame Computer)

These are Peripheral Electronic Units used to pilot most electrical utilities.
They can be connected directly to loads such as lights, sensors and electrical motors.

The F.F.C. is located on the vehicle front below the cab and the R.F.C. is located in the frame center.

They differ by a code (F for Front and R for Rear) and a different assembly hole (*).

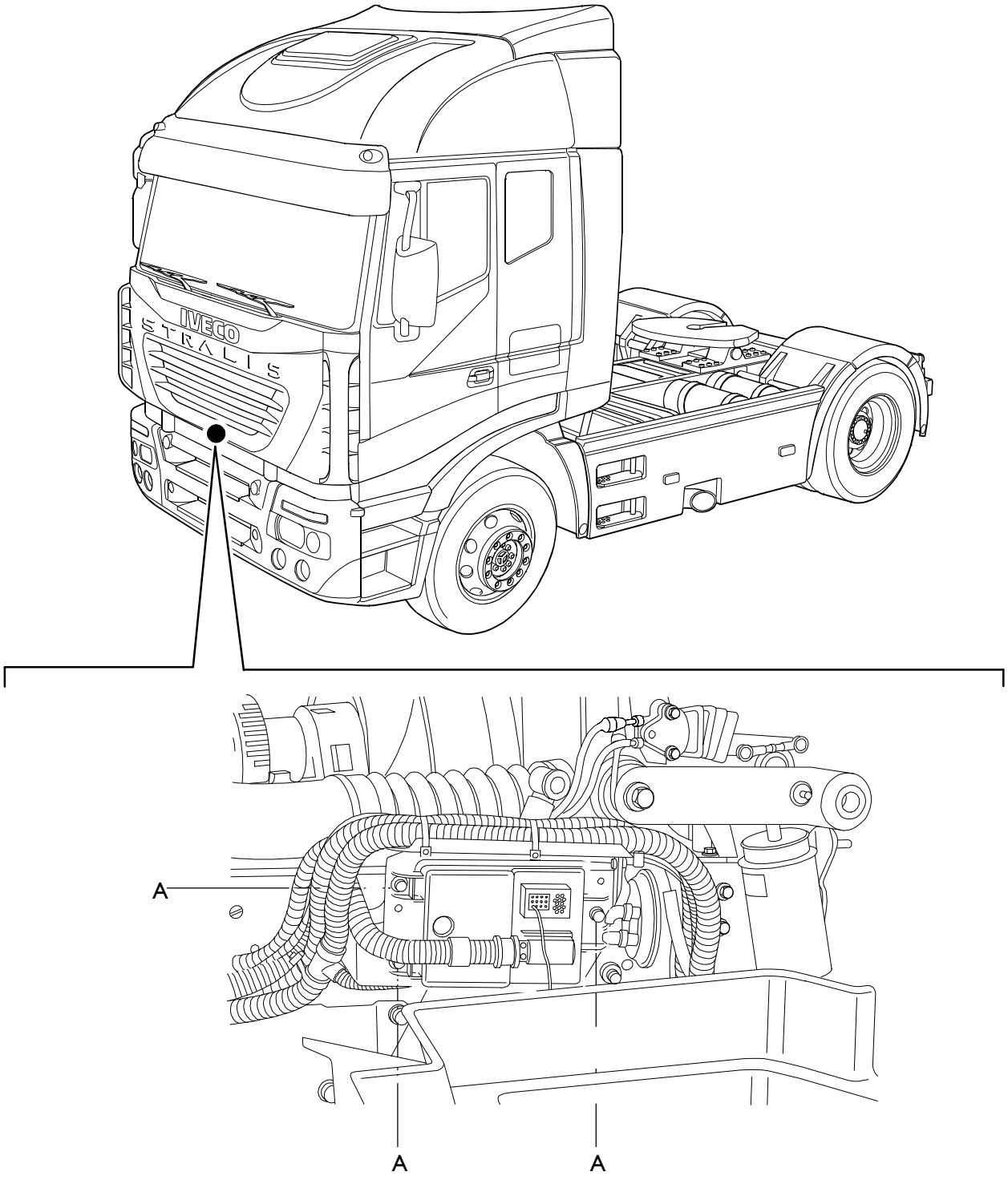
Figure 154



73660

F.F.C. (Services / Engine)

Figure 155

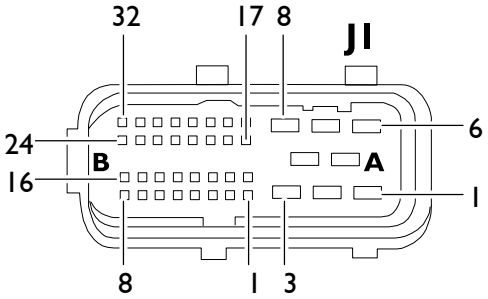


Located on the right frame beam in the vehicle front under the cab. Proceed as follows to remove the electronic center:

- overturn the cabin
- unscrew the three control unit (A) supporting screws;
- disconnect the two connectors without removing cables from the connector seat.

F.F.C. (Services / Engine)
Connector "J1"

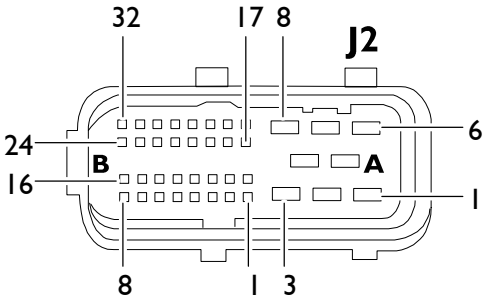
Figure 156



Ref.	Description	Component code	Cable colour code
1	Positive for right low-beam headlight	30001	2223
2	Positive for right high-beam headlight	30001	2221
3	Positive for headlamp washer pump	66005	8821
A 4	Free	-	-
5	Positive for left high-beam headlight	30001	2219
6	Positive for auxiliary lamp high-beam headlights	30010	2229
7	Positive for front fog lights	30011	2228
8	Positive for left low-beam headlight	30001	2231
1	Free	-	-
2	Positive for headlamp trim actuator	30100	9937
3	Free	-	-
4	Free	-	-
5	Free	-	-
6	Free	-	-
7	Positive for front and right-side indicator lights	32002-33001	1123
8	Positive for windscreen washer electric pump	64000	8886
9	Free	-	-
10	Free	-	-
11	Free	-	-
12	Free	-	-
13	Free	-	-
14	Free	-	-
15	Signal for headlamp trim actuator	30100	9936
B 16	Positive for front right dimmer	30001	3330
17	Free	-	-
18	Negative for headlamp trim actuator	30100	9935
19	Free	-	-
20	Free	-	-
21	Free	-	-
22	Free	-	-
23	Free	-	-
24	Positive for front and left-side indicator lights	32002- 33001	1129
25	Free	-	-
26	Free	-	-
27	Free	-	-
28	Free	-	-
29	Free	-	-
30	Free	-	-
31	-	-	-
32	Positive for front left dimmers	30001	3339

Connector "J2"

Figure 157

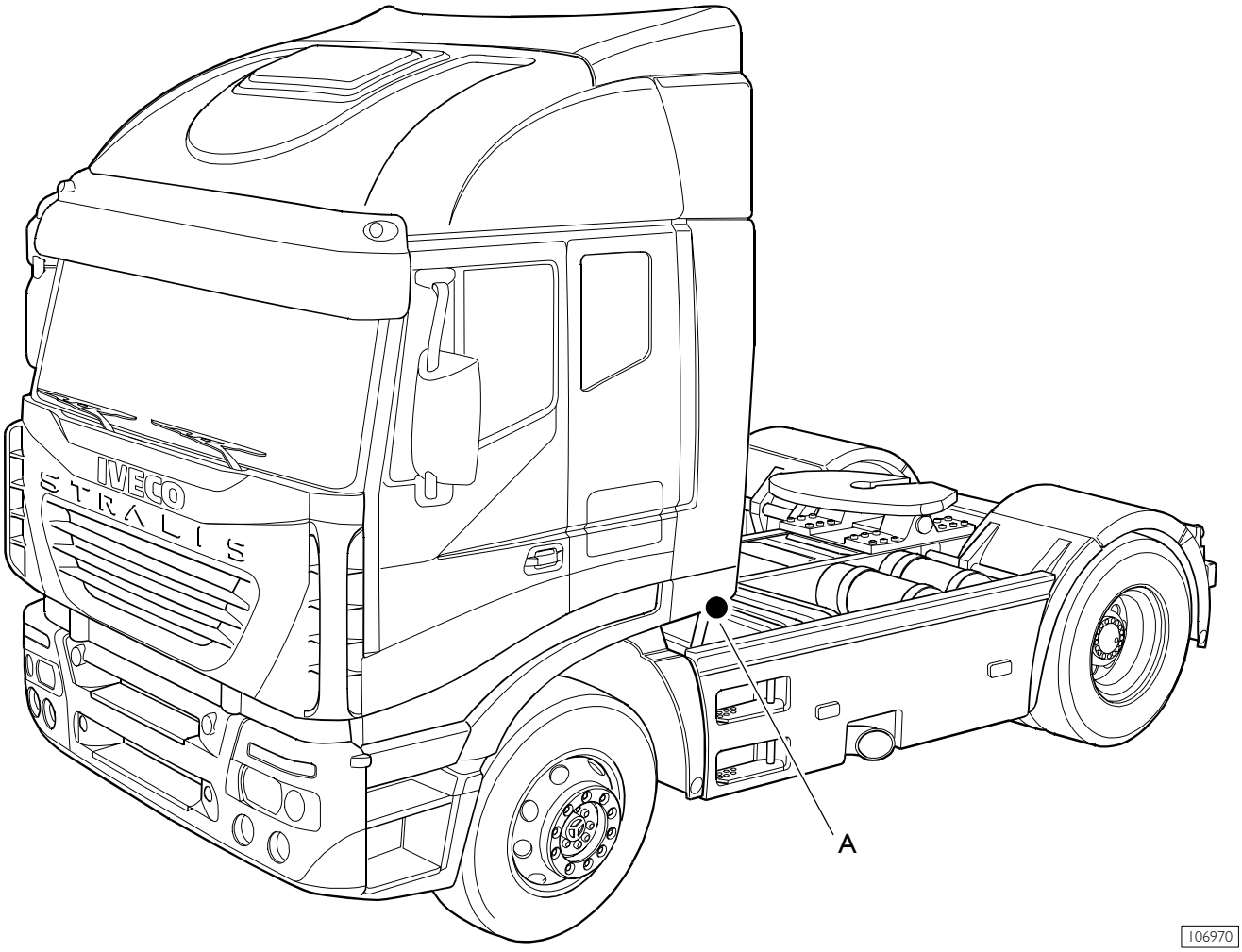


Ref.	Description	Component code	Cable colour code
1	Positive from the light power supply fuse (left side)	70000	7904
2	Positive from the light power supply fuse (left side)	70000	7904
3	Positive from the light power supply fuse (right side)	70000	7903
A 4	Positive from the light power supply fuse (left side)	70000	7904
5	Positive from the light power supply fuse (left side)	70000	7903
6	Positive for motor fan speed 2 electromagnet	47043	5166
7	Chassis ground	-	0000
8	Positive from the light power supply fuse (right side)	70000	7903
1	CAN - H line (BCB)	-	Ws/Bi
2	CAN - L line (BCB)	-	Gn/Ve
3	CAN - H line (BCB)	-	Ws/Bi
4	CAN - L line (BCB)	-	Gn/Ve
5	Free	-	-
6	Free	-	-
7	Negative from the key switch	52502	0987
8	Positive for engine oil level sensor	44043	5506
9	Free	-	-
10	Free	-	-
11	Negative from the fuel filter clogging signalling switch	42700	5531
12	Chassis ground	-	0000
13	Free	-	-
14	Free	-	-
15	Free	-	-
B 16	Free	-	-
17	Positive for +15 power supply (body builders)	-	8871
18	Negative from the front shoe wear signalling sensor	86002	6664
19	Negative from the engine stop switch (from the engine compartment)	53007	0151
20	Negative from the oil filter clogging switch	42551	6618
21	Free	-	-
22	Free	-	-
23	Negative from the indicator power assisted steering low fluid level	44037	5525
24	Signal from alternator (L)	03000	7009
25	Positive for engine fan (speed 1) solenoid valve	78016	9166
26	Horn positive	22000	1116
27	Free	-	-
28	Free	-	-
29	Negative from the front differential locking sensor	53504	-
30	Negative from speed 1 engine compartment start switch	53006	8892
31	Free	-	-
32	Positive from the engine oil pressure sensor	44043	5505

R.F.C.

Located in the vehicle center on the right side. Follow the F.F.C. center instructions for removal.

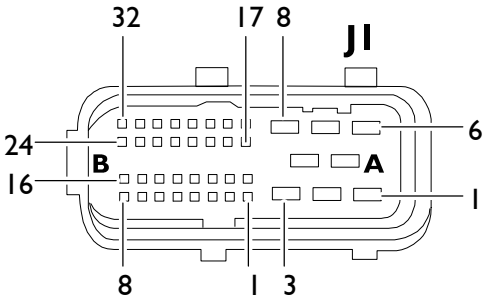
Figure 158



A. R.F.C. electronic center

R.F.C. (chassis) Connector "J1"

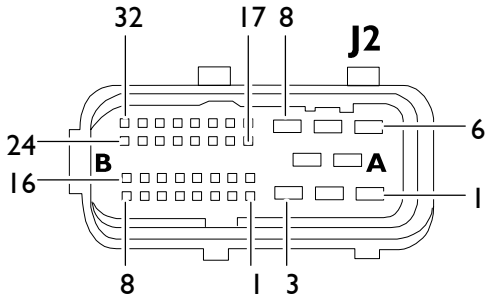
Figure 159



Ref.	Description	Component code	Cable colour code
1	Free	-	-
2	Power supply positive	-	8871
3	Positive for trailer / right side clearance light	33004	3330
A 4	Positive for trailer / left side clearance light	33004	3339
5	Free	-	-
6	Positive for trailer brake lights	72010	1179
7	Positive for trailer reversing lights	72010	2226
8	Positive for the solenoid valves actuating the full P.T.O. on the gearbox	78208	9954
1	Free	-	-
2	Free	-	-
3	Negative of switch for transmission in neutral position	53508	8050
4	Negative of switch for lighting reverse gear lights	53503	2268
5	Negative of switch for signalling reduced speed-gear engaged	53507	9992
6	Negative of switch for signalling clogged air filter	42351	6663
7	Positive for the trailer right direction light	72010	1185
8	Free	-	-
9	Front sensor air pressure signal (APU)	-	5562
10	Rear sensor air pressure signal (APU)	-	5561
11	Negative of the switch signalling trailer braking circuit failure	42111	6689
12	Negative from switch integral traction engaged	53506	-
13	Positive for brakes pressure sensors and shoes wear	61104	5560
14	Positive from fuel level sensor	44031	5557
15	Free	-	-
B 16	Positive for light illuminating the fifth wheel	34011	2224
17	Return from fuel level sensor	44031	5555
18	Free	-	-
19	Free	-	-
20	Free	-	-
21	Free	-	-
22	Free	-	-
23	Free	-	-
24	Positive for the trailer left direction light	72010	1180
25	Free	-	-
26	Free	-	-
27	Free	-	-
28	Free	-	-
29	Free	-	-
30	Signal from the sensor signalling water in Diesel oil filter	86013	5530
31	Negative from the switch signalling rear P.T.O. engaged	53568	0131
32	Positive for trailer rear fog-lights	72010	2283

R.F.C.
Connector "J2"

Figure 160

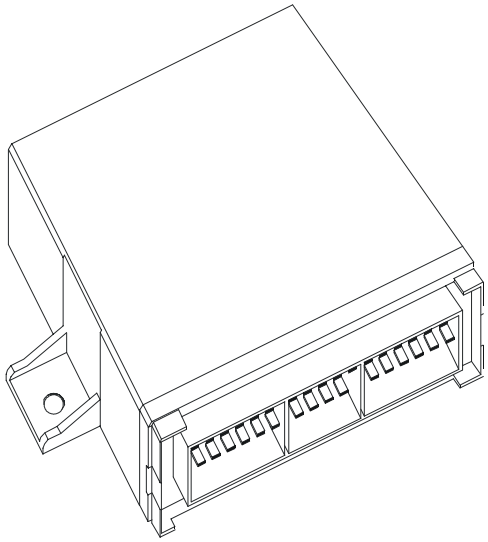


Ref.	Description	Component code	Cable colour code
1	Positive from the light power supply fuse (left side)	70000	7902
2	Positive from the light power supply fuse (left side)	70000	7902
3	Positive from the light power supply fuse (right side)	70000	7901
A 4	Positive from the power supply fuse (left side)	70000	7902
5	Positive from the power supply fuse (right side)	70000	7901
6	Positive for external lights (body builders)	ST 52/3	3333
7	Chassis ground	-	0000
8	Positive from the power supply fuse (right side)	70000	7901
1	CAN - H line (BCB)	-	Ws/Bi
2	CAN - L line (BCB)	-	Gn/Ve
3	Free	-	Ws/Bi
4	Free	-	Gn/Ve
5	Positive for the rear left indicator lights	34000	1120
6	K line (diagnosis connector)	72021	2999
7	Negative from the key switch	-	0987
8	Positive for left brake lights	34000	1175
9	Free	-	-
10	Positive for rear fog lamps	34000	2283
11	Signal for second speed limiter	ST 52/4	0172
12	Negative from the 3rd axis shoe wear signalling sensor	86003	6664
13	Positive for right brake light	34000	1175
14	Positive for rear right dimmer	34000	1125
15	Positive for rear right clearance light	34000	3307
B 16	Positive for right parking indicator light	34000	3315
17	Free	-	-
18	Negative from the pneumatic suspension failure pressure switch	42200	-
19	Negative from the longitudinal differential lock ON signalling switch	53521	6603
20	Negative from the 2nd rear axle shoe wear signalling sensor	86003	6667
21	Free	-	-
22	Signal from the 3rd axis wheel pad wear signalling sensor (left)	88011	6037
23	Negative from the transverse differential lock switch	53801	0041
24	Signal from the 3rd axis wheel pad wear sensor (right)	88011	6035
25	Positive for differential unlock solenoid valve with ABS	-	-
26	Positive for reverse gear light	34000	2226
27	Positive for rear left clearance light	34000	3306
28	Positive for rear left parking light	34000	3305
29	Negative from the 3rd steering axle hydraulic circuit failure signalling switch	53591	0491
30	Negative from the transverse differential lock signalling switch	53801	0040
31	Free	-	
32	Free	-	

D.D.M. / P.D.M. / Cab module

The three centers are identical.
The D.D.M. is located inside the operator door; the P.D.M. inside the passenger door and the CABIN MODULE is in the center bay on the right under-instrument panel (together with the ABS and ECAS).

Figure 161



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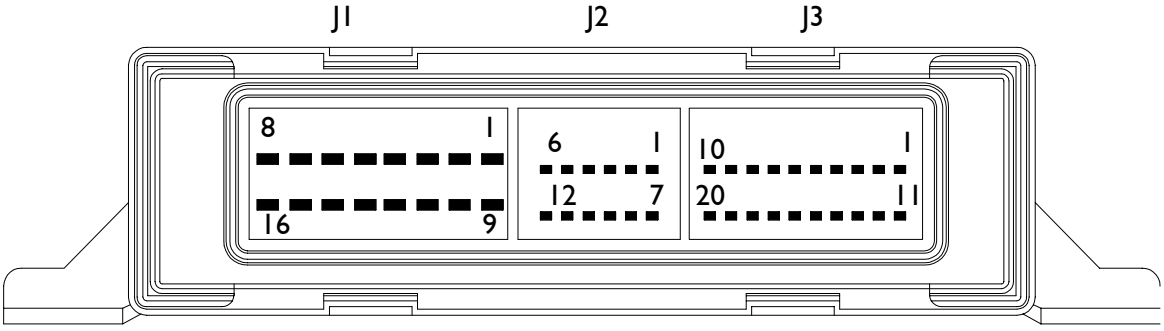


49723

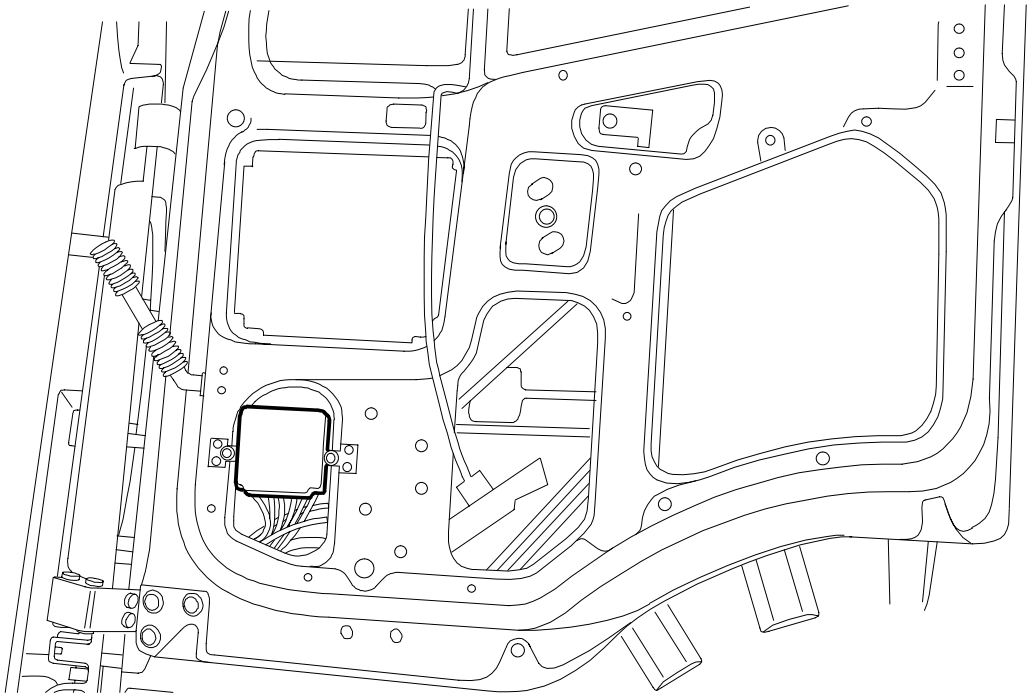
II CAB MODULE manages functions related to the operator cab.

Inputs	Outputs
Rearview mirror heating	Rearview mirror heating
Rearview mirror adjustment	Rearview mirror adjustment
Window lifter	Window lifter
Centralized lock	Centralized lock

The only difference between D.D.M. and P.D.M. is that the P.D.M. pin J2/10 is connected by means of a jumper with pin J1/8 towards the earth for passenger module recognition.

D.D.M. / P.D.M.

Figure 162



49838

These centers manage all the functions appertaining to the two vehicle doors, namely:

- mirror heating
- mirror adjustment
- window lifter
- centralized lock.

They are located inside the vehicle door and removal is as follows:

1. remove the door lining;
2. disassemble the loudspeaker tray by removing the three fastening screws;
3. take DM off the tray by removing the two fastening screws
4. disconnect the three electric connection adapters.

Disassembling operations are the same for both doors.

P.D.M.

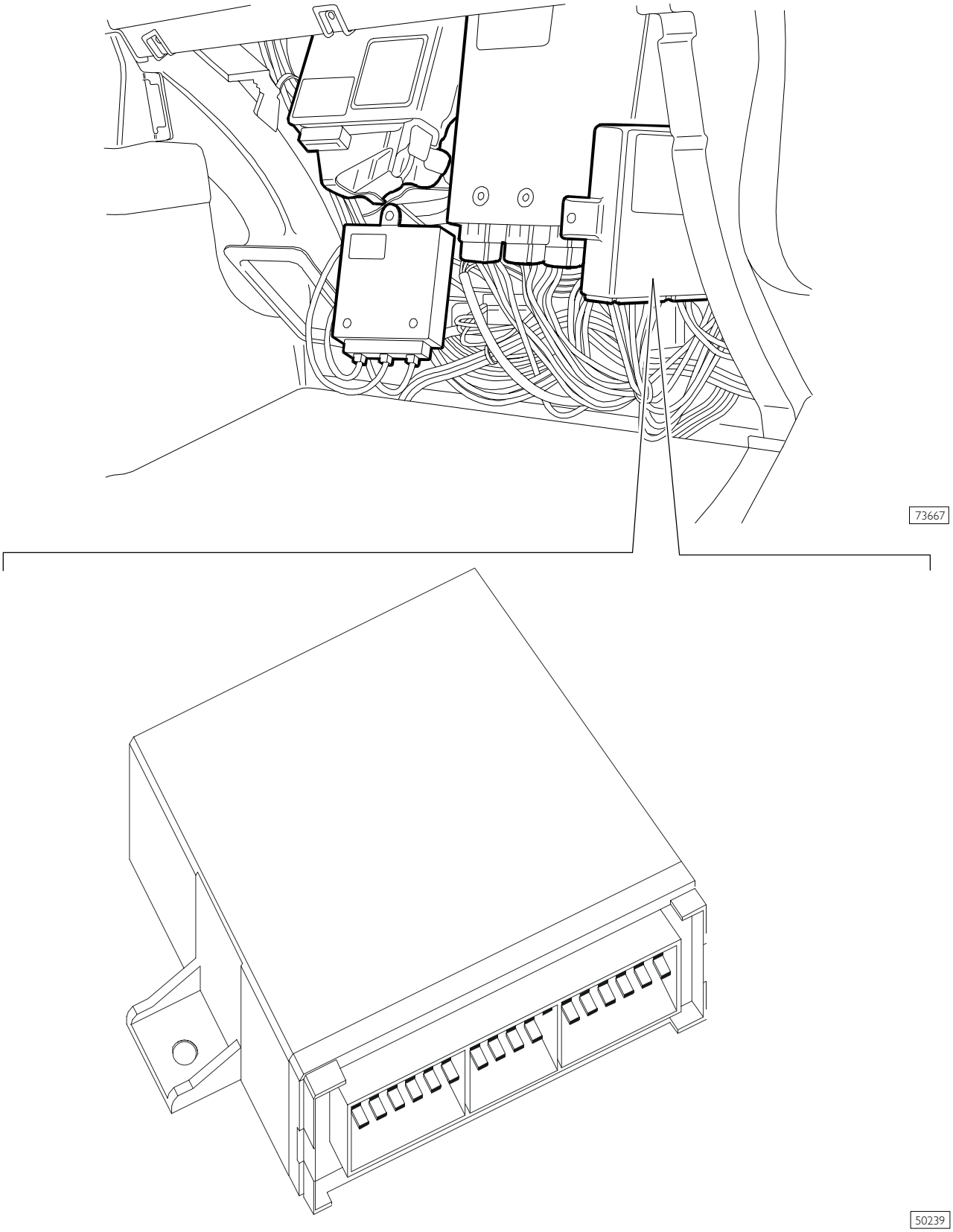
CONNECTOR J1		
Pin	Cable	Function
1	8830	Positive for main rear view mirror heating
2	8830	Positive for wide-angle rear view mirror heating
3	-	-
4	9965	Centralized lock motor control (CDL)
5	9964	Centralized lock motor control (CDL)
6	8863	Window lifter motor control (opening)
7	8865	Window lifter motor control (closing)
8	0000	Mass - Bridge with (J2-10) for module recognition
9	-	Free
10	-	Free
11	0000	Negative for centralized door lock release push button
12	0000	Negative for main rearview mirror heating
13	0000	Negative for wide angle rearview mirror heating
14	-	-
15	2990	K line for diagnosis
16	7990	Center power positive
CONNECTOR J2		
Pin	Cable	Function
1	Ws/Bi	CAN H line (BCB)
2	-	Free
3	-	Free
4	8851	Wide angle rearview mirror control (return)
5	8852	Wide angle rearview mirror control (vertical)
6	8857	Main rearview mirror control (return)
7	Gv/Ve	CAN L line (BCB)
8	8853	Wide angle rearview mirror control (horizontal)
9	-	Free
10	0000	Mass - Bridge with (J1-8) for passenger side ECU recognition
11	8859	Main rearview mirror control (horizontal)
12	8858	Main rearview mirror control (vertical)
CONNECTOR J3		
Pin	Cable	Function
1	0962	Negative from passenger side glass lifter push button
2 ÷ 9	-	Free
10	4442	Positive for passenger side glass lifter push button light
11	0961	Negative from passenger side glass lower push button
12	0960	Negative for passenger side glass control push button + lighting
13 ÷ 20	-	Free

D.D.M.

CONNECTOR J1		
Pin	Cable	Function
1	8830	Positive for main rear view mirror heating
2	8830	Positive for wide-angle rear view mirror heating
3	8830	Positive for front rear view mirror heating
4	9965	Centralized door lock motor control
5	9964	Centralized door lock motor control
6	8863	Window lifter motor control
7	8865	Window lifter motor control
8	0000	Control unit earth
9	-	Free
10	-	Free
11	0000	Negative for Centralized door lock
12	0000	Negative for main rearview mirror heating
13	-	Free
14	-	Free
15	2991	K line for diagnosis
16	7991	Positive for center power
CONNETOR J2		
Pin	Cable	Function
1	Ws/Bi	CAN H line (BCB)
2	-	Free
3	-	Free
4	-	Free
5	-	Free
6	8806	Main rearview mirror control (return)
7	Gv/Ve	CAN L line (BCB)
8	8843	Wide angle rearview mirror control (horizontal)
9	-	Free
10	-	Free
11	8809	Main rearview mirror control (horizontal)
12	8808	Main rearview mirror control (vertical)
CONNECTOR J3		
Pin	Cable	Function
1	0962	Negative from passenger side window lifter push button
2	0966	Negative from passenger side window lower push button
3	0967	Negative from operator side window lifter push button
4	-	Free
5	-	Free
6	0953	Negative from right rearview mirror control push button (movement to the right)
7	0954	Negative from left rearview mirror control push button (movement to the left)
8	0951	Negative from right rearview mirror control push button (movement downwards)
9	0952	Negative from left rearview mirror control push button (movement upwards)
10	4442	Positive for passenger/operator side window push button lighting
11	0961	Negative from passenger side window lower push button
12	0960	Negative for passenger side window control push button + lighting
13	0951	Negative for operator side window control push button + lighting
14	-	Free
15	0950	Negative for rearview mirror control joystick push buttons
16	0600	Negative for rearview mirror control joystick push button lighting
17	-	Free
18	-	Free
19	4442	Positive for rearview mirror control joystick push button lighting
20	-	Free

C.B. (Cab module) Opt

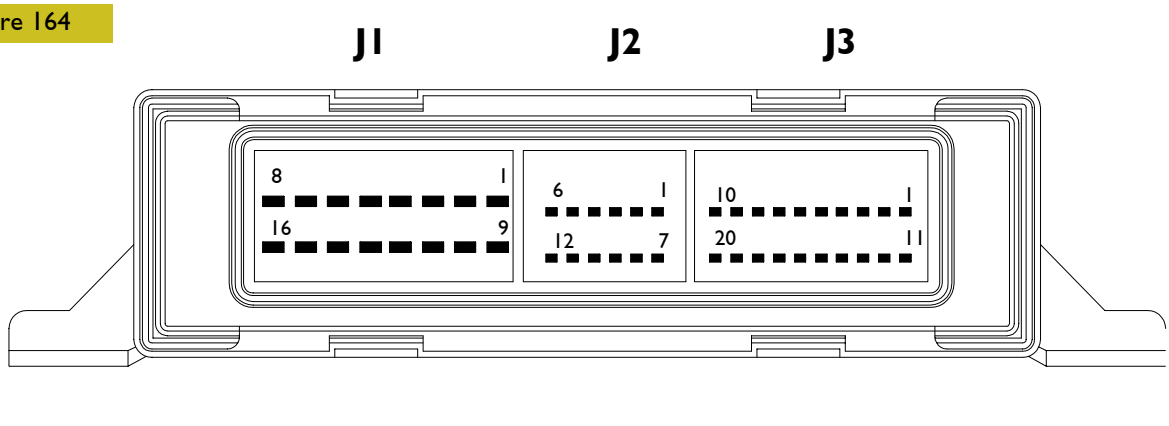
Figure 163



A. Location on the vehicle

Connectors

Figure 164

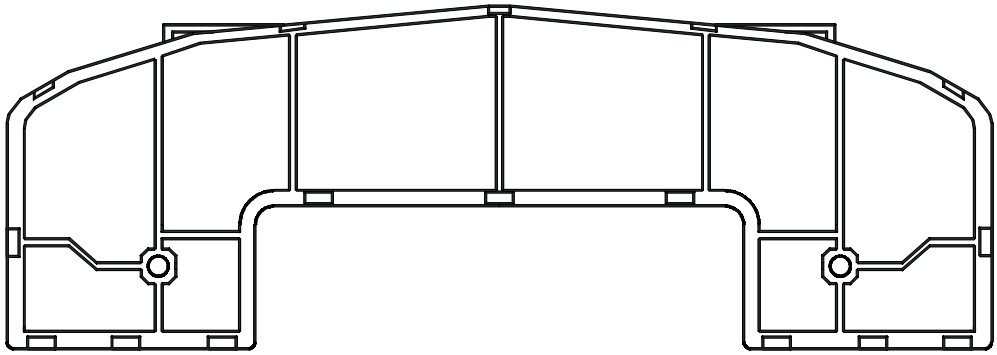


CONNECTOR J1		
Pin	Cable	Function
1 - 2 - 3	4442	Red roof lamps
4	8064	Sun curtain motor
5	8063	Sun curtain motor
6	8886	Wiper pump
7	8821	Light wiper pump
8	0000	Mass
9 ÷ 14	-	Free
15	2993	K line
16	7993	Power
CONNECTOR J2		
Pin	Cable	Function
1	-	CAN H line (BCB)
2 ÷ 4	-	Free
5	6656	ST 14 - 5 (handbrake signal for body builders)
6	1165	ST 14 - 3 (brake pedal pressed signal for body builders
7	-	CAN L line (BCB)
8 ÷ 11	-	Free
12	5515	ST 14 - 4 (stationary vehicle signal for body builders)
CONNECTOR J3		
Pin	Cable	Function
1 ÷ 2	-	Free
3	5521	Wiper fluid level sensor
4 ÷ 5	-	Free
6	0974	Sun curtain position
7	0972	Sun curtain (descent) control
8	0973	Sun curtain (rise) control
9 ÷ 20	-	Free

S.W.I. (Steering wheel / steervator interface)

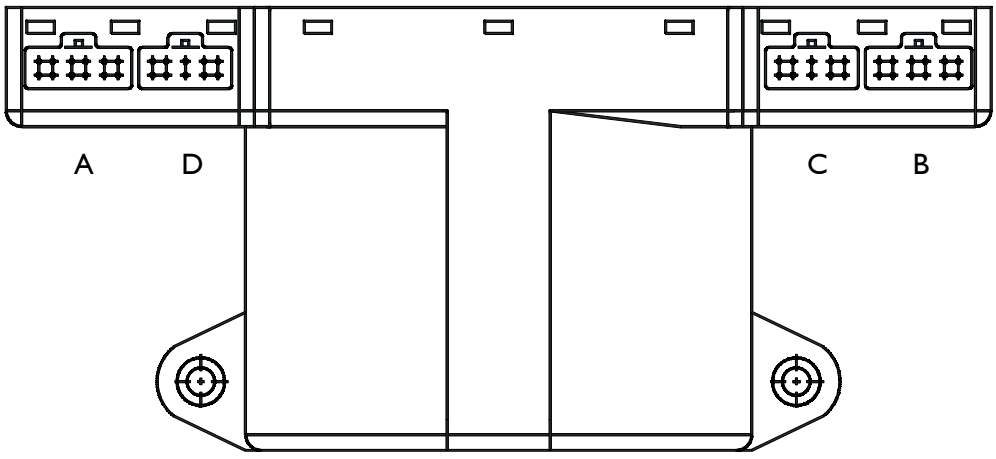
The function of this electronic center located on the steering column is to group together all controls from the two steervator levers and the steering wheel.
It is connected to the vehicle electronic system via a CAN line.

Figure 165



UPPER VIEW

Figure 166

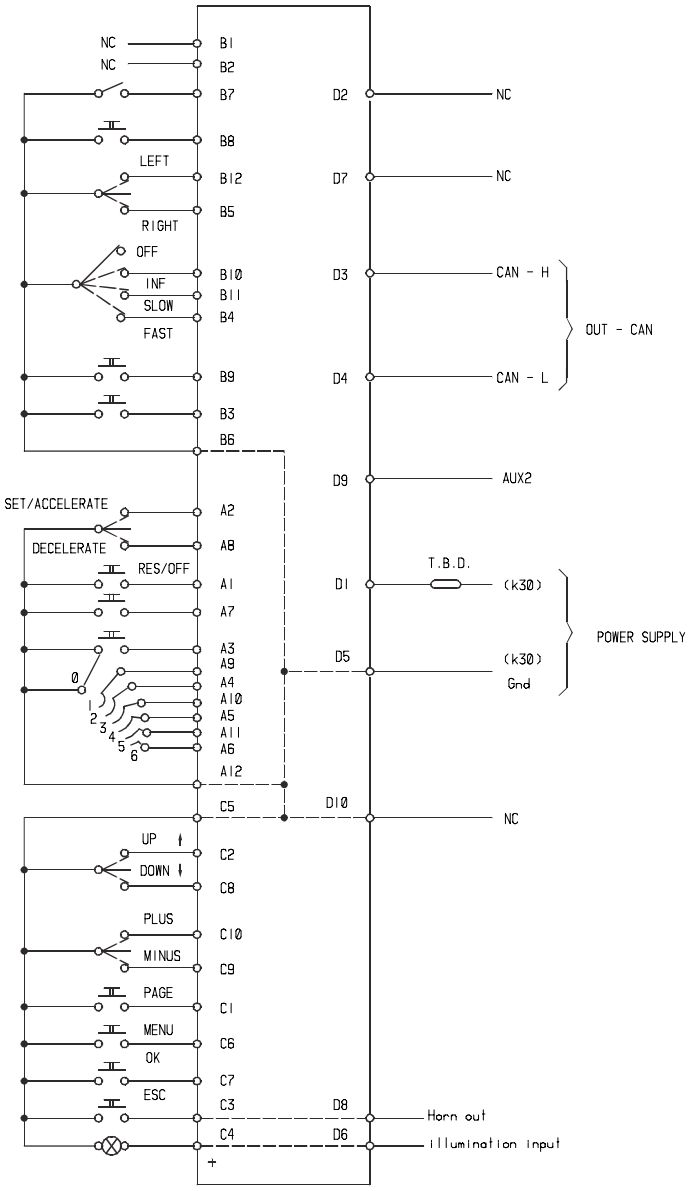


FRONT VIEW

50240

SWI functions

Figure 167



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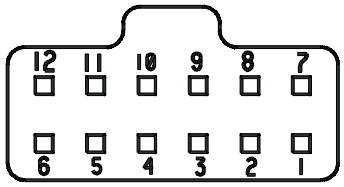
Inputs	Outputs
Key switch	Messages on CAN line
Cruise Control keys	
INTARDER lever	
Change gear	
Flood/dipped lights	
Direction indicators	
Windshield wiper	
Controls on steering wheel	
Control lighting	

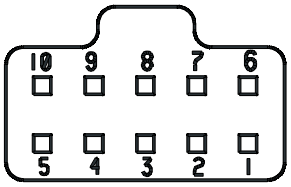
Connectors

Figure 168



A / B

C / D



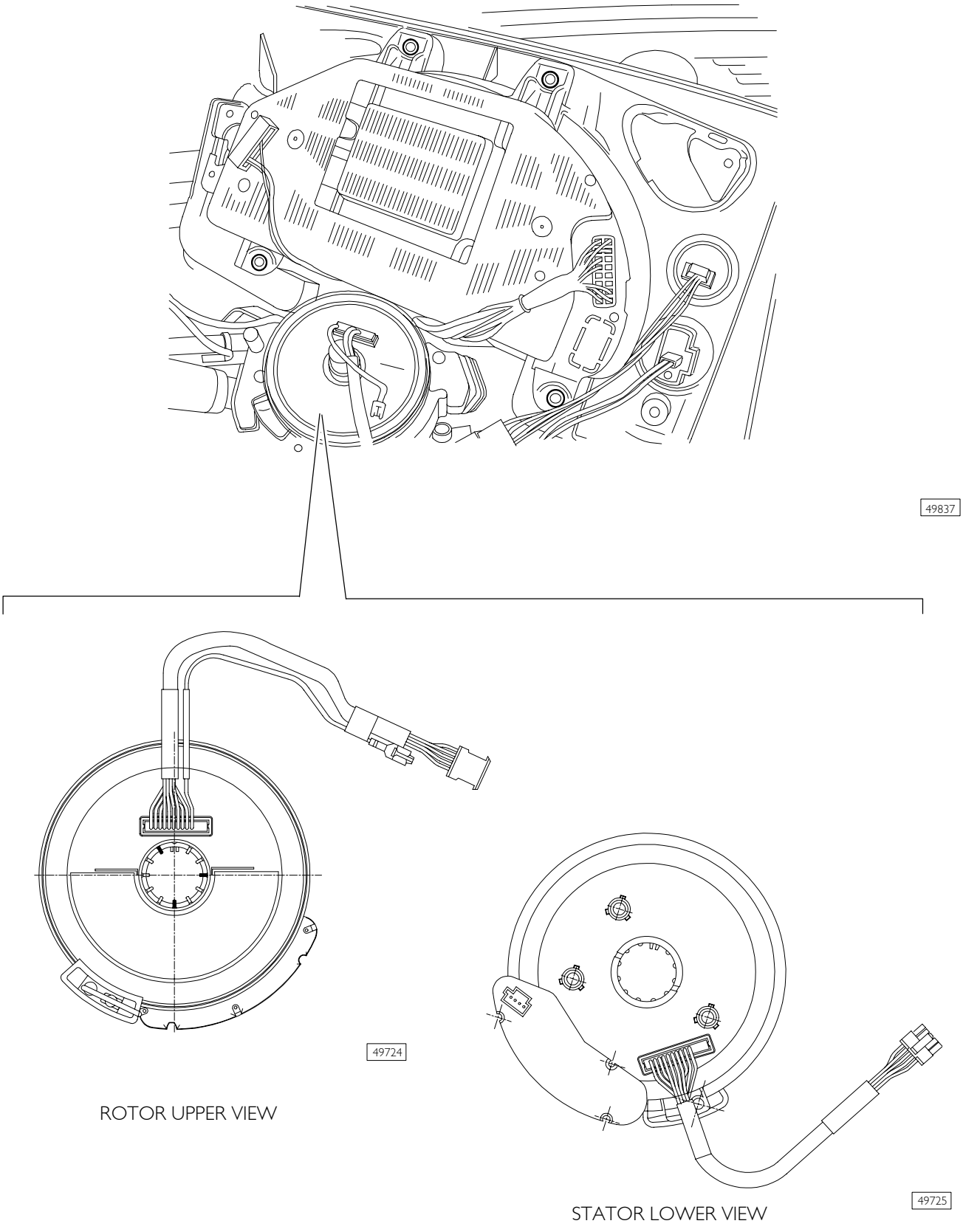
50240

A – Right lever		B – Left lever		C – Steering wheel		D	
1	Cruise Control (Resume)	1	-	1	Display page selection	1	+ 30
2	Cruise Control (Set/Acc.)	2	-	2	Display cursor movement (high)	2	-
3	Change gear (down)	3	Wiper electro pump controls	3	Horn	3	CAN H
4	Intarder (pos.2)	4	Wiper (top speed)	4	Lever lighting (output)	4	CAN L
5	Intarder (pos.4)	5	Direction indicators (right)	5	Mass	5	Mass
6	Intarder (pos.6)	6	Mass	6	Menu selection / confirmation	6	Lever lighting (input)
7	Change gear (up)	7	Flood lights on	7	Main display return (instruments)	7	-
8	Cruise Control (deceler.)	8	Light flashes	8	Display cursor movement (low)	8	Horn (output)
9	Intarder (pos.1)	9	Wiper (one stroke)	9	Control (-)	9	AUX 2
10	Intarder (pos.3)	10	Wiper (intermittent)	10	Control (+)	10	Mass
11	Intarder (pos.5)	11	Wiper (low speed)				
12	Mass	12	Direction indicators (left)				

SPIRALED CONTACT

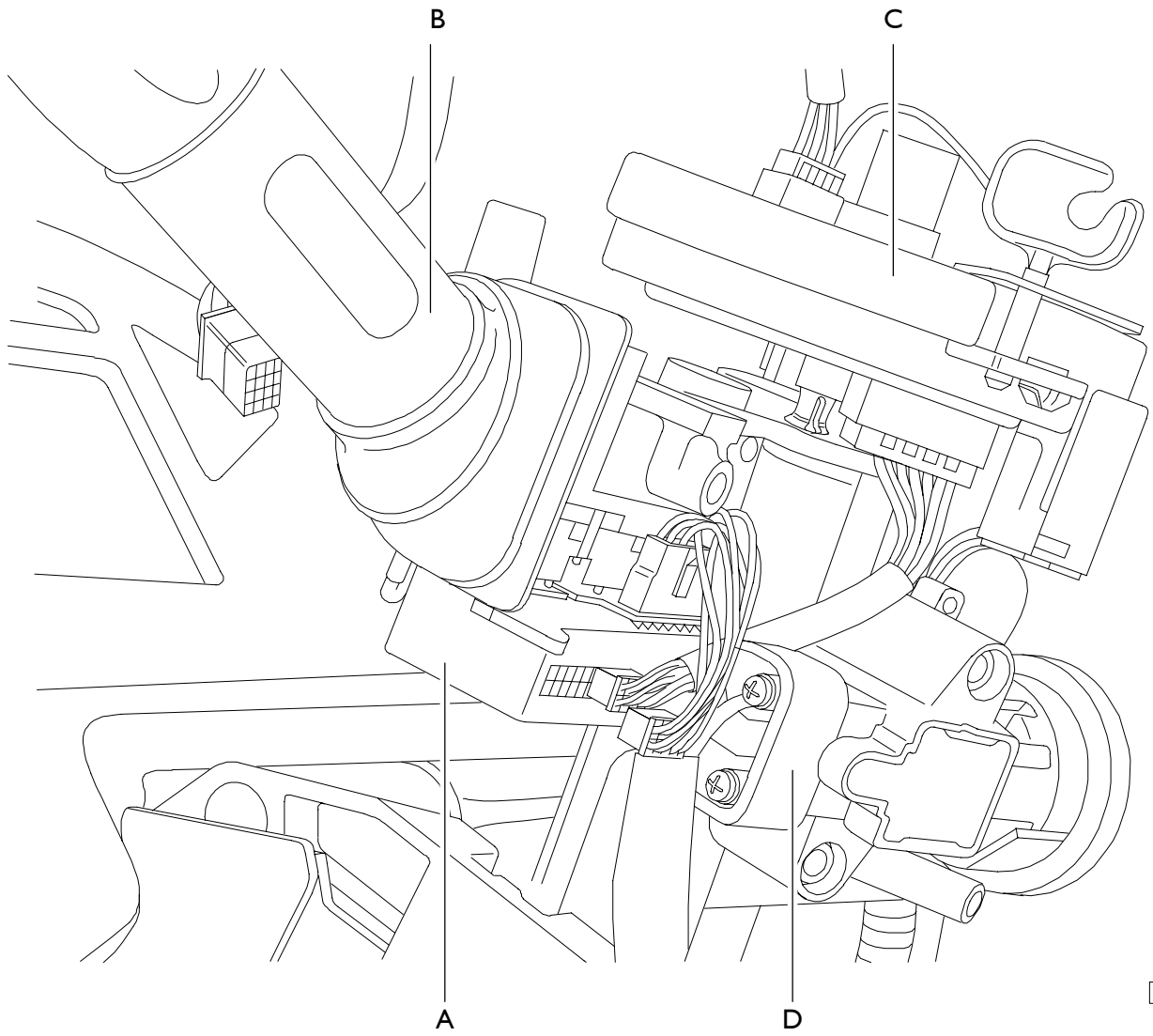
Located below the steering wheel.
Its function is to collect all controls present on the steering wheel and send them to the SWI center.

Figure 169



STEERING COLUMN (COMPONENT LOCATION)

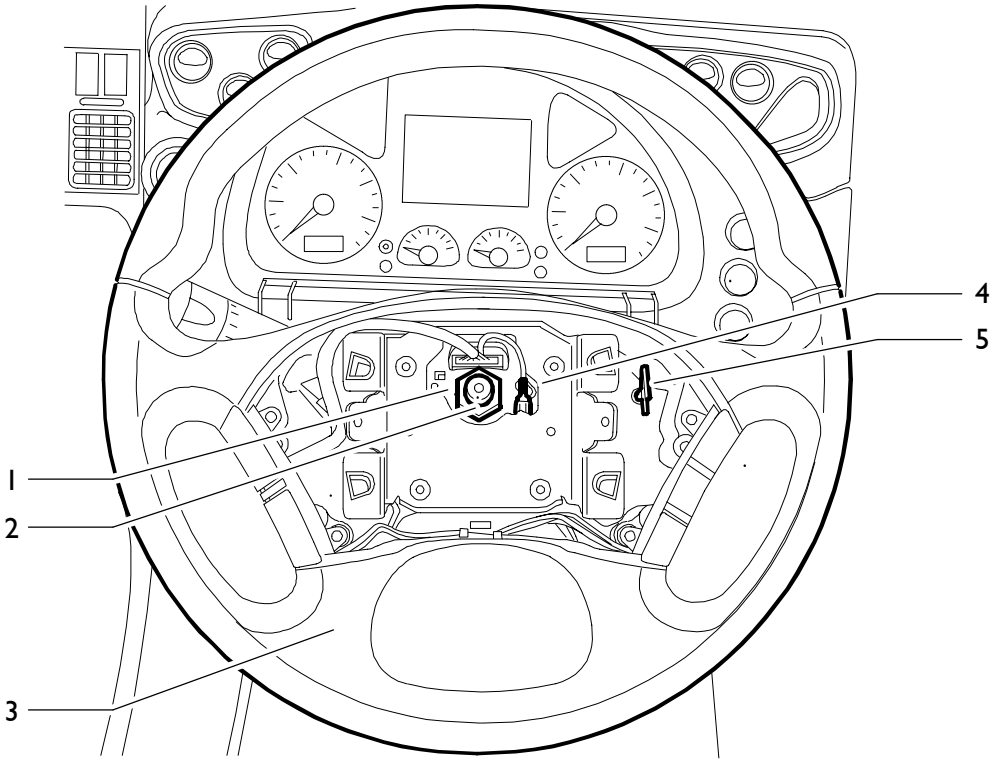
Figure 170



A. S.W.I center. - B. Steervator - C. Spiraled contact - D. Start block

NOTE Follow the procedures described in the following pages in case of spiraled contact disassembly.

Figure 171



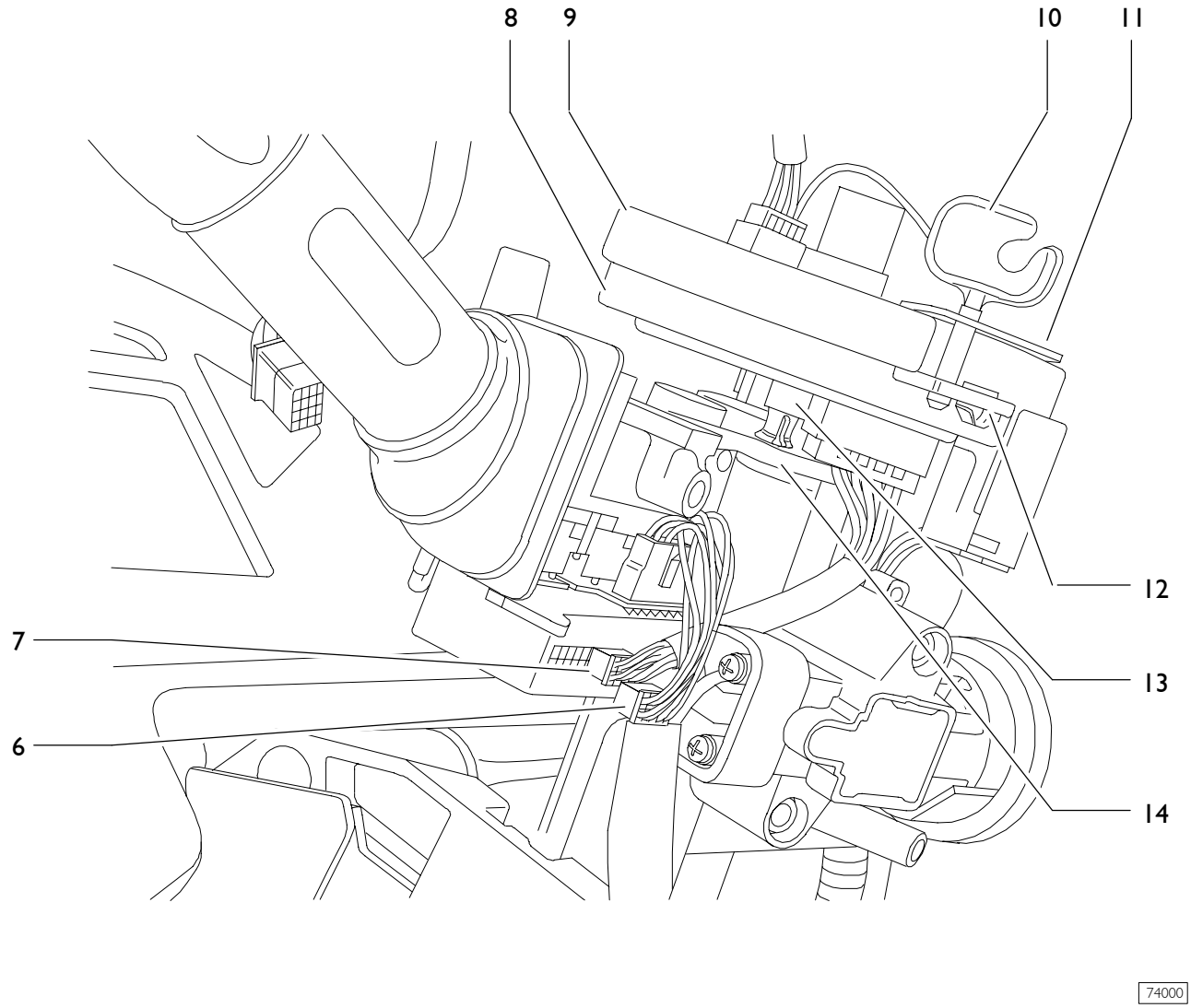
72850

Carefully follow the procedures described hereunder to replace the spiraled contact, to avoid damaging the spiraled cable contained in its box when disassembling and aligning the steering wheel incorrectly.

Disconnect mass cable connection (4).

Remove nut (1) and mark steering wheel assembly position on shaft (2) and remove the steering wheel.

Figure 172



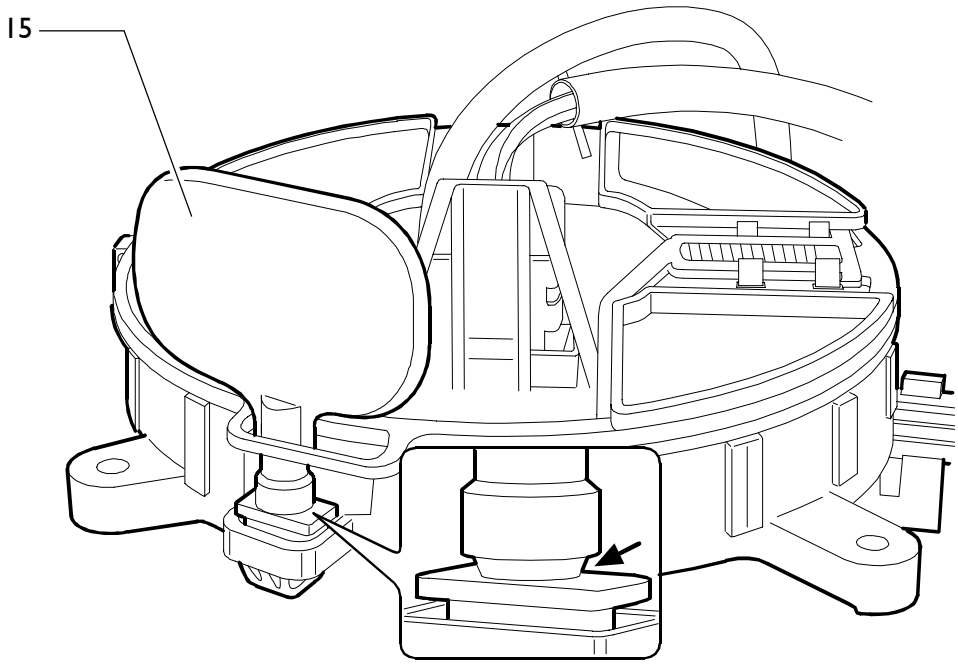
Disconnect electrical connections (6 and 7) from the S.W.I.

Secure contact rotor (9) to its container by inserting key (10) into slots (11 and 12), to prevent rotor (9) and stator (8) from rotating during disassembly.

Keep this situation until assembly. In the lack of a key, use an adequate size nut and bolt.

Carefully raise the contact so elastic retainer pins (13) are removed from support (14). Store it carefully.

Figure 173



72857

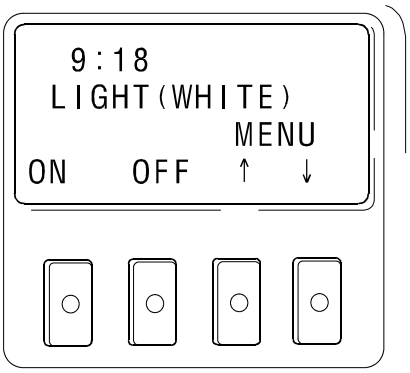
Invert the sequence of operations described above for reassembly.

The spiraled contact is supplied spare with its stop key (15) assembled as shown in the figure. After assembly on the steering wheel control support, rotate the key to cause breakage at the point indicated by the arrow and return it to steering wheel seat (5).

B.M. (BED MODULE)

Positioned at the cab rear

Figure 174



10697

The B.C. identifies its presence but CANNOT be diagnosed.

Its functions are as follows
(variable configuration according to vehicle accessories):

- ❑ Indicazione ora e minuti
- ❑ Accensione / spegnimento luci interne cabina (selezione luci bianche/notturne).
- ❑ Apertura / chiusura porte.
- ❑ Apertura / chiusura vetri elettrici.
- ❑ Apertura / chiusura botola elettrica.
- ❑ Abbassamento / innalzamento tendine parasole.
- ❑ Accensione /spegnimento radio
- ❑ Regolazione volume radio
- ❑ Sintonia radio
- ❑ Funzione sveglia.
- ❑ Accensione / spegnimento riscaldatore supplementare.
- ❑ Regolazione temperatura (solo con riscaldatore supplementare inserito). (Automatico)
- ❑ Regolazione durata accensione riscaldatore (max. 9 ore)

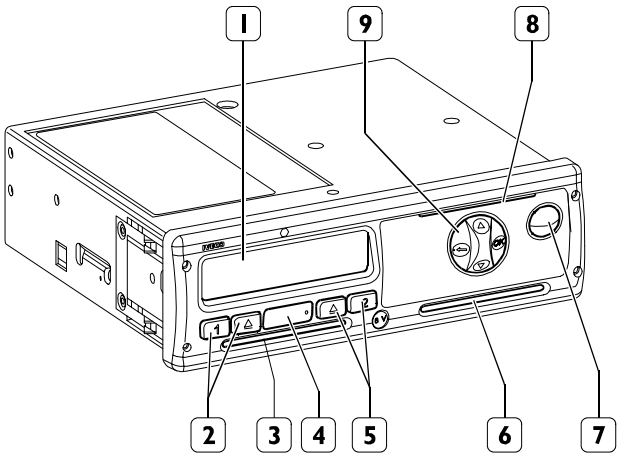
NOTE Press the switch on the instrument panel before adjusting heater temperature.

TACHOGRAPH
Digital Tachograph (DTCO)

Digital Tachograph (DTCO) is a series tachograph for new production vehicles and replaces analogue tachographs in case of failure.
DTCO electrical connections are the same as MTCO electrical connections. In the case of DTCO tachograph, the sensor on the gearbox must be replaced; from electrical point of view, this sensor is the same as former sensor.
The sensor being used for MTCO tachograph (KITAS 2170) cannot be used on new DTCO tachograph, for which KITAS 2171 sensor is mounted.
This sensor (KITAS 2171 sensor) is also compatible with MTCO sensor; however, once it has been configured, it can only be used for that tachograph family.

1. Display
2. Keypad (driver-1)
3. Paper feeder slot-1
4. Download interface / calibration interface
5. Keypad driver-2
6. Paper feeder slot-2
7. Release button, printer drawer
8. Tear-off edge
9. Keys of Display menu

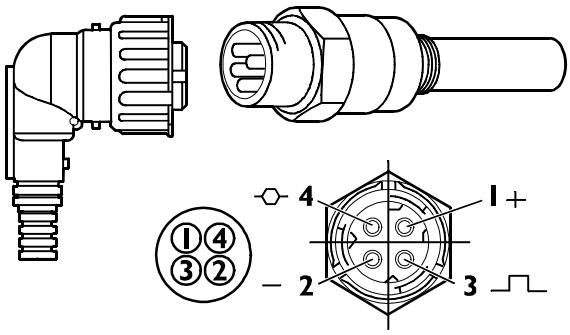
Figure 175



108905

DIGITAL TACHOGRAPH (DTCO)

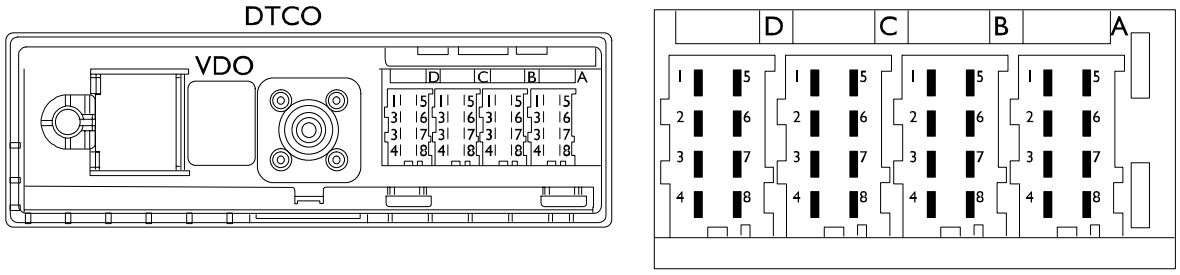
Figure 176



106343

TACHOGRAPH SENSOR

Figure 177



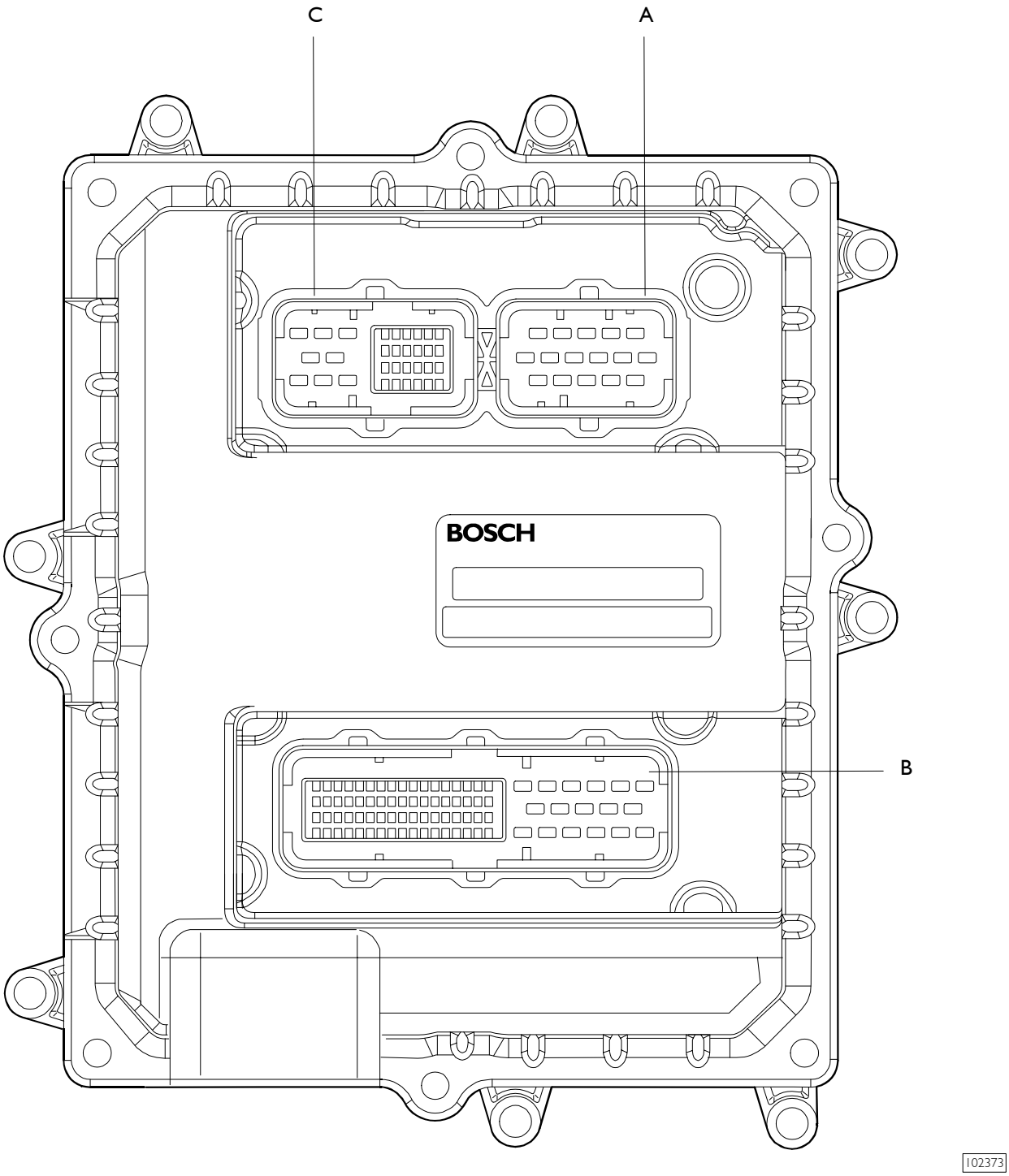
108906

Pin		System	Cable colour code
A	1	Direct battery positive +30	7768
	2	Symbols illumination	4442
	3	Positive +15	8871
	4	CAN line "H" (VDB)	White
	5	Earth	0000
	6	Earth	0000
	7	-	-
	8	CAN line "L" (VDB)	Green
B	1	Power supply for sensor: pin 1	5514
	2	Earth for sensor: pin 2	0058
	3	Sensor speed signal: pin 3	5517
	4	Sensor reversed signal: pin 4	5516
	5	-	-
	6	Speed signal for Cluster	5540
	7	-	-
	8	Run distance signal for Cluster	5518
C	1		-
	2		-
	3		-
	4		-
	5		-
	6		-
	7		
	8		-
D	1		-
	2		-
	3		-
	4		-
	5		-
	6		-
	7	Line L: Cluster: Pin AI / Diagnosis: Pin 14	2297
	8		-

EDC (ECM) SYSTEMS

EDC 7 UC31 electronic control unit

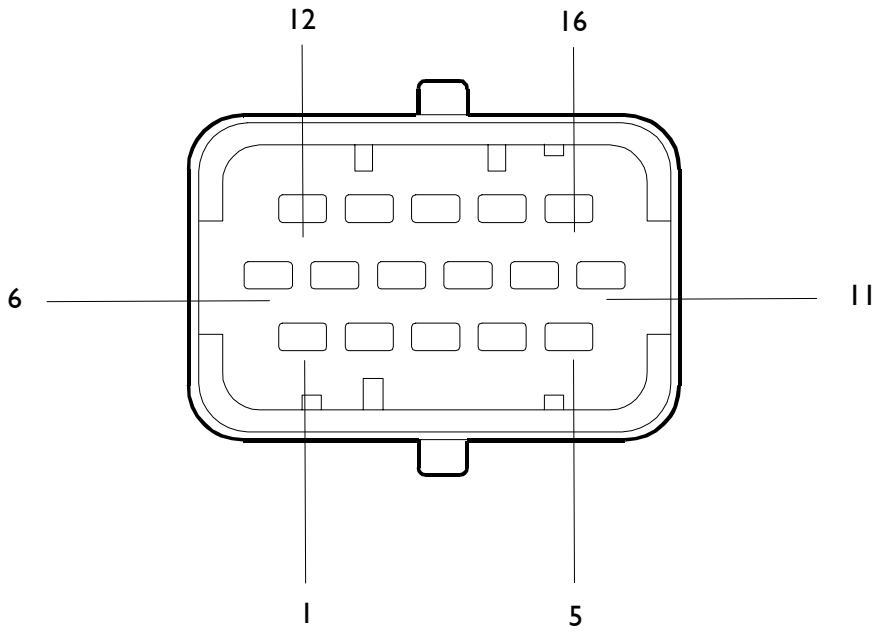
Figure 178



A. Injector connector - B. Chassis connector - C. Sensor connector

Electric injector connector "A"

Figure 179



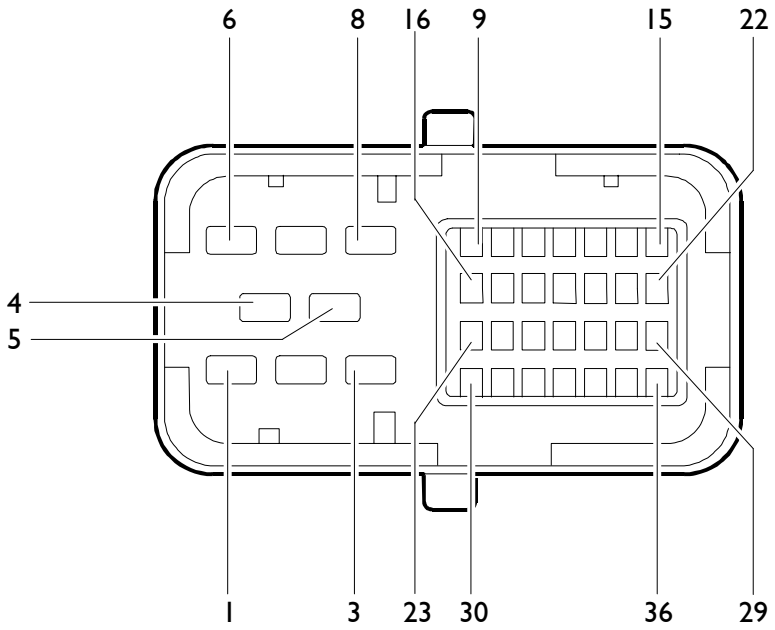
Colour legend

B	black
R	red
U	blue
W	white
P	purple
G	green
N	brown
Y	yellow
O	orange
E	grey
K	pink

ECU Pin	Colour legend	Function
1	-	Free
2	-	Free
3	B	Solenoid valve for electronic cylinder (4-5-6) injection
4	-	Free
5	-	Free
6	W	Solenoid valve for electronic cylinder 2 injection
7	O	Exhaust brake control solenoid valve
8	N	Exhaust brake control solenoid valve
9	-	Free
10	-	Free
11	R	Solenoid valve for electronic cylinder (1-2-3) injection
12	G	Solenoid valve for electronic cylinder 3 injection
13	W	Solenoid valve for electronic cylinder 1 injection
14	U	Solenoid valve for electronic cylinder 4 injection
15	E	Solenoid valve for electronic cylinder 6 injection
16	P	Solenoid valve for electronic cylinder 5 injection

Sensor connector "C"

Figure 180



Colour legend

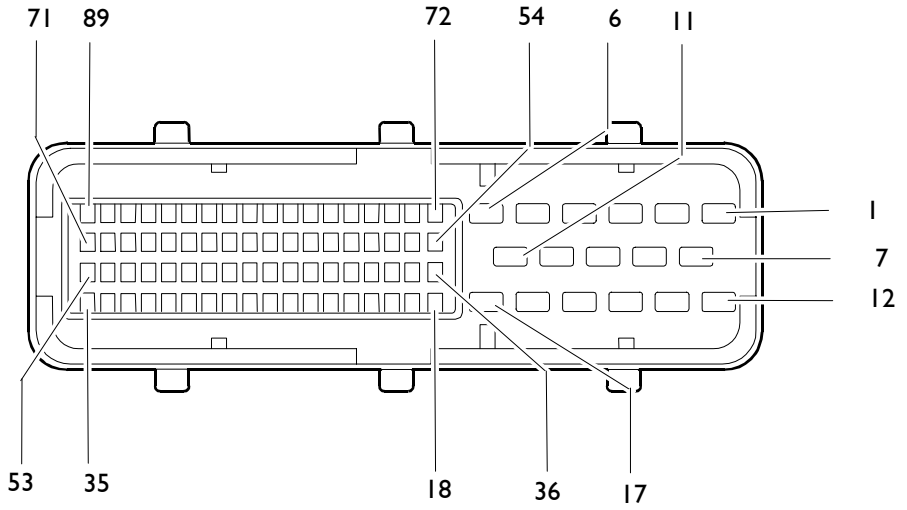
B	black
R	red
U	blue
W	white
P	purple
G	green
N	brown
Y	yellow
O	orange
E	grey
K	pink

e

ECU Pin	Cable colour	Function
1	N	Solenoid valve for variable geometry turbine control
2	-	Free
3	B	Solenoid valve for variable geometry turbine control
4÷8	-	Free
9	W	Valve gear flywheel sensor
10	R	Valve gear flywheel sensor
11÷14	-	-
15	K	Coolant temperature sensor
16 ÷17	-	Free
18	O/B	Fuel temperature sensor
19	B	Flywheel sensor
20	N	Booster speed sensor
21÷22	-	Free
23	W	Flywheel sensor
24	N	Engine oil temperature/pressure sensor ground
25	W	Air temperature/pressure sensor power supply
26	Y	Coolant temperature sensor
27	O/B	Oil temperature signal from the engine oil temperature/pressure sensor
28	U	Oil pressure signal from the engine oil temperature/pressure sensor
29	-	Free
30	W	Booster speed sensor
31	-	Free
32	O	Engine oil temperature/pressure sensor power supply
33	R	Air temperature/pressure sensor power supply
34	G	Air pressure signal from the air temperature/ pressure sensor
35	W/R	Fuel temperature sensor
36	O	Air temperature signal from the air temperature / pressure sensor

Chassis connector "B"

Figure 181



ECU Pin	Cable	Function
1	-	Free
2	7151	+30 positive
3	7153	+30 positive
4	-	Free
5	0151	Ground
6	0151	Ground
7	-	Free
8	7151	+30 positive
9	7151	+30 positive
10	0151	Ground
11	0151	Ground
12	0094	Preheating actuation enable relay ground
13÷25	-	Free
26	5173	Signal cable for combustion air relative humidity sensor with EDC
27	5174	Signal cable for combustion air temperature sensor with EDC
28	0173	Ground cable for combustion air relative humidity and temperature sensors with EDC
29	5163	EDC system diagnosis inducing switch power supply (presetting)
30	-	Free
31	-	Free
32	-	Free
33	-	Free
34	Green	CAN - L line (ECB)
35	White	CAN - H line (ECB)
36÷55	-	-
56	-	Free
57	-	Free
58÷67	-	Free
68	8173	Combustion air relative humidity and temperature sensor power supply with EDC
69÷74	-	-
75	9164	Preheating actuation enable relay positive
76÷88	-	Free
89	2298	EDC control unit diagnosis K line

SYSTEM COMPONENTS
Pump injector (78247)

It mainly consists of three components as follows:

A) Electro valve

B) Pump unit

C) Sprayer

These three parts CANNOT be replaced individually and are NOT subject to overhaul.

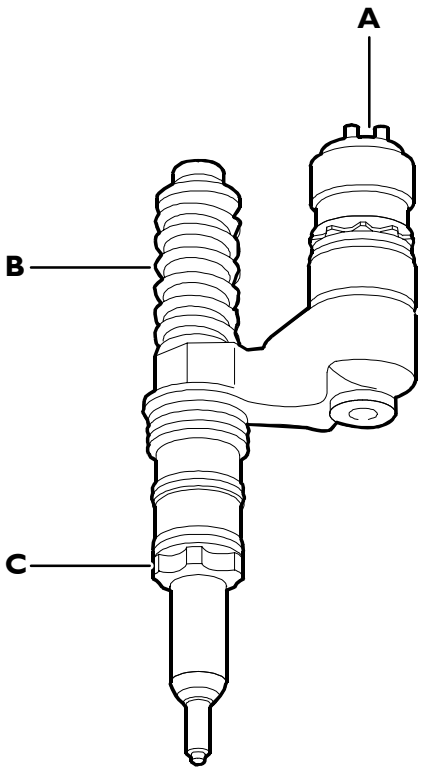
The pump is actuated mechanically at each cycle by a rocker arm and compresses the fuel contained in the pressure chamber.

The sprayer features the same assembly and operation as a conventional injector; it is opened by the fuel under pressure and injects it fine pulverized into the combustion chamber.

An electro valve controlled directly by the electronic center sets delivery modalities based on the control signal.

An injector holder houses the lower part of the pump injector in the cylinder head.

Figure 182



106978

The electro valve is of the N.A. type.

Coil resistance is ~ 0.56 ÷ 0.57 Ohm.

Maximum operating voltage is ~ 12 ÷ 15 Amp.

Based on voltage absorbed by the electro valve, the electronic center can identify whether injection was correct or mechanical problems exist. It can also detect injector errors ONLY with the engine running or during starts.

They are connected to the electronic center with a positive common to groups of three injectors:

Cylinder 1 - 2 – 3 injector to pin A 11
Cylinder 4 - 5 - 6 injector to pin A 3

Injectors are individually connected to the center between pins:

A11 / A13 cylinder 1 injector
A11 / A6 cylinder 2 injector
A11 / A12 cylinder 3 injector
A3 / A14 cylinder 4 injector
A3 / A16 cylinder 5 injector
A3 / A15 cylinder 6 injector

Injectors are connected to the center with connector ST - E mounted on the engine front with a twisted cable, to avoid possible electromagnetic interference problems, so junctions or repairs on it must NOT be performed.

Figure 183

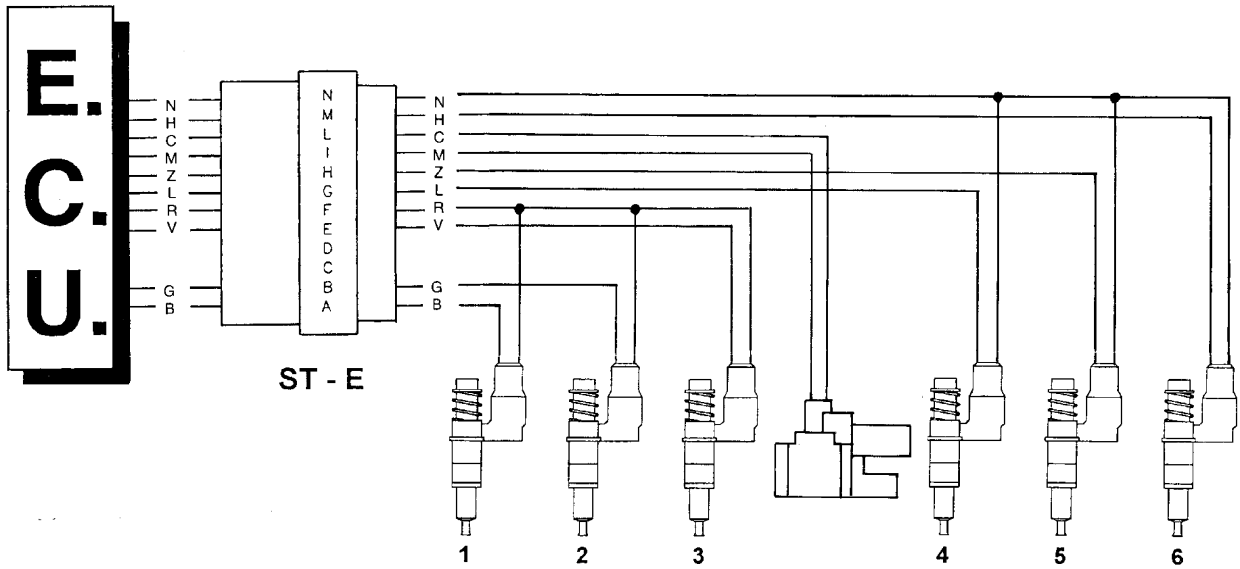
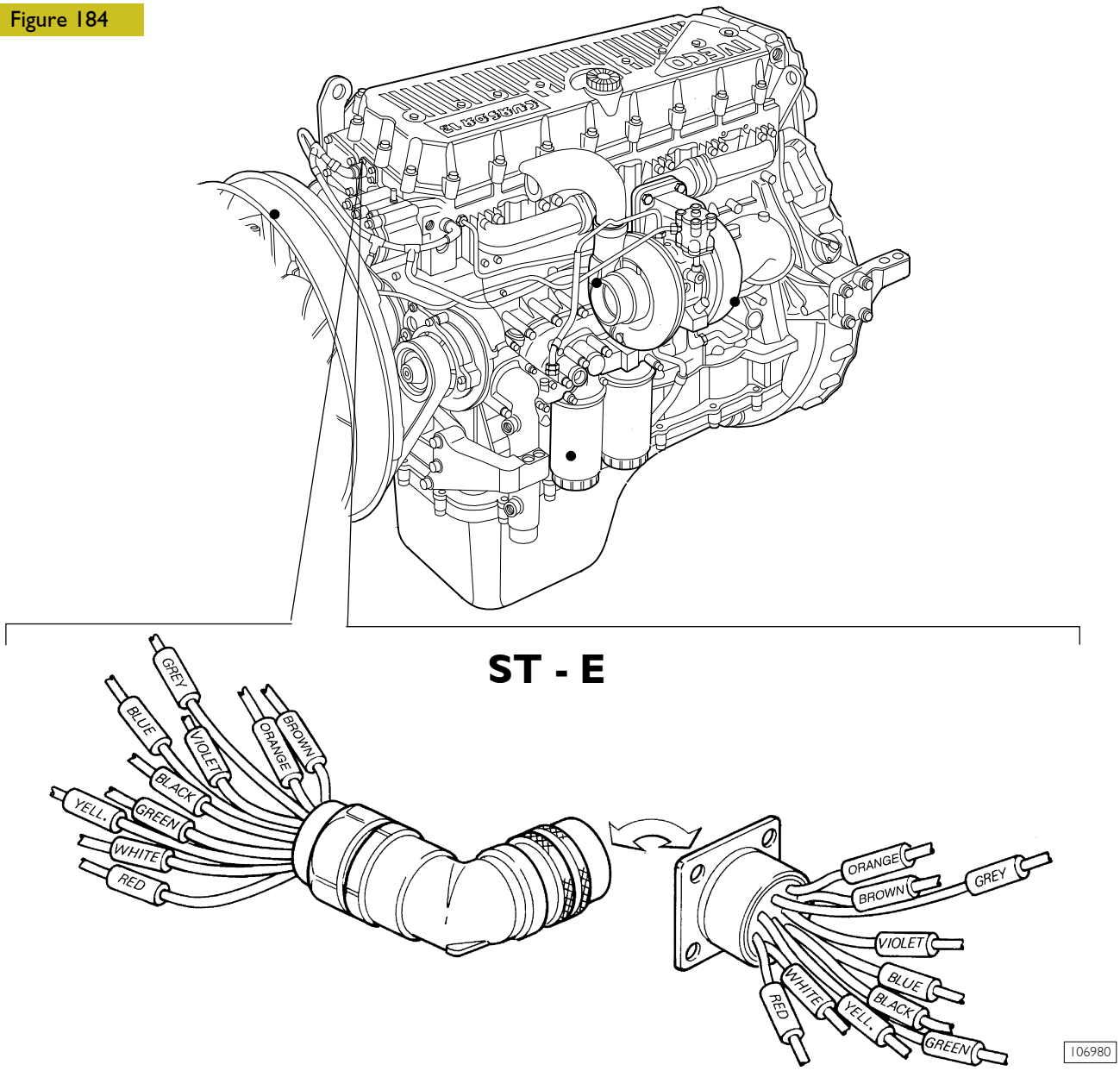
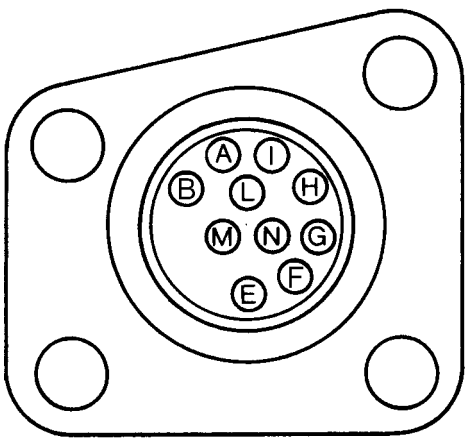


Figure 184



Pin	Cable	Function	Center Pin
A	B	Injector 1 control	A13
B	G	Injector 2 control	A6
C	-	-	-
D	-	-	-
E	V	Injector 3 control	A12
F	R	Injector 1/2/3 supply	A11
G	L	Injector 4 control	A14
H	Z		A16
I	M	Engine brake control electro valve	A8
L	C	Engine brake electro valve supply	A7
M	H	Injector 6 control	A15
N	N	Injector 4/5/6 supply	A3



106981

Engine coolant temperature sensor (85153)

This N.T.C. type sensor located on the water outlet sump on the engine head left measures coolant temperature for the various operating logics with a hot or cold engine and identifies injection enrichment requirements for a cold engine or fuel reduction requirements for a hot engine.

The coolant temperature signal is used for display on the Cluster and to control the fan.

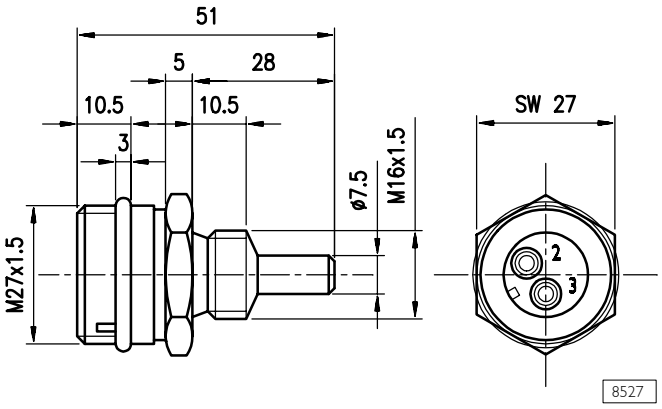
It is connected to electronic center pins C15/C26

Sensor behavior as a function of temperature:

- 10 °C	8,10 ÷ 10,77 kOhm
+ 20 °C	2,28 ÷ 2,72 kOhm
+ 80 °C	0,29 ÷ 0,364 kOhm

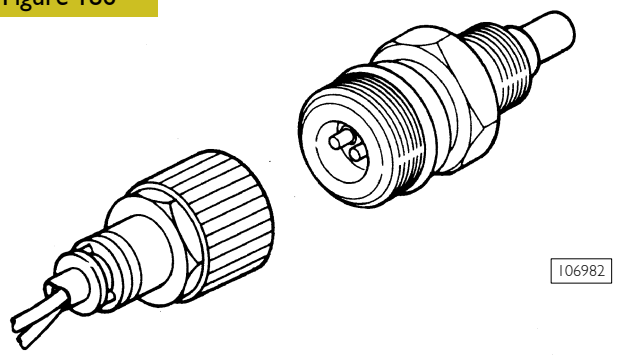
At 60 to 90 °C, voltage at C15 and C26 ranges from 0.6 to 2.4V.

Figure 185



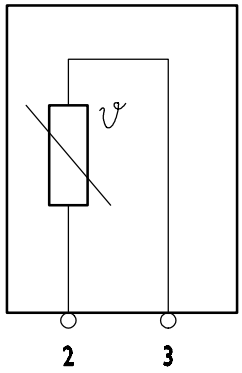
TECHNICAL VIEW

Figure 186



PERSPECTIVE VIEW

Figure 187



WIRING DIAGRAM

Connector	Function	Cable colour
2	To EDC center pin C 15	—
3	To EDC center pin C26	—

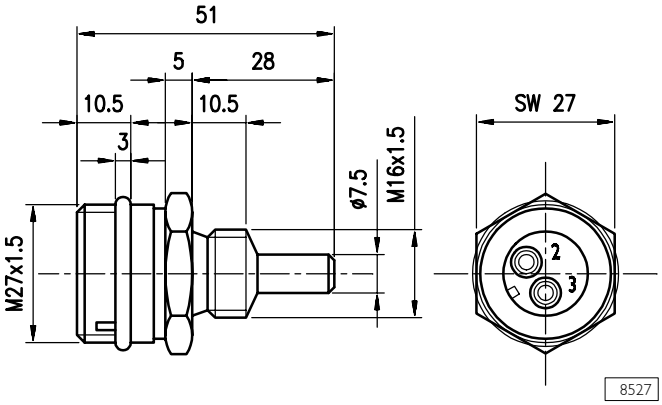
Fuel temperature sensor (47042)

Features

Vendor	BOSCH
Maximum torque	35 Nm

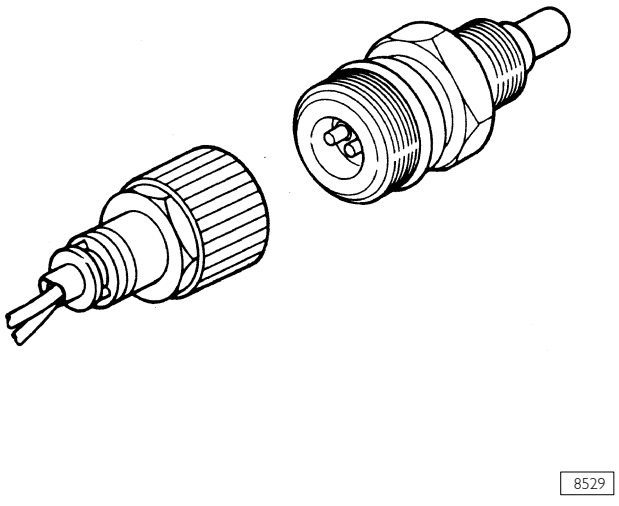
This N.T.C. type sensor located on the fuel filter on the engine left side detects fuel temperature and enables the electronic center to measure fuel density and volume for delivery correction.

Figure 188



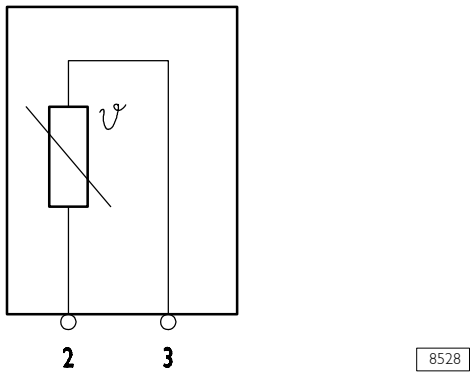
TECHNICAL VIEW

Figure 189



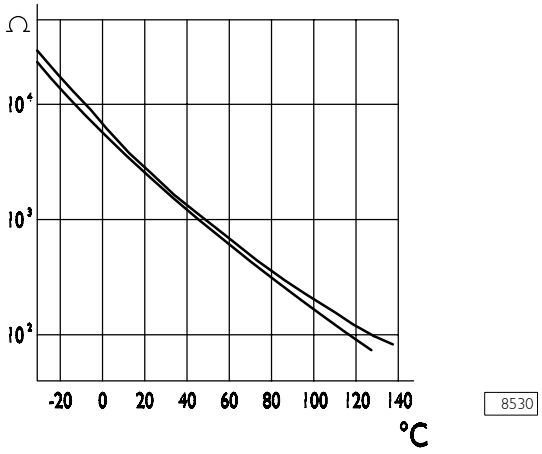
PERSPECTIVE VIEW

Figure 190



WIRING DIAGRAM

Figure 191



RESISTANCE BEHAVIOR

Connector	Function	Cable colour
2	To EDC center pin C18	—
3	To EDC center pin C35	—

Flywheel pulse transmitter (48035)

Features

Vendor	BOSCH
Torque	8 ± 2 Nm
Resistance	880 ÷ 920 Ω

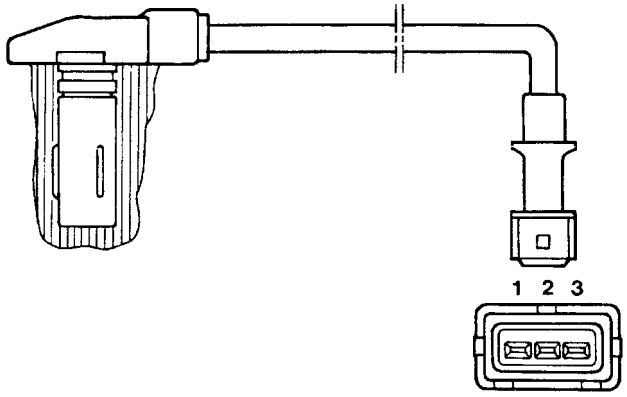
This induction type sensor located on the flywheel generates signals obtained from the magnetic flow lines that close through 54 holes in three series of 18 in the flywheel.

