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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.

BELL EQUIPMENT

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.

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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

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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.

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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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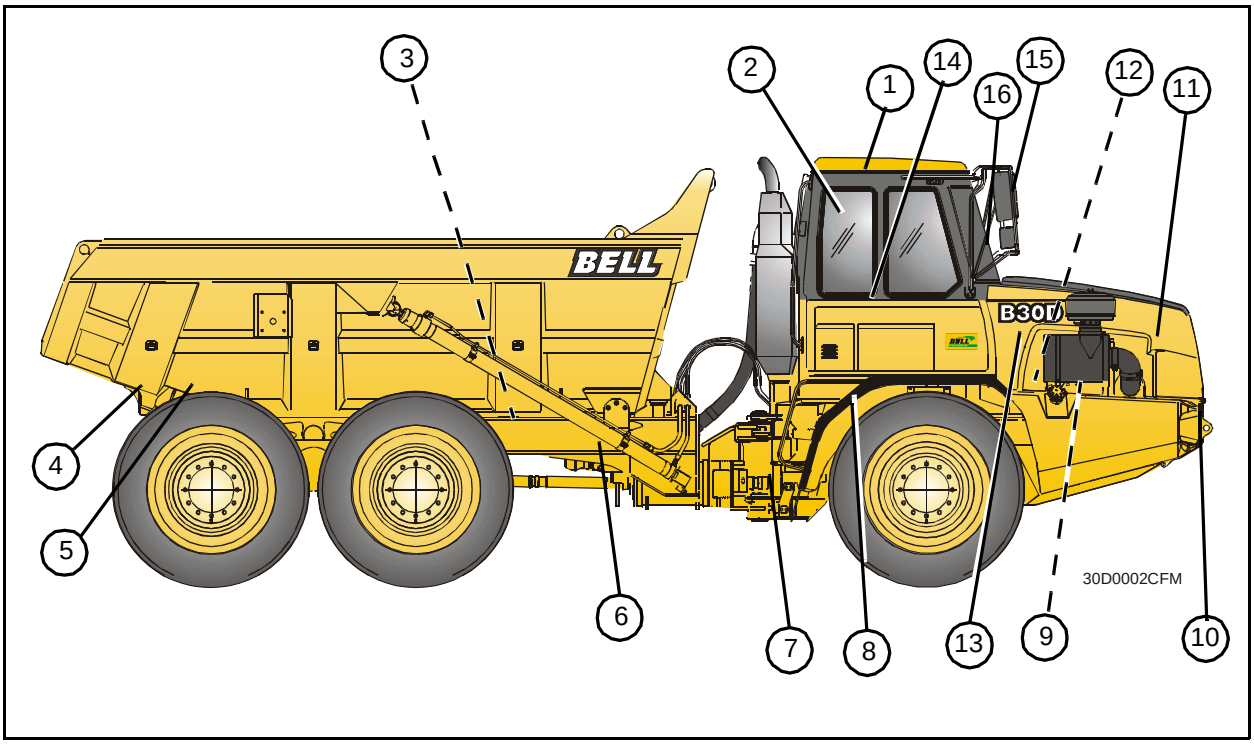
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SAFETY

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.**

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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.

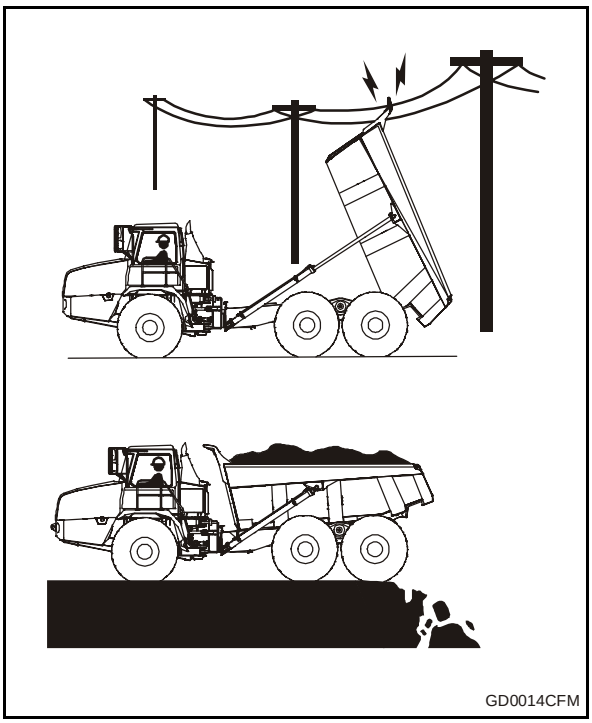
Mounting and Dismounting the Machine

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.

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Avoid Work Site Hazards


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Avoid Overhead Power Lines

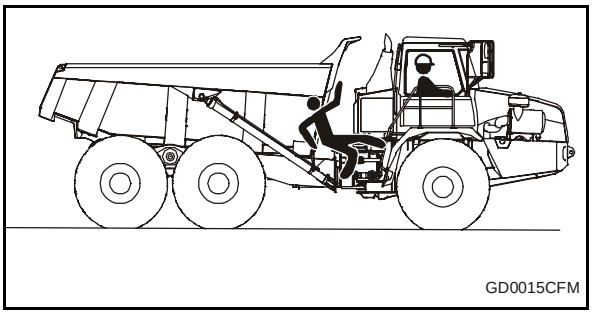
Never move any part of the machine within 3 m (10 ft) plus twice the line insulator length, as serious injury or death may result.

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.

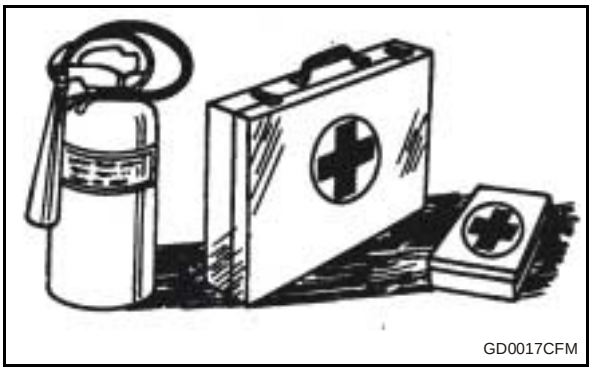
Use caution when backing up to berms before dumping load.

Keep Riders Off the Machine


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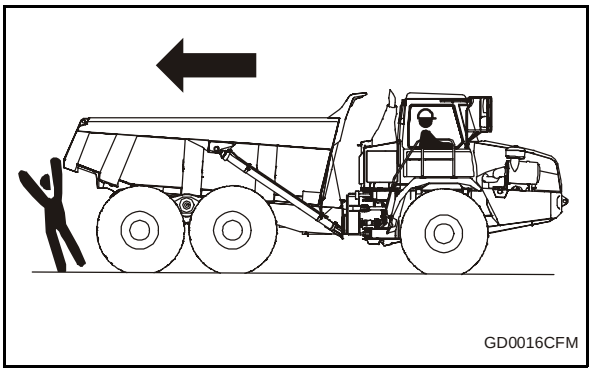
Do not allow unauthorised personnel on the machine.

Prepare for Emergencies


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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


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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.

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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.

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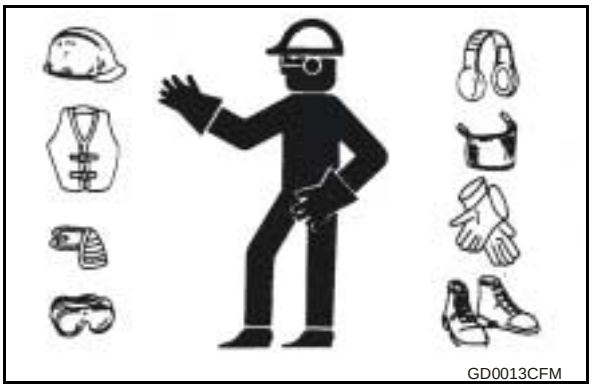
If you spill acid on yourself:

- 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.

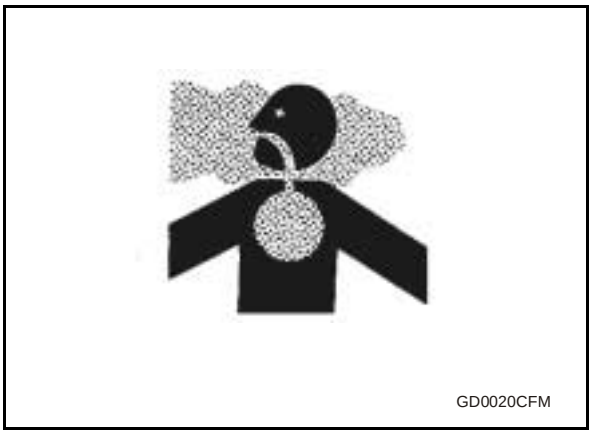
Stay Clear Of Moving Parts

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.

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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


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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

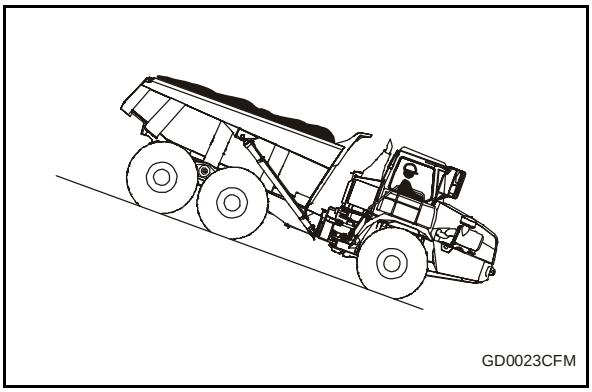
Use safety belt at all times. Do not jump from machine if it tips.

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


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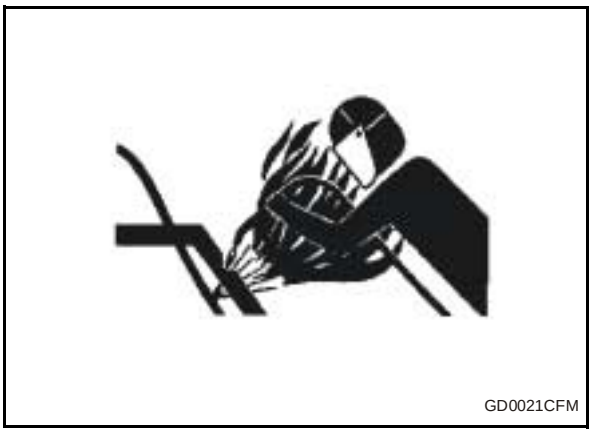
Avoid side slope travel whenever possible.

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.


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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.

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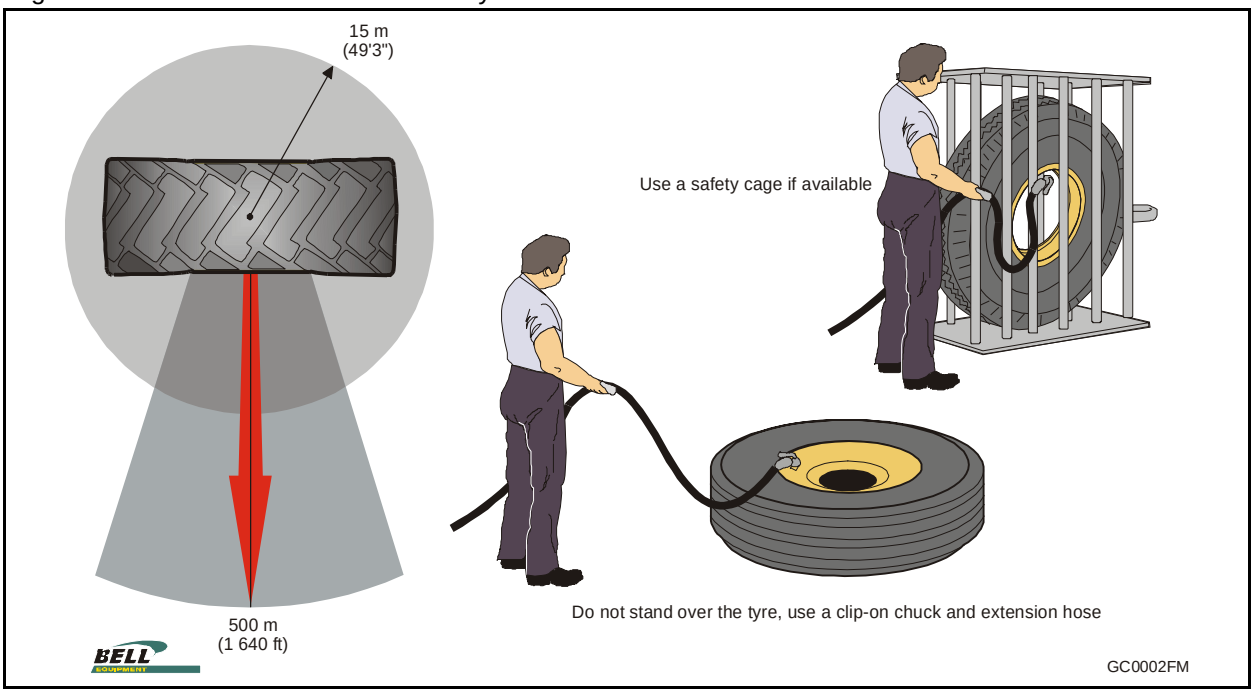
Tyre Information

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, looseness 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

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TECHNICAL DOCUMENTATION BULLETIN RECORD

BULLETIN NO.	SUBJECT	INSERTED BY		
		NAME	SIGNATURE	DATE

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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):_____

_____

_____

_____

_____

_____

_____

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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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

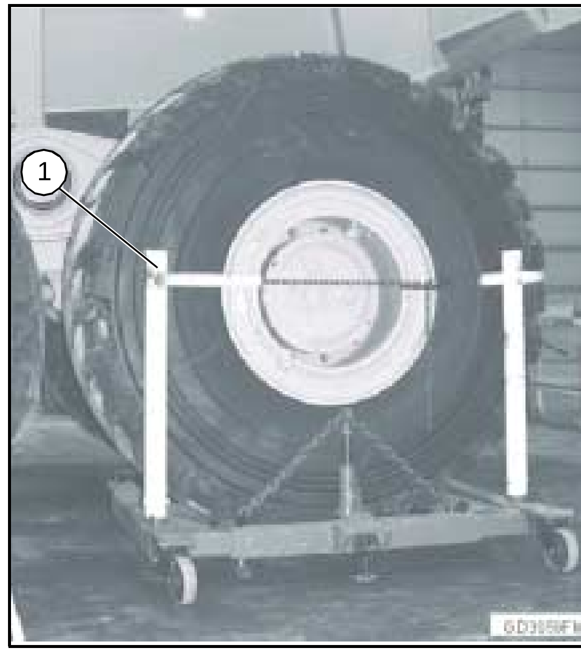
B25D Articulated Dump Truck - Weight ---- 17 700kg (39,000 lb.)

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.

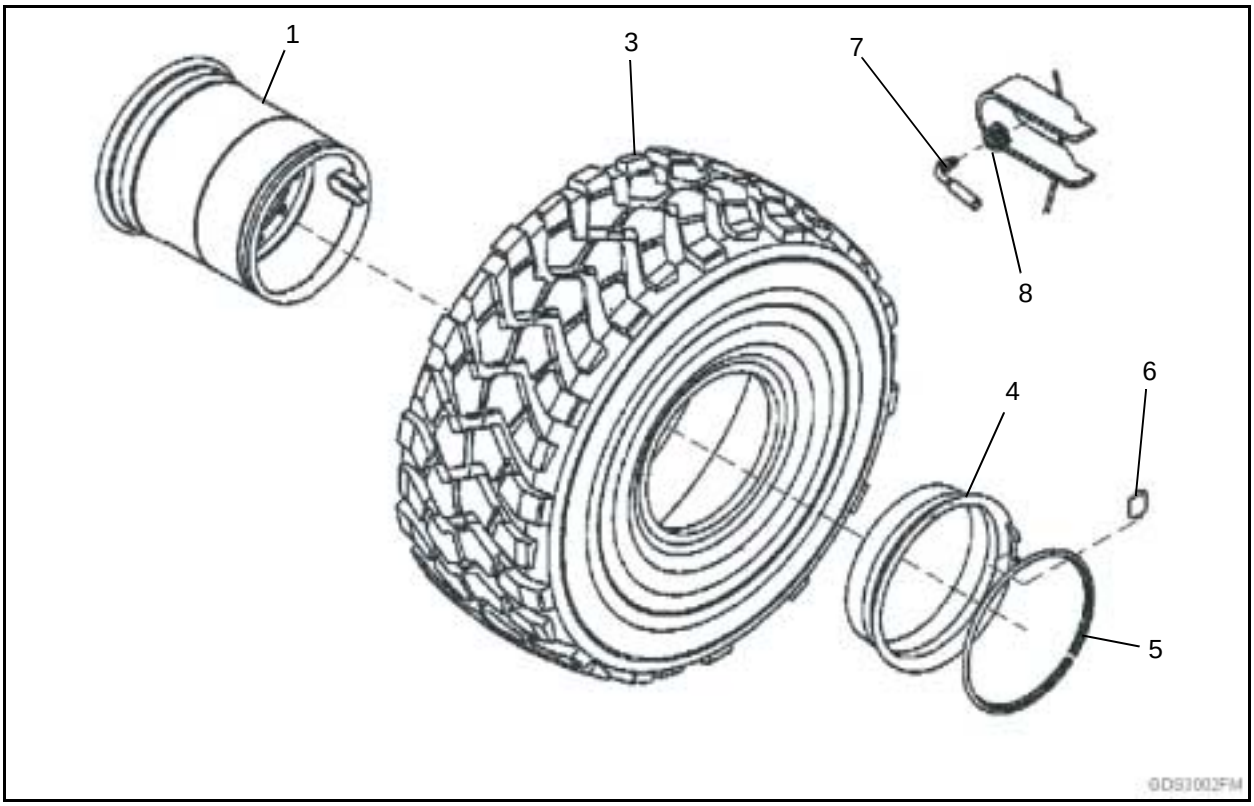
Install Wheel

Install washers and flange nuts.

Tighten flange nuts to specification in a crisscross pattern.

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

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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).**

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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.

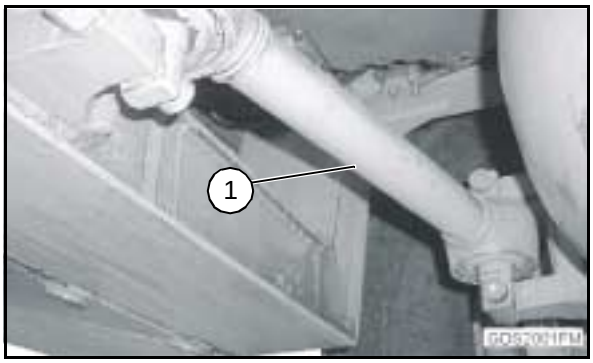
Remove wheels. (**See “Removal” on page 1).**

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

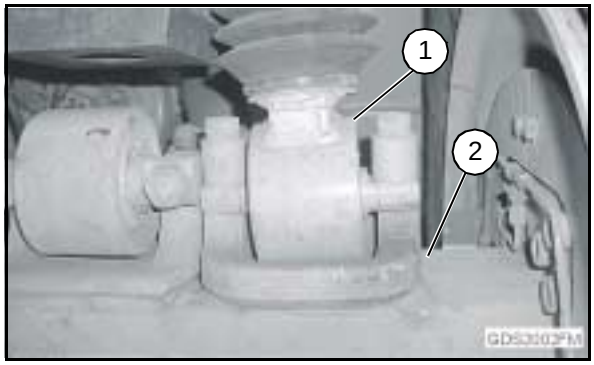
Relieve brake accumulator pressure. Pump service brake pedal at least 100 strokes.

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

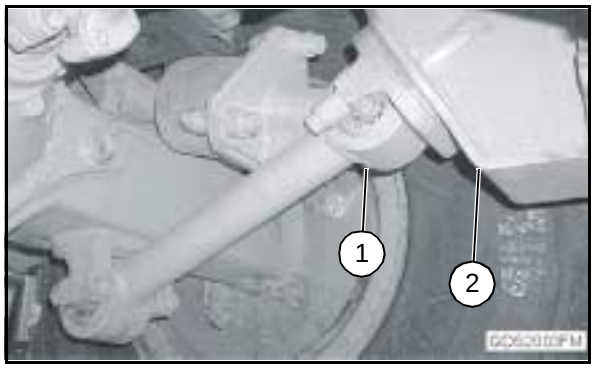
Plug or cap open line(s).



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.

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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

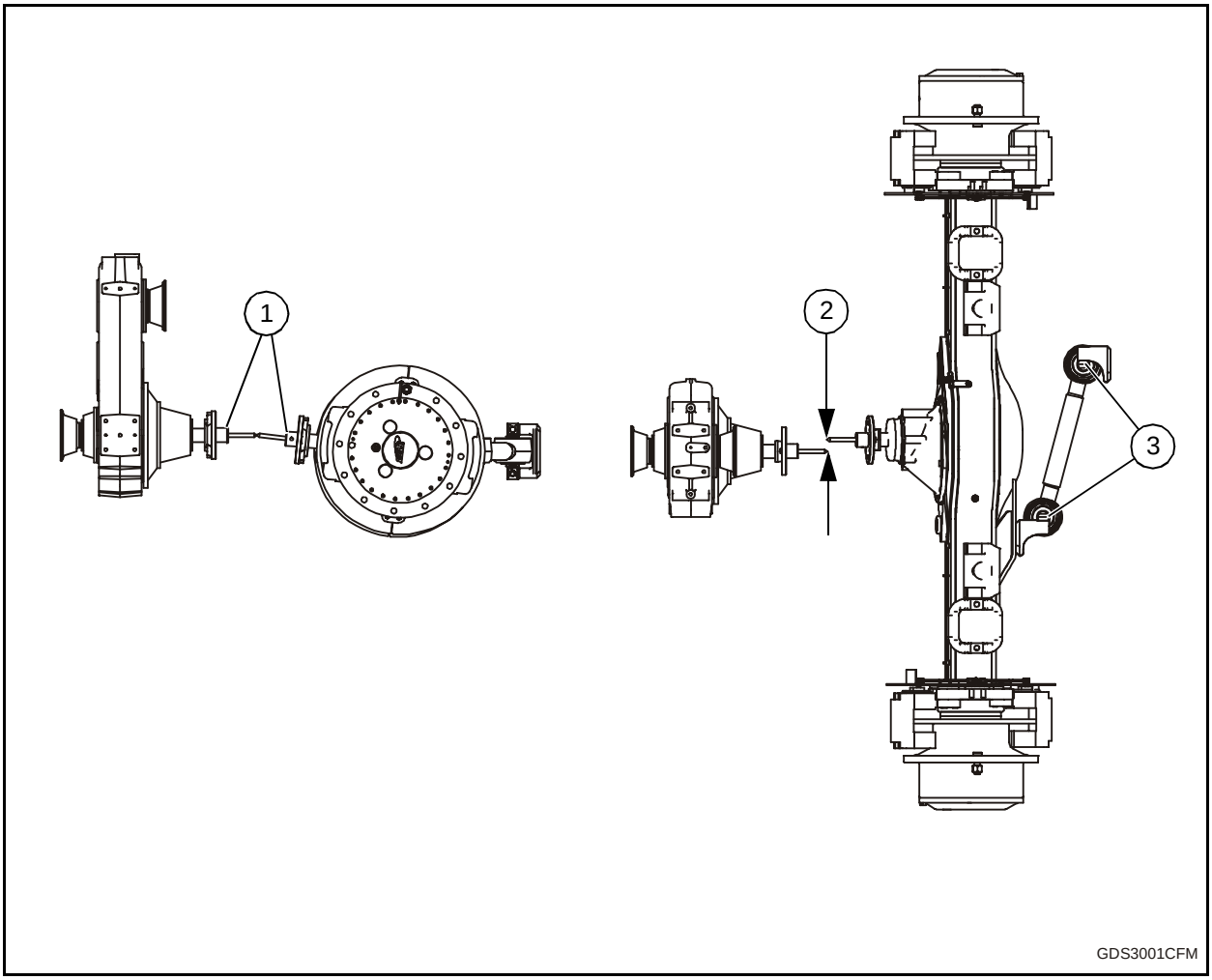
NOTE:Check alignment with all hardware tightened to specifications.

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.

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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

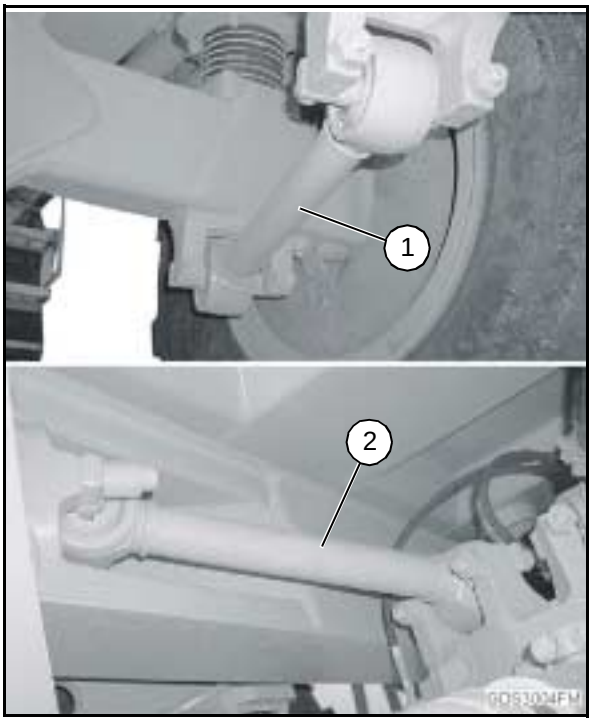
Middle Axle - B30D - Weight - 1066 kg (2350 lb) approximate

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

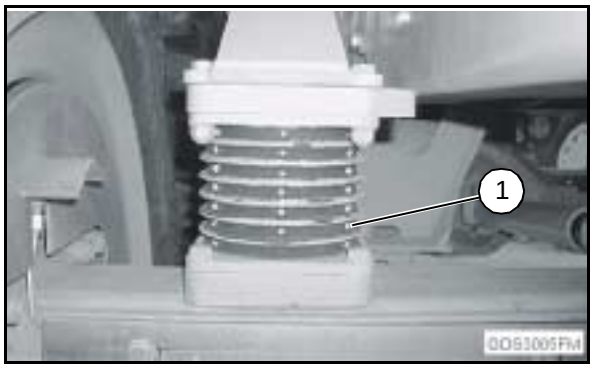
Rear Axle - B30D - Weight - 1043 kg (2300 lb) approximate

Attach a lifting device to axle.

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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).**

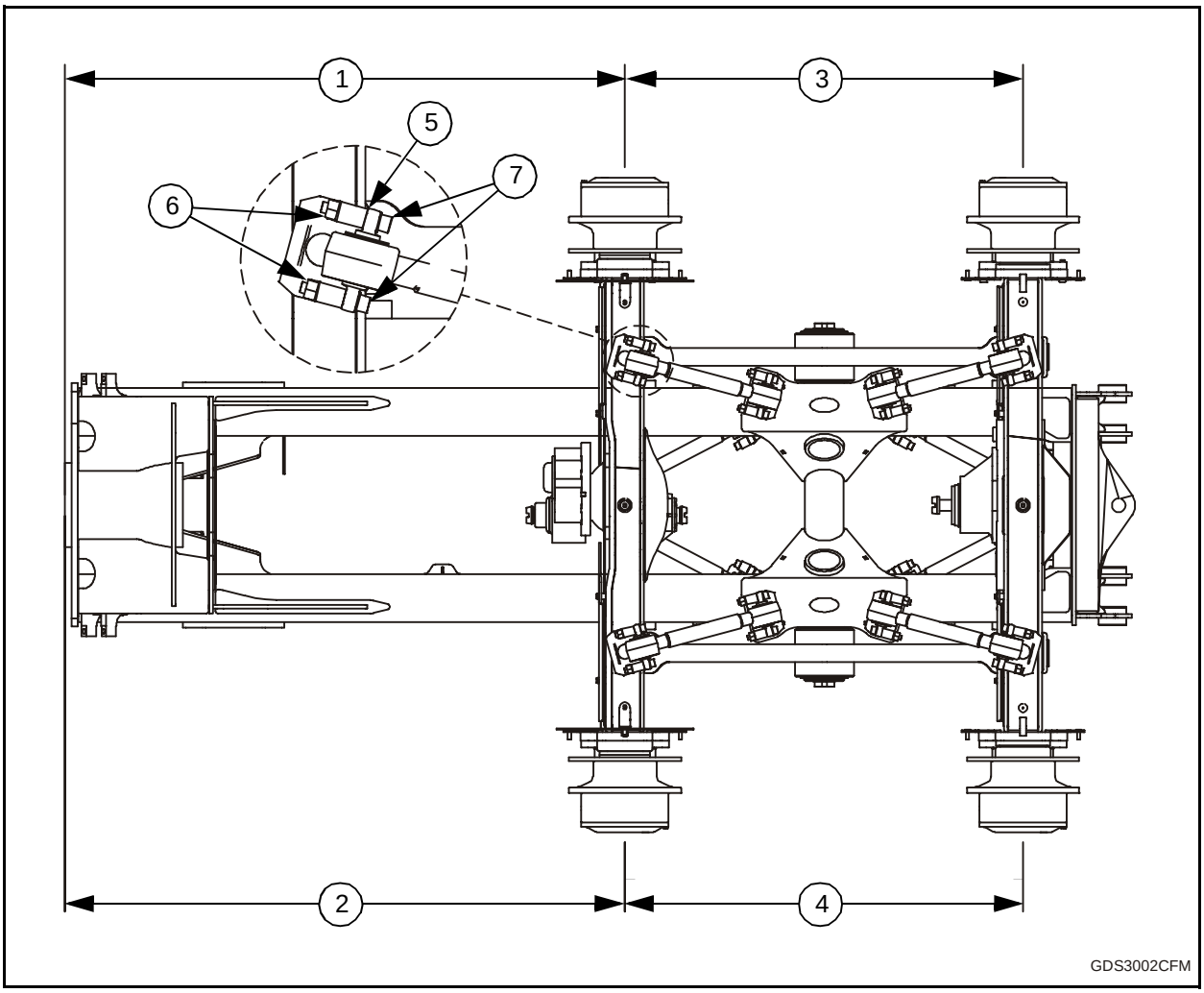
Connect brake line(s).

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).**

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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.

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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.

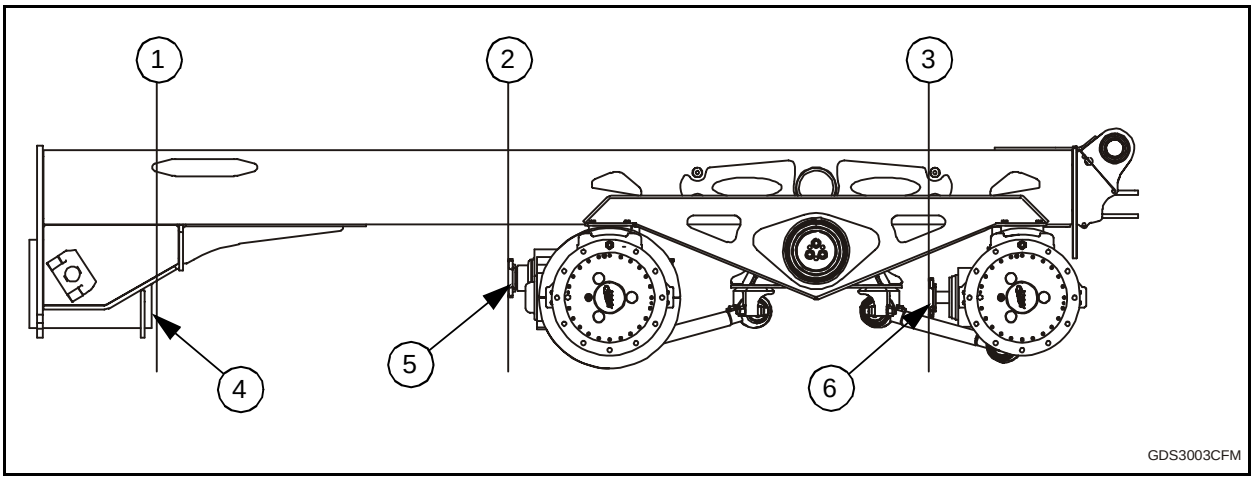
Step 3

- 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°.

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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)

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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

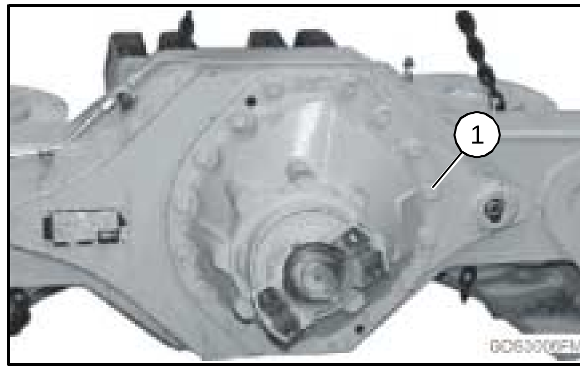
Rear Axle - B30D - Weight - 1043 kg (2300 lb) approximate

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).**



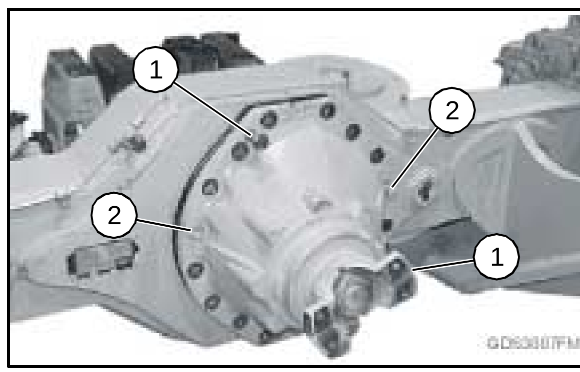
Remove bolts (1).

⚠ CAUTION

Component is heavy. Use lifting device.

Axle Differential Specification

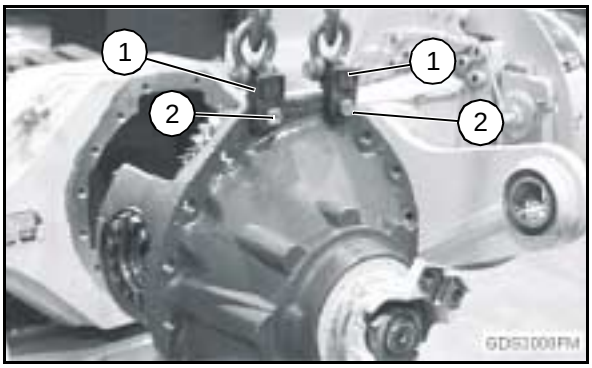
Front or Rear Axle Differential Weight -96 kg (212 lb) approximate



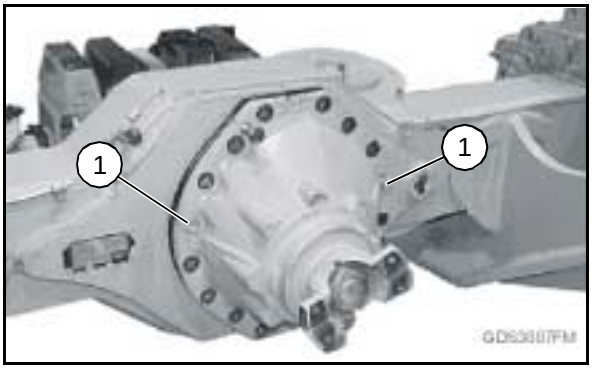
Install bolts (2) to guide and position differential during removal.

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

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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).**

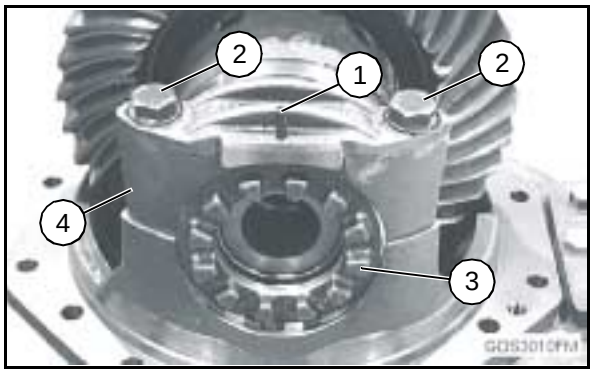
Fill axle housing. **(See Change Axle Oil in Operator's Manual, CHAPTER 15, SECTION 2).**

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.



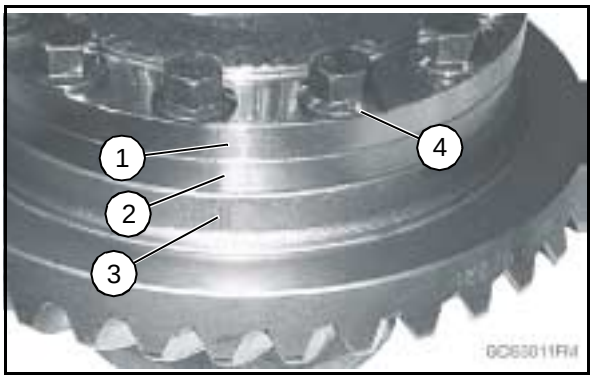
Mark locations of bearing caps (4).

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.

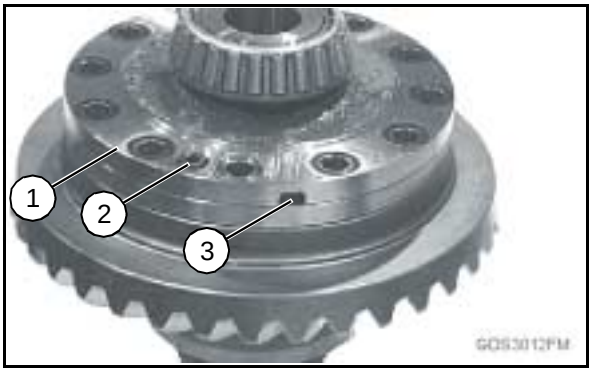
Remove carrier with lifting strap.

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

Remove cap screws (4) and ring gear.



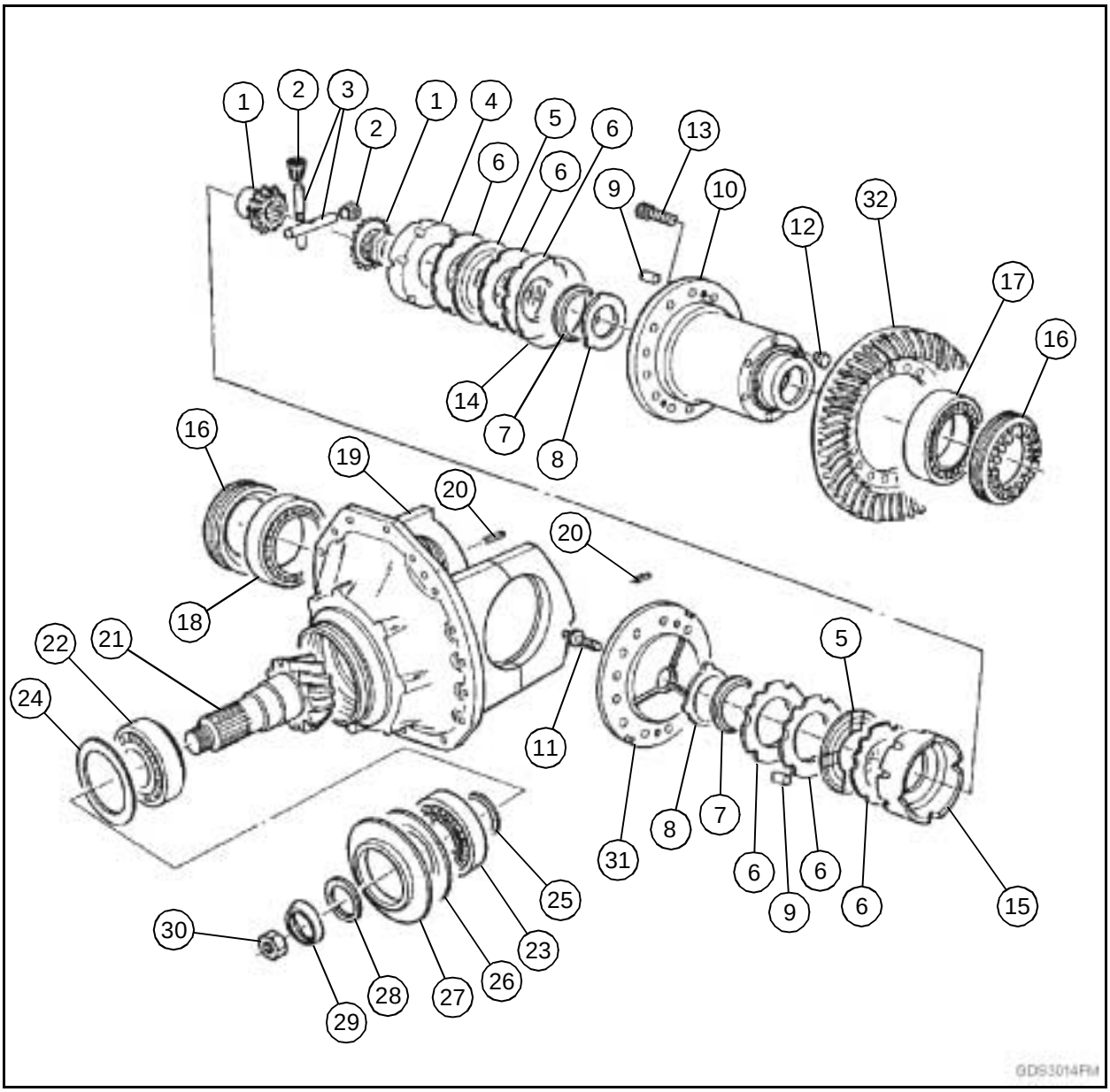
Remove socket head cap screws (2).

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



Remove dowel pins (1).

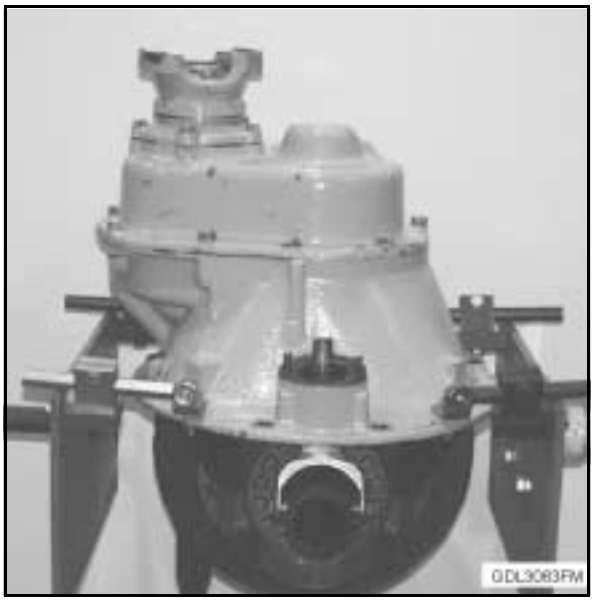
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1. Axle Bevel Gear (2 used).
2. Bevel Gear (4 used).
3. Pinion Cross Shaft (2 used).
4. Ring Housing.
5. Clutch Disk (6 used).
6. Clutch Disk with Inner Spline (2 used).
7. Thrust Washer (2 used).
8. Thrust Washer (2 used).
9. Dowel Pin (12 used).
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.

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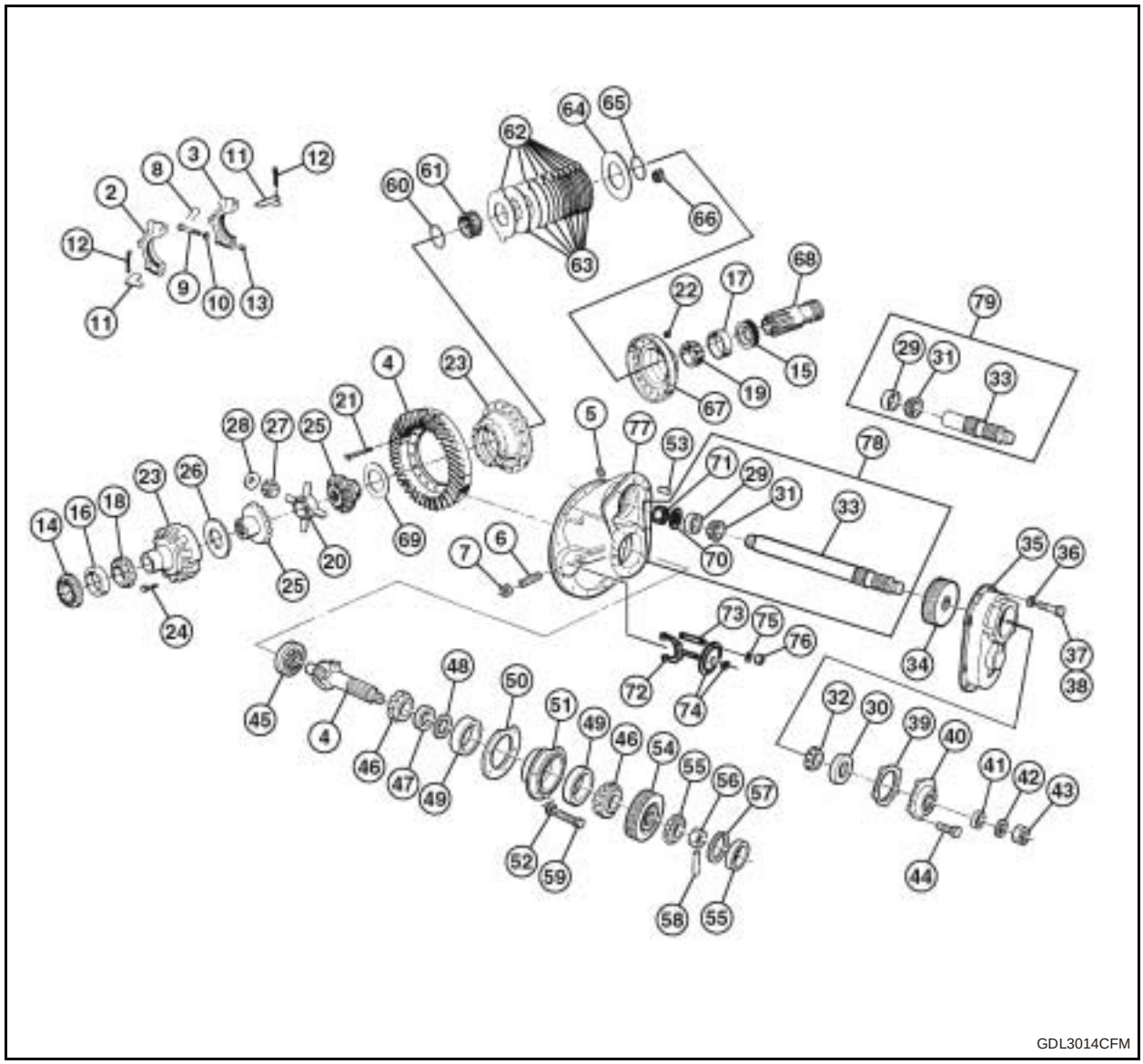
Disassemble



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.

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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).

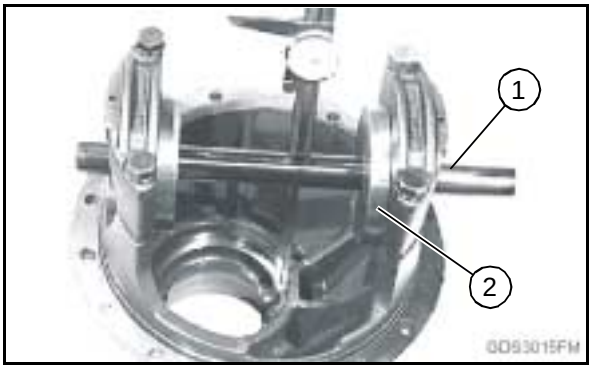
Inspect and clean all parts.

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.)

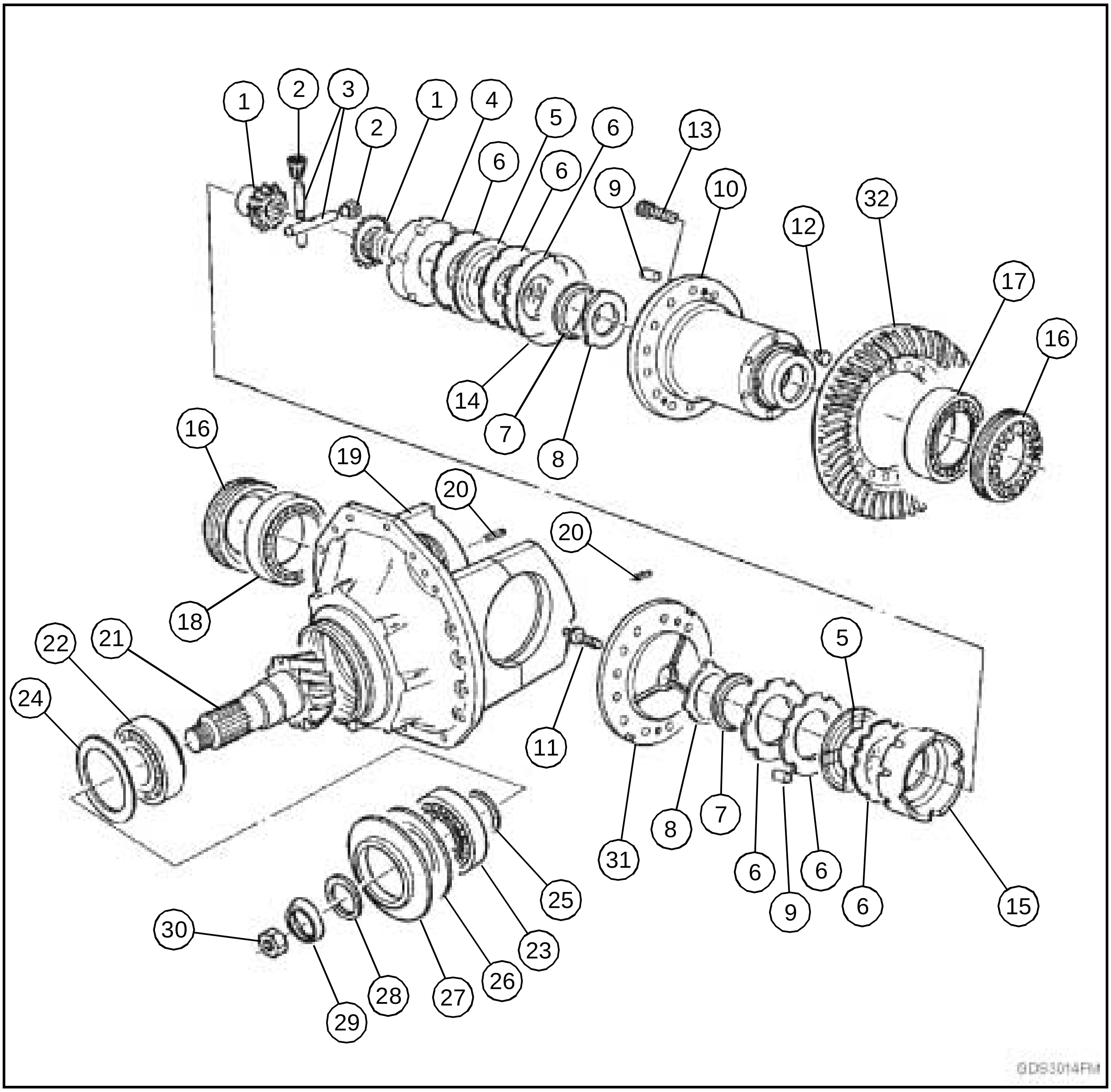


Measure pinion bearing thickness with depth micrometer.

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)

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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.

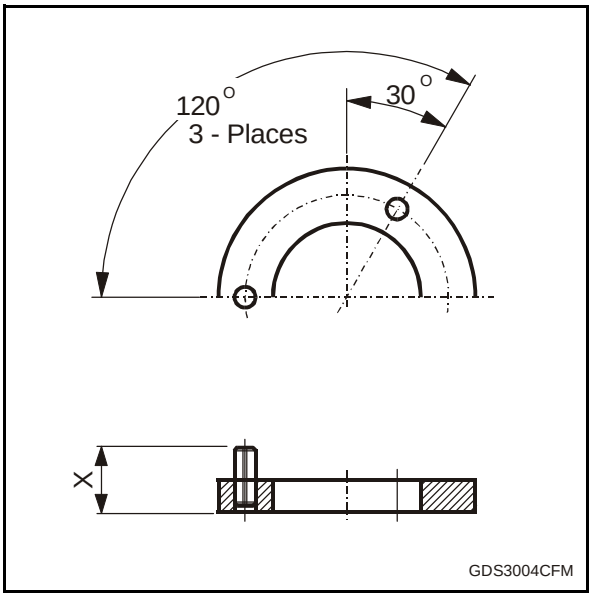
Tighten nut and measure rolling drag torque.

Specification

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

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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.

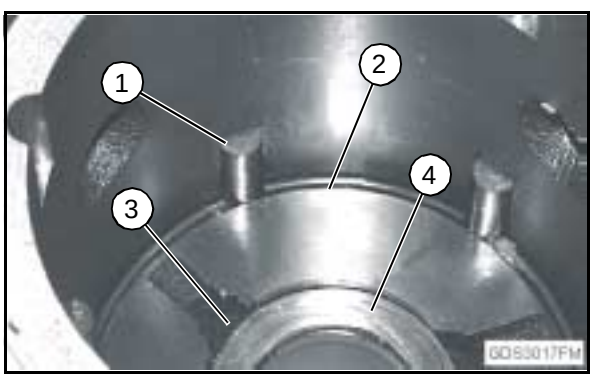
Install seal.

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

Specification

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

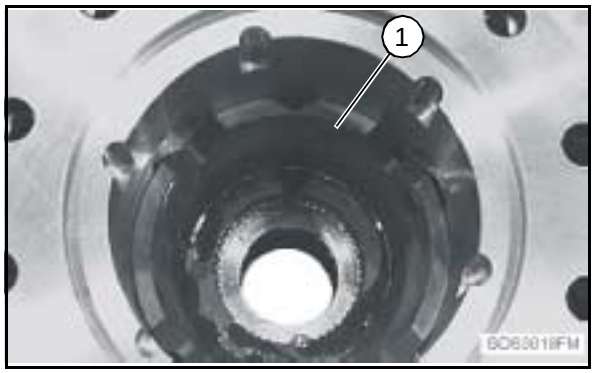
Heat roller bearings (17 and 18) to 110°C (230°F) and install bearings on housing (10) and carrier cover (31).



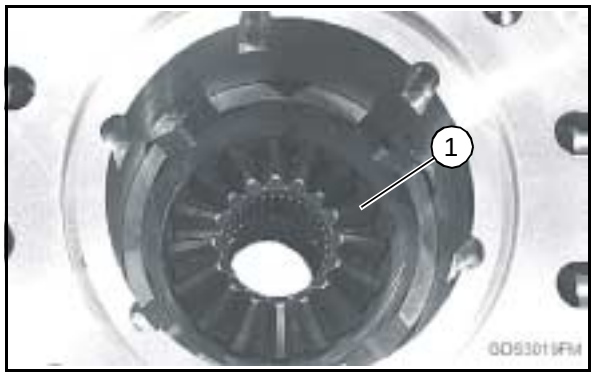
Install thrust washers (3 and 4) in housing.

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

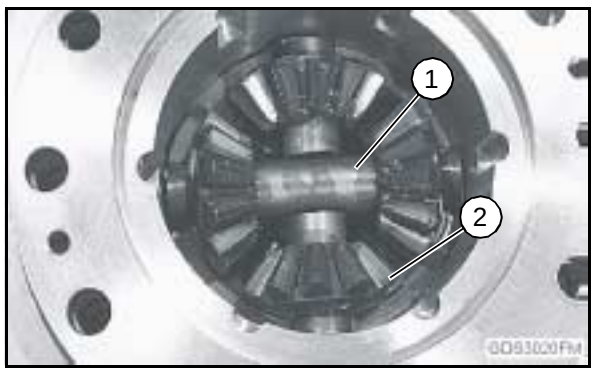
Lubricate and install disks in the following order: notched disk, notched disk, splined disk and notched disk.



Install bevel gear housing (1) onto dowel pins.

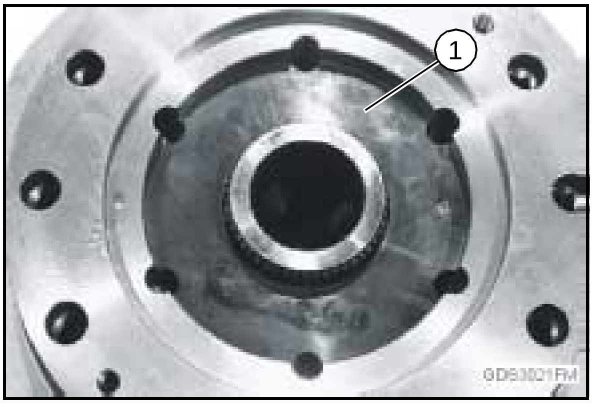


Install axle bevel gear (1). Ensure axle bevel gear engages both splined disks and contacts thrust washer.

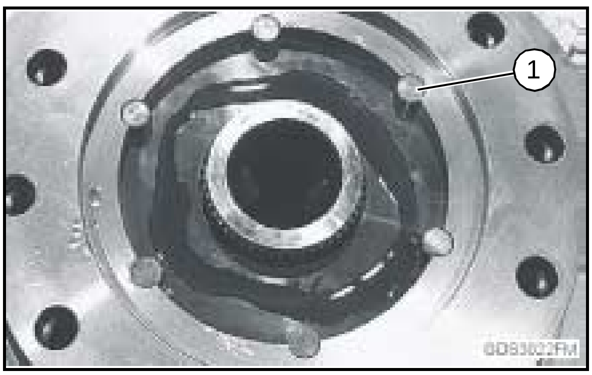


Lubricate and install bevel gears (2) and pinion cross shafts (1) as an assembly.

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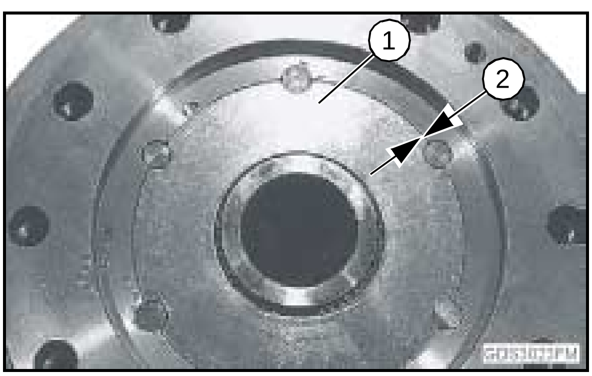


Install bevel gear housing (1) over cross shafts and align with case dowel pin slots.



Install dowel pins (1).

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

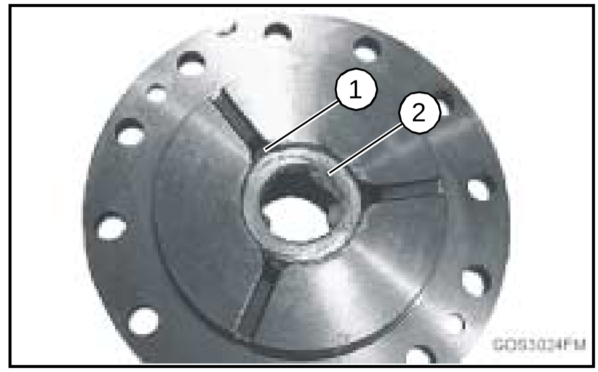


NOTE: Limited slip disk height can be adjusted by installing splined disks of various thickness.

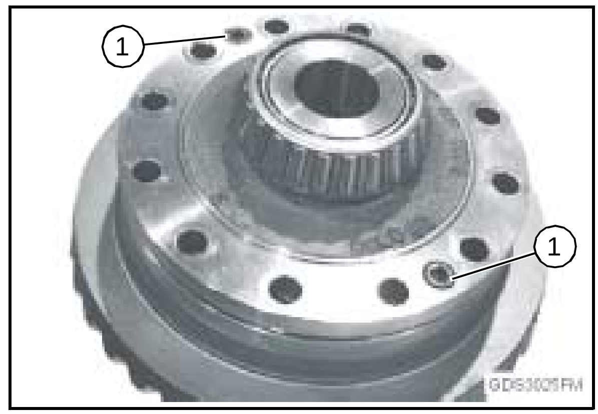
Measure the installed disk height at location (2).

Specification

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

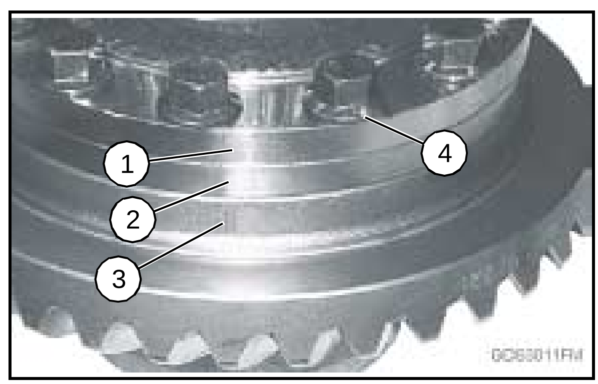


Apply multi-purpose grease to thrust washers (1 and 2) and install in cover.



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

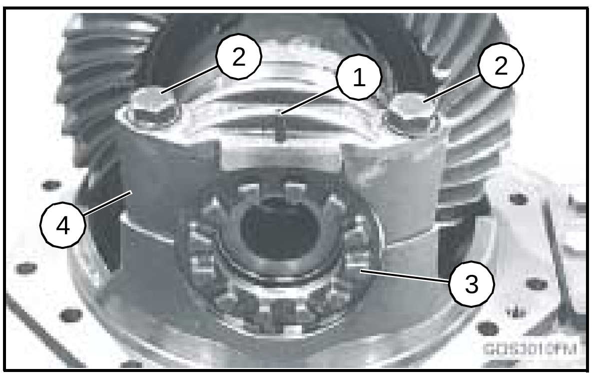
Ring Gear Cap Screw Torque- - - - - 400 Nm (295 lb-ft)

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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

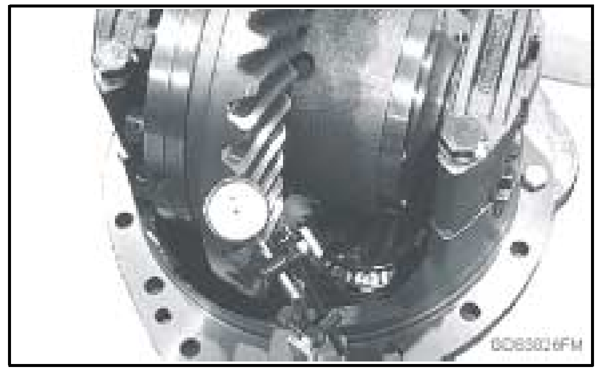
Tighten cap screws (2) to specification.

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.

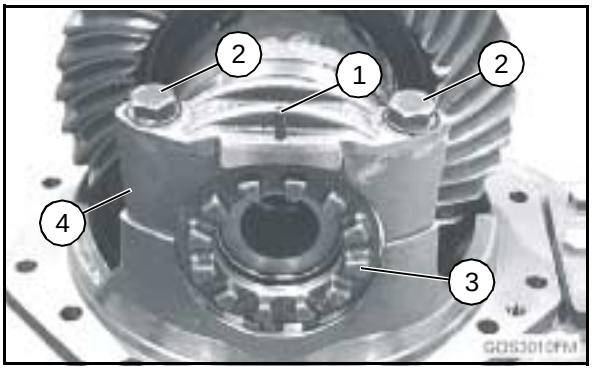
Specification

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

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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)

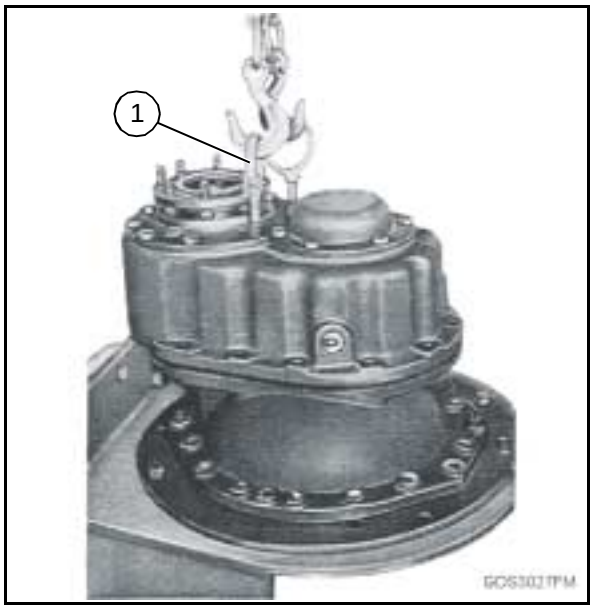
Remove middle axle. **(See "AXLES" on page 3).**

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).**



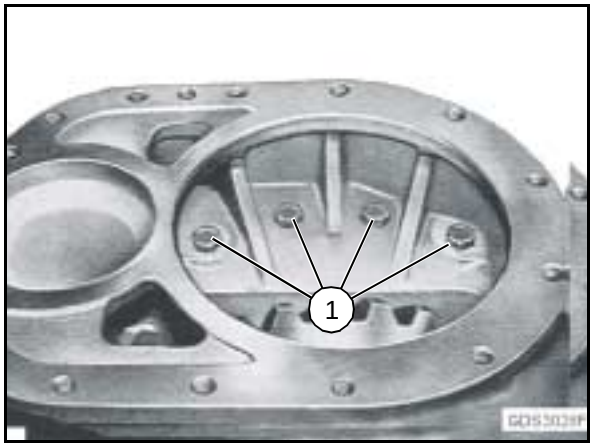
Install JT05550 M12 x 1.75 mm Lifting Eyebolts (1) in adapter case.

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.

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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.

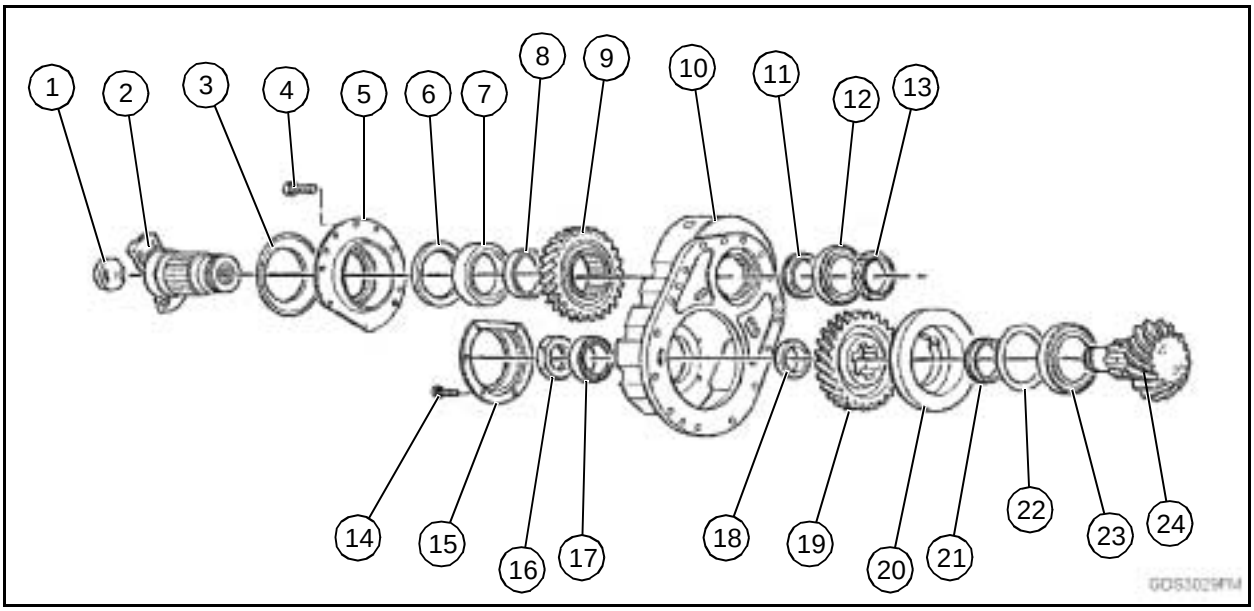
Install axle shafts. **(See Remove and Install Axle Shaft CHAPTER 2, SECTION 5.)**

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).**

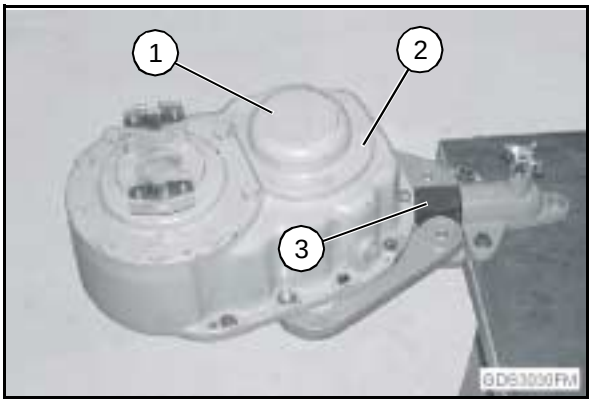
Disassemble



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.

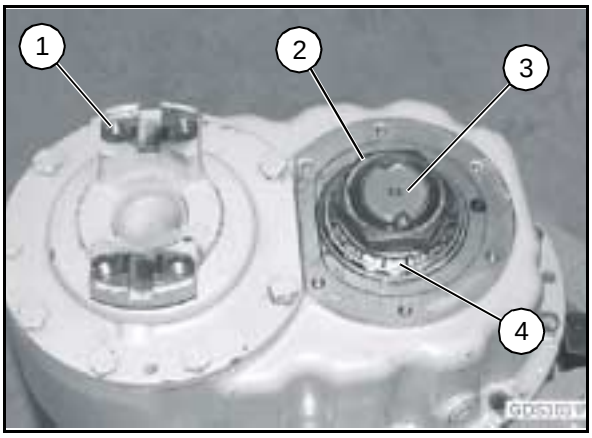
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Remove middle differential from axle housing. **(See “Remove and Install Differential - Middle Axle” on page 20).**



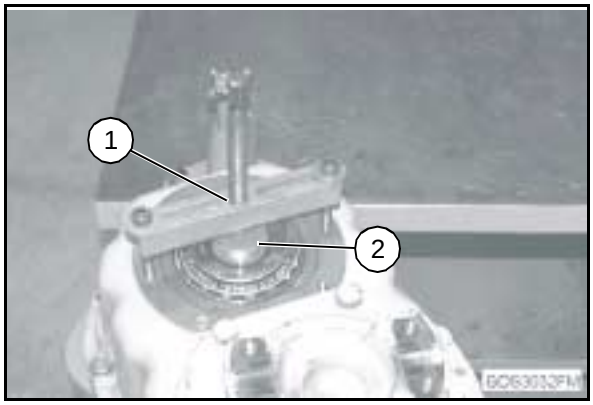
Install D01006AA Bench Mount Fixture (3) to adapter case and lock in bench mount.

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).

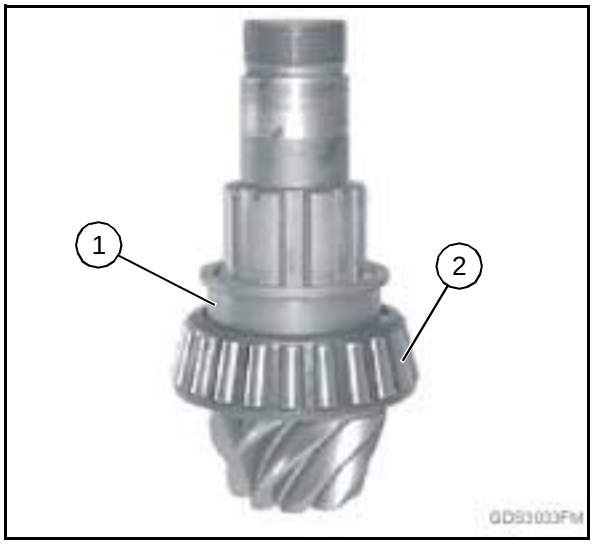


⚠ CAUTION

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

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

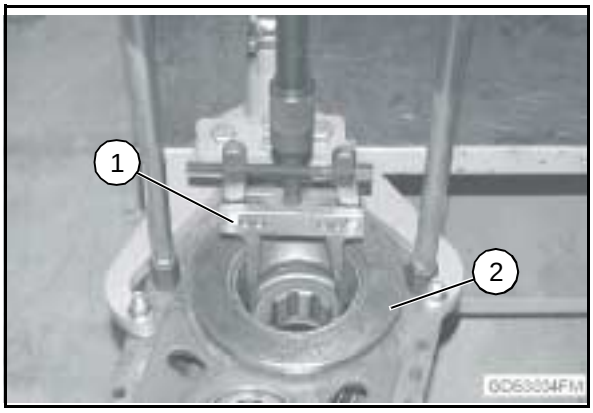
Remove bearing cone.



Remove shim (1).

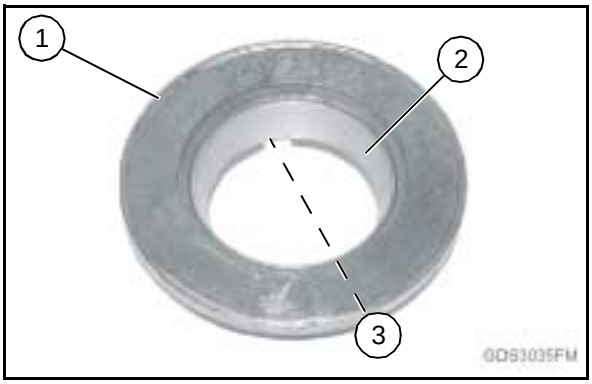
Remove bearing cone (2) from pinion shaft using a press and a knife-edge bearing puller.

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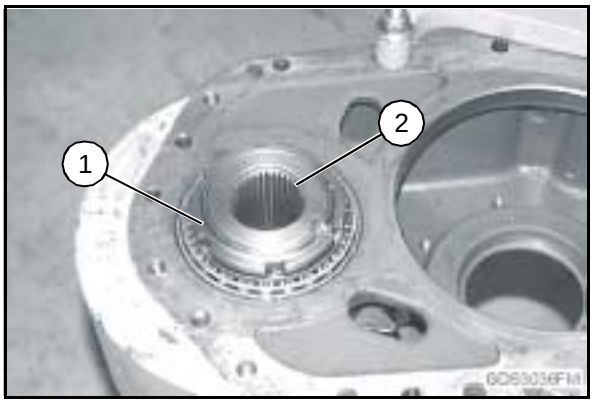
Remove bearing retainer (2) with D01215AA Internal Puller (1) and D01048AA 17-1/2 Ton Puller Set.

Remove spur gear.



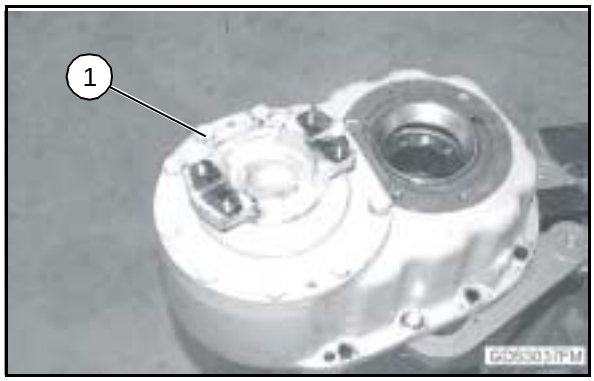
Remove bearing cup (2) and shim (3) from bearing retainer (1).

Clean and inspect all parts for wear or damage.

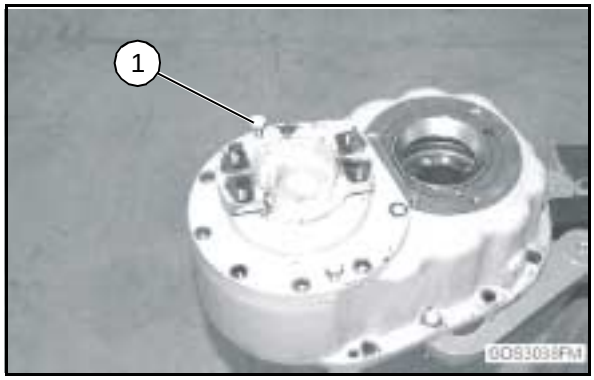


Using a punch and hammer, free stake from spanner nut (1).

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



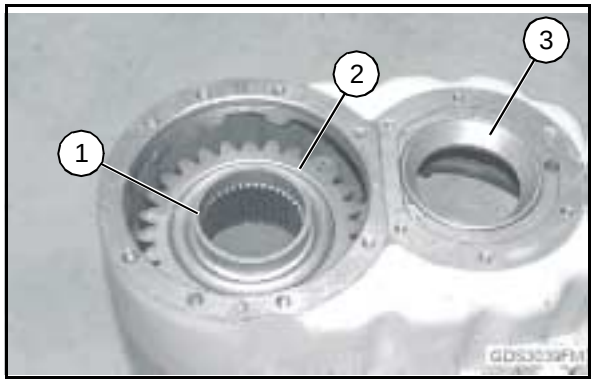
Remove cap screws (1) from bearing housing.



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.

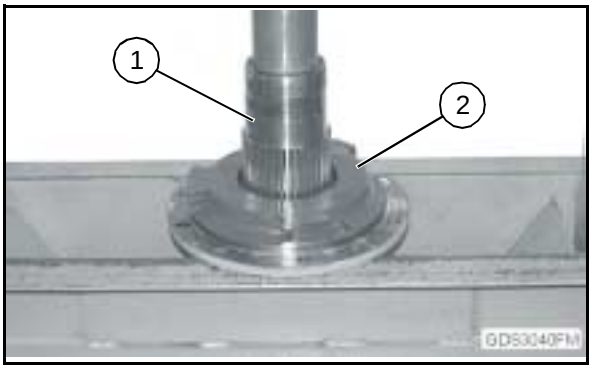
Evenly tighten jack screws to separate bearing housing from case.



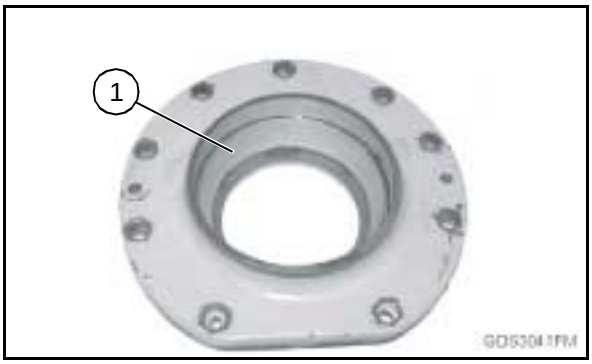
Remove shim (1) and spur gear (2) from housing.

Remove bearing cup (3).

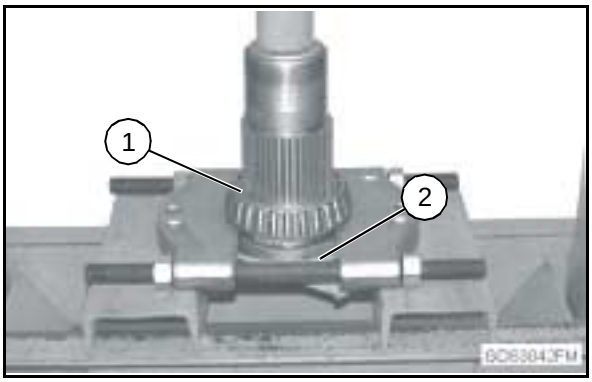
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Press drive shaft (1), bearing cone and seal from bearing housing (2).

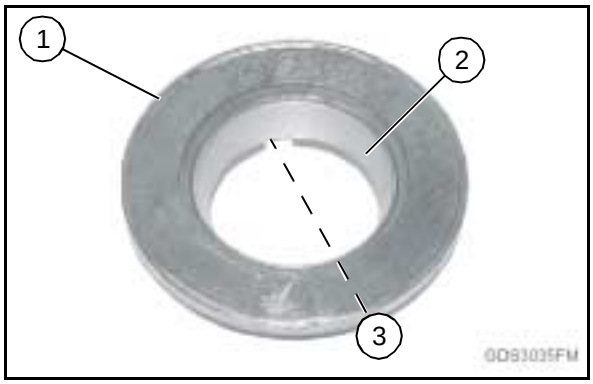


Remove bearing cup (1).



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

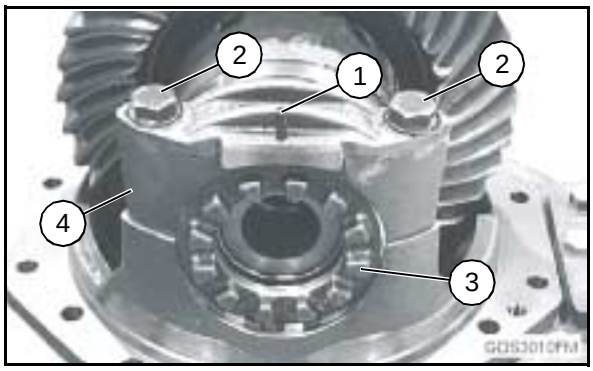
Remove seal (2).



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



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

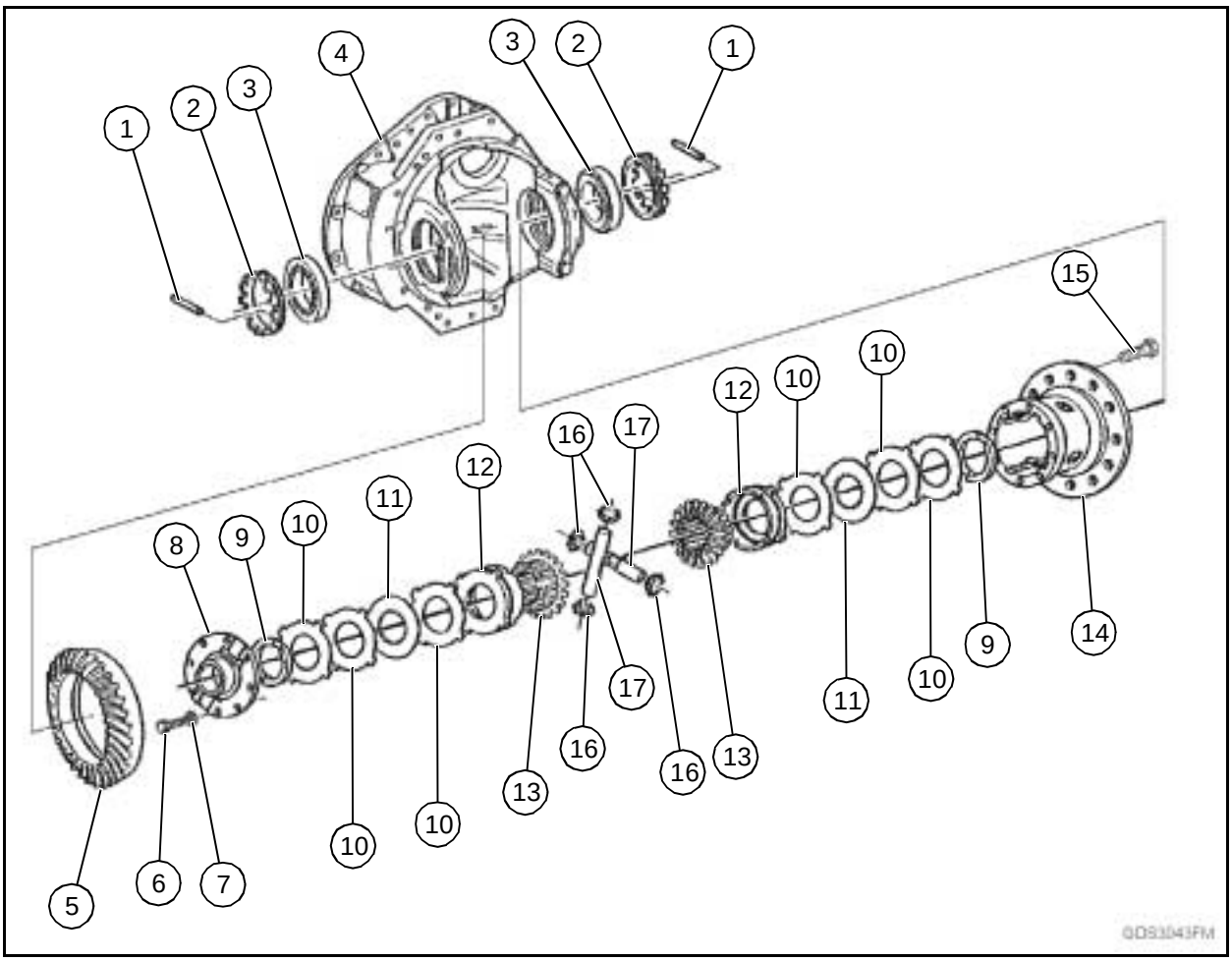


Loosen cap screws (2), remove lock pins (1), and loosen adjuster nuts (3) with JDG1278 Axle Spanner Nut Wrench.

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

Remove the carrier with a lifting strap.

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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.

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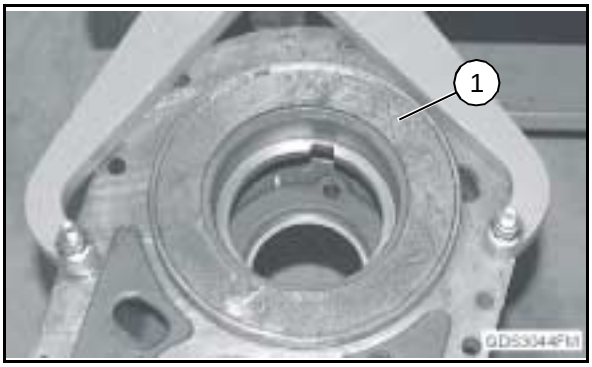
Assemble

Clean and inspect all parts for wear or damage.

⚠ CAUTION

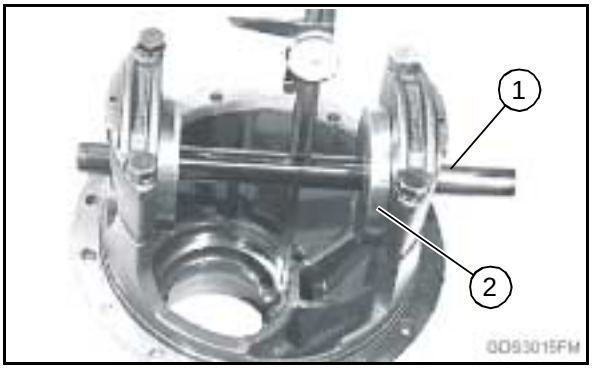
1. If adapter case, bearing retainer, bearing, or pinion shaft have been replaced, the following measuring operations must be done.
2. Failure to make precise measurements and correct shim selection will cause pinion and crown wheel to wear prematurely.

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.)

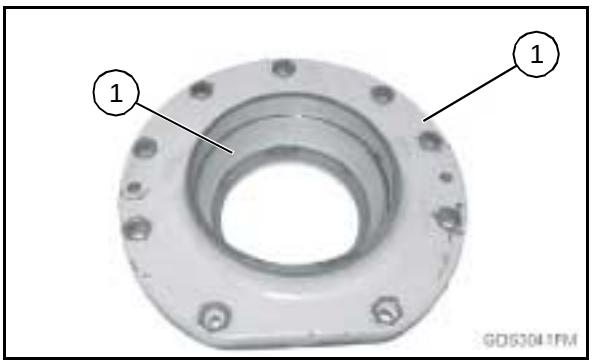


Measure pinion bearing thickness with depth micrometer.

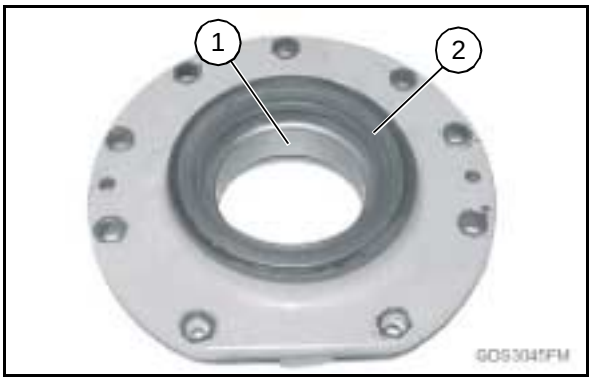
Example of Piston Bearing Thickness Measurement	
Measurement of bearing and cup thickness	37.10 mm (1.461 in.)
Add pinion bearing height (etched on pinion)	+151.7 mm (5.972 in.)
Pinion Bearing Thickness Measurement	188.8 mm (7.433 in)

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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).



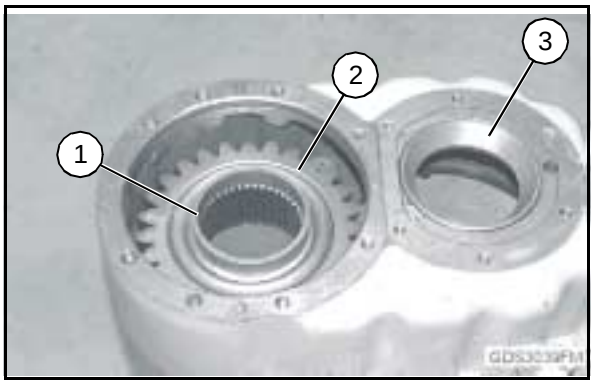
Apply multi-purpose grease to bearing cone (1) and install bearing cone.

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.

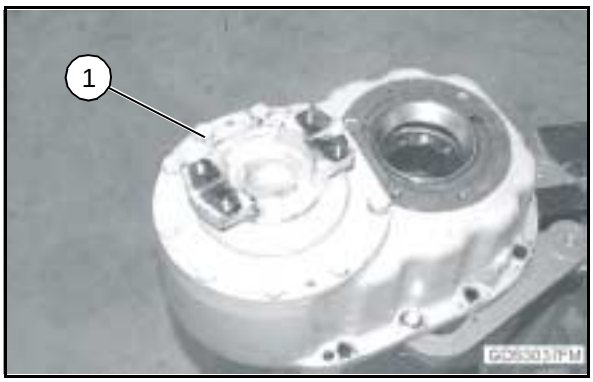
Heat bearing cone to 110°C (230°F). Install assembled bearing housing over input drive shaft ensuring bearing is fully seated.



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

Install shim (1) on spur gear.

Install bearing cup (3).

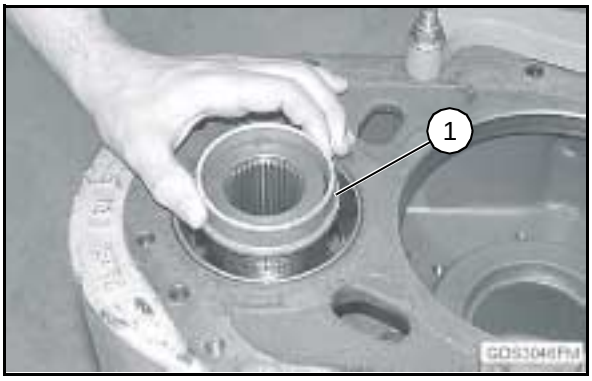


Apply cure primer and form-in-place gasket to mating surfaces of bearing housing.

Install bearing housing and input drive shaft into adapter case.

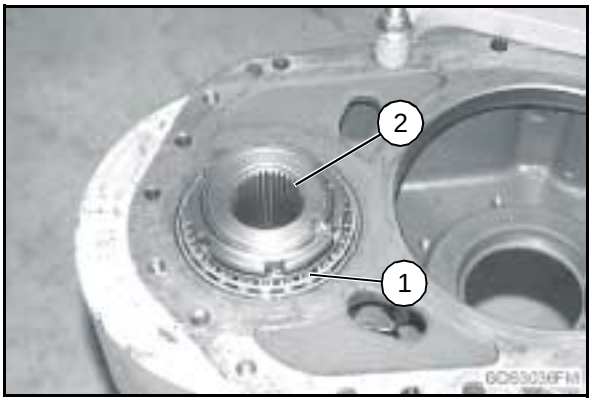
Apply cure primer and thread lock and sealer to threads of cap screws (1). Install and tighten cap screws.

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Install shim (1) with collar against spur gear.

Apply multi-purpose grease to bearing cup.



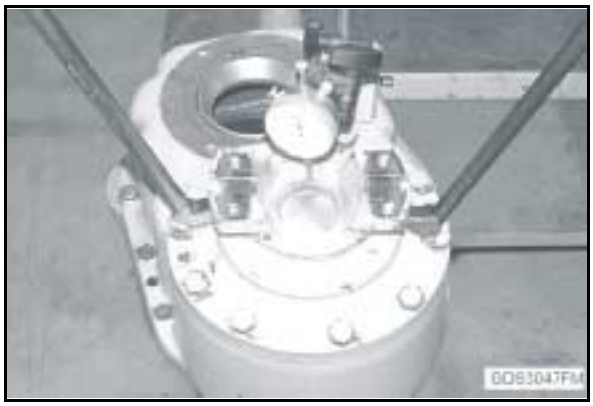
Heat bearing cone (1) and install over drive shaft.

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)

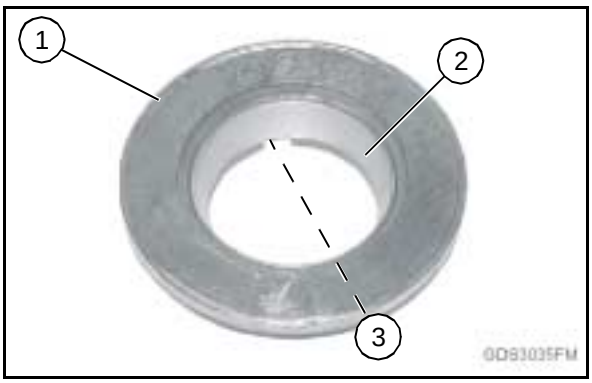


Measure rolling drag torque of the input drive shaft. Record this value for the installation of the pinion shaft.

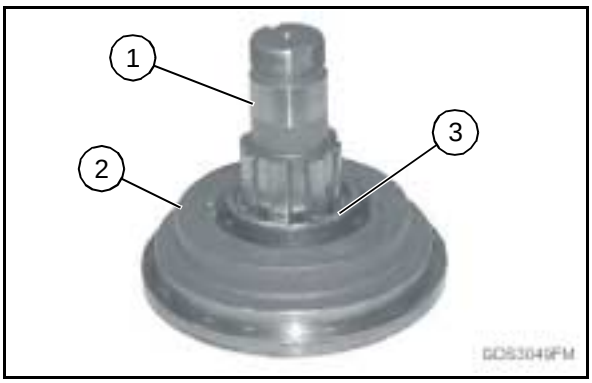
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Install bearing cone (1) on pinion shaft.



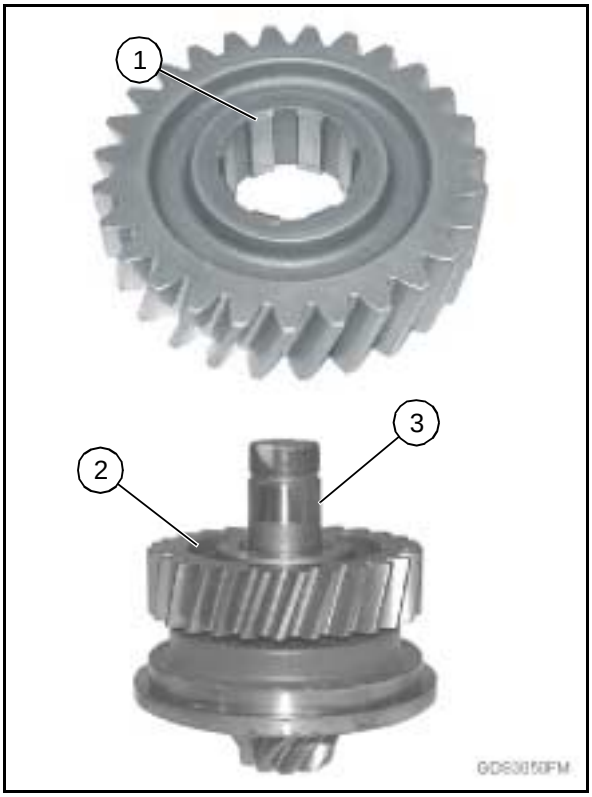
Install pre-determined shim (3) and bearing cup (2) into bearing retainer (1).



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

Install shim (3) with collar up.

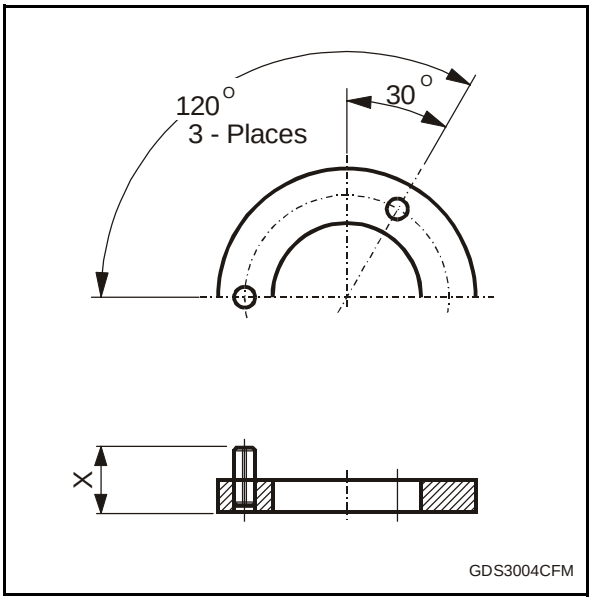
Heat spur gear (2) to 110°C (230°F).



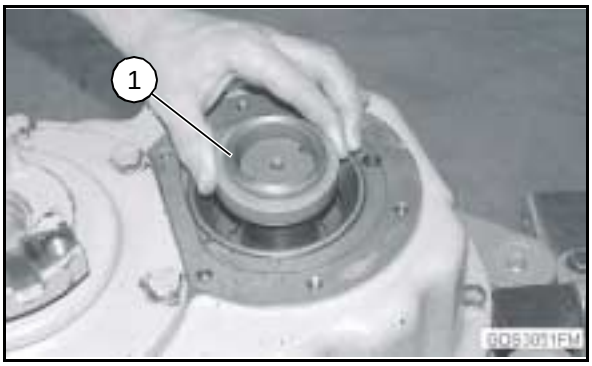
Install spur gear on pinion shaft (3) with chamfer (1) facing down toward shim. Ensure that spur gear is fully seated on shim.

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

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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)



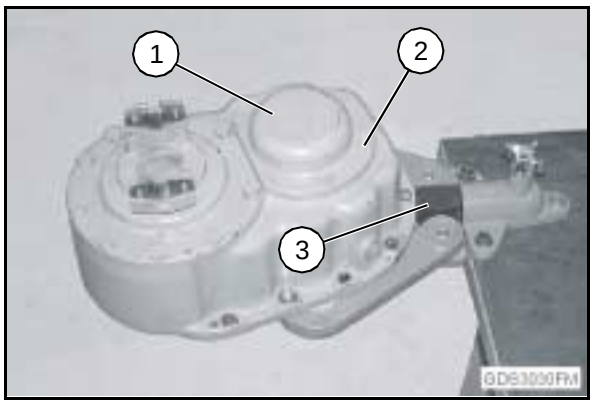
Measure rolling drag of pinion shaft.

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

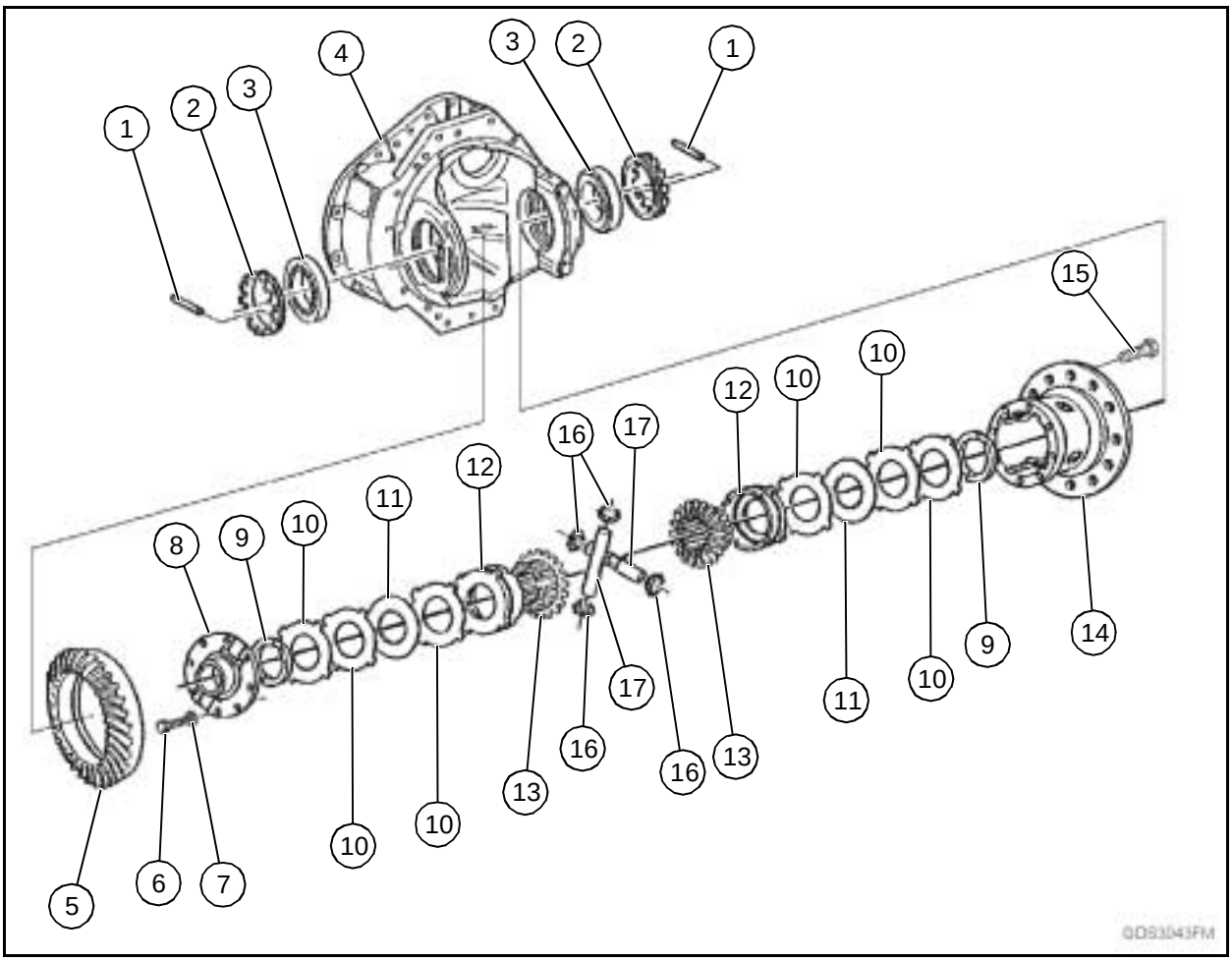
Pinion Bearing Rolling Drag Torque -2 - 3 Nm (17 - 26 lb-in.)



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.

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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).

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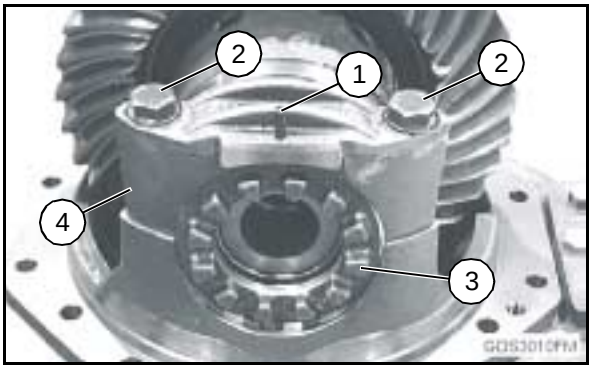


NOTE:Do not apply sealer to mating surfaces at this time.

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.)**

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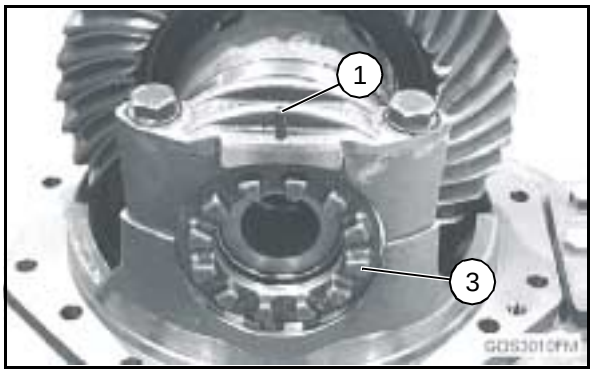
With backlash set, check carrier end play and pinion rolling drag torque.

Specification

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

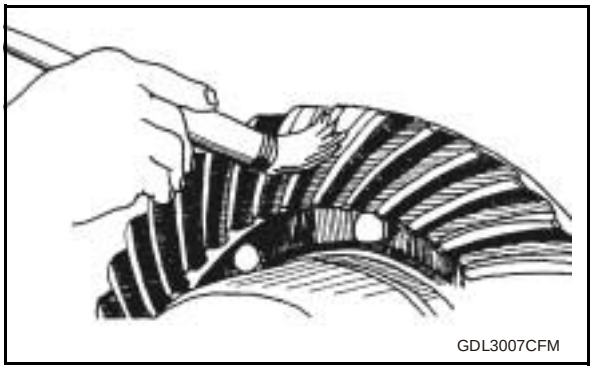
Specification

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



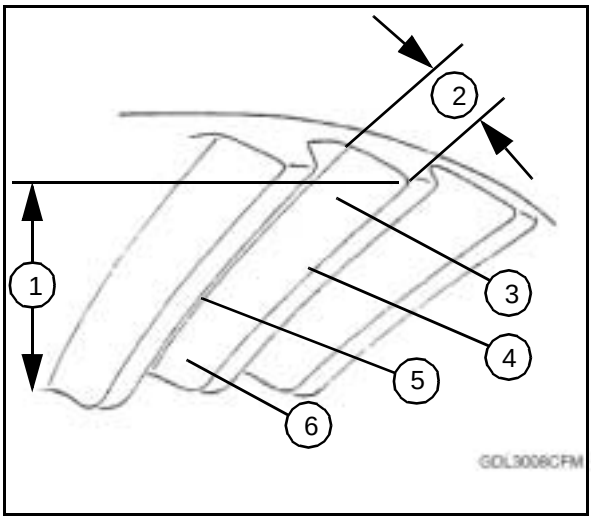
Coat several crown wheel teeth with marking compound.

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.

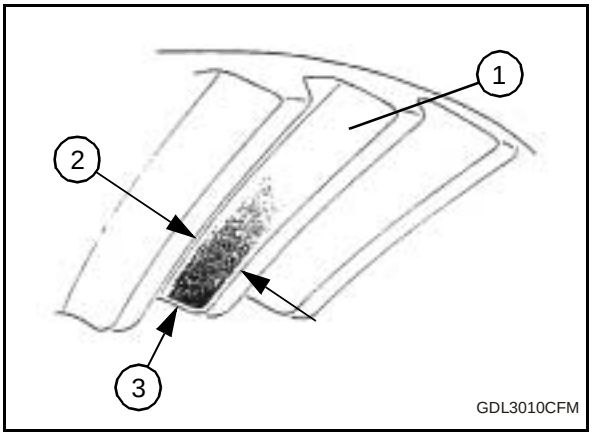
The position of contact pattern is important for all gears.



1. Face Width.
2. Tooth Depth.

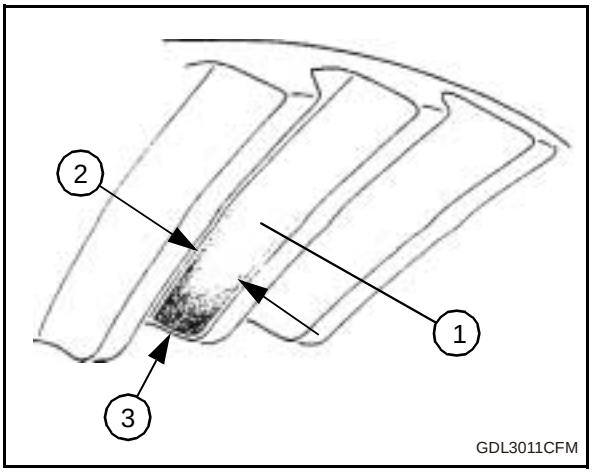
Wear pattern must not be too much toward tooth heel (3), and must not run off of toe (6). Pattern should be centered between top land (4) and root (5).

Compare wear pattern to examples.



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

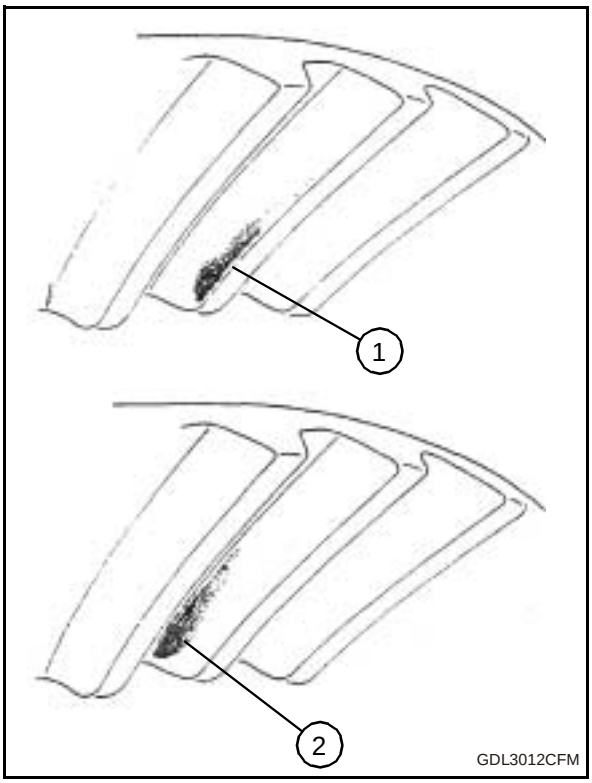
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- Wear patterns for used gears typically vary in shape and length. Wear patterns should not run off of toe, and should not be too close to root or land of tooth.
- When reassembling used gear sets, adjust as necessary to produce the same gear tooth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

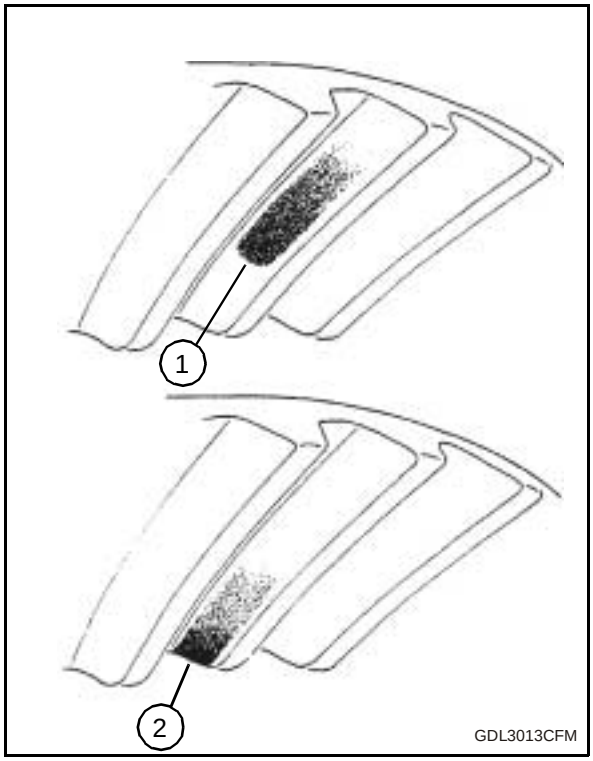
To adjust the tooth contact pattern, the positions of the crown wheel and pinion gear are adjusted.

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.

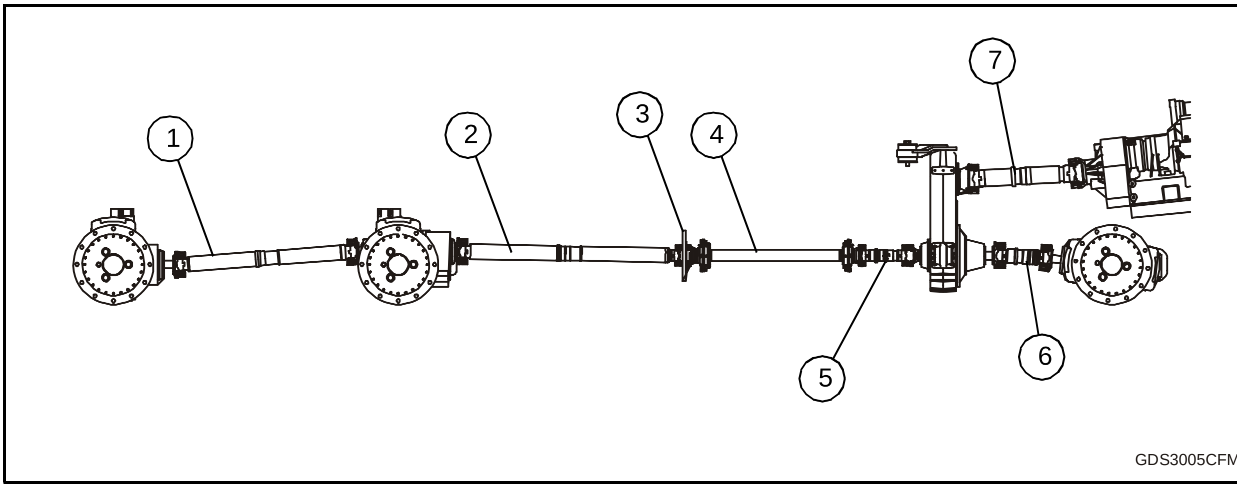
Adjust backlash to specifications after any adjustment or shim change.

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CHAPTER 2. AXLES AND SUSPENSION SYSTEMS

SECTION 3. INPUT DRIVE SHAFTS AND U-JOINTS

DRIVE SHAFTS

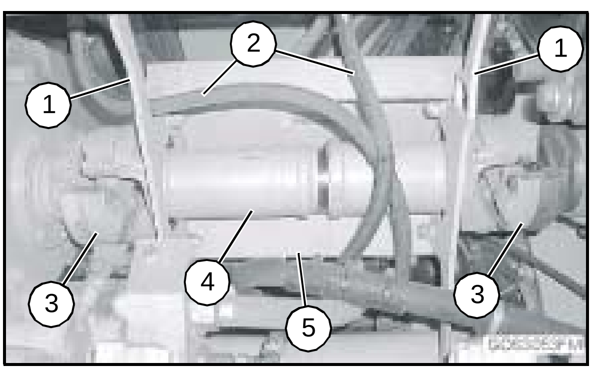


1. Middle Axle-to-Rear Axle Drive Shaft.
2. Park Brake-to-Middle Axle Drive Shaft.
3. Park Brake Disk.
4. Oscillation Joint Through Drive Shaft.
5. Transfer Case-to-Oscillation Joint Drive Shaft.
6. Transfer Case-to-Front Axle Drive Shaft.
7. Transmission-to-Transfer Case Drive Shaft.

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)

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Connect steering hoses.

Install brackets. Attach shield to brackets.

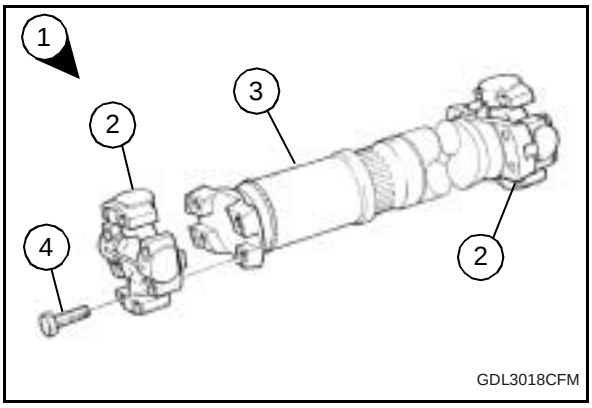
Lower cab.

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

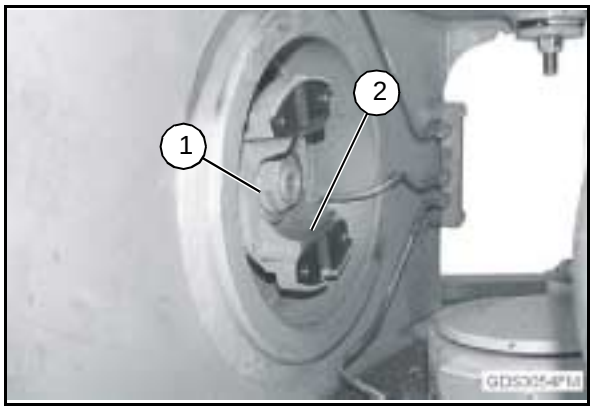
Cross and Bearing Torque - - - - - - - - 120 Nm (89 lb-ft)

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).**

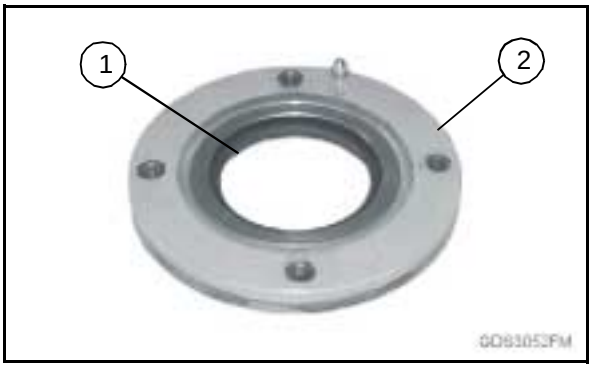
Remove park brake-to-middle axle drive shaft.



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

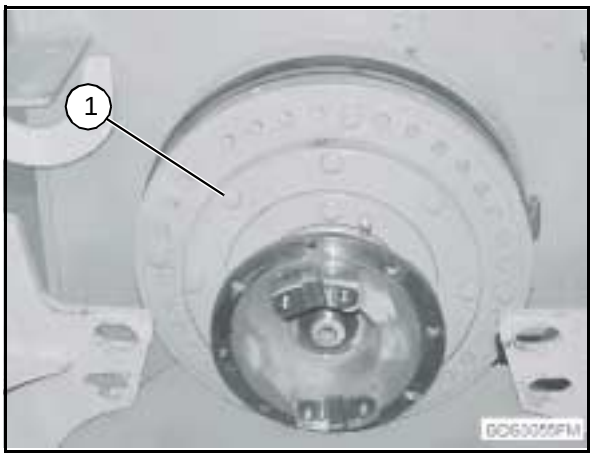
Remove nut and washer (1). Remove front yoke (2) using a suitable puller.

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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.

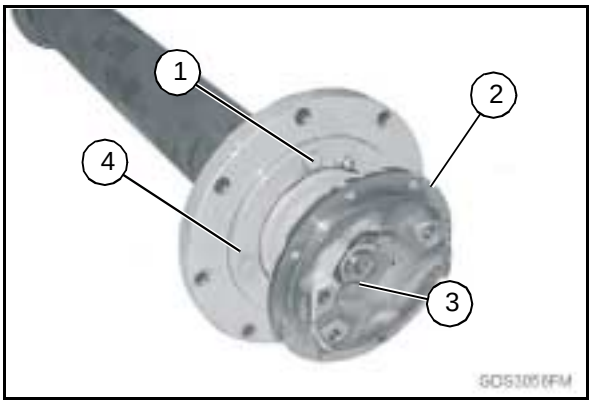
Drive Shafts Specification

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.

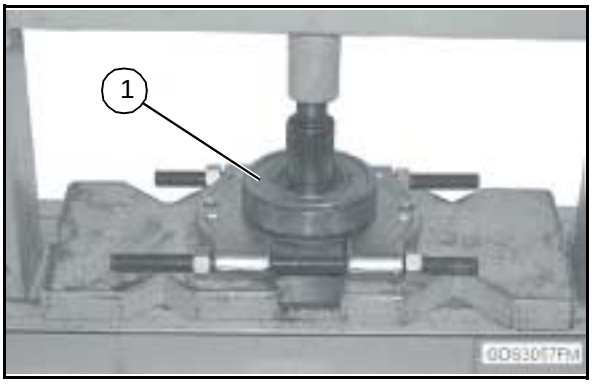


Install new seal (1) in rear seal retainer (2) using a seal driver.

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.

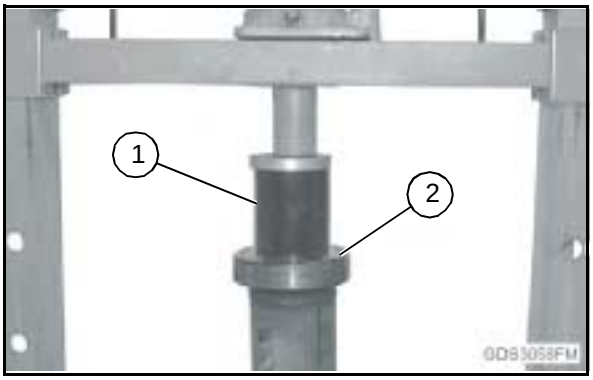
Slide rear bearing retainer off of bearing.

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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.

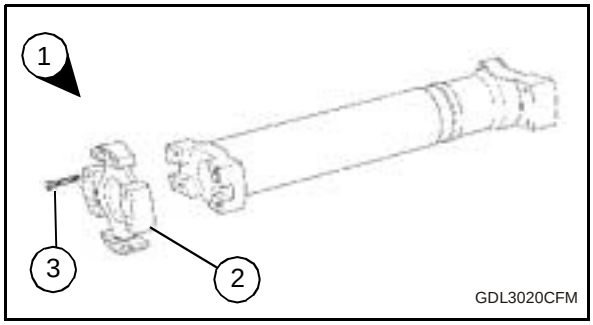
⚠ CAUTION

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.

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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.

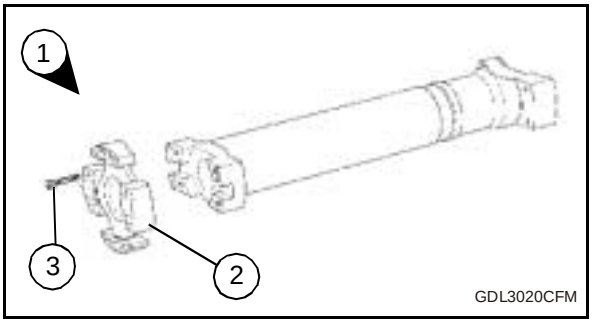
Remove and Install Middle Axle-to-Rear Axle Drive Shaft

⚠ 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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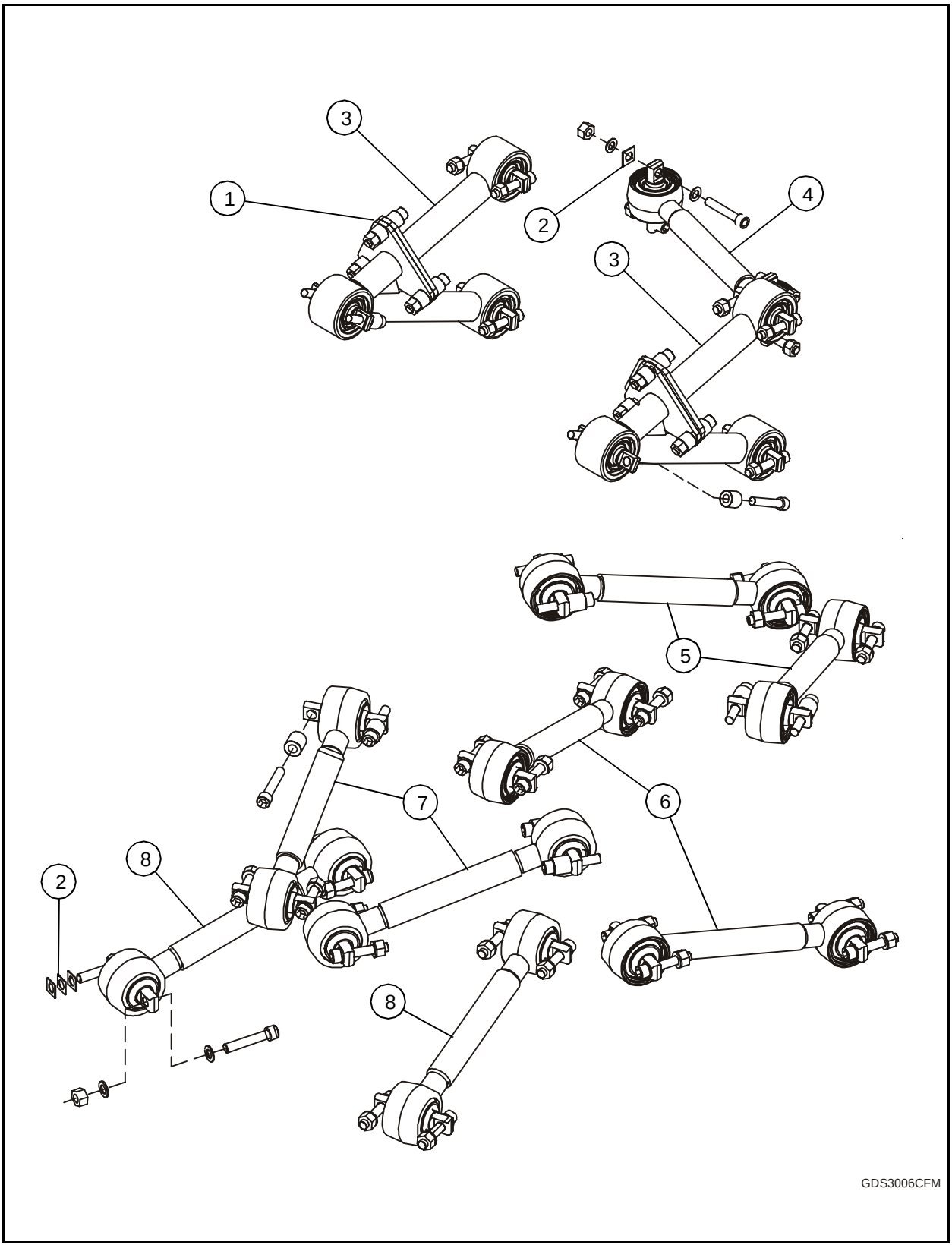
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CHAPTER 2. AXLES AND SUSPENSION SYSTEMS

SECTION 4. AXLE MOUNTING PARTS

AXLE LINKS, STABILIZERS AND STRUTS



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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.

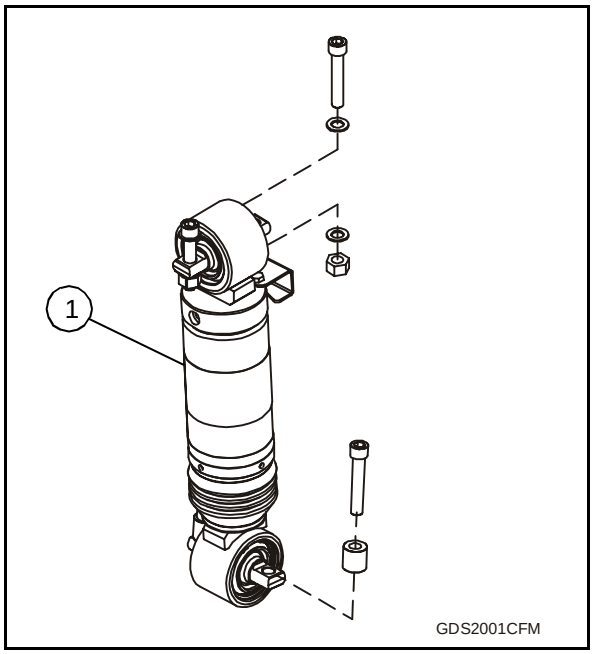
Axle Links, Stabilizers, and Struts Specification

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.

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⚠ 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.

