



Technical Handbook

ContChamp DRD S

This Handbook deals with the design and maintenance of Kalmar machines, type DRD-S for the handling of containers.

In addition, it gives details of troubleshooting and the most common corrective maintenance.

Operation and other matters that are primarily of interest to the operator are included in the Instruction Manual.

Kalmar Industries AB

This handbook applies to machines from and including machine number T34107.0784 as well as T34107.0621 and T34107.0769, see next page.

We reserve the right to modify our design and material specifications without prior notice.

00	General
10	Chassis and cab
20	Electrical system
30	Engine
40	Transmission, drive axle, brakes
50	
60	Steering axle
70	Hydraulic system
80	Boom and attachment
90	Periodic supervision

This Handbook applies to machines from and including machine number T34107.0784 as well as T34107.0621 and T34107.0769

These machines are of a new design that entails the following differences from older machines. The changes do not apply to machines with combi-attachments or top-lift with pileslope.

1. The electrical system is equipped with a separate KDU for the top-lift, component number 791. The KDU communicates with ECU 2 via a CAN bus.
2. The main valve of the top-lift is fed by a variable hydraulic pump.
The main valve is common for all of the top-lift's functions.
3. The length adjustment of the top-lift is manoeuvred by means of a hydraulic motor and chain.
4. The top-lift rotation brake is manoeuvred completely hydraulically.

Contents

Group 00

Safety regulations	2
General	6
Design – Overview	6
Component units	7
Supplementary books	9
Replacement system – Spare parts	9
Tools	9
Tightening torques.....	10
System of units	12




It is important that you read the instruction manual.

Incorrect handling can lead to personal injury or damage to products and/or property. Therefore, read the instruction book very carefully before operating the truck. The instruction manual contains important information about your Kalmar truck, about the operation of the truck, about safety during operation and about the truck's daily maintenance. In addition, you will find useful information that will make operations easier for you in your daily work.

The instruction manual must always be kept in the machine. If the manual should be lost, a replacement must be immediately obtained. Never use a machine with a missing instruction manual.

Ask your foreman/group leader if there is anything in the manual that you do not understand or if you feel that information is missing in any area.



The symbol  is used on our products in certain cases and then refers to important information contained in the instruction manual. Make sure that warning and information symbols are always clearly visible and legible. Replace symbols that have been damaged or painted over.

In this instruction manual warnings are inserted that apply to your own safety. Warnings point out the risk of accident that can cause personal injury.



WARNING!

Warns of the risk of serious personal injury, possible death and/or serious damage to product or property if the regulations are not followed.

For technical warnings, that point out the risk of breakdown, the word IMPORTANT is used:

IMPORTANT!

Is used to draw attention to such occurrences that can cause damage to the product or property.

For information that facilitates the working process or handling, N.B. is used:

N.B. Draws attention to useful information that helps the working process.

Emergency exit

If the doors should not open in an emergency, open the rear window for emergency exit.

A rear window that can be opened is standard on machines with hydraulically moveable cab. Optional on other machines.



Safety regulations aimed at reducing the risk of personal injury and damage to loads or other property.

Intended of use

- The truck may only be used for the purpose for which it was intended, namely, to lift and transport goods, the weight of which does not exceed the maximum permitted load capacity of the truck.
- The truck may not, without specific permission from Kalmar, be modified or re-built so that its function or performance is altered.
- The truck may not be driven on public highways if it has not been adapted to comply with national road safety regulations.

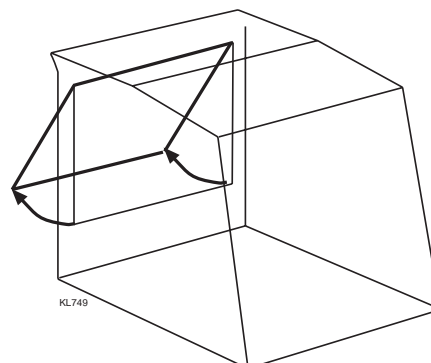
Operator requirements

- The truck may only be driven by operators who have been specially trained and who have the company's authority to do so.
- Laws and other regulations relating to driving licence, operator ID, log book, etc., must be followed at all times.
- The operator must be aware of and follow all local safety regulations.
- It is always the responsibility of the operator to ensure that the truck has approved fire extinguishing equipment in accordance with currently applicable regulations.

Operation of the truck is prohibited:

- If any of the fitted safety equipment, such as rear view mirrors, headlights, reversing alarm (optional), does not function correctly.
- If there is a fault with the brakes, steering or lift equipment.
- If it has been repaired, modified or adjusted without the approval of the work supervisor.
- If the truck is fitted with tyres not approved by Kalmar.

Continued on next page



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Operating regulations

- Before starting, make sure that the cab is locked in the rear-most position by means of the latches, one on each side. The latches must be secured with spring pins. (Applies to manually moveable cabs).
- Before starting, always check to ensure that nobody is in the way of the truck or its equipment.
- The operator must always face the direction of operation and take particular care in areas where persons or other vehicles are likely to appear in the vicinity. If visibility is limited by the load, the operator should operate the truck in reverse.
- It is prohibited to walk or stand underneath raised forks or other equipment, whether they are loaded or not.
- It is prohibited to transport passengers on the truck outside the cab or on the load. Passengers may be transported inside the cab only on condition that it is equipped with a fixed passenger seat.
- It is prohibited to lift people if the truck is not equipped with an approved lift cage.
- It is prohibited to exceed the load capacity of the truck. See capacity plate and loading diagram.
- It is prohibited to transport loads in the raised position as this entails a risk of the truck tipping. All transportation shall take place with the load in the transport position.
- The operator must adapt the speed of the truck to the character of the load, conditions of visibility, the character of the roadway/surface, etc.
- The operator shall avoid powerful acceleration and braking when turning. In addition, the operator shall always moderate the speed of the truck when turning so as to avoid the risk of lateral skidding or tipping.
- The operator shall take particular care when operating in the vicinity of electrical power lines, viaducts, quay-sides, ramps, gates/doors etc.
- Safety belts must always be worn, if fitted. In the event of the truck tipping, always remain in the cab and grip the steering wheel securely. Never try to jump out of the cab.
- The parking brake can also be used as an EMERGENCY BRAKE. **However**, having been used for emergency braking, the brake linings must be checked and replaced if necessary. If the parking brake has been mechanically released, **it must always be reset** in order for the truck to regain the parking brake function.

Interrupted operation, parking

- Always check that the gear lever is in the neutral position before turning the ignition key to restart or to reset an emergency stop.
- Never leave the operator's cab without applying the parking brake (ON position).
- Always remove the ignition key if the truck is to be left unattended.

Other important points to remember

- The truck's hydraulic system includes high pressure hydraulic accumulators. Always be extremely careful when working with the hydraulic system and avoid being unnecessarily close to the hydraulic equipment, lines and hoses. Before working on the hydraulic system, the accumulators

must be emptied into the tank, with the help of the special accumulator evacuation valve.

- Handle batteries and junction boxes with great care. The batteries must always be protected over the poles and connections.
- Always rectify any damage or wear and tear that can risk personal safety or that can affect the functions of the truck or its service life.
- Avoid touching oils and greases. Avoid inhaling exhaust and oil fumes.
- Always use steps and handrails when entering or leaving the machine - Never jump!
To avoid the risk of slipping, tread only on anti-slip surfaces. If the anti-slip protection has become worn, loose or in any way less effective, it should be replaced.
- Welding painted steel produces poisonous gases. Paint should therefore be stripped before welding, good ventilation ensured and/or face mask with filter used.
- Mobile phones used in the cab must always have fixed connections to the machine's electrical system, with a fixed antenna outside the machine, mounted in accordance with the manufacturer's instructions. This will avoid interference with the machine's important electronic functions.

Operating with attachments

- The operator must always take the effect of the wind into account when handling containers. Avoid lifting with a wind strength in excess of 12 m/s (27 mph/40 feet per second).
- Always drive carefully so as to avoid attachments colliding with pillars, cables, etc.
- Carefully study the "Lift methods" section of the instruction manual.
- The tensile strength of the top pane can be seriously weakened by exposure to elements that contain: Aromatic hydrocarbon, ketone, esters or chlorinated hydrocarbon.
Regularly check the surface condition of the top pane and clean only with screen wash or other mild cleaning fluid. After cleaning, rinse thoroughly with warm water. It is prohibited to modify or in any other way make alterations to the top pane. Immediately replace damaged top panes that show signs of cracking or scratching.

CE marking

All trucks and equipment (though not those fitted on the truck or intended as spare parts) supplied from Kalmar are CE marked, which indicates that they comply with the requirements of the EU Machine Safety Directive. In addition, each truck has a so called, "EU Declaration of Conformity" which is the legal proof that the truck complies with the "health and safety" requirements laid down in the Machine Safety Directive, the EMC directive (electro-magnetic compatibility) and the LVD directive (electrical equipment).

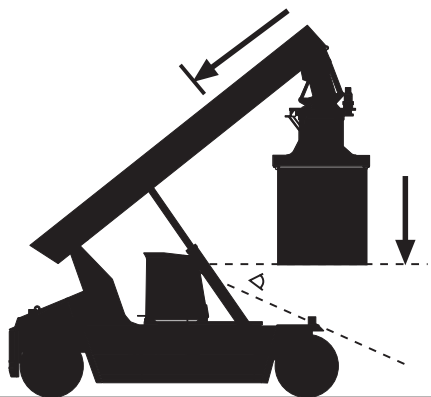
Vibration standard

The truck complies with and is below the limits for vibration standard EN 13059.



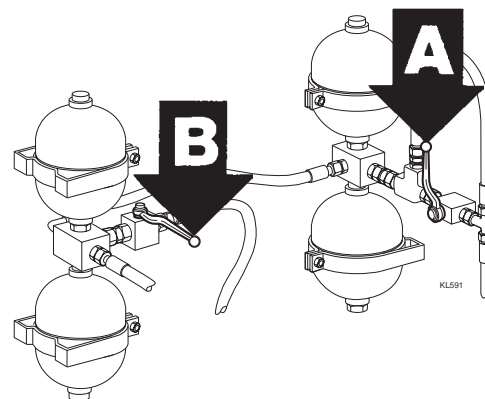
Safety regulations

- Only authorized and qualified personnel may work with the safety system. (ECS-system)
- If the overload safety system override function has been used, there is a risk of forward tipping. The truck should be operated with extreme care to prevent accidents.
- Great care must be exercised at all times when driving the machine. Always remember the great height and width of the machine so that collision with beams, cables etc. is avoided
- It is prohibited to start lifting a container if the warning light TWIST-LOCK UNLOCKED (red) is lit or if any of the warning lights TWIST-LOCK LOCKED (green) or ALIGNMENT (orange) are extinguished. N.B. the ALIGNMENT warning light goes out once the lift has begun.
- If the safety system warning lamps are not functioning, the system must be immediately repaired. To use a truck with faulty warning lamps is a great safety risk.
- Do not drive the truck with load raised high above the ground, since the truck may overturn. The transport of heavy loads must be carried out with the load as close to the truck as possible, i.e. with the boom retracted and lowered as far as possible without obstructing vision, see picture below.
- Never run hands or fingers along any tubes, pipes or hoses whilst investigating for possible leaks as some of these lines (diesel fuel, hydraulic, steering, etc.) operate at extremely high pressures and even the most minute of leaks can cause oil or fluid to penetrate the skin.
- Under no circumstances may compressed air be used to remove a hydraulic piston from its cylinder.
- Always attend to damage and wear that may be of significance to the performance and useful life of the truck or to the safety of the personnel.
- Follow the safety rules whenever carrying out service work on the air conditioner. The refrigerant is injurious to the skin and eyes. Only authorized service personnel may repair the system.
- The truck's hydraulic system includes high pressure hydraulic accumulators. Before working on the hydraulic system, the accumulators must be emptied into the tank, with the help of the special accumulator evacuation valve. Also valve B for emergency pressure to servo system must be opened.
- Never carry out any service work on the boom or attachment when the engine is running.



Transport position

KL1103



A. Quick evacuation valve, accumulators

B. Valve for emergency pressure to servo system



Safety instructions for working with tyres

- Tyre changing can be dangerous and should only be carried out by specially trained personnel using proper tools and procedures. Failure to comply with these procedures may result in faulty positioning of the tyre and/or rim and cause the assembly to burst with explosive force sufficient to cause physical injury or death. Never fit or use damaged tyres or rims.
- Never attempt to weld on an inflated tyre/rim assembly.
- Never let anyone assemble or disassemble tyres without proper training.
- Never run the truck on one tyre of a dual assembly. The load capacity of a single tyre is then dangerously exceeded and operation in this manner may damage the rim.
- **Deflation and dismantling**
 - Always block the tyre and wheel on the opposite side of the vehicle before you place the jack in position. Always crib up the blocks to prevent the jack from slipping.
 - Always check the tyre/rim assembly for proper component seating prior to removal from the truck.
 - Always deflate the tyre by removing the valve core prior to removing the complete assembly from the truck or dismantling any of the component. Before loosening mounting bolts, run a wire through the valve stem to ensure that it is not blocked. Ice or dirt can prevent all the air from escaping. Deflate and remove valve cores from both tyres of a dual assembly.
 - Never position body in front of the rim during deflation.
 - Always follow assembly and dismantling procedures outlined in the manufacturer's instruction manual, or other recognized industry instruction manuals. Use proper rubber lubricant.
 - Never use a steel hammer to assembling or dismantling rim components – use a lead, brass or plastic type mallets. The correct tools are available through rim/wheel distributors.
 - remove bead seat band slowly to prevent accidents. support the band with your thigh and roll it slowly to the ground in order to protect back and toes.
 - Disassembly tools apply pressure to rim flanges to unseat tyre beads. Keep your fingers clear. Slant disassembly tool about 10 degrees to keep it firmly in place. Always stand to one side when applying hydraulic pressure. Should the tool slip off, it may cause fatal injury.
- **Rim inspection**
 - Check rim components periodically for fatigue cracks. Replace all cracked, badly worn, damaged and severely rusted components.
 - Always select the correct tyre size and construction matching the manufacturer's rim or wheel rating and size.
 - Do not use over-size tyres, too large for the rims, e.g. 14.5 inch tyres with 14 inch rims or 16.5 inch tyres with 16 inch rims.
 - Never use damaged, worn or corroded rims/wheels or fitting hardware. Always verify that the rim is in a serviceable conditioning.
 - Always clean and repaint lightly rusted rims.
 - Never use a rim/wheel component that can not be identified. Check rim parts against multi-piece rim/wheel matching charts.
- **Assembly and inflation**
 - It is important that the inflation equipment is equipped with a water separator to remove moisture from the air line in order to prevent corrosion. Check the separator periodically to ensure that it is working properly.
 - Make sure that the lockring is in its right position.
 - Never mix different manufacturer's parts since this is potentially dangerous. Always check manufacturer for approval.
 - Never seat rings with hammering while the tyre is inflated. Do not hammer on an inflated or partially inflated tyre/rim assembly.
 - Always double check to ensure that the rim assemblies have been correctly assembled and that securing studs and nuts are tightened to the correct torque setting.
 - Never inflate tyres before all side and lockrings are in place. Check components for proper assembly after pumping to approximately 5 psi (=34 kPa, =0.34 bar)
 - When adding air to a tyre on an industrial truck, use a clip-on chuck and stay out of the danger area. If the tyres has been run flat then the rim must be dismantled and all parts inspected for damage.
 - Under-inflated tyres have a serious effect on the stability of the truck and reduces the safe load handling capacity. Always maintain tyres at the correct inflation pressures. Check inflation pressure daily. Do not over-inflate.
 - Inspect tyres regularly – every day if possible. Look for and remove broken glass, torn pieces of tread, embedded metal chips etc. Inspect for uneven or rapid tread wear, usually caused by mechanical irregularities, such as brakes out of adjustment or excessive toe-in and toe-out. If discovered, correct the irregularity immediately.
- When installing and tightening trail wheel bolts, observe the following:
 - Ensure that trail wheel or hub mounting surfaces and trail wheel fastener mounting surfaces are clean and free from paint and grease.
 - Tighten bolts to specified torque settings. use staggered sequence; i.e. top bolt, bottom bolt etc.

Design – Overview

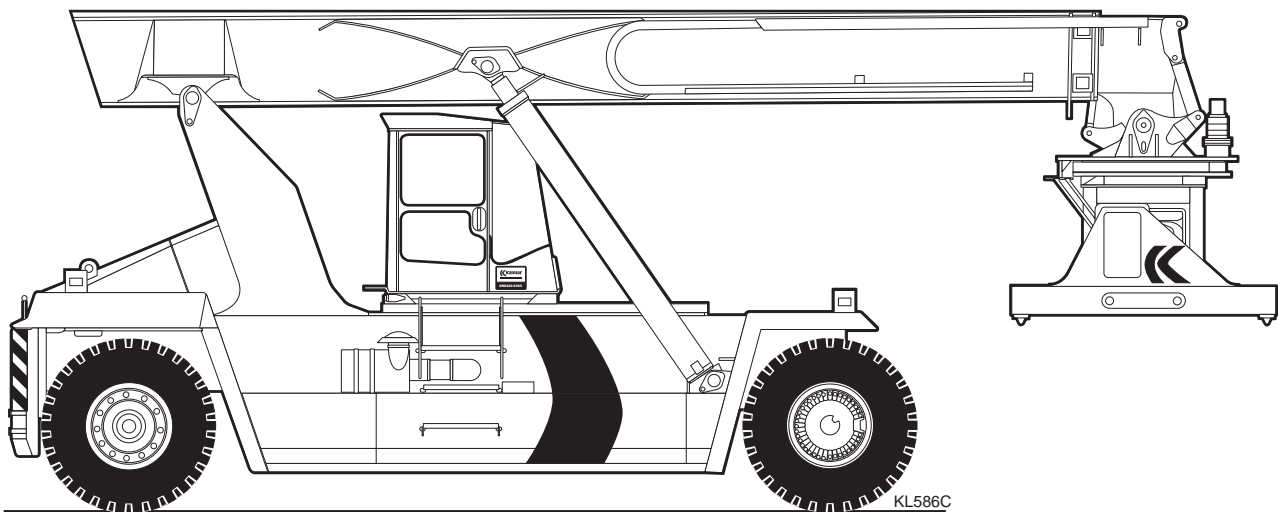
Kalmar DRD420–450 model S diesel trucks are of sturdy design for particularly heavy duty handling of 20-40' loaded containers. They are built around a chassis which has high strength and torsional stiffness and an extremely low centre of gravity.

The operator's cab is provided with vibration isolation and sound insulation and offers excellent all-round visibility.

There are many adjustments that can be made to the operator's driving position. The position of the seat, back support and firmness of the driving seat can be adjusted in a number of ways.

The trucks are equipped with a sliding cab. This puts the operator in an exceptional position to supervise the top lift attachment and offers excellent accessibility to the transmission and hydraulic pumps. The engine is easily accessible through a removable running board.

To special order, the trucks are equipped with hydraulically powered sliding cab.



DRD420-65S5 with 20-40' adjustable top lift

The Volvo six-cylinder turbocharged engine, combined with a four-speed gearbox with torque converter, provides smooth power whenever needed.

The drive axle with hub reduction, oil-cooled hydraulic brake system and pendulum-mounted steered axle with double-acting steering cylinder satisfy very strict demands on strength and mobility when travelling on irregular surfaces.

The hydraulic system is reliable and has high performance.

Component units

- Sound-insulated operator's cab with excellent all-round visibility. The non-slip, substantial steps provide convenient access to the cab. As an optional extra, a hydraulically movable cab is available.
- ECS-system which controls the electric servo circuits and also overload protection system. (With electronic balance, module 60 or 52, the loading conditions are indicated on a display on the ECS-terminal in the operator's cab.)
- Engine - Volvo TWD1031VE/TWD1231VE six-cylinder, four-stroke, turbocharged diesel engine with direct injection and thermostatically controlled water cooling.

The engine is equipped with:

- Injection pump with centrifugal governor that compensates for load variations.
- Smoke limiter for reduced free acceleration and full load smoke.
- Alternator.
- Gearbox with torque converter
 - Constant-mesh gearbox changes by means of hydraulically activated clutches which are electrically operated.
 - Torque converter, which is a hydraulic coupling that amplifies the output torque on an increase in load. Torque conversion takes place smoothly and steplessly throughout the engine speed range.
 - Oil cooler connected to the engine cooling system for cooling the oil in the gearbox and torque converter.
 - Oil pump which supplies oil under pressure to the gearbox and torque converter.
 - Full-flow oil filter for effective cleaning of the gearbox oil.
- Drive axle with two-stage reduction - in the differential and the hub reductions.
 - Hydraulic, oil cooled disk brakes – wet disk brakes – for the foot brake.
 - Disc type parking brake applied by sturdy springs and released by hydraulic oil pressure.

- Hydraulic system, that occurs in two versions:
 1. With common tank for all hydraulic and brake circuits.
 - a double variable hydraulic pump, feeds Lift 1, Extension 1, hydraulic servo, steering system
 - a double variable hydraulic pump, feeds Lift 2, Extension 2, attachment functions
 - a fixed, wing type pump for the feeding of the brake system
 - hydraulic fluid cooler for the brake system cooling circuit
 2. With a separate tank for the working hydraulics and a separate tank for the brake circuit.
 - a double variable hydraulic pump, feeds Lift 1, Extension 1, hydraulic servo, steering system
 - a double variable hydraulic pump, feeds Lift 2, Extension 2, attachment functions
 - a fixed, wing type pump for the feeding of the brake system
 - a hydraulic fluid cooler for the brake system cooling circuit
 - a fixed, wing type pump for the circulation of the main tank's hydraulic fluid through a hydraulic fluid cooler
 - hydraulic fluid cooler for the main tank
- Main valves for controlling the main hydraulics. The valves are controlled by an electro-hydraulic servo system from the cab. An electro-hydraulic servo system is available as an option.
- High pressure filters for effective cleaning of the hydraulic fluid before it is returned to the tank.
- Priority valve giving priority to the steering system when required.
- Steering valve (Orbitrol) - flow-control valve which supplies hydraulic fluid to the steering cylinder.
- A hydraulic oil cooler with electrically powered fan

- Steered axle with pendulum mounting and double-acting steering cylinder.
- Lift cylinders equipped with blocking valves, which eliminate any undesirable sinking of the load. A regeneration system gives high lifting speed at no load conditions.
- Boom of a slender, high-tensile steel construction. The boom is pivot-mounted and comprises a fixed and a telescope section manoeuvred by means of a double-acting extension cylinder. The extension system is equipped with regeneration system for quick boom-out speed at no-load conditions.
- Top-lift attachment, adjustable for handling 20 and 40 foot containers.

Supplementary books

In addition to the Instruction Manual and the Technical Handbook, the following books are delivered with every truck.

Spare parts catalogue

Instruction Manual for Volvo Industrial engines

Replacement system - Spare parts

Kalmar operates a system of replacement parts, repair kits and gasket sets covering most of the vital components of the truck.

For the contents of these kits, see the Spare parts catalogue.

Tools

Kalmar offers a wide range of tools for truck maintenance work.

For further information, please contact Kalmar's service department.

Tightening torques

(According to Kalmar K Standards 20060.0001)

The tightening torques are applicable to steel bolts and nuts tightened with a torque wrench under the following conditions:

Condition	Surface treatment		Lubriation
	Bolt	Nut	
	1	untreated	
2	bright galvanised	untreated	dry or oiled
	bright galvanised	bright galvanised	
	bright galvanised	bright galvanised	
3	hot-dip galvanised	bright galvanised	dry or oiled

The values specified in Table 1 are applicable to nut-and-bolt joints, but can also be used for bolts fitted into tapped holes. However, in the latter case, the preloading force will be somewhat lower, depending on its depth of engagement.

When tightening by machine, the torque specified in Table 1 should be reduced by approx. 5%, due to the increased scatter and to prevent the bolt from being tightened beyond its yield point.

Quality	8,8			10,9	12,9
	Tightening torque, Nm Condition				
Thread					
M fin	1	2	3	1	1
M8×1	27	24	30	39	46
M10×1,25	54	48	61	76	91
M12×1,25	96	85	108	135	162
M16×1,5	230	205	260	323	388
M18×1,5	330	294	373	466	559
M20×1,5	460	409	520	647	777
M24×2	786	700	888	1100	1330
M30×2	2660	1388	1763	2200	2640
M36×3	1560	2367	3005	3730	4480

To reduce the risk of settlement of the material and the associated reduction in the preloading force if the hardness of the surface supporting the bolt head or nut is lower than 200 HB, a washer should be fitted under the bolt head and nut. This is not applicable if flanged bolts or flanged nuts are used.

When tightening is carried out, the specified torque should be applied without pause, to ensure that the torque wrench will not be tripped by the static friction before the joint has been tightened to the specified torque.

Quality	8,8			10,9	12,9
	Tightening torque, Nm Condition				
Thread M	1	2	3	1	1
4	3,2	2,9	3,6	4,6	5,5
5	6,4	5,7	7,2	9,1	11
6	11	9,8	12,5	16	19
8	26	24	30	38	45
10	52	47	59	74	89
12	91	81	103	128	154
16	220	198	250	313	375
20	430	386	49	620	732
24	750	668	848	1050	1270
30	1480	1317	1672	2080	2500

Quality	8,8			10,9	12,9
	Tightening torque, Nm Condition				
Thread UNC	1	2	3	1	1
1/4	12,5	11,1	14,1	17,6	20
5/16	25	22,3	28,3	35	42
3/8	44	39	50	62	73
7/16	70	62	79	100	118
1/2	107	95	121	151	178
9/16	153	136	173	216	255
5/8	210	187	237	298	353
3/4	370	390	418	524	619
7/8	594	528	671	839	990
1	889	791	1005	1260	1480
1 1/8	1260	1120	1424	1780	2100
1 1/4	1760	1565	1990	2490	2940
1 3/8	2320	2065	2620	3280	3870
1 1/2	3060	2720	3455	4320	5100

Quality	8,8			10,9	12,9
	Tightening torque, Nm Condition				
Thread UNF	1	2	3	1	1
1/4	13	11	14	19	22
5/16	26	23	29	37	44
3/8	47	42	53	67	79
7/16	75	66	85	107	126
1/2	114	101	128	162	191
9/16	164	145	185	231	273
5/8	227	202	256	321	379
3/4	396	352	447	559	661
7/8	629	560	710	889	1050
1	937	834	1058	1320	1560
1 1/8	1350	1200	1525	1900	2250
1 1/4	1860	1655	2100	2630	3110
1 3/8	2500	2225	2825	3530	4170
1 1/2	3260	2900	3680	4610	5450

System of units

The SI system of units is employed in this handbook:

The conversion factors are as follows:

Pressure

megapascal	bar	Kilogram-force per square centimetre, kpf/cm ²	Pound-force per square inch, psi
1	10	10,2	145
0,1	1	1,02	14.5
0,098	0,98	1	14.2

Torque

Newton- meter Nm	Kilogram force-metre kgf m	Pound-force foot lbf ft
1	0,102	0.74
9,81	1	7.23

Power

Kilowatt kW	Horsepower (metric) hp	Horsepower hp
1	1,36	1.34
0,735	1	0.986

Group 10

Chassis and cab

Specification	2
Chassis	3
Description	3
Chassis.....	3
Support jacks.....	3
Operator's cab.....	4
Steering column	9
Hydraulics control unit	10
Service	11
Changing the fresh air filter	11
Check and lubrication of brake pedal	11
Windscreen wipers	12
Air conditioning unit	13
Description	13
Service	16
Checking the air conditioning unit	16

Air conditioner

- Cab unit
 - Circulated air flow 500-600 m³/h
 - Electric power consumption approx. 350 W
- Compressor
 - Max. speed 4000 r/min
 - Refrigerant R134a *)
 - Electric power consumption approx. 50 W
 - Oil capacity Zexel PAG SP-20 1.5 dl
- Condenser
 - Electric power consumption 250 W
- Cooling effect 6-8,5 kW
- Heating effect approx. 11 kW

*) Refrigerant R12 is no longer in production due to legislation

Chassis

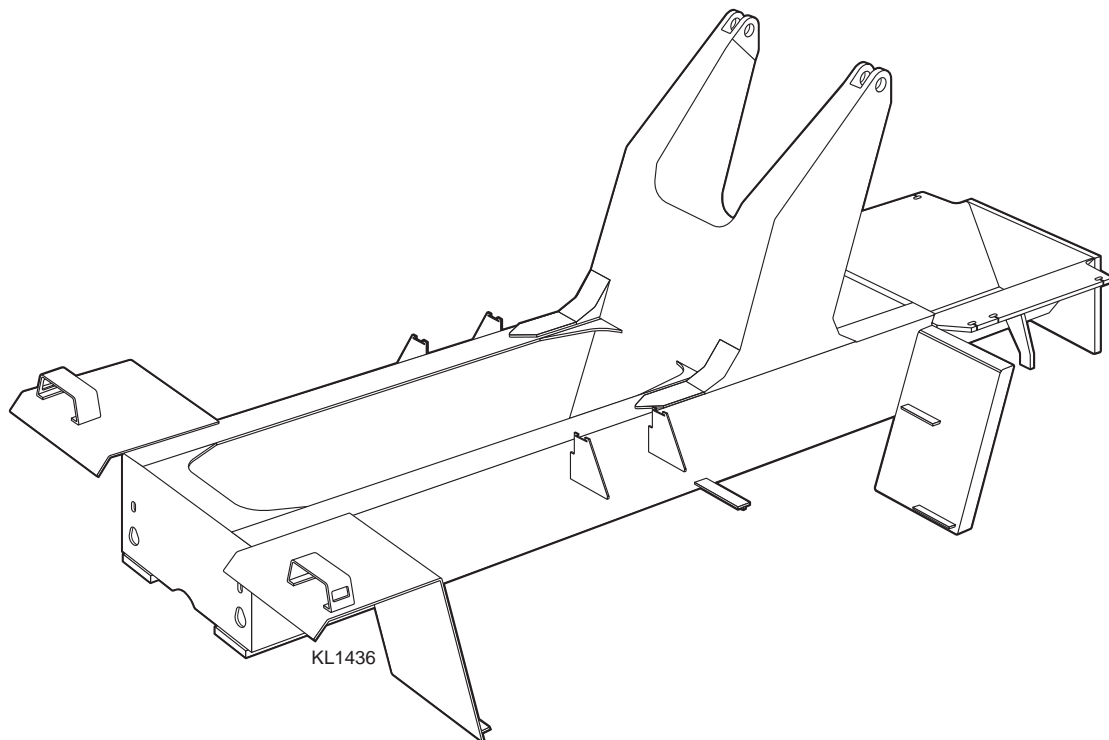
The chassis consists of:

- A unit construction frame built up around two box- sections for best possible strength.
- Mountings for the drive axle, steered axle, telescope-boom, lifting cylinders and transmission.
- The necessary counterweights to provide a very low centre of gravity. Moreover, the steered axle is designed to serve as an additional counterweight.

The hydraulic oil tank and the fuel tank are produced as separate units and are bolted to the side of the chassis. The tanks have a low profile, which contributes to the good visibility.

Support jacks

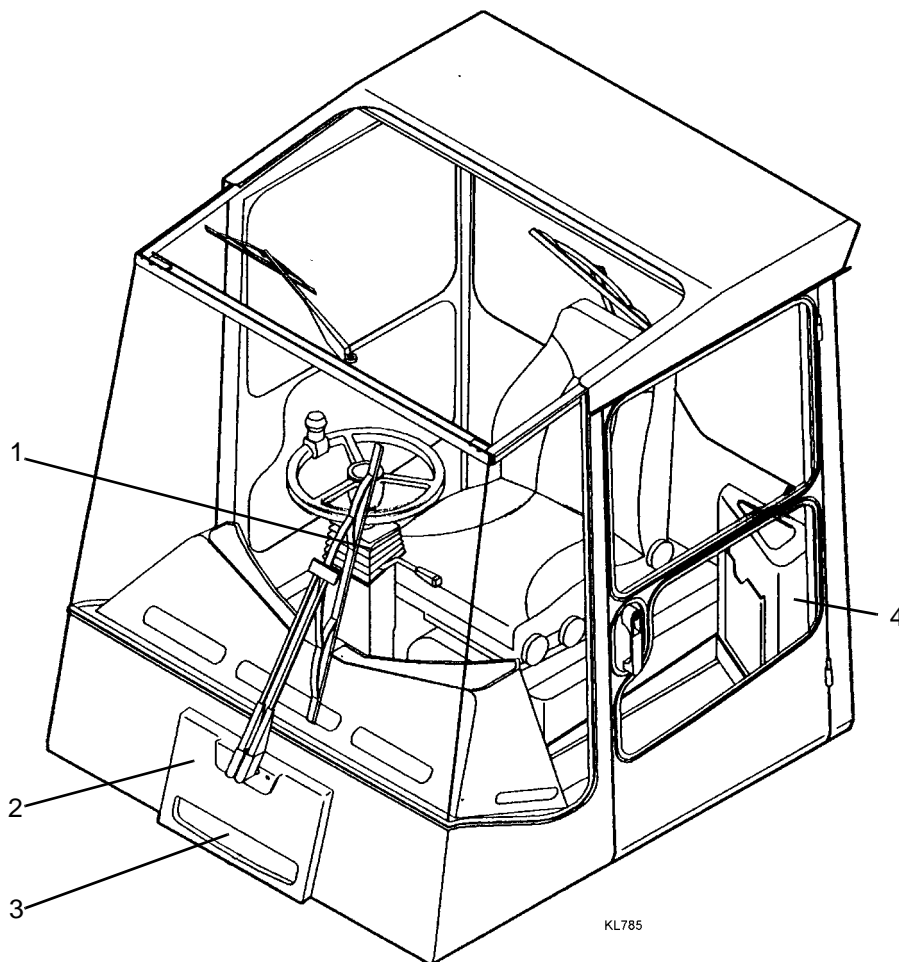
Certain machines are equipped with support jacks to increase the capacity in the third container row, see group 20.



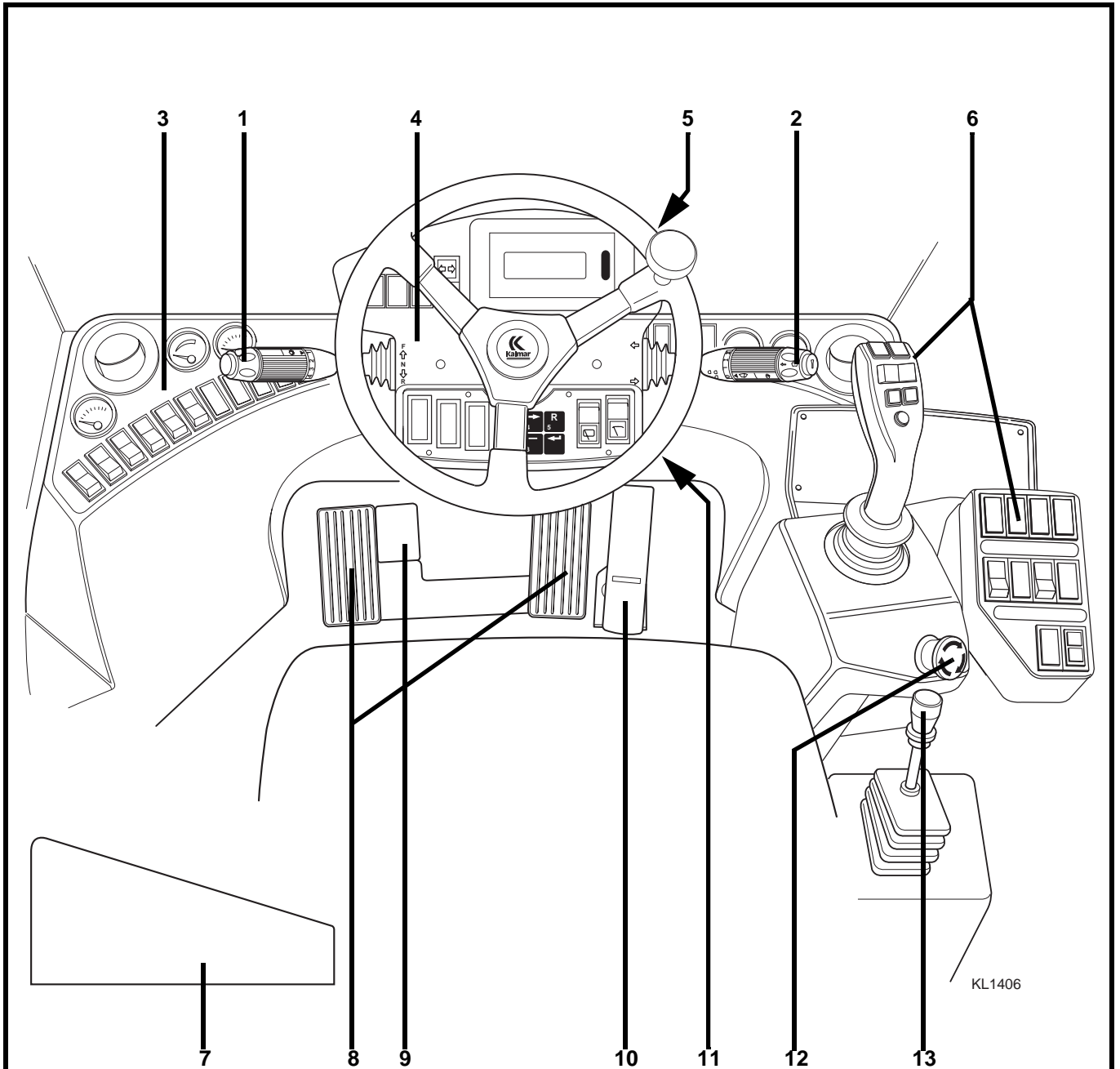
Operator's cab

The operator's cab is a separate structure and rests on the chassis on rubber dampers. The operator's seat, steering wheel and hydraulic control levers can be adjusted for best possible operator comfort. Effective insulation minimises the vibrations and sound level in the cab.

The standard heating system consists of a fan and heater for heating the air in the cab by recirculation. Fresh air is drawn in through a ventilation air filter. Full air conditioning, with cooling, heating and dehumidification, is available to special order.

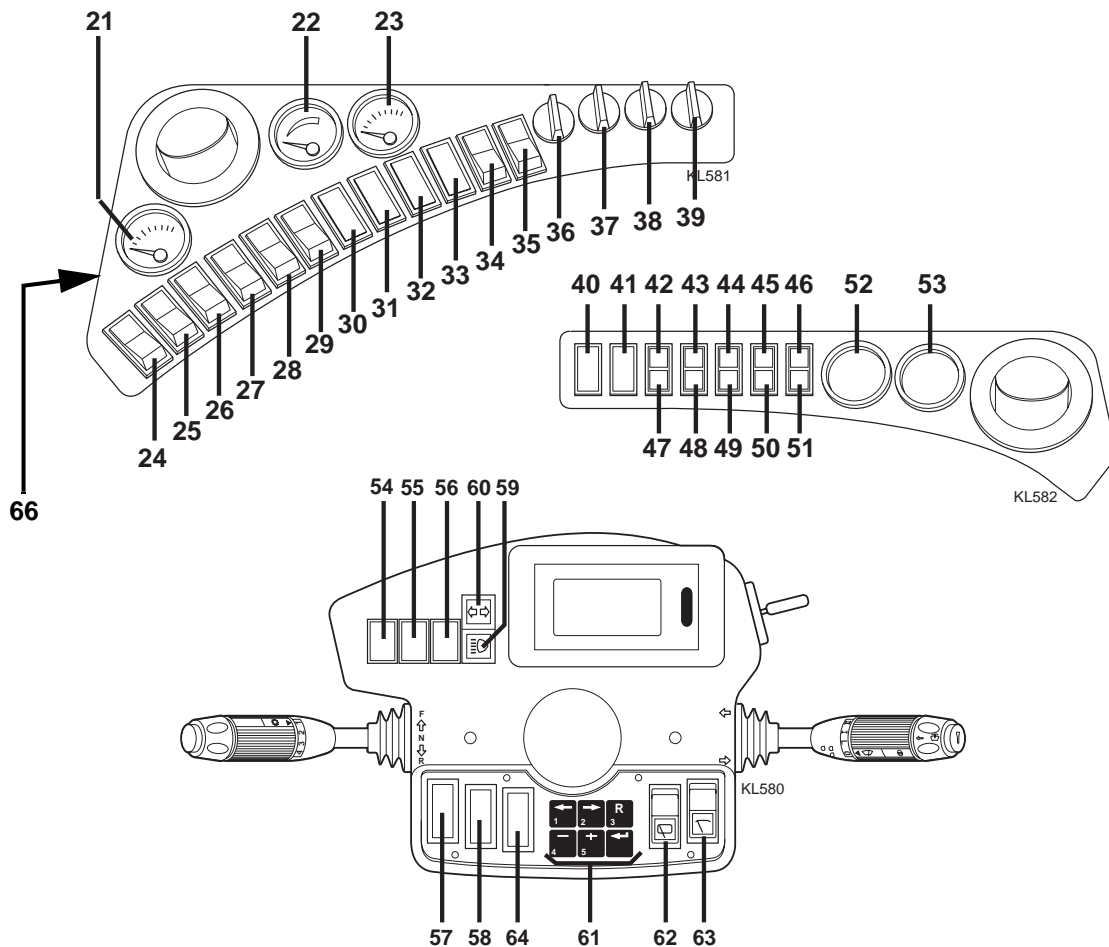


1. Steering column with control levers and switches, ECS-terminal
2. Heating system
3. Air filter
4. Electrical central unit



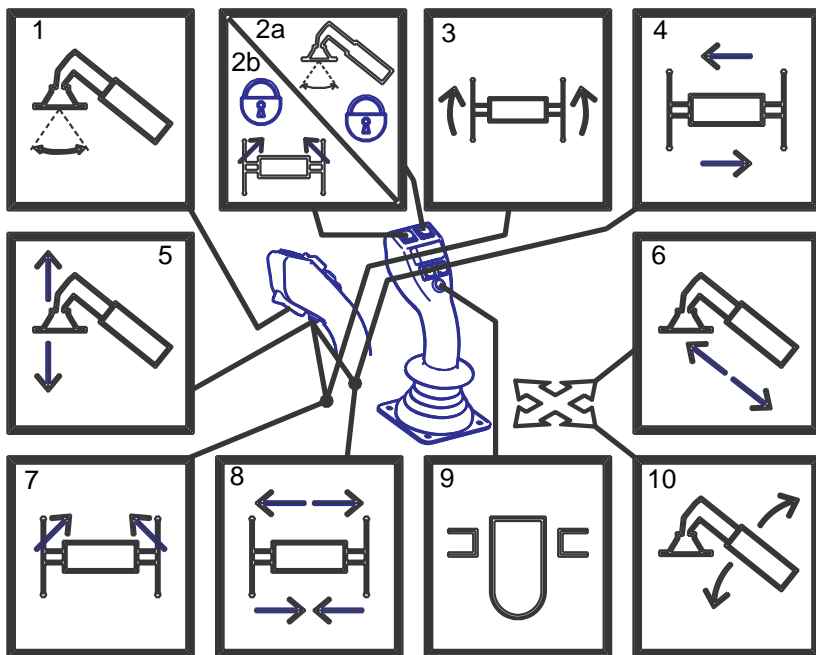
- 1. Gear selector
FORWARD/NEUTRAL/REVERSE 1/2/3/4
- 2. Lever DIRECTION INDICATORS/HORN
FRONT WINDSCREEN WASHER/
FRONT WIPERS/MAIN BEAM
- 3. Instrument panel
- 4. Steering wheel panel
- 5. Starting switch

- 6. Control lever and control panel for hydraulic functions
- 7. Electrical central unit with fuses and relays
- 8. Brake pedals, normal driving brake
- 9. Release clutch
- 10. Accelerator pedal
- 11. Steering wheel adjustment
- 12. Servo circuit breaker
- 13. Parking brake



- | | |
|--|--|
| <p>21. Pressure gauge, gearbox oil pressure
 22. Fuel gauge
 23. Temperature gauge, engine coolant temperature
 24. Switch, working lights
 25. Switch, working lights
 26. Switch, working lights
 27. Switch, flashing beacon
 28. Switch, hazard warning lights
 29. Switch, driving lights
 30. Spare
 31. Spare
 32. Spare
 33. Spare
 34. Switch, compressor air conditioning ¹⁾
 35. Control, recirculation/fresh air
 36. Control, defrost/cab
 37. Switch, fan
 38. Control, heat
 39. Control, cold ¹⁾</p> | <p>40. Spare
 41. Spare
 42. Warning lamp, battery charging
 43. Warning lamp, low engine oil pressure
 44. Warning lamp, low gearbox oil pressure
 45. Warning lamp, low brake pressure (accumulator pressure)
 46. Warning lamp, low engine coolant level
 47. Indicating lamp, preheating
 48. Warning lamp, high engine coolant temperature
 49. Warning lamp, high gearbox oil temperature
 50. Spare
 51. Warning lamp, parking brake ON
 52. Spare
 53. Spare
 54. Spare (Green lamp TWIST-LOCKS LOCKED)
 55. Spare (Orange lamp ALIGNMENT)
 56. Spare (Red lamp TWIST-LOCKS UNLOCKED)
 57. Spare (LOCK/UNLOCK TWIST-LOCKS)
 58. Spare (LENGTH ADJUSTMENT 20-40')
 59. Indicating lamp, headlights
 60. Indicating lamp, direction indicators
 61. ECS terminal
 62. Switch, windscreen wiper, rear
 63. Switch, windscreen wiper, roof
 64. Spare
 65. Fuses
 66. Hour meter</p> |
|--|--|

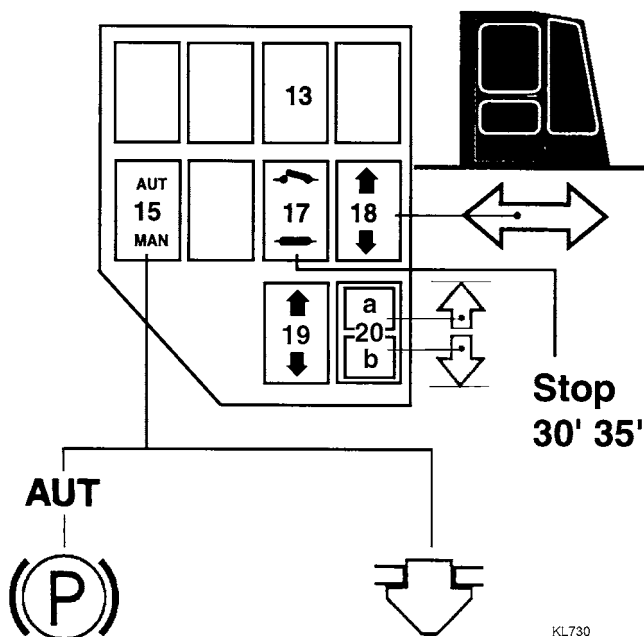
¹⁾ Optional



Joy-stick functions

1. Tilt ¹⁾
2. a. Locking of tilt ¹⁾
b. Locking of levelling¹⁾
3. Rotation
4. Side shift
5. Vertical lift ¹⁾
6. Boom OUT/IN
7. Levelling ¹⁾
8. Length adjustment 20'-40'
9. Unlocking of twist-locks
10. LIFT/LOWER




¹⁾ Optional




Switch functions

13. Rotation limiting
 15. AUT = Automatic locking of twist-locks. The parking brake must be OFF
MAN = Manual locking of twist-locks (spring-back)
Unlocking off twist-locks, see Joy-stick function 9 above
 17. Stop at 30' and 35' ¹⁾
 18. Cab movement horizontal/vertical¹⁾
 19. Support jacks DOWN/UP ¹⁾
 - 20a. Red lamp, the support jacks have left the upper position ¹⁾
 - 20b. Green lamp, support jacks down ¹⁾
- ¹⁾ Optional

Button 17 for the connection and disconnection of the 30' and 35' stops

The  position gives crawling speed the whole time during extension and retraction. In order to by-pass the 30' stop press  and thereafter . The next stop will be 35'.

It is practical to connect in  once the 30' position has been passed.

N.B. When operating a machine which is equipped with hydraulically moveable cab, the doors should be closed or the cab in its rear position otherwise all functions will be broken.

Lamp panel on the boom

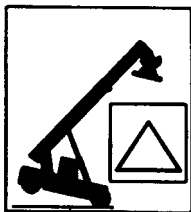
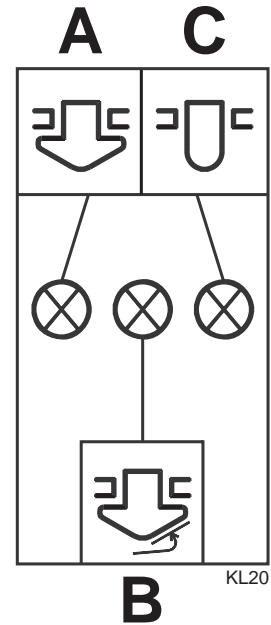
Container handling

- A. Twist-locks locked, green
- B. Alignment, orange
- C. Twist-locks unlocked, red

Lit lamps at container lift:

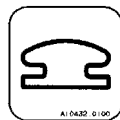
A+B

Go out after lift: B



WARNING!

Overriding of the safety system is at one's own risk and involves a risk of forward tipping.

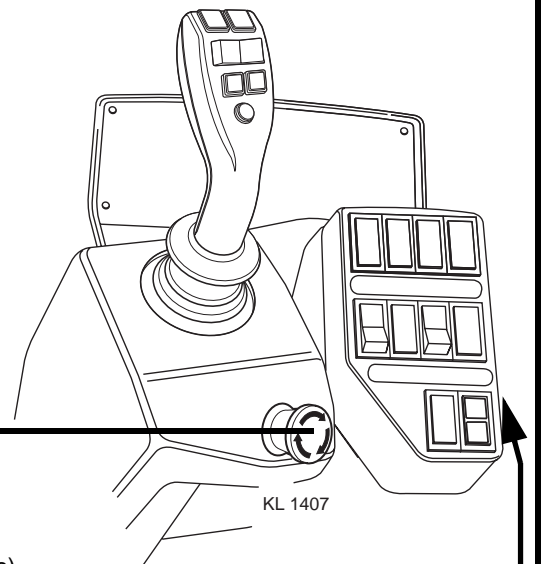


Engagement and disengagement of servo circuits

Override

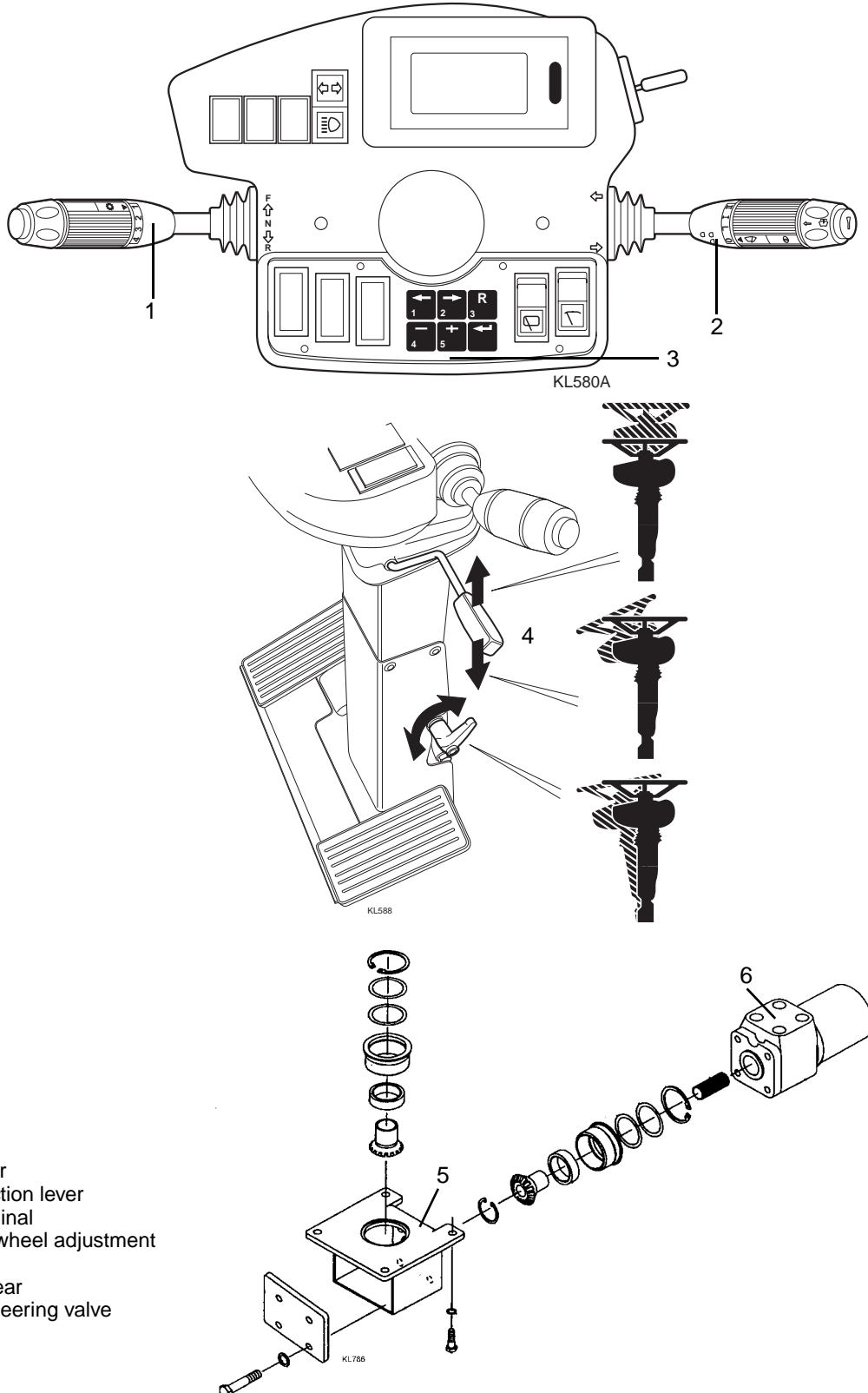
(Only in emergency situations)

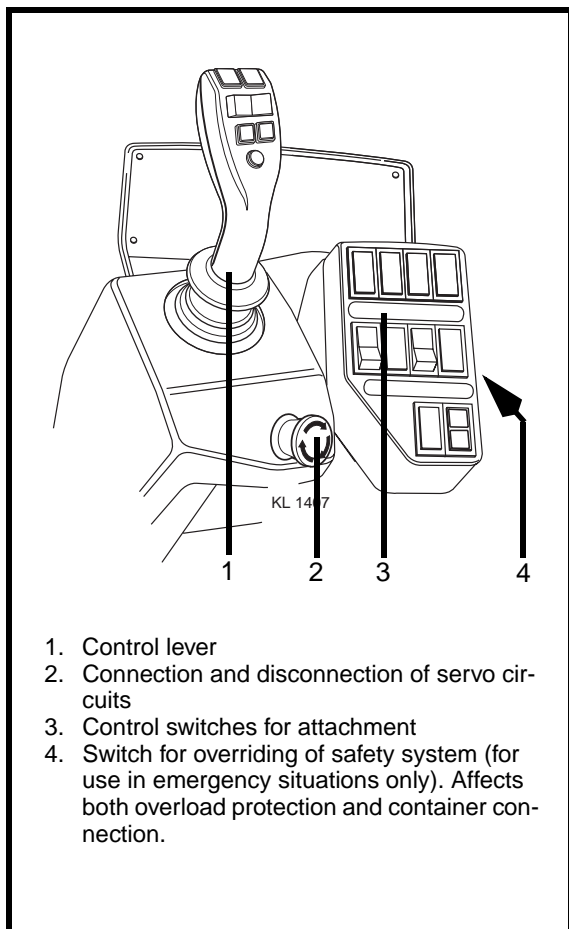
1. Lower
2. Container coupling



Steering column

Surrounding the steering column are multi-function levers for gear changing, indicators, windshield wipers, etc., as well as the instrument panel with the ECS terminal. At the very foot of the steering column is the steering valve (Orbitrol), activated by the steering wheel via an angled gear. The steering column is equipped with an adjustment knob for the alteration of steering wheel height and rake.

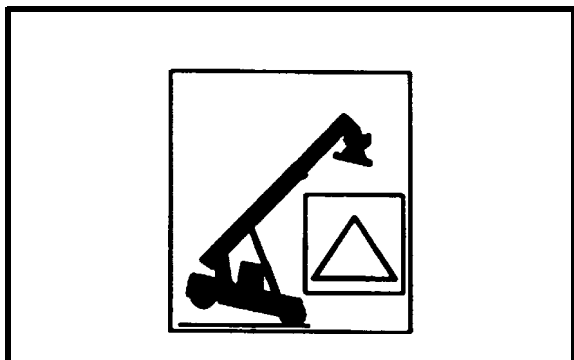




Hydraulics control unit

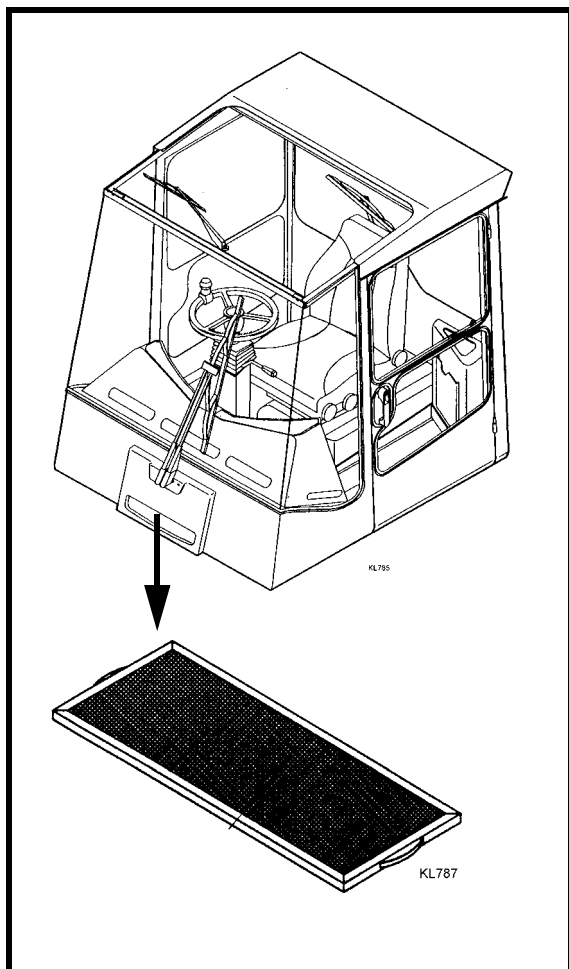
Control lever and switches used to manoeuvre the hydraulics system are located on an adjustable console with comfortable working position

The control lever is a joystick that is electrohydraulically connected to the main valves.



WARNING!

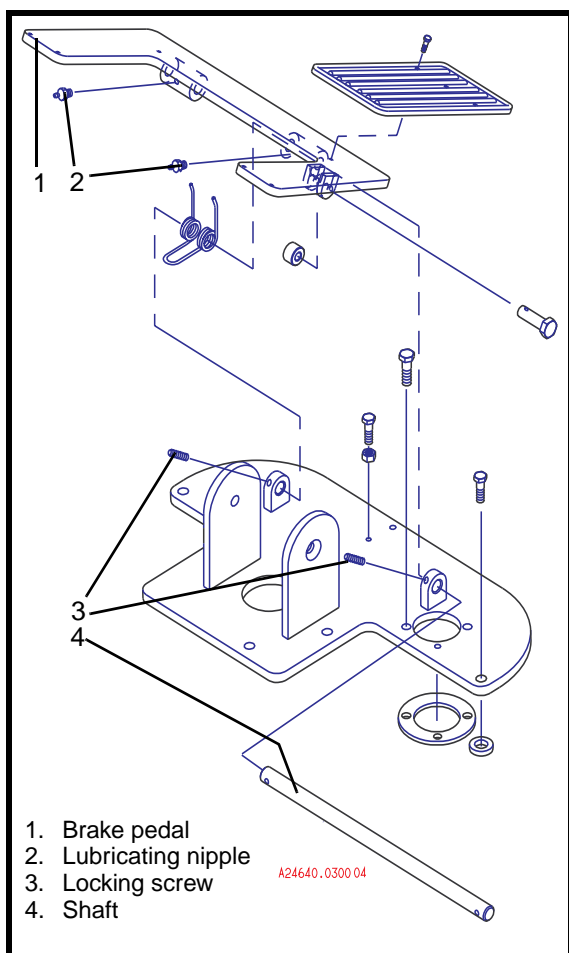
Overriding of the safety system is carried out at your own risk as such overriding involves a risk of forward tipping.



Changing the fresh air filter

(every 200 hours or when needed)

1. Remove the filter casing retaining bolts and remove the filter element.
2. Wash the filter insert with water and detergent or by using a high pressure washer. Replace the insert if necessary.
3. Reinstall the filter insert.



Check and lubrication of brake pedal

(Every 1000:e hours)

1. Check and tighten the locking screws 3, so that the brake pedal is securely fitted in the console.
2. Lubricate the brake pedal shaft through the nipples 2.

1. Brake pedal
2. Lubricating nipple
3. Locking screw
4. Shaft

A24640.0300.04

Windscreen wipers

The wiper arms are fixed to the wiper motor shafts via conical splines. The shafts are manufactured of hardened steel and the wiper arm mounting of soft, pressed metal. When fitting, the nuts must be tightened so hard that the splines are pressed well into the mounting and function as a carrier.

Removal

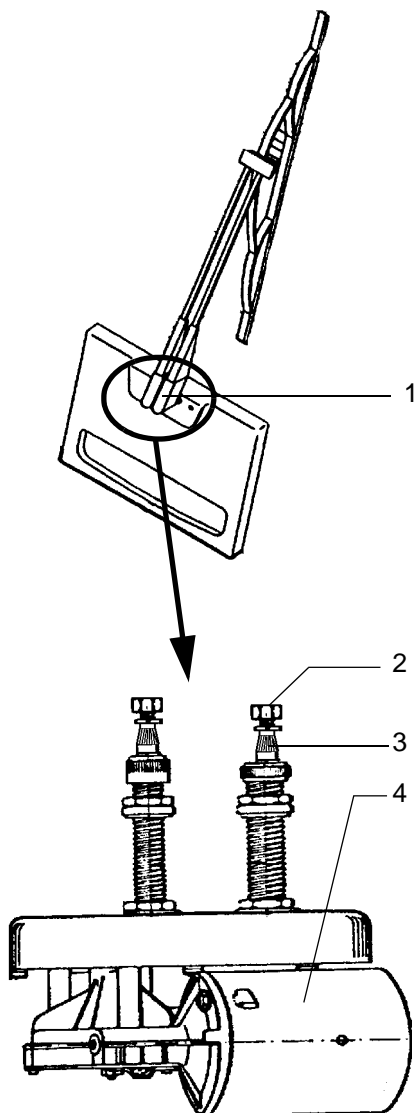
1. Remove the wiper arms by loosening the nuts and thereafter tapping and carefully rocking the arms to and fro.

Fitting

1. Check to ensure that the splines on the motor shaft are free from the softer material from the wiper arm mounting. If this is not the case, clean the splines so that they can be pressed fully into the wiper arm mounting.
2. Fit the wiper arms onto the motor shafts and tighten the nuts to a torque of 16-20 Nm. Hold the wiper arm to take up the torque pressure so that it is not transferred to the motor, which could result in damage

IMPORTANT!

The nuts must be tightened sufficiently hard, otherwise the shafts may start to slip inside the wiper arm mounting, resulting in damage.



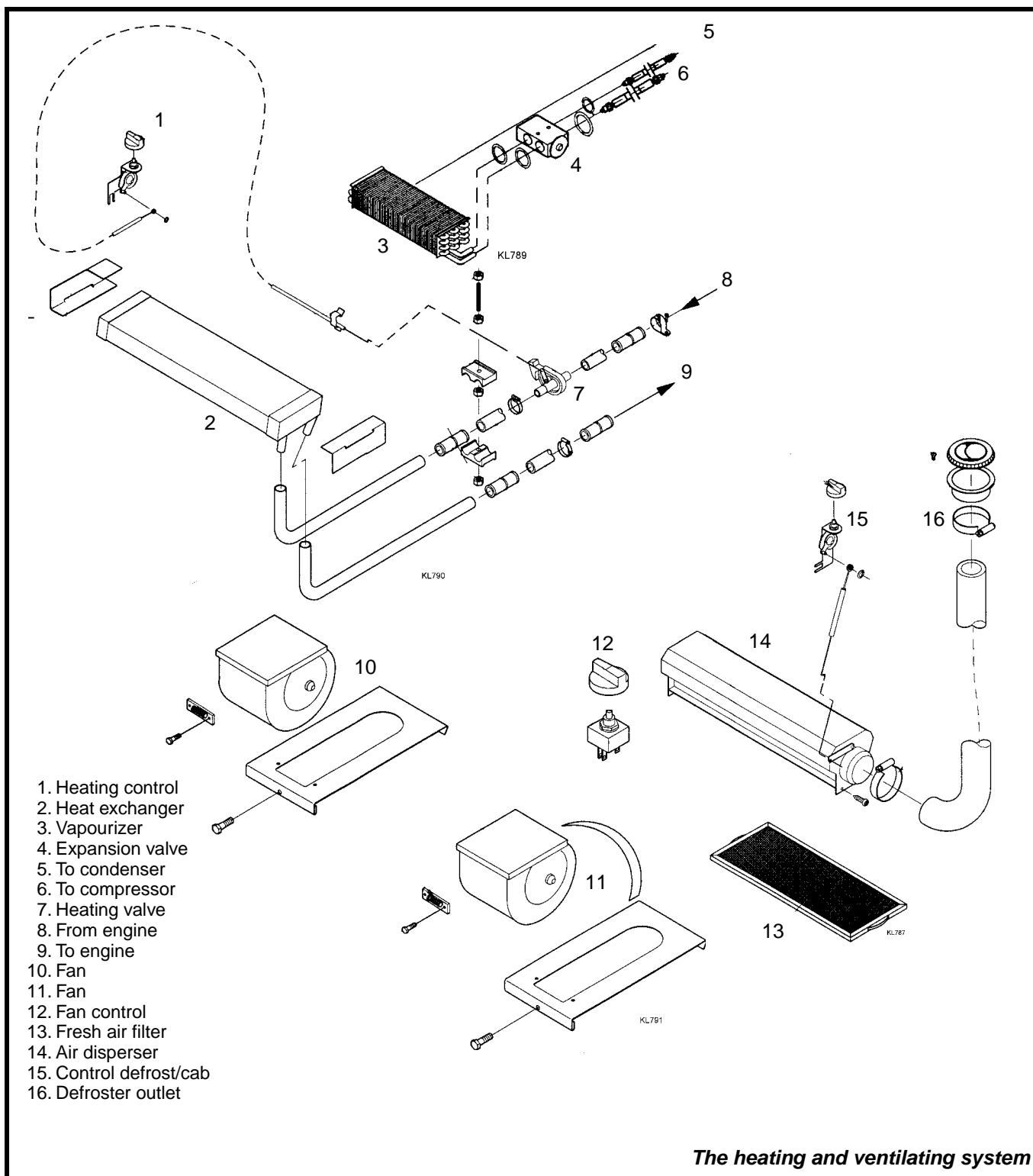
1. Wiper arm fitting
2. Securing nut, wiper arm
3. Grooved cone on motor shaft
4. Wiper motor

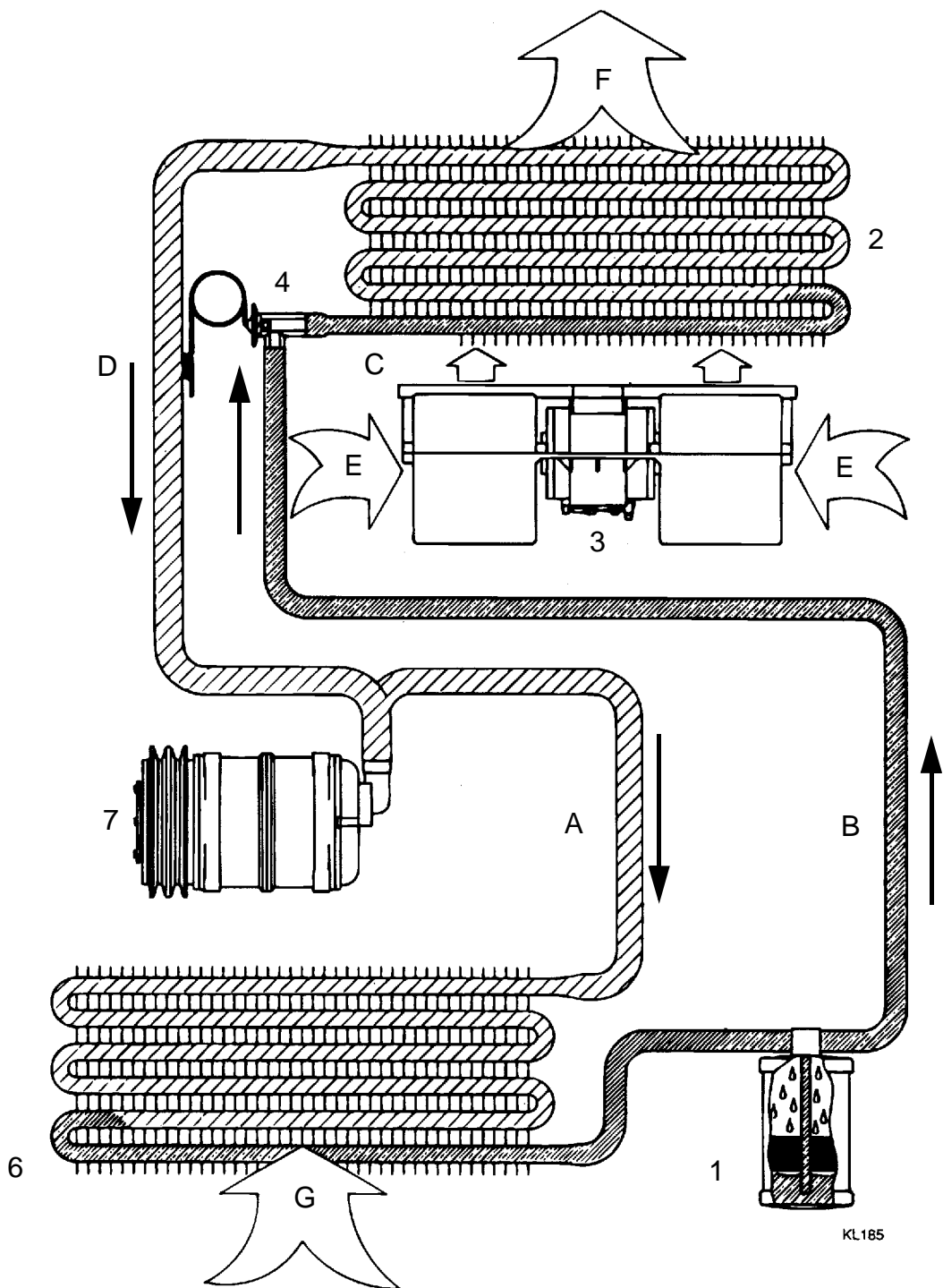
Air conditioning unit

The air conditioning unit consists of the parts shown in the illustration and its function is to maintain the climate in the operator's cab as comfortable as possible. The air conditioning unit:

- heats the air when it is cold
- dehumidifies the air when it is humid
- removes impurities from the air
- cools the air when it is warm

The equipment is controlled by switches and controls on the instrument panel.





KL185

- 1. Liquid receiver/filter dryer
- 2. Evaporator
- 3. Fan
- 4. Expansion valve
- 6. Condenser
- 7. Compressor

- A High-pressure gas
- B High-pressure liquid
- C Low-pressure liquid
- D Low-pressure gas
- E Warm air in cab
- F Cooled air to the cab
- G Outside air for removing heat

Compressor

The air conditioning system is driven by the compressor. This performs as a pump, drawing cold, low-pressure gas from the evaporator, compressing it and thereby raising its temperature, and discharging it at high pressure to the condenser.

The compressor is driven by V-belts directly from the diesel engine. Switching between operation and idling is controlled by an electro-magnetic clutch which, in turn, is controlled by a thermostat whose sensor is located between the fins of the evaporator coil. The thermostat switches off the compressor at low temperatures, to prevent icing of the evaporator.

Condenser

The function of the condenser is to convert the hot high-pressure gas from the compressor into liquid form. The tubes and fins of the condenser coil absorb heat, which is then removed by the air delivered by the fan.

The temperature of the refrigerant in the condenser varies from about +50°C to +70°C. The pressure varies between 12 and 20 bar, depending on the ambient temperature and the flow of air through the condenser. When the refrigerant is condensed into liquid form, it is transferred under pressure to the liquid receiver/filter dryer.

Liquid receiver with filter-dryer

The function of the liquid receiver with integrated filter dryer is to collect the liquid coolant, bind the moisture, and to filter and remove impurities. The receiver, which is located in the condenser housing, also serves as the expansion vessel in the refrigeration circuit.

After flowing through the dryer in the bottom of the liquid receiver, the refrigerant flows through a riser tube. A sight glass enables the operator to check that the liquid flows without the presence of any bubbles, and that the system is filled with a sufficient amount of refrigerant.

Expansion valve

The expansion valve throttles the flow and passes an optimised quantity of refrigerant that the evaporator is capable of evaporating.

The expansion valve is also the part of the circuit which separates the high- pressure side from the low-pressure side. The refrigerant flows to the expansion valve under high pressure and leaves it under low pressure.

The amount of refrigerant which passes the evaporator varies, depending on the thermal load. The valve operates from 'fully open' to 'fully closed' and in-between searches for a point to give optimum evaporation.

Evaporator

The heat necessary for evaporating the refrigerant is extracted from the cab air which is circulated by a fan through the evaporator coil. The cab air is thus cooled, and is distributed and returned to the cab.

In the evaporator, the refrigerant reverts to the gaseous state and returns to the compressor suction, thereby completing the cycle.



WARNING!

- If the refrigerant hose should fail or if other refrigerant leakage should occur, switch off the air conditioner immediately.
- Refrigerant is injurious to the skin and eyes.
- Never release refrigerant in an enclosed space. If released into a service pit, for instance, the gas may cause asphyxia.
- It is forbidden by law to discharge refrigerants into the air intentionally.
- Never carry out welding on a charged refrigeration system or in its vicinity.
- Only authorised service mechanics are allowed to drain off and fill refrigerant in the air conditioning system.

Only the prescribed refrigerant may be used when refilling.

The liquid refrigerant should be completely evaporated before it is allowed to flow from the evaporator. The refrigerant is still cold even when it has completely evaporated. The cold vapour which flows through what remains of the evaporator continues to absorb heat, and then becomes overheated. This means that the temperature of the refrigerant has risen to above the point where it evaporates without changing the pressure.

In an evaporator which operates at a suction pressure of 2 bar, the liquid refrigerant will have a temperature of -1.1°C . When the refrigerant is subsequently evaporated through heat absorption in the evaporator, the temperature of the gas will rise at the evaporator outlet to $+1.6^{\circ}\text{C}$. This represents a difference of 2.7°C between the evaporation temperature and the temperature at the outlet. This is called overheating.

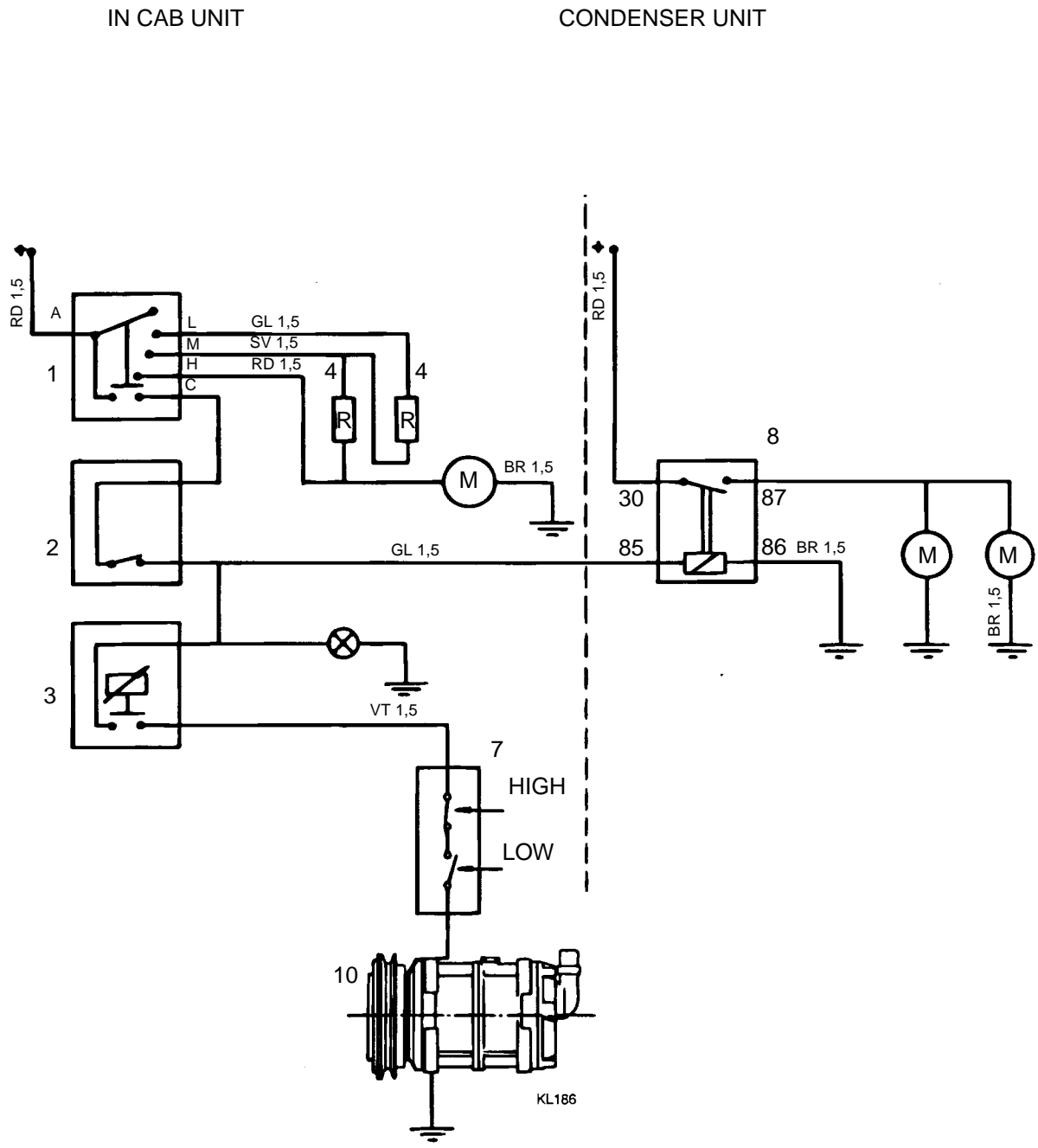
All expansion valves should be adjusted at the plant in such a way that maximum evaporation with overheating is performed in the air conditioning system.

Checking the air conditioning unit

If the unit is in continuous operation, this check should be carried out every week from early spring to late autumn and during extended periods of high humidity during the winter.

If the unit is used very little during cold and dry winter periods, the compressor should be run for a few minutes every week, to lubricate the rubber hoses, couplings, seals and shaft seal.

1. Start the engine and start the air conditioner.
At an outdoor temperature below 0°C , the system cannot start since the low-pressure relay breaks contact.
2. After 10 minutes of operation, check that no bubbles are visible in the sight glass of the filter-dryer. (Bubbles should occur only when the compressor is started and stopped.)
If there are any air bubbles, subsequent filling should be performed by an authorised service mechanic.
3. Check that the condenser is not clogged. If necessary, clean the condenser fins and the fans with compressed air.
4. Change the fresh air filter as necessary.
5. Check the V-belt tension and the compressor mounting.
6. Check that the magnetic coupling engages and disengages satisfactorily.
7. Check that the condensate drain from the cooling element is not clogged. Check for leakage.



1. Fan switch
2. Cooler on/off
3. Anti-freeze thermostat
4. Resistor
5. Fan motor
6. Indicator lamp – cold (in push button)
7. High-/low-pressure monitor
8. Relay
9. Condenser fan
10. Compressor

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Group 20

Electrical system

Specifications	2	ECU 3	
Electrical system	3	Functions	66
Description	3	Circuit board	67
Checking the electrolyte level of the batteries	5	Module 54 Tilt	68
Fuses	5	Module 56 Cab movement.....	69
Relays	6	Module 61 Support jacks	71
Bulbs	7	Diagrams	
Starting from another battery	8	Gearchanging systems	73
Air operated operator's seat.....	8	Components, A38630.0100 and A38630.0200.....	77
ECS-system		ECS overview	78
Overview	9	Electrical diagram explanations	79
Terminal	10	Cable markings.....	80
Menu structure	10	Component list	
Operating menus	11	Electrical diagrams ECS top lift – page	
Error messages.....	15	A24925.2000 - 1, 2, 3	A24925.2200 - 1
Service menus	20	A24927.2000 - 1, 2	A24927.2200 - 1, 2
ECU-processor unit.....	22	A24929.2000 - 1, 2	
Transmission data kit	23	Electrical diagram, truck body.....	A08334.1200
Engine data kit	23	Electrical diagram, inner, standard	A08333.1000
ECU 1		EI-servo, singel ECU (S).....	A38630.0100
Functions.....	24	EI-servo, double ECU (S)	A38630.0200
Circuit board.....	26	Diagram attachment, 4 pages.....	A38414.0100,1-4
01 Automatic gear changing	27	Feed	A38414.0100, 1/4
04 Lever steering	28	Indication	A38414.0100, 2/4
07 Monitoring	31	Servo	A38414.0100, 3/4
		Working lights.....	A38414.0100, 4/4
ECU 2		Cable to twist-locks	A38636.0100
Functions.....	33	Cable feed KDU 791	A38415.0100
Circuit board.....	34		
Installation, boom	35		
Electric servo.....	36		
Control lever.....	37		
Pressure sensors right and left lift cylinders	41		
Lift - regeneration - lower	42		
Boom extension - regeneration.....	45		
Rotation.....	49		
Twist-locks	51		
Side-shift	53		
Length adjustment 20-40'	54		
Module 50 Mechanical Overload Protection	56		
Module 51 Vertical lift for Module 50.....	59		
Module 52 Vertical lift + Balance for Module 50.....	60		
Module 57 Hydraulic Balance	61		
Module 59 Limitation Height/ LC-distance for Module 50/60.....	62		
Module 60 Electronic Overload Protection.....	63		

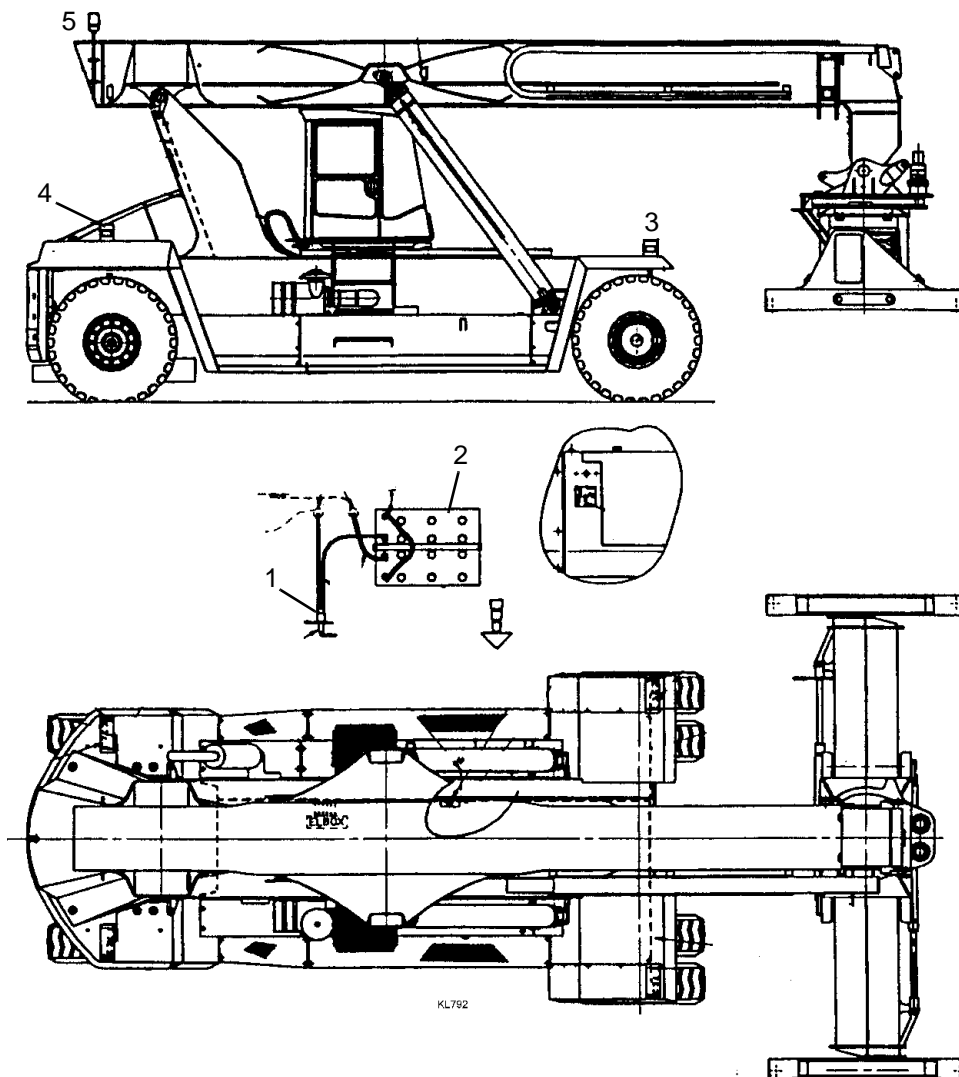
Alternator rating	1920 W
Starting battery voltage	24 V (2 x 12 V)
capacity	140 Ah
earthing	negative

IMPORTANT!

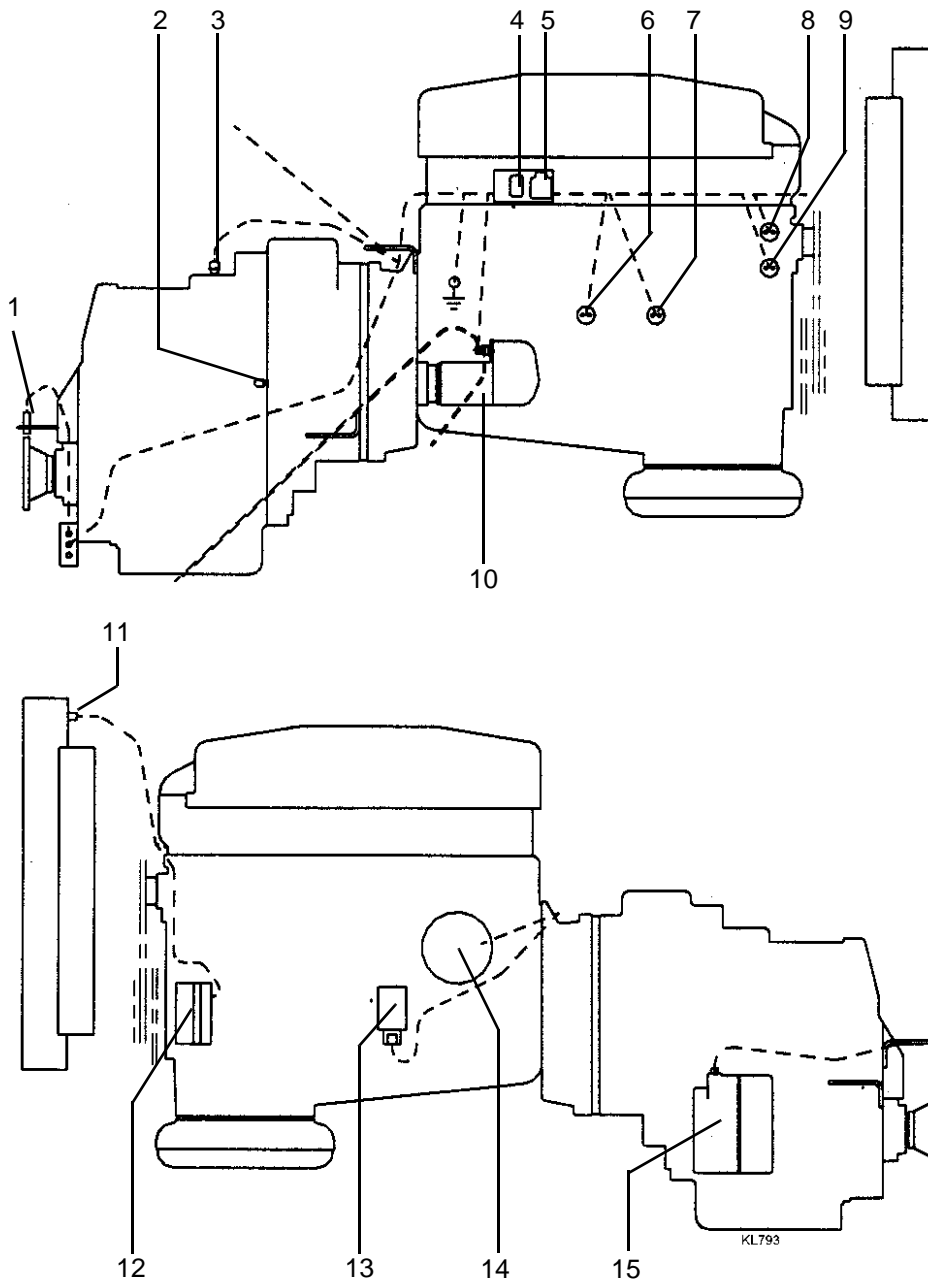
Always open the main switch whenever work is to be carried out on the electrical system, if the truck is to remain idle for some time and whenever welding work is to be carried out on the truck.

The system voltage is 24V and the supply is taken from two 12V batteries connected in series and charged by an alternator across electronic rectifying and voltage stabilisation circuits.

The negative and positive poles are both connected across a main switch. The negative pole is then connected to the chassis. Warning lamps and instruments are clearly arranged on the instrument panel. The central electrical unit with fuses and relays is located on the lower section of the cab's rear wall.



1. Main switch
2. 24 V battery
3. Running lights
4. Rear lights
5. Rotating warning light

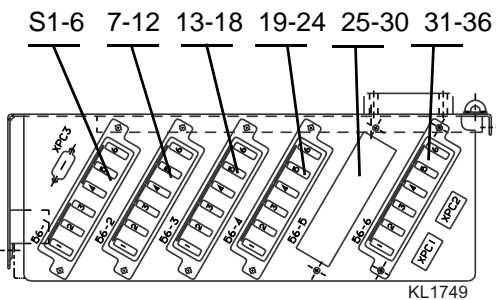


1. Sensor, outgoing revs (ECS or reversing block)
2. Sensor, gearbox oil temperature, warning lamp and meter
3. Sensor, gearbox oil pressure, warning lamp and meter
4. Main fuses 2 X 50A
5. Relay preheater
6. Sensor, engine oil pressure, warning lamp
7. Sensor, engine oil pressure, meter
8. Sensor, coolant temperature, warning lamp
9. Sensor, coolant temperature, meter
10. Starter motor
11. Sensor, coolant level
12. Alternator
13. Solenoid valve, stop engine
14. Throttle lever, injection pump
15. Solenoid valve for gear changing

N.B.

The starting batteries accompanying the truck are of the maintenance-free type, which implies that it should not be necessary to top-up with electrolyte during the life of the batteries.

However, the level of the electrolyte should preferably be checked once or twice a year. Fill as required by adding de-ionized water.



WARNING!

Never use fuses of a higher amperage than stated on the lid decal. Risk of damage or fire.



WARNING!

It is prohibited to connect extra consumers to any fuse.

Checking the electrolyte level of the batteries

The batteries are fitted behind a cover on the left-hand side of the truck. The electrolyte level should be about 10 mm above the cells. Top up with de-ionized water as necessary.

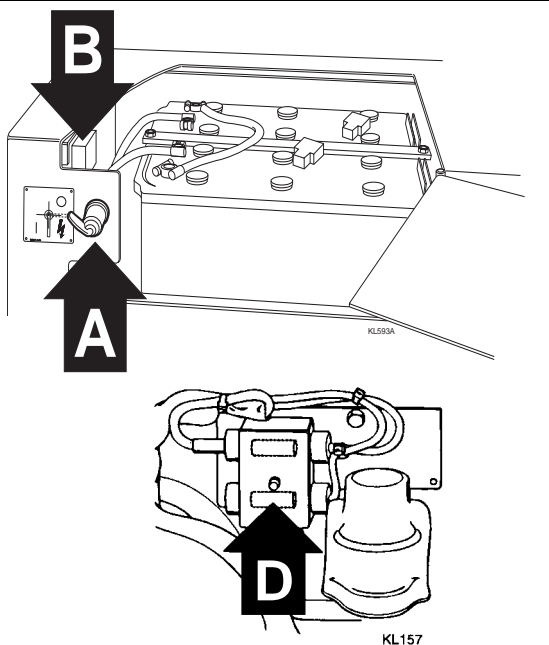
Relay box in cab – fuses

Fuse No.	Circuit protected	Rating A
S1	Wiper motor front, direction indicators, seat buzzer, parking brake sensor.....	10
S2	Ignition key, preheater, starter motor, air conditioner, cab lighting	15
S3	Container attachment, safety interlock	15
S4	Electric gear-changing	5
S5	Warning lamps, instrument illumination, relay, coolant level	5
S6	Brake lights, reversing lights, reversing alarm	15
S7	Fan (Option: Air conditioning) ¹⁾	25
S8	Spare (Option: Container lights) ¹⁾	15
S9	Working lights (15 A for 4 lamps) ¹⁾ Hazard beacon	10
S10	Working lights, standard (15 A for 4 lamps)	10
S11	Horn, screenwash motor, wiper rear and roof, wiper front, intermittent relay	10
S12	Driving lights (main fuse), rear lights (main fuse), position lights	15
S13	Main beam, right-hand	5
S14	Main beam, left-hand.....	5
S15	Dipped beam, right-hand.....	5
S16	Dipped beam, left-hand.....	5
S17	Rear light, left-hand.....	5
S18	Rear light, right-hand.....	5
S19	ECU1 ¹⁾	10
S20	ECU2.....	10
S21	Voltage converter	5
S22-S24	Extra	–
S25-S30	Extra	–
S31	Illumination entry steps, engine compartment ¹⁾	–
S32	Compressor, air operated chair ¹⁾	–
S33	electrically operated parking brake.....	5
S34	Oil cooler, hydraulic oil ¹⁾	–
S36	Central lubrication ¹⁾	–
S36	Water separator ¹⁾	–

¹⁾Optional equipment

Miscellaneous fuses

- A Main switch
- B Main fuse, boom (1x25 A)
- D Main fuse for truck electrical system
Fitted on the engine, 2x50 A



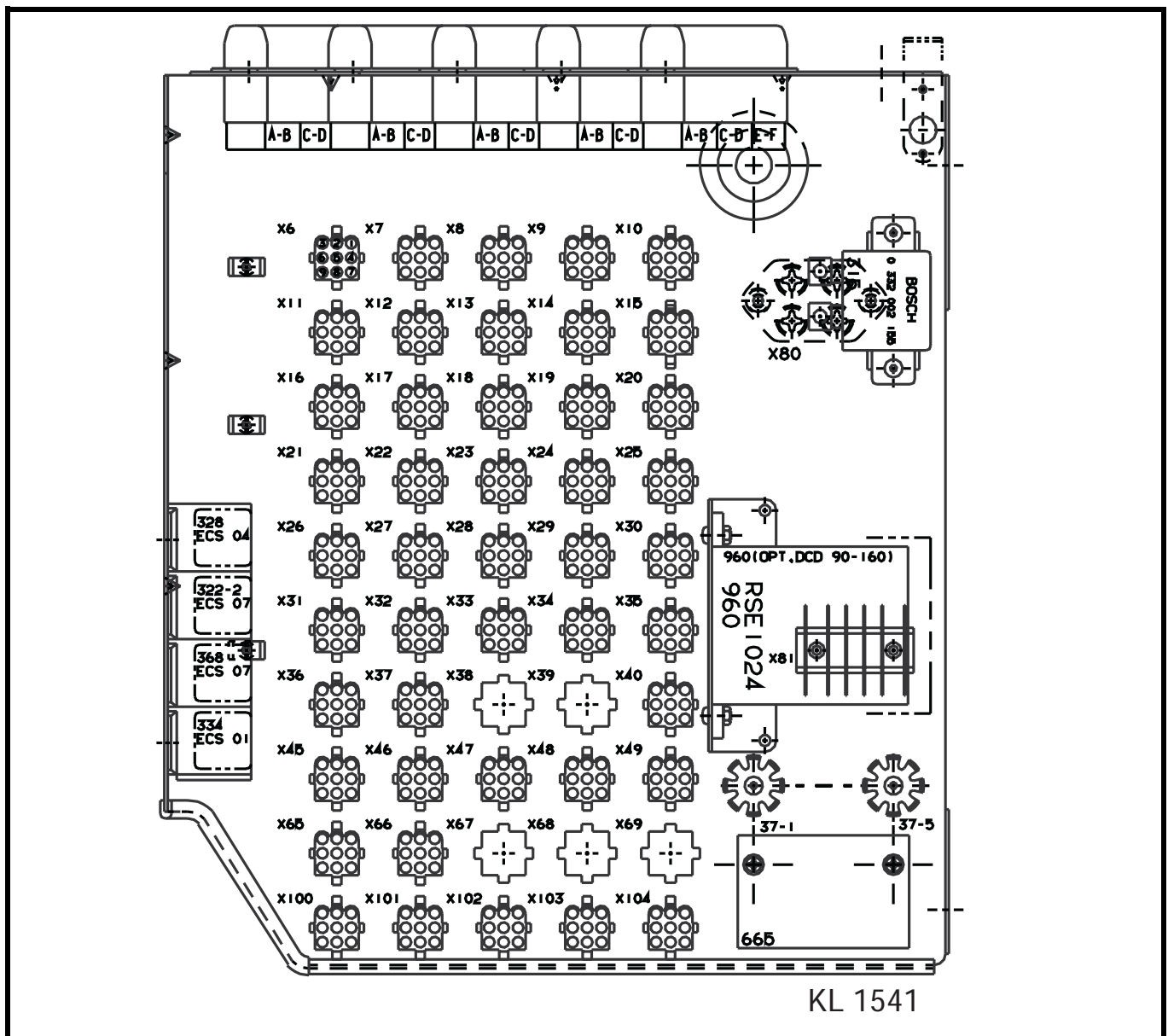
Relays

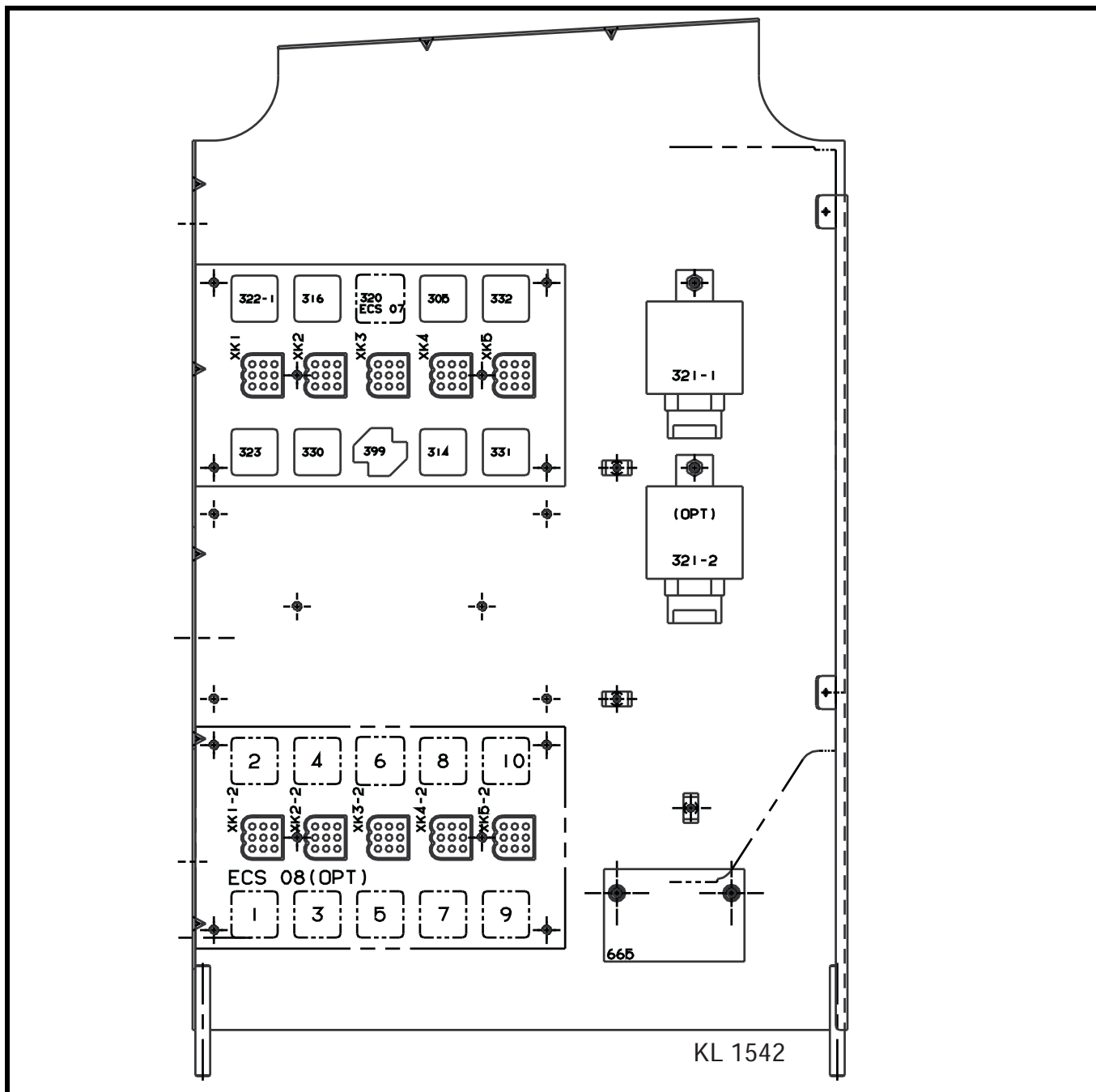
- 305 Reversing light
- 314 Parking brake, disengagement
- 315 High power (Starting switch)
- 316 Wiper motor, front
- 320 Electric stop (ECS 07) ¹⁾
- 322 Coolant level (ECS 07) ¹⁾
- 323 Pulse relay, direction indicators
- 328 Gear shift (ECS 01) ¹⁾
- 330 Starting block
- 331 Propulsion forward
- 332 Propulsion reverse
- 334 Clutch release (ECS 01) ¹⁾
- 367 Lever steering (ECS 04) ¹⁾
- 322-1 Coolant level
- 322-2 Coolant level (ECS 07) ¹⁾
- 399 Spare

Miscellaneous

- 321-1 Intermittent relay wiper front
- 321-2 Intermittent relay wiper rear ¹⁾
- 960 Reversing interlock (excluded at ECS 01)

¹⁾ Optional equipment





Bulbs

Description	Rating Watts	Base
Instruments	3	BA7s
Indicating lamps	1,2	W2x4,6d
Cab lighting	10	S8,5
Rear lights, red	5	BA15s
Brake lights	21	BA15s
Direction indicators	21	BA15s
Position lights	5	SV8,5
Driving lights (full/dipped beam)	75/70	P43t-38
Reversing lights, white	70	PK22s
Working lights	70	PK22s
Hazard beacon	70	PK22s



WARNING!

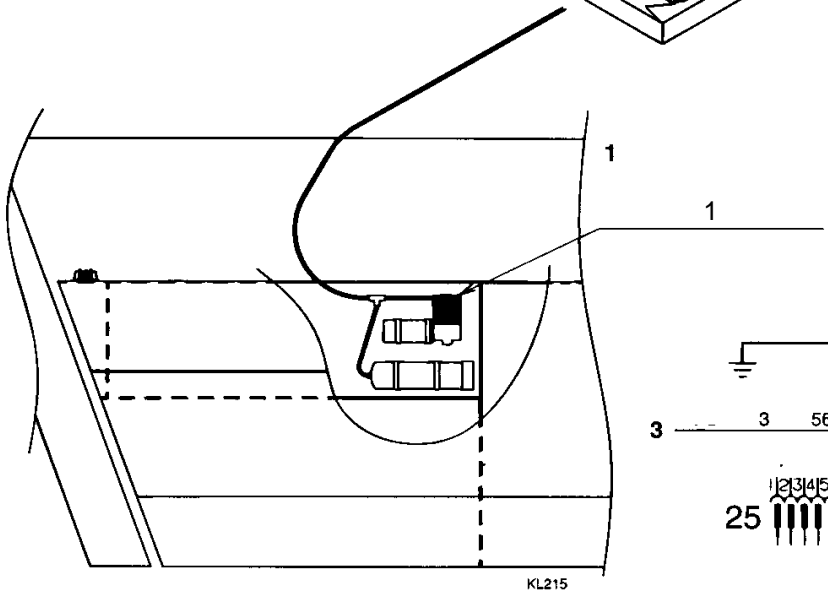
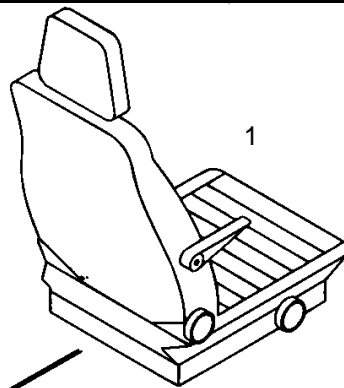
Batteries emit oxyhydrogen which is an explosive gas. A spark, for example from incorrectly connected starting cables, could cause a battery to explode and result in serious injury and damage.

Starting from another battery

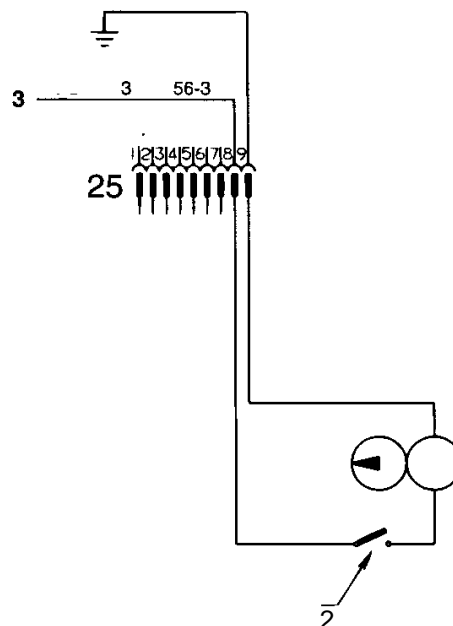
- Make sure the auxiliary batteries are connected in series, so that 24 V will be supplied.

N.B. Do not disconnect the truck-battery cables

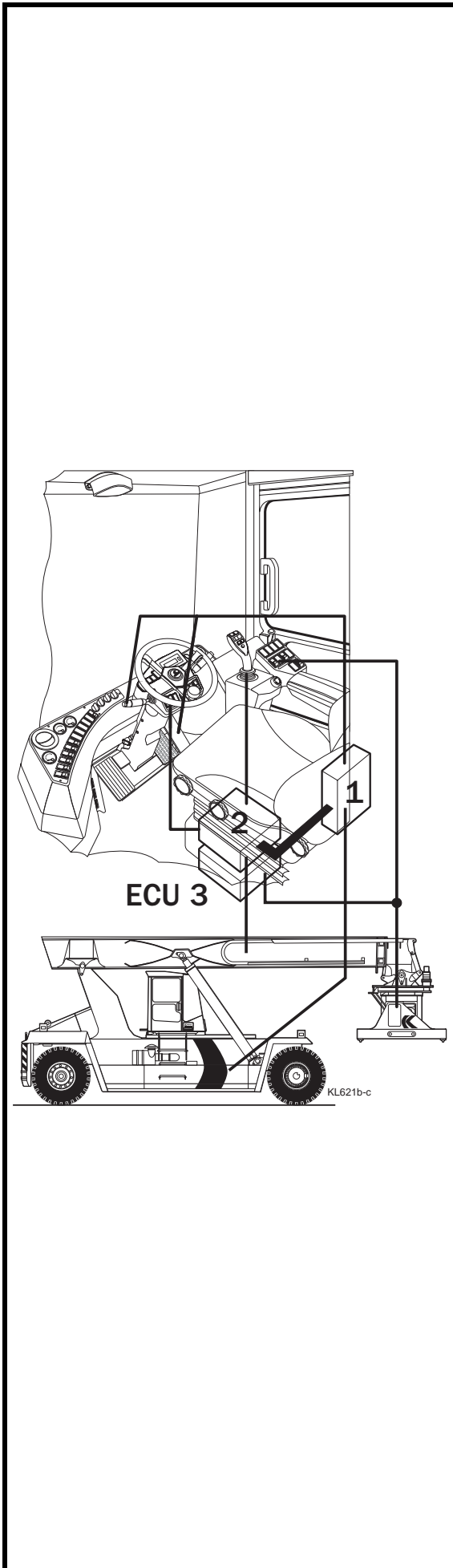
- Connect the jumper cables in the following order:
 1. Red cable (+) to auxiliary battery
 2. Red cable (+) to truck battery
 3. Black cable (-) to auxiliary battery
 4. Black cable (-) to a location **some distance away from** the truck battery, such as the negative cable connection on the chassis.
- Start the engine
Do not disturb the jumper cables while starting, as sparks may otherwise be caused. Do not lean over either battery.
- Disconnect the jumper cables in exactly the reverse order.



1. Motor and compressor
Installed in a box on the right hand side of the machine or beneath the cab
2. Pressure monitor
3. Fuse 3, 56.3



Air operated operator's seat



Kalmar's ECS - Electronic Control System - is a modular control and monitoring system to ensure optimum operational security and total economy. It is possible to combine the system's different modules in a number of different ways.

All vital points of the trucks different systems are connected to one or several central computer units, ECUs. A terminal display in the operator's cab shows current values and generates an alarm if the values exceed the programmed tolerances.

DRD Container machines are equipped with ECS as standard. Depending on how respective machines are equipped, one, two or three ECU central units may be fitted.

- ECU 1 is used for different additional modules, such as 01 Automatic Gear Changing, 04 Lever Steering, 06 Mini-steering, 07 Monitoring. See separate descriptions in respective sections.
- ECU 2 is obligatory and is used to control the EI-Servo circuits. See the EI-Servo section. ECU 2 also functions as overload protection and for the regeneration system.
- ECU 3 is used for machines with modules according to the table below.

ECU 1 ¹⁾	ECU 2	ECU 3 ¹⁾
01 Automatic Gear Changing ¹⁾ 04 Lever Steering ¹⁾ 06 Mini-steering ¹⁾ 07 Monitoring ¹⁾	50 Mechanical overload protection Regeneration 51 Vertical lift ¹⁾ 52 Balance + vertical lift ¹⁾ 53 Locking tilt ¹⁾ 57 Hydraulic balance ¹⁾ 58 Container counter ¹⁾ 59 Limitation Height/LC-distance ¹⁾ 70 PC/Printer ¹⁾ 60 Electronic overload protection Regeneration Vertical lift 53 Locking tilt ¹⁾ 58 Container counter ¹⁾ 59 Limitation Height/LC-distance ¹⁾ 70 PC/Printer ¹⁾	54 Tilt ¹⁾ 55 Pile slope ¹⁾ 61 Support jacks ¹⁾

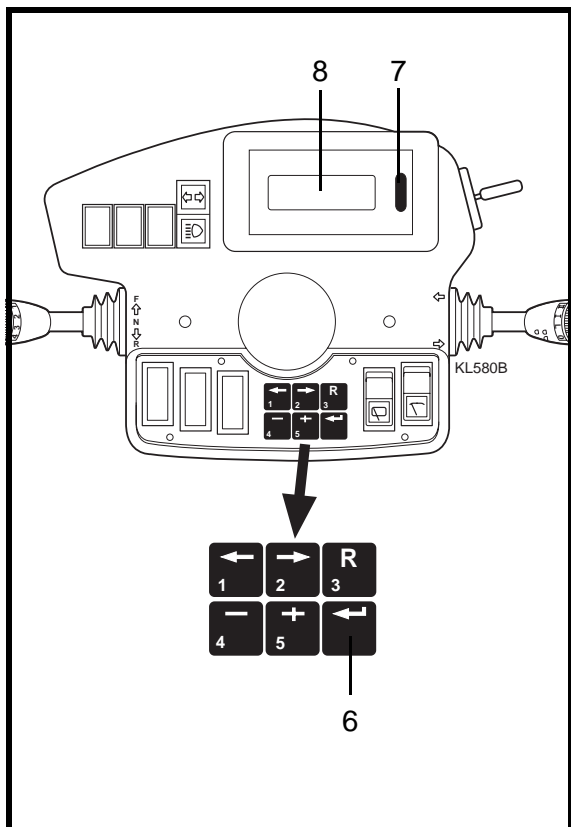
¹⁾ Optional equipment

The ECS:

- monitors the engine and gearbox to ensure reasonable operating conditions
- monitors the components in the system, e.g., sensors, to ensure their correct function
- provides torque controlled automatic gear changing
- interrupts hydraulic functions when overload of the steering axle occurs
- controls the regeneration function for boom extension and lift cylinders
- controls vertical lift, balance, pile slope etc.

If a fault occurs:

- a red warning lamp blinks on the terminal
- an error message appears on the terminal display
- The ECS limits the functions of the truck in different ways depending on the seriousness of the fault. Certain functions are monitored on two levels, where level 2 limits the functions of the truck. See the error messages on the terminal display on the following pages.



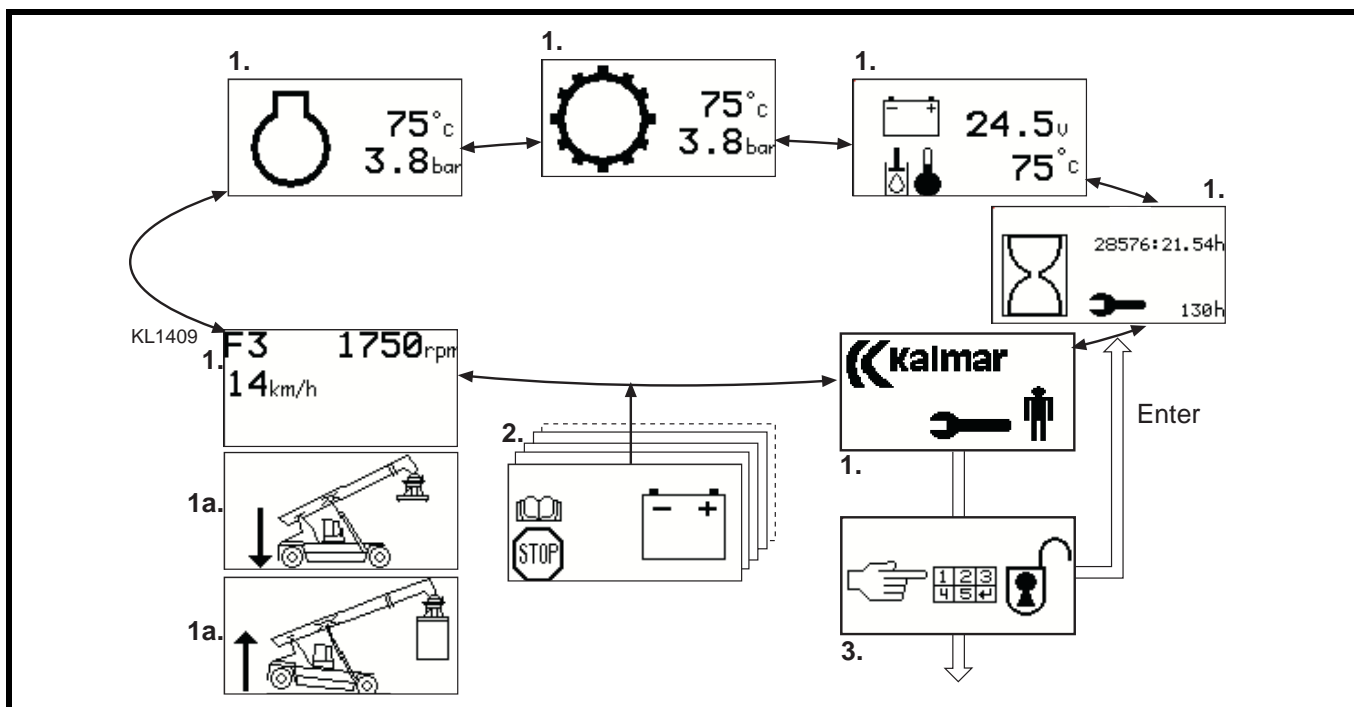
Terminal functions

1. Arrow left is used to scroll between the different menus.
2. Arrow right is used to scroll between the different menus.
3. R is used to reset the display after an error message. All errors, with the exception of certain level 2 errors can be reset by pressing this button. The red warning lamp is then extinguished. The lamp begins to blink again after 3-10 minutes, depending on the fault, if it has not been rectified.
4. - is used to decrease a value.
5. + is used to increase a value.
6. ENTER is used to access the service menus and to save new values when setting up and calibrating the system. Access to the service menus also requires the use of special codes, that are separately obtainable from Kalmar.
7. A red warning light blinks in the event of an error and is extinguished when reset by pressing button 3.
8. The terminal display has 4 lines with space for 20 characters on each line. Graphical presentation of operating menus and error messages.

Menu structure

There are three types of menu:

1. **Operating menus**
The operating menus are accessible to the operator. The menus that can be selected depend on how the truck is equipped and are determined in SETUP. All operating menus are part of a connected loop. Use arrow RIGHT/LEFT to move around the loop. The loop also contains:
 - 1.a **Overload indicator**
Depends on the selected overload protection, module 50/60.
2. **Error messages**
Displayed automatically and have priority over other menus.
3. **Service menus**
The operating menu loop always contains the KALMAR INDUSTRIES SERVICE main menu. The service sub-menus under this main menu require access to codes that can be found on a special list from Kalmar. If ENTER is pressed by mistake in the service menu and the ENTER CODE menu is displayed, return to the operating menu by pressing ENTER. For further information, refer to the respective headings.