The electronic center uses this signal to detect the various engine ratings and pilot the electronic rev counter.

The rev counter does not operate in the absence of this signal.

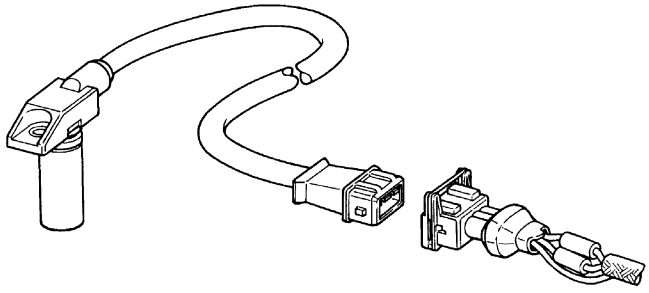
This sensor's air gap is NOT ADJUSTABLE.

Figure 192



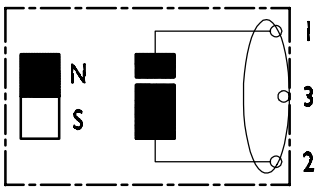
TECHNICAL VIEW 106984

Figure 193



PERSPECTIVE VIEW 106985

Figure 194

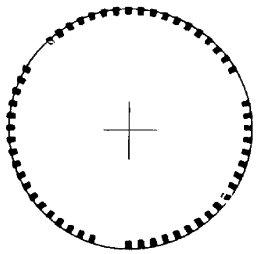


106986

WIRING DIAGRAM

Figure 195

3 x 18



8520

HOLES ON FLYWHEEL

Connector	Function	Cable colour
1	To EDC center pin C 23	—
2	To EDC center pin C19	—
3	Shields	—

Distribution pulse transmitter (48042)

Features

Vendor	BOSCH
Torque	8 ± 2 Nm
Resistance	880 ÷ 920 Ω

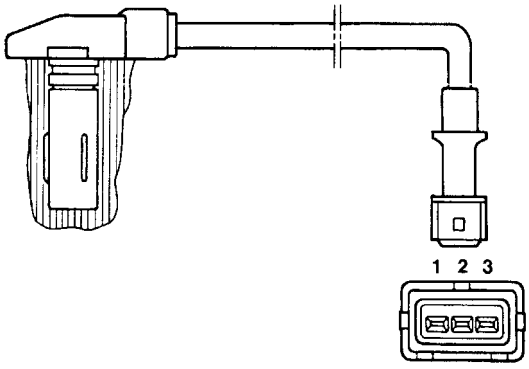
This induction type sensor located on the camshaft generates signals obtained from the magnetic flow lines that close through the 6 plus 1 phase teeth of a sound wheel mounted on the shaft.

The electronic center uses the signal generated by this sensor as an injection step signal.

Though electrically identical to (48035) engine rpm sensor mounted in the camshaft in is NOT interchangeable with it as it cable is shorter and it features a larger diameter.

This sensor's air gap is NOT ADJUSTABLE.

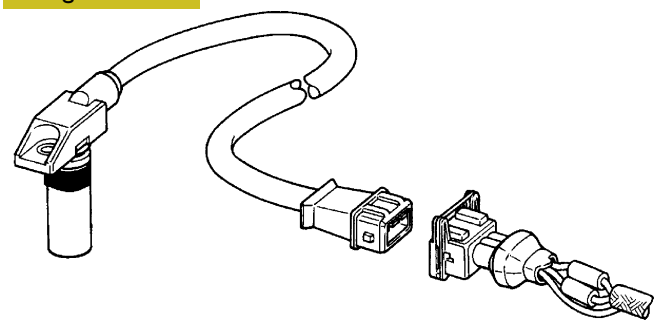
Figure 196



106987

TECHNICAL VIEW

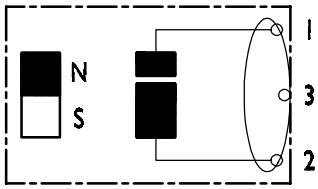
Figure 197



106988

PERSPECTIVE VIEW

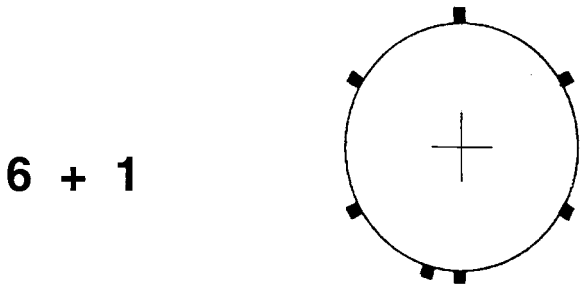
Figure 198



106989

WIRING DIAGRAM

Figure 199



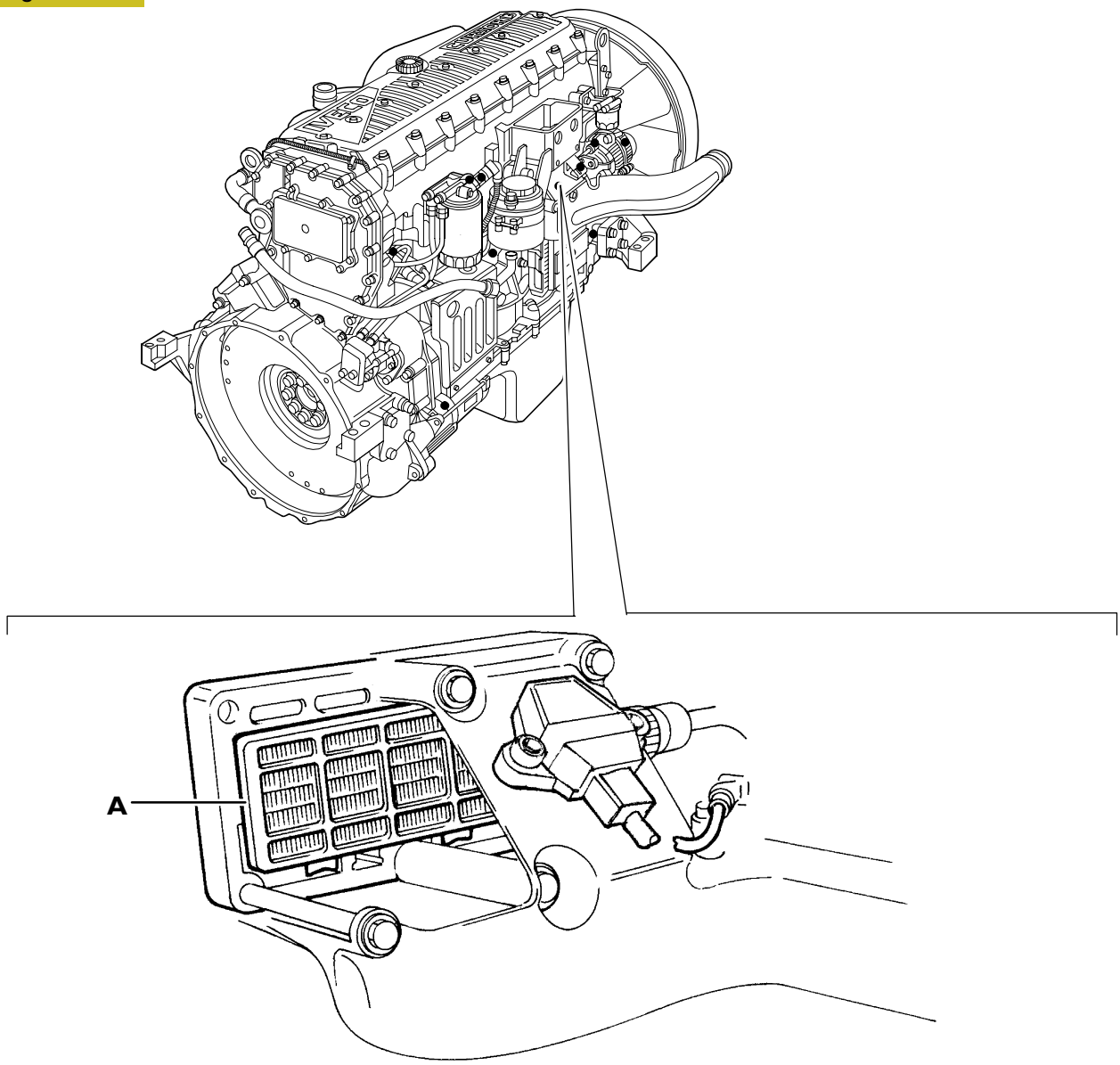
8520

REFERENCE ON SOUND WHEEL

Connector	Function	Cable colour
1	To EDC center pin C 10	—
2	To EDC center pin C 9	—
3	Shields	—

Pre-post reheat resistor (61121)

Figure 200



A. Pre/ort reheat resistor / 0.7 Ohm

106990

This resistor located between the cylinder head and the intake duct is used to heat air in pre/post reheat operations.

By inserting the key switch, when even only one of the water, air or gas oil temperature sensors record less than 10 °C, the electronic center activates pre/post reheating and switches on the warning light on the cab instrument panel for a variable period according to temperature, after which the light starts blinking to inform the operator that the engine can be started.

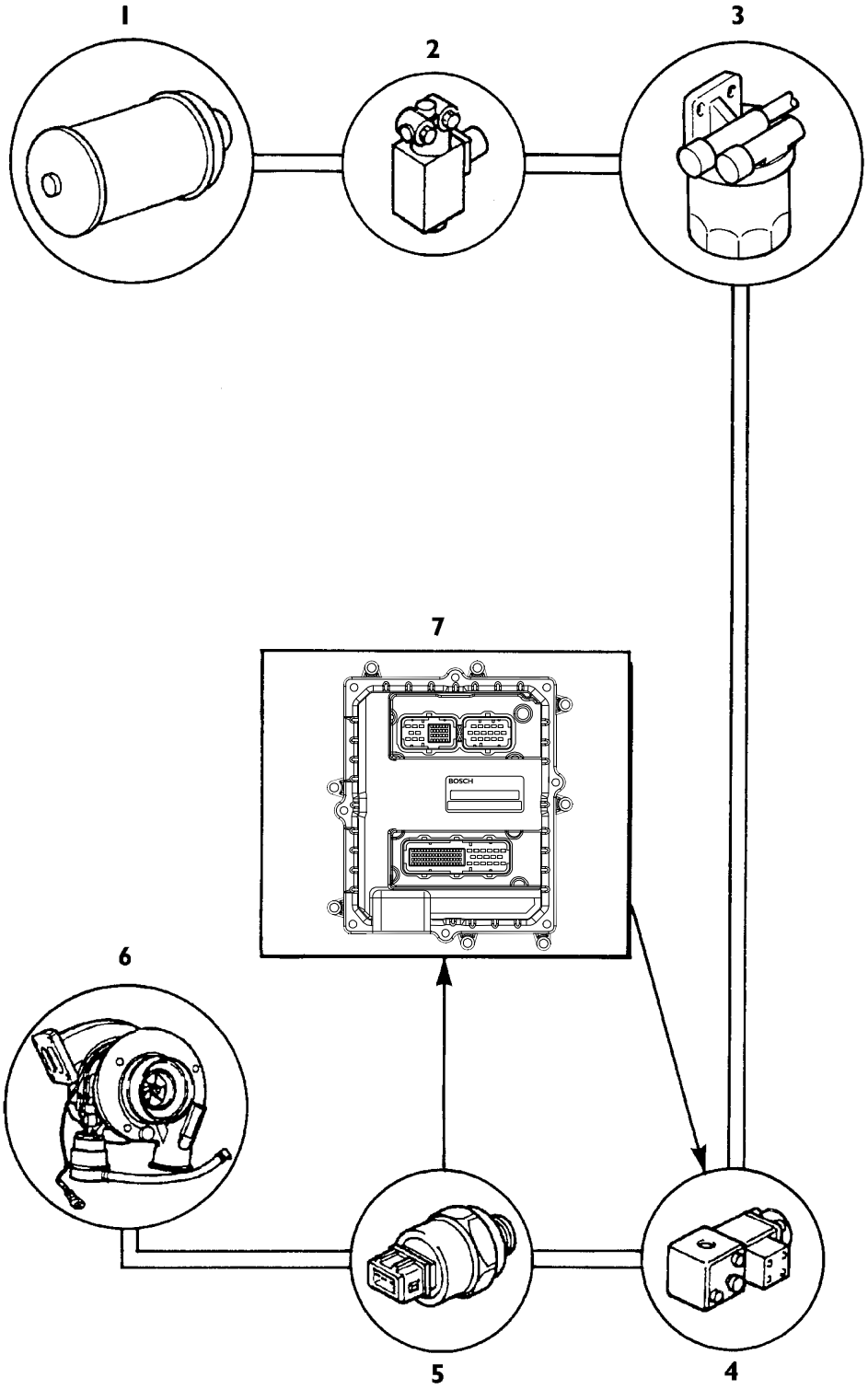
The warning light goes off after engine start but the resistor continues being supplied for a variable period of time to complete post reheating.

The operation is cancelled to prevent uselessly discharging the battery if the engine is not started within 20/25 seconds with the warning light blinking.

When reference temperature is above 10 °C, actuating the ignition key makes the warning light go on for some 2 seconds to complete the test and then turns it of to indicate the engine can be started.

VGT control card

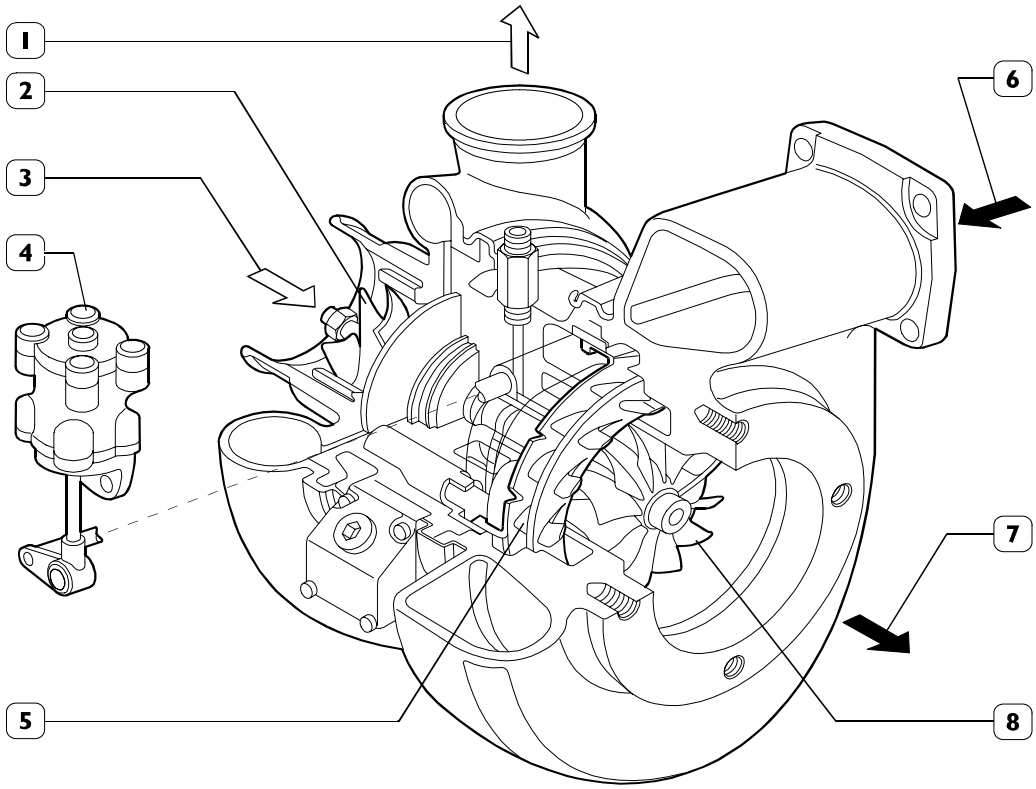
Figure 201



1. Service reservoir - 2. Shut-off electro valve - 3. Air filter - 4. VGT electro valve - 5. Actuator position sensor - 6. Turbine actuator - 7. EDC center

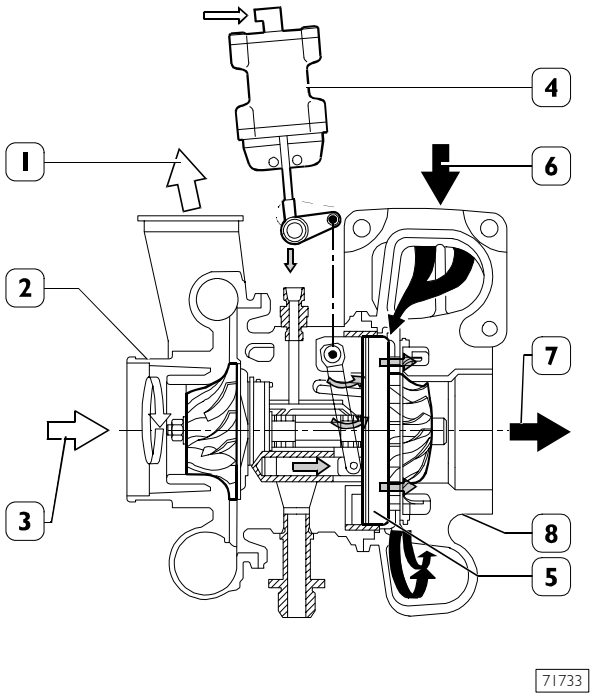
Variable geometry Holset turbo compressor (series HY)

Figure 202

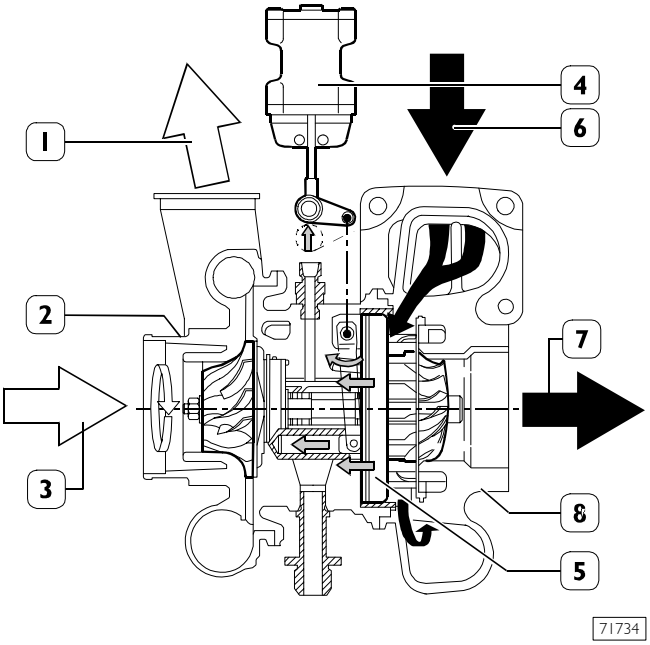


1. Intake duct air delivery - 2. Compressor - 3. Air intake - 4. Actuator - 5. Exhaust gas speed adjustment - 6. Exhaust gas intake - 7. Exhaust gas outlet - 8. Turbine

Figure 203



MINIMUM FLOW SECTION



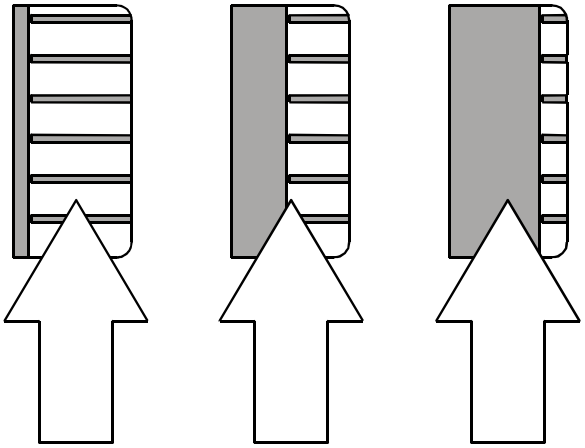
MAXIMUM FLOW SECTION

1. Air delivery to intake manifold - 2. Compressor - 3. Air intake - 4. Actuator - 5. Exhaust gas delivery adjustment ring - 6. Exhaust gas intake - 7. Exhaust gas outlet - 8. Turbine

Operating principle

Figure 204

Exhaust gas section with engine under load



106992

The VGT variable geometry turbo compressor consists of a centrifugal compressor and a turbine provided with a mobile device that adjusts the rate of exhaust gas to the turbine rate by changing the gas passage cross section.

This solution enables keeping gas and turbine rates high even when the engine is operating at low rpm.

Making gasses pass through a reduced cross section in fact increases their rate so the turbine too rotates faster.

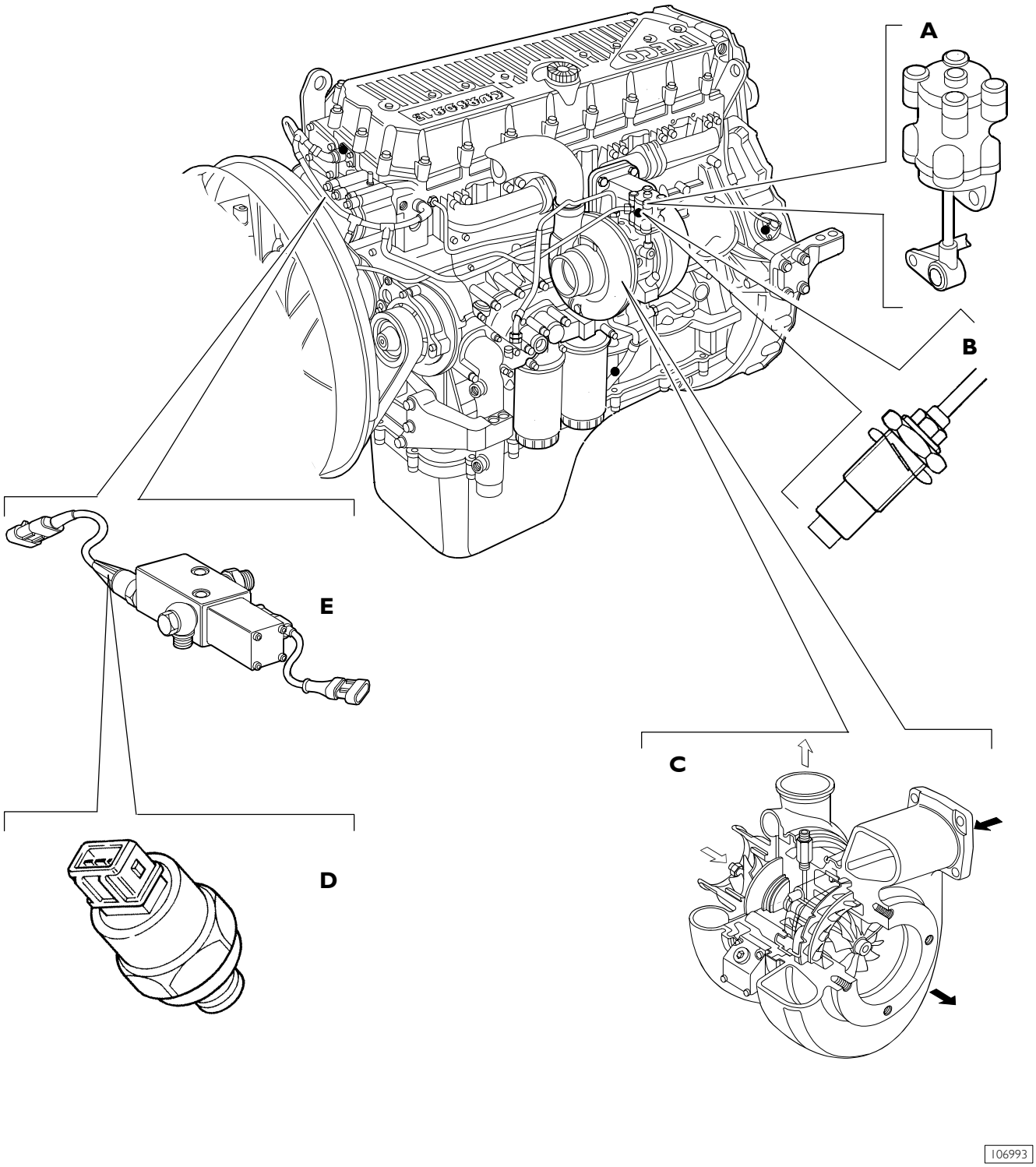
Movement of the exhaust gas intake cross section partialization device is obtained by means of a mechanism controlled by a compressed air actuator, which is controlled by a proportional electro valve.

The device is fully closed at low rpm, while at high engine rpm the electronic control system increases cross section to enable incoming gasses to flow without increasing their speed.

A thoroidal chamber is cast into the central body for coolant passage.

Engine components (VGT)

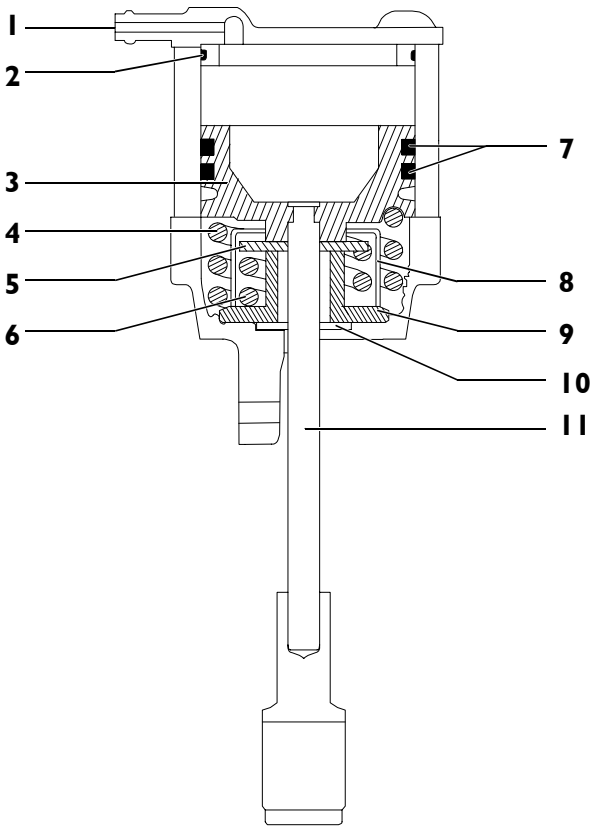
Figure 205



A. Actuator - B. Turbine rpm sensor - C. Turbo compressor - D. VGT actuator position sensor - E. VGT activator control electro valve

Actuator

Figure 206



1. Air intake - 2. Washer - 3. Piston - 4. External spring - 5. Internal spring control disc - 6. Internal spring - 7. O-Ring - 8. Spring holder - 9. Run end - 10. Dust cover - 11. Control rod

Operating principle

The actuator piston connected to the control rod is piloted through the compressed air admitted from air intake 1 on the top of the actuator.

Modulating air pressure varies piston and turbine control rod movement.

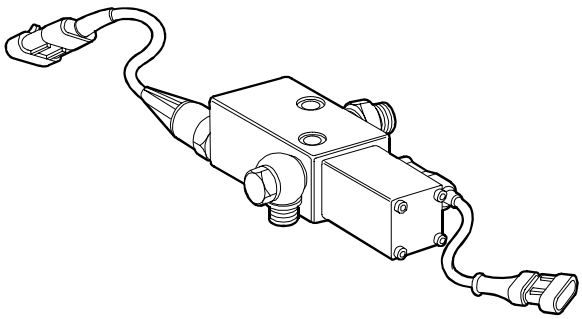
During its movement, the piston progressively compresses external spring 4 until the piston base reaches internal spring 6 control disc 5.

By further increasing pressure, the piston compresses the internal spring through disc 5 until run end, which is reached when disc 5 interferes with lower run end 10.

Use of the two springs enables changing the ratio between pressure and piston travel. About 85% of rod travel is contrasted by the external spring, the remaining 15% being contrasted by the internal one.

VGT control electro valve

Figure 207



This is an N.C. type proportional electro valve mounted on the engine front, behind the fan.

Through a PWM signal, the electronic center pilots this electro valve to adjust turbine actuator feed pressure; actuator position changes modify the exhaust gas intake cross section on the fan blades and thus its speed.

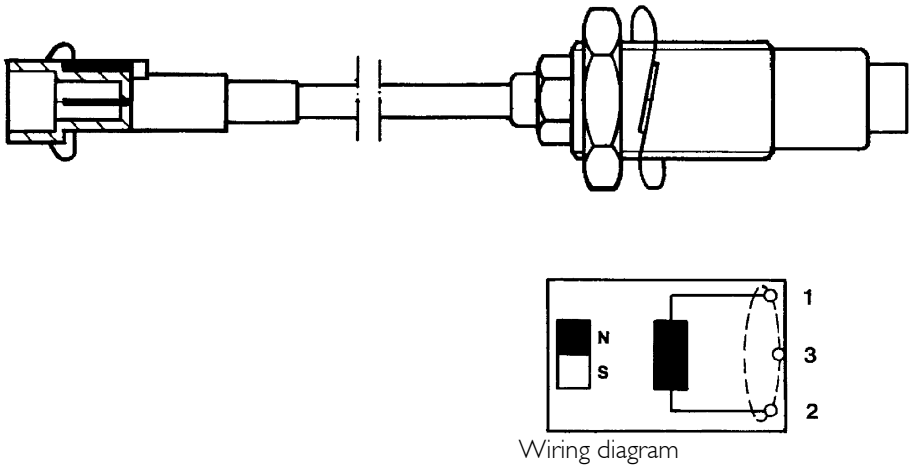
The VGT electro valve is connected between electronic center pins C3/C1.

Coil resistance is ~ 20 ÷ 30 Ohm.

Turbine rpm sensor (48043)

This is an inductive sensor positioned on the impeller shaft.
It generates signals obtained from the magnetic flow lines, which close through a notch obtained on the shaft itself.
The signal generated by this sensor is used by the electronic control unit to verify that the turbine revs number does not exceed the maximum value.
To control the revs number, the control unit acts on variable geometry.
If the revs number keeps on increasing until it reaches excessive r.p.m. values, the electronic control unit will detect an anomaly.
The gap of this sensor CANNOT BE ADJUSTED.
It is connected on electronic control unit pins C30 / C20
The sensor resistance value is 400 Ohm.

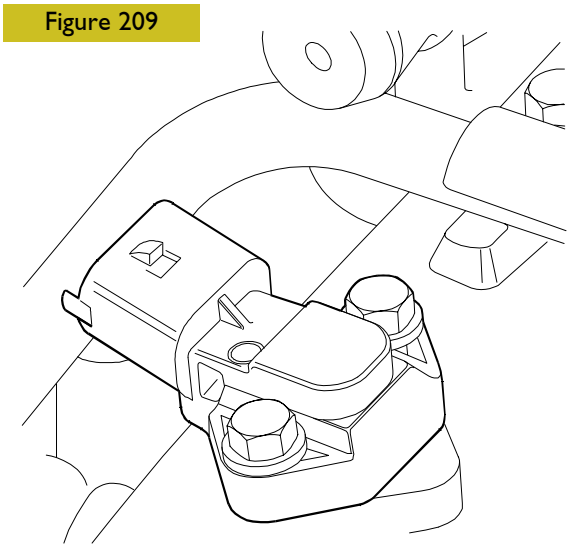
Figure 208



Wiring diagram

106996

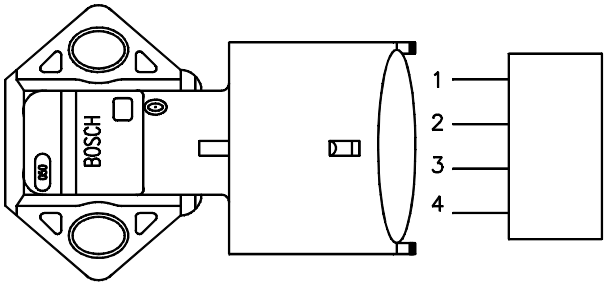
Figure 209



50324

Sensor external view

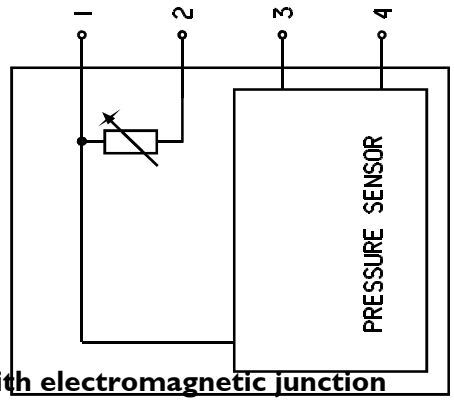
Figure 210



50323

Linking connector

Figure 211



Fan with electromagnetic junction

50344

Wiring diagram

Air pressure/temperature sensor (85156).

This component incorporates a temperature sensor and a pressure sensor.

Ilt replaces the temperature sensors (85155) and pressure sensors (85154) available in the preceding systems.

It is fitted onto the intake manifold and measures the maximum supplied air flow rate used to accurately calculate the amount of fuel to be injected at every cycle.

The sensor is powered with 5 V.

The output voltage is proportional to the pressure or temperature measured by the sensor.

Pin (EDC)	25/C - 33/C	Power supply
Pin (EDC)	36/C	Temperature
Pin (EDC)	34/C	Pressure

Oil temperature/pressure sensor (42030 / 47032)

This component is identical to the air pressure/temperature sensor and replaced single sensors 47032 / 42030.

It is fitted onto the engine oil filter, in a horizontal position.

It measures the engine oil temperature and pressure.

The measured signal is sent to the EDC control unit which controls, in turn, the indicator instrument on the dashboard (low pressure warning lights / gauge).

Pin (EDC)	24/C - 32/C	Power supply
Pin (EDC)	27/C	Temperature
Pin (EDC)	28/C	Pressure

The engine oil temperature is used only by the EDC control unit.

Ref.	Description	Control unit pin	
		Oil	Air
1	Ground	24C	25C
2	Temp. Sign.	27C	36C
3	+5	32C	33C
4	Press. Sign.	28C	34C

Fan with electromagnetic junction

The fan features two possible rotation speeds controlled by the Front Frame Computer center by exciting the compressed air electro valve for slow speed and by coil (11) for second speed.
When neither low nor second speed is activated, the fan is drawn slowly by friction forces present (neutral position).

The parameters/systems that may require fan action via the BC center are as follows:

- Coolant temperature
- Conditioning system coolant pressure
- Intarder

Low speed is activated when:

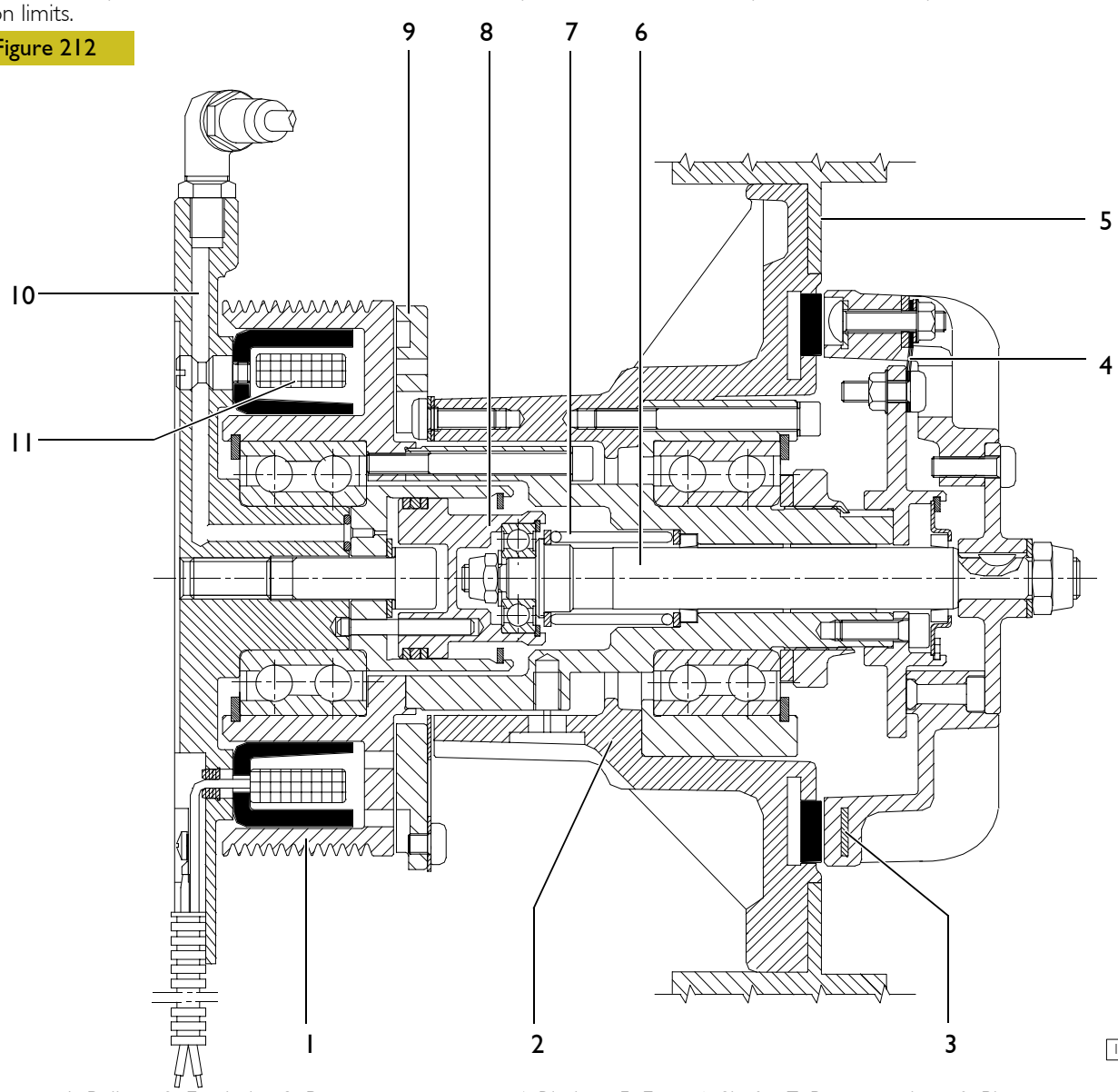
- Engine coolant temperature reaches 80 °C and the intarder is cut in at deceleration power under 41% of maximum.
- Conditioner coolant pressure reaches 18 bars.

Second speed is activated when:

- Conditioner coolant pressure reaches 22 bars.
- Engine coolant temperature reaches 80 °C and the intarder is cut in at deceleration power over 41% of maximum.
- Engine coolant temperature is over 88 °C.

When second speed activation is required, the system pilots the fan for 5 seconds at low speed, then second speed is cut in. This operating logic enables increasing belt and fan component reliability in time.
When fan low speed remains cut in for over 1 minute, the system activates second speed until control parameters return below action limits.

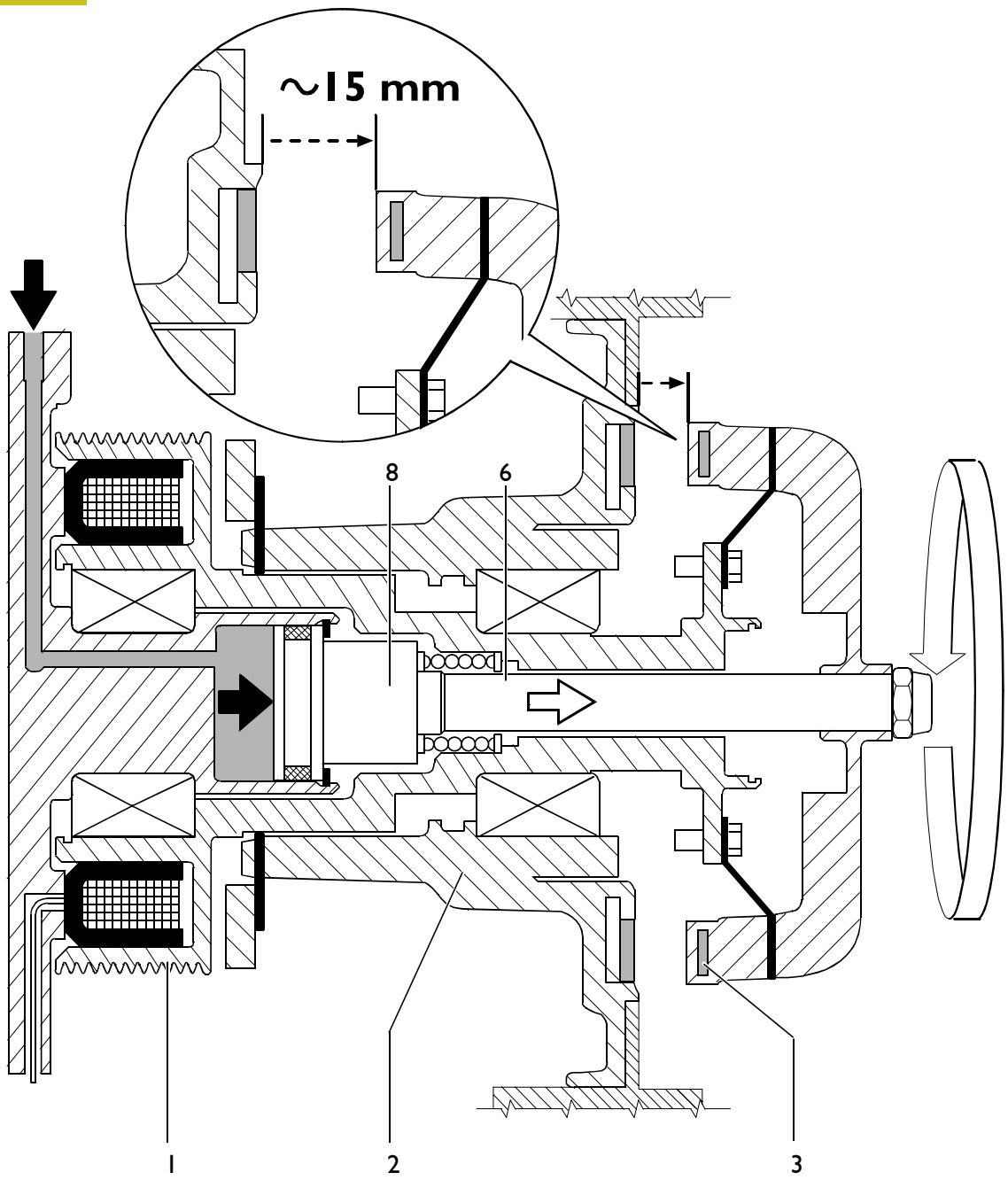
Figure 212



1. Pulley - 2. Fan hub - 3. Permanent magnets - 4. Blades - 5. Fan - 6. Shaft - 7. Return spring - 8. Piston - 9. Floating ring - 10. Air supply pipe - 11. Coil

Fan cut out (neutral position)

Figure 213

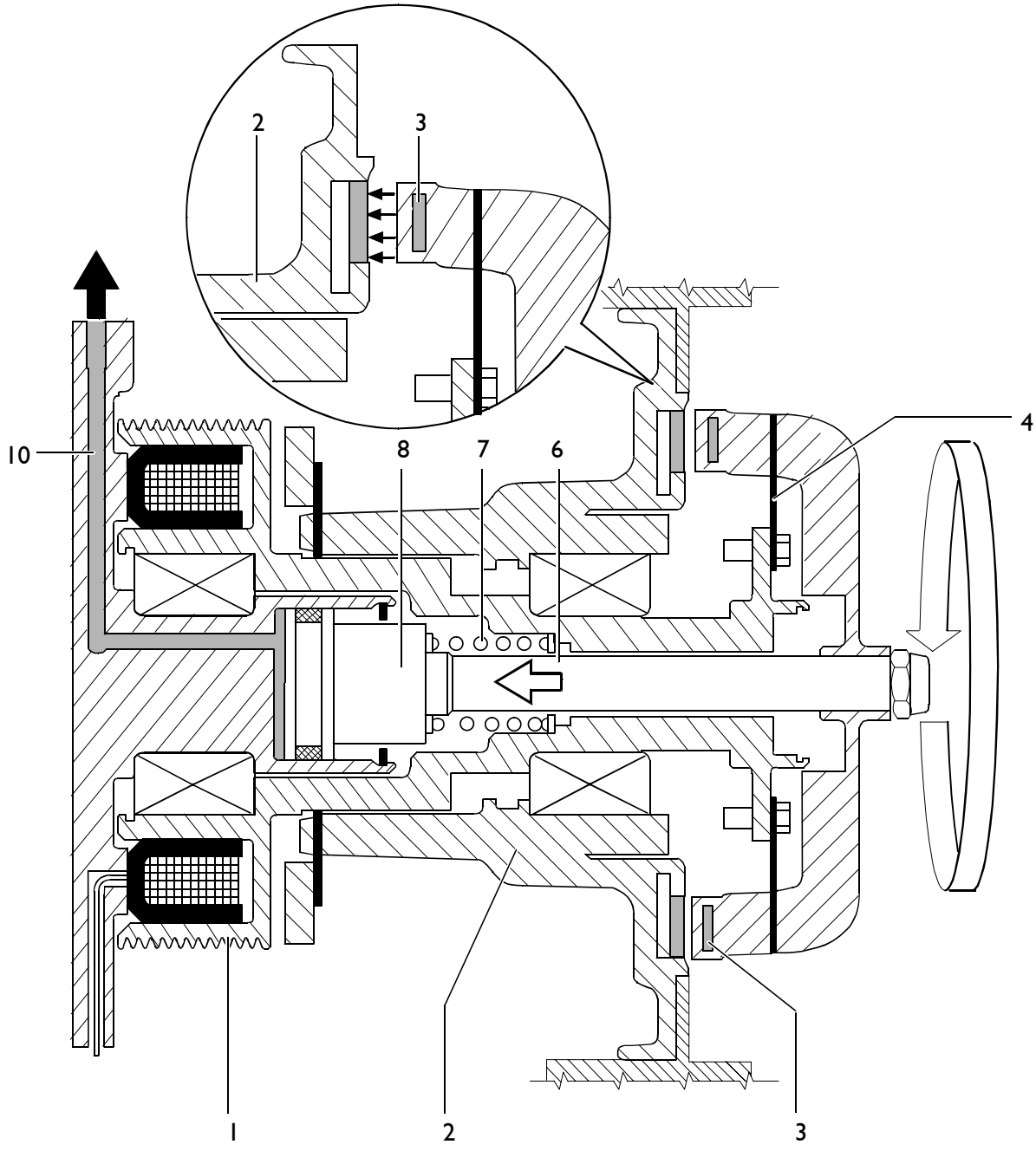


When fan action is not required for proper engine operation, the Front Frame Computer center pilots the compressed air electro valve to move piston (8), displaces permanent magnets (3) from fan hub (2). The magnetic field generated by magnets (3) is not enough to move fan hub (2) by induction.

The fan may rotate slowly due to friction present.

Fan with low speed cut in

Figure 214



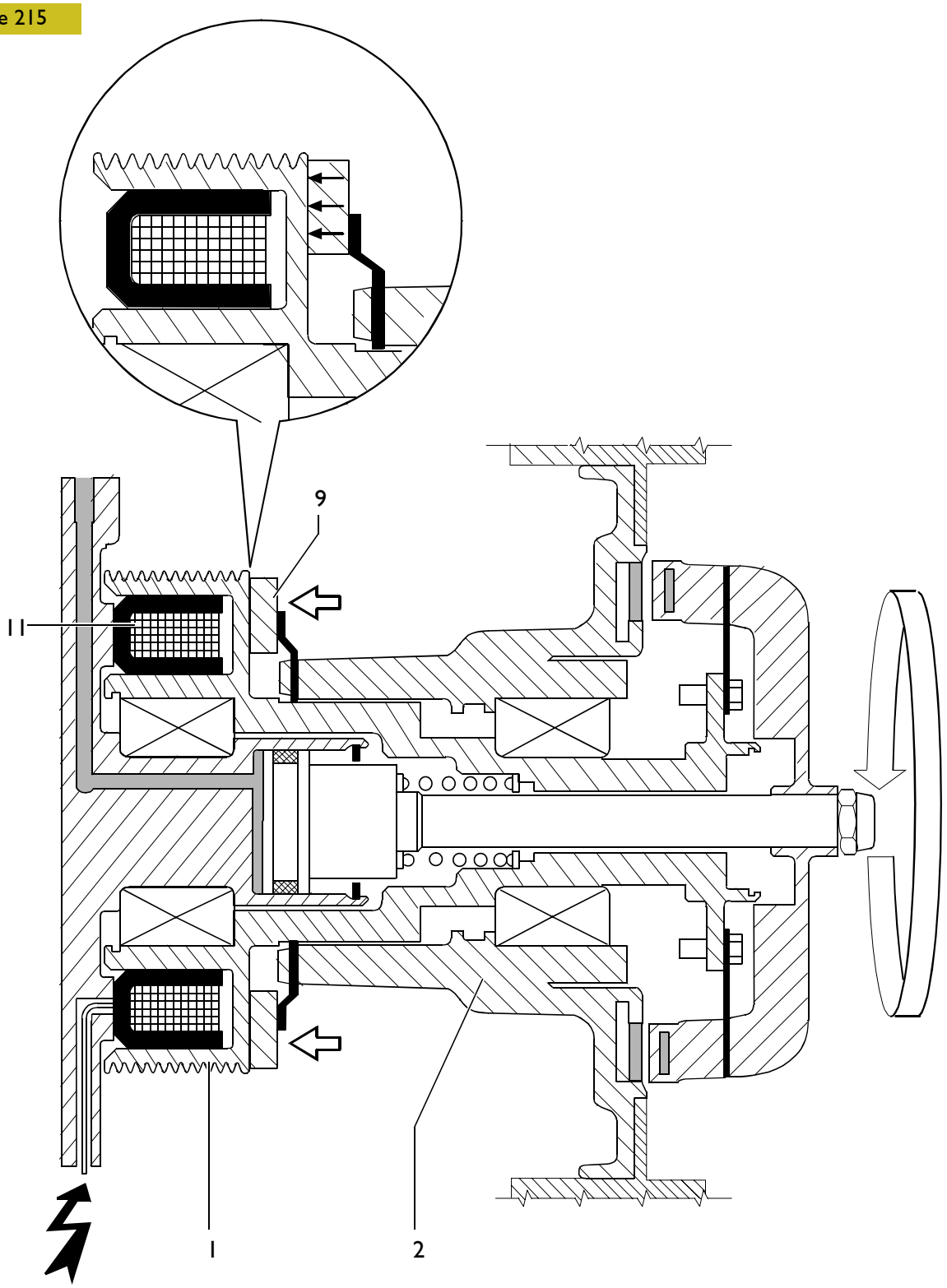
When low speed action is required, the Front Frame Computer center discharge air from duct (10) through the compressed air electro valve; piston (8) moves and draws permanent magnets (3) towards fan hub (2). Piston travel is ensured by return spring (7) and blades (4).

The shaft rotates at the same speed as pulley (1) and the effect of the magnetic field generated by magnets (3) is to make fan hub (2) rotate at the maximum speed of 650 rpm.

For F2B the first speed is always connected since there are no pneumatic solenoid valve nor air exhaust system inside the assembly.

Fan with second speed cut it

Figure 215



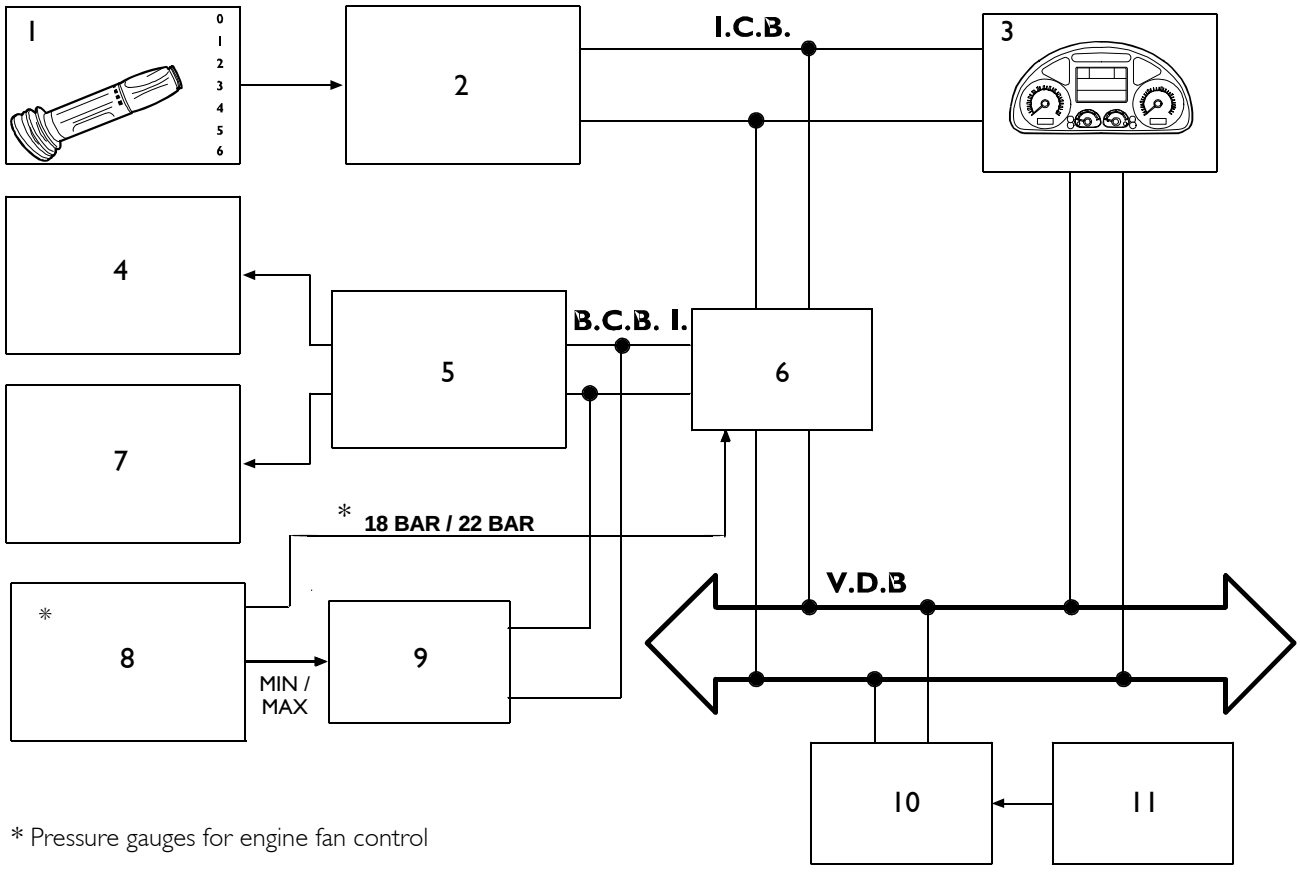
When low speed is not enough to properly cool the engine, the Front Frame Computer center pilots second speed cut-in by exciting coil (11).

The magnetic field generated by the coil attracts fan hub (2) floating ring (9) to pulley (1) making the two units solidal.

In this condition fan speed is the same as pulley speed.

Fan control diagram

Figure 216



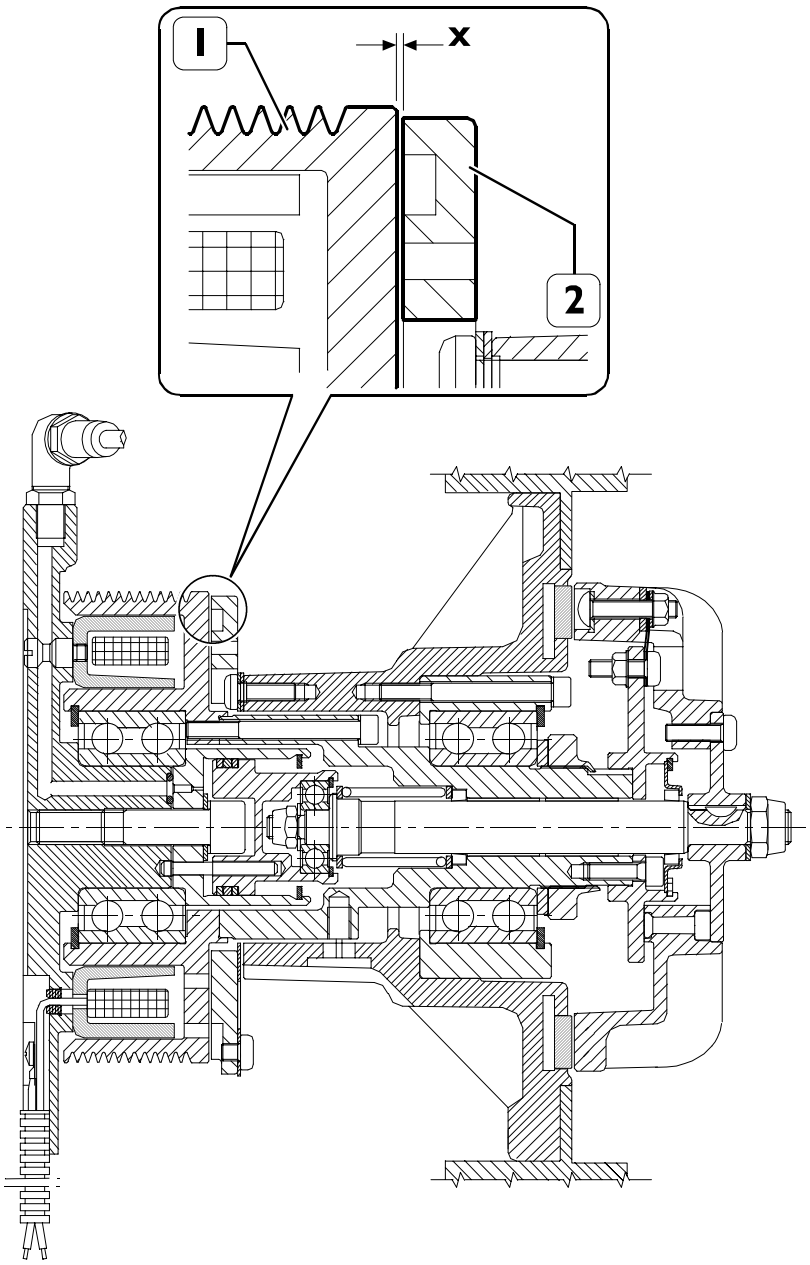
1. Engine brake switch - 2. Steering Wheel Interface - 3. Instrument Cluster - 4. Fan electro valve - 5. Front Frame Computer - 6. Body Computer - 7. Fan electro valve - 8. Conditioner pressure switches - 9. Conditioner - 10. EDC - 11. Water temperature sensor - * The pressure switches involved in fan control are the (18-22 bar) conditioner coolant pressure warning ones.

Defect identification

Defect	Cause
The fan always rotates at low speed	- Air supply pipe clogged - Air supply pipe broken
The fan does not rotate above 650 rpm (low speed)	- Center output does not pilot the coil - Interruption of the center to coil wire - Coils short-circuited - Improper mechanical parts sliding
The fan always rotates at second speed	- The center output always pilots the coil - Improper mechanical parts sliding

Electric fan wear check

Figure 217



In rest conditions, gap X between pulley (1) and floating ring (2) (subject to wear) must range between 0,5 and 1,2 mm.
Wear up to maximum gap thickness of 2,5 mm is permitted.

VCM (VEHICLE CONTROL MODULE) ELECTRONIC CONTROL UNIT

This Electronic Control Unit is interfaced with the other on-board electronic systems through CAN lines:

- ECB - Engine Control Bus
- VDB - Vehicle Data Bus
- ICB - Instrument Cluster Bus
- FMB - Fuhrpark Managemant Bus

Among the Electronic Control Unit input signals we find those of the accelerator pedal sensor, deviator for signalling (ABS) stop, switch on clutch and switch for Economy function, which previously were connected to the EDC Electronic Control Unit.

The Immobilizer Elec. Cont. Unit is eliminated and the immobilizer antenna is connected to the Elec. Cont. Unit VCM.

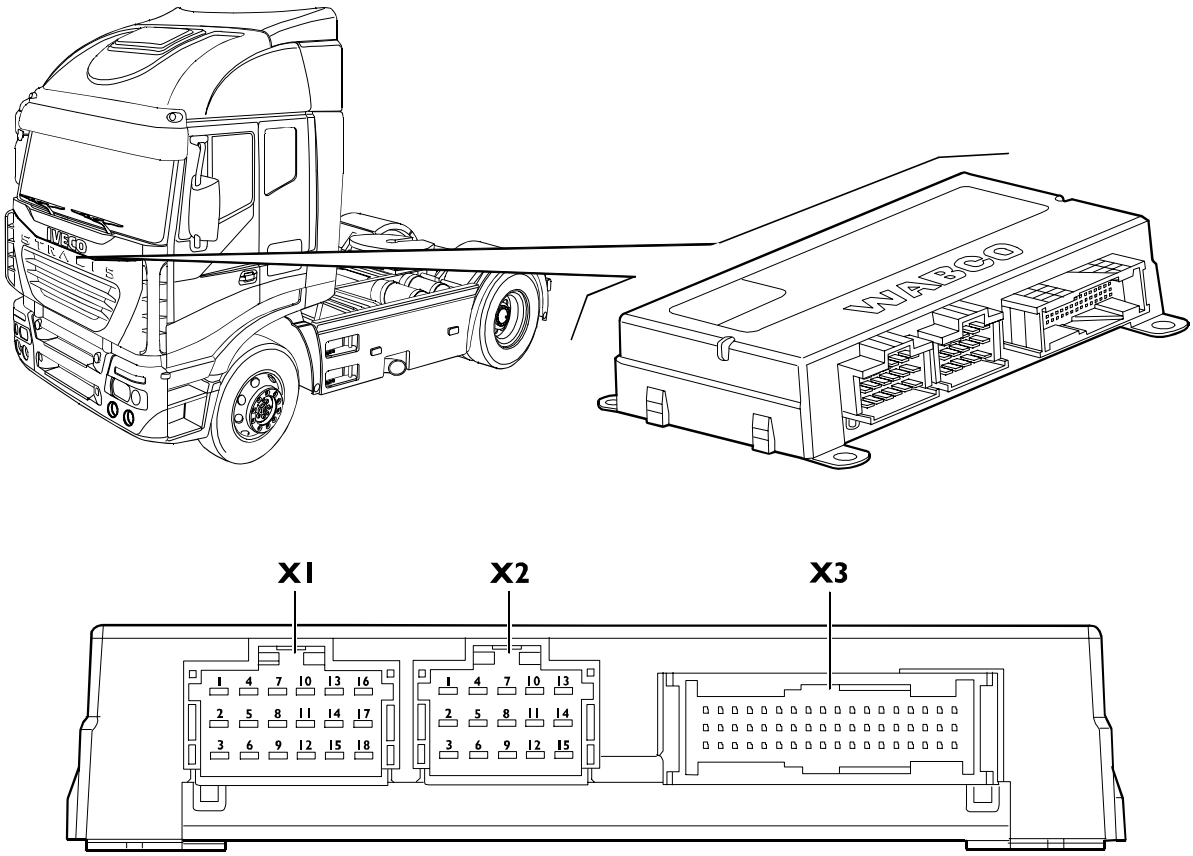
The VCM operates also Cruise Control which before was connected onto Body Computer.

VCM main functions

- **Driveability:** accelerator pedal control and generation of torque requirements via CAN towards the engine according to the driveability maps, Required torque = f (Engine Speed, Accelerator Pedal Position).
- **Arbitration of the requirements of Torque and Engine Speed:** from external systems (Brakes, Transmission, Fitters, etc.) towards the engine during the phases of braking, changing gear, operations in PTO mode, VCM determines the requirement with the highest priority and transmits the corresponding requirement of Torque or Engine Speed via CAN to the engine.
- **Speed limiter:** (main, programmable and secondary) VCM determines the extent of the requirement of torque towards the engine ensuring that the active speed limits are not exceeded.
- **Cruise Control:** VCM adjusts the vehicle speed according to the set Cruise speed by modulating the requirement of torque transmitted via CAN to the engine (torque limitation or control), via the requirement of turning on the exhaust brake and Intarder, integrating the control functions of the conditions of engagement and release.
- **Adaptive Cruise Control:** VCM reads the data of the Radar relating to the distance of the preceding vehicle, adjusts the vehicle speed according to the set Cruise speed, keeping the distance selected by the driver, modulating the requirement of torque transmitted via CAN to the engine (torque limitation or control), via the requirement to turn on the exhaust brake and Intarder, integrating the functions of control of the conditions of engagement and release and in case of risk of collision activating the conventional brakes (interacting with the EBS system).
- **Engine starting / stopping control logic and associated safety devices:** requirement control from cab, engine bay, fitter connector.
- **Power take off (PTO mode):** management of the requirement to adjust engine speed via CAN in accordance with the conditions relating to the PTO 0, 1, 2, 3 (pre-programmed) modes with actuation by the engine.
- **Low Idle control logic:** dynamic High Idle control with requirement relating to the engine via CAN the VCM controls the requirement for engine speed adjustment via CAN with actuation by the engine.
- **Exhaust Brake activation logic:** control of driver requirements and arbitration of the requirements from external systems (Brakes, Transmission, Fitters, etc.), transmission of the value via CAN and actuation by the engine.
- **Engine cooling fan activation logic (Baruffaldi):** management of control logic, transmission of the activation request via CAN and actuation by the engine.
- **ZF Simple H Gearbox:** gearbox control with solenoid activation to pass from low range and high range in conditions of safety
- **ALLISON Gearbox:** standard CAN interface control on lever side, external requirements (Fitters) and for display logic on Instrument Panel.
- **New EUROTRONIC lever (used for ALLISON too):** driver requirement control for sending to EUROTRONIC gearbox and recovery in case of breakdown.
- **Vehicle security system:** Immobilizer
- **Communication on CAN bus:** Point-to-point communication from external bus for dedicated connection to apparatuses of Fleet Management in accordance with Bus - FMS. Interface for connection to Tester for diagnosis via CAN of the on-board systems.
- **Others:** Interface towards Instrument Panel on dedicated bus (ICB on Heavy Range) for information / controls to / from Driver. HW signal generation for fitter connector.

Electronic Control Unit location

Figure 218



108925

Pin - out

Connector 1

Ref.	Cable color code	Description
1		Immobilizer antenna input signal
2		Immobilizer antenna output signal
3	7993	+30 Positive
4	8802	+15 positive
5	0000	Earth
8	6179	Attained ACC (Adaptive Cruise Control) distance control warning light power supply
9	6150	Faulty EDC system warning light power supply
11	1166	Power supply of distance alarm beep with ACC (Adaptive Cruise Control)

Ref.		Description
7	8179	Positive 5 V for distance control with ACC (Adaptive Cruise Control) at great distance
8	6178	Return from distance selector with ACC (Adaptive Cruise Control)
9	0139	Connector ST 34 pin 4

Ref.	Cable color code	Description
1	WS - Bi	CAN - H line VDB
2	GN - Ve	CAN - L line VDB
7	0179	Connector ST 34 pin 1
11	0166	Negative signal from control, Economy Power function switch
14	8153	Primary signal from brake lights for EDC
15	8158	Secondary signal from brake lights for EDC
17	5158	Throttle pedal sensor power supply
19	WS-Bi	ECB CAN H line
20	GN-Ve	ECB CAN L line
23	0147	Negative signal from automatic transmission neutral position
24	0125	Connector ST05 pin 9
25	0127	Forward drive manoeuvre gear negative signal with automatic transmission
30	8154	Signal from switch to turn off Cruise Control (Off)
31	8155	Signal from switch to recall Cruise Control (Res)
32	8157	Signal from switch to decrease Cruise Control speed (Set-)
33	8156	Signal from switch to increase Cruise Control speed (Set+)
34	0159	Signal from switch signalling engine at idle speed
35	5157	Signal from throttle pedal sensor
37	WS-Bi	FMB CAN H line
38	GN-Ve	FMB CAN L line
39	WS-Bi	ICB CAN H line
40	GN-Ve	ICB CAN L line
41	0126	Connector ST05 pin 12
42	0128	Reverse drive manoeuvre gear signal with automatic transmission
48	0117	Negative signal from reduced gears engaged switch (9-speed manual gearbox)
49	0158	Cruise Control signal (int / ex)
50	9968	Speed limiter
51	0160	Negative signal from VCM clutch switch
52	0158	Negative signal from EDC throttle pedal first switch
53	0157	Negative signal from throttle pedal from control unit
54	2292	VCM control unit fault diagnosis K line

IMMOBILIZER

Description and operation

Vehicles are provided with an immobilizer engine lock that is activated automatically by removing the starter key, to increase protection against theft. Keys are provided with an electronic transponder that transmits a coded signal to an ICU centre that only enables engine start at code recognition.

IMMOBILIZER central unit on Euro 4 vehicles is integrated into VCM.
Main technical features are:

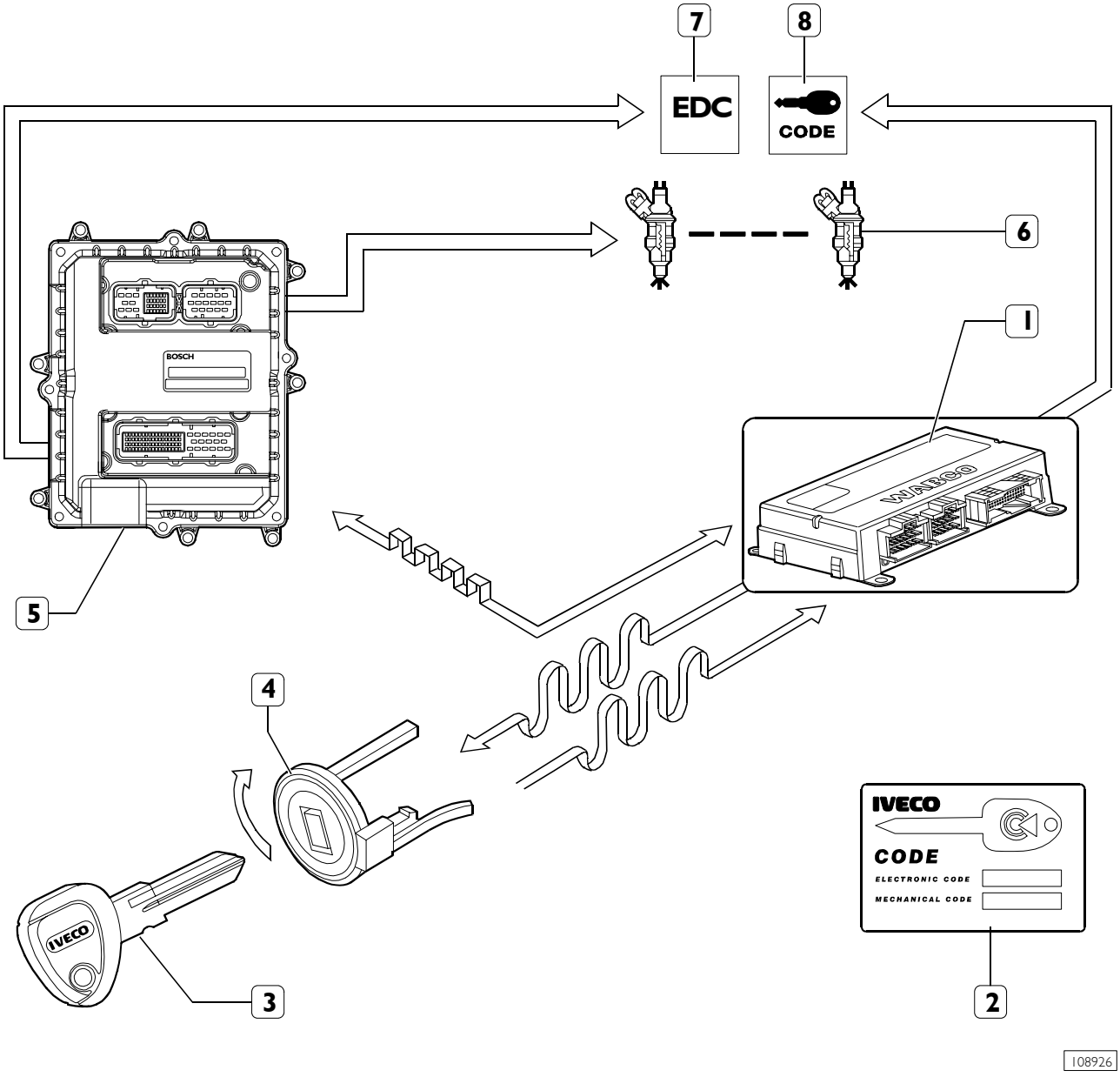
- IMMO central unit integrated into VCM
- New keys (colour BLUE)
- Min 2 max 7 programmable keys
- New antenna connector

VCM / Immobilizer procedures

Replacing a key Adding a key	1) Cut the key into based on existing mechanical profile 2) Provide yourself with Code card 3) Go to environment ENGINE / VCM-IMMOBILIZER \ SPECIFIC FUNCTIONS / KEY STORING
Replacing all keys (loss)	CAUTION! In this procedure, also add working remaining keys, otherwise they will not be enabled any more at start-up. Order the new keys and program them as described above. (Replacing or Adding a key)
Replacing VCM-IMMOBILIZER central unit (NOT COMMUNICATING WITH DIAGNOSIS DEVICE)	1) Replace ECM central unit. 2) Go to environment ENGINE \ ECM-EDC7 UC31 \ SPECIFIC FUNCTIONS \ ACKNOWLEDGING NEW ECM (enter the electronic code that is present on code card). (enter the electronic code that is present on code card). ● If old VCM is out of order and is not communicating any more, ECM must also be either replaced or re-programmed through remote services (Immo code erased). N.B: Only for VCM 5.4 versions ● If old VCM is out of order and is not communicating any more with the other vehicle communication BUSes, the emergency start via electronic code insertion is not possible.
Replacing VCM-IMMOBILIZER central unit (NOT COMMUNICATING WITH DIAGNOSIS DEVICE)	1) Cut the keys into based on existing mechanical profile. 2) Perform following operations: a) Go to environment ENGINE / VCM IMMOBILIZER \ PROGRAMMING \ OTHER \ REPLACING VCM b) Go to environment ENGINE \ VCM IMMOBILIZER \ SPECIFIC FUNCTIONS \ KEY STORING (2 new keys) c) Mount the old VCM to make VCM \ ECM disconnection (present 5.4 version) d) Go to environment ENGINE \ VCM IMMOBILIZER \ SPECIFIC FUNCTIONS \ ACKNOWLEDGING NEW VCM e) Remount the new VCM and perform the start-up operation.

Componentry

Figure 219



Componentry

Ref.	Description
1	VCM control unit
2	Code-card
3	Electronic key
4	Antenna
7	Cluster
6	Electro injectors
5	EDC injection control electronic centre
8	IMMOBILIZER down warning light

ABS-EBL ANTI–LOCK BRAKE SYSTEM - ELECTRONIC BRAKE LIMITER SYSTEM

The ABS – EBL braking system is available as an alternative to the EBS system on 4x2 e 6x2 vehicles.

ABS Anti – Lock Brake System

Braking a moving vehicle and is deceleration and stopping distance are essentially dependant on adherence between tire and road surface. Improved braking with an efficient braking system can only be achieved by acting on tire friction features or road surface quality.

Improved braking with an efficient braking system can only be achieved by acting on tire friction features or road surface quality.

Even in optimum conditions, absolutely safe braking is not guaranteed when critical situations have to be coped with, such as low adherence due on a wet or iced road surface, which obliges the vehicle operator to moderate braking action to prevent possible wheel locks and consequent dangerous loss of vehicle control.

The ABS therefore has the function of ensuring vehicle stability in any braking condition by preventing wheel locks independently of road surface conditions and guarantee full exploitation of available adherence.

In essence, the ABS system:

- prevents wheel locks during vehicle braking in and road adherence conditions
- reduces stop distances
- offers operator safety for stability and vehicle control maintenance.

Electronic Brakes Limiter EBL

The EBL function controls rear axle wheel skidding by comparing it with front wheel speed.

Data entering the center are wheel rpm and braking pressure measured by the pressure sensor installed upstream the rear axle ABS modulators.

The center uses these data to calculate vehicle speed and deceleration, rear axle wheel skid and minimum deceleration required.

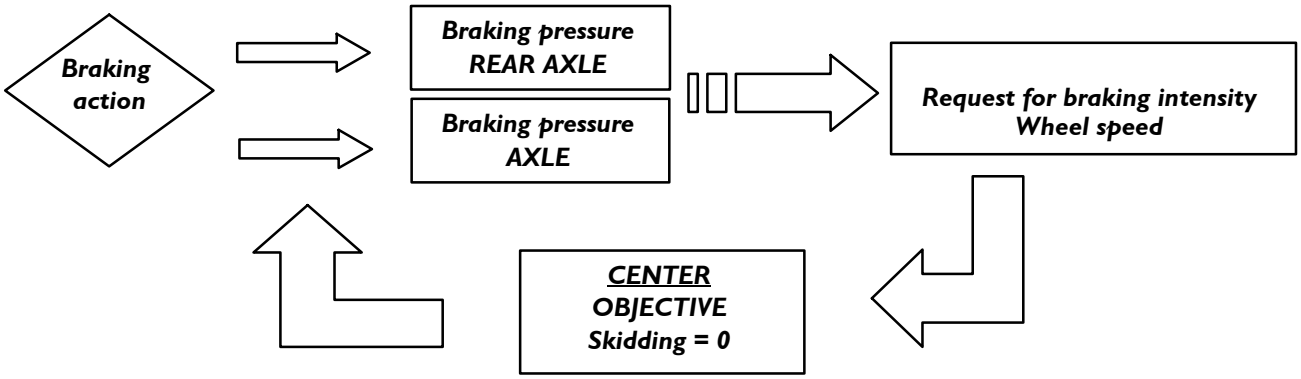
The EBL function is activated with rear ABS modulators maintaining set pressure when the operators applies excess braking force than required for vehicle load conditions, in essence when vehicle deceleration and rear axle skid thresholds are passed.

Operating logic

The objective of the electronic center is to slow down the vehicle as fast as possible, guarantee its stability and avoid the tendency to lock wheels. When braking, the center is informed of the following to reach these objectives:

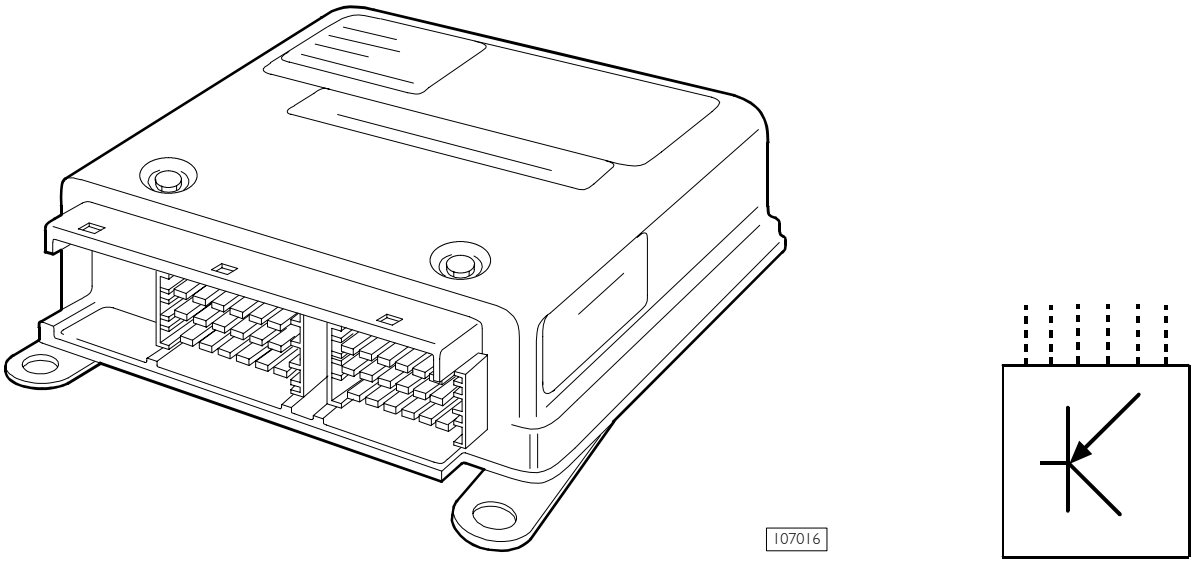
- braking intensity required by the operator via the rear axle pressure sensor
- slowing reaction due to pressures made available via signals from the speed sensors.

Ongoing monitoring and processing of these data referred to the objective set required activation of rear axle modulating valves and consequent braking optimization.



ABS electronic center

Figure 220



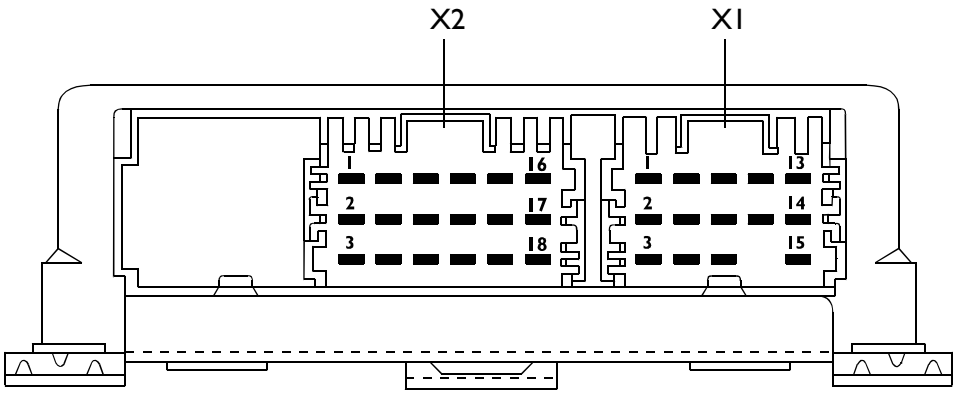
Manages the braking system by setting deceleration to the parameters measured by the various system components.

It communicates with on-board electronic systems via a CAN line and is connected through two polarized connectors.

Though offering the possibility of a blink code displayed via the ASR warning light for preliminary diagnosis, the electronic center is provided with an advanced self-diagnosis system capable of identifying and storing any intermittent anomaly to an operating system subject to environmental conditions, and ensuring proper and reliable repair.

Pin – out ABS center

Figure 221



Connector X1

Pin	Function	Cable
1	CAN line "L"	GN/VE
2	Axle braking detection pressure signal sensor	6245
3	CAN line "H"	WS/BI
4	Mass	0000
5	Negative from switch ABS	0049
6	Negative from switch ASR	0048
7	Power positive under key	8847
8	Power positive direct from battery	7710
9	Mass	0000
10	K line for diagnosis connector (pin 4)	2299
11	L line for diagnosis connector (pin 3)	1199
12	Safety bridge pin 9 / 15	---
13	Negative for ASR warning on (Blink – Code)	6672
14	Negative for third brake cutout	0029
15	Negative for defective ABS warning	6670

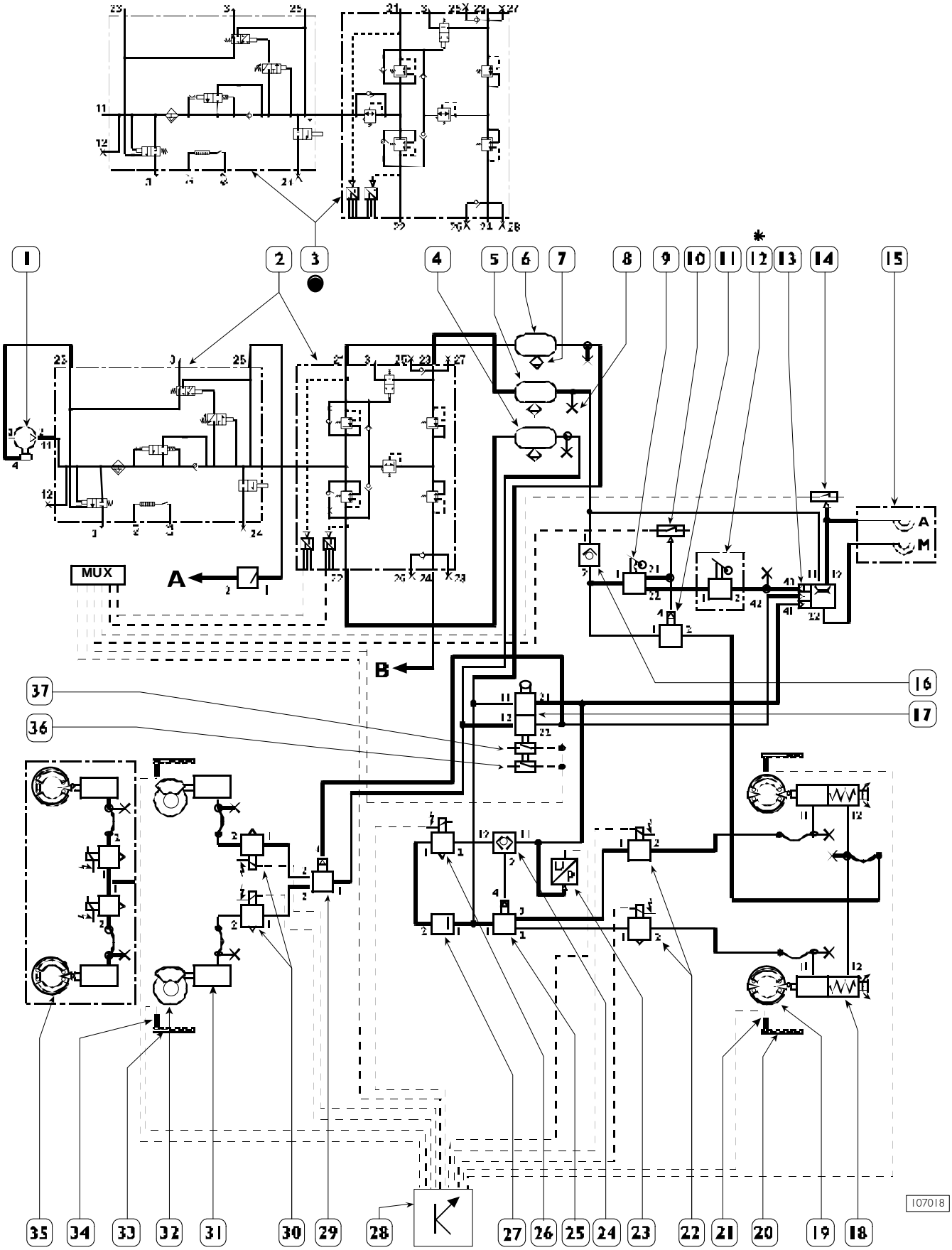
Connector X2

Pin	Function	Cable
1	Positive for front right ABS power electro valve	9920
2	Positive for rear left ABS power electro valve	9931
3	Positive for front left ABS power electro valve	9921
4	Positive for front right ABS discharge electro valve	9918
5	Positive for rear left ABS power electro valve	9929
6	Positive for front left ABS power electro valve	9919
7	Negative for ASR axle electro valve	0260
8	Positive for rear right ABS power electro valve	9930
9	Positive for rear right ABS discharge electro valve	9928
10	Front right sensor	5571
11	Rear right sensor	5572
12	Front left sensor	5570
13	Front right sensor	5571
14	Rear left sensor	5572
15	Front left sensor	5570
16	Positive axle ASR electro valve	9260
17	Rear right sensor	5573
18	Rear right sensor	5573

ABS-EBL compressed air system basic diagrams

ABS-EBL 4x2 Carriages

Figure 222

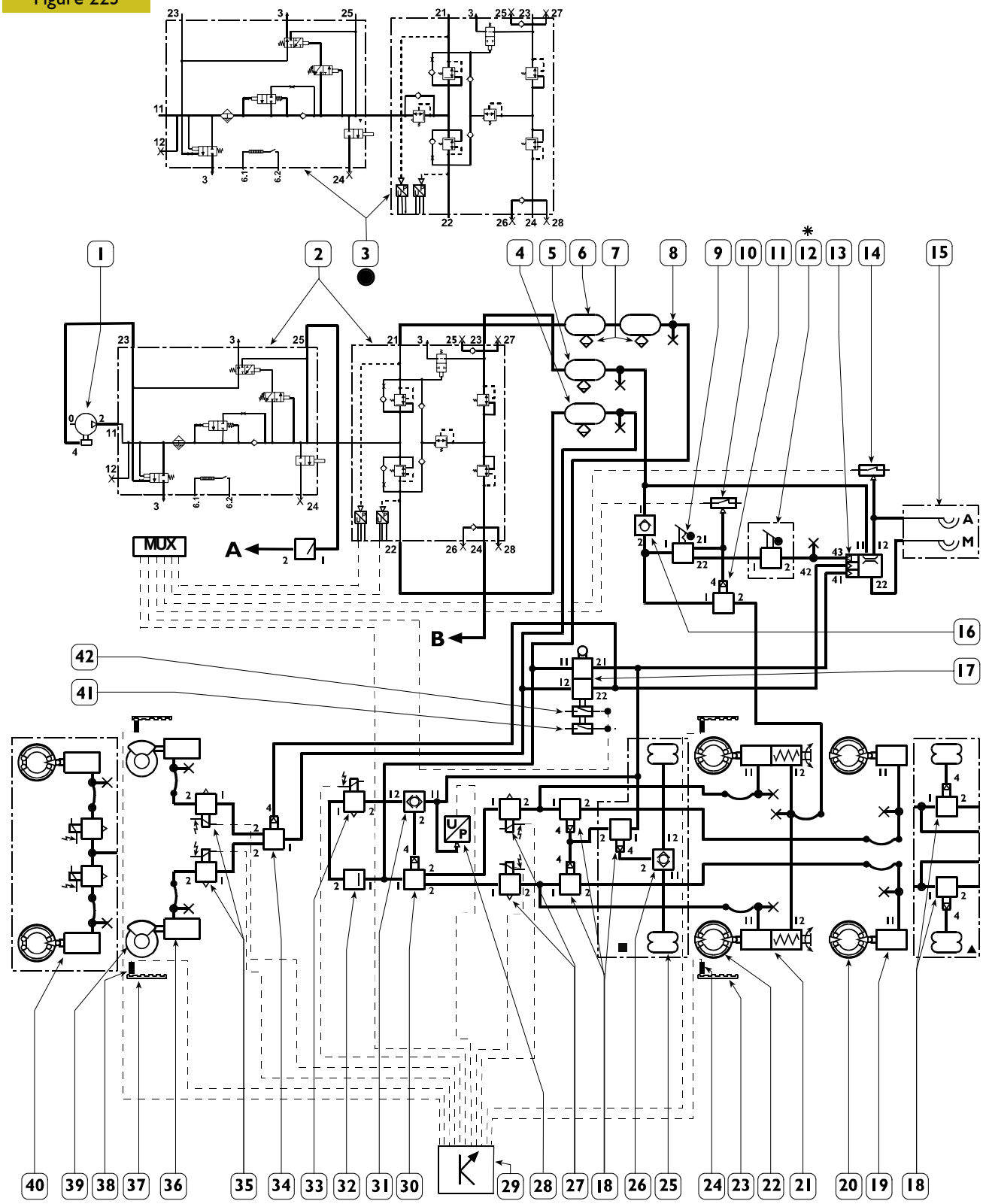


ABS-EBL system for 4x2 Carriages (Legend)

Ref.	Description
1	Two-cylinder compressor ES – 465 cc
2	Air Processing Unit - 10.5 bar
3	Air Processing Unit – 12.5 bar
4	20 l Axle air reservoir
5	20 l Axle parking reservoir
6	20 l Axle air reservoir
7	Manual discharge valve
8	Compressed air control PTO
9	Parking hand control distributor
10	Hand brake low 6.4 bar pressure switch on
11	Parking control relay valve
12	Trailer slowing hand distributor
13	Trailer braking control servo distributor
14	Trailer low 6.4 bar pressure switch
15	Trailer coupling half-junctions
16	Parking system one-way valve
17	Duplex distributor
18	Combined axle cylinder
19	Axle drum brake assembly
20	Axle sound wheel
21	Axle speed sensor
22	Axle ABS electro valves
23	EBL pressure sensor
24	Double stop valve
25	Axle braking control relay valve
26	ASR control electro valve
27	ASR 7.5 bar controlled pressure check valve
28	ABS electronic center
29	Axle braking control relay valve
30	ABS axle electro valve
31	Axle cylinder membrane brake
32	Axle disc brake assembly
33	Axle sound wheel
34	Axle speed sensor
35	Axle drum brake assembly
36	Stop light control micro switch
37	Stop light control micro switch
A	To the compressed air suspension system
B	To the service system
*	Optional
●	Only for CM vehicles

ABS-EBL system for 6x2 Carriages

Figure 223



ABS-EBL system for 6x2 Carriages (Legenda)

Ref.	Description
1	465 cc two-cylinder ES compressor
2	10.5 bar air Processing Unit
3	12.5 bar air Processing Unit
4	20 l axle air reservoir
5	20 l parking air reservoir
6	30 l + 20 l axle air reservoir
7	Manual discharge valve
8	Compressed air control PTO
9	Parking control hand distributor
10	Hand brake low 6.4 bar pressure switch on
11	Parking control relay valve
12	Trailer slowing hand distributor
13	Trailer braking control servo distributor
14	Trailer low 6.4 bar pressure switch
15	Trailer coupling half-junctions
16	Parking system one-way valve
17	Duplex distributor
18	Additional axles brake load ratio relay valves
19	Membrane cylinder
20	Additional axle drum brake assembly
21	Combined axle cylinder
22	Axle drum brake assembly
23	Axle sound wheel
24	Axle speed sensor
25	Added axle suspension air springs
26	Added axle load ration double stop valve
27	Axle ABS electro valves
28	EBL pressure sensor
29	ABS electronic center
30	Axle brake control relay valve
31	Double stop valve
32	ASR 7 bar controlled pressure check valve
33	ASR control electro valve
34	Axle brake control relay valve
35	ABS axle electro valve
36	Axle membrane cylinder brake
37	Axle sound wheel
38	Axle speed sensor
39	Axle disc brake assembly
40	Axle drum brake assembly
41	Stop light control micro switch
42	EDC center micro switch
A	To the compressed air suspension system
B	To the service system
*	Optional
●	Only for CM vehicles
■	Version with ASR
▲	Version without ASR

BRAKE SYSTEM EBS2 (ELECTRONIC BRAKE SYSTEM - 2)

Brake system evolution

ABS - EBL type brake system natural evolution provides for an extension to the whole Heavy disk brake range on rear axle with following logic:

Vehicles	Engines	System type	Brake type
Trucks – Tractors	F3A - F3B	EBS	Dis/Dis
6x4	F3A - F3B	ABS	Dis/Tam

EBS2 new generation systems are oriented to improve brake system performance, safety and functionality.