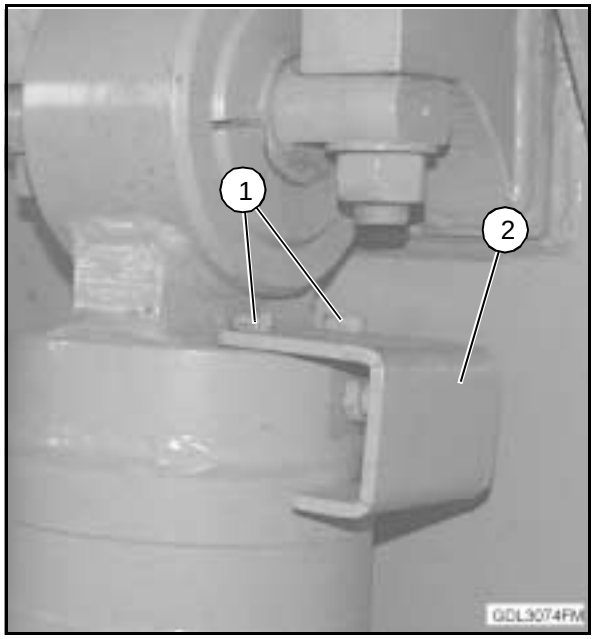
NOTE:To obtain correct pressure and ride height, struts must be recharged while installed on machine.

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

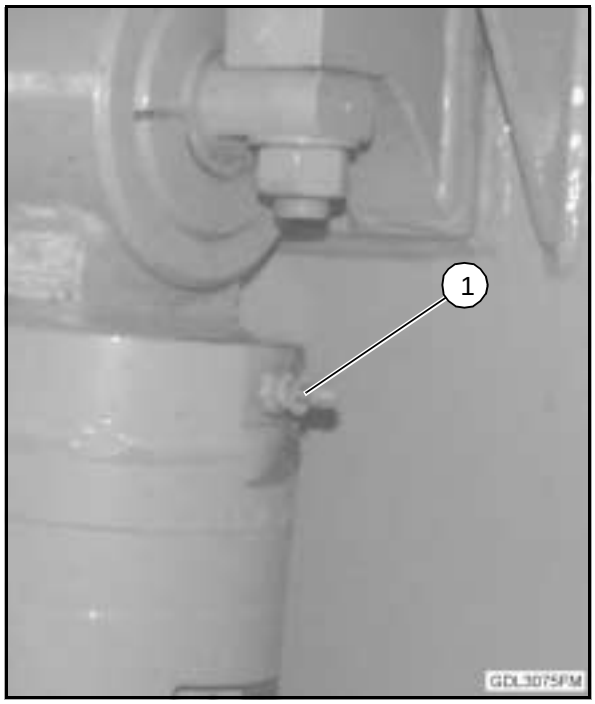
Check ride height. **(See Check Front Axle Suspension Struts Operator’s Manual CHAPTER 13, SECTION 1).**

⚠ CAUTION

Avoid personal injury or death from pressurized gas and fluids.



Remove bolts (1) and guard (2).

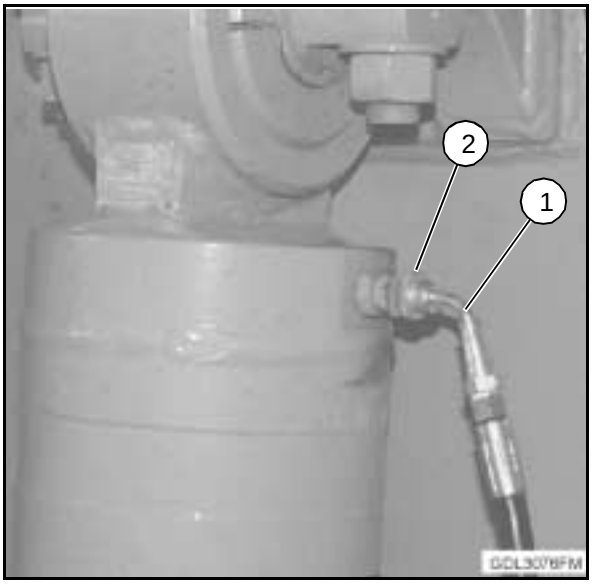


Remove fitting cap (1).

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⚠ 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.

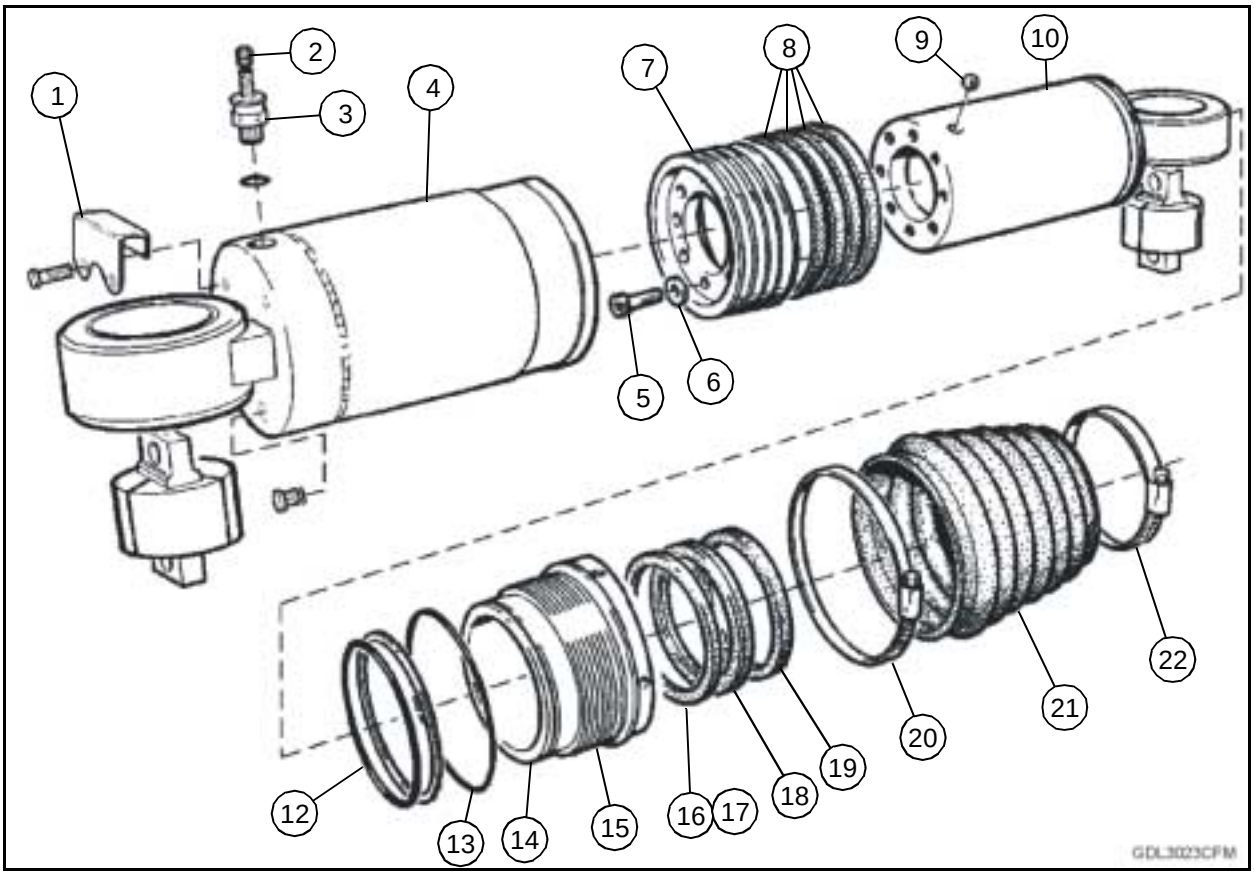
Axle Links, Stabilizers, and Struts Specification

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.



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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

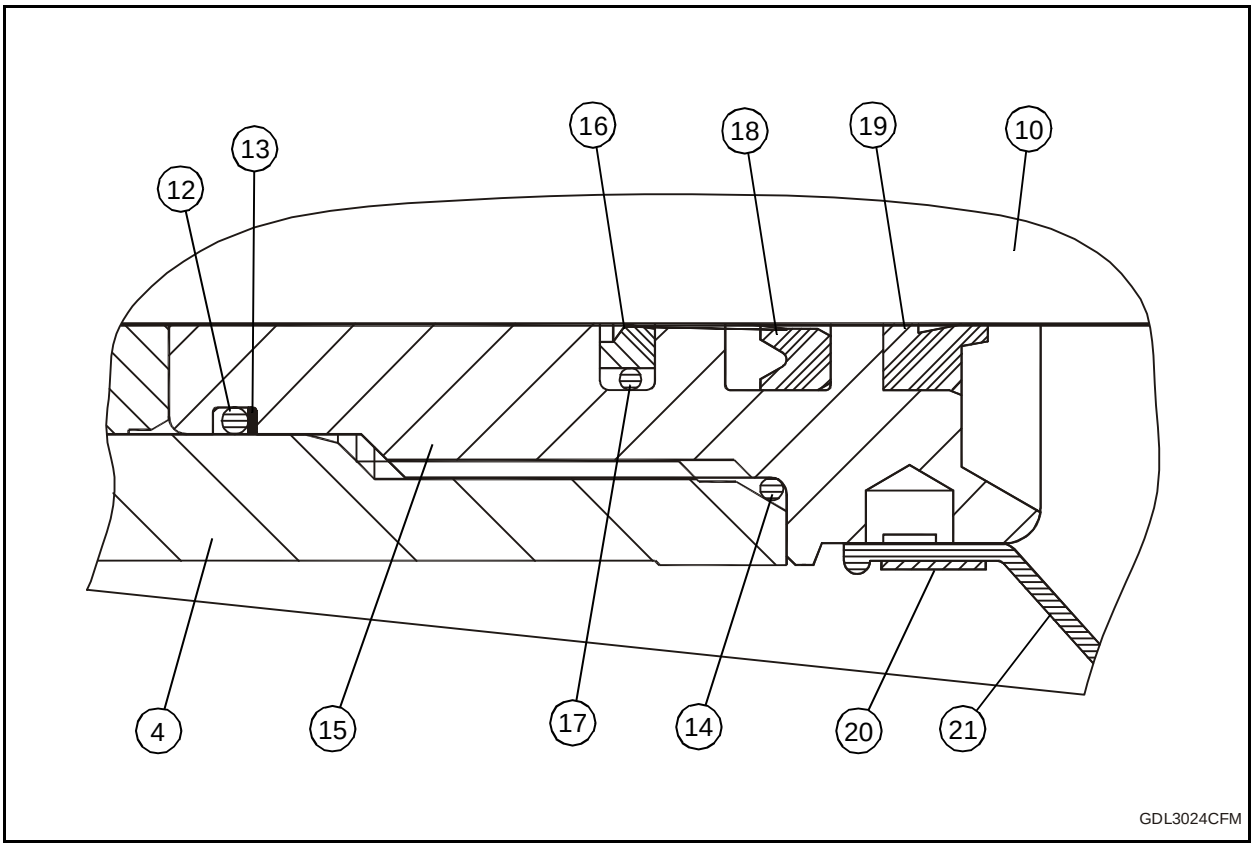
Avoid personal injury or death from pressurized gas and fluids.

- 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.

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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.

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- 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.

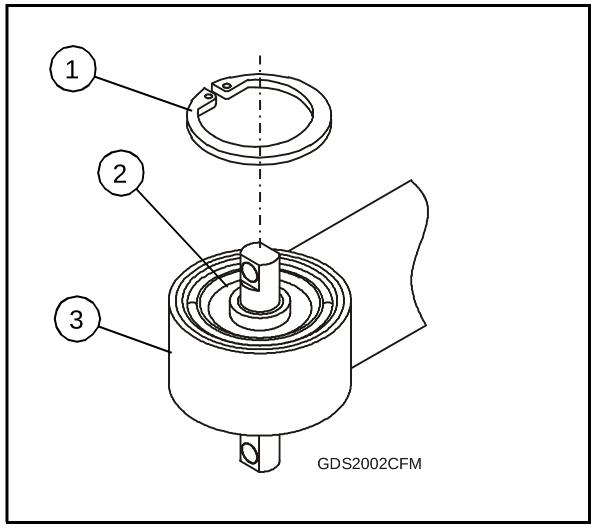
Axle Links, Stabilizers, and Struts Specification

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

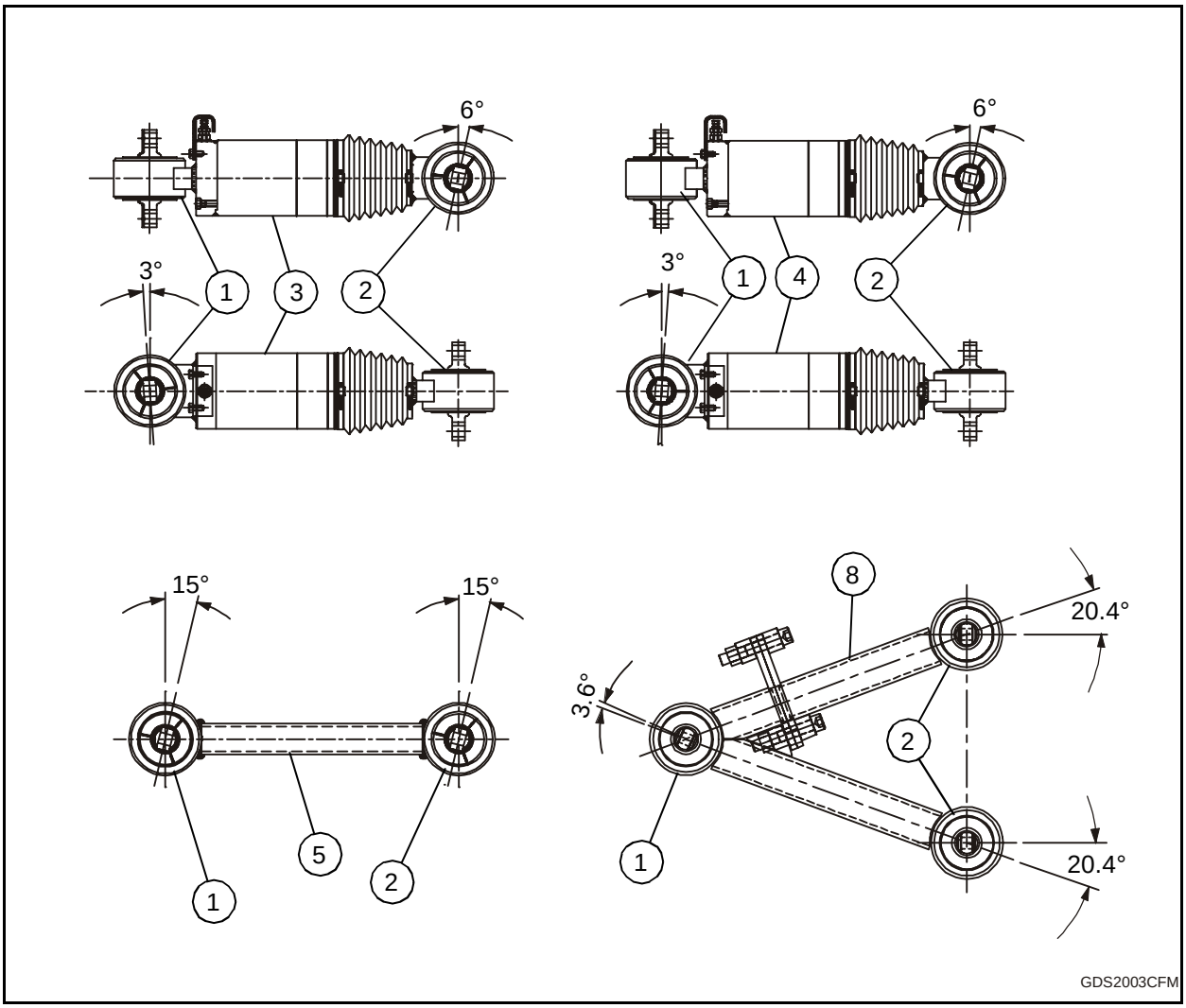


Remove snap ring (1) and press old bushing (2) from bore (3).

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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.

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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

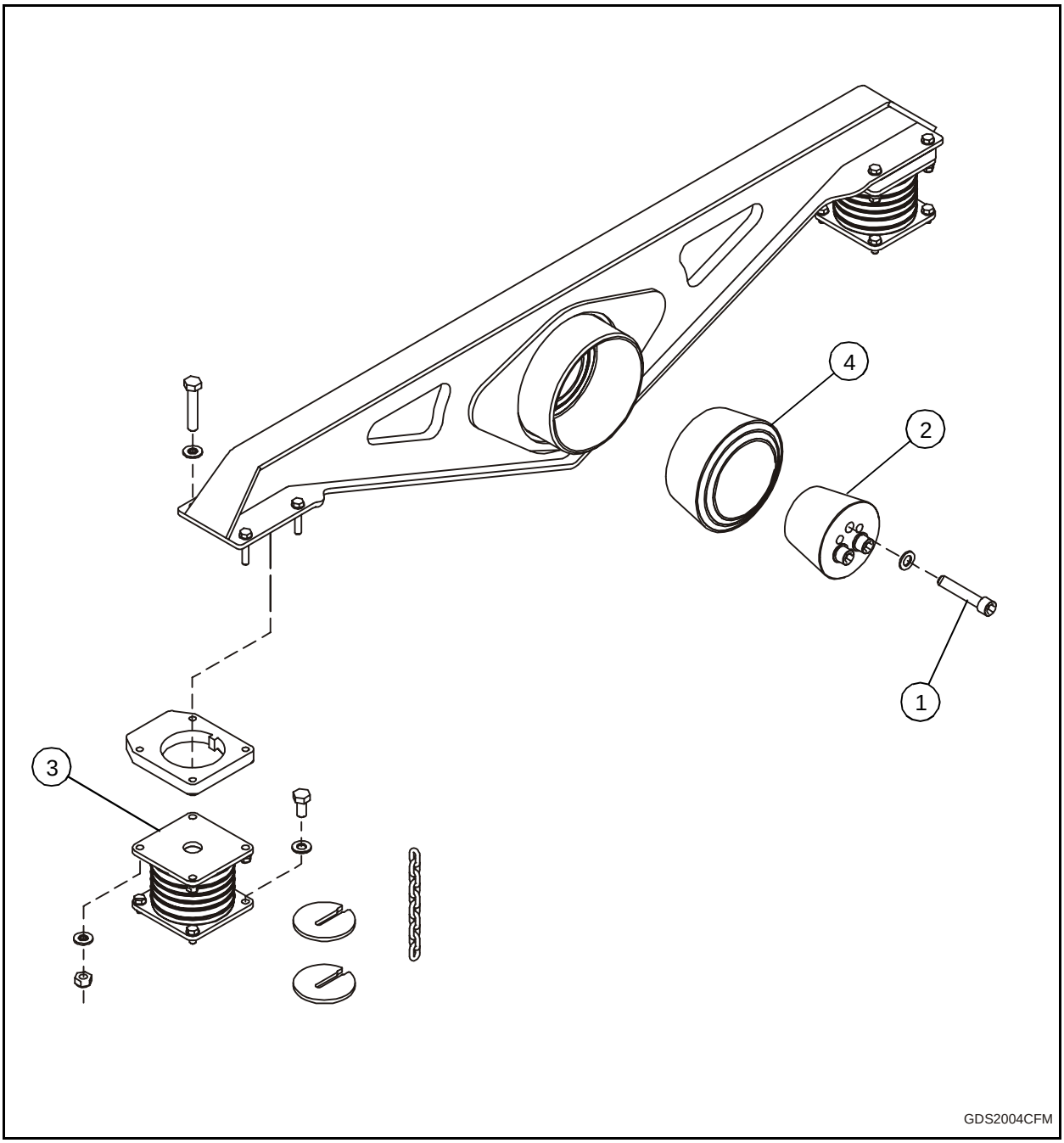
Rear Axle Weight B25D - 907 kg (2000 lb) approximate

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

Attach lifting devices to middle and rear axles.

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

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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).

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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.

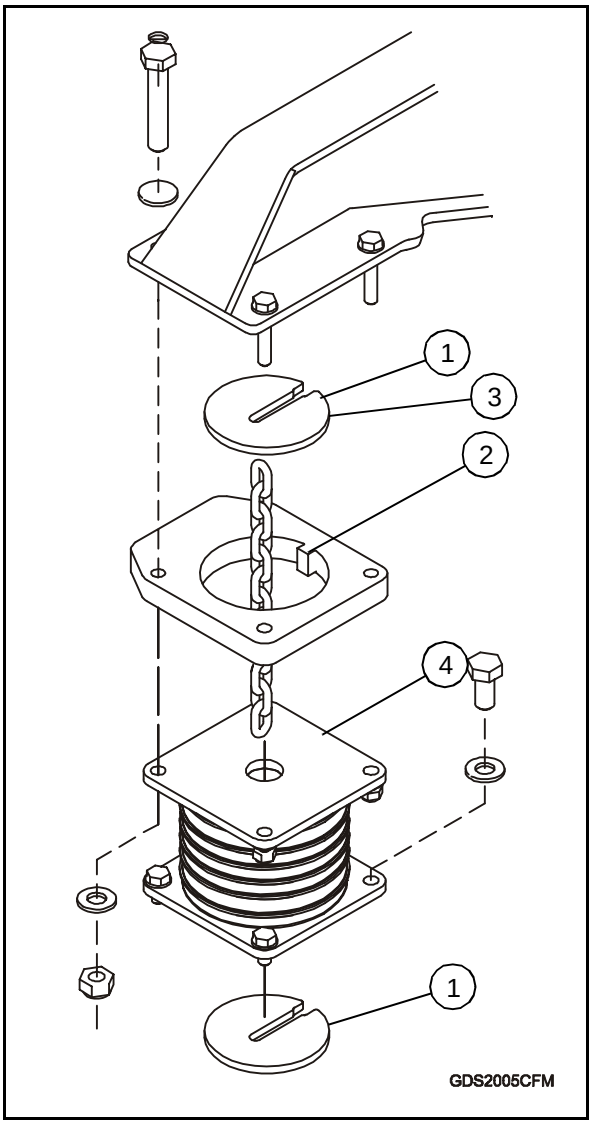
Connect walking beam to rubber mounts.

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.

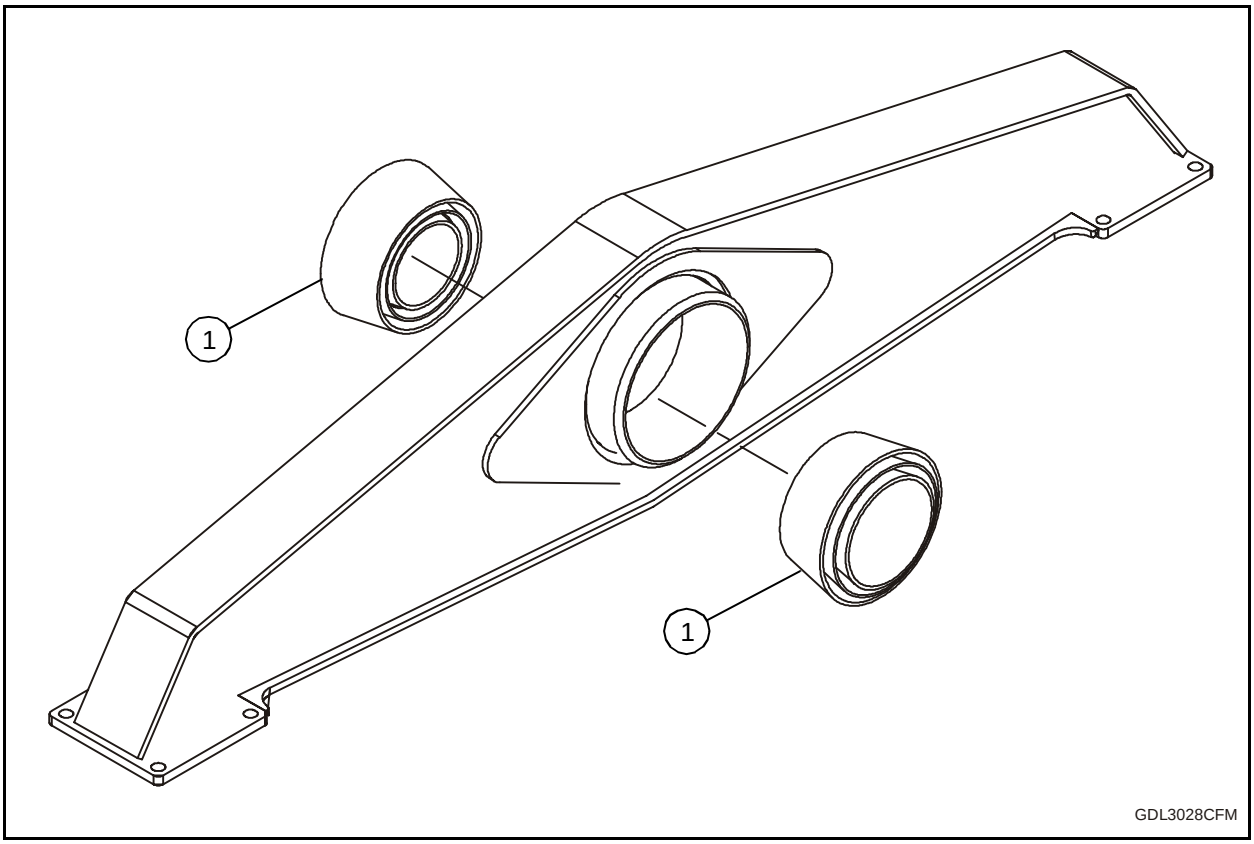
Inspect parts and replace as necessary.

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

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

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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.

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CHAPTER 2. AXLES AND SUSPENSION SYSTEMS

SECTION 5. AXLE SHAFTS, BEARINGS AND REDUCTION GEARS

FINAL DRIVE PLANETARY

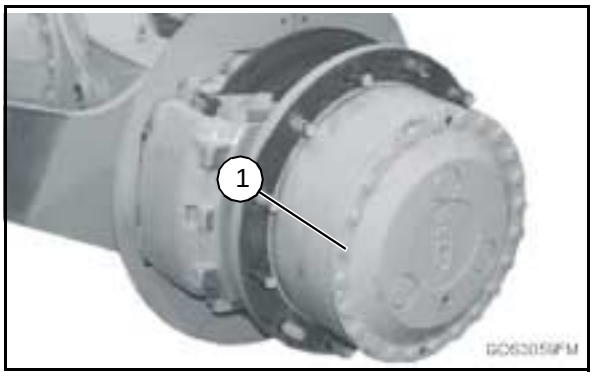
Remove and Install Final Drive Planetary

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

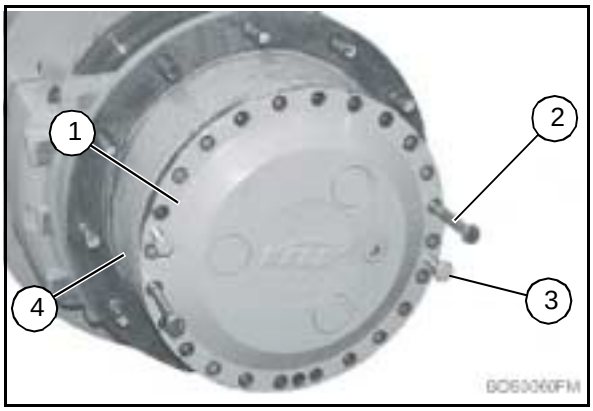
Drain planetary. **(See Change Final Drive Oil Operator's Manual, CHAPTR 15, SECTION 2).**

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).

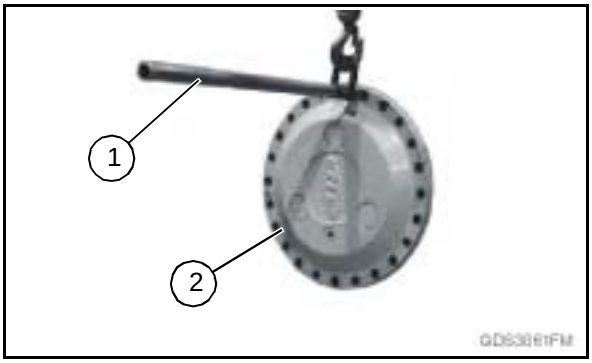
Remove cap screws (3 and 4).

⚠ CAUTION

Component is heavy. Use hoist.

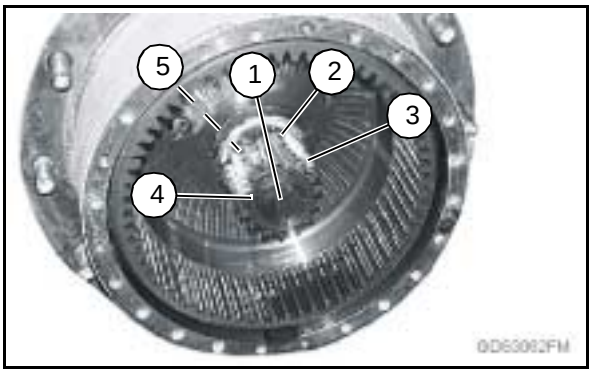
Axle Outboard Planetaries Specification

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.

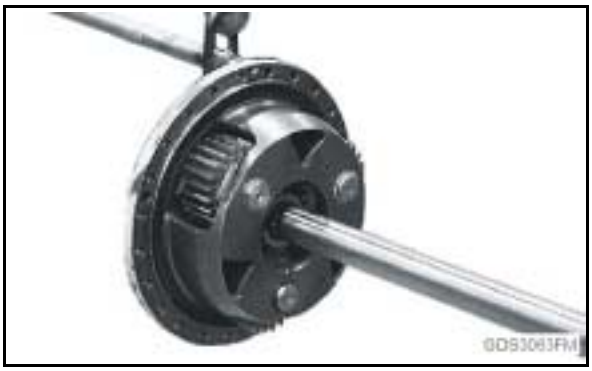


Remove side shaft (1) and sun gear assembly, if not previously removed.

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

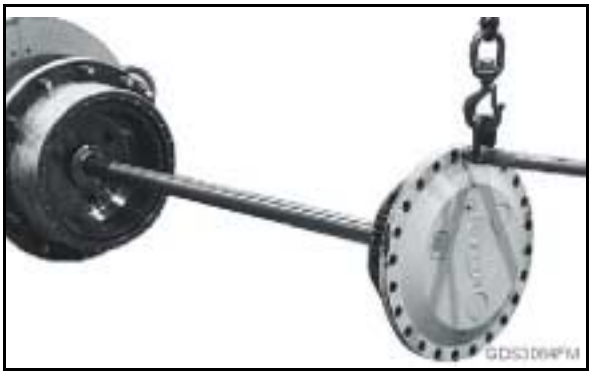
Clean and inspect parts for wear or damage.

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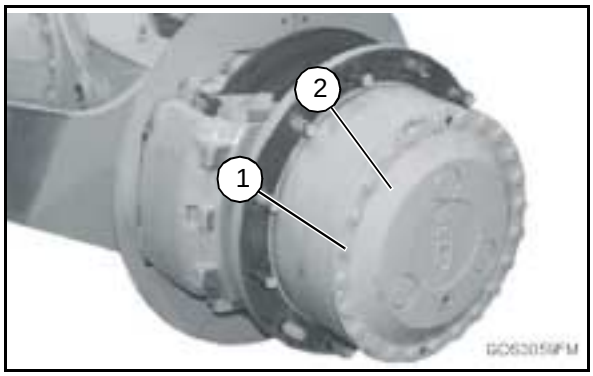


Install side shaft and sun gear assembly in final drive, if previously removed.

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.

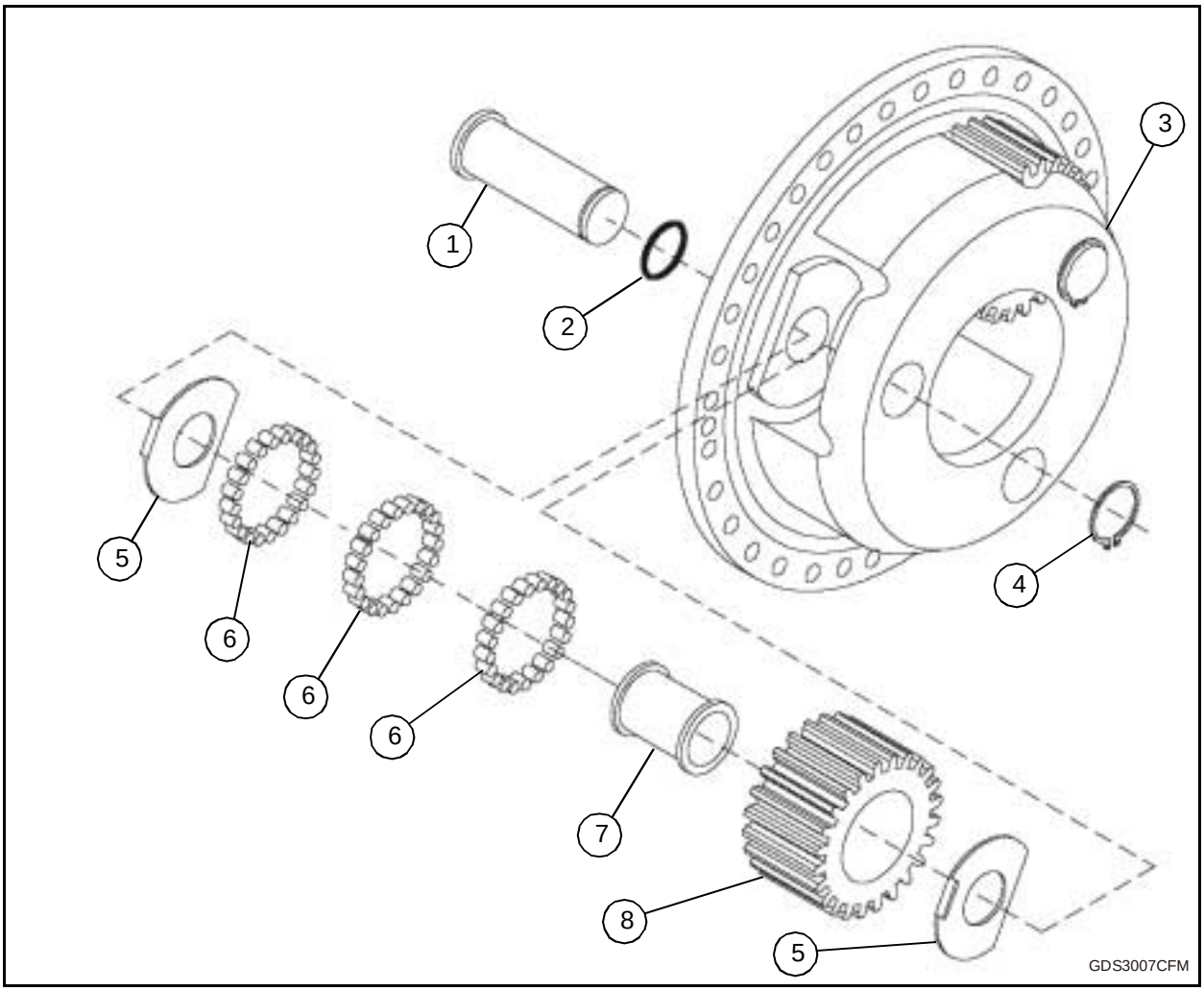


Apply cure primer and thread lock and sealer (medium strength) to threads of cap screws. Install and tighten cap screws (1).

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

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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.

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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

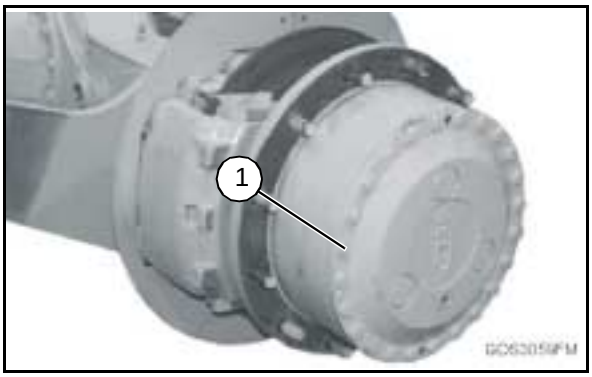
Disassemble and Assemble Wheel Hubs

Raise machine and place floor stand under axle.

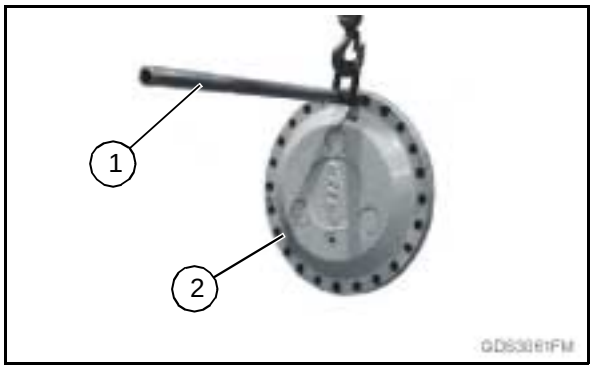
Remove wheels. **(See “Removal” on page 1).**

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)**.



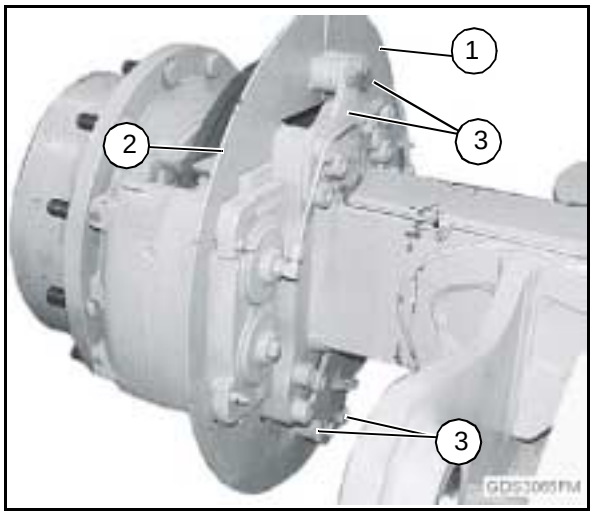
Remove bolts (1).



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.

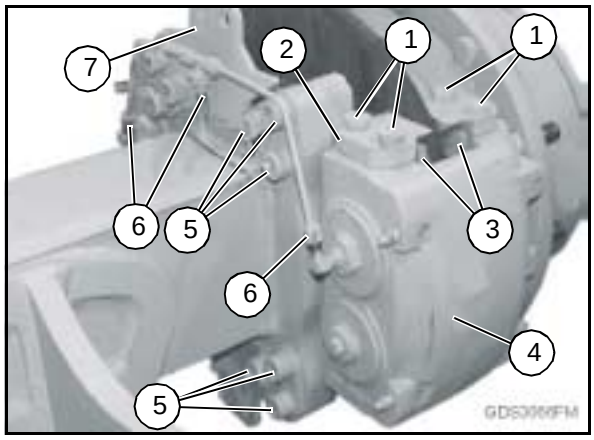
Remove axle and sun gear assembly **(See “Remove and Install Final Drive Planetary” on page 53).**



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).

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

Remove brake pads (3).

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

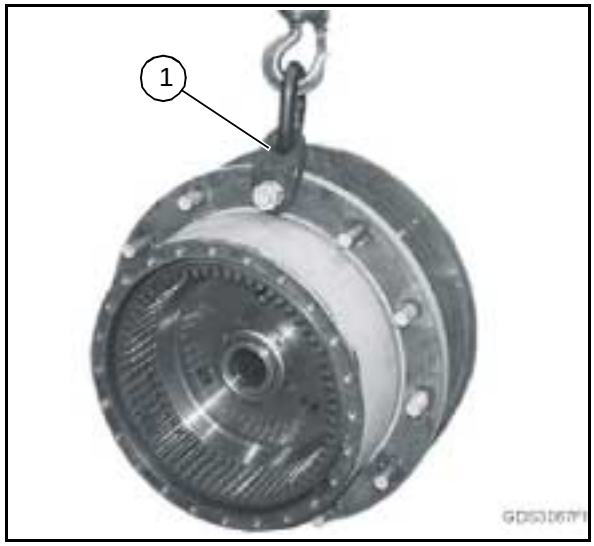
NOTE:Longer caliper cap screws (5) are used to install support plate (7).

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.



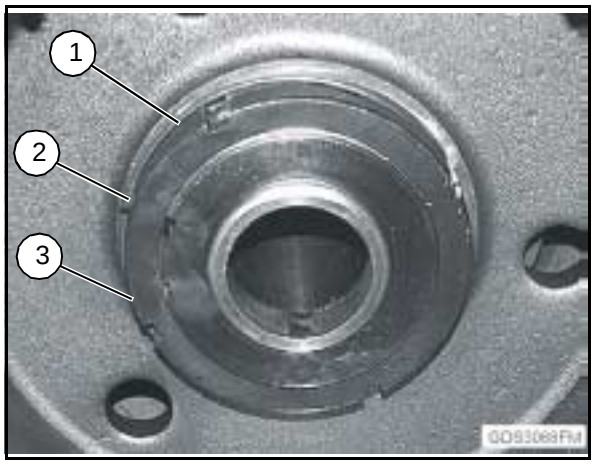
⚠ CAUTION

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

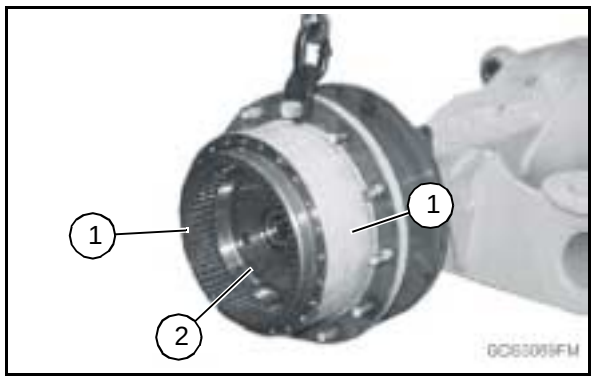
Specification

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

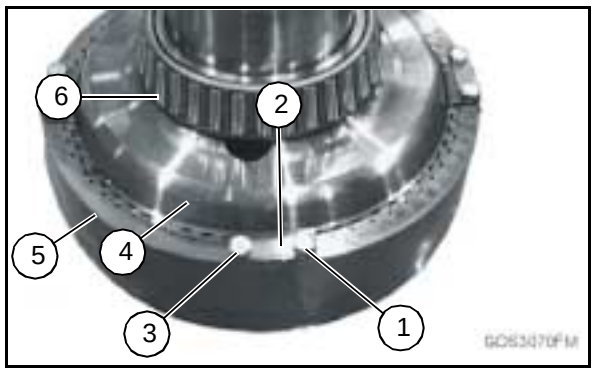
Attach hoist with tool JDG909 Lifting Brackets.



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.

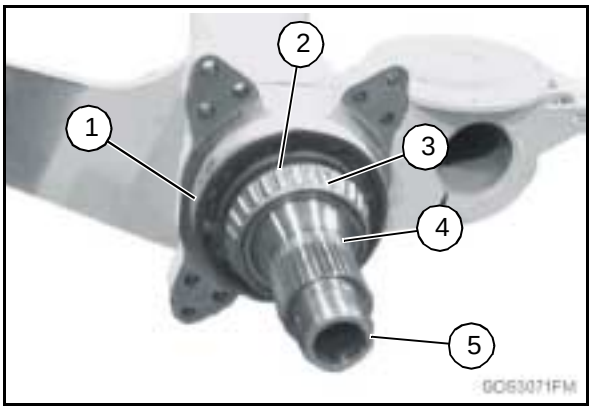
Remove bolts (3), retainers (1), and locks (2).

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Remove inner ring gear (4).

Clean and inspect all parts for wear or damage.

Remove hub.

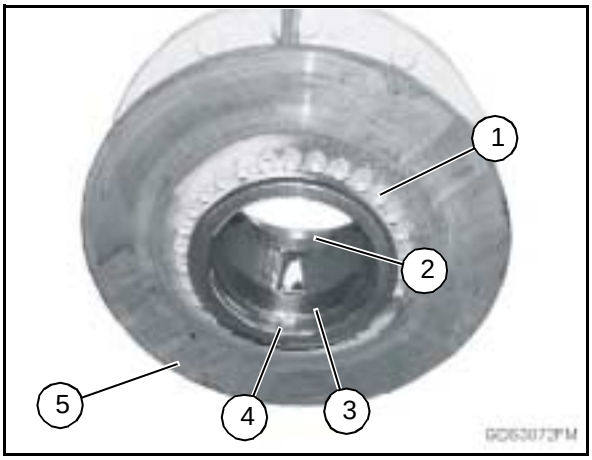


Inspect axle bushing (5) in axle housing and replace if necessary.

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).

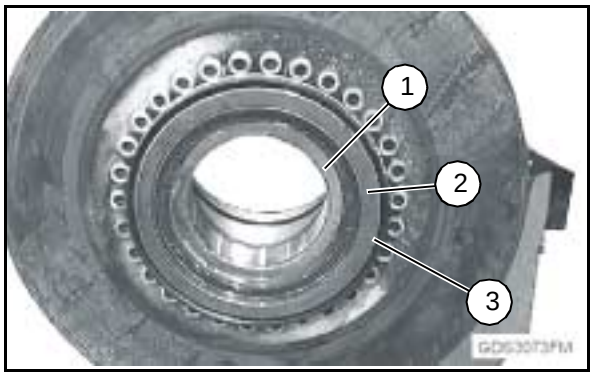
Remove cap screws (1) and brake rotor (5).

Clean and inspect all parts.

Install brake rotor and cap screw.

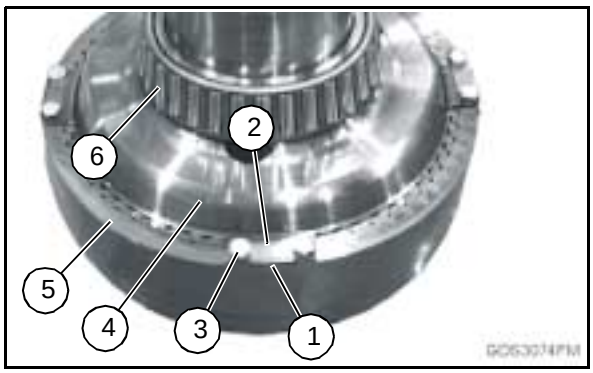
Install inner and outer bearing cups (2 and 3) using D01045AA Bushing, Bearing and Seal Driver Set.

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).

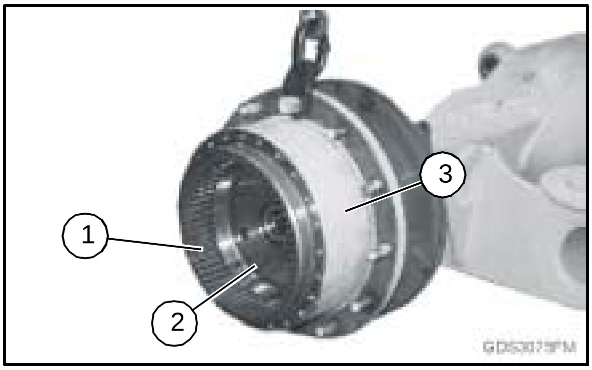


Install inner ring gear (4) in outer ring gear (5).

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

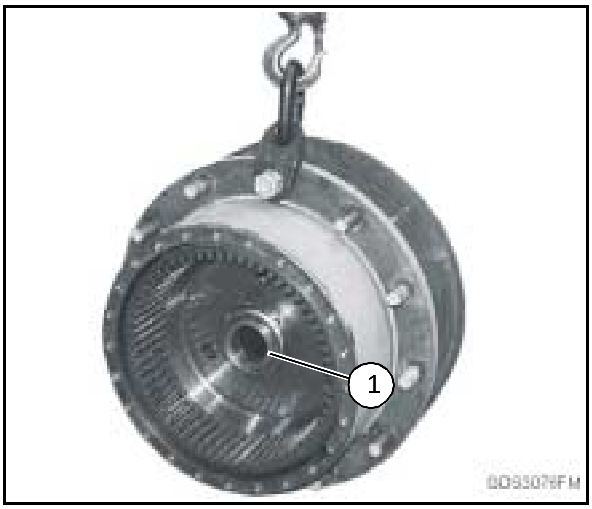
Apply multi-purpose grease to outer wheel bearing (6) and install on inner ring gear.

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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.

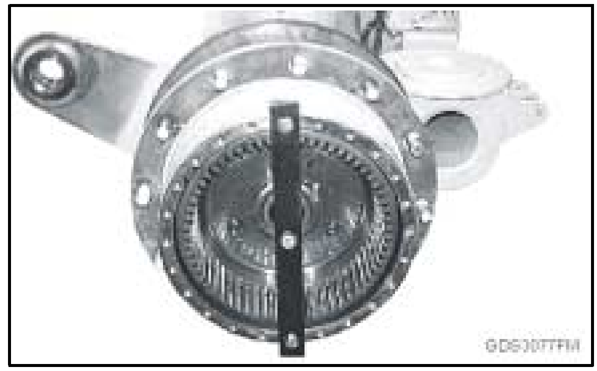
Rotate hub and torque spanner nut using hub nut spanner 280173 to 1000 Nm (737.56 lb.-ft) while rotating the hub to seat bearings and bearing cups.

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.)**

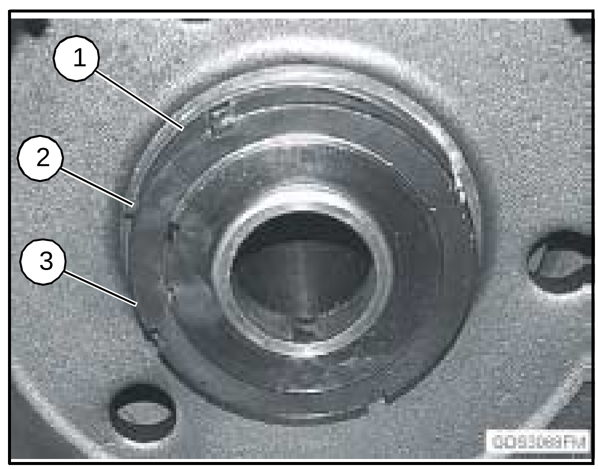
Tighten spanner nut to a rolling torque.

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)

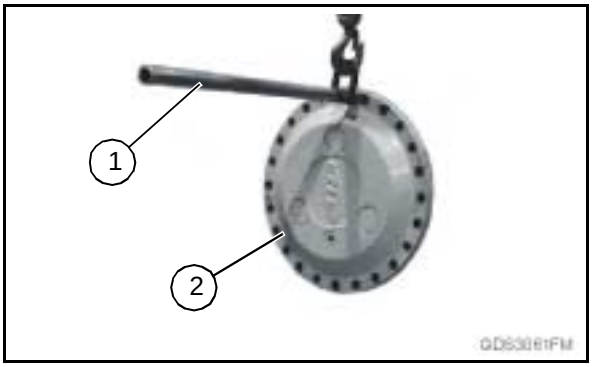
Wheel Bearing Rolling Drag Torque (wet and pads removed) Rolling Drag Torque Max.- 25 Nm (18.4391 lb-in.)



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

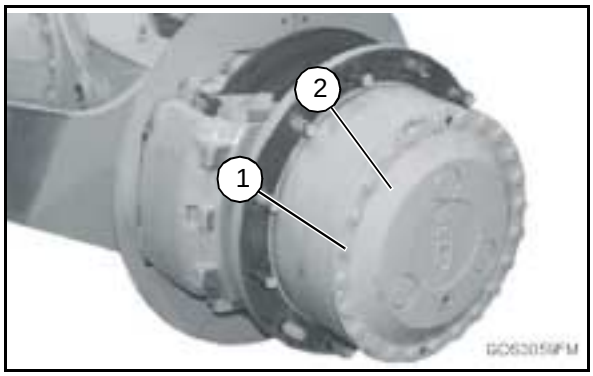
Install lock ring (1).

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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)**.

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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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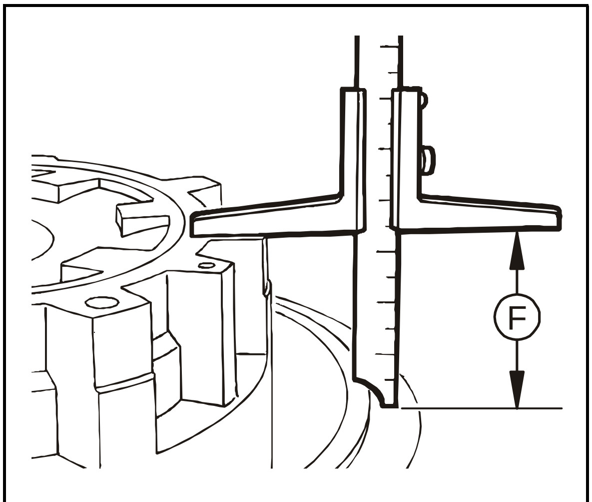
CHAPTER 3. TRANSMISSION

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

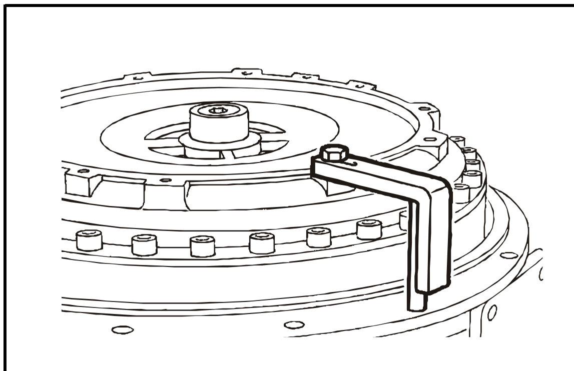
Torque Converter Installed Average Height -86.25 mm (3.40 in.)

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).

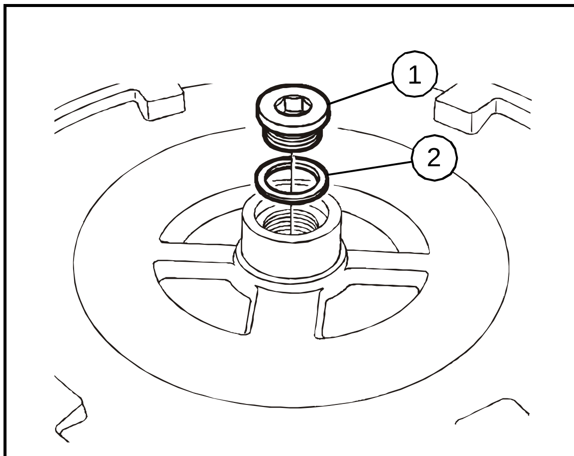
⚠ CAUTION

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



GDS3009CFM

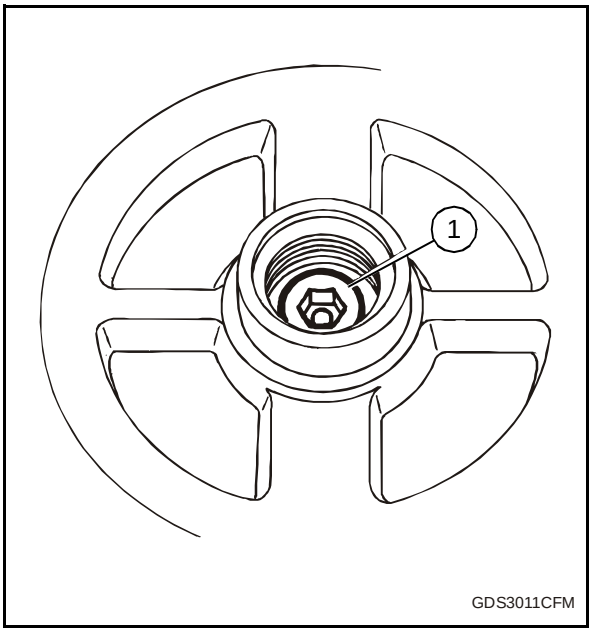
Install DFT1229 Torque Converter Holding Bracket.



GDS3010CFM

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

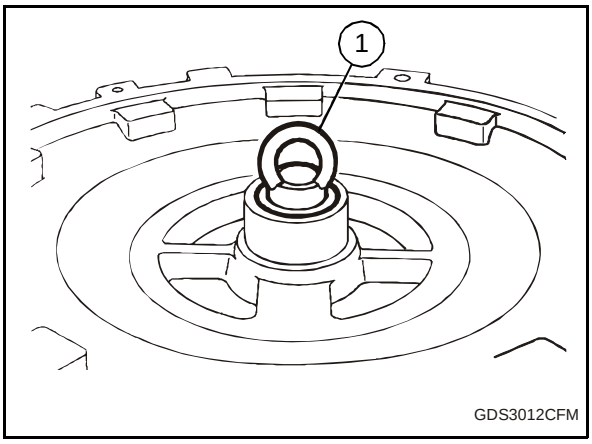
https://truckmanualshub.com/



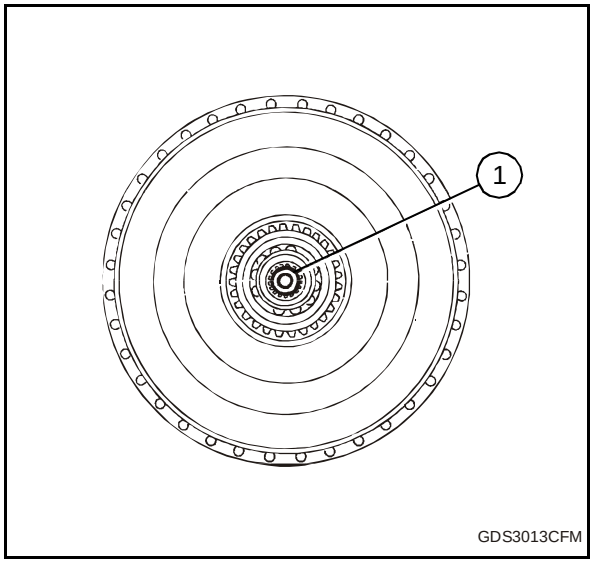
Install JDG1611 Mechanical Holding Tool to hold turbine shaft and remove cap screw (1).

⚠ CAUTION

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

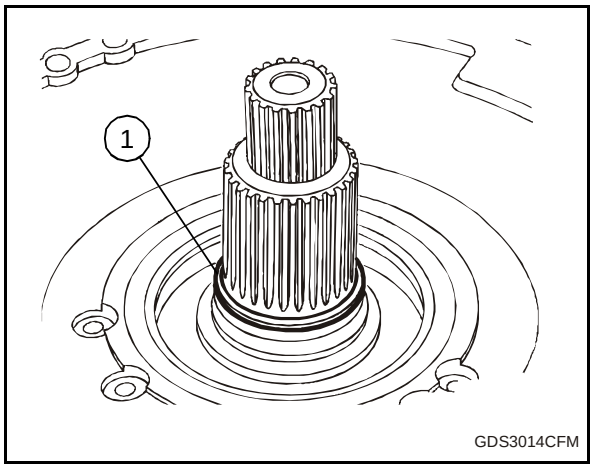


Install 281696 Lifting Device (1) and lift torque converter. Tip torque converter to drain remaining oil.



Support converter on wood blocks to protect converter hub.

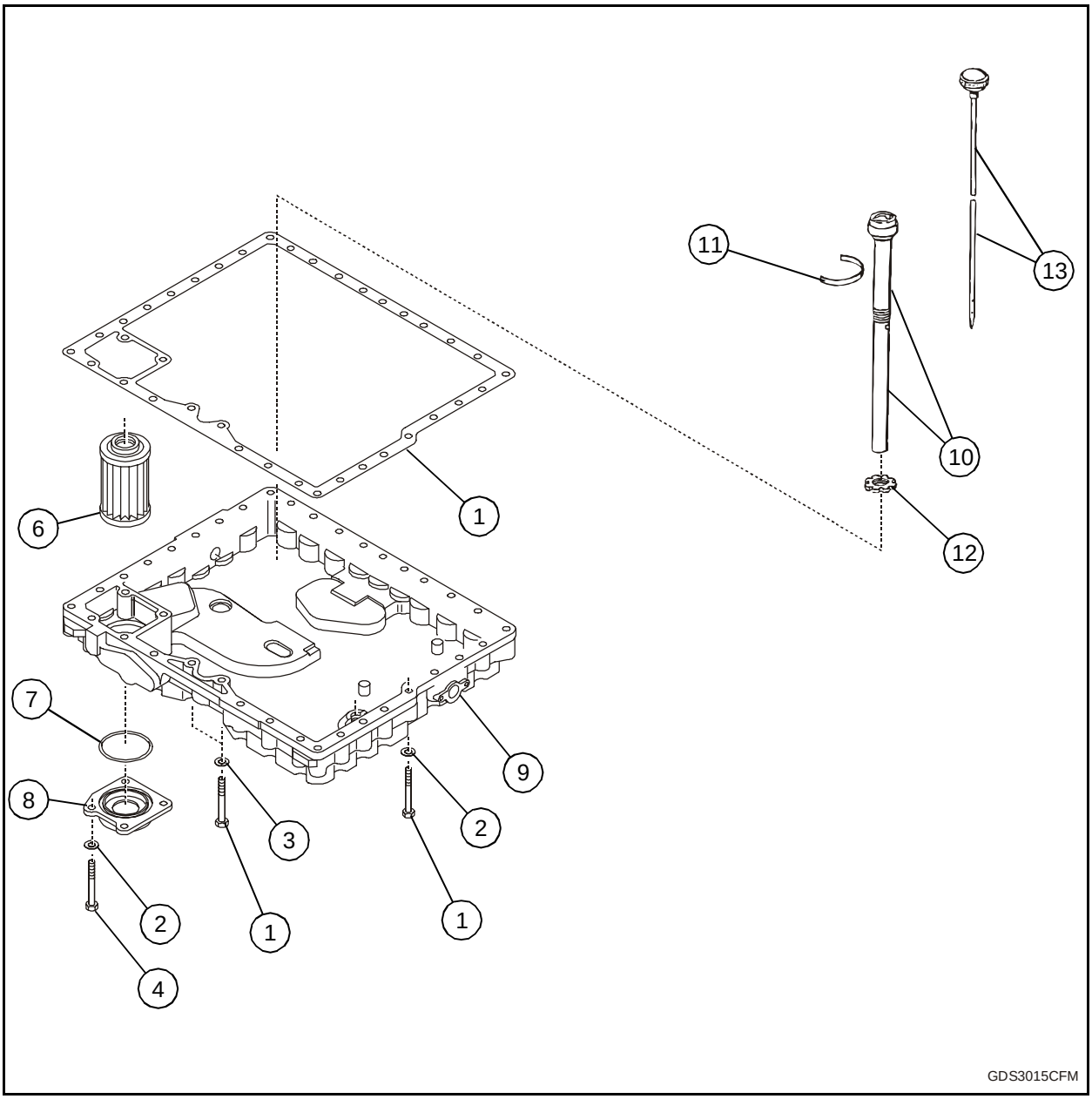
Position converter with hub up and remove shims (1).



Remove stator shaft spacer ring (1).

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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.

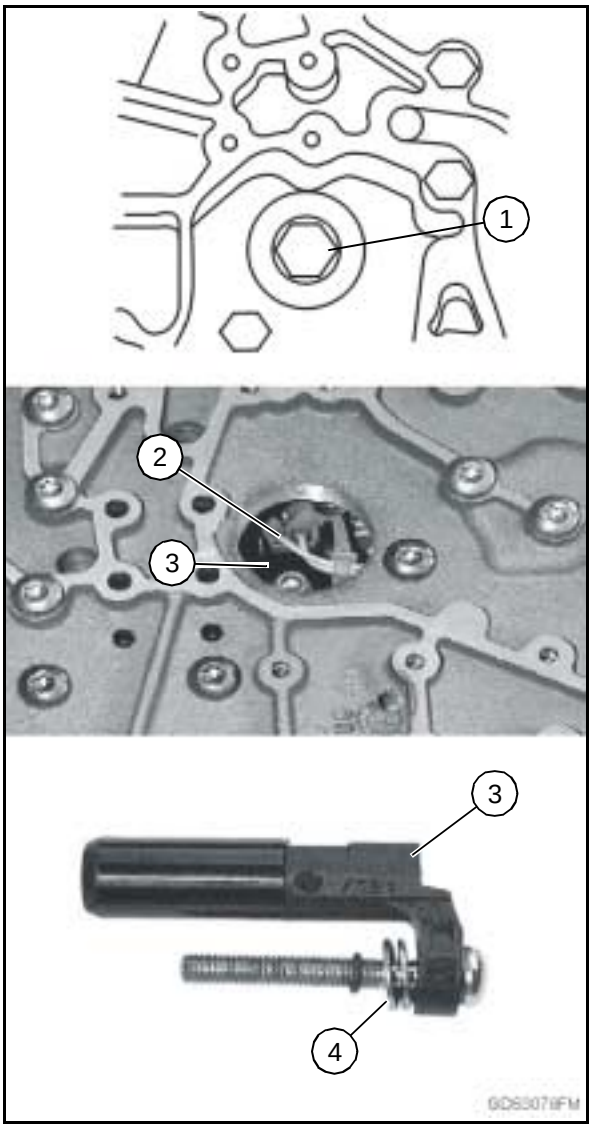
Remove filter cover (8) and filter (6).

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.

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Remove plug (1).

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

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

⚠ CAUTION

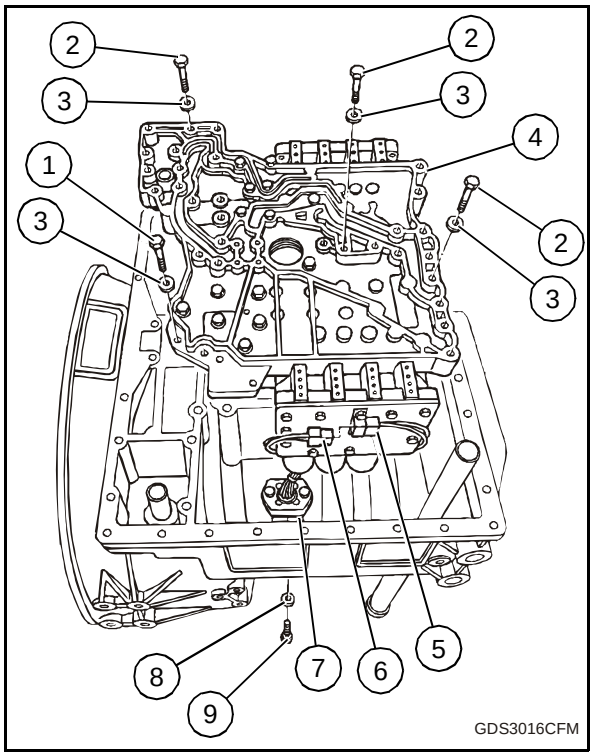
The approximate weight of control valve is 25 kg (56 lb).

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.

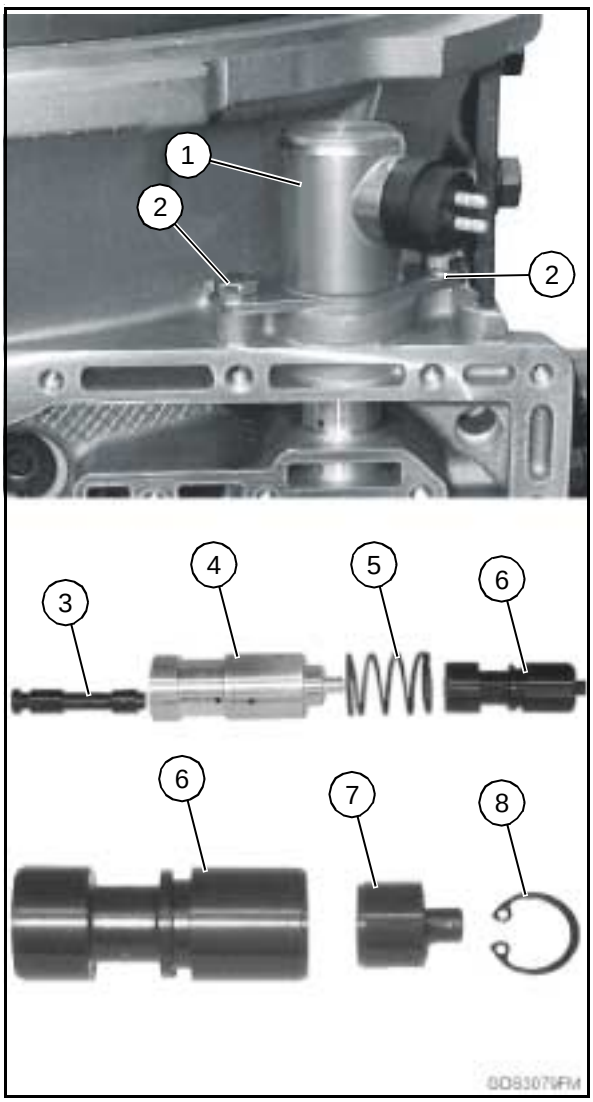
Disconnect output sensor connector (6) and remove retarder resistor connector (5).

NOTE:Bolt length and location.

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

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Remove Retarder Valve



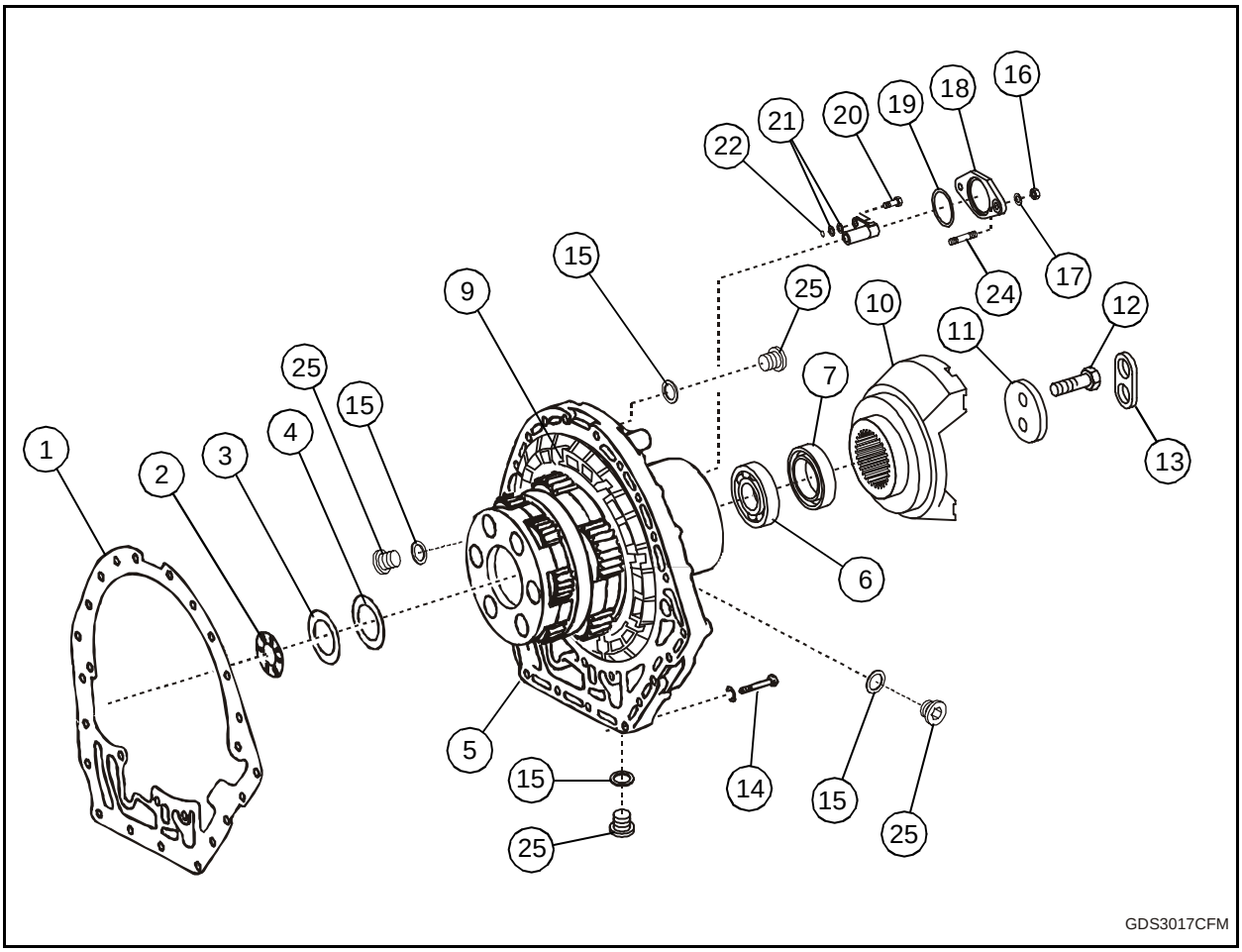
Loosen bolts (2) and remove.

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

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

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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.

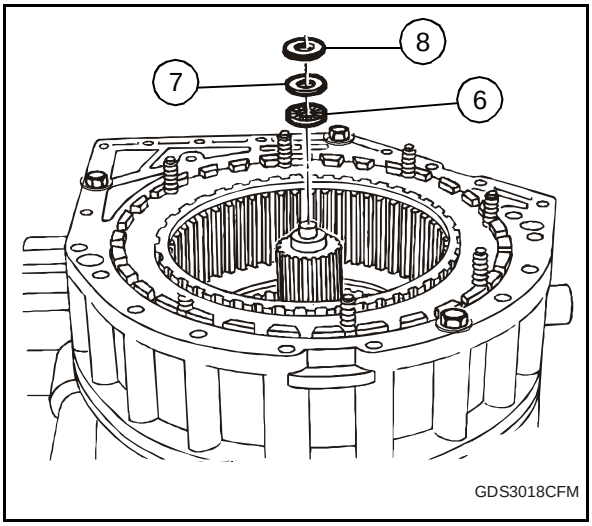
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With torque converter removed and 281710 Lifting Device in place. Install DFT1231 Output Assembly Lift Bracket on output shaft. **(See "CHAPTER 17. DEALER FABRICATED TOOLS" on page 383)**

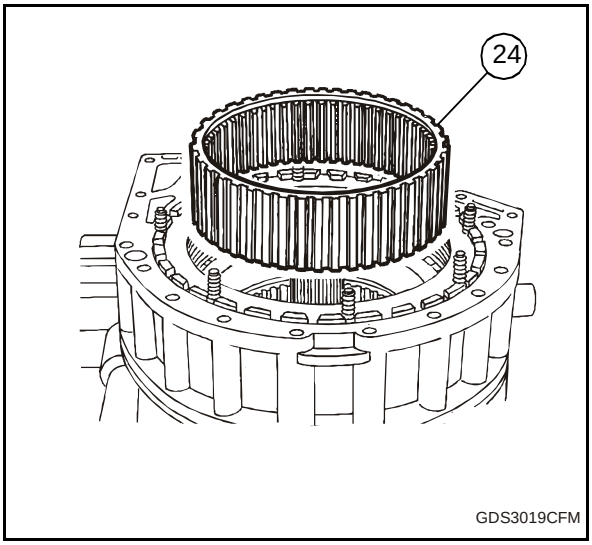
NOTE: Output speed sensor wires must be disconnected prior to output cover removal.

Remove output cover and planetary carrier assembly.

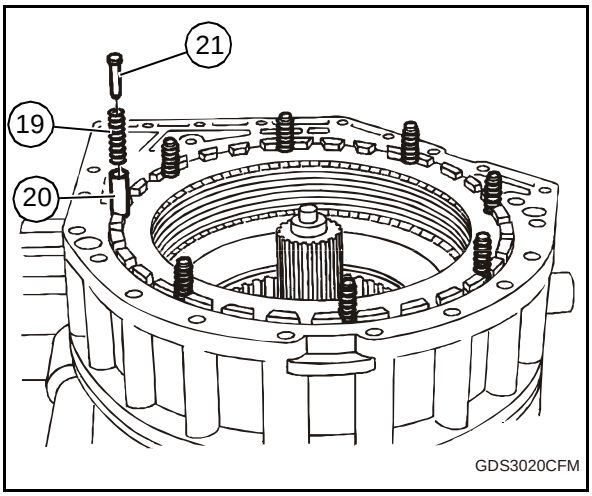
Remove Intermediate Housing and Clutch Element



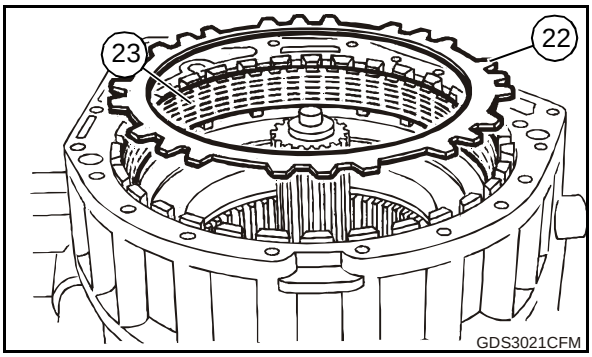
Remove parts (6 - 8) from sun gear shaft.



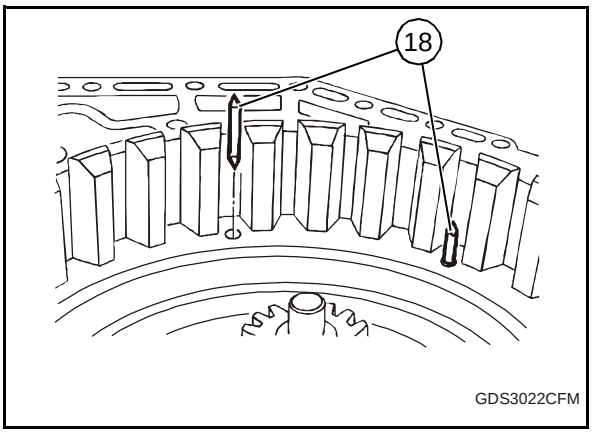
Remove ring gear (24).



Remove parts (19 - 21).

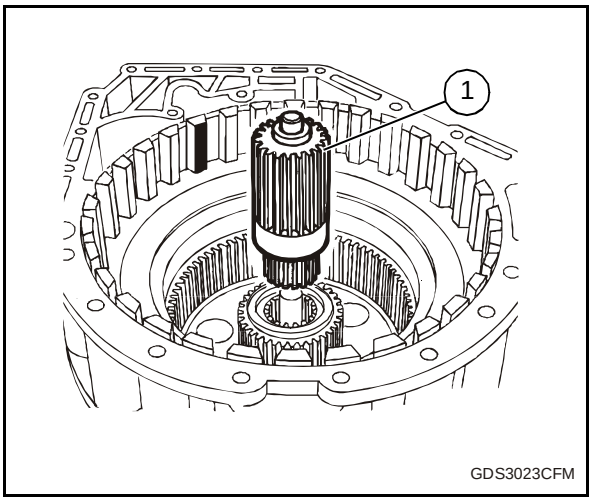


Remove all clutch plates (22 and 23) and mark to maintain correct order.

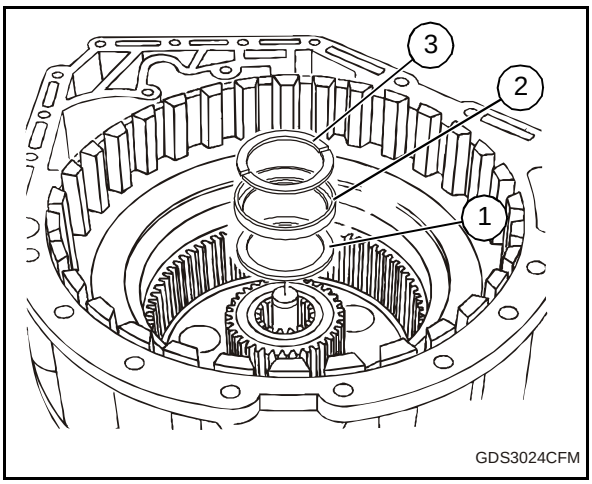


Remove inner guide pins (18).

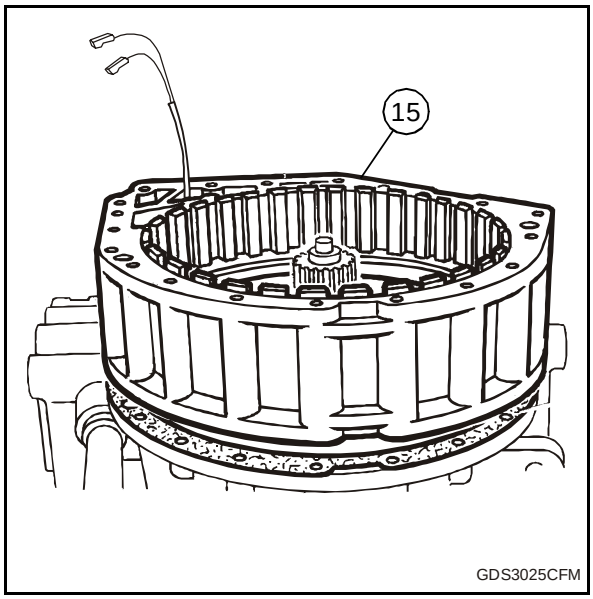
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Remove sun gear shaft (1) and inner ring.



Remove parts (1 - 3).

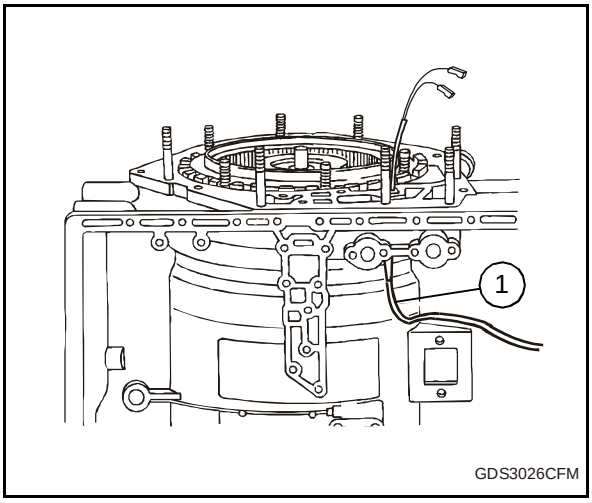


Tap outer edge of intermediate housing (15) with soft face hammer to loosen housing.

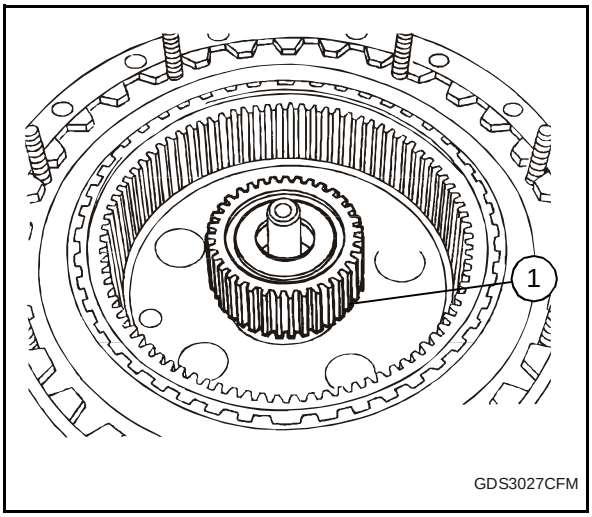
Remove intermediate housing and carefully guide sensor wire harness through housing.

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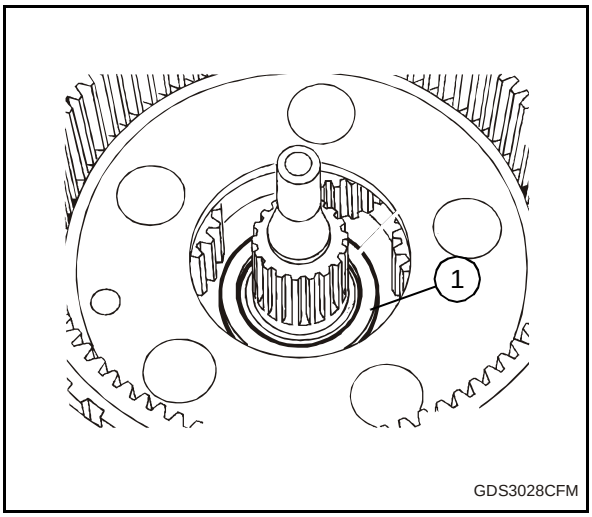
Remove Center Planetary and Clutch Elements



Remove output sensor wire harness (1).



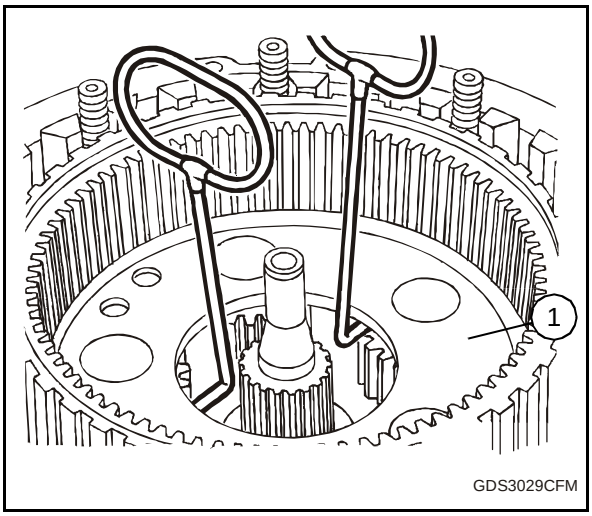
Remove thrust washer and sun gear (1).



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

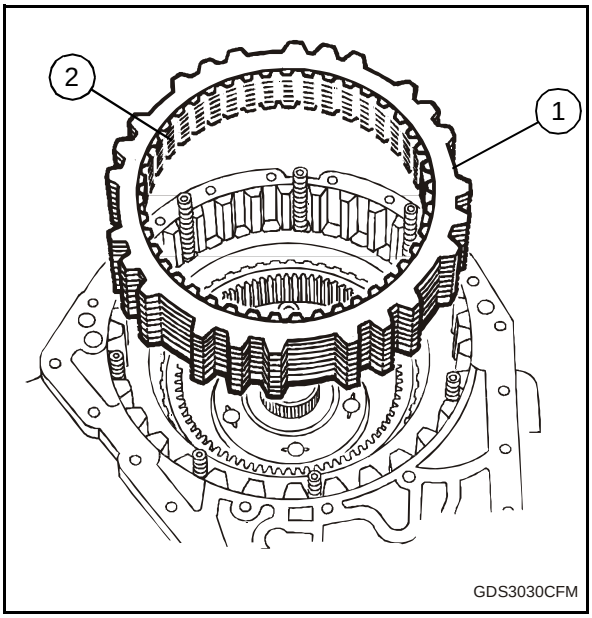
⚠ CAUTION

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



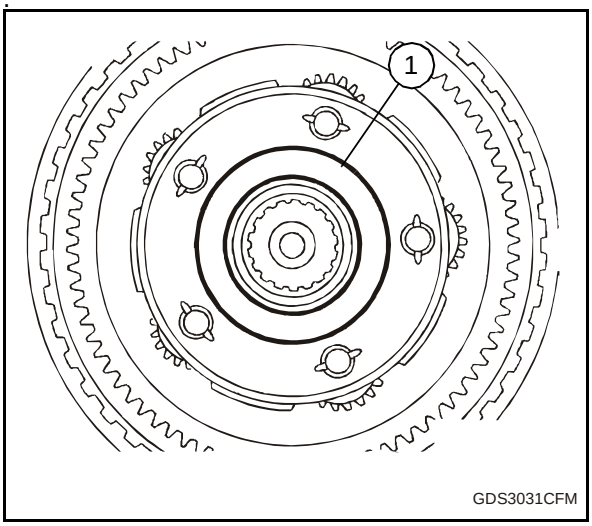
Using DFT1238 Transmission Planetary Lifting Tool remove planetary carrier two (1). **(See "CHAPTER 17. DEALER FABRICATED TOOLS" on page 383).**

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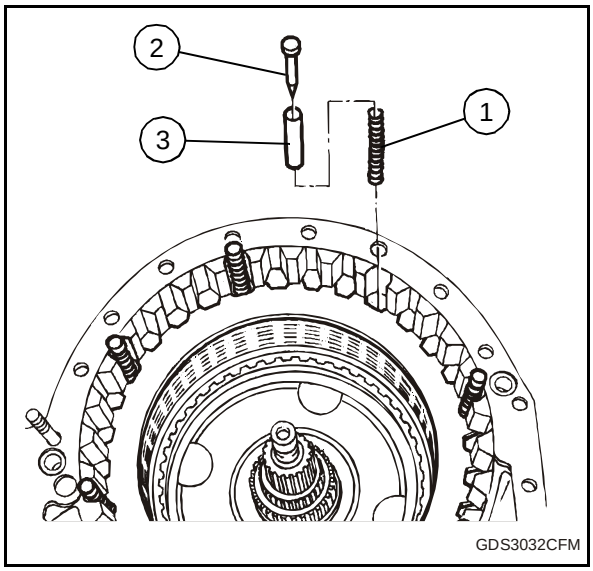


Remove, mark and identify order of clutch F plates (1 and 2)

.



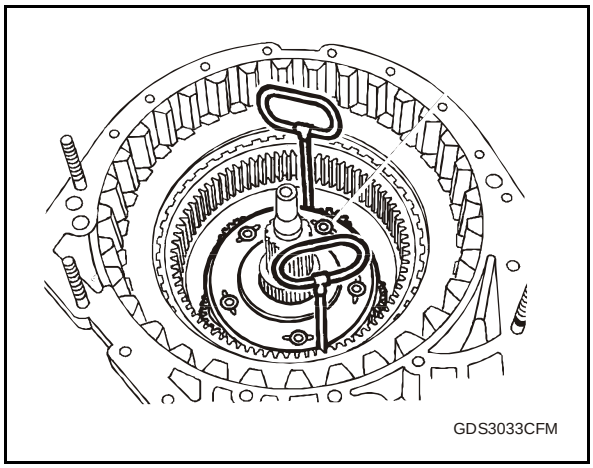
Remove thrust washer (1). Thrust washer may remain attached to planetary carrier.



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

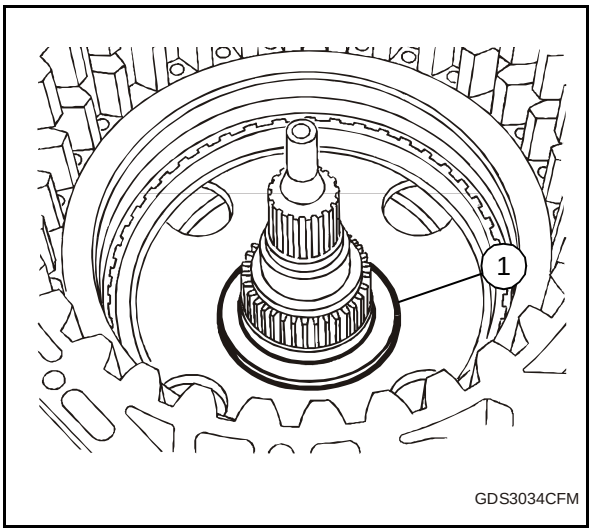
⚠ CAUTION

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

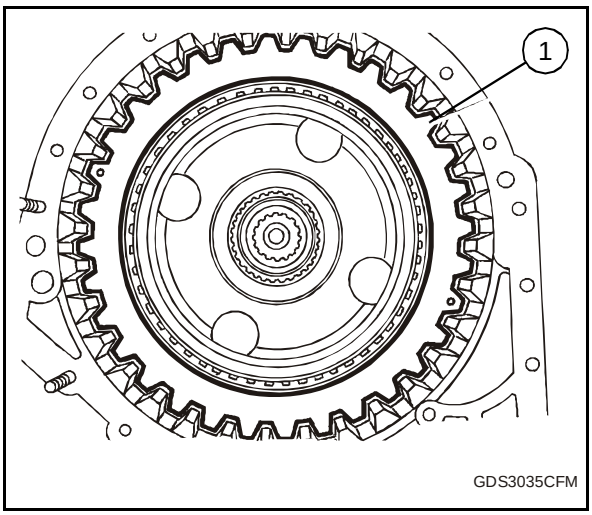


Using DFT1238 remove planetary carrier one.

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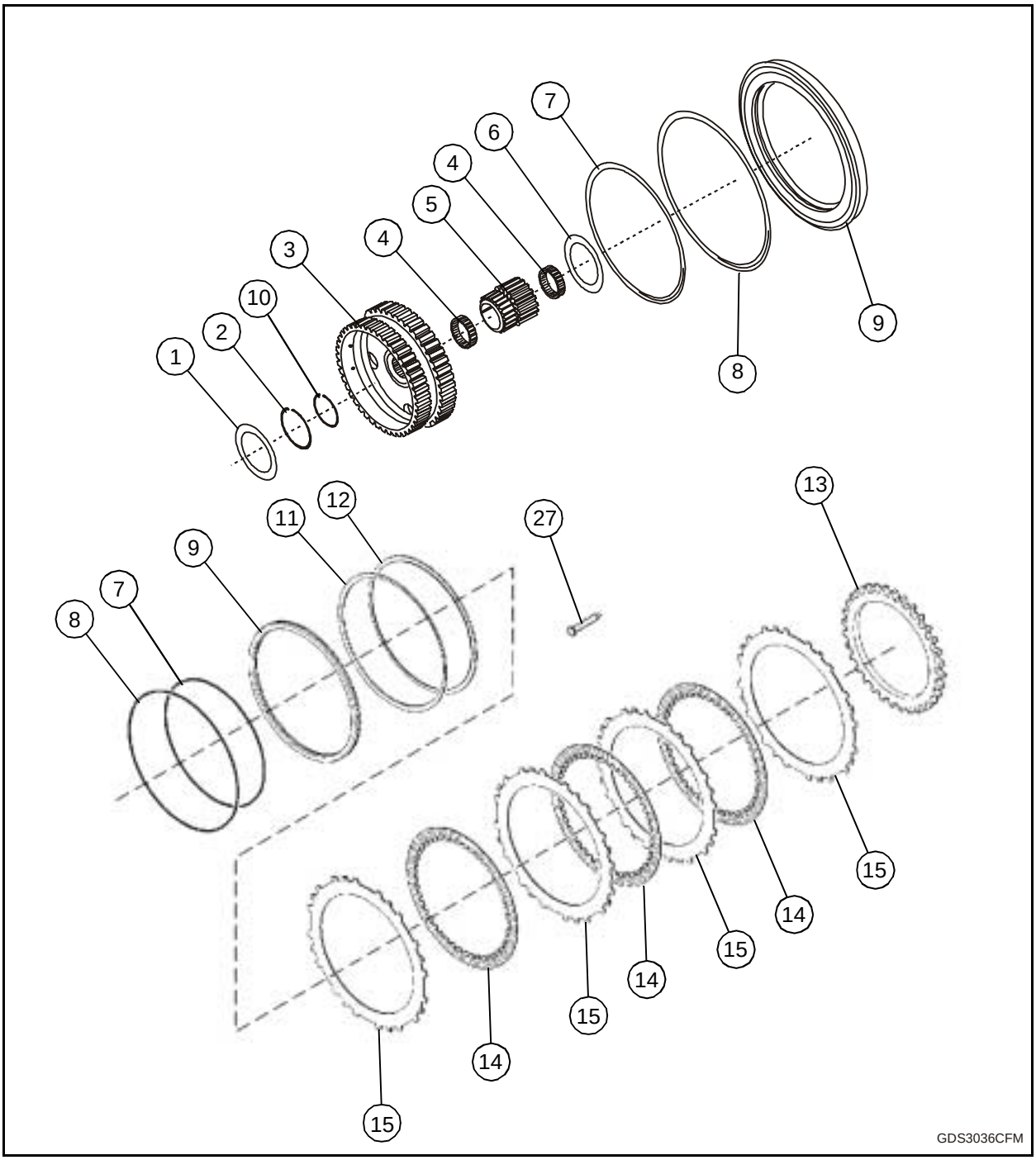
Remove thrust washer (1). Thrust washer may be attached to planetary carrier one.



Rotate and remove thrust ring (1).

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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).

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Remove, mark and identify order of clutch E plates.

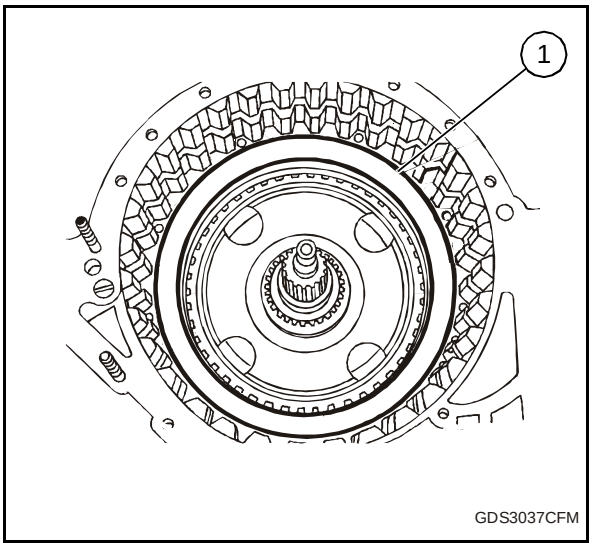
NOTE:During removal do not allow guide pins to drop into transmission.

Remove spring guide centering pin (27).

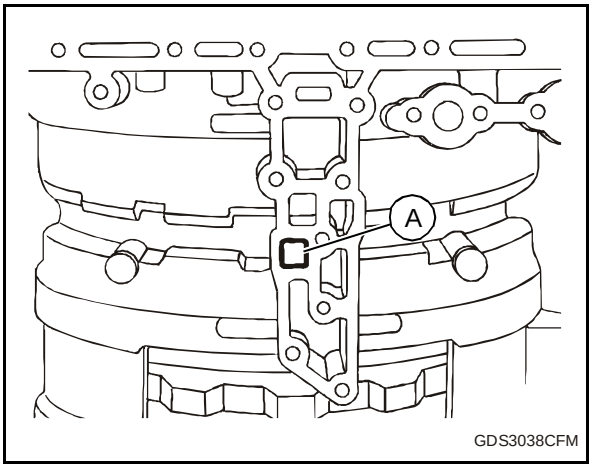
Remove spring plate holder (11) and spring plate (12).

⚠ CAUTION

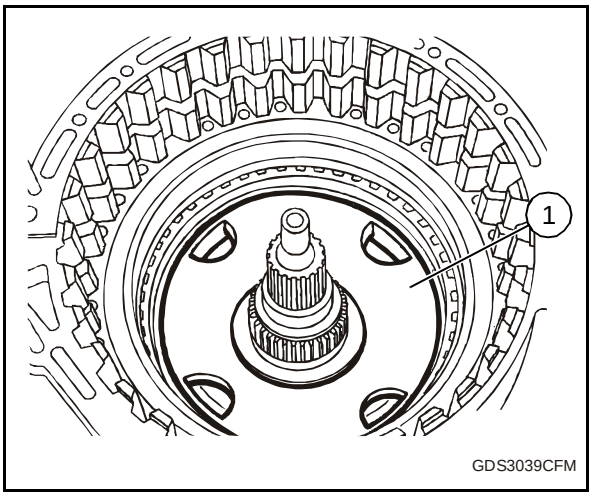
Wear eye and face protection before using compressed air. Cover transmission oil ports with a cloth for protection from transmission oil when using compressed air.



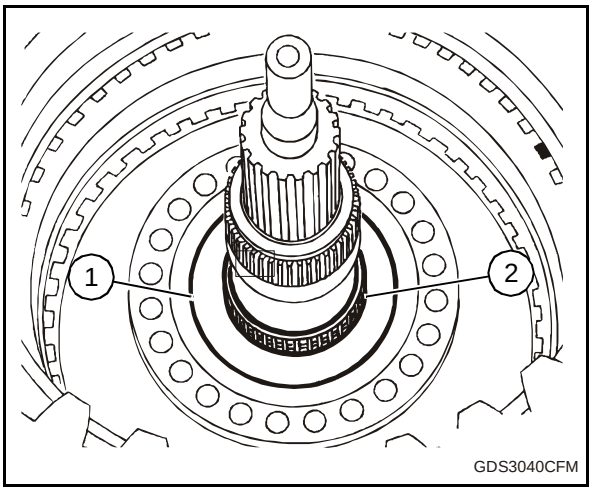
Remove clutch E piston (1).



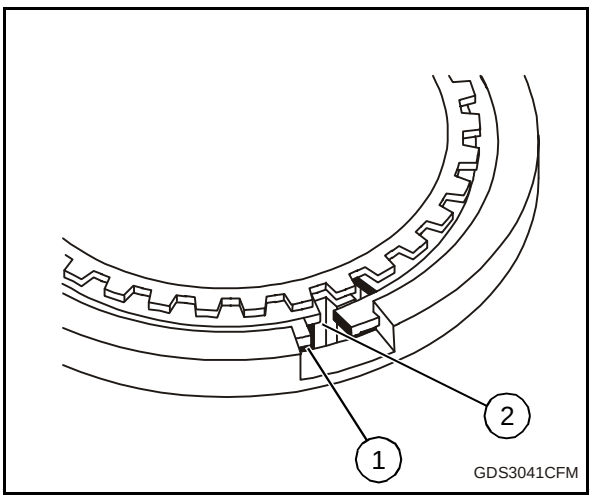
Low air pressure may be applied to port (A) to aid piston removal.



Remove carrier (1).

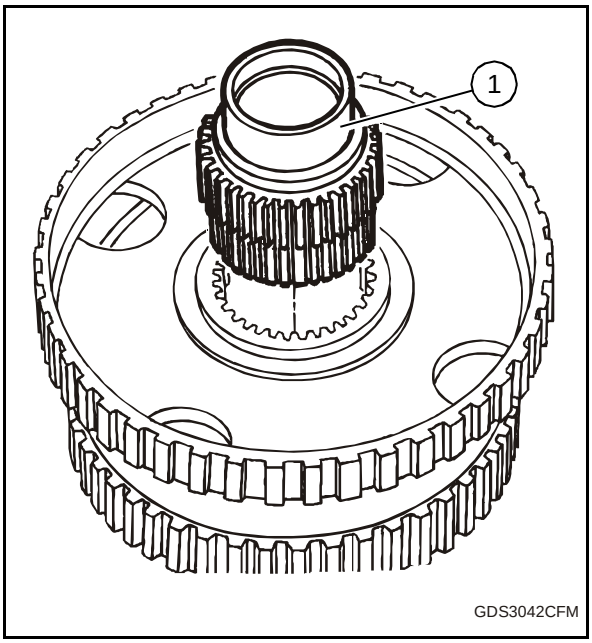


Remove thrust washer (1) and needle bearings (2).



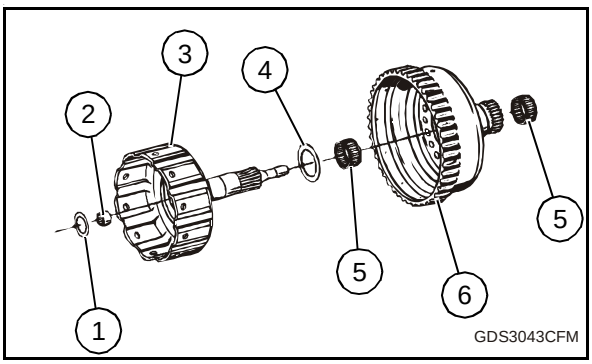
Rotate end of snap rings (1 and 2) to notch opening and remove.

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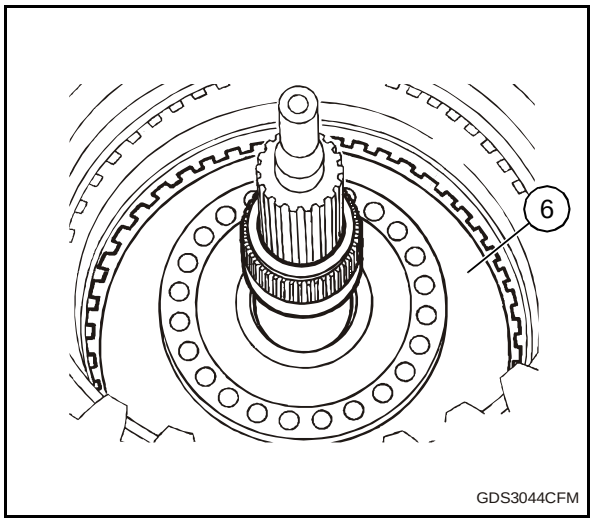


Remove sun gear (1) with suitable driver.

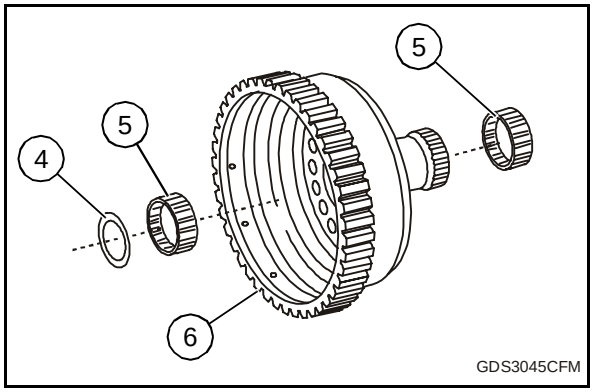
Remove Clutch C Shaft



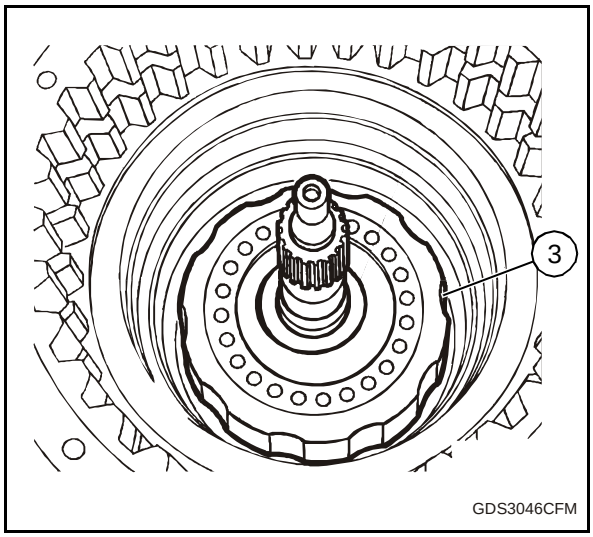
1. Thrust Washer.
2. Needle Bearing.
3. Clutch C Input Shaft.
4. Thrust Washer.
5. Needle Bearing (2 used).
6. Clutch C Hollow Shaft.



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

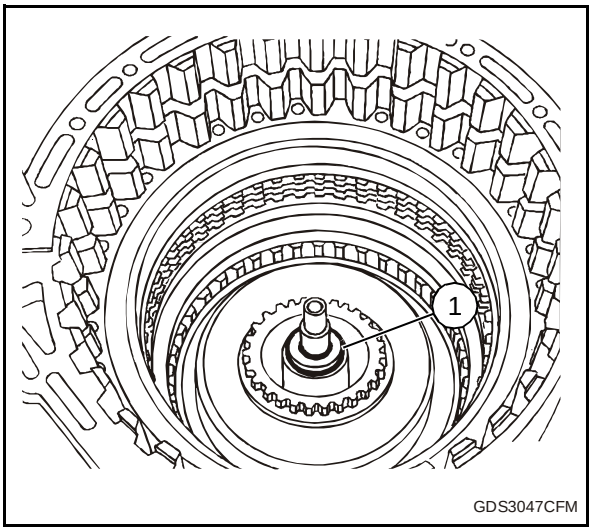


Remove needle bearings (5) and thrust washer (4).

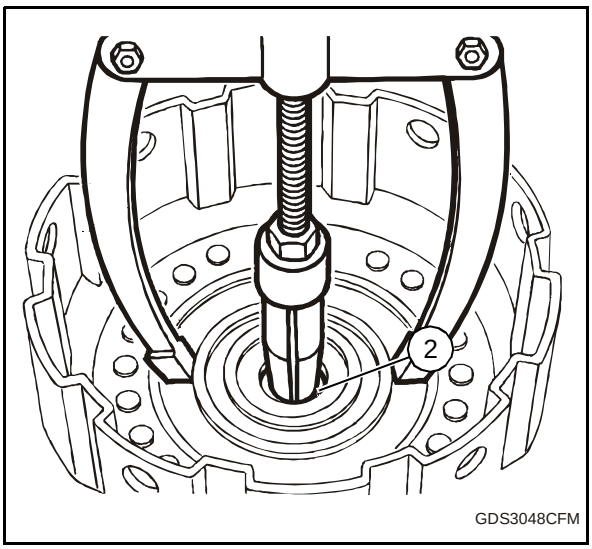


Remove clutch C drive shaft (3).

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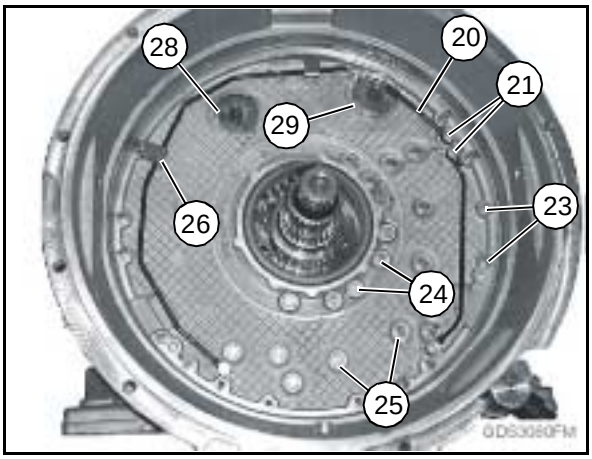
Remove turbine shaft thrust washer (1). Thrust washer may be attached to drive shaft.



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

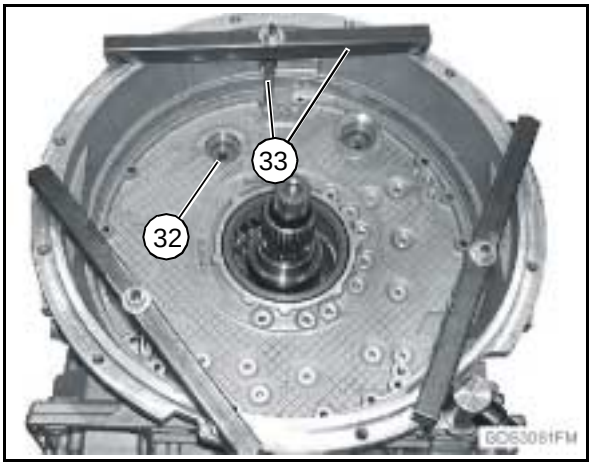
Remove Cover Plate and Auxiliary Drive Gears

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)**

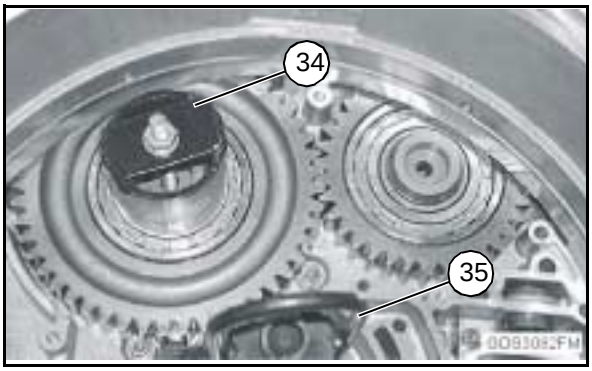
Apply heat to cover at auxiliary drive shafts.

Evenly tighten puller to loosen cover and remove.

⚠ CAUTION

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

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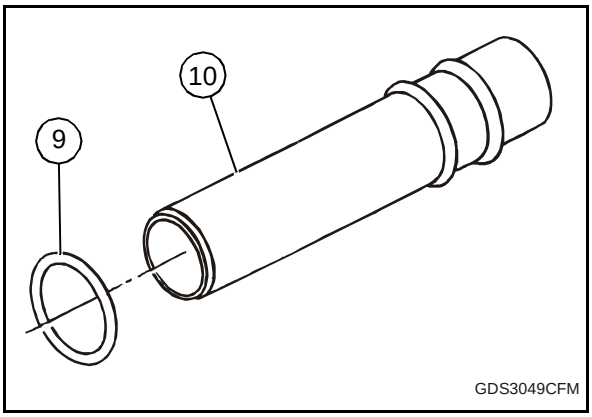


Use DFT1232 Auxiliary Drive Pin Puller (34) to remove auxiliary shafts from drive gears. **(See "DFT1232 AUXILIARY DRIVE PIN PULLER" on page 397)**

Attach 281710 Lifting Device (35).

Remove drive gears.

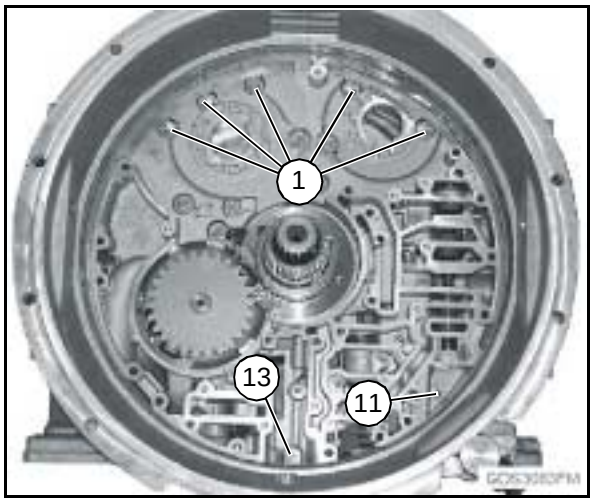
Remove Input Oil Control Body and Clutch Element



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

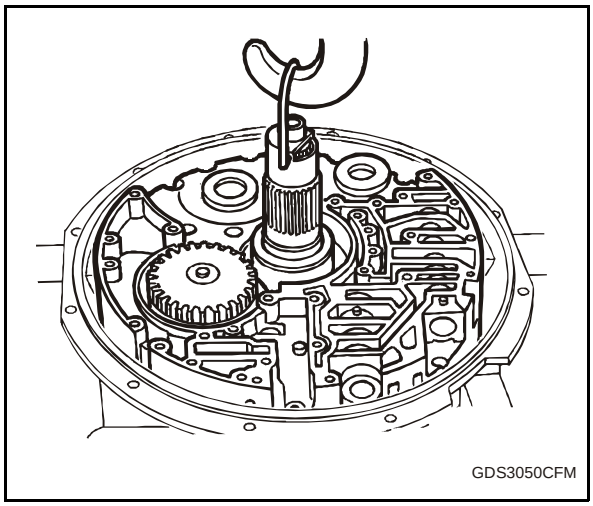
⚠ CAUTION

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.

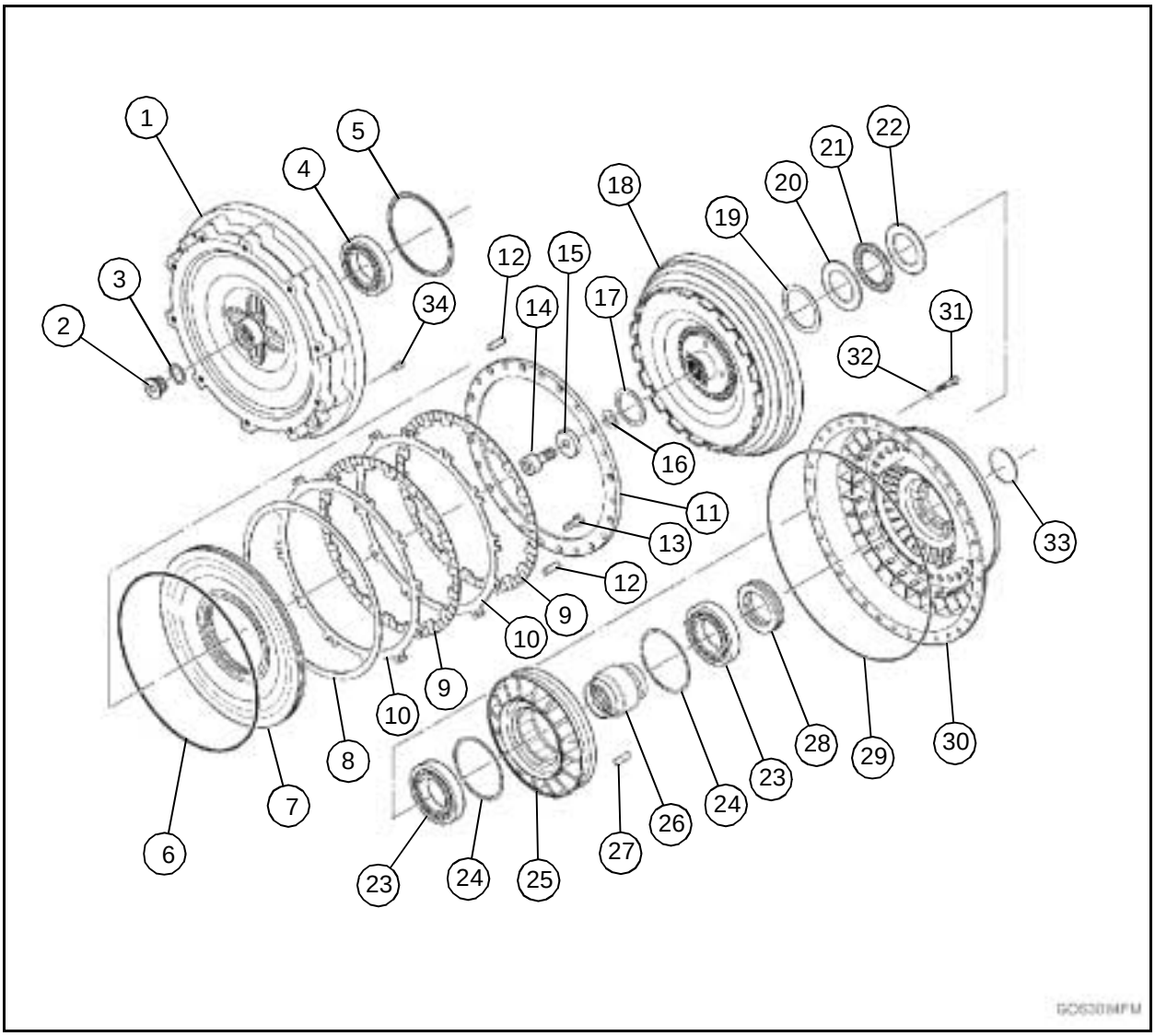
Place control plate on wooden blocks.

Remove Clutch D

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

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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.

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

⚠ CAUTION

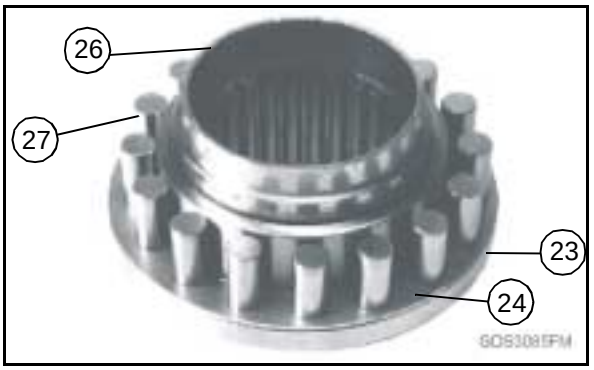
Avoid striking converter circuit cover or pump drive cover during separation. As damage will result.

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.

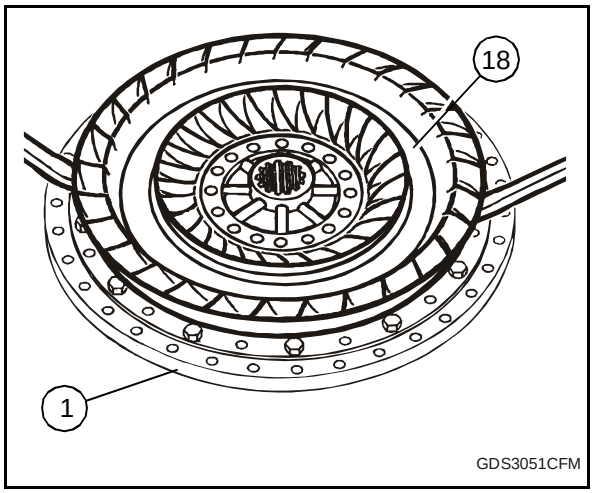
Remove bearing assembly (28) from stator.



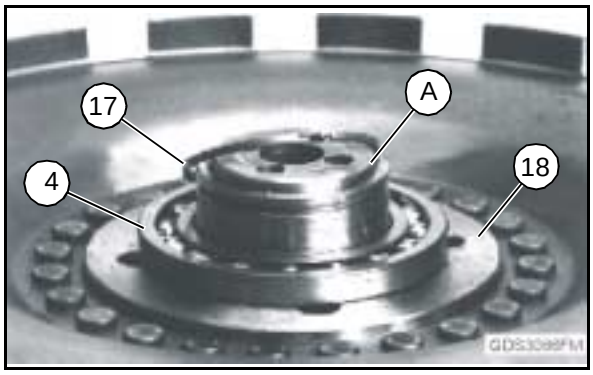
Support stator, using press push roller clutch hub (26) to remove bearing and washer (23 and 24) with clutch rollers (27) from stator.

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).

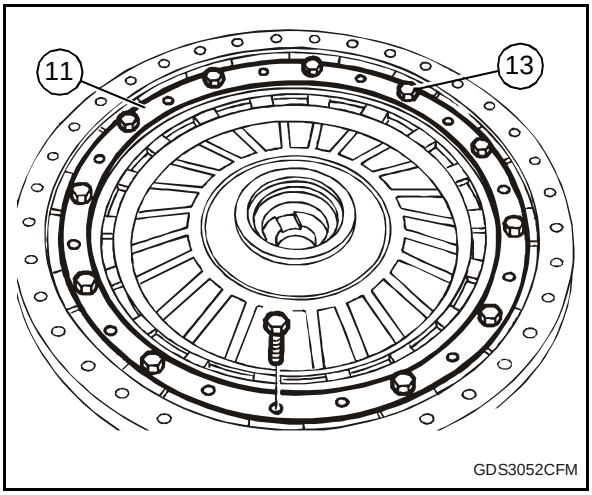


NOTE:Rectangular seal ring (17) has sharp edges. Wear protective gloves.

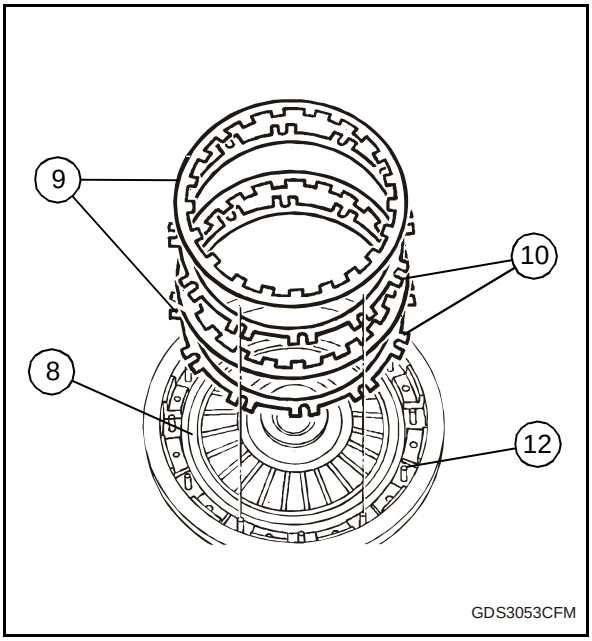
Remove rectangular seal ring (17) and remove bearing (4) using two levers.

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

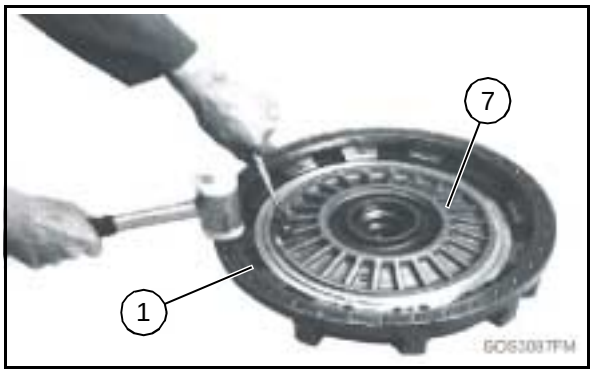
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Remove bolts (13) and end plate (11).



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

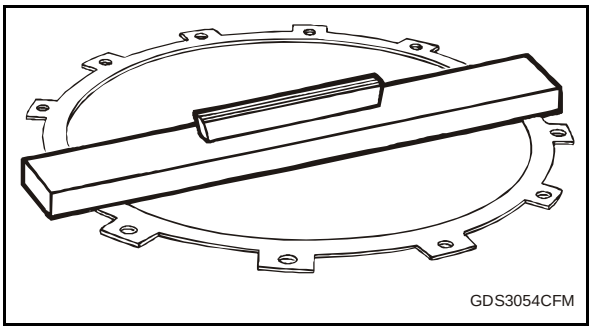


Hold piston (7) with pliers and tap circuit cover lightly with soft faced hammer.

Remove piston seal (5 and 6).

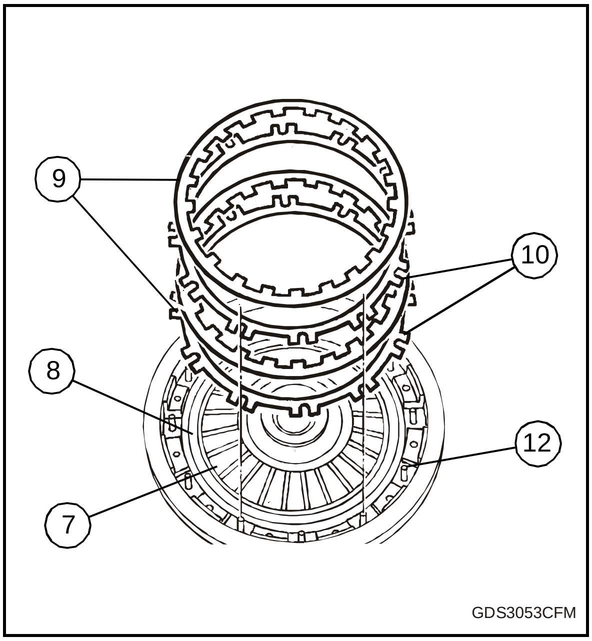
Lubricate and install piston seals (5 and 6). Seal (5) may need to be stretched slightly to make a snug fit in piston groove.

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.

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

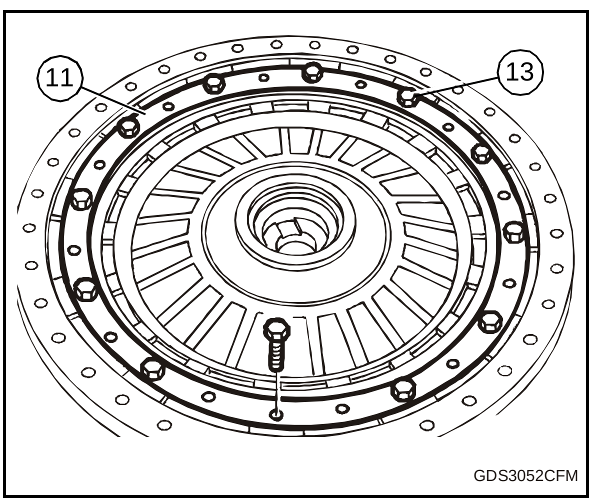
NOTE: Inner plate facing must not show wear, distortion or discoloration.

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).

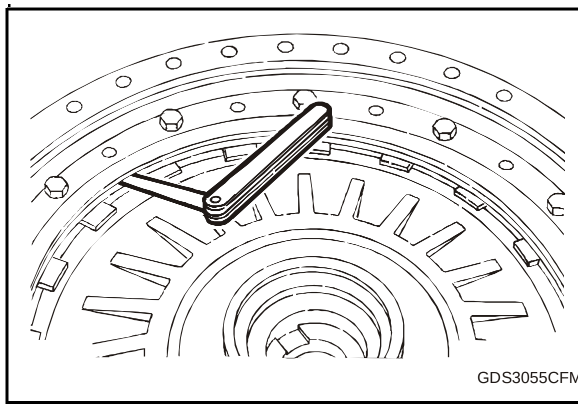


Position and install end plate (11) with bolts (13).

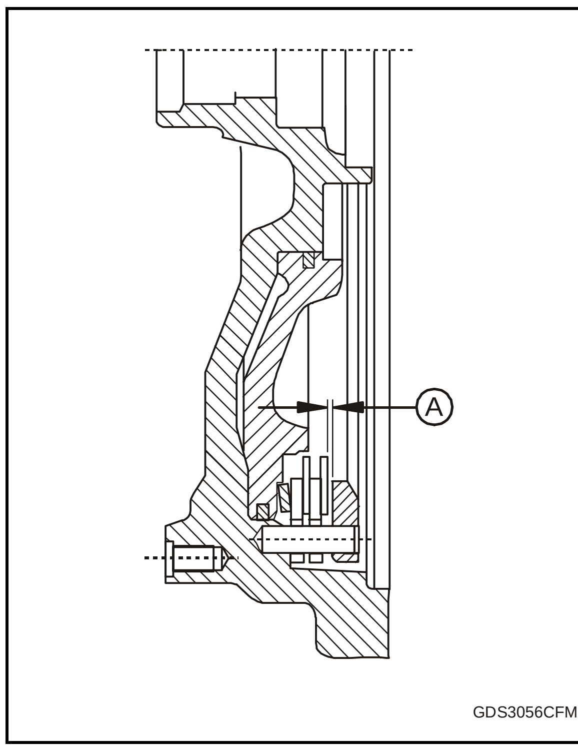
Disassemble and Assemble Torque Converter Specification

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.