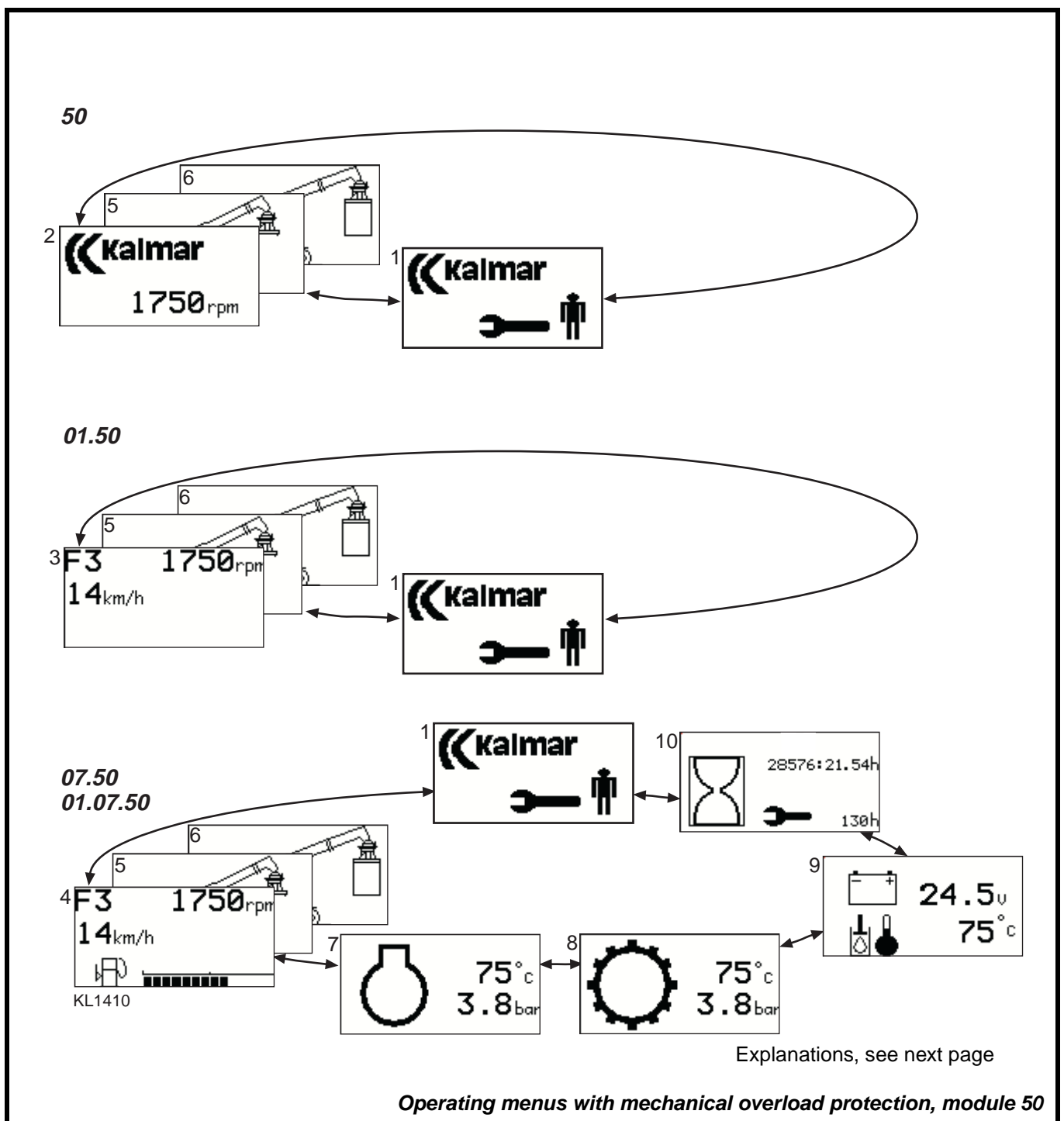
- 01 Automatic gear changing
- 07 Monitoring
- 50 Mechanical overload protection system
- 60 Electronic overload protection system

Operating menus

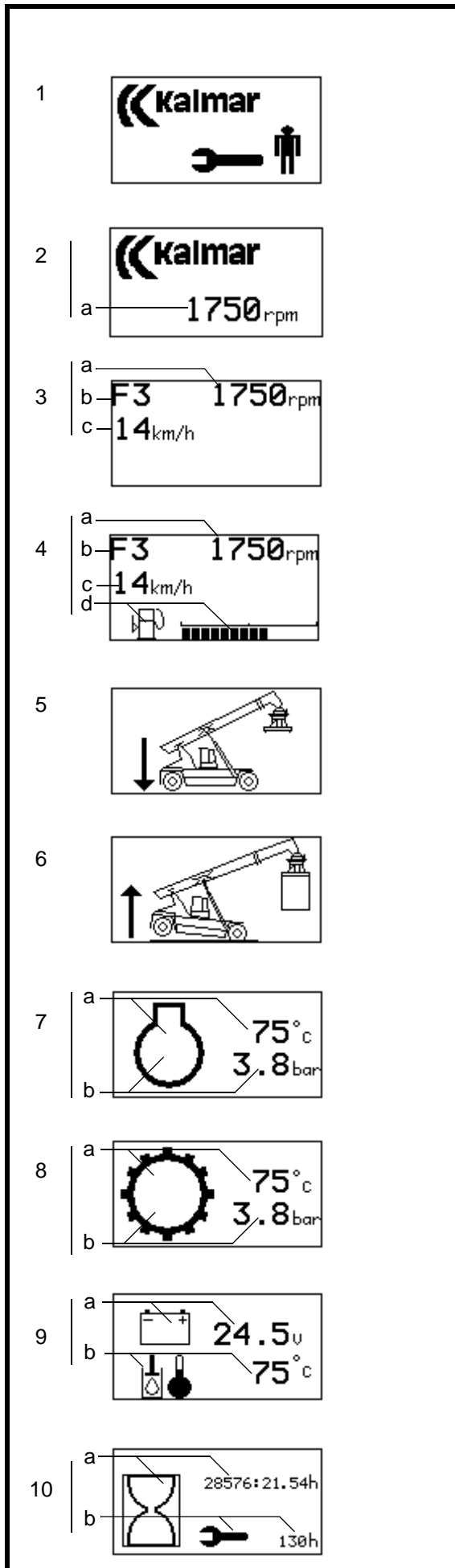
The menus that are displayed on the terminal depend on the modules with which the truck's ECS is equipped. The overview below shows the possible combinations. Use either arrow RIGHT/LEFT to switch between menus. All operating menus are in a connected loop.

Access to the sub-menus under the service menu requires an access code. If ENTER CODE is displayed by mistake, return to the operating menu by pressing ENTER.

N.B. Additional menus may occur as a result of adaptation to specific customer requirements.



Operating menus, module 50



1. Main menu KALMAR INDUSTRIES SERVICE

2. Normal operating condition, module 50
 - a. 1750rpm Engine speed, r/min

3. Normal operating condition, module 50 + module 01
 - a. 1750rpm Engine speed, r/min
 - b. F3 Current gear
 - c. 14 km/h Current speed

4. Normal operating condition, module 50 + module 01 + module 07
 - a. 1750rpm Engine speed, r/min
 - b. F3 Current gear
 - c. 4 km/h Current speed
 - d. Fuel level. The tank is full when the indicator is filled to the right.

5. Red lamp blinks
The steering axle is overloaded.
It is not possible to switch to other menus until the overload is rectified.

6. The system interrupts operation. The red warning lamp lights continuously.
The machine has forward overload.
It is not possible to switch to other menus until the overload is rectified.

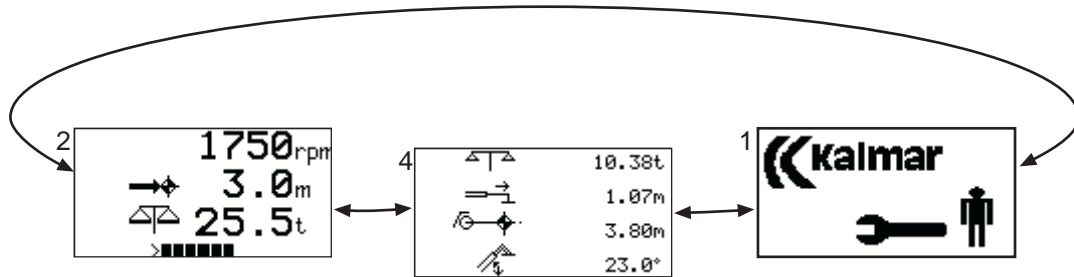
7.
 - a. 75 °C Engine coolant temperature
 - b. 3.8 bar Engine oil pressure

8.
 - a. 75 °C Gearbox oil temperature
 - b. 3.8 bar Gearbox oil pressure

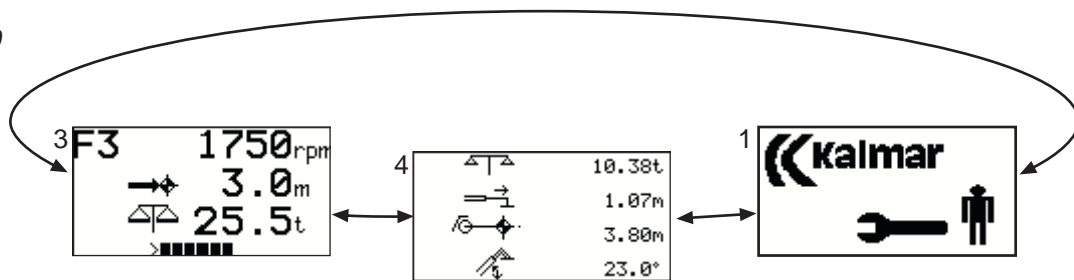
9.
 - a. 24.5 v Battery voltage
 - b. 75 °C Hydraulic oil temperature

10.
 - a. 28576:21.54h Total operating time, tim: min. sek.
 - b. 130h Time to next service, tim

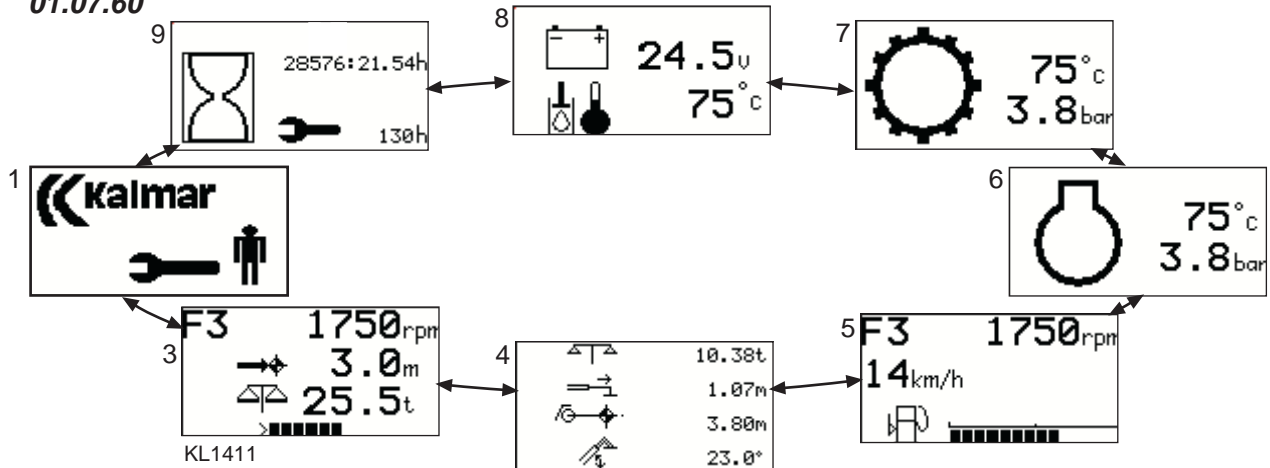
60



01.60



07.60
01.07.60



Explanations, see next page

Operating menus, module 60

Module 60 overload protection function, under normal conditions, functions as a balance and gives a continual reading of the size and position of the load.

1. Main menu KALMAR INDUSTRIES SERVICE

2. Normal operating condition, module 60.

- a. 1750 rpm Engine speed, r/min
- c. 3.0 m Distance between the front edge of the wheels and the centre of gravity of the load.
- d. 25.5 t Current load in tonnes
- e. Indicator showing steering axle load, fills the display to the left for 95-100% of the permitted load. When the indicator reads full, the system interrupts operation due to overloading of the steering axle. The red warning lamp blinks. It is not possible to switch to other menus until the overload is rectified.

f. Load indicator, fills the display to the right for 0-100% loads. When the load indicator reads full, the system interrupts operation due to forward overload. The red warning lamp lights continually. It is not possible to switch to other menus until the overload has been rectified.

3. Normal operating condition, module 60 + module 01 + module 07

- a. 1750 rpm Engine speed r/min
- b. F3 Current gear
- c. d. e. f. See menu 2 explanation above.

4. a. 10.38 t Current load in tonnes
b. 1.07 m Boom extension
c. 3.08 m Lc-distance. Distance between drive axle centre and load centre.
d. 23.0 ° Boom angle

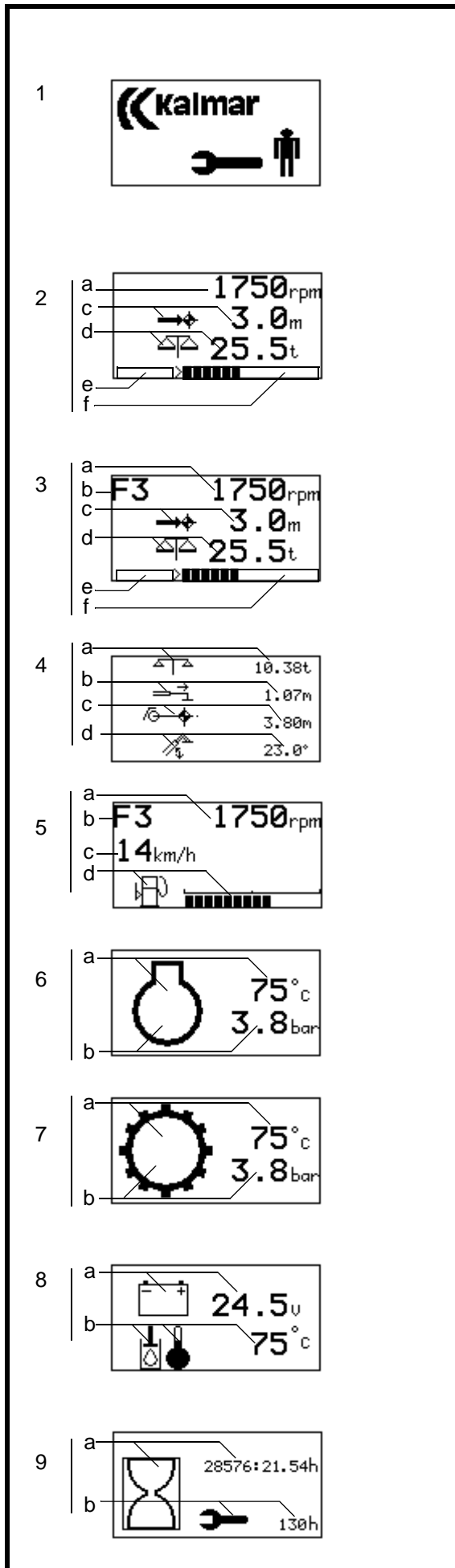
5. a. 1750 rpm Engine speed r/min
b. F3 Current gear
c. 14 km/h Current speed
d. Fuel level. The tank is full when the indicator is filled to the right.

6. a. 75 °C Engine coolant temperature
b. 3.8 bar Engine oil pressure

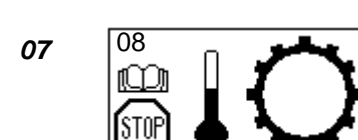
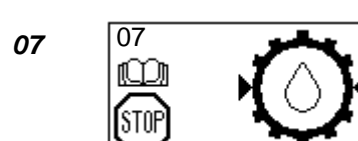
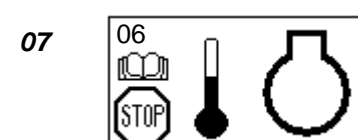
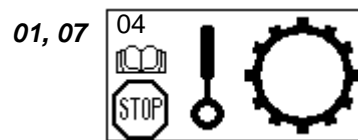
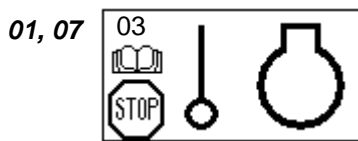
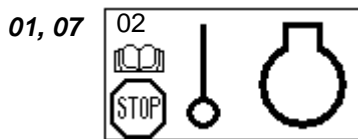
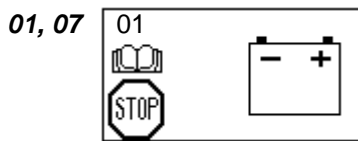
7. a. 75 °C Gearbox oil temperature
b. 3.8 bar Gearbox oil pressure

8. a. 24.5 v Battery voltage
b. 75 °C Hydraulic oil temperature

9. a. 28756:21.54 h. Total operating time, h: min. sec.
b. 130h Time to next service, h



- 01 = Automatic gear changing
- 04 = Lever steering
- 06 = Mini Steering
- 07 = Monitoring
- 50 = Mechanical overload protection
- 60 = Electronic overload protection



Error messages

In order of priority. If two faults occur at the same time, the terminal displays the fault with the highest priority. Error messages always have a higher priority than normal menus.

Errors 01-08 are level 2 errors and cannot be reset prior to the fault being rectified.

The first two figures to the left of the menu pictures show to which module the error message relates.

(These figures do not appear on the display)

01. Battery voltage very low/high
Stop as soon as possible and contact service.

02. Faulty signal from accelerator sensor.
Engine speed reduction.
Stop as soon as possible and contact service.

03. Faulty signal from injection pump motor sensor.
Engine speed reduction.
Stop as soon as possible and contact service.

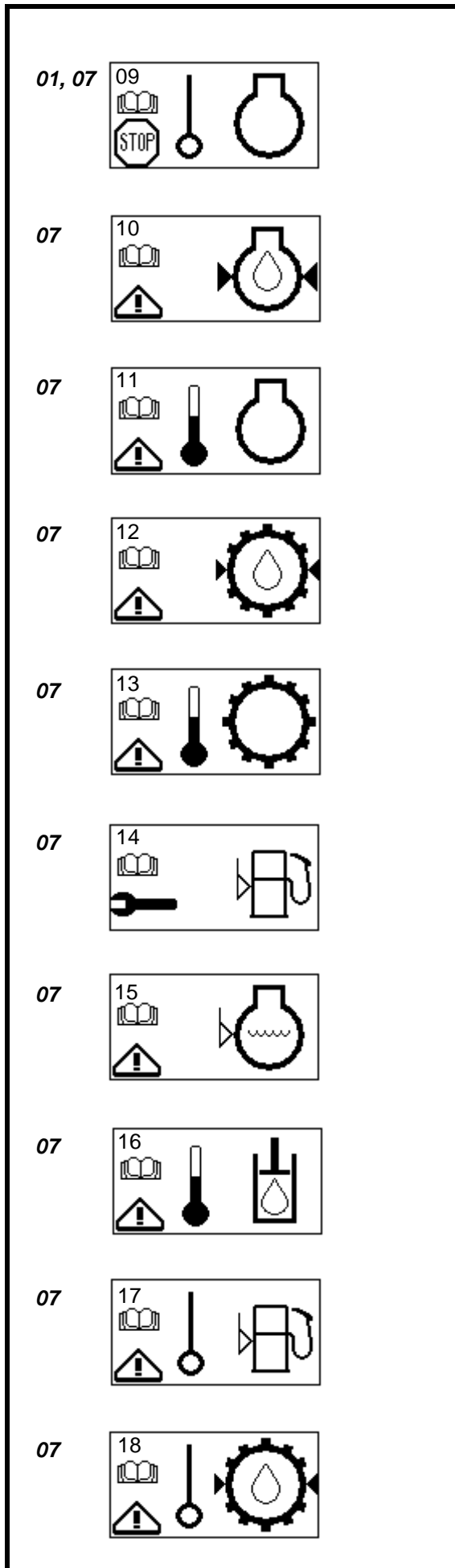
04. Gear lever not functioning.
Engine speed reduction.
Stop as soon as possible and contact service.

05. Engine oil pressure extremely low.
Engine speed reduction.
Stop as soon as possible and contact service.

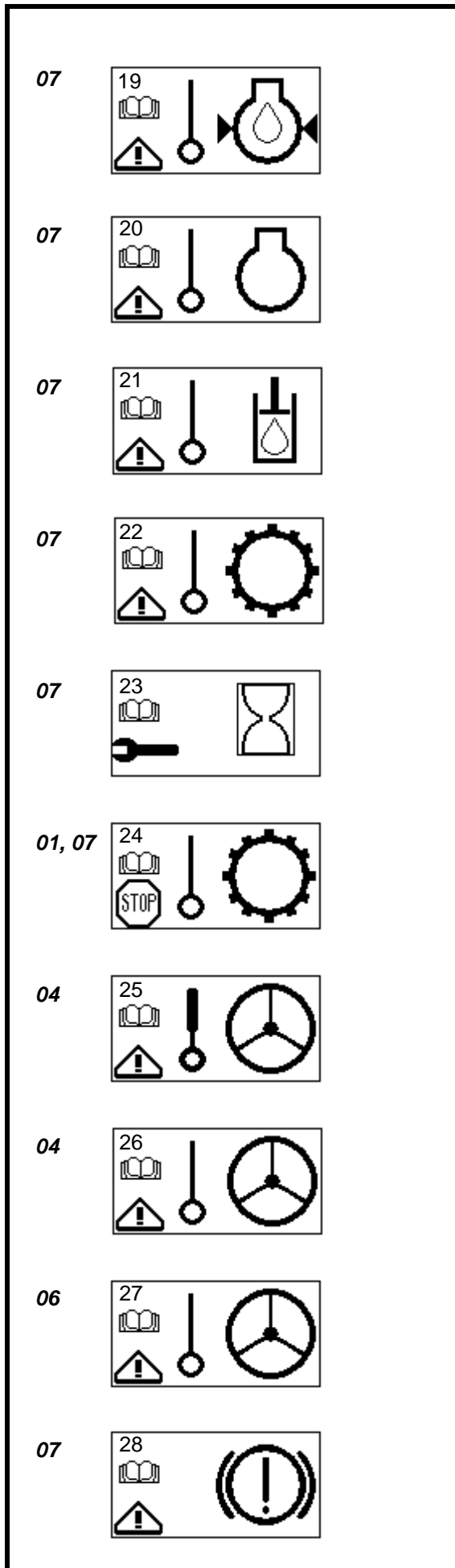
06. Coolant temperature extremely high.
Engine speed reduction.
Stop as soon as possible and contact service.

07. Gearbox oil pressure extremely low.
Engine speed reduction.
Stop as soon as possible and contact service.

08. Gearbox oil temperature extremely high.
Engine speed reduction.
Stop as soon as possible and contact service.



- 01, 07 09. Faulty signal from engine rev sensor.
Engine speed reduction.
Stop as soon as possible and contact service.
- 07 10. Low engine oil pressure.
Check oil level and top up as required.
- 07 11. High coolant temperature.
Check coolant level and top up as required.
- 07 12. Low gearbox oil pressure.
Check oil level and top up as required.
- 07 13. High gearbox oil temperature.
Check oil level and top up as required.
- 07 14. Fuel level extremely low.
Fill the tank to avoid air in the system.
- 07 15. Low coolant level.
Top up the coolant fluid.
- 07 16. High hydraulic oil temperature.
Operation possible.
Contact service.
- 07 17. Faulty signal from fuel gauge sensor.
Operation possible.
Contact service.
- 07 18. Faulty signal from gearbox oil pressure sensor.
Operation possible.
Contact service.



- 19. Faulty signal from engine oil pressure sensor.
Operation possible.
Contact service

- 20. Faulty signal from coolant temperature sensor.
Operation possible.
Contact service.

- 21. Faulty signal from gearbox oil temperature sensor.
Operation possible.
Contact service.

- 22. Faulty signal from hydraulic oil temperature sensor.
Operation possible.
Contact service as soon as possible.

- 23. Service interval exceeded.
Contact service as soon as possible.

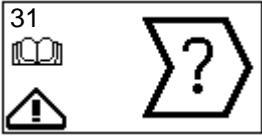
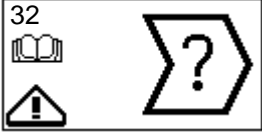
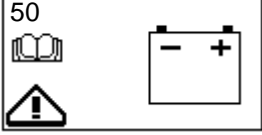
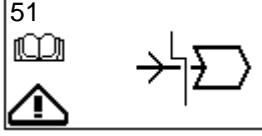
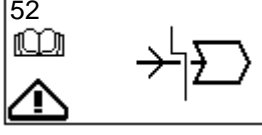
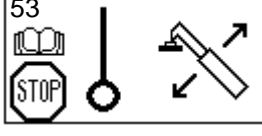

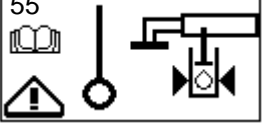
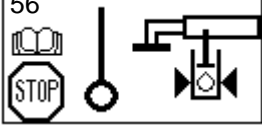
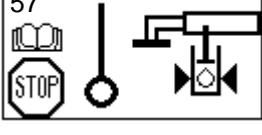
- 24. Faulty signal from prop shaft rpm sensor
Engine speed reduction.
Stop as soon as possible and contact service.

- 25. Steering lever fault.
Switch off the steering system.
Contact service as soon as possible.

- 26. Faulty signal from steering sensor.
Switch off the steering system.
Contact service as soon as possible.

- 27. Faulty signal from mini steering sensor.
Switch off the steering system.
Contact service as soon as possible.

- 28. Warning! Low brake pressure.
Contact service as soon as possible.

-	
-	
07	
60	
60	
60	
60	
50, 60	
50, 60	
50, 60	

31. System fault ECU 1.
Contact service as soon as possible.

32. System fault ECU 2.
Contact service as soon as possible.

50. Battery voltage very low/high.
Contact service as soon as possible.

51. Communication with ECU 3 broken.
Contact service as soon as possible.

52. Communication with ECU 1 broken.
First try switching off and then re-starting the engine!
If the fault remains, contact service as soon as possible.

53. Faulty signal from angle sensor
Stop as soon as possible and contact service.

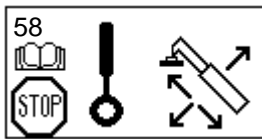
54. Faulty signal from length sensor.
Stop as soon as possible and check the sensor wire.
Contact service if the fault remains.

55. Faulty signal from regeneration sensor.
The regeneration is discontinued.
Contact service.

56. Faulty signal from hydraulic pressure sensors for left lift cylinder. (There is a sensor in both feed and return lines)
Stop as soon as possible and contact service.

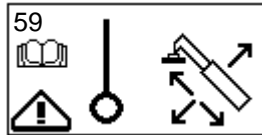
57. Faulty signal from hydraulic pressure sensors for right lift cylinder. (There is a sensor in both feed and return lines)
Stop as soon as possible and contact service.

50



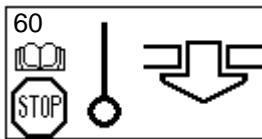
58. Faulty analog signal from joystick.
All boom functions are interrupted.
Stop as soon as possible and contact service.

50



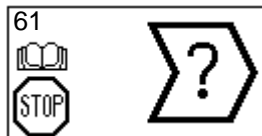
59. Faulty signal from sensor for end position damping
Contact service as soon as possible.

-



60. Faulty signal from twist-locks sensors.
Applies to both locked and unlocked position.
The signal from one or more sensors remains on for more than 60 sec after unlocking of twist-locks.
Check that the contact pins can move freely up and down.
Contact service as soon as possible if the fault remains.

60



61. System fault.
Load curve is missing.
Stop as soon as possible and contact service.

60



62. Each one of the Module 60 errors will activate error menu 62.
When error menu 62 is activated:
Warning lamp on the ECS-terminal lights up
- When pressing RESET:
Menu 62 starts blinking, 5 sec ON and 5 sec OFF
The hydraulic functions LIFT/LOWER and BOOM OUT/IN are operative but at a lower speed.

Detailed descriptions of **SETUP**, **INITIATION** and **CALIBRATION** can be found in the separate **ECS SERVICE Handbook**
Contact Kalmar

Service menus

All service sub-menus are accessible from the main KALMAR INDUSTRIES SERVICE menu, thereafter, a code must be registered. There are four different codes, codes 1, 2, 3 and 4.

- Code 1 leads to the **SETUP**, **INITIATION** and **CALIBRATION** of the modules in ECU1.
- Code 2 leads to the **INITIATION** of the EI-servo in ECU 2.
- Code 3 leads to the **CALIBRATION** of module 60 in ECU 2.
- Code 4 leads to the **DIAGNOSIS** menu.

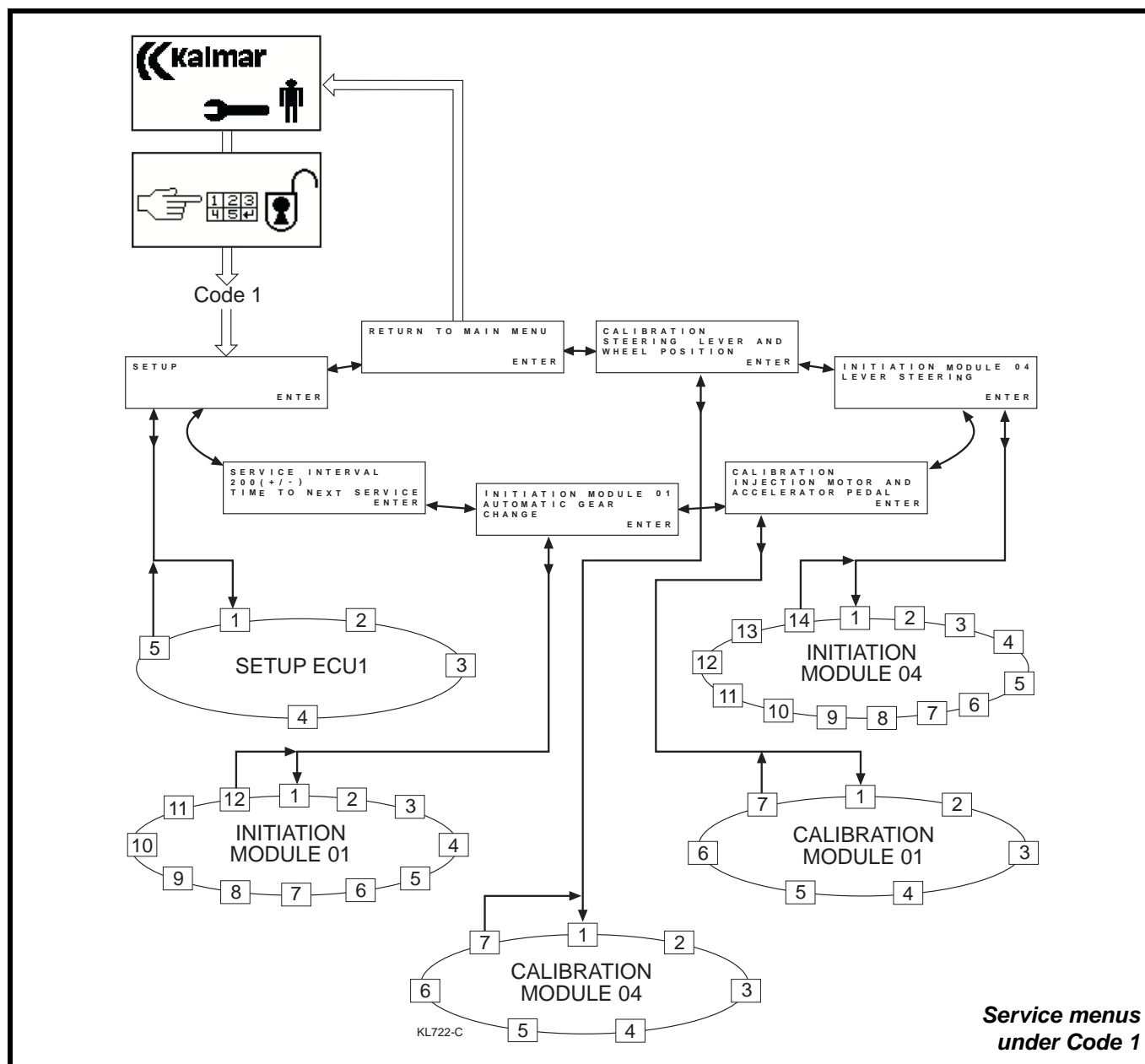
Definition of terms:

SETUP is the setting of the basic values of the machine, defining, for example, the modules with which the machine is equipped. This determines which operational menus then appear.

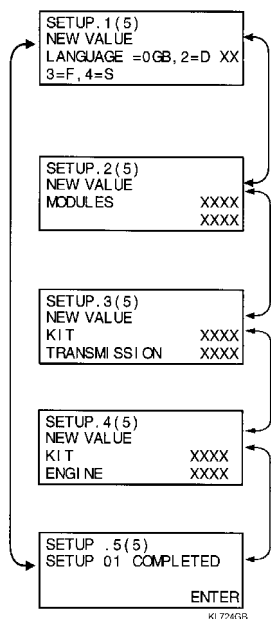
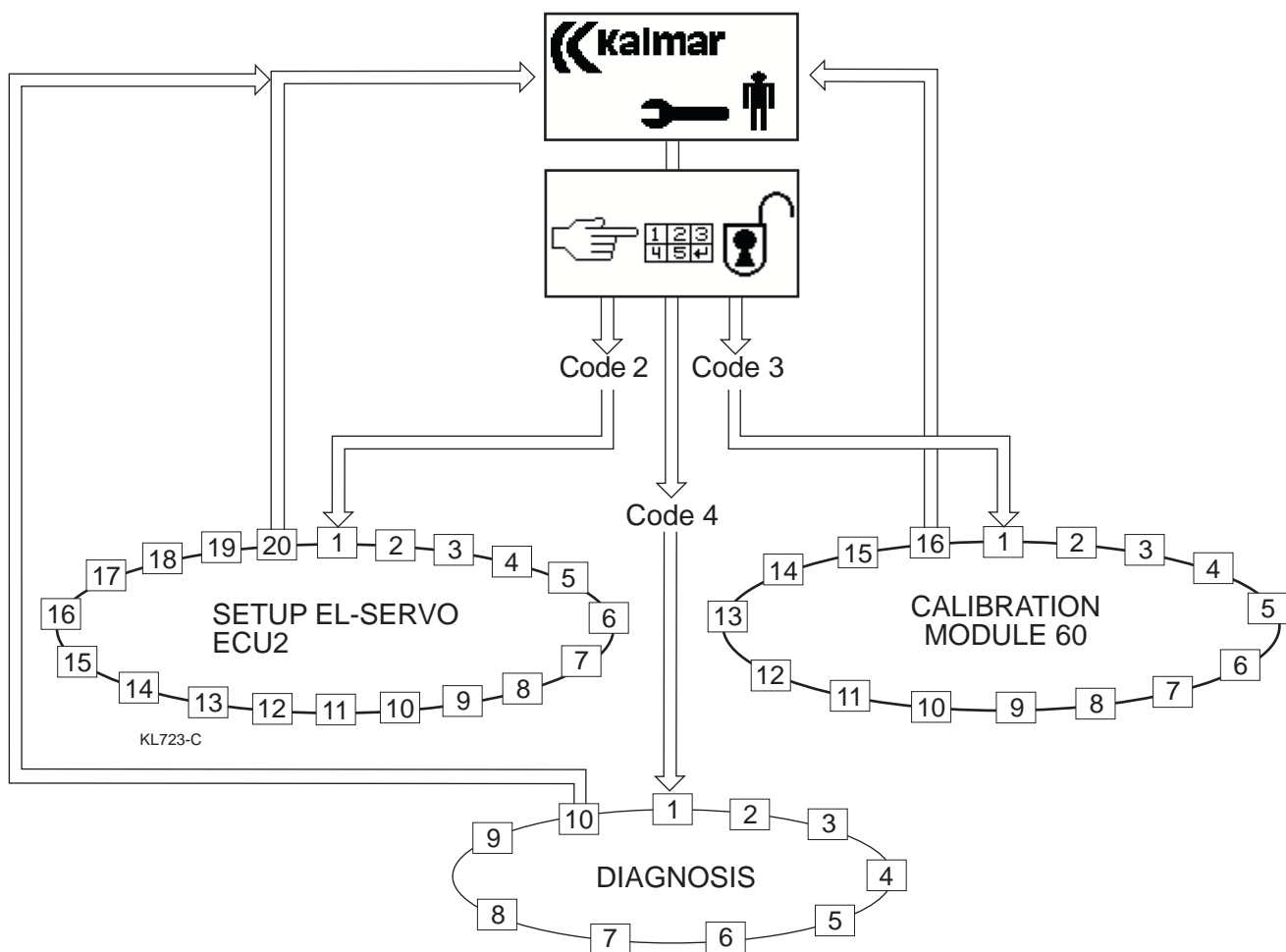
INITIATION is the basic setting of the different modules' parameters.

CALIBRATION is the individual adjustment of the max. and min. values of the different modules' signals. Calibration is unique for each machine.

The illustrations below and on the following page provide an overview of all available service menus. All of them are accessed from the KALMAR INDUSTRIES SERVICE main menu.



Service menus
under Code 1



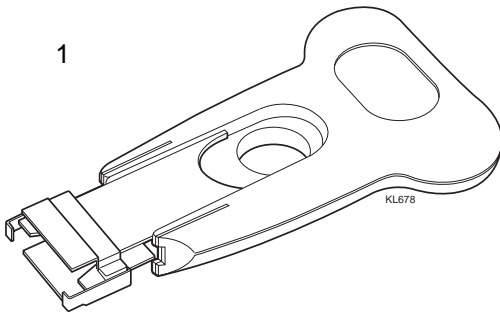
Detailed information about the different service menu paths can be found under respective section descriptions.

The connected loops then appear as shown in the adjacent picture.

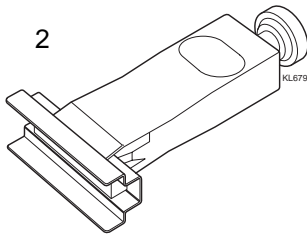
The arrows beside the menus show the switch paths between menus. Use RIGHT/ LEFT arrow keys.

When replacing the EPROM, always use Kalmar's special tools

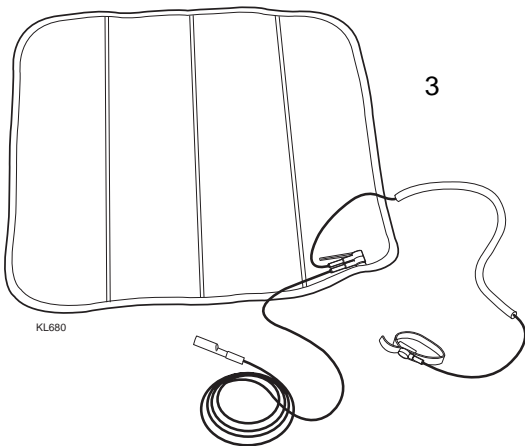
1



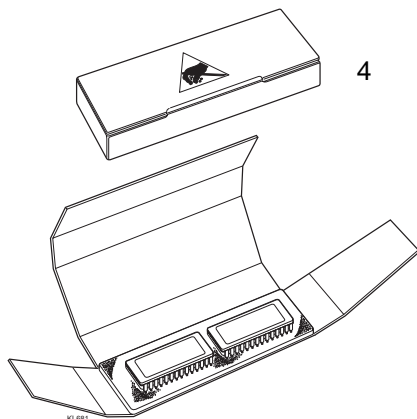
2



3



4



ECU - processor unit

The computer processor unit receives signals from connected sensors, processes the signals and transmits them to the system's different controlling organs, such as valves, motors, etc.

Each ECU contains two identical micro-processors. Each micro-processor has its own EPROM that contains the relevant program-ware and parameters for the machine in question. These EPROMs are marked with the same number as the last three numbers of the corresponding micro-processor number. These three numbers are used to ensure that the EPROM is fitted in the correct location to match the corresponding micro-processor when an EPROM replacement is carried out.

Example: The micro-processor has number 80C592. The corresponding EPROM is then number 592 and must be fitted adjacent to 80C592.

Each EPROM has notch at one end and this should be matched with the corresponding notch in the EPROM socket.

Analogue OUT-signals and digital IN-signals are indicated by red or green LEDs (light emitting diodes). Analogue IN-signals are not indicated. The LEDs are marked LE1-LE42 and are used for fault finding. For each ECU there is a table listing the relevant junction box pins, the corresponding signal, LEDs and machine functions. See respective sections.

In the event of a fault, first investigate the IN-signals. If an IN-signal is incorrect, the fault lies with the sensor and/or cables. If, on the other hand, the IN-signal is correct, the fault lies in the processor.

N.B. The only permissible action to be taken with the ECU is the replacement of the EPROM. If this does not rectify the problem, then the complete ECU, including the housing, must be replaced with an exchange unit from Kalmar.

EPROM = Erasable Programmable Read Only Memory

Kalmar special tools

1, 2 and 3 below, are parts of the ECS kit, art. no. 425817.8068.

1. Extractor.
Art.nr 923827.0002
2. Fitting tool.
Art.nr 923827.0001
3. Anti-static mat.
The mat should be connected to earth and to one wrist.
Art.nr 923830.0001
4. The EPROM pack.
This must always be used for the transportation and storage of the EPROM. The pins should be pressed into the plastic which neutralizes any static electrical charge.
Art.nr923830.0002

Transmission data kit

Data kit no.	Truck	Gearbox	No. of gears	Wheel dimensions	Wheel radius	Pulses per rev	Comments
1	DRD 450	36 000 40 000	4	18.00x25	0.73	12	
8	DRD 450			18.00x25	0.73	50	
9	DRD 450-80X			21.00x35	0.93	50	
10	DRD 450-X			18.00x33	0.83	50	
16	DRD450-80X			21.00x35	0.93	12	
19	DRD 450-X			18.00x33	0.83	12	

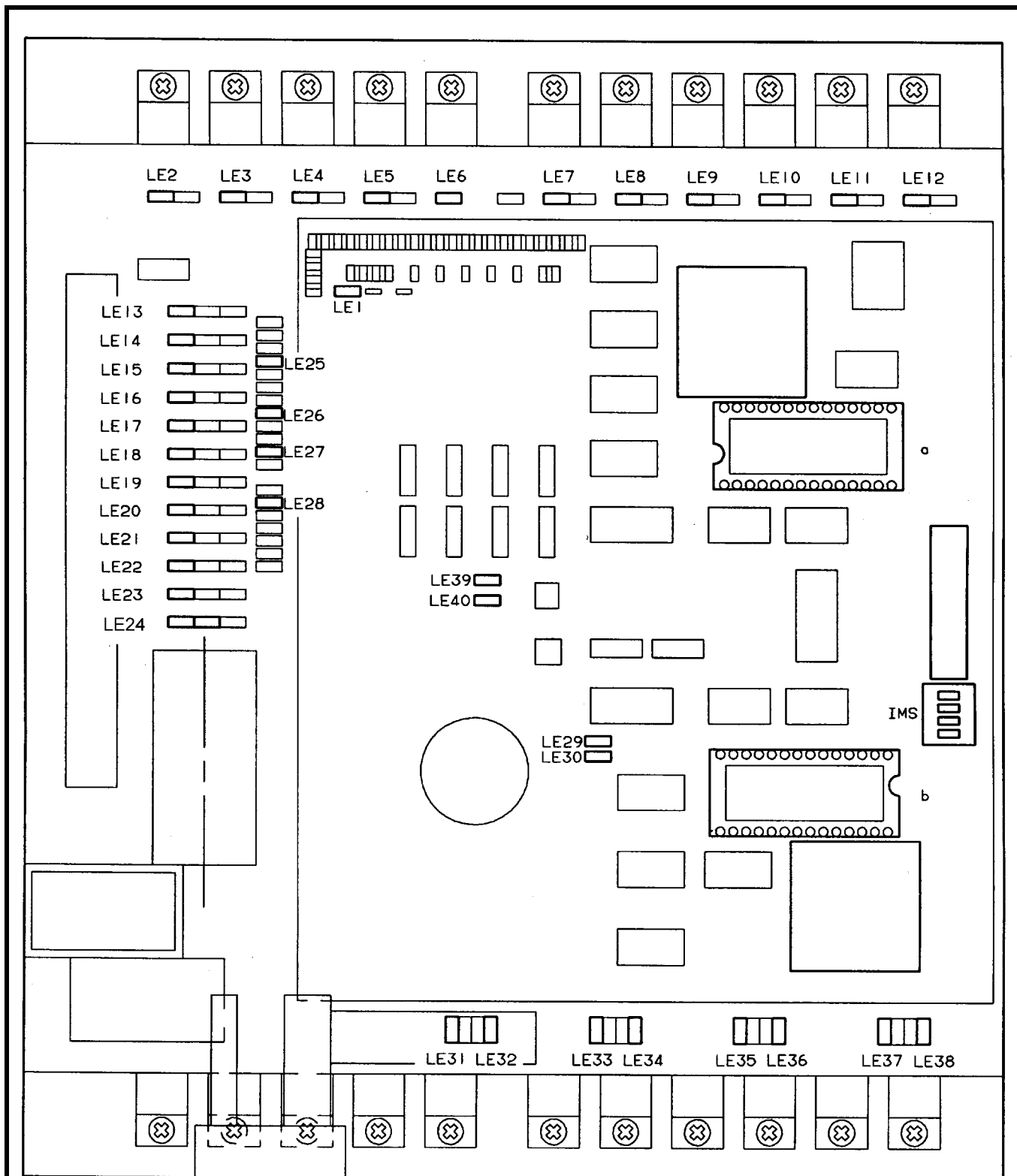
Engine data kit

Data kit no.	Truck	Engine	Model	Pulses per engine rev	Factor	Comments
0	DRD	Cummins	M11	118	260	Magnetic pick-up
1		VOLVO	TD/TWD	30	1023	Volvo-engines without frequency control
4		Scania	DSI 11	158	194	
6		VOLVO	TWD1231ME	30	1023	Frequency control
7		VOLVO	TWD1030	30	1023	The control motor operates inverted
8		Scania	DSI 9	22.7	1352	W-connection alternator 65A
9		Scania	DSI 11	21.1	1457	W-connection alternator 65A
10		Scania	DSI 9	30.3	1014	W-connection alternator 90A
11		Scania	DSI 11	28.1	1093	W-connection alternator 90A
13		Scania	DI 12	21.1	1457	W-connection alternator 65A
14		Scania	DI 12	28.1	1093	W-connection alternator 90A
15		Cummins	6CT	127	242	Magnetic pick-up
20		Volvo	TWD1240VE	38	808	No control motor

ECU 1 functions

ECU Pin	Signal	LED	Function	Module		
				01	04/06	07
40	Analogue IN 1. 0-10V		Steering lever/Mini-steering signal A		x	
42	Analogue IN 2. 0-10V		Accelerator pedal 2	x		
64	Analogue IN 3. 0-10V		Wheel return wheel position, steering axle		x	
65	Analogue IN 4. 0-10V		-			
66	Analogue IN 5. 0-10V		-			
67	Analogue IN 6. 0-10V		Servo motor throttle return	x		
52	Analogue IN 7. 0-10V		Accelerator pedal 1	x		
1	Analogue OUT 1	LE5	Steering valve left		x	
3	Analogue OUT 2				x	
4	Analogue OUT 3					
5	Analogue OUT 4		-			
47	Analogue OUT 5	LE38 (+37)	Steering valve right		x	
69	Analogue OUT 6	LE36 (+35)	Servo motor throttle control (pulses to servomotor)	x		
8	Digital IN 1	LE14	Gear position 1	x	x	x
9	Digital IN 2	LE17	Gear position 2	x	x	x
10	Digital IN 3	LE20	Gear position 3	x	x	x
11	Digital IN 4	LE23	Gear position F	x	x	x
31	Digital IN 5	LE13	Gear position R	x	x	x
32	Digital IN 6	LE16	Brakes/Parking brake active	x		
33	Digital IN 7	LE19	Level monitor engine cooling system			x
34	Digital IN 8	LE22	Seat rotation	x		
55	Digital IN 9	LE15	Brake pressure			x
56	Digital IN 10	LE18	Lever steering ON/OFF. LE18 lights up when the button for lever steering is in the ON position - a check that the cable is OK		x	
57	Digital IN 11	LE21	Manual gear change down		x	
58	Digital IN 12	LE14	Manual gear change up.(Shift MAN/AUT, option)	x	x	
2	Digital OUT 1	LE6	Valve 1 gear changing	x	x	x
24	Digital OUT 2	LE10	Valve 2 gear changing	x	x	x
25	Digital OUT 3	LE7	Valve 3 gear changing	x	x	x
26	Digital OUT 4	LE8	Valve F gear changing	x	x	x
48	Digital OUT 5	LE9	Valve R gear changing	x	x	x
49	Digital OUT 6	LE11	Alarm 1			x
50	Digital OUT 7	LE12	For electric trucks			x
22	Digital OUT 8	LE32 (+31)	Control for changing between steering wheel/lever steering and K lamp contact. LE32 lights red when lever steering is connected. LE31+LE32 shows weak light when normal steering is connected (i.e., lever steering disconnected)		x	
46	Digital OUT 9	LE34 (+33)	Direction of servo motor throttle control. LE34 and 33 alternate depending on the direction of the motor. When the motor stands still, e.g., when the accelerator pedal is in the upper position, both light up "weakly" without alternating. Depress the accelerator and check that the LEDs light alternately	x		

ECU Pin	Signal	LED	Function	Module		
				01	04/06	07
6	NTC 1		Engine coolant temperature			x
7	NTYC 2		Gearbox oil temperature			x
30	NTC 3		Hydraulic fluid temperature			x
53	NTC		Ambient temperature			x
35	Pulse sensor 1	LE28	Engine revs., functions only on Perkins engines	x		x
59	Pulse sensor 2	LE27	Drive shaft revolutions	x	x	x
60	Pulse sensor 3 +	LE25	Steering wheel revolutions, anti-clockwise		x	
36	Pulse sensor 3 -	LE26	Steering wheel revolutions, clockwise. LE25 and 26 will light up alternately, with overlap, when the steering wheel is turned. Wheel turned anti-clockwise: LE25 lights up first. Wheel turned clockwise: LE26 lights up first. If not: Check the sensor and activator on the steering column		x	
27	Rheostat 1		Fuel level			x
28	Rheostat 2		Engine oil pressure 10 bar			x
51	Rheostat 3		Gearbox oil pressure 25 bar			x



KL725

- LE1 Should always be lit, indicating a 5V feed from the voltage transformer
- LE29 Not used
- LE30 Not used
- LE39, LE40 show communication with the ECS terminal. (Applies to the ECU that is connected to the terminal).

LE39 shows communication from the terminal and since ECU 1 is "slave" under ECU 2, LE39 should be extinguished.
LE40 shows communication to the terminal and should blink on all ECUs. If it lights continuously or is extinguished, the program will not start, i.e., something is wrong, for example, the EPROM or electrical supply.

Module 01 - Automatic gear changing, is designed for gearboxes with torque converters. The system controls up and down changing of gears, simplifies operation and extends the service life of the transmission equipment.

See electrical diagrams.

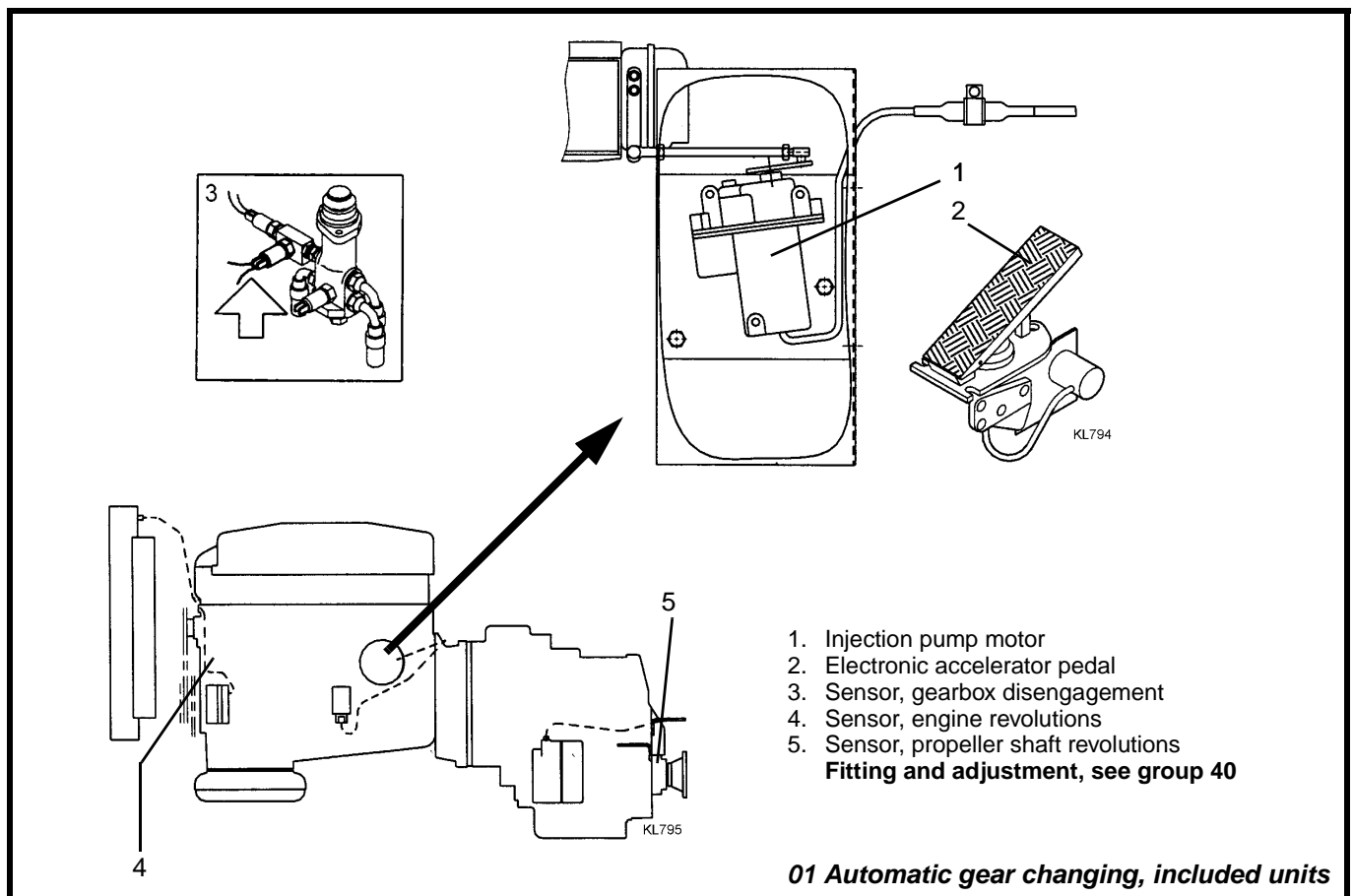
The system

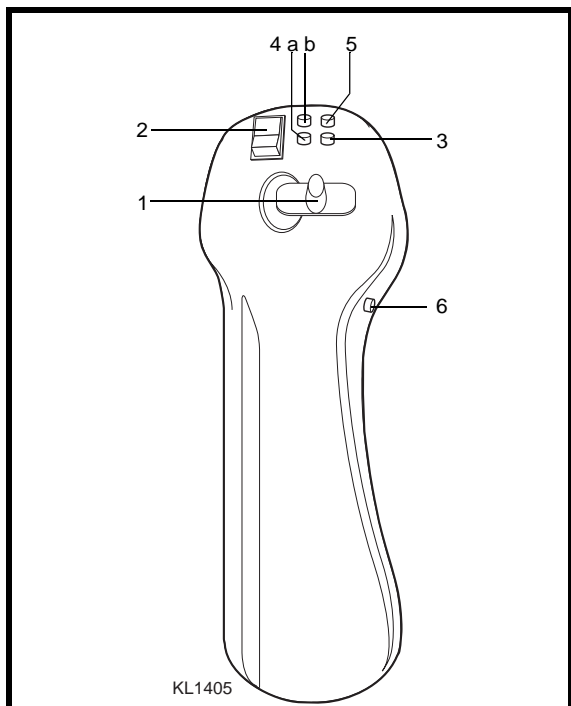
- Prevents the gears from being engaged if engine revolutions exceed 1100 rpm
- Prevents changing between forward and reverse gears if the speed of the truck exceeds 3 kpm
- Locks the present gear if the signal from the prop shaft revolution sensor is incorret or absent
- Reduces engine revolutions when changing to a higher gear so that the speed of the truck remains constant
- Disengages the gearbox if the operator brakes and the speed of the truck is lower than 3 kph
- Provides the required engine revolutions based on the position of the accelerator pedal
- Continually shows the currently engaged gear on the ECS terminal display

Function

The point at which the gearbox changes gear is optimized to the truck's transmission equipment. The torque in the torque converter initiates the change of gear. The system changes to a lower gear when the torque is higher than a pre-programmed value - and vice versa.

The operator can limit gear changes from 4 to 3, 2 or 1 by moving the gear selector to the corresponding position. If the selector is in the 2nd gear position, the system changes automatically between 1st and 2nd gears.





04 Lever Steering

See electric diagrams.

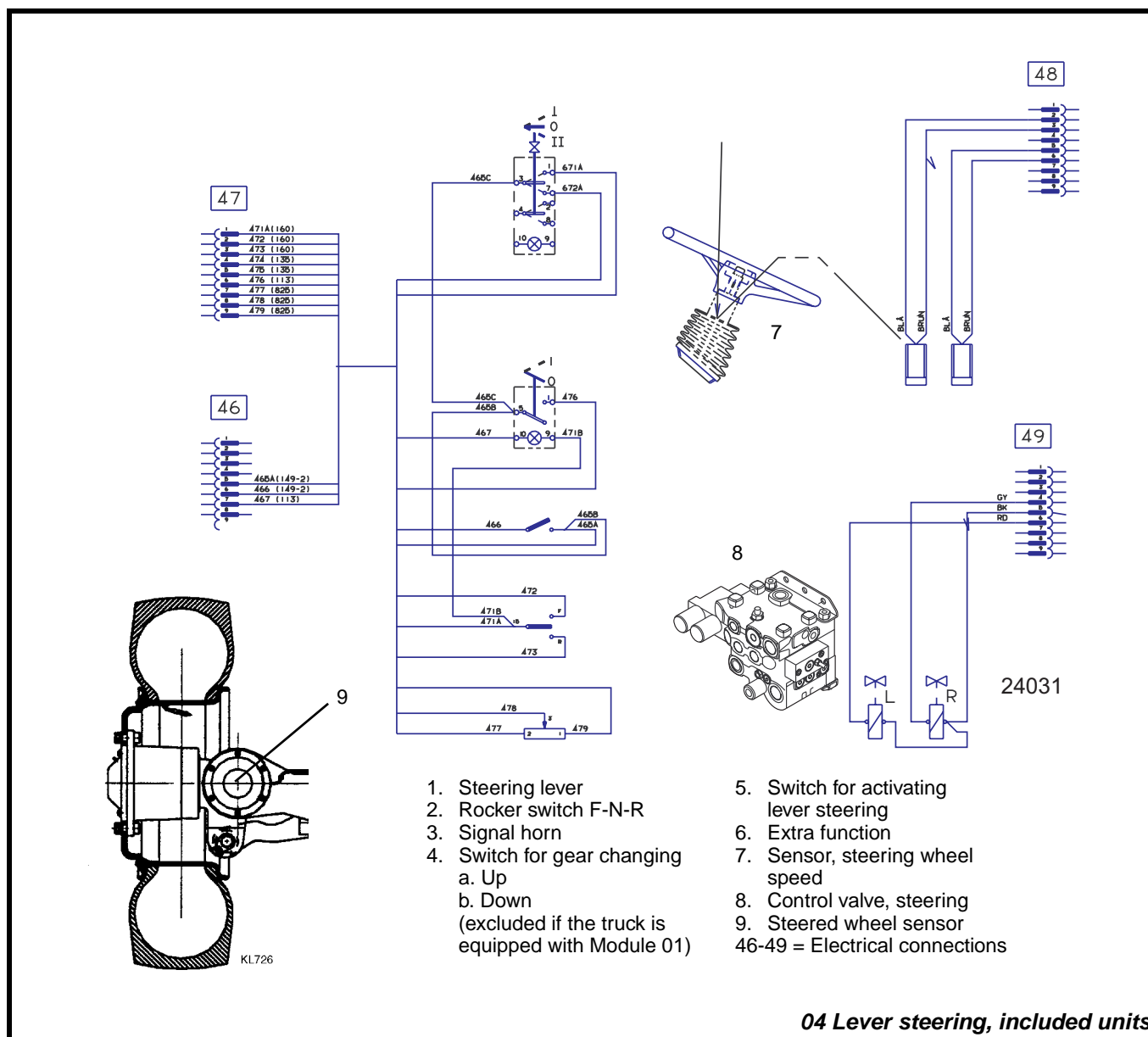
The lever steering module is an electrical system for the steering of the truck by means of a linear steering lever. The steered wheel deflection is inversely proportional to the speed of the truck, i.e., at low speeds, the steered wheel deflection is greater than at higher speeds. The system is available with or without wheel return. With the wheel return system, when the operator releases the lever the steered wheels return to a central position.

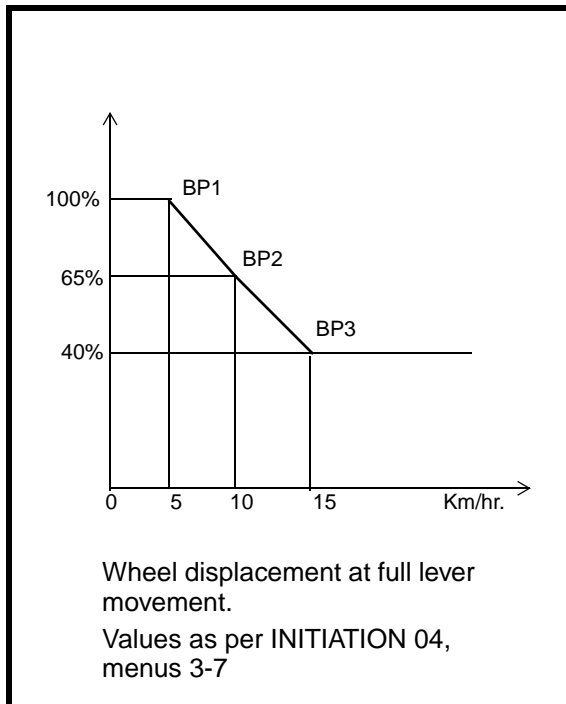
The steering valve is electronically controlled with one magnet for right and one for left. This feeds the flow of hydraulic fluid to and from the steering cylinder. The magnets receive analogue signals from ECU 1.

The standard steering wheel is equipped with two inductive sensors that sense any movement of the steering wheel. The sensors are used to disconnect the lever steering function if the operator is faced with an emergency situation. As soon as the standard steering wheel is used, the lever steering disconnects. This satisfies the relevant safety requirements for a wheel-return system.

The sensor that returns the wheels to a central position is located under a hood adjacent to the steering axle's left hand king pin.

The lever steering module includes a steering lever console .





Lever steering characteristics

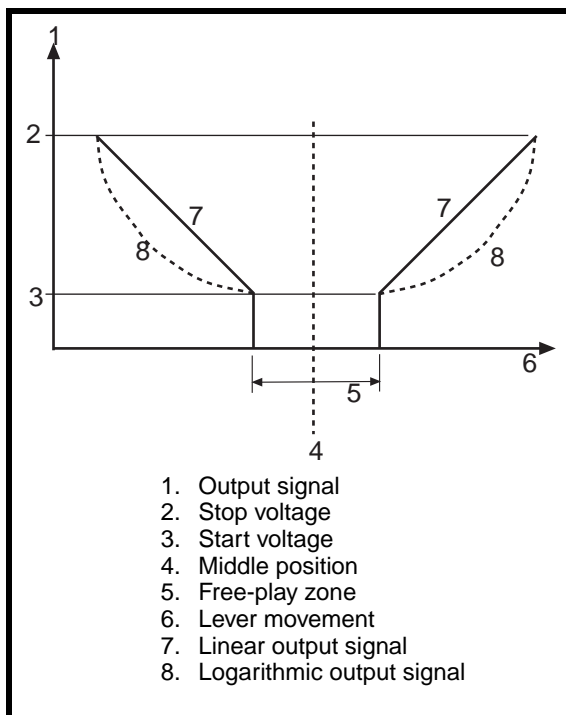
Also applies to Module 06, Mini-steering

The maximum wheel displacement from maximum lever movement is determined by the speed of the truck. Wheel displacement decreases when speed increases. The reduction in displacement follows a curve with three break points, see diagram.

This curve determines the steering sensitivity of the truck. The standard factory setting is as shown in the diagram, i.e., full wheel displacement at 5 kph, 65% displacement at 10 kph and 40% displacement at 15 kph. All of these levels corresponding to full movement of the steering lever.

It is possible to alter the break points and the displacement, see INITIATION MODULE 04. One reason for altering lever steering characteristics can be that a new operator would like less wheel displacement at a certain speed - the truck feels "smoother" to steer. A more experienced operator, on the other hand, may like a quicker steering response, which allows a faster pace of operation.

WARNING!
If wheel displacement is set too high at higher speeds, there is a risk of the truck tipping. Any alteration of lever steering characteristics must be made with great care.



Alteration of the Steering lever output signal

It is possible to alter the output signal from the Steering Lever to follow two different curves - linear or logarithmic

The logarithmic curve provides less sensitive steering.

In the ECS SERVICE Technical Handbook, under Initiation Module 04, a description can be found as to how to choose between the two curves.

Alteration of the Mini-steering device output signal

The number of turns that corresponds to normal steering wheel movement can be set, see Technical Handbook ECS SERVICE, Initiation Module 06.

Monitoring of steering lever & wheel angle sensor

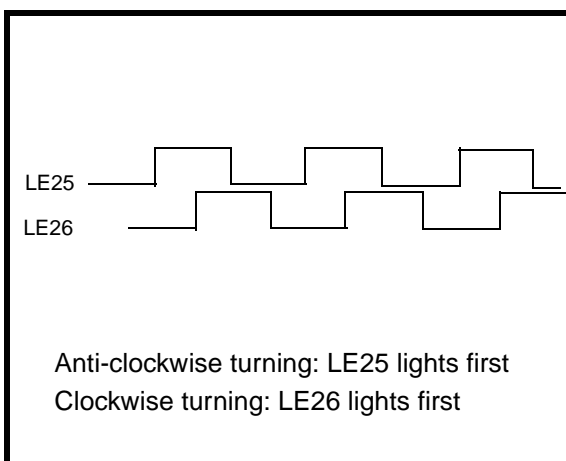
If a fault occurs in the lever steering system - sensor, steering lever, cables - an alarm is generated by the ECS. Lever steering is frozen, i.e., the wheels remain at the current steering angle and the operator must therefore use the steering wheel. After such a fault, re-calibration must be carried out in accordance with the instructions in the Calibration section.

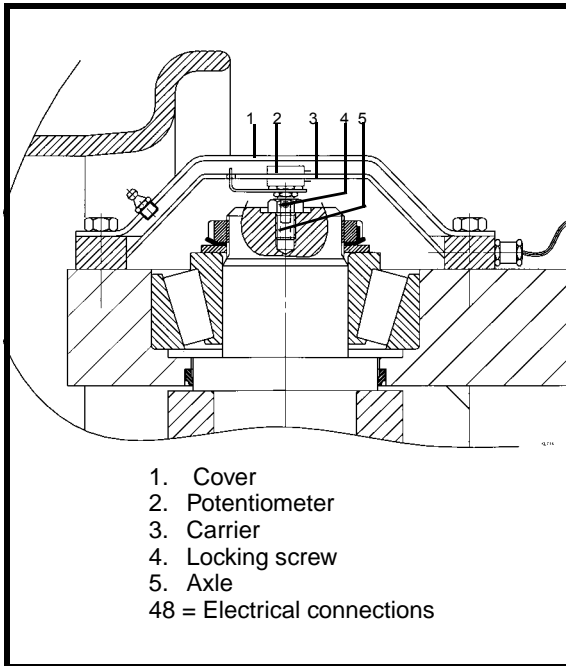
Checking the sensors and activator on the steering column

Two sensors on the steering column monitor steering wheel movement. The sensors are activated by an activator with four cams on the steering column. See the illustration of included units. When a certain movement of the steering wheel occurs, lever steering is disconnected.

The sensors and activator must be regularly checked during service. If a fault occurs with the sensors, there is a danger that the truck will go straight forward.

1. Open ECU 1 so that the LEDs are visible.
2. Locate LE25 and LE26, see ECU 1 Circuit board.
3. Turn the steering wheel and at the same time, check LE25 and LE26. They should light alternately, with a certain overlap, as per the curve.





Fitting/Adjustment of wheel angle sensor

Applies only to wheel return system

1. Adjust the wheels so that they are parallel to the truck.
2. Remove the cover of the left hand steering knuckle.
3. Lift off the carrier 3.
4. Loosen the locking screw 4, remove the connections to the potentiometer and lift it out.
5. Connect a multimeter between the centre pin of the potentiometer and one of the outer pins.
6. Turn the potentiometer until the instrument shows 2,5 kohm. Re-connect the potentiometer.
7. Slide the potentiometer back into the axle 5. Fit the carrier and tighten the locking screw 4. Fit the cover and seal with sealing compound.

Calibrate as per Technical Handbook ECS-SERVICE, Calibration Module 04.

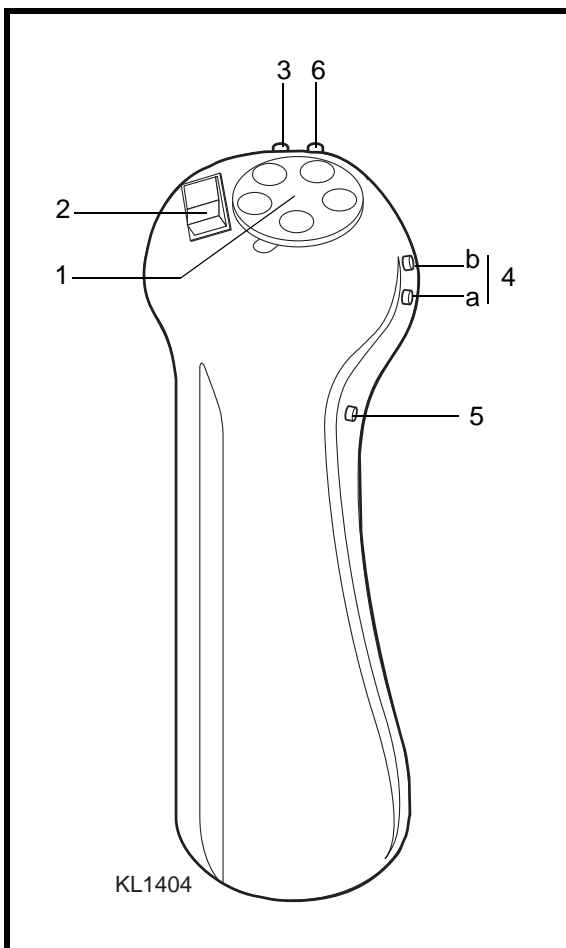
N.B.
Module 06 Mini-steering has a great deal in common with Module 04 Lever steering. See section 04 Lever steering.

Module 06 Mini-Steering

The Mini steering module is an electrohydraulic system for comfortable steering of the truck with the arm on the armrest. The steered wheels follow the position of the Mini steering device. If the operator releases the Mini steering device, both the steering device and the steered wheels remain in the set position.

The standard steering wheel is equipped with inductive sensors that sense the movement of the steering wheel. The sensors disconnect the Mini steering if the operator is faced with an emergency situation and starts using the standard steering wheel. When the Mini steering is disconnected, the lamp in switch 2, see below, is extinguished.

1. Mini steering device
2. Direction switch F/N/R. The lamp in the switch is alight when the lever steering is activated
Forwards position = F. Centre position = N
Backwards position = R
3. Signal horn
4. Switches for gear changing, a=UP, b=DOWN
(Excluded if the truck is equipped with module 01 Automatic gear changing) Press 4a to shift gears 1-2-3-(4) (once for every gear) and 4b to shift down. The gear changing always starts with gear 1 on starting and after the direction switch has passed the N position.
5. Switch for activating Mini steering
Condition: The truck speed must not exceed 3 kph. If the speed exceeds 3 kph it not possible to activate the Mini steering. The lamp in switch 2 is alight when the Mini steering is activated
6. Extra function

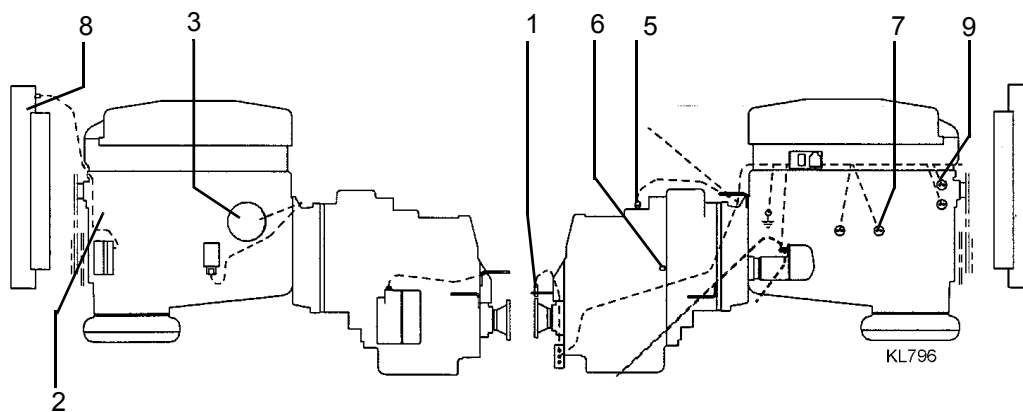
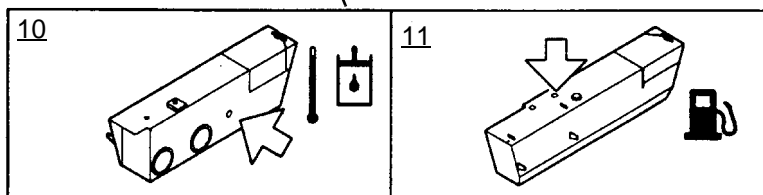
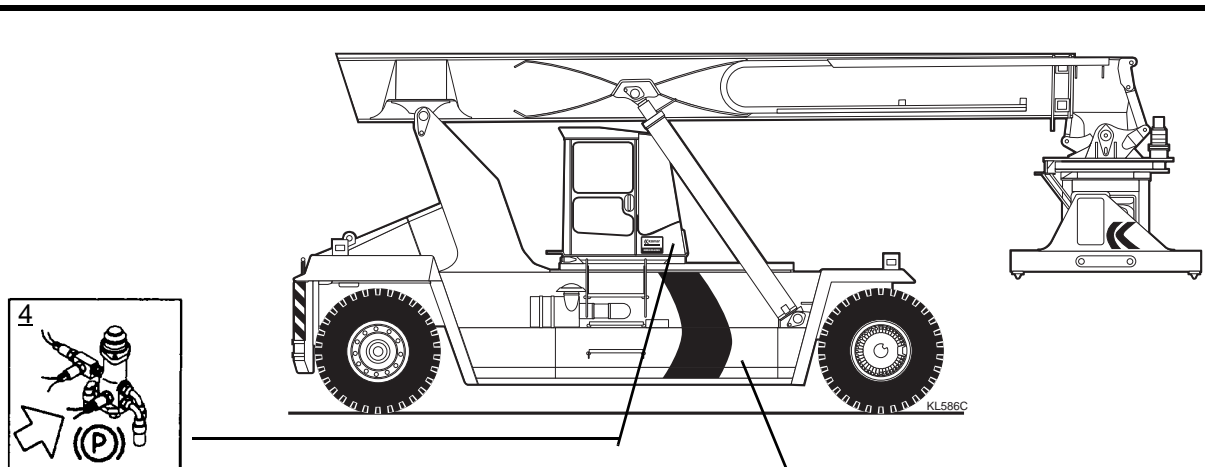


Module 07 Monitoring

See electrical diagrams.

The monitoring module checks that the engine and gearbox operate within reasonable limits and thereby prevents a major breakdown from occurring. The module also monitors the correct function of the different system components, such as sensors, etc.

Values, such as oil pressure and temperature, that are of vital importance when it comes to wear and tear and the risk of breakdown, are monitored on two levels. A red warning lamp lights and an error message appears on the terminal display. If the reason for the fault is not rectified, the system limits the truck's functions. The most serious faults lead to a reduction in engine revolutions.



- | | |
|---|---|
| 1. Sensor, drive shaft revolutions | 6. Sensor, gearbox oil temperature |
| 2. Sensor, engine revolutions | 7. Sensor, engine oil pressure |
| 3. Control motor | 8. Sensor, coolant level |
| 4. Sensor, brake pressure | 9. Sensor, coolant temperature |
| 5. Sensor, gearbox oil pressure and oil temperature | 10. Sensor, hydraulic fluid temperature |
| | 11. Sensor, fuel level |

The following signals are monitored:

1. Battery level, min. <14.4 Volts
2. Engine oil pressure, min. level 1 <1.0 bar
3. Engine oil pressure, min. level 2 <0.5 bar
4. Coolant temperature, max. level 1 >98°C
5. Coolant temperature, max. level 2 >103°C
6. Gearbox oil pressure, min. level 1 <12-15 bar (dependent on selected transmission data kit)
7. Gearbox oil pressure, min. level 2 <10 bar
8. Gearbox oil temperature, max. level 1 >130°C
9. Gearbox oil temperature, max. level 2 >134°C
10. Fuel level, min.
11. Hydraulic fluid temperature, max. >100°C
12. Coolant level, min.
13. Operating time, max. service interval period, shows the time remaining to the next service and generates an alarm when operating time has been exceeded.
14. Brake pressure

The following sensors are checked:

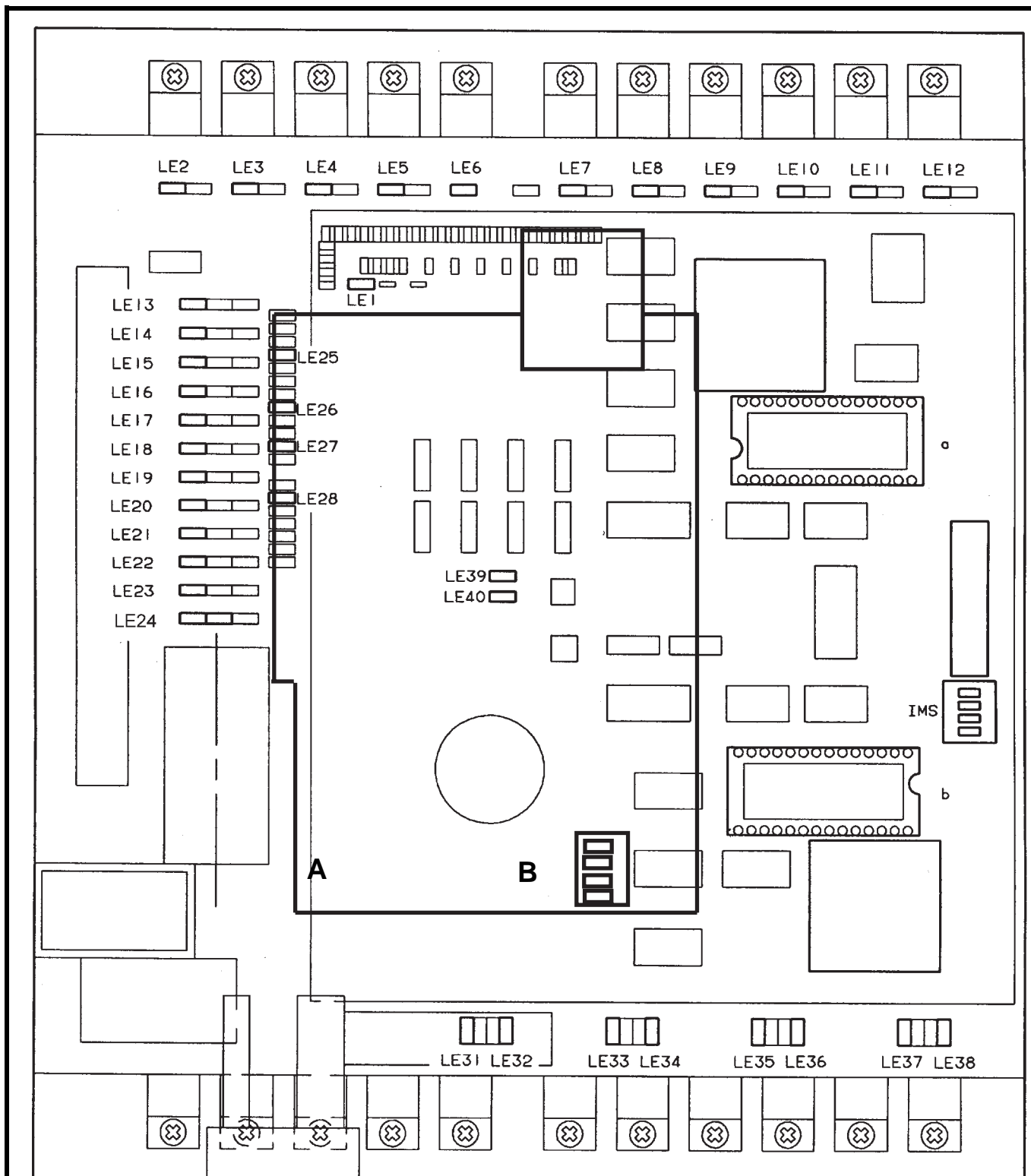
1. Engine revolutions
2. Gear lever
3. Accelerator pedal
4. Fuel injection pump motor
5. Fuel gauge
6. Gearbox oil pressure
7. Engine oil pressure
8. Engine oil temperature
9. Gearbox oil temperature
10. Hydraulic fluid temperature

With non-permissible levels of any of the signals, an alarm is activated - a red warning lamp lights and the terminal display shows in clear text which signal is incorrect. If any signal begins to approach level 2, engine revolutions are reduced, following a defined curve, to a lower rate of rpm.

The different levels are pre-programmed into the ECU and cannot be altered.

ECU 2 Functions

Pin no. ECU 2 S2	Signal	LED	Function
8	Digital IN I/O	LE14	Working lights, top-lift
9	"	LE17	Control lever, side-shift Right (15)
10	"	LE20	Control lever, side-shift Left (16)
11	"	LE23	Control lever, vertical lift
31	"	LE13	Control lever, twist-locks release (8-9)
32	"	LE16	Twist-locks locking/Auto
33	"	LE19	Control lever, doors OK
34	"	LE22	Warning for overloading of steering axle
55	"	LE15	Sensor, activating stop at 30-35'
56	"	LE18	Sensor, activating locking, tilt
57	"	LE21	Overload, mechanical system
58	"	LE24	By-pass connection of safety system
2	Digital OUT PNP I/O	LE6	Activating top-lift/loading of hydraulic pump
24	"	LE10	Indication of alignment, on steering wheel panel
25	"	LE7	Indication of twist-locks released, on steering wheel panel
26	"	LE8	Indication of twist-locks locked, on steering wheel panel
48	"	LE9	Regeneration BOOM OUT
49	"	LE11	Regeneration LIFT
50	"	LE12	Blocking valves, lift cylinders
22	Digital OUT PNP/NPN		
46	"		Buzzer, overload and warning of overloaded steering axle
40	Analogue IN 0-10V		Boom length
42	"		Control lever LIFT/LOWER P1
64	"		Pressure sensor, right lift cylinder, piston side (mod 60)
65	"		Pressure sensor, right lift cylinder, piston rod side (mod 60)
66	"		Control lever, BOOM OUT/IN P2
67	"		Control lever, ROTATION P3
52	"		Boom angle Min=2V, Max=8V
43	Analogue IN 4-20 mA		Pressure sensor, right lift cylinder, piston side (mod 57) + Pressure sensor, left lift cylinder, piston rod side (mod 52, 60)
63	"		Pressure sensor, left lift cylinder, piston side (mod 50, 60)
27	Digital IN 0-196 OHM		End position BOOM OUT (mechanical system)
28	"		End position BOOM ANGLE (mechanical system)
51	"		Separate bottom lift (disconn. of tw-locks and 20-40' funct.)
6	Analogue IN 70-120°C		
7	" -20-120°C		
30			By-pass of rotation stop
53	" 70-120°C		
1	Analogue OUT pwm PNP1	LE5	Boom IN
3	I1		Boom LIFT
4	I2		Boom LOWER
5	" PNP4	LE4	Boom OUT
17			
18			
35	Pulse transmitter 1		
59	Pulse transmitter 2		
36	Digital IN		Rotation stop, counter-clockwise
60	Digital IN		Rotation stop, clockwise
23	Battery plus 24V		
13	Battery plus 24V		
37, 70, 12	Battery minus		



KL 725

LE1 Should always be lit, indicating a 5V feed from the voltage transformer

A Extra circuit board
B Switches, all should be in the ON position

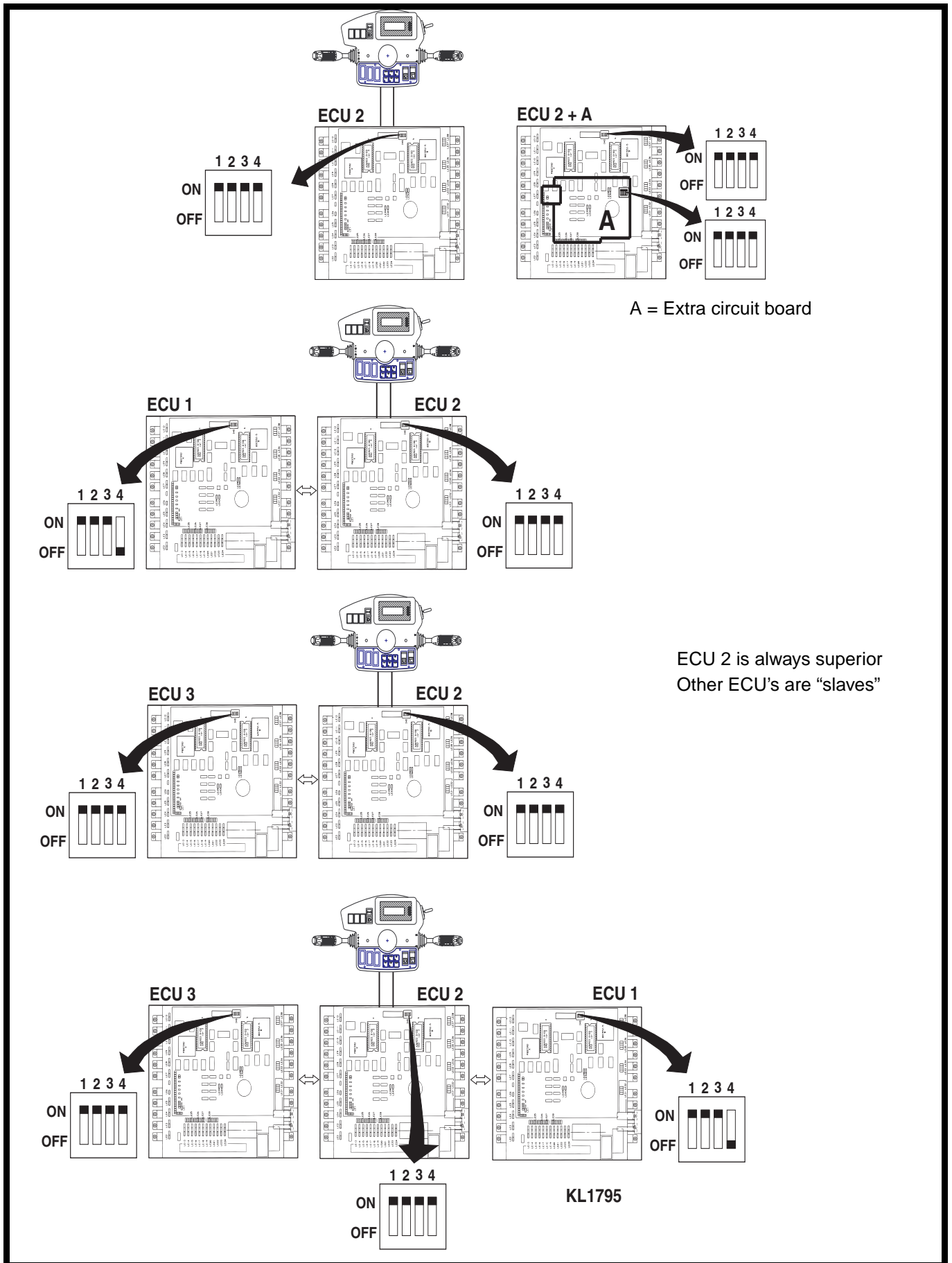
LE39 shows communication from the terminal and should always blink.

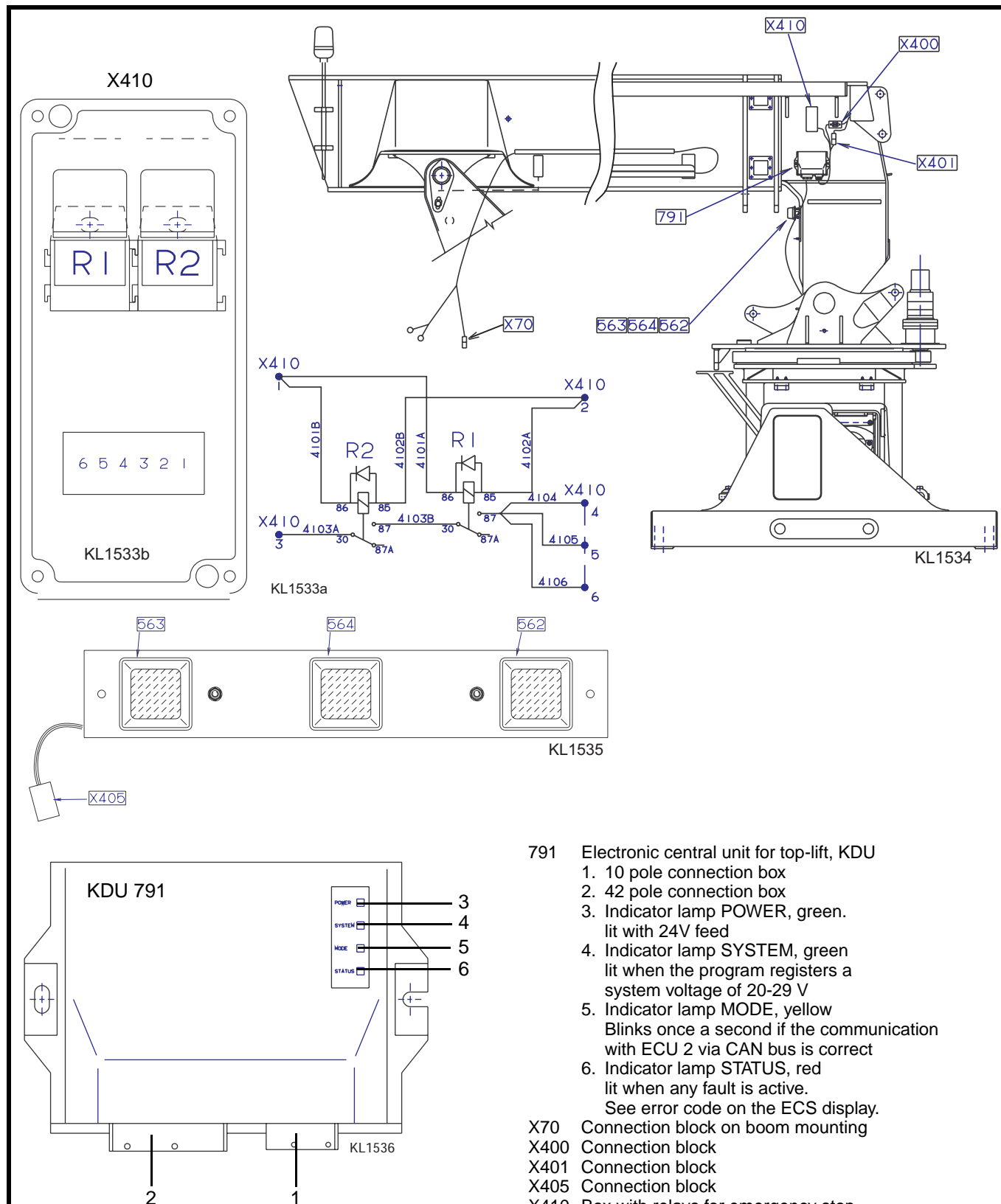
LE40 shows communication to the terminal and should blink on all ECUs. If it lights continuously or is extinguished, the program will not start, i.e., something is wrong, for example, the EPROM or electrical supply.

Different combinations of ECU

Every ECU has four switches.

Check that the switches are in the positions shown in the illustrations.





- 791 Electronic central unit for top-lift, KDU
 1. 10 pole connection box
 2. 42 pole connection box
 3. Indicator lamp POWER, green. lit with 24V feed
 4. Indicator lamp SYSTEM, green lit when the program registers a system voltage of 20-29 V
 5. Indicator lamp MODE, yellow. Blinks once a second if the communication with ECU 2 via CAN bus is correct
 6. Indicator lamp STATUS, red lit when any fault is active. See error code on the ECS display.
- X70 Connection block on emergency stop.
- X400 Connection block
- X401 Connection block
- X405 Connection block
- X410 Box with relays for emergency stop. For safety reasons, there are two relays connected in parallel. The relays are controlled from the emergency switch, see 36 on the servo diagram (S)
- 562 Indicator lamp, red, TWIST-LOCKS RELEASED
- 563 Indicator lamp, green, TWIST-LOCKS LOCKED
- 564 Indicator lamp, orange, ALIGNMENT

N.B.
The permitted load on KDU 791 is limited.
Therefore, connection of extra equipment to the KDU is not allowed.

El-servo

The el-servo system includes:

- Control lever functions for boom movement
- All attachment functions
- Overload protection
- Cab movement
- Support jacks

The references in the following descriptions relate to components in the el-servo diagrams (diagrams marked S), if nothing to the contrary is stated.

El-servo (S) A38630.0100 (ECU 2)

El-servo (S) A38630.0200 (ECU2 + ECU 3)

For top-lift circuits, refer to separate diagram.

When following the circuit descriptions, first select an S diagram and an top-lift diagram that correspond to the machine in question.

Example: S7 shows component no. 7 on the el-servo diagram, i.e., the main valve in the hydraulic system.

S50-S65 show the connectors for ECU 2 under operator's seat.

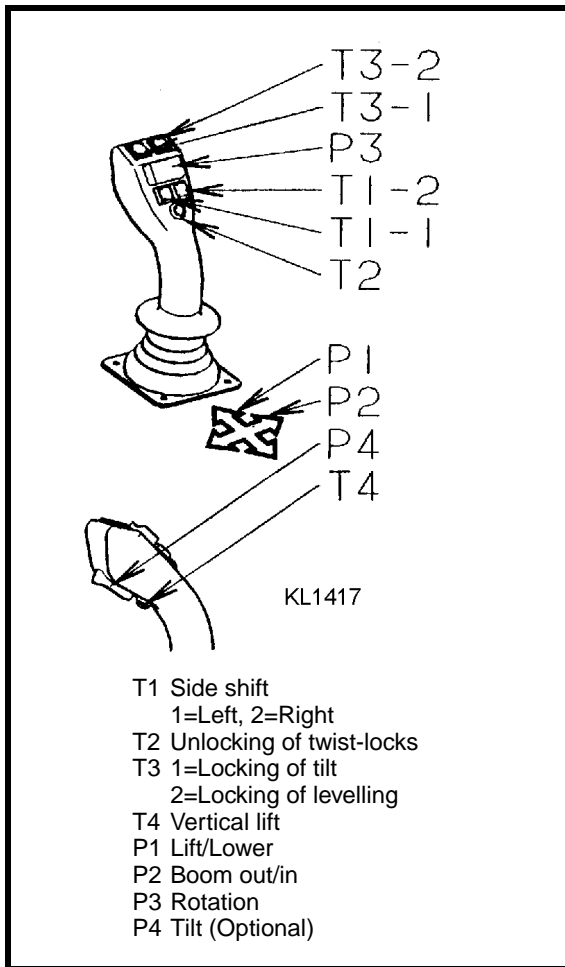
ANA IN = Analogue IN signal

ANA OUT = Analogue OUT signal

DIG IN = Digital IN signal

DIG OUT = Digital OUT signal

LE1-LE43 = LEDs, with green or red light. These can be located on the overview illustration of the ECU 2 circuit board.



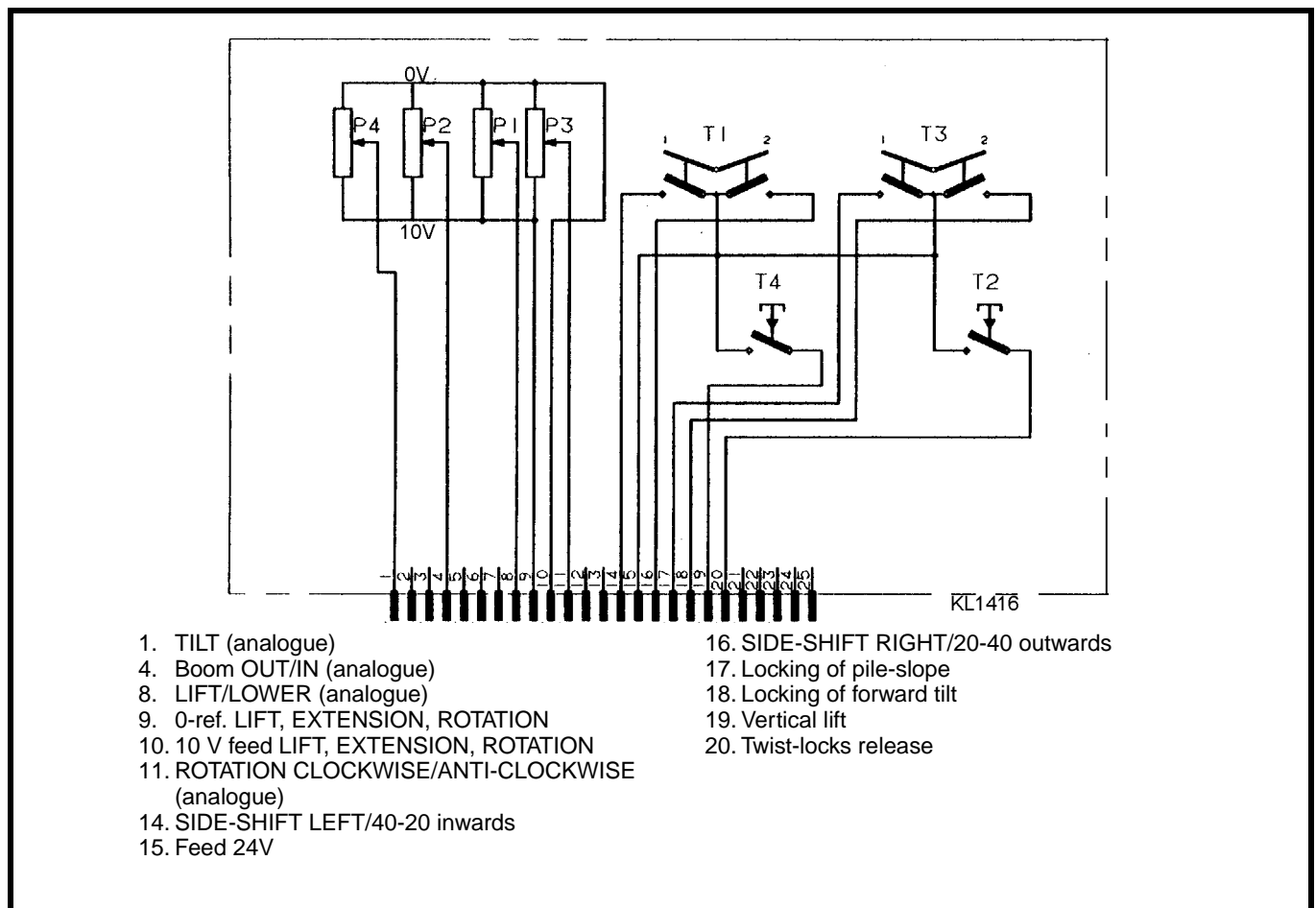
Control lever

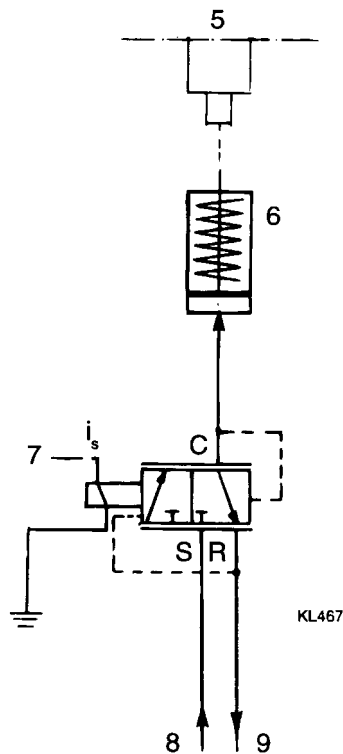
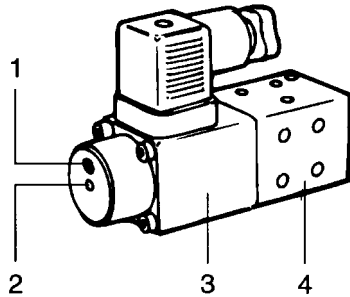
The control lever regulates electrical signals which operate electrohydraulic converters which in turn feeds hydraulic servo pressure to the main valve sections.

The lever handle is equipped with potentiometers P1–P4 and four finger-tip controlled switches T1–T4.

The plus feed from the control unit is delivered via sliding shoes when manoeuvring the machine.

When manoeuvring, the potentiometer setting is altered, and thus the output signal, in proportion to the lever movement. The output signal is amplified in the control unit ECU 2 and thereafter used for controlling the hydraulic servo output from the converter.





1. Vent screw
2. Push button, manual operation
3. Solenoid
4. Pilot valve
5. Main valve
6. Spool actuator
7. Control current
8. Inlet servo pressure
9. Return servo pressure

A given control current i_s results in a definite servo pressure at the spool actuator

Converter

Converter

The converter is a electrically controlled pressure reducing valve for the remote control of hydraulic functions. The output signal is a porportional hydraulic servo pressure which is used to control the spools of the main valves.

The converter consists of a solenoid and a pilot valve. It is connected to the main valve spool actuator block.

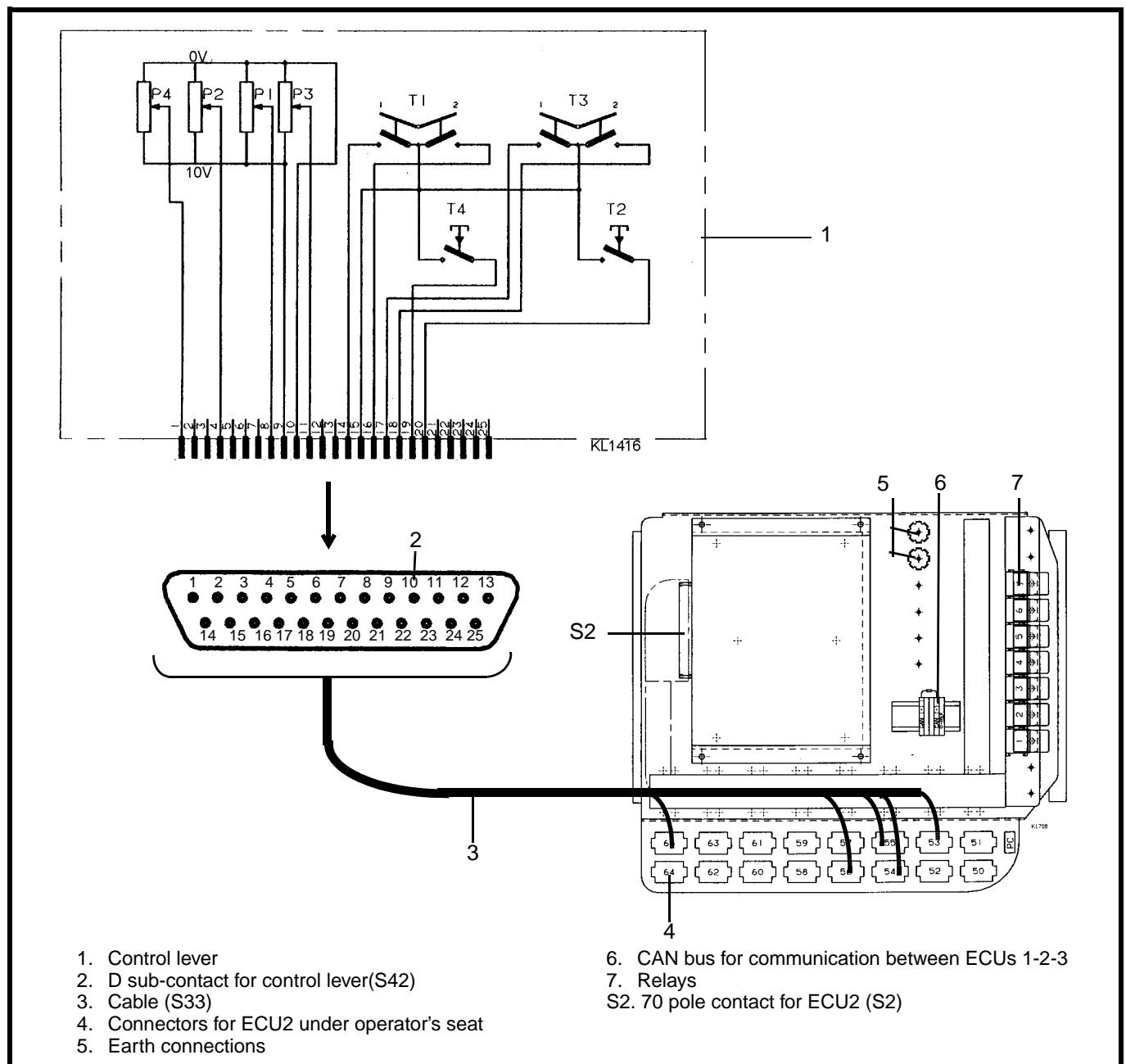
The solenoid exerts a proportional force on the pilot valve. The end of the unit is provided with a vent screw and a pushbutton for emergency manual operation.

The control pressure output delivered by the pilot valve to the spool actuator of the main valve is practically proportional to the input current.

The pilot valve is closed in the neutral position.

Control lever feed

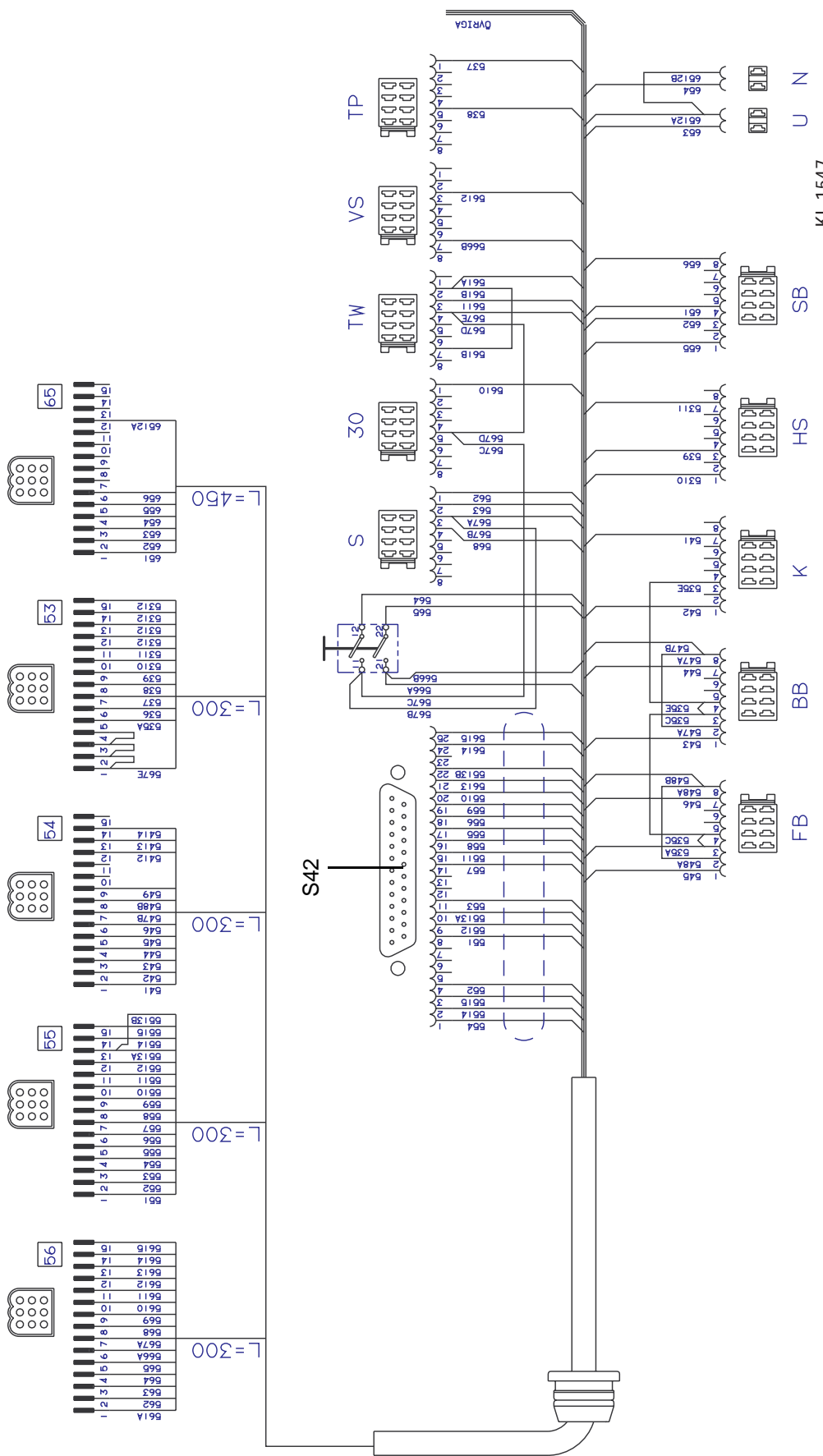
1. The LIFT/LOWER, BOOM OUT/IN and ROTATION functions are fed with 10 V from ECU2, contact S2 (70 pole junction box on ECU2), pin 45 of connector S55 pin 12. From there via cable S33 to the D sub-contact S42 on the control lever S32.
2. Earth reference to the 10V is fed from S2 pin 44 to connector S55 pin 13. From there via cable S33 to S42 on the control lever S32.
3. When the lever is in the neutral position P1, P2, P3 and P4 supply 5V to S42 and from there, on to connector S55. The end positions provide 0V and 10V respectively.
4. The SIDE-SHIFT, LOCKING TILT/PILE SLOPE, STRAIGHT LIFT AND RELEASE TWIST-LOCKS functions are fed with 24V from fuse 3 of the central electrical unit S1. Via the central electrical unit's connector 32 pin 3 to the el-servo connector S55 pin 11. Via cable S33 to S42 pin 11. From there, feed to switches T1, T2, T3 and T4.



1. Control lever
2. D sub-contact for control lever(S42)
3. Cable (S33)
4. Connectors for ECU2 under operator's seat
5. Earth connections

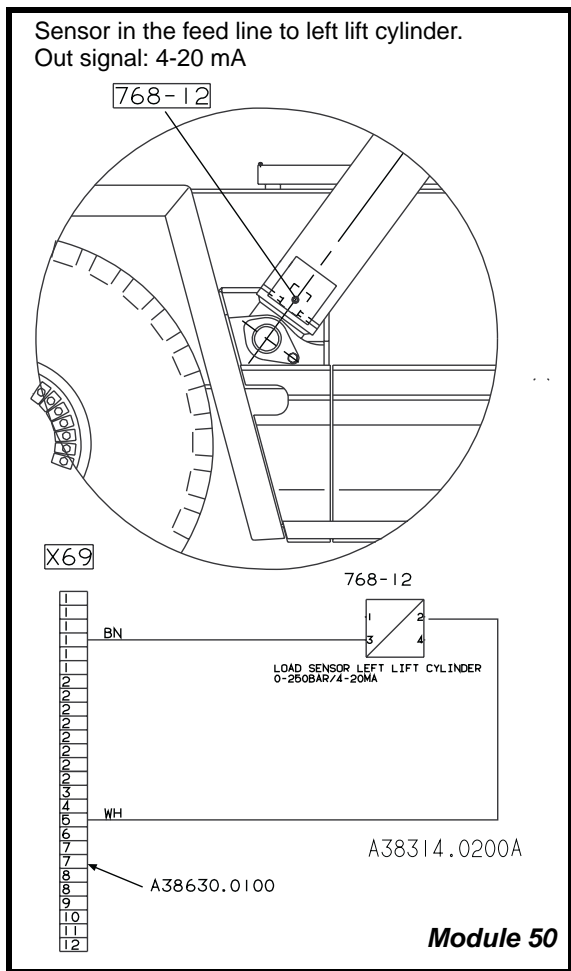
6. CAN bus for communication between ECUs 1-2-3
 7. Relays
- S2. 70 pole contact for ECU2 (S2)

Cable S33 of the el-servo system



- FB = Front legs, bottom lift
- BB = Rear legs, bottom lift
- K = Clamping
- HS = Cab movement
- SB = Support jacks
- U = Lamp, support jacks up
- VS = By-pass connection, rotation stop
- TP = By-pass connection, Max height/Min LC-dist
- N = Lamp, support jacks down
- S = By-pass connection safety system
- 30 = Stop at 30-35'
- TW = Twist-locks
- S42 = D-sub contact at control lever

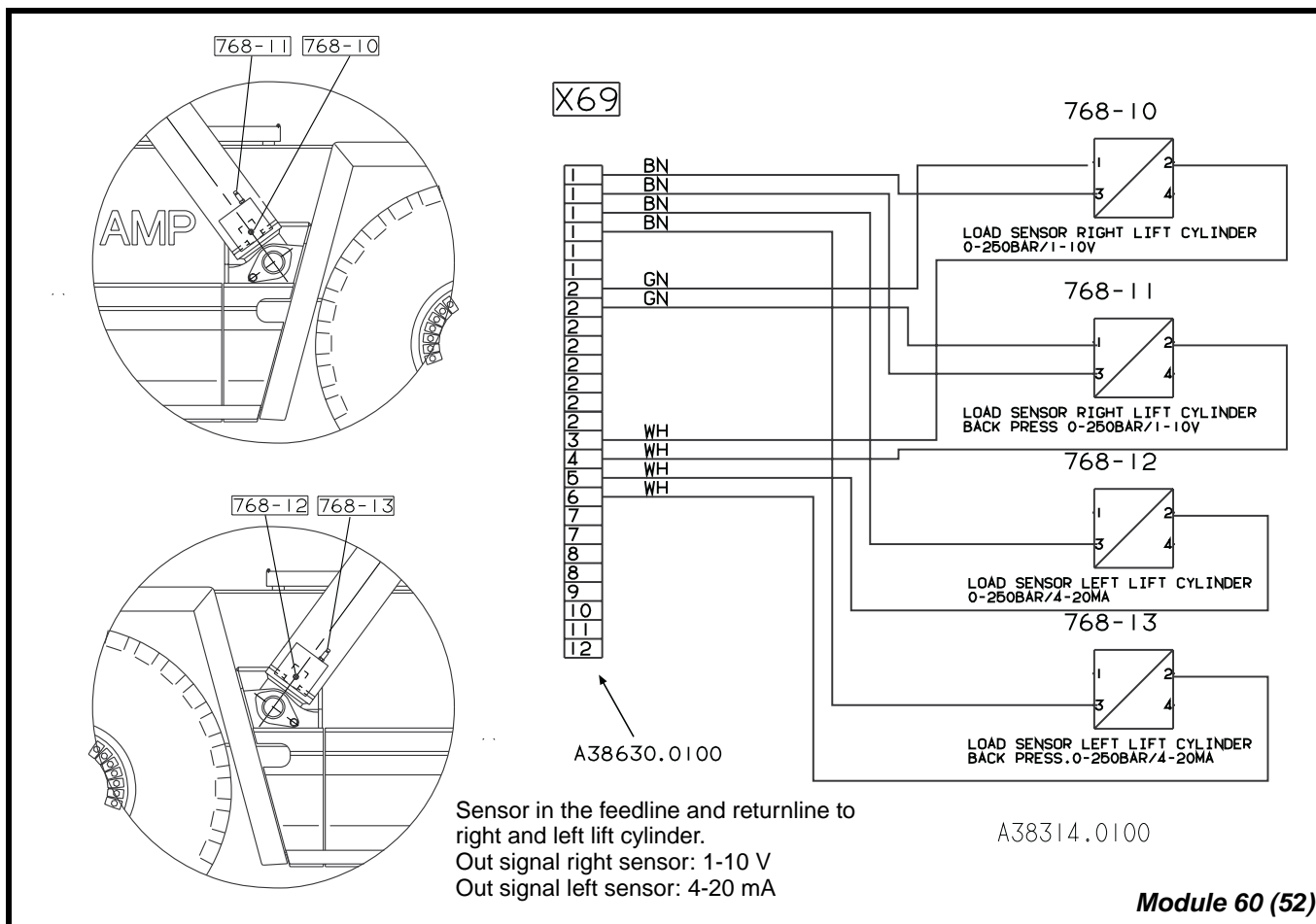
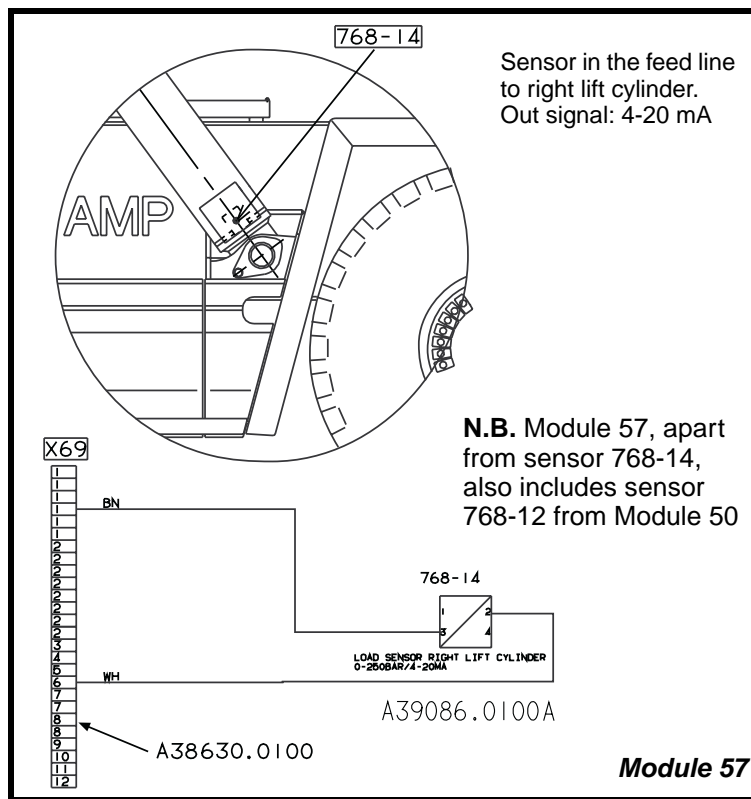
KL 1547

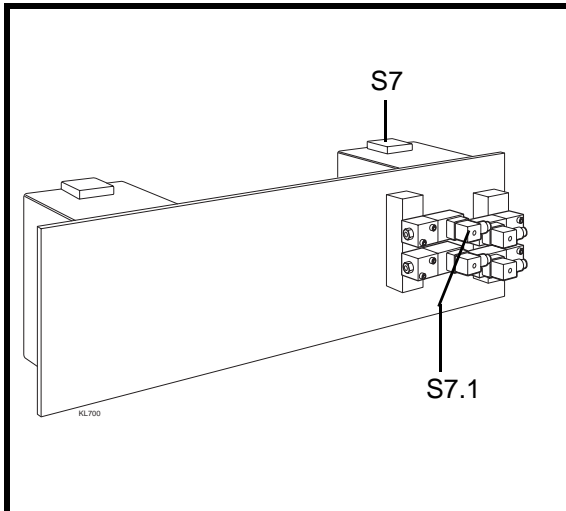


Pressure sensors right and left lift cylinders

N.B. The pressure sensors are different for different modules.
(768-10 and 11 are identical. 768-12, 13 and 14 are identical)

See also the el-servo diagrams (S).





