B25D & B30D 6 X 6

ARTICULATED DUMP TRUCK

REPAIR MANUAL

Document Part Number 872118

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TO THE SERVICE PERSONEL

⚠ WARNING

Do not operate the machine unless you have read the Operator's Manual and fully understand how to operate the machine properly.

This manual is written for an experienced technician and are on-the-job guides containing only the vital information needed for diagnosis, analyses, testing and repair. Essential tools required in performing certain service works are identified and in this manual and are recommended for use.

The safe operation of your ***BELL EQUIPMENT*** machines very important to prevent any personal injury and/or damage. This manual must be read and fully understood before carrying out any tests on your ***BELL EQUIPMENT*** machine.

Right and left hand sides are determined by facing in the direction of forward travel.

This manual is divided into chapters. The information contained in the manual is in logical sequence, with the instructions written in step by step format.

Effective maintenance on your ***BELL EQUIPMENT*** machine is achieved when personnel fully understand the information contained in this manual.

Every effort has been made to ensure that the information contained in this manual was correct at the time of publication. ***BELL EQUIPMENT Co.*** has a policy of continuous product development, improvement, and design. ***BELL EQUIPMENT Co.*** reserves the right to change, amend and update the design of its product at any time without prior notice. With this policy, changes may have occurred that are not included in this manual.

Whilst every endeavour has been made to provide accurate and reliable information, ***BELL EQUIPMENT Co.*** specifically disclaims any actual or implied warranty and under no circumstances shall be liable for any loss, damage or injury to person or property suffered, whether direct, indirect or consequential, arising from the use of this manual. In particular and without detracting from above, the disclaimer also applies in the event of any specification, warning, or representation contained in this manual being inadequate, inaccurate, or unintentionally misleading.

The user is urged to strictly comply with the instructions and warnings that are given in the interests of general safety. Please do not hesitate to contact your ***BELL EQUIPMENT*** Product Support Representative whenever you have a query on your ***BELL EQUIPMENT*** product or this manual.

SAFETY SYMBOL

The following safety symbol is used for all safety messages. When you see the safety symbol, follow the safety message to avoid personal injury or death.

WARNINGS and **CAUTIONS** must be read, fully understood and followed, before carrying out the action or maintenance procedure concerned.

WARNINGS and **CAUTIONS** are always placed before any action or maintenance procedure where personal injury and/or damage to the machine could occur if that action, test or maintenance procedure is not carried out correctly.

WARNING AND CAUTION SYMBOL

Throughout this manual the word **WARNING** is used to alert the operator and others of the risk of personal injury during the operation of the equipment. **CAUTION** indicates the possible damage to the machine. **NOTE** highlights information of special interest.

⚠ CALIFORNIA PROPOSITION 65 WARNING

Diesel engine exhaust and some of its constituents are known to the state of California to cause Cancer, birth Defects and other Reproductive Harm.

B25D and B30D 6X6
ARTICULATED DUMP TRUCK

REPAIR MANUAL

THIS MANUAL IS APPLICABLE TO

B25D 6X6 (E410814)
B30D 6X6 (E409836)

Document Part Number 872118

Issue:0
(Revised:)

Technical Documentation
BELL EQUIPMENT COMPANY
Richards Bay

IMPORTANT

Due to ***BELL EQUIPMENT'S*** policy of continuous product improvement, the information contained in this manual was correct up to the time of printing (Revised date of manual). Any changes after this date will only be included in the next update of this manual.

The illustrations in this manual are pictorial and not necessarily true representations of components. Photographs and illustrations may show optional equipment.

ABBREVIATION LIST

The table below lists the abbreviations used in this manual:

Abbreviation	Meaning
ºC	degrees Celsius
ºF	degrees Fahrenheit
A	ampere
ADT	Articulated Dump Truck
Ah	ampere hours
CB	circuit breaker
d	diagnostic
D	drive
DNS	Do Not Shift
ECU	Electronic Control Unit
FOPS	Falling Objects Protective Structure
ft	foot (feet)
ft lb	foot pound
HP	Horsepower
ISO	International Standards Organisation
kg	kilogram
km	kilometre
km/h	kilometres per hour
kPa	kilo pascal
kW	kilowatt
lb	pound
LCD	Liquid Crystal Display
LED	Light Emitting Diode

Abbreviation	Meaning
m	metre
m^3	cubic metre
N	Neutral
m.p.h.	miles per hour
MSDS	Material Safety Data Sheet
Nm	Newton metre
psi	pounds per square inch
PTO	Power Take-Off
R	Reverse
r.p.m.	revolutions per minute
ROPS	Roll Over Protective Structure
SMR	Service Meter Reading
USGAL	United States Gallon
V	Volt
yd^3	cubic yard

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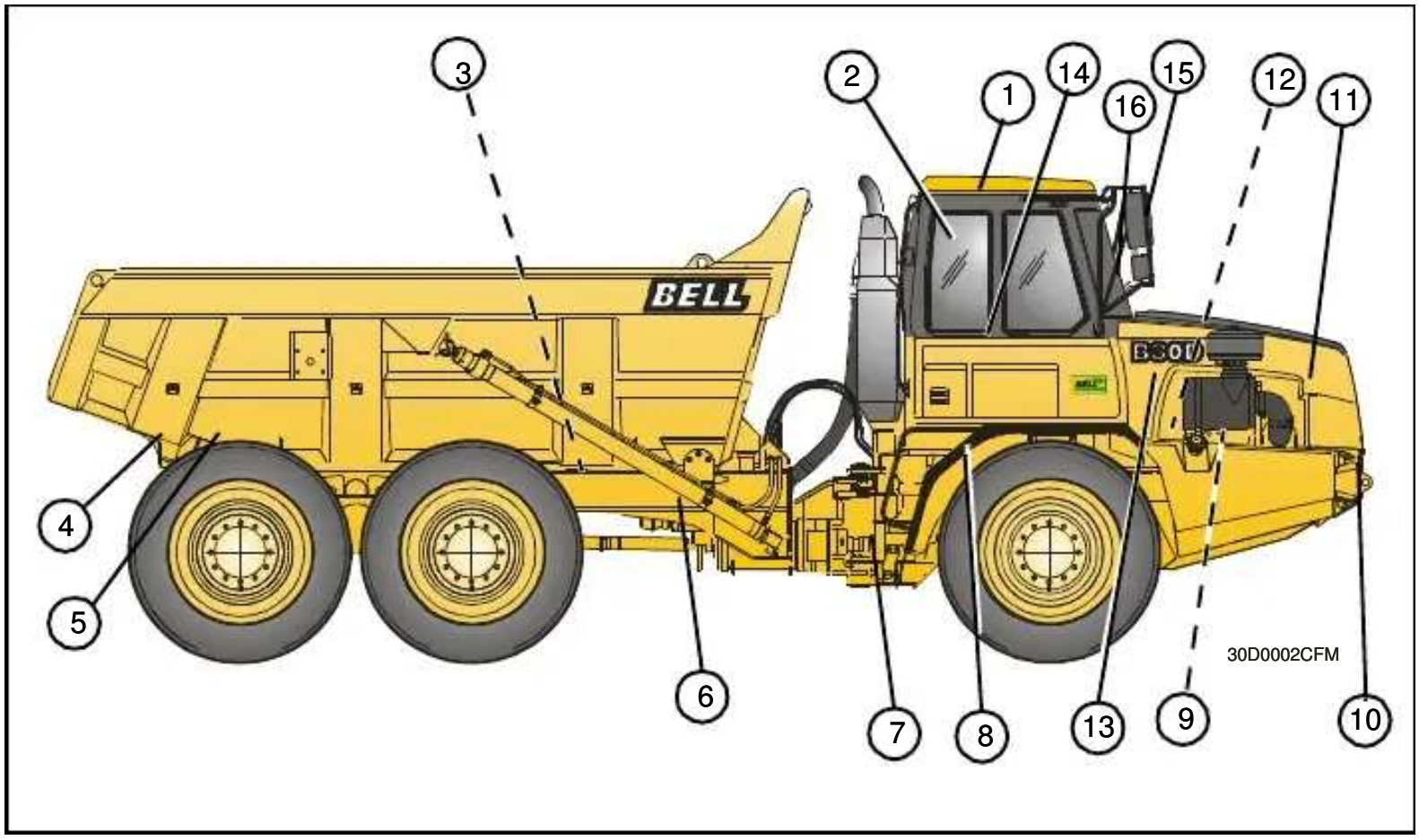
SAFETY

Specification

This machine complies to the CE Specification.

Safety Features



1. **ROPS/FOPS Cab Protection**. The Roll Over Protective Structure has been certified to meet specified test requirements according to SAE J1040 and ISO 3471. The Falling Objects Structure has been certified to meet specified test requirements according to SAE J/ISO 3449 and ISO 3449.

2. **Cab with Heater/Defroster**. Positive pressure ventilation system circulates both outside and inside air through filters for a clean working environment. Built in defroster vents direct air flow for effective window de-fogging/de-icing.

3. **Bin Service Lock (on left hand side of rear chassis).**

4. **Stop/Back lights**. Highly visible lights.

5. **Backup Alarm.**

6. **Independent Parking Brake**.

7. **Articulation locking Bar.**

8. **Secondary Steering**. Ground driven, continuously in operation. Secondary steering indicator light will light when activated.

9. **Horn**.

10. **Halogen Lights and Turn Signals.**

11. **Engine Fan Guard.**

12. **Bypass Start Protection (on starter motor).**

13. **Exhaust Brake and Transmission Retarder (If Equipped).**

14. **Safety Belt Retractors.**

15. **Mirrors.**

16. **Large Windshield Wiper With Washer.**

Material Safety Data Sheets (MSDS)

The Federal Occupational, Safety and Health Administration (OSHA) Standard 29 CFR 1910.1200 and in some cases, State and Local Right-to-Know laws, may require that specific **MSDS** be available to the employees prior to operating this equipment. This may include information on substances contained in this equipment such as antifreeze, engine oil, battery acid, hydraulic fluid and freon (if equipped with an air conditioner).

To ensure a prompt response, please be sure to include your return address and ZIP (postal) code, along with the model, serial number and/or **VIN** number of your machine.

Unauthorised Modifications of the Roll Over Protective Structure (ROPS) and the Falling Objects Protective Structure (FOPS)

Do not make unauthorised modifications or alterations to the ROPS and FOPS such as: welding on extinguisher brackets, CB aerial brackets, fire suppression systems etc. Unauthorised modifications will affect the structural limits of the ROPS and FOPS and will void the certification.

The Roll Over Protective Structure has been certified to meet specified test requirements according to SAE J1040 and ISO 3471. The Falling Objects Protective Structure has been certified to meet specified test requirements according to SAE J/ISO 3449 and ISO 3449.

Any planned modification or change must be reviewed in advance by the ***BELL EQUIPMENT*** **Engineering Department** to determine if the modification or change can be made within the limits of the certifying tests.

It is important that each person in your organisation, including management, be made fully aware of these rules involving **ROPS** and **FOPS**. Whenever anyone sees unauthorised modifications or changes to a machine's **ROPS** or **FOPS** both the customer and manufacturer must be notified in writing.

Make sure that all parts are installed correctly if the **ROPS** or **FOPS** is loosened or removed for any reason. Tighten mounting bolts to the correct torque. The protection offered by **ROPS** or **FOPS** will be impaired if they are subjected to structural damage, is involved in an overturn incident, or is altered in any way. A damaged **ROPS** or **FOPS** must be replaced, not reused.

Noise Emission Levels

The sound pressure was tested according to ISO 6394 (SAE J/ISO 6394) and the sound power was tested according to ISO 6393 (SAE J 2102).\plain \par

General Safety

Be sure all operators of this machine understand every safety message. Replace operator's manual and safety decals immediately if missing or damaged.

Safety Regulation

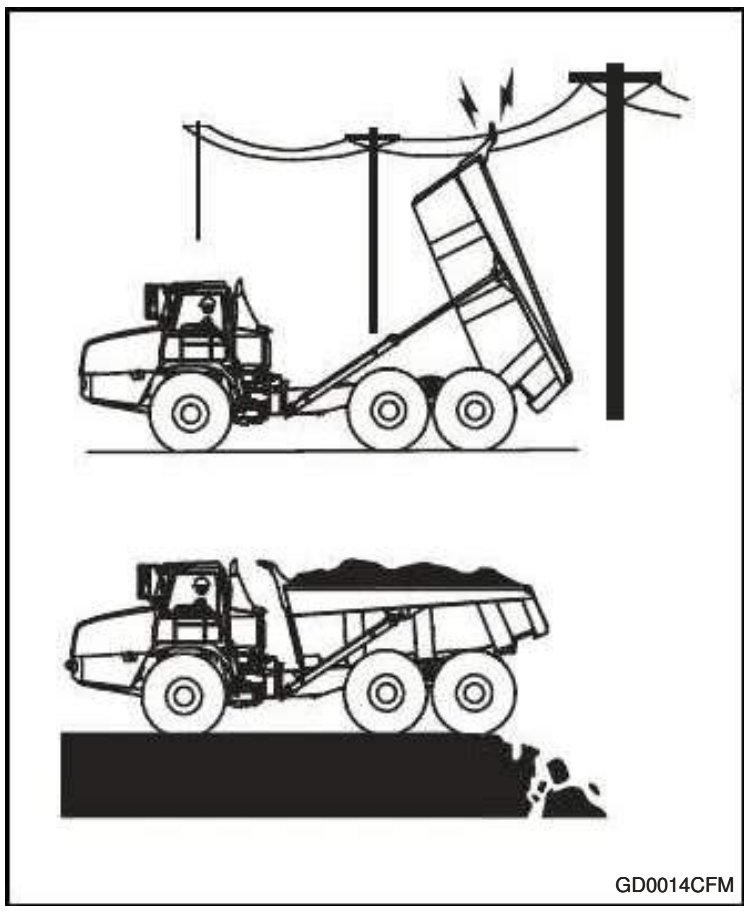
Every country (State) has its own safety regulations. It is the obligation of the operator to know and follow these. This also applies to local regulations covering different types of work. Should the recommendations in this manual deviate from those of your country, your local safety regulations should be followed.

Mounting and Dismounting the Machine

Always use the handrails and steps provided to get on and off the machine. Use both hands and face the machine. Never get on or off a moving machine. Never jump off the machine. Use a hand line to pull equipment up onto the platform, do not climb on or off the machine carrying tools or supplies.

Use extra care when mud, snow, or moisture present slippery conditions. Keep steps clean and free of grease, oil and foreign objects.

Avoid Work Site Hazards



Avoid Overhead Power Lines

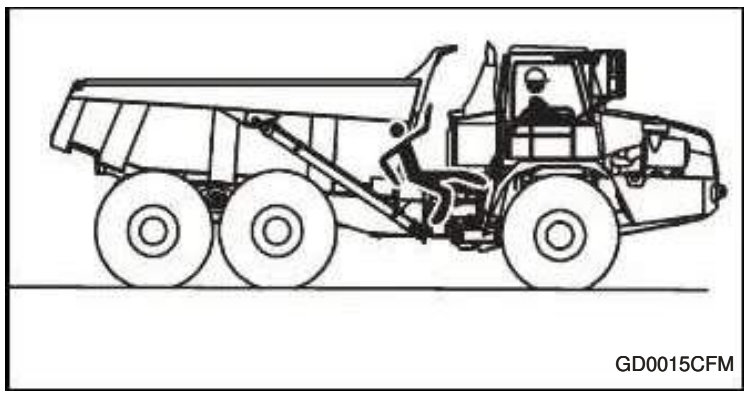
Never move any part of the machine within 3 m (10 ft) plus twice the line insulator length, as serious injury or death may result.

Operate Only On Solid Footing

Operate only on solid footing with strength sufficient to support machine. Be alert working near embankments, excavations and with bin raised. Avoid working on surfaces that could collapse under machine.

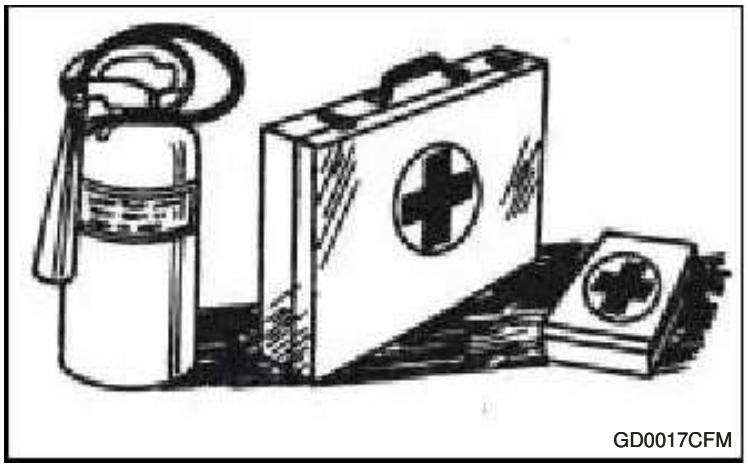
Use caution when backing up to berms before dumping load.

Keep Riders Off the Machine



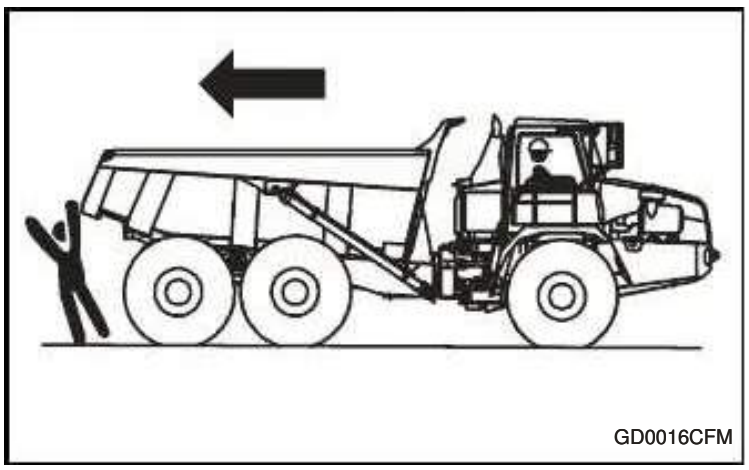
Do not allow unauthorised personnel on the machine.

Prepare for Emergencies



Keep a first aid kit and fire extinguishers handy and know how to use them. Inspect and have your extinguisher serviced as recommended on its instruction plate. Keep emergency numbers for doctors, ambulance service, hospital and fire department near your telephone.

Avoid Backing Over Accidents



Make sure all persons are clear of machine path before moving the machine. Where conditions permit, raise bin for better visibility to the rear. Use mirrors to assist in checking all round machine.

Keep windows, mirrors and backup alarm clean and in good condition.

Use a signal person when backing if view is obstructed and/or in close quarters. Keep signal person in view at all times.

Use prearranged hand signals to communicate.

Handle Chemical Products And Flammable Fluids Safety

Exposure to hazardous chemicals can cause serious injury. Under certain conditions, lubricants, coolants, paints and adhesives used with this machine may be hazardous.

If uncertain about safe handling or use of these chemical products, contact your authorized dealer for a Material Safety Data Sheet (MSDS).

Handle fuel with care, as it is highly flammable. Do not smoke or go near an open flame or sparks while refuelling. Always stop the engine before refuelling the machine and fill the fuel tank outdoors.

Keep all fuels and lubricants in properly marked containers and away from all unauthorised persons. Do not smoke in the storage areas.

Store oily rags and other flammable material in a protective container, in a safe place.

Do not weld or flame cut pipes or tubes that have contained flammable fluids. Clean them thoroughly with nonflammable solvent before welding or flame cutting them.

Starting fluid is highly flammable. Keep all sparks and flames away when using it. To prevent accidental discharge when storing the pressurised can, keep the cap on the can and store it in a cool protected place. Do not burn or puncture a starting fluid container.

Clean the Machine Regularly

Wait until the engine has cooled before removing trash from areas such as the engine, radiator, batteries, hydraulic lines, fuel tank and operators cab. Remove any grease, oil or debris build-up. Keep the machine, especially the walkways and steps, free of foreign material, such as debris, oil, tools and other items which are not part of the machine.

Prevent Battery Explosions and Acid Burns

The standard battery supplied with the machine is a sealed type that does not need maintenance. keep sparks and flames away from the batteries.

If a non-sealed battery is subsequently installed, keep sparks and flames away from the batteries. Use a flashlight to check the battery electrolyte level. Use a voltmeter or hydrometer to check battery charge. Never place a metal object across the posts. Always remove the grounded (Negative -) battery clamp first and replace it last.
Do not smoke in areas where batteries are being charged.

Sulphuric acid in battery electrolyte is poisonous and is strong enough to burn skin, eat holes in clothing and cause blindness if splashed into the eyes.

Avoid the hazard by:

- Filling the batteries in a well ventilated area.
- Wearing eye protection and rubber gloves.
- Avoid breathing fumes when electrolyte is added.
- Avoid spilling or dripping electrolyte.

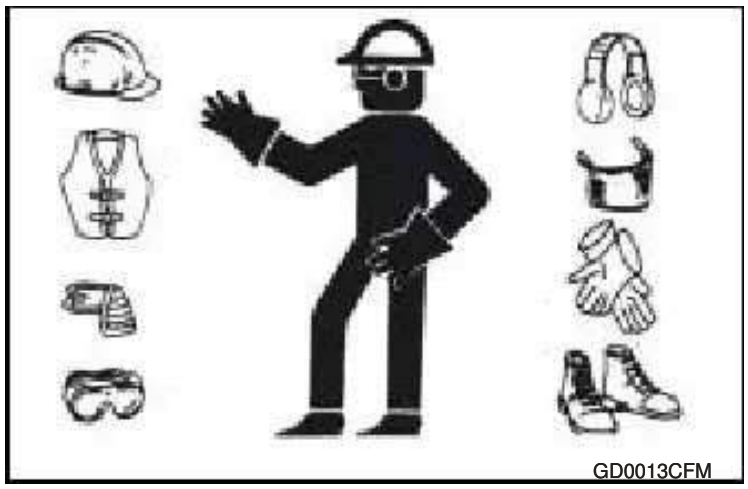
If you spill acid on yourself:

- Flush your skin with water.
- Apply baking soda or lime to help neutralise the acid.
- Flush your eyes with water for 10 - 15 minutes and get medical attention immediately.

If acid is swallowed:

- Drink large amounts of water or milk.
- Then drink milk of magnesia, beaten eggs, or vegetable oil.
- Get medical attention immediately.

Wear Protective Equipment



Wear a hard hat, protective glasses and other protective equipment as required by the job conditions. Do not wear loose clothing or jewellery that can catch on controls or other parts of the machine.

When you drive connecting pins in or out, guard against injury from flying pieces of debris by wearing goggles or protective glasses. Prolonged exposure to loud noise can cause impairment or loss of hearing. Wear a suitable hearing protective device such as earmuffs or earplugs. Wear gloves when handling wire rope cable.

Use the Seat Belt

Use a seat belt at all times to minimise the chance of injury in an accident.

The seat belt must not be altered or modified in any way. Such changes can render the belt ineffective and unsafe.

The seat belt is designed and intended for the seat's occupant to be of adult build and for one occupant of the seat only.

Avoid High Pressure Fluids

Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve the pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. Use a piece of cardboard or paper to search for leaks.

If any fluid is injected into the skin it must be surgically removed within a few hours by a doctor who is familiar with this type of injury or gangrene may result.

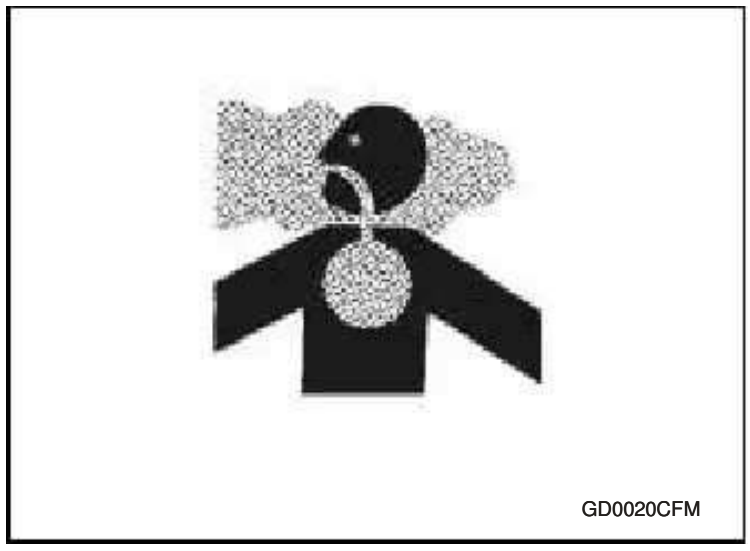
Stay Clear Of Moving Parts

Entanglements in moving parts can cause serious injury.

Stop engine before examining, adjusting or maintaining any part of the machine with moving parts.

Keep guards and shields in place. Replace any guard or shield that has been removed for access as soon as service or repair is complete.

Beware of Toxic Fumes



Prevent asphyxiation. Engine exhaust fumes can cause sickness or death.

Operate only in well ventilated indoor areas. Avoid hazardous fumes by first removing paint on painted surfaces before welding.

Wear an approved respirator when sanding or grinding painted surfaces.

If a solvent or paint stripper is used, wash surface with soap and water. Remove solvent or paint containers before welding and allow at least 15 minutes before welding or heating.

Dispose of Waste Properly

Improper disposal of waste can threaten the environment. Fuel, oils, coolants, filters and batteries used with this machine may be harmful if not disposed of properly.

Never pour waste onto the ground, down a drain or into any water source.

Air conditioning refrigerants can damage the atmosphere. Government regulations may require using a certified service centre to recover and recycle used refrigerants.

If uncertain about the safe disposal of waste, contact your local environmental centre or your dealer for more information.

Start Only From Operator's Seat


GD0022CFM

Avoid unexpected machine movement. Start engine only while sitting in operator's seat. Ensure all controls and working tools are in proper position for a parked machine.

Never attempt to start engine from the ground. Do not attempt to start engine by shorting across the starter solenoid terminals.

Lower bin during work interruptions, apply park brake and be careful not to accidentally actuate controls when co-workers are present.

Operating The Machine

Avoid Tip Over

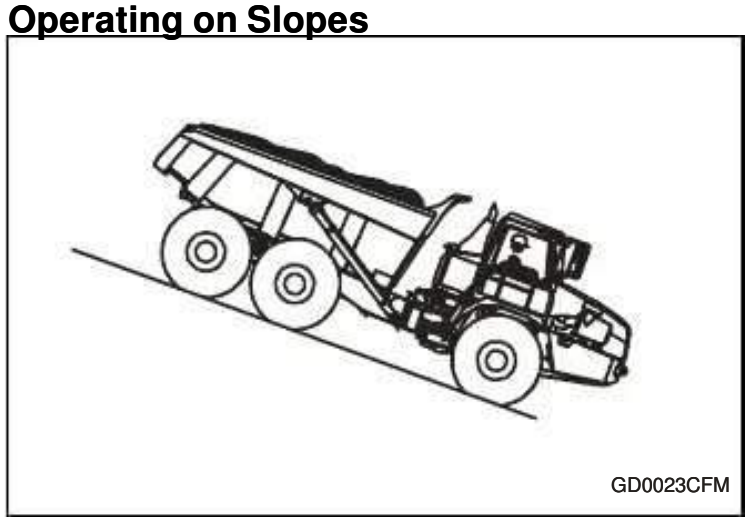
Use safety belt at all times. Do not jump from machine if it tips.

Use extra care when bin is raised. Machine stability is greatly reduced when bin is raised. Drive slowly, avoid sharp turns and uneven ground.

Do not over load the machine.

Before operating machine after it has tipped, carefully inspect all hydraulic and electrical lines.

Operating on Slopes


GD0023CFM

Avoid side slope travel whenever possible.

Check service brakes frequently when operating on slopes

The maximum slope will be limited by the ground conditions.

Welding Repairs

NOTE:Disable electrical power before welding. Turn off main battery switch or disconnect positive battery cable. Separate harness connectors to engine, alternator and vehicle microprocessors.


GD0021CFM

Avoid welding near fluid lines. Do not let heat go beyond work area near fluid lines.

Remove paint properly. Wear eye protection and protective equipment when welding.

Do not inhale dust or fumes.

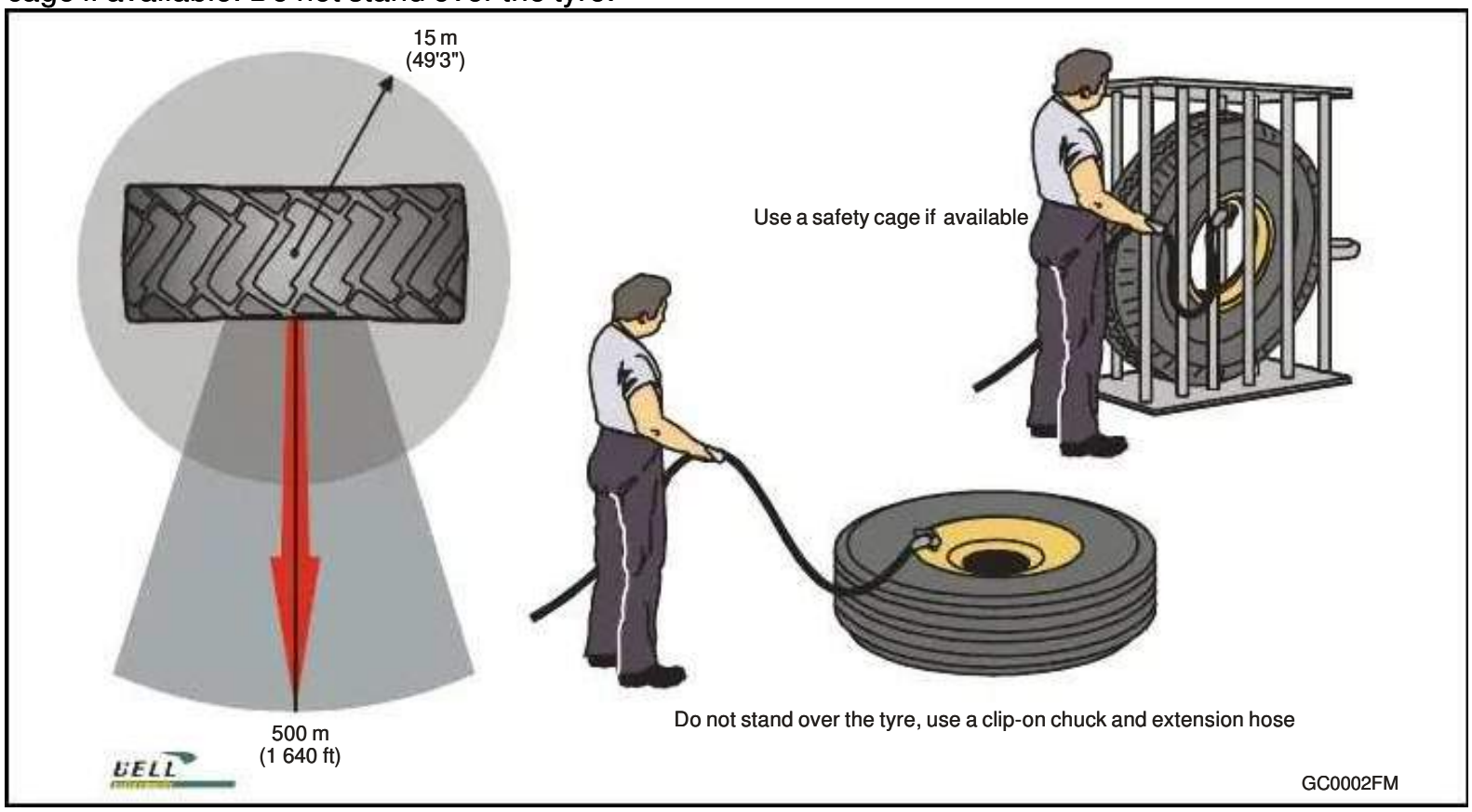
Tyre Information

Welding or heating of the rim components, external fire or excessive use of brakes can cause overheating of the tyres, which could cause a tyre explosion.

This explosion can propel the tyre, rim and final drive components approximately 500 metres (1 640ft) from the machine, which may cause personal injury or death and/or property damage.

If the tyre is overheating and could explode, do not approach it within the area represented by the shaded area in the drawing, until it has cooled.

Stand behind the tread and use a self attaching chuck with extension hose to inflate the tyres. Use a safety cage if available. Do not stand over the tyre.



NOTE:It is recommended that only trained personnel service and change tyres and rims.

Inspect and Maintain ROPS

A damages roll-over protective structure (ROPS) should be replaced, not reused.

If the ROPS was loosened or removed for any reason, inspect it carefully before operating the machine again.

To Maintain the ROPS:

- Replace missing hardware using correct grade hardware.
- Check hardware torque.
- Check isolation mounts for damage, loose-ness or wear; Replace if necessary.
- Check ROPS for cracks or physical damaged.

Drive Metal Pins

Always wear protective goggles or safety glasses and other safety equipment.

Use soft hammer or a brass bar between hammer and object to prevent chipping.

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BULLETINS

Record the relevant information from the Technical Documentation Bulletins, Service Bulletins and Parts Bulletins into this manual as follows:

- Ensure the manual number (87--------) reflected in the bulletin is the same as the 87------ number at the top of the main content pages.
- Carry out the instructions as detailed in the bulletin.
- Record the required information below.
- File the bulletins in numerical order in a suitable 3 or 4 ring binder.

TECHNICAL DOCUMENTATION BULLETIN RECORD				
BULLETIN NO.	SUBJECT	INSERTED BY		
		NAME	SIGNATURE	DATE

TECHNICAL DOCUMENTATION BULLETIN RECORD				
BULLETIN NO.	SUBJECT	INSERTED BY		
		NAME	SIGNATURE	DATE

USER'S INFORMATINON FEEDBACK FORM

Should you, as user of this manual, have any suggestion for improving the manual, or you find any errors or omissions, then we would like to know.

Please complete a facsimile of this form and hand it in to your nearest ***BELL EQUIPMENT*** Product Support Representative or post it directly to your nearest ***BELL EQUIPMENT*** Branch. Addresses are given in the Operator Maintenance Manual.

Ideas, Comments (Please State Page Number):_____

_____

_____

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Machine Model: _____

Serial Number:_____

VIN: _____

Page Number: _____

OVERALL, how would you rate the quality of this publication? (Check one)

Poor		Fair		Good		Very Good		Excellent	
1	2	3	4	5	6	7	8	9	10

Company Name: _____

Technician Name: _____

Address:_____

_____

_____

Phone Number: _____

Fax Number: _____

Thank you for your co-operation.

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TABLE OF CONTENTS

CHAPTER 1. WHEELS

REMOVAL AND INSTALLATION OF WHEELS

Removal

⚠ CAUTION

Always chock at least one other wheel when raising a wheel off the ground.

Park the machine on firm level ground. Chock wheels.

Loosen flange nuts (1) one full turn.

⚠ CAUTION

Components are heavy. Use lifting devices.

Truck - Specification

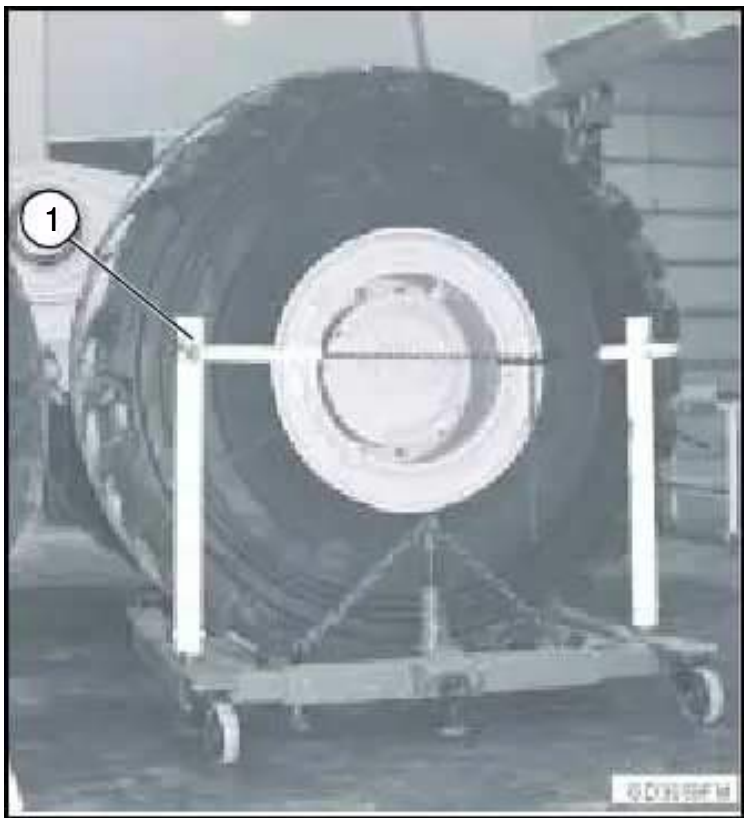
B25D Articulated Dump Truck - Weight - - - - 17 700kg
- -(39,000 lb.)

B30D Articulated Dump Truck - Weight - - - - 18 200 kg
- -(41,000 lb.)

Wheel - Specification

Tyre and Rim - Weight approximate - - - - - - - - - 520kg.
- (1144 lb.)

Raise wheel. Support axle housing with an 18 to 20 ton floor stand.



Attach wheel lift (1) to wheel. Secure tyre with safety chain.

Remove flange nuts and washers. Remove wheel.

Clean threads of wheel bolts and flange nuts.

Clean mating surfaces of flange nuts, washers, rim, and hub.

⚠ WARNING

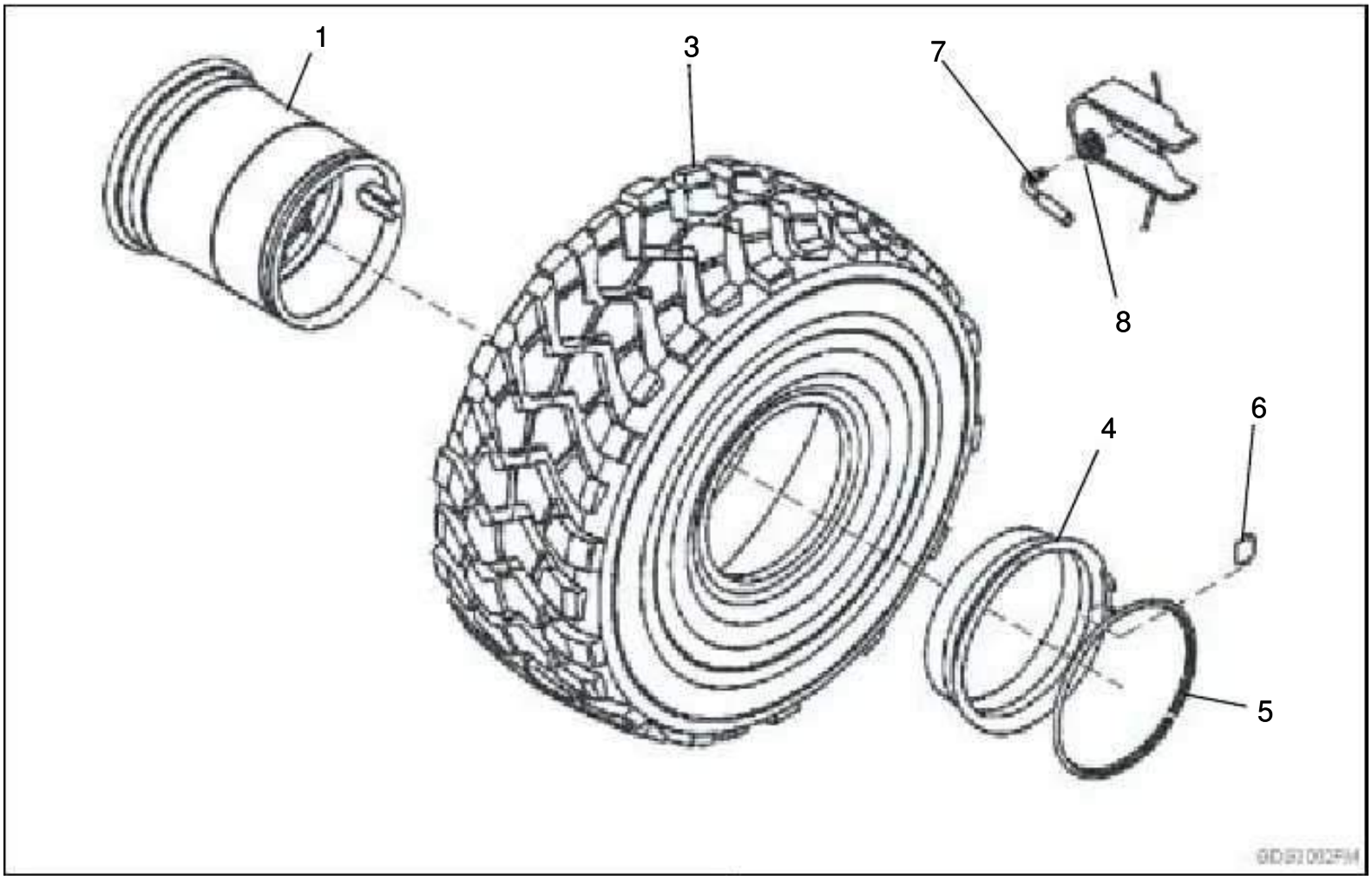
Re-check torque on flange nuts after five hours. Tighten as necessary. Re-check torque every 50 hours thereafter.

Install Wheel

Install washers and flange nuts.

Tighten flange nuts to specification in a crisscross pattern.

Wheel Nut Torque - - - - - - - - - - - - - 650 Nm (480 lb-ft)



1. Rim.
2. Side Ring (2 used - 5-Piece Rims Only).
3. Tyre.
4. Bead Seat Ring.
5. Lock Ring.
6. Driver Block.
7. Valve Stem.
8. Seal Nut.

⚠ CAUTION

Service Tyres Safely. (See CHAPTER "SAFETY").

NOTE: Tyre can be removed without removing wheel from machine. See *BELL EQUIPMENT* Product Support Team for instructions to remove tyre from rim.

Remove valve core from valve stem (7) to deflate tyre (3). Check valve stem for plugging by inserting a probe.

Inspect and replace parts as necessary.

⚠ WARNING

To prevent slippage between tyre and rim during machine operation, clean all contact surfaces thoroughly before assembly.

Thoroughly clean all parts before assembly.

Apply soap lubricant to beads of tyre (3). Assemble wheel set (1 - 6). Ensure that all components are properly aligned and seated.

Install valve stem (7). Hand-tighten seal nut (8). Install pressure-regulating valve, clip-on chuck, and extension hose on valve stem.

⚠ CAUTION

Clear area of all persons. Stand aside while inflating tyre. DO NOT stand in front of tyre. Use only recommended air pressure. Pressure over this limit can cause explosion.

Add air until tyre beads slide out against seats.

Re-check proper alignment of wheel set components around entire circumference before fully inflating tyre.

Inflate tyre to specification. Check air pressure in tyre using an accurate gauge with 7 kPa (0.07 bar) (1 psi) graduations. (**See CHAPTER "SAFETY", in Operator's Manual for correct tyre pressures).**

CHAPTER 2. AXLES AND SUSPENSION SYSTEMS

SECTION 1. REMOVAL AND INSTALLATION

AXLES

Remove and Install Front Axle

Support machine front frame with 20-ton shop stands.

Chock middle and rear wheels securely.

⚠ CAUTION

Component is heavy. Use lifting device.

Axles - Specification

Front Axle - Weight- - - - - - - - - - - - - 1111 kg (2450 lb)

Attach a lifting device to axle.

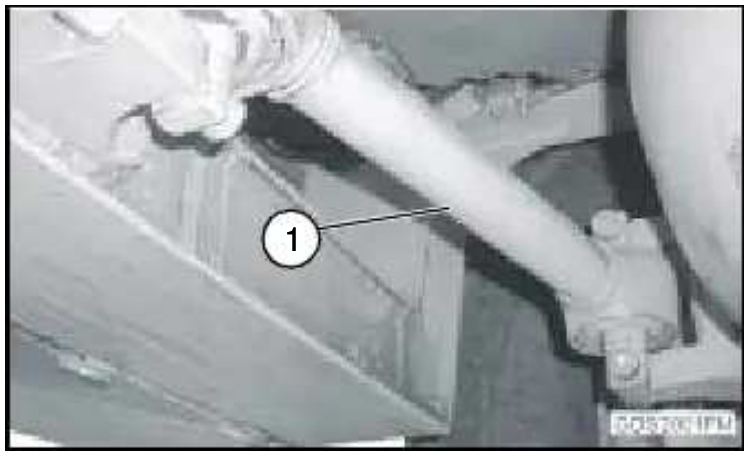
Remove wheels. **(See "Removal" on page 1).**

Remove drive shaft. **(See "DRIVE SHAFTS" on page 35).**

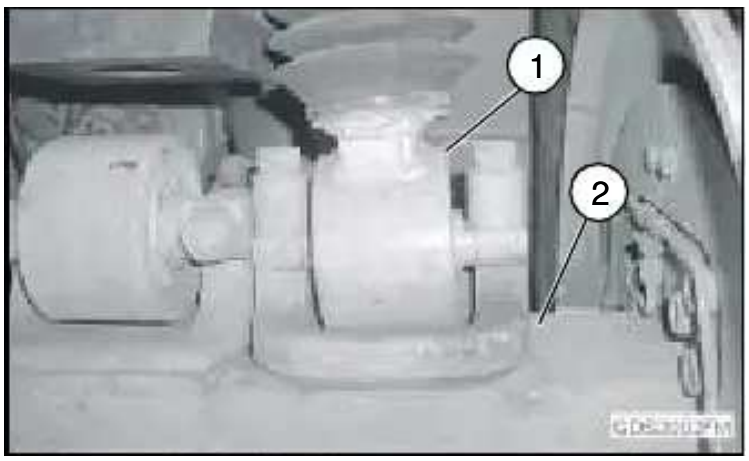
Relieve brake accumulator pressure. Pump service brake pedal at least 100 strokes.

Disconnect brake line(s) at top of differential housing.

Plug or cap open line(s).



Remove front axle stabilizer (1). **(See "AXLE LINKS, STABILIZERS AND STRUTS" on page 41).**



Disconnect struts (1) from front axle (2).

Disconnect link assemblies (1) from frame (2).

Lower axle with lifting device.

Inspect parts and replace or repair as necessary.

Raise axle with lifting device.

Connect link assemblies to frame.

Connect struts to front axle.

Install front axle stabilizer. **(See "AXLE LINKS, STABILIZERS AND STRUTS" on page 41).**

Connect brake line(s) at top of differential housing.

Align front axle input yoke to transfer case front output yoke.

Install drive shaft. **(See "DRIVE SHAFTS" on page 35).**

Install wheels. **(See "Install Wheel" on page 1).**

Bleed Service Brake Hydraulic System. **(See "Bleed Service Brake Hydraulic System" on page 293.)**

Front Axle Alignment

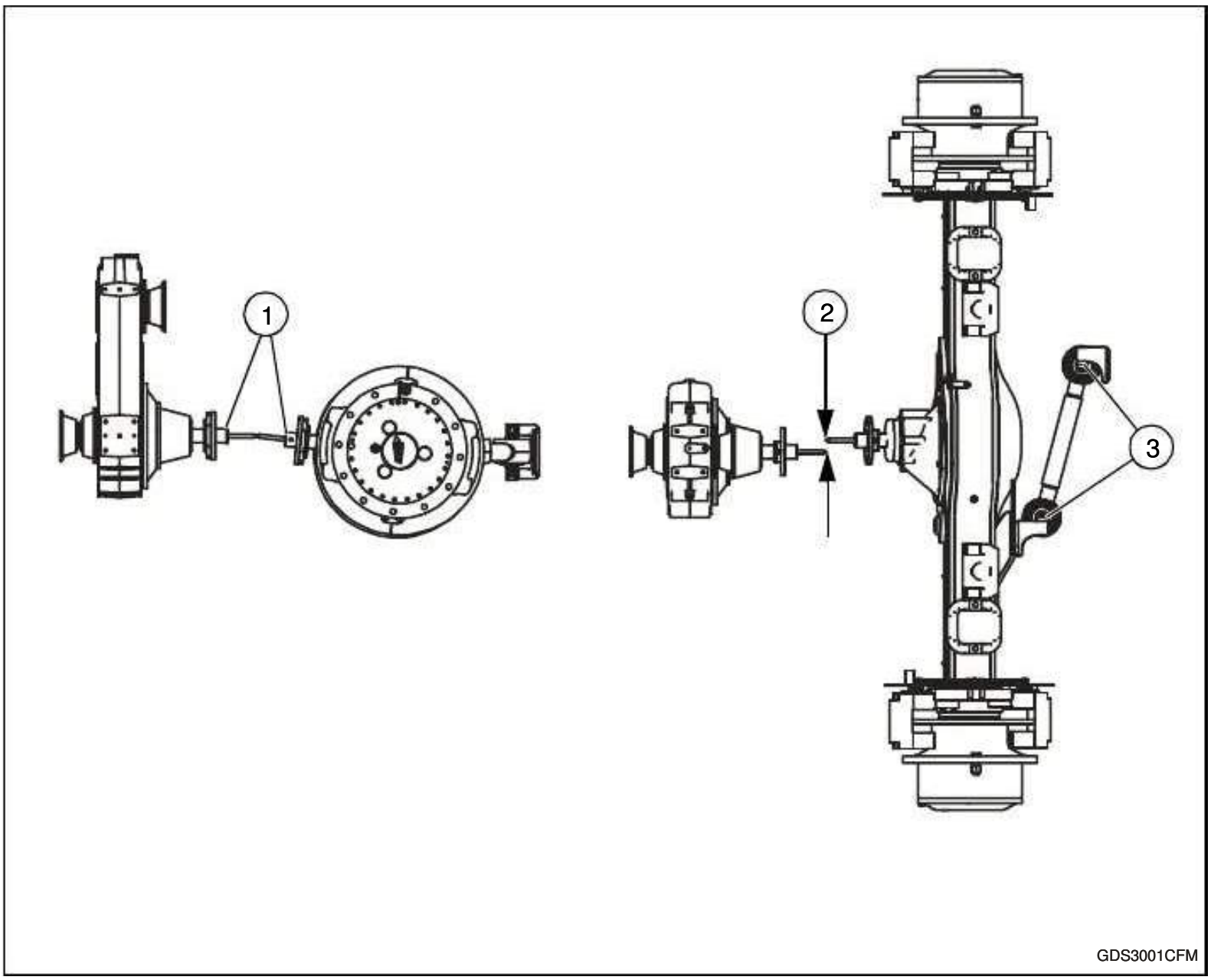
NOTE: Check alignment with all hardware tightened to specifications.

Verify that all front axle mounting hardware are tightened to specifications. **(See "AXLE LINKS, STABILIZERS AND STRUTS" on page 41).**

Recharge front axle suspension struts, if necessary. **(See "AXLE LINKS, STABILIZERS AND STRUTS" on page 41).**

Verify transfer case alignment. Adjust, if necessary. **(See Remove and Install Transfer Case CHAPTE 7, SECTION 1).**

Remove transfer case-to-front axle drive shaft. **(See "DRIVE SHAFTS" on page 35).**



1. 280532 Transfer Case Alignment Tool (Pointer Set - 2 used).
2. Point-to-Point Horizontal Offset Distance.
3. Front Axle Drag Link Shim Locations.

Alignment

Step 1

Install (Tool no. 280532) Transfer Case Alignment Tools (1) on transfer case front output yoke and front axle input yoke.

Step 2

Check alignment of points of (Tool no. 280532) Transfer Case Alignment Tools.

- Viewed from side, points must be accurately aligned.
- Viewed from top, offset distance (2) between points must be at specification. Front axle input yoke offset must be toward left side of machine.

Axles Specification

Transfer Case Front Output Yoke-to-Front Axle Input Yoke Horizontal Offset Distance- - - - - 7 mm (0.28 in.)

Add or remove shims at locations (3) to adjust horizontal offset of front axle, if necessary. Tighten hardware to specification. **(See "AXLE LINKS, STABILIZERS AND STRUTS" on page 41).**

Repeat steps 1 and 2 as necessary.

Remove (Tool no. 280532) Transfer Case Alignment Tools.

Install transfer case-to-front axle drive shaft. **(See "DRIVE SHAFTS" on page 35).**

Remove and Install Middle or Rear Axle

Support machine rear frame with 20-ton shop stands. Chock front wheels securely.

On axle not removed, put wood blocks between axle housing and frame on both sides to support walking beams when wheels are removed from other axle.

Remove wheels. **(See "Removal" on page 1).**

If removing middle axle, remove middle and rear drive shaft(s). If removing rear axle, remove rear drive shaft. **(See "DRIVE SHAFTS" on page 35).**

Relieve brake accumulator pressure. Pump service brake pedal at least 100 strokes.

Disconnect brake pressure line(s) at top of differential housing. Close open line(s) using caps or plugs.

⚠ CAUTION

Component is heavy. Use lifting device.

Axles Specification

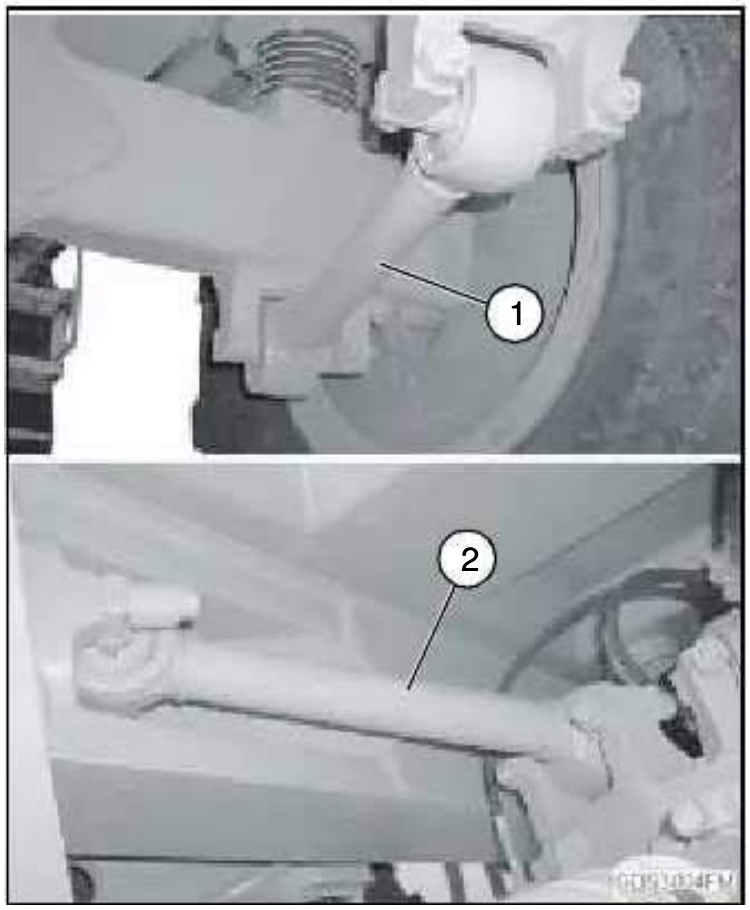
Middle Axle - B25D - Weight -930 kg (2050 lb) approximate

Middle Axle - B30D - Weight - 1066 kg (2350 lb) approximate

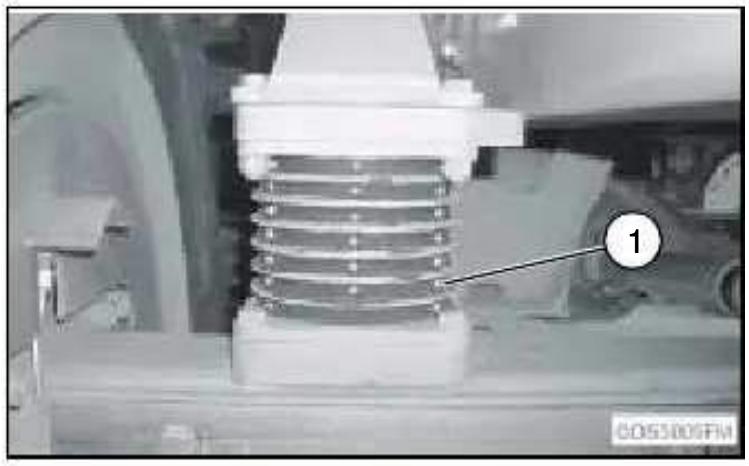
Rear Axle - B25D - Weight -907 kg (2000 lb) approximate

Rear Axle - B30D - Weight - 1043 kg (2300 lb) approximate

Attach a lifting device to axle.



Remove lower drag links (1) and upper drag links (2). **(See "AXLE LINKS, STABILIZERS AND STRUTS" on page 41).**



Disconnect rubber mounts (1) from axle.

Lower axle from walking beams with lifting device.

Inspect and replace parts, as necessary.

Raise axle to walking beams with lifting device.

Connect rubber mounts to axle.

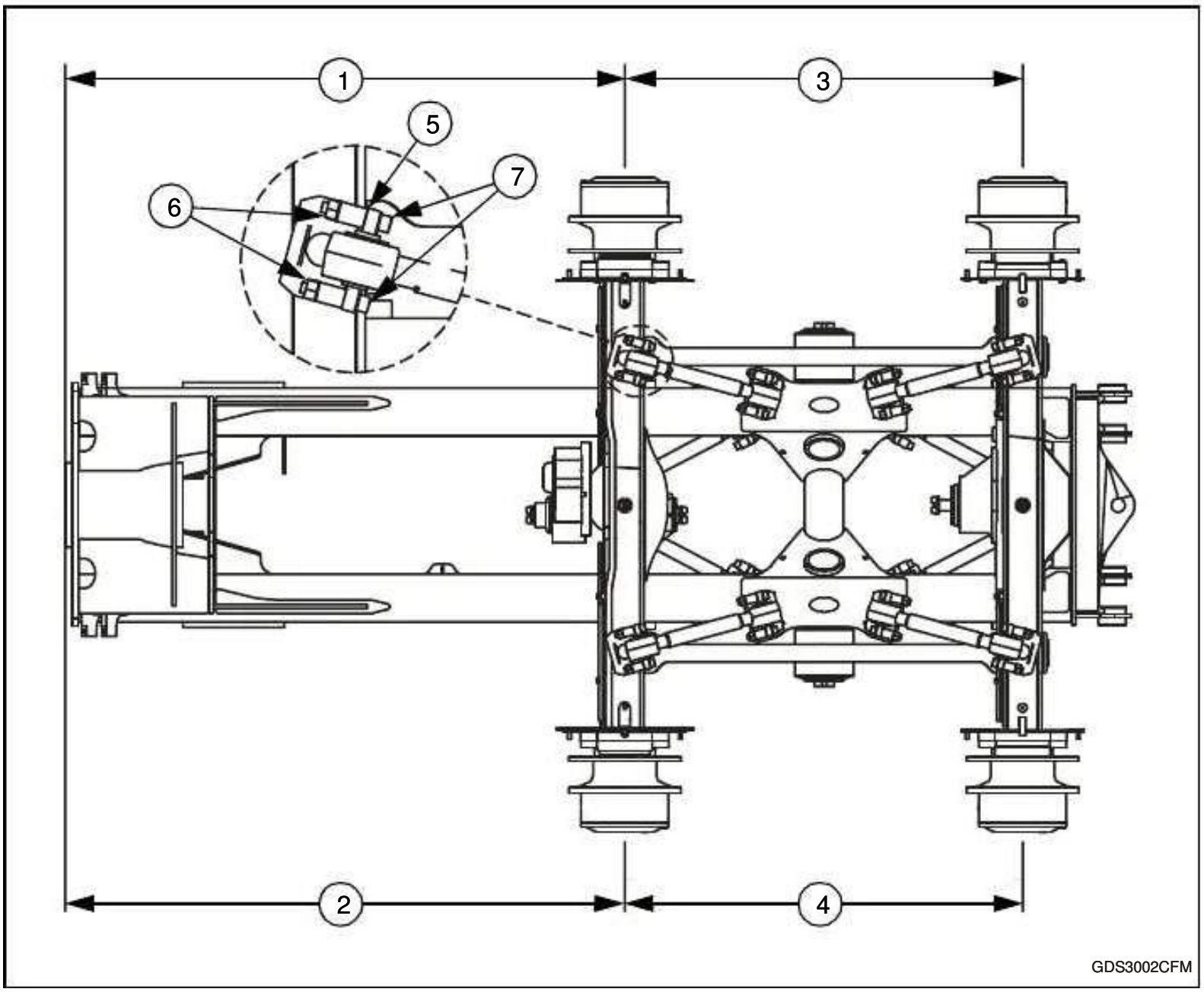
Install lower drag links and upper drag links. **(See "AXLE LINKS, STABILIZERS AND STRUTS" on page 41).**

Connect brake line(s).

Install drive shaft(s). **(See "DRIVE SHAFTS" on page 35).**

Install wheels. **(See "Install Wheel" on page 1).**

Bleed Service Brake Hydraulic System. **(See "Bleed Service Brake Hydraulic System" on page 293).**



1. Distance.
2. Distance.
3. Distance.
4. Distance.
5. Shim Location.
6. Nut.
7. Socket Head Cap Screw.

Middle and Rear Axle Alignment

Ensure machine is parked on a level concrete surface. Align middle axle.

Step 1

- Measure distance (1) and distance (2). If distance (1) equals distance (2) ± 2 mm, then middle axle is properly aligned. Continue with step 2.

If distance (1) does not equal distance (2), then middle axle must be aligned. Continue with **Step 2**.

Step 2

- On side of middle axle where distance is greater, remove socket head cap screws (7) and nuts (6) from axle side of lower drag link.

Step 3

- Install socket head cap screws and nuts. On outside socket head cap screw, install shim(s), as necessary, between drag link mount (5) and lower drag link.
- Repeat Steps 1 - 3, as necessary.

Align Rear Axle

Step 1

- Measure distance (3) and distance (4).
- If distance (3) equals distance (4) ± 2 mm, then rear axle is properly aligned.
- If distance (3) does not equal distance (4), then rear axle must be aligned.
- Continue with **Step 2.**

Step 2

- On side of rear axle where distance is greater, remove socket head cap screws and nuts from rear axle side of lower drag link.

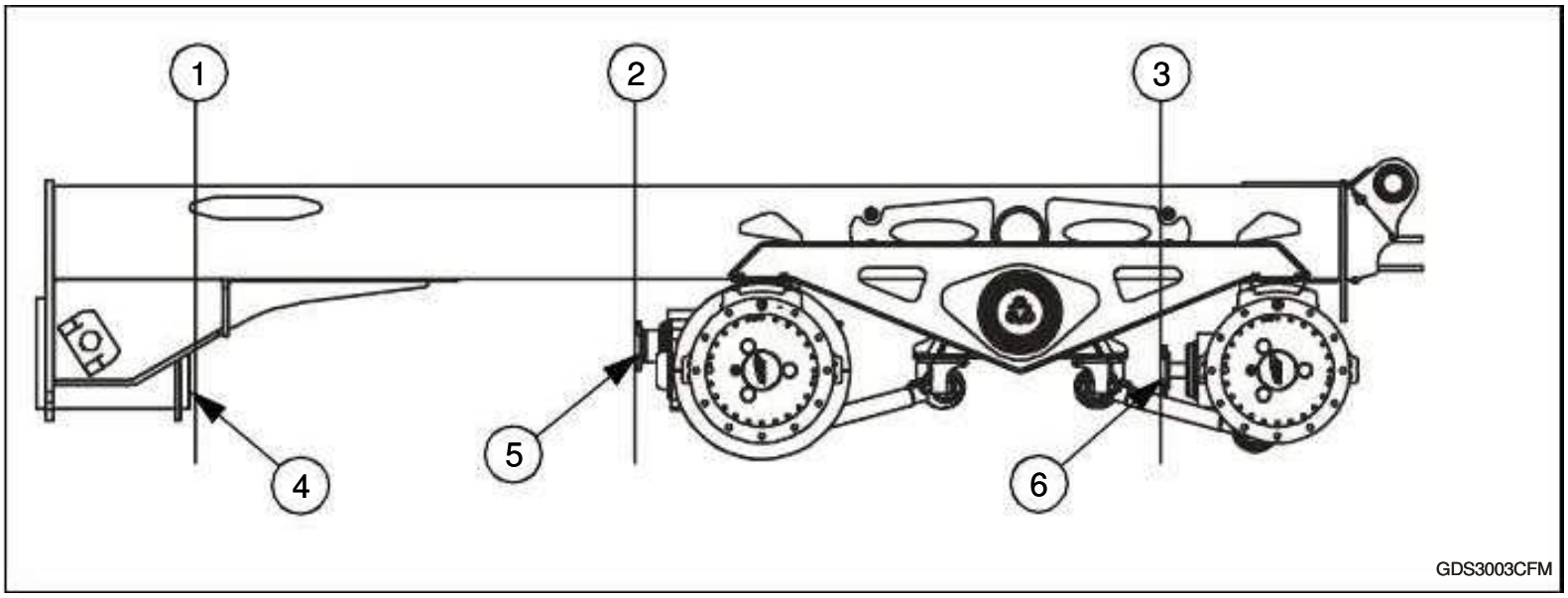
Step 3

- Install socket head cap screws and nuts. On outside socket head cap screw, install shim(s), as necessary, between drag link mount and lower drag link.

Step 4

- Repeat Steps 1 - 3, as necessary.

Adjust Axle Tilt, If Necessary.



1. Oscillation Tube Face Inclination.
2. Middle Axle Yoke Inclination.
3. Rear Axle Yoke Inclination.
4. Oscillation Tube Face.
5. Middle Axle Yoke.
6. Rear Axle Yoke.

NOTE: Prior to checking and adjusting middle and rear axle tilt, ensure that each walking beam is level and oscillation tube face is 90° to walking beams.

Attach inclinometer to oscillation tube face (4) or park brake disk. Determine inclination (1).

Check degree of incline (2) at middle axle yoke (5). Degree of inclination must be the same as oscillation tube ±1°.

If degree of inclination for middle axle is not within specification then:

- To tilt middle axle forward, add shims, as necessary, equally between lower drag link and axle mount, on both cap screws, for each lower drag link.
- To tilt middle axle rearward, add shims, as necessary, equally between lower drag link and frame mount, on both cap screws, for each lower drag link.

Check inclination (3) at rear axle yoke (5). Degree of inclination must be the same as oscillation tube ±1°.

If degree of inclination for rear axle is not within specification then:

- To tilt rear axle forward, add shims, as necessary, equally between lower drag link and frame mount, on both cap screws, for each lower drag link.
- To tilt middle axle rearward, add shims, as necessary, equally between lower drag link and axle mount, on both cap screws, for each lower drag link.

Ensure all lower drag link socket head cap screws are lubricated and tightened to specification.

Drag Link Cap Screw Specification

Link or Stabilizer Cap Screw and Nut Torque -620 Nm (457.289 lb-ft)

LEFT BLANK INTENTIONALLY

CHAPTER 2. AXLES AND SUSPENSION SYSTEMS

SECTION 2. DIFFERENTIAL OR BEVEL DRIVE

AXLE DIFFERENTIAL - FRONT AND REAR

Remove and Install

NOTE: Front axle shown. Procedure is same for rear axle.

Remove axle. **(See "AXLES" on page 3.)**

CAUTION

Component is heavy. Use lifting device.

Axles Specification

Front Axle Weight- 1111 kg (2450 lb) approximate

Rear Axle - B25D - Weight -907 kg (2000 lb) approximate

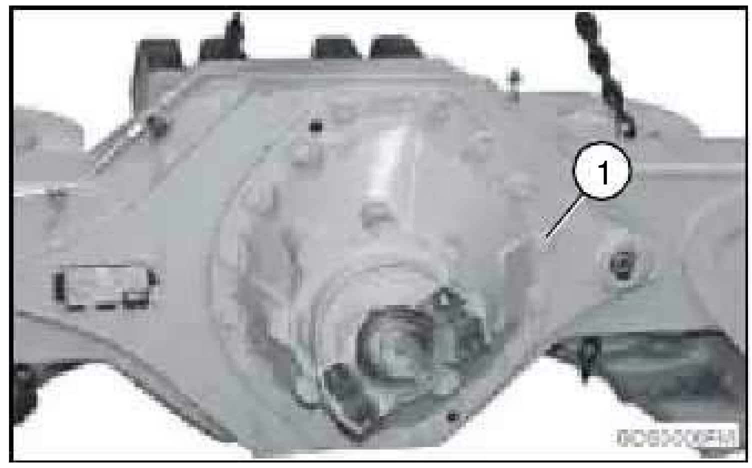
Rear Axle - B30D - Weight -1043 kg (2300 lb) approximate

Put axle on work table.

Drain axle housing. **(See Change Axle Oil in Operator's Manual, CHAPTER 15, SECTION 2).**

Drain planetaries. **(See Change Final Drive Oil in Operator's Manual, CHAPTER 15, SECTION 2.)**

Remove axle shafts. **(See Remove and Install Axle Shaft CHAPTER 2, SECTION 5).**



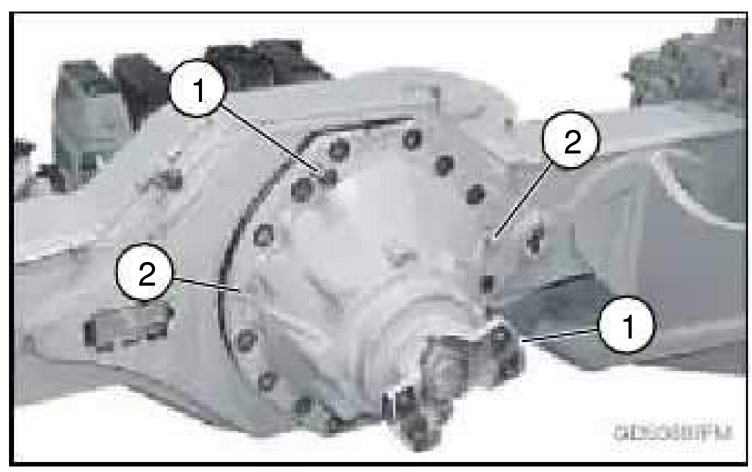
Remove bolts (1).

CAUTION

Component is heavy. Use lifting device.

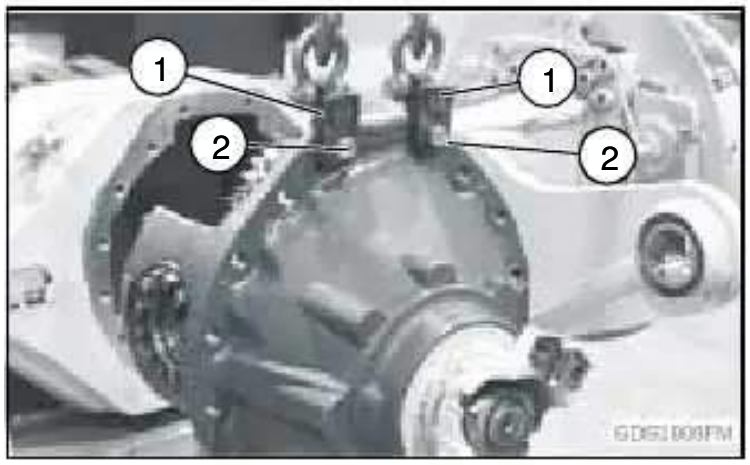
Axle Differential Specification

Front or Rear Axle Differential Weight -96 kg (212 lb) approximate

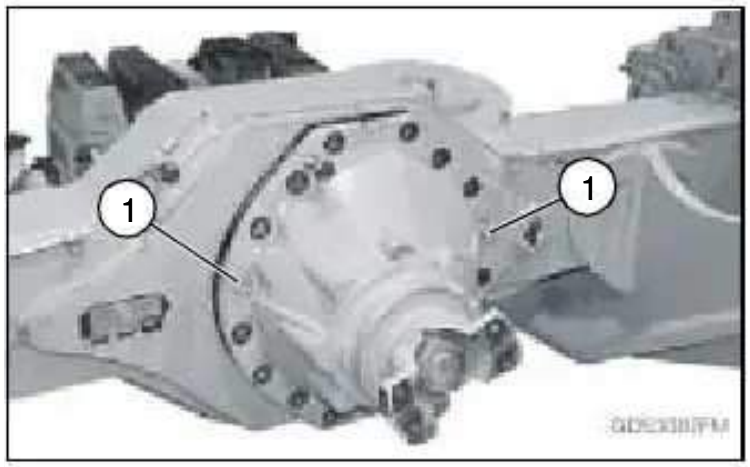


Install bolts (2) to guide and position differential during removal.

Install bolts (1) in threaded holes and tighten evenly to separate differential from axle housing.



Attach JT01748 Lifting Brackets (1) with bolts and nuts (2) to differential and support with hoist.



Remove cap screws (1).

Remove differential from housing.

Clean and inspect axle housing for wear or damage.

Repair or replace differential.

Apply cure primer and flexible form-in-place gasket to differential housing.

Install differential in housing.

Install cap screws as guide. Remove lifting brackets.

Apply cure primer and thread lock and sealer (medium strength) to differential cap screws. Install and tighten cap screws.

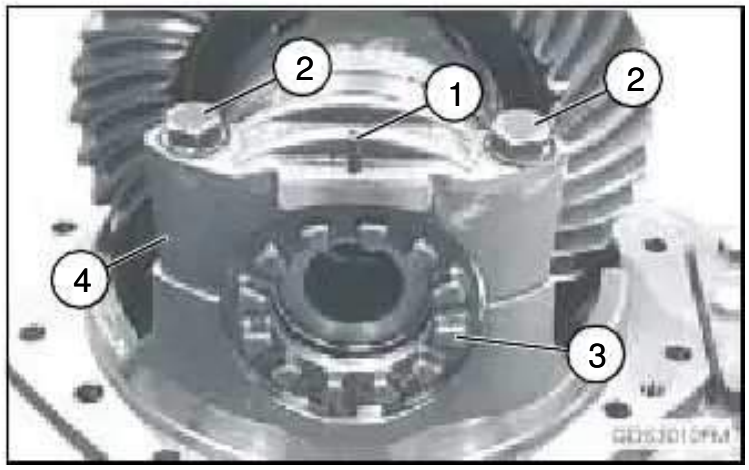
Install axle shafts. **(See Remove and Install Axle Shaft CHAPTER 2, SECTION 5).**

Fill axle housing. **(See Change Axle Oil in Operator's Manual, CHAPTER 15, SECTION 2).**

Fill planetaries. **(See Change Final Drive Oil in Operator's Manual, CHAPTER 15, SECTION 2).**

Disassemble Differential

Attach D01006AA Bench Mount Fixture (1) to housing and lock in bench mount.

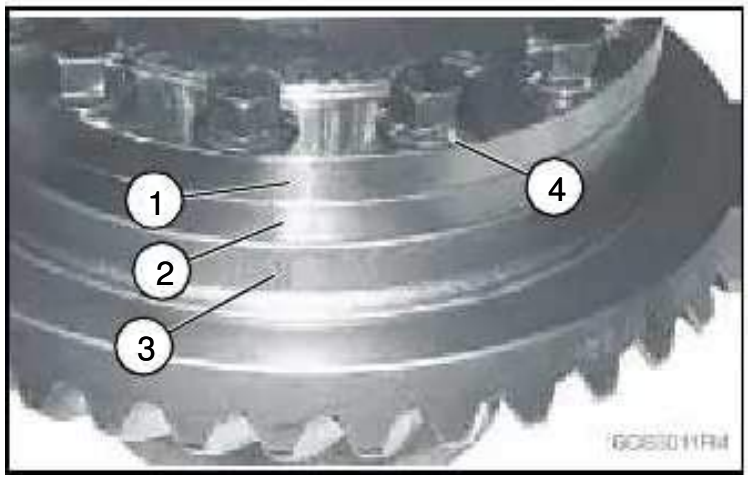


Mark locations of bearing caps (4).

Loosen cap screws (2), remove lock pin (1), and loosen adjuster nuts (3) with JDG1278 Axle Spanner Nut Wrench.

Remove bolts and washers, adjuster nuts, and bearing caps.

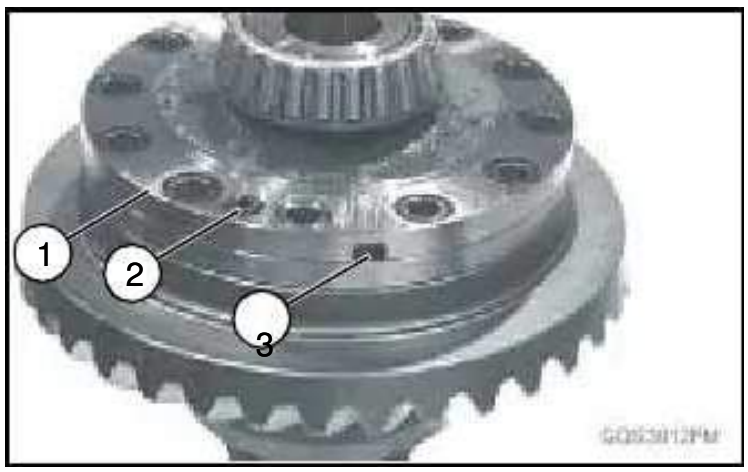
Remove carrier with lifting strap.



Mark carrier case (2), carrier cover (1), and ring gear (3).

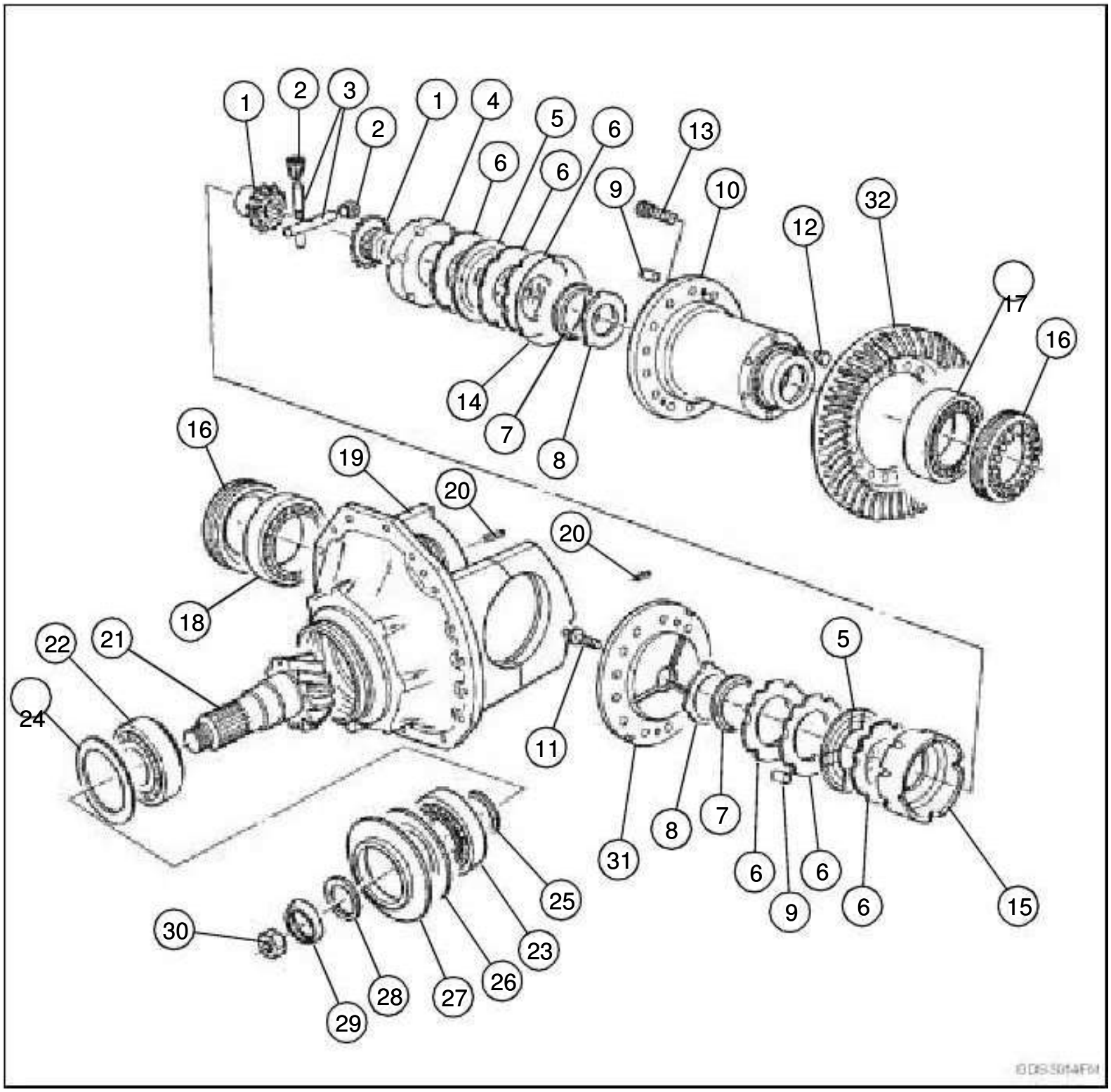
Remove cap screws (4) and ring gear.

Remove dowel pins (1).



Remove socket head cap screws (2).

Remove carrier cover (1) at cover indents (3) with pry bar.

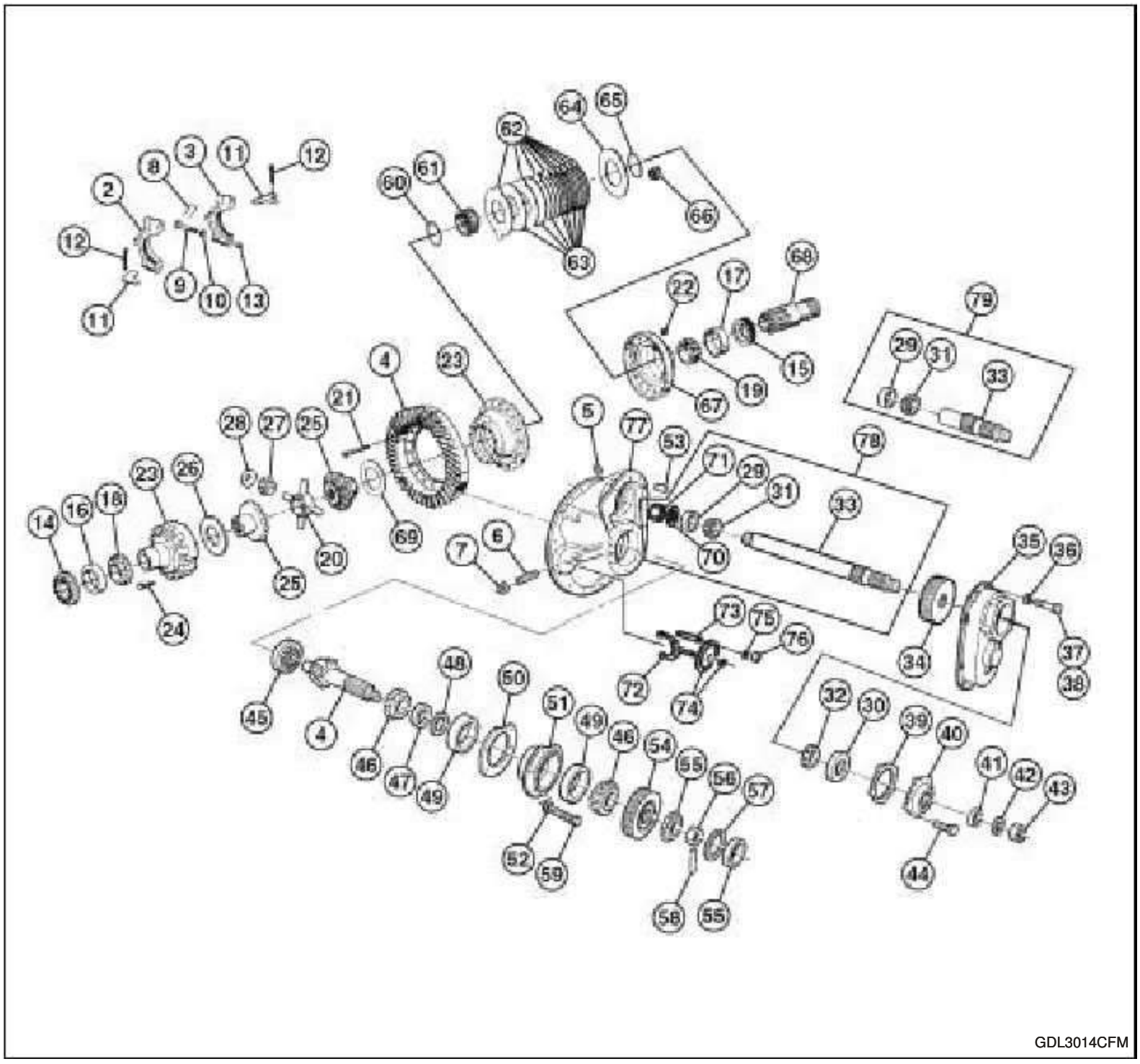


1. Axle Bevel Gear (2 used).
2. Bevel Gear (4 used).
3. Pinion Cross Shaft (2 used).
4. Ring Housing.
5. Clutch Disk (6 used).
6. Clutch Disk with Inner Spline (2 used).
7. Thrust Washer (2 used).
8. Thrust Washer (2 used).
9. Dowel Pin (12 used).
10. Housing.
11. Cap Screw (12 used).
12. Sealing Cap (6 Used).
13. Cap Screw (2 used).
14. Lock Ring.
15. Housing.
16. Adjusting Nut (2 used).
17. Roller Bearing and Cup.
18. Roller Bearing and Cup.
19. Housing.
20. Spring Pin.
21. Pinion Shaft.
22. Roller Bearing and Cup.
23. Roller Bearing and Cup.
24. Selective Shim.
25. Selective Spacer.
26. Seal.
27. Dust Shield.
28. Bushing.
29. Washer.
30. Pinion Nut.
31. Carrier Cover.
32. Ring Gear.

Disassemble

Install differential in a repair stand like D01003AA Repair Stand. Differential must be able to rotate 360 degrees.

Check gear tooth contact pattern. If the wear pattern runs off the teeth and/or heavy wear is evident, the gear set must be replaced.


GDL3014CFM

Remove thrust washers (7 and 8) and clutch disks (5 and 6).

Remove housing (15).

Remove bevel gears (1 and 2) and pinion cross shafts (3), remove bevel gear (1) and ring housing (4).

Remove clutch disks (5 and 6) and thrust washers (7 and 8).

Remove dowel pins (9) and lock ring (14).

Remove roller bearings and cups (17 and 18) with knife-edge bearing puller.

Remove pinion nut (30) and ring gear (32) and pinion shaft (21) with JDG1348 Axle Pinion Input Socket.

Remove washer (29), and bushing (28), dust shield (27), seal (26), and roller bearing (23).

Remove bearing (22) with knife-edge bearing puller and bearing cups (22 and 23) and shim (24).

Inspect and clean all parts.

Assemble Differential

⚠ CAUTION

1. If housing, pinion shaft, roller bearing, ring gear or shim is replaced, the following measuring operations must be done.
2. Failure to make precise measurements and correct shim section will cause pinion and ring gear to wear prematurely.

NOTE: If ring gear and pinion are replaced ensure they have the same match number.

Using Cone Point Centering Disks (2) and JDG74-1 Cone Point Centering Shaft (1).

Measure pinion bearing cup height with caliper.

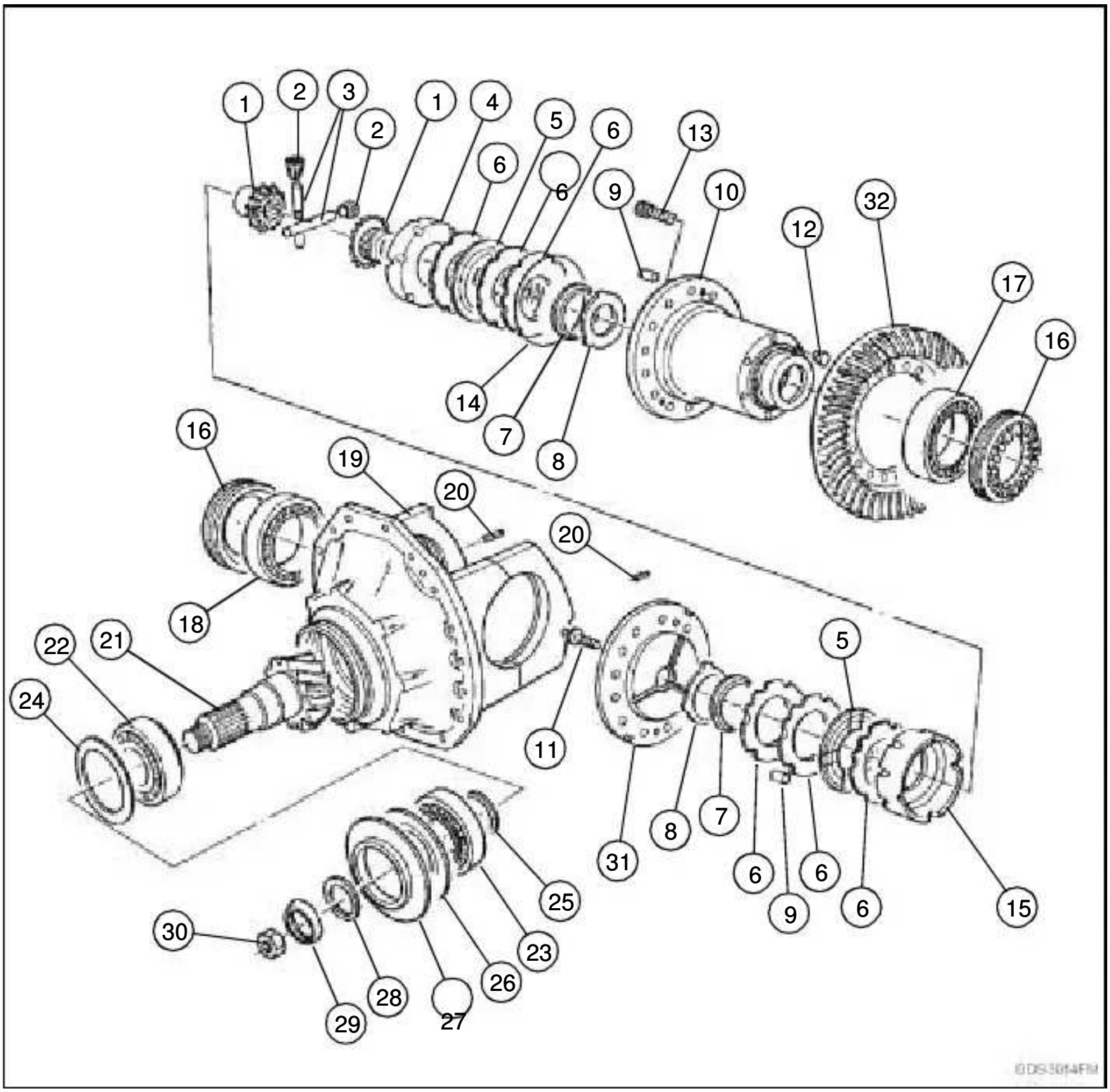
- For B25D, use JDG1350 Cone Point Centering Disks.
- For B30D, use JDG1605-2 and JDG1605-3 Cone Point Centering Disks.

Example of Pinion Bearing Cup Height	
Distance from top of shaft to bearing cup surface	204.60 mm (8.055 in.)
Subtract half of shaft diameter	-15.00 mm (0.590 in.)
Bearing Cup Height Measurement	189.60 mm (7.465 in.)

Measure pinion bearing thickness with depth micrometer.

Example of Piston Bearing Thickness Measurement	
Measurement of bearing and cup thickness	37.10 mm (1.461 in.)
Add pinion bearing height (etched on pinion)	+151.7 mm (5.972 in.)
Pinion Bearing Thickness Measurement	188.8 mm (7.433 in)

Subtract bearing cup height measurement from pinion bearing thickness measurement. Difference will be thickness of bearing shim required. If thickness is between shim sizes use greater size shim.



Install shim (24) and roller bearing cups (22 and 23) in housing (18).

Heat roller bearing (22) to 110°C (230°F) and install on pinion shaft (21), tight against shoulder.

To measure pinion bearing preload: Extend pins of JDG1281 Calibration Ring to outermost position. Install JDG1281 Calibration Ring on pinion shaft with pins pointing away from gear in place of spacer (25).

Install pinion shaft (21) in differential housing and block in place.

Heat roller bearing (23) to 110°C (230°F) and install on shaft.

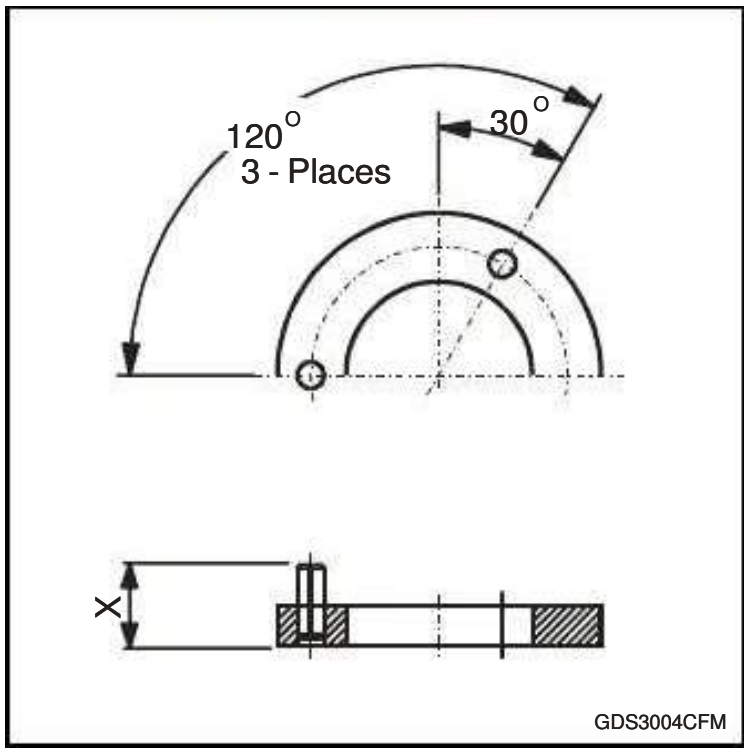
Install bushing (28), washer (29), and pinion nut (30) using JDG1348 Axle Pinion Nut Socket.

Tighten nut and measure rolling drag torque.

Specification

Pinion Bearing Rolling Drag Torque -2 - 3 Nm (17 - 26 lb-in.)

Carefully remove pinion shaft and calibration ring.



Measure calibration ring JDG1281 at all three pins and calculate an average dimension.

Install spacer (25) of this thickness on pinion shaft and install pinion shaft in housing.

Heat outer bearing and install on pinion shaft.

Apply cure primer and flexible form-in-place gasket to outside diameter of seal (26) and lube seal inner lip.

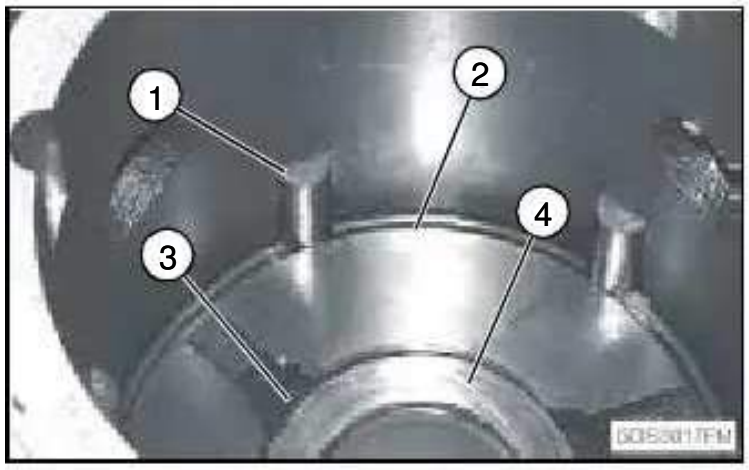
Install seal.

Install dust shield (27), bushing (28), washer (29), and nut (30) and tighten to specification.

Specification

Pinion Nut Torque- - - - - - - - - - - - - 750 Nm (553 lb-ft)

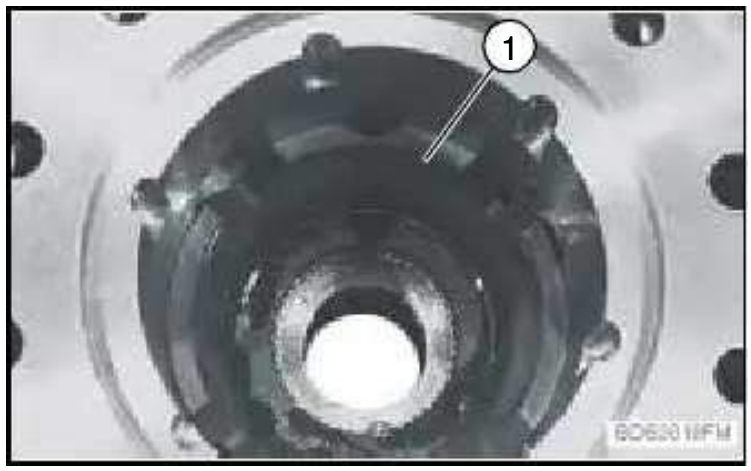
Heat roller bearings (17 and 18) to 110°C (230°F) and install bearings on housing (10) and carrier cover (31).



Install thrust washers (3 and 4) in housing.

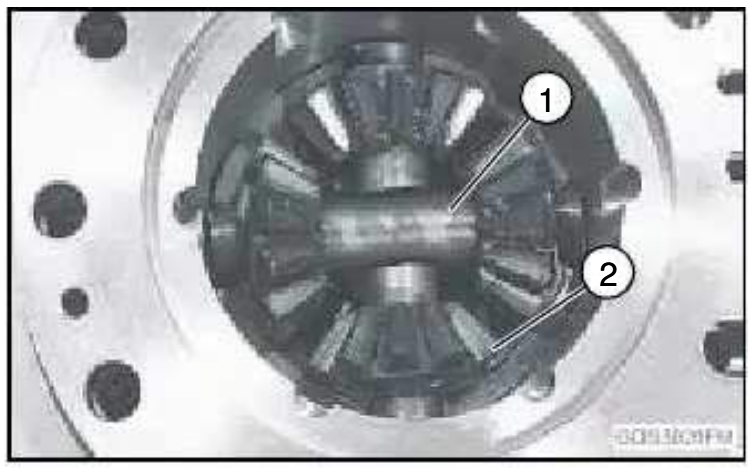
Install lock ring (2) and dowel pins (1).

Lubricate and install disks in the following order: notched disk, notched disk, splined disk and notched disk.

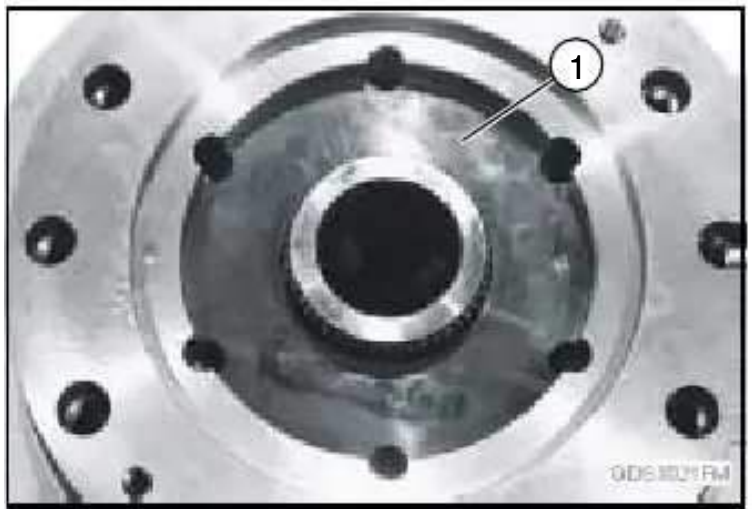


Install bevel gear housing (1) onto dowel pins.

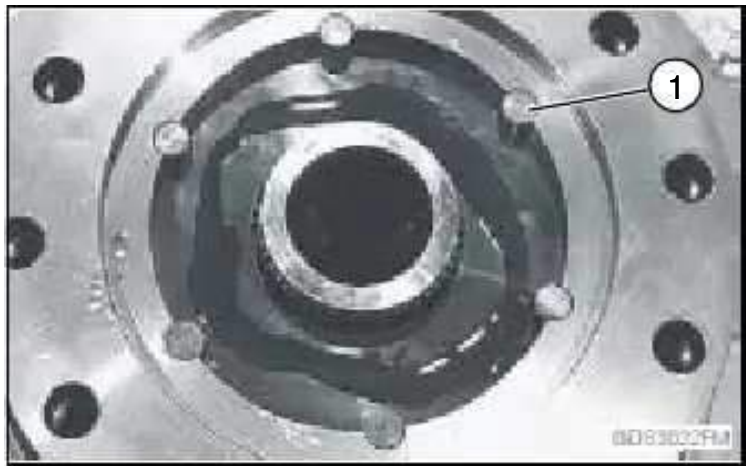
Install axle bevel gear (1). Ensure axle bevel gear engages both splined disks and contacts thrust washer.



Lubricate and install bevel gears (2) and pinion cross shafts (1) as an assembly.

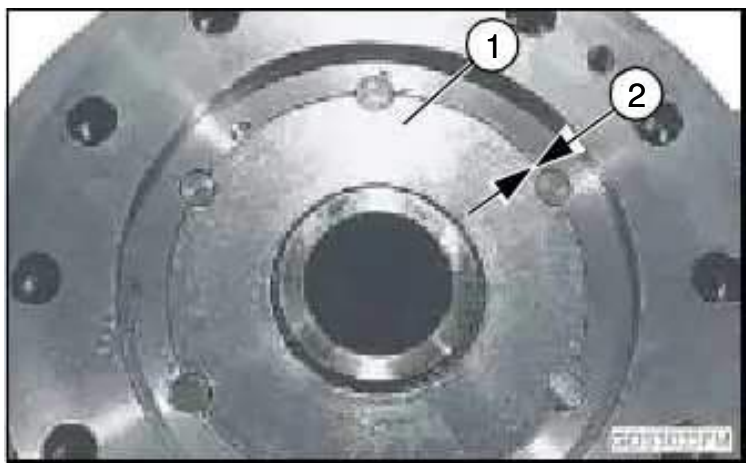


Install bevel gear housing (1) over cross shafts and align with case dowel pin slots.



Install dowel pins (1).

Lubricate and install disks in the following order: notched disk, splined disk, notched disk and notched disk.



NOTE: Limited slip disk height can be adjusted by installing splined disks of various thickness.

Measure the installed disk height at location (2).

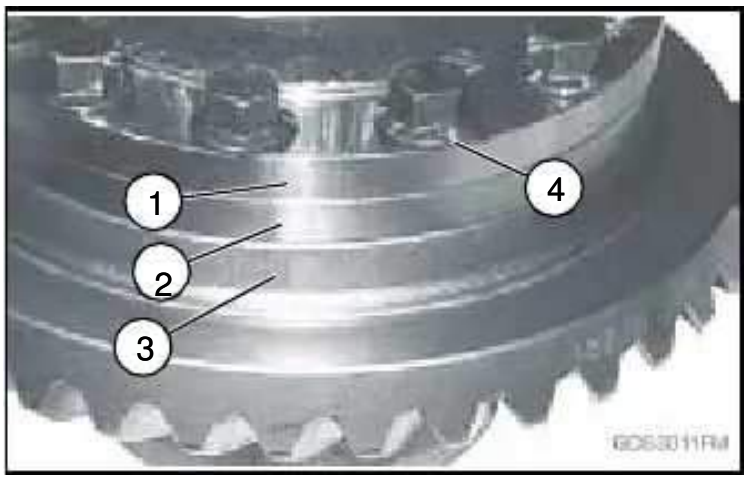
Specification

Limited Slip Disk-to-Case Distance -0.2 - 0.6 mm (0.008 - 0.024 in.)

Apply multi-purpose grease to thrust washers (1 and 2) and install in cover.

Apply cure primer and thread lock and sealer (medium strength) to cap screw (1).

Install cover and cap screws and tighten.



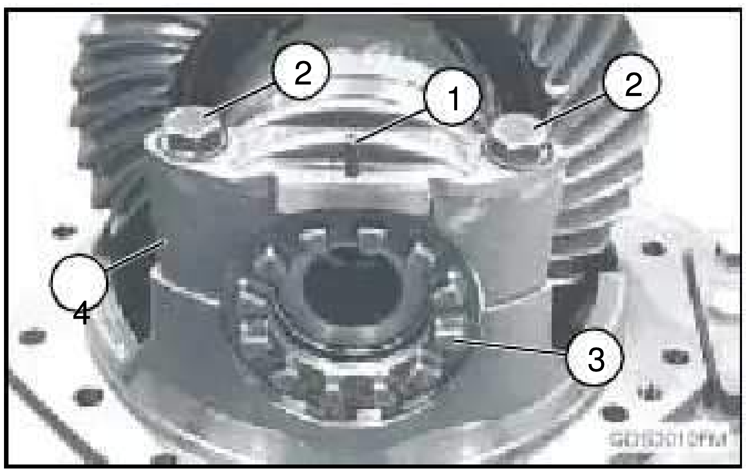
Align location marks of carrier cover (1), carrier case (2), and ring gear (3). Apply cure primer and thread lock and sealer (medium strength) to cap screws (4). Install and tighten cap screws to specification.

Specification

Ring Gear Cap Screw Torque- - - - - 400 Nm (295 lb-ft)

Lubricate bearings with multi-purpose grease and install bearing cups.

Install differential carrier in housing aligning marks.



Apply cure primer and thread lock and sealer (medium strength) to cap screws (2).

Install bearing caps (4), adjusting nut (3), and cap screws and washers. **DO NOT** tighten cap screws at this time.

⚠ CAUTION

If adjusting nuts do not turn freely, bearing caps may not be aligned properly.

NOTE:There must always be some backlash while making preload adjustment.

Use JDG1278 Axle Spanner Nut Wrench to adjust bearing preload by evenly turning both adjusting nuts clockwise until end play of carrier is zero. Make sure ring gear and pinion have some backlash.

Specification

Differential Carrier End Play - - - - - - - - - - - - - - - Zero

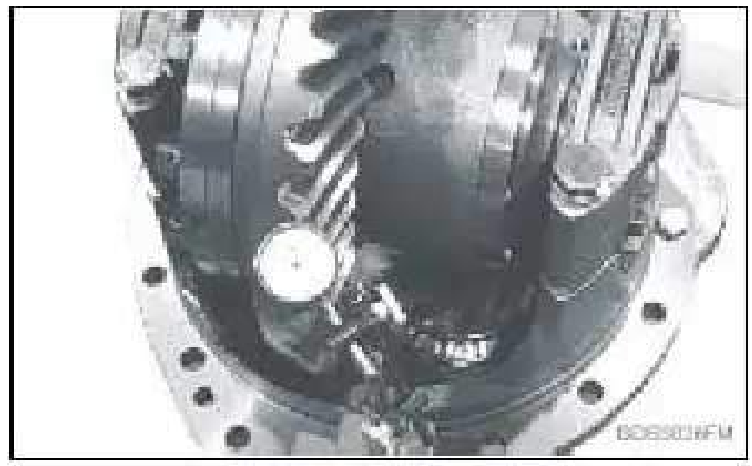
Tighten cap screws (2) to specification.

Specification

Carrier Bearing Cap Screw Torque - 278 Nm (205 lb-ft)

⚠ CAUTION

When adjusting backlash, one adjusting nut MUST be tightened the same amount the other is loosened to keep the correct bearing preload.



Measure backlash with dial indicator and adjust to specification. Measure at three locations on ring gear.

To increase backlash, loosen adjusting nut on ring gear side and tighten nut on opposite side an equal amount.

To decrease backlash, loosen adjusting nut opposite ring gear side and tighten nut on ring gear side an equal amount.

Specification

Ring Gear and Pinion Backlash -0.25 - 0.33 mm (0.010 - 0.013 in.)

⚠ CAUTION

Gear contact pattern MUST be checked on the coast side and drive side with a load applied. The pattern may be correct on the drive and incorrect on coast side causing the differential to make noise when under load.