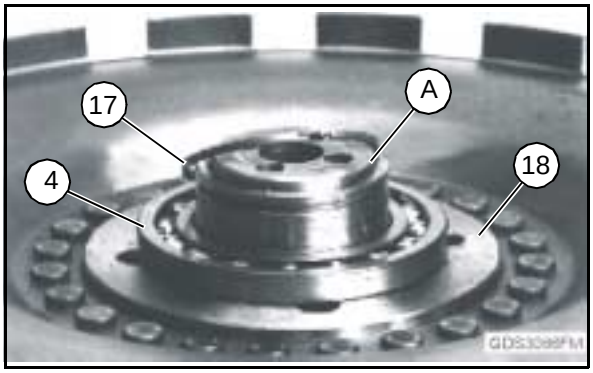
Measure clutch plate clearance between end plate and inner plate. Use a combination of outer plate sizes to adjust clearance.



Disassemble and Assemble Torque Converter Specification

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

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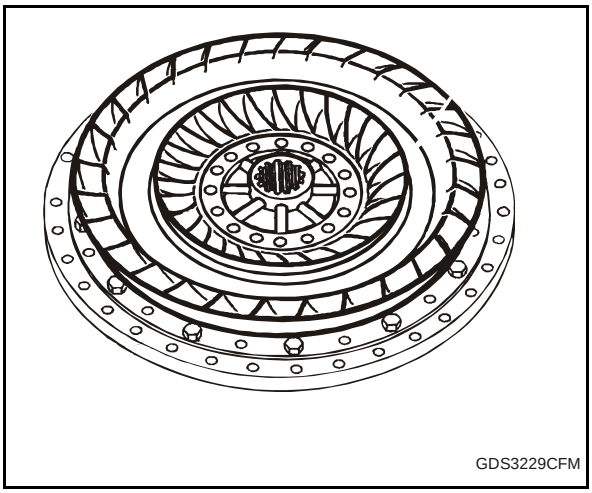


If removed install turbine plate (A) as shown with suitable driver. Secure turbine plate at four evenly spaced locations with punch.

Install bearing (4) with driver.

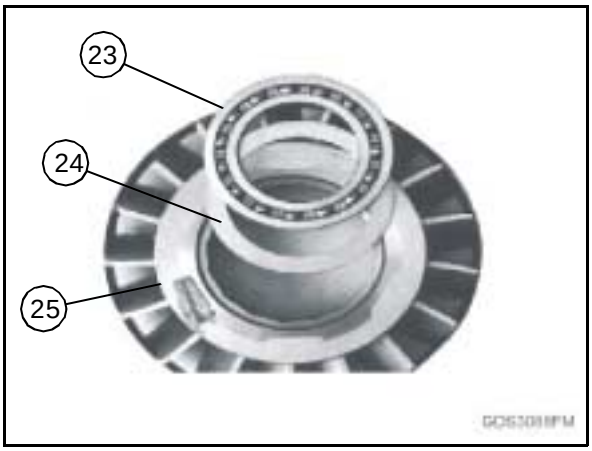
NOTE:Rectangular seal ring (17) has sharp edges. Wear protective gloves.

Install rectangular seal ring (17).



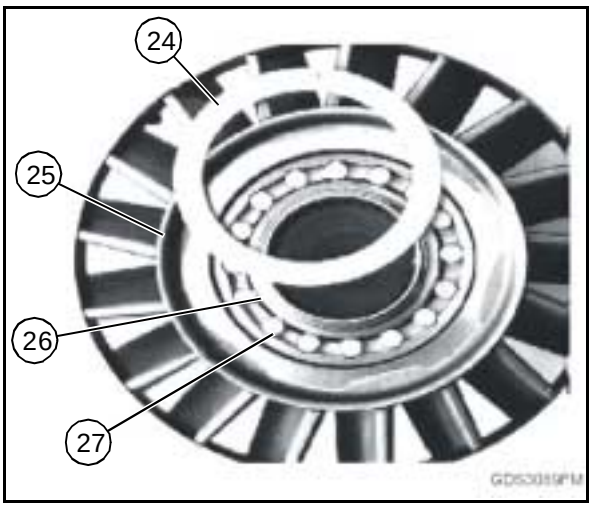
NOTE:Clutch inner plate teeth must engage turbine. Ensure clutch plate teeth are not damaged during turbine installation.

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.

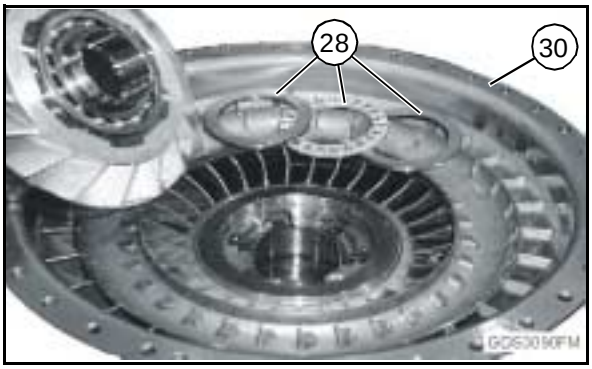


Support stator with bearing and place roller clutch hub (26) longer collar into bearing. Using JDG1628 and press push roller clutch hub into stator and bearing assembly.

Install rollers in stator.

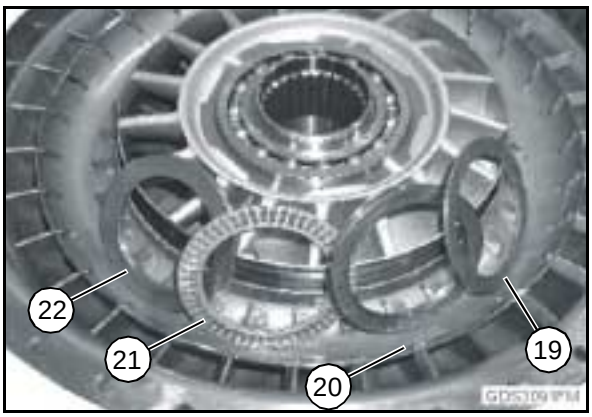
Support stator to install second washer (24) and bearing (23) using 281708 and press.

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

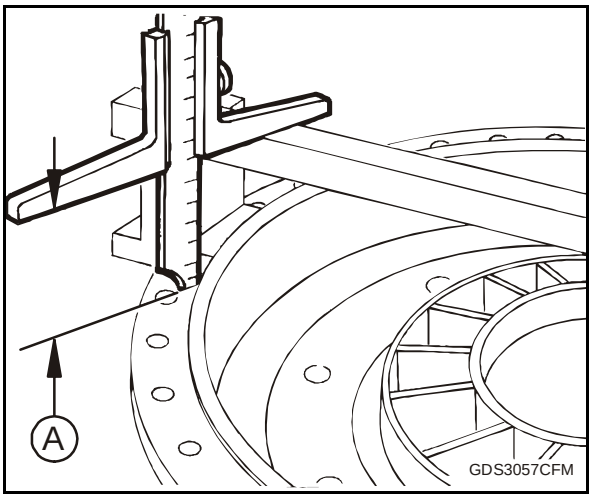
Install stator with long collar of roller down.



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

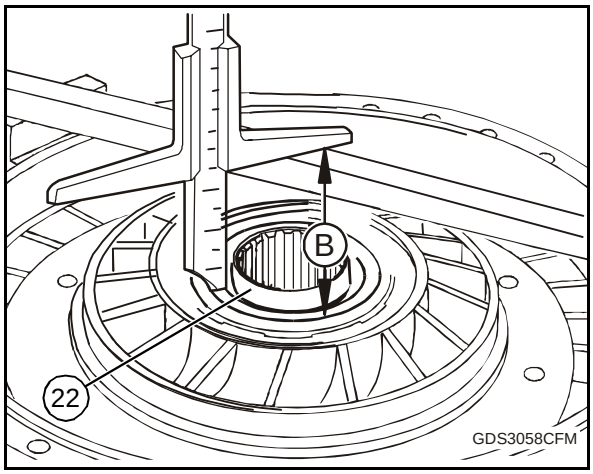
Install washers and bearing (20 - 22). Do not install shim (19) at this time.

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.

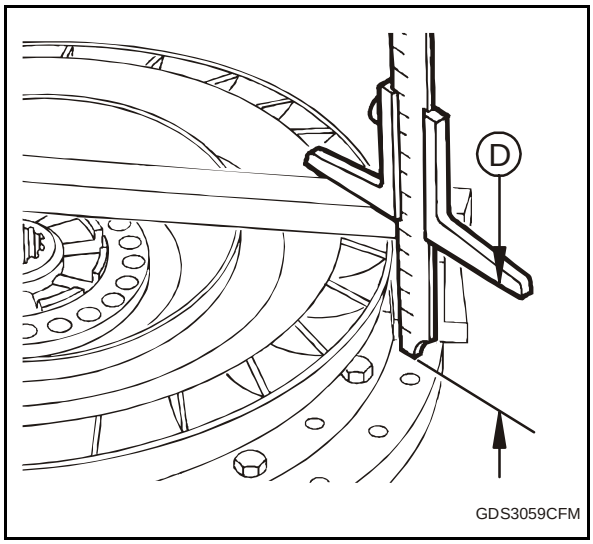
With depth gauge measure and record distance from measuring bar to pump drive sealing surface. Record as dimension **A**.



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

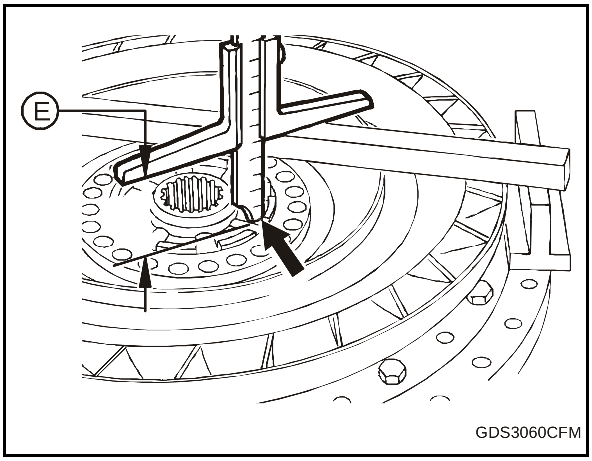
Subtract dimension **B** from dimension **A** and record as dimension **C**. **(A-B) = C**

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**.

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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

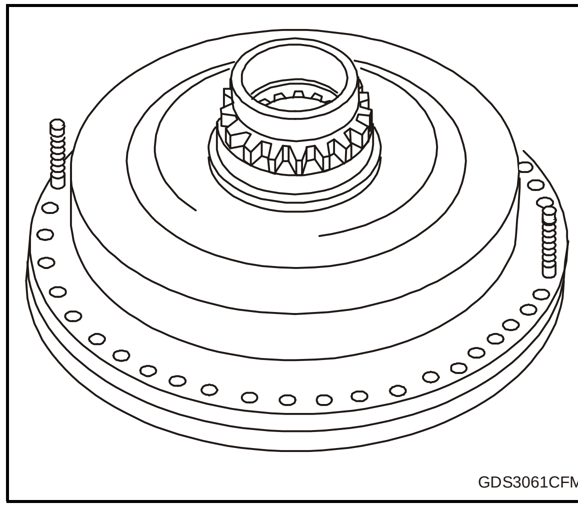
Subtract average thrust bearing clearance H from dimension G. This will give shim (19) size needed. (G-H) = shim size

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

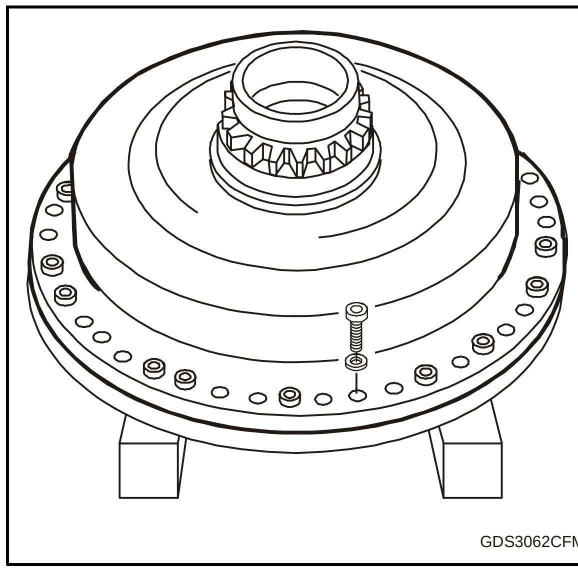
Apply thin layer of oil to bearing (21) and install with washer (22).

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

Install O-ring (29).


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

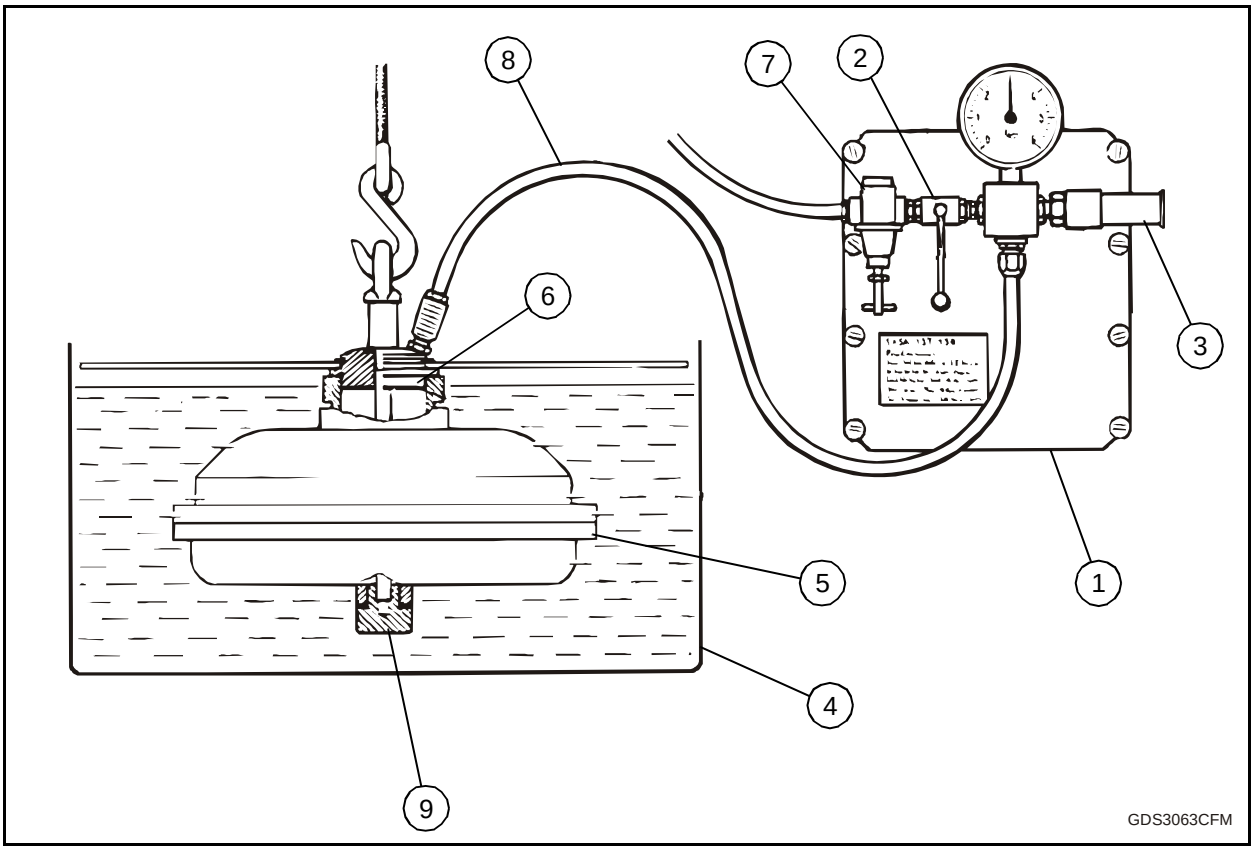

GDS3062CFM

Fit cap screws and tighten.

Disassemble and Assemble Torque Converter Specification

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

https://truckmanualshub.com/



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.

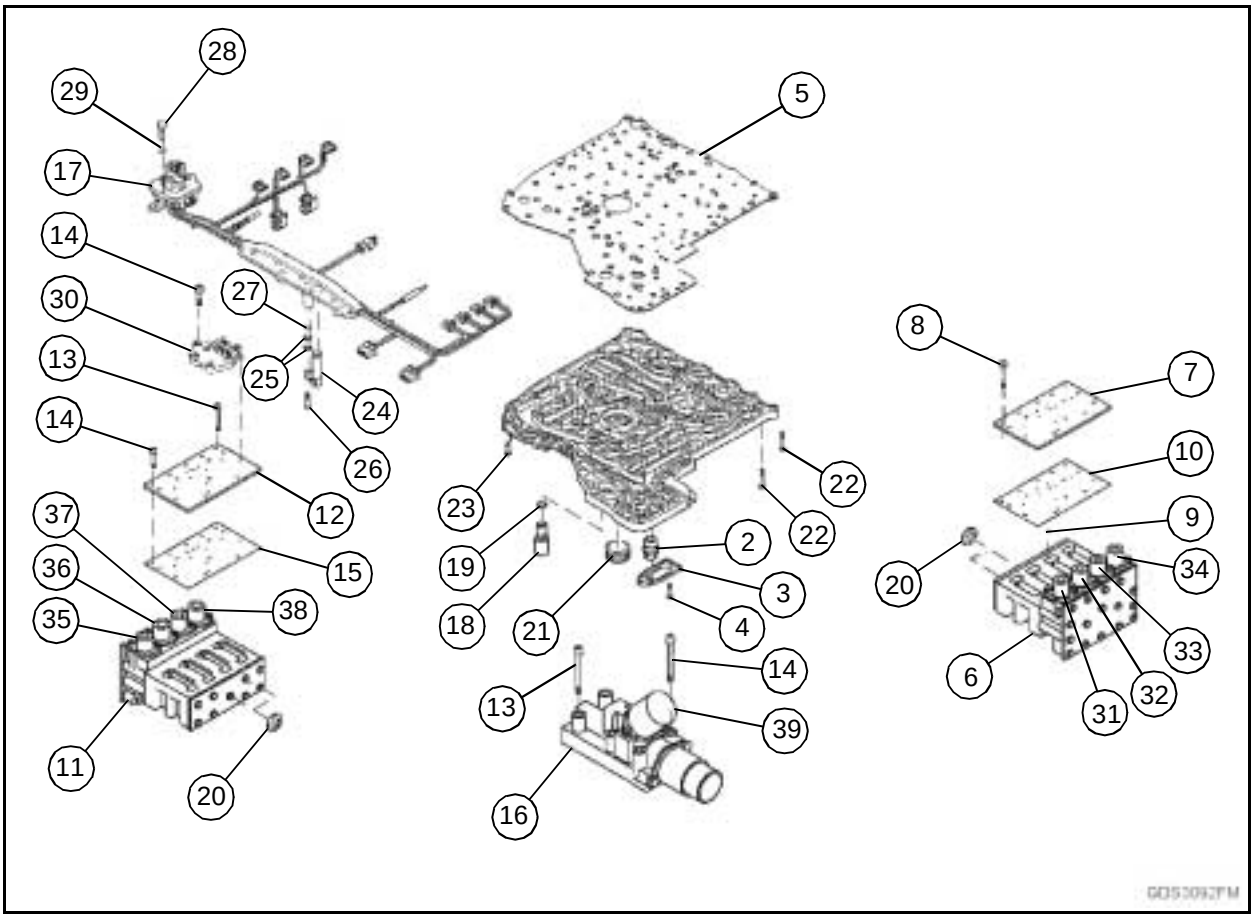
Using hoist lower converter into tank of water mixed with antifreeze at a ratio of 1:120.

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.

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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.

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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).

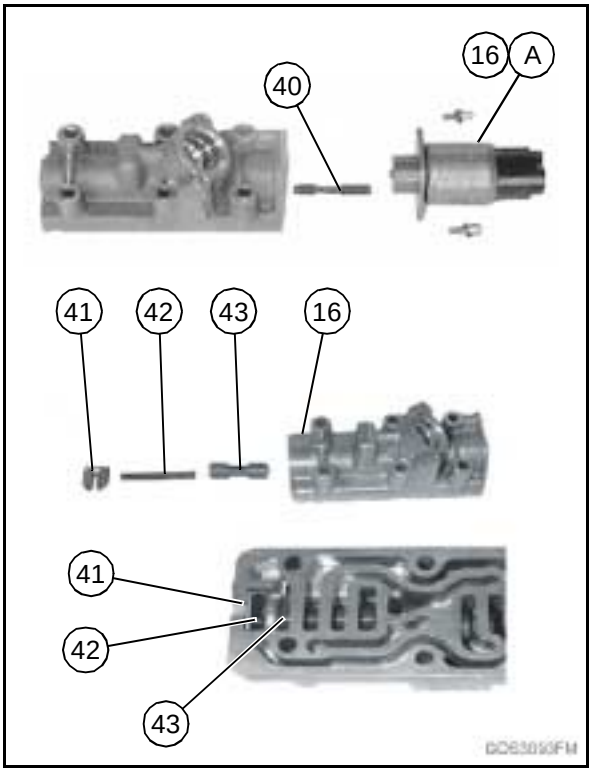
Remove solenoids (31 - 38).

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

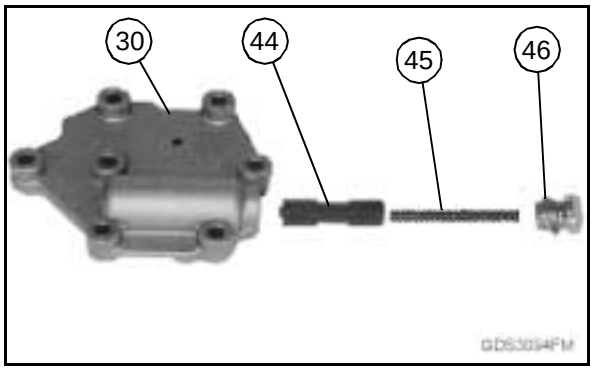
Remove cap screws (13 and 14) and manifold block B (11).

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).

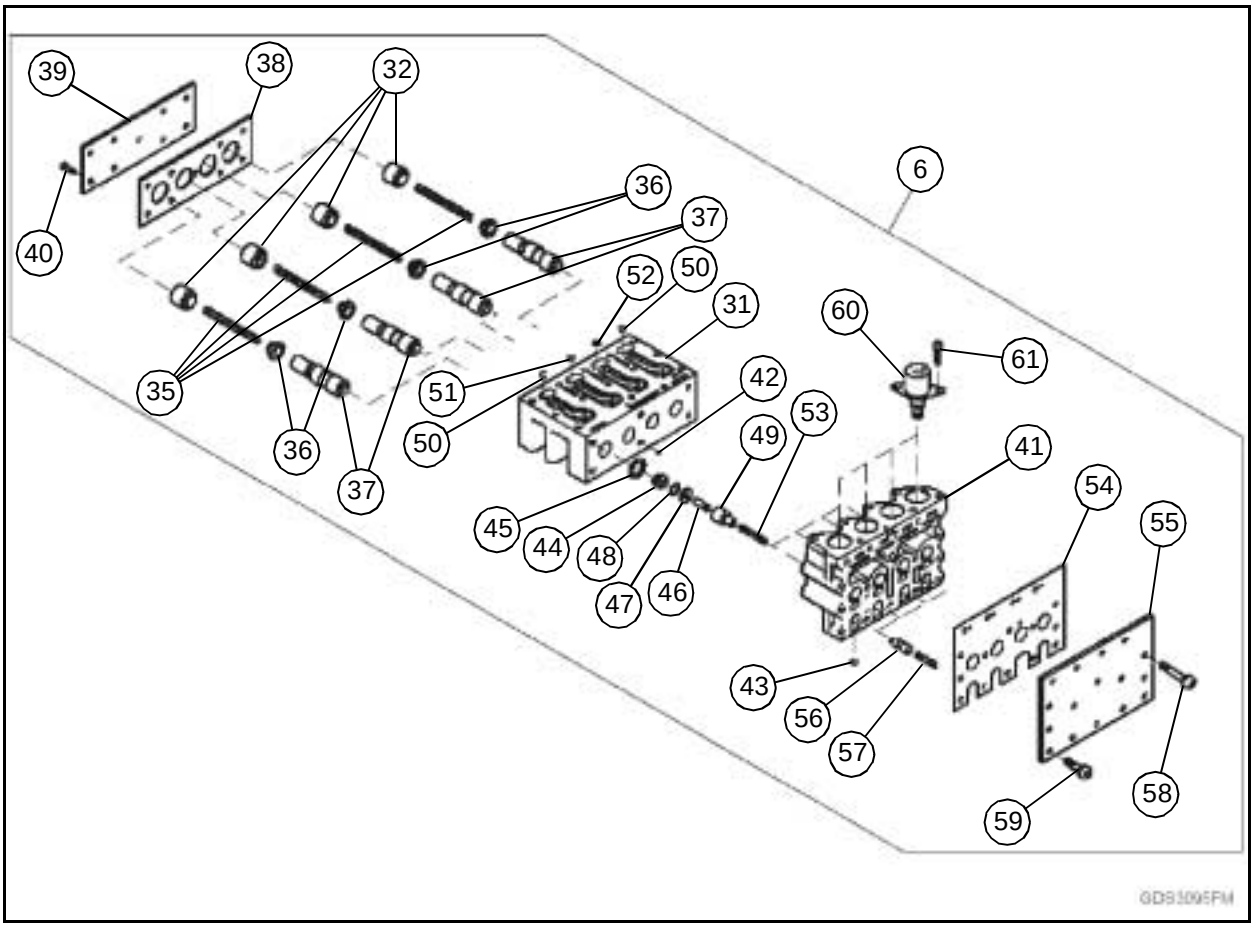


Disassemble F2 valve (30). Inspect, clean and assemble parts (44 - 46).

Disassemble and Assemble Torque Converter Specification

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

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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.

Remove solenoids (60).

⚠ CAUTION

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

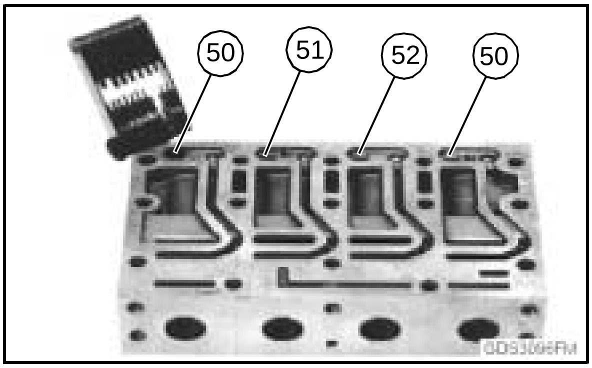
NOTE: Guide pins may aid removal and installation of covers under spring tension.

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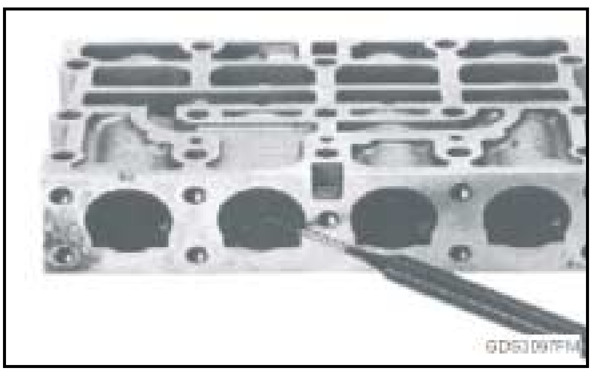
Remove manifold block covers (39 and 55) with care. Covers are under spring tension.

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.

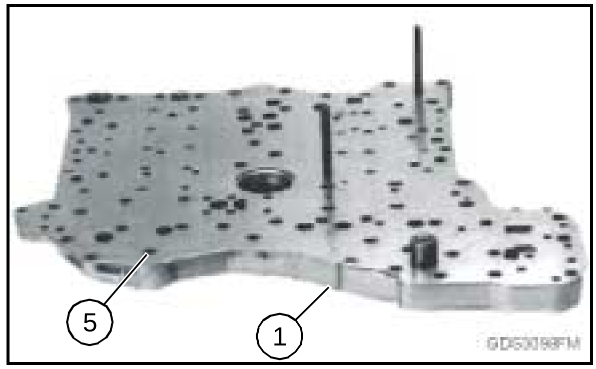
Orifices must secured in place at two points 90 degrees apart with a punch.

Lubricate and assemble manifold components.

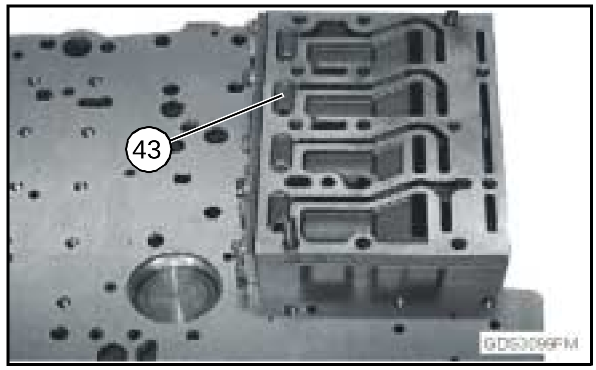
Using guide pins install gaskets (38 and 54) and covers (39 and 55). Compress springs and tighten cap screws.

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.)

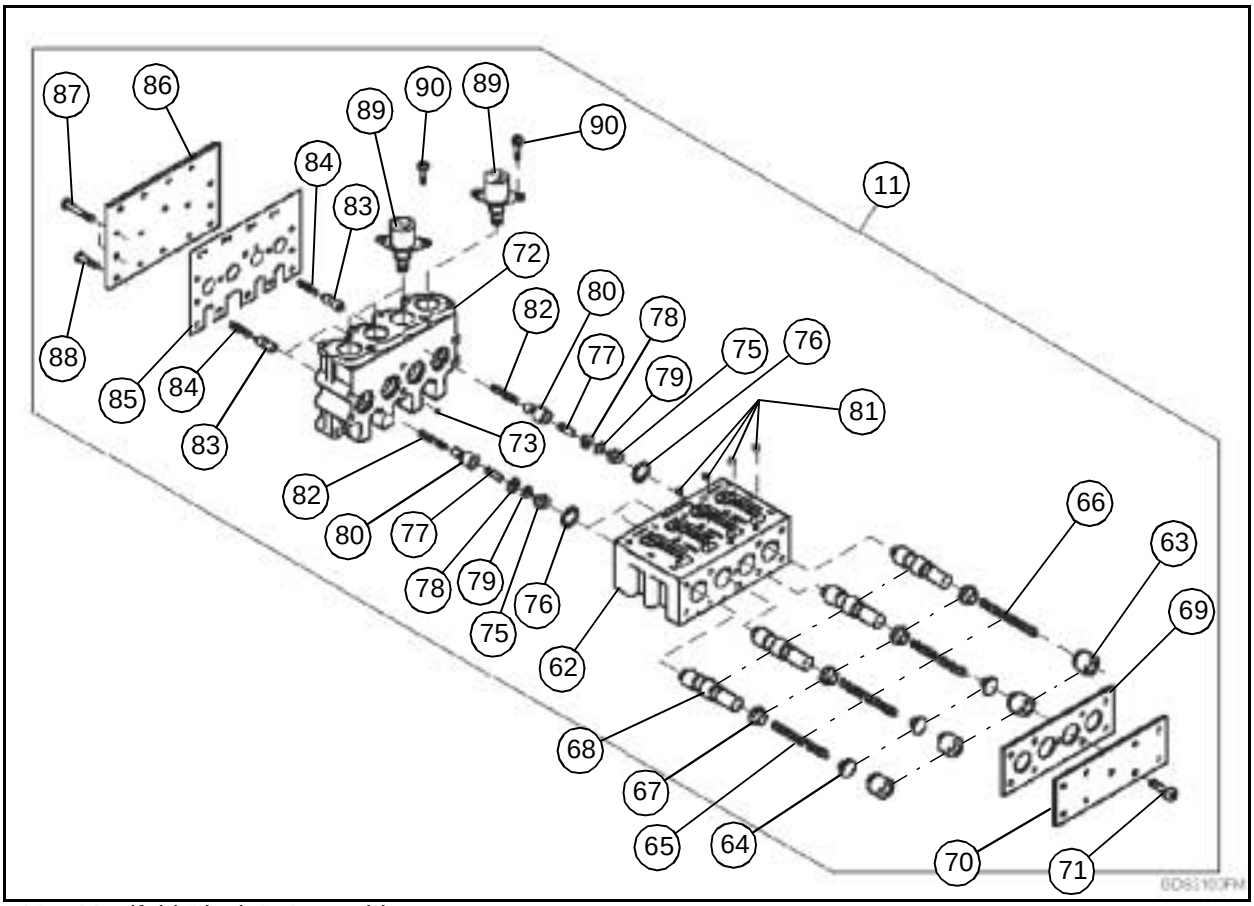
Install manifold block A (6) and check ball (43).

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.)

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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.

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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.

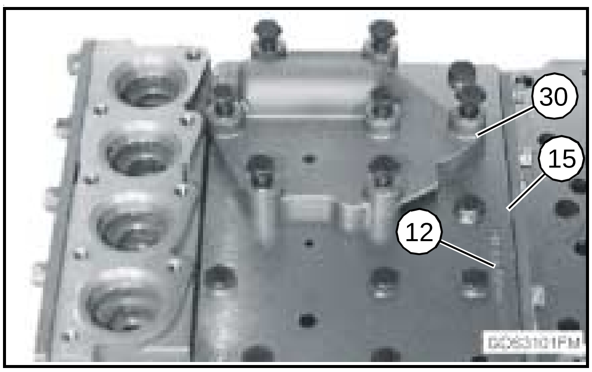
Orifices are replaced similar to manifold A.

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.)

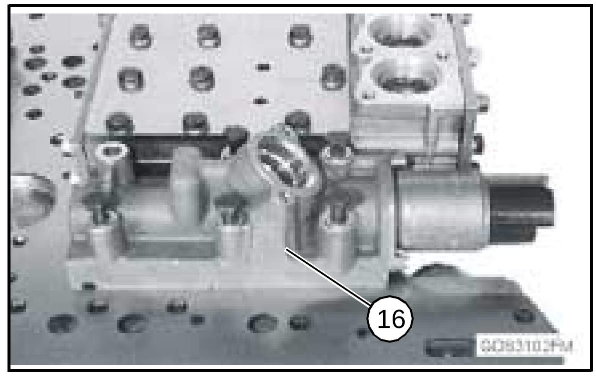


Using guide pins install manifold block B.

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.)



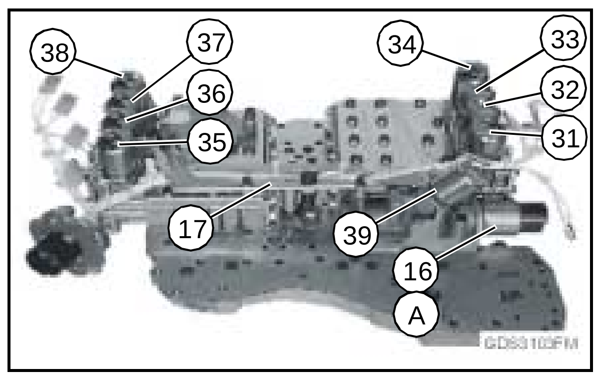
Install F2 valve block (30) and throttle pressure valve (16).

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).

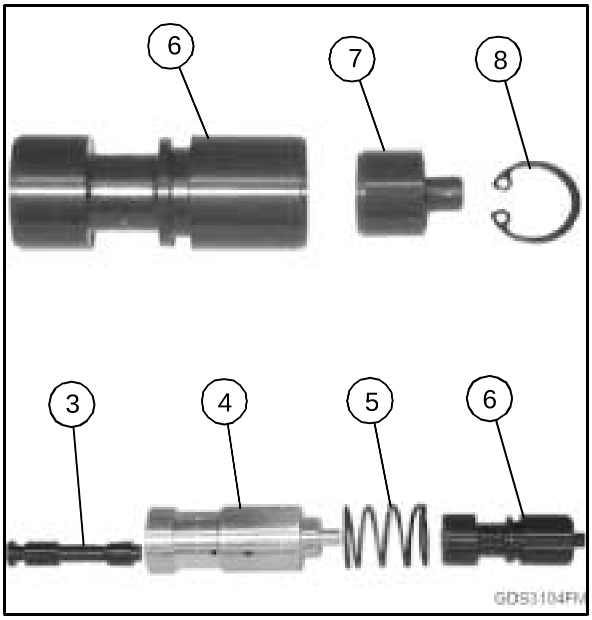
Disassemble and Assemble Control Valve Specification

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

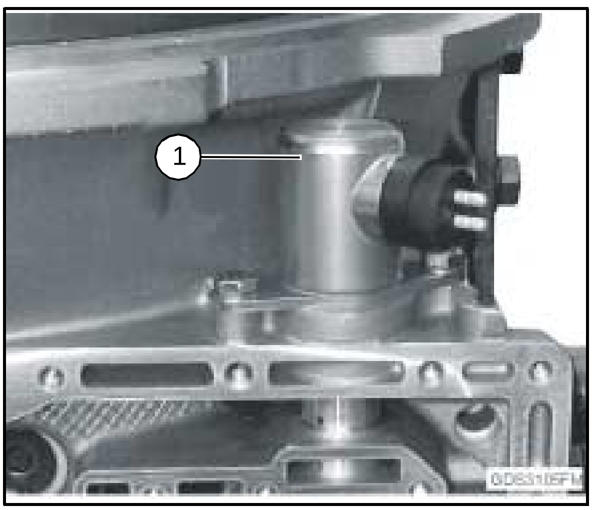
Install wire harness (17) and connect solenoids.

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Assemble Retarder Valve



Assemble parts (3 - 8).



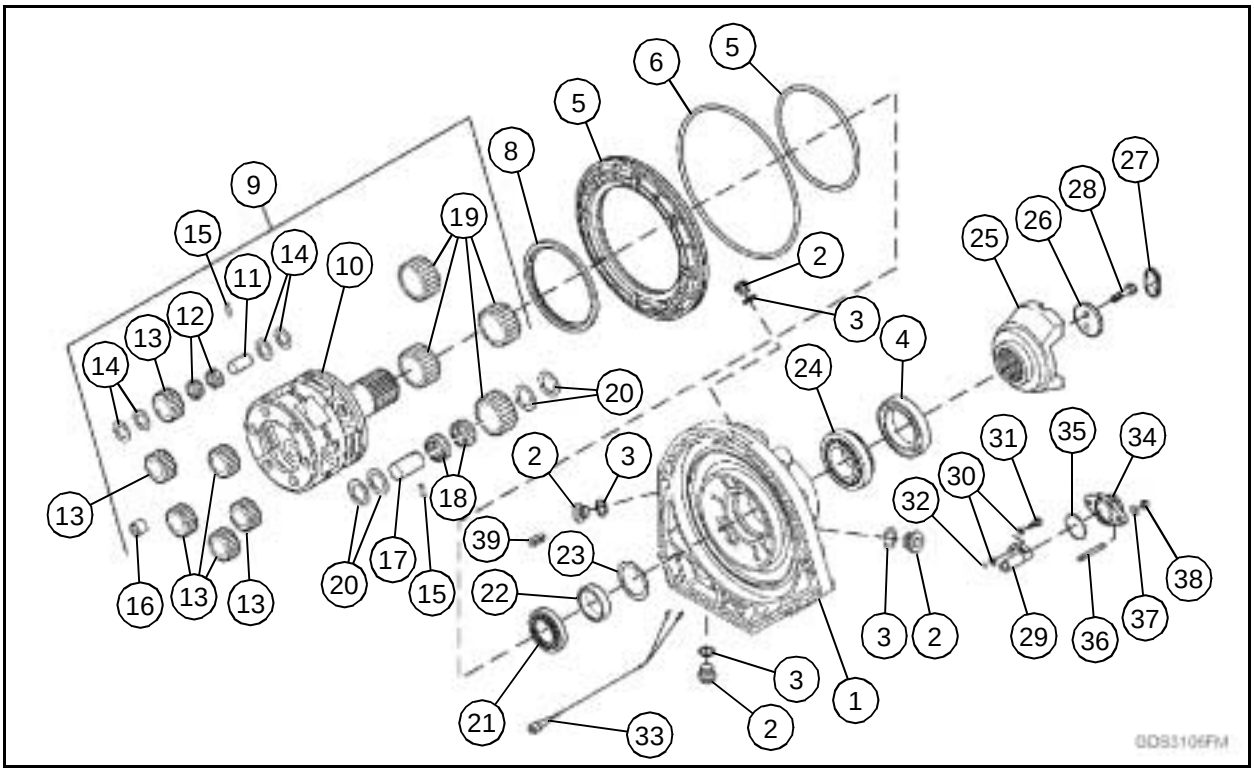
Install retarder valve solenoid (1) and O-ring.

Install Retarder Valve Specification

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

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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.

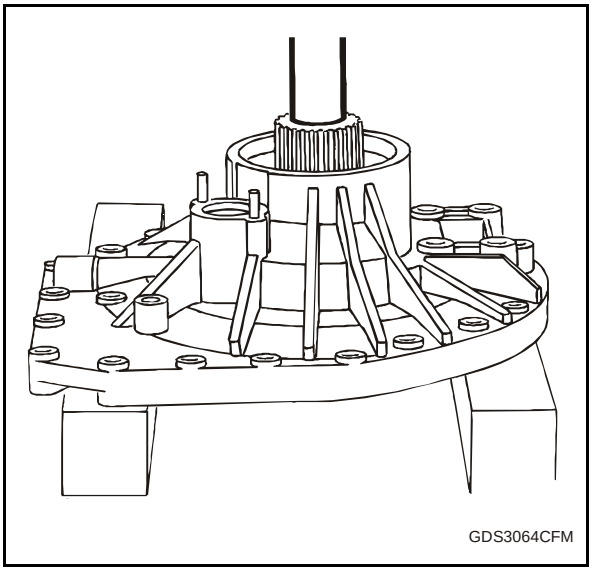
Hold clutch G piston (5) with pliers and tap output cover (1) with soft face hammer to remove clutch G piston.

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

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⚠ CAUTION

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


GDS3064CFM

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.

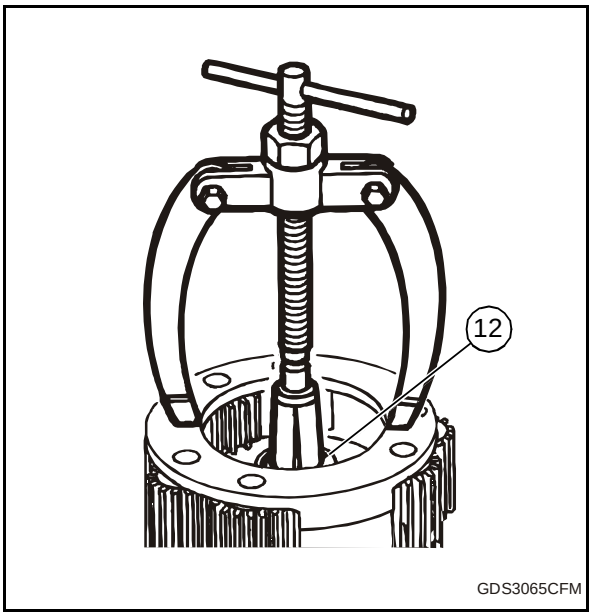
⚠ CAUTION

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.

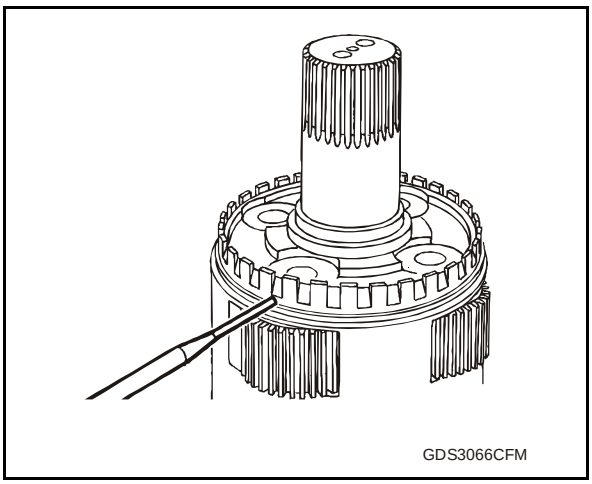
NOTE: Measure planetary pinion end play before disassembly. Disassembly required only if worn or damaged. Planetary pinions must be replaced as a set.

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.

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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.)

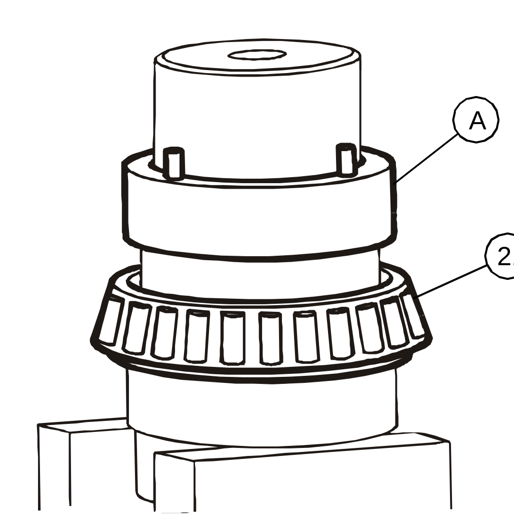
Drive new roll pin (15) into carrier until even with carrier surface. Secure roll pin in carrier with punch.

⚠ 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).



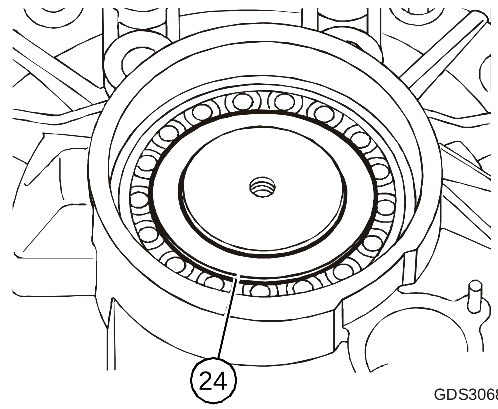
GDS3067CFM

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.

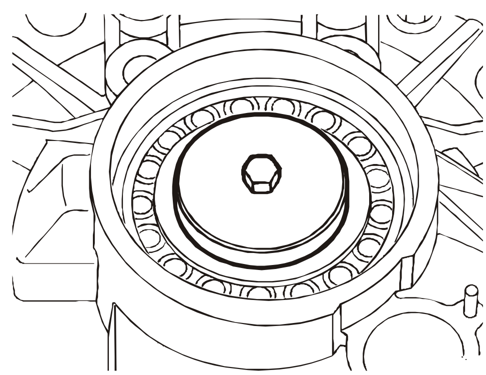
NOTE: Output cover and bearings must be at 20° C (68° F) during shim adjustment procedure.

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



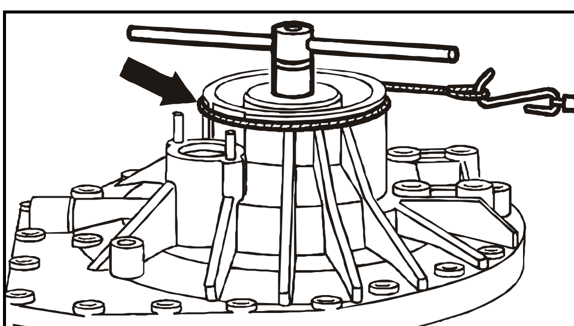
GDS3068CFM

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



GDS3069CFM

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



GDS3070CFM

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

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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

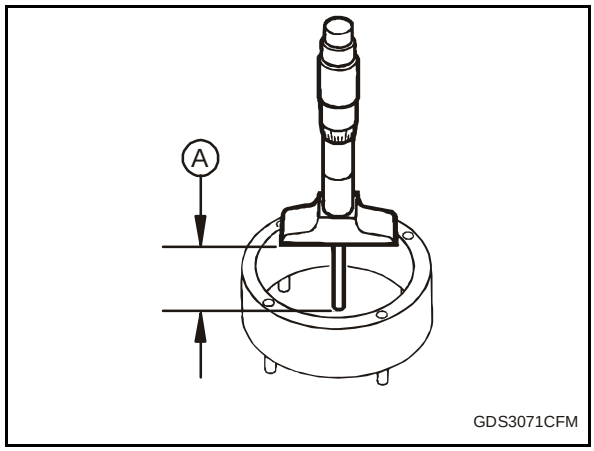
Output Shaft Bearing Rolling Drag Torque - 8 - 10 N (2 lb) force

⚠ 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.



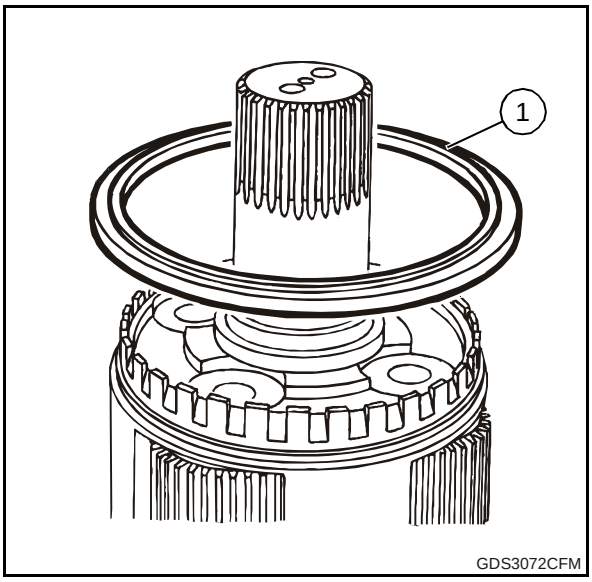
Place adjusting ring on flat surface and measure adjustment ring height (A) as shown. Record as dimension (A).

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

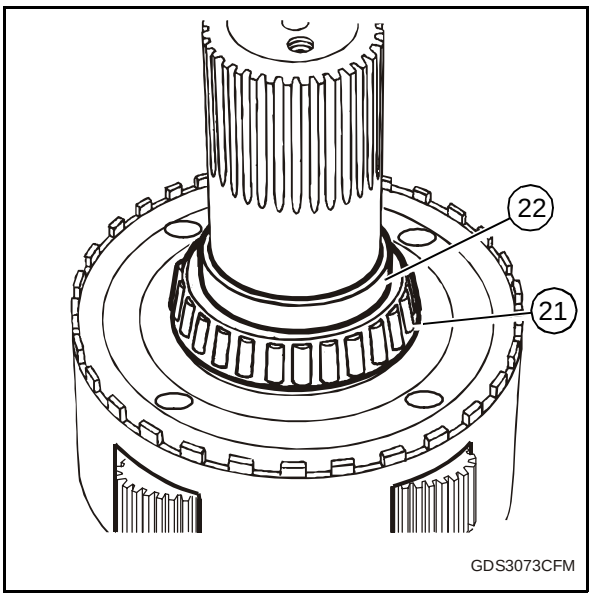
Disassemble and Assemble Output Planetary Specification

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.



Install thrust ring (1).



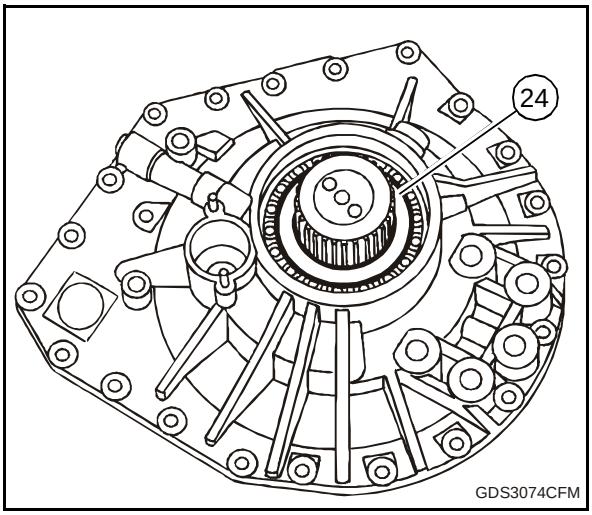
⚠ CAUTION

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.

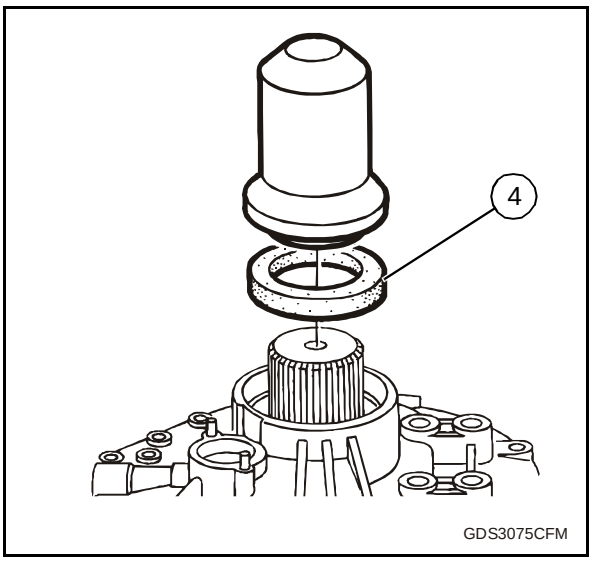
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⚠ CAUTION

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.

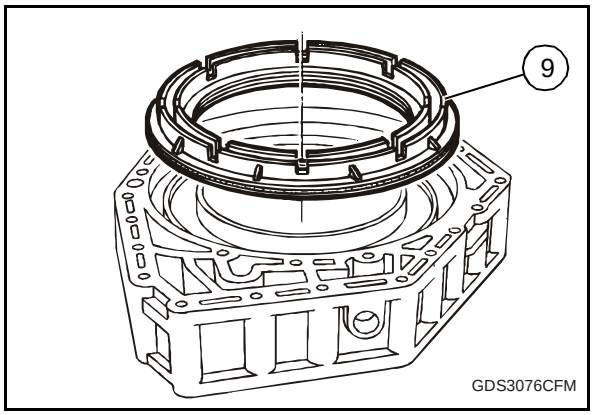
Heat output flange to 140° C (284° F) and install.

Install DFT1231 Output Assembly Lift Bracket.

Disassemble and Assemble Output Planetary Specification

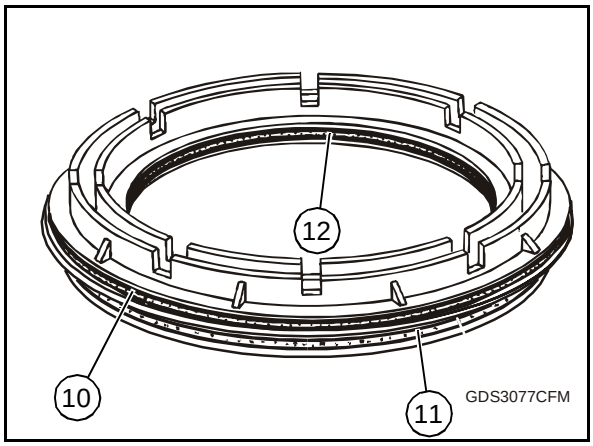
Output Assembly Lifting Bracket Torque - 60 Nm (44lb. -ft.)

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).

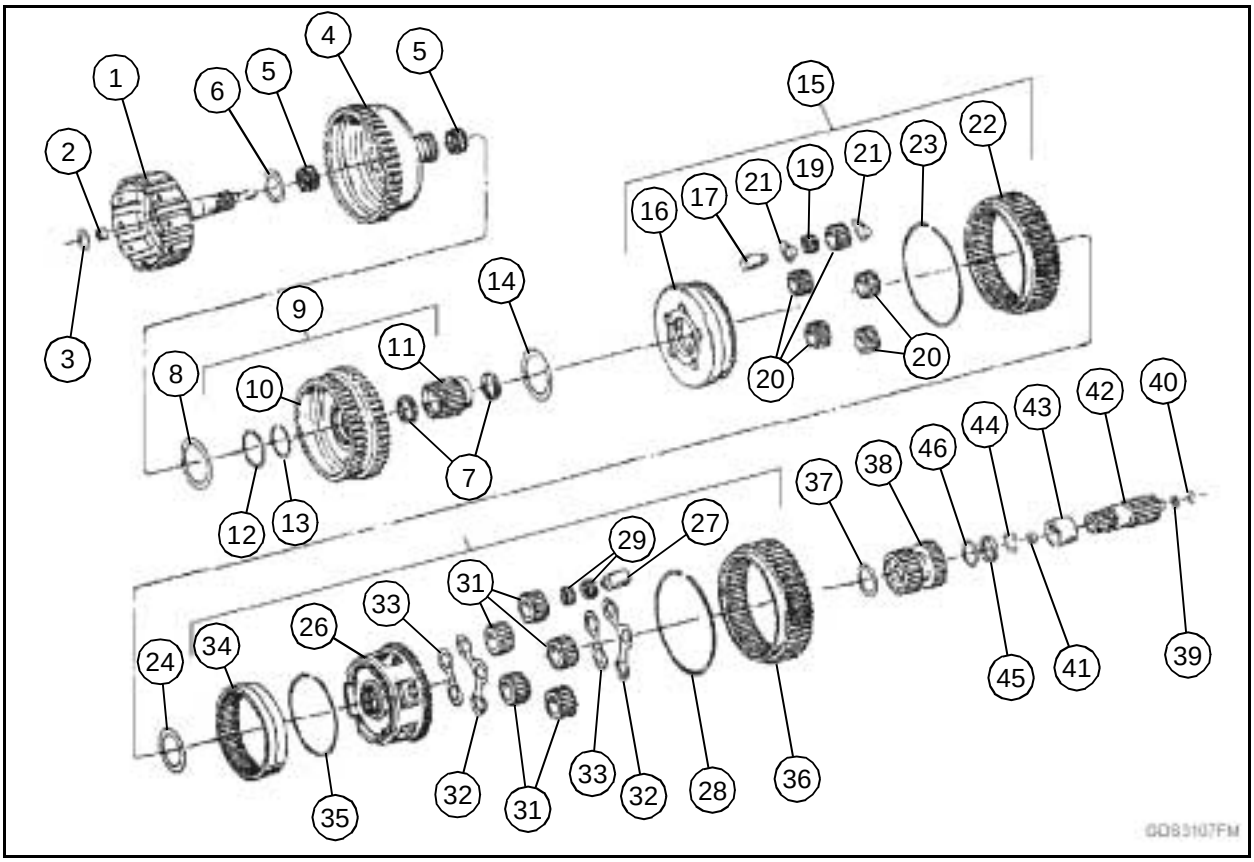


Remove clutch F piston seals (10 - 12).

Install seals and piston.

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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.

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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.

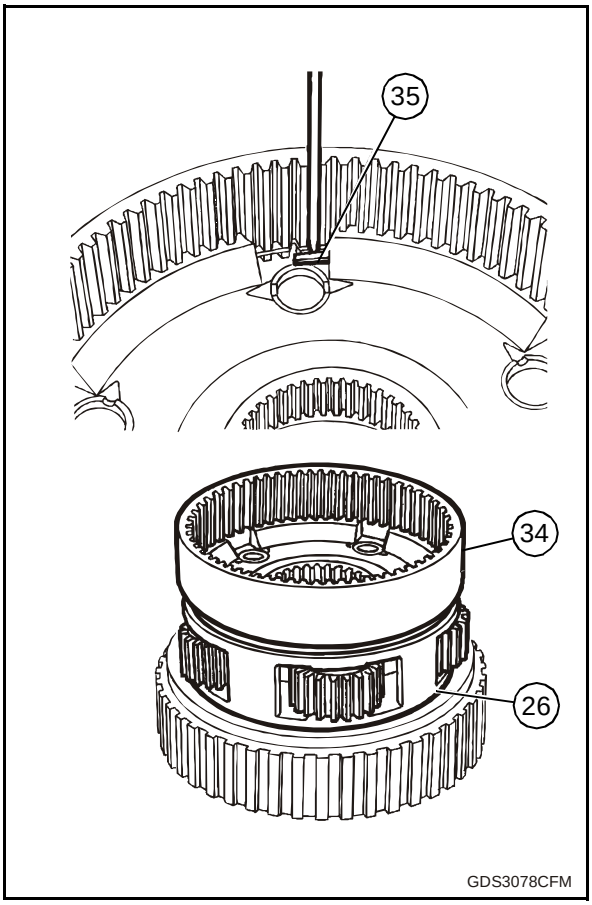
Check all planetary pinion end play and inspect for wear before disassembly.

Planetary may not need to be disassembled.

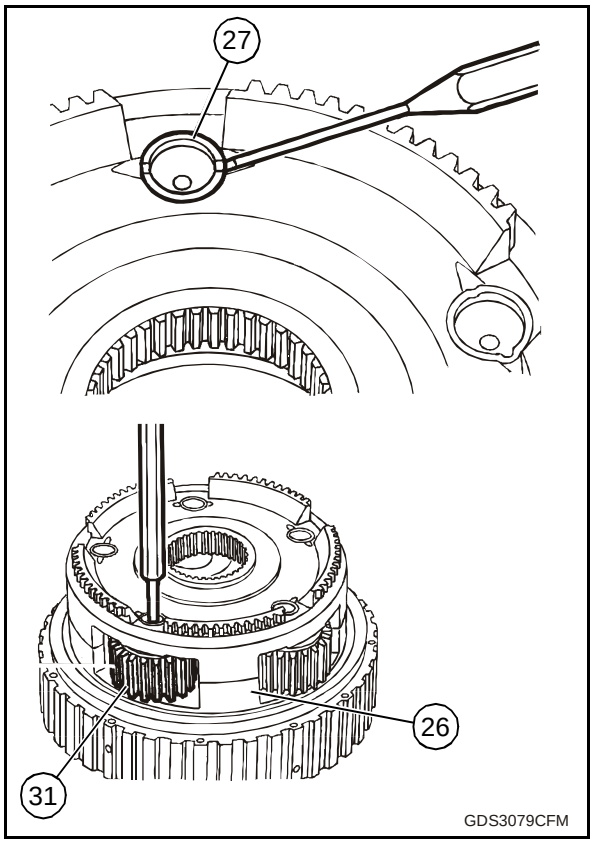
End play of all pinions is measured at pinion outer edge between carrier and thrust plate.

Disassemble and Assemble Planetary One and Two Specification

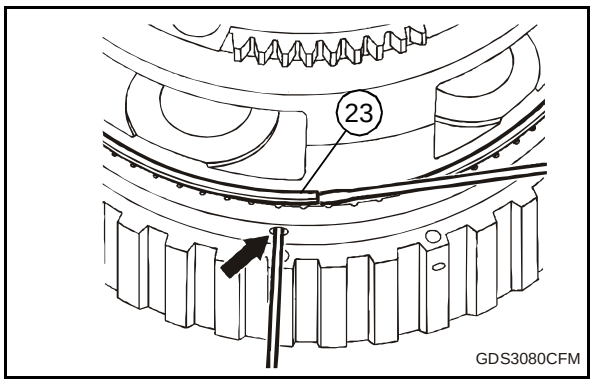
Planetary Pinion End Play 0.5 - 1.2 mm (0.02 - 0.047 in.)



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.



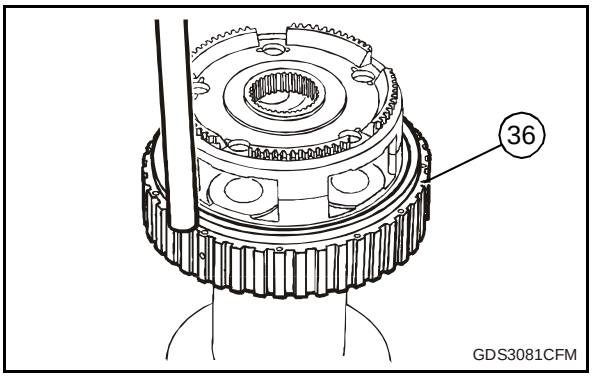
Remove peening in carrier at pinion shafts with suitable punch. Support carrier (26) and remove parts (27 - 31).



NOTE:Ring gear (36) removal may not be necessary.

At arrow push on snap ring (23) and lift from groove.

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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).

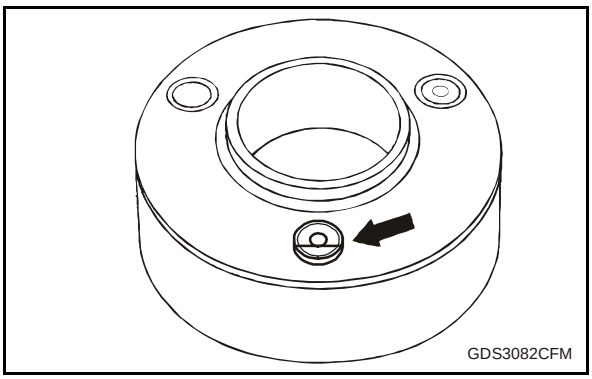
8. Install plates (21, 32 and 33) with steel side to carrier.

Assemble planetary pinions with new pinion shafts (17 and 27).

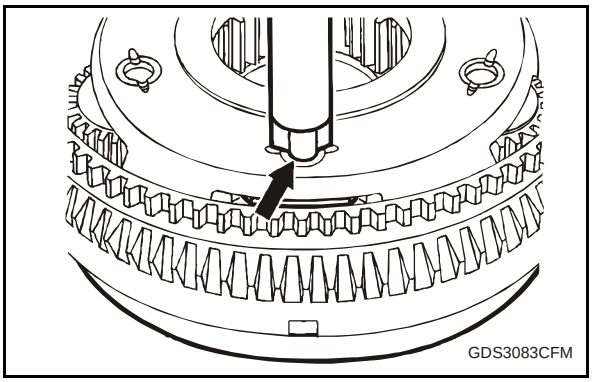
Measure end play of all pinions at pinion outer edge between carrier and thrust plate.

Disassemble and Assemble Planetary One and Two Specification

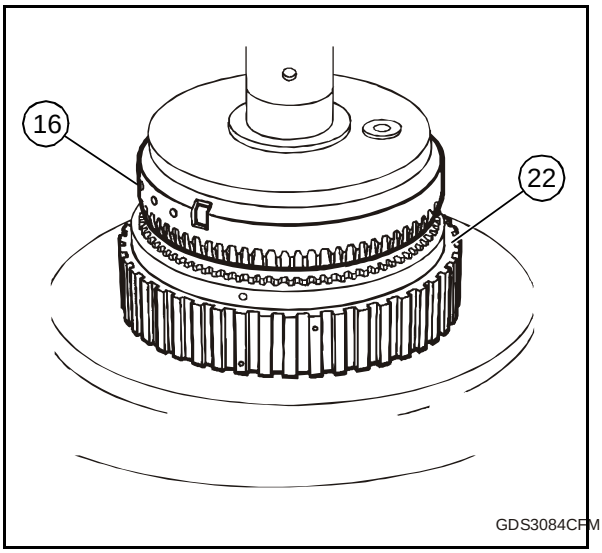
Planetary Pinion End Play- 0.5 - 1.2 mm (0.02 - 0.047 in.)



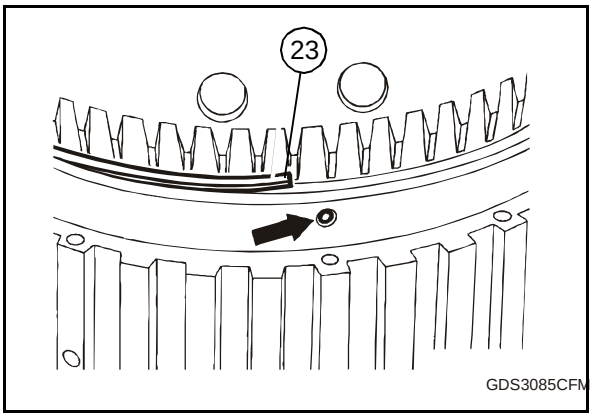
Support pinion shafts with JDG1624 Planetary Gear Pin Support at arrow and secure planetary one pinion shafts with 281714 Punch.



Secure planetary two pinion shafts with 281715 Punch.

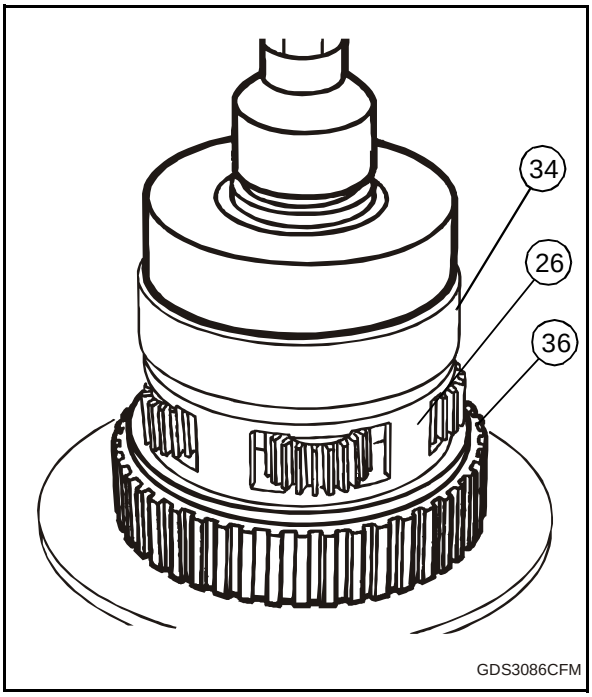


Align ring gear (22) with carrier (16). Using press push ring gear into carrier and install snap ring (23 See next figure) with end gap at opening in ring gear.



Snap ring must be engage in groove completely.

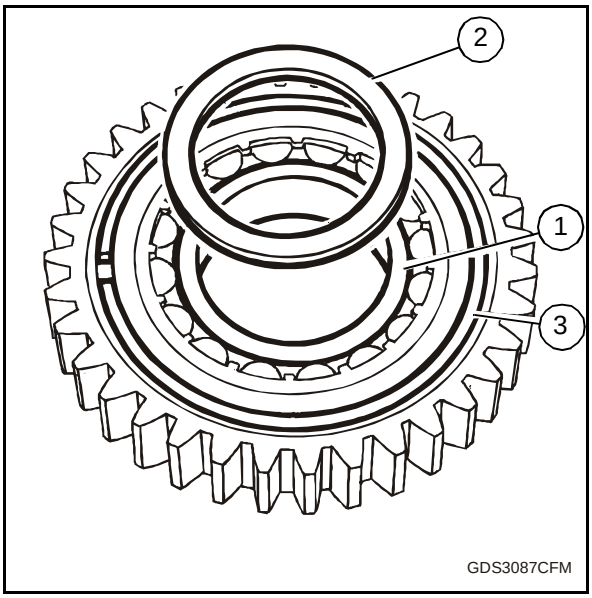
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Install planetary two ring gears (34 and 36) with snap rings (28 and 35) similar to planetary one.

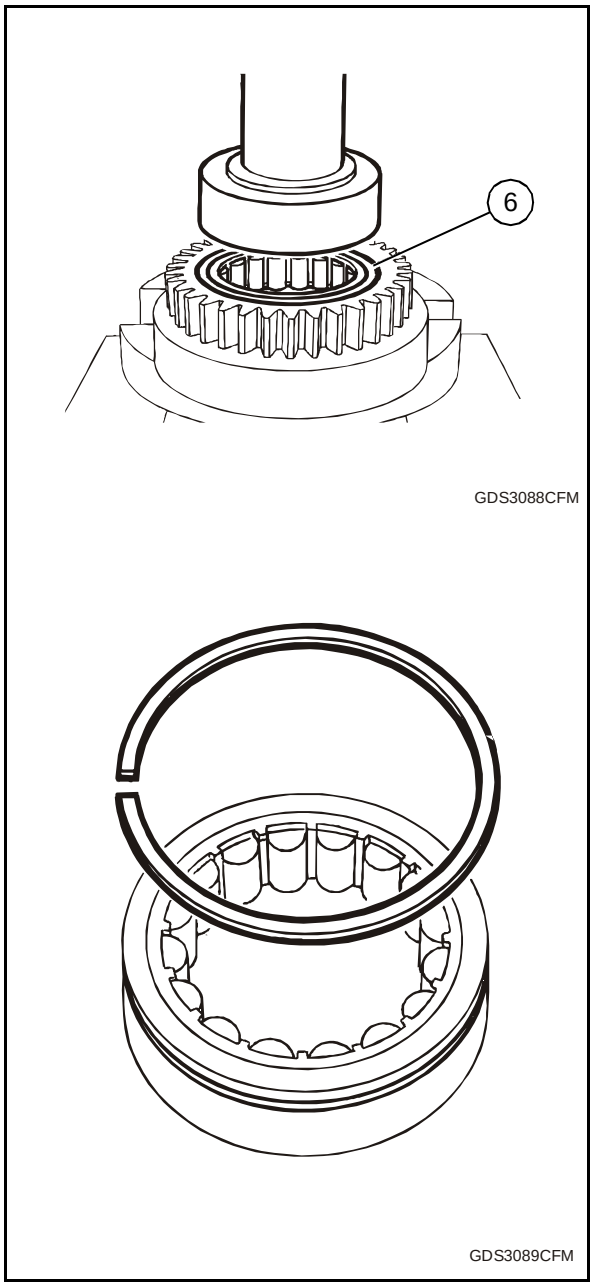
Disassemble and Assemble Auxiliary Drive Cover

NOTE:Remove auxiliary gear bearings only if necessary.



Remove inner bearing race (1) and washer (2) from both gears.

Remove snap ring (3).

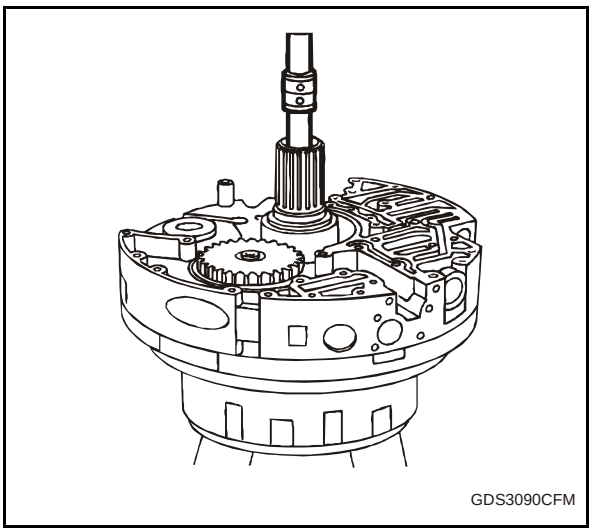


Remove bearings (6) with press.

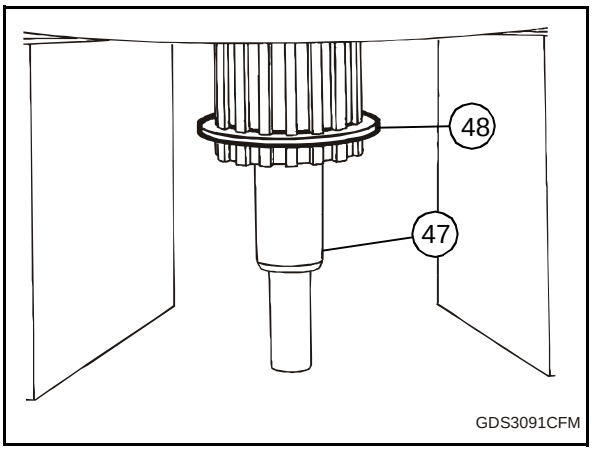
Assemble in reverse order.

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Disassemble and Assemble Input Carrier and Oil Control Element


GDS3090CFM

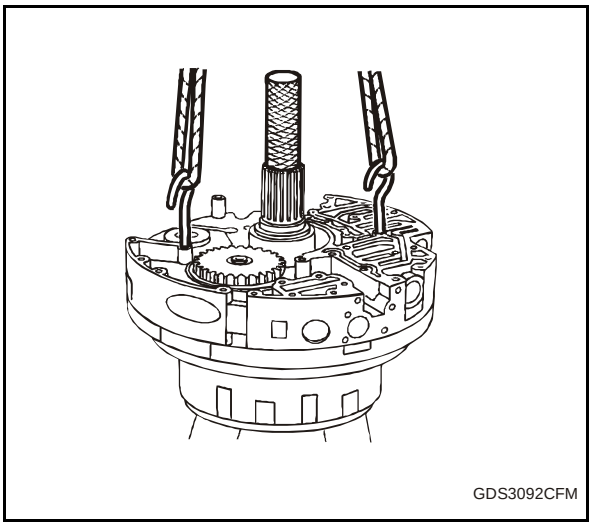
With control element supported on wood blocks. Hold turbine shaft and remove 281710 Lifting Device.



GDS3091CFM

Lower turbine shaft to remove snap ring (48).

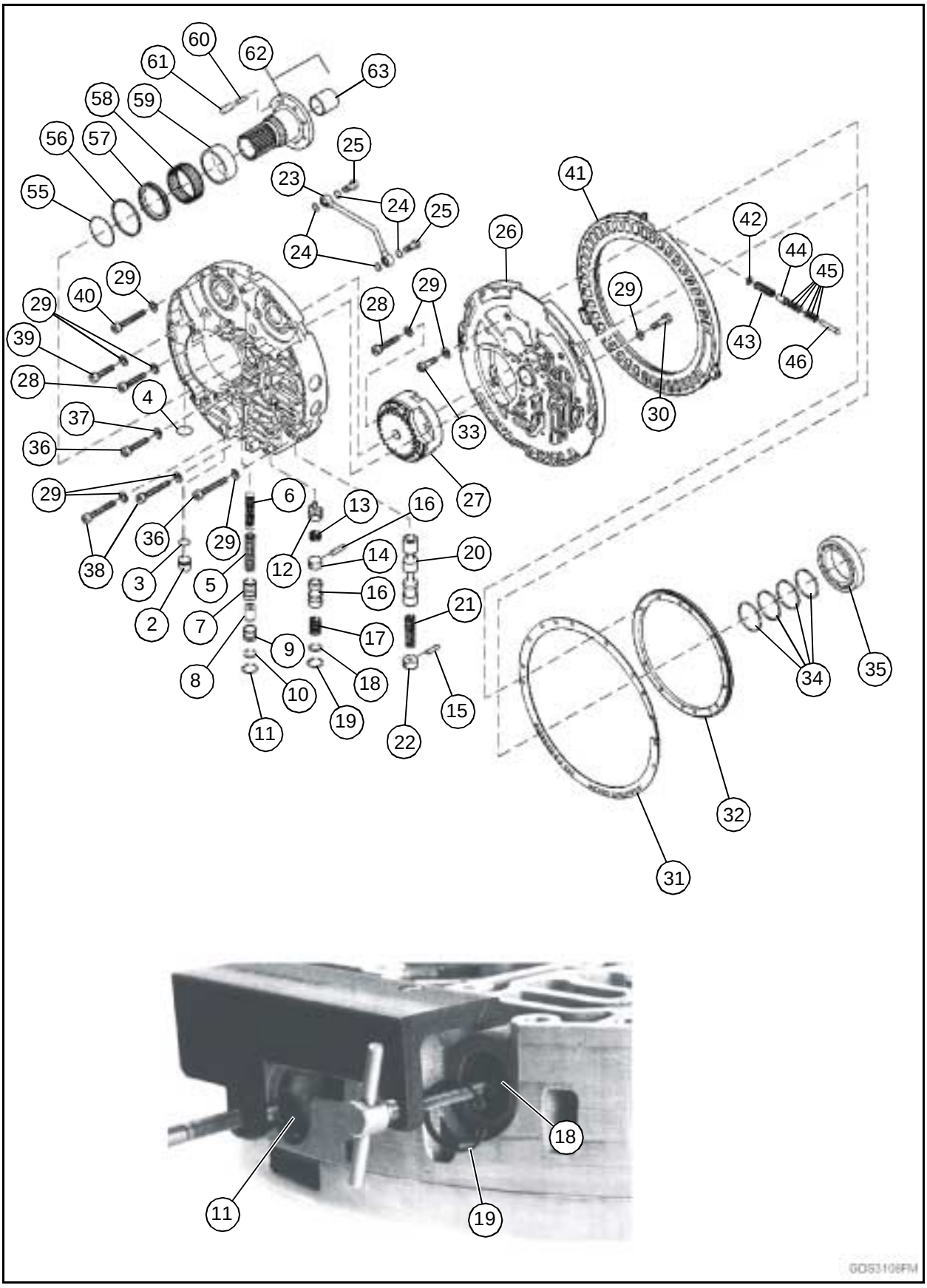
Lift turbine shaft (47) from control element.


GDS3092CFM

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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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.

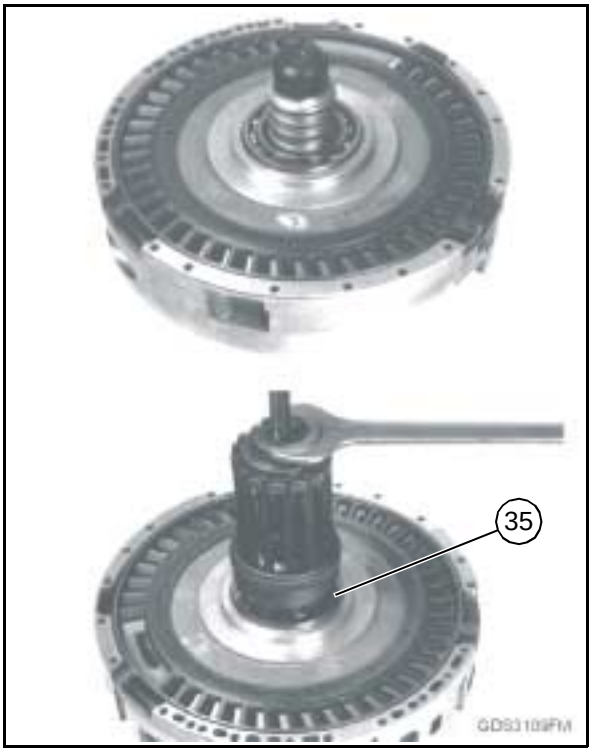
Remove Parts (6 - 10) and (16 - 18).

Apply pressure to spacer (14) with screwdriver and remove pin (15).

Remove parts (12 - 14).

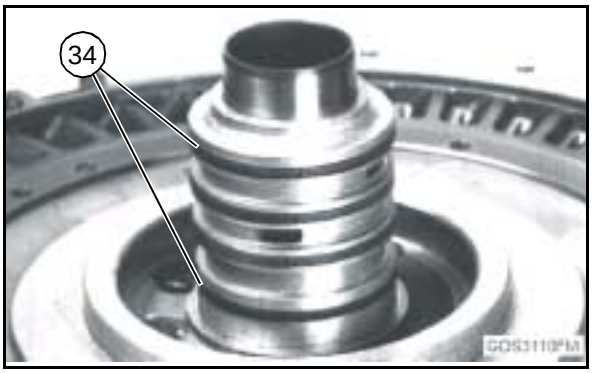
Remove spacer and O-ring (2 and 3).

If not removed. Remove intake pipe O-ring (4).



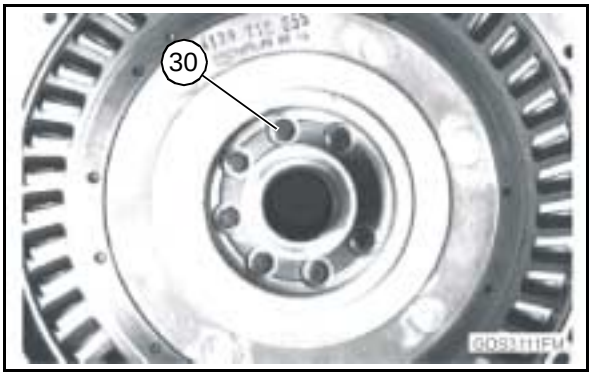
With 281699 Pressure Piece and 281680 Puller, remove bearing (35).

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NOTE:Rectangular seal rings (34) have sharp edges. Wear protective gloves.

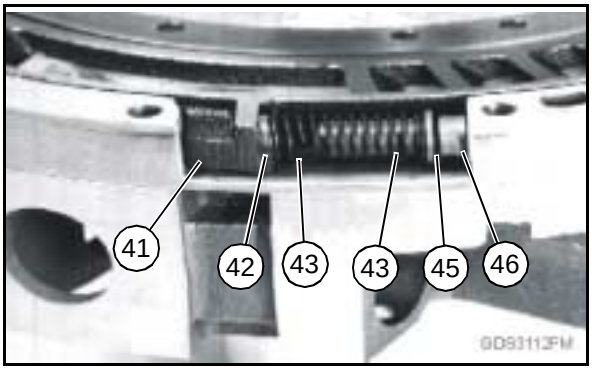
Remove sealing rings (34).



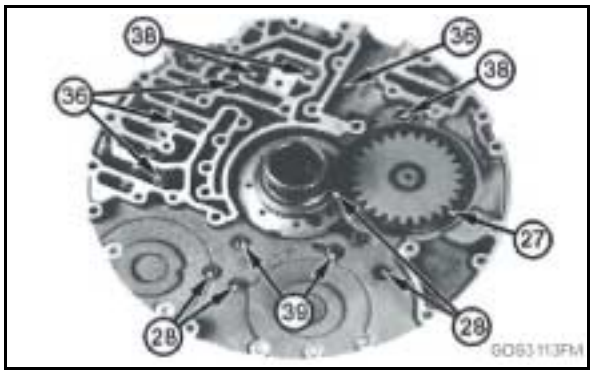
Remove bolts (30).

⚠ CAUTION

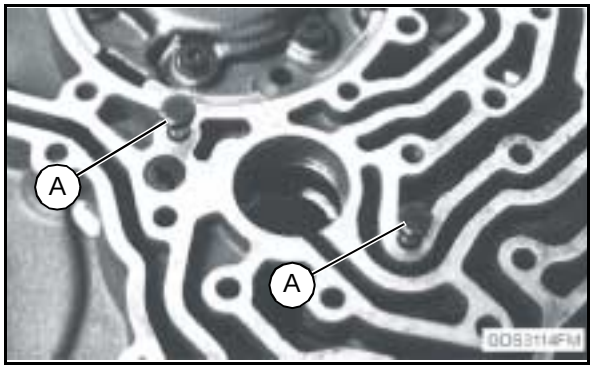
Disk springs and spring guides are under spring tension and should be handled with care while removing them.



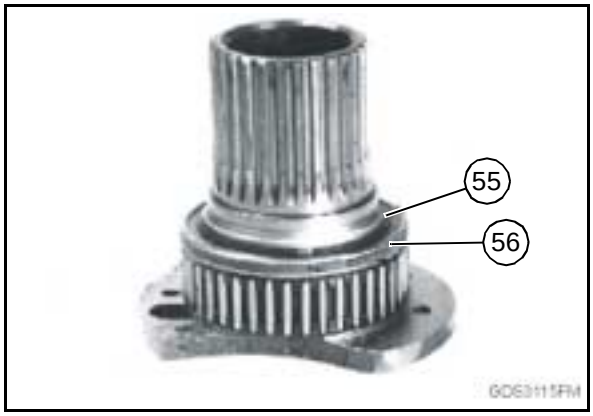
Carefully remove parts (42 - 46).



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).

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Place 281712 Puller in ring carrier groove and remove.

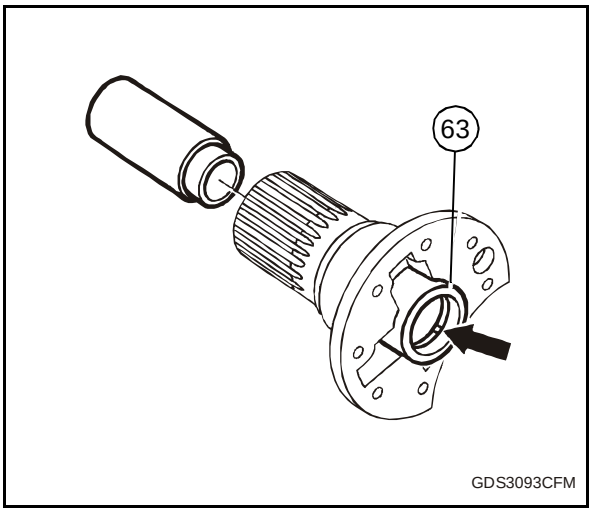
Remove bearing (58).



NOTE:If bearing race is damaged, replace both bearing and race.

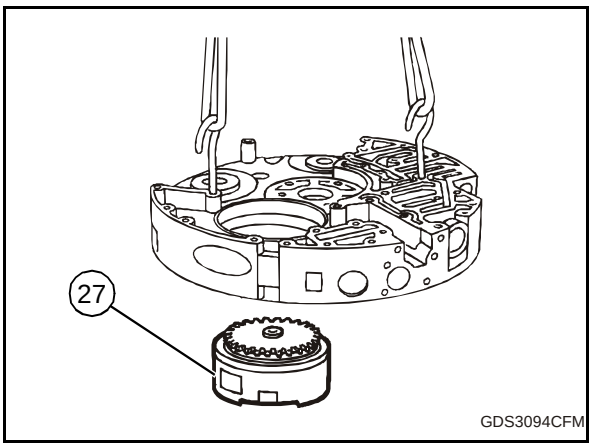
With stamp numbers on 281681 Bearing Puller up and aligned tighten cap screws evenly.

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.



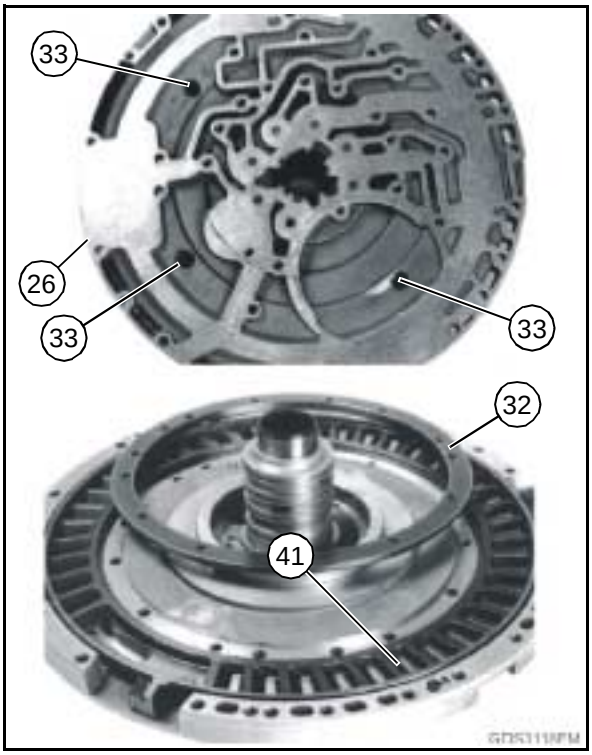
Lift oil control body approximately 100 mm (3.9 in.) up inside heating oven. Ensure main pump gear up. Ensure that the pump gear is facing "**UP**".

⚠ 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.

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Remove bolts (33) to remove thrust ring (32) and stator ring (41).

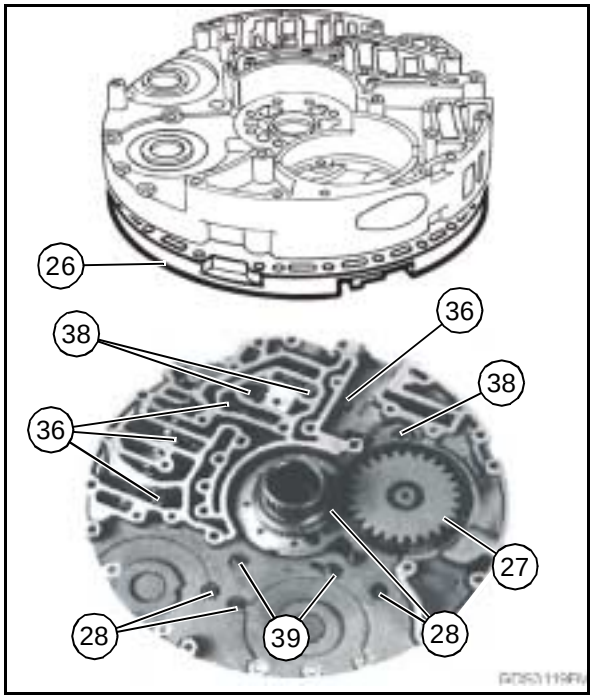
Clean and install stator ring. Vanes must over lap oil feed flange vanes.

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.

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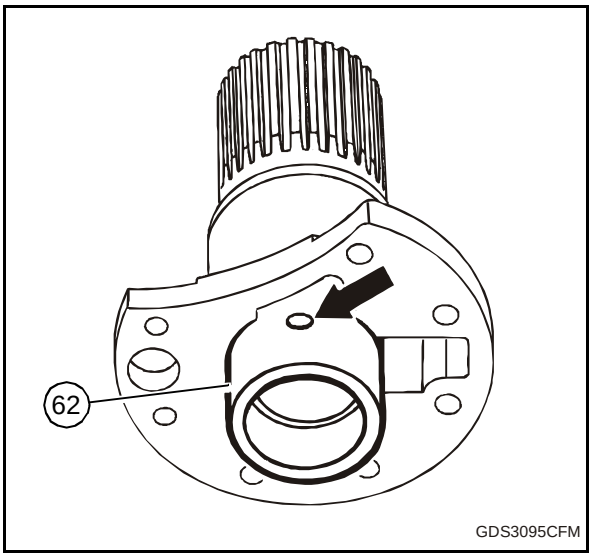
Install guide pin and primary pump. Allow primary pump to bottom in pump bore under its own weight. Do not strike or force pump into position.

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.)

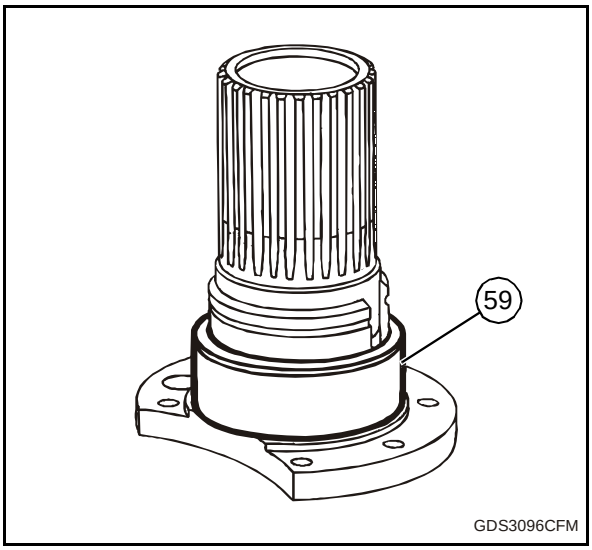


If stator shaft bushing (62) is removed. Heat stator shaft to approximately 150° C (302° F).

⚠ 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.



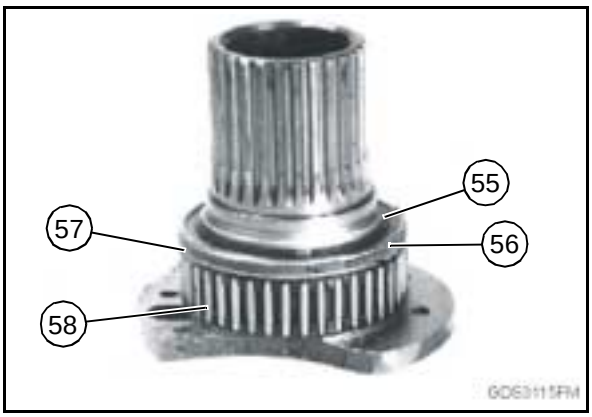
Heat bearing race (59) to approximately 150° C (302° F).

⚠ CAUTION

Wear protective gloves components will be hot.

Push bearing race onto stator shaft to contact shaft shoulder.

Allow bearing race to cool.

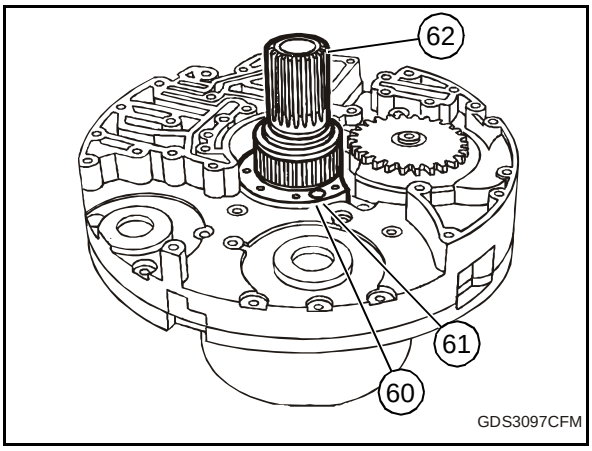


Apply thin layer of oil to bearing (58) and install.

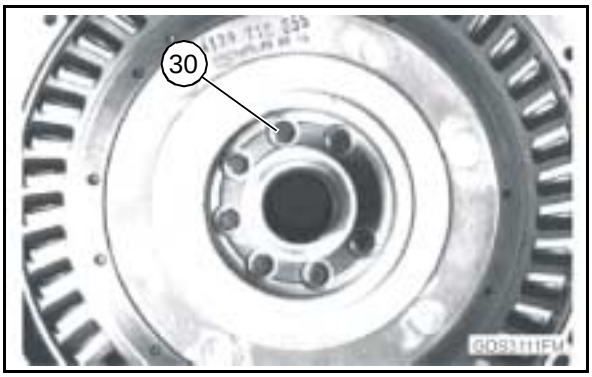
Heat seal ring carrier (57) to approximately 150° C (302° F) and install.

Install snap ring (55) and seal ring (56).

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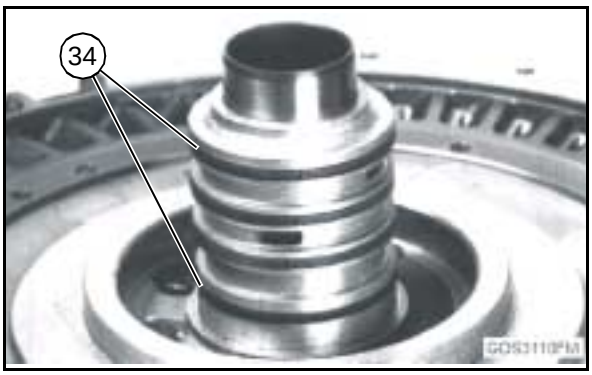
Locate stator shaft on pins (60 and 61) in oil control body and tap with soft face mallet to contact bottom of bore in oil control body.



Install cap screws (30).

Disassemble and Assemble Input Oil Control Element Specification

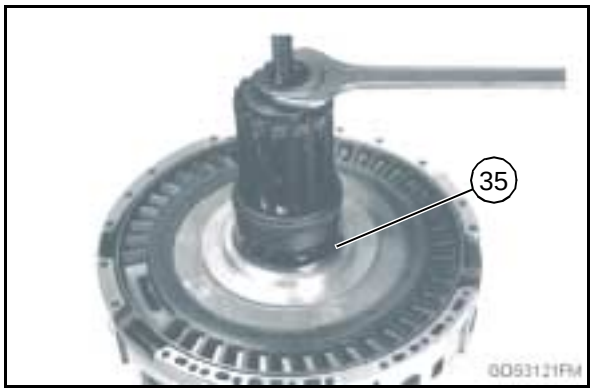
Stator Shaft Torque - - - - - - - - - - - - 23 Nm (204 lb-in.)



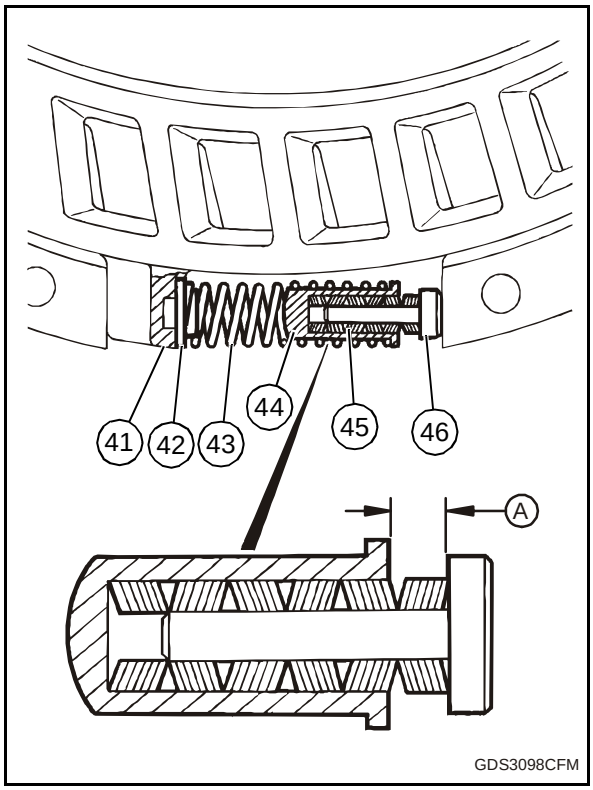
Install seal rings (34).

⚠ 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.

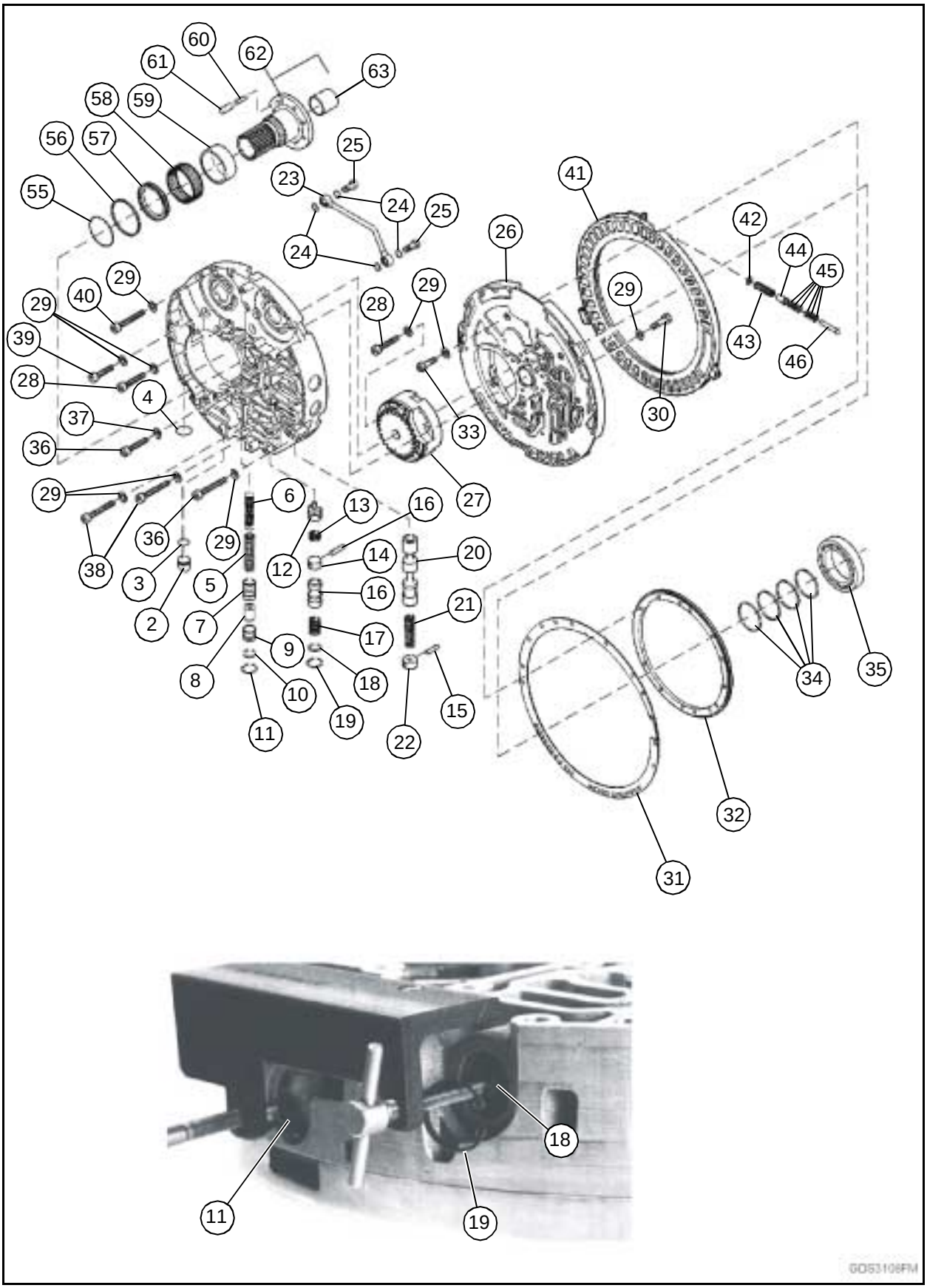
Measure distance between spring guide (44) and guide pin (46) and adjust to specification by adding or removing discs.

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.

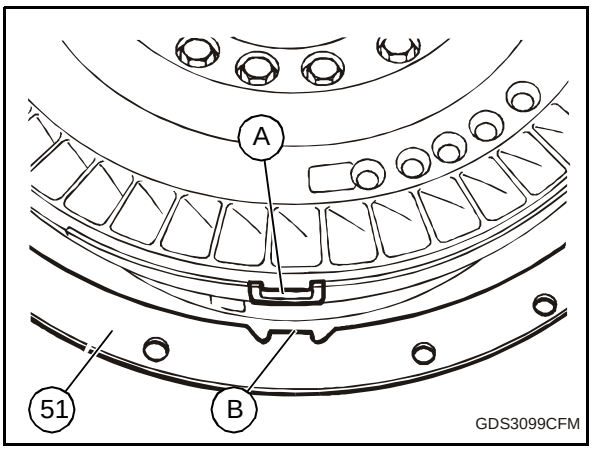
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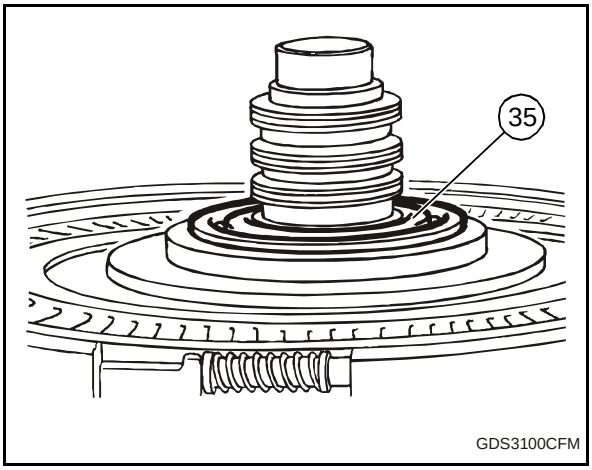
Clean and apply a thin layer of oil to parts (2 - 22).

Install parts (2 - 22) using 281702 Clamping Device.

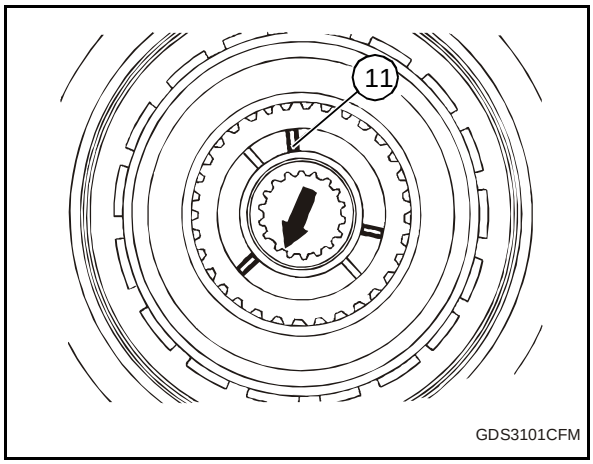


Support clutch carrier on blocks.

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).

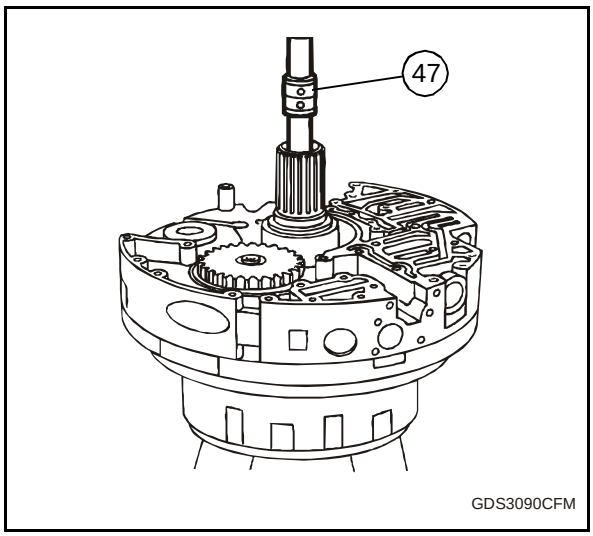


⚠ CAUTION

Wear protective gloves components will be hot.

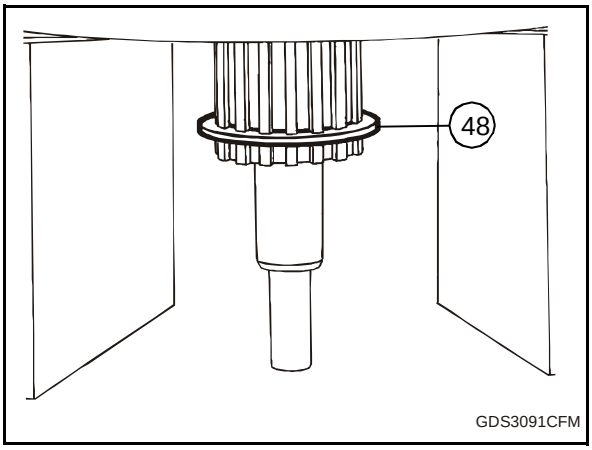
Position and lower oil control body into intermediate plate and clutch carrier. It may be necessary to gently tap oil control body with soft face hammer to make contact with clutch carrier.

Pins (11) should be positioned in hub to allow turbine shaft to be installed.



Install turbine shaft (47).

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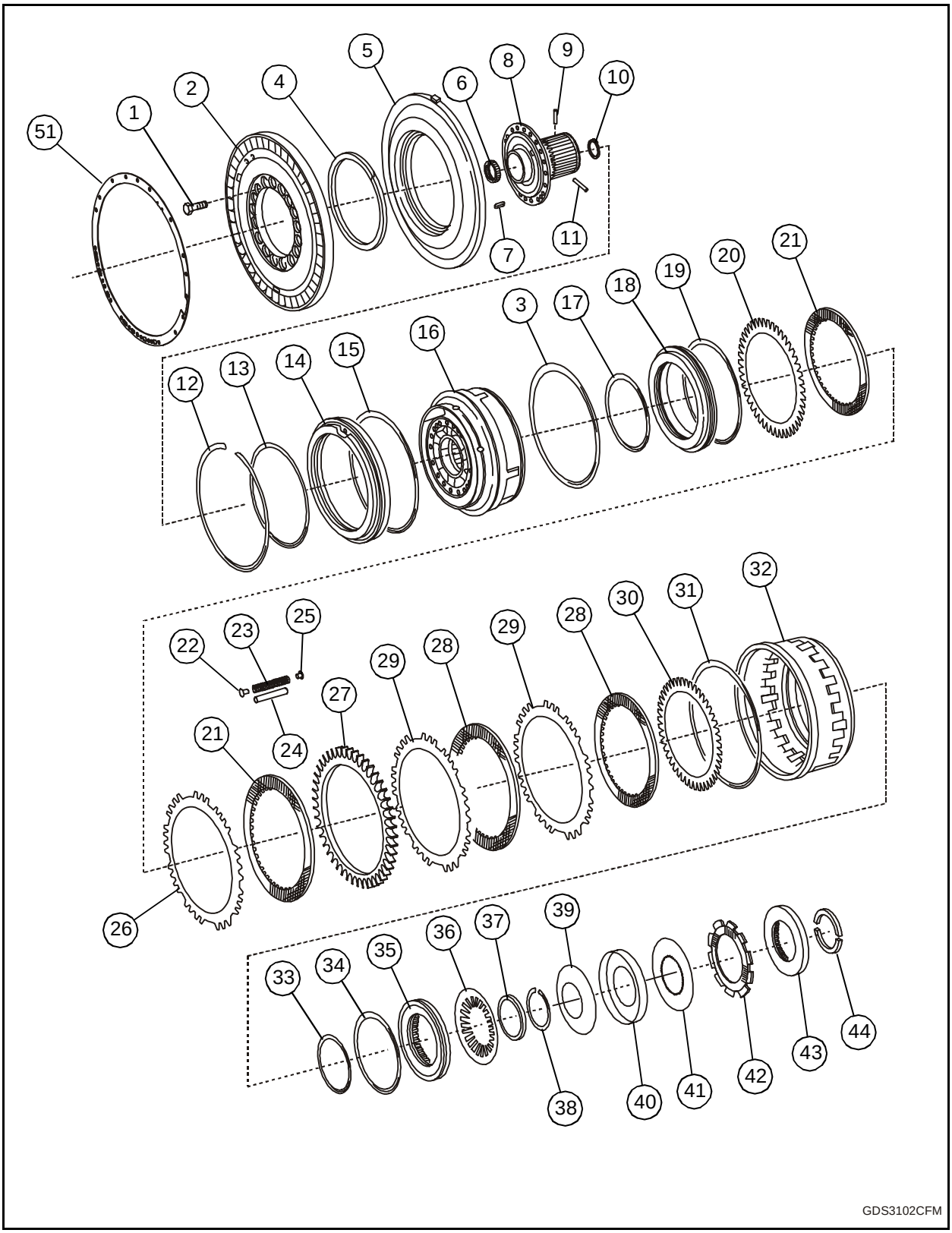


Install snap ring (48).

Install 281710 Lifting Device.

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Disassemble and Assemble Input Clutch Carrier



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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

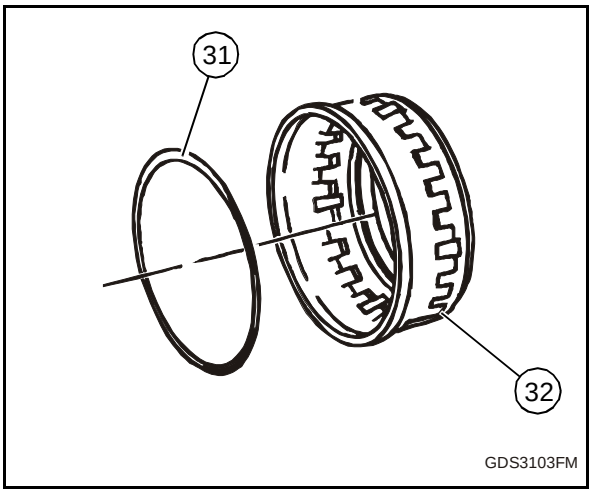
The Approximate weight of clutch carrier is 25 kg (55 lb).

Remove bolt (1) and rotor (2).

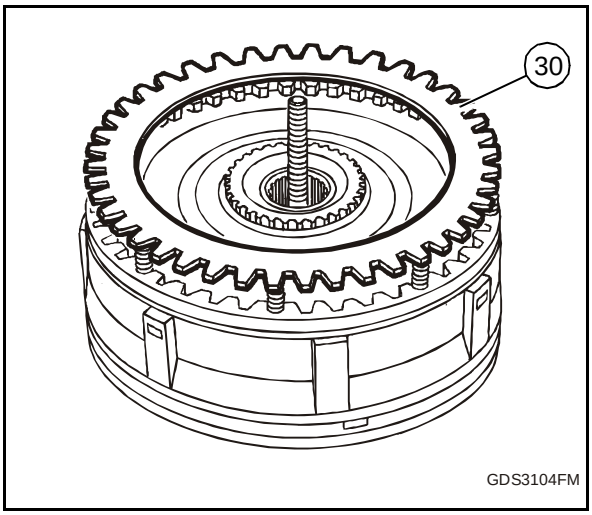
Remove rectangular ring (4) and plate seal (5).

With 281705 Clamping device compress and remove snap ring (12).

Remove clutch C piston (14).

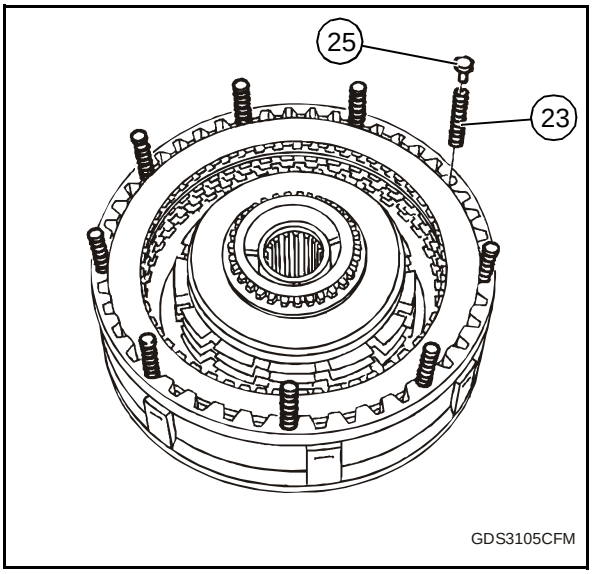


Remove reverse gear housing (32) and O-ring (31).



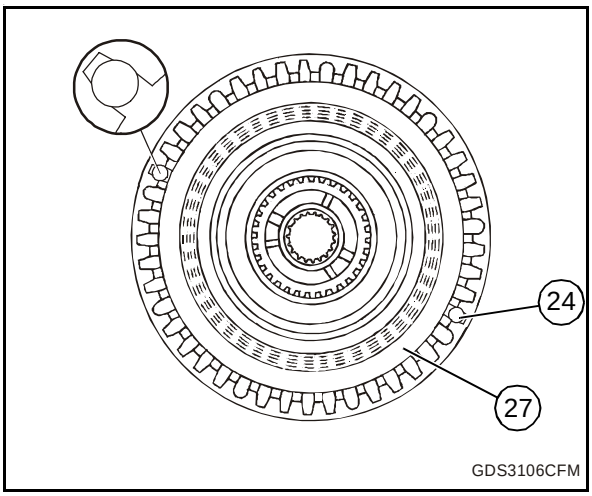
Remove outer plate (30).

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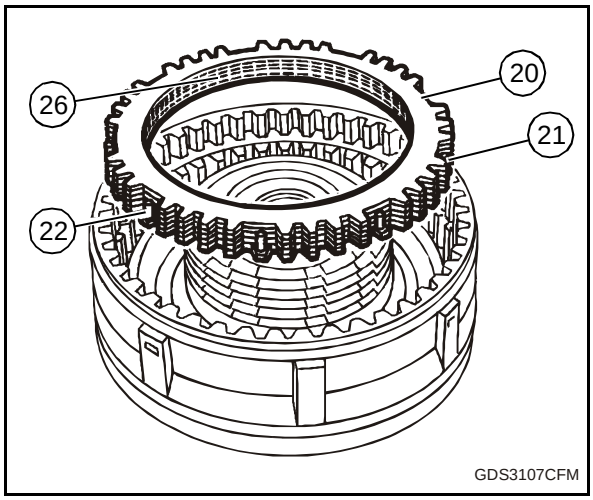


Remove pin (25) and spring (23).

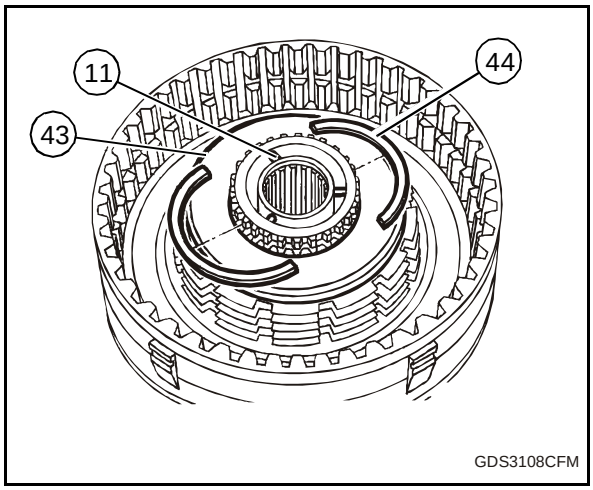
Remove clutch C plates.



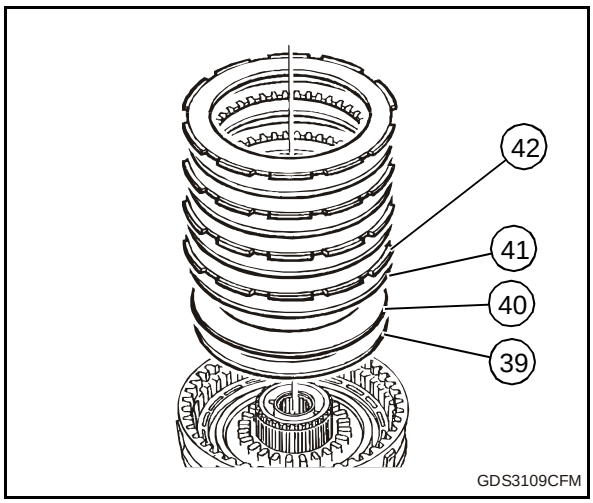
Remove retainer pins (24) and end plate (27).



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).



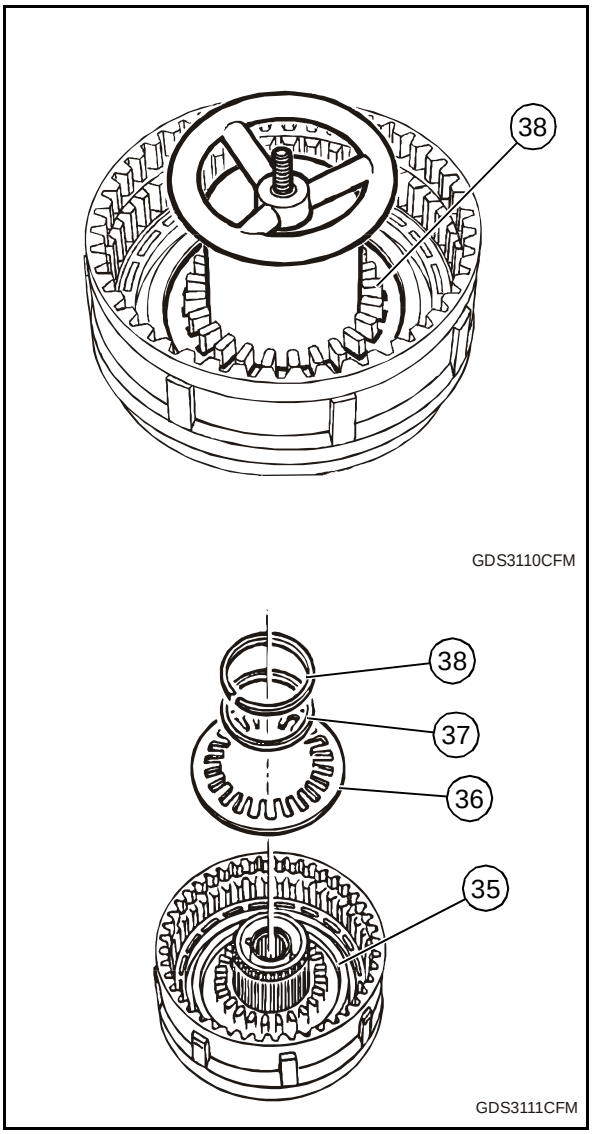
Remove clutch A plates (41 and 42) and retaining plate (40) with spring plate (39).

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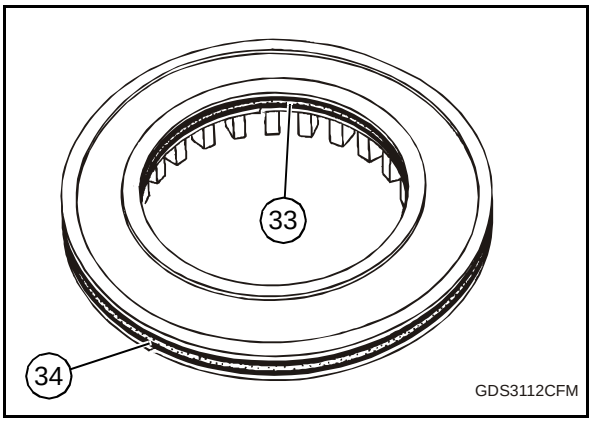


Remove clutch C piston (14) and seals (13 and 15).

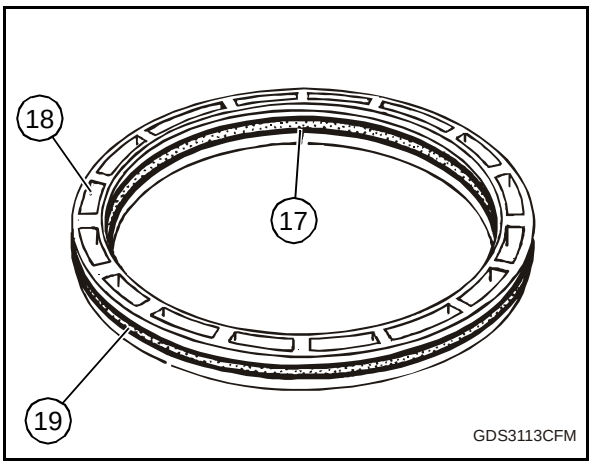
Remove seal (3).



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).

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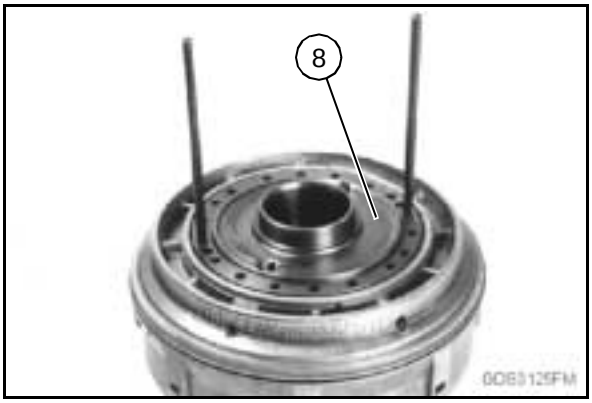


Heat clutch carrier (1) to approximately 150° C (302° F).

⚠ CAUTION

Wear protective gloves components will be hot.

Tap hub (8) with soft faced hammer to remove.

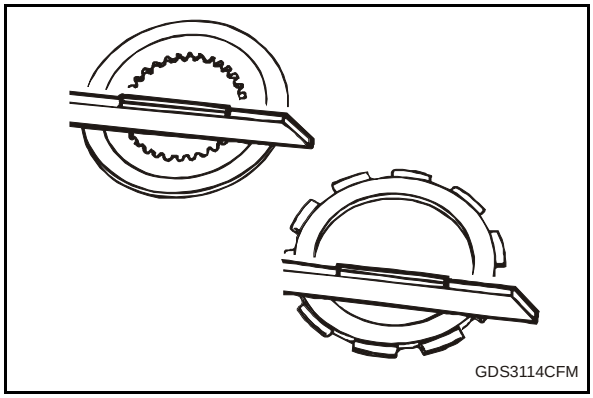


Heat clutch carrier to approximately 150° C (302° F) and install guide pins to install hub.

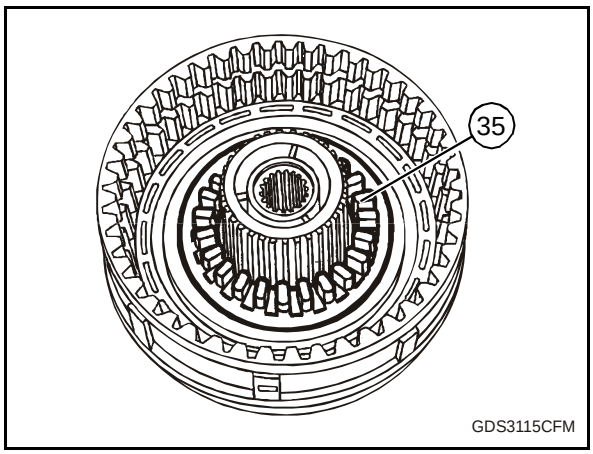
Align cap screw holes in hub (8) with clutch carrier. Hub must make contact with bottom of carrier.

NOTE:Reinforced bearing edge with lettering is driving edge.