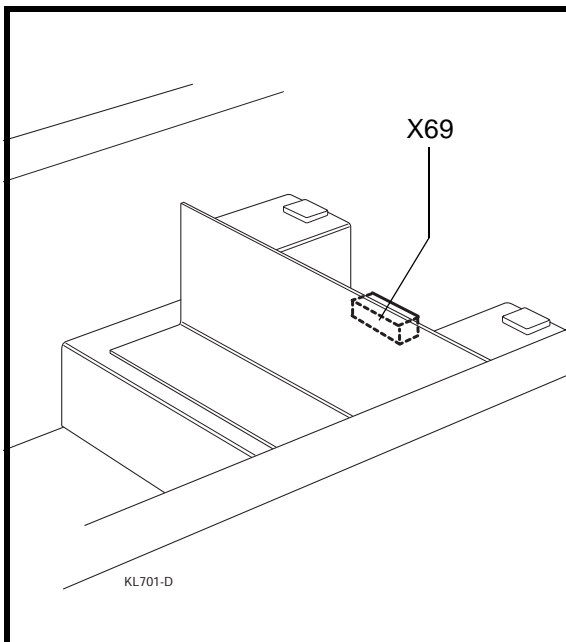
LIFT

See el-servo diagram (S)

1. Control lever used for LIFT, P1 gives a 5-9V analogue signal via 42.8, via cable S33 to X55.1
2. ANA IN S2.42. No indication in ECU2 for analogue IN signals.
3. ANA OUT S2.03. 24V, varies with lever position.
4. X63.1
5. Main valve converter S7.1 opens for servo pressure. Simultaneous feed of servo pressure to S7.8
6. Main valve sections S7.1 and S7.8 opens for LIFT

Conditions:

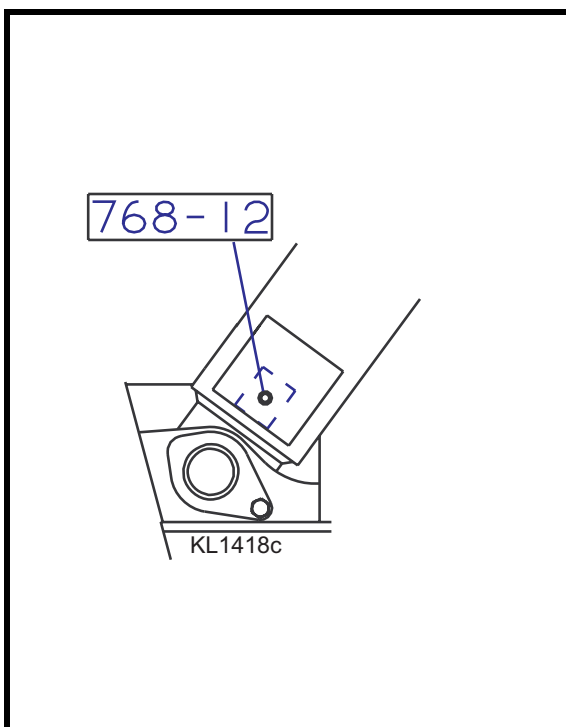
1. DIG IN S2.7. LE19 lit, which means:
 - Cab in rear position
 - If the cab is in the forward position, doors closed
 - With remote control - contact OK
 - Twist-locks either LOCKED or RELEASED
Signal from 791. Control: DIAGNOS, menu 4(8)
 - No front overload, no steering axle overload. (Module 50: LE21 shall be lit. Module 60: No overload indication on the display)



Regeneration, LIFT

See el-servo diagram (S)

1. 24V to X62.8
2. Connector X69.8, see illustration



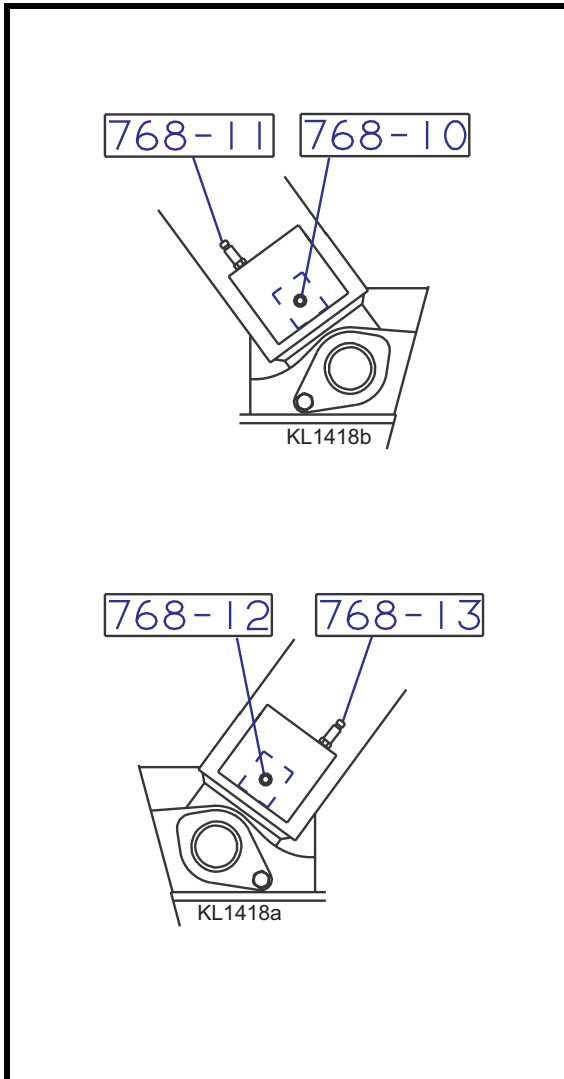
Module 50

Conditions for regeneration:

Connects when pressure in lift circuit <85 Bar

Disconnects when pressure is approx. 185 Bar

3. Pressure sensor 768-12.3 in lift cylinder feed IN 24 V, see illustration
4. Pressure sensor 768-12.2 OUT, 4-20 mA, corresponds to 0-250 bar pressure in lift circuit
5. X69.5
6. X62.5
7. ANA IN S2.63 (no indication)
(cont'd p.14 next page)



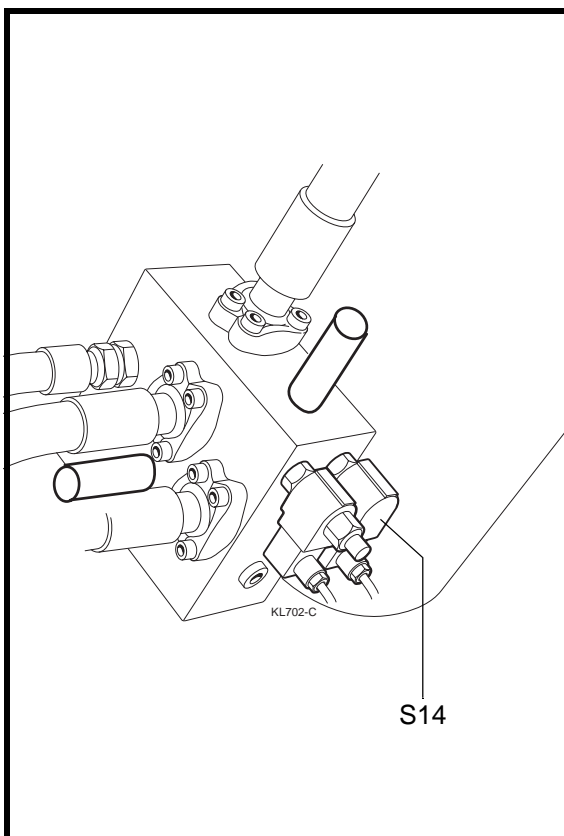
Module 60 (or module 52)

Conditions for regeneration:

Connects when pressure in lift circuit <85 Bar

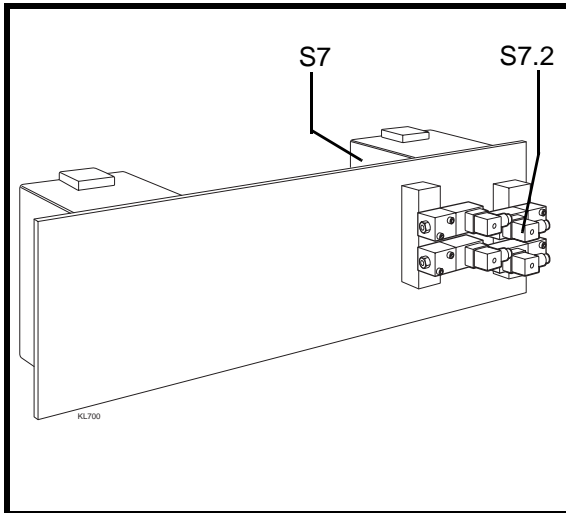
Disconnects when pressure is approx. 185 Bar

8. Feed right sensor: 24V over X69.1 to 768-10.3 and 768-11.3. Ref.voltage =0V from X69.2.
9. Feed left sensor: 24V over X69.1 to 768-12.3 and 768-13.3
10. Out signal right pressure side 768-10.2: 1-10V to S19.3 to X62.3, to S2.64 ANA IN (no indication)
11. Out signal right return 768-11.2: 1-10V to X69.4 to X62.4, to S2.65 ANA IN (no indication)
12. Out signal left pressure side 768-12.2: 4-20 mA to X69.5 to X62.5, to S2.63 ANA IN (no indication)
13. Out signal left return 768-13.2: 4-20 mA to X69.6 to X62.6, to S2.43 ANA IN (no indication)



Modules 50,52,60

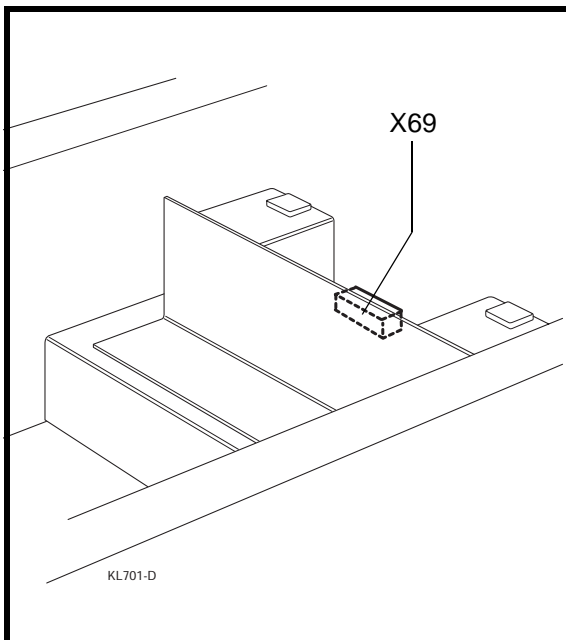
14. DIG OUT S2.49. LE11 lit (Lever movement >50%)
15. X62.8
16. X69.8
17. Regeneration valves S14, right and left, open and regeneration starts.
The regeneration starts with a time-delay which is set in the SET UP EL-SERVO ECU 2, see Technical Handbook ECS SERVICE.
18. Earth signal back via X69.2
19. S62.2 to earth



LOWER

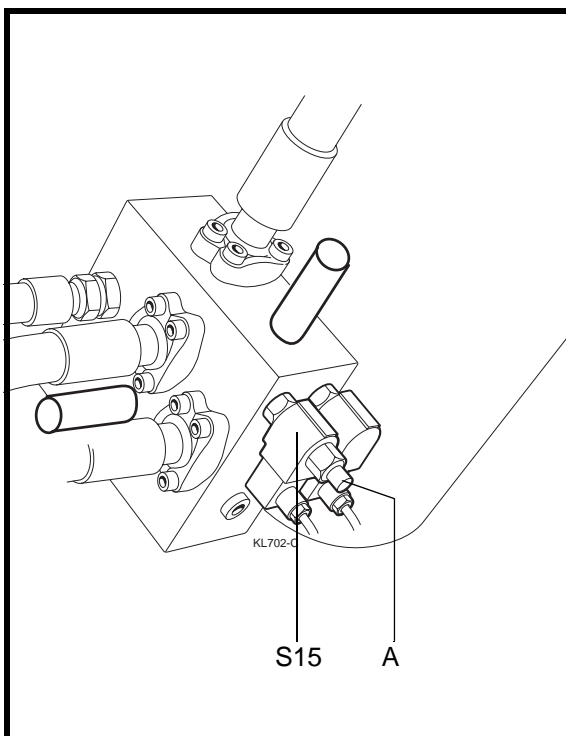
See el-servo diagram (S)

1. Control lever used to LOWER, P1 gives a 5-1 V analogue signal via D sub-contact S42.8, via cable S33 to X55.1
2. ANA IN S2.42. No indication in ECU2 for analogue IN signals.
3. DIG OUT S2.50. (Opens the lift cylinders' blocking valves S15). LE12 lit.
4. 24 V to X62.7.
5. X69.7
6. 24 V to the blocking valves S15, right and left, that open.
7. ANA OUT S2.04 to X63.2
8. Varies 24V between X63.2 and X63.5.
9. Main valve converter S7.2 opens for servo pressure at the same time servo pressure is fed to S7.8.
10. Main valve section S7.2 and S7.8 opens for LOWER



Conditions:

- No alignment indication from attachment, LE14 extinguished.
- Dead man's grip activated, LE19 lit.
- No front overload, no steering axle overload (Module 50: LE21 extinguished. Module 60: No overload indication on the display).

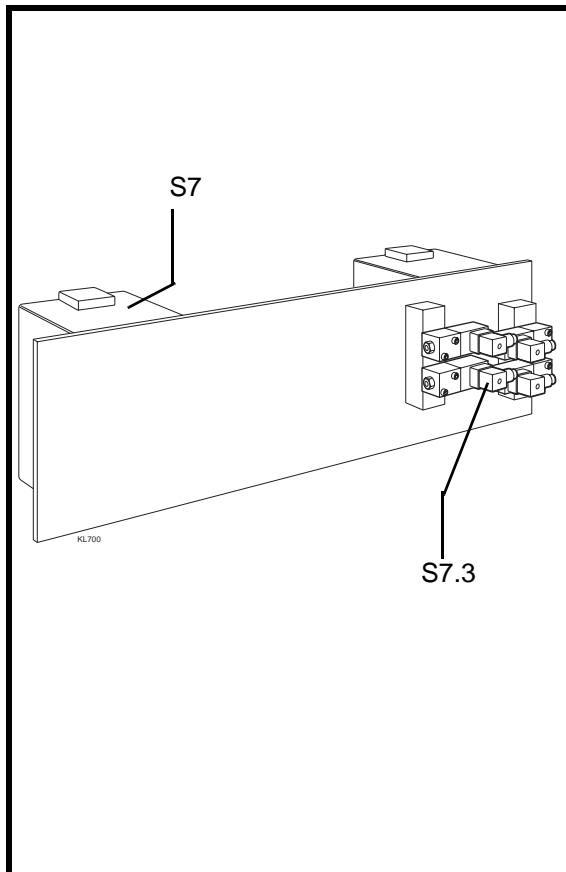


Emergency lowering

In the event of an electrical fault that leads to the blocking valves on the lift cylinders being unable to be opened, i.e., the boom cannot be lowered, there is an emergency lowering function.

On the solenoid S15 for the blocking valves (right and left lift cylinders) there is a knob, A in the illustration. Pull this straight out and turn it one quarter turn and the boom will slowly lower.

NOTE: The emergency lowering applies to unloaded machine only.



BOOM OUT

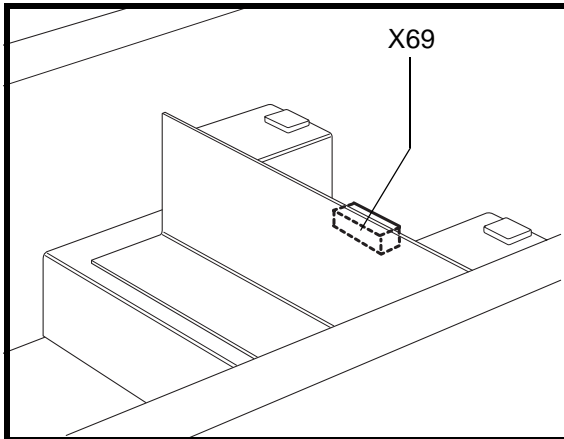
See el-servo diagram (S)

1. Control lever used to BOOM OUT, P2 gives a 5-9 V analogue signal via S42.4, via cable S33 to X55.2
2. ANA IN S2.66.
3. ANA OUT S2.05. LE4 lights depending on voltage.
4. X63.4
5. Main valve converter S7.3 opens for servo pressure. Simultaneous feed of servo pressure to S7.6.
6. Main valve sections S7.3 and S7.6 opens for BOOM OUT.

Conditions:

1. DIG IN S2.33, LE19 lit.
- Safety system not by-passed (S37)
 - No front overload. (Module 50: LE21 lit. Module 60: no overload indication on the display).

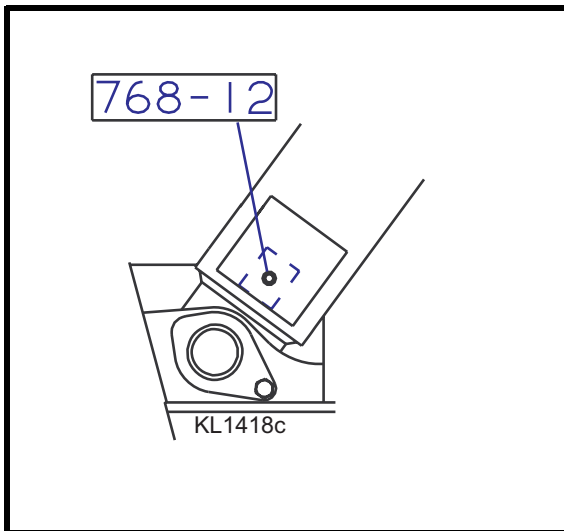
Regeneration, see next page.



Regeneration, BOOM OUT

See el-servo diagram (S)

1. 24V to X62.8
2. Connector X69.7, see illustration.



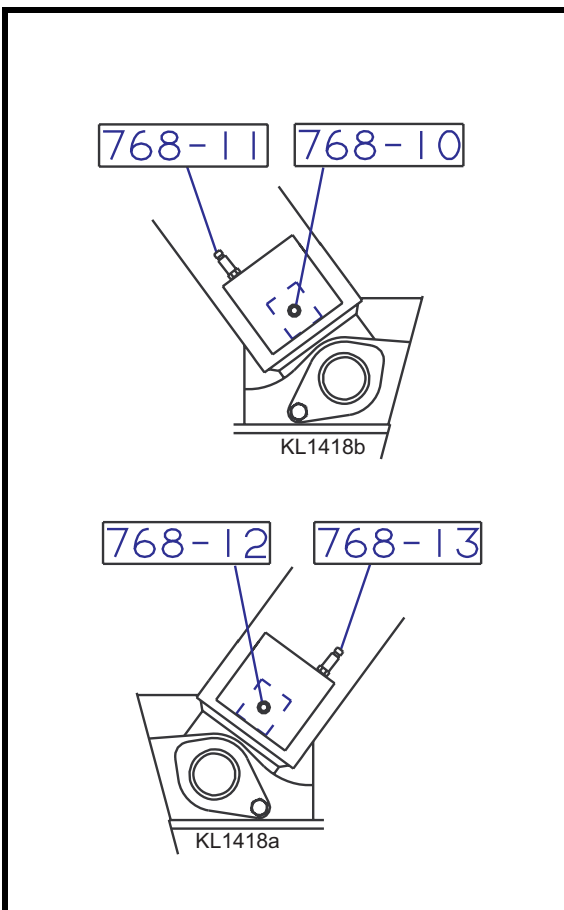
Module 50

Conditions for regeneration:

Connects when the pressure in lift circuit <85 Bar

Disconnects when the pressure is approx. 185 Bar

3. Pressure sensor 768-12.3 for lift cylinder feed IN=24 V, see illustration
4. Pressure sensor 768-12.2 OUT=4-20 mA, corresponds to 0-250 bar pressure in the lift circuit.
5. X69.5.
6. X62.5.
7. ANA IN S2.63 (No indication)
(cont'd p.14 next page)



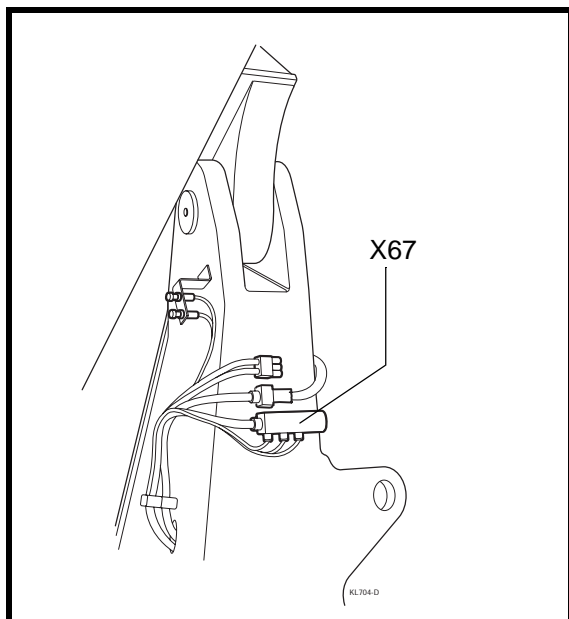
Module 60 (or module 52)

Conditions for regeneration:

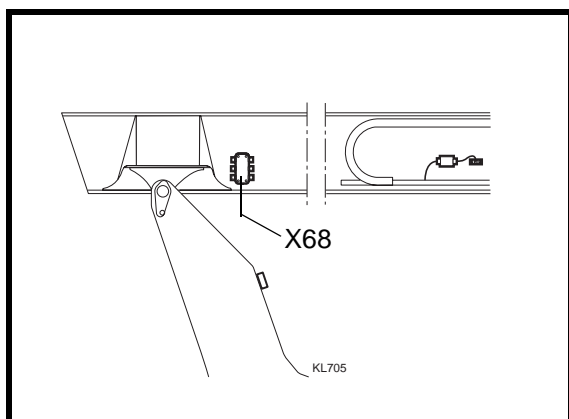
Connects when the pressure in lift circuit <85 Bar

Disconnects when the pressure is approx. 185 Bar

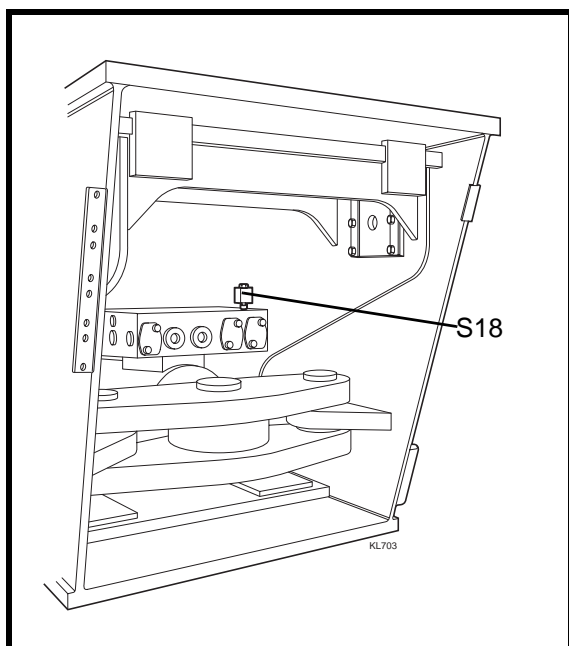
8. Feed right sensor: 24V over X69.1 to 768-10.3 and 768-11.3. Ref.voltage =0V from S19.2.
9. Feed left sensor: 24V over X69.1 to 768-12.3 and 768-13.3
- 10.Out signal right pressure side 768-10.2: 1-10V to X69.3 to X62.3, to S2.64 ANA IN (no indication)
- 11.Out signal right return 768-11.2: 1-10V to X69.4 to X62.4, to S2.65 ANA IN (no indication)
- 12.Out signal left pressure side 768-12.2: 4-20 mA to X69.5 to X62.5, to S2.63 ANA IN (no indication)
- 13.Out signal left return 768-13.2: 4-20 mA to X69.6 to X62.6, to S2.43 ANA IN (no indication)



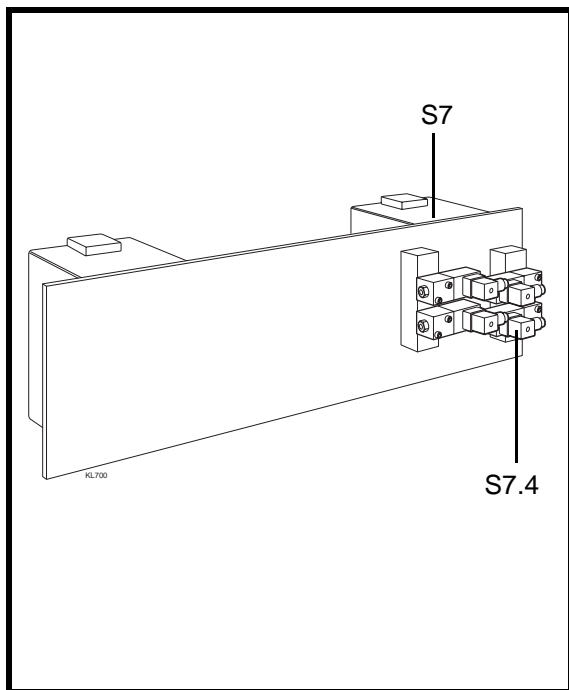
- Modules 50, 52, 60**
14.DIG OUT S2.48. LE9 lit
15.X61.4
16.Connector X67.4, see illustration



- 17.Connector X68.4, see illustration



18. Regeneration valve S18 opens and regeneration starts
The regeneration starts with a time-delay which is set in the SET UP EL-SERVO ECU 2, see Technical Handbook ECS SERVICE.
19.Earth signal to X68.



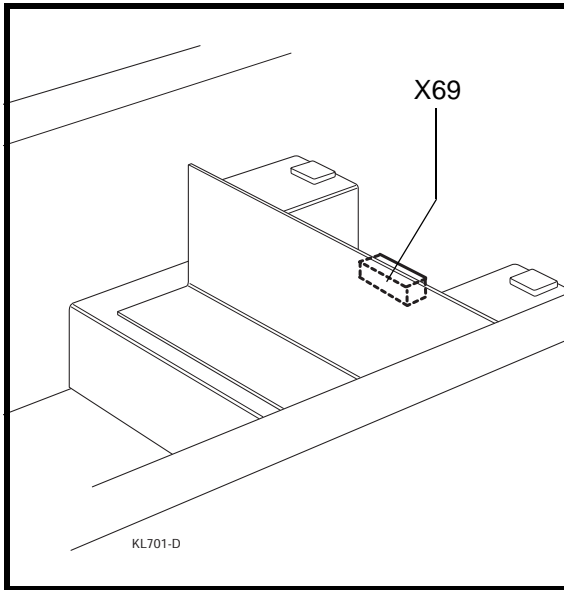
BOOM IN

See diagram S.

1. Control lever used for BOOM IN, P2 gives a 5-1 V analogue signal via S42.4, via cable S33)
2. X55.2.
3. ANA IN S2.66.
4. ANA OUT S2.01. LE5 lit
5. X63.3.
6. Main valve converter S7.4 opens for servo pressure. Simultaneous feed of servo pressure to S7.5.
7. Main valve sections S7.4 and S7.5 opens for BOOM IN.

Conditions:

- DIG IN S2.33, LE19 lit.
- Module 60: No steered axle overload indication on the display.

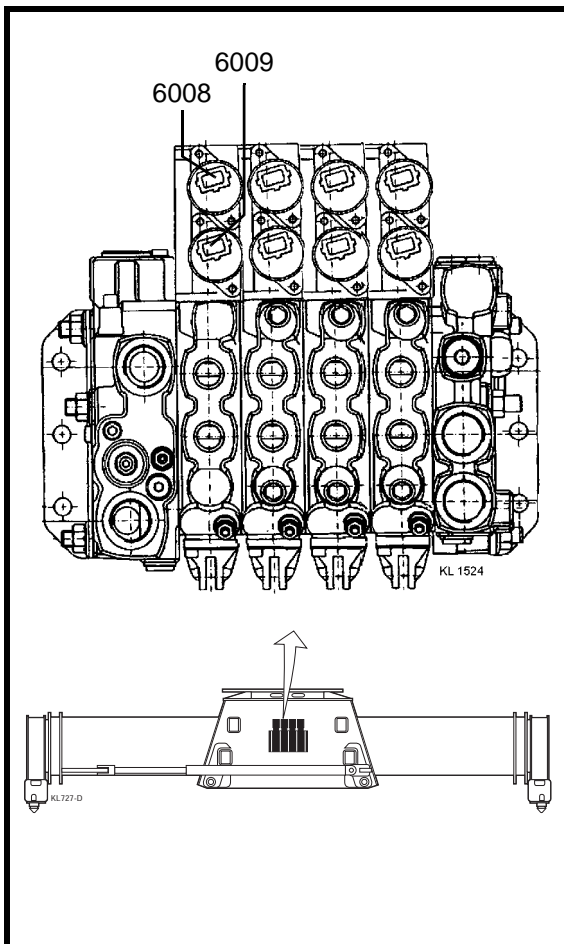


Rotation clockwise

See el-servo diagram (S)

Electrical diagram attachments
(A38414.0100 Top-lift)

1. P3 signal 5-9 V out via S42.11.
2. X55.3.
3. ANA IN S2.67 (No indication)
4. ANA OUT S2.2 (LE6 lit)
5. X62.10.
6. X69.10.
7. Activate solenoid valve, top-lift S73 (loading of hydraulic pump).
8. Signal from ECU 2 via CAN bus to KDU Attachment 791.
9. DIG OUT 791.2.2 to 6008
REF OUT 791.2.16 to 6008



Conditions:

- LE19 lit.
- No front overload. (Module 50: LE21 extinguished. Module 60: No overload indication on the display).

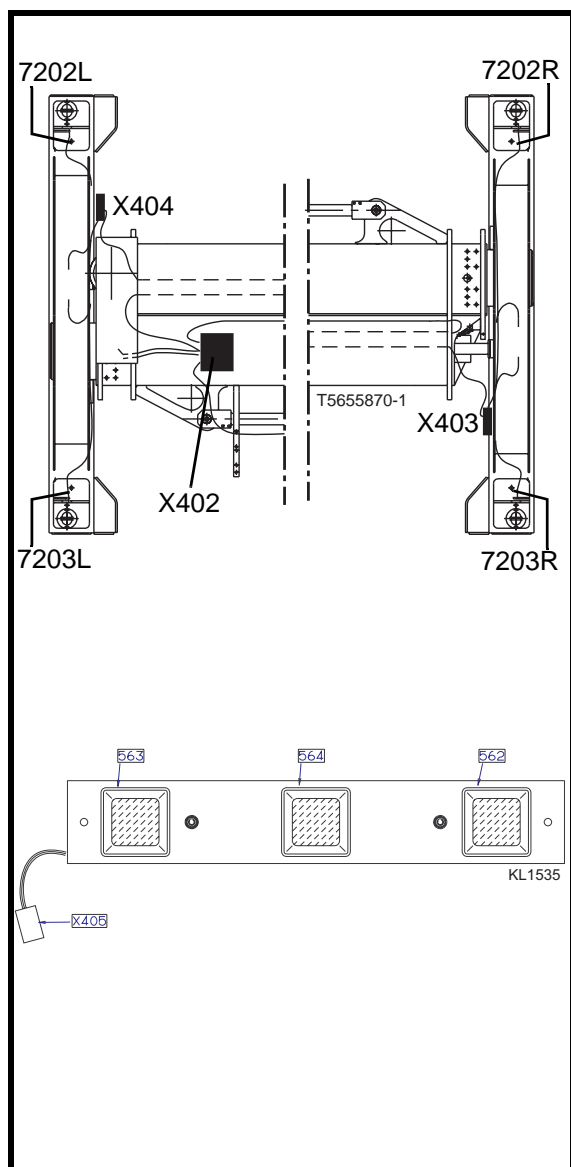
Rotation anti-clockwise

1. P3 signal 5-1 V out via S42.11.
2. X55.3.
3. ANA IN S2.67 (no indication)
4. ANA OUT S2.2 (LE6 lit)
5. X62.10.
6. X69.10.
7. Activate solenoid valve top-lift S73 (loading of hydraulic pump).
8. Signal from ECU 2 via CAN bus to KDU Attachment 791.
9. DIG OUT 791.2.3 to 6009
REF OUT 791.2.17 to 6009.

Conditions:

- LE19 lit.
- No front overload. (Module 50: LE21 extinguished. Module 60: No overload indication on the display).

N.B.
In attachment function descriptions, the term CAN bus occurs. The CAN bus in question effects communication, in the form of a digital pulse stream, between the ECU 2 and 791 computers. These signals cannot be measured without advanced specialised equipment.

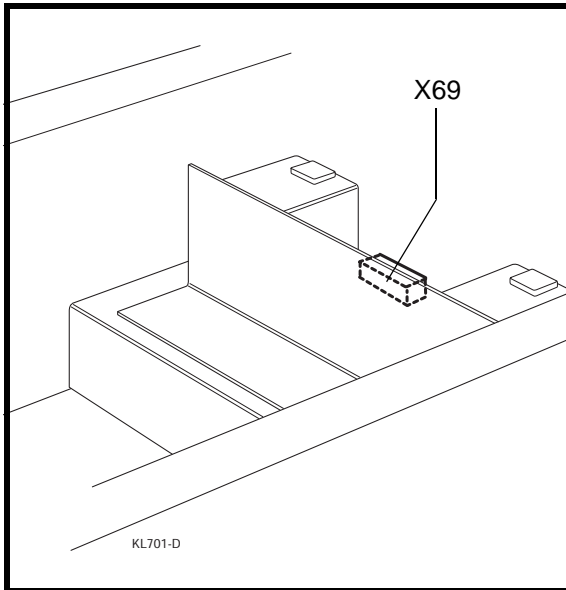


Feed, sensor

1. DIG OUT from 791.2.11 to X402.1, X403.1 and 404.1.
2. Earthing reference REF OUT from 791.2.38 to X402.2, X403.2 and 404.2.

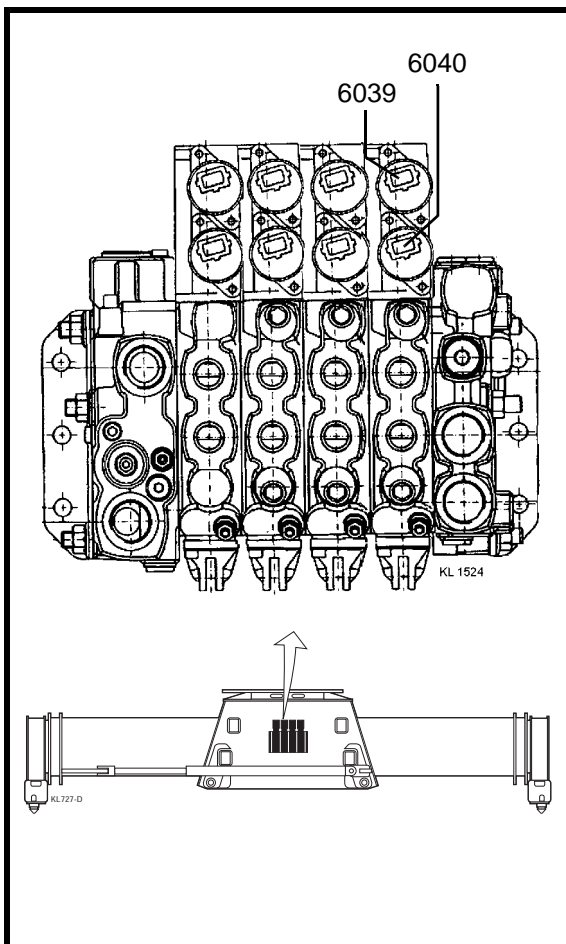
Indicator, ALIGNMENT

1. Signal from 7202R to X403.3 to X403.3.
2. DIG IN 791.2.40.
3. Signal from 7203R to X403.6 to X402.6.
4. DIG IN 791.2.26.
5. Signal from 7202L to X404.3 to X402.7.
6. DIG IN 791.2.13.
7. Signal from 7203L to X404.6 to X402.10.
8. DIG IN 791.2.27.
9. Points 1-8 satisfied, gives DIG OUT 791.2.29 to X405.2.
10. Indicator lamp ALIGNMENT lit.
Signal from 791 via CAN bus to ECU 2.
Control: DIAGNOS 4(8).



Twist-locks, automatic locking

1. Feed +24V from central electrical unit S1 connector X38.7.
Condition: Parking brake RELEASED.
2. X51.7.
3. X56.11.
4. Signal in to switch S34, pin 3
5. Switch S34 in AUT position, signal out from pin 7
6. X56.1.
7. DIG IN S2.32, LE16 lit.
Condition: Signal for alignment from 791. Control: DIAGNOS menu 4(8). Or signal from switch S37 for by-pass of safety system (DIG IN S2.58, LE24 lit).
8. DIG OUT S2.2, LE6 lit.
9. X62.10
10. X69.10.
11. Activate solenoid valve, top-lift (loading of hydraulic pump).
12. Signal from ECU 2 via CAN bus to 791.
13. DIG OUT from 791.2.37 to 6039/791.2.32 to 6040.
REF OUT from 791.2.36 to 6040.
14. Hydraulic feed to twist-lock cylinder that turn the twist-locks to locked position.

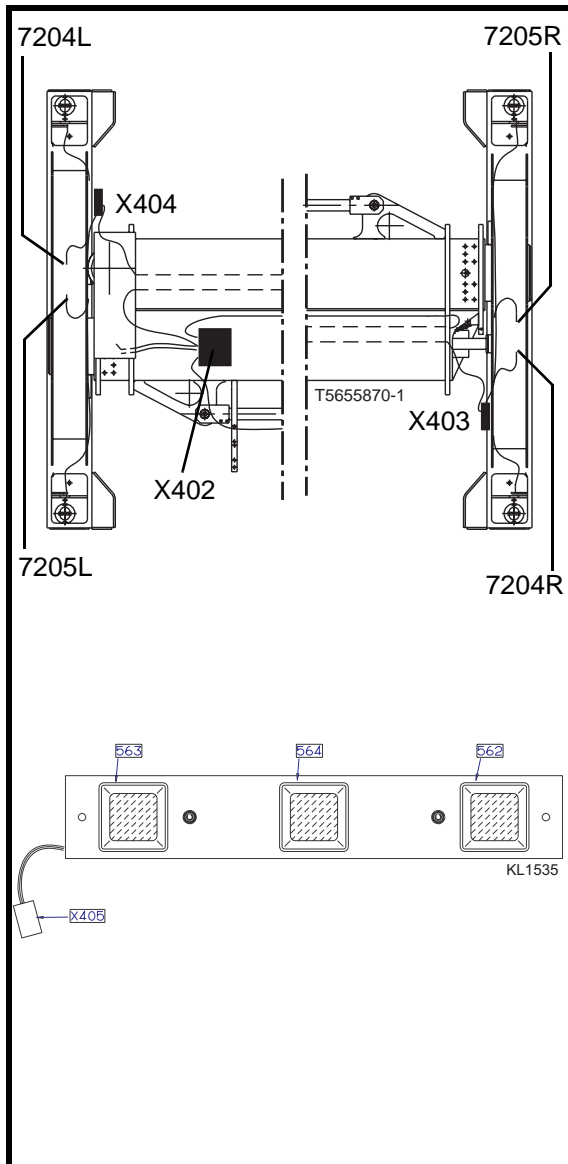


Twist-locks, manual locking

1. Feed +24V from central electrical unit S1 fuse 3 to connector X32.1.
2. X50.1.
3. X56.4.
4. Main switch S36, on through loop 567 via S35.
5. Switch S34 in MAN position, signal out from pin 2 as for point 6 above.

Twist-locks, release

1. Control lever switch T2 used.
2. 24 V to S42.20.
3. X55.10.
4. DIG IN S2.31, LE13 lit.
Condition: Signal for alignment from 791. Control: DIAGNOS menu 4(8). Or by-pass of safety system with S37 (DIG IN S2.58, LE24 lit) and no side-shift, i.e., no signal in to S2.09 (LE17 extinguished) or S2.10 (LE20 extinguished).
5. DIG OUT S2.2, LE6 lit.
6. X62.10
7. X69.10.
8. Activate solenoid valve, top-lift (loading of hydraulic pump).
9. Signal from ECU 2 via CAN bus to 791.
10. DIG OUT from 791.2.23 to 6039.
REF OUT from 791.2.37 to 6039.
11. Hydraulic feed to twist-lock cylinder that turns the twist-locks to the open position.

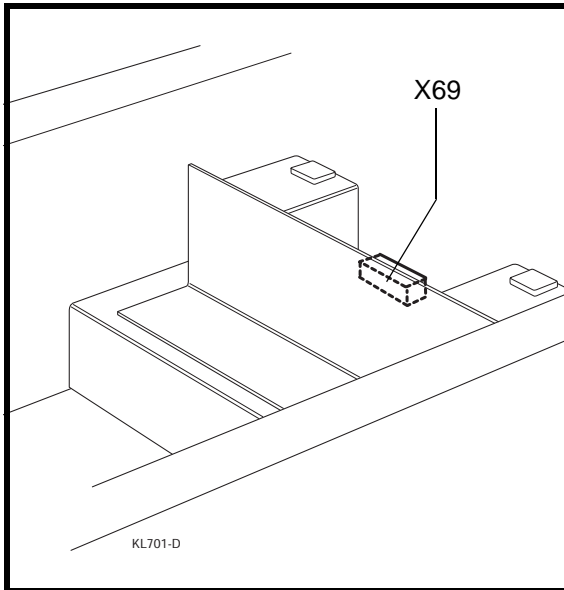


Indicator, twist-locks locked

1. Signal from 7205R to X403.5 to X402.5.
2. DIG IN 791.2.24.
3. Signal from 7205L to X404.5 to X402.9.
4. DIG IN 791.2.23.
5. Points 1-4 satisfied gives DIG OUT 791.2.39 to X405.3
6. Indicator lamp 563 Twist-locks locked lit.
 Signal from 791 via CAN bus to ECU 2.
 Control: DIAGNOS 4(8).

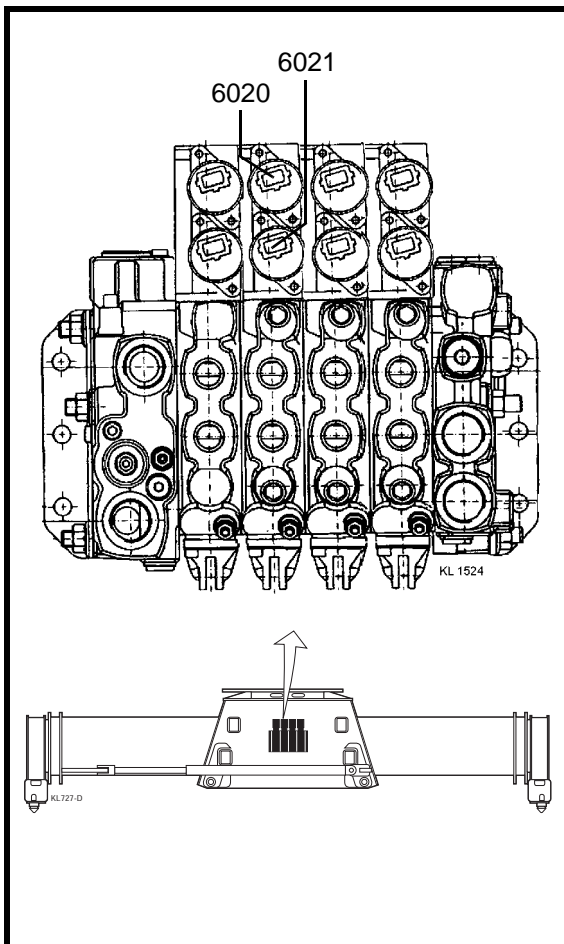
Indicator, twist-locks released

1. Signal from 7204R to X403.4 to X402.4.
2. DIG IN 791.2.41.
3. Signal from 7204L to X404.4 to X402.8.
4. DIG IN 791.2.22.
5. Points 1-4 satisfied gives DIG OUT 791.2.25 to X405.1
6. Indicator lamp 562 Twist-locks released lit.
 Signal from 791 via CAN bus to ECU 2.
 Control: DIAGNOS 4(8).



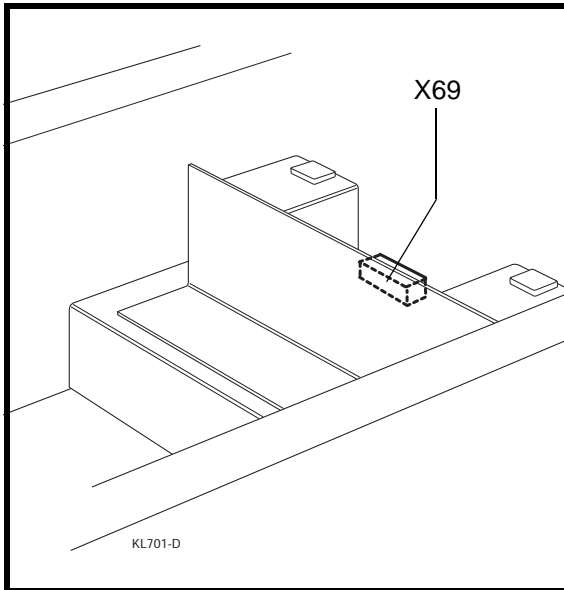
Side-shift left

1. Control lever switch T1 is used for side-shift left.
2. 24 v to S42.14.
3. X55.7.
4. DIG IN S2.10, LE20 lit.
Condition: S2.11 - LE23 extinguished, or S2.56 - LE18 lit, and S2.31 - LE13 extinguished.
5. DIG OUT S2.2, LE6 lit.
6. X62.10.
7. X69.10.
8. Activate solenoid valve top-lift (loading of hydraulic pump).
9. Signal out from ECU 2 via CAN bus to 791.
10. DIG OUT 791.2.31 to 6020
REF OUT 791.2.35 to 6020
11. 6020 opens for hydraulic feed to the side-shift cylinder. Side-shift left.



Side-shift right

1. Control lever switch T1 is used for side-shift right.
2. 24 v to S42.16.
3. X55.8.
4. DIG IN S2.09, LE17 lit.
Condition: S2.11 - LE23 extinguished, or S2.56 - LE18 lit, and S2.31 - LE13 extinguished.
5. DIG OUT S2.2, LE6 lit.
6. X62.10.
7. X69.10.
8. Activate solenoid valve, top-lift (loading of hydraulic pump).
9. Signal out from ECU 2 via CAN bus to 791.
10. DIG OUT 791.2.30 to 6021
REF OUT 791.2.34 to 6021
11. 6021 opens for hydraulic feed to the side-shift cylinder. Side-shift right.



Length adjustment OUT

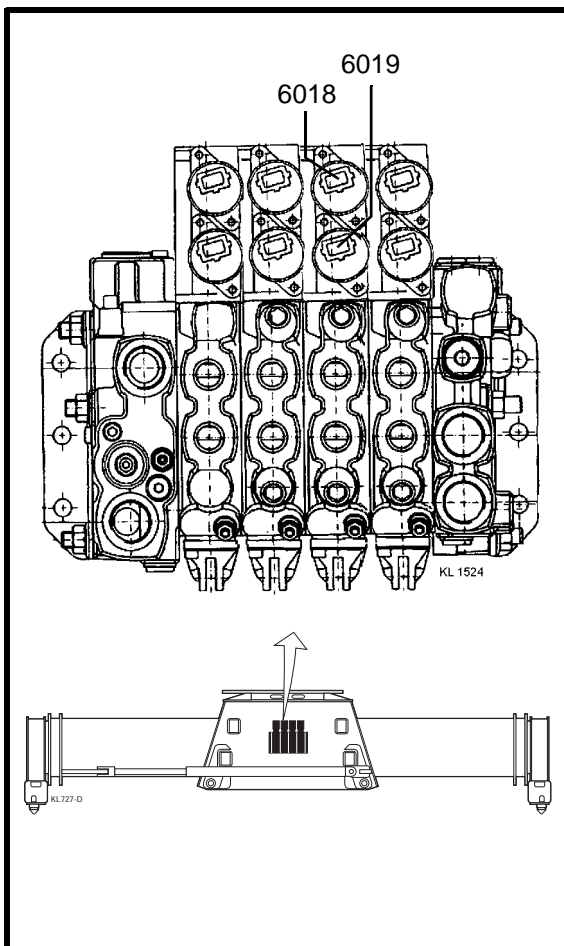
- Control lever switches T1 + T4 are used.

T1

- T1 to the right.
- Signal out to S42.16.
- X55.8.
- DIG IN S2.09, LE17 lit.

T4

- T4 depressed.
- Signal out to S42.19.
- X55.9.
- DIG IN S2.11, LE23 lit.
- DIG OUT S2.2. LE6 lit.
- X62.10
- X69.10
- Activate solenoid valve, top-lift (loading of hydraulic pump).
- Signal out from ECU 2 via CAN bus to 791.
- Conditions: Signal twist-locks released. Control: DIAGNOS 4(8).
Or signal for bypass connection of safety system with S37 (DIG IN S2.58, LE 24 lit)
- DIG UT 791.2.4 to 6018
REF UT 791.2.18 to 6018
- 6018 opens for hydraulic feed to the cylinder, length adjustment OUT begins.



Length adjustment IN

- Control lever switches T1 + T4 are used.

T1

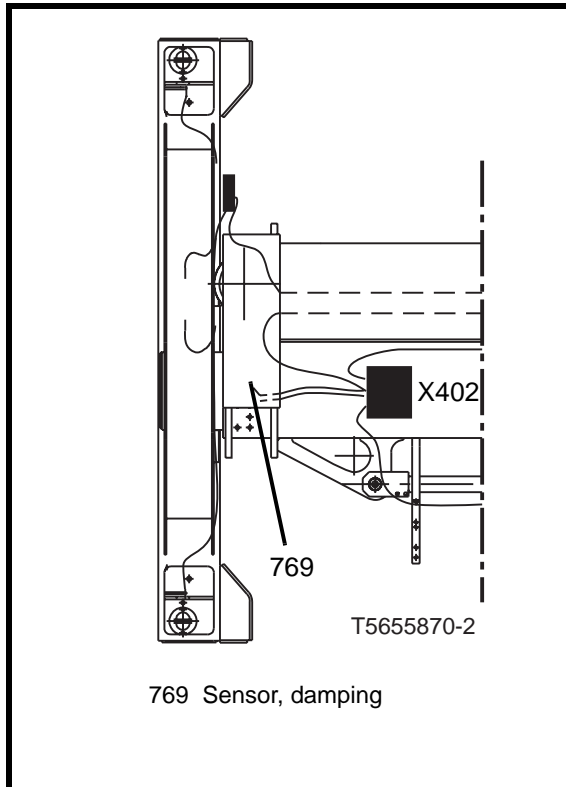
- T1 to the left.
- Signal out to S42.14.
- X55.7.
- DIG IN S2.10, LE20 lit.

T4

- T4 depressed.
- Signal out to S42.19.
- X55.9.
- DIG IN S2.11, LE23 lit.
- DIG OUT S2.2. LE6 lit.
- X62.10
- X69.10
- Activate solenoid valve, top-lift (loading of hydraulic pump).
- Signal out from ECU 2 via CAN bus to 791.
- Conditions: Signal twist-locks released. Control: DIAGNOS 4(8).
Or signal for bypass connection of safety system with S37 (DIG IN S2.58, LE 24 lit)
- DIG OUT 791.2.5 to 6019
REF OUT 791.2.19 to 6019
- 6019 opens for hydraulic feed to the cylinder, length adjustment IN begins.

End-position damping for IN and OUT length adjustment

1. Feed, sensor: DIG OUT 791.2.11 to X402.1
Reference voltage, sensor: REF OUT 791.2.38 to X402.2
2. Signal from 769 to X402.11
3. DIG IN 791.2.12 gives lowered speed at both end positions.



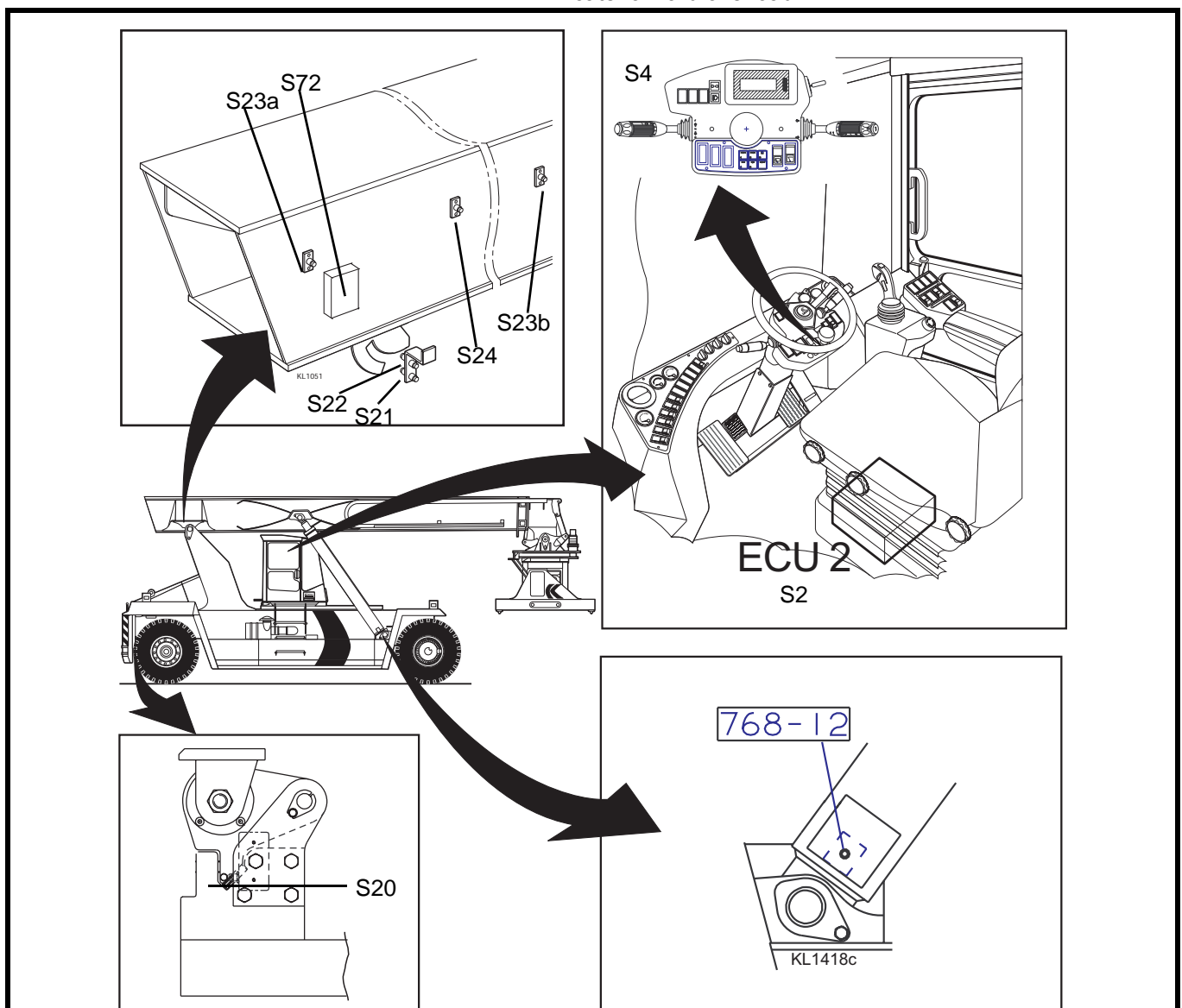
Module 50 Mechanical Overload Protection

The mechanical overload protection function:

- monitors the forward load and generates an alarm on the ECS terminal.
- monitors the rear load on the steering axle.
- controls the regeneration system for LIFT and BOOM OUT.
- controls the end position damping for LIFT, LOWER and BOOM OUT.

The mechanical overload protection system consists of (see illustration below)

- A pressure sensor, 768-12, in the left lift cylinder feed line.
- Five inductive sensors for monitoring boom angle, boom extension and end position.
- An inductive sensor on the steering axle suspension to indicate forward overload.



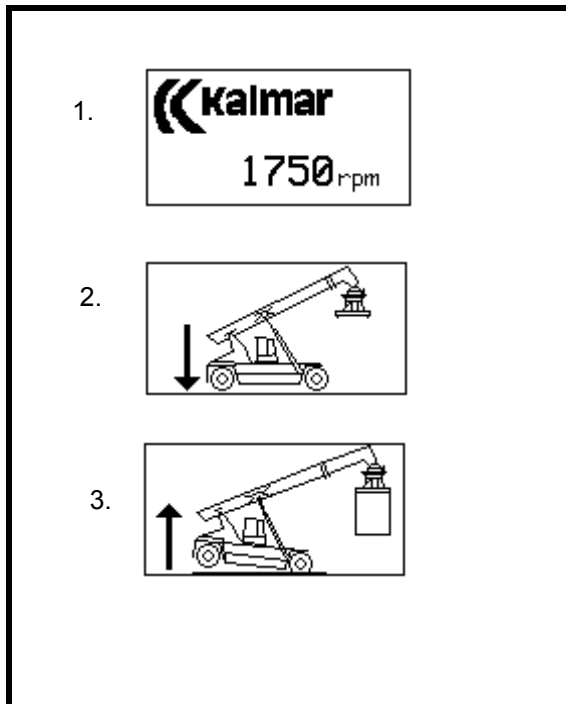
768-12. Pressure sensor, feed line left lift cylinder (page 42)

See servo diagram (S)
S2. ECU2
S4. ECS terminal

See page 59

- S20. Sensor, steering axle overload
- S21. Sensor, boom angle
- S22. Sensor, end position boom angle
- S23a. Sensor, boom inner position
- S23b. Sensor, boom outer position

- S24. Sensor, BOOM OUT
- S72. Relay box, relays for determination inner or outer boom position



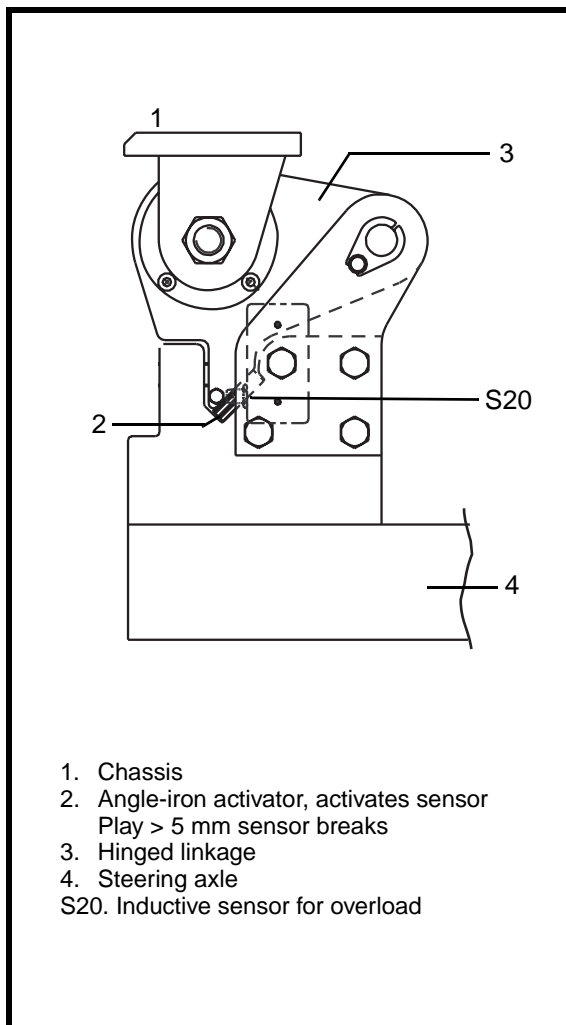
Overload indicator

1. Normal operating condition.
2. Steering axle overload
Monitored by two inductive sensors, 24 for boom extension and 21 for boom angle. When boom extension is less than 1.5 m, the boom angle is greater than 35° and 3rd or 4th gear is engaged both sensors interrupt and generate an alarm for overload of the steering axle. A red lamp blinks and the buzzer sounds intermittently.
3. With forward overload, i.e., when approximately 33% of the safety margin remains (remaining counter-weight), the red warning light on the ECS terminal lights up, a buzzer sounds and the ECS terminal display shows "overload". At the same time, the system interrupts the LIFT, LOWER and BOOM OUT functions. Of these, it is possible to make a by-pass connection of the LOWER function, using the by-pass switch on the side of the hydraulic console in the cab.



WARNING!

At any bypassing of the safety asystem, extreme care must be taken when operating the machine.



1. Chassis
 2. Angle-iron activator, activates sensor
Play > 5 mm sensor breaks
 3. Hinged linkage
 4. Steering axle
- S20. Inductive sensor for overload

The signal for forward overload is supplied by the sensor on the steering axle suspension. The rear steering axle suspension includes a flexibly mounted hinged linkage with pre-determined amount of "play". When the permitted load is exceeded and the steering axle is the only remaining counter-weight, this play increases the distance between the sensor and the angle-iron that activates the sensor. When this play is at its maximum, the sensor's signal ceases, an overload warning is generated and LIFT, LOWER and BOOM OUT functions are interrupted while BOOM IN works as usual.

This means that the machine may become locked in position. To rectify such a situation it is possible to make a by-pass connection with the help of the by-pass switch located on the side of the hydraulic console in the cab. Once the by-pass connection is made, the BOOM IN and LOWER functions can be used.

Regeneration

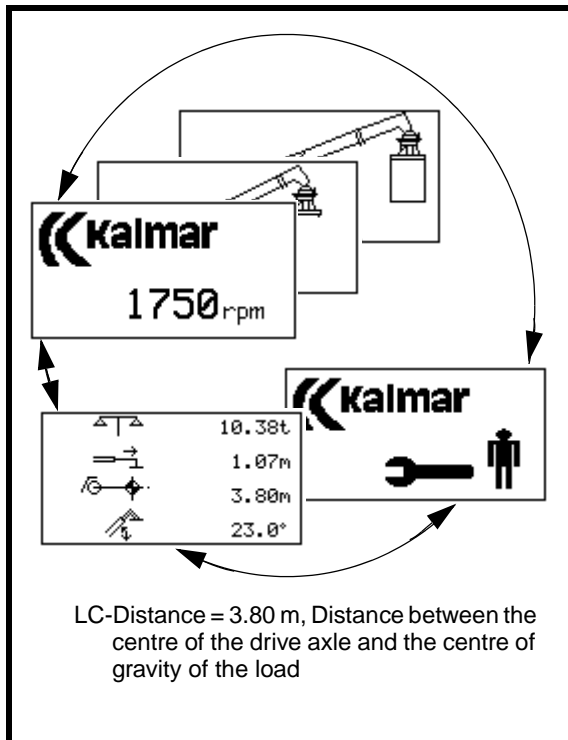
Regeneration operates on the LIFT and BOOM OUT functions and is a system that leads return fluid from the piston sides of the lift and extension cylinders directly back to the cylinder feed. The system is activated at hydraulic pressures lower than 8.5 MPa and considerably increases the piston speed by increasing the flow of hydraulic fluid. More rapid boom movement can thereby be achieved on an unloaded machine. The greatest load which will still allow the regeneration system to be activated is, for example, an empty container in the first row. With a greater load, LIFT and BOOM OUT function as normal.

The regeneration starts with a time delay which is set in the SET-UP EL-SERVO menus, see Technical Handbook ECS SERVICE

End position damping

End position damping reduces the speed of LIFT/LOWER and BOOM OUT/IN functions in order to reduce jolting at stop positions.

Sensors 22 for boom angle and 23a+b for boom extension are activated before the end positions. The system feeds out less current to the main valves which provide a reduced hydraulic flow and thereby, a reduction in speed.



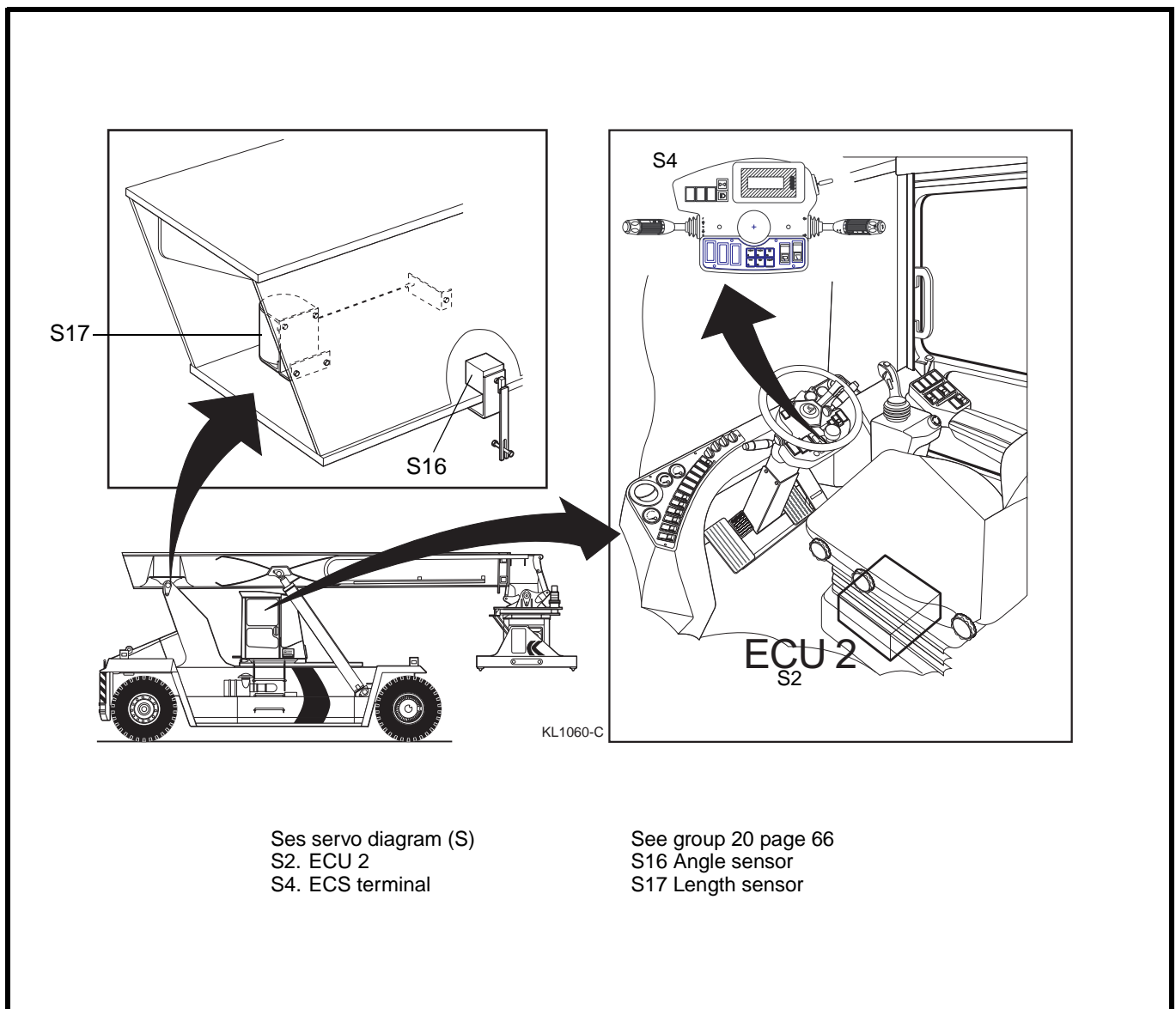
Module 51, vertical lift for Module 50

Module 51 Vertical lift:

- steers LIFT/LOWER and BOOM OUT/IN and coordinates both of these functions so that the load moves completely vertically both up or down.
- numerically displays WEIGHT, BOOM EXTENSION, LC-DISTANCE and BOOM ANGLE.
- displays the Module 50 overload menus, as shown in the adjacent illustration. The menus vary if additional modules are selected, for example, Printer, Container counter, Automatic gear changing.

Module 51 consists of: (see illustration below)

- A potentiometer type length sensor S17 with wire to indicate boom extension length.
- An oil-filled potentiometer angle sensor S16 that indicates the lift angle of the boom.
- S16 and S17 replace S21, S22, S23a+b, S24 and S72 from module 50.
- When Module 51 is installed, ECU 2 must be initiated. Contact Kalmar to obtain the necessary parameters.



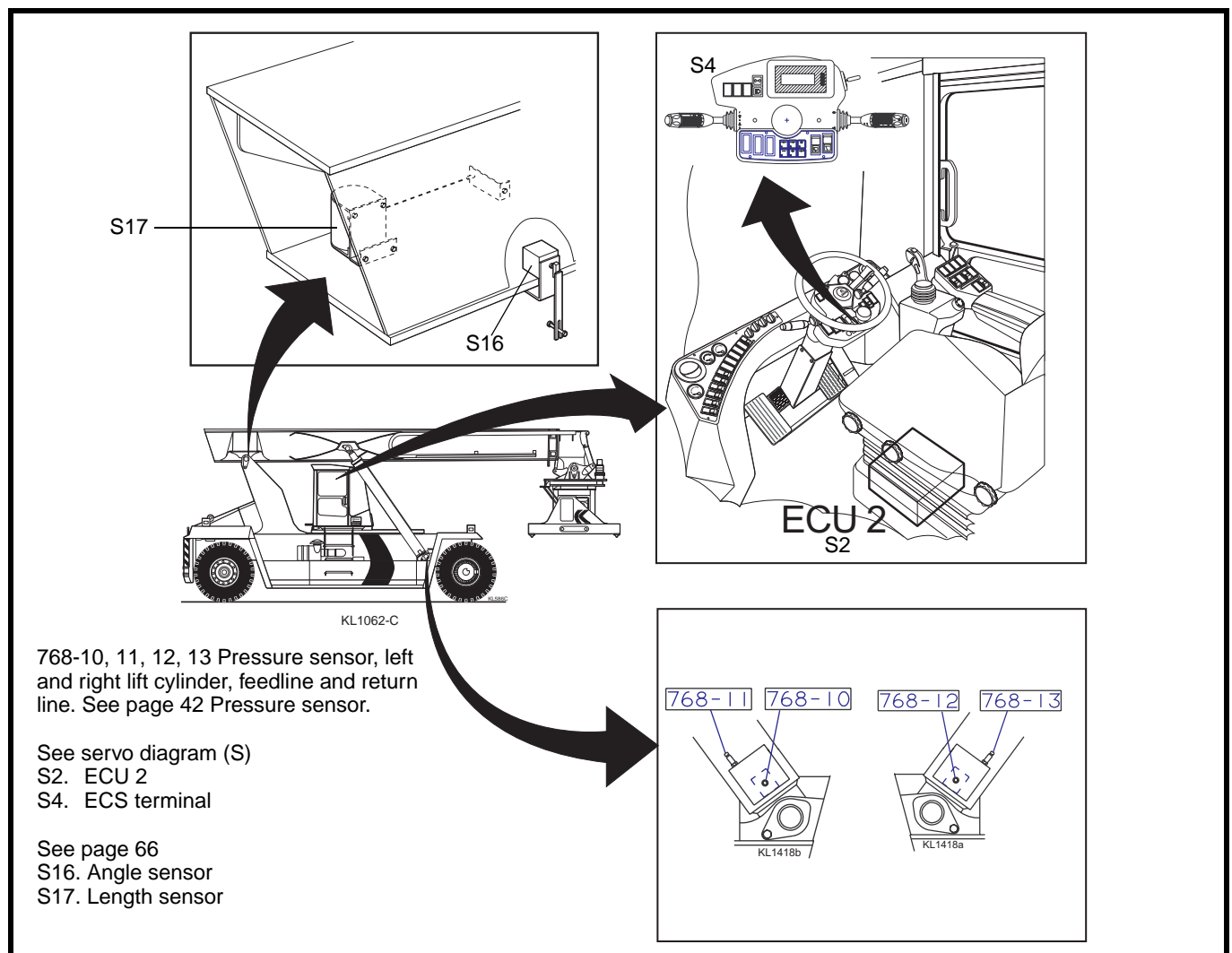
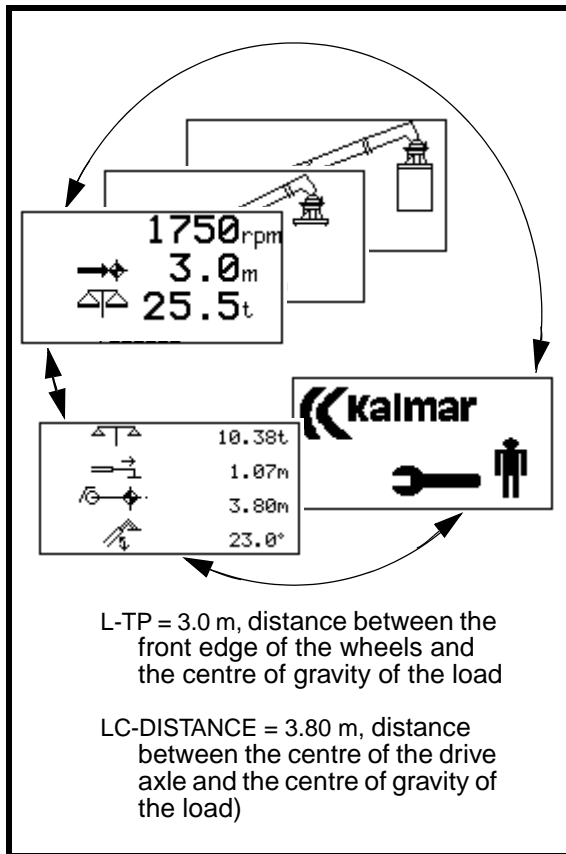
Module 52, Vertical Lift + Balance for Module 50

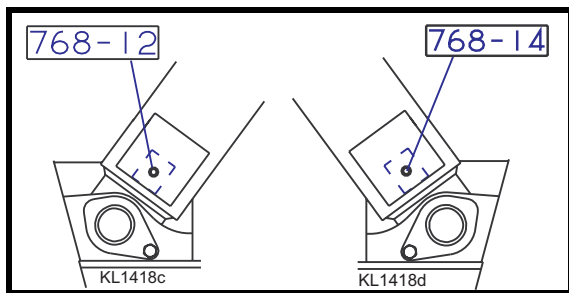
Module 52 Vertical lift + Balance

- steers LIFT/LOWER and BOOM OUT/IN and coordinates both of these functions so that the load moves completely vertically both up or down.
- numerically displays WEIGHT, BOOM EXTENSION, LC-DISTANCE and BOOM ANGLE.
- numerically displays L-TP and current load in tons. Note that graphic load indicator only appears on module 60.
- displays the Module 50 overload menus, as shown in the adjacent illustration. Overload is indicated by sensor S20 i the steered axle suspension. The menus vary if additional modules are selected, for example, Printer, Container counter, Automatic gear changing.

Module 52 consists of: (see illustration below)

- A pressure sensor 768-10, 11, 12, 13 in each of the lift cylinder lyftcylinderns feed and return line.
- A potentiometer type length sensor S17 with wire to indicate boom extension length.
- An oil-filled potentiometer angle sensor S16 that indicates the lift angle of the boom.
- S16 and S17 replace S21, S22, S23a+b, S24 and S72 from module 50.
- When Module 52 is installed, ECU 2 must be initiated. Contact Kalmar to obtain the necessary parameters.

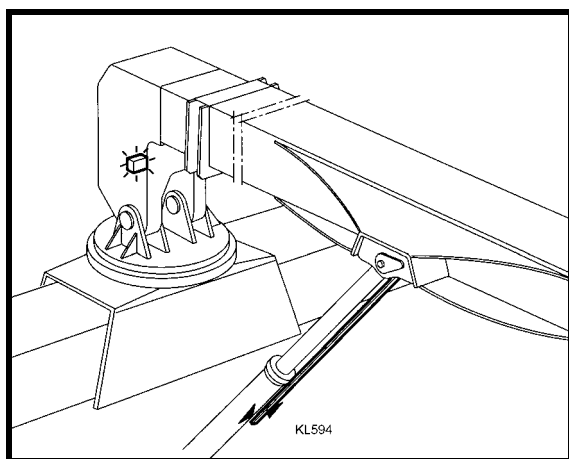




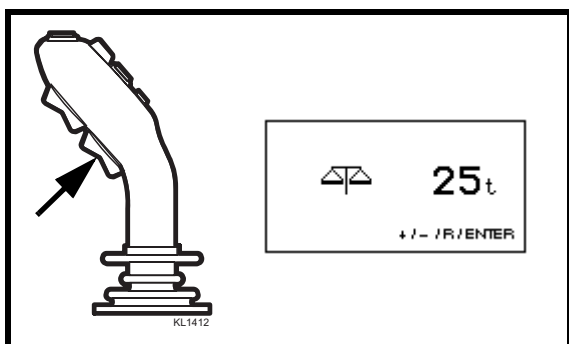
Module 57 Hydraulic Balance

The hydraulic balance is included in the ECU 2 el-servo system. The signal to the system comes from the 768-12 pressure sensor in the left lift cylinder feed and from 768-14, right cylinder.

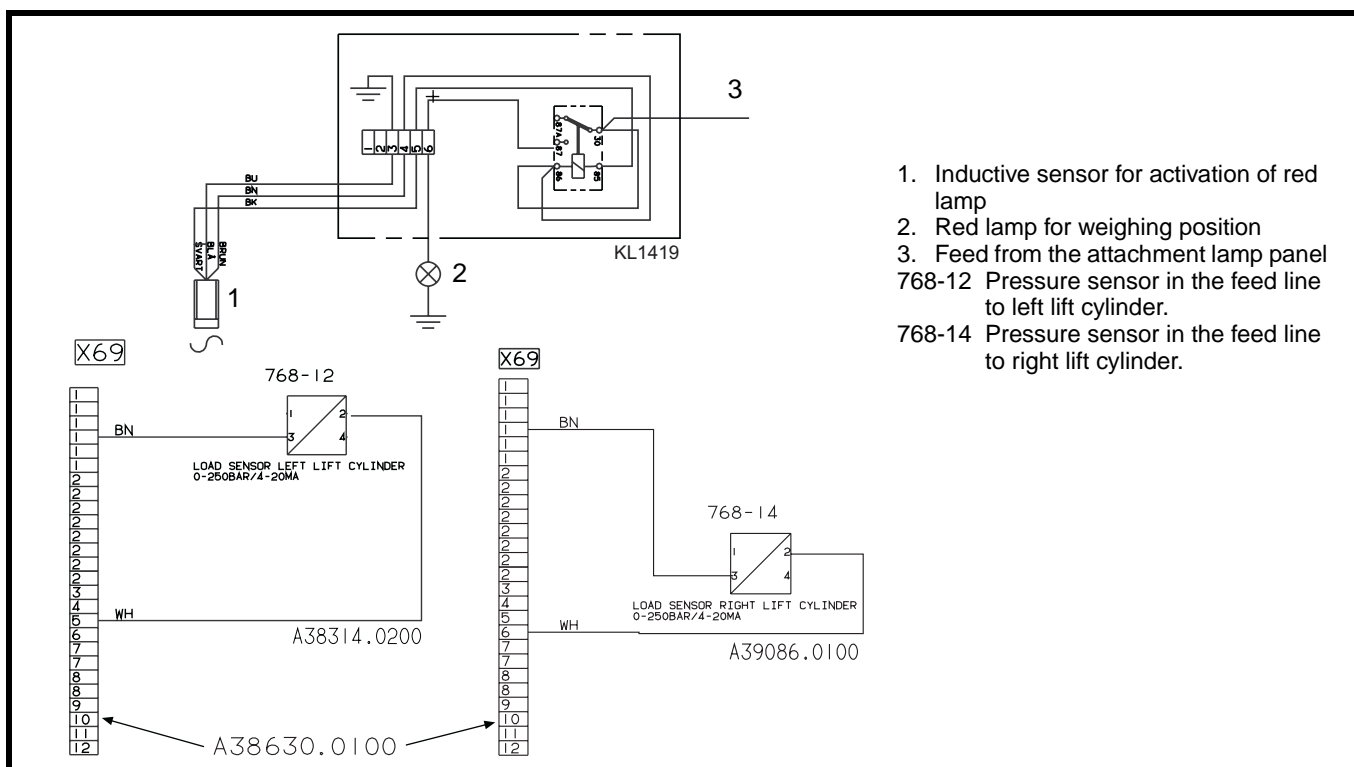
1. Calibration of the balance must be carried out in accordance with the instructions in ECU 2 SETUP, points 20 and 21
2. Connect a loaded container to the machine



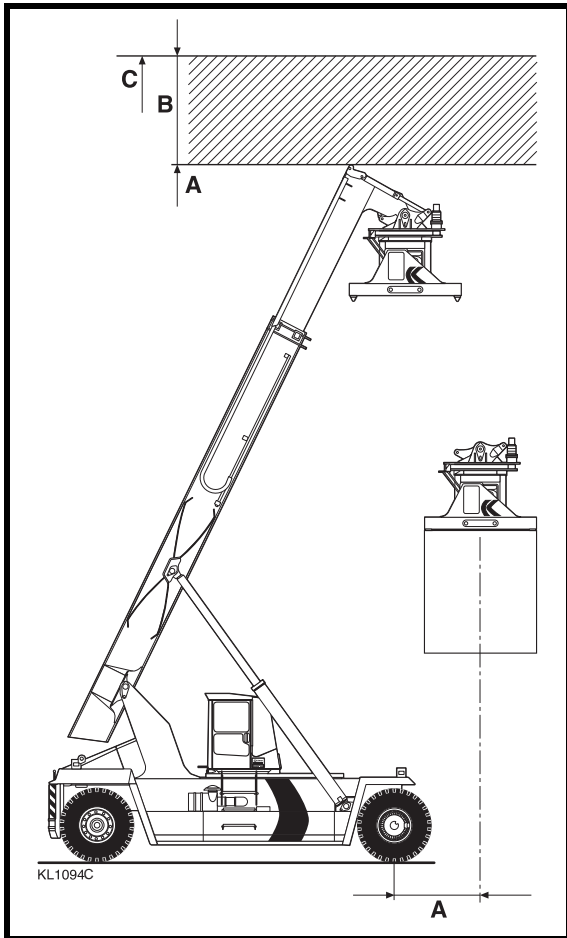
3. Extend the boom until the red lamp lights.
4. Lift the boom approx. 20 cm over the position where the red flags on the left lift cylinder are aligned with each other.
5. Lower the boom until the red flags are exactly aligned with each other.
(By first lifting the boom too high and then lowering it to the correct position, the regeneration system is prevented from building up pressure that can affect the measurement)



6. Press the button for weighing = the vertical lift button on the control lever
7. The result is shown on the ECS terminal display



1. Inductive sensor for activation of red lamp
 2. Red lamp for weighing position
 3. Feed from the attachment lamp panel
- 768-12 Pressure sensor in the feed line to left lift cylinder.
768-14 Pressure sensor in the feed line to right lift cylinder.



Module 59 Limitation Height/LC-distance for module 50/60

In certain cases it may be necessary to limit how high the boom can be lifted, for example, for operations in areas with overhead power lines, bridges, traverses, etc, or how close to the cab the load can be moved.

The pre-set limitation of height or Lc-distance, **A** on the adjacent illustration, can be by-passed using the switch on the hydraulic control panel (S71)

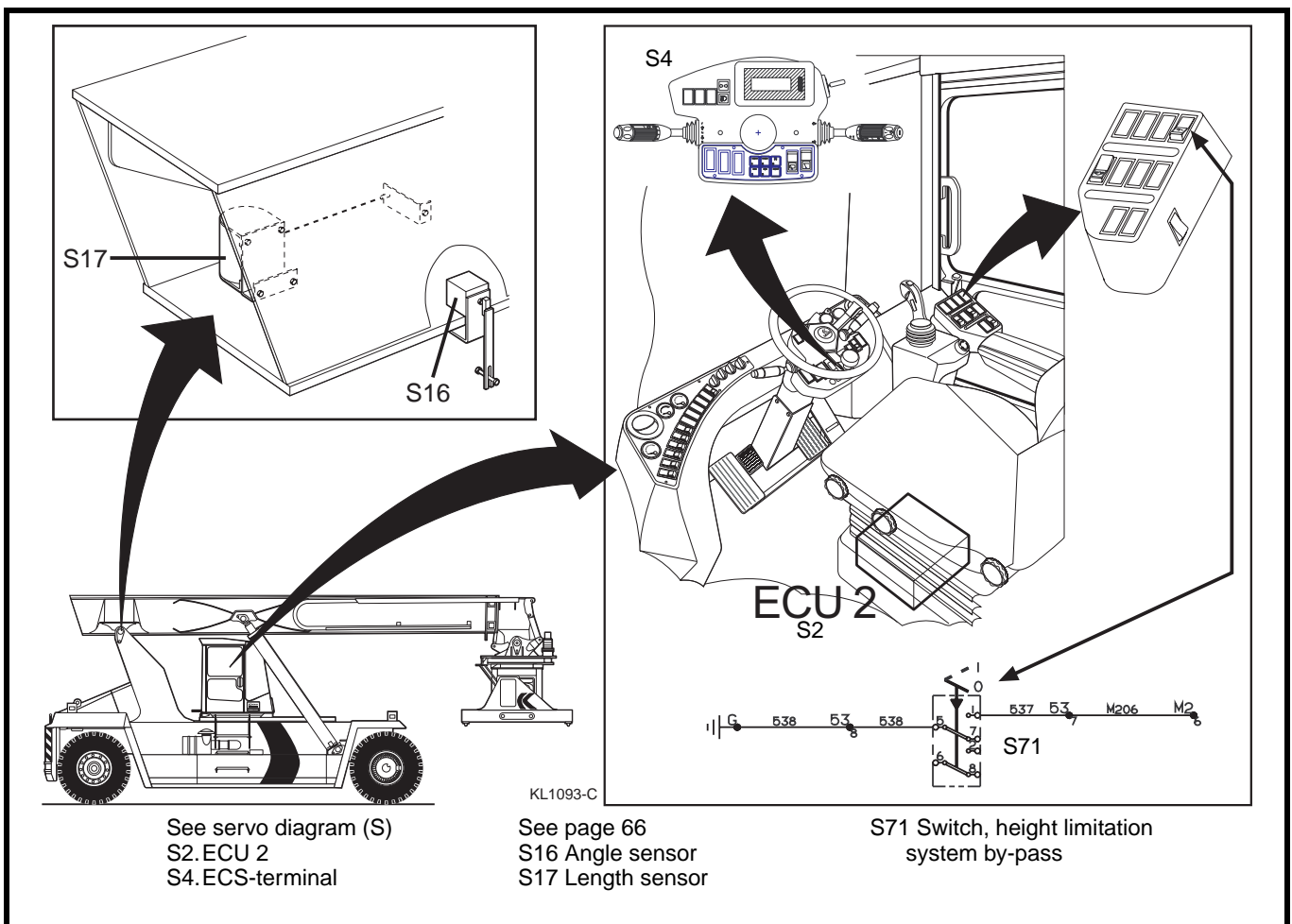
The switch must be continually pressed in whilst the boom (height limitation) moves through the area **B** (700 mm) or the load (limitation of Lc-distance) moves inside limitation **A**.

Above height **C** (height limitation), the system functions as normal. In front of limitation **A** (limitation of Lc-distance) the system functions as normal.

In parallel with switch S71, the switch for by-passing the safety system (located on the side of the hydraulic control panel) can also be used.

Module 59 consists of, see illustration below

- Switch S71 for by-passing the limitation system (height or Lc-distance)
- A potentiometer type length sensor S17 with wire to indicate boom extension length.
- An oil-filled potentiometer angle sensor S16 that indicates the lift angle of the boom.
- S16 and S17 replace S21, S22, S23a+b, S24 and S72 from module 50.
- When Module 59 is installed, the limitation **A** must be set, see Technical Handbook ECS SERVICE, CALIBRATION MODULE 60.



See servo diagram (S)
S2. ECU 2
S4. ECS-terminal

See page 66
S16 Angle sensor
S17 Length sensor

S71 Switch, height limitation system by-pass

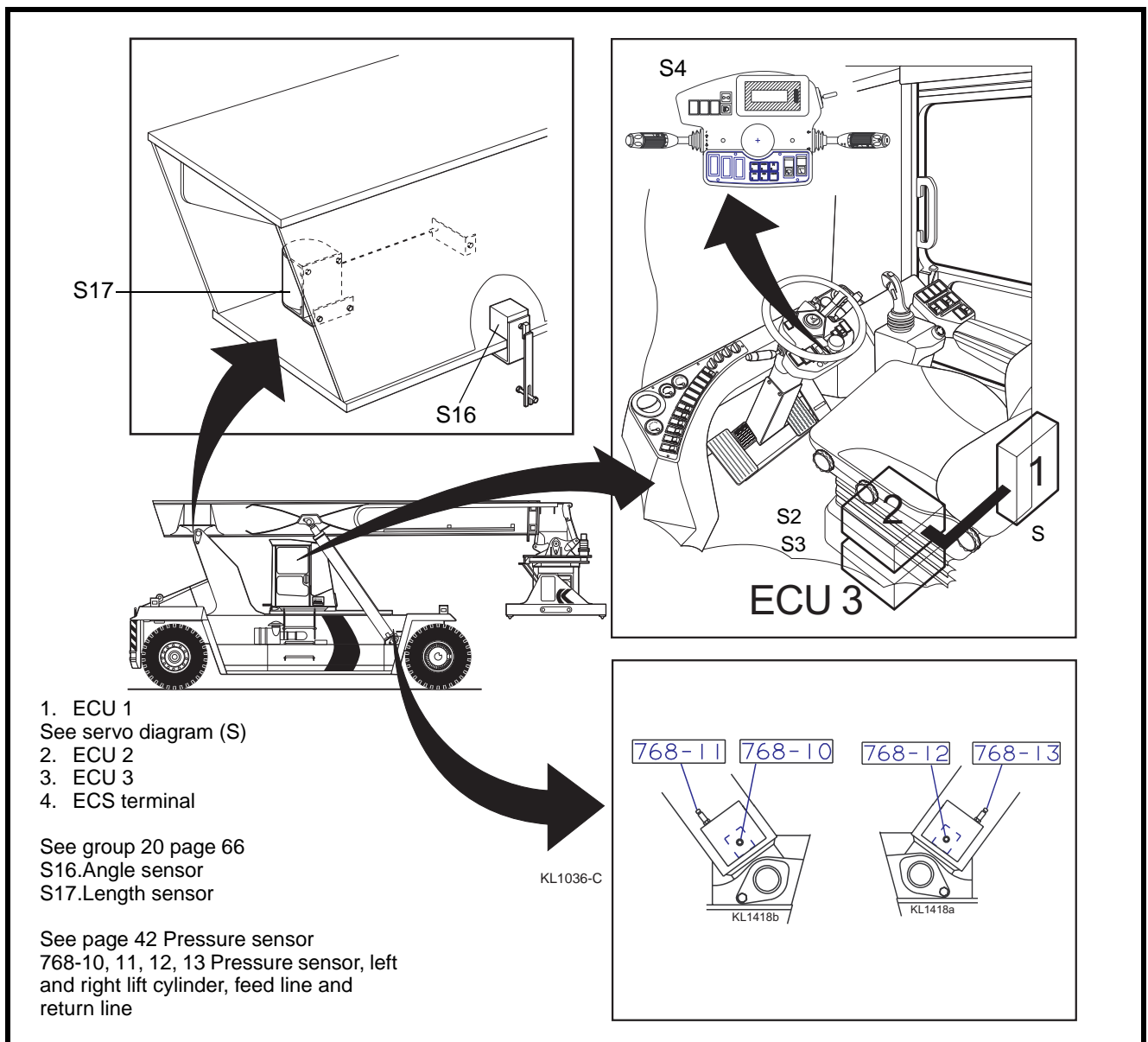
Module 60, Electronic overload protection

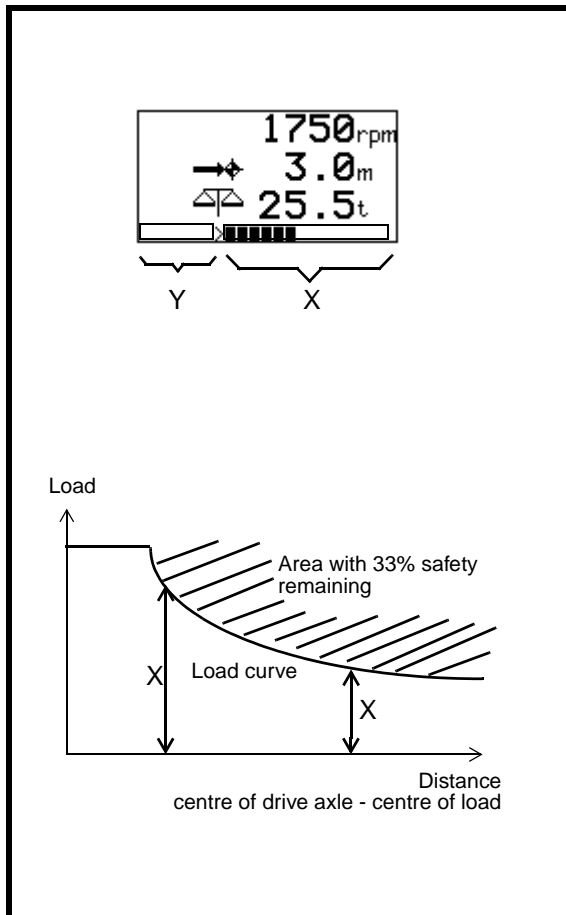
The electronic overload protection:

- monitors the front load and continually shows the results via two different menus on the ECS terminal display, switch between menus using the arrow RIGHT/LEFT keys
- monitors the rear load on the steering axle
- controls the regeneration system for LIFT and BOOM OUT
- includes vertical lift, as standard
- includes completely electronic balance, as standard, measurement precision ± 0.5 tons over 80% of the complete measurement area
- controls the end position damping of LIFT/LOWER and BOOM OUT/IN

Electronic overload protection (see illustration below) consists of:

- A pressure sensor 768-10, 11, 12, 13 in each lift cylinder feed and return lines
- A potentiometer type length sensor S17 with wire to indicate the length of extension.
- An oil-filled potentiometer type angle sensor S16 to indicate the lift angle of the boom.





Overload indicator

Under normal circumstances, the overload protection system functions as a balance and gives a continual read-out of the size and position of the load.

L-TP 4.22M = The distance between the front edge of the wheels and the centre of gravity of the load.

23.5 T = Actual load in tons.

X = Load indicator, fills the display to the right for 0-100% loads. When the load indicator reads full, the system interrupts operation due to forward overload. There remains a safety margin of approx. 33% (remaining counter-weight). The red warning lamp lights continuously, the warning buzzer sounds continuously and the LIFT, LOWER and BOOM OUT functions are interrupted. Of these, it is possible to make a by-pass connection to the LOWER function using the switch on the side of the hydraulic console in the cab.

Load X, along the whole of the load curve corresponds to maximum reading (100%) on the load indicator X (on the ECS terminal display).

Steering axle overload

Y = Indicator for steering axle load, fills the display to the left for 95-100% of permitted load. When the indicator reads full, i.e., with a load of 33 or 43 tons, depending on the type of machine, the red warning lamp on the ECS terminal blinks and the buzzer sounds intermittently.

Regeneration

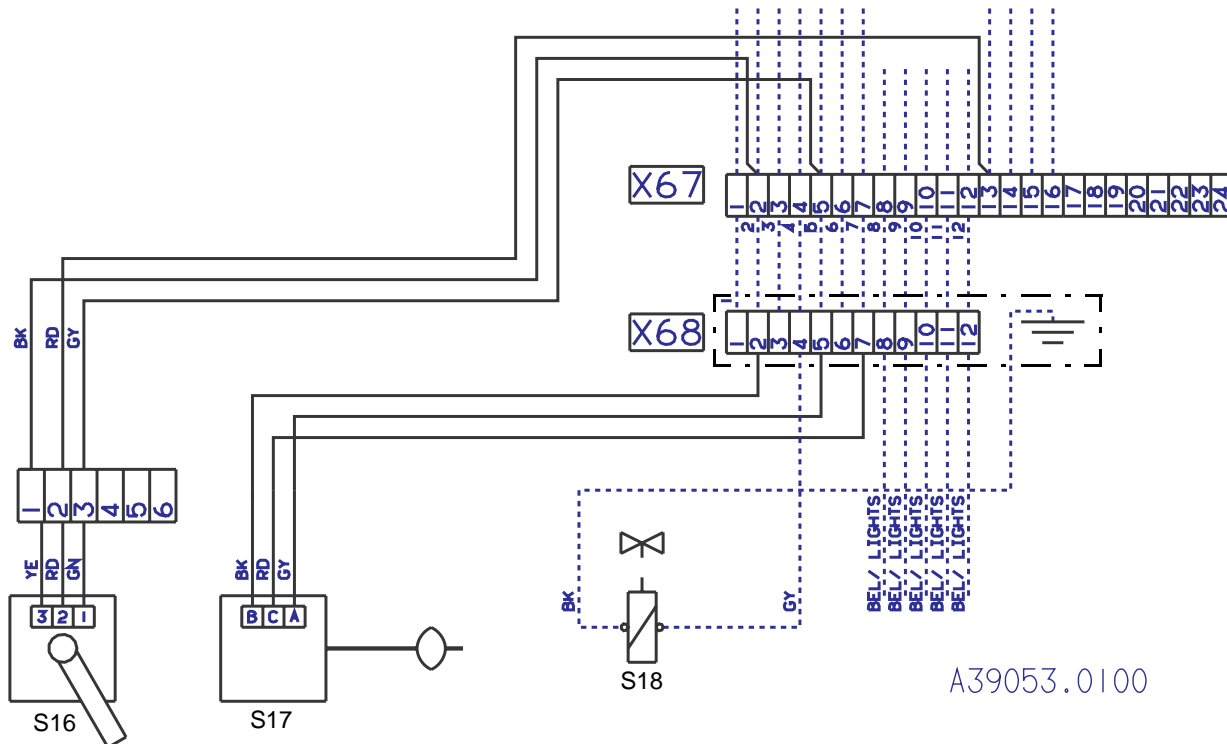
The regeneration function operates on the LIFT and BOOM OUT functions and is a system that directs the return flow of hydraulic fluid from the piston sides of the lift and extension cylinders, directly back to the cylinder feed. The system is activated at hydraulic pressures lower than 8.5 MPa and considerably increases the piston speed by increasing the flow of hydraulic fluid. This means that much more rapid movement is possible with the machine not under load. The greatest load that permits the regeneration system to be activated is, for example, an empty container on the first row. With a greater load, the LIFT and BOOM OUT functions operate normally.

The regeneration starts with a time delay which is set in the SETUP EL-SERVO menus, see Technical Handbook ECS SERVICE

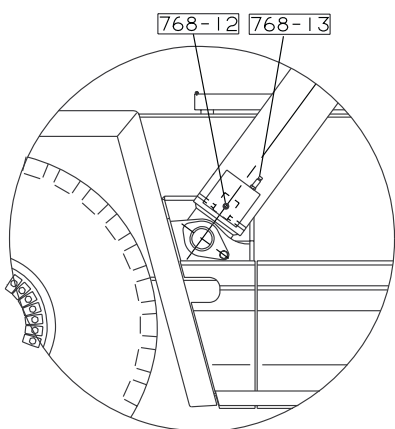
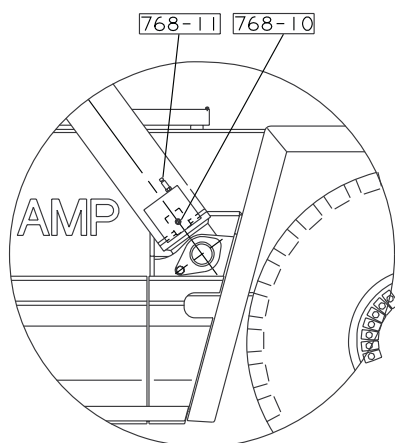
End position damping

End position damping reduces the speed of the LIFT/LOWER and BOOM OUT/IN functions to reduce jolting at stop positions. The system supplies less current to the main valves which then provide a reduced flow of hydraulic fluid/pressure and thereby reduce the speed of the above functions.

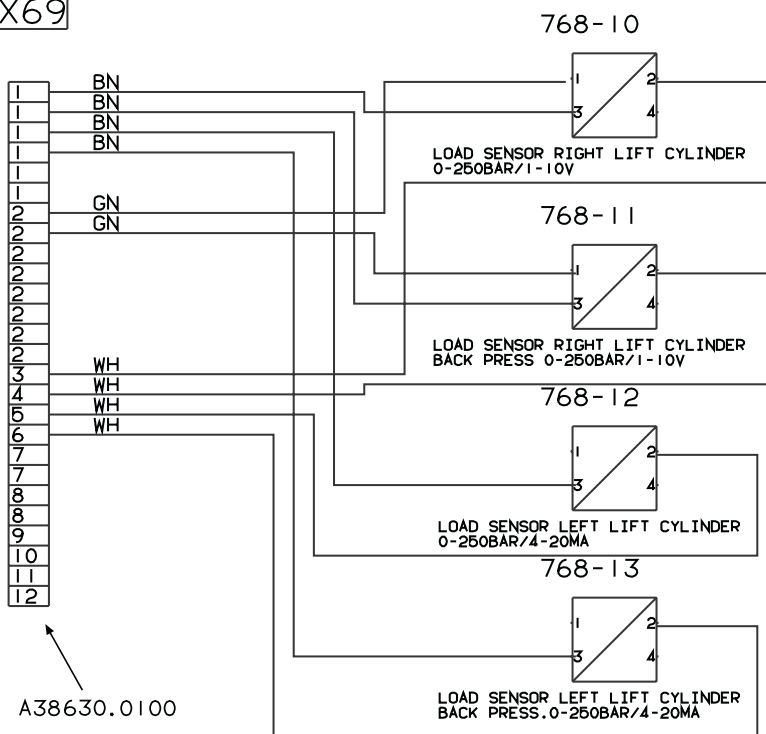
When calibrating Module 60 define and set the distance from the stop positions where end position damping is to be activated.



A39053.0100



X69



A38630.0100

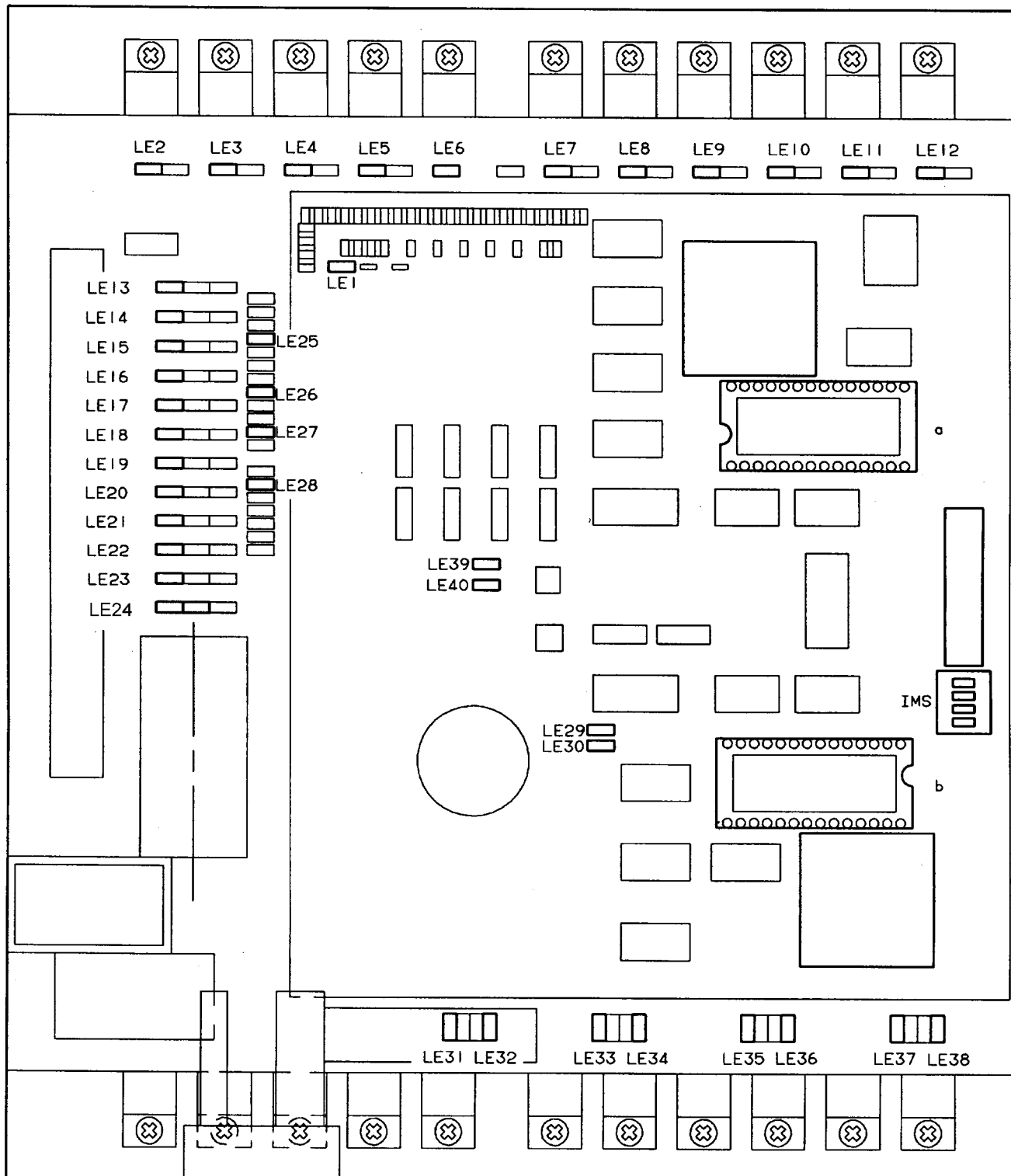
A38314.0100

S16. Angle sensor
S17. Length sensor
S18. Regeneration valve

768-10. Pressure sensor, feedline right lift cylinder
768-11. Pressure sensor, returnline right lift cylinder
768-12. Pressure sensor, feedline left lift cylinder
768-13. Pressure sensor, return left lift cylinder

ECU 3 Functions

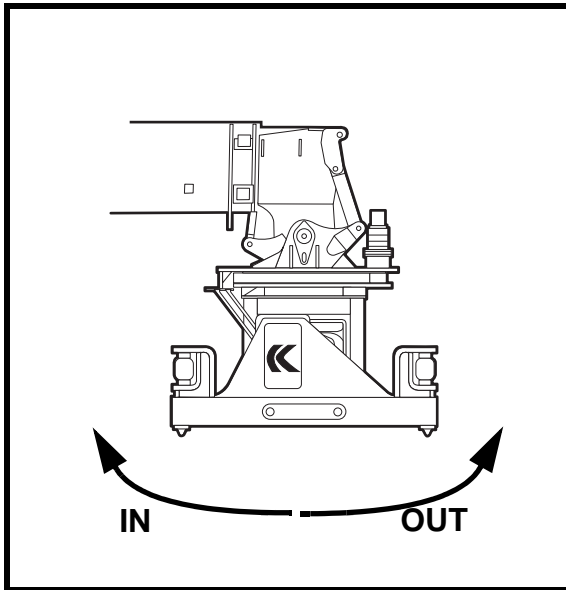
ECU Pin	Signal	Size	LED	Function
8	Digital IN 1	I/O	LE14	Parking brake (Remote control)
9	Digital IN 2	I/O	LE17	
10	Digital IN 3	I/O	LE20	
11	Digital IN 4	I/O	LE23	
31	Digital IN 5	I/O	LE13	
32	Digital IN 6	I/O	LE16	Cab movement, FORWARD
33	Digital IN 7	I/O	LE19	Cab movement, BACK
34	Digital IN 8	I/O	LE22	Cab movement, front and back end positions
55	Digital IN 9	I/O	LE15	
56	Digital IN 10	I/O	LE18	
57	Digital IN 11	I/O	LE21	Remote control
58	Digital IN 12	I/O	LE24	Support jacks, change load curve
2	Digital OUT 1	PNP I/O	LE6	
24	Digital OUT 2	PNP I/O	LE10	
25	Digital OUT 3	PNP I/O	LE7	
26	Digital OUT 4	PNP I/O	LE8	
48	Digital OUT 5	PNP I/O	LE9	
49	Digital OUT 6	PNP I/O	LE11	
50	Digital OUT 7	PNP I/O	LE12	24 V feed to switch for support jacks
22	Digital OUT 1	PNP NPN		
46	Digital OUT 2	PNP NPN		
40	Analogue IN 1	0-10V		
42	Analogue IN 2	0-10V		Lever TILT P4
64	Analogue IN 3	0-10V		
65	Analogue IN 4	0-10V		
66	Analogue IN 5	0-10V		
67	Analogue IN 6	0-10V		
52	Analogue IN 7	0-10V		
43	Analogue IN 1	0-23mA		
63	Analogue IN 3	0-23mA		
27	Analogue IN 1	0-196ohm		
28	Analogue IN 2	0-196ohm		
51	Analogue IN 3	0-196ohm		
6	Analogue IN 1	70..120°C		
7	Analogue IN 2	-20..120°C		
30	Analogue IN 3	-20..120°C		
53	Analogue IN 4	70..120°C		
1	Analogue UT PWM	PNP 1	LE5	TILT OUT
3	Analogue UT PWM	PNP 2	LE3	TILT IN
4	Analogue UT PWM	PNP 3	LE2	
5	Analogue UT PWM	PNP 4	LE4	
47	Analogue UT PWM	PNP/NPN 1	LE38	Cab movement, FORWARD
69	Analogue UT PWM	PNP/NPN 2	LE36	Cab movement, BACK
35	Pulse sensor 1			
59	Pulse sensor 2			
60	Counter			
36				



KL725

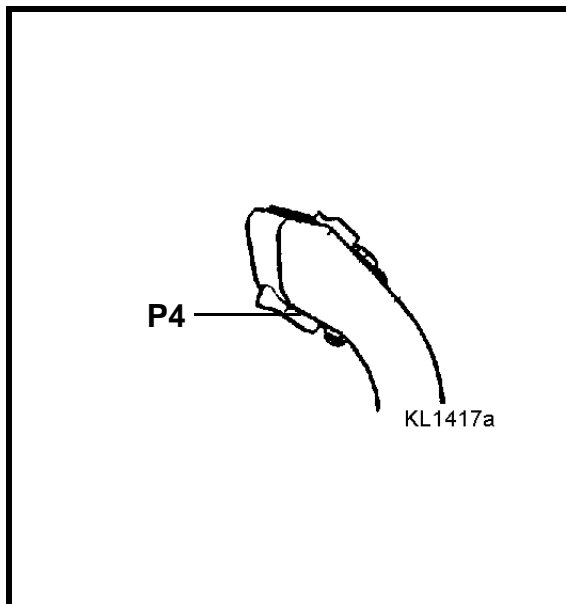
LE1 Should always be lit, indicates 5V feed to ECU3 from the voltage transformer
 LE29 Not used
 LE30 Not used

LE39 Should be extinguished
 LE40 indicates communication to the terminal and should blink.
 If it lights continuously or not at all, the program will not start, i.e., something is wrong, for example, the EPROM or power supply



Module 54 Tilt

1. 10V feed from S3.45 (ECU3) to connector S55.14
2. Via cable S33 to S42.3
3. Reference voltage 10V from ECU 3 S3.44 to connector S55.15
4. Via cable S33 to S42.1
5. Signal from D sub-contact S42.2 to S55.4
6. ANA IN 2 S3.42

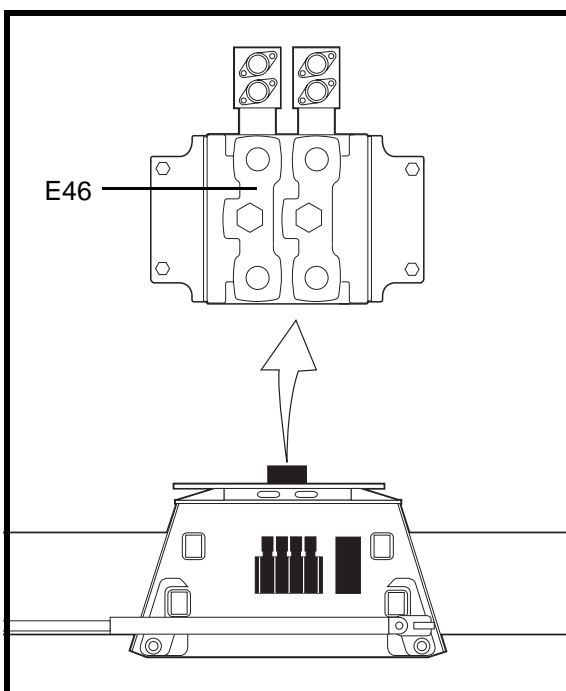


Tilt - OUT

7. Control lever P4 is moved downwards
8. If ANA IN 2 is 5-10V supplies ANA OUT S3.1. LE5 lit
9. S59.1
10. Via S29.13 to top-lift E56.37
11. To E46.11. The attachment tilts outwards

Tilt - IN

12. Control lever P4 is moved upwards
13. If ANA IN 2 is 0-5V supplies ANA OUT S3.3. LE3 lit
14. S59.2
15. Via S29.14 to top-lift E56.38
16. To E46.12. The attachment tilts inwards



Module 56 Cab movement

See diagram next page and the el-servo diagram S.

Conditions: The doors must be closed, otherwise it is only possible to move the cab 100 mm.

1. Connector S56.7 feeds 24 V to the cab movement system. (See el-servo S).
2. 24 V to relay 1.28 pin 30.
3. S52.6 - S52.10
4. See circuit diagram for cab movement
5. To limit switch 3.
6. Current to S52.9.
7. Feed to relay S28.86.
8. Earth signal S52.1 - S52.5 - S52.12.
9. Conditions: Limit switches 4 and 5 break, i.e., The doors are closed. Limit switch 3 breaks, i.e., the cab is not moved.
10. Current to S53.9.
11. The cab movement button (2) forwards, voltage to the button's connector, 7.
12. Feed to S53.11.
13. DIG IN M3.32, LE 16 lit.
14. ANA OUT M3.47. LE38 lit.
15. S63.13.
16. 24 V feed to hydraulic valve 6 that opens for hydraulic feed to the cab movement cylinder. Cab movement forwards or backwards.
17. The cab moving button (2) backwards, as above.
18. DIG IN M3.33, LE19 lit.

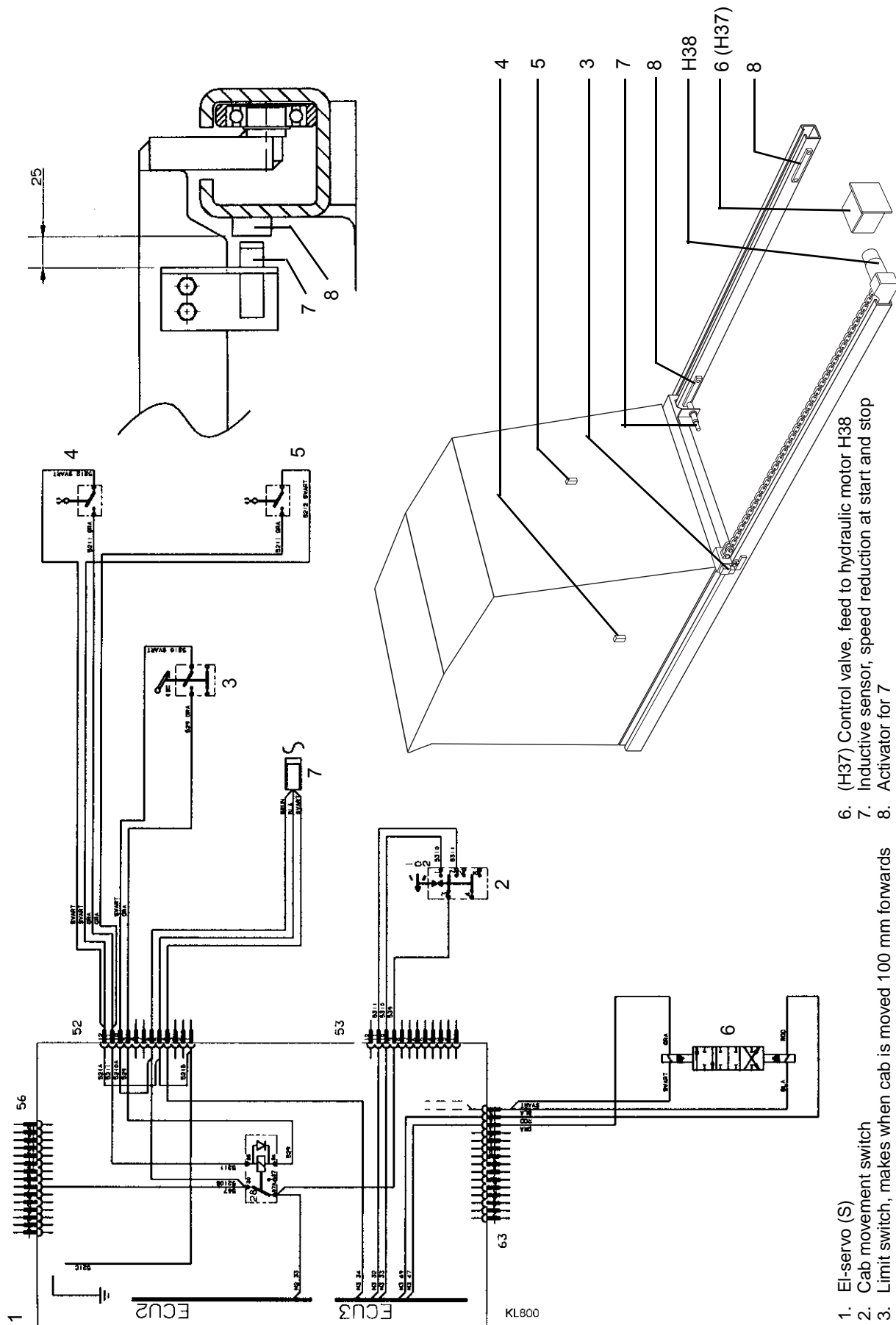
The safety system

1. The limit switch 3 breaks once the cab is moved 100 mm forwards.
2. Current to S52.9.
3. Current to relay S.28.86, relay makes.
4. Hold circuit to S2.33 breaks, LE19 extinguishes.
5. Feed to cab movement breaks and the cab cannot be moved.
6. If any of the doors are open, the earth signal is fed to relay S28.85. If, at the same time, voltage is fed to limit switch 3, relay S28 breaks the hold circuit to S2.33 and the feed to cab movement is thereby also broken.

Starting and braking

Sensor 7 with an activator on the cab movement track provides smooth starting and braking of the cab's movements at the end positions. Even if one of the doors is opened, the cab stops smoothly.