Check Gear Tooth Contact Pattern. **(See "Check Gear Tooth Contact Pattern" on page 33)**

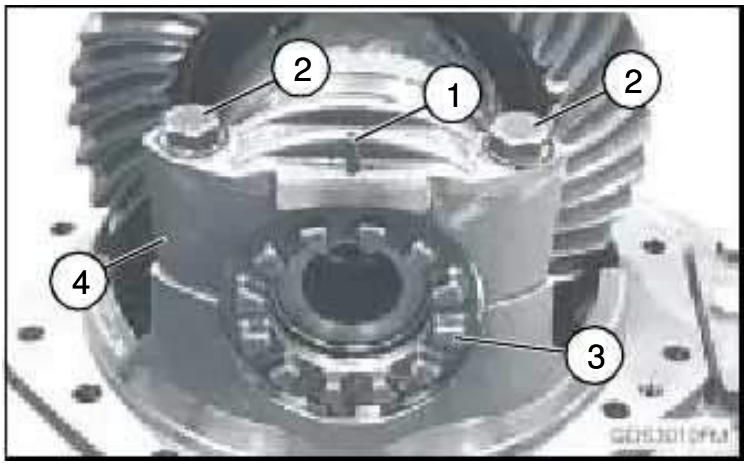
With backlash set, check carrier end play and pinion rolling drag torque.

Specification

Carrier Bearing End Play - - - - - - - - - - - - - - - - - Zero

Specification

Pinion and Ring Gear Rolling Drag Torque- 3 - 4 Nm (26 - 35 lb-in.)



Drive lock pin (1) down to secure adjusting nut.

AXLE DIFFERENTIAL - MIDDLE AXLE

Remove and Install Differential - Middle Axle

⚠ CAUTION

The approximate weight of middle axle is 930 kg (2050 lb). As axle components are removed, axle may become unstable on work surface. Be sure axle is supported properly.

Specification

Middle Axle Weight - - - - - - - - - - - - - - 930 kg (2050 lb)

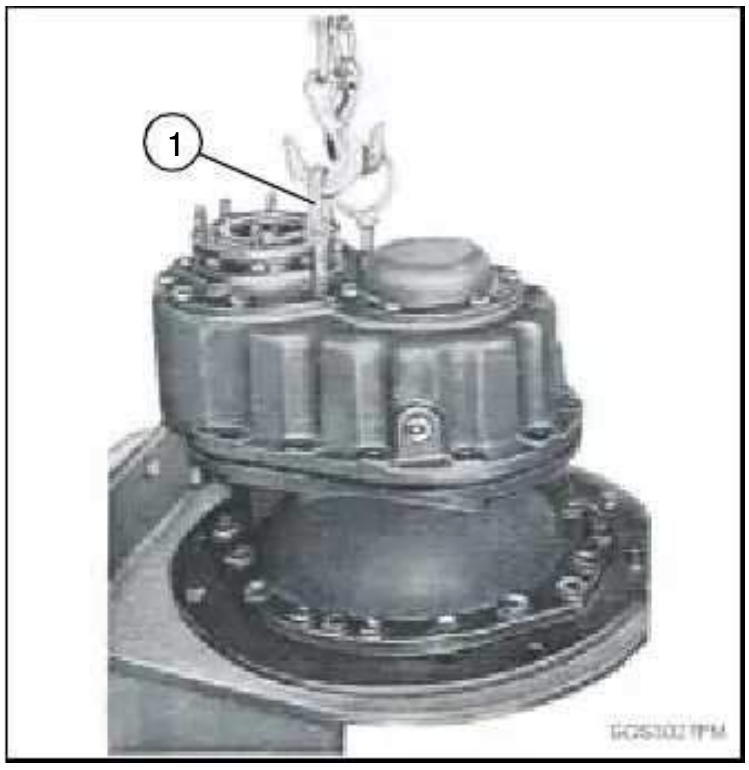
Remove middle axle. **(See "AXLES" on page 3).**

Put axle on work table.

Remove axle shafts. **(See Remove and Install Axle Shaft CHAPTER 2, SECTION 5).**

Drain axle housing. **(See Change Axle Oil In Operator's Manual, CHAPTER 15, SECTION 2).**

Drain planetaries. **(See Change Final Drive Oil In Operator's Manual CHAPTER 15, SECTION 2).**



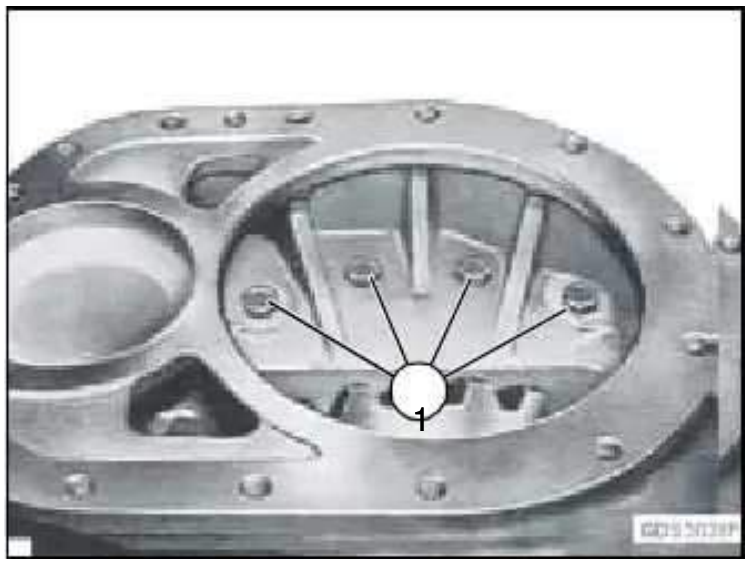
Install JT05550 M12 x 1.75 mm Lifting Eyebolts (1) in adapter case.

Attach chains and hoist.

Remove spring pin.

Remove sixteen cap screws.

Remove adapter case from differential housing.



Remove cap screws (1) from inside of differential housing.

Remove twelve remaining cap screws from differential.

Install JT1748 Lifting Brackets in adapter case cap screw holes and attach chains and hoist.

Install two cap screws in threaded holes and tighten evenly to separate differential from axle housing. Remove differential.

Clean mating surfaces.

Apply cure primer and flexible form-in-place gasket to mating surfaces.

Install differential on axle housing.

Apply cure primer and thread lock and sealer (medium strength) to differential cap screws.

Install and tighten differential cap screws.

Install adapter case to differential.

Install spring pin.

Apply cure primer and thread lock and sealer (medium strength) to adapter case cap screws.

Install and tighten adapter case cap screws.

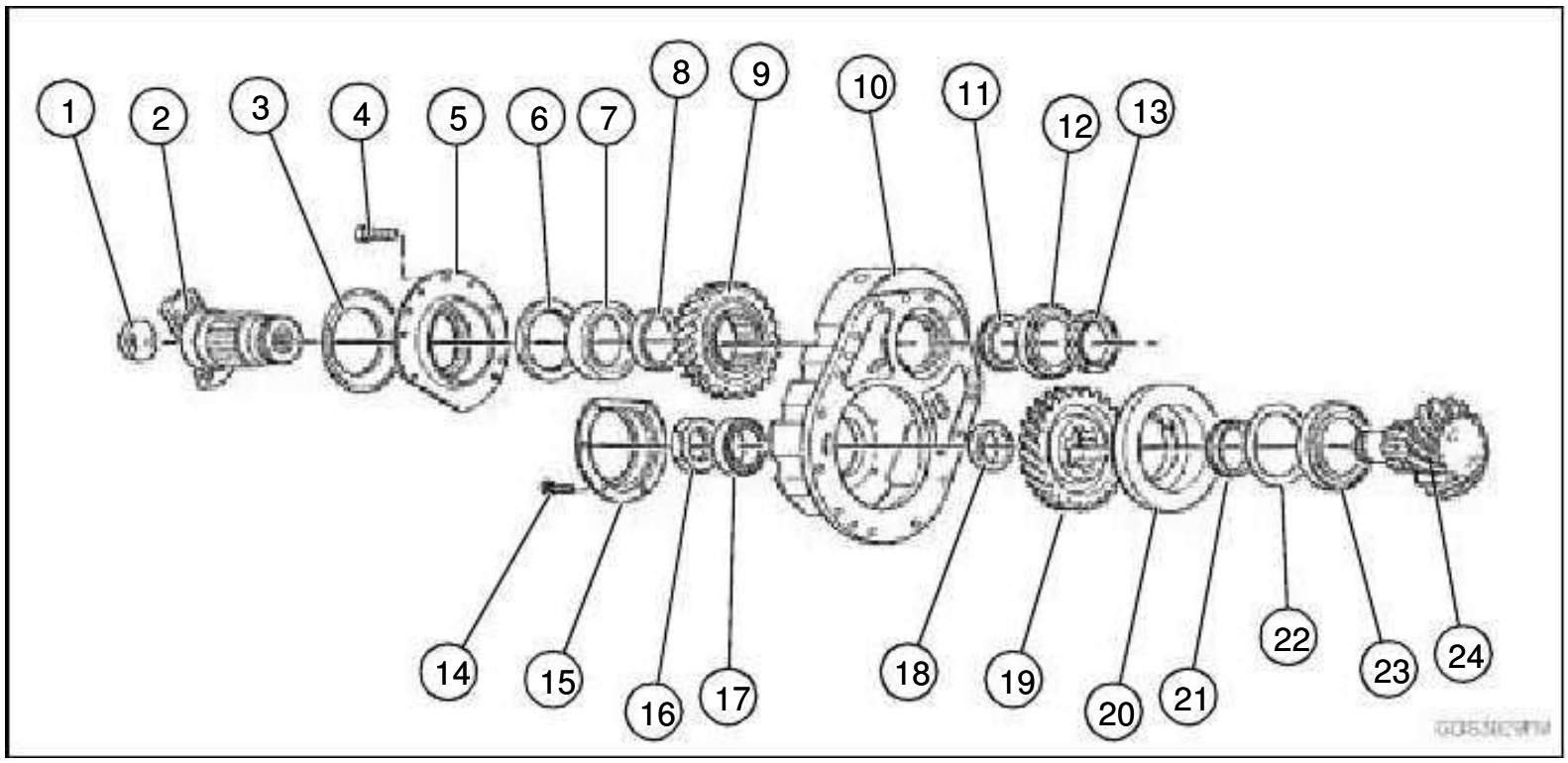
Install axle shafts. **(See Remove and Install Axle Shaft CHAPTER 2, SECTION 5.)**

Install middle axle. **(See "AXLES" on page 3)**

Fill axle with oil. **(See Change Axle Oil In Operator's Manual, CHAPTER 15, SECTION 2).**

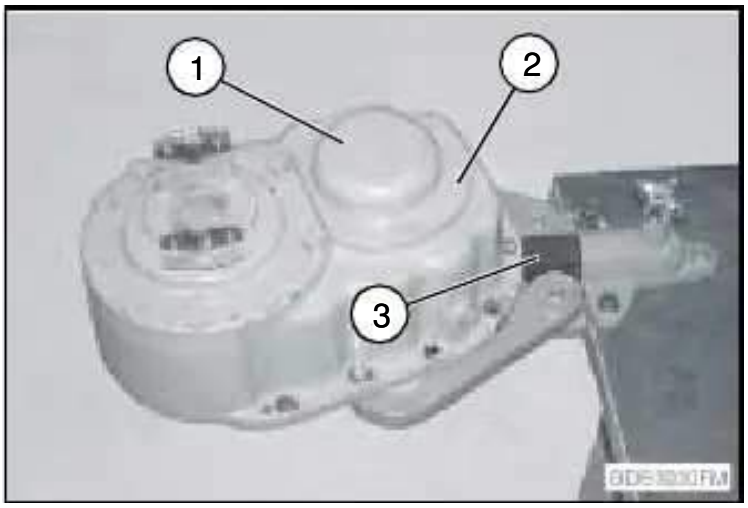
Fill planetaries. **(See Change Final Drive Oil Operator's Manual, CHAPTER 15, SECTION 2).**

Disassemble



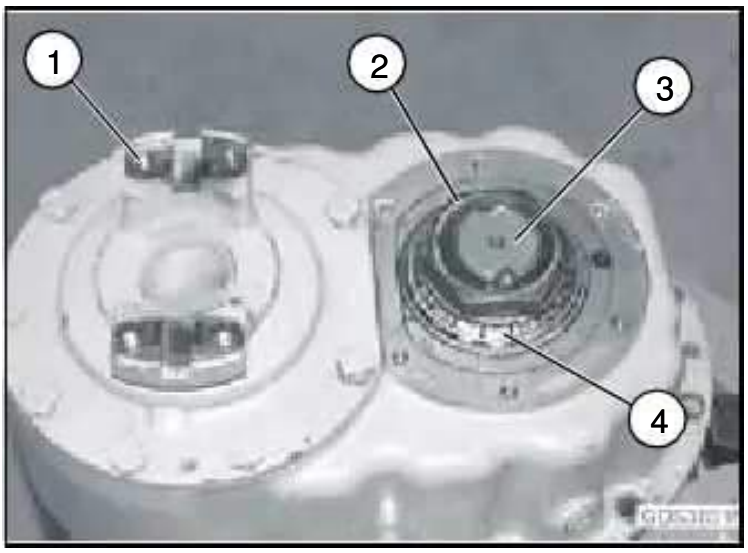
1. Cap.
2. Input Drive Shaft.
3. Cover.
4. Cap Screw (9 used).
5. Bearing Housing.
6. Seal.
7. Bearing.
8. Shim.
9. Spur Gear.
10. Adapter Case.
11. Shim.
12. Bearing.
13. Spanner Nut.
14. Cap Screw (6 used).
15. Cover.
16. Nut.
17. Bearing.
18. Shim.
19. Spur Gear.
20. Bearing Retainer.
21. Shim.
22. Shim.
23. Bearing.
24. Pinion Shaft.

Remove middle differential from axle housing. **(See “Remove and Install Differential - Middle Axle” on page 20).**



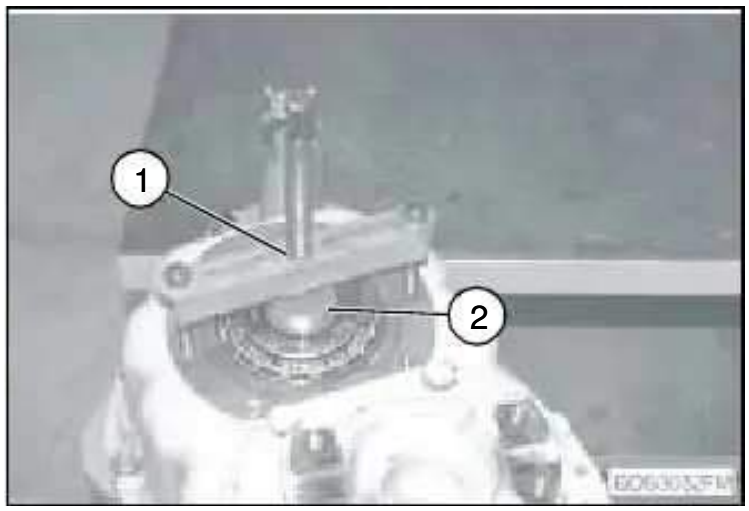
Install D01006AA Bench Mount Fixture (3) to adapter case and lock in bench mount.

Remove cap screws (2) and cover (1).



Using a punch and hammer, free stakes from pinion shaft nut (2).

Hold yoke (1) and remove pinion shaft nut (2).

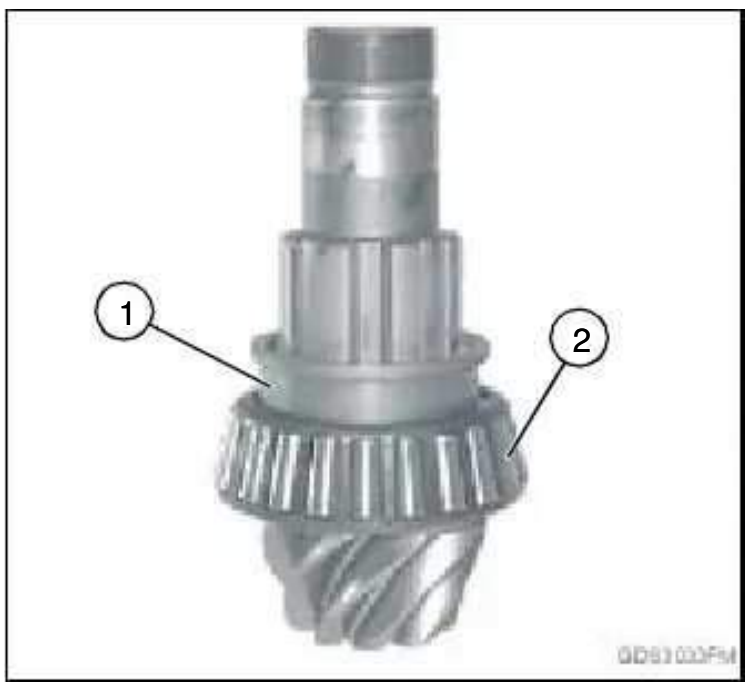


⚠ CAUTION

Support pinion shaft. Pinion shaft will fall when removed from bearing.

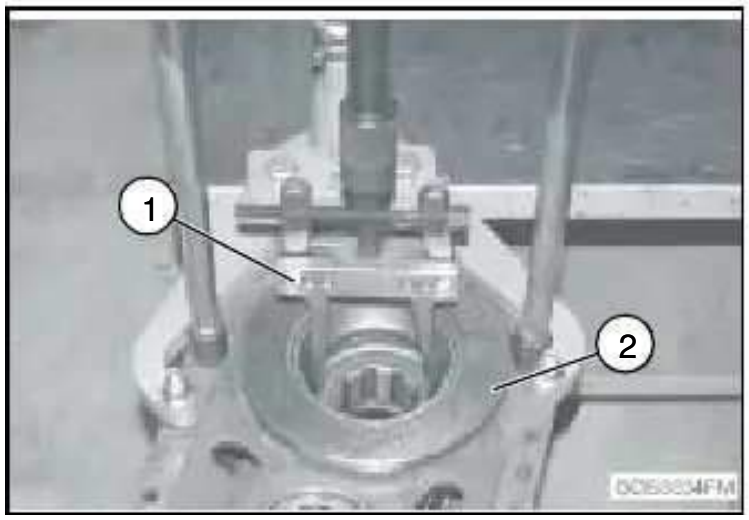
Press pinion shaft (2) from bearing using D01200AA 10-Ton Push-Puller.

Remove bearing cone.



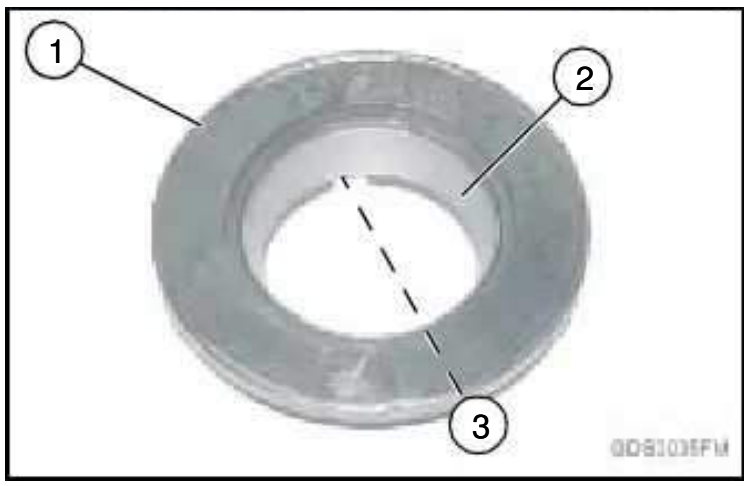
Remove shim (1).

Remove bearing cone (2) from pinion shaft using a press and a knife-edge bearing puller.



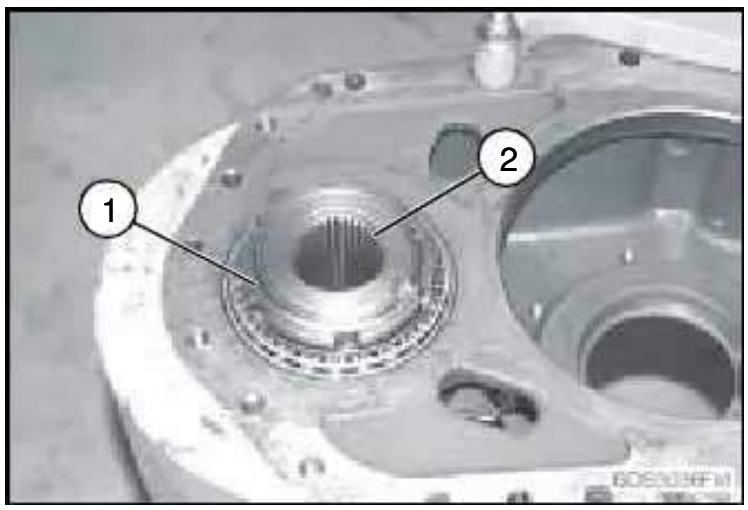
Remove bearing retainer (2) with D01215AA Internal Puller (1) and D01048AA 17-1/2 Ton Puller Set.

Remove spur gear.



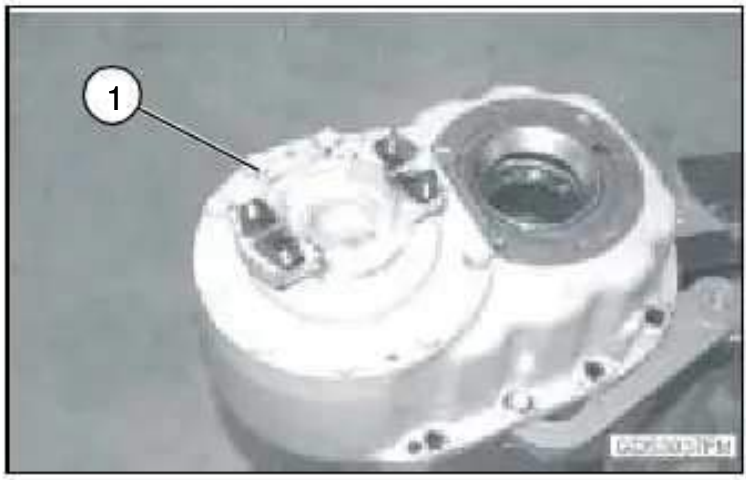
Remove bearing cup (2) and shim (3) from bearing retainer (1).

Clean and inspect all parts for wear or damage.

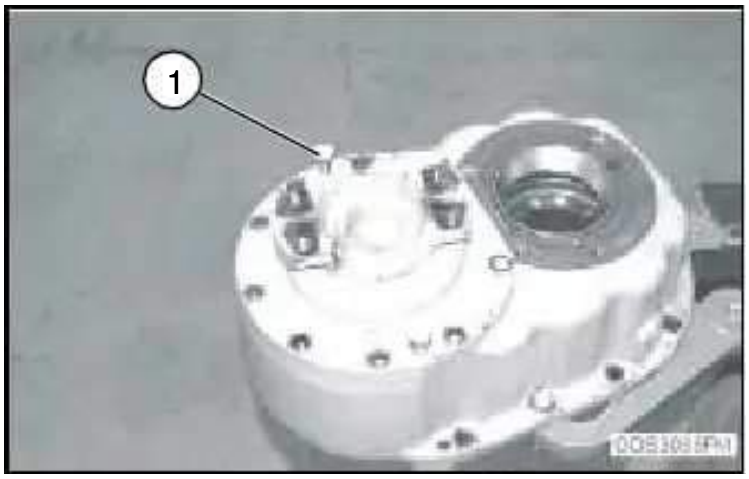


Using a punch and hammer, free stake from spanner nut (1).

Hold yoke on drive shaft (2) and remove spanner nut with JDG1359 Spanner Nut Socket.



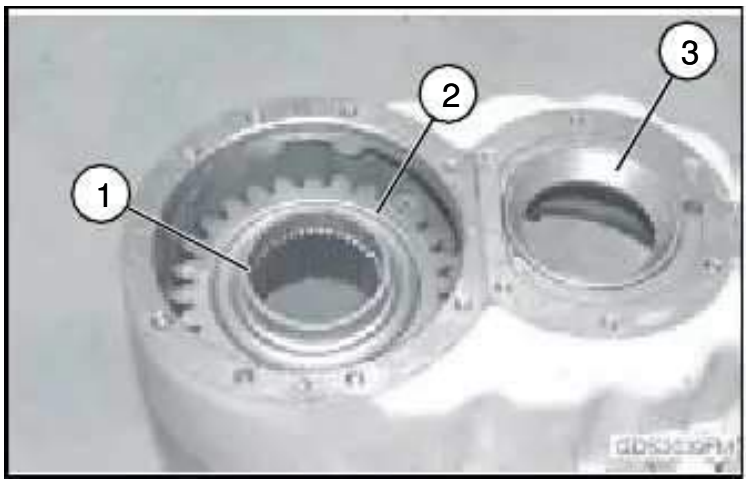
Remove cap screws (1) from bearing housing.



Install jack screws (1) in threaded holes.

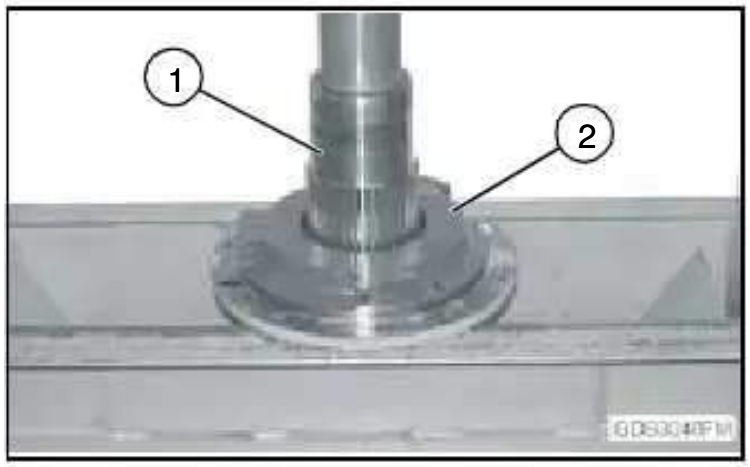
NOTE: Support bearing on bottom of case. Bearing will fall to floor as bearing housing is separated from case.

Evenly tighten jack screws to separate bearing housing from case.

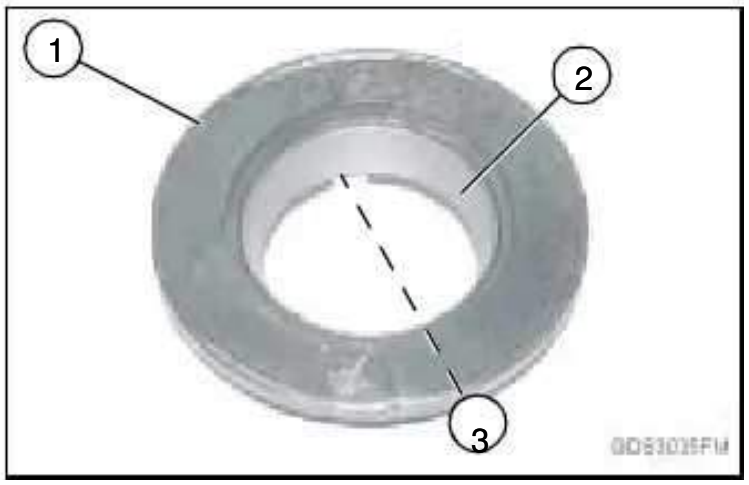


Remove shim (1) and spur gear (2) from housing.

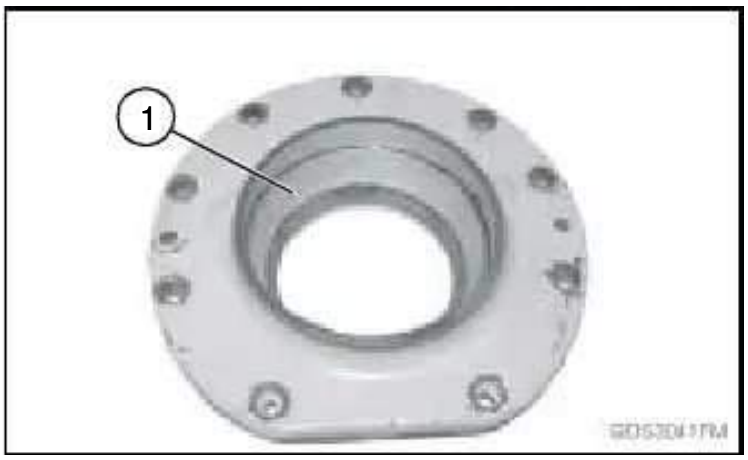
Remove bearing cup (3).



Press drive shaft (1), bearing cone and seal from bearing housing (2).

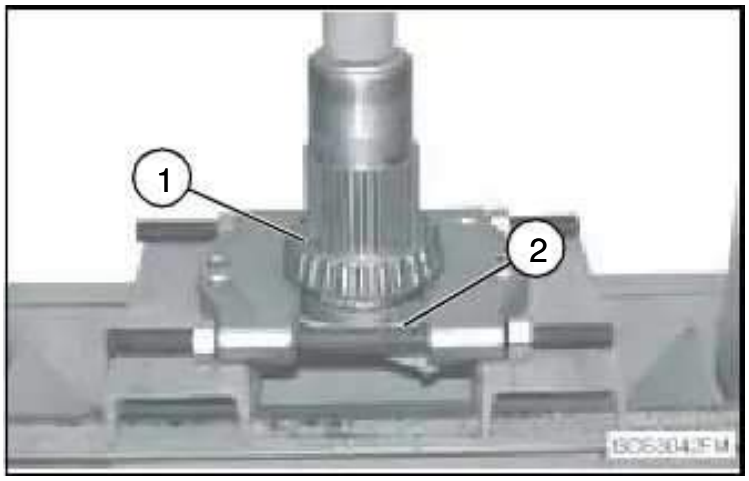


Remove bearing cup (1) and shim (2) from bearing retainer (3).



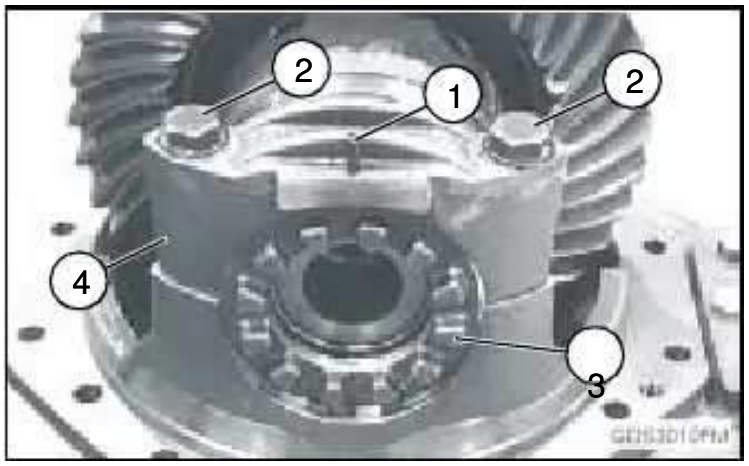
Remove bearing cup (1).

Attach D01006AA Bench Mount Fixture (1) to differential and lock in bench mount.



Remove bearing cone (1) using a press and a knife-edge bearing puller.

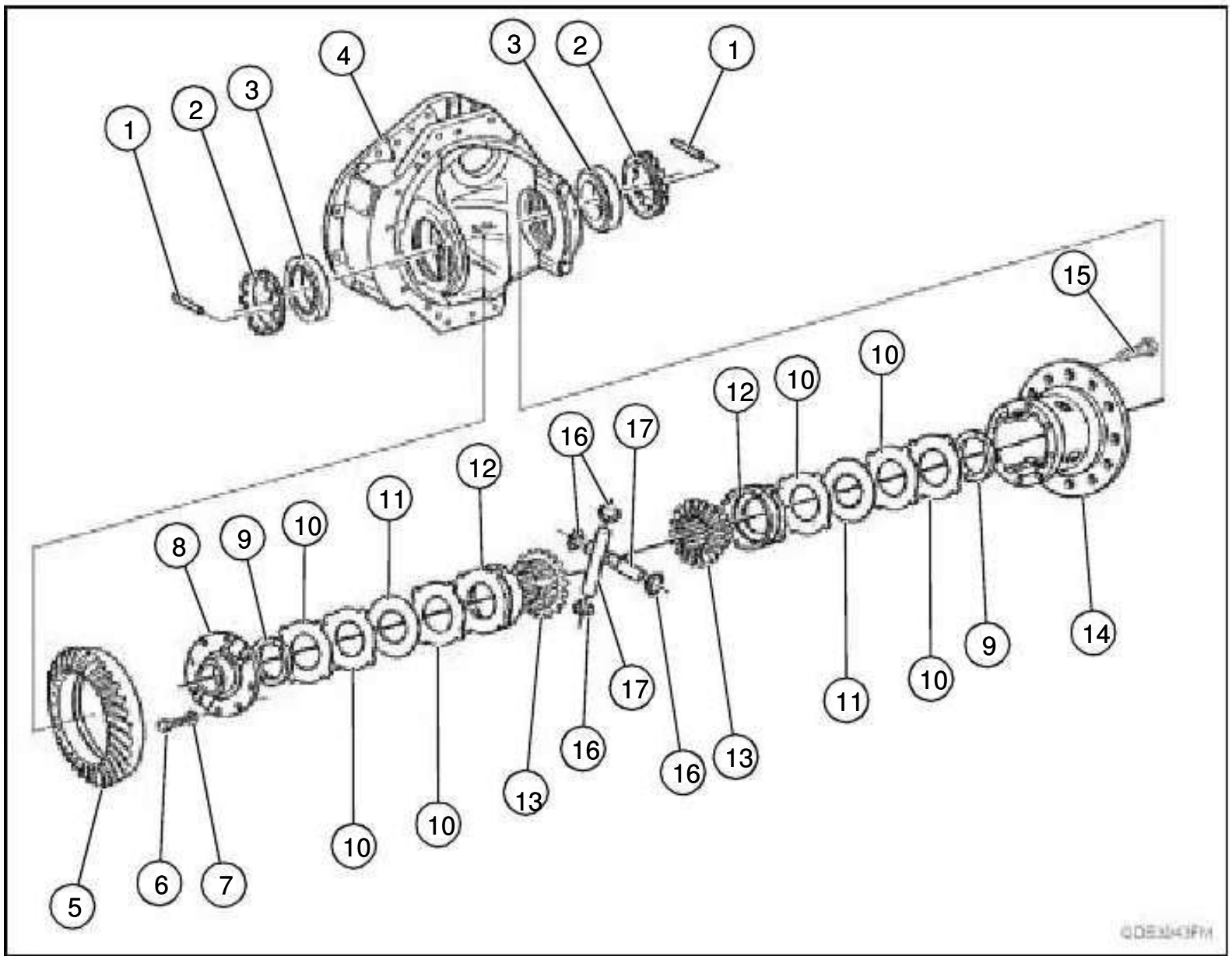
Remove seal (2).



Loosen cap screws (2), remove lock pins (1), and loosen adjuster nuts (3) with JDG1278 Axle Spanner Nut Wrench.

Remove cap screws and washers, adjuster nuts, and bearing cap.

Remove the carrier with a lifting strap.



1. Spring Pin (2 used).
2. Spanner Nut (2 used).
3. Bearing (2 used).
4. Housing.
5. Crown Wheel.
6. Cap Screw (8 used).
7. Washer (8 used).
8. Cover.
9. Thrust Washer (2 used).
10. Disk (6 used).
11. Clutch Disk (2 used).
12. Housing (2 used).
13. Bevel Gear (2 used).
14. Housing.
15. Cap Screw (12 used).
16. Bevel Gear (4 used).
17. Cross Joint.

Remove cap screws (15).

Remove crown wheel (5) from housing.

Remove cap screws and washers (6 and 7).

Remove cover (8).

Remove components (9 - 13).

Remove cross joint (17) and bevel gears (16).

Remove remaining components (9 - 13).

Remove bearings (3) from housing and cover.

Assemble

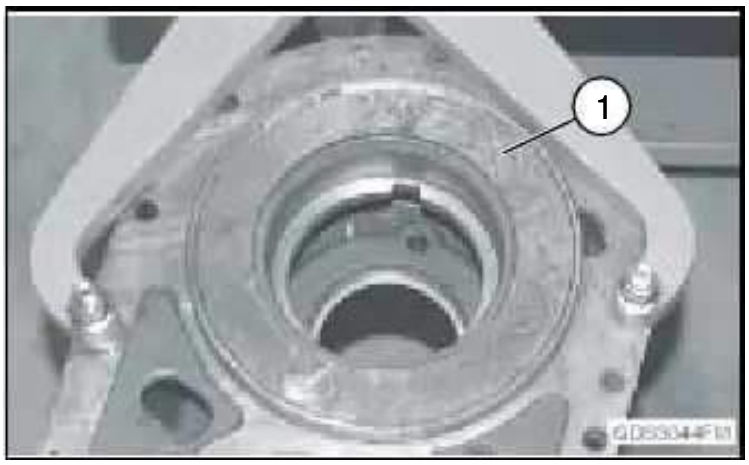
Clean and inspect all parts for wear or damage.

⚠ CAUTION

1. If adapter case, bearing retainer, bearing, or pinion shaft have been replaced, the following measuring operations must be done.

2. Failure to make precise measurements and correct shim selection will cause pinion and crown wheel to wear prematurely.

NOTE: If crown wheel and pinion are replaced be sure they have the same match number.



Heat bore of adapter case and install bearing retainer (1) tight against shoulder.

Install adapter case to differential and tighten cap screws.

Using Cone Point Centering Disks and JDG74-1 Cone Point Centering Shaft.

Measure pinion bearing cup height with caliper.

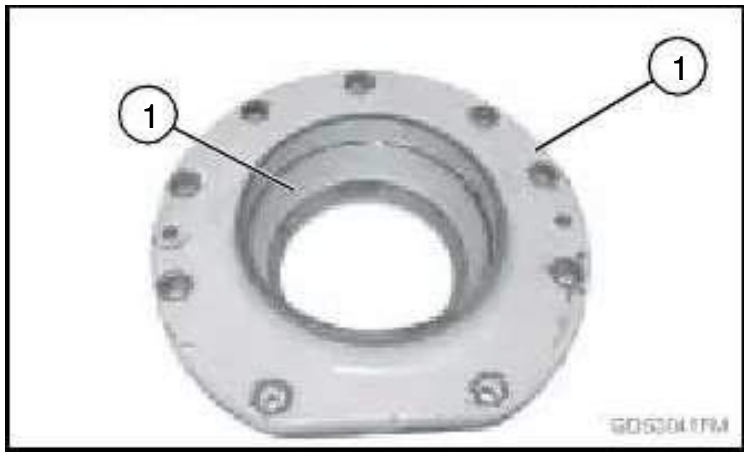
- For 250D, use JDG1350 Cone Point Centering Disks.
- For 300D, use JDG1605-2 and JDG1605-3 Cone Point Centering Disks.

Example of Pinion Bearing Cup Height	
Distance from top of shaft to bearing cup surface	204.60 mm (8.055 in.)
Subtract half of shaft diameter	-15.00 mm (0.590 in.)
Bearing Cup Height Measurement	189.60 mm (7.465 in.)

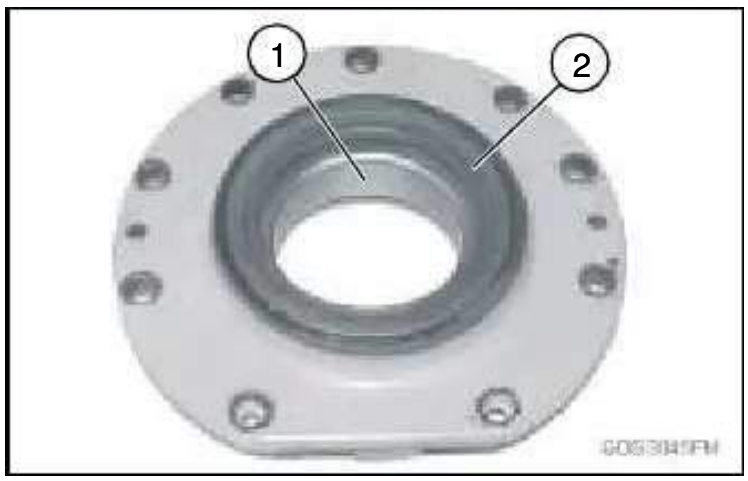
Measure pinion bearing thickness with depth micrometer.

Example of Piston Bearing Thickness Measurement	
Measurement of bearing and cup thickness	37.10 mm (1.461 in.)
Add pinion bearing height (etched on pinion)	+151.7 mm (5.972 in.)
Pinion Bearing Thickness Measurement	188.8 mm (7.433 in)

Subtract bearing cup height measurement from pinion bearing thickness measurement. Difference will be thickness of bearing shim required. If thickness is between shim sizes use greater size shim.



Install bearing cup (1) into bearing housing (2).



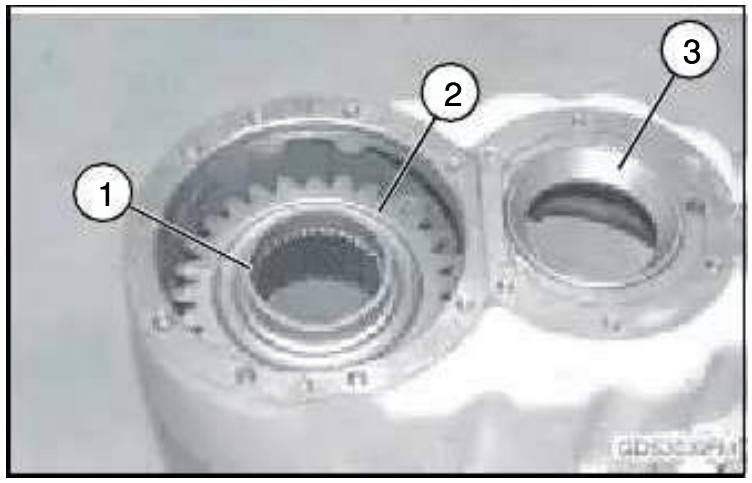
Apply multi-purpose grease to bearing cone (1) and install bearing cone.

Apply cure primer and flexible form-in-place gasket to outer diameter of seal (2) and install seal flush into bearing housing.

⚠ CAUTION

Avoid overheating seal when heating bearing cone.

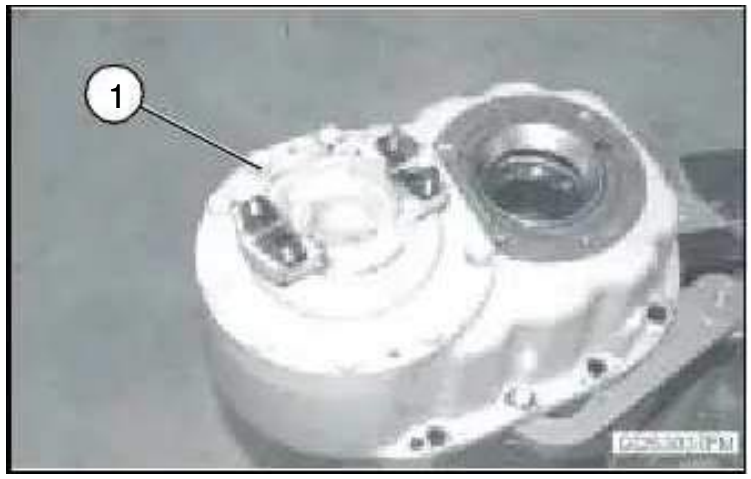
Heat bearing cone to 110°C (230°F). Install assembled bearing housing over input drive shaft ensuring bearing is fully seated.



Install spur gear (2) in adapter case with writing up.

Install shim (1) on spur gear.

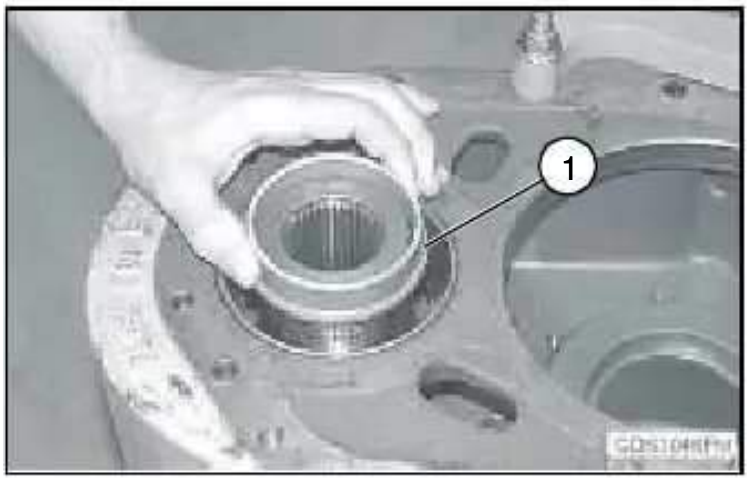
Install bearing cup (3).



Apply cure primer and form-in-place gasket to mating surfaces of bearing housing.

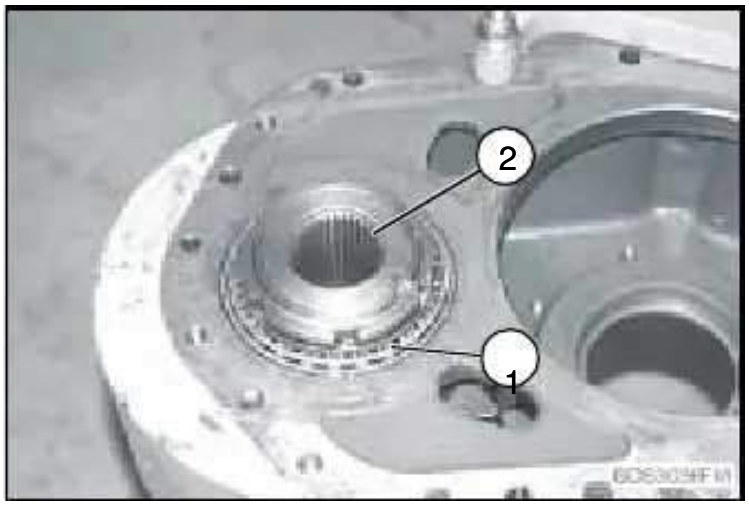
Install bearing housing and input drive shaft into adapter case.

Apply cure primer and thread lock and sealer to threads of cap screws (1). Install and tighten cap screws.



Install shim (1) with collar against spur gear.

Apply multi-purpose grease to bearing cup.



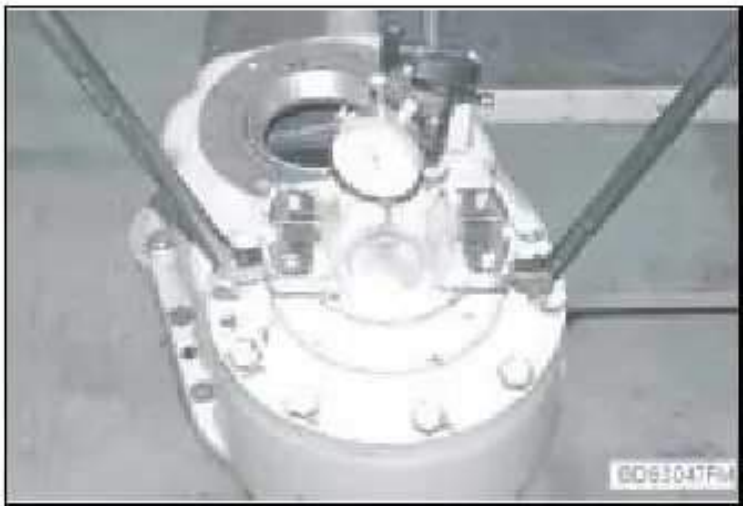
Heat bearing cone (1) and install over drive shaft.

Apply multi-purpose grease to threads of spanner nut.

Hold input drive shaft (2) by yoke and install spanner nut with JDG1359 Spanner Nut Socket. Tighten to specification.

Specification

Middle Axle Differential Housing Spanner Nut Torque - 750 Nm (553 lb-ft)



Using a dial indicator, measure drive shaft end play by prying upward on yoke.

Specification

Middle Axle Drive Shaft End Play - - - - - - - - - - - - Zero

If adjustment is necessary, remove spanner nut with JDG1359 Spanner Nut Socket, bearing housing and drive shaft. Correct end play adjustment by installing different size shim (1).

Apply flexible form-in-place gasket to mating surface.

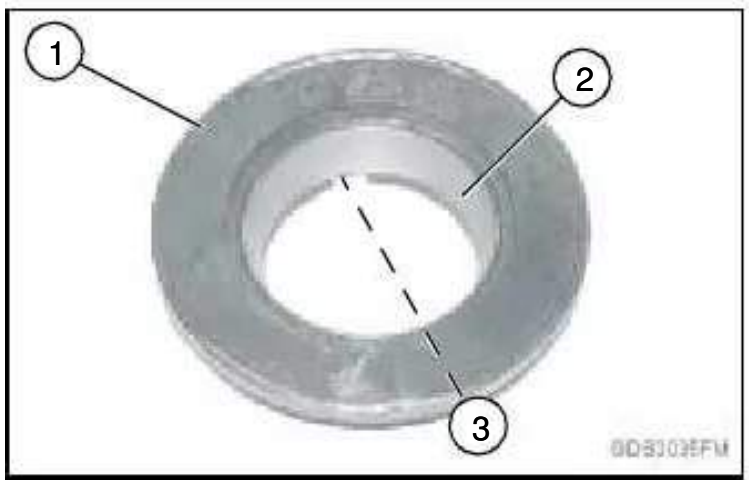
Install bearing housing and input drive shaft, bearing, and spanner nut. Tighten spanner nut with JDG1359 Spanner Nut Socket to specification.

Specification

Middle Axle Differential Housing Spanner Nut Torque - 750 Nm (553 lb-ft)

Measure rolling drag torque of the input drive shaft. Record this value for the installation of the pinion shaft.

Install bearing cone (1) on pinion shaft.



Install pre-determined shim (3) and bearing cup (2) into bearing retainer (1).

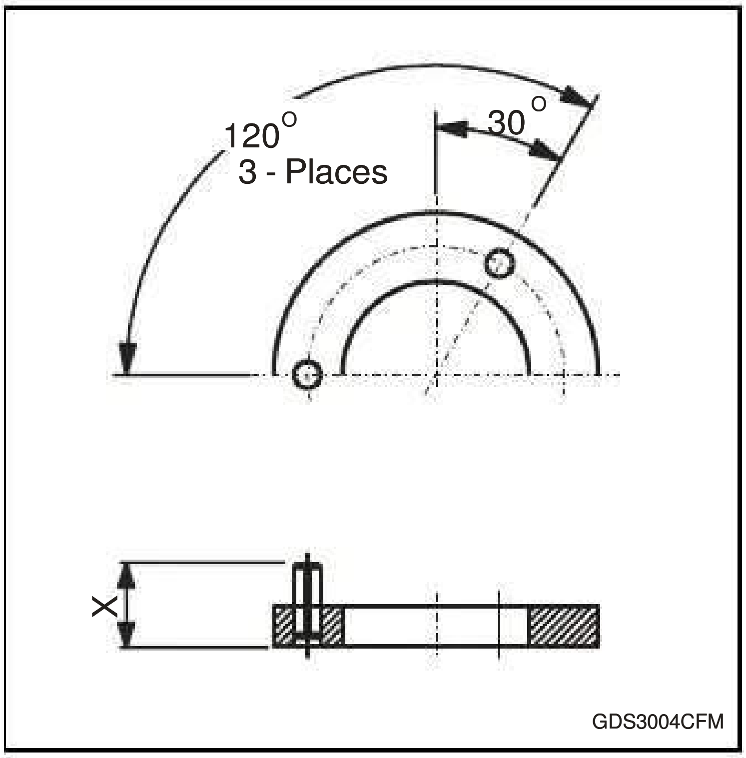
Install bearing retainer (2) on pinion shaft (1).

Install shim (3) with collar up.

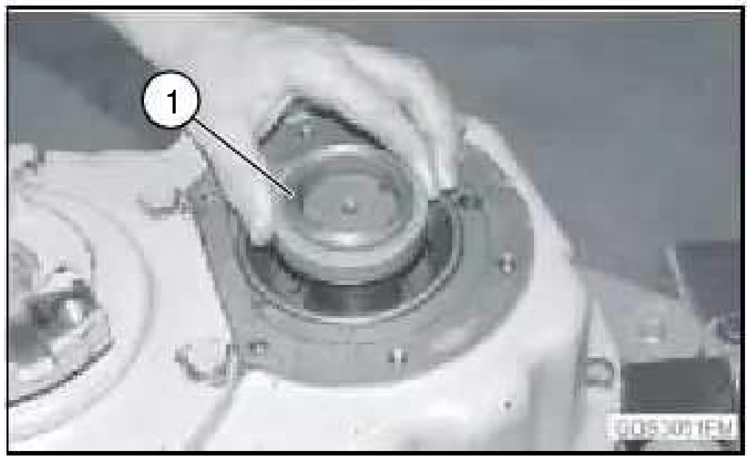
Heat spur gear (2) to 110°C (230°F).

Install spur gear on pinion shaft (3) with chamfer (1) facing down toward shim. Ensure that spur gear is fully seated on shim.

Heat adapter case bore and install pinion shaft as an assembly.



To measure pinion bearing preload: Extend pins of JDG1281 Calibration Ring to outermost position. Install JDG1281 Calibration Ring on pinion shaft with pins pointing away from gear in place of spacer.



Install pinion in adapter case and block in place.

Heat bearing cone to 110°C (230°F) and install on shaft.

Apply multi-purpose grease to pinion shaft nut.

Tighten pinion shaft nut until bearing cone makes contact with bearing cup. Remove nut, pinion shaft bearing cone, and calibration ring.

Measure JDG1281 Calibration Ring at all three pins and calculate an average dimension. This dimension is thickness of shim (1).

Install pinion shaft, shim and bearing cone.

Apply multi-purpose grease to pinion shaft nut.

Install pinion shaft nut and tighten to specification.

Specification

Pinion Shaft Nut Torque- - - - - - - - - 750 Nm (553 lb-ft)

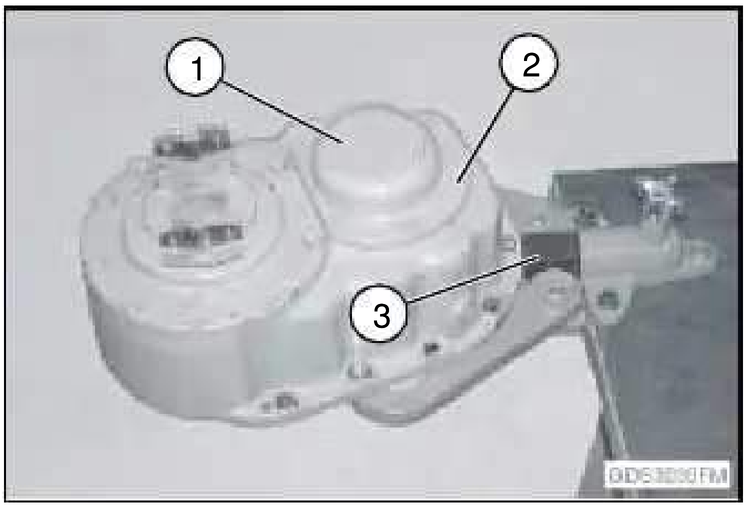
Measure rolling drag of pinion shaft.

Example of Rolling Drag of Pinion Shaft Measurement	
Total rolling drag of drive shaft and pinion shaft.	5.0 Nm (44.25 lb-in.)
Less rolling drag of drive shaft.	-2.5 Nm (22.13 lb-in.)
Rolling drag of pinion shaft.	2.5 Nm (22.13 lb-in.)

If rolling drag of pinion shaft is not within specification, replace shim with a different thickness.

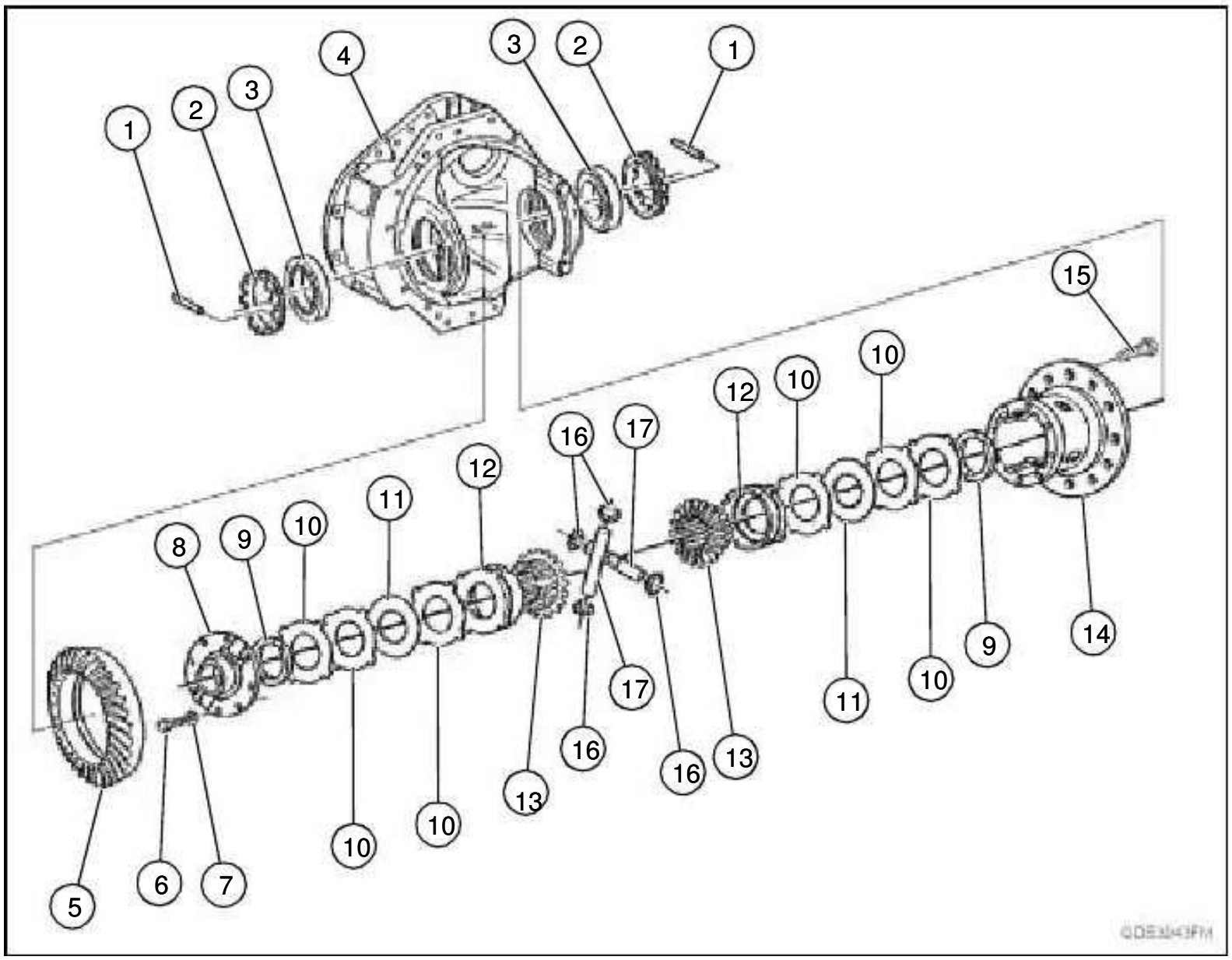
Specification

Pinion Bearing Rolling Drag Torque -2 - 3 Nm (17 - 26 lb-in.)



Stake pinion shaft nut. Apply cure primer and flexible form-in-place gasket to cover mating surface. Apply cure primer and thread lock and sealer (medium strength) to cap screw (2) threads.

Install cover and cap screws. Clean and inspect parts for wear or damage.



1. Spring Pin (2 used).
2. Spanner Nut (2 used).
3. Bearing (2 used).
4. Housing.
5. Crown Wheel.
6. Cap Screw (8 used).
7. Washer (8 used).
8. Cover.
9. Thrust Washer (2 used).
10. Disk (6 used).
11. Clutch Disk (2 used).
12. Housing (2 used).
13. Bevel Gear (2 used).
14. Housing.
15. Cap Screw (12 used).
16. Bevel Gear (4 used).
17. Cross Joint.

Install bearings on housing (14) and cover (8).

Install thrust washer (9).

Install disks (10) and clutch disks (11), beginning with disk (10).

Install housing (12) and bevel gear (13).

Install bevel gears (16) on cross joint. Install in housing.

Install bevel gear (13) and housing (12).

Install clutch disks (11) and disks (10), beginning with disks (10).

Install thrust washer (9) and cover (8).

Install cap screws and washers (6 and 7).

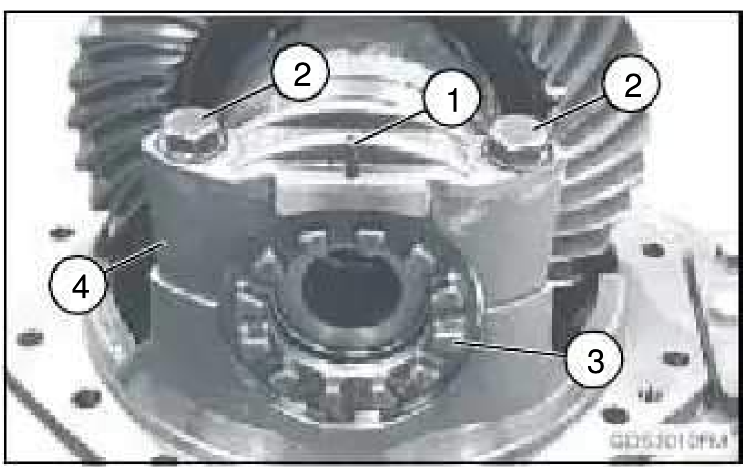
Install crown wheel (5) and cap screws (15).

NOTE: Do not apply sealer to mating surfaces at this time.

Install adapter case to differential housing.

Lubricate bearings with multi-purpose grease and install bearing cups.

Install carrier to differential housing.



Apply cure primer and thread lock and sealer (medium strength) to bolts (2).

Install bearing cap (4), adjusting nuts (3), and cap screws and washers. DO NOT tighten cap screws at this time.

⚠ CAUTION

If adjusting nuts do not turn freely, bearing cap may not be aligned properly.

NOTE: There must always be some backlash while making preload adjustment.

Use JDG1278 Axle Spanner Nut Wrench to adjust bearing preload by evenly turning both adjusting nuts clockwise until end play of carrier is zero. Make sure crown wheel and pinion have some backlash.

Specification

Differential Carrier End Play- - - - - - - - - - - - - - - - Zero

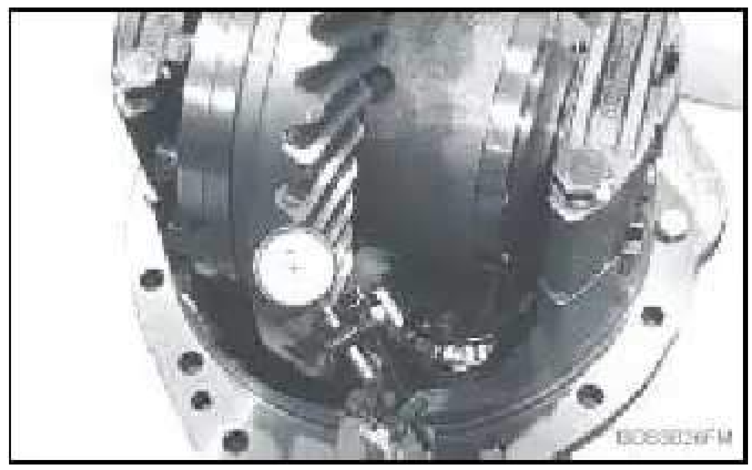
Tighten cap screws (2) to specification.

Specification

Carrier Bearing Cap Screw Torque - 278 Nm (205 lb-ft)

⚠ CAUTION

When adjusting backlash, one adjusting nut MUST be tightened the same amount the other is loosened to keep the correct bearing preload.



Measure backlash with dial indicator and adjust to specification. Measure at three locations on crown wheel.

Specification

Crown Wheel and Pinion Backlash - 0.25 - 0.33 mm (0.010 - 0.013 in.)

To increase backlash, loosen adjusting nut on crown wheel side and tighten nut on opposite side an equal amount.

To decrease backlash, loosen adjusting nut opposite crown wheel side and tighten nut on crown wheel side an equal amount.

⚠ CAUTION

Gear contact pattern MUST be checked on the coast side and drive side with a load applied. The pattern may be correct on the drive and incorrect on coast side causing the differential to make noise when under load.

Check Gear Tooth Contact Pattern. **(See "Check Gear Tooth Contact Pattern" on page 33.)**

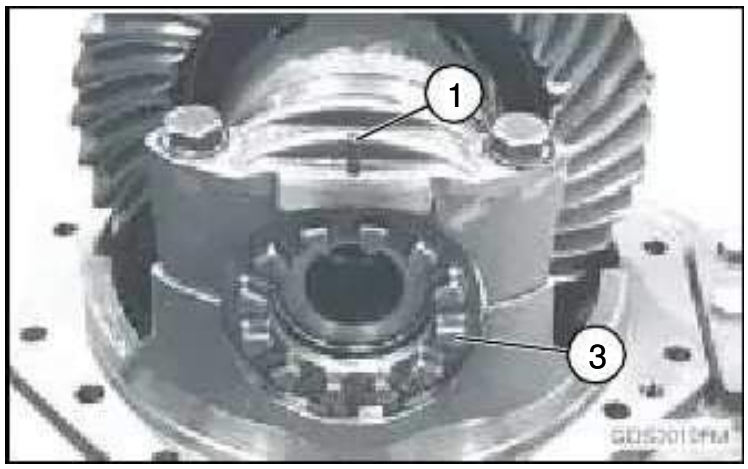
With backlash set, check carrier end play and pinion rolling drag torque.

Specification

Carrier Bearing End Play - - - - - - - - - - - - - - - - - Zero

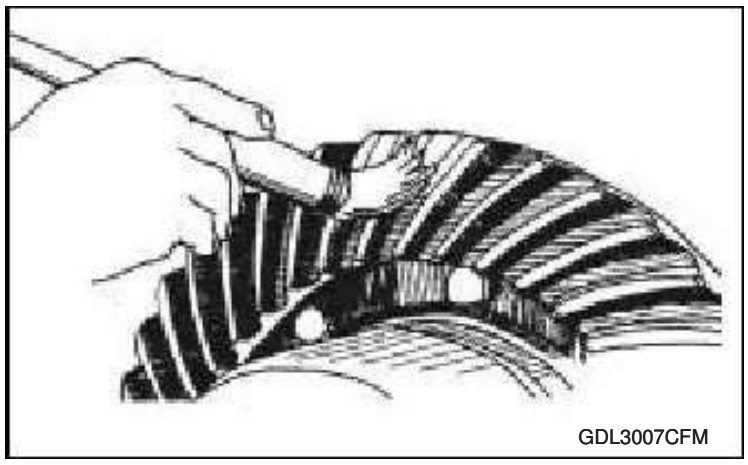
Specification

Pinion and Crown Wheel Rolling Drag Torque (Minus Drive Shaft Rolling Drag)- - - - - 3 - 4 Nm (26 - 35 lb-in.)



Drive lock pins (1) down to secure adjusting nuts (3).

Check Gear Tooth Contact Pattern



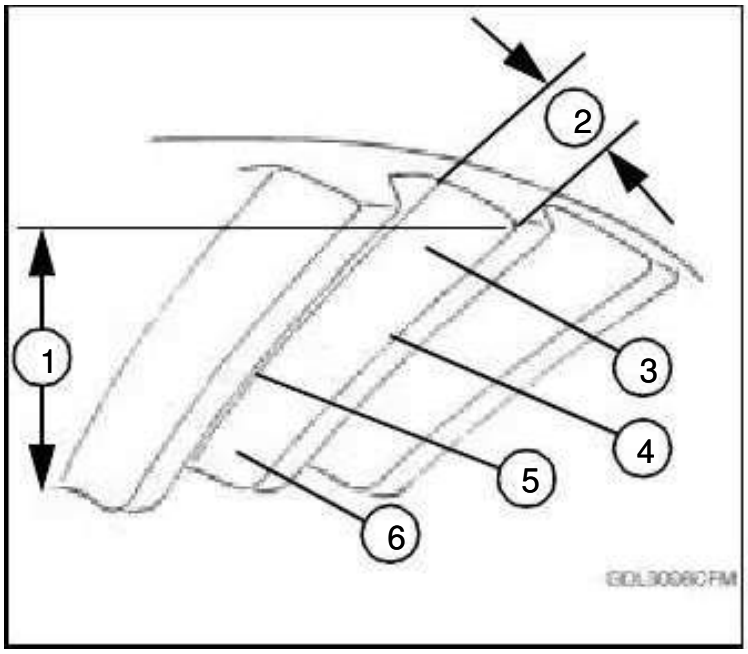
Coat several crown wheel teeth with marking compound.

Turn crown wheel so pinion gear leaves a wear pattern through marking compound.

Inspect wear pattern.

The length and shape of contact pattern varies, especially for used gears.

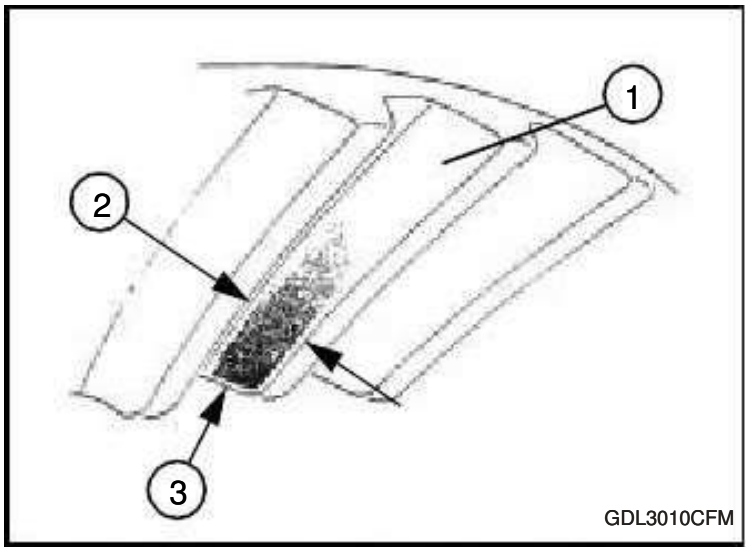
The position of contact pattern is important for all gears.



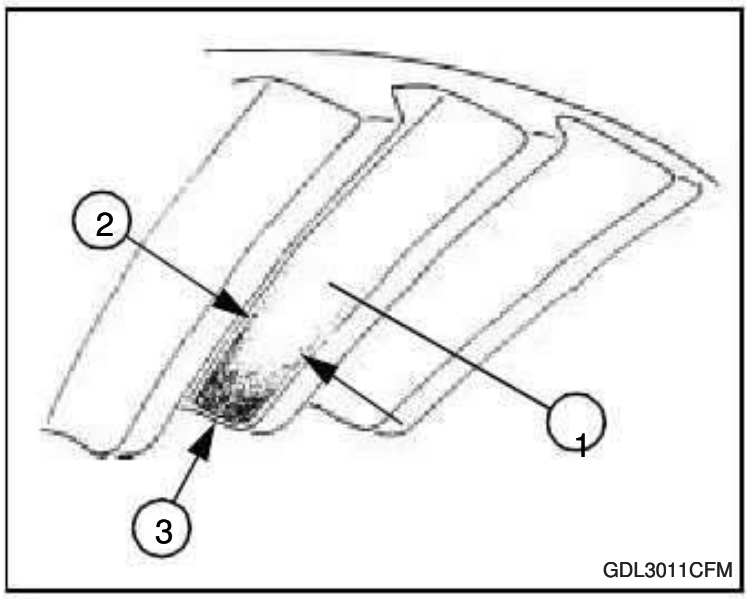
1. Face Width.
2. Tooth Depth.

Wear pattern must not be too much toward tooth heel (3), and must not run off of toe (6). Pattern should be centered between top land (4) and root (5).

Compare wear pattern to examples.



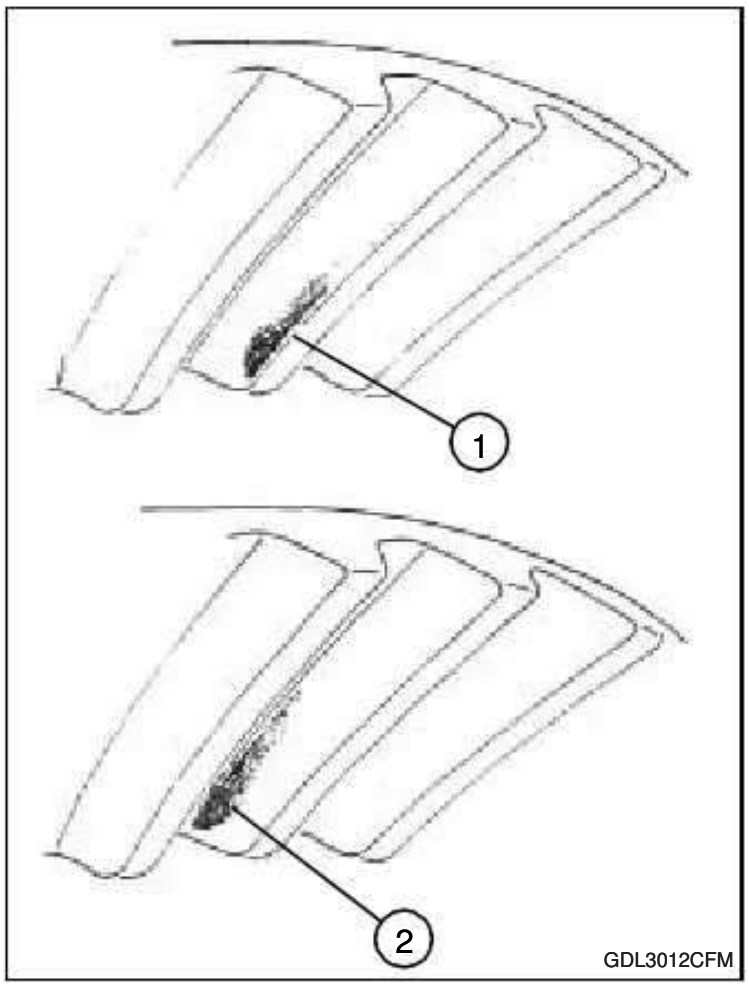
- A correct pattern is up slightly from the toe (3) and centers evenly (2) along the face width.



- Wear patterns for used gears typically vary in shape and length. Wear patterns should not run off of toe, and should not be too close to root or land of tooth.
- When reassembling used gear sets, adjust as necessary to produce the same gear tooth contact pattern as before disassembly.

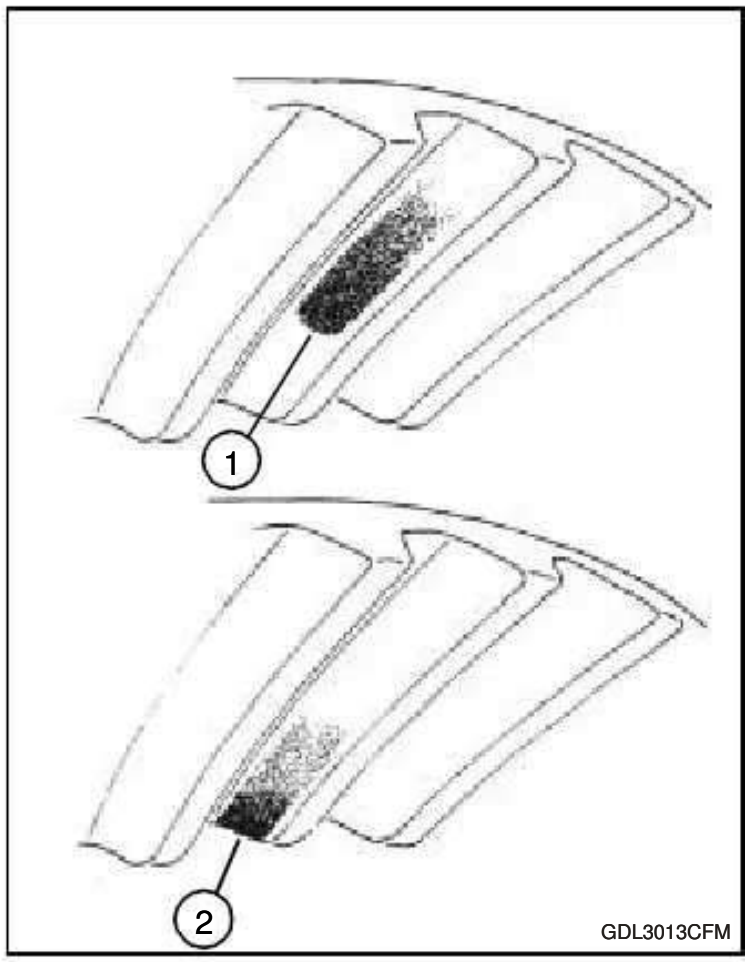
To adjust the tooth contact pattern, the positions of the crown wheel and pinion gear are adjusted.

Shims between the pinion bearing housing and carrier control where the wear pattern is between the top land and root.



- If wear pattern is too close to top land (1), use thinner shim(s) between pinion bearing housing and carrier to move pinion toward crown wheel.
- If wear pattern is too close to root (2), use thicker shim(s) between pinion bearing housing and carrier to move pinion away from crown wheel.

Adjusters on the crown wheel bearings control where the wear pattern is between tooth heel and toe.



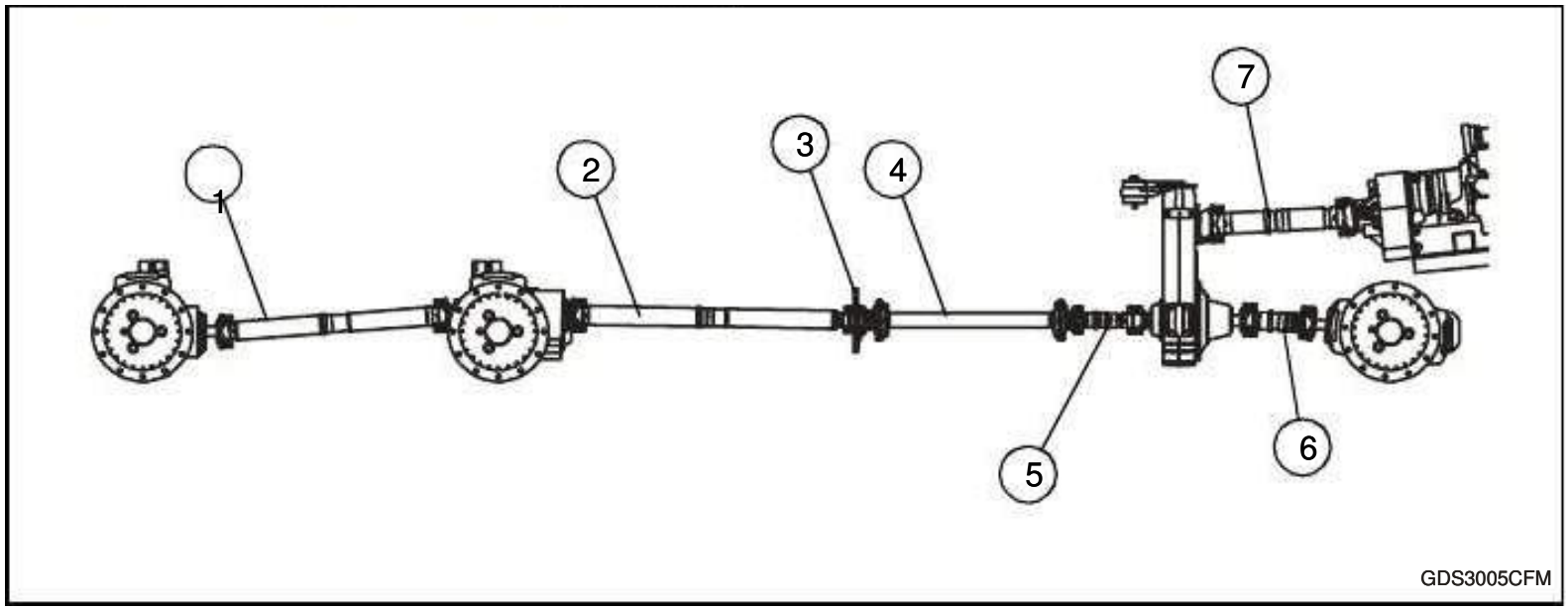
- If wear pattern is too close to tooth heel (1), adjust crown wheel position toward teeth side to move crown wheel toward pinion.
- If wear pattern is too close to tooth toe (2), adjust crown wheel position toward back side to move crown wheel away from pinion.

Adjust backlash to specifications after any adjustment or shim change.

CHAPTER 2. AXLES AND SUSPENSION SYSTEMS

SECTION 3. INPUT DRIVE SHAFTS AND U-JOINTS

DRIVE SHAFTS

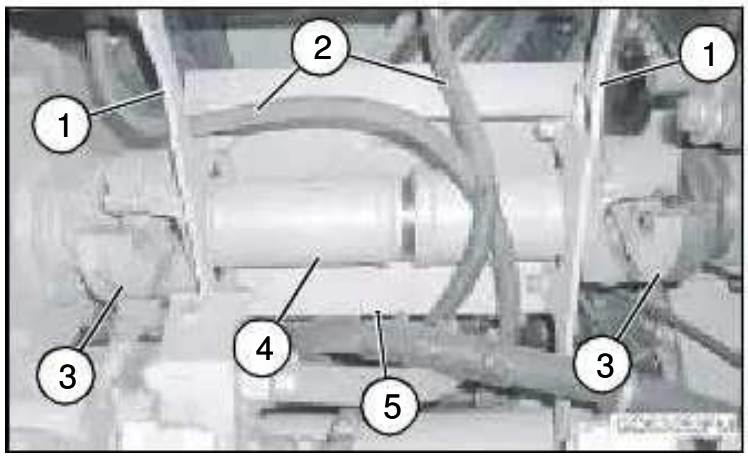


1. Middle Axle-to-Rear Axle Drive Shaft.
2. Park Brake-to-Middle Axle Drive Shaft.
3. Park Brake Disk.
4. Oscillation Joint Through Drive Shaft.
5. Transfer Case-to-Oscillation Joint Drive Shaft.
6. Transfer Case-to-Front Axle Drive Shaft.
7. Transmission-to-Transfer Case Drive Shaft.

Remove and Install Transmission-to-Transfer Case Drive Shaft or Transfer Case-to-Oscillation Joint Drive Shaft

⚠ CAUTION

Component is heavy.



Disconnect shield (5) from brackets (1).

Turn steering wheel from side-to-side three times to relieve hydraulic pressure.

Tilt Cab **(Operator's Manual, CHAPTER 7).**

Support shield from underside of cab, using a hand-operated ratcheting cable winch.

Remove brackets.

Disconnect steering cylinder hydraulic lines (2) at one end. Close all openings with caps and plugs.

Disconnect cross and bearing assemblies (3) from transmission and transfer case yokes. Remove drive shaft assembly.

Inspect and replace parts as necessary.

⚠ WARNING

Assemble drive shaft so yokes on ends of the shaft are aligned. If yokes are not aligned, severe vibration and machine damage may result.

Assemble drive shaft so yokes are aligned.

Apply rigid form-in-place gasket to cap screws. Install drive shaft assembly. Tighten cap screws to specification.

Specification

Drive Shaft Universal Joint Cap Screw Torque - 120 Nm (89 lb-ft)

Connect steering hoses.

Install brackets. Attach shield to brackets.

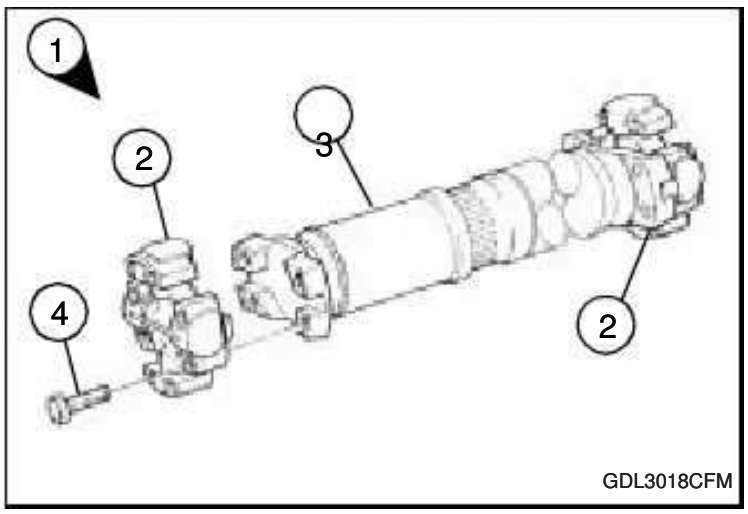
Lower cab.

Remove and Install Drive Shaft and Universal Joint

⚠ CAUTION

Components are heavy. Use lifting devices.

NOTE: Typical drive shaft shown. Procedure is the same for the following drive shafts: transfer case-to-front axle, transfer case-to-oscillation tube, oscillation tube-to-middle axle, and middle axle-to-rear axle.



Remove bolts (4) and drive shaft assembly (1).

Remove cross and bearing assemblies (2) from drive shaft (3).

Inspect and replace parts as necessary.

⚠ WARNING

Assemble drive shaft so yokes on ends of the shaft are aligned. If yokes are not aligned, severe vibration and machine damage may result.

Assemble drive shaft so yokes are aligned.

Install cross and bearing assembles on drive shaft.

Apply rigid form-in-place gasket to cap screws. Install cap screws and tighten to specification.

Remove and Install Drive Shaft and Universal Joint Specification

Cap Screw Torque - - - - - - - - - - - - - 120 Nm (89 lb-ft)

Install drive shaft assembly. Apply rigid form-in-place gasket to cap screws. Install cap screws and tighten to same specification.

Remove and Install Oscillation Joint Drive Shaft

Remove transfer case-to-oscillation tube drive shaft and oscillation tube-to-middle axle drive shaft.

Remove park brake pads, caliper, and disk. **(See Park Brake CHAPTER 11).**

Remove and Install Transfer Case-to-Front Axle Drive Shaft or Transfer Case-to-Oscillation Joint Drive Shaft - Specification

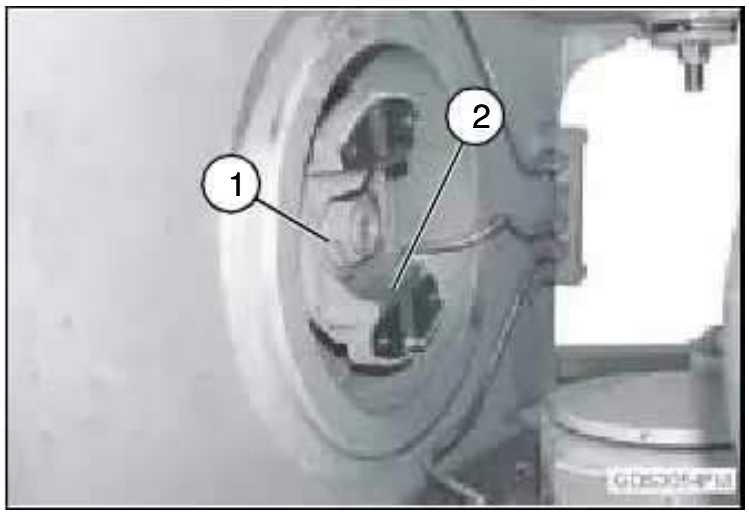
Cross and Bearing Torque - - - - - - - - 120 Nm (89 lb-ft)

Remove and Install Oscillation Joint Through Drive Shaft

Remove transfer case-to-oscillation joint drive shaft.

Remove park brake pads, caliper and disc. **(See CHAPTER 10, SECTION 1).**

Remove park brake-to-middle axle drive shaft.

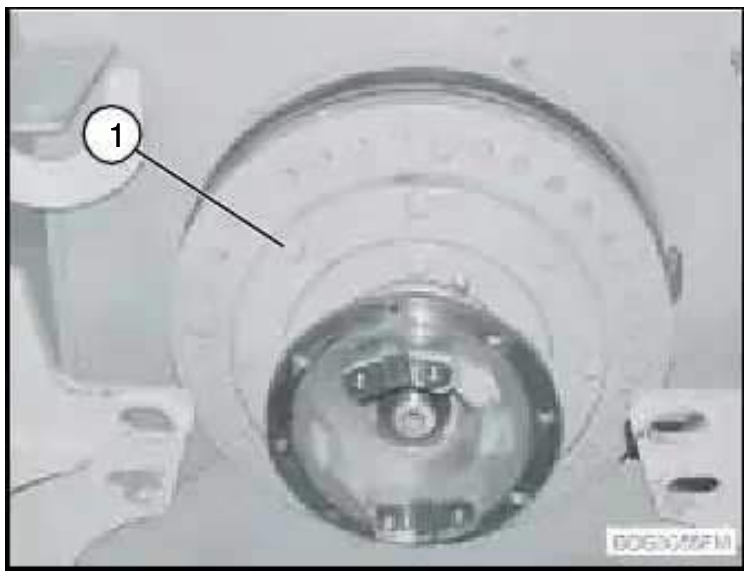


NOTE: Mark yokes and drive shaft. Front and rear yokes must be installed in line with each other.

Remove nut and washer (1). Remove front yoke (2) using a suitable puller.

Disconnect lubrication line from front seal retainer (2).

Remove front seal retainer. Remove outer O-ring from front seal retainer seat. Replace seal (1) using a seal driver.



Disconnect lubrication line from rear seal retainer. Disconnect rear bearing retainer from oscillation tube.

Remove drive shaft, rear bearing carrier, and rear yoke as an assembly.

Clean, inspect, and replace parts as necessary.

Install drive shaft, rear bearing carrier, and rear yoke as an assembly. Connect rear bearing carrier to oscillation tube. Connect lubrication line.

Install new outer O-ring in front seal retainer seat. Install front seal retainer. Connect lubrication line.

NOTE: Front and rear yokes must be installed in line with each other.

Install front yoke, washer, and nut. Tighten nut to specification.

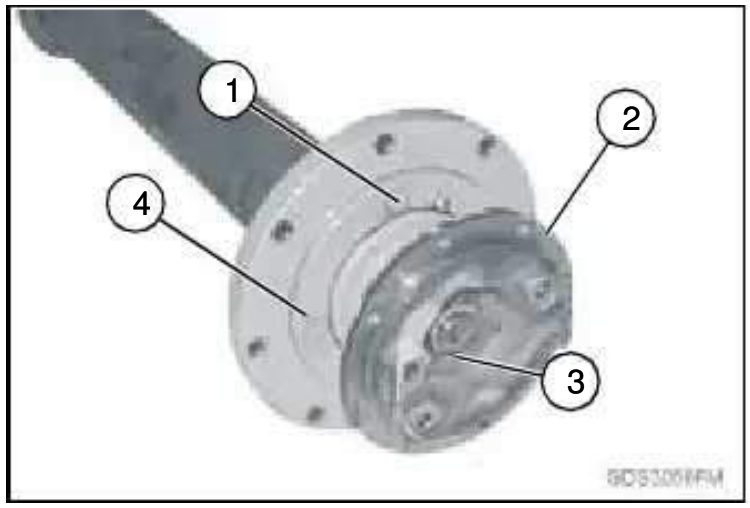
Drive Shafts Specification

Drive Shaft Yoke Nut Torque - - - - - 750 Nm (553 lb-ft)

Install park brake disk, caliper, and pads. **(See Park Brake CHAPTER 11, SECTION 1).**

Install transfer case-to-oscillation tube drive shaft and oscillation tube-to-middle axle drive shaft.

Disassemble And Assemble Oscillation Joint-to-Park Brake Drive Shaft



Remove nut and washer (3).

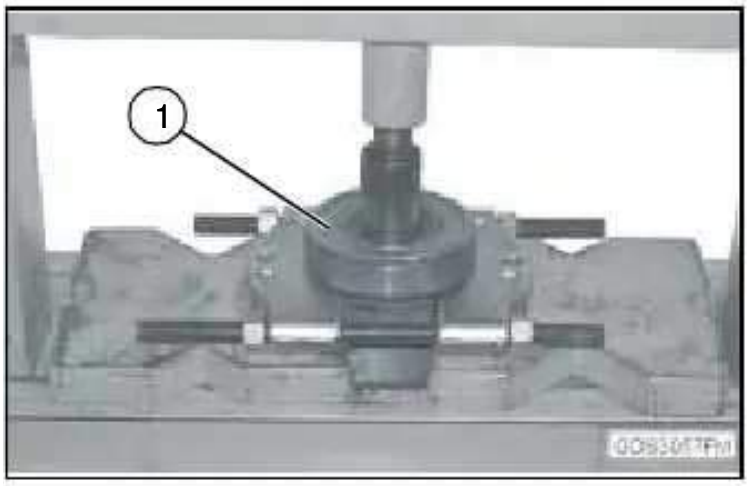
Remove rear yoke (2) using a suitable puller.

Disconnect lubrication line from rear seal retainer (4). Remove rear seal retainer. Remove outer O-ring from rear seal retainer seat.

Install new seal (1) in rear seal retainer (2) using a seal driver.

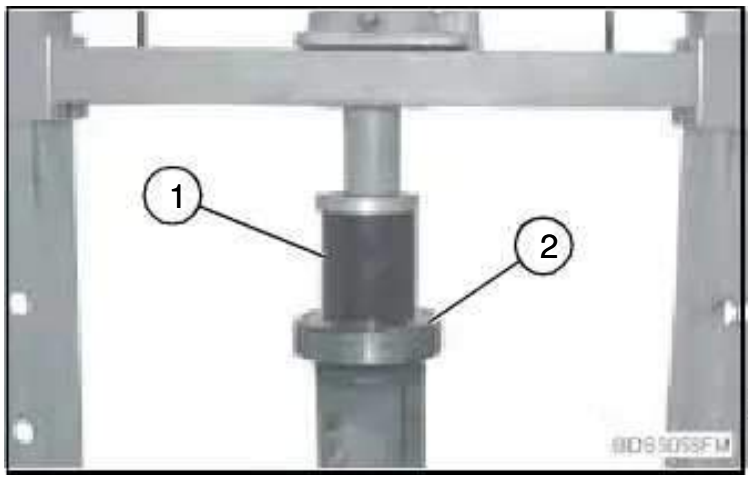
NOTE: 1. Drive shaft must be installed in the same direction as it was removed. Mark drive shaft ends for ease of assembly.
2. Rear bearing retainer (1) is slip fit over bearing.

Slide rear bearing retainer off of bearing.



Remove bearings (1) with a knife-edge bearing puller and a press. Remove bearing retainer from drive shaft.

Clean, inspect, and replace parts as necessary.



NOTE: Ensure that rear bearing retainer faces correct end of shaft.

Install rear bearing retainer on shaft. Install bearings (2) using a 76 mm (3.0 in.) ID pipe (1) and a press.

Slip fit rear bearing retainer onto rear bearing.

Install new outer O-ring in rear seal retainer seat.

Install rear seal retainer. Connect lubrication line.

Install yoke, washer, and nut. Tighten nut to specification.

Drive Shafts Specification

Drive Shaft Yoke Nut Torque - - - - - 750 Nm (553 lb-ft)

Remove and Install Park Brake-to-Middle Axle Drive Shaft

⚠ CAUTION

Component is heavy. Use lifting device.

Support park brake disk with a lifting device.

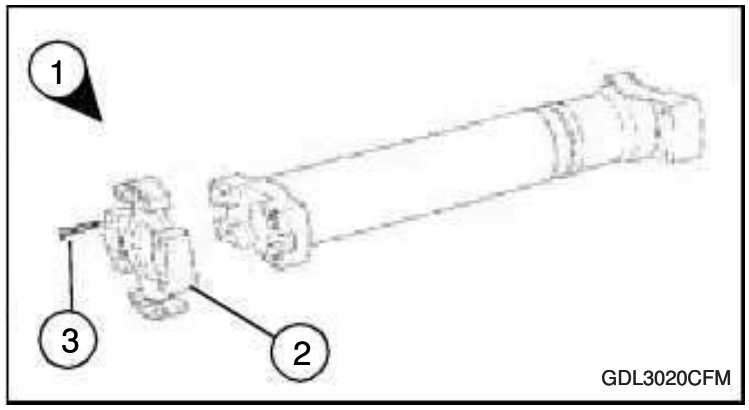
⚠ CAUTION

Component is heavy. Use hoist.

Specification

Park Brake-to-Middle Axle Drive Shaft Weight:
- 40 kg (87 lb) approximate

NOTE: Removing front cross and bearing assembly from machine also disconnects park brake disk.



Remove cap screws (3) and drive shaft assembly (1).

If park brake is not engaged, remove disk from machine. **(See “PARK BRAKE” on page 257).**

Remove cross and bearing assemblies (2) from drive shaft.

Inspect and replace parts as necessary.

⚠ CAUTION

Assemble drive shaft so yokes on ends of the shaft are aligned. If yokes are not aligned, severe vibration and machine damage may result.

Assemble drive shaft so yokes are aligned.

Install cross and bearing assembles on drive shaft.

Apply rigid form-in-place gasket to cap screws. Install cap screws and tighten to specification.

Remove and Install Park Brake-to-Middle Axle Drive Shaft Specification

Cross and Bearing Torque- - - - - - - 142 N•m (104 lb-ft)

Install drive shaft assembly. Install park brake disk, if removed. **(See "PARK BRAKE" on page 257).**

Apply rigid form-in-place gasket to cap screws. Install cap screws.

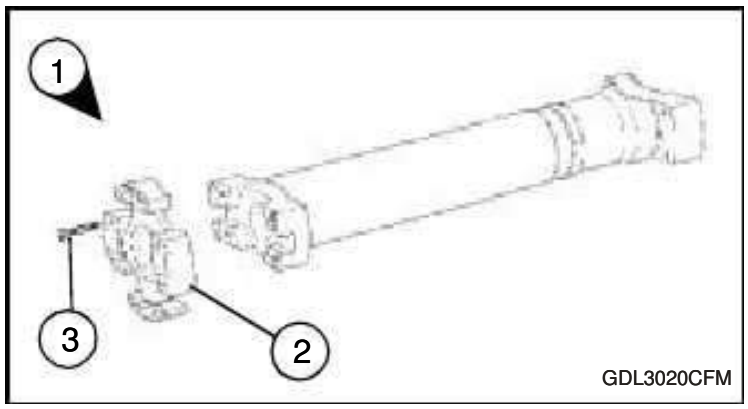
Remove and Install Middle Axle-to-Rear Axle Drive Shaft

⚠ CAUTION

Component is heavy. Use hoist.

Specification

Middle Axle-to-Rear Axle Drive Shaft Weight:
- 68 kg (150 lb) approximate



Remove cap screws (3) and drive shaft assembly (1).

Remove cross and bearing assemblies (2) from drive shaft.

Inspect and replace parts as necessary.

⚠ CAUTION

Assemble drive shaft so yokes on ends of the shaft are aligned. If yokes are not aligned, severe vibration and machine damage may result.

Assemble drive shaft so yokes are aligned.

Install cross and bearing assembles on drive shaft.

Install drive shaft assembly.

Apply rigid form-in-place gasket to cap screws. Install cap screws and tighten to specification.

Remove and Install Middle Axle-to-Rear Axle Drive Shaft Specification

Cross and Bearing Torque - - - - - - - 142 Nm (104 lb-ft)

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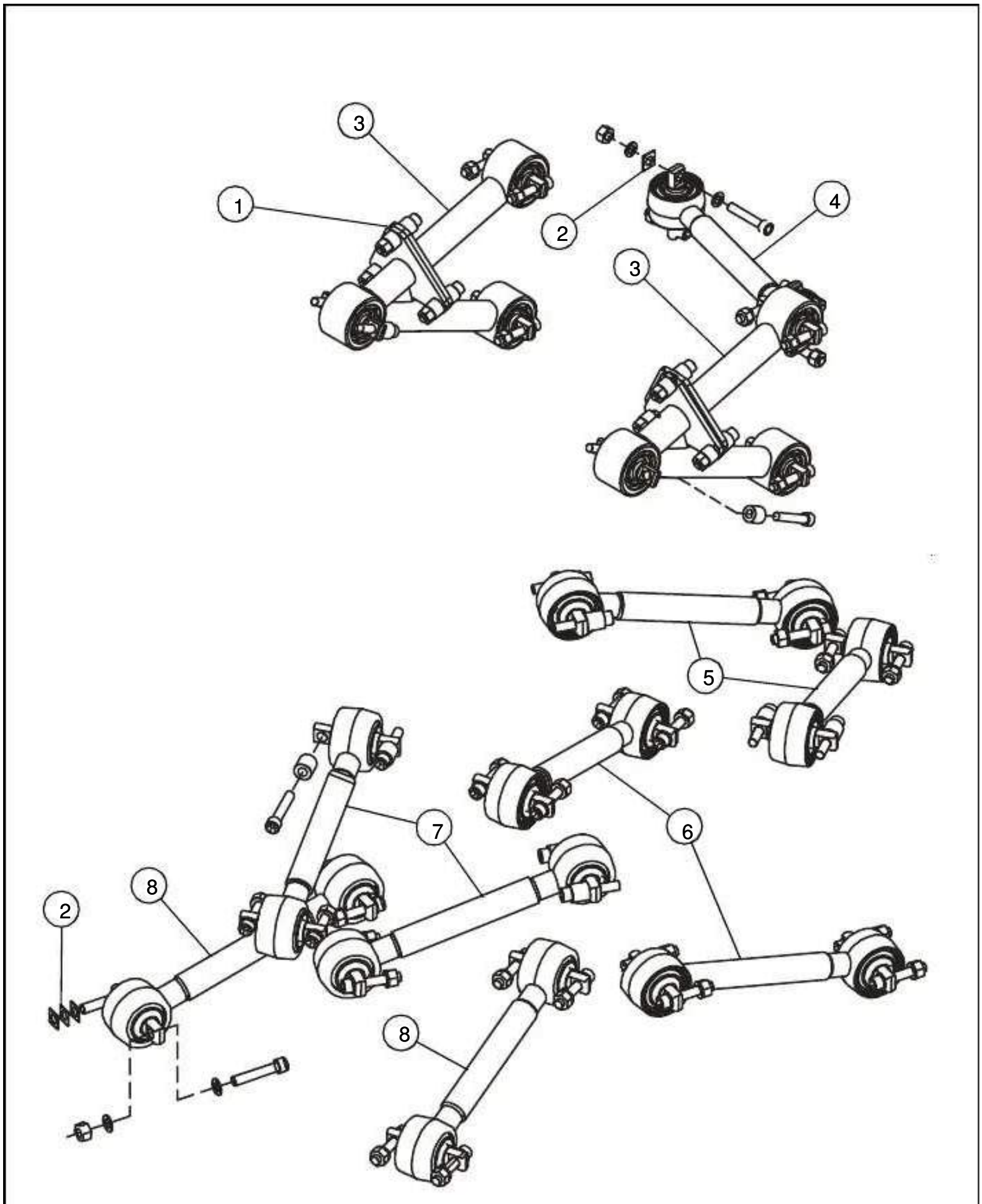
CHAPTER 2. AXLES AND SUSPENSION SYSTEMS

SECTION 4. AXLE MOUNTING PARTS

AXLE LINKS, STABILIZERS AND STRUTS



1. Triangular Flange Assembly (2 used).
2. Shim (as required).
3. Front Axle Link Assembly (2 used).
4. Front Axle Stabilizer.
5. Middle Axle Upper Link (2 used).
6. Middle Axle Lower Link (2 used).
7. Rear Axle Upper Link (2 used).
8. Rear Axle Lower Link (2 used).

Remove and Install Links and Stabilizers

⚠ CAUTION

Components are heavy. Use hoist.

Axle Links, Stabilizers, and Struts Specification

Link or Stabilizer Weight:
- - - - - - - - - - - - - - - - - - 45.5 kg (100 lb) approximate

Remove mounting hardware and component.

Inspect parts and replace as necessary.

Clean cap screw threads with cure primer.

For triangular flange assemblies (1), apply clean oil to threads of cap screws.

For all bushing pins, apply rigid form-in-place gasket to threads of cap screws.

NOTE: Use shims to align Axles ("Front Axle Alignment" on page 4 and "Middle and Rear Axle Alignment" on page 7).

Install component and mounting hardware. Use shims as required.

Tighten mounting hardware to specification.

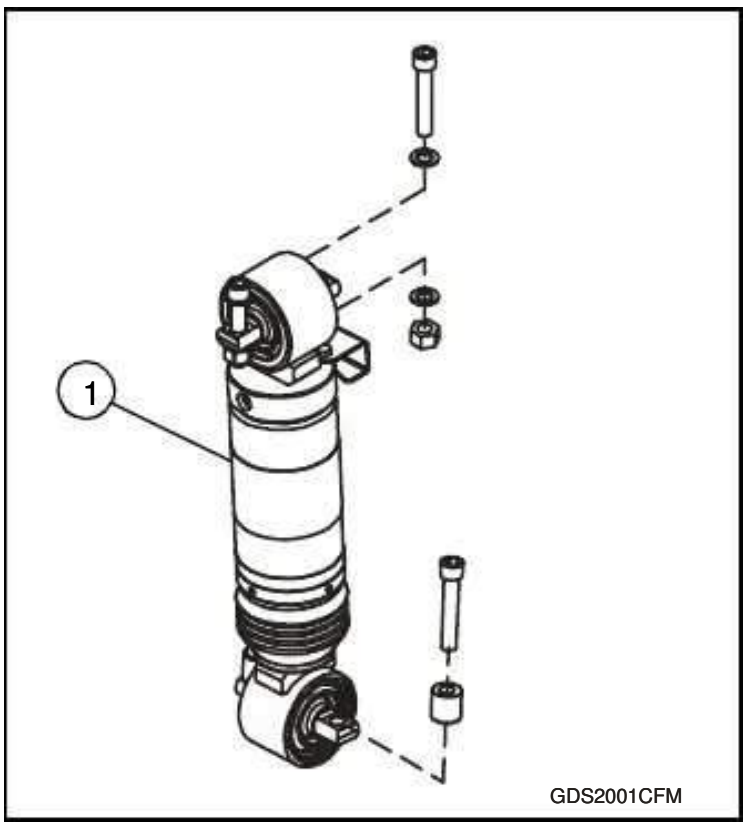
Axle Links, Stabilizers, and Struts Specification

Triangular Flange Cap Screw and Nut Torque - - - - - -
- 600 Nm (443 lb-ft)

Bushing Pin Cap Screw and Nut Torque - - - - - - - - - -
- 600 Nm (443 lb-ft)

Suspension Strut Cap Screw and Nut Torque- - - - - -
- 620 Nm (457.189 lb-ft)

Remove and Install Front Suspension Strut



Inspect suspension struts (1).

- Inspect suspension struts for damage.
- Inspect suspension struts for oil leakage. **(See Front Suspension Strut Leakage Check CHAPTER 4, SECTION 3 in Operation and Test Manual).**
- Inspect suspension struts for correct ride height. **(See Check Front Axle Suspension Struts Operator's Manual, CHAPTER 13, SECTION 1).**

Support machine front frame with 20-ton shop stands.

Chock middle and rear wheels securely.

⚠ CAUTION

Component is heavy. Use lifting device.

Axle Links, Stabilizers, and Struts Specification

Front Axle Weight- 1111 kg (2450 lb) approximate

Attach a lifting device to axle.

Remove wheel. **(See "Removal" on page 1).**

Lower axle to relieve tension on strut.

CAUTION: Strut will be under compression. Use care when removing mounting hardware.

Remove mounting hardware and strut.

Inspect, repair, or replace strut, as necessary.

Clean cap screw threads with cure primer.

Apply rigid form-in-place gasket to cap screw threads.

Install suspension strut and mounting hardware.

Tighten mounting hardware to specification.

Install wheel. **(See "Install Wheel" on page 1).**

Remove lifting device and shop stands.

Recharge suspension struts, if necessary.

Recharge Front Suspension Strut

⚠ CAUTION

DO NOT recharge a suspension strut that leaks or appears damaged. Repair or replace strut.