Main differences from previous systems are:

- New components and new Layout: the electronic central unit, axle proportional solenoid valve and Duplex distributor are integrated into a new component called CBU (Central Brake Unit). The CBU integrates all the functions of old components, and, as an innovation, has a back up valve which acts in case of system electric failure.
- Reduction of maintenance costs.
- New functionalities integrated with basis EBS capability allow to improve vehicle stability and drivability (ESP, ARB):

ESP (Electronic Stability Program)

ESP function, joined to EBS abilities, controls vehicle lateral dynamics.

The main objectives of this function are:

- Improving stability, most of all in both understeering and oversteering conditions
- Reducing braking spaces in change of line conditions on slippery roads

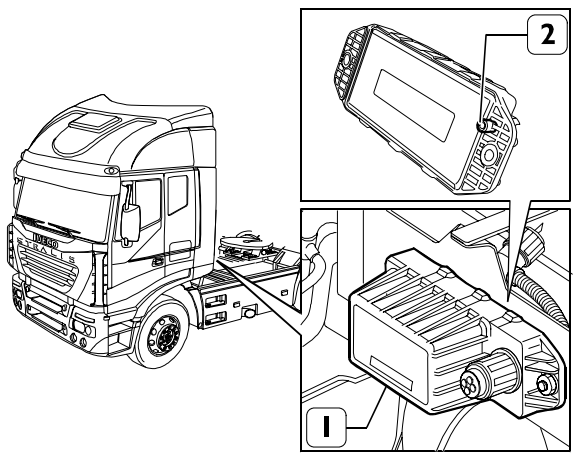
Main central unit input data in order to achieve following objectives, are:

- signal from steering angle sensor (mounted on the steering wheel)
- signals from yaw speed and lateral acceleration sensors (integrated into the ESP module, that is mounted on the chassis and also contains a part of ESP software).

In order to avoid control loss, the ESP will automatically activate the brakes of one wheel per axle only trying to take the vehicle back to correct direction. In this case, the ESP controls towing body skidding angle and slant, as well as the shift between driver's request and actual vehicle yaw speed. To the purpose of withstanding vehicle deceleration, the driving torque will be decreased. In yaw control mode, the ESP very carefully controls driver's reactions and always tries to provide relevant support.

NOTE ESP function is optionally available on tractors only.

Figure 224



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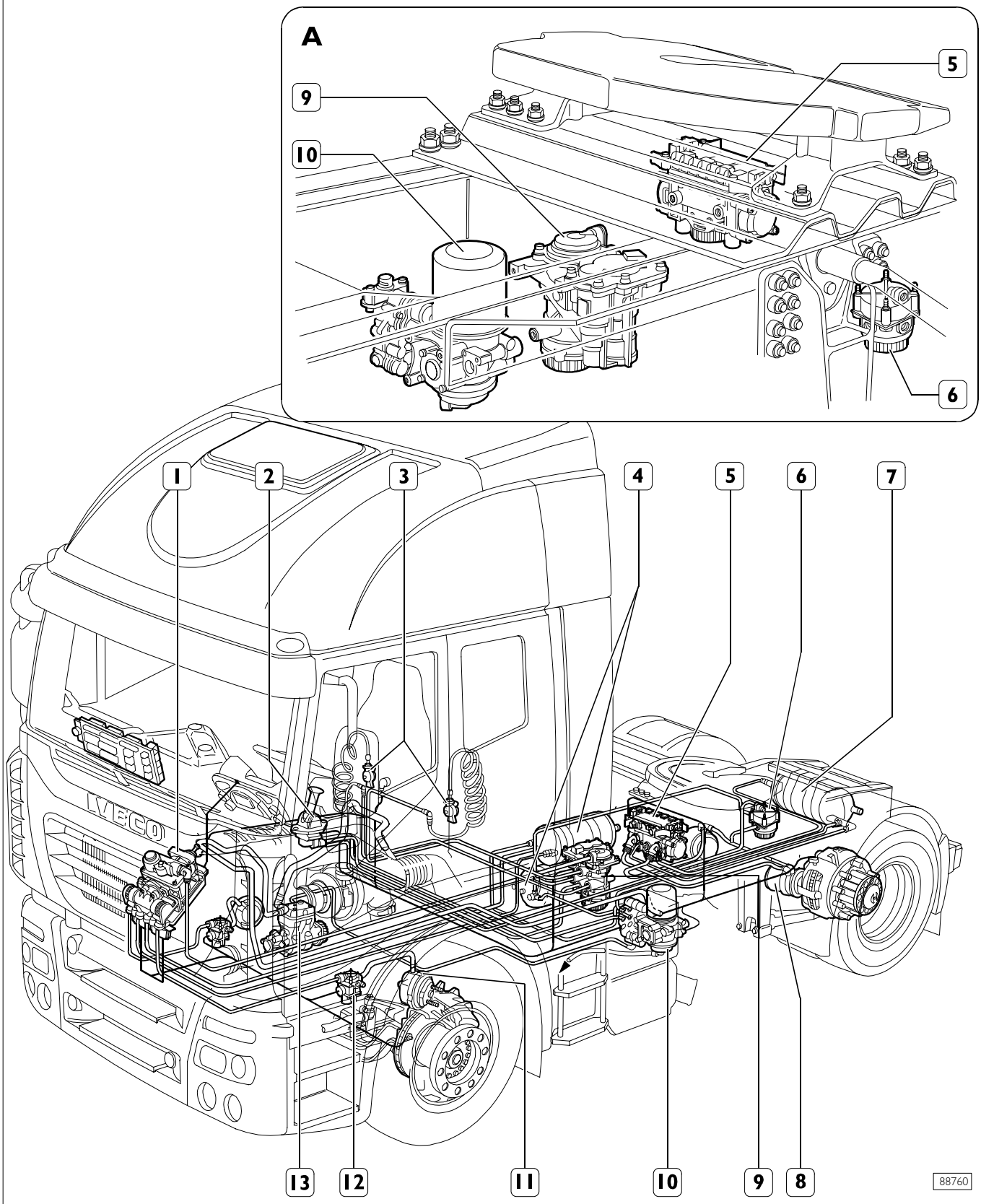
1. ESP module - 2. Reference pin for mounting to support bracket

EBS2 system components location on vehicle (tractors variant)

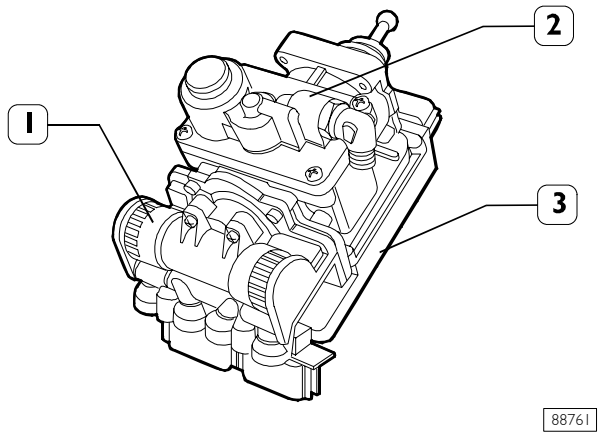
Figure 225



1. CBU (Central Brake Unit) - 2. Hand distributor for parking - 3. Coupling half joints - 4. Air tanks - 5. Axle electropneumatic modulator - 6. Relay valve for parking - 7. Air tank - 8. Spring brake cylinder - 9. Trailer drive servo-assisted distributor - 10. APU - 11. Membrane brake cylinder - 12. ABS solenoid valve - 13. Compressor - A. Real component location 5, 9 and 10.

CBU (Central Brake Unit) (vehicles with EBS2)

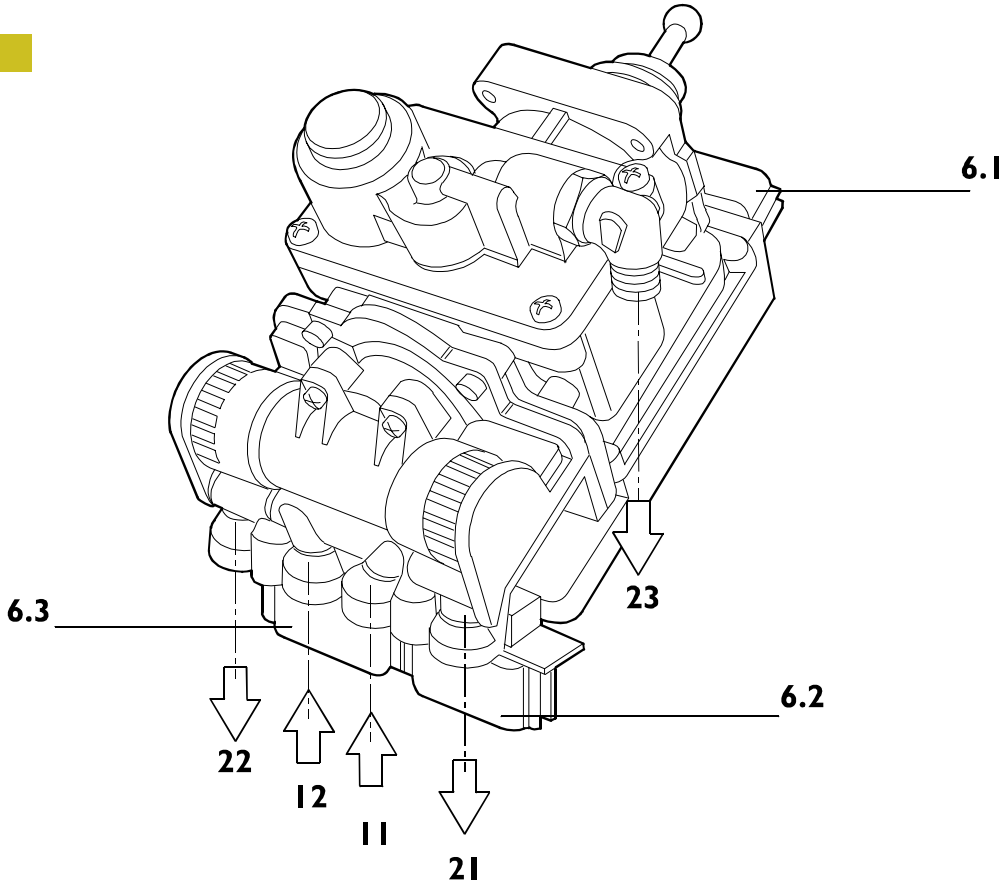
Figure 226



This component integrates the functions of following components:

- duplex distributor, which generates electric and pneumatic signals to increase or decrease pressure in the braking system;
- electronic central unit, which has the task of managing the braking system determining deceleration values as a function of parameters detected from various components;
- proportional relay valve, which modulates pressure at front axle.

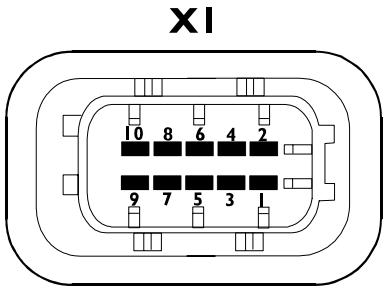
Figure 227



Pneumatic connections	Electric connections
11 - From axle air tank	6.1 - Cab inner side X1 connector
12 - From axle air tank	6.2 - Connector X2 on cab outer side
21 - To ABS solenoid valve	6.3 - Connector X3 on cab outer side
22 - To ABS solenoid valve	
23 - To trailer drive servo-assisted distributor	

Pin – EBS 2 central unit output

Figure 228



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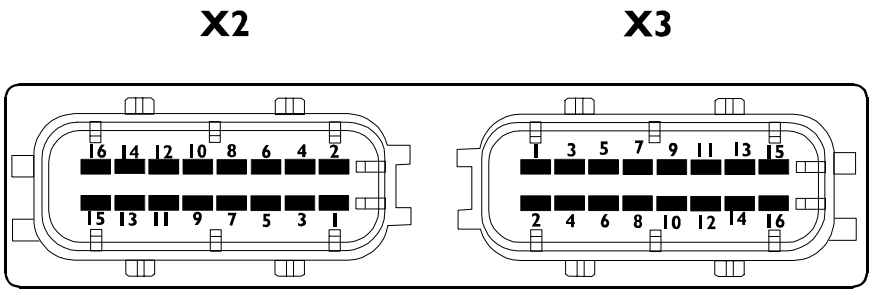
X1 connector

PIN	CABLE	FUNCTION
1	0000	Earth
2	7720	Battery-directed power supply positive
3	7710	Battery-directed power supply positive
4	8847	Locked power supply positive
5	--	--
6	229	K line for diagnosis connector (pin 4)
7	GN/VE	CAN «L» line
8	--	--
9	WS/BI	CAN «H» line
10	0048	Negative from ASR cutoff switch

Figure 229



X2 connector

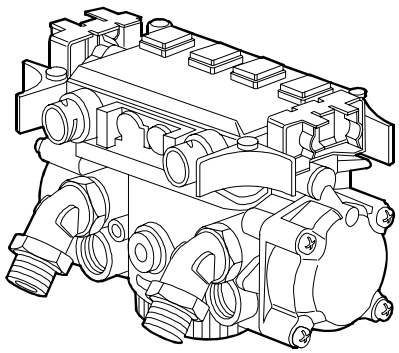
PIN	CABLE	FUNCTION
1	0024	Negative for RH front wheel wear sensor (pin 3 - BR/MA - pin C)
2	6024	Positive for RH front wheel wear sensor (pin 2 - GE/GI - pin B)
3	0226	Negative for LH front wheel wear sensor (pin 3 - BR/MA - pin C)
4	6026	Positive for LH front wheel wear sensor (pin 2 GE/GI - pin B)
5	9920	Positive for RH front ABS feed solenoid valve (pin 3)
6	6025	Signal from RH front wheel wear sensor (pin 1 - SW/NE - pin A)
7	9918	Positive for RH front ABS exhaust solenoid valve (pin 1)
8	6027	Signal from LH front wheel wear sensor (pin 1 - SW/NE - pin A)
9	9921	Positive for LH front ABS feed solenoid valve (pin 3)
10	5571	RH front sensor
11	9919	Positive for LH front ABS exhaust solenoid valve (pin 1)
12	5571	RH front sensor
13	0118	Negative for RH front ABS solenoid valve (pin 2)
14	5570	LH front sensor
15	0122	Negative for LH front ABS solenoid valve (pin 2)
16	5570	LH front sensor

X3 connector

PIN	CABLE	FUNCTION
1	WS/BI	CAN «H» line to SAS steering angle sensor (pin 4) (opt)
2	WS/BI	CAN «H» line to half trailer connector (pin 6)
3	WS/BI	CAN «H» line to ESC module (pin 3) (opt)
4	GN/VE	CAN «L» line to half trailer connector (pin 7)
5	GN/VE	CAN «L» line to SAS steering angle sensor (pin 3) (opt)
6	8275	Positive for SAS steering angle sensor (pin 1) (opt)
7	GN/VE	CAN «L» line to ESC module (pin 4) (opt)
8	8270	Positive for ESC module (pin 1) (opt)
9	--	--
10	--	--
11	WS/BI	CAN «H» line to rear axle modulator (pin 3 - 61)
12	0217	Negative for rear axle redundant solenoid valve
13	--	--
14	9217	Positive for rear axle redundant solenoid valve
15	GN/VE	CAN «L» line to rear axle modulator (pin 4 - 61)
16	7740	Positive for rear axle modulator (pin 1 - 61)

Electropneumatic modulator (vehicles with EBS2)

Figure 230



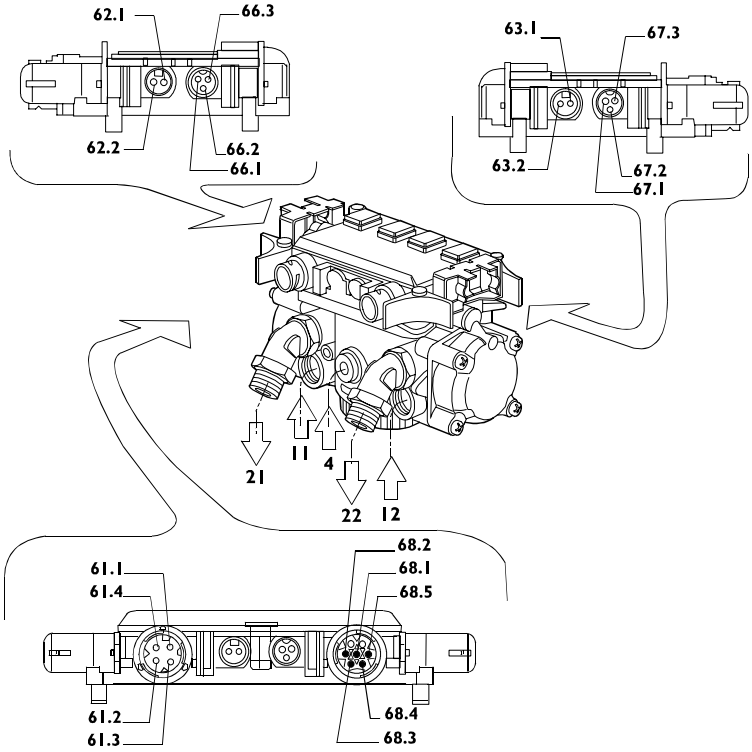
Its task is to modulate pressure at rear axle brake cylinders.

It is provided with an electronic central unit which controls rear r.p.m. sensors and rear axle braking gaskets wear.

This electronic central unit communicates via CAN network with the electronic central unit of the EBS that is integrated in the CBU.

In carts, at gate 4, the redundant valve is connected enabling pneumatic braking in the case of an electric failure.

Figure 231



Pneumatic connections		
11	-	From axle air tank
12	-	From axle air tank
21	-	To (LH) axle brake cylinder
22	-	To (RH) axle brake cylinder
3	-	Exhaust
4	-	Redundant connection

Electric connections			
61.1	-	Positive	Central units connection line
61.2	-	Earth	
61.3	-	CAN "H"	
61.4	-	CAN "L"	
62.1/63.1	-	Speed signal	Speed sensors
62.2/63.2	-	Speed signal	
66.1/67.1	-	Positive	Wear sensors
66.2/67.2	-	Earth	
66.3/67.3	-	Signal	
68.1	-	Positive	Trailer drive valve
68.2	-	Earth	
68.3	-	Signale	
68.4	-	CAN "H"	
68.5	-	CAN "L"	

Pin-out of rear axle pressure modulator
61 connector

PIN	CABLE	FUNCTION
1	77401	Positive from EBS central unit (pin 16 – X3)
2	0000	Earth
3	WS/BI	CAN «H» line to EBS central unit (pin 11 – X3)
4	GN/VE	CAN «L» line to EBS central unit (pin 15 – X3)

62 connector

PIN	CABLE	FUNCTION
1	--	Right rear wheel r.p.m. sensor
2	--	Right rear wheel r.p.m. sensor

63 connector

PIN	CABLE	FUNCTION
1	--	Left rear wheel r.p.m. sensor
2	--	Left rear wheel r.p.m. sensor

66 connector

PIN	CABLE	FUNCTION
1	SW/NE	Signal from RH rear wheel wear sensor (pin 1 - pin A)
2	GE/GI	Positive for RH rear wheel wear sensor (pin 2 - pin B)
3	BR/MA	Negative for RH rear wheel wear sensor (pin 3 - pin C)

67 connector

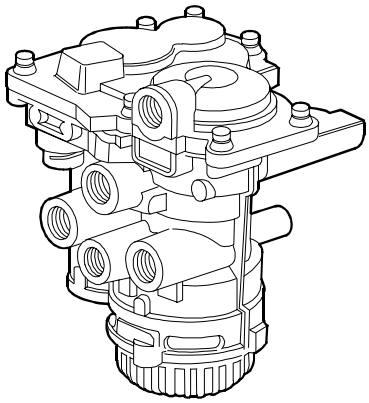
PIN	CABLE	FUNCTION
1	SW/NE	Signal from LH rear wheel wear sensor (pin 1 - pin A)
2	GE/GI	Positive for LH rear wheel wear sensor (pin 2 - pin B)
3	BR/MA	Negative for LH rear wheel wear sensor (pin 3 - pin C)

68 connector

PIN	CABLE	FUNCTION
1	6046	Positive for trailer drive valve pressure sensor (pin 1)
2	0026	Negative for trailer drive valve pressure sensor (pin 2)
3	6047	Signal from trailer drive valve pressure sensor (pin 3)
4	9046	Positive for trailer drive proportional solenoid valve (pin 4)
5	0046	Negative for trailer drive proportional solenoid valve (pin 5)

Trailer drive servo-assisted distributor (vehicles with EBS2)

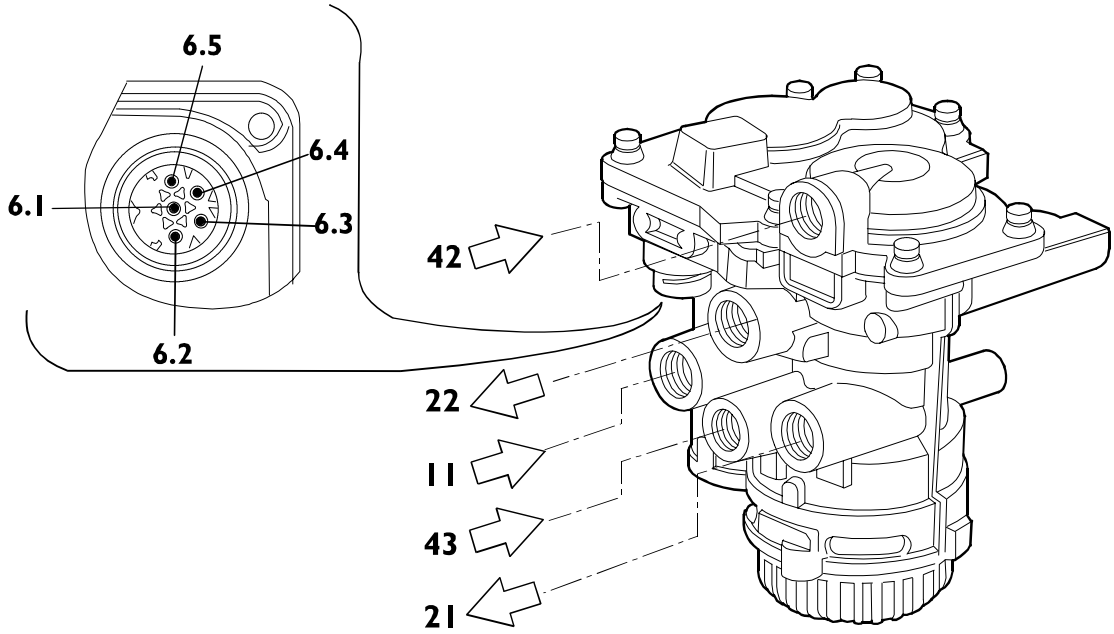
Figure 232



88769

Valve task is to assure both all braking (service, parking, rescue) levels and the adaptation of the prevalence to trailer.

Figure 233



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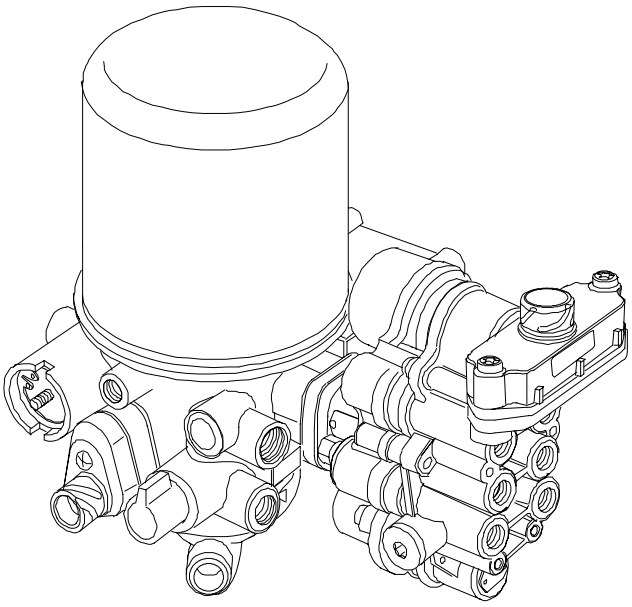
Pneumatic connections			Electric connections			
11	-	From air tank to trailer	6.1	-	Positive	Pressure sensor
21	-	To automatic coupling joint	6.2	-	Earth	Pressure sensor
22	-	To moderable coupling joint	6.3	-	Signal	Pressure sensor
42	-	From (drive) CBU	6.4	-	Positive	Solenoid
3	-	Exhaust	6.5	-	Negative	Solenoid

COMMON COMPONENTS
A.P.U. (Air processing unit) (ABS-EBS2)

Figure 234



107020

It consists of a drier provided with a filter regeneration timer and a 4-way protection valve incorporating a pressure reducer.

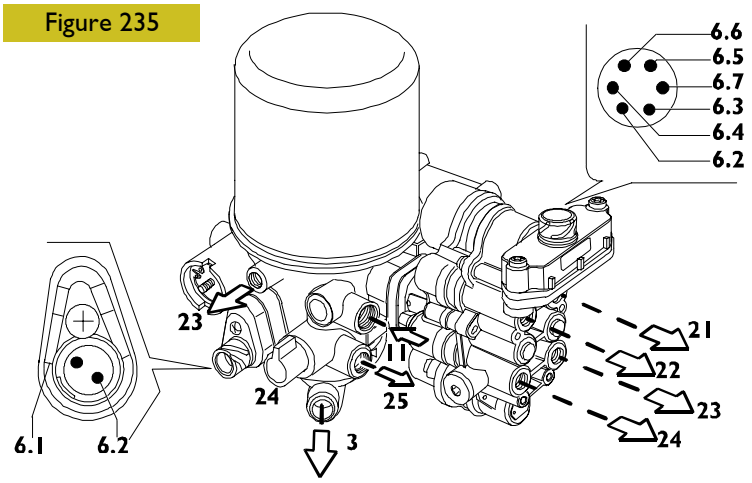
The purpose of the drier is to purify and dry compressed air by adjusting system pressure to its rated value.

The 4-way protection valve distributes air con the various circuits ensuring their operating pressure even in the event of breakdowns.

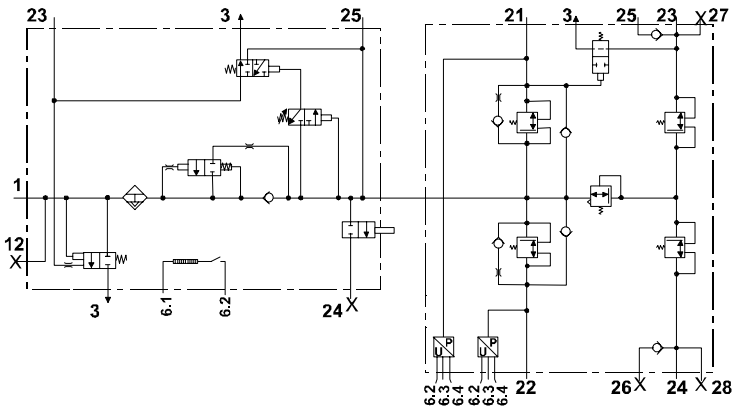
This component is used in all systems and is rated at 10.5 + 0.2 bars; for mobile bowl CM vehicle setting is 12.5 + 0.2 bars.

The APU contains two sensors connected to the MUX system for axle pressure display on the Cluster.

Figure 235



TECHNICAL VIEW



WIRING DIAGRAM

Compressed air connections

1 - Power from the compressor
24 - PTO
25 - Output for 10.5 bar compressed air suspension
23 - To the compressor for Energy Saving control
3 - Venting to outside air
21 - To the 10.5 bar axle reservoir
22 - To the 10.5 bar axle reservoir
23 - To the 8.5 bar parking brake manual distributor and trailer recharge and parking air reservoir
24 - To the 8.5 bar service reservoir

Drier electrical connections

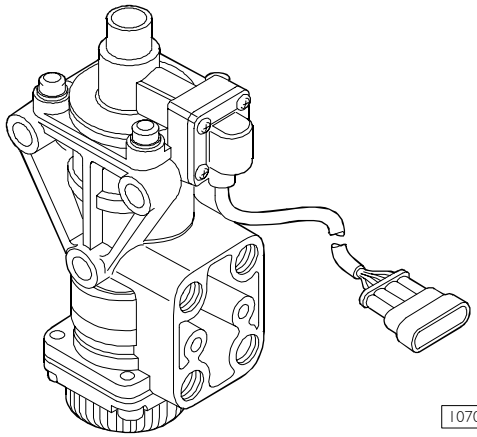
6.1 - Negative for thermostatic resistance
6.2 - Positive for thermostatic resistance

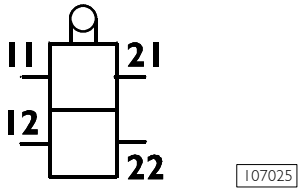
4-way protection valve electrical connections

6.2 - Rear circuit air pressure signal
6.3 - Positive for power
6.4 - Negative
6.5 - Front circuit air pressure signal
6.6 - Positive for power
6.7 - Negative

Duplex distributor (ABS/EBL systems)

Figure 236



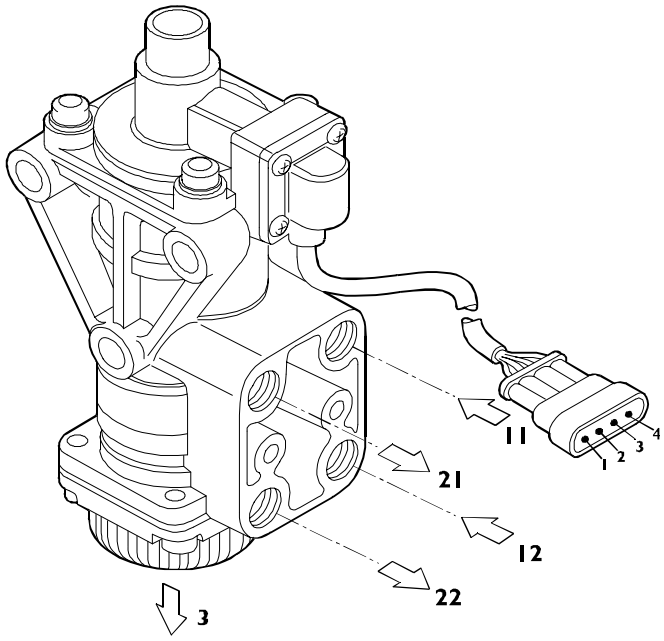


107025

This non self-limited coaxial component consists of a compressed air and an electrical section, the former distributing braking control pressure to the front axle, the rear axle and the trailer control servo distributor.

The electrical section ensures sending the braking signal to the EDC center and to the stop light control relay.

Figure 237



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Compressed air connections:

11 - Power from the axle reservoir

12 - Power from the axle reservoir

21 - Valve output to servo distributor relay valve and trailer control

22 - Valve output to axle relay

3 - Vent to outside air

Electrical connections:

1 - Positive for stop lights/EDC

2 - Input positive

3 - Positive for EDC

4 - Input positive

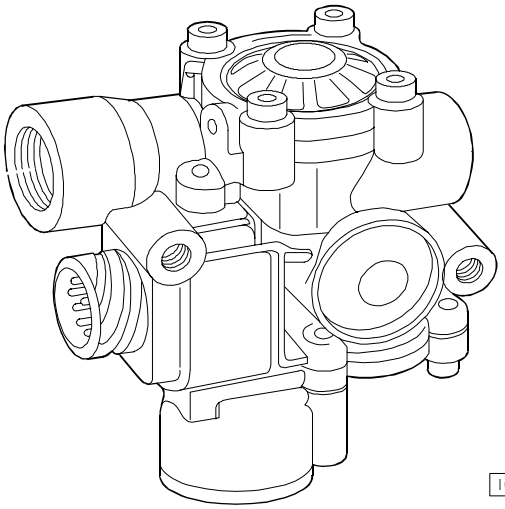
Electro valve ABS/EBS2 78052

This normally open electro valve consists of a power coil and a discharge.

It is used to modulate braking pressure when wheel tendency to lock is detected by the speed sensor.

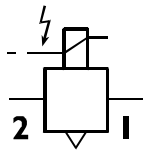
Vehicles with the EBS system feature two of them to control the front axle.

Figure 238



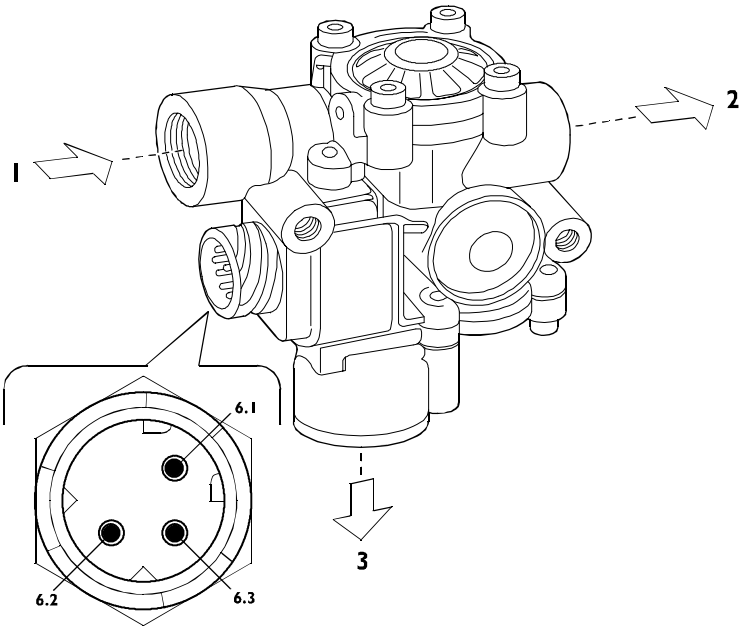
107030

PERSPECTIVE VIEW



107031

WIRING DIAGRAM



107032

Compressed air connections

1 Proportional relay power

2 Axle brake cylinder output

3 Discharge

Electric connections

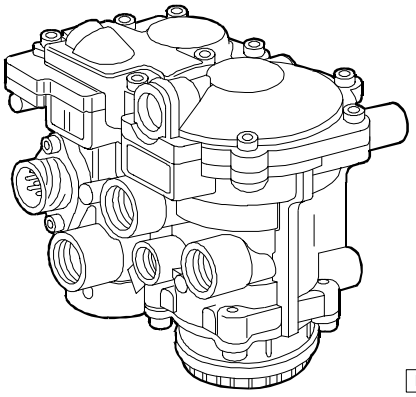
Wheel	Solenoid valve pin 78052	ABS		EBS	
		Cable code	ABS pin	Cable code	EBS pin
Left-hand front LHF	1	9919	X2/6	9919	X4/10
	2	0000	-	0122	X4/12
	3	9921	X2/3	9921	X4/11
Right-hand front RHF	1	9918	X2/4	9918	X3/1
	2	0000	-	0118	X3/3
	3	9920	X2/1	9920	X3/2
Left-hand rear LHR	1	9929	X2/5	-	-
	2	0000	-	-	-
	3	9931	Z2/2	-	-
Right-hand rear RHR	1	9928	X2/9	-	-
	2	0000	-	-	-
	3	9930	X2/8	-	-

Trailer control servo distributor (78058)

The purpose of this component is to supply compressed air power to the trailer and its braking in various operating conditions.

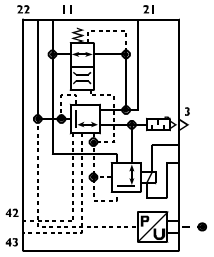
It guarantees service braking via the electronic center electrical control, safety braking in electrical control breakdown conditions via compressed air pressure from the duplex distributor, parking braking via the hand distributor control and emergency braking in duct breakdown conditions via the integrated modulated servo switch device.

Figure 239



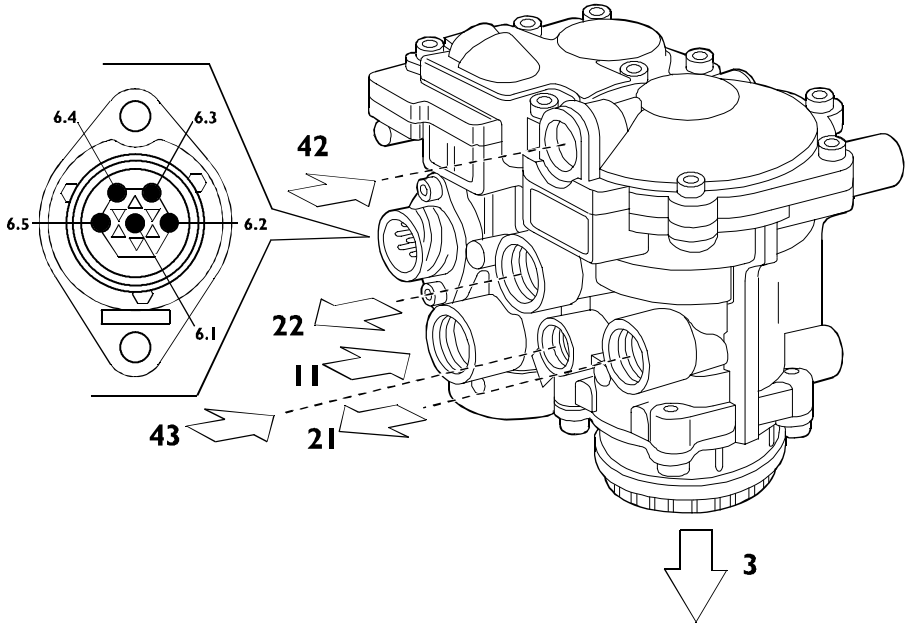
107040

PERSPECTIVE VIEW



107041

WIRING DIAGRAM



107042

Compressed air connections:

11 - Power from the reservoir
21 - Output for the automatic half-shaft
22 - Output for the moderable half-shaft
42 - Control from the duplex distributor
43 - Control from the manual distributor
3 - Discharge

Electrical connections:

6.1 - Positive for sensor (ECU X2 pin 13)
6.2 - Negative for sensor (ECU X4 pin 3)
6.3 - Signal from sensor (ECU X2 pin 14)
6.4 - Electro valve negative (ECU X2 pin 10)
6.5 - Electro valve positive (ECU X2 pin 11)

Sound wheel and speed sensor 88001

Sensors continuously supply the electronic center with all the data it requires to properly pilot the electro valves.

Signals are obtained from magnetic flow lines that close through the teeth of a teethed wheel facing the sensor and rotating together with the wheel.

Passage from full to empty due to the presence or absence of the tooth causes sufficient magnetic flow variation to create induced electromagnetic force at sensor terminals and thus an alternating electrical signal that is sent to the electronic center.

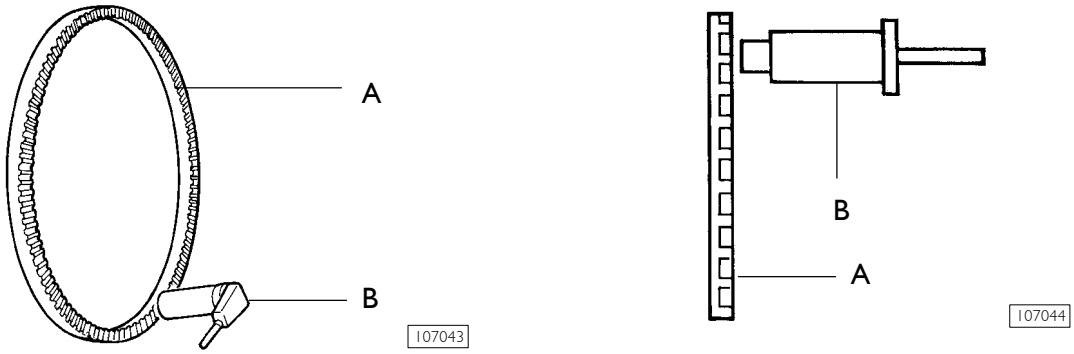
The clearance between the sensor and wheel, called air gap, must obviously be at a pre-set value of 0.8 ÷ 1.6 mm for proper signals to be sent. Resistance of each sensor at connection terminals is between 1 and 2 kW.

The toothed wheel is called sound wheel because the signal it generates has the same frequency as a sound wave.

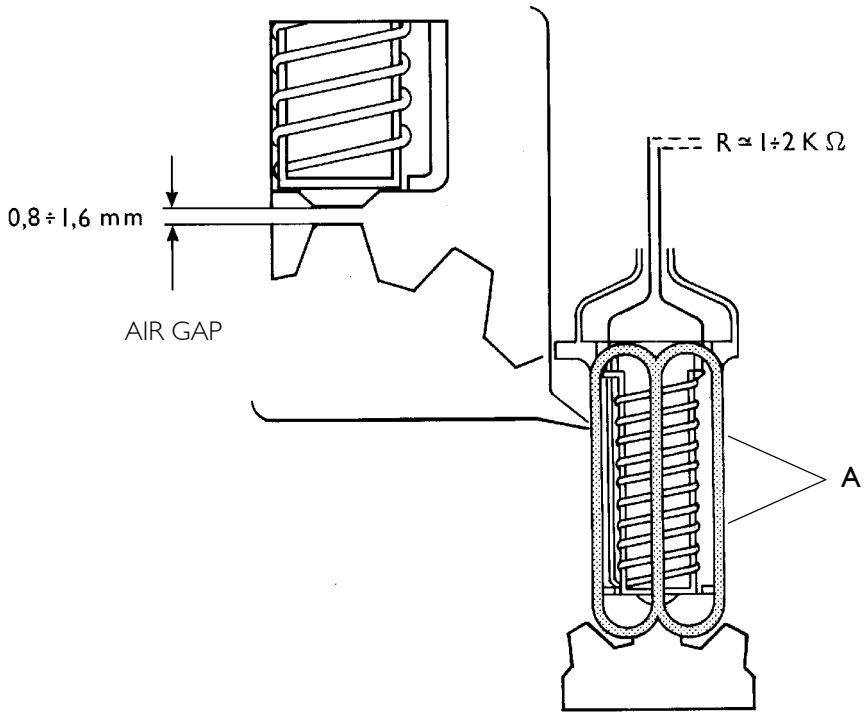
The frequency of this signal serves to define wheel rotation speed.

Frequency variations, or the speed at which signals follow one another, define acceleration and deceleration rates.

Figure 240



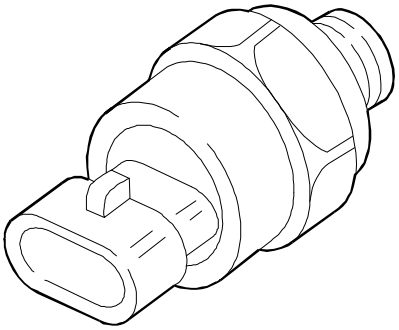
SOUND WHEEL (A) AND SENSOR (B) PERSPECTIVE VIEWS



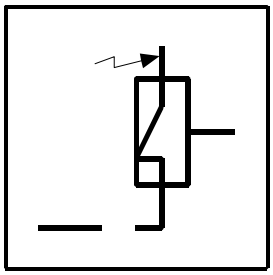
A. Magnetic flow lines

Low pressure switch

Figure 241



107046



107047

It warns the driver, by the warning lights on the CLUSTER, of low pressure in the following systems:

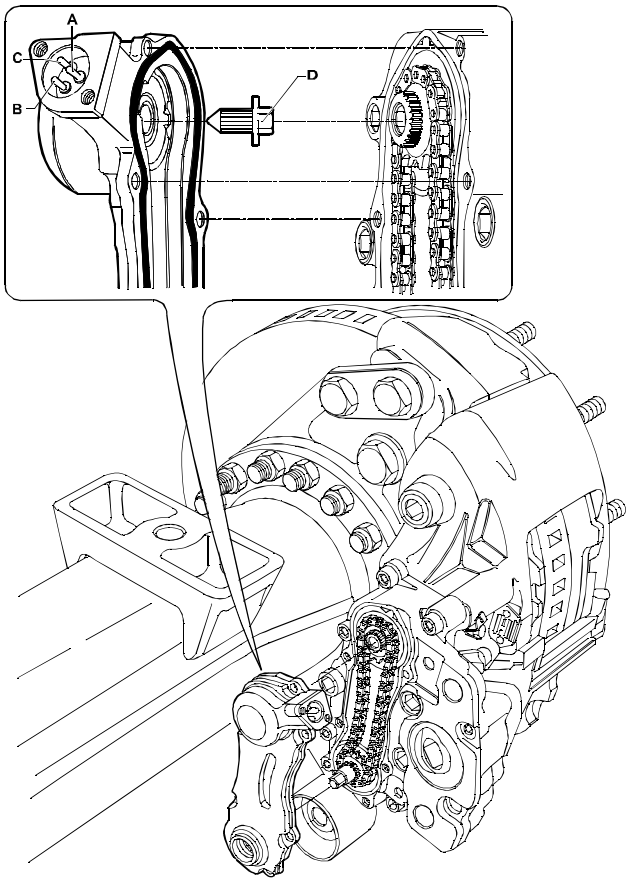
- Hand brake engaged - N.C. 6.6 ± 0.2 bars
- Low trailer pressure recharge - N.C. 6.6 ± 0.2 bars

A normally closed 6.6 ± 0.2 bar switch is also mounted on the axle reservoir to inform the electronic center of any axle circuit low pressure so as to inhibit differentiated axle braking in the ASR function.

Brake pad wear sensor 88007 / 88008 (EBS2)

The signal is sent via the CAN line to the cluster that informs the operator of braking pad wear status with a display.

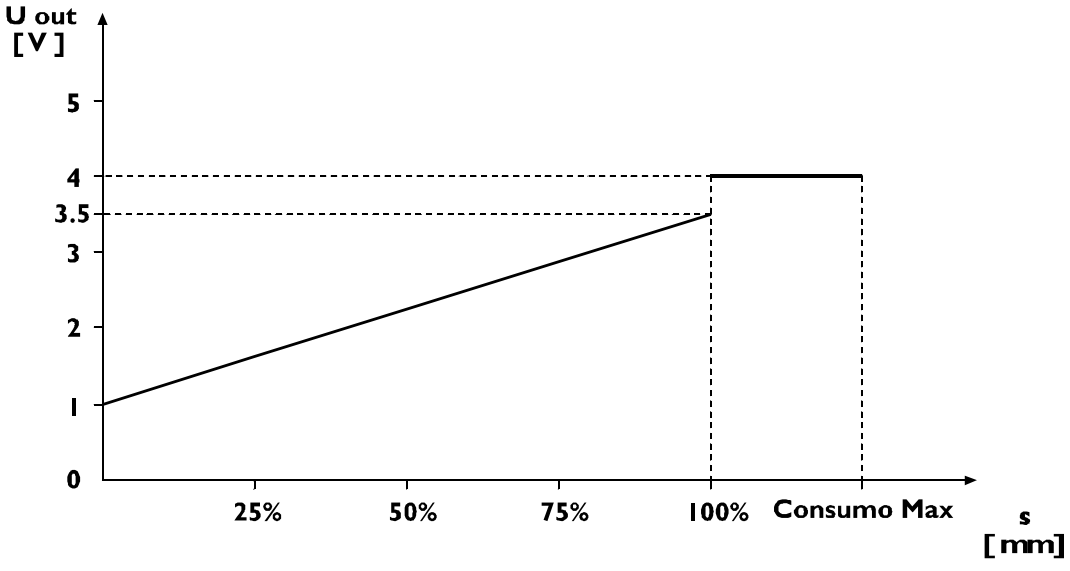
Figure 242



107048

A. Signal - B. Positive - C. Negative - D. Wear warning control pin

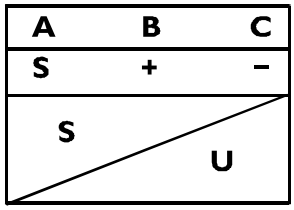
Figure 243



107049

Representation of the electrical signal the sensor sends to the electronic center depends on percent brake pad wear.

Figure 244



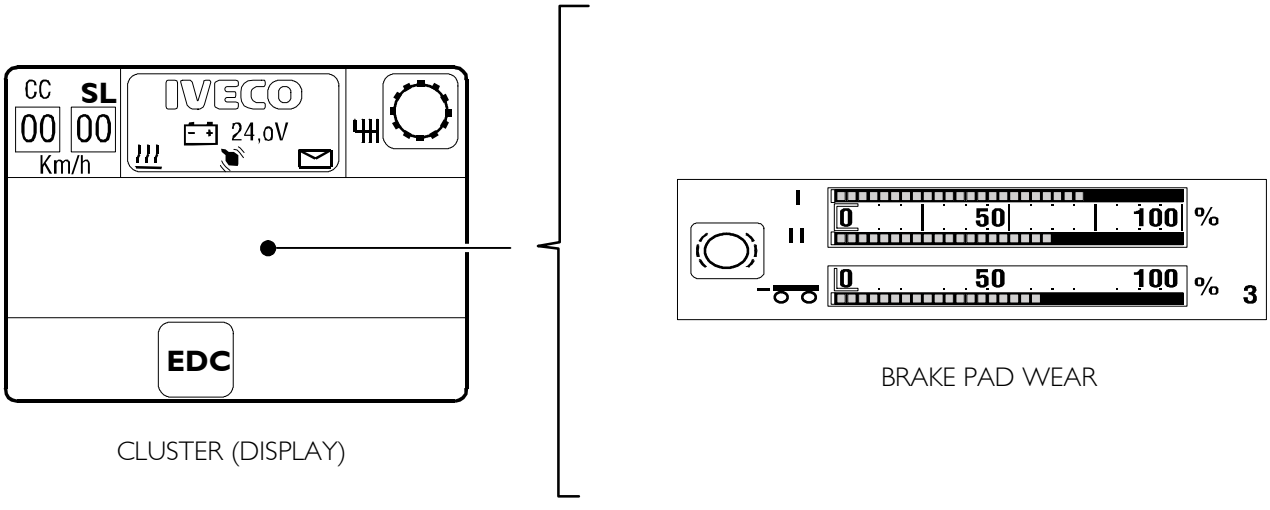
WIRING DIAGRAM
S. Signal - **+** Power - **(-)** Mass

107050

The signal generated by the induction sensor is sent to the EBS center, which sends it via the CAN (VDB) line to the cluster for display and information to the operator on brake pad wear status.

Figure 245

DISPLAY PRESENTATION



CLUSTER (DISPLAY)

BRAKE PAD WEAR

107051

ECAS II SUSPENSIONS

Compressed air suspensions

Compressed air suspensions feature high flexibility, high vibration damping and with system self-adjustment constant frame to road level clearance independently of vehicle load, that can be changed as well as vehicle load height with a special push button provided for this purpose.
In addition to the known advantages offered by compressed air suspension, the ECAS system also features:

- minimized air consumption
- prompt response to adjustment
- simple systems
- top safety level
- complete system diagnosis.

The **Electronically Controlled Air Suspension ECAS** system provides automatic vehicle compressed air suspension rated level monitoring.

All the above operations are subject to operating conditions and connected system safety devices.

The ECAS electronic provides automatic frame ground clearance control via the real values supplied by the sensors, which are compared with stored rated data. In the event of setting deviations or variations, the electronic center pilots the electro-pneumatic units through which it corrects real levels versus those stored previously by the operator.

The system is provided with remote control for frame lifting/lowering and leveling and operations are possible both with the vehicle stationary and moving.

This unit also enables other frame setting level storage and retrieval when required by operating conditions.

Vehicle lifting, lowering and leveling before load and unload operations are via the remote control located on the operator seat side.

The remote control can be extracted from its support so these operations can also be performed from ground level.

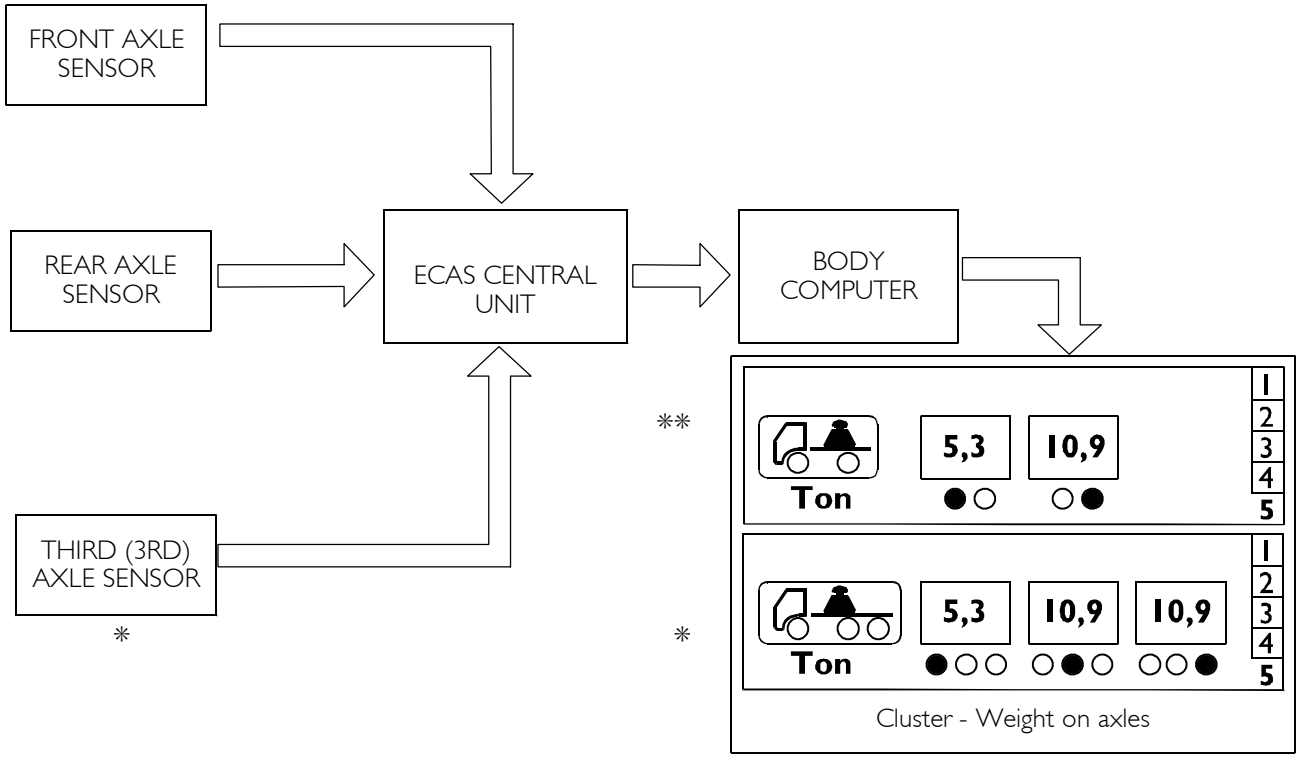
When unloading heavy loads or containers with a crane, the frame can be lowered completely.

Do no stop the engine when warning light (10) goes on.
If warning light (9) goes on when the vehicle moves, stop the vehicle and turn the ignition key to STOP; return it to MAR after about 7 seconds. Contact the Service Network if warning light (9) does not go off after some two seconds.

Axle Load function is available as an option.
In version 4x2 P-FP, it is previewed for the electrical system the use of the central unit present in version 6x2 (of course, 3rd axle, together with its components, is not present).

Load on the axles

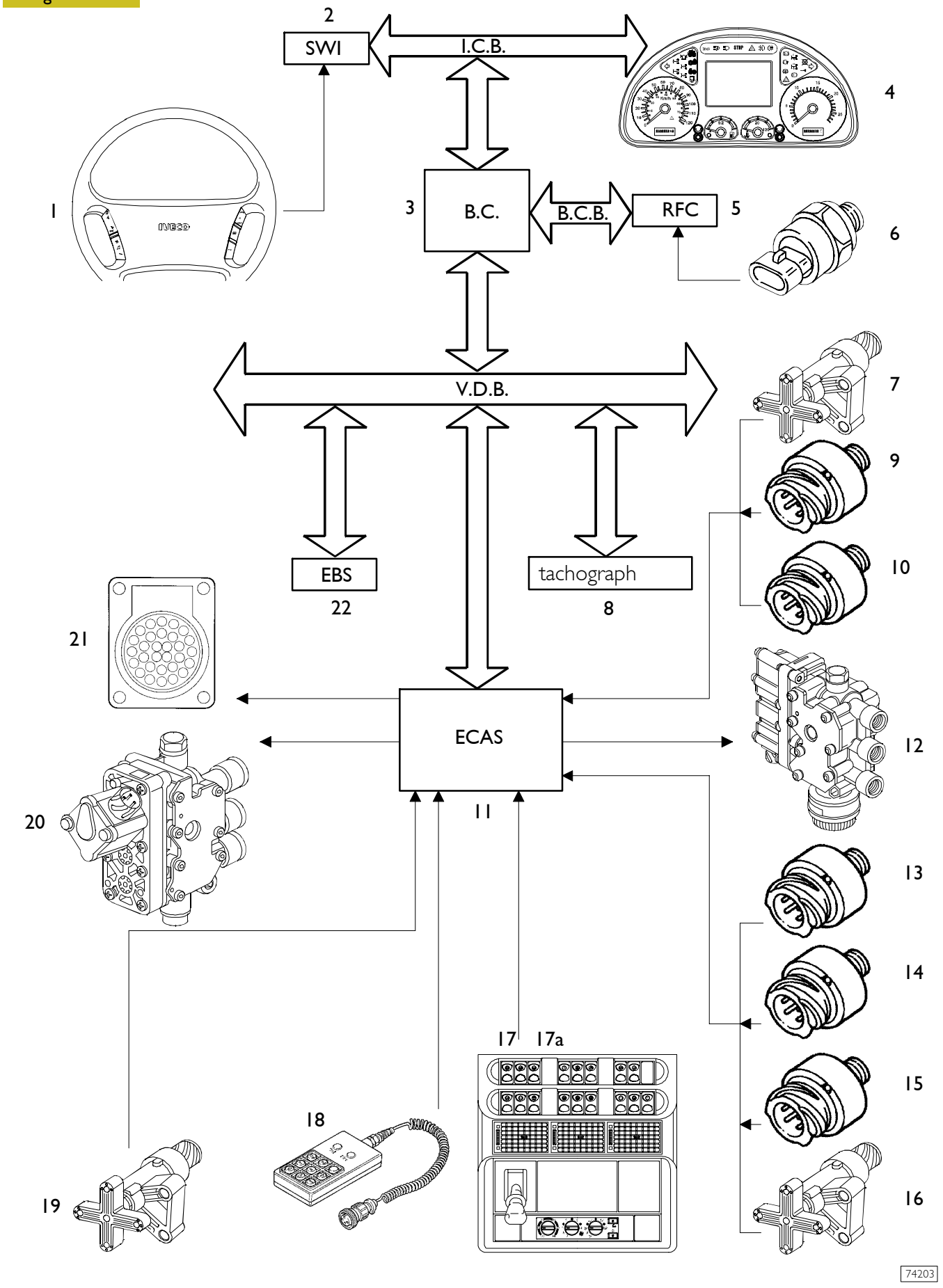
Figure 246



* 6x2

** 4x2

Figure 247

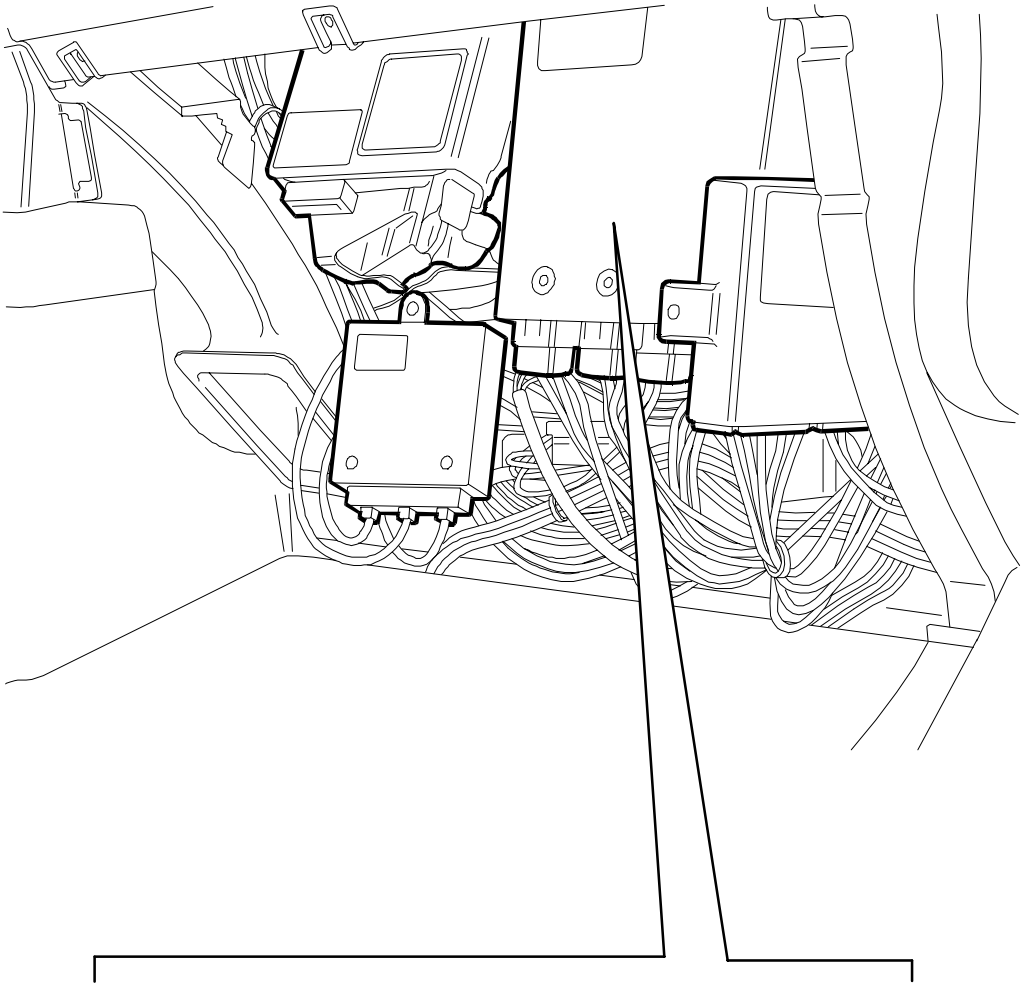

2
SWI
I.C.B.
4
1
3
B.C.
B.C.B.
RFC
5
6
V.D.B.
7
9
10
EBS
22
tachograph
8
21
ECAS
12
20
11
13
14
17
17a
15
18
19
16
74203

Ref.	Description	Component code
1	Steering wheel	-
2	Steering Wheel Interface	86123
3	Body Computer	86116
4	Cluster	50005
5	Rear Frame Computer	86118
6	Low pressure sensor	42200
7	Right rear axles level sensor	40046
8	Electronic tachograph	-
9	Right engine axle sensor	42381/A
10	Left engine axle sensor	42381/B
11	ECAS electronic centre	86023
12	Axle electro valve unit	-
13	3rd axle compressed air lift sensor	42389
14	Right 3rd axle air pressure sensor	42382/A
15	Left 3rd axle air pressure sensor	42382/B
16	Left axle level sensor	40046/B
17	Start support control switch	53030
17a	3rd axle left switch remote control	53309
18	Suspension remote control	85065
19	Axle level sensor	40046/A
20	Axle electro valve unit	78239
21	Diagnosis connector	72021
22	EBS electronic centre	88005

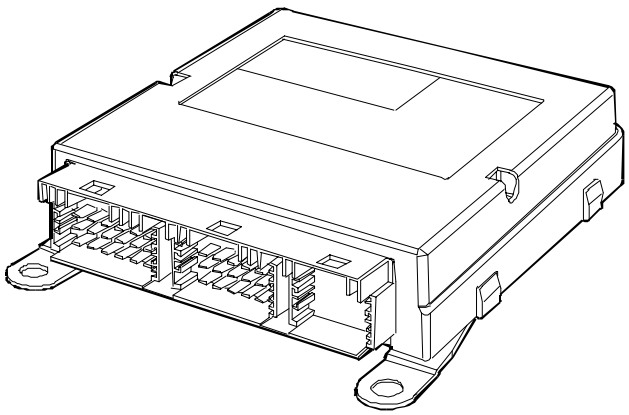
ECAS electronic center

Vendor	WABCO
Voltage	18 ÷ 30 Vdc
Heat range	-40 to 75 °C

Figure 248



73667

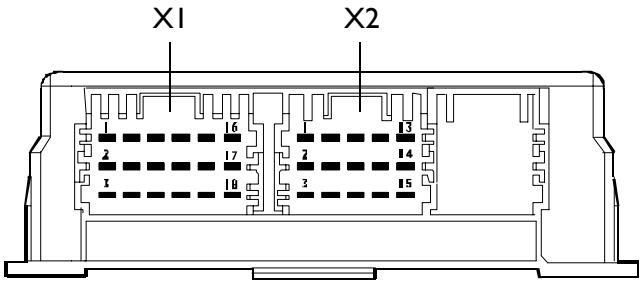


107052

ECAS electronic center

ECAS center for 4x2 P tractore rear compressed air suspension system

Figure 249



107053

* without load indicators

Connector X1

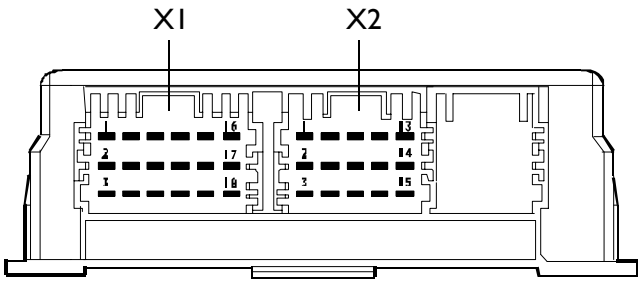
Pin	Cable	Function
1	GN/VE	CAN "L" line
2	---	---
3	WS/BI	CAN "H" line
4	---	---
5	8445	Positive from manual leveling push button (Optional)
6	---	---
7	7440	Power positive direct from battery
8	6402	Remote control communication line (pin 3)
9	2294	K line for diagnosis connector (pin 4)
10	8810	Power positive under key
11	6403	Remote control communication line (pin 4)
12	0000	Mass
13	8810	Remote control power positive (pin 1)
14	---	---
15	0402	Negative for remote control (pin 2)
16	---	---
17	---	---
18	---	---

Connector X2

Pin	Cable	Function
1	8403	Positive for pressure sensors (pin 1)
2	5443	Signal from pressure sensor on RH rear axle (pin 3)
3	---	---
4	9400	Positive for bridge electro valve (pin 2)
5	---	---
6	---	---
7	0400	Negative for level sensor (pin 2)
8	5421	Positive for level sensor (pin 1)
9	---	---
10	---	---
11	9423	Negative for power electro valve (pin 1)
12	---	---
13	9424	Negative for rear frame management electro valve (pin 3)
14	---	---
15	---	---

ECAS center for 4X2 FP tractor and 4X2 P/FP and 6X4 P carriage front/rear compressed air suspension system

Figure 250



107054

* without load indicators

Connector X1

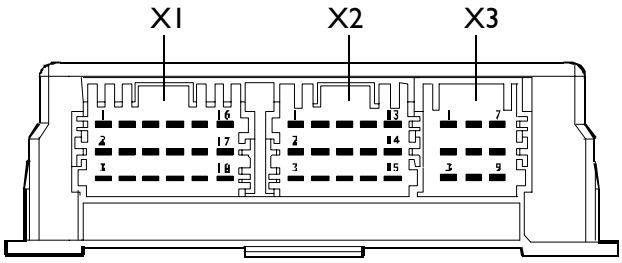
Pin	Cable	Function
1	GN/VE	CAN "L" line
2	---	---
3	WS/BI	CAN "H" line
4	---	---
5	8445	Positive from manual leveling push button (Optional)
6	---	
7	7440	Power positive direct from battery
8	6402	Remote control communication line (pin 3)
9	2294	Diagnosis connector K line (pin 4)
10	8810	Power positive under key
11	6403	Remote control communication line (pin 4)
12	0000	Mass
13	8810	Remote control power positive (pin 1)
14	---	---
15	0402	Remote control negative (pin 2)
16	---	---
17	---	---
18	---	---

Connector X2

Pin	Cable	Function
1	8403	Positive for pressure sensors (pin 1)
2	5443	Signal from pressure sensor on RH rear axle (pin 3)
3	5440	Signal from pressure sensor on front axle
4	9400	Positive for axle (pin 4 and pin 2) electro valve
5	5422	Positive for left axle level sensor (pin 1)
6	5444	Signal from pressure sensor on LH rear axle (pin 3)
7	0400	Negative for level sensor (pin 2)
8	5421	Positive for right axle level sensor (pin 1)
9	5410	Positive for axle level sensor (pin 1)
10	9425	Negative for left rear frame management electro valve (pin 3)
11	9423	Negative for power electro valve (pin 1)
12	---	---
13	9424	Negative for right rear frame management electro valve (pin 2)
14	---	---
15	9413	Negative for front frame management electro valve (pin 1)

ECAS center with pin-out 6x2 P – PT – FP - O rear/front axle compressed air suspension system

Figure 251



Connector X1

Pin	Cable	Function
1	GN/VE	CAN "L"line
2	---	--
3	WS/BI	CAN "H"line
4	8445	Signal from 3rd axle lift/lower push button
5	8445	Positive from manual leveling push button (Optional)
6	8460	Positive from start support push button
7	7440	Power positive direct from battery
8	6402	Remote control communication line(pin 3)
9	2294	Diagnosis connector K line(pin 4)
10	8810	Power positive under key
11	6403	Remote control communication line(pin 4)
12	0000	Mass
13	8810	Remote control power positive (pin 1)
14	---	--
15	0402	Negative for remote control (pin 2)
16	---	--
17	---	--
18	---	--

Connector X2

Pin	Cable	Function
1	8403	Positive for pressure sensors (pin 1)
2	5443	Signal from pressure sensor on RH rear axle (pin 3)
3	5440	Signal from pressure sensor on front axle
4	9400	Positive for axle electro valve (61-62 / pin 4 and 2)
5	5422	Positive for left axle level sensor (pin 1)
6	5444	Signal from pressure sensor on LH rear axle (pin 3)
7	0400	Negative for level and pressure sensors (pin 2)
8	5421	Positive for right axle level sensor (pin 1)
9	5410	Positive for axle level sensor (pin 1)
10	9425	Negative for rear left axle management electro valve (61 - pin 3)
11	9423	Negative for power electro valve (61 - pin 1)
12	9446	Negative for right added axle management electro valve (62 - pin 1) (C - PT)
13	9424	Negative for rear right axle management electro valve (61 - pin 2)
14	9447	Negative for left added axle management electro valve (62 - pin 3) (C - PT)
15	9413	Negative for front/rear frame management electro valve (pin 1)

Connector X3

Pin	Cable	Function
1	9442	Negative for added axle lifting electro valve (62 - pin 1) (C - PT)
2	---	--
3	5442	Signal from left added axle pressure sensor (pin 3) (C - PT)
4	5441	Signal from right added axle pressure sensor (pin 3) (C - PT)
5	5445	Signal from lifter air spring pressure sensor (pin 3) (C - PT)
6	---	--
7	---	--
8	---	--
9	---	--

* present in version 4x2 (P/FP) with load function (axle load function)

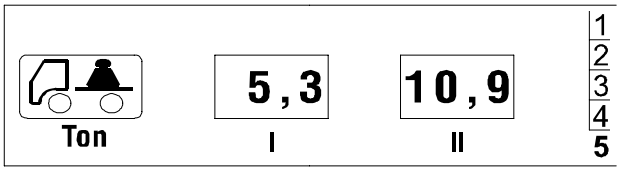
AXLE LOAD METER

Axle load indication is available on the instrument panel display unit of vehicles with pneumatic suspension axles.
By using this functionality, vehicles pneumatic suspension axle weights are shown.
The system provides for up to 4 axles indication.
Measure indicated for information purposes is only consistent with the vehicle stopped. Any values indicated with the vehicle moving are not real.
Loads indicated are for information purposes only.

Activating function

Turn ignition key to position MAR [ride] with engine off.
Choose trip menu pressing key Page on steering wheel and choose page 5.
In connection with vehicle configuration, there will appear on the menu one of following indications:

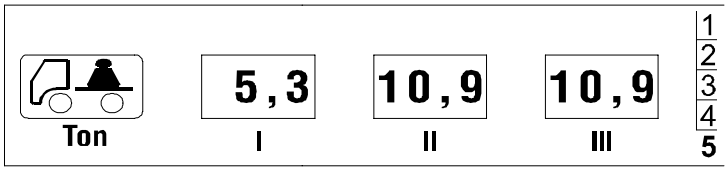
Figure 252



2-axle vehicle

106333

Figure 253



3-axle vehicle

106334

In presence of an axle without a pneumatic suspension, matching symbol is shaded.

Indication tolerance is +2%.
In case of lifted axle there appears measure = 0.0.

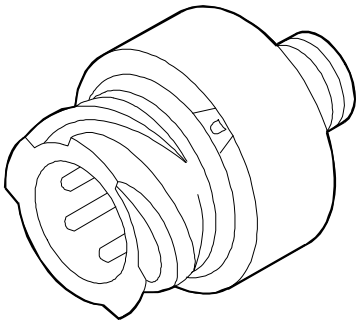
Indication disappears in following cases:
- during chassis level adjustment through suspension ECAS system;
- during chassis lifting/lowering operations through remote control.

PRESSURE SENSORS

This component, that is the same for all systems, is installed on air springs and has the task to acquaint electronic central unit about the variation of pressure/load existing inside the springs.

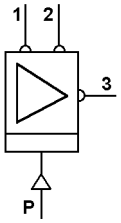
This will be useful to central unit to evaluate the different load distribution among axles, in order that it can enable added axle management to a larger or smaller extent.

Figure 254



106302

Figure 255



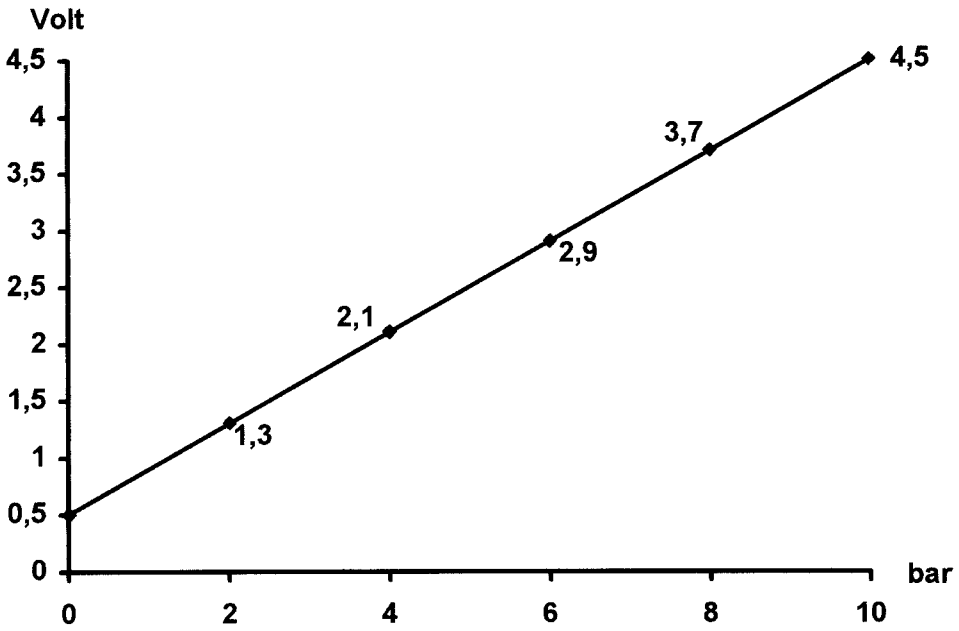
106303

Examined component is connected to the system by a three-pole connector:

- Pin1 - power supply positive
- Pin2 - negative
- Pin3 - signal

Below there is shown pressure sensor characteristic curve depending on pressure present in air springs.

Figure 256



106304

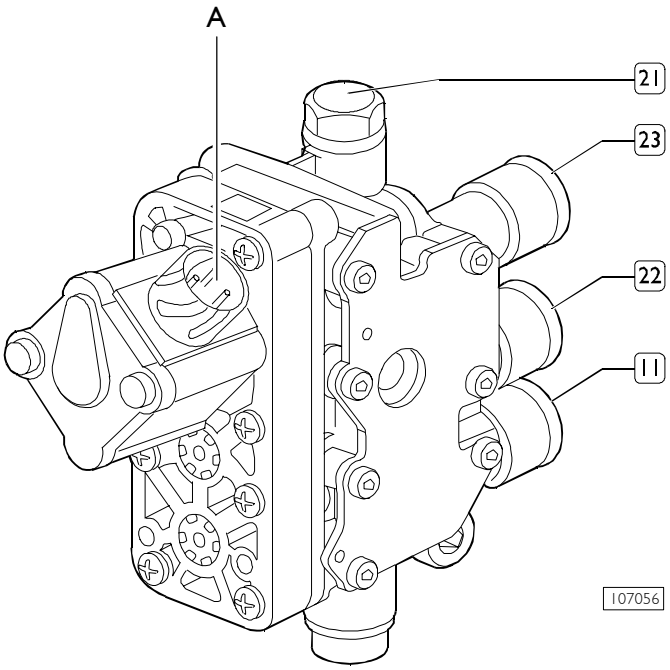
Electro-pneumatic axle distributor for 4x2 – 6x2 – FP tractors

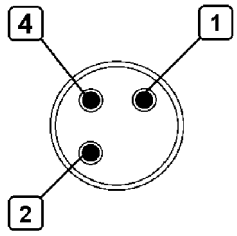
This component is used on all integral suspension vehicles. It consists of a control electro valve and two compressed air distributors for managing both axles sides.

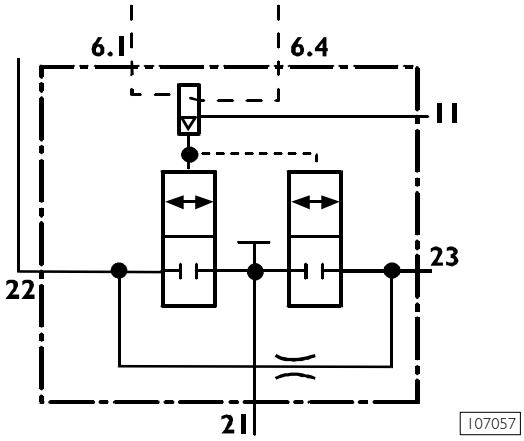
A calibrated hole is provided to prevent pressure overflow between the air springs and consequently stabilize the axles on the internal connection between the two outputs.

The distributor is connected to the system via a 3-pole connector (A).

Figure 257







Connector	Description
1	Electro valve control negative (6.1)
2	Positive (6.4)
4	---

Electro-pneumatic axle for 4x2 P tractors

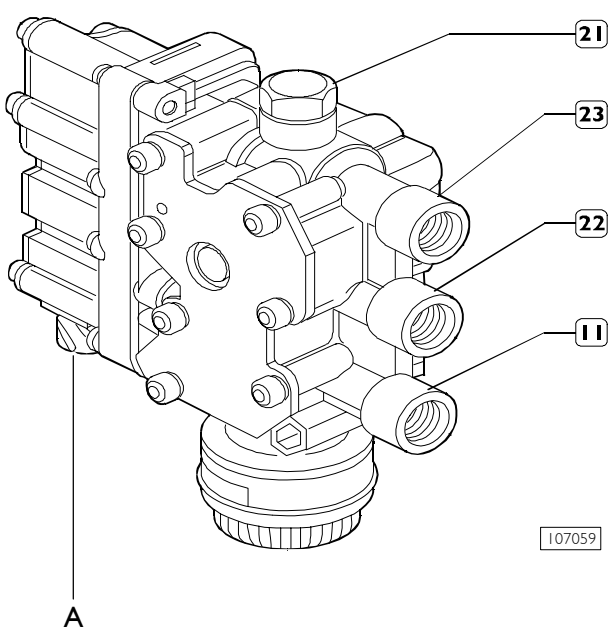
It consists of two control electro valves "A" and "B" and three compressed air distributors.

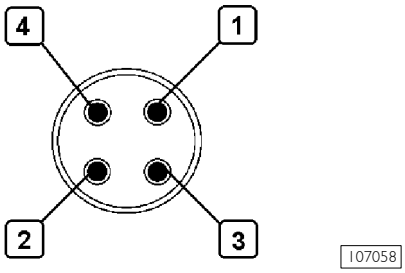
Electro valve "A" manages the input/output distributor.

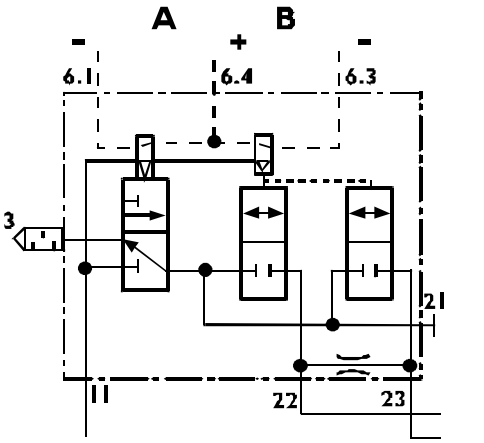
Electro valve "B" manages the frame setting distributor.

The electro-pneumatic distributor is connected to the system via a 4-pole connector.

Figure 258







	Descripción
1	Electro valve "A" control negative
2	Common positive
3	Electro valve "B" control negative
4	---

Electro-pneumatic axle distributor for 4x2 FP tractors and 4x2 P/FP – 6x4 P carriages

It consists of three control electro valves "A", "B" and "C" and the same number of compressed air distributors.

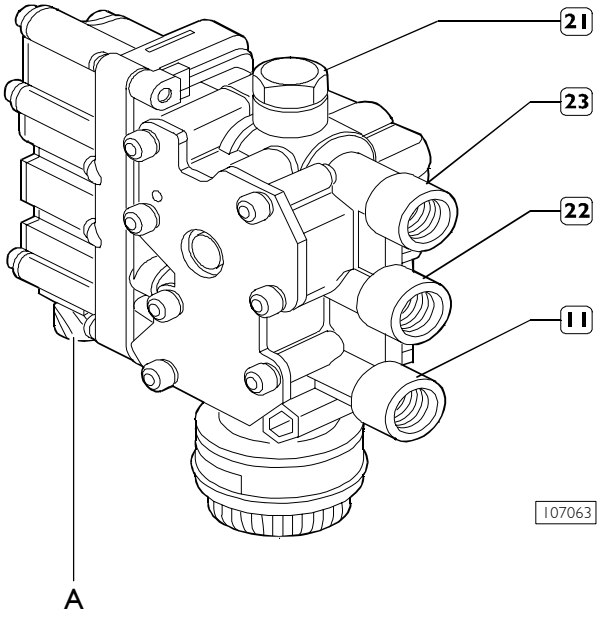
Electro valve "A" manages the input/output distributor.

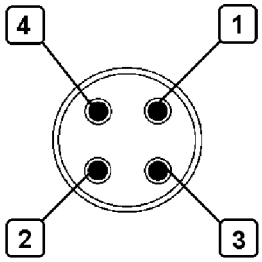
Electro valve "B" manages the right frame setting distributor.

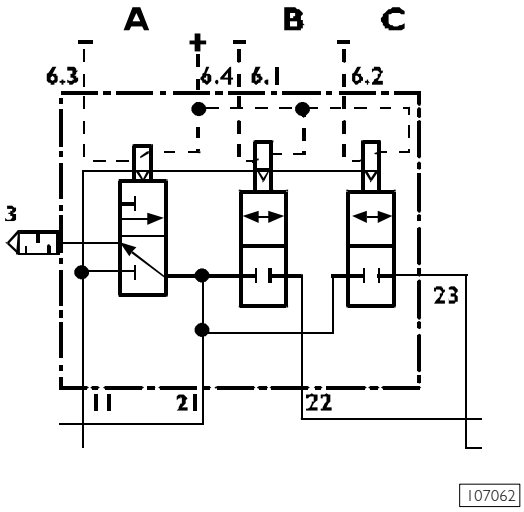
Electro valve "C" manages the left frame setting distributor.

The electro-pneumatic distributor is connected to the system via a 4-pole connector (A).

Figure 259







Connector	Description
1	Electro valve "A" control negative
2	Electro valve "B" control negative
3	Electro valve "C" control negative
4	Common positive

Electro-pneumatic axle distributor for 6x2 TXP tractors

It consists of six control electro valves "A", "B", "C", "E", "F" and the same number of compressed air distributors.

Electro valve "A" manages the input/output distributor.

Electro valve "B" manages the right frame setting distributor.

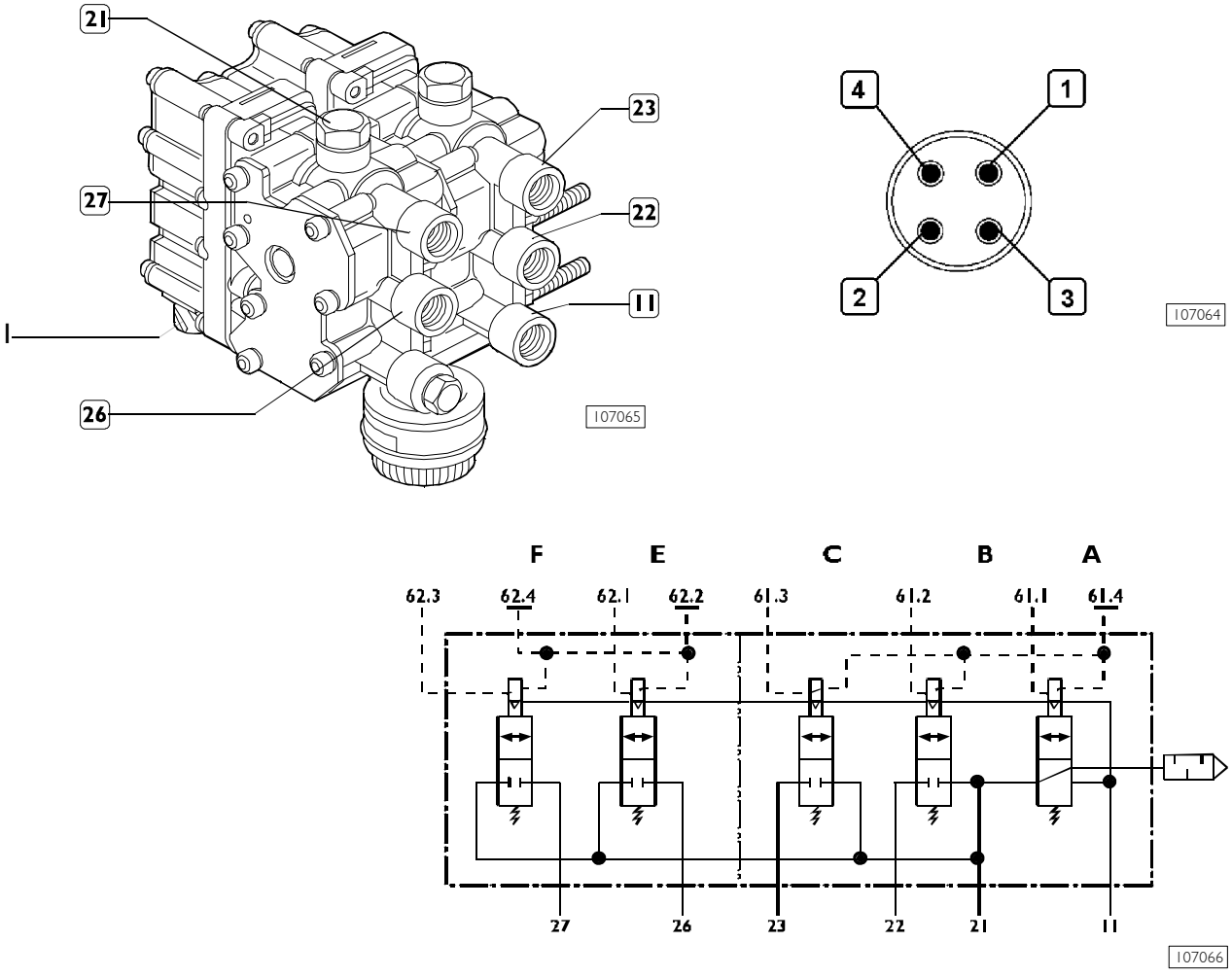
Electro valve "C" manages the left frame setting distributor.

Electro valve "E" manages the right added axle setting distributor.

Electro valve "F" manages the left added axle setting distributor.

The electro-pneumatic distributor is connected to the system via two 4-pole connectors (I) (II).II

Figure 260



"I"

Ref.	Description
1	Electro valve "A" control negative (61.1)
2	Electro valve "B" control negative (61.2)
3	Electro valve "C" control negative (61.3)
4	Common positive (61.4)

"II"

Ref.	Description
1	Electro valve "E" control negative (62.1)
2	Common positive (62.2)
3	Electro valve "F" control negative (62.3)
4	Common positive (62.4)

Electro-pneumatic axle distributor for 6x2 carriages

The component consists of six control electro valves "A", "B", "C", "D", "E", "F" and the same number of compressed air distributors.

Electro valve "A" manages the input/output distributor.

Electro valve "B" manages the right frame setting distributor.

Electro valve "C" manages the left frame setting distributor.

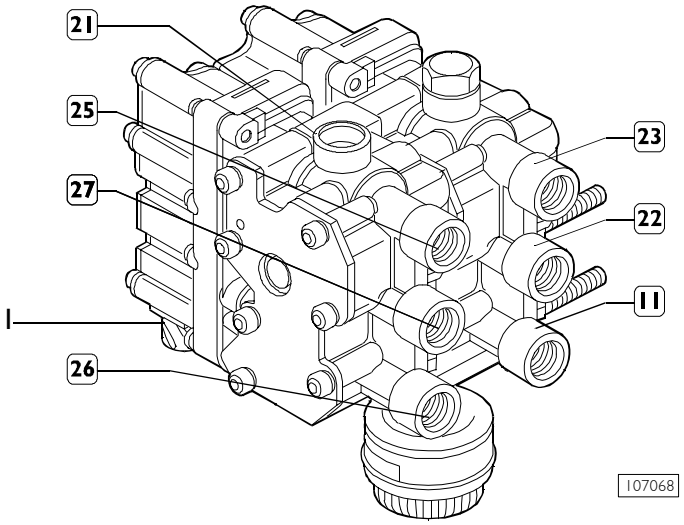
Electro valve "D" manages the right added axle setting distributor.

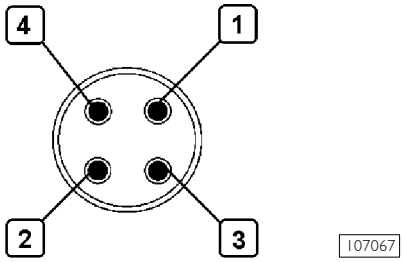
Electro valve "E" manages the left added axle setting distributor.

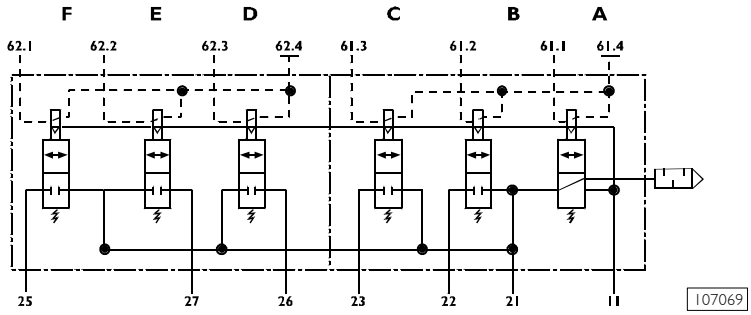
Electro valve "F " manages the lift control distributor.