(Signals Sensor 2 Relay 28 - M3.47, M3.69 must be defined)



1. EI-servo (S)
2. Cab movement switch
3. Limit switch, makes when cab is moved 100 mm forwards
4. Limit switch, makes when right door is open.
5. Limit switch, makes when left door is open
6. (H37) Control valve, feed to hydraulic motor H38
7. Inductive sensor, speed reduction at start and stop
8. Activator for 7
- H38. Hydraulic motor cab movement

Electrical circuit, cab movement

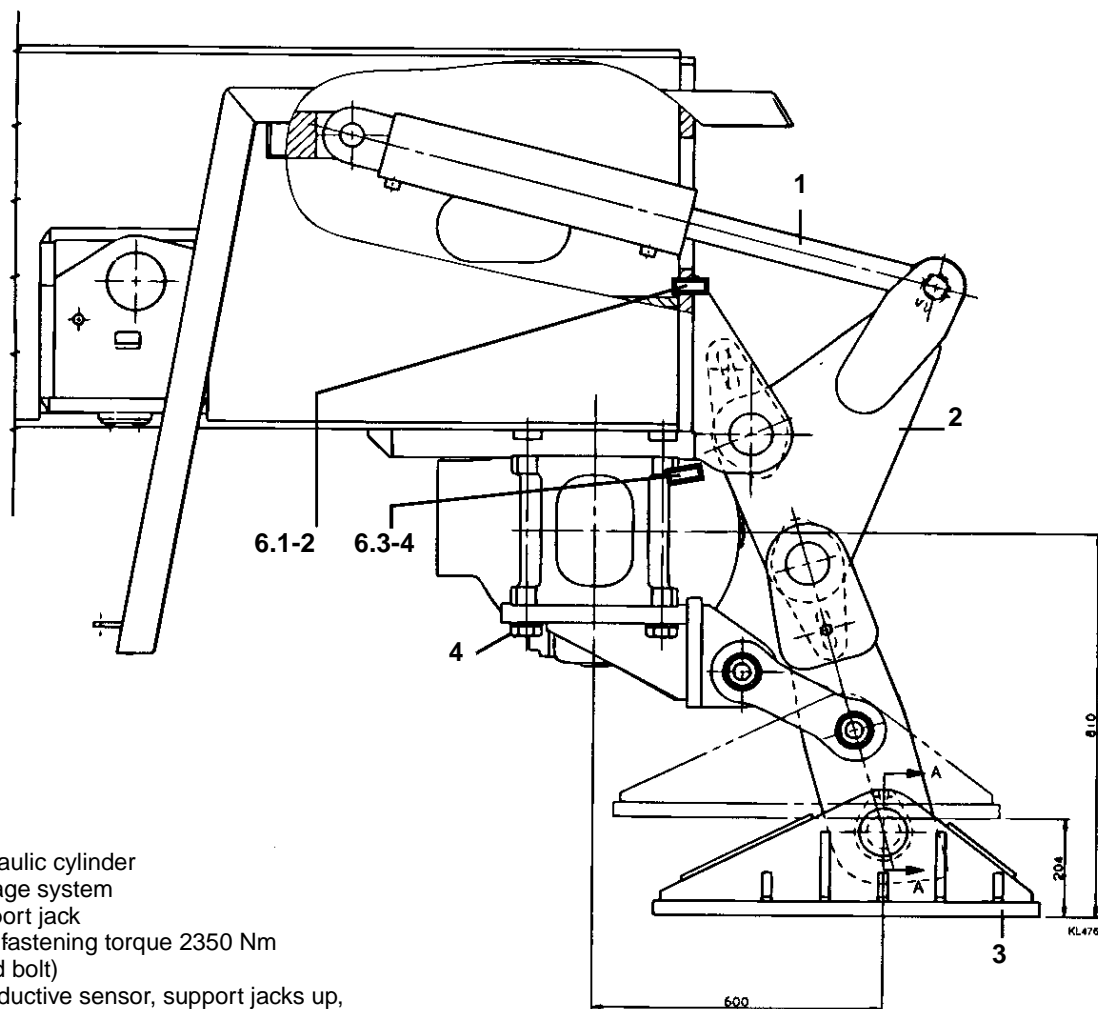
Module 61 Support jacks

Certain machines are equipped with support jacks in order to increase the capacity in the third container row. The support jacks are controlled with a switch in the operator's cab. A hydraulic cylinder affects a linkage system which presses the support jack down and thereby reduces the load center by 600 mm, which increases the third row capacity.

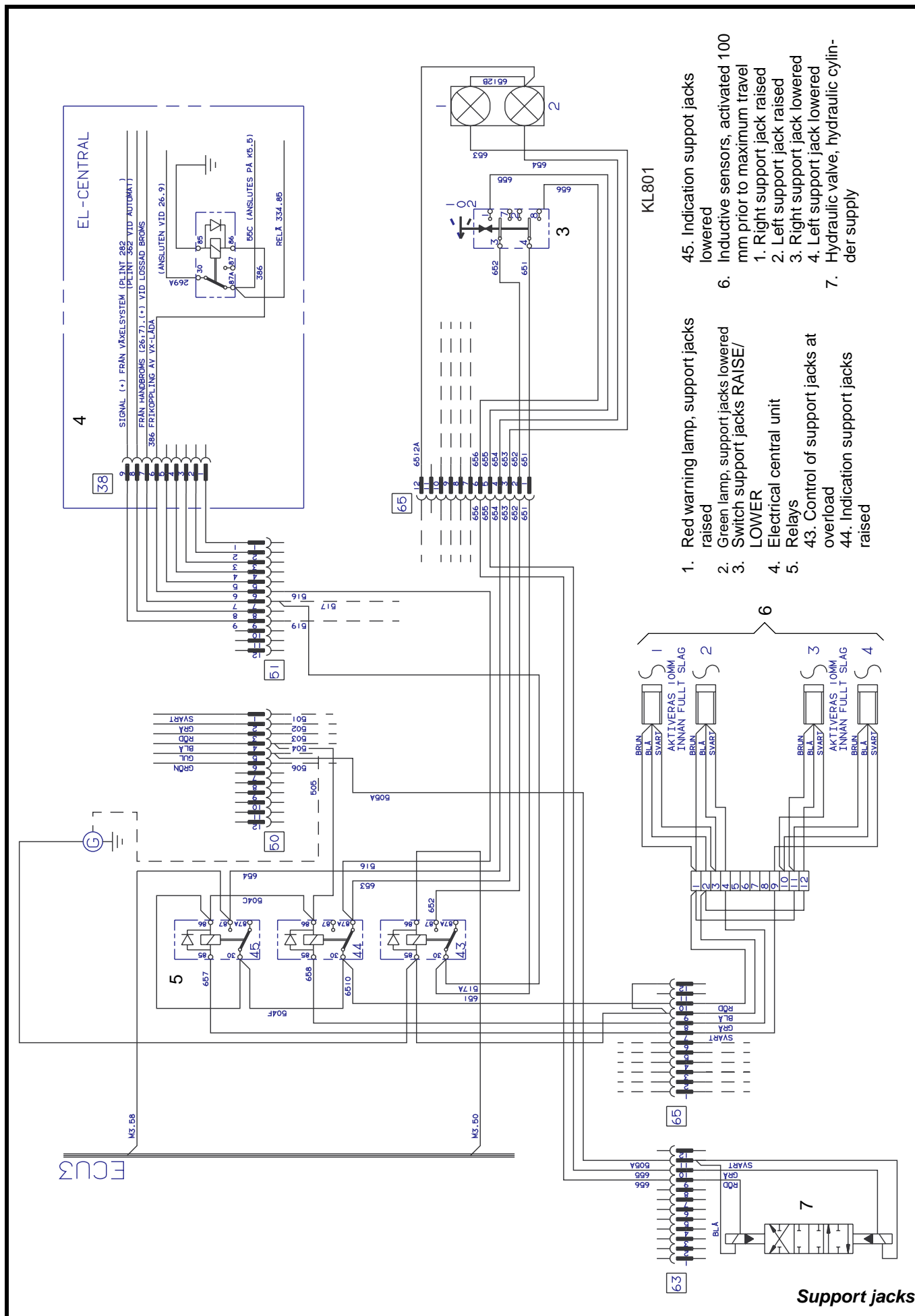
As the support jacks have left their upper position, a red warning lamp will light up simultaneously as the transmission is disengaged. When the support jacks have reached the bottom position a green lamp will light up. Furthermore, the overload safety system changes load curve. As a result of this, the higher capacity (+7 tonnes) in container row 3 can be utilized.

The upper and lower support jack positions are controlled by inductive sensors which are connected to the overload safety system.

If overload occurs, the support jacks can be lowered. On the contrary, the support jacks cannot be raised until the overload is neutralized by disengaging the load or retracting the boom.



- 1. Hydraulic cylinder
- 2. Linkage system
- 3. Support jack
- 4. Bolt; fastening torque 2350 Nm
- 5. (oiled bolt)
- 6.1-2 Inductive sensor, support jacks up, right and left
- 6.3-4 Inductive sensor, support jacks down, right and left



Manual electrical gear-changing system Clark 36000/40000

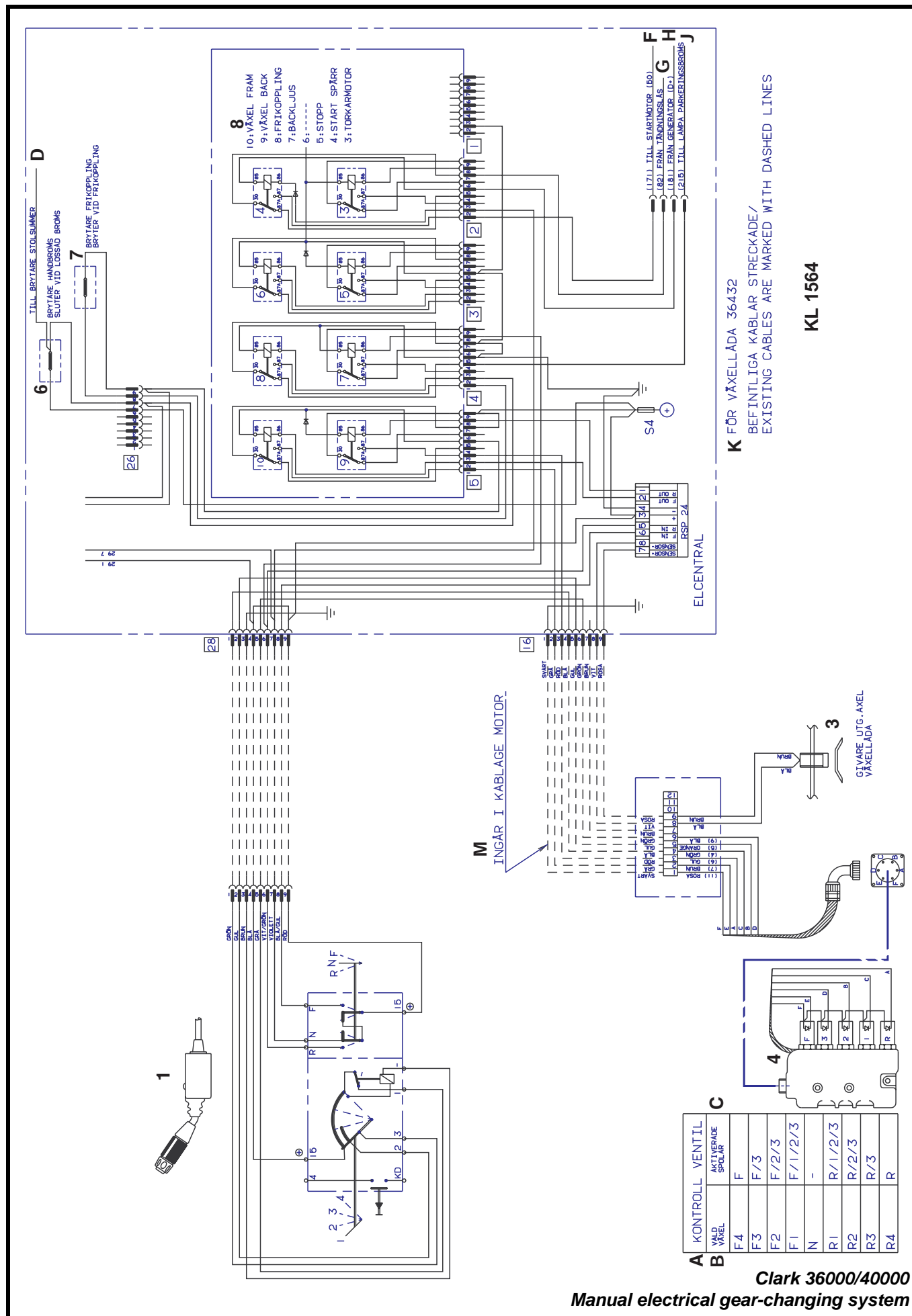
Components

The components shown in this diagram can also be found integrated in the general electrical diagram in this handbook.

- A. Gearbox control valve
- B. Selected gear
- C. Activated solenoids
- D. To seat buzzer switch
- F. To starter motor (50)
- G. From starter switch
- H. From alternator (D+)
- J. To parking brake warning light
- K. For gearbox
- M. Included in engine wiring
- 1. Gear lever
- 3. Sensor for outgoing gearbox revolutions
- 4. Valve housing with solenoid valves
- 5. Central electrical unit
- 6. Switch for parking brake - ON when brake is released
- 7. Inching switch -OFF when inching
- 8. Relays
 - 3. Wiper motor
 - 4. Starter motor
 - 5. Stop
 - 6. -
 - 7. Reversing lights
 - 8. Inching
 - 9. Reverse gear
 - 10. Forward gear
- 9. Reversing inhibitor

Cable colours

- Svart = Black
- Grå = Grey
- Röd = Red
- Blå = Blue
- Gul = Yellow
- Grön = Green
- Brun = Brown
- Vit = White
- Rosa = Pink



Automatic electrical gear-changing system Clark 36000/40000

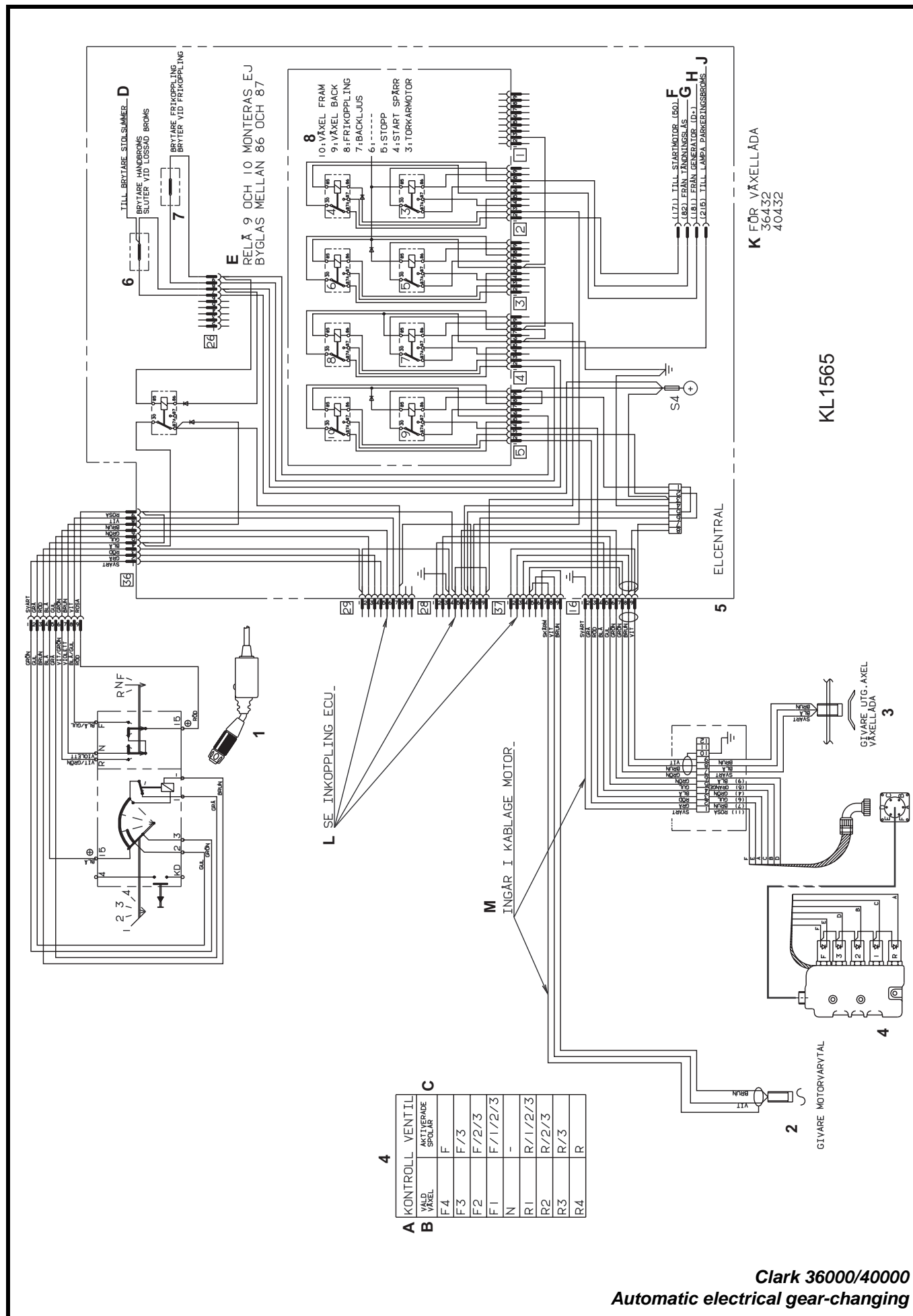
Components

The components shown in this diagram can also be found integrated in the general electrical diagram in this handbook.

- A. Gearbox control valve
- B. Selected gear
- C. Activated solenoids
- D. To seat buzzer switch
- F. To starter motor (50)
- G. From starter switch
- H. From alternator (D+)
- J. To parking brake warning light
- K. For gearbox
- L. ECU connections
- M. Included in engine wiring
- 1. Gear lever
- 2. Revolution sensor on the torque converter (engine revs.)
- 3. Sensor for gearbox outgoing revolutions
- 4. Valve housing with solenoid valves
- 5. Central electrical unit
- 6. Switch for parking brake - ON when brake is released
- 7. Inching switch - OFF when inching
- 8. Relays
 - 3. Wiper motor
 - 4. Starter motor
 - 5. Stop
 - 6. -
 - 7. Reversing lights
 - 8. Inching
 - 9. Reverse gear
 - 10. Forward gear
- 9. Reversing inhibitor

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- Rosa = Pink



El-servo (S)

A38630.0100/0200

Components

1. Central electrical unit
2. ECU2
3. ECU3
4. ECS terminal
5. PC connection (beside connectors under seat)
7. Main valve
 1. LIFT
 2. LOWER
 3. BOOM OUT
 4. BOOM IN
 5. BOOM IN 2
 6. BOOM OUT 2
 7. LOWER 2
 8. LIFT 2
8. Buzzer connected to the warning lamp on the display
Continuous tone for forward overload
Intermittent tone for steering axle overload warning
9. CAN bus, beside ECU 2 under seat
10. Relays
 1. Overload and red warning lamp
 - 2, 3. Warning, overload steered axle
14. Regeneration valves, lift
15. Blocking valves, right and left lift cylinders
With emergency lowering function
31. Cab movement
32. Control lever
33. Cable
34. Switch, Twist-locks
35. Switch, stop at 30-35'
36. Main switch for control panel
37. Switch, by-passing of safety locking
42. D sub-contact below the control lever
43. Solenoid valve, disconnection of hydraulic pump at transportation
(See also Hydraulic diagram, 40)
73. Solenoid valve, activation of pump 3 for feeding of top lift
74. Valve section for TILT in top lift main valve, see also hydraulic diagram top lift with tilt

ECS Diagrams

The following pages contain the diagrams for the current circuits in the ECS. Those diagrams that apply to a specific machine, are combined in certain ways, depending on the modules with which the machine is equipped. See the table below.

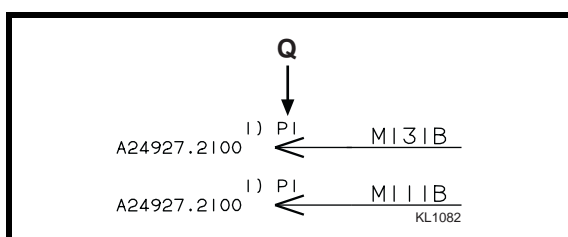
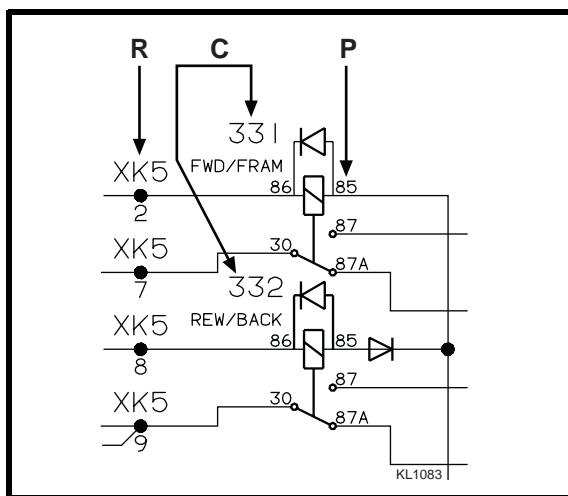
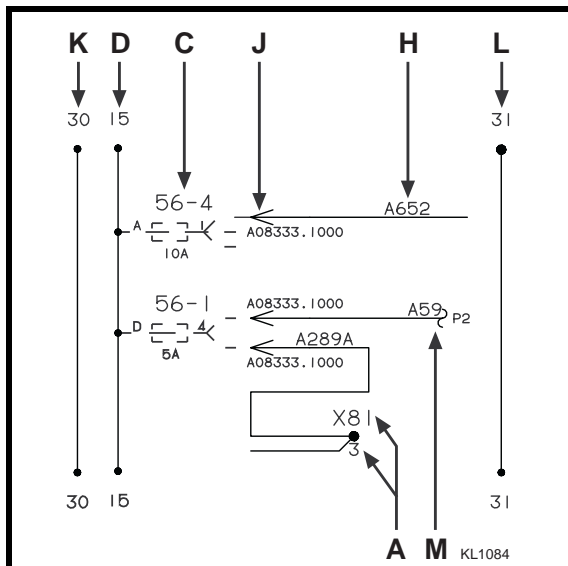
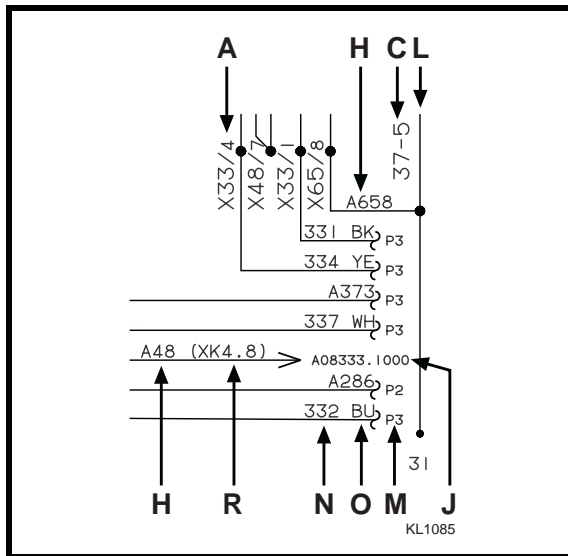
Module 01 = Automatic gear changing

Module 04 = Lever steering

Module 06 = Mini-steering

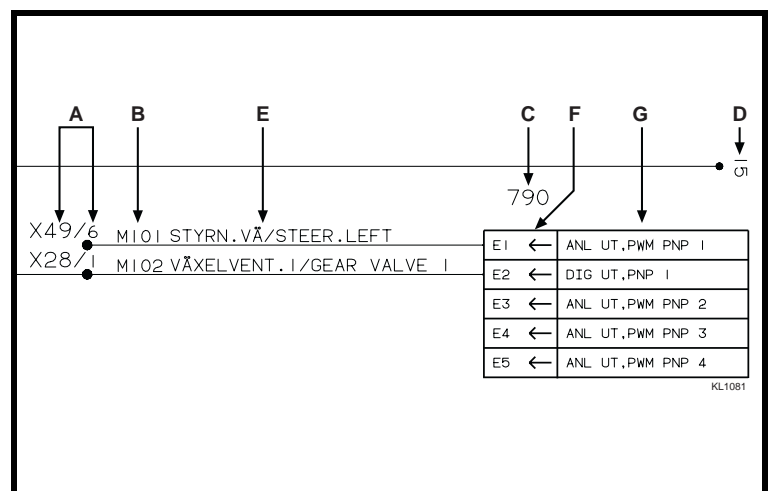
Module 07 = Monitoring

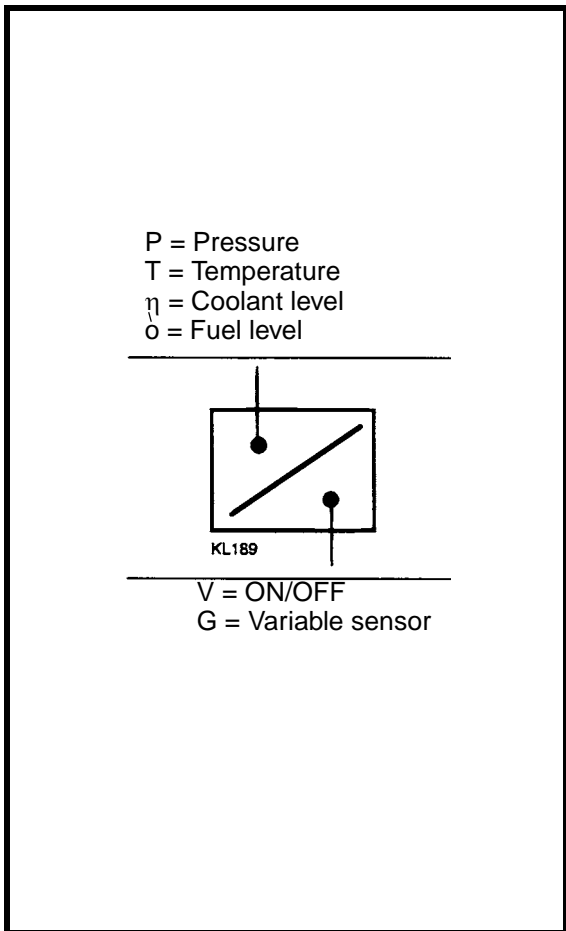
Module combination	Variations	Electrical diagram
01	4 gears	A24925.2000
04 06 (Modules 04/06 in combination with manual gear changing)	Lever steering Mini-steering 4 gears	A24927.2000 A24927.2200 A24925.2200
01+07	Monitoring 4 gears	A24929.2000 A24925.2000
01+04+07	Monitoring 4 gears	A24929.2000 A24925.2000
50	Mechanical overload protection system	A38630.0100 A38630.0200
60	Electronic overload protection system	A38630.0100 A38630.0200



Electrical diagram explanations

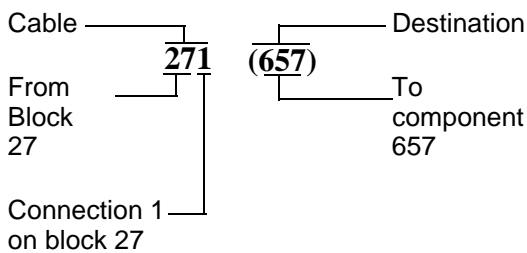
- A. Connector, located outside the central electrical unit circuit board. The second figure denotes the pin number.
- B. Cable marking. M1 shows that the cable goes between ECU 1 and the Central electrical unit.
- C. Component marking, for more detailed explanation, see the components list in the Technical Handbook, Group 20.
- D. + feed after the ignition key.
- E. Function, see tables under headings ECU 1 Functions and ECU 4 Functions respectively.
- F. Pin on the 70 pole coupling on the ECU.
- G. Type of signal. see tables under headings ECU 1 Functions and ECU 4 Functions respectively.
- H. Cable marking, A shows that the cable is located inside the central electrical unit.
- J. Reference, the cable continues on diagram A08333.1000.
- K. Ignition key dependent feed, battery + 24V
- L. Chassis connection
- M. The cable continues on the same diagram, but on another page P3 = page 3
- N. Cable marking, the cable is located outside the central electrical unit.
- O. Cable colours
 BK = Black
 BN = Brown
 RD = Red
 OG = Orange
 YE = Yellow
 GN = Green
 BU = Blue
 VT = Violet
 GY = Grey
 WH = White
 PK = Pink
- P. Connection marking on the actual component.
- Q. Cable M131B continues on diagram A24927, page 1
 P1 = page 1
 1) = Only with Lever steering
- R. Connector 5 on the circuit board in the central electrical unit
 X = Connector
 K = Circuit board
 5 = Connector number





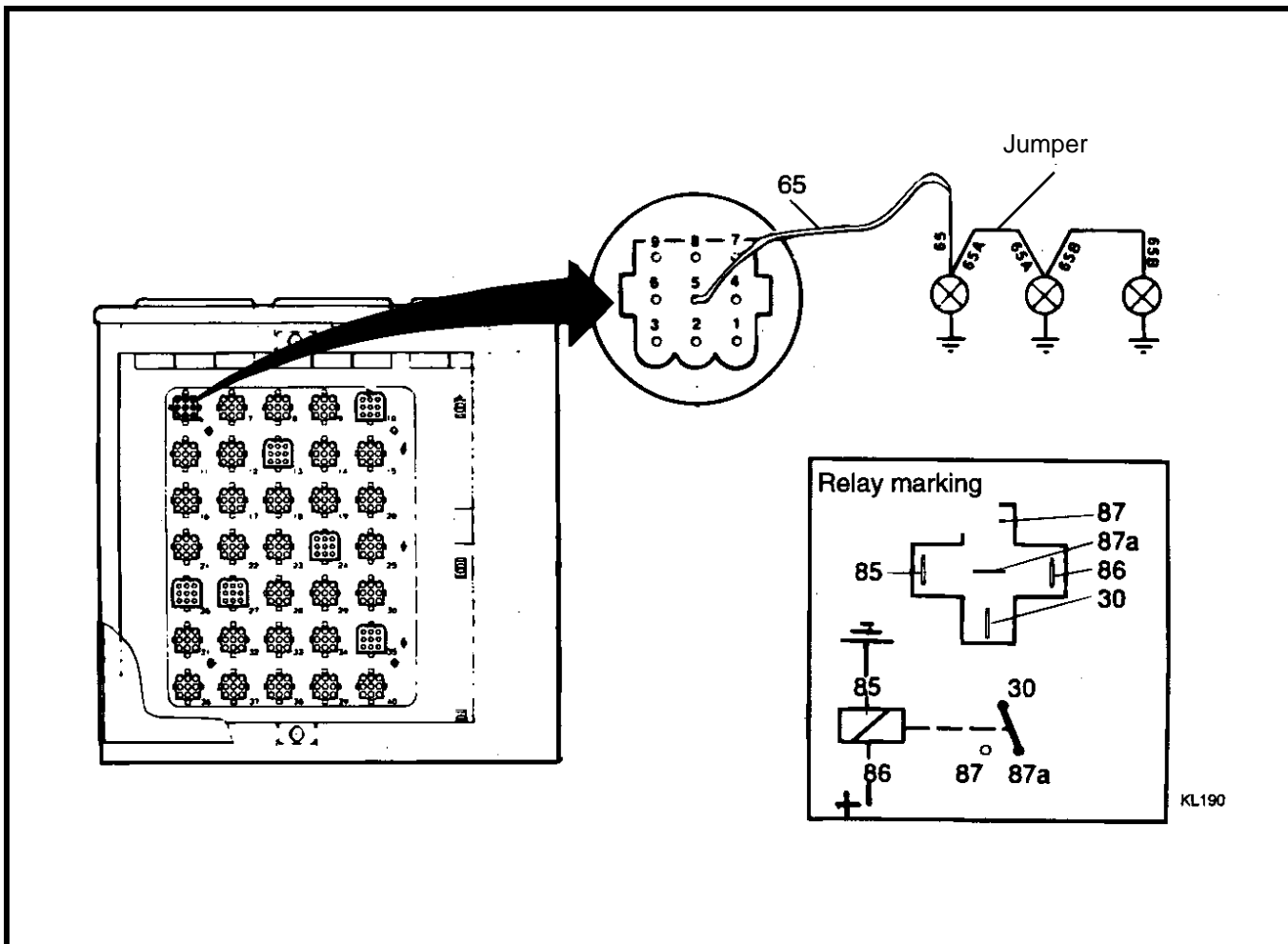
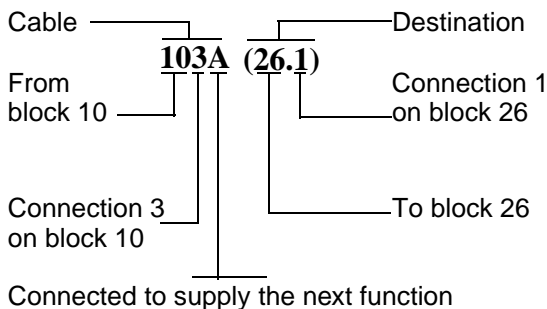
Cable markings

All cables are marked with a number for identifying the terminal points as follows:



If there is a dot in the destination number it describes a terminal block.

If the cable has a connector strap, e.g., a common cable for supplying several functions, a capital letter is added to the cable number.



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Leere Seite
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Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
30	G	Batteri	Battery	Batterie	Batterie
32	A	Kretskort elcentral	Printed circuit board, Junction box	Leiterplatte, Elektrozentrale	Circuit imprimé, centrale électrique
37	X	Terminal stomsanslutning	Earthing terminal on chassis	Terminal, masseanschluss	Borne, mis à la masse
39	X	Terminal minusanslutning	Terminal, negative terminal	Terminal, Minus-Anschluss	Borne, connexion moins
51	F	Säkringshållare 1-polig	Fuse holder, 1-pole	Sicherungshalter, 1polig	Porte-fusible, 1 pôle
52	F	Säkringshållare 2-polig	Fuse holder, 2-pole	Sicherungshalter, 2polig	Porte-fusible, 2 pôles
56	F	Säkringshållare 6-polig	Fuse holder, 6-pole	Sicherungshalter, 6polig	Porte-fusible, 6 pôles
58	F	Säkringshållare 8-polig	Fuse holder, 8-pole	Sicherungshalter, 8polig	Porte-fusible, 8 pôles
59	F	Säkringshållare 12-polig	Fuse holder, 12-pole	Sicherungshalter, 12polig	Porte-fusible, 12 pôles
62	F	Batterihandske 2-polig	Battery connector, 2-pole	Batteriestecker, 2polig	Connecteur de charge de batterie, 2 pôles
64	F	Batterihandske 4-polig	Battery connector, 4-pole	Batteriestecker, 4polig	Connecteur de charge de batterie, 4 pôles
72	X	Stickuttag 2-polig	Outlet, 2-pole	Buchse 2polig	Prise, 2 pôles
77	X	Stickuttag 7-polig	Outlet, 7-pole	Buchse 7polig	Prise, 7 pôles
78	X	Stickuttag extra 7-polig	Outlet, extra, 7-pole	Buchse Extra, 7-polig	Prise supplémentaire, 7 pôles
100	S	Strömställare ljus	Switch, light	Schalter, Beleuchtung	Interrupteur, feu
101	S	Strömställare omk hel/halvljus	Switch, main/dipped beam	Schalter, Umschalter Fern-/Abblendlicht	Interrupteur, commutation route-croisement
102	S	Strömställare dimljus	Switch, fog light	Schalter, Nebelscheinwerfer	Interrupteur, feux de brouillard
103	S	Strömställare fjärrljus	Switch, distance light	Schalter, Fernscheinwerfer	Interrupteur, feux longue portée
104	S	Strömställare lastljus	Switch, mast lights	Schalter, Ladescheinwerfer	Interrupteur, feux de travail
105	S	Strömställare arbetsljus	Switch, working lights	Schalter, Arbeitsbeleuchtung	Interrupteur, feux de travail
106	S	Strömställare containerljus	Switch, container light	Schalter, Containerbeleuchtung	Interrupteur, éclairage conteneur
107	S	Strömställare park broms	Switch, parking brake	Schalter, Feststellbremse	Interrupteur, frein de stationnement
108	S	Strömställare centr smörjning	Switch, central lubricator	Schalter, Zentralschmierung	Interrupteur, graissage centralisé
109	S	Strömställare varningsljus	Switch, hazard lights	Schalter, Warnblinkanlage	Interrupteur, feux de de tresse
110	S	Strömställare rot varningsljus	Switch, rotating hazard beacon	Schalter, Rundum-Kennleuchte	Interrupteur, gyrophares
111	S	Strömställare fönsterhiss	Switch, window regulator	Schalter, Fensterheber	Interrupteur, lève-glace
112	S	Strömställare kylanläggning (AC)	Switch, air conditioner (AC)	Schalter, Klimaanlage (AC)	Interrupteur, groupe de refroidissement climatisation, (AC)
113	S	Strömställare styrning alt	Switch, alternative steering	Schalter, Lenkung Alt.	Interrupteur, type commande de direction
114	S	Strömställare låsbelysning	Switch, reading light	Schalter, Leselampe	Interrupteur, éclairage lecture
115	S	Strömställare instr belysning	Switch, instrument illumination	Schalter, Instrumentenbeleuchtung	Interrupteur, éclairage des instruments
116	S	Strömställare innerbelysning	Switch, interior lighting	Schalter, Innenbeleuchtung	Interrupteur, éclairage intérieur

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
117	S	Strömställare värme	Switch, heating	Schalter, Heizung	Interrupteur, chauffage
118	S	Strömställare fläktm värme	Switch, heater fan	Schalter, Lüftermotor Heizung	Interrupteur, motoventilateur chauffage
119	S	Strömställare vindrutetorkare	Switch, wiper	Schalter, Scheibenwischer	Interrupteur, essuie-glace
120	S	Strömställare spolare	Switch, washer	Schalter, Waschanlage	Interrupteur, lave-glace
121	S	Strömställare blackout	Switch, blackout	Schalter, Ausfall	Interrupteur, blackout
122	S	Strömställare nöd hydraulpump	Switch, emergency hydraulic pump	Notschalter, hydraulikpumpe	Interrupteur, urgence pour la pompe
123	S	Strömställare backspegel	Switch, observation mirror	Schalter, Rückspiegel	Interrupteur, rétroviseur
124	S	Strömställare kallstart	Switch, cold start	Schalter, kaltstart	Interrupteur, démarrage à froid
125	S	Strömställare avgasbroms	Switch, exhaust brake	Schalter, Motorbremse	Interrupteur, ralentisseur sur échappement
126	S	Strömställare diff spärr/broms	Switch, diff. Block	Schalter, Differentialsperre/Bremse	Interrupteur, blocage de différentiel/frein
127	S	Strömställare värmesystem diesel	Switch, heating system diesel	Schalter, Heizsystem Diesel	Interrupteur pour circuit de chauffage diesel
128	S	Strömställare kraftuttag sida	Switch, power take off side	Schalter, Nebenantrieb Seite	Interrupteur, prise de puissance latérale
129	S	Strömställare kraftuttag bak	Switch, power take off rear	Schalter, Nebenantrieb hinten	Interrupteur, prise de puissance arrière
130	S	Strömställare hög/lågväxel	Switch, high/low gear	Schalter, Rangepetribe Hoch/Niedrig	Interrupteur, petite/grande vitesse
131	S	Strömställare färdväljare fram	Switch, gear selector forward	Schalter, Fahrtrichtungswähler vorwärts	Interrupteur, marche avant
132	S	Strömställare färdväljare bak	Switch, gear selector rear	Schalter, Fahrtrichtungswähler rückwärts	Interrupteur, marche arrière
135	S	Strömställare växelväljare	Switch, gear shift	Schalter, Schalthebel	Interrupteur, sélecteur de vitesse
136	S	Strömställare framhjuls styrning	Switch, forward wheel steering	Schalter, Vorderrad Lenkung	Interrupteur, roues avant directrices
137	S	Strömställare 4-hjuls styrning	Switch, 4-wheel steering	Schalter, Vierradlenkung	Interrupteur, 4 roues directrices
138	S	Strömställare crab styrning	Switch, crab steering	Schalter, Diagonal Lenkung	Interrupteur, déplacement en diagonale
139	S	Strömställare defroster	Switch, defroster		
141	S	Strömställare Stegbelysning	Switch, Steplight		
142	S	Strömställare fot	Switch, foot	Fußschalter	Interrupteur, pédale
143	S	Strömställare sitsvärme	Switch, seat heater	Schalter, Sitzheizung	Interrupteur, chauffage d'assise
144	S	Batterifrånskiljare	Battery disconnecting switch	Batterie trennschalter	Interrupteur, général
145	S	Strömställare AT-regulator	Switch, AT-regulator	Schalter, Abgasdruckregler	Interrupteur, régulateur AT
147	S	Strömställare körvisare	Switch, direction indicators	Schalter, Fahrtrichtungsanzeiger	Interrupteur, clignotants
149	S	Strömställare signalhorn	Switch, horn	Schalter, Signalhorn	Interrupteur, avertisseur sonore

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
150	S	Strömställare startlås/ellas	Switch, main key switch	Schalter, Startschloß/E-Sperre	Interrupteur, contacteur antivol/verrou électrique
152	S	Strömställare intervalltorkare	Switch, intermittent wiper	Schalter, Intervallvischer	Interrupteur, balayage intermittent
156	S	Strömställare kupevärmare	Switch, cab heating	Schalter, Kabinenheizung	Interrupteur, chauffage habitacle
157	S	Strömställare stoltit	Switch, seat tilt	Schalter, Kippen des Sitzes	Interrupteur, basculement du siège
158	S	Strömställare dimbakljus	Switch, rear fog light	Schalter, Nebelschlußleuchte	Interrupteur, feux de brouillard arrière
159	S	Strömställare extra fram/back värlare	Switch, extra direction selector	Schalter,	Interrupteur,
160	S	Strömställare komb fram/back	Switch, combi-forward/reverse	Schalter, Kombi - vorn/rückwärts	Interrupteur, sélecteur marche avant/marche arrière
161	S	Strömställare komb signal, ljus hel/halv spol,torkare m intervall körvisare	Switch, combi-horn, light main/dipped beam, washer, wiper (intermittent), direction indicator	Schalter, Kombi-Signal, Beleuchtung Fern-/Abblendlicht, Waschanlage, Intervallvischer, Fahrtrichtungsanzeiger	Interrupteur, avertisseur, feux de route et de croisement, lave-glace,essuie-glace à balayage intermittent, clignotants
162	S	Strömställare komb signal ljus hel/halv, spol, torkare m 2 int, fram/back	Switch, combi horn, light main/dipped beam, washer, wiper w 2int., forward/revers	Schalter, Kombi-Signal, Beleuchtung Fern-/Abblendlicht, Waschanlage, 2 Intervallvischer, vor/rückwärts	Interrupteur, avertisseur, feux de route et de croisement, essuie glace à balayage intermittent
163	S	Strömställare start på 2-an	Switch, start 2nd gear	Schalter, Start 2-gang	Interrupteur, démarrage 2-trans.
165	S	Strömställare stolvärme	Switch, seat heater	Schalter, Sitzheizung	Interrupteur, chauffage du siège
166	S	Strömställare låsning vändskiva	Switch, interlocking of turntable	Schalter, Sperren Sattelkupplung	Interrupteur, verrouillage de la sellette
167	S	Strömställare luftfjädring	Switch, pneumatic springing	Schalter, Luftfederung	Interrupteur, suspension pneumatique
168	S	Strömställare låsn stol	Switch, interlocking of seat	Schalter, Sitzverriegelung	Interrupteur, verrouillage du siège
169	S	Strömställare stolsvändning	Switch, reversible seat	Schalter, Drehan des Sitzes	Interrupteur, pivotement du siège
170	S	Strömställare förångare (LPG)	Switch, evaporator (LPG)	Schalter, Verdampfer (LPG)	Interrupteur, évaporateur (GPL)
171	S	Strömställare v-skiva upp/ner	Switch, fifth wheel up/down	Schalter, Sattelkupplung, uppwärts/abwärts	Interrupteur, sellette montée/descente
172	S	Strömställare v-skiva fr/back	Switch, fifth wheel forward/reverse	Schalter, Sattelkupplung, vorn/hinten	Interrupteur, sellette marche avant/marche arrière
173	S	Strömställare v-skiva skevning	Switch, fifth wheel, levelling	Schalter, Sattelkupplung, Niveaueausgleich	Interrupteur, sellette marché, corr-niveau
174	S	Strömställare utskjut	Switch, projecting	Schalter, Längengeber	Interrupteur, pour le réglage du déploiement
175	S	Strömställare hyttlyft upp	Switch, cab hoist up	Schalter, Kabinenhub, aufwärts	Interrupteur, élévation de cabine, montée

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
176	S	Strömställare nyttlyft ner	Switch, cab hoist down	Schalter, Kabinenhub, abwärts	Interrupteur, élévation de cabine, descente
177	S	Strömställare nyttskjutning	Switch, cab movement	Schalter, Kabinenversetzung	Interrupteur, mouvement cabine
178	S	Strömställare nollställning	Switch, reset	Schalter, Nullstellung	"Interrupteur ""reset""
179	S	Strömställare Aut/man växling	Switch Aut/man gearshifting	Schalter Aut/man getriebe	
180	S	Strömställare fyrhjulsdrift	Switch, 4-WD	Schalter, Vierradantrieb (4WD)	Interrupteur, 4 roues motrices
190	S	Strömställare klimatläggning	Switch, air conditioner	Schalter, Frischluftheizung	Interrupteur, climatisation
191	S	Strömställare recirkulation	Switch, re-circulation	Schalter, Re-Zirkulation	Interrupteur, re-circulation
192	S	Strömställare vattenavskiljare		Switch, waterseparator	Schalter, Wasserabscheider
195	S	Strömställare joy-stick X	Switch, joy-stick X	Schalter, Joy-stick X	Interrupteur, Joy-stick X
196	S	Strömställare joy-stick X+Y	Switch, joy-stick X+Y	Schalter, Joy-stick X+Y	Interrupteur, Joy-stick X+Y
197	S	Strömställare längs/tvårskörning	Switch, length/sideways driving	Schalter, Längs-/Querfahren	Interrupteur, sens longitudinal/transversal
198	S	Strömställare flytläge skevning	Switch, equalizing fifth wheel	Schalter, Ausgleich der Sattelkupplung	Interrupteur, équilibré de la selette
199	S	Strömställare option	Switch, option	Schalter, Option	Interrupteur, option
200	S	Brytkontakt lampa park broms	Contact, breaking, warning lamp, parking brake	Unterbrecherkontakt, Warnlampe, Feststellbremse	Contact à ouverture, voyant, frein de stationnement
201	S	Brytkontakt lampa färdbröms	Contact, breaking, warning lamp, brake	Unterbrecherkontakt, Warnlampe, Betriebsbremse	Contact à ouverture, voyant, frein de service
202	S	Brytkontakt lampa oljetryck motor	Contact, breaking, warning lamp, oil pressure engine	Unterbrecherkontakt, Warnlampe, Öldruck Motor	Contact à ouverture, voyant, pression d'huile moteur
204	S	Brytkontakt tryck ackumulator	Contact, breaking, pressure accumulator	Unterbrecherkontakt, Druck Akkumulatorbehälter	Contact à ouverture, pression réservoir accumulateur
205	S	Brytkontakt innerbelysning	Contact, breaking, interior lighting	Unterbrecherkontakt, Innenbeleuchtung	Contact à ouverture, éclairage intérieur
206	S	Brytkontakt handsfack belysning	Contact, breaking, glove	Unterbrecherkontakt, Handschuhfachbeleuchtung	Contact à ouverture, éclairage de la boîte à gants
207	S	Slutkontakt diff spärr	Contact, making, diff. interlock	Schließkontakt, Differentialsperre	Contact à fermeture, blocage du différentiel
208	S	Slutkontakt lampa temperatur spolrets bromsar	Contact, making, warning lamp temperature brake	Schließkontakt, Warnlampe, Temperatur, Spulenkreis Bremsen	Contact à fermeture, voyant température circuit d'arrosage des freins
214	S	Slutkontakt överväxel	Contact, making, over drive	Schließkontakt, Overdrive	Contact à fermeture, overdrive
215	S	Slutkontakt temp motor	Contact, making, temperature engine	Schließkontakt, Temperatur Motor	Contact à fermeture, température du moteur

Komponentförteckning / List of Components / Komponentenverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
216	S	Slutkontakt bromsljus	Contact, making, brake lights	Schließkontakt, Bremslicht	Contact à fermeture, feux stop
217	S	Slutkontakt backljus	Contact, making, reversing light	Schließkontakt, Ruckfahrerscheinwerfer	Contact à fermeture, feux de recul
218	S	Slutkontakt AT-regulator	Contact, making, AT-control	Schließkontakt, Abgasdruckregler	Contact à fermeture, régulateur AT
219	S	Slutkontakt lampa luftfilter	Contact, making, indicating light air filter	Schließkontakt, Kontrollampe Luftfilter	Contact à fermeture, témoin filtre à air
220	S	Brytkontakt drivning	Contact, breaking, drive cut off	Unterbrecherkontakt, Antrieb	Contact à ouverture, transmission
221	S	Slutkontakt temp växellåda	Contact, making, temperature gear box	Schließkontakt, Temperatur Getriebe	Contact à fermeture, température de la boîte de vitesses
222	S	Slutkontakt lampa temp moment - förstärkare	Contact, making, warning lamp temperature torque amplifier.	Schließkontakt, Warnlampe Temperatur Drehmomentwandler	Contact à fermeture, voyant température convertisseur
223	S	Släpkontakt signal	Contact, brush, horn	Schließkontakt, Signal	Courseur, avertisseur
224	S	Slutkontakt insprutningspump	Contact, making, injection pump	Schließkontakt, Einspritzpumpe	Contact à fermeture, pompe d'injection
225	S	Brytkontakt säkerhetsbälte	Contact, breaking, seat belt	Unterbrecherkontakt, Sicherheitsgurt	Contact à ouverture, ceinture de sécurité
228	S	Slutkontakt hyttlåsning	Contact, making, cab locking	Schließkontakt, Kabinverriegelung	Contact à fermeture, verrouillage de la cabine
229	S	Slutkontakt stolslåsning	Contact, making, seat locking	Schließkontakt, Sitzsperre	Contact à fermeture, verrouillage du siège
230	S	Brytkontakt stol	Contact, breaking, seat	Unterbrecherkontakt, Sitz	Contact à ouverture, siège
231	S	Slutkontakt fotkontroll stolvändning	Contact, making, seat rotation, foot switch	Endkontakt, Drehen des Sitzes, Fußschalter	Contact à fermeture, pivotement du siège contact au plancher
232	S	Brytkontakt lampa luftanslutning släp	Contact, breaking, warning lamp air connection	Unterbrecherkontakt, Warnlampe, Luftanschluß Anhänger	Contact à ouverture, voyant connexion pneumatique remorque
233	S	Slutkontakt lampa låsning vändskiva	Contact, warning, interlocking of turntable	Endkontakt, Warnanzeige, Sperren Sattelkupplung	Contact à ouverture, voyant verrouillage sellette,
235	S	Slutkontakt sidoskjutning stol	Contact, making, side shifting of seat	Endkontakt, Seidl. Sitzverstellung	Contact à ouverture, de placement lateral du siège
236	S	Slutkontakt vattennivå	Contact, water level	Endkontakt, Wasserstand	Contact à ouverture, niveauoéan
239	S	Brytkontakt termisk	Contact, breaking, thermic	Unterbrecherkontakt, thermisch	Contact à ouverture, thermique
240	S	Slutkontakt termisk	Contact, making, thermic	Schließkontakt, thermisch	Contact à fermeture, thermique
241	S	Brytkontakt lampa luftmatning släp	Contact, breaking, warning lamp air supply to trailer	Unterbrecherkontakt, Warnlampe Förderluft Anhänger	Contact à ouverture, témoin air d'alimentation remorque
242	S	Slutkontakt lampa oljetryck v-låda	Contact, making, warning lamp, oil pressure gear box	Schließkontakt, Warnlampe, Öldruck Getriebe	Contact à fermeture, voyant, pression d'huile boîte de vitesses

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
243	S	Brytkontakt tryck kylmedia AC	Contact, breaking, coolant pressure (air condition)	Unterbrecherkontakt, Druck Kühlmittel (Klimaanlage)	Contact à ouverture, pression frigorifère (climatisation)
244	S	Slutkontakt hydraulik aktiverad	Contact, making, hydraulics	Schließkontakt, Hydraulik aktiviert	Contact à fermeture, hydraulique actionnée
245	S	Slutkontakt hydraultryck styrning	Contact, making, hydraulic pressure control	Schließkontakt Hydraulikdruck Lenkung	Contacteur pression hydraulique de la direction
246	S	Slutkontakt tryck kylmedia	Contact, pressure refrigerant	Schließkontakt, Druck Kühlmittel	Contact à ouverture, pression liquide de refroidissement
250	S	Manöverbrytare	Operating Switch		
251	S	Slutkontakt vändbar förarstol	Contact, making, VBFS	Schließkontakt, drehbarer Fahrersitz	Contact à fermeture, siège pivotant
260	S	Slutkontakt lyft steg 1	Contact, making, hoist step 1	Schließkontakt, Hub Stufe 1	Contact à fermeture, élévation étape 1
261	S	Slutkontakt lyft steg 2	Contact, making, hoist step 2	Schließkontakt, Hub Stufe 2	Contact à fermeture, élévation étape 2
262	S	Slutkontakt tilt	Contact, making, tilting	Schließkontakt, Neigung	Contact à fermeture, inclinaison
263	S	Slutkontakt gaffelspridning	Contact, making, fork positioning	Schließkontakt, Gabelverstellung	Contact à fermeture, écartement des bras de fourche
264	S	Slutkontakt sidoföring	Contact, making, sideshift	Schließkontakt, Seitenverschiebung	Contact à fermeture, déplacement latéral
265	S	Slutkontakt stativ in/ut	Contact, making, lifting mast in-out	Schließkontakt, Hubgerüst ein-aus	Contact à fermeture, mat de lev. ext-ret.
266	S	Brytkontakt hytt dörr	Contact, breaking cab door	Unterbrecherkontakt, Kabinetür	Contact à ouverture, portière de cabine
267	S	Slutkontakt bromstryck	Contact, making, brake pressure	Schließkontakt, Bremsdruck	Contact à fermeture, pression de frein
268	S	Slutkontakt kompressor	Contact, making, Compressor	Schließkontakt, Kompressor	Contact à fermeture, Poule compresseur
269	S	Slutkontakt sax inne	Contact, making extender in		
270	S	Slutkontakt överlastskydd	Contact, making, overload protection		
299	S	Slut/brytkontakt option	Contact, making/braking option	Schließ-/Unterbrecherkontakt, (option)	Contact à fermeture/ouverture, (option)
300	K	Relä hel/halvljus	Relay, main/dipped beam	Relais, Fern-/Abblendlicht	Relais, route-croisement
301	K	Relä dimljus	Relay, fog light	Relais, Nebelscheinwerfer	Relais, feux antibrouillard
302	K	Relä fjärrljus	Relay, distance light	Relais, Fernscheinwerfer	Relais, feux longue portée
303	K	Relä lastljus	Relay, mast light	Relais, Ladescheinwerfer	Relais, projecteur de chargement
304	K	Relä arbetsljus	Relay, working light	Relais, Arbeitsbeleuchtung	Relais, projecteur de travail
305	K	Relä backljus	Relay, reversing light	Relais, Rückfahrcheinwerfer	Relais, feux de recul
306	K	Relä hellljus	Relay, main beam	Relais, Fernlicht	Relais, feux de route

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
307	K	Relä halvlyjus	Relay, dipped beam	Relais, Abblendlicht	Relais, feux de croisement
308	K	Relä bromsljus	Relay, brake light	Relais, Bremslicht	Relais, feux stop
309	K	Relä parkeringsbroms	Relay, parking light	Relais, Standlicht	Relais, feux de stationnement
310	K	Relä körvisare vä	Relay, direction indicator left	Relais, Fahrtrichtungsanzeiger, L	Relais, clignotant supplémentaire, ga.
311	K	Relä körvisare hö	Relay, direction indicator right	Relais, Fahrtrichtungsanzeiger, R	Relais, clignotant supplémentaire, dr.
312	K	Relä startelement	Relay,element preheater	Relais, Startelement	Relais, élément de démarrage
313	K	Relä vändbar förarstol	Relay, rotating driver's seat (VBFS)	Relais, drehbarer Fahrersitz	Relais, siège pivotant
314	K	Relä parkeringsbroms	Relay, parking brake	Relais, Feststellbremse	Relais, frein de stationnement
315	K	Relä startlås	Relay, starting key	Relais, Startschloß	Relais, démarreur antivol
316	K	Relä torkare	Relay, wiper	Relais, Wischer	Relais, essuie-glace
317	K	Relä strålkastarkare	Relay, roading lights wiper	Relais, Scheinwerferwischer	Relais, essuie-phare
318	K	Relä AT-regulator	Relay, AT-regulator	Relais, Abgasdruckregler	Relais, régulateur AT
319	K	Relä varningsblinkers	Relay, hazard blinkers	Relais, Warnblinker	Relais, feux de détresse
320	K	Relä elektrisk stopp	Relay, electrical stop	Relais, elektrischer Stopp	Relais, arrêt électrique
321	K	Relä intervalltorkare	Relay, intermittent wiper	Relais, Intervallwischer	Relais, balayage intermittent
322	K	Relä kylvätskenivå	Relay, coolant level	Relais, Kühlfülligkeitsstand	Relais, niveau radiateur
323	K	Relä blinkers	Relay, blinkers	Relais, Blinker	Relais, clignotants
324	K	Relä rangespärr	Relay, range interlock	Relais, Rangesperre	Relais, blocage doubleur
325	K	Relä blinkande bromsljus (back)	Relay, flashing brake lights (reversing)	Relais, blinkendes Bremslicht (beim Zurücksetzen)	Relais, feux stop clignotants (en marche arrière)
326	K	Relä blinkande bromsljus (runt)	Relay, flashing hazard brake lights	Relais, blinkendes Bremslicht (Rund-um)	Relais, feux stop clignotants (gyrophare)
327	K	Relä växel neutral	Relay, gear neutral	Relais, Wechsell neutral	Relais, changement neutre
328	K	Relä växelskifte	Relay, gear shift	Relais, Wechselschaltung	Relais, changement de rapports
329	K	Relä växel hög/låg	Relay, high/low gear	Relais, Wechsel hoch/niedrig	Relais, petite/grande vitesse
330	K	Relä startspärr	Relay, start interlock	Relais, Startsperr	Relais, blocage démarrage
331	K	Relä drivning fram	Relay, forward driving	Relais, Antrieb vorn (LPG, Diesel)	Relais, marche avant
332	K	Relä drivning bak	Relay, reversing driving	Relais, Antrieb hinten (LPG, Diesel)	Relais, marche arrière
333	K	Tidrelä förvärmning	Time relay, automatically preheating	Zeitrelais, Vorwärmautomatik	Relais, temporisé, préchauffage automatique
334	K	Relä frikoppling/drivbrytning	Relay, free wheel/drive disconnection	Relais, Auskuppeln/Antriebsabschaltung	Relais, débrayage/arrêt d'entraînement
335	K	Relä växelventil 1:a (diesel, gas)	Relay, gear change valve 1-gear (diesel,LPG)	Relais, Schaltventil 1 Getriebe (Diesel, LPG)	Relais, distributeur de changement, boîte à 1 rapport (gazole, GPL)

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
336	K	Relä växelventil 2:a (diesel, gas)	Relay, gear change valve 2-gear (diesel,LPG)	Relais, Schaltventil 2 Getriebe (Diesel, LPG)	Relais, distributeur de changement, boîte à 2 rapports (gazole, GPL)
337	K	Relä drivriktning motor	Relay, motor drive direction	Relais, Antriebsrichtung Motor	Relais, sens de marche moteur
338	K	Relä kylfläkt drivmotor	Relay, cooling fan drive motor	Relais, Lüfter Antriebsmotor	Relais, moteur du ventilateur
339	K	Relä kylfläkt elskåp	Relay, cooling fan electrical box	Relais, Lüfter Schaltschrank	Relais, boîtier électrique du ventilateur
340	K	Tidrelä fördröjt tillslag	Time relay, start delay	Zeitrelais, verzögerte Einschaltung	Relais, temporisé, mise en marche temporisée
341	K	Tidrelä fördröjt frånslag	Time relay, stop delay	Zeitrelais, verzögerte Ausschaltung	Relais, temporisé, arrêt temporisée
342	K	Relä drivning 2/4 hjul	Relay, switching 2/4 WD	Relais, 2-Rad/4-Rad-Antrieb	Relais, commutation 2/4 roues motrices
343	K	Relä dimbakljus	Relay, fog light rear	Relais, Nebelschlußleuchte	Relais, feux de brouillard arrière
344	K	Relä momentförstärkare	Relay, torque amplifier	Relais, Drehmomentwandler	Relais, convertisseur de couple
345	K	Relä låsning vändskiva	Relay, interlocking of turntable	Relais, Sperren der Sattelkupplung	Relais, verrouillage de la sellette
346	K	Relä frikoppling stollåsning	Relay, releasing of seat interlocking	Relais, Freigabe Sitzverriegelung	Relais, déverrouillage du siège
347	K	Relä stolvändning/jussignal	Relay, multifunction, seat rotation/light signal	Relais, Multifunktion, Sitzdrehen/Lichtsignal	Relais, multifonction siège/appe de phare
348	K	Relä fläktmotor värmare	Relay, fan heating	Relais, Gebläsemotor Heizung	Relais, chauffage du moteur de ventilateur
349	K	Relä fartreglage	Relay, speed control	Relais, Geschwindigkeitsregelung	Relais, commande de vitesse
350	K	Relä pumpkontakt/pumpkontroll	Relay, pump contactor/pump control	Relais, Pumpenkontrolle	Relais, commande de pompe
351	K	Relä hyttlyft upp	Relay, cab hoist up	Relais, Kabinenhub, aufwärts	Relais, élévation de cabine, montée
352	K	Relä hyttlyft ner	Relay, cab hoist down	Relais, Kabinenhub, abwärts	Relais, élévation de cabine, descente
353	K	Relä säkerhetsslinga	Relay, safety loop	Relais, Sicherheitschleife	Relais, boucle de sécurité
354	K	Relä styrsystem	Relay, signal control system	Relais, Signal Lenkung	Relais, signal système de commande
355	K	Relä sensorstyrning	Relay, sensor control	Relais, Sensorsteuerung	Relais, commande capteurs
356	K	Skiftrelä längskörning/tvärskörning	Shift relay, length/sideways driving	Schaltrelais, Längs-/Querfahren	Relais, de commutation, sens longitudinal/transversal
357	K	Relä roterande varningsljus	Relay, hazard beacon	Relais, rotierende Rund-um-Kennleuchte	Relais, gyrophare
358	K	Relä kompressor luft	Relay, compressor air	Relais, compressor luft	Relais, compresseur du air
359	K	Relä Hydraulolj kylare	Relay hydraulic oil cooler	Relais, Hydraulik Ölkühler	Relais, radiateur huile hydraulique
360	K	Relä startsolenoïd	Relay, starting solenoid	Relais, Anlaßermagnet	Relais, solénoïde démarreur
361	K	Relä kompressor AC	Relay, compressor air conditione	Relais, kompressor Klimaanlage	Relais, compresseur climatisation

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
362	K	Relä vattenventil AC	Relay, water valve air conditioner	Relais, Wasser Ventil für Klimaanlage	Relais, soupape pour l'eau du climatiseur
363	K	Relä kondensator AC	Relay, condenser air conditioner	Relais, kondensator klimaanlage	Relais, condenseur climatisation
364	K	Relä stolsbrytare	Relay seat switch		
365	K	Relä fönsterhiss upp	Relay, electrical screen elevator up	Relais, elektrischer Fensterheber aufwärts	Relais, montée du lève-glace électrique
366	K	Relä fönsterhiss ner	Relay, electrical screen elevator down	Relais, elektrischer Fensterheber abwärts	Relais, descente du lève-glace électrique
367	K	Relä styrning	Relay, steering	Relais, Lenkung	Relais, direction
368	K	Relä lågt bromstryck	Relay, low brake pressure	Relais, niedriger Bremsdruck	Relais, pression de frein petite
369	K	Relä centralsmörjning	Relay, central lubrication	Relais, zentralschmierung	Relais, graissage centralisé
370	K	Relä centralsmörjning, aggregat	Relay, central lubrication, attachment	Relais, zentralschmierung, Aggregat	Relais, graissage centralisé et accessoires
371	K	Relä lyfthöjd	Relay, lift height	Relais, hubhöhe	Relais, élévation
372	K	Relä blinkande varningsljus, höjdbegränsn.	Relay, flashing beacon, lifting height limiter	Relais, blinkende Rundumleuchte, Höhebegränzung	Relais lampe clignotante, limiteur de hauteur
373	K	Relä bakljus	Relay light	Relais, beleuchtung	Relais, feux
375	K	Huvudkontaktors reglersystem	Main contactor, operating control	Hauptschutz, Regelsystem	Contacteur principal, système de régulation
376	K	Kontaktors framreglersystem	Contactors, forward operating control	Schütz, vom Regelsystem	Contacteur, régulation avant
377	K	Kontaktors bakreglersystem	Contactors, reversing operating control	Schütz, hinten Reglersystem	Contacteur, régulation arrière
378	K	Kontaktors by-pass reglersystem/fältförsvagning	Contactors, by-pass operating control/ Field weakening	Schütz, Bypass Reglersystem/ Feldschwächung	Contacteur, système de régulation by-pass/ Affaiblissement de champ
379	K	Kontaktors pumphöjningsmotor	Contactors, pump motor	Schütz, Pumpenmotor	Contacteur, moteur de la pompe
380	K	Kontaktors återladdning	Contactors, recharging	Schütz, Aufladung	Contacteur
381	K	Relä, förbikoppling säkerhetssystem	Relay, by-pass safety system	Relais, überbrückung des Sicherheitssystems	Contacteur, recharge
382	K	Relä, Stolsvärme	Relay, heated seat	Relais, Sitzheizung	Relais, shunt sécurité
383	K	Relä vattenseparator	Relay, waterseparator	Relais, Wasserabscheider	Relais, siège chauffant
384	K	Relä bränslepump insprutning	Relay, fuel injection pump	Relais, Wasserabscheider	Relais, séparateur d'eau
385	K	Relä, hög motortemperatur.	Relay, high motor temperature	Relais, hohe motor temperatur	

Komponentförteckning / List of Components / Komponentenverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
387	K	Relä alternativt gaspedal	Relay alternative throttle pedal		
399	K	Relä option	Relay, option	Relais, Option	Relais, option
400	E	G-lampa vä fram	Light bulb, roading light left hand front	Glühlampe, Scheinwerfer links vorn	Ampoule, projecteur avant gauche
400	E	G-lampa hö fram	Light bulb, roading light right hand rear	Glühlampe, Scheinwerfer rechts vorn	Ampoule, projecteur avant droite
401	E	G-lampa vä bak	Light bulb, roading light left hand front	Glühlampe, Scheinwerfer links hinten	Ampoule, projecteur arrière gauche
401	E	G-lampa hö bak	Light bulb, roading light right hand rear	Glühlampe, Scheinwerfer rechts hinten	Ampoule, projecteur arrière droite
402	E	G-lampa fjärrljus	Light bulb, distance light	Glühlampe, Fernscheinwerfer	Ampoule, feu longue portée
403	E	G-lampa lastljus	Light bulb, mast light	Glühlampe, Ladescheinwerfer	Ampoule, projecteur de chargement
404	E	G-lampa arbetsljus	Light bulb, working light	Glühlampe, Arbeitsbeleuchtung	Ampoule, projecteur de travail
405	E	G-lampa backljus	Light bulb, rear light	Glühlampe, Rückfahrcheinwerfer	Ampoule, feu de recul
406	E	G-lampa cont belysning vänster	Container light left-hand	Containerbeleuchtung links	Eclairage conteneur gauche
406	E	G-lampa cont belysning höger	Container light right-hand	Containerbeleuchtung rechts	Eclairage conteneur droite
408	E	G-lampa park ljus vä fram	Light bulb, parking light, left-hand forward	Glühlampe, Standlicht, links vorn	Ampoule, feu de stationnement, avant gauche
408	E	G-lampa park ljus hö fram	Light bulb, parking light, right-hand forward	Glühlampe, Standlicht, rechts vorn	Ampoule, feu de stationnement, avant droite
410	H	G-lampa broms ljus vä fram	Light bulb, brake light, left-hand forward	Glühlampe, Bremslicht, links vorn	Ampoule, feu stop, avant gauche
410	H	G-lampa broms ljus hö fram	Light bulb, brake light, right-hand forward	Glühlampe, Bremslicht, rechts vorn	Ampoule, feu stop, avant droite
411	H	G-lampa broms ljus vä bak	Light bulb, brake light, left-hand rear	Glühlampe, Bremslichts, links hinten	Ampoule, feu stop, arrière gauche
411	H	G-lampa broms ljus hö bak	Light bulb, brake light, right-hand rear	Glühlampe, Bremslicht, rechts hinten	Ampoule, feu stop, arrière droite
412	H	G-lampa bak ljus vä bak	Light bulb, rear light, left-hand rear	Glühlampe, Rücklicht, links hinten	Ampoule, feu arrière gauche
412	H	G-lampa bak ljus hö bak	Light bulb, rear light, right-hand rear	Glühlampe, Rücklicht, rechts hinten	Ampoule, feu arrière droite
413	H	G-lampa bak ljus vä fram (VBFS)	Light bulb, rear light, left-hand forward (VBFS)	Glühlampe, Rücklicht, links vorn (drehbarer Fahrersitz)	Ampoule, feu arrière, avant gauche

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
413	H	G-lampa bak ljus hö fram (VBFS)	Light bulb, rear light, right-hand forward (VBFS)	Glühlampe, Rücklicht, rechts vorn (drehbarer Fahrersitz)	Ampoule, feu arrière, avant droite
416	H	G-lampa sidomarkering vä fram	Light bulb, side position light, left-hand forward	Glühlampe, seitliche Begrenzungsleuchte, links vorn	Ampoule, feu de position latérale avant gauche
416	H	G-lampa sidomarkering vä bak	Light bulb, side position light, left-hand rear	Glühlampe, seitliche Begrenzungsleuchte, links hinten	Ampoule, feu de position latérale arrière gauche
417	H	G-lampa sidomarkering hö fram	Light bulb, side position light, right-hand forward	Glühlampe, seitliche Begrenzungsleuchte, rechts vorn	Ampoule, feu de position latérale avant droite
417	H	G-lampa sidomarkering hö bak	Light bulb, side position light, right-hand rear	Glühlampe, seitliche Begrenzungsleuchte, rechts hinten	Ampoule, feu de position latérale arrière droite
420	H	G-lampa positionsljus vänster	Light bulb, position light, left-hand	Glühlampe, Positionsleuchte links	Ampoule, feu de position gauche
421	H	G-lampa positionsljus höger	Light bulb, position light, right-hand	Glühlampe, Positionsleuchte rechts	Ampoule, feu de position droite
422	H	G-lampa körvisare vä fram	Light bulb, direction indicator left-hand forward	Glühlampe, Fahrtrichtungsanzeiger links	Ampoule, clignotant avant gauche
423	H	G-lampa körvisare hö fram	Light bulb, direction indicator right-hand forward	Glühlampe, Fahrtrichtungsanzeiger rechts vorn	Ampoule, clignotant avant droite
426	H	G-lampa körvisare vä bak	Light bulb, direction indicator left-hand rear	Glühlampe, Fahrtrichtungsanzeiger links hinten	Ampoule, clignotant arrière gauche
427	H	G-lampa körvisare hö bak	Light bulb, direction indicator right-hand rear	Glühlampe, Fahrtrichtungsanzeiger rechts hinten	Ampoule, clignotant arrière droite
428	H	G-lampa roterande varningsljus	Light bulb, flashing beacon lamp	Glühlampe, Rundum-Kennleuchte	Ampoule, gyrophare
429	E	G-lampa cigarettändare belysning	Light bulb, cigaret lighter illumination	Glühlampe, Zigarettenanzünder-Beleuchtung	Ampoule, éclairage allume-cigares
431	E	G-lampa instrument belysning	Light bulb, instrument illumination	Glühlampe, Instrumentenbeleuchtung	Ampoule, éclairage des instruments
432	E	G-lampa handsfack belysning	Light bulb, glove pocket light	Glühlampe, Handschuhfachbeleuchtung	Ampoule, éclairage de la boîte à gants
433	E	G-lampa instegs belysning	Light bulb, step-in lighting	Glühlampe, Einstiegbeleuchtung	Ampoule, éclairage de l'embarquement
434	E	G-lampa innerbelysning	Light bulb, interior lighting	Glühlampe, Innenbeleuchtung	Ampoule, éclairage intérieur
435	E	G-lampa läsbelysning	Light bulb, reading lighting	Glühlampe, Leselampe	Ampoule, éclairage de lecture
436	E	G-lampa identifikationsljus	Light bulb, identification light	Glühlampe, Identifikationsleuchte	Ampoule, éclairage de plaque
437	E	G-lampa identifikationsljus/takskylt	Light bulb, identification light/roof sign	Glühlampe, ID-Beleuchtung/Dachschild	Ampoule, signalisation toitet interieur cabine
438	E	G-lampa motorrumsbelysning	Light bulb, engine compartment light	Glühlampe, Motorraumbeleuchtung	Ampoule, éclairage compartiment moteur

Komponentförteckning / List of Components / Komponentenverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
439	E	Nummerskyltsbelysning	Light license plate	Kennzeichenbeleuchtung	
440	E	G-lampa värmeregler belysning	Light bulb, heating control light	Glühlampe, Beleuchtung für Heizungsbedieung	Ampoule, éclairage commande chauffage
445	H	G-lampa körvisare vä (extra)	Light bulb, extra direction indicator left	Glühlampe, Fahrtrichtungsanzeiger links, Extra	Ampoule, clignotant supplémentaire gauche
446	H	G-lampa körvisare hö (extra)	Light bulb, extra direction indicator right	Glühlampe, Fahrtrichtungsanzeiger, rechts, Extra	Ampoule, clignotant supplémentaire droite
451	H	G-lampa dimbakljus vänster	Light bulb, fog light rear left	Glühlampe, Nebelschlussleuchte links	Ampoule, feu de brouillard arrière gauche
452	H	G-lampa dimbakljus höger	Light bulb, fog light rear right	Glühlampe, Nebelschlussleuchte rechts	Ampoule, feu de brouillard arrière droite
453	H	G-lampa bromslyjus/körvisare vänster	Light bulb, brake light/dir. indicator left-hand	Glühlampe, Bremslicht/ Fahrriichtung links	Ampoule, feux stop/ clignotant gauche
453	H	G-lampa bromslyjus/körvisare höger	Light bulb, brake light/dir. indicator right-hand	Glühlampe, Bremslicht/ Fahrriichtung rechts	Ampoule, feux stop/ clignotant droit
454	H	G-lampa bromslyjus blackout vänster	Light bulb, brake light blackout left-hand	Glühlampe, Bremslicht/ Ausfall links	Ampoule, feux stop/ clignotant gauche blackout
454	H	G-lampa bromslyjus blackout höger	Light bulb, brake light blackout right-hand	Glühlampe, Bremslicht/ Ausfall rechts	Ampoule, feux stop/ clignotant droit blackout
456	E	G-lampa backljus blackout IR vänster	Light bulb, rear light blackout IR left-hand	Glühlampe, Rueckfahrleuchte Ausfall IR links	Ampoule, feux de recul blackout infra rouge gauche
456	E	G-lampa backljus blackout IR höger	Light bulb, rear light blackout IR right-hand	Glühlampe, Rueckfahrleuchte Ausfall IR rechts	Ampoule, feux de recul blackout infra rouge droit
457	H	G-lampa positionslyjus blackout vänster	Light bulb, position light blackout left-hand	Glühlampe, Positionslampe Ausfall links	Ampoule, feux de position blackout gauche
457	H	G-lampa positionslyjus blackout höger	Light bulb, position light blackout right-hand	Glühlampe, Positionslampe Ausfall rechts	Ampoule, feux de position blackout droit
458	E	G-lampa fram blackout vänster	Light bulb, roading light blackout left-hand	Glühlampe, Abblendlicht Ausfall links	Ampoule, feux de route blackout gauche
458	E	G-lampa fram blackout höger	Light bulb, roading light blackout right-hand	Glühlampe, Abblendlicht Ausfall rechts	Ampoule, feux de route blackout droit
459	E	G-lampa fram blackout IR vänster	Light bulb, roading light blackout IR left-hand	Glühlampe, Abblendlicht Ausfall IR links	Ampoule, feux de route blackout infra rouge gauche
459	E	G-lampa fram blackout IR höger	Light bulb, roading light blackout IR right-hand	Glühlampe, Abblendlicht Ausfall IR rechts	Ampoule, feux de route blackout infra rouge droit

Komponentförteckning / List of Components / Komponentenverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
460	E	G-lampa arb.belysning hytt blackout IR vä	Light bulb, working light cab blackout IR left	Glühlampe, Arbeitsbeleuchtung kabine Ausfall links	Ampoule, éclairage cbine blackout infra rouge gauche
460	E	G-lampa arb.belysning hytt blackout IR hö	Light bulb, working light cab blackout IR right	Glühlampe, Arbeitsbeleuchtung kabine Ausfall rechts	Ampoule, éclairage cbine blackout infra rouge droit
461	E	G-lampa arb.bel. bom 20' blackout IR vä	Light bulb, working light boom20' b.out IR left	Glühlampe, Arbeitsbeleuchtung Ausleger 20; Ausfall IR links	Ampoule, feux de travail gauche sur la poutre pour les 20; blackout infra rouge
461	E	G-lampa arb.bel. bom 20' blackout IR hö	Light bulb, working light boom20' b.out IR right	Glühlampe, Arbeitsbeleuchtung Ausleger 20; Ausfall IR rechts	Ampoule, feux de travail droit sur la poutre pour les 20; blackout infra rouge
462	E	G-lampa arb.bel. bom 40' blackout IR vä	Light bulb, working light boom40' b.out IR left	Glühlampe, Arbeitsbeleuchtung Ausleger 40; Ausfall IR links	Ampoule, feux de travail gauche sur la poutre pour les 40; blackout infra rouge
462	E	G-lampa arb.bel. bom 40' blackout IR hö	Light bulb, working light boom40' b.out IR right	Glühlampe, Arbeitsbeleuchtung Ausleger 40; Ausfall IR rechts	Ampoule, feux de travail droit sur la poutre pour les 40; blackout infra rouge
463	H	G-lampa bak ljus vänster bak, blackout	Light bulb, rear light left-hand rear, blackout	Glühlampe, Rueckfahrleuchte links hinten,Ausfall	Ampoule, feux de recul gauche blackout
463	H	G-lampa bak ljus höger bak, blackout	Light bulb, rear light right-hand rear, blackout	Glühlampe, Rueckfahrleuchte rechts hinten,Ausfall	Ampoule, feux de recul droit blackout
464	E	G-lampa cont belysning IR vänster	Light bulb,Container light IR left-hand	Glühlampe, Container Beleuchtung IR links	Ampoule, éclairage conteneurs infra rouge gauche
464	E	G-lampa cont belysning IR höger	Light bulb,Container light IR right-hand	Glühlampe, Contanier Beleuchtung IR rechts	Ampoule, éclairage conteneurs infra rouge droit
465	H	G-lampa röd saxagregat ute	Light-bulb, red extender extended		
466	H	G-lampa orange vertikålhåining på	Light bulb, orange vertical hold on		
467	H	G-lampa grön klåmtryck OK	Light bulb, green clamp pressure OK		
468		G-Lampa Röd Maxlast	Light bulb,Red Overload		
500	H	Kont lampa körvisare	Indicating lamp, direction indicator	Kontrolllampe, Fahrtrichtungsanzeiger	Témoin, clignotants
501	H	Kont lampa körvisare (extra)	Indicating lamp, direction indicator extra	Kontrolllampe, Fahrtrichtungsanzeiger, Extra	Témoin, clignotant supplémentaire
503	H	Varn lampa oljetryck motor	Warning lamp, oil pressure engine	Warnlampe, Öldruck Motor	Voyant, pression d;huile moteur
504	H	Kont lampa helljus	Indicating lamp, main beam	Kontrolllampe, Fernlicht	Témoin, feux de route
505	H	Varn lampa laddning	Warning lamp, loading	Warnlampe, Ladestrom	Voyant, charge

Komponentförteckning / List of Components / Komponentenverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
506	H	Varn lampa laddning (extra)	Warning lamp, loading extra	Warnlampe, Ladestrom Extra	Voyant, charge supplémentaire
507	H	Varn lampa färdbröms	Warning lamp, brake	Warnlampe, Betriebsbremse	Voyant, frein de service
508	H	Varn lampa parkerings broms	Warning lamp, parking brake	Warnlampe, Feststellbremse	Voyant, frein de stationnement
509	H	Varn lampa nivå kylvatten	Warning lamp, coolant level	Warnlampe, Kühlflüssigkeitsstand	Voyant, niveau liquide de refroidissement
510	H	Kont lampa diff spärr	Indicating lamp, diff. interlock	Kontrolllampe, Differentialsperre	Témoin, blocage du différentiel
512	H	Varn lampa temp momentförst	Warning lamp, temperature converter	Warnlampe, Temperatur Drehmomentwandler	Voyant, température du convertisseur
514	H	Kont lampa överväxel	Indicating lamp, overdrive clutch	Kontrolllampe, Overdrive	Témoin, overdrive
519	H	Kont lampa halvlyjus	Indicating lamp, dipped lights	Kontrolleuchte, Abblendlicht	Témoin, feu de croisement
524	H	Kont lampa luftfilter	Indicating lamp, air filter	Kontrolllampe, Luftfilter	Témoin, filtre à air
525	H	Kont lampa UNIKAT	Indicating lamp, UNIKAT	Kontrolllampe, UNIKAT	Témoin, UNIKAT
528	H	Kont lampa förvärmning	Indicating lamp, preheating	Kontrolllampe, Vorwärmung	Témoin, préchauffage
530	H	Kont lampa framhjul's styrning	Indicating lamp, forward wheel steering	Kontrolllampe, Vorderrad lenkung	Témoin, roue avant directrice
531	H	Kont lampa 4-hjul's styrning	Indicating lamp, 4-wheel steering	Kontrolllampe, Vierradlenkung	Témoin, 4 roues directrices
532	H	Kont lampa crab styrning	Indicating lamp, crab steering	Kontrolllampe, Diagonal lenkung	Témoin, déplacement en diagonal
533	H	Kont lampa hyd.pump	Indicating lamp, emergency hyd. pump	Kontrolllampe, Ackumulatordruckpumpe	Témoin, pompe hydraulique d'urgence
547	H	Varn lampa centralvarning	Warning lamp, central warning	Warnleuchte, Zentrales Warnsystem	Voyant, signalisation centralisée
549	H	Varn lampa oljetryck v-låda	Warning lamp, oil pressure gear box	Warnlampe, Öldruck Getriebe	Voyant, pression d'huile de la boîte
550	H	Varn lampa hyttläsning	Warning lamp, cab lock	Warnlampe, Kabinenverriegelung	Voyant, verrouillage de la cabine
551	H	Varn lampa temp v-låda	Warning lamp, temperature gear box	Warnlampe, Temperatur Getriebe	Voyant, température de la boîte de vitesses
552	H	Varn lampa bromstryck	Warning lamp, brake pressure	Warnlampe, Bremsdruck	Voyant, pression de freinage
554	H	Varn lampa temp spolkrets bromsar	Warning lamp, temp. cooling system brakes	Warnlampe, Temperatur Spülkreis Bremsen	Voyant, température circuit de freins
555	H	Varn lampa temp kylvatten mot	Warning lamp, temperature coolant engine	Warnlampe, Temperatur Kühlwasser Motor	Voyant, température refroidissement moteur
556	H	Varn lampa låsning vändskiva	Warning lamp, interlocking of turntable	Warnleuchte, Sperren der Sattelkupplung	Voyant, verrouillage de la sellette
560	H	Varn lampa temp drivmotor el	Warning lamp, temperature, drive motor	Warnleuchte, Temperatur Antriebsmotor, el.	Voyant, temp.moteur propulsion, élect.

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
561	H	Varn lampa temp pumpmotor el	Warning lamp, temperature, pump motor	Warnleuchte, Temperatur Pumpenmotor el.	Voyant, temp.moteur pompe, élect.
562	H	Varn lampa öppen twistlock	Warning lamp, unlocked twist lock	Warnleuchte, Twistlock offen	Voyant, verrous non verouillés
563	H	Varn lampa låst twistlock	Warning lamp, locked twist lock	Warnleuchte, Twistlock geschlossen	Voyant, verrous verouillés
564	H	Varn lampa anliggning	Warning lamp, alignment	Warnleuchte, Auflage	Voyant, d'aligement
565	H	Varn lampa temp motor el	Warning lamp, temperature motor	Warnleuchte, Temperatur, el.	Voyant, temp.moteur, élect.
569	H	Kont lampa eivärme	Indicating lamp, electric heater	Kontrollleuchte, Elektroheizung	Témoin, chauffage électrique
569	H	Kont lampa eivärme	Indicating lamp, electric heater	Kontrollleuchte, Elektroheizung	Témoin, chauffage électrique
570	H	Varn lampa överkoppling säkerhetssystem	Warning lamp, by-pass safety system	Warnleuchte, Sicherheitssystem umgeschaltet	Voyant, surconnection du système de sécurité
571	H	Kont lampa bränslenivå	Indicating lamp, fuel level	Kontrolllampe, Kraftstoff	Témoin, niveau de carburant
572	H	Varningslampa lyfthöjd	Warning lamp lifting height	Warnlampe Hubhöhe	Lampe alarme, hauteur de levée
573	H	Kontroll lampa motor information	Indicator lamp engine information	Kontrolllampe Motor-Information	Lampe de contrôle, information moteur
574	H	Kontroll lampa stödben nere	Indicator lamp support jacks down	Kontrolllampe Stuetzbein unten	Lampe de contrôle, bequilles abaissées
575	H	Kontroll lampa stödben ur arb.läge	Indicator lamp support jacks out of working pos	Kontrolllampe Stuetzbein außerhalb Arbeitsposition	Lampe de contrôle, béquille relevées
576	H	Kontroll lampa anliggning främre ben	Indicator lamp, alignment front legs	Kontrolllampe Auflage vorderes Bein	Lampe de contrôle, alignement jambes avants
577	H	Kontroll lampa anliggning bakre ben	Indicator lamp, alignment rear legs	Kontrolllampe Auflage hinteres Bein	Lampe de contrôle, alignement jambes arrières
578	H	Kontroll lampa klämläge främre ben	Indicator lamp, clamp position front legs	Kontrolllampe Klemmposition vordere Beine	Lampe de contrôle, position de verrouillage jambes avants
579	H	Kontroll lampa klämläge bakre ben	Indicator lamp, clamp position rear legs	Kontrolllampe Klemmposition hintere Beine	Lampe de contrôle, position de verrouillage jambes arrières
580	H	Kontroll lampa främre ben uppe	Indicator lamp, front legs upper position	Kontrolllampe vorderes Bein oben	Lampe de contrôle, position haute jambes avants
581	H	Kontroll lampa främre ben nere	Indicator lamp, front legs lower position	Kontrolllampe vorderes Bein unten	Lampe de contrôle, position basse jambes arrières
582	H	Varningslampa överlast	Warning lamp overload		
583	H	Kontroll lampa anliggning ett ben	Indicator lamp, alignment one leg		
584	H	Kontroll lampa anliggning alla ben	Indicator lamp, alignment all legs		

Komponentförteckning / List of Components / Komponentenverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
599	H	Kont lampa option	Indicating lamp, option	Kontrolllampe, Option	Témoins, option
600	Y	M-ventil avgasbroms	Solenoid valve, exhaust brake	Magnetventil, Motorbremse	Electrovanne, ralentisseur sur échappement
601	Y	M-ventil diff spärr	Solenoid valve, diff. interlock	Magnetventil, Differentialsperre	Electrovanne, blocage du différentiel
602	Y	M-ventil broms	Solenoid valve, brake	Magnetventil, Bremse	Electrovanne, frein
603	Y	M-ventil värme	Solenoid valve, heater	Magnetventil, Heizung	Electrovanne, chaleur
604	Y	M-ventil kraftuttag sida	Solenoid valve, power take off, side	Magnetventil, Nebenantrieb Seite	Electrovanne, prise de force latérale
605	Y	M-ventil kraftuttag bak	Solenoid valve, power take off, rear	Magnetventil, Nebenantrieb hinten	Electrovanne, prise de force arrière
606	Y	M-ventil 2/4 hjulsdrift	Solenoid valve, 2/4WD	Magnetventil, 2-Rad/4-Rad-Antriebe	Electrovanne, 2/4 roues motrices
607	Y	M-ventil hög/låg växel	Solenoid valve, high/low gear	Magnetventil, Wechsel hoch/niedrig	Electrovanne, petite/grande vitesse
608	M	Pumpaggregat nyttlyft	Pump unit, cab hoist	Pumpenanlage, Kabinenhub	Groupe pompe-moteur, élévation de cabine
609	M	Ställmotor gaspådrag	Regulating motor, throttle	Stellmotor, Gasgeben	Moteur de commande de gaz
610	Y	M-ventil hydraulsystem allm	Solenoid valve, hydraulics, general	Magnetventil, hydraulische Anlage allgemein	Electrovanne, système hydraulique, général
611	Y	M-ventil flödesbegränsning	Solenoid valve, flow restriction	Magnetventil, Fließbegrenzung	Electrovanne, limiteur de débit
612	M	Ställmotor recirkulation	Regulating motor, re-circulation	Stellmotor, Re-zirkulation	Moteur de commande, re-circulation
613	Y	M-ventil momentförstärkare	Solenoid valve, torque amplifier	Magnetventil, Drehmomentwandler	Electrovanne, convertisseur de couple
614	Y	M-ventil rangespärr	Solenoid valve, ranging interlock	Magnetventil, Rangesperre	Electrovanne, blocage du doubleur
615	Y	M-ventil hjulvridning	Solenoid valve, wheel turning	Magnetventil, Radeinschlag	Electrovanne, pivotement roues
616	Y	M-ventil kallstart	Solenoid valve, cold start aid	Magnetventil, Kaltstarthilfe	Electrovanne, pour le démarrage a froid
617	Y	M-ventil AT-regulator by-pass	Solenoid valve, AT-regulator ; by-pass ;	Magnetventil, Abgasdruckregler ; Bypass ;	Electrovanne, by-pass du régulateur AT
618	Y	M-ventil vatten klimatanläggning	Solenoid valve, water air conditioner	Magnetventil, wasser klimaanlage	Electrovanne, pour l'eau du climatiseur
620	Y	M-ventil vändskiva upp	Solenoid valve, fifth wheel up	Magnetventil, Sattelkupplung, aufwärts	Electrovanne, sellette, montée
621	Y	M-ventil vändskiva ner	Solenoid valve, fifth wheel down	Magnetventil, Sattelkupplung, abwärts	Electrovanne, sellette, descente
622	Y	M-ventil vändskiva fram	Solenoid valve, fifth wheel forward	Magnetventil, Sattelkupplung, vorn	Electrovanne, sellette, marche avant
623	Y	M-ventil vändskiva bak	Solenoid valve, fifth wheel rear	Magnetventil, Sattelkupplung, hinten	Electrovanne, sellette, marche arrière
624	Y	M-ventil skevning hö	Solenoid valve, levelling right hand	Magnetventil, Niveausgleich rechts	Electrovanne, corr. -niveau droits

Komponentförteckning / List of Components / Komponentenverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
625	Y	M-ventil skevning vå	Solenoid valve, levelling left hand	Magnetventil, Niveauausgleich links	Electrovanne, corr.-niveau gauche
626	Y	M-ventil AT-regulator	Solenoid valve, AT-regulator	Magnetventil, Abgasdruckregler	Electrovanne, régulateur AT
630	Y	M-ventil v-låda fram	Solenoid valve, gear box, forward gear	Magnetventil, Getriebe Vorwärtsgang	Electrovanne, boîte de vitesses marche avant
631	Y	M-ventil v-låda back	Solenoid valve, gear box, rear gear	Magnetventil, Getriebe Rückwärtsgang	Electrovanne, boîte de vitesses marche arrière
632	Y	M-ventil v-låda spole 1	Solenoid valve, gear box, 1 gear	Magnetventil, Getriebe Schaltstufe I	Electrovanne, boîte vitesses rapport I
633	Y	M-ventil v-låda spole 2	Solenoid valve, gear box, 2 gear	Magnetventil, Getriebe Schaltstufe II	Electrovanne, boîte de vitesses rapport II
634	Y	M-ventil v-låda spole 3	Solenoid valve, gear box, 3 gear	Magnetventil, Getriebe Schaltstufe III	Electrovanne, boîte de vitesses rapport III
635	Y	M-ventil klämtryck	Solenoid valve, clamping pressure	Magnetventil, Anliegedruck	Electrovanne, pression de serrage
636	Y	M-ventil styrning	Solenoid valve, steering	Magnetventil, Lenkung	Electrovanne, direction
637	Y	M-ventil flytläge skevning	Solenoid valve, equalizing fifth wheel	Magnetventil, Ausgleich der Sattelkupplung	Electrovanne, équilibré de la selette
638	Y	M-ventil stopp insprut pump	Solenoid valve, stop injection pump	Magnetventil, Abstellung Einspritzpumpe	Electrovanne, arrêt de la pompe d'injection
639	Y	M-ventil låsning orbitrol ls	Solenoid valve, locking LS orbitrol	Magnetventil, Sperren LS Orbitrol	Electrovanne, verrouillage de LS Orbitrol
640	Y	M-ventil gasol	Solenoid valve, LPG	Magnetventil, LPG	Electrovanne, GPL
641	Y	M-ventil förångare (LPG)	Solenoid valve, evaporator (LPG)	Magnetventil, Verdampfer (LPG)	Electrovanne, évaporateur (GPL)
642	Y	M-ventil park broms	Solenoid valve, parking brake	Magnetventil, Feststellbremse	Electrovanne, frein de stationnement
643	Y	M-ventil låsning stol (VBFS)	Solenoid valve, seat locking (VBFS)	Magnetventil, Sitzsperre (VBFS)	Electrovanne, verrouillage du siège (VBFS)
644	Y	M-ventil låsning vändskiva	Solenoid valve, fifth wheel locking	Magnetventil, Sperren Sattelkupplung	Electrovanne, verrouillage de la sellette
645	Y	Magnetkoppling komp AC	Magnetic clutch, compressor AC	Magnetkupplung, Kompressor Klimaanlage	Coupleur magnétique, compresseur climatisation
646	Y	M-ventil stolsvändning	Solenoid valve, seat rotation	Magnetventil, Drehen des Sitzes	Electrovanne, pivotement du siège
647	Y	M-ventil stolstilt	Solenoid valve, seat tilt	Magnetventil, Kippen des Sitzes	Electrovanne, basculement du siège
648	Y	M-ventil luftfjädring	Solenoid valve, pneumatic springing	Magnetventil, Luftfederung	Electrovanne, suspension pneumatique
649	B	Termostat klimatannläggning	Thermostat, air condition	Thermostat, Klimaanlage	Thermostat, climatisation
650	M	Torkarmotor fram	Wiper motor forward	Scheibenwischermotor vorn	Moteur essuie-glace avant
650	M	Torkarmotor bak	Wiper motor rear	Scheibenwischermotor hinten	Moteur essuie-glace arrière
650	M	Torkarmotor tak	Wiper motor roof	Scheibenwischermotor Dach	Moteur essuie-glace pavillon
650	M	Torkarmotor tak (option)	Wiper motor roof (option)	Scheibenwischermotor Dach (Option)	Moteur essuie-glace pavillon (option)

Komponentförteckning / List of Components / Komponentenverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
651	M	Vindrutespolarmotor	Washer motor	Motor für Scheibenwaschanlage	Moteur lave-glace
652	M	Strålkastarmotor	Light motor	Motor für Scheinwerfer	Moteur projecteurs
653	M	Strålkastarspolarmotor	Light washer motor	Motor für Scheinwerferreinigungsanlage	Moteur lave-phares
654	M	Startmotor	Starter motor	Anlasser	Démarrreur
655	M	Kylfläkt drivmotor (EC)	Cooling fan, main motor (EC)	Lüfter Antriebsmotor (EC)	Moteur du ventilateur (EC)
656	M	Kylfläkt elskåp (EC)	Cooling fan, electrical box (EC)	Lüfter Schaltschrank (EC)	Boîtier électrique du ventilateur (EC)
657	M	Fläktmotor värme	Heating fan	Gebäsemotor (Heizung)	Moteur du ventilateur (chauffage)
658	G	Generator (extra)	Alternator extra	Generator, Extra	Alternateur supplémentaire
659	G	Generator utan laddregulator	Alternator without loading regulator	Generator ohne angebaute Reglerschalter	Alternateur sans régulateur de charge
660	G	Generator med laddregulator	Alternator with loading regulator	Generator mit angebaute Reglerschalter	Alternateur avec régulateur de charge
661	M	Fönsterhissmotor	Screenlevator motor	Fensterhebermotor	Moteur lève-glaces
662	G	Laddregulator	Loading regulator	Reglerschalter	Régulateur de charge
663	M	Doseringspump klimatanläggning	Dosage pump, air condition	Dosierpumpe, Klimaanlage	Pompe de dosage, climatisation
664	M	Cirk pump klimatanläggning	Circulating pump, air condition	Urmwälzpumpe, Klimaanlage	Pompe de circulation, climatisation
665	V	Diode	Diode	Diode	Diode
666	M	Fläktmotor cirkulation	Circulation fan	Umluftgebläse	Moteur du ventilateur (circulation)
667	M	Cirkulationspump värmesystem	Circulation pump heating system	Wärmetauscher Heizsystem	Pompe de circulation circuit de chauffage
668	M	Kylfläkt hydraulolja	Cooling fan, hydraulic oil	Gebläse, Hydrauliköl	Ventilateur, radiateur huile hydraulique
669	E	Värmare kupe/ motor diesel	Heater compartment/engine diesel	Innenheizung/ Dieselmotor	Réchauffeur pour habitacle et moteur
670	M	Kompressor	Compressor	Kompressor	Compresseur
671	M	Doseringspump diesel	Dosage pump diesel	Einspritzpumpe Diesel	Pompe de dosage pour diesel
672	M	Spjäll motor, ECC	Draught valve motor, ECC	Drosselventil Motor, ECC	Valve de traction pour moteur, ECC
673	Y	Vatten ventil motor, ECC	Water valve motor, ECC	Wasserventil Motor, ECC	Soupape pour refroidissement moteur, ECC
674	M	Kylfläkt bromsolja	Cooling fan, brake fluid	Gebläse, Bremsöl	Refroidisseur, huile de frein
685	A	Reglerenhet termostat AC	Control unit, termostat AC	Reglerenheit, Thermostat AC	Unité de régulation, Thermostat AC
690	B	Fartreglage (EC)	Speed control (EC)	Geschwindigkeitsregler (EC)	Régulation de la vitesse (EC)
693	M	Pump centralismörjning	Pump, central lubrication	Pumpe, Zentralschmierung	Pompe, graissage centralisé
694	M	Styrmotor	Steering motor	Steuermotor	Moteur de direction
695	M	Drivmotor (EC)	Drive motor (EC)	Antriebsmotor (EC)	Moteur d'entraînement (EC)

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
696	M	Pumpaggregat nödstyrning	Pump, emergency steering	Pumpe, Notlenkung	Pompe, direction de secours
697	B	Elbroms	Electric brake	E-Bremse	Frein électrique
698	M	Pumpmotor (EC)	Pump motor (EC)	Pumpenmotor (EC)	Moteur de la pompe (EC)
699	Y	M-ventil option	Solenoid valve, option	Magnetventil (option)	Electrovanne, (option)
700	P	Hastighetsmätare	Speedometer	Tachometer	Compteur de vitesse
701	P	Mätare oljetemp v-låda	Gear box oil temperature gauge	Meßinstrument, Öltemperatur Getriebe	Thermomètre, huile de la boîte
702	P	Klocka	Clock	Uhr	Montre
703	P	Varvtalsmätare	Engine rev meter	Drehzahlmesser	Compte-tours
704	P	Tryckluftsmätare	Air pressure gauge	Druckluftmesser	Manomètre, air
705	P	Mätare oljetryck v-låda	Gear box oil pressure gauge	Meßinstrument, Öldruck Getriebe	Manomètre, huile de la boîte
706	P	Termometer temp kylvätska motor	Temperature gauge, engine coolant	Thermometer, Temperatur Kühlfüssigkeit Motor	Thermomètre, temp. liquide refroidissement moteur
707	P	Bränslemätare	Fuel gauge	Kraftstoffanzeiger	Jauge de carburant
708	P	Timräknare	Hour meter	Betriebsstundenzähler	Compteur horaire
709	P	Kapacitetsmätare batteri	Capacity gauge, battery	Kapazitätsmesser	Indicateur de capacité, batterie
710	P	Tidur motor/kupevärmare	Timer, engine- and cab heater	Schaltuhr, motor- und Kabinenheizung	Minuterie, chauffage moteur et habitacle
711	P	Räknare, impuls	Counter, impulse	Zähler, Impuls	Compteur d'impulsion
712	P	Mätare oljetryck motor	Motor oil pressure gauge	Maßinstrument, Öldruck Motor	Minuterie, pression d'huile moteur
714	P	Mätare, temp. Hydraulolja	Hydraulic fluidtemperature, gauge	Maßinstrument, temperatur hydrauliköl	Minuterie, température huile hydraulique
715	P	Extra instrument allm	Extra instrument, general	Zusatzinstrument, allgemein	Instruments supplémentaires, général
720	S	Givare vändbar förarstol	Transmitter, revolving driver's seat (VBFS)	Geber, drehbarer Fahrersitz (VBFS)	Capteur, siège de conduite pivotant (VBFS)
740	D	FleetManager kontrollenhet	FleetManager control unit		
741	U	FleetManager batterifilter	FleetManager battery filter		
742	D	FleetManager kortläsare	FleetManager card device		
743	D	FleetManager accelerations givare	FleetManager acceleration sensor		
751	B	Givare varvtal turbin	Transmitter, speed turbin	Geber, Drehzahl Turbine	Capteur, nombre de tour turbine
752	B	Givare varvtal inre växellåda	Transmitter, speed internal gear chain	Geber, Getriebe Schaltpunkt	Capteur, nombre de tour à l'intérieur de la boîte de vitesse
753	B	Varvtalsgivare motor	Transmitter, engine revolution	Drehzahlgeber Motor	Capteur de régime moteur
754	B	Givare lufttryck	Transmitter, air pressure	Geber, Luftdruck	Capteur, pression d'air

Komponentförteckning / List of Components / Komponentenverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
755	B	Givare hydraulfilter indikering	Transmitter, hydraulics filter indication	Geber, Hydraulfilter Anzeige	Capteur, indication filtre à l'huile
756	B	Temperatur kylvätska motor	Transmitter, engine coolant temperature	Temperaturgeber, Kühlflüssigkeit Motor	Capteur de température, liquide de refroidissement
757	B	Bränslenivågivare	Transmitter, fuel level	Kraftstoffstandgeber	Capteur de niveau de carburant
758	B	Varvtalsgivare v-låda	Transmitter, gear box revolution	Drehzahlgeber Getriebe	Capteur de régime boîte de vitesses
759	B	Nivåindikator kylvätska	Transmitter, coolant level	Flüssigkeitsstandanzeiger, Kühlflüssigkeit	Indicateur de niveau, liquide de refroidissement
760	B	Givare rev-spärr/aut-vxl trans	Transmitter, reversing interlock / automatic gear change system (on gearbox output shaft)	Geber Umkehrsperr/automatische Schaltung Transmission	Capteur blocage marche arrière/ changement automatique transmission
761	B	Givare rev-spärr/aut-vxl motor	Transmitter, reversing interlock / automatic gear changing system (engine speed)	Geber Umkehrsperr/automatische Schaltung Motor	Capteur blocage marche arrière/changement automatique moteur
762	B	Givare temp.spolkrets bromsar	Transmitter, brake flushing circuit	Geber, Temperatur Spülkreis Bremsen	Capteur, temp. circuit refroidiss. freins
763	B	Givare nivå hydraulolja	Transmitter, hydraulic fluid level	Geber, Hydrauliköfllstand	Capteur, niveau huile hydraulique
764	B	Givare servotryck växellåda	Transmitter, gear box servo pressure	Geber, Servodruck, Getriebe	Capteur, pression servo de la boîte
765	B	Givare oljetryck v-låda	Transmitter, oil pressure gear box	Geber, Öldruck Getriebe	Capteur, pression d'huile de la boîte
766	B	Givare oljetemp. v-låda	Transmitter, oil temperature gear box	Geber, Öltemperatur Getriebe	Capteur, température d'huile de la boîte
767	B	Givare oljetryck motor	Transmitter, oil pressure engine	Geber, Öldruck Motor	Capteur, pression d'huile moteur
768	B	Givare oljetryck hydraulik	Transmitter, hydraulic pressure	Geber, Öldruck, Hydraulik	Capteur, pression d'huile hydraulique
769	B	Givare ändläge	Transmitter, end position	Geber, Anschlag	Capteur fin de course
770	B	Givare rattutslag	Transmitter, steering wheel angle	Geber, lenkradeinschlag	Capteur, braquage
771	B	Givare vinkel	Transmitter, angle	Geber, Winkel	Capteur, angle
772	B	Givare temp bromsolja	Transmitter, temperature brake fluid	Geber, Temperatur Bremskuehlöl	Capteur température liquide de frein
773	B	Givare närvaro	Transmitter, presence	Geber, Präsenz	Capteur, présence
774	B	Givare utomhustemp	Transmitter, ambient temperature	Geber, Außentemperatur	Capteur, température extérieure
775	B	Givare temp klimatianläggning	Transmitter, temperature air condition	Geber, Temperatur, Klimaanlage	Capteur, de température, climatisation

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
776	B	Givare temp hydraulioolja	Transmitter, hydraulic temperature	Geber, Temperatur, Hydrauliköl	Capteur, température huile hydraulique
777	B	Givare läge	Transmitter, position	Geber, Position	Capteur, position
778	B	Givare drivbrytning	Transmitter, drive break	Geber, Antriebsabschaltung	Capteur, arrêt d'entraînement
779	A	Reglersystem återladdning (EC)	Control system, recharging (EC)	Steuersystem, Aufladung (EC)	Système de régulation de recharge (EC)
780	A	Reglersystem åkmotor (EC)	Control system main motor (EC)	Regelsystem, Fahrmotor (EC)	Système de régulation moteur d'avancement (EC)
781	A	Reglersystem pumpmotor (EC)	Control system pump motor (EC)	Regelsystem Pumpenmotor (EC)	Système de régulation moteur de la pompe (EC)
782	A	Logik interface 2 drivmotorer	Logic (interface) two main motors (EC)	Logik (Schnittstelle) zwei Antriebsmotoren	Interface deux moteurs de propulsion
783	A	Logik interface gaspådrag	Logic (interface) throttle	Logik (interface) Gasgeben	Interface d'accélérateur
784	A	Logik interface bromsregl	Logic (interface) brake control	Logik (interface) Bremssteuerung	Interface de commande de frein
785	A	Logik interface styrsystem	Logic (interface) control system	Logik (interface) Lenkung	Interface de système de commande
786	A	Servoförstärkare styrsystem	Servo amplifier steering system	Servoverstärker, Steuerungssystem	Amplificateur pour le servo commande du système de direction
789	B	Givare allmän	Transmitter, common	Geber, allgemein	Capteur, général
790	D	Elektronisk kontrollenhet ECU, hytt	Electronic Control Unit ECU, cab	Elektronische Kontrolleinheit ECU, Kabine	Unité de control électronique ECU, cabine
791	D	Elektronisk kontrollenhet aggregat	Electronic Control Unit, attachment	Elektronische Kontrolleinheit, Aggregat	Unité électronique de control accessoire
792	D	Elektronisk kontrollenhet styrning	Electronic Control Unit, steering system	Elektronische Kontrolleinheit, Lenkung	Unité électronique de control système de direction
793	D	Elektronisk kontrollenhet växellåda	Electronic Control Unit, gearbox	Elektronische Kontrolleinheit, Getriebe	Unité électronique de control boîte de vitesse
794	D	Elektronisk kontrollenhet motor	Electronic Control Unit, engine	Elektronische Kontrolleinheit, Motor	Unité électronique de control boîte moteur
795	P	Display	Display	Display	Afficheur
796	D	Elektronisk kontrollenhet, lasthantering	Electronic Control Unit, Loadhandling	Elektronische Kontrolleinheit, Ladengerät	Unité électronique de control pour la manutention de la charge
797	D	Elektronisk kontrollenhet, ram	Electronic Control Unit, frame	Elektronische Kontrolleinheit, Rahmen	Unité de control électronique ECU, chassis
799	A	Logik allm (option)	Logic, general (option)	Logik, allgemein (option)	Circuit logique, général (option)
800	S	Startelement	Start element	Startelement	Réchauffeur de démarrage

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
802	E	Eluppvärm� backspegel	Electrical heated observation mirror	Elektrisch beheizter Rückspiegel	Rétroviseur à chauffage électrique
803	E	Eluppvärm� stol	Electrical heated seat	Elektrisch beheizter Sitz	Siège à chauffage électrique
804	E	Cigaretändare	Cigaret lighter	Zigarettenanzünder	Allume-cigares
805	E	Elvärme hytt	Electrical heating cab	Elektrische Heizung Kabine	Chauffage électrique cabine
806	A	Aggregat klimatanläggning	Aggregate, air conditioner	Aggregat, Klimaanlage	Groupe climatisation
807	R	Potentiometer	Potentiometer	Potentiometer	Potentiomètre
808	E	Eluppvärm� lufttorkare	Electrical heater air dryer	Elektrisch beheizter Lufttrockner	Séchage à l'air, à chauffage électrique
810	A	Kondensör AC, fläkt	Condensor AC, fan	Kondensör Klimaanlage, Gebläse	Condenseur climatisation, ventilateur
815	S	Manöverspak	Control lever	Bedienungshebel	Levier de commande
820	R	Motstånd	Resistor	Widerstand	Résistance
821	C	KONDENSATOR	CAPACITOR		
822	Z	Signalfilter	Signal filter	Signalfilter	Filter de signal
823	U	Signalomvandlare höger	Signal amplifier, right	Signalverstärker, rechts	Amplificateur de signaux, droit
824	U	Signalomvandlare vänster	Signal amplifier, left	Signalverstärker, links	Amplificateur de signaux, gauche
825	R	Reglage spakstyrning	Controls, (steering with control levers).	Regler, Hebelsteuerung	Commande, leviers
826	Y	Ventil spakstyrning	Valve, (steering with control levers).	Ventil, Hebelsteuerung	Distributeur, leviers
827	A	Växellåda	Gearbox	Getriebe	Bolt de vitesse
828	R	Shuntmotstånd	Shunt-resistor		
830	L	Tändspole	Ignition coil	Zündspule	Bobine d'allumage
835	E	Tändstift	Ignition plug	Zündkerze	Bougie
840	S	Strömfördelare	Distributor	Stromverteiler	Distributeur
850	H	Signalhorn	Horn	Signalhorn	Avertisseur sonore
853	H	Summer	Buzzer	Summer	Signal sonore
888	E	Lufttork, kompressor	Air Dryer, Compressor	Luft trocken, Kompressoren	
900	A	Radio/bandspelare	Radio/tape recorder	Radio/Kassettengerät	Radio/lecteur
901	U	Spänningsomvandlare	Voltage converter	Spannungsumwandler	Convertisseur de tension
902	B	Högtalare	Loud speaker	Lautsprecher	Haut-parleur
903	W	Antenn radio	Aerial, radio	Antenne, Radio	Antenne radio
905	A	Kommunikationsradio	Communication radio	CB-Funk	Radiotéléphone
906	W	Antenn kommunikationsradio	Aerial, communication radio	Antenne, CB-Funk	Antenne radiotéléphone
907	A	Monitor	Monitor		

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
908	A	Kamera	Camera		
909	A	Skrivare	Printer		
910	U	Spänningsomvandlare 80V/24V	Voltage converter 80 V / 24 V	Spannungsumwandler 80 V/24 V	Convertisseur de tension 80 V/24 V
911	A	Dataterminal	Dataterminal		
940	A	Logik batterivakt	Logic switch , battery watch	Logik Batteriewächter	Circuit logique de surveillance batterie
950	A	Logik transistortändning	Logic transistor ignition	Logik Transistorzündung	Circuit logique allumage transistorisé
955	A	Logik övervarningskydd (LPG)	Logic overspeed protection (LPG)	logik Överdreningsschutz (LPG)	Circuit logique protection de surrégime (GPL)
960	A	Logik rev-spärr/aut-vxl	Logic unit, reversing interlock/automatic gear changing	Logikeinheit Umkehrsperr/automatische Schaltung	Unité logique blocage de marche arrière/ changement automatique
961	A	Motor/kupevärmare	Engine- and cab heater	Motor- und Kabinenheizung	Chauffeur moteur et habitacle
962	E	Logik slitageind kol elmotor	Logic indication of wear, brush electrical motor	Logik Verschleißanzeige Kohle, Elektromotor	Circuit logique indicateur d'usure des balais, moteur électrique
965	H	Backvarnare	Reversing alarm	Rückfahrwarner	Avertisseur de recul
1001	S	Strömställare, TW	Switch, TW	Schalter, TW	Interrupteur, TW
1002	S	Strömställare, lossa TW	Switch, unlocking of TW	Schalter, Lösen der TW	Interrupteur, deverrouillage TW
1003	S	Strömställare, låsa TW	Switch, locking of TW	Schalter, Verriegelung der TW	Interrupteur, verrouillage TW
1004	S	Strömställare, stopp vid 30' -35'	Switch, stop at 30 -35s	Schalter, Stopp bei 30-35s	Interrupteur, arrêt à 30-35s
1005	S	Strömställare, förbikoppling av säkerhetssystem	Switch, overriding of the safety system	Schalter, överbrückung des sicherheitssystem	Interrupteur, Dérivation du système de sécurité
1006	S	Strömställare, fällning främre ben	Switch, front legs down	Schalter, vorderes Bein ab	Interrupteur, béquille avant baisse
1007	S	Strömställare, fällning bakre ben	Switch, rear legs down	Schalter, hinteres Bein ab	Interrupteur, béquille arrière baisse
1008	S	Strömställare, klämma/lossa ben	Switch, clamping/-releasing legs	Schalter, Klemmen/Lösen der Beine	Interrupteur, serrage/-deserrage béquilles
1009	S	Strömställare, Motor information	Switch, Engine information	Schalter, Motor information	Interrupteur, information moteur
1010	S	Strömställare, tilt av hytt	Switch, tilt of cab	Schalter, Kabinenneigung	Interrupteur, arrêt inclinaison de la cabine
1011	S	Strömställare IR ljus	Switch IR light	Schalter, IR Licht	Interrupteur, lampe IR
1012	S	Strömställare aut. utskjut 20s-40s	Switch, Aut. Extension 20s-40s	Schalter, automatiska Teleskopiere 20s-40s	Interrupteur, extension automatique 20s40s
1013	S	Strömställare stödben	Switch, Support jacks	Schalter, Stuetzbein	Interrupteur, bequilles
1014	S	Strömställare förbikoppling rotationstopp	Switch, over ride rotation stop	Schalter, överbrückung Rotation stopp	Interrupteur pour shunt sstop rotation s

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
1015	S	Strömställare förbikoppling höjdbeg/tp-beg	Switch, over ride height limit/tp-limit	Schalter, überbrückung Höhenbegrenzung/ LSP- Begrenzung	Interrupteur shunt pour hauteur et CDG maxi
1016					
1017	S	Strömställare diagnostik öka/minska	Switch, diagnostics increase/decrease		
1018	S	Strömställare diagnostik on/off	Switch, diagnostics on/off		
1019	S	Strömställare rastvärme	Switch, paus heat		
1020	S	Strömställare automatisk släpp/kiäm funktion	Switch automatic release/clamp funktion		
1021	S	Strömställare sax	Switch extender		
1022	S	Strömställare vertikållning	Switch, vertical position		
1023	S	Strömställare låsning övre arm	Switch, lock upper arm		
1024	S	Strömställare Korta Armen av/på	Switch, Short Arm on/off		
1025	S	Strömställare pappersfunktioner av/på	Switch, paper functions on/off		
1026	S	Strömställare omkoppling pappers/kiämregat	Switch, switch papper/bale clamp		
1027	S	Strömställare lyfthöjdsförval	Switch, lift height selection		
1028	S	Strömställare lyfthöjdsförval öka	Switch, lift height selection increase		
1029	S	Strömställare lyfthöjdsförval minska	Switch, lift height selection decrease		
1030	S	Strömställare läraringång givare ultraljud	Switch, teaching ultrasonic sensor		
1031	S	Strömställare, Over Height Upp/Ned	Switch, Over Height Up/Down		
1032	S	Brytare backljus	Switch reverse light.		
1033	S	Flytta korta armen	Move short arm		
1034	S	Strömställare förbikoppling startspärr	Switch Override Start interlock		
1035	S	Strömställare Val av kiämtryck	Switch, Clamp pressure selection		
1036	S	Strömställare Korta Armen av/på	Switch , Short Arm on/off		
1037	S	Strömställare Arm kontroll	Switch , Arm Control		

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
2000	D	Elektronisk kontrollenhet, proportionalventil	Electronic control unit, proportional valve		
3001	K	Relä rotation	Relay, rotation	Relais, rotation	Relais, rotation
3002	K	Relä tilt	Relay, tilt	Relais, neigung	Relais, inclinaison
3003	K	Relä sidoföring	Relay, side shifting	Relais, seitenverstellung	Relais, translation laterale
3004	K	Relä längdinställning	Relay, length adjustment	Relais, längeneinstellung	Relais, dispersion
3005	K	Relä twist lock	Relay, twist lock	Relais, twist lock	Relais, twist lock
3006	K	Relä spridning	Relay, spreading	Relais, verstellung	Relais, dispersion
3007	K	Relä lyft/sänk	Relay, lifting/lowering	Relais, heben/senken	Relais, élévation/descente
3008	K	Relä hydraulfunktion extra	Relay, extra hydraulic function	Relais, extra hydraulisch funktion	Relais,
3009	K	Relä nödstopp	Relay, emergency stop	Relais, Nothalt	Relais, arrêt d'urgence
3010	K	Relä bromsijus vxl std/blackout	Relay, brake light shift std/blackout	Relais, Bremslicht, Schaltung std/Ausfall	Relais, normal/blackout pour les feux de stop
3011	K	Relä backljus vxl std/blackout	Relay, reversing light shift std/blackout	Relais, Rueckfahrleuchte, Schaltung std/Ausfall	Relais, normal/blackout pour les feux de recul
3012	K	Relä arb.bel hytt vxl std/blackout	Relay, working light cab, shift std/blackout	Relais, Arbeitsbeleuchtung, schaltung std/Ausfall	Relais, normal/blackout pour l'éclairage de la cabine
3013	K	Relä arb.bel. bom 20' vxl std/blackout	Relay, working light boom20' shift std/b.out	Relais, Arbeitsbeleuchtung, Ausleger 20', Schaltung std/ Ausfall	Relais, normal/blackout pour les feux de travail sur la poutre pour les 20'
3014	K	Relä arb.bel. bom 40' vxl std/blackout	Relay, working light boom40' shift std/b.out	Relais, Arbeitsbeleuchtung, Ausleger 40', Schaltung std/Ausfall	Relais, normal/blackout pour les feux de travail sur la poutre pour les 40'
3015	K	Relä vxl bromsijus/blinkers vä	Relay, shift brake light/direction indicator left	Relais, Bremslicht/ Blinker links	Relais, feux de stop clignotant gauche
3015	K	Relä vxl bromsijus/blinkers hö	Relay, shift brake light/direction indicator right	Relais, Bremslicht/ Blinker rechts	Relais, feux de stop clignotant droit
3016	K	Relä signalhorn	Relay, horn	Relais, Hube	Relais, avertisseur
3017	K	Relä containerbelysning	Relay, Container light	Relais, Container Beleuchtung	Relais, eclairge des conteneurs
3018	K	Relä containerbelysning IR	Relay, Container light IR	Relais, Container Beleuchtung IR	Relais, eclairge des conteneurs infra rouge
3305	K	Relä VBFS, backljus	Relay, rotating driver's seat, reversing light	Relais, drehbarer Fahrersitz, Rückfahrcheinwerfer	Relais, siège pivotant, feux de recul
3306	K	Relä VBFS, helijus	Relay, rotating driver's seat, main beam	Relais, drehbarer Fahrersitz, Fernlicht	Relais, siège pivotant, feux de route

Komponentförteckning / List of Components / Komponentenverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
3307	K	Relä VBFS, halvljus	Relay, rotating driver's seat, dipped beam	Relais, drehbarer Fahrersitz, Abblendlicht	Relais, siège pivotant, feux de croisement
3308	K	Relä VBFS, bromsljus	Relay, rotating driver's seat, brake light	Relais, drehbarer Fahrersitz, Bremslicht	Relais, siège pivotant, feux stop
3310	K	Relä VBFS, körvisare vä	Relay, rotating driver's seat, direction indicator left	Relais, drehbarer Fahrersitz, Fahrtrichtungsanzeiger, L	Relais, siège pivotant, clignotant supplémentaire, ga.
3311	K	Relä VBFS, körvisare hö	Relay, rotating driver's seat, direction indicator right	Relais, drehbarer Fahrersitz, Fahrtrichtungsanzeiger, R	Relais, siège pivotant, clignotant supplémentaire, dr.
3330	K	Relä, säkerhetsbälte	Relay, seat belt	Relais, säkerhetsgurt	Relais, ceinture de sécurité
3331	K	Relä VBFS, drivning fram	Relay, rotating driver's seat, forward driving	Relais, drehbarer Fahrersitz, Antrieb vorn (LPG, Diesel)	Relais, siège pivotant, marche avant
3332	K	Relä VBFS, drivning bak	Relay, rotating driver's seat, reversing driving	Relais, drehbarer Fahrersitz, Antrieb hinten (LPG, Diesel)	Relais, siège pivotant, marche arrière
3349	K	Relä VBFS, fartreglage	Relay, rotating driver's seat, speed control	Relais, drehbarer Fahrersitz, Geschwindigkeitsregelung	Relais, siège pivotant, commande de vitesse
3404	K	Relä VBFS, mastljus	Relay, rotating driver's seat, mast light	Relais, drehbarer Fahrersitz, Ladescheinwerfer	Relais, siège pivotant, feux de travail
3412	K	Relä bak ljus	Relay, rotating driver's seat, rear light	Relais, drehbarer Fahrersitz, Rücklicht	Relais, siège pivotant, feu arrière
3768	K	Relä oljetryck hydraulik	Relay, hydraulic pressure	Relais, Öldruck, Hydraulik	Relais, pression d'huile hydraulique
3769	K	Relä, blockering av hytttilt	Relay, blocking of cab tilt	Relais, Kabinenneigung stop	Relais, blocage inclinaison de la cabine
3770	K	Relä anliggning	Relay, alignment		
3771	K	Relä Krok	Relay, Hook		
3772	K	Relä laddsignal (D+)	Relay, charge signal (D+)		
3773	K	Relä 12V för minne radio	Relay 12V for radio memory		
3774		Relä kylfläkt olja	Relay, cooling fan oil		
3775					
5000	H	Kont lampa tryck lyfttång	Indicating lamp, pressure lift tong		
5001	H	Varn lampa, Over Height ben uppe	Warn. Lamp. Over Height leg upper pos		
6001	Y	M-ventil blockering höger	Solenoid valve, blocking right	Magnetventil, Blockierung rechts	Electrovanne, blocage droit
6002	Y	M-ventil blockering vänster	Solenoid valve, blocking left	Magnetventil, Blockierung links	Electrovanne, blocage gauche
6003	Y	M-ventil inkoppling av hydraulik till topplyft	Solenoid valve, activation of toplift hydraulics	Magnetventil, Aktivierung von Oberhubhydraulik	Electrovanne, alimentation hydraulique du levage supérieur

Komponentförteckning / List of Components / Komponentenverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
6004	Y	M-ventil sänkt	Solenoid valve, lower	Magnetventil, Senken	Electrovanne, descente
6005	Y	M-ventil lyft	Solenoid valve, lift	Magnetventil, Heben	Electrovanne, levage
6006	Y	M-ventil bom ut	Solenoid valve, boom out	Magnetventil, Ausleger aus	Electrovanne, flèche sortie
6007	Y	M-ventil bom in	Solenoid valve, boom in	Magnetventil, Ausleger ein	Electrovanne, flèche rentrée
6008	Y	M-ventil vridning medsols	Solenoid valve, rotation clockwise	Magnetventil, Rotation im Uhrzeigersinn	Electrovanne, rotation horaire
6009	Y	M-ventil vridning motsols	Solenoid valve, rotation counter-clockwise	Magnetventil, Rotation entgegengesetzten Uhrzeigersinn	Electrovanne, rotation anti-horaire
6010	Y	M-ventil tilt ut	Solenoid valve, tilt out	Magnetventil, Neigung aus	Electrovanne, inclinaison sortie
6011	Y	M-ventil tilt in	Solenoid valve, tilt in	Magnetventil, Neigung ein	Electrovanne, inclinaison rentrée
6012	Y	M-ventil tilt	Solenoid valve, tilt	Magnetventil, Neigung	Electrovanne, inclinaison
6013	Y	M-ventil fällning främre ben	Solenoid valve, lowering front legs	Magnetventil, vorderes Bein ab	Electrovanne, béquille avant baisse
6014	Y	M-ventil fällning bakre ben	Solenoid valve, lowering rear legs	Magnetventil, hinteres Bein ab	Electrovanne, béquille arrière baisse
6015	Y	M-ventil klämma/lossa ben	Solenoid valve, clamping/releasing legs	Magnetventil, Klemmen/-Lösen der Beine	Electrovanne, serrage/deserrage béquilles
6016	Y	M-ventil Hyttskjutning fram	Solenoid valve, cab movement forward	Elektro-Magnetventil, Kabinenversetzung vorwärts	Electrovanne, mouvement avant de la cabine
6017	Y	M-ventil Hyttskjutning bak	Solenoid valve, cab movement reverse	Elektro-Magnetventil, Kabinenversetzung hinten	Electrovanne, mouvement arrière de la cabine
6018	Y	M-ventil spridning ut	Solenoid valve, spreading out	Elektro-Magnetventil, verstellung auswärts	Electrovanne, dispersion en dehors
6019	Y	M-ventil spridning in	Solenoid valve, spreading in	Elektro-Magnetventil, verstellung einwärts	Electrovanne, dispersion en dedans
6020	Y	M-ventil sidoföring vänster	Solenoid valve, side shift left	Elektro-Magnetventil schiebeträger links	Electrovanne, translation laterale à gauche
6021	Y	M-ventil sidoföring höger	Solenoid valve, side shift right	Elektro-Magnetventil schiebeträger rechts	Electrovanne, translation laterale à droite
6022	Y	M-ventil extra hydraulfunktion ut	Solenoid valve, extra hydraulic function out	Elektro-Magnetventil extra auswärts	Electrovanne, supplémentaire en dehors
6023	Y	M-ventil extra hydraulfunktion in	Solenoid valve, extra hydraulic function in	Elektro-Magnetventil extra einwärts	Electrovanne, supplémentaire en dedans
6024	Y	M-ventil stativ ut	Solenoid valve, mast out	Elektro-Magnetventil hubgerüst aus	Electrovanne mat de lev. ret.
6025	Y	M-ventil stativ in	Solenoid valve, mast in	Elektro-Magnetventil hubgerüst ein	Electrovanne mat de lev. ext.