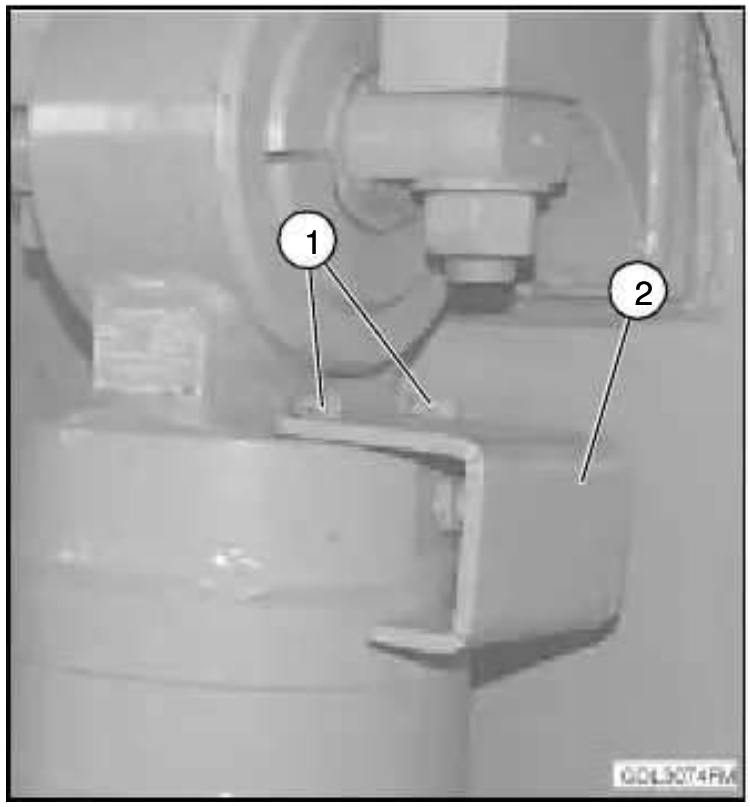
NOTE: To obtain correct pressure and ride height, struts must be recharged while installed on machine.

Inspect strut for damage and leakage. Remove, repair or replace, and install, if necessary.

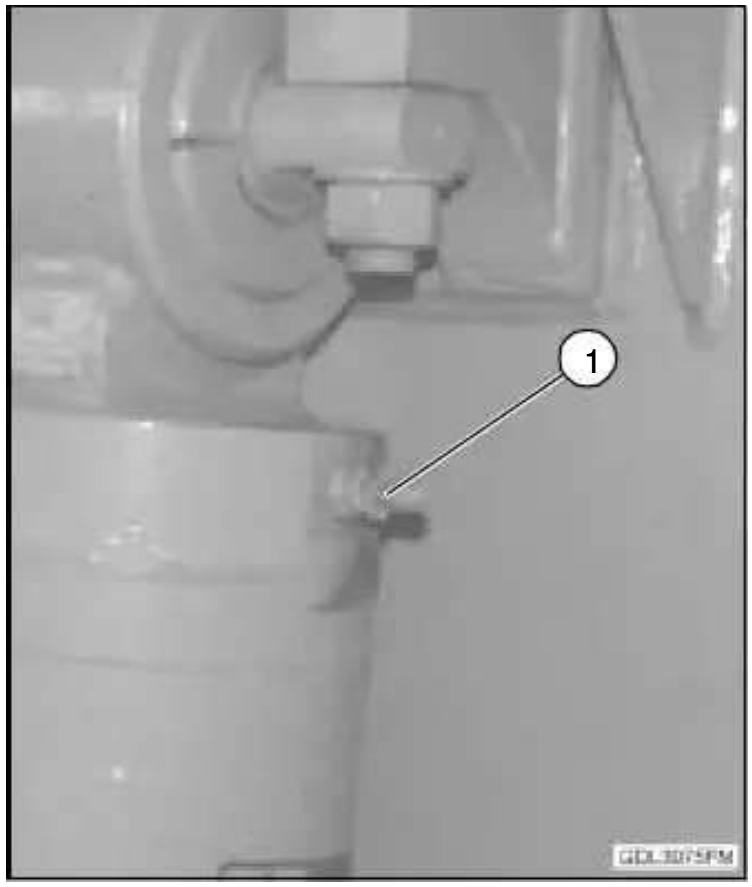
Check ride height. **(See Check Front Axle Suspension Struts Operator's Manual CHAPTER 13, SECTION 1).**

⚠ CAUTION

Avoid personal injury or death from pressurized gas and fluids.



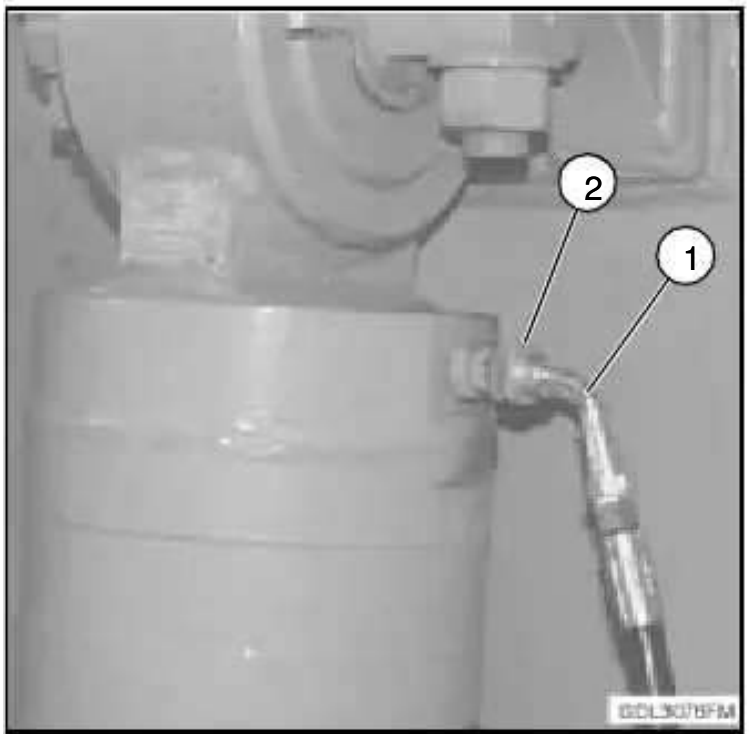
Remove bolts (1) and guard (2).



Remove fitting cap (1).

⚠ CAUTION

Use ONLY dry nitrogen to charge strut. Other gases can cause oxidation or condensation.



Connect JT03522 Adapter and Hose (1) to recharge fitting on strut.

⚠ CAUTION

DO NOT loosen inner nut on recharge fitting. Personal injury will result. Loosen ONLY outer nut.

Turn outside nut (2) on recharge fitting counterclockwise to open. DO NOT loosen inner nut.

Pressure gauge on regulator will read pressure in strut.

Pressurize the strut with dry nitrogen.

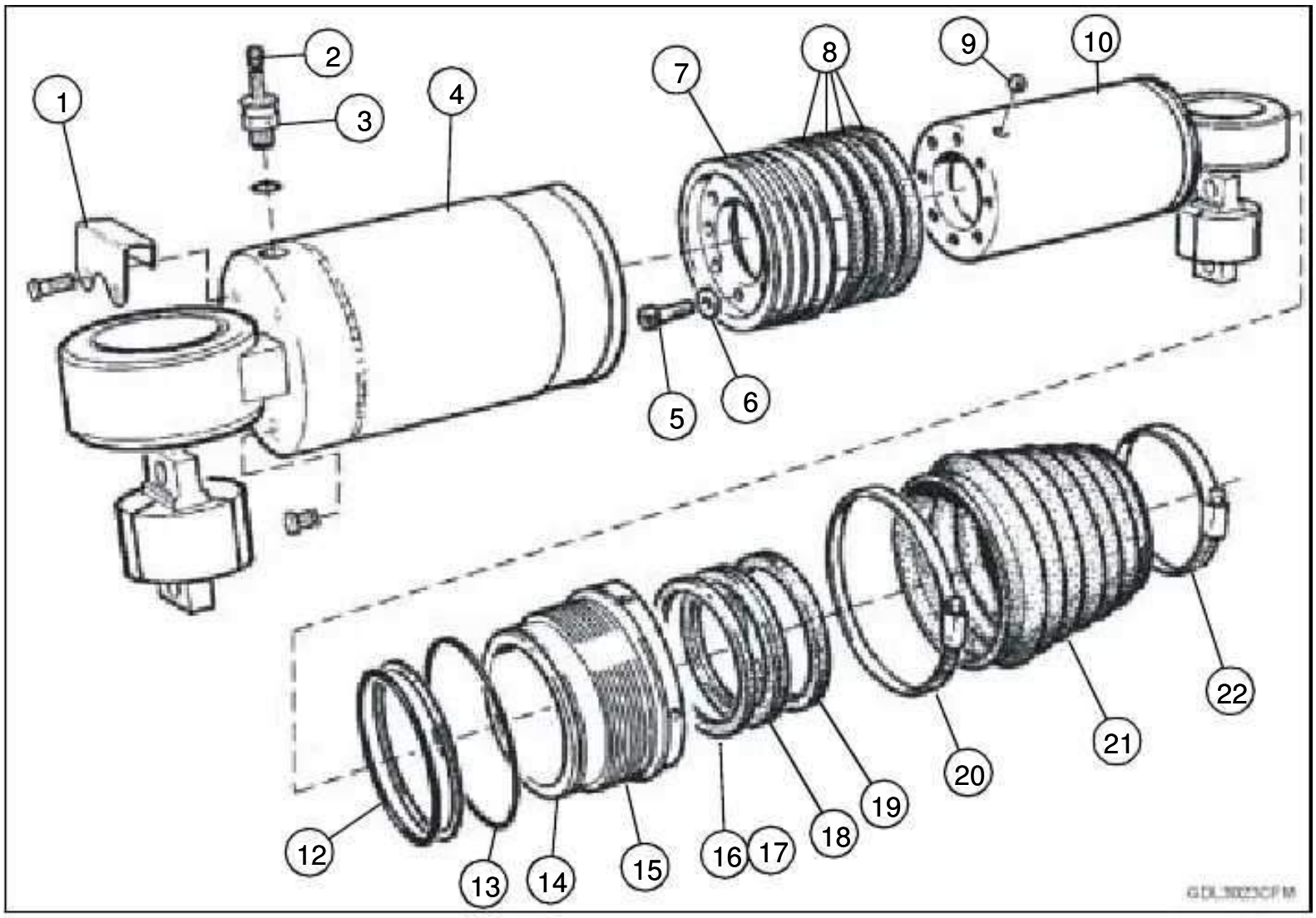
Axle Links, Stabilizers, and Struts Specification

Front Suspension Strut Pressure:
- - - - - - - - - - - - - - - - - - - -3500 kPa (35 bar) (500 psi)

Tighten outer nut on recharge fitting. Remove adapter and hose.

Operate machine and apply brakes a few times to cycle the suspension strut rods. Recheck ride height. **(See Check Front Axle Suspension Struts Operator's Manual, CHAPTER 13, SECTION 1).**

Install clamps, fitting cap, and guard.



1. Valve Guard.
2. Valve Cap.
3. Charging Valve.
4. Barrel.
5. Screw (8 used).
6. Lock Washer (8 used).
7. Piston.
8. Piston Seal (4 used).
9. Ball.
10. Rod.
11. Oil Plug.
12. O-Ring.
13. Backup Ring.
14. O-Ring.
15. Rod Guide.
16. Composite Seal.
17. Composite Seal O-Ring.
18. U-Seal.
19. Wiper Seal.
20. Clamp.
21. Boot.
22. Clamp.

Disassemble and Assemble Front Suspension Strut

Discharge nitrogen pressure from strut.

- Remove valve guard (1) and valve cap (2).

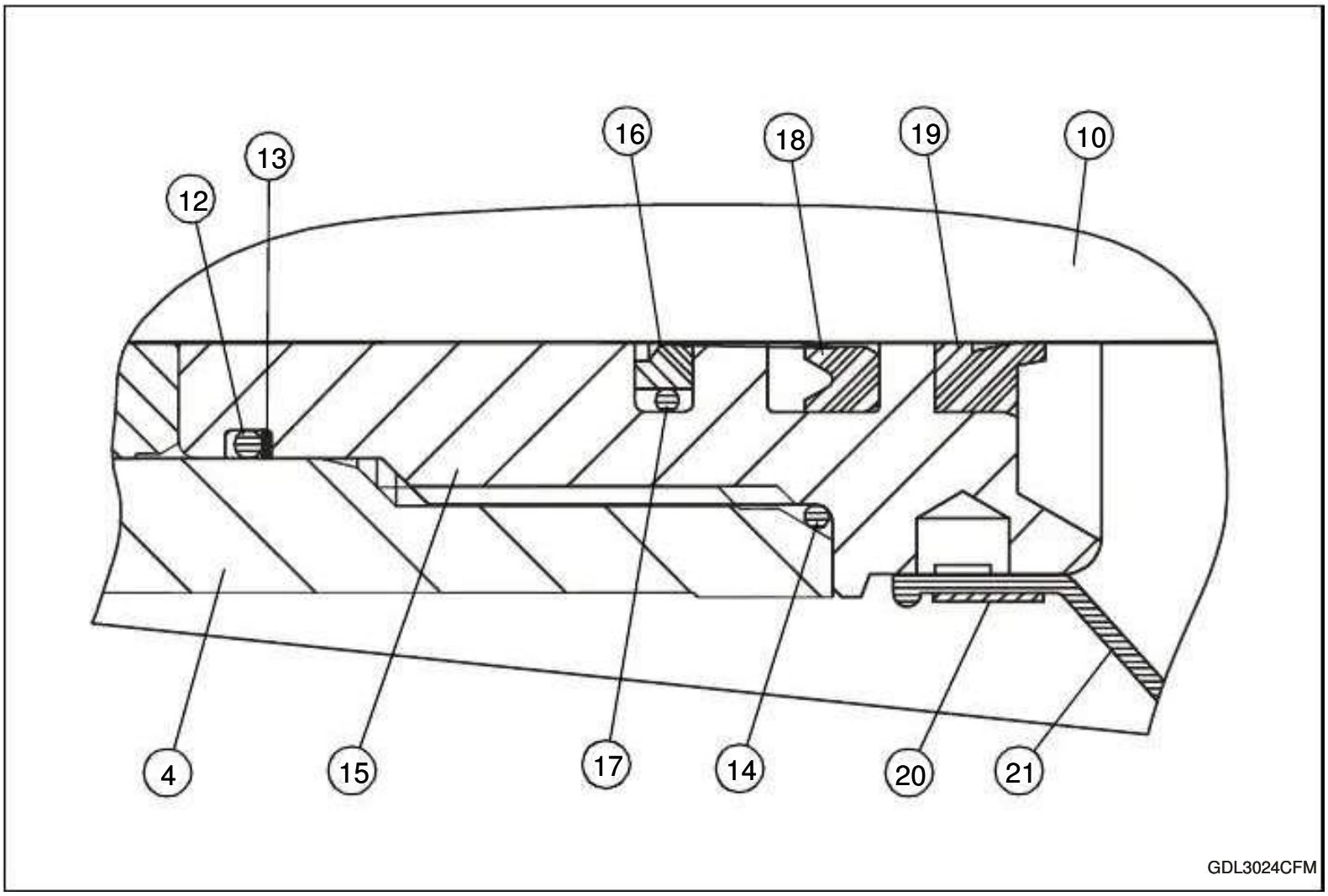
⚠ CAUTION

Avoid personal injury or death from pressurized gas and fluids.

- Slowly loosen outer nut on charging valve (3) to discharge nitrogen pressure. Remove valve after pressure is released.

Disassemble strut.

- Remove oil plug (11) and drain oil.
- Remove clamps (20 and 22) from boot (21). Disconnect boot from rod guide (15).
- Remove rod guide assembly (12 - 19), rod (10), and piston assembly (5 - 8) from barrel (4).
- Remove seals (8) from piston (7). Remove screws (5) and lock washers (6). Remove piston from rod.
- Remove ball (9) from rod.
- Remove rod guide assembly, boots, and clamps from rod.
- Remove rings and seals (12 - 14, 16 - 19) from rod guide (15).
- 3. Clean, inspect, and replace parts as necessary.



4. Barrel.
10. Rod.
12. O-Ring.
13. Backup Ring.
14. O-Ring.
15. Rod Guide.
16. Composite Seal.
17. Composite Seal O-Ring.
18. U-Seal.
19. Wiper Seal.
20. Clamp.
21. Boot.

Assemble strut.

NOTE: Apply a thin layer of petroleum jelly to all internal components during assembly.

- Separate O-ring (17) from composite seal (16). Install O-ring in rod guide.
- Bend composite seal into “kidney” shape. Install composite seal in rod guide.
- Install U-seal (18) in rod guide.
- Install wiper seal (19) in rod guide.
- Install backup ring (13) on rod guide.
- Install O-ring (12) on rod guide.
- Install O-ring (14) on rod guide.
- Install boot on rod.
- Install rod guide assembly on rod.
- Install ball in rod.
- Install seals on piston.
- Install piston assembly on rod.

Apply rigid form-in-place gasket to screws. Install screws and lock washers. Tighten screws to specification.

Axle Links, Stabilizers, and Struts Specification

Suspension Strut Piston Retaining Screw Torque: - 135 Nm (100 lb-ft)

- Install piston assembly, rod, and rod guide assembly in barrel. Tighten rod guide in barrel.
- Fill strut with oil.

- Install strut in 12 ton hydraulic press with oil plug at top. Compress strut until rod extends 100 mm (3.9 in.) from rod guide.
- Install charging valve in barrel. Ensure charging valve is fully open.
- Fill strut until overflowing with Transmax-Z oil. Allow time for oil to settle.
- Compress strut until rod extends 30 mm (1.2 in.) from rod guide. Ensure O-ring is seated firmly on oil plug. Install oil plug.

- Remove strut from hydraulic press.

WARNING

Use ONLY dry nitrogen to charge strut. Other gases can cause oxidation or condensation.

Charge strut with dry nitrogen.

- Connect nitrogen source to charging valve. Charge strut to specification. Close charging valve.

Axle Links, Stabilizers, and Struts Specification

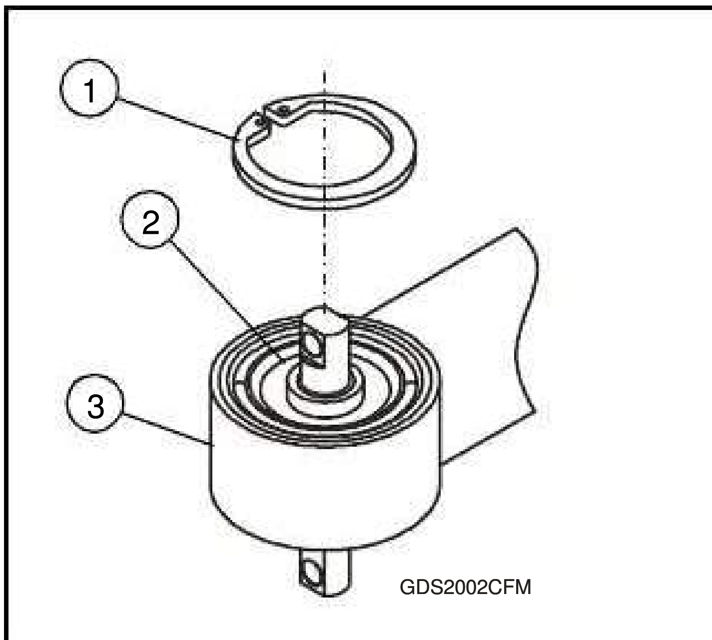
Suspension Strut Nitrogen Charging Pressure: -3585 kPa (35.9 bar) (520 psi)

- Disconnect nitrogen source. Install valve cap. Install valve guard.

- Install strut in 12 ton hydraulic press. Mark rod at rod guide and 50 mm (2.0 in.) from rod guide. Compress strut to mark. Decompress. Ensure strut expands to original mark. Repeat this step once.
- Remove strut from hydraulic press.

Install clamps on boot.

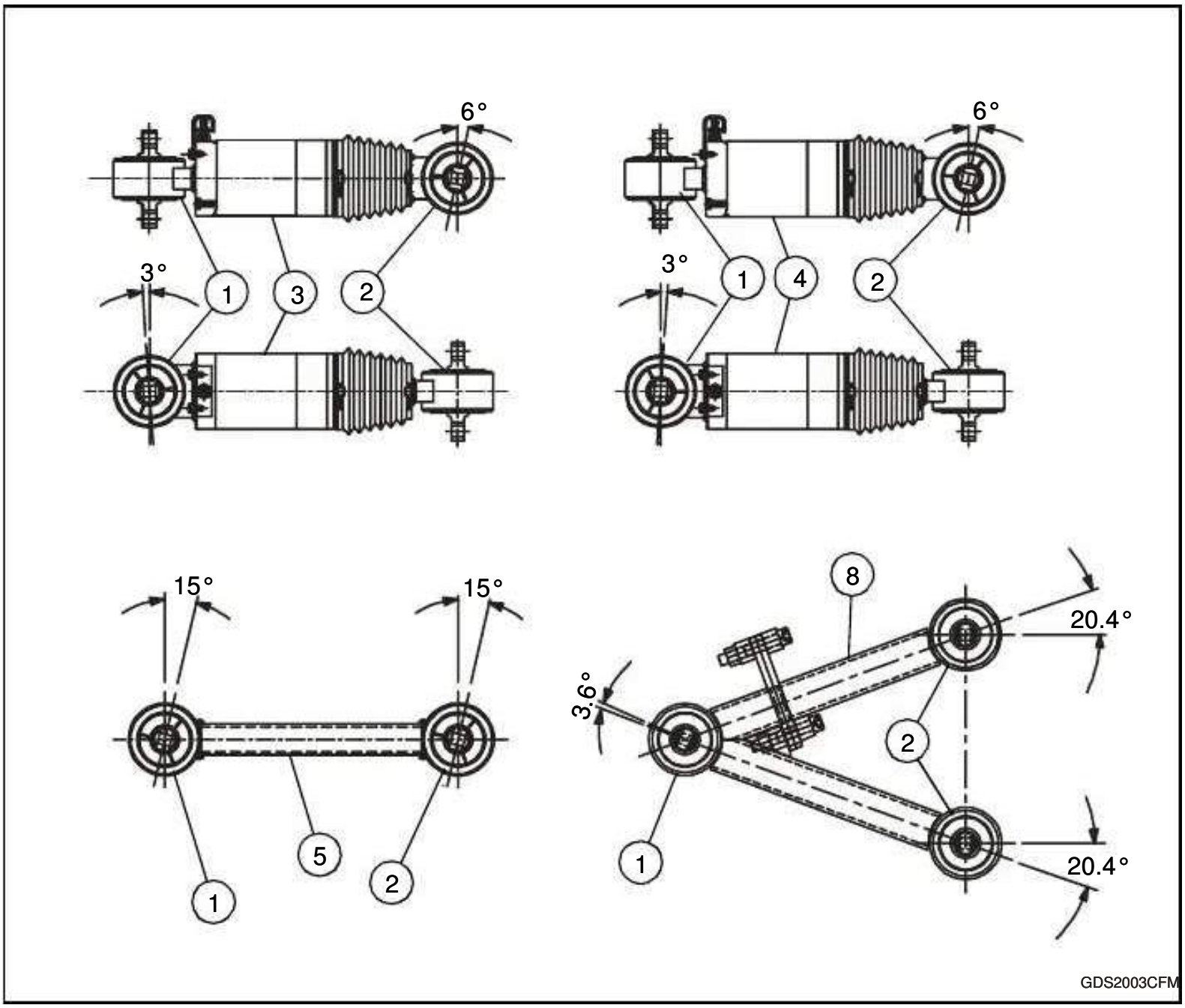
Replace Bushings



Remove snap ring (1) and press old bushing (2) from bore (3).

Replace Bushings

Cut old bushing out with a torch. Bushings cannot be pressed out of bores.



1. Axle End.
2. Frame End.
3. Middle or Rear Axle Upper Link or Drag Link (6 used).
4. Middle Axle Stabilizer.
5. Rear Axle Stabilizer.
6. Front Axle Stabilizer.
7. Front Axle Left Strut.
8. Front Axle Right Strut.

Align new bushing on bore at proper angle, as shown.

Press bushing into bore, using a hydraulic press. Install snap ring.

Middle and Rear Axle Walking Beams

Remove and Install Beam

Support machine rear frame with 20-ton shop stands. Chock front wheels securely.

CAUTION

Components are heavy. Use lifting device.

Middle and Rear Axle Walking Beams Specification

Middle Axle Weight B25D -930 kg (2050 lb) approximate

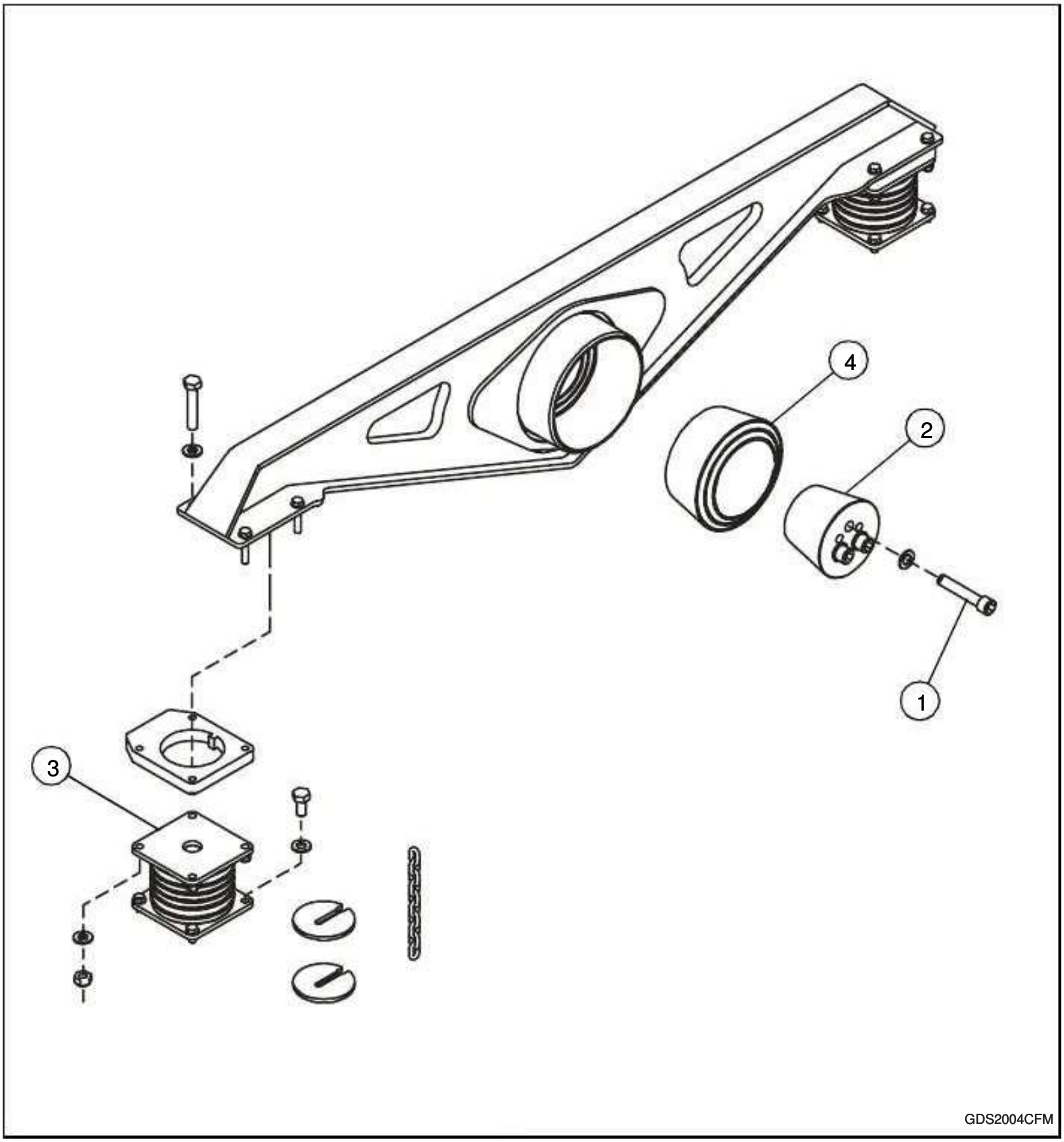
Middle Axle Weight B30D -1066 kg (2350 lb) approximate

Rear Axle Weight B25D - 907 kg (2000 lb) approximate

Rear Axle Weight B30D -1043 kg (2300 lb) approximate

Attach lifting devices to middle and rear axles.

Remove wheels. **(See “Removal” on page 1).**



1. Cap Screw (3 used).
2. Taper Plug.
3. Rubber Mount (2 used).
4. Bushing.

Disconnect walking beam from rubber mounts (3).

Lower middle and rear axles approximately 2.5 cm (1 in.) from walking beam with lifting devices. Support middle and rear axles with 20-ton shop stands.

⚠ CAUTION

Component is heavy. Use lifting device.

Middle and Rear Axle Walking Beams Specification

Walking Beam Weight :
- - - - - - - - - - - - - - - - - - - 263 kg (580 lb) approximate

Attach a lifting device to walking beam.

Remove cap screws (1) and washers from taper plug (2).

Insert DFT1199 Bushing Pusher in threaded holes in taper plug. Turn pushers clockwise evenly until walking beam comes off.

Replace parts as necessary.

Install bearings and taper plug on walking beam.

Install walking beam on machine. Install washers and cap screws.

Attach lifting devices to middle and rear axles. Raise axles to walking beam.

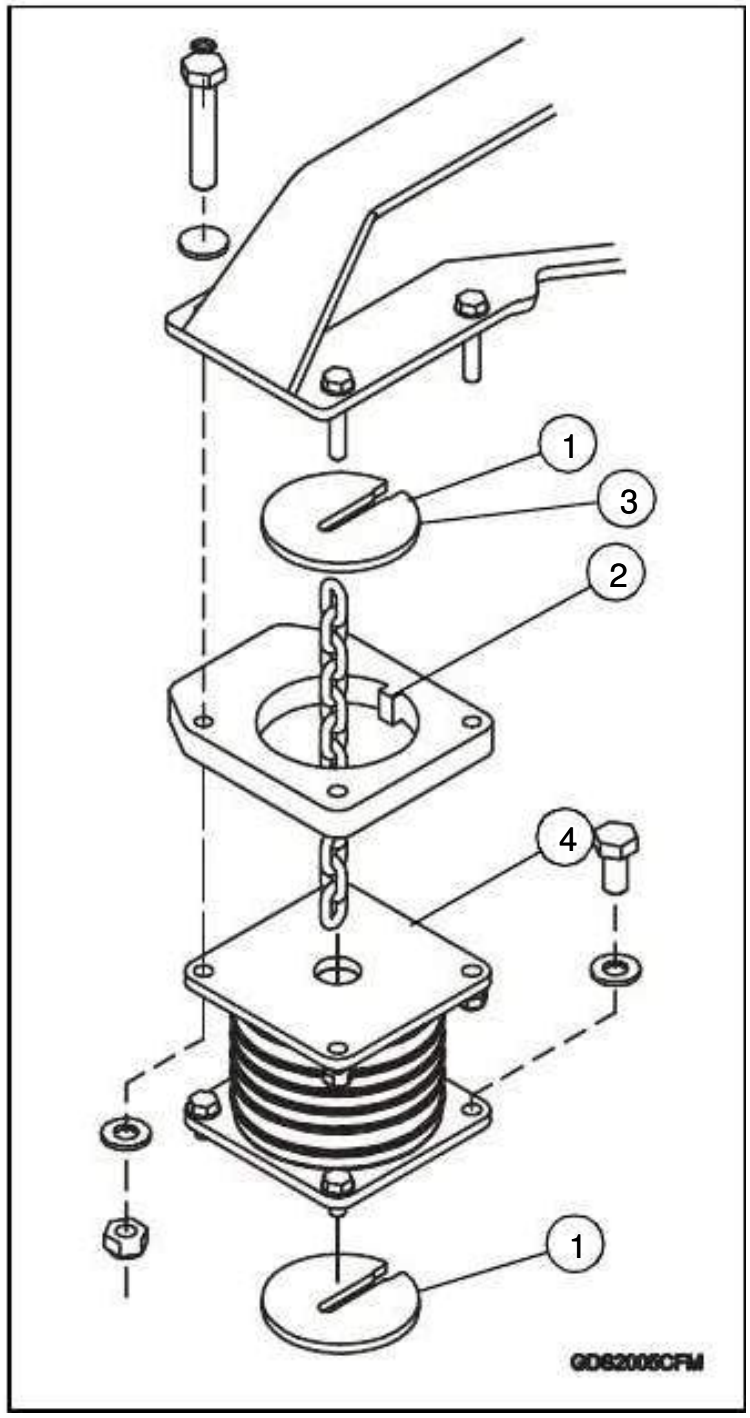
Connect walking beam to rubber mounts.

Install wheels. **(See “Install Wheel” on page 1).**

Remove and Install Rubber Mount

Support axle with lifting device and remove wheel. **(See “Removal” on page 1).**

Support walking beam with shop stand.



1. Retainer (2 used).
2. Spacer.
3. Chain.
4. Rubber Mount.

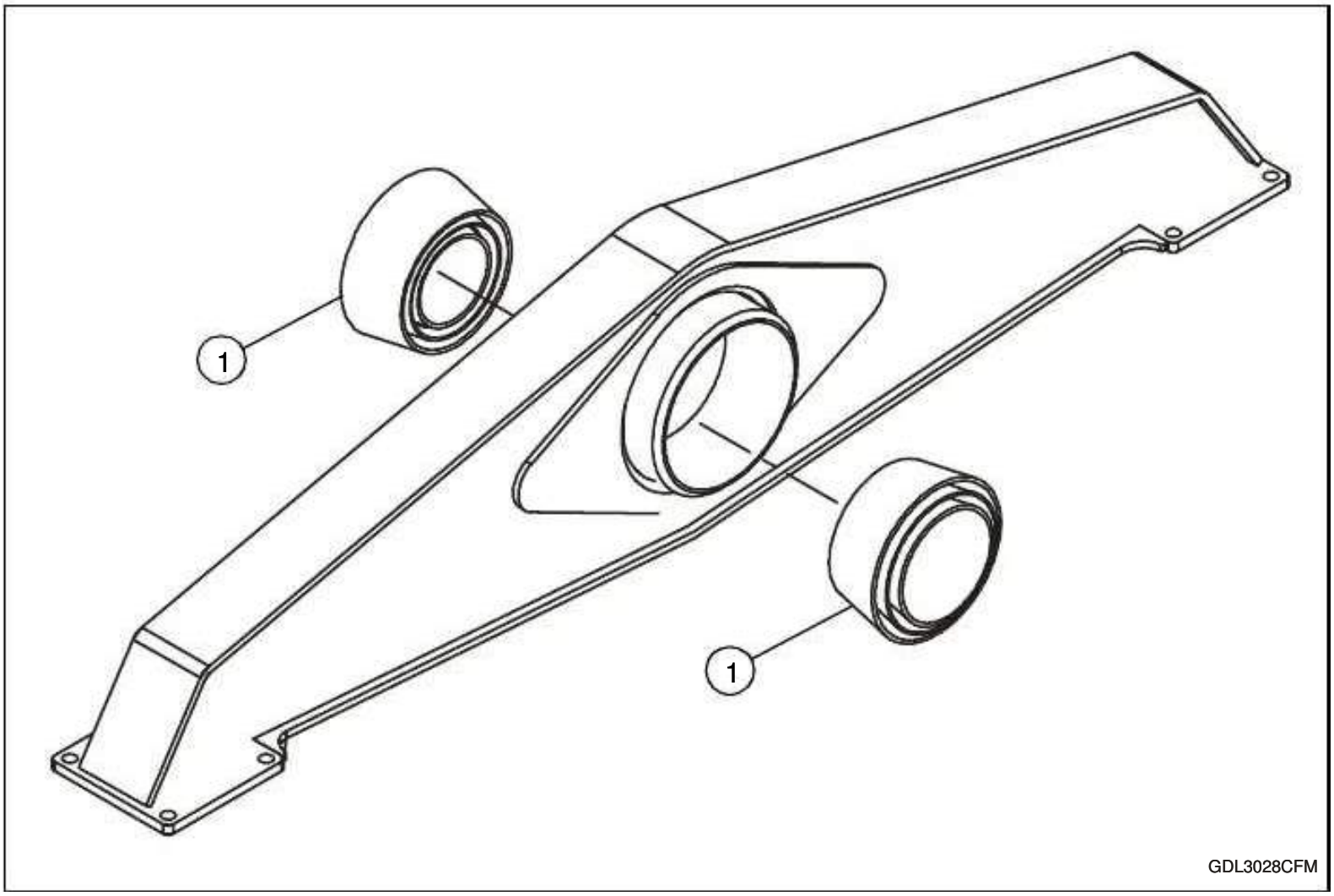
Disconnect rubber mount (4) from walking beam and axle. Lower axle with lifting device. Remove rubber mount.

Inspect parts and replace as necessary.

Install rubber mount on axle. Raise axle with lifting device. Install rubber mount on walking beam.

Install wheel. **(See “Install Wheel” on page 1).**

Remove and Install Bushing



1. Bushing (2 Used).

Remove bushings (1) by cutting with a hand-held grinder or cutting torch.

Press new bushings into bores using DFT1233 Bushing Driver. Press bushings below edge of bore per specifications.

Apply Anti-Seize Lubricant to walking beam pivot shaft and bushing.

CHAPTER 2. AXLES AND SUSPENSION SYSTEMS

SECTION 5. AXLE SHAFTS, BEARINGS AND REDUCTION GEARS

FINAL DRIVE PLANETARY

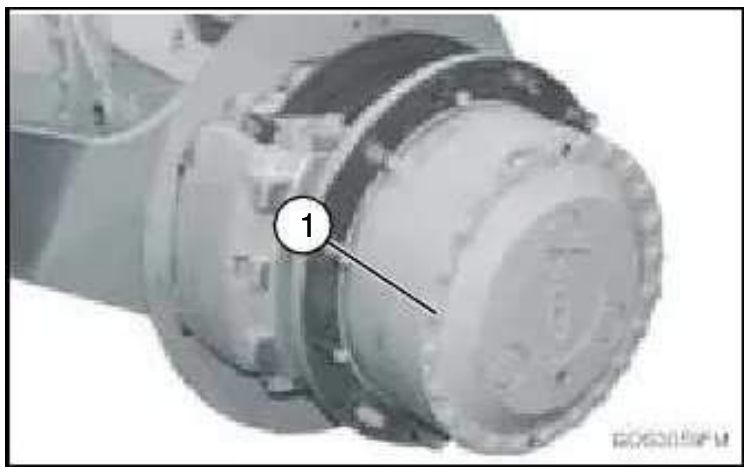
Remove and Install Final Drive Planetary

Remove wheels. **(See "Removal" on page 1).**

Drain planetary. **(See Change Final Drive Oil Operator's Manual, CHAPTR 15, SECTION 2).**

Drain axle oil. **(See Change Axle Oil Operator's Manual, CHAPTER 15, SECTION 2)**.

NOTE:Drain plug must be aligned with cutout in axle housing, or oil will not drain properly.



Remove two bolts (1).

Install two longer bolts (2) to guide planetary cover (1).

Install two bolts (3) into threaded holes and tighten equally to separate planetary cover (1) and hub (4).

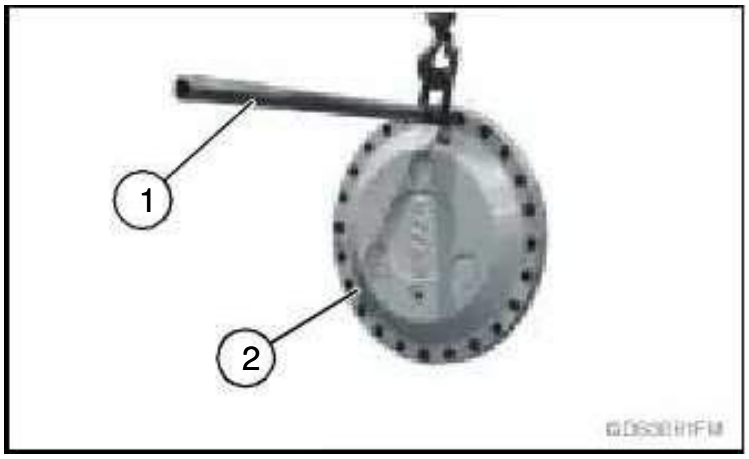
Remove cap screws (3 and 4).

⚠ CAUTION

Component is heavy. Use hoist.

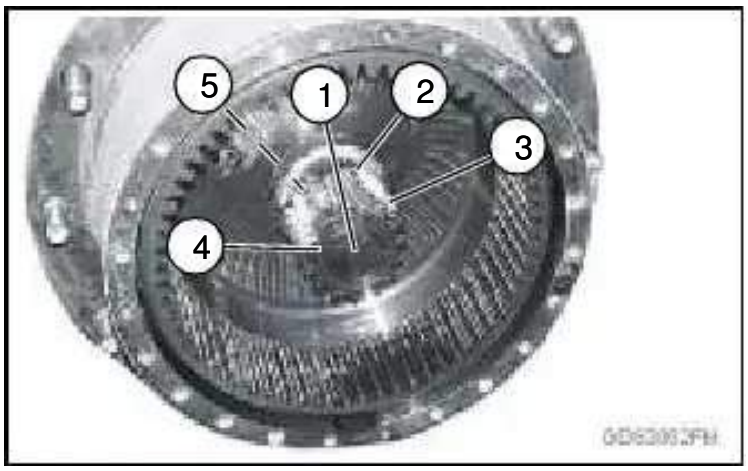
Axle Outboard Planetaries Specification

Planetary Cover Weight:- - - - - - - - - - - - 79 kg (175 lb)



Install DFT1178 Lifting Tool in the threaded hole of final drive planetary cover (2). **(See "DFT1178 LIFTING TOOL" on page 384).**

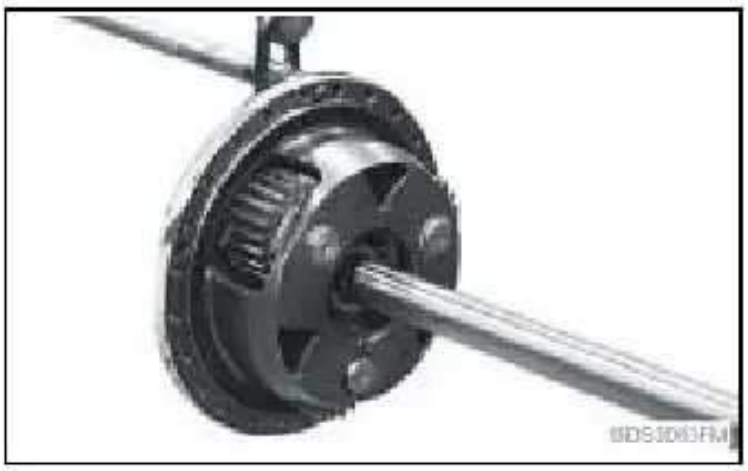
Install hoist to lifting ring and remove final drive planetary cover. Axle and sun gear may remain in axle housing or be removed with final drive planetary.



Remove side shaft (1) and sun gear assembly, if not previously removed.

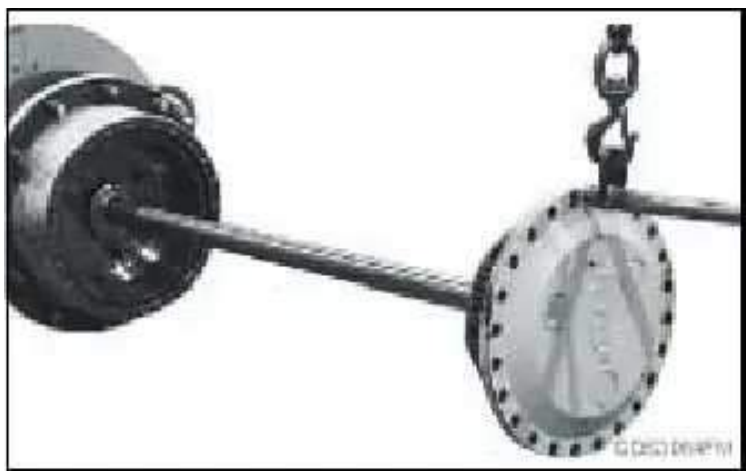
Inspect side shaft bushing (5) in hub and replace if necessary.

Clean and inspect parts for wear or damage.

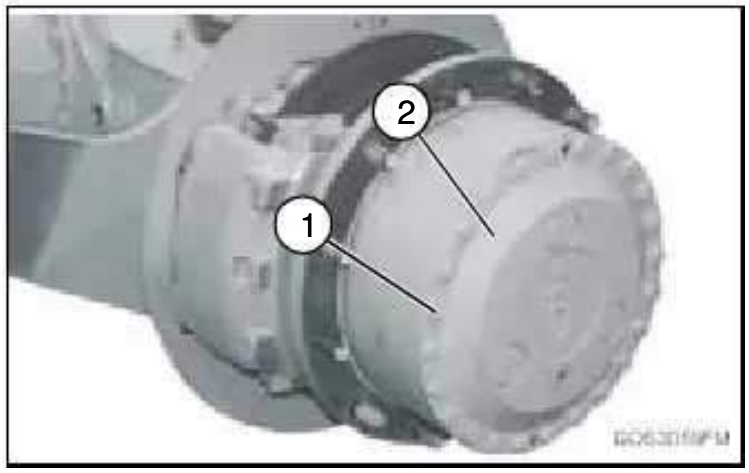


Install side shaft and sun gear assembly in final drive, if previously removed.

Apply cure primer and flexible form-in-place gasket sealer to planetary cover.



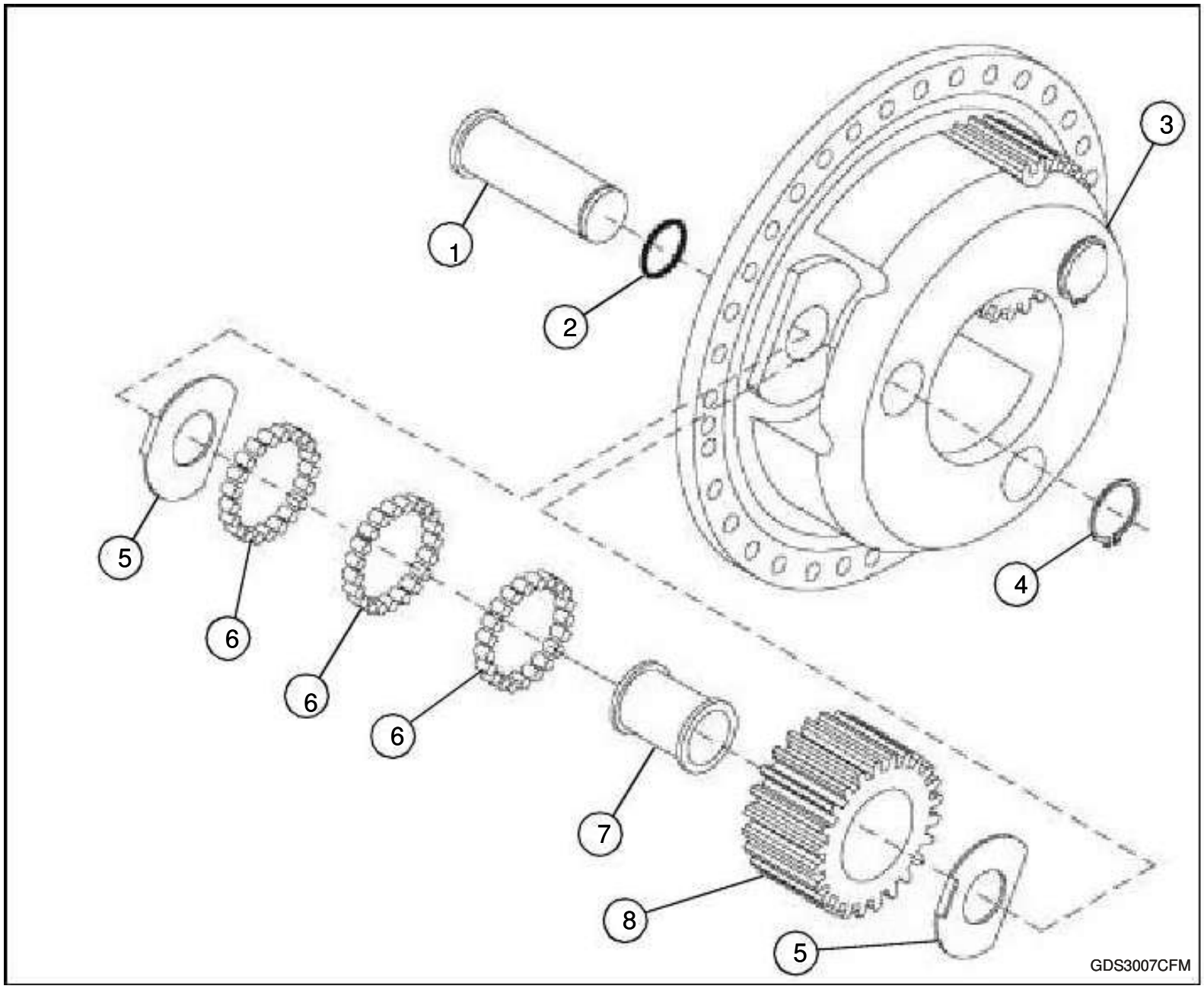
Install side shaft and planetary cover using DFT1178 Lifting Tool to guide axle into differential.



Apply cure primer and thread lock and sealer (medium strength) to threads of cap screws. Install and tighten cap screws (1).

Fill final drive with oil. **(See Axle and Final Drive Oil in Operator's Manual, CHAPTER 15, SECTION 2).**

Disassemble and Assemble



1. Pin (3 used).
2. O-Ring (3 used).
3. Planetary Hub.
4. Snap Ring (3 used).
5. Shim (6 used).
6. Cylindrical Roller (189 used).
7. Inner Bearing Race (3 used).
8. Planet Gear (3 used).

Remove snap ring (4).

Using a press, remove pin (1) from planetary hub (3).

Remove planet gear (8) and parts (5 - 7).

Clean and inspect parts for wear or damage.

Install rollers (6), inner bearing race (7), and shims (5) in planet gear.

Install planet gear in planetary hub.

Install O-ring on pin.

Using a press, install pin and O-ring in planetary hub (3) and bearing race (7). Install snap ring (4).

Repeat steps 1 - 7 on remaining planet gears.

Axle Shafts

Remove and Install Axle Shafts

NOTE:See "Remove and Install Final Drive Planetary" on page 53.

Remove axle shaft.

Inspect parts and repair as necessary.

Install axle shaft part way into housing.

Install planetary cover. Use planetary cover and lifting tool as leverage to align axle shaft splines in differential. **(See).**

Wheel Hubs

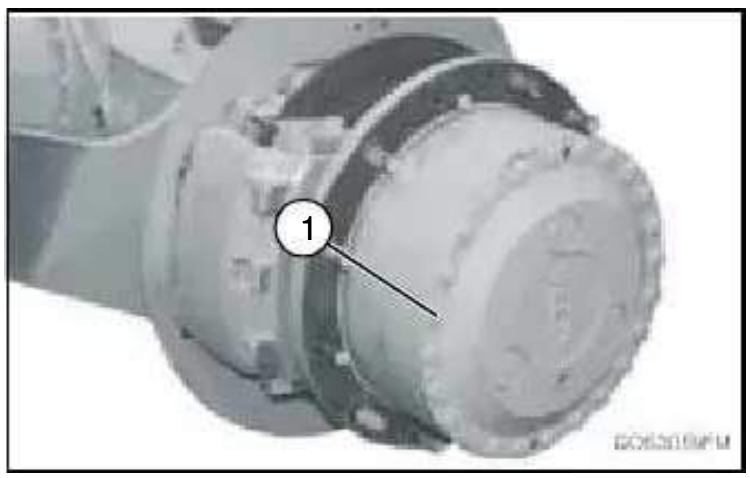
Disassemble and Assemble Wheel Hubs

Raise machine and place floor stand under axle.

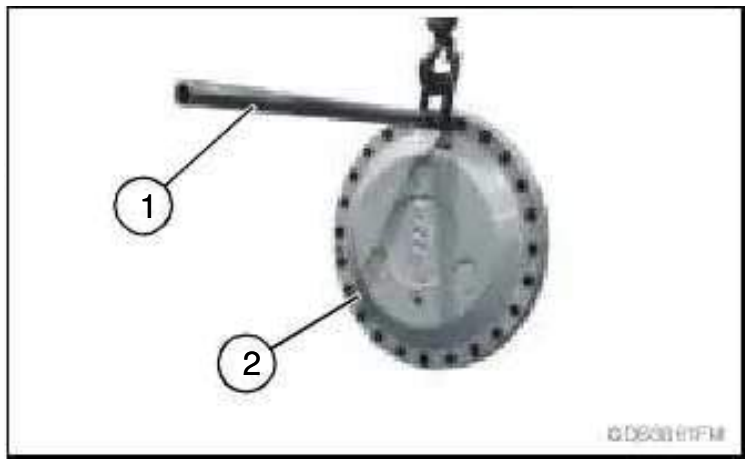
Remove wheels. **(See "Removal" on page 1).**

Drain planetary. **(See Change Final Drive Oil Operator's Manual, CHAPTR 15, SECTION 2).**

Drain axle oil. **(See Change Axle Oil Operator's Manual, CHAPTER 15, SECTION 2)**.



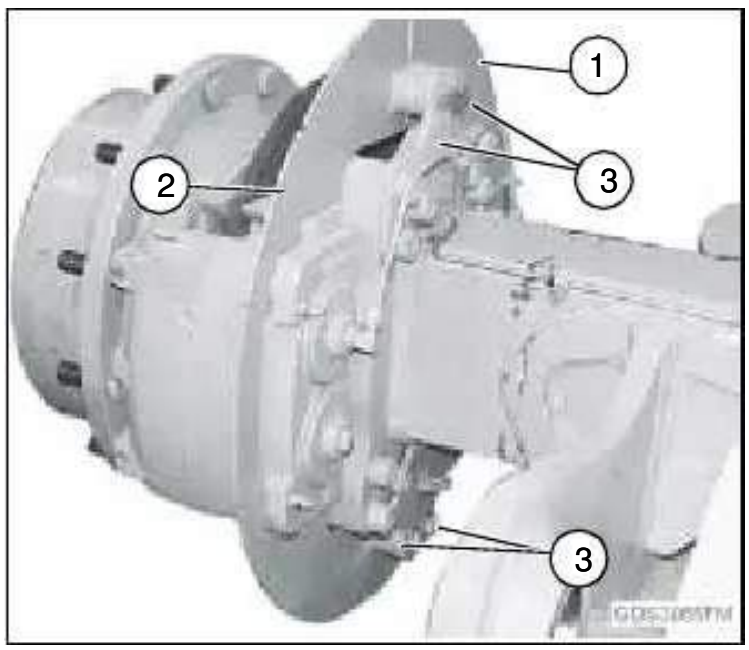
Remove bolts (1).



Install DFT1178 Lifting Tool in the threaded hole of final drive planetary cover (2). **(See "DFT1178 LIFTING TOOL" on page 384).**

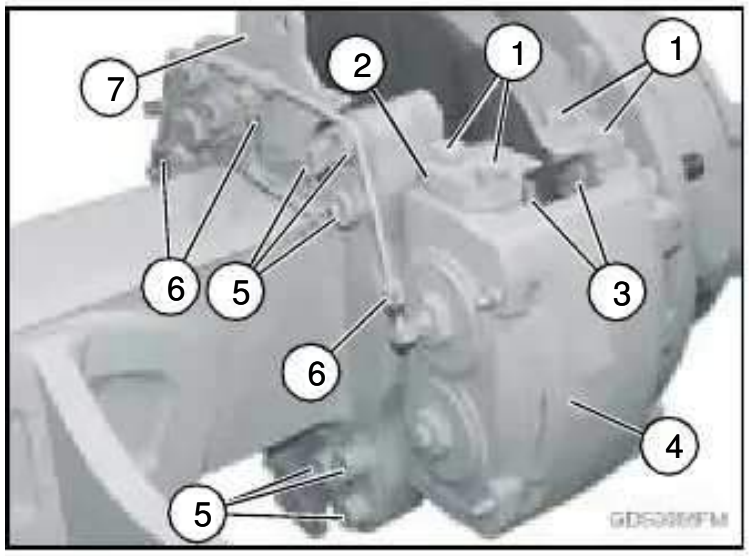
Install hoist to lifting ring and remove final drive cover.

Remove axle and sun gear assembly **(See "Remove and Install Final Drive Planetary" on page 53).**



Scribe a line to mark position of calipers and backing plates to aid in assembly.

Remove cap screws (3) and backing plates (1 and 2).



Remove cap screws (1) and retainers (2).

Remove brake pads (3).

Remove brake line nuts (6). Close all openings with caps and plugs.

NOTE:Longer caliper cap screws (5) are used to install support plate (7).

Remove caliper cap screws (5) and remove plate (7).

Remove caliper (4).

Inspect parts for wear or damaged.

Repeat steps (12 - 15) for front brake and caliper.

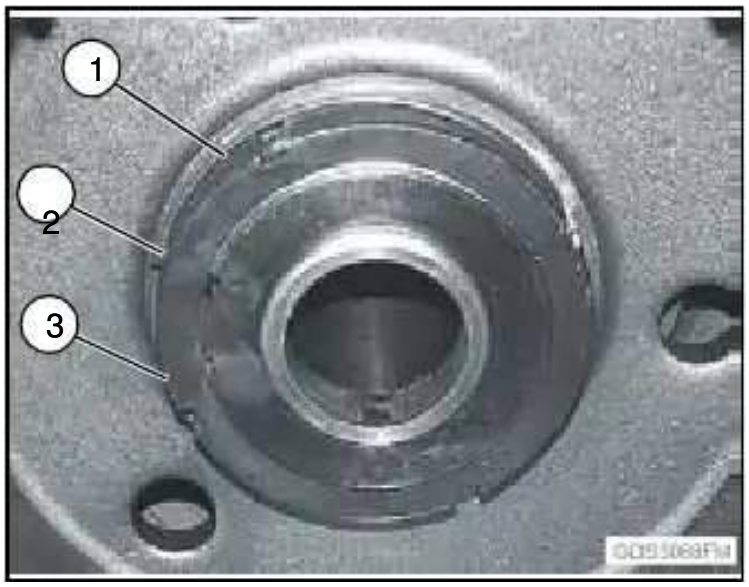
⚠ CAUTION

Approximate weight of hub assembly is 91 kg (200 lb).

Specification

Hub Assembly Weight - - - - - - - - - - - - - 91 kg (200 lb)

Attach hoist with tool JDG909 Lifting Brackets.



Remove lock ring (1), lock pin (2), and remove nut (3) with hub nut spanner 280173.

Remove outer ring gear (1) and inner ring gear (2) with bearing.

Remove outer wheel bearing (6).

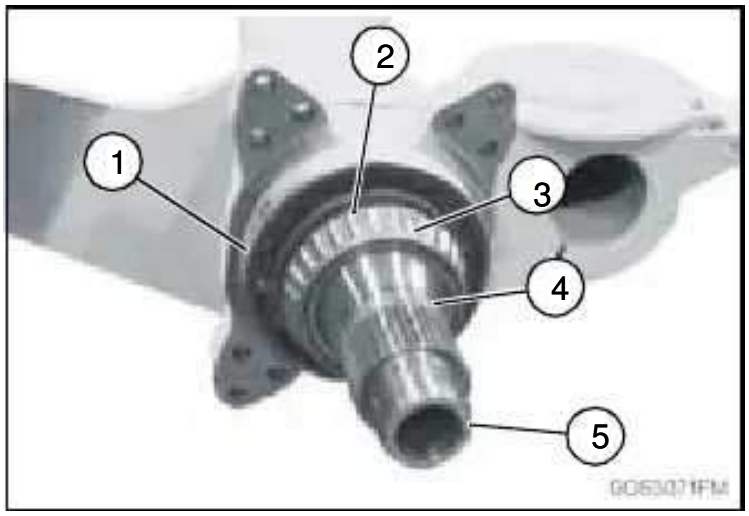
Bend retainer lock (2) tabs.

Remove bolts (3), retainers (1), and locks (2).

Remove inner ring gear (4).

Clean and inspect all parts for wear or damage.

Remove hub.

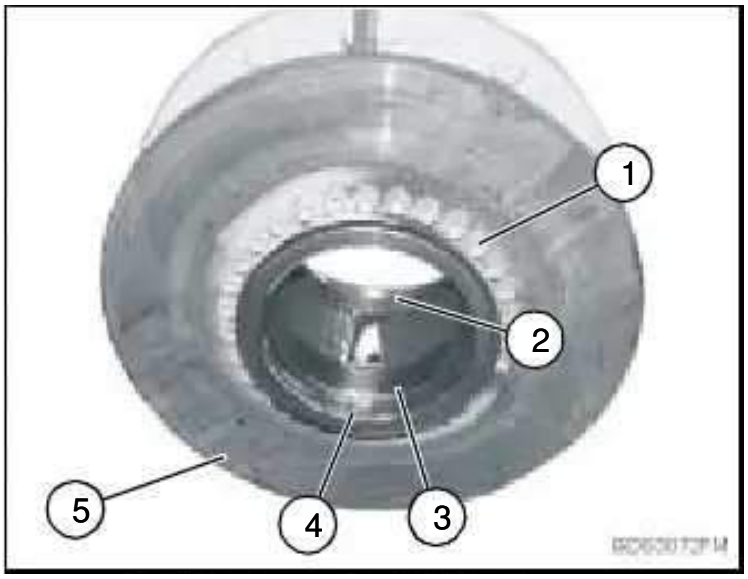


Inspect axle bushing (5) in axle housing and replace if necessary.

Remove inner wheel bearing (3) and seal (2).

Remove seal protector ring (1).

Remove cap screws and spindle (2).



Remove outer bearing cup (2).

Remove snap ring (4) and remove inner bearing cup (3).

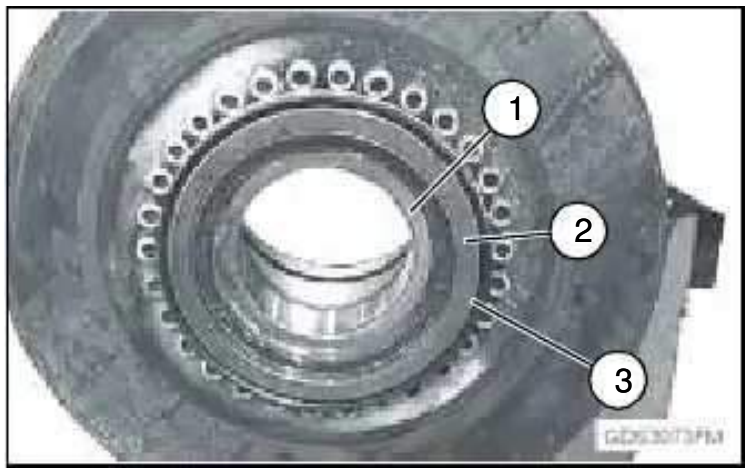
Remove cap screws (1) and brake rotor (5).

Clean and inspect all parts.

Install brake rotor and cap screw.

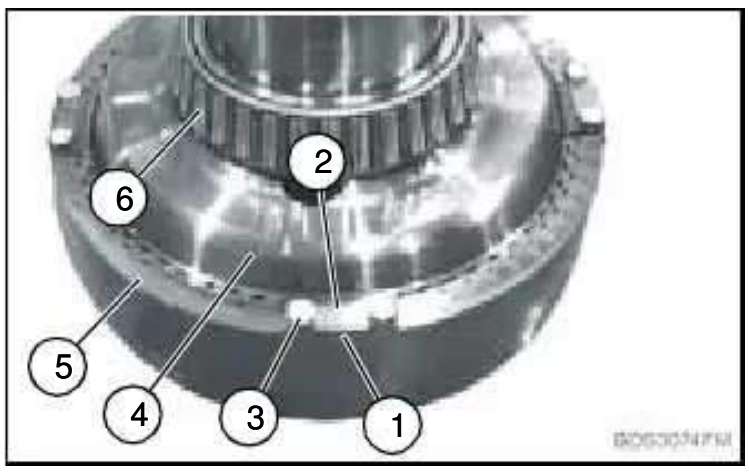
Install inner and outer bearing cups (2 and 3) using D01045AA Bushing, Bearing and Seal Driver Set.

Install snap ring.



Apply multi-purpose grease to inner bearing (1) and install in bearing cone.

Apply cure primer and flexible form-in-place gasket to oil seal (2). Install oil seal flush with hub surface (3).



Install inner ring gear (4) in outer ring gear (5).

Install retainer (1) and retainer lock (2) with cap screws (3).

Apply multi-purpose grease to outer wheel bearing (6) and install on inner ring gear.

Install seal protector and hub (3) on axle spindle.

Install inner and outer ring gears (1 and 2).

Use spanner nut (1) to position hub and bearings on spindle.

Remove hoist and lift tool.

Rotate hub and torque spanner nut using hub nut spanner 280173 to 1000 Nm (737.56 lb.-ft) while rotating the hub to seat bearings and bearing cups.

Loosen the nut and torque to 500 Nm (368.78 lb-ft).

Ensure that the bearings has a maximum rolling resistance of 25 Nm (18.4391 lb-in.).

Specification

Spanner Nut Torque - - - - - - - - - 500 Nm (368.78 lb-ft)

Loosen spanner nut and measure rolling drag torque with DFT1183 Rolling Drag Torque Bar. **(See DFT1183 "DFT1183 ROLLING DRAG TORQUE BAR" on page 386 for instructions to make tool.)**

Tighten spanner nut to a rolling torque.

Rolling drag torque after 100 hours or more of operation with brake pads removed.

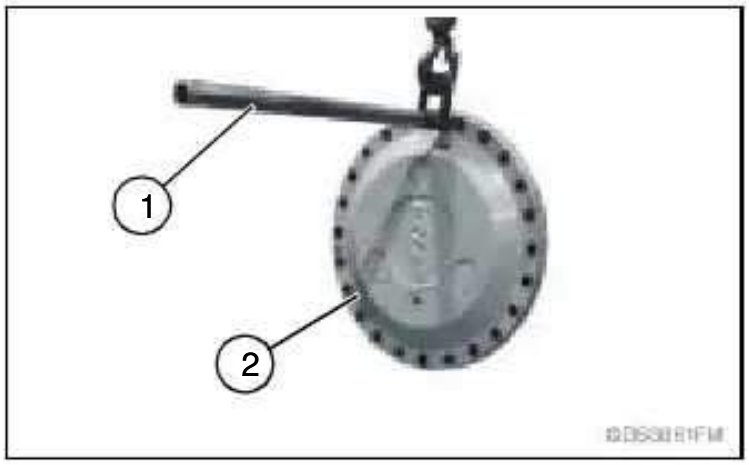
Specification

Wheel Bearing Rolling Drag Torque (dry) Rolling Drag Torque - - - - - - - - - - - - - - - - 40 - 45 Nm (29 - 33 lb-ft)

Wheel Bearing Rolling Drag Torque (wet and pads removed) Rolling Drag Torque Max.- 25 Nm (18.4391 lb-in.)

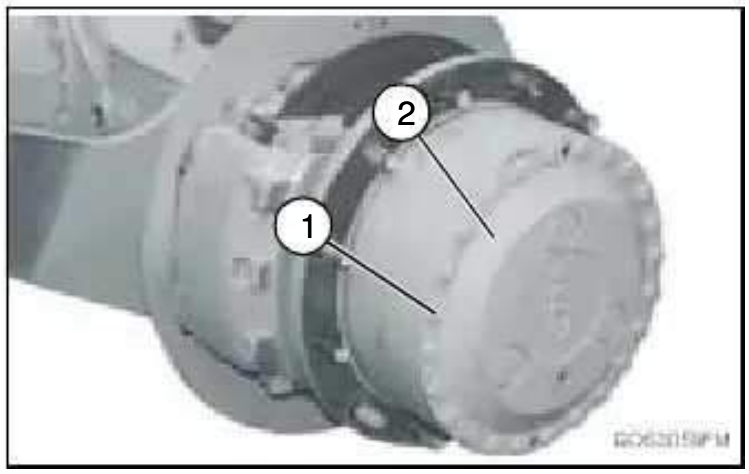
Tighten nut (3) with hub nut spanner 280173 to install lock pin (2).

Install lock ring (1).



Apply cure primer and flexible form-in-place gasket to planetary cover.

Install axle and final drive assembly in axle housing. Use DFT1178 Lifting Tool to guide axle and final drive into position. **(See "DFT1178 LIFTING TOOL" on page 384)**



Apply cure primer and thread lock and sealer (medium strength) to cap screws (1). Install and tighten cap screws.

Fill final drive. **(See Axle and Final Drive Oil in Operator's Manual, CHAPTER 15, SECTION 2).**

Fill axle. **(See Axle and Final Drive Oil in Operator's Manual, CHAPTER 15, SECTION 2)**.

CHAPTER 3. TRANSMISSION

SECTION 1.REMOVAL AND INSTALLATION

REMOVE AND INSTALL TRANSMISSION

Engine and transmission are removed together. Remove engine and transmission, then remove transmission from engine. **("Remove and Install Engine" on page 159).**

Repair or replace as necessary.

Install transmission to engine. **(See "Remove and Install Connector Drive (Flexplate)" on page 253).**

Install transmission. **(See "Remove and Install Engine" on page 159).**

Mount Transmission in Repair Stand

⚠ CAUTION

Approximate weight of transmission is 345 kg (760 lb).

Mount transmission to D01003AA Repair Stand with DFT1228 Transmission Mount Adapters.

Transmission Disassemble Specification

Transmission Mount Adapter Torque -- 225 Nm (166 lb-ft)

See Dealer Fabricated Tools "DFT1228 TRANSMISSION MOUNT ADAPTERS" on page 392.

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SECTION 2. INPUT DRIVE SHAFTS AND U-JOINTS

REMOVE AND INSTALL TRANSMISSION-TO-TRANSFER CASE DRIVE SHAFT

Tilt cab. **(See Tilt Cab Operator's Manual CHAPTER 7, SECTION1).**

⚠ CAUTION

Component is heavy. Use hoist.

Remove drive shaft assembly **(See "Remove and Install Transmission-to-Transfer Case Drive Shaft or Transfer Case-to-Oscillation Joint Drive Shaft" on page 35).**

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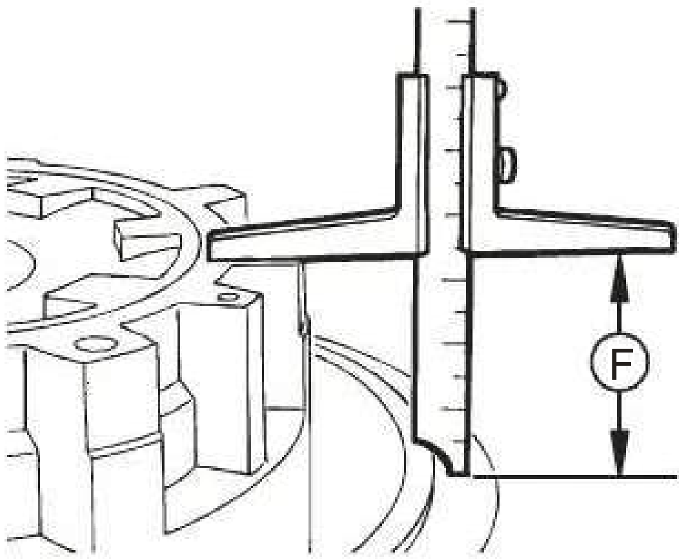
CHAPTER 3. TRANSMISSION

SECTION 3. GEAR, SHAFT AND POWER SHIFT CLUTCHES

DISASSEMBLE TRANSMISSION

Clean and drain transmission to prevent contamination of parts.

Remove Torque Converter



GDS3008CFM

With torque converter up, measure converter depth at several points and calculate the average converter depth.

Specification

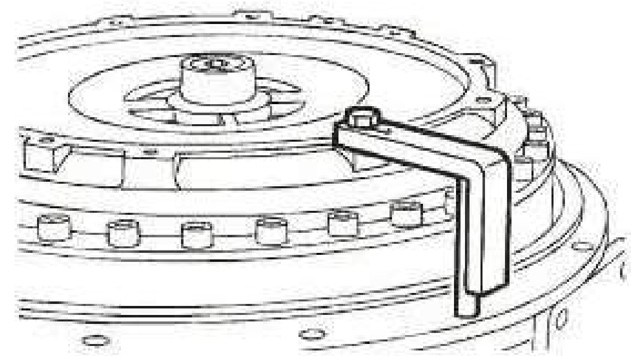
Torque Converter Installed Average Height -86.25 mm (3.40 in.)

NOTE: Torque converter depth measurement will be referenced when installing torque converter.

Measurement is taken from converter flange to transmission housing flange as shown (F).

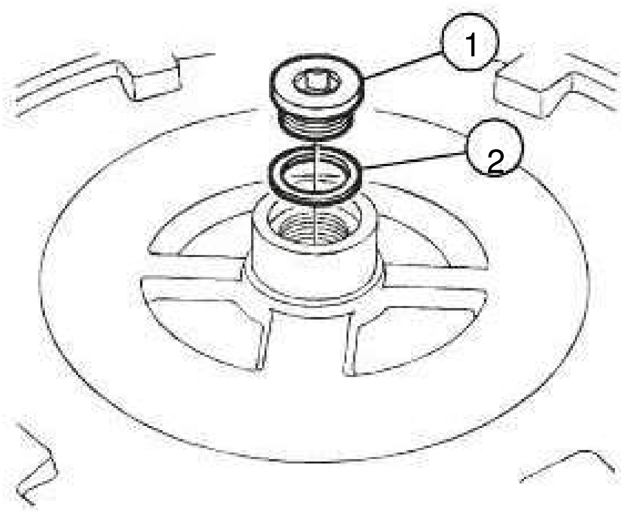
CAUTION

Do Not remove socket head cap screws at torque converter outer perimeter at this time.



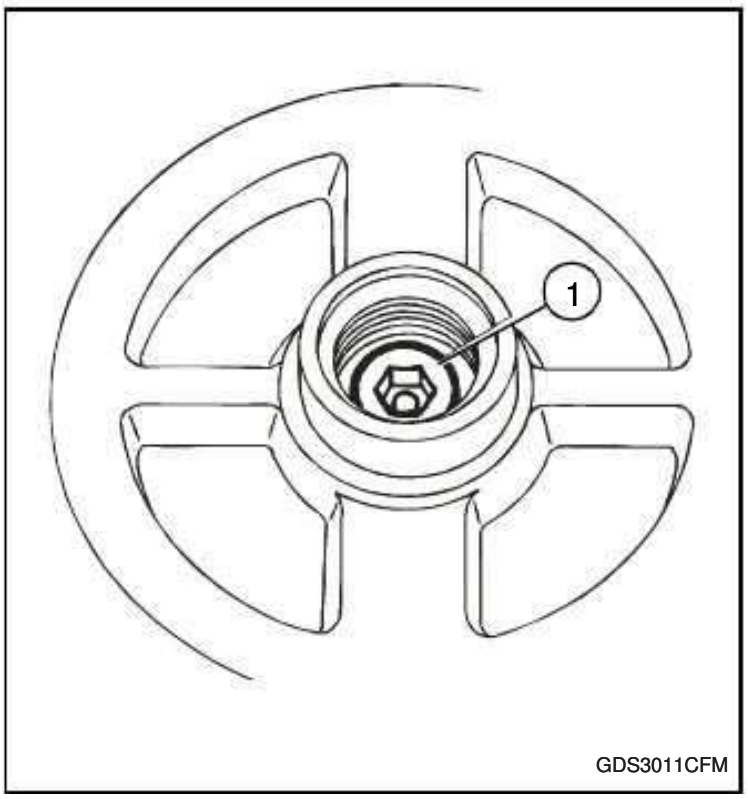
GDS3009CFM

Install DFT1229 Torque Converter Holding Bracket.



GDS3010CFM

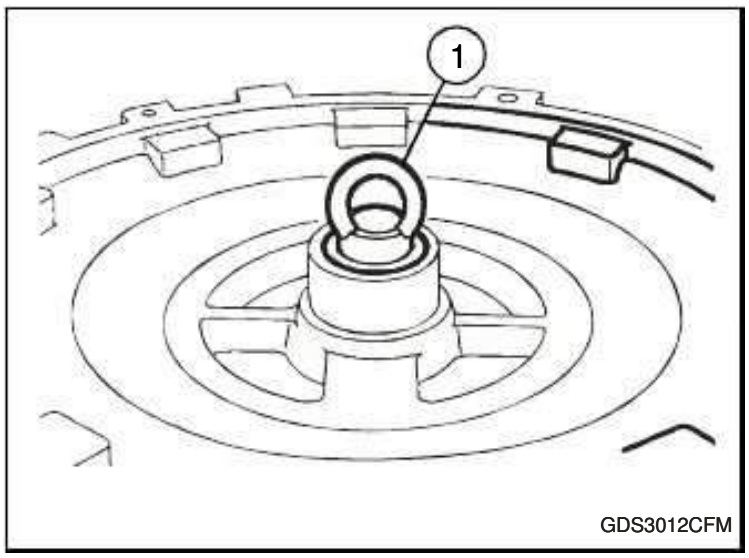
Remove plug (1) and seal (2). **(See “CHAPTER 17. DEALER FABRICATED TOOLS” on page 383.)**



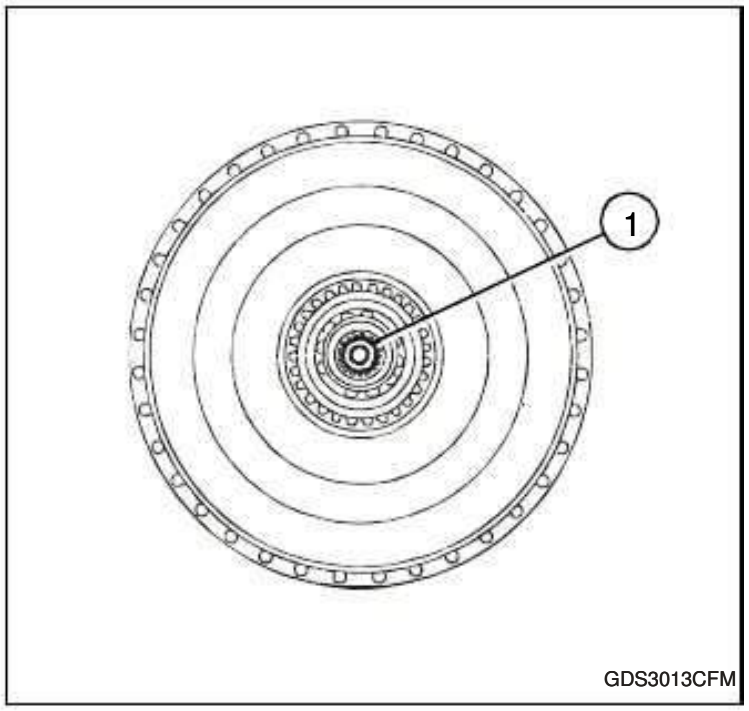
Install JDG1611 Mechanical Holding Tool to hold turbine shaft and remove cap screw (1).

⚠ CAUTION

Heavy componet use hoist. Approximate weight of torque converter is 60 kg (132 lb).

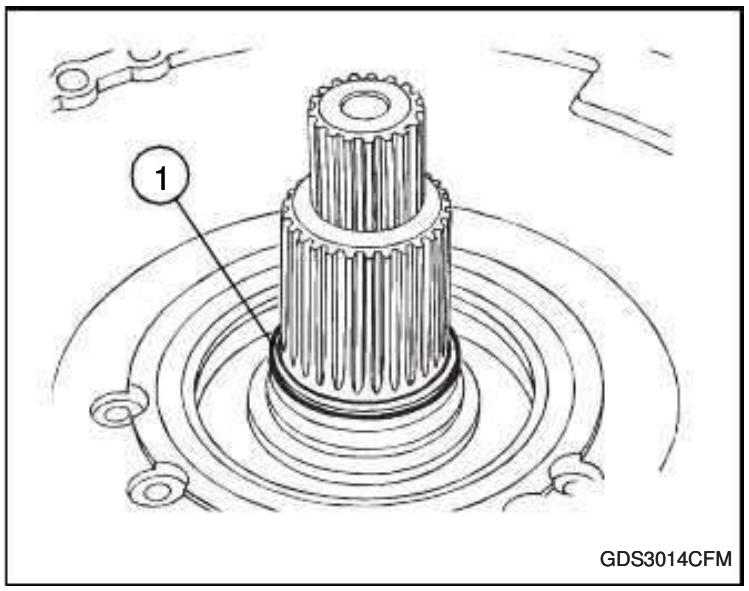


Install 281696 Lifting Device (1) and lift torque converter. Tip torque converter to drain remaining oil.



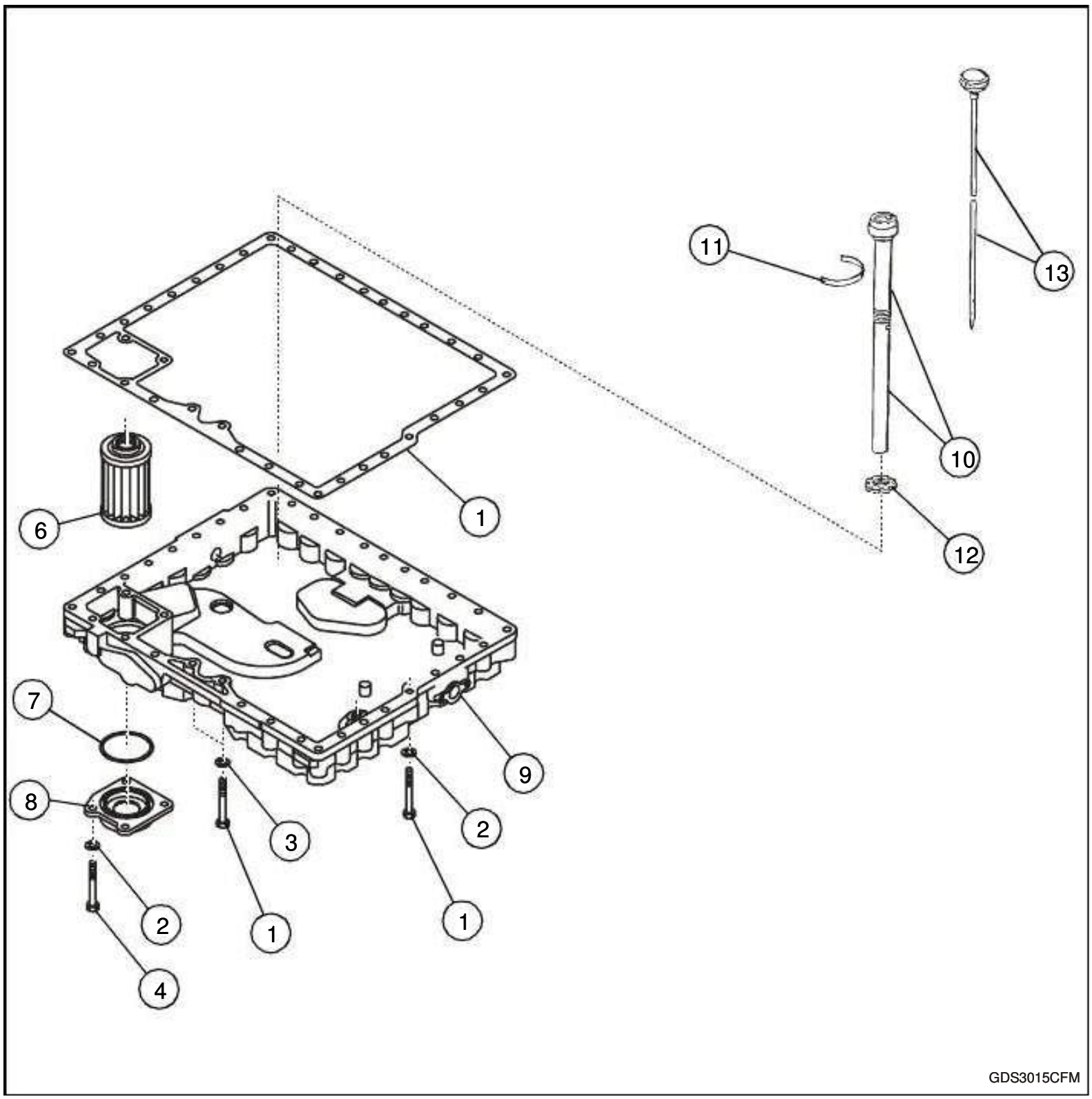
Support converter on wood blocks to protect converter hub.

Position converter with hub up and remove shims (1).



Remove stator shaft spacer ring (1).

Remove Oil Pan and Control Valve



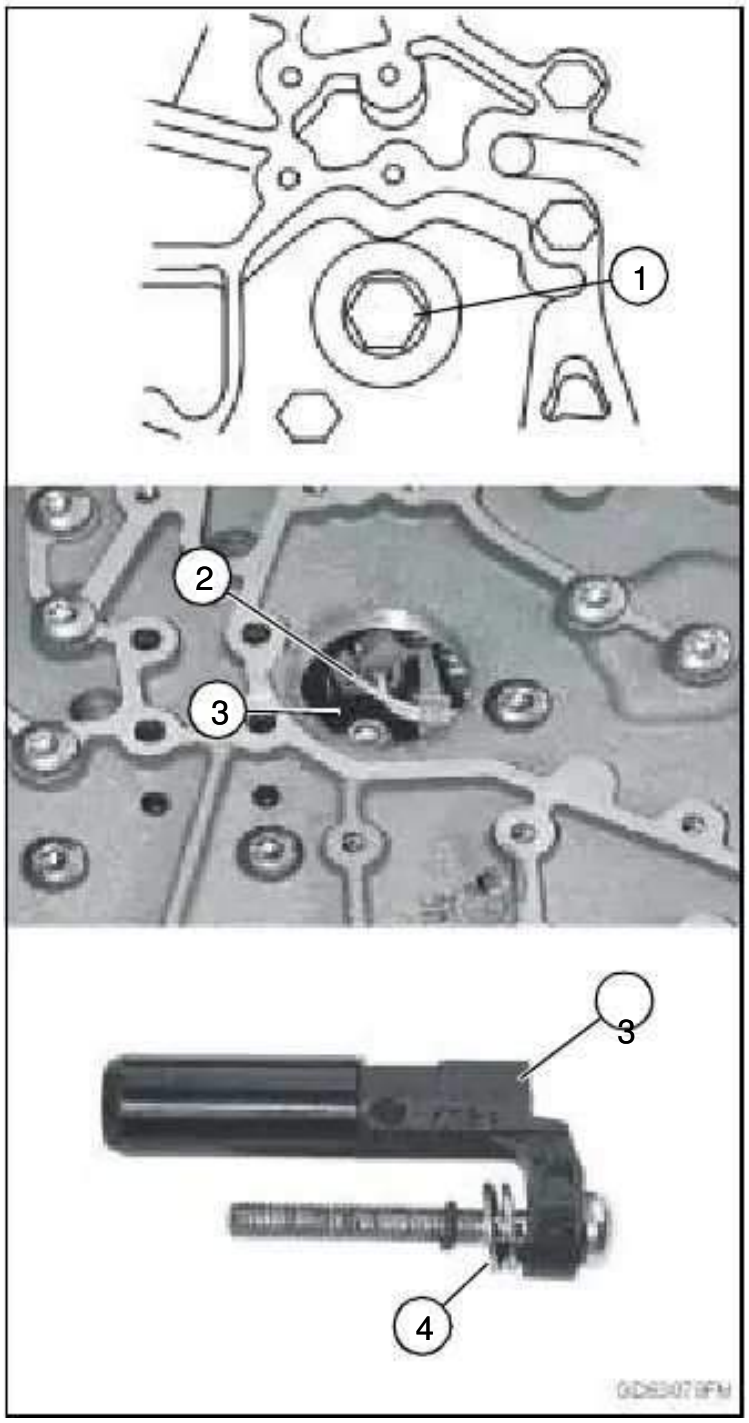
1. Bolt (33 used).
2. Washer (4 used).
3. Copper Washer (33 used).
4. Bolt (4 used).
5. Pan Gasket.
6. Filter.
7. O-Ring.
8. Filter Cover.
9. Oil Pan.
10. Oil Filler Pipe.
11. Sealing Tape.
12. Grooved Lock Nut.
13. Oil Dipstick.

Remove filter cover (8) and filter (6).

Remove oil pan (9) and discard copper washers (3).

NOTE:Oil filler pipe should only be removed when necessary.

Remove oil filler tube (10) if necessary.



Remove plug (1).

Remove wire connectors (2). Wire connector location is not important.

Remove input speed sensor (3) and shim(s) (4).

⚠ CAUTION

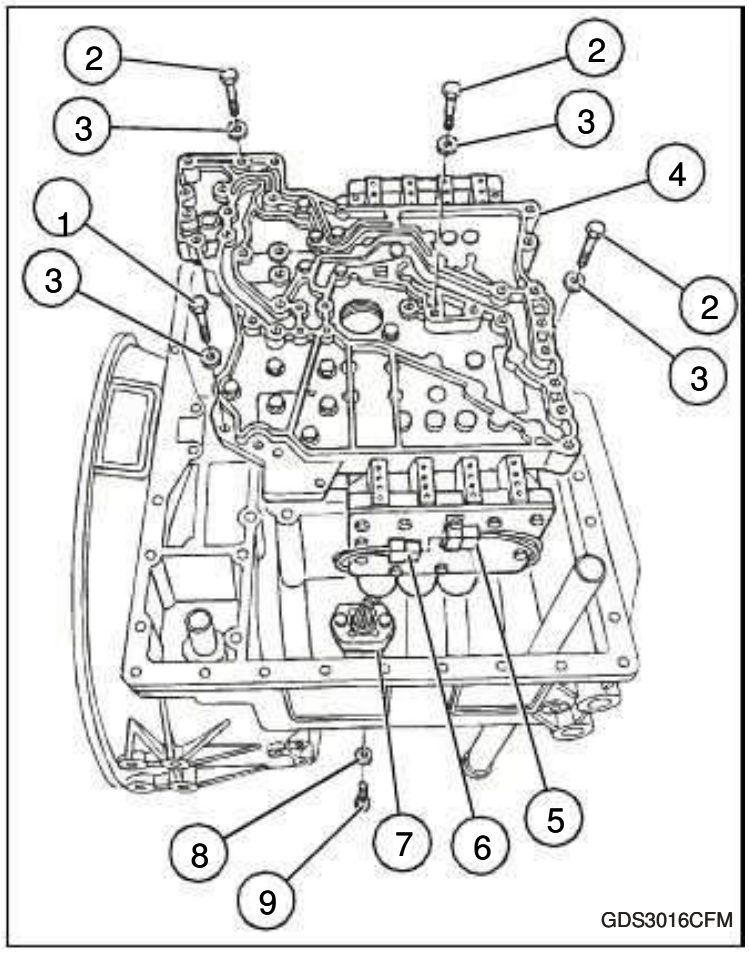
The approximate weight of control valve is 25 kg (56 lb).

Transmission Specification

Control Valve Weight - - - - - 25 kg (56 lb) approximate

Remove control valve (3) and gasket (1) by either prying up on reinforced tabs or using jack bolts.

Position transmission with output shaft up.



1. Bolt (9 used).
2. Bolt (30 used).
3. Washer (39 used).
4. Control Module Assembly.
5. Control Module Connector X-171.
6. Output Sensor Connector.
7. Transmission Connector.
8. Washer (2 used).
9. Bolt (2 used).

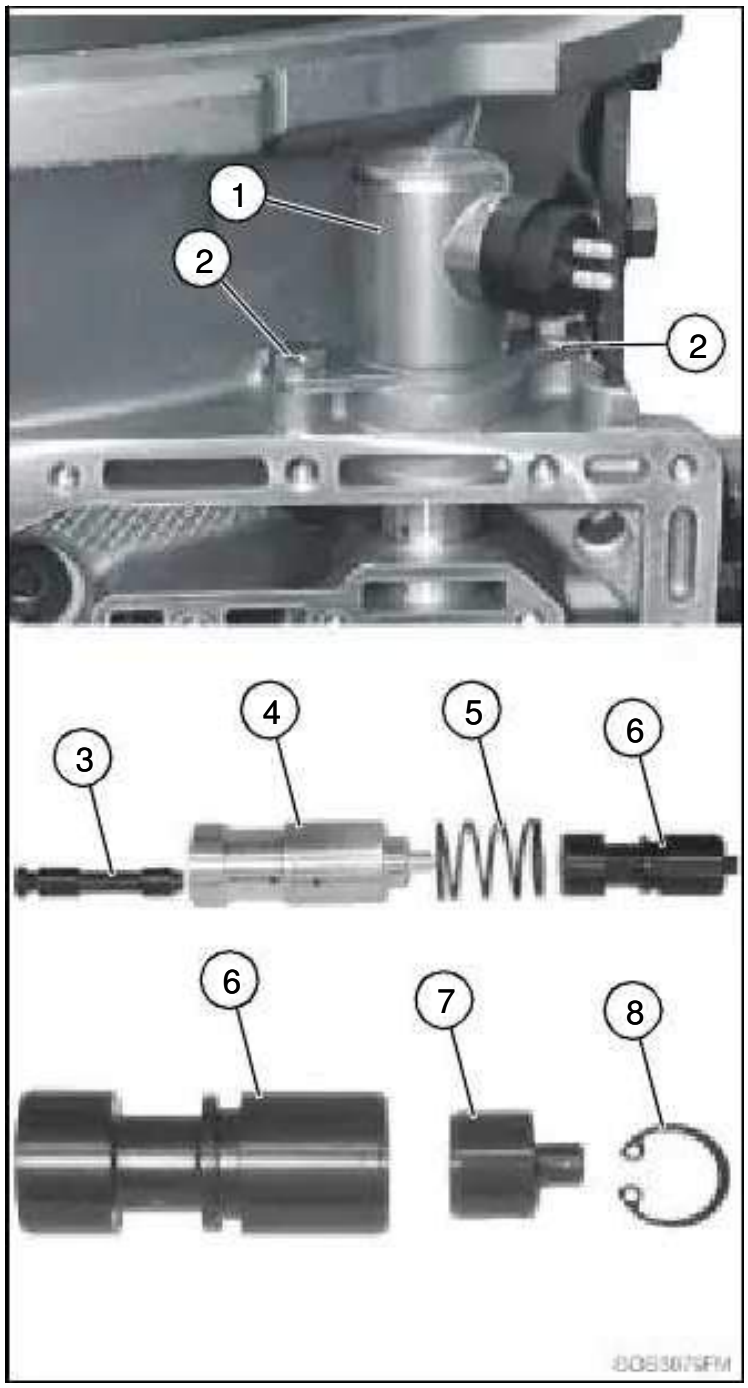
Remove wire connector (7) from transmission case.

Disconnect output sensor connector (6) and remove retarder resistor connector (5).

NOTE:Bolt length and location.

Remove cap screws (1 and 2) to remove control module assembly (4).

Remove Retarder Valve

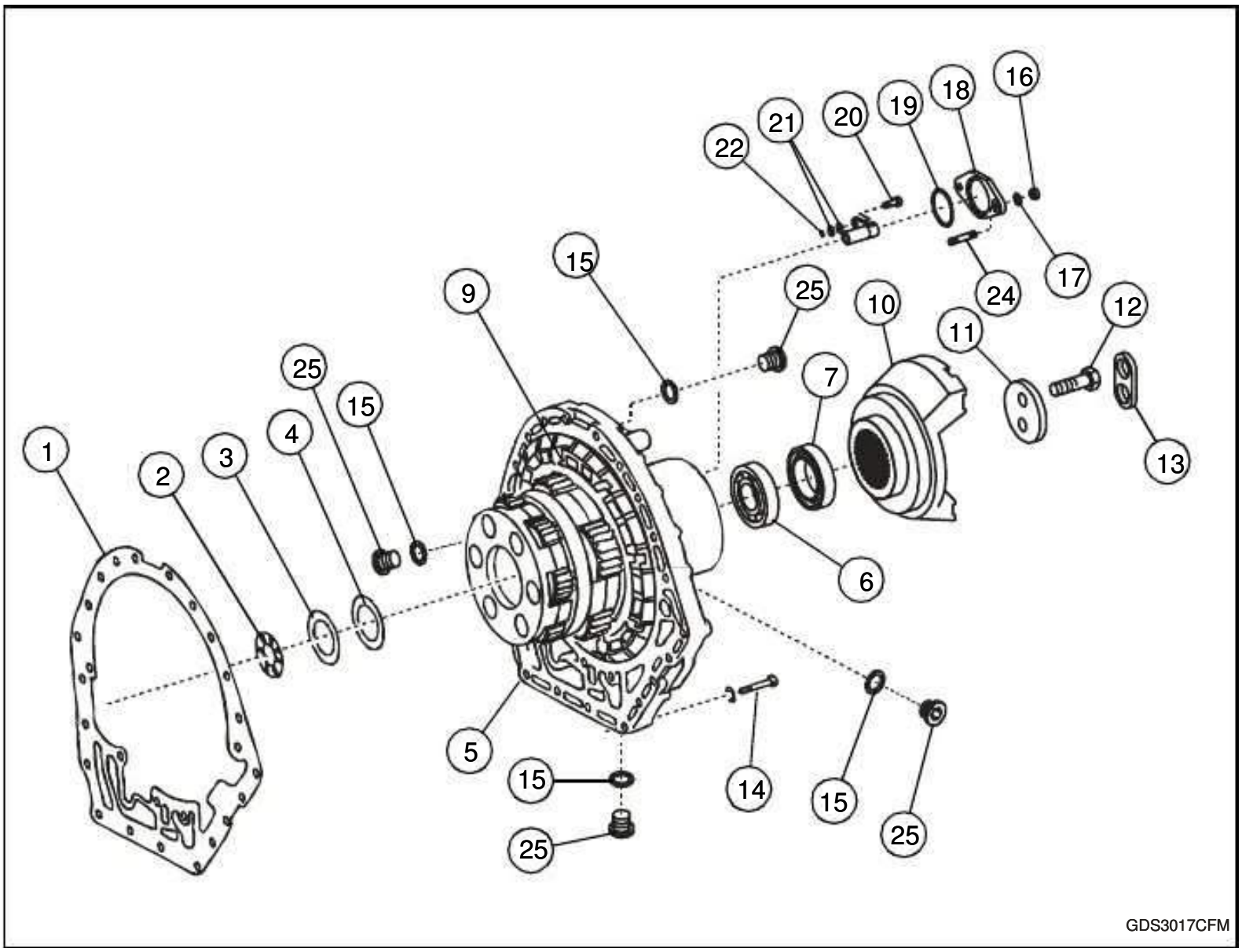


Loosen bolts (2) and remove.

Remove retarder valve solenoid (1) and O-ring.

Remove parts (3 - 8) and inspect for wear or damage.

Remove Output Planetary and Clutch Element



1. Gasket.
2. Needle Bearing.
3. Shim.
4. Shim.
5. Output Cover.
6. Bearing.
7. Seal.
8. Output Planetary Carrier.
9. Piston.
10. Output Flange.
11. Retainer Plate.
12. Bolt.
13. Lock Plate.
14. Bolt.
15. O-Ring.
16. Nut.
17. Washer.
18. Output Sensor Cover.
19. O-Ring.
20. Bolt.
21. Shim (s).
22. O-Ring.
23. Output Speed Sensor.
24. Stud.
25. Plug

Remove output flange (10) with puller.

Remove cover (18) and disconnect wire connectors at output speed sensor.

Remove output speed sensor (23).

⚠ CAUTION

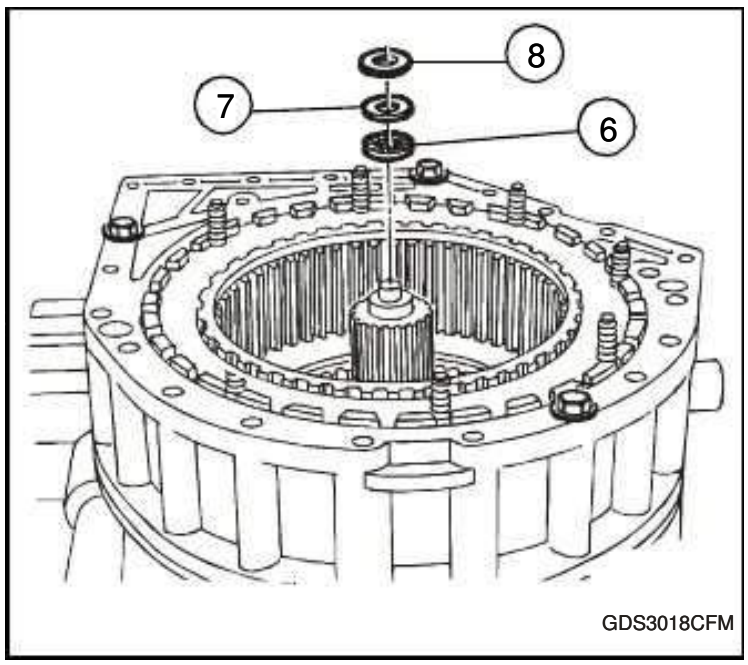
If torque converter is remove, lifting device 281710 Lifting Device must be installed to turbine shaft to prevent it from falling out after output planetary is removed.

With torque converter removed and 281710 Lifting Device in place. Install DFT1231 Output Assembly Lift Bracket on output shaft. **(See "CHAPTER 17. DEALER FABRICATED TOOLS" on page 383)**

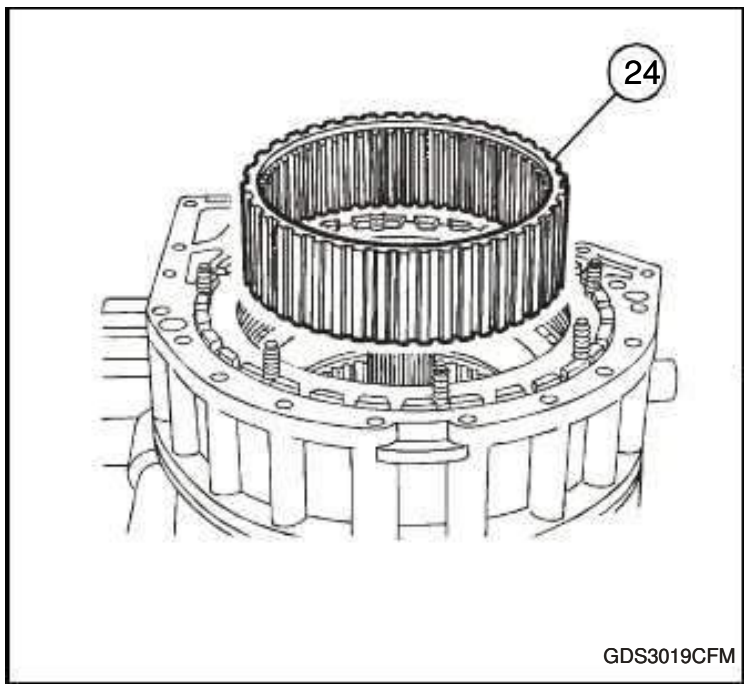
NOTE: Output speed sensor wires must be disconnected prior to output cover removal.

Remove output cover and planetary carrier assembly.

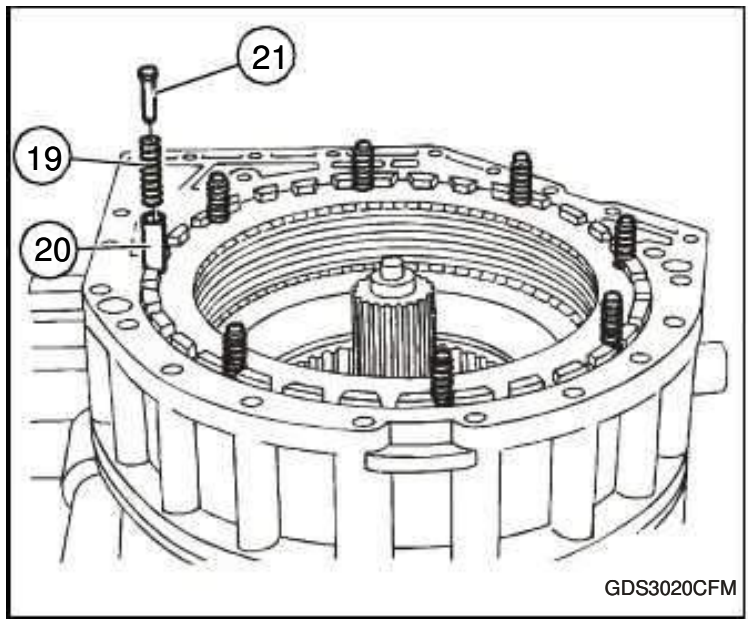
Remove Intermediate Housing and Clutch Element



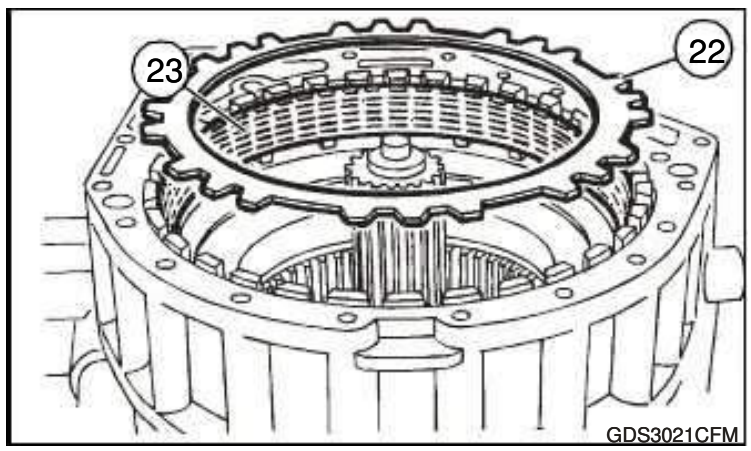
Remove parts (6 - 8) from sun gear shaft.



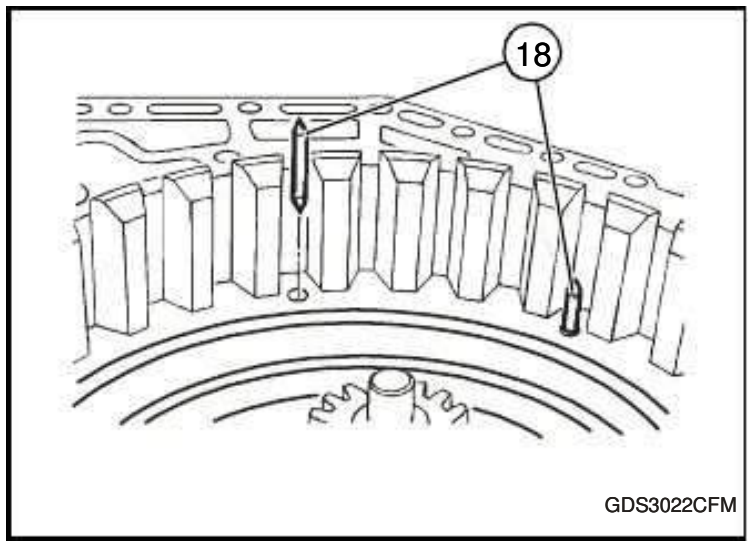
Remove ring gear (24).



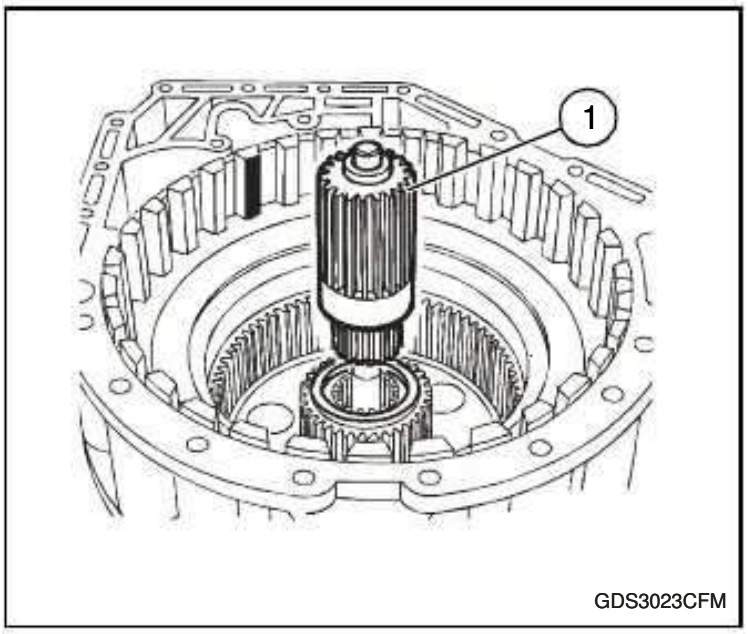
Remove parts (19 - 21).