The electro-pneumatic distributor is connected to the system via two 4-pole connectors (I) (II).

Figure 261







"I"

Ref.	Description
1	Electro valve "A" control negative (61.1)
2	Electro valve "B" control negative (61.2)
3	Electro valve "C" control negative (61.3)
4	Common positive (61.4)

"II"

Ref.	Description
1	Electro valve "F" control negative (62.1)
2	Electro valve "D" control negative (62.2)
3	Electro valve "E" control negative (62.3)
4	Common positive (62.4)

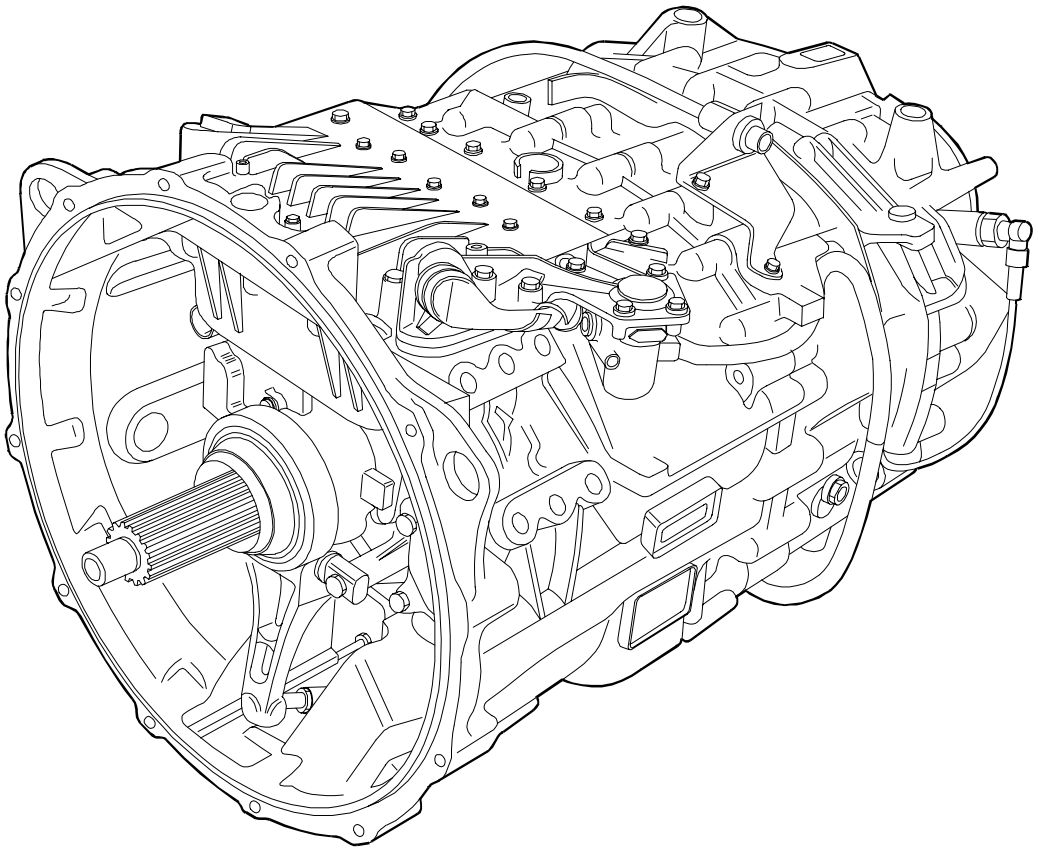
EUROTRONIC AUTOMATIC TRANSMISSION

General

The new generation of Automated EuroTronic transmissions is IVECO's response to new Customer expectations and changed needs. The design of gearshifts with a new inspected and test transmission technology concept combined with advanced electronics has generated a system that guarantees:

- Economic efficiency
- Reliability
- Environmental acceptability

Figure 262



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VIEW OF THE AUTOMATED EUROTRONIC TRANSMISSION

These modern and completely automated transmission systems with highly integrated components have already been developed for EDC center ELECTRONIC CONTROL DIESEL ENGINES.

The system automates gear selection and meshing by automatically controlling the clutch and engine during gear shifting.

The operator decides when to shift gears by actuating a selector lever with no need to release the accelerator pedal.

Unlike previous versions, the Automated EuroTronic enables the operator to use COMPLETELY AUTOMATIC gear shifting management.

The system enables automatic vehicle star and completely eliminates the clutch pedal. On receipt of vehicle and operator signals, the electronic center controls all components involved, optimizes maneuvers and manages safety.

	PRODUCTIVITY				**Comfort**	**Safety**
	Consumption	**Average commercial speed**	**Maintenance courses**	**Payload**		
Operating comfort and less physical and mental stress	•	•			•	•
Precise and fast gear shifting	•	•			•	
Optimized use	•		•			
No use errors	•	•	•		•	•
Selection of maximum rpm for engine brake use	•	•			•	•
Reduced tare				•		
Longer linkage line life (the clutch especially)			•			
Noise abatement (Db)					•	
Automatic gear shifting	•	•			•	

Design features

The entire transmission shaft and universal joint assembly is relieved of considerable load as gear shifting operations and procedures are automated. The main Automated EuroTronic countershaft gearbox consists of the following:

- A couple of low and high speed gears (SPLITTER)
- 4 forward speeds + 1 reverse

The auxiliary box consists of a G.R.E. epicyclical reduction gear mounted at the back to double the number of gear ratios of the main gearbox and enable 16 forward and 2 reverse speeds.

Description

Automated EuroTronic is a completely automatic transmission featuring a regulated dry clutch that eliminates the clutch pedal.

It consists of a reduced noise emission main gearbox with a planetary and split group.

The main unit meshes with front teeth and only the planetary and split group are synchronized.

The 16-speed Automated EuroTronic features sixteen forward and two reverse speeds.

The Instrument cluster supplied the operator with all necessary system information, such as gear meshed, disturbances and the like.

The insert module and the clutch regulator unit are the most important structural elements for complete transmission automation.

The former consists of the transmission electronic system, switching valves, cylinder and sensors.

The transmission electronic system processes all input signals and inserts the speed via the electromagnetic valve and the switching cylinder.

The clutch regulator is set electro-pneumatically and performs all friction actuation operations. In the manual mode, the operator can easily select speeds with the speed selector lever.

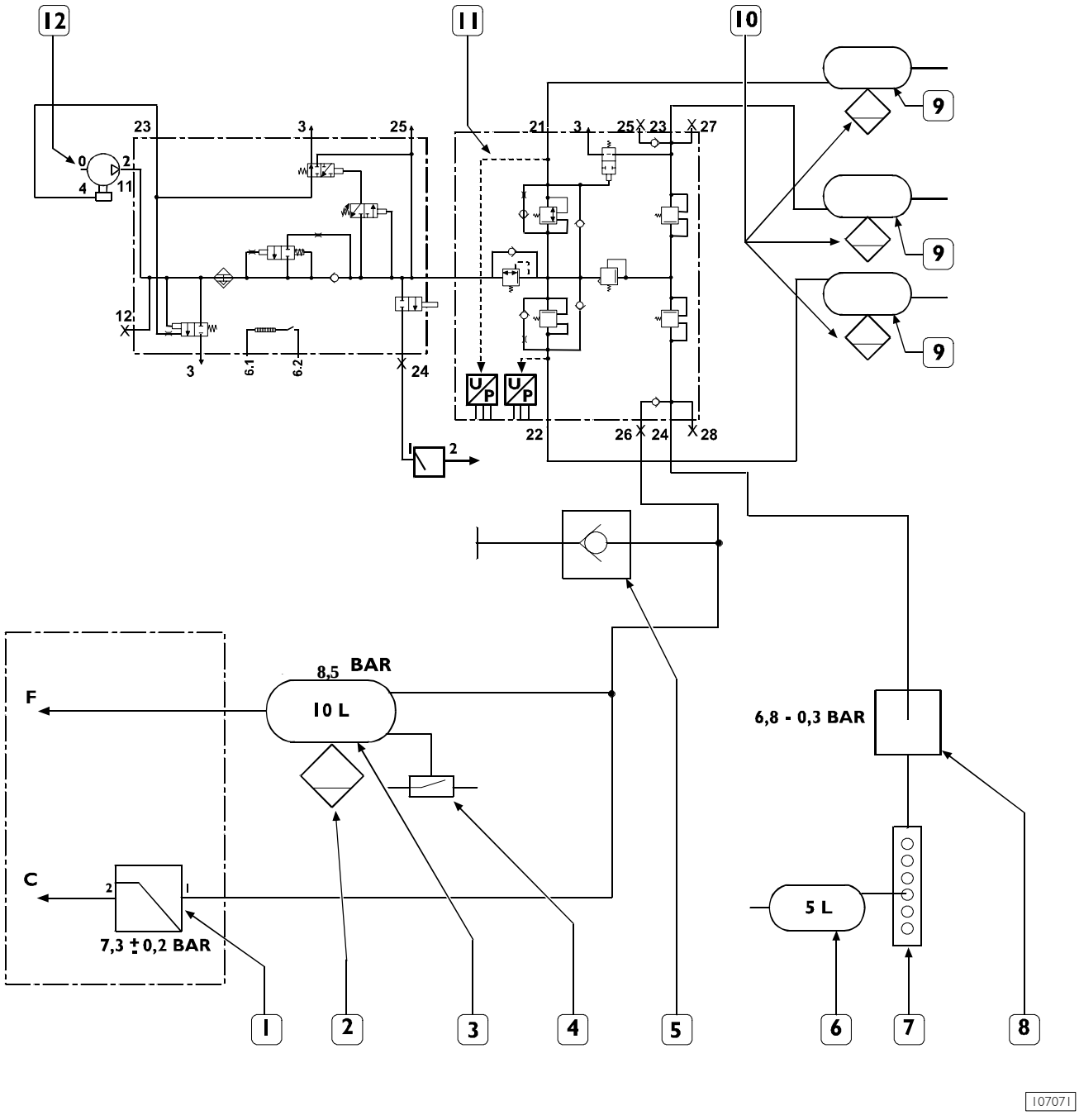
In the automatic mode, the operator only has to actuate the accelerator or brake pedal.

Speeds are selected automatically by the system.

To respect anti-pollution regulations, all gears are helical teeth, which enabled abating noise level about 79 db.

Transmission/clutch connection diagram with the compressed air system

Figure 263

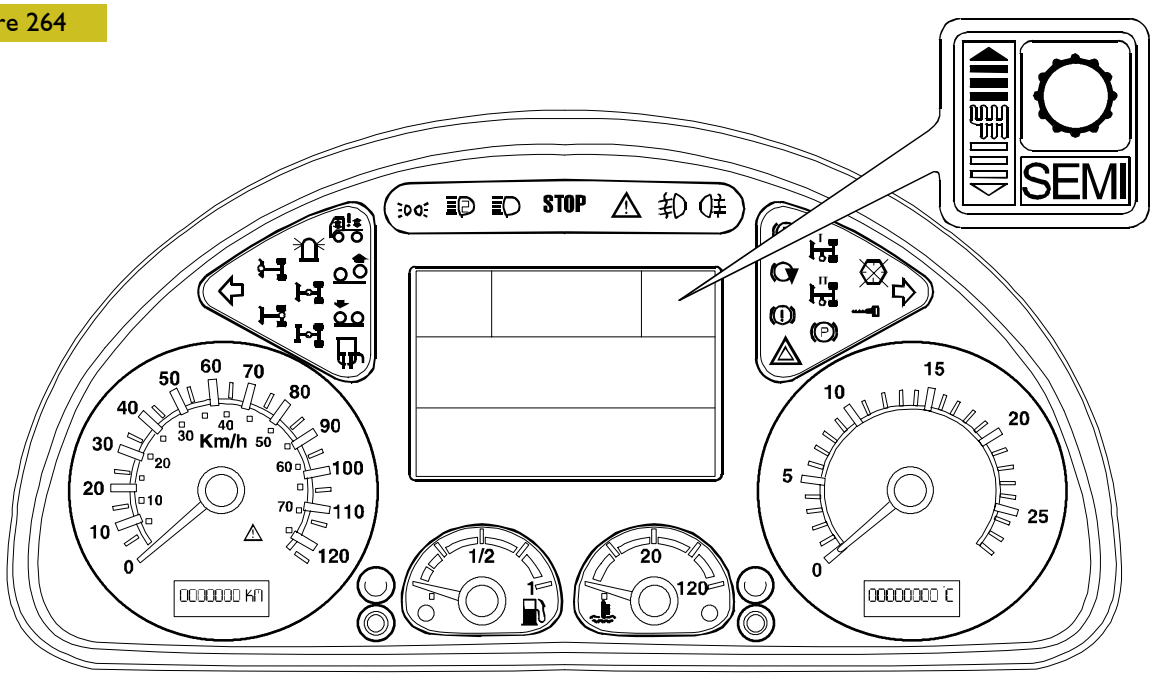


1. Pressure limiter valve - 2. Normal purge valve - 3. 10-l reservoir - 4. Air pressure switch - 5. Pressure control socket - 6. 5-l reservoir - 7. Distributor element - 8. Controlled pressure valve - 9. Reservoir - 10. Normal purge valve - 11. APU Air Processing Unit - 12. Compressor.
F = Clutch
C = Transmission

Display on the Instrument Cluster

The information required by the operator is displayed by the system on the Instrument Cluster central display.

Figure 264



The symbols displayed by the system are as follows:

	System self-diagnosis	CL	Clutch overload
N	Gear in neutral	CW	Duct disc wear
AP	Accelerator pedal pressed before turning the ignition key	SEMI	Transmission in the manual mode
RL	Slow reverse selected	AUTO	Transmission in the automatic mode, with clear display Transmission with the automatic mode pre-selected but not active with shadowed display (moving at low speed)
RH	Fast reverse selected	12	Speed number selected (12th)
AL	Low system air pressure		Transmission in the manual mode, lower speeds recommended by the system Recommended ratios (as many as 3) are displayed with bars

LIMP - HOME

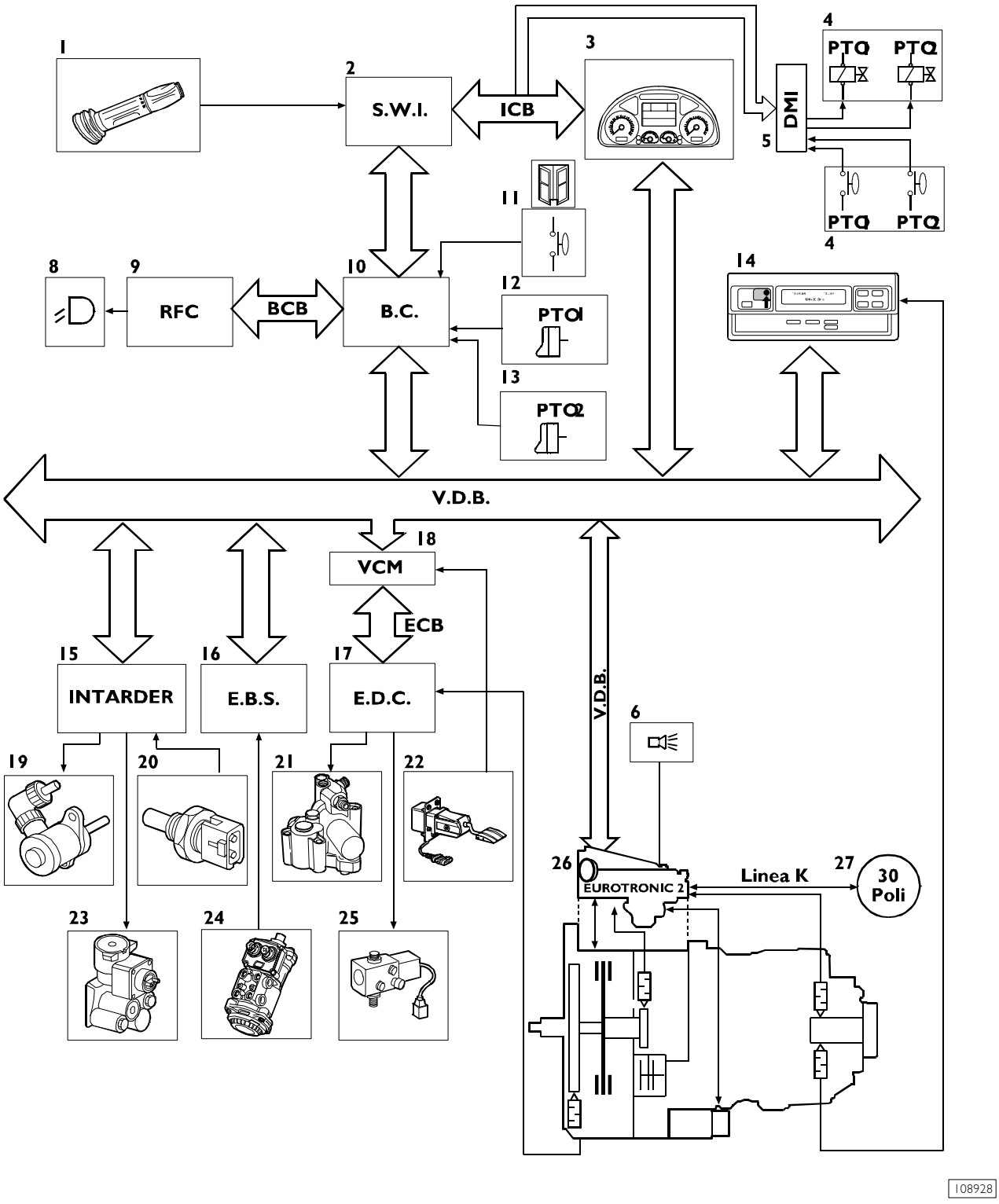
The Limp Home function enables removing the vehicle when the system presents serious anomalies it cannot manage automatically. It cannot move the vehicle when purely mechanical anomalies are present. The operator can activate the Limp Home function as follows:

1. Key switch on stop
2. Key switch on +15
3. Press the blue color push button on the gear shift lever within 5 seconds
4. Keep the blue color push button pressed for at least 5 seconds.

The operator can select the speed at which to start with gearshift lever, and can select as many as 7 speeds forward and 2 reverse with the 16 speed transmissions and 5 and 2 respectively with the 12-speed one. Selection is managed by the system via an internal delay reaction time and not through the speed with which the gearshift lever sensors identify lever movements.
Speed selection must be slow to allow the system to implement each individual speed, as the Cluster displays individual speeds with a delay of a few seconds.
The speeds that can be set with the Limp Home function can only be selected with the vehicle stationary.
After start speed selection, pressing the function push button for at least 2 seconds makes the system control timed clutch engagement.
To prevent the engine from stopping, the clutch disengages automatically when the speed output from the transmission is below a reference threshold. Is the clutch sensor is not operating properly, the clutch can only be engaged/disengaged manually with the Function push button.
The system disregards any gearshift lever movement during vehicle movement. In particular, push button function operation is excluded when engine rpm is over 950 and reactivated at under this rating.
Clutch management can thus also be manual with the function push button on the gearshift lever of the brake pedal when engine rpm is under/equal to 950. When the vehicle is stopped with the Limp Home function, the clutch is managed automatically if possible or manually as described above.
At vehicle stop, the system keeps the Limp Home function active with the start speed set previously and the function remains active until system RESET is completed.

Eurotronic Automated transmission operation diagram

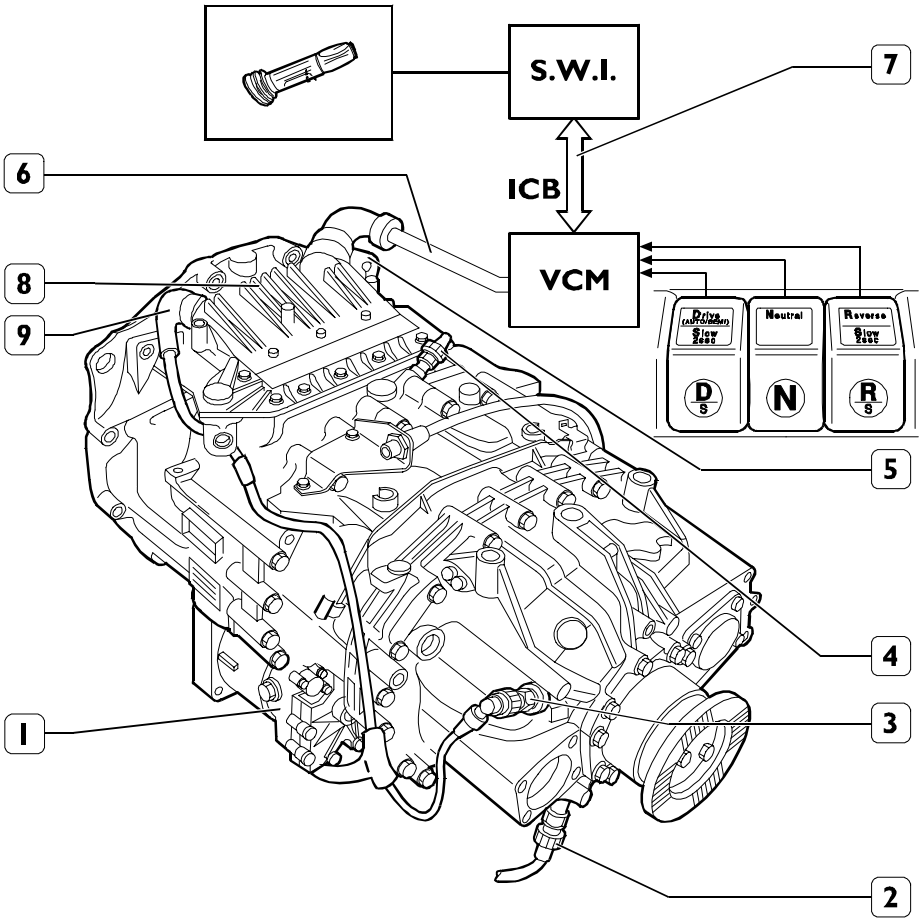
Figure 265



1. Multifunction lever - 2. Steering Wheel Interface - 3. Instrument Cluster - 4. Backup lights - 5. Rear Frame Computer - 6. Body Computer - 7. Door open switch - 8. 9. PTO on request switches - 10. Tachograph - 11. Intarder centre - 12. EBS centre - 13. EDC centre - 14. External buzzer - 15. PTO electro valves- 17. PTO on warning switches - 18. Proportional electro valve - 19. Water temperature sensor - 20. Engine cutout electro valve - 21. Accelerator pedal - 22. ON/OFF electro valve - 23. Brake pedal Duplex distributor - 24. VGT electro valve - 25. Gearshift/transmission electronic centre - 26. Diagnosis connection

Location of main components

Figure 266



1. Clutch actuator - 2. Tachograph gearshift/transmission outgoing speed sensor - 3. Gearshift/transmission outgoing speed sensor for sensor - 4. Gearshift idling position sensor - 5. Frame side centre connector - 6. Vehicle Data Bus VDB CAN line - 7. System internal CAN line - 8. Gearshift/transmission electronic centre - 9. Gearshift/transmission side centre connector

ELECTRONIC CENTER

It is integrated into the gearshift actuator.

Automatic transmission management enables automating speed selection and meshing with automatic clutch and engine control.

It interfaces with the other on-board electronic systems such as the EDC, EBS, INTARDER and Instrument Cluster via a CAN V.D.B. Vehicle Data Bus line.

From connection with the EDC system the transmission electronic center can detect accelerator pedal position, fuel delivery, engine rpm and engine brake and kick-down activation.

The center inside houses center temperature, transmission oil temperature and low air pressure sensors to improve system operation.

Function AL is enabled at <5.8 bar pressure and disabled at> 6 bars. The Automated EuroTronic transmission electronic center offers the possibility of a Cluster displayed error code for preliminary diagnosis and is also provided with an advanced self-diagnosis system capable of identifying and storing any even intermittent anomaly dependent on environmental condition the system may have encountered during operation, to ensure more correct and reliable repair.

Figure 267

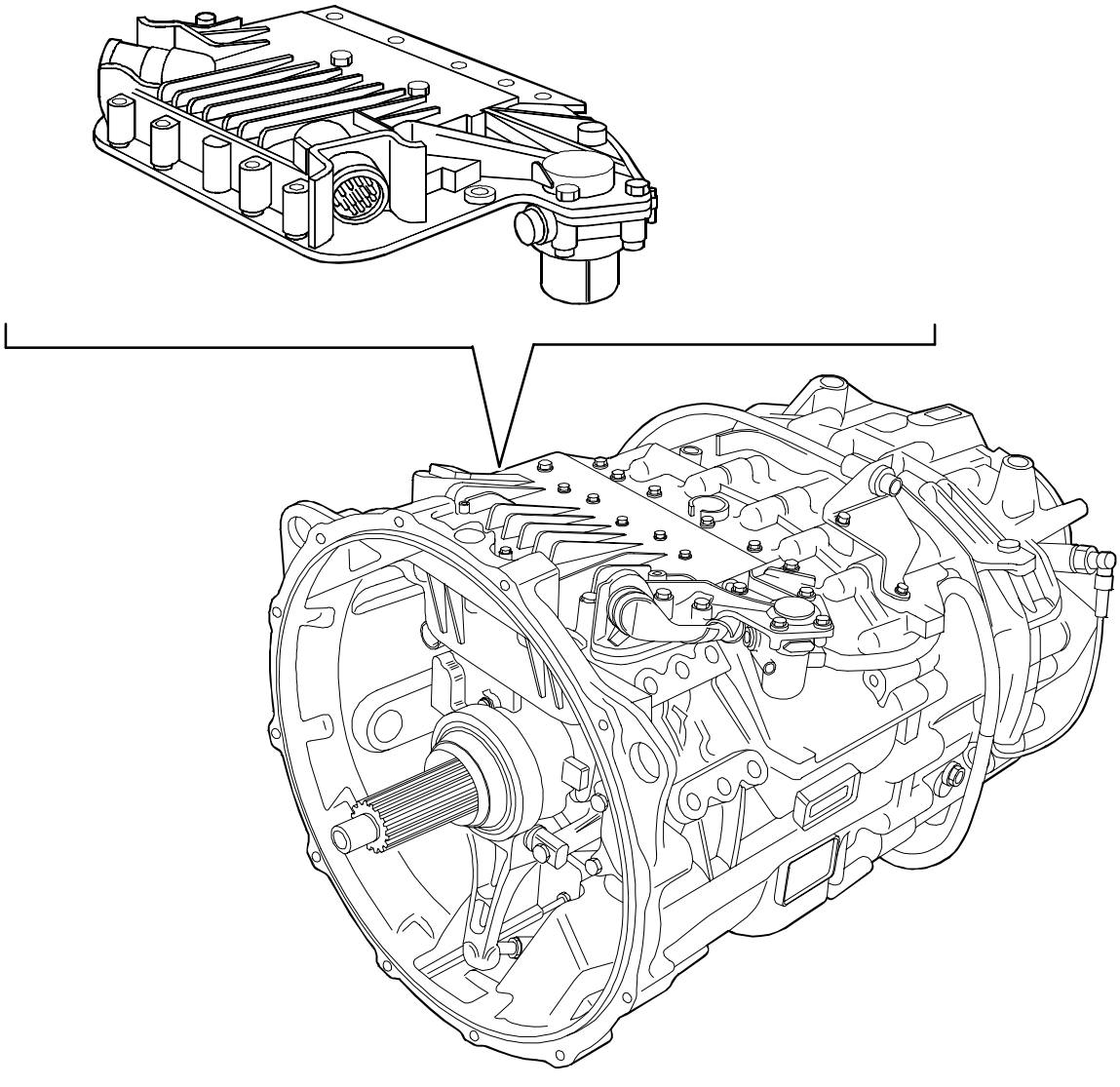


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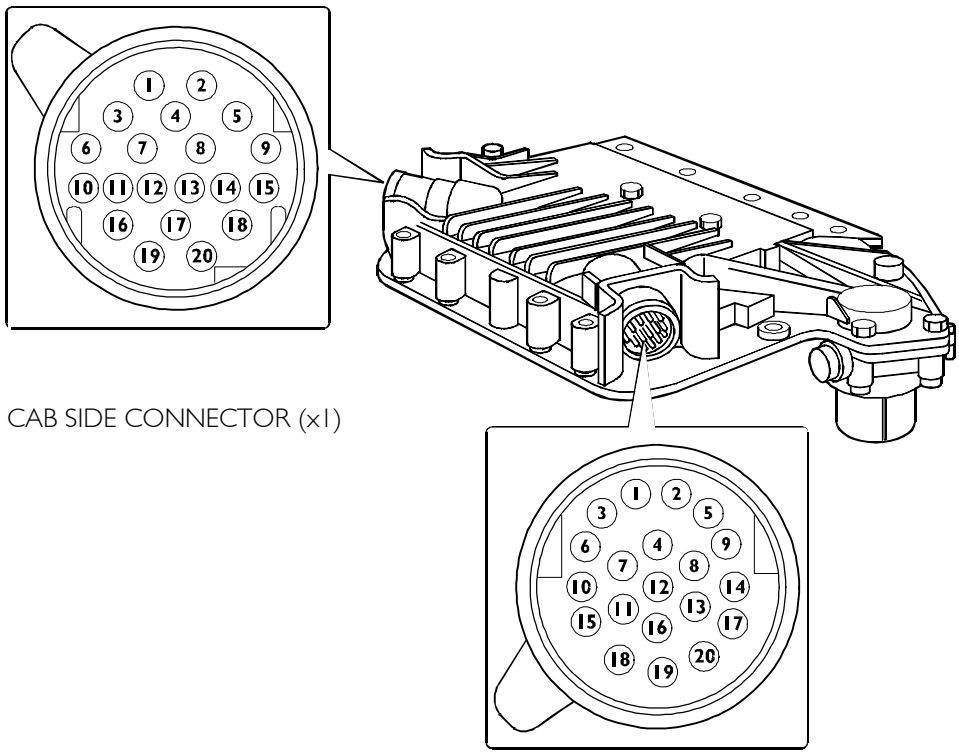
Figure 268



PIN	Cable	Description x1	Pin	Cable	Description
1	8802	Power from Body Computer (J 3/6)	1	–	–
2	2297	Positive 30-pole connector for ground diagnosis	2	–	–
3	-	Free	3	–	–
4	7101	Positive from fuse 70602/2 (+30)	4	–	–
5	7101	Positive from fuse 70602/2 (+30)	5	–	–
6	-	Free	6	–	Gearshift speed sensor mass (pin2)
7	–	Free	7	–	Signal electrovalve Y17 (slow opening) (pin A)
8	WS/BI	CAN VDB line	8	–	Signal electrovalve Y16 (fast opening) (pin B)
9	–	Free	9	–	Signal electrovalve Y15 (slow closing) (pin E)
10	1101	Gearbox malfunction beeper earth	10	–	Clutch position sensor analogic signal(pin F)
11	6100	Gearbox malfunction beeper positive	11	–	Gearshift/transmission outgoing speed sensor signal (pin 3)
12	GN/VE	CAN VDB line	12	–	Signal electrovalve Y14 (fast closing) (pin 0)
13	–	–	13	–	–
14	–	–	14	–	–
15	–	–	15	–	Clutch position sensor power supply (pin G)
16	0000	Negative	16	–	Y15 - Y17 electro valve mass (pin 3)
17	0000	Negative	17	–	Y14 - Y16 electro valve mass (pin C)
18	–	–	18	–	–
19	–	–	19	–	Gearshift/transmission speed sensor power supply (pin 1)
20	–	–	20	–	Clutch position sensor mass (pin H)

TRANMSISSION ACTUATOR

The transmission actuator is mounted on the top of the main gearbox. It consists of a series of electro valves, control cylinder and sensors. The electronic center powers the various electro valves to selected gear ratios available by using sensor signals as a feedback. Actuator operating pressure is 7 bars.

Actuator components

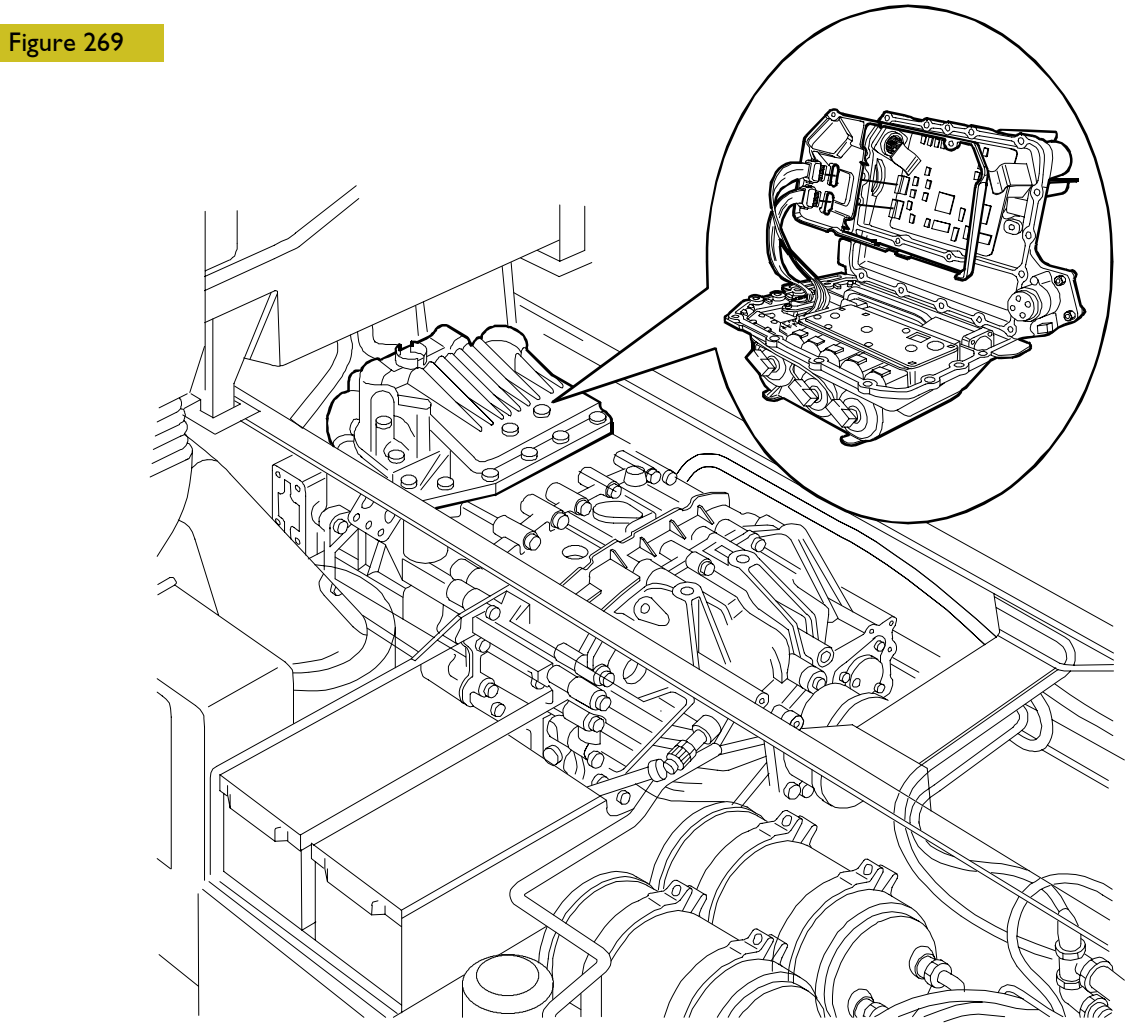
Y1 Inertia brakes control electro valve
Y2 Fast Splitter control electro valve
Y3 Slow Splitter control electro valve
Y4 Speed selection control electro valve
Y5 Speed selection control electro valve
Y6 Gear meshing control electro valve
Y7 Gear meshing control electro valve
Y8 Downshifted speed epicyclical unit control electro valve
Y9 Normal speed epicyclical unit control electro valve
Y10 Cmpressed air supply electro valve
B2 Transmission input rpm sensor
B4 Selected speed sensor
B5 Selector position sensor
B6 Normal and downshifted speed epicyclical unit position sensor
B7 Splitter position sensor

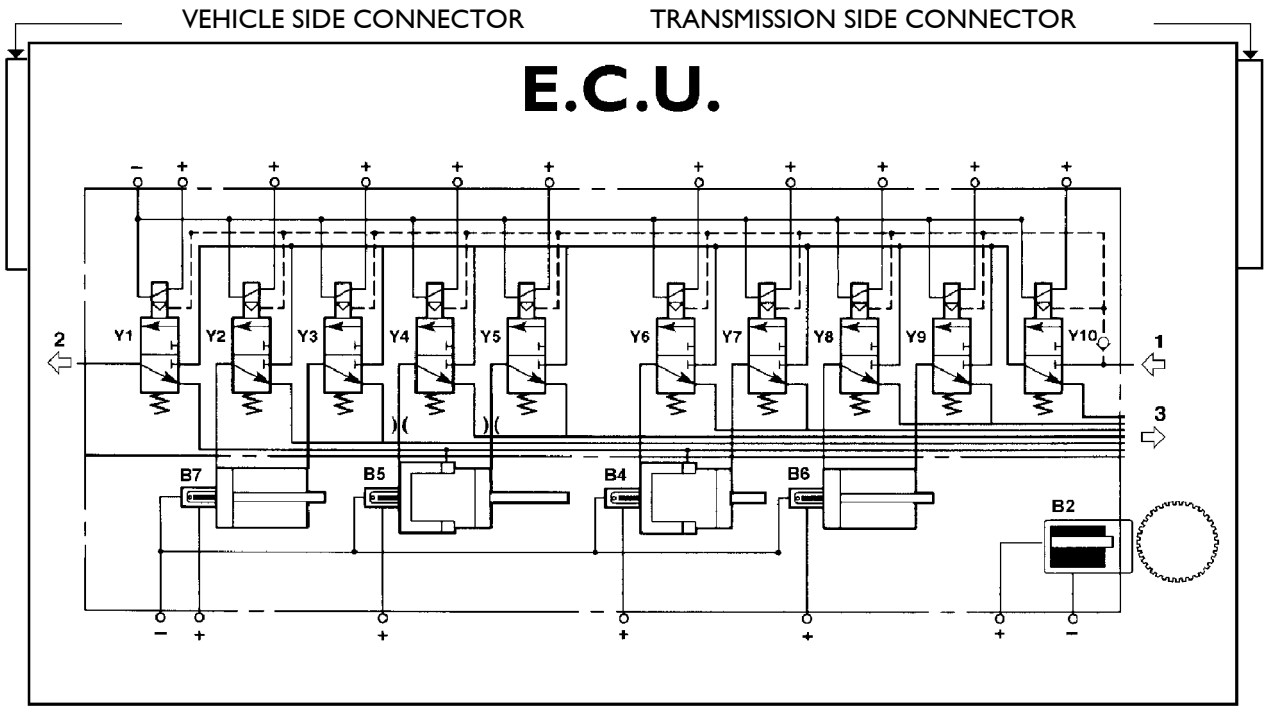
The actuator cannot be overhauled.
For actuator removal, transmission must be on NEUTRA.
The transmission neutral warning switch is located on the gearshift.

Electro valves are of the N.C. on/off type powered at 24 Volt with ~64.2 Ohm resistance at 20 °C.
Induction type transmission input rpm sensor B2 features ~1 Kohm resistance and identified rpm with a 40-teeth sound wheel. This signal is compared with the engine rpm measured by the E.D.C. center; if the two values are NOT identical the transmission center is enabled to detect clutch slide.
Induction type sensors B4, B5, B6 and B7, respectively selector position, epicyclical unit and splitter, are an integral part of the control cylinders and feature ~ 69 Ohm resistance at 20 °C.
The automatic system pressure sensor located downstream the reduction gear is also integrated inside the center.

LOCATION ON THE VEHICLE

Figure 269





CLUTCH ACTUATOR

The clutch actuator is located on the lower part of the clutch bell.

It consists of four electro valves, an actuator cylinder and a clutch run position sensor and is suitable to actuate 17.5" single-disc clutches via a 2.09 ratio lever.

In the load mode as detected by the accelerator pedal sensor signal from the E.D.C. center, the electronic center powers the various electro valves for slow or fast clutch engagement and release.

The center uses the clutch run position sensor to calculate clutch wear at each vehicle start, to enable fast approaches and overcome empty runs.

Actuator components

Y14- Fast clutch engagement electro valve
Y15- Slow clutch engagement electro valve
Y16- Fast clutch release electro valve
Y17- Slow clutch release electro valve
S - Clutch run position sensor
T - Air vent cap

Actuator operating pressure is 11 bars.

Internal channel diameters are as follows:

- 2.5 mm for fast engagement/release;
- 1.5 mm for slow engagement/release.

Actuation times at start, subject to load, slope and accelerator pedal position, are as follows:

- Initial engagement: ~ 1 sec.
- Modulated release: ~ 4 sec.

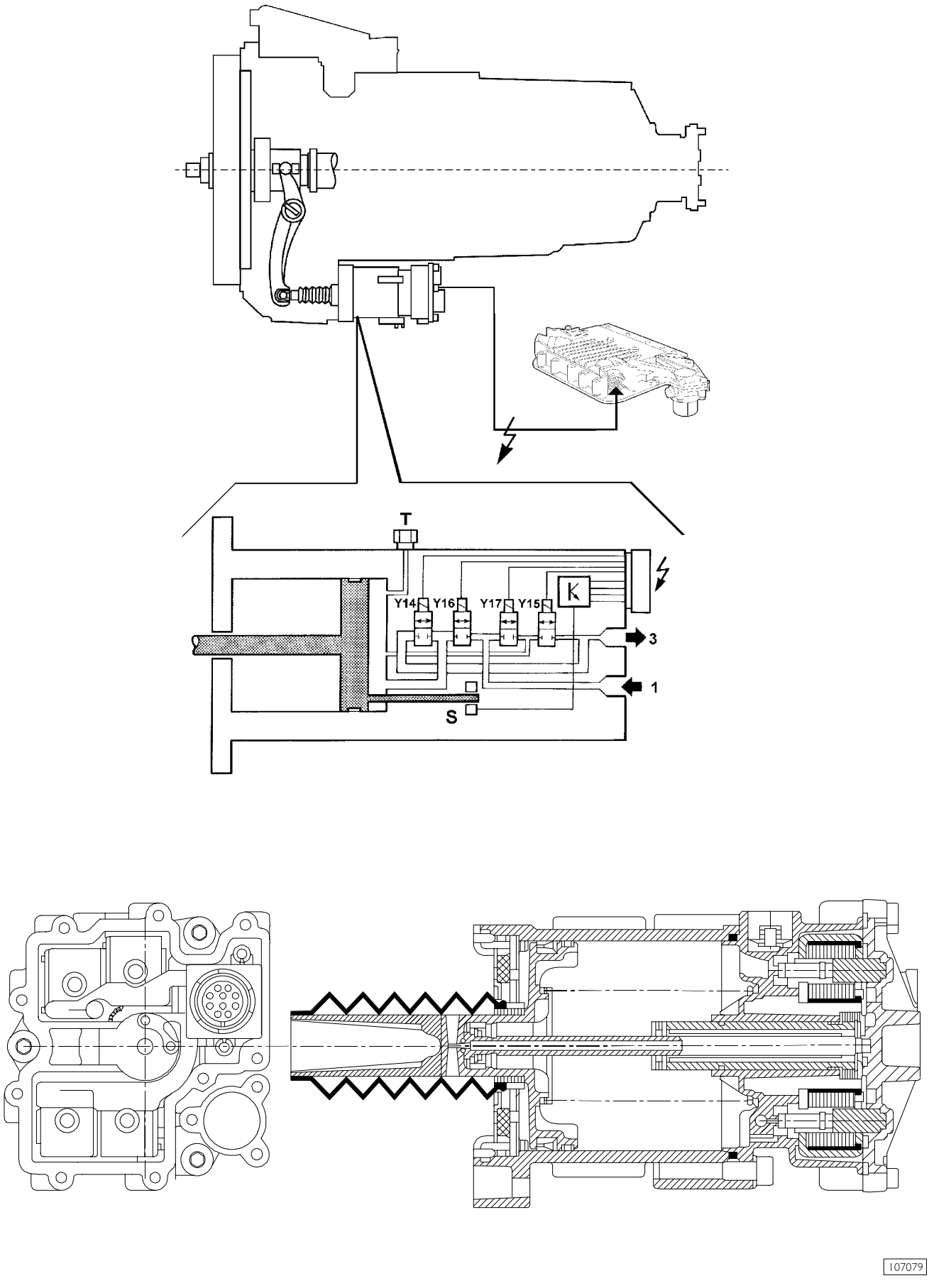
The times change as follows during gear changes to enable fast and precise synchronization:

- Modulated opening: ~ 0.6 sec.
- Complete opening: ~ 0.3 sec.
- Modulated closing: ~ 1 sec.

Actuator features

- Operating fluid:	air (min. 6 bar max 11.5 bar)
- Power:	24 Volt
- Load on lever in operating conditions:	382 kg
- Operating temperature:	40 °C + - 120 °C
- Cylinder diameter:	100 mm
- Piston travel:	70 mm

Figure 270



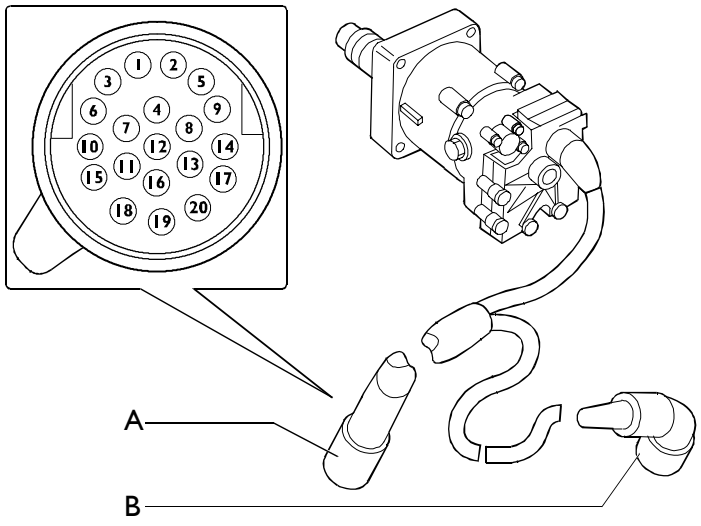
Clutch actuator Pin-out

The N.C. on/off type electro valves are powered at 24 Volt with ~ 14 ÷ 20 Ohm resistance.

The sensor is powered by the center at 5 Volts and the return signal is between 0.5 and 4.5 Volt.

The clutch actuator is connected to the system via a 10-pole connector.

Figure 271



A. 20-pole connector - B. Output transmission rpm sensors

Pin	Function
1	-
2	-
3	-
4	-
5	-
6	Transmission speed sensor mass (pin 2)
7	Y17 electro valve signal (slow opening)
8	Y16 electro valve signal (fast opening)
9	Y15 electro valve signal (slow closing)
10	Clutch position sensor analogic signal
11	Transmission output speed sensor signal (pin 3)
12	Y14 electro valve signal (fast closing)
13	-
14	-
15	Clutch position sensor power
16	Y15 - Y17 electro valve mass
17	Y14 - Y16 electro valve mass
18	-
19	Transmission speed sensor power (pin 1)
20	Clutch position sensor mass

Accelerator pedal

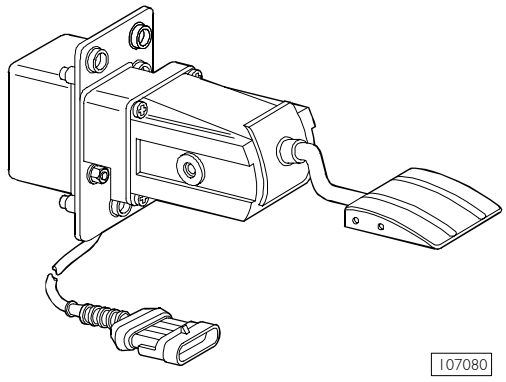
Release pedal NA integrated into the position sensor is used to detect engine idling position and enable clutch engagement at vehicle start.

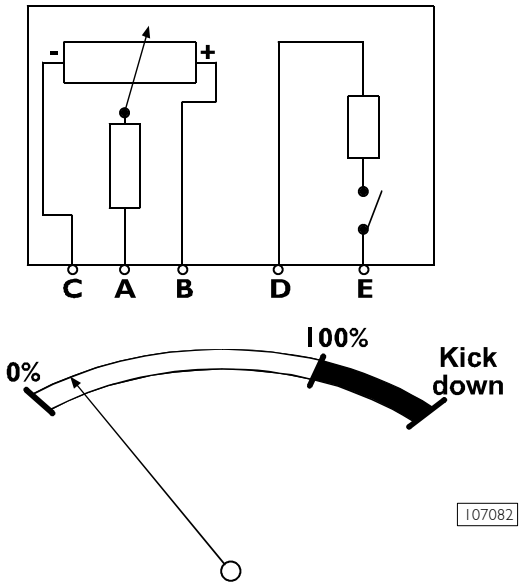
The signal reaches the VCM electronic center via the CAN VDB Vehicle Data Base line and is sent to the Automated EuroTronic transmission center.

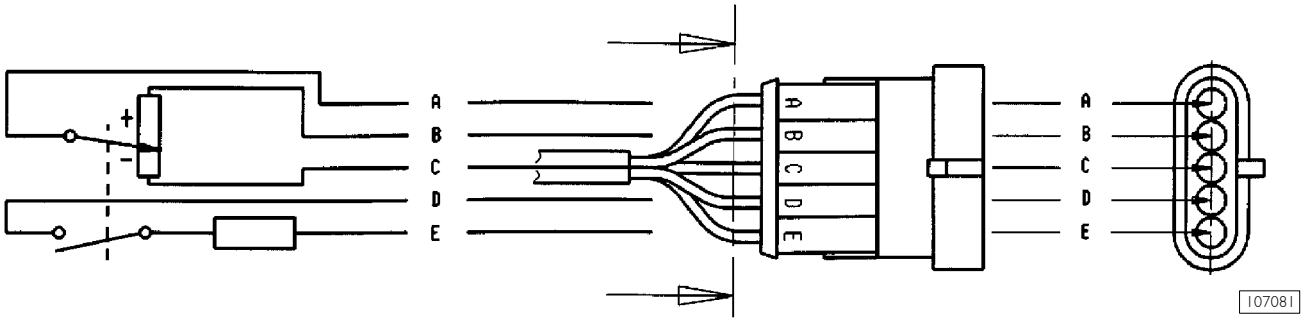
Kick Down is activated with the accelerator pedal in automatic function mode travel. The Kick Down function is activated when accelerator pedal lever (1) move the potentiometer to position 100%, which does not correspond to pedal mechanical travel end.

Stiffened travel end is only mechanical and is used to transmit the feeling Kick Down inserted to the operator.

Figure 272







INTARDER
Operation

The intarder is operated with the 7-position sector located in the right direction indicator (1). INTARDER cut-in indication is managed by the CLUSTER (2) via a specific warning.

The system is provided with a Brensomat constant velocity function used for vehicles without EBS. This function enables keeping a vehicle on a downhill slop moving at the speed as selected by the operator. In this case, the intarder electronic centre automatically selects the braking torque required.

The constant velocity function is only activated in position "0" after storing the speed desired.

Storage can be at any of the 7 selector positions by briefly pressing the push button provided; with higher pressure storing speed at that moment and lower pressure decrease of speed set. The speed programmed previously is restored as soon as the selector is returned to position "0".

Pressing the push button once again disenables the constant velocity function. The oil contained in the sump is sent to the intarder hydraulic circuit via a filter and the circuit is protected by a safety valve.

By acting on selector (1), electronic centre (4) receives via SWI (3) an electrical signal that it processes and sends to electro valve (7) controlling the accumulator and proportional electro valve (5).

The accumulator control electro valve switches and lets air under pressure pass through its piston to send oil to the hydraulic circuit and reduce action time.

The proportional electro valve acts on the control valve to set its pressure. The adjustment valve is piloted by control valve oil pressure. The rotor is connected to the rear axle via the transmission shaft and the stator is connected to the frame through the intarder case.

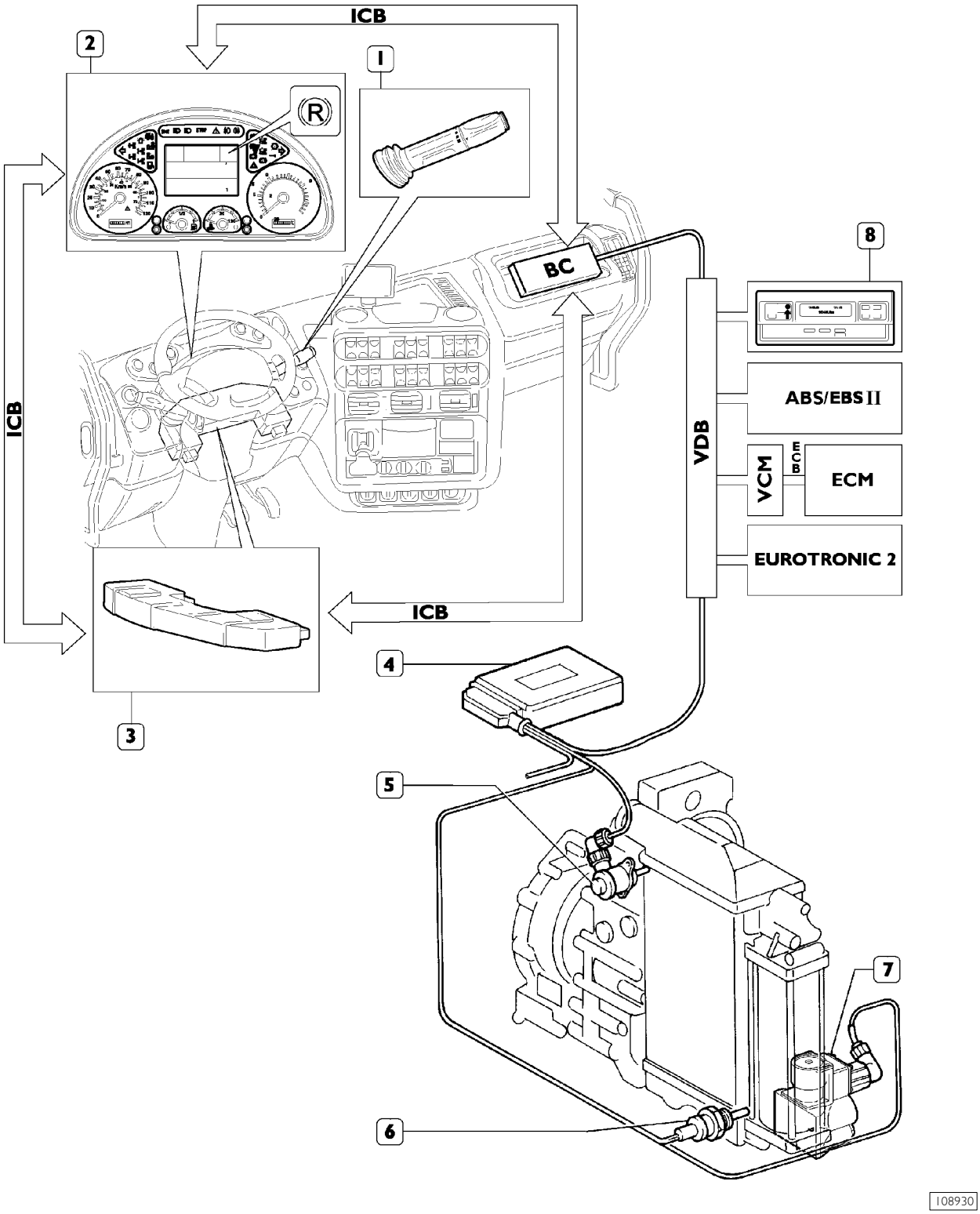
The oil contained in the areas between the rotor and the stator is moved by the rotor blades to create a closed circuit oil flow between mobile and fixed parts.

By impacting the stator blades, oil causes rotor and therefore vehicle braking. Reduced oil flow speed between the rotor and the stator transforms kinetic energy into heat, to dissipate which oil passes through an oil/water heat exchanger, where oil heat is transmitted to cooling water and dissipated through the vehicle cooling system.

The heat exchanger water discharge pipe is provided with a temperature sensor (6) that continually sends cooling water temperature data to the electronic centre to ensure maximum temperature allowed for proper engine operation is not exceeded.
If water temperature rises to reach the safety limit for any reason whatsoever, the centre pilots sump control air adjustment to reduce braking torque.
The electronic centre receives a signal from the ABS/EBS system that causes intarder cutout when actuated and it also receives a signal from electronic tachograph (8) enabling constant velocity function use. This signal is sent via a VDB can line.

Switching to position "0" cuts the intarder off and deactivates the proportional and accumulator control electro valves.

Figure 273



1. Engine brake/Intarder selector - 2. Instrument Cluster - 3. Steering Wheel Interface centre - 4. Intarder electronic centre - 5. Proportional electro valve - 6. Water temperature sensor - 7. Accumulator on/off control electro valve - 8. Electronic tachograph

Hydraulic system diagram
Description

The oil contained in the sump is sent to the intarder hydraulic circuit by a pump through a filter and a 12.5 bar pressure limiter valve.

Intarder on

When the intarder is actuated with control (2), the centre supplies electro valve (19) controlling accumulator (10), whose piston is piloted by the service air system at 9.5 bar pressure to send oil faster to the rotor/stator unit.

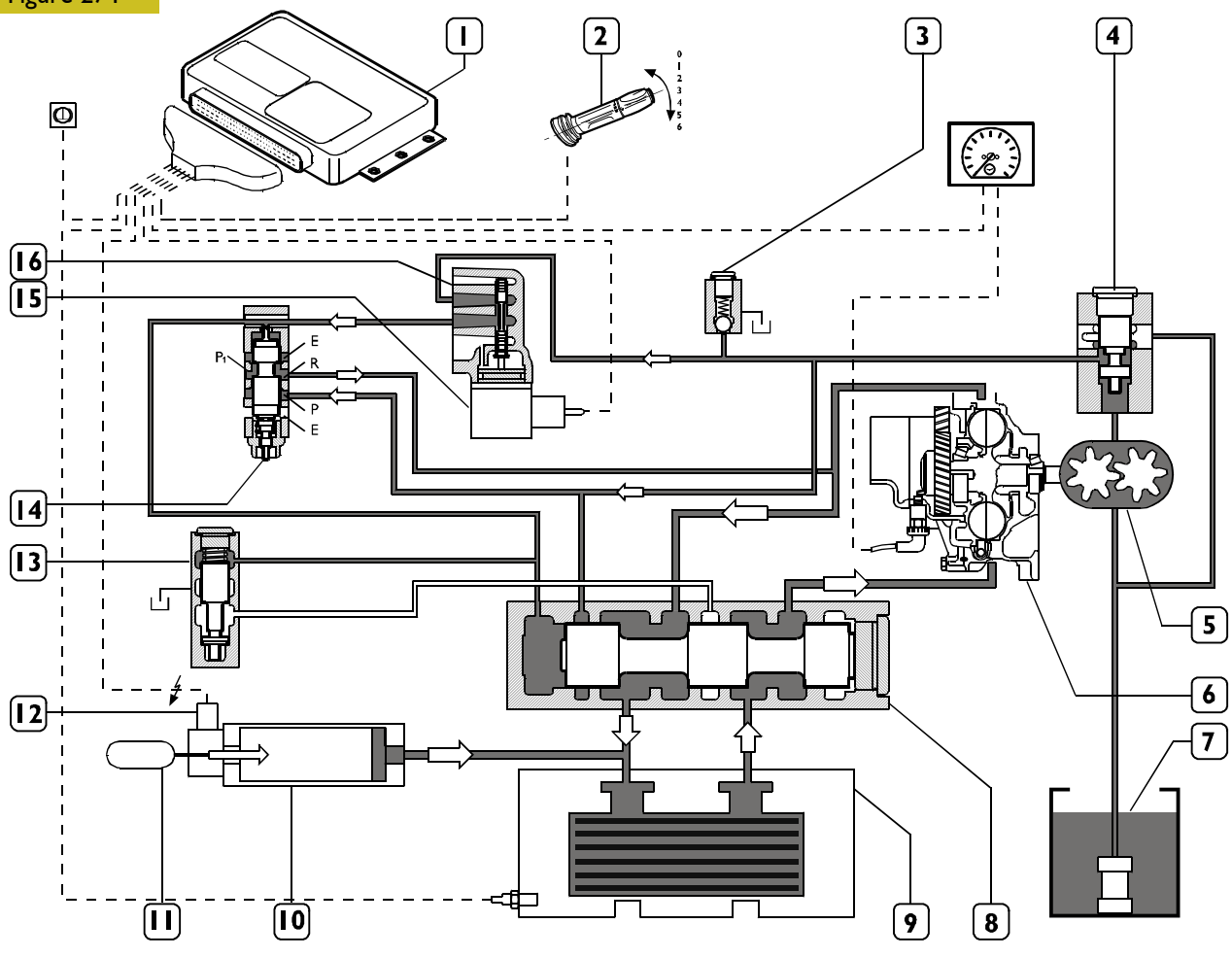
When excited, proportional electro valve (16) acts on valve (16) by moving its hydraulic spool and moves function control pressure to braking level.

Pressure acts on adjustment valve (14), to create communication between input duct P and output ducts P 1 - R.

Thus, oil from pressure limiter electro valve (4) moves the hydraulic spool of valve (8) and puts duct R_{01} 0into communication with the motor/stator via heat exchanger (9).

Pressure (13) is not affected by oil pressure and closes oil discharge into sump (7).

Figure 274

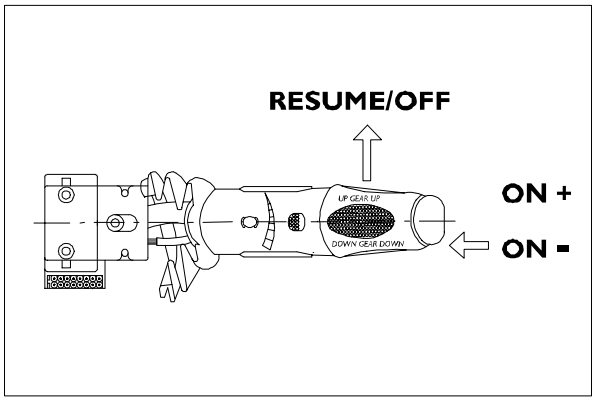


107085

Speed storage and use

By inserting Cruise Control, the system automatically maintains vehicle advance speed without having to use the accelerator pedal. If vehicle speed increases over 2 Km/h more than the speed set, such as when travelling downhill for instance, the engine brake is activated automatically to slow the vehicle down and maintain the speed reached. The intarder is also activated if speed increases by over 3 Km/h.

Figure 275



108931

Its function can only be activated when the following conditions are satisfied:

- ❑ engine brake/intarder lever cut out;
- ❑ vehicle on the move with gear selected;
- ❑ vehicle speed over 20 Km/h;
- ❑ brake pedal released;
- ❑ clutch pedal released.

Adjustment is cut out when the brake or clutch pedal is actuated. The same applies when the minimum speed set is not reached. Top speed is stored in the programme inside the electronic control module and cannot be changed.

1 Basculating push button ON has the following functions:

a)when pressed once, it activates the function and keeps the speed set at that moment by the accelerator pedal. The accelerator pedal can then be released and the vehicle keeps moving at the cruise speed set.

b)with the function already activated, it increases vehicle speed without having to use the accelerator pedal.

2 Basculating push button ON has the following function: with the function activated, it decreases vehicle speed.

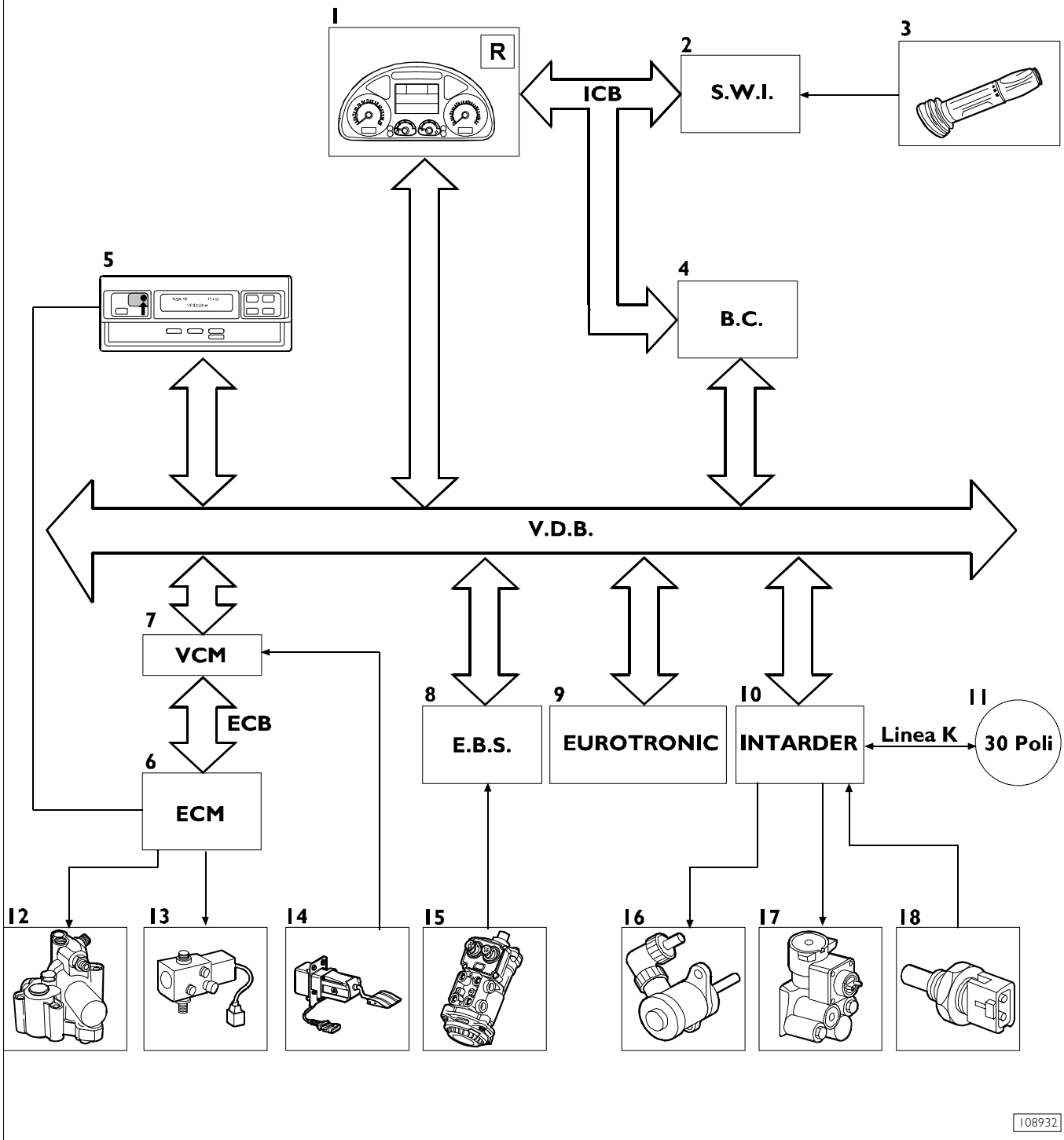
3 The Cruise Control lever actuated OFF towards the steering wheel deactivates the function (CC display shaded).

4 Actuating the steering wheel lever once again (RESUME) the value stored is reactivated (CC display clear).

Control	Vehicle speed adjustment
ON+	Speed increase
ON-	Speed decrease
RESUME	Last stored speed selection
OFF	Speed adjustment cancellation

Assembly

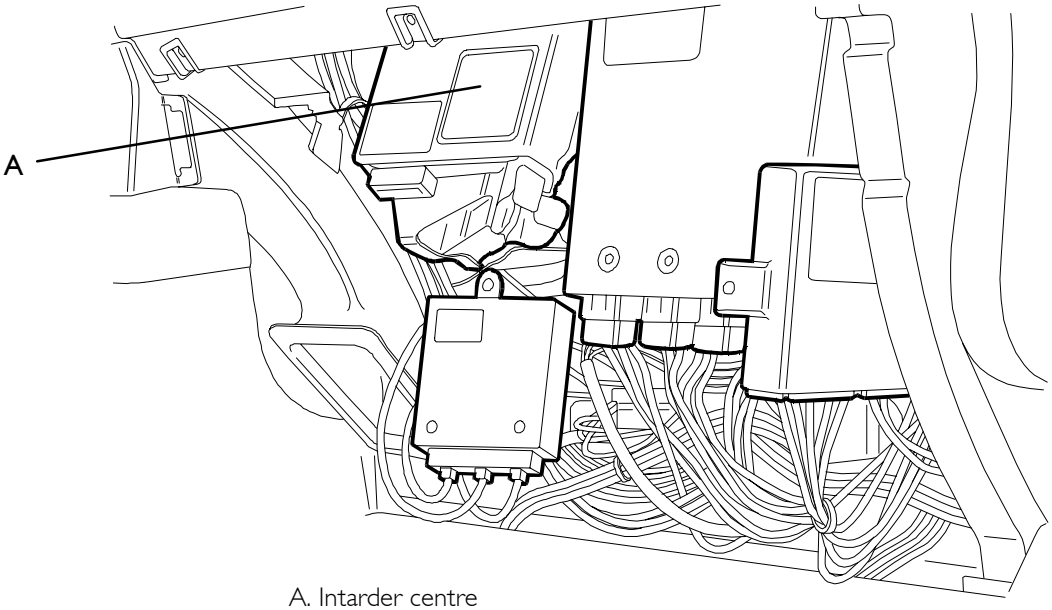
Figure 276



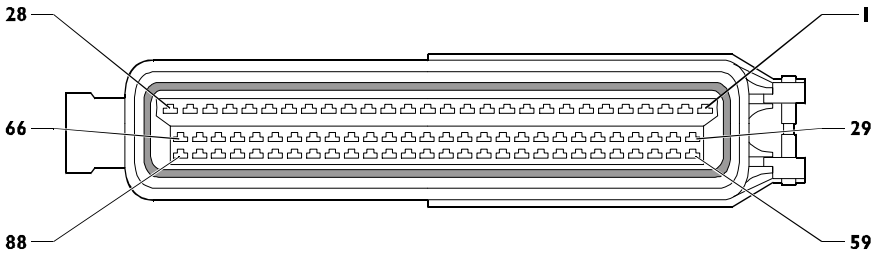
1. Instrument Cluster - 2. Steering Wheel Interface - 3. Engine brake on multi function lever - 4. Body Computer - 5. Tachograph - 6. EDC centre - 7. EBS centre - 8. EuroTronic centre - 9. Intarder centre - 10. Diagnosis connection - 11. Engine brake electro valve - 12. VGT electro valve - 13. Accelerator pedal - 14. Brake pedal Duplex distributor - 15. Proportional electro valve - 16. ON-OFF electro valve - 17. Water temperature sensor

Centre disposition

Figure 277



A. Intarder centre



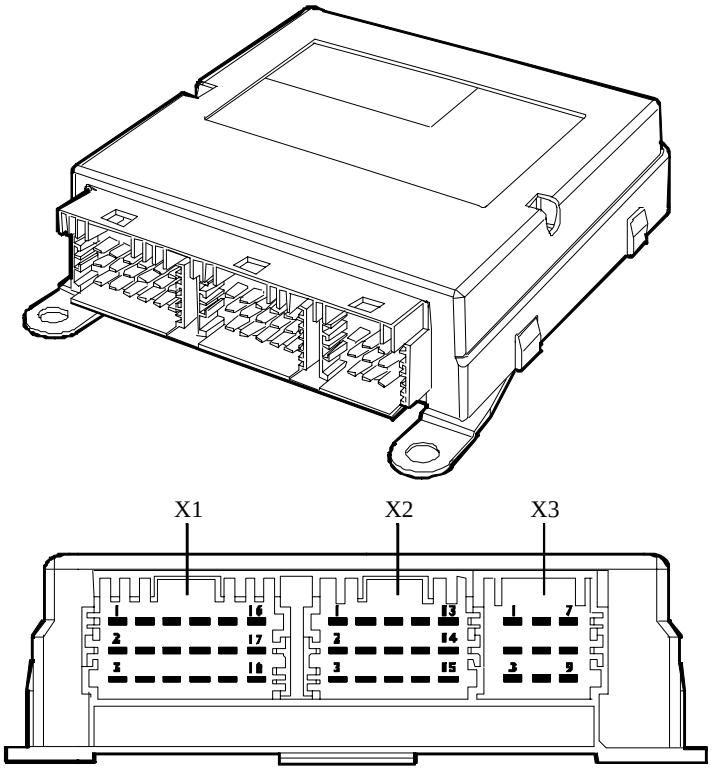
Pin	Cable	Function
1	9311	ON/OFF electro valve positive
3	0310	Proportional electro valve negative
4	9310	Proportional electro valve positive
9	5309	Water temperature transmitter positive
12	3393	30-pole diagnosis connection
14	2293	30-pole diagnosis connection
22	White	CAN VDB (H) line
27	0000	Cab mass
28	0000	Cab mass
34	0311	Oil accumulator electro valve negative
37	0309	Water temperature transmitter negative
49	Green	CAN VDB (L) line
53	8300	+15 power supply
54	7300	+30 power supply
8	5541	Cluster

Pins not mentioned were not used

DMI (DATA MANAGEMENT INTERFACE) (PTO) ELECTRONIC CONTROL UNIT

The DMI control unit is an electronic control unit located in the control unit compartment in the cab (passenger side) that manages the power take-offs and is connected to other control units via ICB CAN line.

Figure 278



112275

Pin - out

Connector X1

PIN	Function	Cable color code
1	DMI system power supply	7166
2	DMI system power supply	8166
3	Earth	0000
4	Power take-off 1 engaged return signal	6131
5	Power take-off 2 engaged return signal	6132
9	ICB CAN H line	WS / Bi
10	K line for DMI and EM	2996
12	ICB CAN L line	GN / Ve
16	Power take-off 1 relay energizing	0134
18	Enabling signal for power take-off 1	0391

Connector X2

PIN	Function	Cable color code
1	Power take-off 2 relay energizing	0136

Connector X3

PIN	Function	Cable color code
4	Power take-off 3 relay energizing	0137
5	Power take-off 3 engaged return signal	6133
6	Enabling signal for power take-off 2	0392
9	Enabling signal for power take-off 3	0393

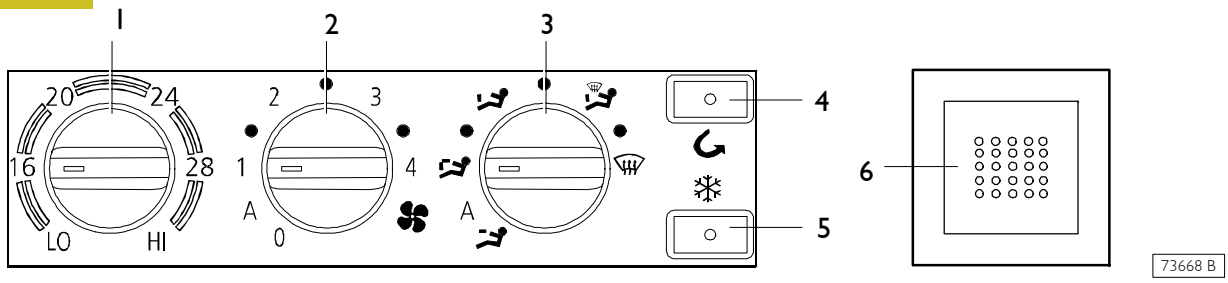
AUTOMATIC AIR CONDITIONER

In automatic version the system is managed by an electronic unit placed in the lower part of central dashboard and integrates control knobs.

The electronic unit is connected to vehicle **CAN BCB** line and is equipped with a very advanced diagnostic system.

The main objective of the unit is adjusting internal cabin temperature (set by the driver) depending on external temperature measured by a suitable sensor.
The system provides for the chance of a completely automatic management, but anyway for the user it is always possible, if he so wishes, to modify the main system operating parameters.

Figure 279



1. Required temperature adjusting knob
2. Fan speed adjusting knob
3. Air flow distribution knob
4. Recirculation function button with embedded led
5. Compressor control button with embedded led
6. Internal temperature sensor

After having set the desired internal temperature, by placing the other two knobs next to letter **A**, the unit is able to automatically check the following functions:

- Air temperature to unions.
- Fan speed
- Air flows distribution
- Supplementary heater connection if external temperature is **< 5 °C.**

In this position the unit does **NOT automatically activate** either compressor or recirculation function: connection of both of them is manually managed by the driver.

"RECIRCULATION" FUNCTION

Connection of this function **is completely manual** and is obtained through a suitable button that allows closing the external air intake by placing the baffle at 95% of internal air and 5% of external air.
The unit **automatically deactivates** this function after about 20 minutes if the compressor is disconnected and after 30 minutes is the compressor is connected.

"COMPRESSOR CONTROL" FUNCTION

Connection of this function is completely manual and is obtained through a suitable button that allows connecting the compressor clutch after a quality check of fluid in the system through safety pressure switches and evaporator temperature by means of the suitable sensor.
The unit does **NOT** automatically connect the compressor.

"SUPPLEMENTARY HEATER CONTROL" FUNCTION

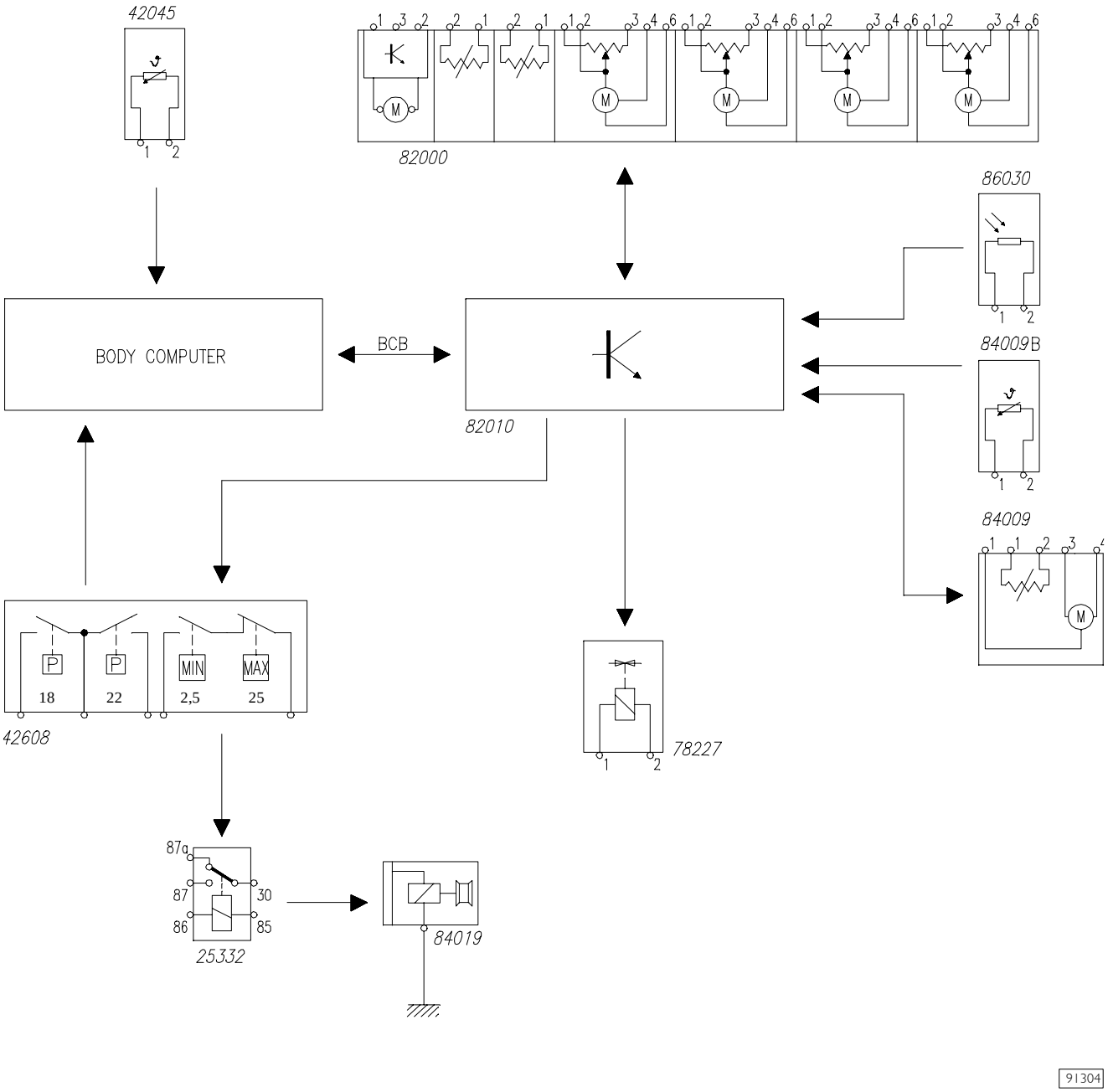
With moving engine the unit automatically connects the supplementary AIR and/or WATER heater only if the external temperature is **< 5 °C.**
With off engine the heater connection depends on driver's setting.

In both cases, the supplementary heater connection is signalled to the driver on Cluster display.

AUTOMATIC AIR CONDITIONER

Automatic air conditioner block diagram

Figure 280

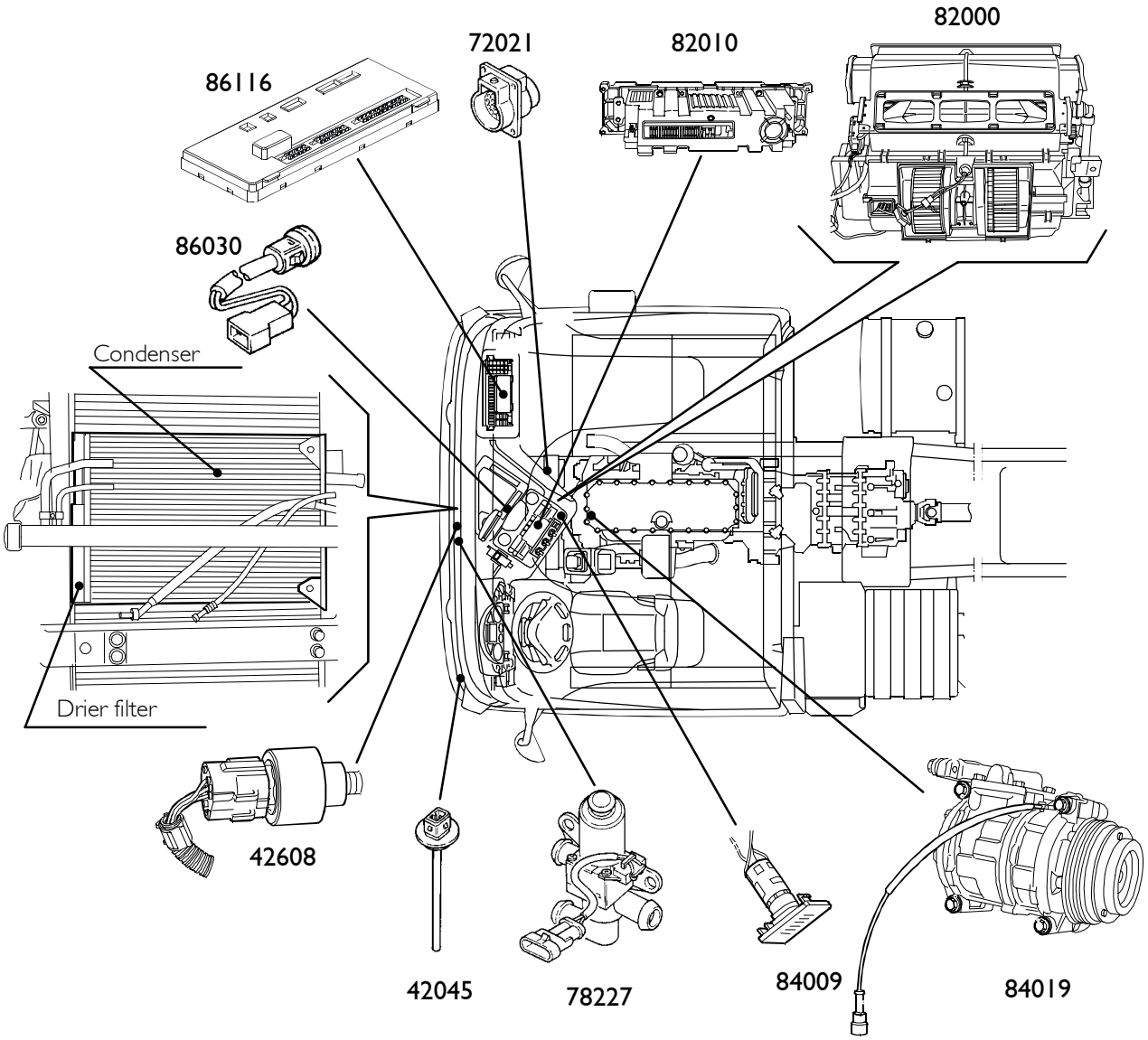


42045. Water temperature transmitter - 82000. Windscreen electric defroster assembly - 82010. Air conditioner control electronic unit - 86030. Sun radiation measuring sensor - 84009. Vented internal temperature measuring sensor - 84009B. Inner temperature detection sensor - 42608. Cooling liquid pressure signaling pressure switches - 25332. Compressor connection remote control switch - 78227. 3-way solenoid valve for radiator water recirculation - 84019. Compressor

Components 82010 - 82000 are placed in the same control assembly.

Component location

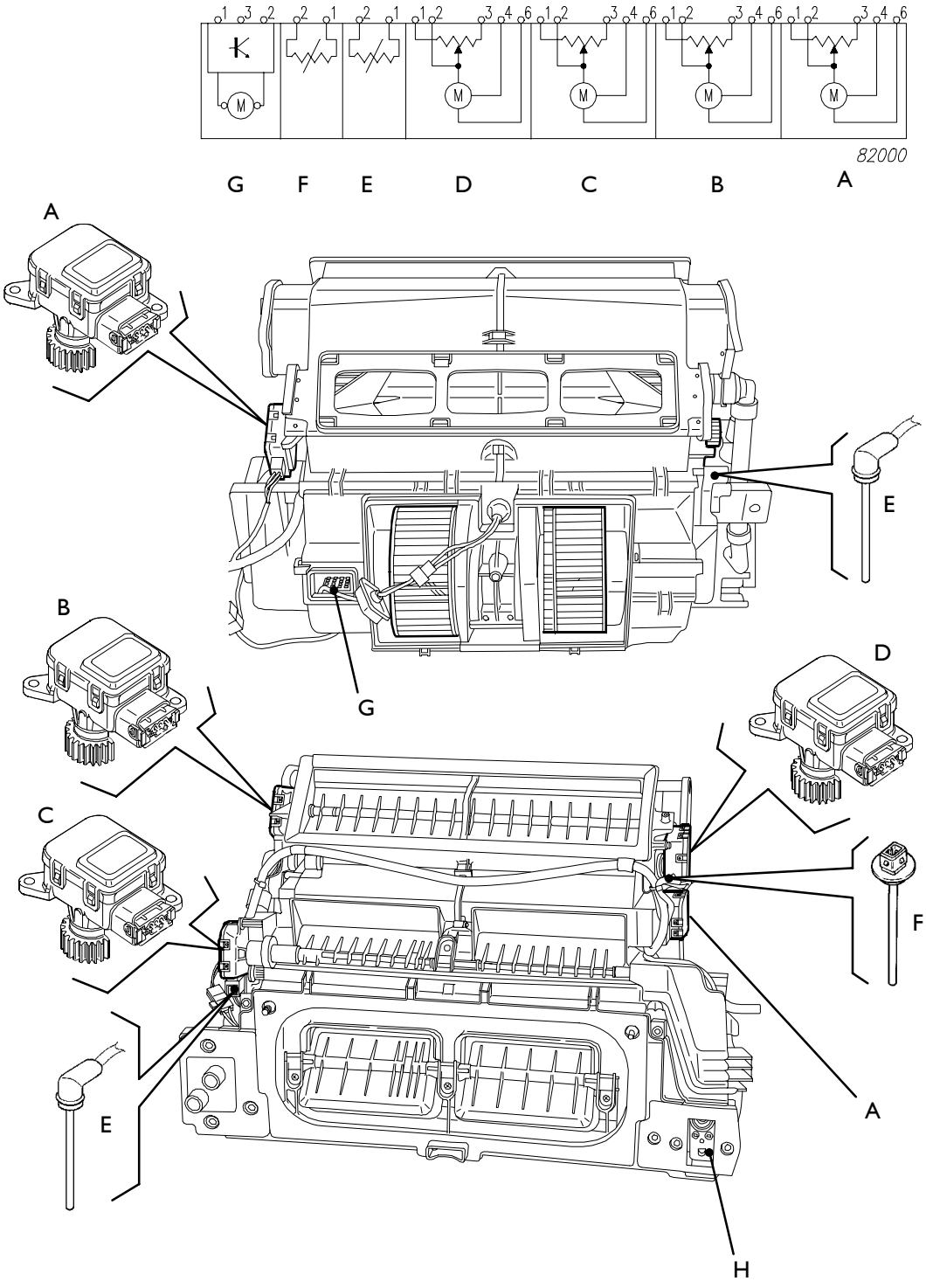
Figure 281



42045. External temperature transmitter - 82000. Windshield defroster unit - 82010. Conditioner electronic control centre - 86030. Sun ray detection sensor - 84009. Internal temperature detection sensor - 42608. Coolant pressure warning pressure switches - 25332. Compressor on remote control switch - 78227. Radiator coolant recirculation electro valve - 84019. Compressor - 86116. Body Computer - 72021. 30-pole connector for diagnosis

Windscreen electric defroster assembly components location

Figure 282

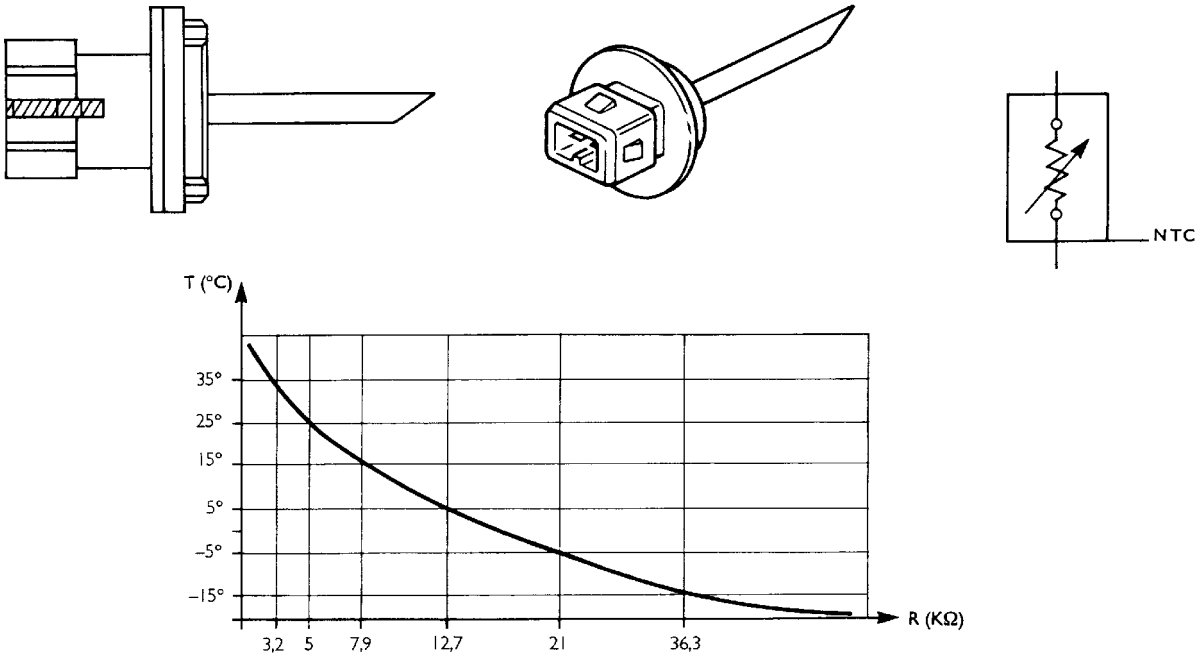


A. Floor reduction gear - B. Windshield defrost reduction gear motor - C. Recirculation reduction gear motor - D. Mixing reduction gear motor - E. Blown temperature sensor - F. Evaporator temperature sensor - G. Blower control module - H. Expansion valve

External temperature sensor

Located on the driver side vehicle front so it is invested by external temperature, as close as possible to reality. Its resistance at 25 °C = ~ 10 Kohm

Figure 283

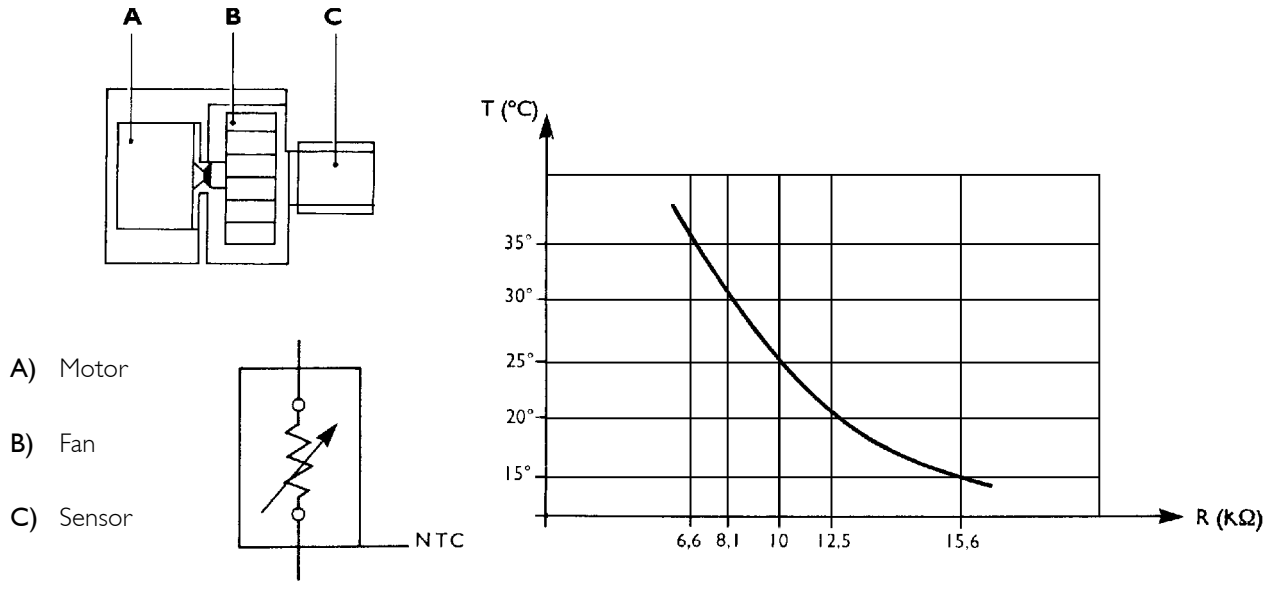


77566

Main interior temperature sensor

Located on the right inside the control module and ventilated by a motor enabling air circulation and preventing erroneous temperature readings between values measured and the cab. Its resistance at 25 °C = ~ 10 Kohm

Figure 284



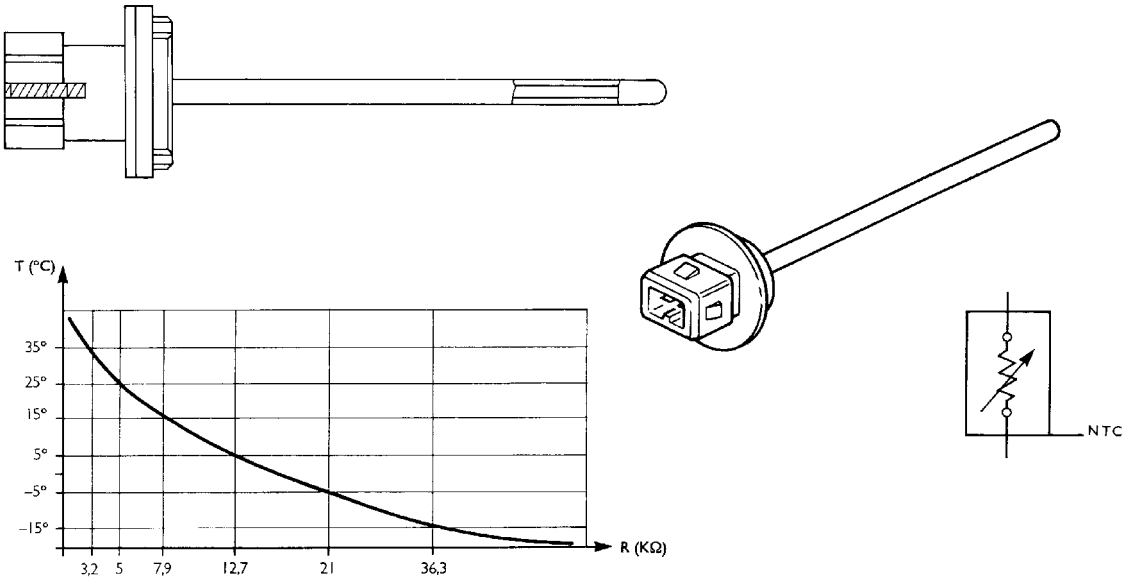
77567

Evaporator temperature sensor

The sensor placed inside the evaporator generates compressor connection and disconnection.