Komponentförteckning / List of Components / Komponentenverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
6026	Y	M-ventil höger framhjul styrning vänster	Solenoid valve, right front wheel, steering left	Magnetventil, Vorderrad rechts, Lenkung links	Electrovanne, roue avant droite/ direction gauche
6027	Y	M-ventil höger framhjul styrning höger	Solenoid valve, right front wheel, steering right	Magnetventil, Vorderrad rechts, Lenkung rechts	Electrovanne, roue avant droite/ direction droite
6028	Y	M-ventil vänster framhjul styrning vänster	Solenoid valve, left front wheel, steering left	Magnetventil, Vorderrad links, Lenkung links	Electrovanne, roue avant gauche/direction gauche
6029	Y	M-ventil vänster framhjul styrning höger	Solenoid valve, left front wheel, steering right	Magnetventil, Vorderrad links, Lenkung rechts	Electrovanne, roue avant gauche/direction droite
6030	Y	M-ventil höger bakhjul styrning vänster	Solenoid valve, right rear wheel, steering left	Magnetventil, Hinterrad rechts, Lenkung links	Electrovanne, roue arrière droite/ direction gauche
6031	Y	M-ventil höger bakhjul styrning höger	Solenoid valve, right rear wheel, steering right	Magnetventil, Hinterrad rechts, Lenkung rechts	Electrovanne, roue arrière droite/ direction droite
6032	Y	M-ventil vänster bakhjul styrning vänster	Solenoid valve, left rear wheel, steering left	Magnetventil, Hinterrad links, Lenkung rechts	Electrovanne, roue arrière gauche/ direction gauche
6033	Y	M-ventil vänster bakhjul styrning höger	Solenoid valve, left rear wheel, steering right	Magnetventil, Hinterrad links, Lenkung rechts	Electrovanne, roue arrière gauche/ direction droite
6034	Y	M-ventil skevning	Solenoid valve, levelling	Magnetventil, Niveausgleich	Electrovanne, levage
6035	Y	M-ventil skevning höger	Solenoid valve, levelling right	Magnetventil, Niveausgleich rechts	Electrovanne, levage droit
6036	Y	M-ventil skevning vänster	Solenoid valve, levelling left	Magnetventil, Niveausgleich links	Electrovanne, levage gauche
6037	Y	M-ventil kylfläkt	Solenoid valve, Cooling fan	Magnetventil, Gebläse	Electrovanne, ventilateur de refroidissement
6038	Y	M-ventil frikoppling koppling	Solenoid valve, lockup clutch	Magnetventil, Auskuppeln	Electrovanne, embrayage à point mort
6039	Y	M-ventil öppna twistlock	Solenoid valve, unlocked twist lock	Magnetventil, Twistlock öppna	Electrovanne, verrous non verrouillés
6040	Y	M-ventil låsa twistlock	Solenoid valve, locked twist lock	Magnetventil, Twistlock schliessen	Electrovanne, verrous verrouillés
6041	Y	M-ventil nöd, twistlock	Solenoid valve, emergency, twistlock	Magnetventil, Twistlock ueberbrueck	Electrovanne, ungence verrous
6042	Y	M-ventil mellan bom	Solenoid valve, middle boom	Magnetventil, Mast mittlerer	Electrovanne, milieu de la poutre télescopique
6043	Y	Magnetventil, fällning torn (RTCH)	Solenoid valve, boom lowering (RTCH)	Magnetventil, Ausleger senken (RTCH)	Electrovanne, abaissement du support AR de la poutre télescopique (RTCH)
6044	Y	M-ventil blockering twistlock	Solenoid valve, blocking twistlock	Magnetventil, Twistlock ueberbruecken	Electrovanne, blocage des twistlocks
6045	Y	M-ventil blockering lyft	Solenoid valve, blocking lift	Magnetventil, Heben ueberbruecken	Electrovanne, blocage de la levée

Komponentförteckning / List of Components / Komponentenverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
6046	Y	M-ventil utskjut	Solenoid valve, projecting	Magnetventil, Längengeber	Electrovanne, pour réglage du déploiement
6047	Y	M-ventil, hyttitilt upp	Solenoid valve, cab tilt up	Magnetventil, Kabinenneigung oben	Electrovanne, inclinaison cab position haute
6048	Y	M-ventil, hyttitilt ner	Solenoid valve, cab tilt down	Magnetventil, Kabinenneigung unten	Electrovanne, inclinaison cab position basse
6049	Y	M-ventil, kylkrets broms	Solenoid valve, cooling circuit brake	Magnetventil, Kühlkreislauf Bremse	Electrovanne, refroidissement des freins
6050	Y	M-ventil blockering utskjut	Solenoid valve, blocking projecting	Magnetventil, Blockierung teleskopieren	Electrovanne pour blocage extension
6051	Y	M-ventil, regenerering höger	Solenoid valve, regeneration right	Magnetventil, regeneration rechts	Electrovanne regeneration droite
6052	Y	M-ventil, regenerering vänster	Solenoid valve, regeneration left	Magnetventil, regeneration links	Electrovanne, regeneration gauche
6053	Y	M-ventil, köräge	Solenoid valve, driving position	Magnetventil, Fahrposition	Electrovanne, en position de conduite
6054	Y	M-ventil, klämma ihop	Solenoid valve, clamping in	Magnetventil, zuklammern	Electrovanne, serrage
6055	Y	M-ventil, klämma isär	Solenoid valve, clamping out	Magnetventil, aufklammern	Electrovanne, déserrage
6056	Y	M-ventil, främre knä ut	Solenoid valve, front knee out	Magnetventil, vorderes Knie ausklappen	Electrovanne, sortie d'articulation avant
6057	Y	M-ventil, främre knä in	Solenoid valve, front knee in	Magnetventil, vorderes Knie einklappen	Electrovanne, rentrée d'articulation avant
6058	Y	M-ventil, bakre knä ut	Solenoid valve, rear knee out	Magnetventil, hinteres Knie ausklappen	Electrovanne, sortie d'articulation arrière
6059	Y	M-ventil, bakre knä in	Solenoid valve, rear knee in	Magnetventil, hinteres Knie einklappen	Electrovanne, rentrée d'articulation arrière
6060	Y	M-ventil, främre ben upp	Solenoid valve, front legs up	Magnetventil, vorderes Bein hoch	Electrovanne, position haute jambes avants
6061	Y	M-ventil, bakre ben upp	Solenoid valve, rear legs up	Magnetventil, hinteres Bein hoch	Electrovanne, position haute jambes arrières
6062	Y	M-ventil, urkoppling hydraulpump	Solenoid valve interruption hydraulic pump	Magnetventil, auskuppeln Pumpe	Electrovanne, coupure de pompe
6063	Y	M-ventil, stödben upp	Solenoid valve, brace up	Magnetventil, Stützbein oben	Electrovanne béquille levée
6064	Y	M-ventil, stödben ner	Solenoid valve, brace down	Magnetventil, Stützbein unten	Electrovanne béquille baissée
6065	Y	M-ventil, frikoppling vridbroms	Solenoid valve, lockup rotation brake		
6066	Y	M-ventil, v-låda, drivning	Solenoid valve, gearbox, drive		

Komponentförteckning / List of Components / Komponentverzeichnis / Liste de composants

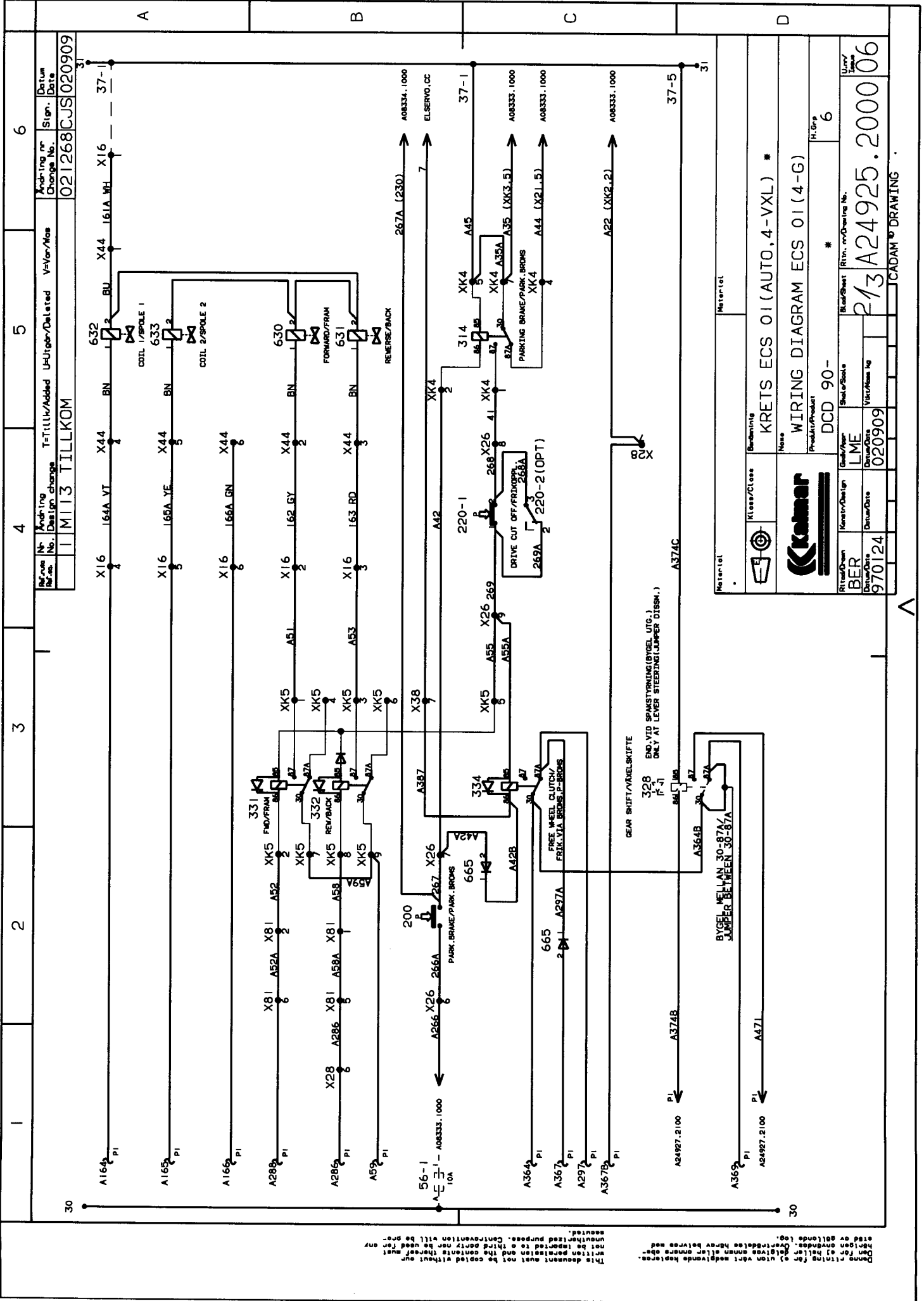
No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
6067	Y	M-ventil, v-låda, oljetryck till 1:a/3:e växeln	Solenoid valve, gearbox, oilpressure to 1st/3rd gear		
6068	Y	M-ventil sax/rotation	Solenoid valve extermder/rotation		
6069	Y	M-ventil, v-låda, oljetryck till 2:a/4:e växeln	Solenoid valve, gearbox, oilpressure to 2nd/4th gear		
6070	Y	M-ventil Over Height upp	Solenoid valve, Over Height up		
6071	Y	M-ventil Over Height ner	Solenoid valve, Over Height down		
6072	Y	M-ventil klämtryck	Solenoid valve clamp pressure		
6073	Y	Proportional ventil, Opti speed	Proportional valve, Opti speed		
6074	Y	M-ventil, v-låda, växelväljare för 2:a/4:e växeln	Solenoid valve, gearbox, gearswitch for 2nd/4th gear		
6075	Y	M-ventil, v-låda, växelväljare för 1:a/3:e växeln	Solenoid valve, gearbox, gearswitch for 1st/3rd gear		
6076	Y	M-ventil blockering sänk	Solenoid valve, blocking lower		
6077	Y	M-ventil Inching	Solenoid valve, Inching	Magnetventil, Inching	Electrovanne, Inching
6078	Y	M-ventil, Avstängning Övre klämarm	Solenoid valve, upper arm off	Magnetventil	Electrovanne
7200	S	Givare, axeltryck höger	Sensor, axle pressure right	Drucksensor, Achsdruck rechts	Capteur de pression, arbre du vérin du levage droit
7201	S	Givare, axeltryck vänster	Sensor, axle pressure left	Drucksensor, Achsdruck links	Capteur de pression, arbre du vérin du levage gauche
7202	S	Givare, anliggning vänster fram	Sensor, alignment left front	Geber, Auflage links vorne	Capteur de pression, alignement avant gauche
7202	S	Givare, anliggning höger fram	Sensor, alignment right front	Geber, Auflage rechts vorne	Capteur de pression, alignement avant droit
7203	S	Givare, anliggning vänster bak	Sensor, alignment left rear	Geber, Auflage links hinten	Capteur de pression, alignement arrière gauche
7203	S	Givare, anliggning höger bak	Sensor, alignment right rear	Geber, Auflage rechts hinten	Capteur de pression, alignement arrière droit
7204	S	Givare, öppen vänster twistlock	Sensor, unlocked twistlock left	Geber, Twistlock links offen	Capteur de position, verrous non verrouillés gauche

Komponentförteckning / List of Components / Komponentenverzeichnis / Liste de composants

No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
7204	S	Givare, öppen höger twistlock	Sensor, unlocked twistlock right	Geber, Twistlock rechts offen	Capteur de position, verrous non verrouillés droit
7205	S	Givare, låst vänster twistlock	Sensor, locked twistlock left	Geber, Twistlock links geschlossen	Capteur de position, verrous verrouillés gauche
7205	S	Givare, låst höger twistlock	Sensor, locked twistlock right	Geber, Twistlock rechts geschlossen	Capteur de position, verrous verrouillés droit
7206	S	Givare, gaffel aggregat	Sensor, fork attachment	Geber, Gabel Aggregat	Capteur de position, accessoire fourches
7207	S	Givare, 2WD/4WD	Sensor, 2WD/4WD	Geber, 2WD/4WD	Capteur de position, 2 ou 4 roues motrices
7208	S	Givare, hytt i köräge	Sensor, Cab in drive position	Geber, kabinverstellung	Capteur, Cabine eu position de conduite
7209	S	Givare, oljefilter indikering	Sensor, Oil filter indication	Geber, Ölfilter indication	Capteur, indication filtre à huile
7210	S	Givare, hytt i transportläge	Sensor, Cab in transportation position	Geber, Kabine im Position	Capteur, cabine en position de transport
7211	S	Givare, lyfthöjd	Sensor, lifting height	Geber, Hubhöhe	Capteur, hauteur de levée
7212	S	Givare, köräge	Sensor, driving position	Geber, Fahrposition	Capteur, position de conduite
7213	S	Givare, Anliggning främre ben	Sensor, Alignment front legs	Geber, Anliegen vordere Beine	Capteur, alignement jambes avants
7214	S	Givare, Anliggning bakre ben	Sensor, Alignment rear legs	Geber, Anliegen hinten Beine	Capteur, alignement jambes arrières
7215	S	Givare, kläm främre ben	Sensor, Clamp front legs	Geber, Anliegen Beine vorne	Capteur, position de verrouillage jambes avants
7216	S	Givare, kläm bakre ben	Sensor, Clamp rear legs	Geber, Anliegen Beine hinten	Capteur, position verrouillage jambes arrières
7217	S	Givare, främre knä	Sensor, front knee	Geber, vorderes Knie	Capteur, articulation avant
7218	S	Givare, bakre knä	Sensor, rear knee	Geber, hinteres Knie	Capteur articulation arriere
7219	S	Givare, främre ben	Sensor, front legs	Geber, vorderes Bein	Capteur jambes avants
7220	S	Givare, bakre ben	Sensor, rear legs	Geber, hinteres Bein	Capteur, jambes arrières
7221	S	Givare, styraxel	Sensor, steering axle	Geber, Lenkachse	Capteur, essieu directeur
7222	S	Givare, stödben uppe	Sensor, brace up	Geber, Stuetzbein oben	Capteur béquille levée
7223	S	Givare, stödben nere	Sensor, brace down	Geber, Stuetzbein unten	Capteur béquille baissée
7224	B	Givare, mätäge våg	Sensor, measurepoint scale		
7225	B	Givare, rotationsstopp	Sensor, rotation stop		
7226	B	Givare, tryck lyftcylinder	Sensor, pressure lift cylinder		
7227	B	Givare, tryck klämma	Sensor, pressure clamp		
7228	B	Givare, lyfthöjd analog	Sensor lift height analogue		
7229	B	Givare, tiltvinkel analog	Sensor tilt angle analogue		

Komponentförteckning / List of Components / Komponentenverzeichnis / Liste de composants

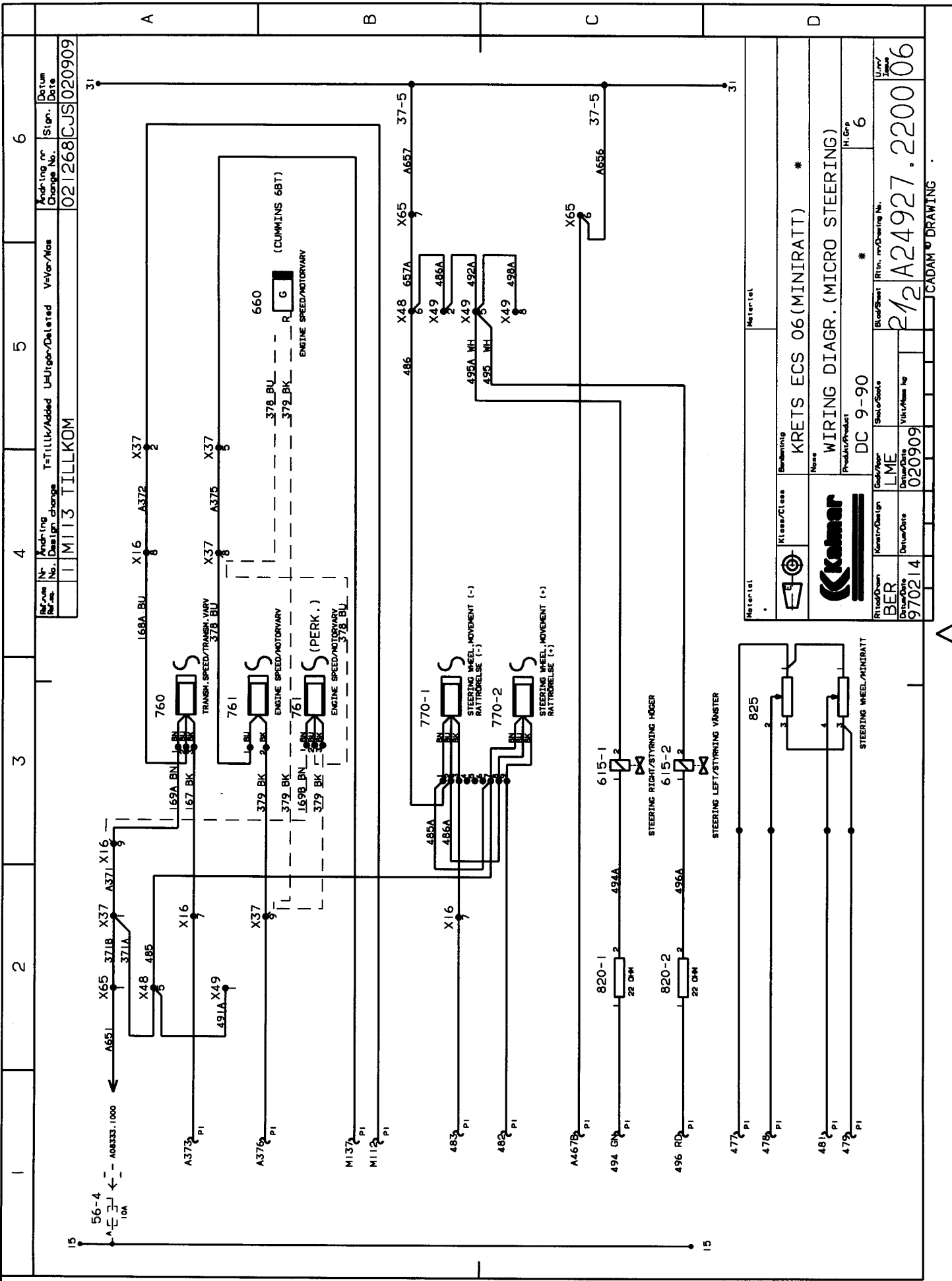
No.	CAT.	SVENSKA	ENGLISH	DEUTSCH	FRANCAISE
7230	B	Givare ultraljud last position	Sensor, ultrasonic load position		
7231	B	Givare, Over Height, Ben uppe	Sensor, Over Height, Leg upper position		
7232	B	Givare,IR Last position	Givare,IR Load position		
8071	R	Potentiometer lyft/sänk	Potentiometer lift/lower	Potentiometer heben/senken	Potentiomètre levage/descente
8072	R	Potentiometer tilt	Potentiometer tilt	Potentiometer neigen	Potentiomètre inclinaison
8073	R	Potentiometer sidoföring	Potentiometer side shifting	Potentiometer schiebeträger	Potentiomètre translation laterale
8074	R	Potentiometer spridning	Potentiometer spreading	Potentiometer verstellung	Potentiomètre dispersion
8075	R	Potentiometer extra	Potentiometer extra	Potentiometer extra	Potentiomètre supplémentaire
8076	R	Potentiometer mast in/ut	Potentiometer reach in/out	Potentiometer ein/aus-fahren	Potentiomètre, mat de lev ext-ret.
8077	R	Potentiometer höger framhjul	Potentiometer right front wheel	Potentiometer vorderrad rechts	Potentiomètre, roue avant droite
8078	R	Potentiometer vänster framhjul	Potentiometer left front wheel	Potentiometer vorderrad links	Potentiomètre, roue avant gauche
8079	R	Potentiometer höger bakhjul	Potentiometer right rear wheel	Potentiometer hinterrad rechts	Potentiomètre, roue arrière droite
8080	R	Potentiometer vänster bakhjul	Potentiometer left rear wheel	Potentiometer hinterrad links	Potentiomètre, roue arrière gauche
8081	R	Potentiometer tiltvinkel	Potentiometer tilt angle	Potentiometer nigungswinkel	Potentiomètre, inclinaison
8082	R	Potentiometer fläkthastighet, ECC	Potentiometer fan speed, ECC	Potentiometer Gebläseschwindigkeit, ECC	Potentiomètre, vitesse ventilateur,ECC
8083	R	Potentiometer temperatur, ECC	Potentiometer temperature, ECC	Potentiometer Temperatur, ECC	Potentiomètre, température,ECC
8084	R	Potentiometer spjäll, ECC	Potentiometer draught valve, ECC	Potentiometer Drossel, ECC	Potentiomètre pour valve de traction ECC
8085	R	Potentiometer rotation	Potentiometer rotation		
8086	R	Potentiometer sax	Potentiometer extender		
8087	R	Potentiometer klämma	Potentiometer clamp		
8088	R	Potentiometer skevning	Potentiometer levelling		
8089	R	Potentiometer krokålsning	Potentiometer flaps		
8090	V	Laser, pappersaggretgat	Lase, Pulp an Paper		
8091					
9000	M	Motor höj/sänkbar stolspelare	Motor rise/lower seat column		
9001	D	Åkerströms fjärrkontroll	Åkerströms Remote Control		
9002					



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Material		Krets ECS 01 (AUTO, 4-VXL) *	
Benämning		Krets ECS 01 (AUTO, 4-VXL) *	
Notes		WIRING DIAGRAM ECS 01 (4-G)	
Product/Product		DCD 90-	
Ritad/Drawn		BER	
Kontroll/Design		LME	
Skick/Issue		2/13	
Datum/Date		970124	
Druck/Print		020909	
Ritningsnummer/Sheet No.		2/13	
Ritningsdatum/Sheet Date		A24925.2000	
H. Grp		6	
Lagen/Version		06	

CADAM DRAWING



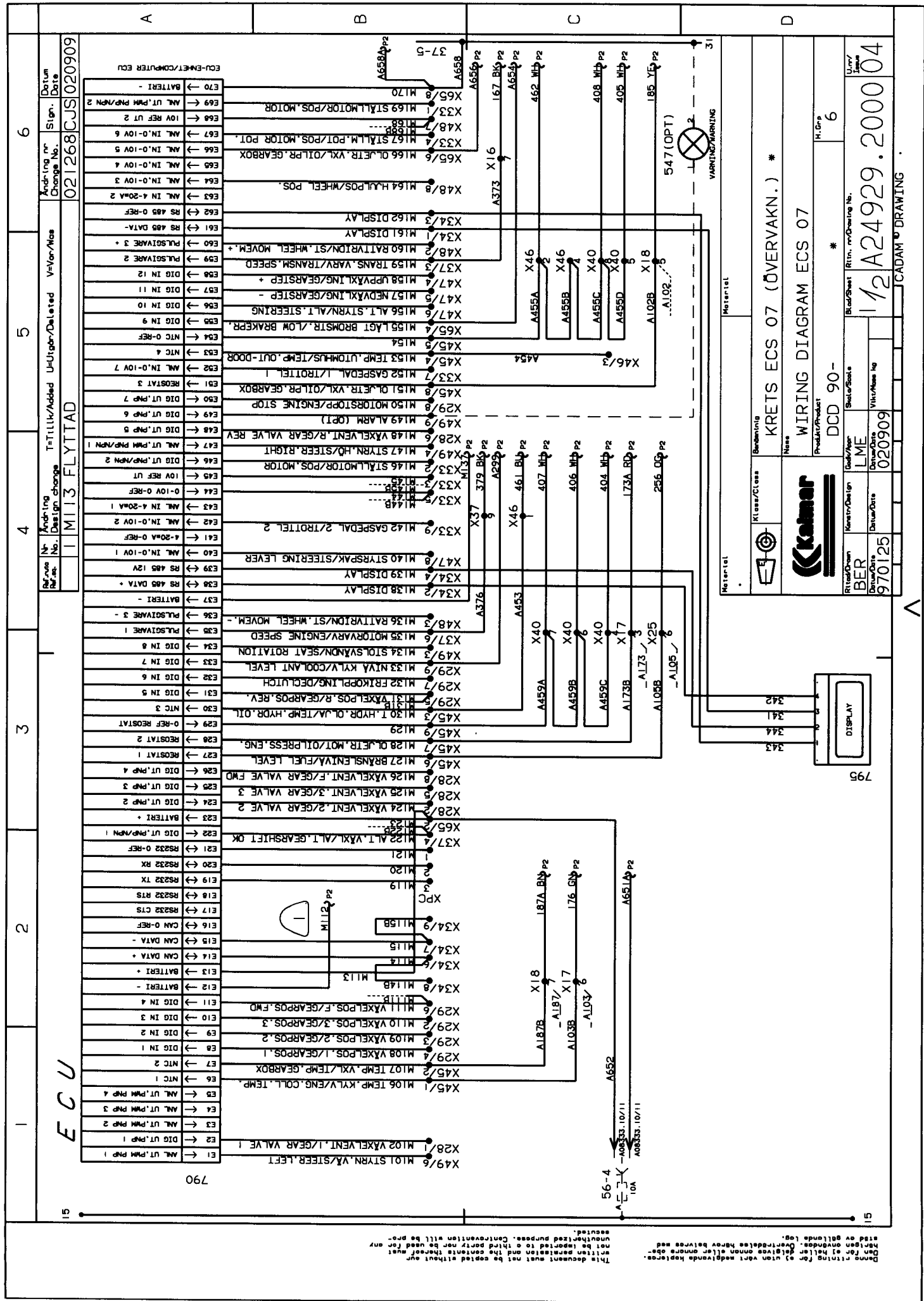
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Ref. No. / No. / Design change 1 / M113 TILLKOM		Adding / Deleted / Added / Deleted / Deleted / Deleted T= Tillik/Added U= Utgår/Deleted V= Var/Mas		Adding nr / Change No. 021268CJS	Sign. / Date 020909

Kabelex Krets/ECS DC 9-90	Benämning KRETS ECS 06 (MINIRATT)	Material
Ritad/Drawn BER	Skapad/Sheet LME	Ritad/Drawn No. 212 A24927.2200 06
Dimension 970214	Utgåva/Version 020909	H. Grp 6

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ECU

Ref. No.	Design change	T= Tillik/Added	U= Utgår/Deleted	V= Var/Misc	Andring nr. Change No.	Datum Date
1	M113 FLYTTAD				021268	CJS 020909
2						
3						
4						
5						
6						

Krets ECS 07 (ÖVERVAKN.)

WIRING DIAGRAM ECS 07

Kabelex

CCD 90-

BER

LME

970125

020909

795

DISPLAY

342

341

344

343

Upp/Rev: 6

Blad/Sheet: *

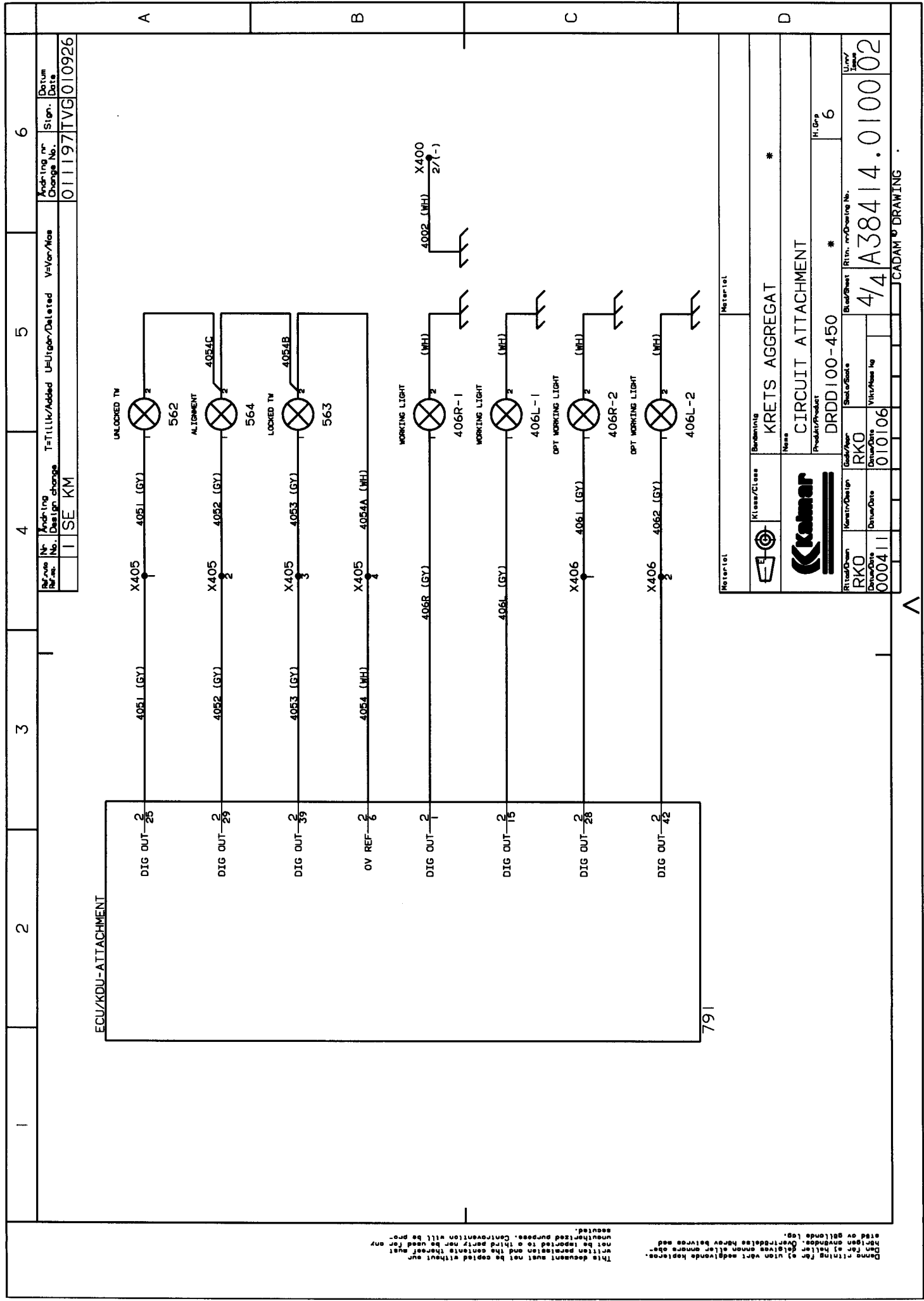
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A24929.2000 04

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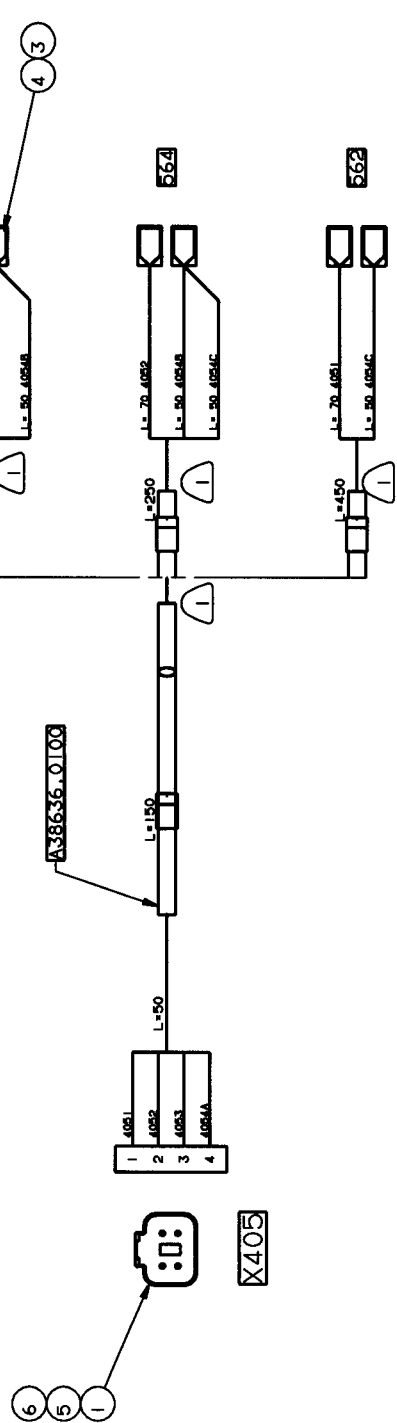
791

Material		Material	
Klass/Class	Bestemming	KRETS AGGREGAT *	
RKO		CIRCUIT ATTACHMENT	
DRDD100-450		DRDD100-450	
Kennr/Design	Bestnr/State	Ritm. nr/Ordering No.	H.Grp
RKO	RKO	4/4	6
Datum/Date	Datum/Date	A38414.0100	
000411	010106	02	

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ALLA INGÅENDE DETALJER SKALL UPPFYLLA FÖLJANDE TEMPERATURKRAV
 DRIFT -40 TILL +70 °C
 LAGRING -40 TILL +70 °C

ALL INCLUDING DETAILS SHALL FULFIL FOLLOWING TEMPERATURE REQUIREMENTS
 USAGE -40 TO +70 °C
 STORAGE -40 TO +70 °C

SAMTLIGA LEDNINGAR R2 1,5 GY DÄR EJ ANNAT ANGES
 ALL WIRES R2 1,5 GY WHERE NOTHING ELSE IS STATED
 KABLAGET TILLVERKAT ENLIGT
 CABLING MANUFACTURED ACCORDING TO
 KALMAR LMV K-STANDARD 20800.0001

XXX ALLA PLINT OCH KOMPONENTBETÄCKNINGAR SKALL MÄRKAS PÅ KABLAGET/ ALL PLINT AND COMPONENT NOTATION SHALL BE MARKED ON THE HARNESS

NR.	FÄRG	LÅNED	AREA	TYP	ZAMM.
4051	GY		1,5	R2	
4052	GY		1,5	R2	
4053	GY		1,5	R2	
4054	WH		1,5	R2	
4055	WH		1,5	R2	
4056	WH		1,5	R2	

KABELLAGE X405-TW.LAMPOR
 HARNESS X405-TW LAMPS
 DRDD 420-450

RKO 010115
 RKO 010115
 A38636.0100

CADAR DRAWING

Group 30

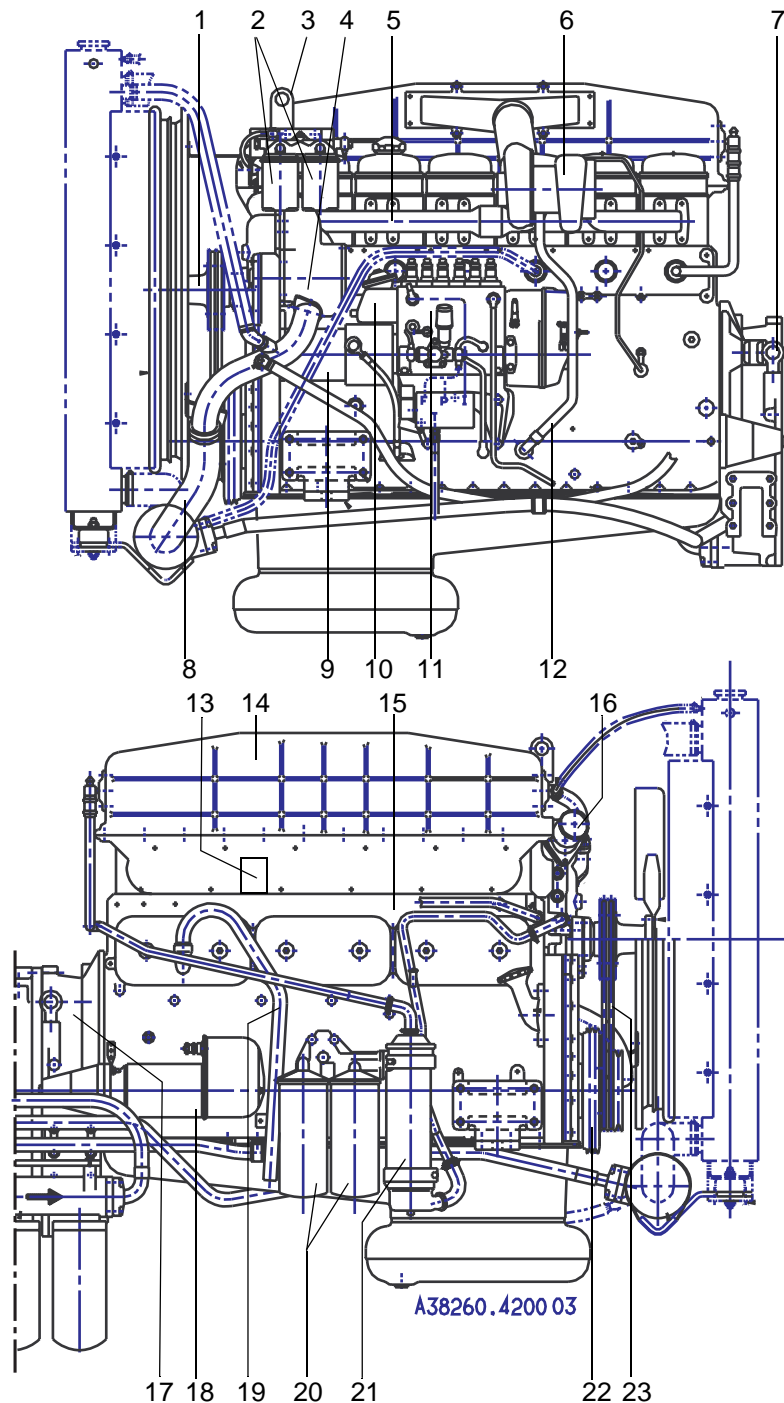
Engine

Specifications	2
Engine	3
Description	3
General.....	3
Cooling system.....	5
Fuel system	7
Lubrication system	10
Combusting air system.....	12
Service	14
Coolant quality.....	14
Lubrication oil quality.....	14
Draining the water from the fuel tank	14
Inspection of air cleaner and changing the filter element.....	14
Changing the oil and oil filter	15
Checking V-belt tension	15
Checking and adjusting the valve clearances	16
Changing the fuel filters.....	16
Preventive maintenance on turbo-charger	17
Maintenance of exhaust-gas cleaner	17

Manufacturer, type	Volvo, TWD1031VE	Volvo TWD1231VE
Coolant volume, litres	65	75
Rating ISO 3046 kW (hp) at r/min	235 (320) 2100	275 (374) 2100
Torque ISO 3046, Nm at r/min	1500 1100	1745 1100
Number of cylinders	6	6
Swept volume, litres	9,60	12
Valve clearance, cold engine inlet, mm exhaust, mm	0.40 0.70	0.40 0.70
Idling speed, r/min (Adjust so that the engine runs smoothly)	675±25	600±25
Injection pump timing	10°±0.5 BTDC	12°±0.5 BTDC
Thermostat starts to open at °C fully open at °C	82 95	82 95
Lubricating oil filter	Full-flow, disposable paper elements with by-pass valve	
Lubricating oil pressure, kPa running speed idling speed	300-500 60 min	350-500 150 min
Lubricating oil grade viscosity	See group 90	
Volume incl filters, litres	32	38

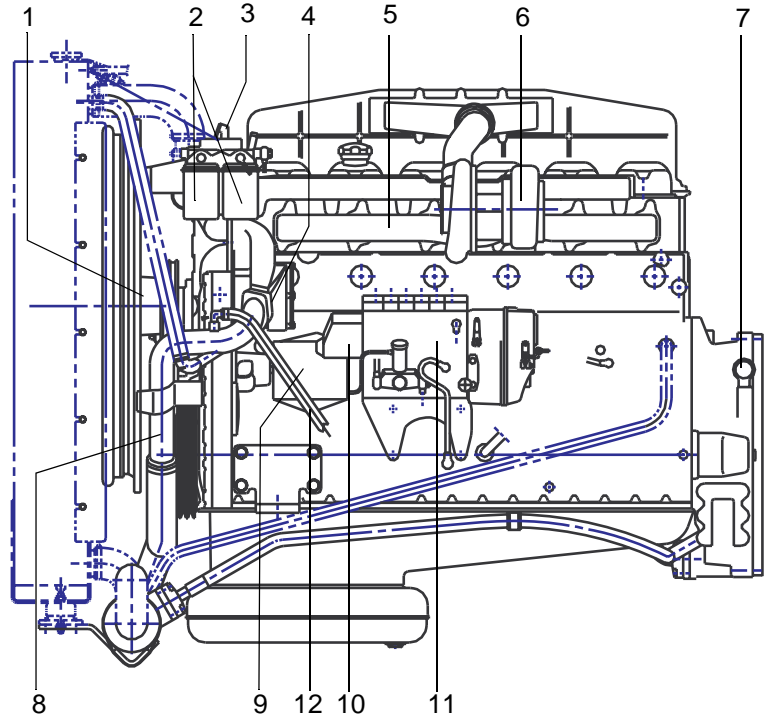
General

The engine TWD1031VE or TWD1231VE is a 6-cylinder, inline, 4-stroke diesel engine with overhead valves. The engine is turbo-charged, i.e. combustion air is supplied under pressure. As a result, the quantity of fuel injected can be increased, which increases the engine output. The turbocharger is driven by the exhaust gases and uses energy that would otherwise be lost.

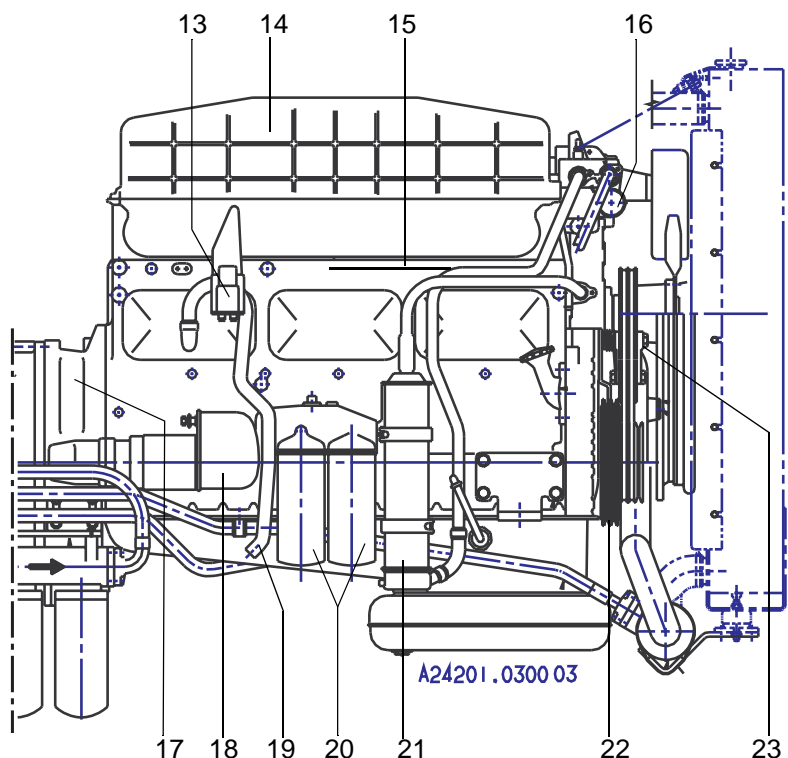


1. Fan hub
2. Twin fuel filters of throw-away type
3. Lift eyelet
4. Gear driven coolant pump
5. Air cooled exhaust manifold
6. Turbo-charger
7. Lift eyelet
8. Coolant pipe, inlet
9. Pump coupling guard
10. Smoke limiter
11. Injection pump
12. Fuel pipes for tank connection
13. Relay for inlet manifold heater
14. Intercooler
15. Cable iron
16. Coolant pipe, outlet
17. Flywheel housing, SAE 1
18. Starter motor
19. Crankcase ventilation
20. Full-flow oil filters of spin-on type
21. Oil cooler
22. Vibration damper
23. Automatic belt tensioner

The engine is pressure-lubricated and incorporates an oil pump which delivers oil to all lubrication points. A full-flow oil filter effectively cleans the lubricating oil. The fuel system is protected against impurities by replaceable filters. The engine has replaceable wet cylinder liners. The engine has separate, mutually interchangeable cylinder heads for each cylinder.



1. Fan hub
2. Twin fuel filters of throw-away type
3. Lift eyelet
4. Gear driven coolant pump
5. Air cooled exhaust manifold
6. Turbo-charger
7. Lift eyelet
8. Coolant pipe, inlet
9. Pump coupling guard
10. Smoke limiter
11. Injection pump
12. Fuel pipes for tank connection
13. Relay for inlet manifold heater
14. Intercooler
15. Cable iron
16. Coolant pipe, outlet
17. Flywheel housing, SAE 1
18. Starter motor
19. Crankcase ventilation
20. Full-flow oil filters of spin-on type
21. Oil cooler
22. Vibration damper
23. Automatic belt tensioner



The following description is valid for both TWD1031VE and TWD1231VE if not otherwise stated.

Cooling system

The engine is liquid-cooled and equipped with a closed cooling system consisting of the following main components:

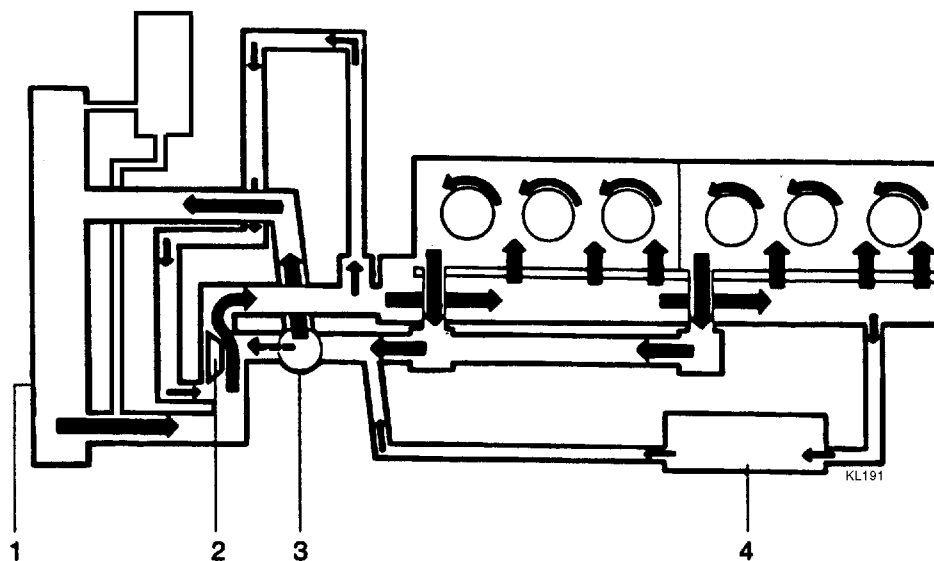
- Coolant pump
- Radiator
- Thermostat
- Radiator fan
- Coolant passages
- Engine oil cooler
- Gearbox oil cooler

The coolant flows through a longitudinal passage into the engine block. The opening into the cooling jacket of each cylinder is individually sized to ensure that each cylinder will be supplied with the same rate of coolant flow.

The coolant flows in the separate return lines converge into a common pipe in the thermostat housing. The coolant then flows to the coolant pump and then into the engine and to the oil cooler. When the engine has reached its normal operating temperature, the thermostat will open the circuit to the radiator.

The piston-type thermostat is capable of passing a high coolant flow rate at a minimum of pressure drop, thus contributing to favourable coolant circulation in the engine.

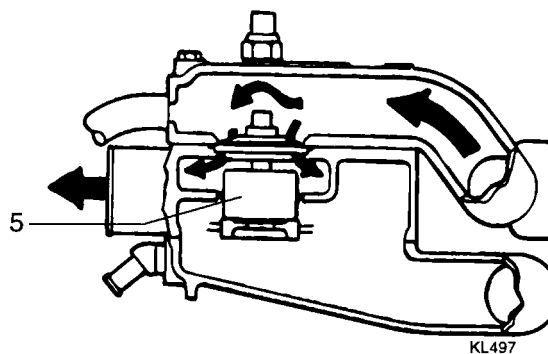
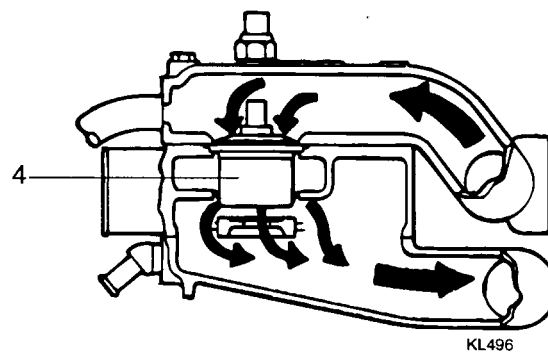
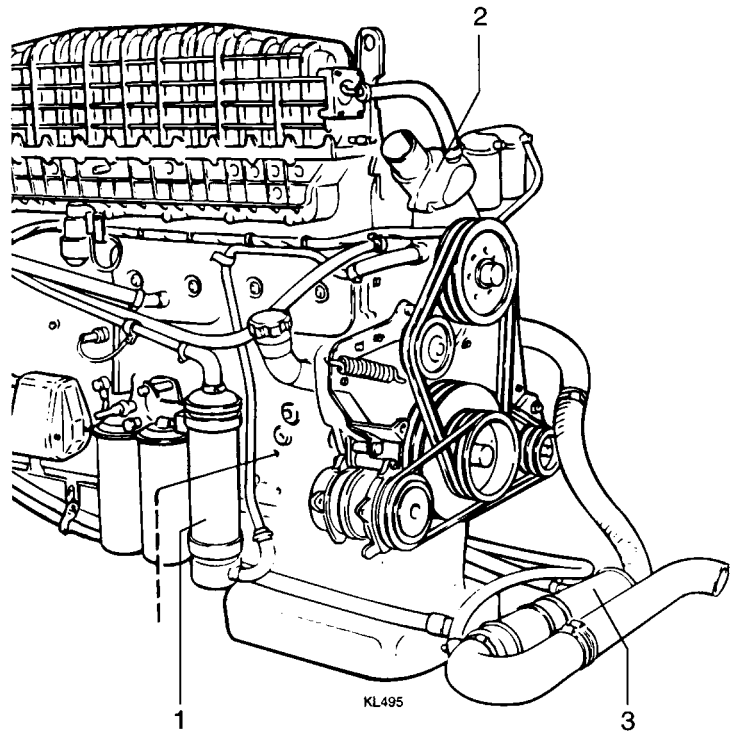
The coolant pump is gear-driven with high capacity .



1. Cooler
2. Coolant pump
3. Thermostat housing
4. Oil cooler

The cooling system is equipped with a sensor which activates the "Low coolant level" warning lamp on the instrument panel, see group 20.

The engine lubricating oil is cooled efficiently and reliably in a separately mounted tubular oil cooler. The gearbox oil is also cooled by the engine coolant, but in a separate shell-and-tube cooler.



1. Oil cooler, engine oil
2. Thermostat housing
3. Oil cooler, gearbox oil
4. Thermostat, closed
5. Thermostat, open

Fuel system

The fuel circulates in two circuits - the high-pressure circuit and the low-pressure circuit. When the engine is started, the feed pump draws fuel from the tank and delivers it at relatively low pressure through fine filters up to the injection pump. This then delivers fuel at high pressure to the injectors which supply the fuel in atomised form to the engine combustion chambers.

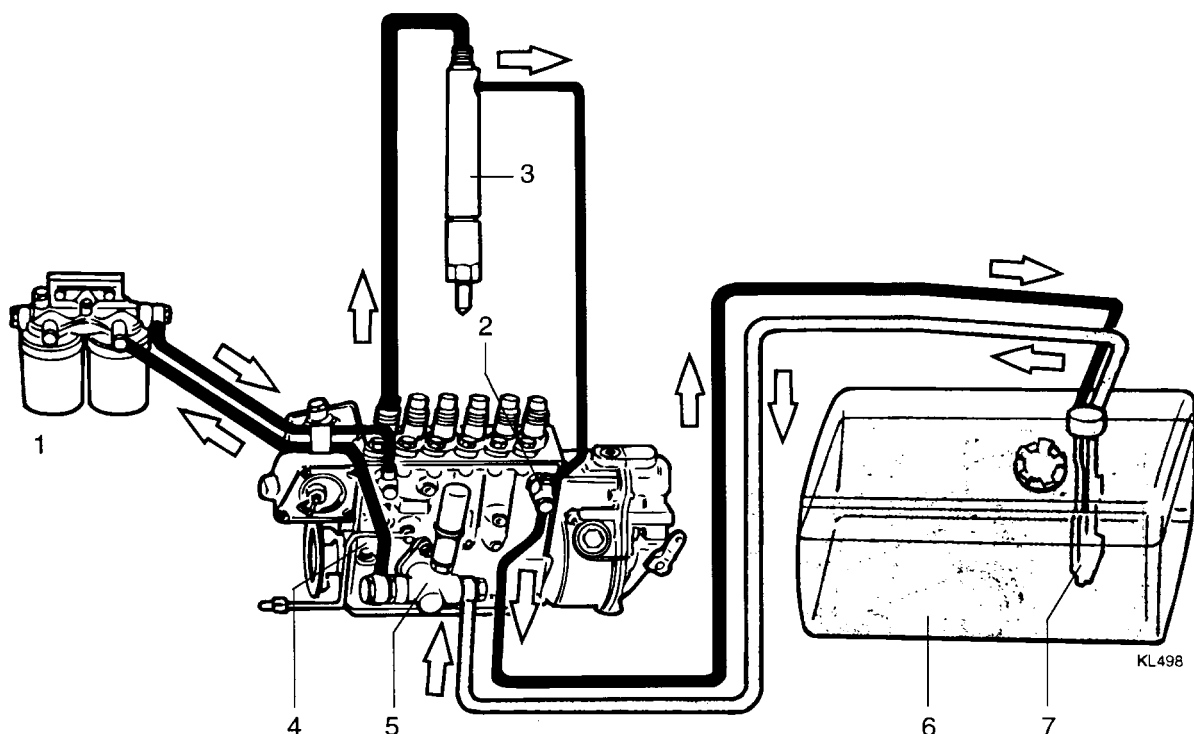
Excess fuel which is circulated in the low-pressure system is also cleaned in the fine filters and is returned through a spill valve back to the tank.

The fuel system includes the following components:

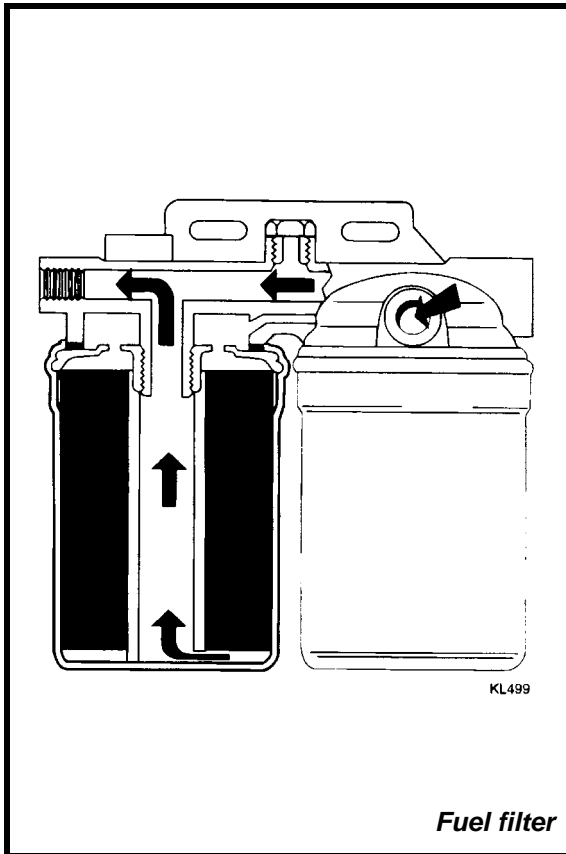
Fuel tank - a separate unit located on the left-hand side of the truck. The fuel volume in the tank can be read on a gauge on the instrument panel.

Feed pump - of piston type, supplies fuel at a certain pressure and flow rate to the injection pump.

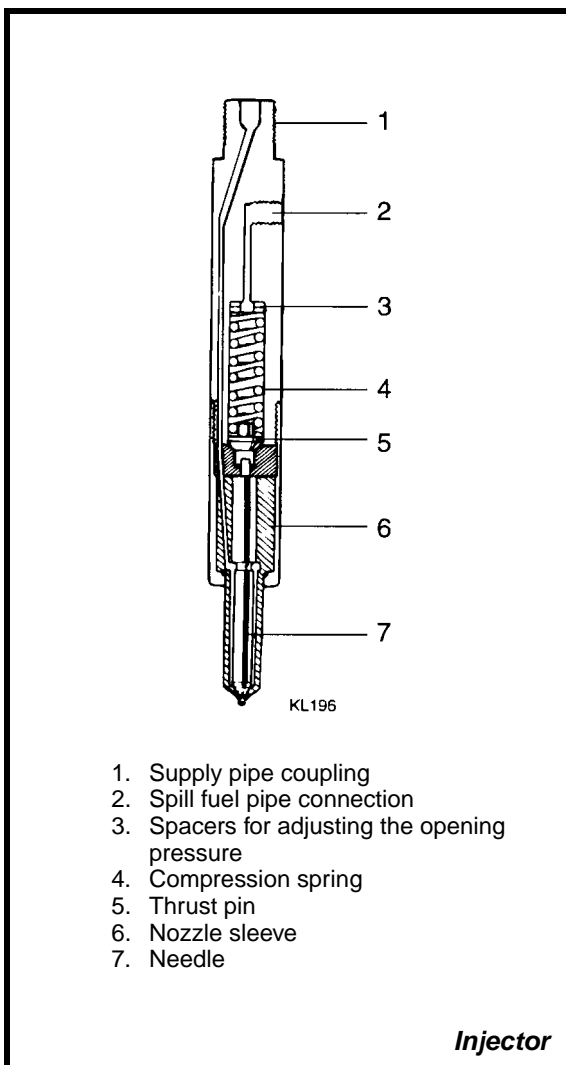
Spill valve - which restricts the fuel feed pressure and provides continuous venting of the fuel system. Excess fuel flows through the injection pump before returning to the tank, thus cooling the fuel in the fuel chamber of the pump, which contributes to more uniform distribution of the fuel to the various cylinders.



1. Fuel filter
2. Spill valve
3. Injector
4. Injection pump
5. Feed pump
6. Fuel tank
7. Suction strainer

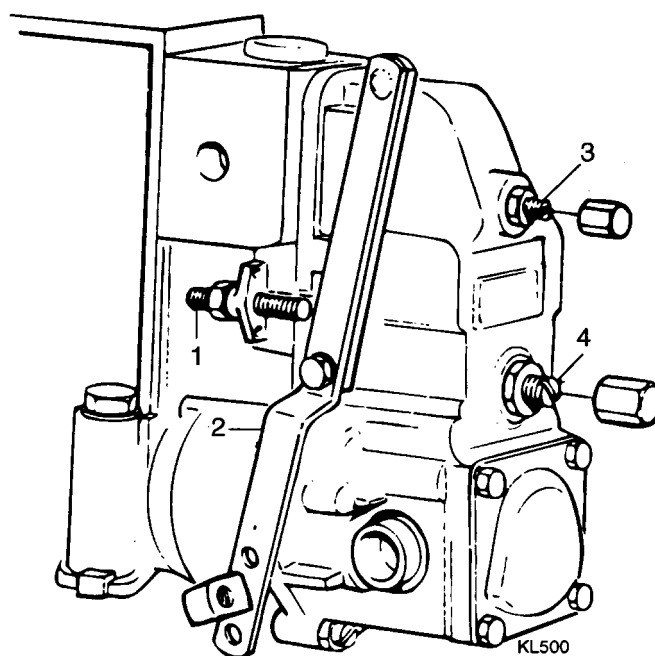


Fuel filters - two filters connected in parallel and with a common cover. The filters are of disposable type, with the filter elements made of spirally wound paper.

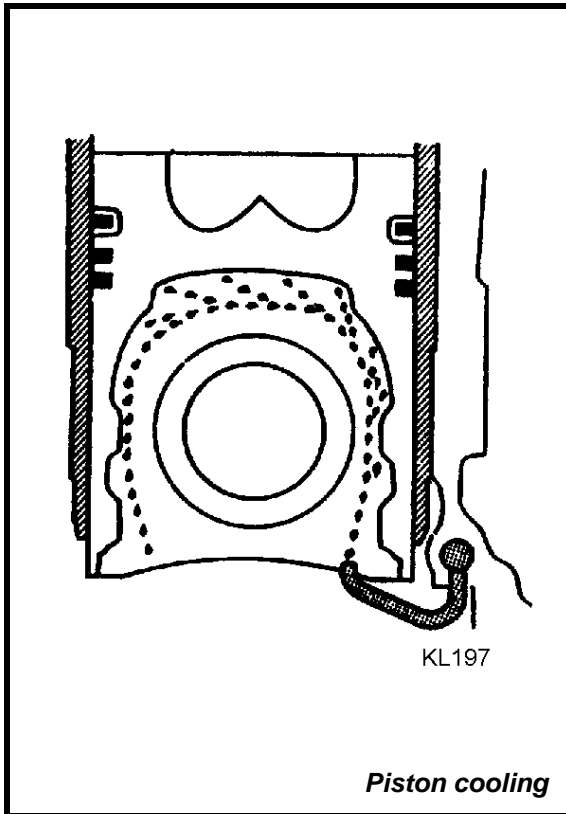


Injectors - each with a nozzle holder and a nozzle. When the fuel pressure has risen to the preset value, the needle will lift and atomised fuel will be injected into the combustion chamber through accurately calibrated holes in the nozzle sleeve.

Injection pump - located on the left-hand side of the engine and driven by gears. The pump is equipped with an RSV governor which has a steep control characteristic at low engine speeds. As a result, the engines appear more powerful and have a higher tractive effort at low speeds.



1. Stop screw for maximum speed, sealed
2. Accelerator lever
3. Adjusting screw for idle speed
4. Adjusting screw for idle speed stabilizing



Lubrication system

The engine is pressure-lubricated, and the oil is supplied by a pump in the oil sump. All lubricating oil flows through a double full-flow filters.

The lubricating oil is cooled in an externally mounted tubular oil cooler by the engine coolant.

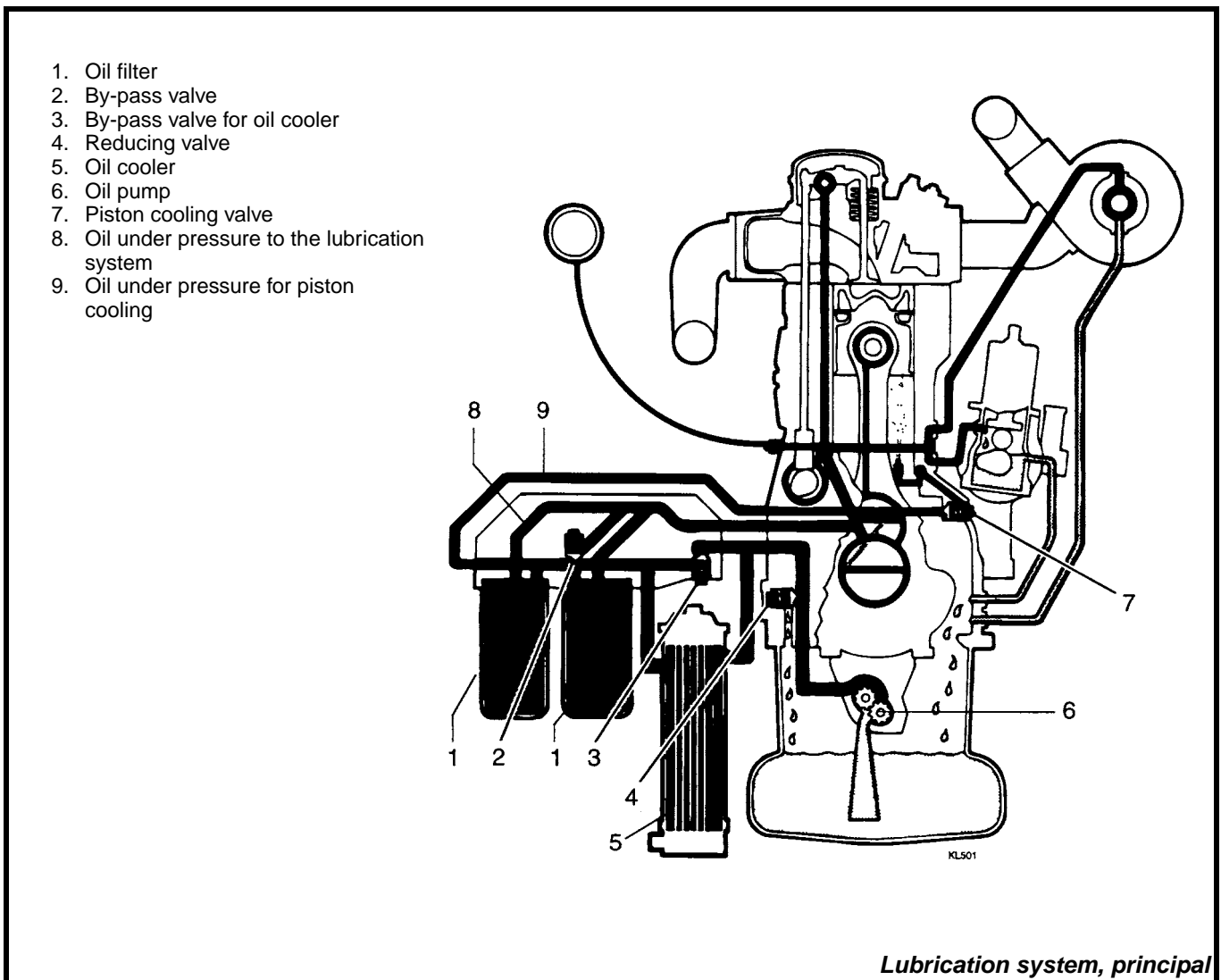
The lubricating system includes the following main components:

Oil pump - of gear type, which draws oil through a coarse strainer that arrests larger particles. The pump delivers oil through the lubricating oil filters to the various passages of the lubricating system.

Piston cooling - reduces substantially the piston temperature which, in turn, contributes to a longer life of the piston rings, reduces the risk of carbon deposits and lowers the oil consumption.

The pistons are cooled by oil which is sprayed by nozzles into the underside of each piston and into the cooling passages when the piston is at the bottom dead centre.

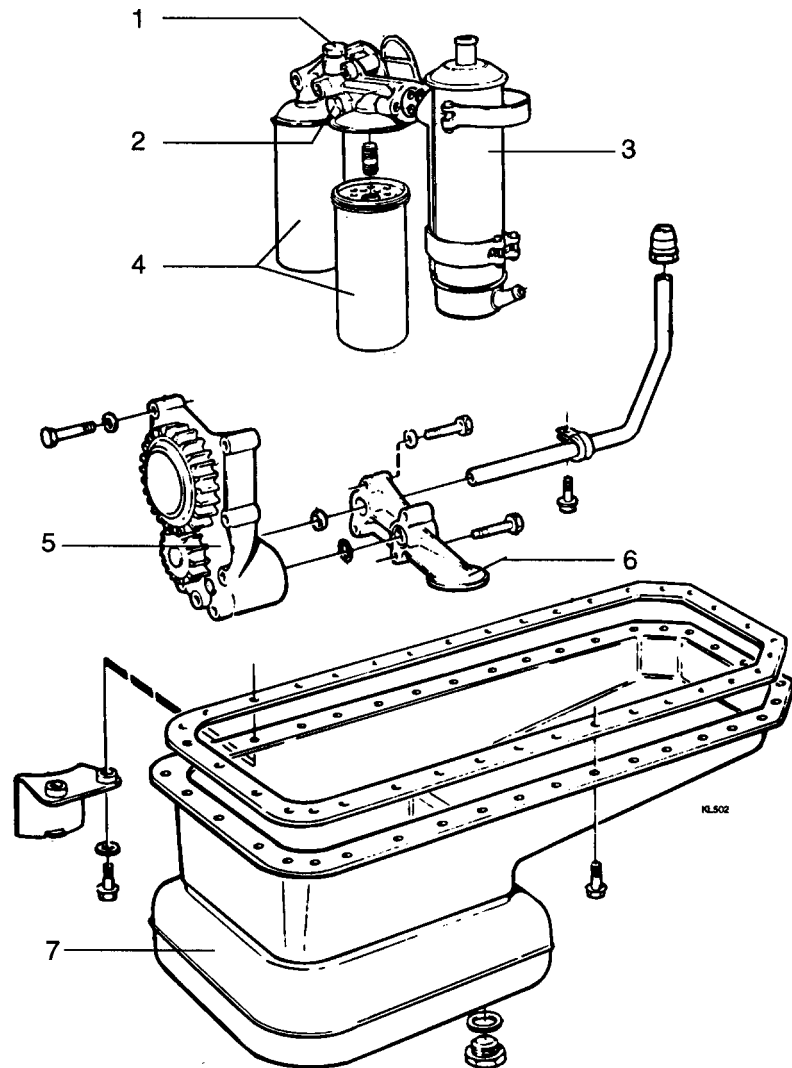
Cooling is controlled by a piston cooling valve which shuts off the cooling oil supply at low engine speeds. This ensures that the lubricating oil flow will be a maximum when the engine is started and when it is running at idling speed. The valve also restricts the pressure of the piston cooling oil at high engine speeds, to make more oil available for lubrication.



Reducing valve - located just before the filter. The valve will open if the lubricating oil pressure is too high and will return excess oil back to the sump.

Oil filter - of full-flow type, with a filter element of pleated filter paper. To protect the engine against insufficient lubricating oil, a by-pass valve is fitted in the oil filter bracket. The valve will open if the lubricating oil pressure should rise above a certain pressure due to clogging of the filter. When the valve is open, unfiltered oil will flow to the engine. The filters are of disposable type and should be scrapped after use.

Crankcase ventilation - prevents pressurising of the crankcase and collects fuel vapour, steam and other gaseous products of combustion. Crankcase ventilation is provided by a pipe connected to the crankcase inspection cover on the right-hand side of the engine, between the starter motor and the oil filter.



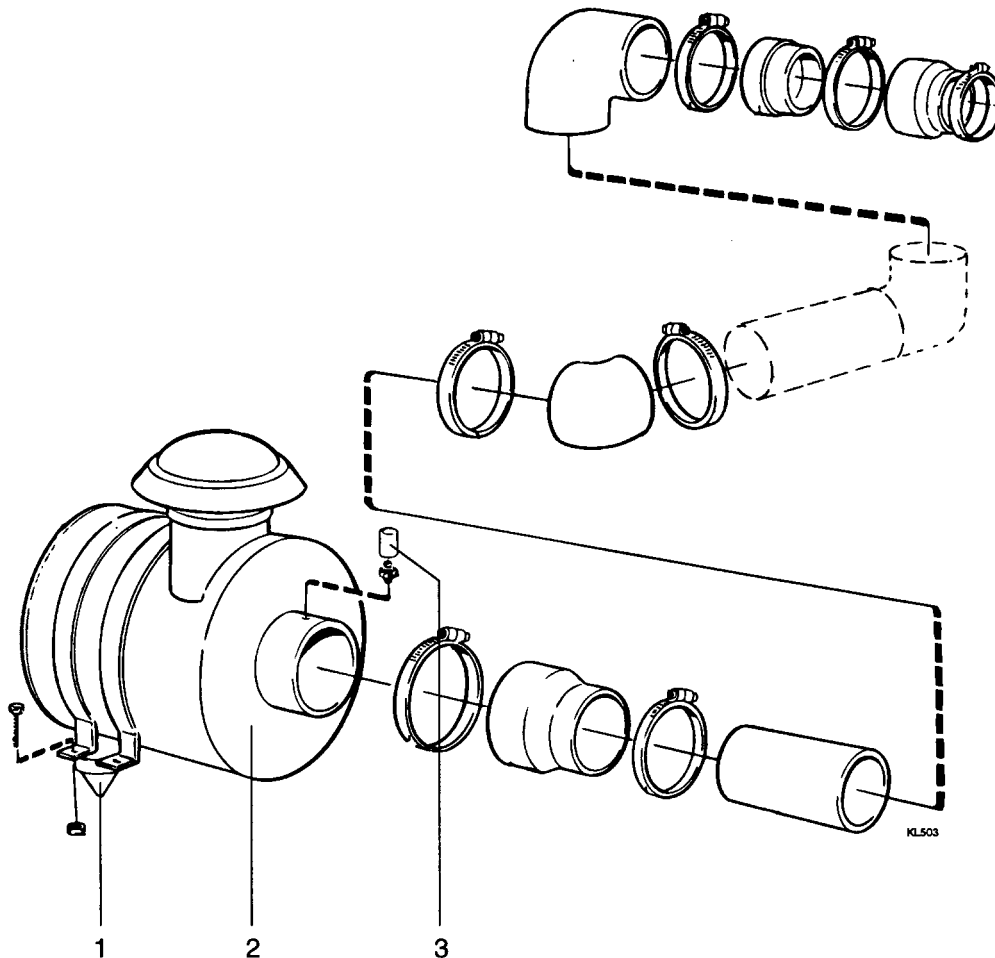
1. Filter by-pass valve
2. Oil cooler by-pass valve
3. Oil cooler
4. Full flow filter
5. Oil pump
6. Suction strainer
7. Oil sump

Combustion air system

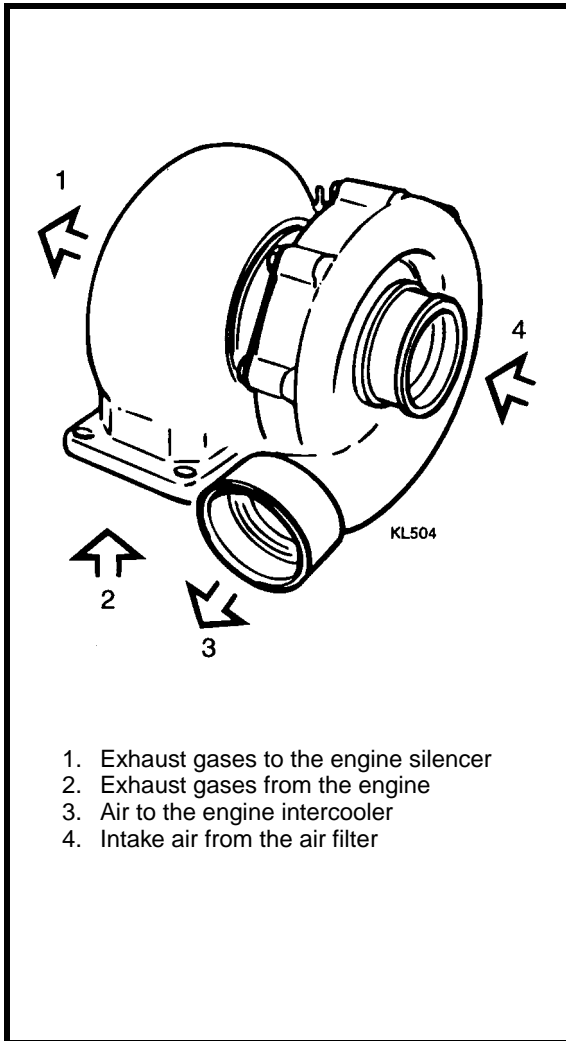
Large quantities of air are necessary for burning the fuel supplied to the engine. Free, unrestricted flow of fresh air and exhaust gases is therefore essential to allow the engine to run efficiently.

Air cleaner

The intake air is cleaned in a two-stage air cleaner, the first stage of which collects coarse particles by cyclone action, and the particles are disposed of through a particle ejector. The second stage consists of a filter element - the main filter element. A pressure indicator shows red signal if the pressure drop in the filter exceeds approximately 500 mm water column. At this point the filter insert should be replaced. A safety filter element is located on the inside of the main element. The safety element prevents the ingress of impurities into the engine while the main element is being changed and if the main element should sustain damage while the engine is running, e.g. due to incorrect installation.



1. Particle ejector
2. Air filter
3. Pressure drop indicator



Turbocharger

The turbocharger supplies more air to the combustion chambers than the engine would be capable of drawing naturally. This enables the engine to burn more fuel which, in turn, increases the engine output.

The turbocharger consists of a turbine wheel and a centrifugal compressor impeller, each with a separate casing but mounted on a common shaft.

The exhaust gases provide the energy necessary for driving the turbine wheel which, in turn, drives the compressor.

The turbocharger is lubricated and cooled by the lubricating oil from the engine.

Intercooler

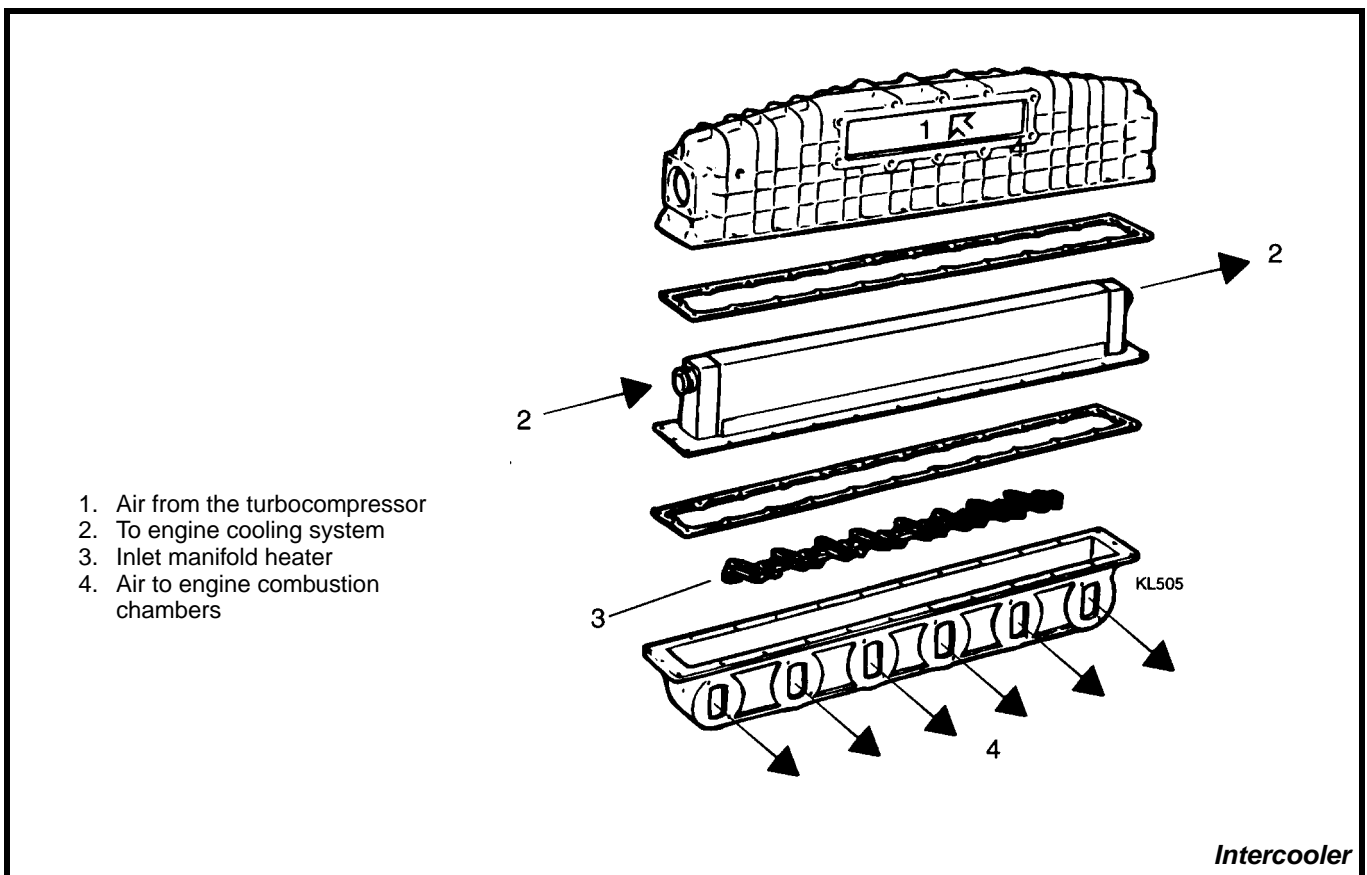
In intercooling, the air that has been compressed and heated by the turbo is cooled in an intercooler.

The intercooler increases the oxygen supply during combustion so allowing the injected fuel to be burnt more effectively whilst reducing fuel consumption as well as the level of exhaust emission.

Intercooling also reduces the thermal stressed on the engine, increasing durability and reducing oil consumption.

Inlet manifold heater

Before the air is admitted into the combustion chamber, it flows across an electrically heated starting element. This has a high rating of 3 kW and heats the intake air sufficiently for the engine to start at low ambient temperatures. The heater element is energised when the starting key is turned to the heating position. Suitable preheating time is about 50 seconds.



Intercooler

Coolant quality

Throughout the year, the coolant should consist of a mixture of 60% of water and 40% of ethylene glycol. The coolant should be changed and the cooling system should be flushed once a year. Always add a corrosion inhibitor (Kalmar part No. 923.110.0003) to the coolant, if the above mixture is not used in the cooling system.

N.B. Never add a corrosion inhibitor if the cooling system contains glycol, since this would cause foaming which seriously impairs the cooling capacity.

Lubricating oil quality

See Group 90, Periodic supervision.

Draining the water from the fuel tank

Drain any water from the fuel tank by removing the drain plug. Immediately refit the drain plug as soon as the flow of fuel is free from water and other impurities.

Inspection of the air cleaner and changing the filter element

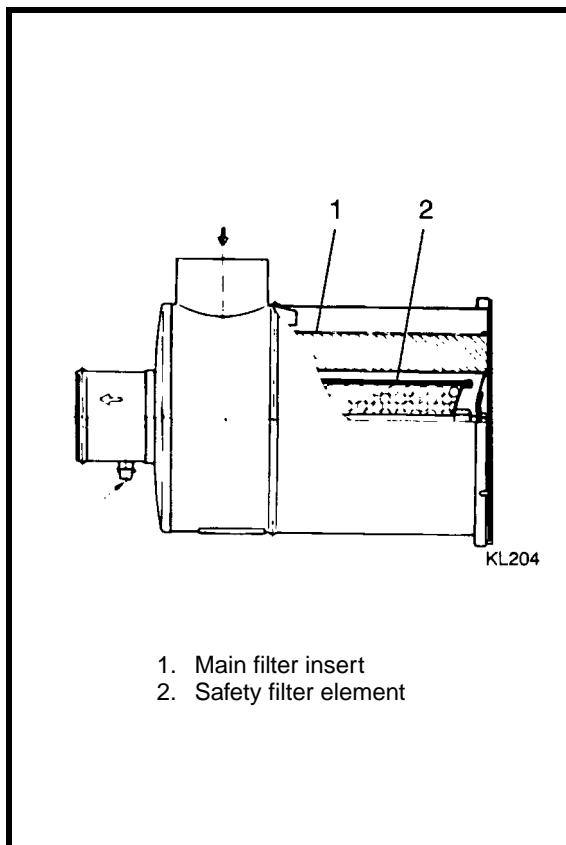
Check the indicator when the engine is running. If it shows red, the main filter element must be changed. The collecting efficiency of the filter element will not be improved if the element is changed too early. But if changing of the filter element is delayed, smoke emission from the engine will increase, the engine may lose power due to insufficient supply of combustion air, and engine damage may occur in certain cases.

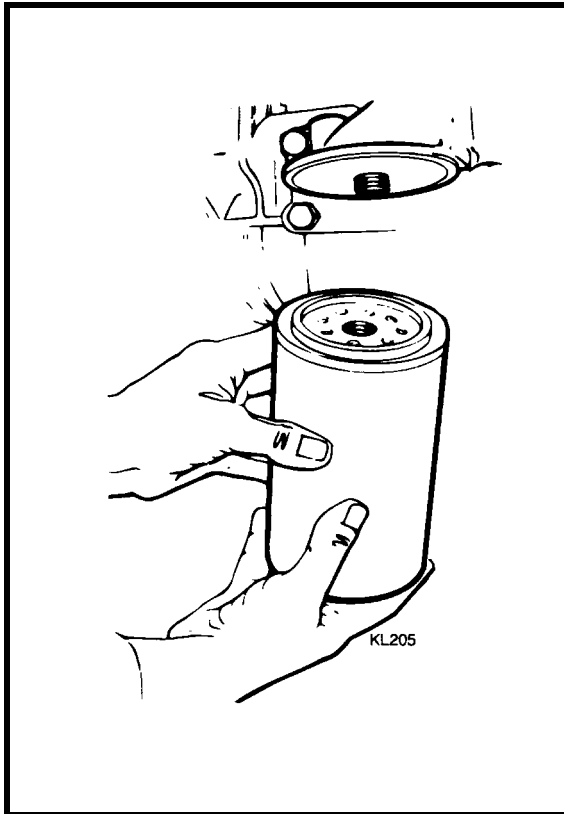
The air pipe from the air cleaner to the engine should be checked for tightness from time to time. Minor leakage, such as that caused by loose hose clips, and damaged or porous hoses may cause dust to be drawn into the engine, which will give rise to costly engine wear.

Change the filter element as follows:

1. The engine must not be running.
2. Clean the outside of the air cleaner.
3. Remove and clean the dust receiver.
4. Release and carefully remove the main filter element. Do not remove the safety filter element.
5. Fit a new main filter element. Carefully check that it is not damaged. Note on the safety filter element when the main element was replaced.
6. Change the safety filter element:
 - after the main filter element has been changed five times
 - at least every other year
 - if the indicator shows red after the main element has been changed
 - if the engine has been run with the main element damaged

The safety filter element must not be cleaned and reused. The engine must not be run without the main filter element. If the main element must be cleaned and refitted in emergency cases, don't use compressed air to clean it, since the filter element may be damaged. Before refitting it, carefully check that the main filter element is undamaged.



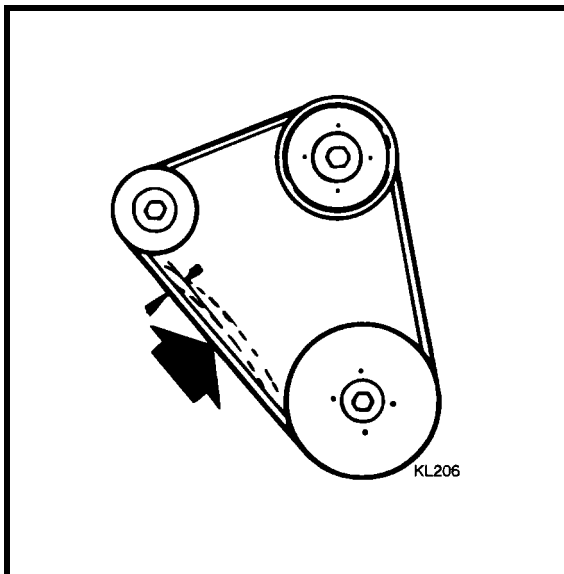


Changing the oil and oil filter

N.B. Before draining the oil, make sure that it is at normal working temperature.

1. Remove the drain plug from the underside of the sump and drain the oil.
2. Clean the area round the filters and place a tray under the filters to collect any spillage.
3. Remove and discard the filter canisters, which are of disposable type.
4. Pour clean oil into the centre of the new filters, wait until the oil has seeped through the filter paper and top up until the filters are full.
5. Lubricate the canister seals with oil.
6. Fit the new filters and tighten them - by hand only.
7. Fill the engine with oil (see Group 90, Lubrication chart).
8. Run the engine and check that no oil leaks at the filters.
9. Stop the engine and check the oil level after a few minutes. Top up as necessary to the MAX level on the dipstick.

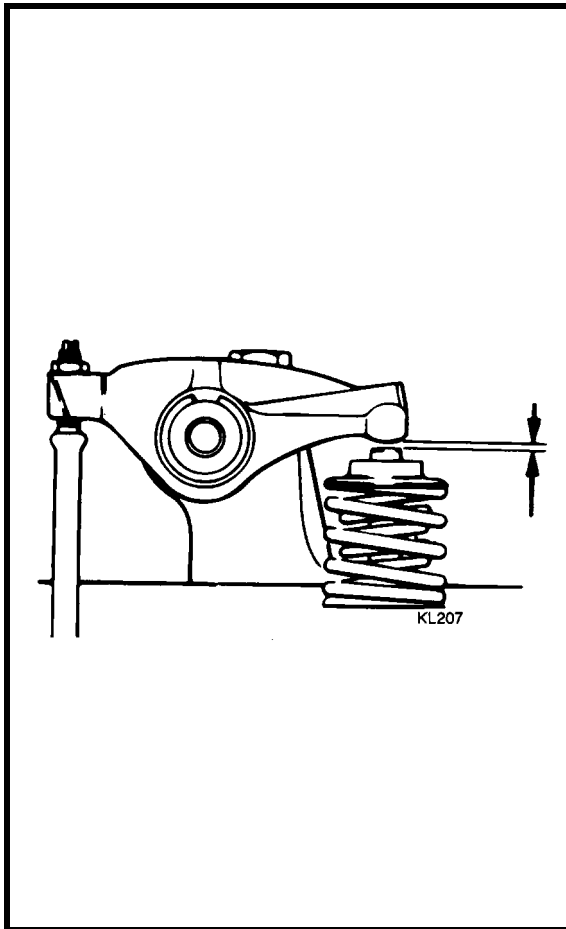
N.B. To avoid serious damage to the engine, use only genuine Kalmar filters.



Checking the V-belt tension

1. Check at regular intervals that the V-belts are correctly tensioned. It should not be possible to depress the V-belt more than 10 - 12 mm mid-way between the pulleys.
2. The engines are equipped with an automatic belt tensioner which maintains the belt tension constant.

N.B. If the belt drive consists of two belts, always change both belts.



Checking and adjusting the valve clearances

N.B. Never attempt to check the valve clearances when the engine is running. The engine must be stationary and cold.

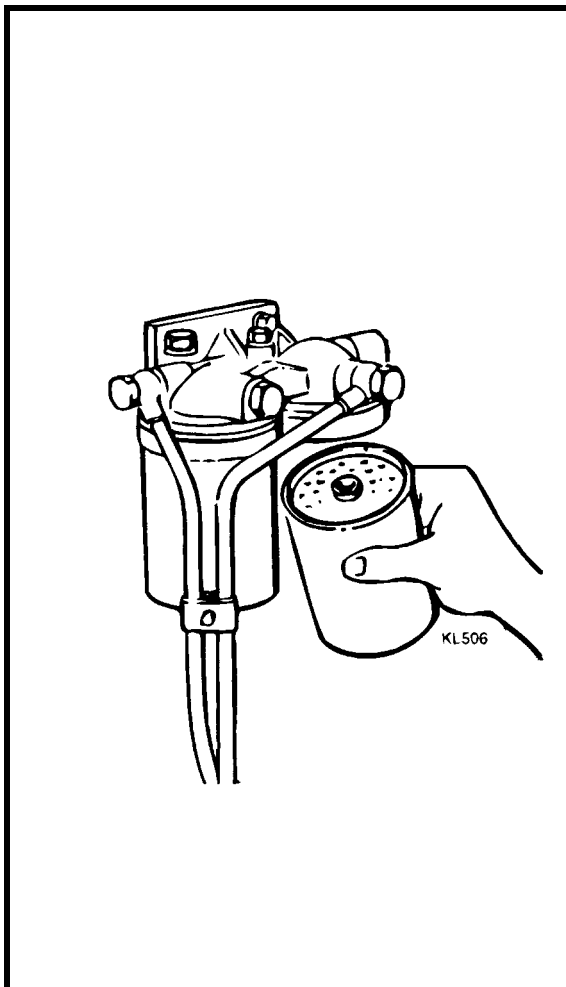
1. Turn the crankshaft in its normal direction of rotation until the inlet valve of No. 6 cylinder has just opened and the exhaust valve of the same cylinder has not yet closed fully. Check the valve clearances on No. 1 cylinder and adjust as necessary.

Valve clearances

Engine	TWD1031VE	TWD1231VE
Inlet	0,40 mm	0,40 mm
Exhaust	0,70 mm	0,70 mm

2. Check the other valves in accordance with the table below.

Check the valve clearance of cylinder No	1	5	3	6	2	4
...when the inlet and exhaust valves of the following cylinders are just changing over (are moving simultaneously)	6	2	4	1	5	3



Changing the fuel filters

1. Clean the outsides of the filters.
2. Remove the filters and discard them.
3. Clean the filter head.
4. Check that the new filters are perfectly clean and that the seals are in good condition.
5. Fit the new filter canisters and tighten them by hand until the seal is in contact with the seating surface. Then tighten them a further half a turn.



WARNING!

Never run the engine with the air inlet or exhaust pipes disconnected from the turbocharger, since personnel could then sustain injuries.

IMPORTANT!

Adjustments on the injection pump are to be performed by authorized personnel only.

Preventive maintenance on the turbocharger

The turbocharger may be damaged and, in the worst case, may break down if the engine is not properly serviced.

1. Check that the engine air inlet system is in good condition, i.e. that the air cleaner is clean, that none of the hoses are worn and that hose connections are not defective, which would allow oil to seep past the seals on the compressor side and be entrained by the inlet air. The latter may lead to high exhaust gas temperatures and overheating of the turbine shaft bearing. If corrective action is then not taken, the turbocharger may break down.
2. Change the lubricating oil and filter at the specified intervals. Check at regular intervals that the lubricating oil lines to the turbocharger are in good condition and do not leak. Also check regularly that the oil pressure is not too low, since this could quickly lead to damage to the turbocharger.
3. Ensure that the fuel system is serviced at the specified intervals. Inadequate fuel supply caused by clogged fuel filters or incorrect setting of the injection pump reduces the turbocharger speed which, in turn, results in a lower engine output.
4. Check that there are no restrictions in the crankcase ventilation. If the vent is blocked, pressure may build up and may force oil into the inlet air system of the turbocharger and engine.

Maintenance of the exhaust gas cleaner

The exhaust-gas cleaner of a well maintained engine needs hardly any maintenance. Yet, an iterative check-up for carbonization ought to be made, appr. twice a year. If necessary dismount and clean the exhaust-gas cleaner as follows:

1. Loosen the tube clamps and remove the cleaner.
2. Dry-brush the cleaner on the intake-side.
3. Clean with pressured air from the exhaust-side.
4. Soak the cleaner in soap-water for, at least, one hour.
5. Clean with pressured air from the exhaust-side.
6. Clean with high-pressured water (0.3 MPa max.) from the exhaust side.
7. Dry with pressured air.

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Group 40

Transmission, drive axle, brakes

Specification	2
Transmission	3
Description	3
Torque converter	3
Gearbox.....	3
Oil circuit.....	5
Service	6
Oil level check	6
Changing gearbox oil and filter.....	6
Checking pressures in the Clark 36000 gearbox	7
Drive axle.....	8
Description	8
WDB-system	11
Parking brake system.....	12
Service	13
Changing the drive-axle oil.....	13
Parking brake – initial adjustment	14
Compensation of lining wear	14
Inspection of dismountable rims.....	see group 60
Safety test when changing tyres	see group 60

Torque converter and gearbox Model	Clark - 15.5 HR 36432
Number of gears	4F - 4R
Oil capacity, total system, litres	57
Oil grade	See group 90
Oil operating temperature, °C	82-93
Max permissible temperature, °C	120
Clutch pressure, bar	17-20
with parking brake applied, oil temp. 82-93°C, engine idling at 625 rpm	All clutch pressures should be equal to within 0.4 bar as indicated on pressure gauge in cab
Clutch type	Multiple disc, hydraulic. Automatic wear compensation (no adjustment) All clutches oil cooled and lubricated
Stall speed, r/min	1782±50, TWD1031VE/15.5 HR 36432 1923±50, TWD1231VE/15.5 HR 36432
Oil filtration	Full-flow oil filter with safety by-pass, also strainer screen in sump at bottom of transmission case
Drive axle Model	Rockwell PRC 7534 W4H
Brake system	Wet disc brakes
Parking brake system	Spring-activated disc brake on drive axle input shaft
Wheel dimensions, front/rear, in	See data sheet
Tyre pressure, bar	9 bar (0.9 MPa)
Oil change capacities, litres	Each hub 12 Differential 50
Oil grade	See Group 90
Tightening torque	
Drive axle mounting bolts, Nm	2350 (240 kpm)
Rim clamp nuts, Nm	402 Nm (41 kpm)
Universal drive axle joint, Nm	
- against gear box	99 (109 kpm), oiled screw
- against driven axle	115 (12 kpm), oiled screw

The transmission consists of a torque converter integrated with the gearbox, and a propeller shaft, driven axle with differential, hub reductions and brakes.

The torque converter and gearbox run together, using a common hydraulic system. The torque converter can be regarded as a hydraulic coupling and is located between the engine output shaft and the gearbox input shaft.

IMPORTANT!
The machine must not be run at stall speed longer than 30 seconds at a time. The torque converter will otherwise overheat, causing damage to the seals and thus necessitating expensive overhaul.

Torque converter

The most important components of the torque converter are the pump impeller, turbine wheel and stator. Engine power is transmitted mechanically to the pump impeller. The impeller starts an oil flow in the torque converter, and is comparable to a centrifugal pump which draws oil into the centre and discharges it at the periphery.

The turbine wheel is located opposite the pump impeller and is connected to the torque converter output shaft. The oil enters the turbine wheel at the periphery and is discharged at the centre.

The stator is located between the pump impeller and the turbine wheel, at their inside diameter. The function of the stator is to guide the flow of oil from the inside diameter of the turbine wheel back to the inside diameter of the pump impeller in the best possible way.

Torque conversion takes place in the oil circuit of the torque converter. When the load on the truck increases, i.e. when the torque required increases, the turbine wheel slows down in relation to the pump impeller, and the oil flowing through the stator then increases the torque.

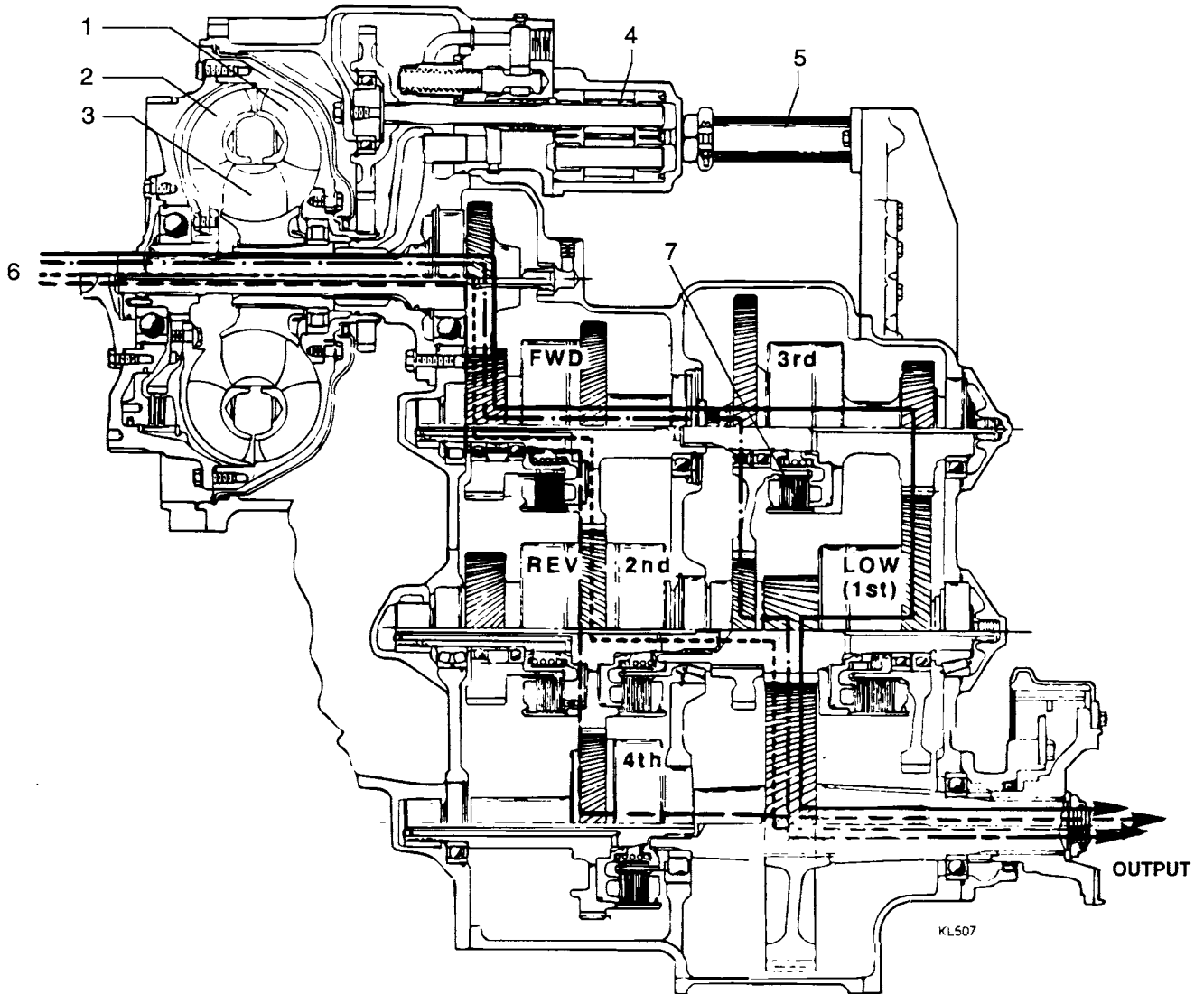
The output torque gradually increases as the speed of the output shaft decreases and is a maximum when the output shaft and thus also the turbine wheel are stationary, i.e. are stalled, see Technical data.

Gearbox

The gearbox is of constant-mesh type. Gear-changing is carried out by clutch plates for the various gears being hydraulically actuated.

The valve body mounted on the side of the gearbox includes spool valves which guide the oil flow to the various clutches. The spools are activated in turn by solenoid valves. These are activated electrically by the gear selector in the cab. As an optional extra an automatic gear changing system is available. See Group 20.

The gearbox has four ratios in each direction and is also provided with disengagement, which is actuated by the brake pedal and comes into operation at a certain brake pressure.



FORWARD
 1ST = —————
 2ND =
 3RD = - - - - -
 4TH = - - - - -

- 1. Pump impeller
- 2. Turbine wheel
- 3. Stator
- 4. Charging pump
- 5. Suction tube
- 6. From engine
- 7. Clutch plates

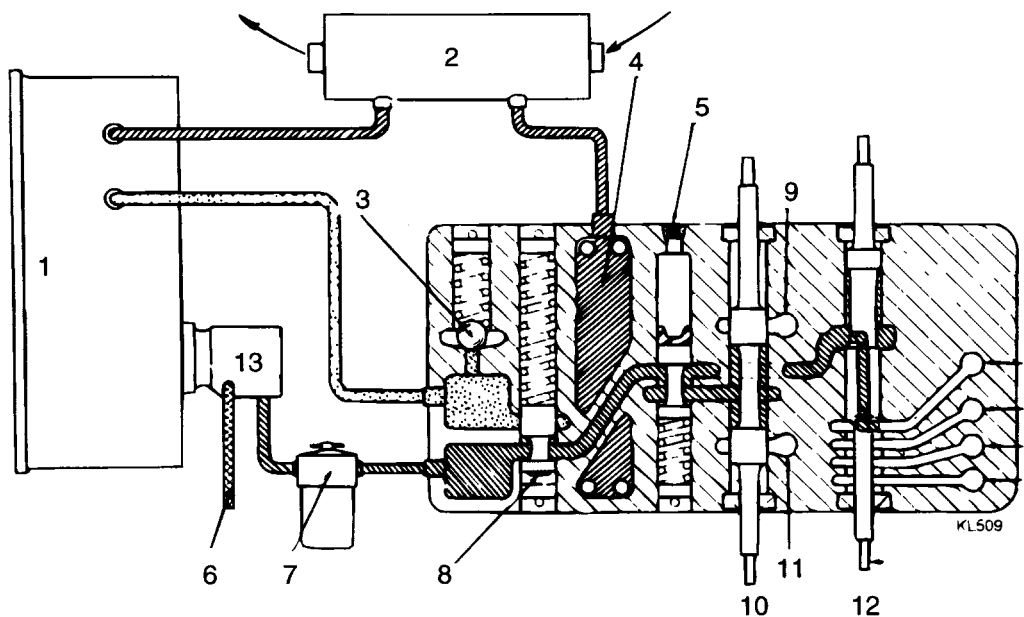
Oil circuit

The function of the oil is:

- to transmit the engine output to the gearbox. The torque converter can multiply the engine torque by up to three times, but at the expense of the speed rotation.
- to apply the clutches in the gearbox.
- to dissipate the heat from the torque converter.
- to lubricate the gearbox and the torque converter.
- transport any solid particles to the filter.

When the engine is running, the oil pump draws oil through a suction strainer from the gearbox sump and then delivers it through a fine filter to a pressure regulating valve.

The regulating valve delivers oil at the right pressure to the gearbox valve body, which actuates the clutch plates for Forward/Reverse and 1st/2nd/3rd/4th. The clutches use only a small proportion of oil delivered by the pump. The remainder is fed through the torque converter circuit to the oil cooler, and returns to the gearbox for lubrication.



1. Converter
2. Oil cooler
3. Converter safety valve
4. Lube manifold
5. Automatic clutch release valve
6. Suction from transmission sump
7. Filter
8. Clutch pressure regulating valve
9. For
10. Direction selector valve
11. Rev
12. Speed selector valve
13. Pump

Oil level check (transmission, incl. converter)

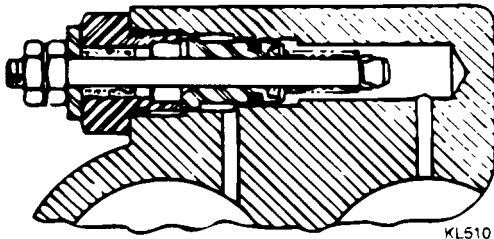
Check the oil level daily with the engine at idling speed and the oil temperature between 82 and 93°C.

Maintain the oil level at the FULL mark.

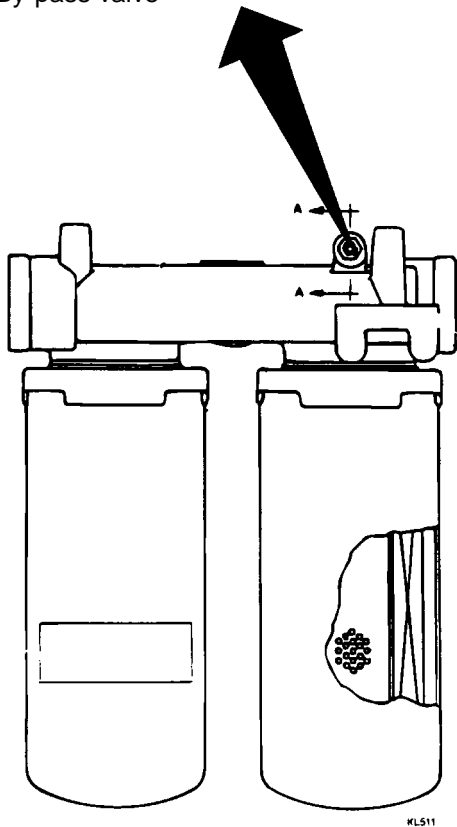
Changing the gearbox oil and filter

This should be carried out when the oil is at normal working temperature (82–93°C).

1. Remove the gearbox drain plug and drain the oil.
2. Release the suction strainer, withdraw it and clean the strainer gauze. N.B. If metal particles are found in the strainer gauze, investigate the reason before topping up with new oil.
3. Fit a new gasket to the suction strainer and fit the strainer.
4. Unscrew the filter bowl, remove the filter and fit a new filter element.
5. Fit the new filter and tighten it.
6. Fit the drain plugs and tighten them.
7. Fill with oil to the MIN mark on the dipstick.
8. Start the engine and run it at 500–600 r/min until the oil has reached working temperature, and the hoses, cooler and torque converter have been filled with oil.
9. Keep the engine running at idling speed, check the oil level and top up to the MAX mark on the dipstick.



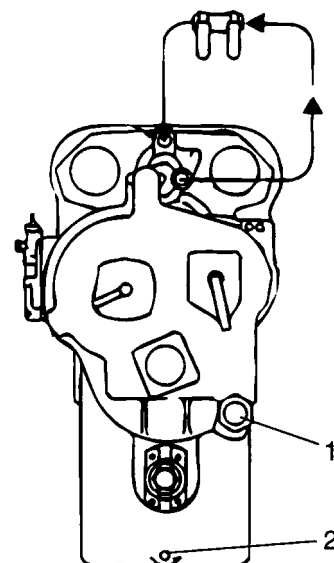
By-pass valve



Oil filter

IMPORTANT!

In the event of gearbox damage, always replace the oil cooler – the damage may have been caused by the oil cooler being faulty.



1. Suction strainer
2. Drain plug

KL512

Oil filter

IMPORTANT!
When the check is carried out under identical conditions, the pressure must not vary by more than 0.4 bar between the various clutches.

Checking pressures in the Clark 36000 gearbox

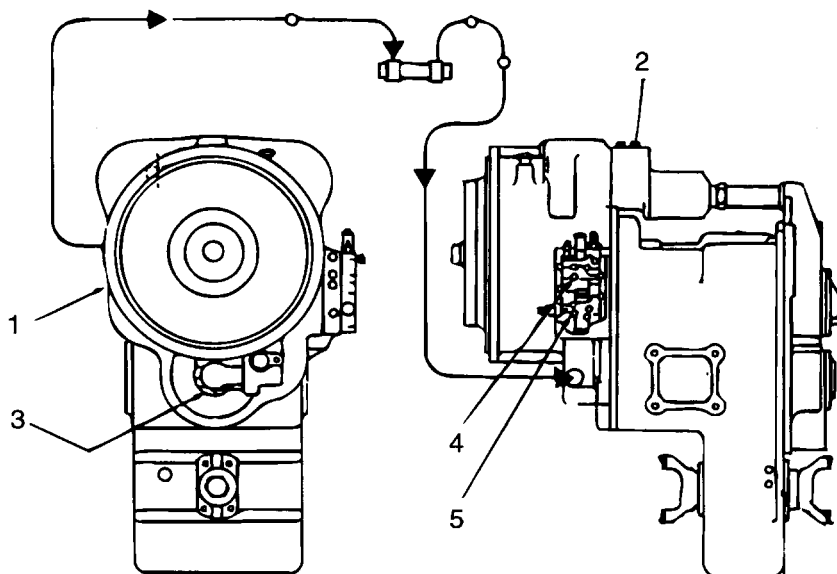
The pressure should always be checked when the oil is at the normal working temperature of 82–93°C and the gearbox is in neutral.