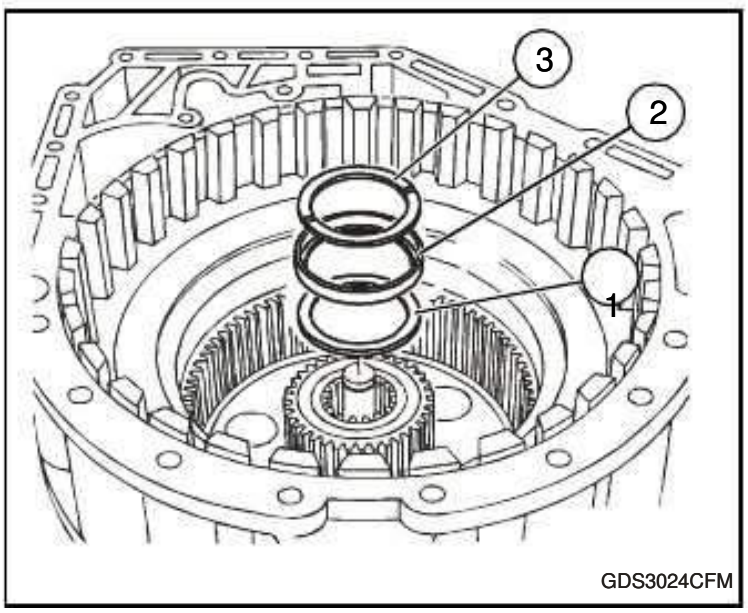
Remove all clutch plates (22 and 23) and mark to maintain correct order.



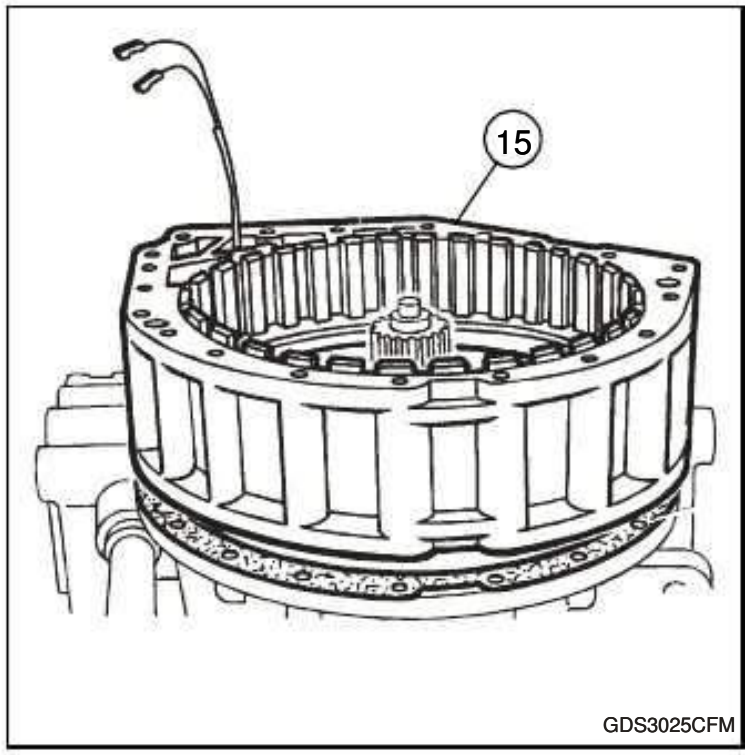
Remove inner guide pins (18).



Remove sun gear shaft (1) and inner ring.



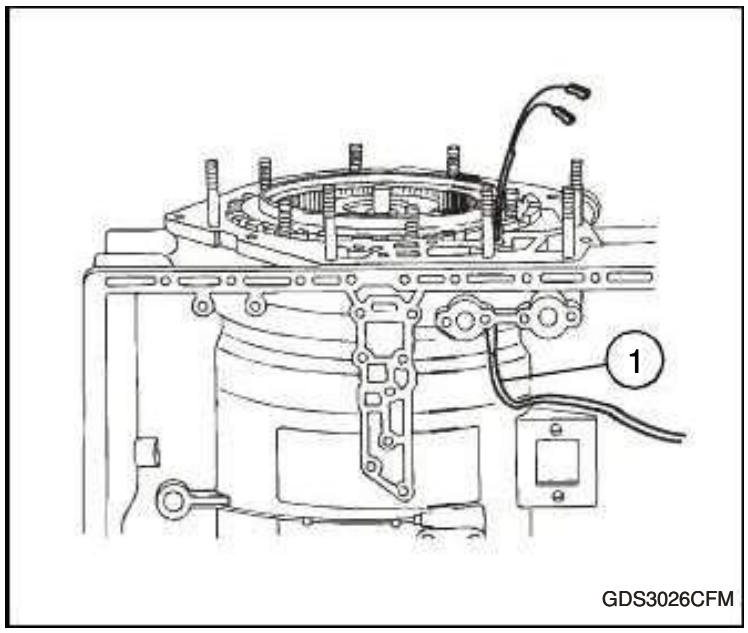
Remove parts (1 - 3).



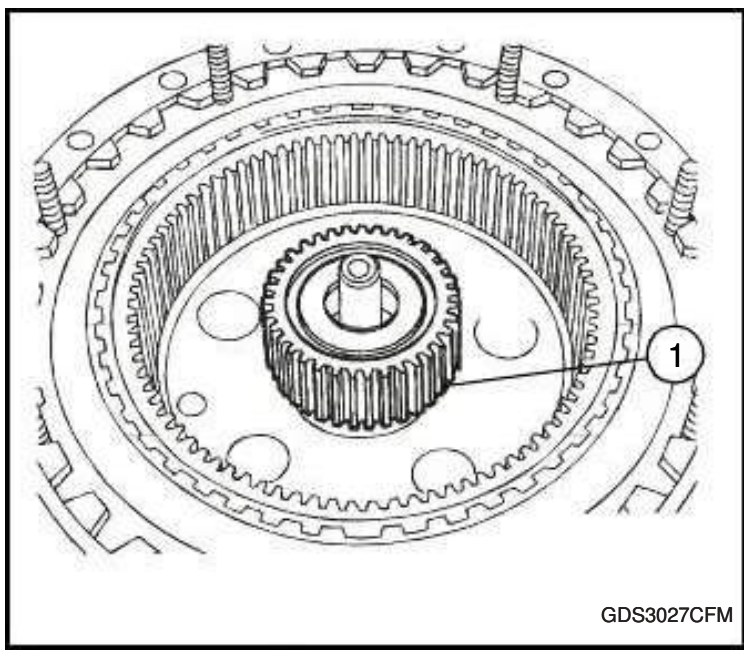
Tap outer edge of intermediate housing (15) with soft face hammer to loosen housing.

Remove intermediate housing and carefully guide sensor wire harness through housing.

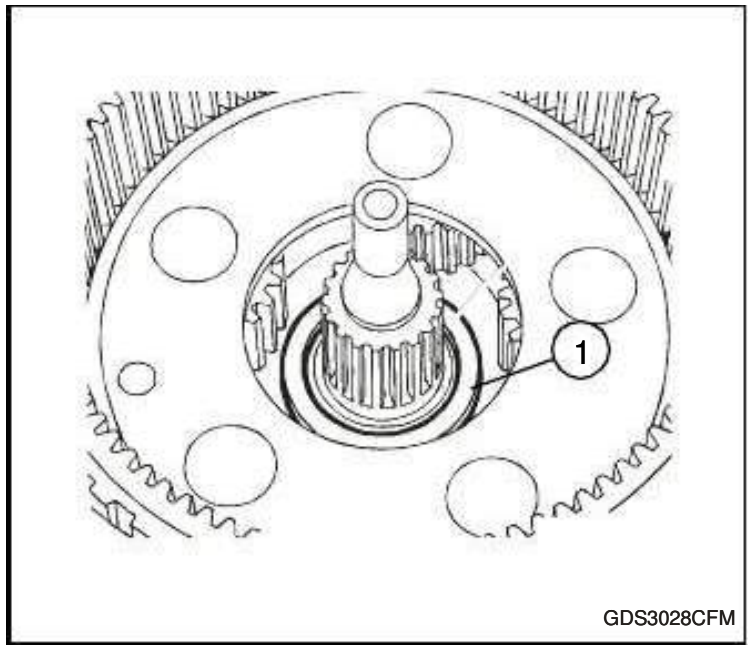
Remove Center Planetary and Clutch Elements



Remove output sensor wire harness (1).



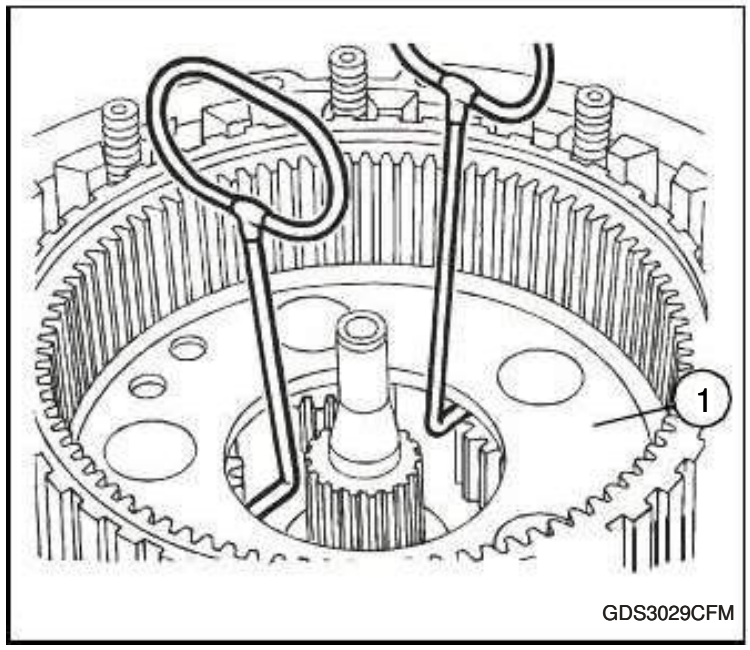
Remove thrust washer and sun gear (1).



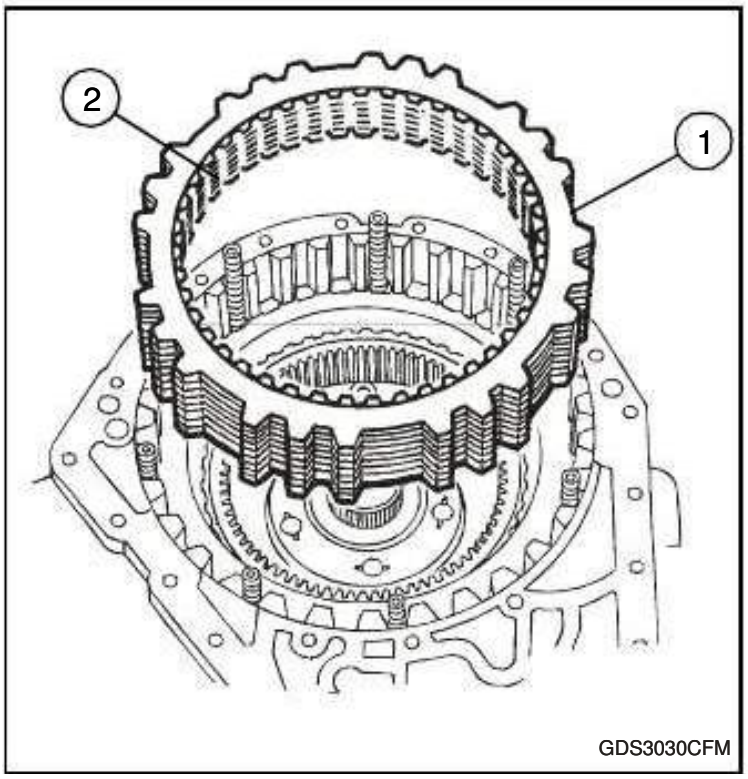
Remove thrust washer (1). Thrust washer (1) may remain attached to sun gear.

⚠ CAUTION

When lifting carrier with DFT1238 Planetary Carrier Lifting Tool, carrier will be unstable and may fall causing damage to planetary or cause bodily injury.

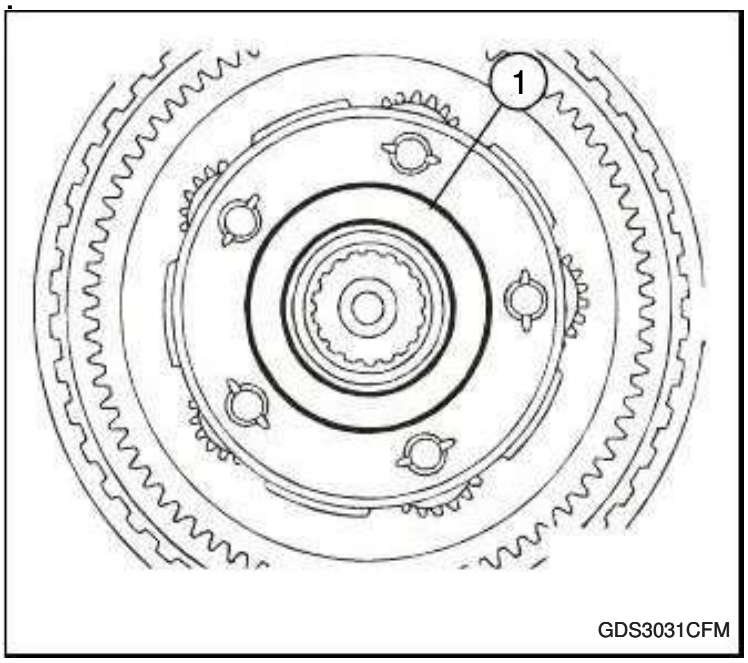


Using DFT1238 Transmission Planetary Lifting Tool remove planetary carrier two (1). **(See “CHAPTER 17. DEALER FABRICATED TOOLS” on page 383).**

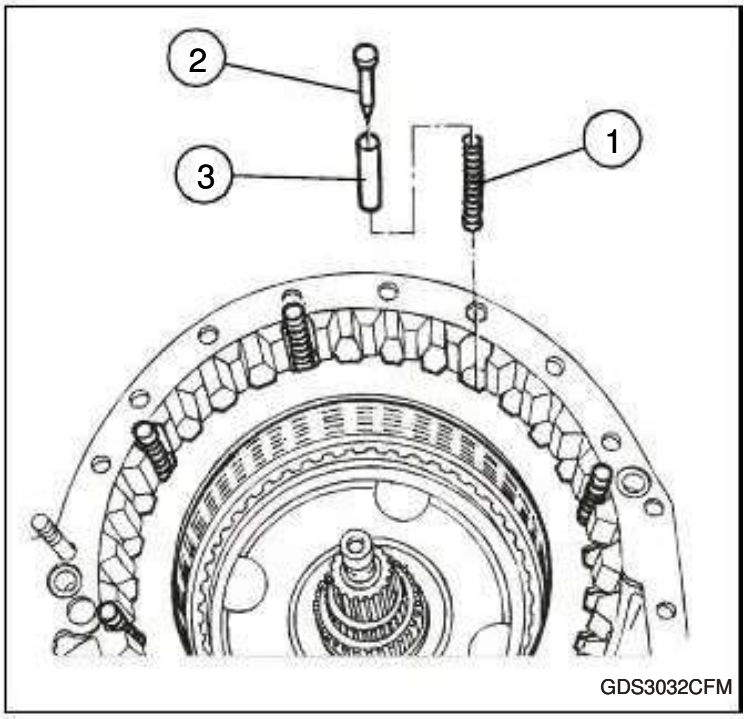


Remove, mark and identify order of clutch F plates (1 and 2)

.



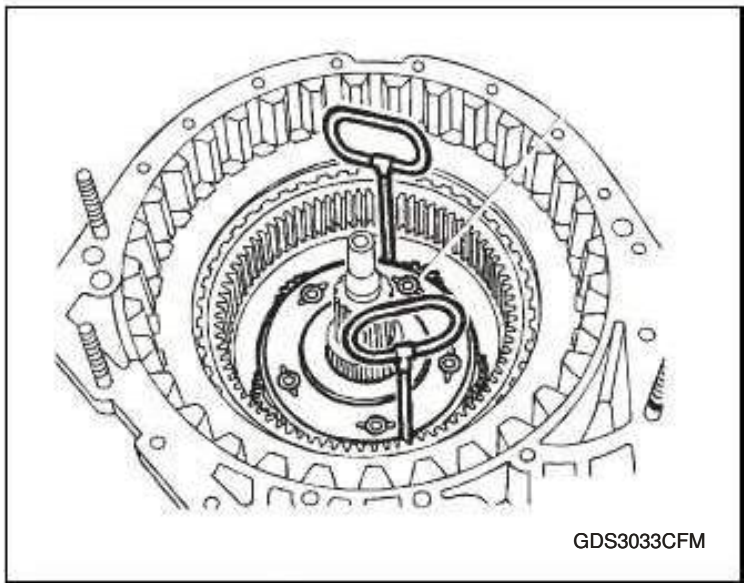
Remove thrust washer (1). Thrust washer may remain attached to planetary carrier.



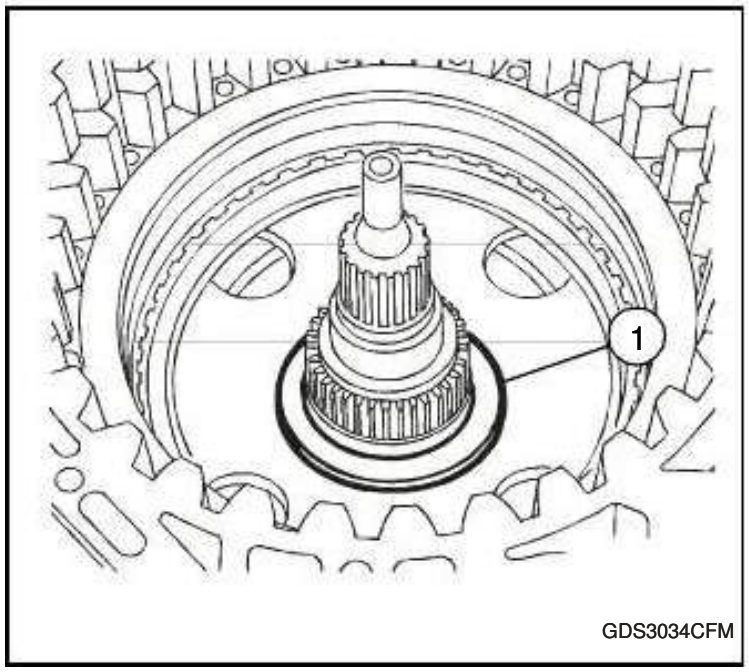
Remove compression springs (1), guide pins (2) and guide tubes (3).

⚠ CAUTION

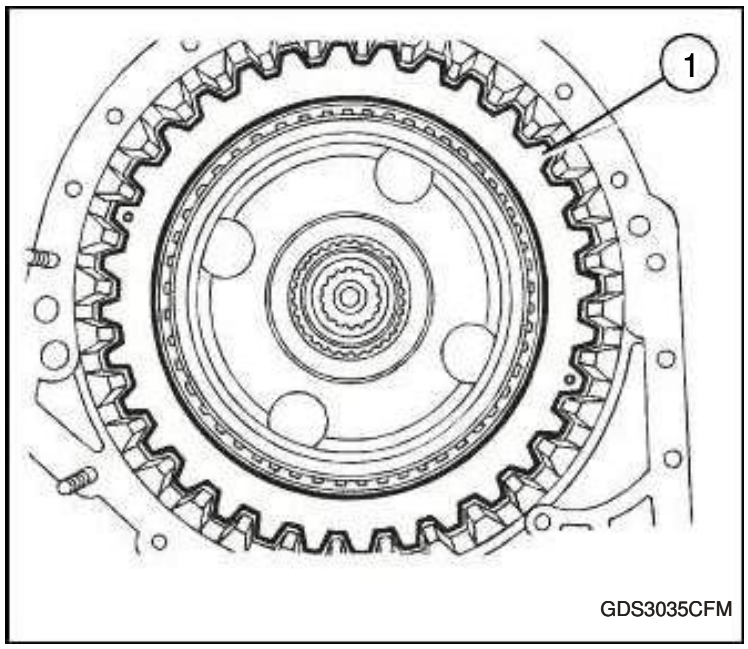
When lifting carrier with hooks, carrier will be unstable and may fall causing damage to planetary or cause bodily injury.



Using DFT1238 remove planetary carrier one.

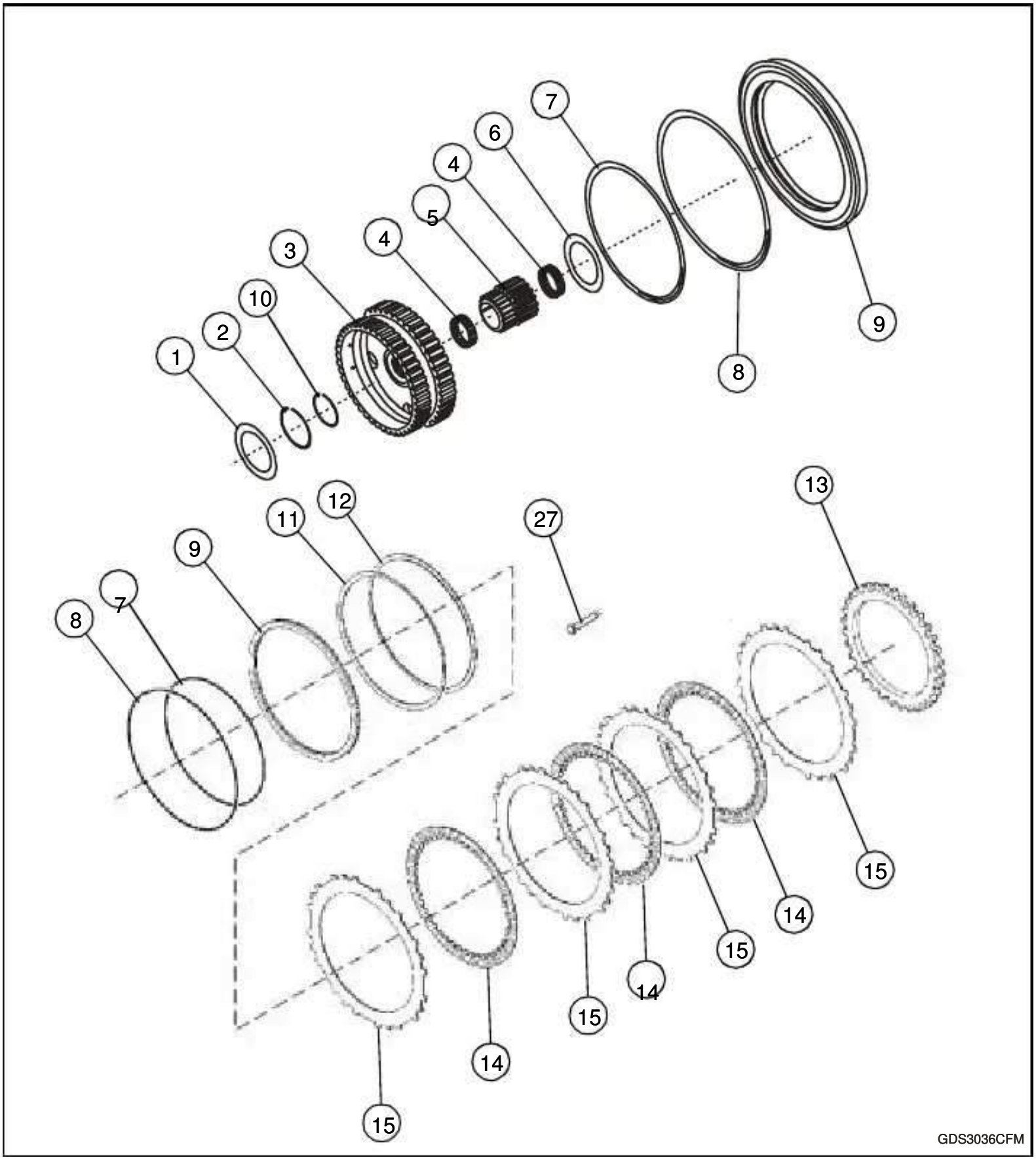


Remove thrust washer (1). Thrust washer may be attached to planetary carrier one.



Rotate and remove thrust ring (1).

Remove Clutch E Shaft



1. Thrust Washer.
2. Snap Ring.
3. Clutch Plate Carrier.
4. Needle Bearing (2 used).
5. Sun Gear.
6. Thrust Washer.
7. Lip Seal Ring.
8. Lip Seal Ring.
9. Clutch E Piston.
10. Snap Ring.
11. Spring Plate Holder.
12. Spring Plate.
13. Thrust Ring.
14. Inner Plate (7 used).
15. Outer Plate (7 used).
27. Pin (8 used).

Remove, mark and identify order of clutch E plates.

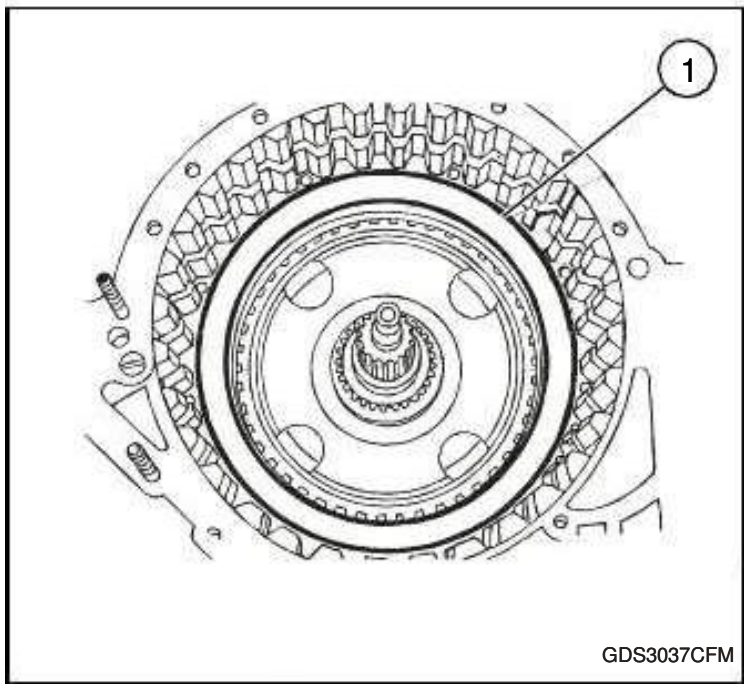
NOTE:During removal do not allow guide pins to drop into transmission.

Remove spring guide centering pin (27).

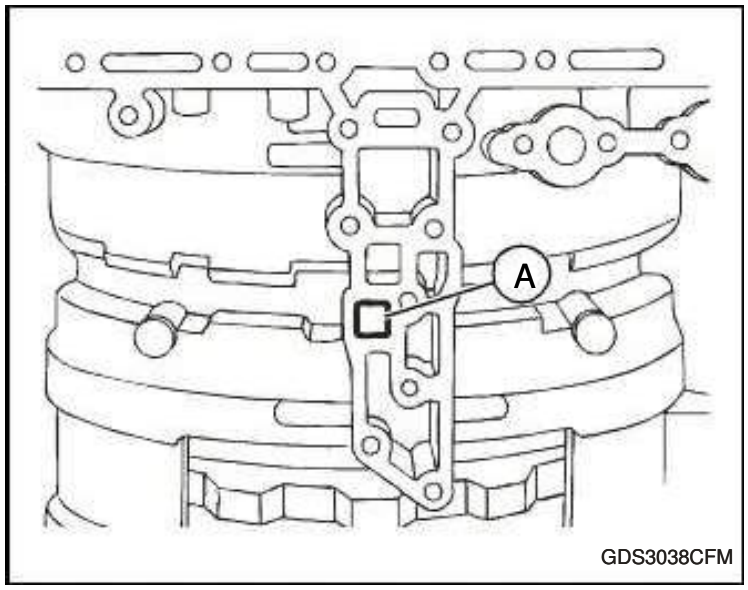
Remove spring plate holder (11) and spring plate (12).

⚠ CAUTION

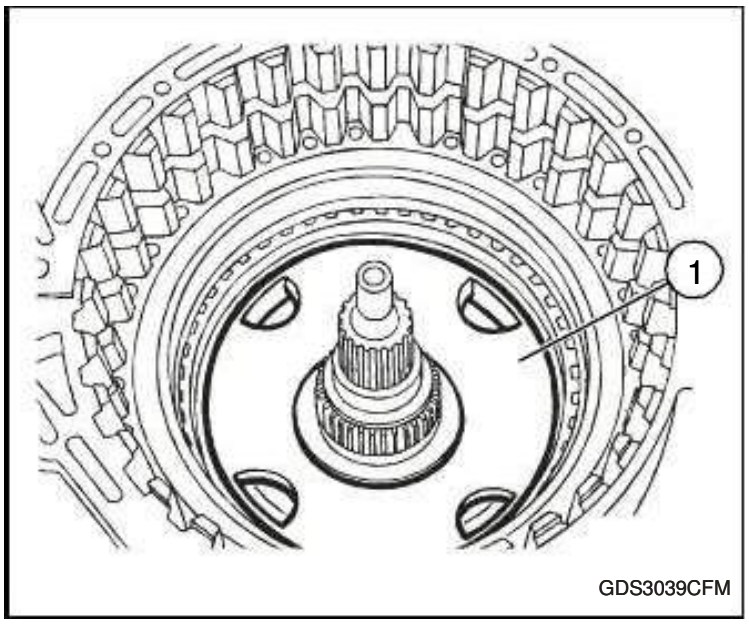
Wear eye and face protection before using compressed air. Cover transmission oil ports with a cloth for protection from transmission oil when using compressed air.



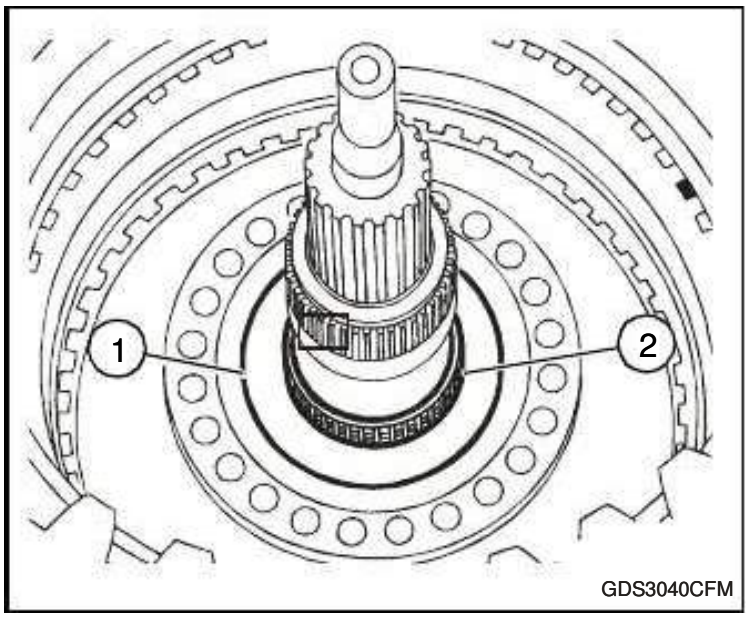
Remove clutch E piston (1).



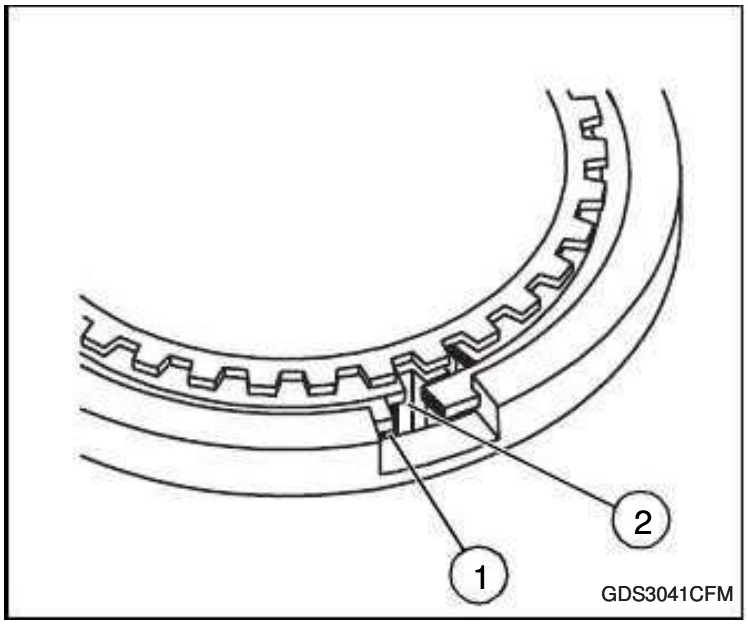
Low air pressure may be applied to port (A) to aid piston removal.



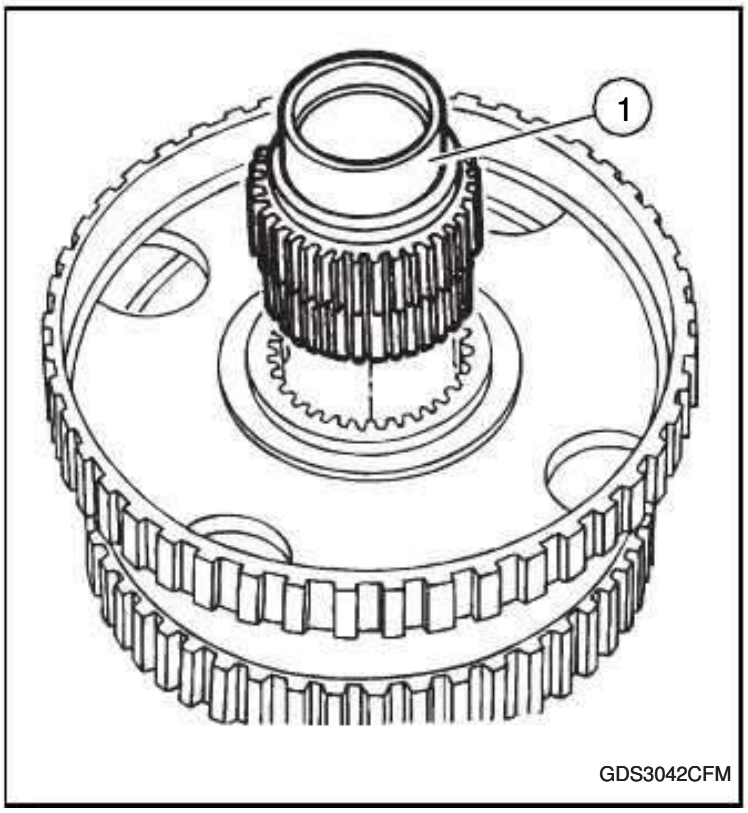
Remove carrier (1).



Remove thrust washer (1) and needle bearings (2).

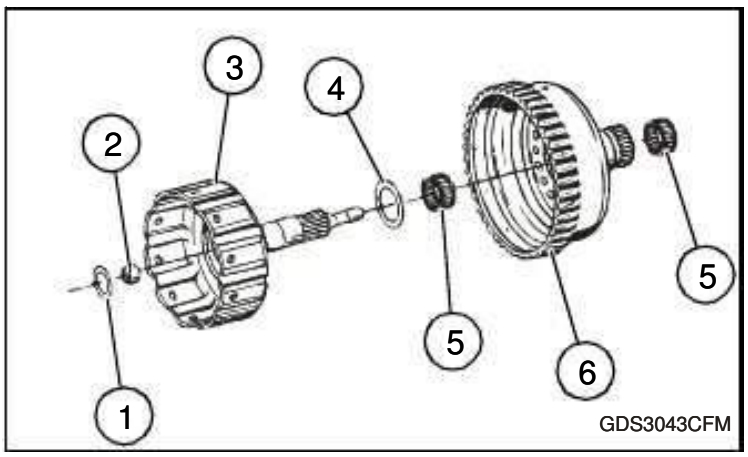


Rotate end of snap rings (1 and 2) to notch opening and remove.

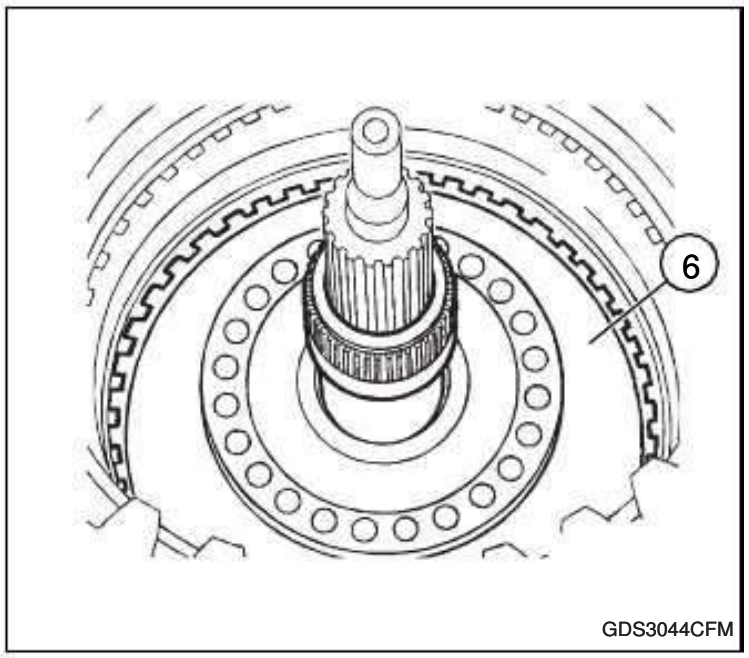


Remove sun gear (1) with suitable driver.

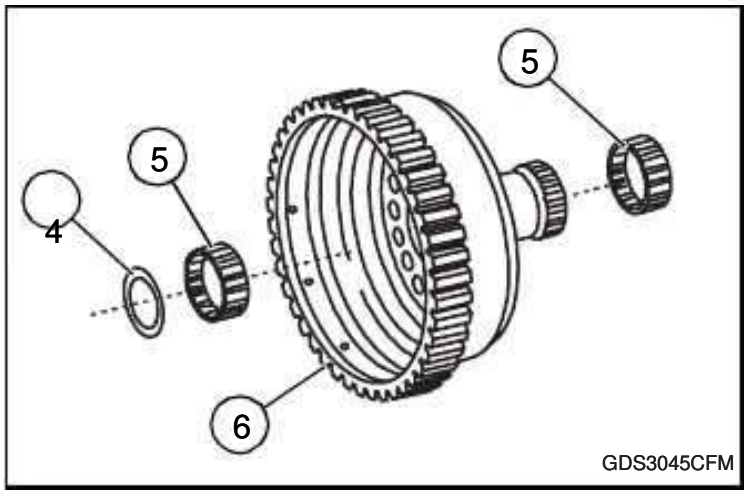
Remove Clutch C Shaft



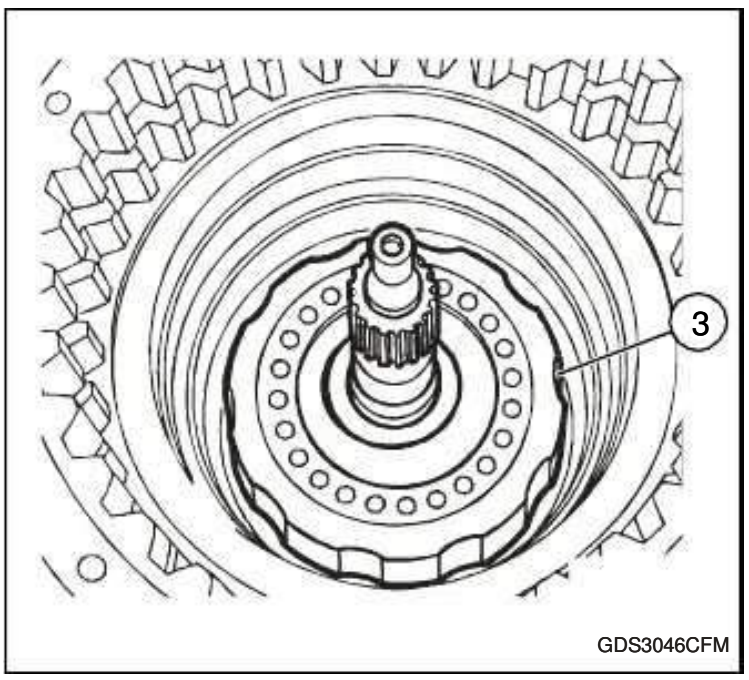
1. Thrust Washer.
2. Needle Bearing.
3. Clutch C Input Shaft.
4. Thrust Washer.
5. Needle Bearing (2 used).
6. Clutch C Hollow Shaft.



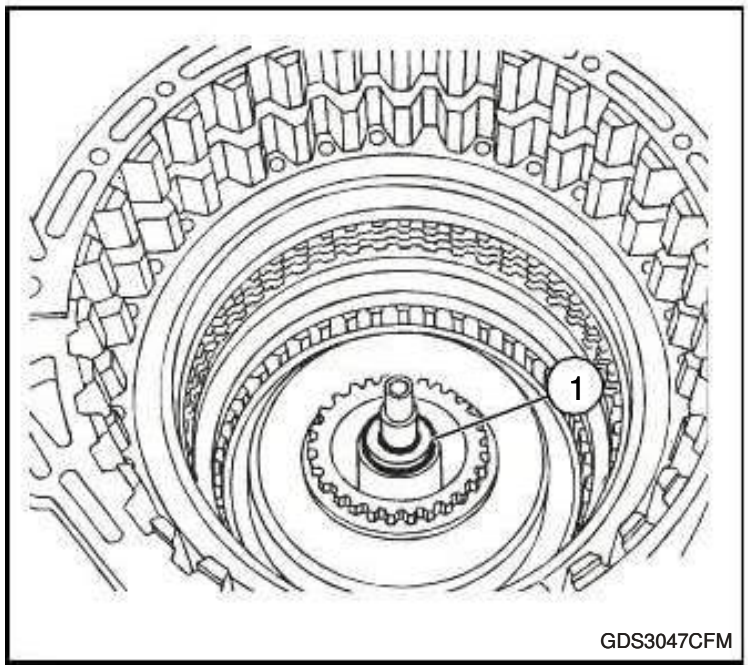
Lift and rotate clutch C shaft (6) aligning inner plates to remove.



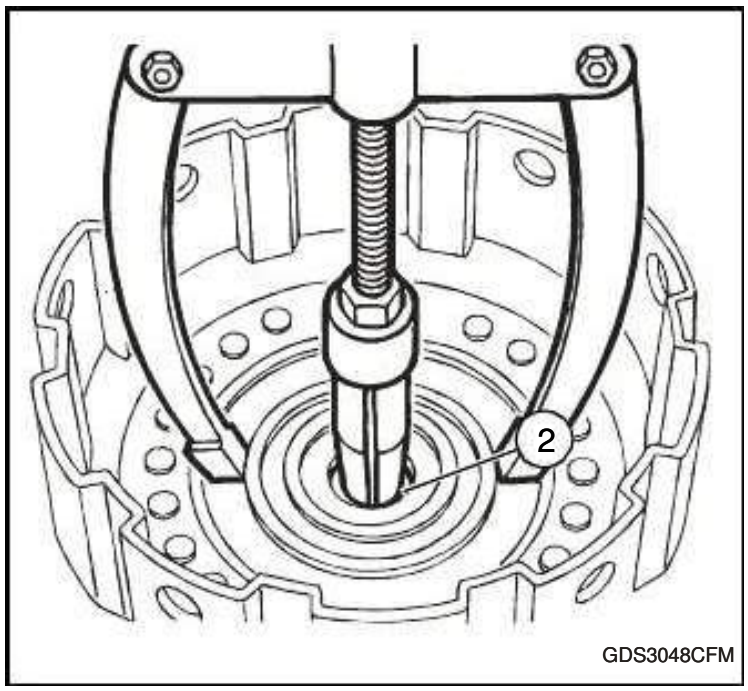
Remove needle bearings (5) and thrust washer (4).



Remove clutch C drive shaft (3).



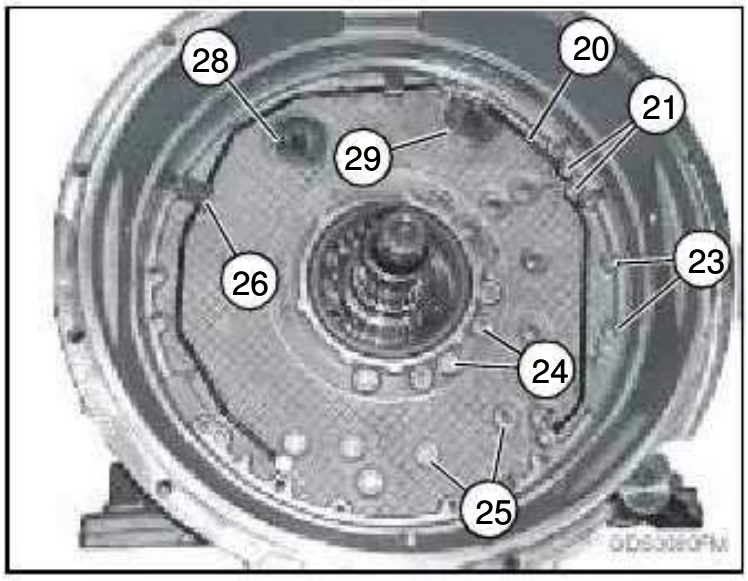
Remove turbine shaft thrust washer (1). Thrust washer may be attached to drive shaft.



Remove clutch C drive shaft needle bearing (2) only if needed with internal puller D01061AA Blind-Hole Puller Set.

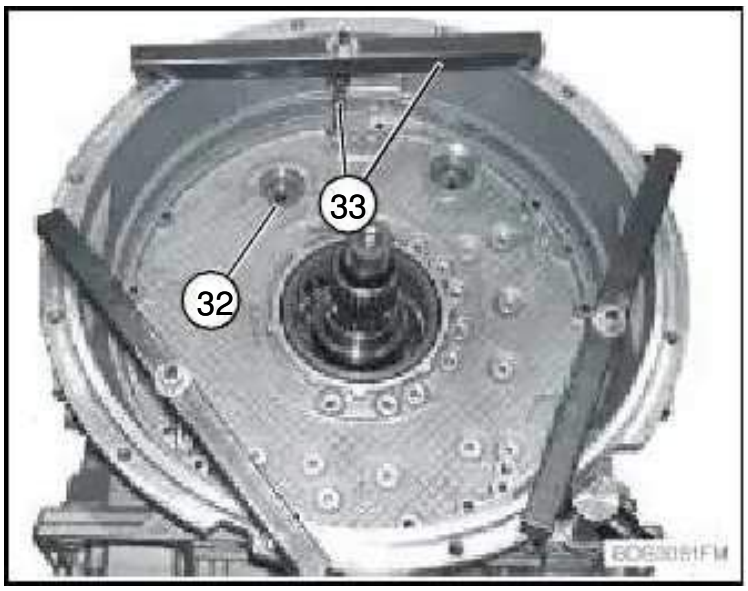
Remove Cover Plate and Auxiliary Drive Gears

Position transmission with front cover up to drain remaining oil.



Remove cap screws (23, 24, and 25) noting length and position.

Remove auxiliary drive shaft retainers (28 and 29).



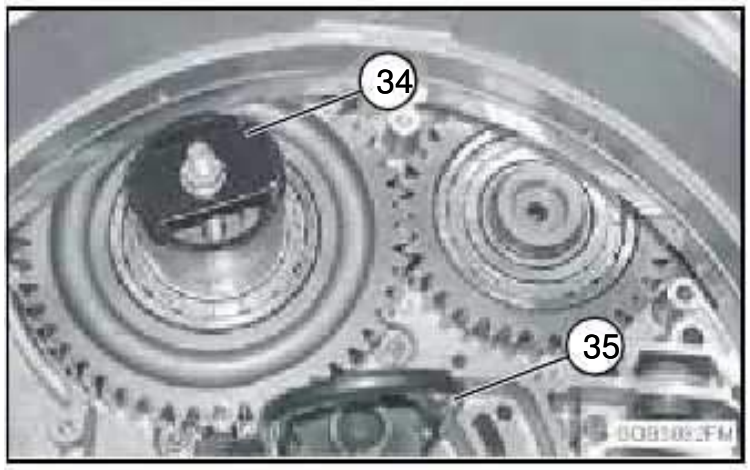
Install DFT1230 Transmission Pump Cover Puller. **(See "DFT1230 TRANSMISSION PUMP COVER PULLER" on page 395)**

Apply heat to cover at auxiliary drive shafts.

Evenly tighten puller to loosen cover and remove.

⚠ CAUTION

Be careful not to damage front cover sealing surface when using auxiliary shaft puller.

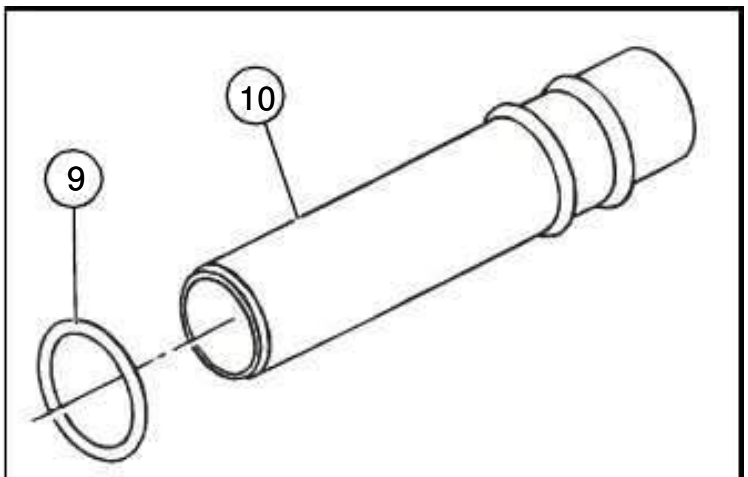


Use DFT1232 Auxiliary Drive Pin Puller (34) to remove auxiliary shafts from drive gears. **(See "DFT1232 AUXILIARY DRIVE PIN PULLER" on page 397)**

Attach 281710 Lifting Device (35).

Remove drive gears.

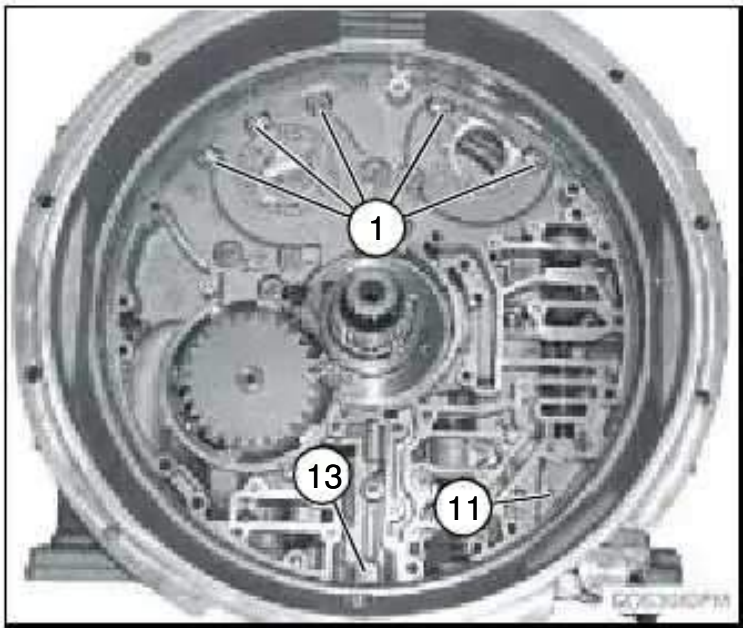
Remove Input Oil Control Body and Clutch Element



Remove oil intake pipe (10) and O-ring (9).

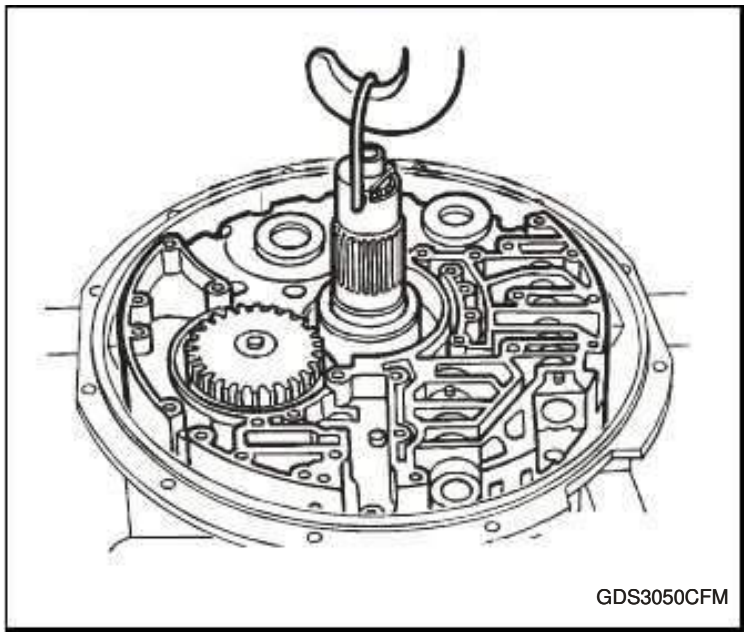
⚠ CAUTION

Carefully remove cap screws (1, 11 and 13). Do Not damage front cover seal surface during cap screw removal.



Carefully remove cap screws (1, 11, and 13).

Heat transmission housing at control element level to 85° C (185° F).



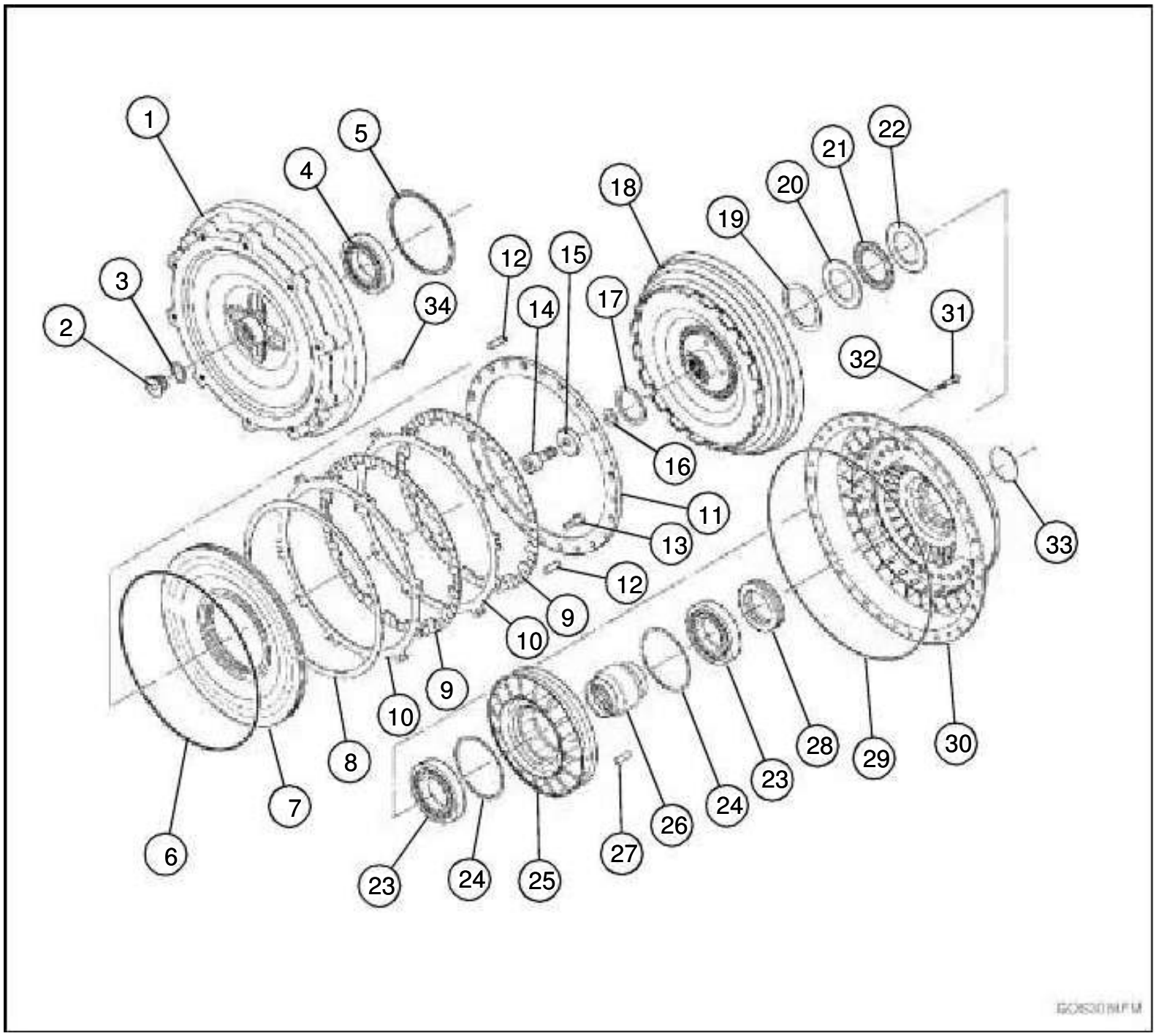
Using hoist and 281710 Lifting Device to remove control element.

Place control plate on wooden blocks.

Remove Clutch D

(See Disassemble and Assemble Clutch D in this group).

Disassemble and Assemble Torque Converter



1. Circuit Cover.
2. Plug.
3. Seal.
4. Ball Bearing.
5. Seal Ring.
6. Seal Ring.
7. Piston Plate.
8. Piston Spring.
9. Inner Clutch Plate (2 used).
10. Outer Clutch Plate (2 used).
11. End Plate.
12. Guide Pin (12 used).
13. Cap Screw.
14. Cap Screw.
15. Spacer Washer.
16. Shim Washer.
17. Snap Ring.
18. Turbine Cover.
19. Selective Shim.
20. Housing Washer.
21. Thrust Roller Bearing.
22. Shaft Washer.
23. Bearing (2 used).
24. Washer (2 Used).
25. Stator.
26. Roller Clutch Hub.
27. Clutch Roller (16 used).
28. Thrust Bearing Assembly.
29. O-Ring.
30. Pump Drive Cover.
31. Cap Screw (36 used).
32. Washer (36 used).
33. Washer.
34. Pin.

Support converter on wooden blocks and remove cap screw (31).

⚠ CAUTION

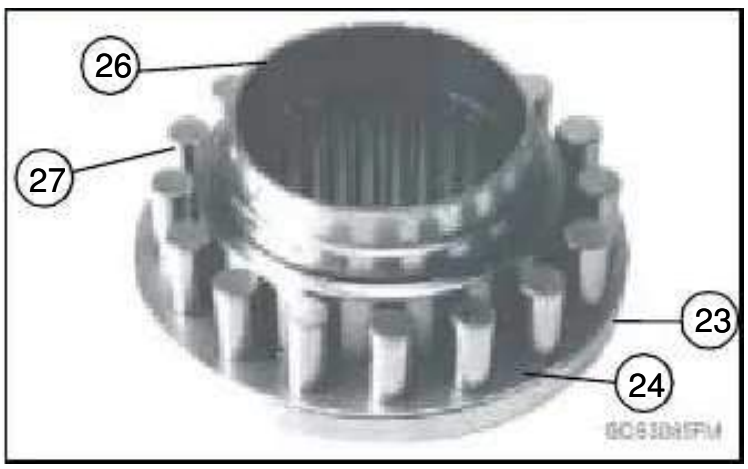
Avoid striking converter circuit cover or pump drive cover during separation. As damage will result.

Tighten 281696 Lifting Device to separate cover (1) and pump drive cover (30).

Remove and mark location of parts (19 - 22).

Remove stator assembly (25) from turbine.

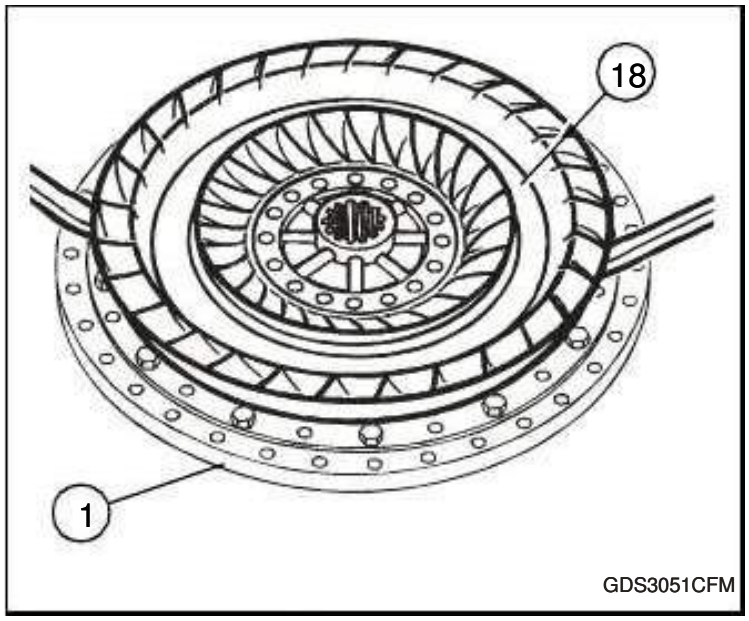
Remove bearing assembly (28) from stator.



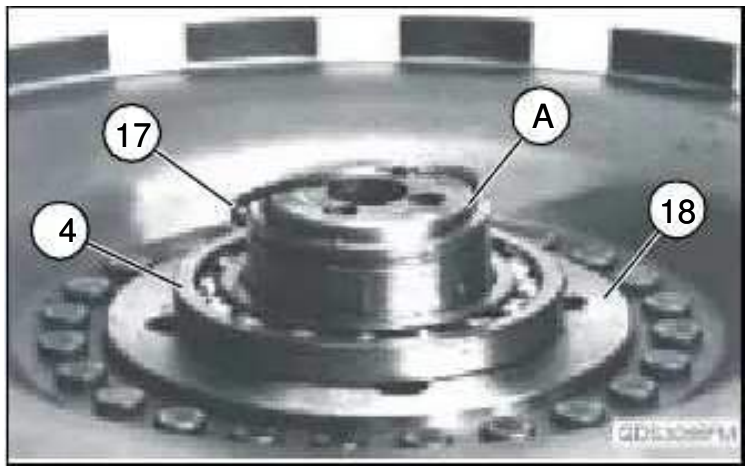
Support stator, using press push roller clutch hub (26) to remove bearing and washer (23 and 24) with clutch rollers (27) from stator.

Using press remove remaining bearing and washer (23 and 24).

Using press remove clutch hub (26) from bearing (23).



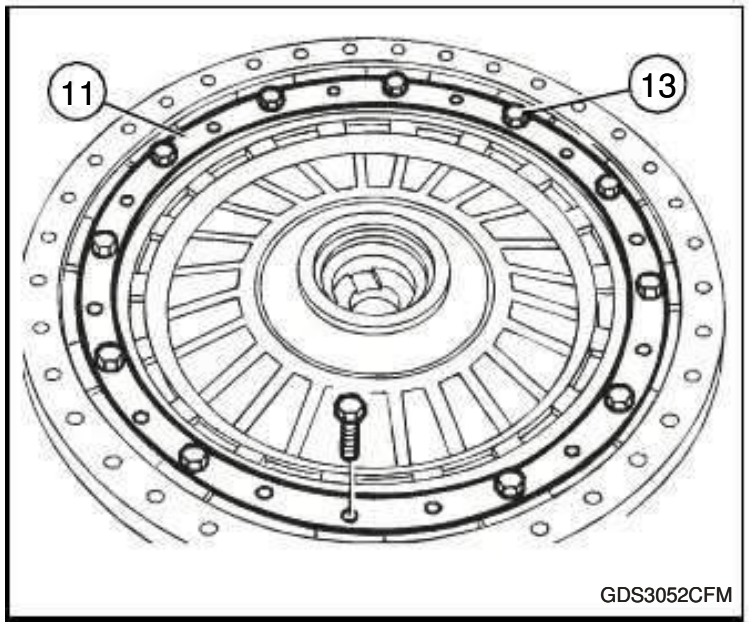
With two levers remove turbine (18) from cover (1).



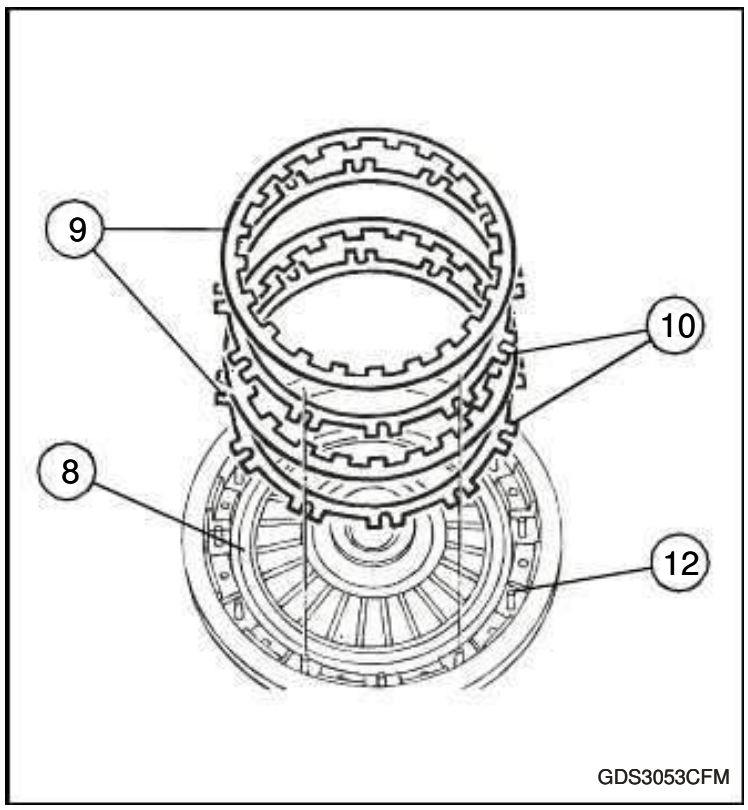
NOTE:Rectangular seal ring (17) has sharp edges. Wear protective gloves.

Remove rectangular seal ring (17) and remove bearing (4) using two levers.

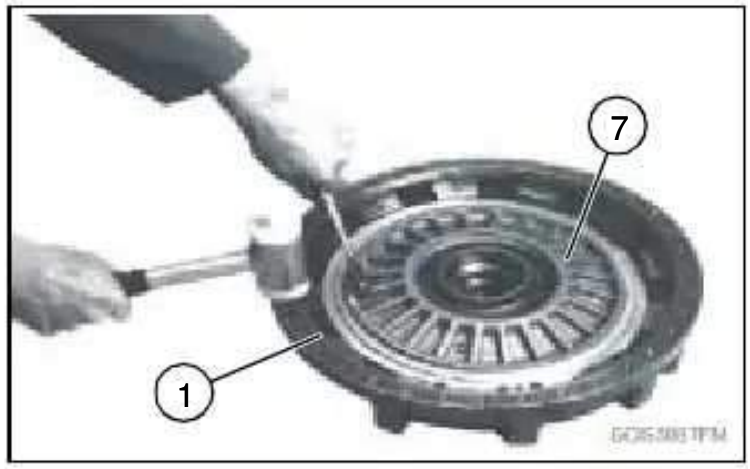
Remove plate (A) only if damaged with suitable driver.



Remove bolts (13) and end plate (11).



Remove clutch plates (8 - 10) and pins (12).

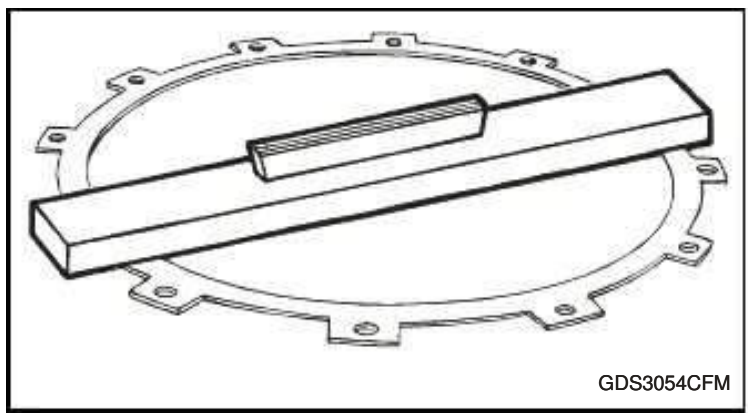


Hold piston (7) with pliers and tap circuit cover lightly with soft faced hammer.

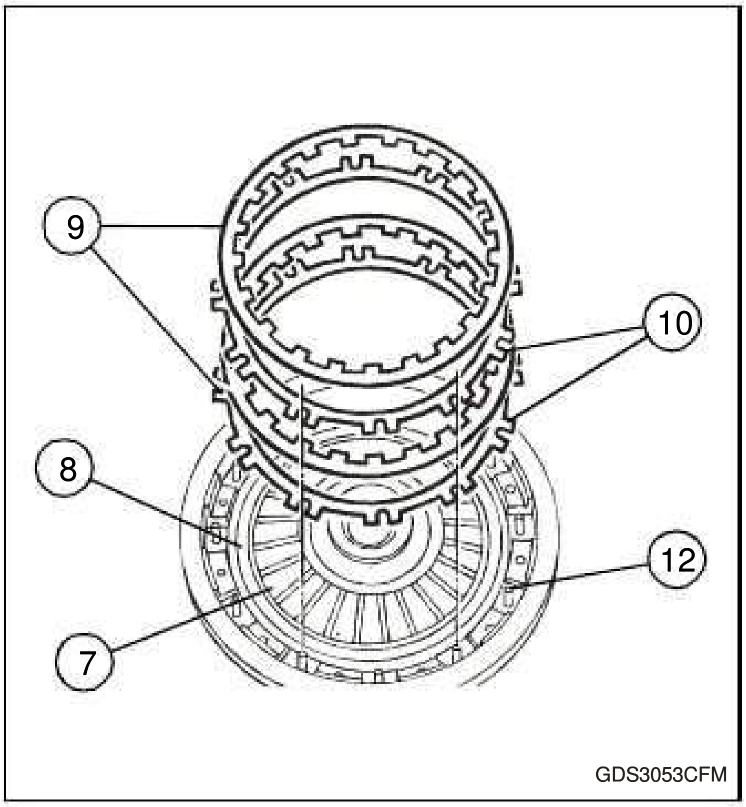
Remove piston seal (5 and 6).

Lubricate and install piston seals (5 and 6). Seal (5) may need to be stretched slightly to make a snug fit in piston groove.

Lubricate and install plate piston (7). Piston must be inserted without tilting seals and positioned with piston face in contact with bottom of circuit cover.



Check inner and outer plates for distortion with straight edge.



Install spring plate (8) with convex side to piston and insert pins (12).

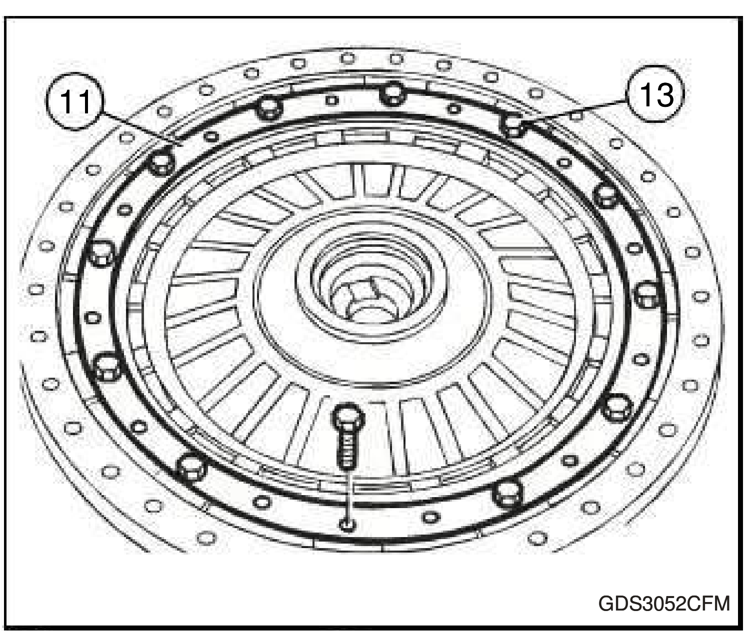
NOTE:Inner plate facing must not show wear, distortion or discoloration.

Disassemble and Assemble Torque Converter Specification

Torque Converter Clutch Plate Flatness- 0.3 mm (0.012 in.) Maximum

Torque Converter Inner Plate Tooth Wear Distance- 0.2 mm (0.008 in.) Maximum

Apply a thin layer of oil to clutch plates (9 and 10) and install in alternating order. Outer plate notch must be placed over pins (12).

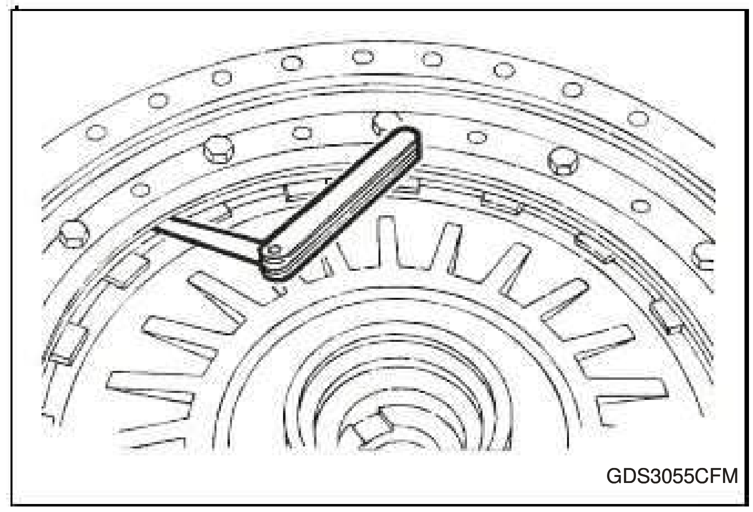


Position and install end plate (11) with bolts (13).

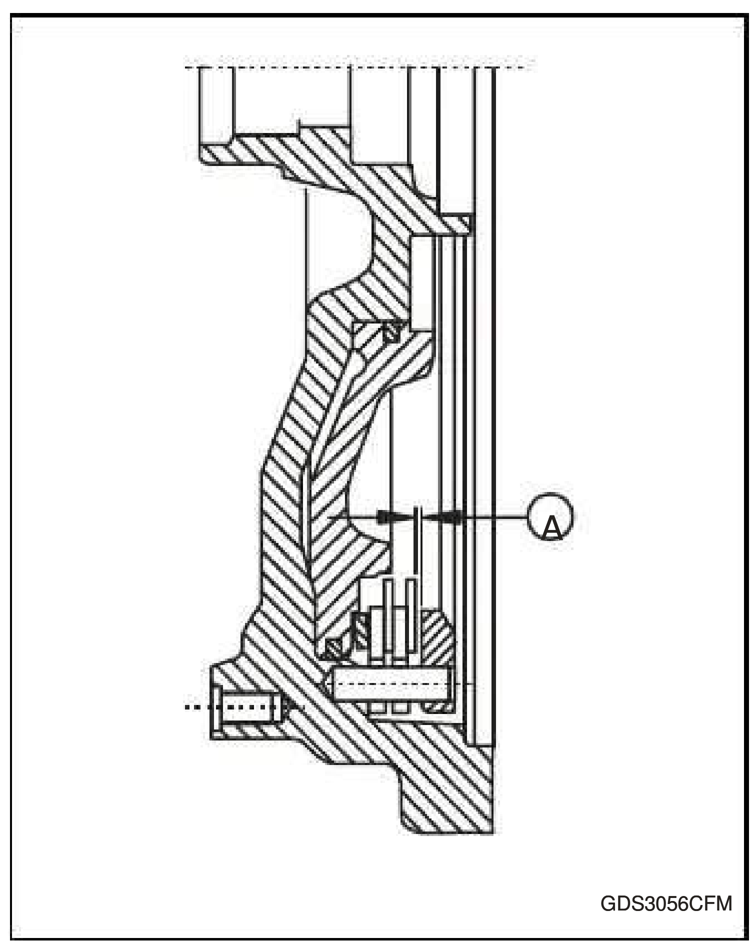
Disassemble and Assemble Torque Converter Specification

Torque Converter End Plate Bolt Torque - 35 Nm (26 lb-ft)

NOTE:Outer plates are supplied in 3.5 mm (0.138 in.) and 4.0 mm (0.157 in.). Use a combination of outer plate sizes to adjust clearance.

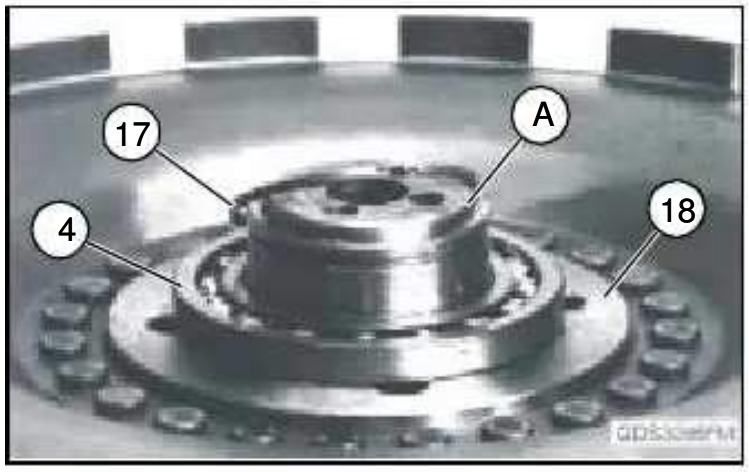


Measure clutch plate clearance between end plate and inner plate. Use a combination of outer plate sizes to adjust clearance.



Disassemble and Assemble Torque Converter Specification

Torque Converter Clutch Plate Clearance Clearance - 0.5 - 1.1 mm (0.02 - 0.043 in.)

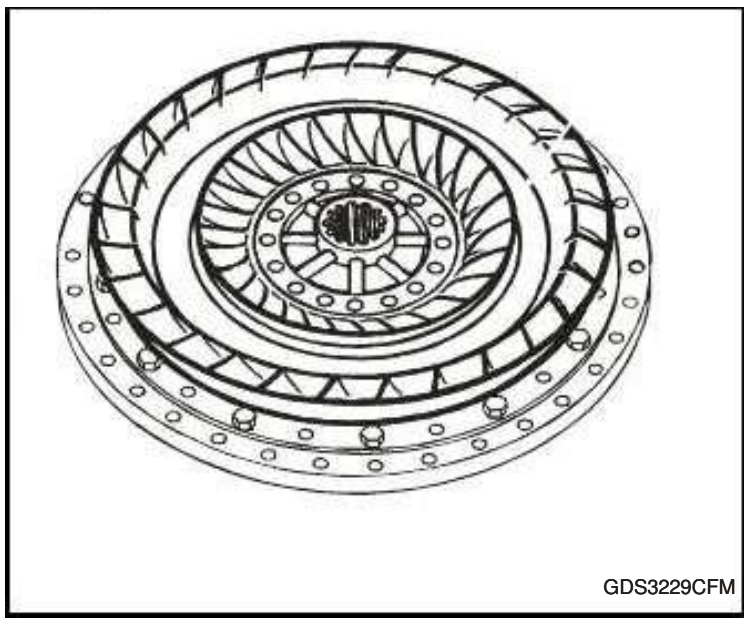


If removed install turbine plate (A) as shown with suitable driver. Secure turbine plate at four evenly spaced locations with punch.

Install bearing (4) with driver.

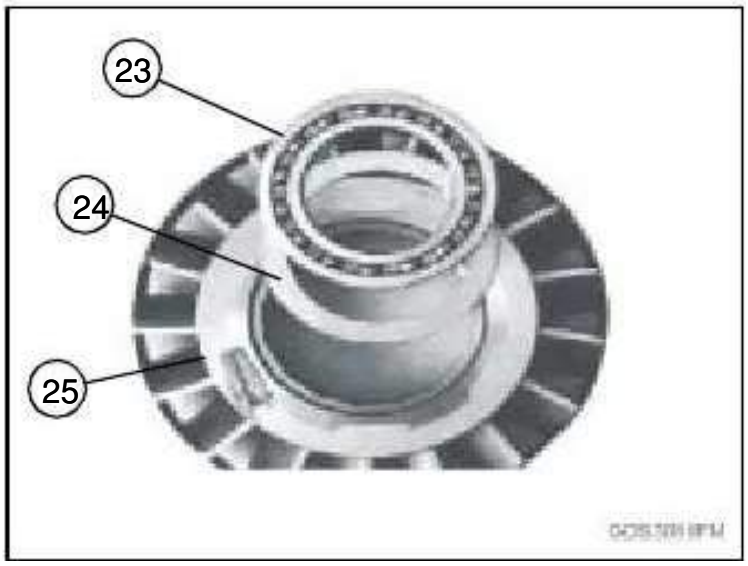
NOTE:Rectangular seal ring (17) has sharp edges. Wear protective gloves.

Install rectangular seal ring (17).



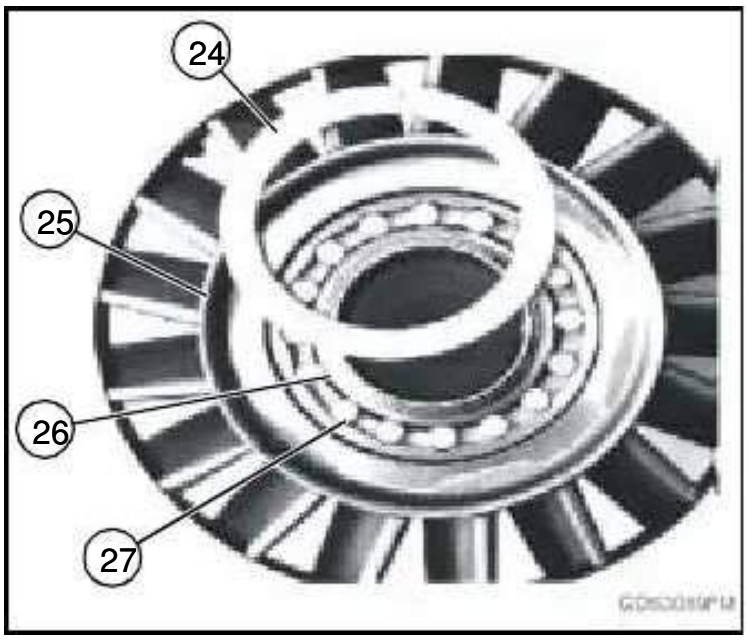
NOTE:Clutch inner plate teeth must engage turbine. Ensure clutch plate teeth are not damaged during turbine installation.

Position teeth of clutch inner plates even to each other. To engage turbine, rotate turbine back and forth to engage clutch teeth. It maybe necessary to gently tap turbine with soft faced hammer to insure turbine has made contact with bearing.



Position stator (25) in press with JDG1628 Stator Bearing Support.

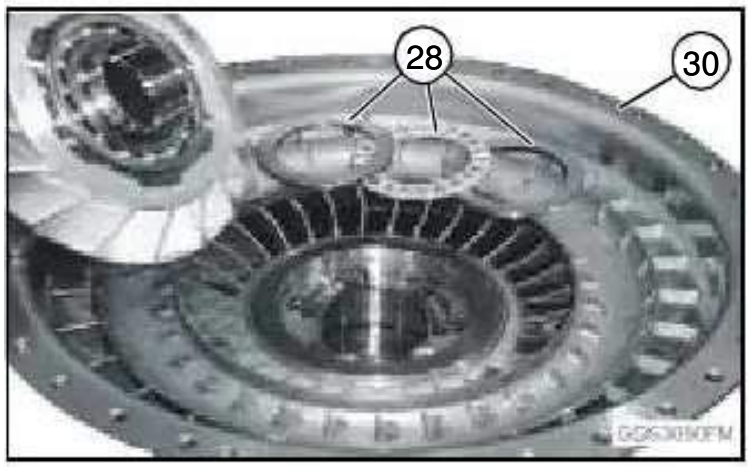
Install washer (24) and bearing (23) using 281708 and press.



Support stator with bearing and place roller clutch hub (26) longer collar into bearing. Using JDG1628 and press push roller clutch hub into stator and bearing assembly.

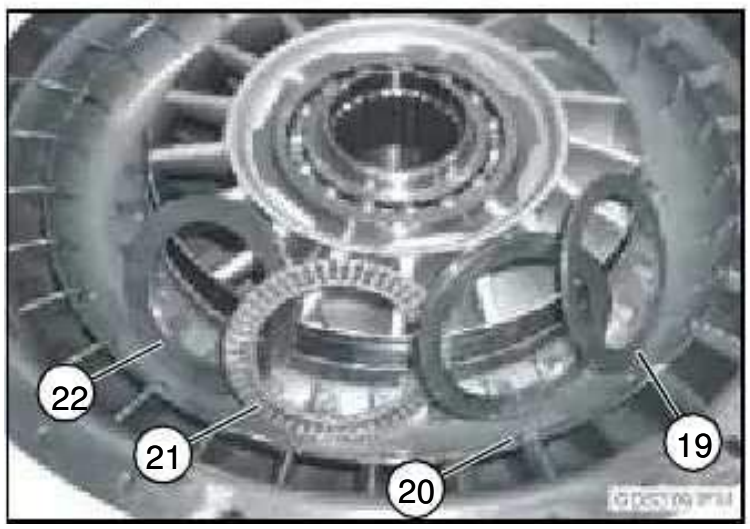
Install rollers in stator.

Support stator to install second washer (24) and bearing (23) using 281708 and press.



Install bearing (28) in pump drive cover (30).

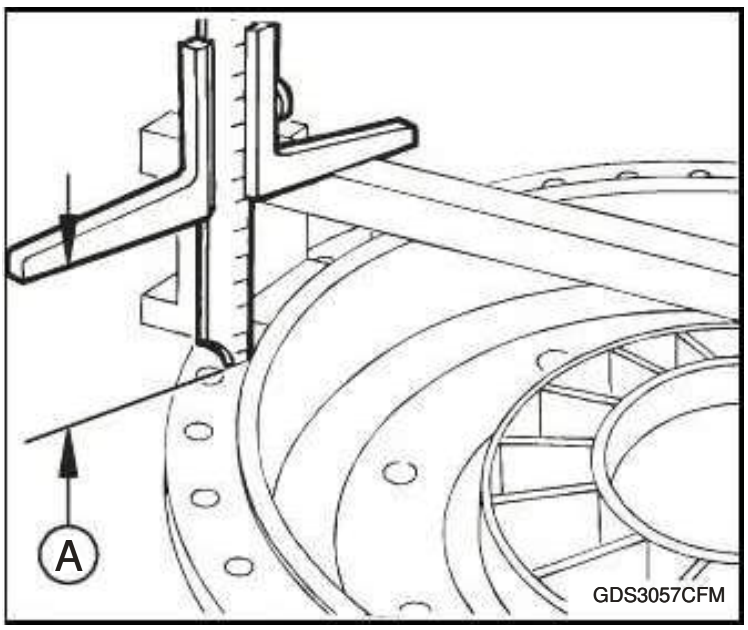
Install stator with long collar of roller down.



NOTE:Shim (19) is not installed to measure stator thrust bearing clearance.

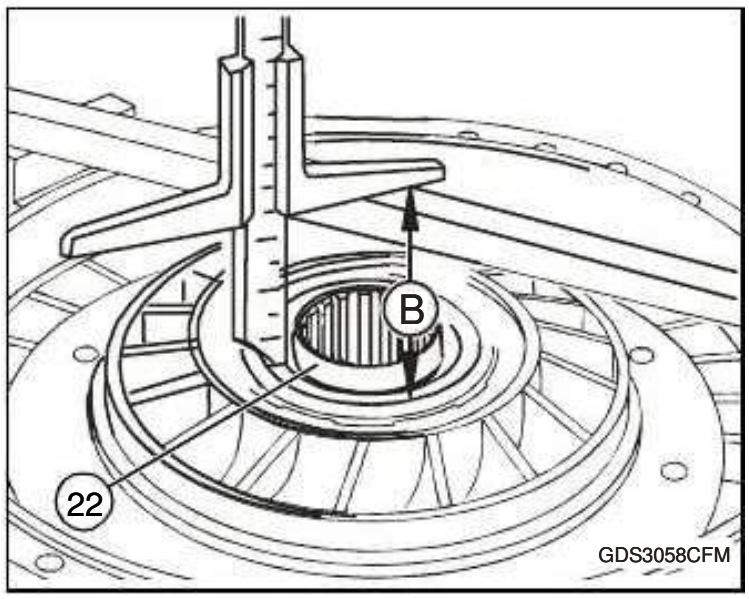
Install washers and bearing (20 - 22). Do not install shim (19) at this time.

NOTE:Torque convertor gasket must be included in the measuring proses.



Place measuring plate and bar on sealing surface of pump drive cover. Measuring bar must not rest on stator.

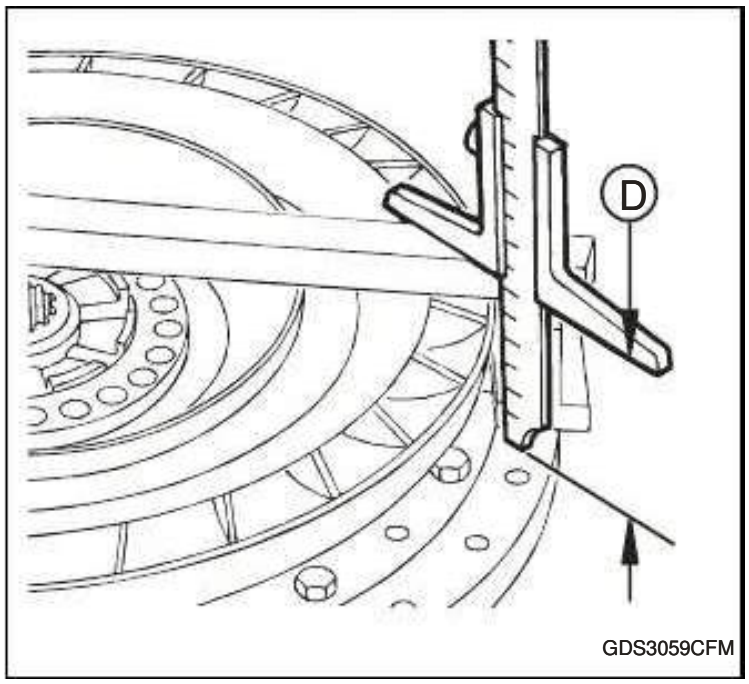
With depth gauge measure and record distance from measuring bar to pump drive sealing surface. Record as dimension **A**.



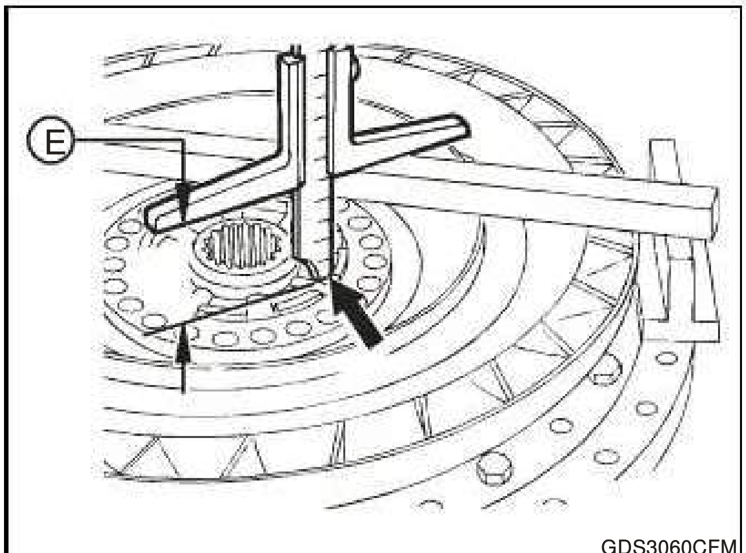
Measure distance from measuring bar to stator thrust bearing washer (22). Record as dimension **B**.

Subtract dimension **B** from dimension **A** and record as dimension **C**. **(A-B) = C**

Place measuring plates and bar on sealing surface of circuit cover (1). Measuring bar must not rest on turbine.



With depth gauge measure and record distance from measuring bar to circuit cover sealing surface. Record as dimension **D**.



GDS3060CFM

Measure distance from measuring bar to shim (19) contact surface on turbine cover (18). Record as dimension **E**.

Subtract dimension **E** from dimension **D** and record as dimension **F**. **(D-E) = F**

Thrust bearing clearance is 0.1 - 0.3 mm (0.004 - 0.012 in.). Average clearance is 0.2 mm (0.008 in.) dimension H.

Disassemble and Assemble Torque Converter Specification

Stator Thrust Bearing Clearance ------------------------------------- 0.1 - 0.3 mm (0.004 - 0.012 in.)

To determine shim size subtract dimension F from dimension C and record as dimension G. (C-F) = G

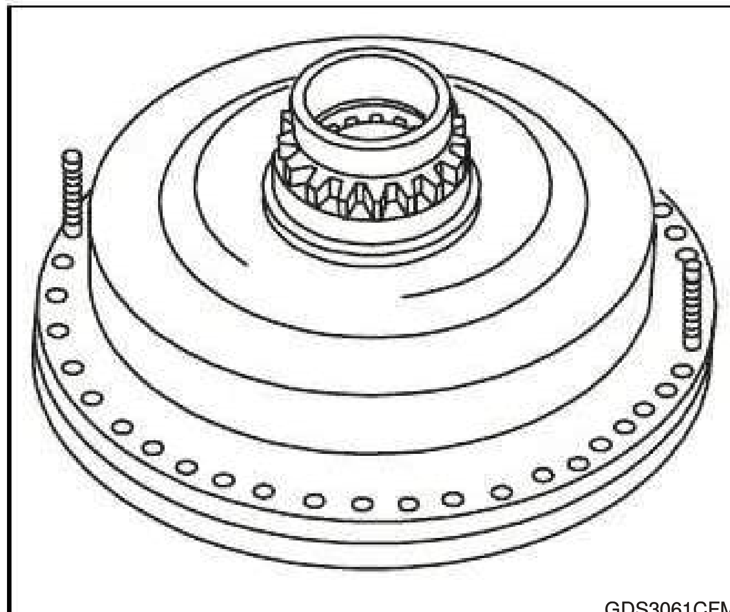
Subtract average thrust bearing clearance H from dimension G. This will give shim (19) size needed. (G-H) = shim size

Place correct shim and washer (20) in turbine cover with chamfer side of washer toward shim.

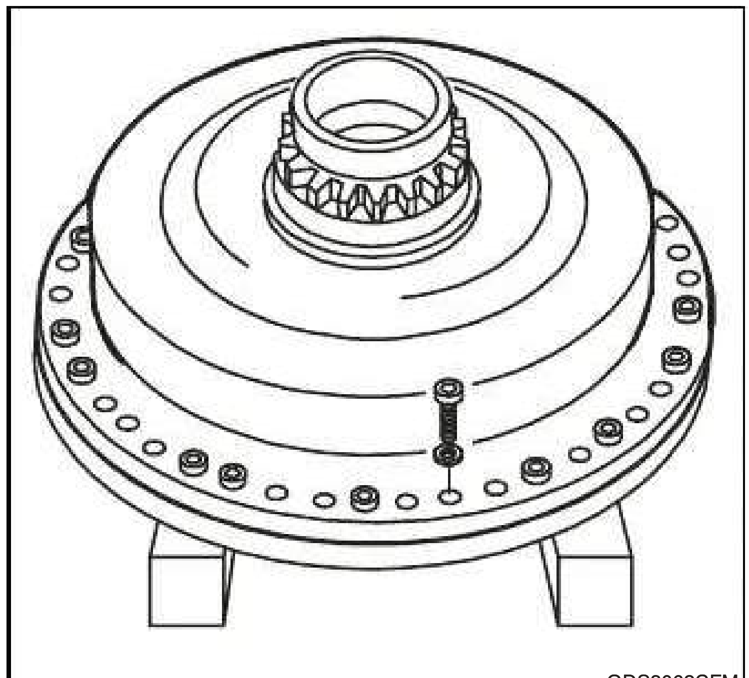
Apply thin layer of oil to bearing (21) and install with washer (22).

Position stator and bearing (28) on turbine pump cover.

Install O-ring (29).


GDS3061CFM

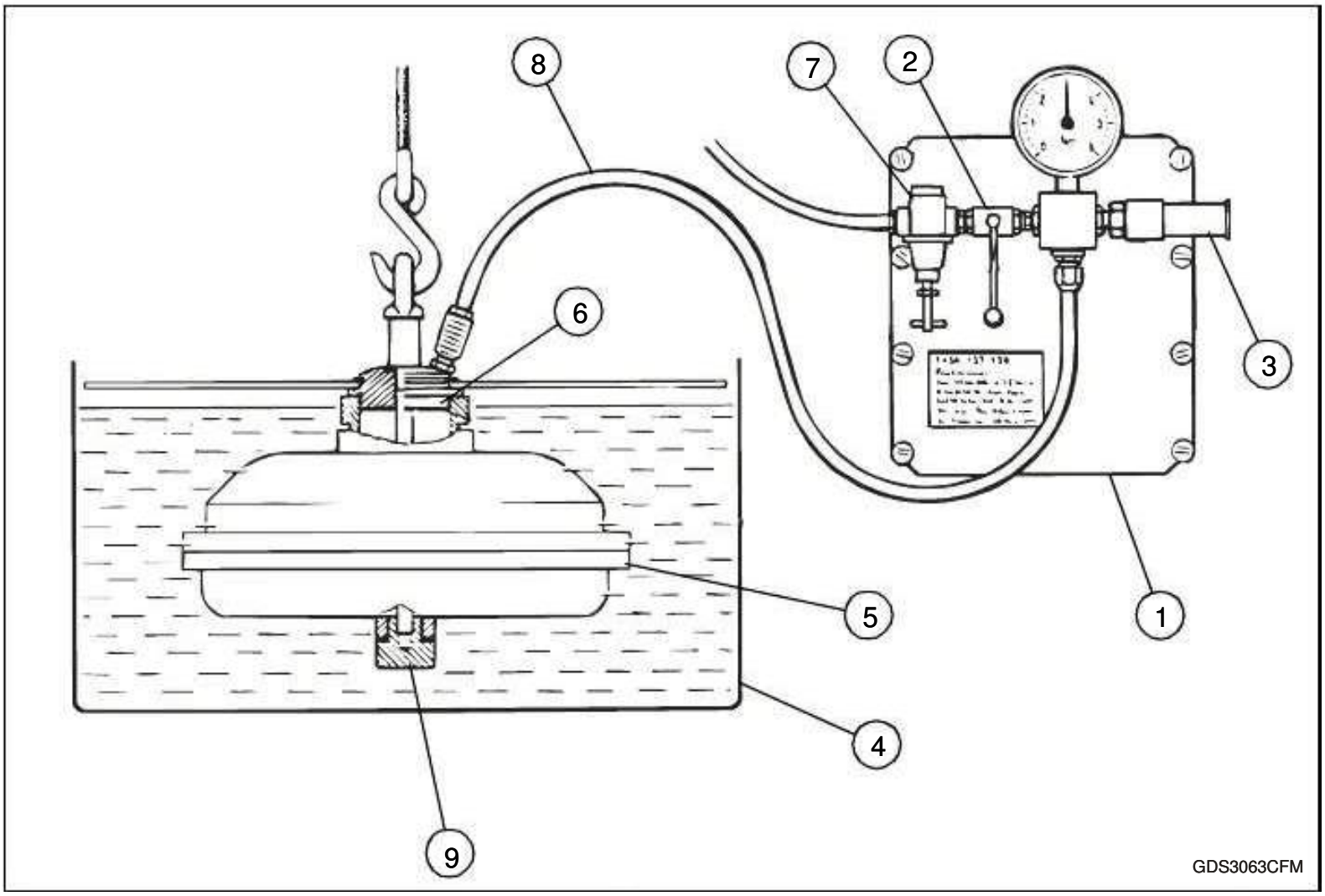
Install two guide pins to assemble circuit cover and pump drive cover.


GDS3062CFM

Fit cap screws and tighten.

Disassemble and Assemble Torque Converter Specification

Torque Converter Cap Screws Torque -- 35 Nm (26 lb-ft)



1. Compressed Air Unit.
2. Shut-Off Valve.
3. Safety Valve.
4. Water Tank.
5. Torque Converter Assembly.
6. JDG 1620 Torque Converter Leakage Check Adapter.
7. Air Pressure Regulator.
8. Compressed Air Hose.
9. Retaining Nut.

⚠ CAUTION

Heavy Component use hoist. The approximate weight of torque converter is 60 kg (132 lb).

Install JDG1620 Torque Converter Leakage Check Adapter (6) in converter opening.

Attach retaining nut (9) to JDG1620.

Set regulated air pressure to 250 kPa (2.5 bar) (36 psi) and connect to inlet of JDG1620.

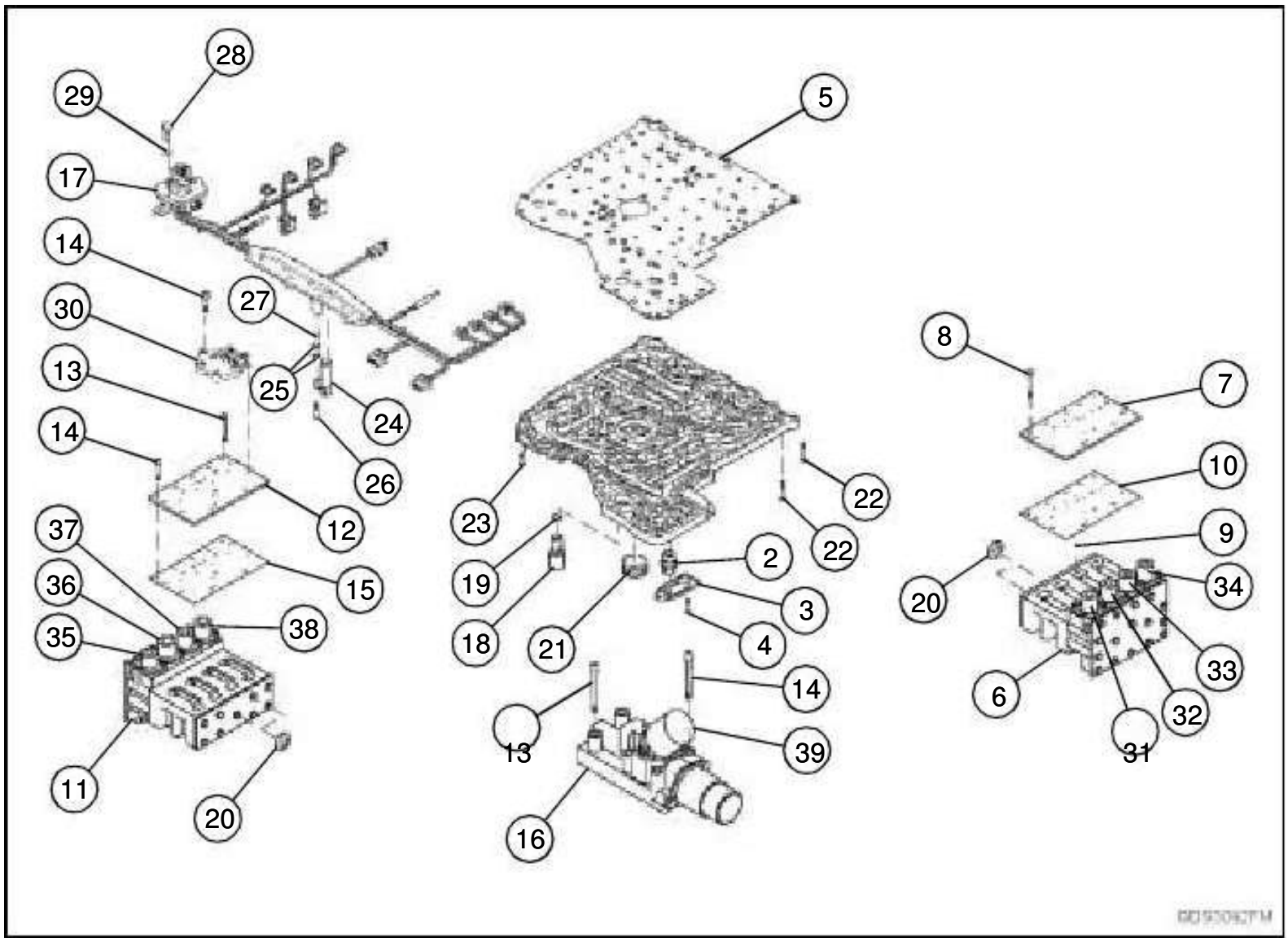
NOTE: Water in test tank should be 20° C (68° F) and be mixed with antifreeze at a ratio of 1:120.

Using hoist lower converter into tank of water mixed with antifreeze at a ratio of 1:120.

With air pressure applied converter should be completely air tight.

Use compressed air to dry torque converter and apply thin layer of oil to pump drive gear.

Disassemble and Assemble Shift Control Valve



1. Shift Control Body.
2. Converter Drain Valve.
3. Spring Plate.
4. Cap screw.
5. Intermediate Plate.
6. Manifold Block A.
7. Cover.
8. Cap Screw (15 used).
9. Check Ball.
10. Gasket.
11. Manifold Block B.
12. Cover.
13. Cap Screw.
14. Cap Screw.
15. Gasket.
16. Throttle Pressure Valve.
17. Wire Harness.
18. Converter Pressure Valve.
19. Washer.
20. Debris Magnet (4 Used).
21. Plug.
22. Cap Screw.
23. Cap Screw.
24. Input Speed Sensor.
25. Shim.
26. Cap Screw.
27. O-Ring.
28. Cap Screw.
29. Washer.
30. F2 Valve Block.
31. Clutch A Solenoid.
32. Clutch C Solenoid.
33. Clutch WK Solenoid.
34. Clutch F Solenoid.
35. Clutch B Solenoid.
36. Clutch E Solenoid.
37. Clutch D Solenoid.
38. F2 Solenoid.
39. Retarder Solenoid Valve.

Disconnect and remove wire harness (17) and input speed sensor (24).

Remove converter drain valve parts (2 - 4).

Remove retarder solenoid (39) and throttle pressure valve (16).

Remove F2 valve block (30) and debris magnets (20).

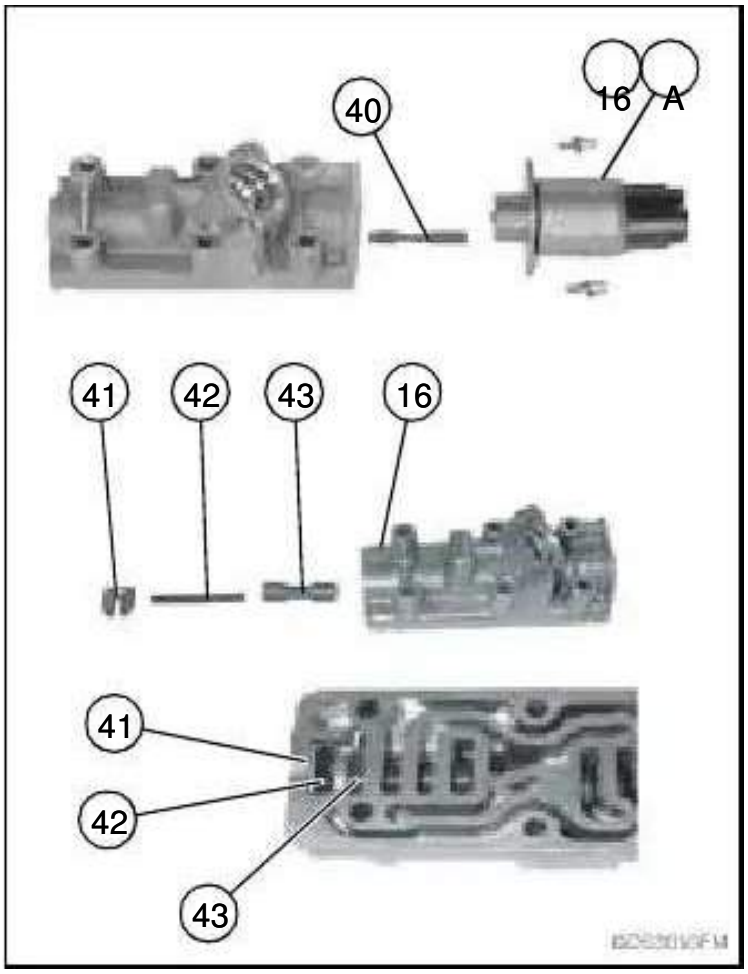
Remove solenoids (31 - 38).