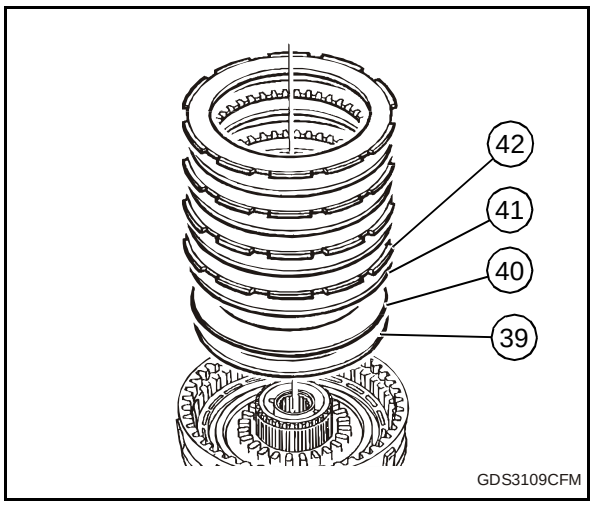
Lubricate and install needle bearing (6) in hub with Mounting 281698. Reinforced edge of bearing with lettering is towards driver.



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).

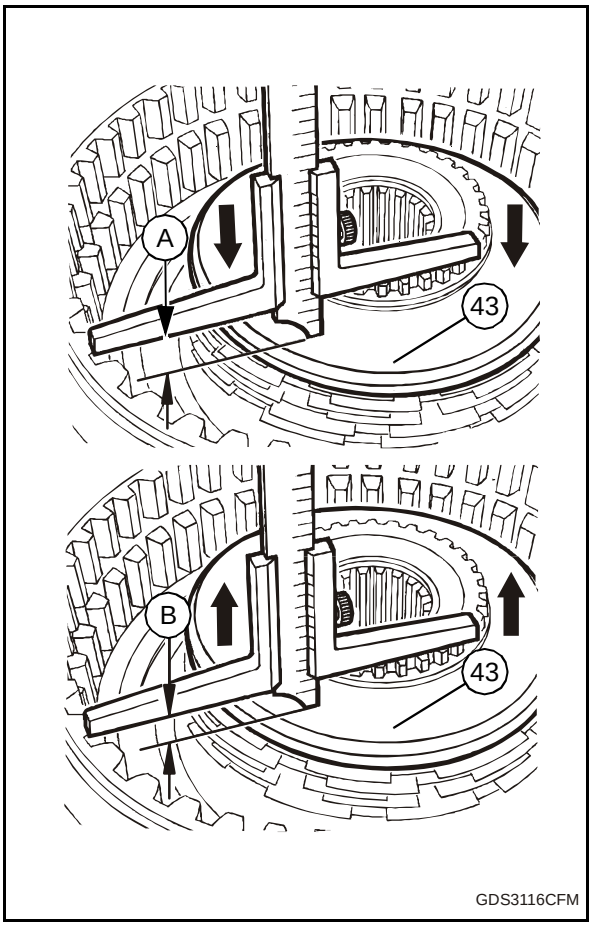


Install spring plate (39) and retaining plate (40) with closed side up.

Install inner and outer plates (41 and 42) in alternating order starting with inner plate and ending with outer plate.

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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

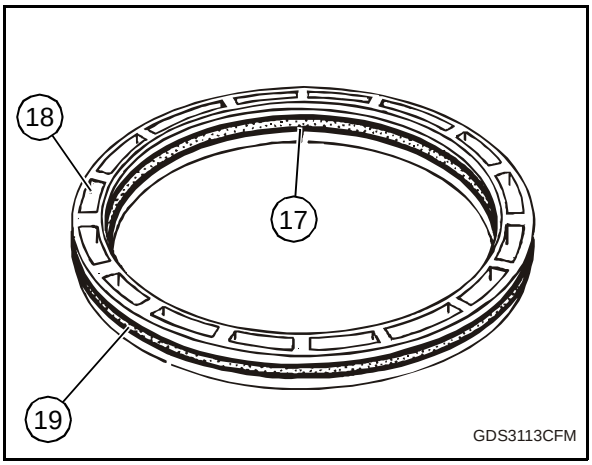
Disassemble and Assemble Input Clutch Carrier Specification

Clutch A Plate Clearance 3.2 - 3.7 mm (0.126 - 0.146 in.)

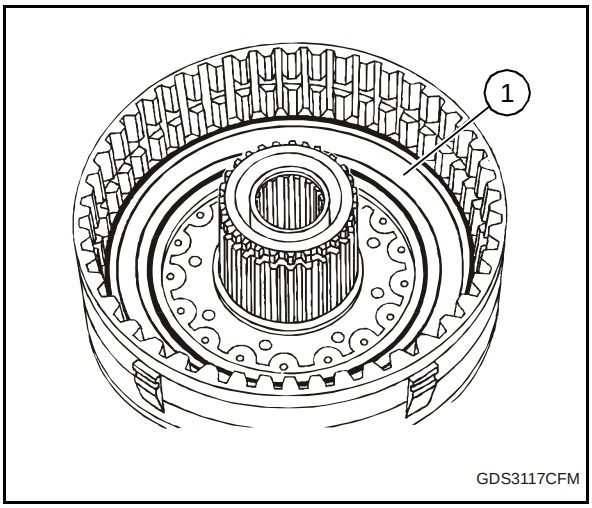
NOTE:Outer plate (42) is available in 2.0 mm (0.079 in.) and 2.5 mm (0.098 in.) sizes. Use a combination of plate sizes to adjust clutch A clearance.

Adjust clearance by using a combination of sizes of outer plate (42).

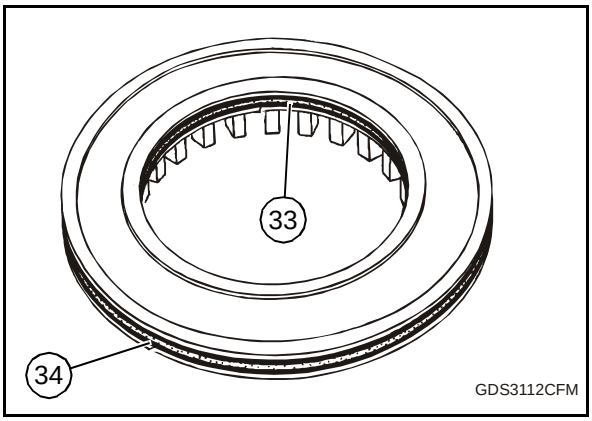
With correct clearance obtained disassemble clutch A.



Install seals (17 and 19) on clutch B piston (18).



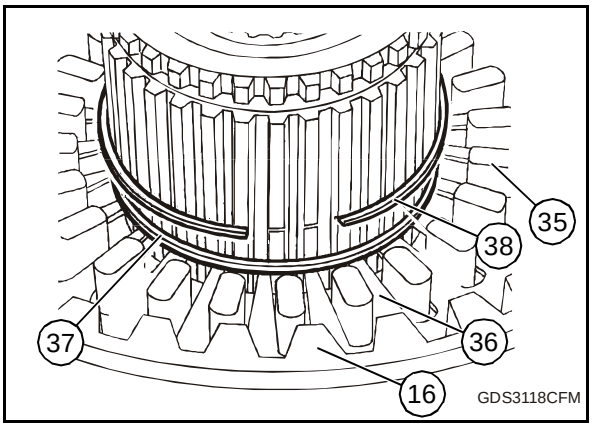
Apply a thin layer of oil to seal and install piston (1) in clutch carrier.



Install seals (33 and 34) on clutch A piston.

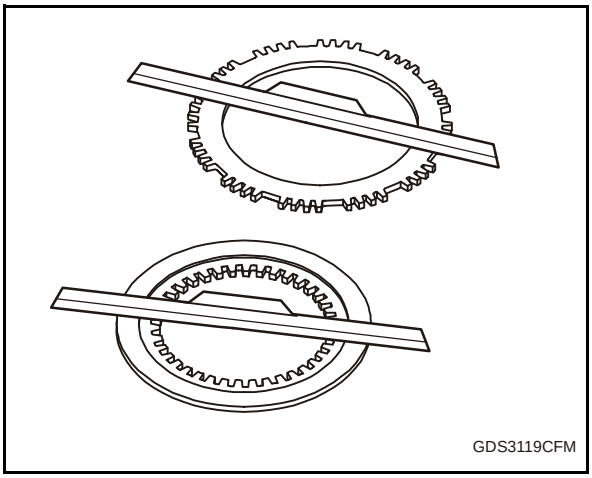
Apply a thin layer of oil to seal and install piston A in clutch carrier.

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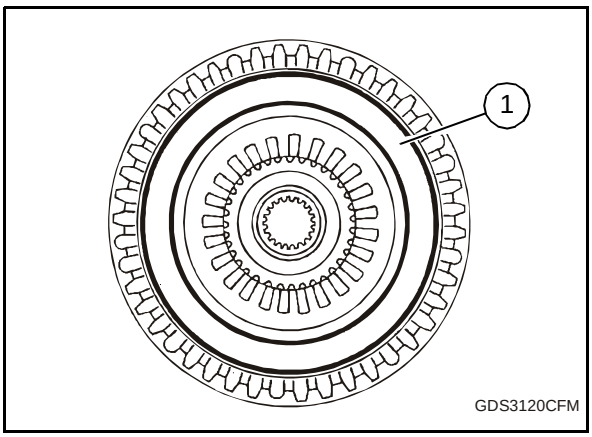


Install spring plate (36) and retainer plate (37) with recess up.

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.

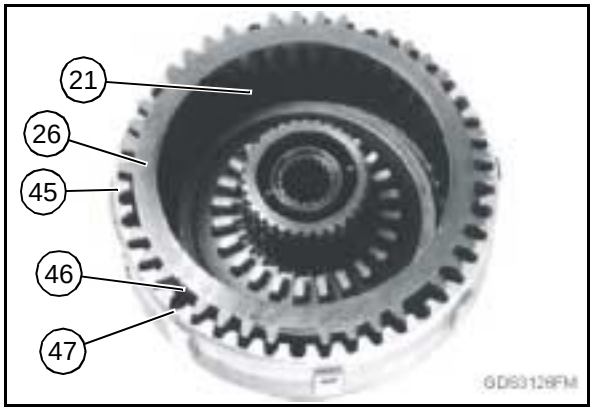


Use straight edge to check clutch B inner and outer plates. Worn or damaged plates must be replaced.



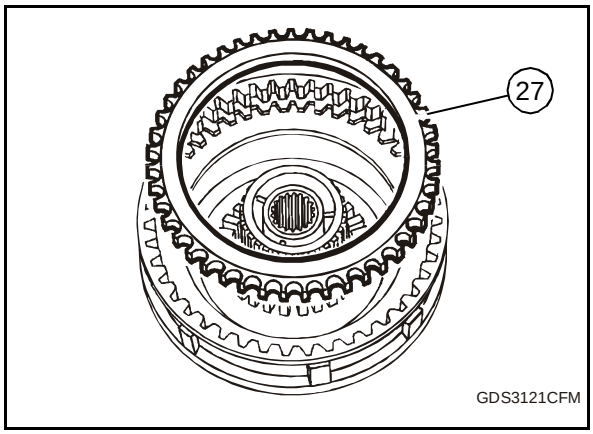
Install clutch B end plate (1).

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.



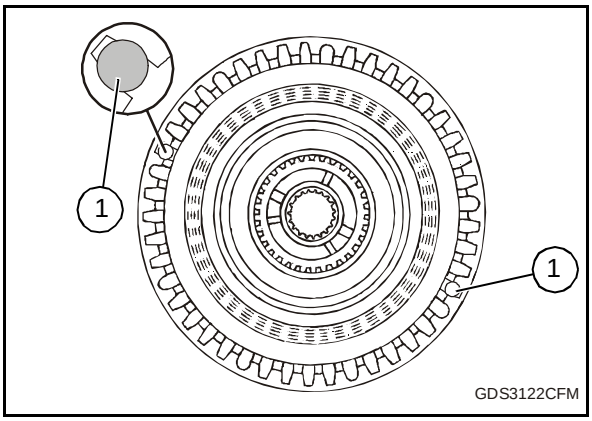
Install inner (21) and outer (26) plates alternately. Inner plate first.

Install outer plate as shown with spaces (46) aligning with spring bores (47). Three tooth pattern should be positioned at square cut grooves (45).



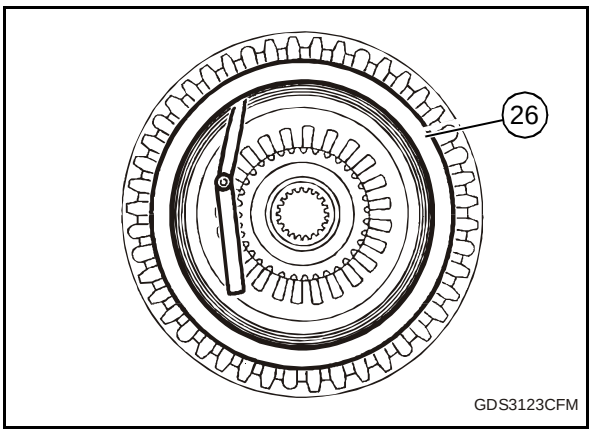
Install Clutch B end plate (27) with machined smaller bores located at square cut groves.

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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.

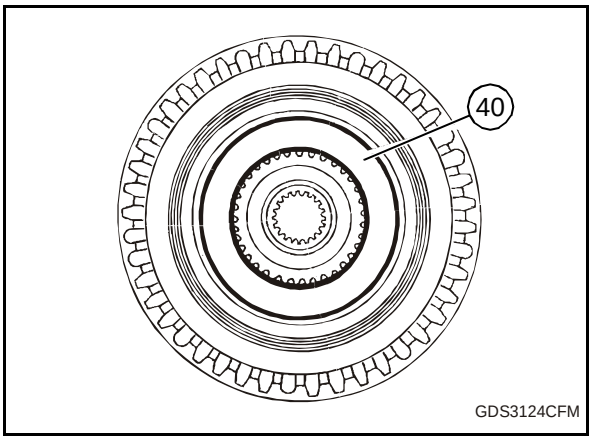


With feeler gauge measure clutch B clearance at multiple locations and calculate average clearance.

Disassemble and Assemble Input Clutch Carrier Specification

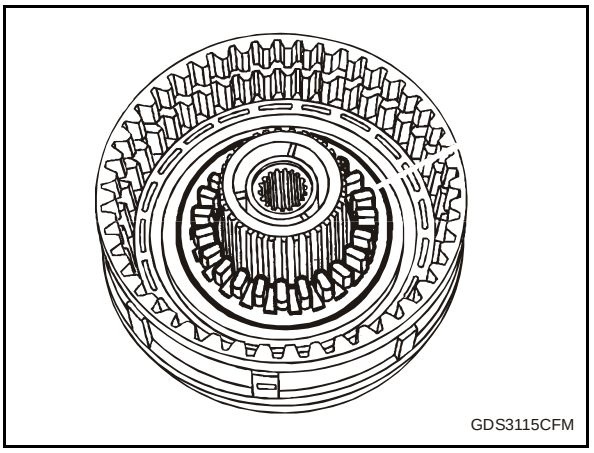
Clutch B Plate Clearance 2 - 2.5 mm (0.079 - 0.098 in.)

Use a combination of different sizes of outer plates (26) to adjust clearance.



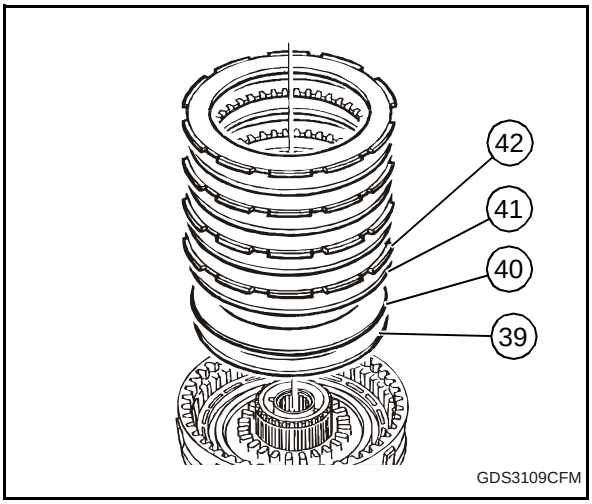
Install spring plate (39) and push retainer plate over spring plate

With closed side up push retainer ring (40) over spring plate (39).



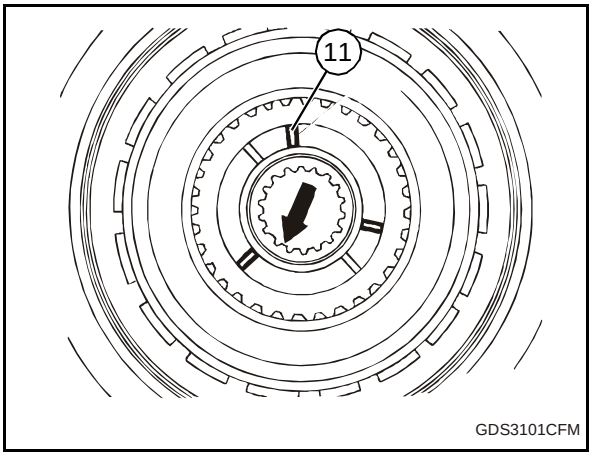
Install clutch A inner and outer plates in alternating order starting with inner plate and ending with outer plate.

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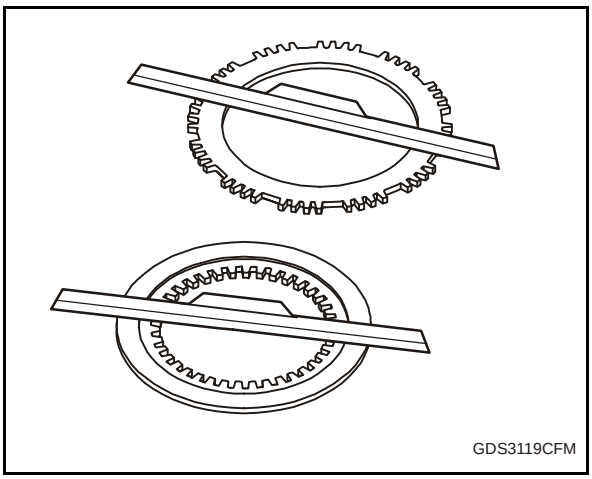


Install spring plate (39) and retaining plate (40) with closed side up.

Install end plate (43) and split ring (44).

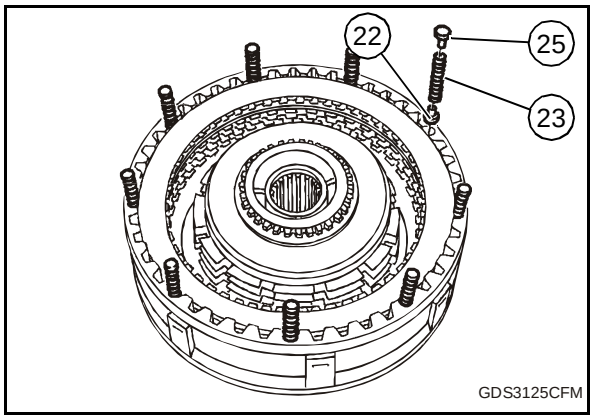


Install retainer pins (11).

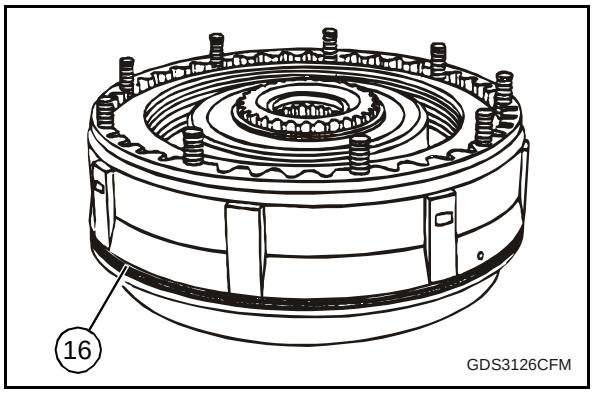


Use straight edge to check clutch C inner and outer plates. Worn or damaged plates must be replaced.

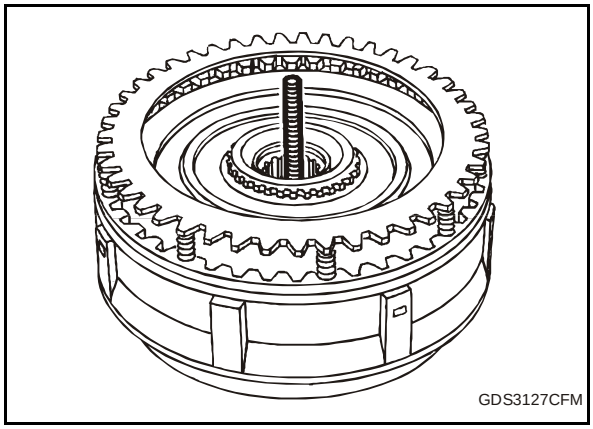
Install one clutch C outer plate (29) and one inner plate (28) alternate remaining plates ending with inner plate.



Position pins (22) on clutch B outer plate (20) with spring (23) and pin (25).



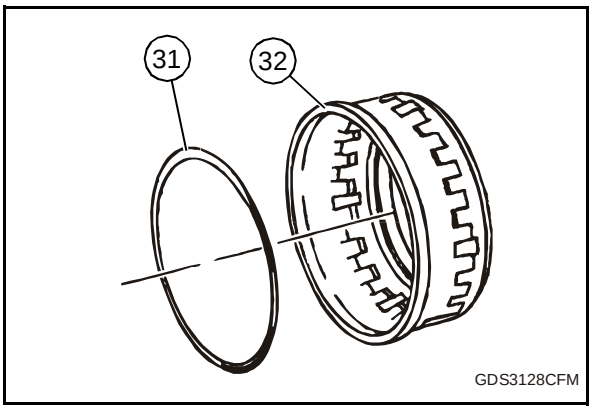
Install seal (3).



Position outer plate (30) on pin (25) and position clutch carrier on 281705 Clamping Device.

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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.

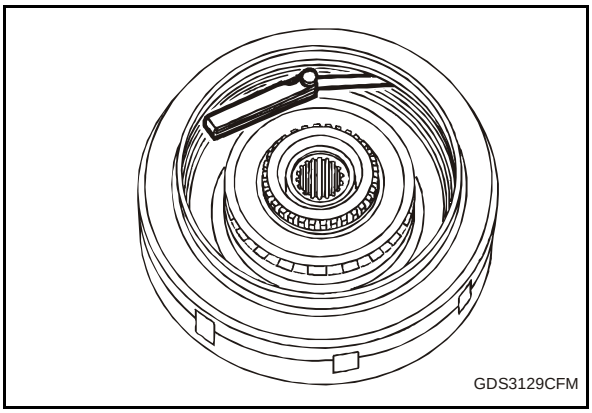
Compress springs (23) and turn assembly over.

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.



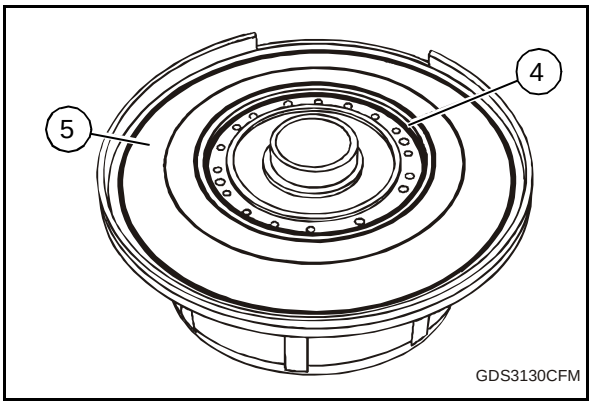
Measure clutch C clearance at equally space locations and note average clearance.

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

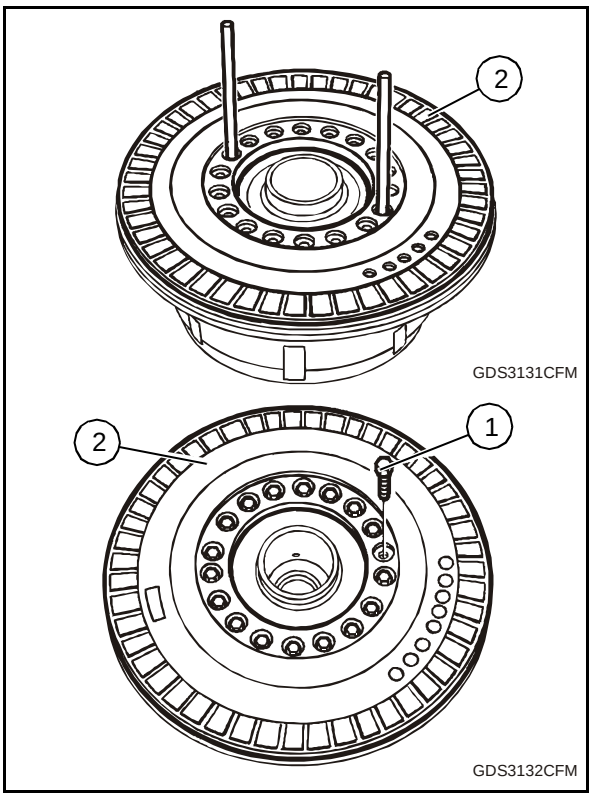
Clutch C Plate Clearance - 1.6 - 2.1 mm (0.063 - 0.083 in.)



Install plate seal (5) and rectangular ring (4). Rectangular ring (4) must lettering “**TOP** or “**R**” up.

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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.

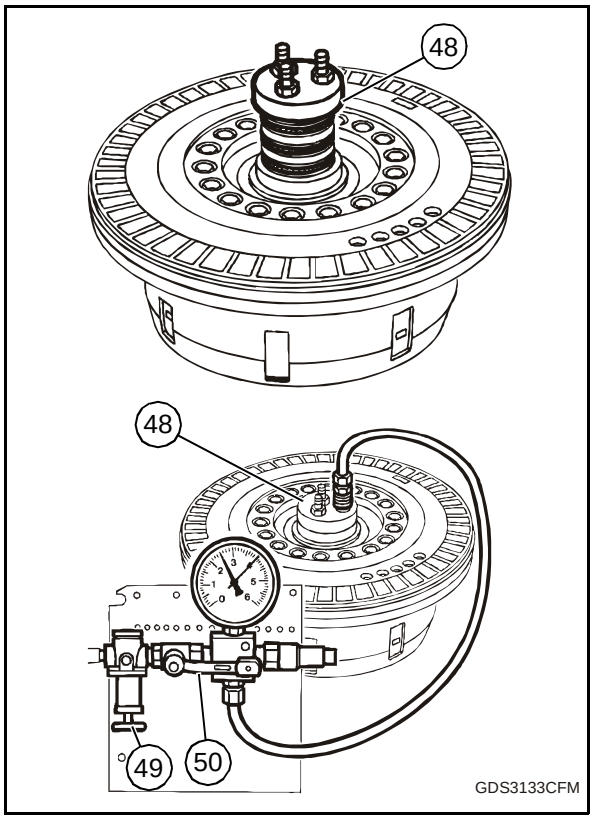
Disassemble and Assemble Input Clutch Carrier Specification

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.



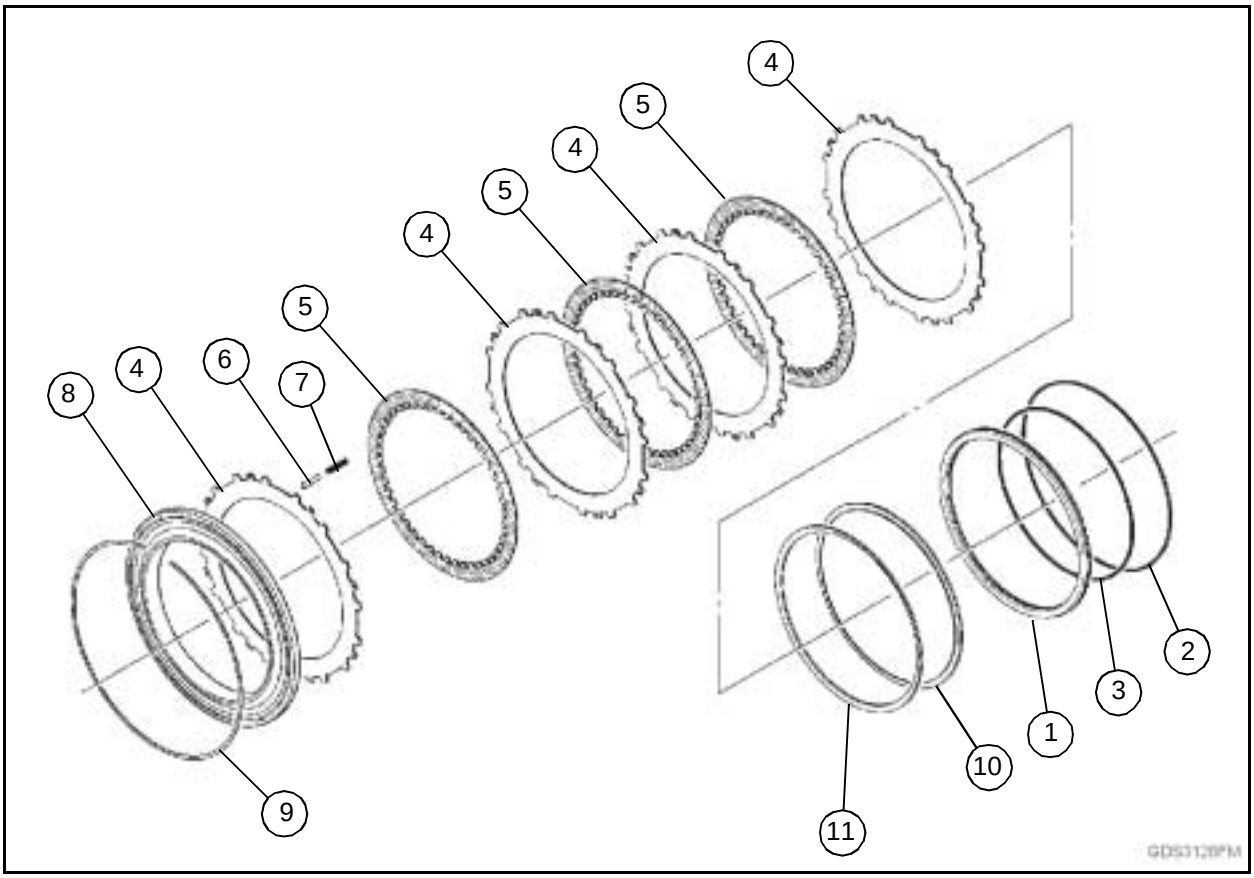
With adapter (48) secured in clutch carrier, adjust regulator (49) to apply 300 kPa (3 bar) (44 psi) maximum compressed air pressure. Attach to clutch fitting apply pressure and shut-off. Each clutch must maintain a minimum pressure of 140 kPa (1.4 bar) (20 psi) for 10 seconds.

Disassemble and Assemble Input Clutch Carrier Specification

Clutch A, B and C Seal Test Pr essure	140 kPa (1.4 bar) (20 psi) minimum

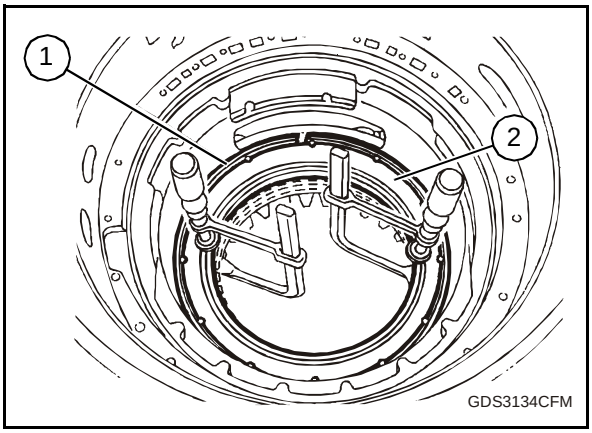
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Disassemble and Assemble Clutch D



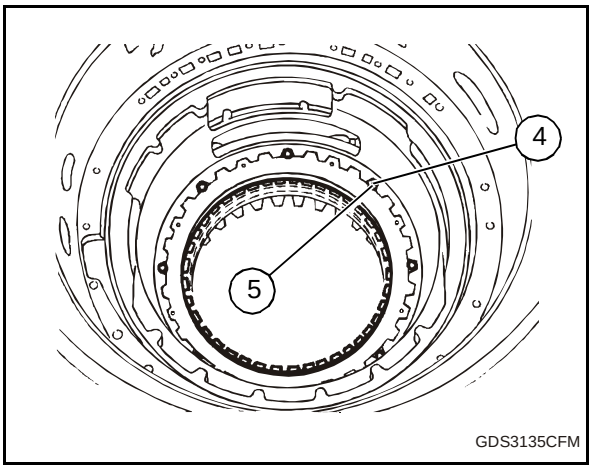
1. Clutch D Piston.
2. Seal.
3. Seal.
4. Outer Plate.
5. Inner Plate.
6. Pin (8 used).
7. Spring (8 used).
8. End Plate.
9. Snap Ring.
10. Spring Plate Holder.
11. Spring Plate.

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Use screw clamps to compress clutch D springs as shown to remove snap ring (1).

Release screw clamps evenly and remove end plate (2).

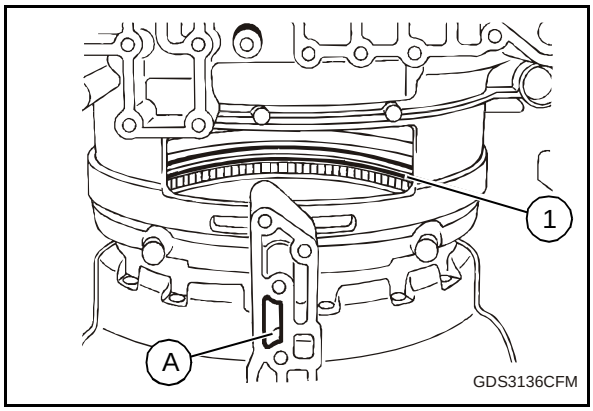


Remove springs (5) and pins (4).

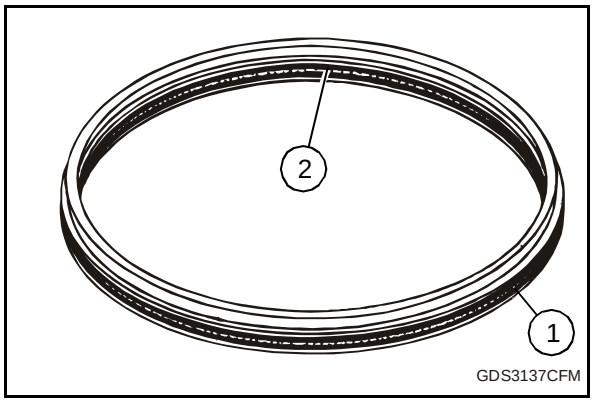
Remove plates, mark and identify order and position.

⚠ 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).



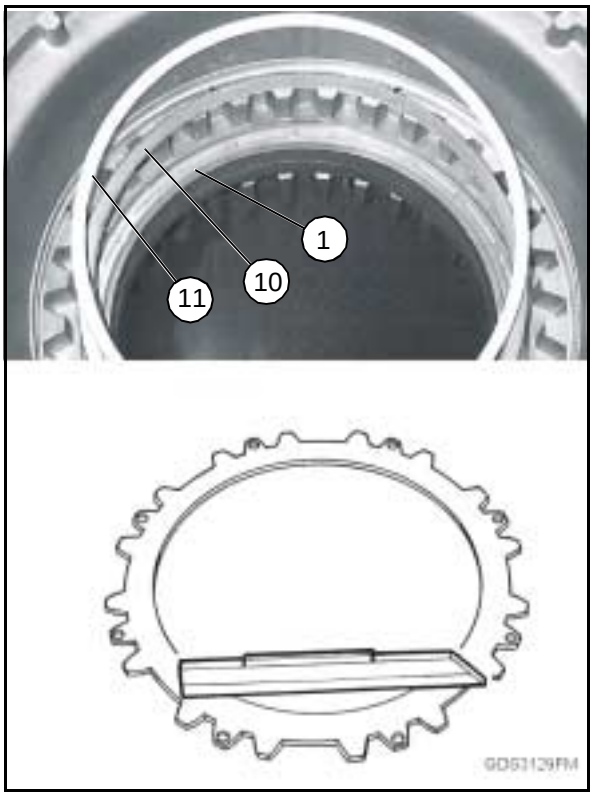
Replace seals (1 and 2). Seal lip must be positioned toward pressure side of piston.

NOTE: Piston must move freely and rest at bottom of bore.

Apply a thin layer of petroleum jelly and install clutch piston D (1).

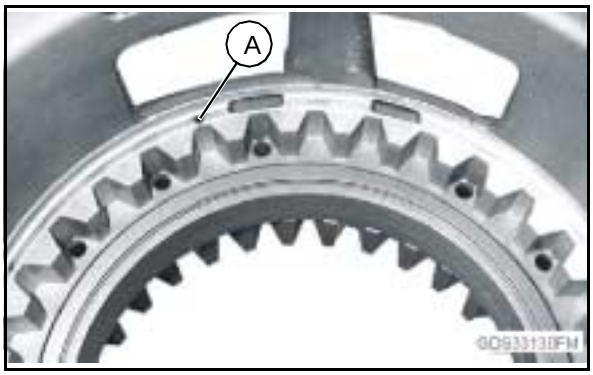
NOTE: Spring plate inner edge must be positioned on spring plate holder.

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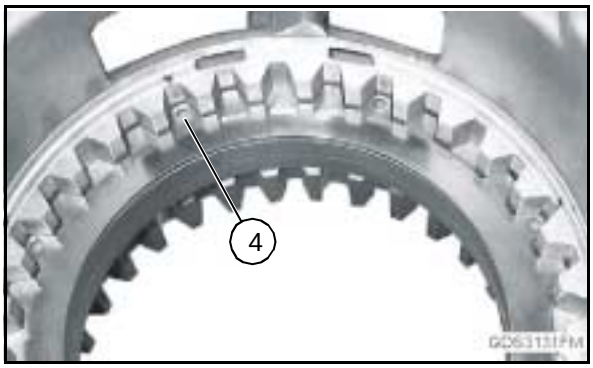
Install spring plate holder (10) and spring plate (11).

Use straight edge to check clutch D inner and outer plates. Worn or damaged plates must be replaced.

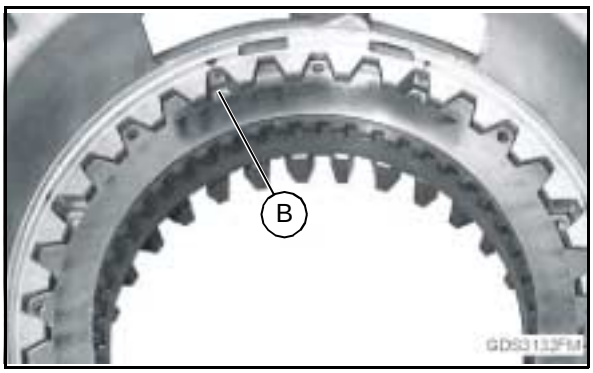


Mark housing between two holes (A).

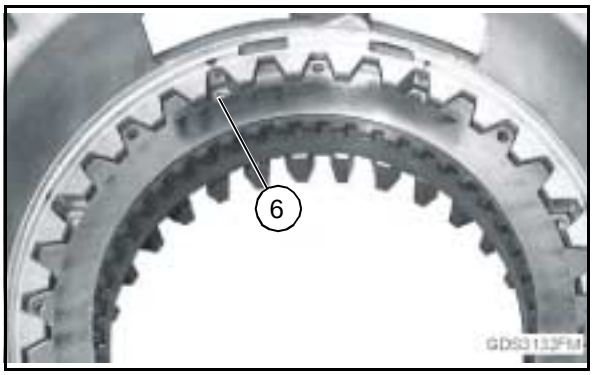
NOTE:Teeth of outer plates should cover hole in transmission housing.



Align hole in first outer plate (4) with mark on housing.

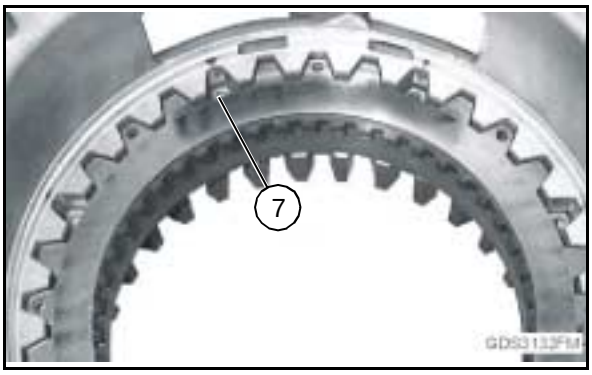


Install four inner plates and remaining outer plates in alternating order with recess at hole in first outer plate (B). Last plate is an outer plate.

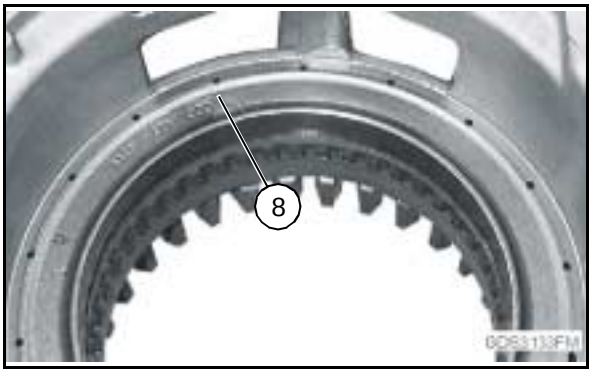


Install pin (6) in hole in first plate.

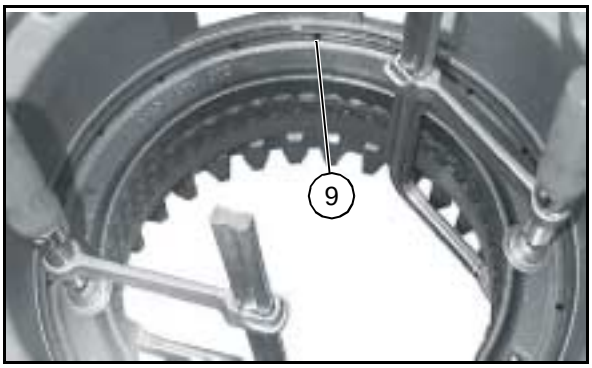
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Install spring (7) over pin.



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.)

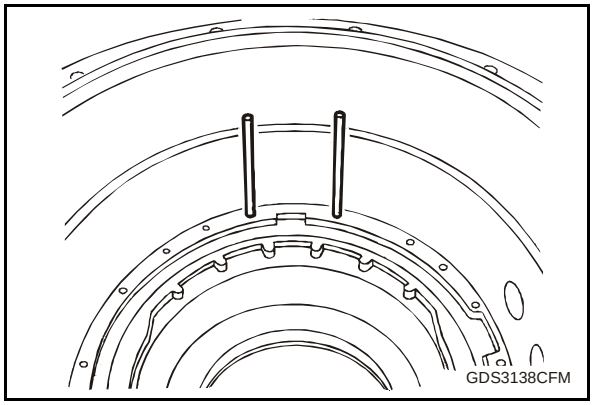
Assemble Transmission

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.



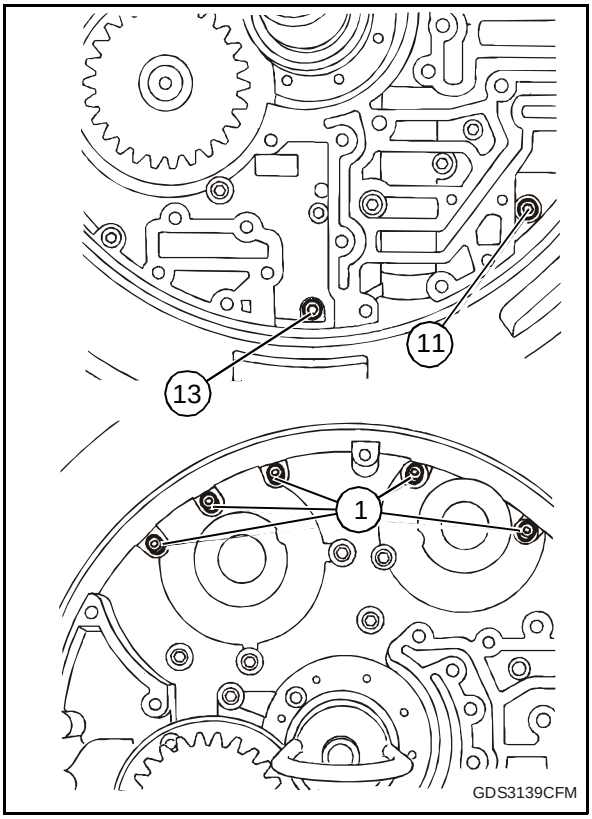
Lower input oil control body and clutch carrier on guide pins into position in transmission housing. Oil control body must make full contact with transmission housing at all locations.

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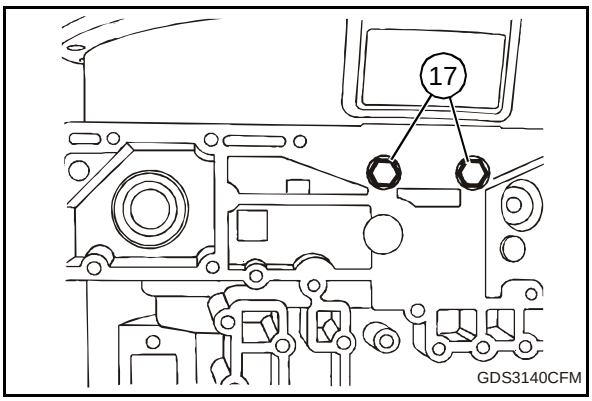
⚠ CAUTION

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

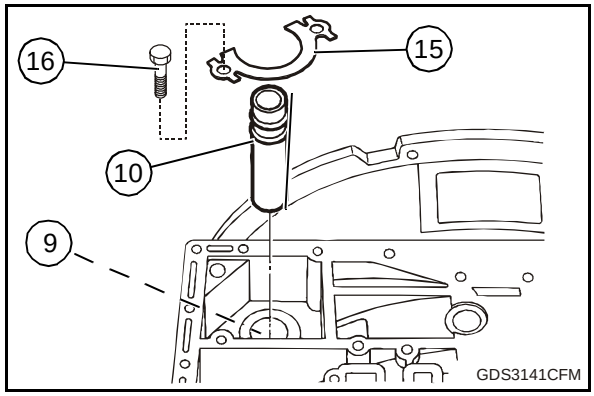
Carefully tighten cap screws to avoid damage to sealing surfaces. Damage to surface will cause low oil pressure.

Tighten cap screws (1, 11, and 13) to specification.

Install Input Oil Control and Clutch Carrier Specification

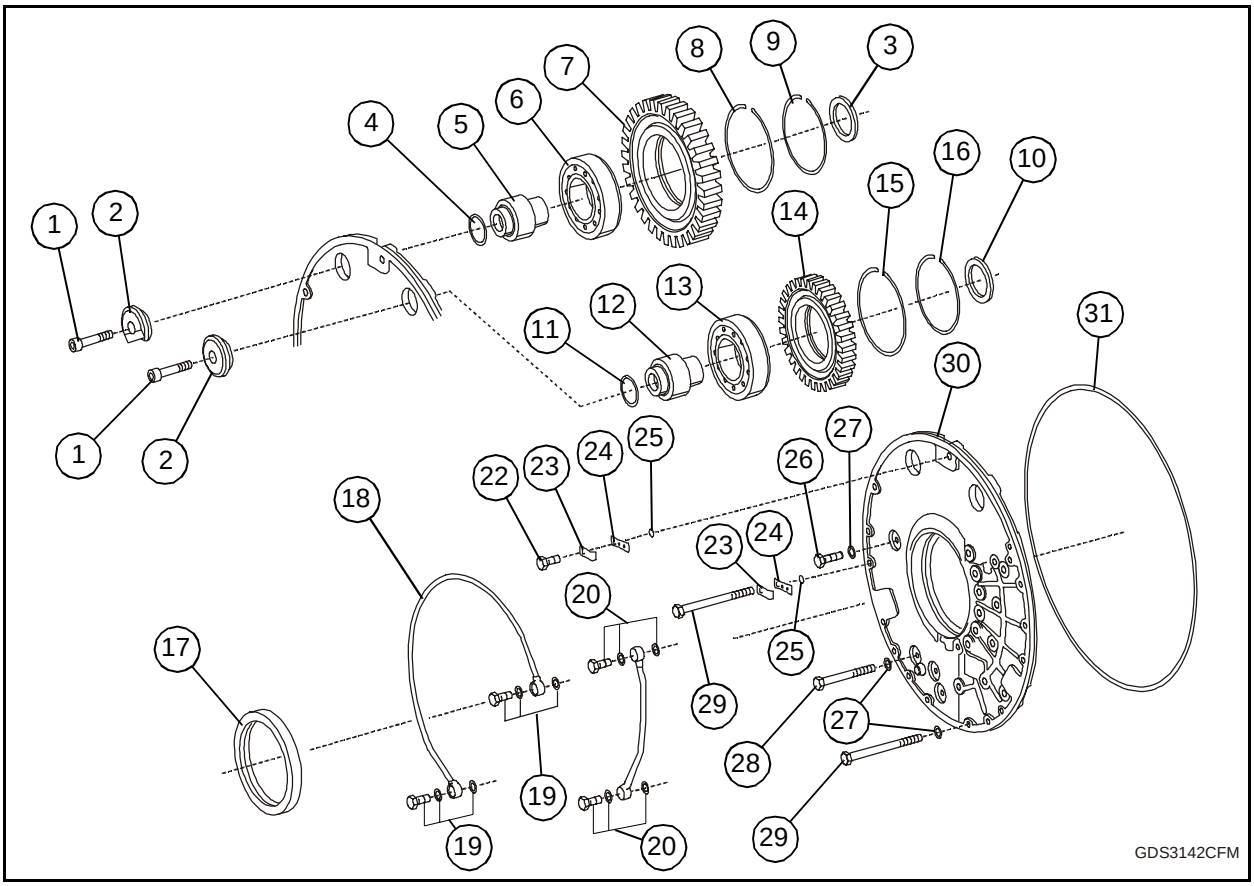
Input Oil Control Body Torque - - - - - 23 Nm (204 lb-in.)

Remove bolts (17) and washer.



Install oil intake pipe (10) and O-ring (9) with lock plate (15).

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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.

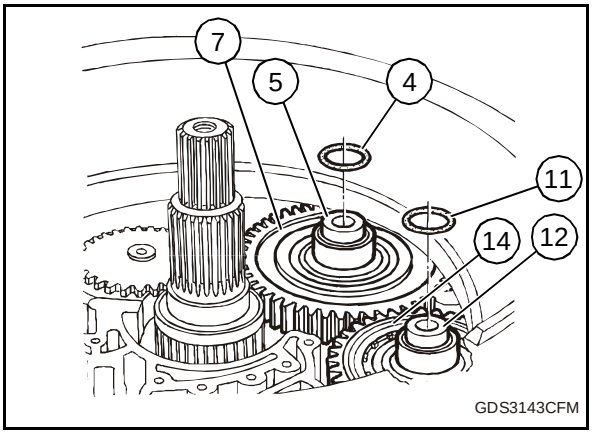
Align gears and washers with shaft bore in oil control body.

Heat bearing inner race to 85° C (185° F).

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⚠ CAUTION

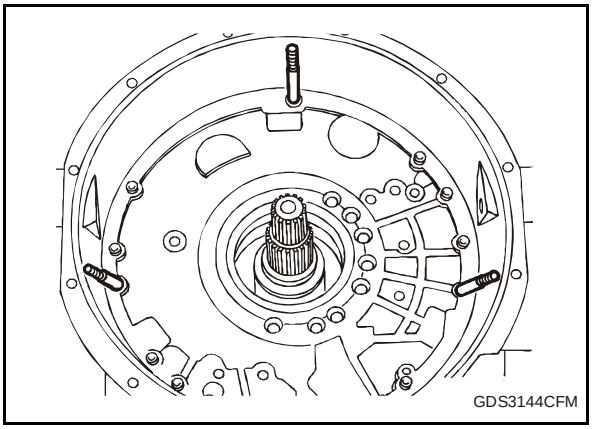
Wear protective gloves components will be hot.



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.

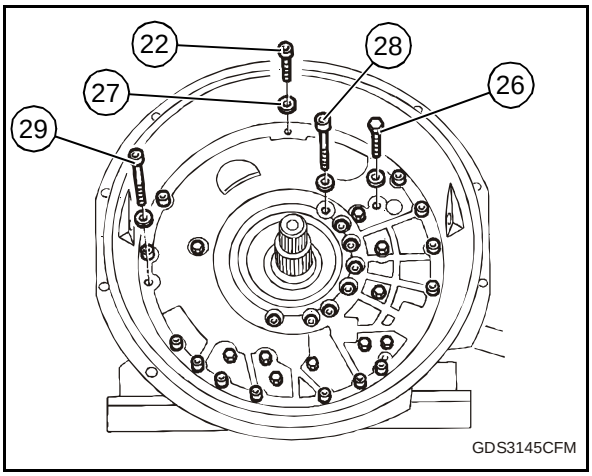
Apply a thin layer of petroleum jelly to O-ring (31) and install.



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.

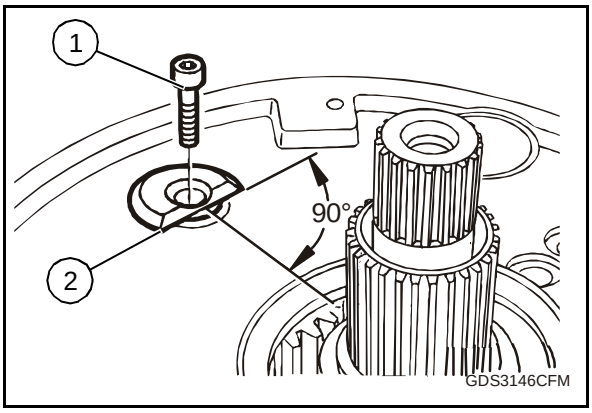


Cap screws at guide pin locations require copper seal rings to be place in the following order; copper seal ring, washer, copper seal ring.

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.)

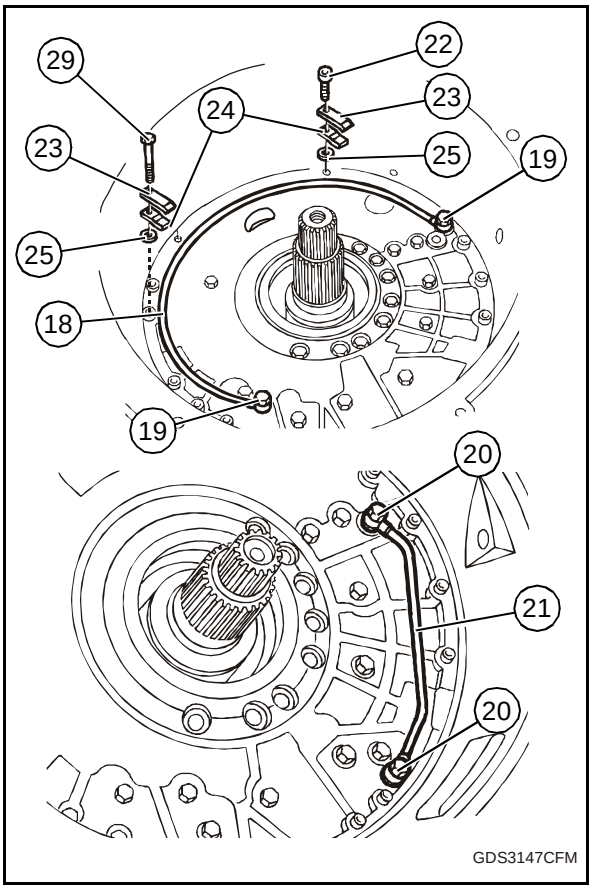


Position retainers (2) with bevel edge facing turbine shaft. Tighten cap screw to specification.

Install Cover Plate and Auxiliary Drive Gears Specification

Auxiliary Shaft Retainer Torque - - - - - 32 Nm (24 lb-ft)

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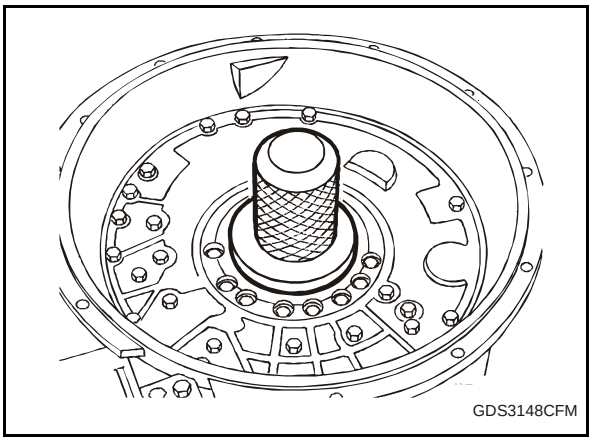


Install oil lines (18 and 21) as shown. Tighten banjo cap screws (19 and 20) to specification.

Install Cover Plate and Auxiliary Drive Gears Specification

Oil Line Banjo Cap Screw Torque - 18 Nm (159 lb-in.)

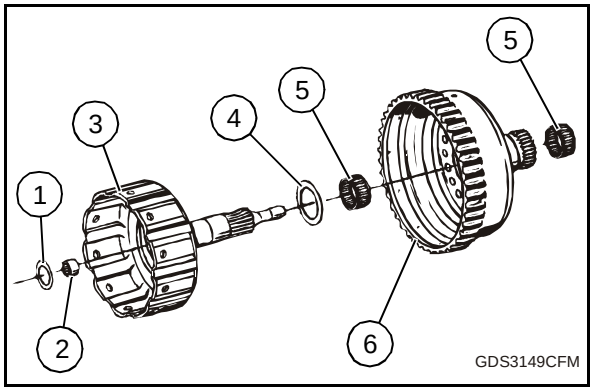
Install clamps and restrainers and tighten.



Apply thin layer of petroleum jelly to inner seal lip and a water soluble lubricant to outer seal edge.

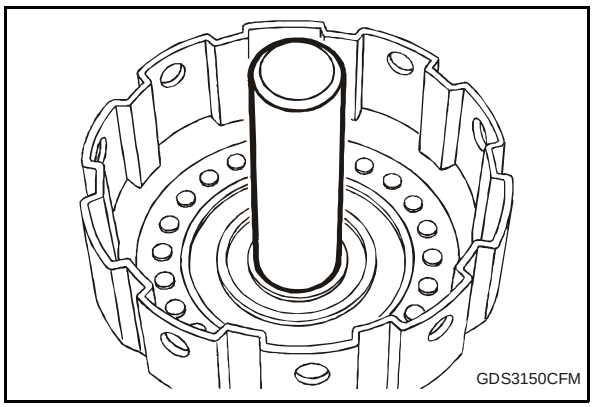
Install seal (17) with 281687 Drift.

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.).

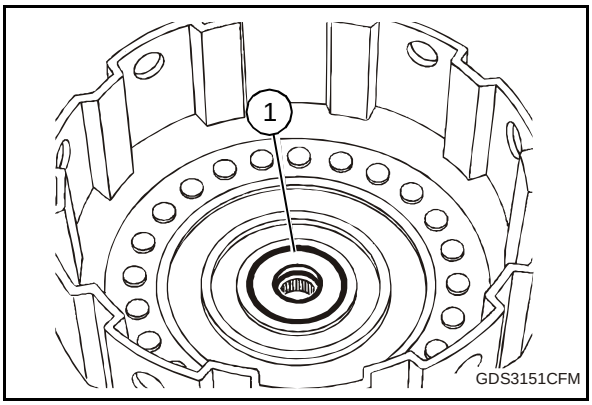


If removed install needle bearing (2 previous figure) with 281697 Mounting. With thick edge of bearing toward driver, drive bearing to a depth of 4.5 mm ± 0.5 mm (0.177 ± 0.02 in.).

Install Clutch C Element Specification

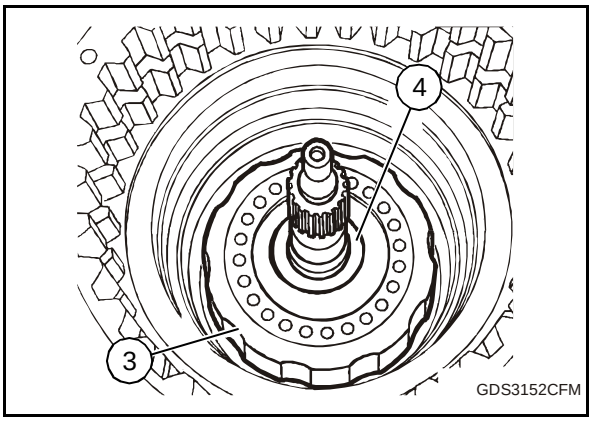
Clutch C Needle Bearing Depth - 4.5 mm ± 0.5 mm (0.177 ± 0.02 in.)

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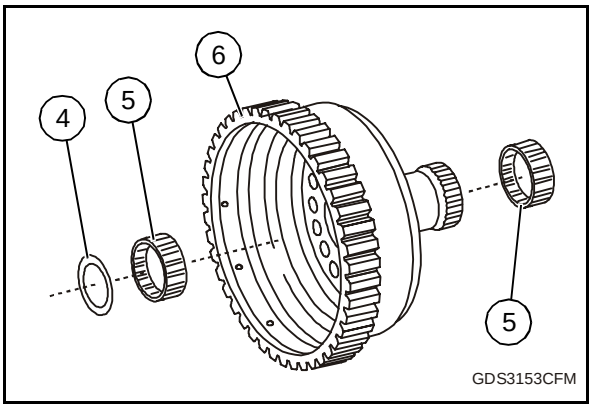
Apply layer of petroleum jelly and position thrust washer (1).

Align clutch A outer plates so teeth are even and centered.

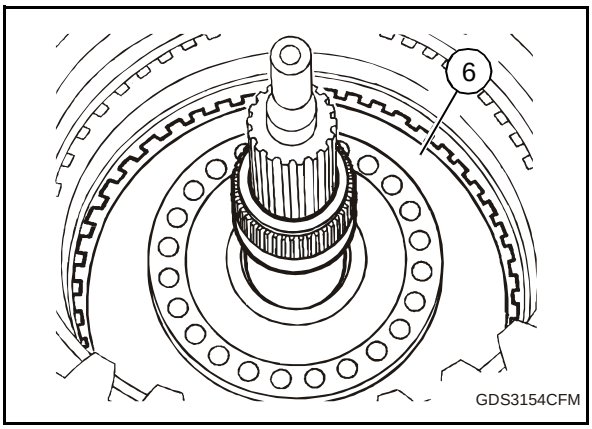


Install drive shaft (3). Ensure contact is made with thrust washer.

Apply petroleum jelly to thrust washer (4) and install.



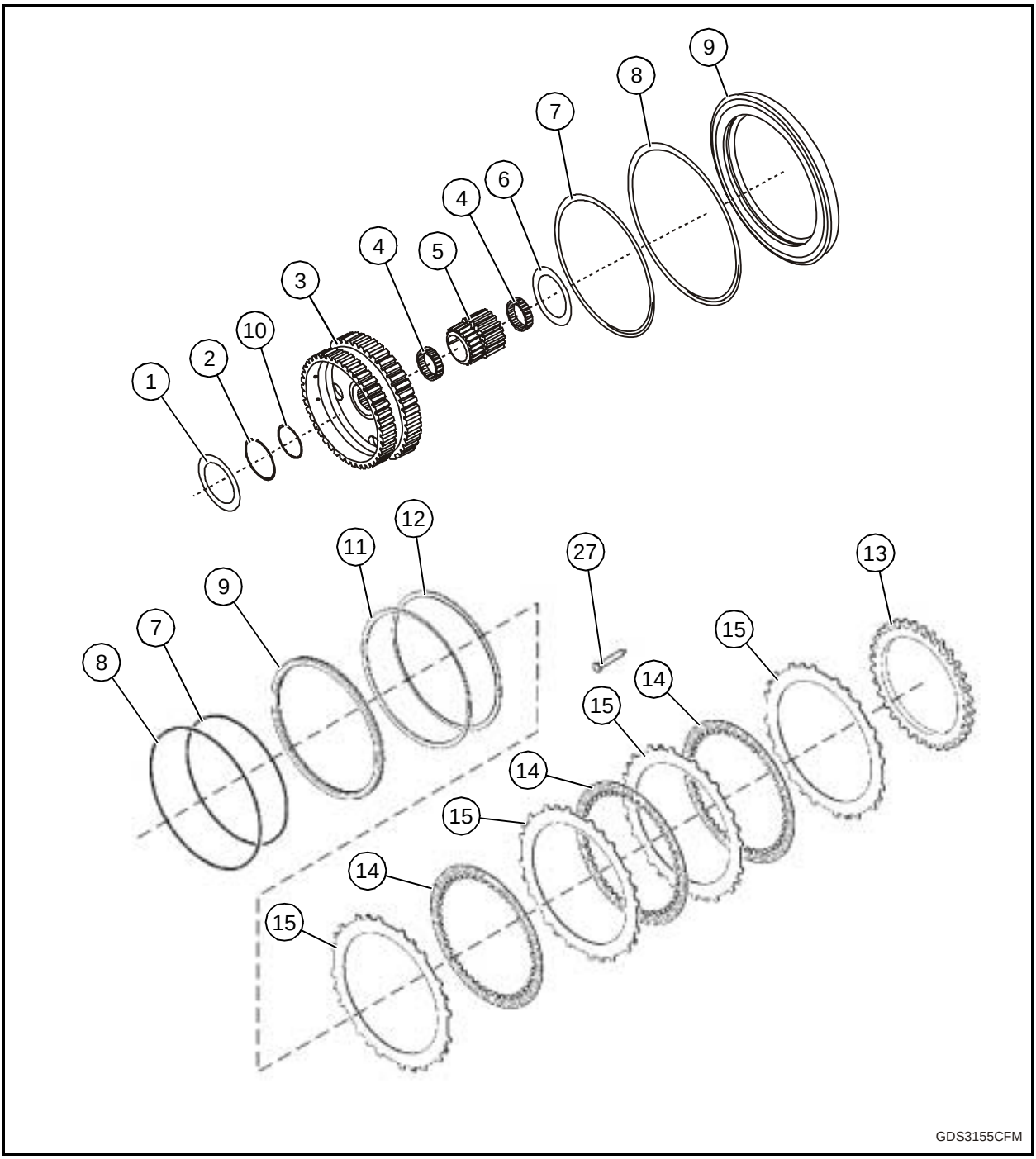
Apply petroleum jelly to needle bearing (5) and install in drive shaft (6).



Align inner plates of clutches B and C and install drive shaft (6). Ensure contact with thrust washer.

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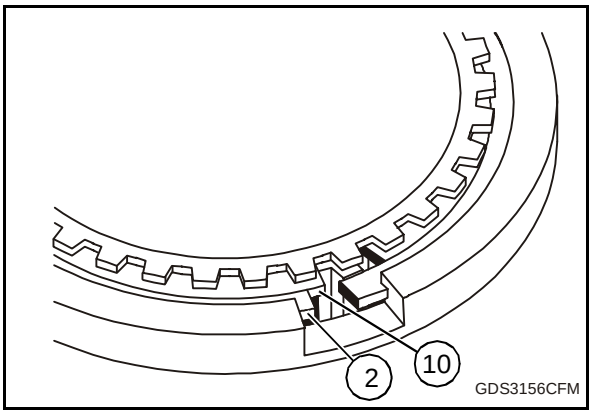
Install Clutch E Element



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).

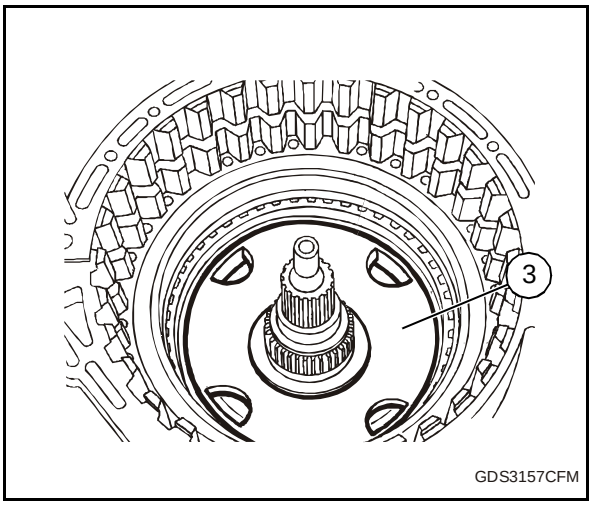
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Apply petroleum jelly to needle bearings (4) and install in sun gear (5).



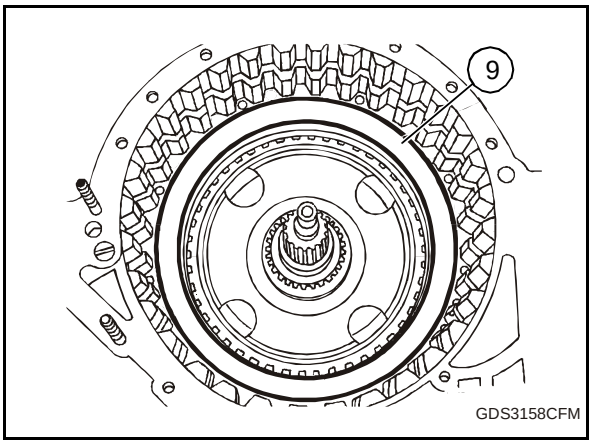
Install sun gear into plate carrier (3) and install snap rings (2 and 10) with ends positioned as shown.

Install thrust washer (1) on plate carrier.



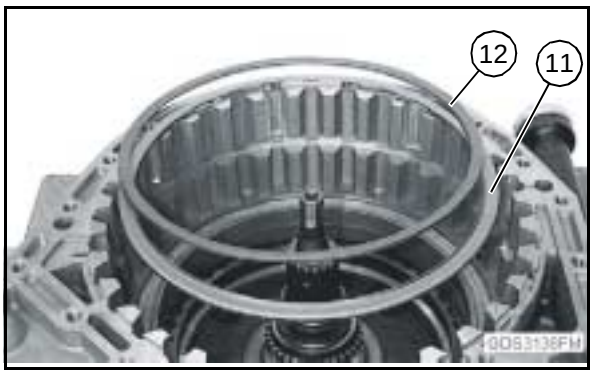
Install plate carrier and ensure needle bearings remain in position. Make sure carrier makes contact with thrust washer.

Apply thin layer of petroleum jelly install thrust washer (3).

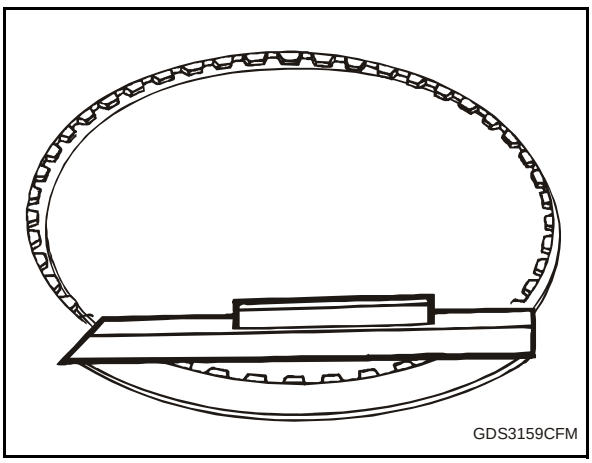


Install lip seal rings (7 and 8) with lip towards pressure side.

Install clutch E piston (9). Piston must make contact at bottom of piston bore.

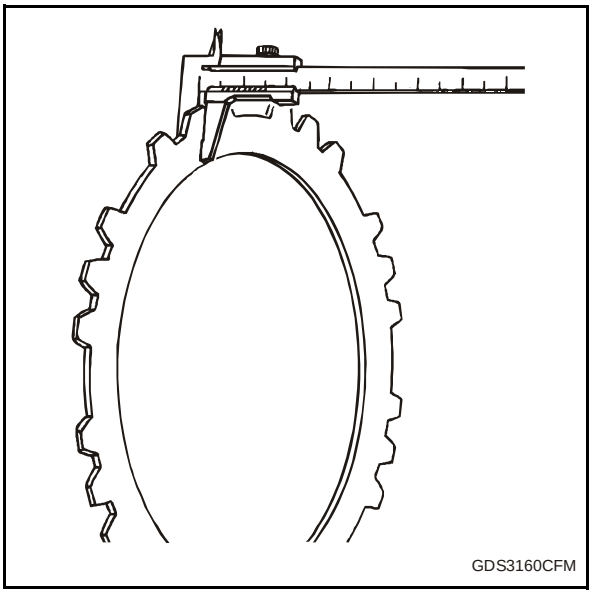


Install spring plate holder (11) and spring plate (12).



Clutch plates must be straight and flat.

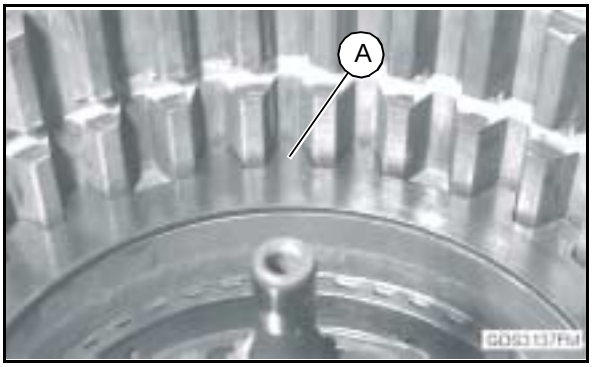
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Measure outer clutch plate thickness.

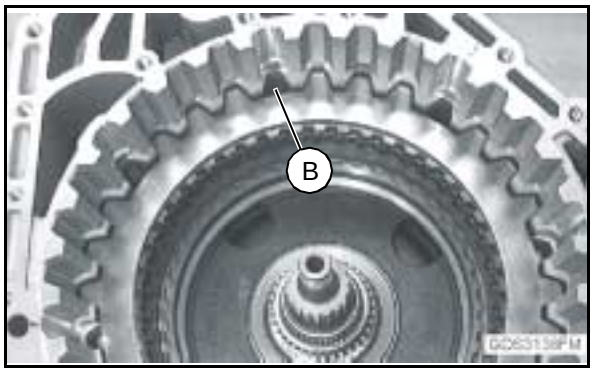
NOTE:First outer plate thickness must measure 3 mm (0.118 in.).

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).

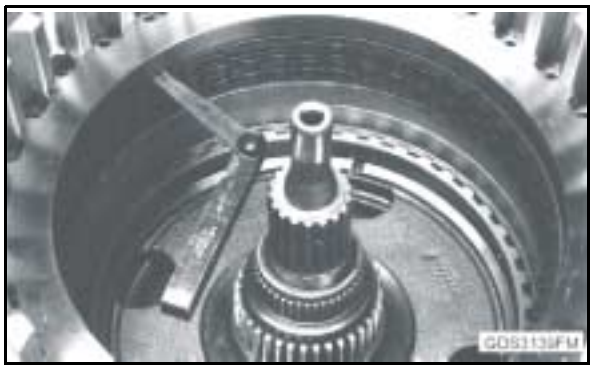


Install second outer plate with notch at marked location (B).

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.

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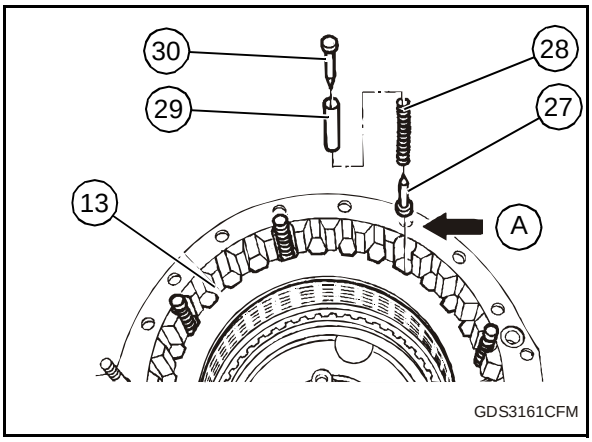
Install Planetary One and Two



Install planetary one carrier using DFT1238 Transmission Planetary Lifting Tool. Ensure contact with thrust washer.



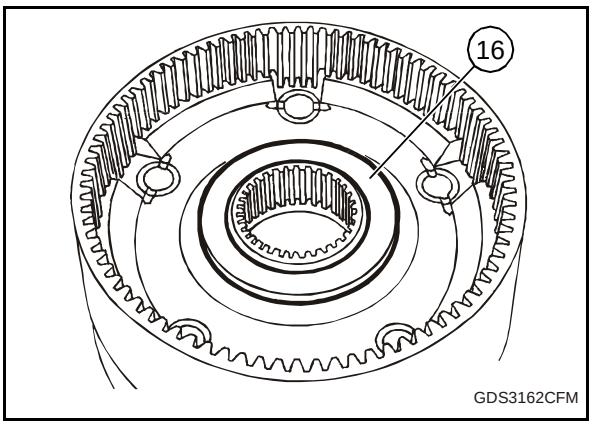
Install clutch E plate pack with 3 mm (0.118 in.) outer plate first, as previously described.



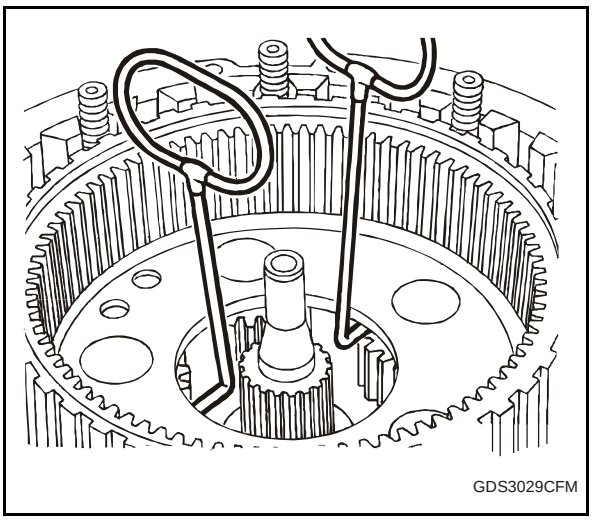
Install thrust ring (13) locating round recesses with outer plate notch.

Install parts (27 - 30) at recesses (A) with long bevel side of guide tube up.

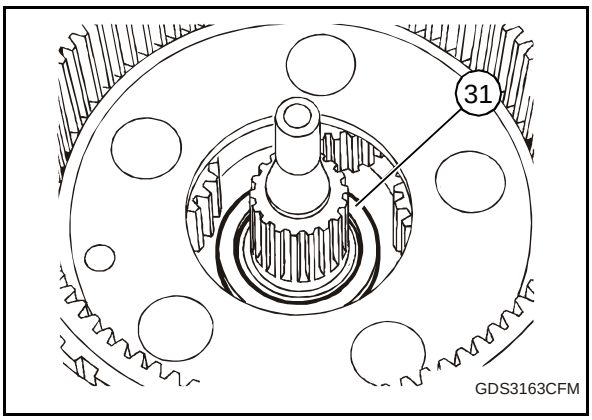
Install Intermediate Housing and Clutch Element



Apply petroleum jelly to thrust washer (16) and position on planetary two carrier.

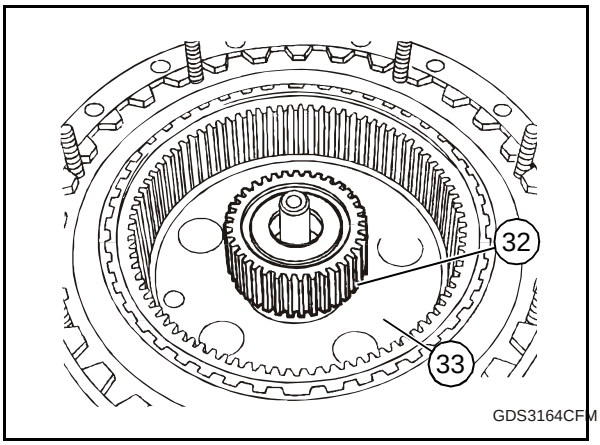


Install planetary two carrier. Ensure thrust washer remains in position and makes contact with planetary one.

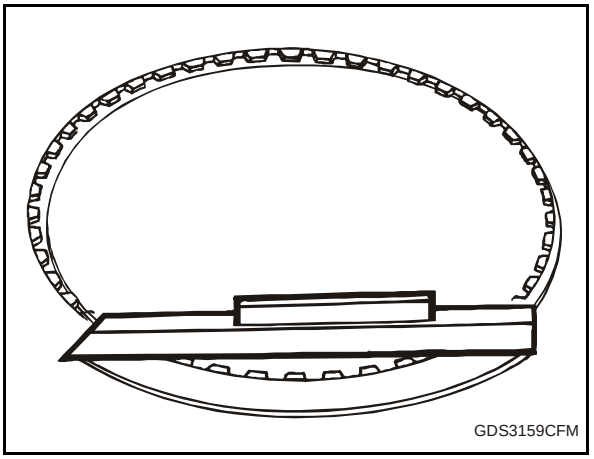


Install thrust washer (31).

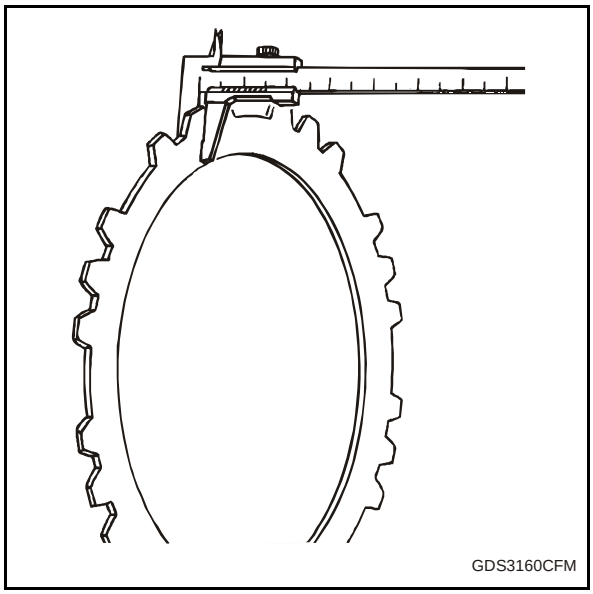
https://truckmanualshub.com/



Install sun gear (32), and thrust washer (33).

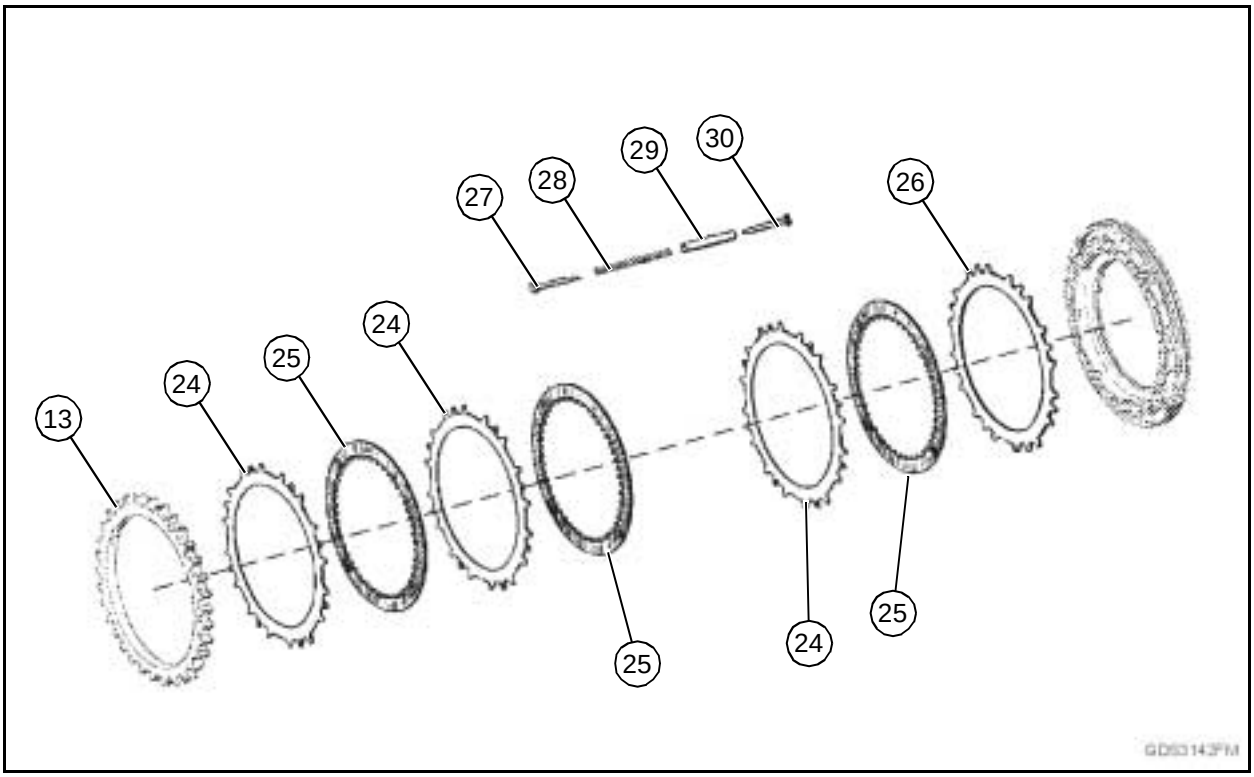


Clutch plates must be straight and flat.



Measure first outer clutch F plate thickness.

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13. Clutch E 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.

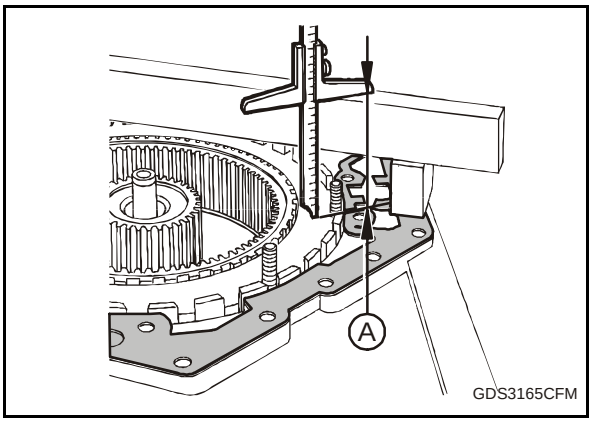
Install remaining plates in alternating order with inner plate last.

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.

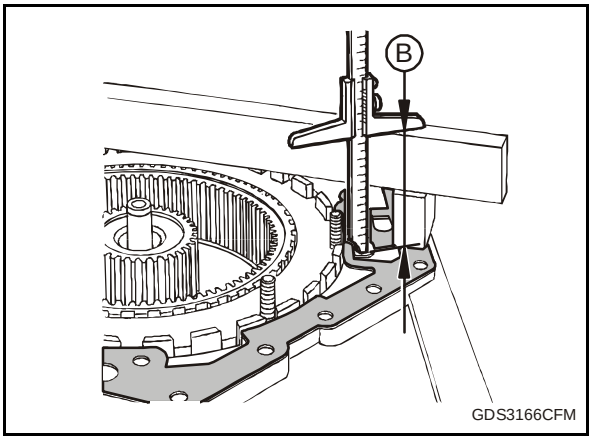
Place gasket into position on transmission housing.

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With caliper and measuring blocks measure clutch F end plate height at multiple locations.

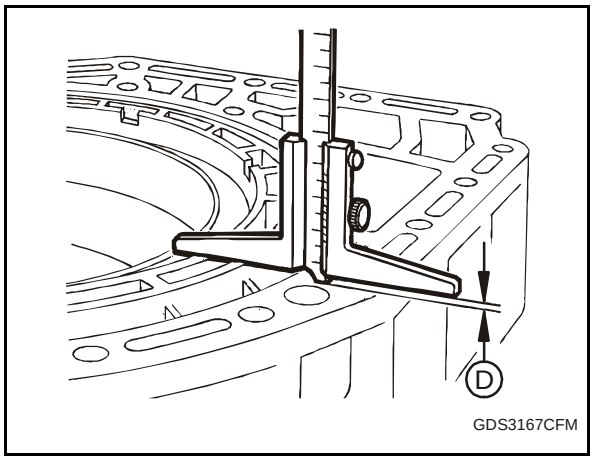
Calculate average and record as dimension (A).



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.

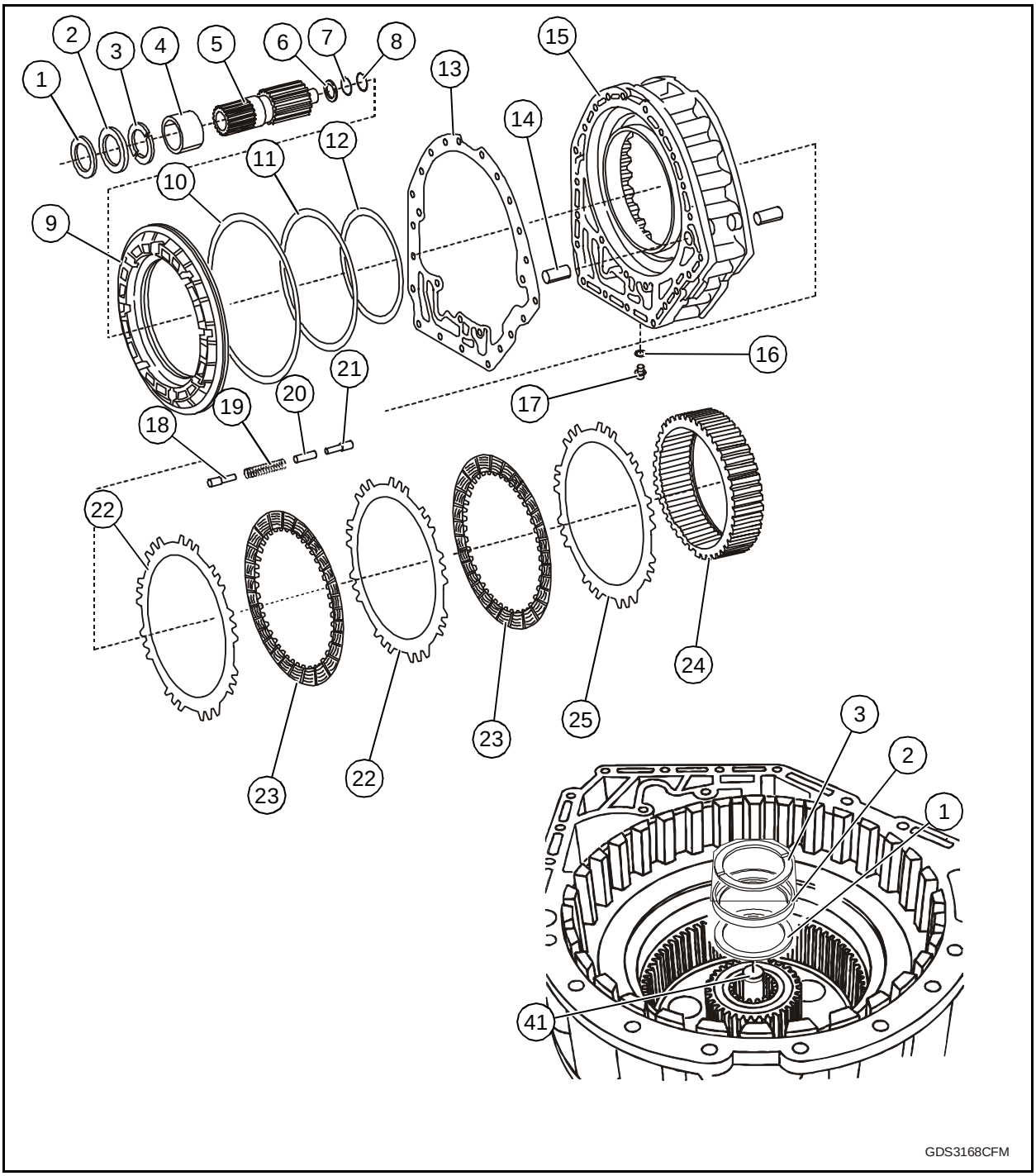
Combine different sizes of outer plate (24) to adjust clearance.

Specification

Clutch F Plate Clearance - 3.2 - 3.7 mm (0.126 - 0.146 in.)

Remove clutch F piston.

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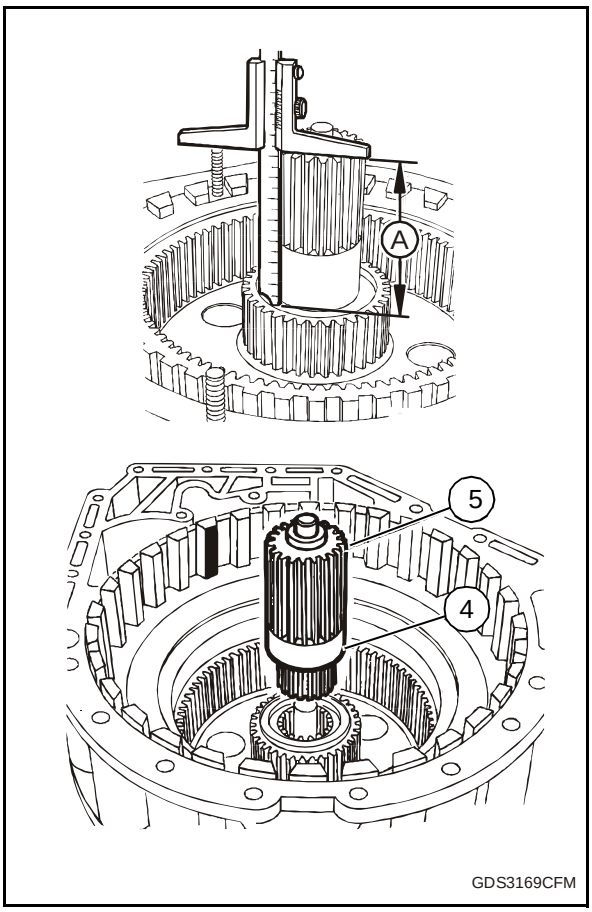


1. Shim.
2. Angle Ring.
3. Split Ring.
4. Inner Ring.
5. Sun Gear Shaft.
6. Thrust Needle Bearing.
7. Thrust Washer.
8. Shim.
9. Clutch F Piston.
10. Lip Seal.
11. Rectangular Seal.
12. Rectangular Seal.
13. Gasket.
14. Dowel Pin (2 used).
15. Intermediate Housing.
16. Seal Ring.
17. Plug.
18. Guide 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.

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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.

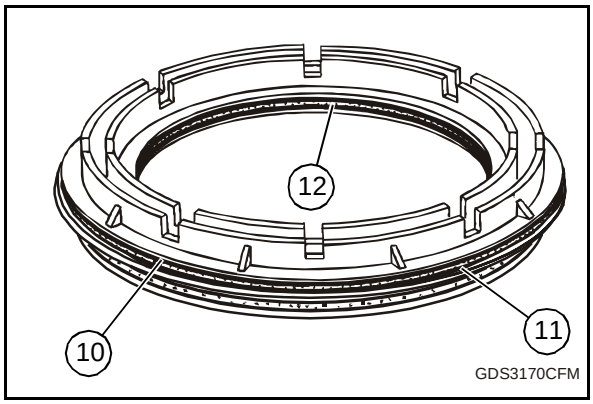
Raise sun gear to contact sun gear shaft and measure again. Note as dimension B.

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.

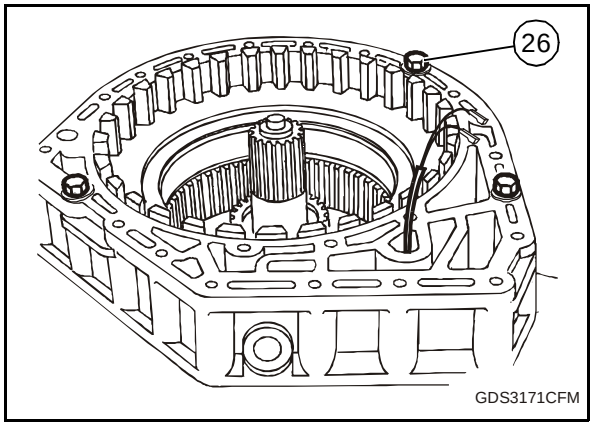
Install clutch F piston.

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.

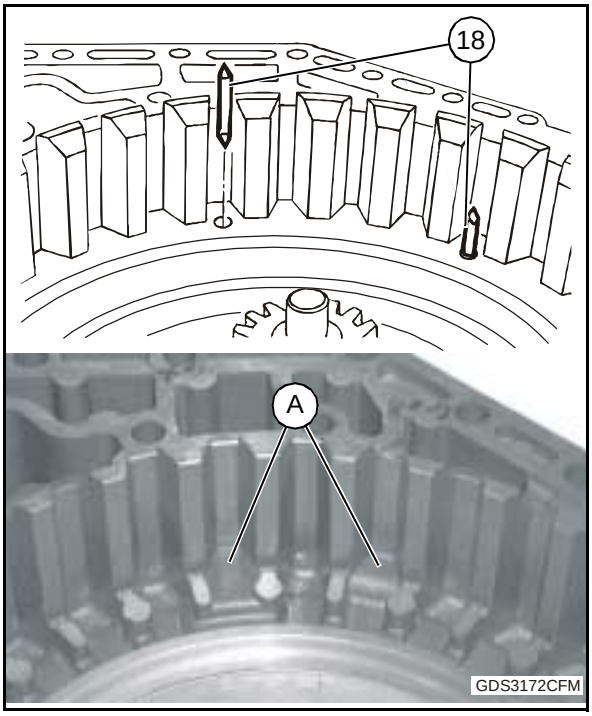


Install speed sensor harness through housing.

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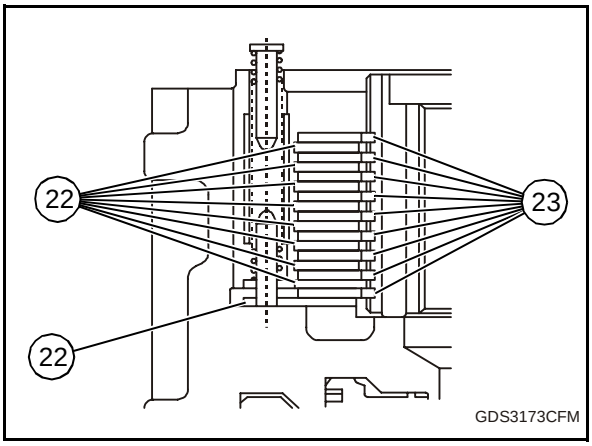
Use straight edge to make sure plates are flat.

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.

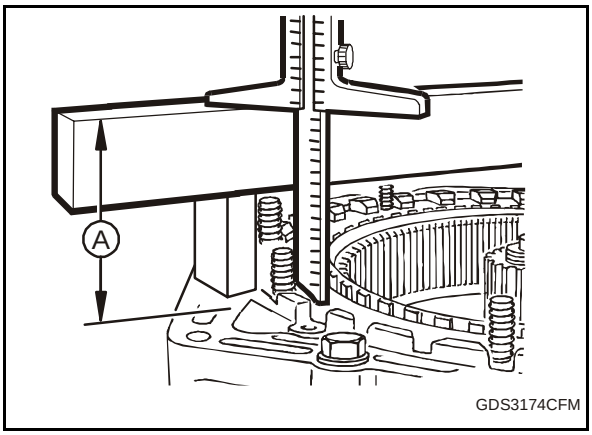


Install one inner plate (23).

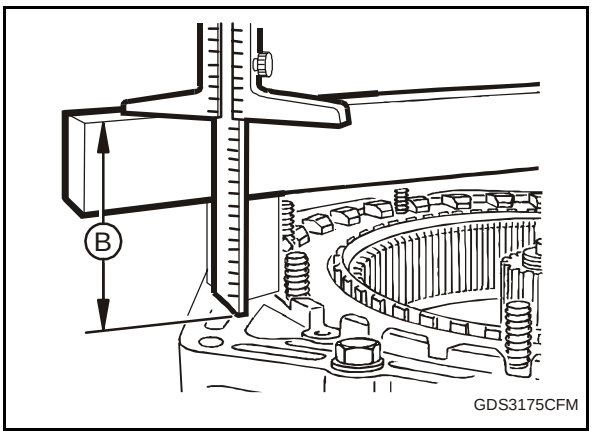
Install second outer plate with notch at guide pin location.

Install remaining plates in alternating order ending with inner plate.

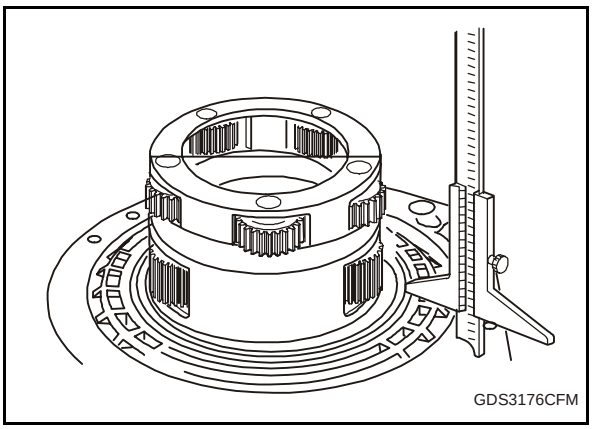
Install end plate (25).



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

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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.

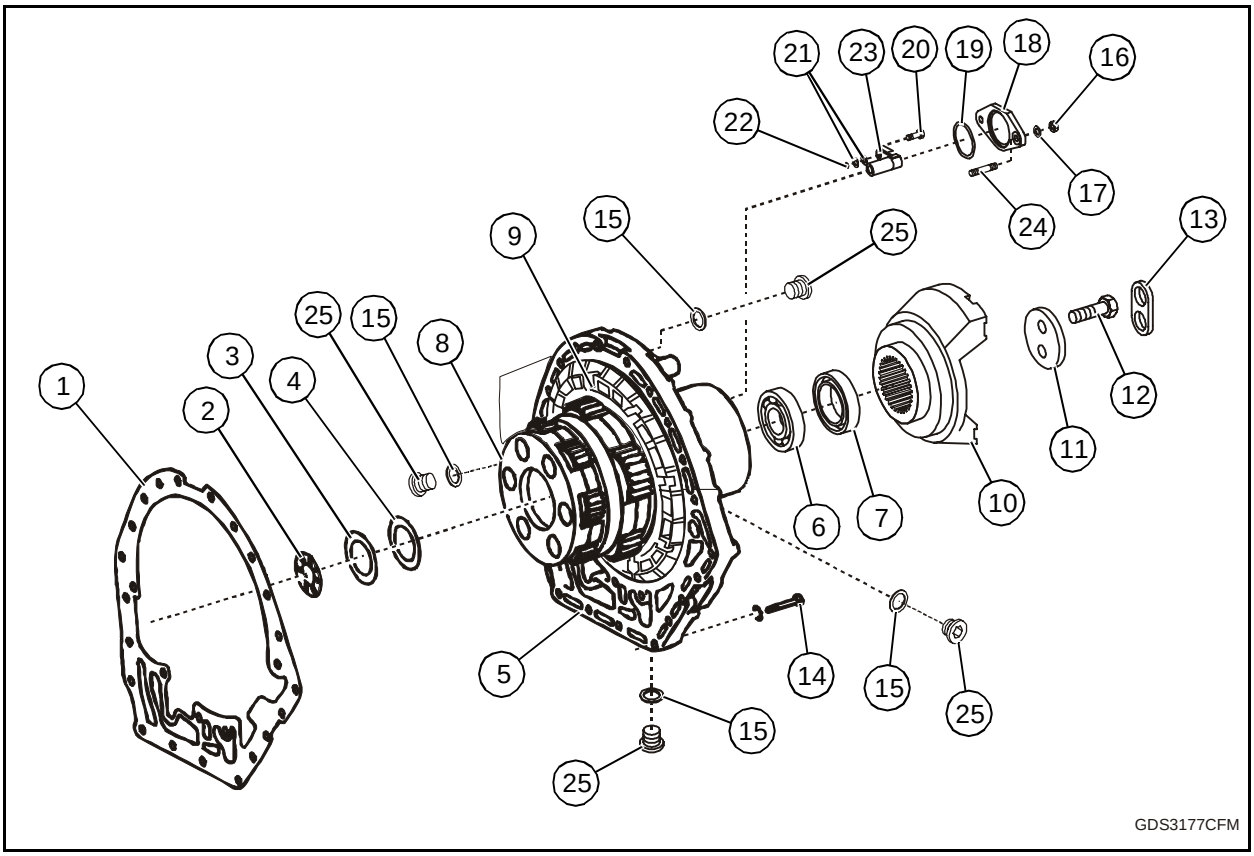
NOTE: Outer plate (22) is available in 2.0 mm (0.079 in, and 2.5 mm (0.098 in.) sizes. Use a combination to adjust clutch G clearance.

Combine different sizes of outer plate (22) to adjust clearance.

Install Intermediate Housing and Clutch Element Specification

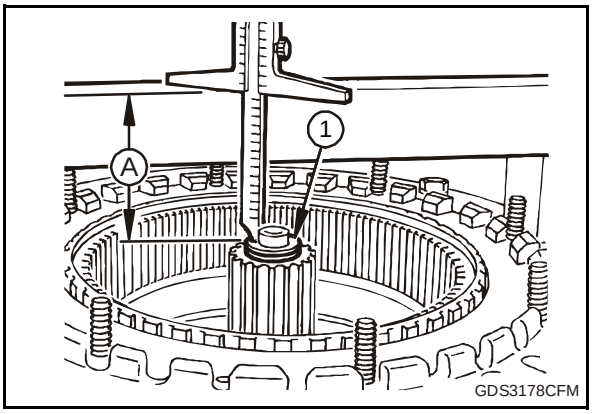
Clutch G Plate Clearance- 3.6 - 4.1 mm (0.142 - 0.161 in.)

Output Planetary and Clutch Element

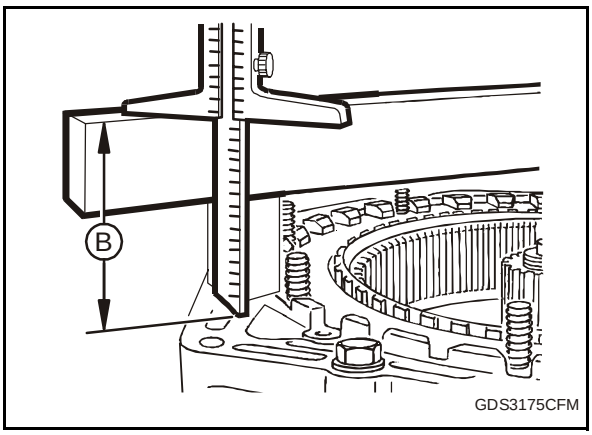


1. Gasket.
2. Needle Bearing.
3. Shim.
4. Shim.
5. Output Cover.
6. Bearing.
7. Seal.
8. Planetary Carrier.
9. Clutch G Piston.
10. Output Flange.
11. Retainer Plate.
12. Bolt (2 used).
13. Lock Plate.
14. Bolt.
15. O-Ring (3 used).
16. Nut (2 used).
17. Washer (2 used).
18. Speed Sensor Cover.
19. O-Ring.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

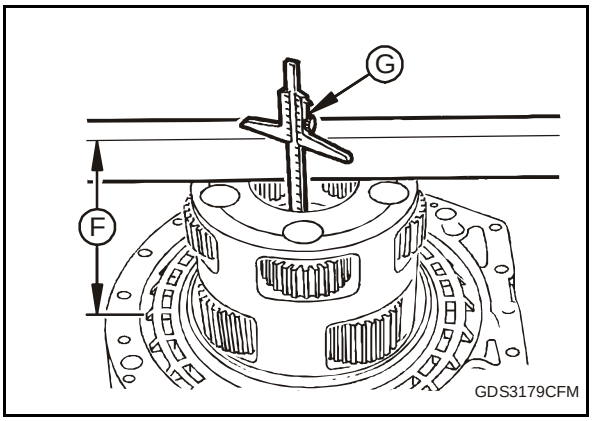
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With intermediate housing secured, use measuring blocks and measure sun gear height with needle bearing and thrust washer (1) in place. Record as dimension (A).



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.

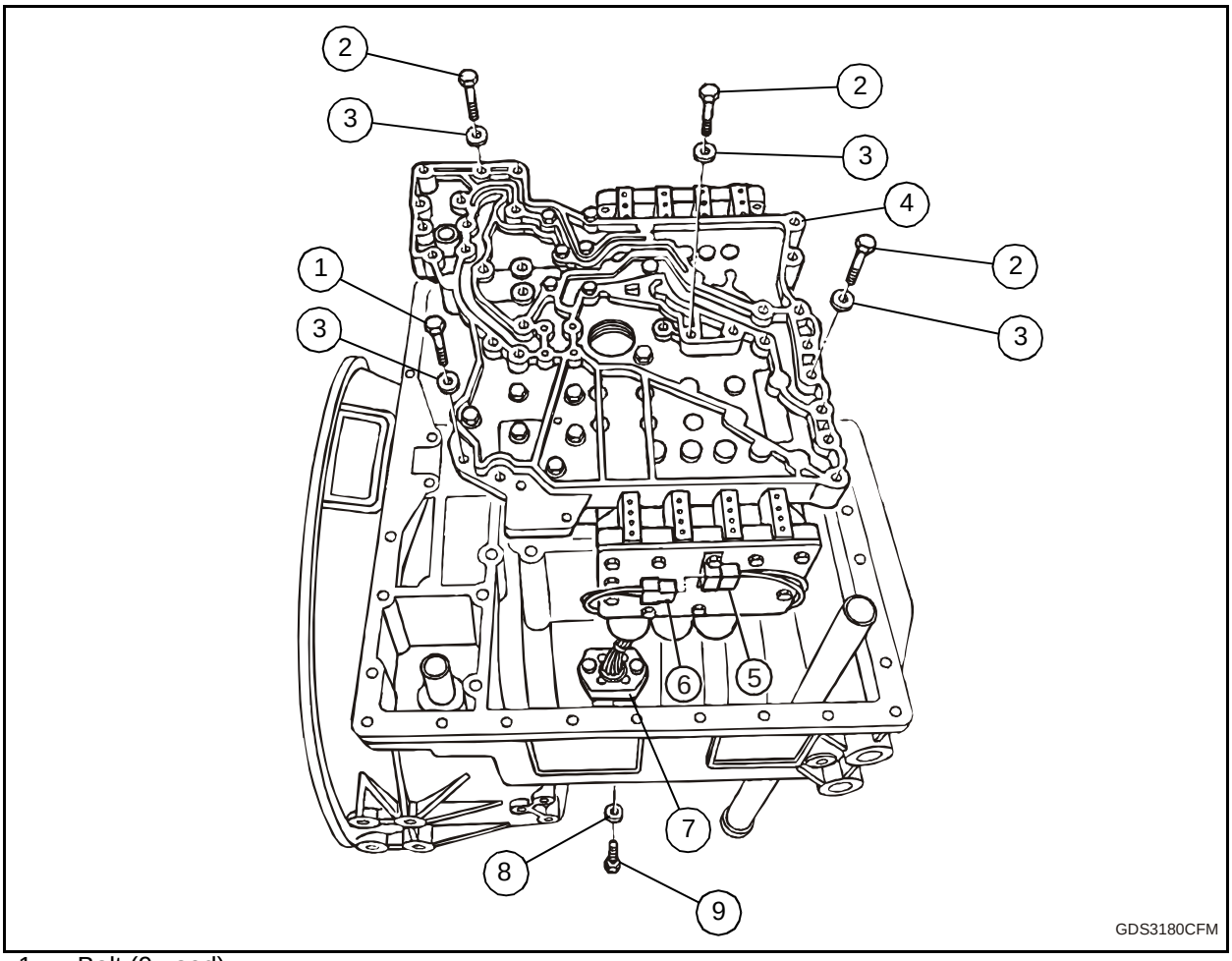
Output Planetary and Clutch Element Specification

Output Yoke Torque - - - - - - - - - - - - - 60 Nm (44 lb-ft)

Install new lock plate (13) with 281683 Punch.

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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.)

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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.

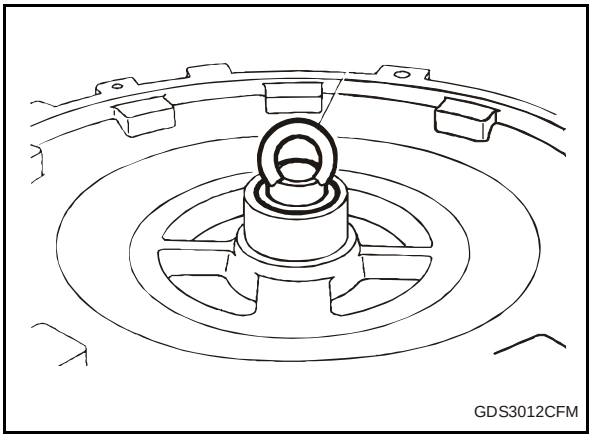
Install Oil Pan and Control Valve Specification

Oil Filter Cover Torque - - - - - - - - - 23 Nm (204 lb-in.)

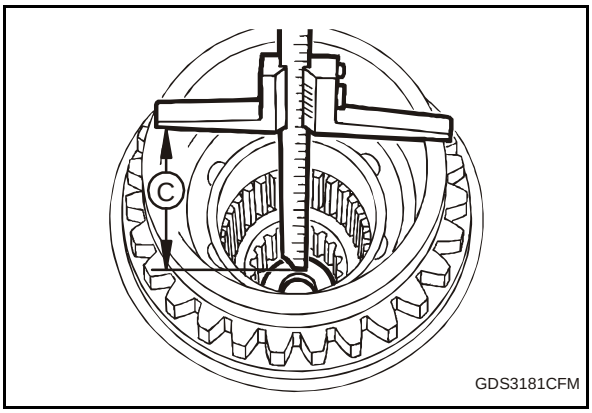
Install Torque Converter

⚠ CAUTION

Approximate weight of Torque Converter is 60 kg (132 lb).

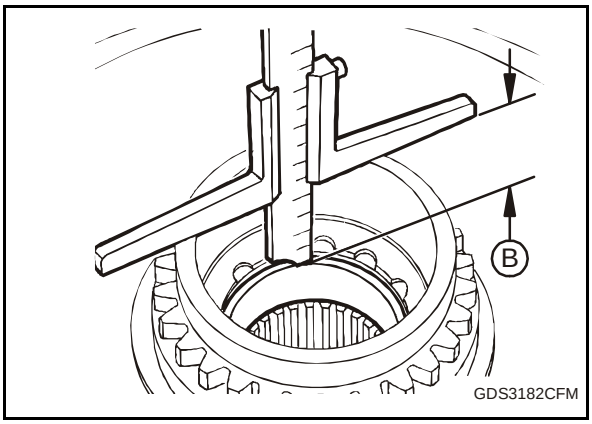

GDS3012CFM

Install 281696 Lifting Device to secure turbine wheel in converter.



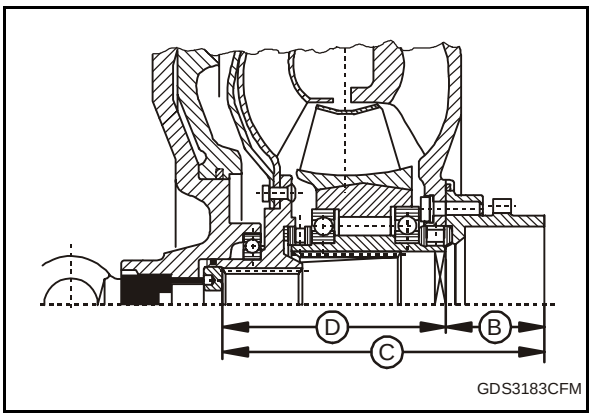
GDS3181CFM

With converter hub up, measure distance from face of spur gear to turbine gear shoulder (C). Record as measurement C.



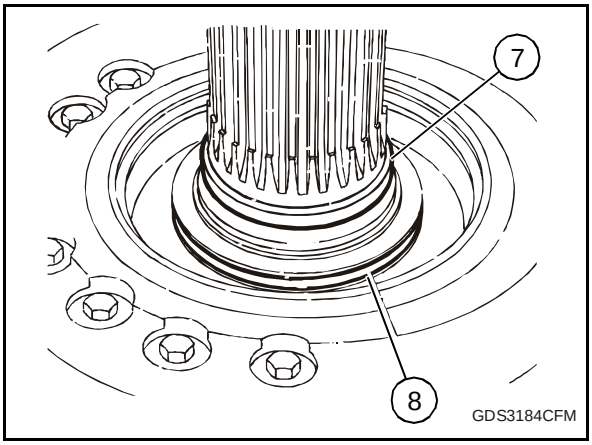
GDS3182CFM

Measure distance from spur gear face to one-way roller clutch ring face (B). Record as measurement B.



GDS3183CFM

Calculate distance (D) and record. (C-B) = D

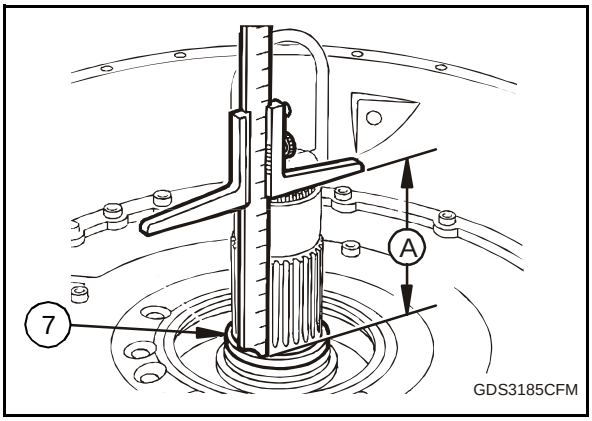


GDS3184CFM

Inspect and install ring (8) on stator shaft with ends locked.

Position spacer (7) to remove axial movement in stator shaft.

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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.

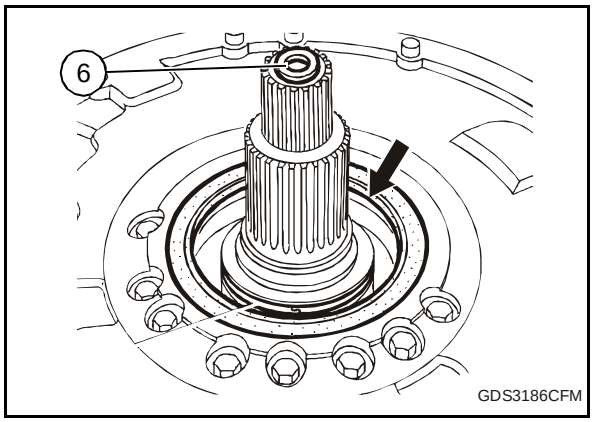
NOTE: A thicker shim allows more end play. Torque converter shims are available in .01 mm (0.004 in.) increments from 1.0 mm (0.039 in.) to 2.6 mm (0.102 in.).

Calculation Example:

(C-B) = D (174.7 mm - 55.2 mm) = 119.5

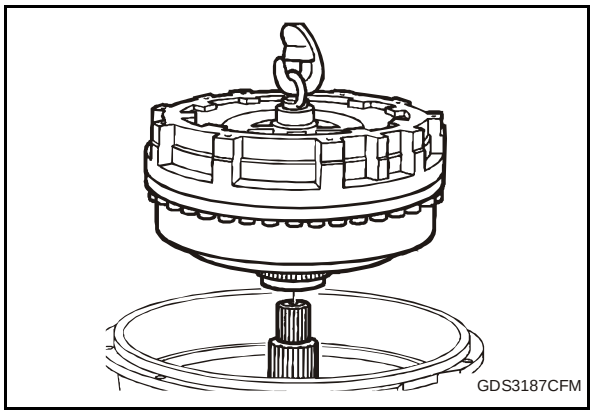
(D-A) = E (119.5 mm - 118.3 mm) = 1.2

(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.

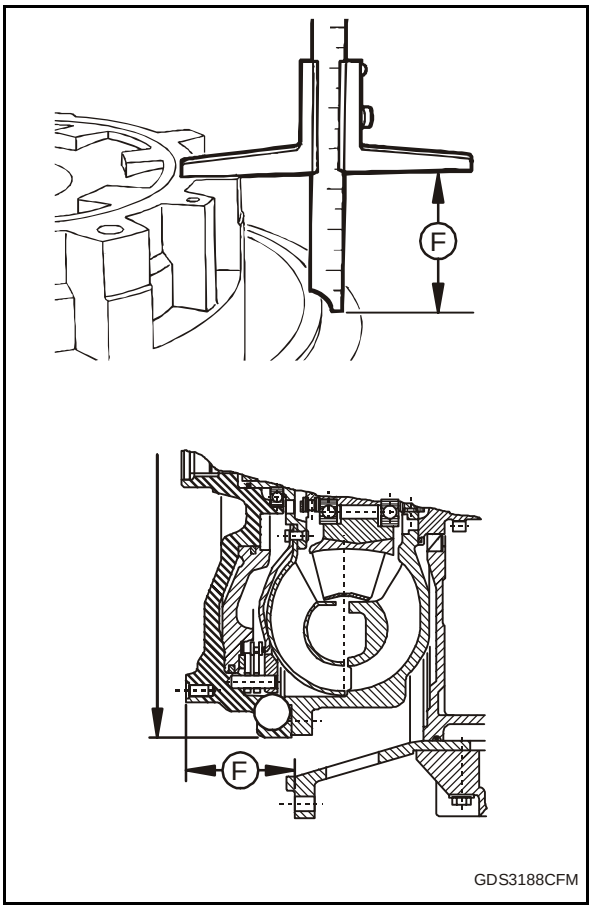


Install 281696 Lifting Device to converter and lower converter into position. Rotate converter slightly to ensure engagement of turbine shaft, stator, and pump drive gear.

⚠ CAUTION

Converter must be positioned correctly before converter cap screw is installed.

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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.)

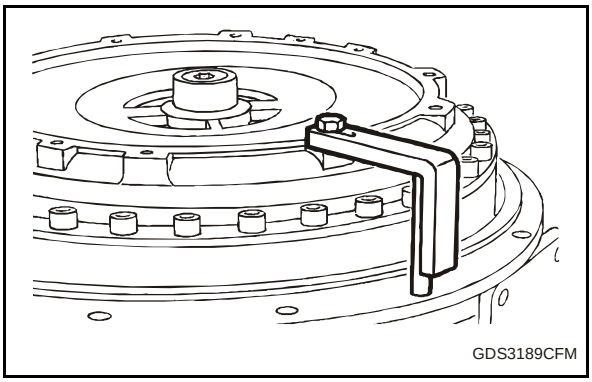
⚠ CAUTION

If spacer ring is added or removed, shim (6) must also be change by an equal amount to avoid damage to bearing.

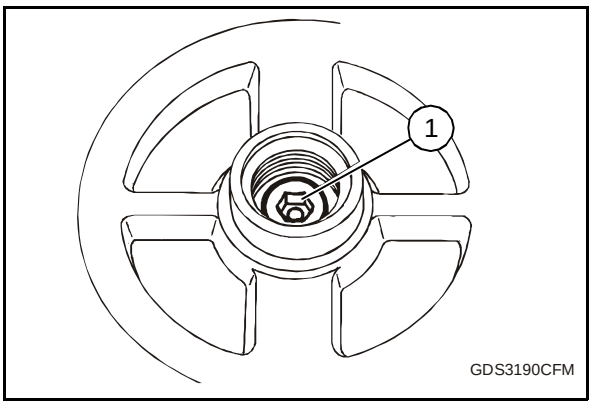
If installed height is less than (F) -0.05 mm (0.002 in.) a second spacer ring (7) should be installed to stator shaft.

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).



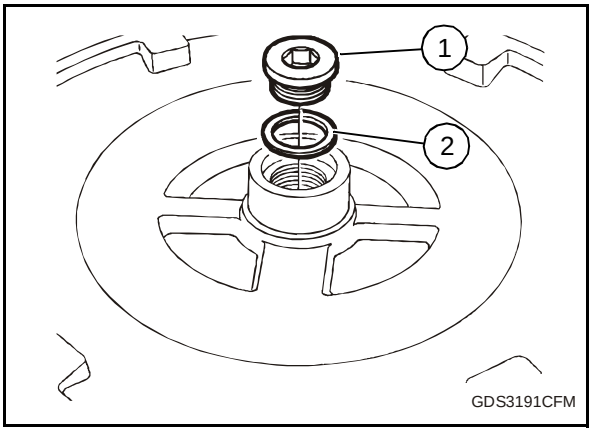
Install DFT1229 Torque Converter Holding Bracket and socket head cap.



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

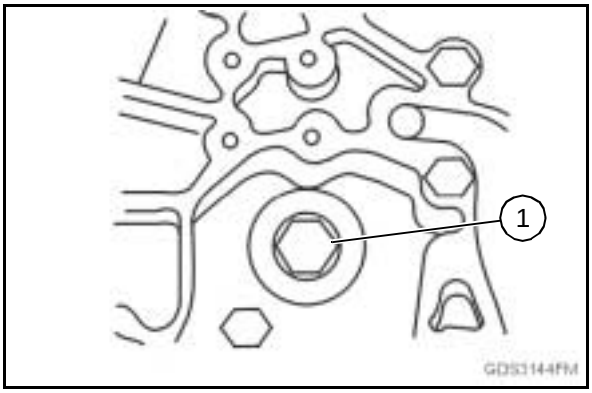
Torque Converter Plug Torque - - - - 200 Nm (148 lb-ft)

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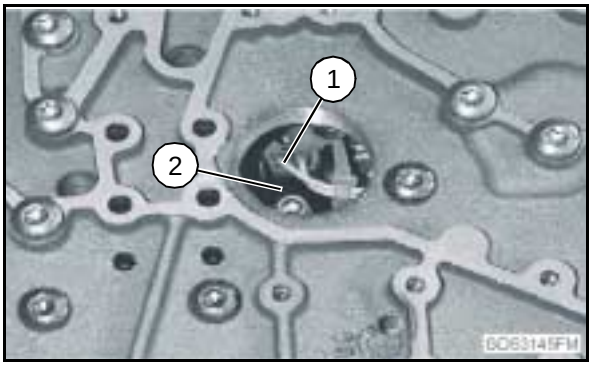
Input Speed Sensor Adjustment

Drain transmission oil. **(See Change Transmission Oil in Operator Manual CHAPTER 15, SECTON 2).**

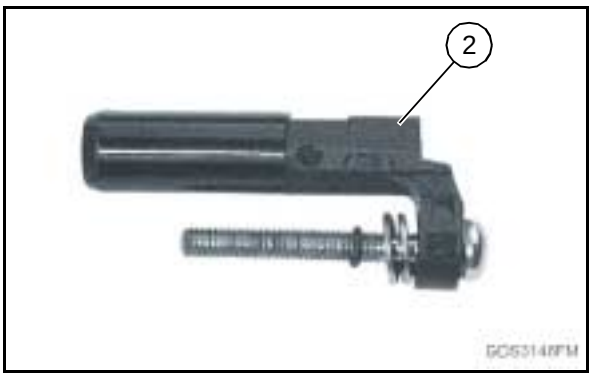
Remove transmission oil pan.



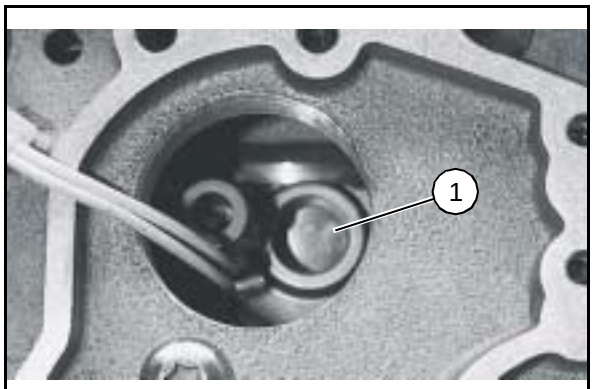
Remove plug (1).

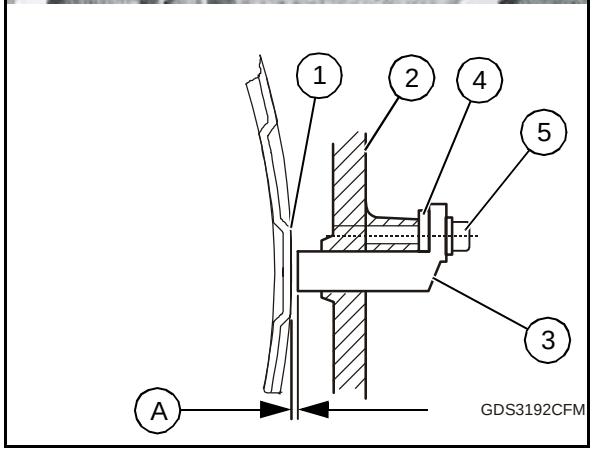


Remove wire connectors (1). Wire connector location is not important.



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.