Converter outlet pressure:

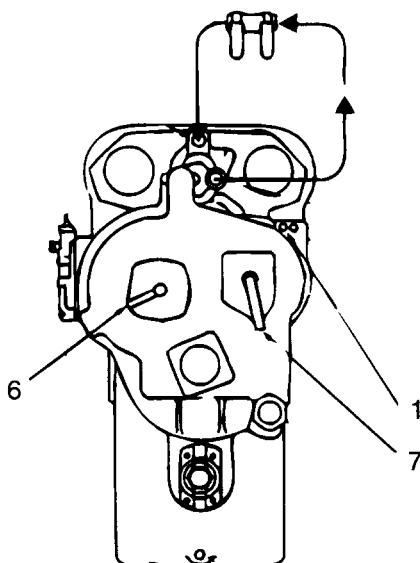
Above 1.7 bar at an engine speed of 2000 r/min, although the pressure must not exceed 4.9 bar when the engine is running at top speed.

Clutch pressure:

17 – 20 bar with parking brake set, oil temperature 82–93°C, engine at idle (400-600 r/min) shift through direction and speed clutches



KL513



1. Converter "out"
2. Clutch pressure port
3. 4th clutch pressure port
4. Fwd clutch
5. Rev clutch
6. Low (1st) speed clutch pressure port
7. 3rd speed clutch pressure port

The drive axle features two-stage reduction (differential and hub).

Rockwell planetary axles permit the bevel or hypoid gearing of the carrier and the axle shafts to carry only a nominal torsional load while at the same time providing the highest practical gear reduction ratio at the wheels.

The differential assembly employs a heavy duty hypoid drive pinion and ring gear. The differential and gear assembly is mounted on tapered roller bearings. The straddle mounted pinion has two tapered roller bearings in front of the pinion teeth which take the forward and reverse thrust and a third bearing behind the pinion teeth to carry the radial load.

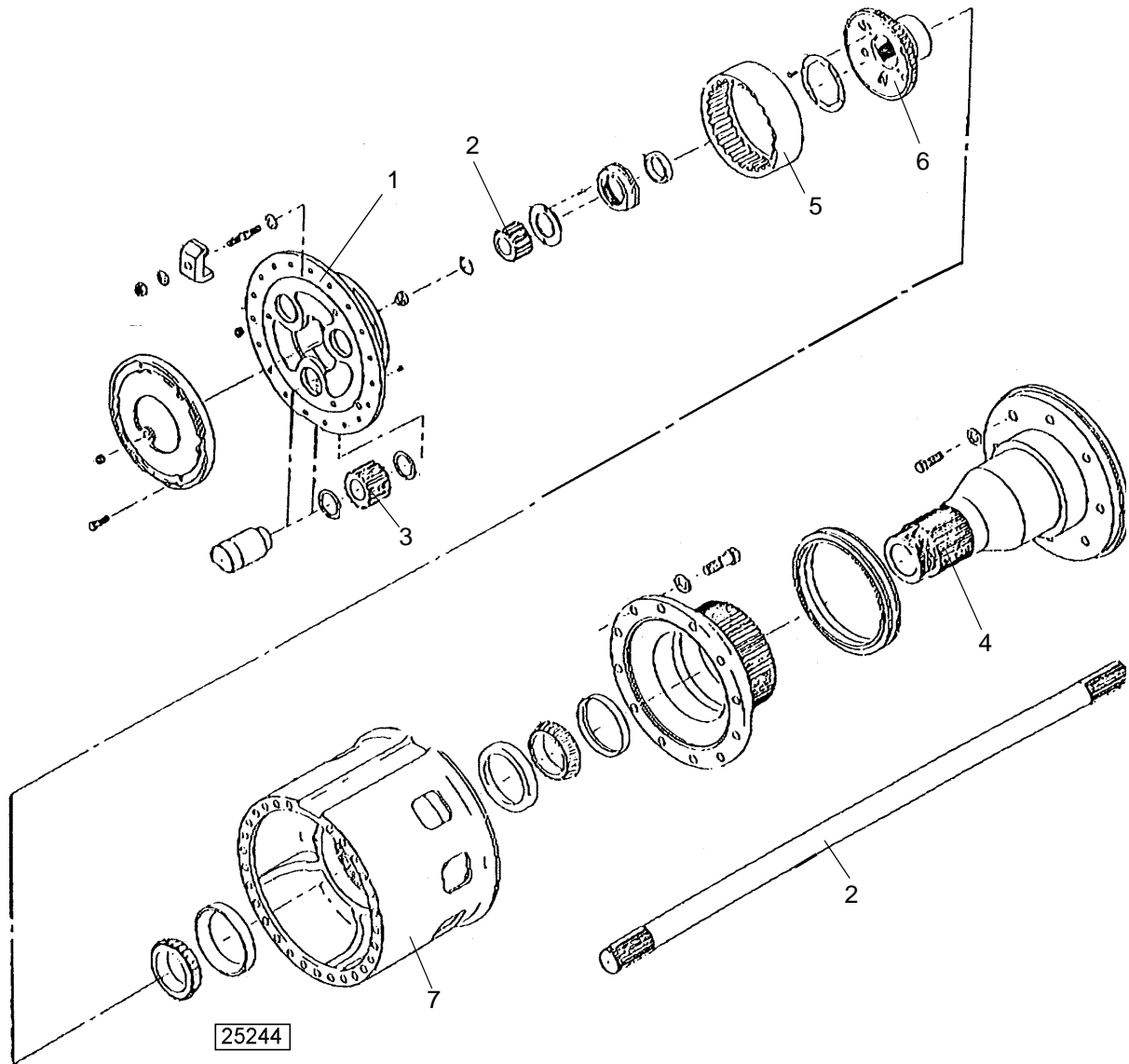
The hub reduction consists of a planetary gear. Each hub reduction consists of a sun wheel, three planet wheels which rotate around the sun wheel, and a ring gear surrounding the planet wheels.

The hub reduction consists of a planetary gear with sun gear, three planet spur gears and a floating ring gear.

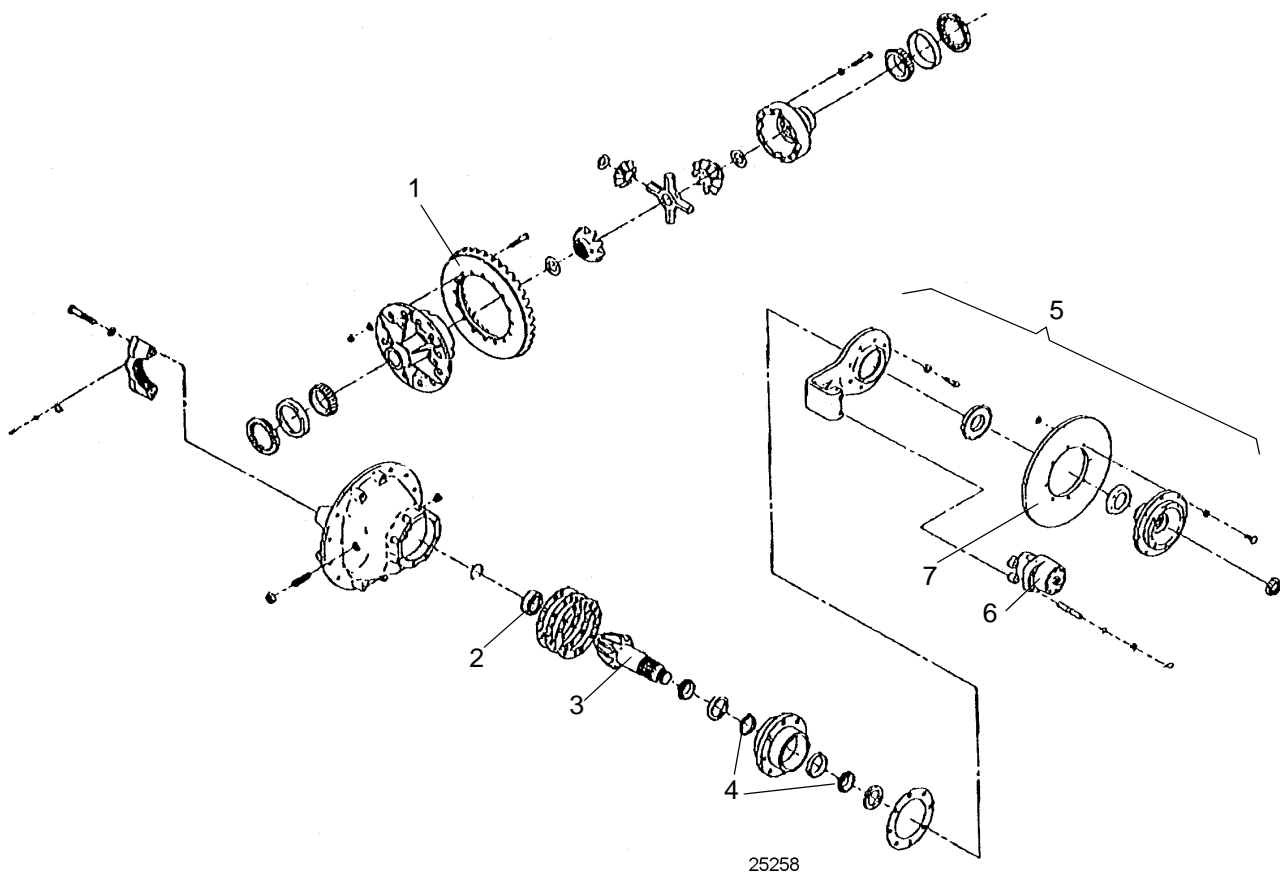
The spur teeth of the sun gear (which floats) mesh with the teeth of the planet spur gears. The planet spur gears rotate on planet pins which are mounted in a spider. The planet spur teeth, in turn, mesh with the teeth of the floating ring gear.

Power is transmitted by the pinion and gear of the differential to the axle shafts driving the sun gear of the second reduction, through the revolving planet gears, and then to the planetary spider which drives the wheel hub.

The axle is equipped with an oil-cooled brake system – the wet disk brake system.



1. Planet holder
2. Insert axle with sun wheel
3. Planet wheel
4. Axle end
5. Ring wheel
6. Ring wheel hub
7. Wheel hub



1. Crown wheel
2. Radial roller bearing
3. Pinion
4. Tapered roller bearings for axial thrust
5. Parking brake assembly
6. Brake cylinder
7. Brake disc

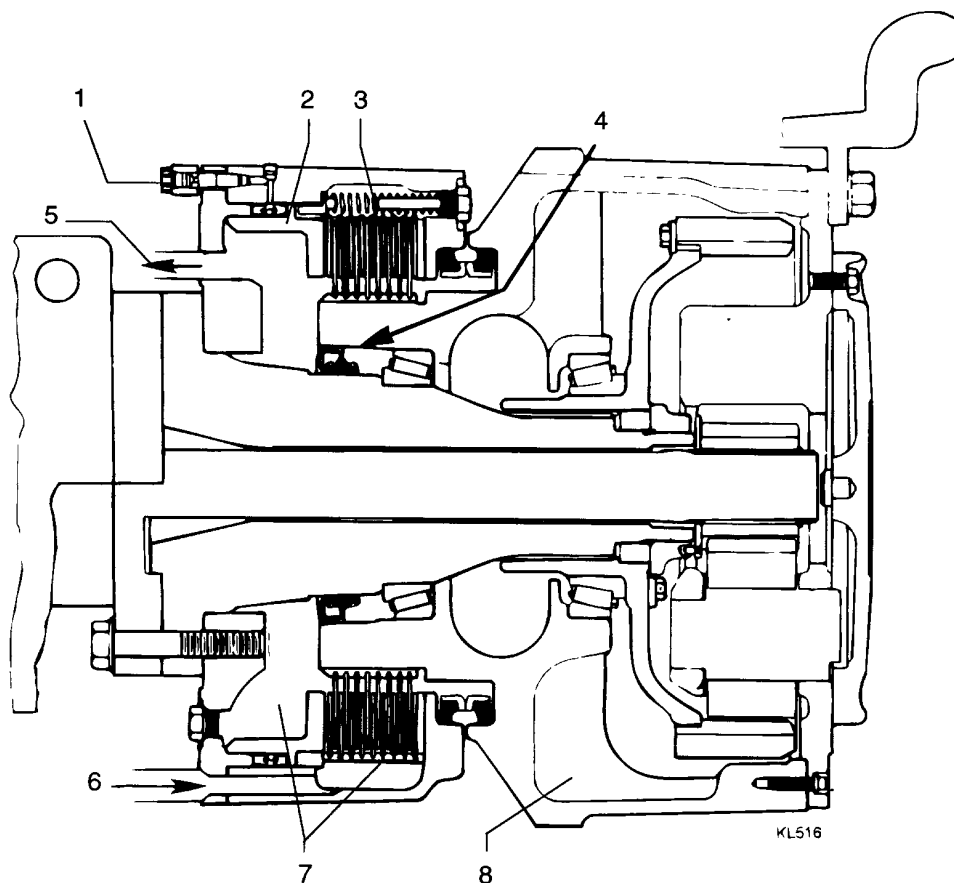
WDB-system

The wet disc brake system is maintenance free, being immune to wear. Neither are the brakes prone to the fading which normally occurs under tough operating conditions. Furthermore, adjustment of the brakes is not required.

The brakes consist of a series of stationary and rotary discs arranged alternately. The stationary discs are anchored (splined) to the brake housing. The friction discs fit between the stationary discs and revolve with the wheel hub. Hydraulic pressure supplied by the accumulator when the brake pedal is operated moves a large hydraulic piston outwards which in turn pushes the discs together to slow the rotation of the re-revolving friction discs. This slows the motion of each wheel hub and stops the vehicle.

The system is fully enclosed, thereby effectively excluding all dirt and contamination.

A cooling circuit is provided to dissipate the heat produced when braking. The cooling circuit uses fluid from the general hydraulic system, which means that the total volume of hydraulic fluid in the truck participates in the cooling process.

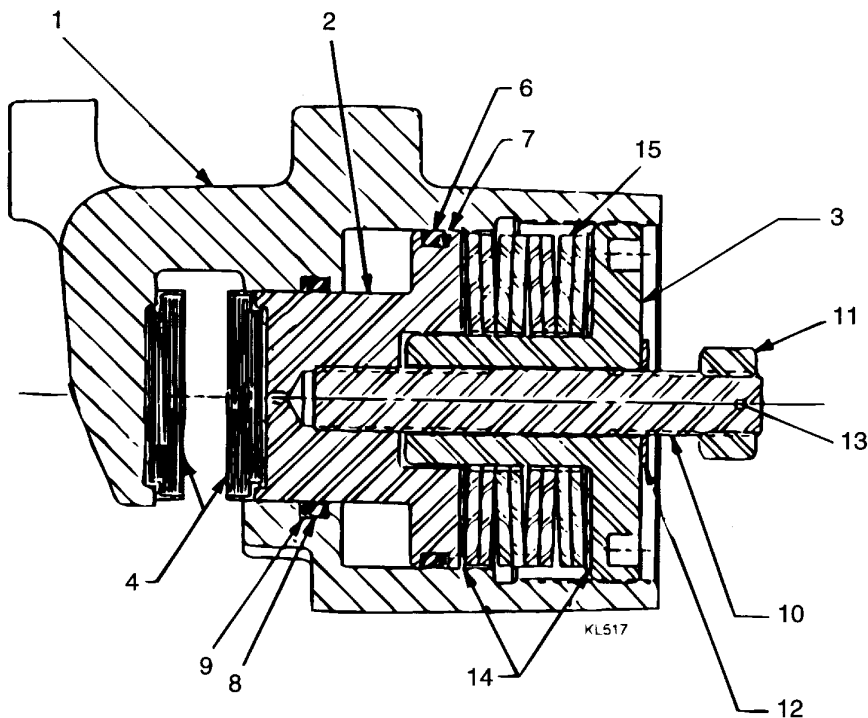


1. Brake pressure from foot brake
2. Hydraulic piston
3. Disc arrangement
4. Hub to spindle seal
5. To vehicle hydraulic system
6. Cooling fluid from vehicle hydraulic system
7. Cooling fluid cavity
8. Lubricating fluid cavity

Parking brake system

The parking brake, which is of the disc type, is mounted on the drive axle input shaft. The brake is operated by a heavy-duty spring in the parking brake cylinder and is released by hydraulic pressure, counteracting the spring force. The brake cylinder and the calliper assembly form an integral unit. The hydraulic pressure is applied via the parking brake control lever in the operator's cab.

The parking brake can also be used as an emergency brake. Emergency braking causes heavy wear to the brake pads. Therefore the brake pads have to be changed after two emergency brake operations.

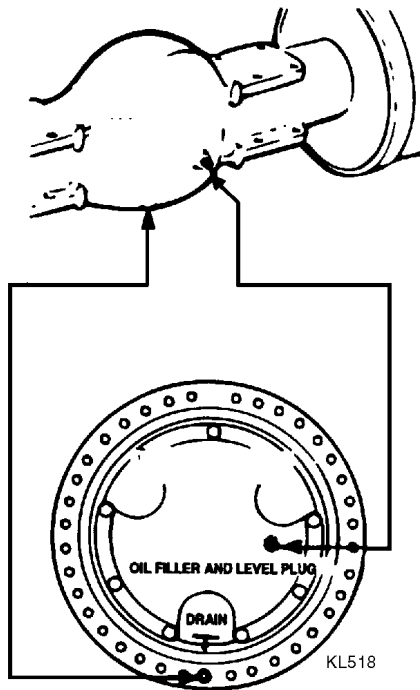


1. Cylinder and calliper assembly
2. Piston
3. Spring cap
4. Brake linings
6. Seal, large
7. Back up ring, large
8. Seal, small
9. Backup ring, small
10. Stud
11. Lock nut
12. Washer
13. Locking pin
14. Washer
15. Spring

Changing the drive axle oil

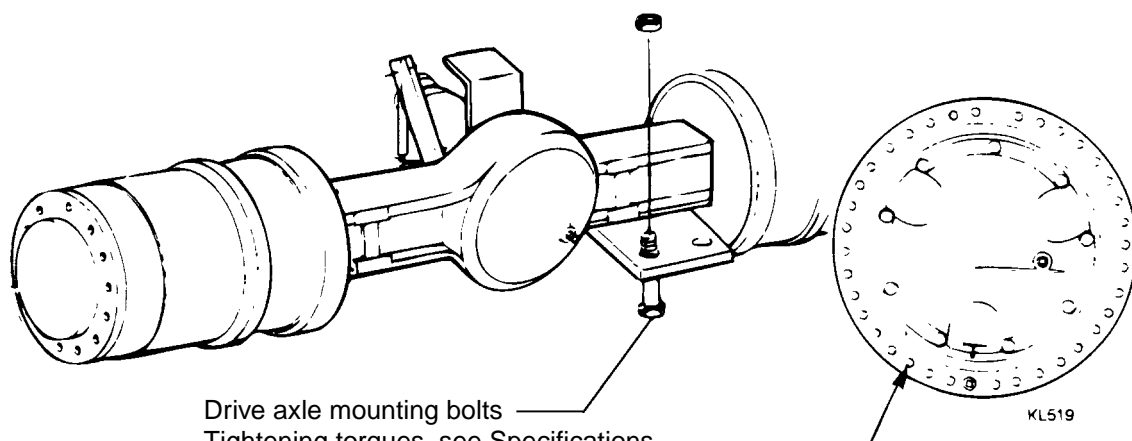
IMPORTANT!

To assure that the wheel ends of planetary axles with a common wheel end/housing bowl oil level are initially lubricated, fill each wheel end directly with oil before vehicle is put back into operation. DO NOT FILL THE AXLE THROUGH THE DRIVE UNIT OR HOUSING BOWL ONLY.



Drive axle oil

1. Drive the truck forward until the oil drain plug on one of the wheel hub reductions is at its lowest point of travel.
2. Remove the oil plug and drain the oil. Refit the plug.
3. Repeat the procedure on the other wheel.
4. Remove the drain plug from the bottom of the differential and drain the oil. Refit and tighten the drain plug.
5. Fill each reduction with fresh oil. The level indicator shall be horizontal as shown on figure. Remove the filler plug and top up with oil. Refit and tighten the filler plug Volume: See Specifications.
6. Remove the level plug from the differential and fill the differential with oil. Refit and tighten the level plug. Volume: See specifications.
7. Check that the oil level is up to the level holes. Top up as necessary



Drive axle mounting bolts
Tightening torques, see Specifications

Rim clamp nuts
Tightening torques, see Specifications

The parking brake can also be used as an EMERGENCY BRAKE.



WARNING!

After emergency braking the brake pads has to be checked and replaced if necessary..

Parking brake - initial adjustment

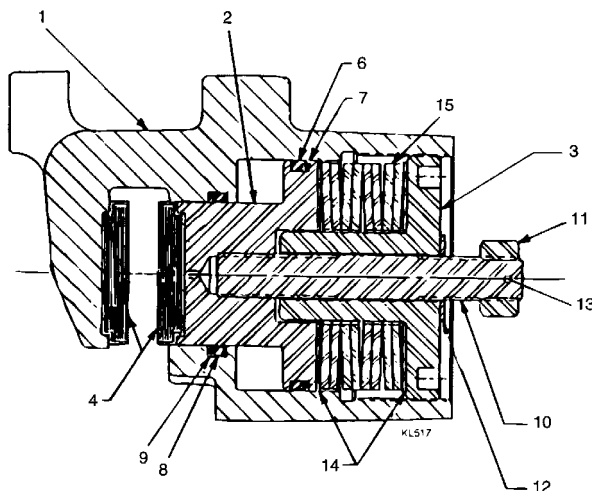
Note! The spring cap (3) has a clock-wise thread and the stud (10) has an anti- clockwise thread.

Never try to screw the spring cap (3) in with springs in compression as the threads may be damaged.

1. Ensure that the spring cap (3) is fully engaged in the housing (1).
2. Loosen the parking brake.
3. Turn the nut (11) against the washer (12).
4. Apply the parking brake.
5. Turn the spring cap (3) until the total clearance between the disc and the lining (2) is 0.5 mm.
6. Loosen the parking brake.
7. Back up the nut (11) and lock it with the pin (13). The brake is now ready for operation.

Compensation of lining wear

1. Apply pressure.
2. Turn the nut (11) against the washer (12).
3. Release the pressure.
4. Turn the spring cap (3), until the total clearance between the disc and the linings (4) is reduced to 0,5 mm.
5. Apply pressure.
6. Back up the nut (11) and lock it with pin (13). The brake is now operational again. .



1. Cylinder and calliper assembly
2. Piston
3. spring cap
4. Brake linings
5. -
6. Seal, large
7. Back up ring large
8. Seal, small
9. Back up ring, small
10. Stud
11. Lock nut
12. Washer
13. Locking pin
14. Washer
15. Spring

Group 60

Steered axle

Specifications	2
Steered axle	3
Description	3
Service	4
Replacement of steering cylinder	4
Replacement of knuckle pin bearings	4
Replacement of steering wheel bearings	6
Miscellaneous.....	7
Inspection of dismountable rims.....	8
Safety test when changing tyres	10

Tightening torques

Wheel nuts, Nm	400 (41 kpm)
Steered wheel bearing nuts, Nm	500 ¹⁾
Nuts for lower knuckle-pin bearings, Nm	1750
Nuts for upper knuckle-pin bearings, Nm	1500
Mounting screw, M24	670
Steering cylinder, Nm	oiled bolt

1) Steered wheel bearings should be tightened during simultaneous rotation of the wheels. This makes the bearing rollers set correctly.

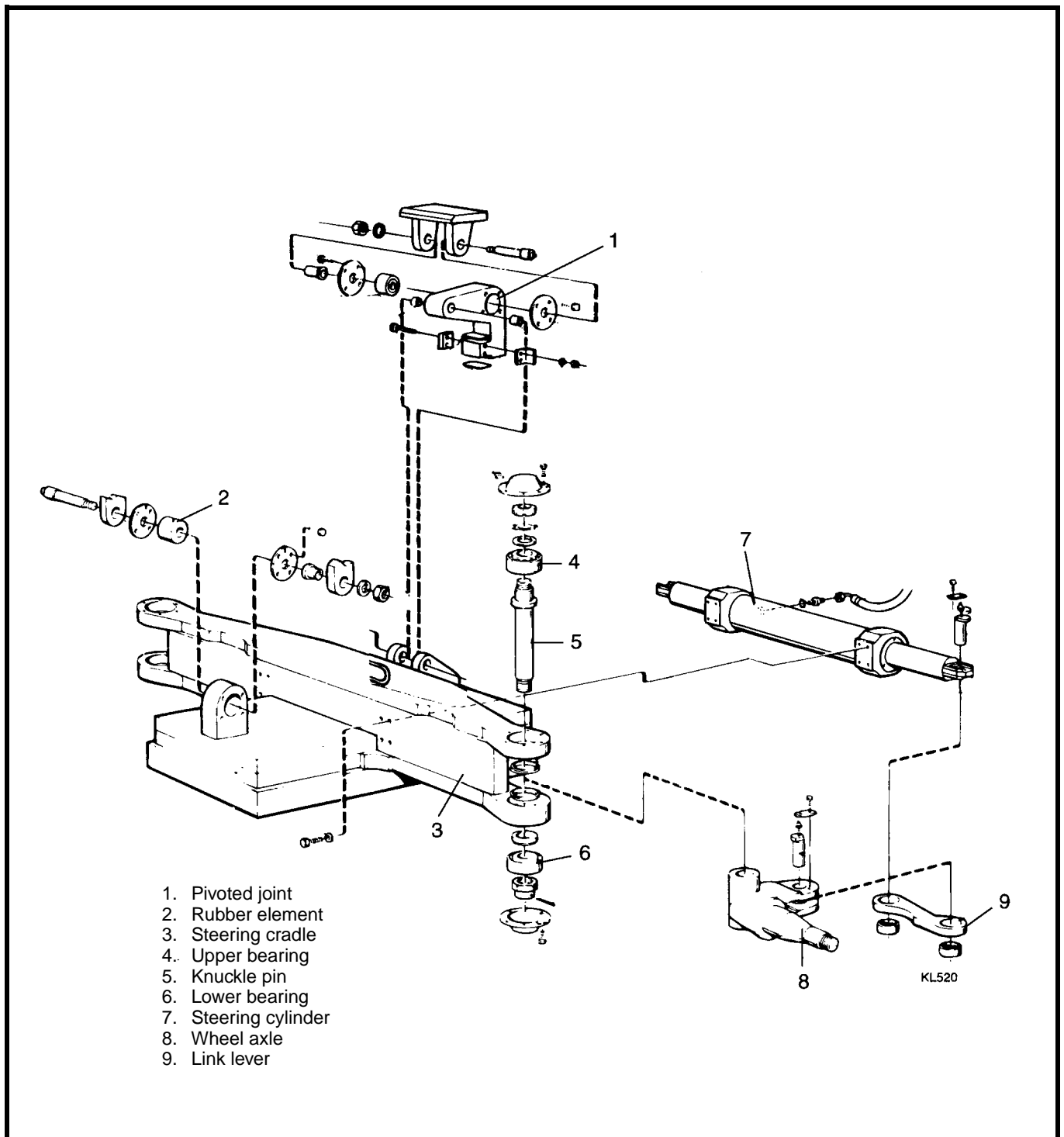
Note that a jacked-up wheel gives a certain resistance when rotated.

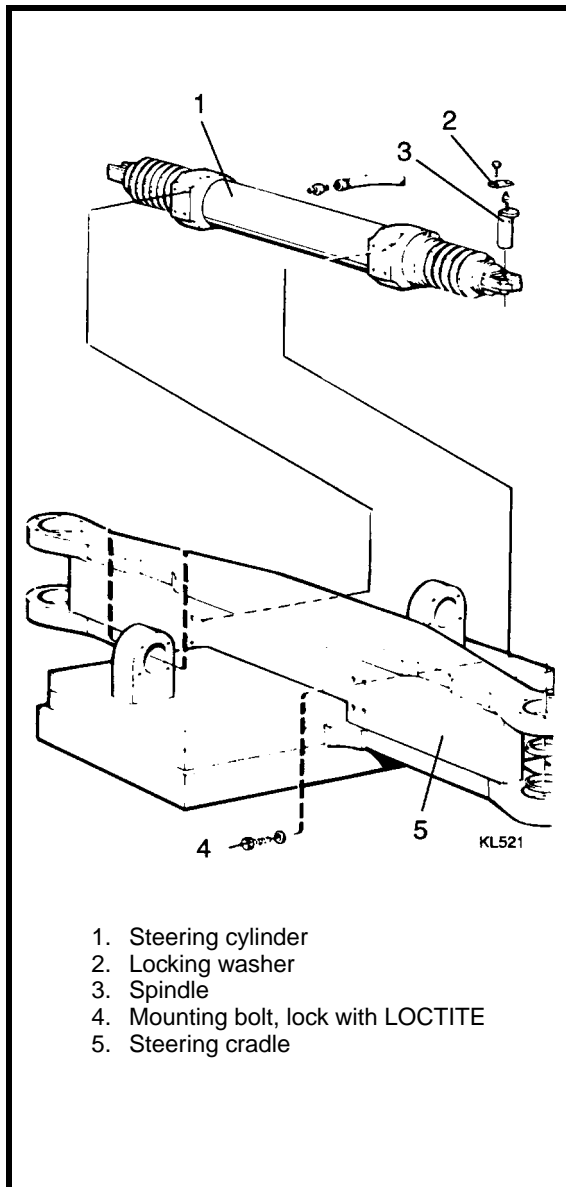
After tightening of steered wheel bearings, the truck should be run for some 100 meters. After that the bearing nut should be tightened again to 500 Nm. Then the bearing nut must not be loosened.

The steered axle is supported by a pendulum suspension and is operated by a double-acting steering cylinder. The mechanism includes the smallest possible number of moving parts to minimise the number of service points and to simplify maintenance.

The mounting in the chassis comprises entirely maintenance-free rubber elements. On certain machines, the rear suspension is fitted with a pivoted joint. This is used to indicate a too low loading of the steered axle, i.e. the risk of tipping forwards. When only the weight of the steered axle remains, a "gap" is created which is indicated by a sensor. See further description under Group 20, overload indication system.

The knuckle pins and wheel axles are mounted in taper roller bearings. The hydraulic circuits of the steering system are described in Group 70.





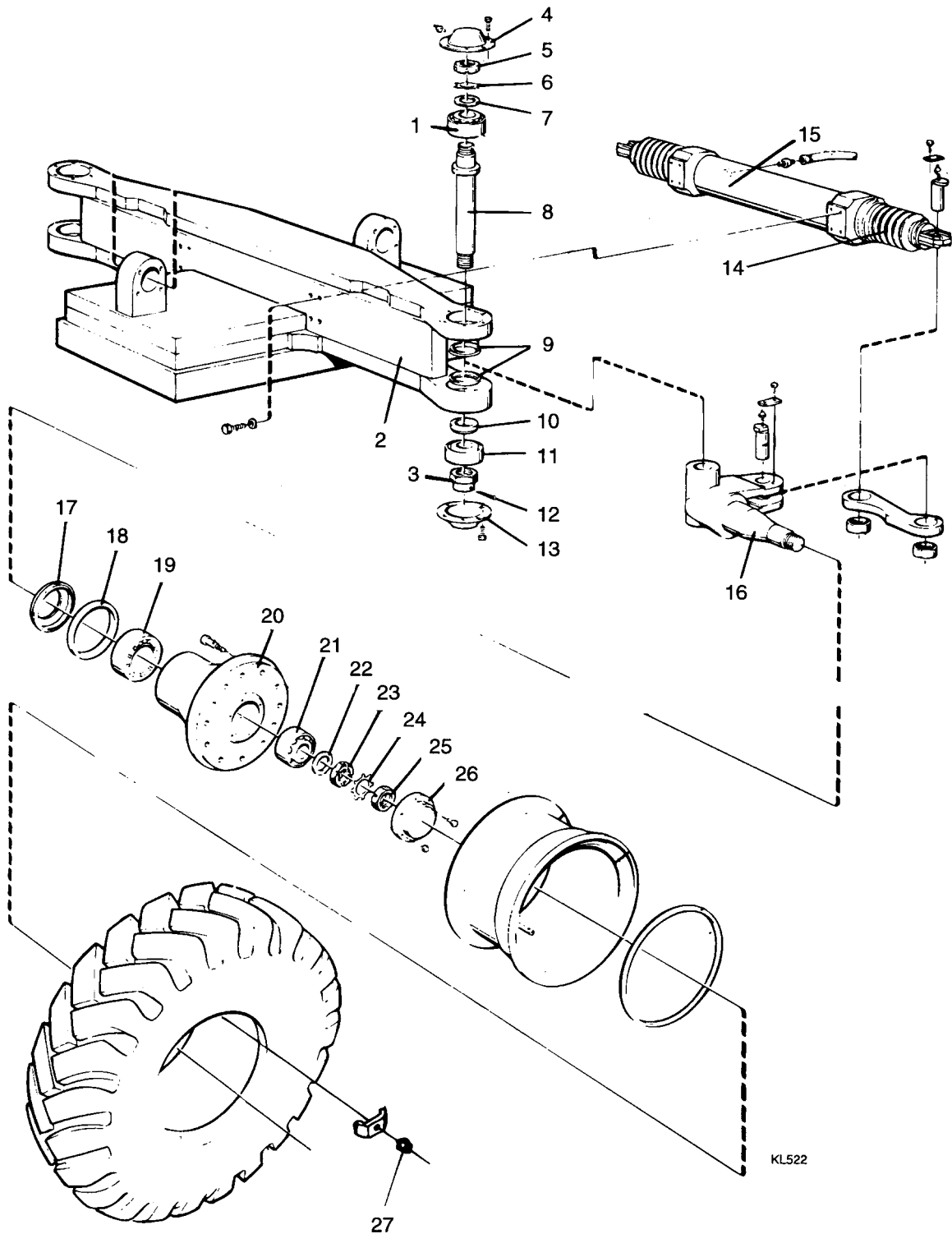
Replacement of steering cylinder

1. Disconnect the hydraulic connections from the steering cylinder, and protect the open ends of the cylinder and hoses by means of caps or plugs.
2. Release and remove the piston rod pivot spindles.
3. Remove the bolts retaining the cylinder on the steering cradle.
4. Remove the cylinder.
5. Fit the new cylinder and coat the mounting bolts with LOCTITE.
6. Connect the piston rod ends to the link levers. Secure the pivot spindles by means of the locking washers.
7. Connect the hydraulic hoses.

Replacement of knuckle pin bearings

Dismantling

1. Jack up the steered wheel end of the truck and block it up in a safe manner.
2. Remove the retaining ring from the steered wheel and remove the wheel.
A trolley with a rest for holding the wheel securely will be needed for handling purposes.
3. Secure a sling around the hub neck and lift until the hub is held in position.
Use a trolley, pallet truck or the like provided with a rest.
4. Remove the protective cover from the upper bearing of the knuckle pin.
5. Release the tabs of the tab washer. Remove the upper bearing nut and remove the tab washer and plain washer.
6. Remove the protective cover from the lower bearing, remove the split pin from the bearing nut and remove the nut. The inner race of the bearing is loose and can be removed.
7. Remove the knuckle pin by tapping it upwards. The inner race of the upper bearing will accompany the pin.
8. Use a trolley to lift out the wheel axle.
9. Remove the wipers from the steering cradle.
10. Remove the outer bearing races from the steering cradle by means of an internal puller.
Note. If a suitable puller is not available, lugs for a pulling tool may be welded to the inner race. The race will then shrink and will be easier to remove.



KL522

- | | | |
|------------------------------|-----------------------|-------------------------------|
| 1. Upper bearing | 10. Spacer | 19. Inner bearing |
| 2. Steering cradle | 11. Lower bearing | 20. Hub |
| 3. Bearing nut | 12. Split pin | 21. Outer bearing |
| 4. Cover | 13. Cover | 22. Washer |
| 5. Bearing nut | 14. Gaiter | 23. Bearing nut |
| 6. Tab washer, to be greased | 15. Steering cylinder | 24. Tab washer, to be greased |
| 7. Plain washer | 16. Wheel axle | 25. Lock nut |
| 8. Knuckle pin | 17. Spacer | 26. Cover |
| 9. Wiper | 18. Sealing ring | 27. Wheel nut |

Assembly

1. Pack the outer races of the bearings with grease and press them into the steering cradle.

Note that these are taper bearings. Fit the inner races so that the larger inside diameter faces outwards.

A round plate should be made for each bearing size for pressing in the races. A heavy hammer can then be used to hammer the plate for driving in the race. Don't hammer the bearings directly since they may not enter straight and may become jammed in the housing.

2. Fit new wipers to the steering cradle, using a suitable ring to tap them in. Tapping the wipers in with a hammer will damage them.
3. Lift the wheel axle into position by means of a hand trolley or hoist.
4. Make sure that the contact surface of the wheel axle is clean and in proper contact with the knuckle pin. Insert the knuckle pin, fit the spacer and lower bearing inner race (packed with grease), and fit the bearing nut.
5. Fit the upper bearing inner race (packed with grease), the plain washer and the tab washer in position. Grease the tab washer to ensure that it will not be damaged by the bearing nut.
6. Tighten the lower bearing nut, see Data, and secure it with a split pin.
7. Tighten the upper bearing nut, see Data. Release the lifting device as the nut is tightened to ensure that the lifting device does not prevent tightening.
8. Coat the covers with sealing compound, pack them with grease and top up with grease through the grease nipple when the cover is in position and the sealing compound has dried.
9. Check the tightening torques every 1000 running hours.

Replacement of steered wheel bearings

Dismantling

1. Jack up the steered wheel end of the truck and block it up in a safe manner.
2. Remove the retaining ring from the steered wheel and remove the wheel.

Note. A trolley with a rest for holding the wheel securely will be needed for handling purposes.

3. Remove the hub cover.
4. Secure a lifting sling to the hub, preferably using one of the hub bolts. Fit a nut to secure the bolt. Use a hand trolley, pallet truck or the like for lifting the hub.

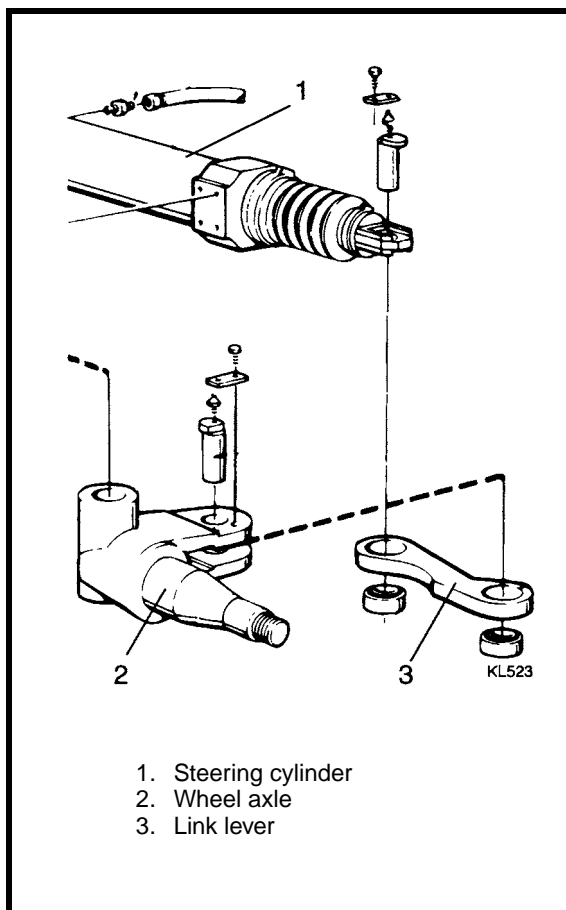
5. Remove the tab washer, locknut and bearing nut. The plain washer is loose.
6. Remove the hub off the wheel axle by means of the hand truck. The inner race of the outer bearing will accompany the hub.
7. Withdraw the inner race of the inner bearing from the wheel axle.
8. Remove the seal, but leave the spacer in position.

Assembly

1. Pack the outer races of the bearings with grease and press them into the hub.
Note that these are taper bearings. Fit the inner races so that the larger inside diameter faces outwards.

A round plate should be made for each bearing size for pressing in the races. A heavy hammer can then be used to hammer the plate for driving in the race. Don't hammer the bearings directly since they may not enter straight and may become jammed in the housing.

2. Press a new seal into the hub. Use a suitable round plate for this purpose. Tapping the seal itself with a hammer will damage it.
3. Clean the spacer and pack it with grease.
4. Tap the inner race of the inner bearing onto the wheel axle, using a suitable tube. Pack the inner race with grease.
5. Lift the hub onto the axle, fit the inner race of the outer bearing position and pack it with grease.
6. Fit the plain washer and bearing nut with the flat surface facing inwards. Tighten the bearing nut, see Data.
7. Fit the tab washer and locknut. Grease the tab washer to prevent damage by the nut. Tighten the locknut and lock both the bearing nut and the locknut with the tabs.
8. Pack the outer bearing with grease, pack the bearing cover with grease and fit it into position. Top up with grease through the grease nipple.



Miscellaneous

The steered wheel alignment is not adjustable. If the link levers have been deformed so that the wheel alignment has been disturbed, the link levers must be replaced.

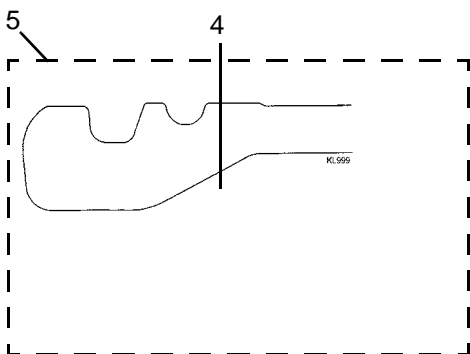
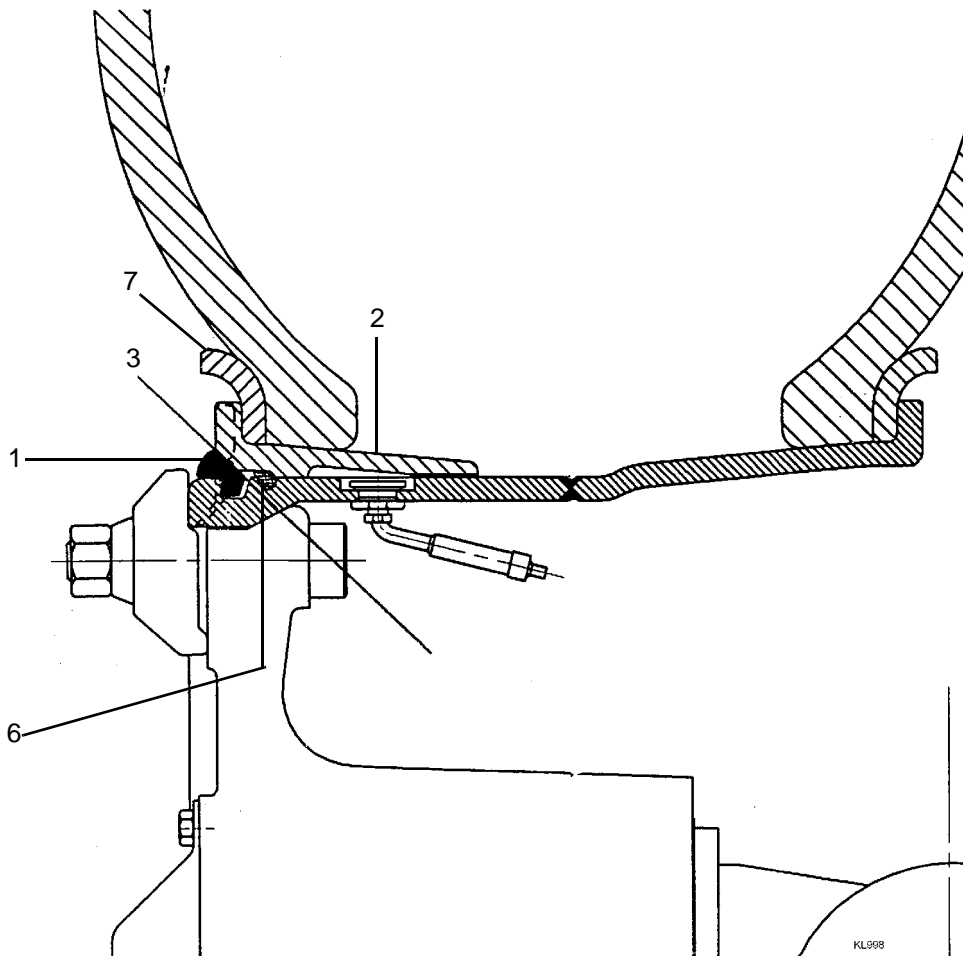
IMPORTANT!

The orientation of the link levers must be correct, since they will otherwise be damaged by the wheels when the steering movements are large. The correct orientation of the levers is shown in the figure.

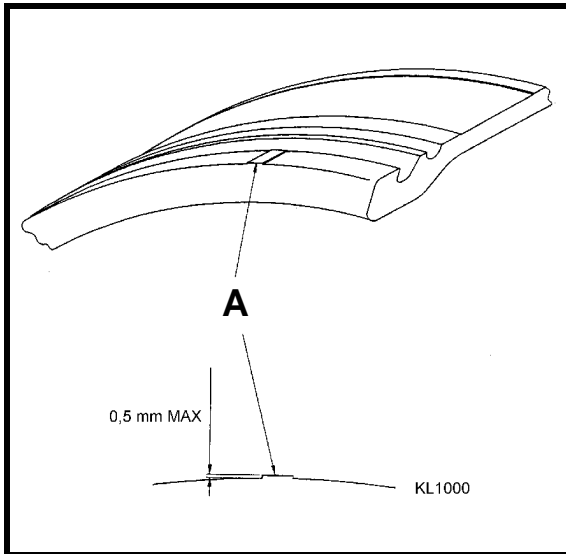
Inspection of dismantable rims

Due to special operating conditions for dismantable rims, there is a risk of excessive wear of the lock ring groove in the rim bead, the lock ring itself and the 45° face on the beadseat or loose flange. In extreme circumstances this can lead to breakage of the rim bead which in turn has potentially dangerous consequences.

To minimize the risk of an accident the inspection should be carried out on all EM-wheels (EM=Earth Moving) and dismantable rims.

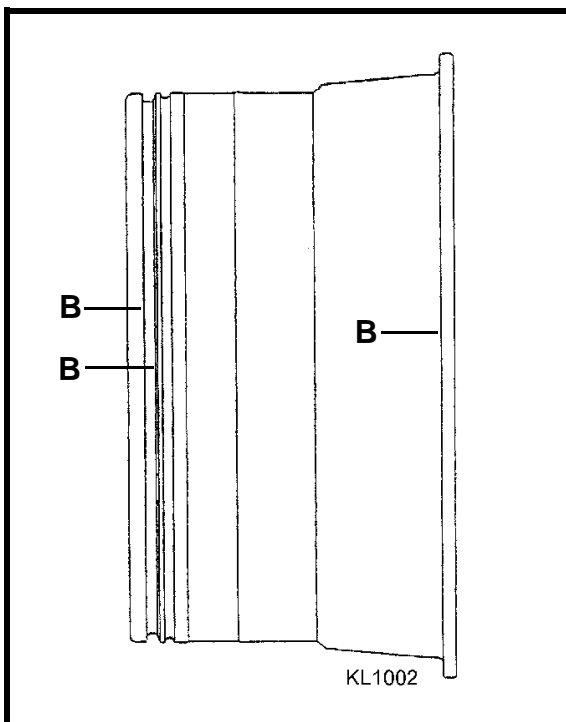
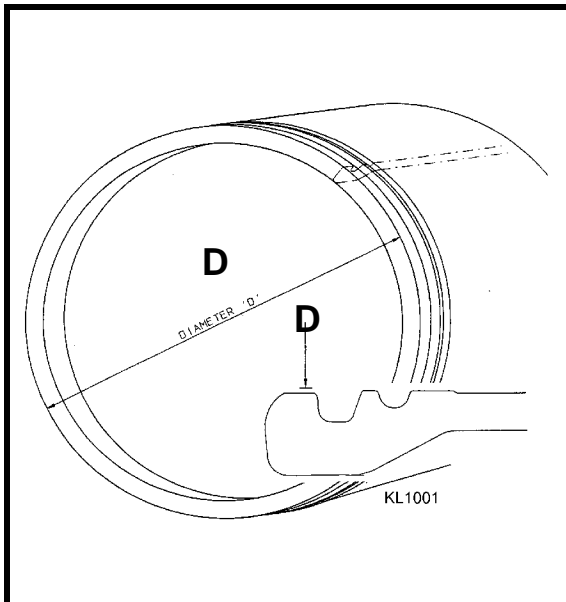


1. Lock ring
2. Beadseat
3. 45° surface on the beadseat or loose flange
4. Lock ring groove
5. Rim bead
6. O-ring
7. Support ring



Inspection procedure

1. Dismantle the rim according to the standard procedures, see also Safety instructions when working with tyres, group 00.
2. Carefully clean the outside of the rim beadrim bead by using a wire brush.
3. The wear of the lock ring on the rim bead outside diameter can produce a mark A. The mark is located between the ends of the lock ring, see picture.
4. Measure the depth of the wear at this point using a straight edge and feeler gauge. If the wear exceeds 0,5 mm, the wheel, the lock ring, and the beadseat or loose flange must be discarded and replaced with new.
5. If a wear mark is not possible to find, measure the circumference of the rim bead using a measuring tape.
6. Calculate the diameter $D = \text{Circumference} / 3.14$
7. If the diameter is below the minimum specified, the wheel, the lock ring and the beadseat or loose flange must be discarded. Information on the minimum diameter of your rim bead can be received from Kalmar.



High stress areas, how to identify rim damage

1. High stress areas are marked with B on the illustration
2. Typical faults are: circumferential cracks, fretting, corrosion pitting, distortion, wear.
3. Inspect above areas at each tyre change

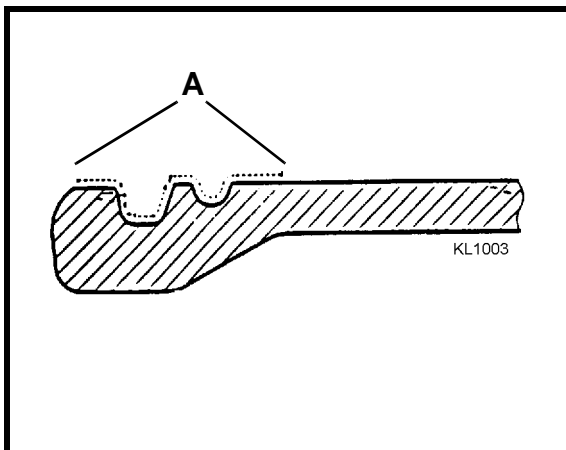
Safety test when changing tyres

The test is intended for detecting cracks in wheels. Cracks can lead to safety risks if they are not detected and remedied.

Potential cracks that cause air leakage are not detected in the test described here.

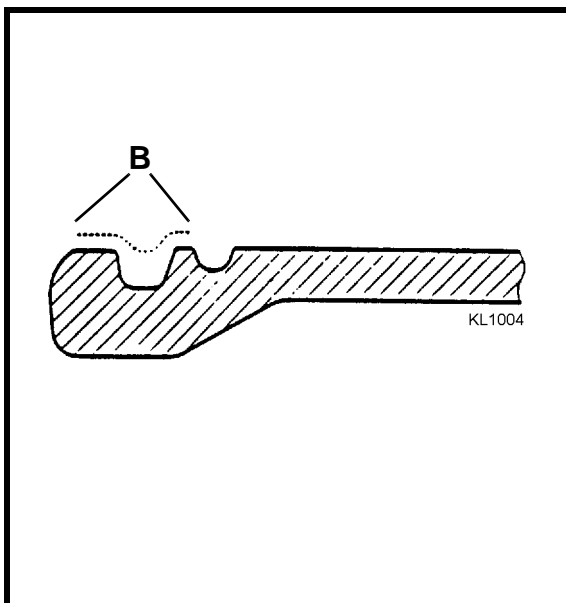
The test is carried out in two steps

1. Magnetic examination, which quickly indicates the crack.
2. The actual crack is then tested with penetrance.



Magnetic examination

1. Dismantle the loose components of the wheel
2. Clean area **A** on the the wheel totally for paint residue by using shot blasting.
3. Carry out magnetic examination by using e.g.:
Equipment: Yoke Tiede
Technique:a. Electricity AC
b. Contrast paint
Test medium:a. Wet
b. colour (E-G- Tiede ferrolux)
4. If no cracks are indicated in the magnetic examination, the test is completed and the wheel approved. In case cracks are indicated, carry out the penetrance test.

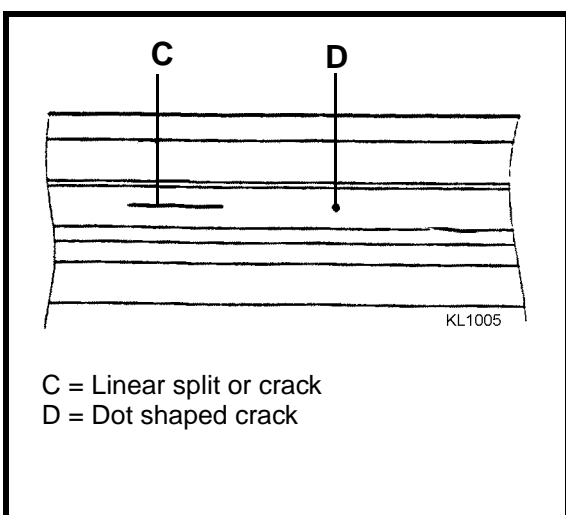


Penetrance test

1. Clean area **B** with cleaning fluid, part.no. 923626.0668.
2. Spray penetrance on the cleaned area and let the sprayed area dry for approximately 10 minutes
Penetrance: Part no. 923626.0669
3. Clean off the penetrance by using cleaning fluid (Part.no. 923626.0668). All excessive penetrance should be removed.
4. Wipe off the cleaning fluid with a cloth, the remaining penetrance must evaporate.
5. Spray developer on the area **B**.
Developer: Part.no 923626.0670
6. Let the sprayed area dry for 1-2 hours.
7. Inspect the lock ring groove visually.
8. If the marked area **B** shows no linear or dot shaped cracks the wheel is approved.
9. If the marked area **B** shows linear or dot shaped cracks, the wheel must be rejected.

C = Linear split or crack

D = Dot shaped crack

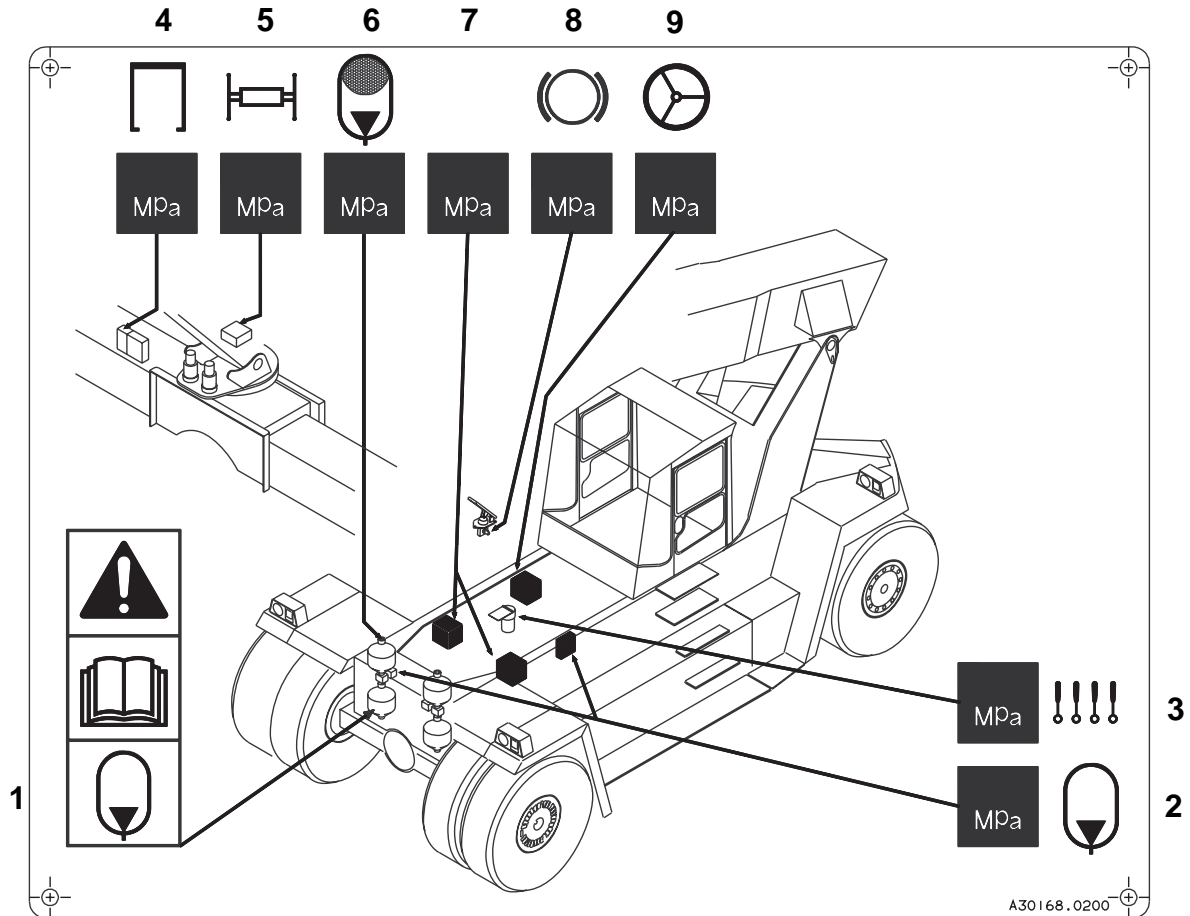


Group 70

Hydraulic system

Specifications	2
Main hydraulics	3
Description	3
Overview	3
Electro-hydraulic servo system, principles	3
Working hydraulics, feed	4
Servo circuits	10
Lift	11
Boom extension	13
Service	15
Hydraulic fluid	15
Hydraulic oil filter	15
Breather filter	15
Hydraulic fluid filter for the servo hydraulics	16
Hydraulic fluid filter for the brake cooling circuit	16
Steering system	17
Description	17
Steering valve	18
Priority valve	20
Brake system	22
Description	22
Brake system	22
Cooling circuit	23
Main components of the brake system	23
Brake system, feed	24
Hydraulic accumulators	26
Accumulator charging valve	27
Hydraulic brake pedal	28
Parking brake	29
Parking brake valve	29
Service	30
Accumulators, checking the pre-charging pressure	30
Hydraulic oil cooler	31
Adjusting the WDB brake system	33
Cab movement	34
Tilt, attachment	34
Hydraulic pumps	35
Description	35
Variable axial piston pump	35
Vane pump	36
Service	37
Setting the variable pumps	37
Main valve	39
Description	39
Service	40
Hydraulic cylinders	41
Service	41
Repairs to leaking hydraulic cylinders	41
Lifting cylinder	42
Telescoping cylinder, main boom	43
Damping cylinders, attachment	44
Diagrams	
Hydraulic diagram, component list	45
Hydraulic diagram, standard (H)	A23056.0400
Hydraulic diagram, separate brake system tank (H)	A23056.0500

See the hydraulic plate
 where all present settings are specified.



1. Warning! High pressure accumulators.
 Always empty the accumulators before working on the system. Use the accumulator evacuating valve. Carefully study the Instruction Manual and the Technical Handbook.
2. Charging pressure, accumulators.
 Setting on the accumulator charging valve.
3. Hydraulic servo pressure. Not adjustable.
4. Hydraulic pressure to bottom lift. (optional)
5. Hydraulic pressure to toplift.
6. Pre charging pressure, nitrogen, accumulators
7. Hydraulic pressure, working hydraulics, main valve
8. Hydraulic pressure, brake system
9. Hydraulic pressure, steering system

Overview

The numbers in the text preceded by an H, for example, H13, refer to the hydraulic system diagram. The numbering in the different illustrations is common with the hydraulic system diagram.

The hydraulic system consists of the following sub-systems:

- Working hydraulics that include:
 - Servo hydraulics that supply pressure to the electro-hydraulic servo system
 - Extension and retraction of the boom
 - Lift and lowering of the boom
- Attachment hydraulics (see group 80)
 - Rotation of the yoke (hydraulic motor)
 - Length adjustment of top-lift (hydraulic motor)
 - Side-shift of top-lift
 - Locking/release of twist-locks
- Foot brake system
 - WDB system, hydraulically controlled, oil-cooled multiple brake discs with external cooling
- Parking brake system, disk brake on the drive axle's ingoing axle, spring activated with hydraulic release.
- Steering system

Electro-hydraulic servo system, principles

The working hydraulics are controlled via an electro-hydraulic servo system, the principle components of which are illustrated on the next page.

All hydraulic system functions are controlled via three independent sub-systems:

- El-servo
- hydraulic-servo
- working hydraulics

The el-servo system is controlled by the ECU2 central computer unit as part of the truck's ECS system. Descriptions of the servo circuits can be found in group 20, under the ECU2 section.

From ECU2, digital or analogue signals are fed to the control lever. The signals are affected by the degree of movement of the control lever, after which they are fed back to and processed in ECU2.

The out-signals for LIFT/LOWER and BOOM OUT/IN from ECU2 are fed to converters (H14 and H15) on the main valve H16. The converters are electrically controlled pressure reduction valves that convert the electrical signal to a proportional hydraulic pressure - servo pressure.

The servo pressure affects the control slide in the main valve for the function in question and from there, the main flow.

Main valve 13 has no converter but obtains its servo pressure from the converter for the main valve 16.

The pressure regulator valve for the servo circuit obtains its hydraulic pressure from pump 2 and provides 30-35 bar servo pressure to the converters on the main valves of the truck and attachments and for release of the parking brake.

Working hydraulics, feed, standard system

The trucks working hydraulics are fed from five different pumps. Pumps H2 and H3 are double variable axial piston pumps that feed the main valves for lift and boom extension as well as the steering system's priority valve. Both pumps are connected together and can therefore be regarded as a single pump. The non-return valve H6 ensures that the pumps cannot interfere with each other.

The priority valve H10, ensures that there is always pressure to the steering system and thereafter, that there is servo pressure via the pressure regulator valve H10a and that the residual flow goes to lift and boom extension.

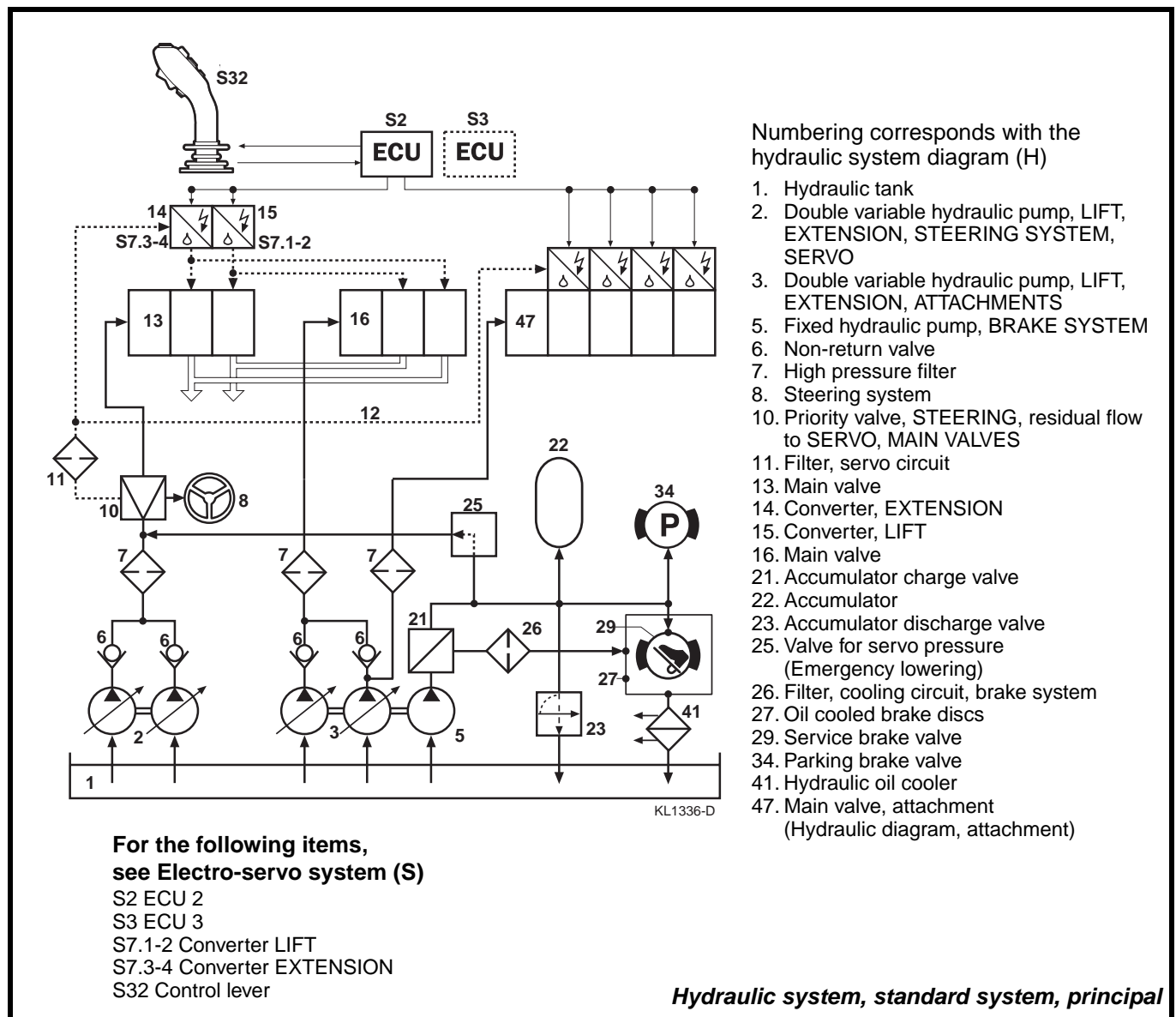
Pump H3b feeds the different attachment functions.

Pump 5 is a fixed vane type pump that feeds the brake system's brake and cooling circuits via an accumulator charging valve H21.

Both main valves are connected in parallel, both for servo and main flows, which takes maximum advantage of pump capacity for lift and boom extension.

The pumps draw fluid from the hydraulic tank that is located on the right hand side of the truck. The pressurized fluid travels from the pumps to the high pressure filter for cleaning prior to circulating in the system.

The hydraulic system is controlled, from the cab, with a joystick.

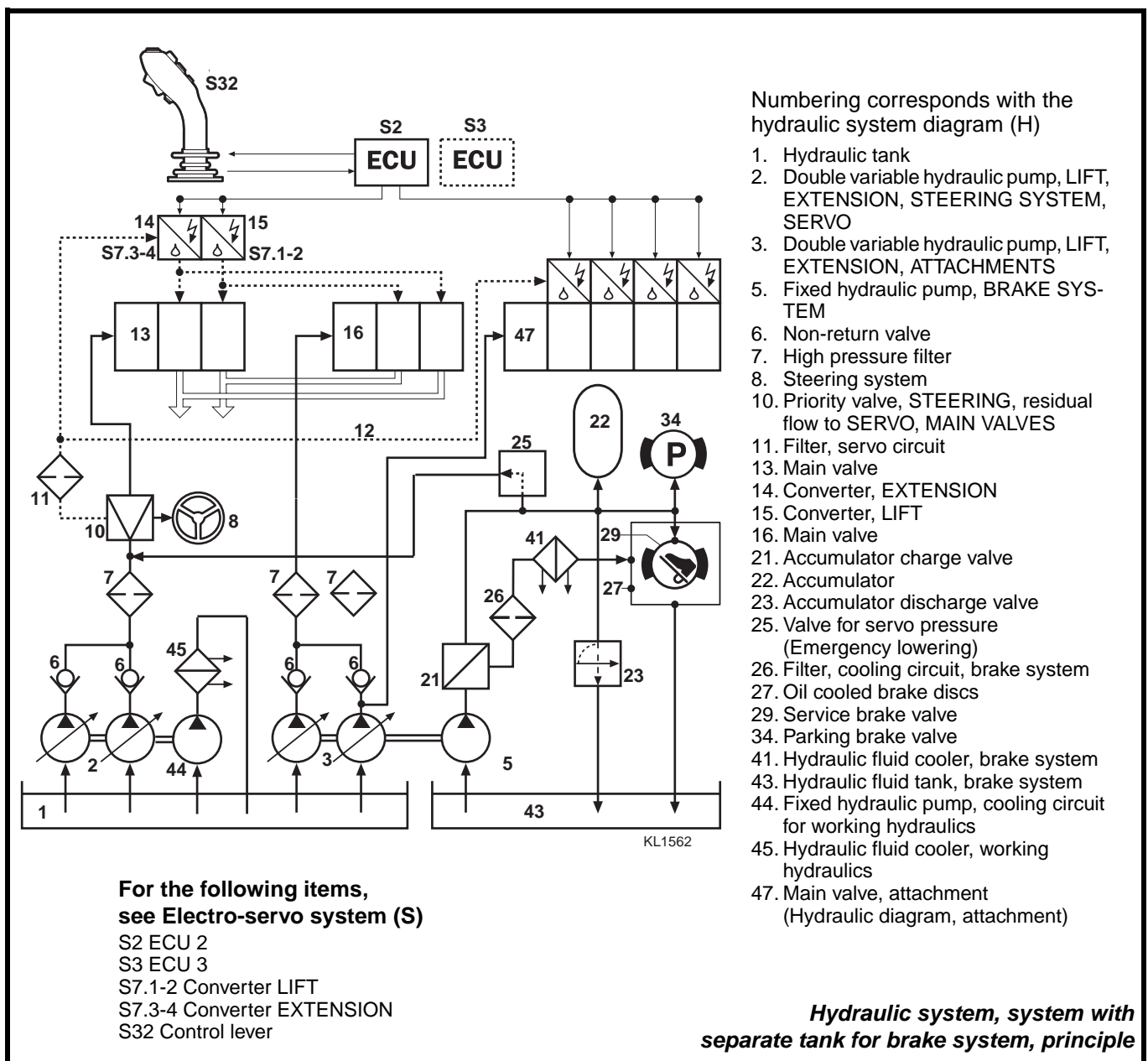


System with separate tank for brake system

Certain machines are equipped with a separate hydraulic tank for the brake system. The brake system is fed, as with the standard system, by means of the fixed pump 5 and is cooled by means of the hydraulic fluid cooler 41.

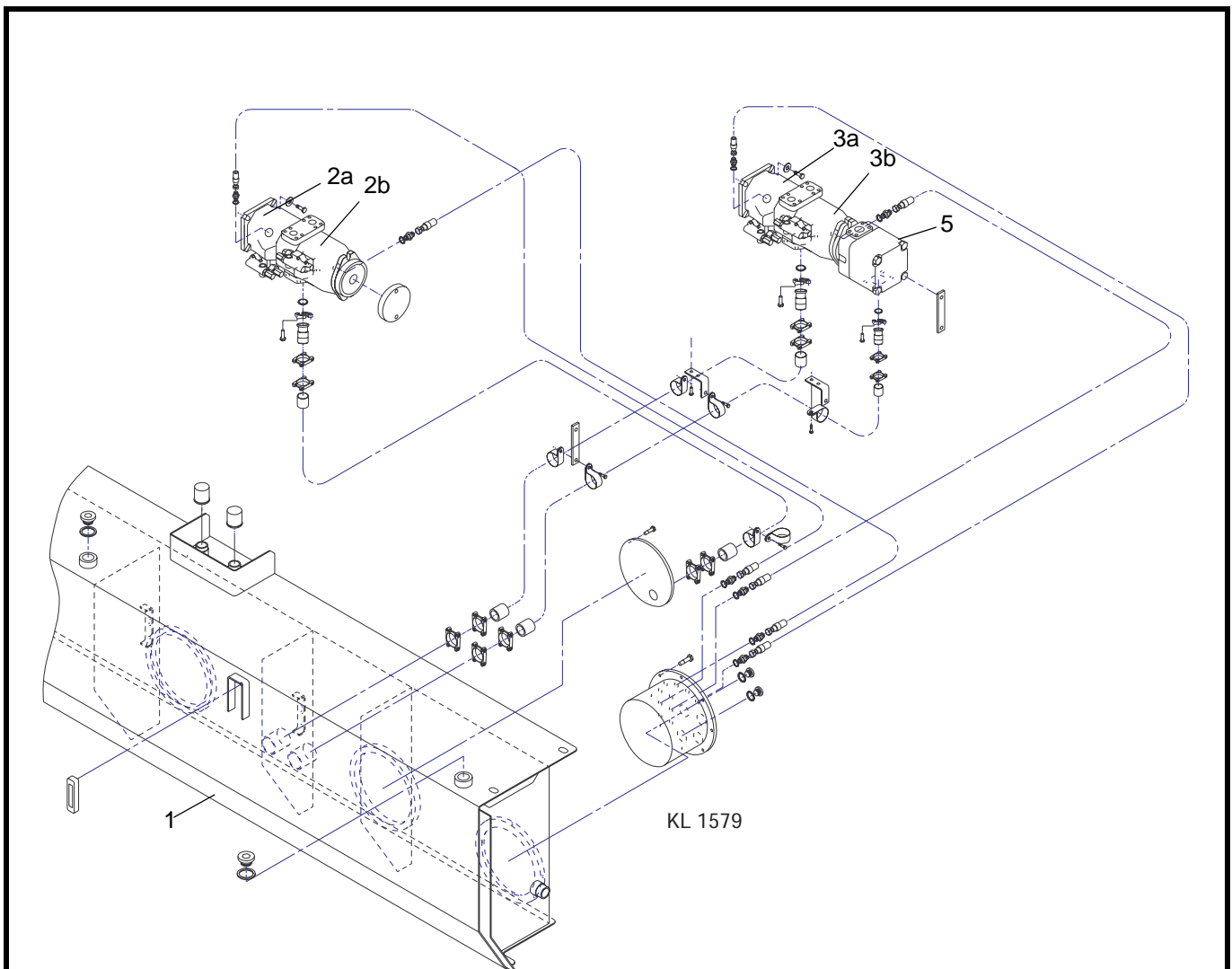
Working hydraulics are complemented with a separate fixed pump 44 for circulation in the cooling circuit through the hydraulic fluid cooler 45.

Otherwise, the system works in the same way as the standard system.



The double variable pumps H2 and H3 are controlled by load signals (LS). The flow requirement in each function determines the degree of pump output. The outer pump H3b receives LS-signal from the priority valve H10. In the H3 LS-line is a solenoid valve H40 which, when deactivated, drains H3b LS-connection to tank. (See hydraulic diagram and pictures following pages). This will happen when any gear is engaged and the parking brake is OFF, e.g., when the truck is transporting. During lifting, when the gearbox is in neutral or when the gearbox is disengaged, the solenoid valve H40 is activated and the pump H3b works normally.

Another solenoid valve, H42, loads pump H3b for feeding the attachment when any of the attachment functions are affected, regardless of whether the truck is standing still or in transport mode.



The numbers correspond to the hydraulic diagram (H)

1. Hydraulic tank
2. Double, variable hydraulic pump, LIFT, EXTENSION, STEERING SYSTEM, SERVO
3. Double, variable hydraulic pump, LIFT, EXTENSION, TOP LIFT
4. -
5. Fixed hydraulic pump, BRAKE SYSTEM

***Pumps, suction side and tank return,
standard system,***

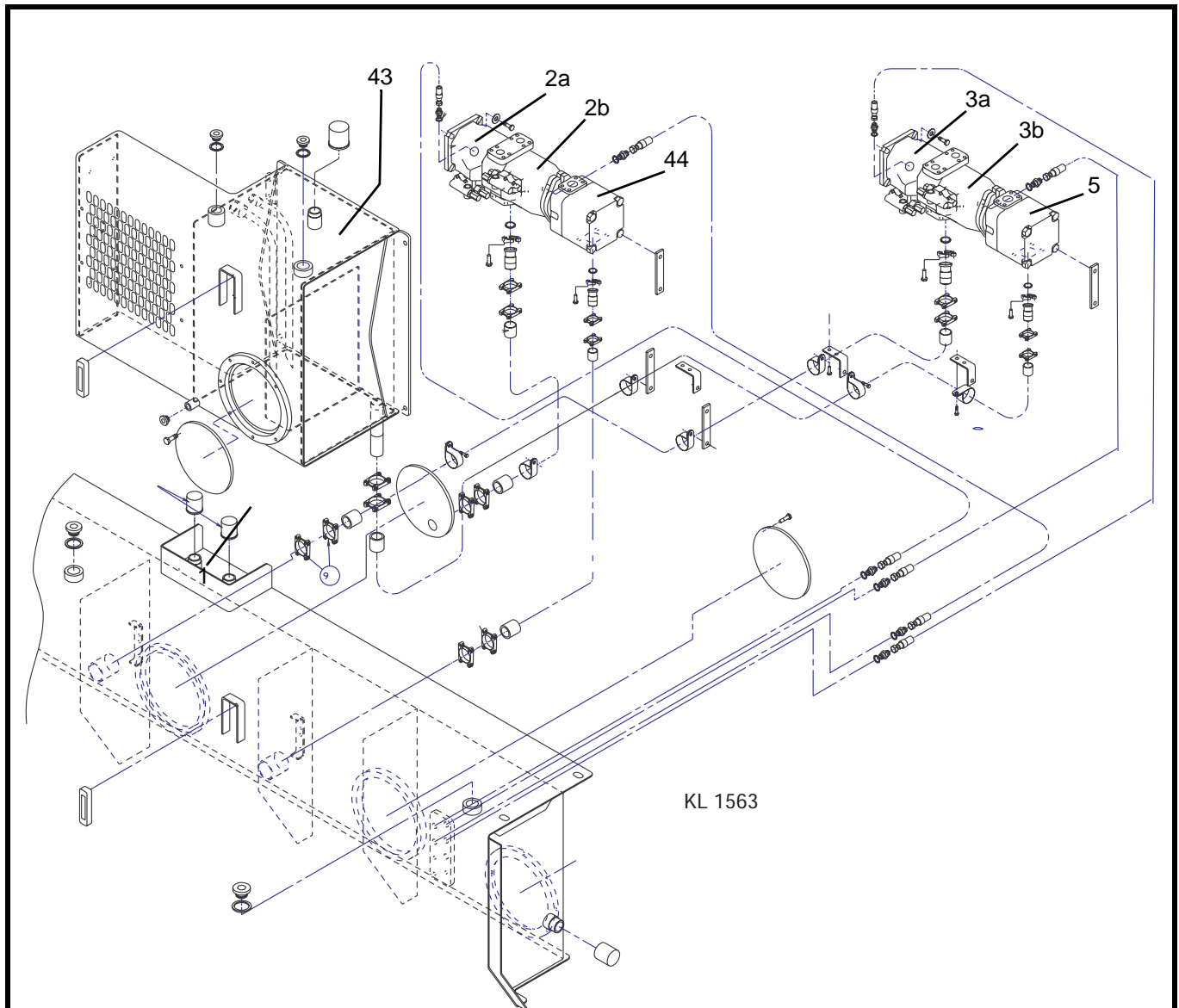
System with separate tank for brake system

The fixed hydraulic pump 44 provides the circulation in the cooling circuit of the working hydraulics.

Tank 43 is completely separate from the other hydraulics and contains hydraulic fluid for the brake system's brake and cooling circuits.

IMPORTANT!

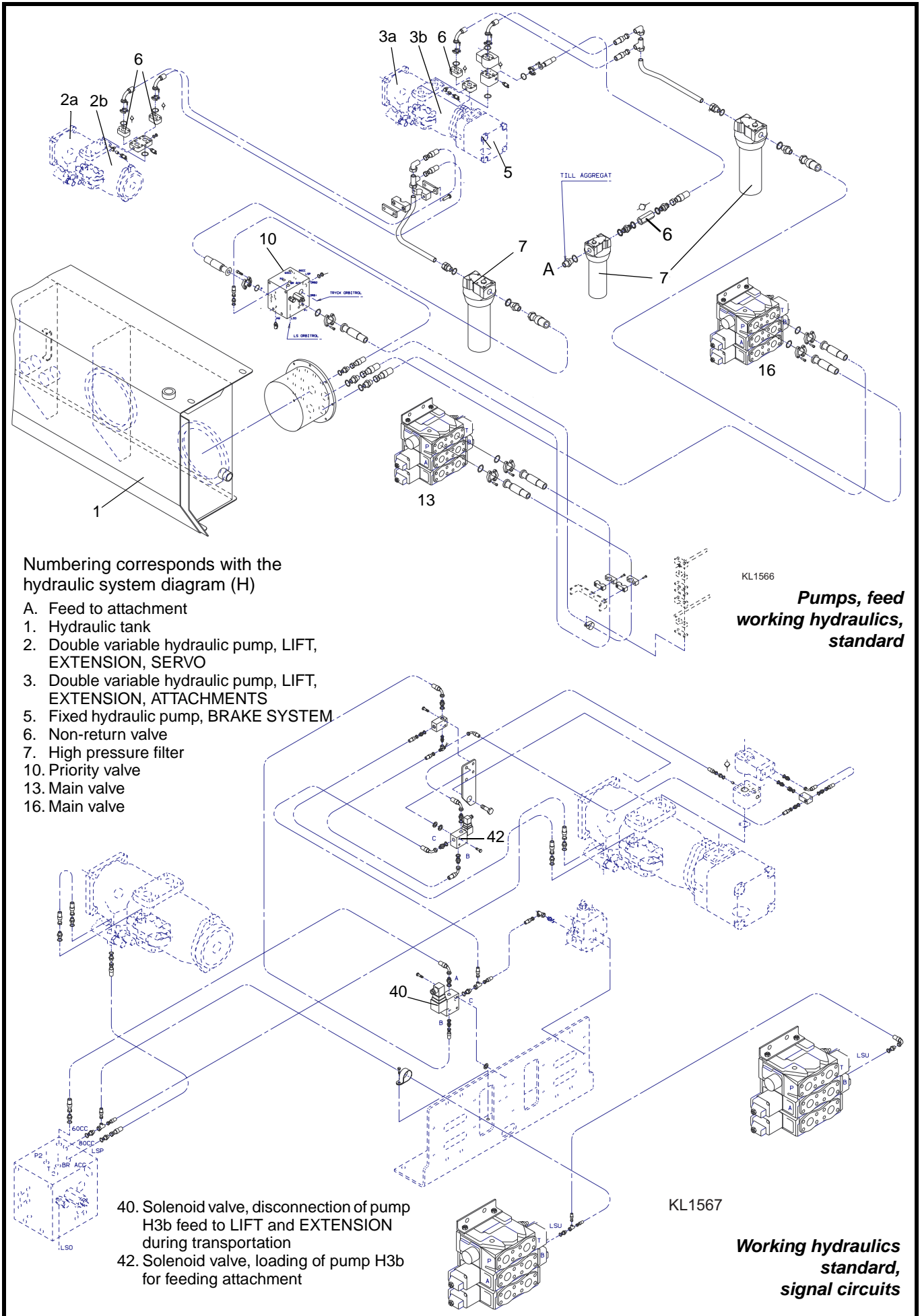
The hydraulic fluid in the separate tank for the brake system must never contain any additives.



The numbers correspond to the hydraulic diagram (H)

- 1. Hydraulic tank
- 2. Double, variable hydraulic pump, LIFT, EXTENSION, STEERING SYSTEM, SERVO
- 3. Double, variable hydraulic pump, LIFT, EXTENSION, TOP LIFT
- 4. -
- 5. Fixed hydraulic pump, BRAKE SYSTEM
- 43. Hydraulic fluid tank, brake system
- 44. Fixed hydraulic pump, cooling circuit for working hydraulics

***Pumps, suction side and tank return,
 system with separate tank for brake system***



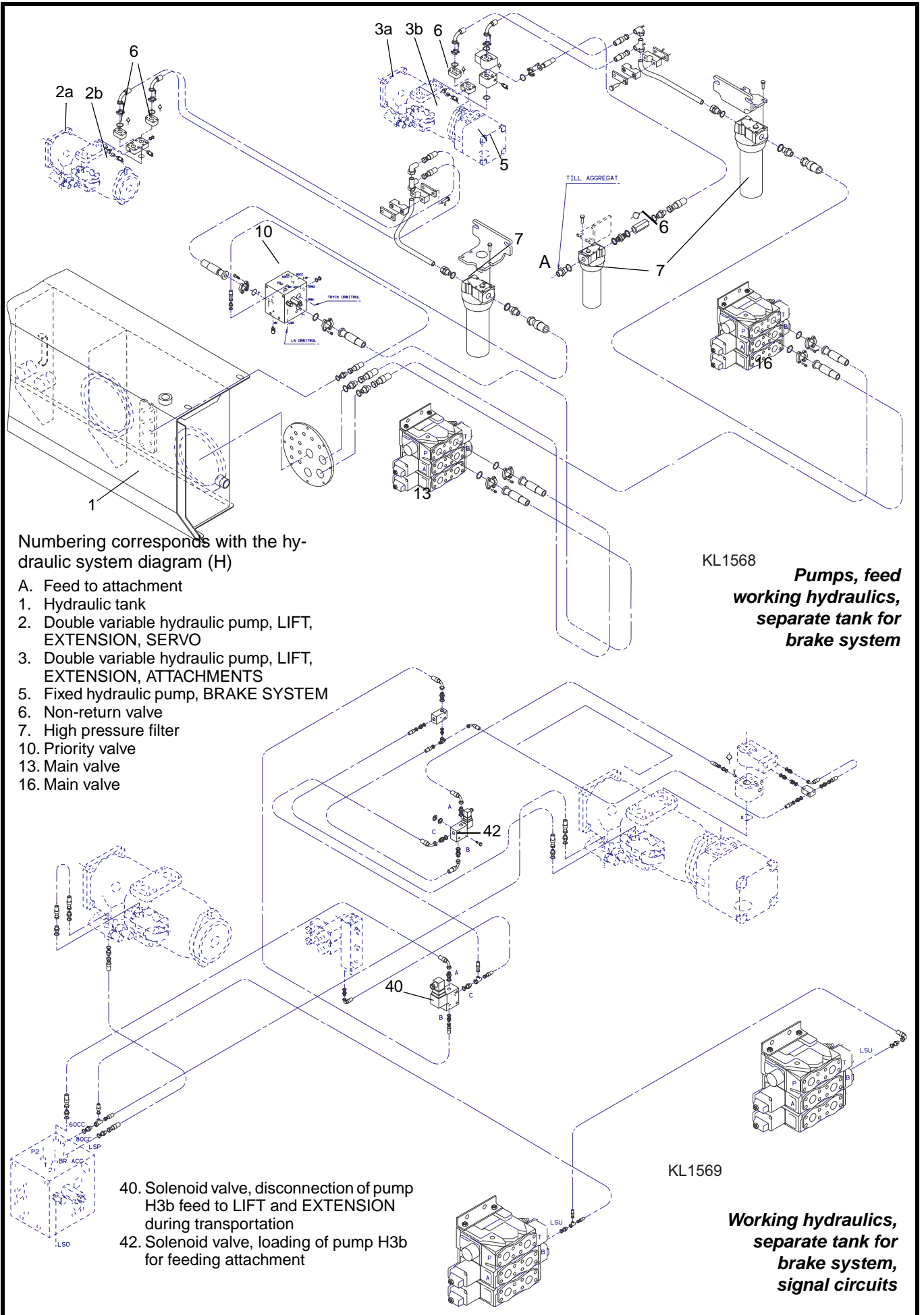
Numbering corresponds with the hydraulic system diagram (H)

- A. Feed to attachment
- 1. Hydraulic tank
- 2. Double variable hydraulic pump, LIFT, EXTENSION, SERVO
- 3. Double variable hydraulic pump, LIFT, EXTENSION, ATTACHMENTS
- 5. Fixed hydraulic pump, BRAKE SYSTEM
- 6. Non-return valve
- 7. High pressure filter
- 10. Priority valve
- 13. Main valve
- 16. Main valve

KL1566
**Pumps, feed
 working hydraulics,
 standard**

- 40. Solenoid valve, disconnection of pump H3b feed to LIFT and EXTENSION during transportation
- 42. Solenoid valve, loading of pump H3b for feeding attachment

KL1567
**Working hydraulics
 standard,
 signal circuits**



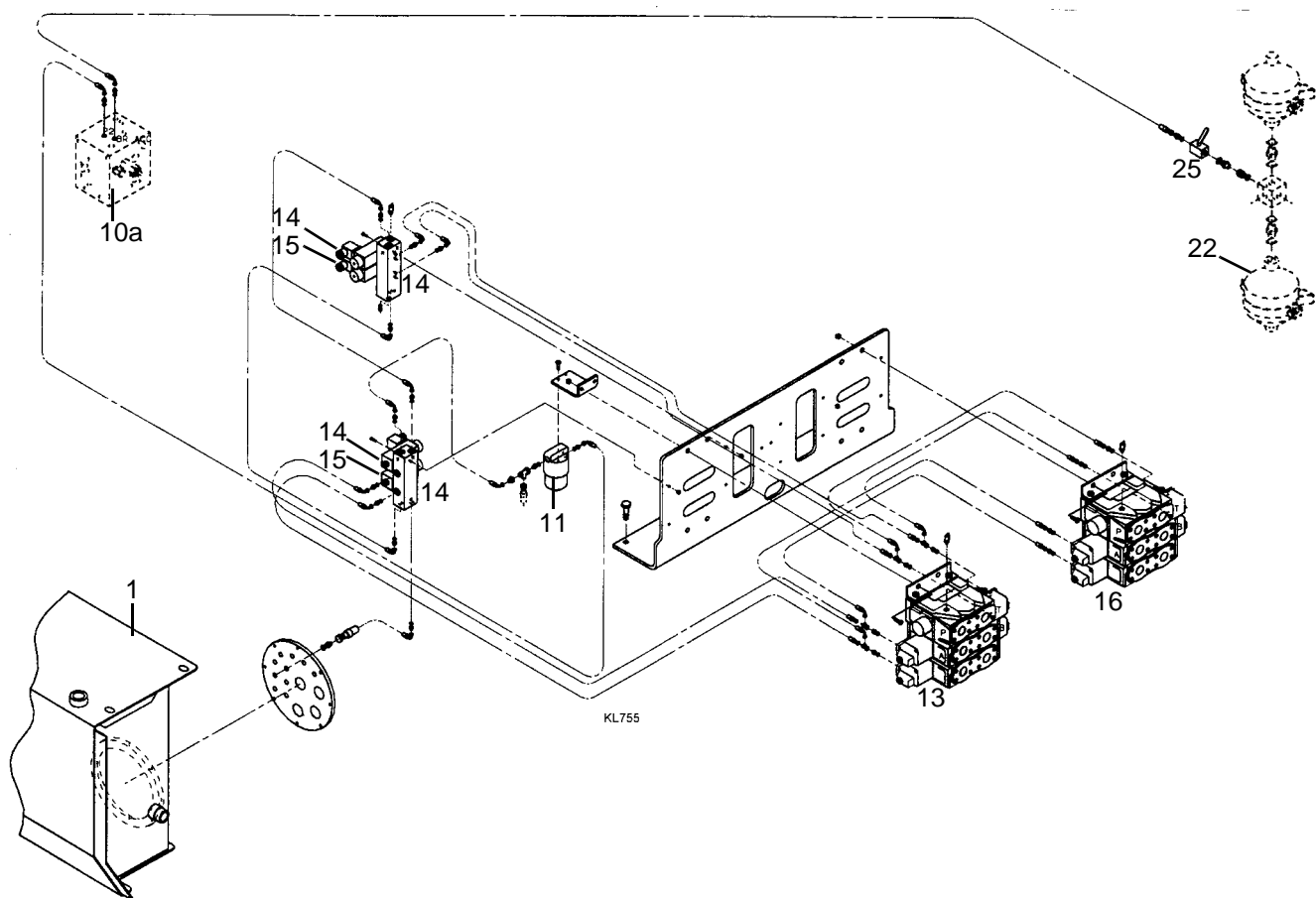
Numbering corresponds with the hydraulic system diagram (H)

- A. Feed to attachment
- 1. Hydraulic tank
- 2. Double variable hydraulic pump, LIFT, EXTENSION, SERVO
- 3. Double variable hydraulic pump, LIFT, EXTENSION, ATTACHMENTS
- 5. Fixed hydraulic pump, BRAKE SYSTEM
- 6. Non-return valve
- 7. High pressure filter
- 10. Priority valve
- 13. Main valve
- 16. Main valve

KL1568
Pumps, feed working hydraulics, separate tank for brake system

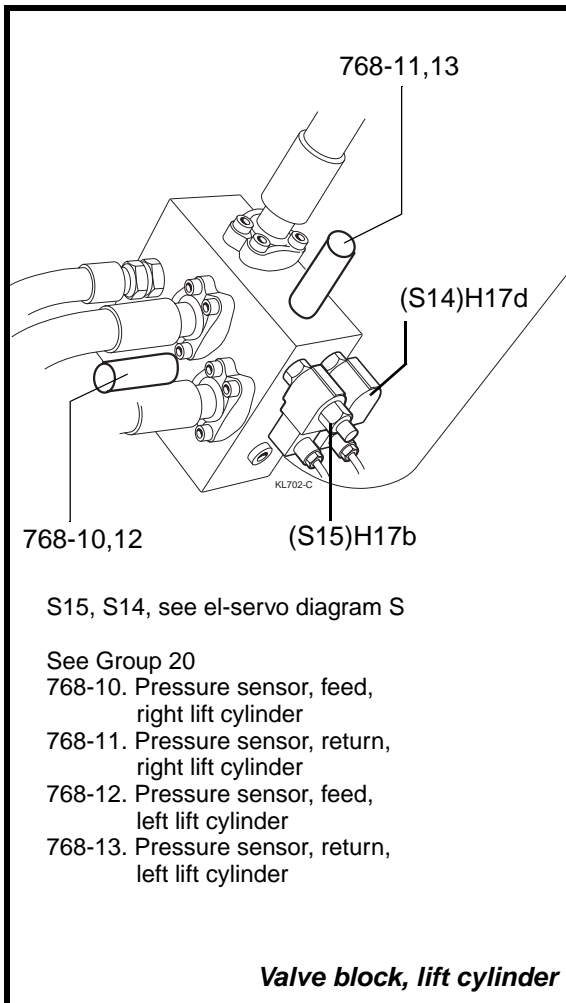
KL1569
Working hydraulics, separate tank for brake system, signal circuits

- 40. Solenoid valve, disconnection of pump H3b feed to LIFT and EXTENSION during transportation
- 42. Solenoid valve, loading of pump H3b for feeding attachment



Numbering corresponds with the hydraulic system diagram (H)

- 1. Hydraulic tank
- 10a. Pressure regulator valve SERVO, 30-35 bar
- 11. Filter, servo circuit
- 13. Main valve
- 14. Converter, EXTENSION
- 15. Converter, LIFT
- 16. Main valve
- 22. Accumulator
- 25. Valve for reserve servo pressure



Lift

Both lift cylinders are, on the piston side, provided with valve blocks (H17) which contain blocking valves.

When the lift cylinder is in the bottom position and the lift lever is not touched, the blocking piston is held in the closed position by spring pressure as well as by blocking pressure through the solenoid valve. When lifting, hydraulic fluid is fed to the inlet VA, the piston opens and releases fluid through port C+ to the lift cylinder. Opening pressure is 2.5 bar.

The valve holds the load by means of fluid pressure from the lift cylinder to port C+. The pressure is choked as blocking pressure and presses the piston towards the closed position.

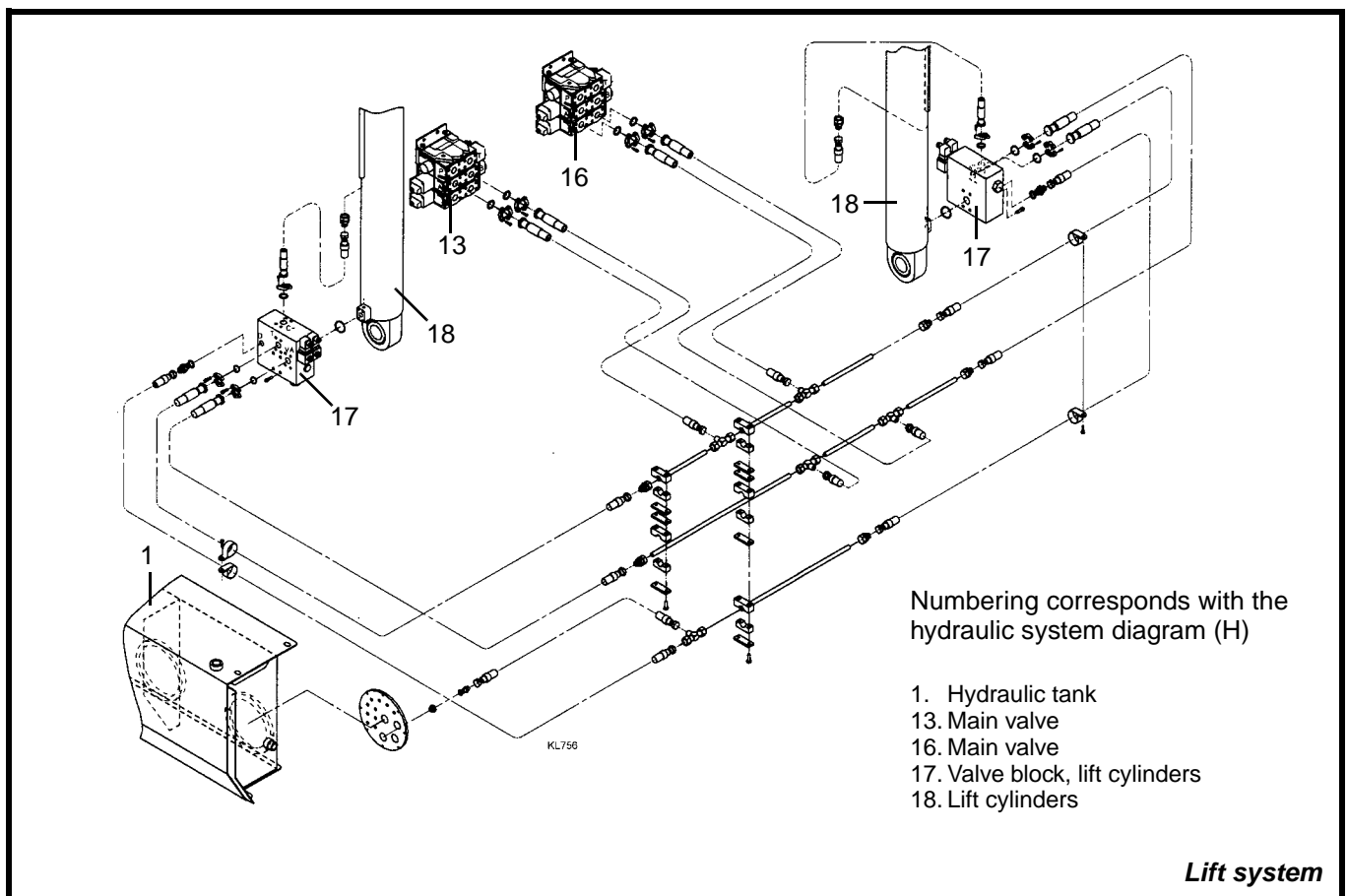
The blocking valves prevent communication between lift cylinders, which, in turn, prevents any twisting of the boom with uneven loads.

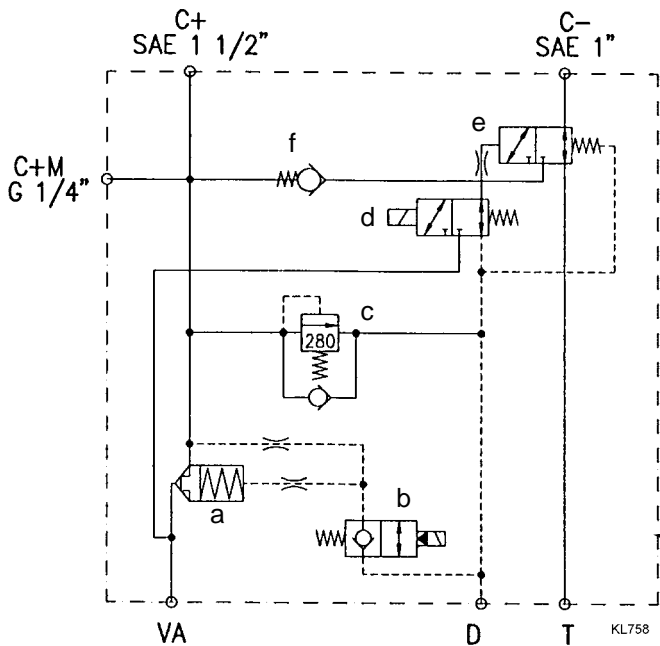
The lift cylinders are connected in parallel and are fed from both main valves with the combined capacity from the hydraulic systems four variable pumps.

Regeneration

For unloaded lift, i.e., low pressure in the lift circuit, the regeneration valve H17e opens. The return flow from the cylinder's rod side is re-routed and fed direct to the piston side. This provides considerable additional lift speed as the flow to the cylinder increases. With a certain increase in pressure in the lift circuit the regeneration valve closes and the system returns to normal lift.

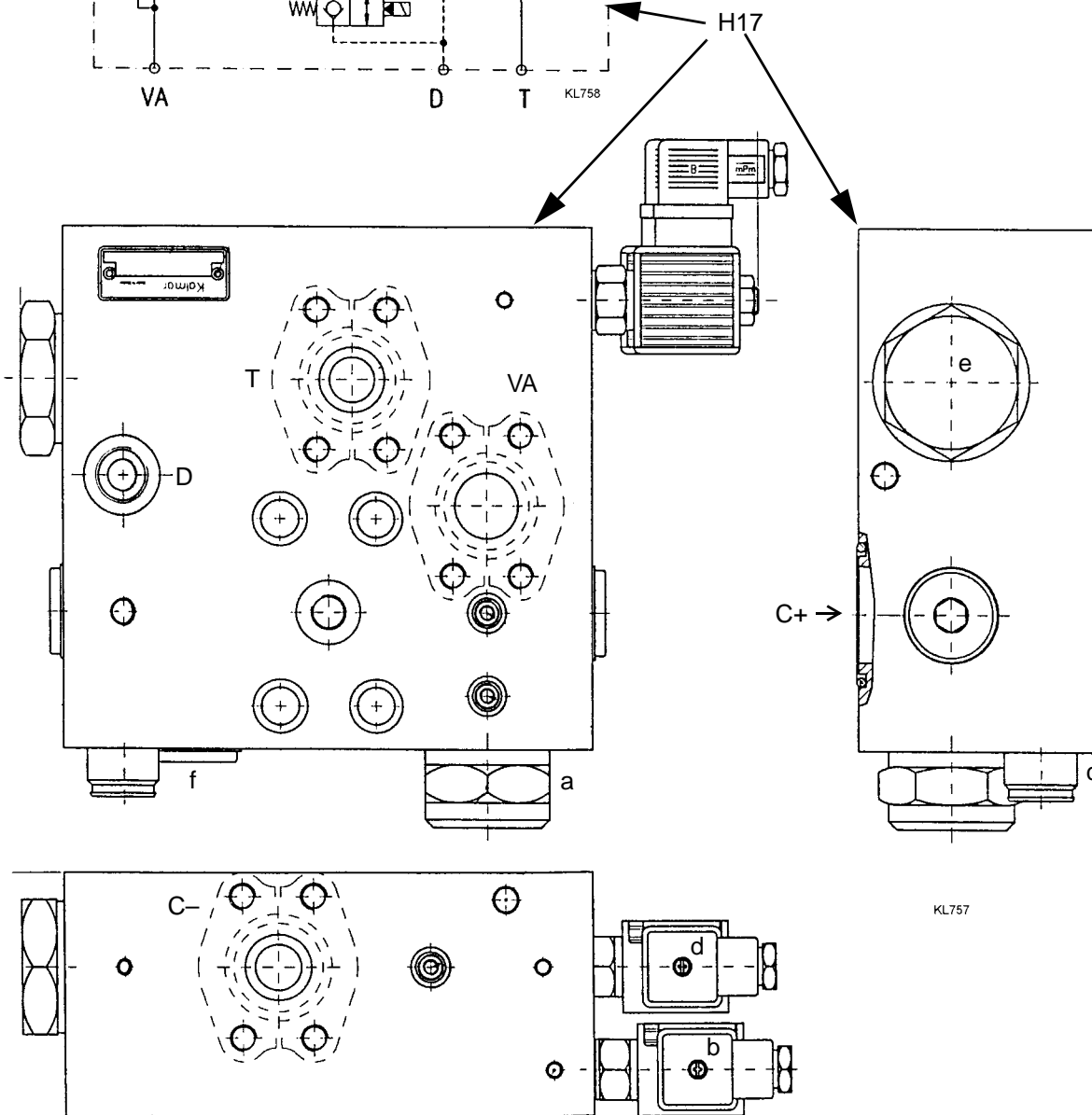
A detailed description of lift and regeneration functions can be found in group 20 El-Servo.





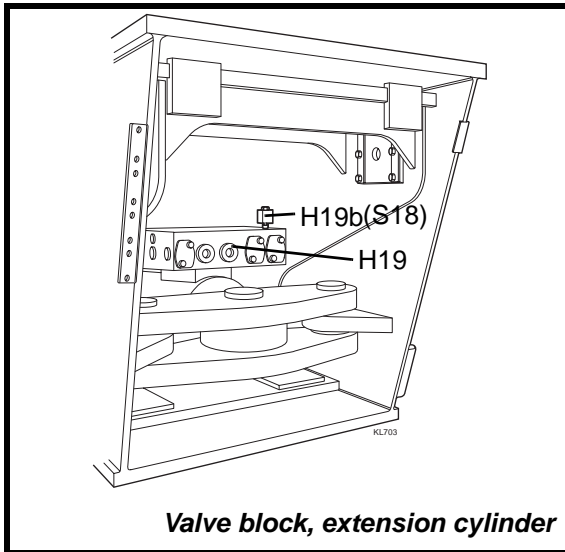
D Draining to tank
 C+ Feed to lift cylinder
 C- Return from lift cylinder
 T Tank return
 VA Feed from pumps

H17. Valve block, lift cylinders
 a. Blocking valve
 b. Solenoid valve, control of blocking valve
 c. Choke valve, 280 bar
 d. Solenoid valve, control of regeneration
 e. Regeneration valve
 f. Non-return valve



KL757

Valve block lift cylinder



Valve block, extension cylinder

Boom extension and retraction

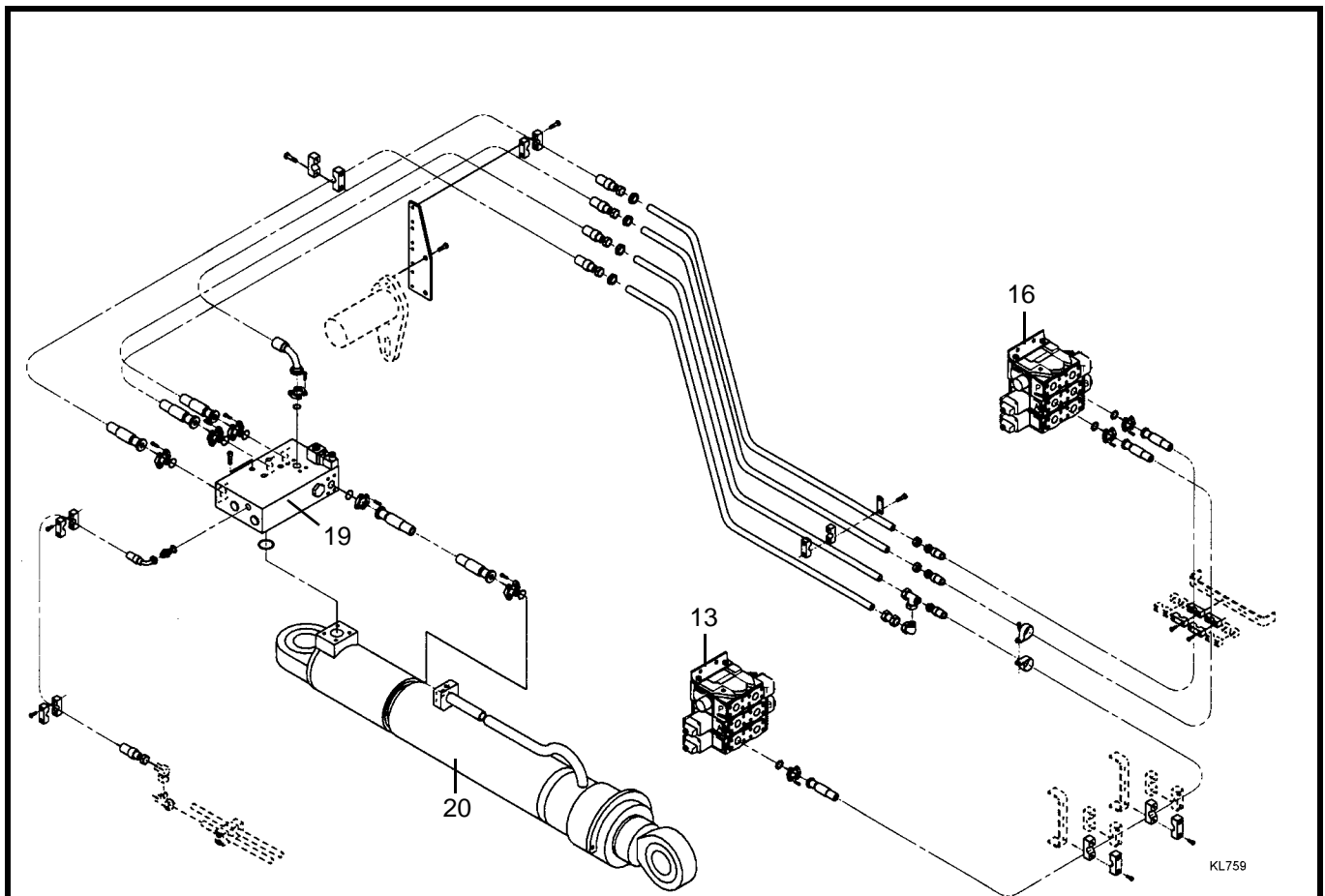
The extension cylinder is fed with hydraulic pressure from a section of each of the main valves. In this way advantage can be taken of the flow from all four hydraulic pumps.

In each of the feed lines there is a lowering (retraction) brake valve with pressure compensated choking, which prevents the boom from being retracted too quickly due to the load. This also functions as hose protection.

Regeneration

For unloaded lift, i.e., low pressure in the lift circuit, the regeneration valve H19c opens. The return flow from the cylinder's rod side is re-routed and fed direct to the piston side. This provides considerable additional boom extension speed as the flow to the cylinder increases.

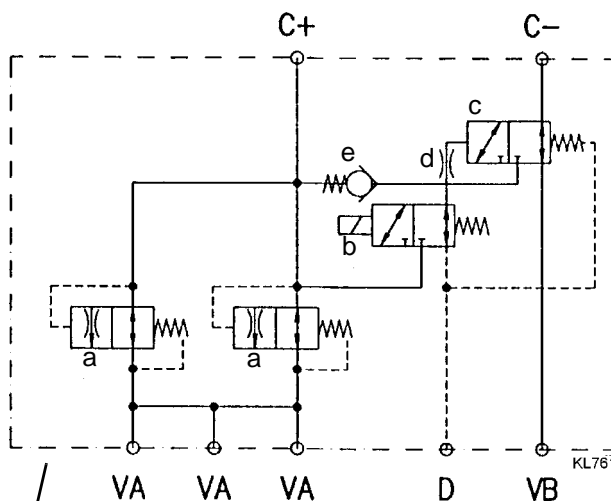
See also detailed circuit description in group 20.



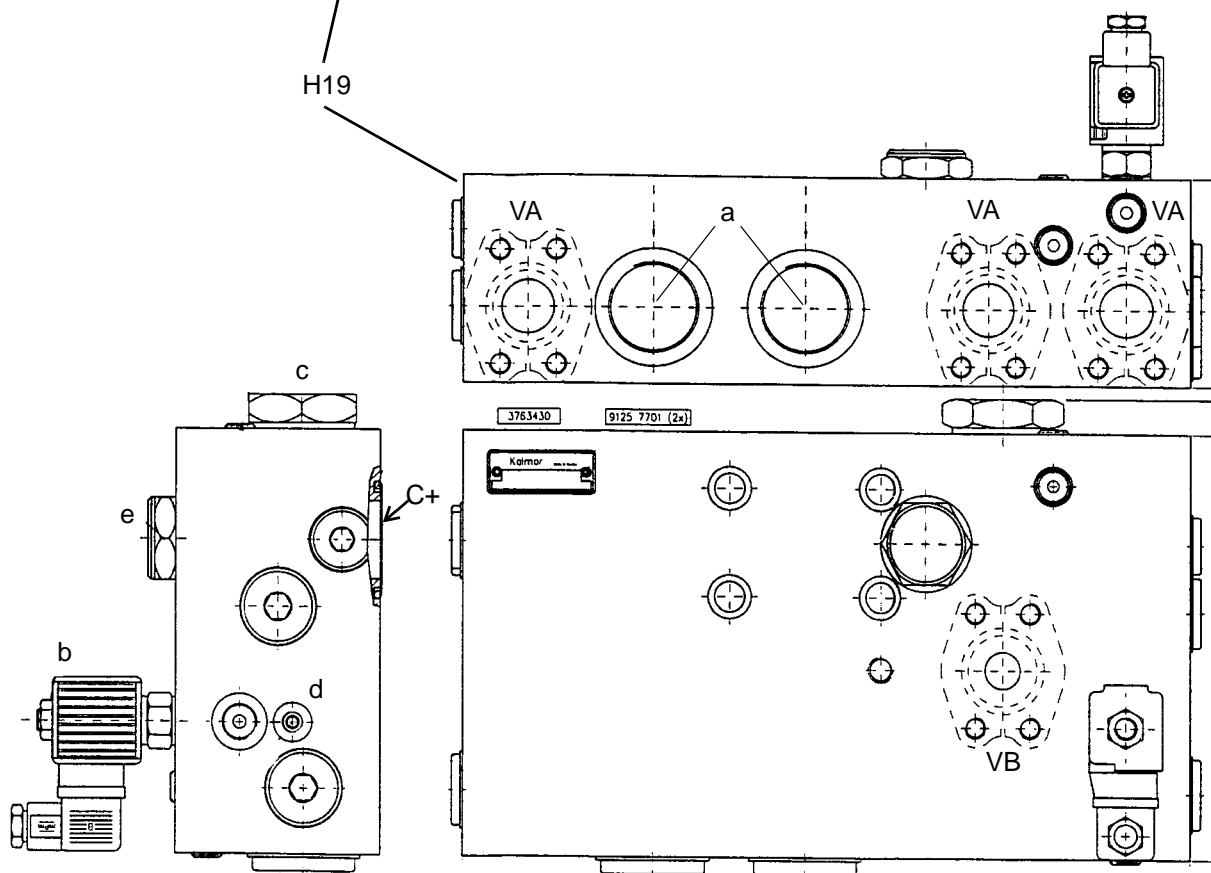
The numbers correspond to the hydraulic diagram (H)

- 13. Main valve
- 16. Main valve
- 19. Valve block, extension cylinder
- 20. Extension cylinder

Boom extension system



H19



The numbers correspond to the hydraulic diagram (H)

- H19. Valve block, extension cylinder
- a. Lowering brake valve with pressure compensated choking
 - b. Solenoid valve, control of regeneration valve
 - c. Regeneration valve
 - d. Restriction
 - e. Non-return valve
- VA Feed from pumps
 D Draining to tank
 VB Tank return
 C+ Feed to extension cylinder
 C- Return from extension cylinder

Valve block, extension cylinder

Hydraulic fluid

The hydraulic-fluid tank is located on the right-hand side of the truck.

Check the fluid level on the fluid sight-glass, with all hydraulic pistons in the bottom positions.

Top up the hydraulic fluid as necessary. See the Specification for the oil grades.

If the truck has an oil-cooled wet disc brake system, any hydraulic oil used for topping-up should contain Lubrizol additive which is necessary for good performance of the brake system. See Grop 90, Oil and lumatic recommendations

The additive is not consumed during normal operation and must only be added at oil change and refill. Lubrizol may be ordered from Kalmar Service department.

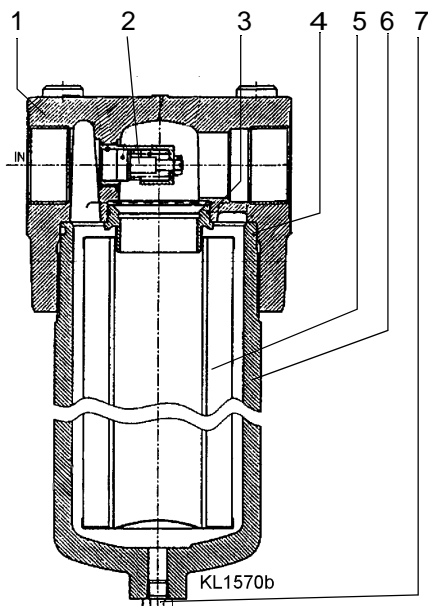
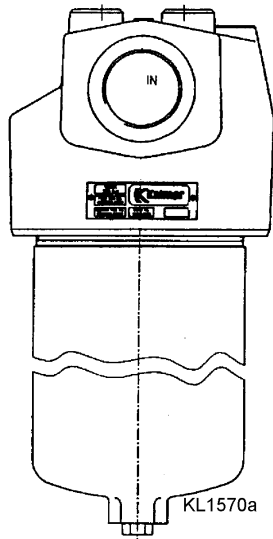
IMPORTANT!

**Systems with separate tank for the brake system:
The hydraulic fluid for the brake system must never
contain any additives.**



WARNING!

**Hydraulic fluid is chemically
aggressive. Avoid extended contact with the skin.**



1. Filter head
2. By-pass valve, 7 bar opening pressure
3. O-ring
4. O-ring
5. Filter cartridge
6. Filter bowl
7. Drain plug

IMPORTANT!

**The filter has an arrow on it indicating
the direction of the flow. The filter must
therefore be fitted so that the arrow
points in the direction of the flow.**

Hydraulic oil filter

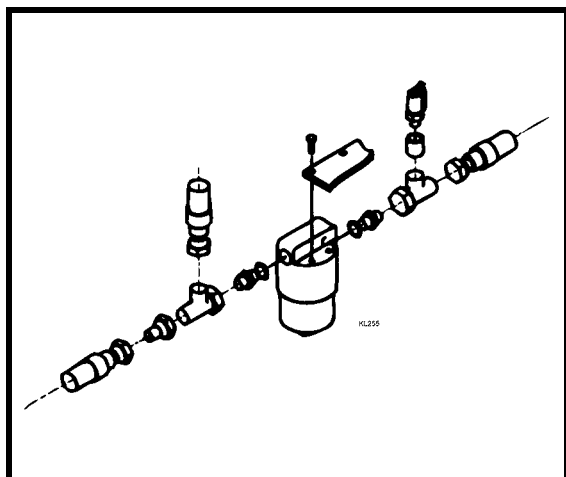
The high pressure filter for the hydraulic oil must be changed at the intervals specified in the lubrication chart. In addition, the filter must always be changed whenever work has been carried out on the hydraulic system.

The filter contains a by-pass valve which opens at a counter pressure of 7 bar in case the filter should be clogged by impurities.

1. Clean the outside of the filter and the area around it.
2. Place a vessel under the filter to collect any spillage.
3. Empty the filter bowl by unscrewing the drain plug.
4. Unscrew the filter bowl.
5. Slide off the filter cartridge.
6. Replace the two O-rings between the filter head and the filter bowl.
The O-rings are included with the filter cartridge.
Moisten the O-rings with hydraulic fluid prior to fitting.
7. Remove the filter cartridge from its packaging and immediately fit it.
8. Clean the filter bowl carefully and half fill it with hydraulic fluid.
9. Screw back the filter bowl in position.
10. Start the engine to purge the system of air, and check that the filter does not leak.