Remove cap screws (8) and manifold block A (6).

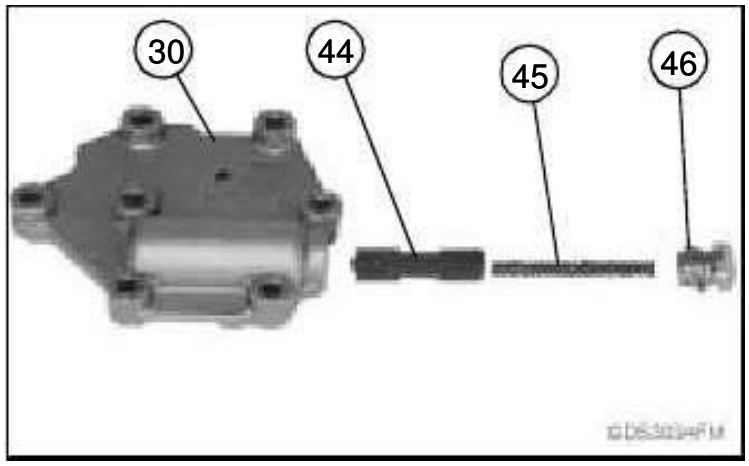
Remove cap screws (13 and 14) and manifold block B (11).

Remove intermediate plate (5).

Tap converter pressure valve (18) with soft face hammer to expose snap ring and remove. Tap valve out of body in opposite direction.



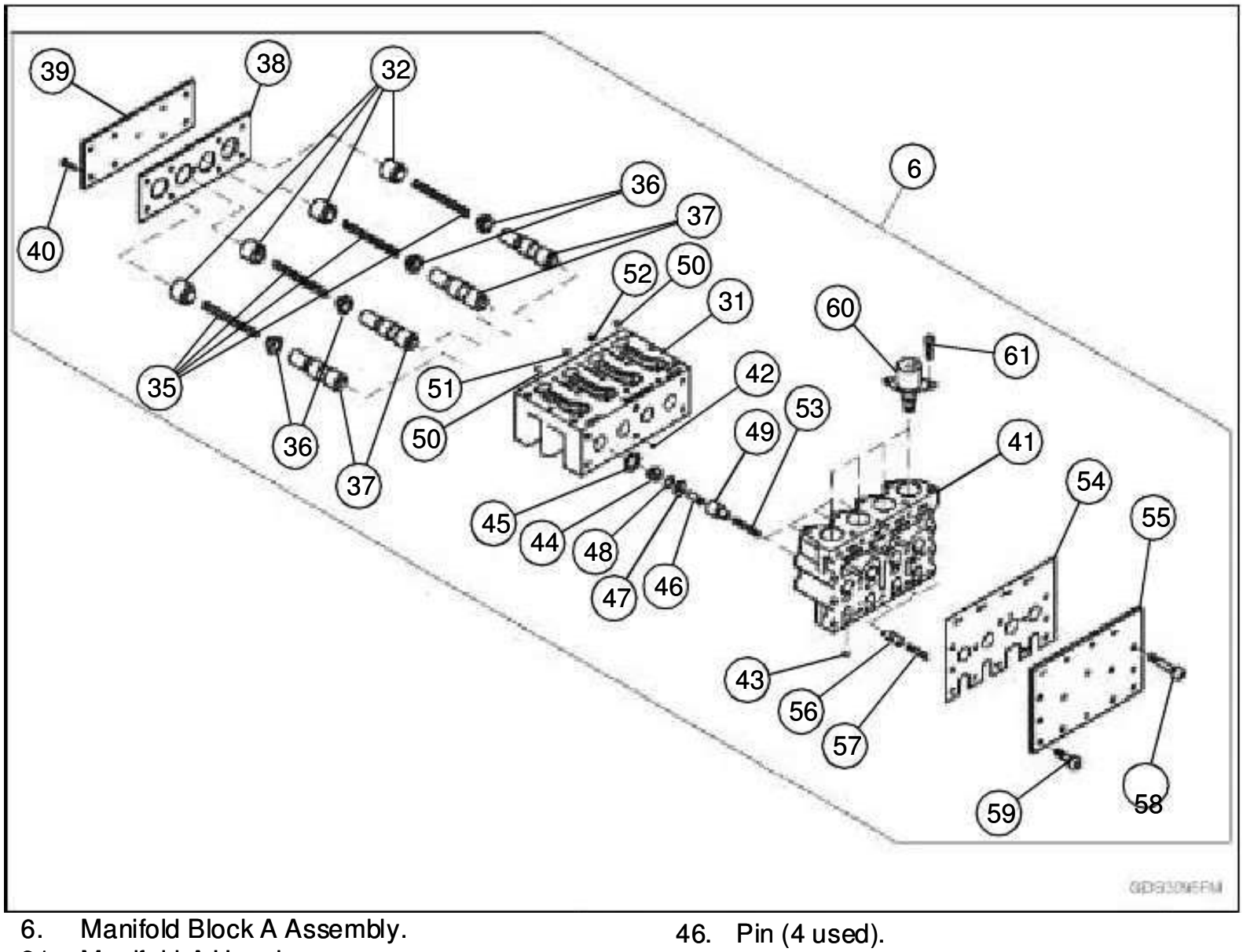
Disassemble throttle pressure valve (16). Inspect, clean and assemble parts (40 - 43).



Disassemble F2 valve (30). Inspect, clean and assemble parts (44 - 46).

Disassemble and Assemble Torque Converter Specification

F2 Valve Plug Torque - - - - - - - - - - - - 35 Nm (26 lb-ft)



6. Manifold Block A Assembly.
31. Manifold A Housing.
32. Piston (4 used).
33. Spring.
34. Spring.
35. Spring (2 used).
36. Washer (4 used).
37. Piston (4 used).
38. Gasket.
39. Cover.
40. Cap screw (9 used).
41. Manifold A Body.
42. O-Ring.
43. Check Ball.
44. Bushing (4 used).
45. O-Ring (4 used).
46. Pin (4 used).
47. Washer (4 used).
48. Snap Ring (4 used).
49. Piston (4 used).
50. Orifice (2 used).
51. Orifice.
52. Orifice.
53. Spring (4 used).
54. Gasket.
55. Cover.
56. Piston (4 used).
57. Spring (4 used).
58. Cap Screw (5 used).
59. Cap Screw (11 used).
60. Solenoid (4 used).
61. Cap screw (8 used).

⚠ WARNING

Mark and note location of all components for correct location. Components are similar and are not to be interchanged.

⚠ CAUTION

Manifold block cover (39 and 55) are under spring tension. Remove cap screws slowly and evenly to release spring tension.

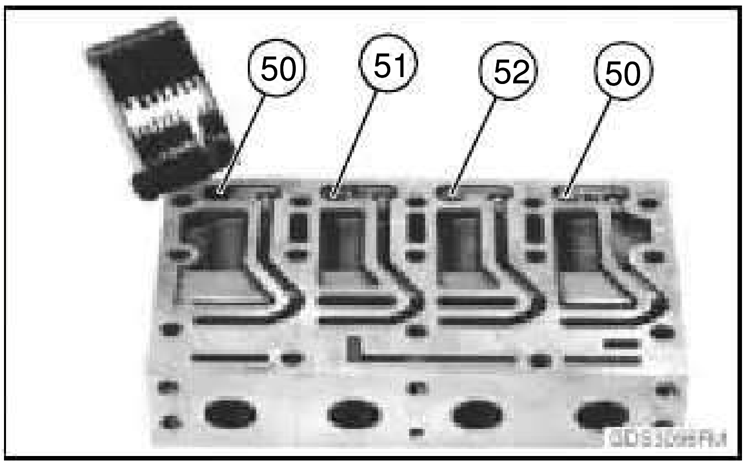
Remove solenoids (60).

NOTE: Guide pins may aid removal and installation of covers under spring tension.

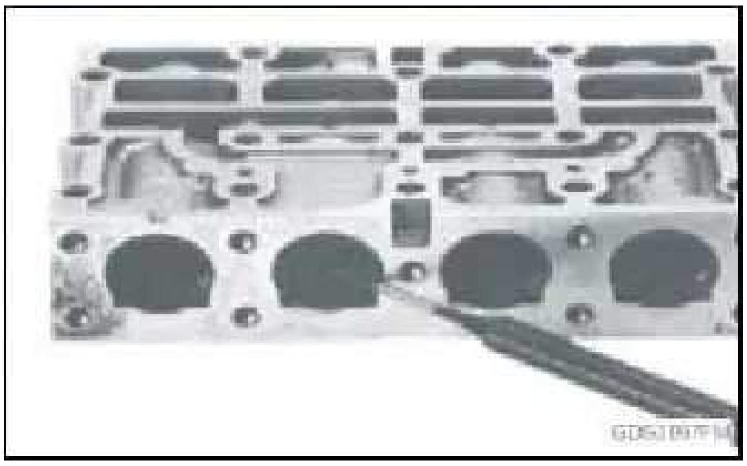
Remove manifold block covers (39 and 55) with care. Covers are under spring tension.

Mark and note location of components. Components are similar and are not to be interchanged.

Disassemble manifold components. Clean and inspect for wear or damage.



Clean and inspect orifices (50 - 52).



If needed orifices can be removed with a bent punch.

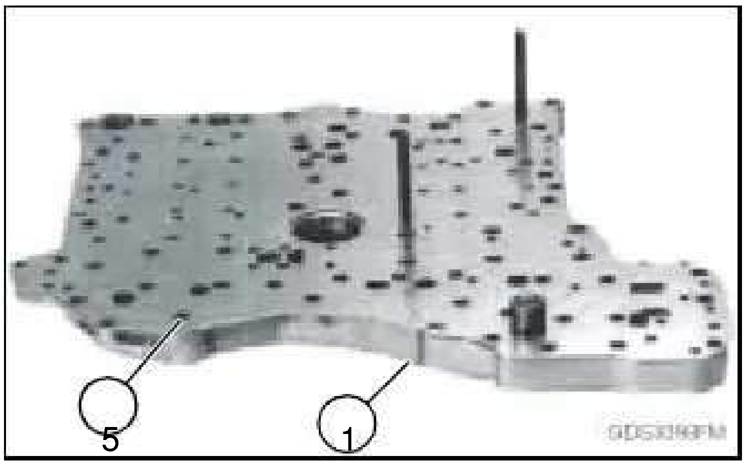
Orifices must secured in place at two points 90 degrees apart with a punch.

Lubricate and assemble manifold components.

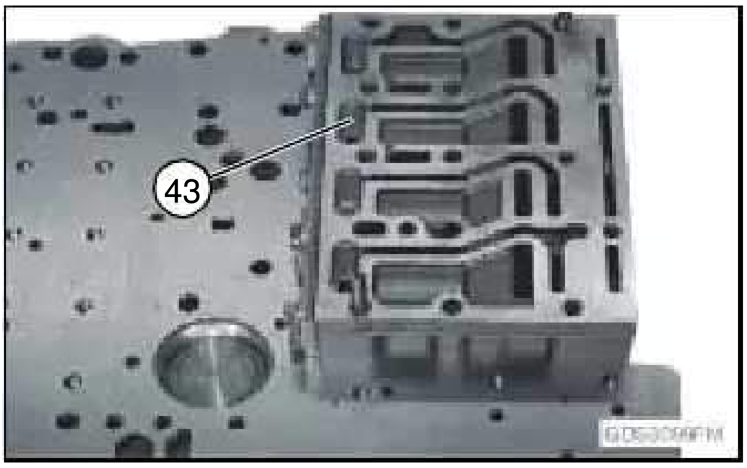
Using guide pins install gaskets (38 and 54) and covers (39 and 55). Compress springs and tighten cap screws.

Disassemble and Assemble Control Valve Specification

Manifold Cover Cap Screw Torque -9.5 Nm (84 lb-in.)



Install guide pins and intermediate plate (5) to Shift control body (1).



Measure diameter of check ball (43).

Disassemble and Assemble Control Valve Specification

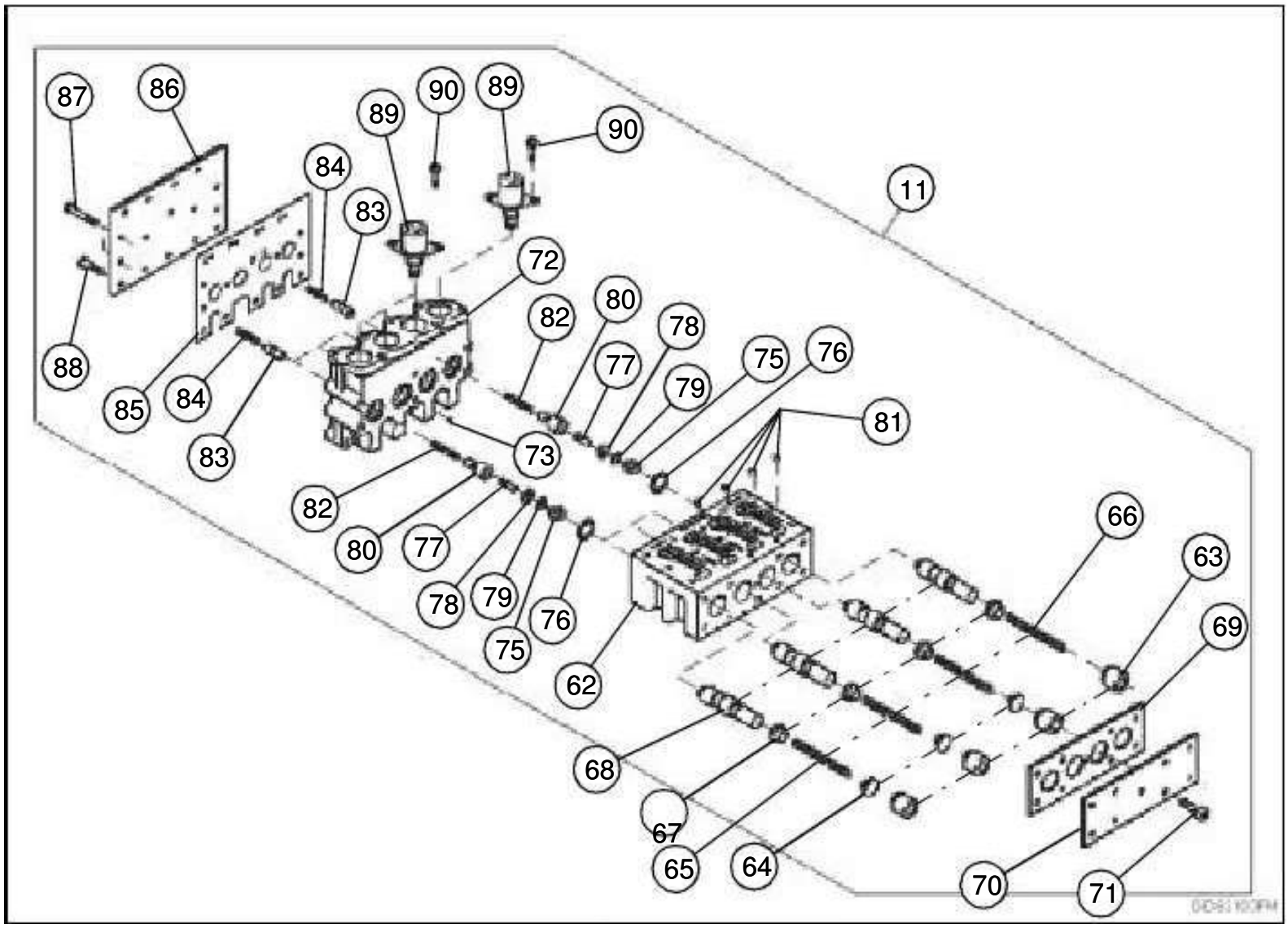
WC Port Check Ball Diameter - - - - - 5 mm (0.197 in.)

Install manifold block A (6) and check ball (43).

Install gasket (10) and cover (7). Tighten cap screws.

Disassemble and Assemble Control Valve Specification

Manifold A Cap Screw Torque - - - - 9.5 Nm (84 lb-in.)



11. Manifold Block B Assembly.
62. Manifold B Housing.
63. Piston (4 used).
64. Stop (3 used).
65. Spring (3 used).
66. Spring.
67. Washer (4 used).
68. Piston (4 used).
69. Gasket.
70. Cover.
71. Bolt (9 used).
72. Manifold B Body.
73. O-Ring.
74. Not Used.
75. Bushing (4 used).
76. O-Ring (4 used).
77. Pin (4 used).
78. Washer (4 used).
79. Snap Ring (4 used).
80. Piston (4 used).
81. Orifice (4 used).
82. Spring (4 used).
83. Piston (4 used).
84. Spring (4 used).
85. Gasket.
86. Cover.
87. Bolt (5 used).
88. Bolt (11 used).
89. Solenoid (4 used).
90. Cap Screw.

⚠ WARNING

Mark and note location of all components for correct location. Components are similar and not to be interchanged.

Remove solenoids (89).

⚠ CAUTION

Manifold block cover (70 and 86) are under spring tension. Remove cap screws slowly and evenly to release spring tension.

NOTE: Guide pins may aid removal and installation of covers under spring tension.

Remove manifold block covers (70 and 86) with care. Covers are under spring tension.

Mark and note location of components. Components are similar and are not to be interchanged.

Disassemble manifold components. Clean and inspect for wear or damage.

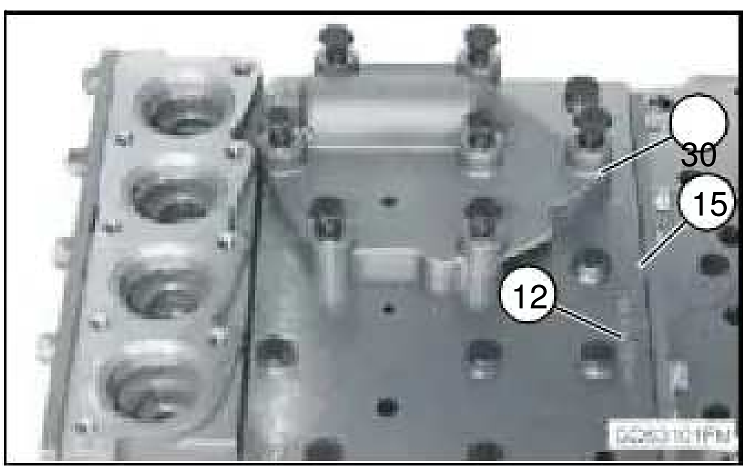
Orifices are replaced similar to manifold A.

Lubricate and assemble manifold components.

Using guide pins place gaskets (69 and 85) and covers (70 and 86). Compress springs and tighten cap screws.

Disassemble and Assemble Control Valve Specification

Manifold Cover Bolt Torque - 9.5 Nm (84 lb-in.)

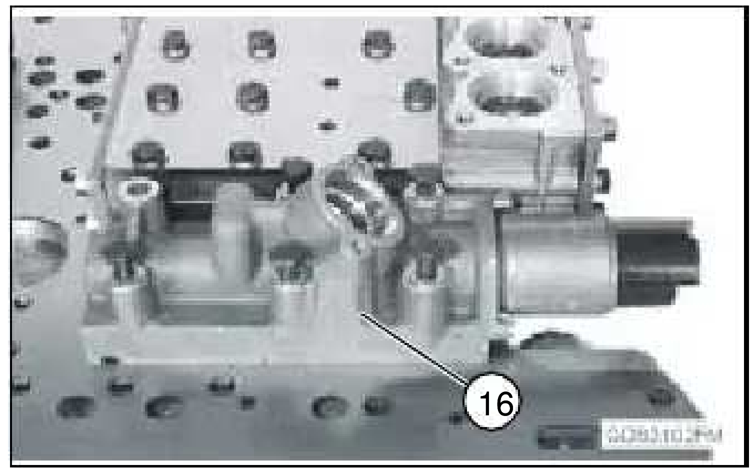


Using guide pins install manifold block B.

Install gasket (15) and cover (12). Tighten cap screws.

Disassemble and Assemble Control Valve Specification

Manifold B Bolt Torque- - - - - - - - - - 9.5 Nm (84 lb-in.)



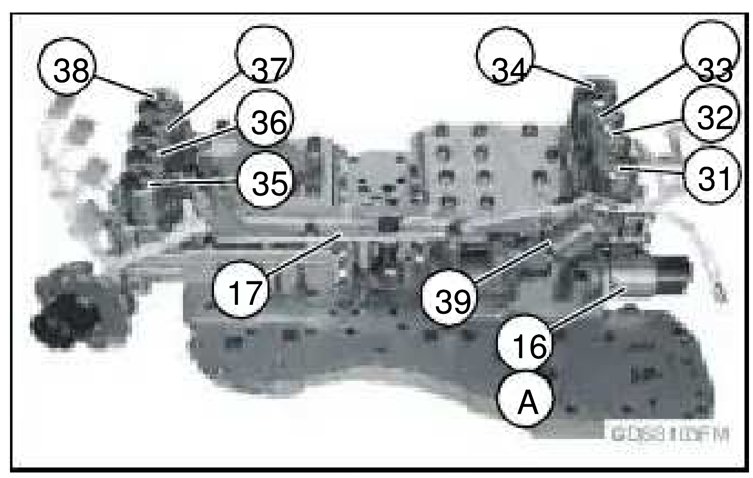
Install F2 valve block (30) and throttle pressure valve (16).

Disassemble and Assemble Control Valve Specification

F2 Valve Block Bolt Torque - 9.5 Nm (84 lb-in.)

Disassemble and Assemble Control Valve Specification

Throttle Pressure Valve Bolt Torque - 9.5 Nm (84 lb-in.)



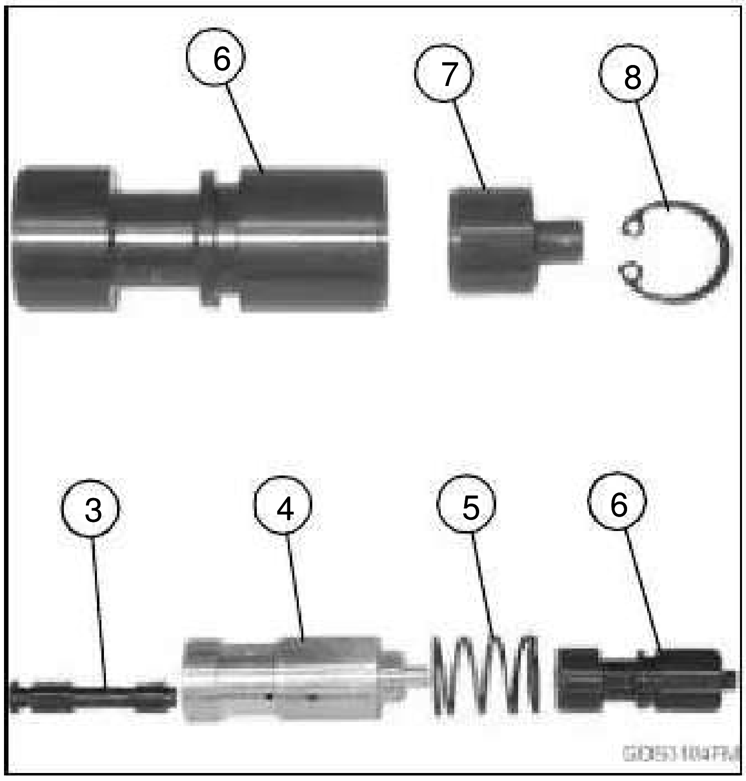
Install solenoids 16 and (31 - 39).

Disassemble and Assemble Control Valve Specification

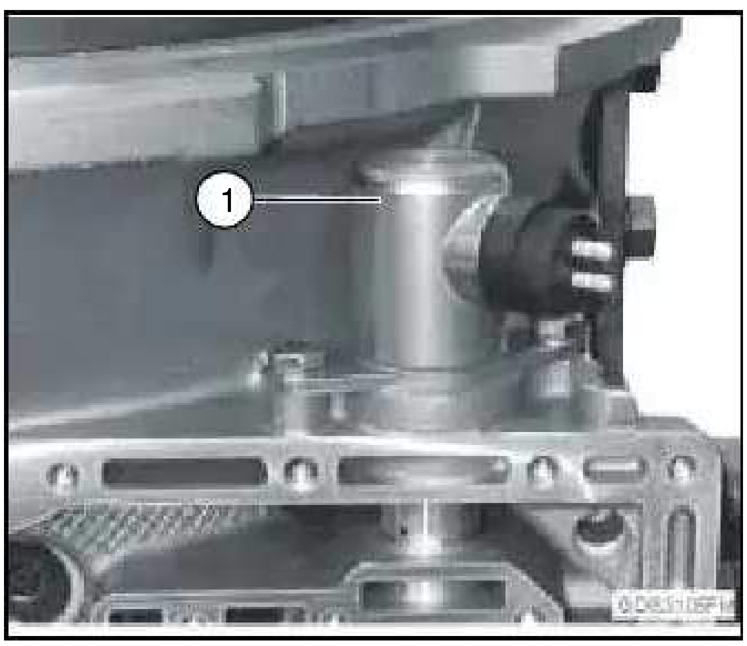
Solenoid Cap Screw Torque- - - - - - 5.5 Nm (49 lb-in.)

Install wire harness (17) and connect solenoids.

Assemble Retarder Valve



Assemble parts (3 - 8).

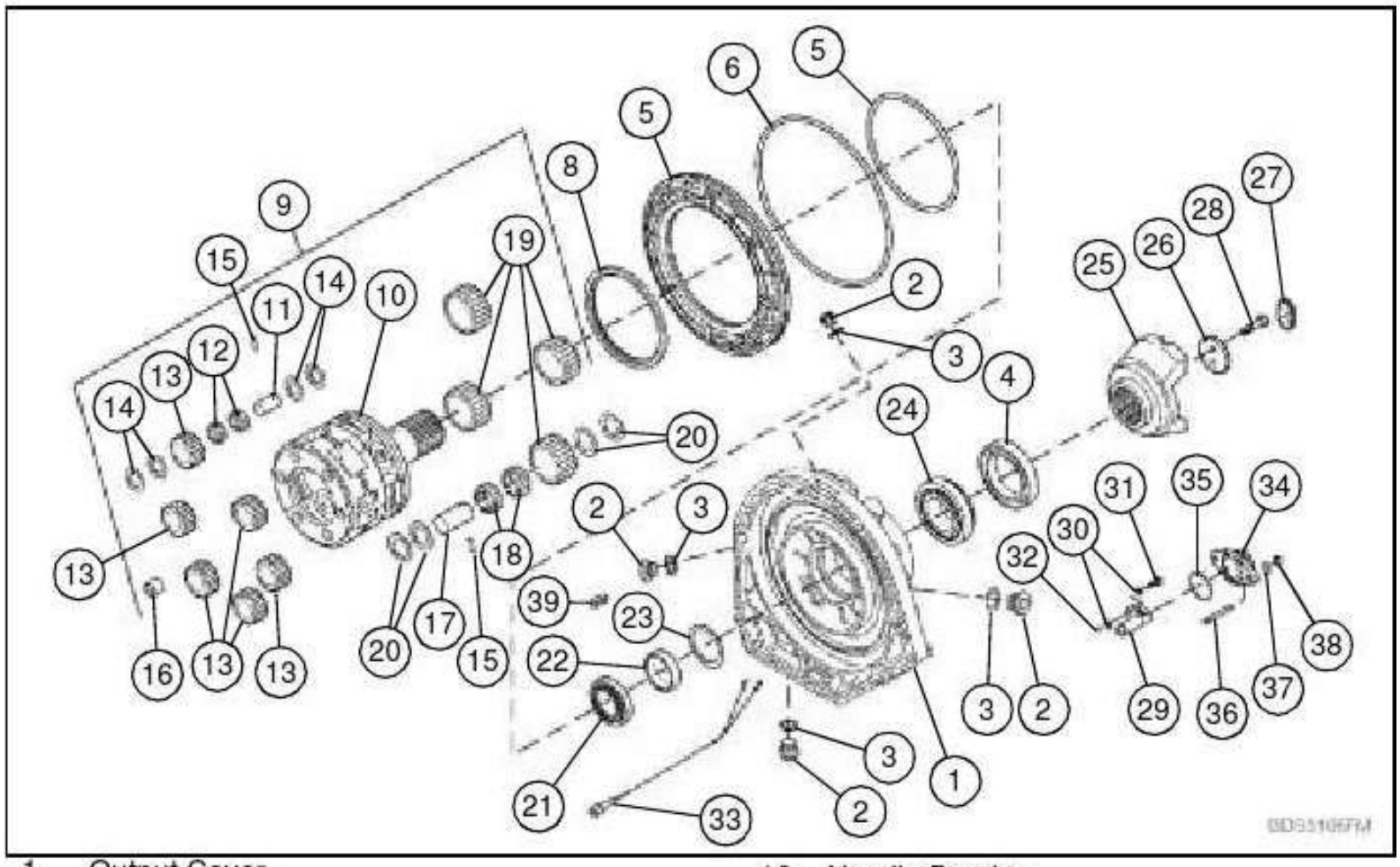


Install retarder valve solenoid (1) and O-ring.

Install Retarder Valve Specification

Retarder Solenoid Torque - 23 Nm (204 lb-in.)

Disassemble and Assemble Output Planetary and Clutch Element



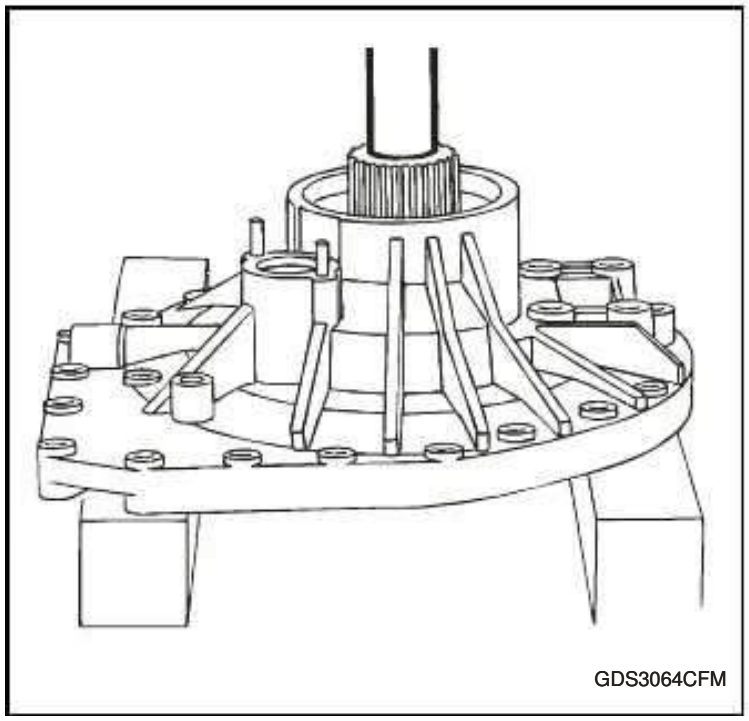
1. Output Cover.
2. Plug (4 used).
3. Plug Seal (4 used).
4. Seal.
5. Clutch G Piston.
6. Piston Seal.
7. Piston Seal.
8. Thrust Ring.
9. Planetary Assembly.
10. Planetary Carrier.
11. Pinion Shaft (6 used).
12. Bearing (12 used).
13. Planetary Pinion Set.
14. Thrust Washer (24 used).
15. Roll Pin (10 used).
16. Needle Bearing.
17. Pinion Shaft (4 used).
18. Bearing (8 used).
19. Planetary Pinion Set.
20. Thrust Washer (16 used).
21. Bearing.
22. Spacer Bushing.
23. Shim.
24. Bearing.
25. Flange.
26. Retainer.
27. Bolt Lock.
28. Bolt (2 used).
29. Output Speed Sensor.
39. Valve.

Hold clutch G piston (5) with pliers and tap output cover (1) with soft face hammer to remove clutch G piston.

Tap output cover with soft face hammer and remove valve (39).

⚠ CAUTION

Do not damage shaft face when removing bearings. Use suitable pressure disc on shaft.



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Support output cover. Using press push planetary carrier (10) from output cover.

NOTE: Remove bearing race from output cover only when bearings are replaced.

Remove seal (4) and outer bearing (24).

Remove shims (23).

Remove bushing (22) and bearing (21) with suitable puller.

Inspect and replace bearings and races as needed.

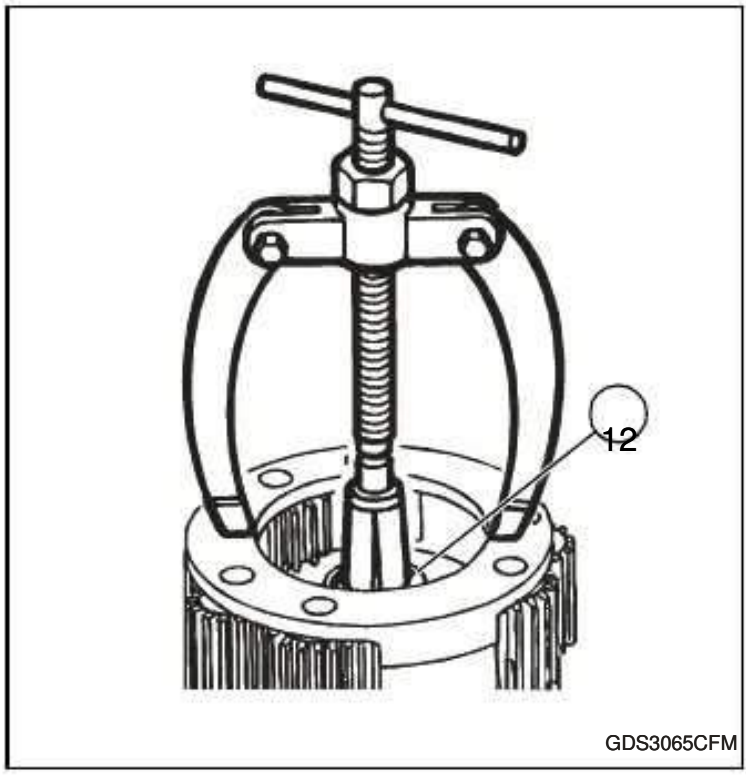
⚠ CAUTION

Wear protective gloves components will be hot.

Heat output cover to approximately 85° C (185° F) and remove bearing races at grooves in housing.

Use press to remove bearing from shaft.

Remove thrust ring (8).



GDS3065CFM

Remove needle bearing (16) with suitable puller.

NOTE: Measure planetary pinion end play before disassembly. Disassembly required only if worn or damaged.

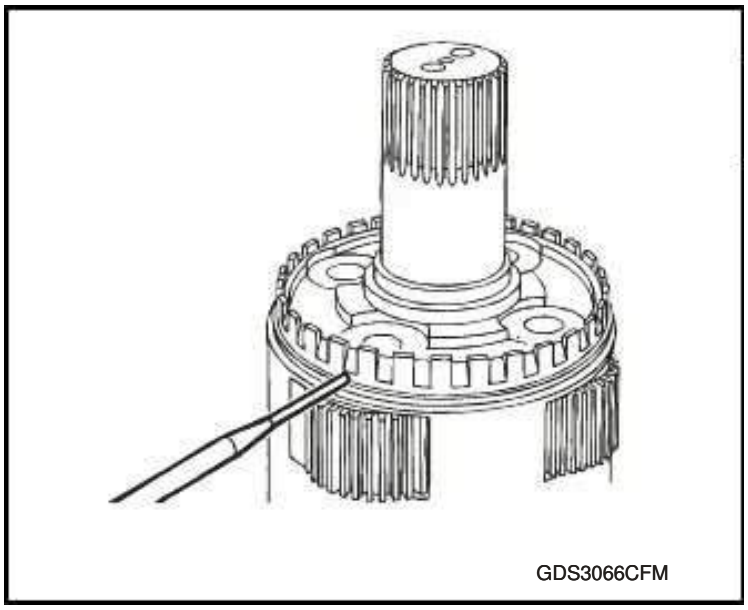
Planetary pinions must be replaced as a set.

Measure planetary pinion end play.

Disassemble and Assemble Output Planetary Specification

Carrier Pinion End Play - 0.5 - 1.2 mm (0.02 - 0.047 in.)

Planetary pinions are replace as a set.



GDS3066CFM

Carefully drive roll pins (15) into center of pinion shafts (11 and 17).

Drive pinion shafts from carrier (10) and remove roll pins.

Remove parts (11 - 14) and (18 - 20). Inspect carrier (10) for wear or damage.

Install needle bearing (16) with suitable driver. Secure bearing in carrier at three evenly space locations.

Install planetary pinion parts (11 - 14) and (18 - 20). Locate roll pin hole in pinion shaft with hole in carrier.

Measure end play at all pinions.

Disassemble and Assemble Output Planetary Specification

Carrier Pinion End Play -0.5 - 1.2 mm (0.02 - 0.047 in.)

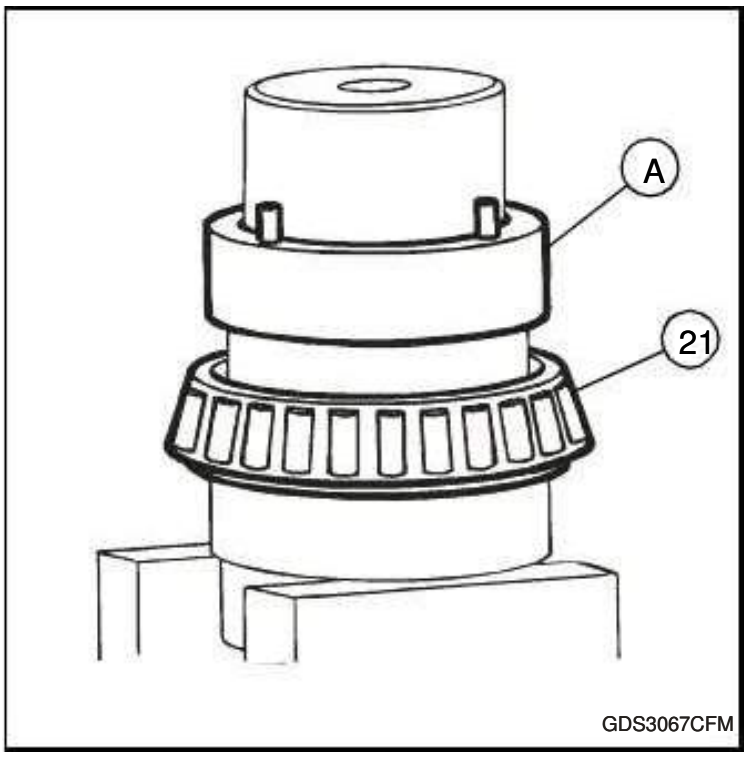
Drive new roll pin (15) into carrier until even with carrier surface. Secure roll pin in carrier with punch.

⚠ CAUTION

Wear protective gloves components will be hot.

If removed heat output cover to 85° C (185° F) and install bearing (21 and 24) races.

Clean and lightly lubricate bearings (21 and 24).

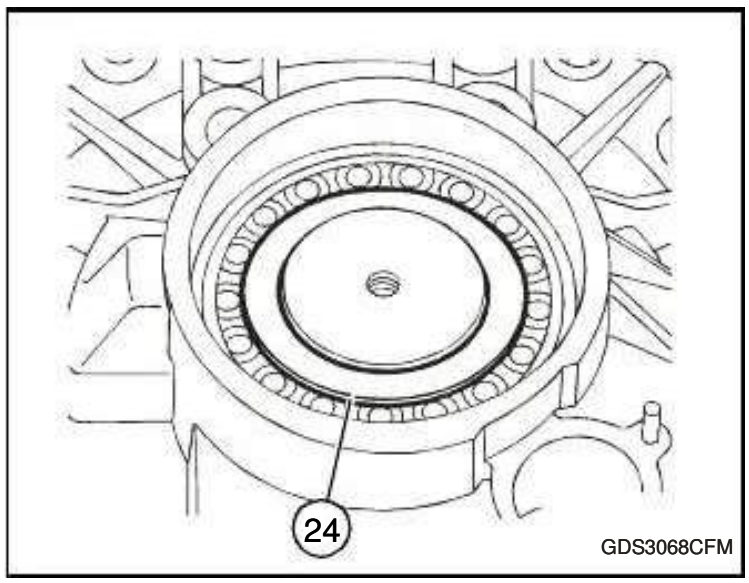


Place 281691 Device Adjusting in vice with bearing (21).

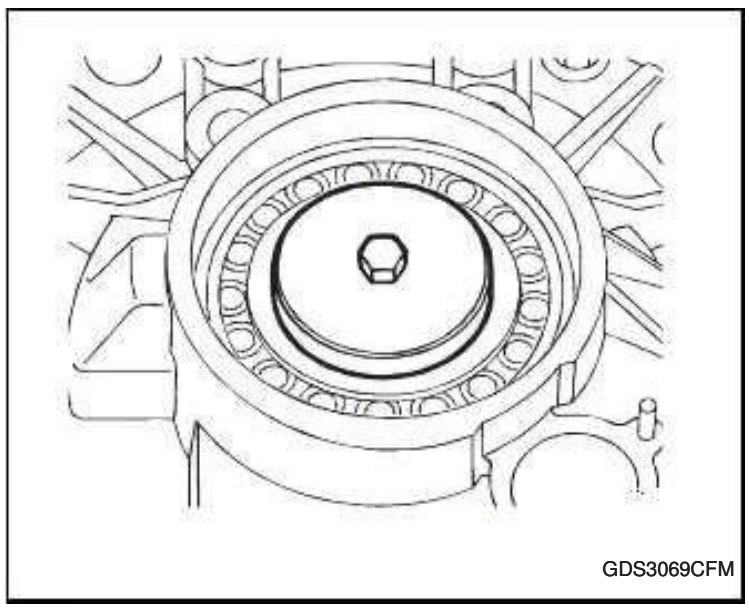
Place adjuster ring (A) with dowels extending at least 5 mm (0.197 in.) on adjuster tool.

NOTE: Output cover and bearings must be at 20° C (68° F) during shim adjustment procedure.

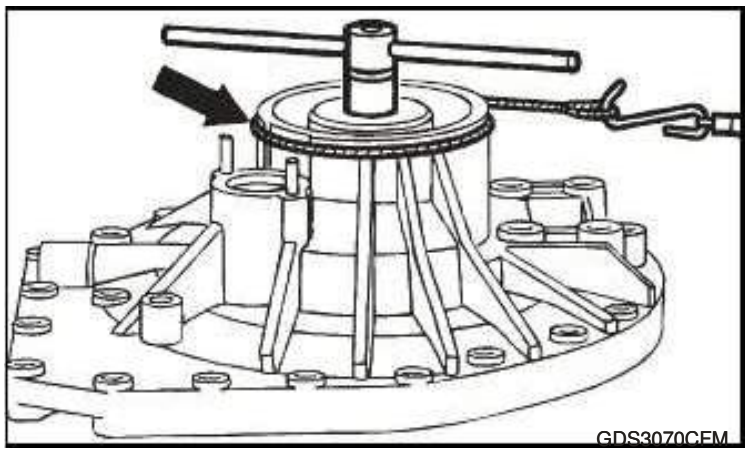
Place output cover on adjusting tool with bearing outer races installed.



Place bearing (24) and washer of adjuster with recess toward bearing.



Install adjuster cap screw and tighten until bearing roller make contact with bearing race.



Wrap a cord several times around output cover as shown and hook to spring balance.

**NOTE: If the pulling force is less than 8 N (2 lb)force, tighten cap screw to obtain 8 - 10 N (2 lb) force.
If the pulling force is greater than 10 N (2 lb) force, the adjusting tool dowel pins must be reset and start again.**

Evenly pull spring balance to start output cover to turn. The pulling force while cover is turning should be 8 - 10 N (2 lb) force.

Disassemble and Assemble Output Planetary Specification

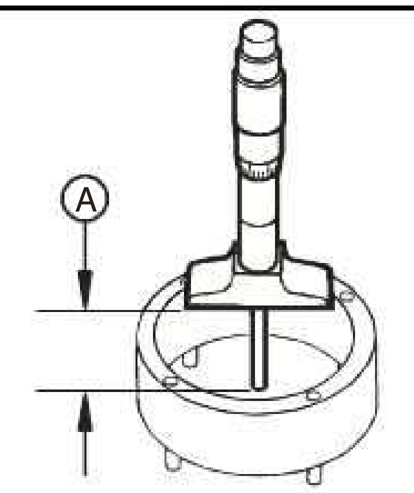
Output Shaft Bearing Rolling Drag Torque - 8 - 10 N (2 lb) force

CAUTION

Carefully remove output cover from adjusting tool. Dowel pins on adjustment ring must not be disturbed.

With rolling force obtained remove cap screw and output cover not disturb dowel pins in adjusting ring.

Remove adjustment tool.



GDS3071CFM

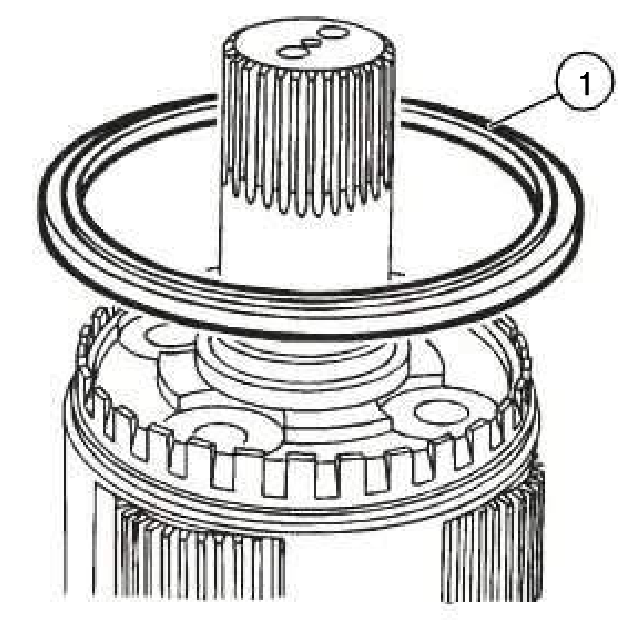
Place adjusting ring on flat surface and measure adjustment ring height (A) as shown. Record as dimension (A).

Measure height of spacer bushing (22) and add bearing end float nominal thickness of 0.05 mm (0.002 in.). Record as dimension (B).

Disassemble and Assemble Output Planetary Specification

Output Shaft Bearing Float End Play - - - - - - - - - 0.02 - 0.07 mm (0.001 - 0.003 in.)

To determine shim (23) size. Subtract dimension (B) from dimension (A) (A-B) = shim size.



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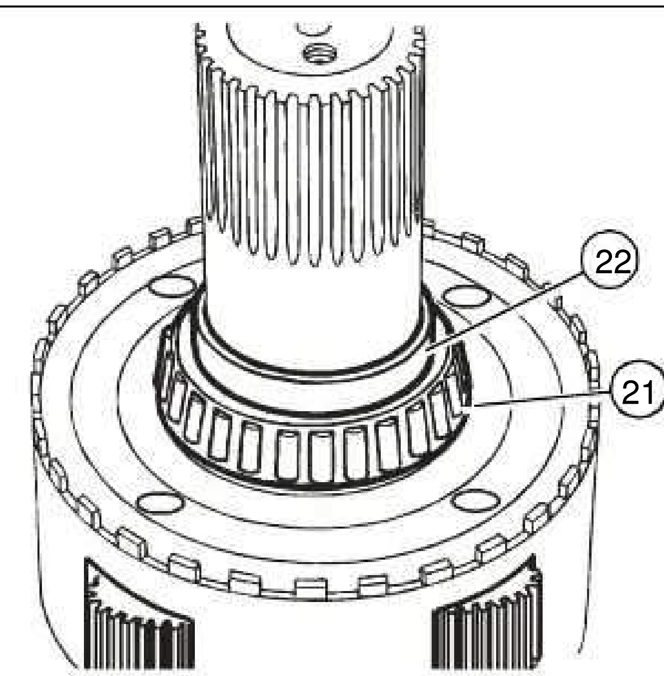
Install thrust ring (1).



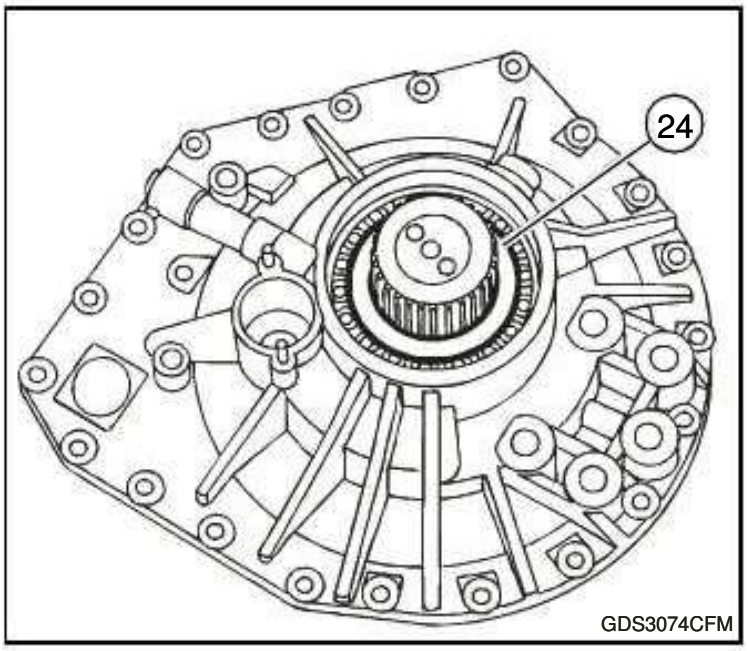
GDS3073CFM

CAUTION

Wear protective gloves components will be hot.

Heat bearing (21) to 140° C (240° F) and install to shoulder on output shaft.

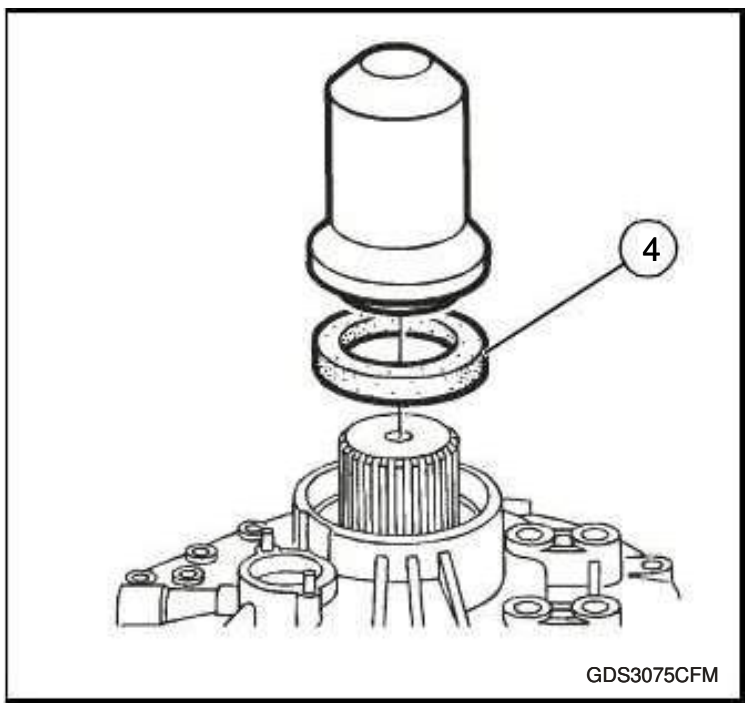
Install spacer bushing (22) and shim. Locate output cover on output shaft.



⚠ CAUTION

Wear protective gloves components will be hot.

Heat bearing (24) to 140° C (284° F) and install. Make sure bearing makes contact with bearing race.



Apply a thin layer of liquid soap to output cover seal (4) surface. Apply a thin layer of petroleum jelly to inner seal surface and install using 281695 Drifter.

⚠ CAUTION

Wear protective gloves components will be hot.

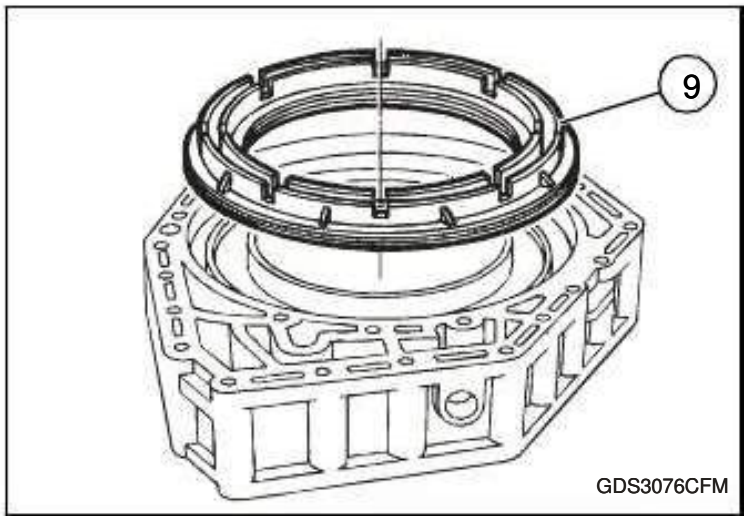
Heat output flange to 140° C (284° F) and install.

Install DFT1231 Output Assembly Lift Bracket.

Disassemble and Assemble Output Planetary Specification

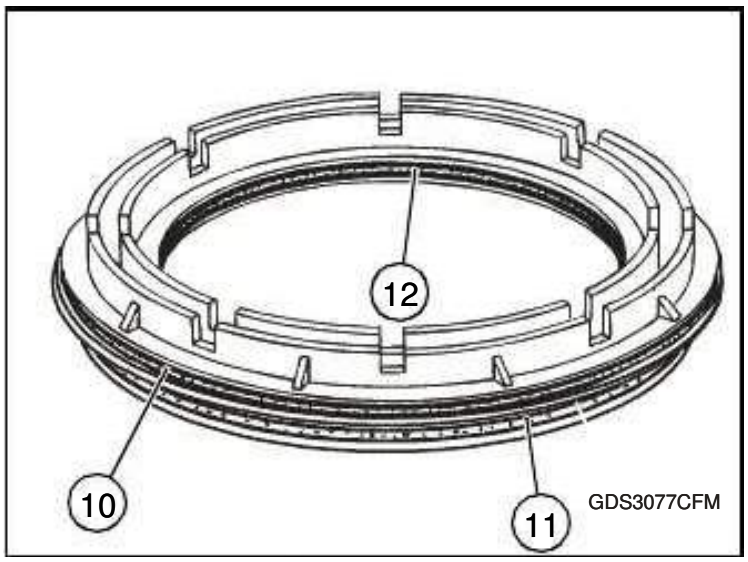
Output Assembly Lifting Bracket Torque - 60 Nm (44lb. -ft.)

Disassemble and Assemble Intermediate Housing and Clutch Element



Remove clutch F plates if not removed, mark position and order of plates.

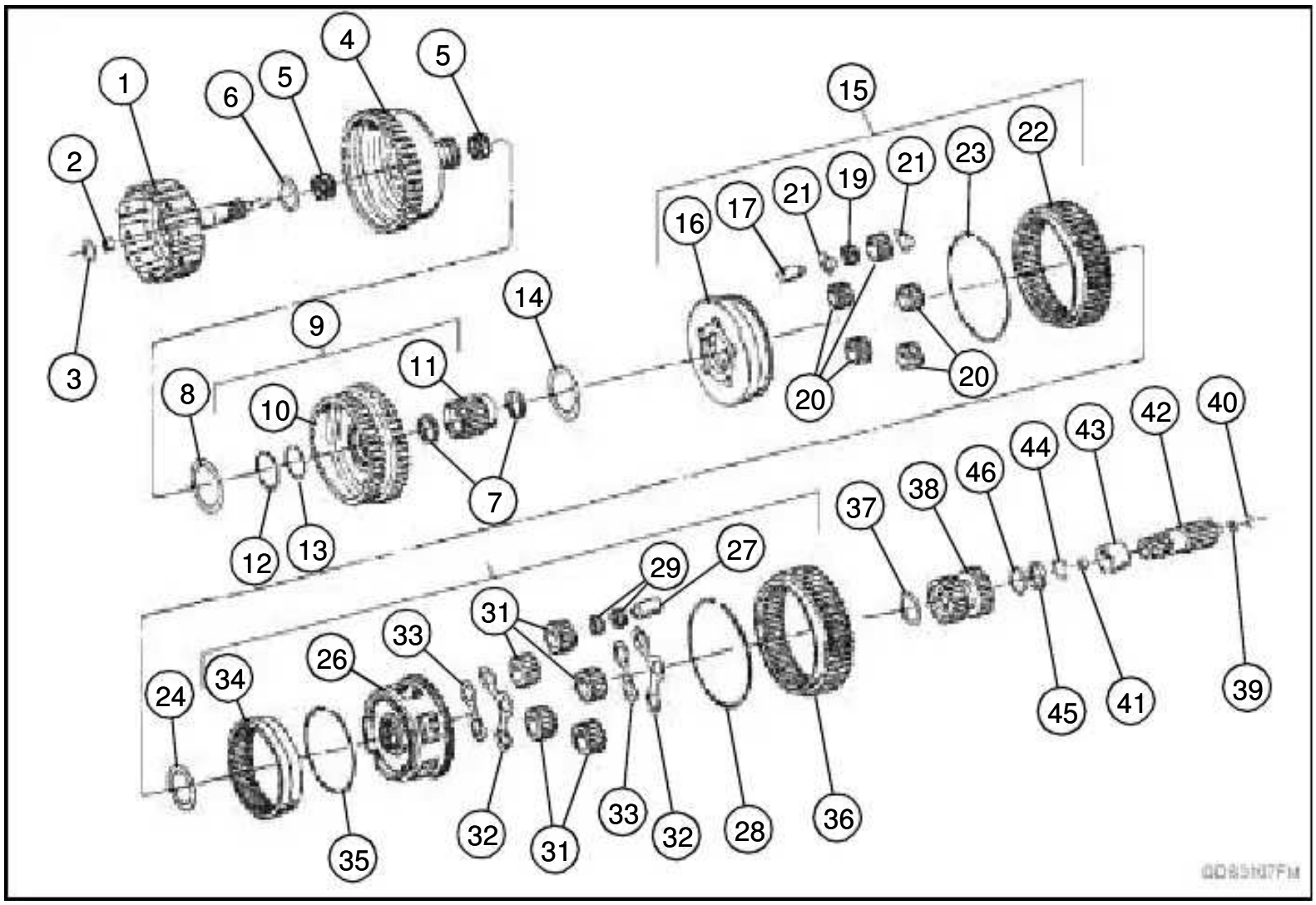
Remove clutch F piston (9).



Remove clutch F piston seals (10 - 12).

Install seals and piston.

Disassemble and Assemble Planetary One and Two



1. Clutch C Shaft Input.
2. Bushing Sleeve.
3. Thrust Washer.
4. Clutch C Hollow Shaft.
5. Bearing (2 used).
6. Thrust Washer.
7. Bearing (2 used).
8. Thrust Washer.
9. Planetary Assembly.
10. Planetary Carrier.
11. Sun Gear.
12. Snap Ring.
13. Snap Ring.
14. Thrust Washer.
15. Planetary One Assembly.
16. Planetary Carrier.
17. Pinion Shaft (5 used).
18. Not Used.
19. Bearing (5 used).
20. Pinion (5 used).
21. Pinion Plate (10 used).
22. Ring Gear.
23. Snap Ring.
24. Thrust Washer.
25. Planetary Two Assembly.
26. Planetary Carrier.
27. Pinion Shaft (5 used).
28. Snap Ring.
29. Bearing (10 used).
30. Not Used.
31. Pinion (5 used).
32. Pinion Plate (2 used).
33. Pinion Plate (2 used).
34. Ring Gear.
35. Snap Ring.
36. Ring Gear.
37. Thrust Washer.
38. Sun Gear.
39. Bearing.
40. Shim (s).
41. Spacer.
42. Shaft.
43. Bearing.
44. Ring.
45. Ring.
46. Shim.

Planetary one and two disassembly and assembly are similar.

Planetary Carrier One and Two

NOTE: Pinion end play measurement is taken at pinion outer edge between carrier and thrust plate.

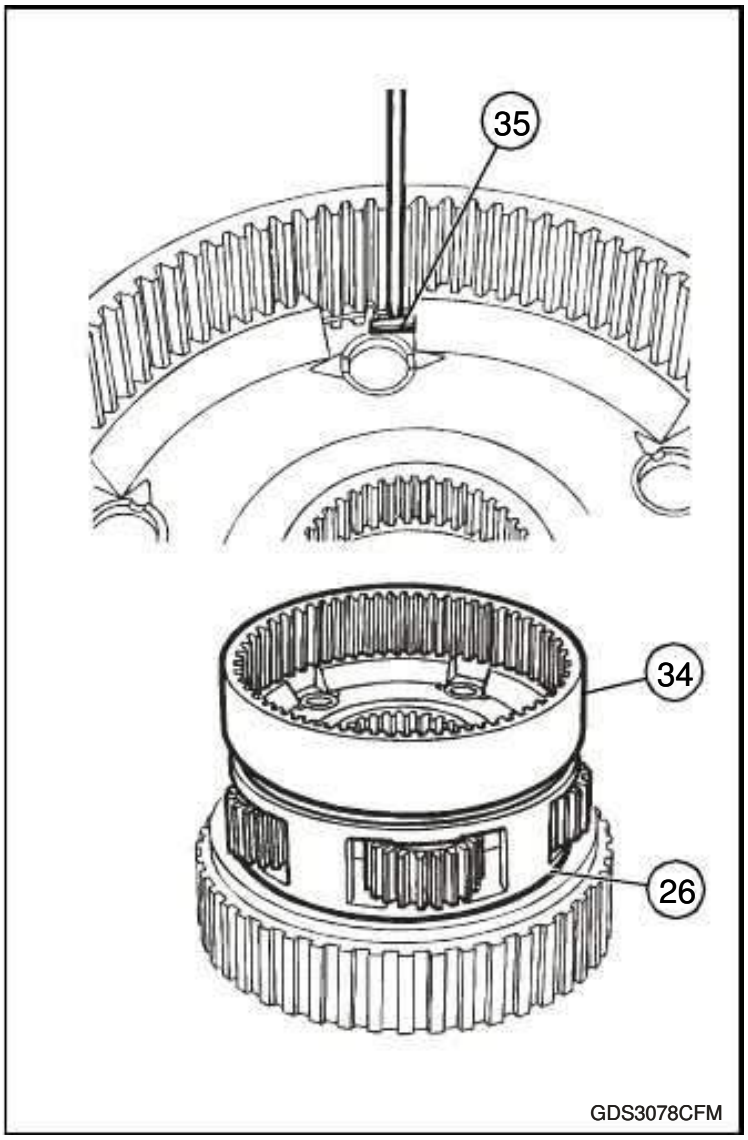
Check all planetary pinion end play and inspect for

wear before disassembly.
Planetary may not need to be disassembled.

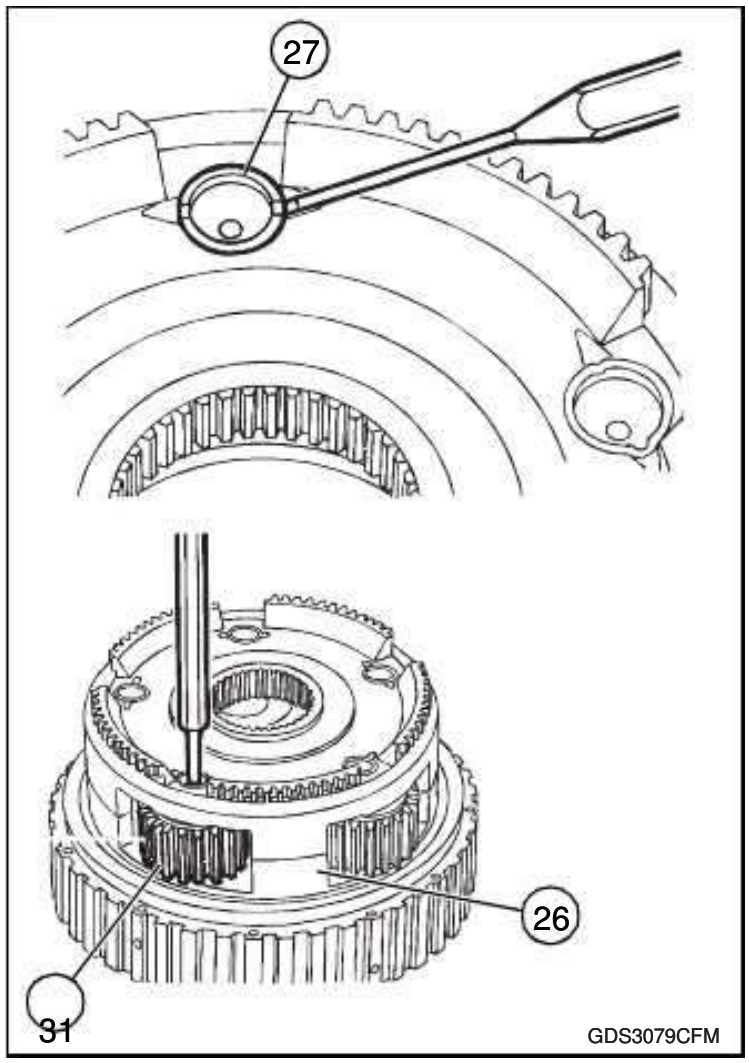
End play of all pinions is measured at pinion outer edge between carrier and thrust plate.

Disassemble and Assemble Planetary One and Two Specification

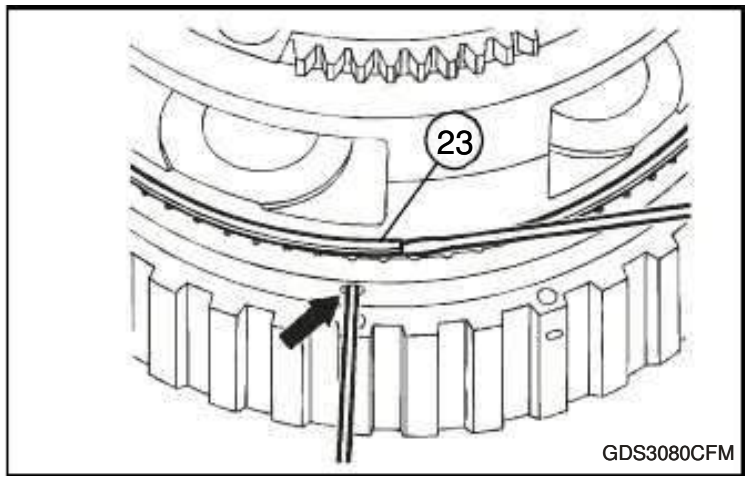
Planetary Pinion End Play 0.5 - 1.2 mm (0.02 - 0.047 in.)



At notched locations move snap ring (35) from groove and hold to remove ring gear (34) from planetary carrier (26). A plastic drift maybe used to remove ring gear.

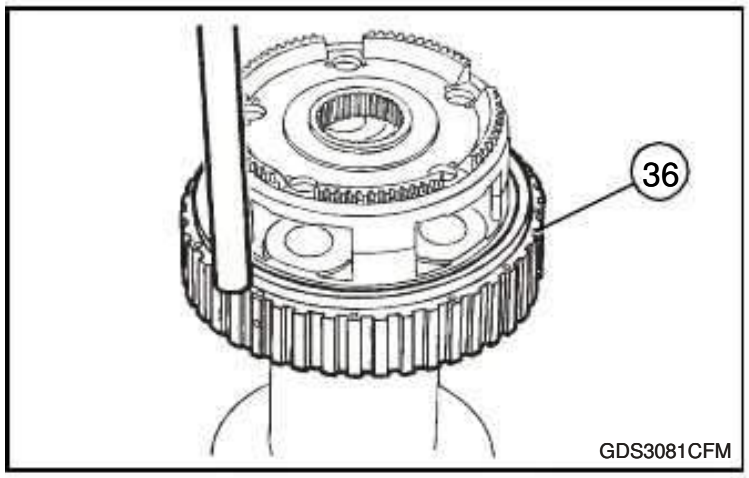


Remove peening in carrier at pinion shafts with suitable punch. Support carrier (26) and remove parts (27 - 31).



NOTE: Ring gear (36) removal may not be necessary.

At arrow push on snap ring (23) and lift from groove.



Use plastic drift to remove ring gear (36).

Planetary one is disassembled similar to plane tary two.

Inspect , clean, lubricate and assemble parts (16 - 23) and (23 - 36).

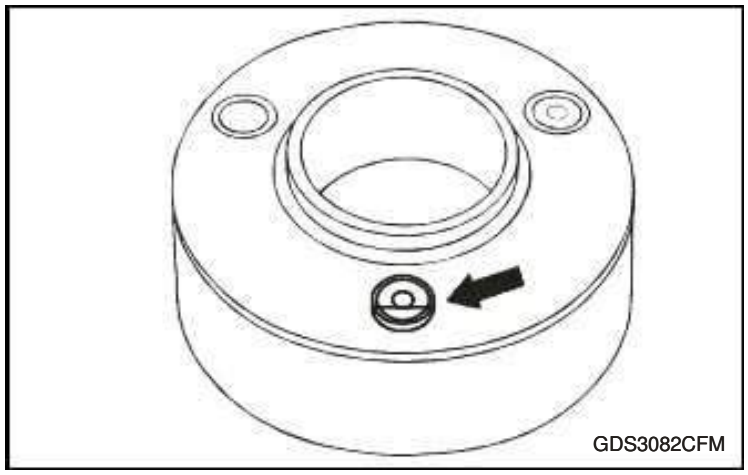
8. Install plates (21, 32 and 33) with steel side to carrier.

Assemble planetary pinions with new pinion shafts (17 and 27).

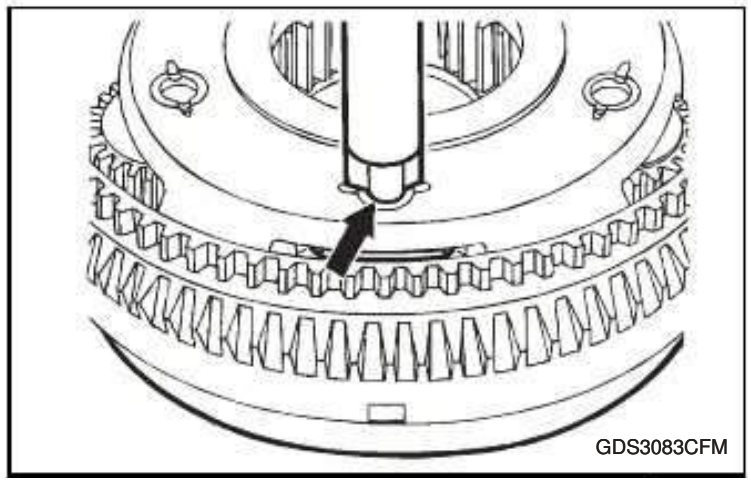
Measure end play of all pinions at pinion outer edge between carrier and thrust plate.

Disassemble and Assemble Planetary One and Two Specification

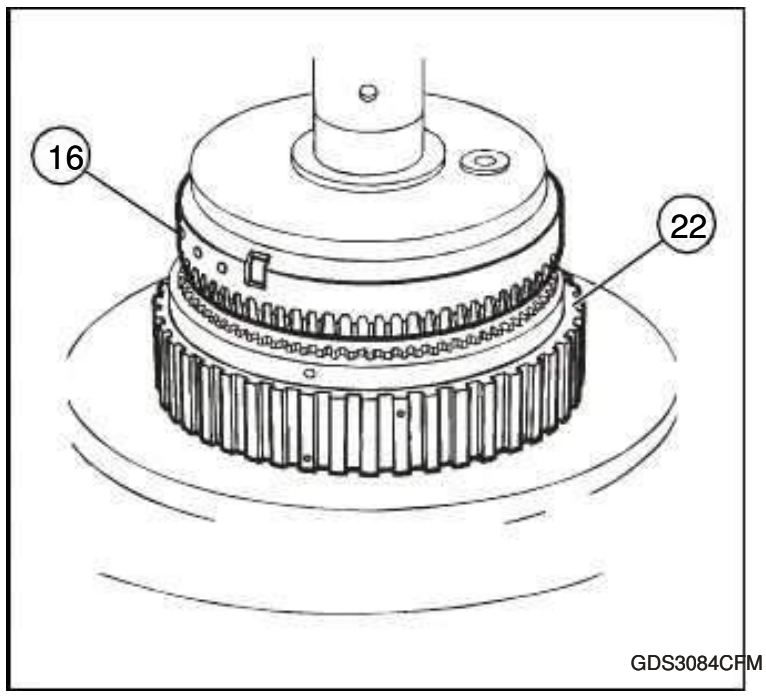
Planetary Pinion End Play- 0.5 - 1.2 mm (0.02 - 0.047 in.)



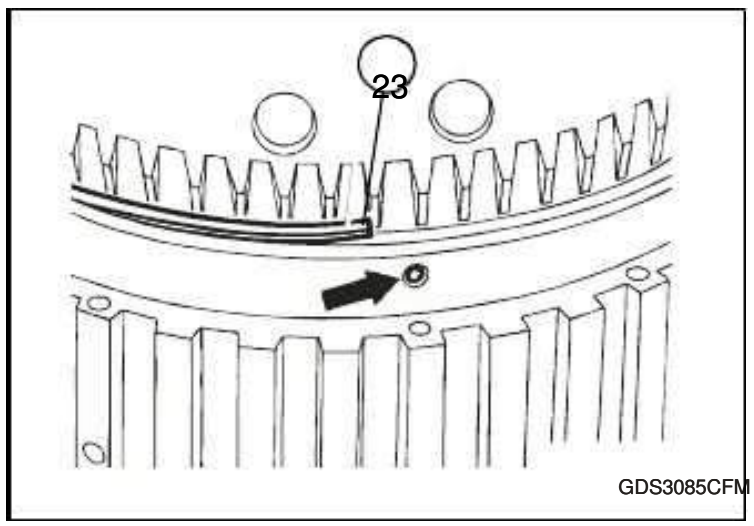
Support pinion shafts with JDG1624 Planetary Gear Pin Support at arrow and secure planetary one pinion shafts with 281714 Punch.



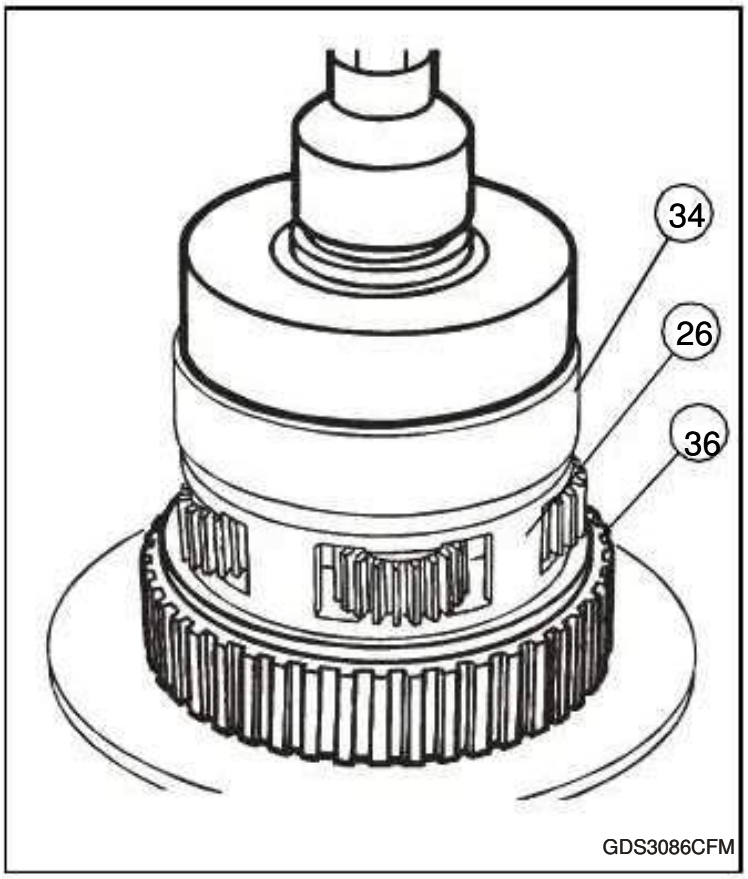
Secure planetary two pinion shafts with 281715 Punch.



Align ring gear (22) with carrier (16). Using press push ring gear into carrier and install snap ring (23 See next figure) with end gap at opening in ring gear.



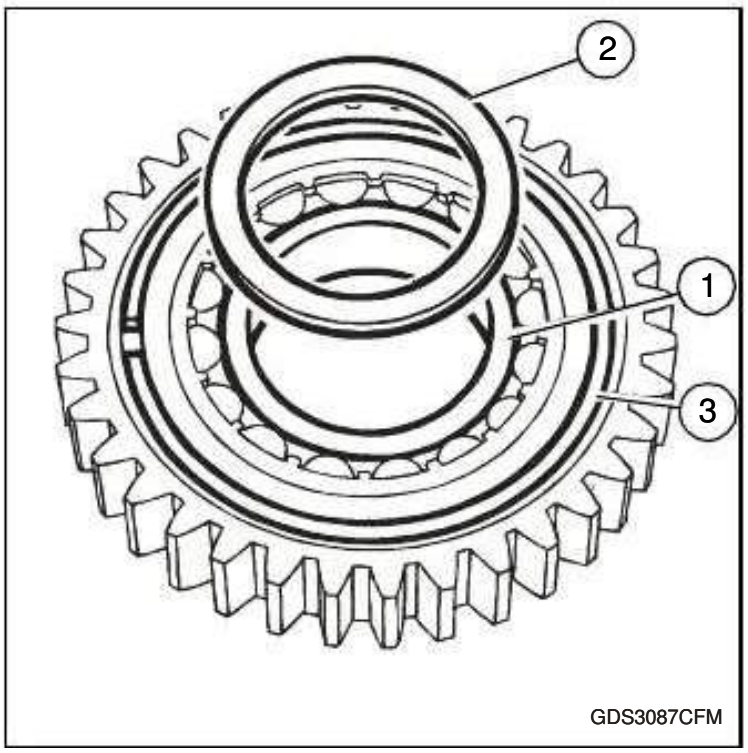
Snap ring must be engage in groove completely.



Install planetary two ring gears (34 and 36) with snap rings (28 and 35) similar to planetary one.

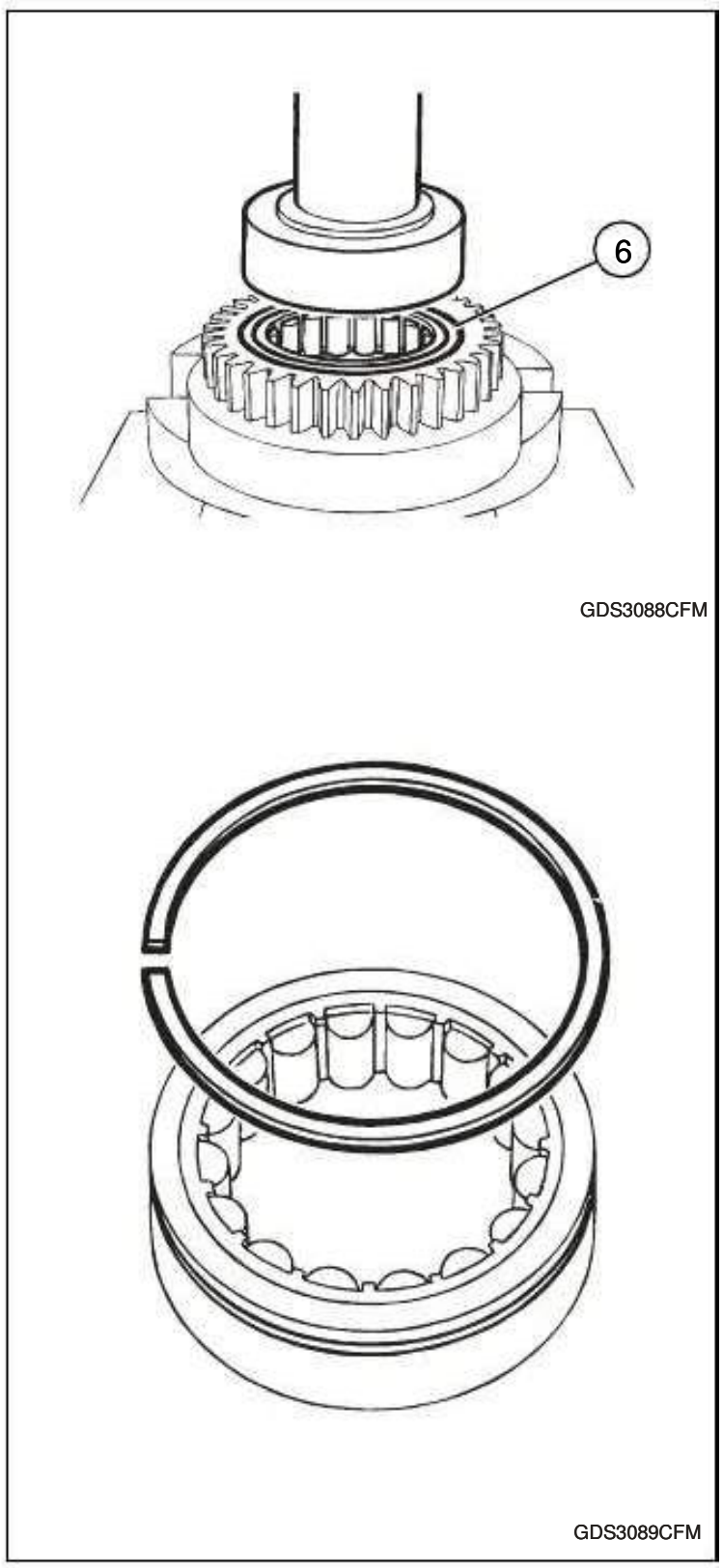
Disassemble and Assemble Auxiliary Drive Cover

NOTE: Remove auxiliary gear bearings only if necessary.



Remove inner bearing race (1) and washer (2) from both gears.

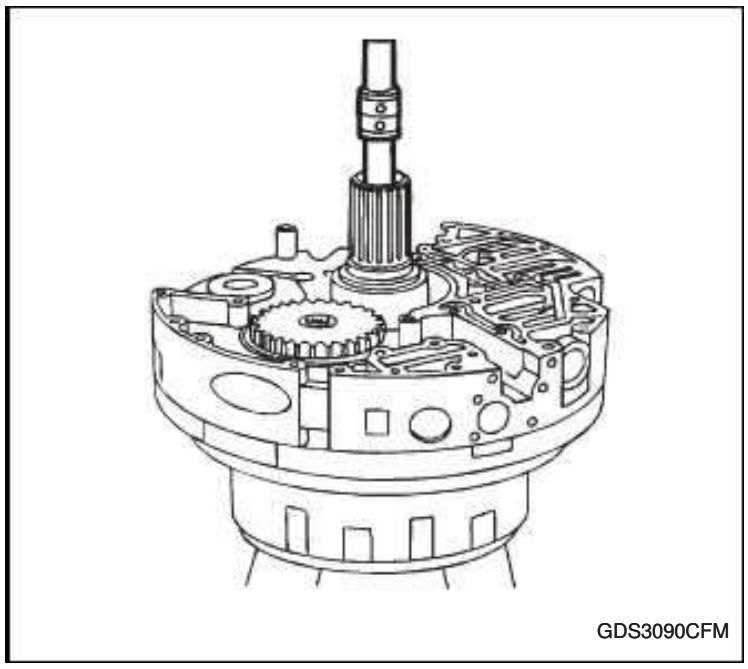
Remove snap ring (3).



Remove bearings (6) with press.

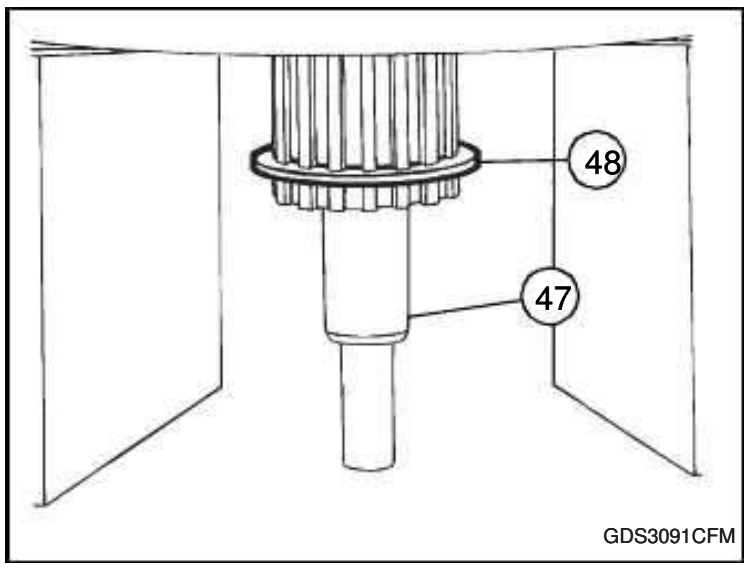
Assemble in reverse order.

Disassemble and Assemble Input Carrier and Oil Control Element



GDS3090CFM

With control element supported on wood blocks. Hold turbine shaft and remove 281710 Lifting Device.



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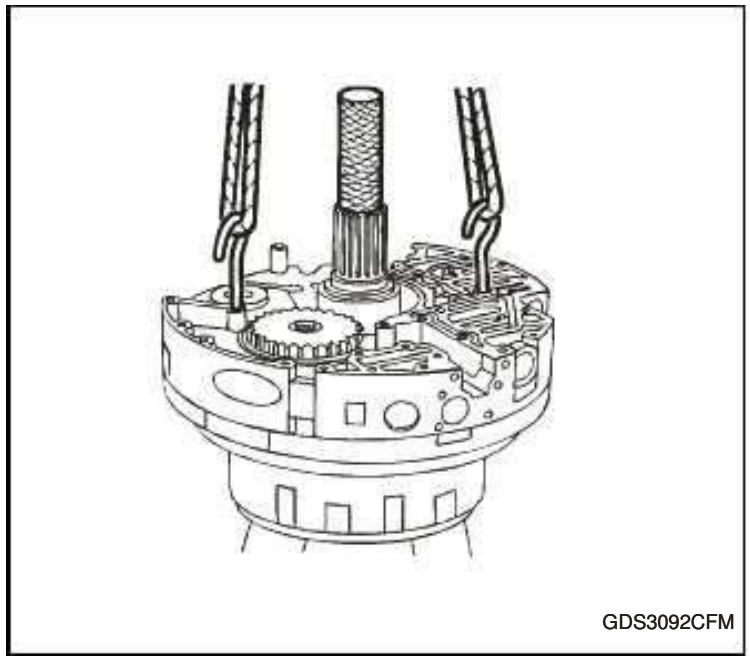
Lower turbine shaft to remove snap ring (48).
Lift turbine shaft (47) from control element.



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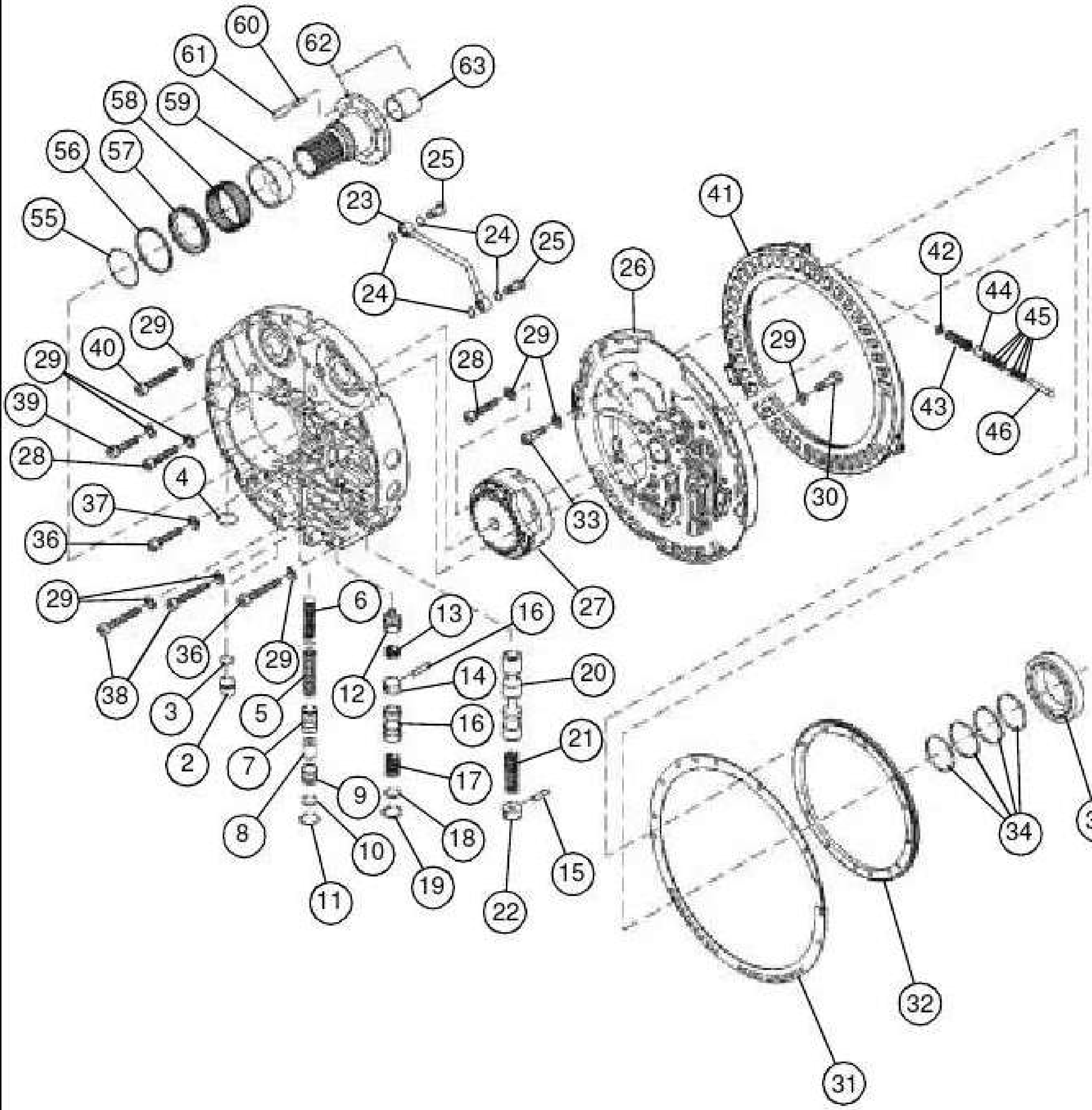
With hoist and eyebolts lift oil control element and remove drive clutch carrier with driver 281703 Punch.

Support clutch carrier on wood blocks.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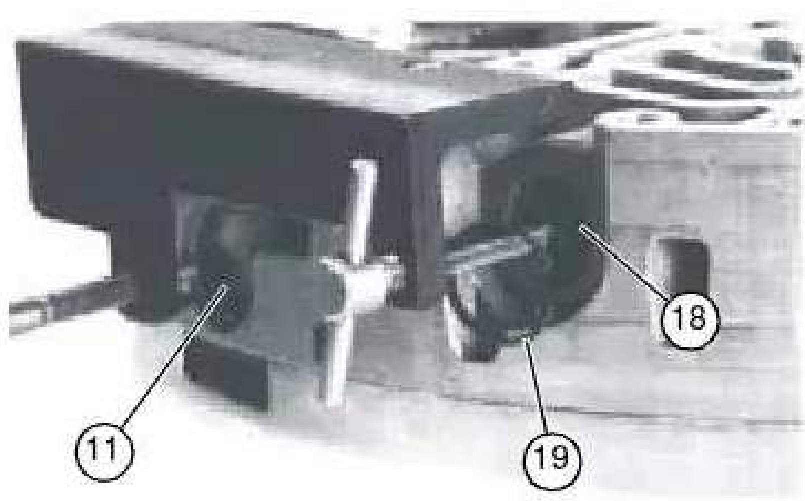
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19

1. Oil Control Body.
2. Spacer.
3. O-Ring.
4. O-Ring.
5. Spring.
6. Valve.
7. Piston.
8. Piston.
9. Bushing.
10. Washer.
11. Snap Ring.
12. Piston.
13. Spring.
14. Spacer.
15. Retainer Pin (2 used).
16. Piston.
17. Spring.
18. Washer.
19. Snap Ring.
20. Piston.
21. Spring.
22. Spacer.
23. Oil Line.
24. Seal (12 used).
25. Fitting (2 used).
26. Oil Feed Flange.
27. Pump.
28. Cap Screw (2 used).
29. Washer (31 used).
30. Cap Screw (7 used).
31. Intermediate Plate.
32. Thrust Ring.
33. Cap Screw (3 used).
34. Seal Ring (4 used).
35. Bearing.
36. Cap Screw (4 used).
37. Not Used.
38. Cap Screw (4 used).
39. Cap Screw (3 used).
40. Cap Screw (5 used).
41. Retarder Stator Ring.
42. Spring Seat (3 used).
43. Spring (3 used).
44. Spring Guide (3 used).
45. Disc Spring (48 used.
46. Guide Pin (3 used).

⚠ CAUTION

Retaining washers are under spring pressure. Take care when removing.

Apply pressure and hold spacer (22) to remove retainer pin (15) and remove spring and valve (20 and 21).

Use 281702 Control Valve Clamp to compress springs (5 and 17).

Remove snap rings (11 and 19) and release spring tension.

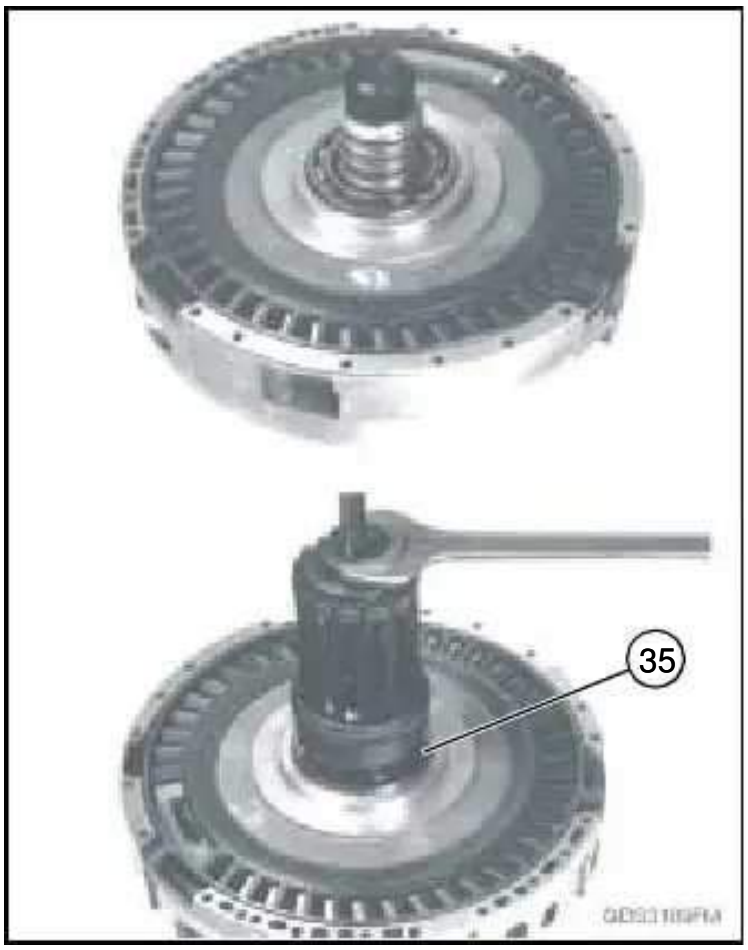
Remove Parts (6 - 10) and (16 - 18).

Apply pressure to spacer (14) with screwdriver and remove pin (15).

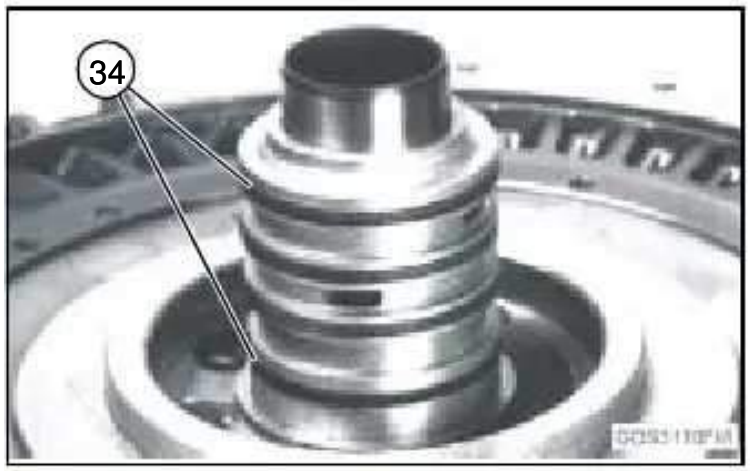
Remove parts (12 - 14).

Remove spacer and O-ring (2 and 3).

If not removed. Remove intake pipe O-ring (4).

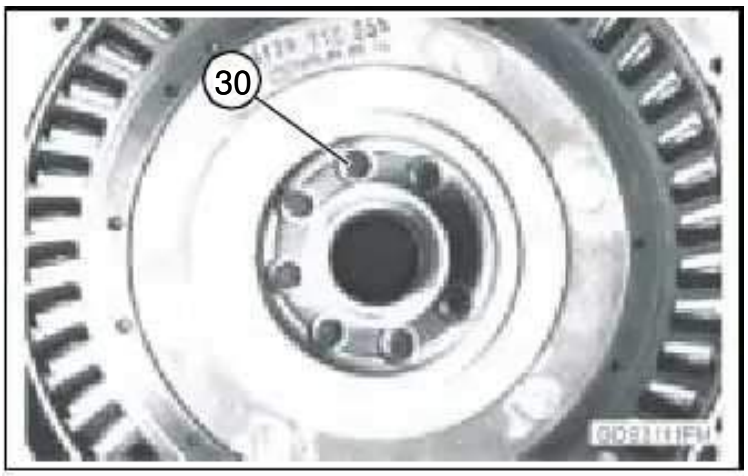


With 281699 Pressure Piece and 281680 Puller, remove bearing (35).



NOTE: Rectangular seal rings (34) have sharp edges. Wear protective gloves.

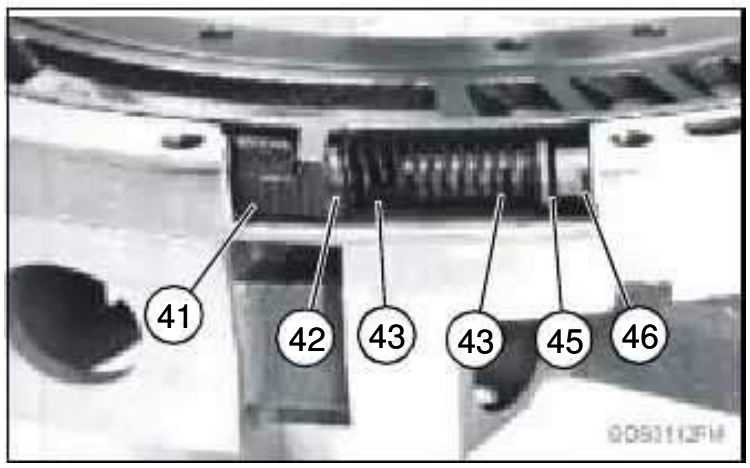
Remove sealing rings (34).



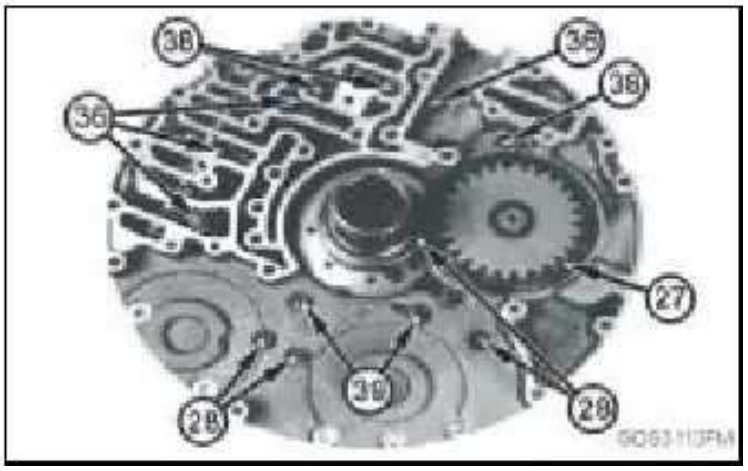
Remove bolts (30).

⚠ CAUTION

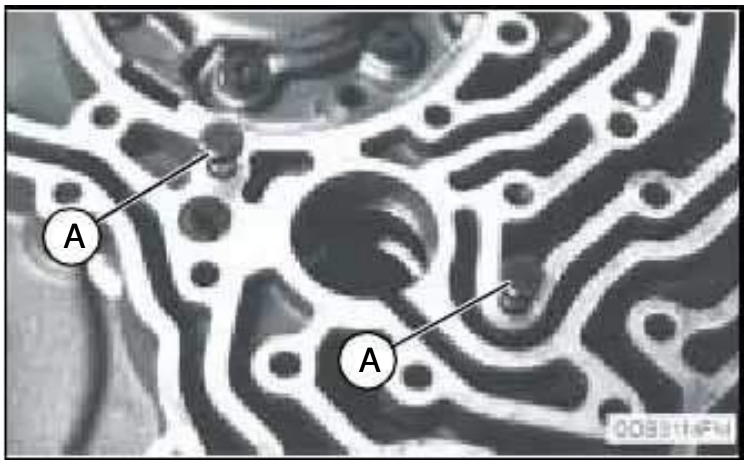
Disk springs and spring guides are under spring tension and should be handled with care while removing them.



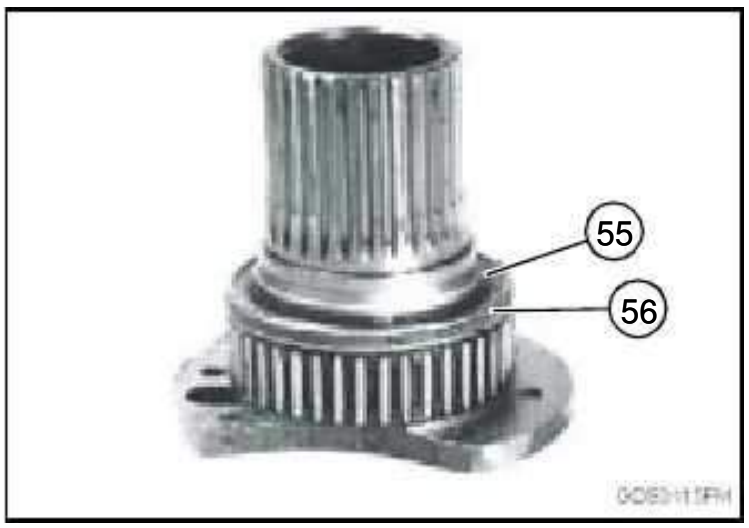
Carefully remove parts (42 - 46).



Remove bolts (28, 36, 38, and 39) and separate oil control body (1) and oil feed Flange (26).



Install two bolts at (A) and tap lightly to loosen and remove stator shaft (62).



Remove seal ring (55) and snap ring (56).

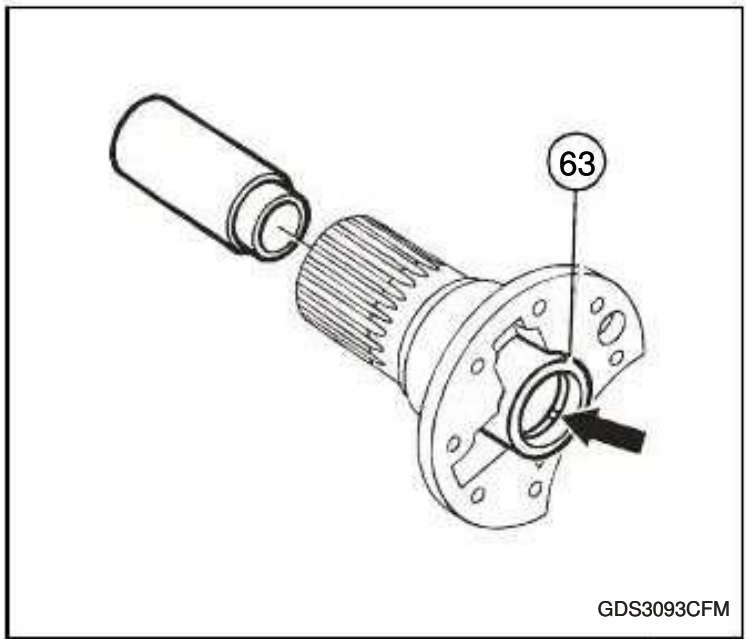
Place 281712 Puller in ring carrier groove and remove.

Remove bearing (58).

NOTE:If bearing race is damaged, replace both bearing and race.

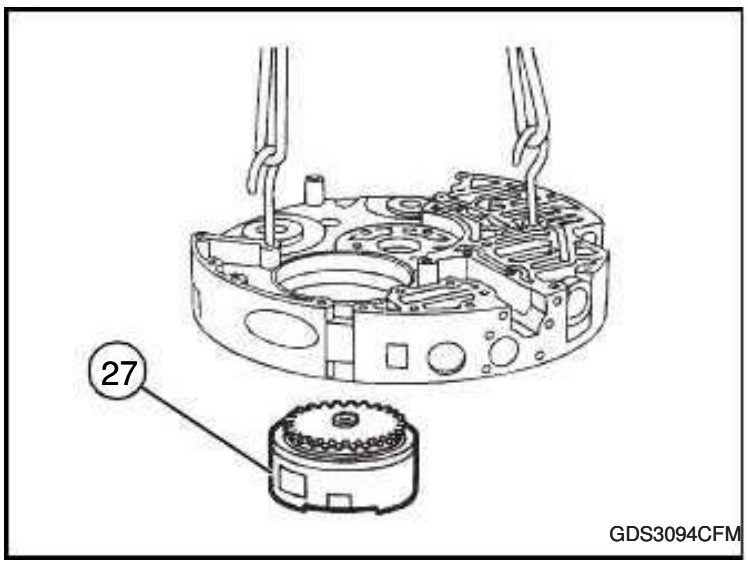
With stamp numbers on 281681 Bearing Puller up and aligned tighten cap screws evenly.

Remove bearing race (59).



NOTE:Only remove bushing if replacement is necessary. Bushing and internal ring are a single component.

Remove bushing (63) with suitable driver.