Disconnection to avoid dispenser freezing occurs at a temperature < 2 °C, while connection at a temperature > 5,5 °C. Its resistance at 25 °C = ~ 3,28 Kohm

Figure 285

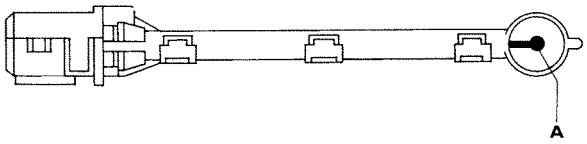


77559

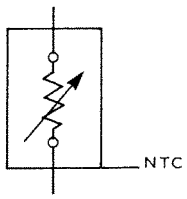
Blown air temperature sensor

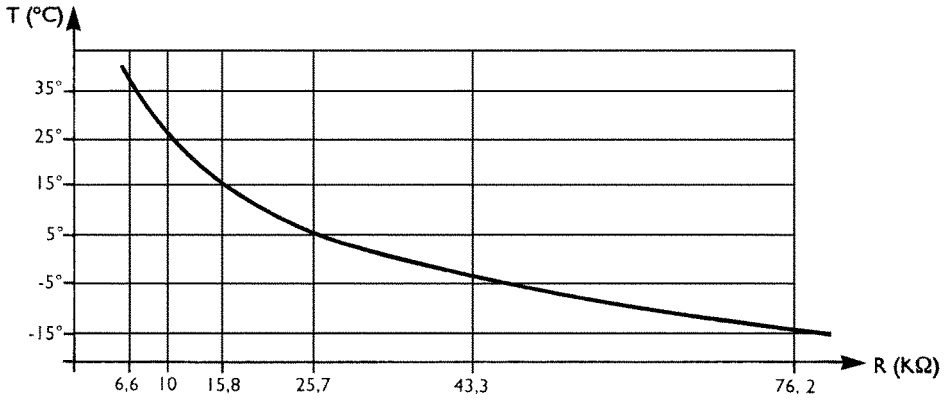
Located downstream the heat exchanger, it gives the temperature of air inlet into the cab and enables the centre to adjust more properly. Its resistance at 25 °C = ~ 10 Kohm

Figure 286



A) Sensor



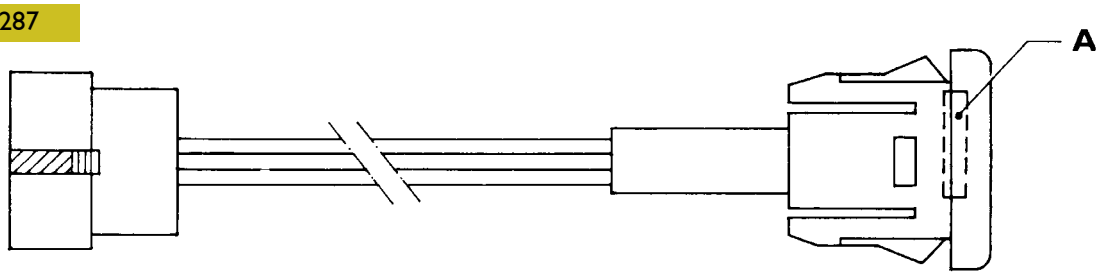


77574

Sun ray sensor

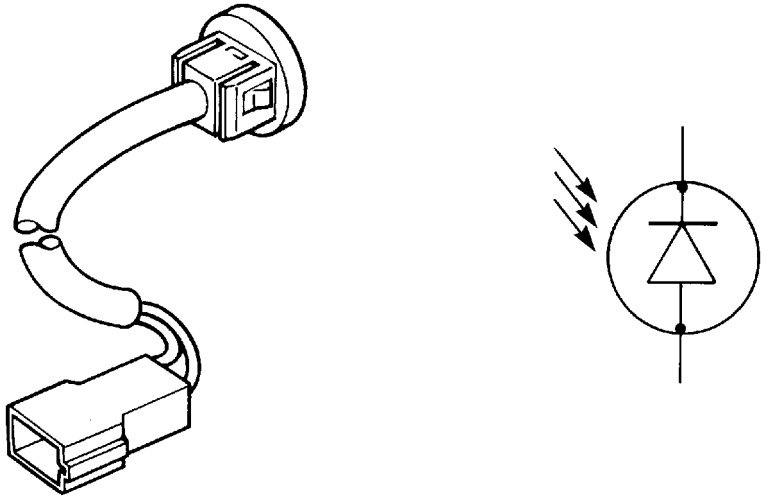
It is a photodiode placed on vehicle dashboard to point out luminous intensity that the cabin receives from outside.

Figure 287



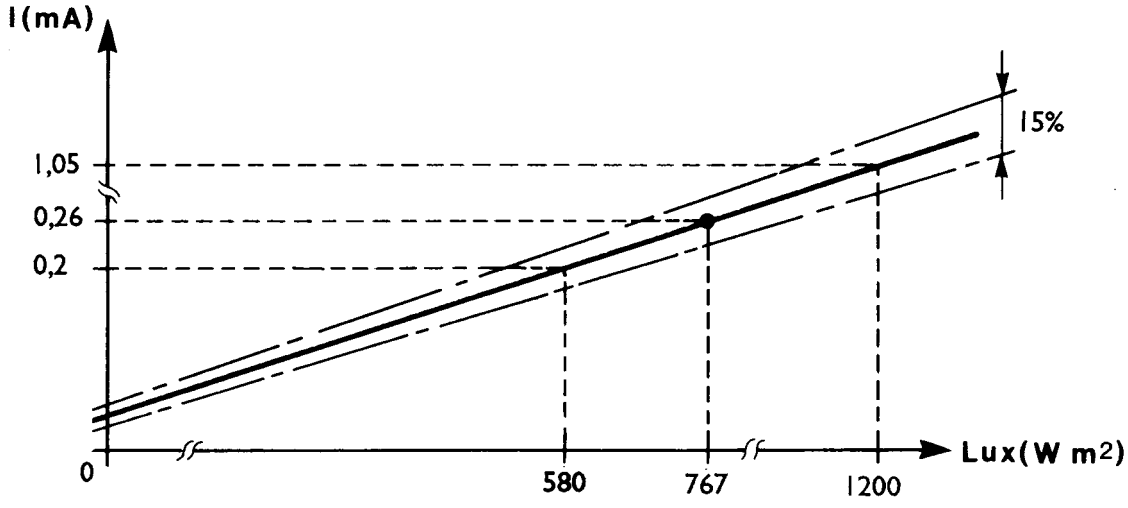
A) Sensor

77563



77564

Figure 288



77565

Reduction gear motors

The four automatic system units are located in the heater/conditioner inside the cab, according to their functions.

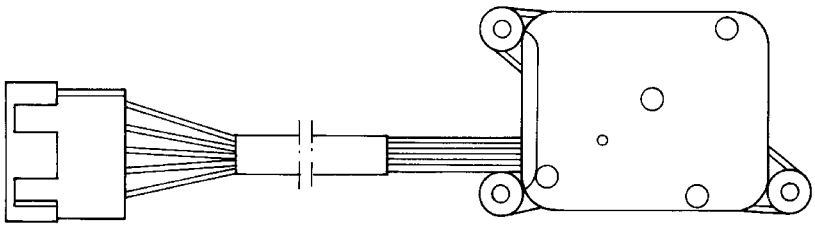
Their electrical features are the same.

They are activated directly by the electronic centre at 24 V rated voltage and absorb from 20 to 40 mA. Motor resistance = ~ 112 Ohm.

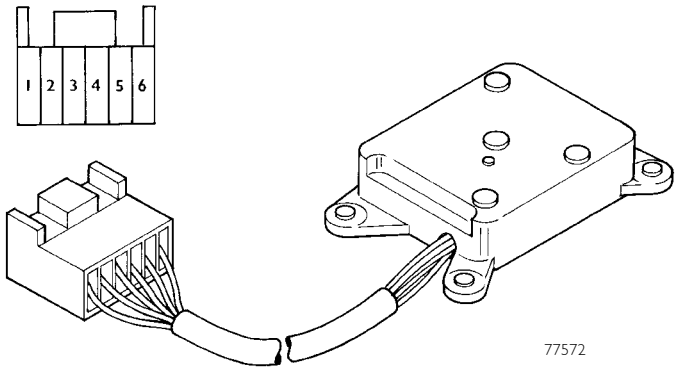
Maximum absorption at travel end is 200 mA, when the centre cuts supply off.

Their potentiometer is used as a return signal and when first lit, the centre detects and stores end travel values to divide the operating field. It is supplied at 5V, its resistance = ~ 5 Kohm.

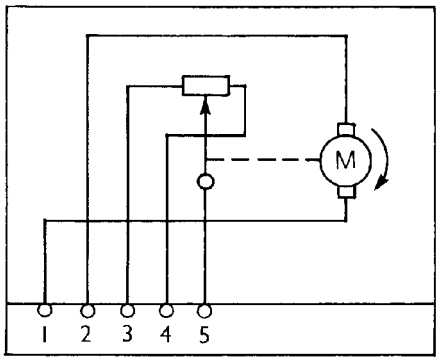
Figure 289



77571



77572



77573

Pin-out

Pin	Cable colour	
1	White	+/- 24V
2	Violet	+/- 24V
3	Blue	0V
4	Orange	0 ÷ 5V
5	Green	+ 5V
6	-	Free

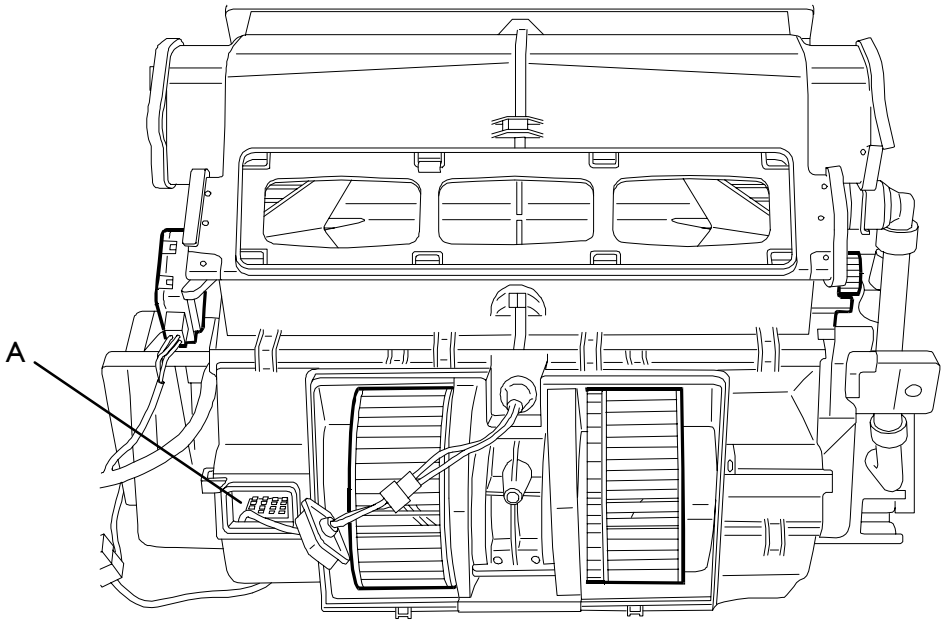
NOTE If a ratio motor is replaced, it is MANDATORY to carry out the system RESET by disconnecting and reconnecting vehicle batteries.

Blower control module

This electronic circuit located in the heater/conditioner unit adjusts double fan radial blower speed with some 200 different rates in the automatic mode and 8 in the manual mode.

The module is driven by the unit with a signal from 0 to 5 Volts while fans with a voltage from 0 to 24 Volts.

Figure 290



74244

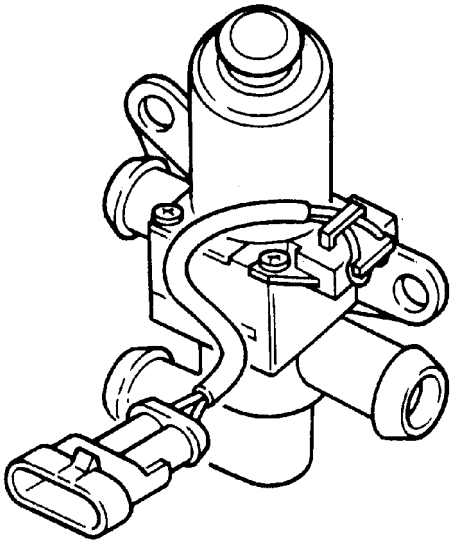
A. Blower control module

Pin	Cable	Function
1	0000	Negative direct from the battery
2	7555	Centre control positive
3	7551	Positive direct from the battery

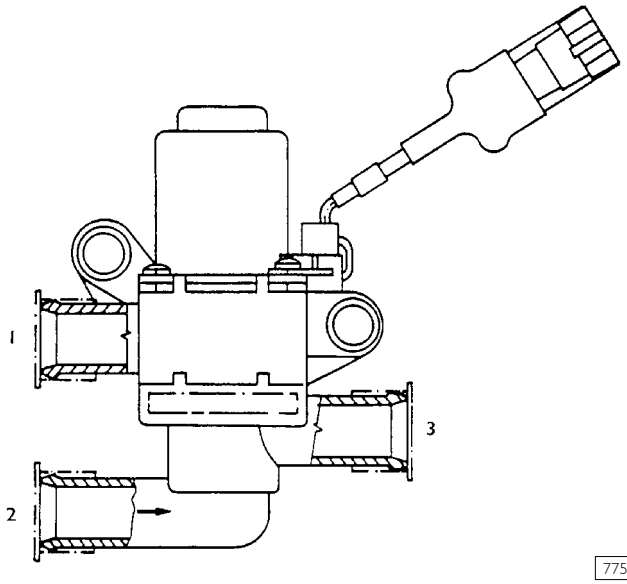
Solenoid valve (3 ways)

This one-directional NA unit is supplied by a battery-directed positive.
The electronic centre adjusts its duty cycle by supplying a mass.
This three-way valve performs all dosing and by-pass functions.
It is supplied by a battery-directed positive and is piloted by the negative supplied by the centre monitoring the duty cycle.

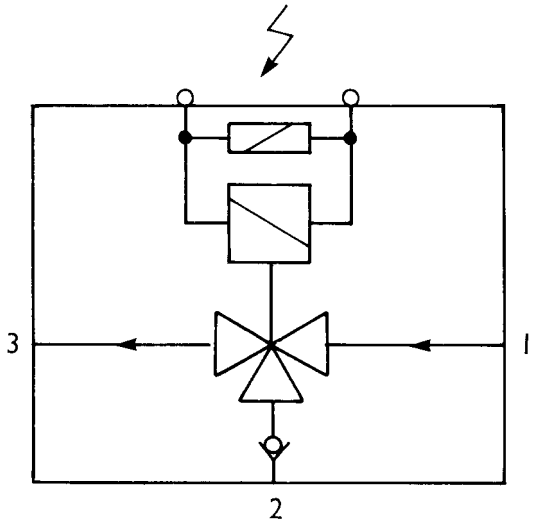
Figure 291



77569



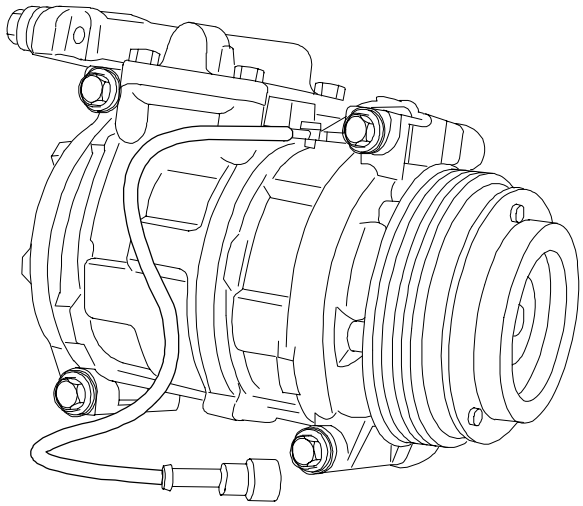
77568



77570

Compressor

Figure 292



106393

	NIPPODENSO
	ND 10 PA 17
Coolant	R134a
Lube oil	ND80
Quantity of coolant	700g
Quantity of oil	200cc.

R134a coolant is anyhow exclusively used in the STRALIS range

Drier filter and safety pressure switches

The drier filter is integral with the condenser located on the vehicle front.

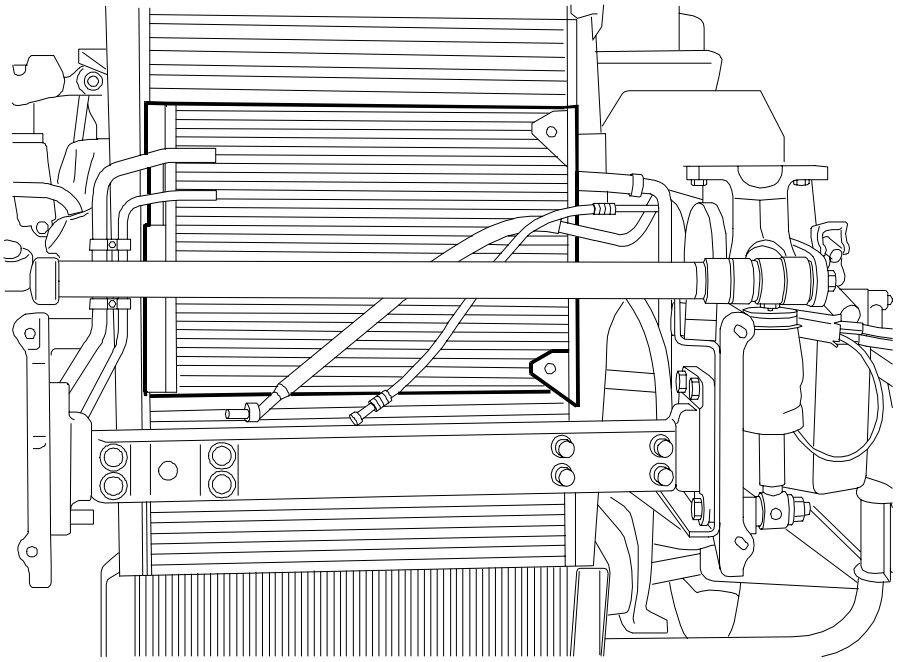
The cooling system uses R134a coolant as specified on its cover plate.

The 4-level safety pressure switch unit is installed on the condenser return line.

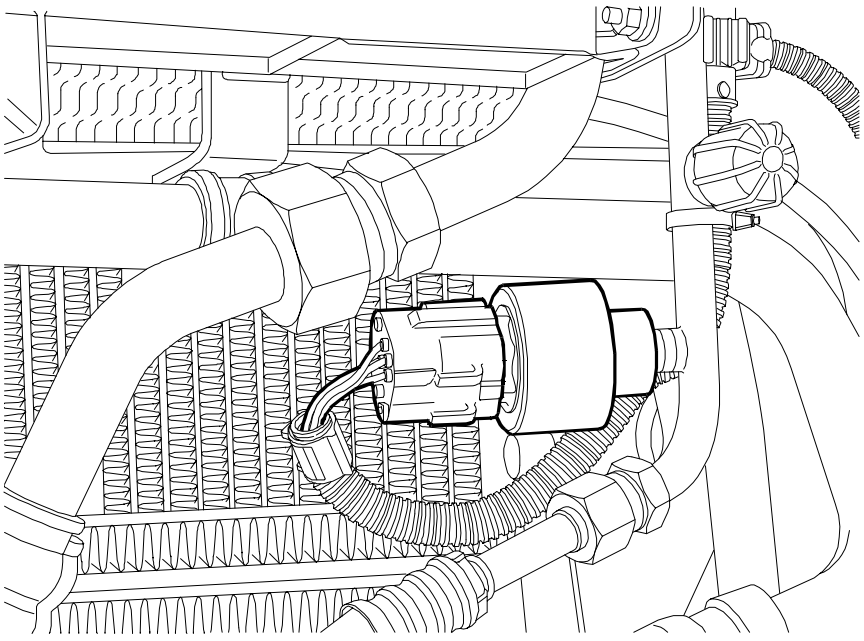
The two type NC and NA pressure switches keep system pressure constant from a minimum of 2.5 (for the NA) to a maximum of 25 bars (for the NC). The system is cut off when values are outside this range.

The two NA pressure switches are to cutout the engine cooling fan coil when system pressure is between 18 and 22 bars. This is achieved by means of a mass signal the two switches transmit to the Body Computer control centre.

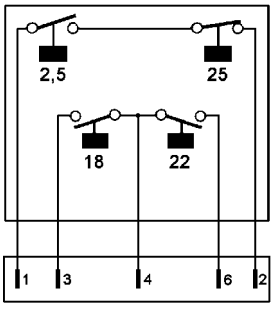
Figure 293



74245



74247



77560

Expansion valve

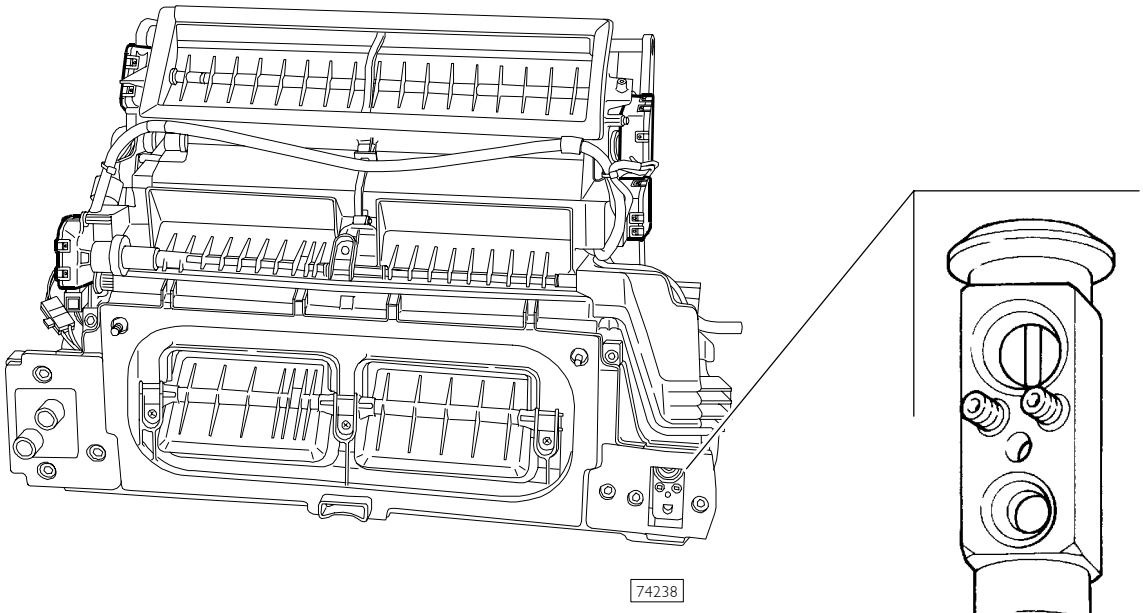
Its function is to lower liquid pressure from the condenser to a preset value so by circulating inside the evaporator the coolant can be sucked as a gas by the compressor.

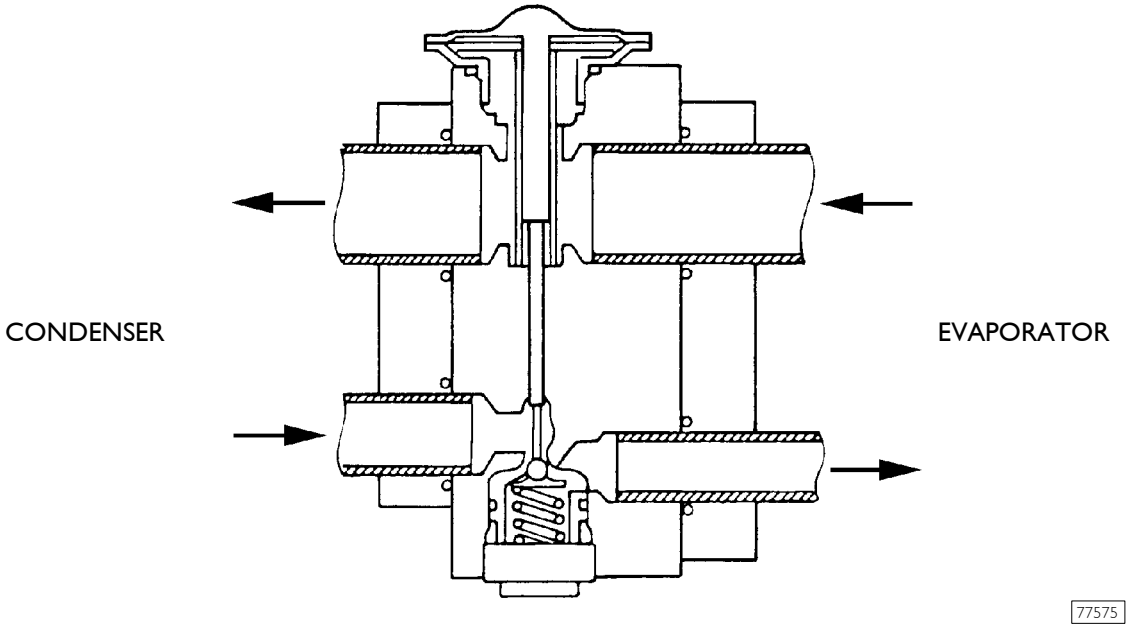
It thus completes three basic functions:

- DOSING
- MODULATING
- MONITORING

It is installed on the heater/conditioner unit close to the blower control module.

Figure 294



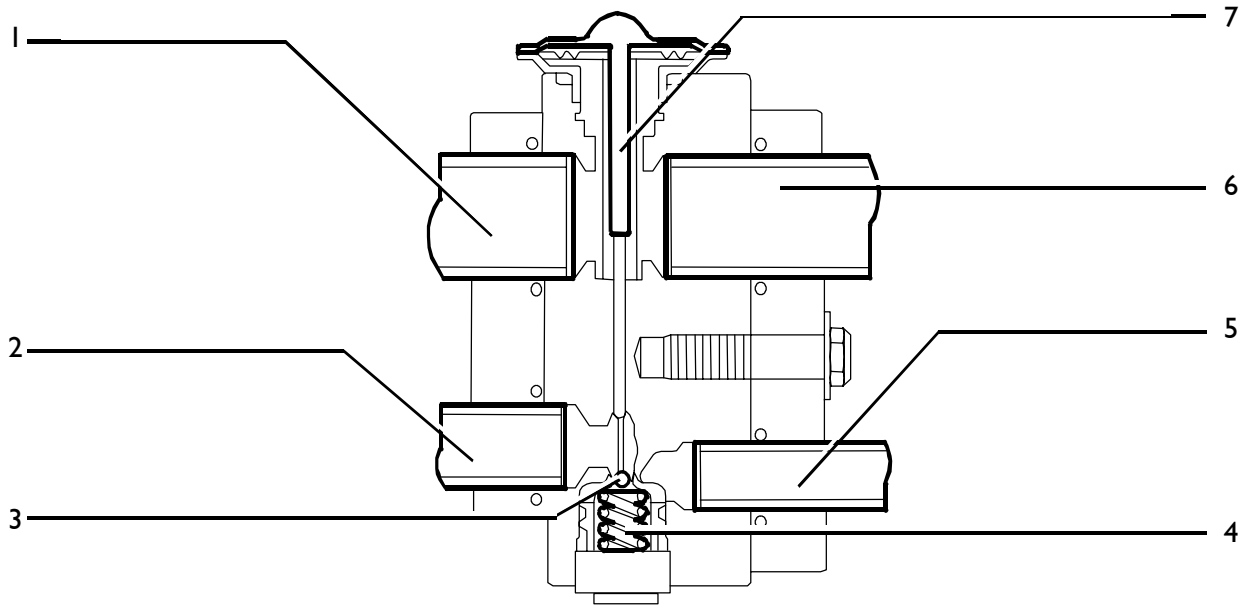


The expansion valve is of the union type and is placed between drier filter and evaporator.

Its task is checking and batching the cooling fluid flow in order to obtain the maximum refrigerating power from the system and to lower the cooling liquid pressure (upon exiting the filter) to a pre-established value, so that the fluid itself, by then circulating into the evaporator, can be sucked by the compressor in a completely gaseous state.
In this valve there are two cooling fluid passages:

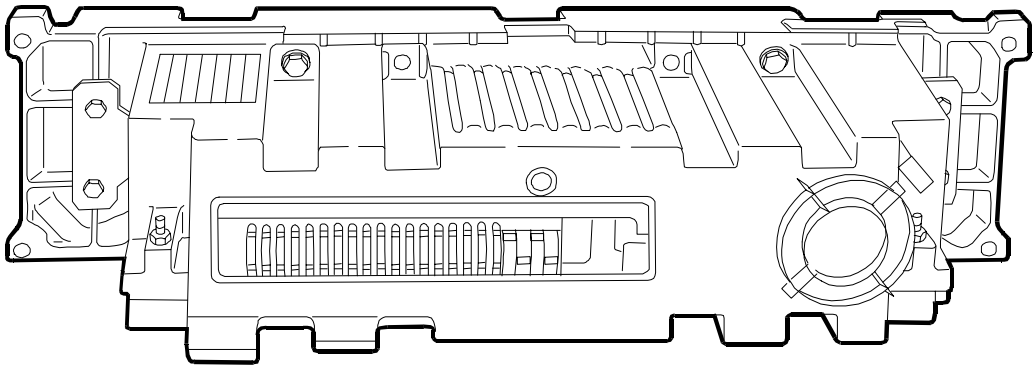
- The lower one that allows the cooling fluid to pass from drier filter (5) to evaporator (2). Along this path a spring (4) is placed that, suitably calibrated, allows obtaining such a temperature jump (overheating) as to ensure that the cooling fluid, upon entry the evaporator, is completely in a gaseous state. Moreover there is also a modulating element, in this case a ball (3) housed in the calibrated duct, that checks the cooling fluid flow rate to the evaporator.
- The upper one that allows the cooling fluid to pass from evaporator (1) to compressor (6). Along this path instead there is a temperature sensor (7) that, depending on the temperature upon exiting the evaporator, allows obtaining a control action on the cooling fluid flow rate, through the modulating and overheating checking element (3), through the spring (4).

Figure 295

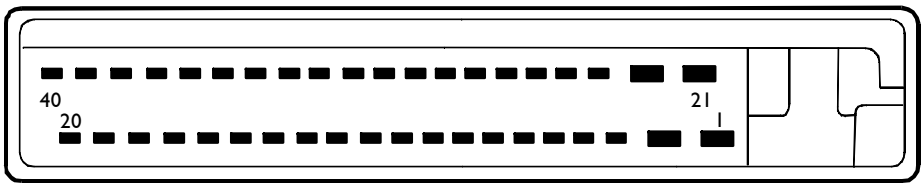


Conditioner control centre

Figure 296



74239



74248

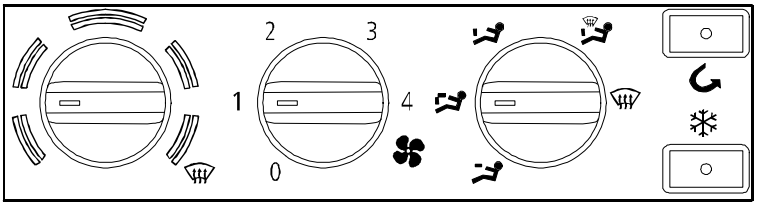
Pin	Cable	Function
1	-	-
2	7550	Positive direct from the battery
3	-	-
4	2296	K line for diagnosis
5	Ws/Bi	CAN - H (BCB) line
6	9993	Outgoing positive compressor electromagnetic clutch signal
7	7568	Mixer reduction gear motor power supply
8	7566	Recirculation reduction gear motor power supply
9	0562	Floor reduction gear motor power supply
10	7564	Windshield defrost reduction gear motor power supply
11	-	-
12	0550	Sensor and reduction gear motor mass
13	7572	Evaporator temperature reference signal
14	7574	Sun ray sensor signal
15	7565	Recirculation potentiometer reference voltage
16	7561	Floor potentiometer reference voltage
17	-	-
18	2290	Internal temperature sensor motor signal
19	-	-
20	7555	Outgoing positive blower control module signal
21	0000	Negative direct from the battery
22	9552	Outgoing negative electro valve signal
23	-	-
24	-	-
25	Gn/Ve	CAN - L (BCB) line
26	0568	Mixer reduction gear motor power supply
27	7569	Internal temperature sensor motor power supply
28	0566	Recirculation reduction gear motor power supply
29	-	-
30	0564	Windshield defrost reduction gear motor power supply
31	7562	Floor reduction gear motor power supply
32	7575	Internal temperature sensor signal
33	7571	Blow air temperature reference signal
34	7567	Recirculation potentiometer reference voltage
35	7563	Windshield defrost potentiometer reference voltage
36	7560	5-Volt Mix / Floor / Rec / Defrost potentiometer signal
37 ÷ 40	-	-

MANUAL AIR CONDITIONER

In the manual version the refrigerating circuit and heater checks occur by means of a device with leverages and knobs placed in the lower part of the central dashboard.

The system is checked by an electronic unit but by means of knob controls used for the following functions:

Figure 297



73668 C

1. Heating water cock control
2. Internal fans speed
3. Air flows distribution
4. Compressor control switch
5. Recirculation function switch

CONTROLS DESCRIPTION

Water cock control

The knob rotation adjusts water cock position and consequently the amount circulating inside the cabin radiator.
If supplementary **WATER** heater is present, this knob controls three microswitches used for the following functions:

20% supplementary heater water pump activation
60% top flap closing motor activation (TOP FLAP)
80% supplementary heater connection

If supplementary **AIR** heater is present, this knob controls two microswitches used for the following functions:

60% top flap closing motor activation (TOP FLAP)
85% supplementary heater connection

NOTE The **motor** for **TOP FLAP** function is present only in manual version, since in automatic version this function is performed through a bowden cable connected to air mixing motor (MIX).

- Maximum heating = TOP FLAP closed
- Maximum cooling = TOP FLAP open

Internal fan speed

This knob is composed of a multiple switch that controls three adjusting resistances for different motor speeds.

Air flows distributions

This control through bowden cables allows distributing the air flows in the desired cabin areas.

Recirculation function switch

This button allows, through a specific motor, closing the external door with a percentage of 95% of internal air and 5% of external air.
The motor has no position sensors since it works only under the two all-closed or all-opened conditions.
On the button there is a yellow-coloured led that signals its connection.
There is no time limit for this function.

Compressore control switch

This button allows connecting the air conditioner compressor.
The cluth closure is constrained by safety system pressure switches and by fixed-calibration evaporator thermostat
Such thermostat, of the mechanical type, adjusts the temperature inside the evaporator in order to disconnect the compressor clutch upon reacihing ~ 2 °C and reconnect it at ~ 5.5 °C
The compressor operation is constrained by the manual connection of at least one fan speed.
A yellow-amber-coloured led is present on the button and signals the compressor connection.

RATIO MOTORS

In manual system **there are two ratio motors** placed on heater assembly
They are composed of a motor without potentiometers ahd have the same electric characteristics.

The ratio motors are used to perform the following functions:

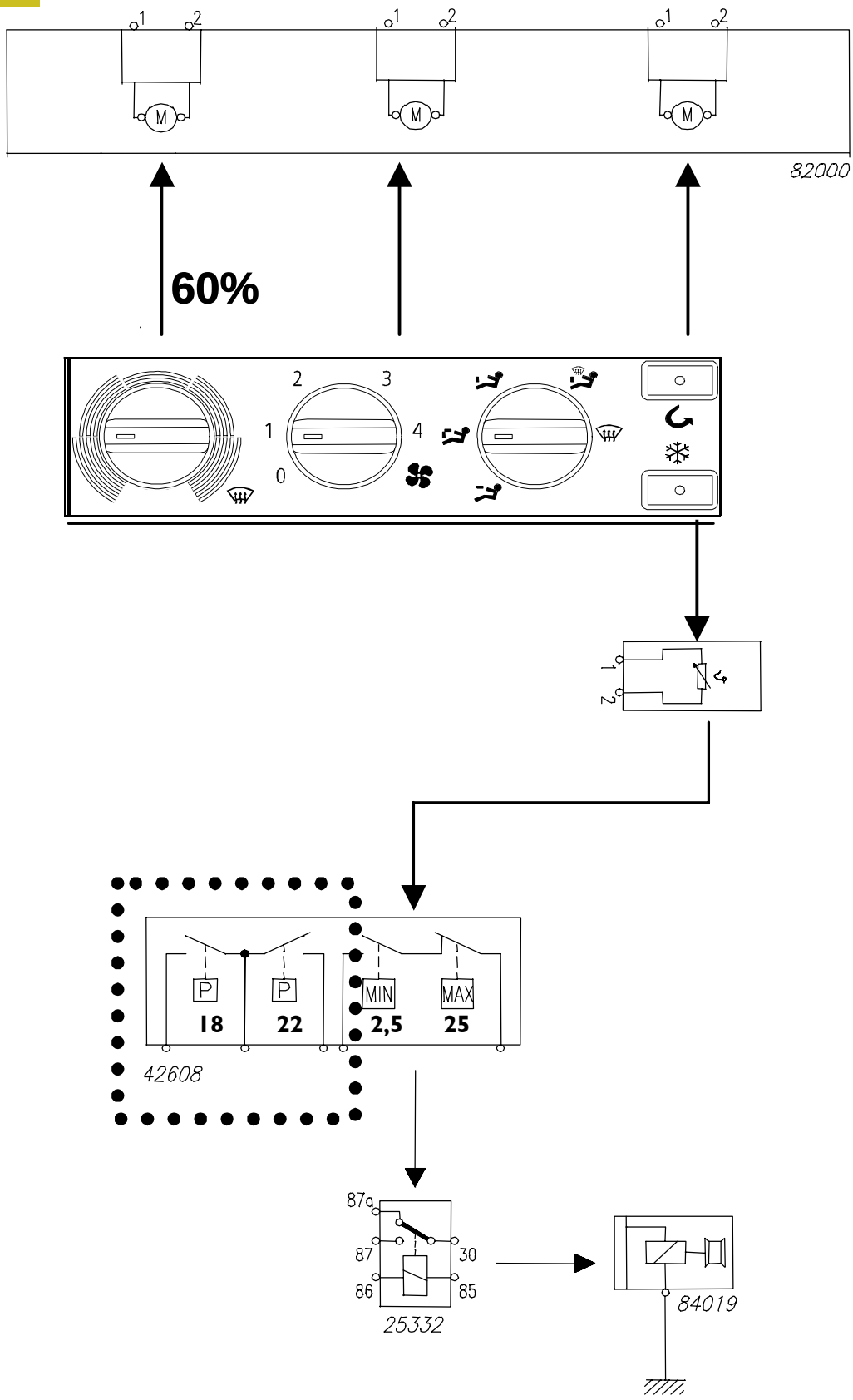
RECIRCULATION (RIC)
TOP FLAP (TOP FLAP)

MOTORS

- They are supplied at **24 V.**
- Motor resistance is **~112 Ohm.**
- No-load absorption is **about 30 mA.**
- Limit absorption is **about 200 mA.**

Block diagram

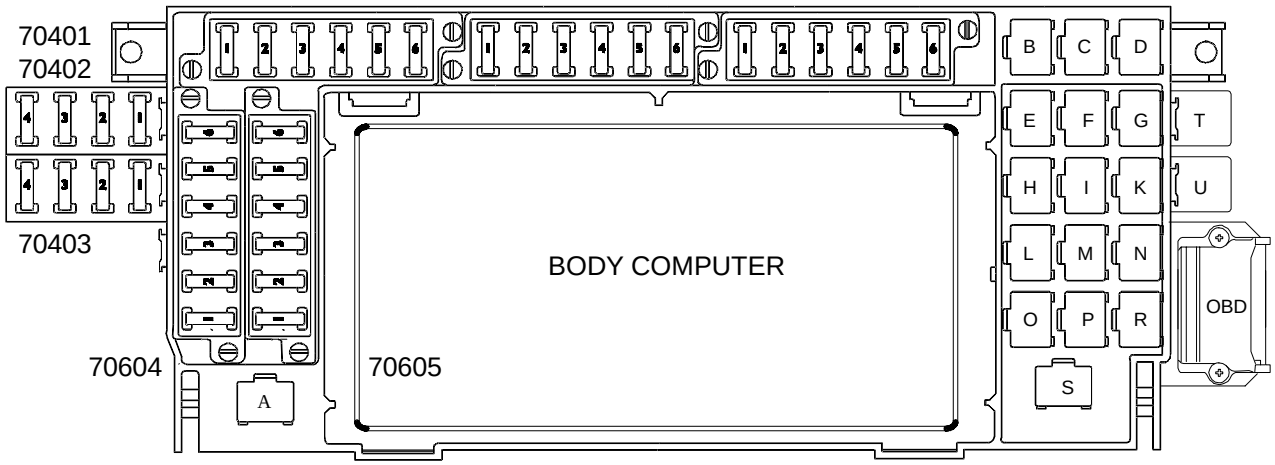
Figure 298



42045. External temperature sensor - 82000. Windscreen defroster assembly - 84009. Internal temperature sensor - 42608. Cooling fluid safety pressure switches - 25332. Compressor connection remote control switch - 84019. Compressor

Air conditioner fuses remote control switches

Figure 299



Black-coloured fuse-holder (70604)

Position	Description	Delivery A
1	Air conditioning system	15
2	Air conditioning system	15
3	Air conditioning system	5
4	Supplementary heating	15
5	Supplementary heating	5
6	CM (Cabin Module)	20

Ref.	Description	Component code
D	Manual conditioner remote control switch	25545
E	Water heated remote control switch	25325
G	Manual conditioner remote control switch	25544
I	Manual conditioner remote control switch	25874
K	Manual conditioner remote control switch	25310
M	Manual conditioner remote control switch	25322
N	Manual conditioner remote control switch	25332
P	Manual conditioner remote control switch	25327
R	Manual conditioner remote control switch	25332

HYDRONIC D 10 WATER HEATER

System operation

By connecting the burner, the electronic unit controls water pump, fuel batching pump, burner motor and ignition spark plug.

The water pump circulates the cooling liquid in the cooling circuit of the engine to be heated.

The burner motor sucks and inserts the right amount of air necessary for combustion.

The ignition spark plug heats air and burns fuel injected by the batching pump.

Purpose of the batching pump is taking and injecting fuel onto spark plug.

After 90 seconds, the unit, through the flame sensors, checks that the exhaust gases temperature value is included between **500 and 600 °C**, (ignition has correctly occurred).
Upon reaching about **700 °C** the unit disconnects the spark plug and the burner works in self-combustion.

If the flame sensor does not measure the above temperature, thereby the burner is not turned on, the unit repeats the ignition procedure. If it does not start again, the unit turns the burner off and it will then be mandatory to manually switch it on again.

If the heater does not start for three consecutive times, it is blocked.

The unit checks, through water temperature sensor and overheating sensor, whether combustion and burner correctly operate.

The **water temperature sensor** is used by the unit to adjust the burner working power (maximum, medium, minimum and stand by).
In the manual version, upon reaching **55 °C**, the system connects the fans inside the cabin.

The **overheating sensor** is used by the unit to turn the burner off in case of excessive water temperature (about **115 °C**).

The burner operating time is determined by driver's settings.
Upon turning off, the burner performs a washing phase that lasts for about 3 minutes in order to be ready for the following starting.

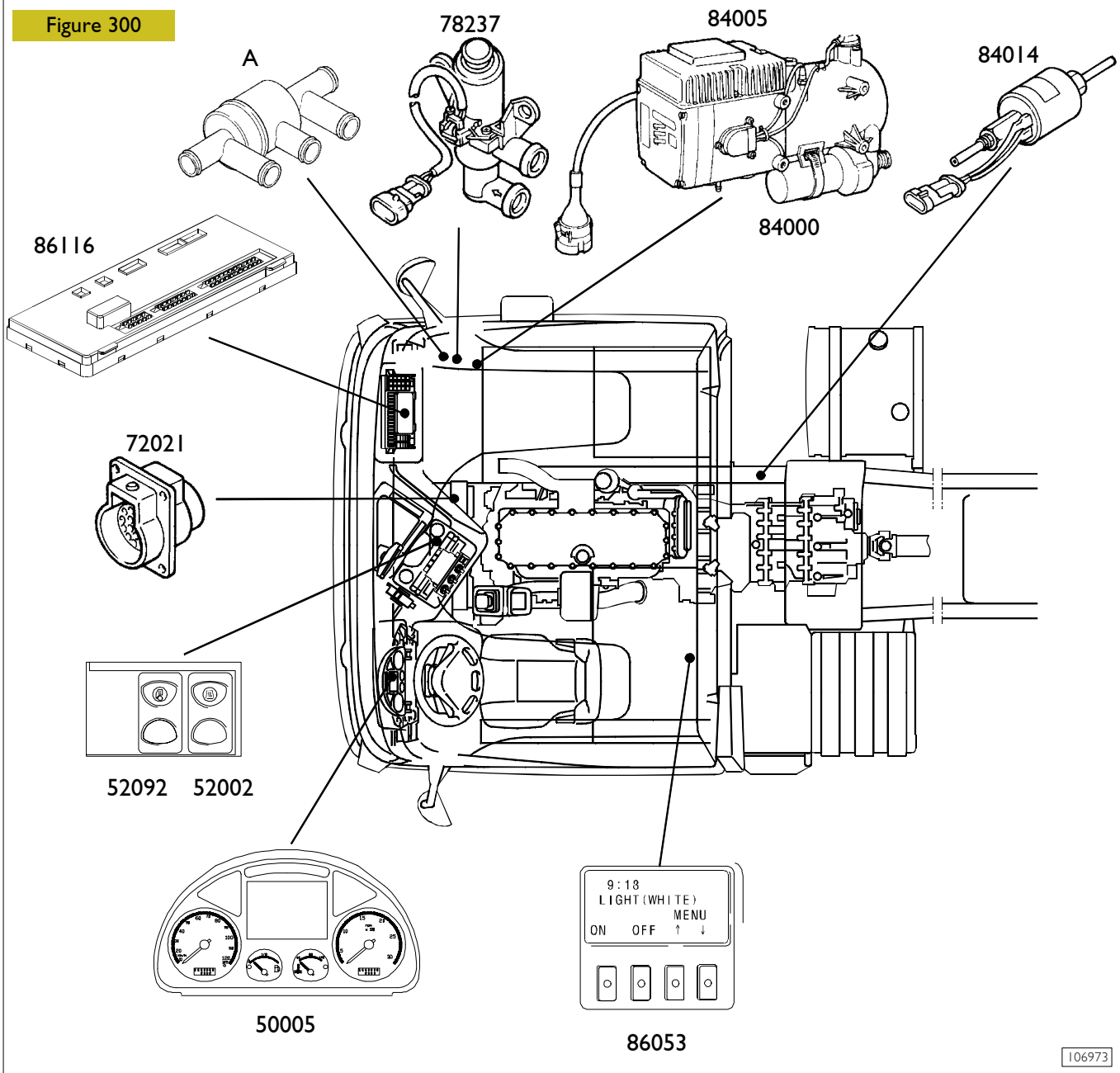
The heater is connected with its own control logic in the air conditioning system and is therefore equipped with an electronic unit with related connector.

The unit is directly assembled onto the heater.

The heater can be directly driven by the automatic air conditioning system, by the version with manual control or through the Bed Module unit.

COMPONENTS LOCATION

Figure 300



Legend

A	Thermostat 65 °C
50005	Cluster
52002	Heater connecting switch
52092	Cabin/engine heating swtich
72021	30-pole diagnosis connector
78237	Two-way solenoid valve (D+)
84000	Supplementary water heater
84005	Heater control electronic unit
84014	Fuel batching pump
86053	Bed Module
86116	Body Computer

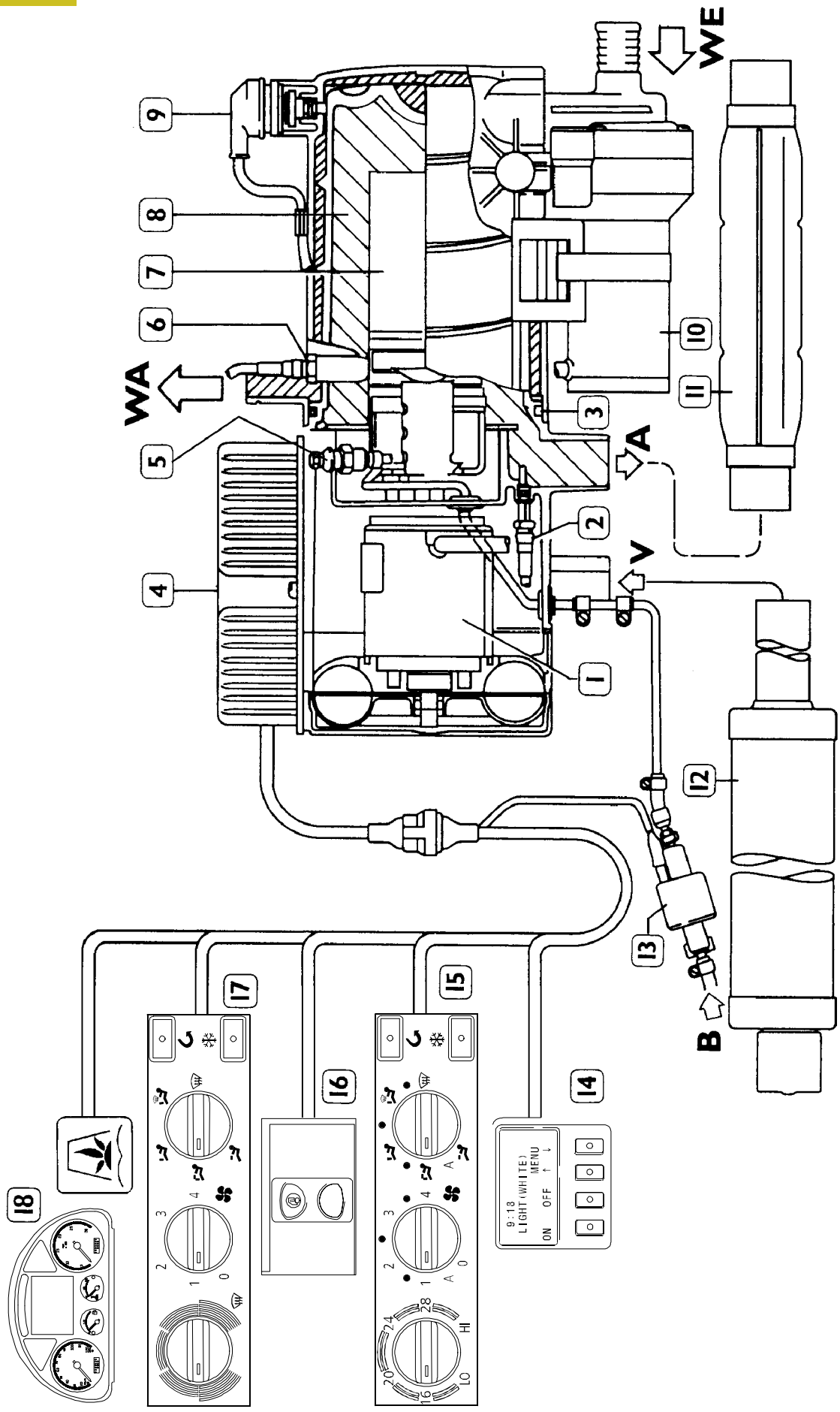
SYSTEM COMPONENTS

1) Burner motor
2) Flame sensor
3) Combustion chamber
4) Burner control unit
5) Ignition spark plug
6) Water temperature sensor
7) Flame pipe
8) Heat exchanger
9) Overheating sensor
10) Water pump
11) Silencer
12) Air suction pipe
13) Fuel batching pump
14) Bed Module unit
15) Automatic Webasto air conditioner electronic unit
16) Cabin/engine heating and heater connecting switch
17) Air conditioner control dashboard for manual version
18) Cluster

Connection to circuit

WE. Water inlet
WA. Water outlet
V. Comburent air inlet
B. Fuel supply
A. Exhaust gases outlet

Figure 301


WE
WA
A
V
B
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
9:18
LIGHT(WHITE)
MENU
ON OFF
HI
LO
106974

65 °C THERMOSTAT

It is assembled on the right vehicle side near the burner and has been inserted in order to allow quickly heating the cabin when the engine is off.

It is equipped with a temperature-sensitive membrane calibrated at 65 °C.

With temperature **< 65 °C** water will only circulate in cabin (small circuit).

With temperature **> 65 °C** the thermostat switches its position, allowing water to circulate both in cabin and in engine, heating them both (big circuit).

3-WAY SOLENOID VALVE

In the WEBASTO air conditioning system there is a single 3-way solenoid valve that performs the function of batching and bypassing cooling water from engine to radiator inside the cabin.

The valve is placed next to the front left side of the engine (driver side).

It is of the Normally Open type at rest and is supplied by a direct battery positive.

The electronic unit, by providing it with a mass, adjusts its working cycle (Duty-Cicle).

WATER PUMP

The water pump is directly assembled on the lower part of the burner.

It is used to circulate the engine cooling water in the circuit.

The supply voltage is **24 Volt.**

The minimum flow rate is **about 500 l/h.**

FUEL BATCHING PUMP

It is assembled on the chassis next to fuel tanks with a slant of 15° to facilitate air drain. It is used to take and inject gas oil inside the burner.

The unit supplies the pump with a pulse signal.

For a correct operation the internal delivery pipe diameter must be **2 mm** and must not exceed the length of **5 meters**.

It embeds a small fueld filter and a unidirectional check valve.

The fuel flow rate is **about 0.2 l/min.**

WATER TEMPERATURE SENSOR

It is a **PTC sensor** assembled on heat exchanger; it measures different water temperatures in order to adjust the burner power and, only in manual version, upon reaching **55 °C**, it allows connecting the fans.

The sensor resistance at **20 °C** is **~950 Ohm**.

FLAME SENSOR

It is a **PTC sensor** assembled inside the combustion chamber next to the exhaust gas outlet and measures the current temperature, in order to disconnect the spark plug in case the burner has not been turned on.

It disconnects the spark plug at an exhaust gas temperature of about **700°C**

The sensor resistance at **20 °C** is **~1080 Ohm**.

IGNITION SPARK PLUG

It is a **resistance** placed inside the combustion chamber.

The unit supplies it with pulses through an internal electronic regulator.

The rated operating voltage is **18 Volt** to allow its operation also with battery voltages of ~ 22 Volt.

The resistance at **20 °C** must be **< 2 Ohm**.

OVERHEATING SENSOR

It is a **temperature sensor** assembled on the heat exchanger, it measures the different water temperatures to possibly disconnect the burner upon reaching about **115 °C**

In case of intervention the sensor restores itself autonomously. It is not of the manual restoring type.

The sensor resistance at **20 °C** is **~ 10 K Ohm.**

BURNER MOTOR

It is embedded into the assembly in the rear burner part.

The rotation speed is managed by the unit by means of an integrated electronic regulator.

It embeds an inductive sensor that measures the engine rotation speed.

ELECTRONIC UNIT

It is directly assembled on heater body and is interfaced with vehicle through a 14-pin connector.

It is connected to **CAN BCB** line.

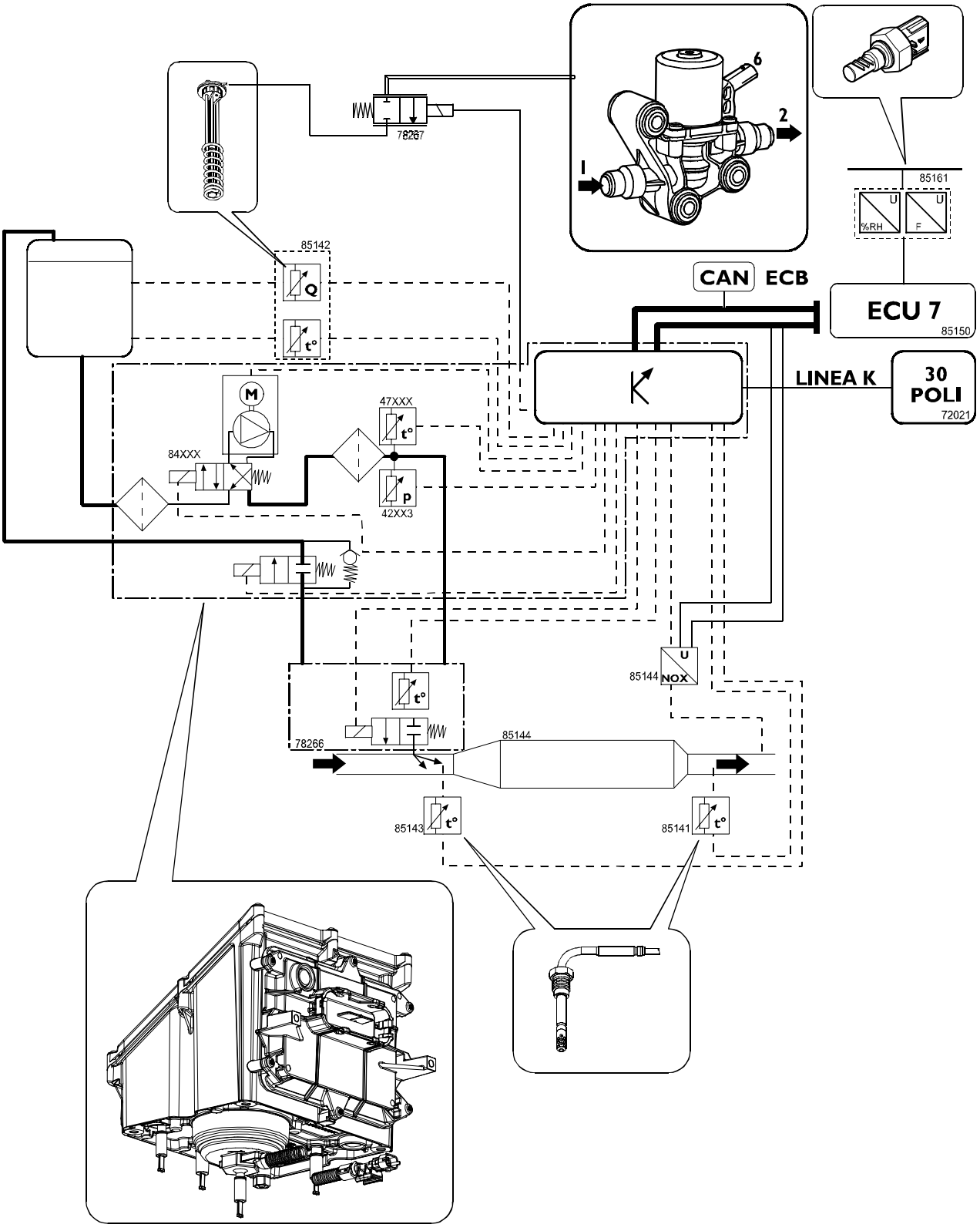
It has a very advanced diagnostic system and transmits possible error codes on vehicle Cluster.

Pin	Cable	Function
A1	7506	Positive from water cock knob manual version (25% position)
A2	7711	Positive from boiler activating switch
A3	Ws/Bi	CAN H line
A4	7775	Positive for ambient thermostat control (manual version)
B1	Gn/ve	CAN H line
-	-	-
B3	2296	Diagnosis K line
B4	6605	Positive for cabin/engine heating key warning light
-	-	-
C2	7708	Direct positive from battery
C3	0000	Direct negative
C4	7783	Positive for fuel batching pump control
-	-	-
-	-	-

SCR (SELECTIVE CATALYTIC REDUCTION) SYSTEM - DENOX 2

The system operation is described in the "Engine" section of this manual.

Figure 302



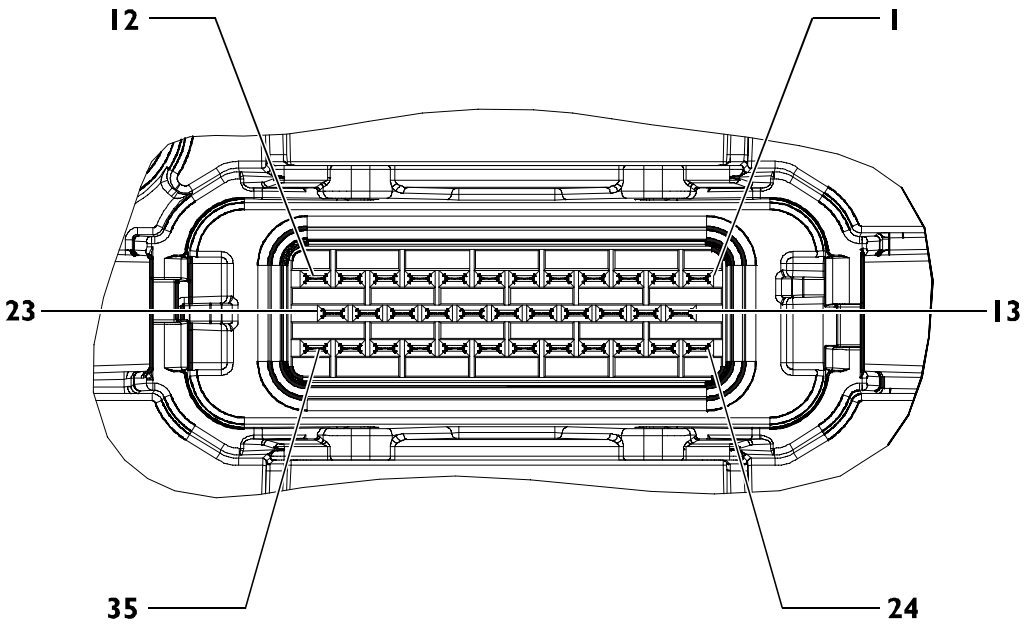
SCR SYSTEM OPERATION DIAGRAM

108913

Name	Description
42XX3	AD-Blue solution pressure sensor
47XXX	AD-Blue solution temperature sensor
72069	16-pole joint for OBD (on-board diagnosis)
78266	Measuring module solenoid valve with SCR
78267	Engine water circulation solenoid valve for UREA tank heating with SCR
84XXX	Electric displacement pump with pressure control valve and circulation valve
85140	Electronic control for SCR pumping module
85141	Catalyst output temperature sensor with SCR
85142	UREA tank level and temperature sensors with SCR
85143	Catalyst input temperature sensor with SCR
85144	Nitric oxide (NOx) measuring sensor with SCR (if applicable)
85150	EDC control unit
85161	Combustion air relative humidity and temperature sensors with EDC

Pin - out

Figure 303



CONNECTOR VIEW (CABLE SIDE)

Ref.	Description	Cable colour code
1	Solenoid valve power supply positive for engine coolant circulation	7542
2	Power supply of urea filter output heater	7546
3	Power supply +30	7540
4	Power supply +30	7540
5	CAN H line (ECB)	White
6	CAN L line (ECB)	Green
11	Urea electric meter control	9541
12	Power supply of metering module solenoid valve with SCR	7541
14	Earth	0000
15	Earth	0000
17	Earth cable for input temperature sensor of catalyst with SCR	0544
18	Signal cable to urea tank level sensor with SCR	6543
19	Level sensor earth and urea reservoir temperature	0543
23	Urea tank heating solenoid valve earth	9542
24	Positive +15	8540
25	Earth cable for output temperature sensor of catalyst with SCR	0541
26	Output temperature sensor signal of catalyst with SCR	6541
28	Signal cable for input temperature sensor of catalyst with SCR	6544
29	Signal cable to urea tank temperature sensor with SCR	6542
31	Fault diagnosis "K" line for SCR control unit	2257
33	Urea filter output heater control	9546

CENTRAL LOCKING WITH REMOTE CONTROL

The system consists of one or several (max. 8) transmitters and a receiver.

Transmitter

The transmitter has a special container of its own, equipped with an eyelet and ring.. The shock-proof transmitter container is also waterproof.
The transmitter sends the receiver a variable code (rolling code) by means of a radiofrequency signal at 433.92 MHz (EC Directive 95/56).
It is equipped with two buttons for door opening and closing, respectively.
By keeping the button pressed down for 50 msec, the variable code will be fully transmitted. If the button is actuated continuously, however, transmission will be interrupted after 5 seconds (± 10%).
The transmitter operating range is 10 m.
The battery guarantees a 2 years' service life. Following the replacement, the transmitter may be briefly actuated twice in order to restore synchronism with the receiver. This sequence is also permitted at any time other than battery replacement

Receiver

The receiver is housed inside a container with a white cover, which includes a transmitter programming button (easily accessible and protected against unintentional actuation), a programming check green LED, and a 8-way connector.
It is housed in instrument panel upper side, in front of passenger's seat.
The receiver antenna is housed inside the container, too.
The receiver receives and decodes the code_that was sent by the transmitter, and can store up to eight codes. Doors locking and unlocking commands go from the transmitter to the receveir, which sends the signal to Body Computer central unit, which in turn via CAN line sends a message to Door Modules to activate the locks.
If the vehicle is in the key-ON condition (+15 is available), the receiver will perform no actuation through the remote control.
The receiver manages synchronization between the locks, and resumes correct alignment through a sequence of two or several transmitter or lock key drives.

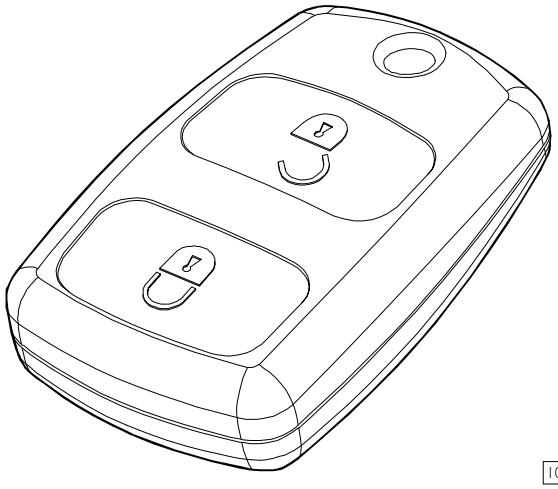
Blinker control

Door lock locking and opening will be signalled by the lighting of the indicator lights. Therefore, the receiver need be interfaced with the Body Computer control unit that manages the above-mentioned lights.
The receiver features an output (to the ground) that is connected in parallel with the emergency light switch. The latter consists of an unstable button that actuates and deactivates the blinking sequence (blinker signal).

Description of blinker controls:

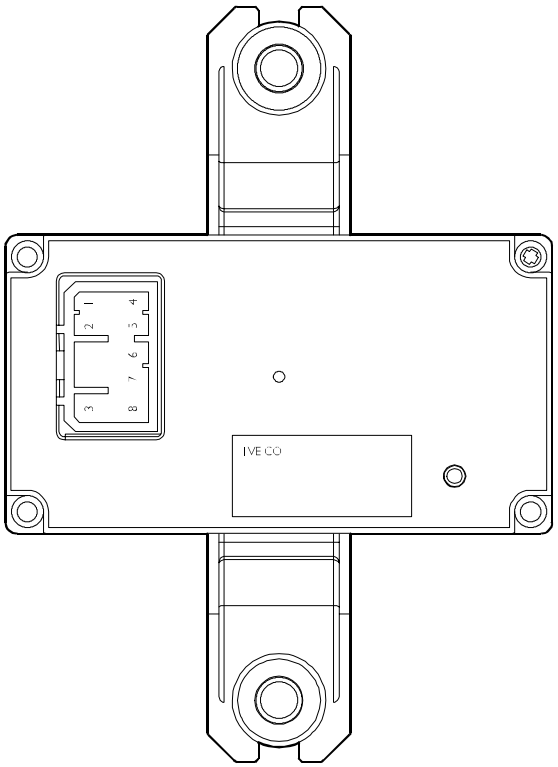
- T1 = 120 msec (Start)
- T2 = 700 msec (Delay - Lock)
- T2 = 1550 msec (Delay - Unlock)
- T3 = 120 msec (Stop)

Figure 304



TRANSMITTER

Figure 305



CENTRAL LOCKING CONTROL UNIT (RECEIVER)

Control unit pin-out (receiver)

Pin	Function	Cable colour code
1	Blinker control	1113
2	Free	-
2	Battery positive	7772
4	Earth	0000
5	Central locking control (door closing)	0064
6	Central locking control (door opening)	0065
7	+15 power supply	8871
8	Free	-

Programming

The programming status makes it possible to get the receiver to recognize the transmitters enabled to control the respective functions.
Programming is accessed through the rest state when the +15 signal is not available.
The receiver may be controlled by a transmitter with a universal code as long as at least one transmitter is not programmed.
After a variable code (other than the universal code) has been programmed, the latter will not be recognized any longer.
Transmitters are programmed in the FIFO mode.
Two transmitter programming modes are available:

- ❑ simplified programming: it allows you to program the transmitters quickly. It can be actuated until 128 actuations are performed after the first programming, or until it is disabled.
- ❑ Protected programming: it guarantees the customer against the risk of other transmitters being programmed without the knowledge of the customer themselves. It involves using a password (shown on the tag enclosed with the transmitter) that can be obtained from the transmitter code.

Simplified programming

The first code (and the subsequent ones as well) are programmed as follows:

- ❑ press the button on the receiver: the LED will light up and blink;
- ❑ the operator presses, while keeping the button on the receiver pressed down, any of the key of the transmitter, which sends out the code;
- ❑ the receiver stores, after detecting three subsequent transmission instances (with the current checksum), the code into the memory;
- ❑ the receiver LED will, at the very time when it recognizes the code, light up steadily, thus signalling that the code has been received: now the operator may release the transmitter button to end the programming.

Simplified programming disable
Simplified programming may be disabled by entering the password as follows:

- ❑ press the small button on the receiver: the LED will light up and blink;
- ❑ release the small button: the LED will blink once;
- ❑ enter, by means of the small button, a 4-digit code (password): each digit shall be included between 0 and 9 (code written on the label delivered together with the transmitter). An optical feedback will be generated on the LED every time the small button is pressed;
- ❑ after each digit has been entered, wait for the LED to blink again to request the next digit, up to the fourth digit;
- ❑ the procedure will be over after the last digit is entered.

Protected programming

Every time a new transmitter is to be recognized after firstly entering the password, you will need to enter the password of any of the transmitters previously stored into the memory. Correct recognition of the password will be signalled by the LED blinking after the password has been entered (if the password is not recognized, the LED will remain ON for 10 seconds). When the LED is blinking, keep the receiver button pressed down, then transmit with the new remote control to be stored into the memory, by following the simplified programming instructions.

DIAGNOSTIC

MODUS (Maintenance and diagnostic system)

Computer-assisted diagnosis station used for diagnosis of braking systems, pneumatic suspensions, electronically-controlled systems and engines.

The station is equipped with auxiliary functions such as electronic control unit programming, spare list catalogue referencing, time-charts, etc.

The vehicle is equipped with a 30-pole diagnosis takeoff for interface with the vehicle.

IT 2000 (IVECO Electronic Tester)

The IVECO electronic tester makes it possible to immediately intervene on the vehicle, by recognizing the latter by means of the chassis number.

This tester stores the results of the diagnostic operations carried out.

It can also be used as a portable PC, and is set for remote diagnosis.

By using MODUS as a mother station, IT 2000 can be updated and configured.

IT 2000 is interfaced with the vehicle by means of a 30-pole diagnosis takeoff.

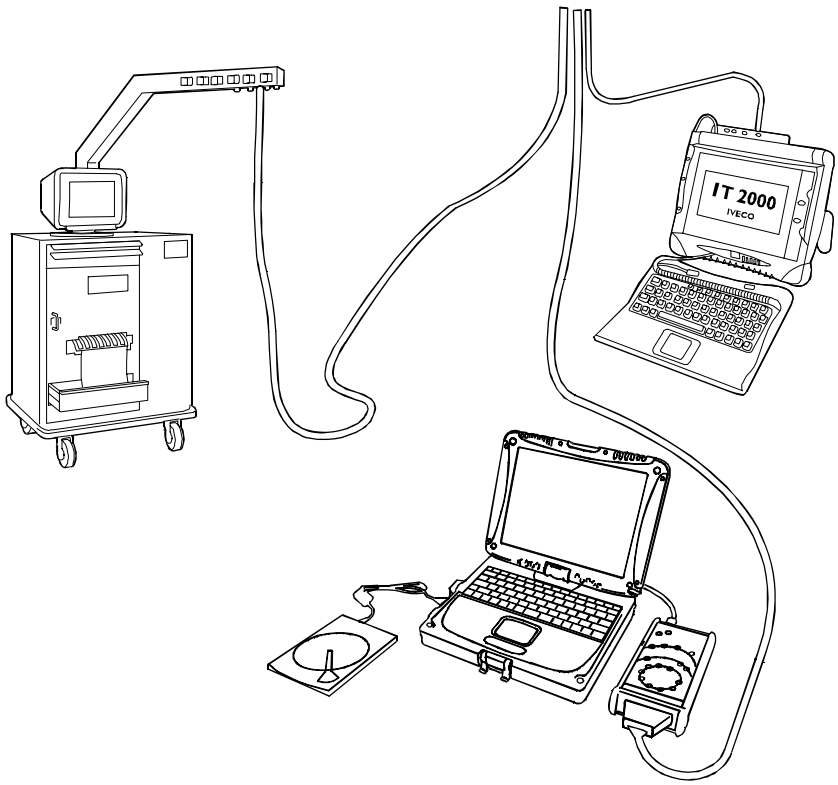
E.A.SY.

E.A.SY. system allows to simply make the diagnosis and programming of the various electronic central units aboard the vehicle.

E.A.SY. system is made up of ECI module communicating with the electronic central units and of a Panasonic PC.

ECI module, exploiting the Panasonic PC, also allows easy on the road interventions: in particular, thanks to Panasonic PC wireless technologies (e.g. GPRS), diagnostic interventions can be assisted by a remote expert centre.

Figure 306

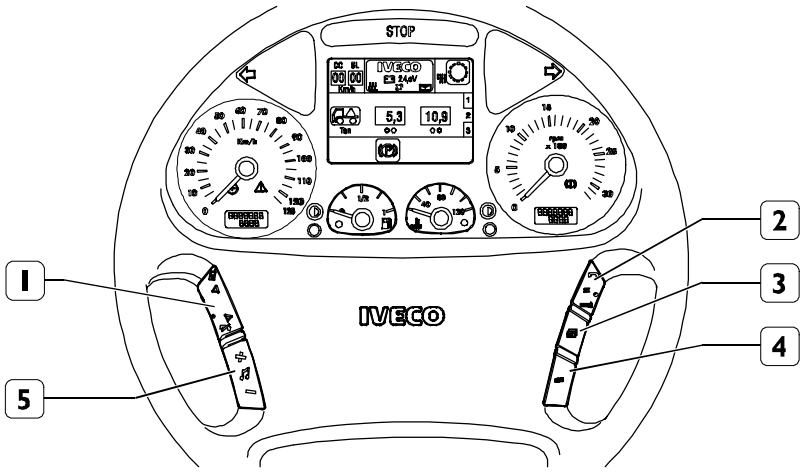


101586

Diagnosis on Cluster

Access to the fault memory is possible through the "menu" function key (2) available on the steering wheel.

Figure 307



1. Button ▲ or ▼ - 2. Button MENU/OK - 3. Page button - 4. Escape button - 5. Button + and –

Turn key switch to MARCIA (+15), then press "menu" function button (2): the display will show the data exchange menu containing the list of available functions (e.g. HI-FI, telephone, diagnostic, etc.).

Select, by means of function ▲ and ▼ button (1), the diagnostic function, then confirm correct selection by means of function "OK" button (2).

The available electronic systems can be selected by means of select/confirm buttons (1) and (2).

The diagnosed systems are:

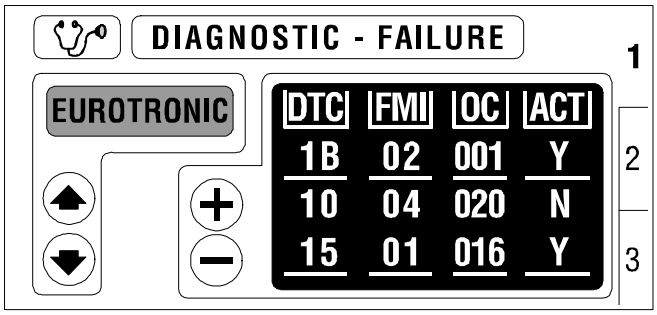
1	EDC	10	FFC (Front Frame Computer)
2	EUROTRONIC	11	RFC (Rear Frame Computer)
3	INTARDER	12	DDM (Drive Door Module)
4	EBS (or ABS)	13	PDM (Passenger Door Module)
5	ECAS	14	CM (Cabin Module)
6	IMMOBILIZER*	15	ACLC (Automatic air conditioner)
7	MTCO (Tachograph*)	16	AHT_w (Auxiliary water heater)
8	DC (Body Computer)	17	AHT_a (Auxiliary air heater)
9	IC (Instrument Cluster)		

* Function not active

NOTE EDC control unit errors are not displayed after the engine has been started.

- The anomaly-free system is displayed with a GREEN background.
- The faulty system is displayed with a RED background
- The systems not available on the vehicle or not diagnosed (tachograph and Immobilizer) are displayed with a GREY background.
- If several anomalies related to a system are available, the list can be run through by means of button (5, Figure 306) "+" and "–".

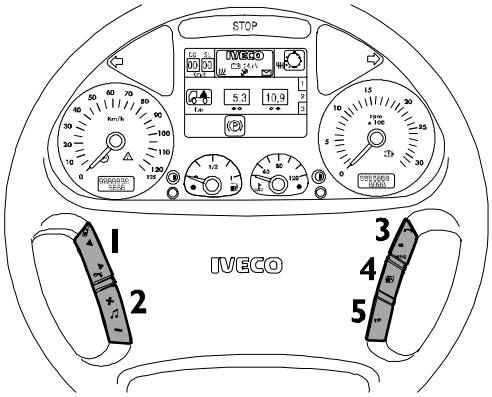
Figure 308



86029

The different codes shown allow you to identify the faulty component, the type of stored error (open circuit, short-circuit, etc.), the error occurrences and, finally, whether the error is currently present or intermittent.

Figure 309



86030

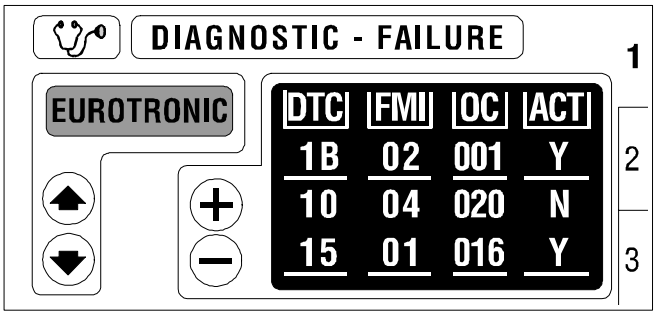
To display intermittent faults, press simultaneously buttons "OK" and "(–)" (3-2) of the figure.

INFORMATION ON CLUSTER

The diagnosis information shown on the cluster is divided into three screens:

- the first screen allows you to display all the stored/currently present anomalies (if any);
- the second screen allows you to cancel intermittent errors (provided that the respective password is available);
- the third screen allows you to know the software version of the various Multiplex electronic control units.

Figure 310



73687

First screen

If several anomalies are found, the respective list can be run through by means of buttons "+" and "–".
Information on every single fault is displayed on four columns with the following data:

DTC	FMI	OC	ACT
Displays the anomaly code related to the fault	Indicates the type of fault	Anomaly rate counter	Active/not active anomaly condition
Two digits (hexadecimal)	Two digits (hexadecimal)	Three digits (decimal)	One character (Y-yes, N-no)

Second screen

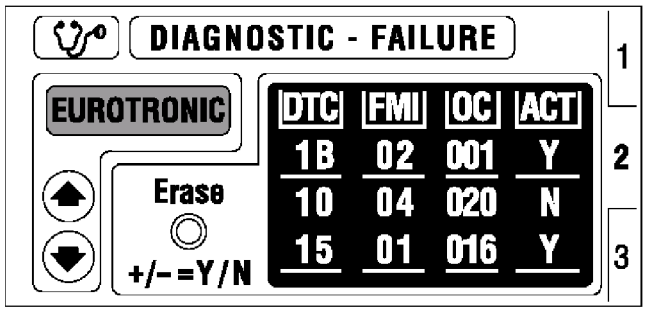
To select the second screen, press button "page" on the steering wheel.

Cancelling errors

The system can be selected by means of buttons ▲ and ▼ available on the steering wheel.
Anomaly display can be cancelled as follows:

- Press "+"
- The display will show the deletion confirm request: press "OK" to continue.
- Enter the requested password (see next paragraph ENTERING THE PASSWORD), then press "OK" to confirm.

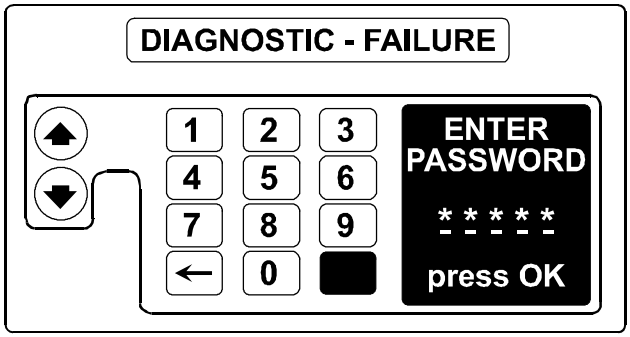
Figure 311



74225

Entering the password

Figure 312



86031

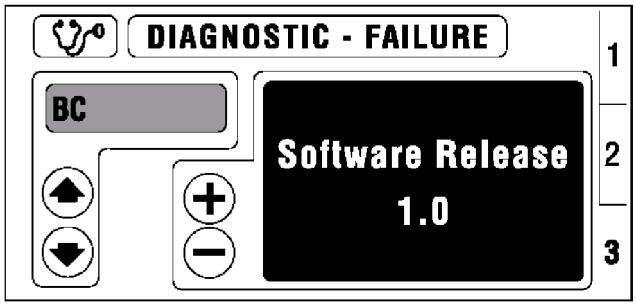
- Select the first number of the password by means of buttons ▲ and ▼.
- Press button OK to confirm each number.
- Press ◀ to cancel the latest selected number.
- After the password has been completed, select the key symbol to confirm it.

Third screen

To select the third screen, press button "page" available on the steering wheel.