Breather filters

Two breather filters on top of the hydraulic tank protect the hydraulic liquid from impurities as air needs to enter and leave the tank. The filters are of spin-on type.



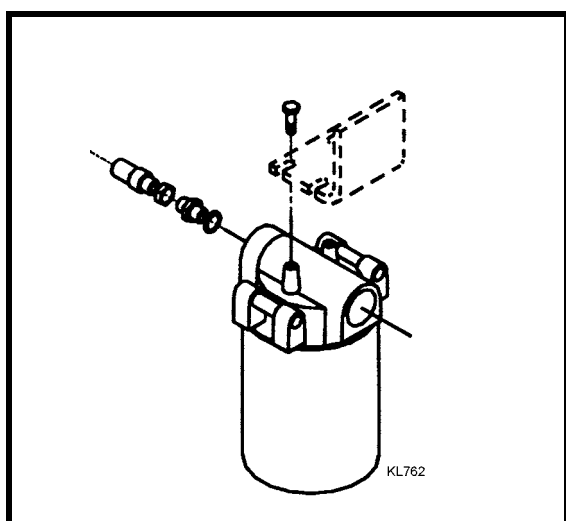
Hydraulic oil filter for the servo hydraulics

The high-pressure filter filters the circulating servo oil to protect the components downstream of the filter and prevent maloperation.

A by-pass valve opens at 3.5 bar if the filter should become clogged.

The filter contain a cartridge which should be changed every 1000 hours of operation.

1. Unscrew the bottom section of the housing and withdraw the cartridge downwards.
2. Fit a new cartridge, check the O-ring and refit the bottom section of the housing.



Hydraulic oil filter for the brake cooling circuit

Change the filter every 1000 hours of operation. (Option: Two filters. Change both filters every 1000 hours of operation.)

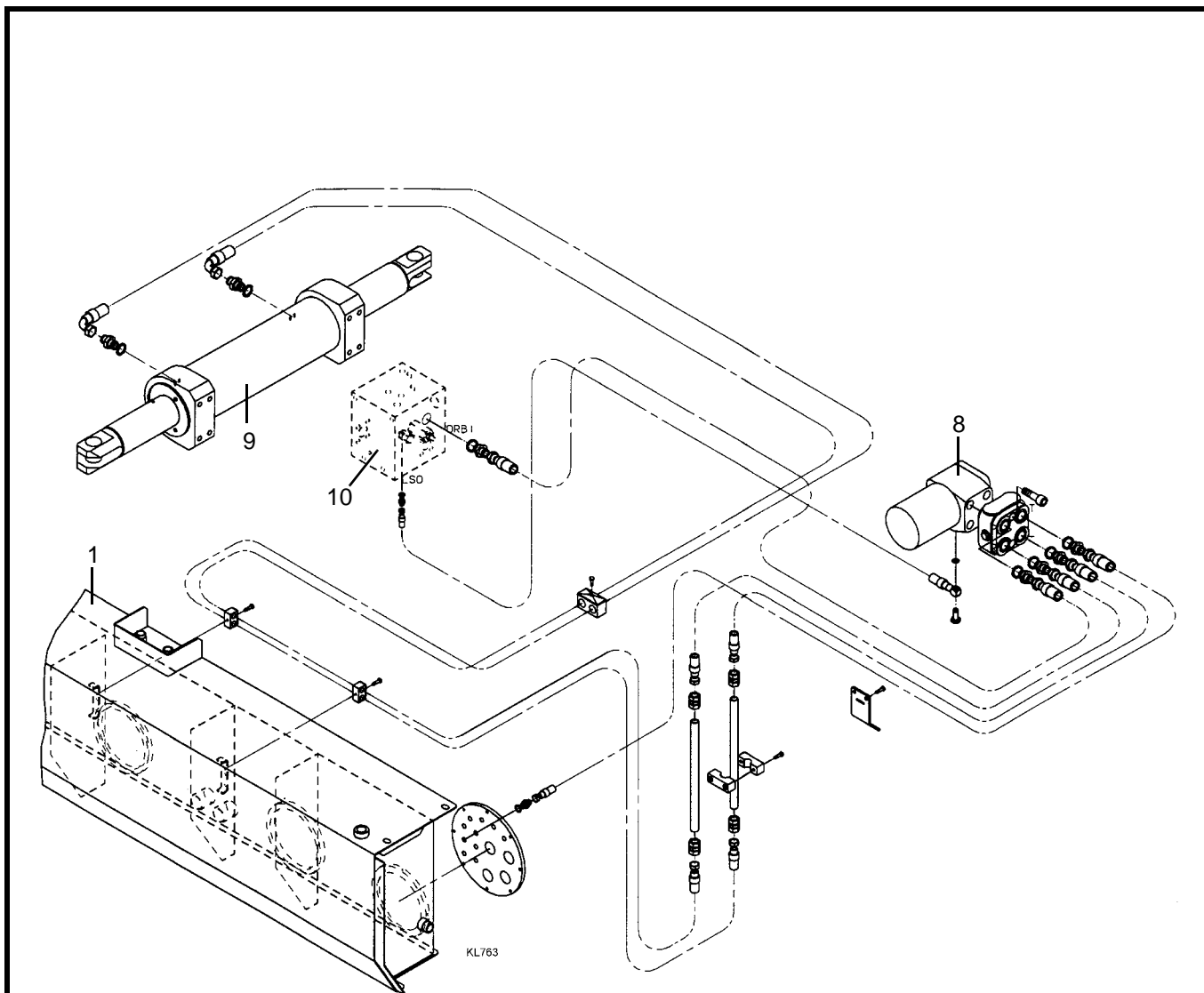
Steering system

The steering system is fed from hydraulic pump 2.

A priority valve ensures that the steering valve always has sufficient fluid. The residual flow goes to the working hydraulics.

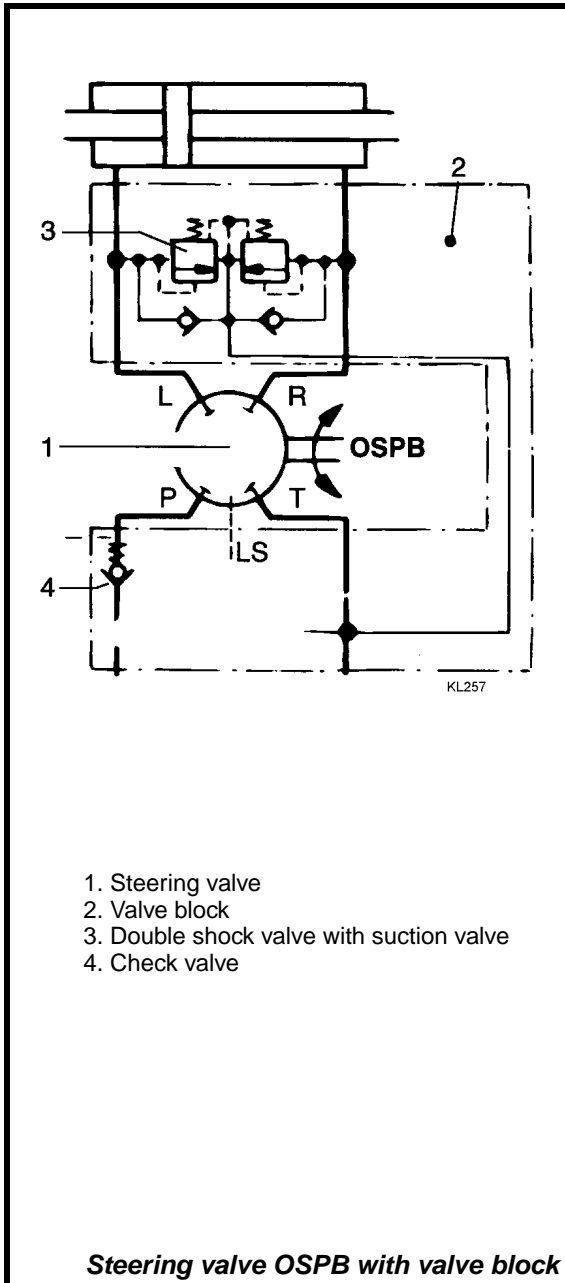
From the ORB2 connection on the priority valve there is always a certain signal pressure in communication with the steering valve's pressure connection. As soon as the steering wheel is moved, this, via the steering cylinder circuit, will give a load signal LS back to the priority valve (LSO-connection), which shifts position and feeds out sufficient pump capacity to the steering valve.

The pressure in the steering system is determined by a relief valve in the priority valve (10d).



The numbers correspond to the hydraulic system diagram (H)

- 1. Hydraulic tank
- 8. Steering valve ORBITROL
- 9. Steering cylinder
- 10. Priority valve

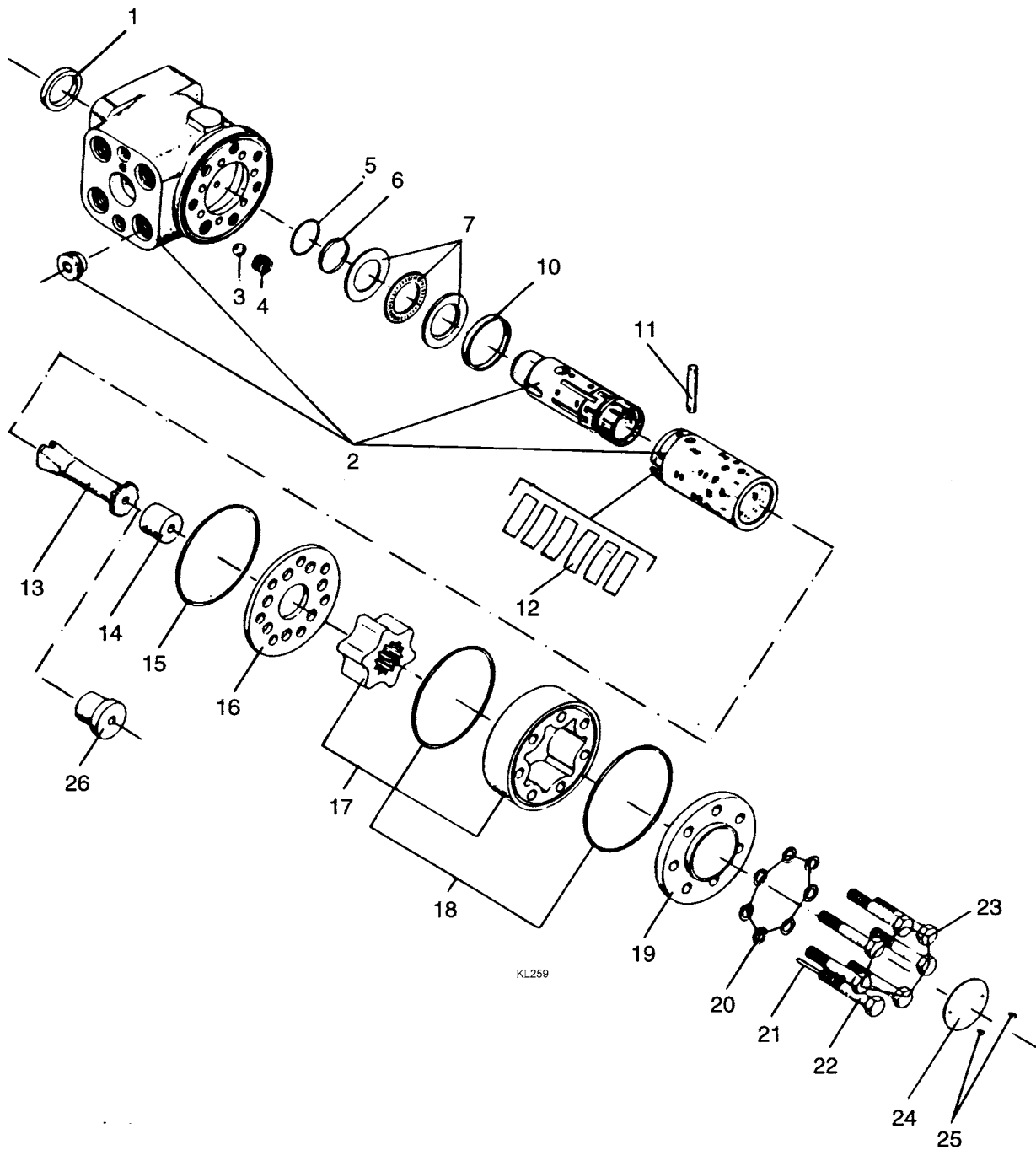


Steering valve

The steering valve is of the closed-centre, non-reaction type with a load signal connection to the priority valve. The load signal ensures load-dependent control of the flow from the priority valve to the steering valve. The closed-centre feature means that the valve shuts off the flow between the pump and the tank when the valve is in the neutral position. This is necessary to enable a signal pressure to be connected to the steering valve.

The steering valve consists of a gear pump and a distribution valve. When the steering valve is turned, fluid is supplied from the steering pump across the gear pump to the distribution valve, which ensures that the flow will be supplied to the port corresponding to the direction in which the steering valve has been turned. The gear pump ensures that the flow supplied to the cylinder will be proportional to the angle through which the steering wheel has been turned. If the flow from the steering pump should cease, the steering valve will automatically perform as a manual pump, i.e. some degree of emergency control will still be available.

A valve block with built-in double shock and suction valves is connected to the steering valve. The shock valves opening at 280 bar, prevent pressure surges caused by blows against the steered wheels from being propagated to the steering valve. The suction valves open to prevent vacuum on the opposite side of the piston, which could lead to cavitation.



KL259

- | | |
|-------------------------------------|----------------------------|
| 1. Dust seal | 15. O-ring |
| 2. Housing - spool - sleeve | 16. Distributor plate |
| 3. Ball | 17. Gear set |
| 4. Threaded bush | 18. O-ring |
| 5. O-ring | 19. End cover |
| 6. Guide ring | 20. Washer |
| 7. Bearing | 21. Pin |
| 10. Ring | 22. Bolt with drilled head |
| 11. Dowel | 23. Locking wire |
| 12. Neutral position springs, 1 set | 24. Nameplate |
| 13. Shaft | 25. Self-tapping screw |
| 14. Spacer | 26. Spacer |

Priority valve

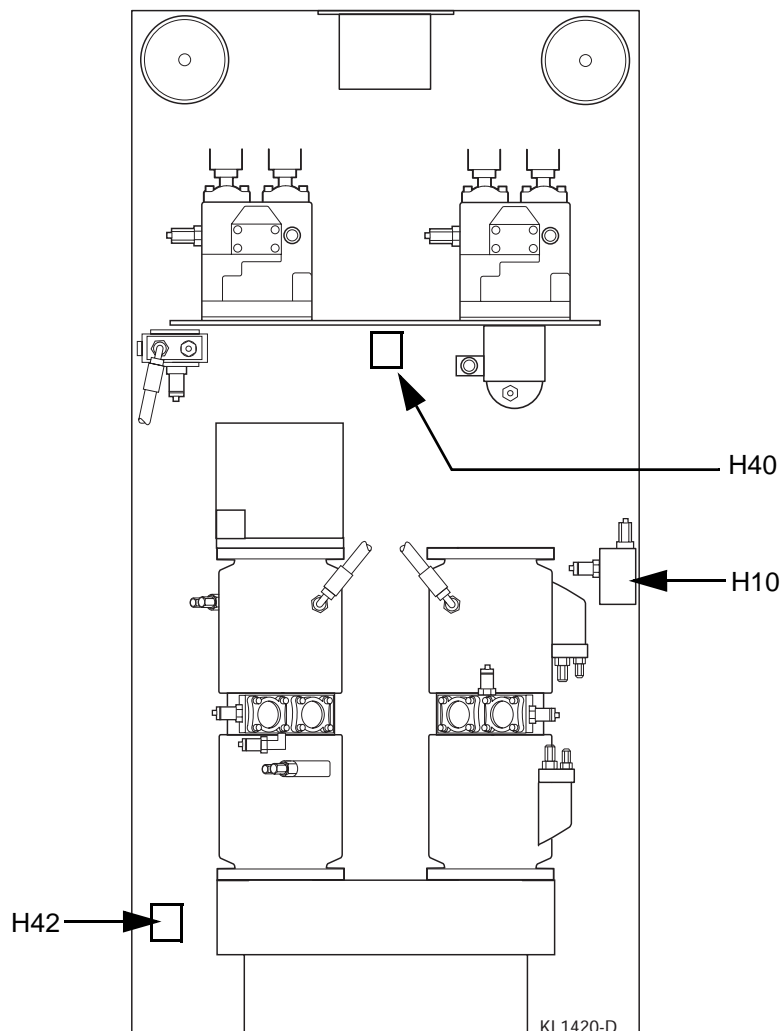
The priority valve apportions the flow of fluid from the pump H2 so that a sufficient flow always goes to the steering valve.

The priority valve is built into a valve block that also contains the pressure regulator valve for the servo system.

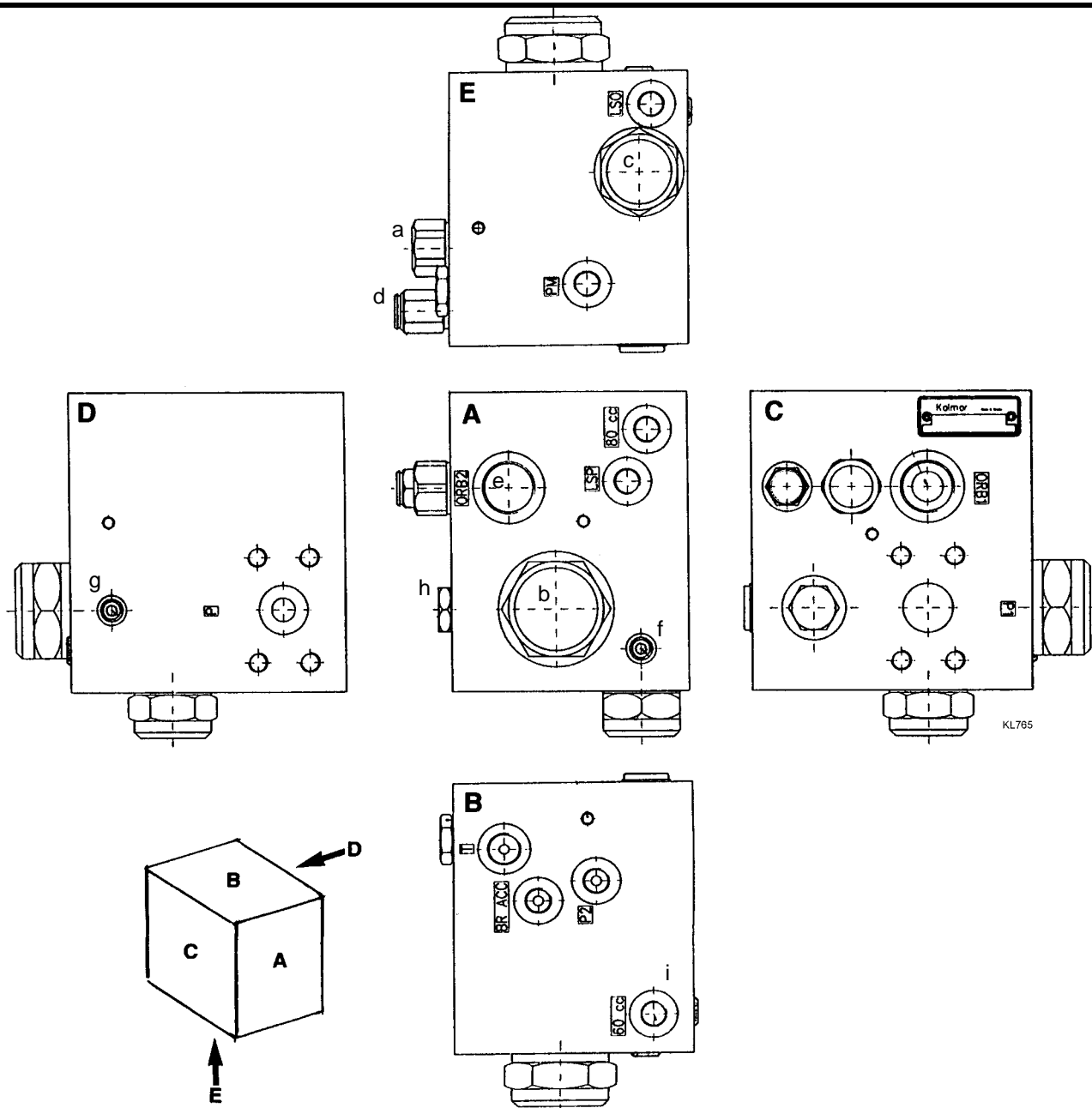
Steering valve H8-LS is fed with a dynamic load signal, a flow of 2-3 l/min. continually circulates from the priority valve connection H10-LSO to the control valve. When the steering wheel is turned this flow is shut off and pressure builds up. The pressure activates pump H2 and resets priority valve H10c for feeding of the steering valve H8 (P).

When the steering wheel is not turned, all the flow from the pump goes to main valve of the working hydraulics, H13, with the exception of a minor flow that feeds the servo system via pressure reduction valve H10a.

The pressure reduction valve H10d is adjustable and determines the steering pressure.

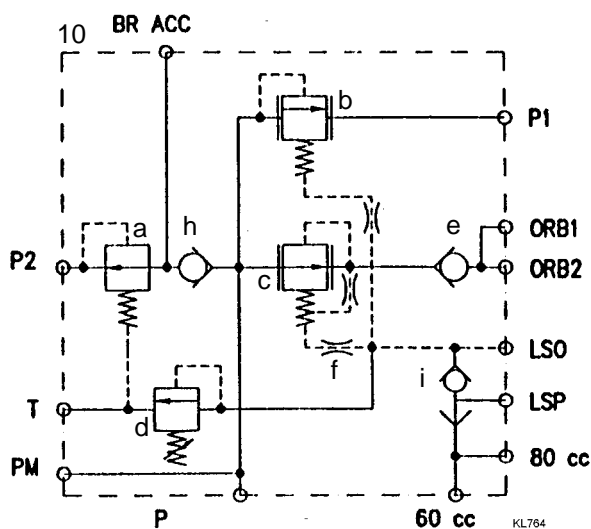


- H10. Priority valve
- H40. Solenoid valve, disconnection of H3b feed to LIFT and EXTENSION in transport mode
- H42. Solenoid valve, loading of pump H3b for feeding attachment



H10. Priority valve

- a. Pressure regulator valve SERVO, 30-35 bar
- b. Valve, feed for working hydraulics
- c. Priority valve, feed for steering system
- d. Overflow valve, setting of steering pressure
- e. Non-return valve
- f. Restriction
- g. Restriction
- h. Non-return valve
- i. Shuttle valve



- BR ACC Connection, reserve servo pressure from accumulator
- P1 Feed, working hydraulics
- ORB 1 Feed, steering valve, with lever steering
- ORB 2 Feed, steering valve, with normal steering
- LSO Connection, load signal from steering valve
- LSP Connection, load signal cab movement valve
- P Connection, pump pressure
- T Tank connection
- P2 Feed, servo system, 30 bar
- 60CC Connection, load signal, pumps
- 80CC Connection, load signal main valves and pumps

WDB brake system

This system is known as the wet disc brake system, in which each hub is equipped with a multiple-disc assembly. The disc assembly comprises stationary discs arranged alternately with a number of rotating discs. The disc assembly is compressed by hydraulic pressure to provide effective braking action. The assembly is submerged in a hydraulic oil bath to dissipate the heat generated by braking. A separate cooling circuit is provided to cool the hydraulic oil.

The advantages of the wet disc brake system include the fact that no adjustment is needed, and that no fading or wear occur. Moreover, the enclosed oil bath keeps the system completely free from water and impurities.

The wet disc brake system comprises three separate hydraulic circuits, i.e. the foot-brake circuit, the cooling circuit and the parking brake circuit. All circuits are supplied with hydraulic fluid under pressure from a fixed vane-type pump. The brake circuits are supplied from four hydraulic accumulators and the cooling circuit is supplied directly from the pump.

The pump feeds a charging valve which ensures that a minimum pressure will always be maintained in the accumulators. During the charging process, the charging valve serves as a priority valve, so that a certain residual flow will be supplied to the cooling circuit. If the engine runs at no load, the residual flow may be so small that the flow in the cooling circuit will temporarily stop. When the accumulator has been charged to full pressure, the charging valve transfers the entire pump flow to the cooling circuit.

N.B. Certain machines have a separate tank for the brake system.

Cooling circuit

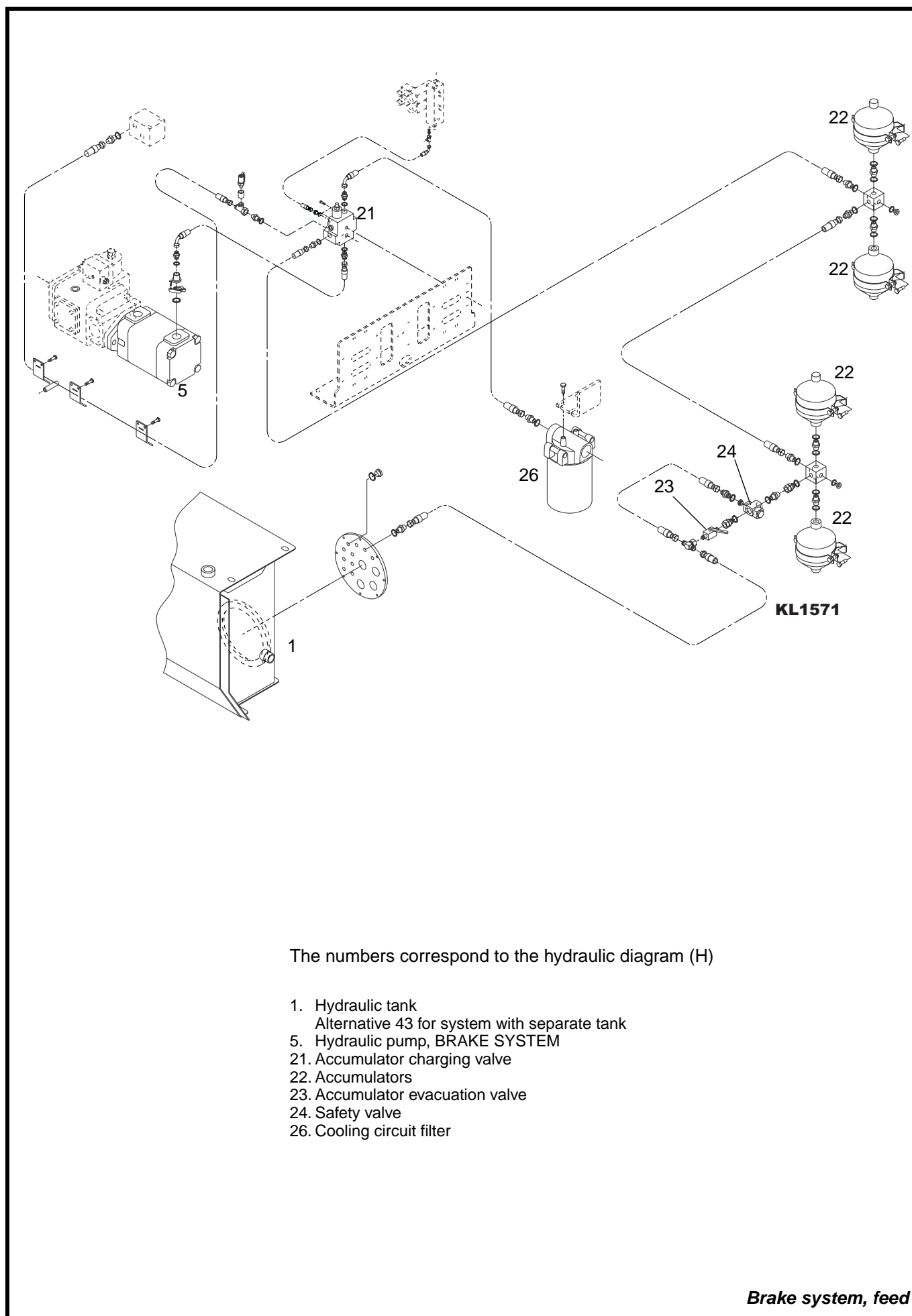
When the accumulators are charged, oil is fed to the cooling oil cavities in the drive axle. A by-pass valve between the supply and return lines ensures that the cooling oil pressure will not exceed 1,5 bar, in order to protect the drive axle.

The feed is carefully cleaned through filters. The hydraulic fluid is cooled by means of a fluid cooler. Machines with a separate tank for the brake system have one hydraulic fluid cooler for the working hydraulics and one for the brake system.

Main components of the brake system

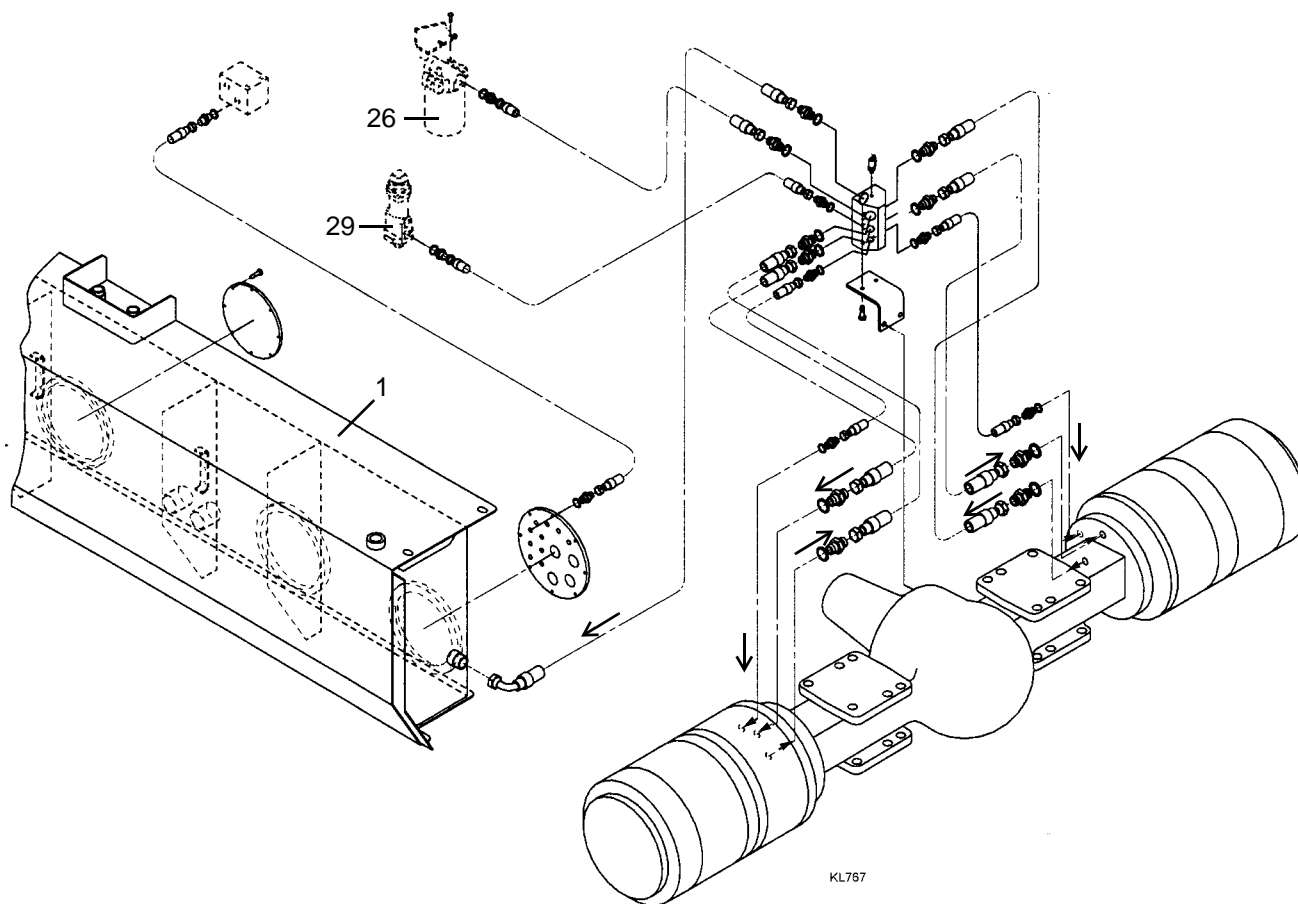
Numbering refers to system illustrations and hydraulic diagram (H).

5. Hydraulic pump, which generates the brake pressure and is driven by a power take-off on the variable pump.
21. Accumulator charging valve, serving as a priority valve which gives first priority to the brake system. The remaining flow is delivered to the cooling circuit.
22. Accumulators which are charged by the accumulator charging valve, are pre-charged with nitrogen and ensure that pressure will be available in the brake circuit even if the engine should temporarily stop.
23. Accumulator evacuation valve, opened for emptying of accumulator to the tank before any work is carried out on the hydraulic system. Valve 25 must be opened when draining the system.
24. Safety valve 210 bar
25. Valve for reserve servo pressure. Used in emergency situations if the engine does not run and servo pressure is needed for the working hydraulics. When draining the system, both this valve and the accumulator evacuation valve (23) should be opened.
29. Brake pedal. Supplies oil at a reduced pressure from the accumulator to the drive axle disc brake assembly.
30. Disc assemblies in the wheel hubs.
31. Release clutch switch, disengages the transmission at a given brake pressure.
32. Sensor, brake lights
33. Sensor, low brake pressure (accumulator pressure), activates lamp 45 on the instrument panel
34. Parking brake valve which supplies fluid at a reduced pressure from the accumulator to the parking brake cylinder when the parking brake is released. Sensor 31 switches on the parking brake warning lamp when the parking brake is applied, and also initiates a signal to a buzzer in the cab to indicate that the operator has left the seat without applying the parking brake.
36. Parking brake cylinder. Actuated by a heavy spring when the brake is applied, i.e. when the oil has been discharged through the parking brake valve. The brake is released by hydraulic oil from the parking brake valve.
41. Hydraulic oil cooler with electrically powered fan
43. Separate tank for the brake system



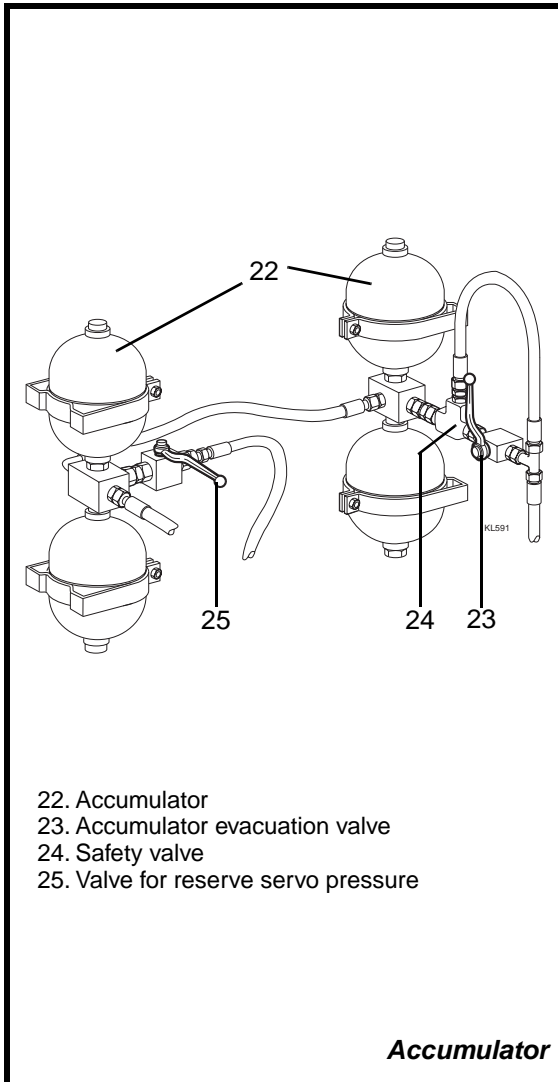
The numbers correspond to the hydraulic diagram (H)

- 1. Hydraulic tank
Alternative 43 for system with separate tank
- 5. Hydraulic pump, BRAKE SYSTEM
- 21. Accumulator charging valve
- 22. Accumulators
- 23. Accumulator evacuation valve
- 24. Safety valve
- 26. Cooling circuit filter



The numbers correspond to the hydraulic diagram (H)

- 1. Hydraulic tank
Alternative 43 for system with separate tank
- 26. Filter, cooling circuit
- 29. Service brake valve



Accumulator

The hydraulic system is connected to membrane type accumulators which are pre-charged with nitrogen (100 bar). The membrane is forced upward causing the pressure of the nitrogen to increase as the accumulator becomes charged with hydraulic fluid. When the hydraulic system requires power from the accumulator, the membrane presses fluid back into the system.

The accumulator is fitted at the top with a connection for testing the pressure of the nitrogen, and for refilling nitrogen with the aid of special filling equipment. Contact KALMAR spare parts. Part. No. 923120-0542.

The pressurized fluid from the accumulator is utilized to power the driving brake and parking brake systems.

A special valve (25) can be used to provide reserve servo pressure to the working hydraulics.

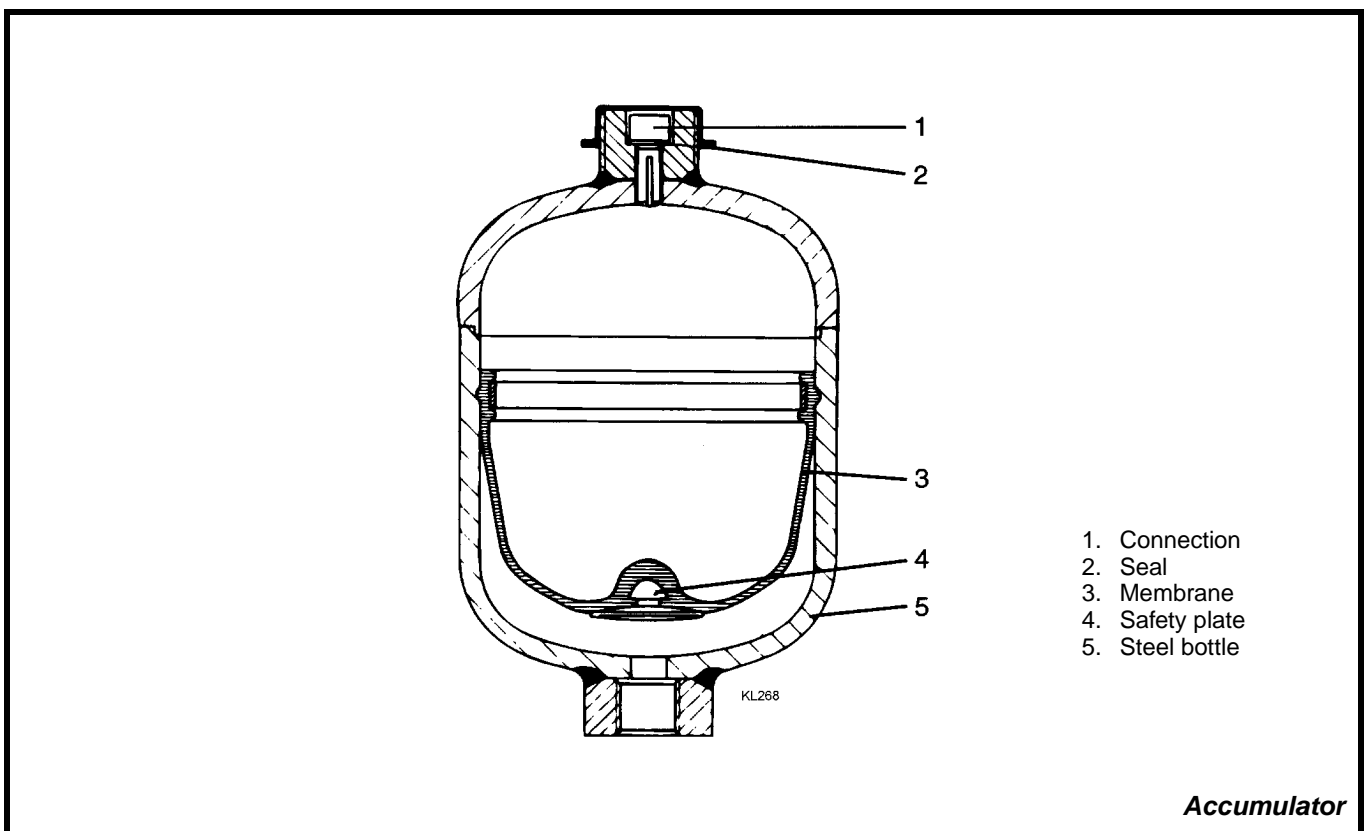
An evacuating valve 23 is fitted between the accumulator and reservoir. This valve shall be used to relieve the accumulator of pressure before carrying out any work on the hydraulic system.

At the same time, the valve for reserve servo pressure (25) should be opened.



WARNING!

The hydraulic system includes high-pressure accumulators. Open both accumulator evacuation valves (23) and the reserve servo valve (25) before carrying out any work on the system.



Accumulator charging valve

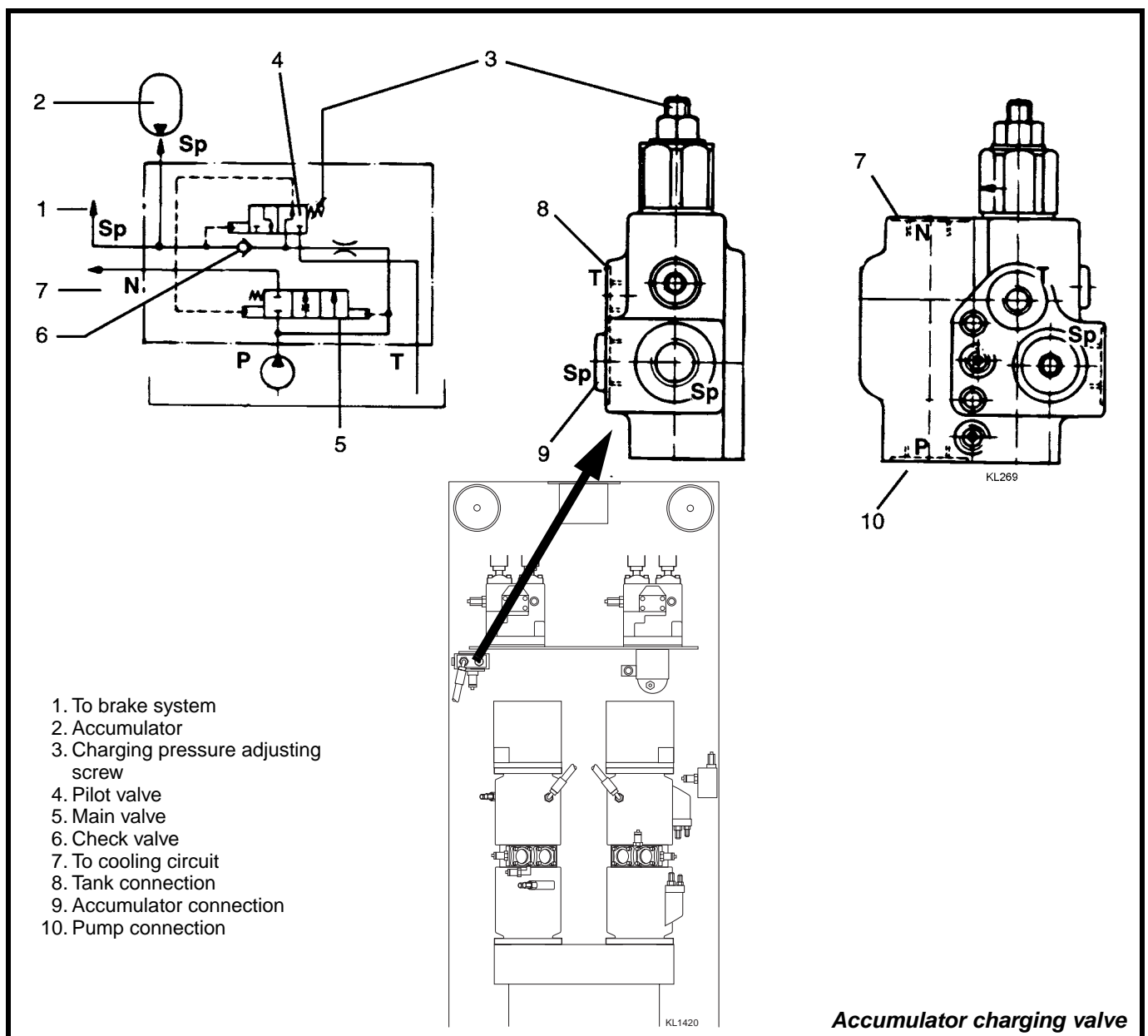
The function of the accumulator charging valve is to divert the pump flow to the accumulator whenever the latter needs charging. This ensures that the brake system is given priority and is first to receive oil.

When the accumulators are fully charged, the entire flow from pump 5 is fed to the brake cooling circuit

During charging, the pump delivers oil through a check valve to the accumulator. A restriction limits the flow to a maximum of approx. 17 l/min. At the same time, pilot oil pressure is supplied across the pilot valve to the main valve, where it is added to the spring force and keeps the main valve closed.

When the accumulator has been charged, the oil pressure from the accumulator overcomes the spring force in the pilot valve which changes over and relieves the pilot pressure to the tank. The main valve changes over and opens the connection to the cooling circuit motor.

The difference between the pressures at which charging is started and stopped is determined by the difference in area between the pressure and tank connections of the valve, and amounts to about 18% of the pressure at which charging is stopped, i.e. about 27 bar at a pressure of 150 bar and about 30 bar at 165 bar.

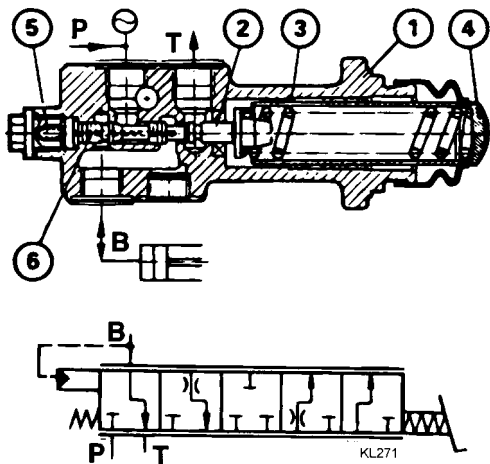


Hydraulic brake pedal

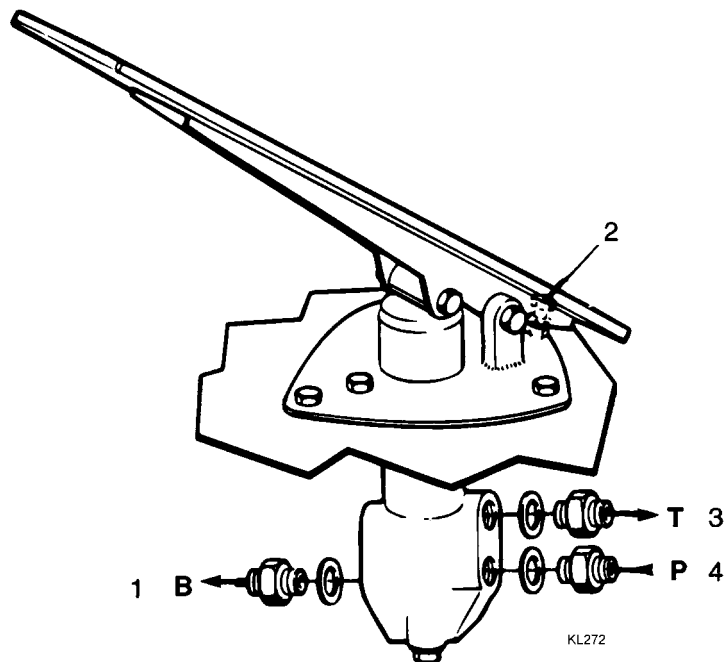
The hydraulic brake pedal consists of a direct-acting pressure-reducing valve of three-way type designed for continuously variable mechanical operation. The pressure-reducing valve consists of the components shown in the figure.

When stop 4 is depressed by the pedal, the main spring acts on the control piston which moves and closes outlet T to the tank. The circuit between pressure connection P and brakeline B is then opened. As the pressure in the brake line increases, a pilot pressure will act on the control piston through the pilot orifice, counteracting the main spring load. As a result, the brake pressure will increase in proportion to the force exerted on the pedal. If the pedal force is maintained constant, the brake line pressure will also be constant.

When the pedal is released, the spring returns the control piston so that it closes the connection between P and B, simultaneously opening a connection between B and T to relieve the brake pressure to the tank.



1. Housing
2. Control piston
3. Main pressure spring
4. Pedal stop
5. Return spring
6. Pilot pressure orifice



1. Brake line
2. Neutral position adjustment
3. To tank
4. From accumulator

Parking brake

The parking brake consists of a disc brake with a brake cylinder on the drive axle input shaft. The brake is applied by a heavy spring in the brake cylinder.

The parking brake can also be used as an EMERGENCY BRAKE. During emergency braking, the brake linings are subjected to very heavy wear. The linings should therefore be changed after any emergency braking operation.

The parking brake is released by hydraulic pressure being supplied to the cylinder to counteract the spring force. All supply is controlled by a manual valve which is open when the parking brake is released.

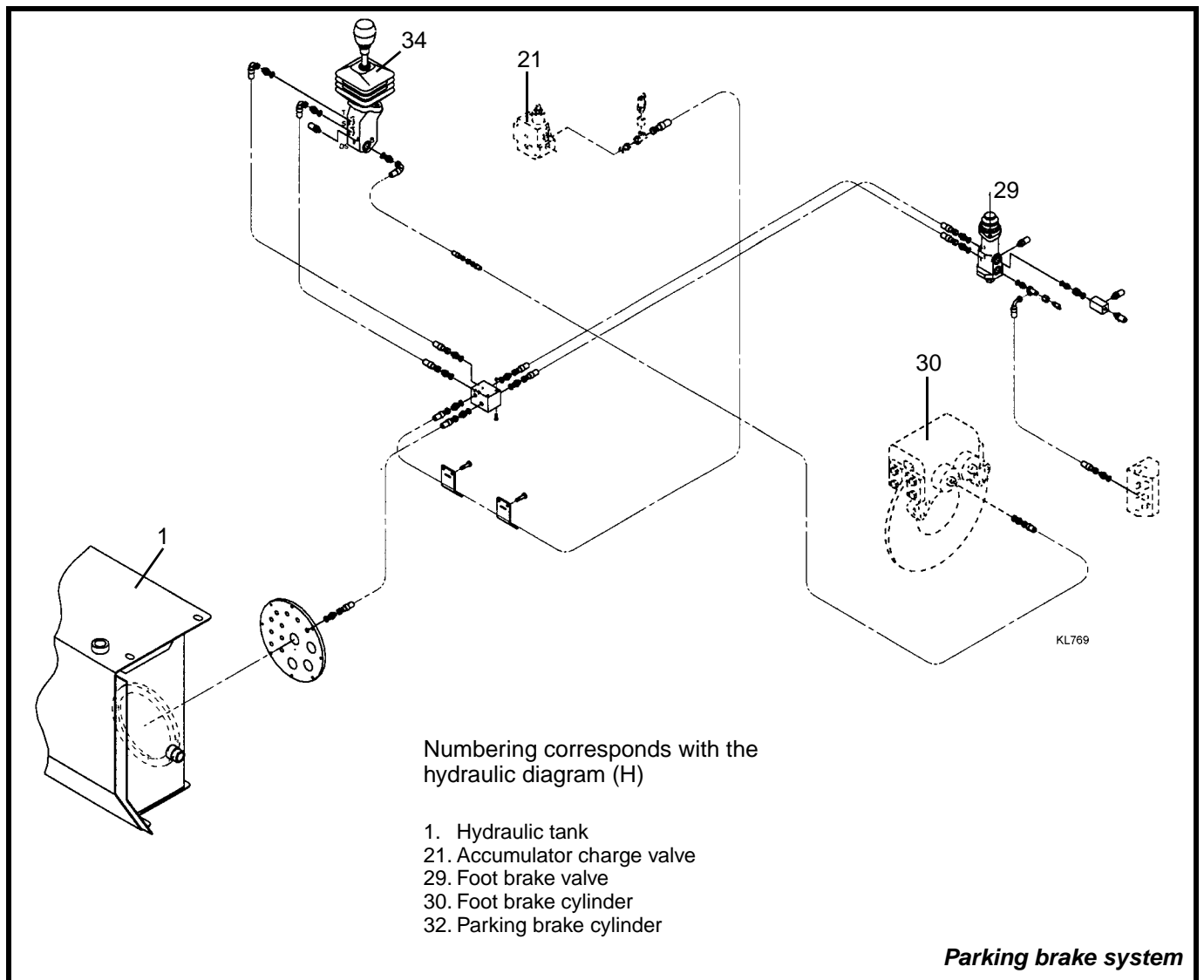
When the parking brake is applied, the flow of oil to the brake cylinder is interrupted and the oil in the cylinder is discharged to the tank. The brake is then applied by the spring.

If the accumulator pressure should drop below 115 bar, the warning lamp low BRAKE PRESSURE will light up on the instrument panel.

Parking brake valve

The parking brake valve is a direct-acting, three-way pressure-reducing valve. The pressure output is continuously variable, although for practical use in the parking brake system, the valve can be regarded as an ON/OFF valve.

To prevent inadvertent application of the parking brake, the lever is provided with a latch which must be raised before the lever can be moved.





WARNING!

Danger of personal injury

Always empty the accumulators before working on the system. Use the accumulator evacuating valve (23) adjacent to the accumulator connection point. Open valve 25 also.

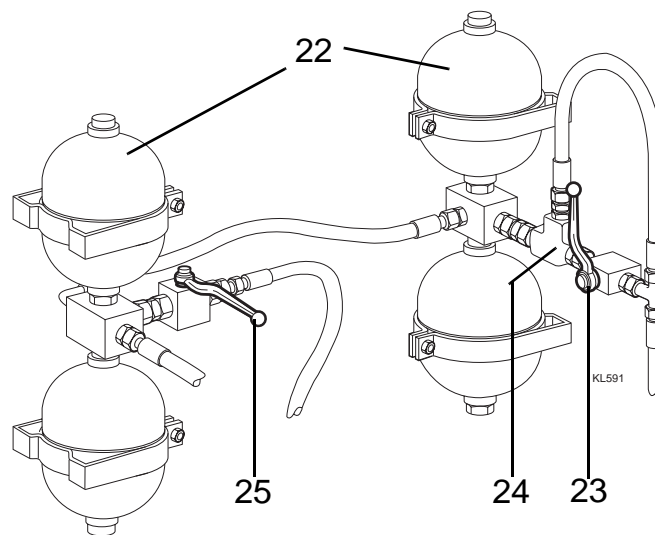
Immediately shut down the engine if the charging pressure exceeds the levels stated on the information plate for the hydraulic system.

Accumulators, checking the pre-charging pressure (At least once every year)

Always check that the engine shut-off controls function correctly.

1. Empty the accumulators into the tank by opening the accumulator evacuating valve (23) – see illustration.
2. Remove three of the accumulators from the connector and plug the connector holes.
3. Connect a 0–250 bar pressure gauge to the test outlet on the accumulator charging valve.
4. Start the engine and allow the first accumulator to build up pressure.
5. Switch off the engine and reduce the pressure by pumping the foot brake repeatedly. The hydraulic pressure should then fall slowly. At a pressure that is, at lowest, approximately 5 bar below the recommended pre-charging pressure (gas pressure), the pressure should immediately fall to 0. If the accumulator lacks pre-charging pressure the pressure shown on the pressure gauge will fall immediately the engine is switched off. In both cases, this indicates internal leakage and the accumulator should therefore be replaced.
6. Open the accumulator evacuating valve (23) and empty the accumulator into the tank.
7. Repeat the check for the other three accumulators

N.B. It is also possible to check the pre-charging pressure using test equipment (Art. no. 923120-0542). Follow the instructions supplied with the test equipment.



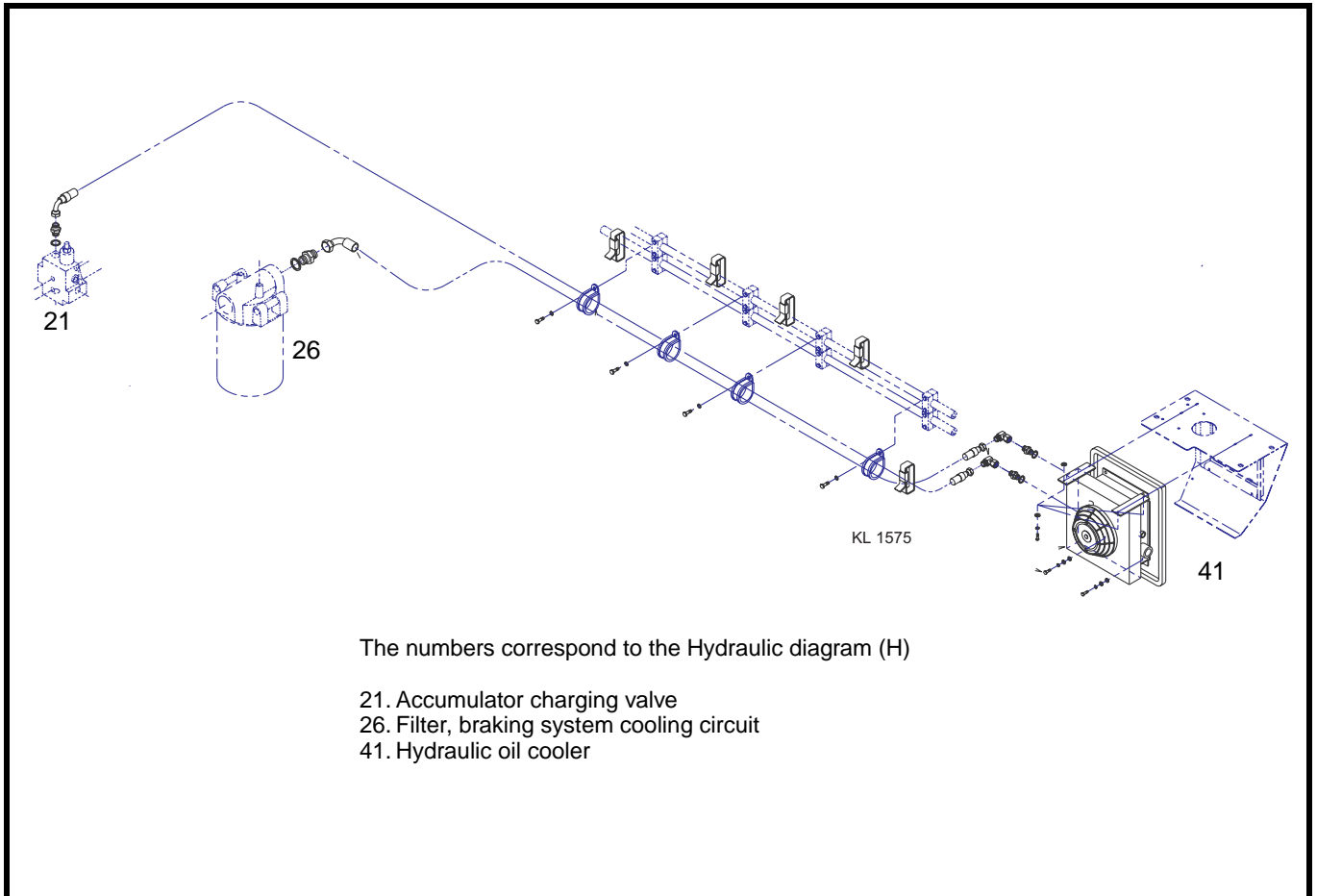
Numbering corresponds with the hydraulic diagram (H)

- 22. Accumulator
- 23. Accumulator evacuation valve
- 24. Safety valve
- 25. Valve for reserve servo pressure

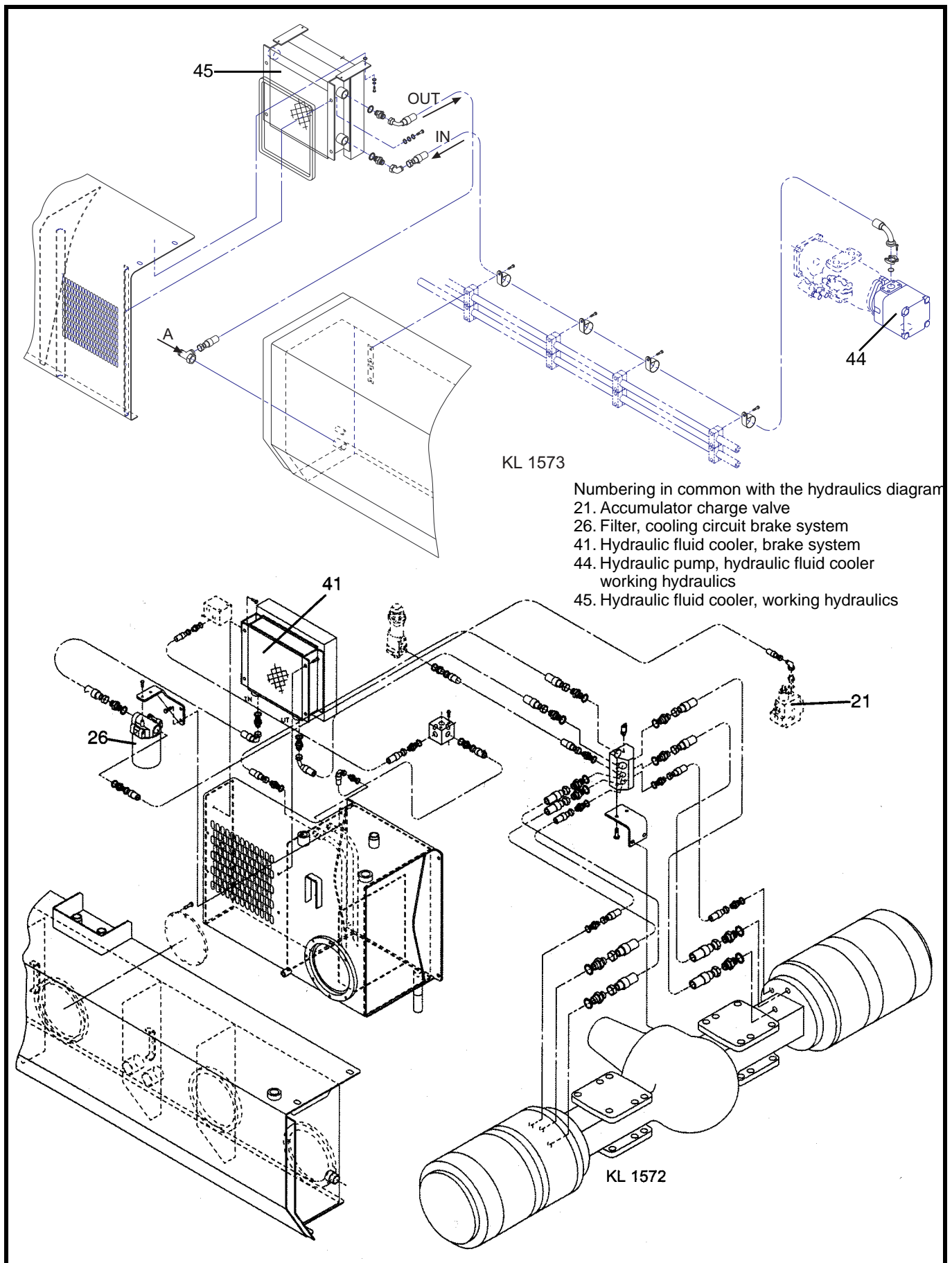
Hydraulic oil cooler

An oil cooler with electrically powered fan is used for dissipation of heat, produced mainly by frequent braking.

Machines with a common tank for working hydraulics and braking system have a common hydraulic fluid cooler for both systems.



Machines with a separate tank for braking system have one hydraulic fluid cooler for the braking system and one for the working hydraulics, see illustration below and hydraulics diagram..

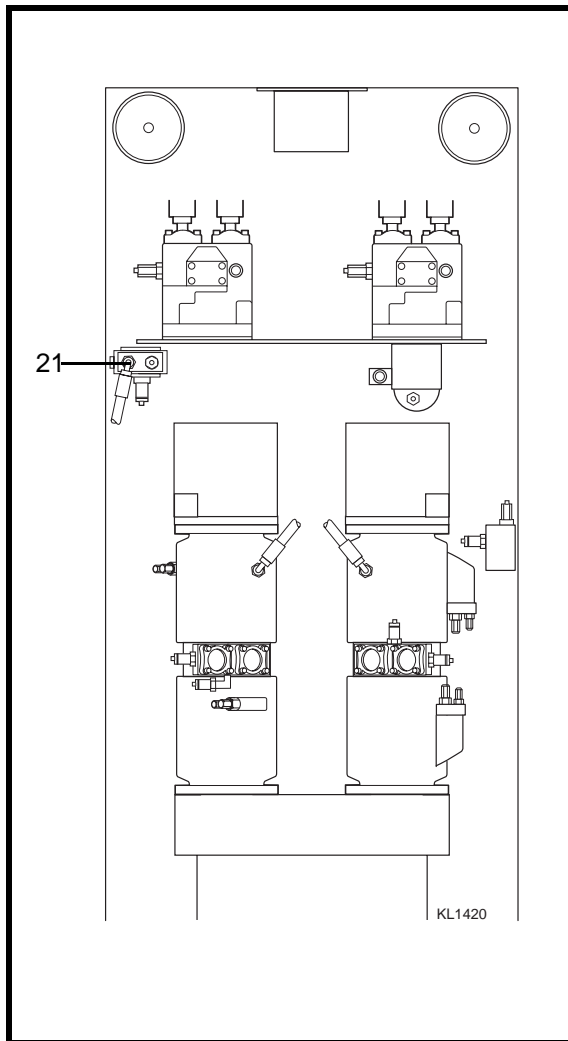


KL 1573

Numbering in common with the hydraulics diagram

- 21. Accumulator charge valve
- 26. Filter, cooling circuit brake system
- 41. Hydraulic fluid cooler, brake system
- 44. Hydraulic pump, hydraulic fluid cooler working hydraulics
- 45. Hydraulic fluid cooler, working hydraulics

KL 1572

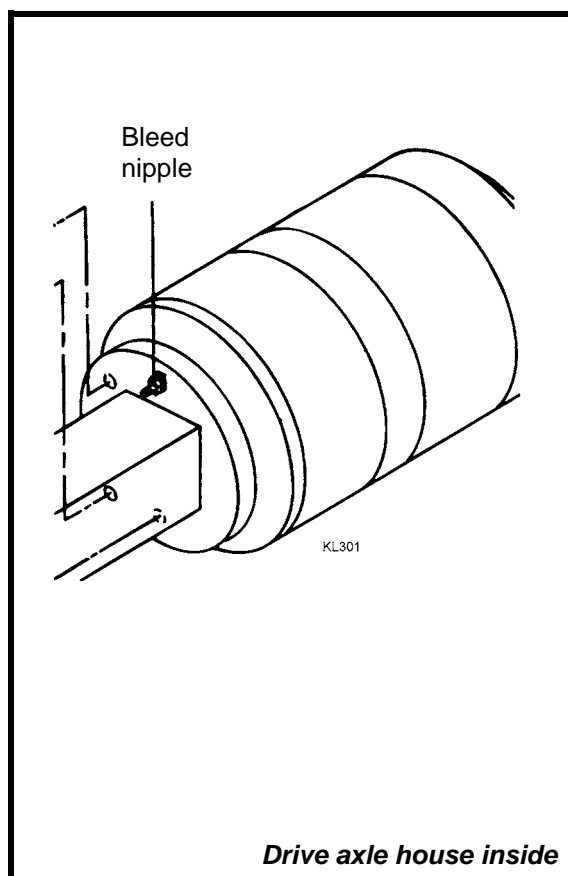


Adjusting the WDB brake system

The engine and hydraulic system should be at normal operating temperature before adjustments are carried out. Always check that the engine stopping device is working.

The various pressures for the machine are given on a separate plate attached to the machine.

1. Check the pre-charging pressure of the accumulators, see separate section.
Check the accumulator charging pressure, engine stopped.
 - Connect a pressure gauge (0–250 bar) to the measurement tapping on the accumulator charging valve 21.
 - Use the accumulator evacuating valve to discharge the accumulator.
 - Close the valve 23, start the engine, allow the accumulator to be charged and read the charging pressure. Adjust the accumulator charging valve as necessary.
 - If the adjustment must be repeated, evacuate the accumulators again, let them recharge, read the new charging pressure, and so on.
2. Bleed the brake circuit.
 - A bleed nipple is provided on the inside of each drive axle hub. Use a piece of hose to discharge the oil into a suitable container.
 - Open the bleed nipple, depress the brake pedal and let the oil flow out of the nipple until it is completely free from air bubbles. Shut off the nipple while the brake pedal is still depressed.
 - Repeat the bleeding for the other hub.
Check the pressure from the brake pedal.
 - Connect a pressure gauge to the measurement tapping on the brake pedal valve (below the operator's cab)
 - Depress the pedal fully and read the pressure, which should be according to the hydraulic system plate. Leave the pressure gauge in position.
3. Stop the engine and check that there is no leakage at the pedal.
 - Depress the pedal and read the pressure on the pressure gauge. The pressure should be the same as in item 4 above and must not drop for 15 seconds.
 - Release the pedal, and the pressure should then drop to 0. If not, the brake valve is leaking and may cause the brake to remain applied while the truck is being used, and thus overheat.
4. Use the accumulator evacuating valve to release the pressure from the accumulator.
5. Start the engine and run it until full pressure is achieved
6. Stop the engine and check that the brakes can be applied 6-8 times before the pressure drops to 70 bar. The warning lamp 45 for low brake pressure should light up at 115 bar pressure.



Drive axle house inside

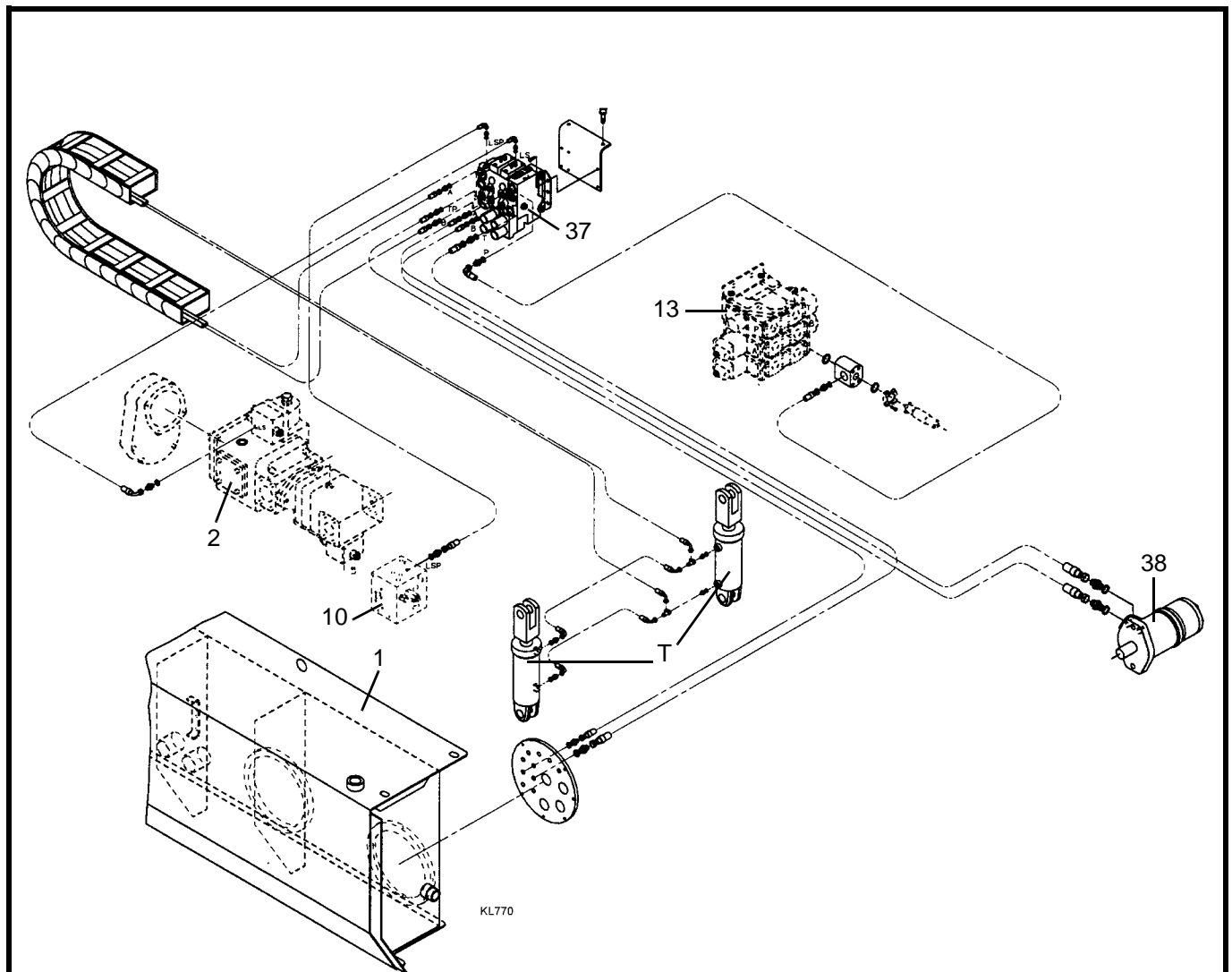
Cab movement

Cab movement is a hydraulic system that uses the flow from hydraulic pump 2. The start and stop of the cab's movement are dampened, which is controlled by the ECS system. For further information see description in group 20.

The principle hydraulic system component is a variable control valve (37) that feeds a hydraulic motor (38). The rotation of the motor is transmitted to the cab via a chain.

Tilt, attachment (optional extra)

Trucks equipped with forward tilt are fitted with an additional section to the cab movement control valve. The same feed as for cab movement is used. For further information see the description in group 20.

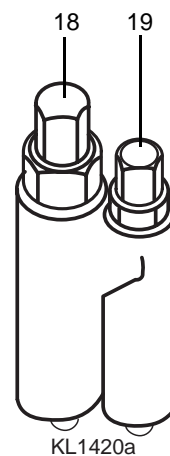
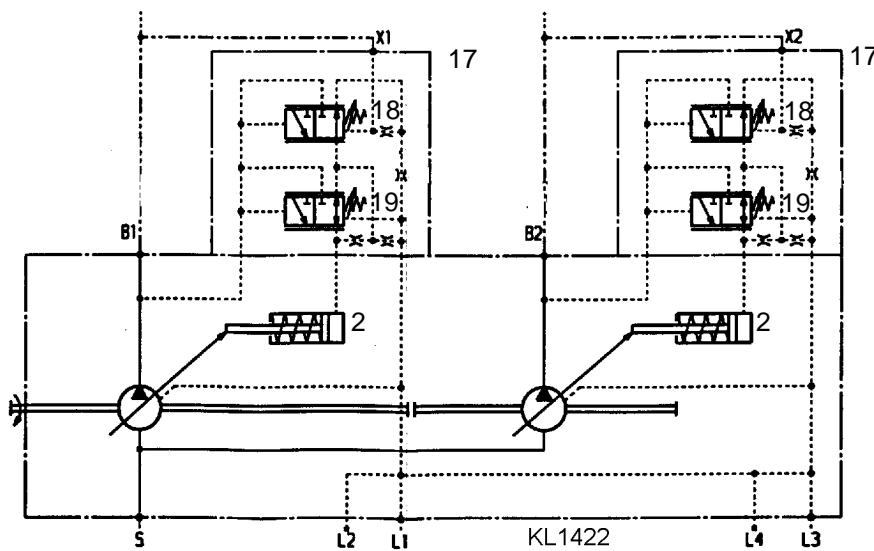
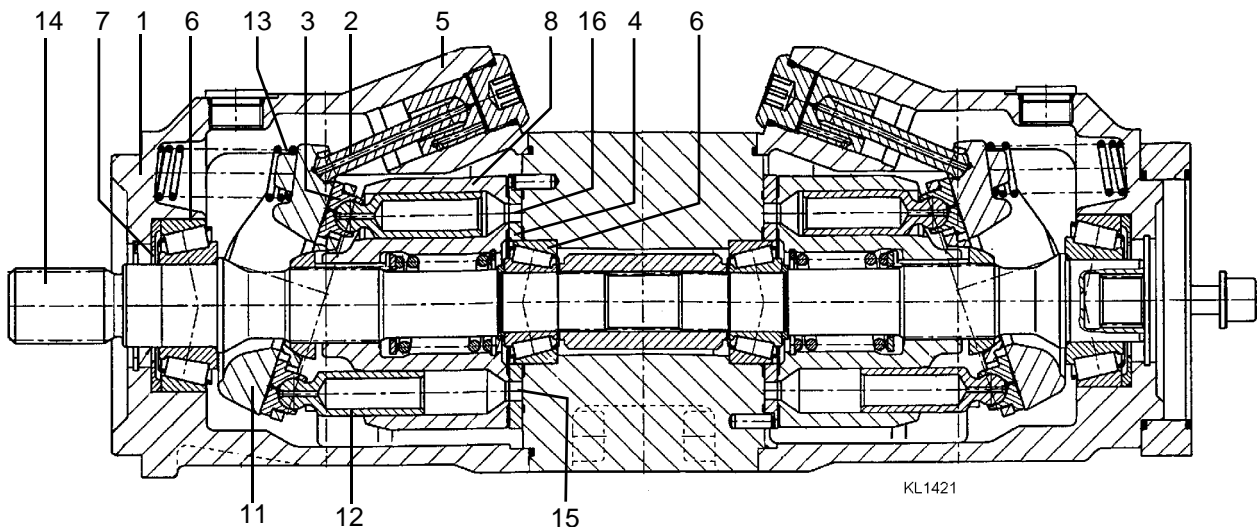


Numbering corresponds with the hydraulic diagram (H)

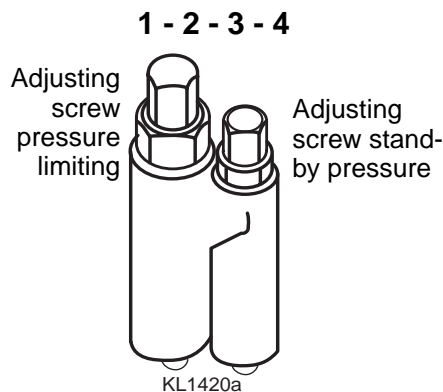
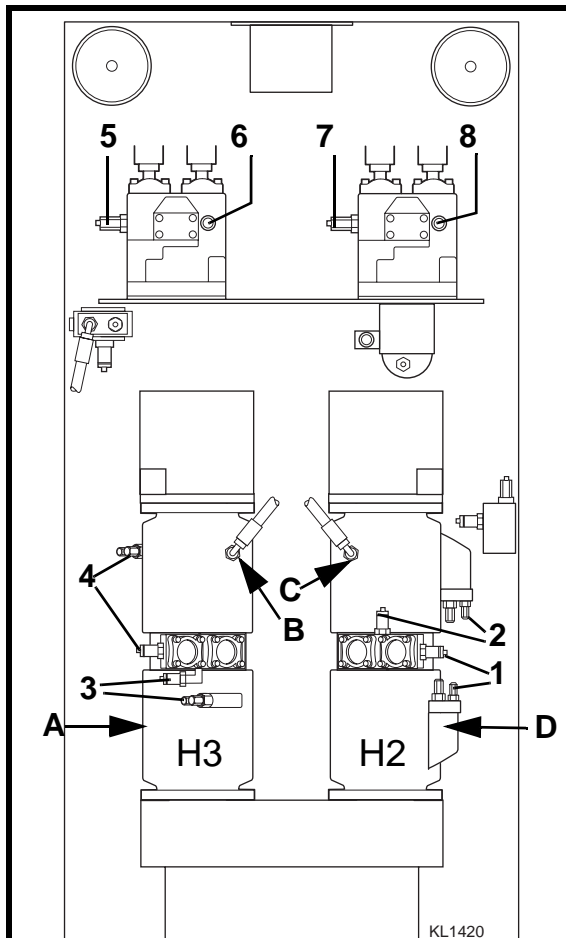
- 1. Hydraulic tank
- 2. Variable hydraulic pump
- 10. Valve block (priority valve)
- 13. Main valve
- 37. Control valve, cab movement
- 38. Hydraulic motor
- T = Tilt cylinder

Variable axial piston pump

The two double variable pumps H2 and H3 that feed the lift, boom extension and top lift are variable axial piston pumps with five pistons placed in a cylinder rotor. The stroke length of the pistons is determined by the position of an angled pressure plate. The pistons are secured in slip-shoes that rotate against the pressure plate. The stroke volume area and the area within the pistons are filled with hydraulic fluid during the suction phase. During the pressure phase, the hydraulic fluid is fed into the pressure lines via a valve plate. A hole in the head of each of the pistons allows hydraulic fluid to be forced out and gives a balanced counter pressure from the pressure plate as well as a film of fluid that lubricates the surfaces and inhibits wear.



- | | |
|------------------------|-------------------------------|
| 1. Rear housing | 12. Pump piston |
| 2. Control piston | 13. Pressure spring |
| 3. Slip-shoe | 14. Drive axle |
| 4. Valve plate | 15. Suction line connection |
| 5. Pump housing | 16. Pressure line connection |
| 6. Sealed axle bearing | 17. Regulator DFR |
| 7. Axle packing | 18. Max pressure setting |
| 8. Cylinder rotor | 19. Stand-by pressure setting |
| 11. Pressure plate | |



1. Test outlet and regulator, pump H2, inner
2. Test outlet and regulator, pump H2, outer
3. Test outlet and regulator, pump H3, inner
4. Test outlet and regulator, pump H3, outer
5. Test outlet, left main valve
6. Main pressure limiting valve, left main valve
7. Test outlet, right main valve
8. Main pressure limiting valve, right main valve

H2, H3, see hydraulic diagram



WARNING!

Immediately shut down the engine if the charging pressure exceeds the pressure stated on the hydraulic plate.

Setting the variable pumps

These settings may be carried out only by authorized personnel
Settings must be carried out with the hydraulic system at normal working temperature.

Venting the pumps

1. The pumps must be vented before the engine is started.
2. Connect compressed air at max 0,1 bar pressure to one of the breather filter connections on the hydraulic tank. Plug the other breather filter connection.
3. Loosen following hoses somewhat from the pump connections: **A** on the underside, **B** and **C**, **D** on the side.
4. Tighten the hose connections again when air free hydraulic fluid runs out.
5. Empty the accumulators by opening the accumulator evacuating valve.
6. Start the engine and stop it again to check the stop function.

Setting of Stand-by pressures

7. Start the engine and allow it to idle.
8. Connect a manometer (0-250 bar) to the measurement outlet 1, 2, 3, 4 and check the stand-by pressure on pump after pump. The pressures should be:
1 = 2,3 MPa, 2 = 2,1 MPa, 3 = 2,3 MPa, 4 = 2,1 MPa.
Adjust if needed on the adjustment screws for stand-by pressure.
Note: These settings relate to a standard machine. Certain higher capacity machines may have higher stand-by pressures. However, the same differentials in pressure must always be maintained.

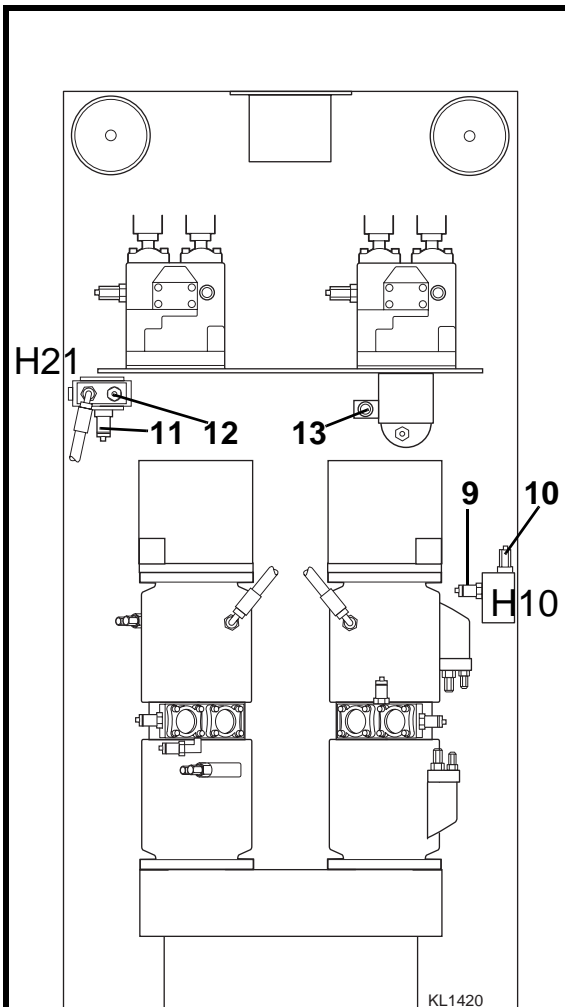
Setting of main pressure limitation valves

N.B. If the main valves are to be replaced or if the seals have been broken, the main valve main pressure limitation valve must be adjusted as per points 8, 9 and 10 below. If not, skip these points.

9. Unscrew fully counter-clockwise the adjusting screws 1 and 2 for pressure limitation on both inner pumps.
10. Screw in fully clock-wise the adjusting screws 5 and 7 on both main valves.
11. Connect the manometer to test outlet 6, see illustration.
12. Let an assistant increase engine revs to approx 1100 rpm and extend the boom max. out until the function is overflowing and keep overflowing during next item.
13. Screw in the adjusting screw 3 for pressure limitation (pump H3 inner) until the manometer reading is 5 MPa higher than the pressure stated on the hydraulic plate.
14. Unscrew counter-clockwise the adjusting screw 5 on the left main valve until the manometer reading is 3 MPa higher than the pressure stated on the hydraulic plate.
15. Move the manometer to test outlet 8 on the right main valve and repeat items 13 and 14 for pump H2 inner, adjusting screw 1, and right main valve, adjusting screw 7.

Setting of system pressure

16. Connect the manometer to test outlet 1, pump H2 inner, see illustration.
17. Overflow the extension function in the same way as in item 12 above
18. Set the system pressure for pump H2 (inner) with the adjusting screw 1 for max pressure. See the hydraulic plate for actual pressure.
19. Move the manometer to test outlet 2 and set pump H2 (outer), adjusting screw 2 for max pressure.
20. Repeat the setting for all four pumps in the same way. All pumps should be set to the same pressure, the sequence is of no significance.
N.B. The pressure stated on the truck's hydraulic plate for the main valves must be set **on the pumps** - not on the main valves.



Setting of steering pressure

21. Connect the manometer to the test outlet (9) on the priority valve H10. Turn the steering wheel to max wheel deflection and rev up the engine to 1200 rpm. Check that the pressure reading corresponds to the hydraulic plate.

22. Adjust if needed with the adjusting screw (10)

Checking of accumulator charging pressure

23. Allow the engine to idle.

24. Connect the manometer to the test outlet (11) on the accumulator charging valve H21.

25. Close the accumulator evacuating valve.

26. Check that the accumulator charging starts at 15 MPa and stops at the pressure stated on the hydraulic plate.

27. Adjust if needed with the adjusting screw (12)

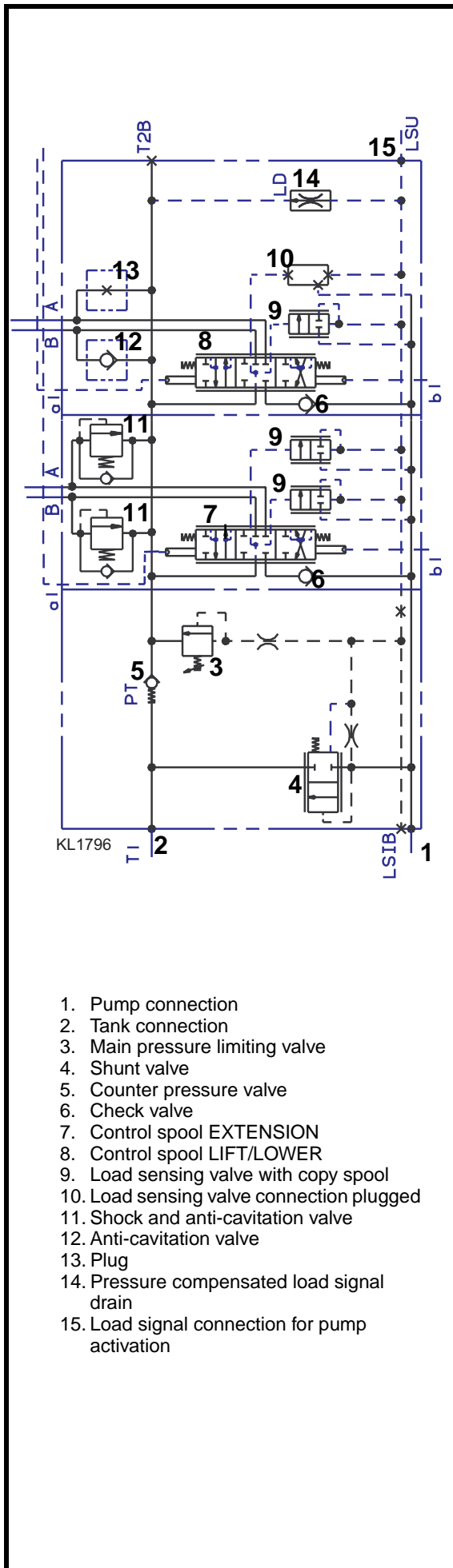
Checking of servo pressure

28. Connect the manometer to the test outlet (13)

29. Check that the pressure reading corresponds to the hydraulic plate. The pressure is not adjustable.

- 9. Test outlet for steering pressure, on priority valve H10
- 10. Adjusting screw, steering pressure
- 11. Test outlet, accumulator charging, on accumulator charging valve H21
- 12. Adjusting screw, accumulator charging pressure (H21)
- 13. Test outlet servo pressure

H10, H21, see Hydraulic diagram



Main valve

The main valve is a load-sensing, pressure-compensated directional control valve of modular type. In the hydraulic system there are two units, each one comprising:

- Inlet section
- Control section
- Combined control and outlet section

The inlet section is provided with:

1. Pump connection
2. Tank connection
3. Adjustable pilot-controlled main pressure limiting valve. A small direct acting pressure limiter controls the spool of the shunt valve 4 and opens the connection to the tank by moving the spool when the preset pressure is reached. The pilot pressure is fed from the supply channel. The load signal channel is blocked.
4. Shunt valve with two parts, one idling spool and one control spool. When the main valve spools are in neutral position, the idling spool is open, e.g. the flow is passing to the tank with low pressure drop. Whenever a function is being manouvrred, the idle spool will close and the control spool will take over. The pressure drop over the control spool is determined by the heaviest load plus the spring power of the shunt valve. This results in the pump pressure always being higher than what is required by the heaviest load.
5. A counter pressure valve in the return line with the function to maintain the pressure in the return line thereby improving the refill function.

The control section is equipped with:

6. A check valve in the supply line to prevent inadvertent lowering of the load when several functions are operated simultaneously.
7. Control section EXTENSION with double-acting, electrohydraulically controlled spool for one double-acting function. The spool is spring-centred.
8. Control section LIFT/LOWER with double-acting, electrohydraulically controlled spool for one single-acting function. The spool is spring-centred.
9. Load sensing valve for transmitting the load signal to the variable pumps for pump activation. The load sensing valve employs the pump pressure to control a copy spool which, in turn, is supplied with oil from the supply line to control the pumps.
10. For single acting function, e.g. LIFT/LOWER there is no copy spool for LOWER.
11. The pressure outlet is protected against overload and cavitation by a combined shock and anti-cavitation valve.

The outlet section has, in addition to 6, 7, 9/10:

12. Anti-cavitation valve in the pressure outlet for refilling and cavitation prevention.
13. For single acting function, e.g. LIFT/LOWER there is anti cavitation valve only for LOWER. The connection in this case is plugged.
14. Pressure compensated load signal drain.
15. Load signal connection for pump activation.

1. Pump connection
2. Tank connection
3. Main pressure limiting valve
4. Shunt valve
5. Counter pressure valve
6. Check valve
7. Control spool EXTENSION
8. Control spool LIFT/LOWER
9. Load sensing valve with copy spool
10. Load sensing valve connection plugged
11. Shock and anti-cavitation valve
12. Anti-cavitation valve
13. Plug
14. Pressure compensated load signal drain
15. Load signal connection for pump activation

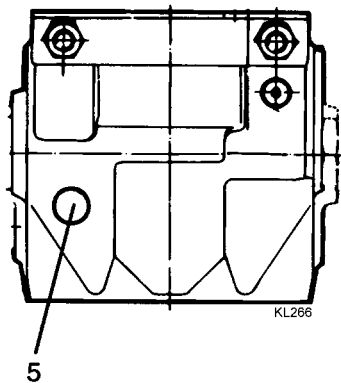
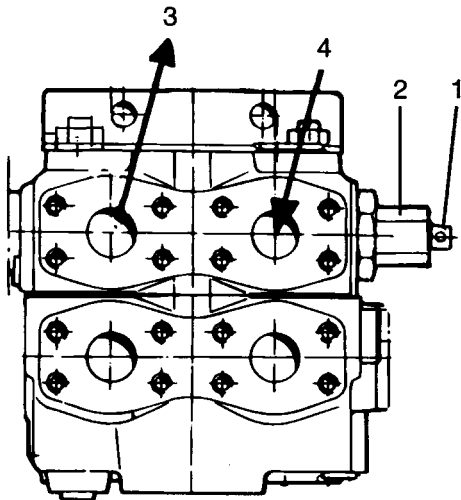
Main valve

The main valves are of precision type and must be handled with great care to safeguard their good performance. The following rules apply to service work:

1. Never use the spool ends or housings for clamping or gripping when lifting a valve block.
2. Never subject spool ends or housings to blows or shocks. Rough treatment may deform the spool, which will lead to immediate seizure.
3. Protect the valves from moisture and dirt. Take particular care to prevent dirt from entering the connection ports. Protect the ports and other joint faces to prevent scoring and bruising. Keep unconnected ports plugged with plastic plugs or the like.
4. When fitting pipes and hose couplings, observe meticulous cleanliness. Make sure that no swarf, flakes of paint or other impurities enter the valve. To avoid unnecessary stresses in the valve, do not overtighten the couplings.

Main valve – adjusting max pressure

***N.B. The pump is set to a lower pressure.
See Setting of variable pumps.***



1. Adjustment of main pressure limiting valve
2. Locknut
3. Return
4. Supply
5. Measurement tapping

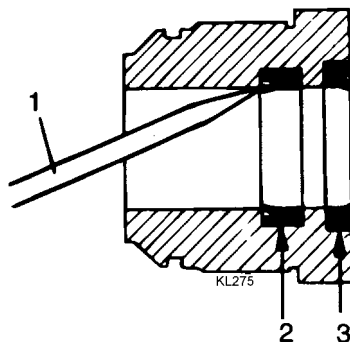
IMPORTANT!

Never use compressed air for removing the piston from the cylinder. You could sustain serious injuries.

Repairs to leaking hydraulic cylinders – replacing the seal

See also separate Supplement

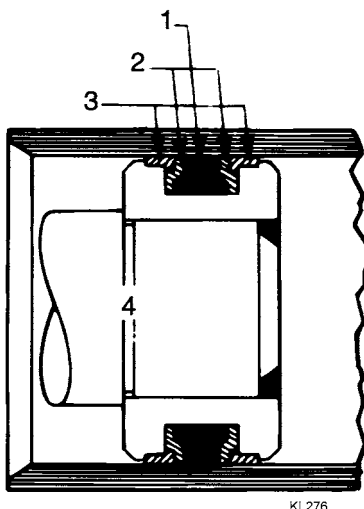
Hydraulic cylinders, Publ. No.920 937-9279



1. Screw driver
2. Lip seal
3. Scraper ring

General instruction applicable to all cylinders

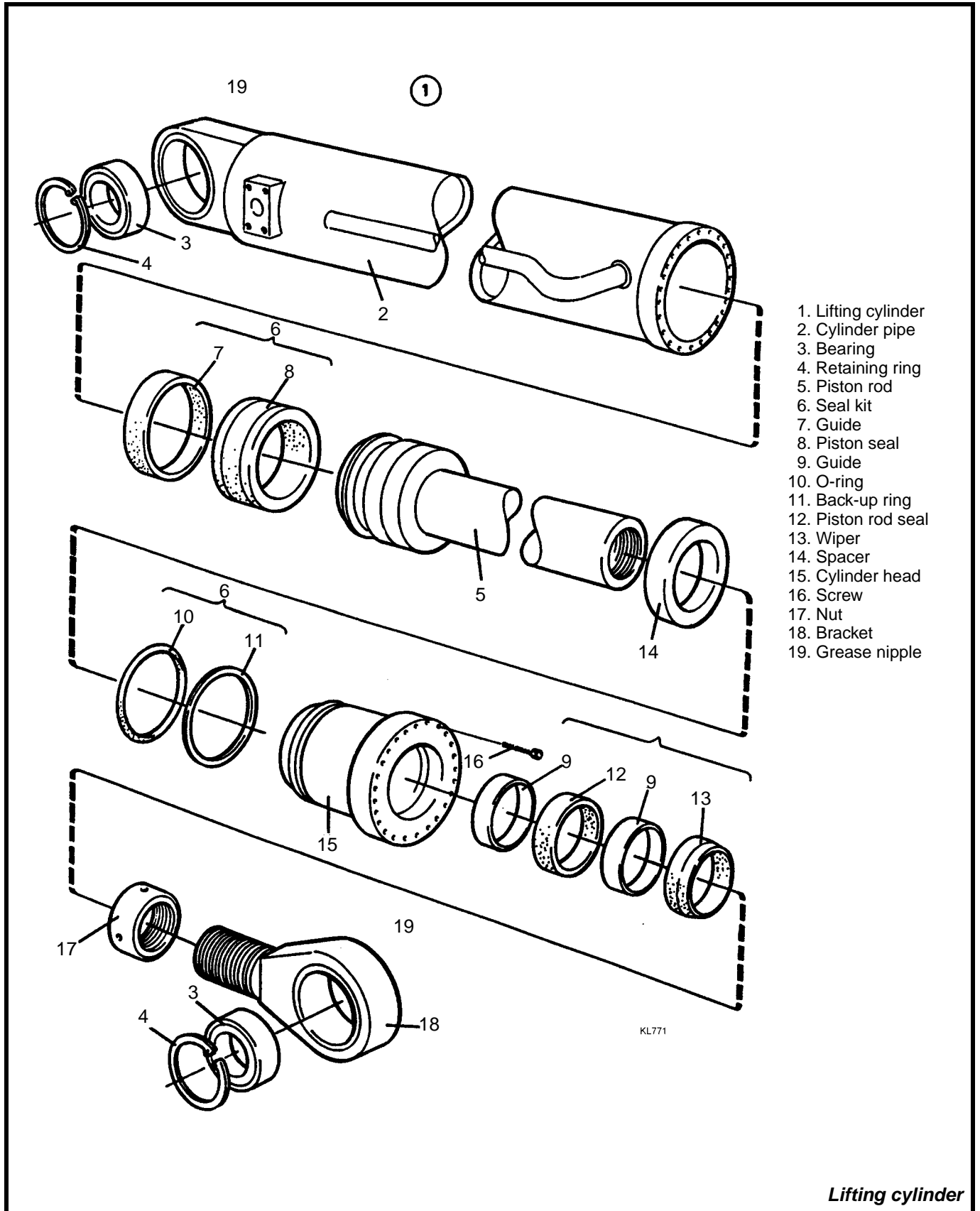
1. Remove the relevant hydraulic cylinder. Fit immediately protective caps or plugs to the hydraulic cylinder and hose connections.
2. Take the cylinder to the workshop, drain any oil remaining in it and carefully wash the outside of the cylinder.
3. Dismantle and assemble the cylinder in accordance with the instructions for that particular cylinder type.
4. Removing the seals:
 - Whenever repair work is carried out on hydraulic cylinders, all seals, scraper rings, etc. must be replaced.
 - Take extreme care when removing the seal in the cylinder head, to avoid scratching the bottom of the groove, since oil leakage will otherwise occur in the future. Use a screwdriver as shown in the figure.
 - Clean all components very thoroughly.
5. Fitting of lip seals:
 - Fit the seal in the cylinder head with the lip facing inwards towards the piston. Oil the seal and press it in by hand. N.B. Don't use any tools, since the seal may otherwise be scratched. Even a minute scratch may cause the seal to leak.
6. Fitting the piston seal:
 - All piston seals are of the same design and consist of five components, i.e. a centre sealing ring, two backing rings and two guide rings.
 - Dismantle the piston seal and start by fitting the sealing ring onto the piston, and then fit the backing rings and the guide rings. All of this must be done by hand.



1. Sealing ring
2. Backing rings
3. Guide rings
4. Piston head

Lifting cylinder

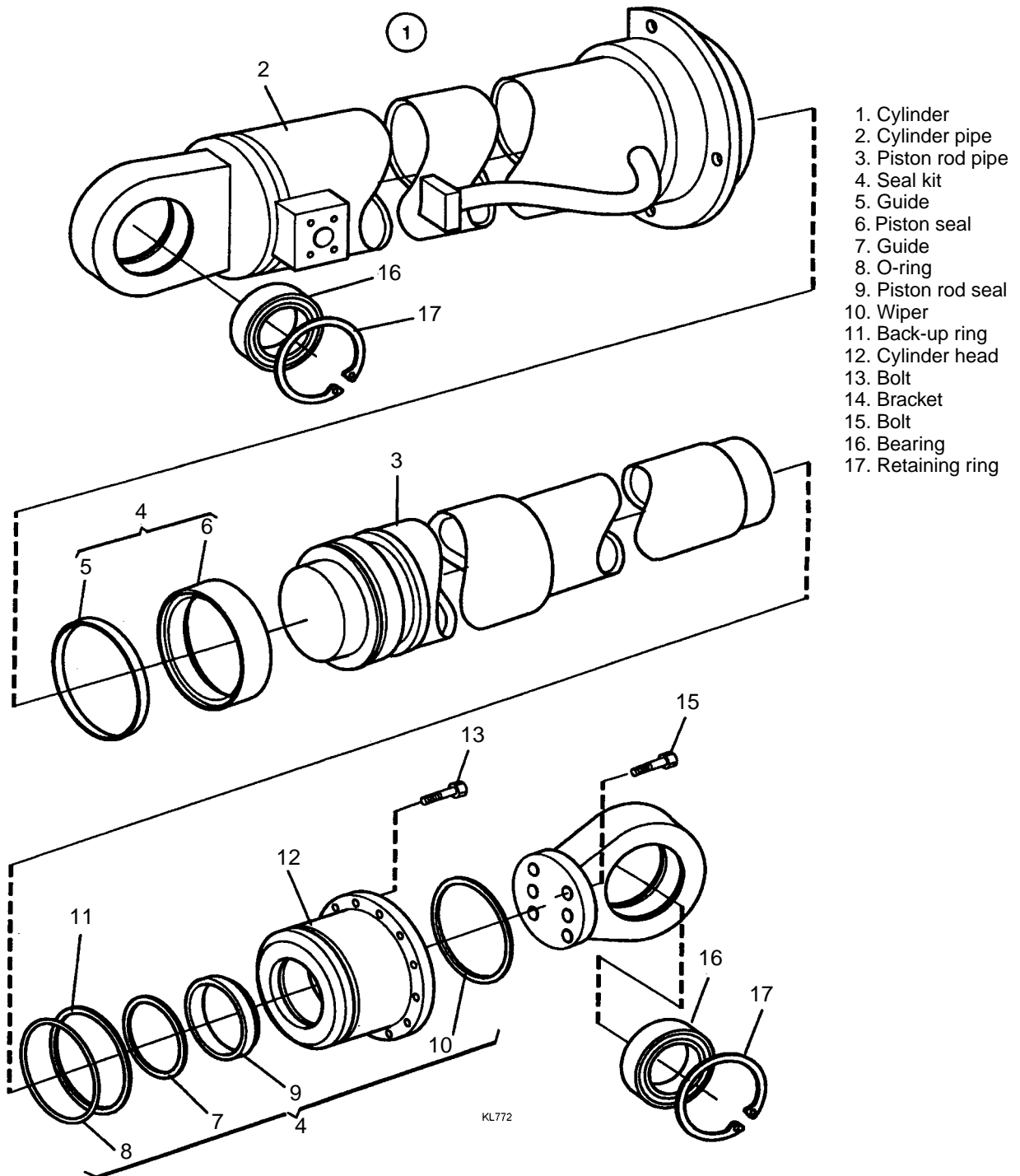
1. The lifting cylinder is provided with bearings at both ends. The piston rod lug is threaded into the piston rod and locked with locknut.
2. The cylinder head and the cylinder tube are provided with mounting flanges joint together with hexagon-headed screws.



Lifting cylinder

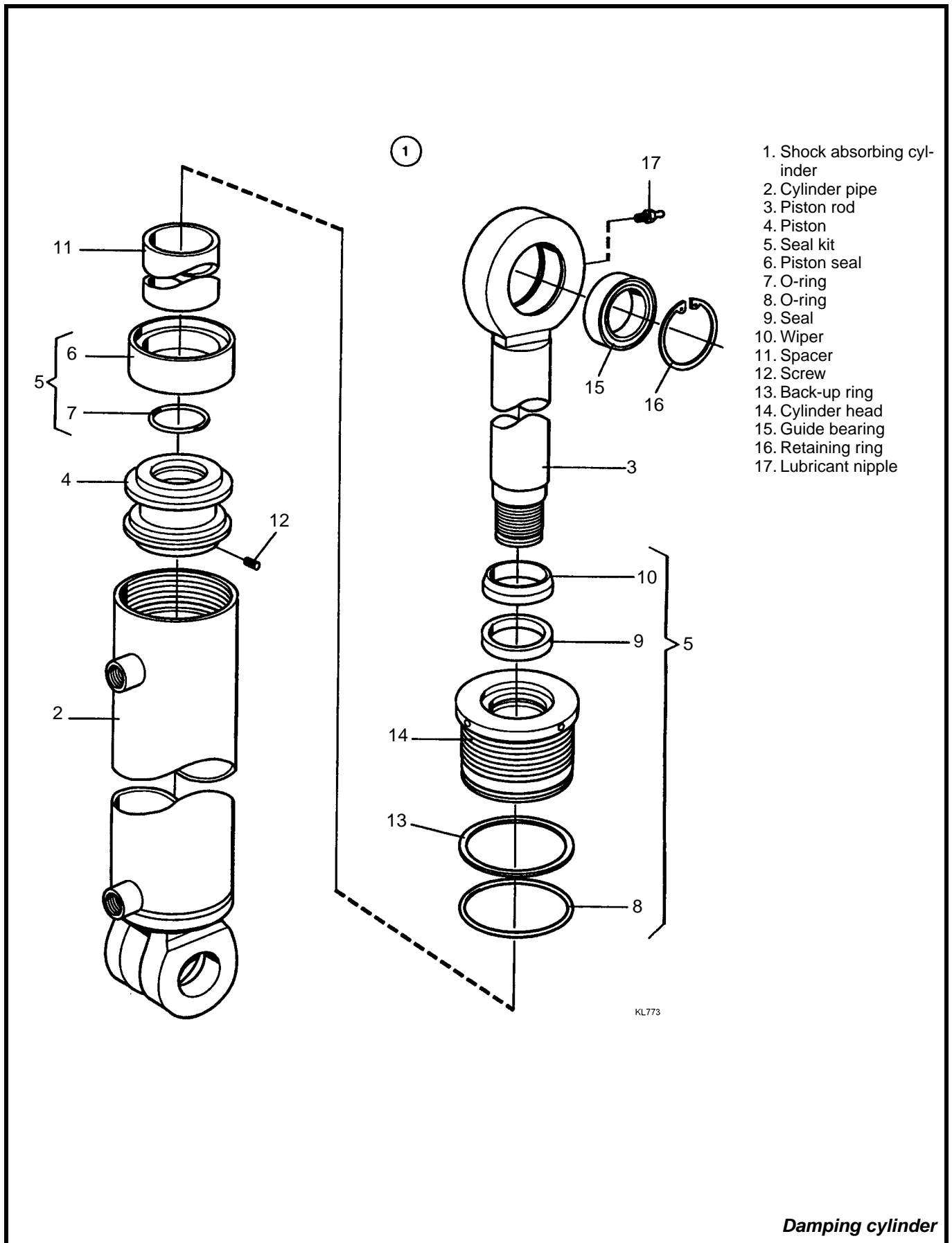
Telescoping cylinder, main boom

1. The extension cylinder's piston rod end is lug shaped with a flange that is fixed to the piston rod with hexagonal bolt.
2. The cylinder head is fitted with a flange that is attached to the cylinder tube with hexagonal bolts.



Damping cylinder, attachment

1. The mounting lug is welded to the piston rod which, in turn, is threaded into the piston and locked with a locking screw.
2. The cylinder head is threaded into the cylinder tube.



Hydraulic diagram, components

Diagram (H), A23056.0400/0500

1. Hydraulic tank
2. Double variable hydraulic pump, LIFT, EXTENSION, STEERING SYSTEM, SERVO
3. Double variable hydraulic pump, LIFT, EXTENSION
4. Fixed hydraulic pump, ATTACHMENT
5. Fixed hydraulic pump, BRAKE SYSTEM
6. Check valve
7. High pressure filter
8. Steering valve ORBITROL
9. Steering cylinder
10. Priority valve, STEERING, residual flow to SERVO, MAIN VALVES
 - a. Pressure regulator valve SERVO, 30-35 bar
 - b. Valve, feed working hydraulics
 - c. Priority valve, feed steering system
 - d. Overflow valve, setting of steering pressure
11. Filter, servo circuit
12. –
- 13/16. Main valve, see also detailed description page 39
 - a. Shunt valve
 - b. Main pressure limiting valve
 - c. Control spool EXTENSION
 - d. Control spool LIFT/LOWER
 - e. Load sensing valve with copy spool
 - f. Counter pressure valve
 - g. Pressure compensated load signal drain
 - h. Shock and anti-cavitation valve
 - k. Anti-cavitation valve
 - m. Plug
14. Converter, LIFT/LOWER
15. Converter, BOOM OUT/IN
16. Main valve, see 13 above
17. Valve block, left and right lift cylinders
 - a. Blocking valve
 - b. Solenoid valve, control of blocking valve
 - c. Shock valve, 280 bar
 - d. Solenoid valve, control of regeneration
 - e. Regeneration valve
18. Lift cylinder, left and right
19. Valve block at extension cylinder
 - a. Lowering brake valve with pressure compensated throttling
 - b. Solenoid valve, control of regeneration valve
 - c. Regeneration valve
20. Extension cylinder
21. Accumulator charge valve
22. Accumulator
23. Accumulator discharge valve
24. Safety valve 210 bar
25. Valve for reserve servo pressure
26. Filter, cooling circuit, brake system
27. Oil cooled brake discs
28. Non-return valve, 1.5 bar, safety valve for drive axle cooling circuit
29. Service brake valve
30. Brake cylinder
31. Sensor, disengagement
32. Sensor, brake lights
33. Sensor, low brake pressure (accumulator pressure)
34. Parking brake valve
35. Sensor, indicator lamp parking brake ON and seat buzzer
36. Parking brake cylinder
37. Control valve, cab movement
38. Hydraulic motor, cab movement
39. Control valve Lever steering/Mini steering
40. Solenoid valve, disconnection of pump H3b when transporting
41. Hydraulic oil cooler
42. Solenoid valve, activation of pump H3b for feed to the top-lift
43. Separate tank for brake system
44. Fixed hydraulic pump for working hydraulics cooling circuit
45. Hydraulic fluid cooler for working hydraulics cooling circuit

**Supplement
Hydraulic Cylinders
Technical Handbook
All Trucks**

Contents

Clean hydraulics	3
Measures to prevent pollution of the hydraulic system.....	4
Fault finding for leakage	6
The function and removal of seals.....	7
Piston rod seals	7
Support ring and O ring	9
Wiper	10
Single action V type piston seals with support ring	11
Double action piston seals	12
Repairing the piston rod surface.....	12
Lubrication	13
Dismantling the steering cylinder.....	14

Clean hydraulics

Hydraulic systems are extremely sensitive to impurities - a hydraulic system is just as sensitive as a diesel engine's fuel system, with its pumps, filters and lines.

It is therefore extremely important that hydraulic systems are kept clean and free from impurities. A clean system means that there are no impurities in the system, whether it be in the hydraulic fluid, component parts of the system or hydraulic lines and hoses.

By impurity, we refer to everything and anything that is not intended to be in the system:

- solid particles such as dust, grit, threads of cotton waste, flakes of rubber from hoses or seals, etc.
- liquids
- gasses

Possible sources of impurity

- Existing impurities
 - Casting sand, welding cinder, dust, water, etc., from components, hydraulic lines and hoses.
- Generated impurities
 - Scaling. When particles that come between two moving surfaces attach themselves to one of the surfaces and thereafter act as a cutting surface to the opposite surface where it cuts or grinds off material. The newly formed particles then harden and cause even more wear and tear as they circulate in the system.
 - Erosion
 - Cutting or "cold welding"
 - Cavitation, insufficient flow to pump
 - Corrosion that generates particles
 - Fatigue/wear and tear that generates particles
- Accidentally added impurities
 - During repair operations
 - As a result of topping up with impure hydraulic fluid
- Penetrative impurities
 - Penetration via breather air to the hydraulic tank
 - Penetration via the piston rod's lubricating film
 - Penetration through poorly sealed inspection hatches
 - Condensation
 - Penetration via rod seals

Solid particles

It is possible to see a particle of 40 μ in size with the naked eye, but not one of 10 μ . (1 μ = 1/1000 mm).

By comparison, a strand of human hair is approx. 70 μ thick. The smallest particles are less than 25 μ in size and are not visible to the naked eye. If the number of small particles is sufficiently large, they merely discolour the hydraulic fluid - by which time there are far too many impurities in the system.

It is not, therefore, possible to judge, with the naked eye, whether or not hydraulic fluid is sufficiently clean! A particle count using special machinery or magnification equipment must be made to establish the degree of impurity.

Solid impurities in hydraulic systems cause many different types of problem. Large quantities of impurity dramatically reduce the operative lifespan of the system. Hydraulic components break down as a result of internal wear. Particles cause directional and servo valves to seize, which, in turn, leads to the burning out of the magnetic spools.

Gasses

The most common gas that occurs as an impurity in a hydraulic system is air. Unlike fluids, gasses can be compressed. If air is allowed to enter a hydraulic system, this compression will be experienced as a “sponginess” of operation, making hydraulic movements difficult to control.

Air in the hydraulic fluid can also cause corrosion damage, particularly when localized, sudden reductions in pressure, known as cavitation, occur.

Liquids

The most common liquid impurity that occurs in a hydraulic system is water, for example, through condensation. This can cause rust to form, resulting in flakes or particles of rust entering the system. This most commonly occurs in the tank and those parts that are above the level of the hydraulic fluid. Such parts can be inside single action cylinders where the complete length of the hydraulic piston stroke, is seldom or never used. One simple preventive measure for such parts is to regularly run all hydraulic functions to their end positions so that the whole of the cylinders are lubricated.

Measures to prevent pollution of the hydraulic system

When changing attachments

Many machines have attachments that can be changed, which also means that hydraulic lines and hoses must be loosened and switched over. This entails a major risk of impurities penetrating into the system.

- Always clean the connection point extremely thoroughly before disconnecting
- If possible, use quick release connectors fitted with a non-return valve. This will then reduce the risk of impurities entering the system and fluid being spilt
- Clean the connectors extremely thoroughly before making the connection. Make sure that no impurities are forced into the connectors themselves.

When the system is operating

All protruding hydraulic components, such as hydraulic piston rods, are at considerable risk from both mechanical damage and impurities. Due to the fact that the level of hydraulic fluid in the tank varies, the tank will “breathe” through the breather filter and if the level becomes too low, the hydraulic pump will fill the system with air.

- Be extremely careful with hydraulic piston rods so as to avoid physical damage to them
- Regularly empty condensation water from the hydraulic tank
- Make sure that the fluid level in the hydraulic tank is always as high as possible
- Make sure that all filters in the system function correctly. Regularly replace filter elements, in accordance with the machine’s lubrication chart
- Regularly check the wiper and rod seals and replace them as required

Storage and topping up of hydraulic fluid

- Be particularly careful when topping up hydraulic fluid - carelessness is one of the major causes of impurities entering the system
- Store drums, cans and funnels in as clean conditions as possible, for example, under a tarpaulin and not directly on the floor.
- Handle drums, cans and funnels with care and clean them as necessary
- Store drums of hydraulic fluid horizontally so that bungs and taps are below the fluid level, which will reduce the risk of impurities and humid air entering the drum.
- Always top-up hydraulic fluid through a clean strainer, preferably through a filter, using a top-up pump.
- Never use the very last of the fluid in the drum. This could contain water and other impurities, depending on the number of times that the drum has been opened.

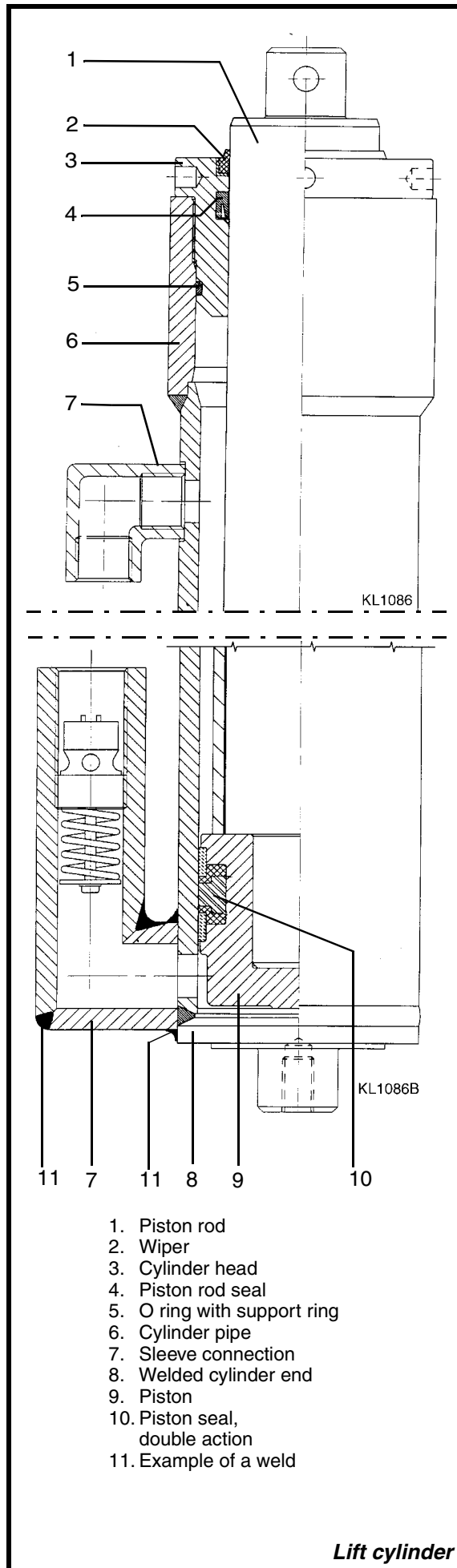
Repairs and Service

As soon as a hydraulic system is opened, there is always a great risk of impurities entering the system

- Thoroughly clean the area around the system on which work is to be carried out
- Isolate the area where work is to be carried out with the help of, for example, clean protective plastic sheeting
- Do not open sensitive components out in the field, replace the complete component instead
- Immediately insert protective plugs in all open connections
- Make sure that exchange components are thoroughly clean
- Carry out the repair as soon as possible
- After dismantling, clean all parts
- If a serious breakdown has occurred, for example, if a pump or hydraulic motor has seized, metal particles may have been spread and polluted the entire system. In such cases, it is extremely important to carefully filter or replace the hydraulic fluid. Under all such circumstances, the system's filters must always be replaced
- Never fit components where the protective plugs have fallen out - impurities may have entered the system

IMPORTANT!