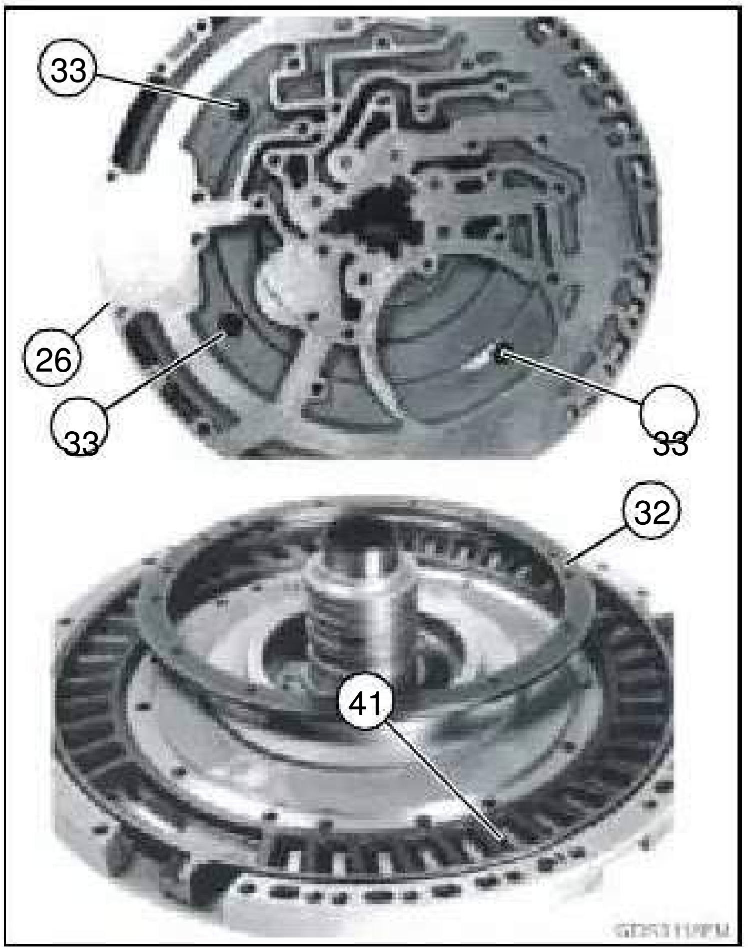


Lift oil control body approximately 100 mm (3.9 in.) up inside heating oven. Ensure main pump gear up. Ensure that the pump gear is facing “**UP**”.

⚠ CAUTION

DO NOT strike primary pump damage to pump will occur.
Wear protective gloves components will be hot.

With oil control body disassembled heat oil control body to approximately 150°C (302°F). Allow pump to release by heating only. **DO NOT** strike primary pump.



Remove bolts (33) to remove thrust ring (32) and stator ring (41).

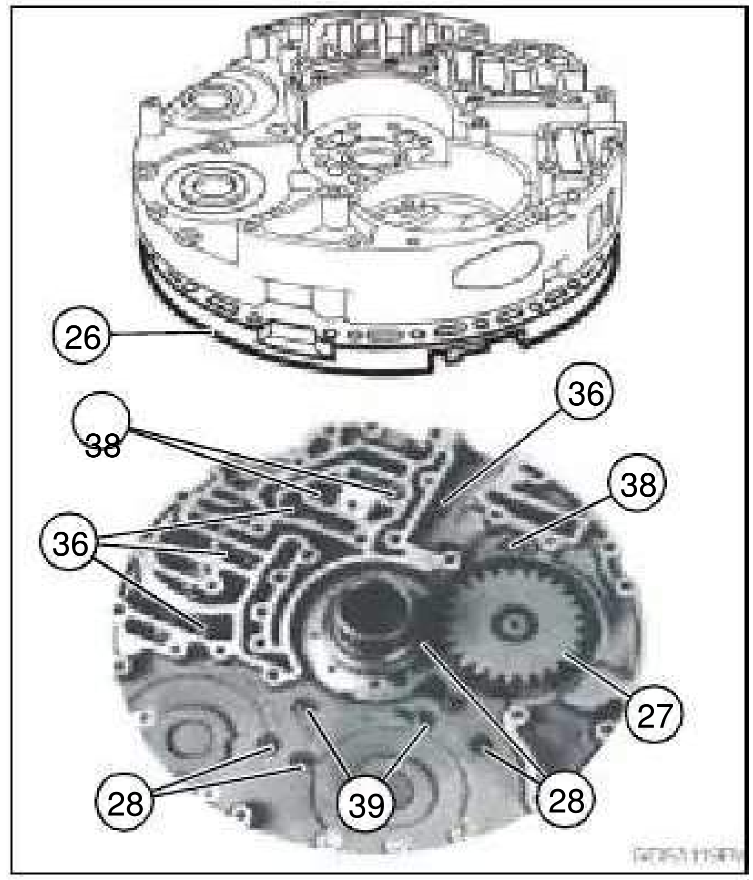
Clean and install stator ring. Vanes must over lap oil feed flange vanes.

Position thrust ring recess toward stator ring and align threaded holes in thrust ring. Tighten cap screws.

Stator ring must be move freely.

Disassemble and Assemble Input Oil Control Element Specification

Oil Control Body Thrust Ring Torque - 16 Nm (142 lb-in.)



Support oil feed flange (26) on 281692 Fixture Holding. Position and align oil control body on oil feed flange.

Install cap screws (28, 36, 38, and 39) hand tight. Then tighten to specification.

Disassemble and Assemble Input Oil Control Element Specification

Oil Control Body-to-Oil Feed Flange Torque- 23 Nm (204 lb-in.)

Heat oil control body to approximately 150° C (302° F).

CAUTION

DO NOT strike primary pump. Damage to pump will occur.

Wear protective gloves components will be hot.

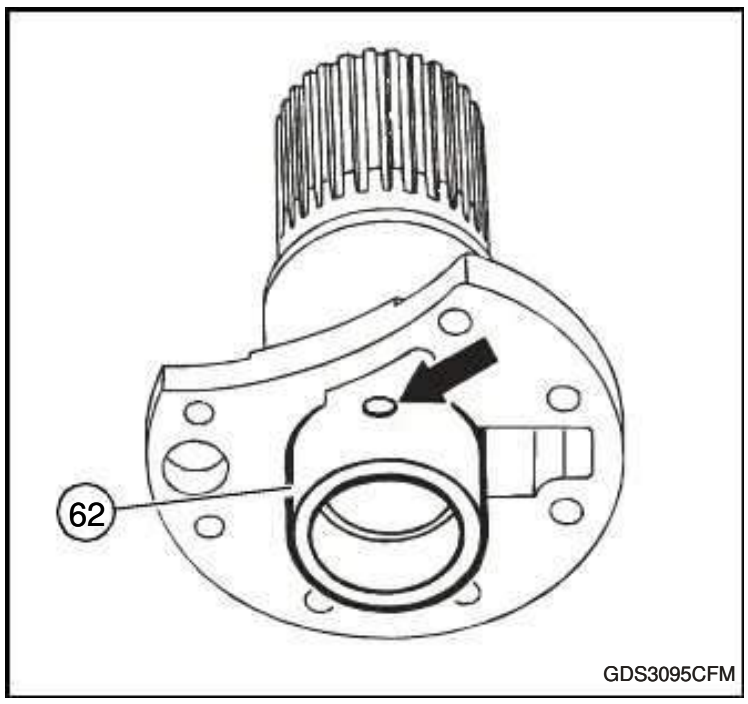
Install guide pin and primary pump. Allow primary pump to bottom in pump bore under its own weight. Do not strike or force pump into position.

Remove guide pin and install cap screw hand tight.

Allow oil control body to cool. Tighten caps screws to specification.

Disassemble and Assemble Input Oil Control Element Specification

Primary Pump Torque - - - - - - - - - - 23 Nm (204 lb-in.)

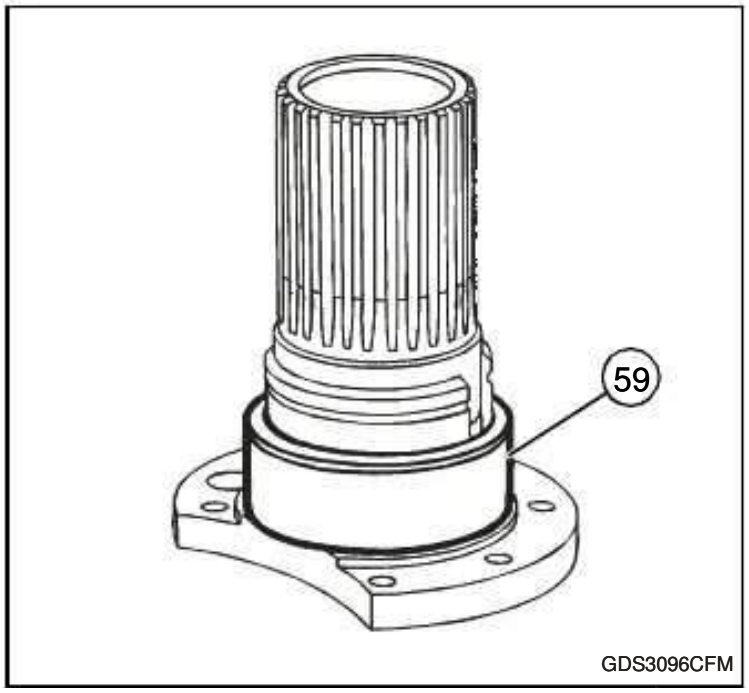


If stator shaft bushing (62) is removed. Heat stator shaft to approximately 150° C (302° F).

⚠ CAUTION

Wear protective gloves components will be hot.

Align lubrication bore in stator shaft to bore in bushing and push bushing into shaft to contact shaft shoulder.



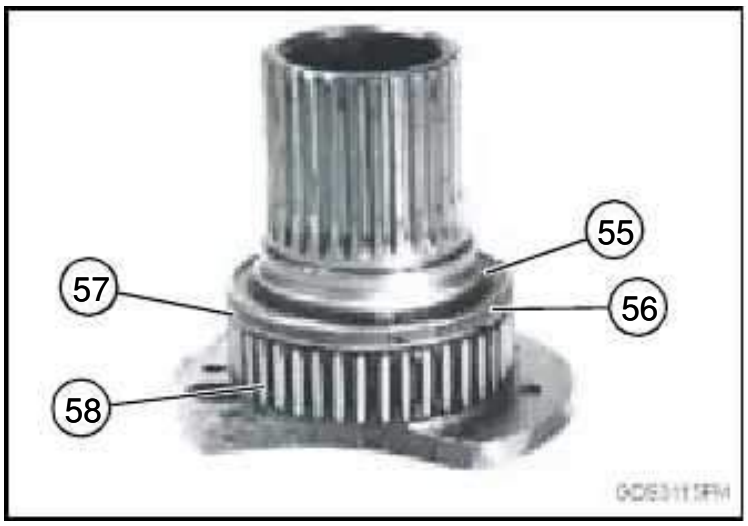
Heat bearing race (59) to approximately 150° C (302° F).

⚠ CAUTION

Wear protective gloves components will be hot.

Push bearing race onto stator shaft to contact shaft shoulder.

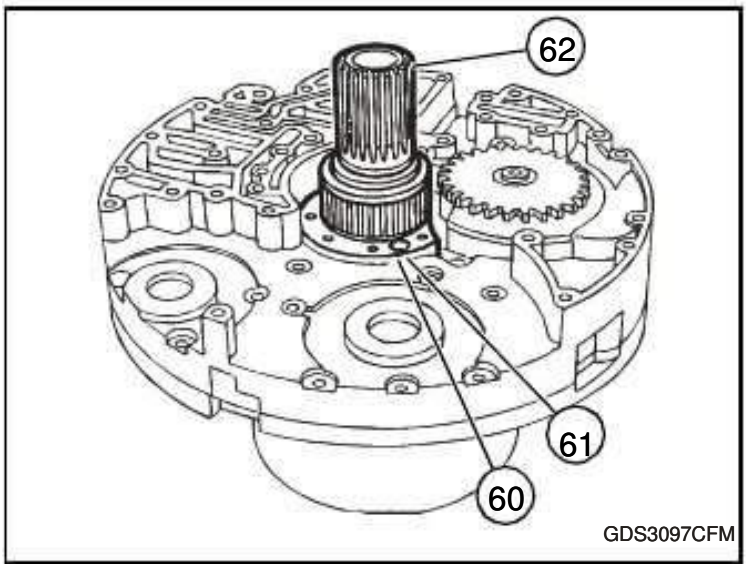
Allow bearing race to cool.



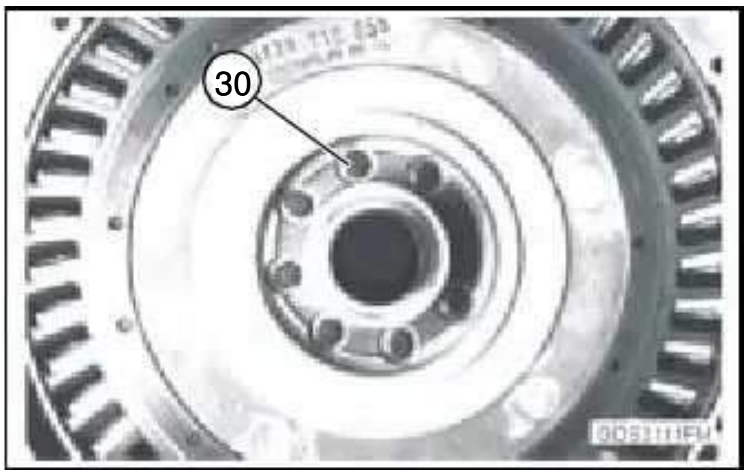
Apply thin layer of oil to bearing (58) and install.

Heat seal ring carrier (57) to approximately 150° C (302° F) and install.

Install snap ring (55) and seal ring (56).



Locate stator shaft on pins (60 and 61) in oil control body and tap with soft face mallet to contact bottom of bore in oil control body.



Install cap screws (30).

Disassemble and Assemble Input Oil Control Element Specification

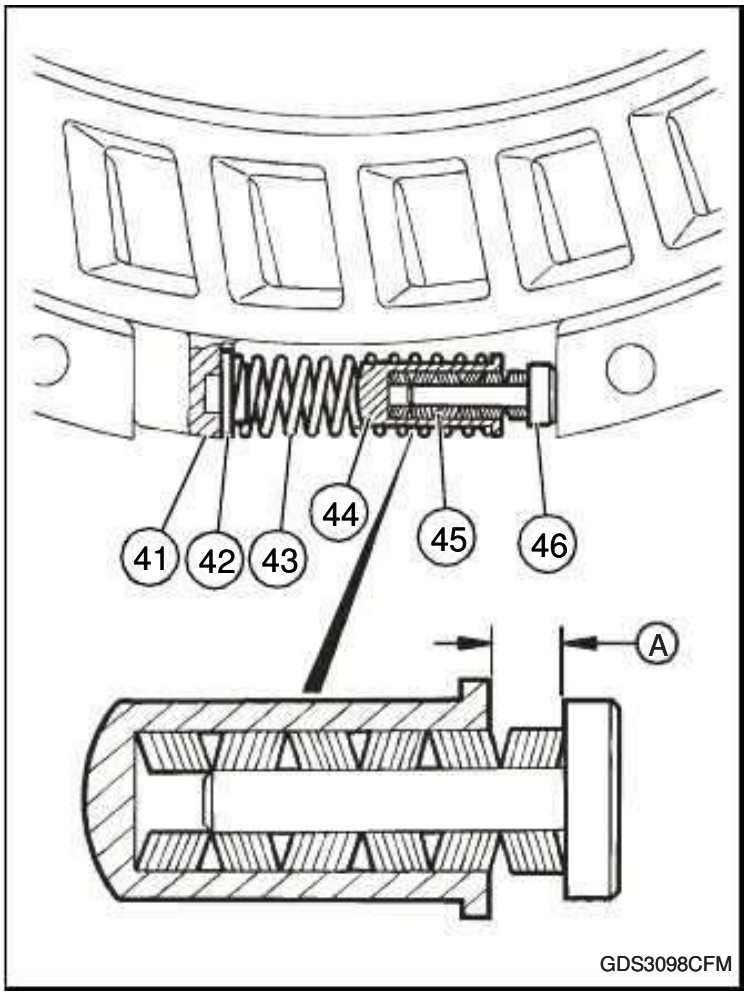
Stator Shaft Torque - - - - - - - - - - - - 23 Nm (204 lb-in.)

Install seal rings (34).

⚠ CAUTION

Wear protective gloves components will be hot.

Heat oil feed flange and install bearing (35) with soft faced mallet. Bearing must make contact with oil feed flange shoulder.



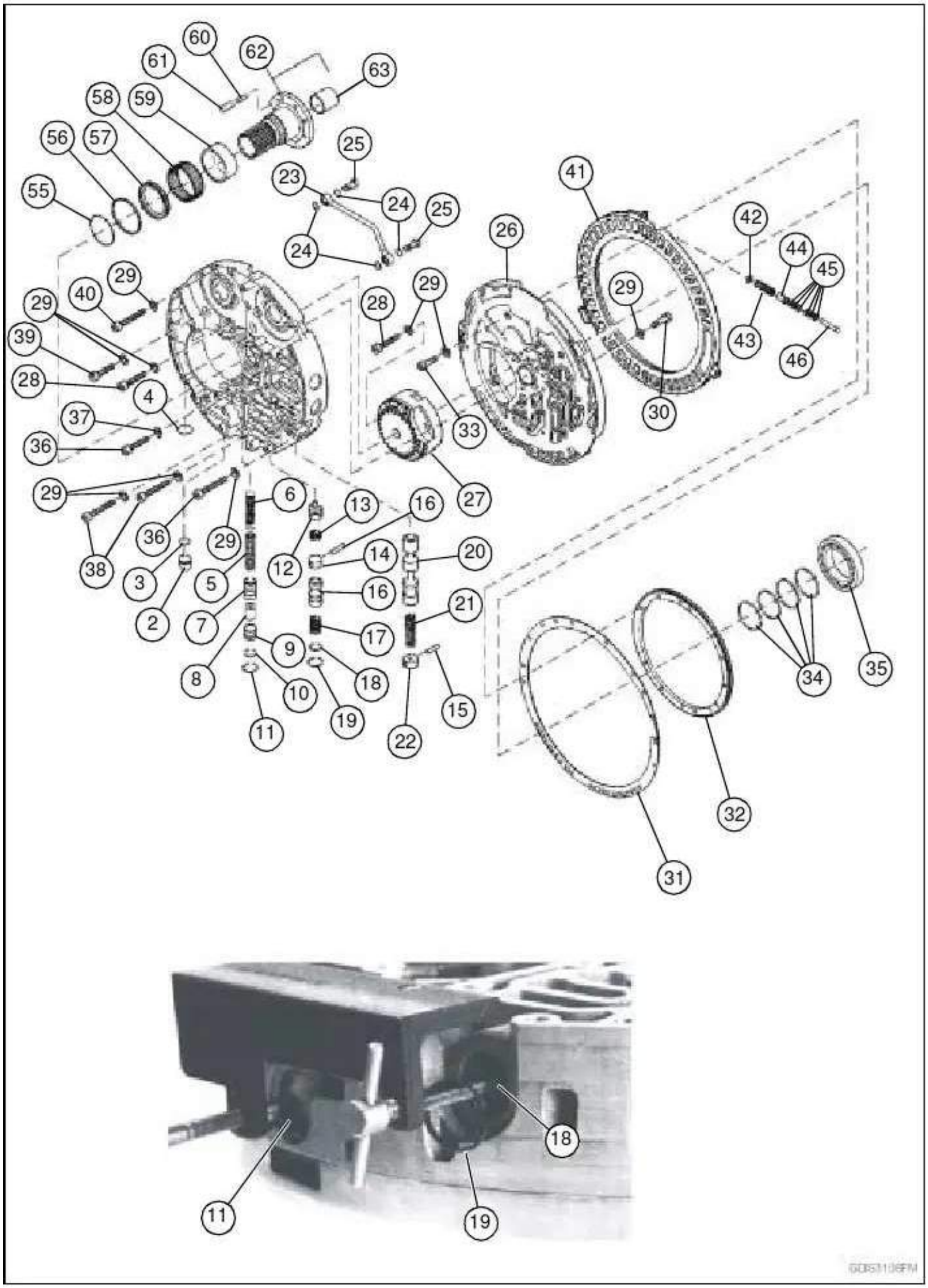
Assemble spring disks (45) in groups of six and install alternating cone direction in spring guide (44) as shown.

Measure distance between spring guide (44) and guide pin (46) and adjust to specification by adding or removing discs.

Disassemble and Assemble Input Oil Control Element Specification

Retarder Stator Ring Spring Guide Distance - 1.6 - 2.1 mm (0.063 - 0.083 in.)

Move stator ring to open position and install parts (42 - 46). Position spring pin (46) to rest evenly on oil feed flange.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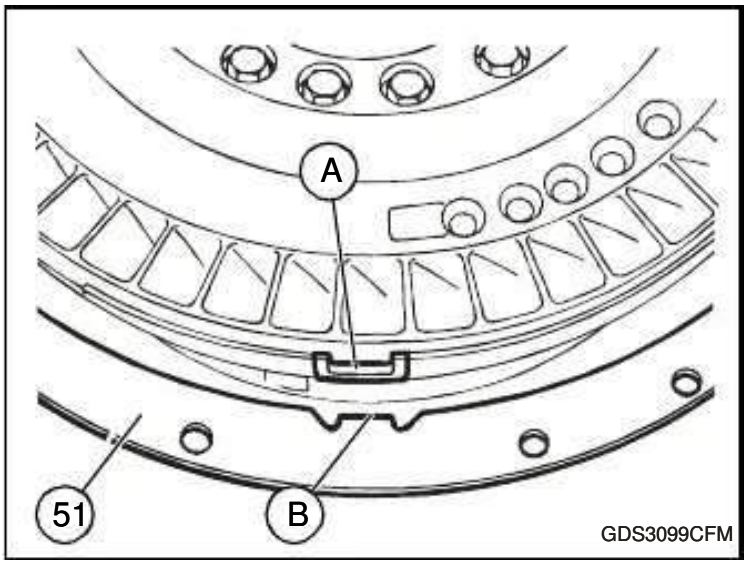
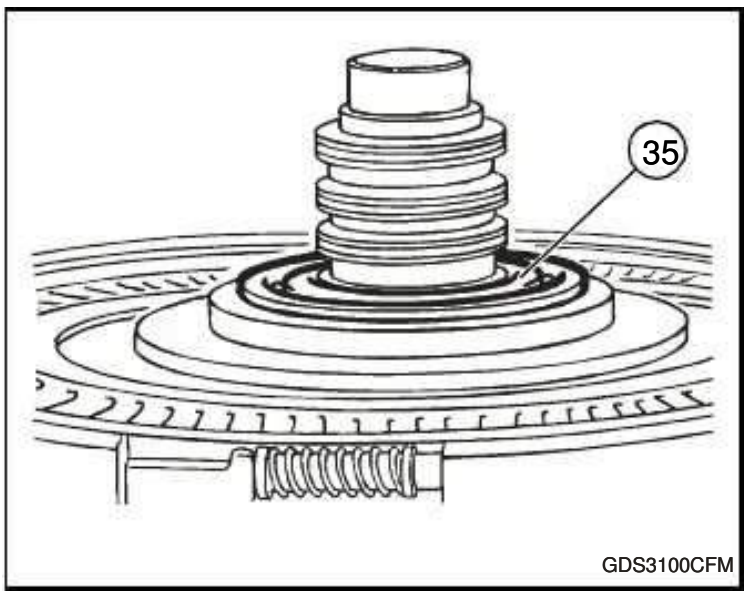
Clean and apply a thin layer of oil to parts (2 - 22).

Install parts (2 - 22) using 281702 Clamping Device.

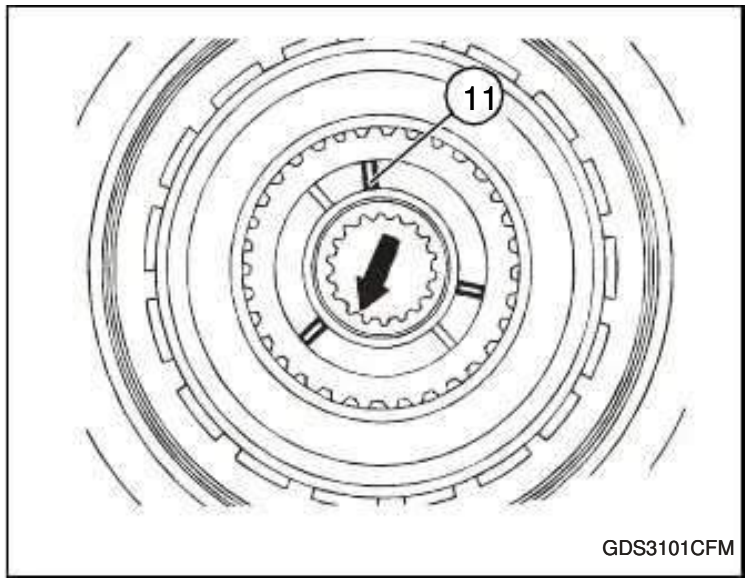


Support clutch carrier on blocks.

Install intermediate plate (51) and sealing washer. Align recess in sealing washer (A) with intermediate plate lug (B).



Heat bearing (35) inner race to approximately 85° C (185° F).

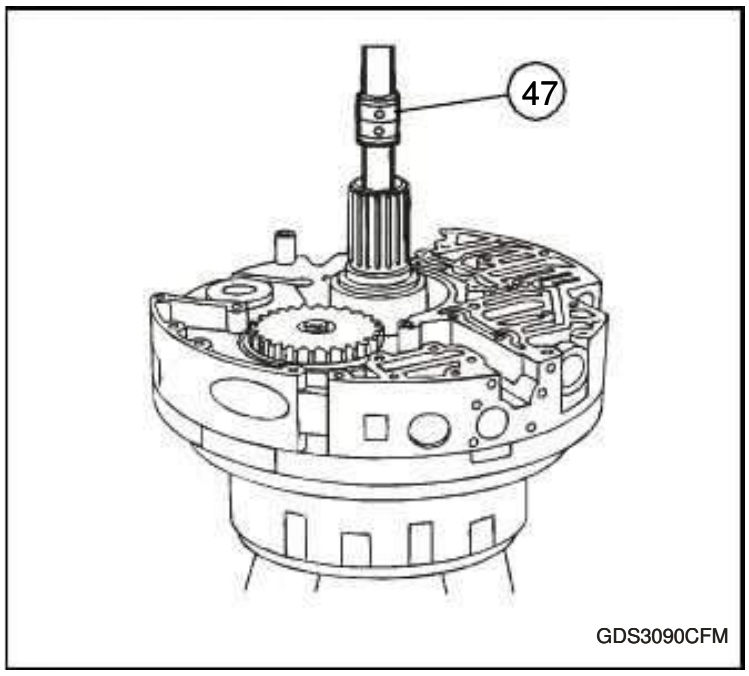


⚠ CAUTION

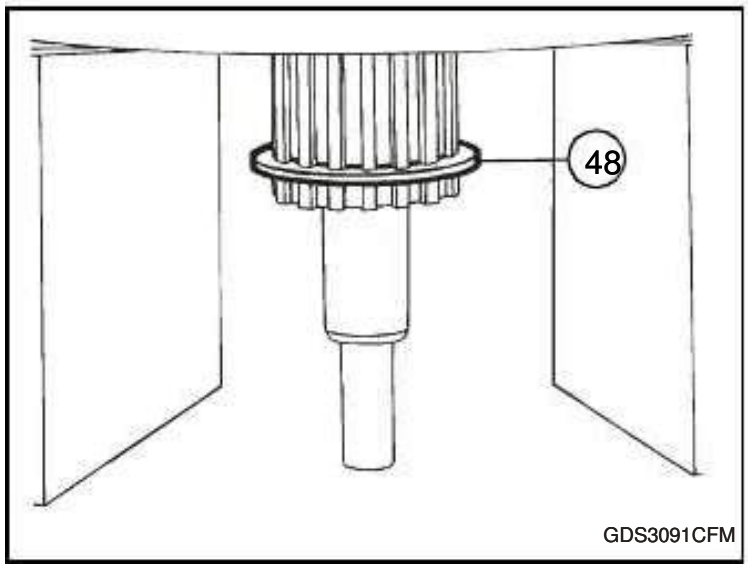
Wear protective gloves components will be hot.

Position and lower oil control body into intermediate plate and clutch carrier. It may be necessary to gently tap oil control body with soft face hammer to make contact with clutch carrier.

Pins (11) should be positioned in hub to allow turbine shaft to be installed.



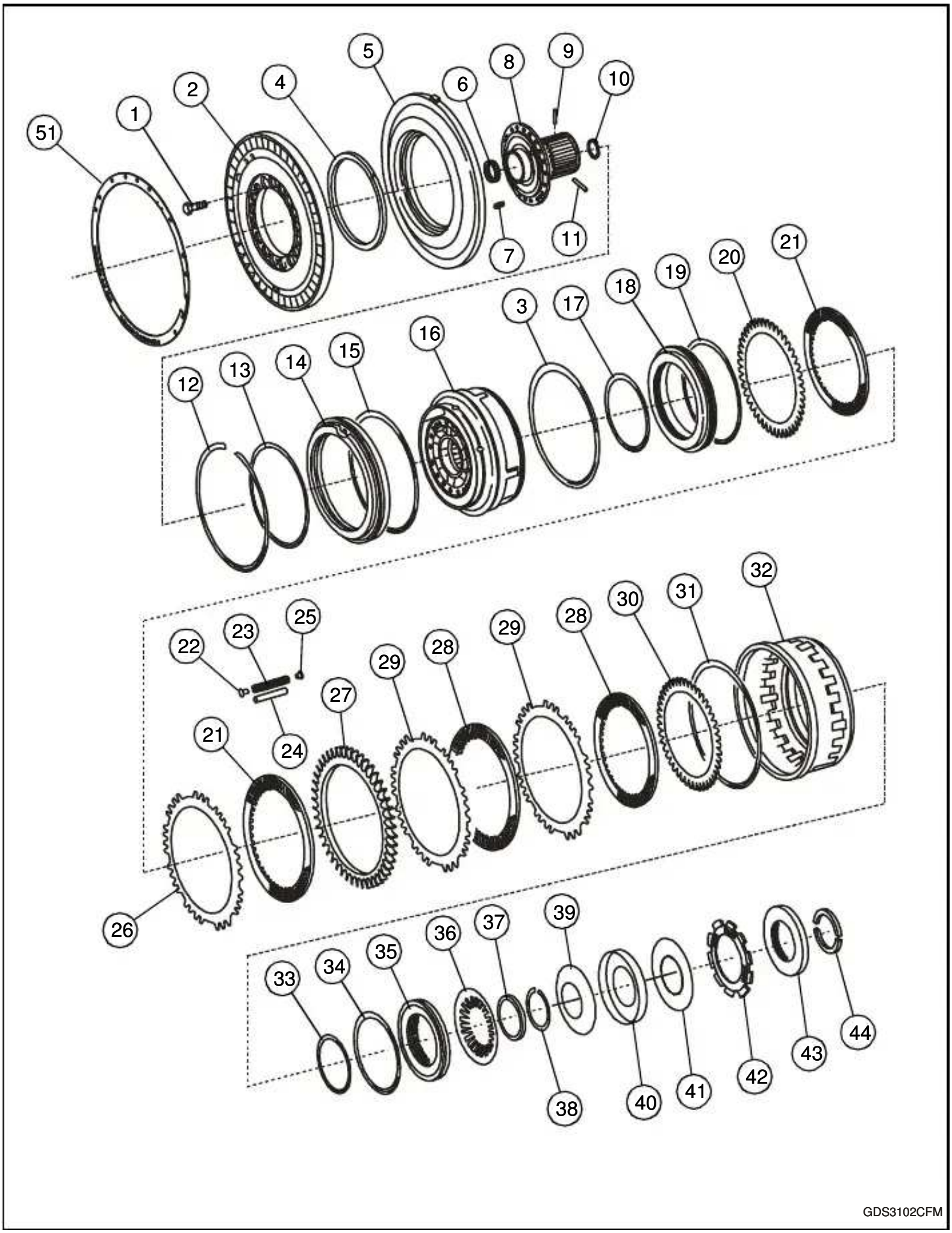
Install turbine shaft (47).



Install snap ring (48).

Install 281710 Lifting Device.

Disassemble and Assemble Input Clutch Carrier



1. Bolt (18 used).
2. Rotor.
3. Seal.
4. Rectangular Ring.
5. Disk Seal.
6. Needle Bearing.
7. Dowel Pin.
8. Hub.
9. Pin.
10. Snap Ring.
11. Retainer Pins (3 used).
12. Snap Ring.
13. Lip Seal.
14. Clutch C Piston.
15. Lip Seal.
16. Clutch Carrier.
17. Seal.
18. Clutch B Piston.
19. Seal.
20. Clutch B End Plate.
21. Clutch B Inner Plate.
22. Pin (9 used).
23. Spring (9 used).
24. Retaining Pin (2 used).
25. Pin (9 used).
26. Clutch B Outer Plate.
27. Clutch B End Plate.
28. Clutch C Inner Plate.
29. Clutch C Outer Plate.
30. Clutch C End Plate.
31. O-Ring.
32. Reverse Gear Housing.
33. Lip Seal.
34. Lip Seal.
35. Clutch A Piston.
36. Spring Plate.
37. Retainer Plate.
38. Snap Ring.
39. Spring Plate.
40. Retainer Plate.
41. Clutch A Inner Plate.
42. Clutch A Outer Plate.
43. Clutch A End Plate.
44. Split Ring.

⚠ CAUTION

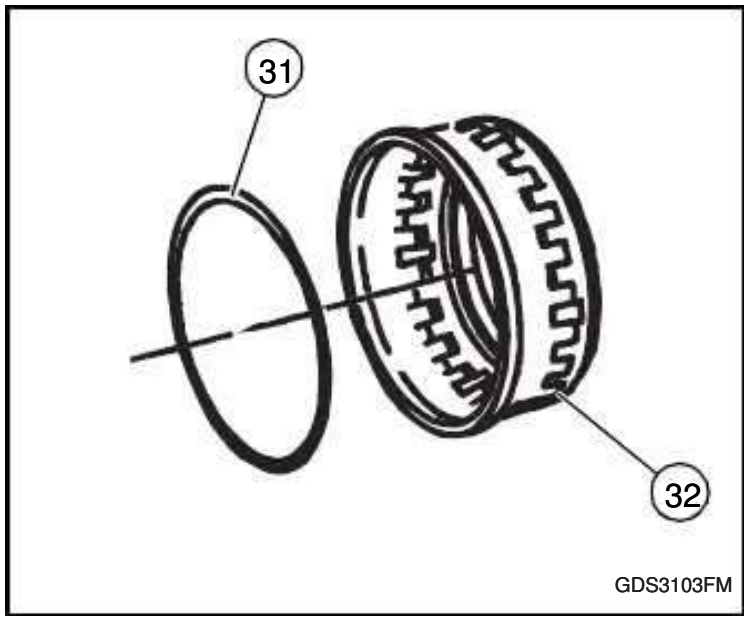
The Approximate weight of clutch carrier is 25 kg (55 lb).

Remove bolt (1) and rotor (2).

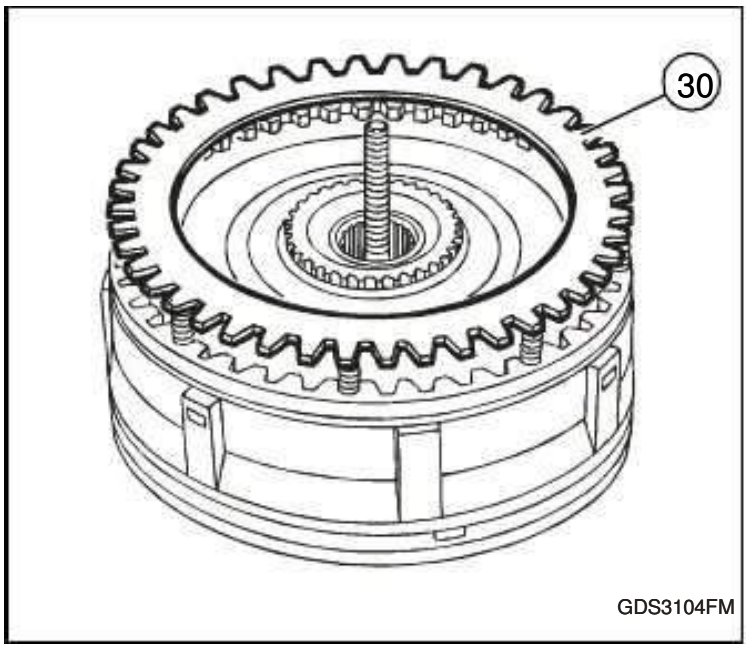
Remove rectangular ring (4) and plate seal (5).

With 281705 Clamping device compress and remove snap ring (12).

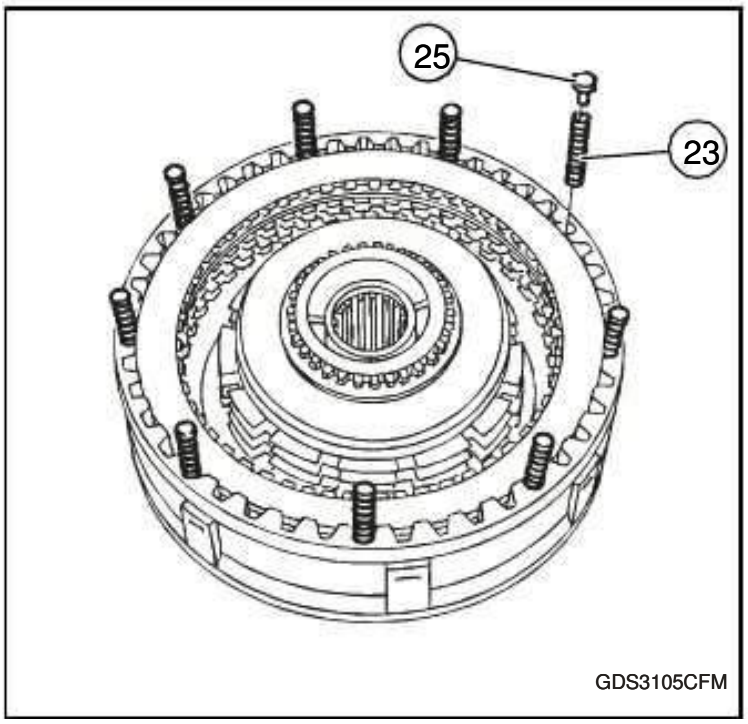
Remove clutch C piston (14).



Remove reverse gear housing (32) and O-ring (31).

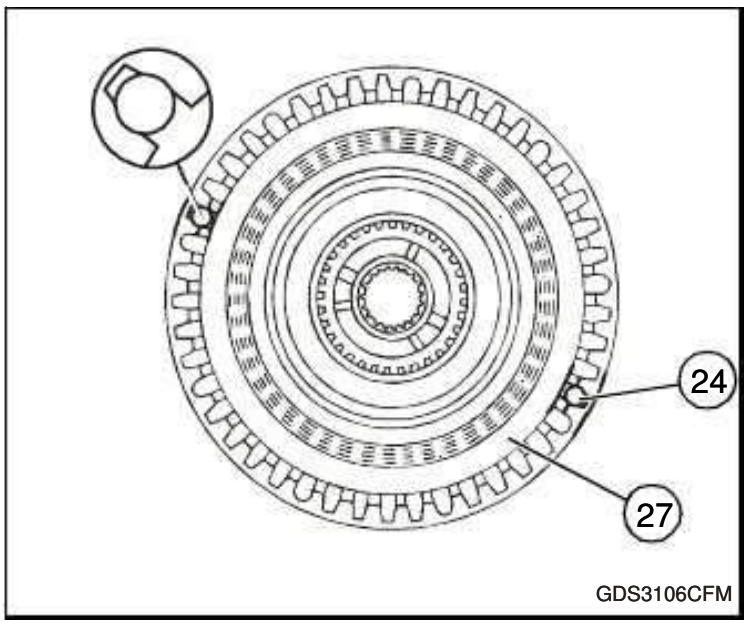


Remove outer plate (30).

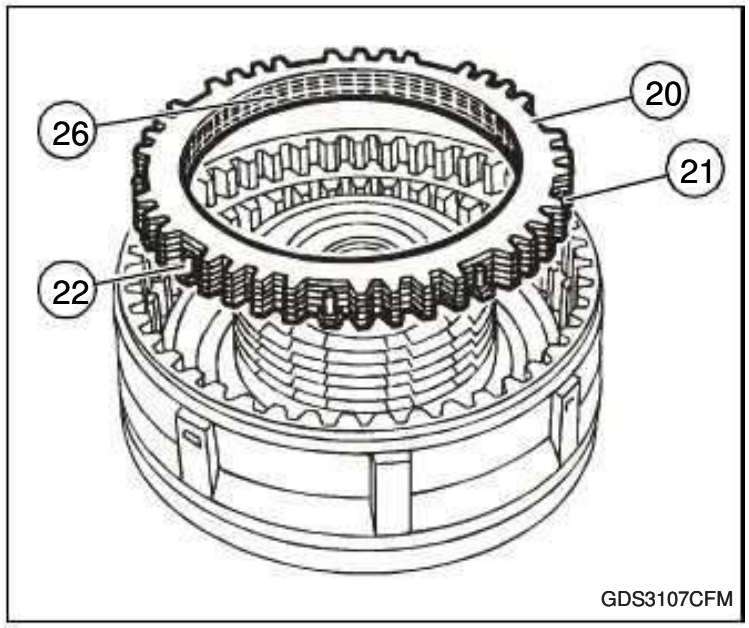


Remove pin (25) and spring (23).

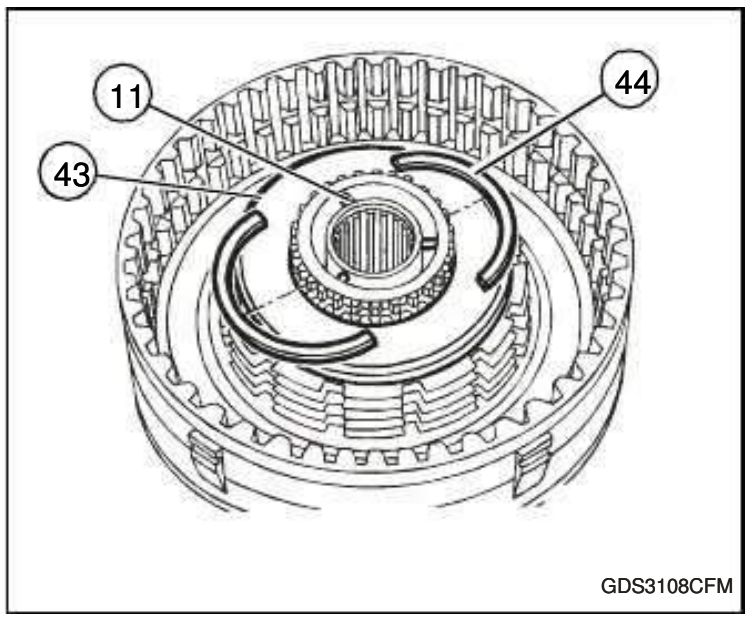
Remove clutch C plates.



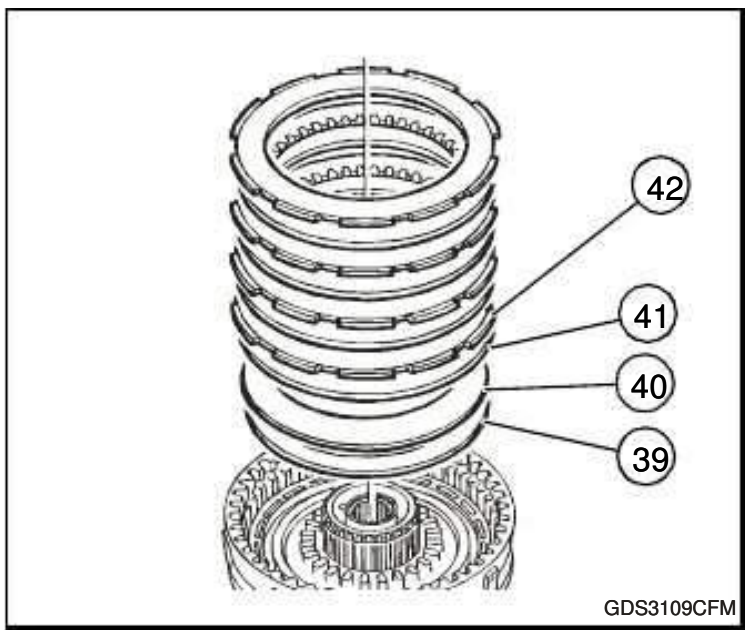
Remove retainer pins (24) and end plate (27).



Remove Clutch B plate (20, 21, and 26) and pins (22).



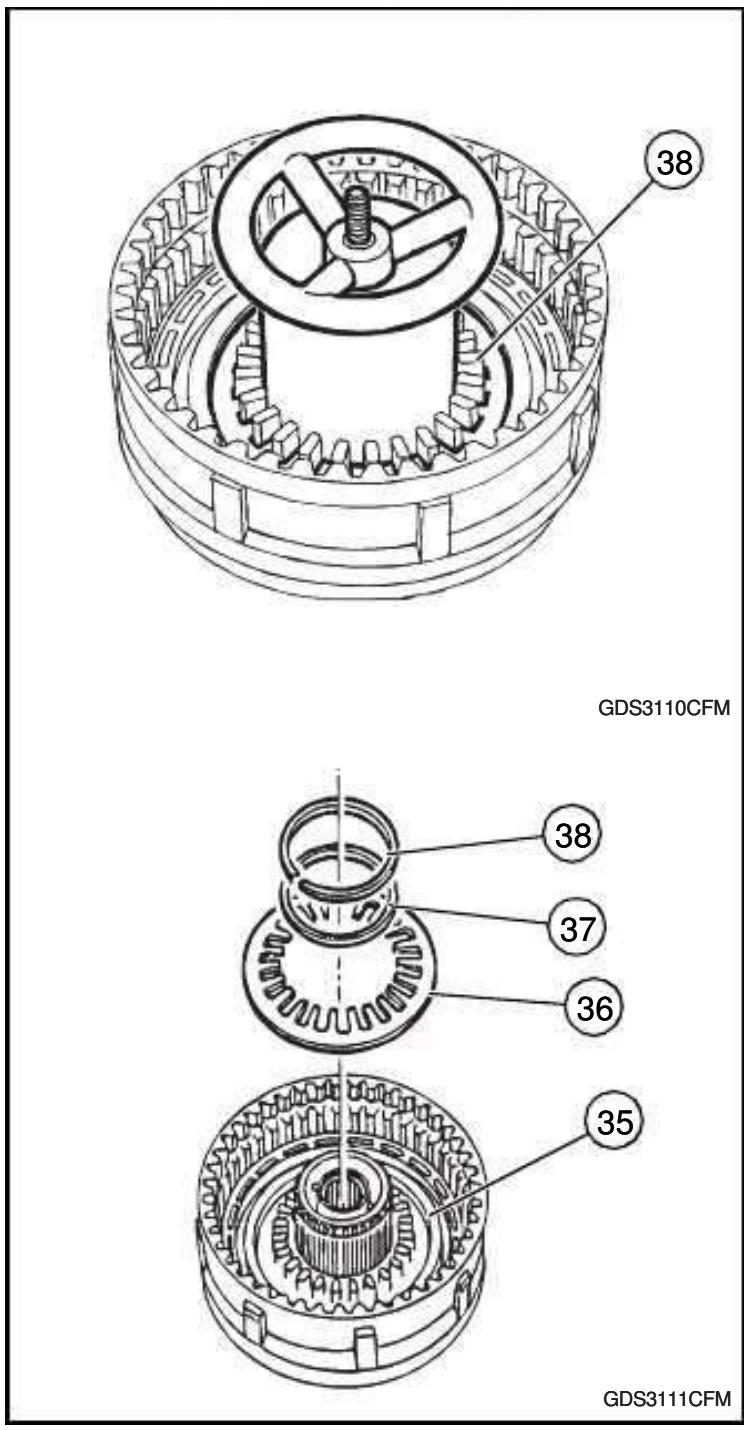
Push pins (11) toward center to remove split ring (44) and clutch A end plate (43).



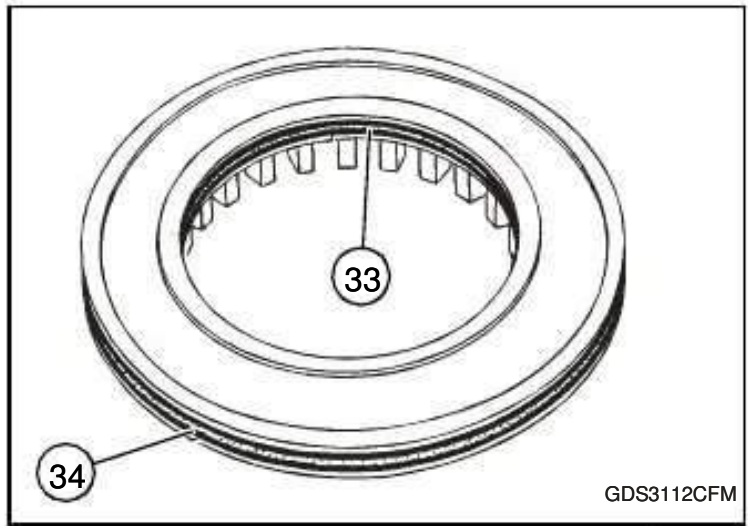
Remove clutch A plates (41 and 42) and retaining plate (40) with spring plate (39).

Remove clutch C piston (14) and seals (13 and 15).

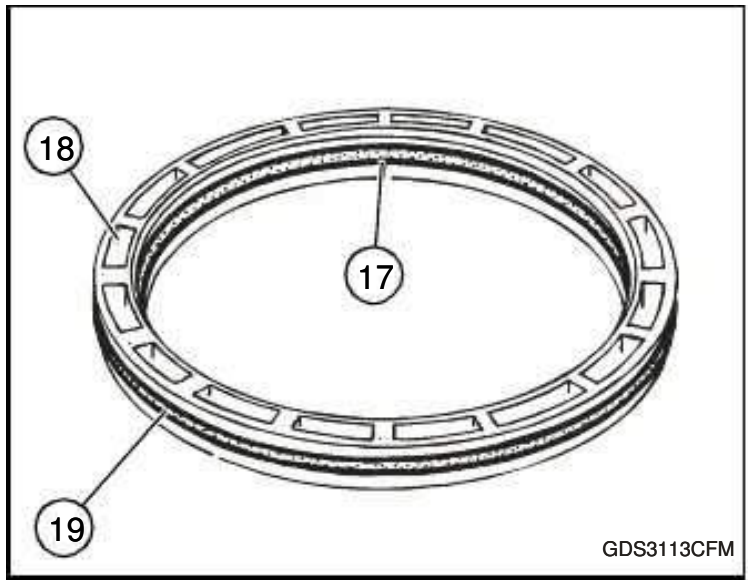
Remove seal (3).



Use 281705 Clamping Device and 281700 Pressure Piece to compress spring (36) to remove snap ring and retainer plate (37 and 38).



Remove piston and seals (33 and 34).



Remove piston (18) and remove seals (17 and 19).

NOTE:Needle bearing (6) should only be remove if necessary.

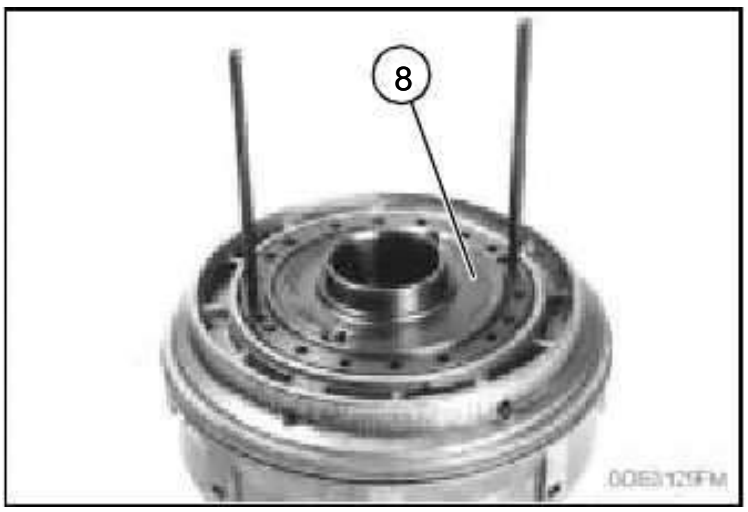
Use D01061AA Blind Hole Puller Set to remove needle bearing (6).

Heat clutch carrier (1) to approximately 150° C (302° F).

⚠ CAUTION

Wear protective gloves components will be hot.

Tap hub (8) with soft faced hammer to remove.

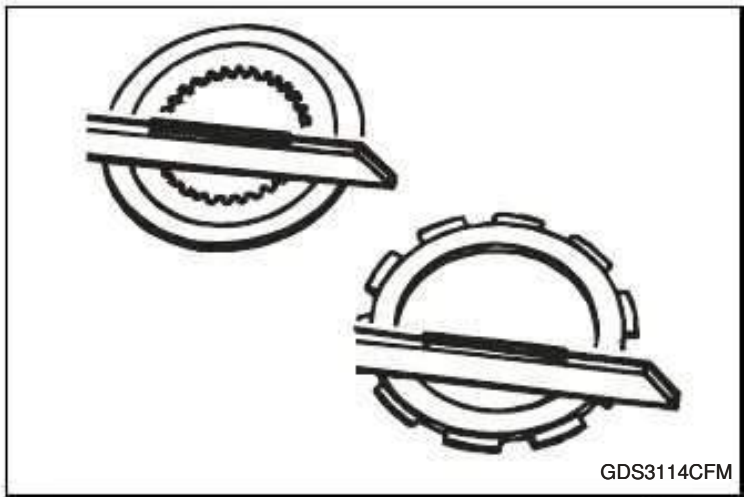


Heat clutch carrier to approximately 150° C (302° F) and install guide pins to install hub.

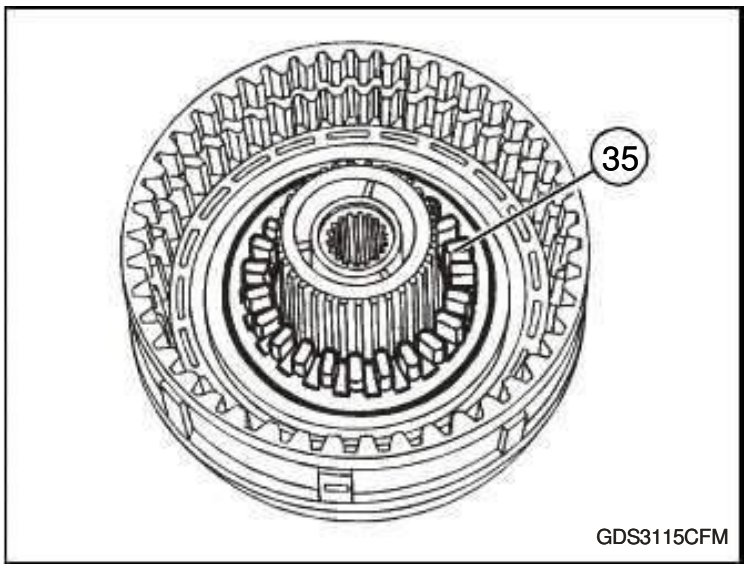
Align cap screw holes in hub (8) with clutch carrier. Hub must make contact with bottom of carrier.

NOTE: Reinforced bearing edge with lettering is driving edge.

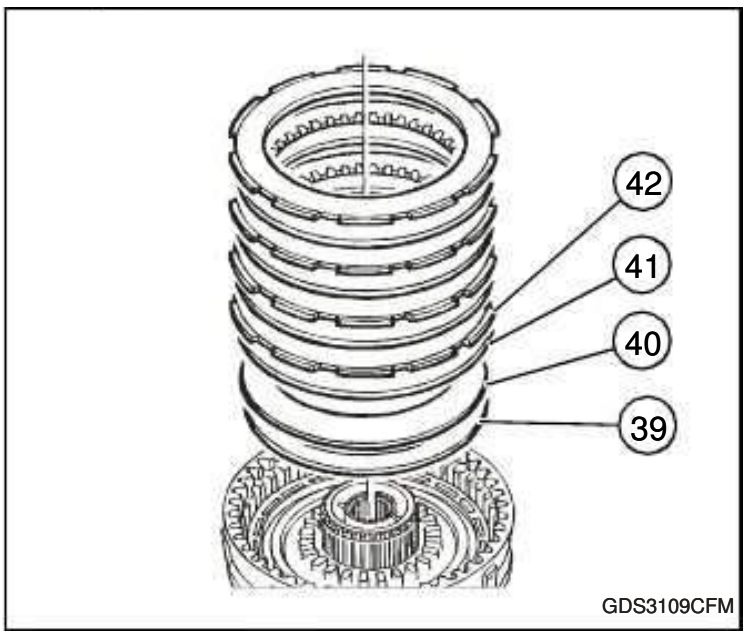
Lubricate and install needle bearing (6) in hub with Mounting 281698. Reinforced edge of bearing with lettering is towards driver.



Use straight edge to check clutch A inner and outer plates. Worn or damaged plates must be replaced.



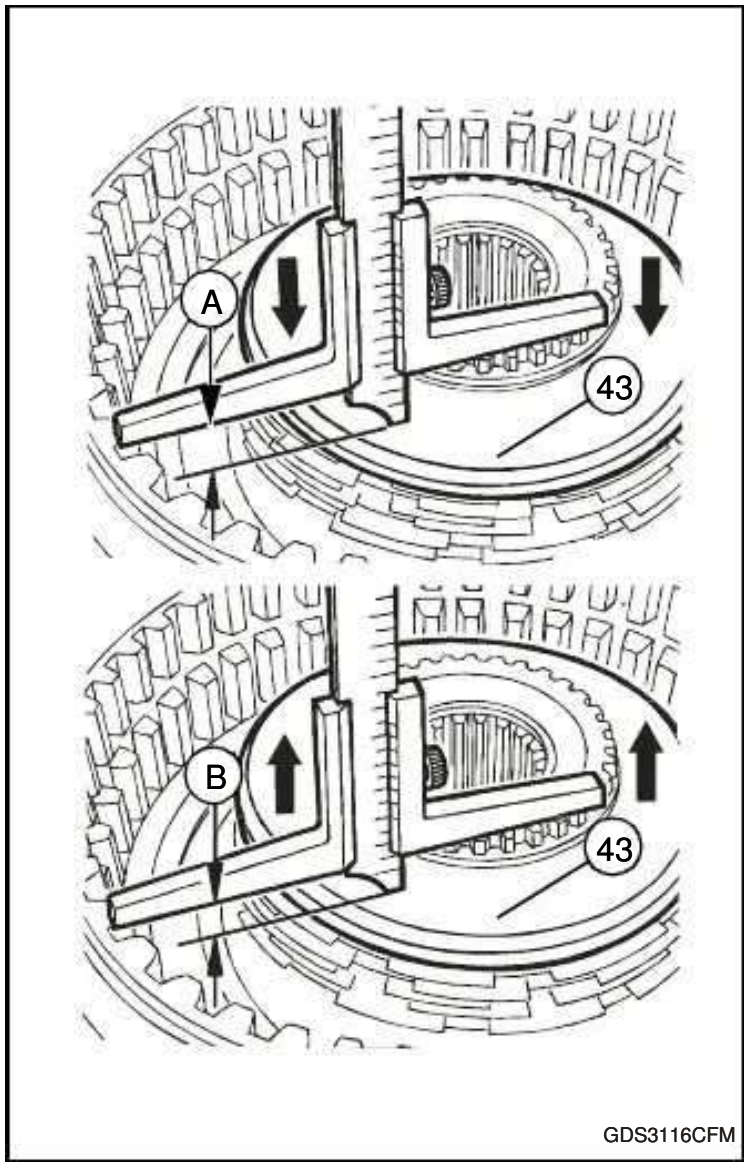
Install clutch A piston (35) without seals (33 and 34) in clutch carrier (16).



Install spring plate (39) and retaining plate (40) with closed side up.

Install inner and outer plates (41 and 42) in alternating order starting with inner plate and ending with outer plate.

Install end plate (43) and split ring (44).



Measure from hub face edge to end plate (43) face. Record as dimension A.

Raise end plate (43) to split ring (44) and measure from hub face edge to end plate (43). Record as dimension B.

Subtract dimension (B) from dimension (A) to calculate clutch B clearance. (A-B) = Clutch A clearance

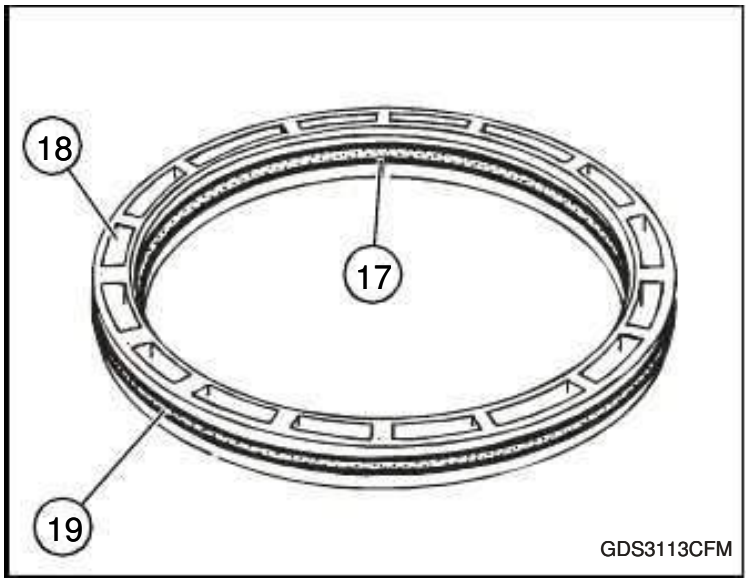
Disassemble and Assemble Input Clutch Carrier Specification

Clutch A Plate Clearance 3.2 - 3.7 mm (0.126 - 0.146 in.)

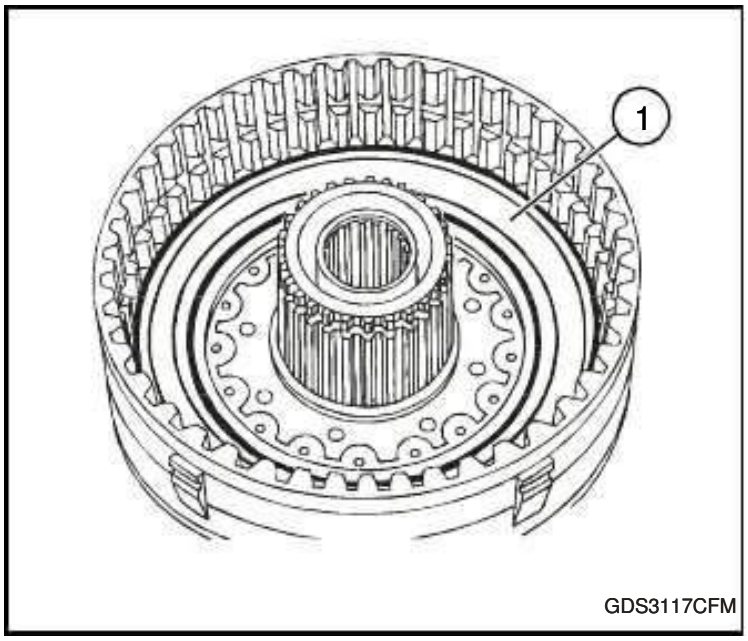
NOTE: Outer plate (42) is available in 2.0 mm (0.079 in.) and 2.5 mm (0.098 in.) sizes. Use a combination of plate sizes to adjust clutch A clearance.

Adjust clearance by using a combination of sizes of outer plate (42).

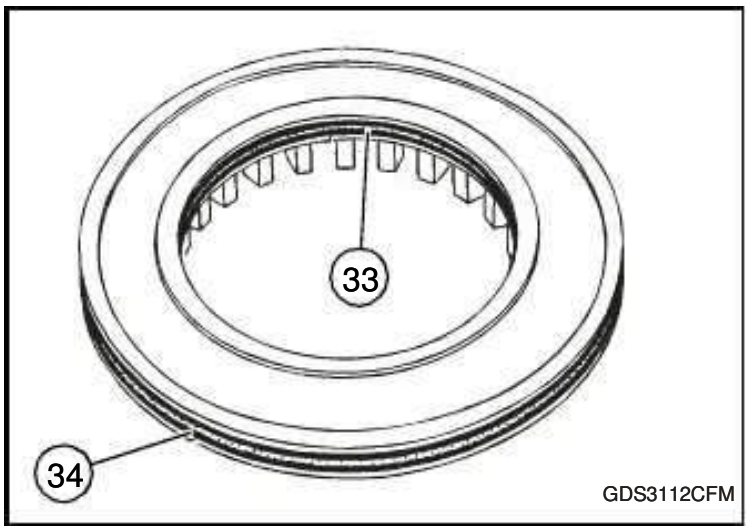
With correct clearance obtained disassemble clutch A.



Install seals (17 and 19) on clutch B piston (18).

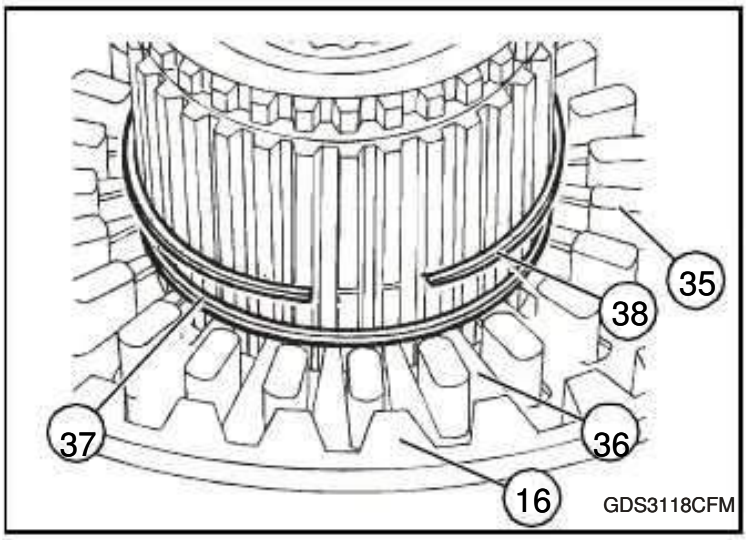


Apply a thin layer of oil to seal and install piston (1) in clutch carrier.



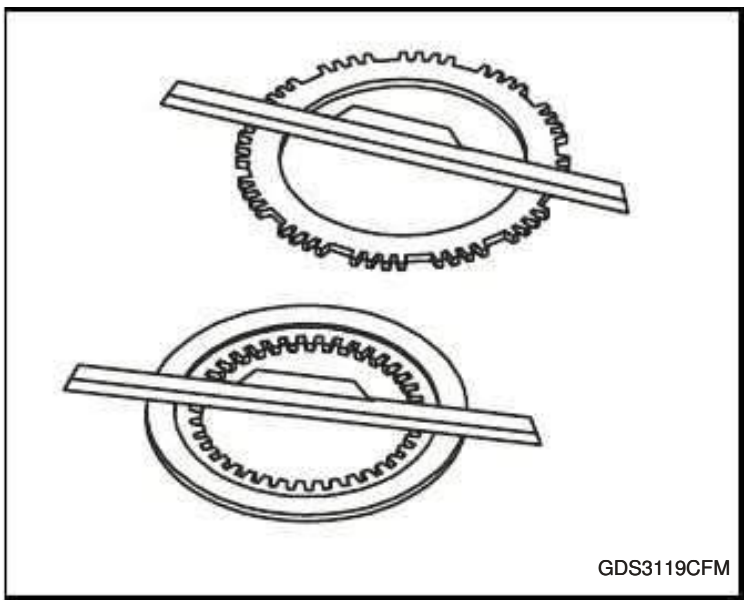
Install seals (33 and 34) on clutch A piston.

Apply a thin layer of oil to seal and install piston A in clutch carrier.

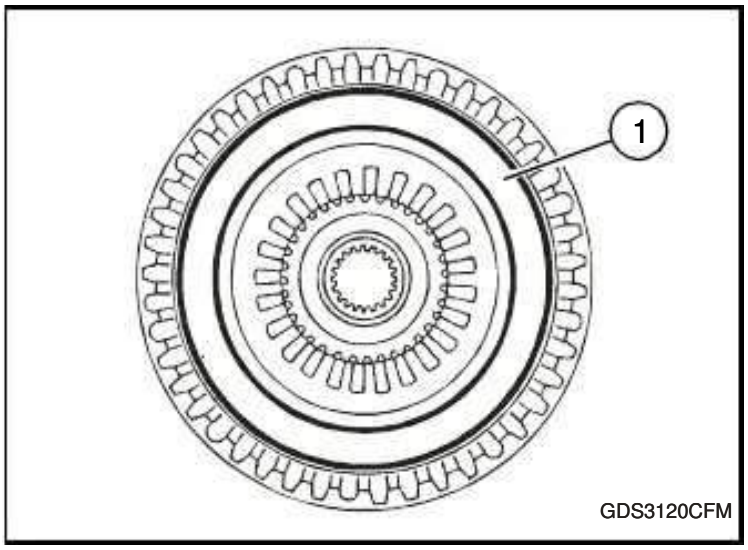


Install spring plate (36) and retainer plate (37) with recess up.

Place snap ring (38) on hub use 281705 Clamping Device and 281700 Pressure Piece to compress spring plate. Insert snap ring in groove on hub and retainer plate.

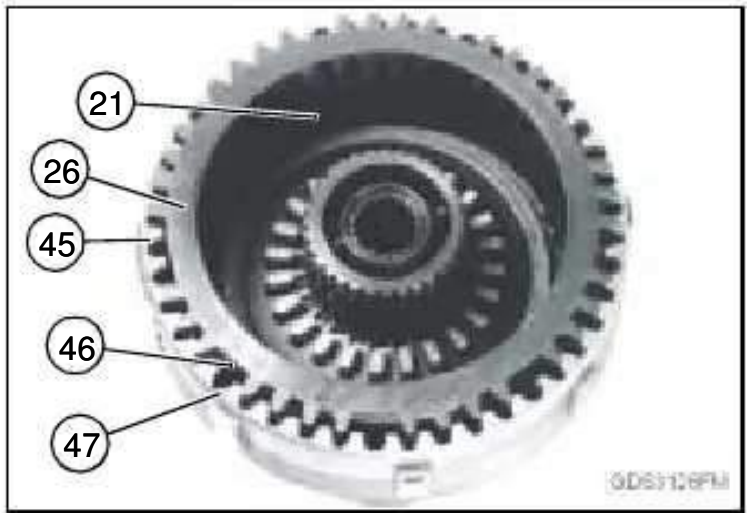


Use straight edge to check clutch B inner and outer plates. Worn or damaged plates must be replaced.



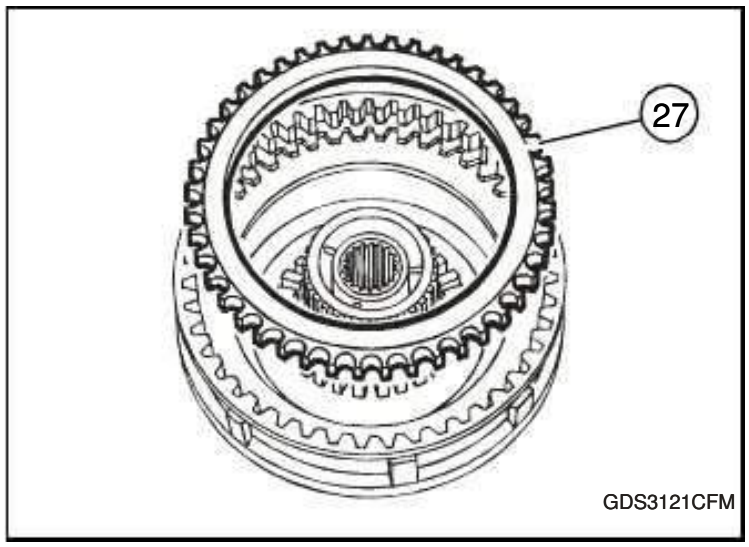
Install clutch B end plate (1).

NOTE:Outer plates have groups of three and four teeth. Spaces should be aligned with spring bores in clutch carrier. Three tooth group should be aligned with two square cut grooves.

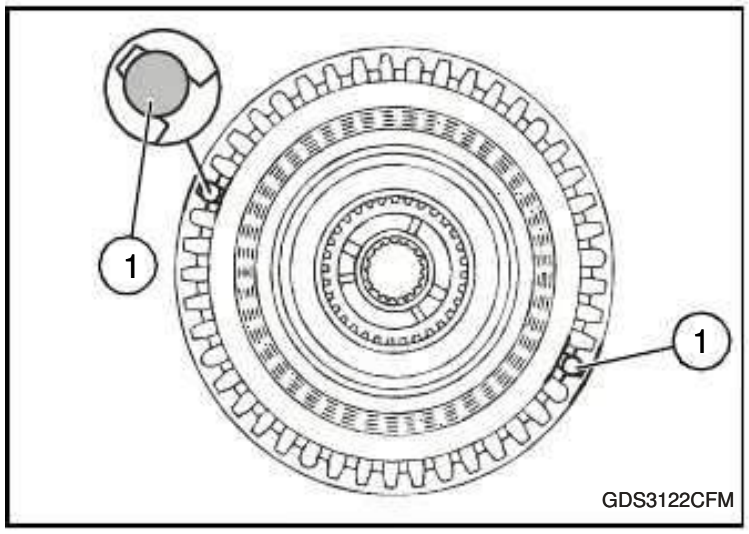


Install inner (21) and outer (26) plates alternately. Inner plate first.

Install outer plate as shown with spaces (46) aligning with spring bores (47). Three tooth pattern should be positioned at square cut grooves (45).

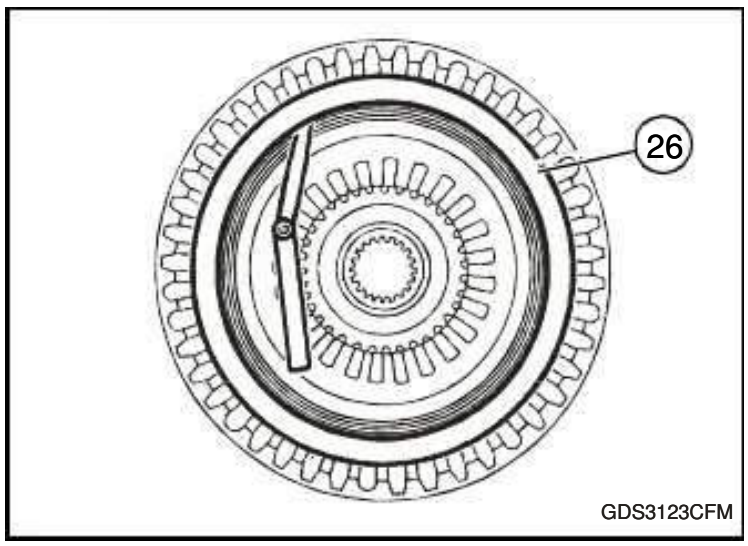


Install Clutch B end plate (27) with machined smaller bores located at square cut groves.



Install pins (1) at square cut grooves.

NOTE:Outer plate (26) is available in 2.0 mm (0.079 in.) and 2.5 mm (0.098 in.) sizes. Use a combination of sizes to adjust clutch B clearance.

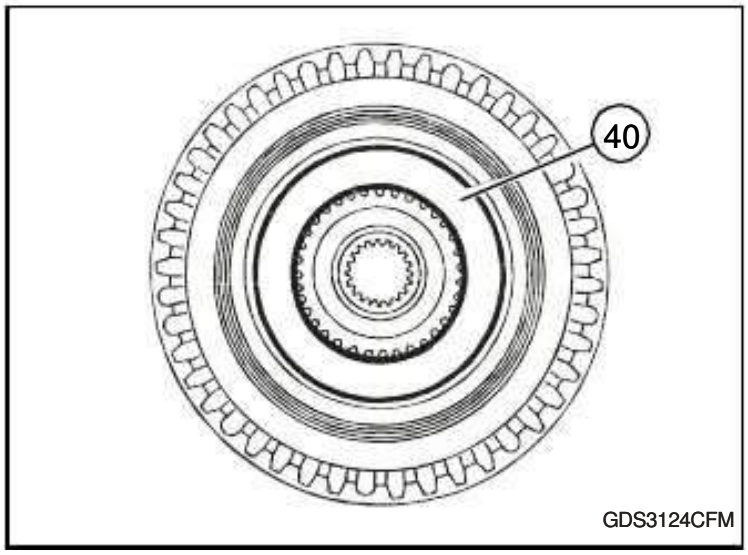


With feeler gauge measure clutch B clearance at multiple locations and calculate average clearance.

Disassemble and Assemble Input Clutch Carrier Specification

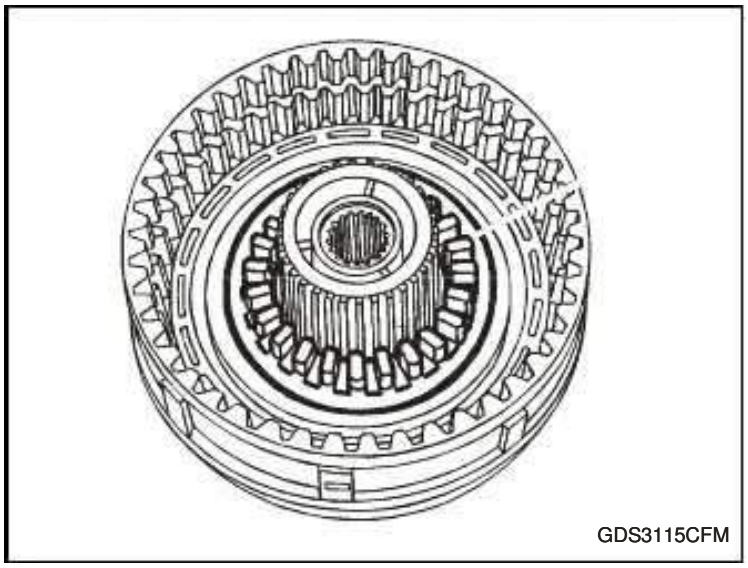
Clutch B Plate Clearance 2 - 2.5 mm (0.079 - 0.098 in.)

Use a combination of different sizes of outer plates (26) to adjust clearance.

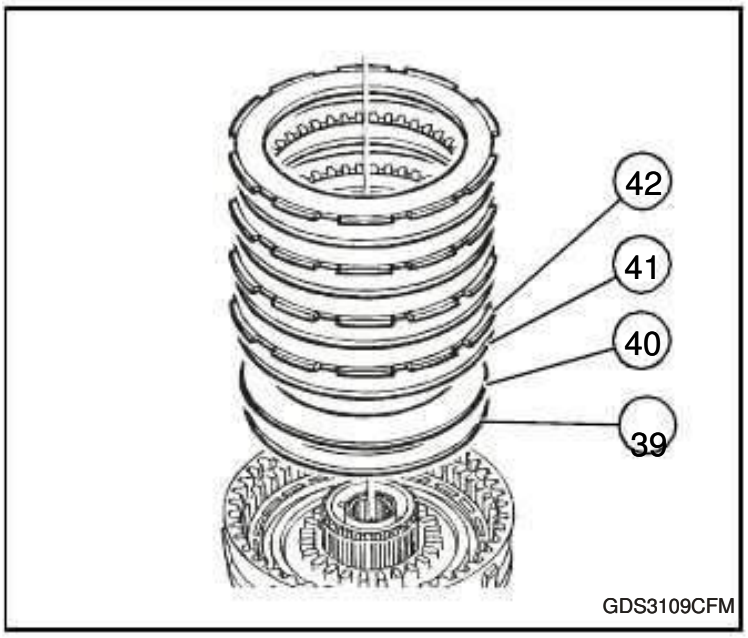


Install spring plate (39) and push retainer plate over spring plate

With closed side up push retainer ring (40) over spring plate (39).

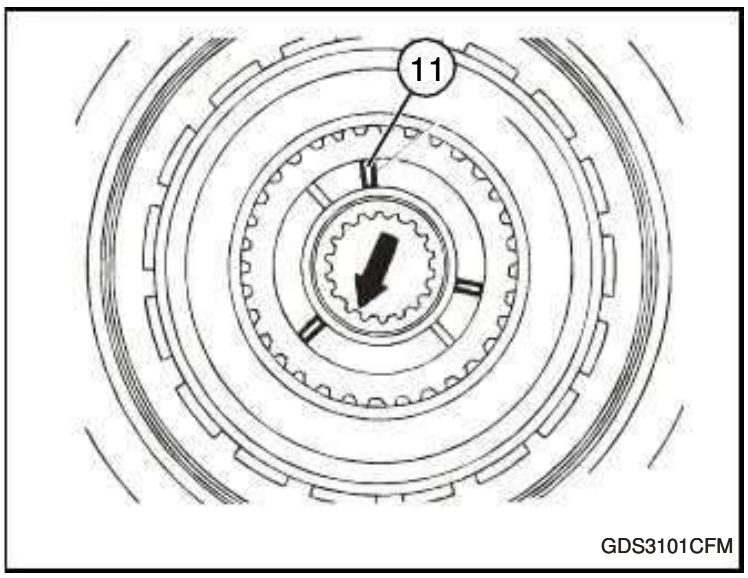


Install clutch A inner and outer plates in alternating order starting with inner plate and ending with outer plate.

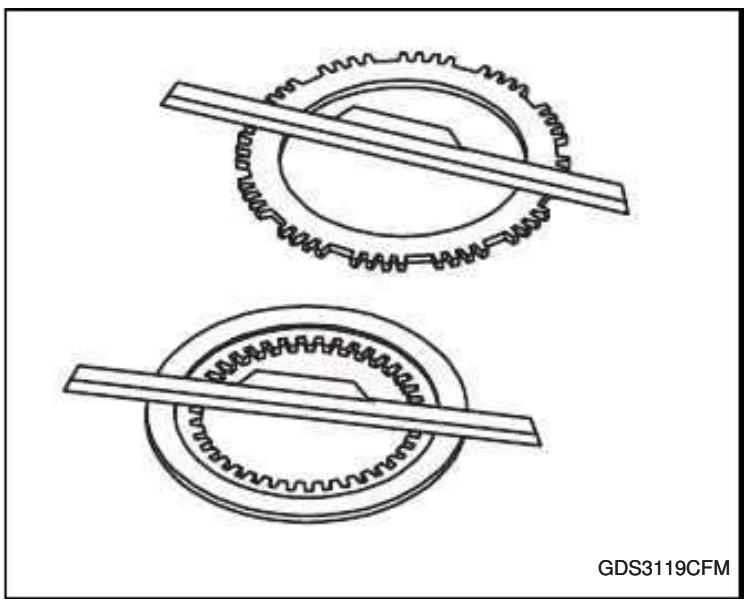


Install spring plate (39) and retaining plate (40) with closed side up.

Install end plate (43) and split ring (44).

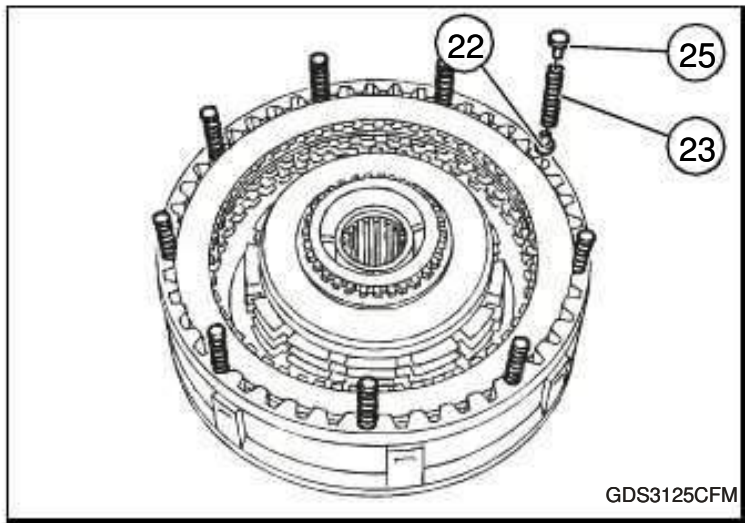


Install retainer pins (11).

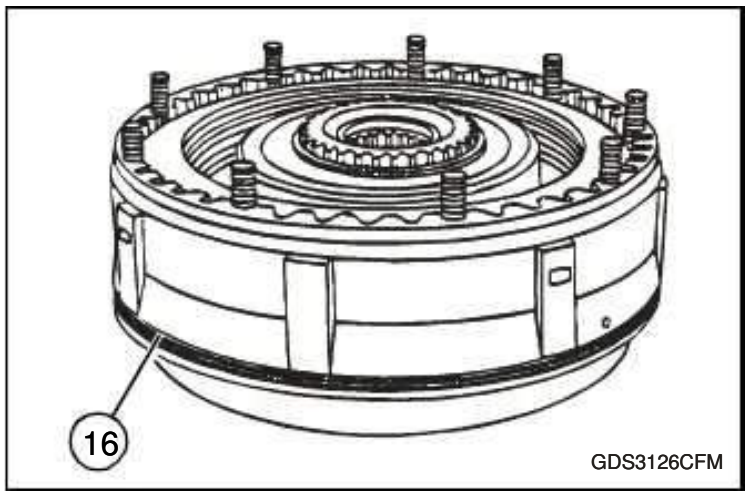


Use straight edge to check clutch C inner and outer plates. Worn or damaged plates must be replaced.

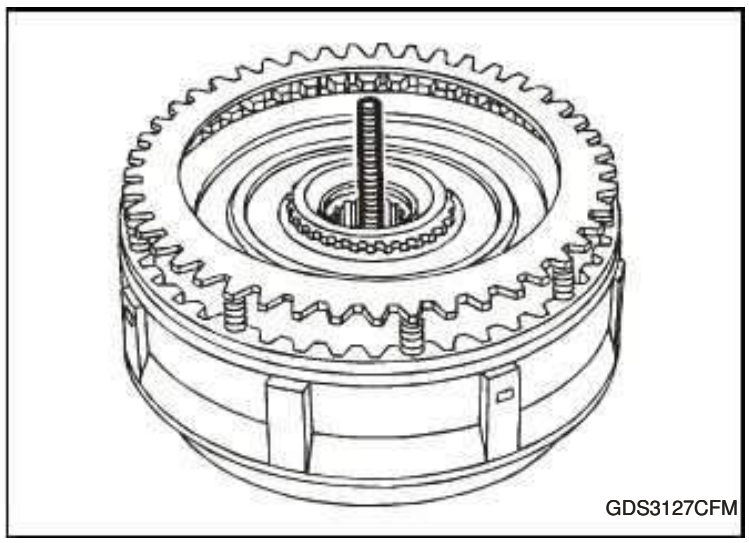
Install one clutch C outer plate (29) and one inner plate (28) alternate remaining plates ending with inner plate.



Position pins (22) on clutch B outer plate (20) with spring (23) and pin (25).

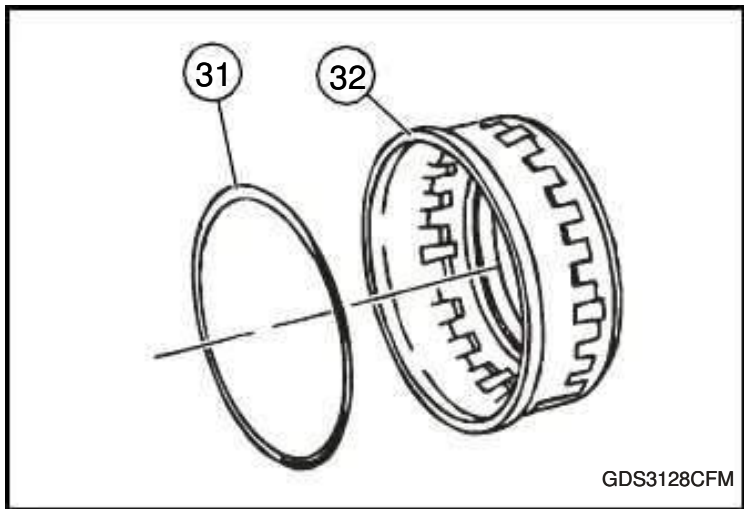


Install seal (3).



Position outer plate (30) on pin (25) and position clutch carrier on 281705 Clamping Device.

NOTE:Stretch inner seal before installing. Seal must fit groove snug. Clutch C piston must move easily in housing.



Lubricate O-ring (31) and install in reverse gear housing (32).

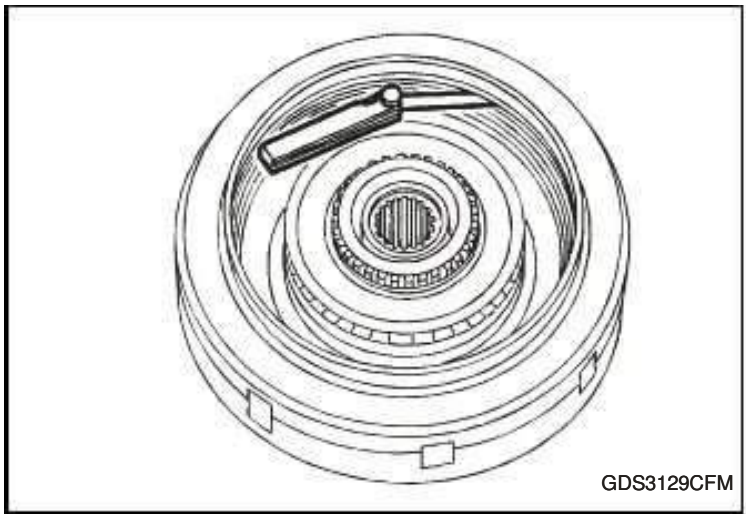
Position reverse gear housing on clutch carrier aligning groove guides and maintaining outer plate (30) in position.

Compress springs (23) and turn assembly over.

Install seals (13 and 15) on clutch C piston (14) with seal lip toward pressure side.

Install piston in reverse gear housing.

Install snap ring (12). Insure snap ring is positioned properly in groove.



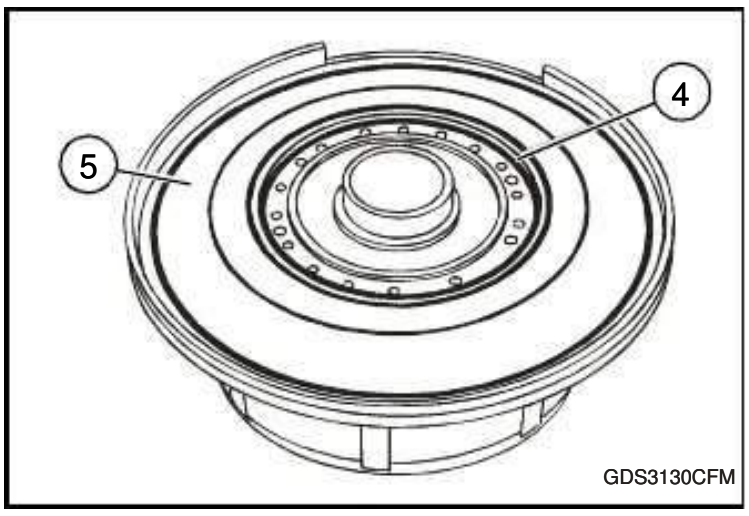
Measure clutch C clearance at equally space locations and note average clearance.

NOTE:Clutch C outer plates available in 2 mm (0.079 in.) and 2.5 mm (0.098 in.) sizes.

Use a combination of outer plate sizes to adjust clutch C clearance.

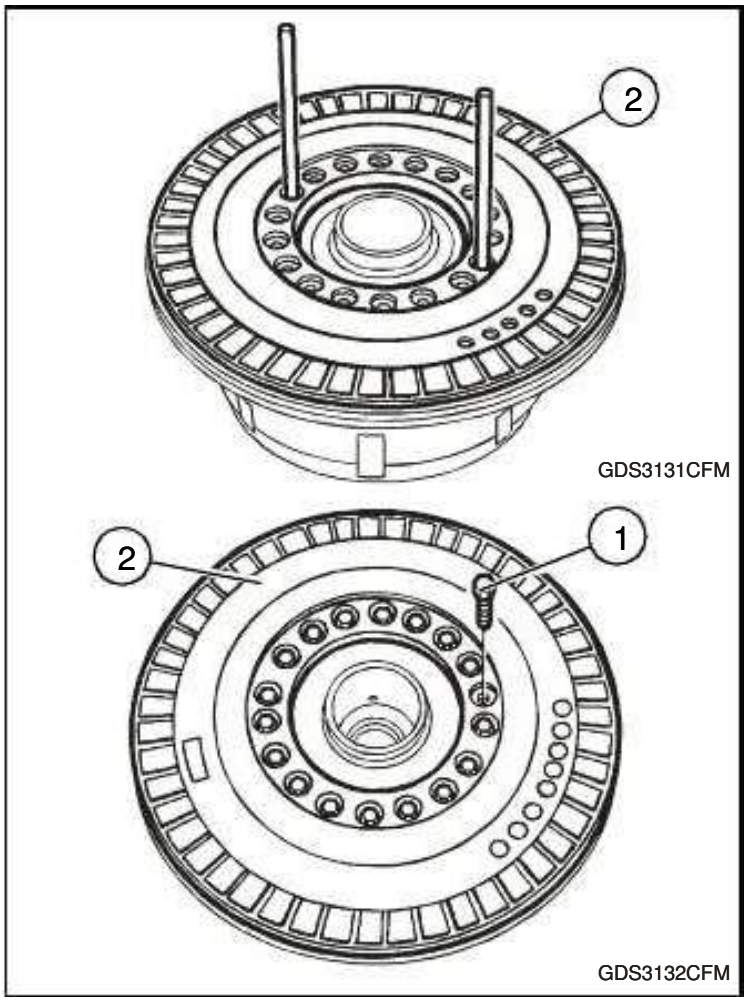
Disassemble and Assemble Input Clutch Carrier Specification

Clutch C Plate Clearance	1.6 - 2.1 mm (0.063 - 0.083 in.)



Install plate seal (5) and rectangular ring (4). Rectangular ring (4) must lettering “**TOP** or “**R**” up.

NOTE:Rotor cap screw pattern will allow rotor to be installed in only one position.



Install rotor (2) using two guide pins and tighten bolts (1) to specification.

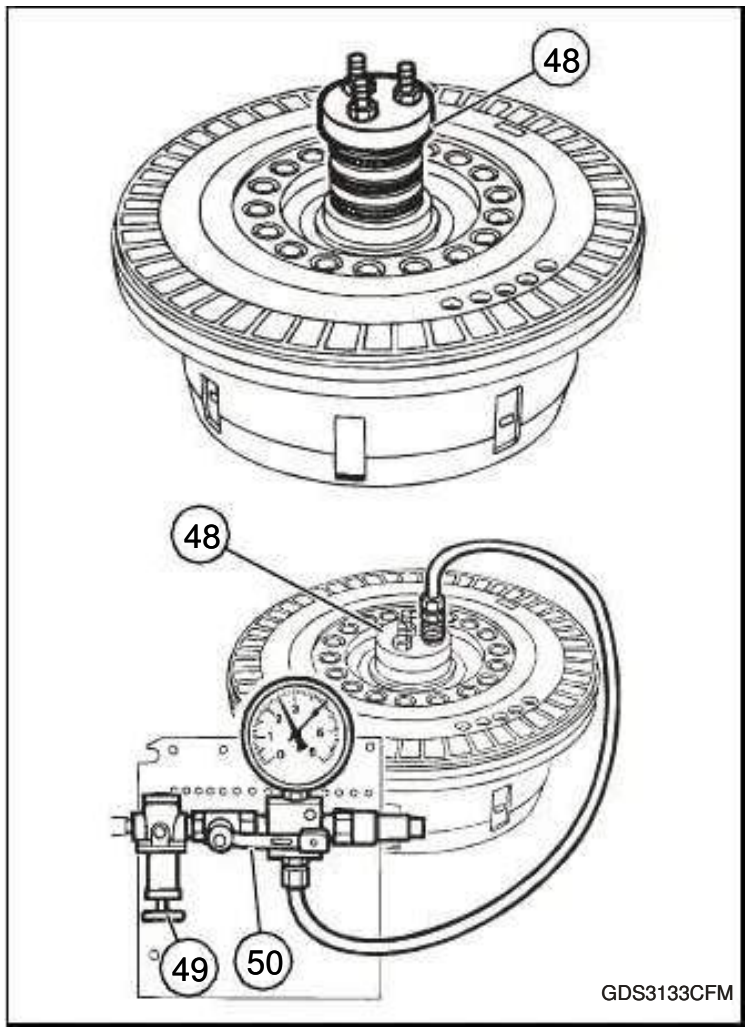
Disassemble and Assemble Input Clutch Carrier Specification

Rotor Torque	32 Nm (24 lb-ft)

Lubricate seal rings and install 281706 Tool Test.

⚠ CAUTION

Do not apply more than 300 kPa (3 bar) (44 psi) maximum compressed air pressure to clutches. Seal damage may occur.

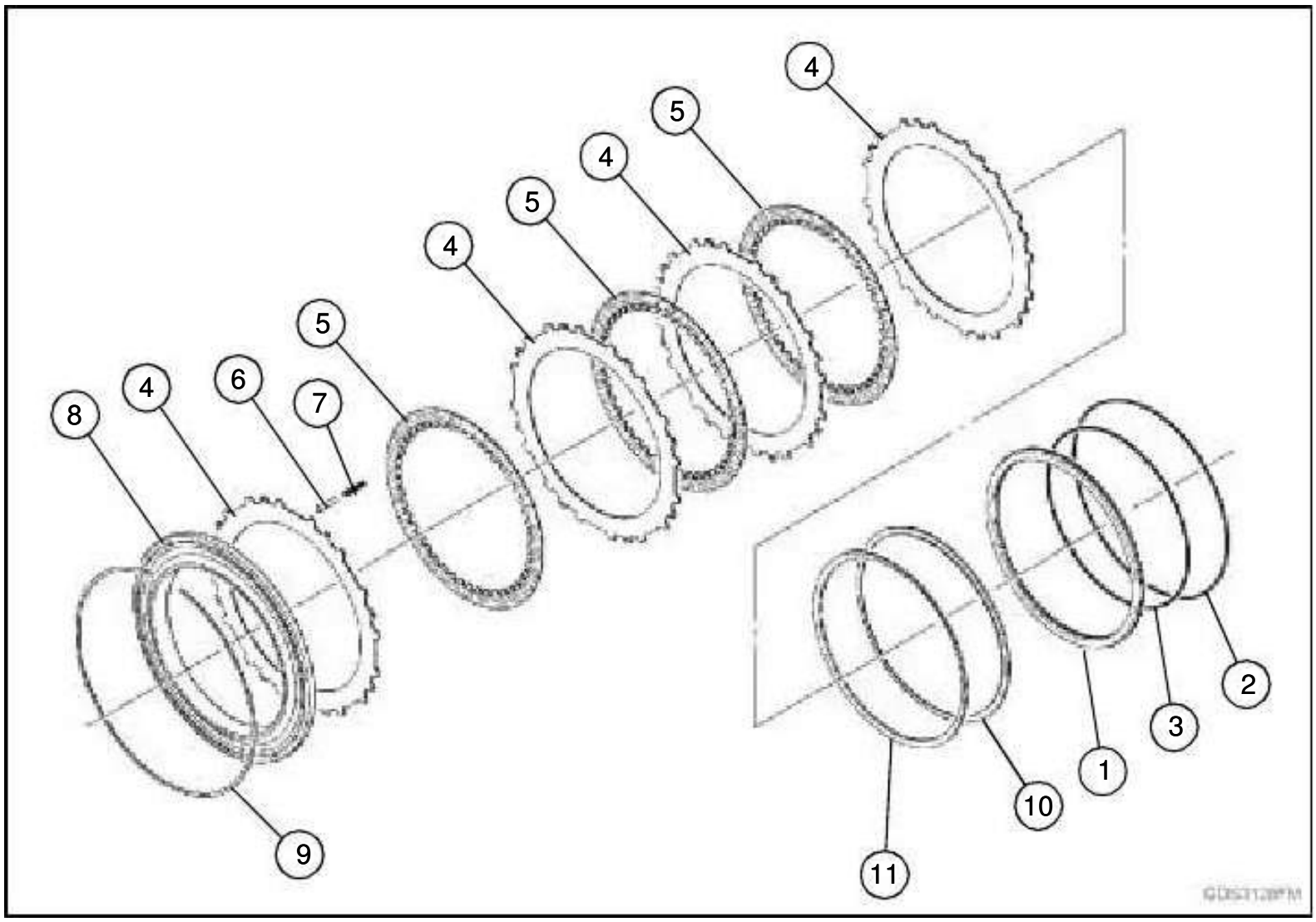


With adapter (48) secured in clutch carrier, adjust regulator (49) to apply 300 kPa (3 bar) (44 psi) maximum compressed air pressure. Attach to clutch fitting apply pressure and shut-off. Each clutch must maintain a minimum pressure of 140 kPa (1.4 bar) (20 psi) for 10 seconds.

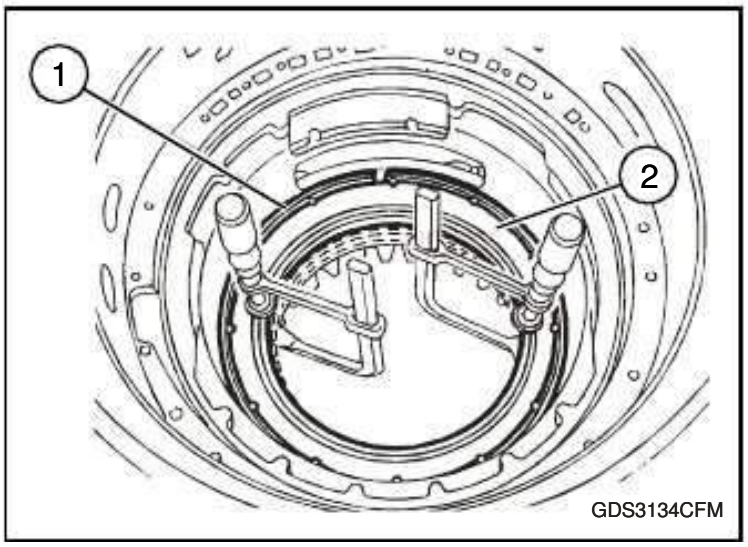
Disassemble and Assemble Input Clutch Carrier Specification

Clutch A, B and C Seal Test Pressure	140 kPa (1.4 bar) (20 psi) minimum

Disassemble and Assemble Clutch D

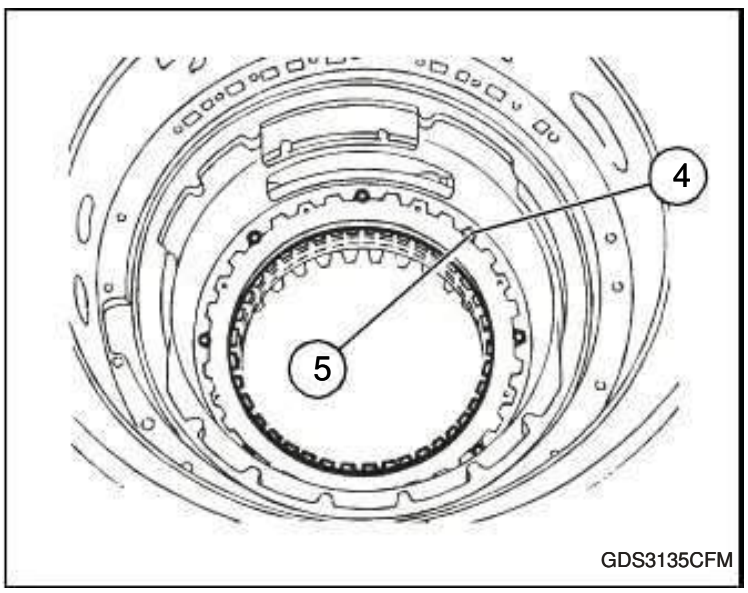


1. Clutch D Piston.
2. Seal.
3. Seal.
4. Outer Plate.
5. Inner Plate.
6. Pin (8 used).
7. Spring (8 used).
8. End Plate.
9. Snap Ring.
10. Spring Plate Holder.
11. Spring Plate.



Use screw clamps to compress clutch D springs as shown to remove snap ring (1).

Release screw clamps evenly and remove end plate (2).

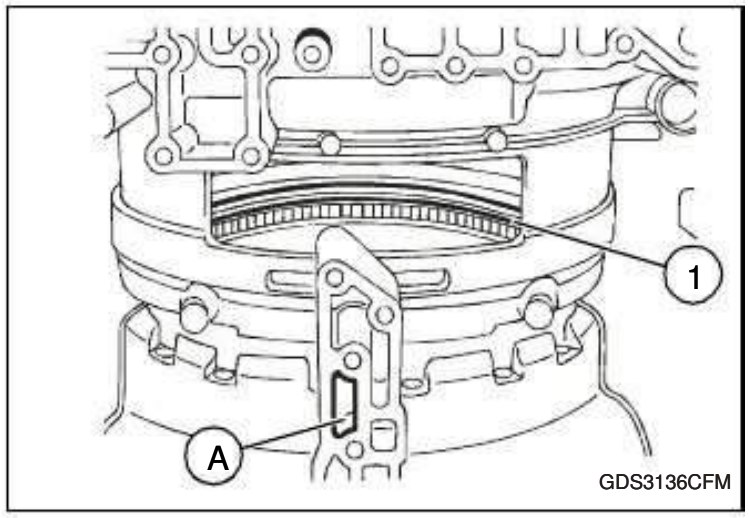


Remove springs (5) and pins (4).

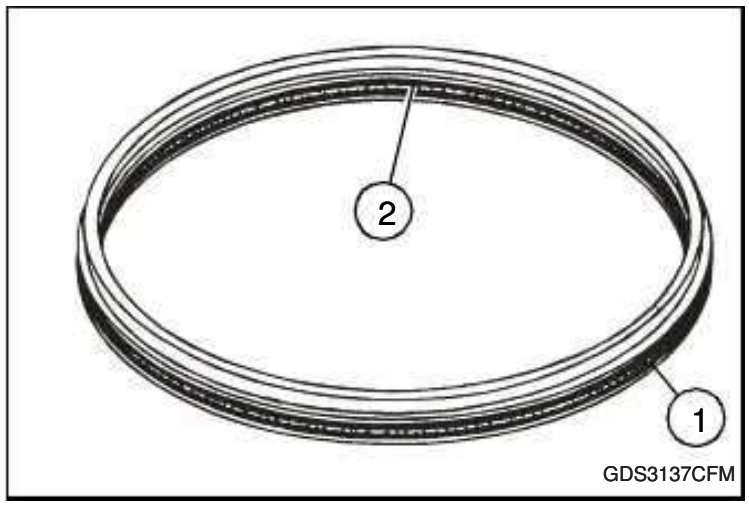
Remove plates, mark and identify order and position.

⚠ CAUTION

Wear eye and face protection before using compressed air. Cover transmission oil ports with a cloth for protection from transmission oil when using compressed air.



Remove clutch D piston (1) with low air pressure applied to port (A).

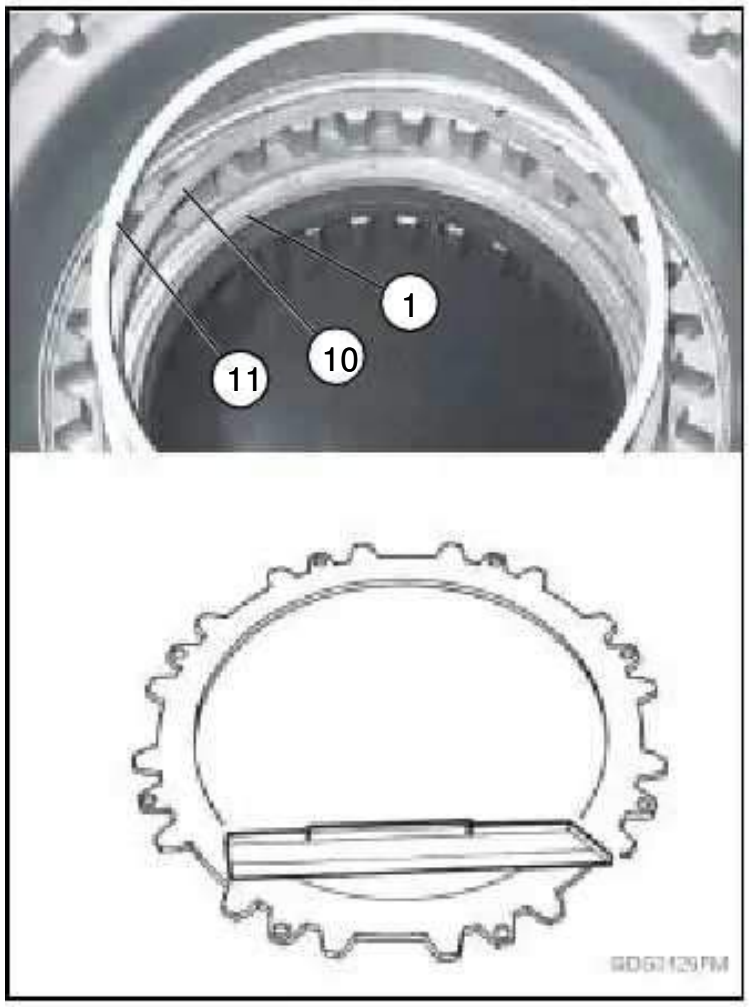


Replace seals (1 and 2). Seal lip must be positioned toward pressure side of piston.