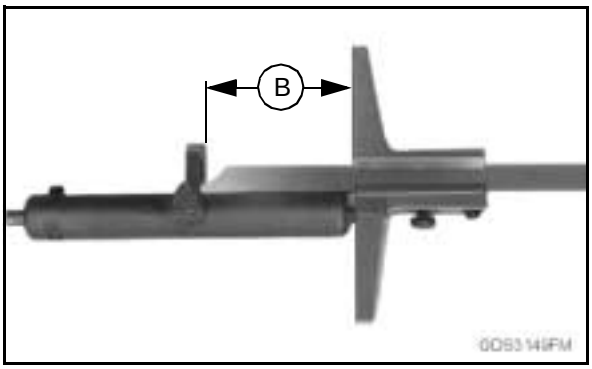
Input Speed Sensor Adjustment Specification

Input and Output Sensor Depth Measuring Shaft
Torque - 9.5 Nm (84 lb-in.)

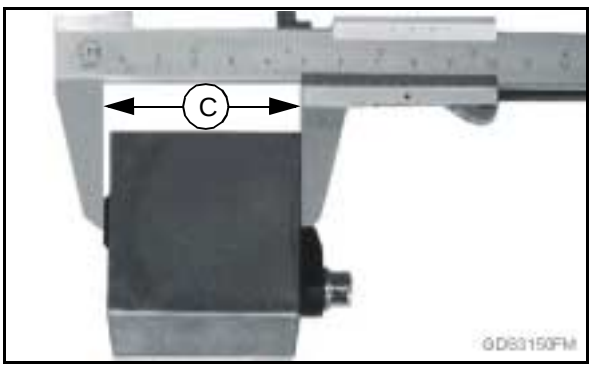
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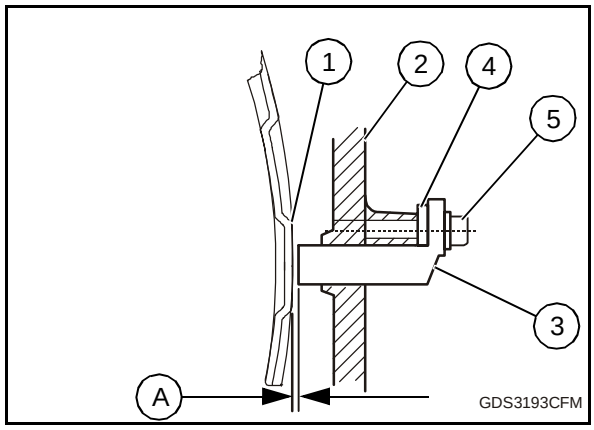
Position measurement pin (1) on pulse ring upper face and tighten set screw.



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.)

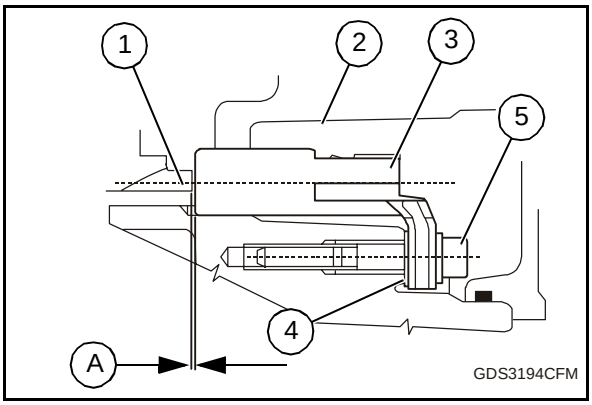
Install drain plug and fill transmission oil. **(See Change Transmission Oil in Operator's Manual CHAPTER 15, SECTION 2.)**

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Output Speed Sensor Adjustment

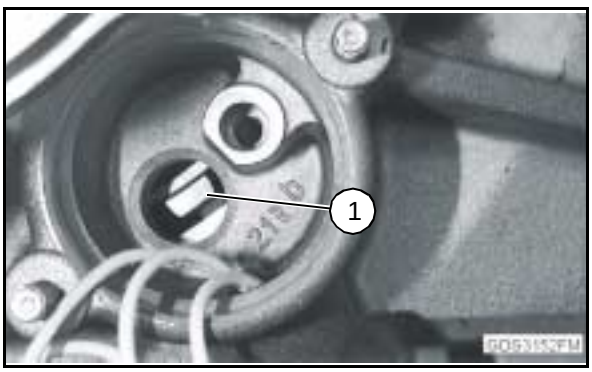


Remove cover and wire connectors (1). Wire connector location is not important.

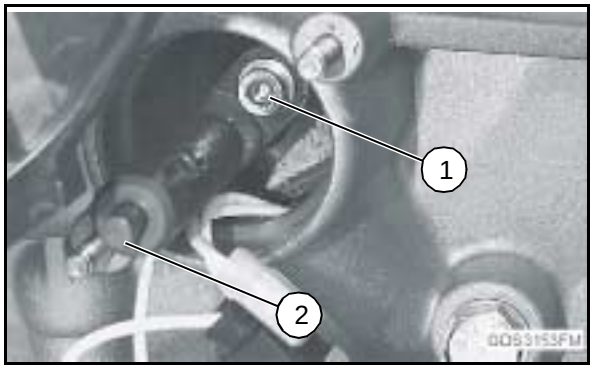


Remove output speed sensor cap screw (5).

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).**

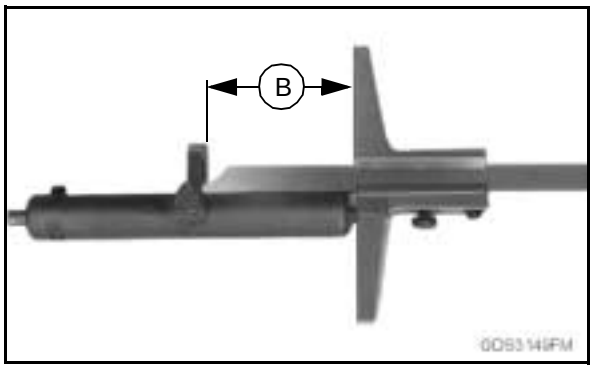


Position and install JDG1629 Sensor Depth Measuring Shaft. Tighten cap screw (1).

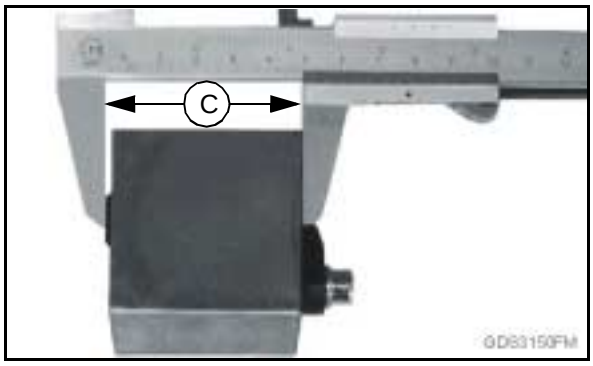
Output Speed Sensor Adjustment Specification

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.

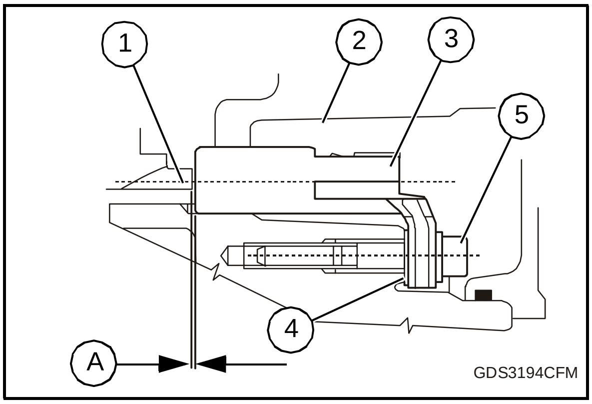


Remove measuring rod and measure distance from mounting face to measurement pin face. Note as dimension (B).



Position speed sensor in JDG1630 Sensor Length Measuring Block and measure distance from sensor sensing surface to mounting surface. Note as dimension (C).

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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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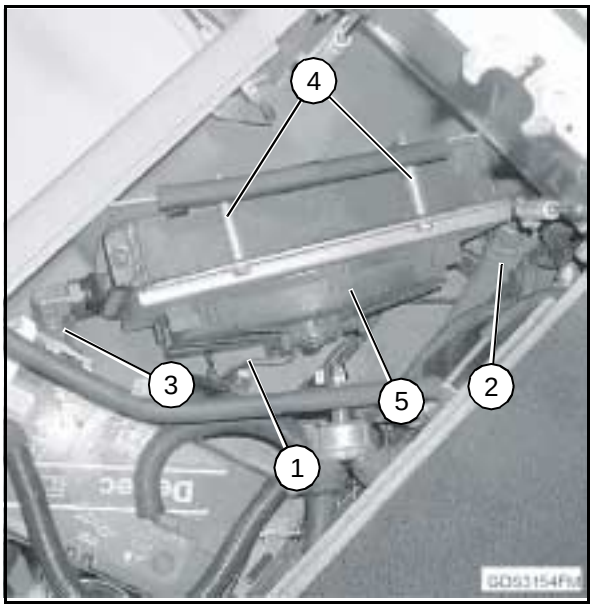
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CHAPTER 3. TRANSMISSION

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.

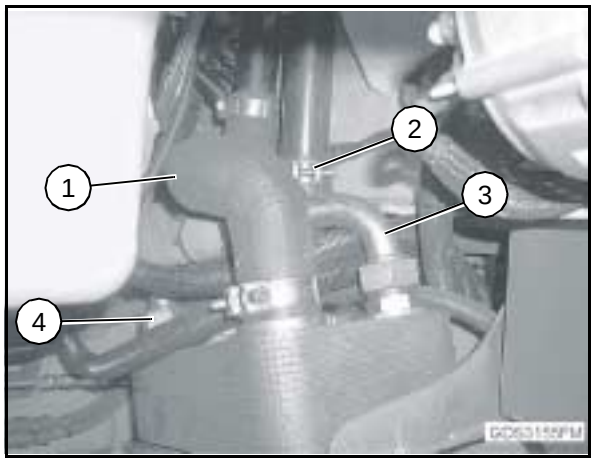
Repair or replace as required.

Install cooler and shroud using cap screws, spacers, and nuts.

Connect oil lines and wire connector.

Remove and Install Transmission Oil-to-Water Cooler

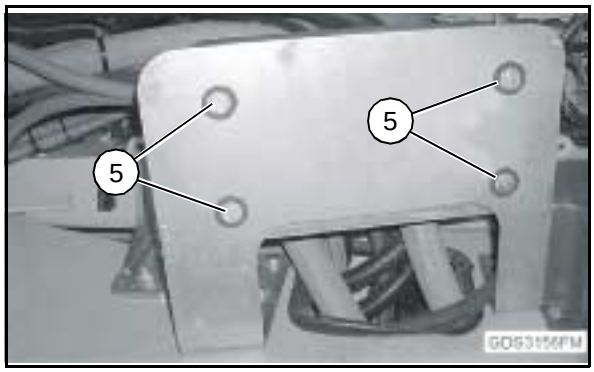
Turn battery disconnect off.



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**.

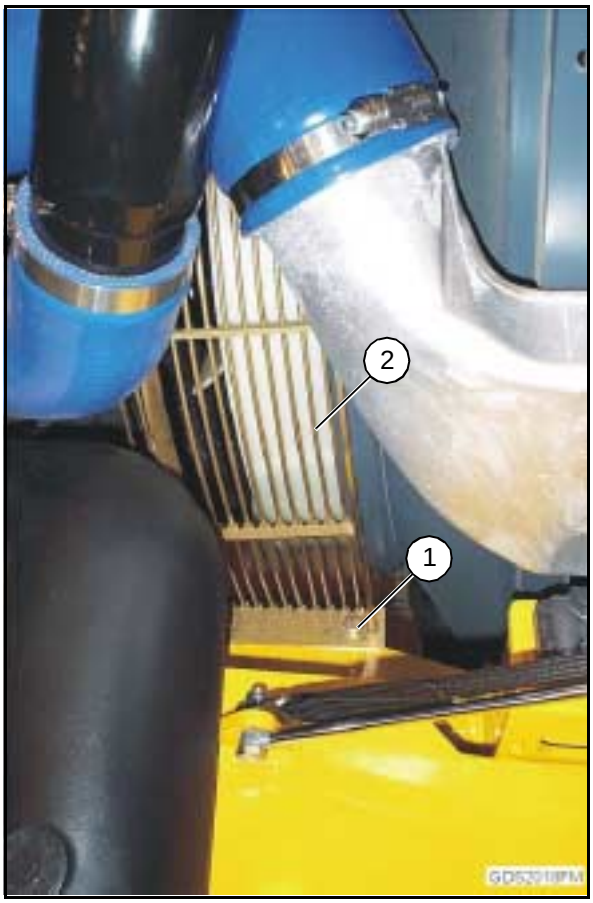
Remove hood. **(See "BONNET" on page 335)**.

Lower belly plates.

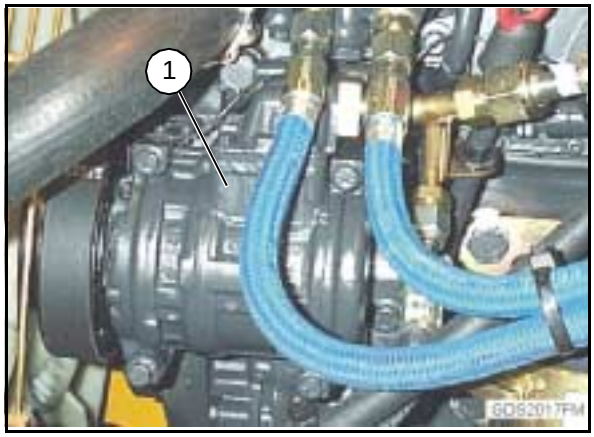
NOTE: Mark all connectors, fittings and pipes clearly for correct installation.

Disconnect all wire harnesses.

Remove charge air after cooler and radiator. **(See "Remove and Install Charge Air Aftercooler" on page 241).**



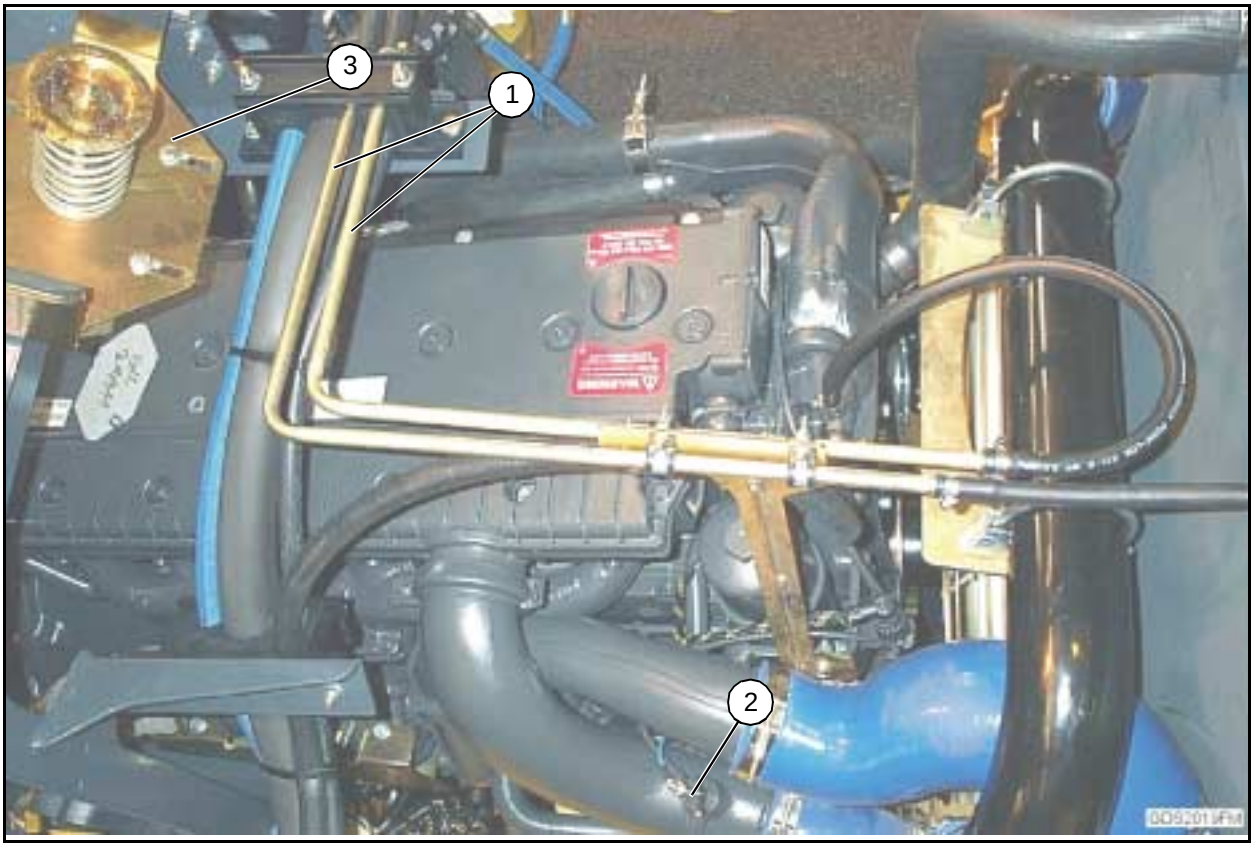
Remove bolts (1) and fan guard (2) from the left and right side.



Disconnect high and low pressure lines from air conditioner compressor (1).

Disconnect wires from starter motor, alternator and harnesses connected to the engine.

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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.

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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.

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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.

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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.

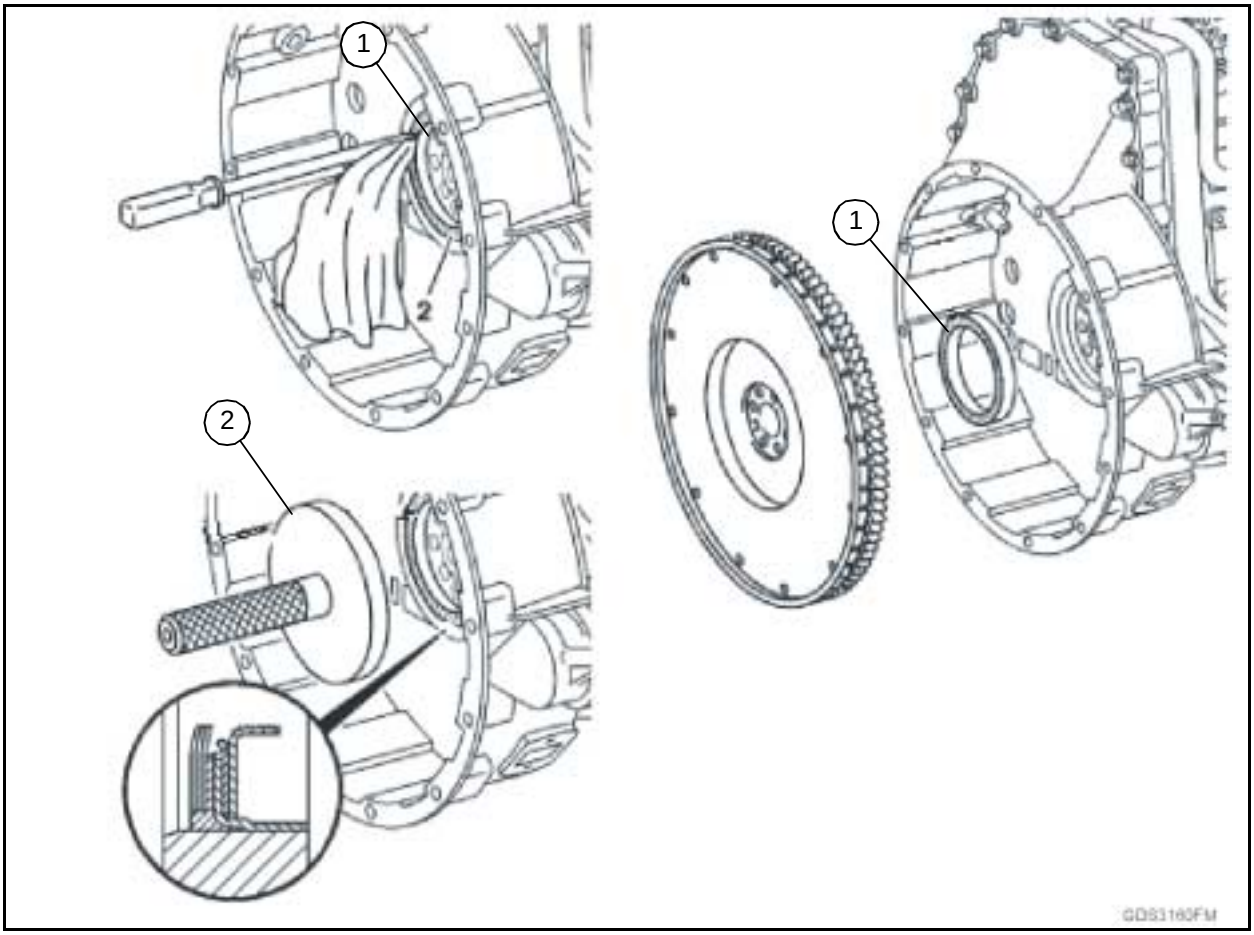
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CRANKSHAFT OIL SEALS

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.)**

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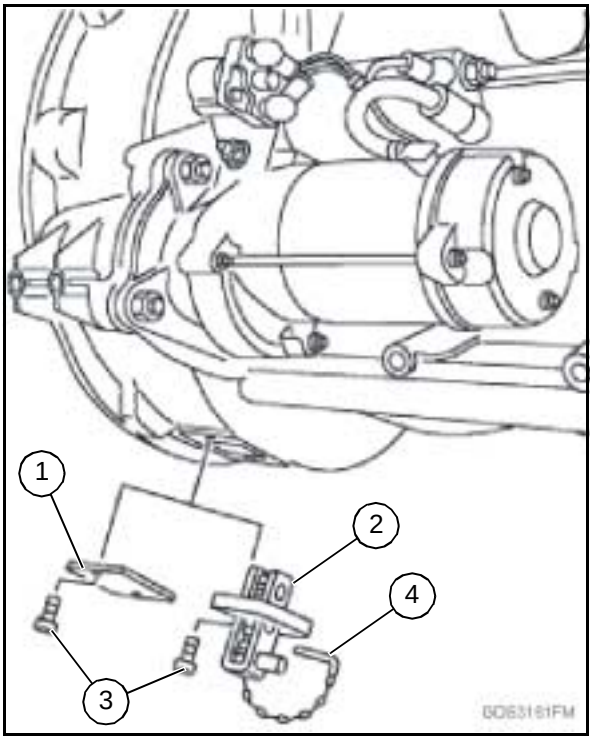
Remove and Install Belt Pulley/ Vibration Damper

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

Install Cranking Device

⚠ CAUTION

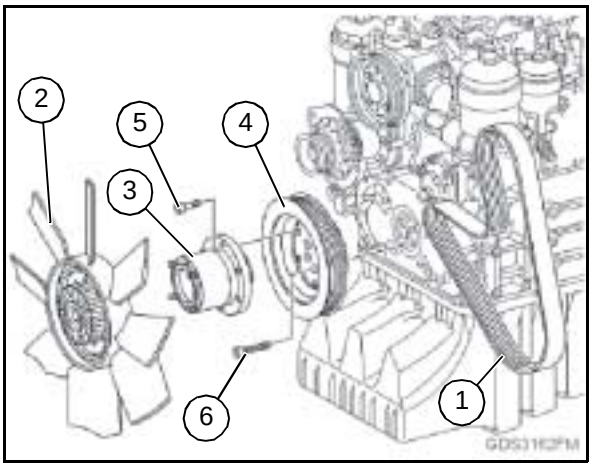
Cranking device must be removed before starting the engine.



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")

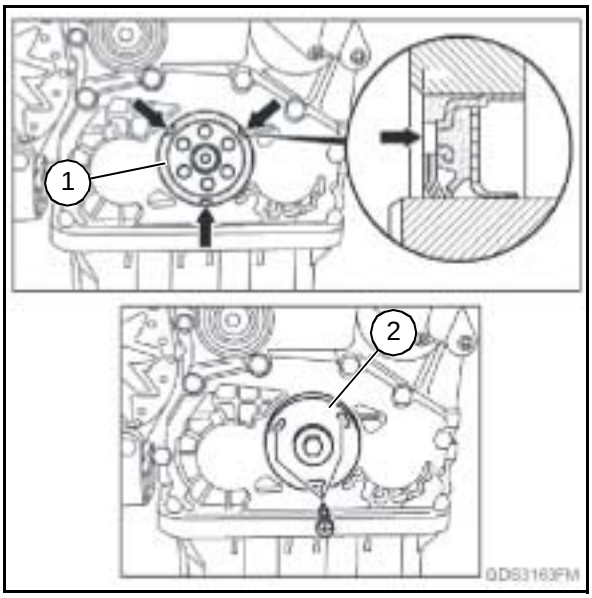
Assemble in reverse order.

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Remove and Install Front Oil Seal

Remove Front Oil Seal

Remove vibration damper **(See previous procedure).**

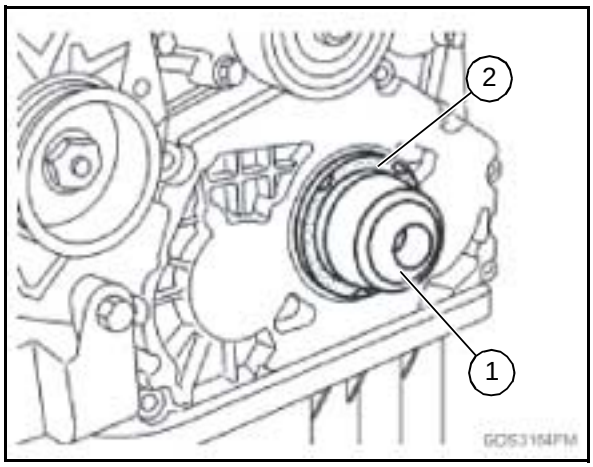


Attach puller (2) to the seal (1) with three self-tapping screws (Dia. 3.2mm).

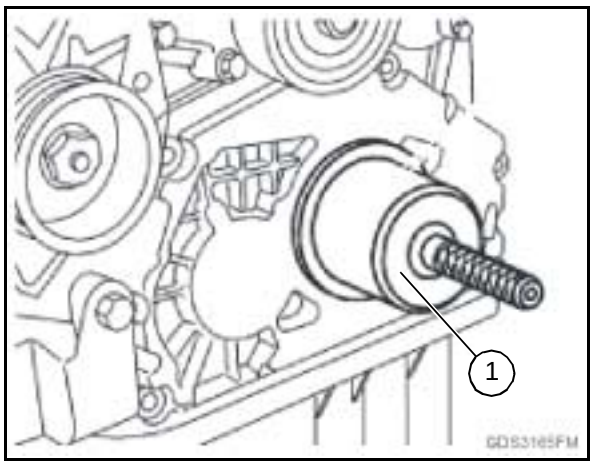
Pull seal off.

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.



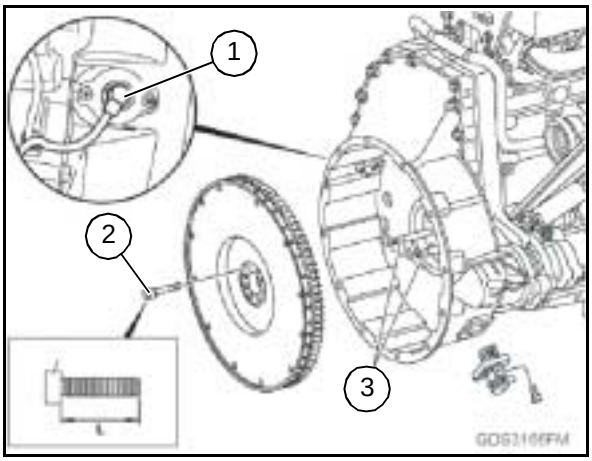
Press the seal into the oil pump with the punch (1).

Install vibration damper **(See previous procedure).**

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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.

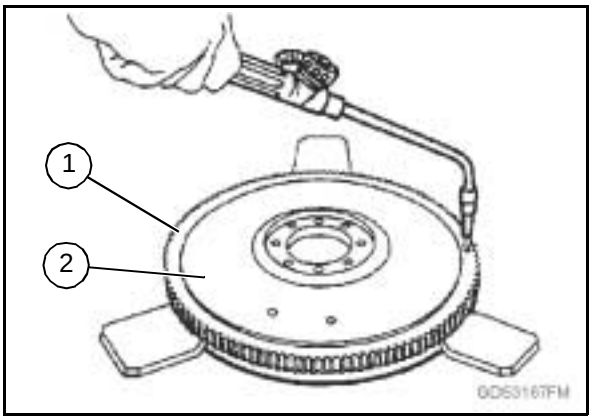
Inspect ring gear for wear.

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.

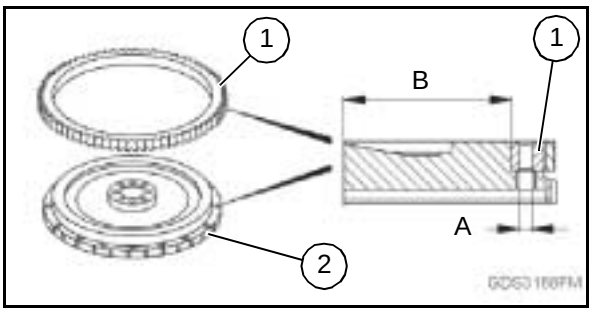
Press the ring gear (1) off the flywheel (2).

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.

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Ring Gear Specifications

Starter Ring Gear/Flywheel Permissible Runout - 0.5mm (0.020")

Starter Ring Gear Width - - - 15.6 - 16mm (0.61" - 0.63")

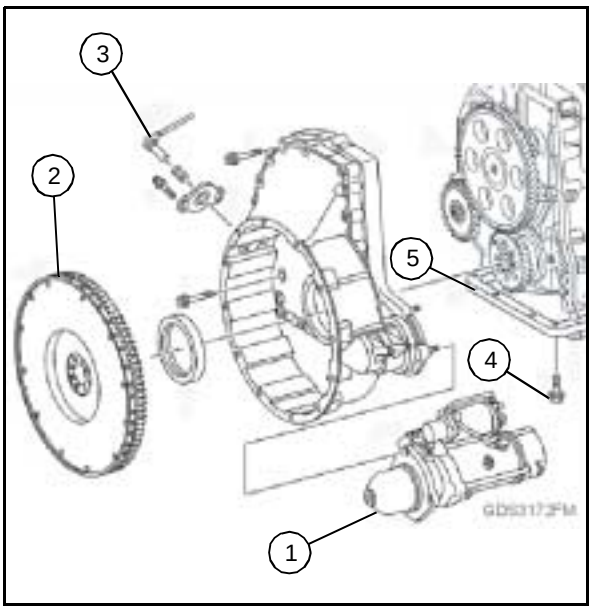
Starter Ring Gear Inner Dia. - 432 - 432.155mm (17.008 - 17.014")

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)

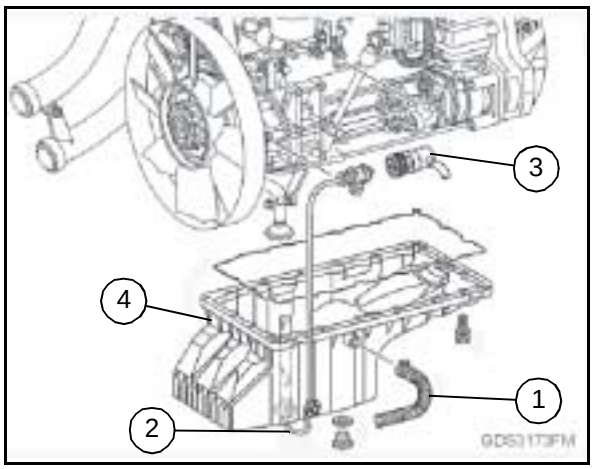
Oil pan to crankcase - - - - - - - - - - - - 25 Nm (18.5 lb-ft)

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).

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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).**

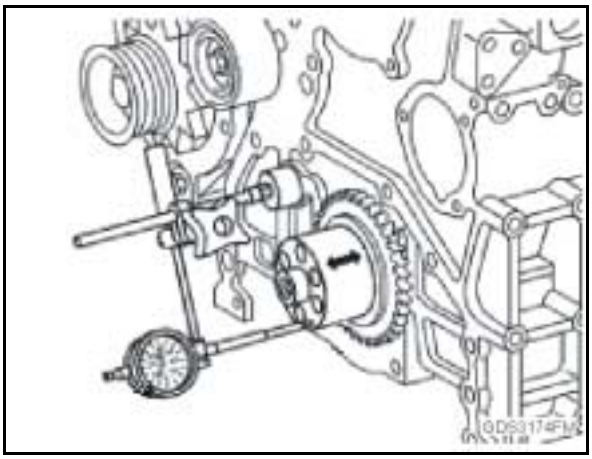
Start engine and check oil pressure with engine idling.

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.)

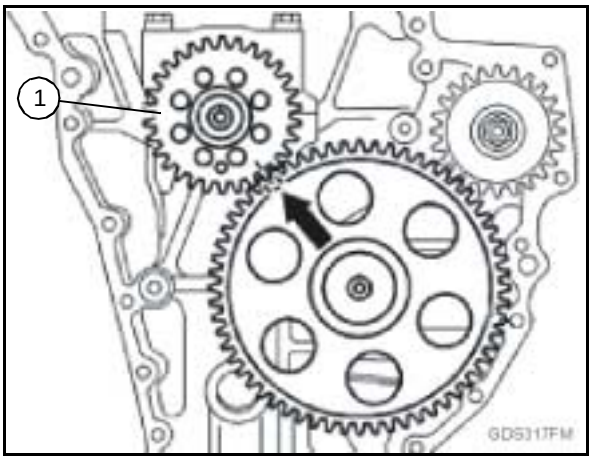
Remove Crankshaft

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).**

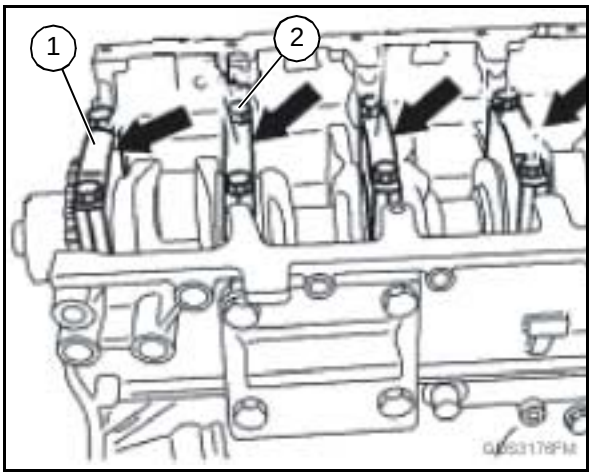
Remove oil pump. **(See "Remove Oil Pump" on page 177).**



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.

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Rotate crankshaft as required to remove connecting rod cap screws and caps.

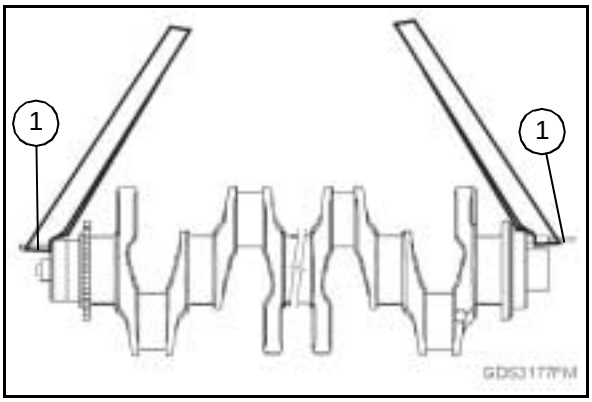
Remove main bearing lateral bolts (2).

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.

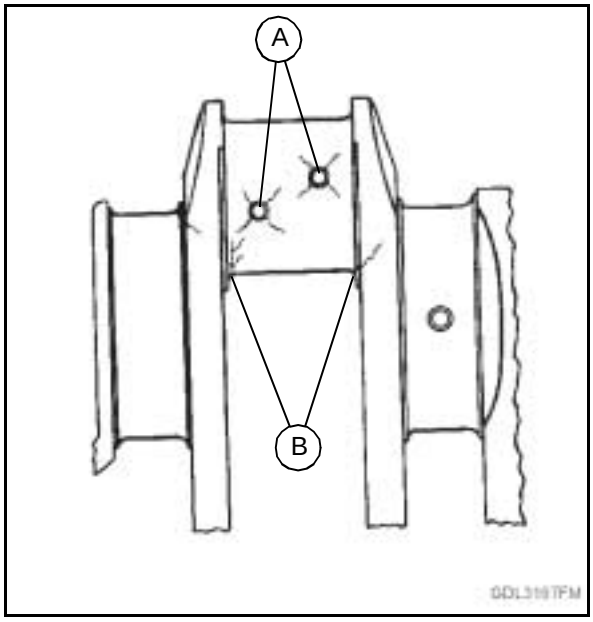
Carefully remove crankshaft from block with a hoist.

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.

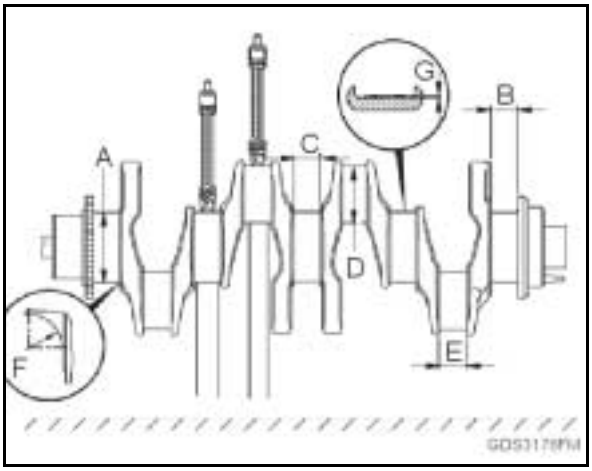
⚠ CAUTION

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.

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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.)

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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

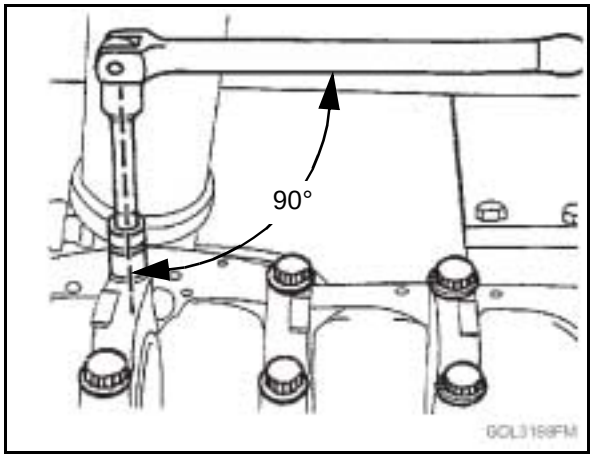
Crown

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)

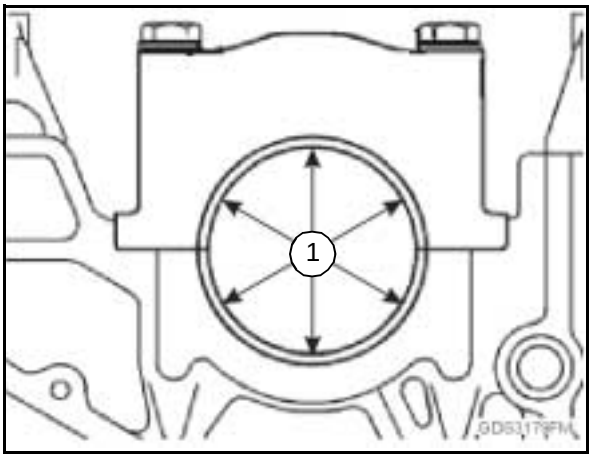
Main Bearing Cap To Crankcase Screw Torque - - - - -
2nd Stage- 80 Nm (59 lb-ft)

Main Bearing Cap To Crankcase Screw Torque - - - - -
3rd Stage - 155 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.

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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.

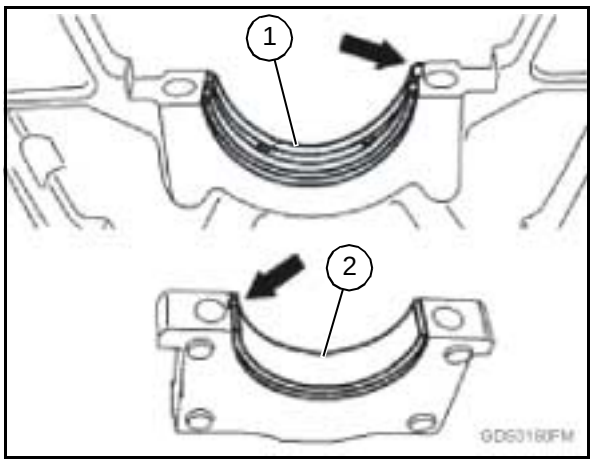
⚠ CAUTION

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.

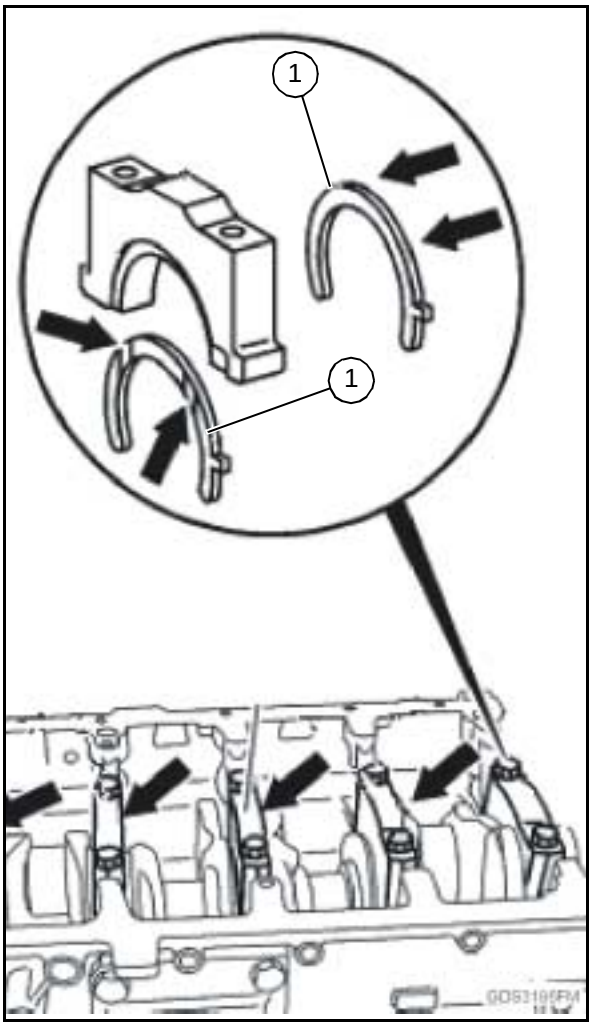
NOTE:The locking lugs (Arrow) of the crankshaft bearing shells should be located in the slots of the crankcase basicbores. Oil holes in the crankshaft bearing shells and crankcase should be aligned.



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.

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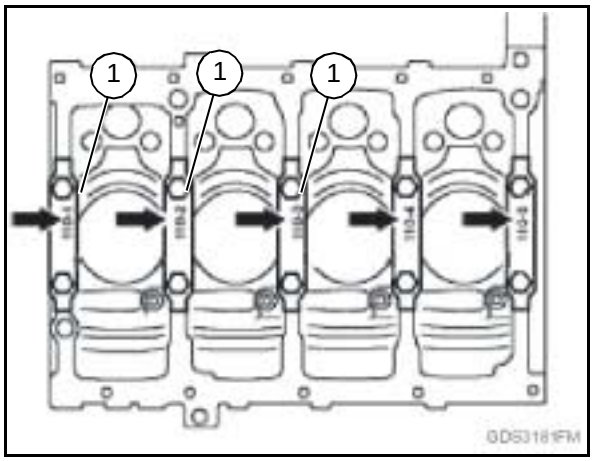
Fit bearings and thrust washers.

⚠ 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.

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GRINDING GUIDELINES

NOTE: Crankshaft grinding should be done ONLY by experienced personnel on equipment capable of maintaining crankshaft size and finish specifications.

In addition to the standard size bearings, undersize bearings are available for main bearing and rod bearing journals. **(See "Crankshaft Specification" on page 172.)**

If journals are tapered, out-of-round, scored, or damaged, grind the crankshaft and install the proper undersize bearings.

NOTE: If undersize bearings are used, check bearing clearance after bearing caps have been tightened to specified torque.
If undersize bearings are too tight and clearance is not within specifications, the journal and bearing will be wiped clean of all oil.
This would result in premature wear of parts.

If the crankshaft is to be reground, use the following recommended guidelines:

Compare the crankshaft journal measurements taken during inspection and determine the size to which the journals are to be reground.

Grind all main journals or all connecting rod journals to the specified size. **(See "Crankshaft Specification" on page 169).**

NOTE: Care must be taken to avoid localized heating which often produces grinding cracks.
Cool the crankshaft while grinding by using coolant generously. DO NOT crowd the grinding wheel into the work.
Grind crankshaft with journals turning counterclockwise, as viewed from the front end of the crankshaft. Lap or polish journals in opposite direction of grinding.

Polish or lap the ground surfaces to prevent excessive wear of the journals.

NOTE: Production crankshafts are induction hardened and shotpeened at the factory.
Field shotpeening is not recommended due to the equipment required and part geometry.
When thrust surfaces are reground and an oversized bearing is used, crankshaft end play specification must be maintained. (See "Check Crankshaft End Play" on page 169).

Stone the edge of all oil holes in the journal surfaces smooth.

When finished grinding, inspect the crankshaft for cracks with the Fluorescent Magnetic Particle method, or similar method. Demagnetize crankshaft after inspection.

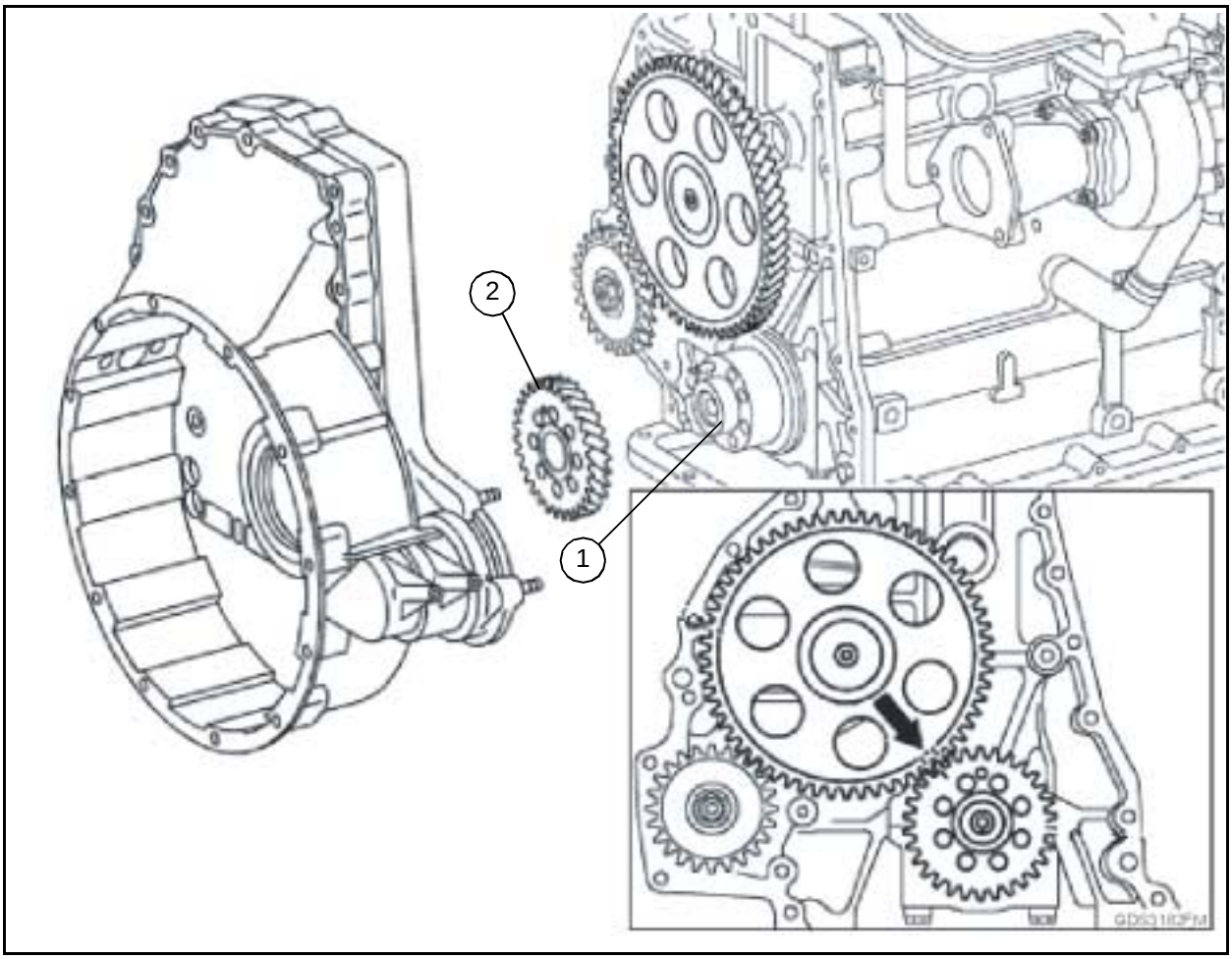
Thoroughly clean the crankshaft and oil passages using a volatile, non-petroleum base solvent. Dry the crankshaft.

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Remove and Install Crankshaft Gear

NOTE:Remove crankshaft gear only if replacement is necessary.

Remove timing case **(See “Remove and Install Timing Case” on page 168).**



Rotate crankshaft until timing marks on crankshaft gear and camshaft gear is aligned. **(See Arrow).**

Remove crankshaft gear (2) from crankshaft (1) using a suitable puller.

Install in reverse order.

⚠ CAUTION

When installing gear, do not gouge or nick crankshaft flange. Use only enough force as necessary. Excessive striking force may damage thrust bearings.

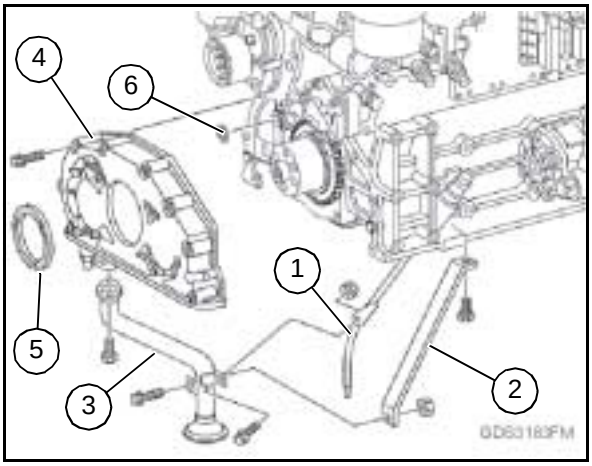
Firmly seat gear against crankshaft flange using a driver. Ensure crankshaft gear locates properly on dowel pin.

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Remove Oil Pump

Remove vibration damper. **(See "Remove and Install Belt Pulley/Vibration Damper" on page 165).**

Remove oil pan. **(See "Removing Oil Pan" on page 168).**



Take off dipstick tube (1) and bracket (2) at suction pipe (3).

Take off suction pipe (3).

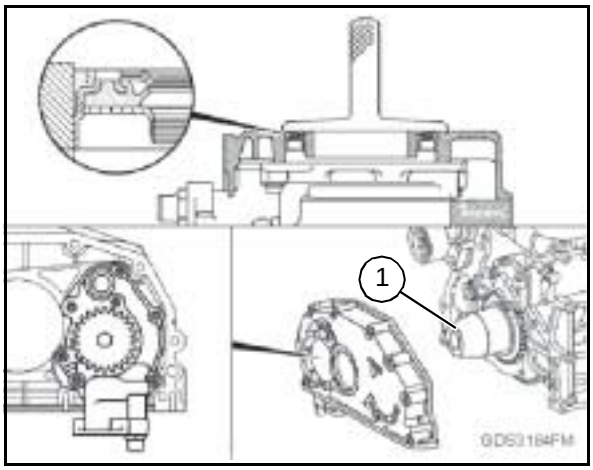
Take off oil pump (4).

Remove radial seal (5).

Remove O-ring (6).

Inspect contact surface of crankshaft for signs of scoring or rubbing.

NOTE: If wear exists, a radial seal with race has been available from about 10/ 1996 for repairs.
Use a drift to replace the radial seal as far as the stop.



Position guide sleeve (1) onto the crankshaft flange and install oil pump.

Install in reverse order.

Tighten bolts to specification.

Oil Pump Bolt Specification

Oil pump to crankcase - - - - - - - 25 Nm (18.4391 lb. ft.)

Intake pump to oil pump - - - - - - 25 Nm (18.4391 lb. ft.)

Bracket of oil pump suction pipe to crankcase - 50 Nm (36.878 lb. ft.)

BLEED ENGINE OIL CIRCUIT AFTER MAJOR OVERHAUL

⚠ CAUTION

After major overhaul of the engine, the oil circuit must be bled to ensure proper lubrication when the engine is first started.

Fill a container, that can be pressurized using a hand pump, with clean engine oil.

Remove valve cover. **(See "Removing And Installing Cylinder Head Cover" on page 201).**

Remove plug and seal from oil filter housing.

Install fitting. Adapt pump to fitting.

Pressurize container to approximately 300 kPa (3 bar) (43 psi). Open shut-off valve on container and observe rocker arms. Allow oil to flow until oil from rocker arms is free of bubbles. Maintain at least 150 kPa (1.5 bar) (22 psi) in container during bleed procedure.

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Disconnect line from oil filter base, remove adapter and install seal and plug. Tighten to specification.

Oil Filter Base Specification

Plug Torque - - - - - - - - - - - - - - - - - - 65 Nm (48 lb-in.)

Install valve covers. **(See "Removing And Installing Cylinder Head Cover" on page 201).**

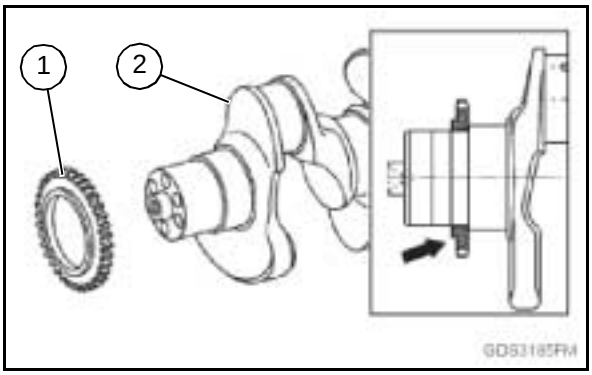
Remove And Install Drive Gear For Oil Pump On Crankshaft

Remove crankshaft. **(See "Remove Crankshaft" on page 169).**

⚠ WARNING

Risk of injury to eyes and skin from handling hot or glowing objects. Wear protective clothing.

Heat drive gear to about 200° C (392° F).



Pull drive gear (1) off crankshaft (2).

Heat new gear to about 200° C (392° F).

⚠ CAUTION

Note the position of the chamfer (arrow).

Install in reverse order.

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CHAPTER 4. ENGINE

SECTION 3. CAMSHAFT AND TIMING GEAR TRAIN

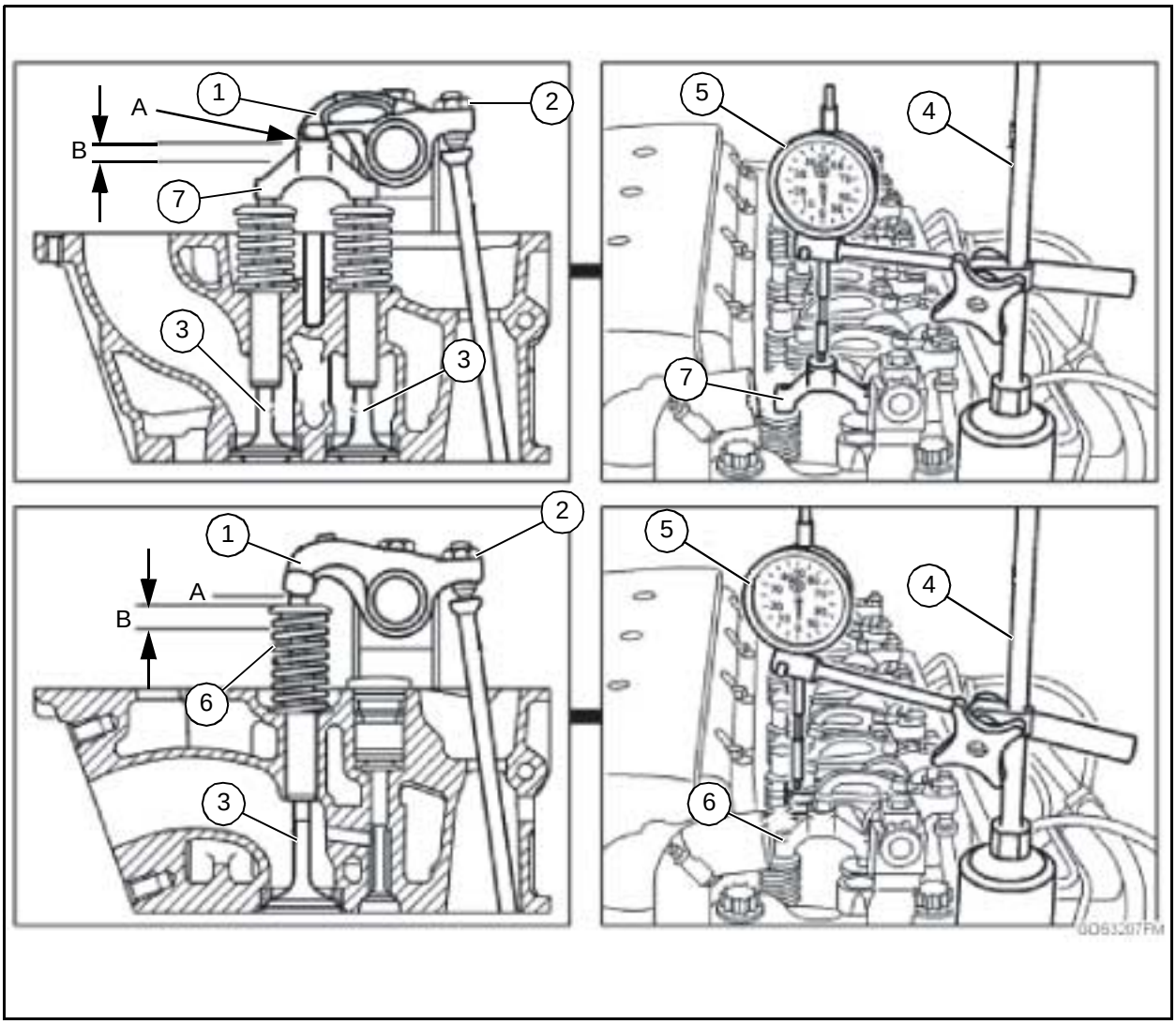
CAMSHAFT

Check Valve Lift And Valve Clearance

Remove cylinder head cover. **(See “Removing And Installing Cylinder Head Cover” on page 201).**

Install cranking and blocking device. **(See “Install Cranking Device” on page 165).**

Rotate engine with cranking device until the piston of the cylinder to be inspected is positioned at ignition TDC.



NOTE: Valve clearance checked between valve and rocker on exhaust valve and between rocker and breech on inlet valves.

Loosen lock nut (2) on rocker arm. Adjust valve clearance “A”.

Put dial indicator tip on adjusting screw as shown. Be sure that valve is fully closed.

Check pre-set on dial indicator. Set dial indicator pointer at zero.

Manually turn engine in the direction of rotation.

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Observe dial indicator reading as valve is moved to fully open position. Record reading and valve number.

Valve Lift Specification Dim. “B”

Intake Valve Lift at specified valve clearance Max. - 9.7 mm (0.382 in.)

Exhaust Valve Lift at specified valve clearance Max.- 10.7 mm (0.4213 in.)

Intake Valve Clearance - - - - - - - - -0.40 mm (0.016in.)

Exhaust Valve Clearance - - - - - - - -0.60 mm (0.024in.)

Locknut tightening torque - - - - - - - - - - 50Nm (37 lb-ft)

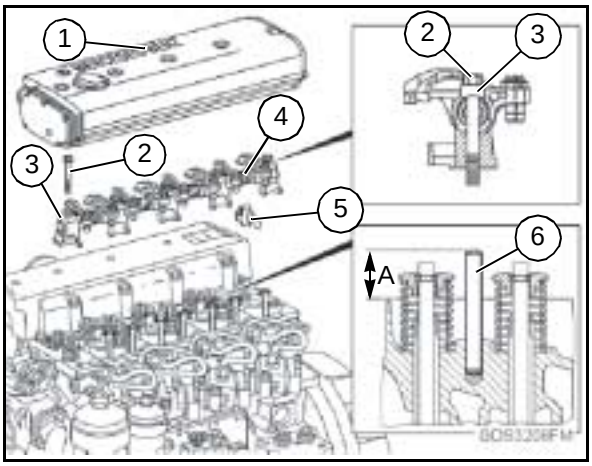
Repeat procedure on all remaining valves.

Remove cranking and blocking device.

Reassemble in reverse order.

Remove And Install Rocker Arm Asembly

Remove cylinder head cover (1). **(See “Removing And Installing Cylinder Head Cover” on page 201).**



Loosen bolts (2) and remove.

Remove clamping piece (3) and rocker arm asembly (4).

Take off valve bridges (5).

Measure projection (A) of guide bolts (6) from cylinder head. If out of specification, withdraw and replace.

Install in reverse order.

Set valve clearance.

Valve Lift Specification Dim. “B”

Valve bridge guide bolt projection A. - 25.1 - 25.5 mm (0.988 - 1.004 in.)

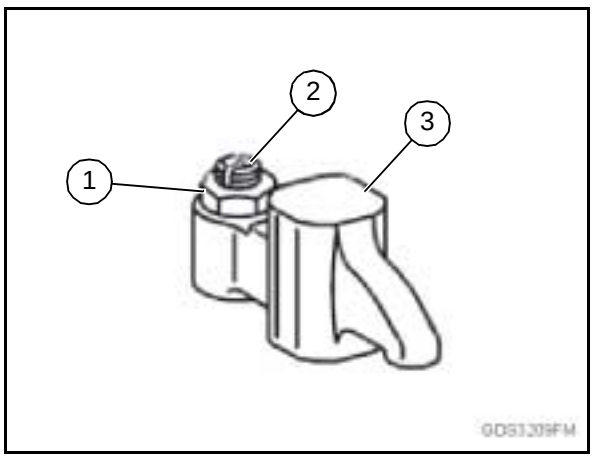
Bolt of rocker arm to cylinder head torque.- 30 Nm (22.1269 lb. ft.)

Locknut at adjusting screw of valve bridge torque- 25 Nm (18.4391 lb. ft.)

Adjusting Vavle Bridge

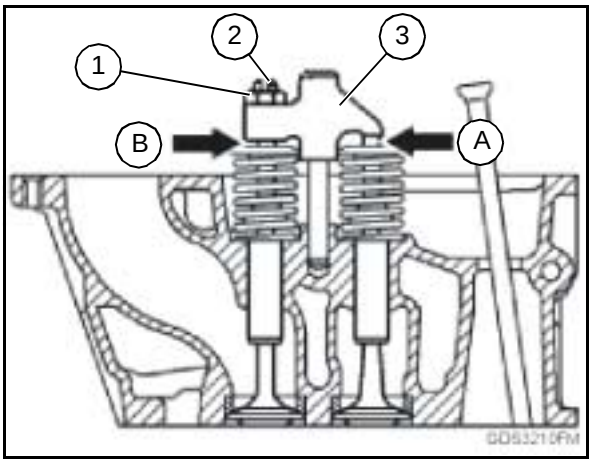
⚠ CAUTION

Setting of valve bridges (3) to be set only when engine is cold or thoroughly warmed through. Wait at least30 minutes after switching off the engine.



Clamp valve bridge (3) in a vise, slacken locking nut (1) and unscrew adjusting screw (2) about 3 turns.

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Install valve bridges (3) over bolts on the cylinder head.

Press valve bridge 93) down. Valve bridge should be making contact with valve stem (arrow A).

With valve bridge pressed down, screw in adjusting screw (2) by hand until the adjusting screw makes slight contact with the valve stem (arrow B). **Bridge must not move up.**

Screw on locking nut (1) by hand until it makes contact.

Take of valve bridges at cylinder head.

Clamp valve bridges in vice, tighten adjusting screw (2) and locking nut (1) to specified torque.

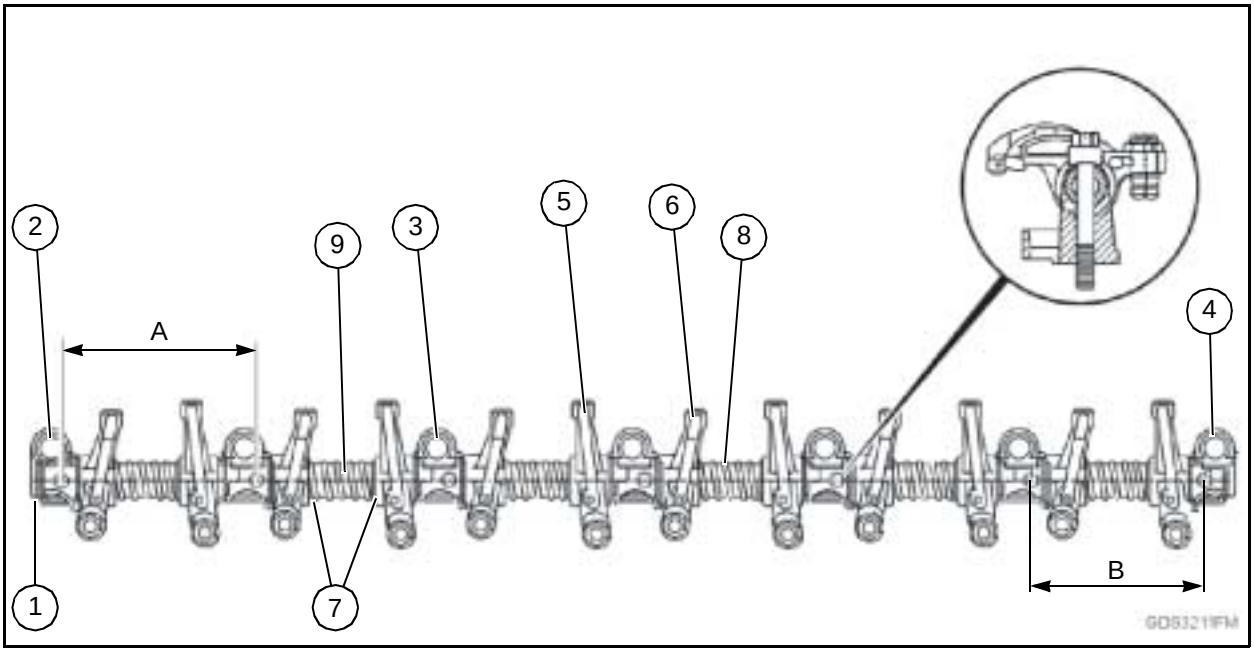
Install valve bridges over the guide bolt on the cylinder head.

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Disassembling, Assembling Rocker Arm Asembly

emove rocker arm assembly. **(See “Remove And Install Rocker Arm Asembly” on page 180).**

Disassemble rocker Arm



Remove circlips (1).

Take rocker arm brackets (2, 3 & 4), rocker arm (5 & 6), washers (7) and springs (8) off the rocker arm (9).

Inspect parts for wear, replace if necessary.

Measure rocker arm bearing bush inner dia. and rocker arm shaft dia.

Assemble in reverse order and secure with circlips.

⚠ CAUTION

Pay attention to position of outer rocket arm brackets (2 & 4) and brackets (3) and distance of holes of outer brackets.

Rocker Arm Bracket Specifications

Distance A - - - - - - - - - - - - - - - - - - 122 mm (4.803 in.)

Distance B - - - - - - - - - - - - - - - - - - 110 mm (4.331 in.)

Rocker arm bearing bush inner dia. - 22.00 - 22.021 mm (0.866 - 0.867 in.)

Rocker arm shaft dia. - 21.967 - 21.98 mm (0.8648 - 0.8654 in.)

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Remove Camshaft

Remove timing case. **(See "Remove and Install Timing Case" on page 168)**

Remove cylinder head cover. **(See "Removing And Installing Cylinder Head Cover" on page 201)**

Remove rocker arm assembly. **(See "Remove And Install Rocker Arm Asembly" on page 180).**

Pull out tappet rods.

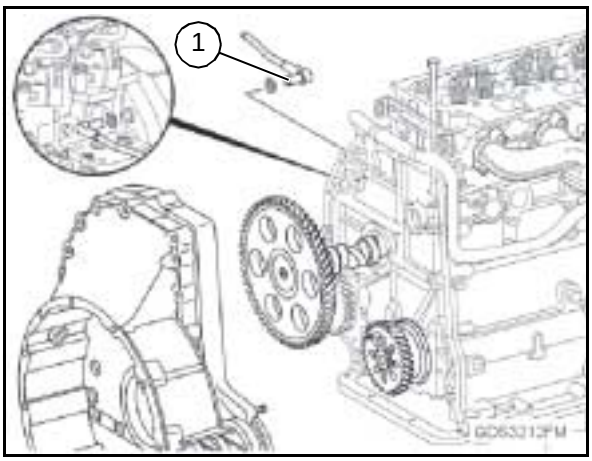
Remove fuel pump. **(See).**

Remove all unit pumps. **(See).**

Remove timing case. **(See "Remove and Install Timing Case" on page 168).**

Remove oil pan. **(See "Removing Oil Pan" on page 168).**

NOTE:Mark or identify cam followers when removing. Lifters should be installed in the same bore they were removed from.



Remove camshaft TDC sensor (1) at crankcase.

NOTE:When removing camshaft, pull straight out and hold as level as possible to avoid bearing damage.

⚠ CAUTION

Camshaft lobe edges are sharp. Wear protective gloves when handling camshaft to prevent injury to hands.

Remove camshaft out of flywheel side, guiding wear sleeve through bearings to prevent damage.

Carefully pull camshaft out of crankcase.

Remove cam followers.

Inspect cam followers for damage and wear.

Measure cam followers outer dia. and cam follower bore dia. in crankcase.

Inspect hardness, runout and cam rise of camshaft.

Install in reverse order and fill engine with oil.

Camshaft Specification

Measure	Size
Hardness of cams and bearing journals	HRc 57 - 63
Camshaft radial runout when mounted on outer bearing journals - Timing gear seat max.	0.020 mm (0.0008 in.)
Camshaft radial runout when mounted on outer bearing journals - Cam base circle max.	0.025 mm (0.001 in.)
Camshaft radial runout when mounted on outer bearing journals - Bearing point 1 - 5 max	0.030 mm (0.0012 in.)
Cam rise - valve cams over base circle dia. - inlet min.	7.3 mm (0.287 in.)
Cam rise - valve cams over base circle dia. - outlet min.	8.2 mm (0.323 in.)
Cam rise - unit pump over base circle dia.	13.8 mm (0.5433 in.)

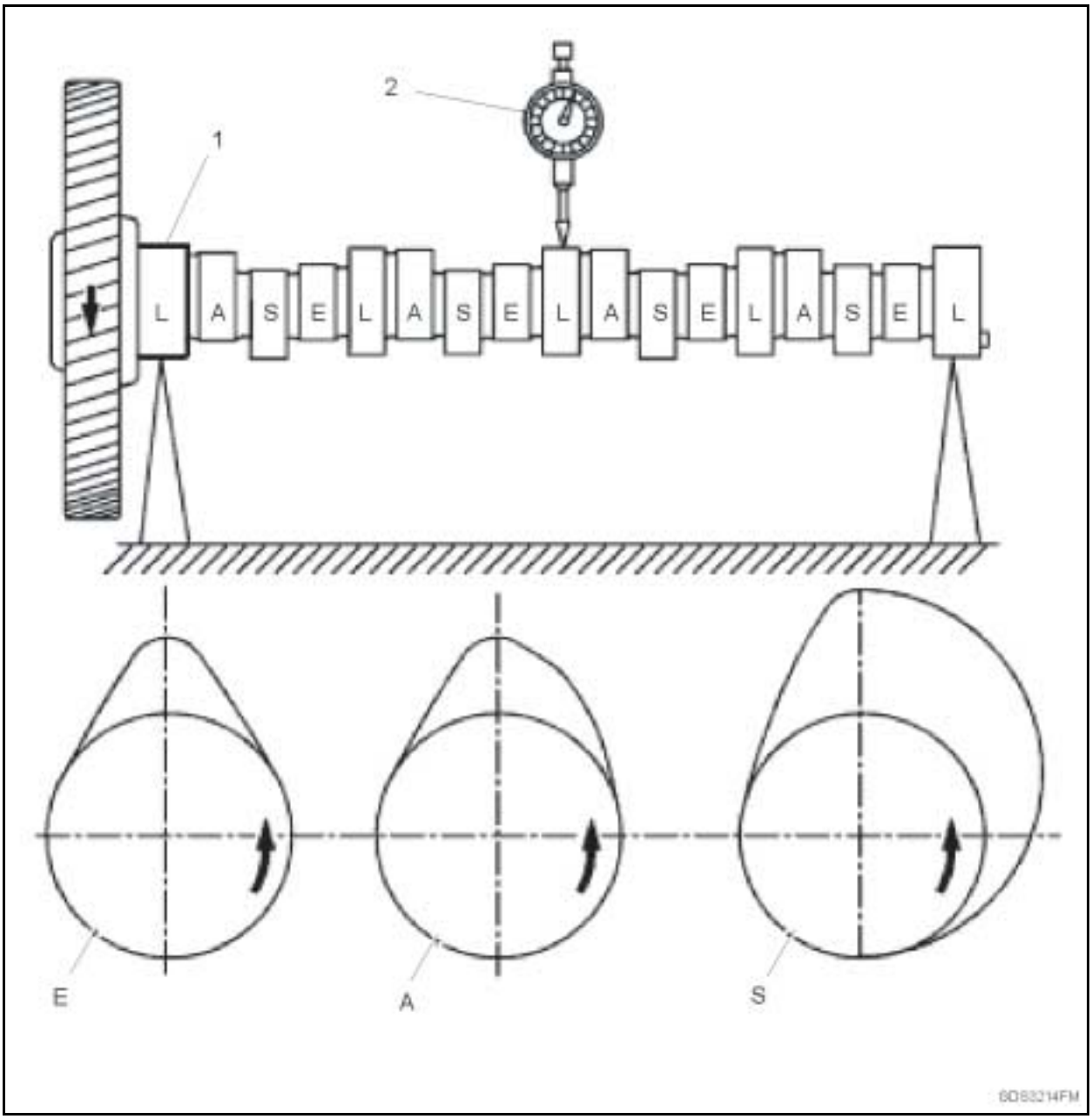
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Cam follower Specification

Measure	Size
Cam follower outer dia. - Standard	17.944 - 17.965 mm (0.7065 - 0.7073 in.)
Cam follower outer dia. - Oversize 0.25	18.194 - 18.215 mm (0.7163 - 0.7171 in.)
Camm follower bore in crankcase - Standard	18.000 - 18.018 mm (0.7087 - 0.7094 in.)
Camm follower bore in crankcase - Oversize 0.25	18.250 - 18.268 mm (0.7185 - 0.7192 in.)

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Inspect Camshaft

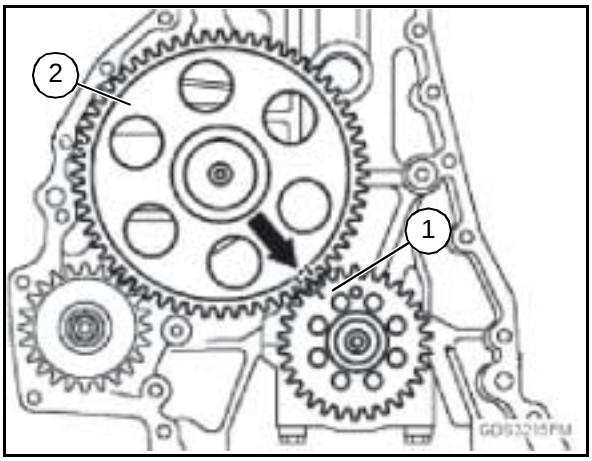


- A = Exhaust
- S = Unit pump cams
- L = Bearing points
- E = Inlet

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Install Camshaft

Turn engine in the direction of rotation until the No. 1 cylinder is at TDC on the compression stroke so timing marks on crankshaft gear and camshaft gear can be aligned.



Turn engine in the direction of rotation until the timing marks on the crankshaft gear (1) align with the timing marks on camshaft drive gear (2).

⚠ CAUTION

1. When installing camshaft, hold as level as possible and slowly slide through bores to avoid bearing damage.
2. Camshaft lobe edges are sharp. Wear protective gloves when handling camshaft to prevent injury to hands.

Align timing marks on camshaft drive gear (2) and crankshaft gear (1).

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CHAPTER 4. ENGINE

SECTION 4. CYLINDER BLOCK, LINERS, PISTONS AND CONNECTING RODS

LINER, PISTON AND ROD ANALYSIS

Scuffed or Scored Pistons

- Overheating.
- Overfueling.
- Insufficient lubrication.
- Insufficient cooling.
- Improper piston-to-liner clearance.
- Coolant leakage into crankcase.
- Misaligned or bent connecting rod.
- Improperly installed piston.
- Low oil level.
- Improper operation.
- Incorrect connecting rod bearing clearance.
- Carbon build-up in ring groove.
- Improper engine break-in.
- Worn piston.
- Contaminated oil.
- Distorted cylinder liner.
- Plugged piston cooling orifice.
- Ingestion of dust through air intake.

Worn or Broken Compression Rings

- Insufficient lubrication.
- Insufficient cooling.
- Improper ring installation.
- Improper timing.
- Abrasives in combustion chamber.

Clogged Oil Control Ring

- Improper oil.
- Excessive blow-by.
- Contaminated oil.
- Improper periodic service.
- Low operating temperature.

Stuck Rings

- Improper oil classification.
- Improper periodic service.
- Poor operating conditions.
- Coolant leakage into crankcase.
- Excessive cylinder liner taper.

Mottled, Grayish or Pitted Compression Rings

- Internal coolant leaks.

Dull Satin Finish and Fine Vertical Scratches on Rings

- Dirt and abrasives in air intake system.

Piston Pin and Snap Ring Failure

- Misaligned connecting rod.
- Excessive crankshaft end play.
- Incorrect snap rings.

Broken Connecting Rod

- Inadequate piston-to-liner clearance.
- Worn connecting rod bearing.
- Distorted cylinder line.
- Piston pin failure.

Cylinder Liner Wear and Distortion

- Incorrectly installed compression rings.
- Insufficient lubrication.
- Uneven cooling around liner.
- Inadequate piston-to-liner clearance.
- Liner bore damage.

Warped Cylinder Block

- Insufficient cooling.

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Pistons and Connecting Rods

Remove Pistons and Connecting Rods

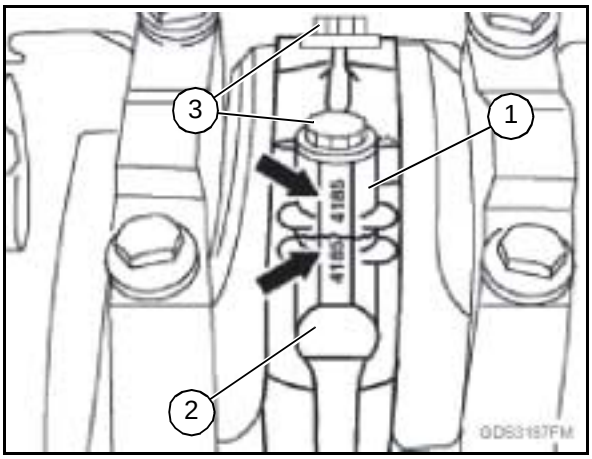
Remove cylinder head. **(See "Cylinder Head" on page 206).**

Remove oil pan. **(See "Removing Oil Pan" on page 168).**

Remove any ridges from top of liner bores with a scraper or ridge reamer before removing pistons.

⚠ CAUTION

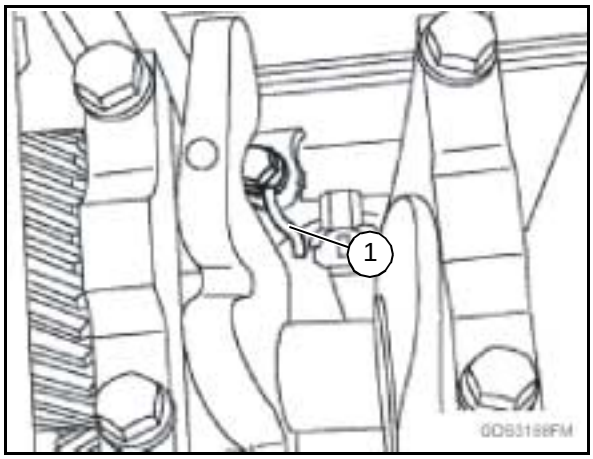
Make sure connecting rods and caps are marked before removing caps.



Note stamped numbers of connecting rod cap (1) and connecting rod (2).

Remove cap screws (3) from connecting rod and cap.

Remove connecting rod caps and cap bearings from crankshaft. Keep bearings with their respective caps.



Mark piston and rod to ensure they are installed in the same location as removed.

⚠ CAUTION

When removing piston and rod, be careful not to damage piston cooling nozzles (1).

Rotating engine as required, gently tap piston and rod through top of cylinder block, holding rod to avoid scratching liner.

Disassemble Pistons and Connecting Rods

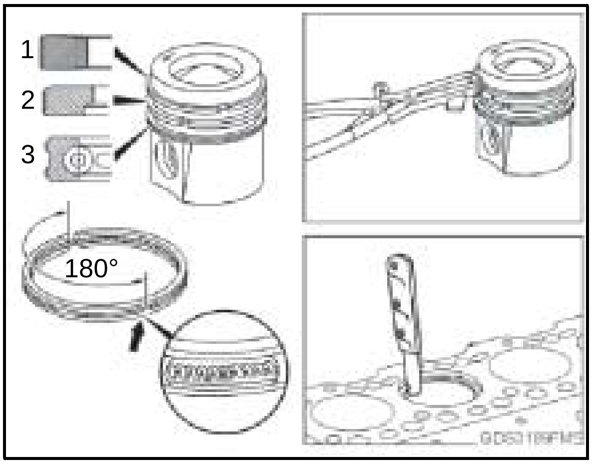


Remove piston snap rings. Remove piston pin and connecting rod from piston.

Discard snap rings, DO NOT re-use.

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Remove And Install Piston Rings



Remove piston rings (1, 2 and 3) in order from top to bottom.

Measure piston ring gap clearance of piston rings (1 & 2).

If checking rings to determine cause of engine trouble, ring end gap should be as follows:

Pistons and Connecting Rods Specification

No. 1 Piston Compression Ring End Gap - 0.35 - 0.55 mm (0.0138 - 0.0217 in.) new

No. 1 Piston Compression Ring End Gap - - - - - - - - - - - - - - - - - - -1.0 mm (0.039 in.) repair limit

No. 2 Piston Compression Ring End Gap - - - - - - - - - - - -0.40 - 0.6 mm (0.0157 - 0.0236 in.)new

No. 2 Piston Compression Ring End Gap - - - - - - - - - - - - - - - - - - -1.0 mm (0.039 in.) repair limit

No. 3 Piston Oil Ring End Gap - - - - - - - - - - - -0.25 - 0.5 mm (0.0098 - 0.0197 in.)new

No. 3 Piston Oil Ring End Gap - 1 mm (0.039 in.) repair limit

Remove piston rings using the JDG1500-31 Piston Ring Pliers. Discard all rings.

Measure and Inspect Connecting Rod

Inspect rod and bearings for damage or wear. If any blueing or discoloration is present rod should be discarded.

⚠ CAUTION

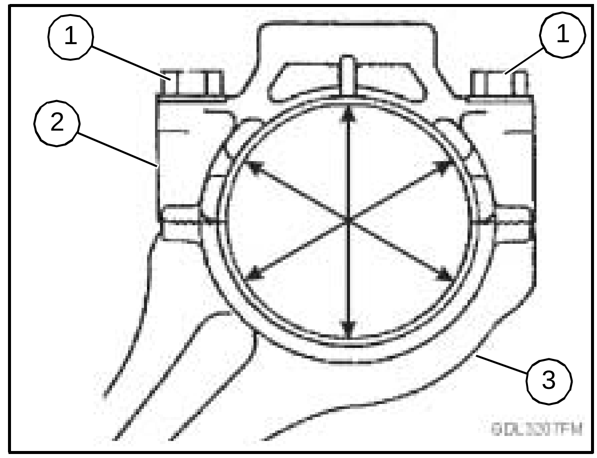
Never use new connecting rod cap screws when checking rod bearing ID. Use new cap screws only for final assembly of connecting rods.

Measure con rod bush. If dimension exceeded specification, replace con rod.

Conrod Bush Specification

Conrod bush inner dia. - 40.03 - 40.04 mm (1.576 - 1.5764 in.)

Conrod Bearing



Install connecting rod cap (2) on to connecting rod (3) with bearings in correct position using cap screws (1).

Tighten cap screws.

Using an inside micrometer measure rod ID at three places as shown. Compare measurements to specifications.

Conrod Bearing Inner Diameter

Measure	Size
Standard	70.054 - 70.093 mm (2.758 - 2.7596 in.)
Undersize -0.25mm (0.010”)	69.804 - 69.843 mm (2.7482 - 2.7497 in.)
Undersize -0.5mm (0.020”)	69.554 - 69.593 mm (2.7383 - 2.740 in.)
Undersize -0.75mm (0.030”)	69.304 - 69.343 mm (2.7285 - 2.7300 in.)
Undersize -1.0mm (0.040”)	69.054 - 69.093 mm (2.7187 - 2.7202 in.)

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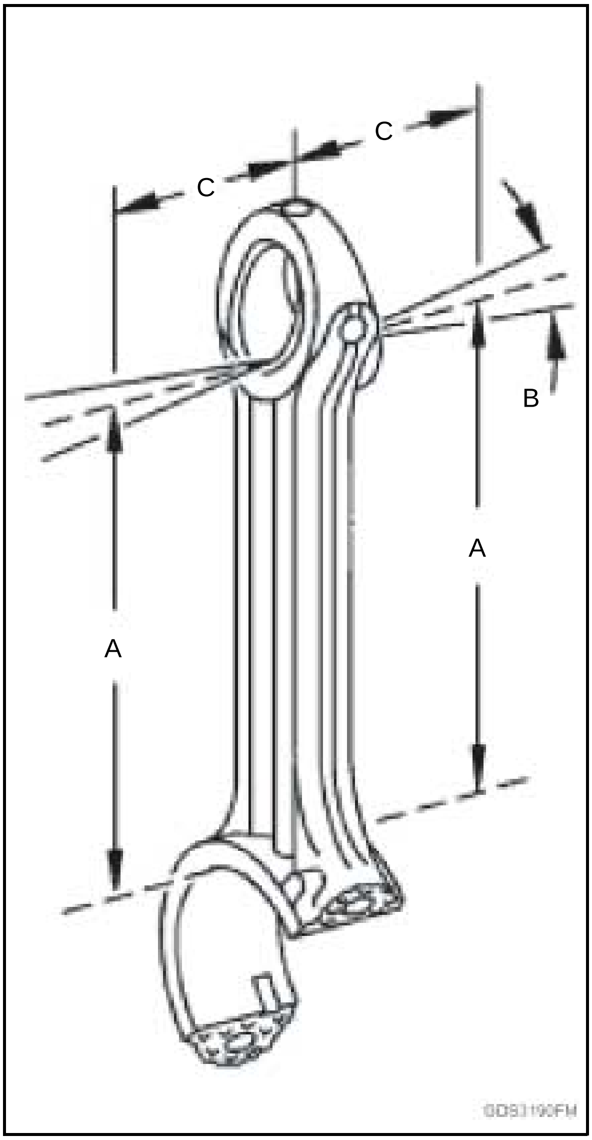
Basic Bore For Conrod Bearings

Measure	Size
	75.000 - 75.019 mm (2.9528 - 2.9525 in.)

Conrod Bearing Play

Measure	Size
Radial	0.039 - 0.098 mm (0.0015 - 0.0039 in.)
Axial	0.170 - 0.470 mm (0.0067 - 0.0185 in.)

Dimension "A"



Measure Dim. A both sides.

Dimension "A" Specification

Distance "A" - 157.445 - 157.510 mm (6.1986 - 6.2012 in.)

Measure permissible difference (dim.) of axial parallelism between conrod bearing seat and conrod bush inner diameter at distance "C".

If ot of specification, **DO NOT** straighten conrod - **Replace**. **(See specification below).**

Parallelism Between Conrod Bearing And Conrod Bush Over A Distance Of 50mm (2").

Measure	Size
Max	0.025 mm (0.004 in.)

Conrod Out of roundness

Measure	Size
Bearing dia.	0.008 mm (0.0003 in.)
Bush dia.	0.006 mm (0.0002 in.)

Conrod Width

Measure	Size
	33.730 - 34.830 mm (1.328 - 1.371in.)

Conrod Bolt

Measure	Size
Thread dia.	M12 x 1.25
Shank lenth new	56 mm (2.2047 in.)
Shank lenth max.	57 mm (2.2441 in.)

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Clean Piston

⚠ CAUTION

Always follow manufacturer's instructions and safety steps exactly.



Clean piston ring grooves using a piston ring groove cleaning tool.

⚠ CAUTION

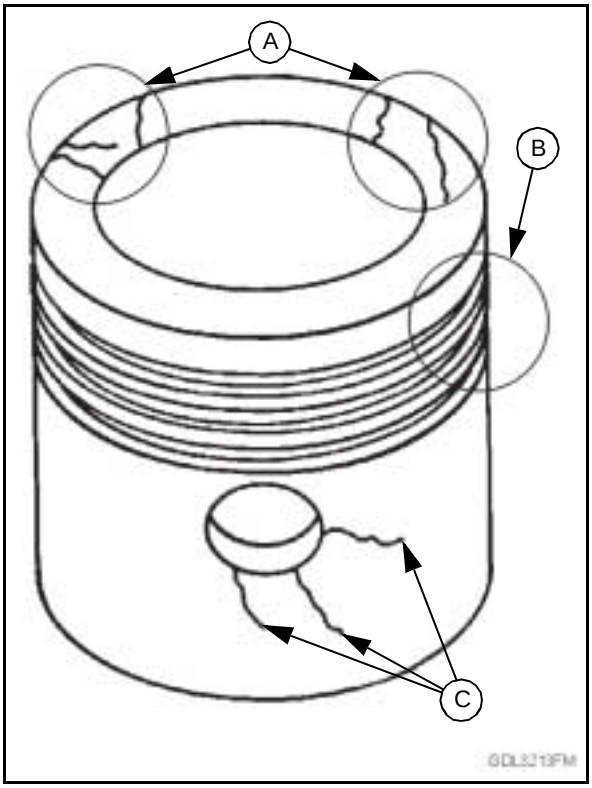
When washing pistons, always use a stiff bristle brush - NOT A WIRE BRUSH - to loosen carbon residue. DO NOT bead blast ring groove areas.

Clean pistons by any of the following methods:

- Chemical soaking following the manufacturer's instructions.
- Glass bead cleaning following the manufacturer's instructions.
- Hot water with liquid detergent soap.

If cleaning with hot water and liquid detergent, soak pistons in a 50 percent solution of liquid household detergent and hot water for 30 to 60 minutes. Use a stiff bristle brush - NOT A WIRE BRUSH - to loosen carbon residue. Thoroughly dry the pistons.

Visually Inspect Piston



Carefully inspect pistons under magnification. Check for:

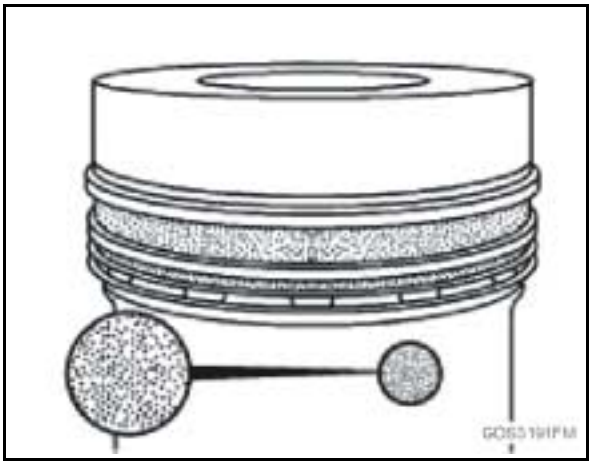
- Signs of fatigue.
- Fine cracks in the piston head (A).
- Bent or broken ring lands (B).
- Cracks in the skirt (C) at inner and outer ends of piston pin bore.
- Excessive piston skirt wear. (Original machining marks must be visible.)

If any imperfections are found, replace the piston and liner as a set.

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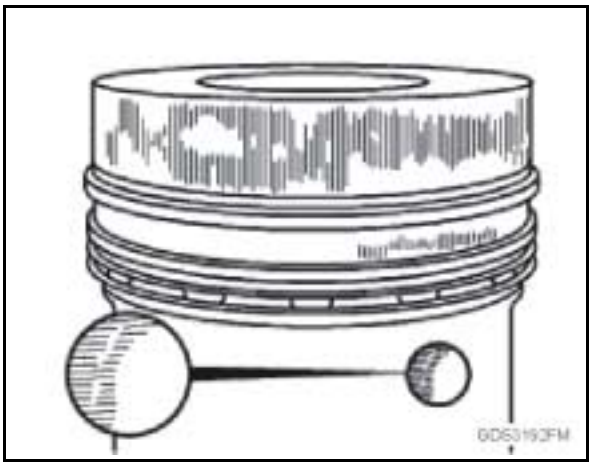
Piston Without Dust Damage

NOTE:The machining grooves at the circumference are intentional recesses which are filled with oil and contribute to better lubrication.



The contact surface of the piston stem is visible over a large area and the machining grooves can still be recognized within this area.

Piston With Dust Damage



The contact surface of the piston stem has a mat (pumiced) appearance and the machining grooves are completely worn away within the contact surface.

In the advanced stage of wear, slight traces of seizure are already present on the stem and the piston rings are sharp-edged.

Assign Pistons To Cylinder Bore



Tolerance Group Markings On Pistons

Measure	Size
Piston dia. Group BA	101.781 - 101.790 mm (4.0071 - 4.0075in.)
Piston dia. Group BC	101.790 - 101.799 mm (4.0075 - 4.0078in.)
Piston Comp. Height Standard Group 102 BA	64.360 - 64.40 mm (2.5339 - 2.5354 in.)
Piston Comp. Height Standard Group 102 BC	64.360 - 64.40 mm (2.5339 - 2.5354 in.)
Piston Comp. Height Undersize I Group 102 BA -0.3	64.06 - 64.10 mm (2.5220 - 2.5236 in.)
Piston Comp. Height Undersize I Group 102 BC -0.3	64.06 - 64.10 mm (2.5220 - 2.5236 in.)
Piston Comp. Height Undersize II Group 102 BA -0.6	63.76 - 63.80 mm (2.5102 - 2.5118 in.)
Piston Comp. Height Undersize II Group 102 BC -0.6	63.76 - 63.80 mm (2.5102 - 2.5118 in.)
Piston Comp. Height Undersize III Group 102 BA -0.9	63.46 - 63.50 mm (2.4984 - 2.5 in.)
Piston Comp. Height Undersize III Group 102 BC -0.9	63.46 - 63.50 mm (2.4984 - 2.5 in.)

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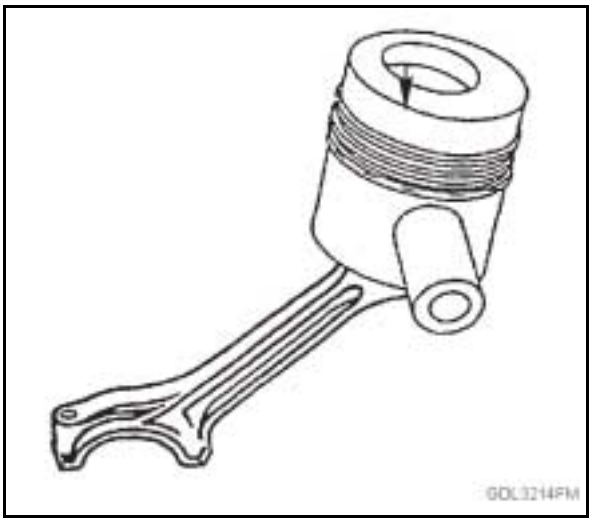
Pistons marked “AB” to be used in cylinders “A” or ”B” and pistons marked “CD” in cylinders “B” or “C”

Assemble Piston and Connecting Rod

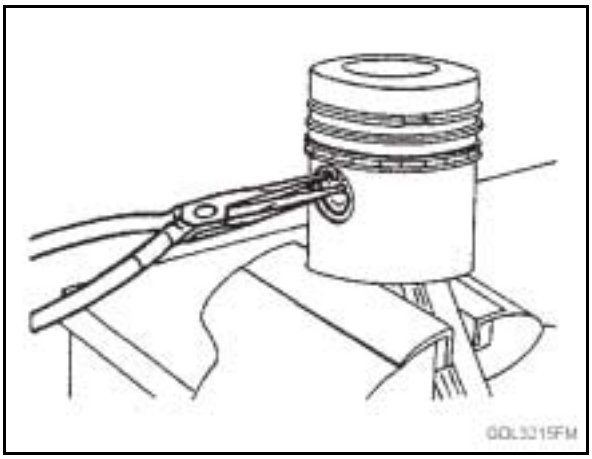
⚠ CAUTION

1. Pistons must be installed on same connecting rods from which they were removed.
2. New piston pin snap rings must be used.

Apply clean engine oil to piston pins.

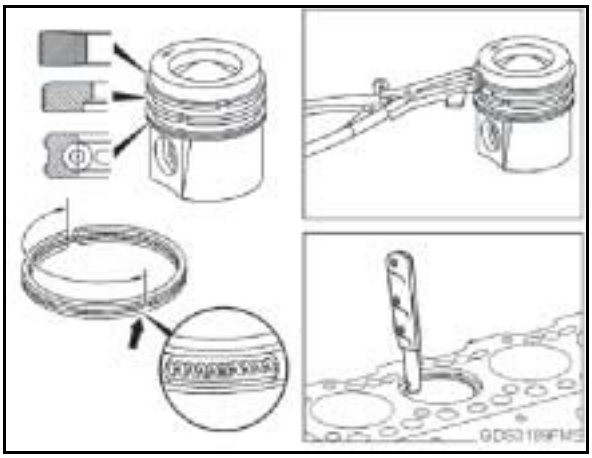


Install pistons on connecting rods. Arrow or triangle should point to the flywheel.



Install piston pins using new retaining rings.

NOTE: If old rings were not removed, ensure rings are clean before reinstalling piston, especially center piston ring.



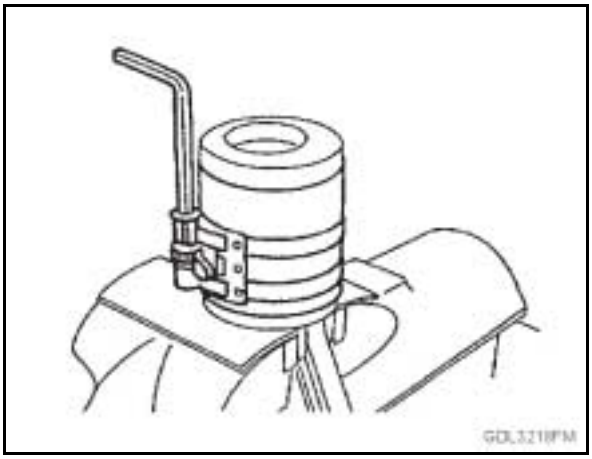
Install new rings into cylinder and check ring end gap using a feeler gauge. **(See “Remove And Install Piston Rings” on page 189).**

Apply clean engine oil to rings and install piston rings on piston using JDG1500-31 Piston Ring Pliers.

Install piston rings in proper grooves as called out in figure. Stagger ring gaps 120°.

Install Piston-conrod assemblies

Check that ring gaps are ofset by 120°.



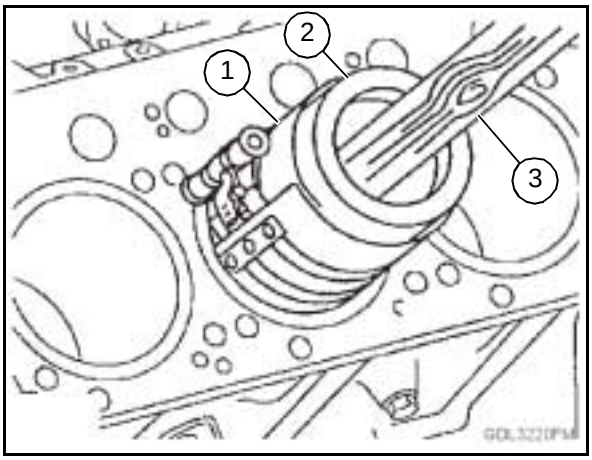
Fit tensioning strap onto piston.

Apply clean engine oil to piston, ID of liner and piston ring compressor. Install ring compressor on piston tight enough to where ring compressor can just be shifted on piston.

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⚠ CAUTION

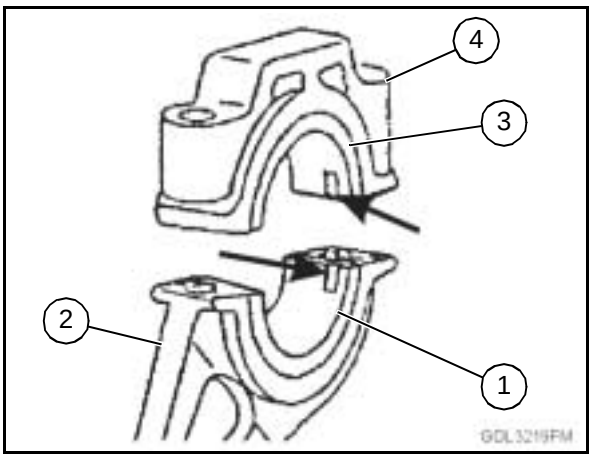
Piston and liners have code letters stamped on them. All pistons will not fit all liners. Check code stampings before installing pistons in liners. (See "Cylinder Liners Specification" on page 198).



Apply clean engine oil to piston rings and inside of ring compressor (1). Use a piston ring compressor to compress rings into ring grooves.

Install piston and rod into liner with the arrow or triangle pointing towards the flywheel. Do not let rod drag on liner or hit piston cooling nozzles when being installed.

Tap piston (2) into liner using a wooden dowel (3), rotating crankshaft as required until connecting rod bearing is resting on journal of crankshaft. Remove piston ring compressor.



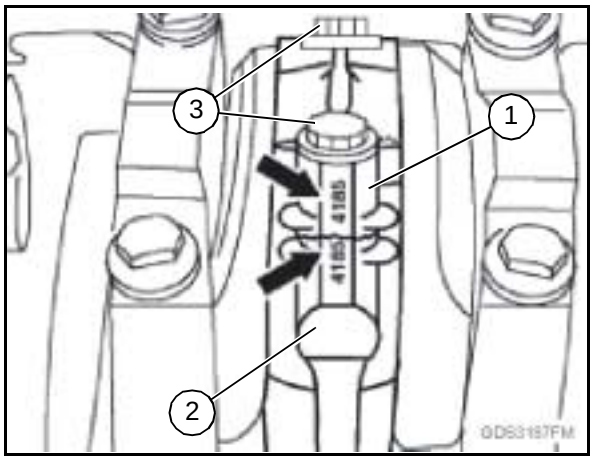
Install bearings (1 and 3) in connecting rod (2) and cap (4). Make sure that tabs (arrows) on bearings are properly seated in rod and cap recess.

⚠ WARNING

Connecting rod cap screws are stretched when tightened to specification. Cap screws are usable up to a maximum shank length of 68.5 mm (2.69 in.) measured from the end of cap screw to the bottom of cap screw head. If any cap screw is at or longer than the specification, replace both cap screws for the that bearing cap.

Measure the shank length of connecting rod cap screws from the end of cap screw to the bottom of cap screw head. Replace both cap screws for that bearing cap if either cap screw is at or longer than the specification.

Oil the running surface of bearing and install bearing into rod cap, ensuring tab on bearing is properly seated in recess of rod.



Install cap on connecting rod ensuring stamped number on connecting rod cap (1) and stamped number on connecting rod (2) are towards the same side as shown.

Dip cap screws (3) into clean engine oil fully coating threads.

Install cap screws (3) and tighten to specification.

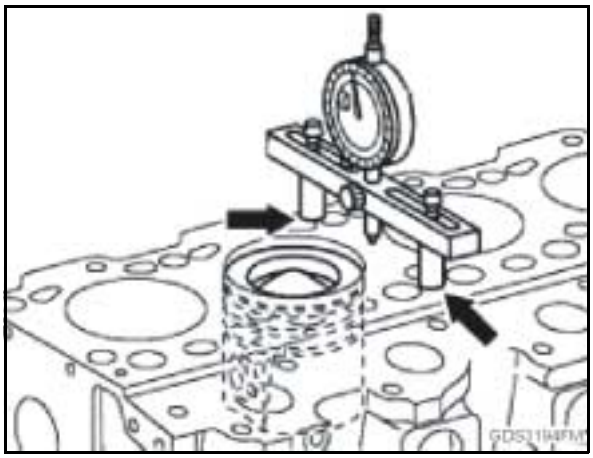
Pistons and Connecting Rods Specification

Connecting Rod Cap Screw First Stage Torque	10 Nm (7.3756 lb-ft)
Connecting Rod Cap Screw Second Stage Torque	45 Nm (33.1903 lb-ft)
Connecting Rod Cap Screw Final Stage Torque	Turn 90°

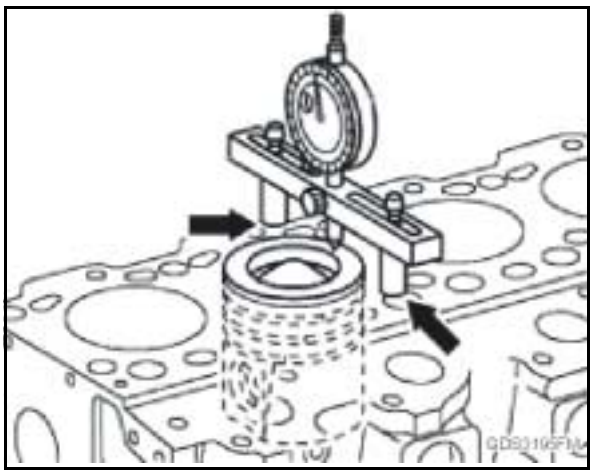
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Measure Piston Projection

NOTE:This measurement must be taken without cylinder head gasket.



Rotate crankshaft until the piston to be measured is about 5° before TDC. Zero the dial gauge on the crankcase top and move it over the cylinder.



Rotate crankshaft until piston is at TDC. The reading obtained is the piston projection. Compair with specification. **(See "Tolerance Group Markings On Pistons" on page 192).**

Cylinder Liners

Remove cylinder head. **(See "Remove Cylinder Head" on page 206).**

Clean area around top of cylinder liner and crankcase.

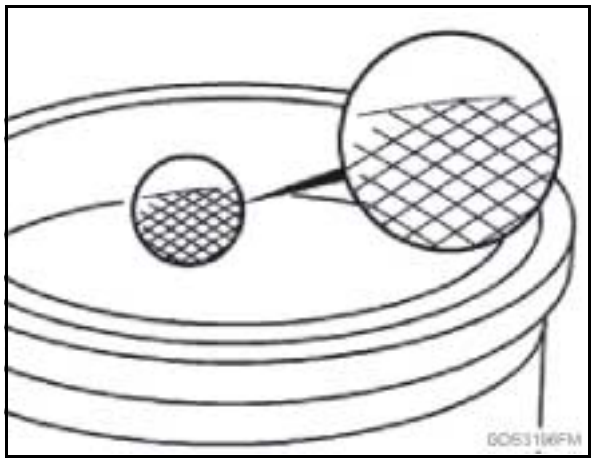
Remove pistons. **(See "Remove Pistons and Connecting Rods" on page 188).**

Visually Inspect Cylinder Walls

Clean cylinder liners.

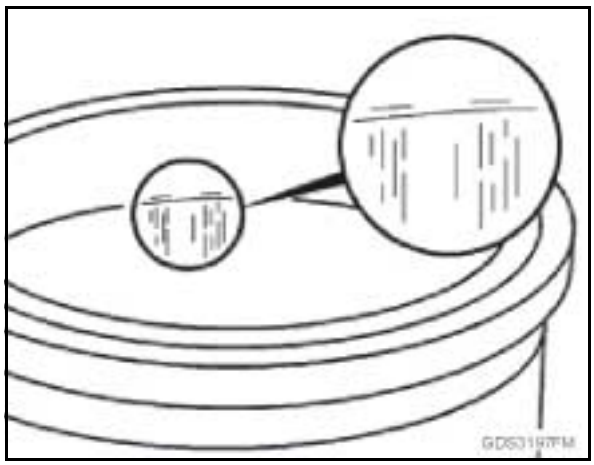
NOTE:1. Dust damage is caused by poor sealing, splits, chafing damage of the intake lines, seals and hoses.
2. When carring out repair and service work, make a careful inspection of intake lines, seals and hoses, also at points not easily accessible.

Cylinder Walls And Cylinder Liners Without Dust Damage



The honing is more or less clearly visible on the entire contact surface. The honing may be partially worn at the reversal point of the first piston ring.

Cylinder Walls And Cylinder Liners With Dust Damage



The traces of machining from honing are only very faintly visible or not at all. If the wear is well advanced, a wear step can be felt at the reversal point of the first piston ring.

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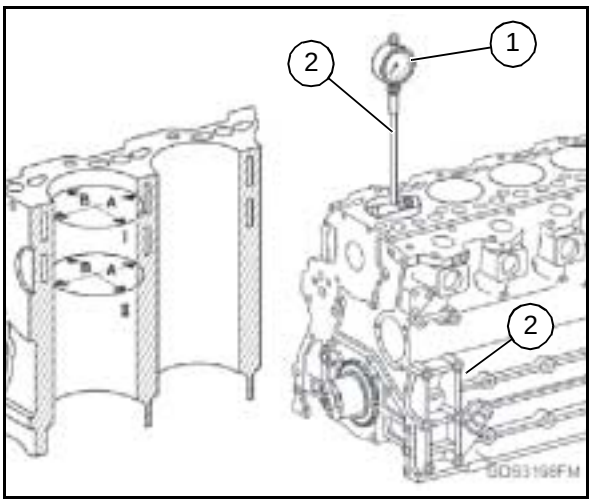
Measure Cylinder Bores

Remove cylinder head. **(See).**

Turn crankshaft until piston is at BDC.

Clean cylinder walls.

Inspect cylinder walls. **(See “Visually Inspect Cylinder Walls” on page 195).**



Measure wear of liner with a dial gauge (1) and quick calipers (2) at points (I & II) in direction “A” and “B”.

Compair to specification.

Cylinder Liner Dia. Specification

Measure	Size
Cylinder liner inner dia. Group A	101.985 - 101.991 mm (4.0152 - 4.0154in.)
Cylinder liner inner dia. Group B	101.790 - 102.799 mm (4.0075 - 4.0472in.)
Cylinder liner inner dia. Group C	102.360 - 102.40 mm (4.0299 - 4.0315 in.)
Difference in shape of cylinder wall	0.012 mm (0.0005 in.)
Wear to cylinder wall or cylindeer liner measured in direction of travel and transverse direction.	0.05 mm (0.002 in.)

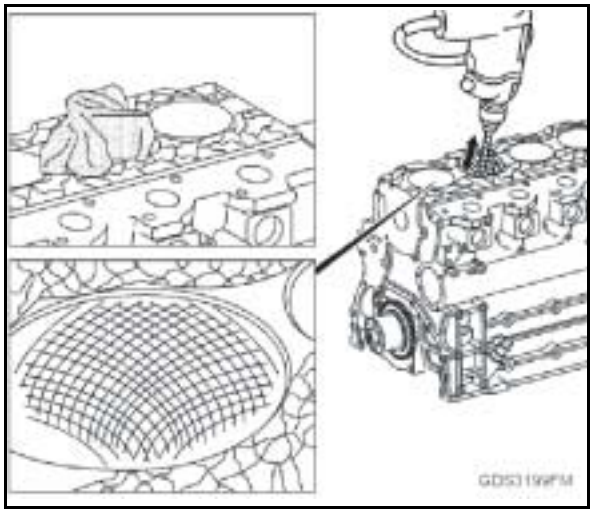
Flex-honing Cylinder Wall

Remove pistons. **(See “Remove Pistons and Connecting Rods” on page 188).**

Measure cylinder bores.

Mask over crankcase contact surface and other openings.

Insert pieces of foam through the cylinder walls over the crankshaft and bearings for protection against grinding residues.



Clamp honing brush into hand drill. Immerse honing brush in lubricant. (Use honing oil, viscous engine oil or diesel as lubricant).

Insert honing brush into cylinder bore to be machined.

Move honing brush evenly up and down while drill is running not higher than 200 r.p.m.

Change direction on drill as soon as honing brush protrudes about 1/4at top of crankcase.

Take out honing brush and inspect surface. Am for a 45° patternand a mat appearance. If surface is glossy, repeat honing.

Remove pieces of foam and grinding residues.

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⚠ WARNING

Do not use gasoline, kerosene, or commercial solvent to clean liners. Solvents will not remove all the abrasives from liner walls.

Thoroughly clean liner ID with a 50 percent solution of hot water and liquid detergent.

Rinse thoroughly and wipe dry with a clean rag.

Swab out liner as many times as necessary with clean 10W engine oil.

Clean liner until a white rag shows no discoloration.

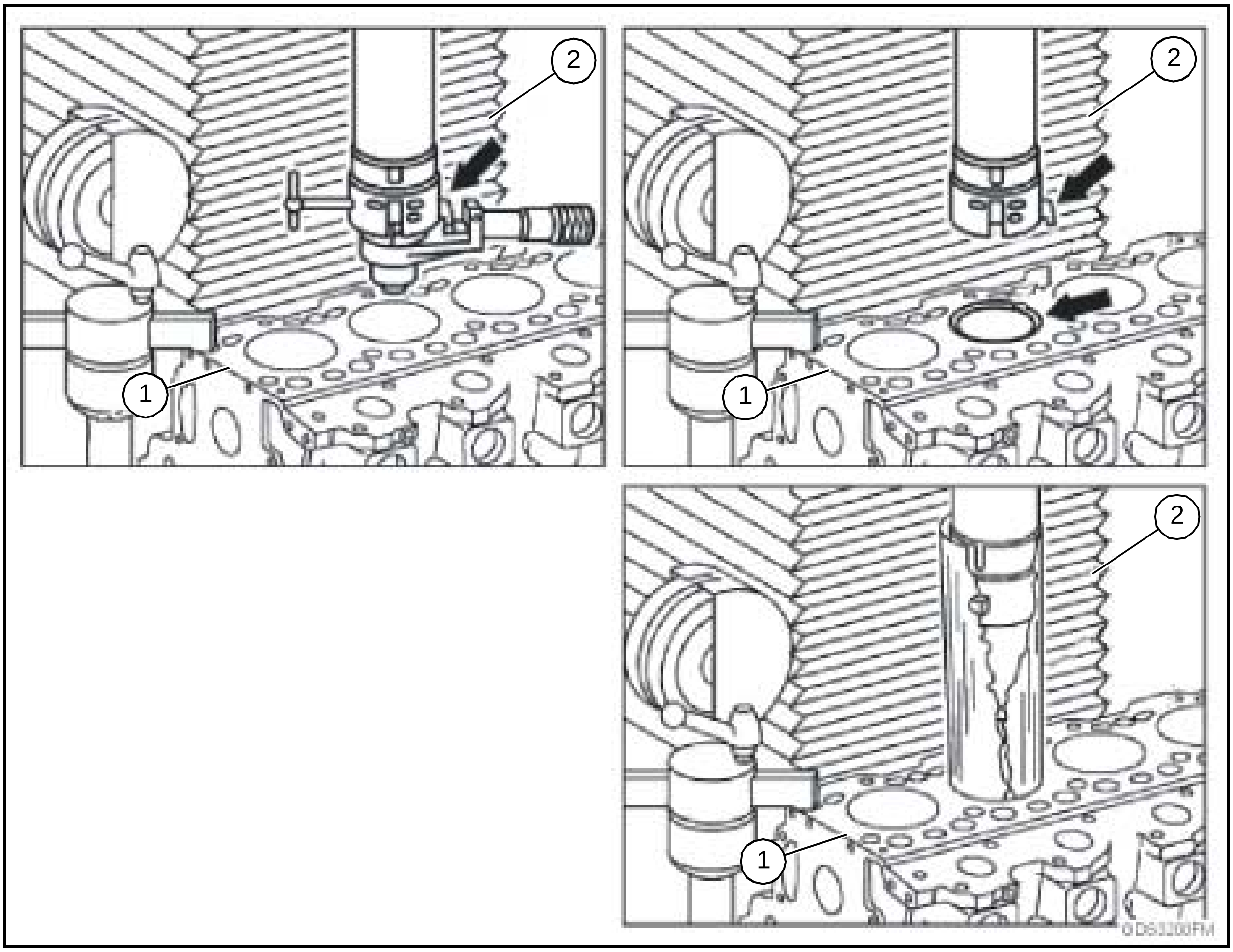
Clean cylinder walls with white spirits and remove masking on crankcase contact surface.

Re-assemble in reverse order.

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Remove Cylinder Liner

Remove crankshaft. **(See “Remove Crankshaft” on page 169).**



Clamp crankcase (1) to boring machine (2).

Align cylinder wall to boring machine.

⚠ CAUTION

If several cylinders are removed, pay attention to sequence of work in order to avoid excessive thermal stresses. Cylinder bore order 1-3-5-2-4-6

Bore cylinder liner up to 0.2 mm (0.008 in.) smaller than the cylinder liner outer diameter.

Draw a triangular file over the entire surface of the cylinder liner from bottom to the top so that the liner breaks apart.

Remove the liner.

Cylinder Liners Specification

Cylinder liner inner dia. code letter “A”- 101.985 - 101.991 mm (4.0152 - 4.0154 in.)

Cylinder liner inner dia. code letter “B”- 101.992 - 102.008 mm (4.0154 - 4.0161 in.)

Cylinder liner inner dia. code letter “C” - - - - - - - - - - - - - - - - - - - 102.009 - 102.015 mm (4.0161 - 4.0164 in.)

Cylinder liner outer dia. - 106.075 - 106.095 mm (4.1762 - 4.177 in.)

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Widening Cylinder Bore In Crankcase

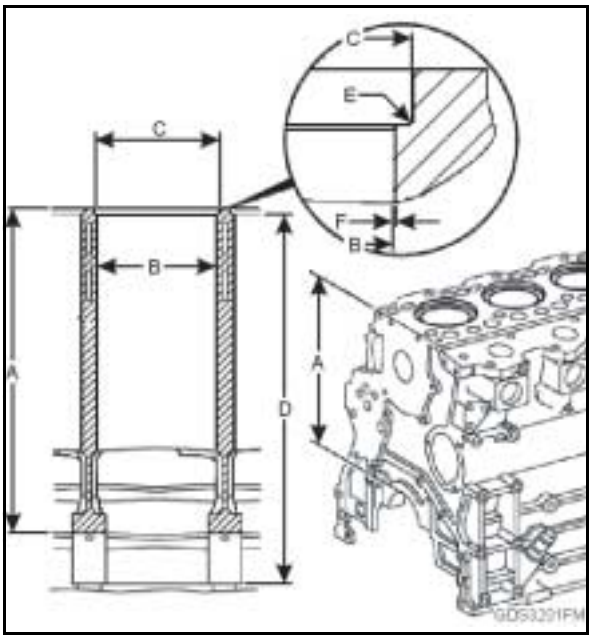
Clamp crankcase to boring machine.

Align cylinder wall relative to boring machine.

⚠ CAUTION

1. If several cylinder liners are installed, pay attention to sequence of work in order to avoid excessive thermal stresses. Boring sequence for 6 cylinder: 1-3-5-2-4-6.
2. Widen to leave approximately 0.05 mm (0.002 in) of the final desired final dimension of the cylinder liner outer diameter.

Clamp brong tool and widen cylinder bore in several operations.



Hone cylinder bore to final dimension. (Dim. B).

Bore seat of liner collar. (Dim. C).

Distance between cylinder liner collar seat and contact surface of crankshaft bearing cap. (Dim. D).

Fillet radius. (Dim. E).

Chamfer. (Dim. F).

Measure	Size
Crankcase height (A) Standard	298.35 - 298.5 mm (11.746 - 11.752 in.)
Undersize -0.3mm (0.012”)	298.05 - 298.2 mm (11.734 - 11.740 in.)
Undersize -0.6mm (0.024”)	297.75 - 297.9 mm (11.722 - 11.7284 in.)
Undersize -0.9mm (0.036”)	297.45 - 297.6 mm (11.711 - 11.717 in.)
Bore Dia. for cylinder liner in crankcase - (B)	106.00 - 106.035 mm (4.173 - 4.175 in.)
Bore dia. for cylinder liner collar in crankcase -(C)	109.572 - 109.626 mm (4.314 - 4.316 in.)
Distance Liner collar seat to contact surface of main bearing cap seat - (D)	338.9 - 339.1 mm (13.343 - 13.35 in.)
Peak-to-valley height of bored (Honed) cylinder bore for installing cylinder liner	0.025 mm (0.001 in.)
Contact surface of cylinder liner in crankcase - concentricity	0.03 mm (0.0012 in.)
Contact surface of cylinder liner in crankcase - flatness	0.010 mm (0.0004 in.)
Contact surface of cylinder liner in crankcase - peak-to-valley height	0.016 mm (0.0006 in.)
Cylinder liner collar bore dia. - concentricity	.060 mm (0.0024 in.)
Cylinder liner collar bore dia. - peak-to-valley height	0.025 mm (0.001 in.)
Overlap of cylinder liner to machined crankcase	0.04 mm (0.002 in.)

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Measure	Size
Radius for cylinder liner collar in bottom of liner recess in crankcase - (E)	0.2 mm (0,008 in.)
Chamfer at cylinder liner collar seat to cylinder bore - (F)	0.3 - 0.4 mm (0.012 - 0.016 in.) @ 45°

Deburr crankcase at the chamfer with a burnishing stone.

Installing Cylinder Liner

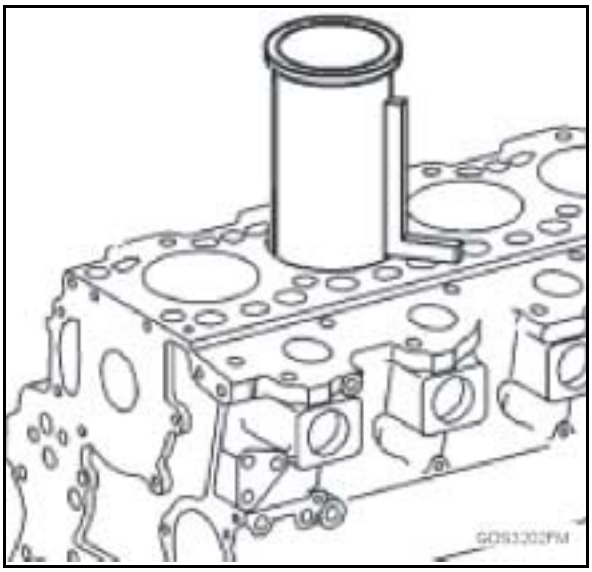
Widening cylinder bore diameter or remove old liner.

Measure cylinder bore dia. and collar seat in crankcase.

Coat bore in crankcase with acid free grease.

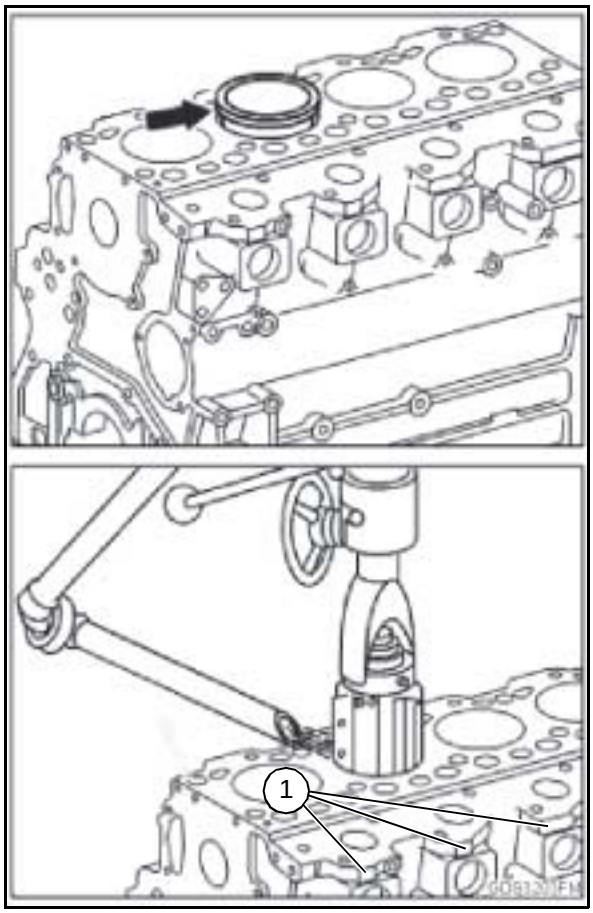
Measure cylinder liner outer diameter, collar diameter and overlap.

Place crankcase on press and align.



Position cylinder liner at right angles to the bore.

Use a suitable plate and press the liner in until liner protrudes about 20 mm (0.787 in.)



Inspect collar seat for abrasion and clean with compressed air if necessary.

Press liner in fuly. (Press in with aprox. 3 tons; then briefly release pressure and then press in fully with approx. 7 tons for a period of approx. 5 seconds.)

Face contact surface of crankcase.

NOTE:Pay attention to undersize stages of crankcase height (A), peak-to-valley height, flatness of crankcase contact surface and parallelism of crankcase contact surface.

Hone cylinder liner to final dimension. **(See “Cylinder Liners Specification” on page 198).**

Clean crankcase.

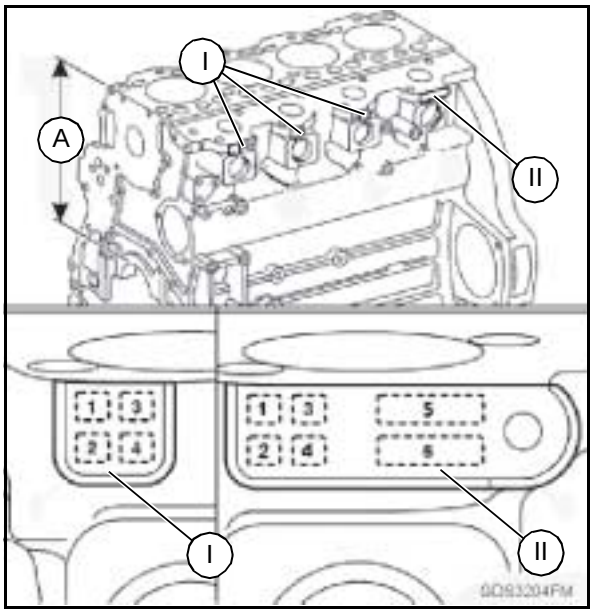
Re-mark marking surfaces 1 on crankcase after machining. **(See “Cylinder Liners Specification” on page 198).**

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Marking Of Crankcase

The markings (classification) of the cylinder bore dia. and of the crankcase height (dim. A) are indicated on the marking surfaces (I) and (II) on the crankcase in the area of the unit pump bores.

Engine 906 with 5 marking surfaces (I) at cylinders 1 to 5 and 1 marking surface (II) at cylinder 6.



Box “1”: Classification of cylinder bore dia. with abbreviated symbol “A”; “B” or “C”.

- If the cylinder bore dia. differs, box “1” should be marked at all cylinders with the appropriate letters.
- If the cylinder bore dia. is uniform, box “1” at the last cylinder is blank

Box “2”: At the last cylinder, classification of uniform cylinder bore dia. with abbreviated symbol “A”; “B” or “C”. (Marking in box “1” at last cylinder not required).