Software version

Figure 313



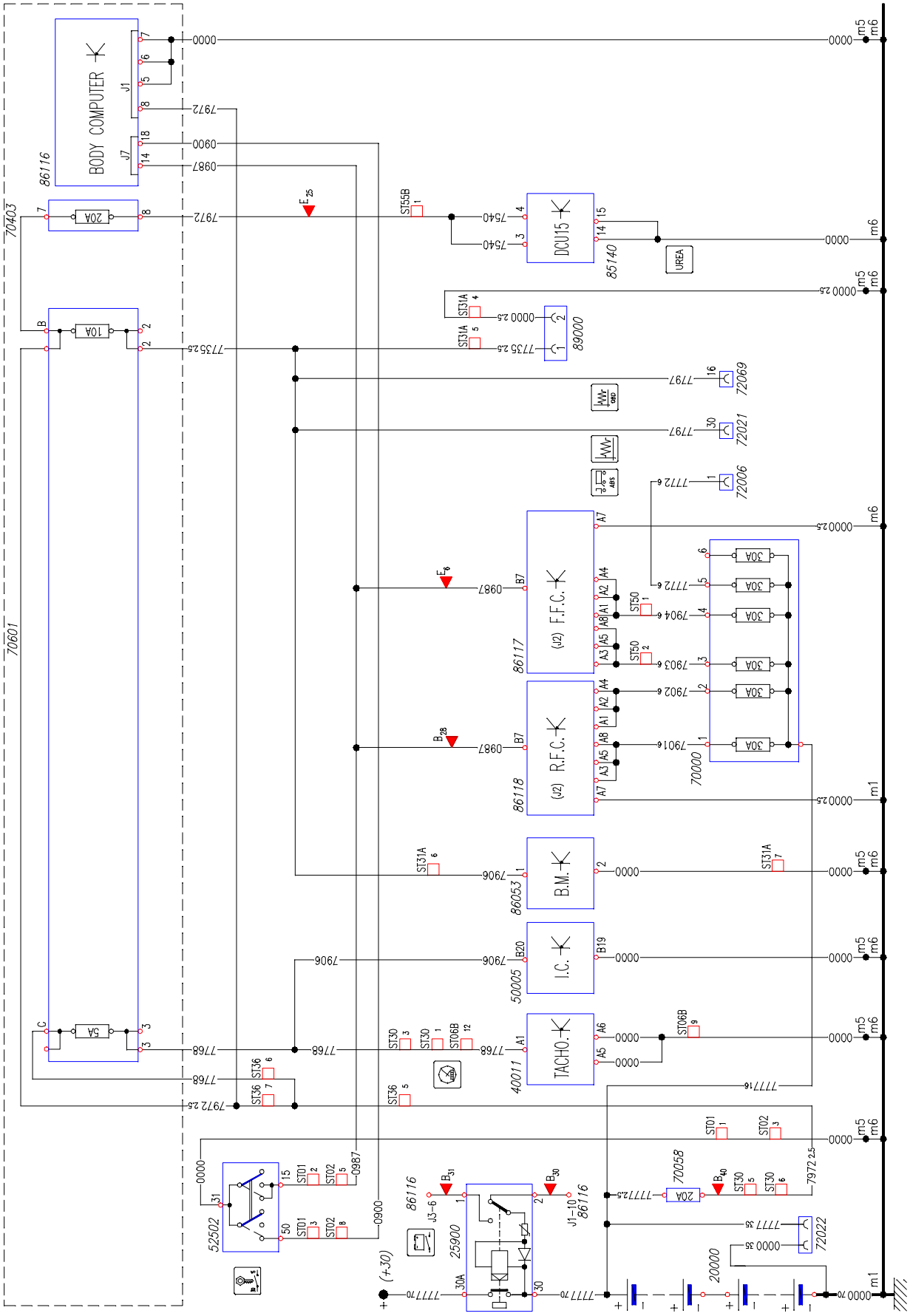
74227

The software version is displayed only for the Multiplex system control units.
The release of the following control units can be selected by means of buttons ▲ and ▼:

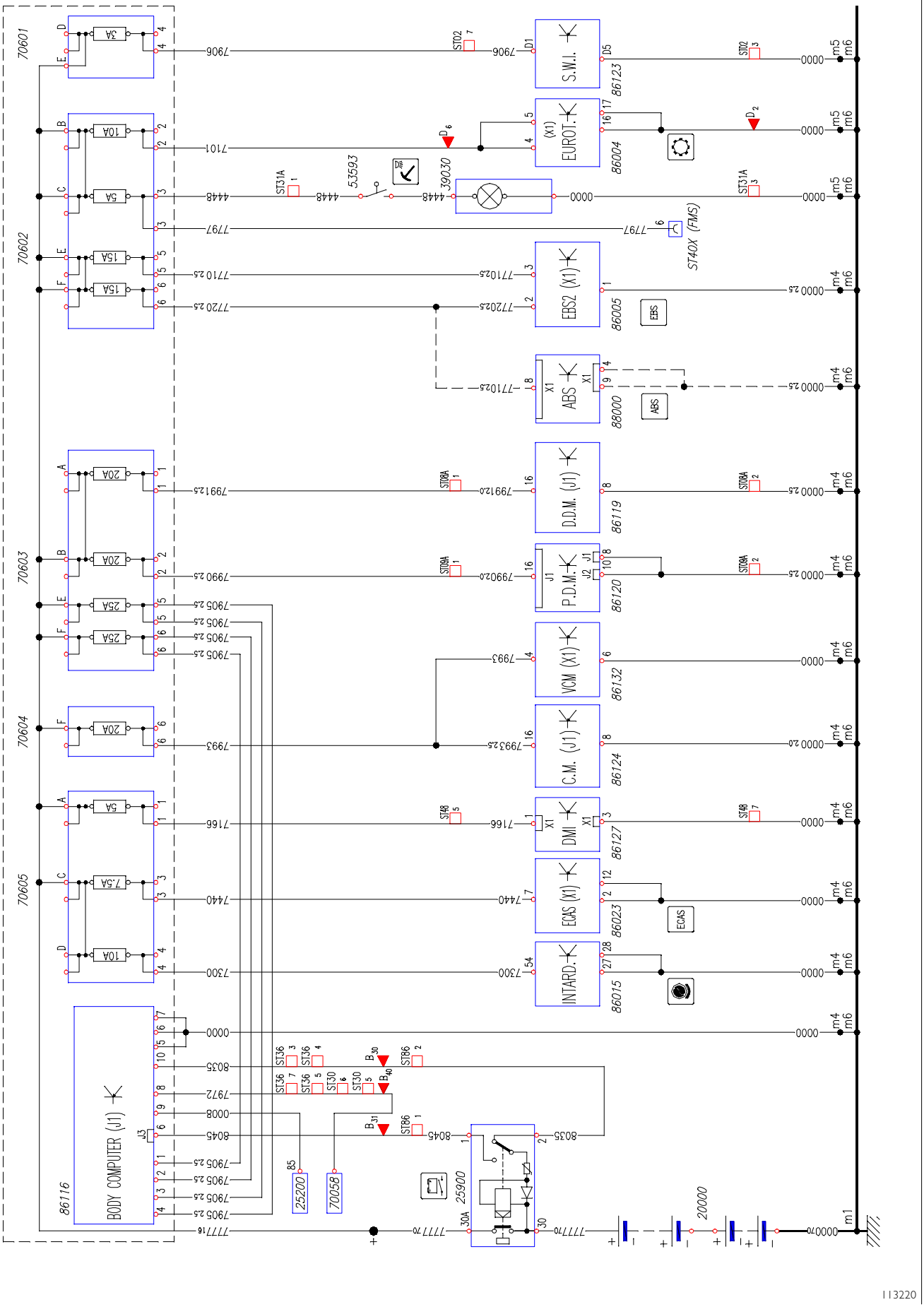
1. Body Computer
2. Front Frame Computer
3. Rear Frame Computer
4. Driver Door Module
5. Passenger Door Module
6. Instrument Cluster
7. Cabine Module

Circuit card

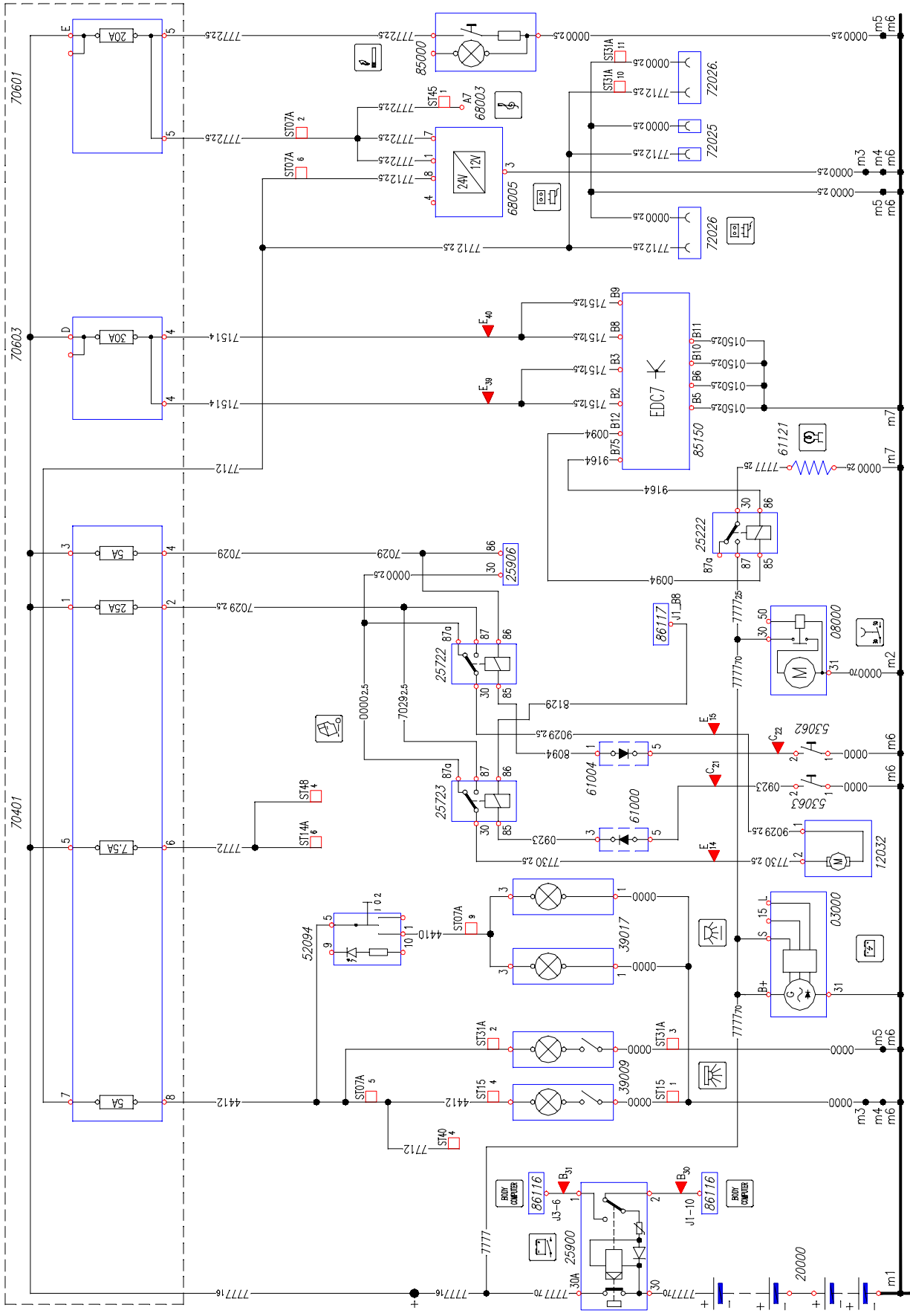
Card 1 Power supply voltage (+30)



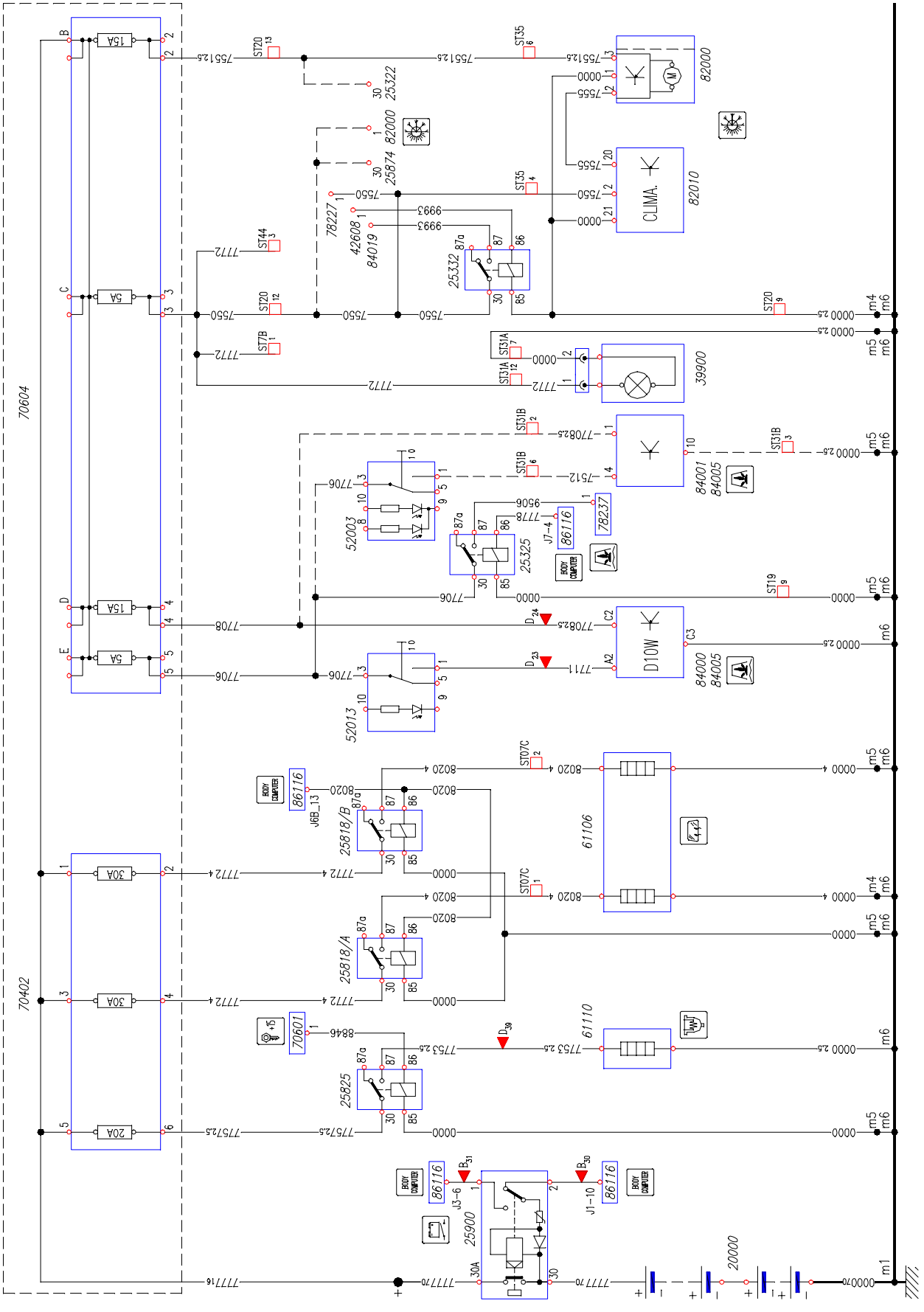
Card 2 Power supply voltage (+30) after TGC



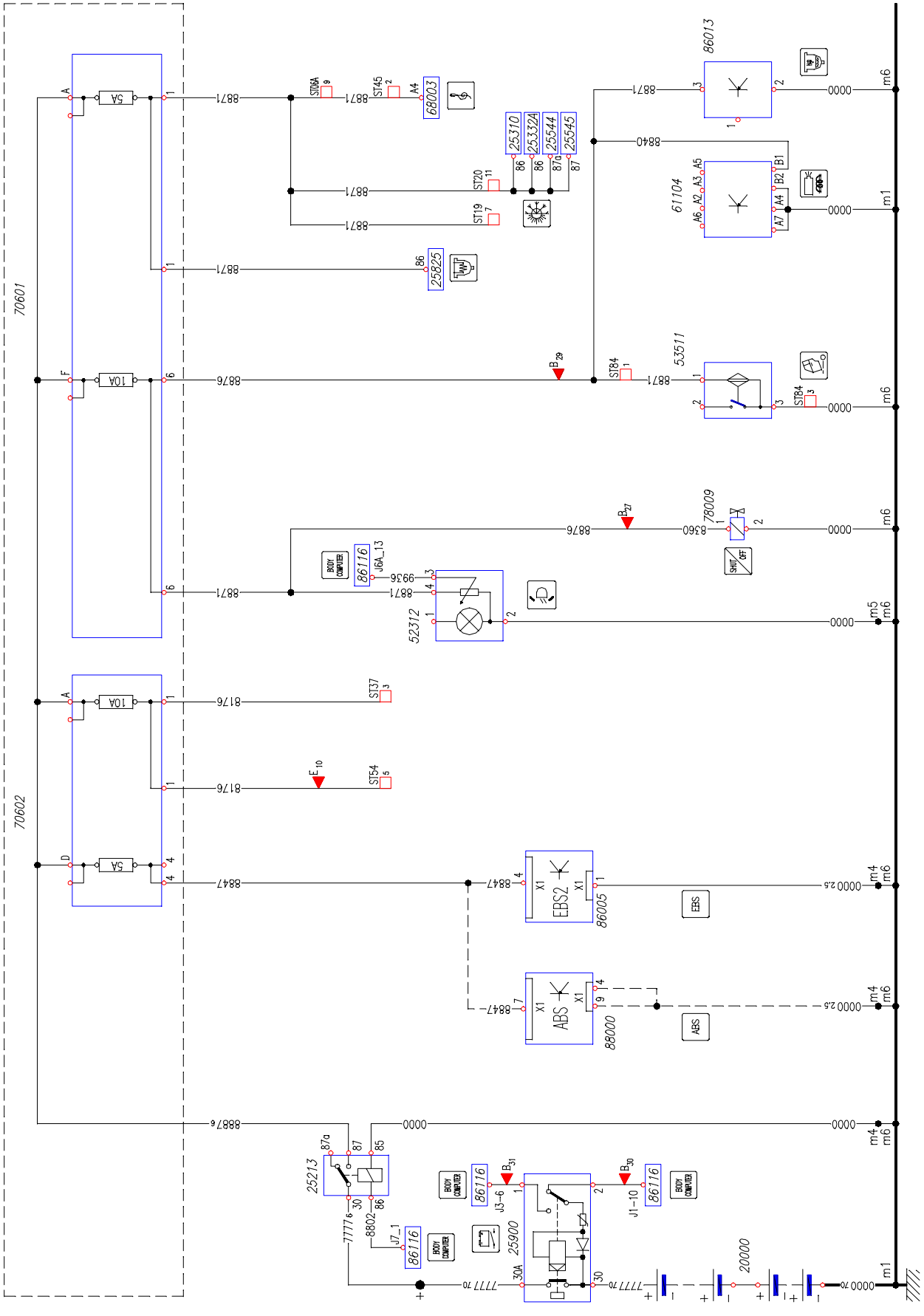
Card 3 Power supply voltage (+30) after TGC



Card 4 Power supply voltage (+30) after TGC

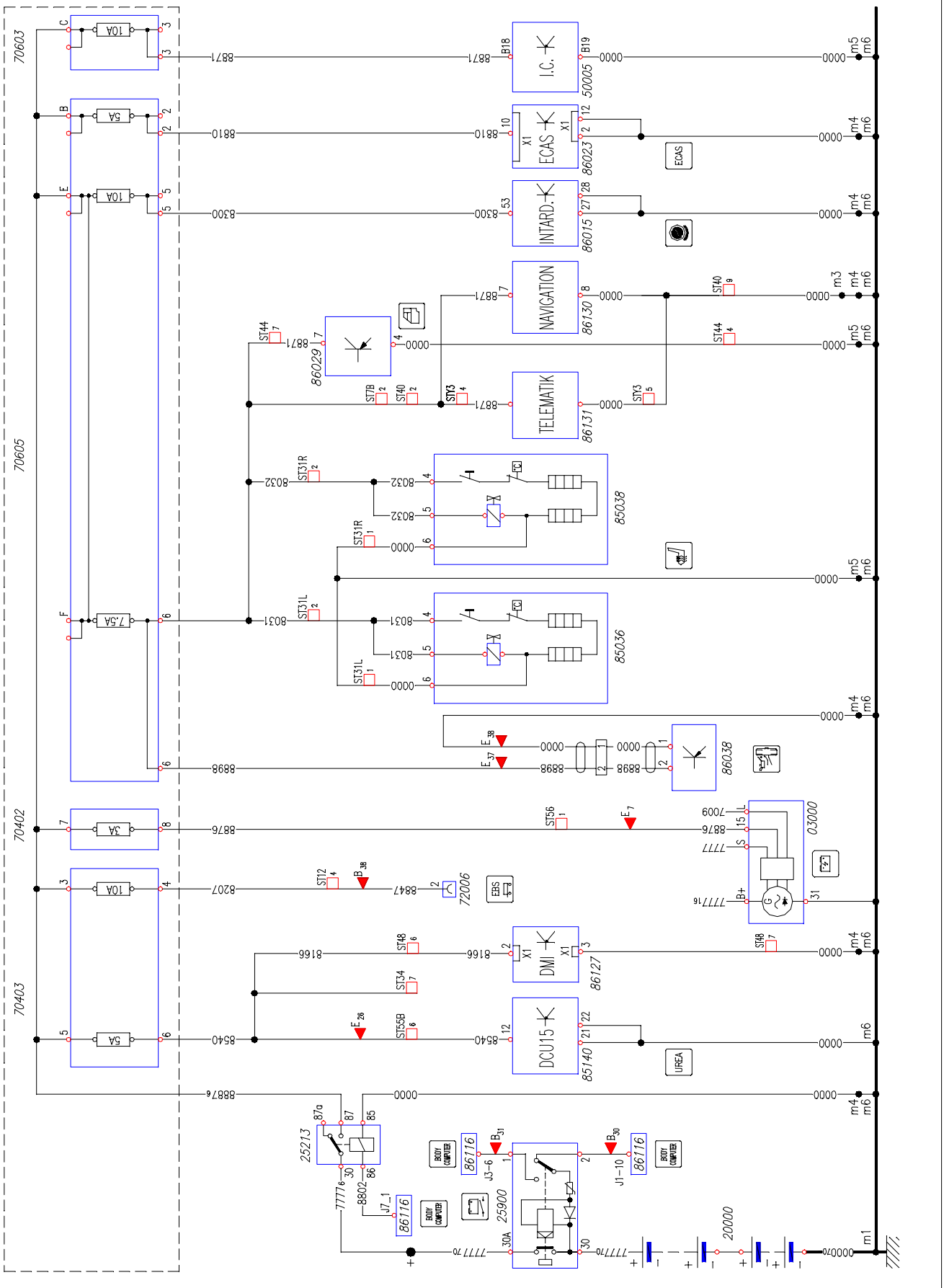


Card 5 Power supply voltage (+15)



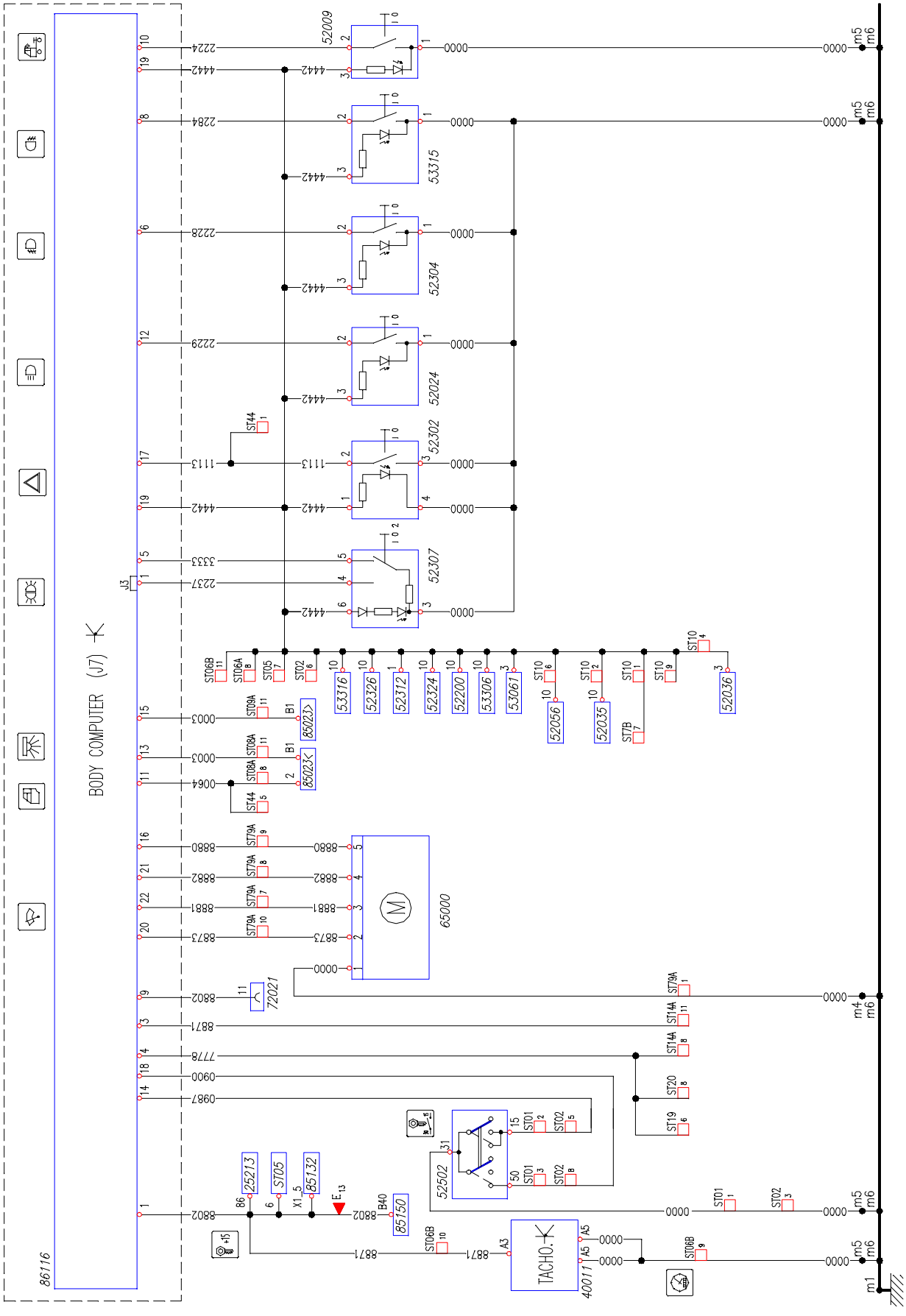
113261

Card 6 Power supply voltage (+15)

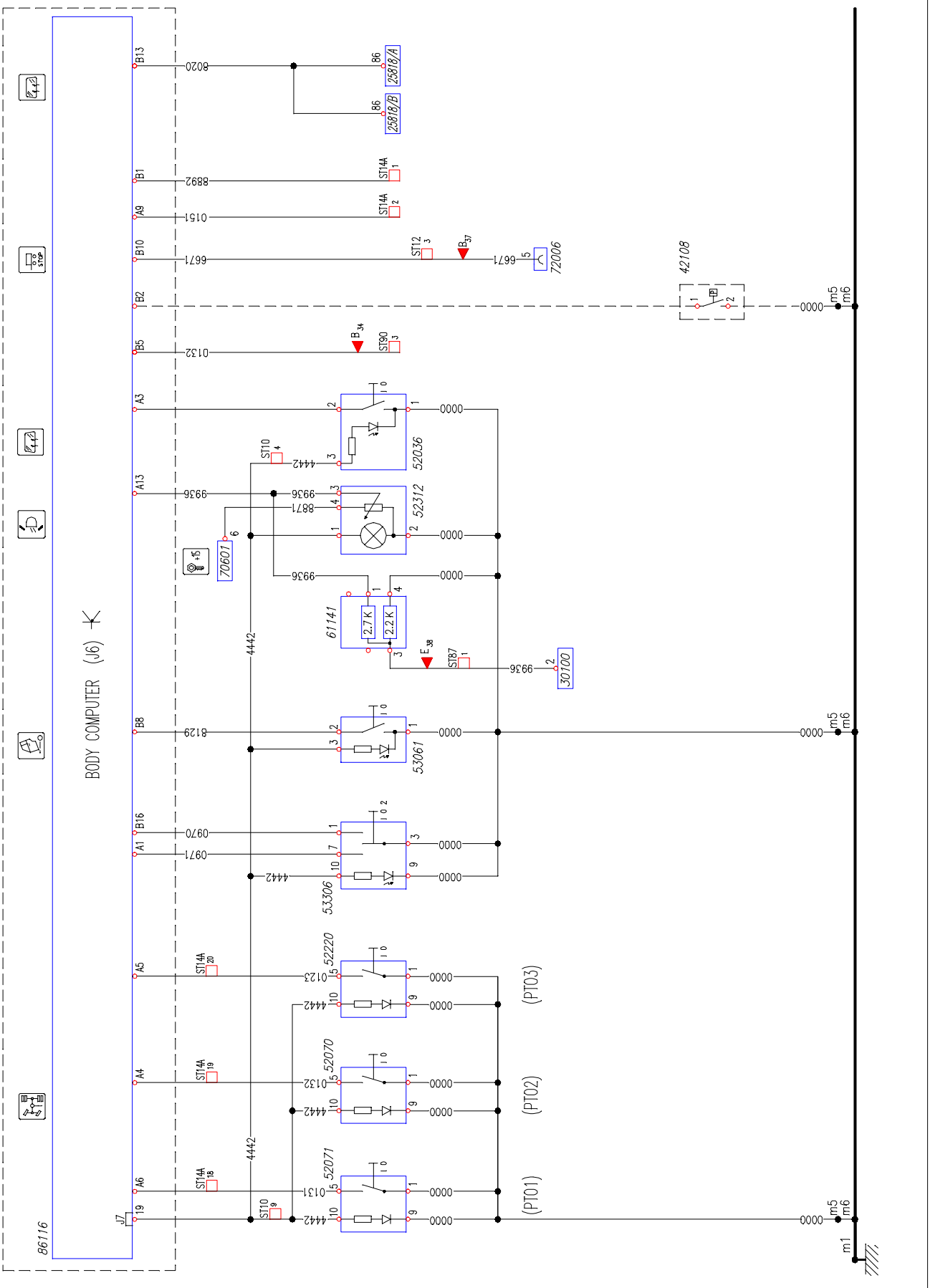


113222

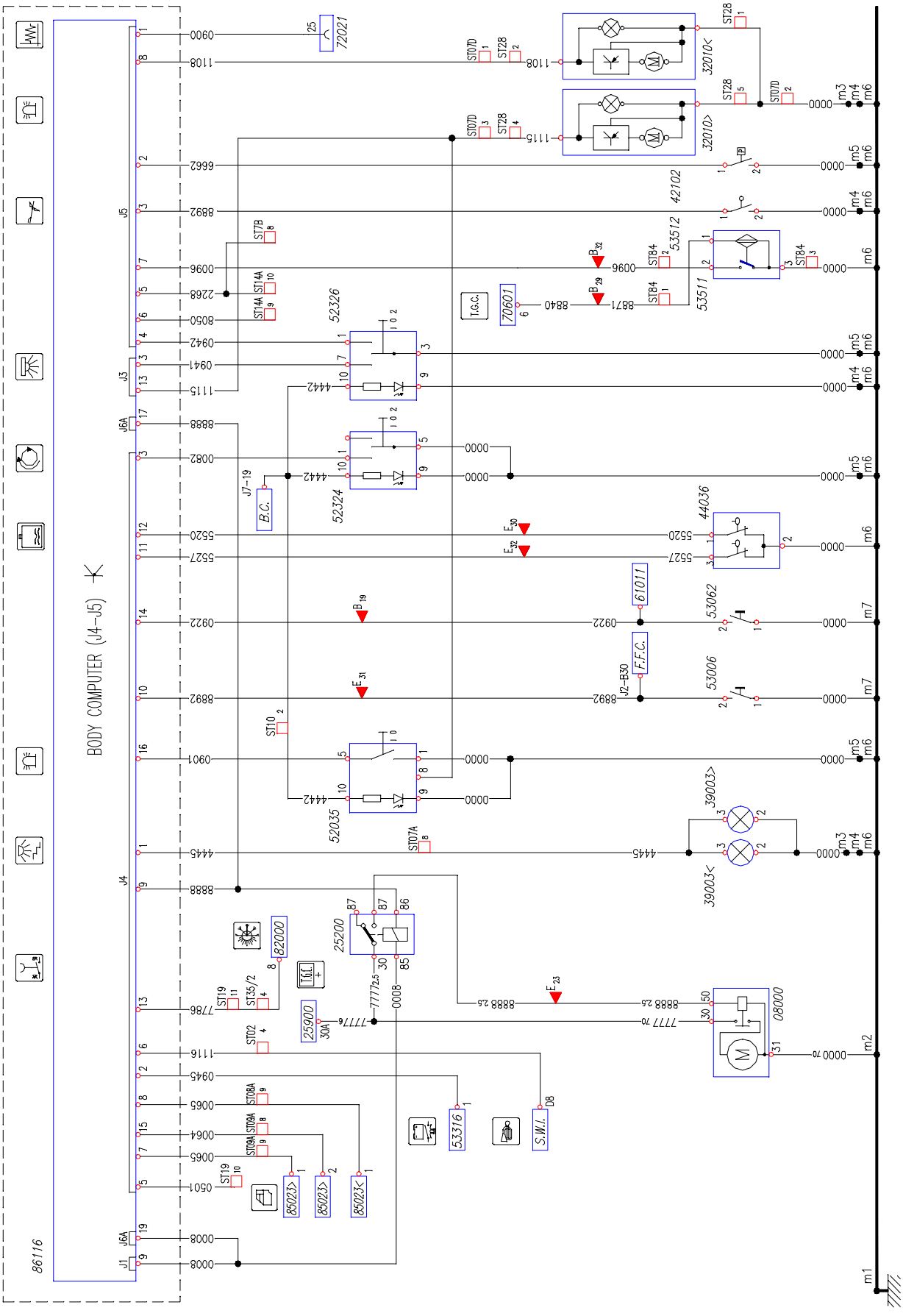
Card 7 Body Computer (BC)



Card 8 Body Computer (BC)

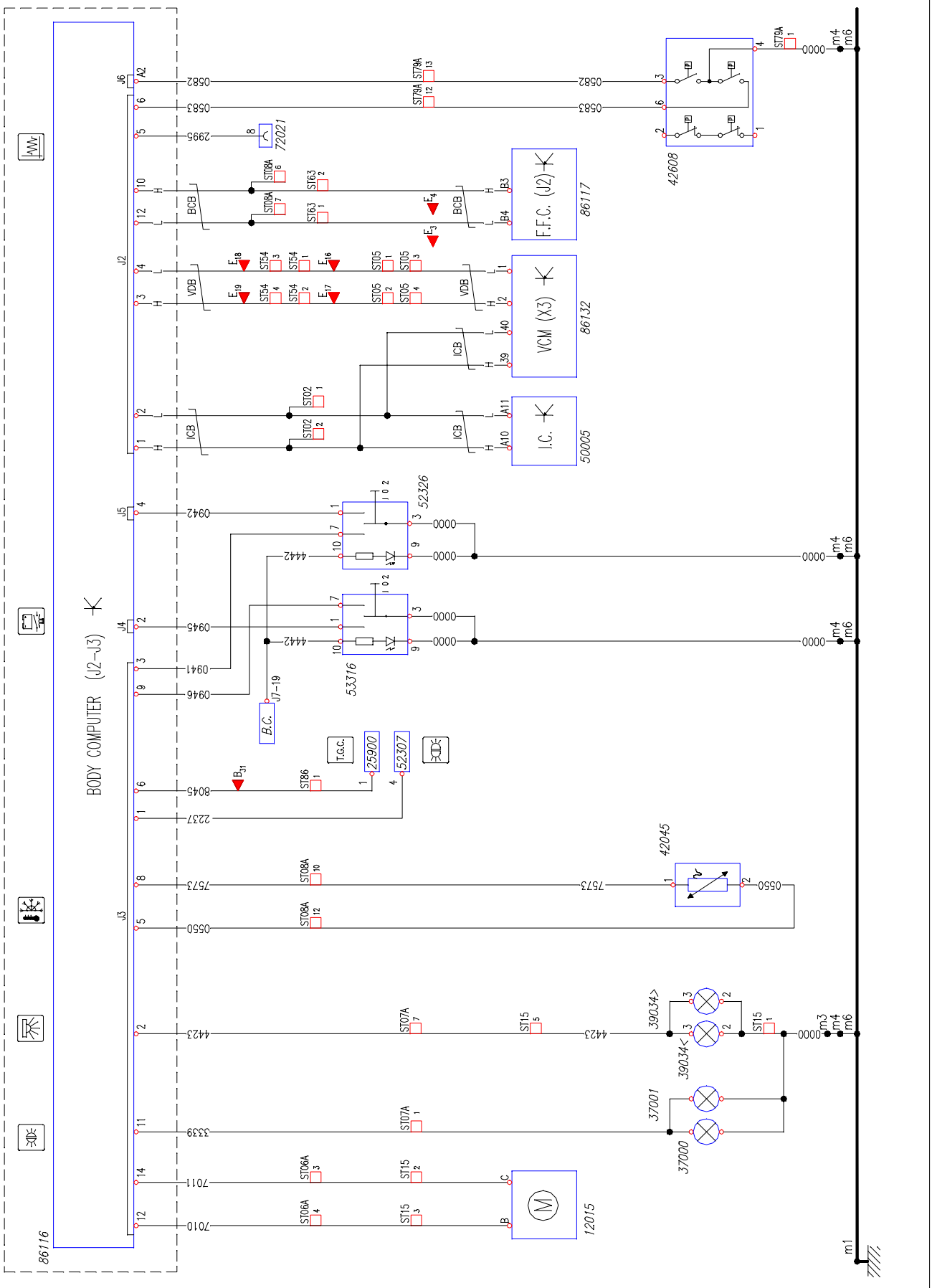


Card 9 Body Computer (BC)

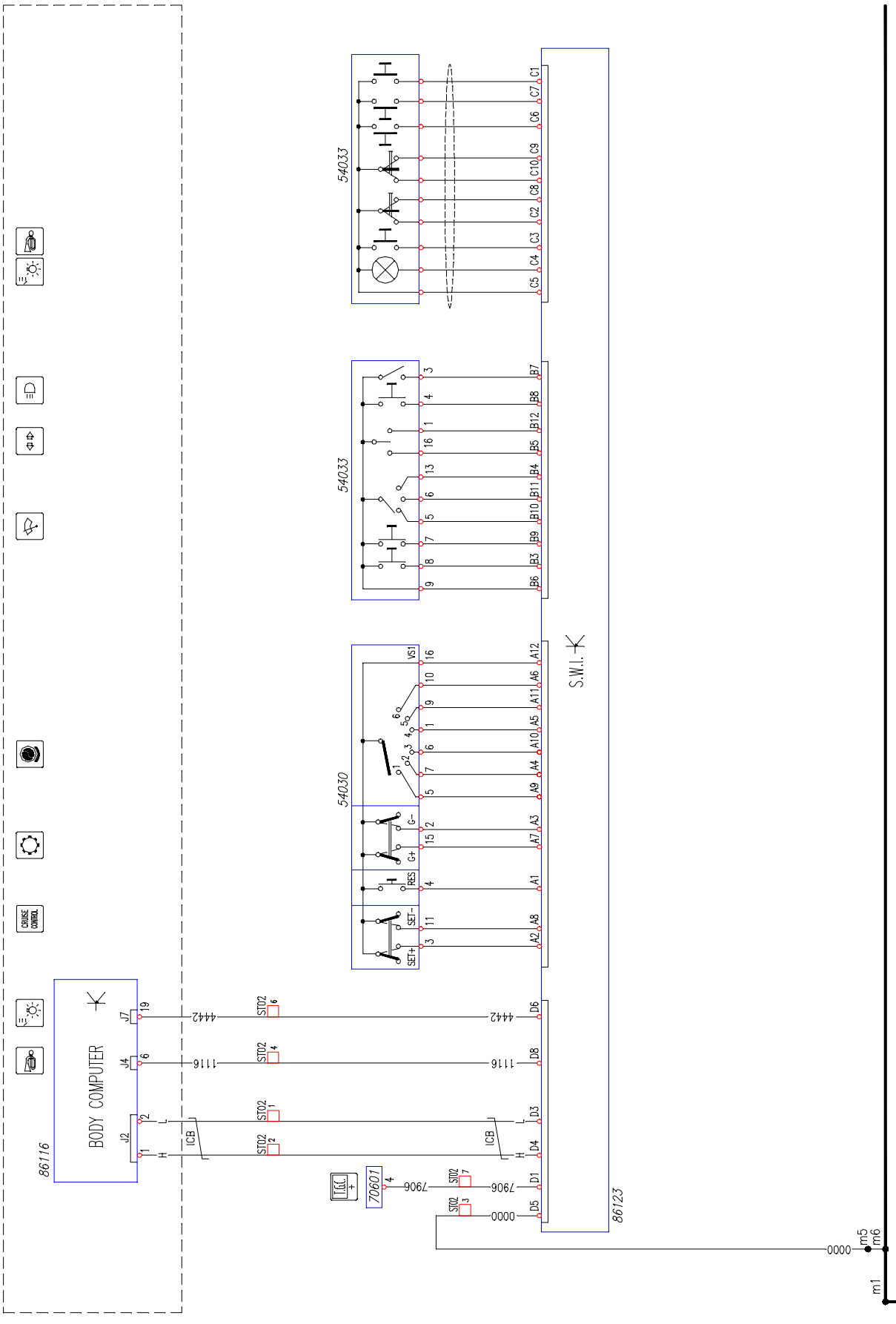


113262

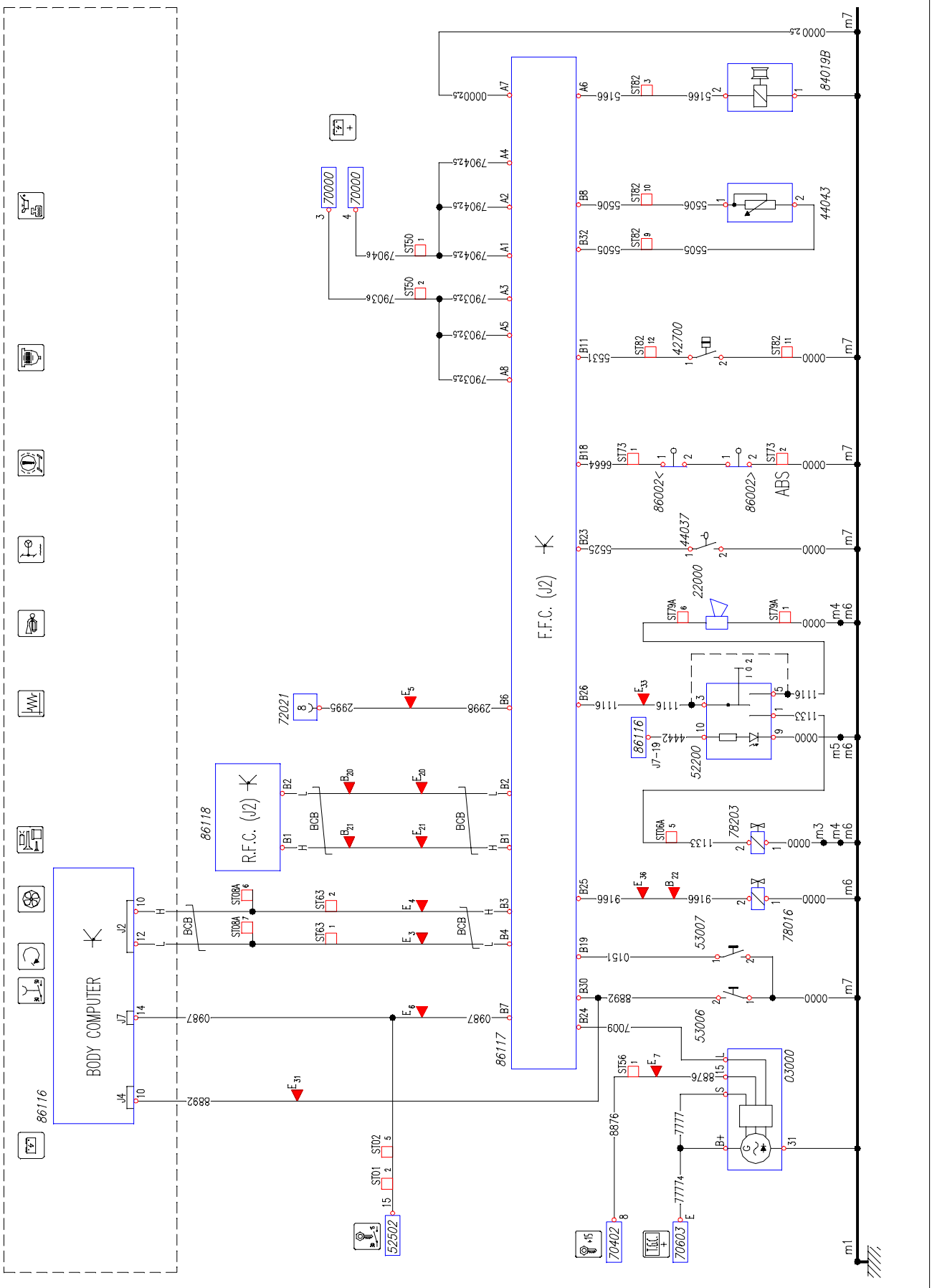
Card 10 Body Computer (BC)



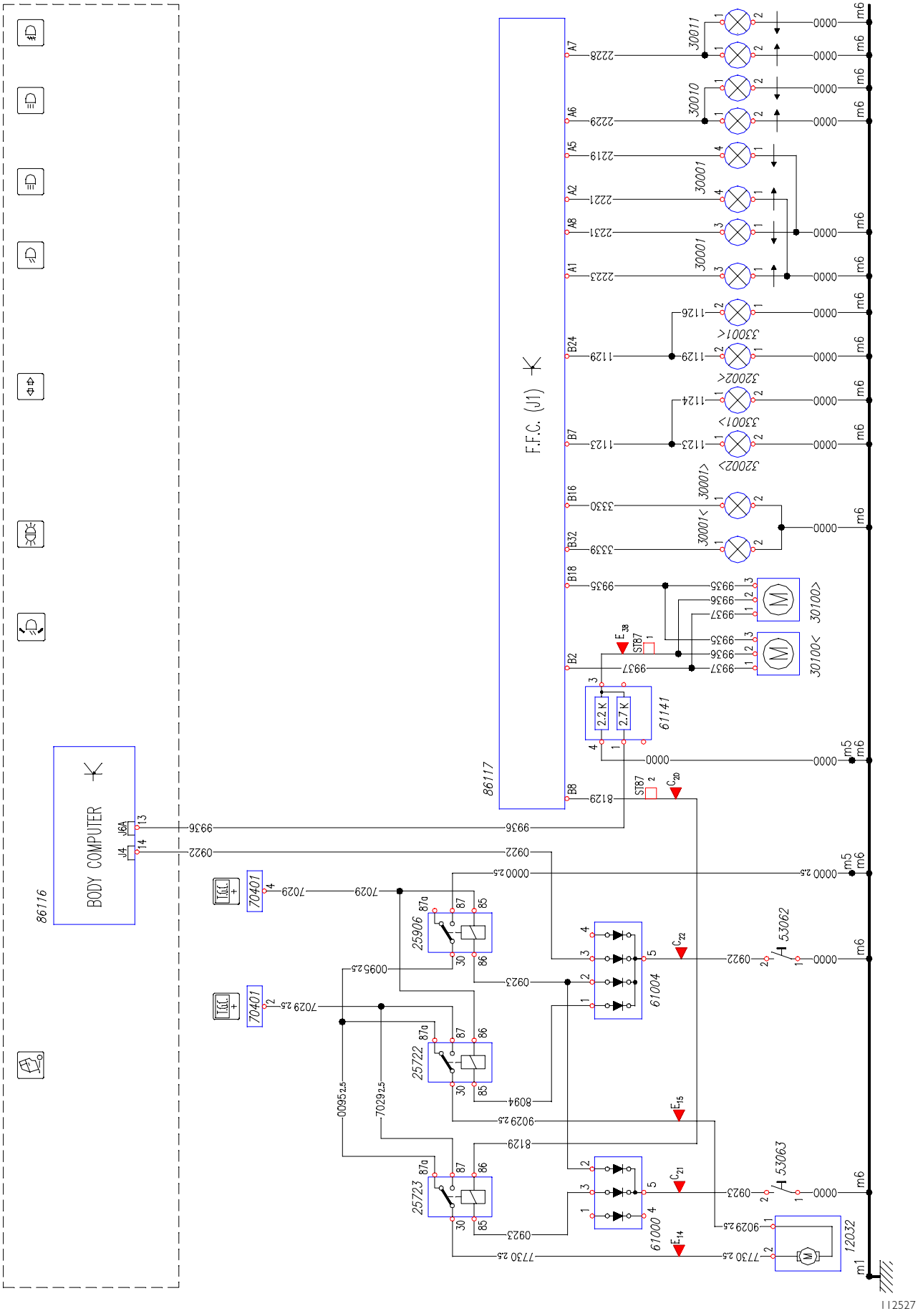
Card 11 Steering Wheel Interface (SWI)



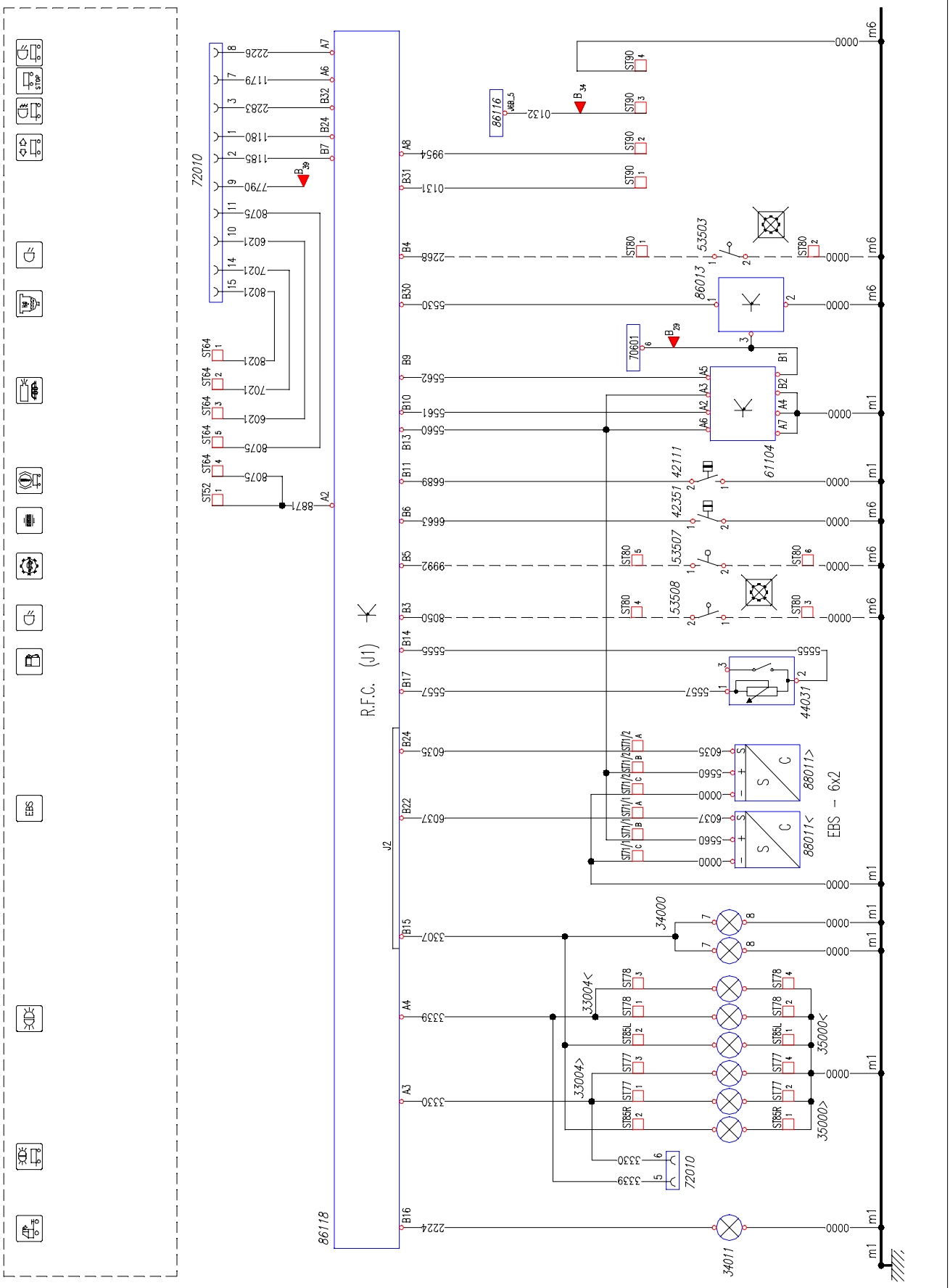
Card 12 Front Frame Computer (FFC)



Card 13 Front Frame Computer (FFC)

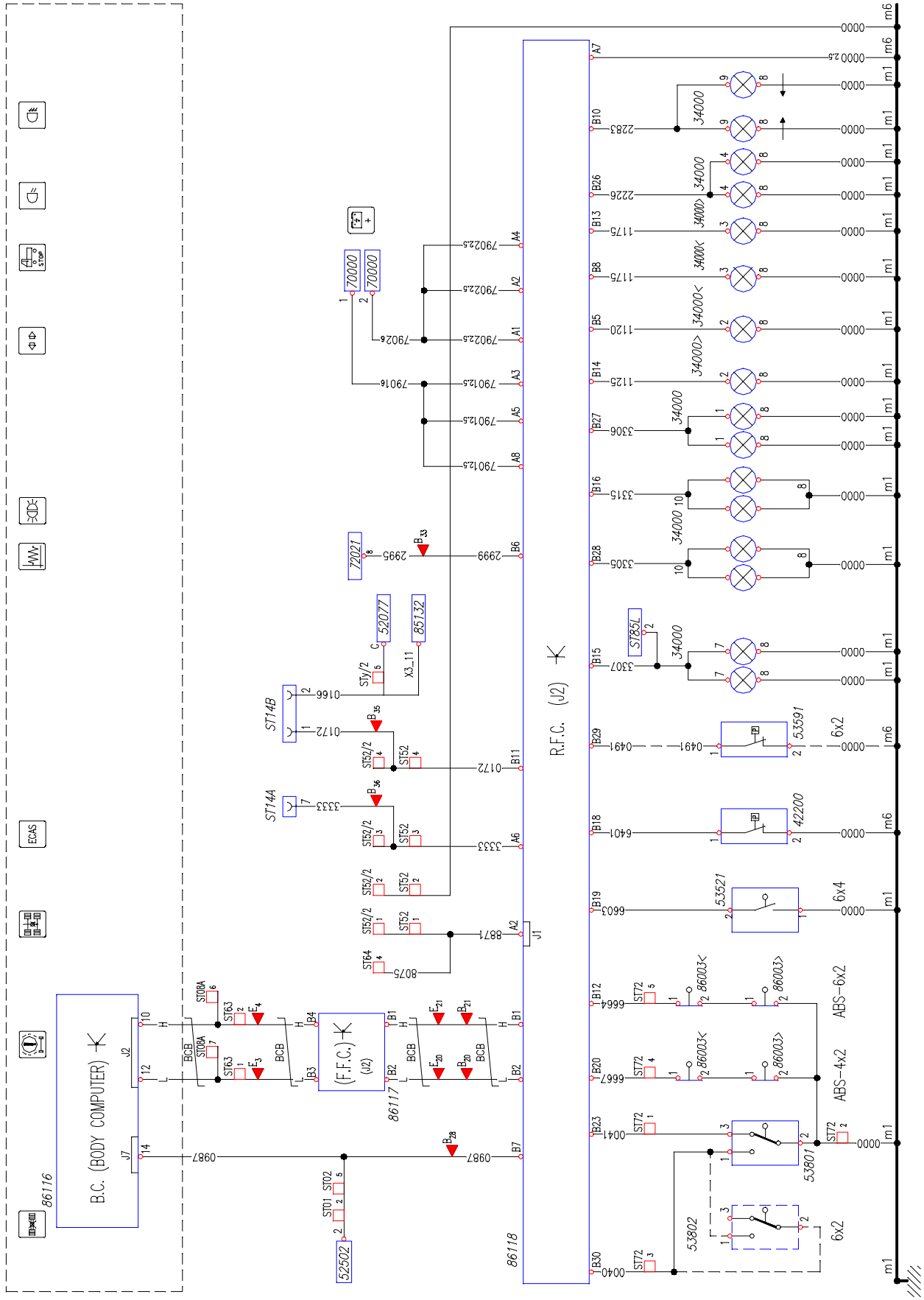


Card 14 Rear Frame Computer (RFC)



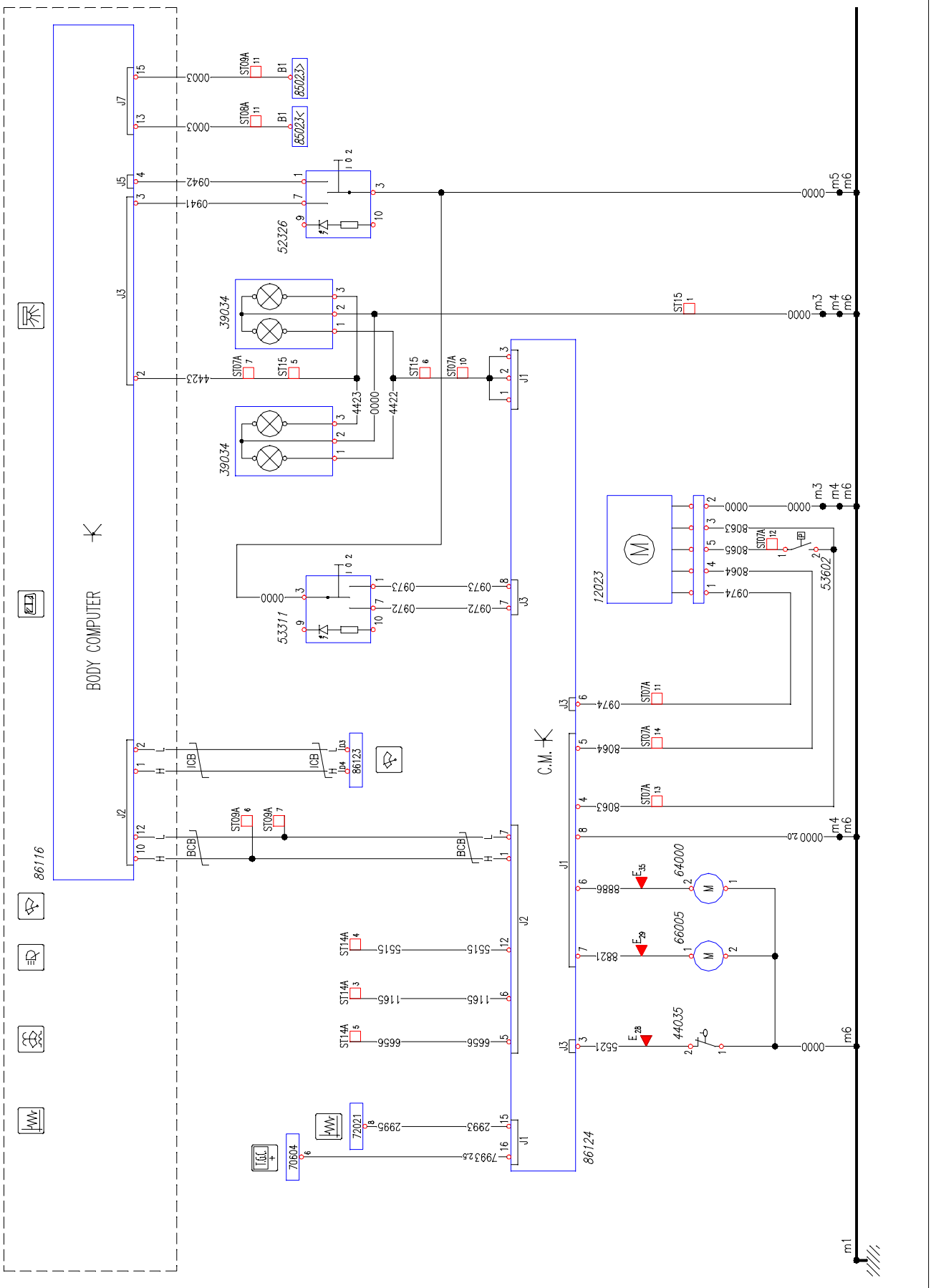
113226

Card 15 Rear Frame Computer (RFC)

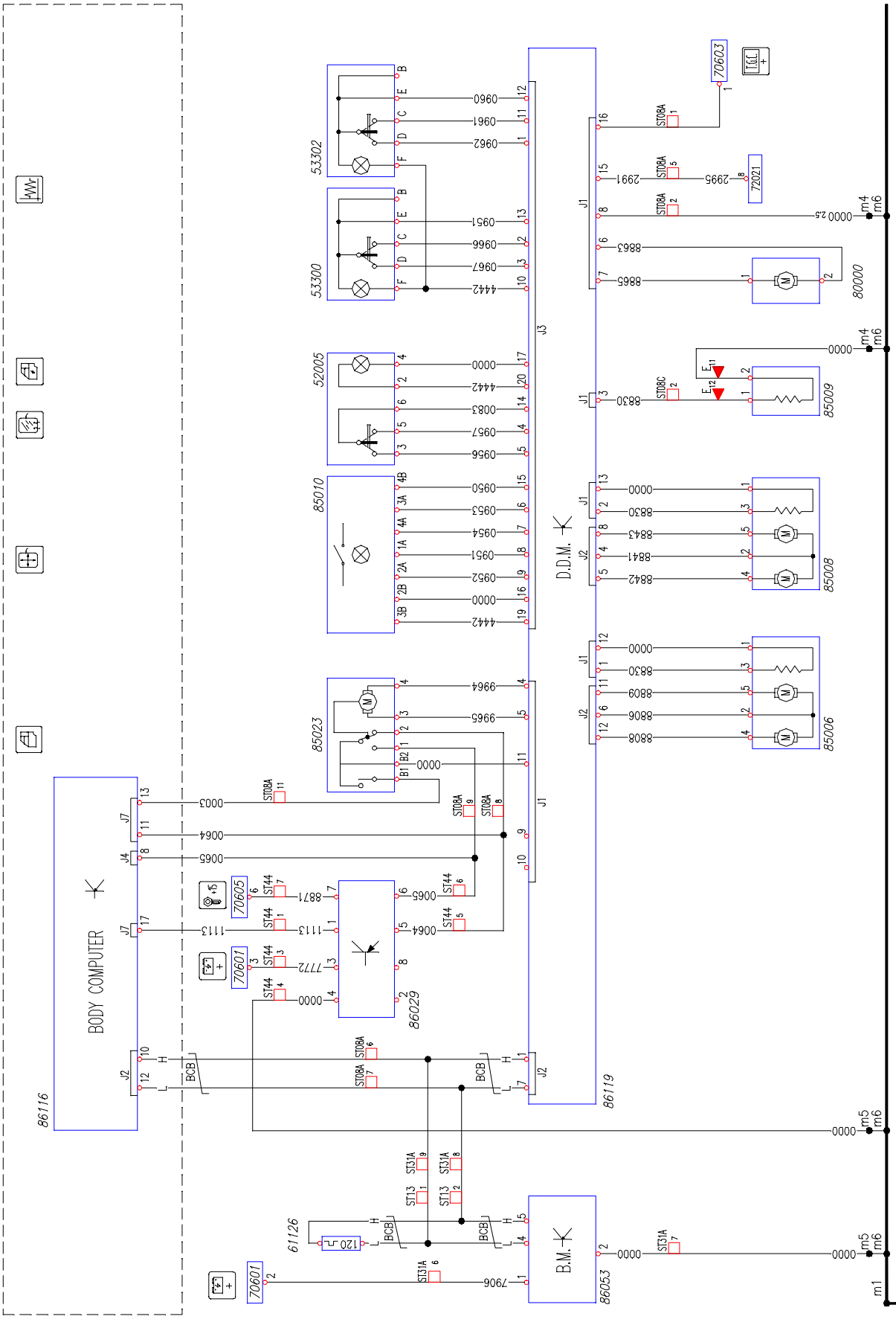


113264

Card 16 Cabin Module (CM)

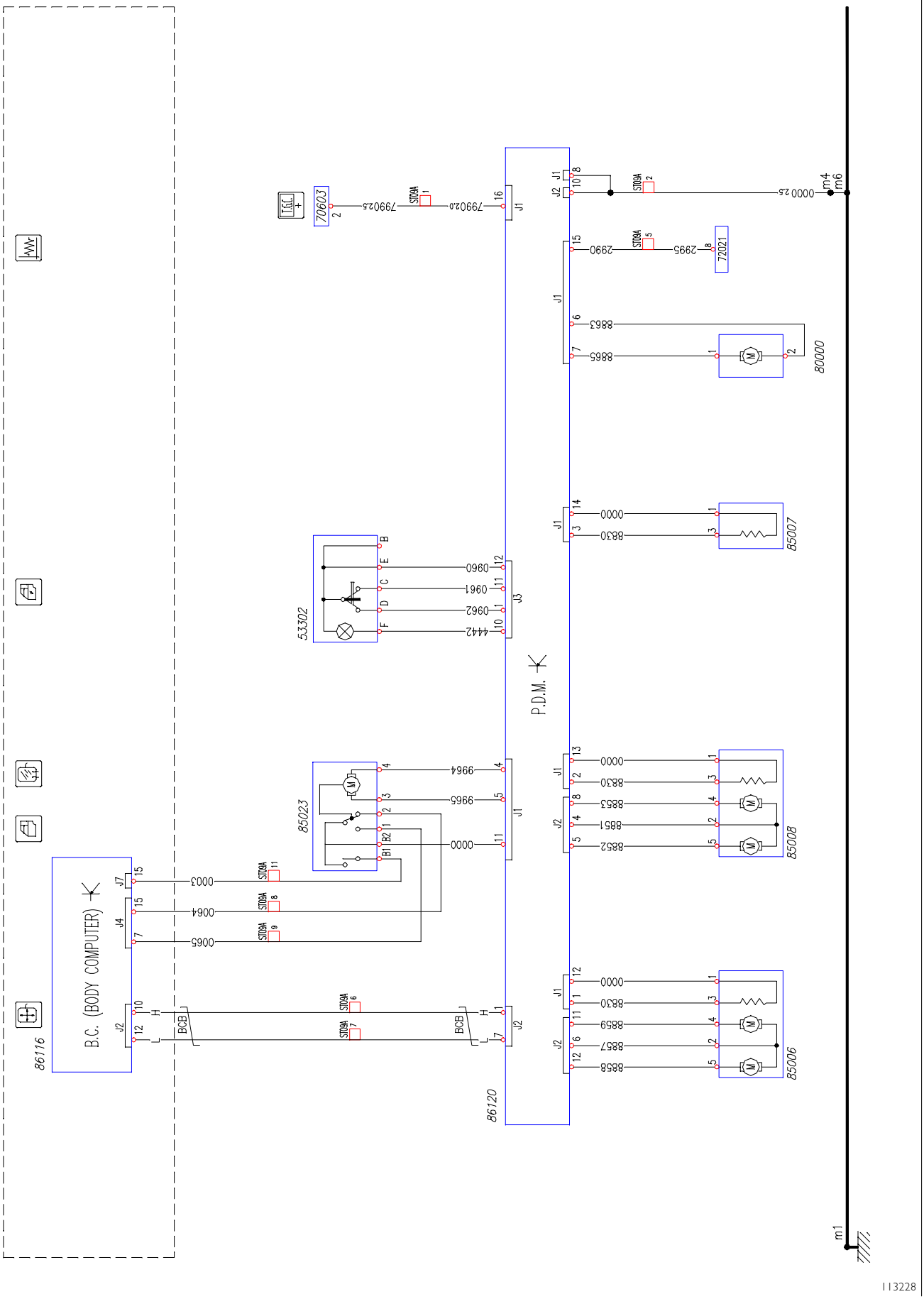


Card 17 Driver Dool Module (DDM) / Bed Module (BM)

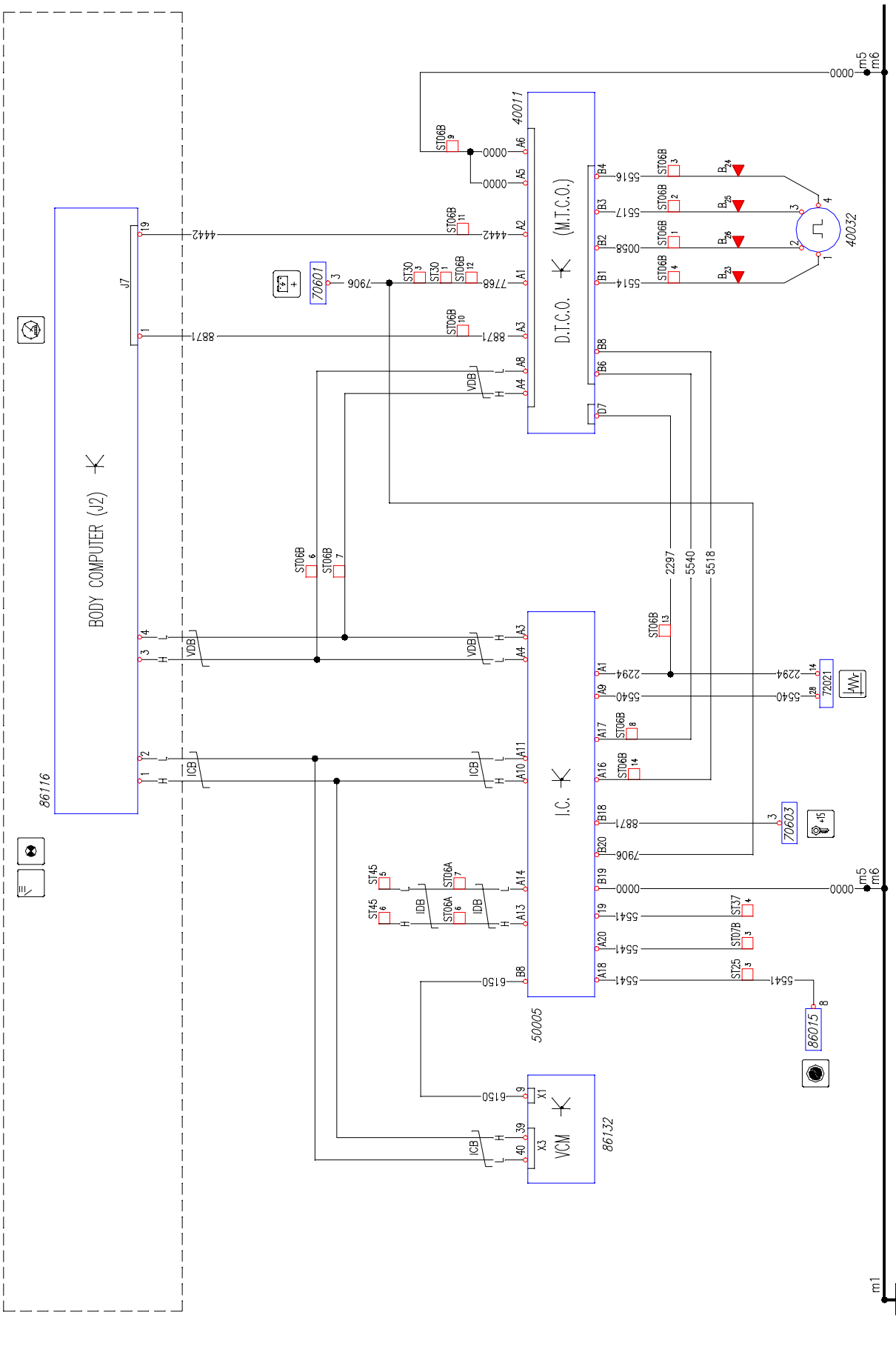


113227

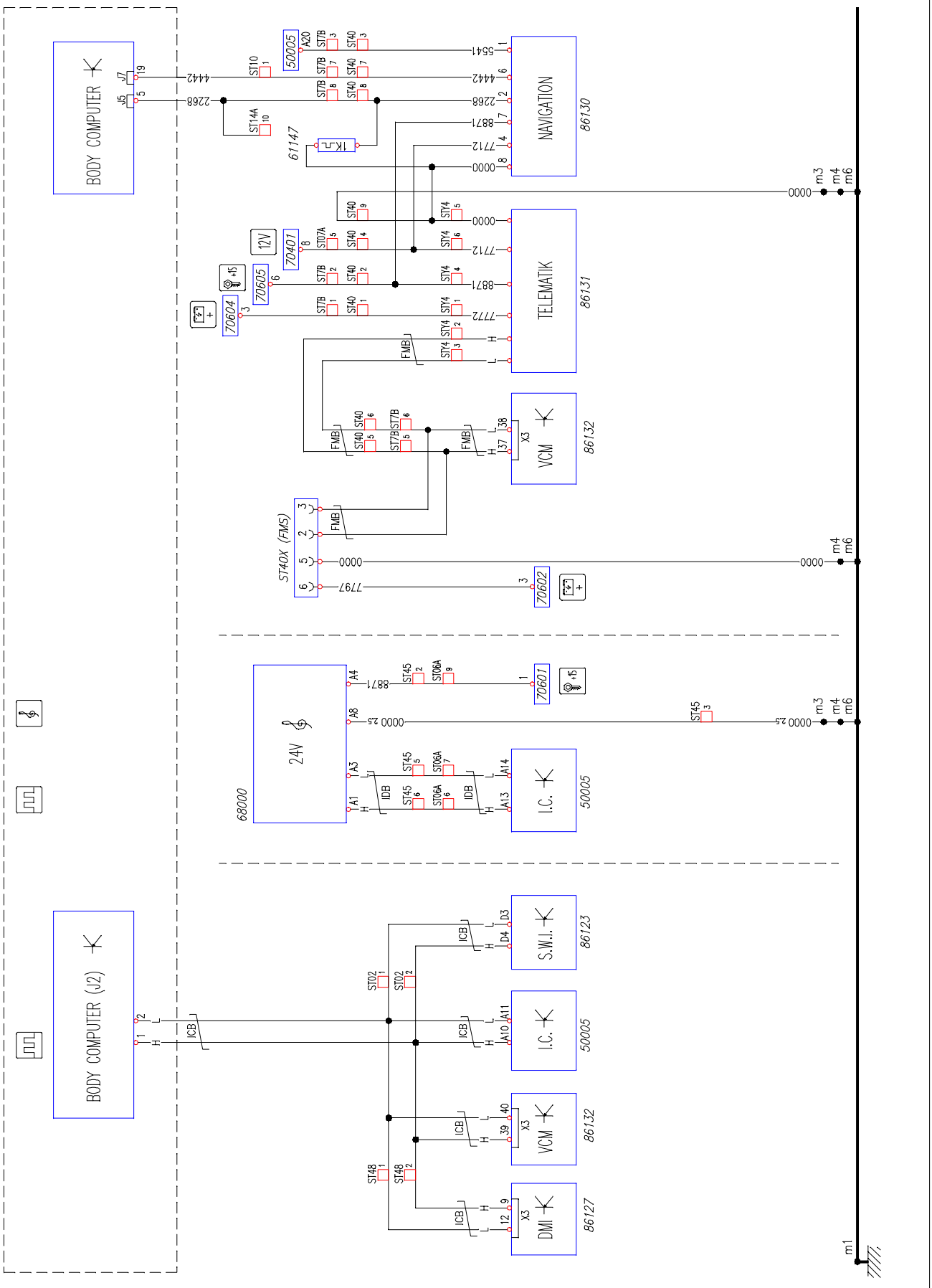
Card 18 Passenger Door Module (PDM)



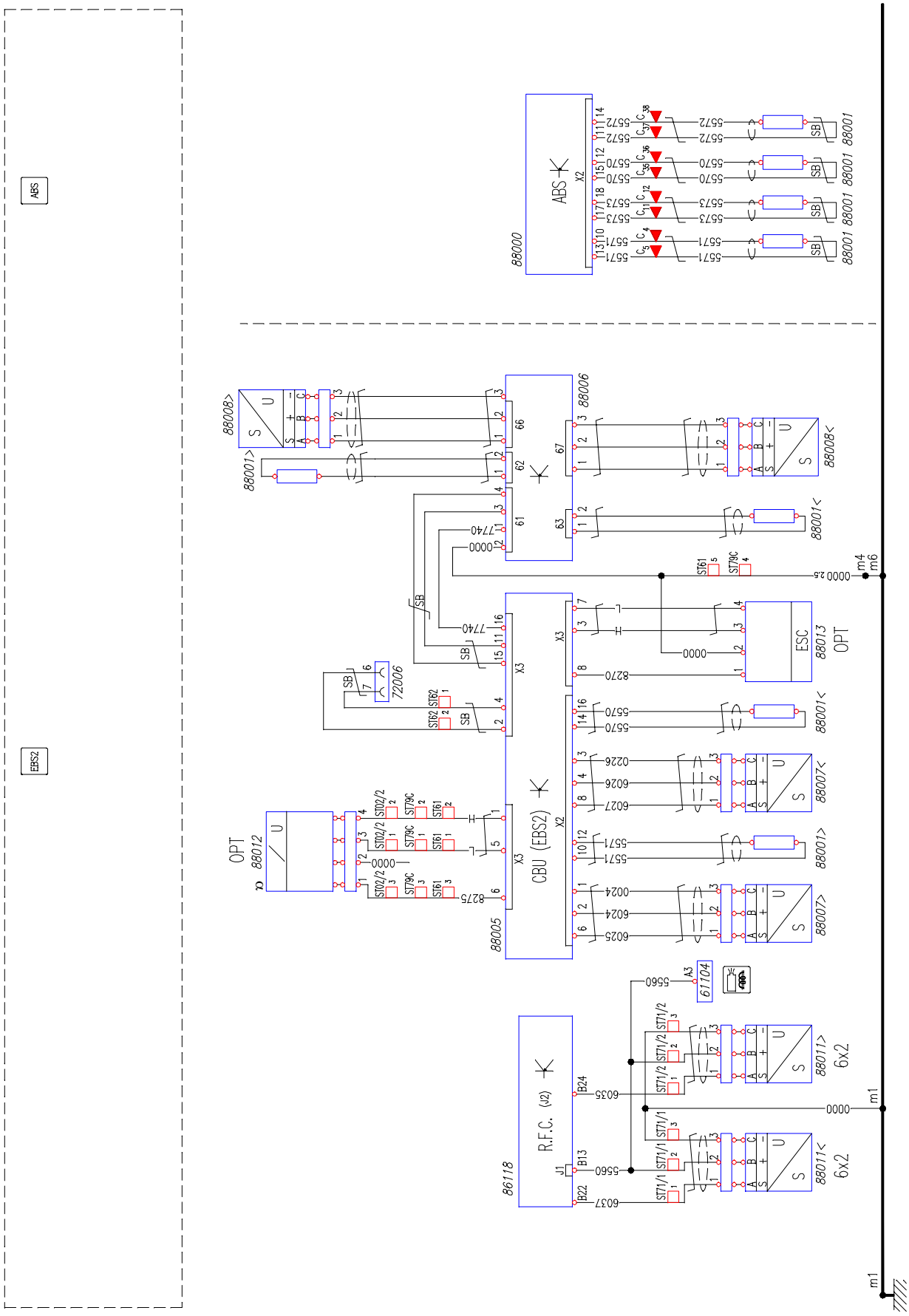
Card 19 Instrument Cluster (IC) / Tachograph



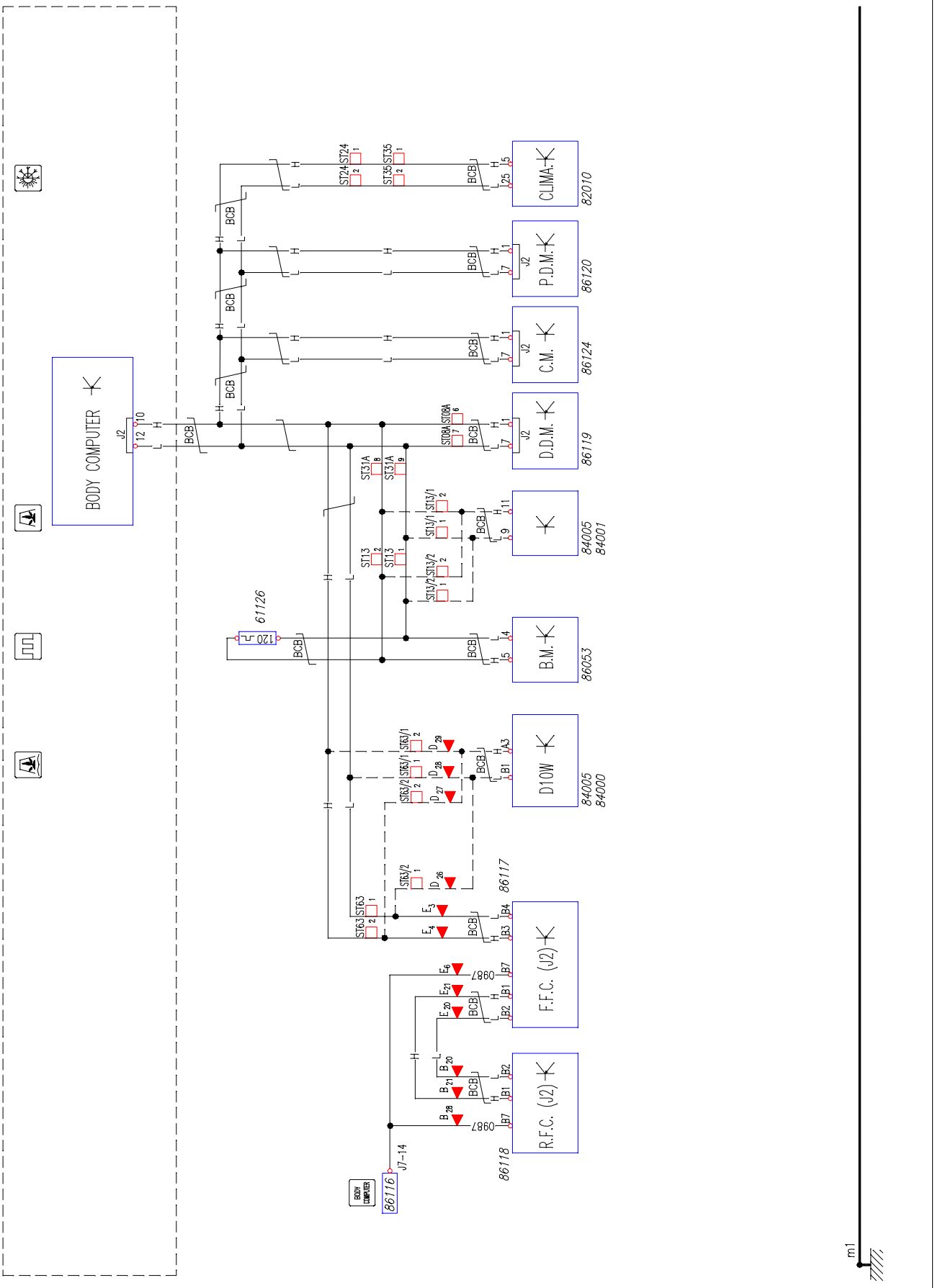
Card 20 Can lines “ICB” - “IDB” - “FMB”



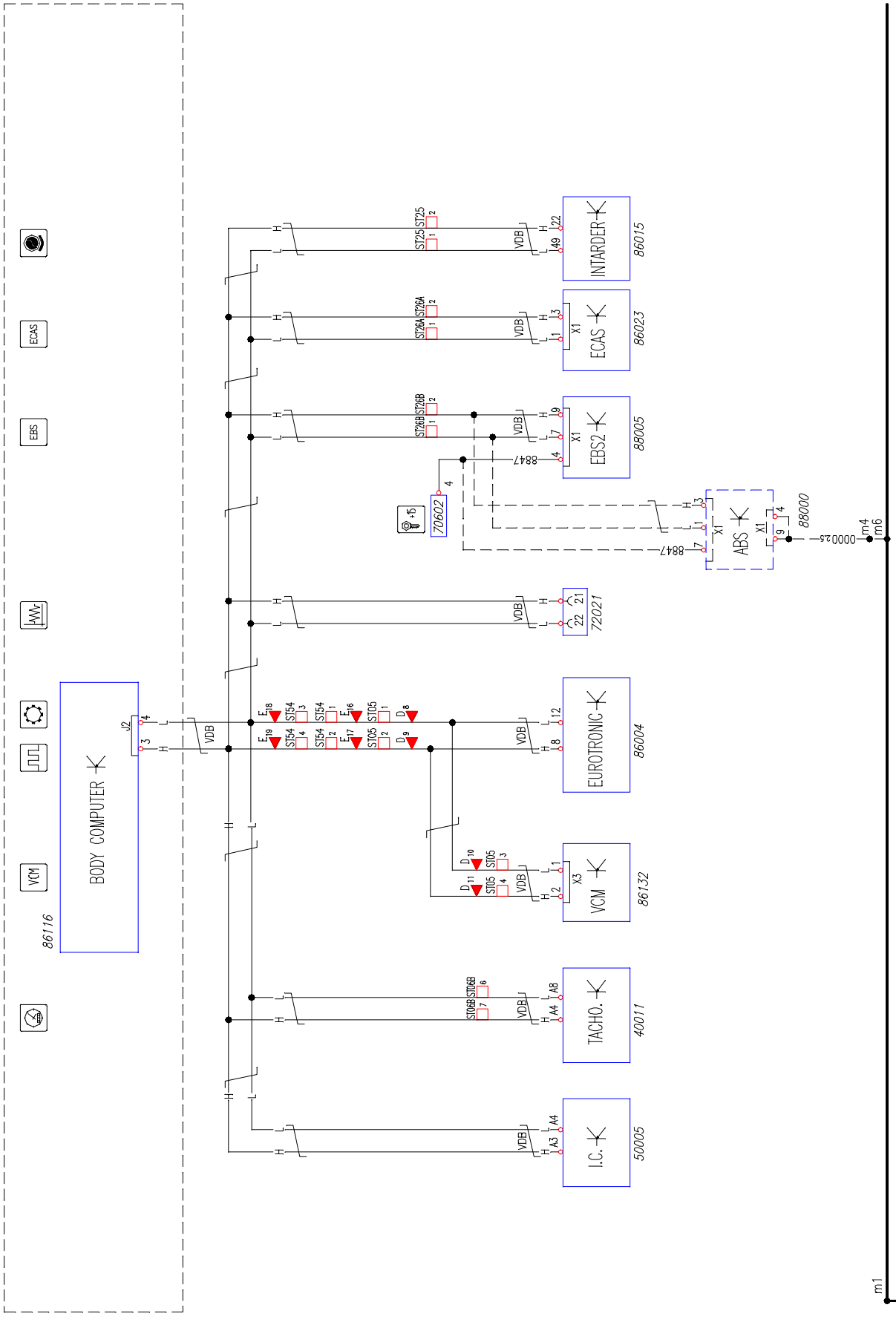
Card 21 Can lines "SB" (EBS2-ABS)



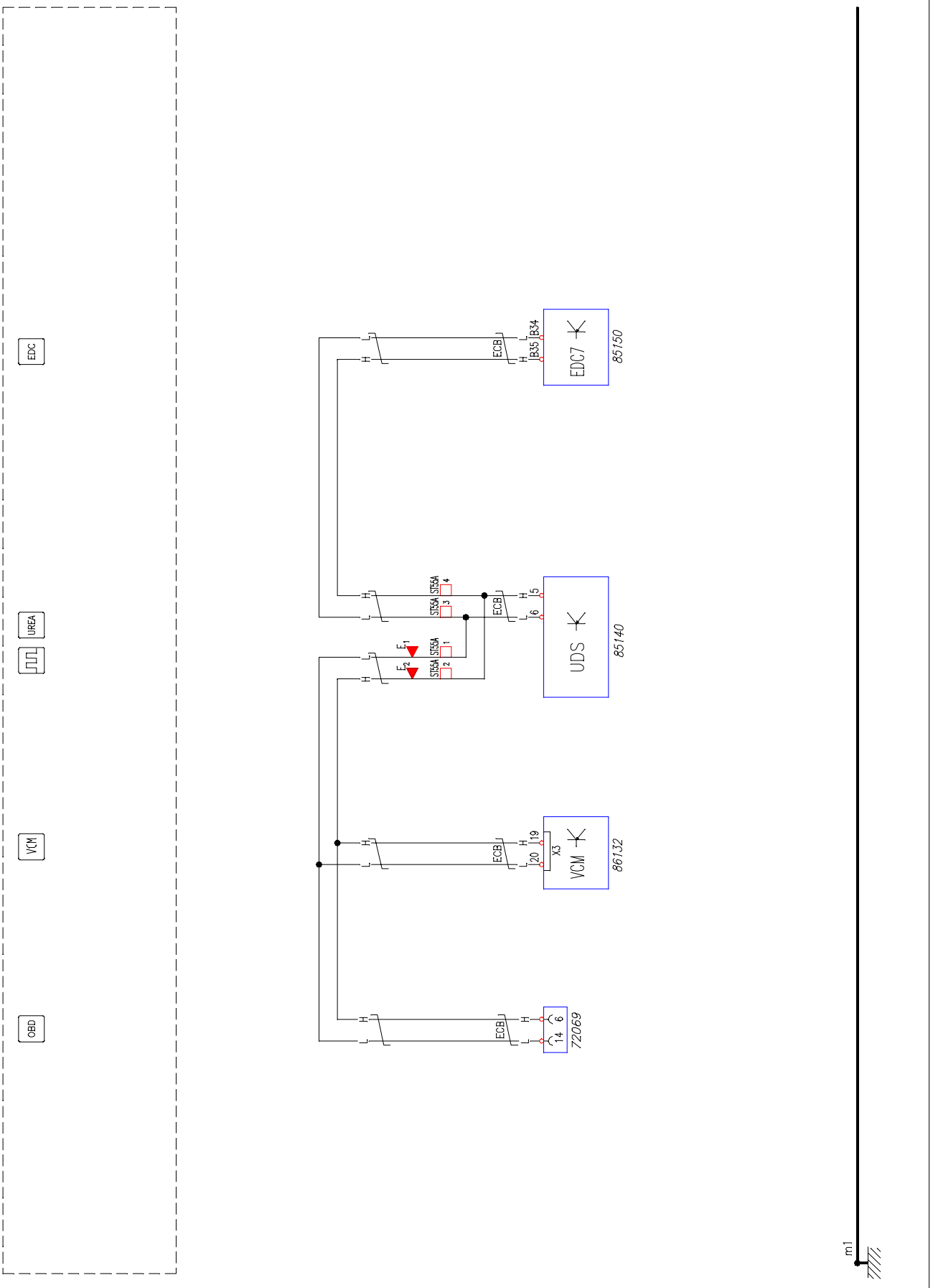
Card 22 Can lines "BCB"



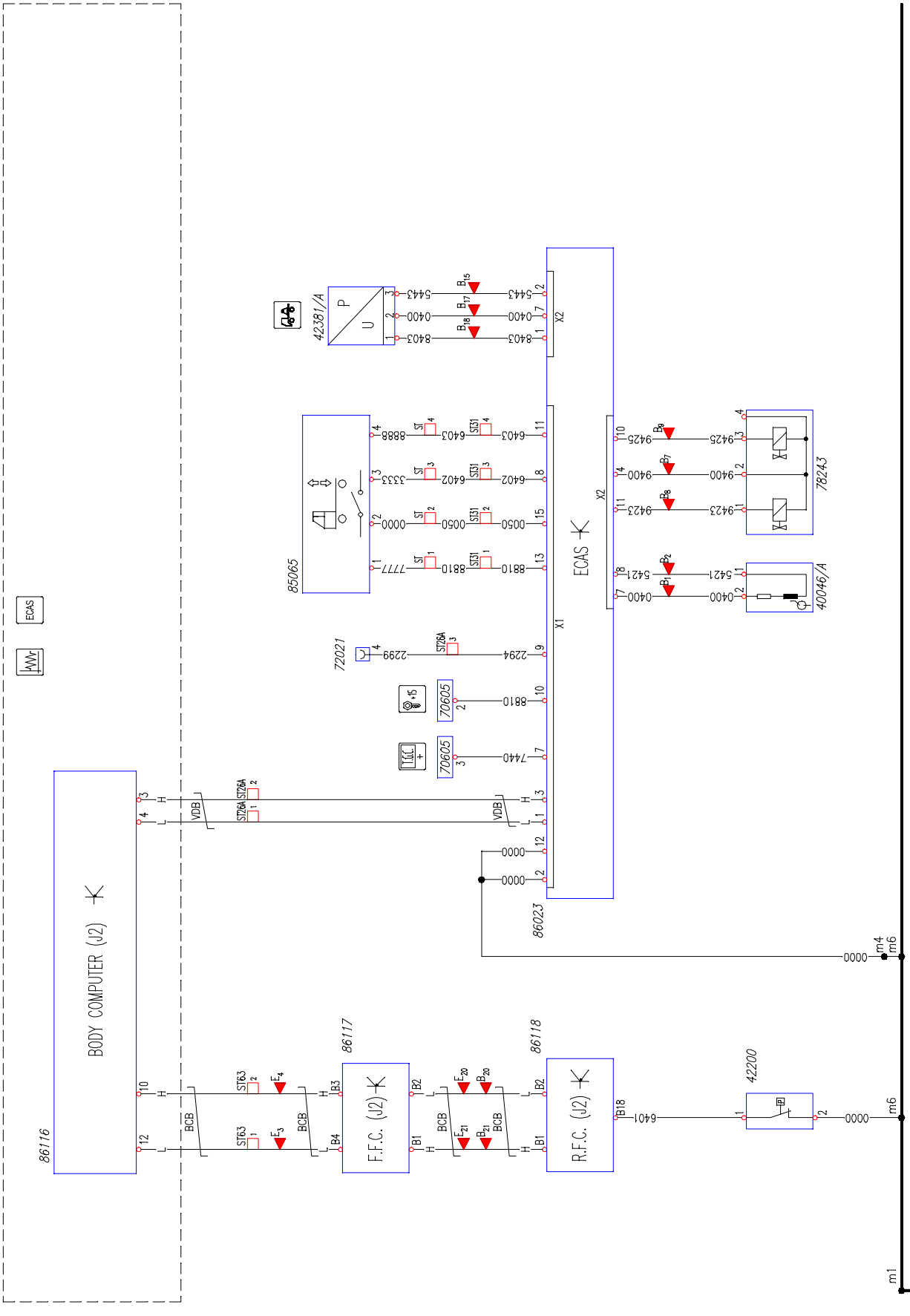
Card 23 Can lines "VDB"



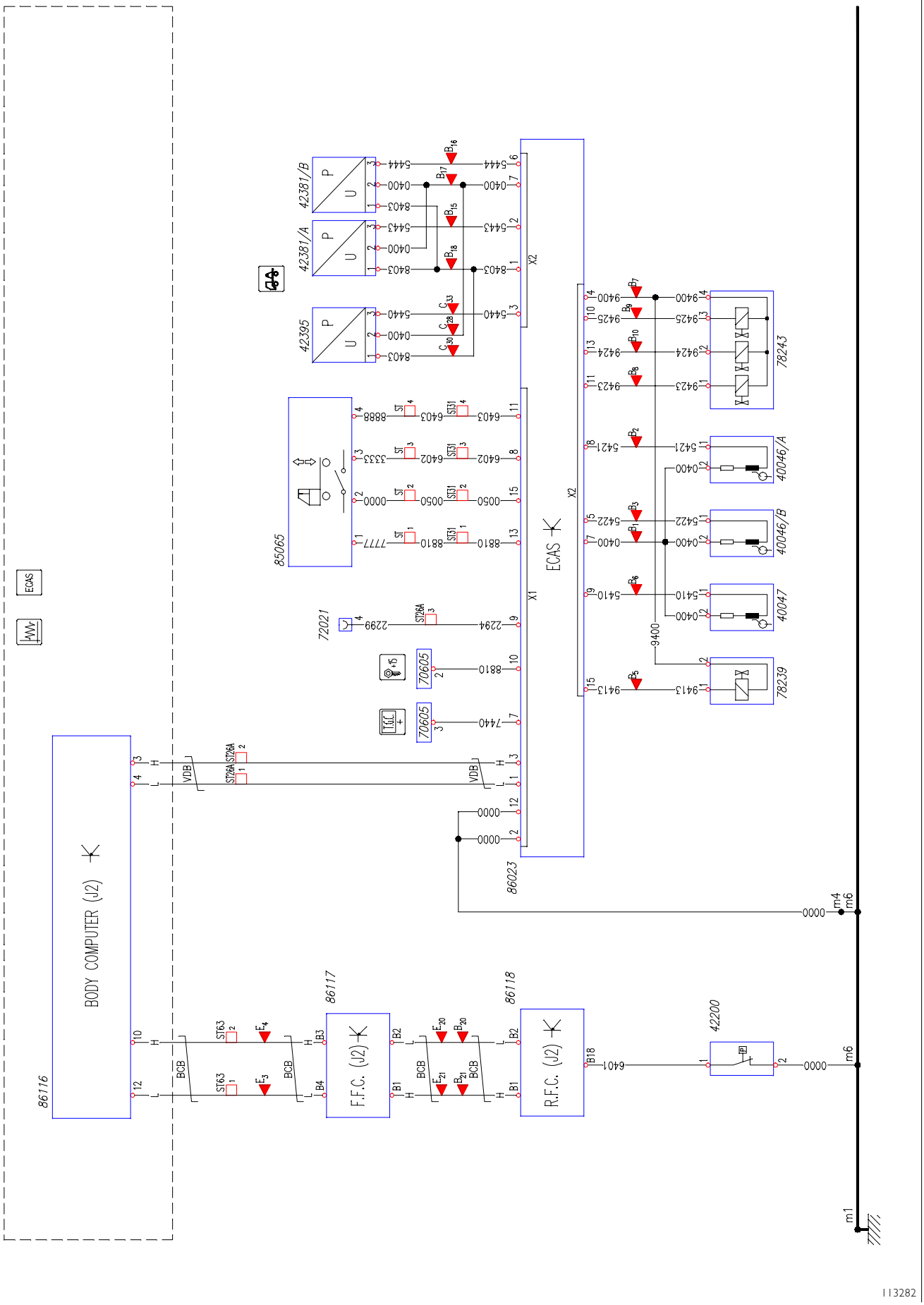
Card 24 Can lines "ECB"