NOTE: Piston must move freely and rest at bottom of bore.

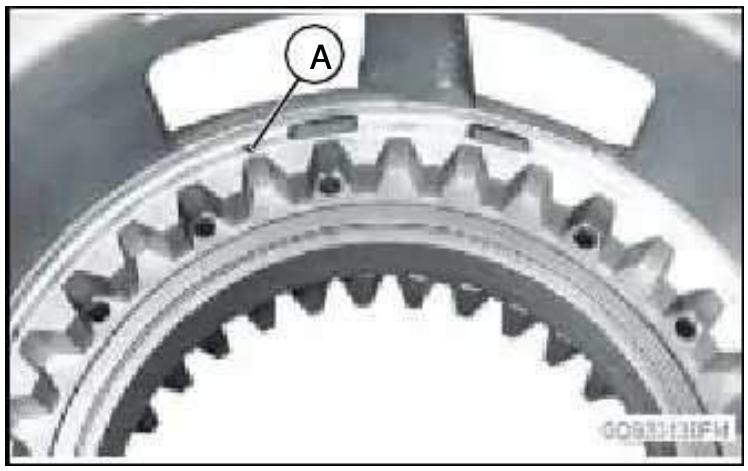
Apply a thin layer of petroleum jelly and install clutch piston D (1).

NOTE: Spring plate inner edge must be positioned on spring plate holder.



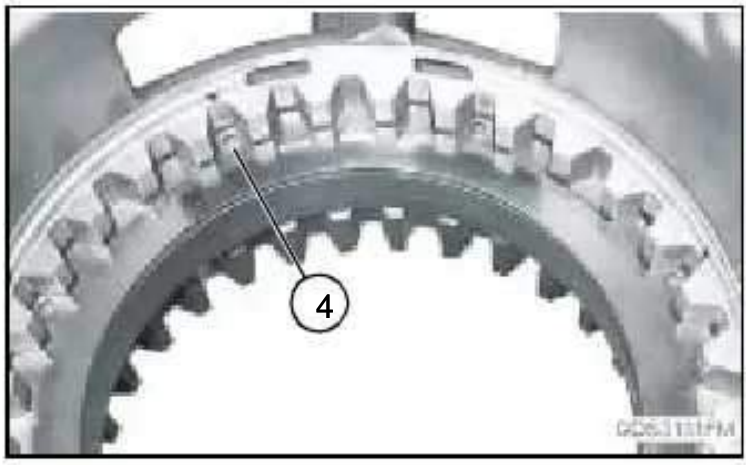
Install spring plate holder (10) and spring plate (11).

Use straight edge to check clutch D inner and outer plates. Worn or damaged plates must be replaced.

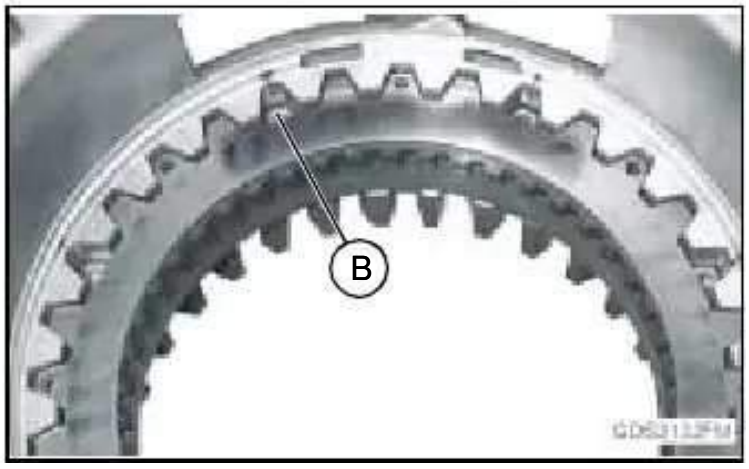


Mark housing between two holes (A).

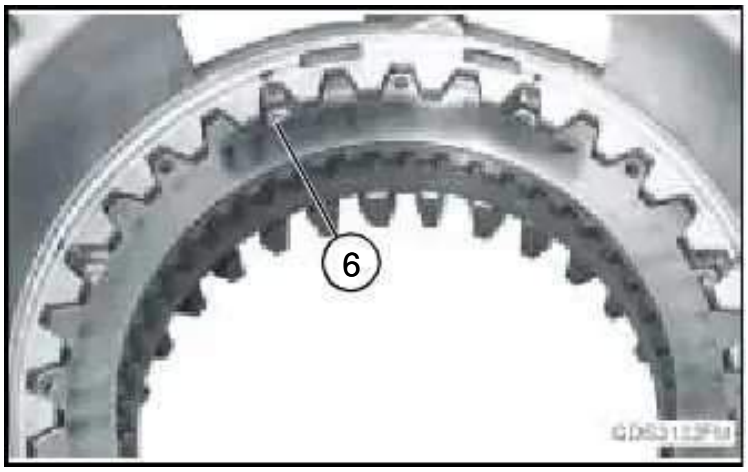
NOTE:Teeth of outer plates should cover hole in transmission housing.



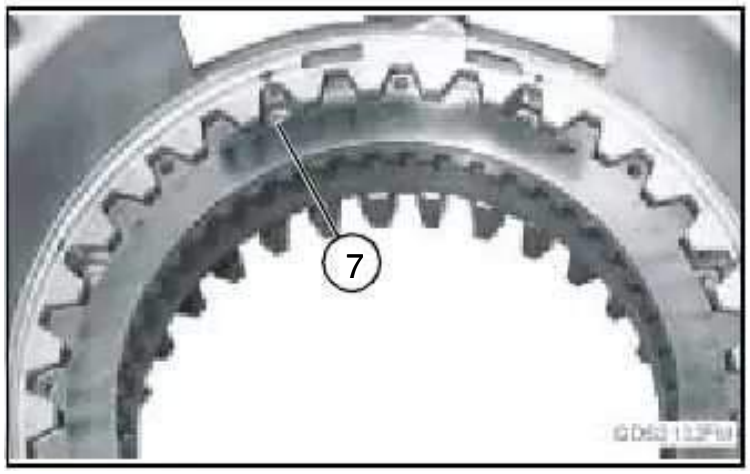
Align hole in first outer plate (4) with mark on housing.



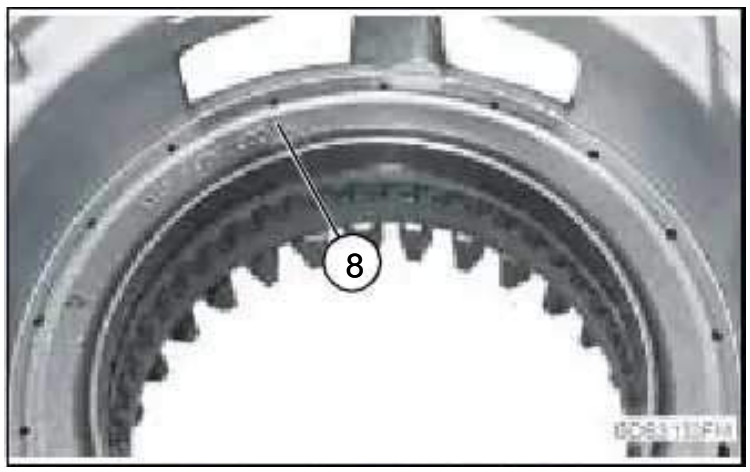
Install four inner plates and remaining outer plates in alternating order with recess at hole in first outer plate (B). Last plate is an outer plate.



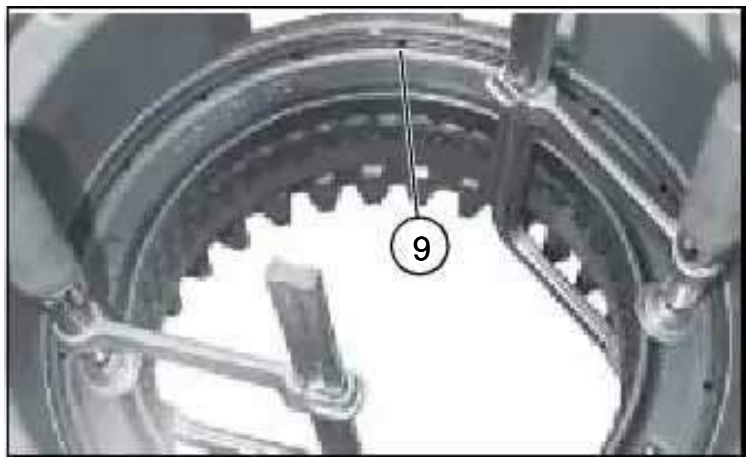
Install pin (6) in hole in first plate.



Install spring (7) over pin.



Install end plate (8).



Compress springs evenly with two clamps.

NOTE:Clutch D outer plates available in 2 mm (0.079 in.), 2.5 mm (0.098 in.), 3 mm (0.118 in.) 3.5 mm (0.138 in.) sizes.

Measure plate clearance at equally spaced locations and calculate average clearance.

Use a combination of outer plate sizes to adjust clutch D clearance.

Disassemble and Assemble Clutch D Specification

Clutch D Plate Clearance 1.6 - 2.1 mm (0.063 - 0.083 in.)

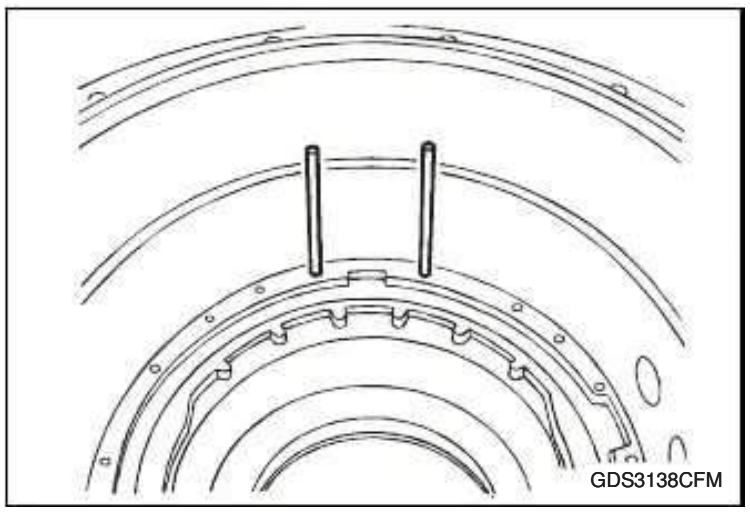
Assemble Transmission

Install Input Oil Control and Clutch Carrier

With clutch D assembled install guide pins and heat transmission housing at oil control body location to 140° C (284° F).

⚠ CAUTION

Wear protective gloves components will be hot.

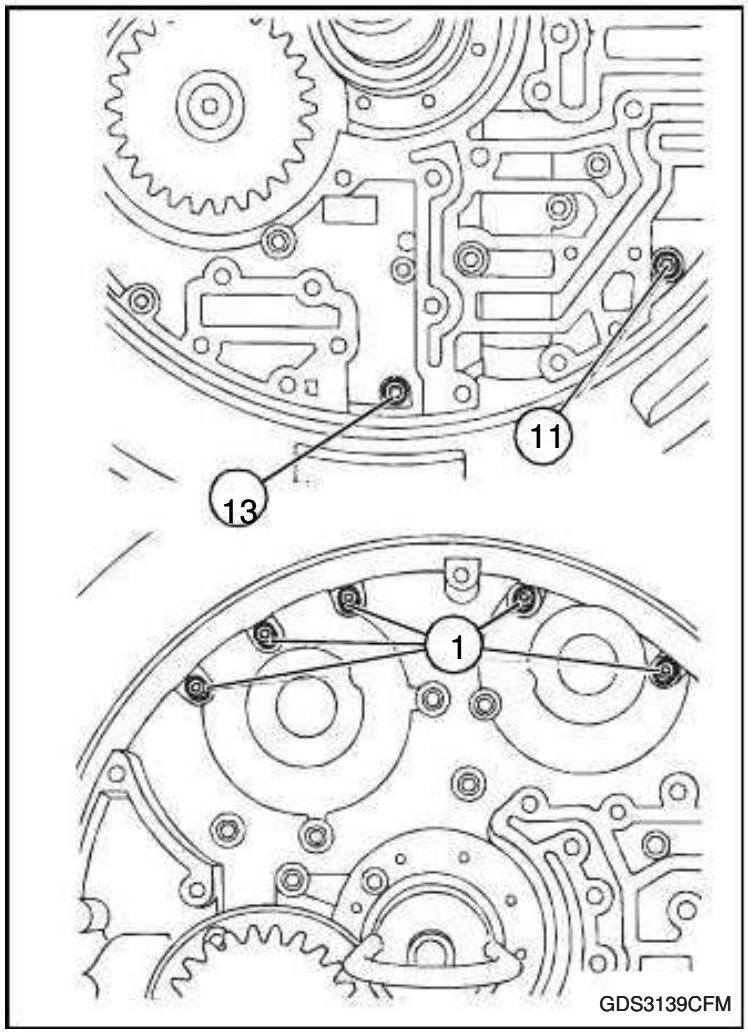


Lower input oil control body and clutch carrier on guide pins into position in transmission housing. Oil control body must make full contact with transmission housing at all locations.

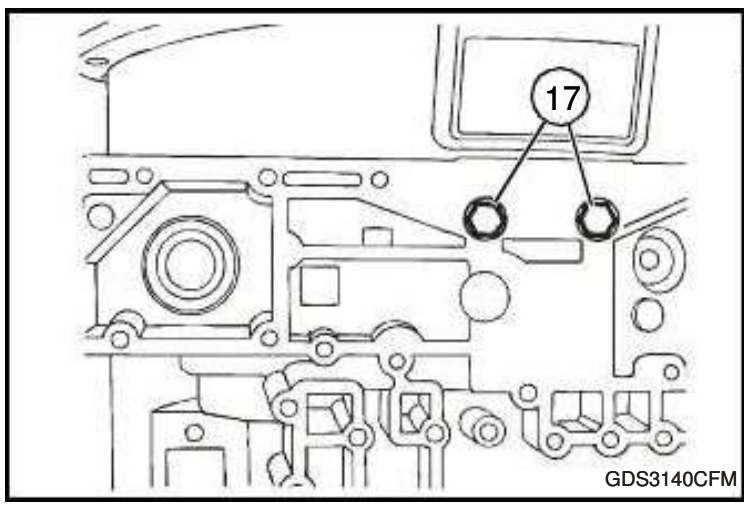
⚠ CAUTION

Wide washers or shim must be used on alignment cap screws (17) to avoid damage to sealing surface. Damage to surface will cause low oil pressure.

NOTE: Alignment cap screw (17) must be installed and tightened prior to tightening oil control body cap screws (1, 11, and 13).



Install cap screws (1, 11, and 13) hand tight.



Install bolt (17) and tighten to specification.

Install Input Oil Control and Clutch Carrier Specification

Input Oil Control Body Alignment Cap Screw Torque - 23 Nm (204 lb-in.)

⚠ CAUTION

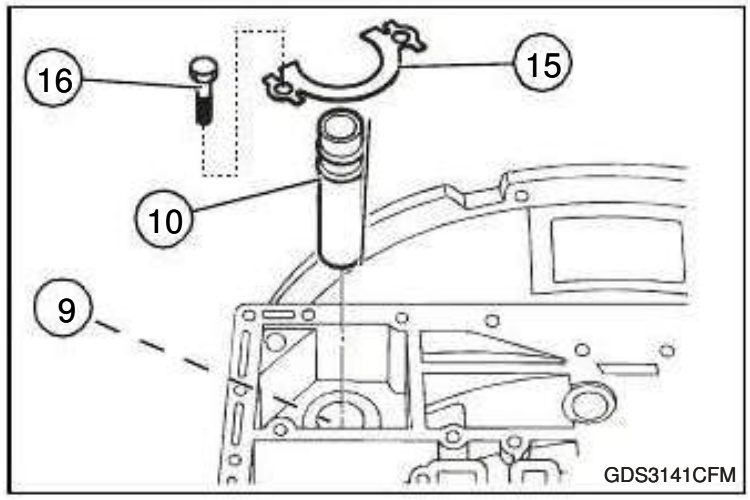
Carefully tighten cap screws to avoid damage to sealing surfaces. Damage to surface will cause low oil pressure.

Tighten cap screws (1, 11, and 13) to specification.

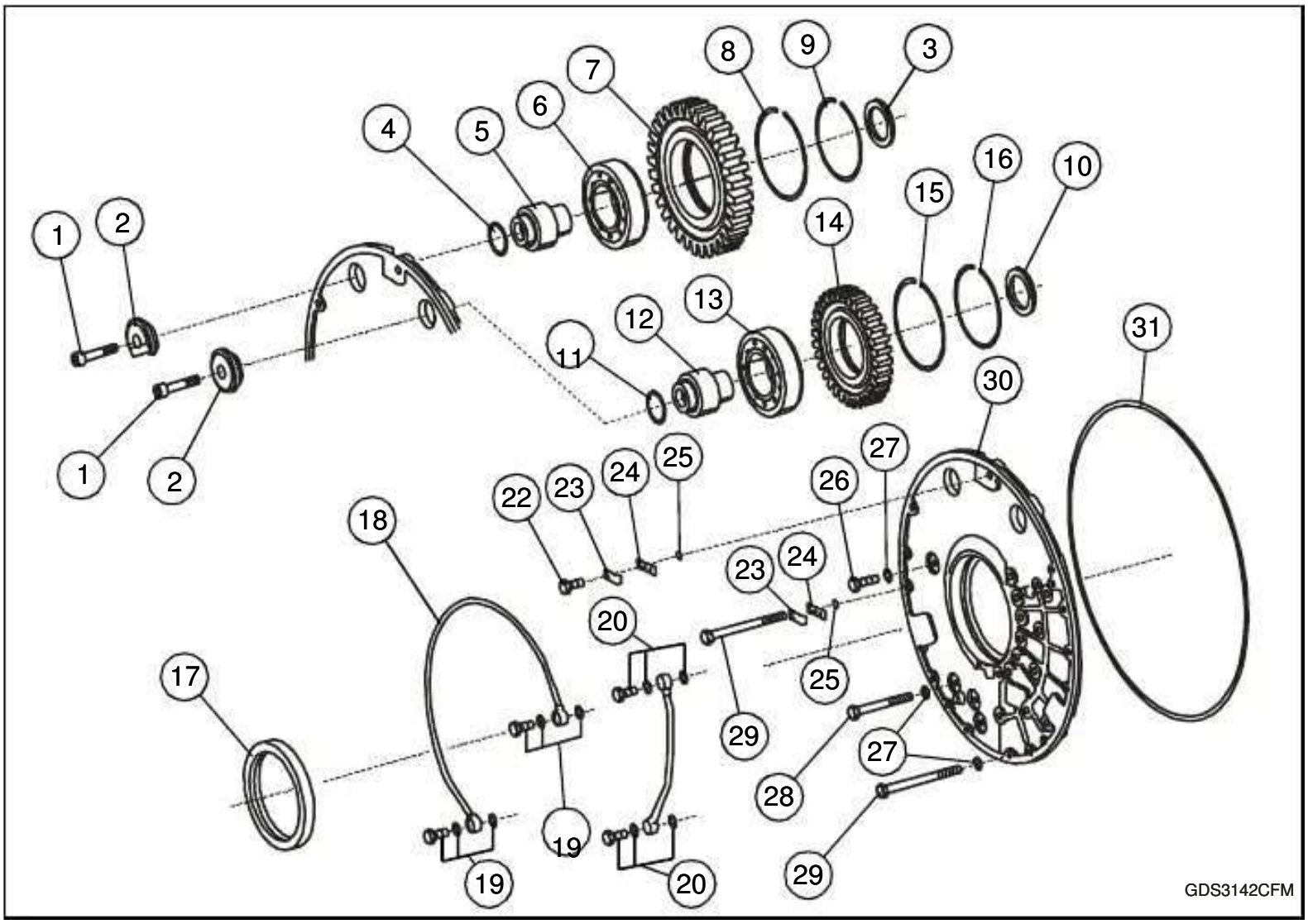
Install Input Oil Control and Clutch Carrier Specification

Input Oil Control Body Torque - - - - - 23 Nm (204 lb-in.)

Remove bolts (17) and washer.



Install oil intake pipe (10) and O-ring (9) with lock plate (15).



1. Cap Screw (2 used).
2. Retainer.
3. Thrust Washer.
4. O-Ring.
5. Shaft.
6. Bearing.
7. Drive Gear.
8. Snap Ring.
9. Snap Ring.
10. Thrust Washer.
11. O-Ring.
12. Shaft Washers (2 used).
13. Bearing.
14. Driven Gear.
15. Snap Ring.
16. Snap Ring.
17. Seal.
18. Oil Line.
19. Banjo Cap Screw and Washers (2 used).
20. Banjo Cap Screw and Washers (2 used).
21. Oil Line.
22. Cap Screw.
23. Clamp (2 used).
24. Retainer (2 used).
25. O-Ring.
26. Cap Screw.
27. Seal.
28. Cap Screw (8 used).
29. Cap Screw (14 used).
30. Cover Plate.
31. O-Ring.

Install Cover Plate and Auxiliary Drive Gears

Install thrust washers (3 and 10).

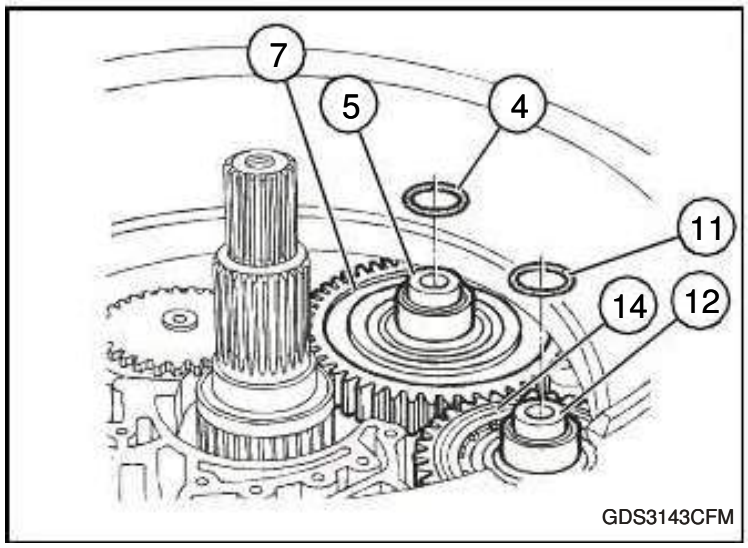
Position gear and bearing assemblies (7 and 14) with inner race plate and snap ring toward oil control body.

Align gears and washers with shaft bore in oil control body.

Heat bearing inner race to 85° C (185° F).

⚠ CAUTION

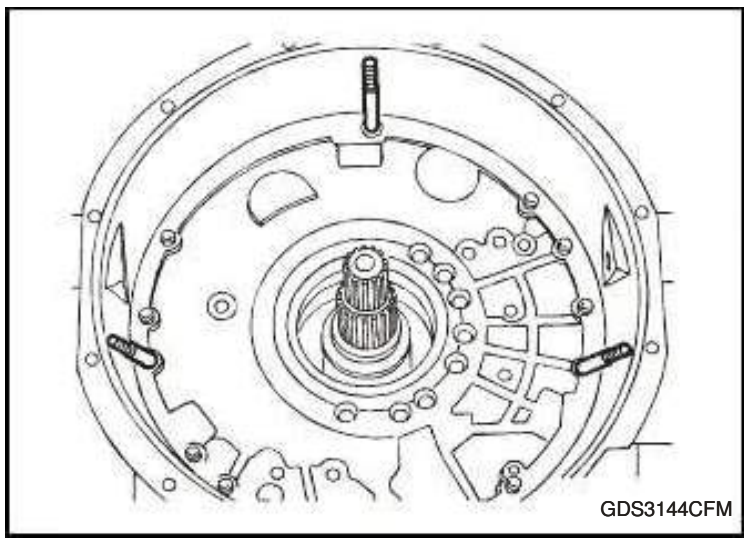
Wear protective gloves components will be hot.



Install shafts (5 and 12) with threaded bore up. Drive shaft with suitable driver to make contact with shoulder at bottom of bore in oil control body.

Apply a thin layer of petroleum jelly to O-rings (4 and 11) and install.

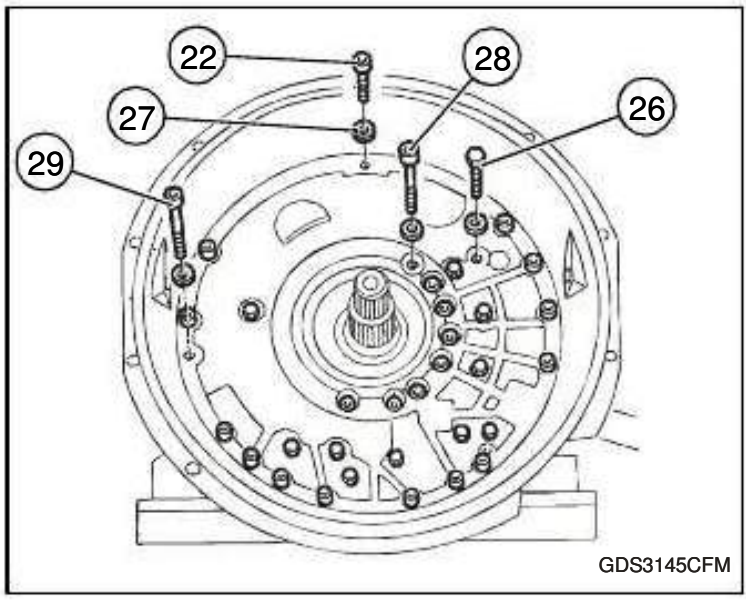
Apply a thin layer of petroleum jelly to O-ring (31) and install.



Install three guide pins in threaded holes.

Position cover and push cover down to bottom of bore. Tap cover into position with soft faced hammer.

NOTE: Cap screws at three guide pin locations require special copper sealing ring order; copper seal ring, washer, copper seal ring.

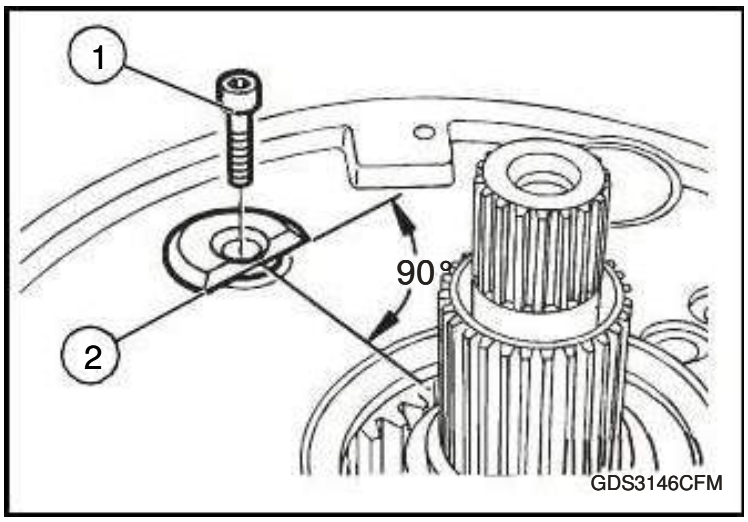


Cap screws at guide pin locations require copper seal rings to be place in the following order; copper seal ring, washer, copper seal ring.

Using new copper seal rings install remaining cap screws (26, 28, and 29) and tighten to specification.

Install Cover Plate and Auxiliary Drive Gears Specification

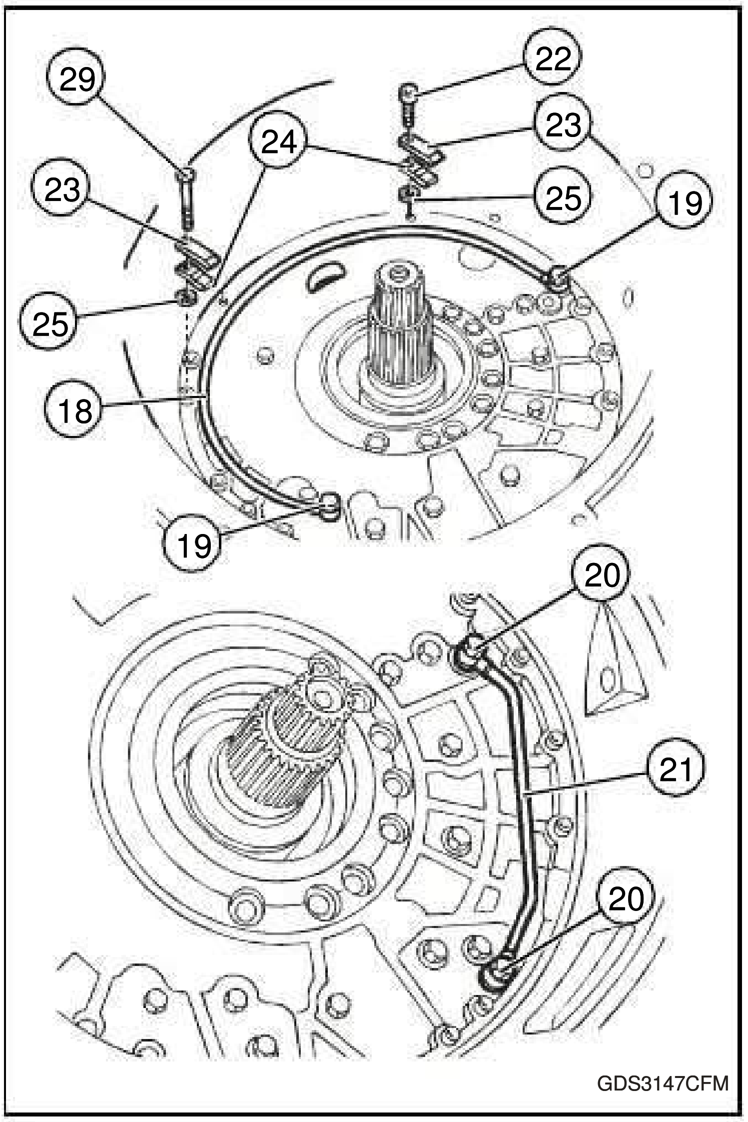
Cover Plate Torque - - - - - - - - - - - 23 Nm (204 lb-in.)



Position retainers (2) with bevel edge facing turbine shaft. Tighten cap screw to specification.

Install Cover Plate and Auxiliary Drive Gears Specification

Auxiliary Shaft Retainer Torque - - - - - 32 Nm (24 lb-ft)

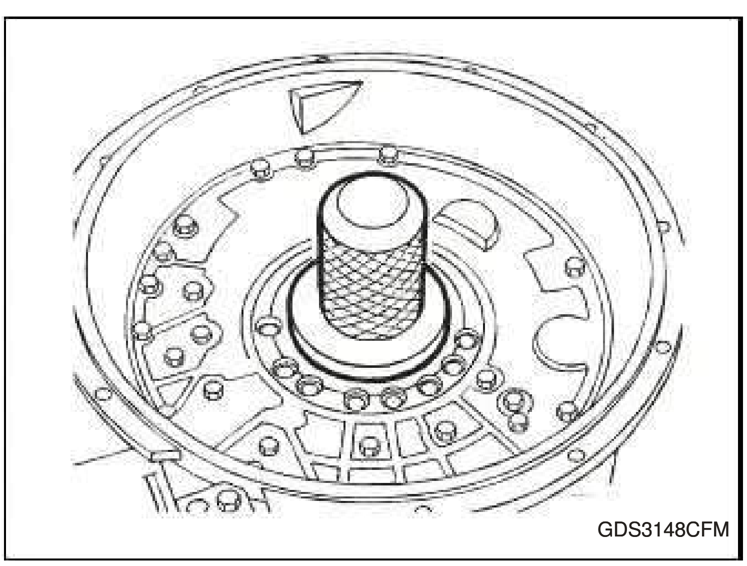


Install oil lines (18 and 21) as shown. Tighten banjo cap screws (19 and 20) to specification.

Install Cover Plate and Auxiliary Drive Gears Specification

Oil Line Banjo Cap Screw Torque - 18 Nm (159 lb-in.)

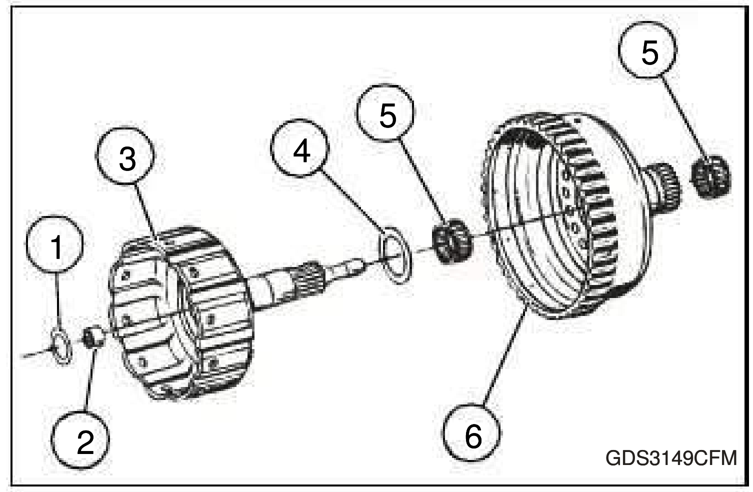
Install clamps and restrainers and tighten.



Apply thin layer of petroleum jelly to inner seal lip and a water soluble lubricant to outer seal edge.

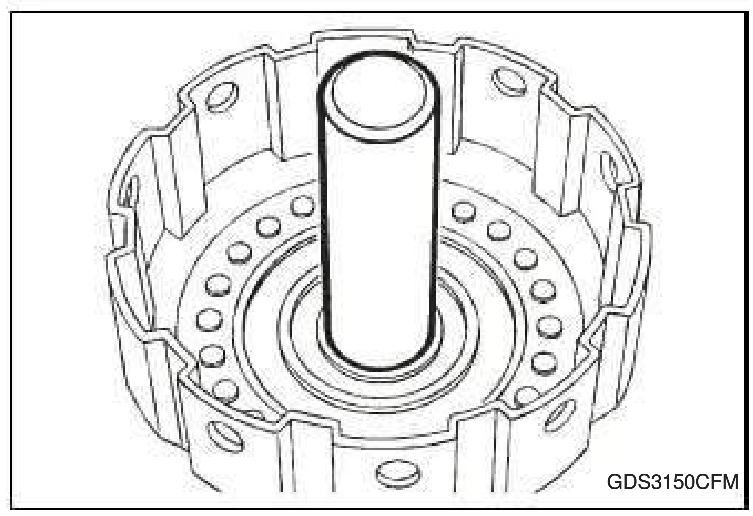
Install seal (17) with 281687 Drift.

Install Clutch C Element



1. Thrust Washer.
2. Needle Bearing.
3. Clutch C Drive Shaft.
4. Thrust Washer.
5. Needle Bearing (2 used).
6. Clutch C Hollow Shaft.

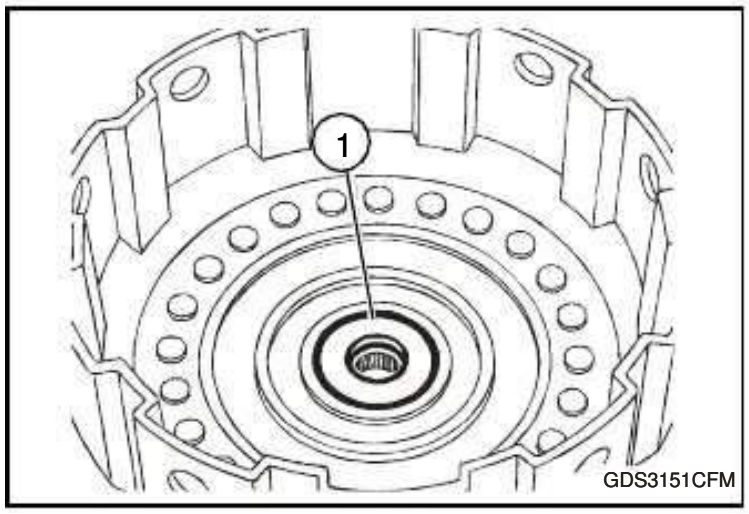
NOTE:Needle bearing (2) must installed with thick edge up and at a depth of 4.5 mμ± 0.5 mm (0.177 ± 0.02 in.).



If removed install needle bearing (2 previous figure) with 281697 Mounting. With thick edge of bearing toward driver, drive bearing to a depth of 4.5 mm ± 0.5 mm (0.177 ± 0.02 in.).

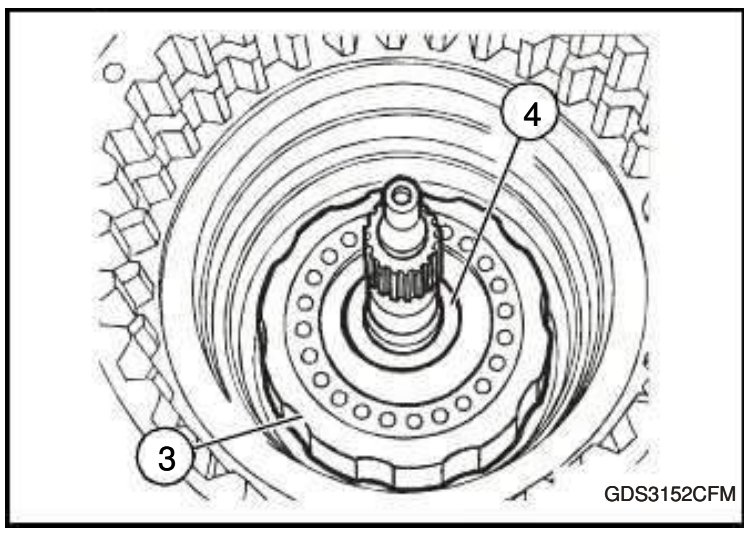
Install Clutch C Element Specification

Clutch C Needle Bearing Depth - 4.5 mm ± 0.5 mm (0.177 ± 0.02 in.)



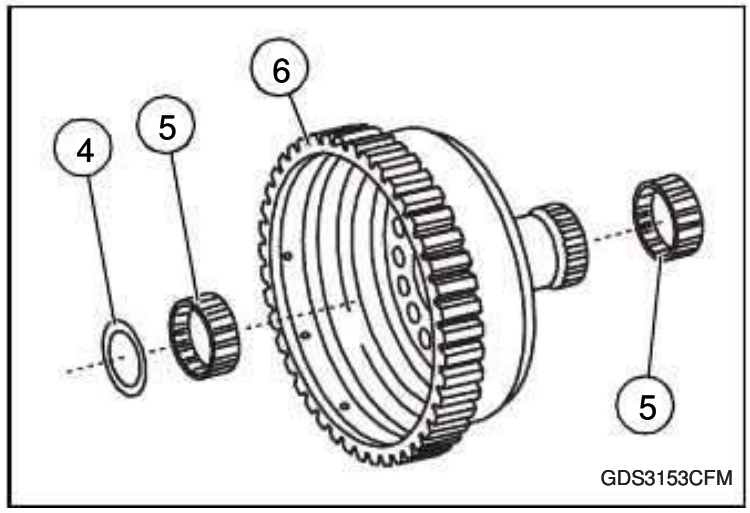
Apply layer of petroleum jelly and position thrust washer (1).

Align clutch A outer plates so teeth are even and centered.

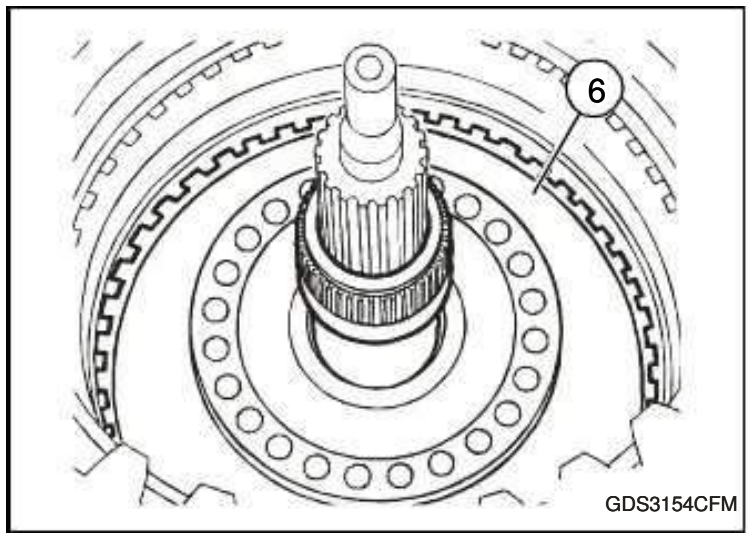


Install drive shaft (3). Ensure contact is made with thrust washer.

Apply petroleum jelly to thrust washer (4) and install.

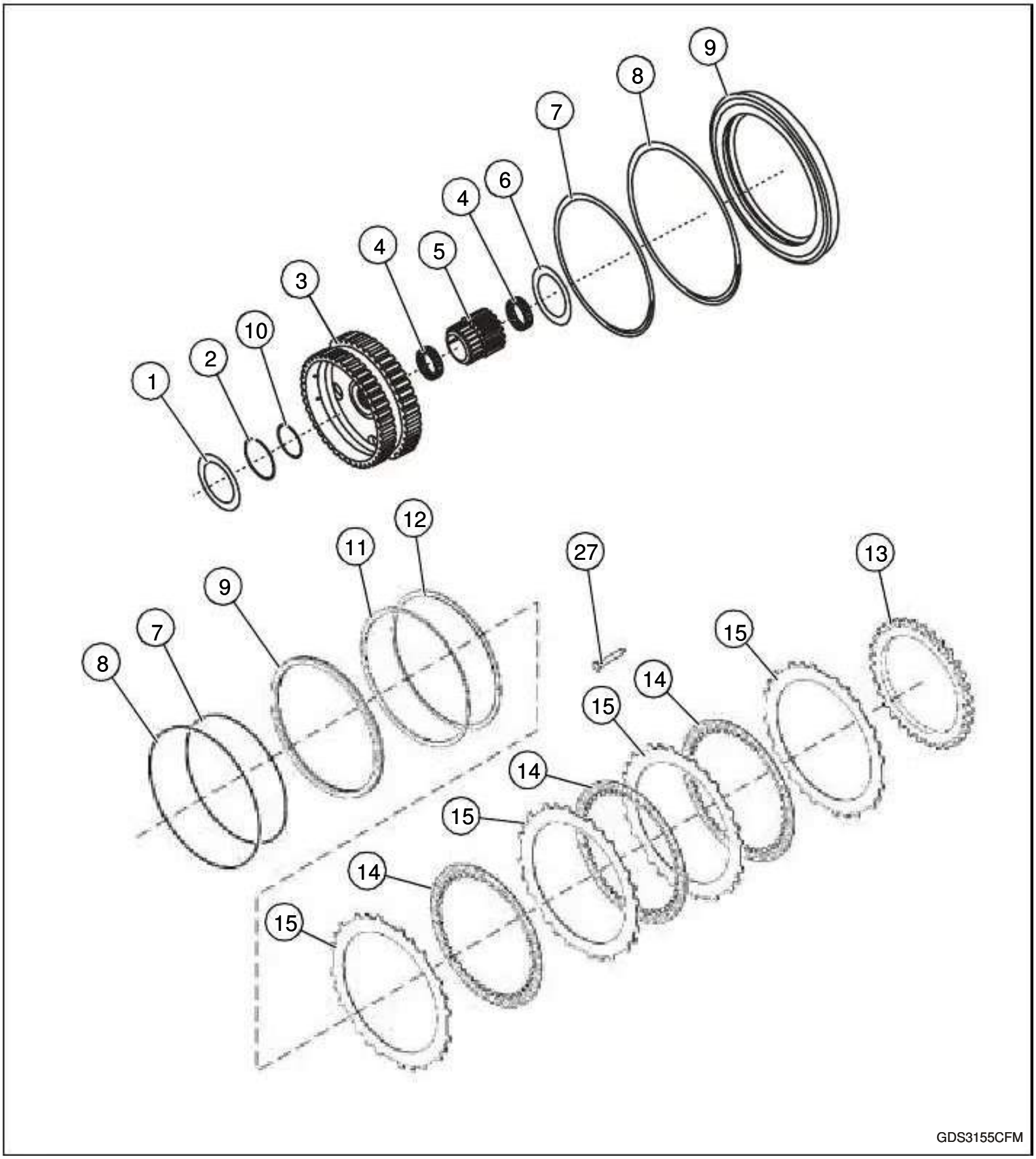


Apply petroleum jelly to needle bearing (5) and install in drive shaft (6).



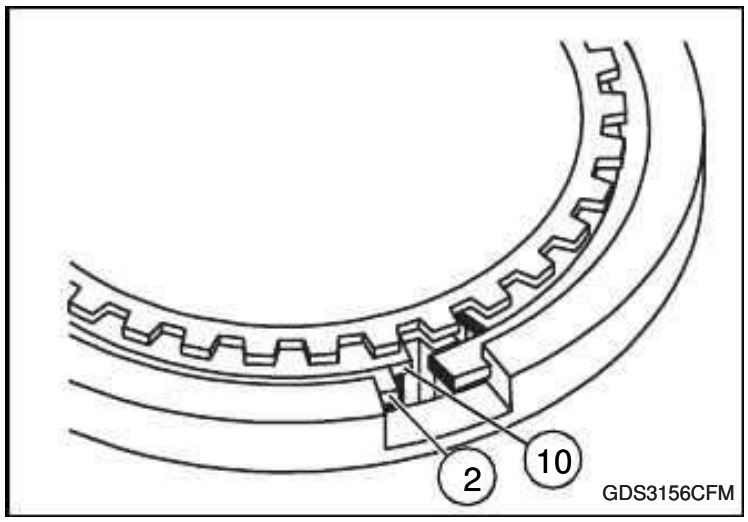
Align inner plates of clutches B and C and install drive shaft (6). Ensure contact with thrust washer.

Install Clutch E Element



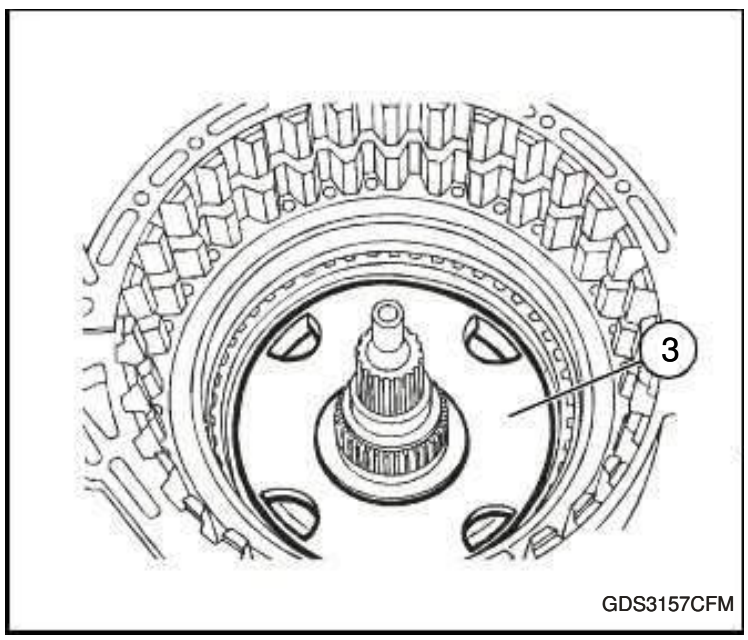
1. Thrust Washer.
2. Snap Ring.
3. Clutch Plate Carrier.
4. Needle Bearing (2 used).
5. Sun Gear.
6. Thrust Washer.
7. Lip Seal Ring.
8. Lip Seal Ring.
9. Clutch E Piston.
10. Snap Ring.
11. Spring Plate Holder.
12. Spring Plate.
13. Thrust Ring.
14. Inner Plate (7 used).
15. Outer Plate (7 used).
27. Pin (8 used).

Apply petroleum jelly to needle bearings (4) and install in sun gear (5).



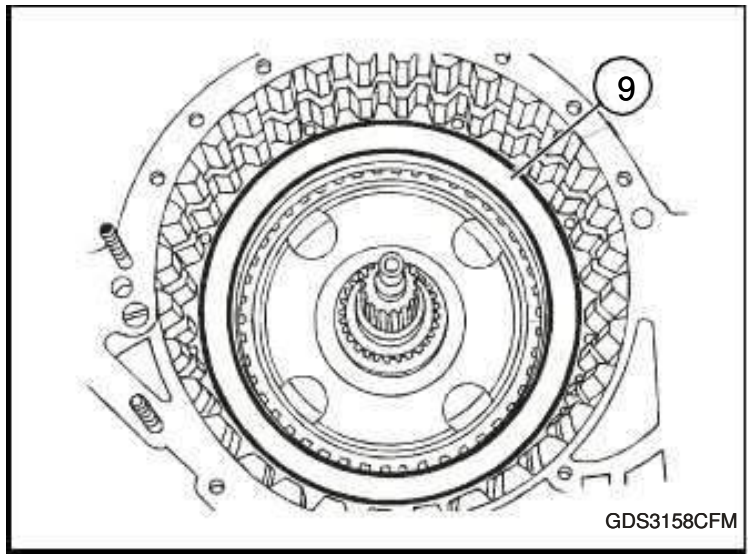
Install sun gear into plate carrier (3) and install snap rings (2 and 10) with ends positioned as shown.

Install thrust washer (1) on plate carrier.



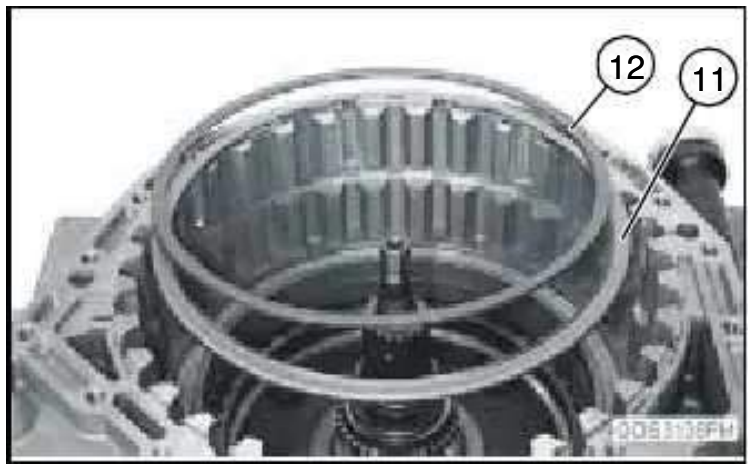
Install plate carrier and ensure needle bearings remain in position. Make sure carrier makes contact with thrust washer.

Apply thin layer of petroleum jelly install thrust washer (3).

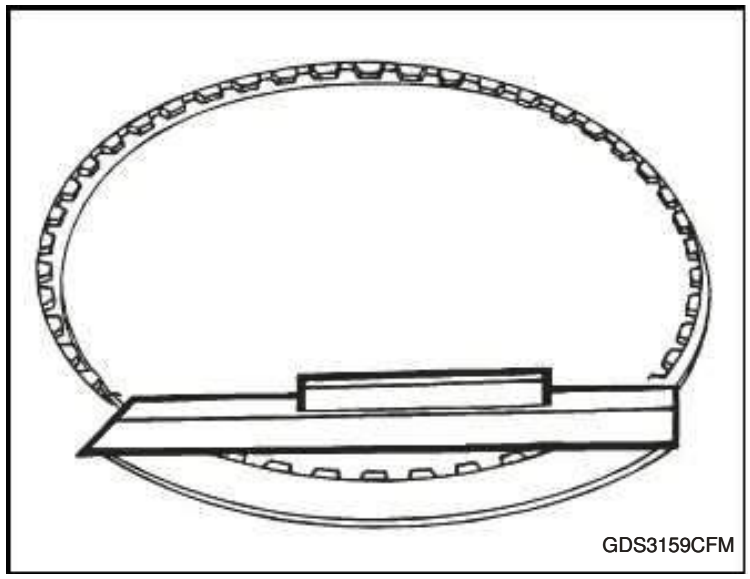


Install lip seal rings (7 and 8) with lip towards pressure side.

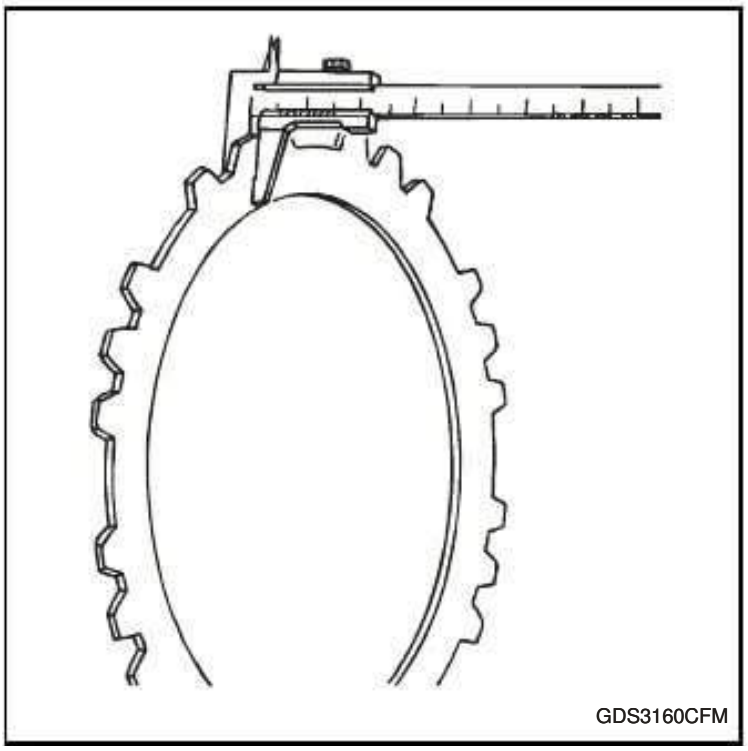
Install clutch E piston (9). Piston must make contact at bottom of piston bore.



Install spring plate holder (11) and spring plate (12).



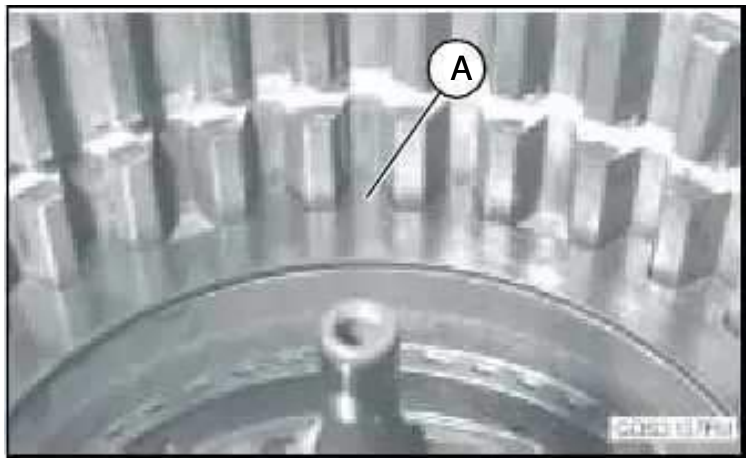
Clutch plates must be straight and flat.



Measure outer clutch plate thickness.

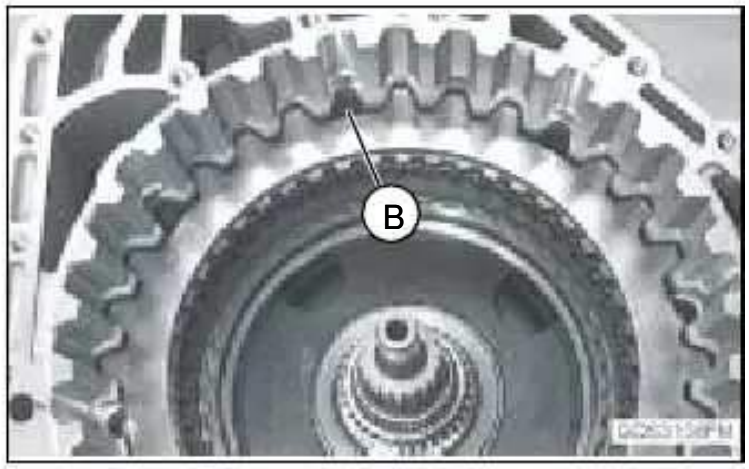
NOTE:First outer plate thickness must measure 3 mm (0.118 in.).

First outer plate must measure 3 mm (0.118 in.).



Install first outer plate and mark housing for center tooth location as shown (A).

Install one inner plate (14).



Install second outer plate with notch at marked location (B).

Install remaining plates (five outer and six inner) in alternating order with outer plate last.

Install thrust ring (13). Slightly lift thrust ring and rotate to position ring under housing teeth.

NOTE:Outer plate (15) is available in 2.0 mm (0.079 in.), 2.5 mm (0.098 in.), and 3 mm (0.118 in.) sizes. Use a combination to adjust clutch E clearance.

With feeler gauge measure clutch E clearance at multiple locations and calculate average clearance.

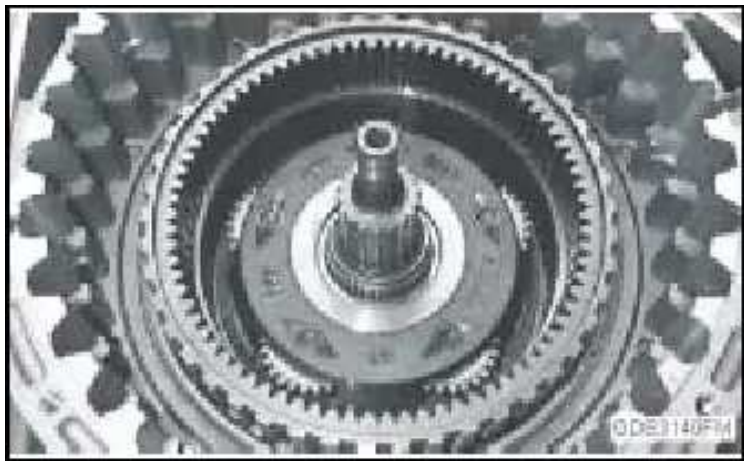
Install Clutch E Element Specification

Clutch E Plate Clearance - 2.8 - 3.3 mm (0.110 - 0.130 in.)

Use combination of outer plate (13) sizes to adjust clearance.

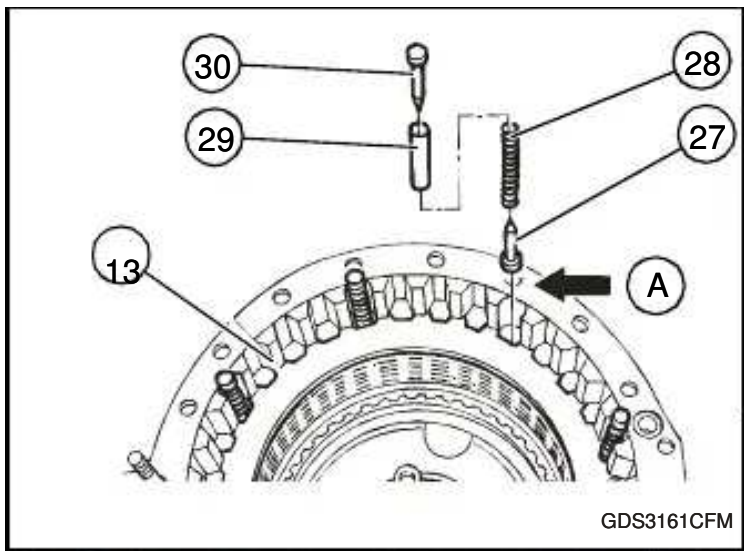
With clearance obtained remove complete clutch E clutch plate pack.

Install Planetary One and Two



Install planetary one carrier using DFT1238 Transmission Planetary Lifting Tool. Ensure contact with thrust washer.

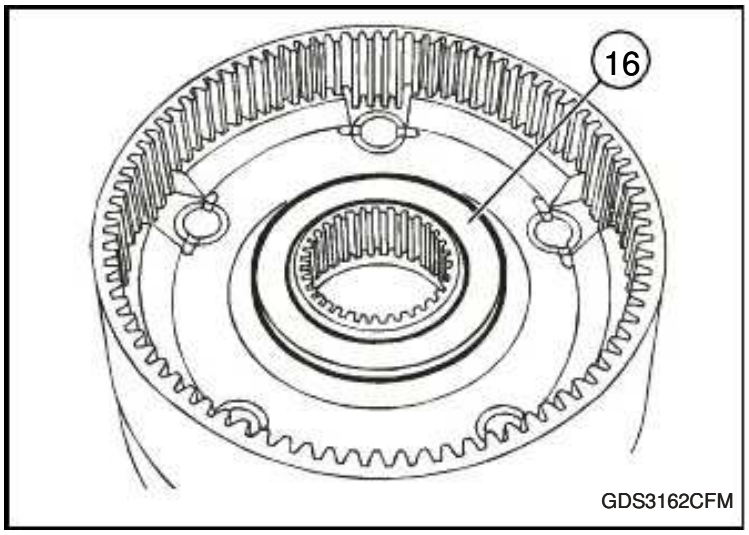
Install clutch E plate pack with 3 mm (0.118 in.) outer plate first, as previously described.



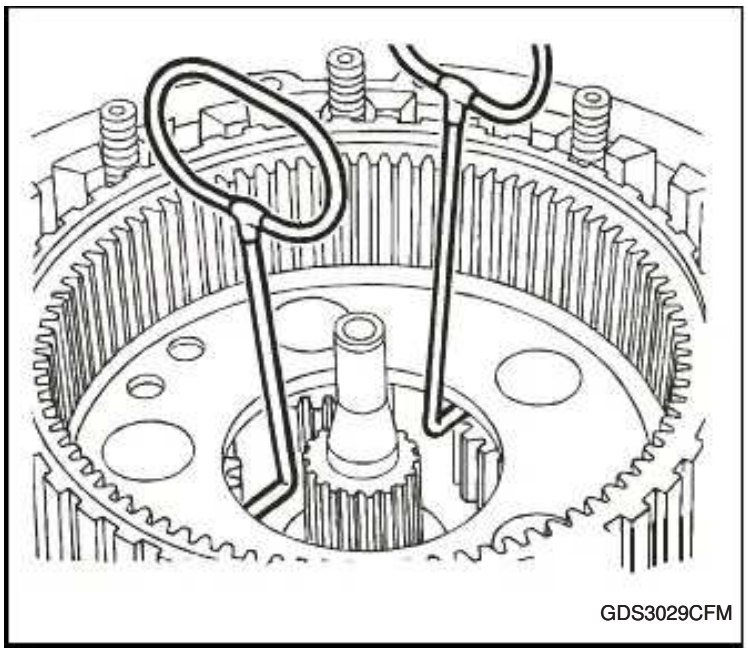
Install thrust ring (13) locating round recesses with outer plate notch.

Install parts (27 - 30) at recesses (A) with long bevel side of guide tube up.

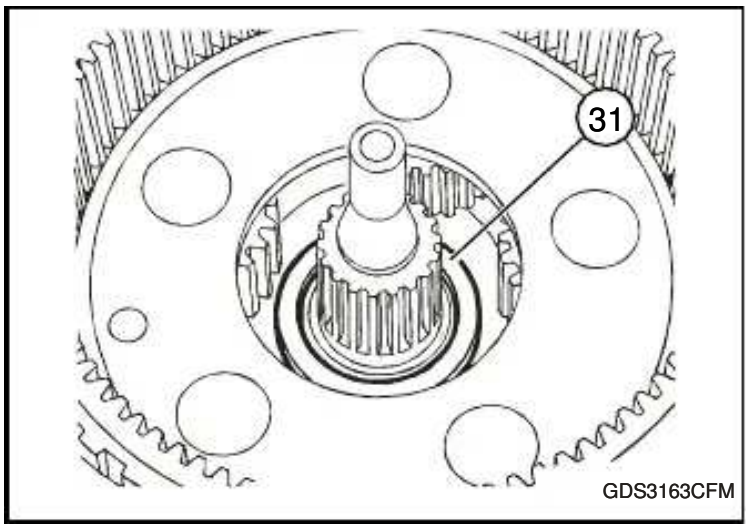
Install Intermediate Housing and Clutch Element



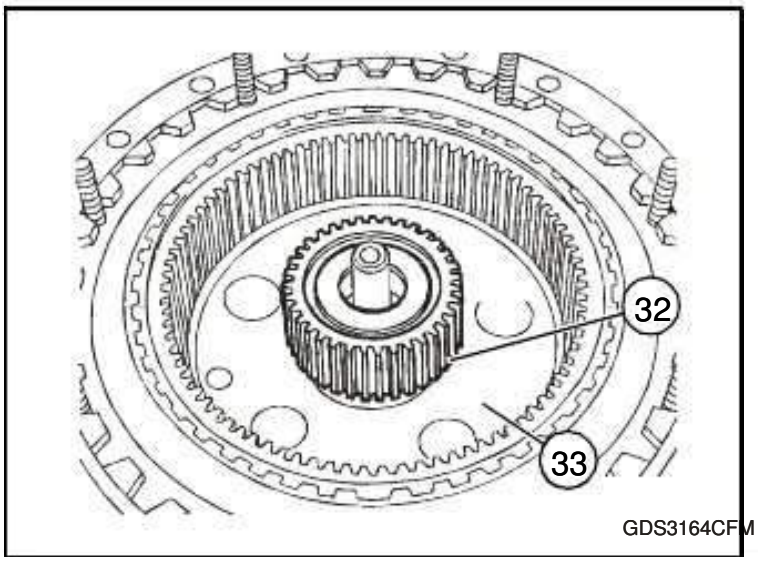
Apply petroleum jelly to thrust washer (16) and position on planetary two carrier.



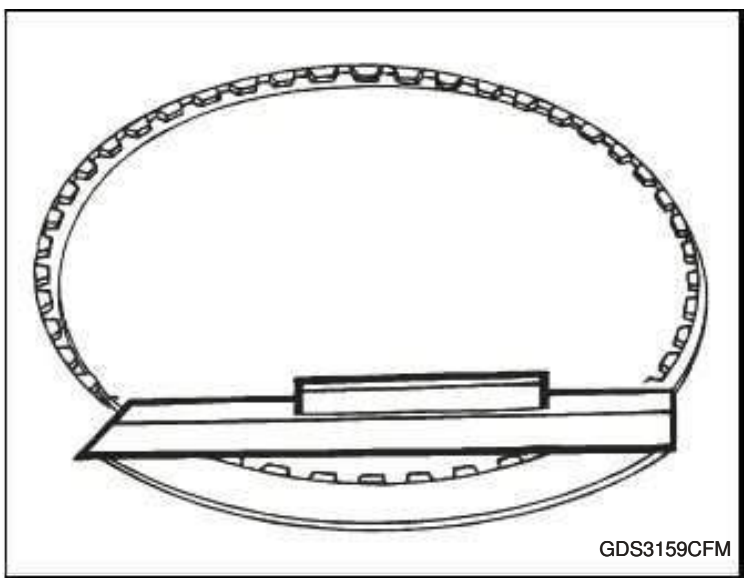
Install planetary two carrier. Ensure thrust washer remains in position and makes contact with planetary one.

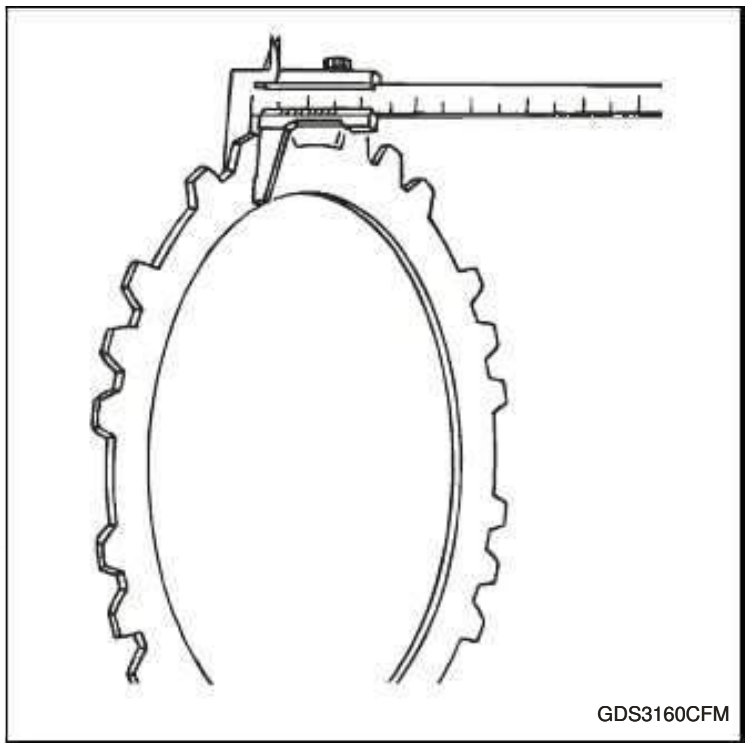


Install thrust washer (31).



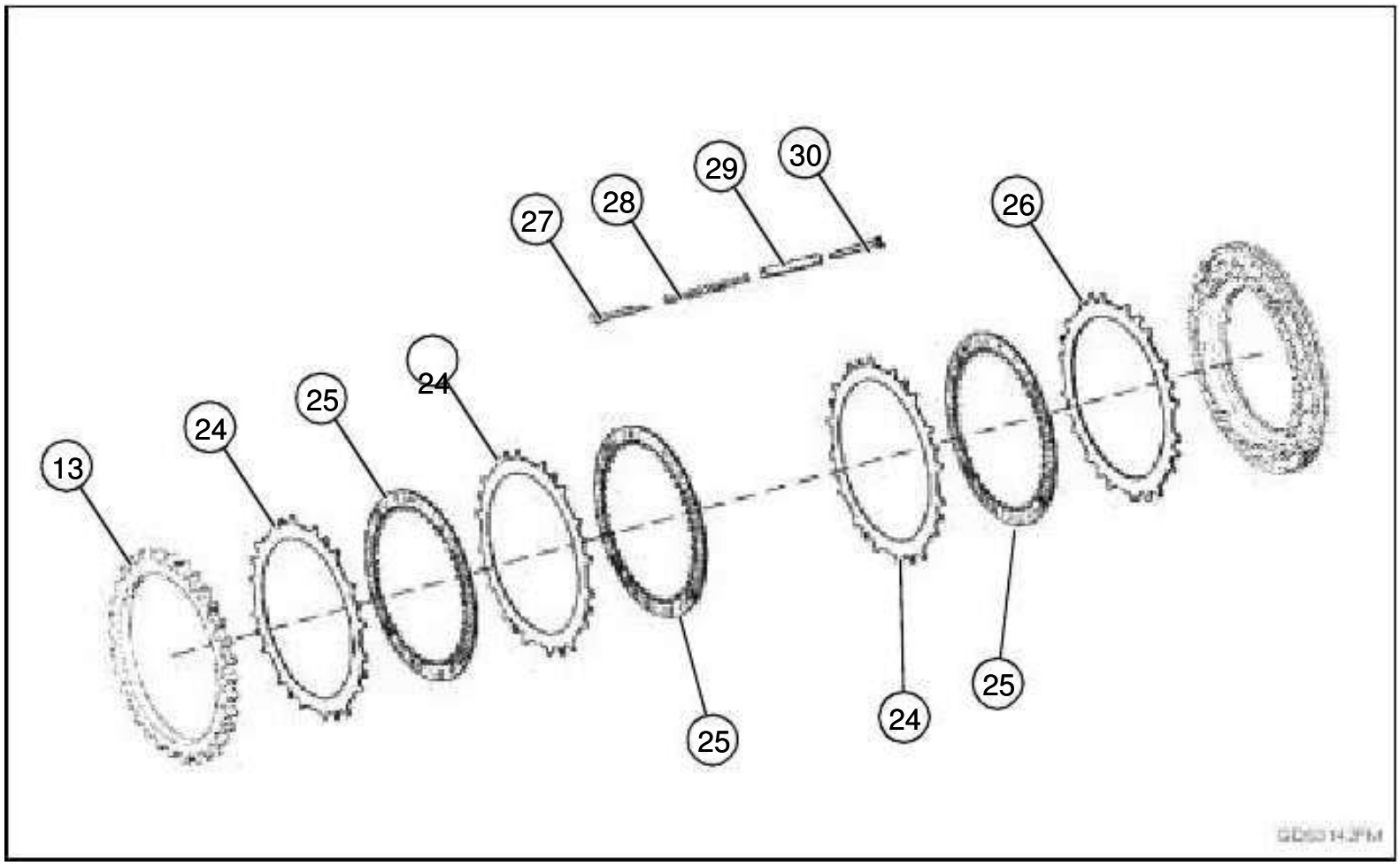
Install sun gear (32), and thrust washer (33).





Measure first outer clutch F plate thickness.

Clutch plates must be straight and flat.



13. Clutch F Thrust Ring.
24. Outer Plate (6 used).
25. Inner Plate (7 used).
26. End Plate.
27. Pin (8 used).
28. Spring (8 used).
29. Guide Tube (8 used).
30. Pin (8 used).

End plate must measure 3 mm (0.118 in.) .

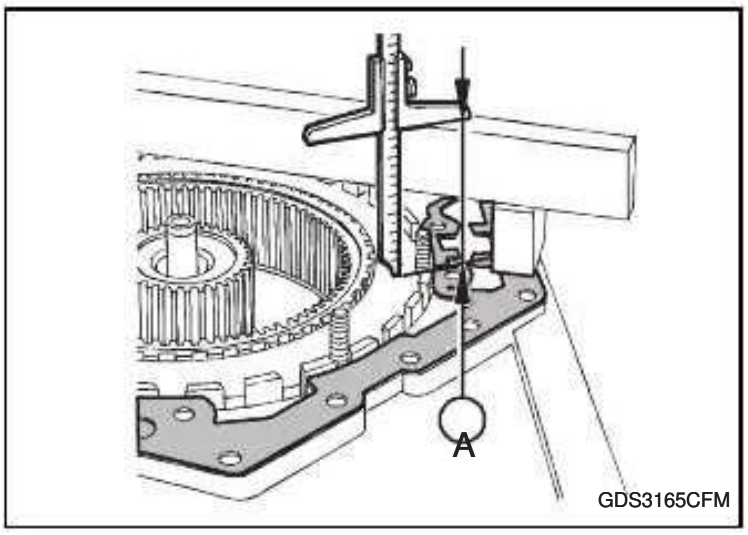
Install first outer plate with notches located at spring pins.

Install remaining plates in alternating order with inner plate last.

NOTE: End plate (26) teeth are larger than outer plates.

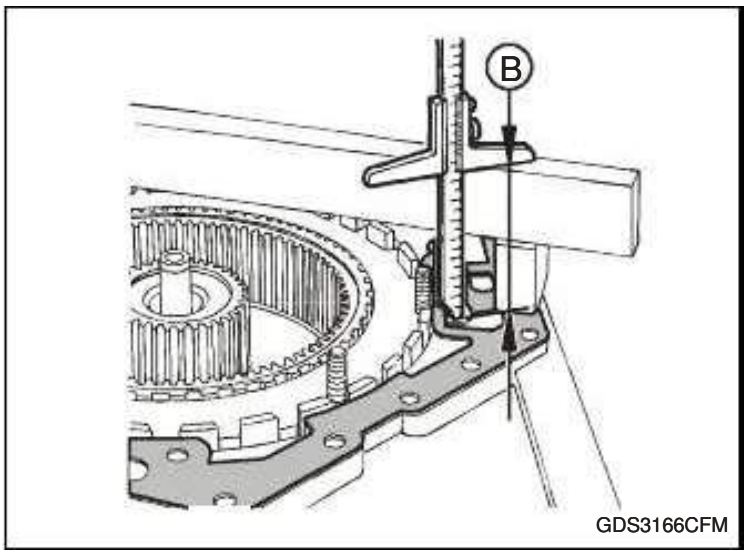
Measure thickness of end plate (26) and install. End plate has larger teeth and must measure 3 mm (0.118 in.) thick.

Place gasket into position on transmission housing.



With caliper and measuring blocks measure clutch F end plate height at multiple locations.

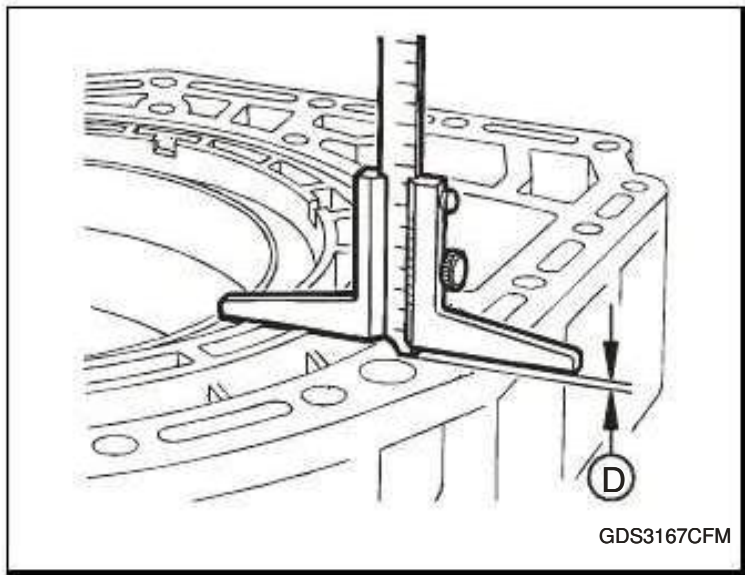
Calculate average and record as dimension (A).



Measure distance to gasket in several locations. Calculate average and record as dimension (B).

Subtract dimension (B) from dimension (A) and note as dimension (C). (A-B) = C

Insert clutch F piston without seals and measure distance from edge of piston to transmission housing without gasket at several locations.



Calculate average piston height and record as dimension (D).

To calculate plate clearance subtract dimension D from dimension (C). (C-D) = clutch plate clearance

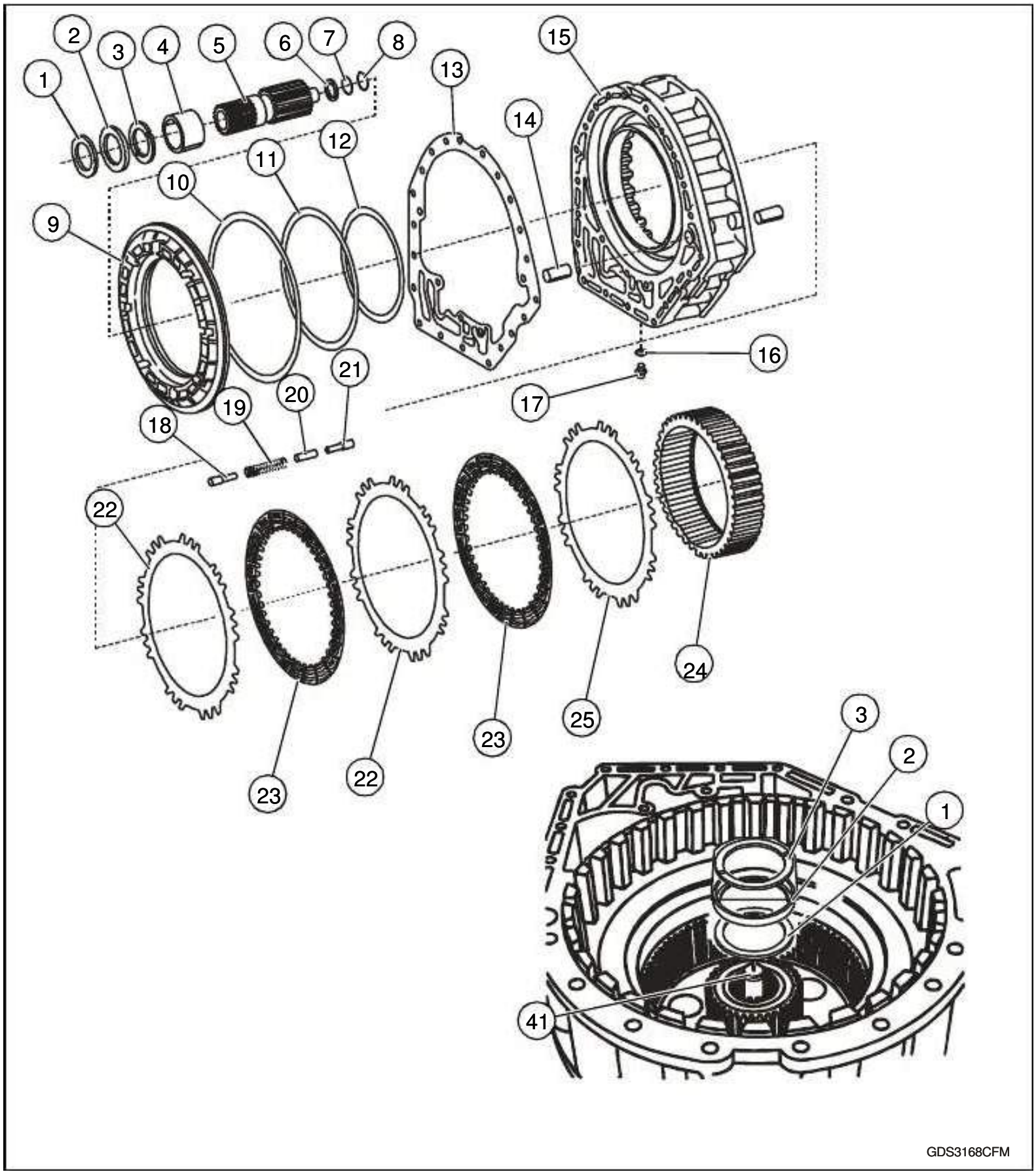
NOTE: Outer plate (24) is available in 2.0 mm (0.079 in.), 2.5 mm (0.098 in.), and 3 mm (0.118 in.) sizes. Use a combination to adjust clutch F clearance. Last outer plate (26) is 3 mm (0.118 in.) and should not be used to adjust clearance.

Combine different sizes of outer plate (24) to adjust clearance.

Specification

Clutch F Plate Clearance - 3.2 - 3.7 mm (0.126 - 0.146 in.)

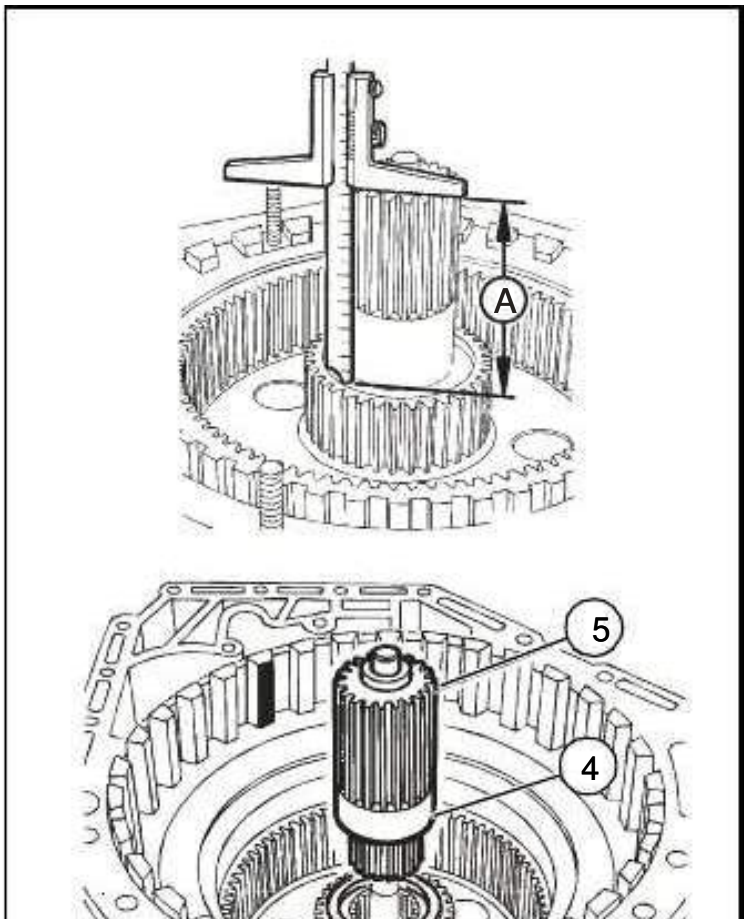
Remove clutch F piston.



1. Shim.
2. Angle Ring.
3. Split Ring.
4. Inner Ring.
5. Sun Gear Shaft.
6. Thrust Needle Bearing.
7. Thrust Washer.
8. Shim.
9. Clutch F Piston.
10. Lip Seal.
11. Rectangular Seal.
12. Rectangular Seal.
13. Gasket.
14. Dowel Pin (2 used).
15. Intermediate Housing.
16. Seal Ring.
17. Plug.
18. Guide Pin (8 used).
19. Spring (8 used).
20. Guide Tube (8 used).
21. Guide Pin (8 used).
22. Outer Plate (9 used).
23. Inner Plate (9 used).
24. Ring Gear.
25. End Plate.
41. Spacer.

Install spacer (41) on clutch C shaft.

Install parts (2 - 4) with sun gear (5) without shim (1).



Measure distance (A) from end face of sun gear shaft (5) to contact face of sun gear.

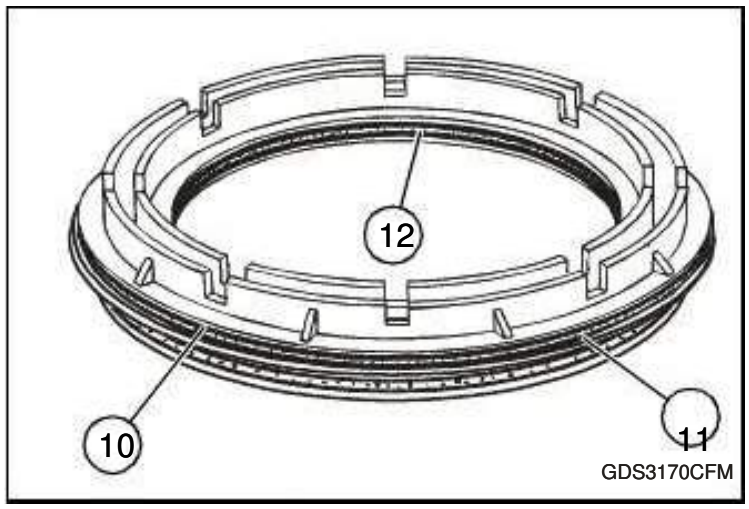
Raise sun gear to contact sun gear shaft and measure again. Note as dimension B.

To calculate sun gear end play subtract dimension (B) from dimension (A). (A-B) = sun gear end play.

Install Intermediate Housing and Clutch Element Specification

Intermediate Housing Sun Gear End Play 0.4 - 0.6 mm (0.016 - 0.024 in.)

Select correct size shim (1) to adjust sun gear end play.



Install seals (11 and 12).

Install lip seal (10) with sealing lip towards pressure side.

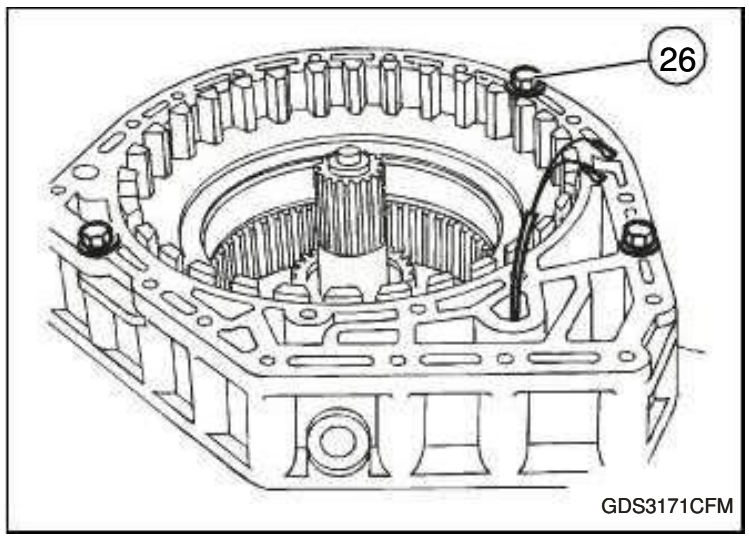
Install clutch F piston.

Position gasket (14) and dowel pin (13) in transmission housing.

⚠ CAUTION

Use wide washer or shim on sealing surface of intermediate housing to prevent damage.

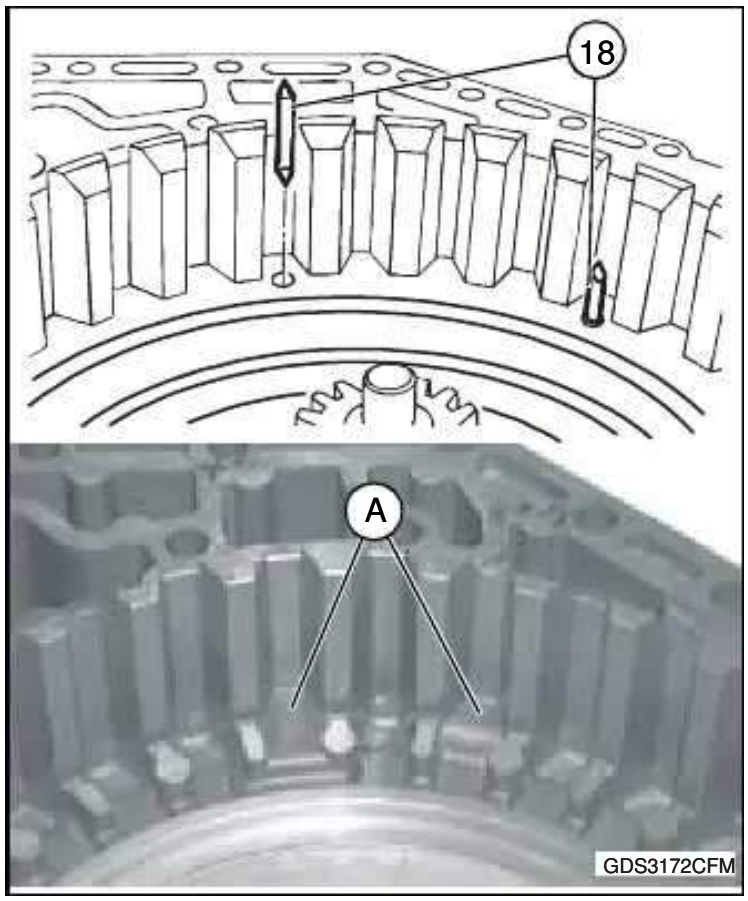
Position intermediate housing and hold in place with three equally space bolts with washers.



Install speed sensor harness through housing.

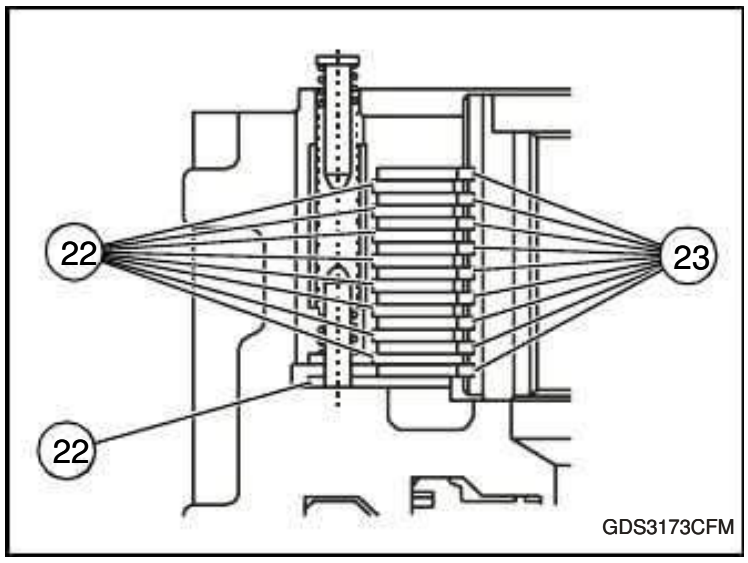
Use straight edge to make sure plates are flat.

Position and install first outer plate (22). Guide pin bore should not be located over a raised area (A) in intermediate housing.



Install guide pins (18) in bores of first outer plate.

Install ring gear.

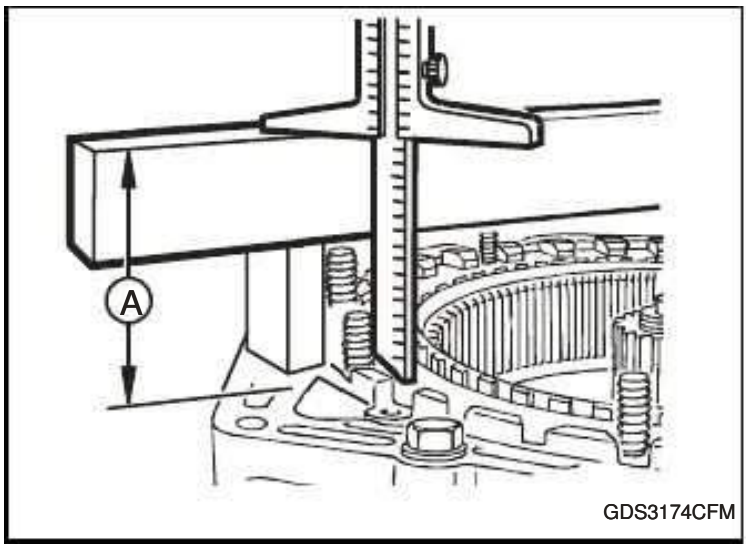


Install one inner plate (23).

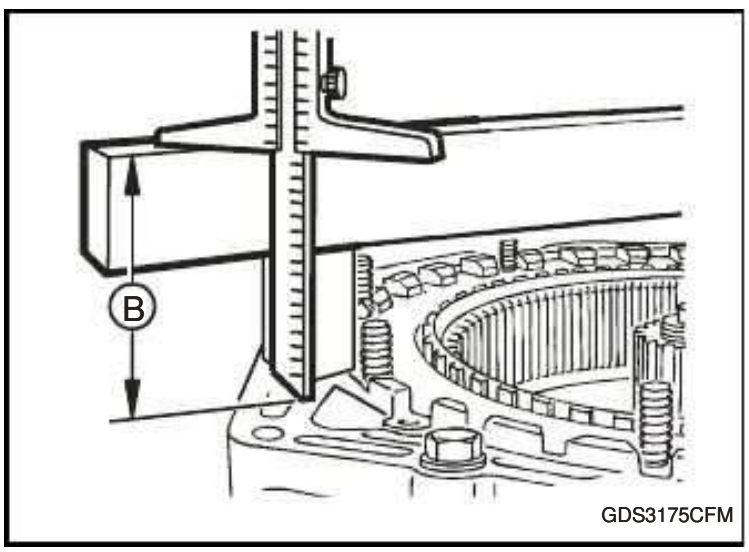
Install second outer plate with notch at guide pin location.

Install remaining plates in alternating order ending with inner plate.

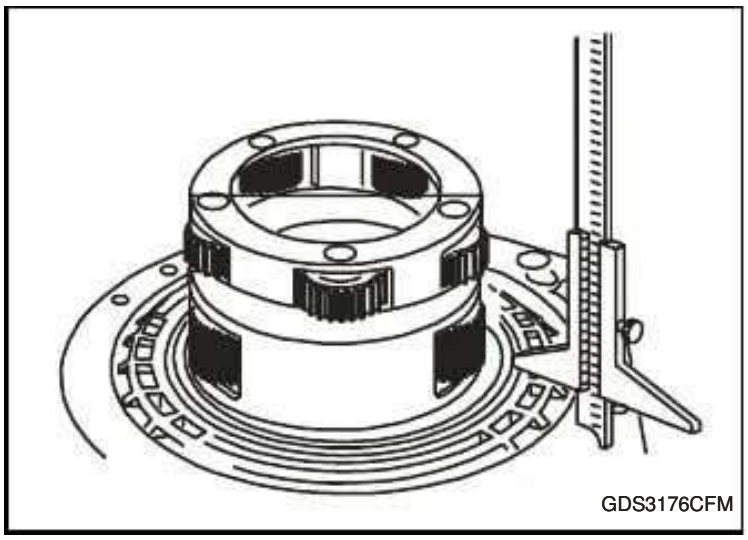
Install end plate (25).



Using measuring blocks measure clutch G end plate height at several locations. Calculate average height and record as dimension (A).



Using same measuring blocks measure to intermediate housing at several locations and calculate average height. Record as dimension (B).



Calculate clutch G clearance. Subtract dimension (B) from dimension (A) which equals (C) plate stack height. (A-B) = C

Position gasket on output end cover and with clutch G piston bottomed in bore measure piston height at several locations.

Calculate average piston height and record as dimension (D).

Subtract dimension (D) from dimension (C) which equals clutch G plate clearance. (D-C) = G clutch plate clearance.

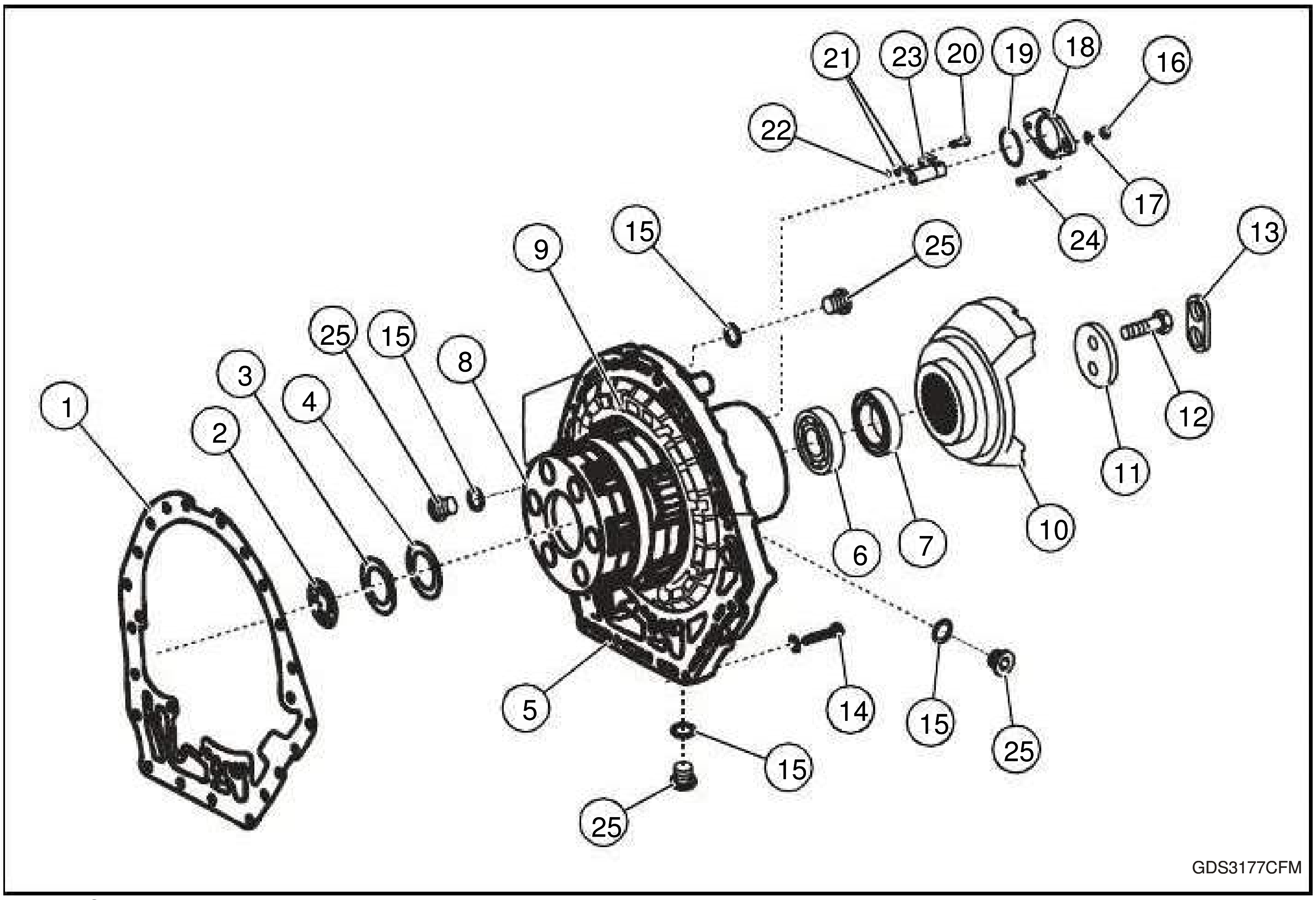
NOTE: Outer plate (22) is available in 2.0 mm (0.079 in, and 2.5 mm (0.098 in.) sizes. Use a combination to adjust clutch G clearance.

Combine different sizes of outer plate (22) to adjust clearance.

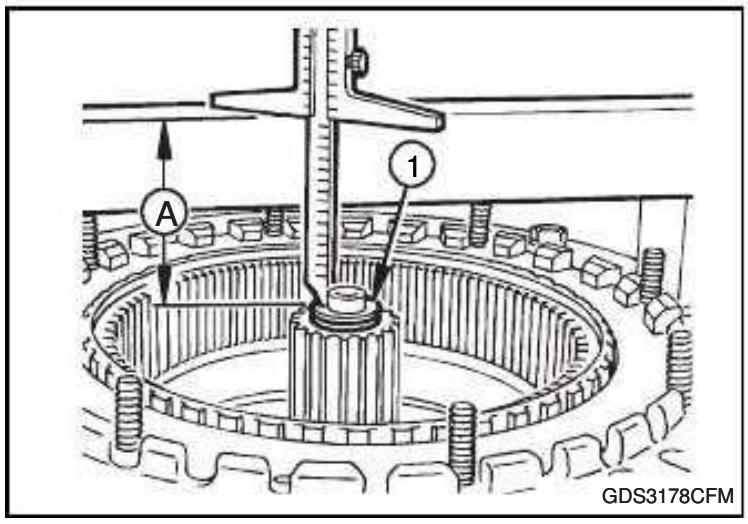
Install Intermediate Housing and Clutch Element Specification

Clutch G Plate Clearance- 3.6 - 4.1 mm (0.142 - 0.161 in.)

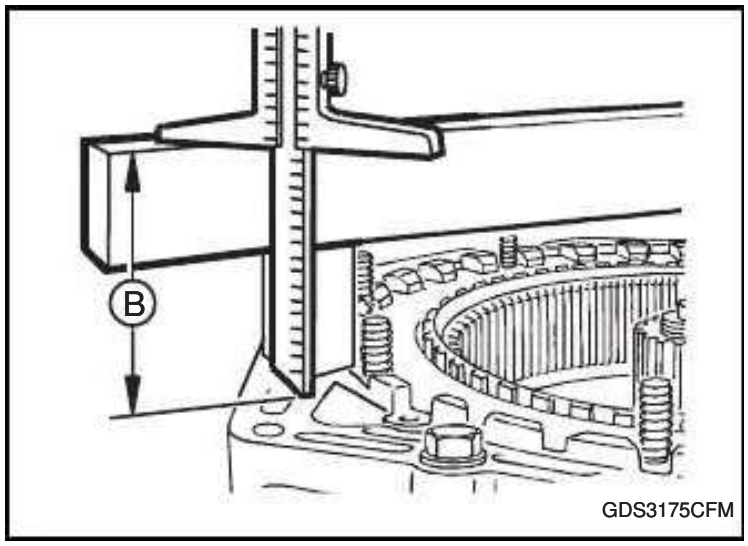
Output Planetary and Clutch Element



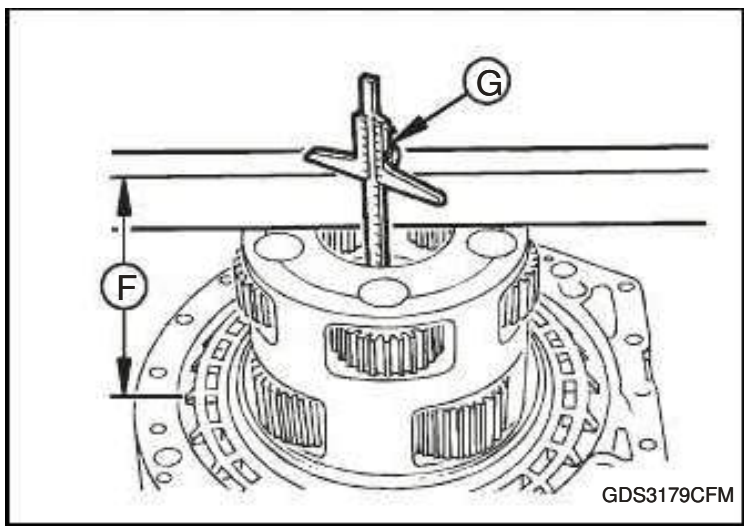
1. Gasket.
2. Needle Bearing.
3. Shim.
4. Shim.
5. Output Cover.
6. Bearing.
7. Seal.
8. Planetary Carrier.
9. Clutch G Piston.
10. Output Flange.
11. Retainer Plate.
12. Bolt (2 used).
13. Lock Plate.
14. Bolt.
15. O-Ring (3 used).
16. Nut (2 used).
17. Washer (2 used).
18. Speed Sensor Cover.
19. O-Ring.
20. Cap Screw.
21. Shim (s).
22. O-Ring.
23. Speed Sensor.
24. Stud (2 used).
25. Plug (3 used).



With intermediate housing secured, use measuring blocks and measure sun gear height with needle bearing and thrust washer (1) in place. Record as dimension (A).



With measuring blocks measure intermediate housing without gasket at several locations and calculate average. Record as dimension (B).



Subtract Dimension (A) from dimension (B). Record as dimension (C). (B-A) = C

Position gasket on output housing and measure output planetary carrier height at several locations. Calculate average height and record as dimension (F).

With measuring block on planetary carrier measure thrust washer surface height and record as dimension (G).

Calculate correct shim size (H).

Subtract dimension (F) from (G) and note as dimension (D). (G-F) = F

Subtract dimension (C) from dimension (D) and note as dimension (E). (D-C) = E.

Subtract sun gear end play specification average 0.5 mm (0.020 in.) from dimension (E). Record as shim size (H). (0.5 mm (0.002 in.) - E) = H shim size.

Output Planetary and Clutch Element Specification

Sun Gear End Play - - 0.4 - 0.6 mm (0.016 - 0.024 in.)

Use combination of two shim sizes for end play adjustment.

Install needle bearing and shims on sun gear.

Remove three cap screws holding intermediate housing and install gasket.

Attached DFT1231 Output Assembly Lifting Bracket to output shaft.

Using guide pins lower output planetary cover and guiding speed sensor harness through housing. Planetary gears must align and mesh with sun gear.

Tighten cap screws in a side to side cross pattern to specification.