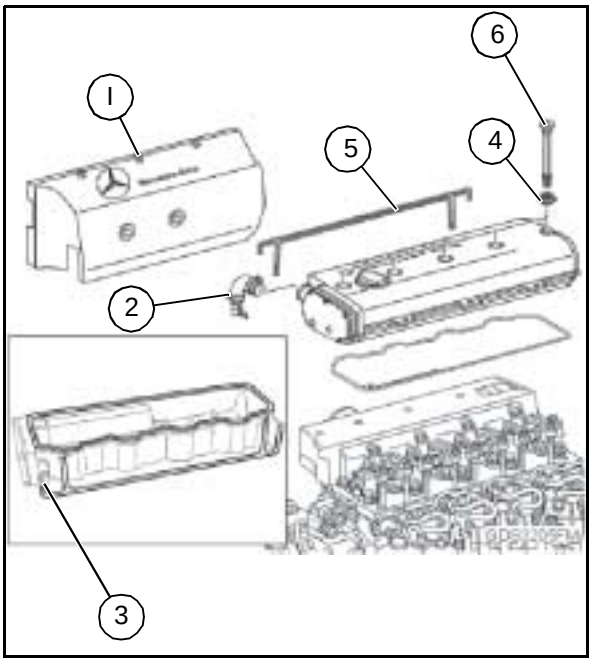
Box “3; 4; 5”: No significance for repairs (Machining codes for engine production).

Box “6”: At the last cylinder:

- No markings means “standard crankcase with no lines”.
- If the box is marked with the marking “-.3”; “-.6” or “-.9”, this is a crankcase height undersize.
- If the box is additionally marked with the marking “Z”, cylinder liners are installed in this crankcase.

Removing And Installing Cylinder Head Cover

NOTE:Four cylinder engine shown.



Remove engine trim panel (1) and ventilation hose (2) at engine cover (3).

Take cylinder head cover (3) off.

Clean all sealing surfaces on cover and cylinder head.

Install Cylinder Head Cover

Replace sealing washers (4).

Inspect gasket (5) between cylinder head and boost air manifold, if necessary.

Assemble in reverse order.

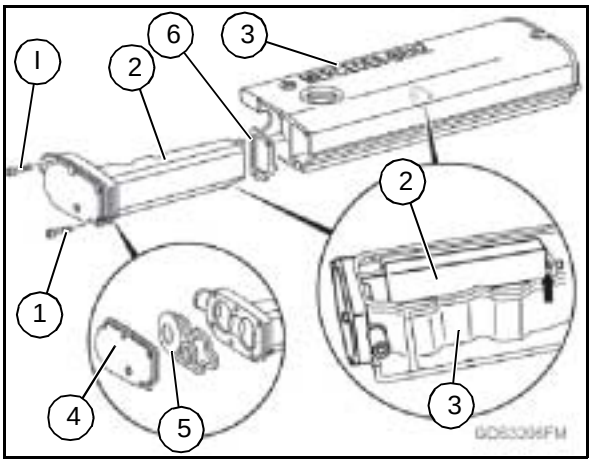
Cylinder Head Cover Bolt (6) Torque Specification

cylinder head cover to cylinder head torque spec. - 30Nm (33.1903 lb. ft.)

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Removing And Installing Oil Seperator

Remove cylinder head cover (3). **(See "Removing And Installing Cylinder Head Cover" on page 201).**



Remove oil seperator (2) at cylinder head (3).

Pull off cover (4) at oil seperator and recover diaphragm (5). Inspect diaphragm and replace if necessary.

Installing Oil Seperator

Clean all sealing surfaces.

Replace gasket (4) at oil seperator.

Intall in reverse order.

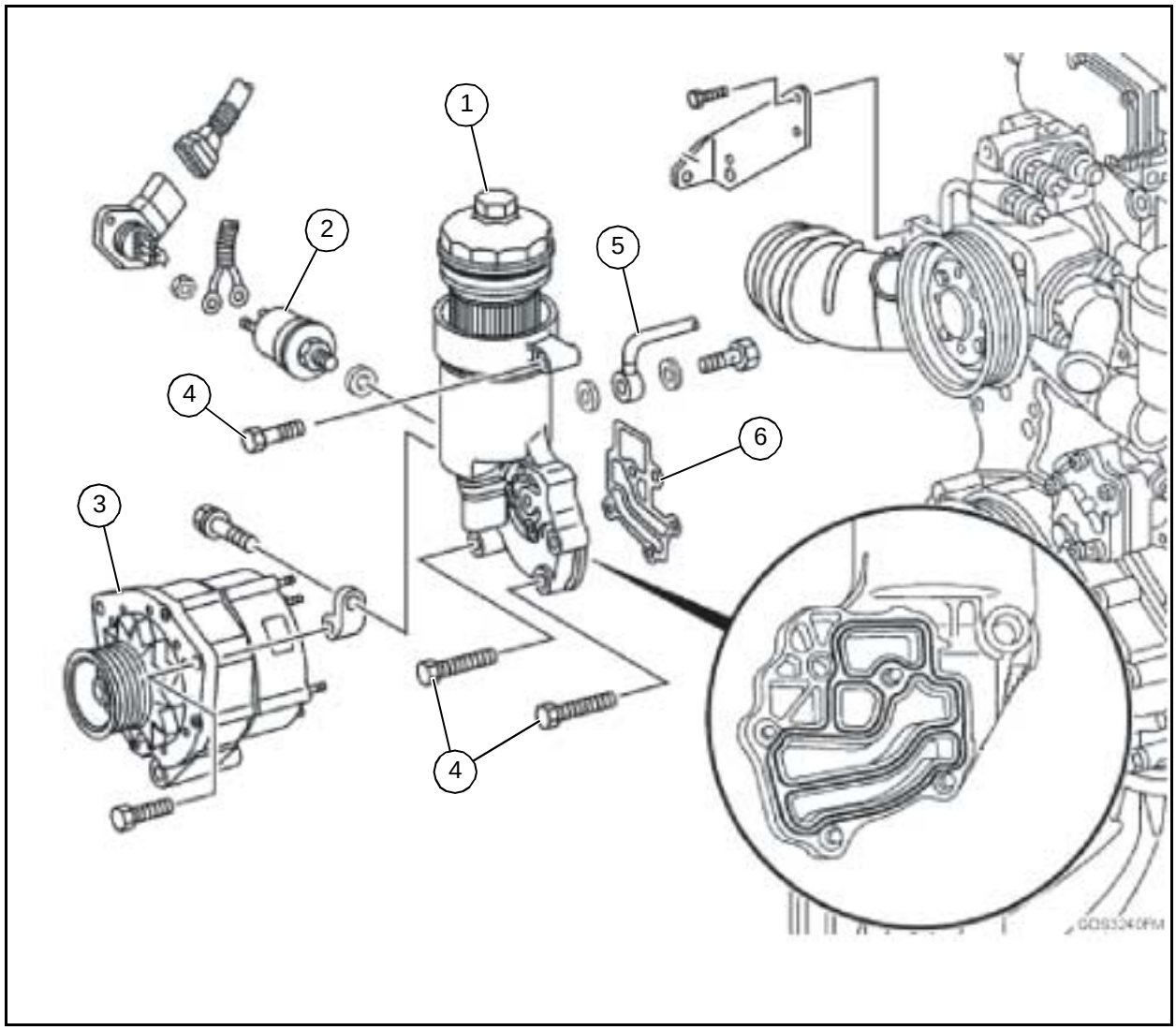
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CHAPTER 4. ENGINE

SECTION 5. LUBRICATION SYSTEM

REMOVE AND INSTALL OIL FILTER HOUSING

Remove air intake hose.



Remove poly V-belt tensioning device.

NOTE:When the oil filter cap is unscrewed, the engine oil flows back into the oil pan.

Remove oil filter cap and element (1).

Remove oil pressure sensor (2).

Detach bracket at oil filter housing.

Loosen and remove adjusting screw on the alternator (3).

Loosen mounting bolts and swing alternator out of the way.

Detouch oil delivery pipe (5) at oil filter housing.

Loosen and remove bolts (4) of oilfilter housing.

Detach oil filter housing at crankcase.

Collect oil which flows out.

Remove gasket (6).

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Clean sealing surfaces and housing.

Inspect all components for cracks and damage.

Replace if necessary.

Install in reverse order. Tighten cap screws to specification.

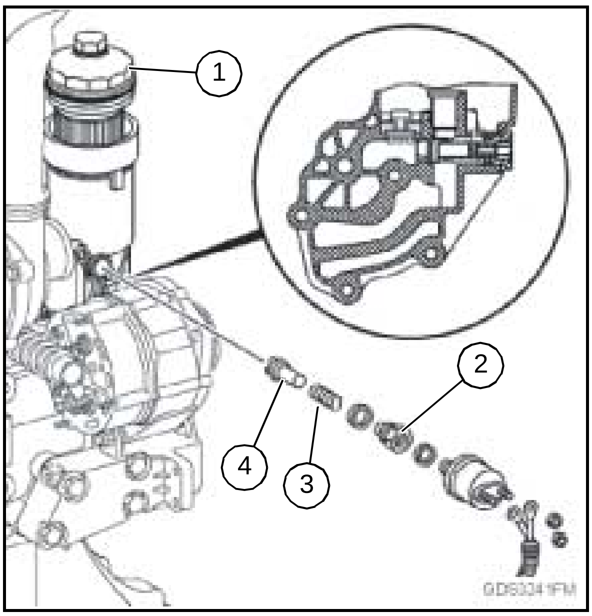
Engine Oil Filter Housing Specification

Oil filter housing bolts to crankcase Torque - 25 Nm (18.44 lb-ft)

Engine Oil Filter Cap Specification

Cap Torque - - - - - - - - - - - - - - - - - 25 Nm (18.44 lb-ft)

REMOVE, INSPECT, AND INSTALL ENGINE OIL FILTER BYPASS VALVE



Disconnect oil pressure sensor wires.

Unscrew oil filter cap (1).

Remove screw plug (2). The plug will be pushed out by the spring (3).

Remove spring and oil filter bypass valve (4).

Clean and inspect all components. Clean all sealing surfaces.

Install new gasket/sealing rings.

Assemble in reverse order.

Tighten to specification.

Bypass Valve Specification

Screw plug to oil filter housing Torque - 50 Nm (40 lb-ft)

Oil Pressure Sensor Specification

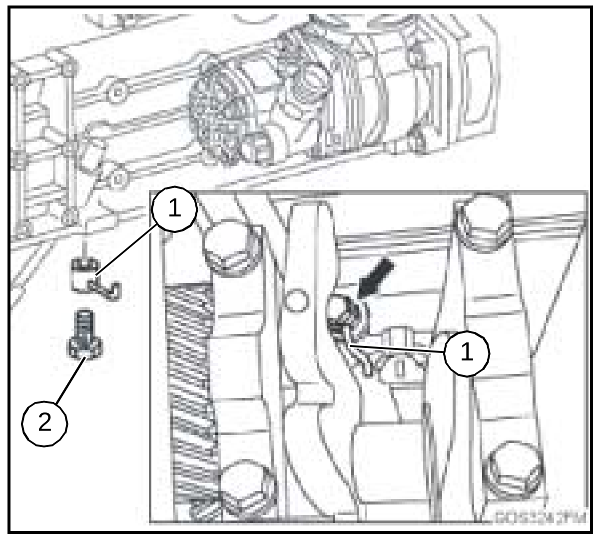
Oil pressure sensor to oil filter housing Torque - 25 Nm (18.44 lb-ft)

REMOVE, INSPECT AND INSTALL PISTON COOLING ORIFICES

Remove oil pan. **(See “Removing Oil Pan” on page 168).**

Attach cranking and blocking device.

Turn crankshaft untill oil spray nozzle to be removed is accessible.



Unscrew the banjo bolt (2) and remove the nozzle (1).

Clean oil spray nozzles with solvent. Dry thoroughly.

Inspect oil spray nozzle and replace if damaged.

Install in reverse order.

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CHAPTER 4. ENGINE

SECTION 6. CYLINDER HEAD AND VALVES

CYLINDER HEAD AND VALVES FAILURE ANALYSIS

Make preliminary inspection of cylinder head and valve assembly during disassembly.

Look for the following conditions:

Sticking Valves

- Carbon deposits on valve stem.
- Worn valve guides.
- Scored valve stems.
- Warped valve stems.
- Misaligned or broken valve springs.
- Worn or distorted valve seats.
- Insufficient lubrication.

Warped, Worn, or Distorted Valve Guides

- Lack of lubrication.
- Cylinder head distortion.
- Excessive heat.
- Unevenly tightened cylinder head cap screws.

Distorted Cylinder Head and Gasket Leakage

- Loss of cylinder head cap screw torque.
- Broken cylinder head cap screw.
- Overheating from low coolant level operation.
- Insufficient liner stand-out.
- Coolant leakage into cylinder causing hydraulic failure of gasket.
- Cracked cylinder head.
- Cracked cylinder liner.
- Damaged or incorrect gasket.
- Overpowering or overfueling.
- Damaged cylinder head or block surfaces.
- Improper surface finish on cylinder head.
- Improperly tightened cylinder head cap screws.
- Faulty gasket installation (misaligned).

Worn or Broken Valve Seats

- Misaligned valves.
- Distorted cylinder head.
- Carbon deposits on seats due to incomplete combustion.
- Valve spring tension too weak.
- Excessive heat.
- Improper valve clearance.
- Improper valve timing.
- Incorrect valve or seat installed.

Burned, Pitted, Worn, or Broken Valves

- Worn or distorted valve seats.
- Loose valve seats.
- Worn valve guides.
- Insufficient cooling.
- Cocked or broken valve springs.
- Improper engine operation.
- Improper valve train timing.
- Faulty valve rotators.
- Warped or distorted valve stems.
- “Stretched” valves due to excessive spring tension.
- Warped cylinder head.
- Bent push rods.
- Carbon build-up on valve seats.
- Rocker arm failure.
- Incorrect valve or seat installed.
- Incorrect piston-to-valve clearance.

Improper Valve Clearance

- Inefficient use of fuel.
- Engine starts harder.
- Maximum engine power will not be achieved.
- Shorter service life of valve train.
- Greater chance for engine to overheat.

Excessive Valve Recession

- Worn valve guides.
- Bent valves.
- Debris passed through valve train.

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Cylinder Head

Remove Cylinder Head

⚠ CAUTION

1. Explosive release of fluids from pressurized cooling system can cause serious burns.
2. Shut off engine.
3. Remove filler cap only when cool enough to touch with bare hands.
4. Slowly loosen cap to first stop to relieve pressure before removing completely.

Drain engine coolant.

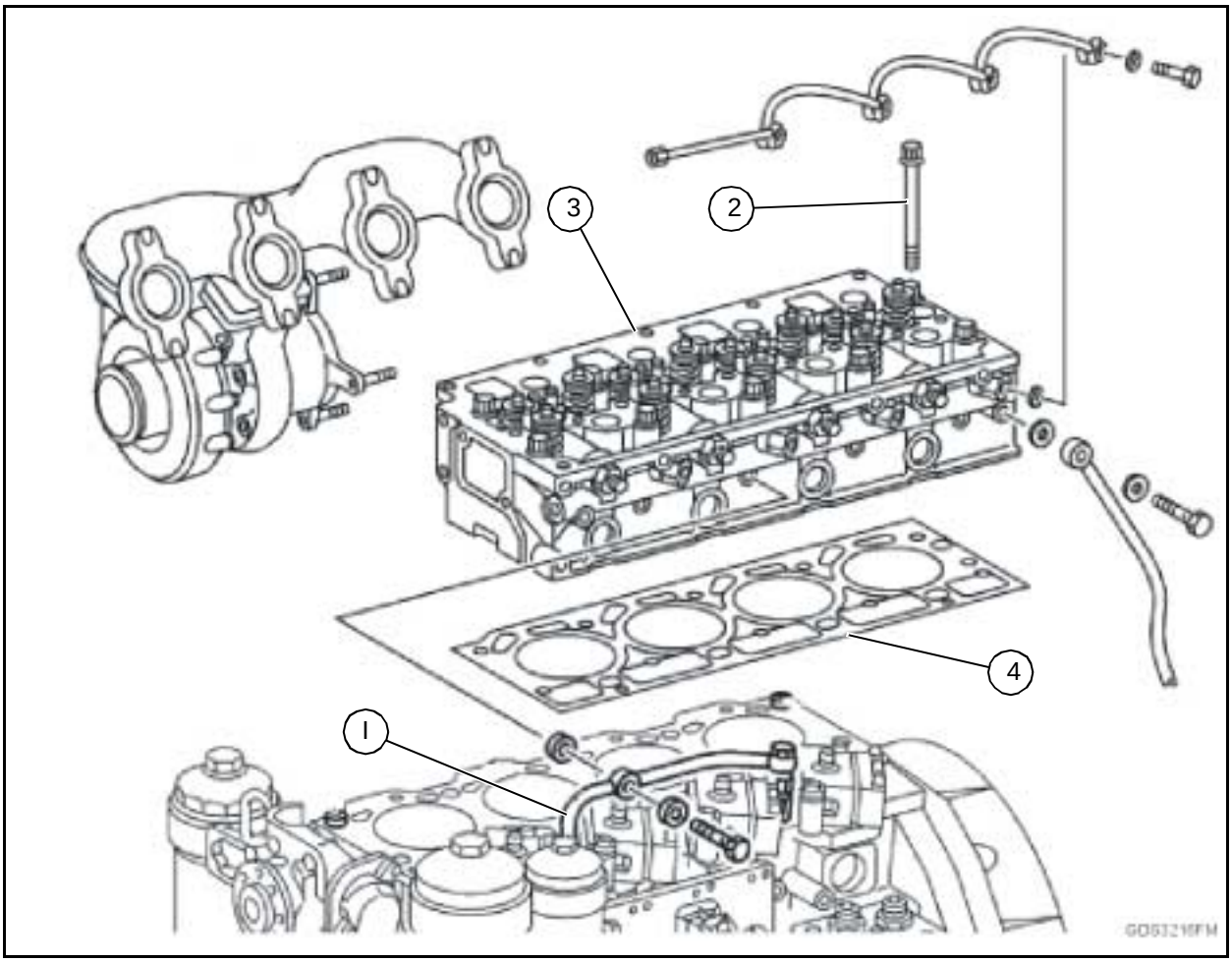
Remove exhaust manifold. **(See "REMOVE AND INSTALL EXHAUST MANIFOLD" on page 221).**

Remove intake manifold. **(See "REMOVE AND INSTALL AIR INTAKE MANIFOLD" on page 225).**

Remove cylinder head cover. **(See "Removing And Installing Cylinder Head Cover" on page 201).**

Remove fuel delivery nozzle(s) from cylinder head. **(See "Removing And Installing Nozzle Holder Combination" on page 215).**

Remove rocker arm assembly from cylinder head. **(See "Remove And Install Rocker Arm Asembly" on page 180).**



Remove push rods from cylinder head.

Disconnect leak-off line (1).

Remove exhaust brake line.

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Attach lifting device to cylinder head.

Remove cylinder head cap screws (2), cylinder head (3) and cylinder head gasket (4).

Clean threaded, oil and coolant holes in crankcase.

Measure length of shank of cylinder head cap screws, if out of specification, replace.

Inspect cylinder head for cracks and damage.

Inspect cylinder head for flatness of contact surface with knife-edge straightedge. Face cylinder head and crankcase if out of specification.

Install Cylinder Head

Use tap and die for head bolt holes and bolts to clean up threads in cylinder block and cap screws.

Install centring sleeves into cylinder block.

Install new head gasket over centring sleeves.

Install cylinder head onto crankcase.

⚠ WARNING

Cylinder head cap screws are stretched when tightened to specification. Cap screws are usable up to the maximum shank length specification measured from the end of cap screw to the bottom of cap screw head. If any cap screw is longer than the specification, replace all cap screws for that cylinder head.

Cylinder Head Specification

Cap Screw Shank Length - - - - - - - - - - 149.0 mm (5.866 in.) new

Cap Screw Shank Length - - - - - - - - - - 151.0 mm (5.945 in.) max.

Permissible flatness over entire length - - - - - - - - - - 0.05 mm (0.002 in.)

Permissible flatness over a length of 150 mm (5.906 in.) - - - - - - - - - - 0.02 mm (0.0008 in.)

Cylinder head cap screw to crankcase torque 1st stage - - - - - - - - - - 20 Nm (14.751 lb. ft.)

Cylinder head cap screw to crankcase torque 2nd stage 70 Nm (51.630 lb. ft.)

Cylinder head cap screw to crankcase torque 3rd stage - - - - - - - - - - 170 Nm (125.386 lb. ft.)

Cylinder head cap screw to crankcase torque 4th stage - - - - - - - - - - 280 Nm (206.517 lb. ft.)

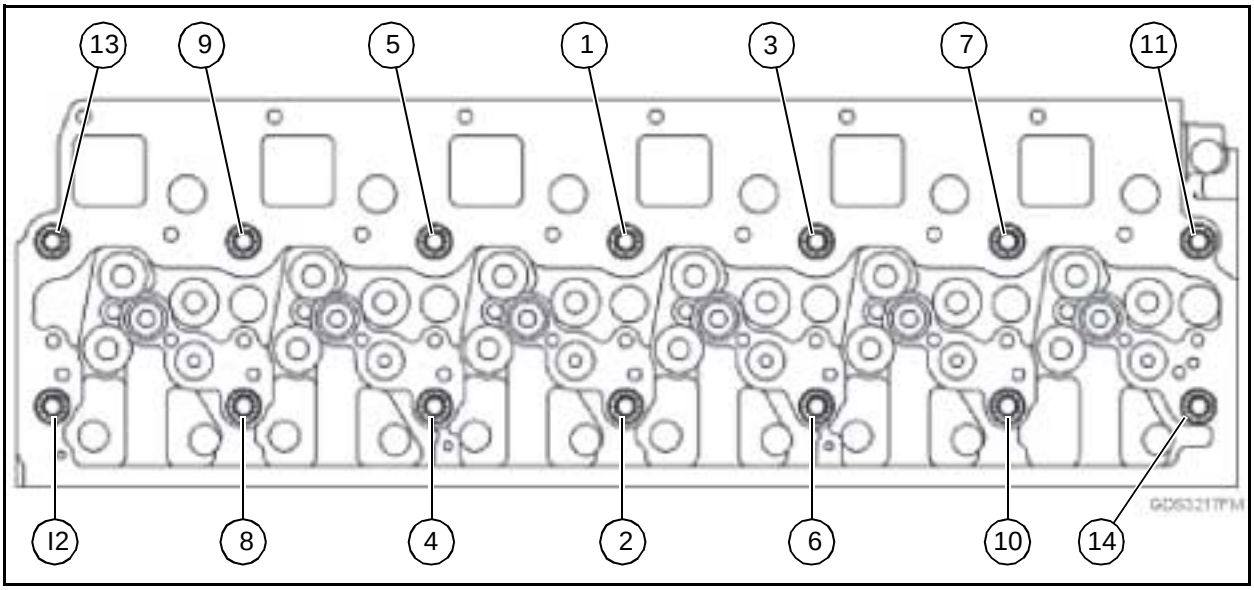
Cylinder head cap screw to crankcase torque 5th stage - - - - - - - - - - 90°

Cylinder head cap screw to crankcase torque 6th stage - - - - - - - - - - 90°

Oil threads of cap screws with clean engine oil and install cylinder head cap screws (6).

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Torque Sequence



Torque the cylinder head cap screws in the sequence shown.

Incase a cylinder head cap screw is over torque, remove and measure the length.

If length is out of specification, replace the cap screw.

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Install push rods.

Install exhaust brake line.

Connect leak-off line.

Install rocker arm assembly (4) and valve cradle (5) to cylinder head(s). **(See "Remove And Install Rocker Arm Asembly" on page 180).**

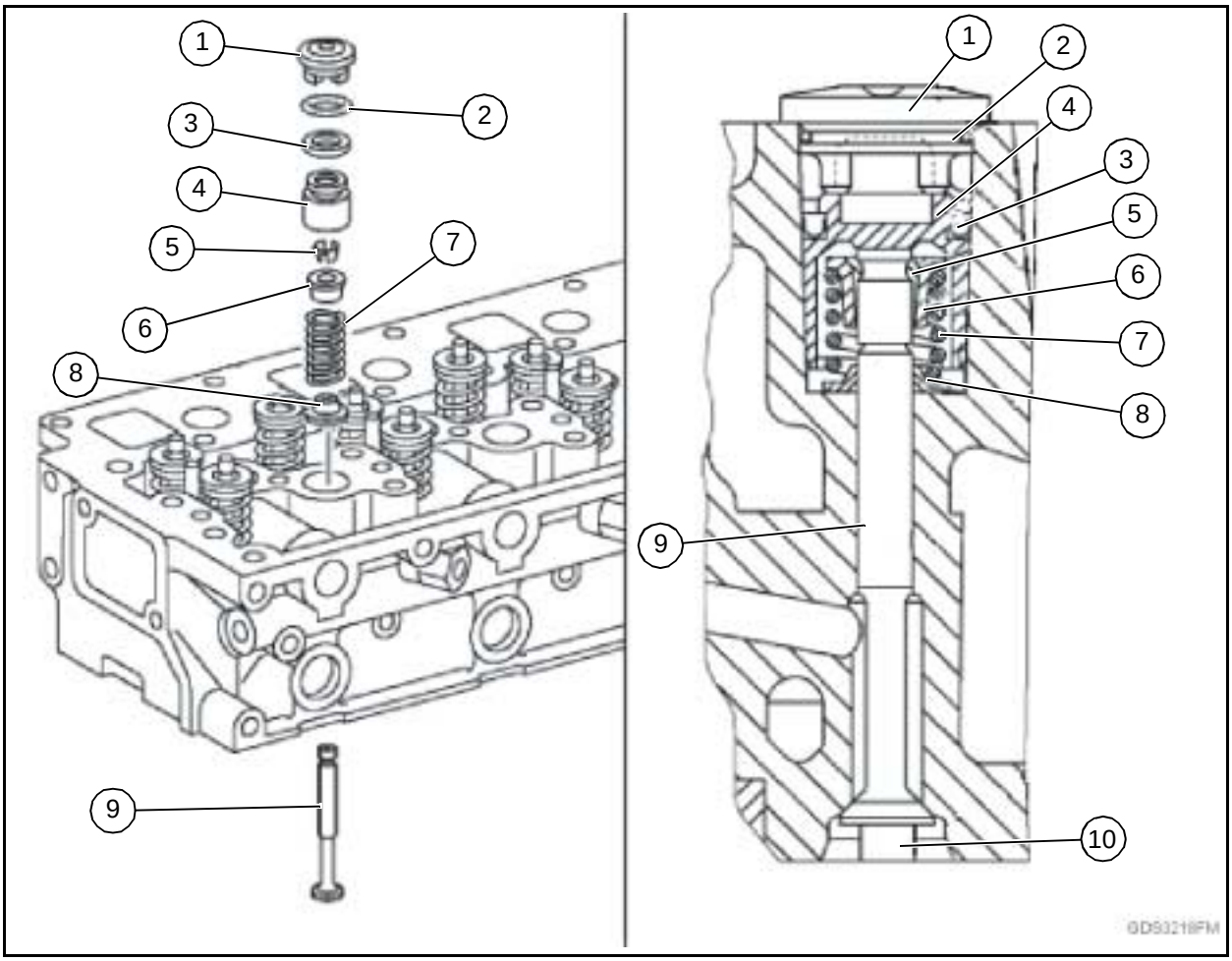
Install fuel delivery nozzle(s) to cylinder head(s). **(See "Removing And Installing Nozzle Holder Combination" on page 215).**

Install cylinder head cover. **(See "Removing And Installing Cylinder Head Cover" on page 201).**

Install intake manifold. **(See "REMOVE AND INSTALL AIR INTAKE MANIFOLD" on page 225).**

Install exhaust manifold. **(See "REMOVE AND INSTALL EXHAUST MANIFOLD" on page 221).**

Remove and Install Engine Exhaust Valve Brake

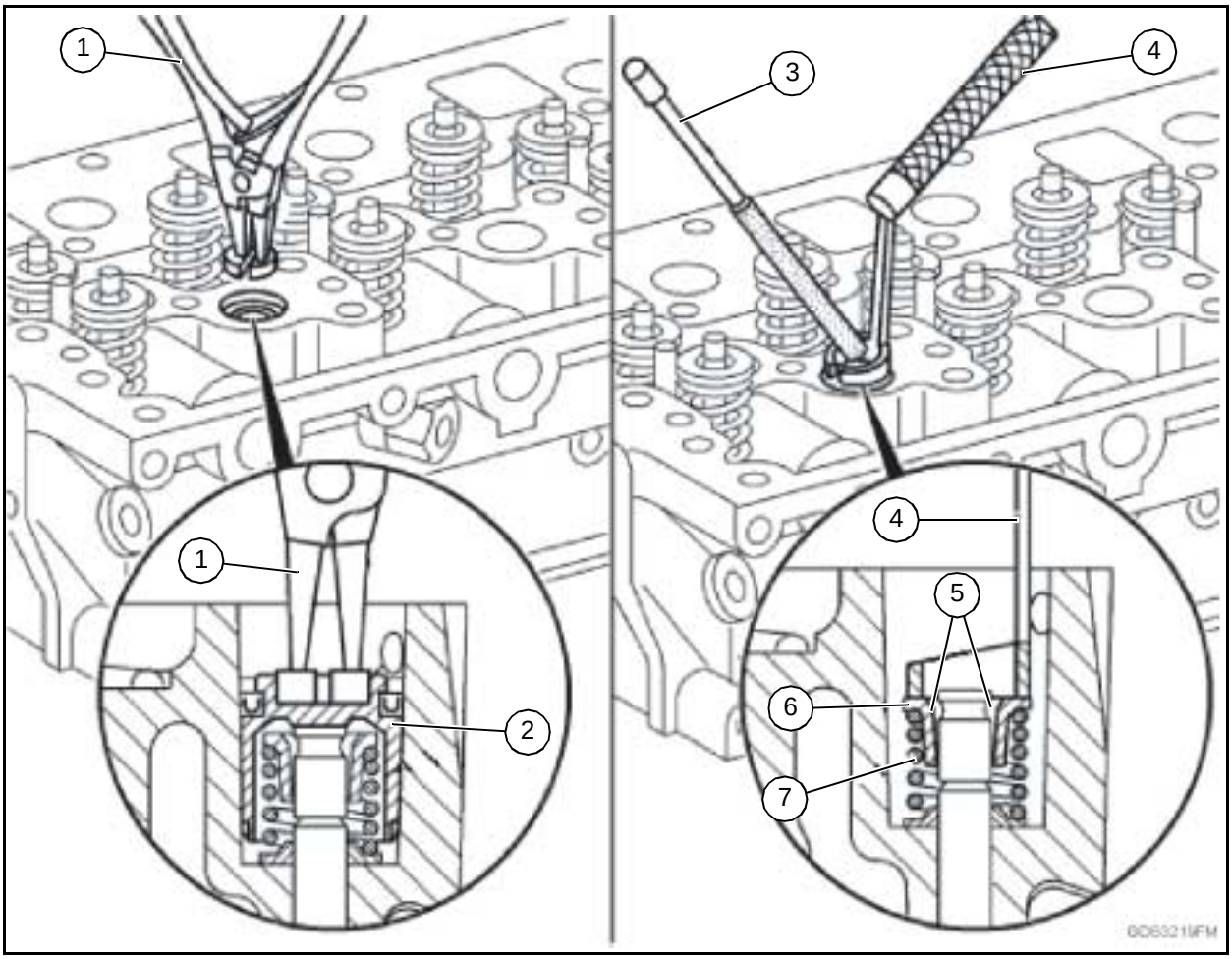


Remove cylinder head. **(See "Remove Cylinder Head" on page 206).**

Remove plug (1).

Use a spacer (10) to keep valve in closed position.

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Remove piston (2).

Remove retainer locks (5) using JDG1592 Spring Retainer Depressor.

Remove spring retainer (6), spring (7), spring guide and valve. Inspect parts and replace as necessary.

NOTE:Replace piston with seal.

Install valve, spring guide, spring and spring retainer.

Install retainers ensuring they are seated in the valve stem groove.

Install piston into cylinder head.

Install plug.

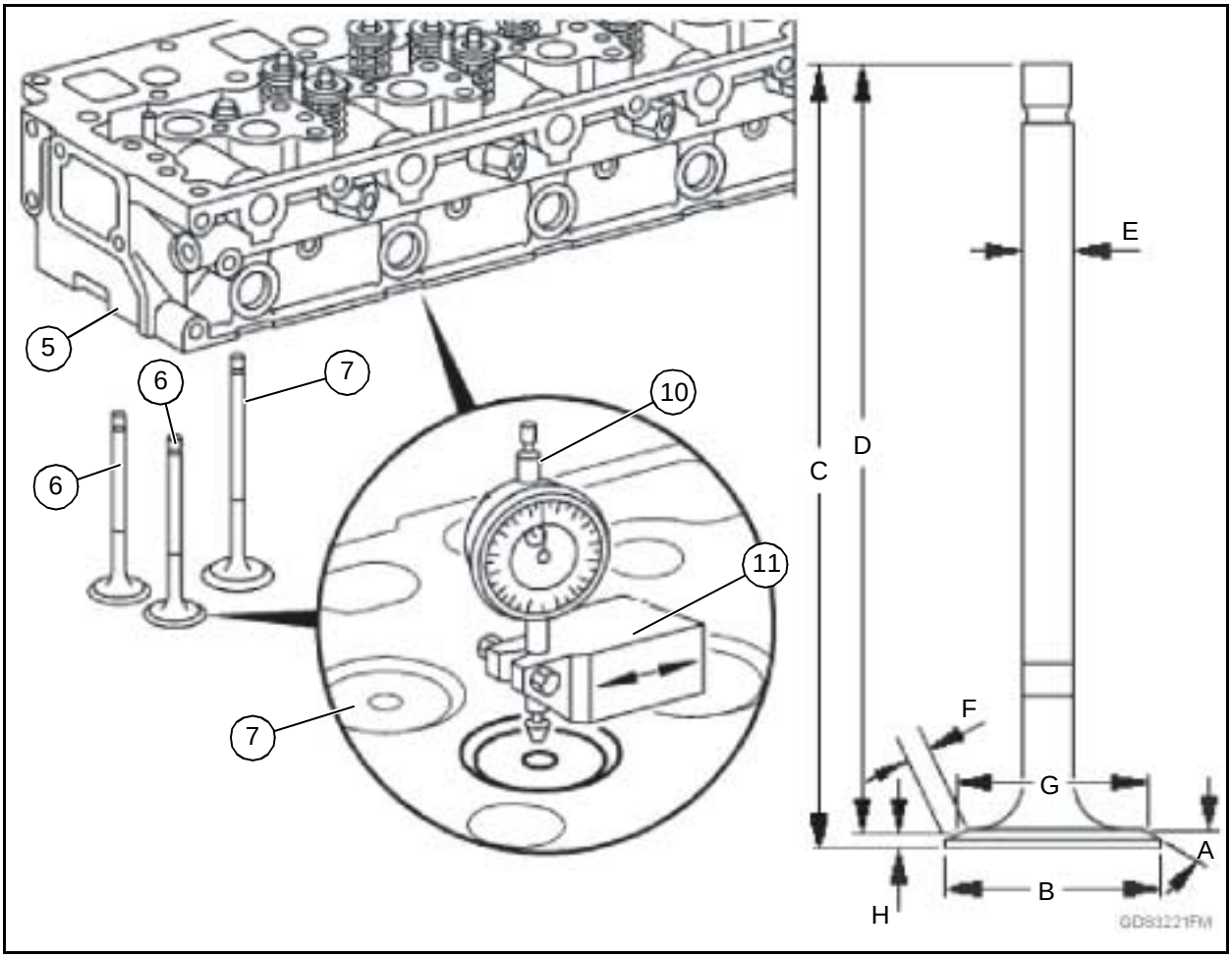
Install cylinder head. **(See “Install Cylinder Head” on page 207).**

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Intake and Exhaust Valves

Remove Intake and Exhaust Valves

Remove cylinder head. **(See “Cylinder Head” on page 206)**.

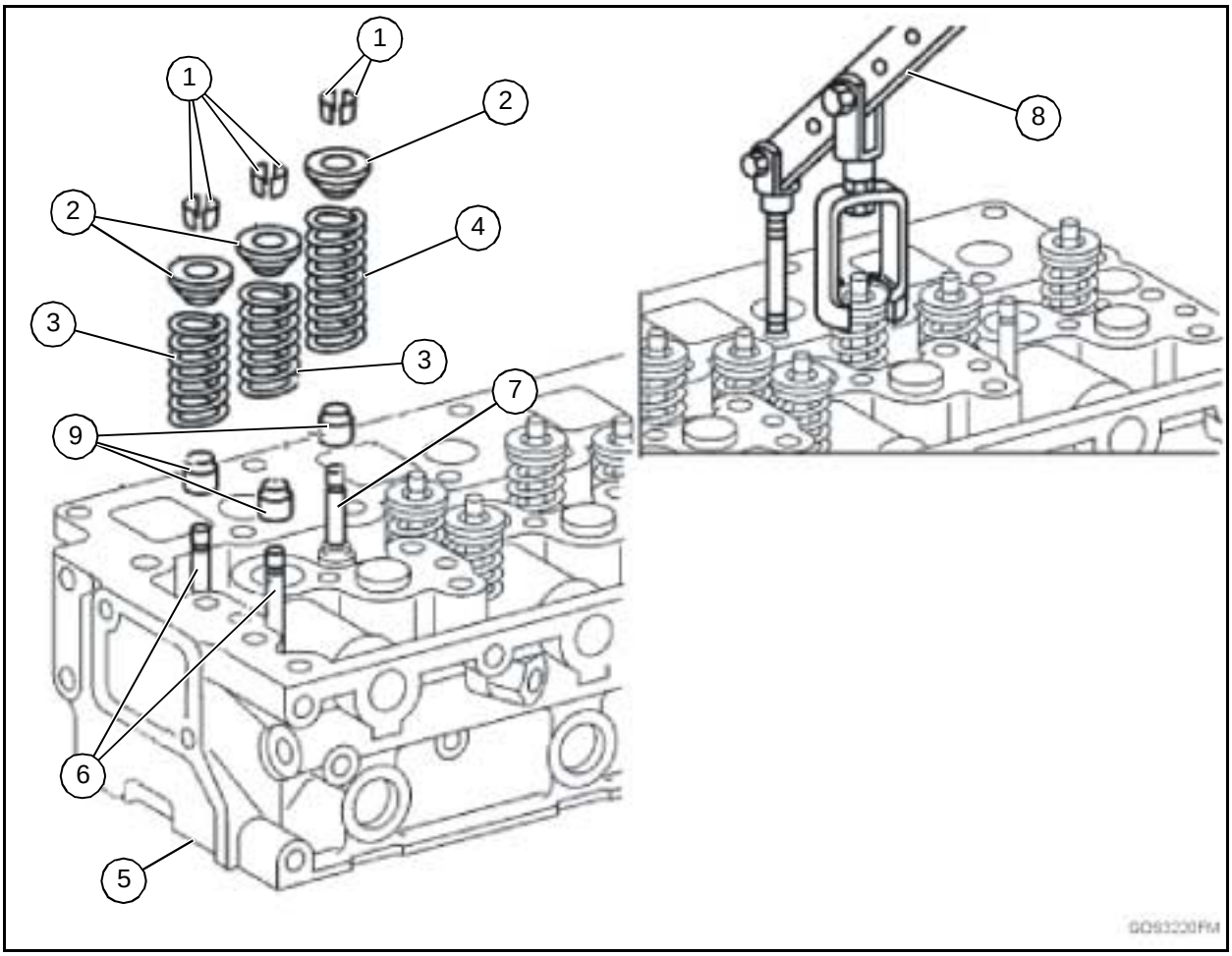


Use a dial gauge and block and measure valve setback from cylinder head surface on inlet and outlet valves. If dimension is out of specification, remachine valve steats.

Measure difference between both valves (inlet and outlet dimensions “C” and “D”). If dimension is out of specification, remachine valve steats.

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Remove Valves



Attach valve removing tool (8) to bolts on cylinder head (5).

Press down valve spring retainer (2) with valve lifter and take off collets (1) with a magnet pin.

Relieve the pressure on the valve lifter and remove spring retainers and valve springs (3 & 4).

Remove valve stem seals (9).

NOTE:Mark valves to ensure correct installation.

Remove valves, clean and inspect for wear and size.

Clean cylinder head and inspect valve seat rings.

Use plug gauge and inspect valve guides for wear.

If the side of the plug gauge marked with a “+” can go into the valve guide, replace the valve guide.

Valve Specifications

Valve set back relative to cylinder head contact surface - - - - - - - - - - - - - - - 1.1 - 1.5 mm (0.0433 - 0.0591 in.)

Valve seat angle (A) inlet valve - - - - - - - - - - - - - - - 20°

Valve seat angle (A) exhaust valve - - - - - - - - - - - - 45°

Valve disc dia. (B) inlet - 33.9 - 34.1 mm (1.335 - 1.343 in.)

Valve disc dia. (B) exhaust - 33.9 - 34.1 mm (1.335 - 1.343 in.)

Valve seat width at disk (F) inlet - 3.3 - 4.3 mm (0.130 - 0.170 in.)

Valve seat width at disk (F) exhaust - 3.5 - 4.2 mm (0.138 - 0.165 in.)

Valve length (C) inlet - 125.7 - 126.1 mm (4.949 - 4.965 in.)

Valve length (C) exhaust - 152.5 - 152.9 mm (6.004 - 6.020 in.)

Valve stem dia. (E) inlet - 7.935 - 7.950 mm (0.3124 - 0.313 in.)

Valve stem dia. (E) exhaust - 7.925 - 7.940 mm (0.312 - 0.3126 in.)

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Inlet valve seat surface machining dimension (H) related to valve seat surface dia. (G) - - - - - - - - - - - - -
Dim (G) - - - - - - - - - - - - - - - - - - - 31.0 mm (1.2205 in.)
Dim (H) - - - - - - - - - - 2.7 - 3.1 mm (0.1063 - 0.122 in.)

Exhaust valve seat surface machining dimension (H) related to valve seat surface dia. (G) - - - - - - - - - - - - -
Dim (G) - - - - - - - - - - - - - - - - - - - 36.0 mm (1.4173 in.)
Dim (H) - - - - - - - - - - 2.5 - 3.2 mm (0.0984 - 0.126 in.)

Hardness at valve stem end inlet & exhaust - HRc 54 - 60

Concentricity of valve seat to valve stem inlet & exhaust - 0.03 mm (0.0012 in.)

Permissible difference of inlet valves measured between cylinder head and valve stem end- 0.2 mm (0.008 in.)

Inspect Valve Springs



Inspect valve springs for alignment, wear, and damage.

Put springs on a flat surface to see that they are square and parallel.

Inspect Valve Spring Retainers and Retainer Locks

Inspect valve spring retainers for excessive wear in area where valve springs and retaining locks seat.

Replace as needed.

Inspect retainer locks for excessive wear. Replace as needed.

Install Intake and Exhaust Valves

Install Valve Seal

Use Valve Seal Installation Tool to install valve seal.

Apply a light film of multi-purpose grease to sleeve of valve seal.

Slide valve seal down sleeve and push firmly onto valve guide.

Apply a light film of multi-purpose grease to the stems of intake valves and exhaust valve.

Install valves into head and through valve seals.

Install valve springs and retainers.

Compress valve spring.

Apply grease to the insides of retainer locks (1) to hold them in place when being installed.

Install retainer locks onto valves and release spring tension. Make sure retainer locks stay in the groove on the valve when spring tension is released.

Install cylinder head. **(See “Cylinder Head” on page 206).**

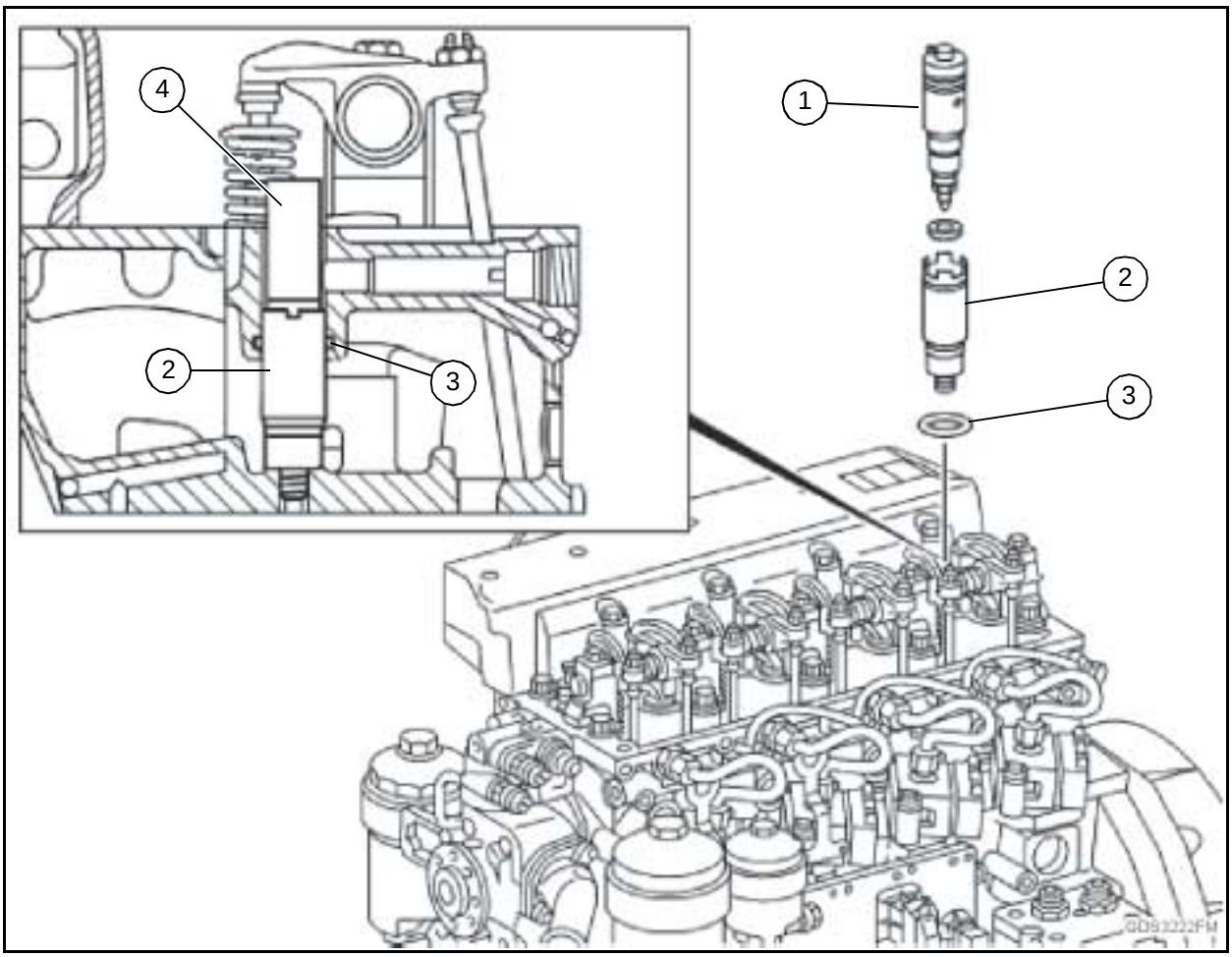
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Cylinder Head

Remove, Inspect and Install Protective Sleeve

NOTE:Protective sleeve can be removed with cylinder head installed. If removed with cylinder head installed, drain coolant and remove fuel delivery nozzle (See “Removing And Installing Nozzle Holder Combination” on page 215) before removing protective sleeve.

Remove cylinder head cover. **(See “Removing And Installing Cylinder Head Cover” on page 201).**



Remove nozzle holder assembly (1). **(See).**

Remove protective sleeve (2) and o-ring (3).

Inspect protective sleeve and o-ring. Replace as necessary.

Install protective sleeve and o-ring.

Protective sleeve to cylinder head torque

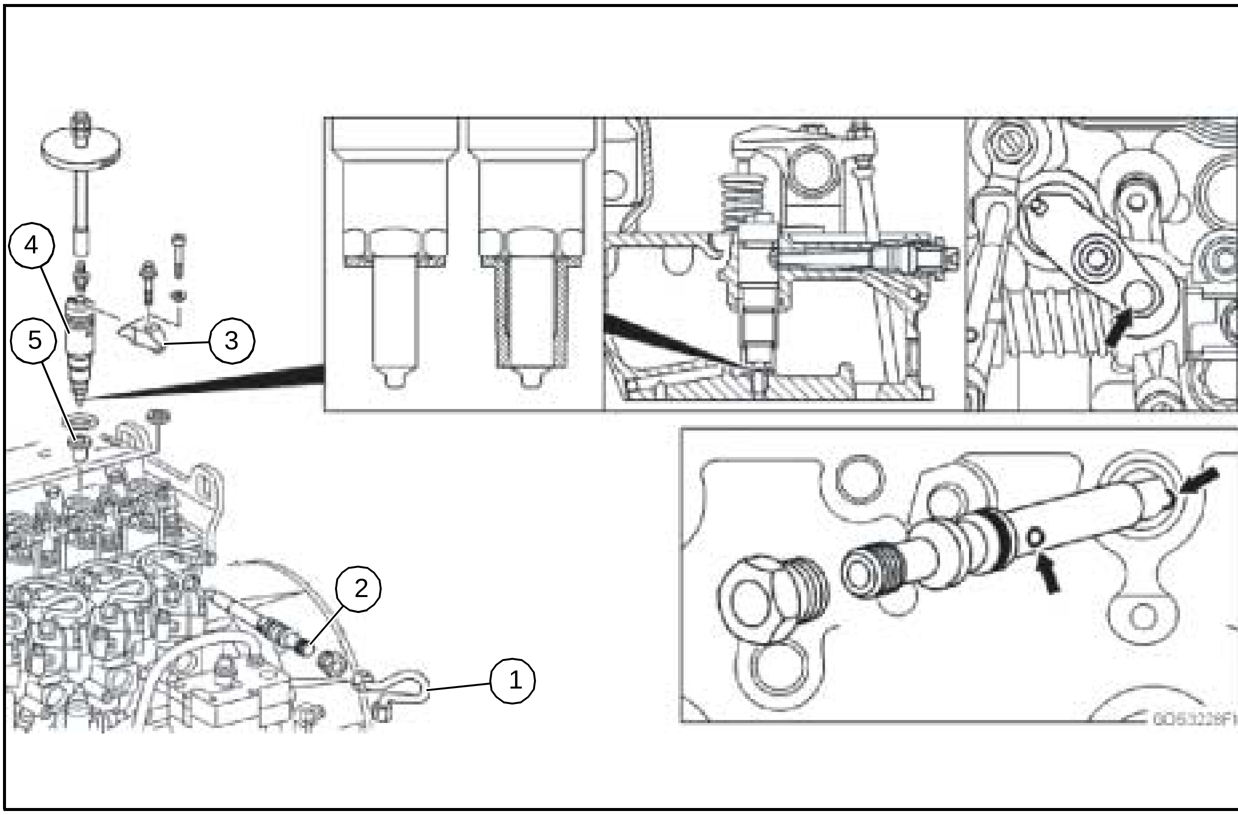
Torque M12 x 1- - - - - - - - - - - - 40 Nm (29.5025 lb. ft.)

Torque M14 x 1- - - - - - - - - - - - 45 Nm (33.1903 lb. ft.)

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Removing And Installing Nozzle Holder Combination

Remove cylinder head cover. **(See "Removing And Installing Cylinder Head Cover" on page 201).**



Remove injection line (1).

Remove pressure pipe connection (2).

Remove tensioning arm (3).

Attach adapter and impact extractor to the female thread (M8) of the nozzle holder combination (4).

Pull out the holder combination.

Remove adapter and impact extractor at the nozzle combination.

Take off seal (5).

Installing nozzle holder combination

Fit seal (5) on nozzle holder combination. **Pay attention to installation position and thickness of seal; small ring surface on seal points in direction of nozzle holder combination.**

Install nozzle holder combination into the cylinder head. **Pay attention to the installation position of nozzle holder combination relative to pressure pipe connection. Interference-fit ball (arrow) in the tensioning arm must be aligned with the locating element in the end cover of the constant throttle.**

Screw tensioning arm (3) tight.

Assemble in reverse order.

Specification

Pressure pipe to cylinder head torque -40 Nm (29.5 lb. ft.)

Bolt of tensioning arm Allen bolt -30 Nm (22.127 lb. ft.)

Bolt of tensioning arm bolt with 12 point head with spherical collar- - - - - - - - - - - - - - -35 Nm (25.815 lb. ft.)

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Inspect Cylinders and Cylinder Liners

Remove cylinder head cover. **(See "Removing And Installing Cylinder Head Cover" on page 201.)**

Remove protected sleeve. **(See "Remove, Inspect and Install Protective Sleeve" on page 214.)**

Install cranking and blocking device. **(See "Install Cranking Device" on page 165).**

Rotate crankshaft until specific cylinder is at TDC.

Insert inspection equipment probe through theprotective sleeve hole in cylinder head.

Inspect combustion face for evidence of physical damage, oil or coolant leakage, or gasket failure prior to cleaning the cylinder head.

Repair or replace cylinder head if there is evidence of physical damage, such as cracking, abrasion, distortion, or valve seat "torching."

Check Cylinder Head Combustion Face Flatness

Check cylinder head flatness with Straightedge and feeler gauge. Check lengthwise, crosswise, and diagonally.

If any measurement exceeds specification, the cylinder head must be either resurfaced or replaced.

⚠ CAUTION

The peak-to-valley height (waviness) must be maintained.

Cylinder Head Specification

Cylinder Head Out-of-Flatness per any 150 mm (5.9 in.) length - - - - - - - - - - - - - - - - - 0.02 mm (0.0008 in.)

Cylinder Head Out-of-Flatness over entire length - 0.05 mm (0.002 in.)

Cylinder Head Height New - 107.9 - 108.1 mm (4.248 - 4.256 in.)

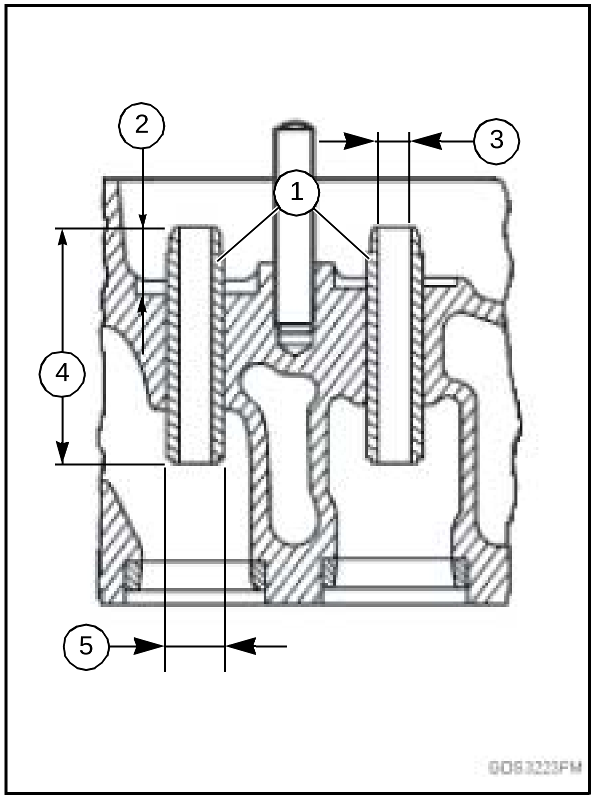
Cylinder Head Height- 106.9 mm (4.209 in.) Minimum

Peak-to-valley height - 0.008 - 0.016 mm (0.0003 - 0.0006 in.)

Clean, Inspect and Repalce Valve Guides

Use an appropriate valve guide end brush to clean valve guides before inspection or repair.

A few drops of light oil or kerosene will help to fully clean the guide.



1. Valve Guide (18 used).
2. Projection of Valve Guide from Cylinder Head.
3. Valve Guide ID.
4. Valve Guide Length.
5. Valve Guide OD.

Measure valve guides and compare to specifications. For valve guide ID measurement (3) use a telescoping gauge and micrometer and take measurement half-way into the valve guide.

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Valve Guide Specification

Valve Guides ID machined (Dim. (3))
- - - - - - - - - - - - - - -8.000 - 8.022 mm (0.315 - 0.316 in.)

Standard OD (Dim. (5))
- - - - - - - - - - - 13.028 - 13.046 mm (0.5129 - 0.5136 in.)

0.20 mm Oversize OD (Dim. (5))
- - - - - - - - - - - 13.228 - 13.246 mm (0.5208 - 0.5215 in.)

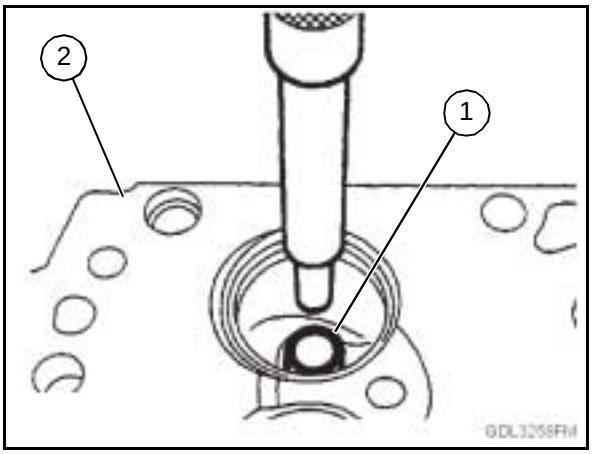
Projection of valve guide (Dim. (2)) inlet - - - - - - - - - - -
- - - - - - - - - - - - - - -14.1 - 14.5 mm (0.5551 - 0.5709 in.)

Projection of valve guide (Dim. (2)) exhaust - - - - - - - -
- - - - - - - - - - - - - - -17.6 - 18.0 mm (0.6929 - 0.7087 in.)

Valve guide length - - - - - - - - - - - - 60 mm (2.3622 in.)

Valve guide overlap in cylinder head - - - - - - - - - - - - -
- - - - - - - - - - - - 0.010 - 0.046 mm (0.0004 - 0.0018 in.)

Remove Valve Guides



If valve guide(s) (1) need to be replaced, knock out old valve guide from combustion side of head (2) towards top of cylinder head.

Bore out cylinder head valve guide bore to specification for guide size being replaced.

NOTE:Take note of overlap size between valve guide O.D. and cylinder head valve guide bore.

⚠ WARNING

Wear heat-protective clothing and full eye protection. Ensure adequate ventilation. Risk of injury from handling liquid nitrogen or from contact with severely supercooled objects and suffocation from inhaling nitrogen gas.

Place valve guide into supercooling box and pour in liquid nitrogen.

Remove valve guide from cooling box with pliers and press into heated cylinder head with the drift and the spacer sleeve.

Ream out valve guide for proper valve stem-to-guide clearance.

Clean valve guides and install valves.

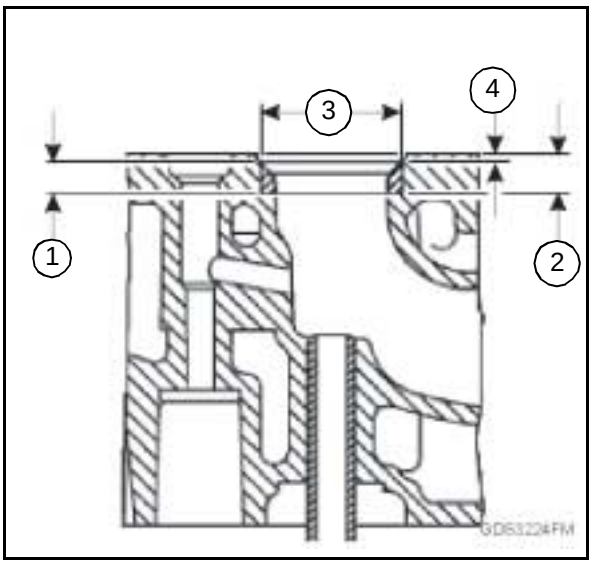
Clean and Inspect Valve Seats

Use an electric hand drill with D17024BR End Brush or equivalent brush to remove all carbon on valve seats.

Check seats for cracks, pits, or excessive wear.

Check entire combustion face for rust, scoring, pitting, or cracks.

Measure Valve Seats



1. Valve Seat Width.
2. Valve Seat Recess in Cylinder Head.
3. Valve Seat Diameter.
4. Distance between cylinder head contact surface and face of valve seat ring.

Measure valve seats for proper specifications listed below.

Intake and Exhaust Valve Specification

Intake Valve Seat Width dim. (1) - - - - - - - - - - - - - - - -
- - - - - - - - - - - - - - -7.60 - 7.7 mm (0.2992 - 0.3031 in.)

Exhaust Valve Seat Width dim. (1) - - - - - - - - - - - - - - -
- - - - - - - - - - - - - - - - 8.0 - 8.1 mm (0.315 - 0.319 in.)

Intake Valve Seat-to-Cylinder Head Recess dim. (2) - -
- - - - - - - - - - - - - 11.4 - 11.6 mm (0.4488 - 0.4567 in.)

Exhaust Valve Seat-to-Cylinder Head Recess dim. (2)-
- - - - - - - - - - - - - - -11.4 - 11.6 mm (0.4488 - 0.4567 in.

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Intake Valve Seat Outer Diameter Standard - 35.07 - 35.08 mm (1.3807 - 1.3811 in.)

Intake Valve Seat Outer Diameter Oversize 0.3 - - - - - - - - - - - - - - - - - - 35.37 - 35.38 mm (1.3925 - 1.3929 in.)

Intake Valve Seat Outer Diameter Oversize 0.5 - - - - - - - - - - - - - - - - - - 35.57 - 35.58 mm (1.4004 - 1.4008 in.)

Exhaust Valve Seat Outer Diameter Standard - - - - - - - - - - - - - - - - - - - 40.07 - 40.08 mm (1.5776 - 1.578 in.)

Exhaust Valve Seat Outer Diameter Oversize 0.3 - - - - - - - - - - - - - - - - - - 40.37 - 40.38 mm (1.589 - 1.590 in.)

Exhaust Valve Seat Outer Diameter Oversize 0.5 - - - - - - - - - - - - - - - - - - 40.57 - 40.58 mm (1.5972 - 1.598 in.)

Inlet valve seat ring overlap in cylinder head - - - - - - - - - - - - - - - - - - 0.045 - 0.080 mm (0.0018 - 0.0031 in.)

Exhaust valve seat ring overlap in cylinder head - - - - - - - - - - - - - - - - - - 0.045 - 0.080 mm (0.0018 - 0.0031 in.)

Inlet valve seat ring face to cylinder head contact surface - - - - - - - - - - - - 3.7 - 4.0 mm (0.1457 - 0.1575 in.)

Exhaust valve seat ring face to cylinder head contact surface - - - - - - - - - - - - 3.3 - 3.6 mm (0.130 - 0.1417 in.)

If valve seat is not within specification, recondition valve seat by grinding, or replace valve seat inserts if reconditioning is not possible. **(See "Grind Valve Seats" on page 218).**

Grind Valve Seats

⚠ WARNING

Valve seat grinding should only be done by experienced personnel familiar with equipment and capable of maintaining required specifications. ALWAYS keep work area clean when grinding valve seats. Be sure valve guide bores are clean before grinding valve seats.

If valve seats need grinding, only a few seconds are required to recondition the average valve seat.

Avoid the tendency to grind off too much. Do not use excessive pressure on the grinding stone.

Check the seat width and contact pattern between the seat and valve with bluing.

Seat width **MUST BE** maintained within specification.

Use a vernier caliper or scale to measure seat width.

Thoroughly clean seat area after grinding and replace valves and valve seat inserts as necessary.

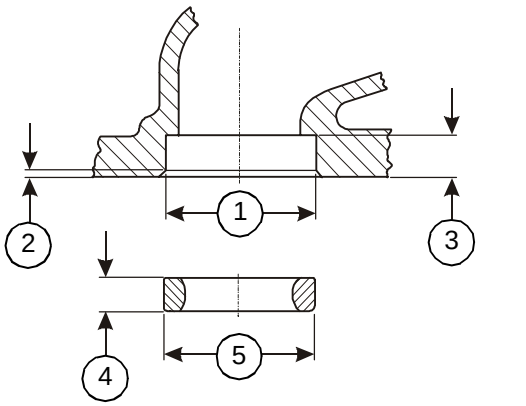
NOTE: Valve seat width can be reduced with a narrowing stone. This will change the angle at the top of the seat and increase the diameter. If valve seat width is too narrow, valve may burn or erode. Varying the width changes the fine contact between valve face and seat.

Grind valve seats to specification. **(See "Measure Valve Seats" on page 217).**

Replace Valve Seat Inserts

⚠ CAUTION

The lower edge of valve seat must not contact bottom of bore in cylinder head or premature valve and valve seat failure will occur. Removal and installation of valve seats and valve seat grinding should only be done by experienced personnel familiar with equipment and capable of maintaining required specifications.



GDL3037CFM

1. ID of Cylinder Head Bore for Valve Seat Insert.
2. Distance from Cylinder Head Surface-to-Valve Seat.
3. Depth of Valve Seat Bore in Cylinder Head.
4. Height of Valve Seat Insert.
5. Valve Seat Insert OD.

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Install valve seat inserts using the following specifications:

Valve Seat Bore Specification

Bore dia. of inlet valve seat rings in cylinder head - standard - - - - - 35.000 - 35.025 mm (1.378 - 1.379 in.)

Bore dia. of inlet valve seat rings in cylinder head - oversize 0.3 mm- 35.30 - 35.325 mm (1.390 - 1.391 in.)

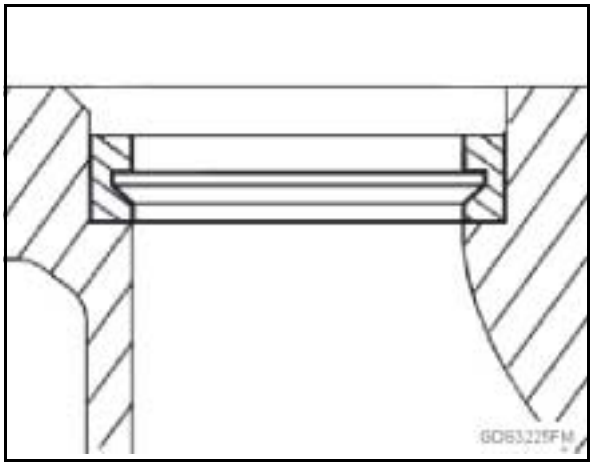
Bore dia. of inlet valve seat rings in cylinder head - oversize 0.5 mm- 35.50 - 35.525 mm (1.398 - 1.399 in.)

Bore dia. of exhaust valve seat rings in cylinder head - standard - - - 40.000 - 40.025 mm (1.5748 - 1.5758 in.)

Bore dia. of inlet valve seat rings in cylinder head - oversize 0.3 mm- 40.30 - 40.325 mm (1.5866 - 1.5876 in.)

Bore dia. of inlet valve seat rings in cylinder head - oversize 0.5 mm- 40.50 - 40.525 mm (1.5945 - 1.5955 in.)

Bore depth of Intake and Exhaust Valve Seat Inserts in cylinder head - 11.4 - 11.6 mm (0.4488 - 0.4567 in.)



Mill a groove in old valve seat ring.

⚠ CAUTION

Place copper plates below the counter supports of the puller to prevent damage to the cylinder head surface.

Attach an internal puller and remove the old valve seat ring.

Install New Valve Seat Rings

NOTE:valve guide bore.

⚠ WARNING

Wear heat-protective clothing and full eye protection. Ensure adequate ventilation. Risk of injury from handling liquid nitrogen or from contact with severely supercooled objects and suffocation from inhaling nitrogen gas.

Place valve seat ring into supercooling box and pour in liquid nitrogen. Cool valve seat for about 20 to 30 minutes.

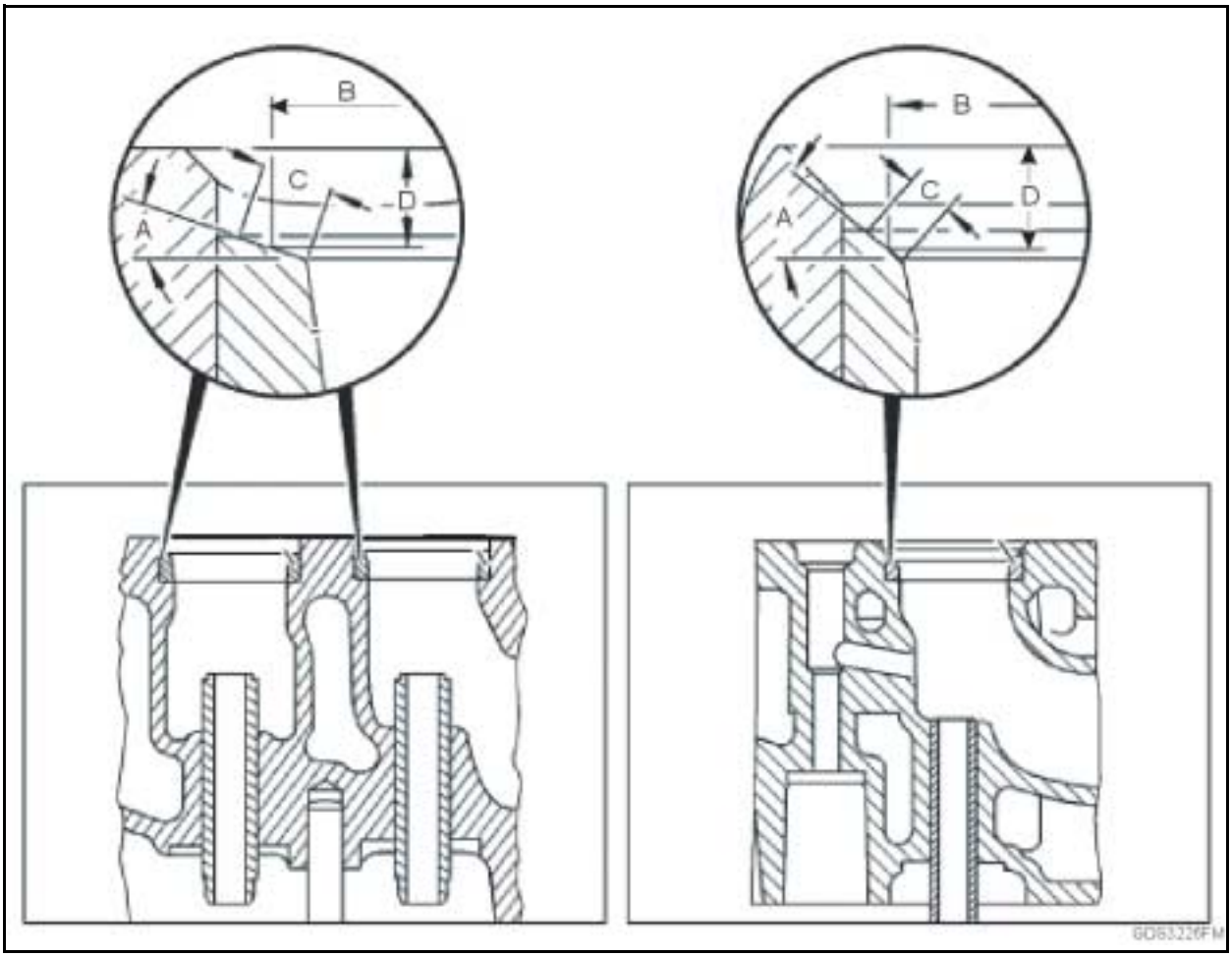
Heat cylinder head in hot water of about 80° C.

Remove valve seat ring from cooling box with pliers and knock into heated cylinder head with a suitable drift.

Machine valve seat ring to specification.

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Valve Seat Ring Machining Specifications



Dimentions

A = 20° inlet

A = 45° exhaust

Inlet valve seat surface dia. B = 31.0 mm (1.2205 in.) at dim. H = 4.2 - 4.4 (0.1654 - 0.1732 in.)

Exhaust valve seat surface dia. B = 36.0 (1.4173 in.) at dim. H = 4.3 - 4.5 mm (0.1693 - 0.1772 in.)

C = 1.5 - 2.5 mm (0.059 - 0.098 in.) inlet.

C = 1.8 - 3.0 mm (0.071 - 0.118 in.) exhaust.

Grinding Valves

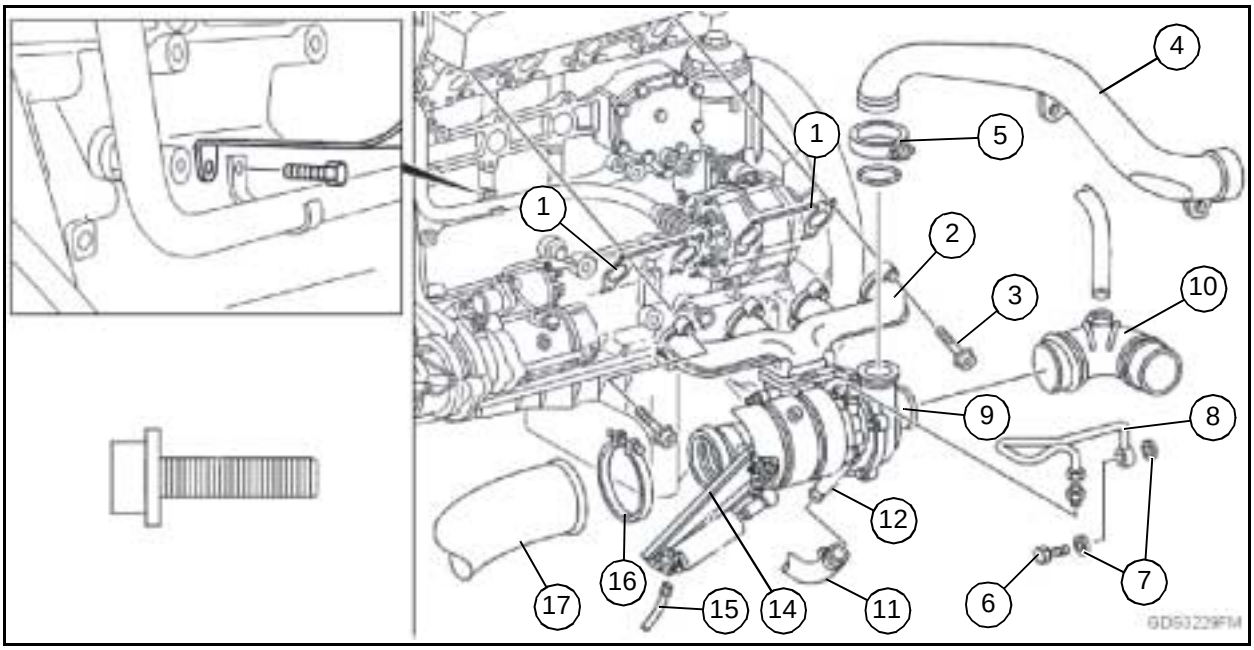
See **“Valve Specifications” on page 212**.

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CHAPTER 4. ENGINE

SECTION 7. EXHAUST SYSTEM

REMOVE AND INSTALL EXHAUST MANIFOLD



1. Gasket.
2. Exhaust Manifold.
3. Exhaust Manifold Bolt.
4. Boost Air Pipe.
5. Clamp.
6. Banjo Bolt.
7. Seal.
8. Oil Delivery Line.
9. Turbocharger.
10. Air Intake Hose.
11. Oil Return Flow Hose.
12. Heat Shield.
13. Bolt.
14. Engine Brake Flap Connection.
15. Compressed Air Line.
16. Clamp.
17. Exhaust Pipe.

⚠ CAUTION

Prevent possible injury from hot exhaust pipes. Exhaust pipes can be hot enough to cause burns. Wait for exhaust pipes to cool before working on the machine.

Remove boost air pipe (4).

Detach exhaust pipe (17) at engine brake flap connection (14).

Detach compressed air line (15).

Detach heat shield (12) at turbocharger.

Detach oil return flow hose (11).

Detach oil delivery line (8) at oil filter and turbocharger. Collect engine oil that flows out.

Detach air intake hose (10) at turbocharger.

Loosen exhaust manifold bolts (3) and exhaust manifold (2).

Remove gaskets (1).

Inspect manifold bolts. If out of specification; replace.

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Detach turbocharger with brake flap connection. Plug holes in turbocharger.

Install in reverse order.

Remove and Install Exhaust Manifold Specification

Exhaust manifold bolt to cylinder head torque 1st stage - 10 Nm (7.376 lb-ft)

Exhaust manifold bolt to cylinder head torque 2 nd stage - 55 Nm (40.566 lb-ft)

Exhaust manifold bolt to cylinder head torque 3 rd stage - 90°

Nut of turbocharger to exhaust manifold - 30 Nm (22.127 lb. ft.)

Bolt of oil delivery line to turbocharger - M8 40 Nm (29.503 lb. ft.)

Bolt of oil delivery line to turbocharger - M6 10 Nm (7.376 lb. ft.)

Exhaust manifold bolt length M10 new- 47 mm (1.85 in.)

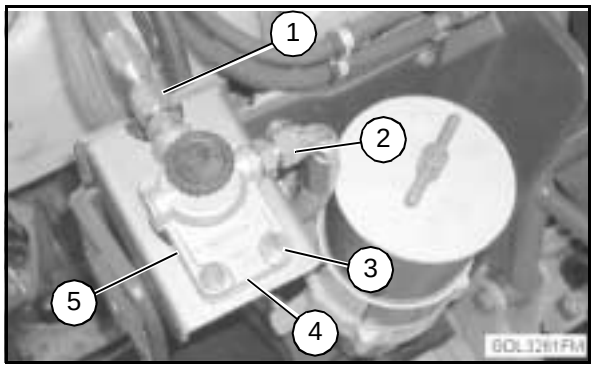
Exhaust manifold bolt length M10 Max - 47.5 mm (1.87 in.)

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CHAPTER 4. ENGINE

SECTION 8. FUEL INJECTION SYSTEM

REMOVE AND INSTALL HAND PRIMER PUMP



Disconnect inlet line (1) and outlet line (2).

Remove cap screws, washers, and nuts (3).

Remove primer (5) and spacer (4).

Clean, repair, or replace parts as necessary. See Clean Fuel Screen. **(See Operator's Manual, CHAPTER 17, SECTION 1)**.

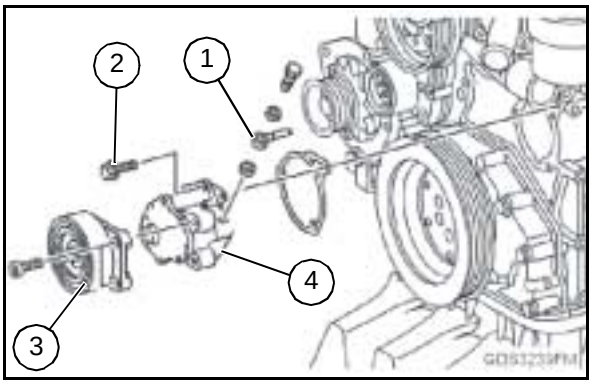
Install spacer, primer, cap screws, washers, and nuts.

Connect inlet line and outlet line.

Prime fuel system. See Prime Fuel System. **(See Operator's Manual, CHAPTER 17, SECTION 1)**.

REMOVE AND INSTALL FUEL SUPPLY PUMP

Raise cab. See Tilt Cab. **(See Operator's Manual CHAPTER 7, SECTION 1).**



Disconnect fuel inlet line (1).

Remove bolts (2), guide pulley assembly

(3) and fuel supply pump (4).

Install fuel supply pump and cap screws. Tighten cap screws to specification.

Fuel Supply Pump Specification

Mounting Bolt Torque - - - - - - - - - - 25 Nm (18.44 lb-ft)

Connect fuel inlet line and fuel outlet line. Tighten banjo fittings to specification.

Fuel Supply Pump Specification

Banjo Fittings Torque - - - - - - - - - - 25 Nm (18.44 lb-ft)

Fuel Supply Pump Specification

Cap To Fuel Filter Housing Torque- - - 40 Nm (30 lb-ft)

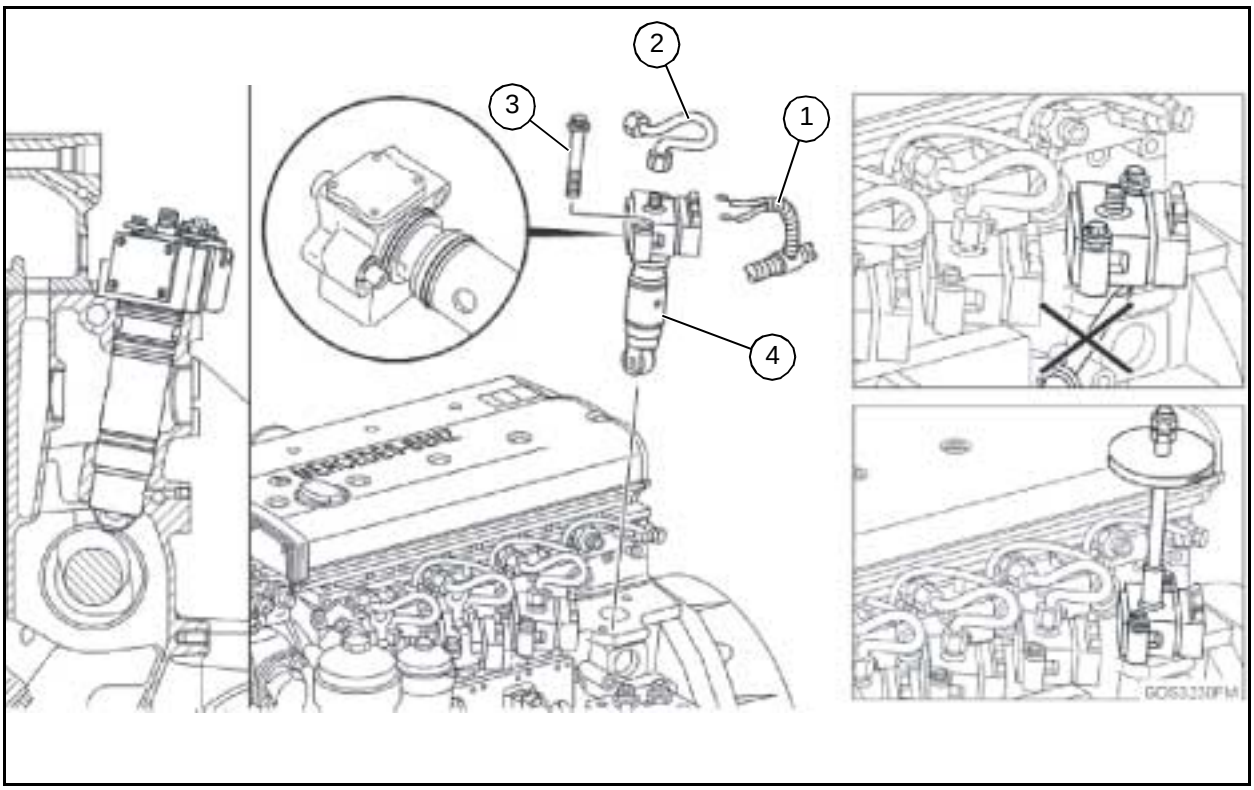
Lower cab. **See Tilt Cab. (See Operator's Manual CHAPTER 7, SECTION 1).**

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REMOVE AND INSTALL ELECTRONIC UNIT INJECTOR (EUI)

Turn battery disconnect switch to OFF.

Remove air intake manifold. **(See "REMOVE AND INSTALL AIR INTAKE MANIFOLD" on page 225).**



Disconnect engine harness (1) from electronic unit injector (EUI).

Remove fuel line (2) from EUI and cylinder head.

If EUI is difficult to remove, rotate engine in direction of rotation to press EUI out of crankcase. To help this, a sliding hammer can also be used.

Remove cap screws (3) and EUI (4).

Inspect EUI. Replace o-rings, if necessary.

Install EUI and cap screws.

Electronic Unit Injector (EUI) Specification

Cap Screw Torque- - - - - - - - - - - - - - - 65 Nm (48 lb-ft)

Install fuel line to cylinder head and EUI.

Connect engine harness to EUI.

Install air intake manifold. **(See "REMOVE AND INSTALL AIR INTAKE MANIFOLD" on page 225).**

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CHAPTER 4. ENGINE

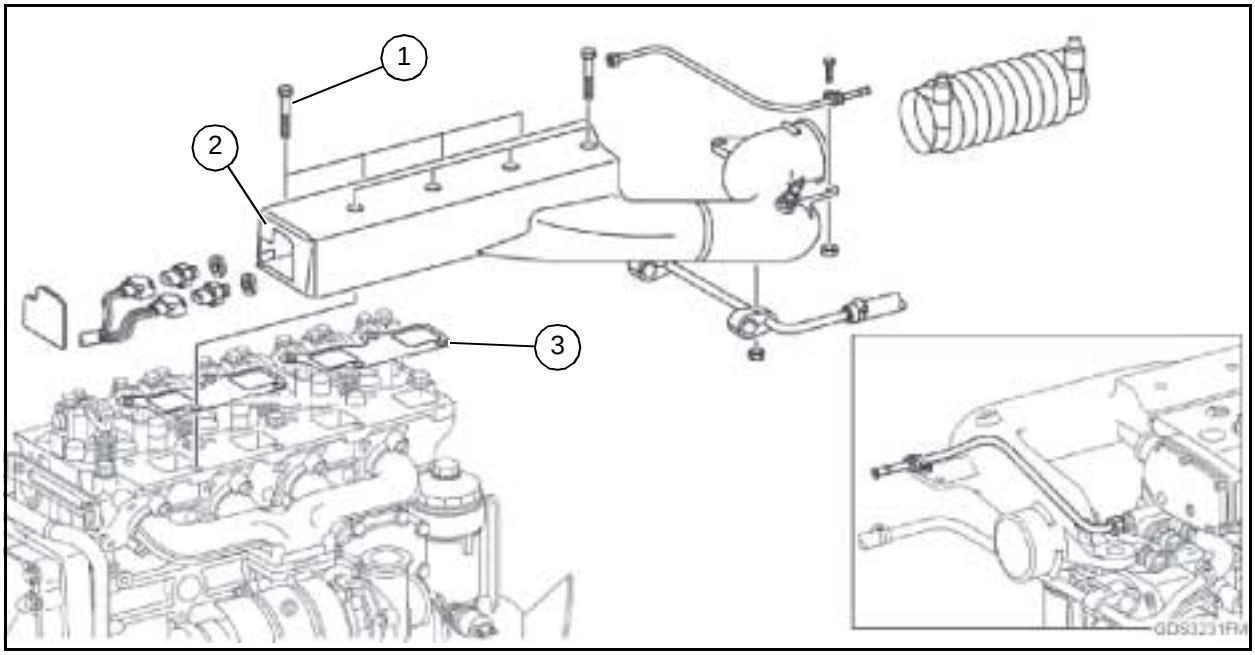
SECTION 9. AIR INTAKE MANIFOLD SYSTEM

REMOVE AND INSTALL AIR INTAKE MANIFOLD

Drain coolant. **(See CHAPTER 11, SECTION 2 in the Operator's Manual).**

Disconnect wire connector on cold start unit.

Disconnect all pipes and connectors.



1. Screw.
2. Intake Manifold.
3. Gasket.

Loosen the screws (1) and remove.

Take off intake manifold (2).

Remove old gasket (3).

Clean and inspect manifold.

Install new gasket onto cylinder head.

Install in reverse order.

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CHAPTER 4. ENGINE

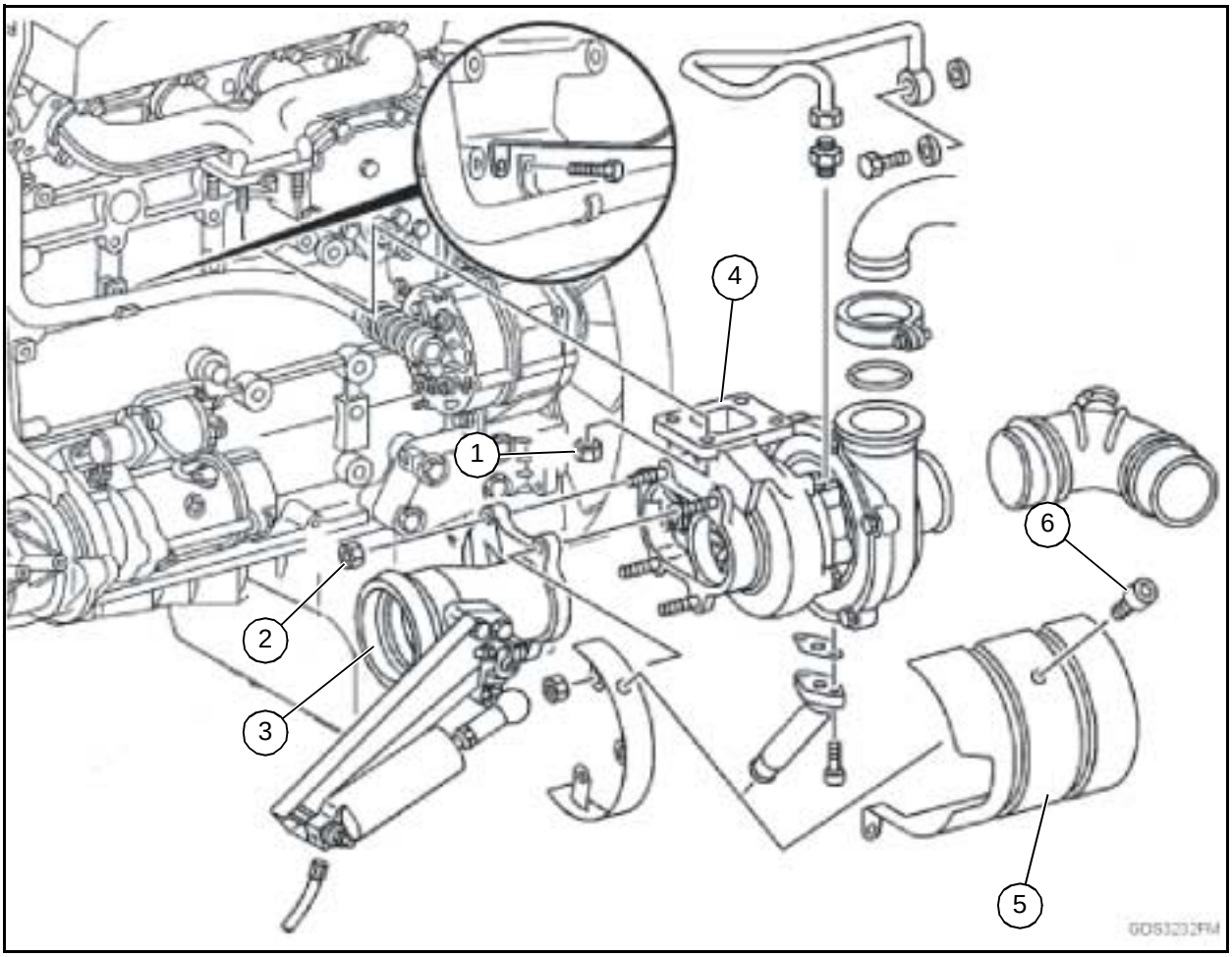
SECTION 10. TURBOCHARGER

TURBOCHARGER

Remove and Install Turbocharger

⚠ CAUTION

Prevent possible injury from hot exhaust pipes and turbocharger. Exhaust pipes and turbocharger can be hot enough to cause burns. Wait for exhaust pipes and turbocharger to cool before working on the machine.



1. Nut.
2. Nut.
3. Exhaust Brake Flap Assembly.
4. Turbocharger.
5. Heat Shield.
6. Cap Screw.

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Remove screw (6) and heat shield (5).

Disconnect air intake hose.

Disconnect oil return line.

Remove oil delivery pipe.

Remove nuts (2) and remove exhaust brake flap assembly (3).

Remove nuts (1) and remove turbocharger (4).

Assemble in reverse order.

Tighten to specification.

Remove and Install Turbocharger Specification

Turbocharger Mounting Nuts Torque
- 30 Nm (22.127 lb-ft)

Bake flap to Turbocharger Mounting Nuts (M8) Torque
- 30 Nm (22.127 lb-ft)

Bake flap to Turbocharger Mounting Nuts (M10) Torque
- 50 Nm (36.88 lb-ft)

Using new gaskets and sealing washers, install oil delivery and return pipes.

Tighten hardware to specification.

Remove and Install Turbocharger Specification

Oil Delivery and Return Lines Cap Screws (M6)Torque
- 10 Nm (7.376 lb-in.)

Oil Delivery and Return Lines Cap Screws (M8)Torque
- 40 Nm (29.5 lb-in.)

Connect boot (4) and pipe (15).

Turbocharger Lubrication

⚠ CAUTION

Never spin the turbocharger turbine and compressor with compressed air. Damage to the turbine shaft and bearings can occur because there is no lubrication to the bearings.

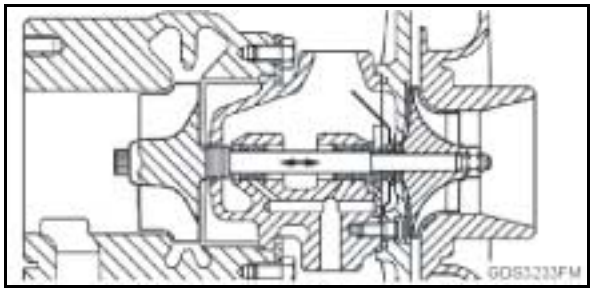
Fill oil return (drain) port with clean engine oil.

Turn the compressor and turbine by hand to properly lubricate turbine shaft and bearings.

If turbocharger is to be stored for an extended period of time, lubricate internally and install protective covers on all openings.

Radial Bearing Clearance Check

NOTE:1. This test will give an indication of the condition of the radial bearings within the centre housing and rotating assembly.
2. Radial clearance is determined only at the turbine end of turbocharger.



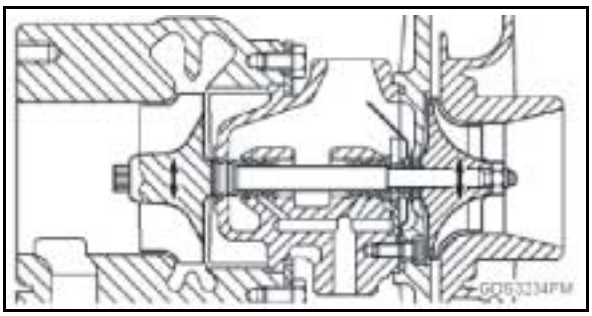
Press turbine wheel to the side. Inspect whether there is any sign of touching the turbine or compressor wheel.

If there is no sign of the rotor shaft touching the turbocharger housing the axial play is “OK”. Replace the turbocharger if there are any signs of it touching.

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Axial Bearing End Play Check

This test will give an indication of the condition of the thrust bearing within the center housing and rotating assembly.



Deflect rotor shaft in radial direction while turning shaft. Check if turbine is touching turbocharger housing.

If not, the turbocharger is still “OK”.

Replace turbocharger if there is any sign of touching.

Turbocharger Seven-Step Inspection

The following inspection procedure is recommended for systematic failure analysis of a suspected failed turbocharger. This procedure will help to identify when a turbocharger has failed, and why it has failed so the primary cause of the failure can be corrected.

Proper diagnosis of a non-failed turbocharger is important for two reasons. First, identification of a non-failed turbocharger will lead to further investigation and repair of the cause of a performance complaint.

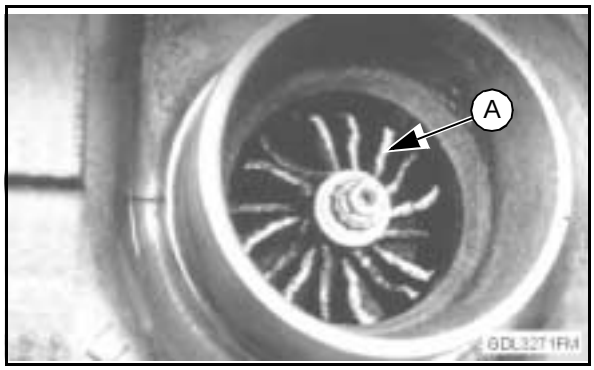
Second, proper diagnosis eliminates the unnecessary expense incurred when a non-failed turbocharger is replaced.

The seven recommended inspection steps, which are explained in detail on following pages, are:

- Compressor Housing Inlet and Compressor Wheel.
- Compressor Housing Outlet.
- Turbine Housing Inlet.
- Turbine Housing Outlet and Turbine Wheel.
- External Center Housing and Joints.
- Internal Center Housing.
- Turbocharger Bench Test.

NOTE:1. To enhance the turbocharger inspection, an inspection sheet (Form No. DF-2280 available from Distribution Service Center - English only) can be used that lists the inspection steps in the proper order and shows potential failure modes for each step.
2. Check off each step as you complete the inspection and record any details or problems obtained during inspection.
3. Retain this with the work order for future reference.

Compressor Housing Inlet and Compressor Wheel



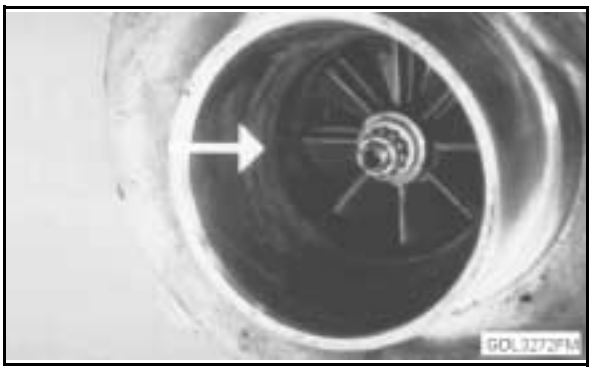
Check compressor inlet and compressor wheel (A) for foreign object damage.

NOTE:Foreign object damage may be extensive or minor. In either case, the source of the foreign object must be found and corrected to eliminate further damage.

Mark findings on your checklist and continue the inspection.

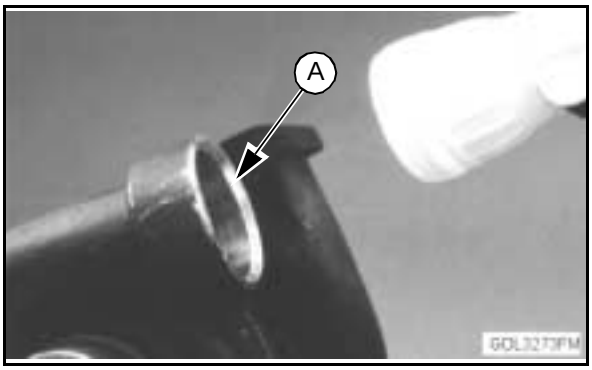
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NOTE: You will need a good light source for this check.



Check compressor inlet for wheel rub on the housing (arrow). Look very closely for any score marks on the housing itself and check the tips of the compressor wheel blades for damage.

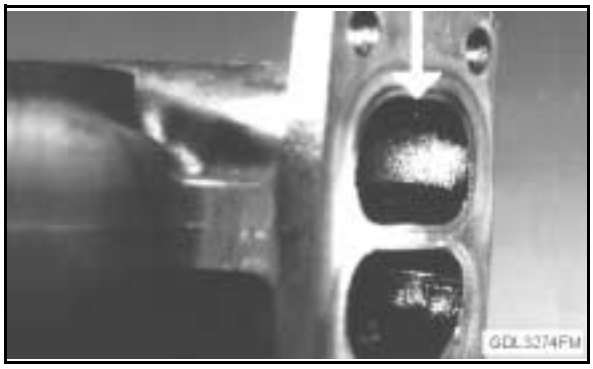
Compressor Housing Outlet



Check compressor housing outlet (A). The outlet should be clean and free of dirt or oil.

Mark it on your checklist if dirt or oil is found and continue the inspection.

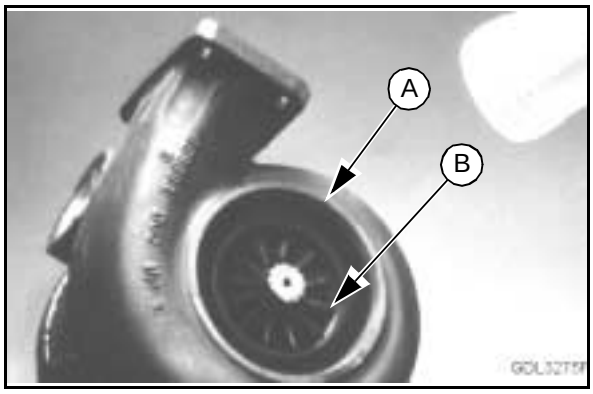
Turbine Housing Inlet



Check the turbine housing inlet ports (arrow) for oil in housing, excessive carbon deposit or erosion of center walls.

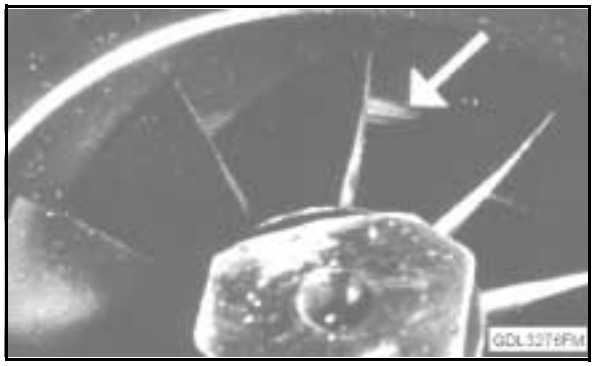
NOTE: If the inlet is wet with oil, or has excessive carbon deposits, an engine problem is likely. Center wall erosion (cracking or missing pieces), indicate excessive exhaust temperature.

Turbine Housing Outlet and Turbine Wheel



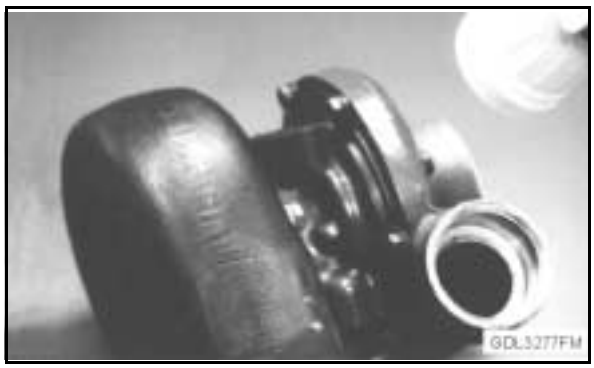
Use a flashlight to look up inside the turbine housing outlet (A) and check blades (B) for foreign object damage.

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Inspect the wheel blades and housing for evidence of wheel rub (arrow). Wheel rub can bend the tips of the blades with the housing showing wear or damage.

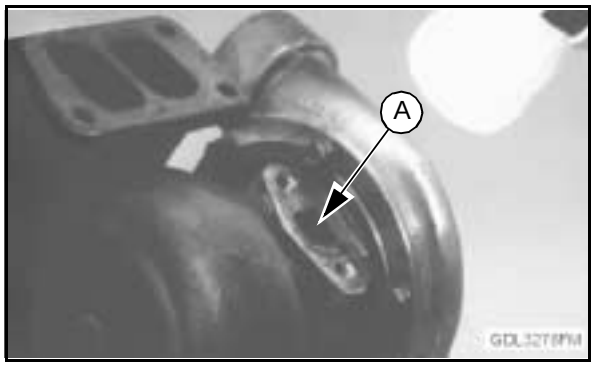
External Center Housing and Joints



Visually check the outside of the center housing, all connections to the compressor, and turbine housing for oil.

NOTE: If oil is present, make sure it is not coming from a leak at the oil supply or return line.

Internal Center Housing



Using a flashlight, look through the oil return hole (A), to check the condition of the shaft and/or bearings.

There should not be excess carbon deposits on the shaft or in the housing.



Excessive “**blueing**” or “**coking**” of oil along the complete length of the shaft indicates a possible lack of lubrication caused by an engine failure, or improper operation, such as hot shutdowns.

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Turbocharger Bench Test

Mount the turbocharger in a vise.



Rotate the shaft, using both hands, to check rotation and clearance. The shaft should turn freely, however, there may be a slight amount of drag.

⚠ CAUTION

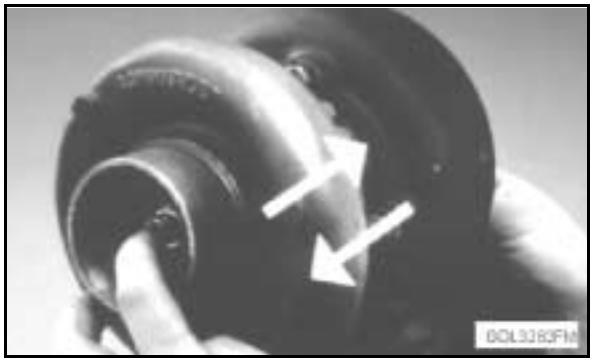
Use only moderate hand force of 0.7 - 0.9 N (3 - 4 lb-force) on each end of shaft.



Next, pull up on the compressor end of the shaft and press down on the turbine end while rotating shaft.

Neither the compressor wheel nor the turbine wheel should contact the housing at any point.

NOTE: There will be some “play” because the bearings inside the center housing are free floating.



Next, check shaft endplay by moving the shaft back and forth while rotating. There will be some endplay but not to the extent that the wheels contact the housings.

NOTE: These diagnostic procedures will allow you to determine the condition of the turbocharger. If the turbocharger has failed, analysis of your inspection notes should direct you to the specific areas of the engine to correct the problems causing the turbocharger failure. It is not unusual to find that a turbocharger has not failed. If your turbocharger passes all the inspections, the problem lies somewhere else.

⚠ WARNING

Before you finalize your conclusion that the turbocharger has not failed, it is strongly recommended that the following procedures of checking radial bearing clearance and axial bearing endplay with a dial indicator be performed. These procedures are not required if a failure mode has already been identified.

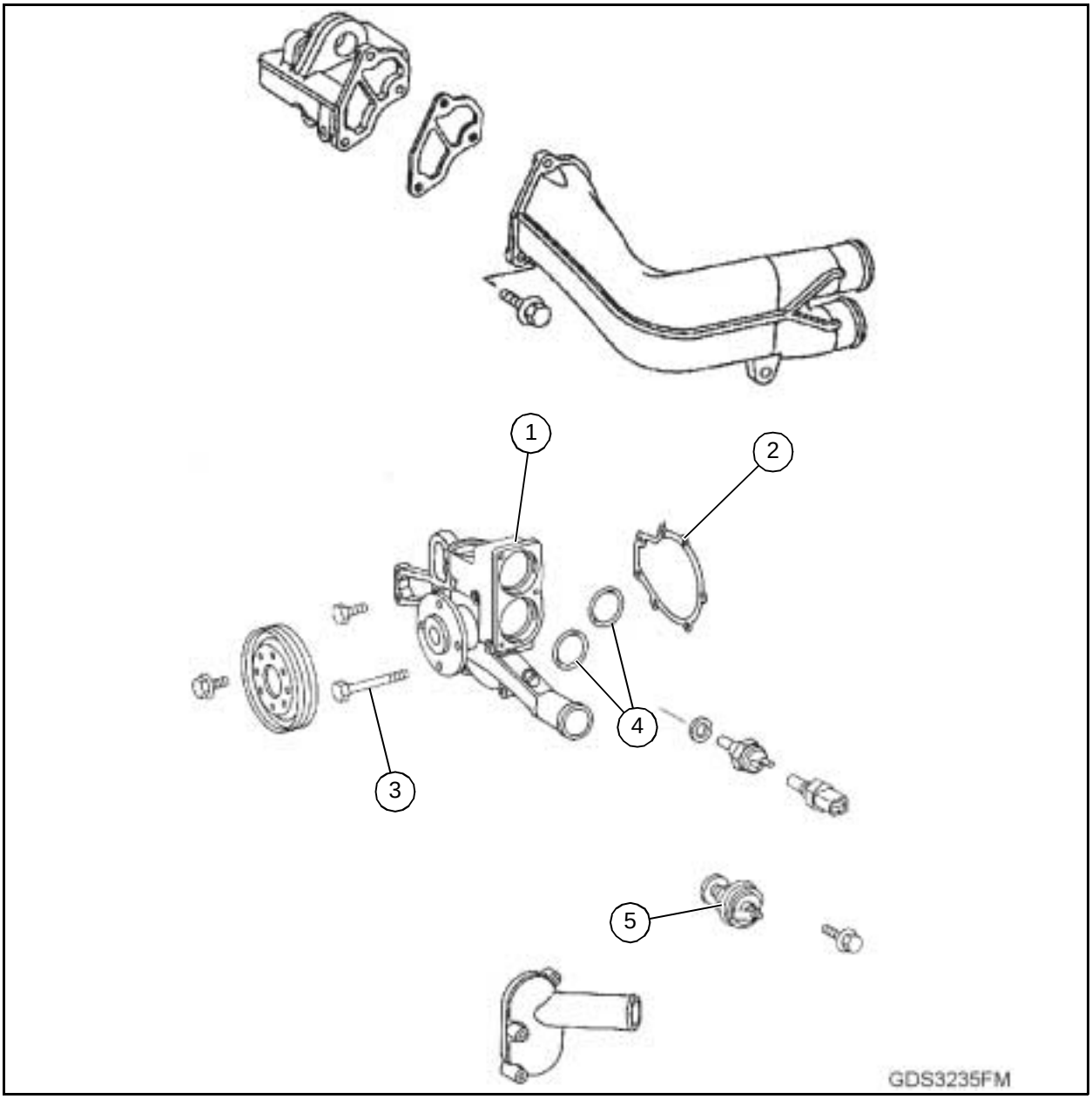
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CHAPTER 4. ENGINE

SECTION 11. COOLING SYSTEM

WATER PUMP

Remove and Install Water Pump



1. Water Pump.
2. Gasket.
3. Bolt (9 Used).
4. O-ring.
5. Thermostat (2 used).

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Remove and Install Thermostats and Housing

(See "THERMOSTATS AND HOUSING" on page 237).

Loosen belt and remove from pulley

Remove bolts and disconnect adapter pipe from water pump (1).

Remove pulley.

Remove bolts (3) and remove water pump.

Repair or replace as required.

Install water pump using a new gasket (2) and bolts (3).

Tighten to specification.

Remove and Install Water Pump Specification

Water Pump bolts To CrankcaseTorque
- 25 Nm (221 lb-in.)

Install pulley.

Tighten bolts to specification.

Remove and Install Water Pump Specification

Water Pump Pulley bolts Torque
- 25 Nm (221 lb-in.)

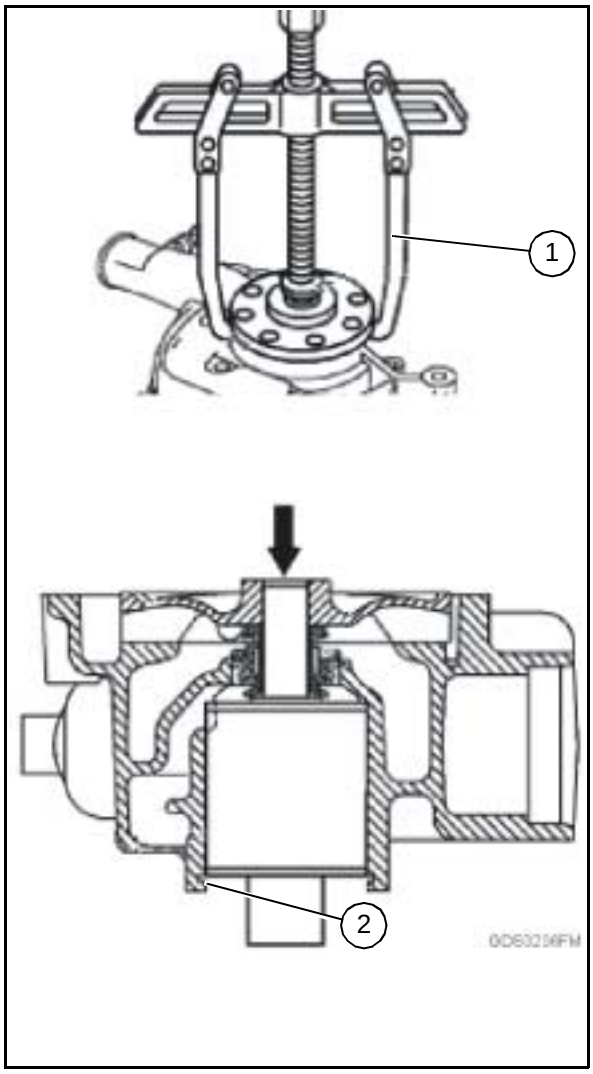
Install belt.

Install thermostat housing. **(See "Remove And Install Thermostats And Housing" on page 237)**

Disassemble and Assemble

Remove water pump from engine. **(See "WATER PUMP" on page 233).**

Remove thermostats and housing. **(See "Remove And Install Thermostats And Housing" on page 237).**

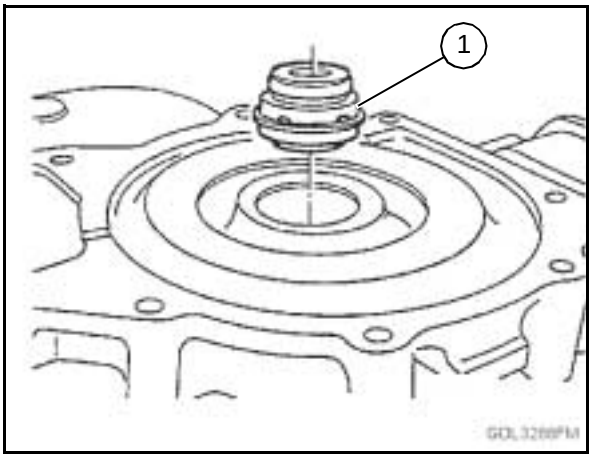


Remove water pump pulley hub (1) with a gear puller.

Remove snap ring (2) from front bore of water pump housing with snap ring pliers.

Use a suitable drift to press bearing out of the impeller and coolant pump housing.

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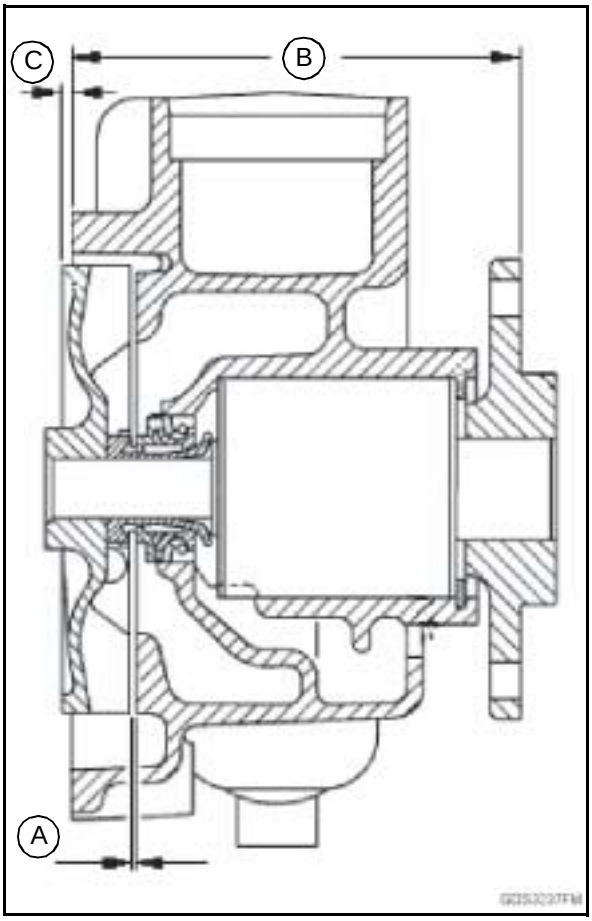


Remove and discard cassette-type seal (1).

Inspect water pump housing for cracks or damage. Inspect parts for wear or damage. Inspect weep holes for oil or coolant leakage.

Remove gasket material from housing and clean with suitable solvent. Dry thoroughly.

Measure water pump housing and parts. Measurements must be within specification.



A. Gap between impeller and coolant pump housing.
B. Distance between coolant pump housing and flange.
C. Projection of impeller and coolant pump housing.

Water Pump Specification

Dimension A - - - - - - - 0.6 - 1.0 mm (0.024 - 0.039 in.)
Dimension B - - - - 112.7 - 113.3 mm (4.437 - 4.461 in.)
Dimension C - - - - - - - - - - - - - - - - - -0.5 mm (0.02 in.)

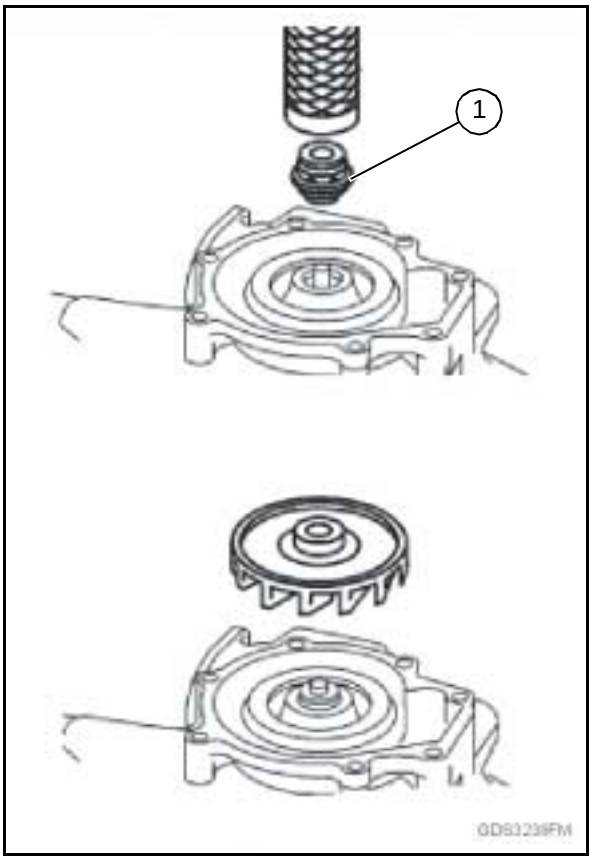
NOTE:Oil leakage indicates a damaged sealed bearing. Coolant leakage indicates a damaged housing seal.

Assemble Water pump

⚠ WARNING

DO NOT press against end of bearing shaft. Only press against outer race when installing bearing and shaft into housing.

Oil bearing with engine oil at outer race.



Press bearing outer race (1) into water pump housing using a suitable drift.

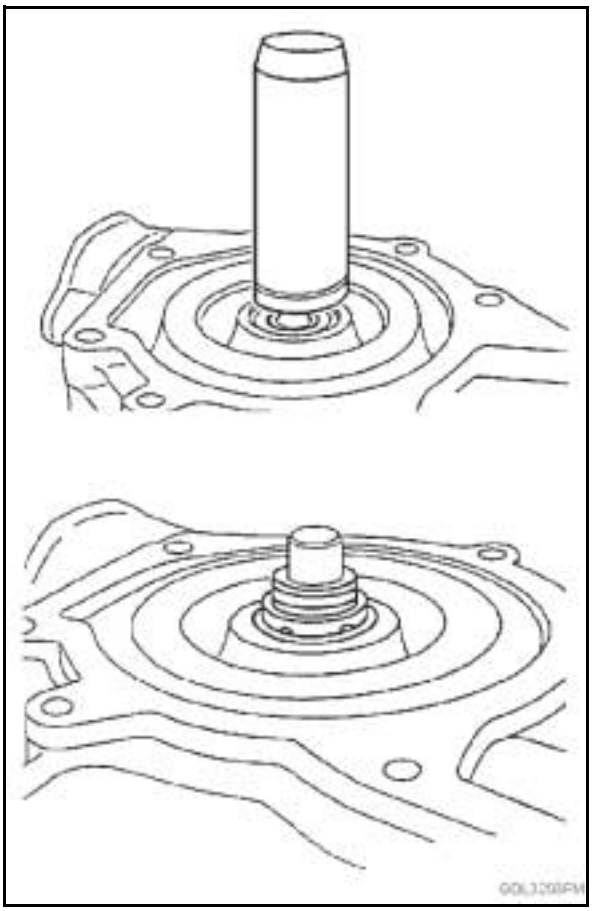
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⚠ WARNING

Wear protective gloves, protective clothing and if required protective goggles.

Install internal snap ring with snap ring pliers.

Heat flange and press onto bearing with shaft. Measure size B.



Install new cassette-type bearing over the shaft using a suitable drift to press in as far as coolant pump housing.

Press impeller onto shaft and measure distance C.

Rotate coolant pump flange and check for free rotation.

Install water pump onto the engine.

Install in reverse order.

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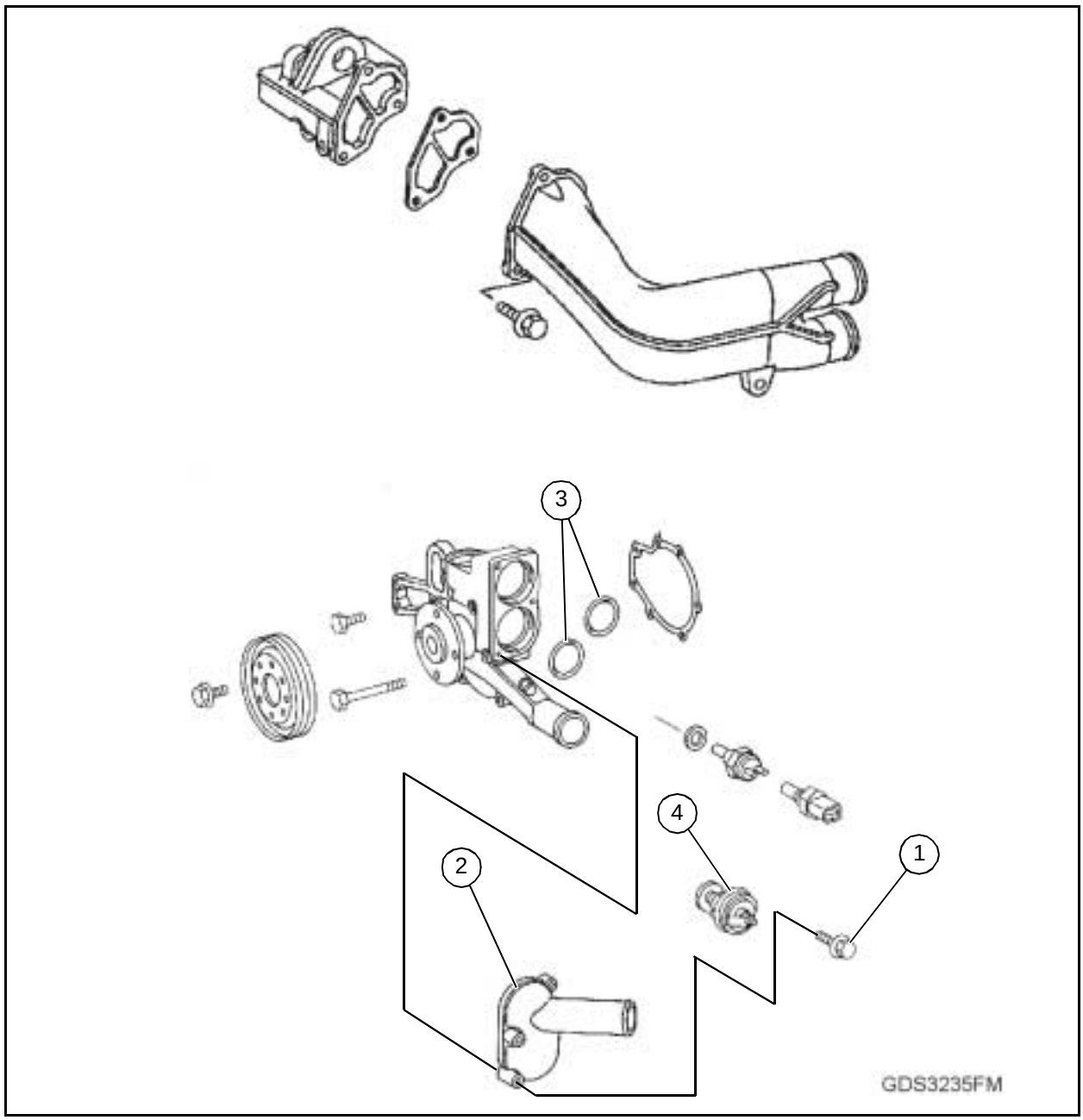
CHAPTER 4. ENGINE

SECTION 12. THERMOSTATS, HOUSING AND WATER PIPING

THERMOSTATS AND HOUSING

Remove And Install Thermostats And Housing

Drain coolant from engine. (**See Change Engine Coolant In Operator's Manual, CHAPTER 11, SECTION 2).**



Disconnect upper radiator hose coolant pipe.

Remove bolts (1).

Remove coolant pipe (2).

Remove the O-Rings (3).

Remove the thermostats (4).

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⚠ CAUTION

Bleed hole in thermostat must be to the top for cooling system to properly purge itself of all trapped air.

Install thermostats in thermostat housing so bleed hole is to the top.

Install new O-rings (3).

Install coolant pipe and bolts. Tighten bolts to specification.

Coolant Pipe Specification

bolts Torque - - - - - - - - - - - - - - - - 25 Nm (18.44 lb-in).

Fill engine coolant. **(See Change Engine Coolant. in Operator's Manual, CHAPTER 11, SECTION 2).**

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CHAPTER 5. ENGINE AUXILIARY SYSTEM

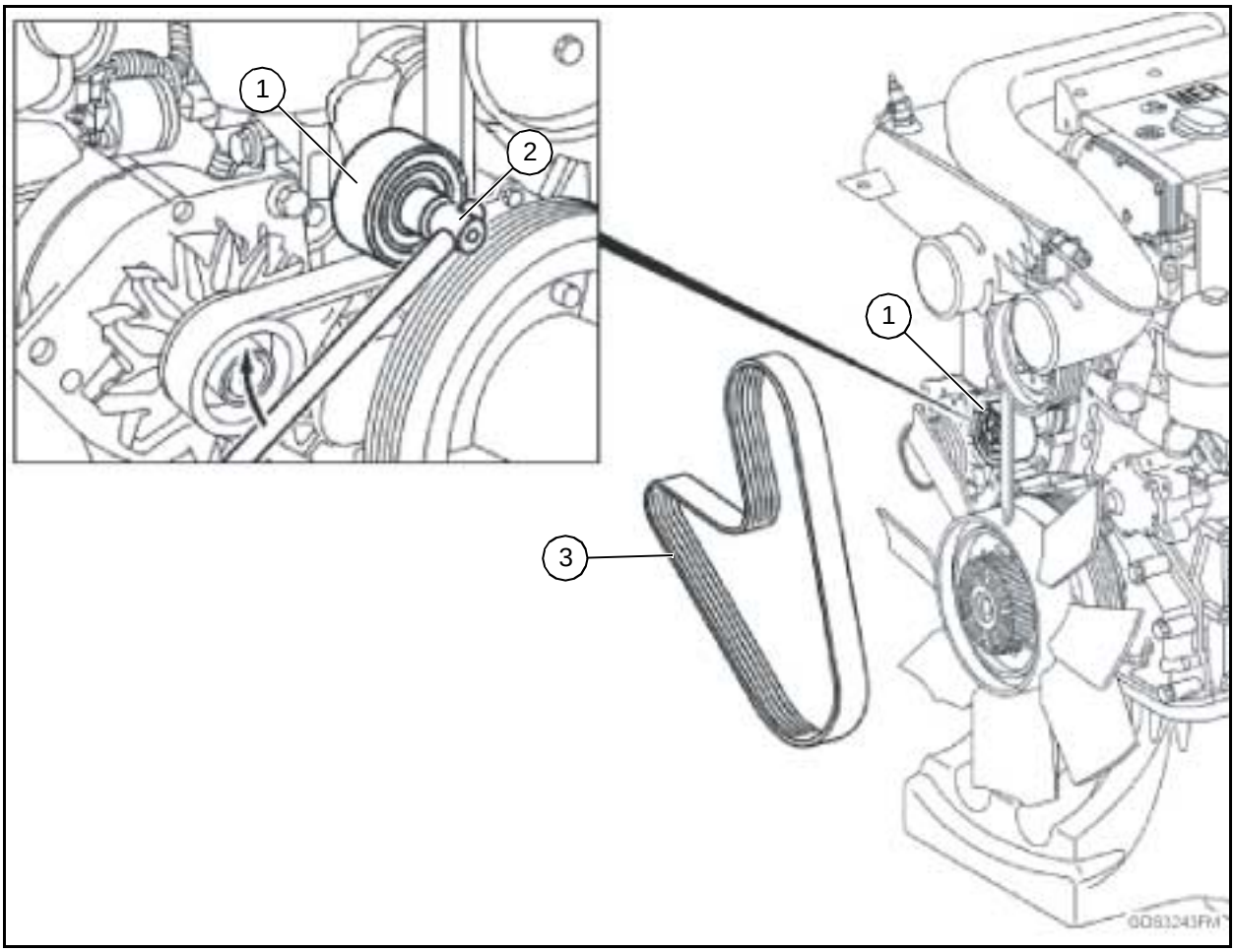
SECTION 1. COOLING SYSTEM

FAN BELT

Remove and Install Fan Belt

Remove fan guard.