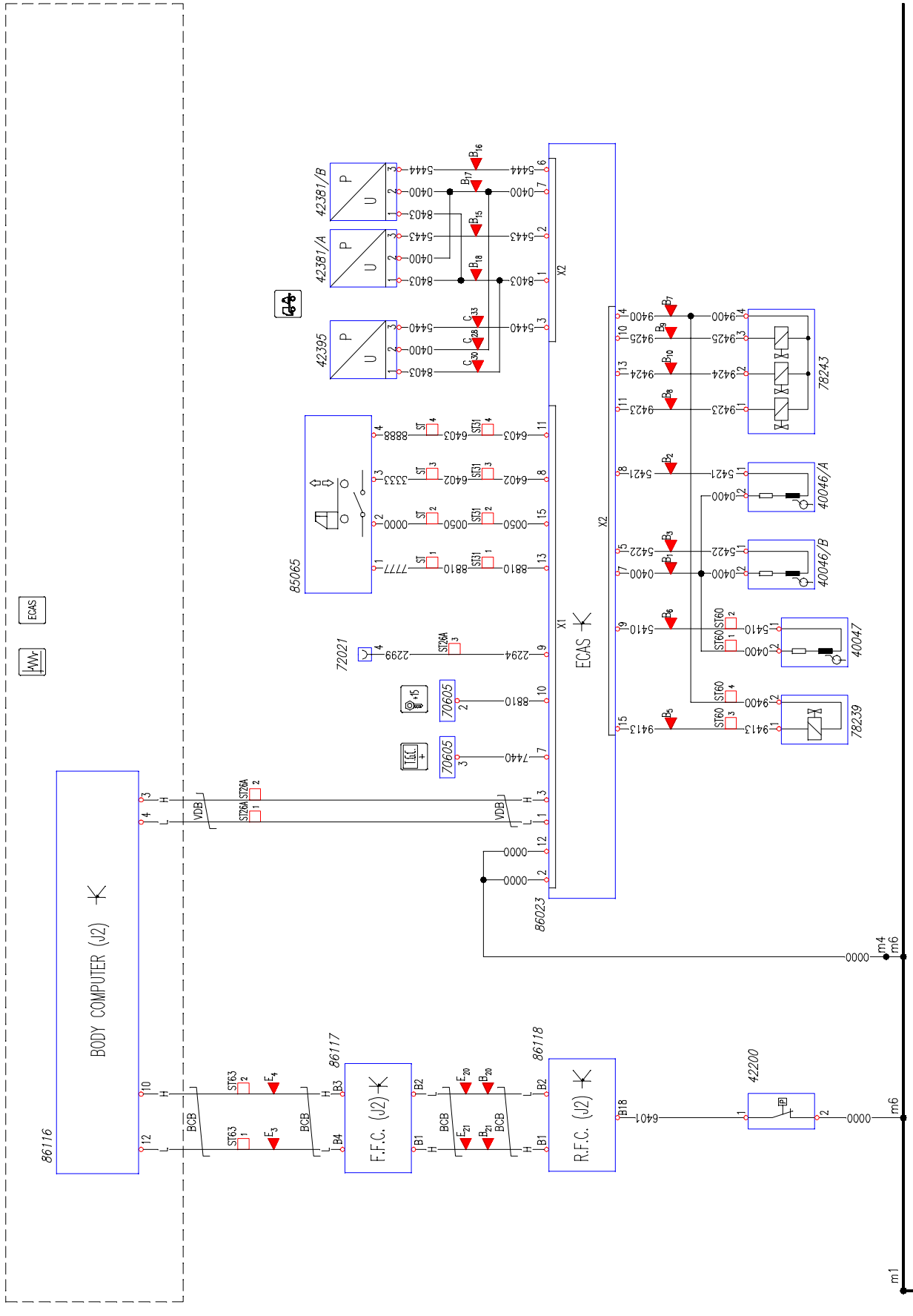
Card 25 Ecas 4x2 P (Tractor)



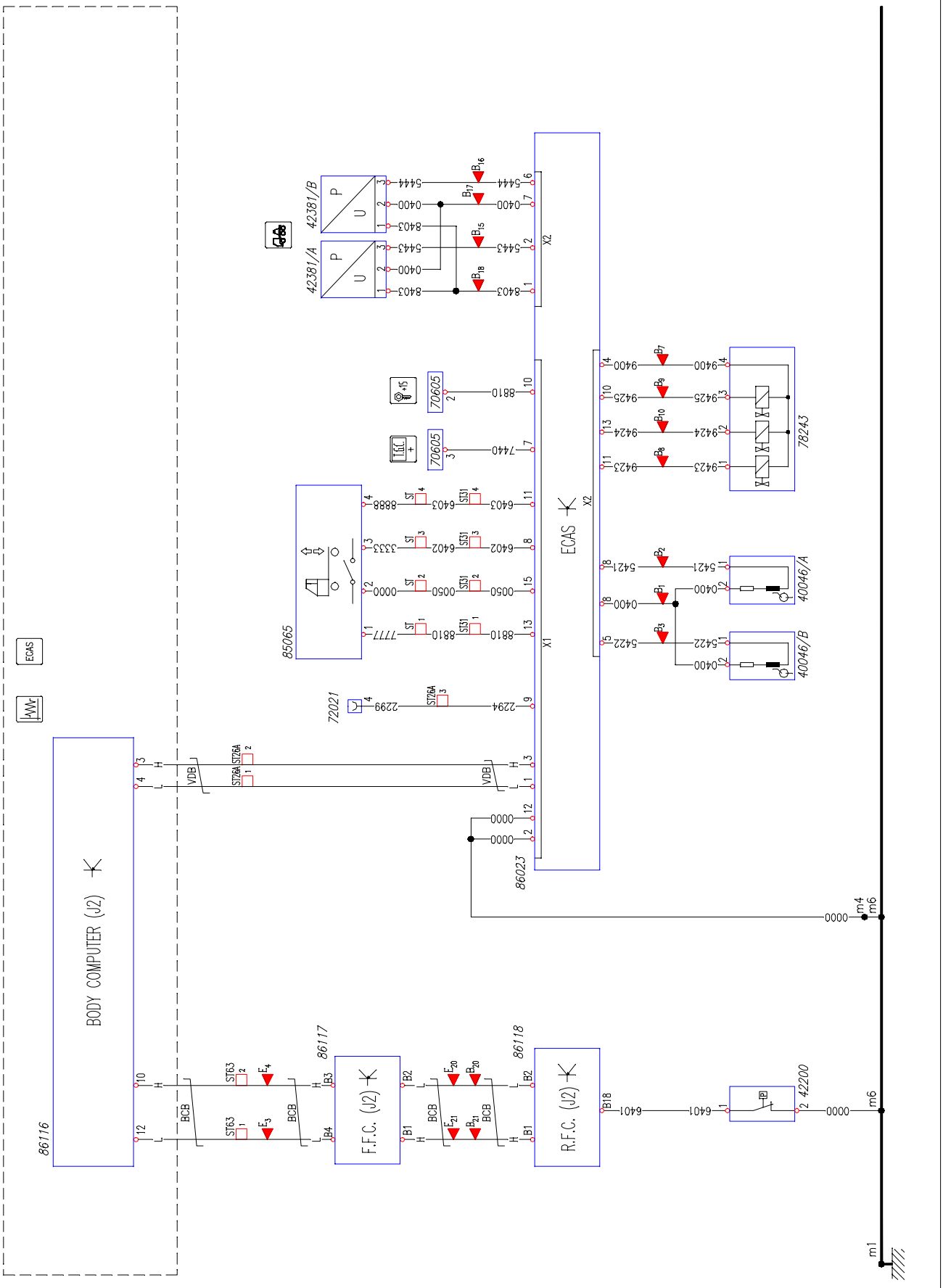
Card 26 Ecas 4x2 FP (Tractor)



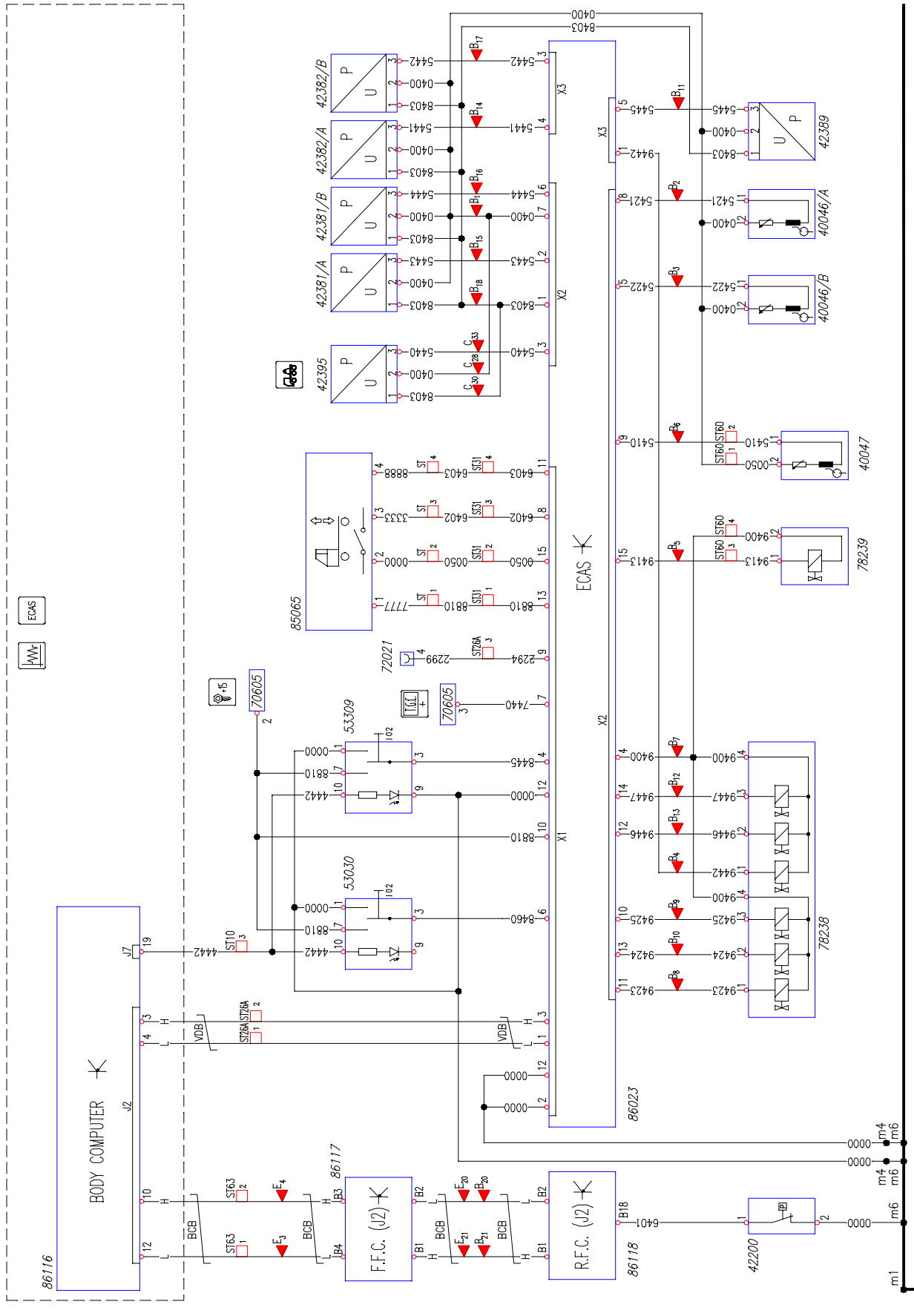
Card 27 Ecas 4x2 P / FP (Truck)



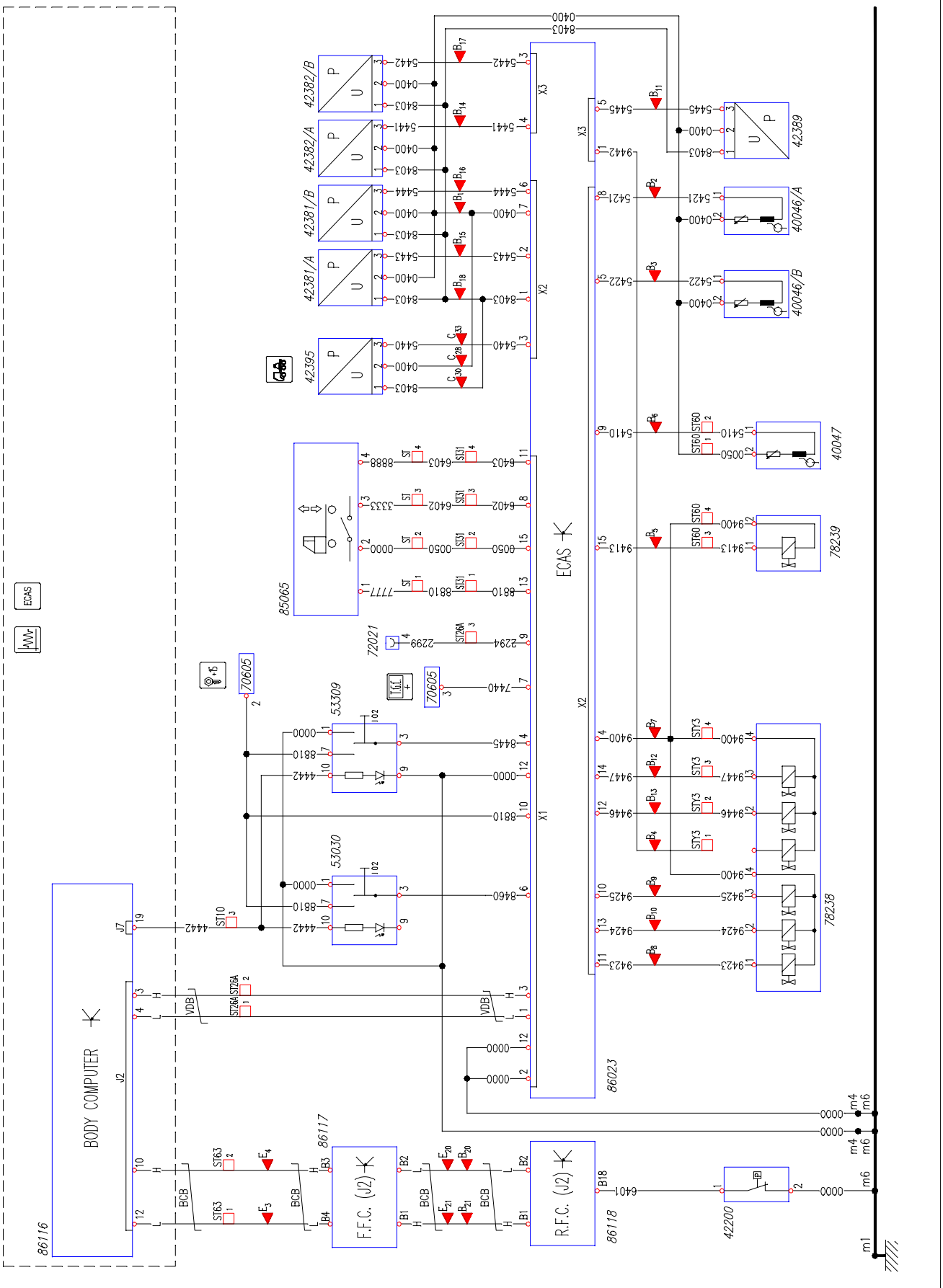
Card 28 Ecas 6x4 P



Card 29 Ecas 6x2 P / FP / C (3rd axle liftable)

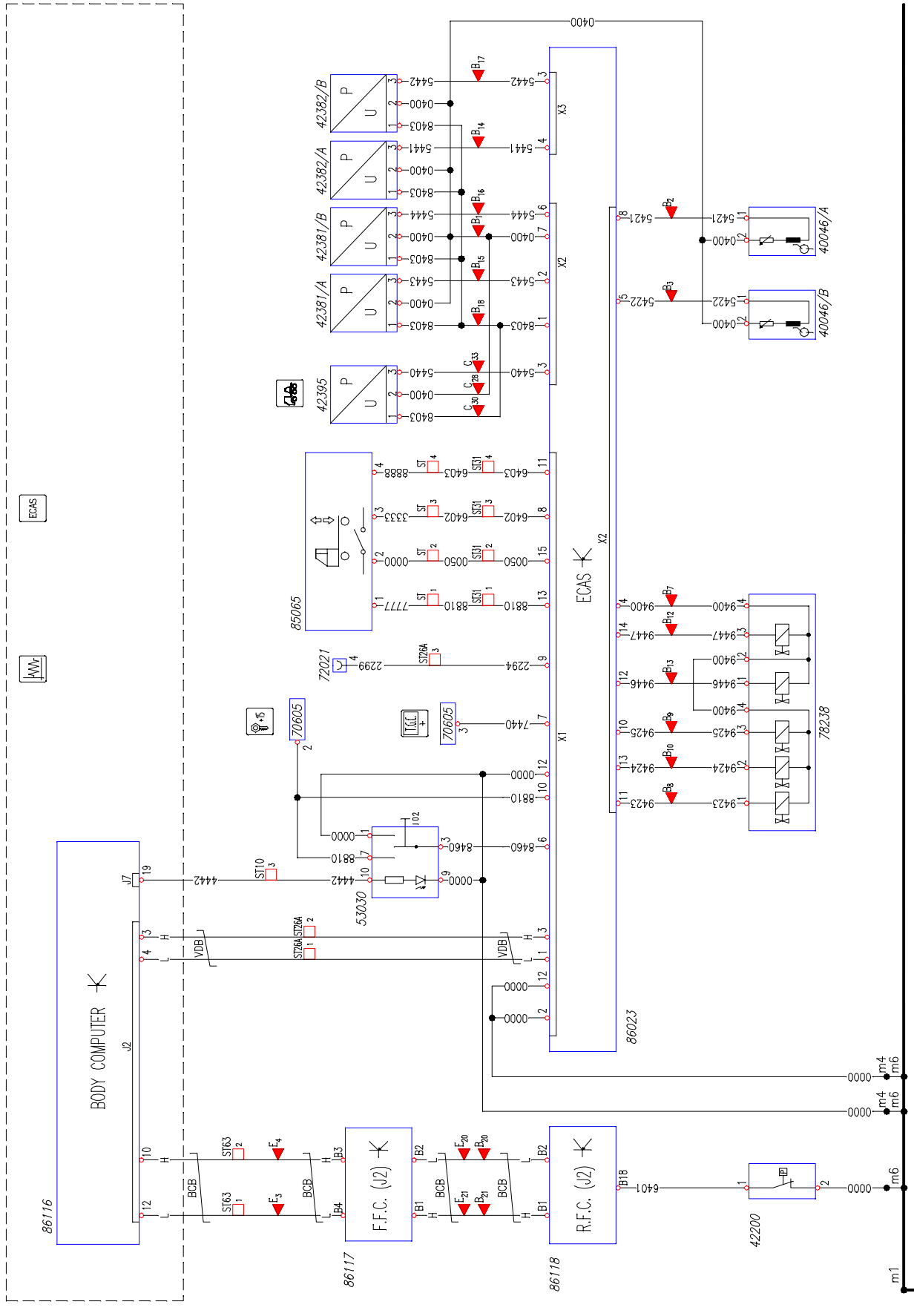


Card 30 Ecas 6x2 P / FP (3rd axle not liftable)



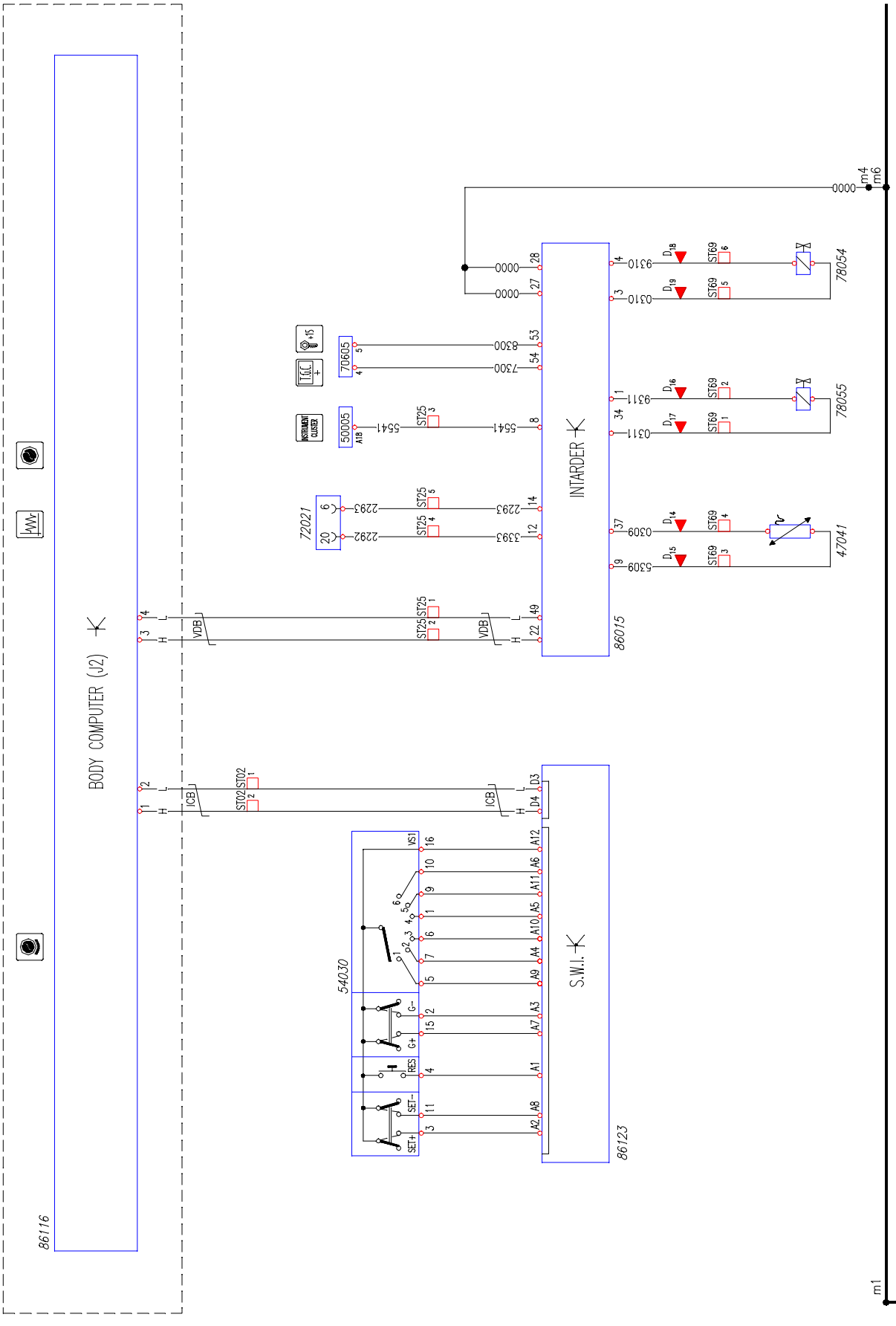
113285

Card 31 Ecas 6x2 C (Tractor - 3rd axle not liftable)

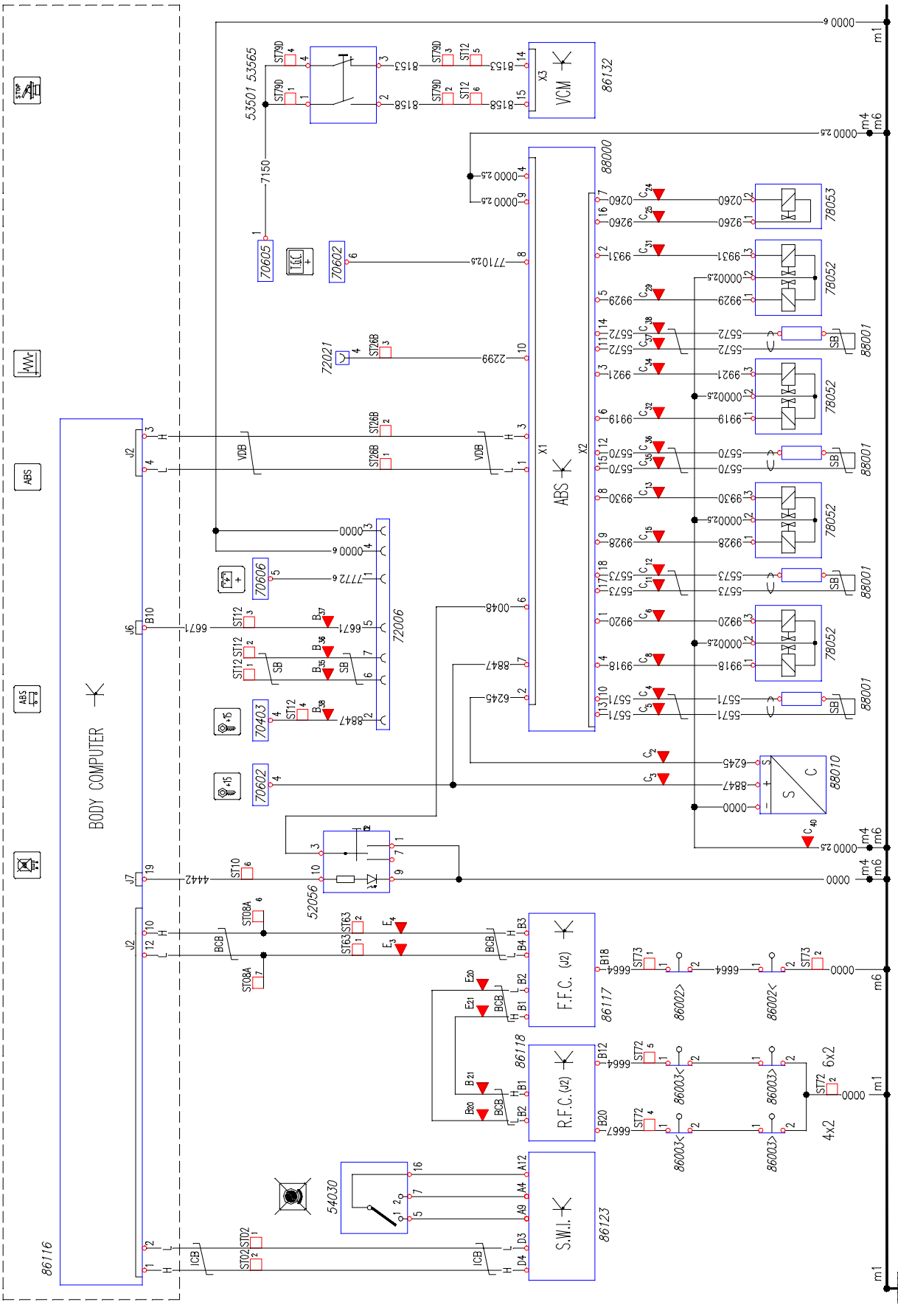


113286

Card 32 Retarder ZF

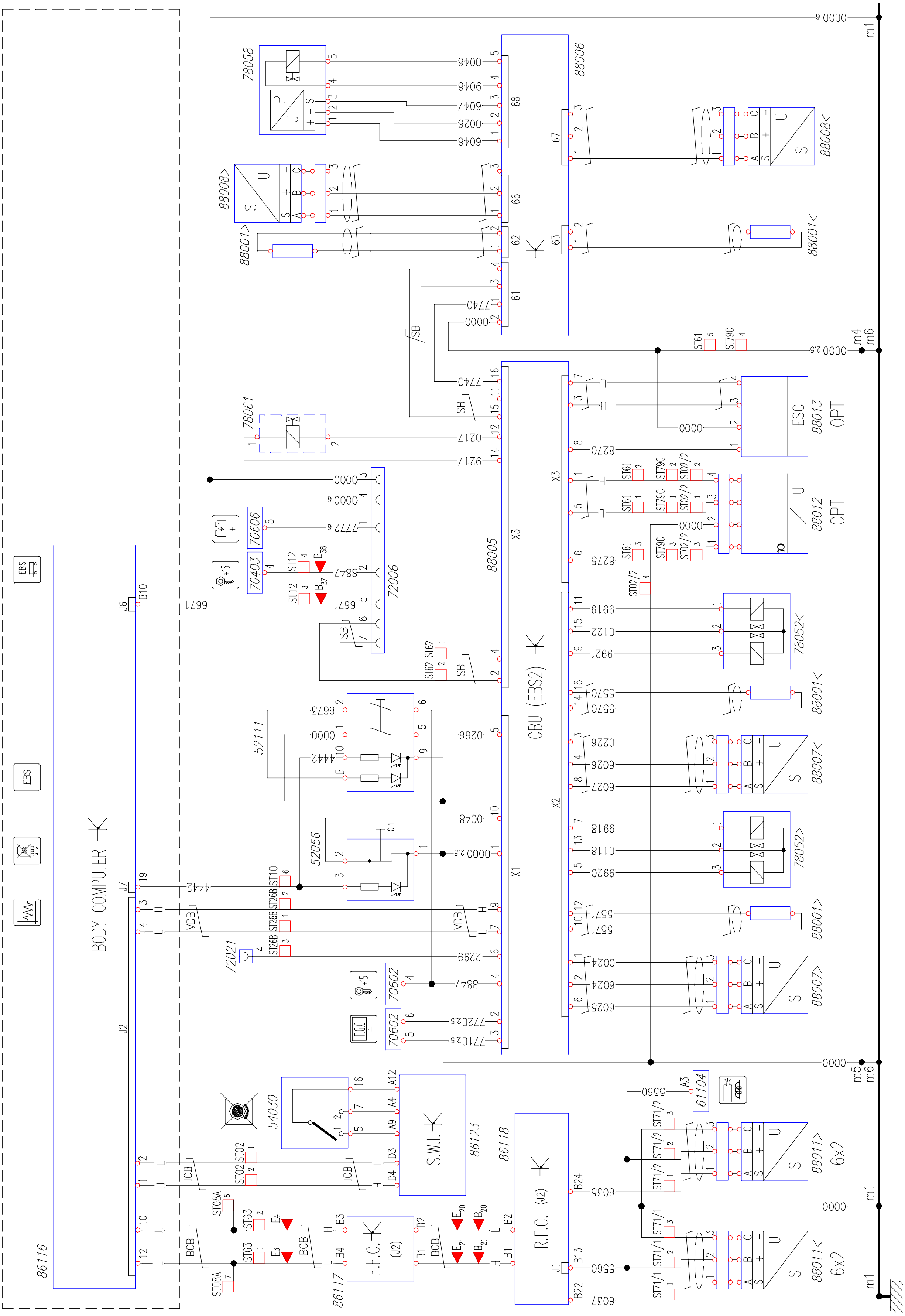


Card 33 ABS



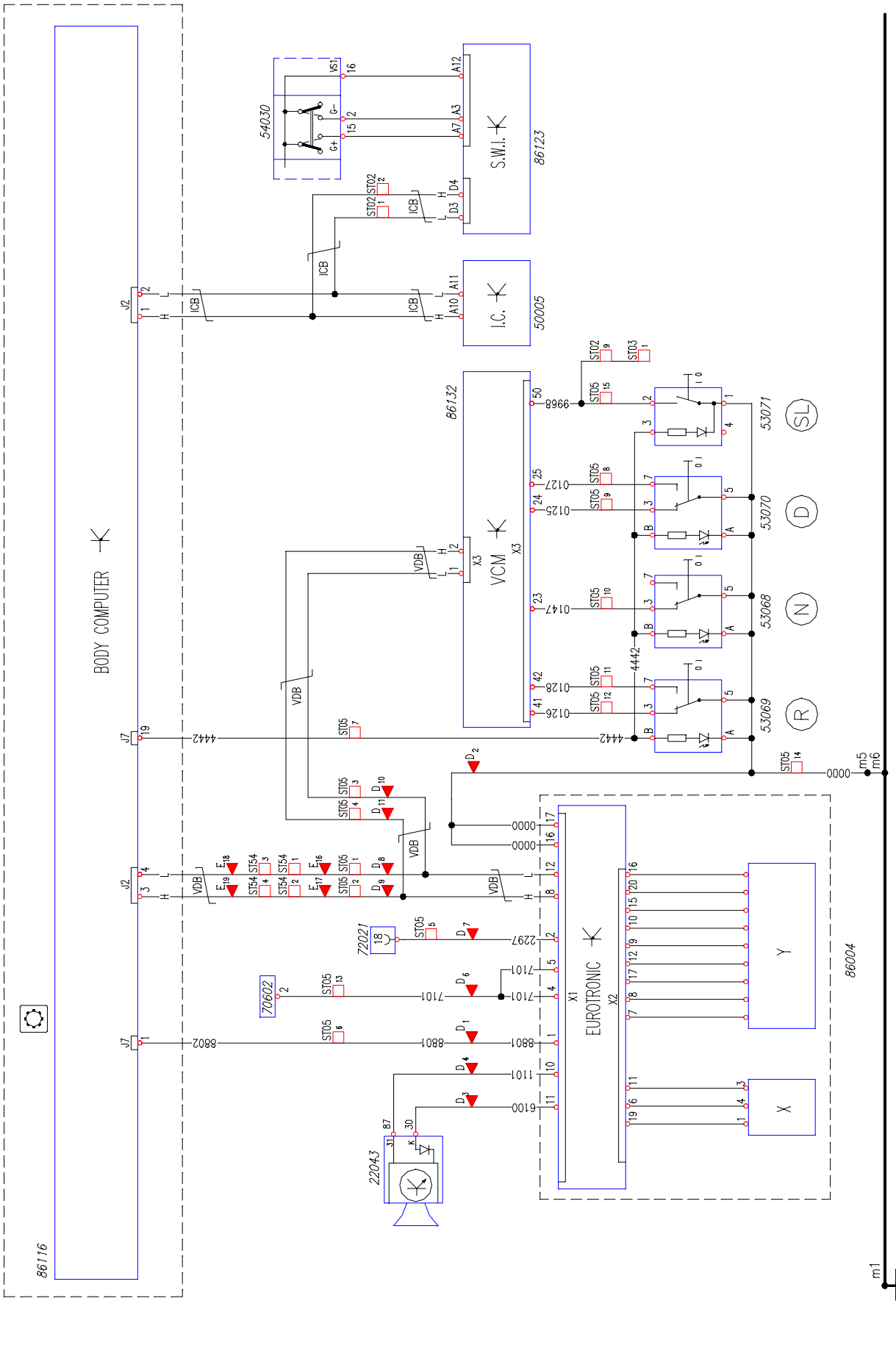
113232

Card 34 EBS2



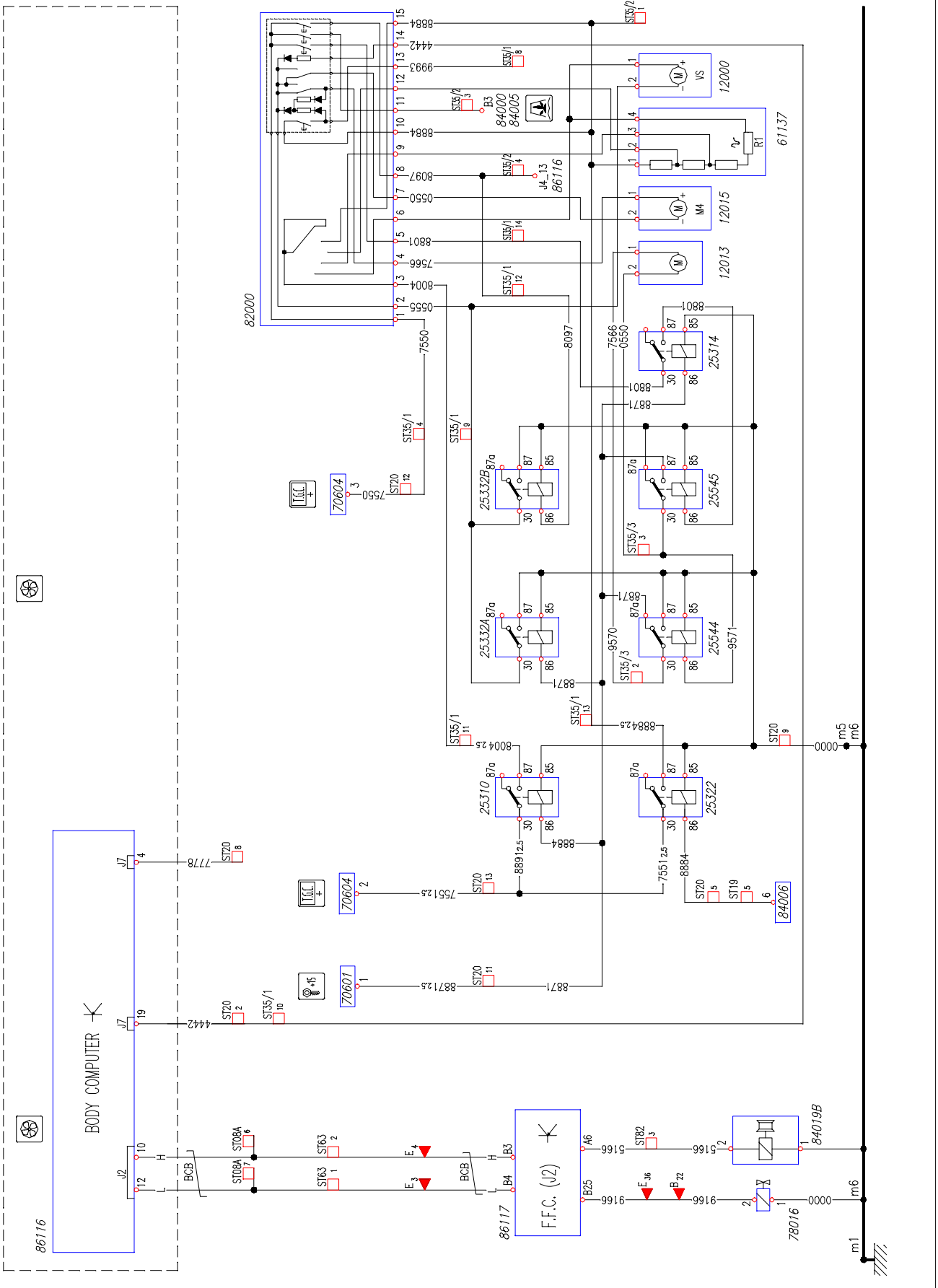
113233

Card 35 Eurotronic II

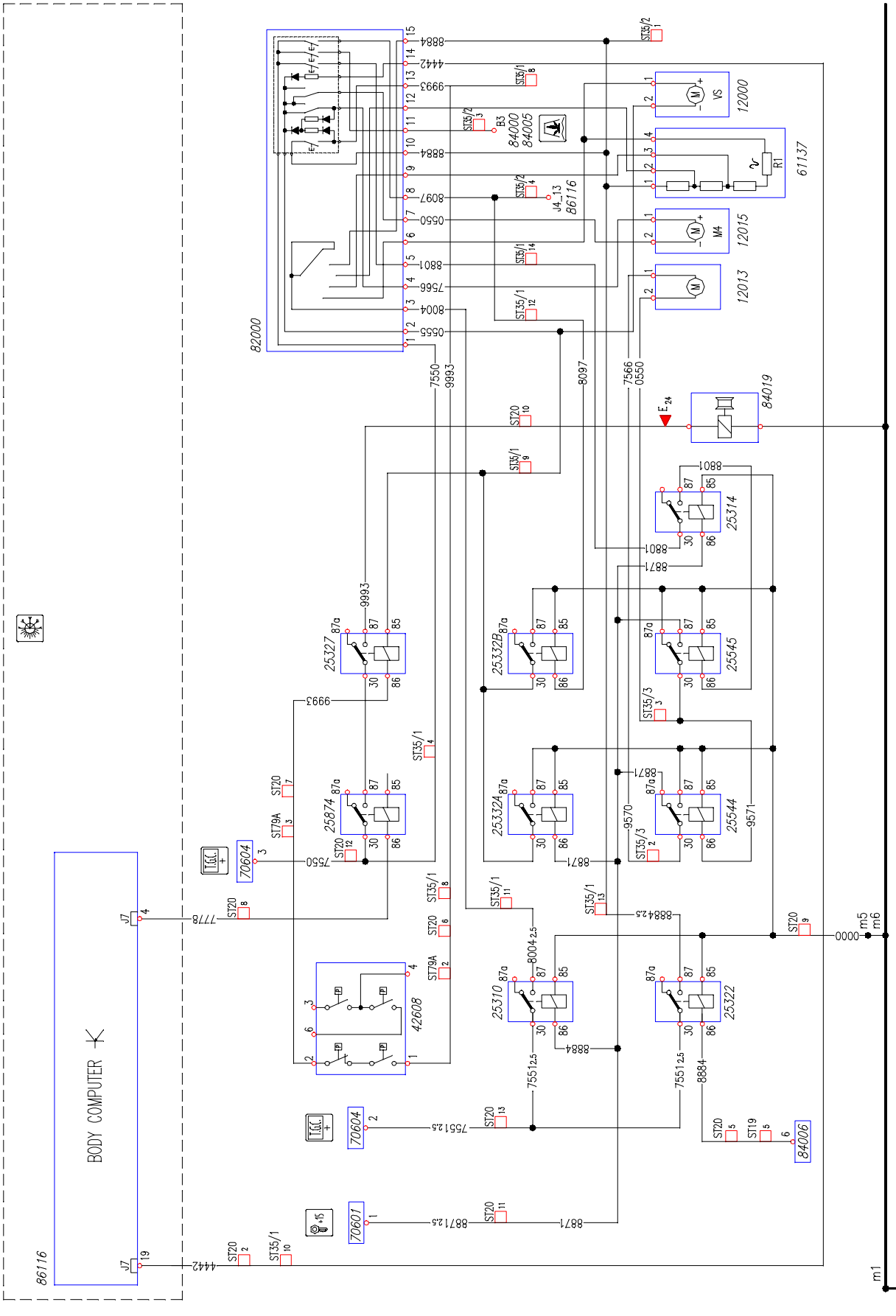


113234

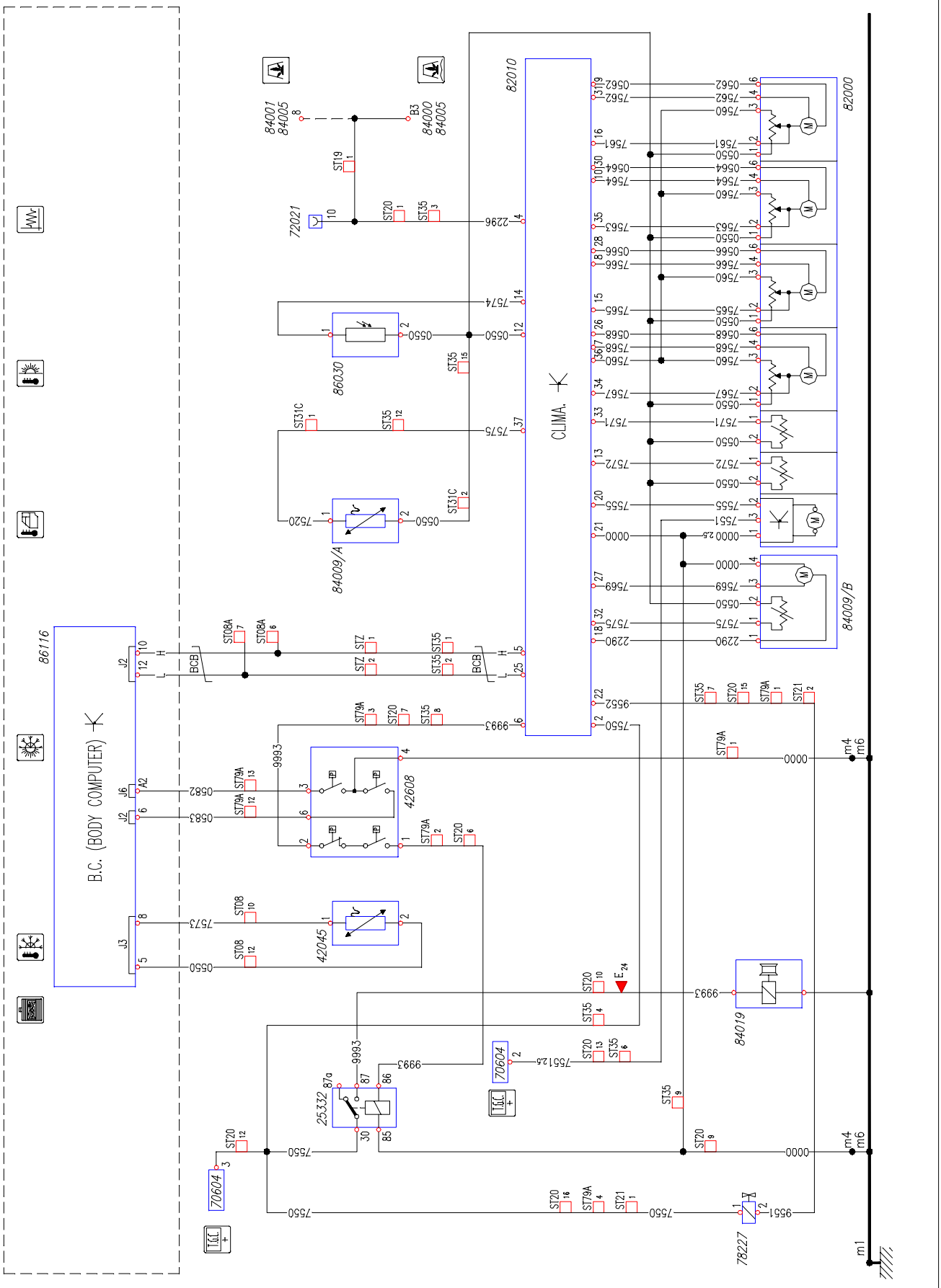
Card 36 Cooling / Engine ventilation



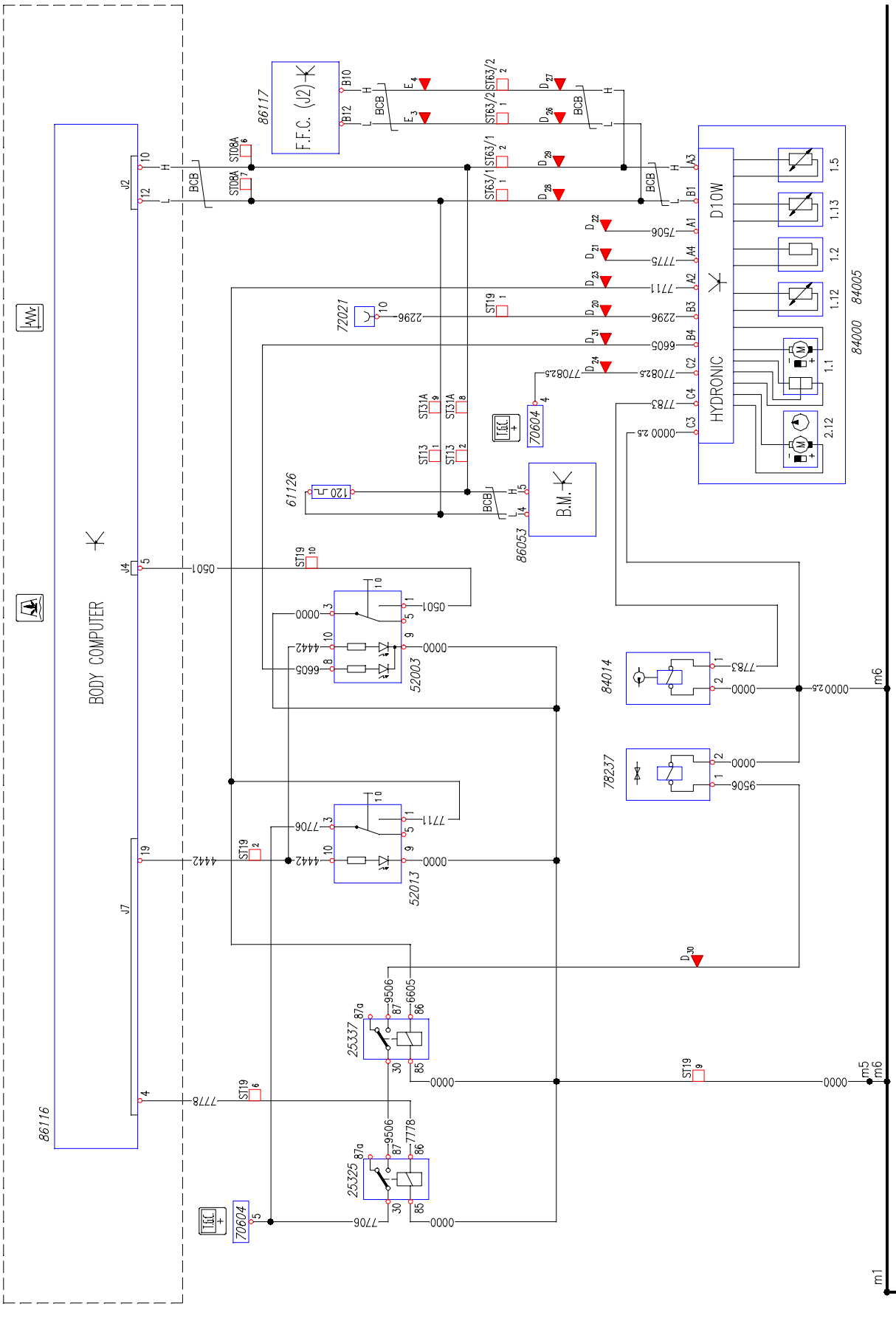
Card 37 Hand-operated conditioning system



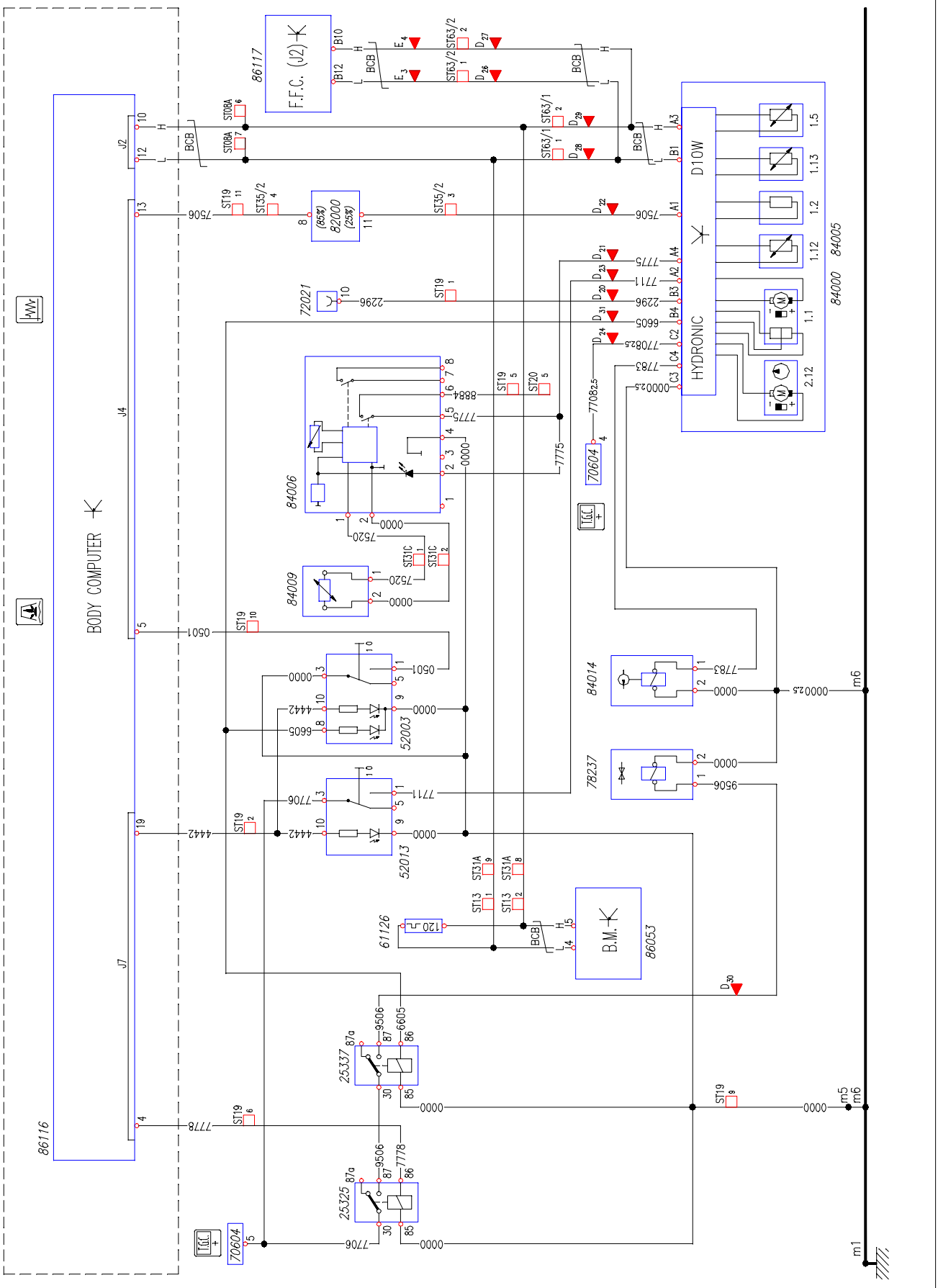
Card 38 Automatic conditioning system



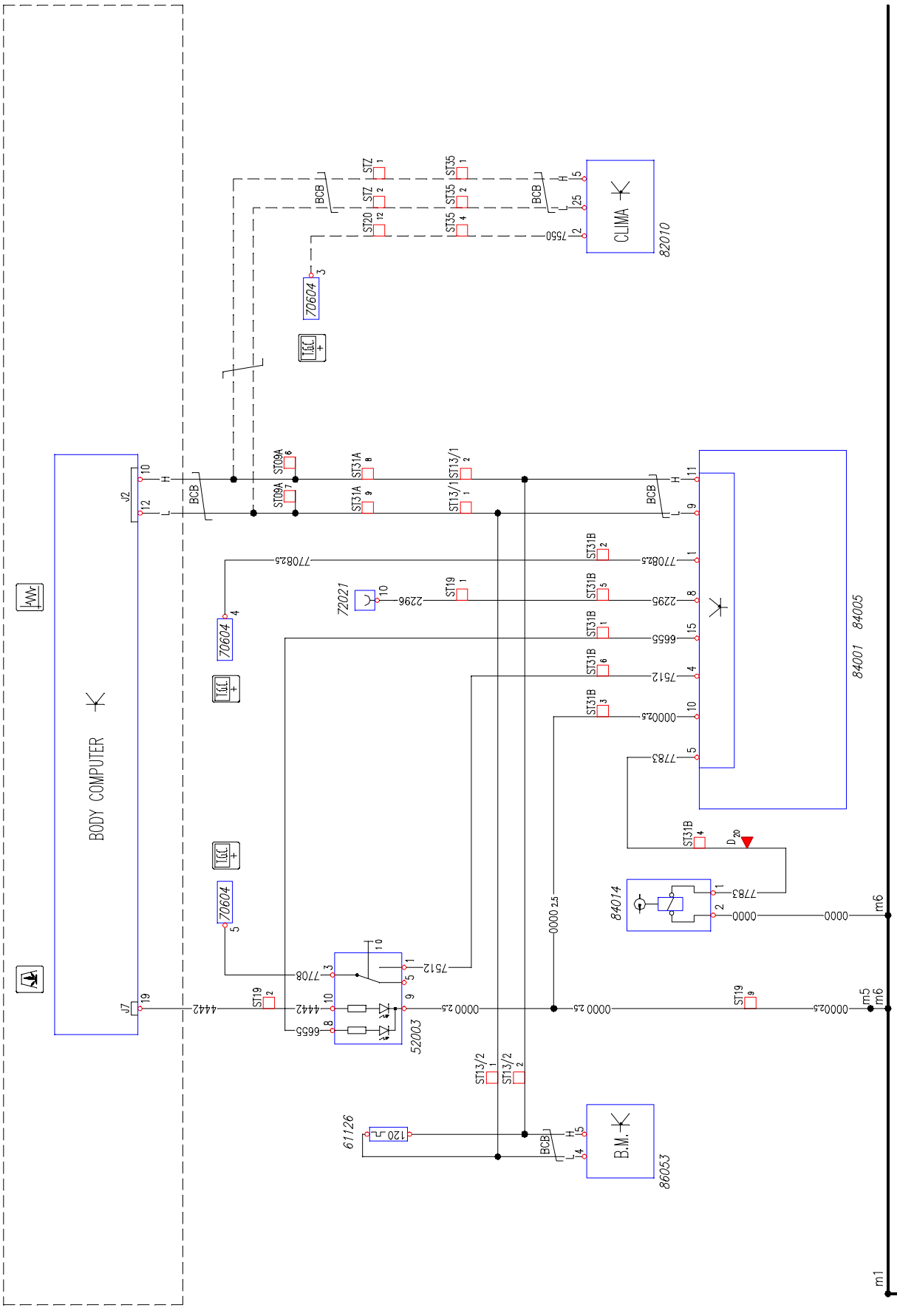
Card 39 Automatically controlled supplementary water heater



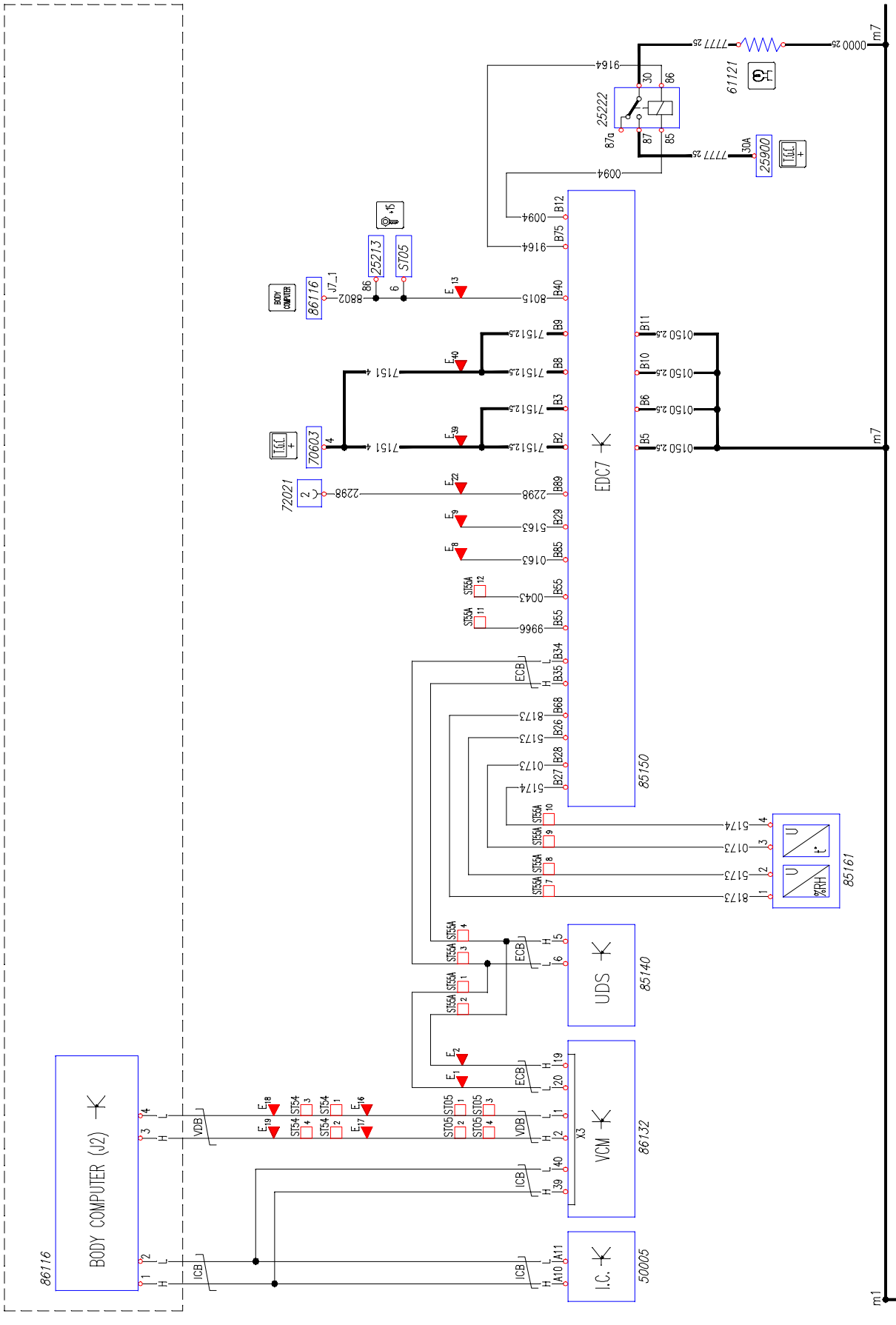
Card 40 Hand-operated supplementary water heater



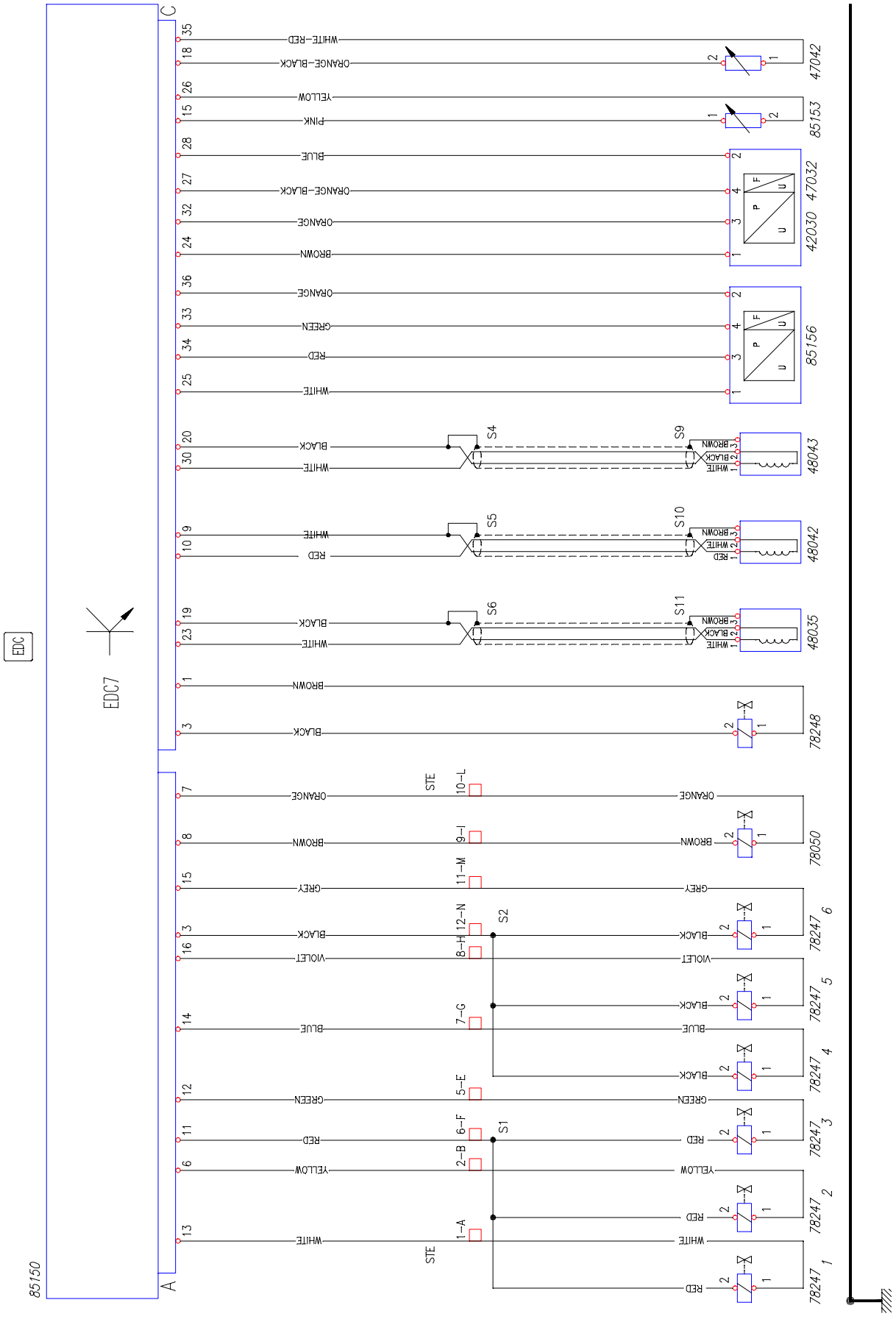
Card 41 Supplementary air -operated heater (manual / automatic)



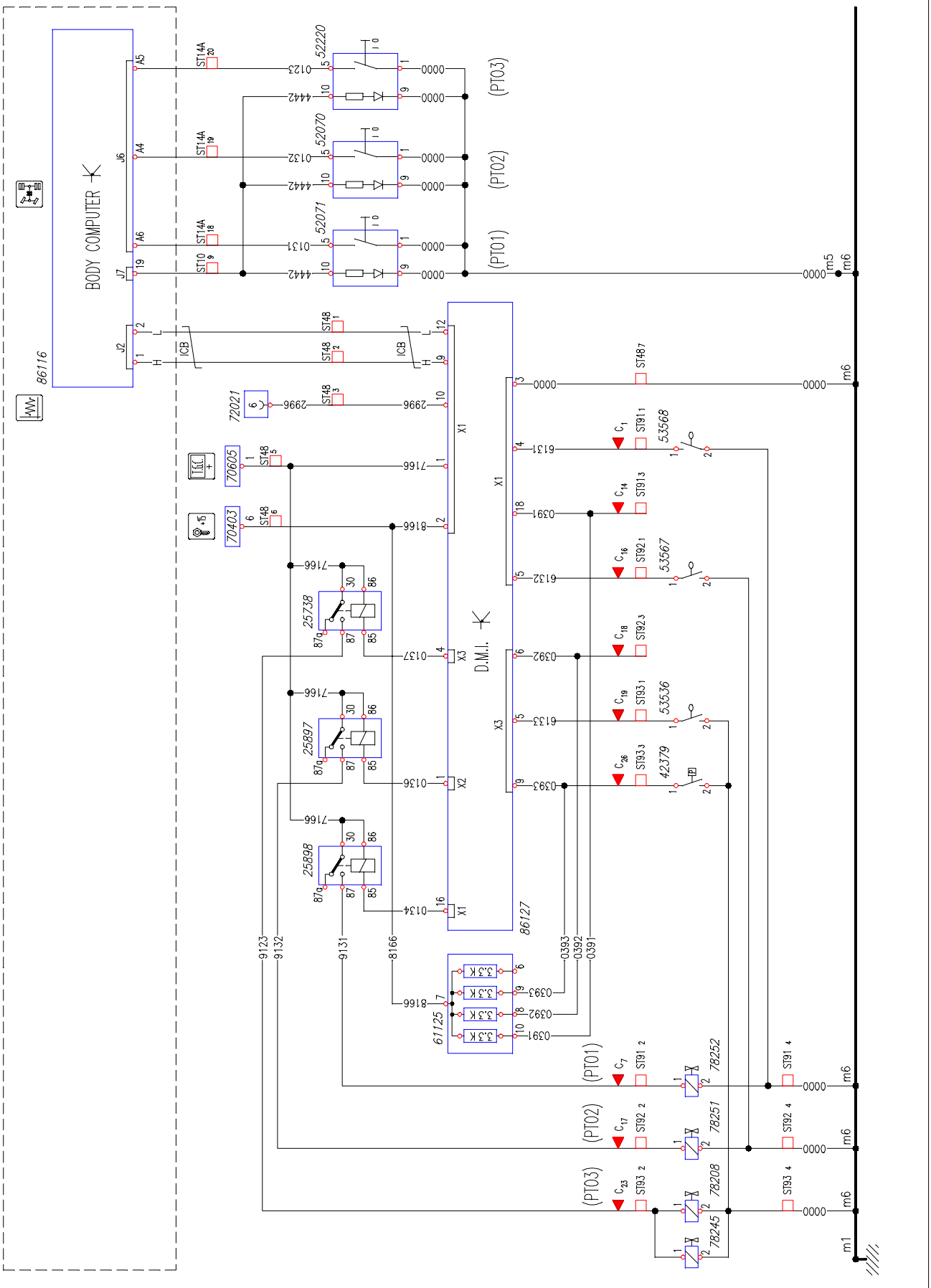
Card 42 EDC (connector B)



Card 43 EDC (connector A)

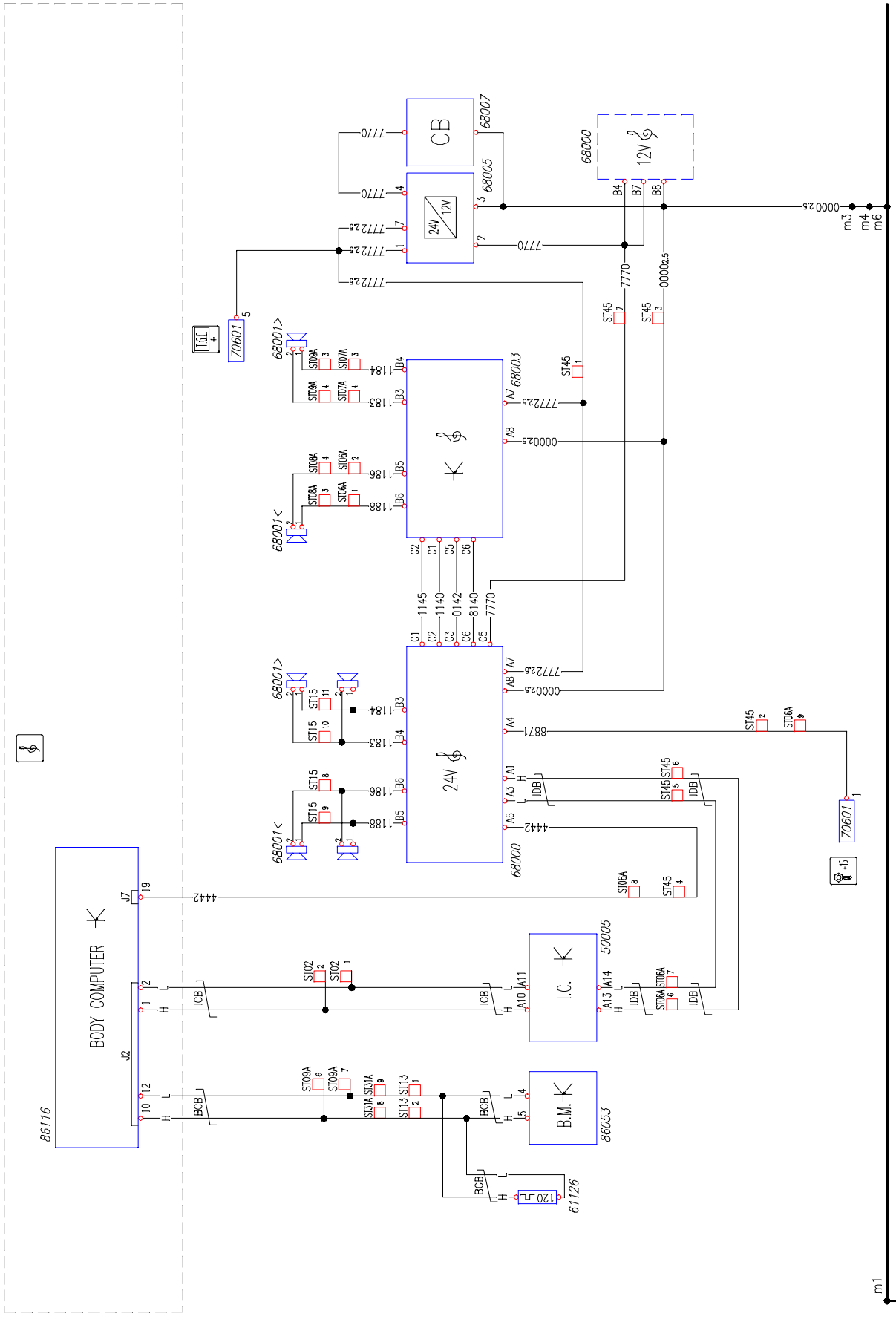


Card 44 DMI PTO control unit

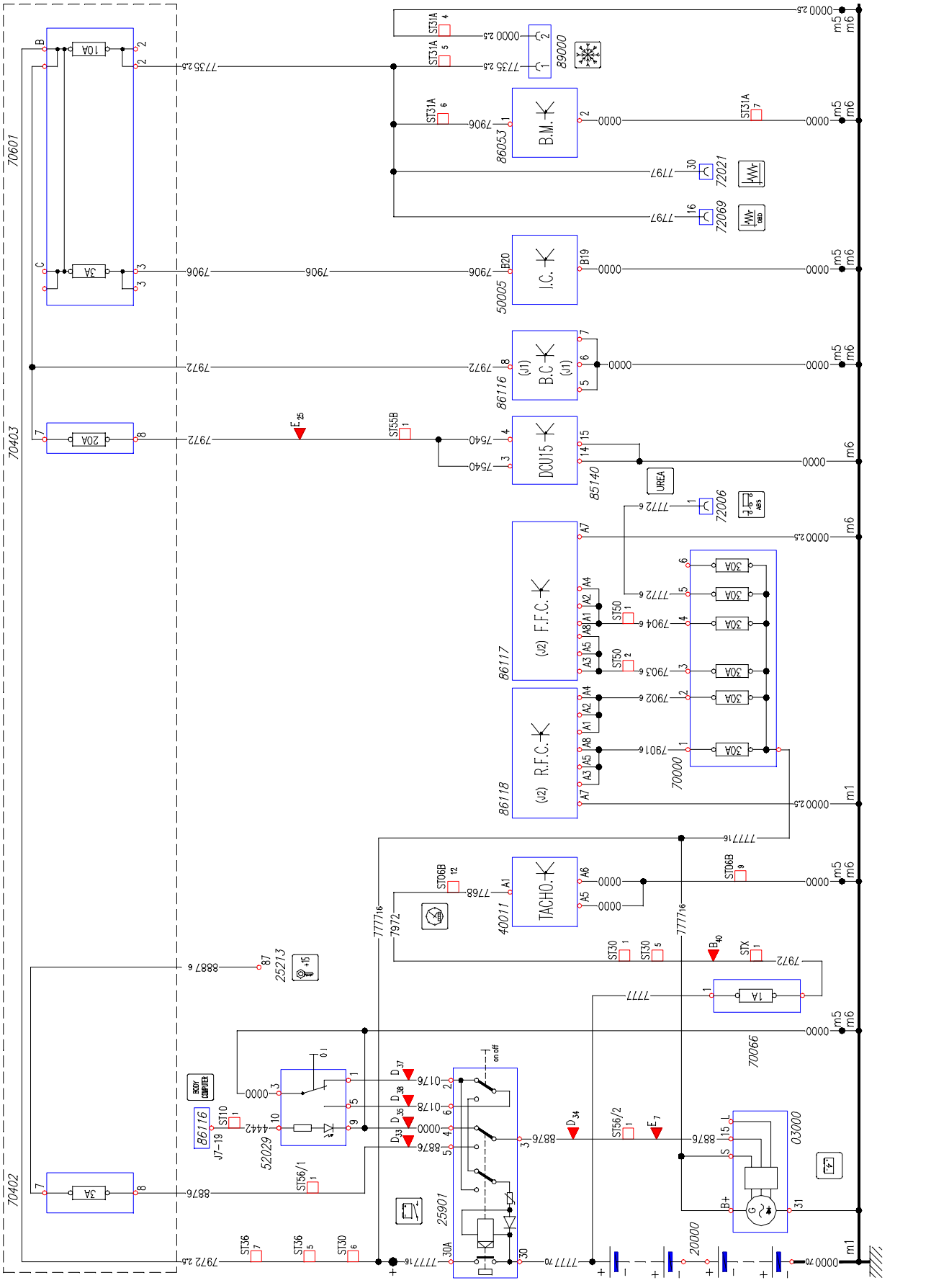


113238

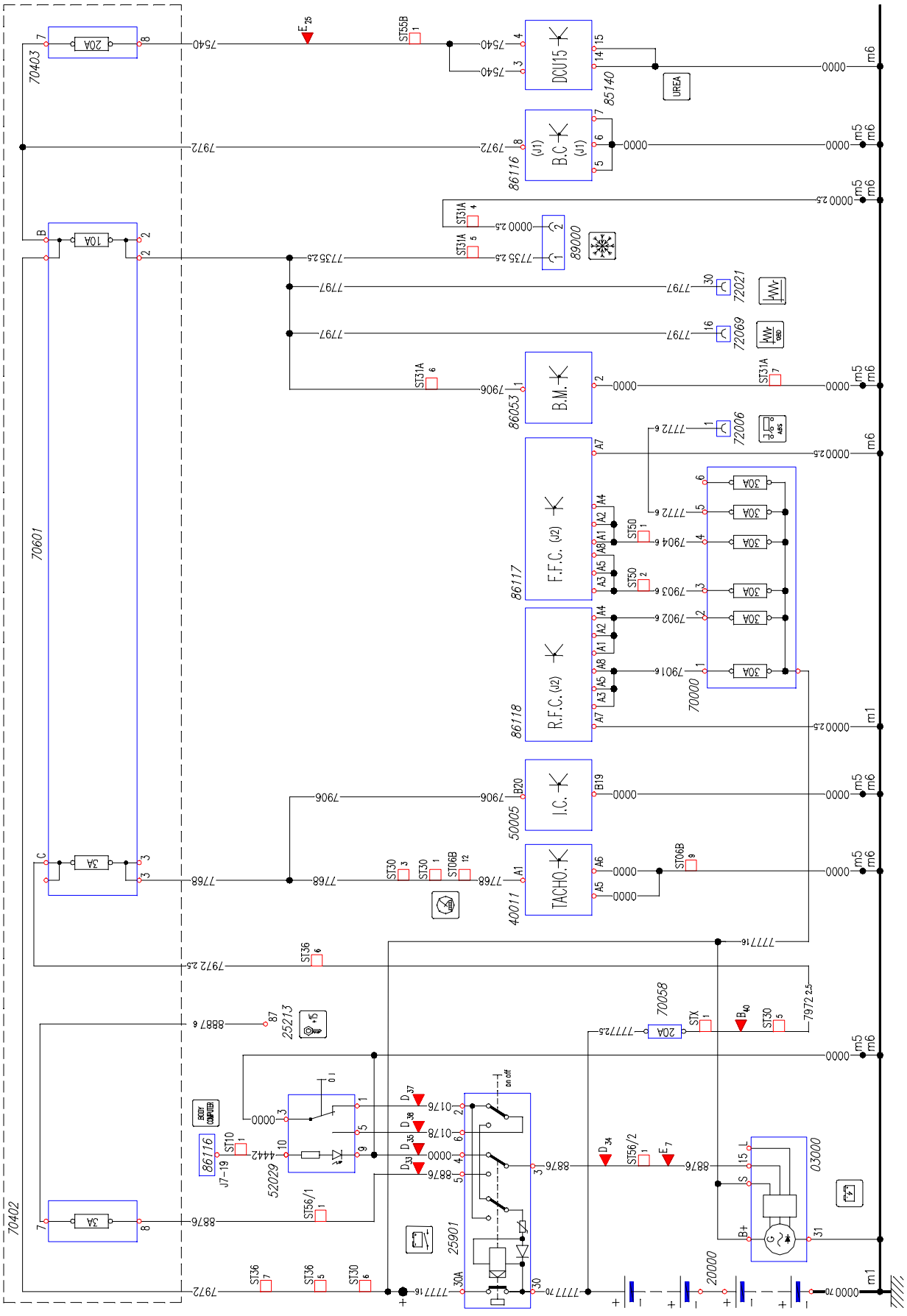
Card 45 Radio receiver



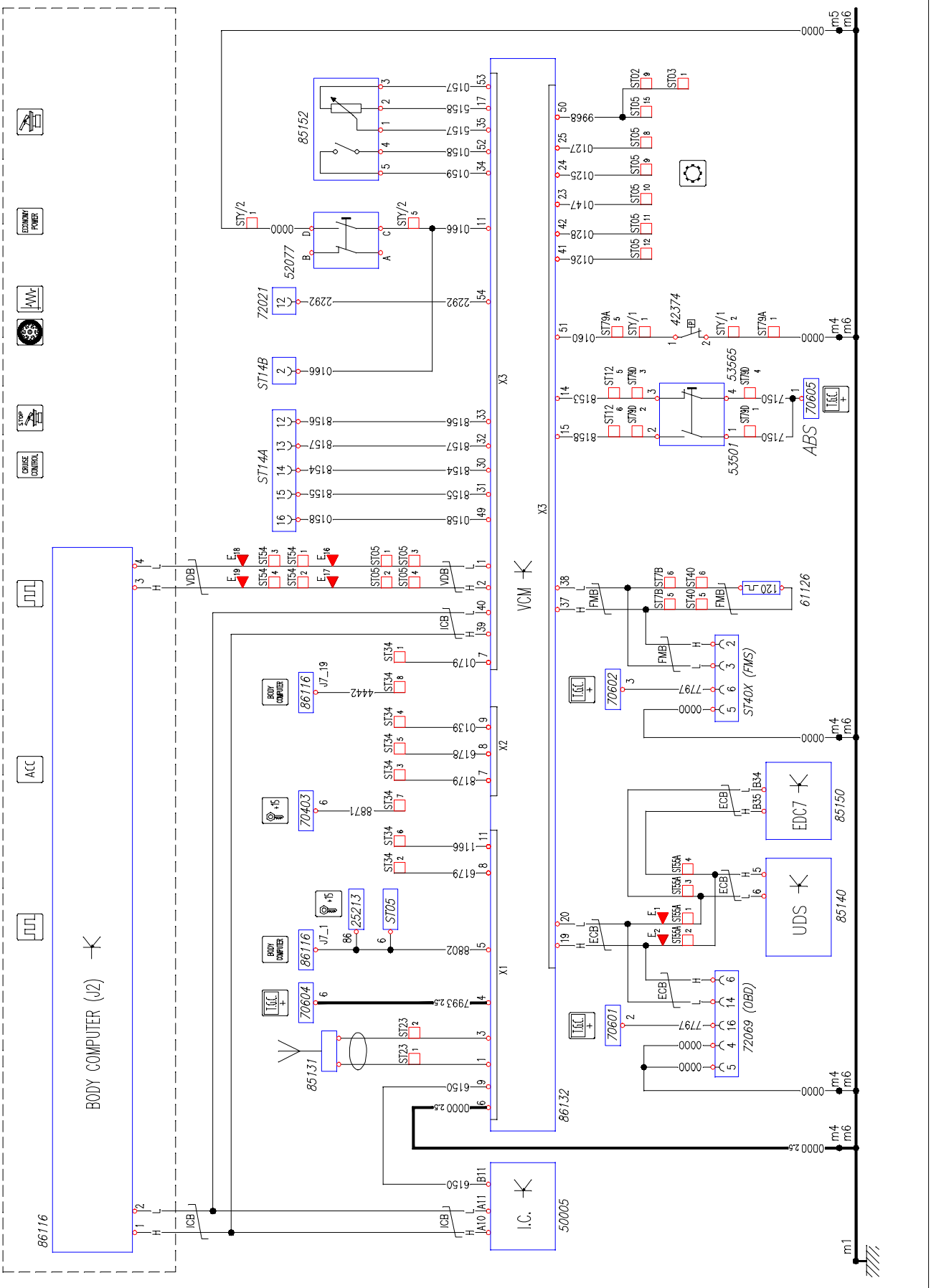
Card 46 ADR (2001 94/9/EG)



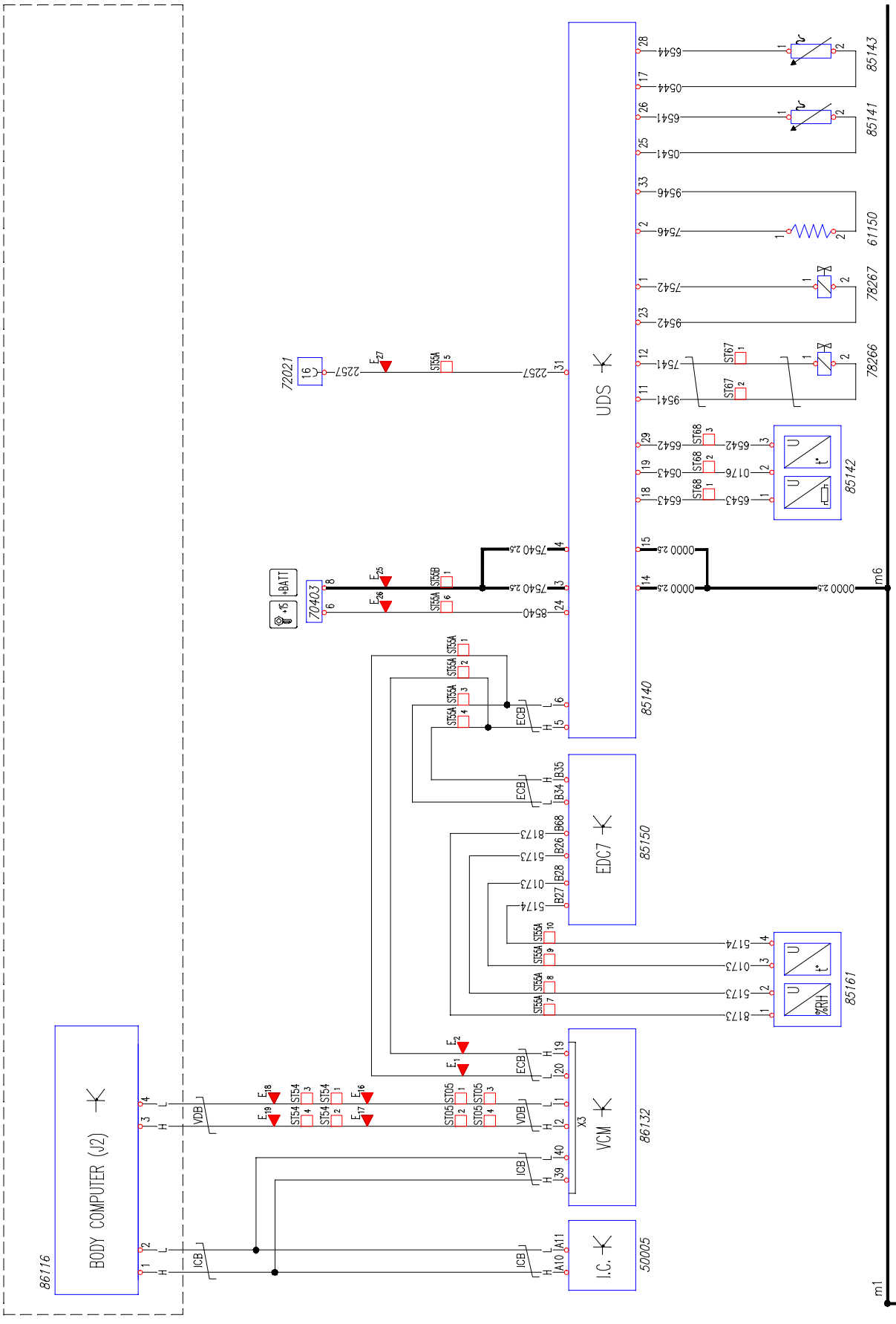
Card 47 ADR (OPT. 0129)



Card 48 Electronic Control Unit VCM



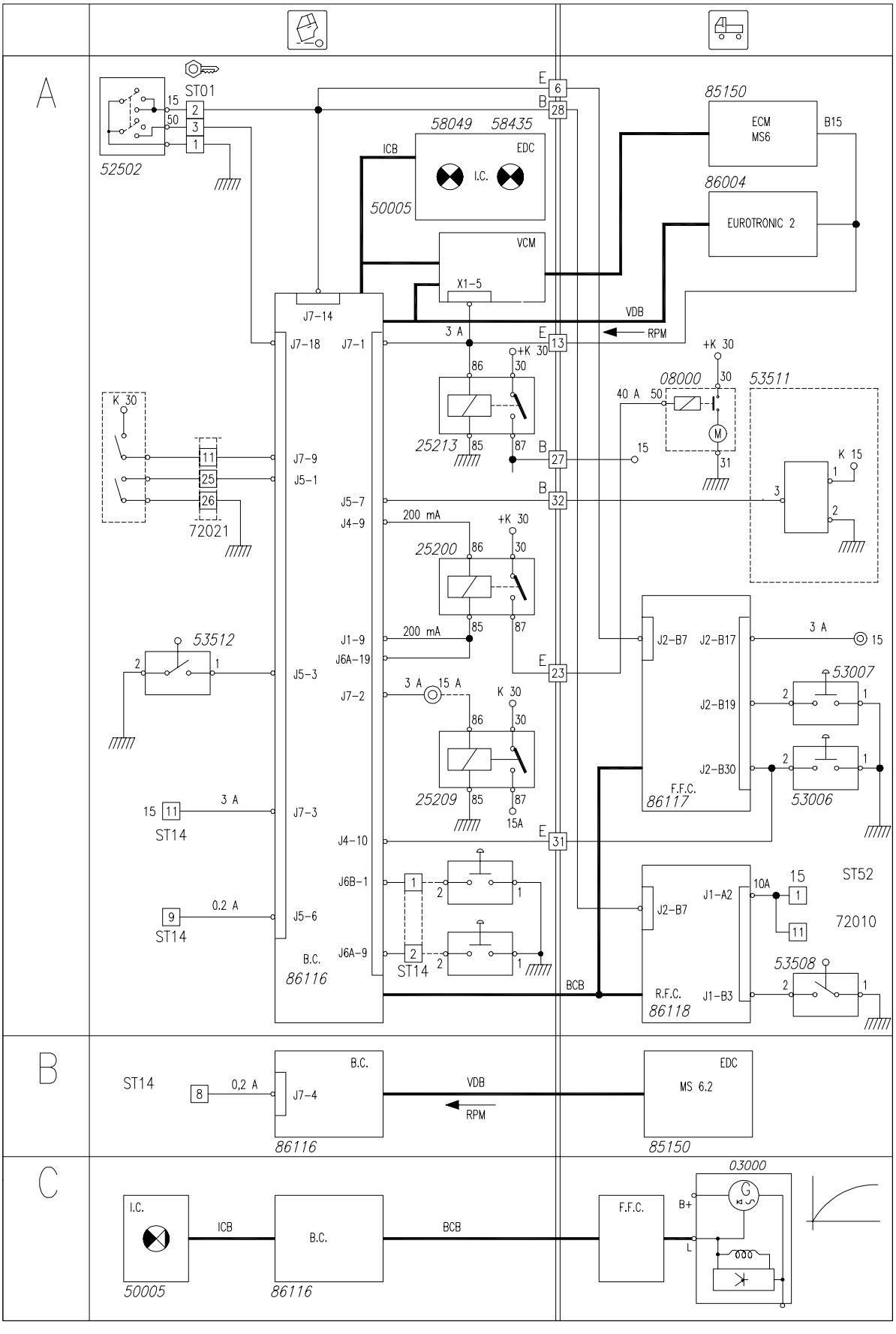
Card 49 Electronic Control Unit DCU 15 (System SCR)