If there is the slightest doubt about the purity of the hydraulic fluid - send a fluid sample to the manufacturer of the fluid, or to Kalmar Service



1. Piston rod
2. Wiper
3. Cylinder head
4. Piston rod seal
5. O ring with support ring
6. Cylinder pipe
7. Sleeve connection
8. Welded cylinder end
9. Piston
10. Piston seal, double action
11. Example of a weld

Fault finding for leakage

1. All fault finding should take place with the minimum hydraulic pressure required to actually discover the leakage. High pressure will tighten all seals and make it more difficult to discover any leakage.
2. Check extremely carefully where the leakage comes from before taking any action. It may be possible to stop the leakage without the necessity of costly dismantling.
3. Check for external leakage
 - welds on cylinder ends
 - welds on coupling connections
 - leakage between the cylinder pipe and the cylinder head, could be due to a faulty O ring or damage to the O ring's sealing surface. Both problems can be corrected with the cylinder in place
 - leakage between the cylinder head and the piston rod, could be due to a damaged piston rod or damaged/worn piston rod seal
4. Check for internal leakage
 - leakage between the hydraulic piston seal and the cylinder pipe, due to worn piston seal. Put the cylinder under pressure and check to see if the piston sinks back

Dismantling hydraulic cylinders

Before dismantling, always check that the piston rod is free from any remains of paint. Also check to ensure that there are no burrs or impact damage by the connections or couplings. Make sure that the chamfer up to the chrome surface of the piston rod is free from burrs and any remains of paint.

1. Loosen the cylinder from its mounting and loosen the hydraulic connections
2. Immediately plug the cylinder connections and hoses/lines.
3. When the cylinder is opened - observe the highest possible level of cleanliness! Study the Technical Handbook to see how respective cylinders are designed and constructed.

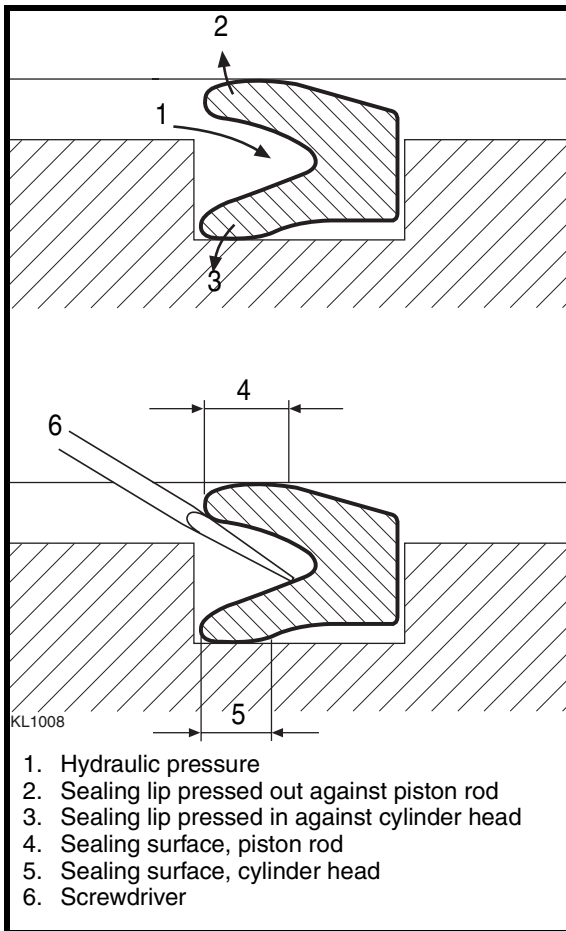
Check surfaces

1. Check the surfaces of seals. Always think about how the seals function and the type of sealing surfaces that they have. See the following descriptions:
 - O ring grooves internal and external
 - piston rod seals in the cylinder head
 - sealing groove on the piston
 - cylinder pipe surface
 - piston rod surface. The piston rod has a chromium plated surface of 20-50 μ in thickness. Very minor damage to this plated surface will not necessarily directly result in leakage
 - all sliding surfaces (dynamic surfaces). These are always the most difficult to ensure a tight seal, for example, cylinder pipe and piston rod.

IMPORTANT!

When fitting the cylinder head:

Fit the head absolutely straight, preferably by hand. Do not, under any circumstances, hit it with a mallet or hammer. If the cylinder head is fitted askew the lip of the piston rod seal can be damaged and any sealing function will be lost. This applies to all types of piston rod seals.



The function and removal of seals

Piston rod seals

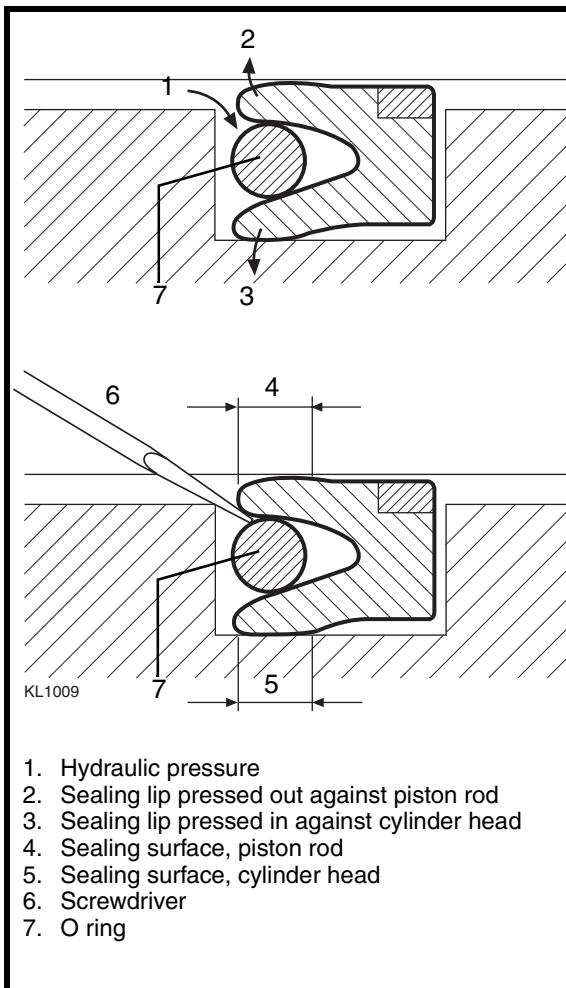
The piston rod seal is the seal that sits in a groove in the hydraulic cylinder head forming a seal against the piston rod. This seal is very exposed as it performs both dynamic and static sealing functions, i.e., it is seals against the moving surface of the piston rod whilst the sealing surface against the cylinder head is static.

There are different types of piston rod seals:

- Single V seals
- Pre-tensioned V seals with support ring
- Compressible seals

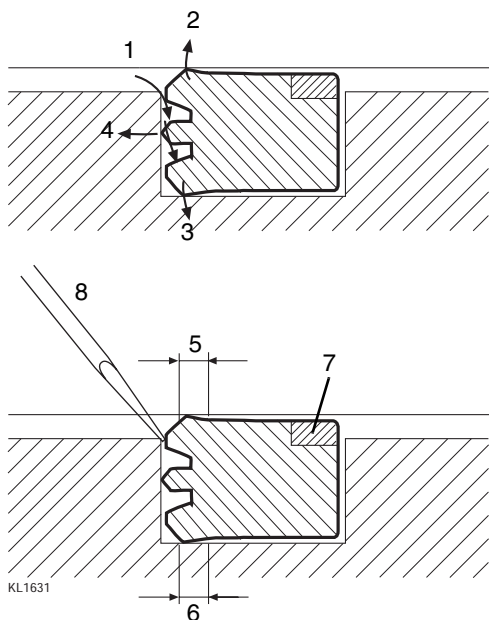
The single V seal has a V shaped section with two lips which seal in each respective direction. The hydraulic pressure works itself into the V shape and presses the sealing lips outwards against the sealing surface of the piston rod and in the cylinder. Even the smallest amount of damage to the sealing lips can cause a major leakage. Check the sealing lips by carefully feeling around the seal with a finger nail.

Use a screwdriver to remove a V seal, see illustration. Lever out and twist up the seal. It is extremely important that the screwdriver only comes into contact with the inside of the V shape so that it cannot touch and thereby damage any sealing surface. A score from a screwdriver on the sealing surface will have a disastrous effect and cause major leakage.



The pre-tensioned V seal has, in addition, an O ring within the space formed by the V shape. The O ring provides a greater sealing effect at low hydraulic pressure as the O ring, even when not under hydraulic pressure, presses the sealing lips out against the sealing surfaces. It is equally sensitive to damage as the V seal. Check the seal in the same way.

Use a screwdriver to remove the seal, see illustration. Lever out and twist up the seal. It is extremely important that the screwdriver only comes into contact with the inside of the V shape so that it cannot touch and thereby damage any sealing surface. A score from a screwdriver on the sealing surface will have a disastrous effect and cause major leakage.



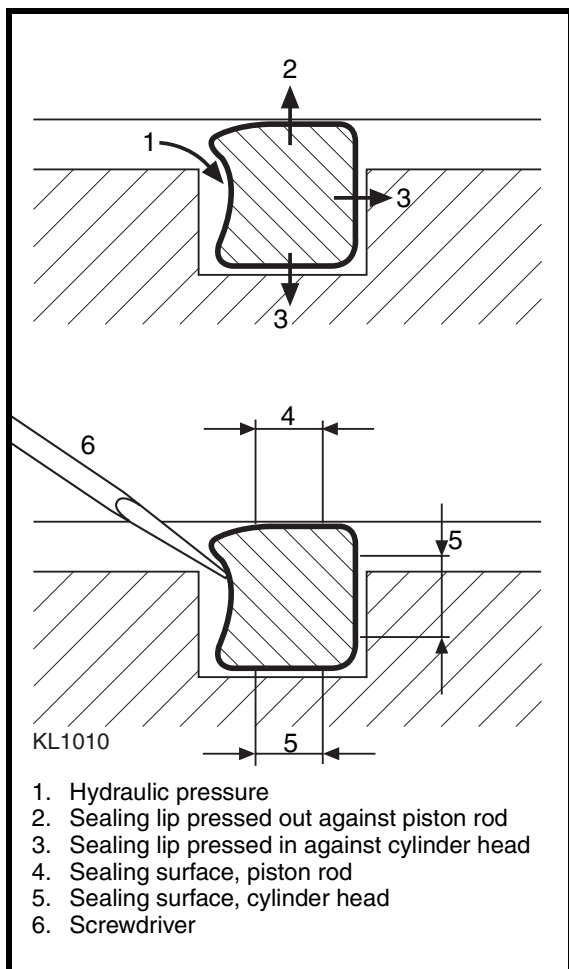
1. Hydraulic pressure
2. Inner sealing lip, pressed against the piston rod
3. Outer sealing lip, pressed against the cylinder head
4. Beam for axial fixation
5. Sealing surface, piston rod
6. Sealing surface, cylinder head
7. Support ring
8. Screwdriver

Piston rod seal type TICLA is of compact design with integrated support ring. It has an inner sealing lip against the piston rod and an outer sealing lip which seals with press fit against the cylinder head. An intermediate bead between the sealing lips provides axial fixation

The bead has recesses to admit hydraulic pressure on both outer and inner sealing lips.

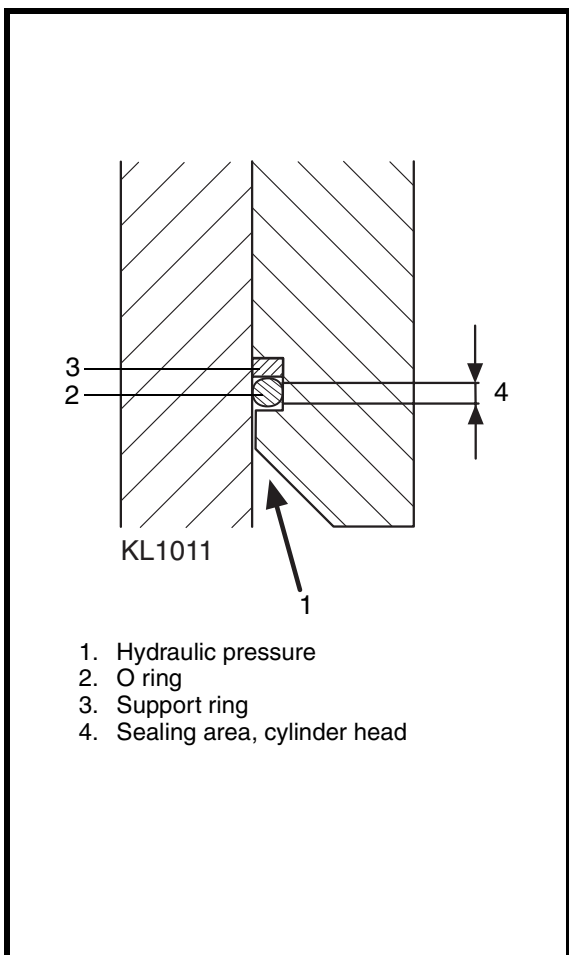
Even the smallest amount of damage to the sealing lips can cause a major leakage. Check the sealing lips by carefully feeling around the seal with a finger nail.

Use a screwdriver to remove the seal, see illustration. Lever out and twist up the seal. It is extremely important that the screwdriver is inserted between the inner sealing lip and the intermediate bead so that it cannot touch and thereby damage any sealing surface. A score from a screwdriver on the sealing surface will have a disastrous effect and cause major leakage.



The **compressible piston rod seal** consists of a solid rubber profile and gives a greater sealing area than V seals.

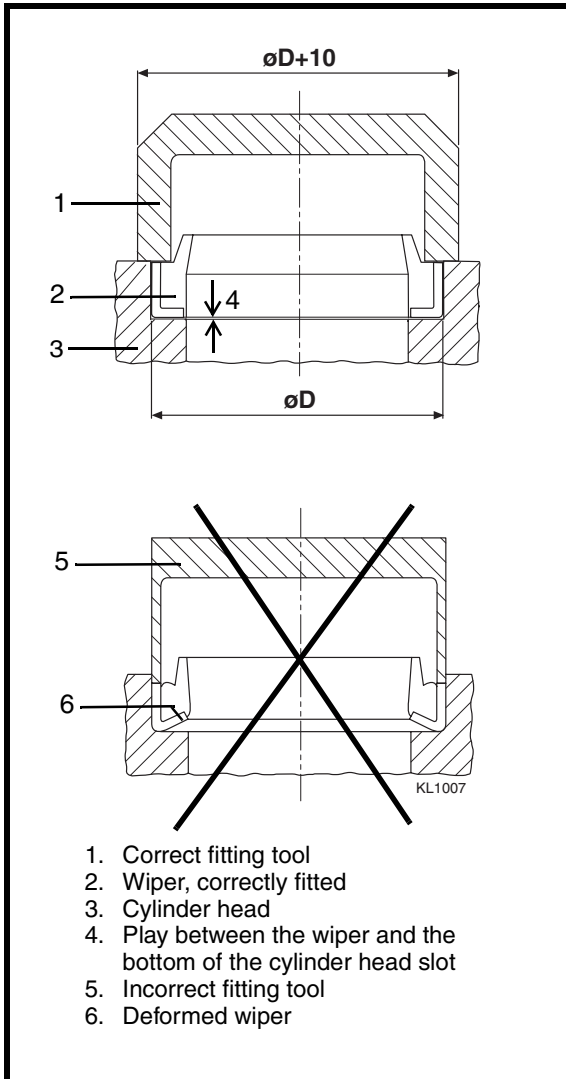
Use a screwdriver to remove the seal, see illustration. Lever out and twist up the seal. With this type of seal where the sealing area covers such a large part of the sealing groove, it is vitally important that the screwdriver is not allowed to make any mark.



Support ring and O ring

The support ring and O ring combination is used to seal between two static surfaces, such as, for example, between the cylinder pipe and the cylinder head, even in those cases where the cylinder head is threaded onto the cylinder pipe.

The task of the support ring is to brace the O ring so that it does not change shape. The O ring is pressed against the support ring and the sealing surface by the hydraulic pressure in the cylinder. When the cylinder head is to be fitted into the pipe: Be extremely careful so as not to damage the O ring.

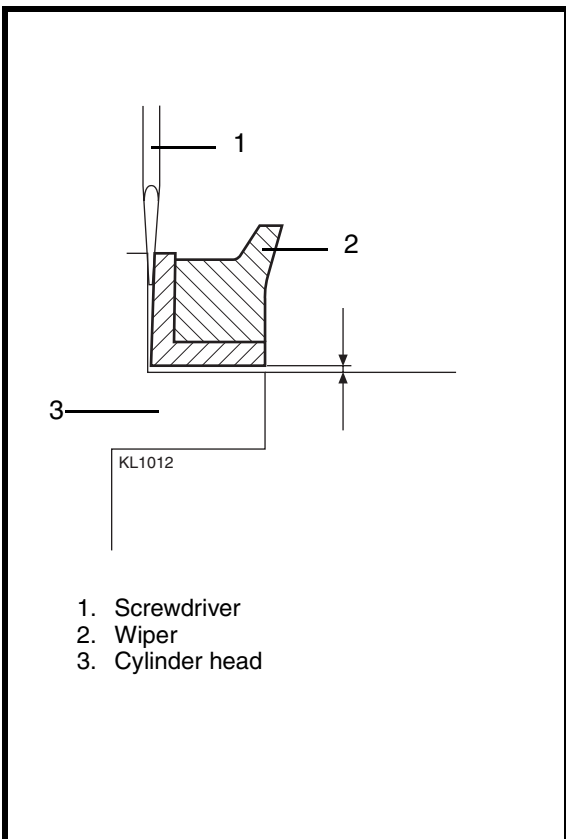


Wiper

The task of the wiper is to scrape the piston rod clean and prevent any impurities being drawn into the cylinder pipe.

The wiper must be fitted with a special tool. This tool must have a greater outer diameter than the wiper, so that the pressure against the wiper ceases just as the wiper is pressed into position. If the wiper should be pressed further in, the metal cap will be deformed (see lower illustration) which would thereby reduce the efficiency of the wiper.

To prevent the wiper "bottoming" in its slot in the cylinder head, the slot in the cylinder head is somewhat deeper than the width of the wiper.



The wiper can be removed without the necessity of dismantling the cylinder. A screwdriver can be used to remove the wiper. This must always be employed against the outer edge of the wiper, see illustration. Carefully tap the screwdriver down between the wiper and the cylinder head and thereafter, lever the wiper out. Polish off any marks on the cylinder head.

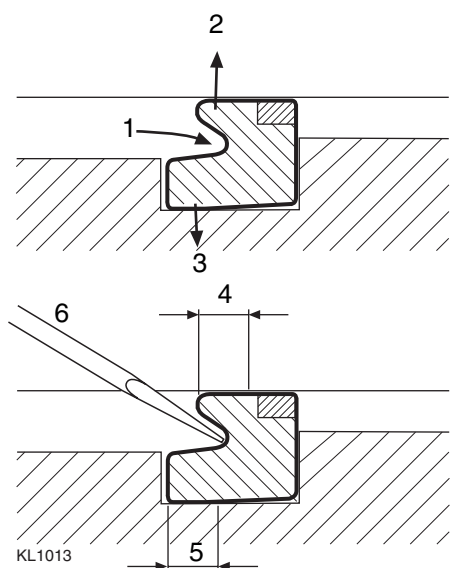
IMPORTANT!

No tools should be introduced from the inside. This can score the cylinder pipe, which in turn, can damage the piston rod. Scoring can also damage the piston rod seals when the piston is fitted.

Single action V type piston seals with support ring

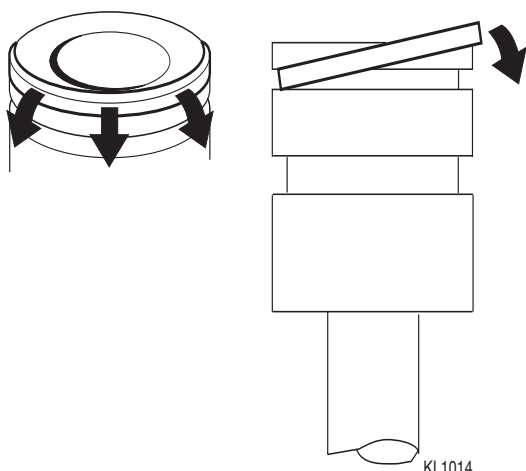
On single action V seals it is always the long side that seals against the static and the short side that seals against the moving surface.

Use a screwdriver to remove the seal, see illustration. Lever out and twist up the seal. It is extremely important that the screwdriver only comes into contact with the inside of the V shape so that it cannot touch and thereby damage any sealing surface. A score from a screwdriver on the sealing surface will have a disastrous effect and cause major leakage.



KL1013

1. Hydraulic pressure
2. Seal pressed outwards against cylinder pipe
3. Seal pressed inwards against piston
4. Sealing surface, cylinder pipe
5. Sealing surface, piston
6. Screwdriver



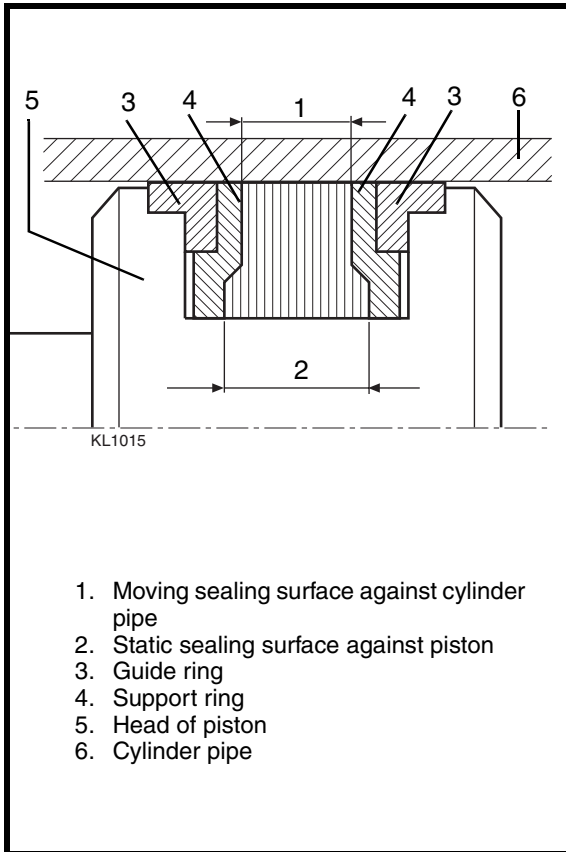
KL1014

The seal must always be fitted coupled together with the support ring.

Always fit by hand, no tools should be used as the surface of the piston can be easily damaged.

To make fitting easier, the seal can be warmed in hot water to soften it.

Lubricate with hydraulic fluid.



Double action piston seals

Double action seals function with pressure from both directions, e.g., in a steering cylinder.

The whole of the surface within the cylinder pipe is the sealing surface, it is therefore extremely important that this surface is not damaged in any way.

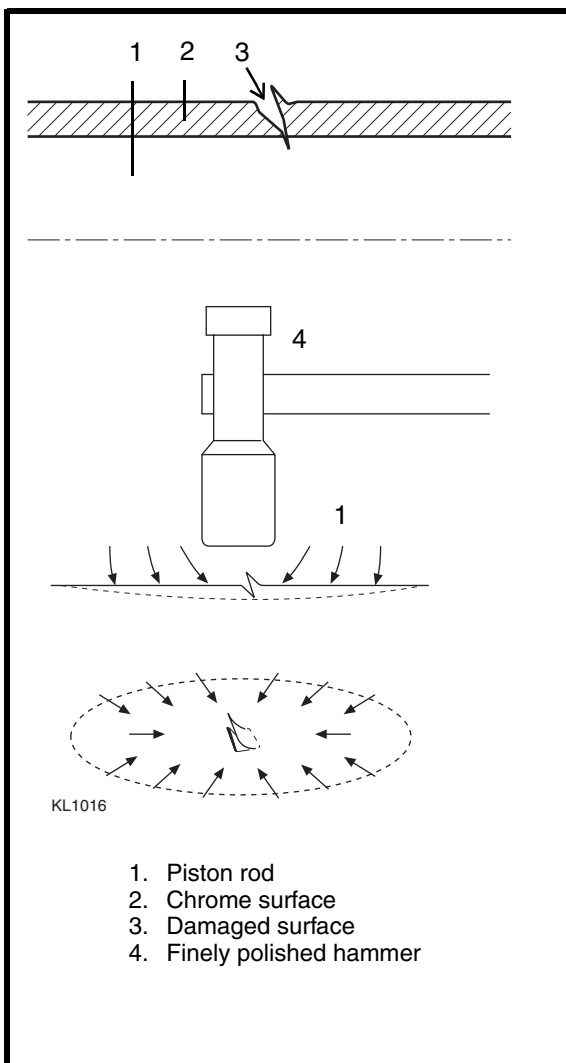
Be very careful when fitting the piston in the cylinder pipe to avoid any damage to the seal from the threading in the cylinder pipe.

Dismantling

1. Remove guide rings and support rings.
2. Move the sealing body over to one side of the sealing groove.
3. Press up the materials so that there is a gap between the seal and the piston.
4. Without damaging the surface of the piston, cut the seal off with a knife.
5. Carefully check the seal to discover any damage that can have caused leakage. This can be achieved most easily by bending over the seal section by section and checking the sealing surface with a finger nail.

Fitting

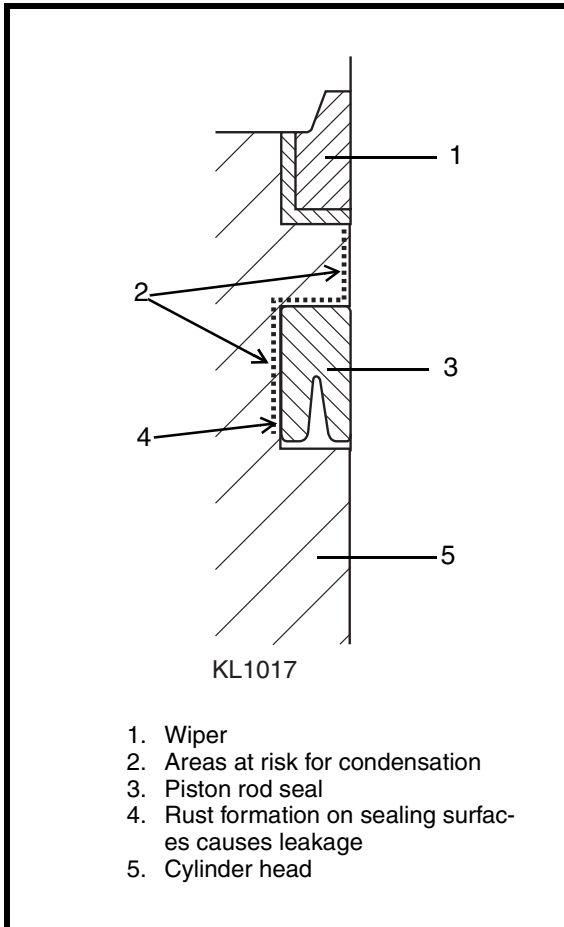
1. All double action piston seals are constructed in the same way, a middle sealing body, thereafter support rings and finally, guide rings, see illustration.
2. First fit the sealing body, thereafter the support rings and finally the guide rings - everything must be done by hand, without the use of tools, in order to prevent damage.



Repairing the piston rod surface

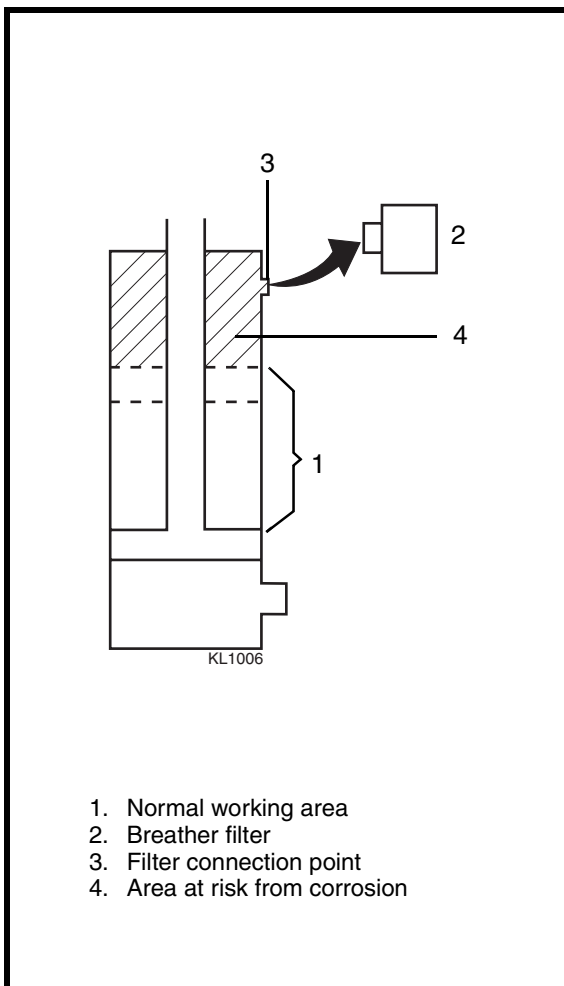
The smallest damage to a piston rod can be enough to cause leakage. The chromium plating has a thickness of 20-50 μ and can be worked on to repair smaller damage. This can be a viable alternative to costly dismantling.

1. Locate the damage with finger tips and finger nails.
2. Use a small, finely polished, panel beating hammer and work in the material from the area surrounding the damage, work from the outside in towards the damage.
3. Instead of a sharp mark, there will now be a more even irregularity in the chrome surface.
4. Polish with emery cloth, in stages, use grades from 240 - 600. Wrap the emery cloth around a file to support the cloth well. N.B. Sufficient chrome must always be visible at the point of damage.
5. It is important, before both dismantling and fitting, to repair small dents and other physical damage so that they do not damage the cylinder head.
6. For larger damage to a piston rod:
 - fill the damaged area with a weld
 - completely remove all welding cinder
 - file down the weld to the same level as the chrome surface
 - polish to an even finish with emery cloth



Lubrication

1. Within the actual hydraulic system - never anything other than the normal hydraulic fluid used in the hydraulic system.
2. On the cylinder head thread - use copper paste (e.g., Moly-cote CU 7439). Make sure that the paste does not enter the system.
3. In areas where there is a risk of condensation building up - grease with a thin layer of copper paste in the sealing groove of the cylinder head, in order to prevent condensation. Condensation causes rust formation that can corrode the sealing groove and cause leakage. Apply the copper paste with a finger.
4. If any copper paste comes outside the sealing groove - wipe clean with lint free paper. Never use cotton waste



Lubricating single action cylinders

1. This type of cylinder does not have any hydraulic fluid supply on the piston rod side. If a cylinder normally operates over only a limited part of the piston stroke, there is a risk for corrosion in the upper part of the cylinder.
2. Unscrew the breather filter.
3. Spray 300-500 ml of hydraulic fluid into the filter connection.
4. Run the cylinder to the limits of the piston stroke a number of times until no more hydraulic fluid is forced out of the breather filter connection point.

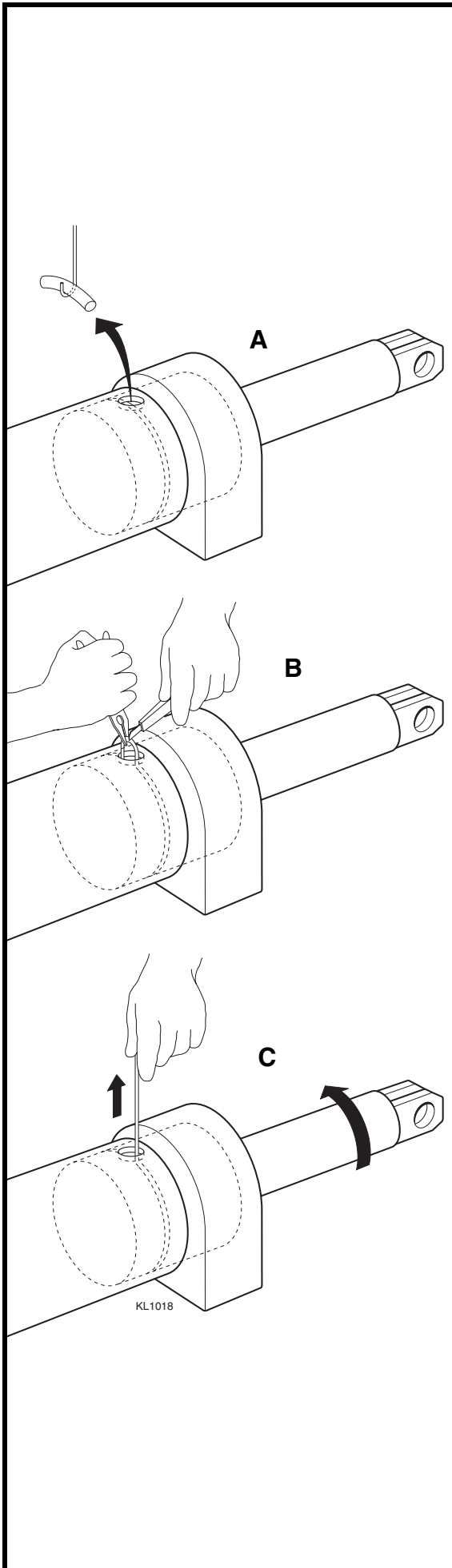
Daily lubrication, all cylinders

Run all cylinders to the piston stroke limit so that the whole of the cylinder is lubricated.

Dismantling the steering cylinder

On the steering cylinder, it can be very difficult to remove the piston from the cylinder as the O ring in the cylinder head sticks in the locking ring groove of the cylinder pipe. It is best, therefore, to first remove the O ring before attempting to draw out the piston rod from the cylinder.

1. Unscrew the end piece at the cylinder head.
2. Unscrew the connection nipple for the hydraulic hose.
3. Push in the piston rod with piston head until the O ring is visible through the nipple hole.
4. Use a strong, bent steel wire to hook onto the O ring, illustration A.
5. Draw up the O ring a little and get a grip on the O ring with a pair of thin nosed pliers, illustration B.
6. Continue and draw out the O ring through the hole.
7. Maintain a grip on the O ring and cut through it with a knife.
8. Rotate the piston rod and simultaneously draw out the O ring through the hole, illustration C.
9. Remove the locking ring from the cylinder pipe.
10. Carefully draw out the piston rod from the cylinder pipe.



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Group 80

Telescope-boom with rotator, attachment

Specification	2
Boom with rotator	3
Description	3
Telescope boom	3
Rotator	4
Damping/Forward tilt	5
Service	6
Checking lubrication	6
Checking boom fixtures, extension boom and fixed boom	6
Checking the sliding plates	6
Top lift	8
Description	8
Top-lift	8
Twist-locks	10
24 V feed	11
Service	12
Indicating lamps	12
Alignment control	12
Safety interlocking system	12
Checking of ALIGNMENT indicating lamps and electrical interlocking system	12
Adjustment and lubrication of sliding plates	13
Control of twist-lock lifting pins	14
Inductive sensors	14
Chain adjustment	15
Bleeding the damping cylinders	16
Setting the resistance of the damping cylinders	16
Manoeuvre control valve, setting the pressure	17
Diagrams	
Hydraulic diagram, component list	18
Hydraulic diagram, top lift without tilt	A40853.0100
Hydraulic diagram, top lift with tilt	A40853.0200

See current data sheet

Telescope boom

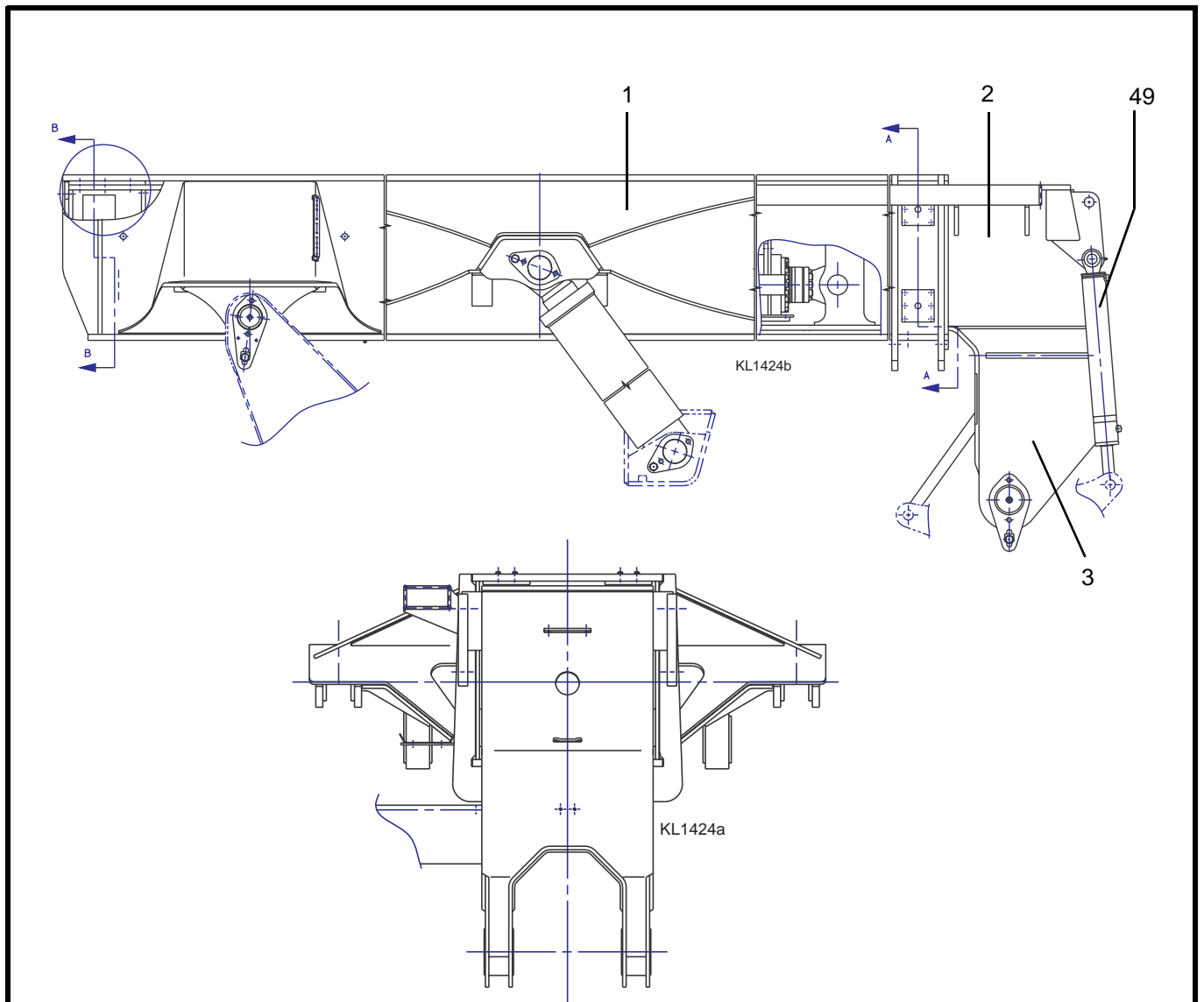
The telescope-boom of the ContChamp is made of highly resistant steel of a very sturdy design. The number of welds has been kept to a minimum to ensure the highest possible strength.

The boom comprises the following:

- Fixed boom
- Extension boom
- Extension cylinder.

The extension boom runs inside the fixed boom on greased sliding plates made of Robalon. The extension boom is provided with a mounting attachment for the rotator.

The fixed boom's attachments are provided with bearings. Cables and hydraulic hoses run on a trailer chain on the outside of the boom.



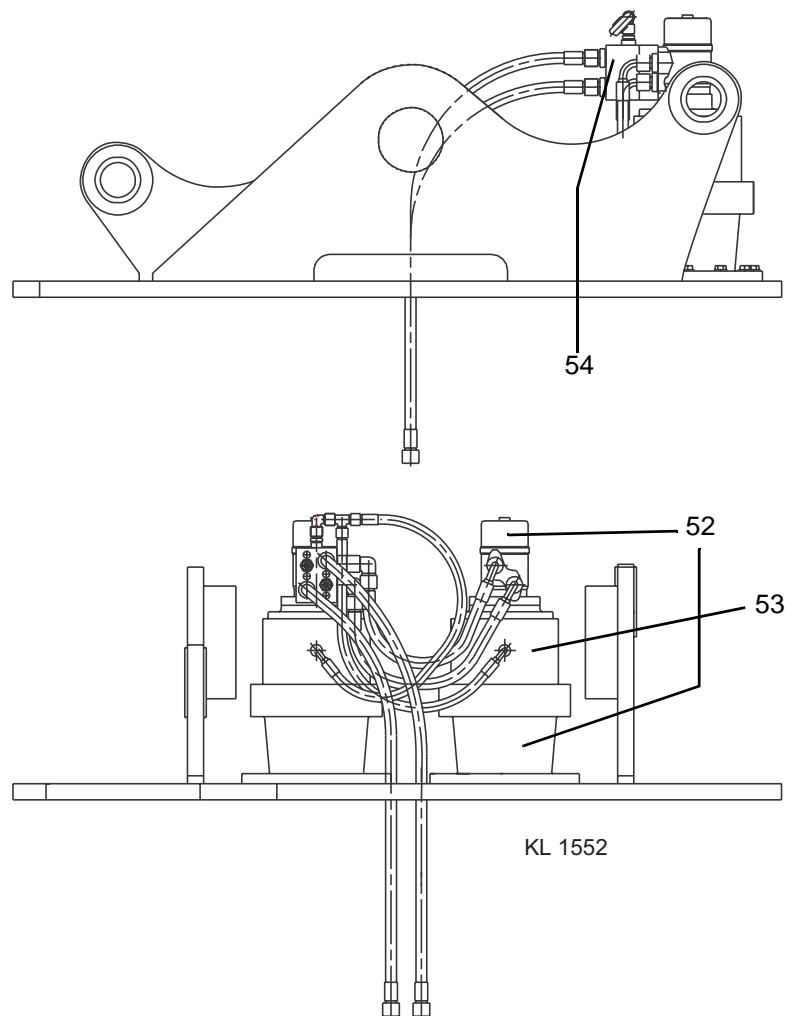
1. Fixed boom
2. Extension boom
3. Rotator mounting
49. Damping cylinder

Rotator

The rotator consists of an upper and lower yoke, connected to each other by a gear wheel and a powerful roller bearing, which facilitates the rotation of the lower yoke in relation to the upper yoke.

The rotation function is described in greater detail in group 20, under EI-servo.

It is possible to rotate the attachment through $+195^{\circ}$ – 105° with the help of hydraulic motors, steered by the control lever. The rotation brake prevents undesired rotation. When the hydraulic motors for rotation are activated by the control lever, servo pressure is fed to the brake, which then releases and rotation can begin. The over-centre valve (50) provides controlled rotation by preventing the load from moving of its own momentum resulting in faster rotation than that of the hydraulic motors.

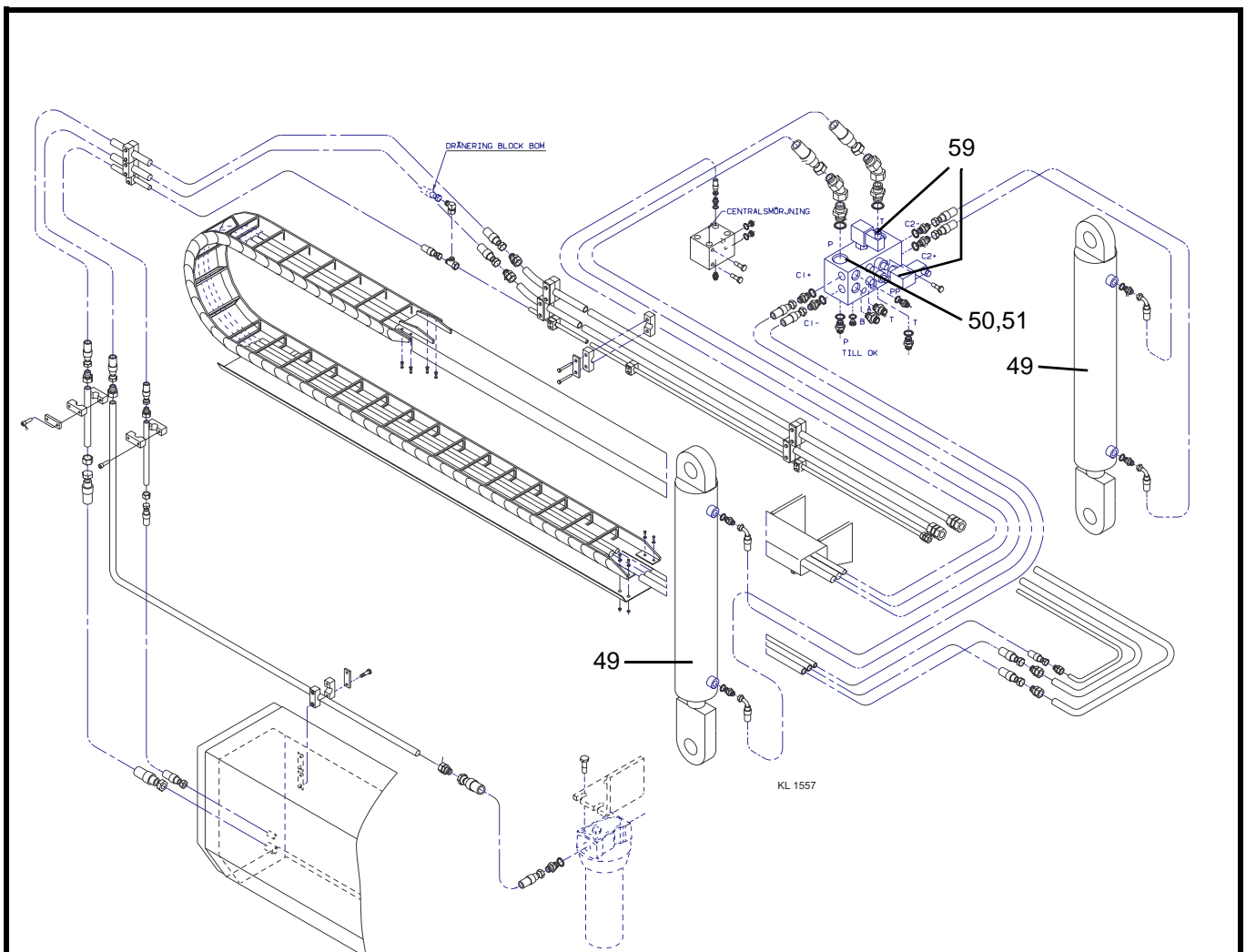


- 52. Rotation motor with planetary gear
- 53. Rotation brake
- 54. Over-centre valve

Damping/Forward tilt

The suspension of the rotating yoke is equipped with two hydraulic cylinders (49) the function of which is to dampen uncontrolled swinging. The cylinders are filled with fluid that, when the yoke moves, must pass a throttle-check valve (51), which determines the degree of damping. The damping system is a passive system. As an optional extra, a system is available with forced steering of damping cylinders, known as Forward Tilt. The cylinders are then fed from main valve section 47a, see hydraulic diagram, top lift.

Certain special handling operations require the ability to be able to lock the forward tilt. The system is then equipped with stop valves 59 (6012 on the top lift circuit diagram).



Numbering corresponds to the hydraulic diagram for top-lift.

- 49. Damping cylinder
- 50. Shock valve
- 51. Throttle-check valve
- 59. Solenoid valve, only system with locking of tilt or damping



WARNING!

No service work on boom and attachment is allowed when the engine is running.

Checking lubrication

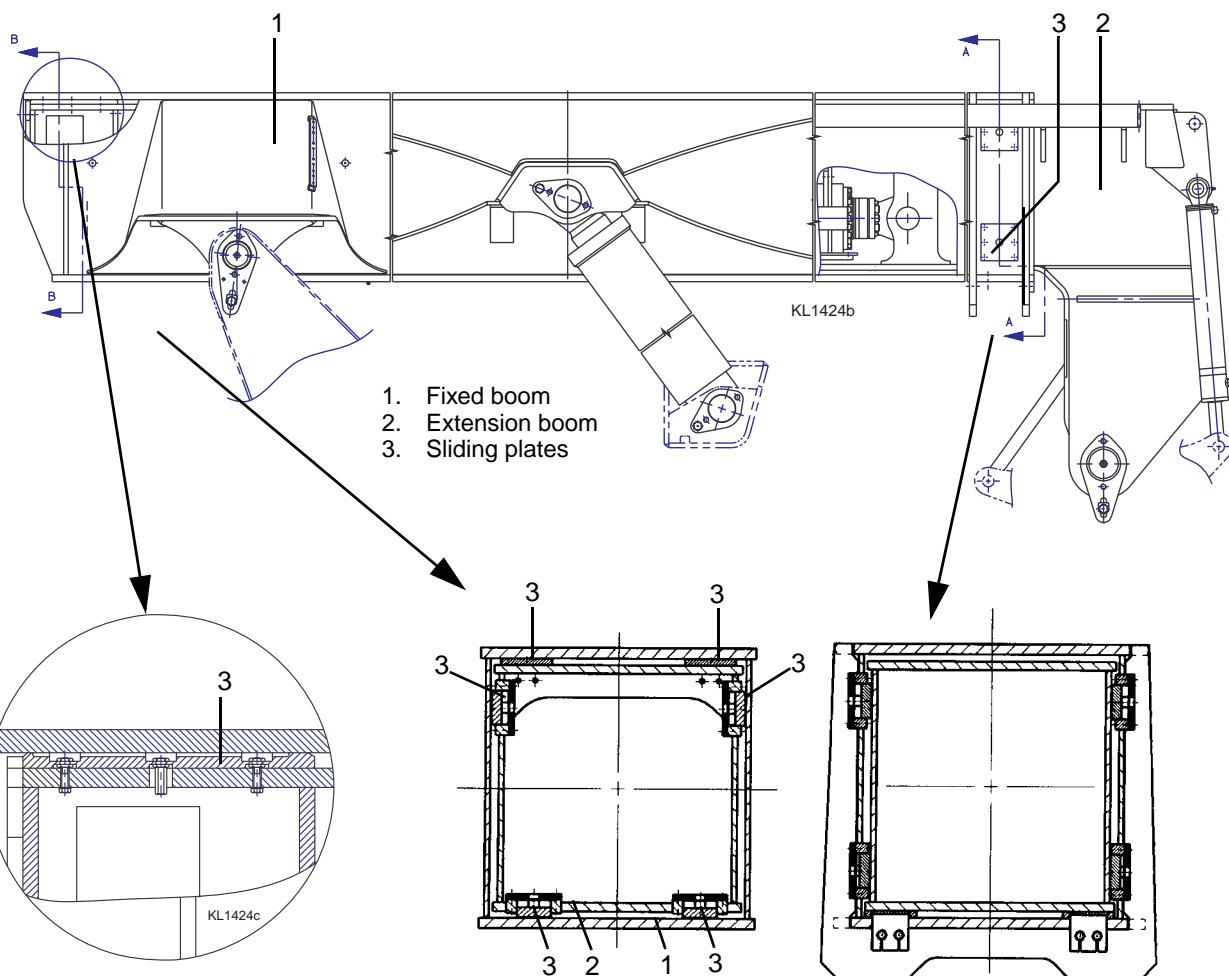
Check regularly that hoses and connections are undamaged. Also check that the lubricant actually reaches the point of lubrication.

Checking boom fixtures, extension boom and fixed boom

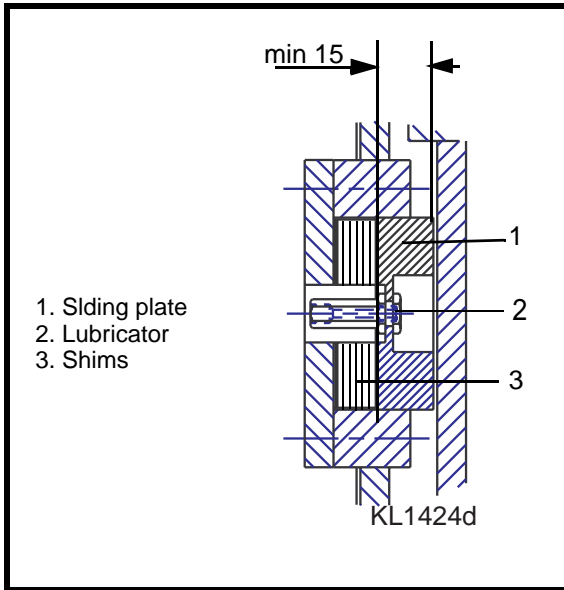
1. Check all parts for damage or wear. Check the sliding surfaces and sliding plates especially.

Checking the sliding plates

The sliding plates are positioned at the front of the inner surface of the fixed boom and at the rear of the outer surface of the extension boom. The sliding plates are so positioned that they absorb both vertical and lateral forces. The fixed boom has six sliding plates at the front end. Each plate is fitted with a grease nipple which is accessible from the outside. The extension boom has four sliding plates at its rear end. These plates are also fitted with a grease nipple, accessible from the inside. All sliding plates are fitted with shims to ensure a perfect fit between the sliding surfaces.



Position of sliding-plates

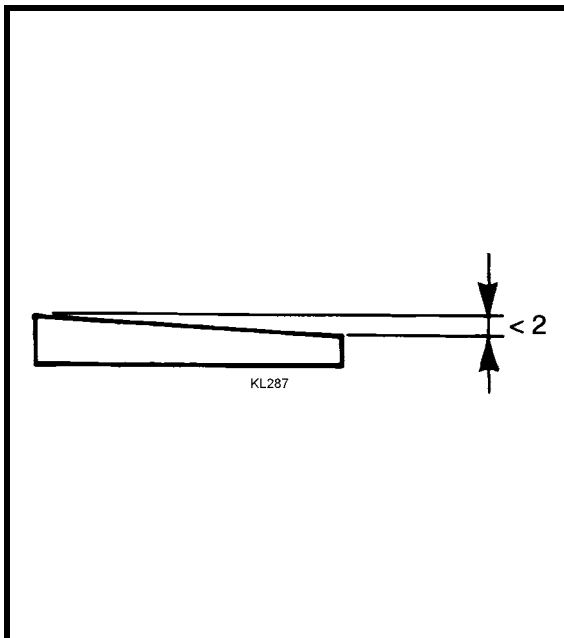


Check the following:

Wearing of sliding plates

1. The thickness of the sliding plates should be at least 15 mm. The sliding surfaces of the extension boom are protected by a special coating. If the sliding plates are worn, so that the bolts damage the sliding surface, the boom has to be dismantled for service.
2. If the sliding plates are thicker than 15 mm and the play between sliding plate and sliding surface is bigger than approx 2 mm, the sliding plates should be fitted with more shims.

Please, contact Kalmar service department for further information.



Wearing of sliding plates on one side

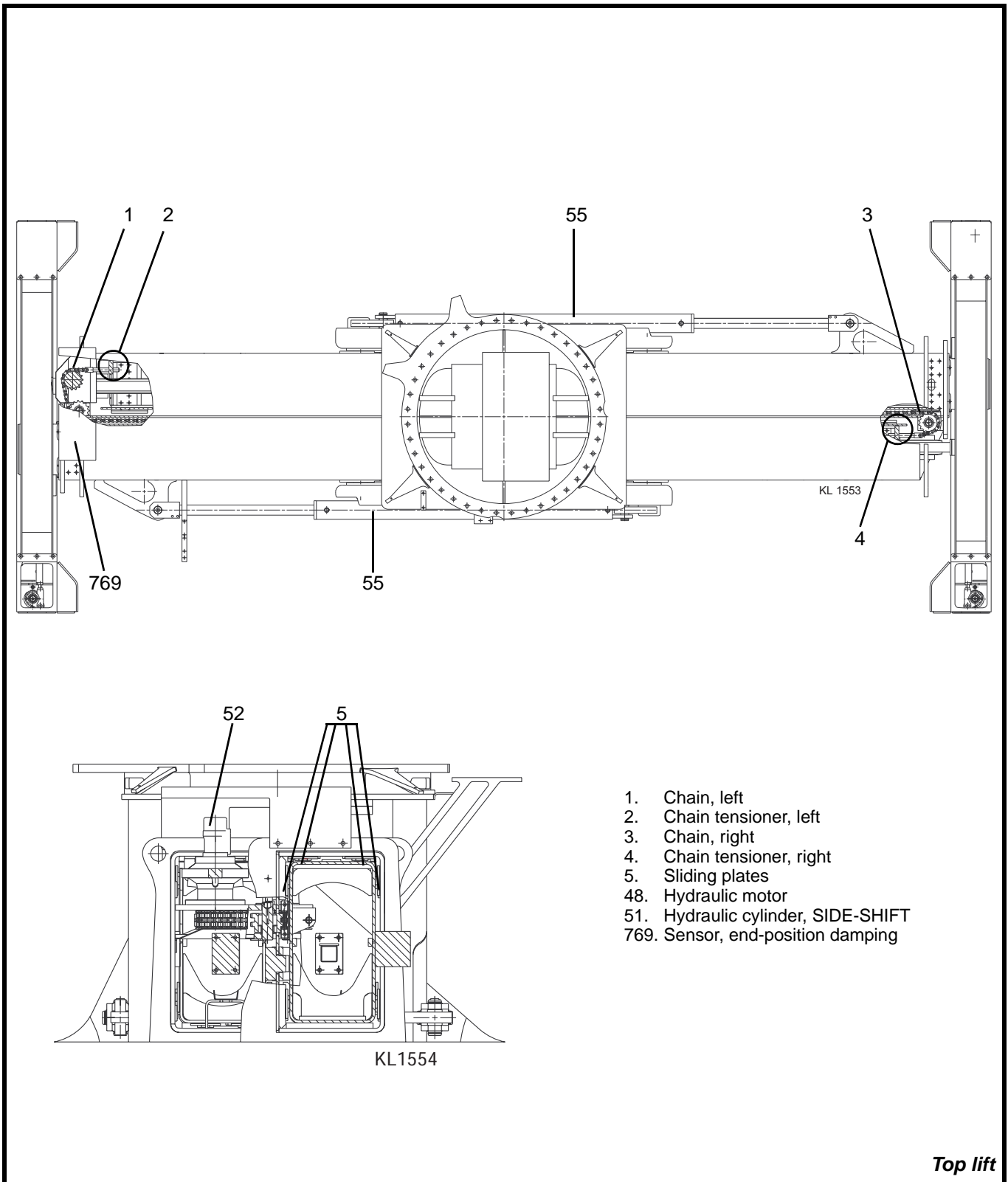
1. If the sliding plates are worn on one side, the boom will be exposed to torsional stress. Therefore it is important to check the plates regularly.
2. The maximum difference in thickness allowed is 2 mm. If this value is exceeded, the plates have to be dismantled and planed or replaced.

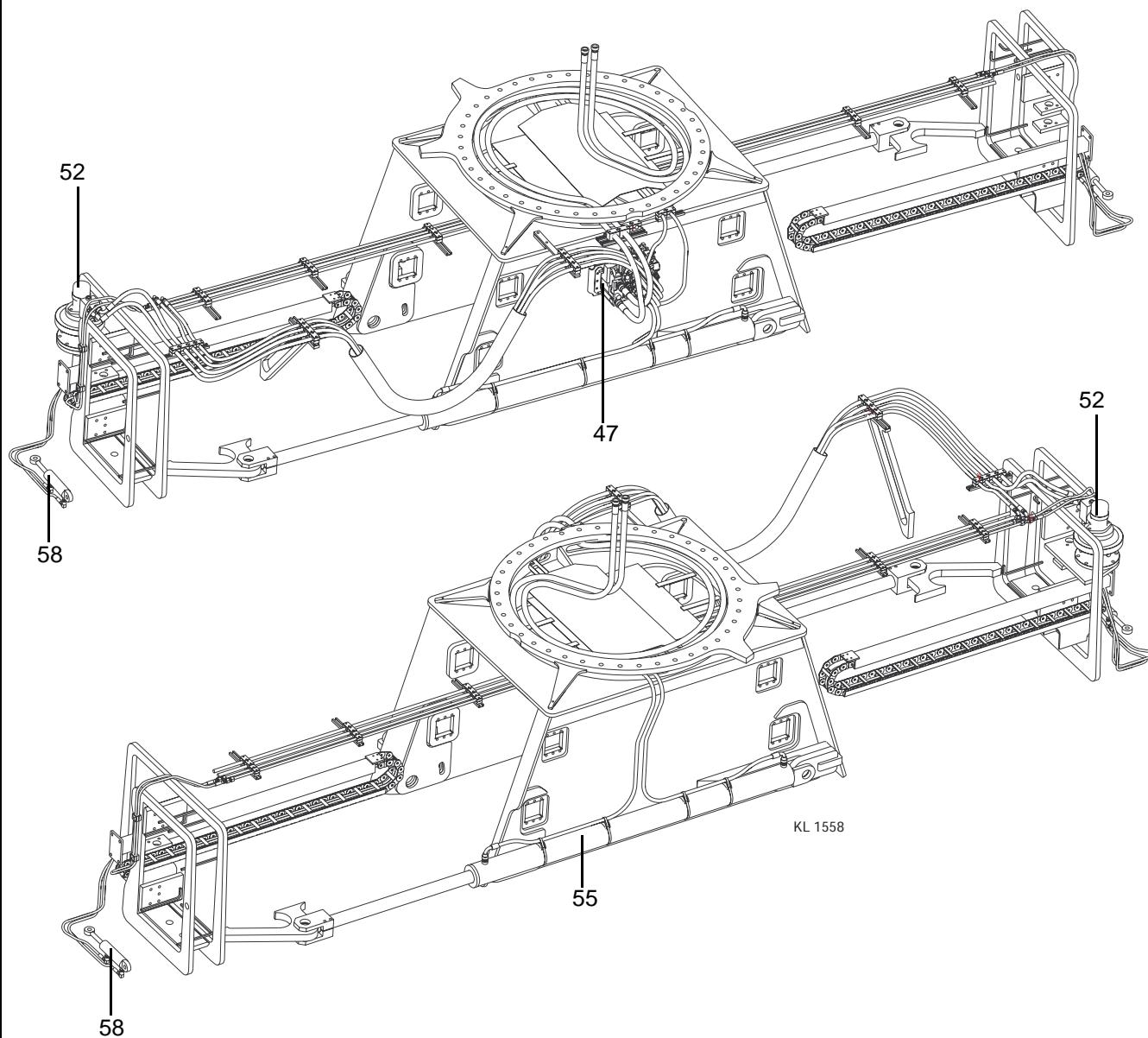
Top-lift

For a detailed function description, see group 20, EI-servo.

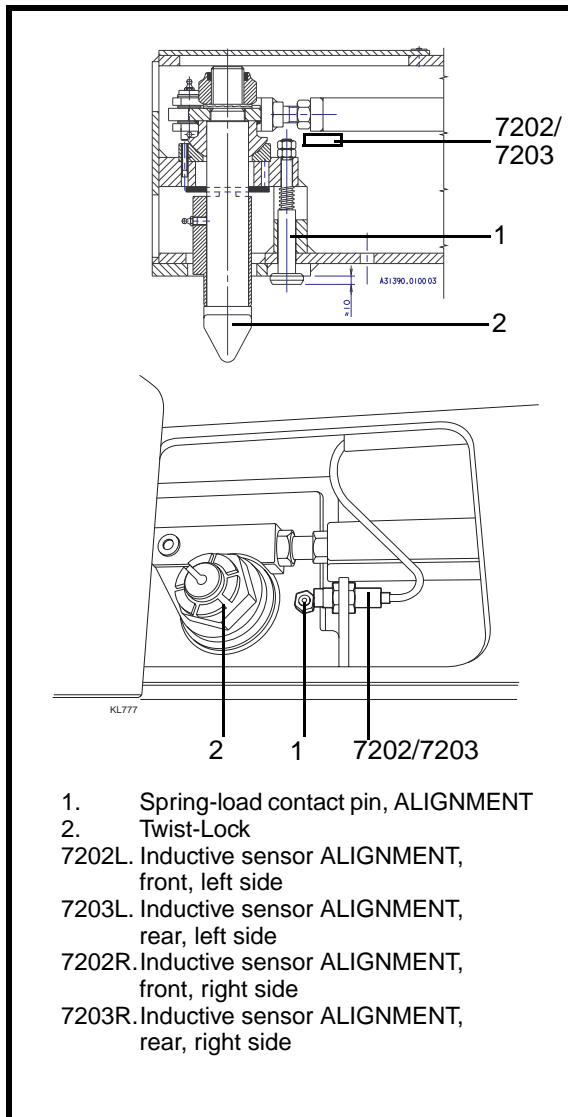
The top-lift is adjustable for 20-40' containers and is constructed of welded steel profiles that run within each other on sliding plates made of Robalon. The top lift is controlled electro-hydraulically from the operator's cab and has a main valve with three sections for EXTENSION/TWIST-LOCKS/SIDE-SHIFT AND ROTATION. See separate hydraulic diagram.

Extension is achieved via a hydraulic motor and two chains. Two hydraulic cylinders provide 800 mm side-shift.





- 47. Main valve
- 52. Hydraulic motor
- 55. Hydraulic cylinder, SIDE-SHIFT
- 58. Hydraulic cylinder, TWIST-LOCKS



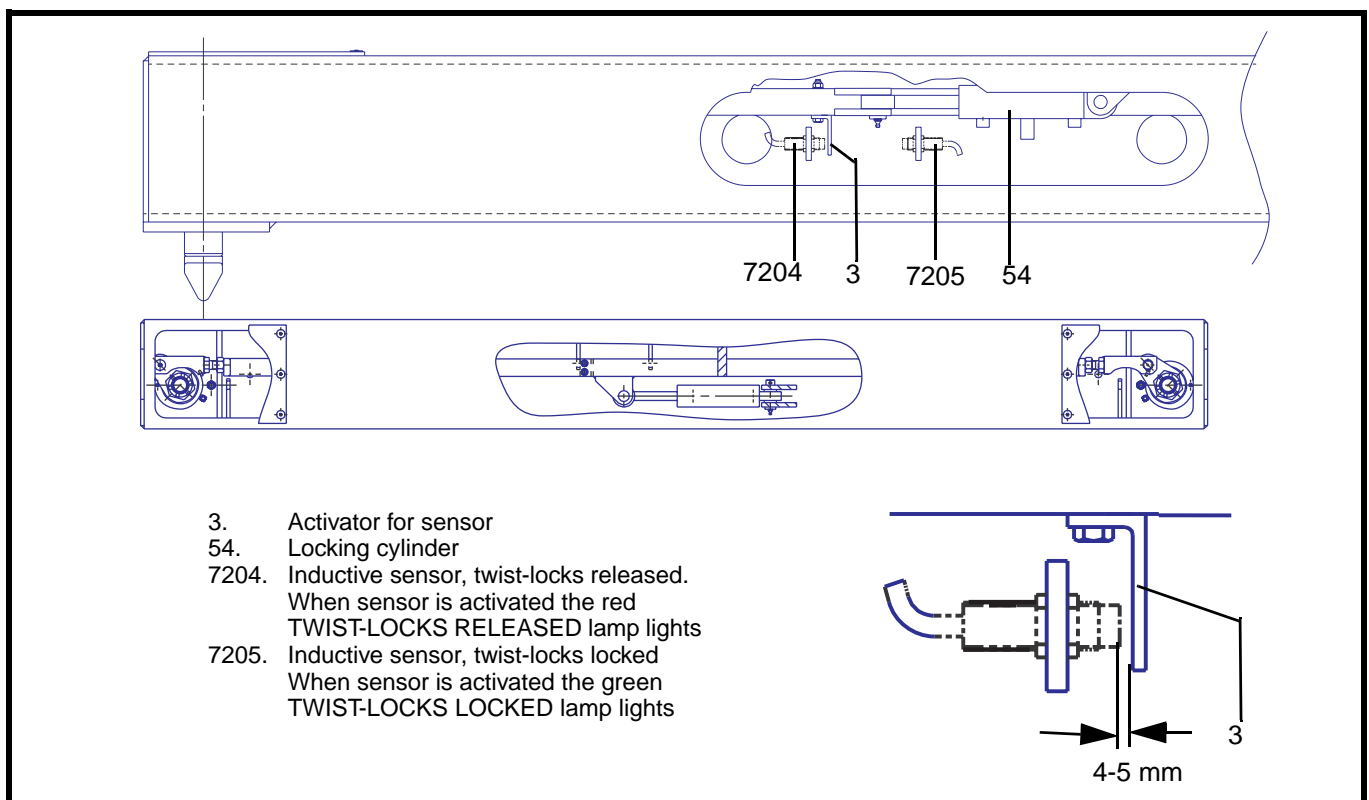
Twist locks

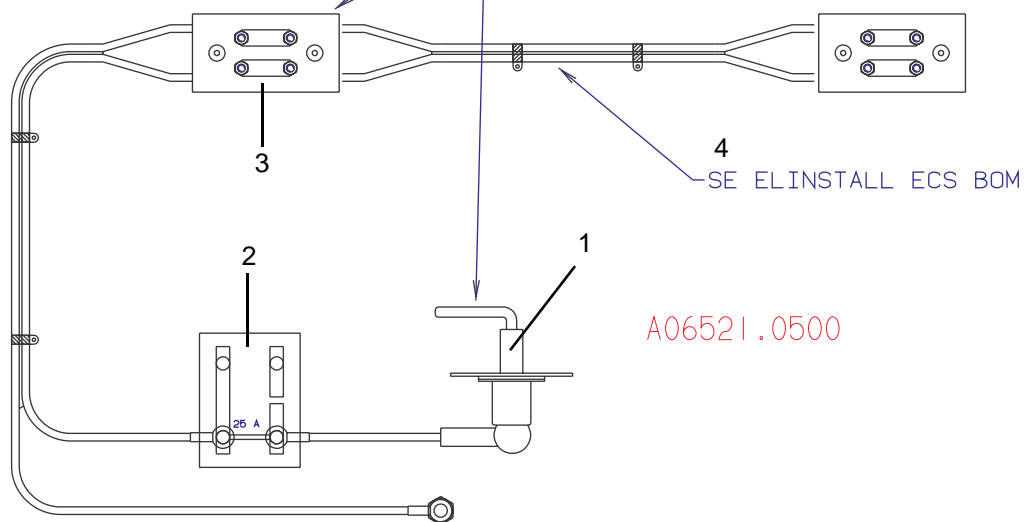
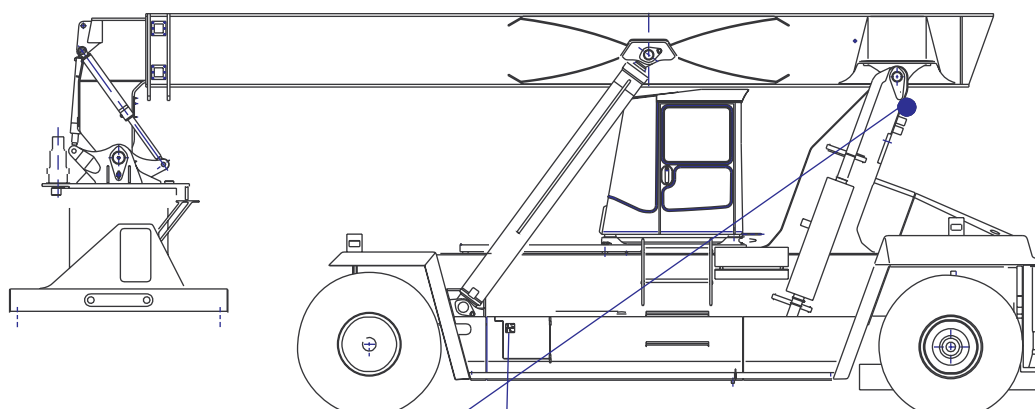
A spring loaded contact pin and an inductive sensor at each twist lock are used to control and check the alignment. An electrical locking system prevents twisting of the twist locks before they have fully entered the container locking holes. When all four contact pins are depressed, the ALIGNMENT lamp lights up on the boom. Only then is it permissible to lock the twist-locks.

Locking and indicating the twist-lock position

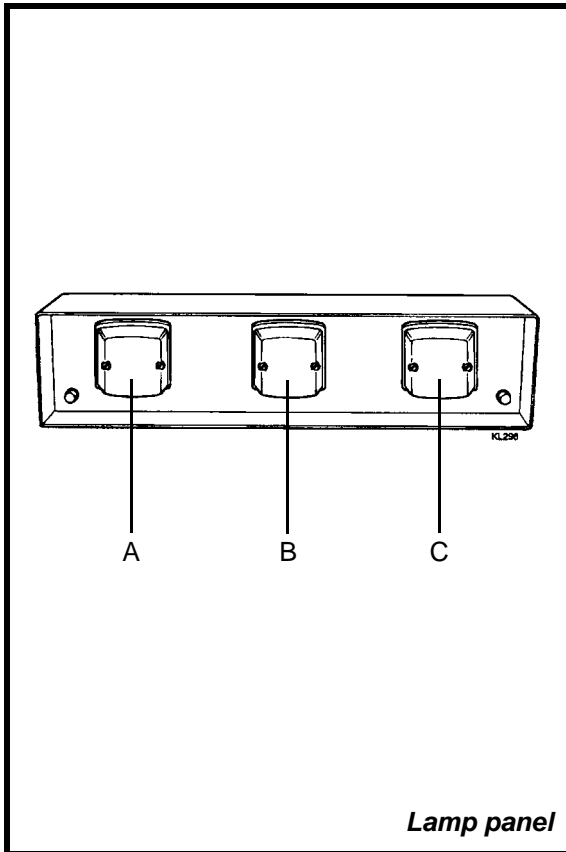
On each side of the top-lift there is a locking cylinder that, via a rod, turns the front and rear 90° in the containers locking hole. Two inductive sensors on each side monitor whether the twist-locks are locked or released. See illustration below. The activator, 3, activates the sensor at respective end positions. The distance between activator and sensor at the end position should be 2-3 mm. Sensor 7205 activates the green TWIST-LOCKS LOCKED lamp which indicates that both sides of the top-lift are locked onto the container which is thereby ready to be lifted. When lifting, the ALIGNMENT lamp is extinguished, i.e., the alignment signal ceases which prevents accidental release of the twist-locks during lifting. The electrical locking device also prevents lifting if the twist-locks are not released or turned 90° in the container's locking hole.

Sensor 7204 activates the red TWIST-LOCKS RELEASED lamp. The attachment can then be lifted from the container.





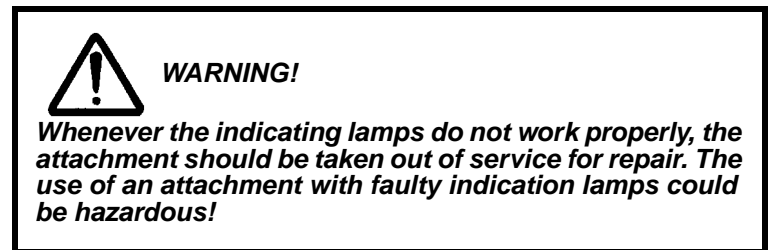
1. Main switch
2. Main fuse
3. Coupling, at rear of boom
4. See electrical installation ECS boom, see group 20, page 36



Indicating lamps

The top lift has a set of three indicating lamps for container handling:

- A. Green left: TWIST-LOCKS LOCKED
- B. Orange middle: ALIGNMENT
(The lamp will be extinguished at lifted container)
- C. Red right: TWIST-LOCKS UNLOCKED



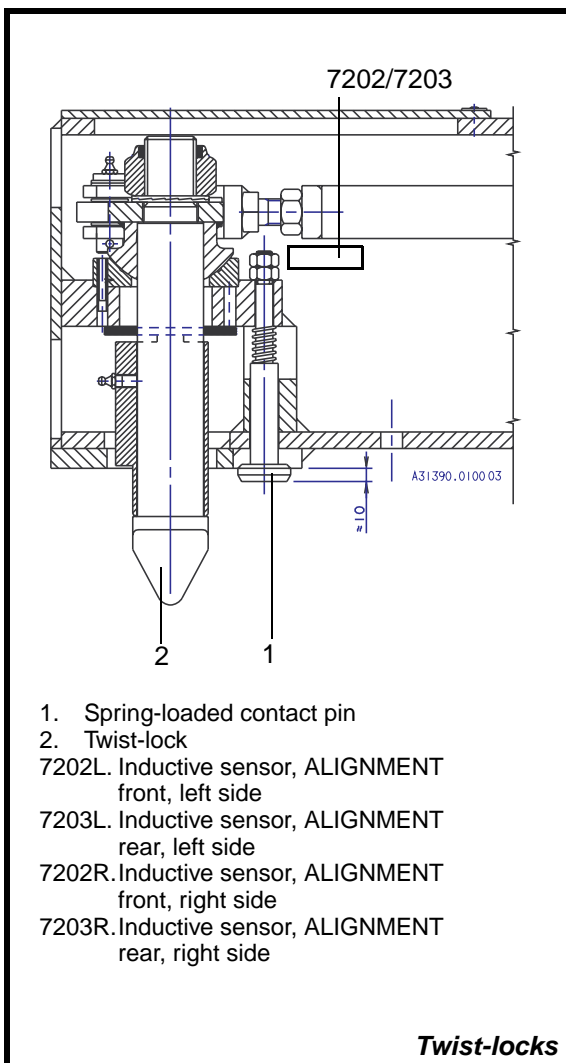
Alignment control

A spring-loaded contact pin and an inductive sensor at each twist-lock is used for alignment control. The top-lift is fully aligned onto the container when all pins have been depressed and the distance between each pin and sensor have decreased to 4–5 mm. Then the indicating lamp ALIGNMENT lights up and the twist-locks are ready for locking.

Safety interlocking system

After locking of the twist-locks the lifting starts. A built in play between twist-locks and container corner boxes allows the attachment to be lifted enough for the inductive sensors to be deactivated, i.e. the distance between sensor and contact pin increases to more than 8 mm.

This will brake the minus feed to the twist-lock solenoid valve, thus making it impossible to operate the twist-locks when lifting. This electrical interlocking can, in emergency situations, be bridged by an override switch in the operator's cab. The override switch will feed "false" alignment minus signal to the twist-lock solenoid valve thus making it possible to operate the twist-locks. A red warning lamp lights up in the operator's cab when the electrical interlocking is bridged.



Checking of ALIGNMENT indicating lamps and electrical interlocking system

1. Check that the contact pins in the corner boxes are freely moveable up and down. A pin which binds in the upper position may indicate correct alignment although the top-lift is not in contact with all four container corners.
2. Check that the indicating lamp ALIGNMENT lights up when the top-lift is fitted to the container and that the lamps are extinguished when the container is lifted.
3. When lifting an empty container just enough to make the lamp ALIGNMENT go out, check that it is impossible to unlock the twist-locks.
4. The sensor 7202/7203 for alignment should be adjusted to give a signal when the contact pin is depressed 3-4 mm.

Adjustment and lubrication of sliding plates

The sliding plates are made of brass and must be thoroughly lubricated in order to minimize wear. The degree of wear is highly dependant on the environment and may vary considerably.

Equally important is the play between fixed and moveable parts, which is adjusted by means of shims.

Adjustment of play using shims.

1. Operate the length adjustment and check the play which should be 1-2 mm on both sides of the moveable member, horizontally as well as vertically.
2. If needed, disassemble the sliding plates in question and put suitable shims under the sliding plates. Sliding plates are fitted in the ends of each moveable member and also each end of the fixed main beam, see figure.

Shims of various thickness can be ordered from Kalmar, see Spare Parts Catalogue.

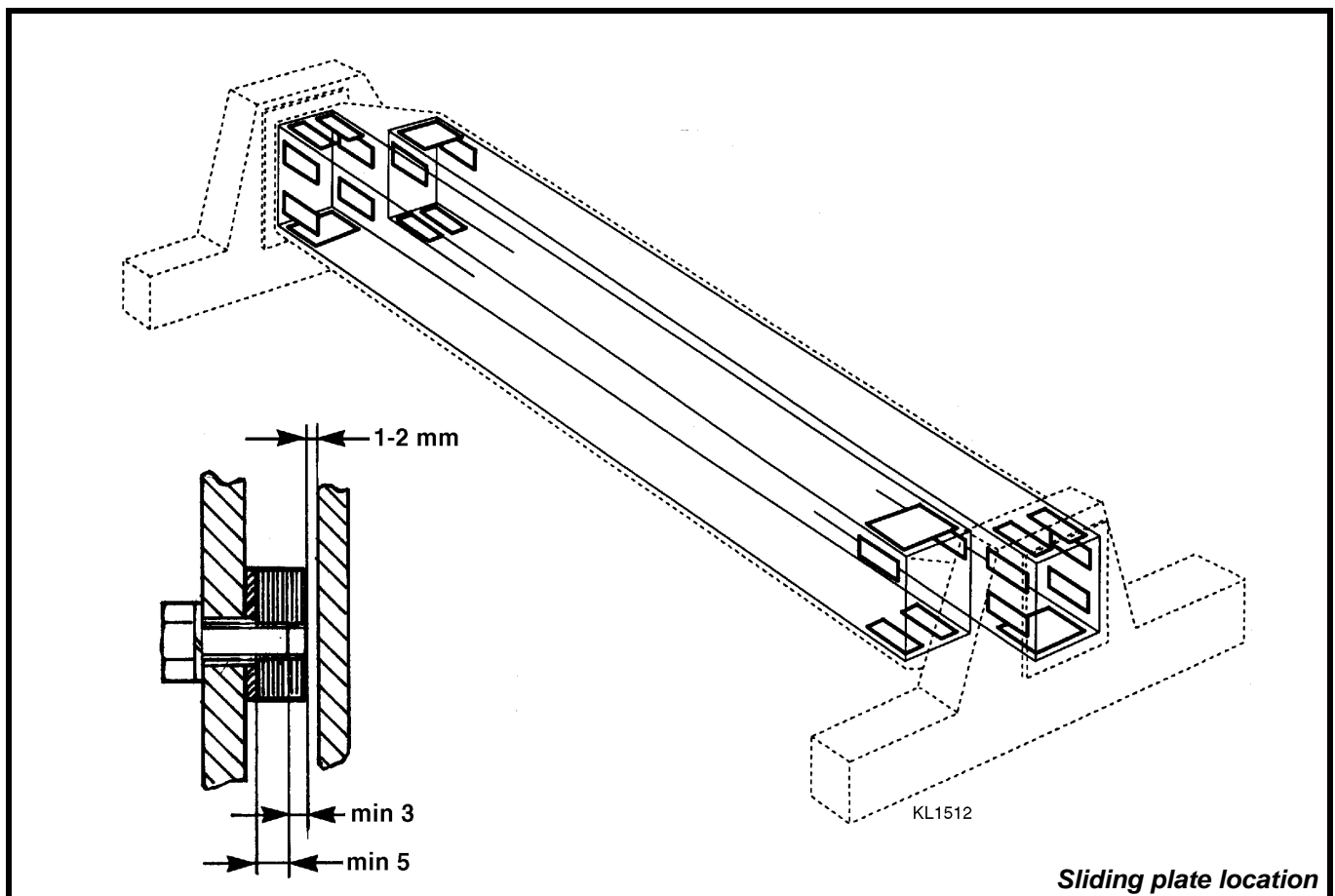
N.B. The shims must be fitted equilateral in order to maintain the attachment aligned and levelled, otherwise there is a risk of malfunction.

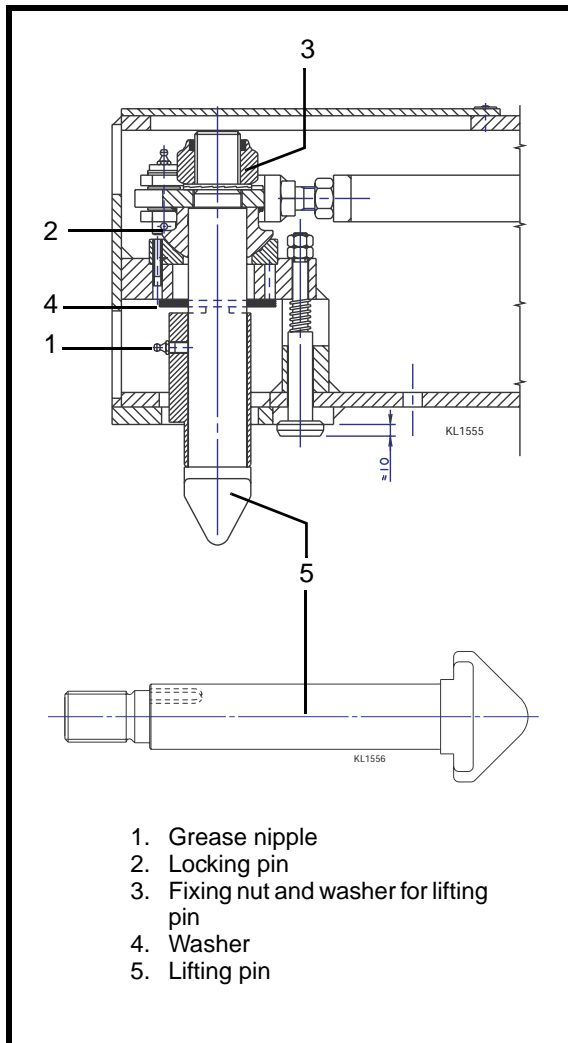
3. Check the remaining thickness of the sliding plates.
Minimum screw mesh: 5 mm. Minimum clearance between sliding surface and screw tip: 3 mm.

If necessary when thick shims are needed, change to longer screws, but note the 3 mm clearance between screw tip and sliding surface.

Lubrication

1. Set the length adjustment to maximum.
2. Use a brush on a long handle to reach into the fixed main beam. Grease the sliding surfaces on sides, roof and bottom with a graphitebased grease.





1. Grease nipple
2. Locking pin
3. Fixing nut and washer for lifting pin
4. Washer
5. Lifting pin

Control of twist-lock lifting pins

N.B. This control should be first carried out after 5000 hours of service, or after 2 years - whichever ever occurs first. Thereafter, the lifting pins should be checked every year.

Removing the lifting pins

1. Unscrew the grease nipple 1.
2. Remove the locking pin 2.
3. Unscrew nut 3 including washer, at the same time, support the underside of the lifting pin.
4. Remove the lifting pin 5 downwards, the washer 4 comes with it.

Lifting pin control

1. Use magnetic powder testing or penetration fluid.
2. Check to ensure that there are no fractures or splits in any part of the lifting pin.

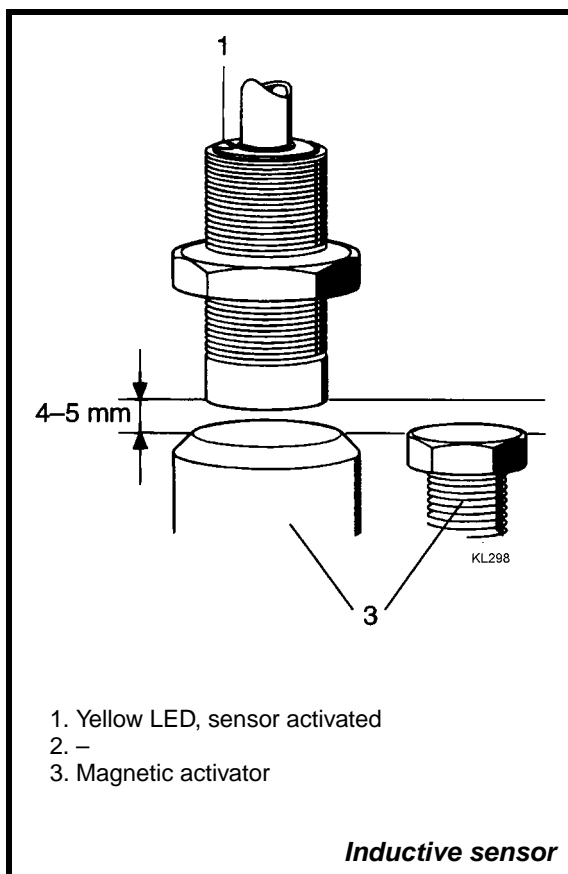
IMPORTANT!

If any split or fracture is discovered then the lifting pin must be immediately replaced.

If the lifting pin has any other visible damage, then it must be immediately replaced.

All lifting pins shall be replaced after 20,000 hours of service, even if they appear undamaged.

3. Place the washer 4 on the lifting pin and refit the lifting pin.
4. Refit the locking pin 2, and the grease nipple 1.
5. Fit new washer and nut 3.
Tighten the nut to a torque of 300 Nm.



1. Yellow LED, sensor activated
2. -
3. Magnetic activator

Inductive sensor

Inductive sensors

The inductive sensors control the various functions of the container attachments.

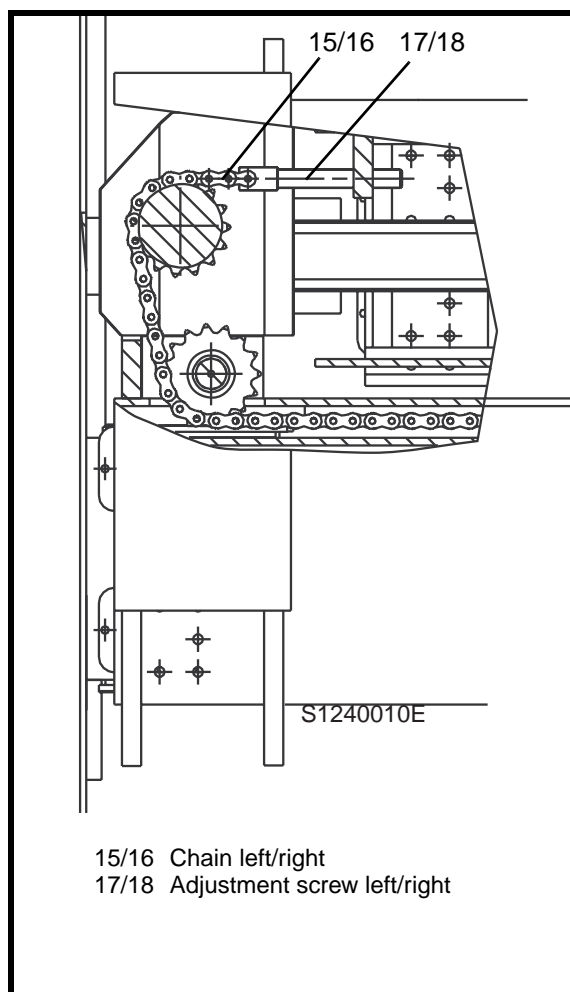
The sensors are of the type PNP – positive/negative/positive, the last P indicating that the sensor produces a positive signal when activated. The sensor is activated when a magnetic object gets closer than approx 8 mm from the top of the sensor.

The sensor has one Yellow light diode, which can be used for checking of the sensor function.

Yellow – indicates 24 V plus and minus feed to the sensor

Sensor adjustment and check

1. The gap between sensor and magnetic activator should be set to 4–5 mm. At a distance of more than 8 mm, the sensor is deactivated.
2. When the sensor is activated, the yellow diode should be alight.
3. Check that the sensor is clean and free from grease and that it is undamaged. (Grease may activate the sensor).



Chain, adjustment

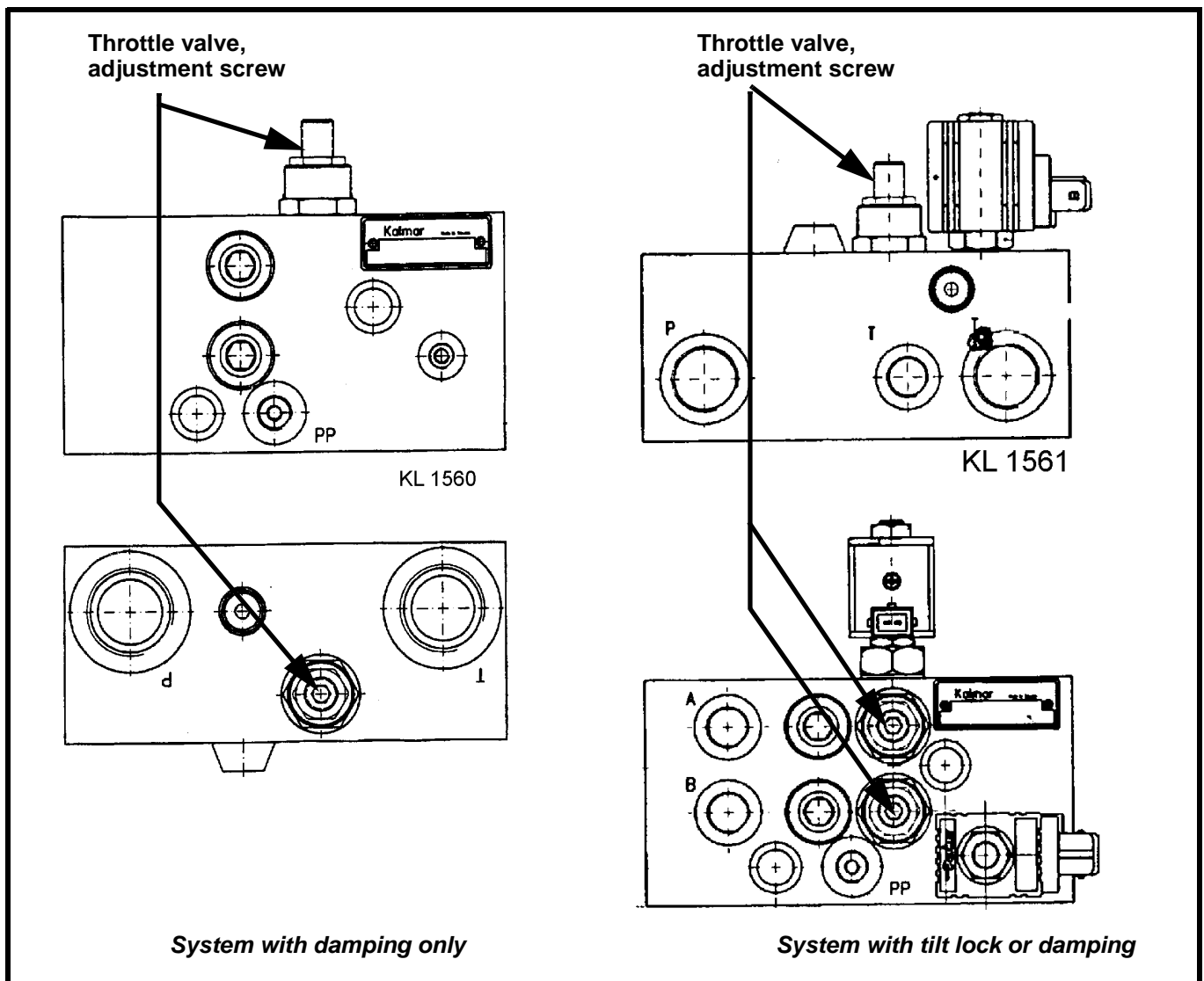
1. The chain tension is controlled by two sets of plate springs and adjusting nuts.
2. The chain play should be max 10-15 mm at retracted attachment, when pressing with the thumb.
3. Adjust if needed with adjusting nuts. Lock with locknuts.
4. After 1–2 years or if the adjustment is fully utilized, remove a link from the chain.
5. If the chain is slipping over the gear wheel, check the lubrication, specially the fixed beam bottom surface, see section Adjustment and lubrication of sliding plates.

Bleeding the damping cylinders

1. Set the boom in its lowest position.
2. Allow the engine to idle.
3. Carefully loosen the hose connection to one of the damping cylinders until hydraulic fluid starts to leak out. First air-free fluid will come from the connection and thereafter, fluid mixed with air. Re-tighten the connection once air-free fluid again starts to flow.
4. Repeat this bleeding process for all four connections.
5. Run the boom up to its highest position and then down again.
6. Repeat the complete bleeding process once more.

Setting the resistance of the damping cylinders

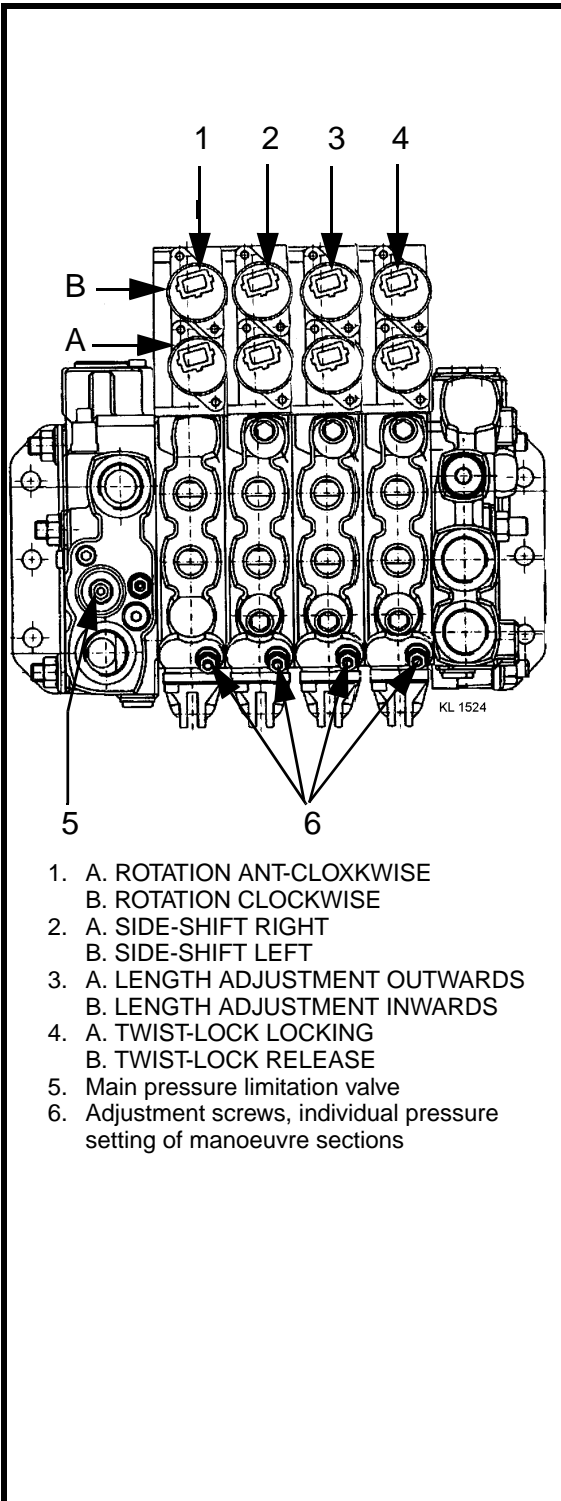
1. Run the boom up and down again. Check to see how the top-lift moves. In the lower position it shall, relatively easily, set itself in the horizontal after having hung somewhat angled inwards.
2. As required, adjust the choking of the throttle valve. Two different types occur
 - With one adjustment screw for systems with damping only.
 - With two adjustments screws for systems with tilt locking or damping.
3. The block with the throttle valve can be found on the front of the nose of the boom.



System with damping only

System with tilt lock or damping

Control valve, setting the pressures



1. The main pressure limitation valve (5) shall be set at the overall system pressure as shown on the hydraulic plate.
2. The pressure of the manoeuvre sections shall be set separately for each section. Adjust the adjustment screws (6)
The pressure shall be:

ROTATION, section 1:	150 bar
SIDE-SHIFT, section 2:	160 bar
LENGTH ADJUSTMENT, section 3:	120 bar
TWIST-LOCKS, section 4:	System pressure as shown on sign
3. To check the pressure, connect a T-connector to either the output of the manoeuvre section or to the incoming line of respective cylinders. Connect a pressure gauge to the T-connector.
4. Run respective functions to their stop positions, read off the pressure and adjust the adjustment screw (6) as necessary.

1. A. ROTATION ANT-CLOCKWISE
B. ROTATION CLOCKWISE
2. A. SIDE-SHIFT RIGHT
B. SIDE-SHIFT LEFT
3. A. LENGTH ADJUSTMENT OUTWARDS
B. LENGTH ADJUSTMENT INWARDS
4. A. TWIST-LOCK LOCKING
B. TWIST-LOCK RELEASE
5. Main pressure limitation valve
6. Adjustment screws, individual pressure setting of manoeuvre sections

Hydraulic diagram, top-lift

Components

3. Dubbel variabel hydraulic pump
 - b. Top lift supply
42. Solenoid valve, activation of pump 3b for top lift supply
47. Top lift main valve
 - a. Control section TILT
 - b. Control section ROTATION
 - c. Control section SIDE-SHIFT
 - d. Control section LENGTH ADJUSTMENT
 - e. Control section TWIST-LOCKS
 - f. Converter
 - g. Pressure reducing valve, individual setting of control section supply pressure
 - h. Main pressure limitation valve
 - j. Shock valve
 - k. Reduction valve for servo pressure, 30 bar
 - l. Refill valve
 - m. Safety valve (pressure limiting)
 - n. Filter, servo circuit
 - o. By-pass valve, opens when filter is blocked
48. High pressure filter
49. Hydraulic cylinder, DAMPING/TILT
50. Shock valve
51. Throttle-check valve
52. Hydraulic motor, ROTATION
53. Rotation brake
54. Over-centre valve
55. Hydraulic cylinder, SIDE-SHIFT
56. Hydraulic motor, LENGTH ADJUSTMENT
57. Over-centre valve
58. Hydraulic cylinder, TWIST-LOCKS

Group 90

Periodic supervision

General survey	3
General survey chart	4
Daily supervision	8
Every 200 hours	9
Every 600 hours	10
Every 1000 hours	11
Oil and lubricant recommendations	12

General survey

To extend the service life of the truck and to prevent the risk of faults causing injury to personnel or damage to equipment, the truck must be subjected to regular periodic supervision.

If the truck is used under conditions in which road traffic regulations are applicable, the special maintenance instructions issued by the authorities must be followed.

Special procedures are required on trucks used under difficult conditions, such as in difficult terrain or for the transport of hot goods. These procedures are not dealt with here.

The intervals at which service measures are carried out can be determined on the basis of the operating hour meter readings. When carrying out a 1000-hour service, it is advisable to work in the following order:

1. Every 1000 hours
2. Every 600 hours
3. Every 200 hours

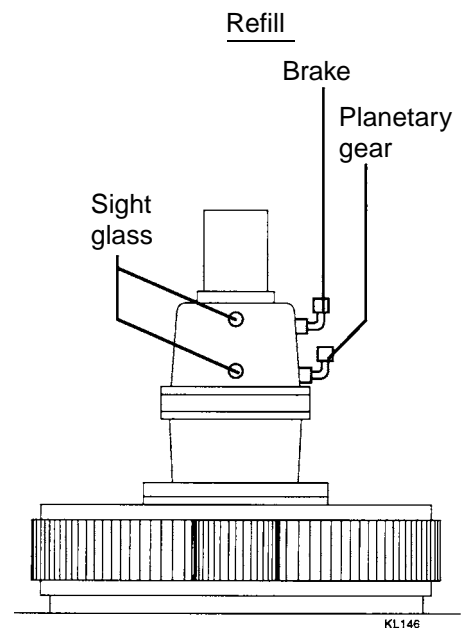
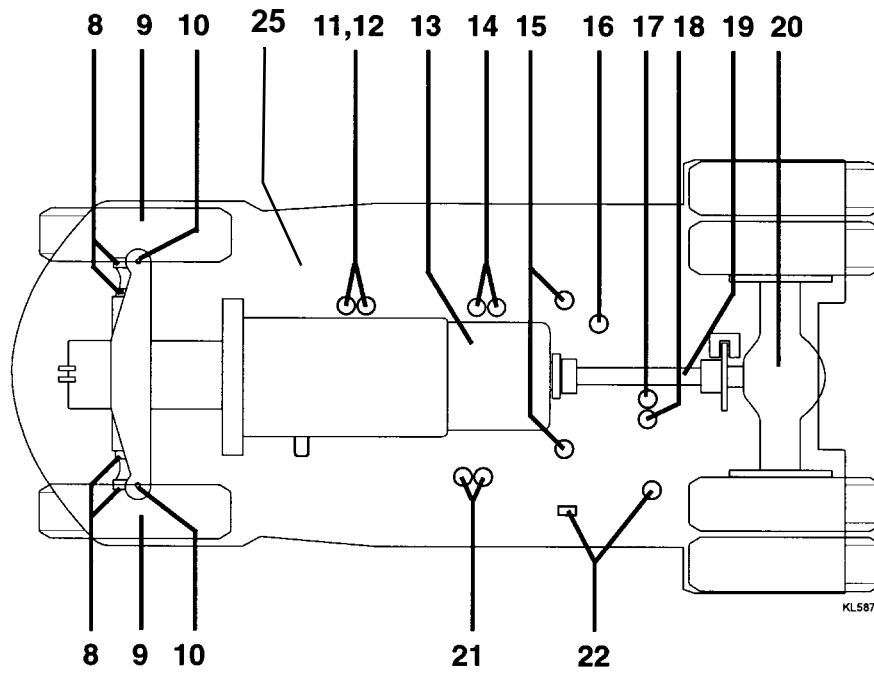
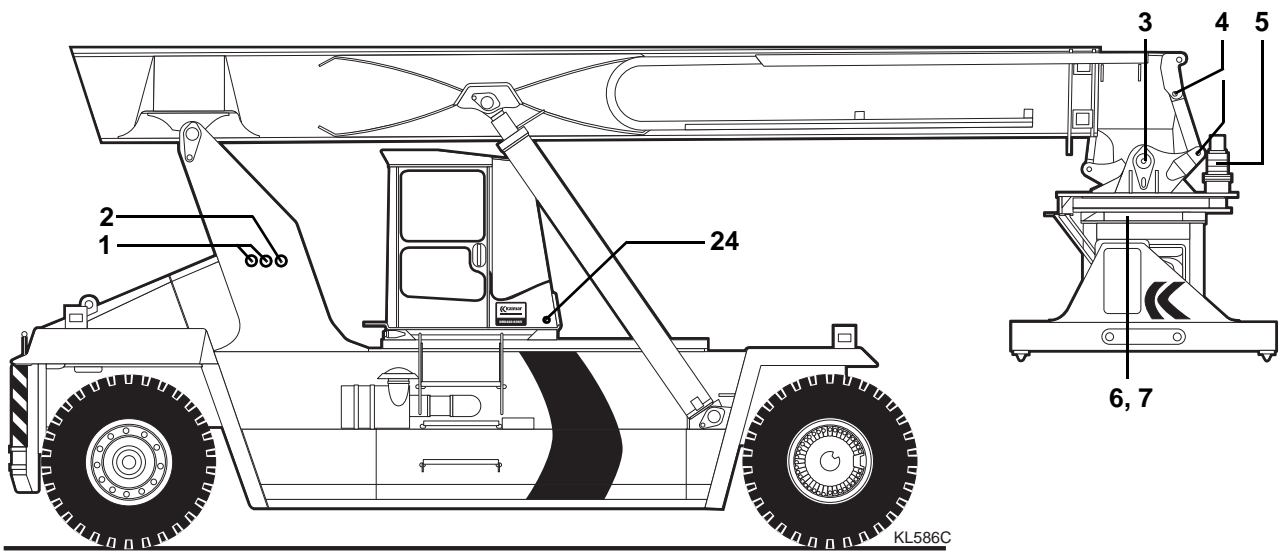
The same procedure also applies to work carried out in a 600-hour service.

General survey chart

Operating time	Maintenance intervals, hours			Anm
	1000	600	200	
200			•	Guarantee service after 50 hours. Work in accordance with list below:
400			•	
600		•	•	
800			•	
1000	•	•	•	
1200			•	
1400		•	•	
...				
2000	•	•	•	
...				

WARRANTY SERVICE at 50 working hours

1. 200 hours service according to Technical Handbook, group 90
2. Perform and fill in control chart in the Warranty certificate
3. Changing of oil in engine, gearbox, drive axle, rotator reduction gear and reduction gear on the top lift.
4. Changing filter in engine, gearbox and hydraulic system, (all filters incl. WDB, servo filter etc)
5. Valve clearance adjustment (engine)
6. Check all bolt joints (see also SI94-003)



KL587

KL146

LUBRICATION CHART

Item No.	Description	Interval operating hours			No. of lub. points	Remarks
		200	600	1000		
1	Boom mounting	L			2	
2	Slide plates, boom	L				Manually pump grease while the boom is moved slowly outwards and inwards to its end positions
3	Rotator mounting	L			2	
4	Tilt cylinders	L			4	
5	Rotator reduction gear (Brake and planetary gear)	x	C	xx	4	Check the level. Top up the red point on the sight glasses ²⁾ x) First oil change at warranty service xx) Thereafter oil change every 1000 h
6	Rotator bearing	L			4	2 nipples on each side
7	Pinion and ring gear	L			3	Brush on with grease
8	Link levers	L			4	
9	Steered wheel bearing				2	Remove, clean, inspect and pack with grease every 4000 h
10	Knuckle pin bearings				4	Remove, clean, inspect and pack with grease every 4000 h
11	Engine oil	x				x) Change the oil every 200 h ¹⁾
12	Engine oil filter		x		2	x) Change the filter every 400 h
13	Gearbox oil	C		x	1	x) Change the oil. Check the level at idling speed
14	Gearbox oil filter		x		2	x) Change the filters
15	Hydraulic oil filter, working hydraulics			x	2	x) Change the filters
16	Hydraulic oil filter, brake system cooling circuit			x	1	x) Change the filter
17	Hydraulic oil, servo system			x	1	x) Change the filters
18	Hydraulic oil filter, top lift			x	1	x) Change the filters
19	Propeller shaft	L			3	
20	Drive axle	C		x	3	Change the oil
21	Breather filters, hydraulic tank			x	2	x) Change filters every 2000 h
22	Hydraulic oil	C		x		x) Change oil every 2000 h
23	Door and panel hinges					Lift off the doors and panels
24	Brake pedals			C L	2	Check and retighten the pedal axle locking screws. Lubricate axle nipples
25	Hydraulic oil, brake system	C		x	1	x) Change the oil. N.B. Only machines with separate tank for brake system

1)The interval is greatly dependent on the fuel and lubricant quality as well as the operating conditions.

If intervals longer than 200 hours are desired, the condition of the oil must be checked by the company making the oil, by means of regular lubricant tests.

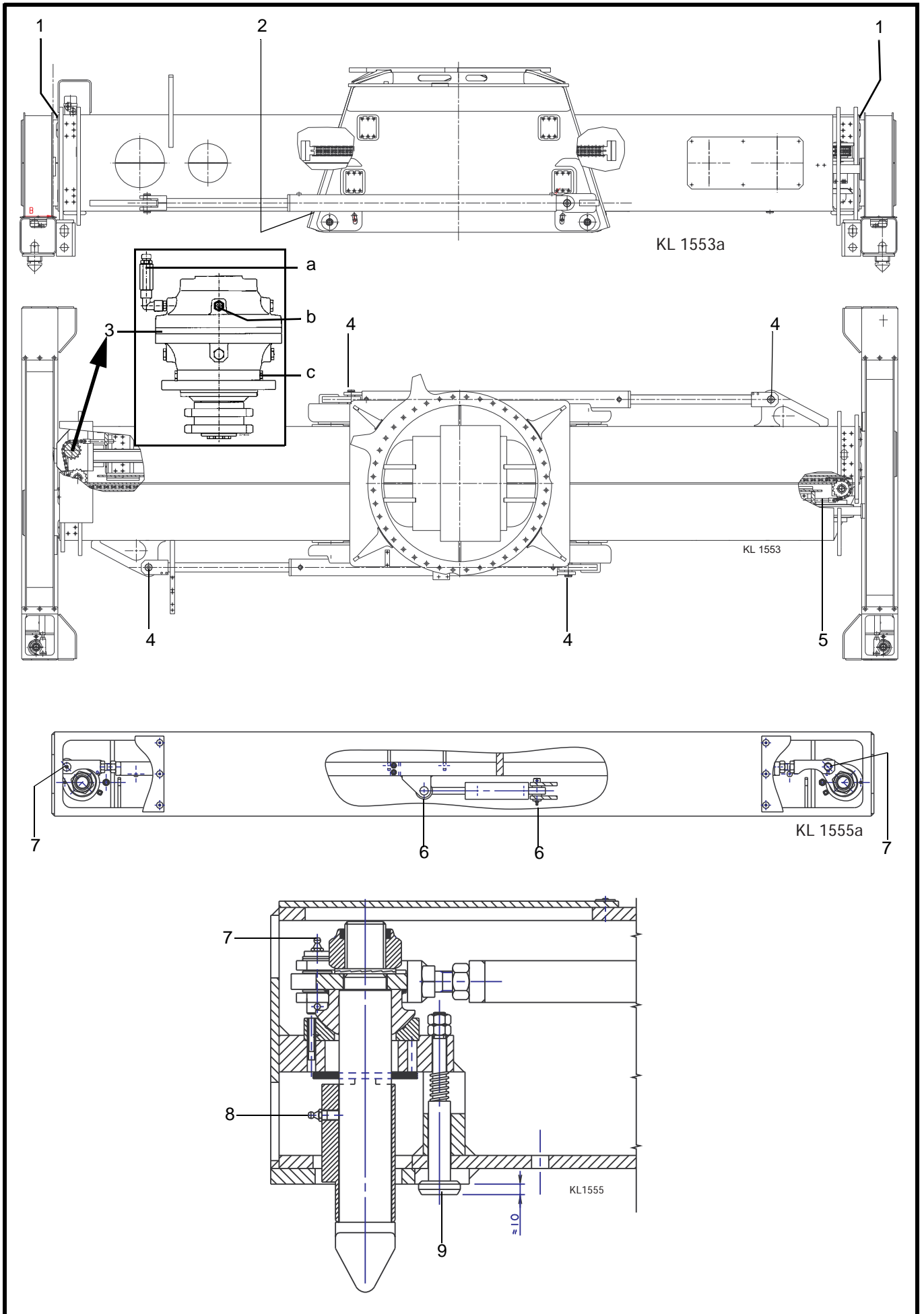
²⁾ Note! Different oils in brake and planetary gear.
(Volume brake: 0.6 l. Volume gear: 1.6 l)

For volumes, see **Technical Data**. For lubricating oil grades, see **Oil and lubricant recommendations**

L=Lubricate
C=Check

N.B.
If the truck is standing unused outdoors, with the piston rods protruding, all piston rods must be greased to prevent corrosion.

After they have been washed with degreasing agent, all pistons should be moved backwards and forwards several times to obtain a new protective oil film.



LUBRICATION CHART, Top lift

Item No.	Description	Interval operating hours			No. of lub. points	Remarks
		200	600	1000		
1	Sliding surfaces, length adjustment	L				Brush onto all sliding surfaces with the in the fully extended position
2	Sliding surfaces, side-shift	L				Brush onto all sliding surfaces with the top-lift fully side-shifted in both directions
3	Planetary gear a. Venting/Topping up b. Sight glass c. Magnetic plugg, oil drainage	C		x	1	Level check, fill to the red spot on the sight glass. Oil volume 2.4 litres. x First oil change - guarantee service x Then, oil change every 1000 hours
4	Cylinders, side-shift	L			4	
5	Chains	L			2	
6	Locking cylinders, twist-locks	L			4	Check that the sensors are free from grease and that the sensor faces are undamaged
7	Lifting pin twist connection	L		x	4	Dismantle and check the twist-locks every 5000 h. See group 80. Same procedure should be used if damage to the twist-locks is suspected.
8	Lifting pin	L		x	4	
9	Contact pin	L			4	Lubricate with grease Check that the sensors are free from grease and that the sensor faces are undamaged

L = Lubricate
C = Check

DAILY SUPERVISION

DAILY SUPERVISION	Or when refueling	Check	Refill if required
Brakes		Function	
Steering		Function	
Rear steered axle suspension (On machines with mechanical overload protection system)		Check that the rear suspension is clean. Check that the sensor is free from grease	
All instruments. Blinkers, brake lights, horn, Head-lights, reflectors		Function	
Boom pivot suspension and sliding plates		Damage	
Attachment and rotator		Operation	
Engine, gearbox, drive axle		Noises?	
Hydraulic hoses		Oil leakage?	
Fuel		Amount The fuel meter must never show 0	•
Engine oil	•	Level	
Air cleaner	•	Indicator	•
Coolant	•	Level	•
Hydraulic oil	•	Level	•
Gearbox oil	•	Level	•
Wipers	•	Fluid level	•
Wheels	•	Damages Tyre pressure 1 MPa	•

Every 200:e hours

Item	Unit	Action	Remarks
1	Truck	Wash	Note! Do not use highpressure on bearings or bearing housings
2	Radiator	Clean the fins of the radiator with water and detergent	Note! Do not usehigh-pressure.
3	Engine	Check the oil and coolant connections for leakage	
4	Air cleaner	Check the indicator. Replace if required.	See Group 30.
5	Brakes	Check for oil leakage. Test brake performance.	See Group 70.
6	Battery cables, terminals and fuses	Clean the terminals and apply petroleum jelly. If necessary, replace cables and terminals.	
7	V-belts	Check the belt tension	
8	Telescope boom and attachment	Check for damage. Retighten the bolted joints. Check slidingplates for wear. Apply special lubricant. Specially check for cracks in welds on boom and mountings	See Group 80
9	Steering axle	Check for play, damage	
10	Steered and driven wheels	Tighten the wheel nuts. Inspect tyres and rims for possible damage.	See Group 40 resp 60 Specifications
11	Drive axle and propeller shaft	Tighten bolt joints. Check for leakage	See Group 40 Specifications
12	Gear box	Check for oil leakage.	
13	(Air conditioner)	Check the performance	See Group 10
14	(Exhaust gas emission control system)	Inspect the catalyst and top up as necessary.	See Group 30
15	Lubrication points, oil and filter changes in accordance with the Lubrication chart.	On trucks with automatic lubrication, check to make sure that all lubrication lines are undamaged and that all lub points are correctly lubricated	
16	Inductive sensors	Check setting. Clean the sensors Check for damage.	See Group 80
17	For optional equipment, please refer to special instructions issued.		

IMPORTANT!
Always attend to any damage, wear or faults that are important to the performance of the truck and its service life or the safety of the personnel.

Every 600 hours

Item	Unit	Action	Remark
1	Air cleaner	Change the filter element if the indicator shows red.	See Group 30
2	Turbo charger	Check for leakage.	See Group 30
3	Exhaust system	Check for leakage.	
4	Steered wheels	Check the wheel alignment, and check for deformation or bearing play.	See Group 60
5	Telescope boom and attachment	Check that the hose guide runs freely and that the hoses are in good condition.	
6	Lubrication points, oil and filter changes in accordance with the Lubrication chart.		
7	200 hours service		

IMPORTANT!
Always attend to any damage, wear or faults that are important to the performance of the truck and its service life or the safety of the personnel.

Every 1000 hours

Item	Unit	Action	Remarks
1	Fresh-air filter	Change filter element	See Group 10
2	Engine	Check valve clearances, cooling system, starter motor, alternator and fuses	See Volvo Workshop Manual and Group 30
3	Fuel tank	Drain	
4	Fuel filter	Change the filter. Bleed the fuel system.	
5	Injectors	Check	See Volvo Workshop Manual
6	V-belts	Check and change as necessary.	
7	Batteries	Check.	
8	Wheels	Check for damage	
9	Propeller shaft	Check the bolted joints and check the universal joints for play	See Group 40
10	Gearbox and drive axle	Clean the breather	
11	Steered axle	Check knuckle pin bearings tightening torque	See Group 60
12	Brakes	Check	See Group 70
13	Painting and safety marking	Touch up	
14	All functions	Test-drive and check	
15	(Air conditioner)	Check the refrigerant level. Clean the fans and condensor flanges.	See Group 10
16	Lubrication points, oil and filter changes in accordance with the Lubrication chart.		
17	Hydraulic pressure	Check and adjust if necessary.	
18	600 and 200 hours service		

IMPORTANT!
Always attend to any damage, wear or faults that are important to the performance of the truck and its service life or the safety of the personnel.