Output Planetary and Clutch Element Specification

Output Planetary Cover Torque - - - - - 46 Nm (34 lb-ft)

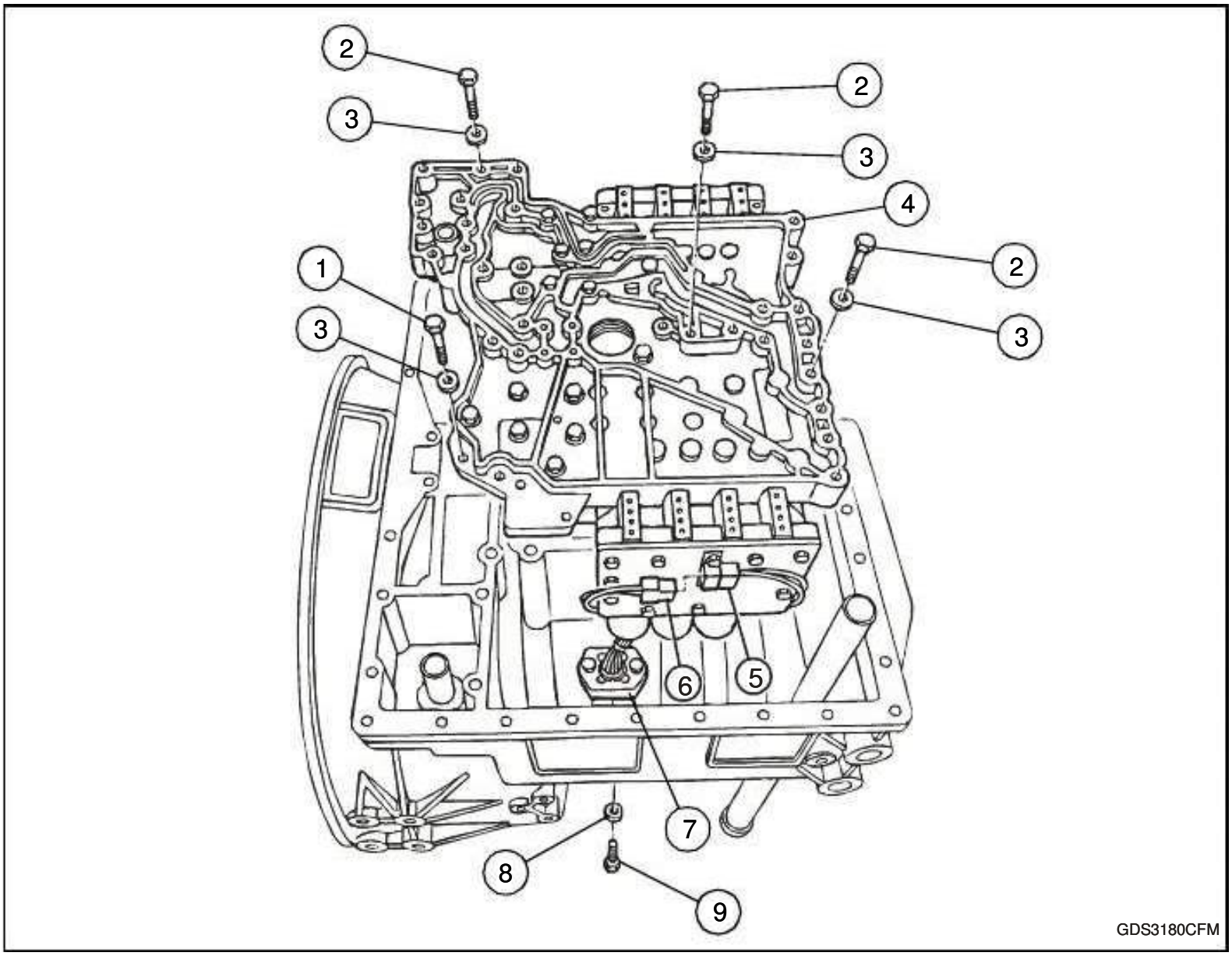
Install flange (9) and retainer plate (11) with bevel edge out. Tighten cap screw.

Output Planetary and Clutch Element Specification

Output Yoke Torque - - - - - - - - - - - - - 60 Nm (44 lb-ft)

Install new lock plate (13) with 281683 Punch.

Install Oil Pan and Control Valve



1. Bolt (9 used).
2. Bolt (30 used).
3. Washer (30 used).
4. Control Module Assembly.
5. Control Module Connector.
6. Output Sensor Connector.
7. Transmission Connector X-171.
8. Washer (2 used).
9. Bolt (2 used).

Install Transmission Connector X-171.

Install Oil Pan and Control Valve Specification

Transmission Connector X-171 Torque - 23 Nm (204 lb-in.)

Position control module and install cap screws (1 and 2) hand tight.

Tighten bolts starting in center and proceed to outer edge.

Install Oil Pan and Control Valve Specification

Control Module Torque - - - - - - - - - 23 Nm (204 lb-in.)

Connect wire harness (5 and 6).

Install Oil Pan and Control Valve Specification

Speed Sensor Plug Torque 90 - 100 Nm (66 - 74 lb-ft)

Do speed sensor adjustment. **(See “Input Speed Sensor Adjustment” on page 152)**

Wrap oil filler pipe with sealing tape and install if removed.

Measure and adjust oil filler pipe height and tighten lock nut.

Install Oil Pan and Control Valve Specification

Oil Filler Pipe Length - - - - - - - - - - - -40 mm (1.575 in.)

Install Oil Pan and Control Valve Specification

Oil Filler Pipe Jamb Nut Torque - - - - - 80 Nm (59 lb-ft)

Install oil pan and gasket.

Install Oil Pan and Control Valve Specification

Oil Pan Torque 23 Nm (204 lb-in.)

Apply thin layer of petroleum jelly to filter O-ring and filter cover O-ring. Install filter and cover.

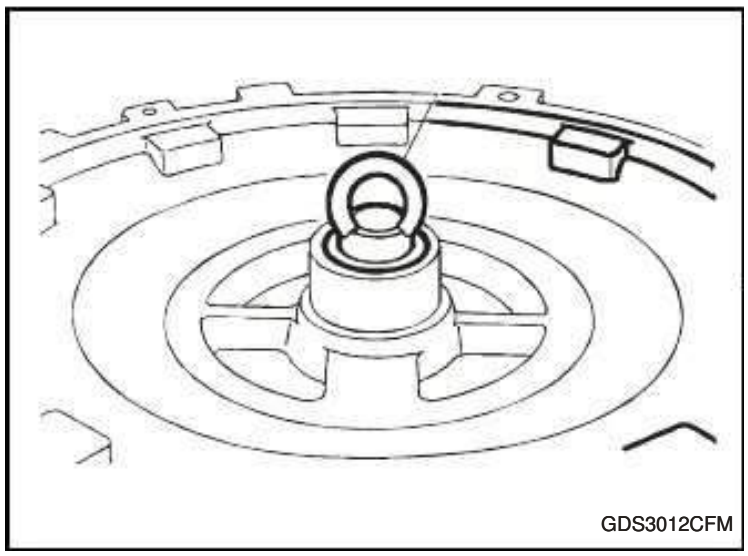
Install Oil Pan and Control Valve Specification

Oil Filter Cover Torque - - - - - - - - - 23 Nm (204 lb-in.)

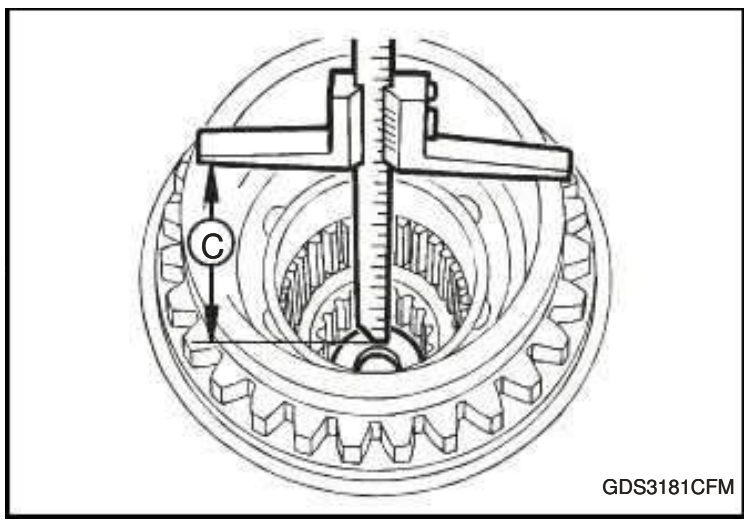
Install Torque Converter

⚠ CAUTION

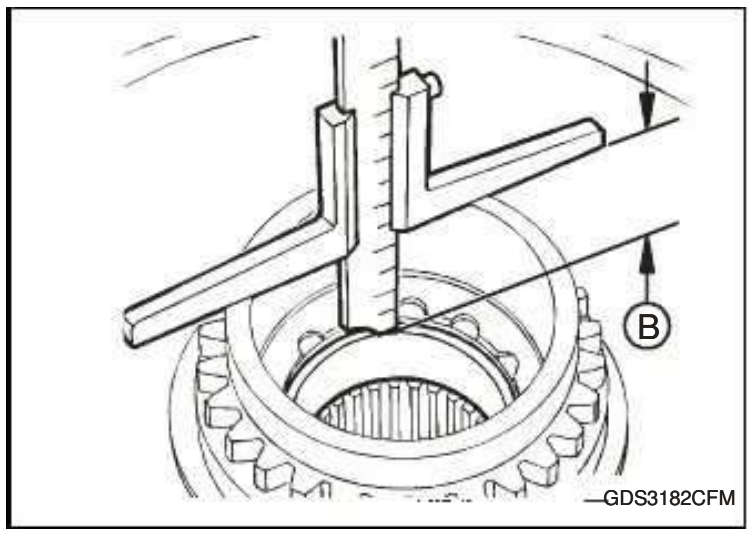
Approximate weight of Torque Converter is 60 kg (132 lb).



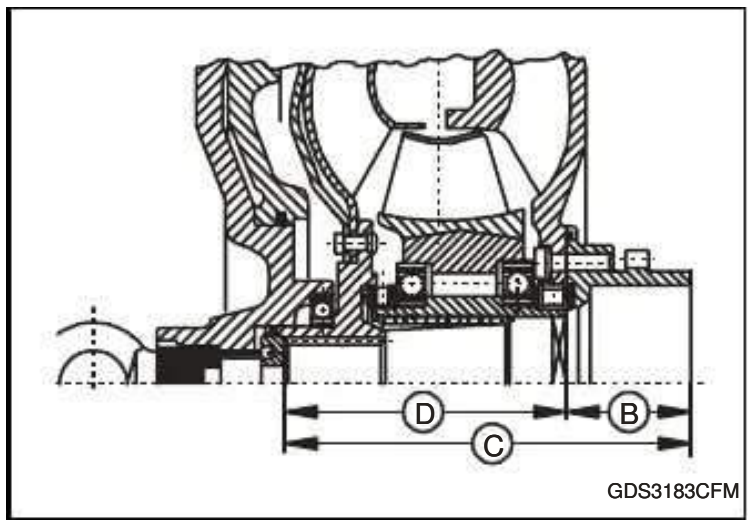
Install 281696 Lifting Device to secure turbine wheel in converter.



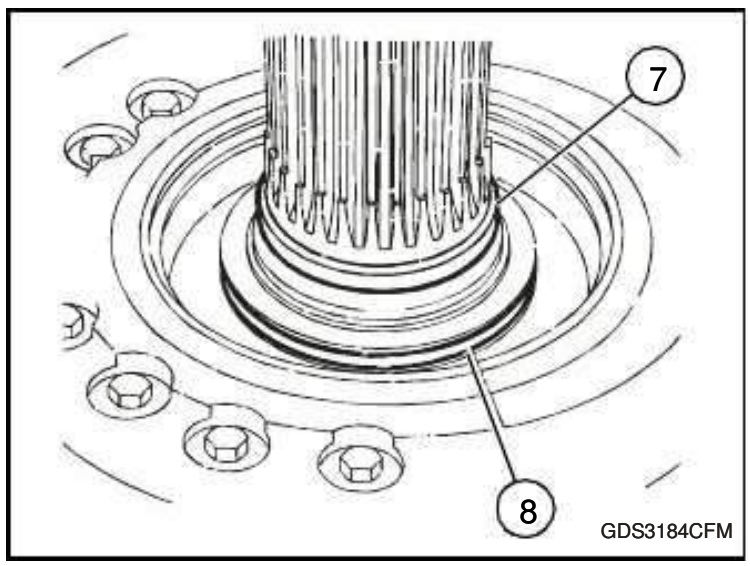
With converter hub up, measure distance from face of spur gear to turbine gear shoulder (C). Record as measurement C.



Measure distance from spur gear face to one-way roller clutch ring face (B). Record as measurement B.

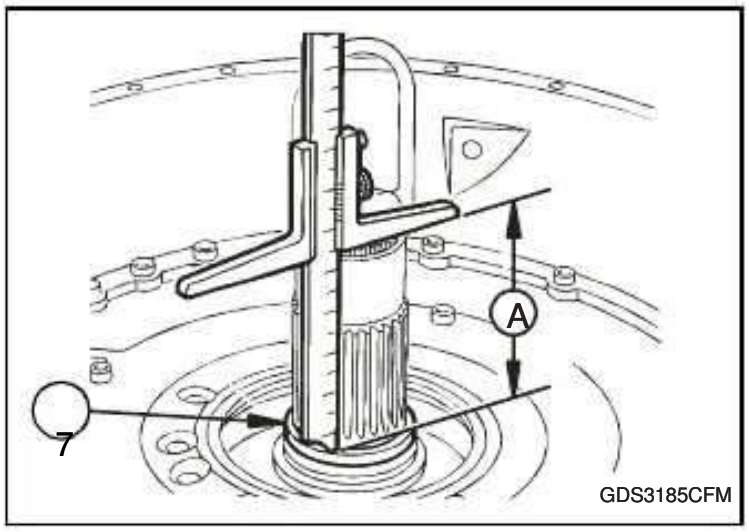


Calculate distance (D) and record. (C-B) = D



Inspect and install ring (8) on stator shaft with ends locked.

Position spacer (7) to remove axial movement in stator shaft.



Install 281710 Lifting Device by hand to remove turbine shaft end play.

With depth gauge measure distance (A) from end turbine shaft to face of spacer (7) and record.

Remove lifting eye.

Calculate turbine shaft length E. (D-A) = E.

Calculate size of shim (S).

Turbine shaft length (E) must be added to torque converter end play tolerance (G) to determine correct shim size. (E+G) = S.

Install Torque Converter Specification

Torque Converter Floating Tolerance G End Play - - - - - - - - - - - - - - - - - - -0.3 - 0.4 mm (0.012 - 0.016 in.)

⚠ CAUTION

Dimension G must be added to E or bearing will be damaged.

NOTE: A thicker shim allows more end play.

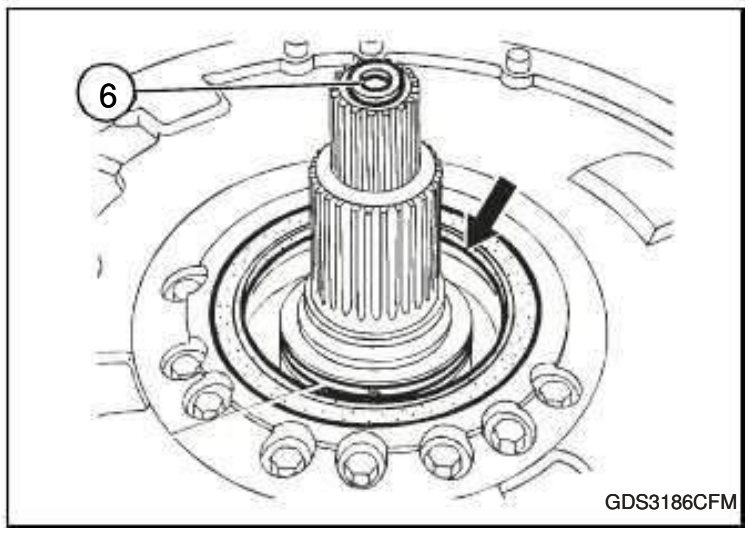
Torque converter shims are available in .01 mm (0.004 in.) increments from 1.0 mm (0.039 in.) to 2.6 mm (0.102 in.).

Calculation Example:

(C-B) = D (174.7 mm - 55.2 mm) = 119.5

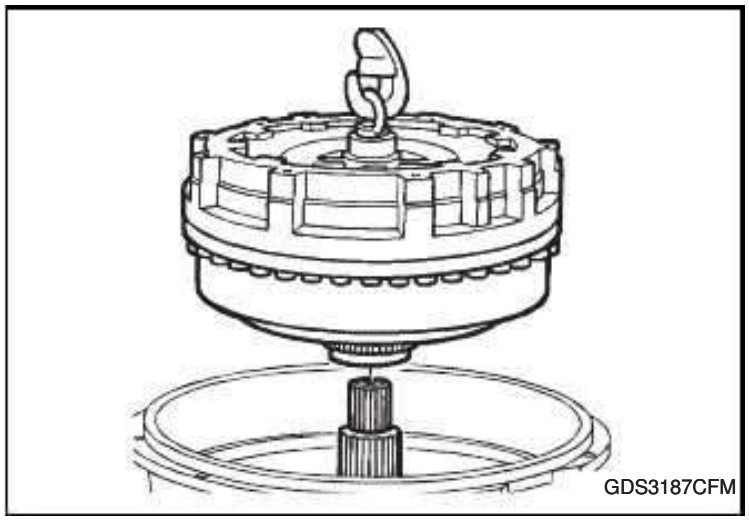
(D-A) = E (119.5 mm - 118.3 mm) = 1.2

(E+G) = S (1.2 mm + 0.35 mm) = 1.55 mm



Apply thin layer of petroleum jelly to shim and position at center of turbine shaft (6).

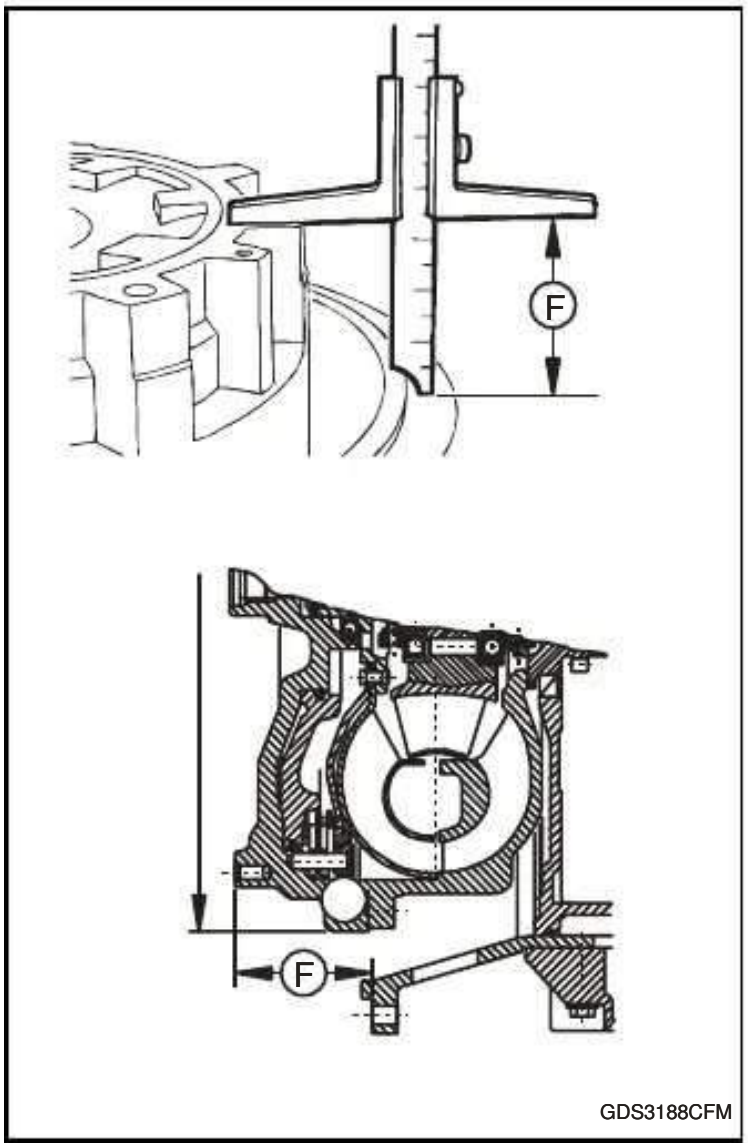
Apply thin layer of transmission oil to seal at arrow.



Install 281696 Lifting Device to converter and lower converter into position. Rotate converter slightly to ensure engagement of turbine shaft, stator, and pump drive gear.

⚠ CAUTION

Converter must be positioned correctly before converter cap screw is installed.



Loosen lifting eye one turn and measure converter height (F) ±0.05 mm (0.002 in.). See table to determine if converter height is correct.

Specification

Torque- - - - - - - - - - - - - - - - - - - 86.25 mm (3.396 in.)

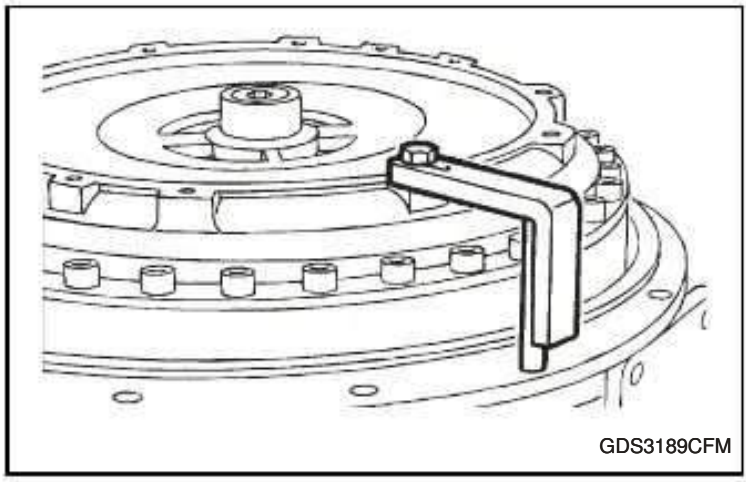
⚠ CAUTION

If spacer ring is added or removed, shim (6) must also be change by an equal amount to avoid damage to bearing.

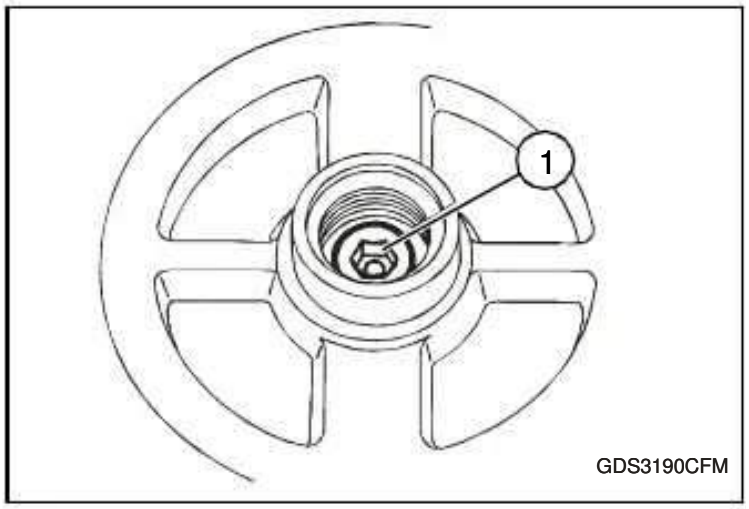
If installed height is less than (F) -0.05 mm (0.002 in.) a second spacer ring (7) should be installed to stator shaft.

If installed is greater than (F) +0.05 mm (0.002 in.) spacer ring (7) should be removed.

Spacer ring thickness is 1 mm (0.040).



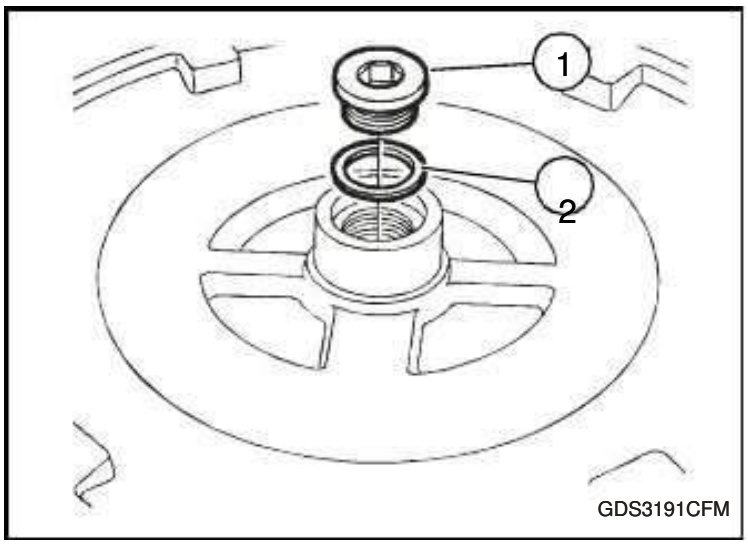
Install DFT1229 Torque Converter Holding Bracket and socket head cap.



Tighten cap screw (1) and measure torque converter height again.

Install Torque Converter Specification

Torque Converter Locking Cap Screw Torque- 185 Nm (136 lb-ft)



Install plug (1) and seal (2).

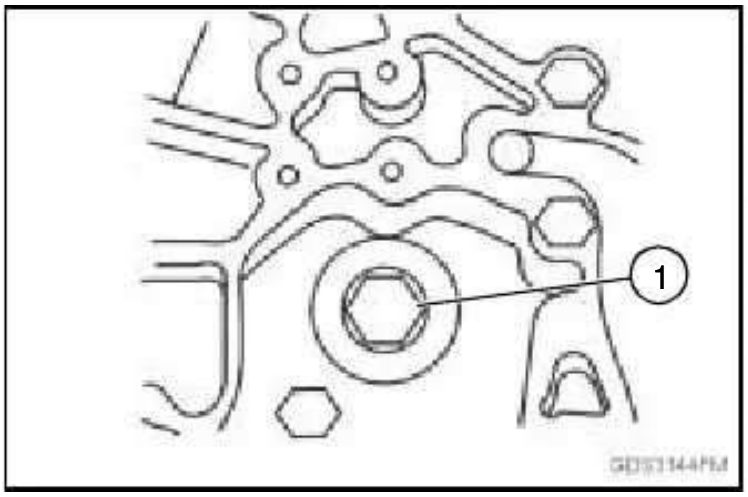
Install Torque Converter Specification

Torque Converter Plug Torque- - - - 200 Nm (148 lb-ft)

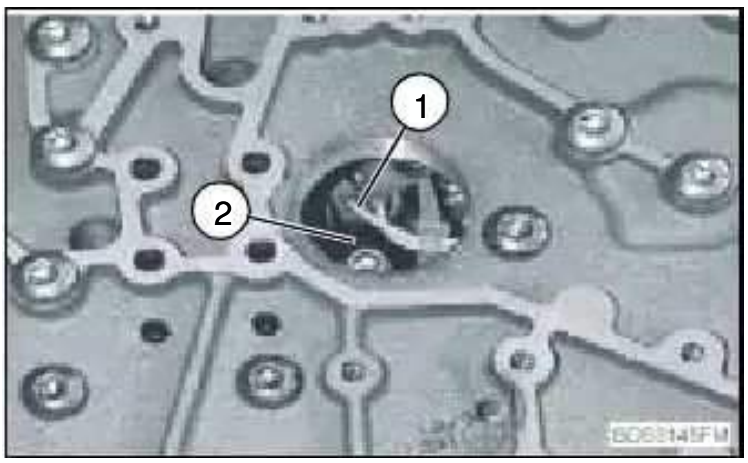
Input Speed Sensor Adjustment

Drain transmission oil. **(See Change Transmission Oil in Operator Manual CHAPTER 15, SECTON 2).**

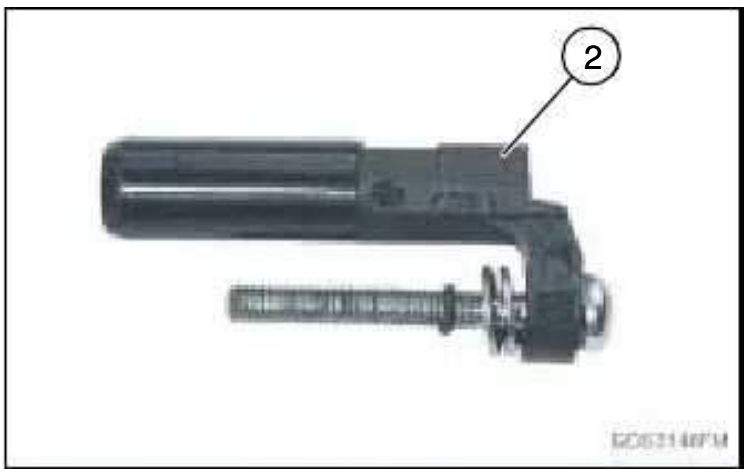
Remove transmission oil pan.



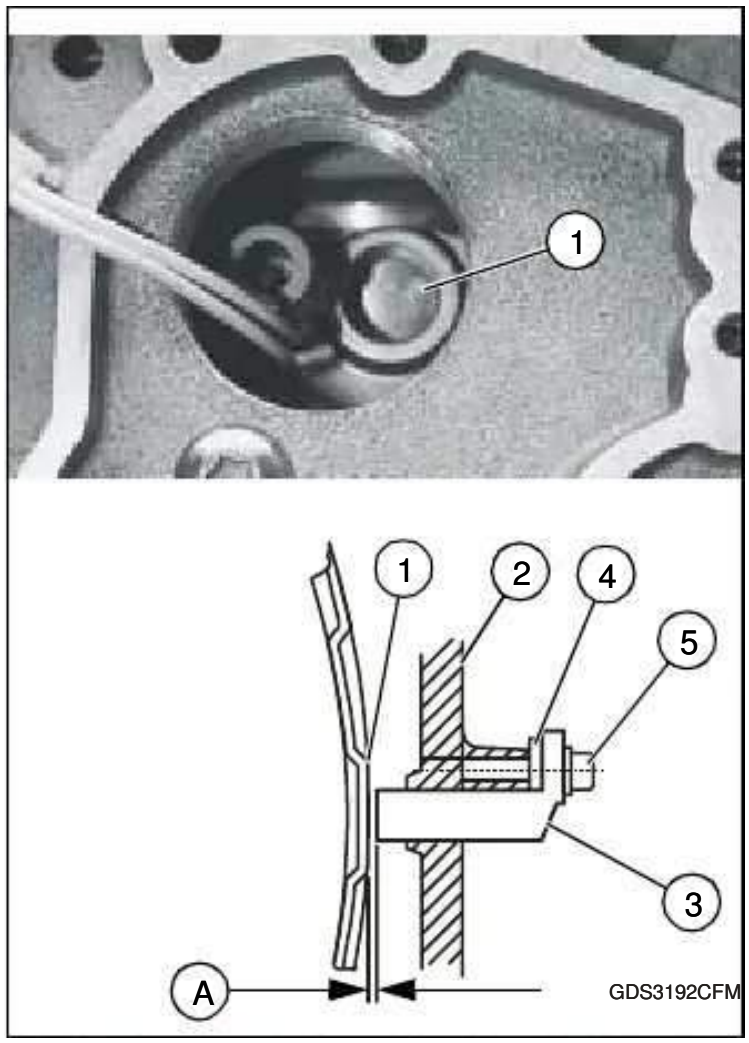
Remove plug (1).



Remove wire connectors (1). Wire connector location is not important.



Remove input speed sensor (2) and shim(s).



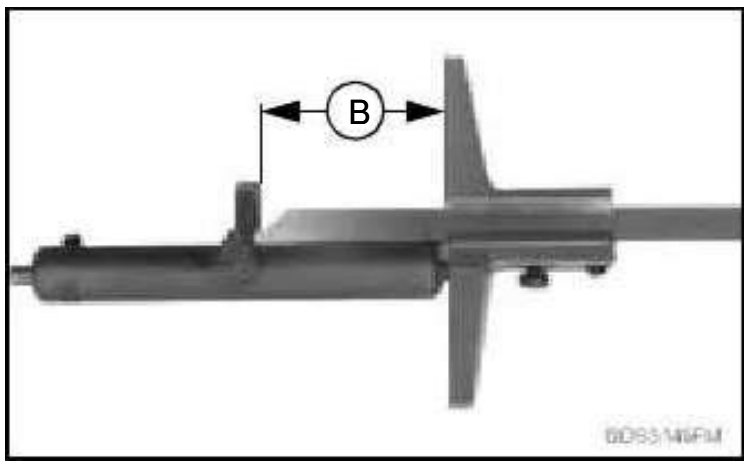
With input sensor removed rotate output shaft to locate upper face of pulse ring projection. Transmission-to-Transfer Case Drive Shaft may need to be disconnected. **(See "Remove and Install Transmission-to-Transfer Case Drive Shaft or Transfer Case-to-Oscillation Joint Drive Shaft" on page 35.)**

Position and install JDG1629 Sensor Depth Measuring Shaft. Tighten cap screw.

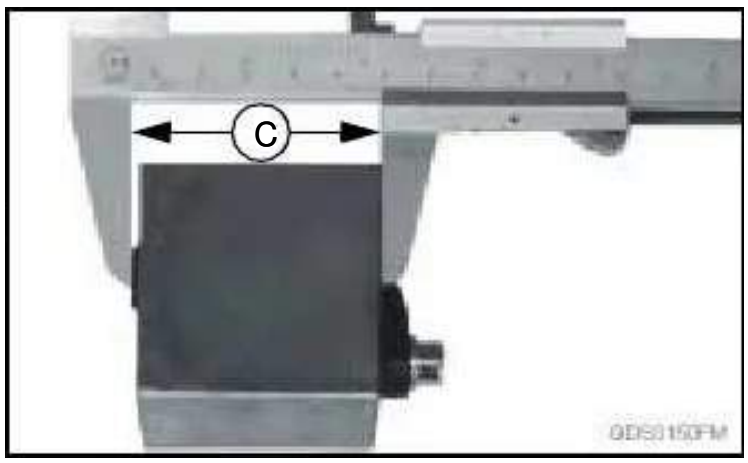
Input Speed Sensor Adjustment Specification

Input and Output Sensor Depth Measuring Shaft
Torque - 9.5 Nm (84 lb-in.)

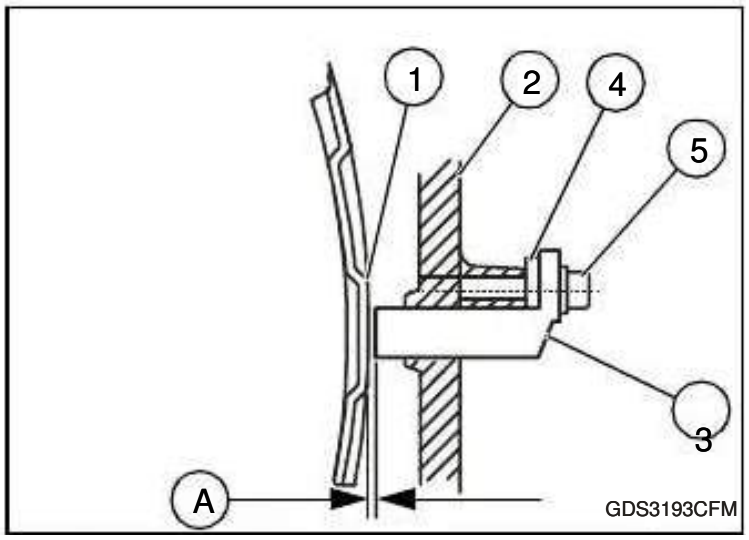
Position measurement pin (1) on pulse ring upper face and tighten set screw.



Remove measuring rod and measure distance from mounting face to pulse ring contact face. Note as dimension (B).



Position speed sensor in JDG1630 Sensor Length Measuring Block and measure distance from sensor sensing surface to mounting surface. Note as dimension (C).



Speed sensor clearance 0.6 - 0.8 mm (0.024 - 0.031 in.) is dimension (A).

Input Speed Sensor Adjustment Specification

Speed Sensor Clearance 0.6 - 0.8 mm (0.024 - 0.031 in.)

NOTE:Speed sensor shims are available in 0.1 mm (0.004 in.) increments from 0.8 - 6.0 mm (0.024 - 0.236 in.).

Calculate speed sensor shim size.

Subtract dimension (B) from dimension (C) and note as dimension (D).

Add dimension (D) to clearance average 0.7 mm (0.028 in.) this will be shim size required.

Position shims and O-ring and install sensor.

Input Speed Sensor Adjustment Specification

Input and Output Speed Sensor Torque - 9.5 Nm (84 lb-in.)

Install Plug.

Input Speed Sensor Adjustment Specification

Input Speed Sensor Plug Torque - 90 - 100 Nm (66 - 74 lb-ft)

Install oil pan and gasket.

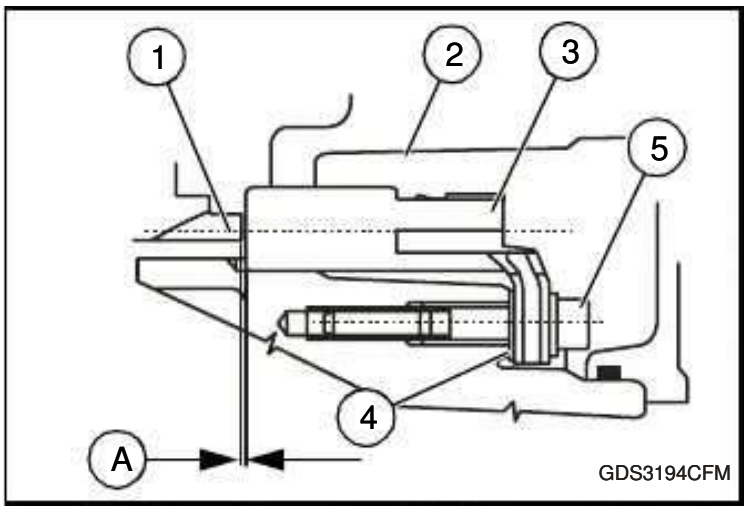
Input Speed Sensor Adjustment Specification

Oil Pan Torque- - - - - - - - - - - - - - - - 23 Nm (204 lb-in.)

Install drain plug and fill transmission oil. **(See Change Transmission Oil in Operator's Manual CHAPTER 15, SECTION 2.)**

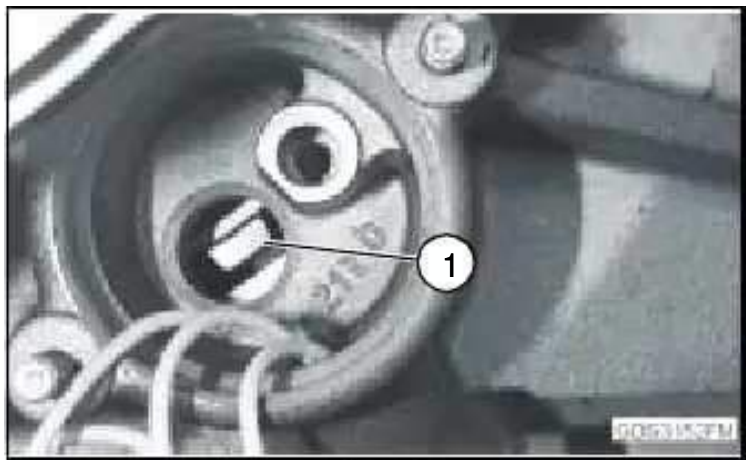
Output Speed Sensor Adjustment

Remove cover and wire connectors (1). Wire connector location is not important.

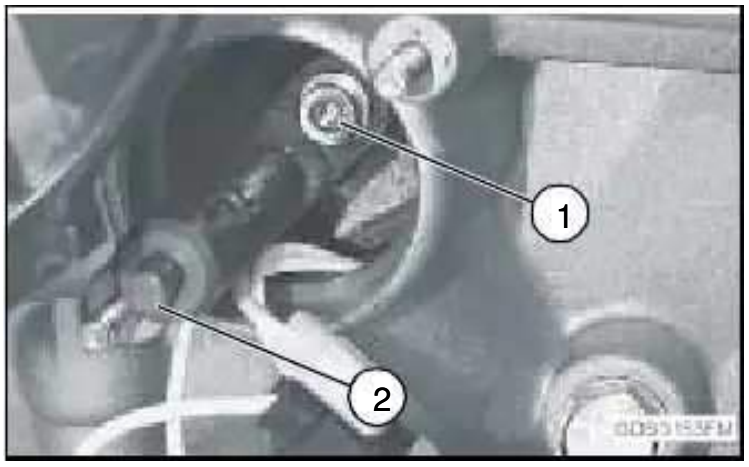


Remove output speed sensor cap screw (5).

Remove output sensor (3) and shims (4).



With output sensor removed rotate output shaft and locate planetary carrier tooth (1). Transmission-to-Transfer Case Drive Shaft may need to be disconnected. **(See "REMOVE AND INSTALL TRANSMISSION-TO-TRANSFER CASE DRIVE SHAFT" on page 63).**

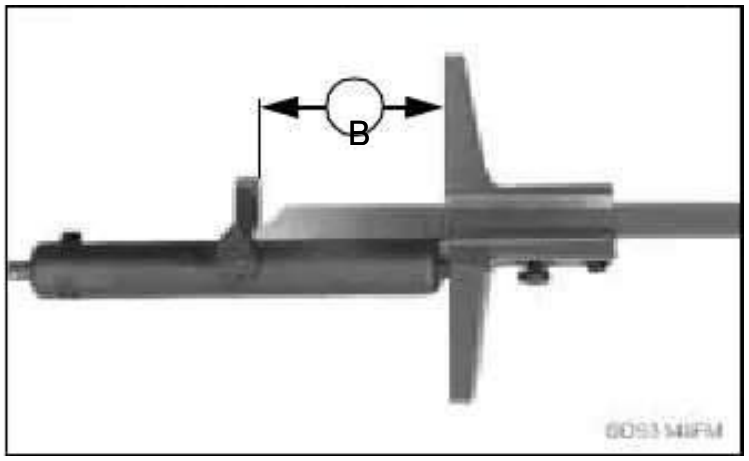


Position and install JDG1629 Sensor Depth Measuring Shaft. Tighten cap screw (1).

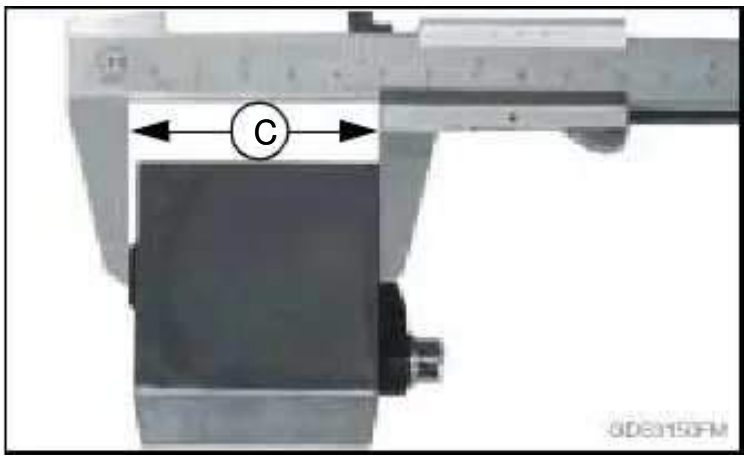
Output Speed Sensor Adjustment Specification

Input and Output Sensor Depth Measuring Shaft
Torque - 9.5 Nm (84 lb-in.)

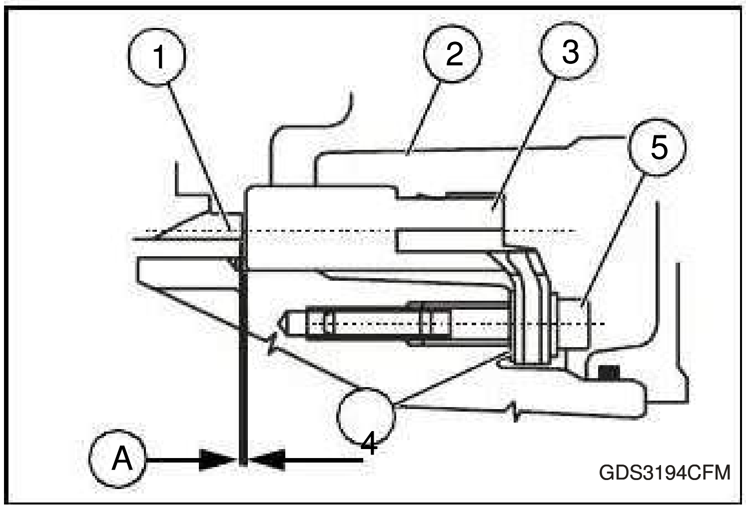
Position measurement pin (2) on planetary carrier tooth and tighten set screw.



Remove measuring rod and measure distance from mounting face to measurement pin face. Note as dimension (B).



Position speed sensor in JDG1630 Sensor Length Measuring Block and measure distance from sensor sensing surface to mounting surface. Note as dimension (C).



Speed sensor clearance 0.6 - 0.8 mm (0.024 - 0.031 in.) is dimension (A).

Output Speed Sensor Adjustment Specification

Speed Sensor Clearance -- 0.6 - 0.8 mm (0.024 - 0.031 in.)

NOTE:Speed sensor shims are available in 0.1 mm (0.004 in.) increments from 0.8 - 6.0 mm (0.024 - 0.236 in.).

Calculate speed sensor shim size.

Subtract dimension (B) from dimension (C) and note as dimension (D).

Add dimension (D) to clearance average 0.7 mm (0.028 in.) this will be shim size required.

Position shims and O-ring and install sensor.

Output Speed Sensor Adjustment Specification

Input and Output Speed Sensor Torque ------------------------------------- 9.5 Nm (84 lb-in.)

Connect wire connectors and install cover.

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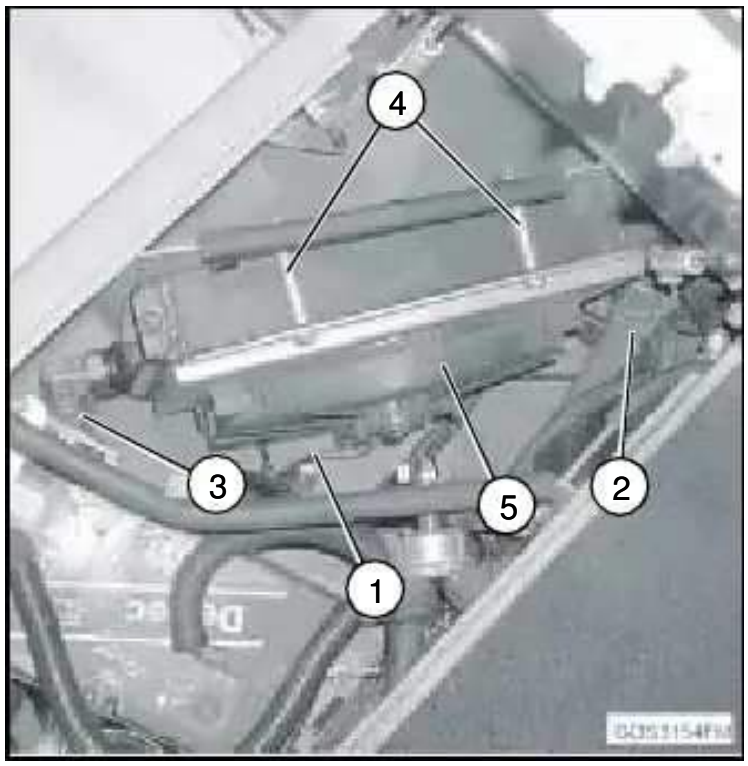
CHAPTER 3. TRANSMISSION

SECTION 4. HYDRAULIC SYSTEM

REMOVE AND INSTALL TRANSMISSION OIL-TO-AIR COOLER

Turn battery disconnect switch off.



Disconnect fan wire connector (1).

Disconnect oil lines (2 and 3) from cooler. Close all openings using caps and plugs.

Remove bolts, spacers, and nuts (4).

Remove fan and shroud (5) and then remove cooler.

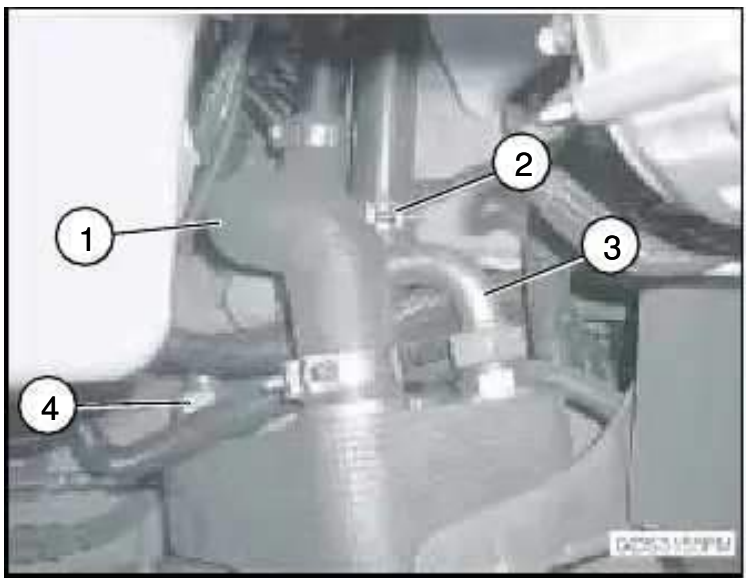
Repair or replace as required.

Install cooler and shroud using cap screws, spacers, and nuts.

Connect oil lines and wire connector.

Remove and Install Transmission Oil-to-Water Cooler

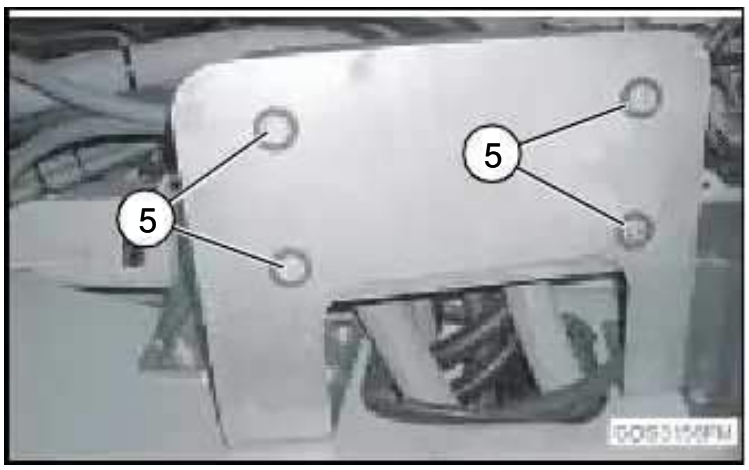
Turn battery disconnect off.



Drain engine coolant.

Disconnect coolant hoses (1 and 2).

Disconnect oil lines (3 and 4). Close all openings using caps and plugs.



Remove bolts (5) and remove cooler.

Repair or replace as required.

Install cooler using bolts.

Connect oil lines and coolant lines.

Fill engine with coolant.

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CHAPTER 4. ENGINE

SECTION 1. REMOVAL AND INSTALLATION

ENGINE

Remove and Install Engine

Turn battery disconnect switch to **OFF**.

Remove hood. **(See "BONNET" on page 335)**.

Lower belly plates.

NOTE: Mark all connectors, fittings and pipes clearly for correct installation.

Disconnect all wire harnesses.

Remove charge air after cooler and radiator. **(See "Remove and Install Charge Air Aftercooler" on page 241).**

Remove bolts (1) and fan guard (2) from the left and right side.

Disconnect high and low pressure lines from air conditioner compressor (1).

Disconnect wires from starter motor, alternator and harnesses connected to the engine.

Disconnect lines (1) from expansion tank.

Disconnect heater hoses.

Disconnect start aid glow plug wire connector (2) and fuel line.

Remove cap screws that holds cross member (3). Lift up cross member and swing over to right side fender. Install one cap screw to hold cross member in place.

Disconnect intake boot.

Remove clamp and disconnect exhaust pipe.

Disconnect output line from compressor.

Disconnect fuel lines and plug holes.

Remove clamp and move lines towards right frame rail.

Disconnect wire connector.

Disconnect output speed sensor, retarder temperature sensor, turbine speed sensor, input speed sensor, retarder sensor, and transmission control module wire connectors. **(See Transmission Harness Component Location in Operation and Test Manual CHAPTER 3, SECTION 1).**

Disconnect coolant line and drain fluid from cooler into suitable container. Close all openings using caps and plugs.

Disconnect transmission drive shaft. **(See "REMOVE AND INSTALL TRANSMISSION-TO-TRANSFER CASE DRIVE SHAFT" on page 49).**

⚠ CAUTION

Approximate weight of engine and transmission is 1542 kg (3400 lb).

Remove and Install Engine Specification

Engine and Transmissionm Weight
- 1542 kg (3400 lb)

Attach JDG23 Lifting Beam to suitable hoist and hook to three engine hookup points.

Remove bolts for front engine mounts (1).

⚠ CAUTION

Do not mix engine mounting, transmission or transfer case shims.

NOTE:Note location of washers between rubber mounts and frame.

Remove transmission mounts (1). Note location of washers between rubber mounts and frame.

Remove engine. Use shop stands or wooden blocks to support the engine and transmission.

Using JDG1500-16 turning tool rotate engine until flex plate cap screws (1) appear in access hole.

Rotate engine and remove cap screws.

⚠ CAUTION

Approximate weight of transmission is 544 kg (1200 lb)

Attach JDG1501-6 main case holding fixture tool to transmission. Attach a suitable hoist to tool.

Remove bolts (1) and remove transmission from engine. Remove bolts holding flexplate adapter to flywheel.

Repair or replace as necessary.

Install flexplate adapter to flywheel. Tighten cap screws to specification.

Remove and Install Engine Specification

Flexplate Adapter-to-Flywheel Cap Screws Torque
- 110 Nm (81 lb-ft)

Before installing the transmission, align one of the cap screw holes in the flex plate discs and one of the tapped holes in torque converter adapter with hole in flywheel housing.

Install transmission to flywheel housing.

Apply rigid form in place gasket to threads of transmission-to-flywheel housing cap screws.

Tighten to specification.

Remove and Install Engine Specification

Transmission-to-Flywheel Housing Cap Screws Torque
- 65 Nm (47.942 lb-ft)

Appy medium strength thread lock and sealer to threads of cap screws.

Rotate engine and install flexplate-to-converter adapter cap screws.

Tighten to specification.

Remove and Install Engine Specification

Flexplate-to-Converter Adapter Cap Screws Torque
- 81 Nm (59.743 lb-ft)

⚠ CAUTION

Approximate weight of engine and transmission is 1542 kg (3400 lb)

Using a suitable hoist, attach JDG23 lifting beam to three lifting points on engine. Install engine into frame.

Note location of rubber mounts and washers and install bolts through mounts and frame.

Tighten to specification.

Remove and Install Engine Specification

Engine and Transmission Mounts-to-Frame Cap Screws Torque - - - - - - - - - - - - - 435 Nm (320.84 lb-ft)

Connect transmission drive shaft. **(See "REMOVE AND INSTALL TRANSMISSION-TO-TRANSFER CASE DRIVE SHAFT" on page 49).**

Connect transmission lines.

Connect transmission drive shaft. **(See "REMOVE AND INSTALL TRANSMISSION-TO-TRANSFER CASE DRIVE SHAFT" on page 49).**

Connect output speed sensor, retarder temperature sensor, turbine speed sensor, input speed sensor, retarder sensor, and transmission control module wire connectors. **(See Transmission Harness Component Location in Operation and Test Manual CHAPTER 3, SECTION 1)**

Connect wire connector.

Connect fuel lines. Use new sealing washers and tighten banjo bolt to specification.

Remove and Install Engine Specification

Fuel Line-to- Fuel Controller Banjo Bolt Torque
- 40 Nm (30 lb-ft)

Install in reverse order.

CHAPTER 4. ENGINE

SECTION 2. CRANKSHAFT, MAIN BEARINGS AND FLYWHEEL

INSTALL ENGINE ON REPAIR STAND

Remove belt, engine fan, fan hub, and crankshaft pulley.

Remove mounts from engine block.

Mount engine on a stand.

⚠ CAUTION

The approximate weight of engine is 1087 kg (2400 lb)

Install Engine on Repair Stand Specification

Engine Weight - - - - - - - - - - - - - - - 1087 kg (2400 lb)

Lower engine on repair stand and install cap screws where original engine mounts were.

Install bracket using cap screws and nuts.

Install bolt into engine.

Tighten all cap screws and remove hoist.

CRANKSHAFT AND MAIN BEARING FAILURE ANALYSIS

Scored Main Bearing

(Diagnosis also applies to connecting rod bearing.)

- Oil starvation.
- Contaminated oil.
- Engine parts failure.
- Excessive heat.
- Poor periodic service.

“Wiped” Bearings

- Fuel in lubricating oil (incomplete combustion).
- Coolant in lubrication system (cracked block, liner seal failure, or leaking water pump seal with plugged hole).
- Insufficient bearing oil clearance.
- Parts not lubricated prior to engine operation.
- Wrong bearing size.

Inconsistent Wear Pattern

- Misaligned or bent connecting rod.
- Warped or bowed crankshaft.
- Distorted cylinder block.

Broken Main Bearing Caps

- Improper installation.
- Dirt between bearing and crankshaft journal.
- Low oil pressure.

- Oil pump failure.

Cracked, Chipped or Broken Bearings

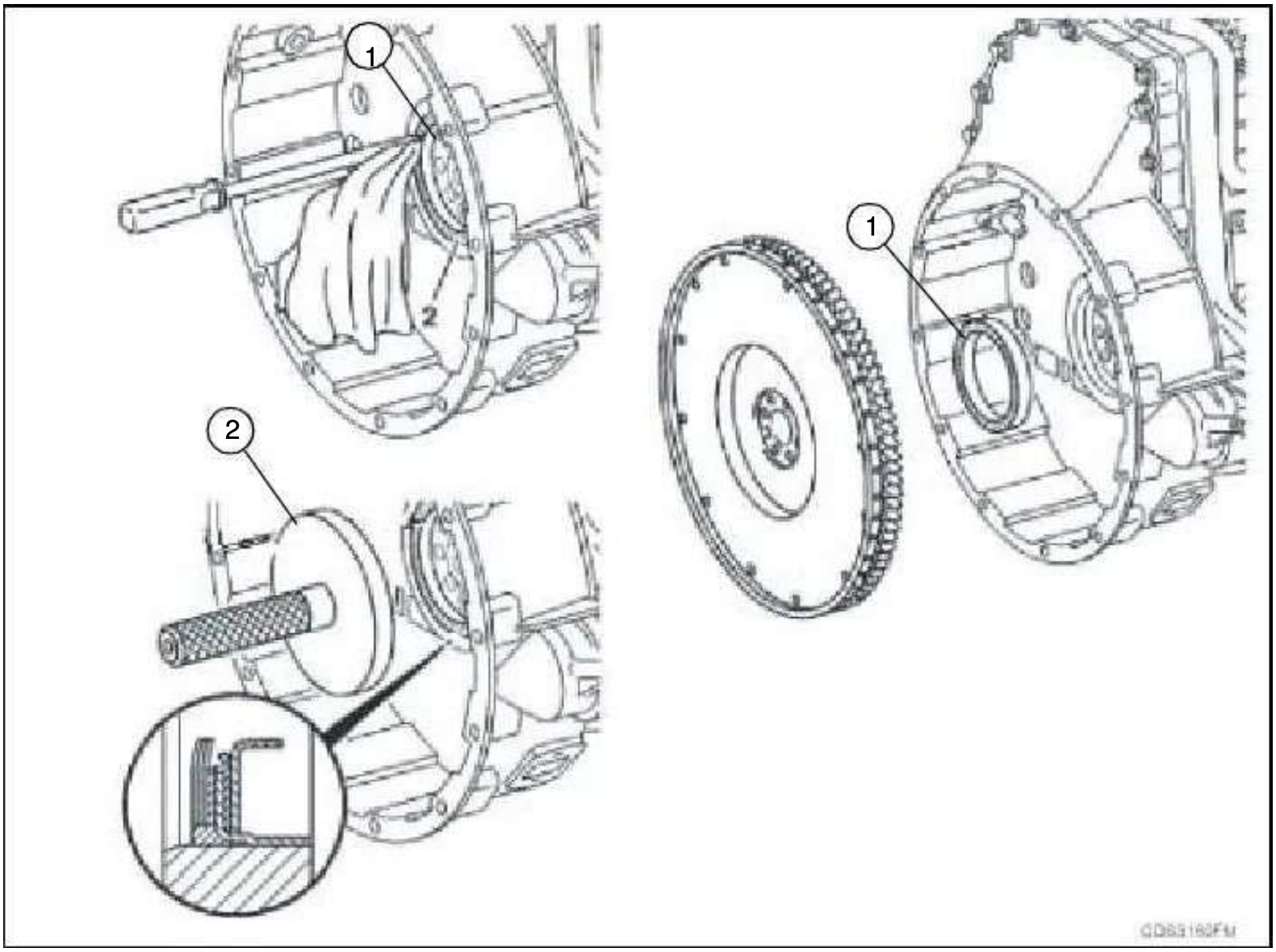
- Over speeding.
- Excessive idling.
- Lugging.
- Excessive oil clearance.
- Improper installation.

CRANKSHAFT OIL SEALS

Remove and Install Rear Oil Seal

Remove the engine. **(See “Remove and Install” on page 105).**

Remove flywheel. **(See “FLYWHEEL” on page 167).**



Carefully remove rear oil seal (1) from timing case. Inspect contact surface on flywheel for scores or signs of wear.

NOTE: Apply engine oil to lip of rear oil seal for conventional type seals. Install dry for fibre type seal.

Fit new oil seal (1) in timing case and press in with drift (2).

Install flywheel. **(See “FLYWHEEL” on page 167.)**

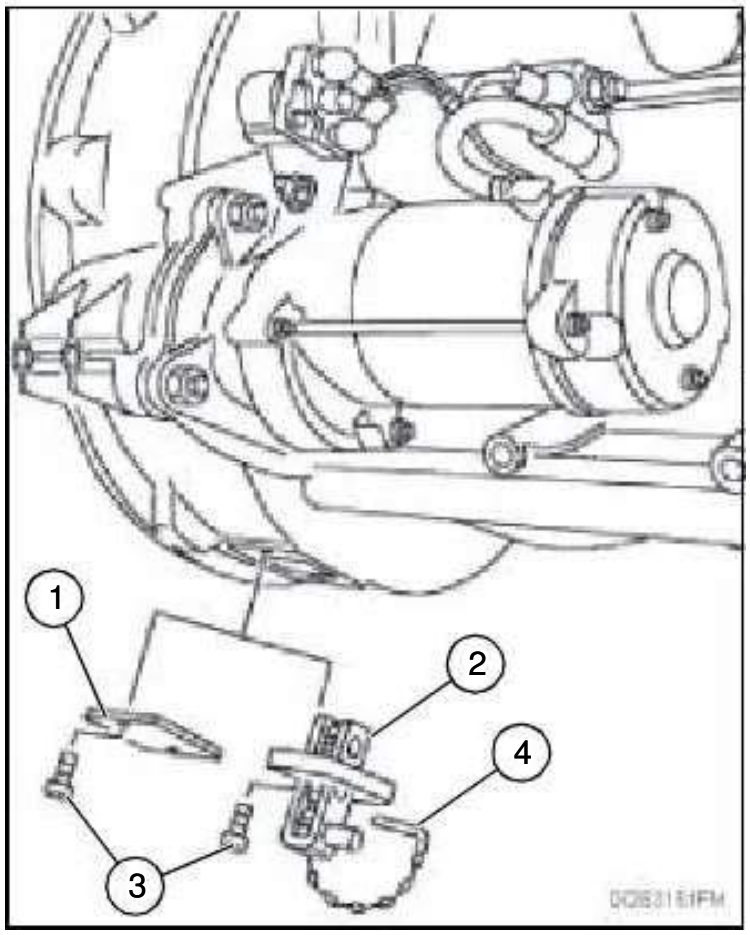
Remove and Install Belt Pulley/ Vibration Damper

Remove fan guard **(See "Remove and Install Engine" on page 159).**

Install Cranking Device

⚠ CAUTION

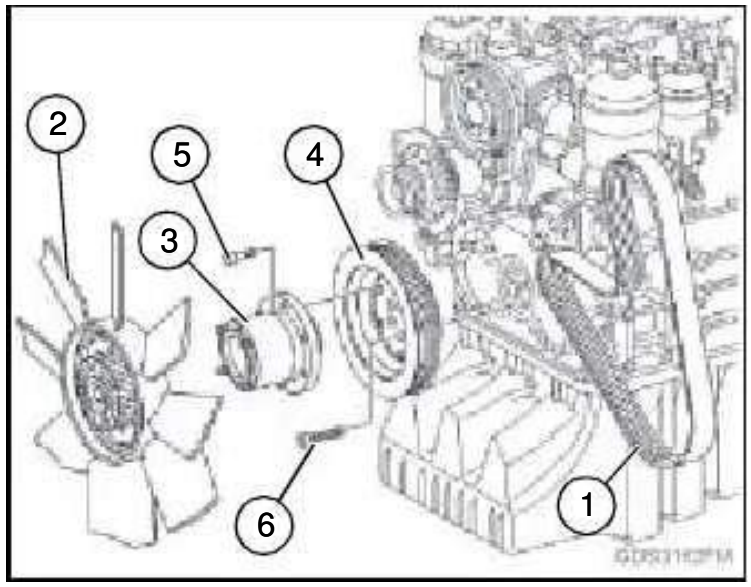
Cranking device must be removed before starting the engine.



Remove cover (1) at flywheel housing.

Attach cranking device (2) to flywheel housing with bolts (3).

To stop the device from turning, insert the pin (4).



Slacken poly V-belt (1) and take off.

Remove viscous fan (2).

Loosen hexagon bolts (5) and remove intermediate piece (3).

Loosen multi point socket bolts (6).

Remove vibration damper (4).

Measure the length of the bolts, if out of specification, replace with new bolts.

Bolt Specification

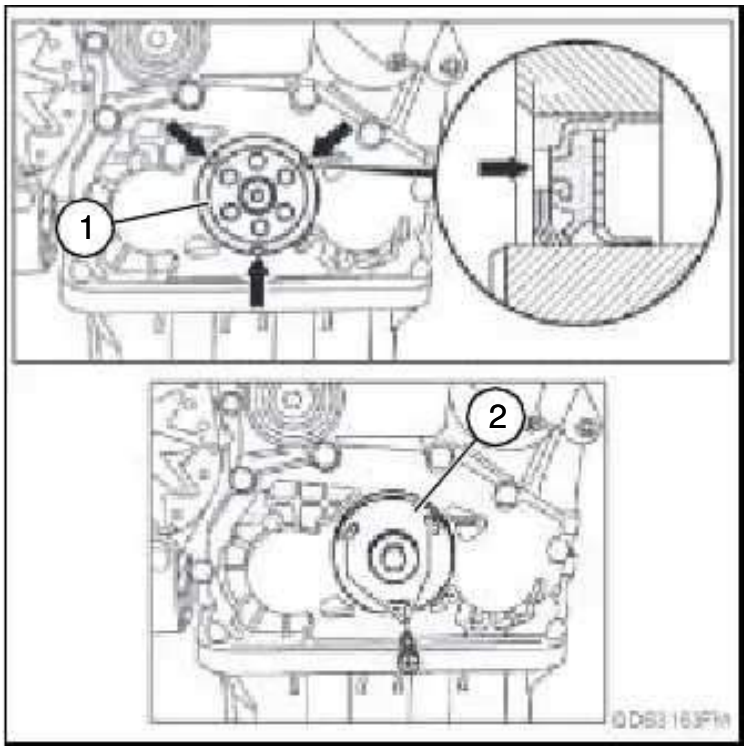
M14 New- 60mm (2.36")
M14 Max. - 61mm (2.4")
M16 New- 61mm (2.4")
M16 Max. - 61.8mm (2.43")

Assemble in reverse order.

Remove and Install Front Oil Seal

Remove Front Oil Seal

Remove vibration damper **(See previous procedure).**

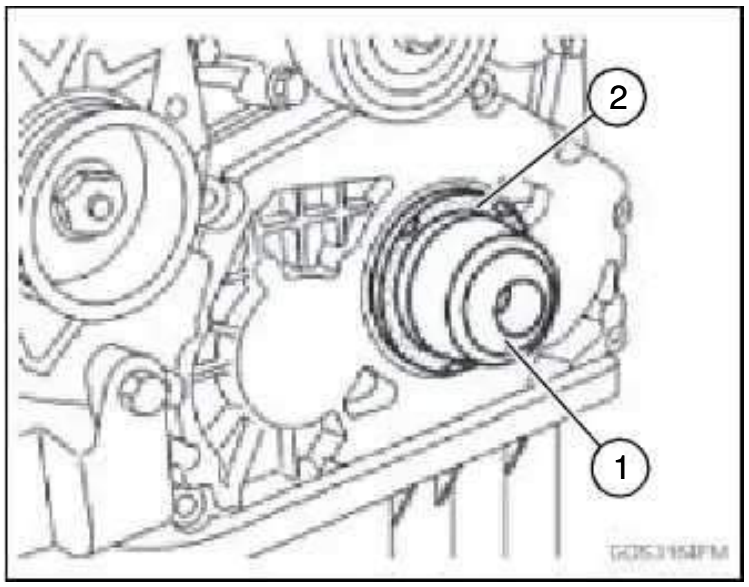


Attach puller (2) to the seal (1) with three self-tapping screws (Dia. 3.2mm).

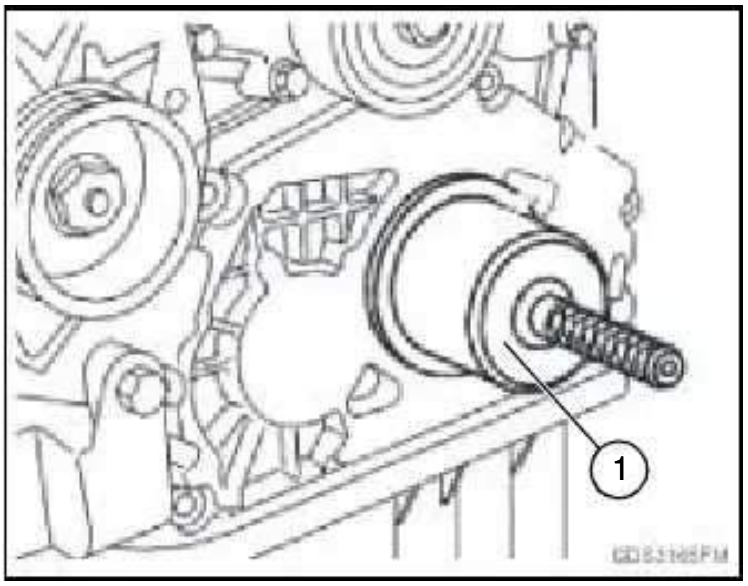
Pull seal off.

Inspect contact surface at crankshaft for scores or traces of wear.

Install Front Oil Seal



Fit guide sleeve (1) onto the crankshaft and push the seal (2) over the guide sleeve.

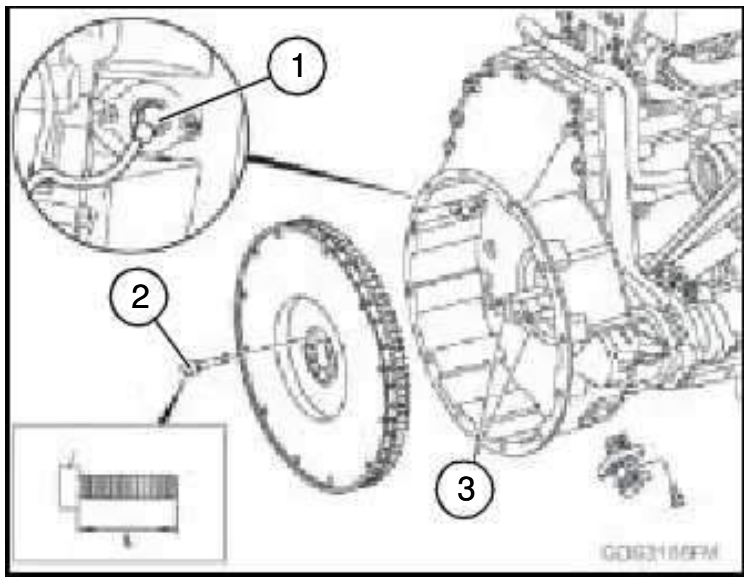


Press the seal into the oil pump with the punch (1).

Install vibration damper **(See previous procedure).**

FLYWHEEL

Remove and Install Flywheel



Pull crankshaft position sensor (1) out from timing case approximately 8 mm (0.3 in.).

Attach cranking device to timing case **(See "Install Cranking Device" on page 165).**

Unscrew flywheel bolts (2).

Screw centering drifts (3) into two oppositethreaded holes.

Remove cranking device.

Remove the flywheel over the centering drifts.

Measure flywheel bolts. If the bolts are to long or to short, replace the bolts with new bolts.

Inspect the flywheel for size, scorches, scores or cracks. If out of specification, replace the flywheel.

Flywheel Bolts Specification

M14 New- 60mm (2.36")

M14 Shank Length Max. - - - - - - - - - - - - - 61mm (2.4")

Flywheel Thickness between friction surface and mounting flange - - - - - - - - - - - - - - - - - - - 55 mm (2.2")

Flywheel Bolt torques first stage - - - -50Nm (36.9 lb-ft)

Flywheel Bolt torques second stage - 125Nm (92 lb.-ft.)

Flywheel Bolt torques third stage - - - - - - - - - - - - 90°

Inspec flywheel flange for signs of wear and traces of hollowing caused by seal.

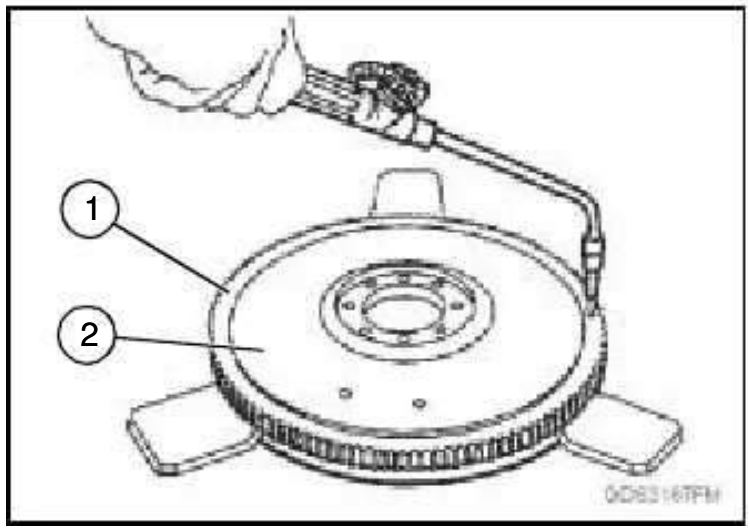
Inspect ring gear for wear.

Install in reverse order.

Replace Ring Gear

⚠ WARNING

Wear protective gloves, clothing and eye protection. Risk of injury to eyes and skin from handling hot or glowing objects.



Use a welding torch to rapidly heat ring gear.

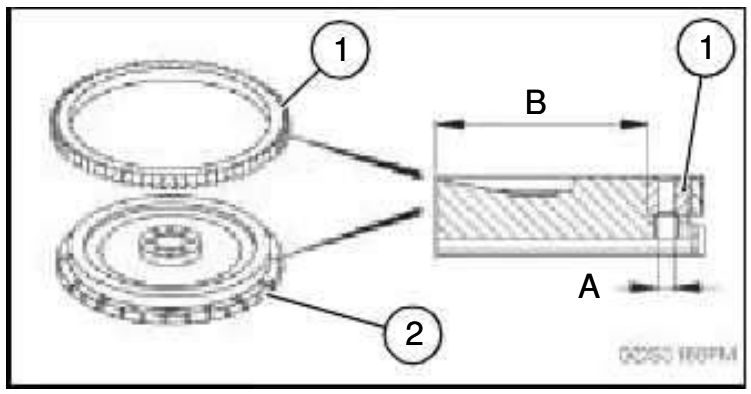
Press the ring gear (1) off the flywheel (2).

Measure the flywheel dia. for mounting the starter ring gear.

Measure ring gear inner.

Heat new starter ring gear.

NOTE:Temperature is reached once the ring gear has a bright yellow annealing colour.



Press the ring gear onto the flywheel as far as the contact surface.

Drill holes "A" for mounting the clutch pressure plate in the ring gear and tap thread M14 x 1.5.

Install flywheel.

Ring Gear Specifications

Starter Ring Gear/Flywheel Permissible Runout - 0.5mm (0.020")

Starter Ring Gear Width - - -15.6 - 16mm (0.61" - 0.63")

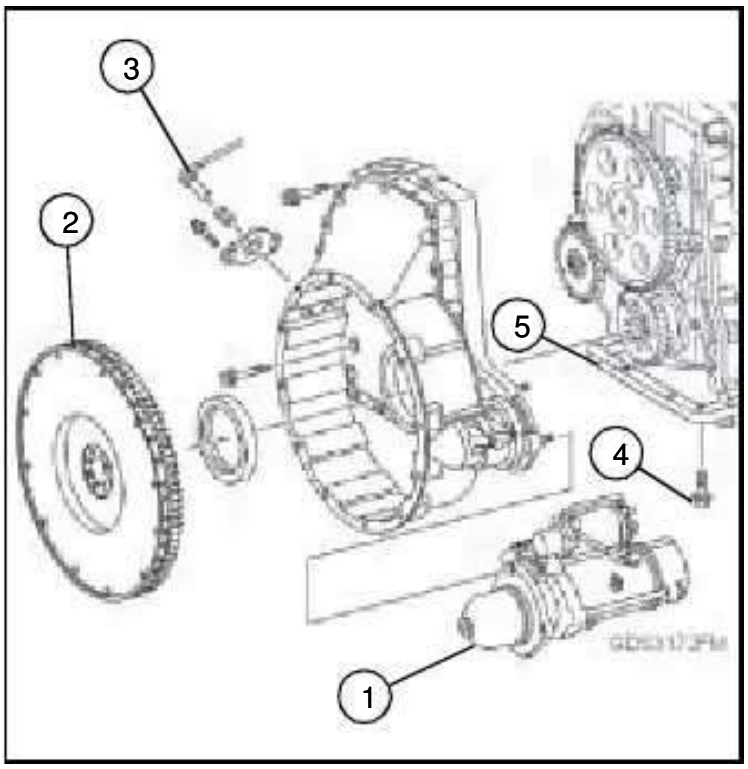
Starter Ring Gear Inner Dia. - 432 - 432.155mm (17.008 - 17.014")

Starter Ring Gear/flywheel overlap - - - 0.5mm (0.020")

Starter Ring Gear Fitting Temp.- 250°C - 280°C (482°F - 536°F)

Remove and Install Timing Case

Remove starter motor wiring.



Loosen nuts on starter motor and remove starter (1).

Remove flywheel (2) **(See "Remove and Install Flywheel" on page 167).**

Pull out crankshaft angle position sensor (3).

Unscrew bolts (4) at oil pan (5) in the area of the oil pan.

Slacken remaining bolts of the oil pan and lower the oil pan (5).

NOTE:Do not damage oil pan gasket. If necessary replace oil pan gasket.

Detach timing case and remove.

Cover opening of oil pan to prevent dirt from falling into opening.

Installing Timing Case

Clean all contact surfaces of timing case and mating parts.

Cover all contact surfaces with sealant.

NOTE:When replacing radial seal note crankshaft dimensions as installation dimension is related to crankshaft.

Install in reverse order.

Timing Case Torque Specification

Timing case to crankcase- - - - - - - - - 50 Nm (37 lb-in.)

End cover of inspection hole to timing case - 25 Nm (18.5 lb-ft)

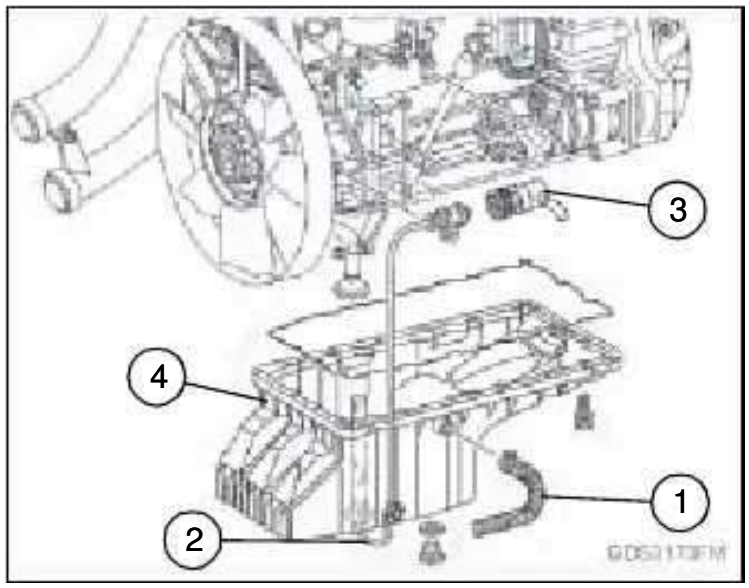
Oil pan to crankcase - - - - - - - - - - - - 25 Nm (18.5 lb-ft)

Removing Oil Pan

Drain the oil.

⚠ WARNING

Keep hands and any thing else out of the engine when oil pan is removed. Serious injury can result if engine is accidentally cranked.



Detach oil filter line (1) at the oil pan.

Disconnect electric cable of engine oil level sensor (2) at wiring harness (3).

Remove oil pan (4).

Clean and inspect all components. Replace worn or damaged components.

Install Oil Pan

NOTE:Note oil pan gasket position.

Install in reverse order.

Oil Pan Specifications

Oil drain plug torque (M26x1.5) - - - 85 Nm (62.7 lb. ft.)
Oil drain plug torque (M20x1.5) - - - - -65 Nm (48 lb. ft.)
Oil pan to crankcase bolts - - - - - - - 25 Nm (18.4 lb. ft.)

Fill engine with oil. **(See OMM Chapter 1 for correct oil specifications).**

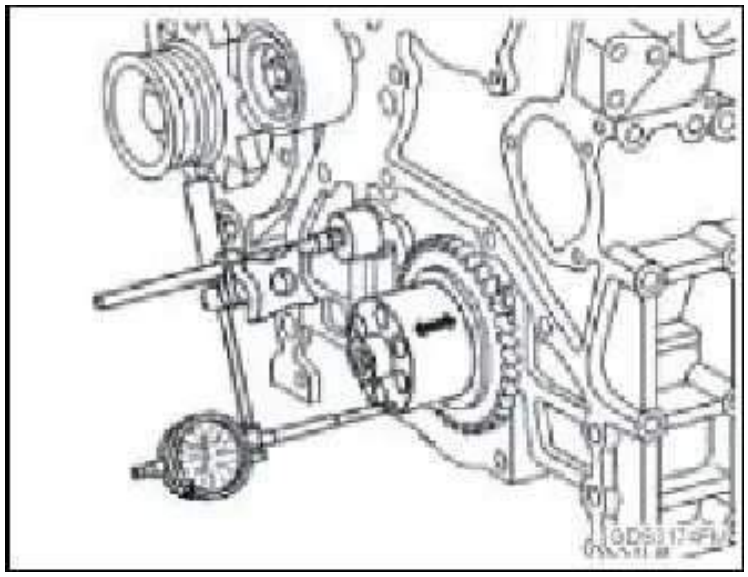
Start engine and check oil pressure with engine idling.

Switch engine off and check for leaks.

CRANKSHAFT

Check Crankshaft End Play

NOTE:Measure crankshaft end play prior to removing crankshaft to determine condition of thrust bearings.



Attach a magnetic base and dial indicator to crankcase.

NOTE:DO NOT apply too much pressure on pry bar. Bearings can be damaged.

Gently pry crankshaft as far to rear of engine as possible using a pry bar.

Turn the dial indicator to zero.

Gently pry crankshaft as far forward as possible and note dial indicator reading. If end play is not within specifications, replace crankshaft thrust bearing.

Crankshaft Specification

Axial End Play
- - - - - - - - - - - - 0.160 - 0.380 mm (0.0063 - 0.015 in.)

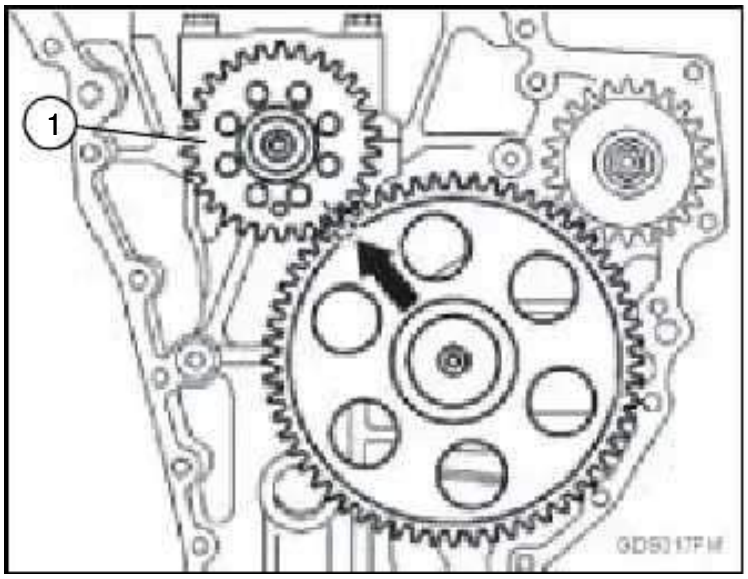
Remove Crankshaft

Remove timing case. **(See "Remove and Install Timing Case" on page 168).**

Remove vibration damper. **(See "Remove and Install Belt Pulley/Vibration Damper" on page 165).**

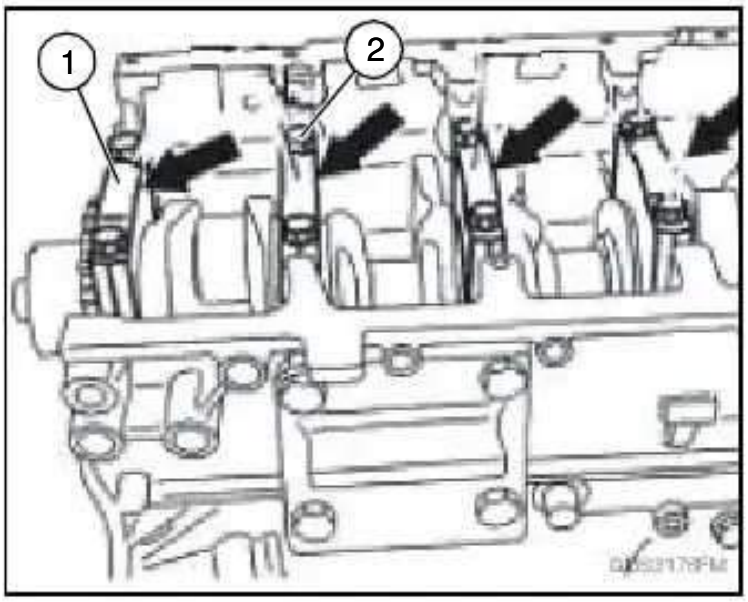
Remove the oil pan **(See "Removing Oil Pan" on page 168).**

Remove oil pump. **(See "Remove Oil Pump" on page 177).**



Pull crankshaft gear (1) off crankshaft flange.

NOTE:1. Mark main bearing caps and bearings and rod caps and bearings for ease in assembly.
2. If cylinder head is removed from engine, ensure that pistons do not fall to floor when connecting rod caps are removed. Put a suitable container with padding under engine.



Rotate crankshaft as required to remove connecting rod cap screws and caps.

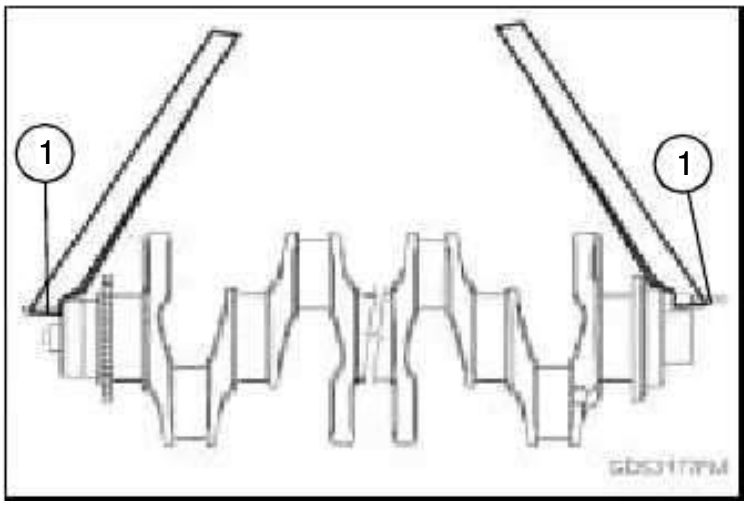
Remove main bearing lateral bolts (2).

Remove main bearing caps (1) using a soft-face (plastic) hammer, if necessary. Tap gently, using the minimum force necessary.

Mark the order of main bearing caps as well as the shells to the caps.

⚠ CAUTION

Use a lifting device for heavy components.



Install Pilot Bolts (1) in ends of crankshaft. Attach a lifting strap.

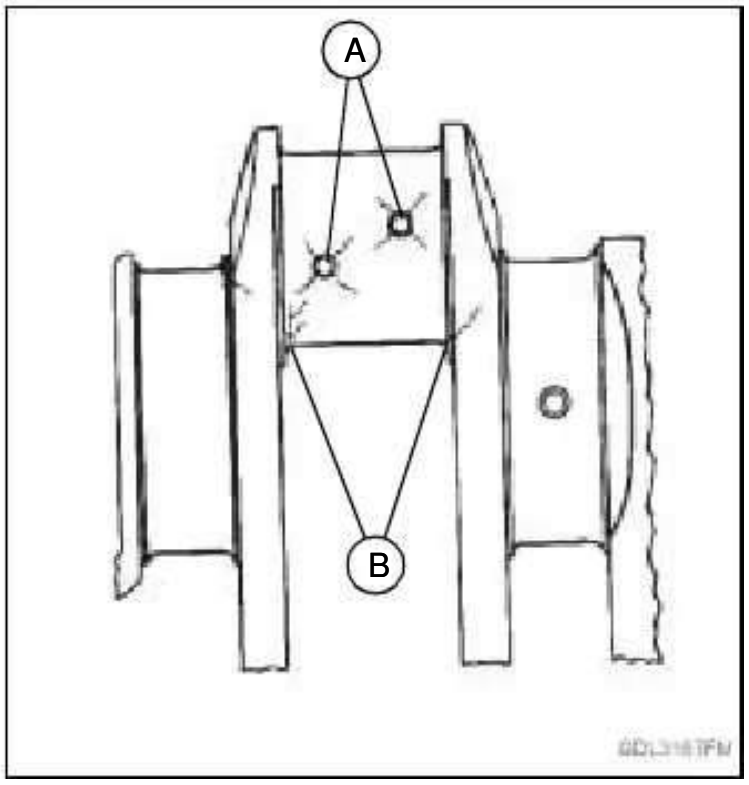
Carefully remove crankshaft from block with a hoist.

Clean crankshaft, especially oil passages. Dry thoroughly.

Place crankshaft on clean V-blocks.

Inspect Crankshaft

Thoroughly clean crankshaft. Clear restrictions from all oil passages.



Inspect crankshaft for signs of load stress, cracks, or scratches on journals.

Also check each journal for evidence of excessive overheating or discoloration.

If either condition exists, replace crankshaft, since heat treatment has probably been destroyed.

Inspect front crankshaft gear for cracks, chipped teeth, or excessive wear. Replace gear as required.

Inspect the keyway for evidence of cracks or wear. Replace crankshaft as necessary.

Carefully check the crankshaft for cracks in the area of rod journal oil holes (A) and at journal fillets (B).

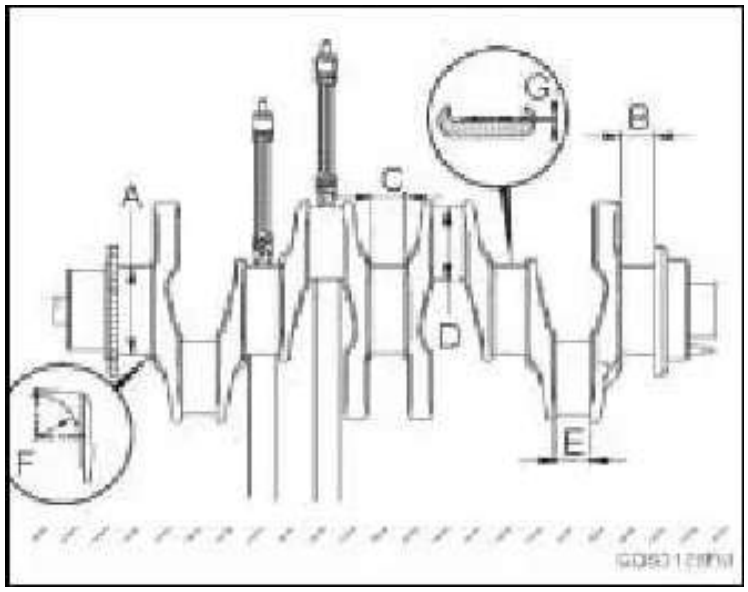
Replace crankshaft if any cracks are found.

⚠ CAUTION

Small cracks may not be visible to the eye. Use a method such as the Fluorescent Magnetic Particle method. This method magnetizes the crack, using magnetic particles which are fluorescent and glow under 'black light'. The crankshaft must be demagnetized after inspection.

Measure Crankshaft Journals

NOTE:Measure journal diameters at two points at approximately 90° offset.



Main Bearing Journal Diameter A

Measure	Size
Standard	85.990 - 86.010 mm (3.385 - 3.386 in.)
Undersize -0.1mm (0.004”)	85.890 - 85.910 mm (3.381 - 3.382 in.)
Undersize -0.25mm (0.010”)	85.740 - 85.760 mm (3.375 - 3.376 in.)
Undersize -0.5mm (0.020”)	85.490 - 85.510 mm (3.366 - 3.367 in.)
Undersize -0.75mm (0.030”)	85.240 - 85.260 mm (3.356 - 3.357 in.)
Undersize -1.0mm (0.040”)	84.990 - 85.010 mm (3.346 - 3.347 in.)

Fitted Bearing Journal Width

Measure	Size
Standard	31.000 - 31.062 mm (1.220 - 1.223 in.)
Oversize -0.3mm (0.012”)	31.300 - 31.362 mm (1.232 - 1.235 in.)
Oversize -0.5mm (0.020”)	31.500 - 31.562 mm (1.240 - 1.243 in.)

Main Bearing Journal Width

Measure	Size
Standard	31.000 - 31.200 (1.220 - 1.228)

Conrod (Big End) Bearing Journal Diameter B

Measure	Size
Standard	69.995 - 70.015 mm (2.7557 - 2.7565 in.)
Undersize -0.1mm (0.004”)	69.895 - 69.915 mm (2.7518 - 2.7526 in.)
Undersize -0.25mm (0.010”)	69.745 - 69.765 mm (2.7459 - 2.7467 in.)
Undersize -0.5mm (0.020”)	69.495 - 69.515 mm (2.736 - 2.7368 in.)
Undersize -0.75mm (0.030”)	69.245 - 69.265 mm (2.7262 - 2.727 in.)
Undersize -1.0mm (0.040”)	68.995 - 69.015 mm (2.7163 - 2.7171 in.)

Conrod Bearing Journal Width

Measure	Size
Standard	34.000 - 34.200 mm (1.339 - 1.3465 in.)

Main and Conrod Bearing Journals Permissible Out-of-roundness (Oval)

Measure	Size
Limit	0.005 mm (0.0002 in.)

Main and Conrod Bearing Journals Permissible Conicity (Taper)

Measure	Size
Limit	0.005 mm (0.0002 in.)

Permissible Lateral Runout

Measure	Size
Fitted bearing journals	0.015 mm (0.0006 in.)

Radial Run out Measured At Middle Main Bearing Journal (Mounted On Outer Main Bearing Journals)

Measure	Size
	0.11 mm (0.004 in.)

Fillet Radii

Measure	Size
Main and conrod bearing journals	2.5 - 3.0 mm (0.1 - 0.118 in.)

Hardness

Measure	Size
Main and conrod bearing journals	52 HRc

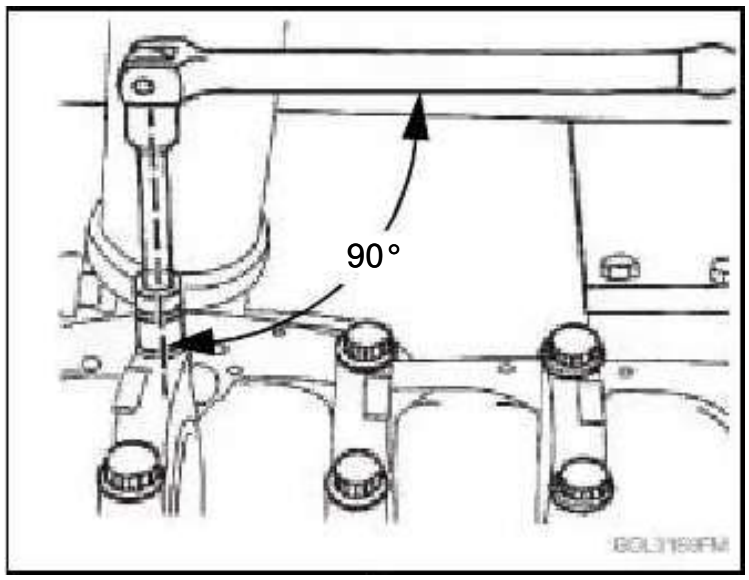
Crown

Measure	Size
Main and conrod bearing journals	0.0 - 0.004 mm (0.0 - 0.0002 in.)

Measure Main Bearings In Engine Block

With crankshaft removed from engine, install main bearing caps with bearing (if previously removed).

Ensure bearings are installed correctly and dry. **(See "Install Crankshaft" on page 173).**



Tighten main bearing cap screws to specification. **(See below).**

Tighten main bearing cap screws to their final torque by placing ratchet handle centerline to crankshaft, then turn clockwise an additional 90°, as shown.

Handle should then be perpendicular to crankshaft centerline.

Crankshaft Specification

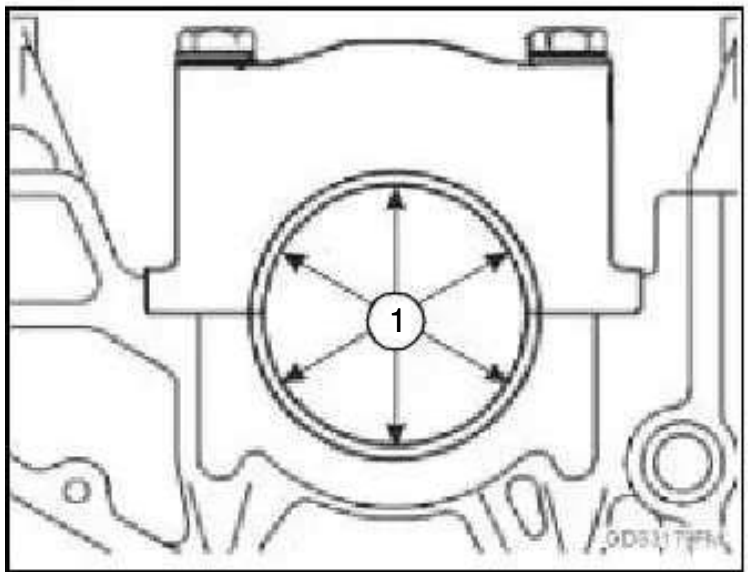
Main Bearing Cap To Crankcase Screw Torque - - - - -
1st stage - 30 Nm (22 lb-ft)

Main Bearing Cap To Crankcase Screw Torque - - - - -
2nd Stage- 80 Nm (59 lb-ft)

Main Bearing Cap To Crankcase Screw Torque - - - - -
3rd Stage - 135 Nm (59 lb-ft)

Main Bearing Cap To Crankcase Screw Torque - - - - -
4th Stage - 90°

NOTE: If engine has previously had a major overhaul and undersized bearings were used, ID and OD dimensions may not be the same as those recorded. However, oil clearance must be as specified in this procedure. See Crankshaft Grinding Specifications in this procedure for under size bearing and crankshaft journal specifications.



Measure ID of all assembled bearings with an inside micrometer in three locations: vertical and 30° above and 30° below joint face.

Compare measurements with the following specifications:

NOTE:1. Main bearing shells are factory-supplied ready for installation and also in oversizes for repairs. It is not permitted to carry out any rework.
2. Factory supplied bearing shell sets, consisting of a standard shell and a sputter bering shell.
3. Sputter shell carries the greater load center

Main Bearing Inner Diameter

Measure OD of all respective crankshaft journals in four locations 90° apart. Compare measurements with the following specifications.

Measure	Size
Standard	86.066 - 86.108 mm (3.3884 - 3.3901 in.)
Undersize -0.1mm (0.004”)	85.966 - 86.008 mm (3.3845 - 3.3861 in.)
Undersize -0.25mm (0.010”)	85.816 - 85.858 mm (3.3786 - 3.3802 in.)
Undersize -0.5mm (0.020”)	85.566 - 85.608 mm (3.3687 - 3.3704 in.)
Undersize -0.75mm (0.030”)	85.316 - 85.358 mm (3.3589 - 3.3606 in.)
Undersize -1.0mm (0.040”)	84.066 - 85.108 mm (3.3097 - 3.3507 in.)

Determine crankshaft-to-main bearing oil clearance based on bearing ID and journal OD measurements above, and compare to the following specifications.

Crankshaft Specification

Crankshaft-to-Main Bearing Oil Clearance
- - - - - - - - - - - 0.056 - 0.118 mm (0.0022 - 0.0046 in.)

Measure connecting rod journal OD and width.

Compare to the following specifications.

Permissible imbalance of crankshaft with pin for fixing flywheel but without flywheel, mounted on outer main bearings - 30gcm.

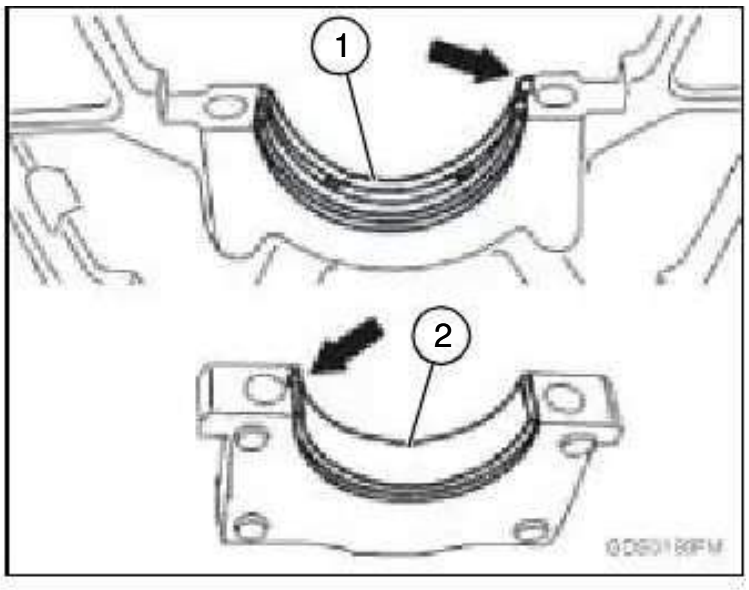
⚠ CAUTION

The dimensions stated in the previous tables must be adhered to. If one of the measurments obtained is beyond the tolerance, machine crankshaft.

Install Crankshaft

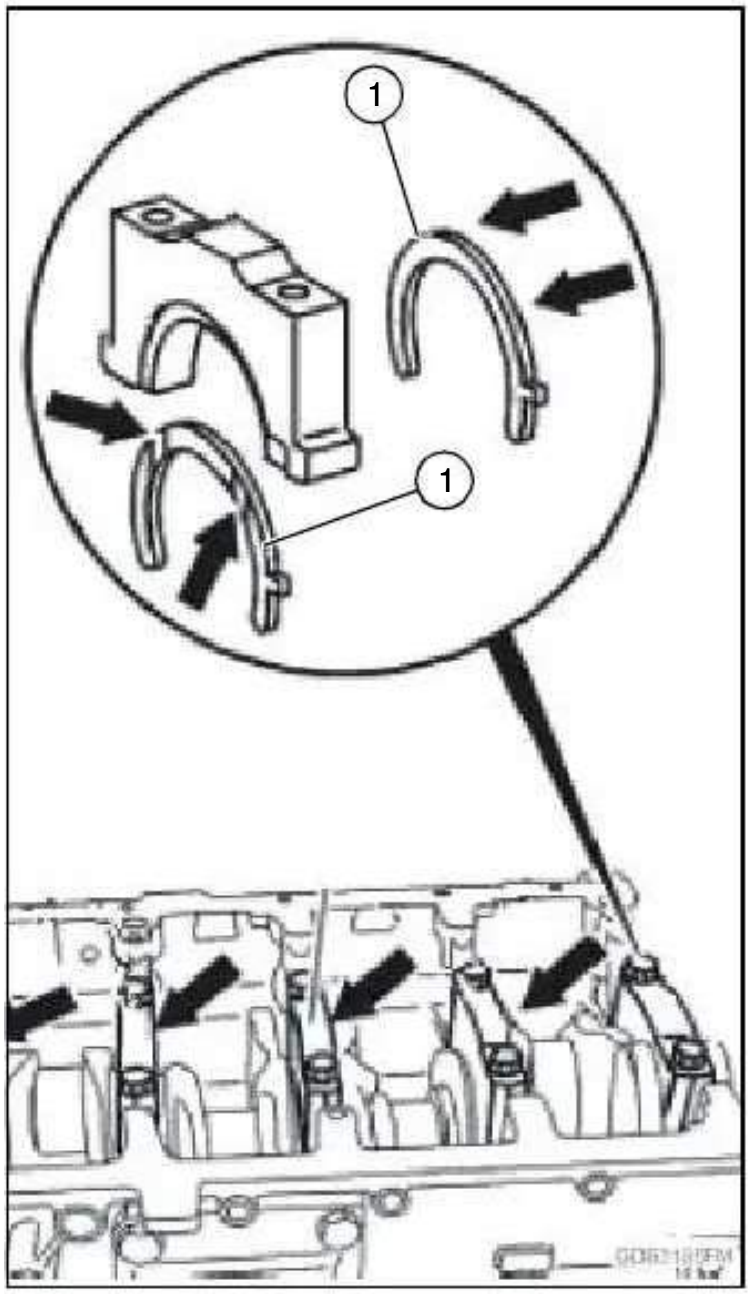
Clean bearing points in the crankcase and main bearing cap with a chamois leather.

NOTE:The locking lugs (Arrow) of the crankshaft bearing shells should be located in the slots of the crankcase basicbores. Oil holes in the crankshaft bearing shells and crankcase should be aligned.



Insert crankshaft bearing shells (1) into the crankcase in the order marked.

Insert crankshaft bearing shells (2) into the main bearing caps in the order marked.



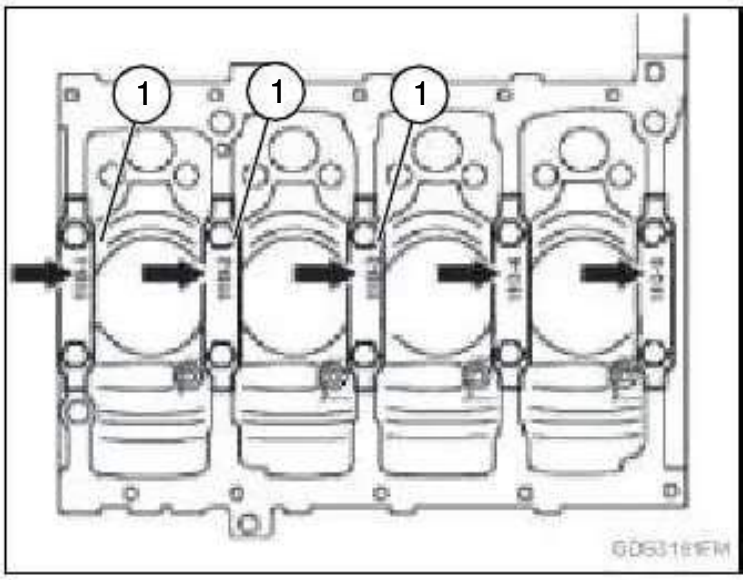
Fit bearings and thrust washers.

⚠ CAUTION

Use a hoist to lift the crankshaft. It is heavy and may injure personnel if lifted by hand.

Lubricate bearing shells, crankshaft and crankcase with the correct grade of oil. **(See Operator's Manual, Chapter 1 for correct grade and specifications).**

Install crankshaft into crankcase.



Install main bearing caps and torque to specification. **(See "Crankshaft Specification" on page 172).**

Install conrod bearing caps and torque to specification. **(See).**

Thrust Washer Specification

Measure	Size
Standard	3.240 - 3.3 mm (0.1276 - 0.13 in.)
Oversize 0.3mm (0.012")	3.54 - 3.6 mm (0.1394 - 0.1417 in.)
Oversize 0.5mm (0.020")	3.74 - 3.8 mm (0.1472 - 0.1496 in.)

Assemble in reverse order.