113241

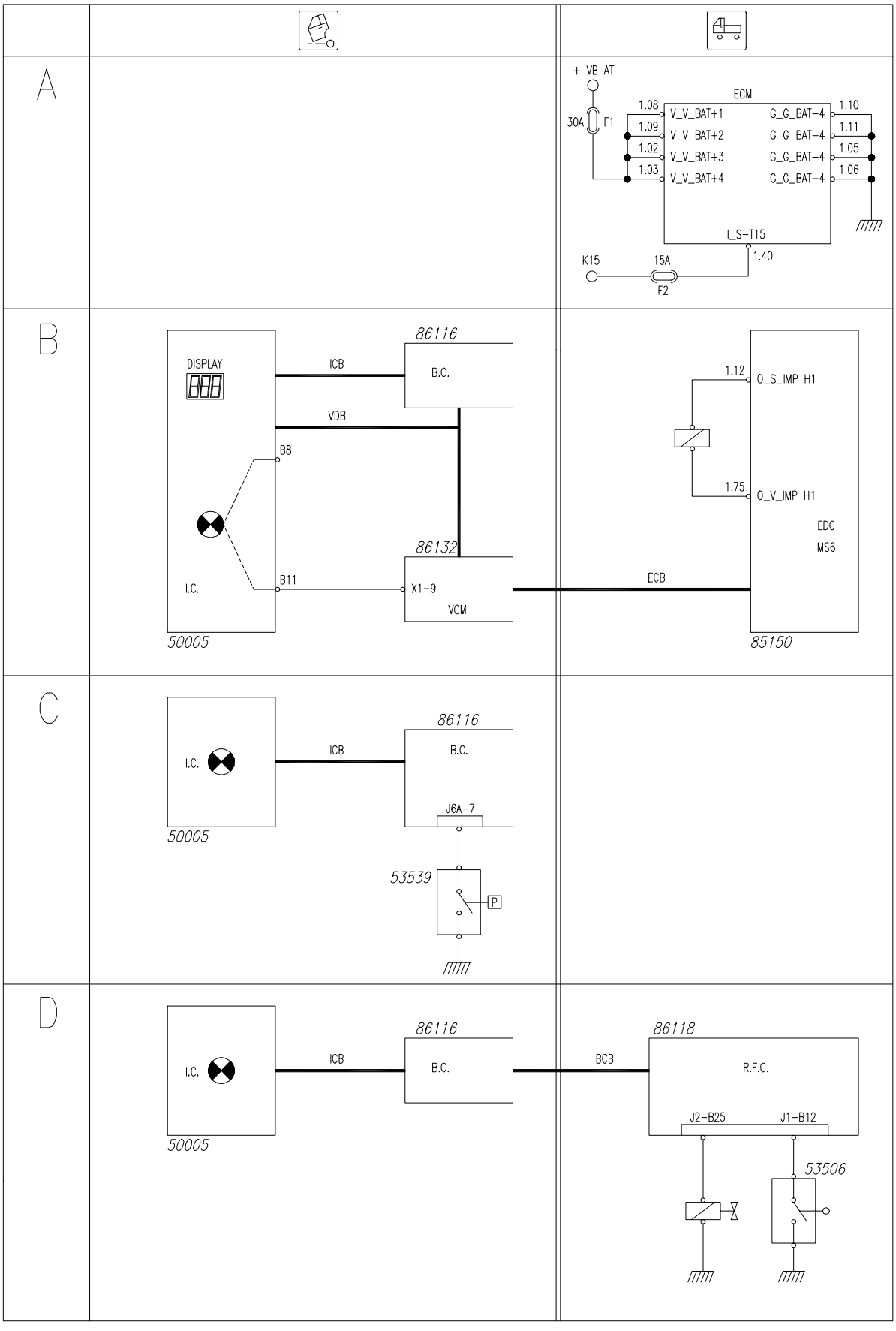
Block diagram

Diagram 1: A. Start-up
B. Engine revs signal for body builders
C. Recharge



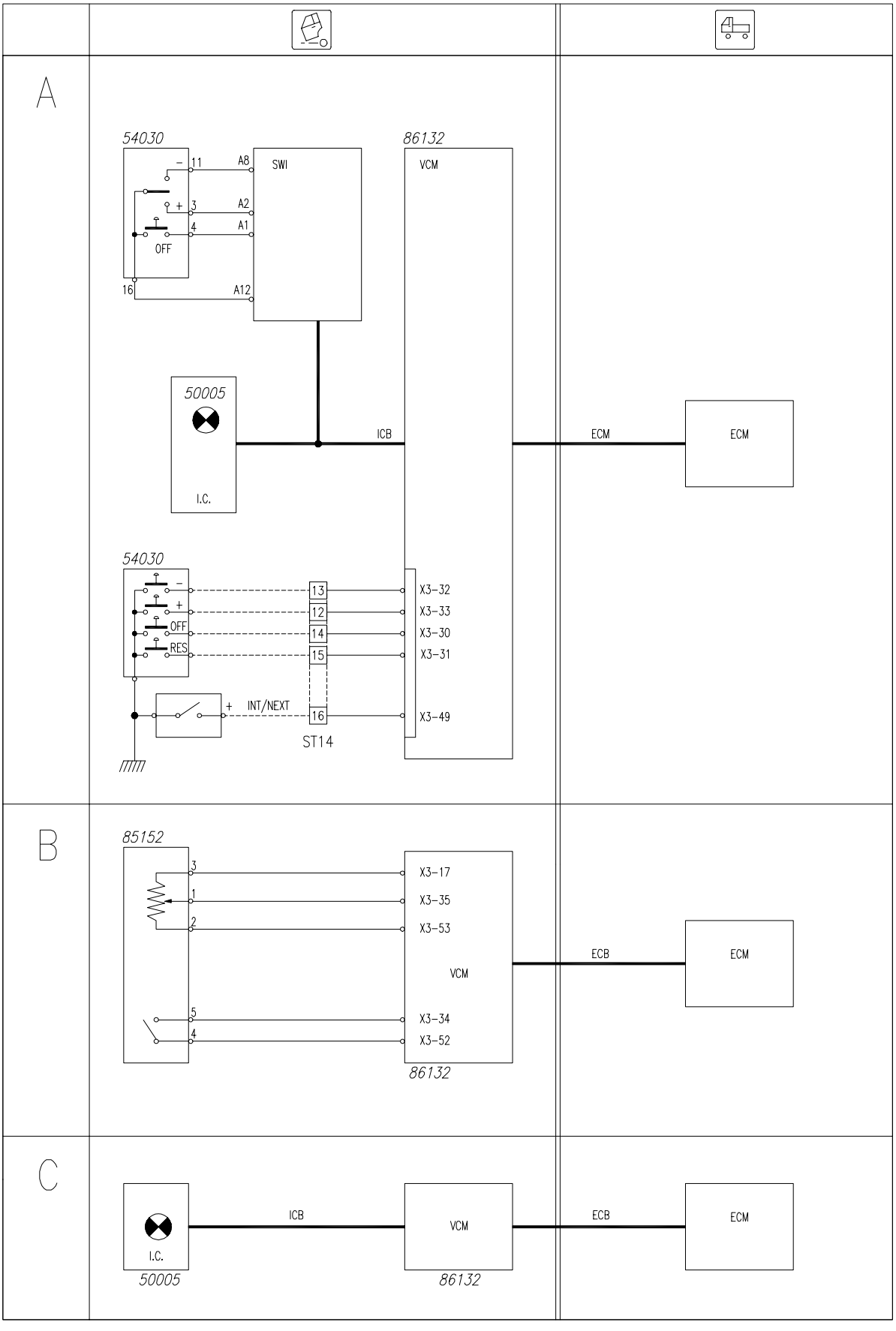
112248

Diagram 2:
A. EDC power supply
B. EDC / VCM failure
C. Snow chains fitted
D. All-wheel drive ON



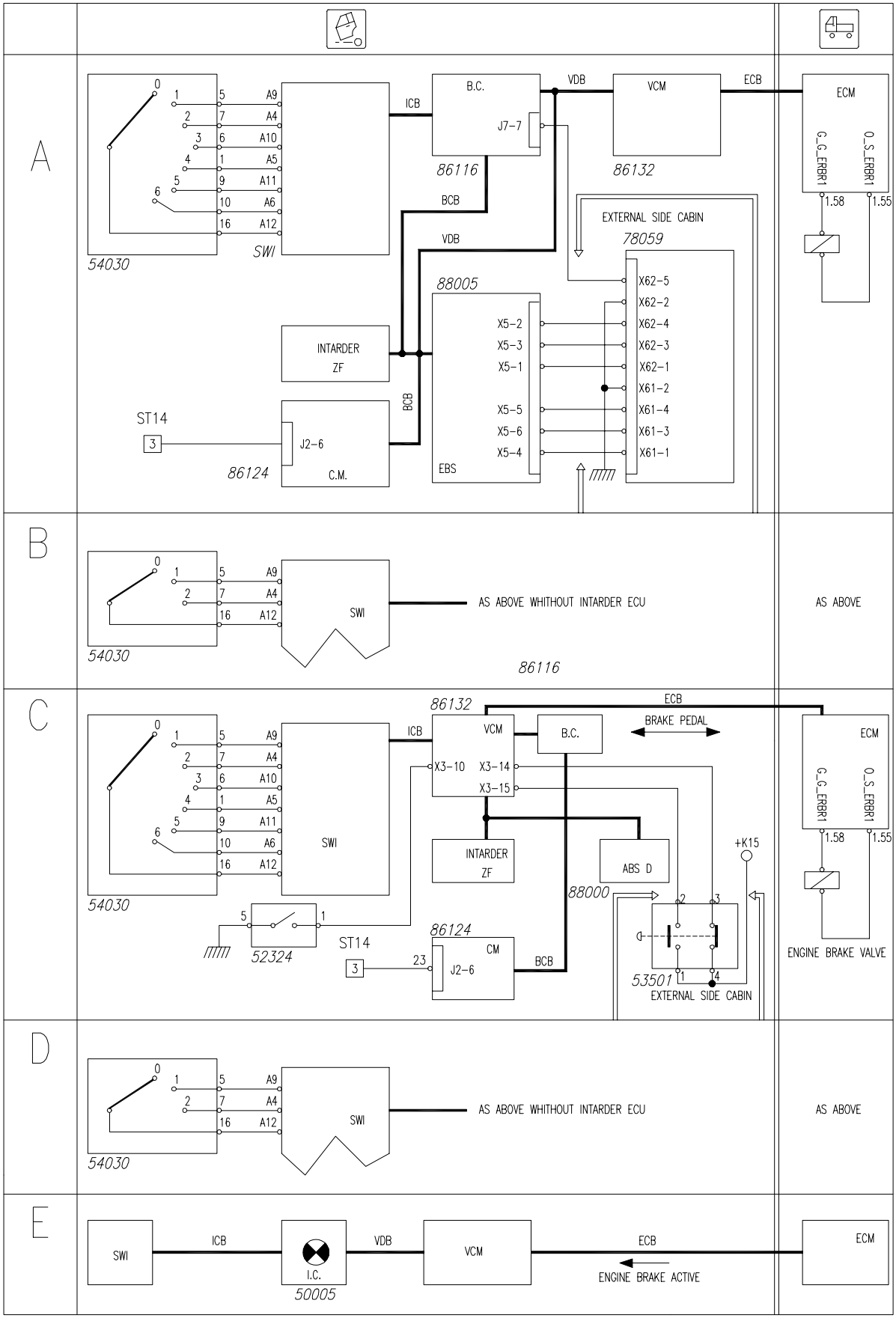
112249

Diagram 3: A. Cruise Control
B. Accelerator pedal sensor
C. Preheating



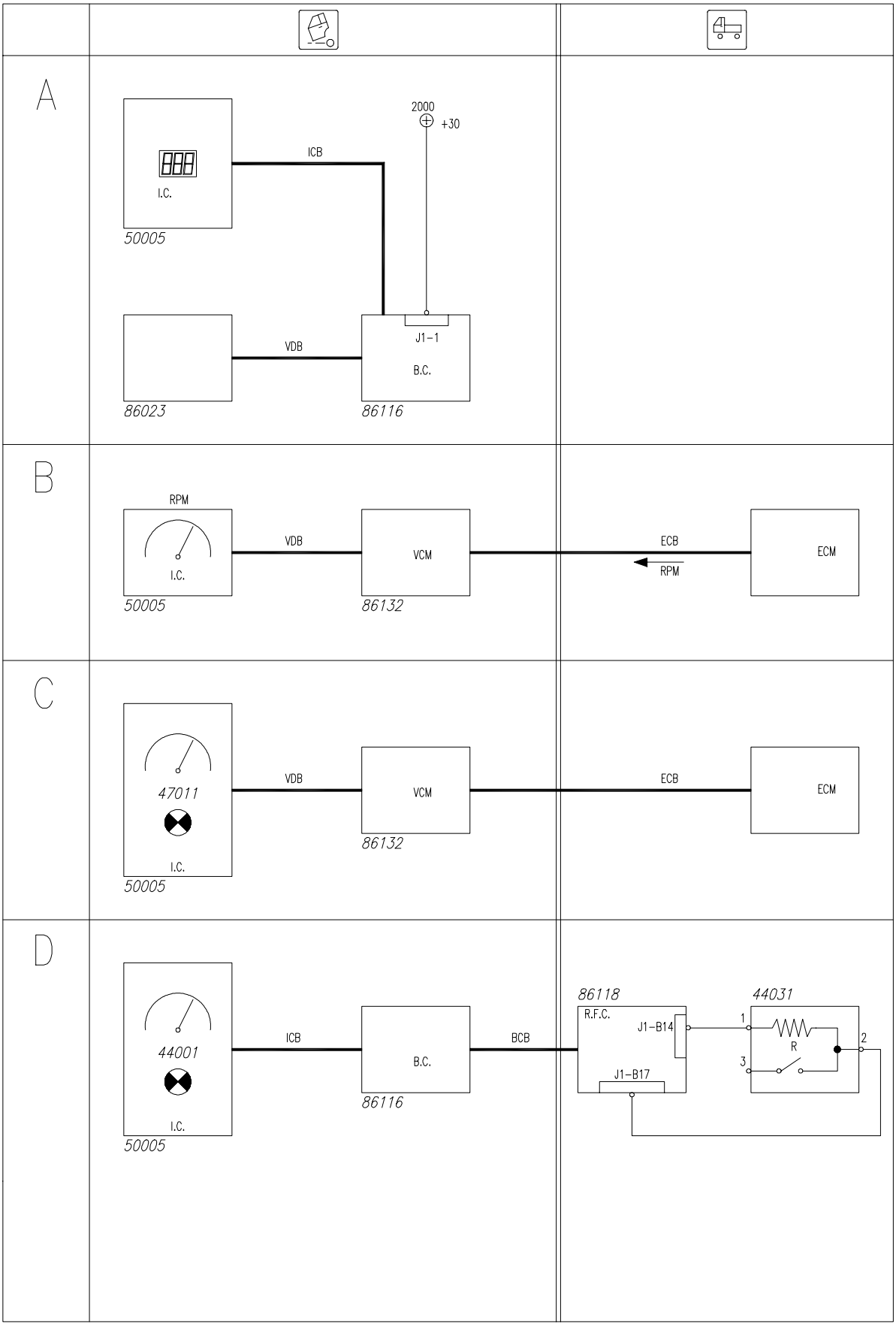
112250

Diagram 4: ABS/EBS



112251

Diagram 5:
A. Voltmeter
B. Revs counter
C. Engine water temperature
D. Fuel level



112252

Diagram 6: A. Engine oil level indication
B. Engine oil pressure indication
C. windscreen washer fluid level indication
D. Power steering oil level indication
E. Engine water indication

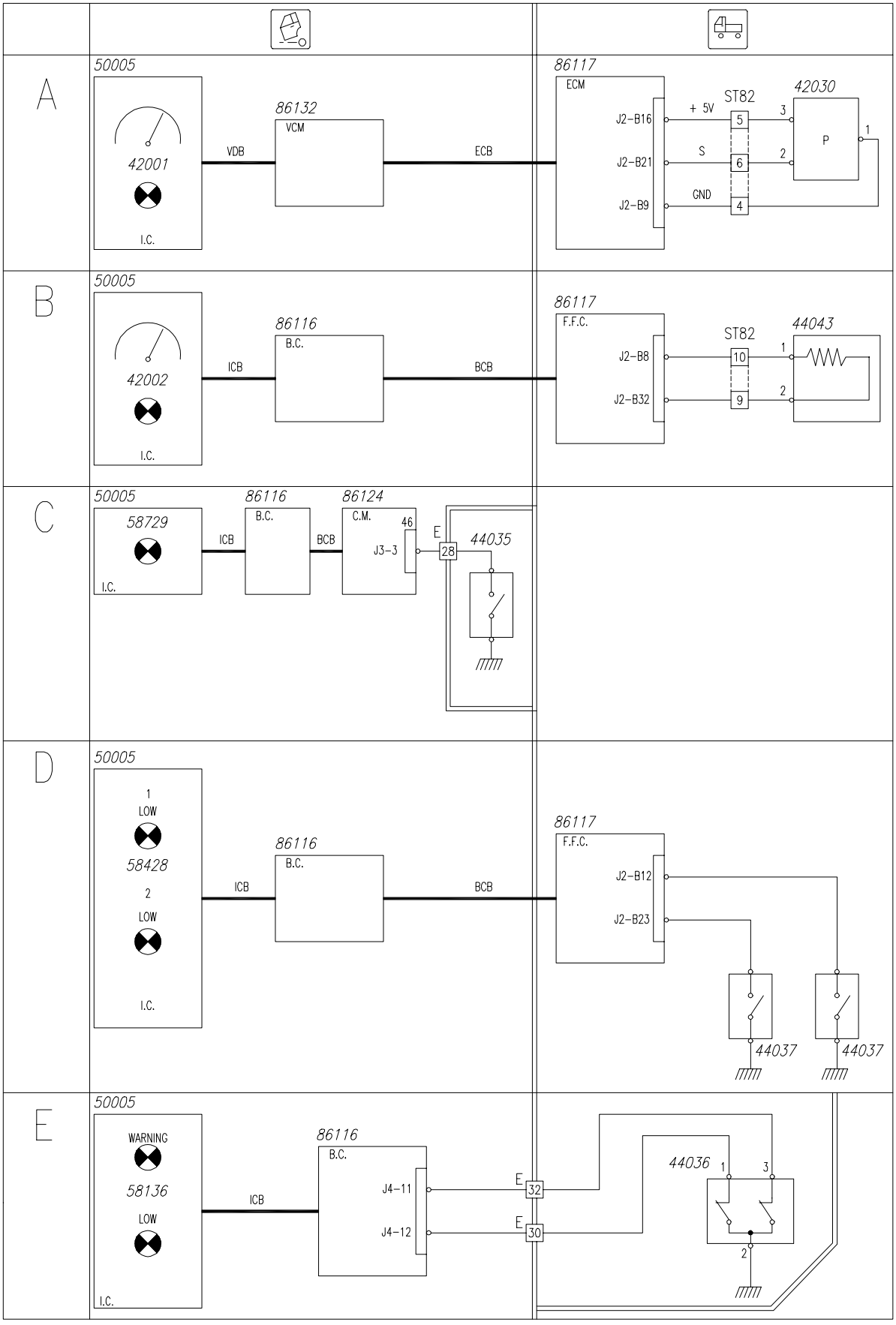
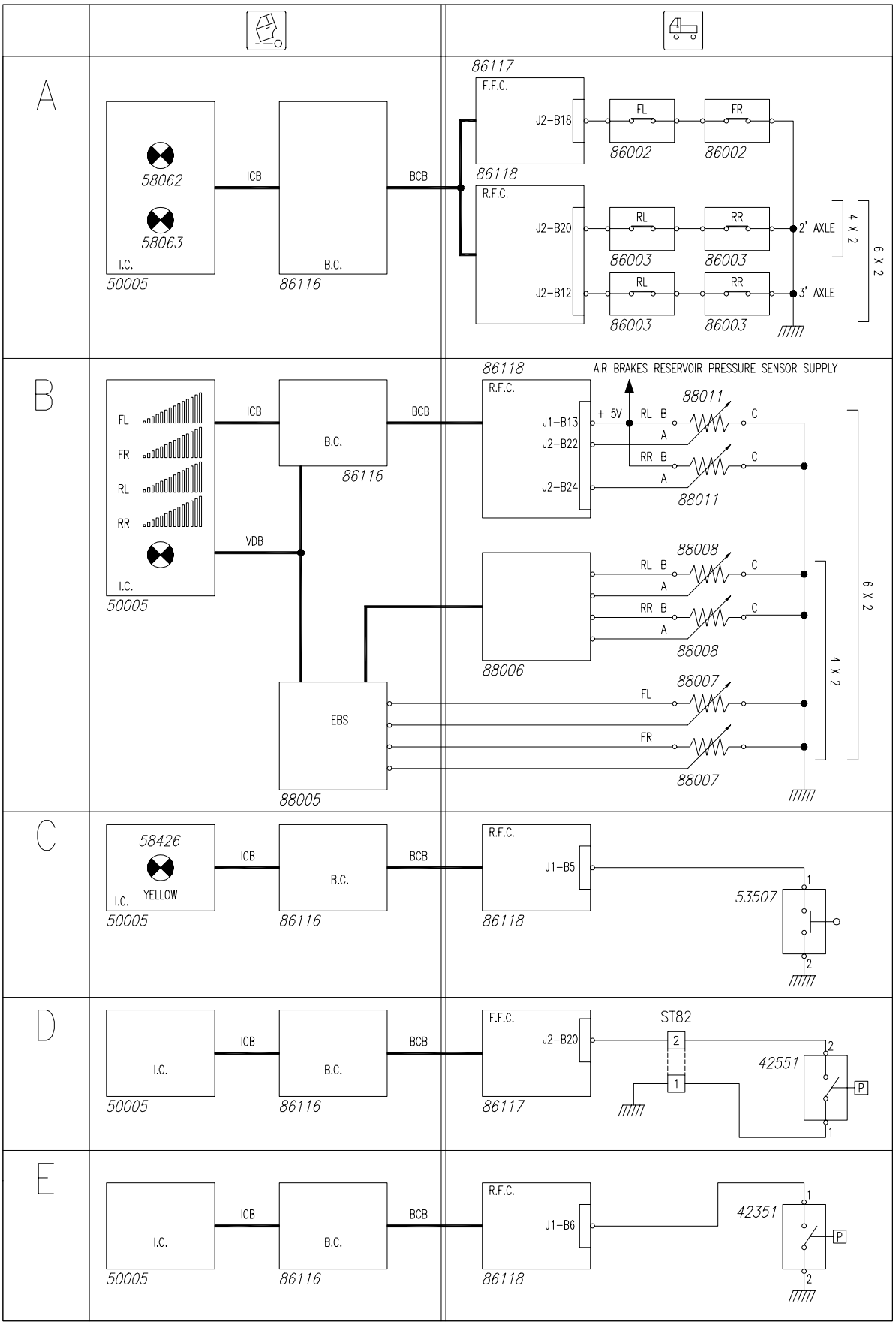


Diagram 7:

A. Brake wear signal (ABS)
B. Brake wear signal (EBS)
C. Geared-down speed ON signal
D. Oil filter clogging signal
E. Air filter clogging signal



112254

Diagram 8:

A. Hand brake ON signal
B. Transverse differential lock (on-road)
C. Transverse differential lock (off-road)
D. Longitudinal differential lock
E. Signalling the presence of water in the diesel fuel filter

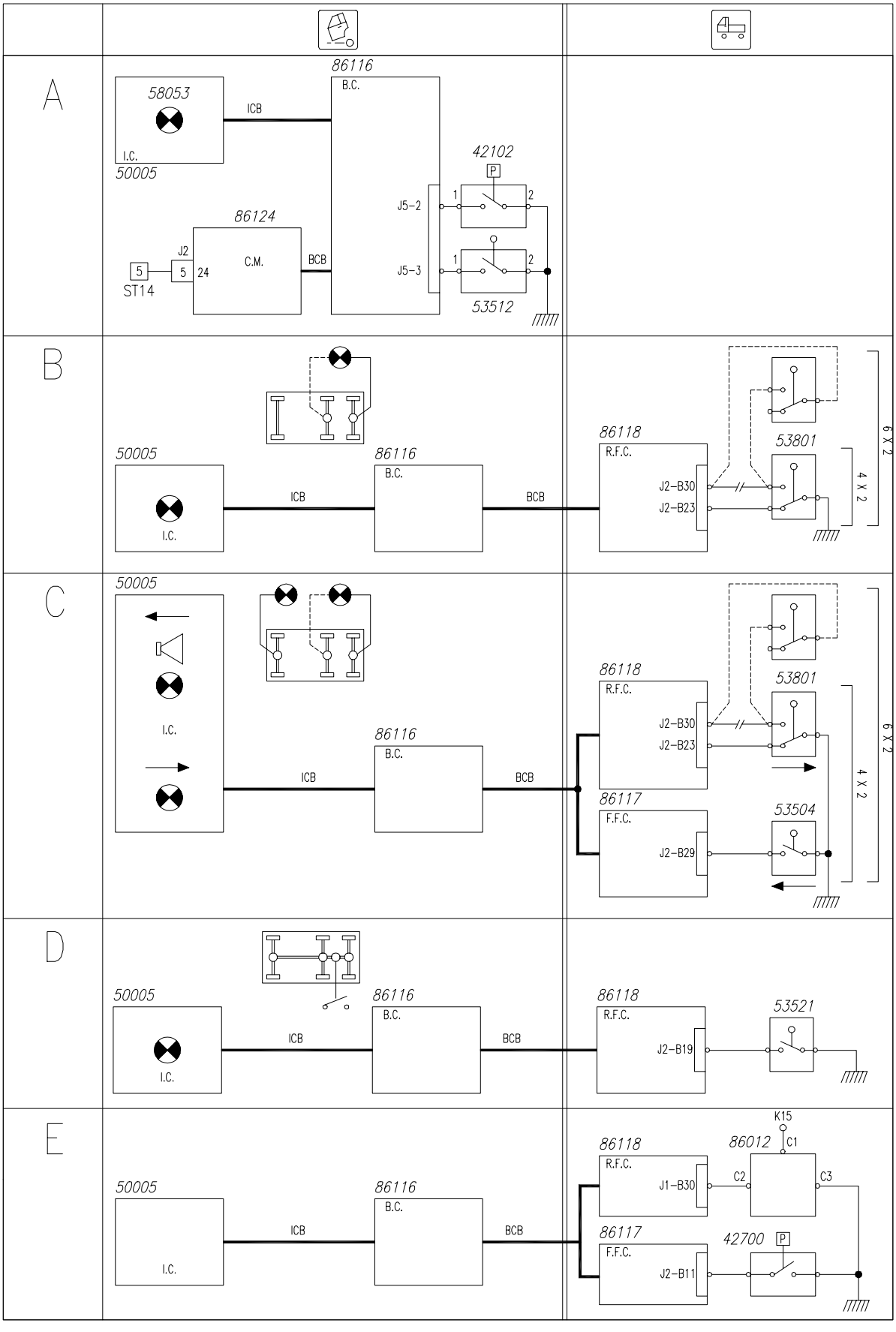
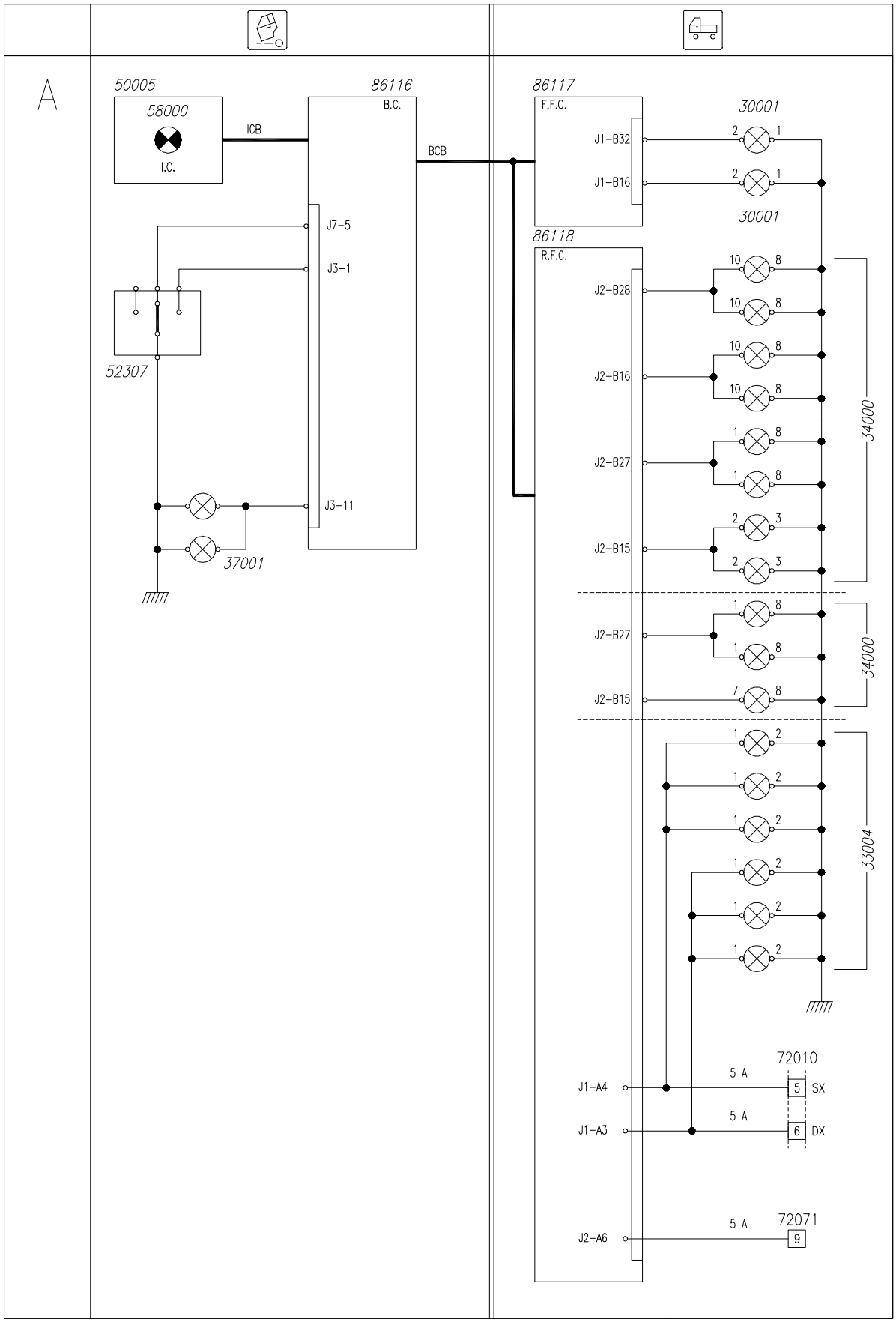
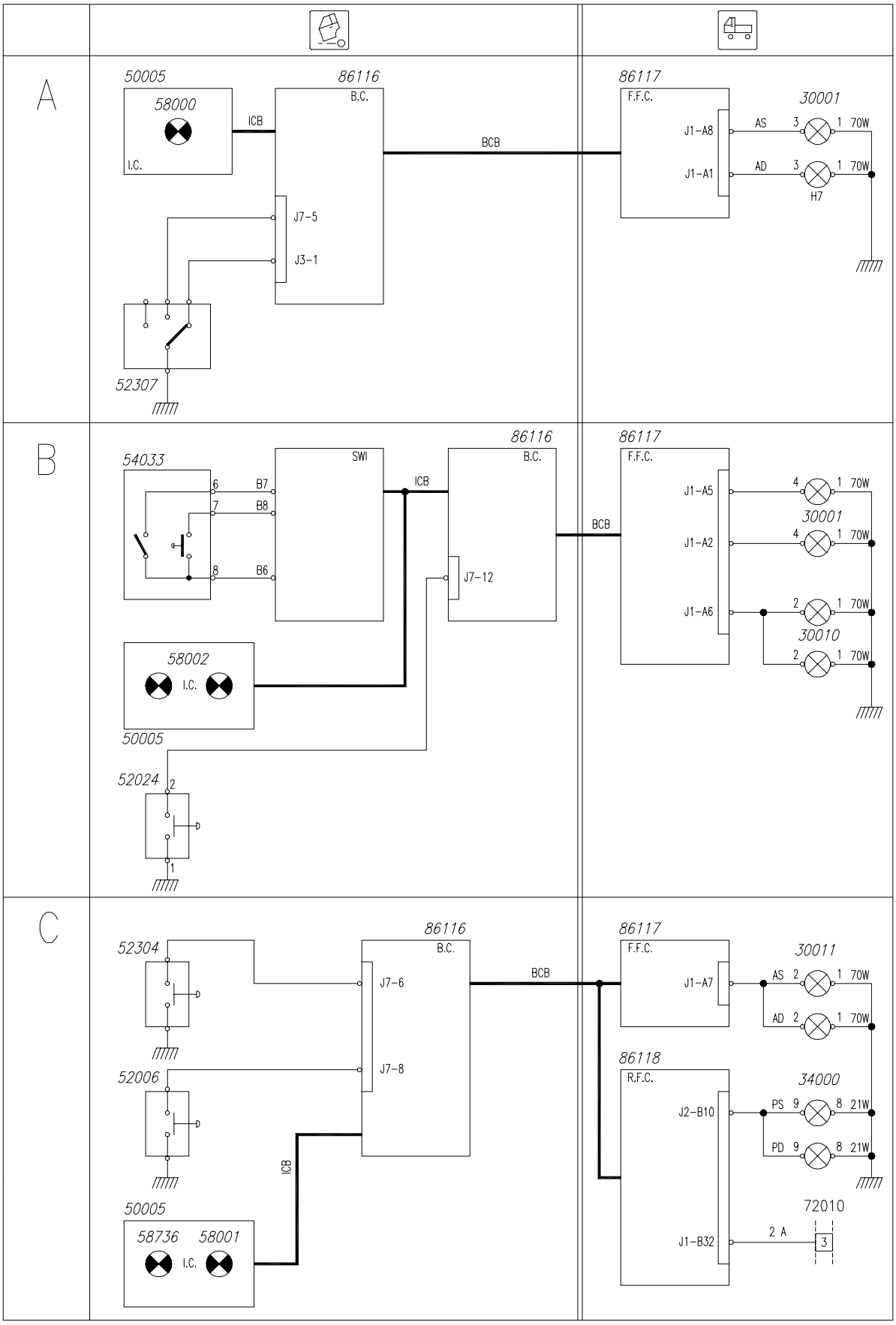


Diagram 9: External lights



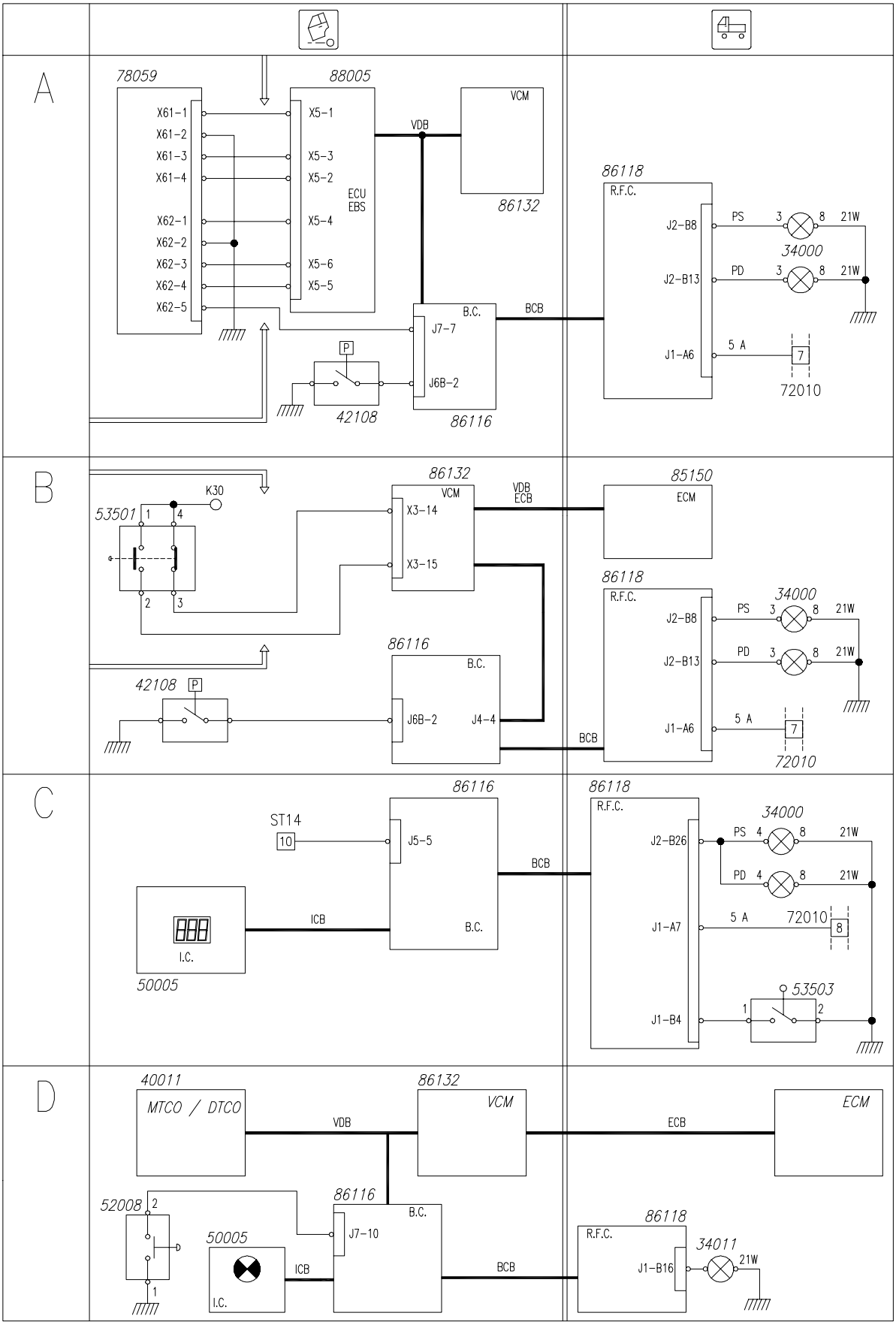
112256

Diagram 10: A. Low-beam headlights
B. High-beam headlights
C. Fog lights/rear fog lights



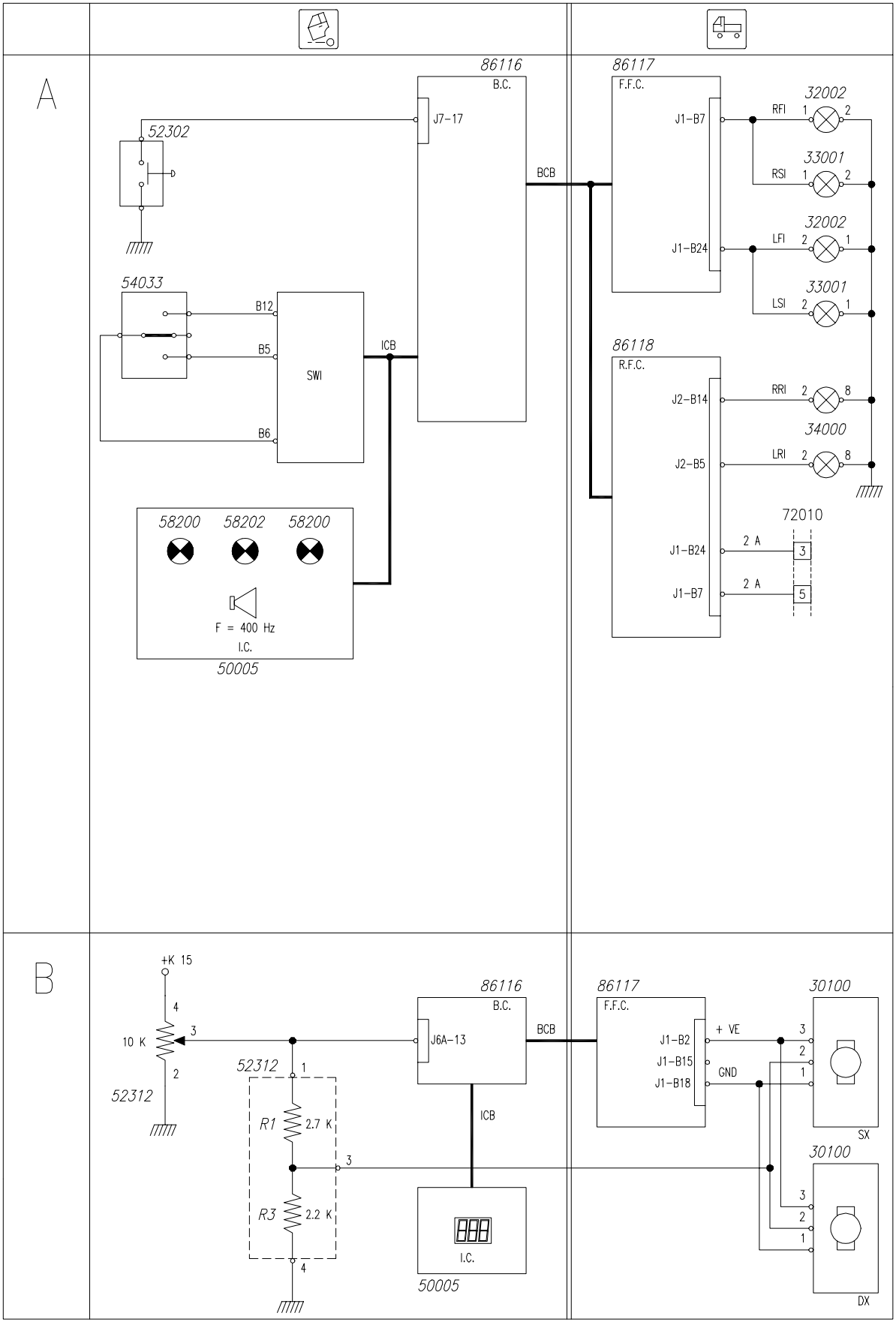
112257

Diagram 11: A. Brake lights
B. Brake lights
C. Reversing lights
D. Fifth wheel lighting



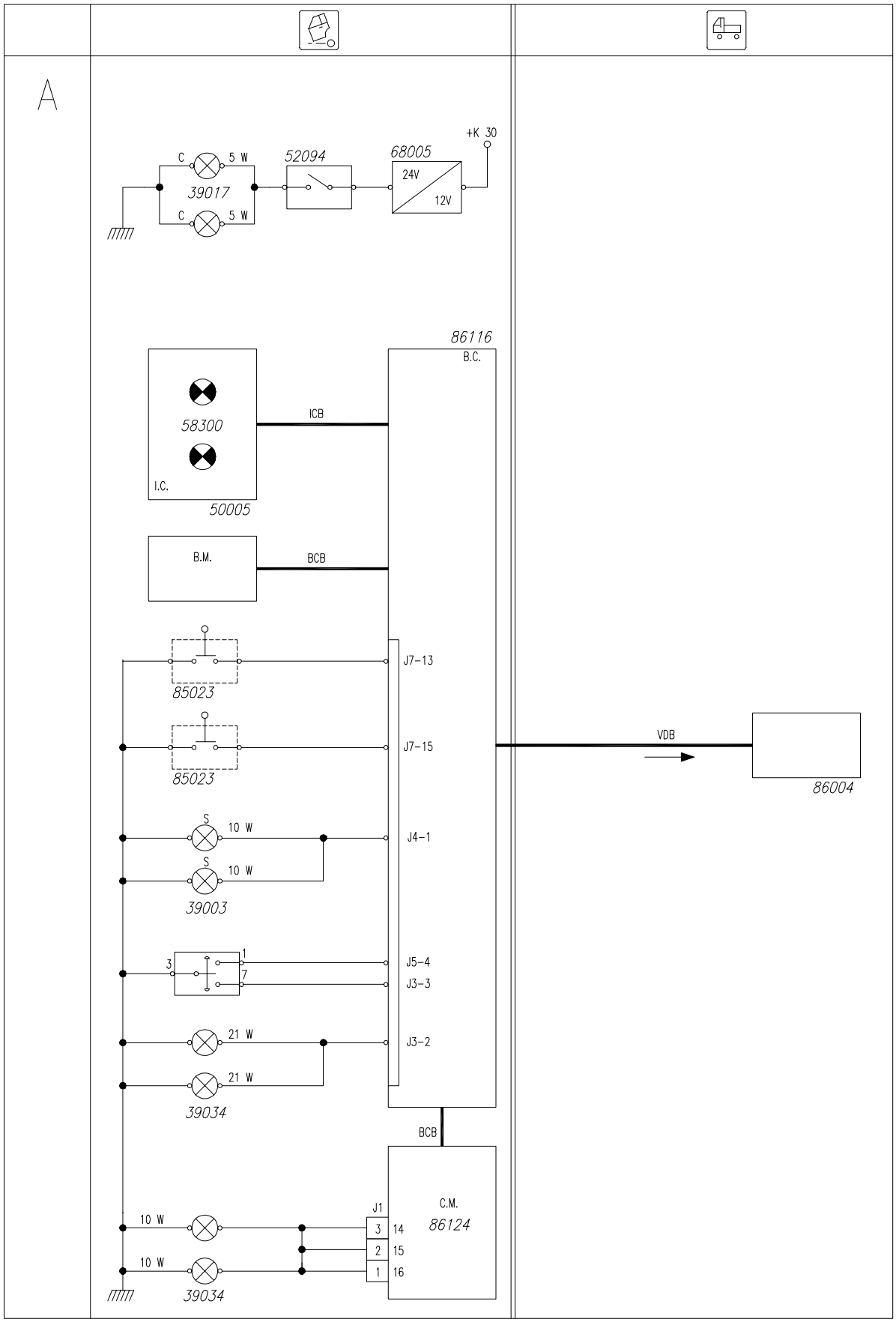
112258

Diagram 12: A. Indicator/emergency lights
B. Headlamp adjustment



112259

Diagram 13: Internal lights



112260

Diagram 14: A. Windscreen wiper
B. Horn
C. Counter

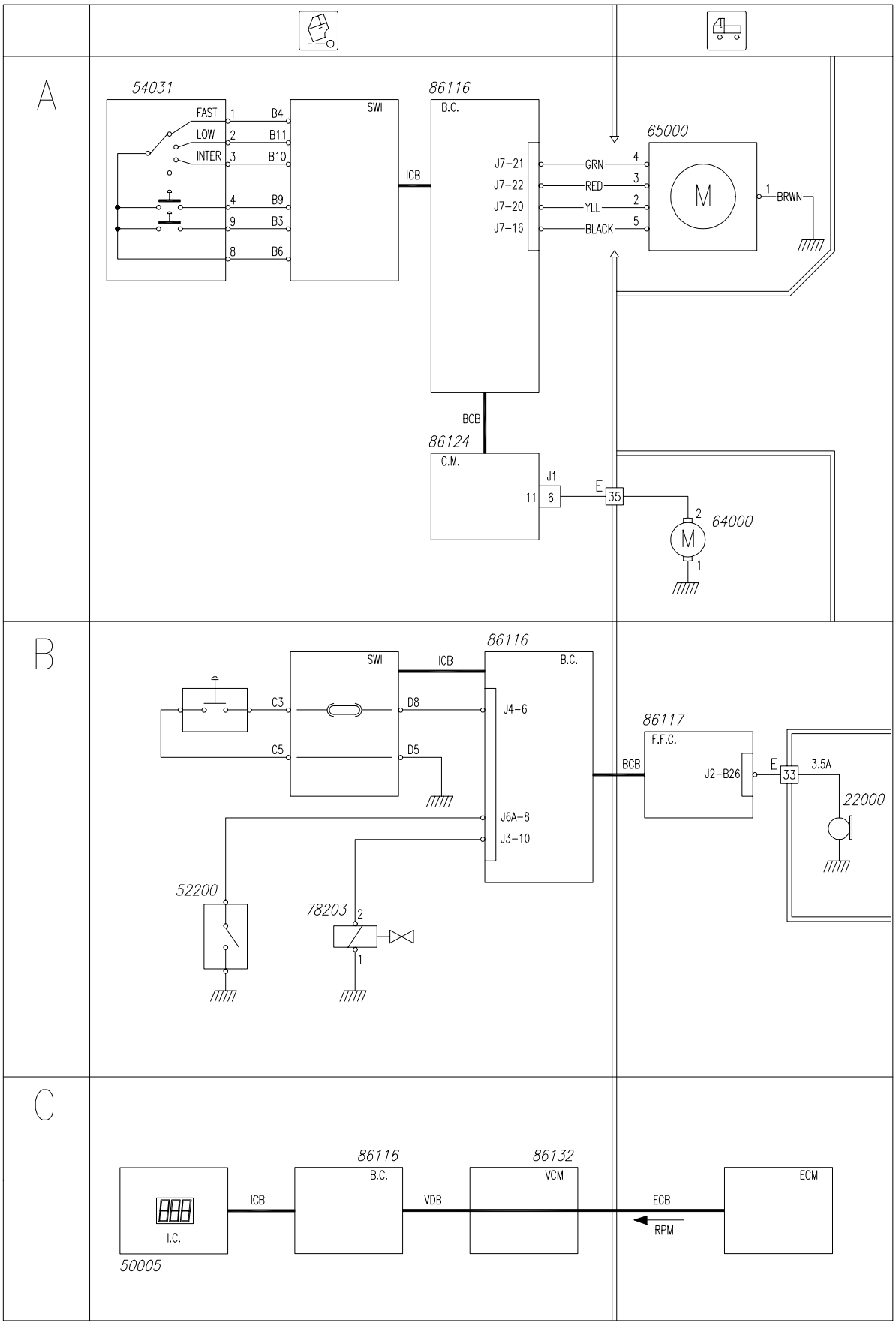


Diagram 15: TGC

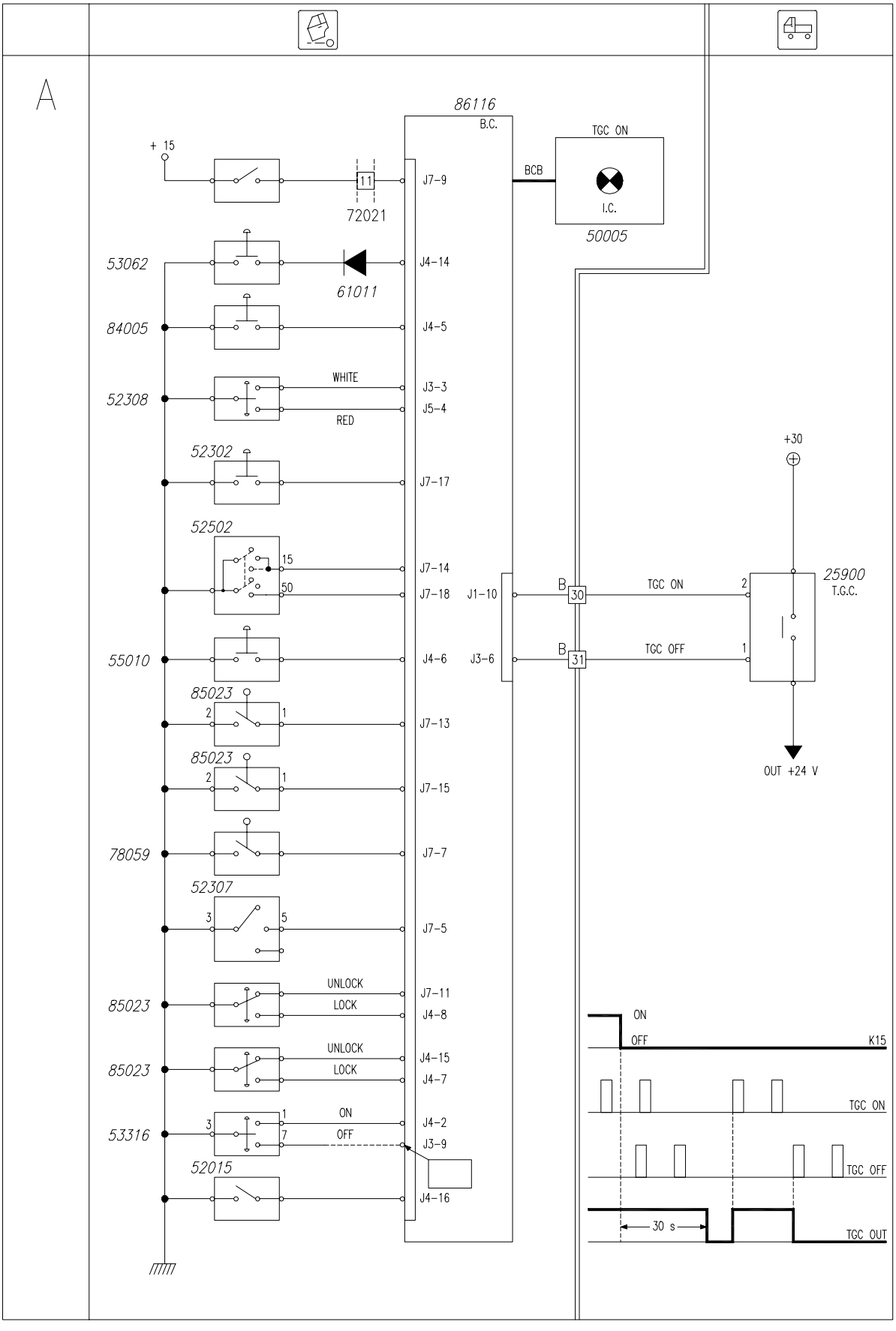
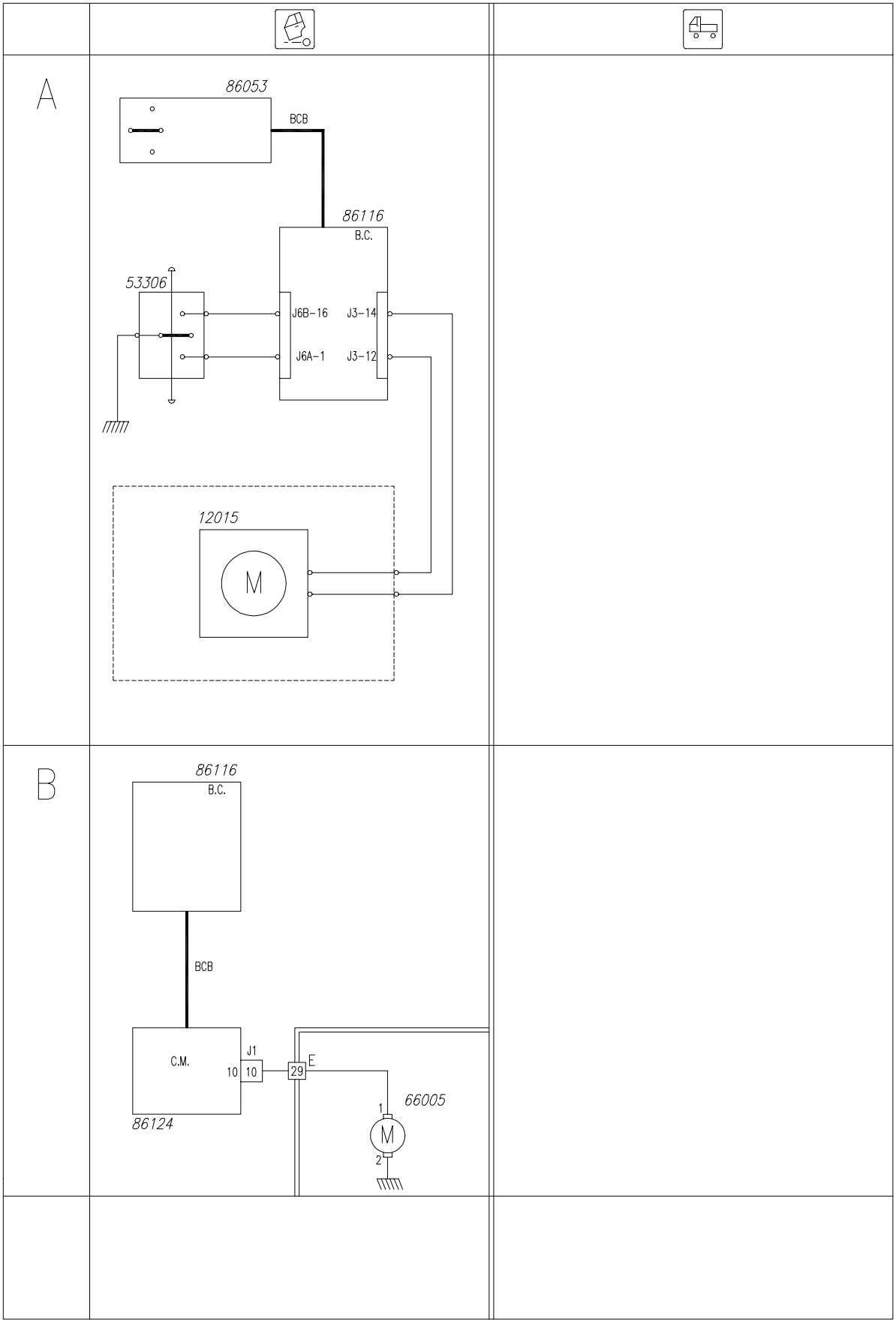
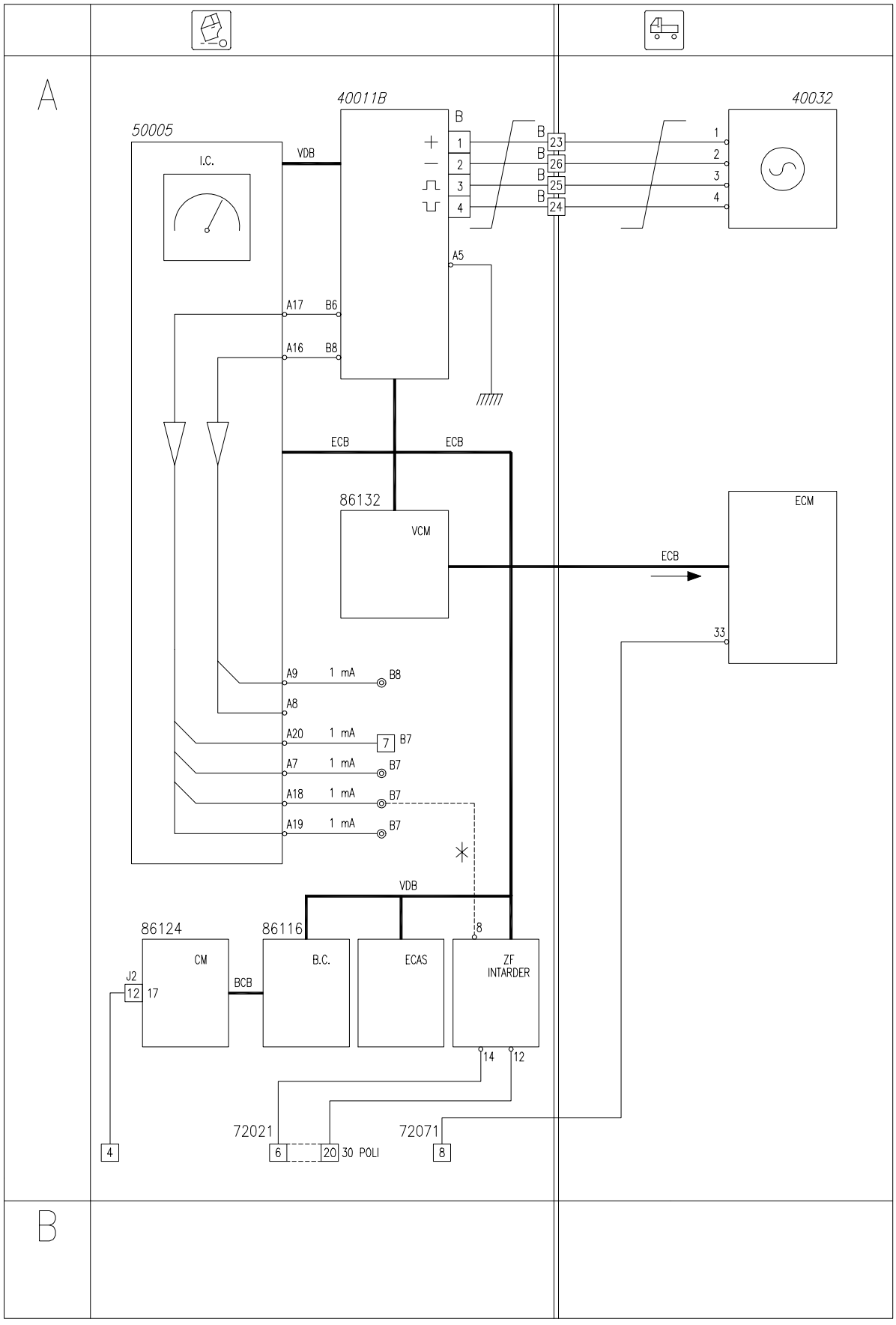


Diagram 16: A. Sunroof
B. Headlamp washer



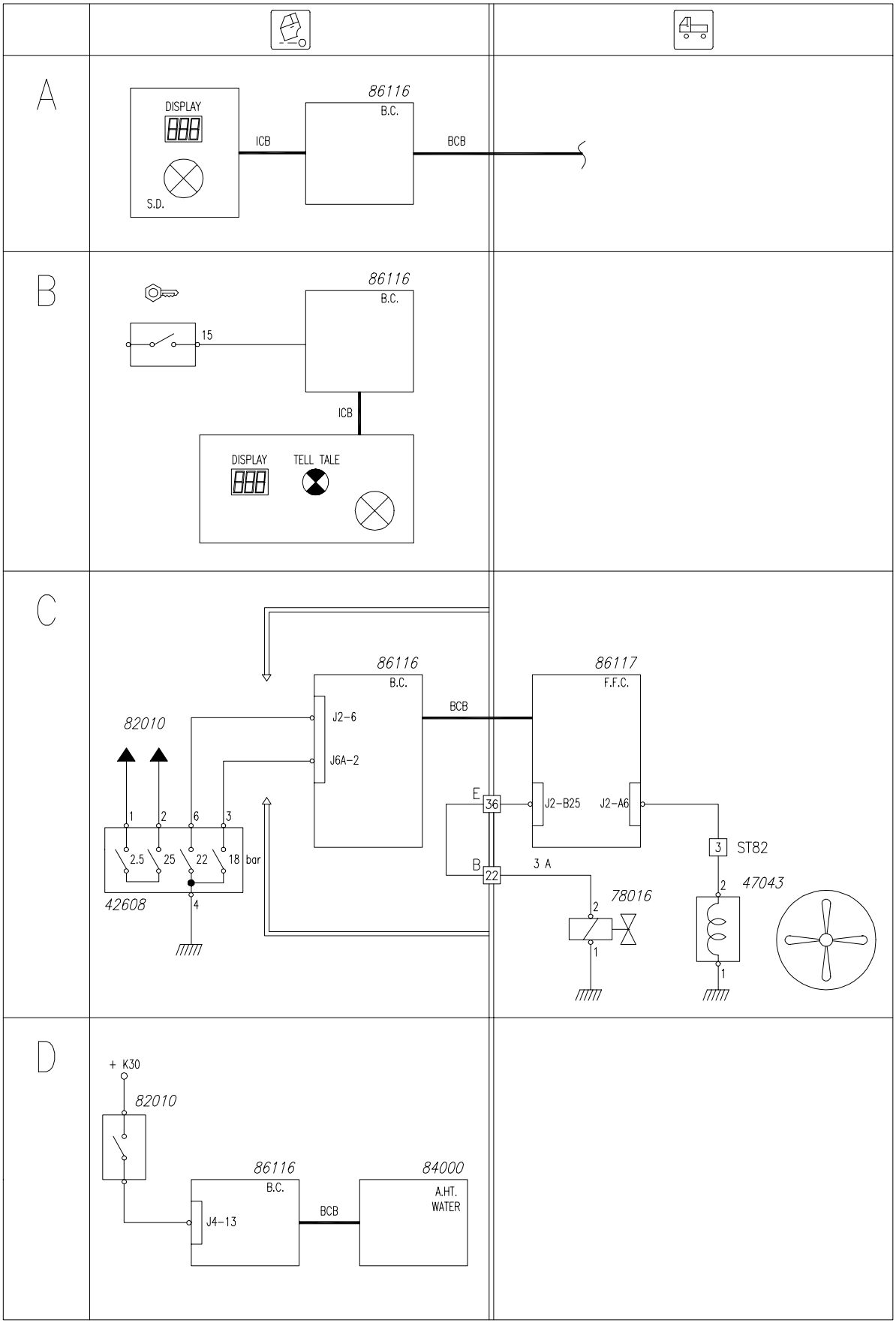
112263

Diagram 17: Tachograph



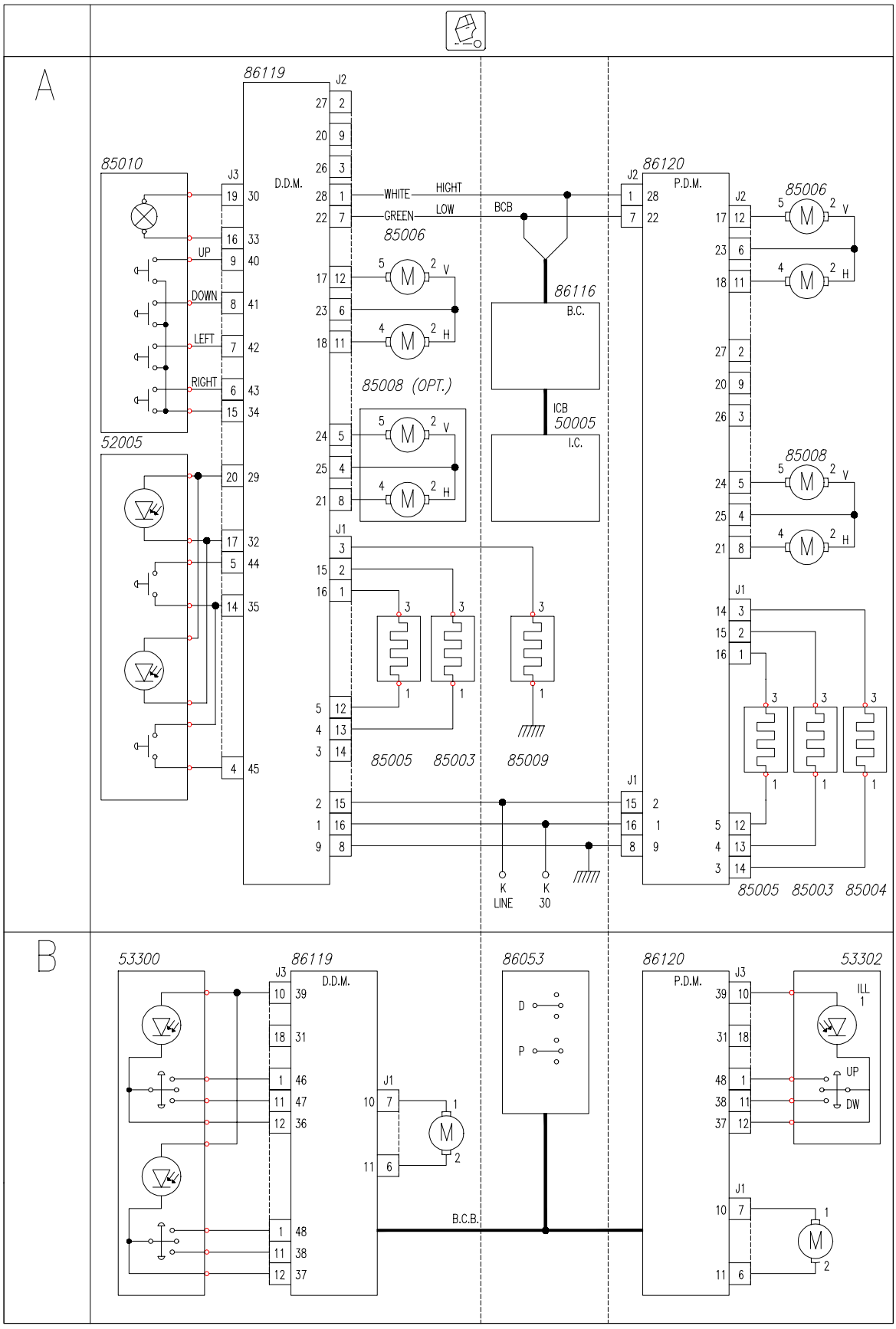
112264

Diagram 18: A. Diagnosis
B. Diagnosis (optical indicators)
C. Engine fan control
D. Manual air conditioner control



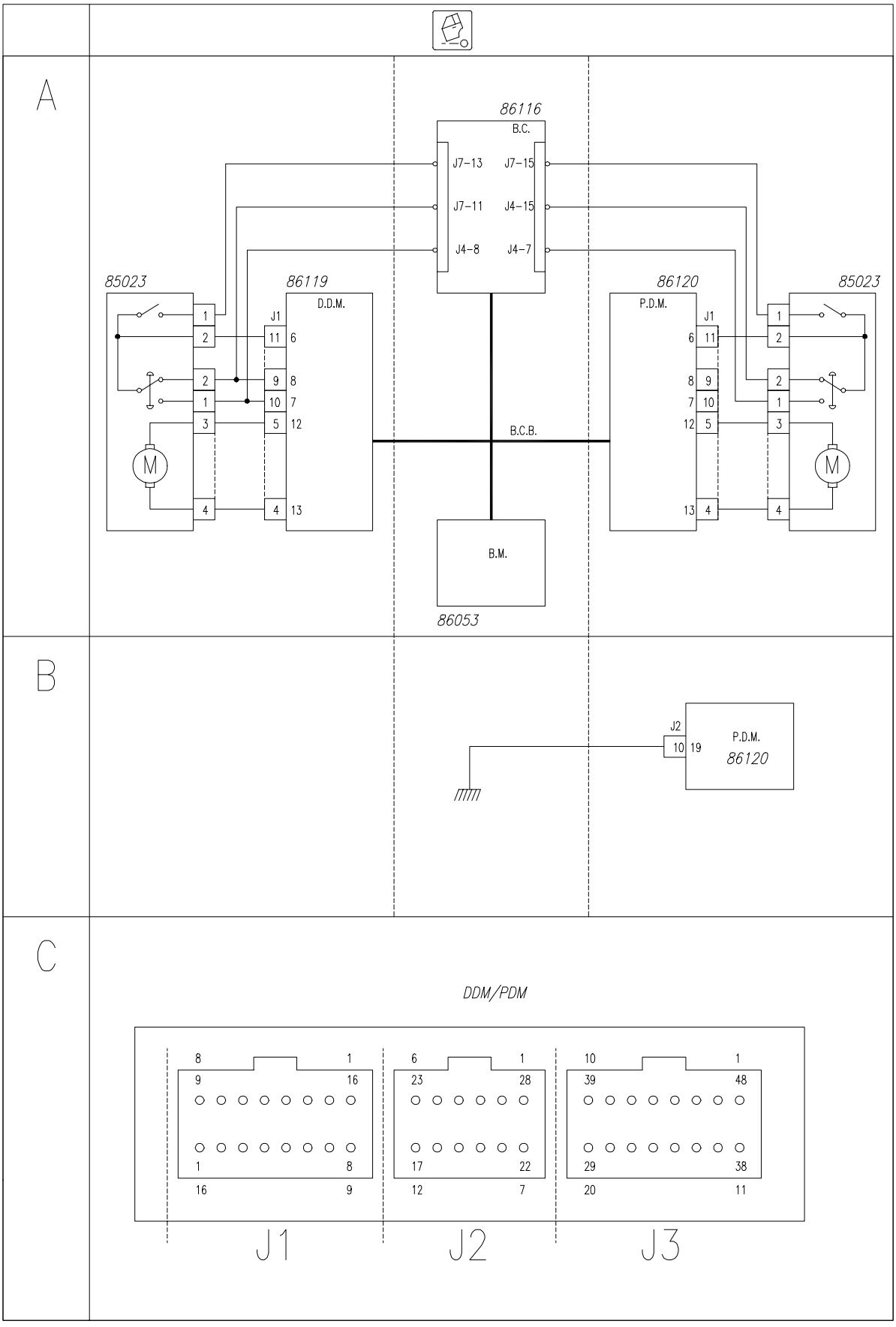
112265

Diagram 19: A. Rear-view mirror control
B. Window regulator control



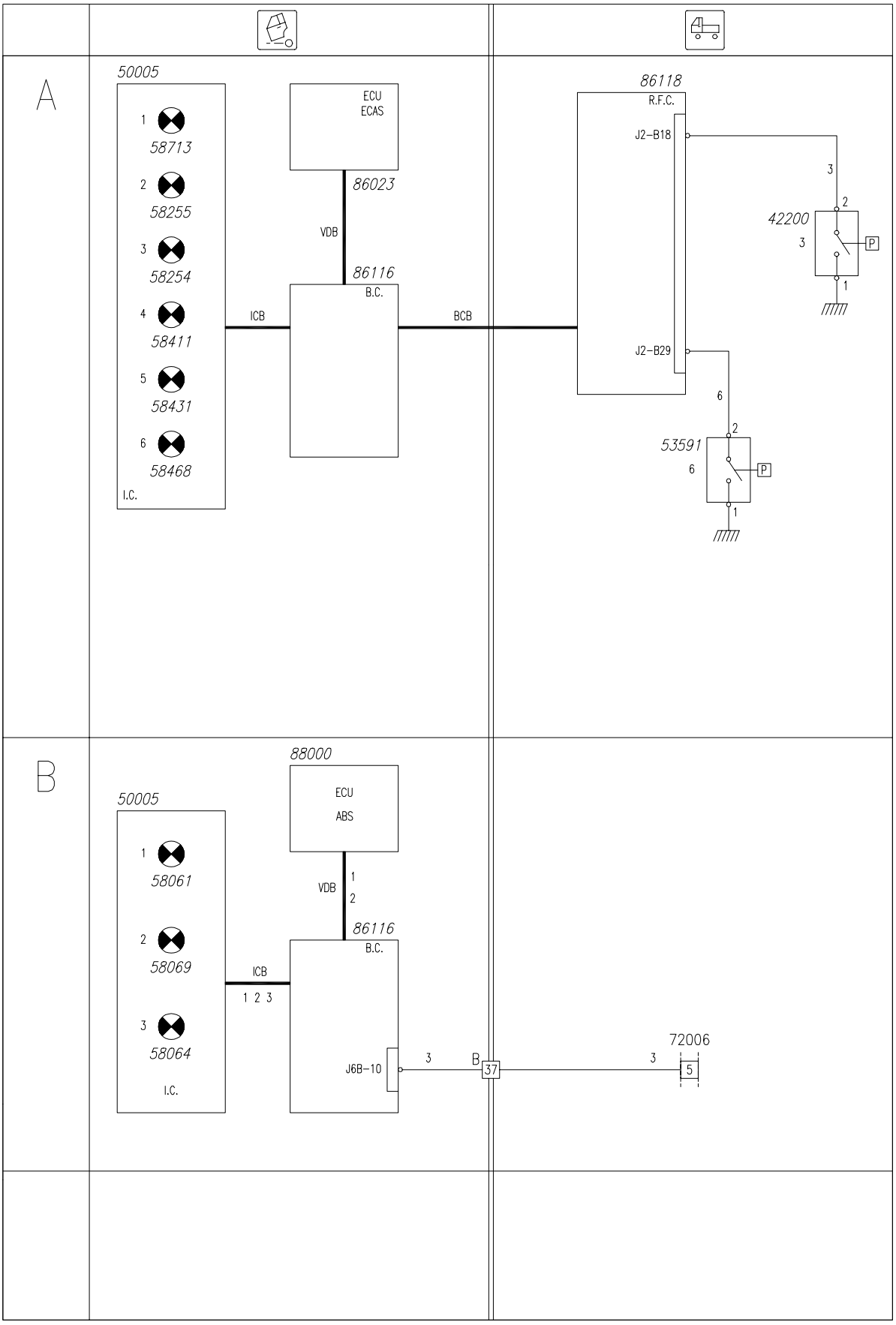
113242

Diagram 20: A. Central locking control



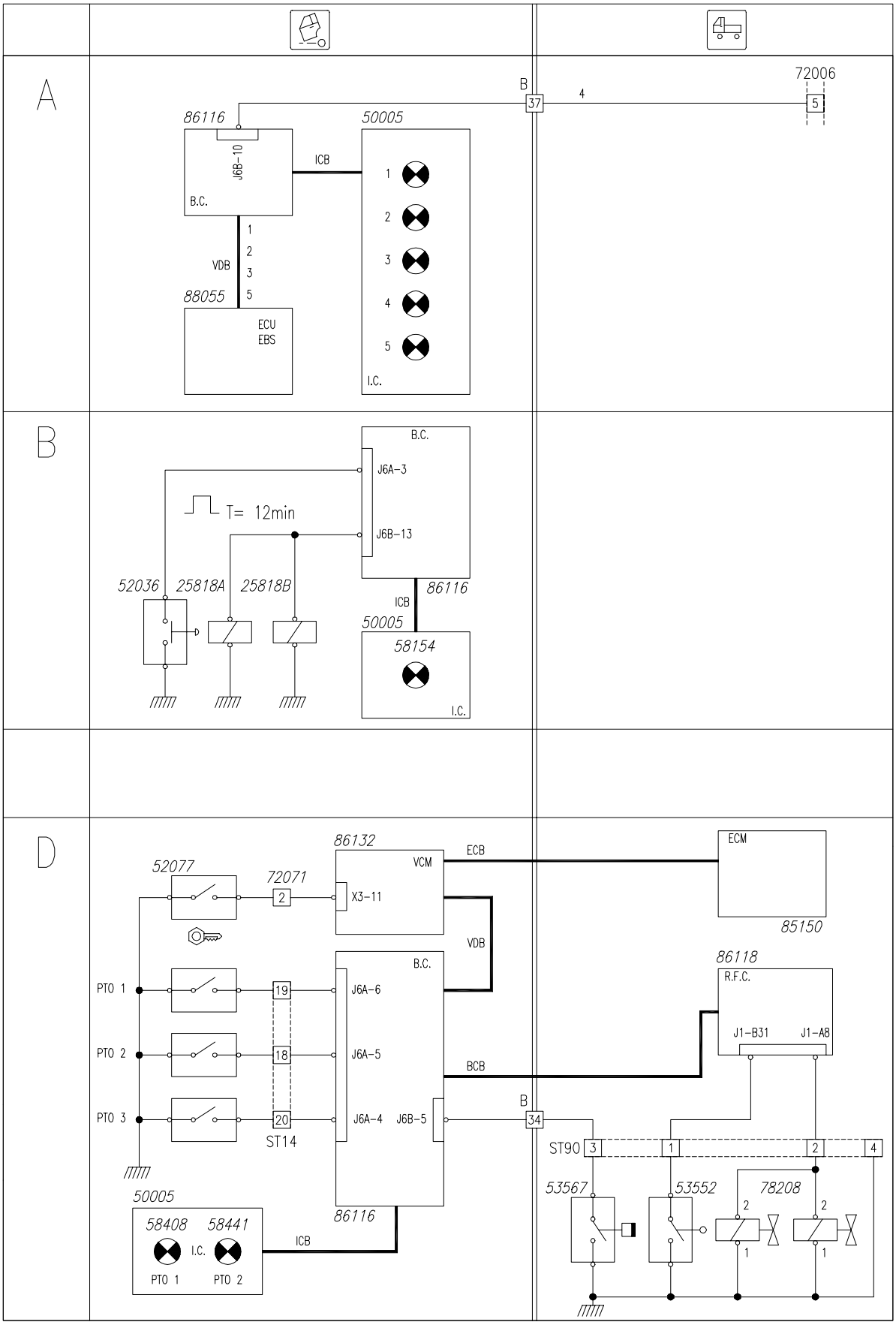
112267

Diagram 21: A. ECAS (optical indicators)
B. ABS (optical indicators)



112268

Diagram 22: A. EBS (optical indicators)
B. Heated windscreen
C. P.T.O.



112269

Diagram 23: A. Decelerator (optical indicator)
B. Diesel fuel filter clogged
C. Cabin tilting

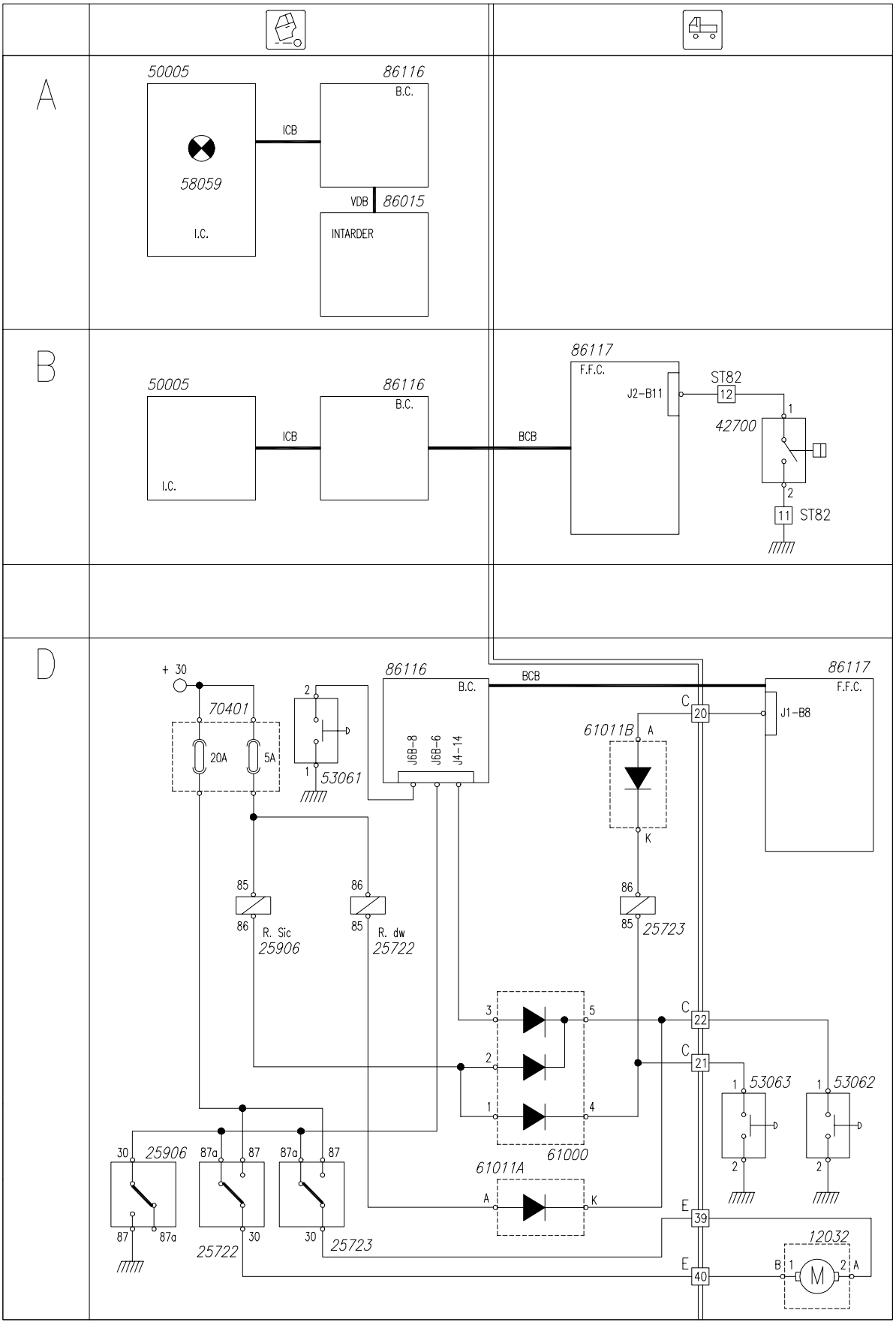


Diagram 24: A. Brake air pressure indication
B. Front/rear axle load indication
C. External temperature indication

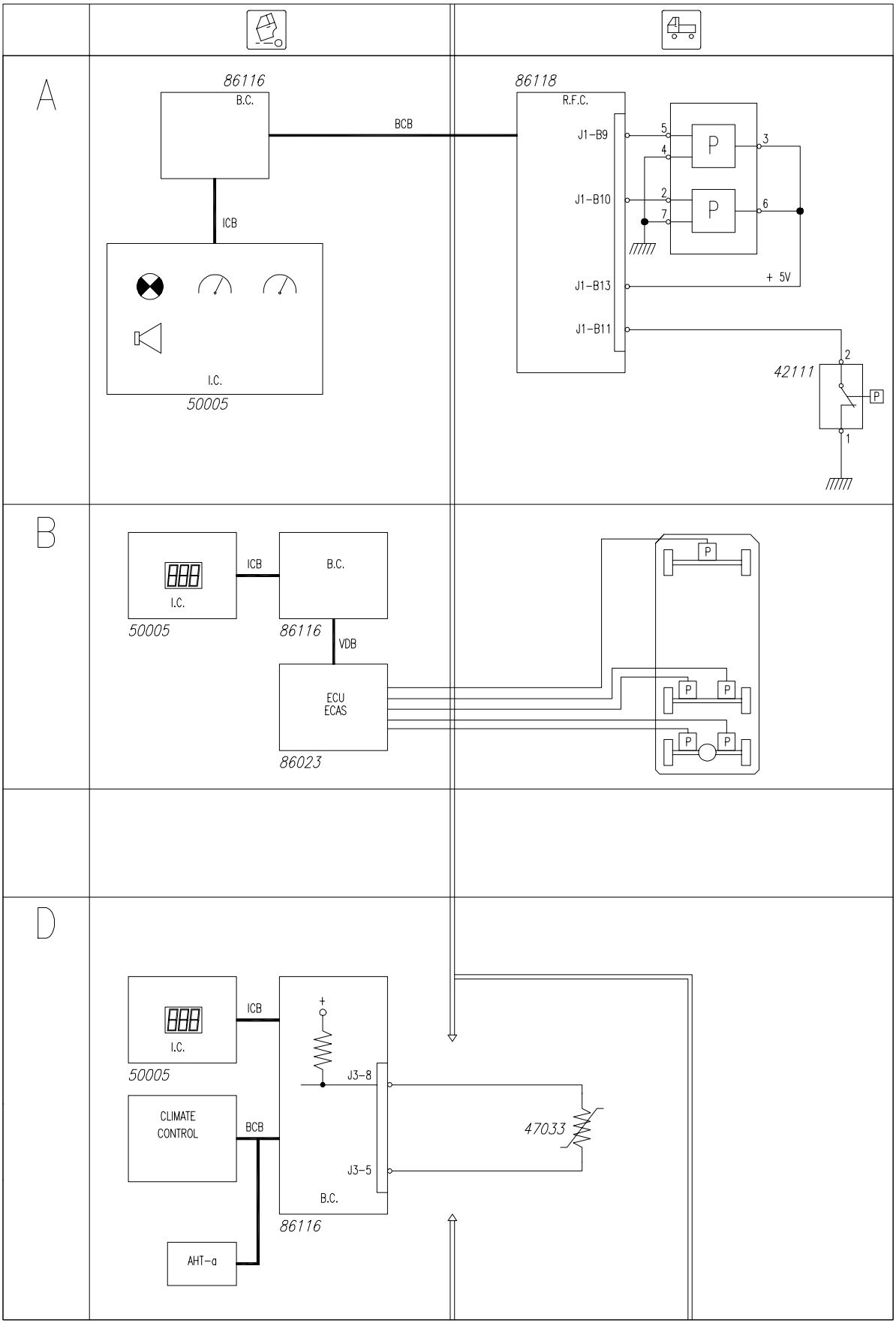


Diagram 25: A. Full/partial km displaying
B. Gear engaged displaying
C. Speed limiter
D. Clutch switch signal

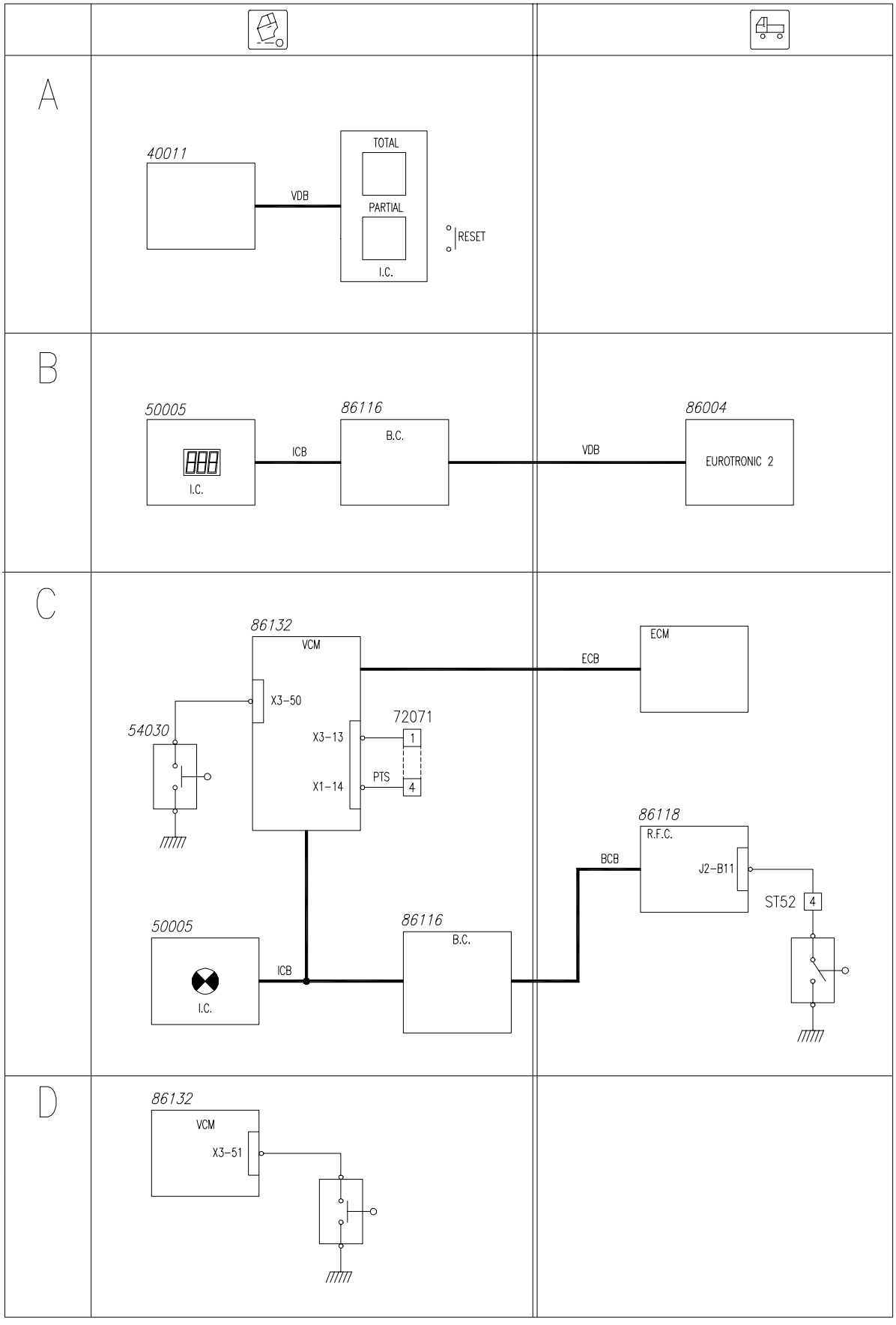
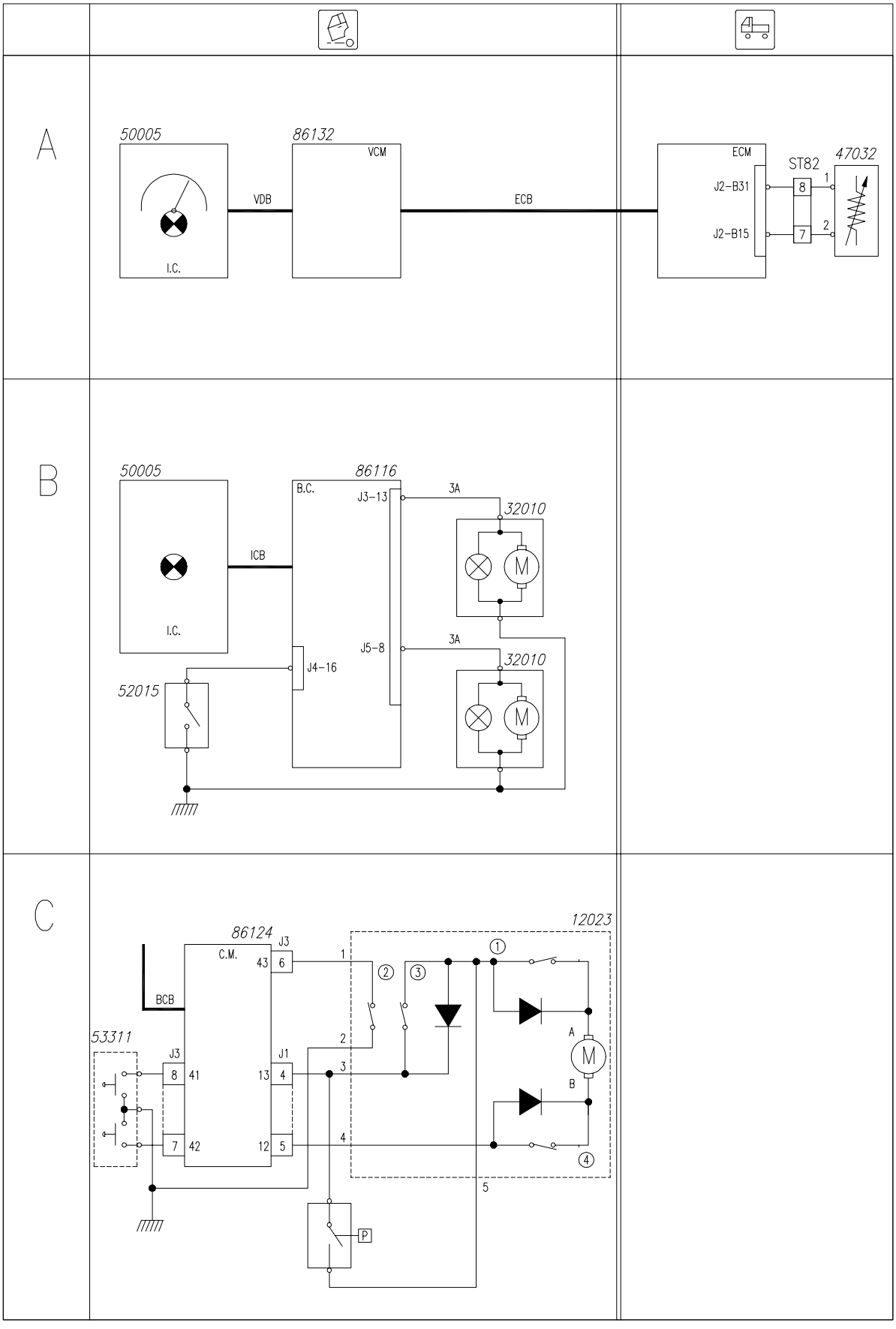


Diagram 26: A. Engine oil temperature signal
B. Rotary lamp control
C. Sun visor control



112273