NOTE:Belt must be moved between fan and fan shroud for removal and installation.



Use T-bar (2), rotate tensioner lever counterclockwise. Remove belt from tensioner pulley (1). Remove belt from other pulleys.

Remove belt (3) from machine.

Install belt on machine. Ensure belt is correctly seated on all pulleys.

Rotate tensioner lever counterclockwise and install belt on tensioner pulley.

Install fan finger guard.

Assemble in reverse order.

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CHAPTER 5. ENGINE AUXILIARY SYSTEM

SECTION 2. AIR INTAKE SYSTEM

INTAKE SYSTEM

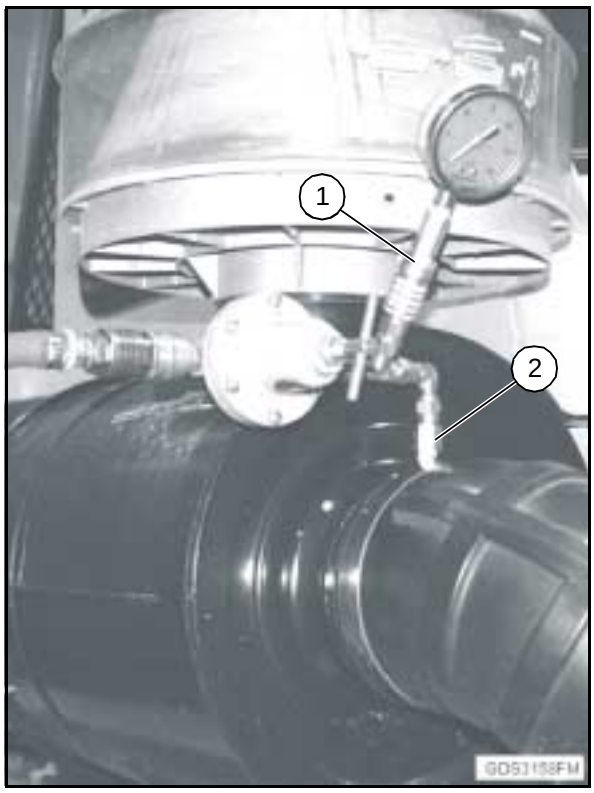
Leakage Check

Remove air cleaner cover. Remove primary air filter element.



Install large plastic bag on primary air filter element as shown.

Install primary air filter element. Install air cleaner cover.



Remove air restriction indicator. Connect air pressure regulator (1) to air cleaner using hose and fitting (2) from JDE147 Manifold Pressure Tester.

Pressurize air intake system to specifications. Turn engine slightly to close valves, if necessary.

Air Intake System Specification

Leakage Test Pressure - 14 - 34.5 kPa (0.14 - 0.345 bar) (2 - 5 psi)

Spray a soap solution over all connections from the air cleaner to turbochargers. Check for air leaks.

Tighten clamps or replace parts as needed.

Remove test assembly. Install air restriction indicator.

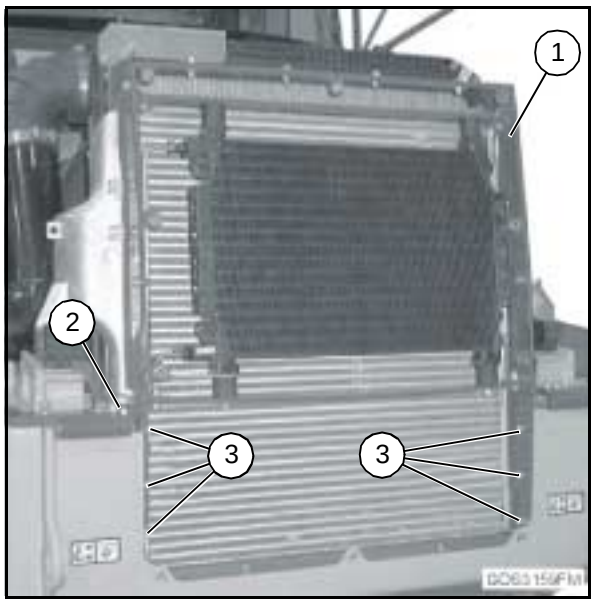
Remove plastic bag from primary air filter element. Assemble air cleaner.

Remove and Install Charge Air Aftercooler

Remove Hood. **(See Hood in CHAPTER 13, SECTION 1).**

Remove grille.

Drain radiator. **(See Change Engine Coolant in Operator's Manual, CHAPTER 11, SECTION 2).**



Disconnect refrigerant lines (2). Close all openings with caps and plugs. **(See Remove and Install Condenser CHAPTER 12, SECTION 3).**

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Remove cap screws (3) from condenser mounting frame (1). Remove mounting frame and condenser from machine.

Remove hoses from charge air aftercooler.

Remove hoses from radiator.

Remove fan guards.

⚠ CAUTION

Component is heavy. Use hoist.

Attach hoist to lifting flanges (6).

Remove cap screws (8). Remove aftercooler and radiator from machine.

Inspect and replace parts as necessary.

Install aftercooler and radiator in machine. Install cap screws.

Install fan guards.

Install hoses on radiator.

Install hoses on aftercooler.

Install condenser and mounting frame. Ensure that mounting frame forms a tight seal against face of aftercooler.

Connect condenser refrigerant lines. **(See Remove and Install Condenser in CHAPTER 12, SECTION 3.)**

Fill radiator. **(See Change Engine Coolant in Operator's Manual, CHAPTER 11, SECTION 2).**

Install grille.

Install Hood. **(See Hood in CHAPTER 13, SECTION 1.)**

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CHAPTER 5. ENGINE AUXILIARY SYSTEM

SECTION 3. EXTERNAL EXHAUST SYSTEM

MUFLER AND EXHAUST PIPES

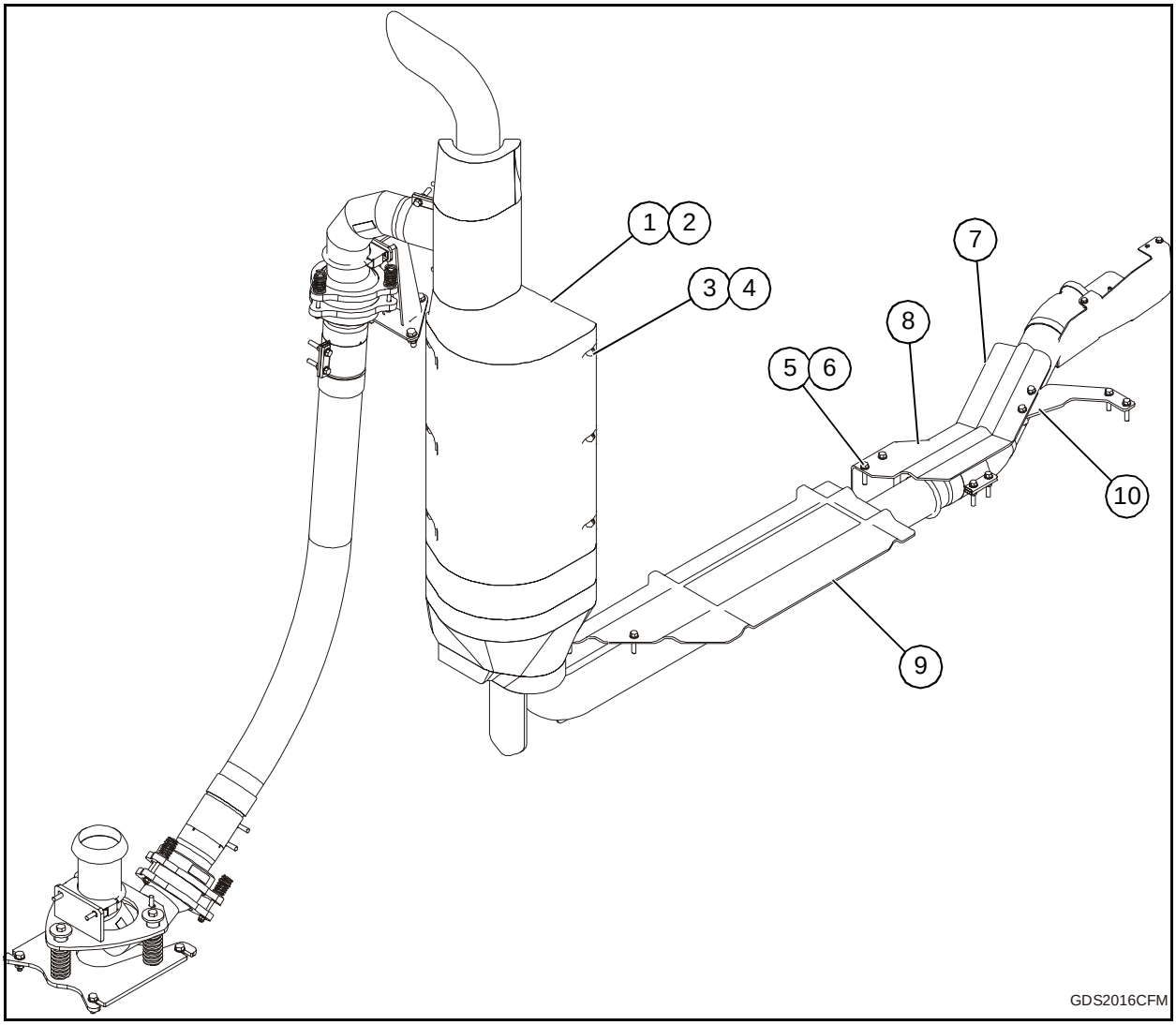
Remove and Install Muffler and Exhaust Pipes

Tilt Cab **(Operator's Manual, CHAPTER 7, SECTION 1)**.

⚠ CAUTION

Exhaust pipes and muffler can be hot.

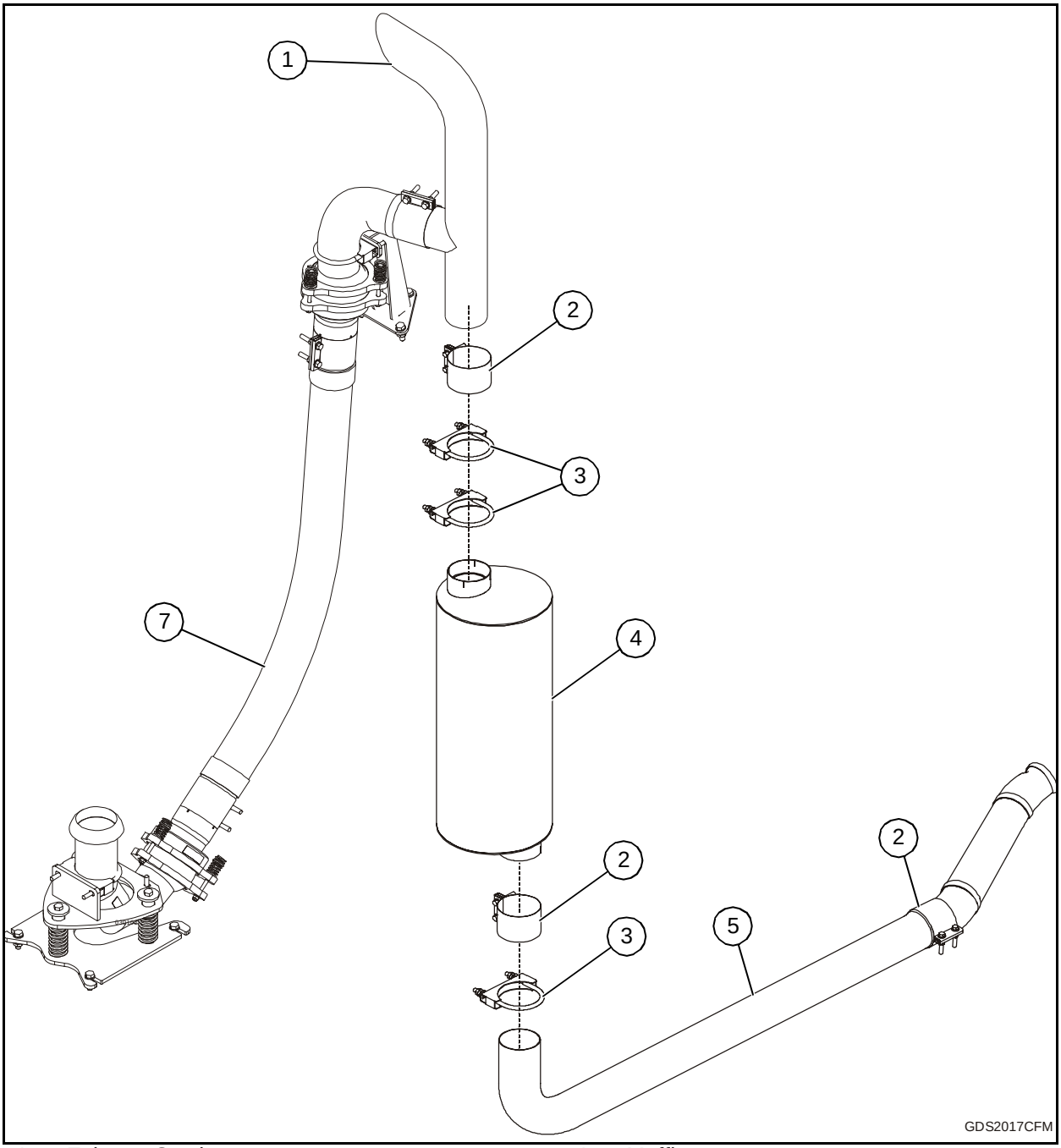
Allow the exhaust parts to cool before servicing.



1. Exhaust Shield.
2. Exhaust Shield.
3. Washer (8 used).
4. Bolt (8 used).
5. Washer.
6. Bolt.
7. Shield.
8. Shield.
9. Shield.
10. Bracket.

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Remove parts (1 - 11) as necessary to access muffler and exhaust pipes.



1. Exhaust Stack.
2. Seal Clamp.
3. Clamp.
4. Muffler.
5. Exhaust Pipe.
7. Bin Heating Exhaust Pipe Assembly.

Repair or replace parts (1 - 7), as necessary.

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Remove and Install Exhaust Brake Valve Flapper

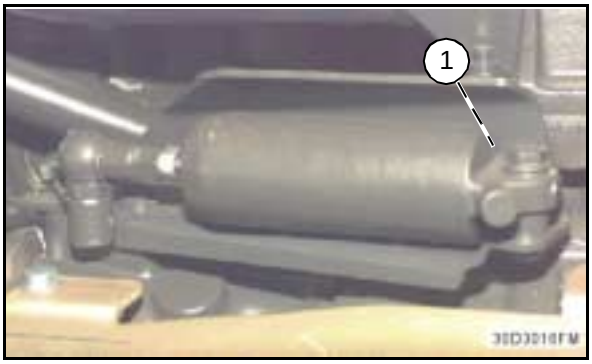
Relieve Pneumatic Pressure.

Tilt Cab. **(See Operator's Manual, CHAPTER 7, SECTION 1).**

⚠ CAUTION

Exhaust pipes and muffler can be hot.

Allow the exhaust parts to cool before servicing.



Disconnect air line (1).

Loosen link.

Unscrew bolt and remove.

Remove valve assembly from machine. Cover turbocharger exhaust port.

Inspect and replace parts, as necessary.

Install valve assembly on machine.

Connect air line.

Body Heater Pipes

Remove and Install

⚠ CAUTION

Prevent personal injury from unexpected machine movement. Always install the dump body prop and articulation safety lock bar before working with the body raised and in the articulation joint area.

Install Articulation Safety Lock Bar. **(See Operator's Manual, CHAPTER 7, SECTION 1).**

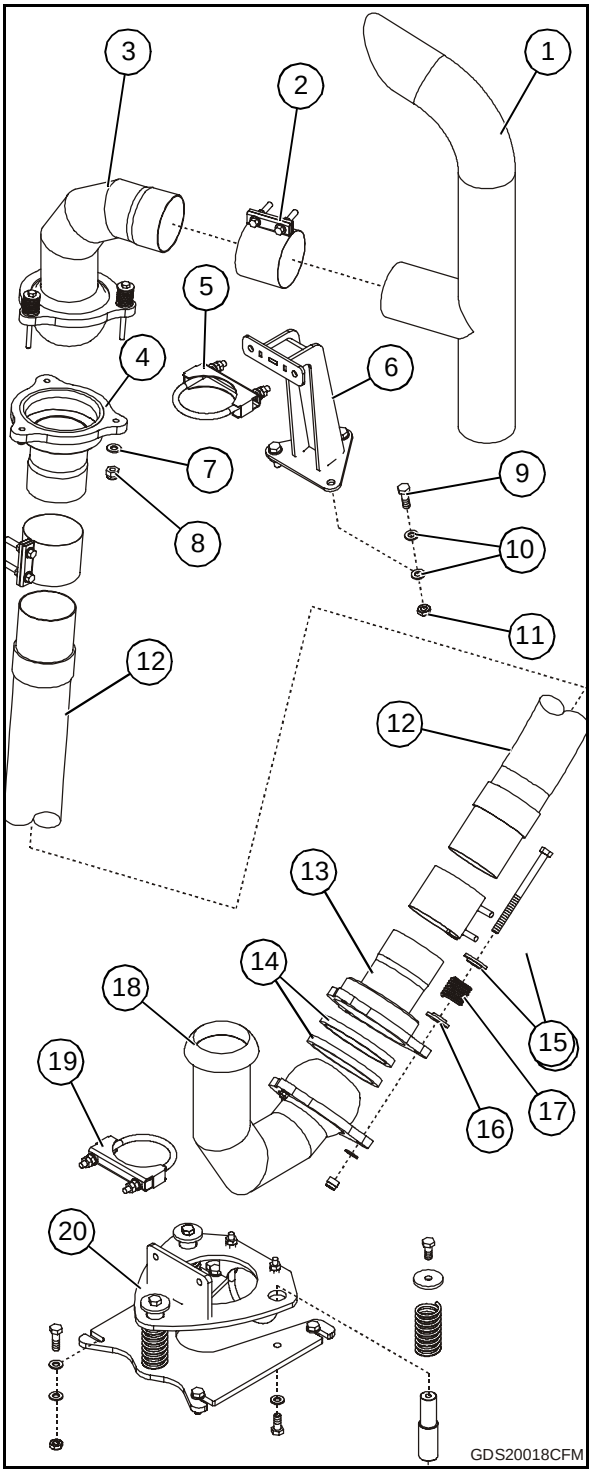
Install Bin Prop. **(See Operator's Manual, CHAPTER 7, SECTION 1).**

⚠ CAUTION

Exhaust pipes and muffler can be hot.

Allow the exhaust parts to cool before servicing.

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1. Exhaust Stack.
2. Seal Clamp.
3. Exhaust Pipe Elbow.
4. Exhaust Pipe Fitting.
5. Clamp.
6. Support Bracket.
7. Washer.
8. Lock Nut.
9. Bolts.
10. Washer.
11. Nut.
12. Flexible Exhaust Pipe.
13. Exhaust Pipe Fitting.
14. Seal.
15. Bolts.
16. Spring Washer.
17. Spring.
18. Exhaust Pipe Swivel.
19. Clamp.
20. Support.

Remove and repair or replace parts (1 - 20), as necessary.

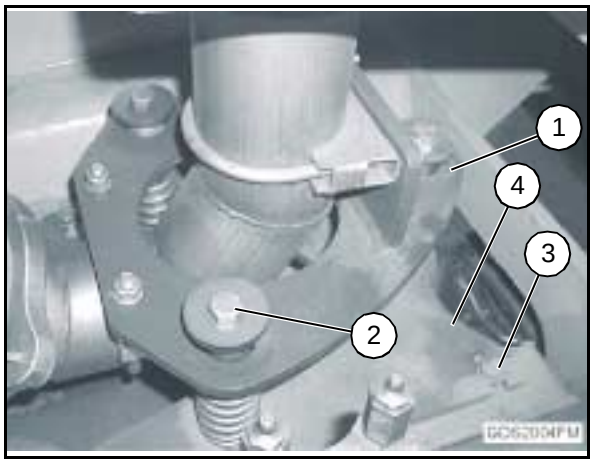
Tighten bolts and nuts in all seal clamps (2).

Adjust body heater exhaust collar, if necessary.

Tighten swivel spring assemblies. Tighten only enough to compress springs (17). Ensure that swivel turns freely against seal rings (8) when machine frames articulate and oscillate.

Adjust Body Heater Exhaust Collar

Remove flexible exhaust tube.



Tighten spring retaining bolts (2).

Loosen mounting bolts (3). Move exhaust collar (1) so mounting plate (4) is centered on frame bracket holes.

Put hardwood blocks approximately 40 mm (1.6 in.) thick on each side of rear frame under front rubber dump body pads. Lower dump body onto blocks.

Check alignment and adjust position of exhaust collar, if necessary.

Remove hardwood blocks and float dump body down until at rest. Raise dump body and install dump body prop. Tighten mounting bolts.

Install flexible exhaust tube.

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CHAPTER 5. ENGINE AUXILIARY SYSTEM

SECTION 4. ENGINE MOUNTING

ENGINE AND TRANSMISSION MOUNTINGS

Remove and Install Engine And Transmission Rubber Mountings

Engine

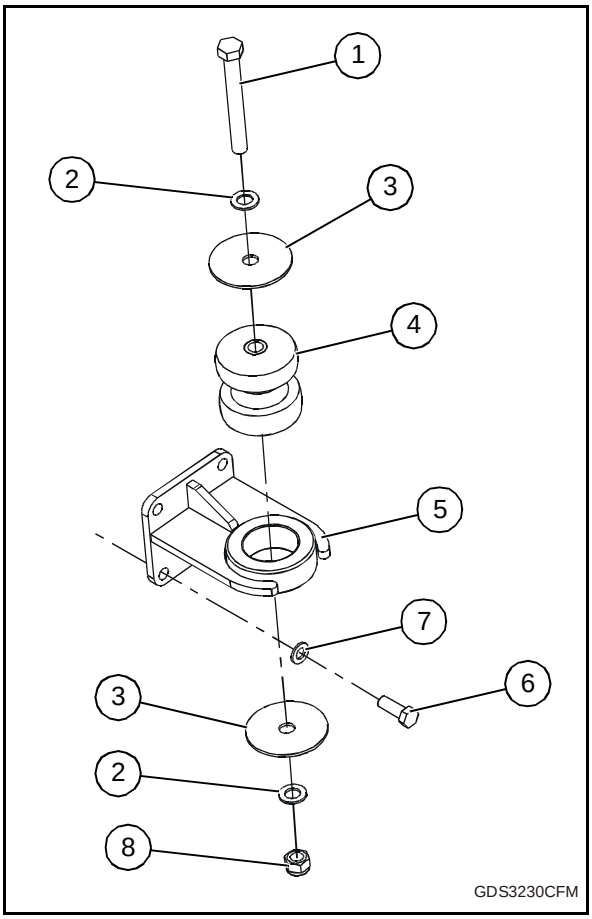
Right Side Engine Mounts

⚠ CAUTION

The approximate weight of engine and transmission is 1179 kg (2600 lb).

Tilt Cab **(Operator's Manual, CHAPTER 7, SECTION 1).**

Lift the engine and transmission just enough to relieve pressure on mounts. **(See Remove Engine CHASPTER 4, SECTION 1).**



1. Cap Screw
2. Washer (2 used)
3. Retaining Washer
4. Rubber Cushion
5. Right Engine Mount Bracket
6. Cap Screw (4 used)
7. Washer (4 used)
8. Nut

Remove engine mounting cap screw (1), washers (2), retaining washer (3) and nut (8).

Remove rubber cushions (4).

Install rubber cushions. Lower engine onto cushions.

Install mounting cap screw, washers, retaining washer and nut. Tighten to specification.

Remove and Install Engine and Transmission Rubber Mounts Specification

Engine and Transmission Weight	1179 kg (2600 lb)
Engine Mount Bracket Cap Screw Torque	280 Nm (207 lb-ft)
Engine Mount Bracket Socket Head Cap Screw Torque	140 Nm (103 lb-ft)
Engine Mount Cap Screw Torque	435 Nm (320 lb-ft)

Lower cab. **(See Tilt Cab in Operator's Manual, CHAPTER 7, SECTION 1).**

Left Side Engine Mounts

See Right Side Engine Mounting.

Transmission Rubber Mounts

⚠ CAUTION

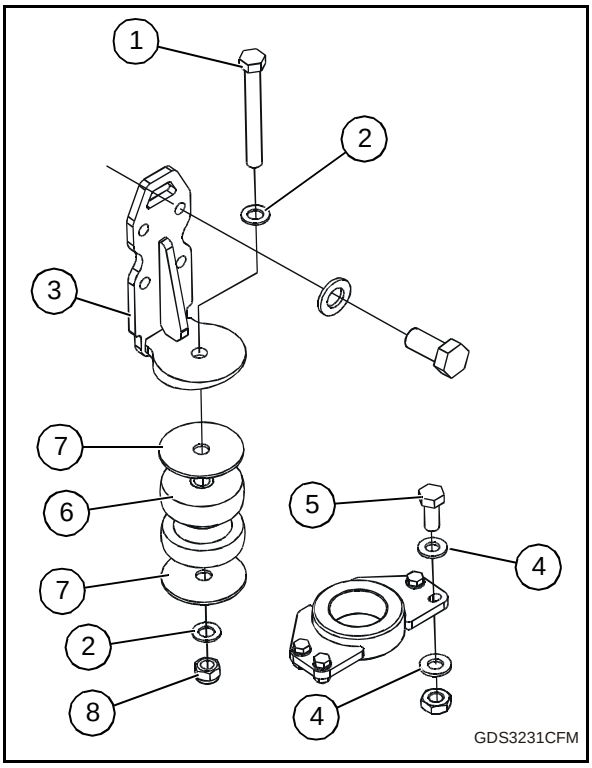
The approximate weight of engine and transmission is 1179 kg (2600 lb).

Lift the engine and transmission just enough to relieve pressure on mounts. **(See Remove Engine CHAPTER 4, SECION 1).**

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Transmission Mounts

Tilt Cab **(Operator's Manual, CHAPTER 7, SECTION 1).**



1. Cap Screw.
2. Washer (2 used).
3. Transmission Mount Bracket.
4. Washer (4 used).
5. Cap Screw (4 used).
6. Rubber Cushion.
7. Retaining Washer.
8. Nut.

Remove cap screw (1), washers (2), retaining washer (7) and nut (8).

⚠ CAUTION

The approximate weight of engine and transmission is 1179 kg (2600 lb).

Remove rubber cushions (6).

Remove transmission mount bracket (3), if necessary.

Install transmission mount bracket and plate. Tighten cap screws to specification.

Install rubber cushions. Lower transmission onto cushions.

Install mounting cap screw, washers, retaining washer and nut. Tighten to specification.

Remove and Install Engine and Transmission Rubber Mounts Specification

Transmission Mount Bracket Cap Screw Torque - 215 Nm (158 lb-ft)

Transmission Mount Cap Screw Torque - 435 Nm (320 lb-ft)

Lower cab. **(See Tilt Cab Operator's Manual, CHAPTER 7, SECTION 1).**

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CHAPTER 5. ENGINE AUXILIARY SYSTEM

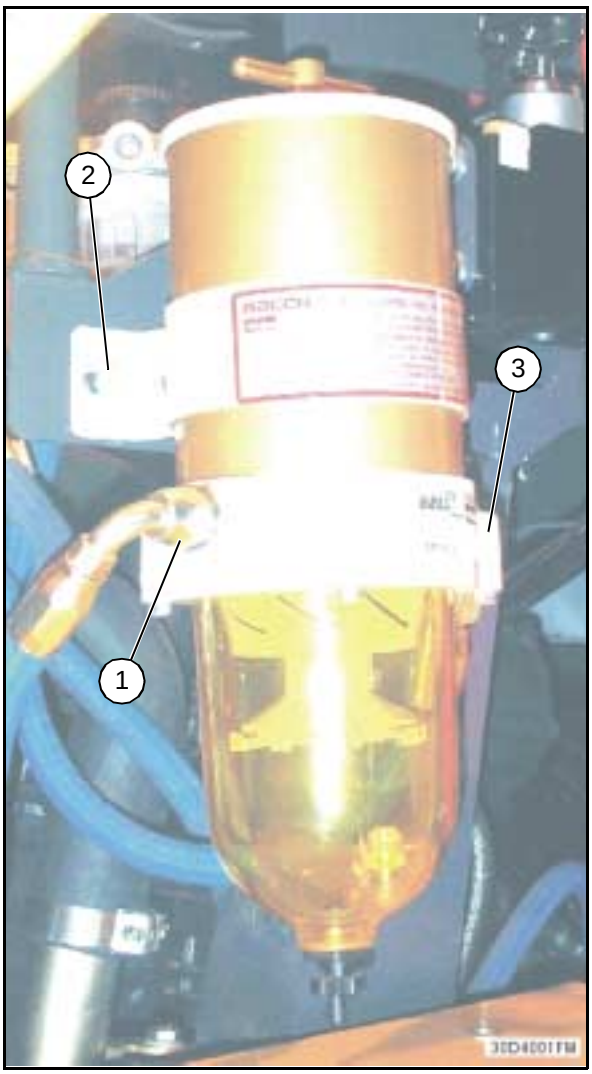
SECTION 5. EXTERNAL FUEL SUPPLY SYSTEMS

PRIMARY FUEL FILTER

Remove and Install Primary Fuel Filter (Water Separator)

Drain Primary Fuel Filter (Water Separator) until empty. Close drain screw. **(See Operator's Manual, CHAPTER 11, SECTION 1).**

Disconnect heater wire, if equipped.



1. Outlet Line.
2. Cap Screw and Nut (2 used).
3. Inlet Line.

Disconnect inlet line (3) and outlet line (1).

Remove cap screws and nuts (2). Remove filter assembly.

Repair or replace parts as necessary. **(See Replace Primary Fuel Filter (Water Separator) Operator's Manual, CHAPTE 14, SECTION 1).**

Install filter assembly, nuts, and cap screws.

Connect outlet line and inlet line.

Connect heater wire, if equipped.

Fill filter housing with clean fuel.

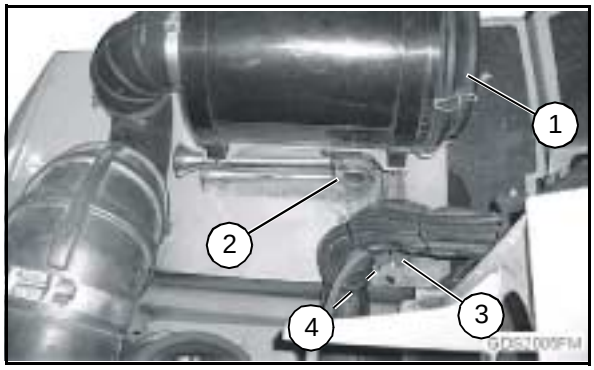
Prime Fuel System **(Operator's Manual, CHAPTER 17, SECTION 1).**

Remove and Install Fuel Tank

Drain fuel from fuel tank.

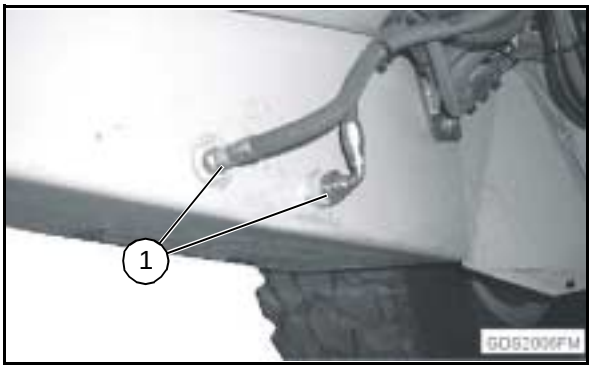
Remove and Install Fuel Tank Specification

Fuel Tank Capacity- - - - - - - - - - - - - - - - 340 L (90 gal)

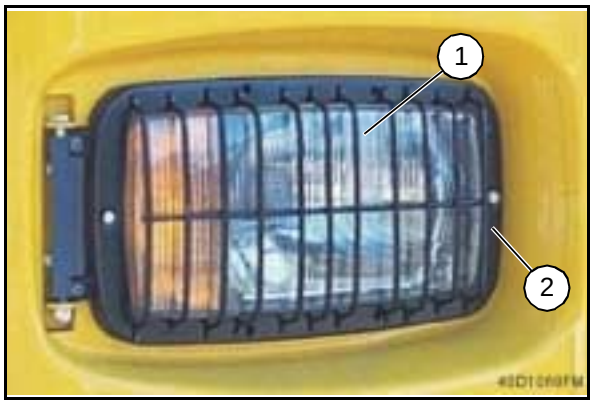


Remove air cleaner (1). Remove pneumatic line from air horn (2). Remove plate (3) and disconnect wiring harness from fuel level sender (4).

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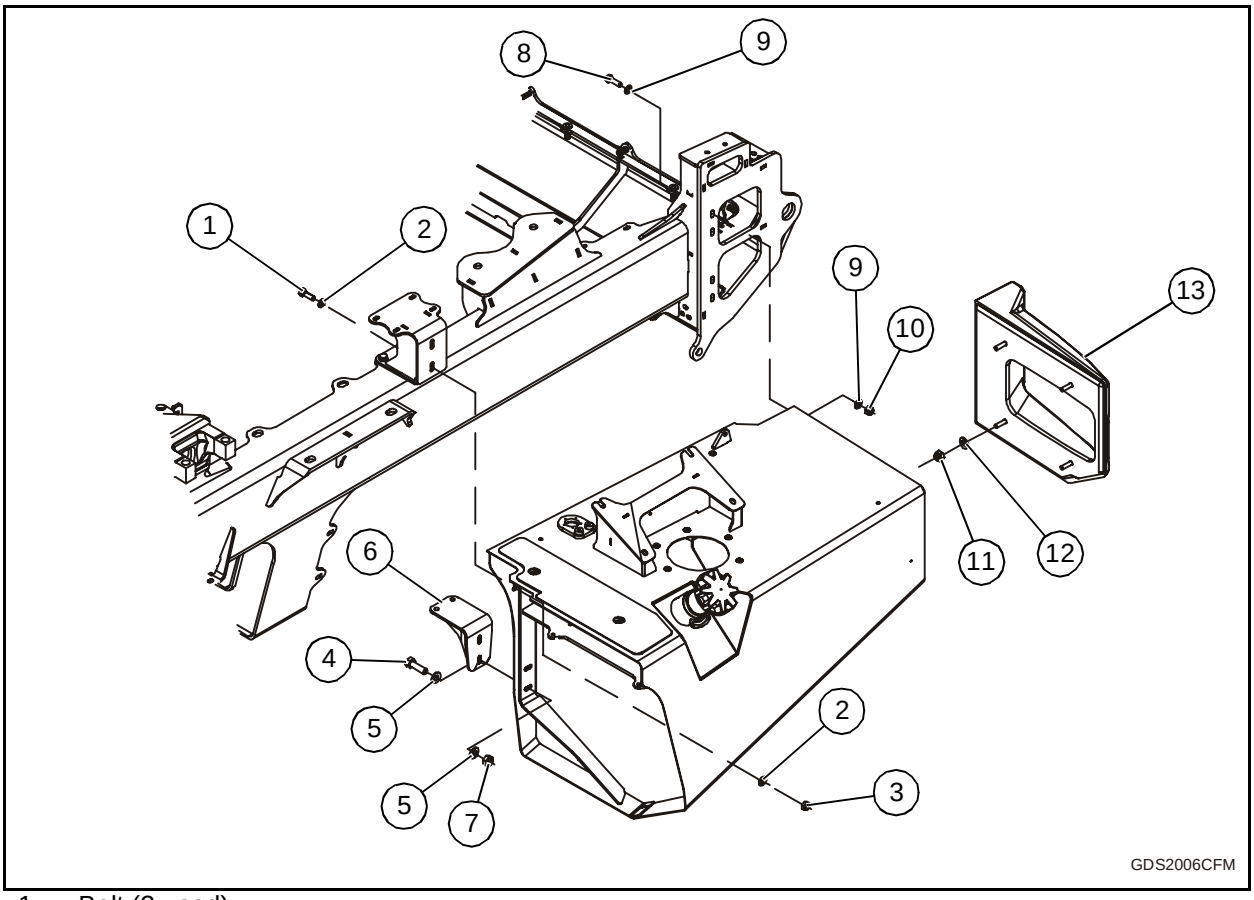


Disconnect fuel lines (1) from fuel tank. Close openings using caps and plugs.



Disconnect harness connectors from headlight and remove headlight (1) and headlight frame (2).

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1. Bolt (2 used).
2. Washer (4 used).
3. Nut (2 used).
4. Bolt (2 used).
5. Washer (4 used).
6. Lower Bracket.
7. Nut (2 used).
8. Bolt (4 used).
9. Washer (8 used).
10. Nut (4 used).
11. Nut (4 used).
12. Washer (4 used).
13. Head Light Housing.

Remove nuts (11), washers (12) and headlight housing (13).

⚠ CAUTION

Component is heavy. Use hoist.

Support fuel tank with hoist.

Remove bolts (1), washers (2) and nuts (3).

Remove bolts (4), washers (5) and nuts (7) from fuel tank and lower bracket (6).

Remove bolts (8), washers (9) and nuts (10) from frame and fuel tank.

Install fuel tank. Install bolts, washers, and nuts.

Install headlight housing, headlight and headlight frame.

Connect fuel lines.

Connect wiring harness to fuel level sender and install plate. Install pneumatic line on air horn. Install air cleaner.

Fill tank with fuel.

Prime Fuel System. **(See Operator's Manual, CHAPTER 17, SECTION 1.)**

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CHAPTER 6. CONNECTOR DRIVE (FLEXPLATE)

SECTION 1. ELEMENTS

CONNECTOR DRIVE (FLEXPLATE)

Remove and Install Connector Drive (Flexplate)

Check crankshaft end play. **(See "Check Crankshaft End Play" on page 169).**

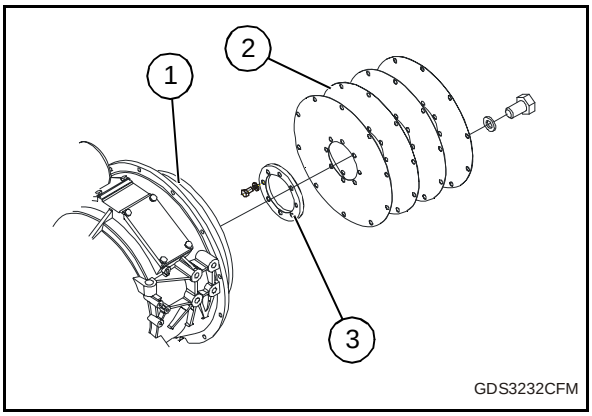
Remove engine and transmission from machine.

Disconnect flexplates from torque converter.

Disconnect transmission from flywheel housing. **(See Remove Engine in CHAPTER 4, SECTION 1).**

⚠ CAUTION

Ensure that flywheel does not fall off of crankshaft when cap screws are removed.



1. Flywheel.
2. Flexplate (4 used).
3. Retainer Plate.

Remove retainer plate (3) and flexplates (2) from flywheel (1).

Repair or replace parts as necessary.

⚠ CAUTION

DO NOT reuse flywheel-to-crankshaft cap screws.

Install flexplates and retainer plate on flywheel. Apply rigid form-in-place gasket to threads of new cap screws. Tighten cap screws to specification.

Remove and Install Connector Drive (Flexplate) Specification

Flywheel-to-Crankshaft Cap Screw Torque	162 ± 16 Nm (119 ± 12 lb-ft)

Align torque converter to flexplates and connect transmission to flywheel housing. Connect flexplates to torque converter. Install engine and transmission in machine. **(See Install Engine in CHAPTER 4, SECTION 1).**

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CHAPTER 7. TRANSFER CASE (DROP BOX)

SECTION 1. REMOVAL AND INSTALLATION

TRANSFER CASE (DROP BOX)

Remove and Install Transfer Case (Drop Box)

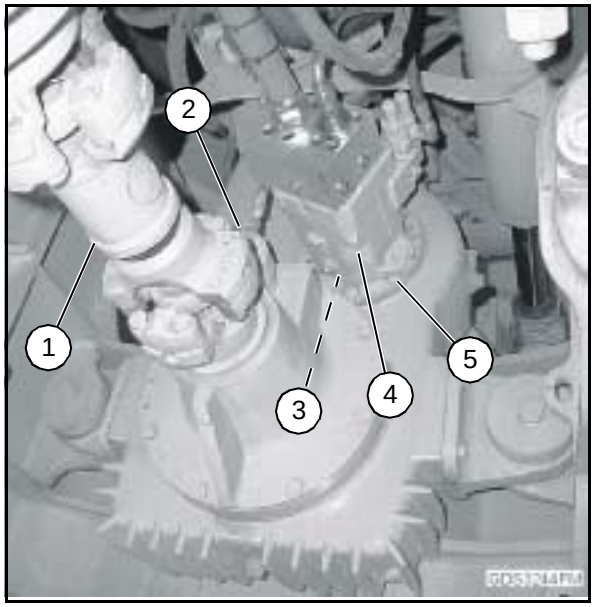
⚠ CAUTION

Machine must be steered to straighten articulation joint when installing and aligning transfer case. Ensure that articulation safety lock bar is installed.

Steer machine to straighten articulation joint. Park machine. Install articulation safety lock bar. Relieve hydraulic and pneumatic pressure. **(See Prepare Machine for Maintenance in Operator's Manual, CHAPTER 7, SECTION 1).**

Remove cab rear grab bar and glass guard.

Tilt Cab **(Operator's Manual, CHAPTER 7, SECTION 1).**



Remove transfer case-to-oscillation joint drive shaft. Remove transfer case-to-front axle drive shaft (1). **(See "DRIVE SHAFTS" on page 35.)**

Disconnect transmission-to-transfer case drive shaft. **(See "REMOVE AND INSTALL TRANSMISSION-TO-TRANSFER CASE DRIVE SHAFT" on page 63).**

Disconnect pneumatic hose (2). Close all openings with caps and plugs.

NOTE: It is not necessary to disconnect hydraulic lines from the secondary steering pump.

Disconnect secondary steering pump (4) from idler shaft front bearing housing (5). Move pump aside.

Remove O-ring (3) from bearing housing and discard.

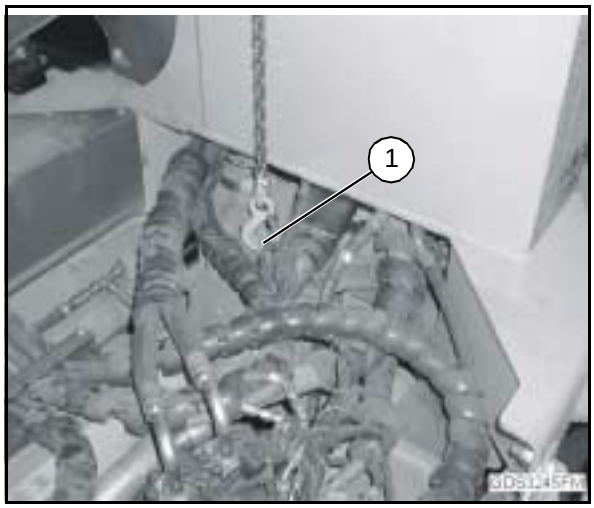
Remove transfer case breather and install a plug.

⚠ CAUTION

Component is heavy. Use hoist.

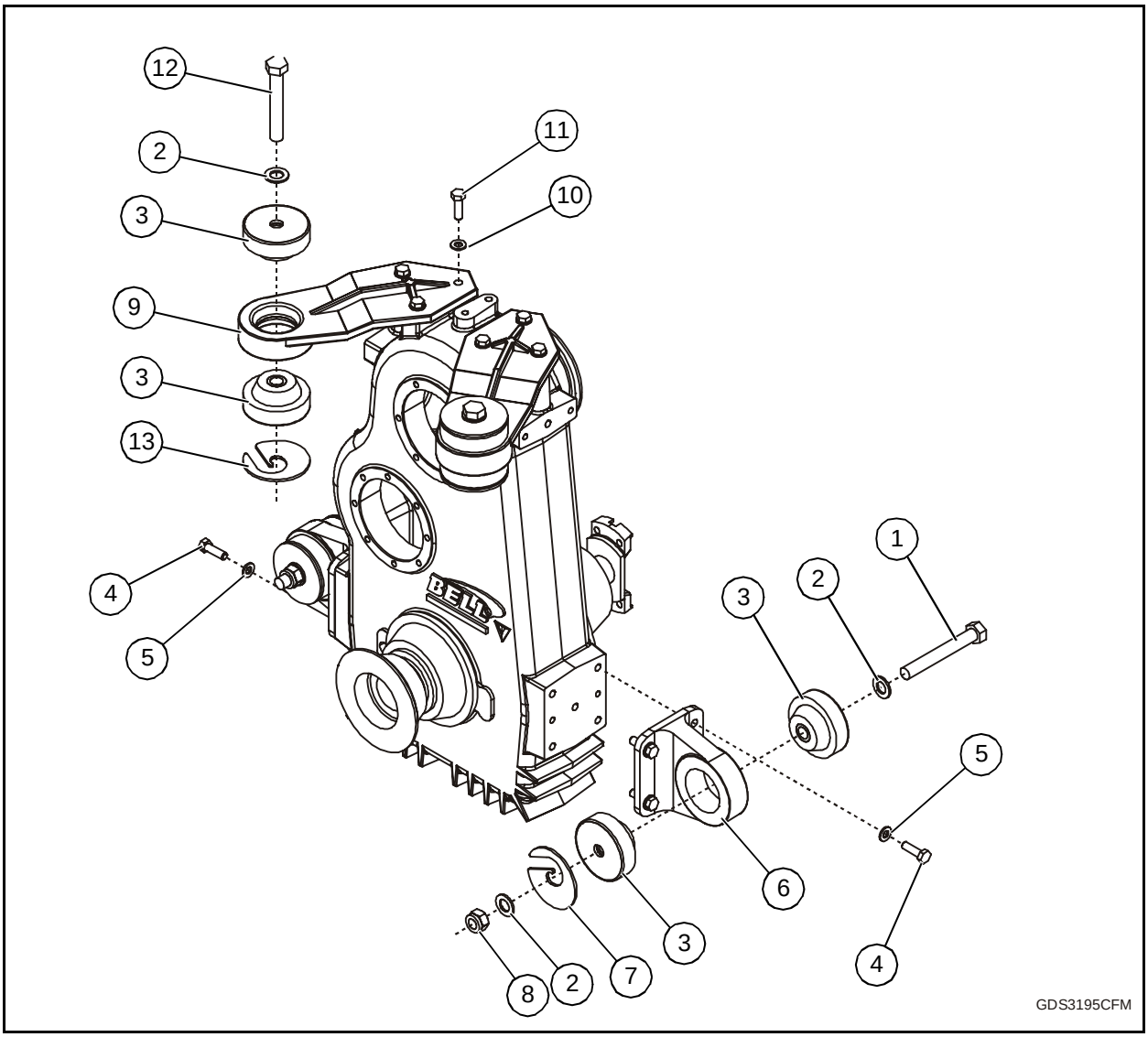
Remove and Install Transfer Case Specification

Transfer Case Weight - - - 220 kg (440 lb) approximate



Connect hoist to eyebolt (1) on transfer case.

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1. Bolt (2 used).
2. Washer (6 used).
3. Rubber Mount Pad (8 used).
4. Bolt (8 used).
5. Washer (8 used).
6. Lower Support Bracket (2 used).
7. Lower Shim (as required).
8. Nut (2 used).
9. Upper Support Bracket (2 used).
10. Washer (6 used).
11. Bolt (6 used).
12. Bolt (2 used).
13. Upper Shim (as required).

⚠ CAUTION

Location and quantity of transfer case shims must be noted to maintain correct driveline alignment.

Remove rubber mount pads (3) and shims (7) from lower support brackets (6). Remove lower support brackets.

Remove upper support bolts (11).

Lower transfer case from frame.

Inspect and replace parts as necessary. **(See "TRANSFER CASE (DROP BOX)" on page 255).**

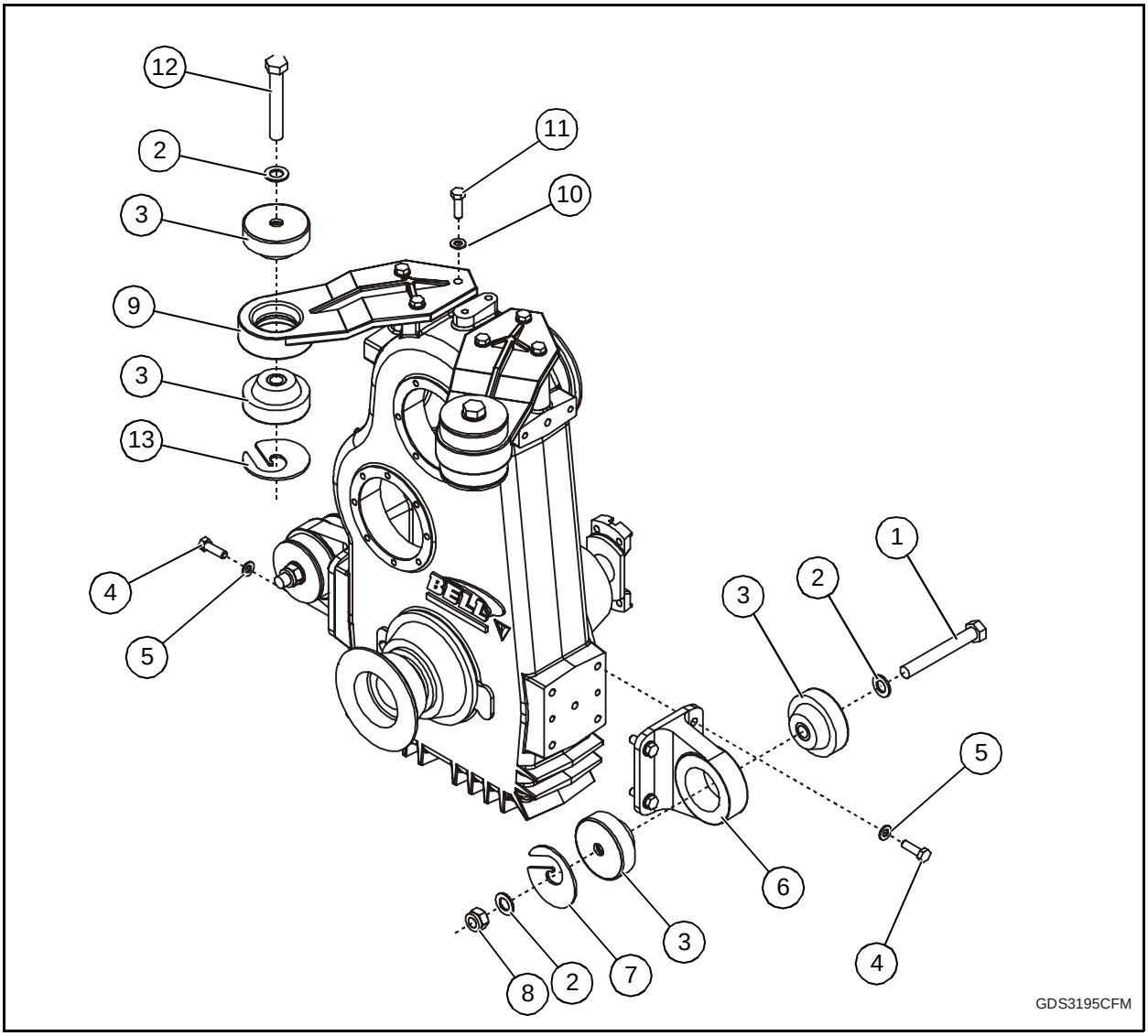
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Install and Align Transfer Case

⚠ CAUTION

Machine must be steered to straighten articulation joint when installing and aligning transfer case. Ensure that articulation safety lock bar is installed.

Position transfer case and lift into frame.



Attach transfer case to upper support brackets (9).

Install lower support brackets (6). Tighten bolts (4 and 11) to specification.

NOTE: If shim thicknesses (7 and 13) are known, install shims as removed. If transfer case housing has been replaced or thicknesses are not known, transfer case alignment must be done.
Keep shims with relevant mountings.

Remove and Install Transfer Case Specification

Support Bracket Cap Screw Torque	110 Nm (81 lb-ft)

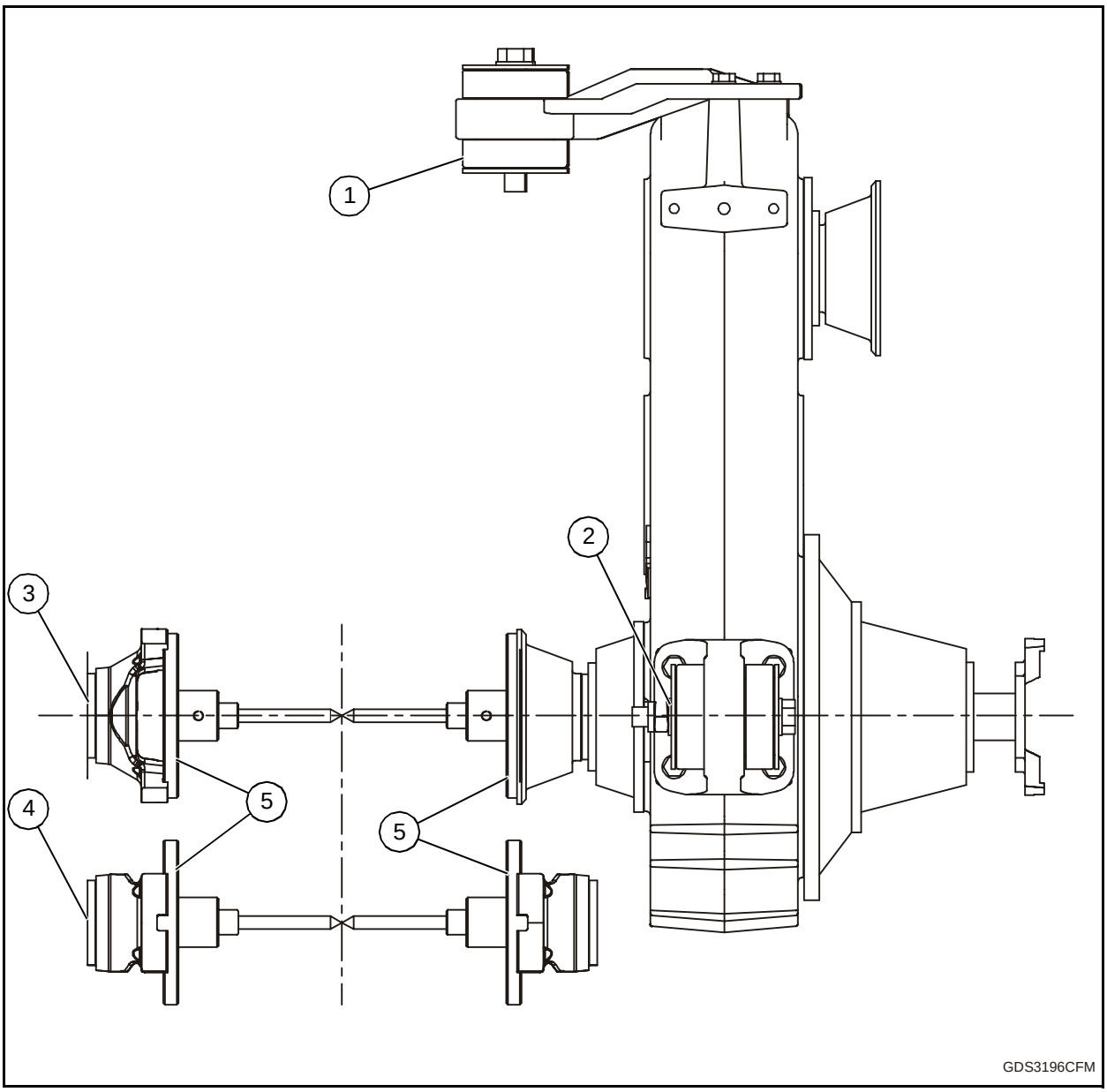
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Install rubber mount pads (3) and shims (7) on lower mount brackets. Tighten lower mount pad bolts and nuts (1 and 8) and upper mount pad bolts (12) to specifications.

Remove and Install Transfer Case Specification

Mount Pad Bolt Torque- - - - - - - - - - 435 Nm (320 lb-ft)

Alignment



1. Upper Mount Pad Shim Location.
2. Lower Mount Pad Shim Location.
3. Side View.
4. Top View.
5. (Tool no. 280532) Transfer Case Alignment Tool (2 used).

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Do transfer case alignment.

Install (Tool no. 280532) Transfer Case Alignment Tool (5) **(CHAPTER 17, SECTION 1)** on transfer case rear output yoke and oscillation tube through shaft input yoke.

NOTE: Check alignment with all hardware tightened to specifications.

Check alignment of points of (Tool no. 280532) Transfer Case Alignment Tools. Points must be aligned. Points must not be offset or skewed.

Add or remove shims at location (1) to adjust vertical position of output shaft.

Add or remove shims at location (2) to adjust centerline angle of output shaft.

Repeat steps above steps as necessary.

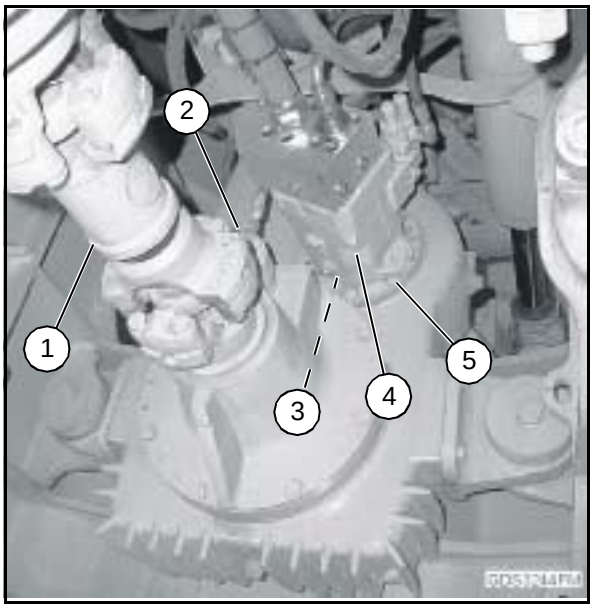
Tighten all transfer case mounting hardware to specifications.

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

Check front axle to transfer case alignment, **(See "Front Axle Alignment" on page 4).**

⚠ CAUTION

If any hydraulic lines have been disconnected from the secondary steering pump, (See Secondary Steering Pump CHAPTER 8, SECTION 1 for installation instructions.



Apply a thin layer of petroleum jelly to new O-ring (3) and install on idler shaft front bearing housing (5).

Install secondary steering pump (4).

Connect pneumatic hose (2).

Remove plug from breather hole and install breather.

Connect transmission-to-transfer case drive shaft. **(See "REMOVE AND INSTALL TRANSMISSION-TO-TRANSFER CASE DRIVE SHAFT" on page 63).**

Install transfer case-to-front axle drive shaft (1). Install transfer case-to-oscillation joint drive shaft. **(See "DRIVE SHAFTS" on page 35).**

Lower cab. **(See Tilt Cab Operator's Manual, CHAPTER 7, SECTION 1)**.

Install rear cab grab bar and glass guard.

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CHAPTER 7. TRANSFER CASE (DROP BOX)

SECTION 2. GEAR SHAFTS AND BEARINGS

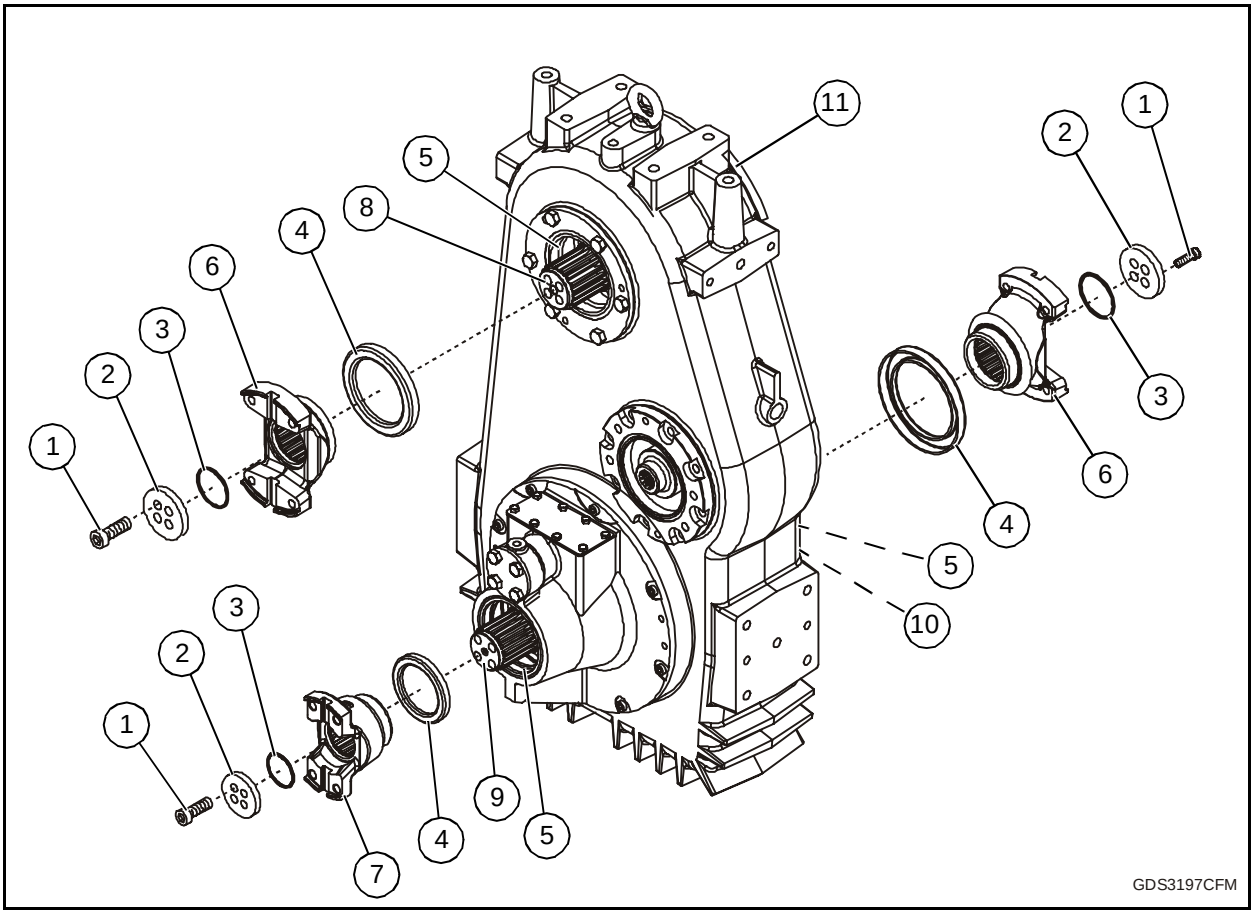
TRANSFER CASE (DROP BOX)

Disassemble Transfer Case Housing

Clean outside of transfer case.

Mount transfer case in D05223ST Engine Repair Stand with DFT1182 Transfer Case Mounting Bracket **("DFT1182 TRANSFER CASE MOUNTING BRACKET" on page 385)**.

Drain oil from transfer case. Dispose of waste properly. See Change Transfer Case Oil **(Operator's Manual, CHAPTER 15, SECTION 2).**



1. Cap Screw (12 used).
2. Retainer (3 used).
3. O-Ring (3 used).
4. Dust Shield (3 used).
4. Dust Shield (3 used).
5. Seal (3 used).
6. Yoke (2 used).
7. Yoke.
8. Input Shaft.
9. Front Output Shaft.
10. Rear Output Shaft.
11. Transfer Case.

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Remove yokes.

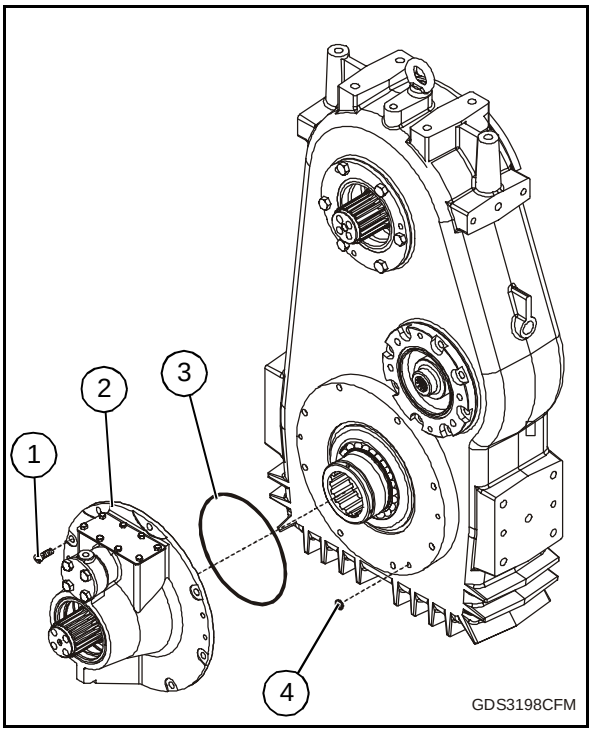
Remove parts (1 - 4 and 6) from input shaft (8).

Remove parts (1 - 4 and 7) from front output shaft (9).

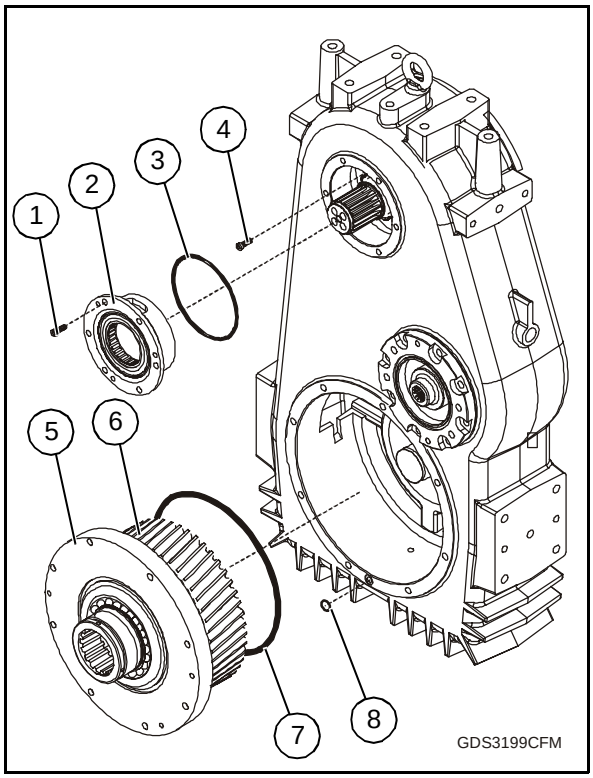
Remove parts (1 - 4 and 6) from rear output shaft (10).

Remove dust shields (4) from yokes (6 and 7).

Clean all parts thoroughly.



Remove front output housing assembly (2), using jack screws. Remove O-rings (3 and 4).



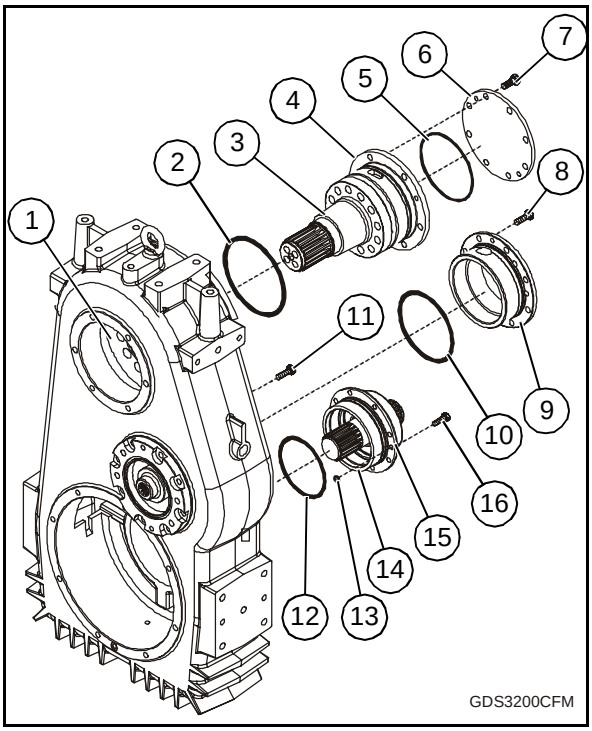
Remove output assembly (5 - 8), using jack screws.

Remove input shaft front bearing housing (2) and O-ring (3), using jack screws.

Remove cap screws (4) securing input gear to shaft.

Rotate transfer case 180° so rear of case is up.

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Remove input shaft cover (6).

Loosen input shaft rear bearing housing (4), using jack screws.

Tap input shaft (3) with soft-faced hammer to remove shaft from input gear (1). Remove input shaft assembly.

Remove idler shaft rear bearing housing (9), using jack screws.

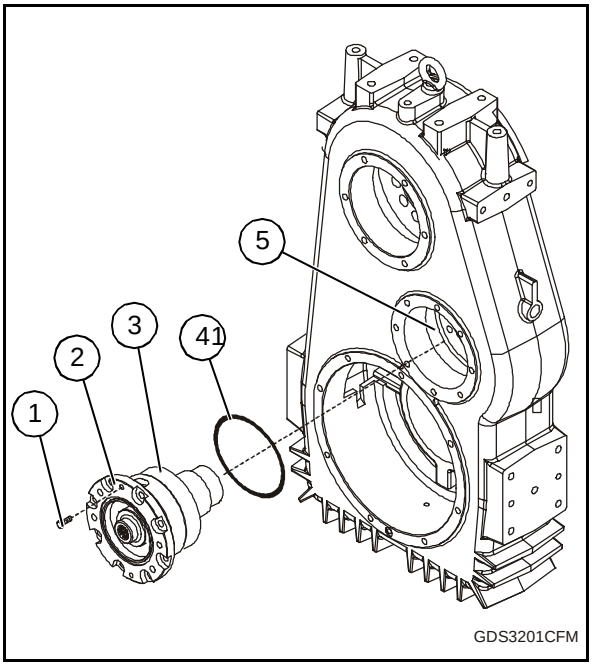
Remove cap screws (11) securing idler gear to shaft.

Remove rear output shaft assembly (12 - 15), using jack screws.

⚠ CAUTION

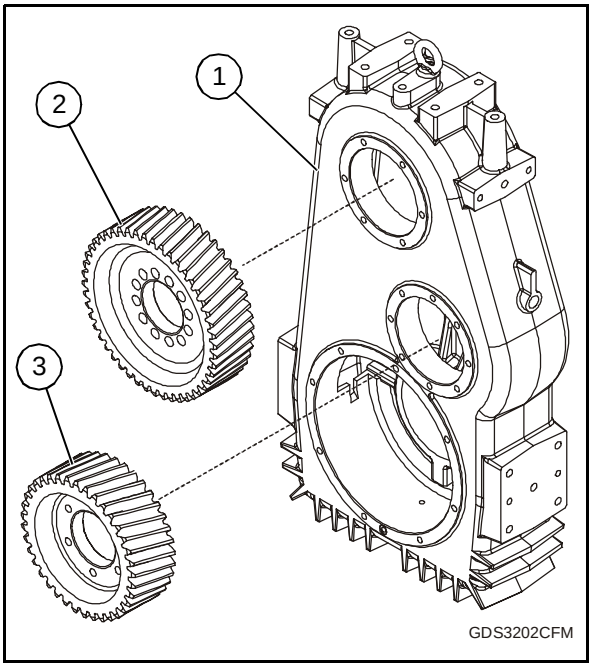
DO NOT rotate transfer case right-side up. Input and idler gears can fall from case.

Rotate transfer case 180°. Ensure that top of case rotates downward, so gears do not fall from case.



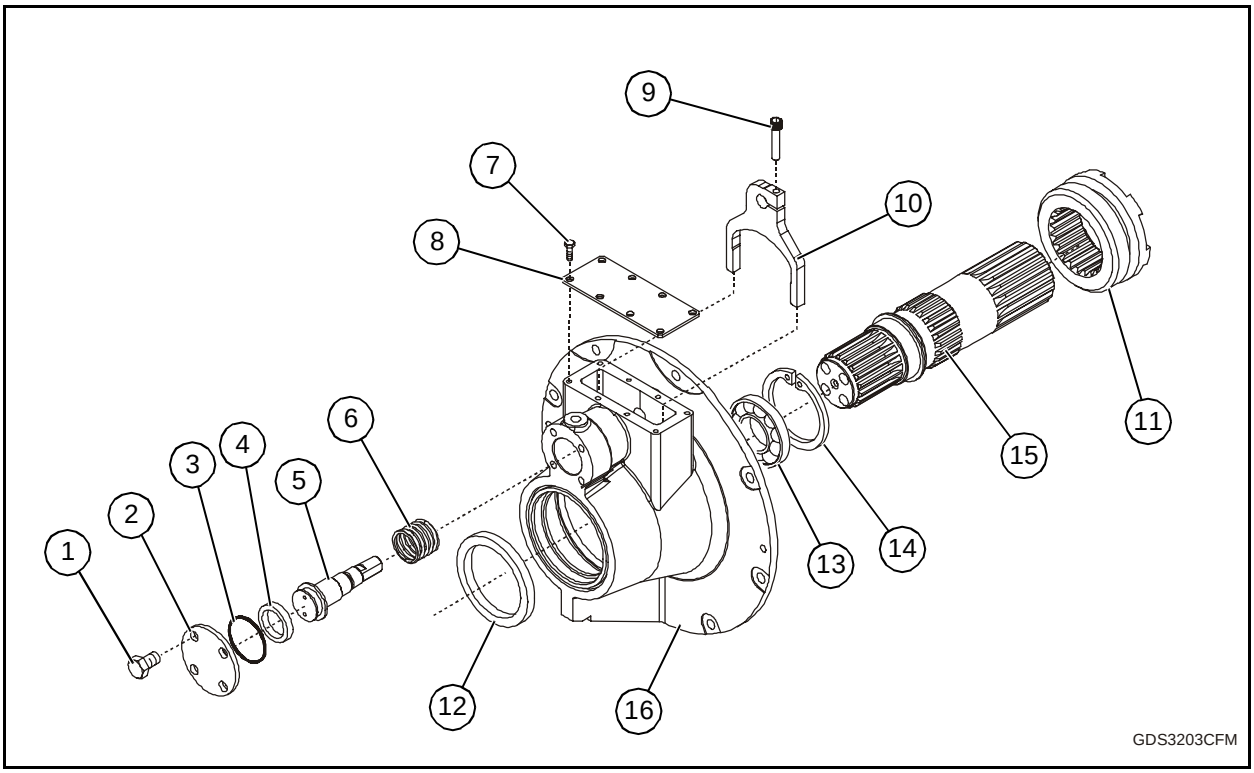
Loosen idler shaft front bearing housing (2), using jack screws.

Tap idler shaft (3) with soft-faced hammer to remove from idler gear (4). Remove idler shaft assembly (2 - 4).



Remove idler gear (3) and input gear (2) from transfer case (1).

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1. Bolt (4 used).
2. Piston Cover.
3. O-Ring.
4. Piston Seal.
5. Piston.
6. Spring.
7. Bolt (8 used).
8. Fork Cover.
9. Cap Screw.
10. Fork.
11. Slide Collar.
12. Seal.
13. Bearing.
14. Snap Ring.
15. Front Output Shaft.
16. Front Output Housing.

Disassemble and Assemble Front Output Shaft and Inter-Axle Lock

Remove covers (2 and 8) and O-ring (3).

Loosen cap screw (9). Turn and remove piston (5) and seal (4), using an adjustable two-pin spanner wrench. Remove spring (6) and fork (10).

Remove seal (12).

Support front output housing (16). Push shaft (15) from bearing (13), using press and D01045AA Bushing, Bearing, and Seal Driver Set.

Remove snap ring (14).

Press bearing (13) from housing.

Inspect and replace parts as necessary.

Heat front output housing (16) to 85°C (185°F). Install bearing (13) tight to bottom of bore. Install snap ring (14).

Heat inner race of bearing (13) to 85°C (185°F). Install shaft (15) so shoulder is tight against bearing.

Allow assembly to cool.

Apply Flexible Form-In-Place Gasket to outer circumference of seal (12). Install seal.

Install slide collar (11) over shaft (15) with teeth facing away from bearing.

Slide collar must move freely over splined area.

Install cap screw (9) and piston (5) in fork (10). Tighten cap screw until clearance is removed, but piston rotation is still possible.

Maintain cap screw setting and remove piston from fork.

Install fork (10) in housing (16). Ensure that tines of fork engage groove of slide collar (11).

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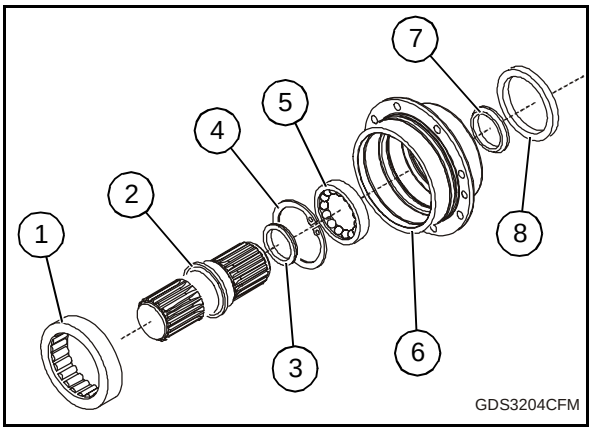
Apply a thin layer of petroleum jelly to lip of seal (4). Install seal on piston (5), with seal lip facing away from piston body.

Apply a thin layer of petroleum jelly to front housing piston bore and to journals of piston.

NOTE: Fork adjustment must be done after assembly of transfer case.

Install spring (6) and piston (5), using an adjustable two-pin spanner wrench.

Do not tighten at this time.



1. Output Gear Rear Support Bearing Outer Race.
2. Rear Output Shaft.
3. Inner Race.
4. Snap Ring.
5. Bearing.
6. Rear Output Bearing Housing.
7. Inner Race.
8. Seal.

Disassemble and Assemble Rear Output Shaft

Support rear output bearing housing (6) with exterior side up. Tap on rear output shaft (2) with a soft-faced hammer to remove rear output shaft with inner race (3).

Remove seal (8) and inner race (7).

Remove output gear rear support bearing outer race (1).

Remove snap ring (4). Remove bearing (5), using a press.

Clean, inspect, and replace parts as necessary.

Heat rear output bearing housing (6) to 85°C (185°F). Install bearing (5) and snap ring (4).

NOTE: The output gear rear support bearing inner race is installed on the output planetary housing. Always replace inner and outer bearing races as a set.

Heat rear output bearing housing (6) to 85°C (185°F).

Install output gear rear support bearing outer race (1) to bottom of bore.

Heat inner race (3) to 85°C (185°F). Install inner race on shaft (2).

NOTE: Ensure that race is tight against shoulder.

Install output shaft (2) in housing (6).

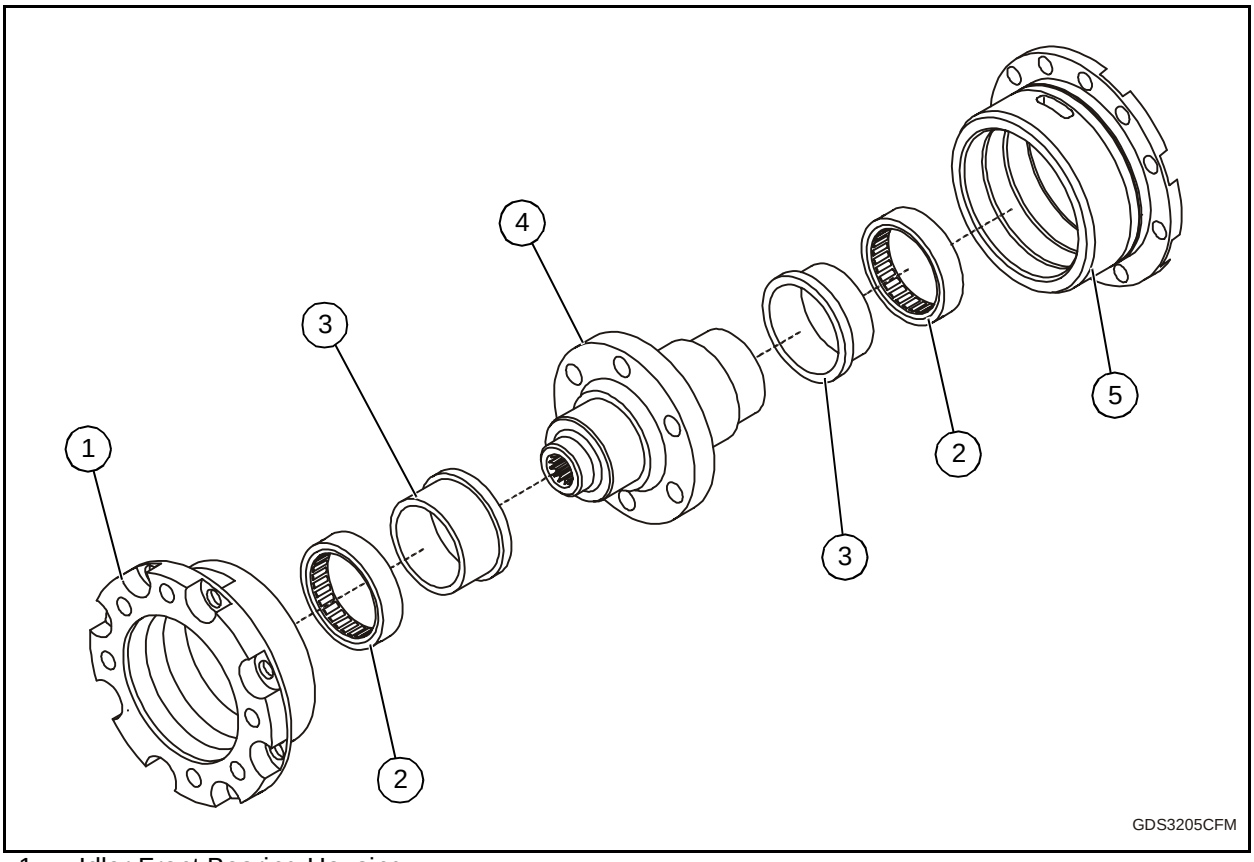
Heat inner race (7) to 85°C (185°F). Install inner race.

NOTE: Ensure that race is tight against shoulder.

Allow assembly to cool.

Apply Flexible Form-In-Place Gasket to outer circumference of seal (8). Install seal.

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1. Idler Front Bearing Housing.
2. Bearing (2 used).
3. Inner Race (2 used).
4. Idler Shaft.
5. Idler Rear Bearing Housing.

Disassemble and Assemble Idler Shaft

Remove inner bearing races (3) from shaft (4), using a puller.

Remove bearings (2) from housings (1 and 5), using a puller.

Clean, inspect, and replace parts as necessary.

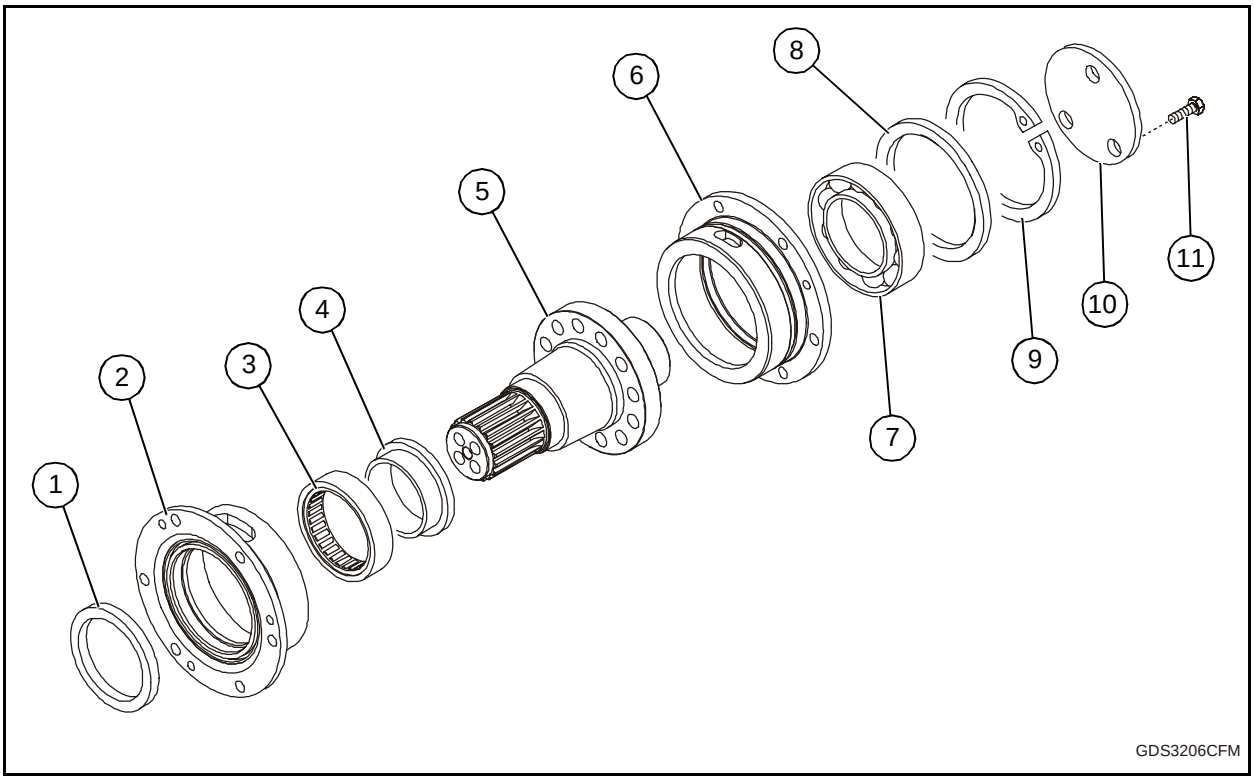
Heat housings (1 and 5) to 85°C (185°F). Install bearings (2) to bottoms of bores.

Heat inner races (3) to 85°C (185°F). Install inner races on shaft (4).

NOTE:Ensure that races are tight against shoulders.

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Alignment



1. Seal.
2. Input Shaft Front Bearing Housing.
3. Bearing.
4. Inner Race.
5. Input Shaft.
6. Input Shaft Rear Bearing Housing.
7. Bearing.
8. Spacer.
9. Snap Ring.
10. Retainer.
11. Bolt (3 used).

Disassemble and Assemble Input Shaft

Remove seal (1) from housing (2).

Remove bearing (3) from housing (2), using a bearing puller.

Remove inner race (4) from input shaft (5), using a bearing puller.

Remove retainer (10), snap ring (9), and spacer (8).

Support housing (6). Remove shaft (5), using a press.

Remove bearing (7), using a bearing puller.

Inspect and replace parts as necessary.

Heat housings (2 and 6) to 85°C (185°F). Install bearings (3 and 7).

⚠ CAUTION

Open end of snap ring (9) must be aligned with oil hole in housing.

Install spacer (8) and snap ring (9). Ensure that open end of snap ring is aligned with oil hole in housing.

Heat inner race of bearing (7) to 85°C (185°F) and install input shaft (5).

Install retainer (10). Tighten bolts (11) to specification.

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Transfer Case Specification

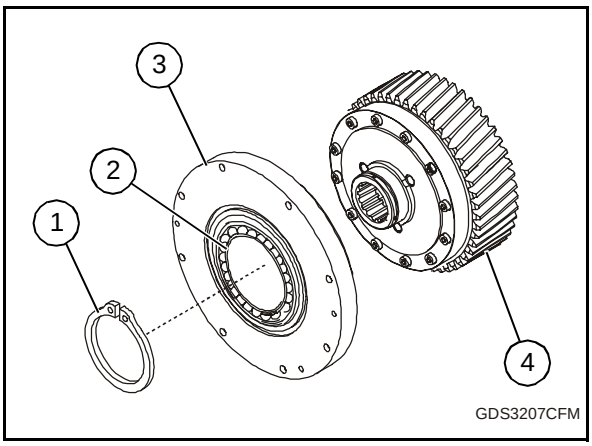
Input Shaft Retainer Bolt Torque - 88 Nm (65 lb-ft)

Heat inner race (4) to 85°C (185°F) and install on input shaft, tight against shoulder.

Apply Flexible Form-In-Place Gasket to outer circumference of seal (1).

Install seal.

Disassemble and Assemble Planetary Gear Assembly

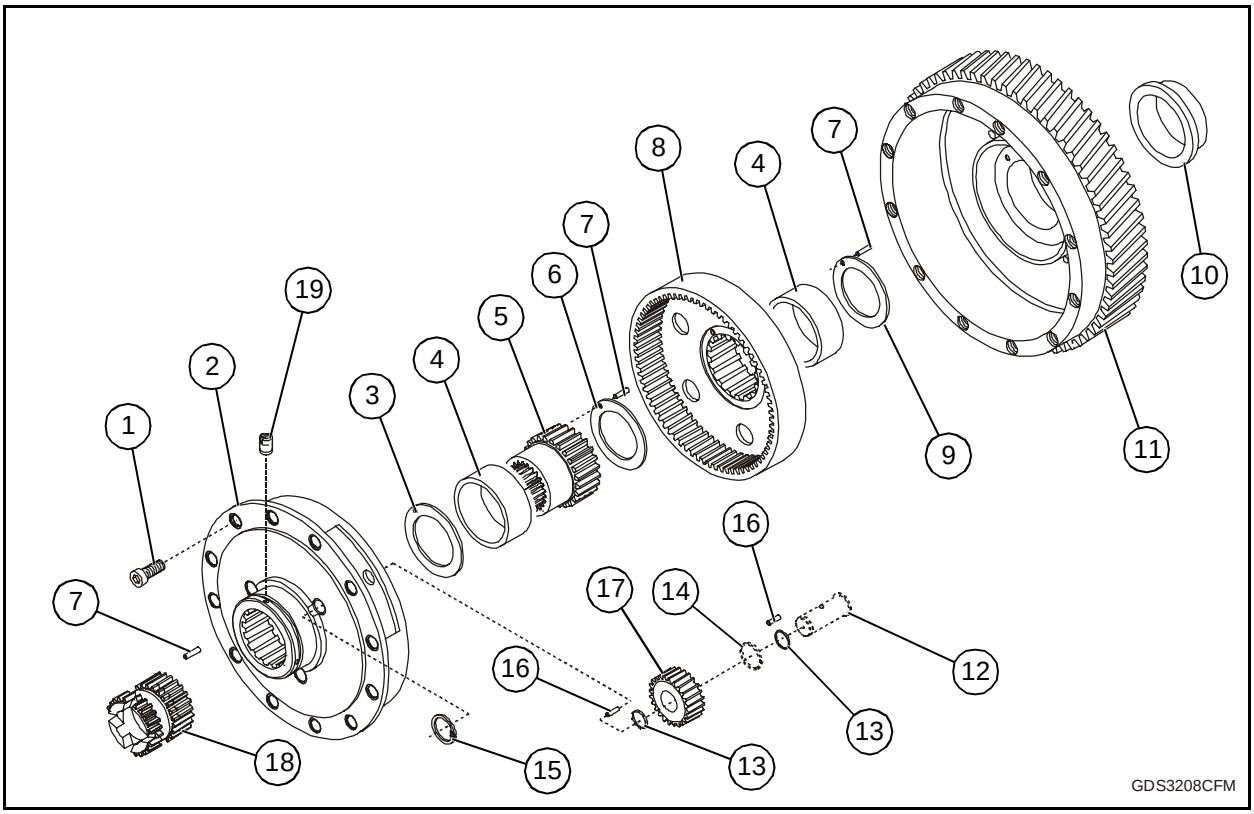


Remove snap ring (1).

Support cover (3). Push output gear (4) from cover, using a press.

Push bearing (2) from cover, using a press.

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1. Cap Screw (20 used).
2. Carrier.
3. Thrust Washer.
4. Bushing (2 used).
5. Sun Gear.
6. Thrust Washer.
7. Spring Pin (3 used).
8. Ring Gear.
9. Thrust Washer.
10. Output Gear Rear Support Bearing Inner Race.
11. Output Gear.
12. Shaft (3 used).
13. Wear Washer (6 used).
14. Spacer (3 used).
15. Snap Ring (3 used)
16. Needle Roller (168 used).
17. Planetary Gear (3 used).
18. Coupler Hub.
19. Set Screw (3 used).

Remove set screws (19) and coupler hub (18).

Remove cap screws (1) and output gear (11).

Remove inner race (10) from output gear.

Remove parts (3—9). Replace bushings (4) and thrust washers (3, 6, and 9).

Remove snap rings (15). Remove shafts (12), using a press.

NOTE:Needle rollers will fall off of shafts when planetary gears are removed. Keep planetary gears together as a set.

Remove planetary gears (17), needle rollers (16), spacers (14) and wear washers (13) from shafts (12).

Inspect and replace parts as necessary.

Put shafts (12) in freezer.

Apply petroleum jelly to bores of planetary gears (17). Assemble needle rollers (16), spacers (14), and wear washers (13). Install on shafts (12).

⚠ CAUTION

Align oil passages in planetary gear shafts (12) toward outer edge of carrier (2).

Heat planetary carrier (2) to 75°C (167°F). Align planetary gear assemblies on carrier. Oil hole identification notches on flange ends of shafts (12) must be aligned toward outer edge of carrier.

Install planetary gear assemblies.

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⚠ CAUTION

Align open ends of snap rings (15) toward outer edge of carrier (2).

Install snap rings (15). Ensure that open ends of snap rings are aligned toward outer edge of carrier.

Check to ensure that all planetary gears rotate freely.

⚠ CAUTION

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

Clear petroleum jelly from oil passages in pins (12) with low air pressure.

If spring pins (7) have been removed from coupler hub (18), ring gear (8), or output gear (11), install new pins to specification.

Transfer Case Specification

Planetary Thrust Washer Locating Spring Pin Protrusion - - - - - - - - - 1.3 ± 0.2 mm (0.051 ± 0.008 in.)

Install coupler hub (18) in carrier housing.

Clean set screws (19) with Cure Primer. Apply Medium Strength Thread Lock and Sealer to threads. Install set screws. Tighten to specification and stake with a center punch.

Transfer Case Specification

Coupler Hub Set Screw Torque - - - - 12 Nm (106 lb-in.)

Apply a thin layer of petroleum jelly to thrust washer (3).

Install thrust washer over spring pin (7), with metallic side toward planetary carrier (2).

Apply a thin layer of petroleum jelly to thrust washers (6 and 9).

Install thrust washers over spring pins (7), with metallic sides toward ring gear (8).

Apply a thin layer of petroleum jelly to outside diameters of bushings (4).

Install first bushing in planetary carrier (2), using a press.

Push bushing into bore until flush with inner surface of carrier.

Install second bushing into output gear (11), using a press. Push bushing into bore until tight against thrust washer (9).

Install sun gear (5) in carrier (2). Check backlash.

Transfer Case Specification

Output Sun Gear-to-Planetary Gear Backlash - - - - - - - - - - - - - - - - 0.154 - 0.234 mm (0.006 - 0.009 in.)

Install ring gear (8) on planetary carrier (2). Check for free rotation of planetary gear set. Check backlash.

Transfer Case Specification

Output Planetary Gear-to-Ring Gear Backlash- - - - - - - - - - - - - - - - 0.199 - 0.328 mm (0.008 - 0.013 in.)

The output gear rear support bearing outer race is installed in the rear output bearing housing. Always replace inner and outer bearing races as a set.

Heat inner race (10) to 75°C (167°F). Install inner race onto stub of output gear (11). Ensure that inner race is firmly seated.

Apply a thin layer of petroleum jelly to inside diameters of bushings (4).

Install output gear (11) on carrier assembly with two equally-spaced, dry-threaded cap screws (1). Tighten cap screws to initial specification.

Transfer Case Specification

Output Gear Cap Screw Initial Torque - 80 Nm (59 lb-ft)

Check for free rotation of planetary gear set.

Remove the two dry-threaded cap screws after remaining cap screws are installed. Apply Cure Primer and Medium Strength Thread Lock and Sealer to threads.

Tighten to final specification.

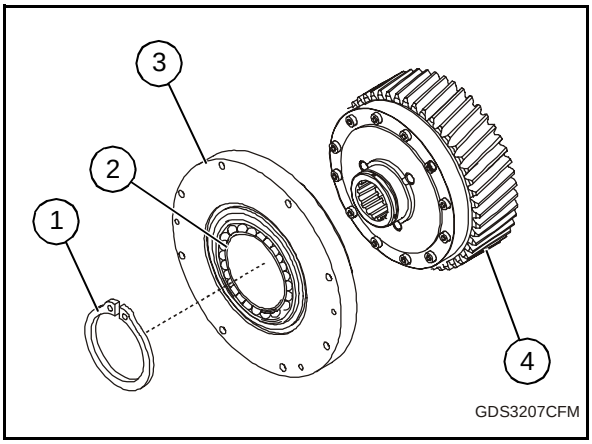
Apply Cure Primer and Medium Strength Thread Lock and Sealer to threads of cap screws (1).

Tighten to final specification.

Transfer Case Specification

Output Gear Cap Screw Final Torque - 156 Nm (115 lb-ft)

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Heat cover (3) to 85°C (185°F). Install bearing (2) to specified protrusion above surface of cover.

Transfer Case Specification

Output Gear Front Support Bearing-to-Cover Surface Protrusion - - - - 13.85 ± 0.15 mm (0.55 in. ± 0.006 in.)

Check for proper seating of bearing (2) by measuring protrusion at three equally-spaced locations around bearing circumference.

Protrusion must be within specification at all locations. Overall variance between protrusion measurements must be within specification.

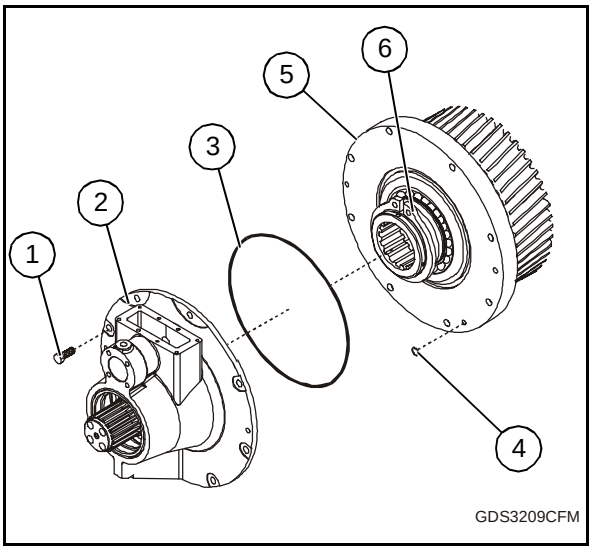
Transfer Case Specification

Overall Variance of Front Output Gear Bearing Protrusion - - - - - - - - - 0.055 mm (0.002 in.) maximum

Heat inner race of bearing (2) to 85°C (185°F).

Install bearing and cover on planetary assembly (4).

Allow assembly to cool. Install snap ring (1).



Apply a thin layer of petroleum jelly to O-rings (3 and 4) and install in grooves on front output housing (2).

Heat bearing inner race (6) to 85°C (185°F).

Install front output housing onto output gear front cover plate (5).

Install two bolts to secure assembly temporarily.

Assemble Transfer Case Housing

⚠ CAUTION

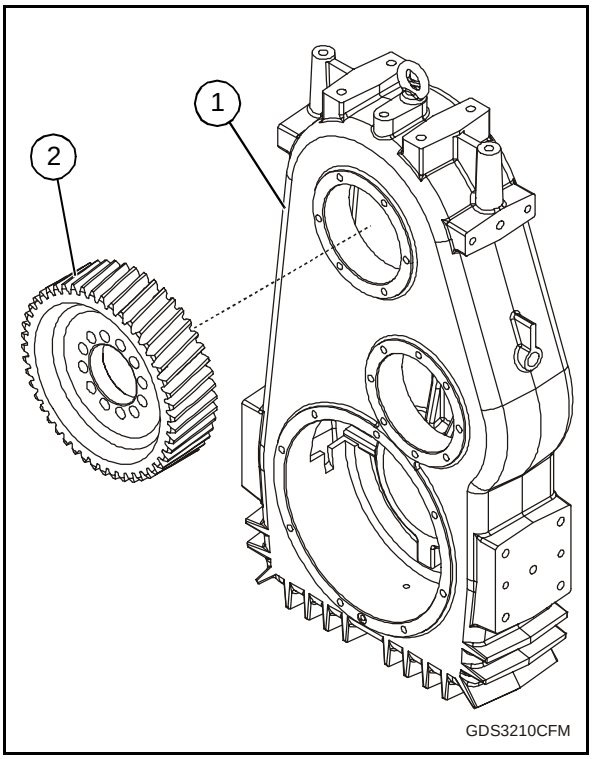
It is critical to keep transfer case and all components dry and free of contaminants during the assembly procedure. Do not allow any sealants, grease, or other contaminants on contact surfaces of any component, unless otherwise specified.

With transfer case still in repair stand, clean transfer case thoroughly.

Inspect transfer case mounting surfaces for flatness.

Check for cracks at bolt holes. Remove any nicks or sharp edges, using an oil stone.

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Install input gear assembly.

Rotate transfer case in repair stand so front is up and horizontal.

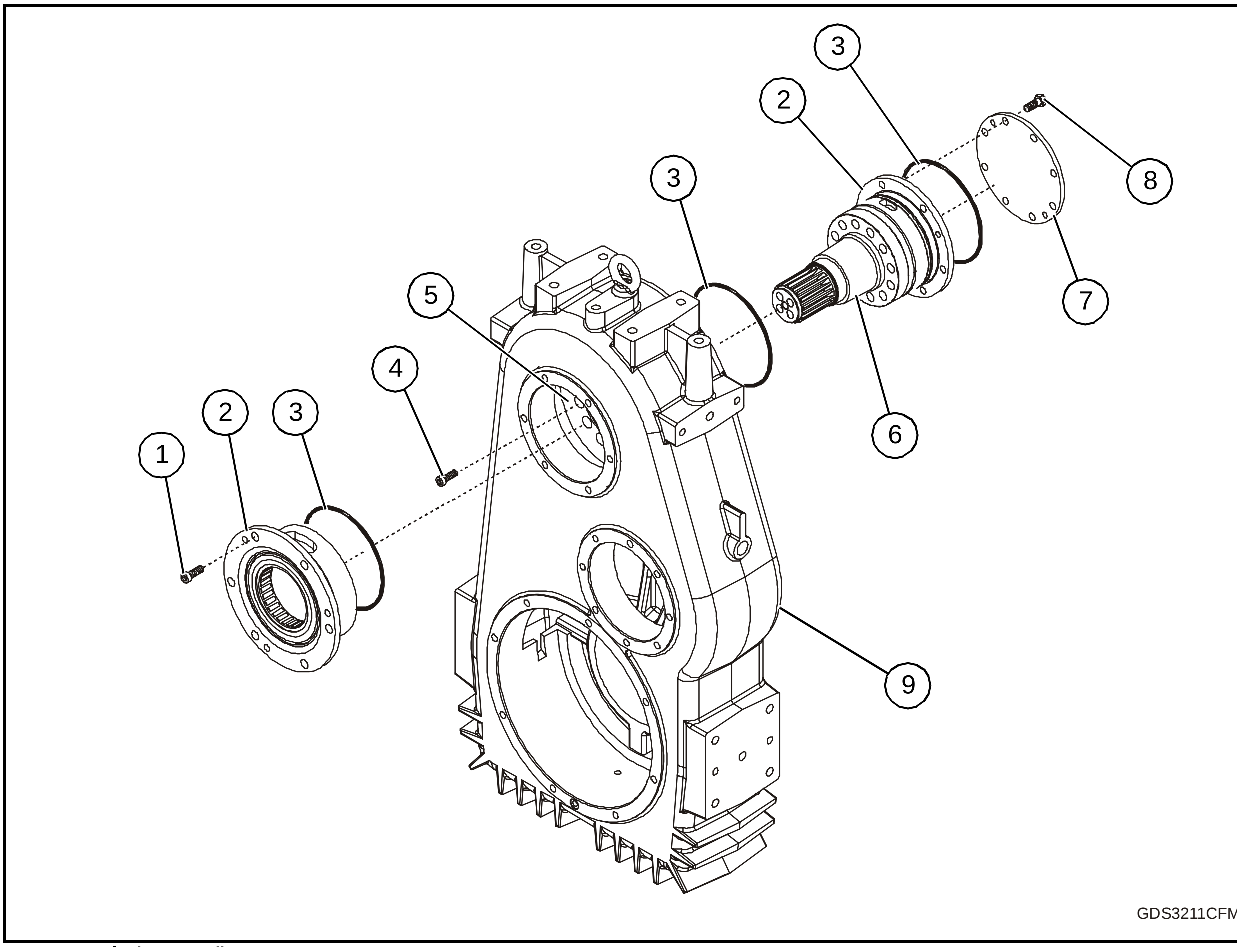
Install input gear (2) in transfer case (1) with machined contact surface down, toward rear of transfer case. Slide input gear to top end of case.

⚠ CAUTION

DO NOT rotate transfer case right-side up. Input gear can fall from case.

Rotate transfer case 180° until rear of case is up. Ensure that top of case rotates downward, so gear does not fall from case.

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1. Bolt (6 used).
2. Input Shaft Bearing Housing (2 used).
3. O-Ring (3 used).
4. Cap Screw (12 used).
5. Input Gear.
6. Input Shaft.
7. Cover.
8. Bolt (8 used).
9. Transfer Case.

Apply a thin layer of petroleum jelly to O-rings (3). Install O-rings on bearing housings (2).

Install two guide pins in input shaft (6) and two guide pins in transfer case (9).

⚠ CAUTION

Align oil passages in transfer case (9) and input shaft rear bearing housing (2).

Heat input shaft opening of transfer case (9) to 85°C (185°F).

Install input shaft (6) and rear bearing housing (2). Ensure that oil passages are aligned. Remove guide pins from transfer case.

Install cover (7). Install bolts (8) and tighten to specification.

Transfer Case Specification

Input Shaft Rear Bearing Housing Bolt Torque -54 Nm (40 lb-ft)

Rotate transfer case 180° so front of case is up.

⚠ CAUTION

Ensure that input gear is seated evenly on input shaft.

Remove guide pins from input shaft. Clean threads of cap screws (4) with Cure Primer and apply Medium Strength Thread Lock and Sealer.

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Install cap screws. Tighten evenly in increments, following a criss-cross pattern. Tighten to specification.

Transfer Case Specification

Input Gear Cap Screw Torque- - - - - 156 Nm (115 lb-ft)

Measure axial clearance (end play) of bearing at input shaft. Replace bearing if measurement is not within specifications.

Transfer Case Specification

Input Shaft Bearing Axial Clearance (End Play) -0.4 - 1.2 mm (0.016 - 0.047 in.)

⚠ CAUTION

Align oil passages in transfer case (9) and input shaft front bearing housing (2).

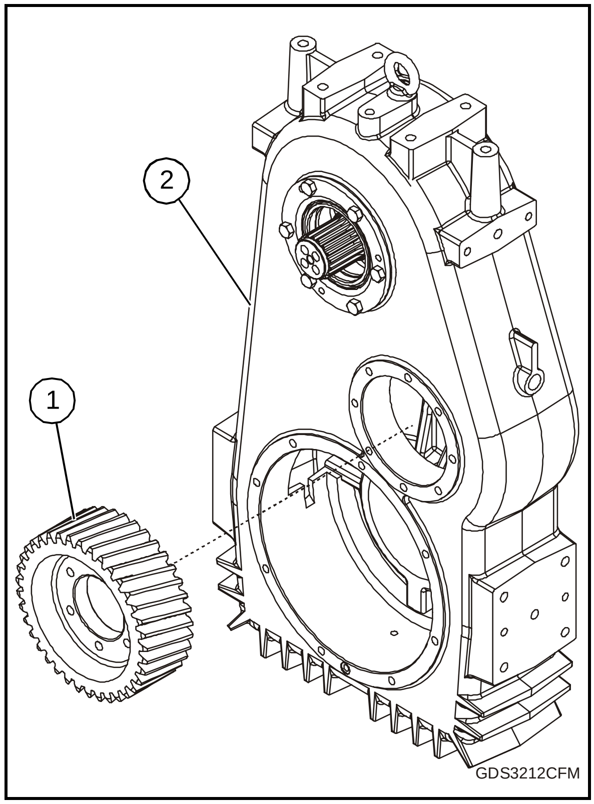
Install two guide pins in transfer case (9). Install input shaft front bearing housing (2).

NOTE:Ensure that oil passages are aligned.

Remove guide pins. Install bolts (1) and tighten to specification.

Transfer Case Specification

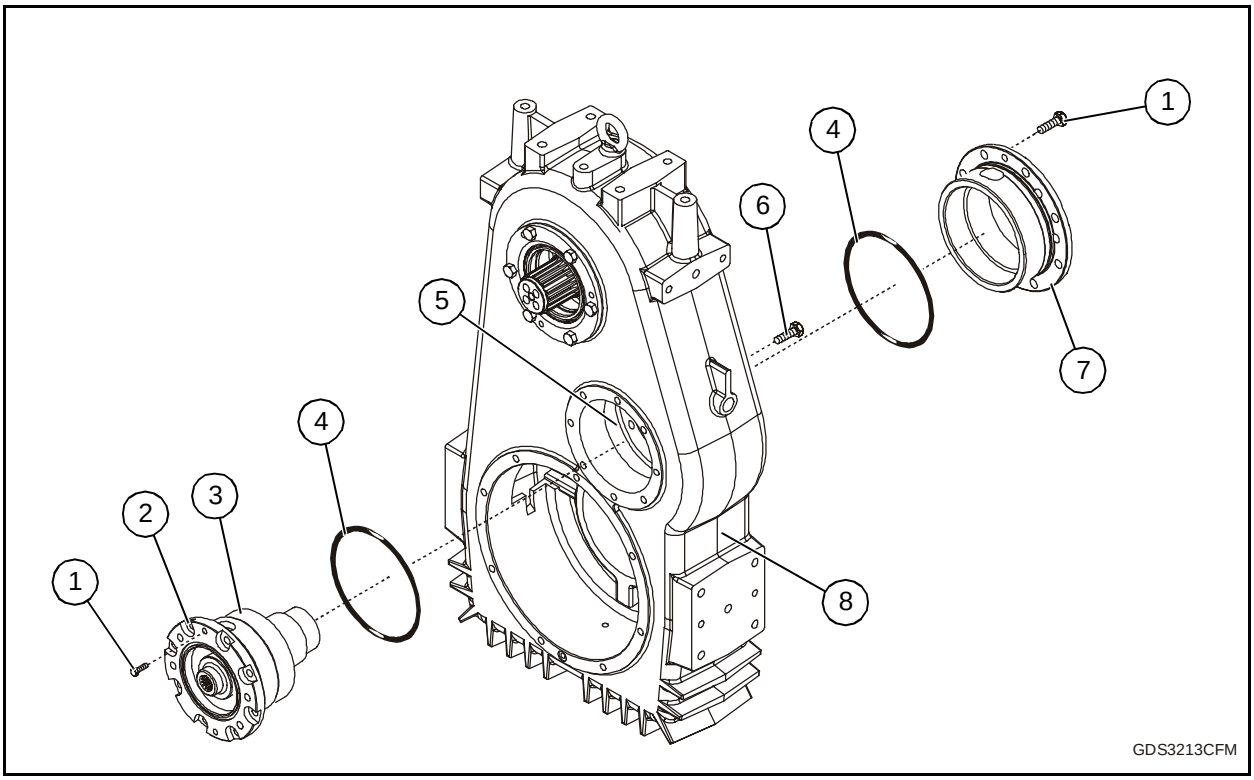
Input Shaft Front Bearing Housing Bolt Torque- 54 Nm (40 lb-ft)



Install idler gear assembly.

Install idler gear (1) in transfer case (2) with machined contact surface up, toward front of transfer case. Slide idler gear into position.

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1. Cap Screw (16 used).
2. Idler Shaft Front Bearing Housing.
3. Idler Shaft.
4. O-Ring (2 used).
5. Idler Gear.
6. Bolt (6 used).
7. Idler Shaft Rear Bearing Housing.
8. Transfer Case.

Apply a thin layer of petroleum jelly to O-rings (4) and install on idler shaft bearing housings (2 and 7).

Install guide pins on idler shaft (3) and transfer case (8).

⚠ CAUTION

Align oil passages in transfer case (8) and idler shaft front bearing housing (2).

Install idler shaft (3) and front bearing housing (2). Ensure that oil passages are aligned.

Remove guide pins from transfer case. Install cap screws (1) hand-tight at this time.

Rotate transfer case 180° in stand, so rear of case is up.

⚠ CAUTION

Ensure that idler gear is seated evenly on idler shaft.

Remove guide pins from idler shaft. Clean threads of bolts (6) with Cure Primer and apply Medium Strength Thread Lock and Sealer.

Install cap screws. Tighten evenly in increments, following a criss-cross pattern. Tighten to specification.

Transfer Case Specification

Idler Gear Cap Screw Torque - - - - - 156 Nm (115 lb-ft)

Measure axial clearance (end play) of bearing at idler shaft. Replace bearing if measurement is not within specifications.

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Transfer Case Specification

Idler Shaft Bearing Axial Clearance (End Play) - 0.4 - 1.2 mm (0.016 - 0.047 in.)

⚠ CAUTION

Align oil passages in transfer case (8) and bearing housing (7).

Install two guide pins in transfer case (8). Install idler shaft rear bearing housing (7). Ensure that oil passages are aligned.

Install bearing housing in transfer case. Remove guide pins. Install cap screws (1) and tighten to specification.

Transfer Case Specification

Idler Shaft Rear Bearing Housing Cap Screw Torque - 54 Nm (40 lb-ft)

Rotate transfer case 180° in stand so front of case is up.

Tighten cap screws (1) to specification.

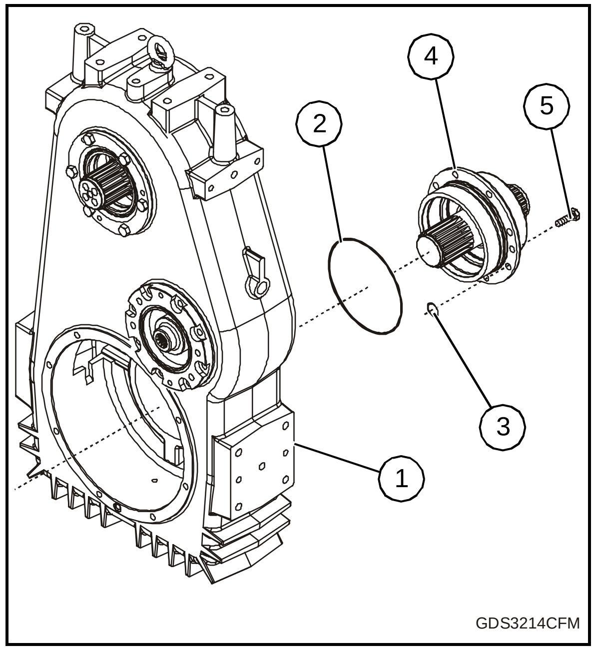
Transfer Case Specification

Idler Shaft Front Bearing Housing Cap Screw Torque - 54 Nm (40 lb-ft)

Check backlash between input gear and idler gear.

Transfer Case Specification

Input Gear-to-Idler Gear Backlash - 0.25 - 0.42 mm (0.010 - 0.017 in.)



Install output assemblies.

Rotate transfer case 180° in stand, so rear of case is up.

Apply a thin layer of petroleum jelly to O-rings (2 and 3). Install O-ring (2) on rear output bearing housing (4). Install O-ring (3) on transfer case (1).

⚠ CAUTION

Align oil passages in transfer case (1) and rear output bearing housing (4).

Install two guide pins in transfer case (1). Install rear output bearing housing (4).

NOTE:Ensure that oil passages are aligned.

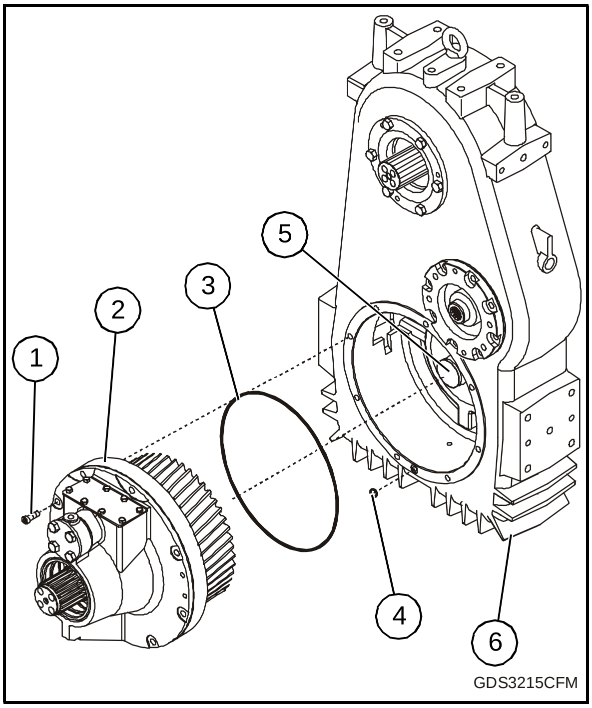
Remove guide pins. Install cap screws (5) and tighten to specification.

Transfer Case Specification

Rear Output Housing Cap Screw Torque - 54 Nm (40 lb-ft)

Rotate transfer case 180° in stand so front of case is up.

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Apply a thin layer of petroleum jelly to O-rings (3 and 4). Install O-ring (3) on output gear assembly (2). Install O-ring (4) on transfer case (6).

⚠ CAUTION

Align oil passages in transfer case (6) and output gear assembly (2).

Install two guide pins in transfer case (6). Install output gear assembly (2) in transfer case.

Ensure that oil passages are aligned. Remove guide pins. Install cap screws (1) and tighten to specification.

Transfer Case Specification

Front Output Assembly Cap Screw Torque -54 Nm (40 lb-ft)

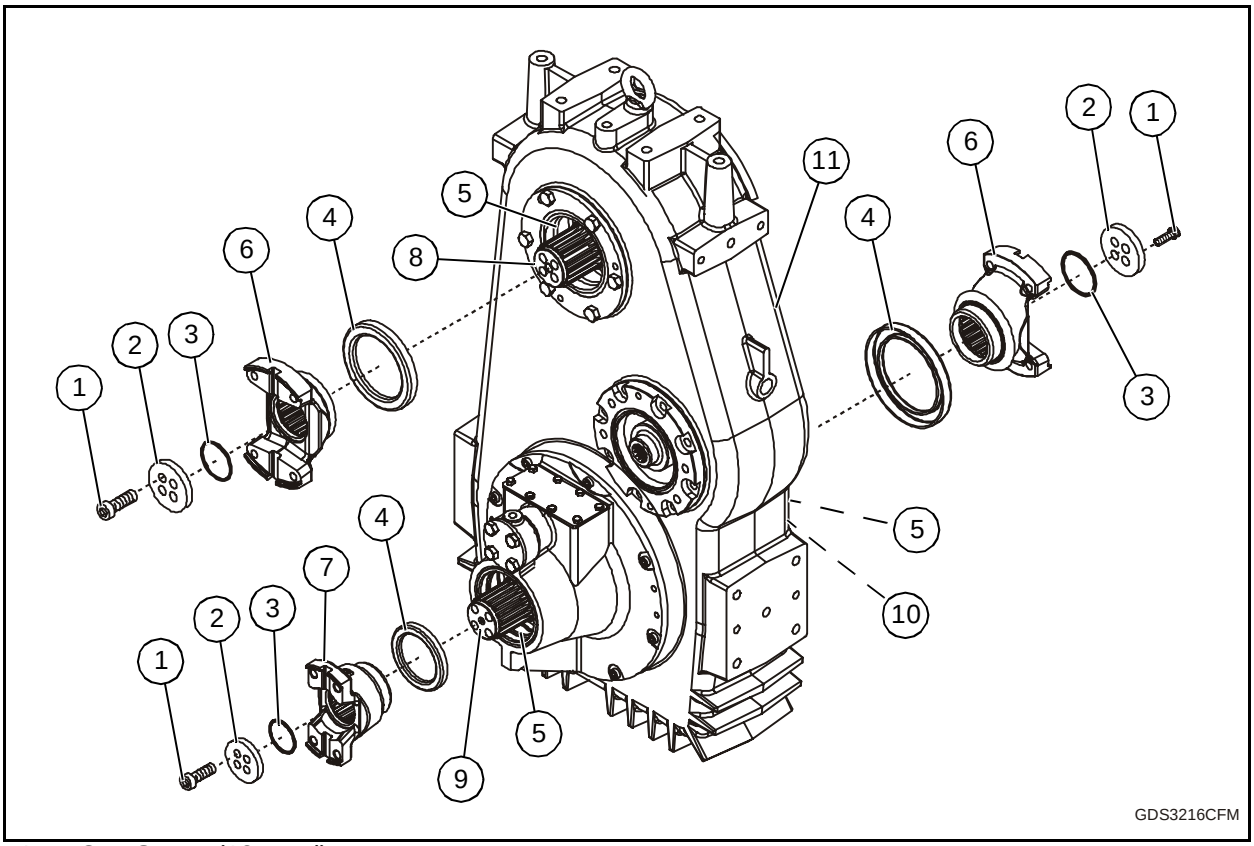
NOTE: Access output gear through drain plug port.

Check backlash between idler gear and output gear.

Transfer Case Specification

Idler Gear to Output Gear Backlash - 0.25 - 0.42 mm (0.010 - 0.017 in.)

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1. Cap Screw (12 used).
2. Retainer (3 used).
3. O-Ring (3 used).
4. Dust Shield (3 used).
5. Seal (3 used).
6. Yoke (2 used).
7. Yoke.
8. Input Shaft.
9. Front Output Shaft.
10. Rear Output Shaft.
11. Transfer Case.

Install yokes.

Apply Maximum Strength Retaining Compound to inside diameters of all dust shields (4). Press dust shields onto yokes (6 and 7).

Apply anti-seize lubricant to splines of shafts (8 and 9). Apply a thin coating of petroleum jelly to lips of seals (5).

NOTE:Front output shaft yoke (7) is slightly smaller than other two yokes (6).

Install yokes (6 and 7).

Apply a thin layer of anti-sieze lubricant to new O-rings (3). Install O-rings in grooves of yokes.

Install retainers (2). Apply Medium Strength Thread Lock and Sealer to threads of cap screws (1). Install cap screws and tighten to specification.

Transfer Case Specification

Yoke Retainer Cap Screw Torque - 156 Nm (115 lb-ft)

Rotate transfer case 180° in stand so rear of case is up.

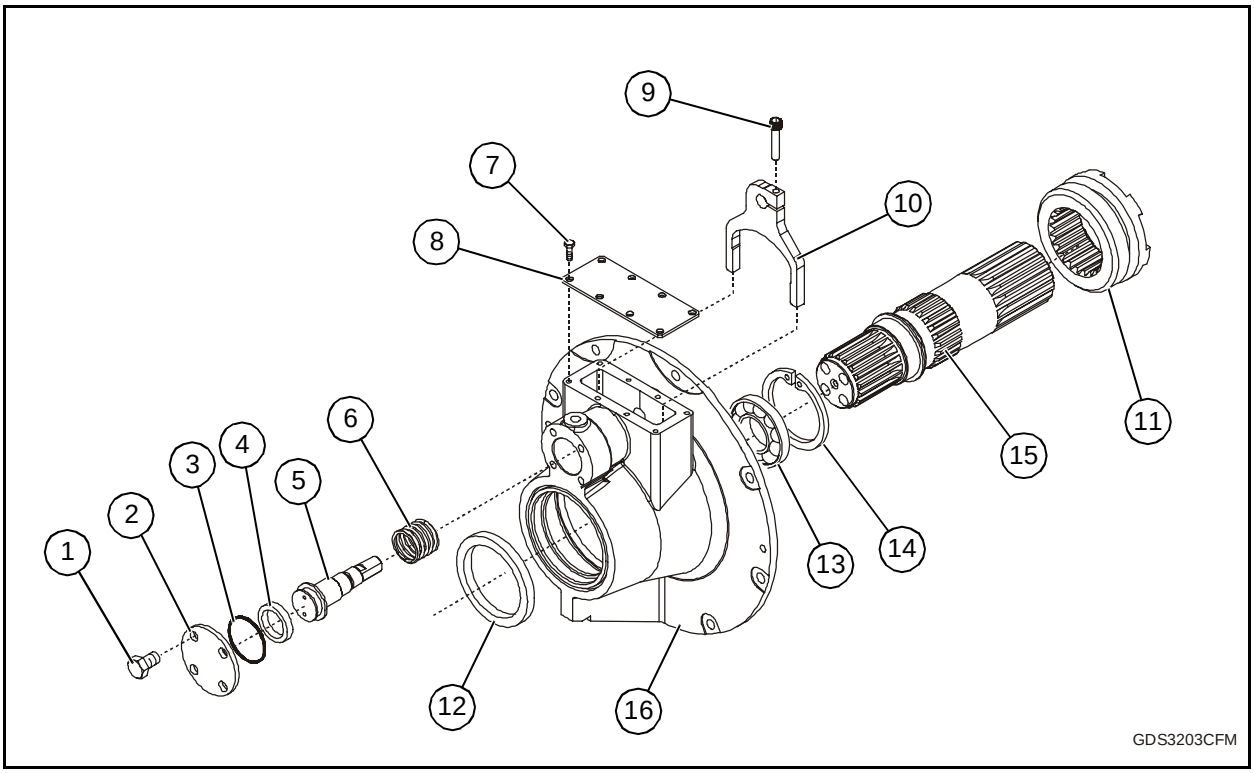
Repeat steps b - e for rear output shaft (10) and yoke (6).

Adjust inter-axle lock actuator.

Install new copper washers on fill and drain plugs.

Fill transfer case with oil. **(See Change Transfer Case Oil Operator's Manual, CHAPTER 15, SECTION 2).**

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1. Bolt (4 used).
2. Piston Cover.
3. O-Ring.
4. Piston Seal.
5. Piston.
6. Spring.
7. Bolt (8 used).
8. Fork Cover.
9. Cap Screw.
10. Fork.
11. Slide Collar.
12. Seal.
13. Bearing.
14. Snap Ring.
15. Front Output Shaft.
16. Front Output Housing.

Adjust Inter-Axle Lock Actuator

NOTE: Actuator adjustment must be done after transfer case is completely assembled.

Rotate front output shaft (15) until teeth of slide collar (11) and teeth of planetary coupler hub are positioned to engage.

⚠ CAUTION

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

NOTE: Thread size at pneumatic port is M12 x 1.5.

Adjust air pressure to specification. Connect air supply to pneumatic port. Apply air pressure to engage inter-axle lock. Slide collar teeth must fully engage hub teeth.

Transfer Case Specification

Inter-Axle Lock Actuator Pneumatic maximum Pressure - - - - - - - - 6.0 - 9.1 bar (600 - 910 kPa) (87 - 132 psi)

Relieve air pressure to disengage inter-axle lock. Coupler teeth must fully disengage from hub.

Apply and relieve air pressure several times to check for air leaks and actuator function.

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⚠ CAUTION

Fork (10) must not press against groove of slide collar (11) under load when engaged, or premature wear will result.

NOTE: Adjust clearance to high end of tolerance range.

Apply air pressure to engage inter-axle lock. Be sure slide collar and coupler hub teeth are fully engaged. Check clearance between actuator fork rear surface and inside surface of slide collar groove, using a feeler gauge. Rotate piston (5) to adjust clearance to specification, using an adjustable two-pin spanner wrench.

Transfer Case Specification

Actuator Fork Rear Surface-to-Slide Collar Groove Clearance - - - - - - - - 0.20 - 0.40 mm (0.008 - 0.016 in.)

⚠ CAUTION

Teeth of slide collar and teeth of coupler hub must not make contact when inter-axle lock is disengaged.

Relieve air pressure to disengage inter-axle lock. Check clearance between slide collar teeth and coupler hub teeth. Rotate piston (5) to adjust clearance to specification, using an adjustable two-pin spanner wrench.

Transfer Case Specification

Slide Collar Teeth-to-Coupler Hub Teeth Clearance - 1.0 mm (0.04 in.) minimum

Repeat steps above as necessary until both measurements are within specification.

Remove shift fork cap screw (9). Clean threads with Cure Primer and apply Medium Strength Thread Lock and Sealer. Install cap screw and tighten to specification.

Transfer Case Specification

Actuator Fork Cap Screw Torque - 18 Nm (159 lb-in.)

Install O-ring (3) and piston cover (2). Tighten bolts (1) to specification.

Transfer Case Specification

Piston Cover Bolt Torque - - - - - - - - - 54 Nm (40 lb-ft)

Apply Flexible Form-In-Place Gasket to contact surface of fork cover (8) and to threads of cap screws (7). Install fork cover. Tighten bolts to specification.

Transfer Case Specification

Fork Cover Bolts Torque - - - - - - - - 12 Nm (106 lb-in.)

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CHAPTER 8. STEERING SYSTEM

SECTION 1. SECONDARY STEERING

SECONDARY STEERING PUMP

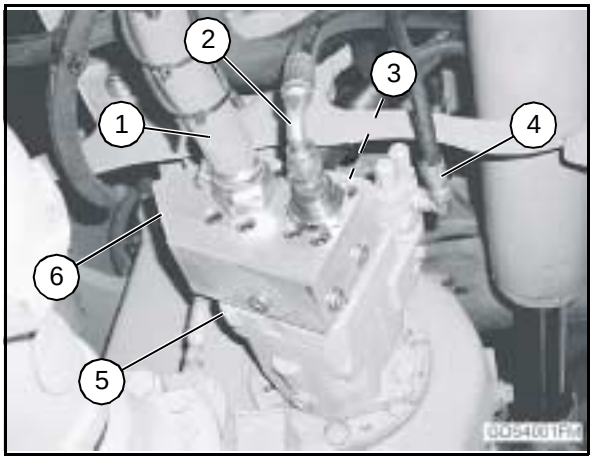
Remove and Install Secondary Steering Pump

⚠ CAUTION

Prevent personal injury from unexpected machine movement. Always install articulation locking bar before working in the articulation joint area.

Install articulation locking bar.

Drain oil from hydraulic reservoir. The approximate capacity of reservoir is 78.8 L (20.8 gal).



1. Inlet Line.
2. Outlet Line.
3. Case Drain Line.
4. Hydraulic Load Sense Line.
5. Secondary Steering Pump.
6. Anti-Cavitation Valve.

Mark and disconnect lines (1 - 4).

Remove secondary steering pump (5) and mounting flange O-ring. Repair or replace as necessary.

Install pump using new mounting flange O-ring. Connect lines as marked.

⚠ CAUTION

Secondary steering pump will be damaged if housing is not filled with oil before moving machine.

Fill pump housing with oil through case drain port.

Fill hydraulic reservoir to proper level.

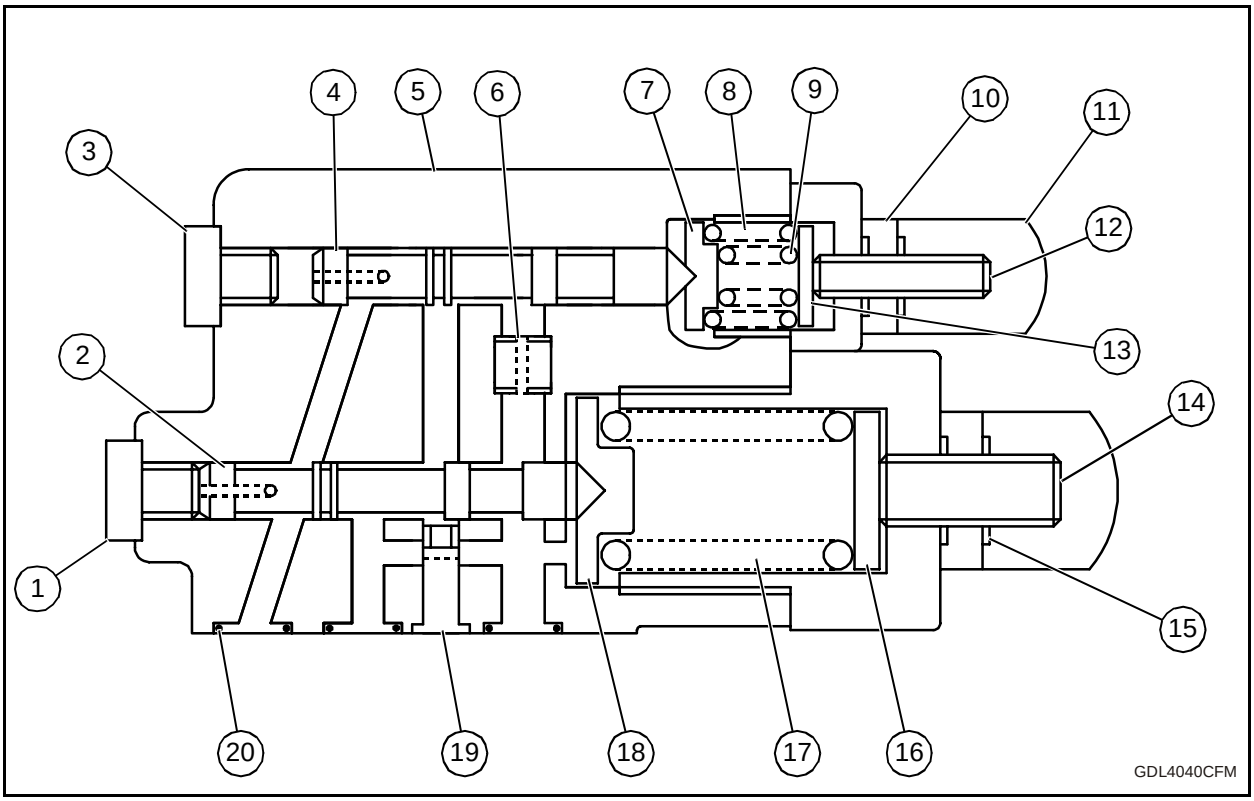
Adjust residual and compensator valves. Do Secondary Steering Pump Residual and Compensator Valves Test and Adjustment. **(See CHAPTER 5, SECTION 3 in Operation and Test Manual).**

Disassemble and Assemble

Clean and drain pump.

Remove anti-cavitation valve.

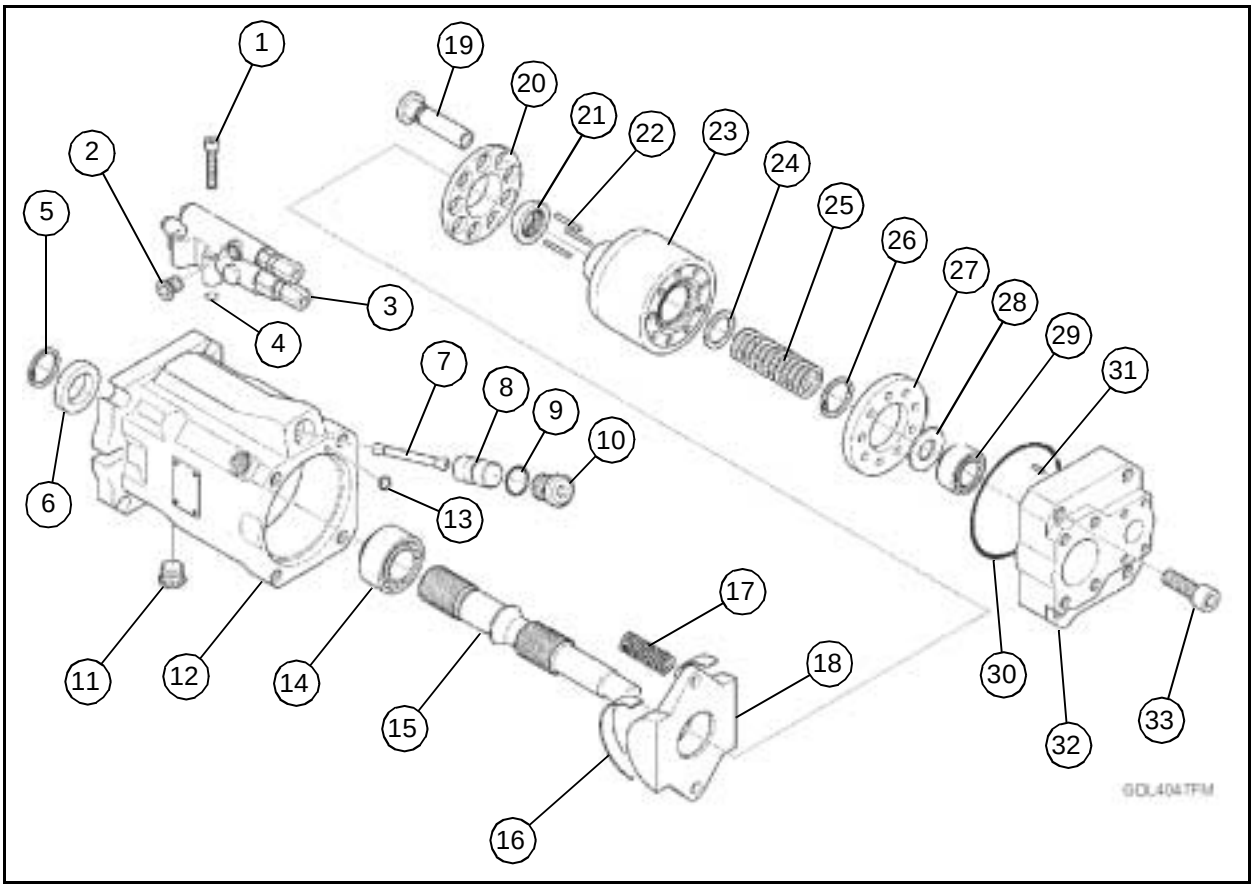
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1. Plug.
2. Compensator Valve Spool.
3. Plug.
4. Residual Valve Spool.
5. Pump Regulator Valve.
6. Orifice.
7. Spring Guide.
8. Outer Spring.
9. Inner Spring.
10. Nut (2 used).
11. Cap (2 used).
12. Adjusting Screw.
13. Plate.
14. Adjusting Screw.
15. Sealing Washer (4 used).
16. Plate.
17. Spring.
18. Spring Guide.
19. Orifice.
20. O-Ring (3 used).

Remove regulator valve. Disassemble as necessary.

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1. Cap Screw (4 used).
2. Plug.
3. Pump Regulator Valve.
4. O-Ring (3 used).
5. Snap Ring.
6. Oil Seal.
7. Control Rod.
8. Control Piston.
9. O-Ring.
10. Plug.
11. Plug.
12. Pump Housing.
13. Seal.
14. Tapered Roller Bearing Cone and Cup.
15. Drive Shaft.
16. Swash Plate Bearing (2 used).
17. Spring.
18. Swash Plate.
19. Piston (9 used).
20. Retainer Plate.
21. Guide Ball.
22. Pin (3 used).
23. Cylinder Block.
24. Washer.
25. Spring.
26. Snap Ring.
27. Distributor Plate.
28. Spacer.
29. Tapered Roller Bearing Cone and Cup.
30. O-Ring.
31. Dowel Pin.
32. Port Plate.
33. Cap Screw (4 used).

⚠ CAUTION

The distributor plate may stick to the port plate when removed. The highly machined surface on port plate, distributor plate, and cylinder block must not be damaged. Lay parts on clean, lint-free towels to protect the machined surfaces.

Remove port plate (32) and distributor plate (27).

Remove tapered roller bearing cone (29) and spacer (28).

Remove the rotary group (19 - 26) as an assembly.

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⚠ CAUTION

Spring (25) is under compression. A press must be used to compress spring to remove snap ring (26).

Inspect cylinder block. Remove spring (25) only if replacement is necessary.

Remove control piston assembly (7 - 10).

Remove swash plate (18), drive shaft (15), spring (17), and bearings (16).

Remove tapered roller bearing cone (14) using a press. Remove bearing only if replacement is necessary.

Remove snap ring (5) and oil seal (6).

Clean and inspect all parts for wear and damage. Replace parts as necessary.

⚠ CAUTION

Replace all oil seals and O-rings. Old seals and O-rings will leak.

Install oil seal (6) with lip facing inside of housing. Press seal into housing just far enough to install snap ring. Apply petroleum jelly to sealing lip.

Put pump housing in vise with large opening up, at approximately a 30° angle with control piston port at bottom.

⚠ CAUTION

Apply clean oil to all internal parts as they are assembled.

Install swash plate bearings and spring.

Install tapered roller bearing cone on drive shaft tight against shoulder. Bearing cone is a press fit.

Install drive shaft and swash plate. Position spring (17) on swash plate using a screwdriver.

Install control rod (7) by pushing the swash plate to one side and moving end of control rod in the opposite direction.

Install control piston, O-ring, and plug.

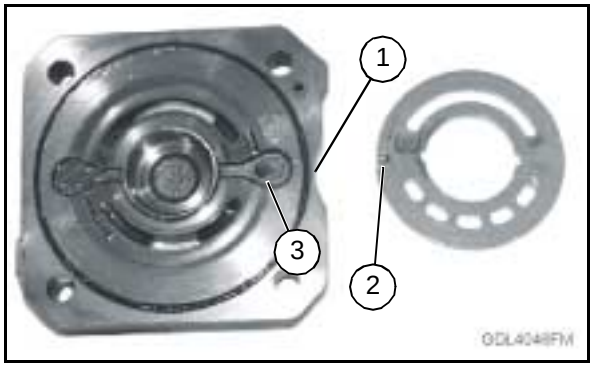
Move pump housing to a horizontal position.

Assemble rotary group (19 - 26). A press must be used to install spring (25). Pins (22) are installed in cylinder block between washer (24) and guide ball (21).

Install assembled rotary group into pump housing.

Install spacer (28) and bearing cone (29).

Install O-rings (13 and 30).



1. Port Plate.
2. Notch.
3. Dowel Pin.

Apply a small amount of petroleum jelly on the mating surface of distributor plate and port plate (1).

Install the distributor plate on port plate so notch (2) engages the dowel pin (3).

Install port plate.

Tighten cap screws to specification using a crisscross pattern.

Secondary Steering Pump Specification

Port Plate-to-Pump Housing Cap Screw Torque- 47 Nm (35 lb-ft)

Install pump regulator valve.

Install anti-cavitation valve.

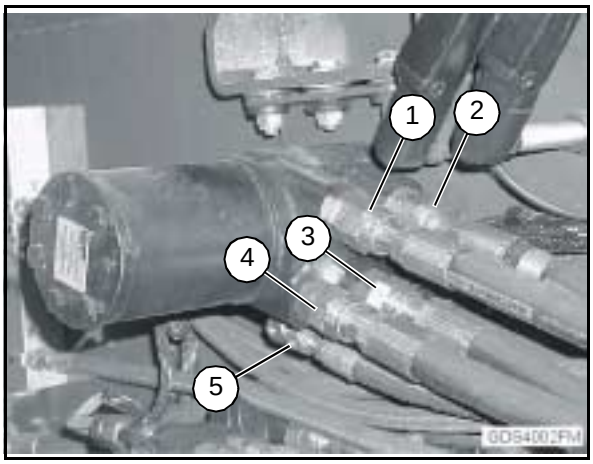
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CHAPTER 8. STEERING SYSTEM

SECTION 2. HYDRAULIC SYSTEM

STEERING VALVE

Remove And Install Steering Valve



1. P Port Line.
2. T Port Line.
3. L Port Line.
4. R Port Line.
5. LS Port Line.

Mark and disconnect lines (1 - 5).

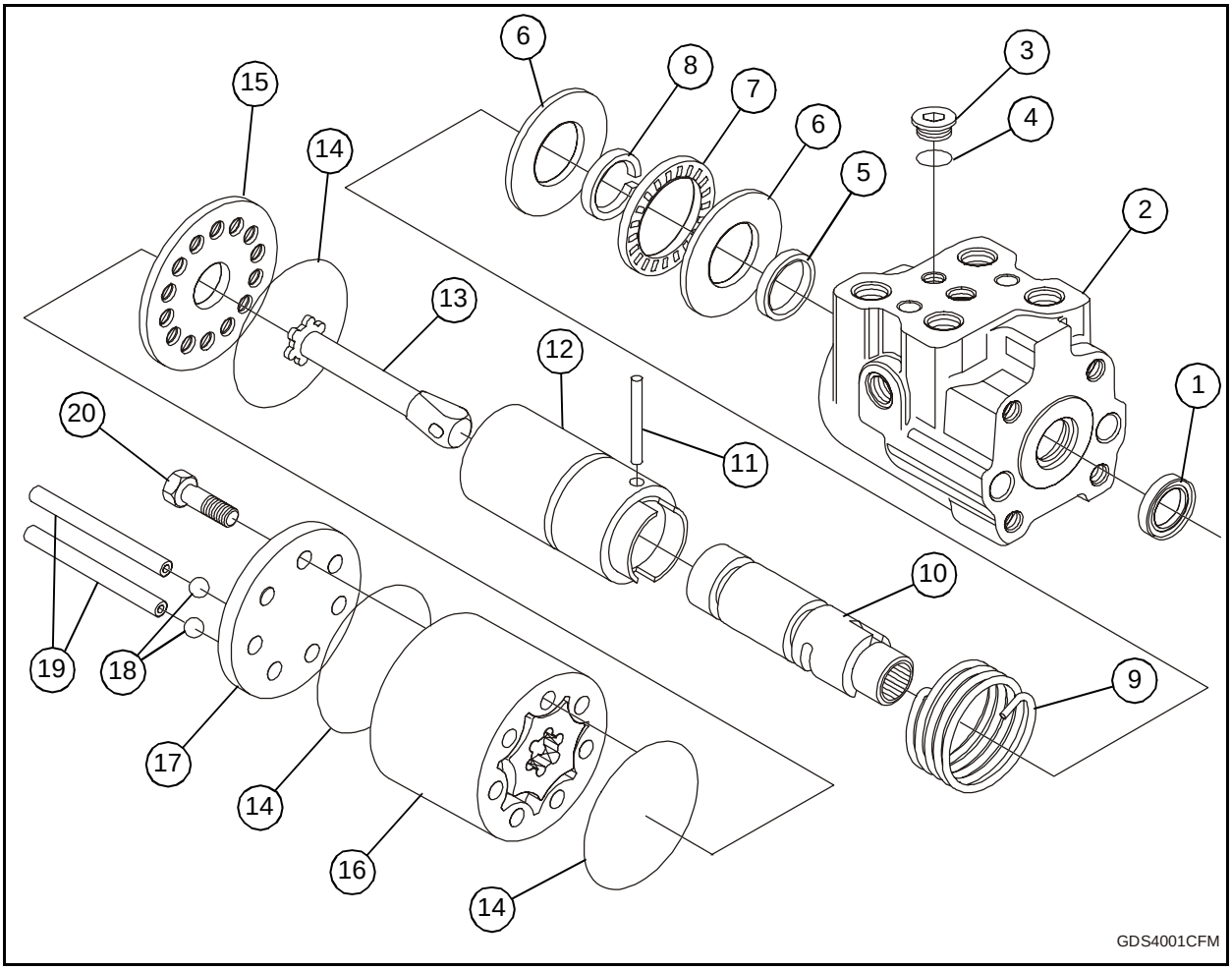
Remove mounting cap screws and steering valve.

Repair or replace steering valve as necessary.

Install steering valve.

Connect lines as marked.

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1. Seal.
2. Housing.
3. Plug.
4. O-Ring.
5. Seal (Three Piece).
6. Bearing Race (2 used).
7. Thrust Bearing.
8. Snap Ring .
9. Centering Spring.
10. Spool.
11. Pin.
12. Sleeve.
13. Drive Shaft.
14. O-Ring (3 used).
15. Spacer Plate.
16. Gerotor Assembly.
17. End Cap.
18. Ball (2 used).
19. Roll Pin (2 used).
20. Cap Screw (7 used).

Disassemble and Assemble

Clean steering valve housing (2).

Drain oil from housing.

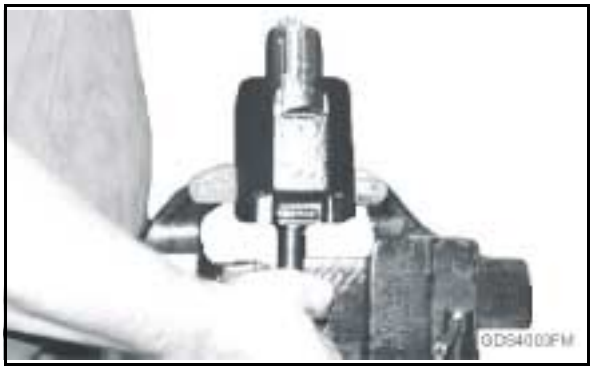
Put valve in vise with gerotor end up. Scribe a line across housing to aid in assembling.

Remove gerotor assembly parts (14 - 17).

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⚠ CAUTION

Centering spring must be completely compressed while removing or installing sleeve or damage to valve housing bore will occur.



Install JDG1319 Steering Spool Remover in end of spool (10) and turn to compress centering spring (9). With centering spring compressed, push spool, sleeve, and drive shaft (13) out of housing.

Remove centering spring only if replacement is necessary. Spool, sleeve, and drive shaft are not serviceable. If parts are found worn or damaged, replace complete steering valve.

Remove parts (1 - 8), replace as necessary.

⚠ CAUTION

Replace all seals and O-rings with new. Apply petroleum jelly to all seals and O-rings. Apply clean hydraulic oil to all internal parts while assembling.

Install seal (1), plug (3), and O-ring (4).



Install centering spring by inserting one end of spring in groove of spool and sleeve. Turn spring counterclockwise to compress and insert other end of spring in groove of spool and sleeve as shown.

Install thrust washers (6), snap ring (8), thrust bearing (7), and seal (5).

⚠ CAUTION

Centering spring must be completely compressed while removing or installing sleeve or damage to valve housing bore will occur.

Compress spring using JDG1319 Steering Spool Remover and install spool and sleeve in housing.

Install balls (18) and roll pins (19) if removed.

Install parts (14 - 17) using scribe line as a guide.

Install cap screws (20). Tighten cap screws in a crisscross pattern to specification.

Steering Valve Specification

End Cap-to-Housing Cap Screws Initial Torque- 17 Nm (150 lb-in.)

End Cap-to-Housing Cap Screws Final Torque - 34 Nm (300 lb-in.)

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STEERING CYLINDER

Remove and Install

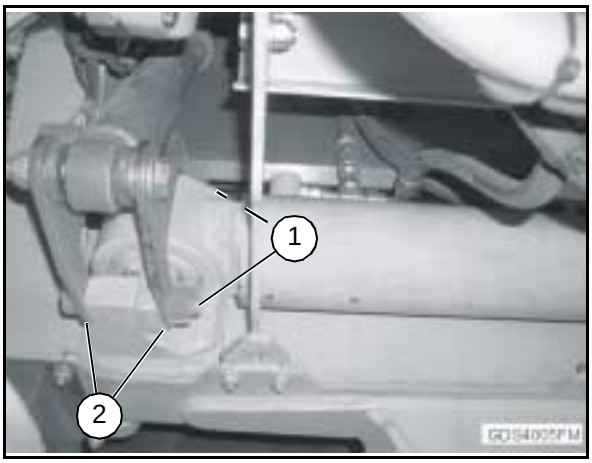
Turn front of truck so the steering cylinder to be removed is fully extended.

Tilt Cab. **(See Operator's Manual, CHAPTER 7, SECTIOn 1).**

Label and disconnect hydraulic lines from steering cylinder.

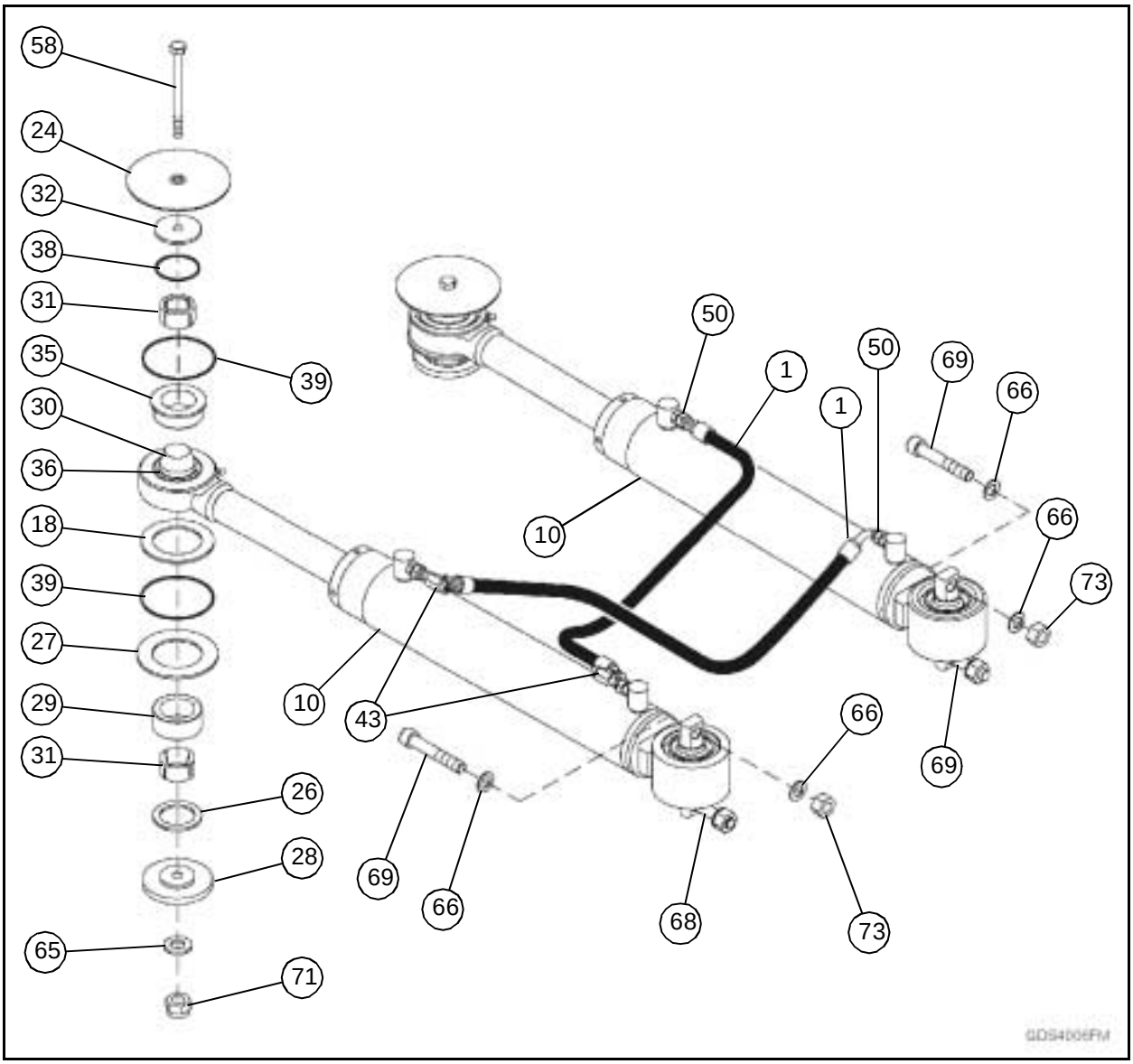
⚠ CAUTION

DO NOT remove mounting cap screws unless cab tilt support strut is properly engaged and tilt cylinder pressure is relieved.



Remove front mounting cap screws (1). Move cab tilt cylinder bracket (2) away from steering cylinder.

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1. Hose.
2. Hose.
10. Steering Cylinder.
18. Spacer.
24. Washer.
26. Shim.
27. Shim.
28. Plate.
29. Boss.
30. Pin Fastener.
31. Bearing Cone.
32. Plate.
35. Plate.
36. Bearing.
38. O-Ring.
39. O-Ring.
43. Tee Fitting.
43. O-Ring.
50. O-Ring.
50. Adapter.
58. Cap Screw.
65. Washer.
66. Washer.
68. Cap Screw.
69. Cap Screw.
71. Lock Nut.
73. Lock Nut.

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⚠ CAUTION

Component is heavy. Use lifting device.

Attach a lifting sling to steering cylinder.

⚠ CAUTION

Note location and quantity of shim's removed. The same number of shim's must be installed during assembly.

Disassemble rear cylinder pivot assembly. Remove cylinder.

Clean, inspect, repair, or replace parts as necessary.

Install steering cylinder.

Position steering cylinder into front mounts and move cab tilt bracket in place.

Install mounting cap screws and tighten.

Apply grease to all pivot parts and assemble as shown.

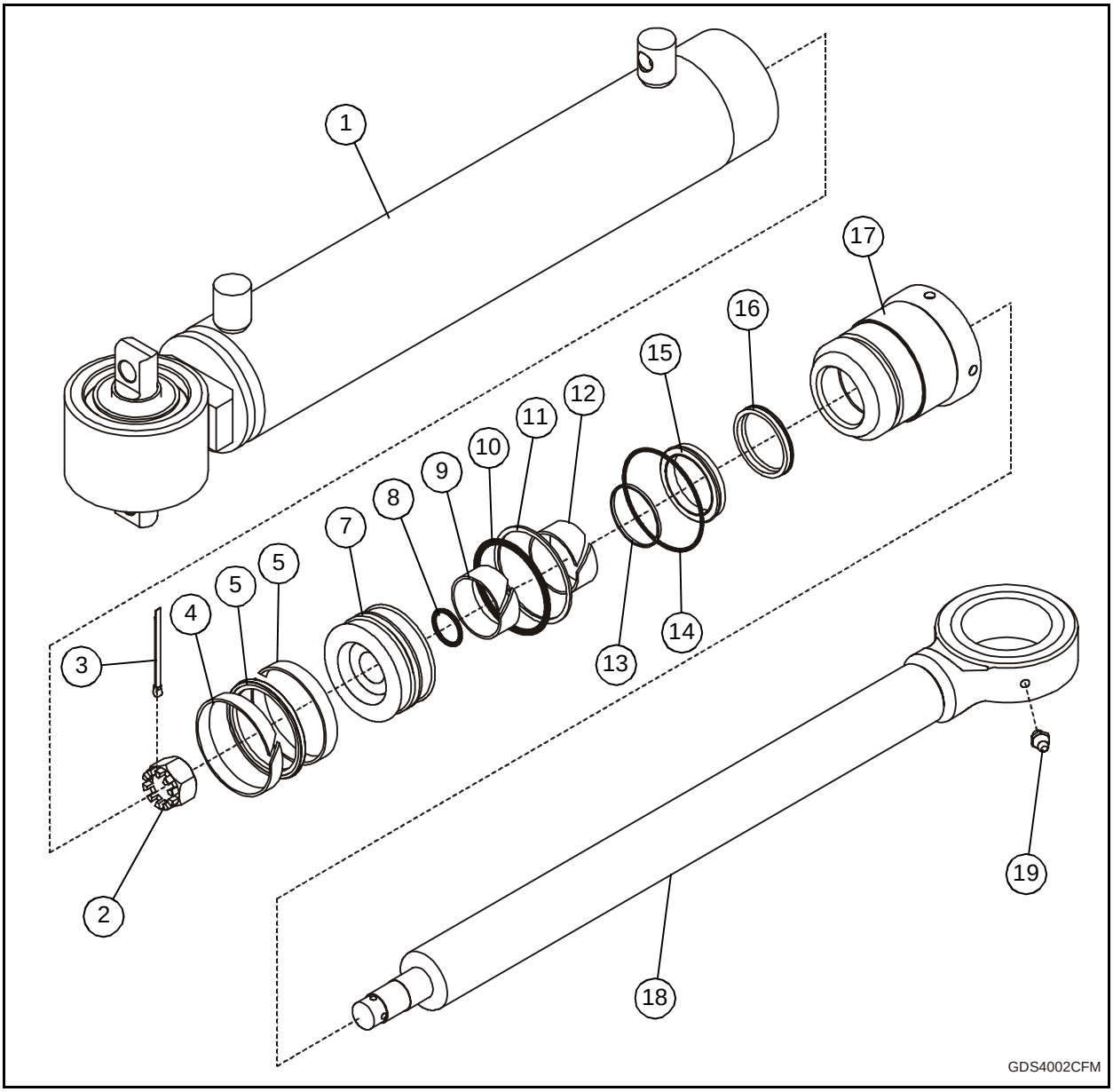
Connect hydraulic lines.

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Disassemble and Assemble

⚠ CAUTION

Component is heavy. Use hoist.



1. Barrel.
2. Rod Nut.
3. Cotter Pin.
4. Wear Ring.
5. Seal.
6. Wear Ring.
7. Piston.
8. O-Ring.
9. Wear Ring.
10. O-Ring.
11. Backup Ring.
12. Wear Ring.
13. O-Ring.
14. O-Ring.
15. Seal.
16. Wiper.
17. Rod Guide.
18. Rod.
19. Grease Fitting.

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Loosen rod guide (17) using a spanner wrench. Remove rod guide, rod (18), and piston (7) from barrel (1).

Remove and disassemble piston assembly (2 - 8).

Remove and disassemble rod guide assembly (9 - 17).

⚠ CAUTION

Replace all O-rings, backup rings, wear rings, seals, and wiper.

Clean, inspect, or replace parts as necessary.

⚠ CAUTION

Apply clean hydraulic oil to all rod guide and piston components during assembly.

Assemble rod guide assembly. Install seal (15) with lip facing rod end.

Install rod guide.

Assemble piston assembly.

Install piston on rod.

Apply rigid form-in-place gasket to threads of nut (2). Tighten nut to specification. Install cotter pin.

Steering Cylinder Specification

Rod Nut Torque - - - - - - 350 - 400 Nm (258 - 295 lb-ft)

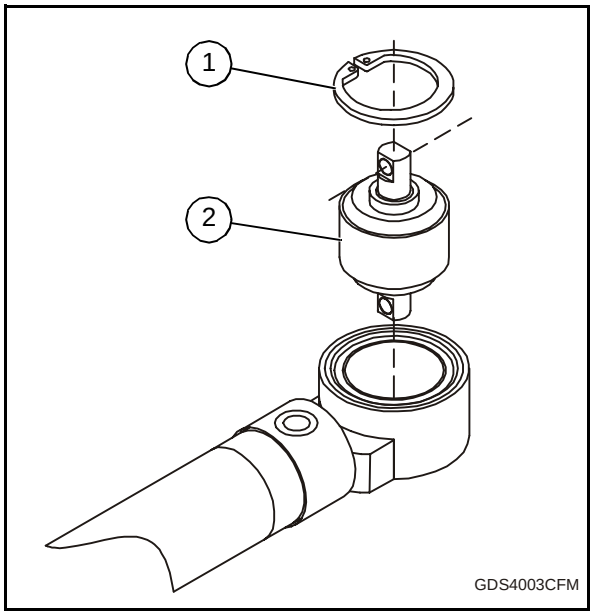
Install rod assembly in barrel.

Apply an anti-seize lubricant to threads of rod guide. Tighten rod guide to specification.

Steering Cylinder Specification

Rod Guide Torque - - - - - 750 ± 75 Nm (553 ± 55 lb-ft)

Replace Head End Pivot Pin Bushing



Remove snap ring (1).

Remove bushing (2), by pressing on center shaft with a hydraulic press.

NOTE: Clean bore of any rust or debris before attempting to install new bushing.

Align new bushing over bore with mounting hole parallel to center line of cylinder barrel. Press bushing into bore by pressing on center shaft until bushing contacts shoulder.

Install snap ring.

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CHAPTER 9. SERVICE BRAKES

SECTION 1. ACTIVE ELEMENTS

SERVICE BRAKES

Bleed Service Brake Hydraulic System

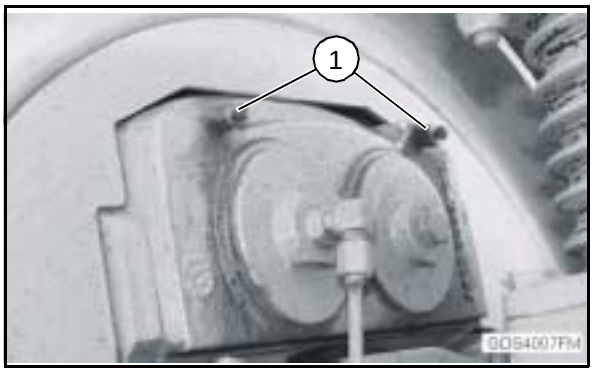
The brake system must be bled every time that any maintenance or repair is performed on the brake system which could cause air to enter the hydraulic system.

The following procedure must be used to bleed the brake system when brake bleeding equipment is not available:

1. Ensure that the hydraulic oil level is correct.

2. Ensure that the park brake is applied.

3. Start the engine and allow to idle during bleeding procedure.



4. Attach a clear plastic hose to the bleed nipple (1) on one of the brake calipers.

5. Direct the other end of the pipe into a 1 L (1 qt) container.

6. Depress the brake pedal fully.

7. Open the bleed screw on the brake caliper approximately 1/4 turn.

8. When clean, air-free oil flows from the bleed nipple through the plastic tube, close the bleed nipple.

9. Follow the bleeding procedure on each of the brake calipers on wheels.

10. Inspect the bleed screws on the brake calipers for leaks.

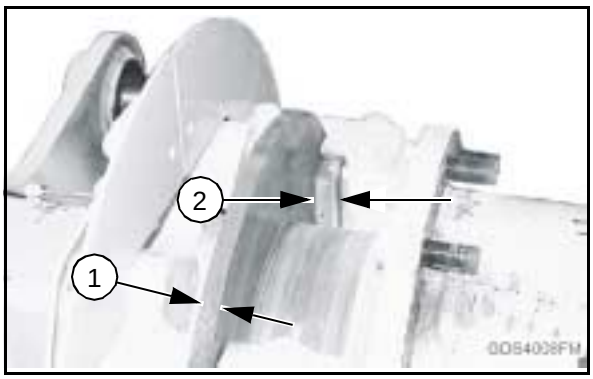
11. Dispose of waste oil properly.

12. Check the hydraulic oil level and replenish if necessary.

Remove and Install Service Brake Pads

NOTE: Front axle shown. Procedure is the same for all remaining axles.

Remove wheels. **(See "REMOVAL AND INSTALLATION OF WHEELS" on page 1).**



Inspect brake pads (2) and disks (1) for wear. Brake pads should be replaced if thickness is 2.0 mm (0.08 in.) or less. Brake disks should be replaced if thickness is 12.7 mm (0.5 in.) or less.

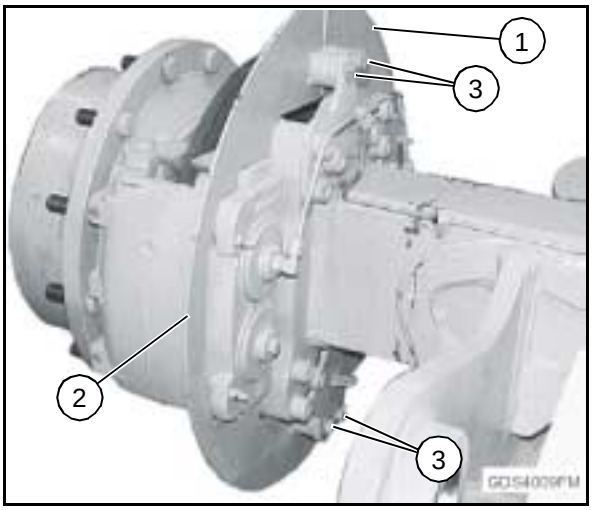
Specification

Brake Pad Thickness - - - - -2.0 mm (0.08 in.) minimum

Brake Disk Thickness - - - -12.7 mm (0.5 in.) minimum

Inspect caliper for wear or damage.

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

Repeat steps 1 - 3 for two lower remaining brake pads.

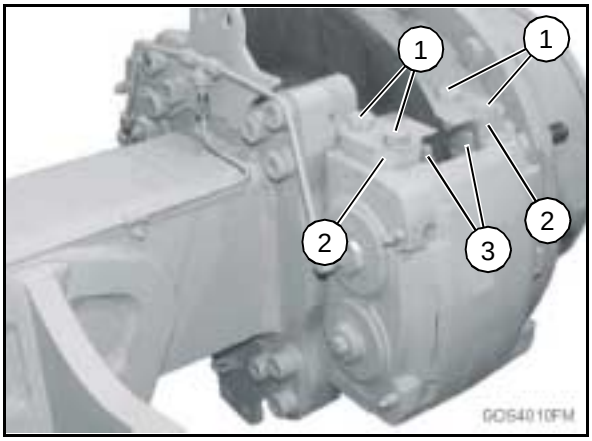
Retract caliper pistons.

Install brake pads.

NOTE:Wear indicator plate is for upper pads only.

Install retaining plate with indicator tabs positioned over brake pads.

Repeat steps 5 - 7 for two lower remaining brake pads.



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

Remove brake pads (3).

Loosen bleed screw and return pistons in caliper to full-release position.

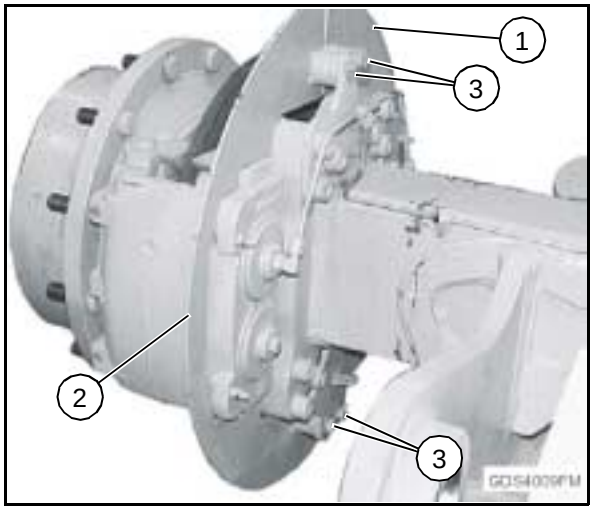
Install brake pads.

Install brake pad retainers (2).

Apply cure primer and medium strength thread lock and sealer to cap screws. Tighten cap screws to specification.

Specification

Brake Retainer Cap Screw Torque - 210 Nm (154 lb-ft)



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

Tighten cap screws.

Install wheels. **“REMOVAL AND INSTALLATION OF WHEELS” on page 1**

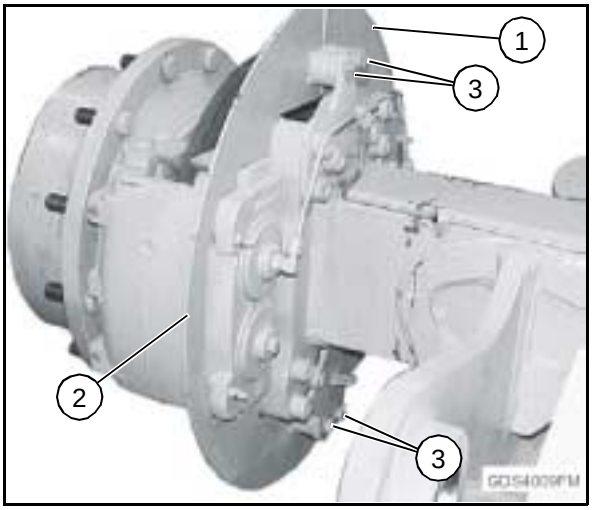
Bleed brakes. **(See “Bleed Service Brake Hydraulic System” on page 293)**

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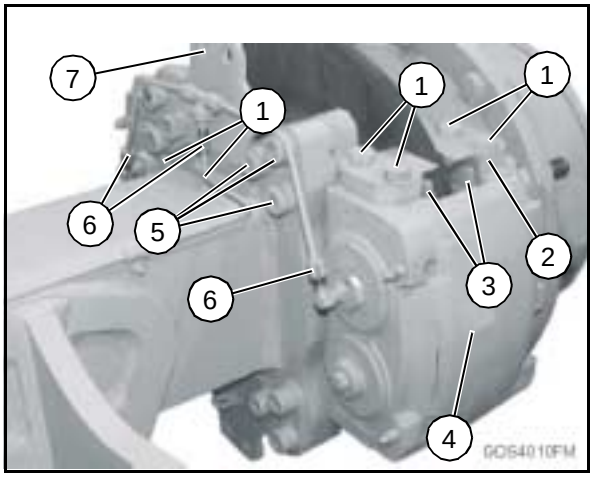
Remove and Install Service Brake Caliper

NOTE:Front axle shown. Procedure is the same for all remaining axles.

Remove wheels. **(See "REMOVAL AND INSTALLATION OF WHEELS" on page 1).**



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



1. Cap Screw (4 used).
2. Brake Pad Retainer (2 used).
3. Brake Pad (2 used).
4. Caliper.
5. Socket Head Cap Screw (12 used).
6. Brake Line Nut (3 used).
7. Support Plate.

Check pads for clearance at disk.

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

Remove brake pads (3).

Remove brake line nuts (6).

Close openings with caps and plugs.

NOTE:Caliper cap screw lengths are different on front axle. Longer cap screws are used at support plate.

Remove socket head cap screws (5) and remove support plate (7).

Remove caliper (4).

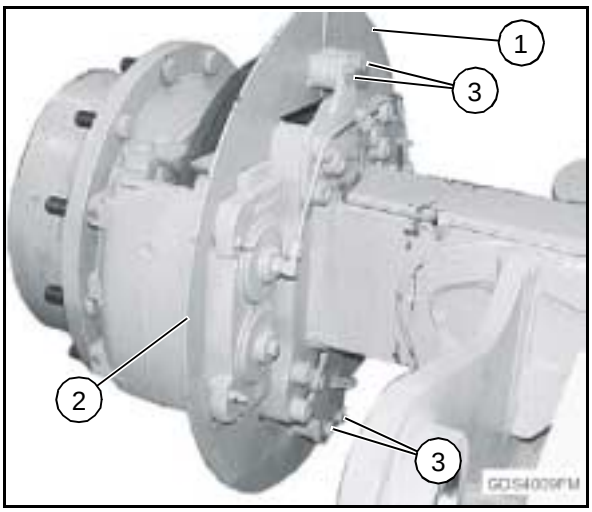
Inspect parts for wear or damage. Replace as necessary.

Install caliper.

Install support plate and socket head cap screws.

Install brake line nuts.

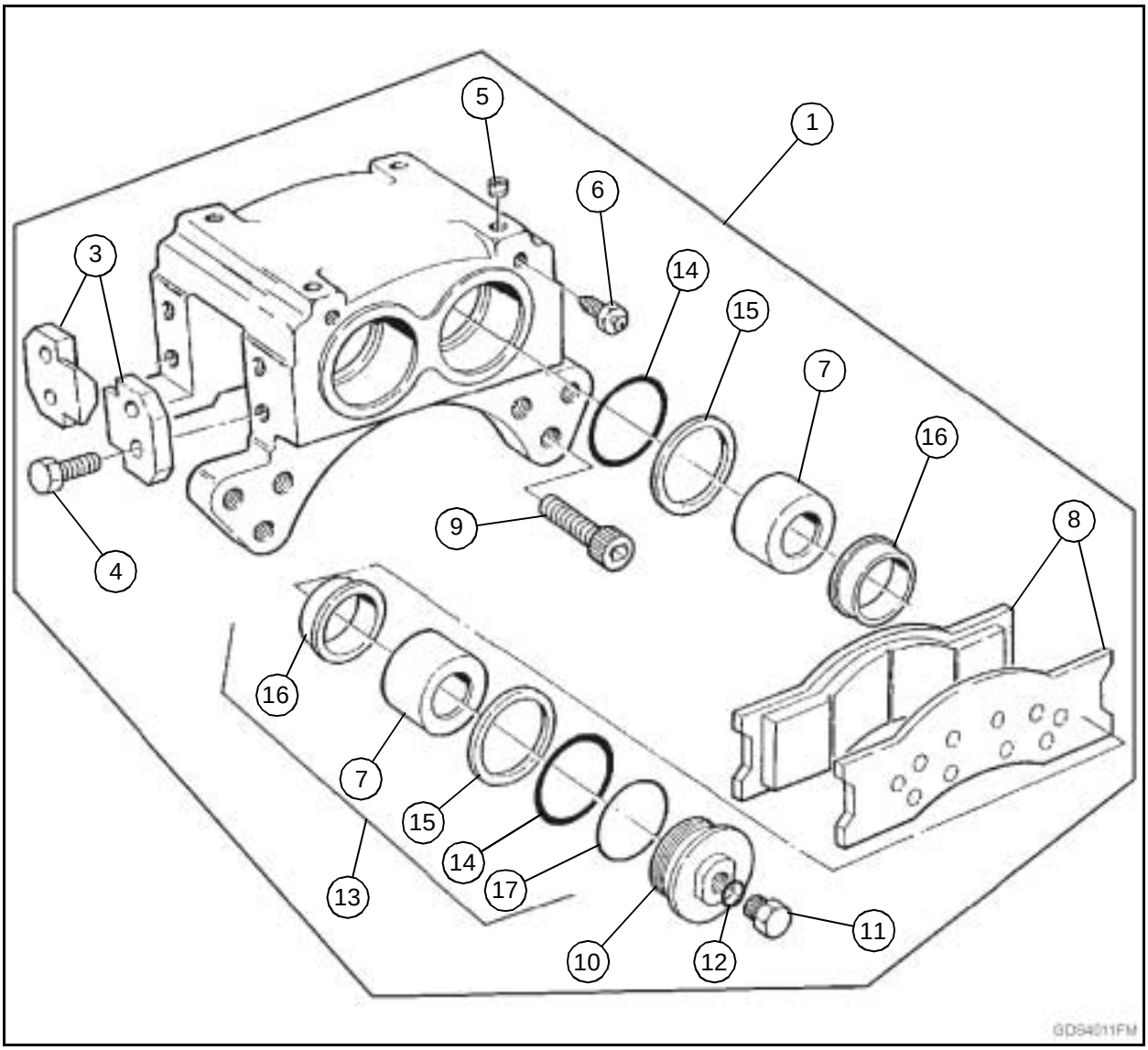
Install brake pads, brake pad retainers, and cap screws.



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

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Disassemble and Assemble Service Brake Caliper



1. Brake Caliper Assembly.
2. Not Used.
3. Brake Pad Retainer (2used).
4. Retainer Cap Screw (4 used).
5. Plug.
6. Bleed Screw.
7. Caliper Piston (2 used).
8. Brake Pad (2 used).
9. Caliper Cap Screw (6 used).
10. Piston Plug Fitting.
11. Plug Fitting.
12. O-Ring.
13. Seal Kit.
14. Seal (Part of Kit).
15. Seal (Part of Kit).
16. Seal (Part of Kit).
17. Seal (Part of Kit).

Disassemble parts (5 - 7, 10 - 12, and 14 - 17).

NOTE:Parts (14 - 17) are part of kit (13).

Clean and inspect all parts for wear or damage. Replace as needed.

Lubricate parts and assemble.

Remove and Install Brake Disk

See **“Wheel Hubs” on page 56.**

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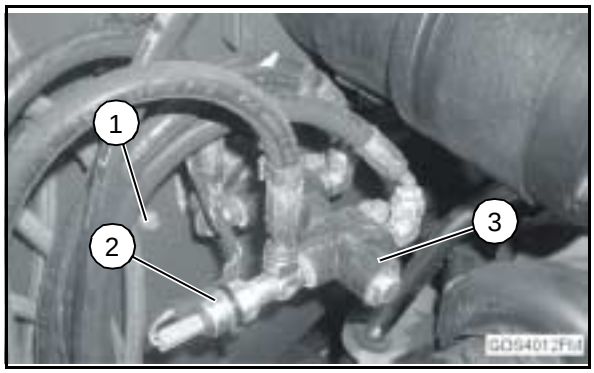
CHAPTER 9. SERVICE BRAKES

SECTION 2. HYDRAULIC SYSTEM

BRAKE VALVE

Remove and Install Brake Valve

Relieve brake accumulator pressure. Pump service brake pedal repeatedly until no oil “hiss” is heard from accumulators.



1. Cap Screw (4 used).
2. Sensor.
3. Brake Valve.

Disconnect wire leads from sensor (2).

Disconnect hydraulic lines. Close all openings with caps and plugs.

Remove cap screws (1).

Remove brake valve (3).

Inspect, repair, or replace parts as necessary.

Install brake valve.

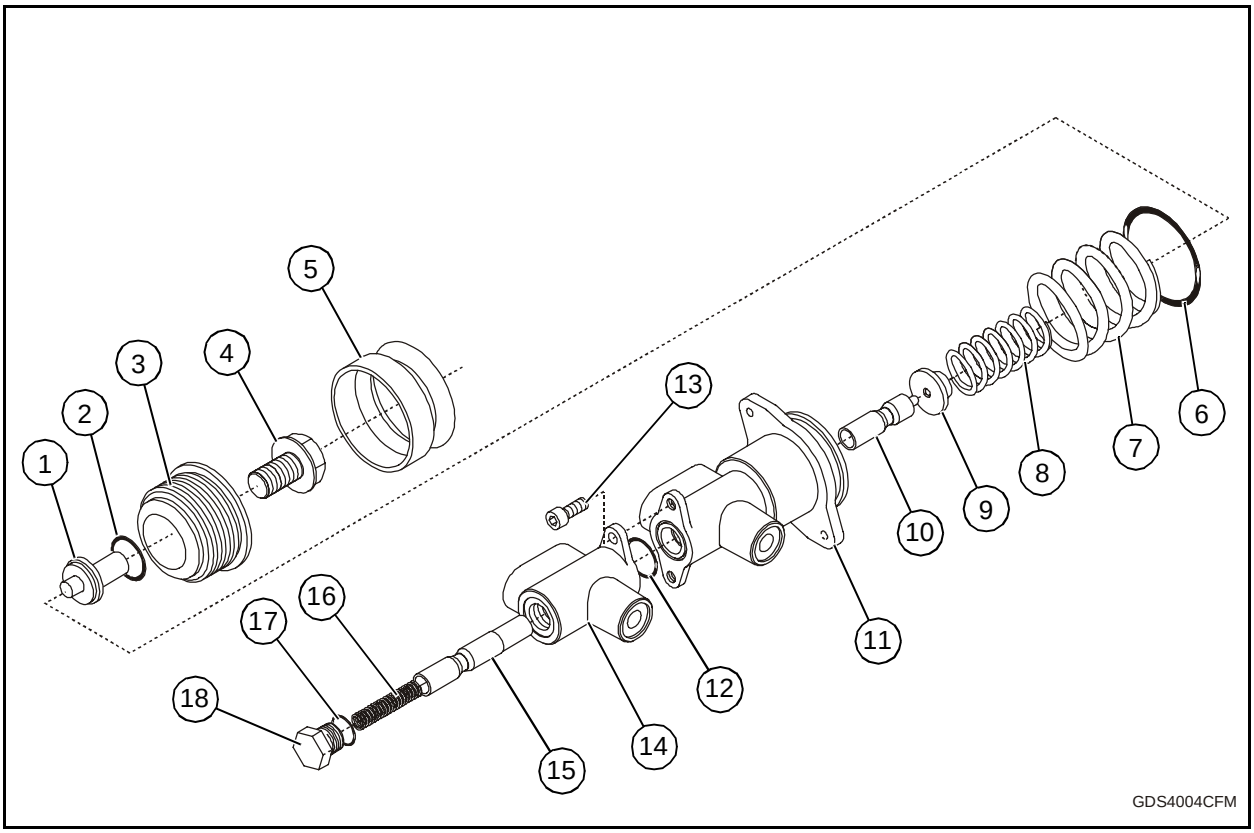
Install cap screws.

Install hydraulic lines.

Install wire leads on sensor.

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Disassemble and Assemble Brake Valve



1. Piston.
2. O-Ring.
3. Rear Cap.
4. Cap Screw.
5. Dust Cover.
6. O-Ring.
7. Spring.
8. Spring.
9. Spring Retainer.
10. Piston.
11. Rear Housing.
12. O-Ring.
13. Screw (2 used).
14. Front Housing.
15. Piston.
16. Spring.
17. O-Ring.
18. Front Plug.

Clean brake valve housing before disassembling.

Remove parts (1 - 18).

Inspect all parts for wear or damage. Replace parts as necessary.

⚠ CAUTION

Replace all O-rings. Used O-rings will leak. Apply clean hydraulic oil to all internal parts before assembling.

NOTE: To ease assembly, tighten rear cap and front plug after all valve parts are installed.

Assemble parts (1 - 18).

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Brake Accumulators

Remove and Install Brake Accumulators

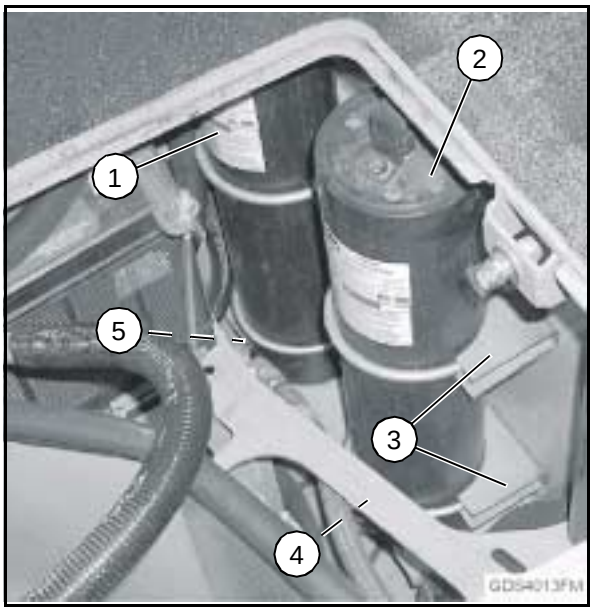
⚠ CAUTION

To prevent injury from escaping hydraulic oil under pressure, relieve the pressure in the system before removing hydraulic lines.

Relieve brake accumulator pressure. Pump service brake pedal repeatedly until no oil “hiss” is heard from accumulators.

Turn battery disconnect switch off and remove outer battery.

NOTE: Rear brake accumulator (2) must be removed before front brake accumulator (1) can be removed.



1. Front Brake Accumulator.
2. Rear Brake Accumulator.
3. Clamp (4 used).
4. Rear Brake Accumulator Hydraulic Line.
5. Front Brake Accumulator Hydraulic Line.

Remove clamps (3) and disconnect hydraulic lines (4 and 5) from accumulators.

Recharge or replace as required.

Connect hydraulic lines and install accumulators.

Install outer battery.

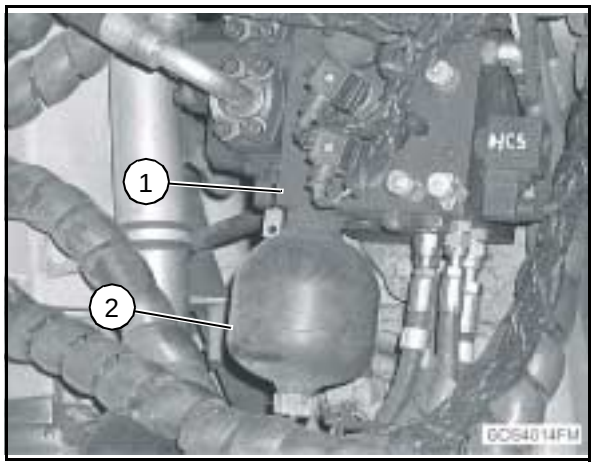
Remove and Install Brake Charge Accumulator

⚠ CAUTION

To prevent injury from escaping hydraulic oil under pressure, relieve the pressure in the system before removing hydraulic lines.

Relieve brake accumulator pressure. Pump service brake pedal repeatedly until no oil “hiss” is heard from accumulators.

Tilt cab. **(See Operator’s Manual, CHAPTER 7, SECTION 1).**



1. Hydraulic System Manifold.
2. Brake Charge Accumulator.

Clean hydraulic system manifold (1) area where brake charge accumulator (2) is located.

Remove brake charge accumulater.

Install brake charge accumulator.

Lower cab.

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CHAPTER 10. PARK BRAKE

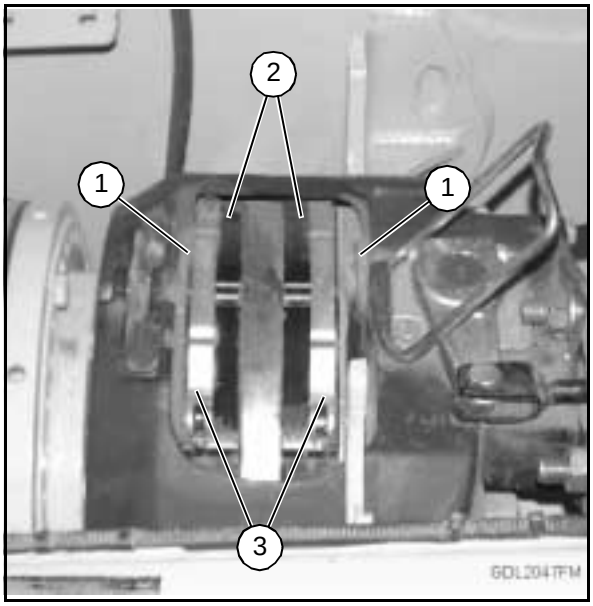
SECTION 1. ACTIVE ELEMENTS

PARK BRAKE

Remove And Install Park Brake Pads

Install dump body prop. Install wheel chocks. Relieve pneumatic pressure. **(See Prepare Prepare Machine For Maintenance in Operator's Manual, CHAPTER 7).**

Release the park brake. **(See Mechanically Releasing Park Brake Operator's Manual CHAPTER 6, SECTION 1).**

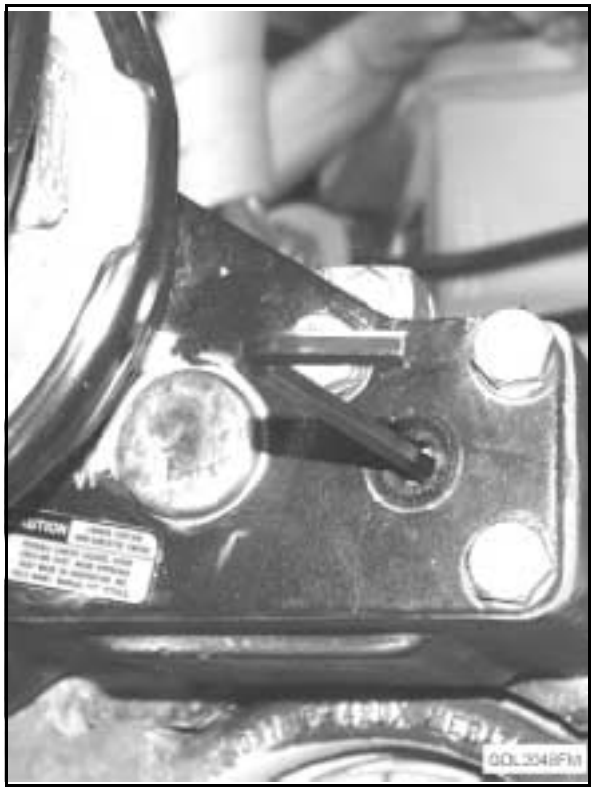


Move retaining bar aside. Remove brake pads (2).

Remove backing plates (1) from calipers.

Remove retaining clips (3) from pads.

Clean and inspect parts for wear or damage.



Remove plug and washer from socket head adjustment screw.

Turn socket head adjustment screw counterclockwise until resistance is felt.

A "clicking" sound is heard as adjusting screw is turned.

Install retaining clips on pads. Install backing plates.

Install pads. Install retaining bar.

Apply park brake. **(See Mechanically Releasing Park Brake in Operator's Manual CHAPTER 6, SECTION 1).**

Turn socket head adjustment screw clockwise until resistance is felt.

Turn counterclockwise to specification. Install washer and plug over socket head adjustment screw.

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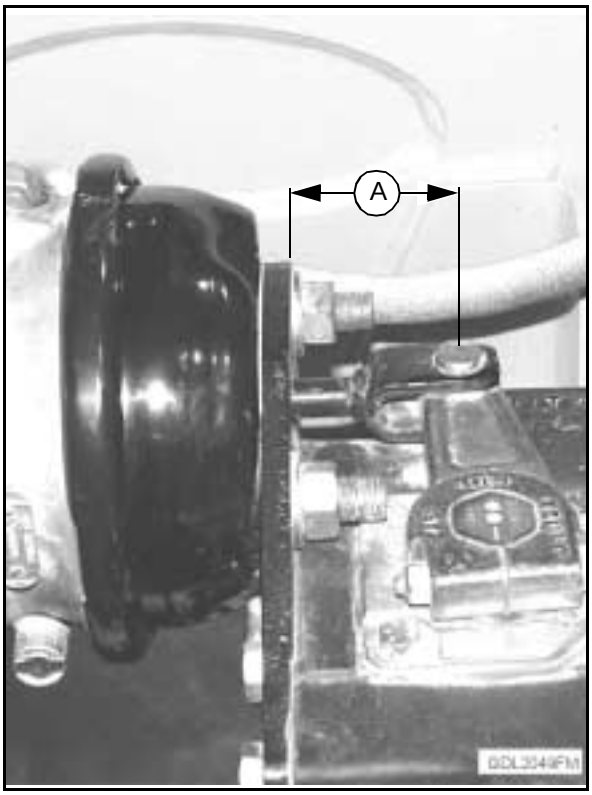
Specification

Adjusting Screw Initial Rotation
- - - - - - - - - - - - - - - - Clockwise until resistance is felt.

Final Rotation - - - - - - - - - - Counterclockwise 7 clicks.

Measure actuator rod travel.

- Start engine. Allow air system to increase to normal operating pressure.
- Release park brake. Measure from bottom of park brake actuator to center of clevis on actuator rod. Record measurement.
- Apply park brake. Measure from bottom of park brake actuator to center of clevis on actuator rod. Record measurement.
- Subtract smallest measurement from largest measurement to get actuator rod travel.



- Compare actuator rod travel to specification.

Specification

Actuator Rod Travel Distance
- - - - - - - - - - - - - - - - - - 50.8 mm (2.0 in.) maximum

If actuator rod travel is greater than specification, pneumatically release and apply park brake 20 times to help seat parts.

Repeat actuator rod travel measurements. If travel is still greater than specification, actuator has failed and must be replaced.

Remove and Install Caliper

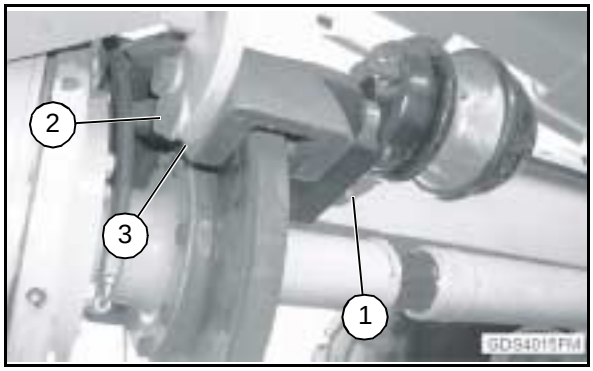
Install dump body prop. Install wheel chocks. Relieve pneumatic pressure. **(See Prepare Machine for Maintenance Operator's Manual CHAPTER 7, SECTION 1).**

Remove park brake pads.

⚠ CAUTION

Component is heavy. Use hoist.

NOTE: Write down the number of shims (3) removed from each side of caliper mount.



Disconnect air line (1) from actuator.

⚠ CAUTION

Component is heavy. Use hoist.

NOTE: Write down the number of shims (3) removed from each side of caliper mount.

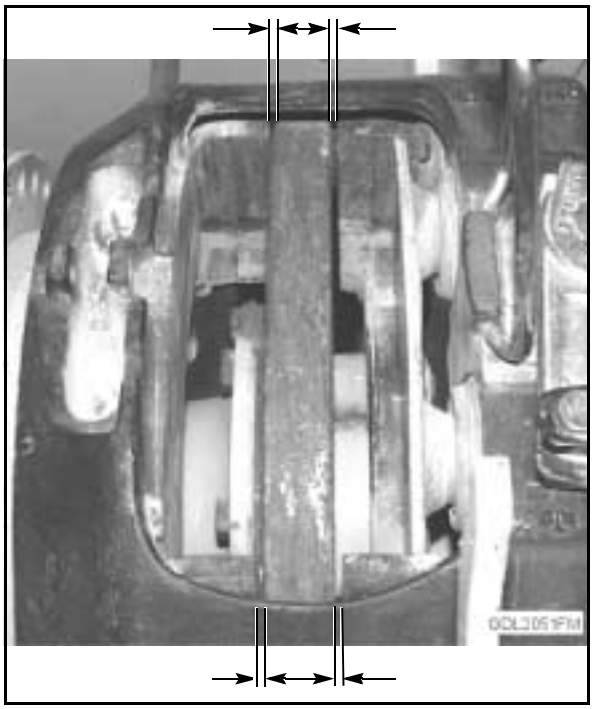
Remove cap screws and washers (2) and shims.

Remove caliper from machine.

Repair or replace parts as necessary.

Install caliper in machine.

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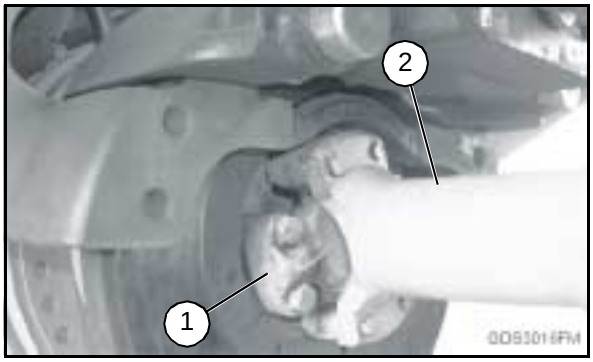
Install shims as needed. Park brake disk should be centred in calliper. Install cap screws and washers.

Attach air line.

Remove and Install Disk

Install dump body prop. Install wheel chocks. Relieve pneumatic pressure. **(See Prepare Machine for Maintenance Operator's Manual CHAPTER 7, SECTION 1).**

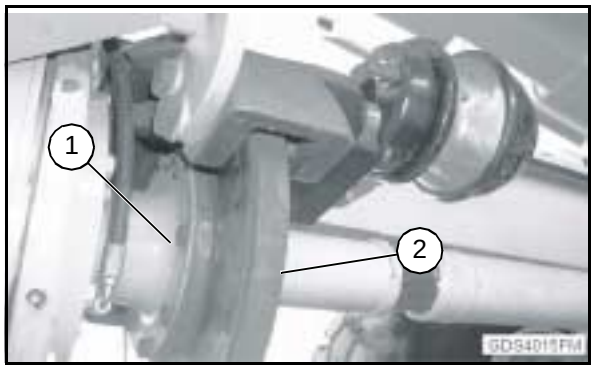
Remove park brake pads.



Disconnect cross and bearing assembly (1). Move oscillation tube-to-middle axle drive shaft (2) aside. **(See "DRIVE SHAFTS" on page 35).**

⚠ CAUTION

Components are heavy. Use lifting devices.



Support park brake disk (2) with lifting device. Disconnect park brake disk from flange (1) of oscillation joint-to-park brake drive shaft. Remove park brake disk from machine.

Install park brake disk in machine. Connect disk to flange.

Connect cross and bearing assembly. **(See "DRIVE SHAFTS" on page 35).**

Install park brake pads.

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CHAPTER 11. FRAME AND SUPPORTING STRUCTURE

SECTION 1. FRAME INSTALLATION

WELDING ON MACHINE

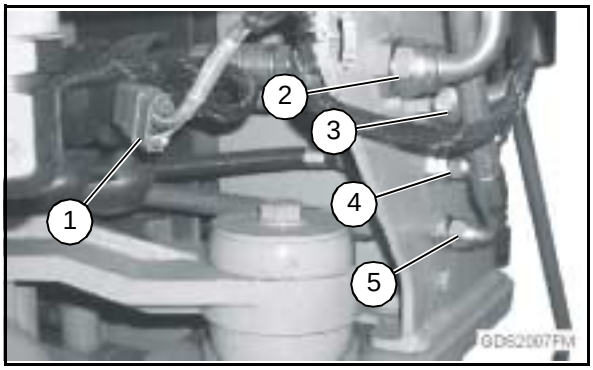
Use caution when Welding on Machine **(See Operator's Manual, Safety Section)**.

SEPARATE FRONT AND REAR FRAMES

Raise bin and Install Bin Prop **(See Operator's Manual, CHAPTER 7, SECTION 1).**

Relieve hydraulic pressure. Install wheel chocks at front and rear of front wheels. **(See Prepare Machine for Maintenance Operator's Manual, CHAPTER 7, SECTION 1).**

Relieve Pneumatic Pressure **(See Operator's Manual, CHAPTER 7, SECTION 1).**



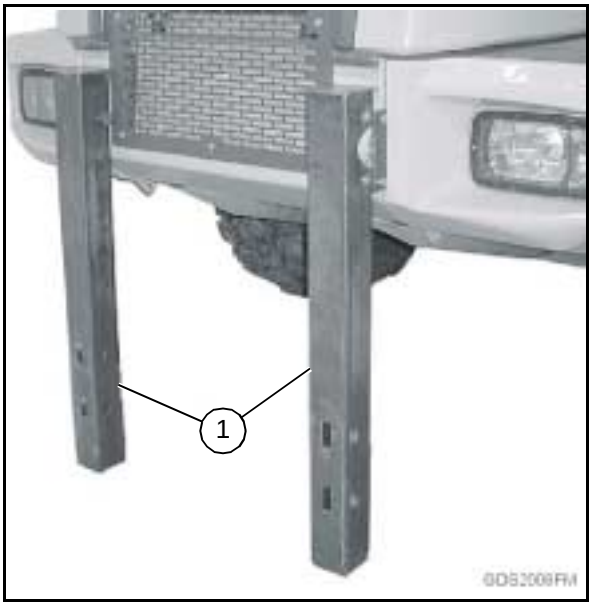
Disconnect electrical connector (1) at articulation joint.

Label and disconnect hydraulic connections (2 - 4) and pneumatic connection (5) at articulation joint.

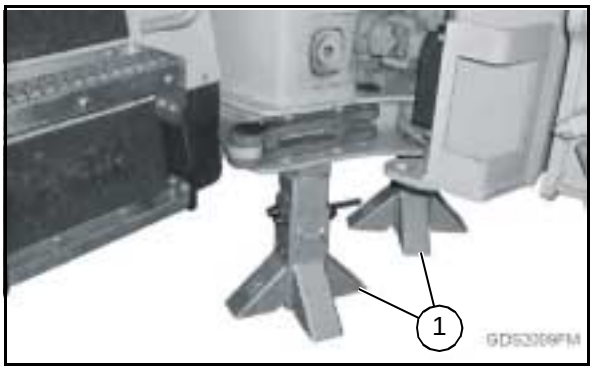
Remove park brake-to-middle axle drive shaft. **(See "DRIVE SHAFTS" on page 35).**

Remove park brake pads, caliper, and disk. **(See "PARK BRAKE" on page 301).**

Remove park brake pads, caliper, and disk. **(See "PARK BRAKE" on page 257).**



Support front of machine, using DFT1185 Supports (1).

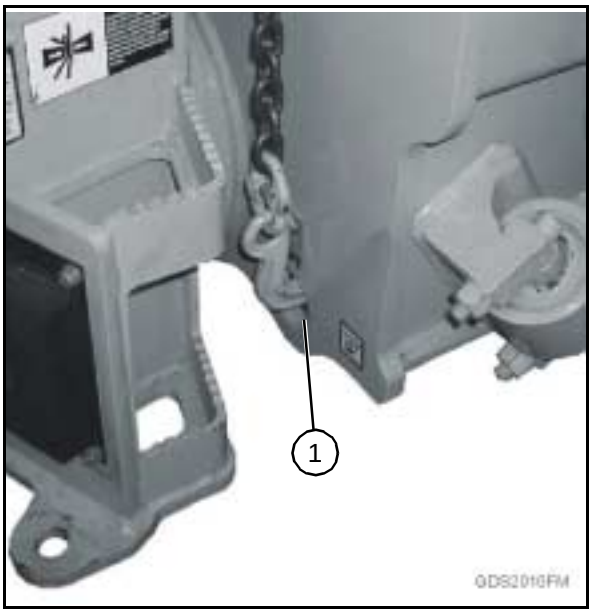


⚠ CAUTION

Machine may tip backwards when separated.

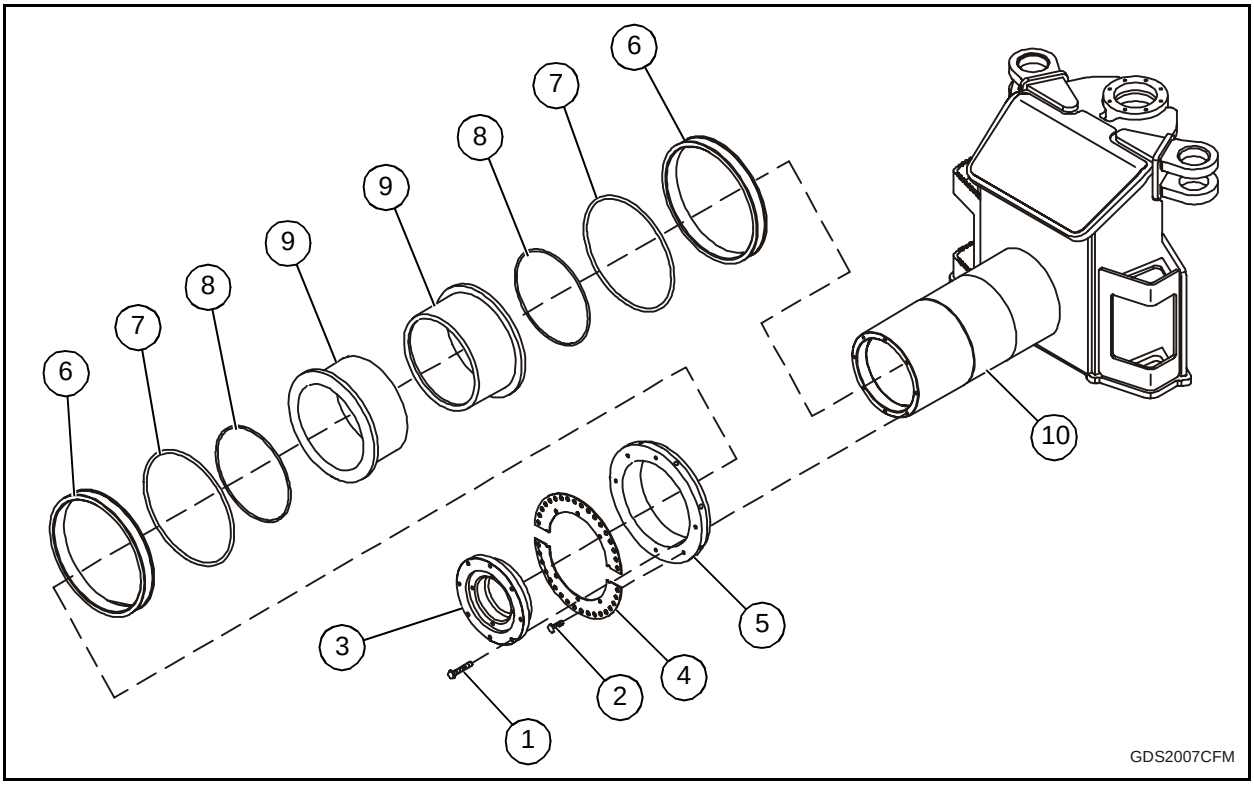
Support rear of front half of machine with 20-ton floor stands.

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Support front of equipment frame using chains and overhead hoist. Attach chains at equipment frame front tie-downs.

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1. Bearing Housing-to-Oscillation Tube Bolt (8 used).
2. Lock Plate-to-Spanner Nut Bolt (6 used).
3. Bearing Housing.
4. Lock Plate (2 used).
5. Spanner Nut.
6. Seal (2 used).
7. Outer O-Ring (2 used).
8. Inner O-Ring (2 used).
9. Oscillation Bushing (2 used).
10. Oscillation Tube.

Remove bolts (1 and 2). Remove locking plates (4). Install bolts (1).

⚠ CAUTION

Component is heavy.

Separate Front and Rear Frames Specification

Spanner Nut Weight - - - - - - 29 kg (63 lb) approximate

Remove spanner nut (5) using a spanner wrench.

Remove seal (6) and O-rings (7 and 8) from rear bushing (9).

Attach a forklift or other machine to rear towing point of equipment frame.

Slowly pull equipment frame rearward to separate oscillation joint. Adjust overhead hoist to keep tube and bushings aligned during separation.

Support front of equipment frame with 20-ton shop stands.

Remove seal (6) and O-rings (7 and 8) from front bushing (9). Discard seal and O-rings.

Clean, inspect, repair, and replace parts as necessary. **(See “DRIVE SHAFTS” on page 35)**

Apply a layer of all-purpose grease inside bushings. Pack space between bushings with grease.

Install new O-rings on front bushing. Apply a layer of all-purpose grease to O-rings and to lip of bushing. Install new seal over lip of bushing.

⚠ CAUTION

Ensure that front bushing O-rings (7and 8) and seal (6) are not damagedduring assembly of oscillation joint.

Slowly push equipment frame forward. Adjust overhead hoist to maintain alignment of tube and bushings. Ensure that front bushing O-rings and seal are properly seated.

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Install new O-rings on rear bushing. Apply a layer of all-purpose grease to O-rings and to lip of bushing. Install seal over lip of bushing.

Install spanner nut (5) with spanner wrench. Do not tighten. Ensure that rear bushing O-rings and seal are properly seated.

Remove cap screws (1). Install lock plates. Install cap screws (1). Do not tighten.

Adjust oscillation joint end play. **(See "DRIVE SHAFTS" on page 35)**

Install park brake disk, caliper, and pads. **(See "PARK BRAKE" on page 301).**

Install park brake-to-middle axle drive shaft. **(See "DRIVE SHAFTS" on page 35).**

Connect air and hydraulic hoses.

Connect electrical harness.

Articulation Frame

Remove and Install Articulation Frame

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

Separate Front and Rear Frames. **(See "SEPARATE FRONT AND REAR FRAMES" on page 305)**

⚠ CAUTION

Components are heavy. Support with chains.

Articulation Frame Specification

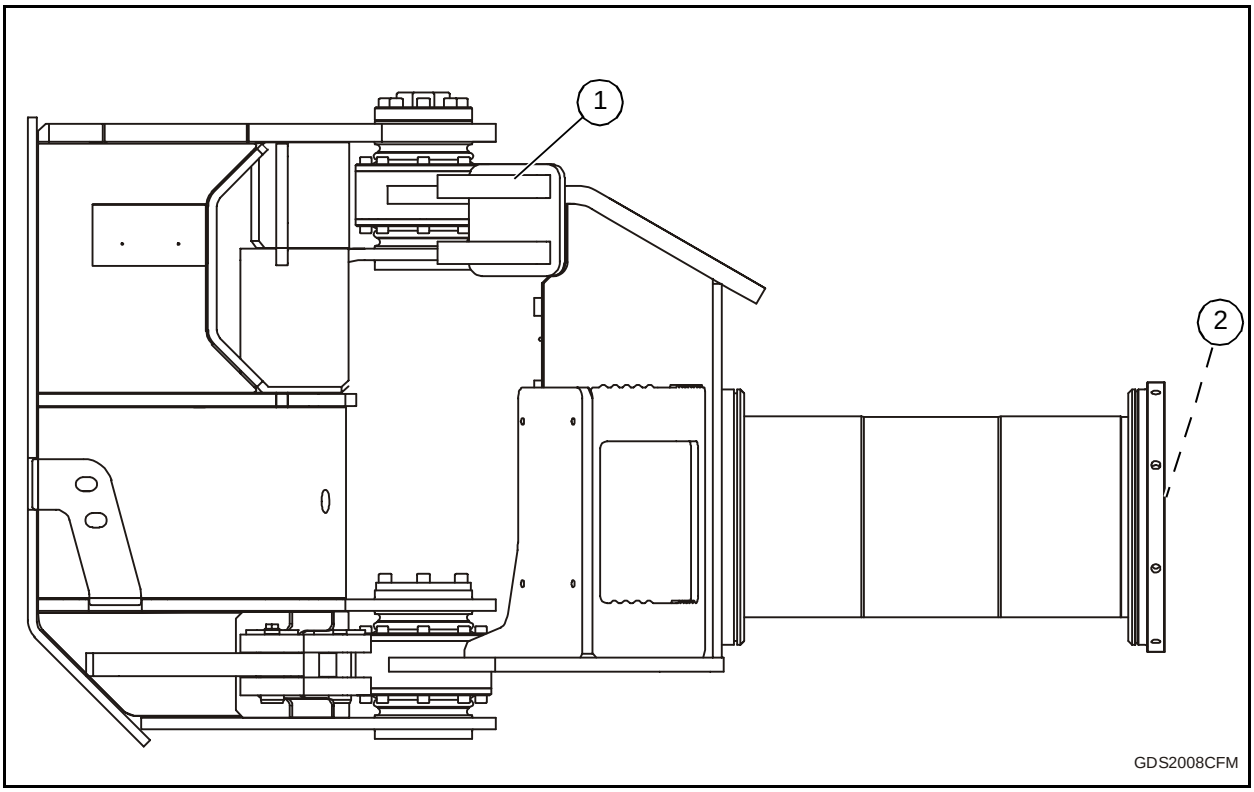
Steering Cylinder Weight - - - - - - - - - - - 95 kg (210 lb)

⚠ CAUTION

Prevent machine damage. Wrap cylinder rods with nylon lifting straps. DO NOT attach chains directly to rods.

Support steering cylinder rods to engine frame with straps and chains. Disconnect steering cylinder rod-end pins from articulation frame. Move rods aside. **(See "STEERING CYLINDER" on page 288).**

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1. Steering Cylinder Rod End Pin Mounting Bore (2 used).
2. Through Shaft Output Yoke.

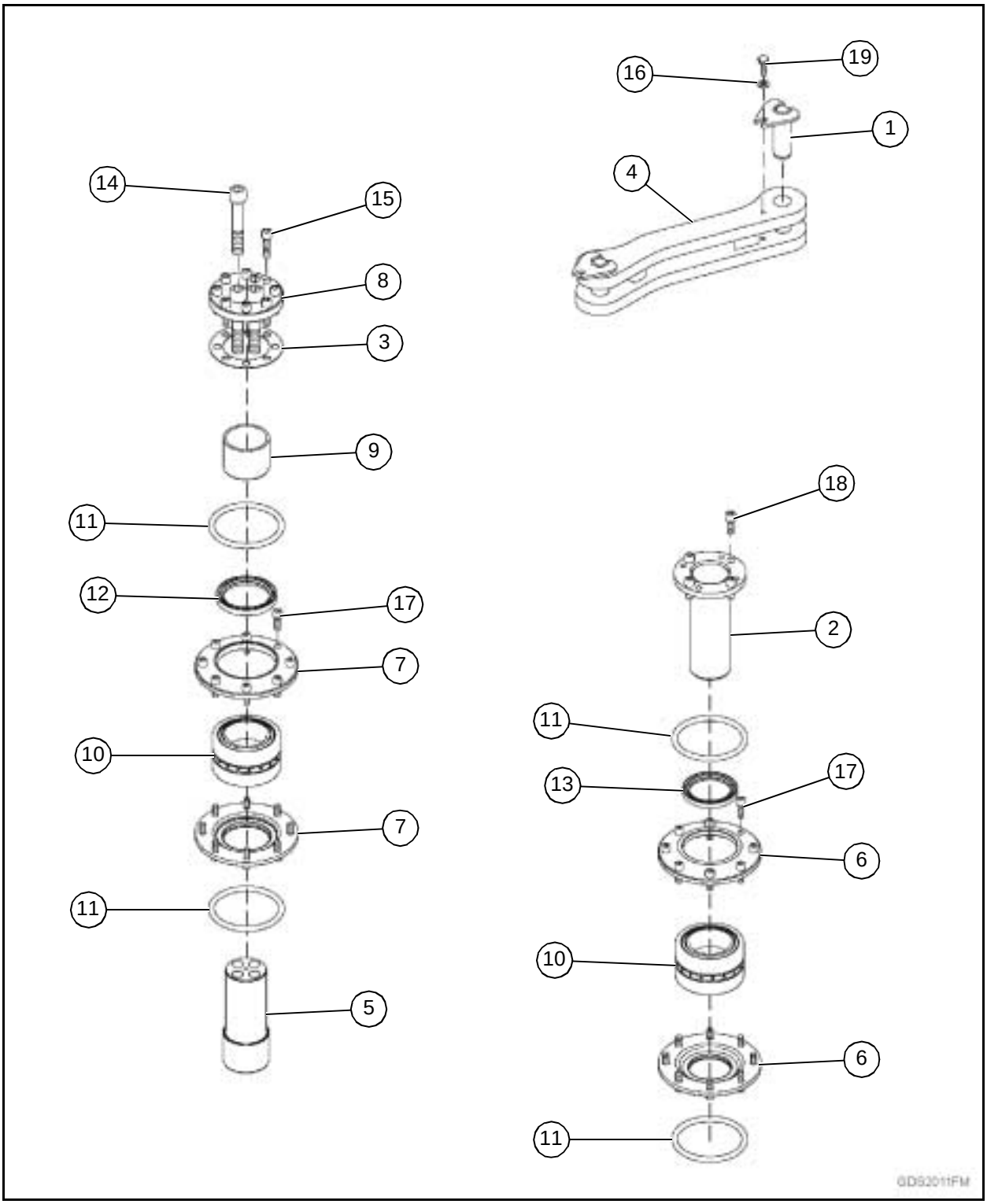
⚠ CAUTION

Component is heavy. Use hoist.

NOTE:Articulation frame angle must be adjusted during removal.

Support articulation frame with hoist, using chains at steering cylinder pin bores (1) and an adjustable lifting strap at rear drive shaft yoke (2).

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1. Articulation Locking Bar Pin (2 used).
2. Lower Articulation Pin.
3. Shim (as required).
4. Articulation Locking Bar.
5. Upper Articulation Pin.
6. Lower Articulation Bearing Retainer (2 used).
7. Upper Articulation Bearing Retainer (2 used).
8. Upper Articulation Pin Retaining Plate.
9. Sleeve.
10. Bearing Set (2 used).
11. O-Ring (4 used).
12. Seal.
13. Seal.
14. Socket Head Cap Screw (4 used).
15. Socket Head Cap Screw (8 used).
16. Washer.

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17. Socket Head Cap Screw (32 used).
18. Socket Head Cap Screw (4 used).
19. Cap Screw.

Remove upper articulation pin (5).

a. Remove cap screws (14), cap screws (5), retainer plate (8), and shim(s) (3).

b. Drive pin (5) downward and remove from machine.

c. Drive sleeve (9) upward with a brass drift and remove from machine.

Remove cap screws (18) and lower articulation pin (2).

Move articulation frame away from engine frame.

Remove and discard O-rings (11).

Clean, inspect, and replace parts as necessary. Disassemble and assemble bearings, if necessary.

Apply anti-seize lubricant to inner bores of bearings (10).

Install new O-rings (11).

Move articulation frame toward engine frame.

Install lower articulation pin with a hydraulic jack. Install cap screws and tighten to specification.

Articulation Frame Specification

Lower Articulation Pin-to-Engine Frame Plate Cap Screw Torque- - - - - - - - - - - - - - - - 145 Nm (107 ft-lb)

Install upper articulation pin.

a. Press pin into bore with a hydraulic jack.

b. Install sleeve, using a brass hammer.

c. Install shim(s) as removed. Install retainer plate. Install cap screws (5 and 14). Tighten until snug, but do not torque.

Adjust articulation joint bearings.

Install steering cylinder pins. **(See “STEERING CYLINDER” on page 288).**

Assemble front and rear frames. See Separate Front and Rear Frames.

Disassemble and Assemble Upper and Lower Bearings

Remove cap screws (17) and retainers (7). Remove and discard oil seals (12).

⚠ CAUTION

DO NOT mix bearings and spacers from upper and lower joints. Bearings and spacers must be replaced as a set.

Remove bearings (10) from bores.

Clean, inspect, and replace parts as necessary.

Install bearings in bores. Ensure that each bearing assembly is centered vertically in bore, to allow grease to flow to rollers through grooves in bores.

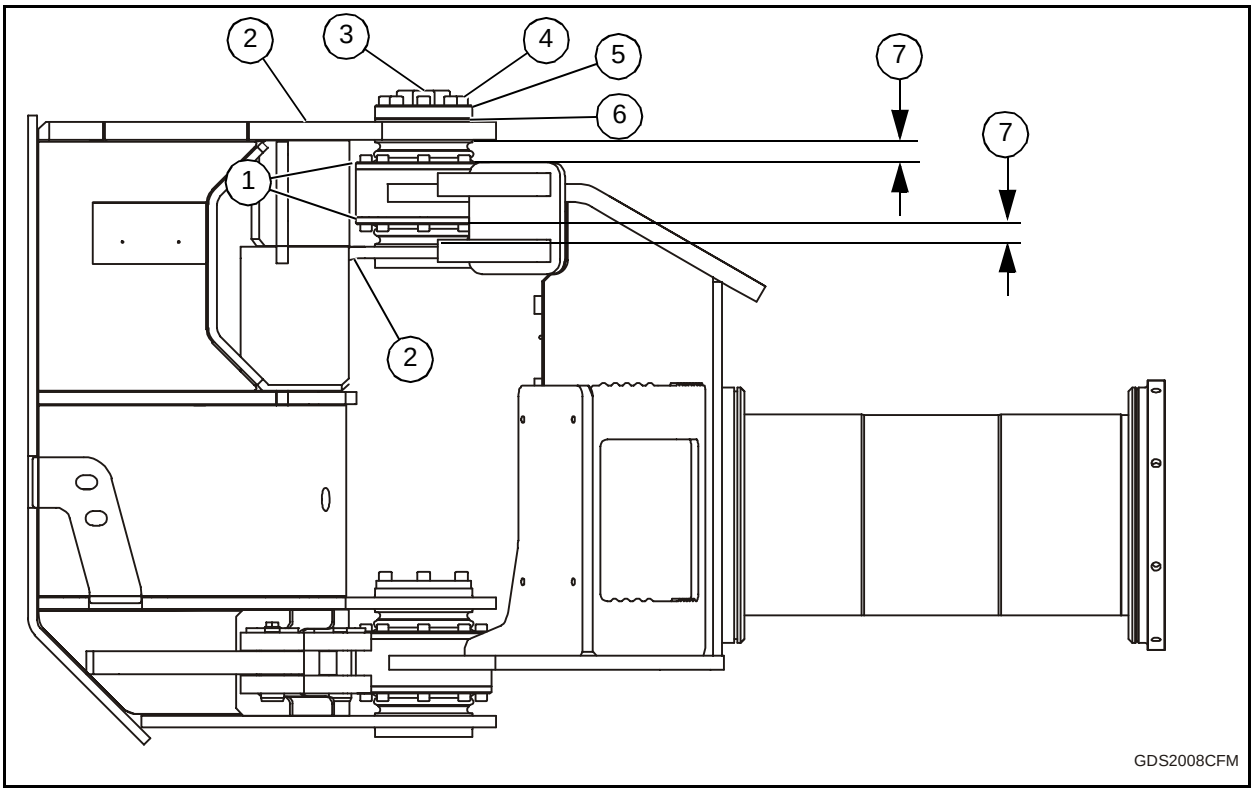
Install new seals in retainers, using D01045AA Bushing, Bearing, and Seal Driver Set.

Install retainers. Tighten socket head cap screws (17) to specification.

Articulation Frame Specification

Bearing Retainer Cap Screw Torque -83 Nm (61 ft-lb)

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1. Bearing Retainer (2 used per bearing assembly). 3.Socket Head Cap Screw (4 5. Upper Articulation Pin 7.Frame Plate-to-Bearing
used) Retaining Plate Retainer Gap
2. Engine Frame Plate (2 used 4.Socket Head Cap Screw (8 6.Shim (as required)
per bearing assembly) used)

Adjust Articulation Joint Bearings

Tighten cap screws (3 and 4) until snug.

Measure gaps (7) between engine frame plates (2) and bearing retainers (1) of upper articulation joint. Gaps should be equal.

Add or remove shims (6) as necessary under pin retaining plate (5) to adjust gaps.

Repeat steps 1 - 3 as necessary until gaps are equal.

Remove cap screws (3 and 4) and apply medium-strength thread lock and sealer to threads. Install retainer plate. Install cap screws (3 and 4) and tighten to specification.

Articulation Frame Specification

Retaining Plate-to-Engine Frame Plate Cap Screw Torque - 145 Nm (107 ft-lb)

Retaining Plate-to-Upper Articulation Pin Cap Screw Torque - 690 Nm (509 ft-lb)

Oscillation Joint

Replace Bushings

Separate Front and Rear Frames. **(See “SEPARATE FRONT AND REAR FRAMES” on page 305.)**

NOTE:Replace one bushing at a time.

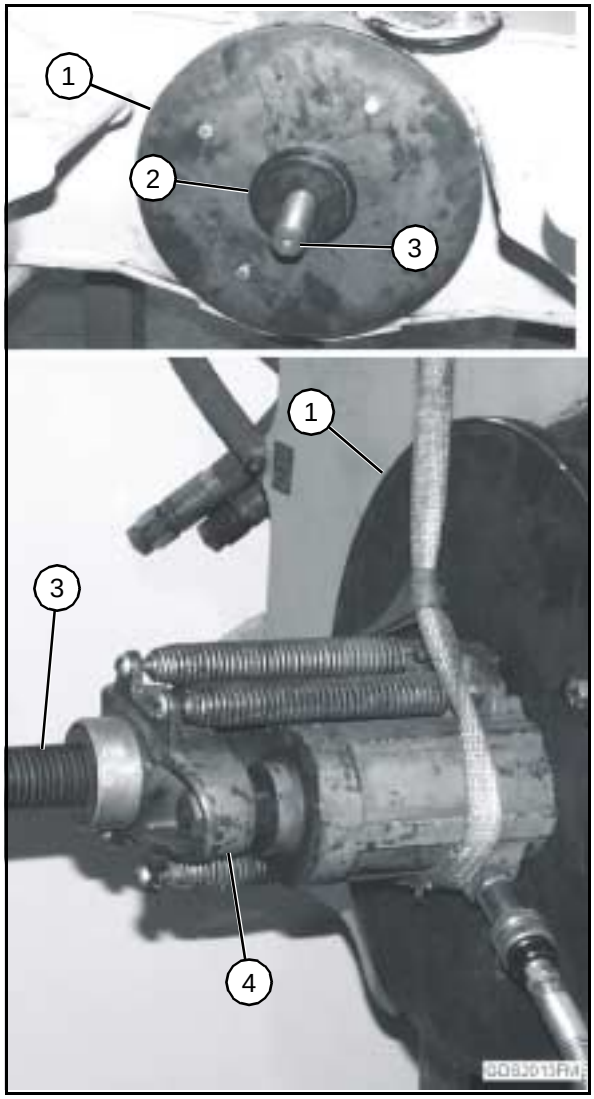


- Using a rotary grinder, cut slots through bushing. Drive bushing out with a brass drift.
- Clean grease and grinding residue from bushing seat and interior of tube.

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⚠ CAUTION

Vent passage of front bushing must be aligned at top of tube. Vent passage of rear bushing must be aligned at bottom of tube.



- Assemble DFT1198 Oscillation Bushing Installation Tool (1), JDG902-1 60-in. Screw (3), and JDG902-2 Adapter Plate (2) on one end of oscillation joint. Assemble D01019AA Hydraulic Hand Pump (4) and bushing on other end of oscillation joint.
- Press bushing flange tight against end of bore.
- Repeat above steps for other bushing, if necessary.
- Assemble front and rear frames. **(See "SEPARATE FRONT AND REAR FRAMES" on page 305)**

Adjust End Play

NOTE: Oscillation joint end float is adjusted when rear frame is attached to articulation frame.

Install wheel chocks behind rear wheels.

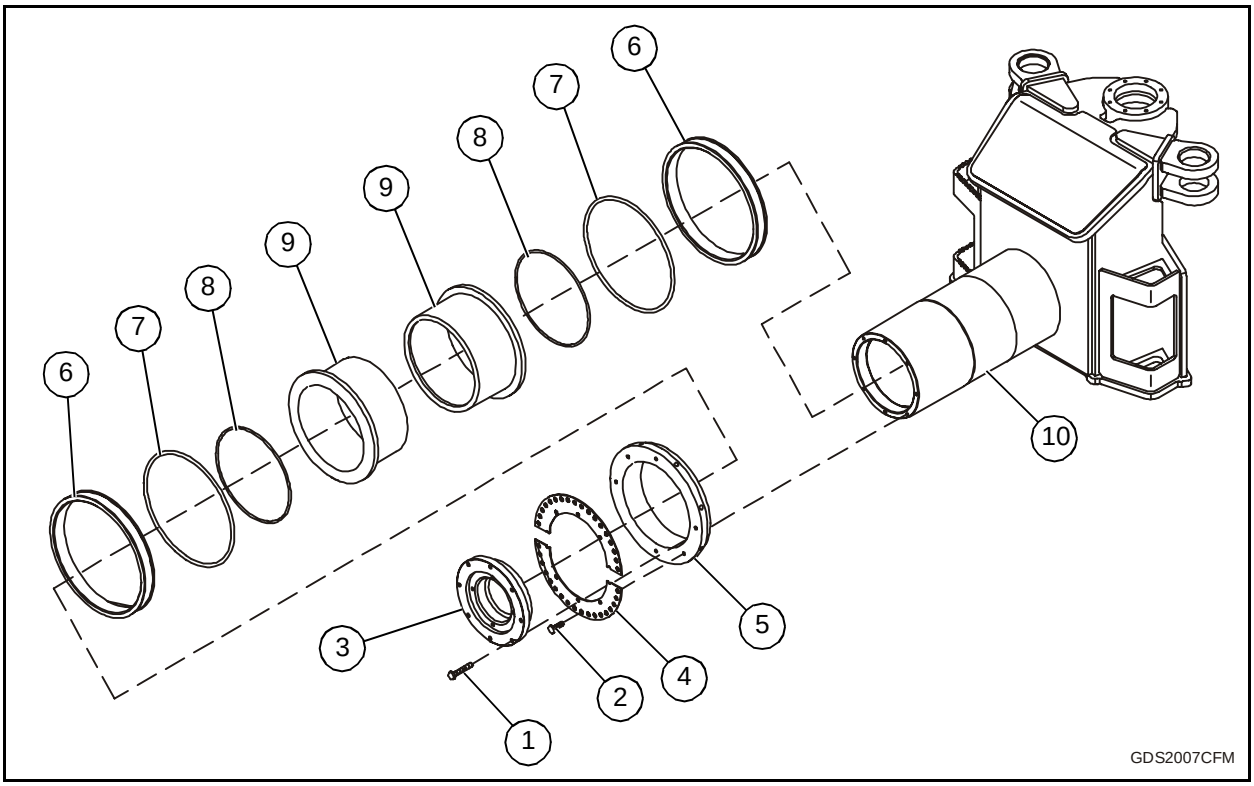
Start engine. Put transmission in REVERSE. Drive slowly to tighten rear wheels against wheel chocks.

Stop engine.

Install wheel chocks in front of front wheels.

Remove Park Brake pads and caliper **("PARK BRAKE" on page 301).**

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Remove bolts (2). Loosen bolts (1).

Tighten spanner nut (2). Ensure that rear bushing O-rings (7 and 8) and seal (6) are properly seated.

Loosen spanner nut until the first set of holes in the lock plates (4) are aligned.

Install bolts (2). Tighten bolts (1 and 2).

Install Park Brake caliper and pads **("PARK BRAKE" on page 301).**

Remove wheel chocks.

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CHAPTER 12. OPERATOR's STATION

SECTION 1. CAB

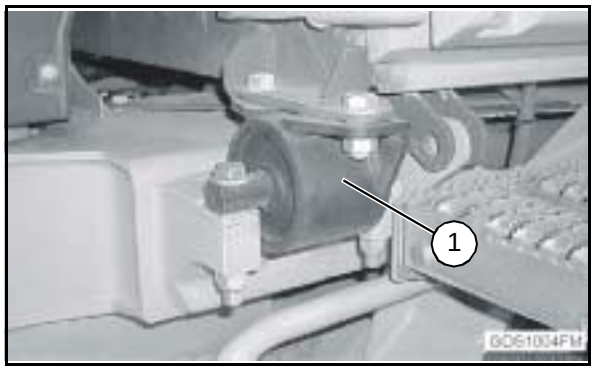
CAB MOUNTINGS

Remove and Install Cab Mounts

⚠ CAUTION

Component is heavy. Use hoist.

Attach hoist to cab.



Remove all cap screws, washers, and nuts from rubber mounts (1) as necessary.

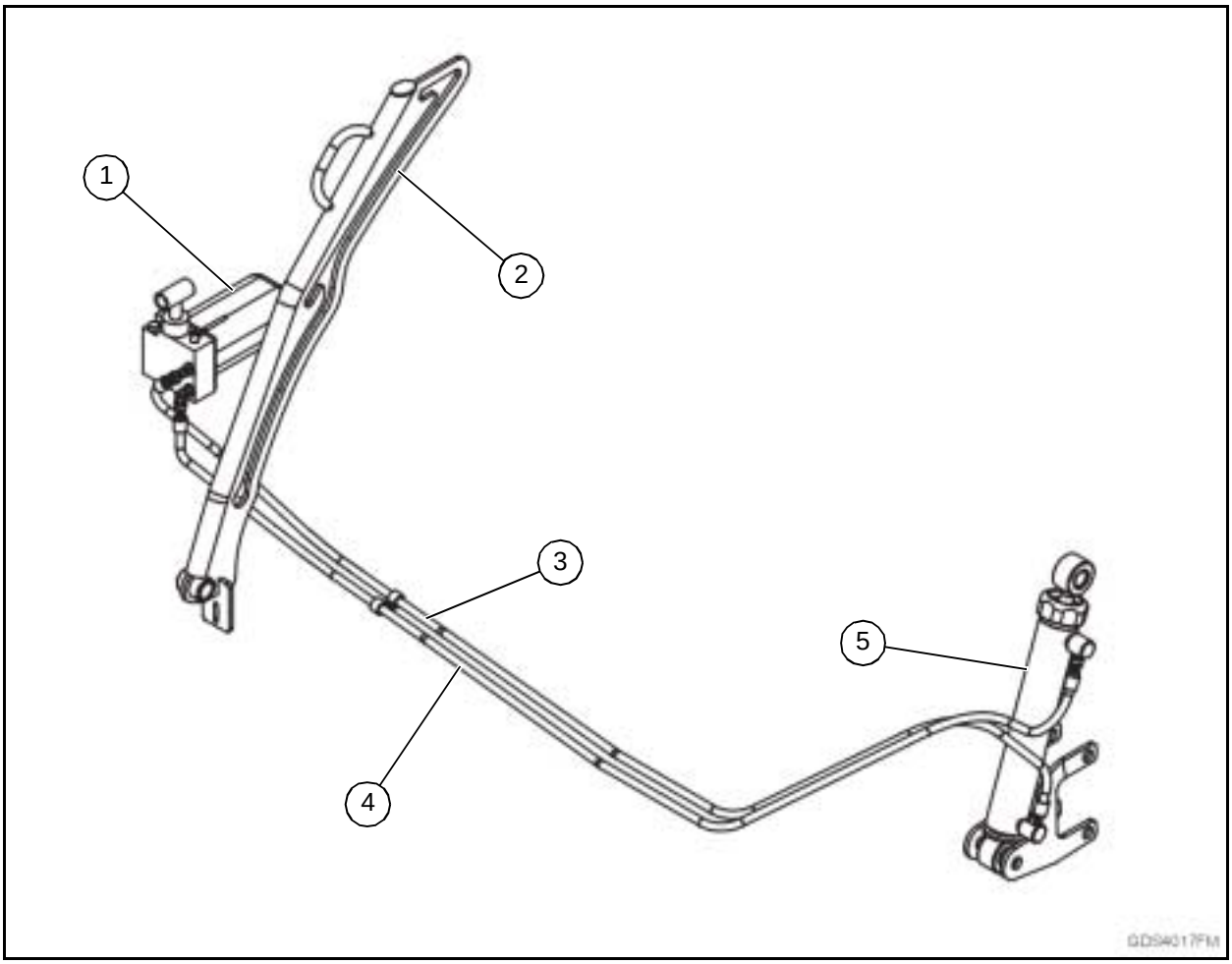
Lift cab slightly and remove rubber mount(s).

Install rubber mount(s).

Install all cap screws, washers, and nuts. Lower cab onto rubber mounts. Tighten cap screws and nuts.

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Remove and Install Cab Tilt Pump and Cylinder



1. Pump.
2. Support Strut.
3. Line to Cylinder Head End.
4. Line to Cylinder Rod End.
5. Cylinder.

Tilt cab. Ensure that support prop is engaged. **(See Tilt Cab Operator's Manual CHAPTER 7).**

Turn pump valve lever clockwise to "Float" position to relieve hydraulic pressure.

Remove pump (1), if necessary. Remove lines (3 and 4), if necessary. Remove cylinder (5), if necessary.

Inspect, repair, and replace parts as necessary. **(See "Disassemble and Assemble Cab Tilt Cylinder" on page 317).**

NOTE: Fill each component with oil during assembly, working from bottom to top.

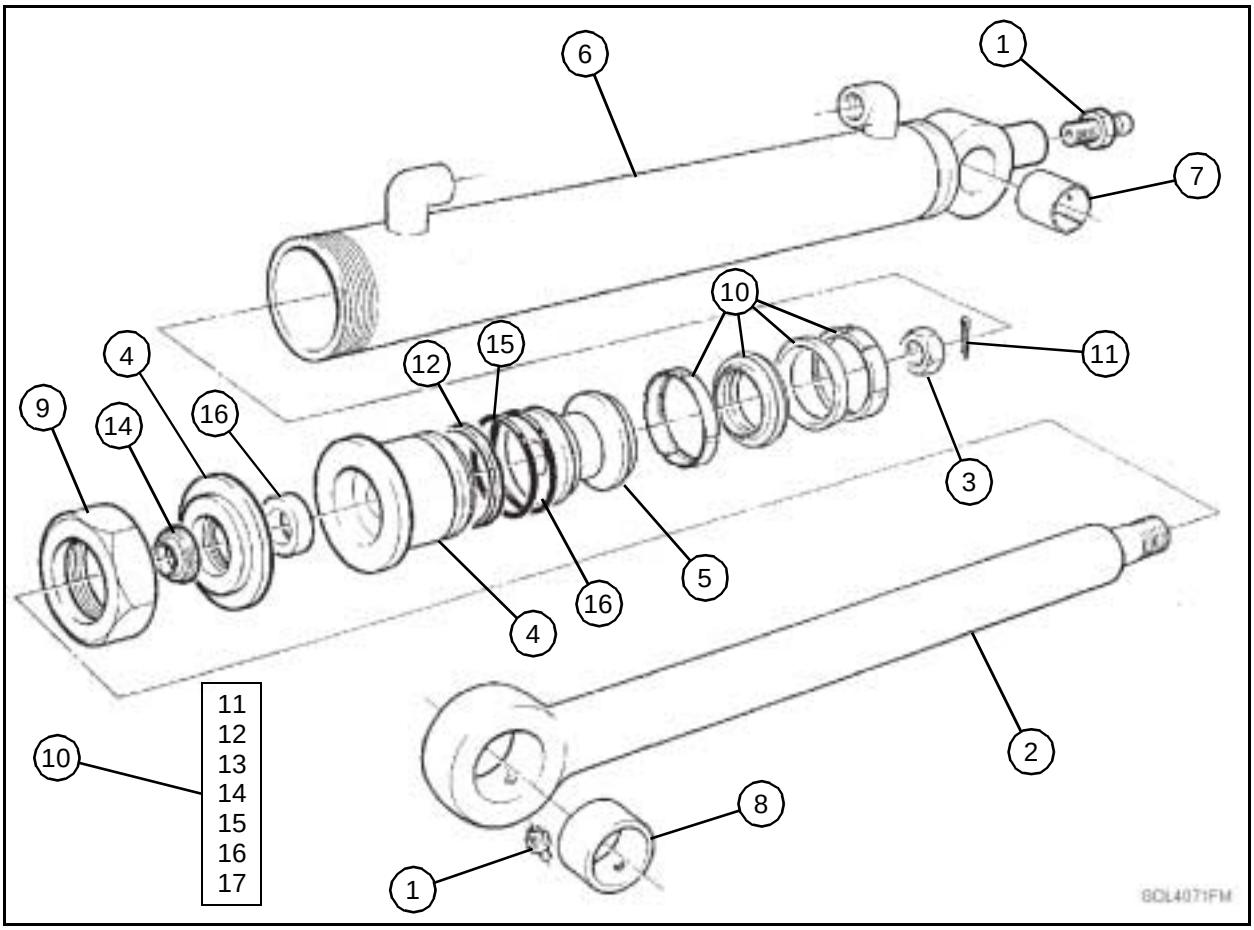
Install cylinder, if removed. Install lines, if removed. Install pump, if removed.

Lower and raise cab several times with pump to move air pockets to top of system.

With cab lowered, remove plug from fill port on top of pump and add oil as necessary.

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Disassemble and Assemble Cab Tilt Cylinder



1. Lubrication Fitting (2 used).
2. Rod.
3. Nut.
4. Rod Guide.
5. Piston.
6. Hydraulic Cylinder Barrel
7. Bushing
8. Bushing
9. Nut.
10. Hydraulic Cylinder Kit.
11. Cotter Pin.
12. Backup Ring
13. Seal.
14. Seal.
15. O-Ring.
16. Seal.
17. O-Ring

Install cylinder in a service stand such as JT30043 Cylinder Service Stand.

Apply rigid form-in-place gasket to threads of nut (3).

Tighten nut to specification. Install cotter pin (11).

Cab Tilt Cylinder Specification

Piston-to-Rod Nut Torque - - - - - - - 500 Nm (370 lb-ft)

Apply clean hydraulic oil to seals (13) and O-rings (15 and 17) before installing piston and rod guide (4) into the barrel.

Apply an anti-seize lubricant to the threads of nut (9).

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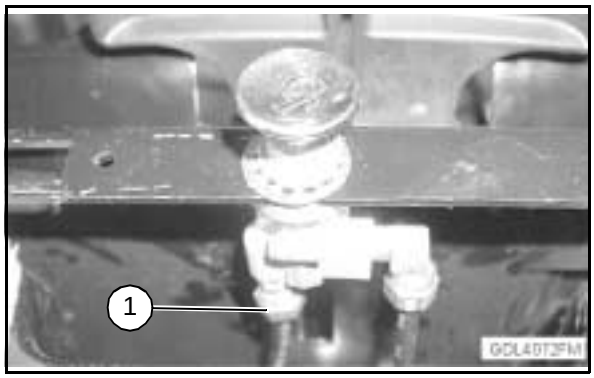
CHAPTER 12. OPERATOR's STATION

SECTION 2. SEAT AND SEAT BELT

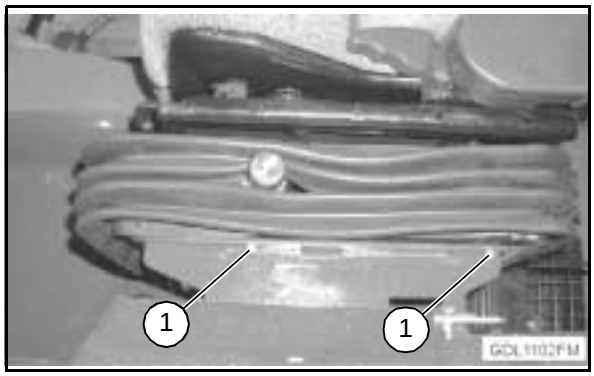
OPERATOR'S SEAT

Remove and Install Seat

Relieve pneumatic pressure. **(See Relieve Pneumatic Pressure Operator's Manual CHAPTER 7).**



Disconnect air supply line (1) at valve. Remove air supply line from seat at rear of boot.



Remove cap screws and washers (1).

⚠ CAUTION

Component is heavy. Use hoist.

Specification

Operator's Seat Weight- - - - 44 kg (97 lb) approximate

Remove seat from cab.

Repair or replace parts as necessary.

Install seat in cab.

Install cap screws and washers.

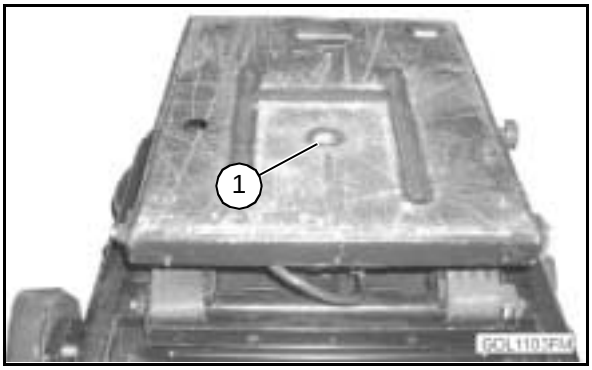
Install air supply line through rear of boot.

Connect air supply line at valve. Ensure boot is properly attached.

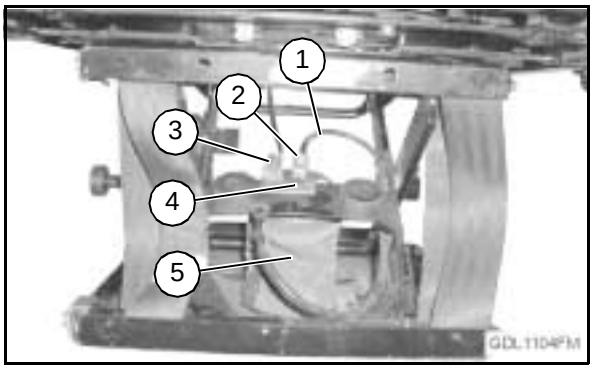
Remove and Install Air Spring

Remove seat from cab.

Operate air spring valve to relieve pneumatic pressure inside air spring.



Remove screw (1) from bottom of seat.



Disconnect air line (1) from fitting (2).

Remove the cap screw (4) and bracket (3). Remove air spring (5) from seat.

Install air spring in seat. Install bracket and cap screw.

Connect air line to fitting.

Install screw in bottom of seat.

Install seat in cab.

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CHAPTER 12. OPERATOR's STATION

SECTION 3. HEATING AND AIR CONDITIONING

REFRIGERANT CAUTIONS AND PROPER HANDLING

⚠ CAUTION

1. DO NOT allow liquid refrigerant to contact eyes or skin. Liquid refrigerant will freeze eyes or skin on contact. Wear goggles, gloves and protective clothing.
2. If liquid refrigerant contacts eyes or skin, DO NOT rub the area. Splash large amounts of COOL water on affected area. Go to a physician or hospital immediately for treatment.
3. DO NOT allow refrigerant to contact open flames or very hot surfaces such as electric welding arc, electric heating element and lighted smoking materials.
4. DO NOT heat refrigerant over 52°C (125°F) in a closed container. Heated refrigerant will develop high pressure which can burst the container.
5. Keep refrigerant containers away from heat sources. Store refrigerant in a cool place.
6. DO NOT handle damp refrigerant container with your bare hands. Skin may freeze to container. Wear gloves.
7. If skin freezes to container, pour COOL water over container to free the skin. Go to a physician or hospital immediately for treatment.

NOTE: To meet government standards relating to the use of refrigerants, R134a is used in the air conditioning system. Because it does not contain chlorine, R134a is not detrimental to the ozone in the atmosphere.

⚠ WARNING

1. It is illegal to discharge any refrigerant into the atmosphere. It must be recovered using the appropriate recovery stations.
2. Use correct refrigerant recovery, recycling and charging stations. Never mix refrigerants, hoses, fittings, components or refrigerant oils.

NOTE: Use only Bell Equipment approved R134a refrigerant products. Mixing of products not compatible will cause system damage and contaminate recovery, recycling and charging station equipment.

⚠ CAUTION

Care must be taken to identify and use equipment, refrigerant oil and refrigerant designed only for R134a refrigerant systems. Refrigerant should be tested for type and purity before recovery, recycling or charging of system. JT02167A refrigerant test instrument should be used before any testing or repair to system is preformed.

Prism Pro Refrigerant Identification Instrument:

----------JT02167A

To safely identify type and check purity of refrigerant prior to recovery, recycling and recharging of A/C systems.

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R134a REFRIGERANT OIL INFORMATION

⚠ CAUTION

1. All new compressors are charged with a mixture of nitrogen, R134a refrigerant and TY22025 (R134a) refrigerant oil. Wear safety goggles and discharge the compressor slowly to avoid possible injury.
2. DO NOT leave system or R134a compressor oil containers open. Refrigerant oil easily absorbs moisture. DO NOT spill R134a compressor oil on acrylic or ABS plastic. This oil will deteriorate these materials rapidly. Identify R134a oil containers and measures to eliminate accidental mixing of different oils.

NOTE: Do not add any more oil than required or maximum cooling will be reduced.

A new compressor from parts depot contains 190 ± 10 mL (6.42 ± .34 fl oz) of new oil. Oil level visible through suction port normally is below drive shaft.

Normal operating oil level of a compressor removed from operation is 30 mL (1.0 fl oz). This level cannot be seen through suction port of compressor.

Compressors can be divided into three categories when determining correct oil for system.

- New compressor from parts depot
- Used compressor removed from operation
- Compressor internally washed with flushing solvent.

Determining the amount of system oil prior to installation of compressor on a machine.

When complete system, lines, and components are flushed add correct amount of oil as described.

- New compressor from parts depot contains amount of new oil of 190 ± 10 mL (6.42 ± .34 fl oz). System requires an additional amount of new oil of 20 mL (1.0 fl oz) of new oil.

Refrigerant Oil Capacity Specification

New Compressor Volume
- - - - - - - - - - - - - - - - - - 190 ± 10 mL (6.42 ± .34 fl oz)

Air Conditioning System Additional Oil Volume
- -20 mL (1.0 fl oz)

Compressor Operating Oil Level Volume
- -30 mL (1.0 fl oz)

- Used compressor removed from operation, oil drained, and system flushed requires 209.6 mL (7.1 fl oz) of new oil.

Refrigerant Oil Capacity Specification

Used Compressor and System Flushed Oil Volume
- 209.6 mL (7.1 fl oz)

When complete system was not flushed add correct amount of oil for compressor plus amount of oil for each component that was serviced.

- New compressor from parts depot, drain and return 30 mL (1 fl oz) of oil to compressor.

Refrigerant Oil Capacity Specification

New Compressor Operating Oil Level Volume Drain and return- 30 mL (1 fl oz)

- Used compressor removed from operation and oil drained. Add 30 mL (1 fl oz) of new oil.

Refrigerant Oil Capacity Specification

Used Compressor Drained-Oil Volume
- 30 mL (1 fl oz)

- Used compressor removed from operation, oil drained, and flushed add 39.6 mL (1.34 fl oz) of new oil.

Refrigerant Oil Capacity Specification

Used Compressor-Flushed Oil Volume
- 39.6 mL (1.34 fl oz)

- Components listed below which have been removed, drained and flushed, require removal of compressor to determine correct oil. Use following chart as a guide for adding oil to components:

Refrigerant Oil Capacity Specification

Evaporator Oil Volume - - - - - - - - - - -30 mL (1.0 fl oz)

Condenser Oil Volume - - - - - - - - - - -30 mL (1.0 fl oz)

Receiver/Dryer Oil Volume - - - - - - - -30 mL (1.0 fl oz)

Flushed Compressor Oil Volume - - - -60 mL (2.0 fl oz)

Hose Oil Volume
- - - 3 mL per 30 cm (0.1 fl oz per ft) Approximate Total Length.

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NOTE:Hoses =3 mL per30cm(0.1 fl oz per ft) Approximate total length equals 600 cm (20 ft).

- If any section of hose is removed and flushed or replaced, measure length of hose and use formula 3 mL per 30 cm (0.1 fl oz per ft) to determine correct amount of oil to be added.
- Drain compressor oil into graduated container while rotating compressor shaft and record amount.
- If oil drained from a compressor removed from operation is very black or amount of oil is less than 6 mL (0.2 fl oz), perform the following and discard oil properly:

  – Determine if R134a leakage was detected, remove component and repair or replace component.

  – Remove and discard receiver/dryer.

  – Flush complete system with TY16134 air conditioning flushing solvent.

If component is serviceable, pour flushing solvent in ports and internally wash out old oil and discard oil properly.

Install a new receiver-dryer. **(See "Remove and Install Receiver-Dryer" on page 288).**

Install required amount of TY22025 refrigerant oil in compressor.

Connect all components.

Evacuate and charge system. **(See "Evacuate R134a System" on page 326 and "Charge R134a System" on page 326).**

R134a Refrigerant Recovery/Recycling and Charging Station Installation Procedure

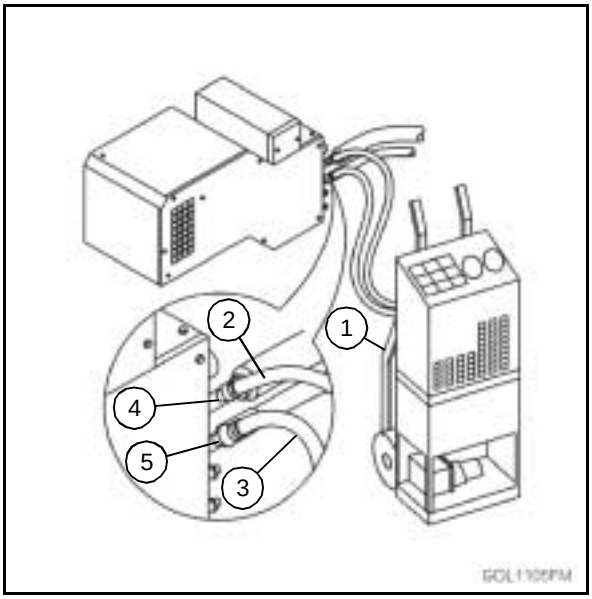
⚠ WARNING

Use only Bell Equipment approved R134a refrigerant products. Mixing of products not compatible will cause system damage and contaminate recovery/recycling and charging station equipment. Care must be taken to identify and use equipment, refrigerant oil and refrigerant designed only for R134a refrigerant systems. Refrigerant should be tested for type and purity before recovery/recycling or charging of system. JT02167A refrigerant test instrument should be used before any testing or repair to system is preformed.

⚠ WARNING

Use only Bell Equipment approved refrigerant recovery/recycling and charging stations. DO NOT mix refrigerant, hoses, fittings, components or refrigerant oils.

Follow refrigerant cautions and proper handling procedures. **(See "REFRIGERANT CAUTIONS AND PROPER HANDLING" on page 321).**



Close both high-side and low-side valves on refrigerant recovery/recycling and charging station (1).

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Remove cap from low pressure charge port (4) and connect blue hose (2).

Remove cap high pressure charge port (5) and connect red hose (3).

Recover R134a Refrigerant

⚠ WARNING

Use correct refrigerant recovery/recycling and charging stations. DO NOT mix refrigerant, hoses, fittings, components or refrigerant oils.

Follow refrigerant cautions and proper handling procedures. **(See "REFRIGERANT CAUTIONS AND PROPER HANDLING" on page 321)**

Run air conditioning system for three minutes to help in recovery process. Turn air conditioning system off before proceeding with recovery steps.

With engine OFF identify refrigerant type using JT02167A refrigerant identification instrument.

Connect refrigerant recovery system. **(See "R134a Refrigerant Recovery/Recycling and Charging Station Installation Procedure" on page 323)**

Follow manufacturer's instructions when using refrigerant recovery/recycling and charging station.

Flush and Purge Air Conditioner System

Add flushing solvent to system with JT02075 Flusher and JT02098 Fitting Kit.

NOTE: Flushing can be performed on machine.

Follow refrigerant cautions and proper handling procedures. **(See "REFRIGERANT CAUTIONS AND PROPER HANDLING" on page 321)**

Recover refrigerant. **(See "Recover R134a Refrigerant" on page 324)**

Add flushing solvent to system with JT02075 Flusher and JT02098 Fitting Kit.

Remove and discard receiver-dryer. **(See "Remove and Install Receiver-Dryer" on page 288)**

Connect flusher outlet hose to inlet end of compressor discharge line using JT02102 Adapter.

Fill flusher tank with 4 L (1gal) of solvent and fasten all connections.

Flush and Purge System Specification

Flusher Tank Capacity 4 L (1 gal)

NOTE: Air pressure must be at least 620 kPa (90 psi) (6.2 bar) for flushing and purging.

Flush and Purge System Specification

Air Pressure Minimum Pressure
--- 620 kPa (90 psi) (6.2 bar) for flushing and purging

Connect a supply line of moisture-free compressed air or dry nitrogen to flusher air valve.

Open air valve to force flushing solvent into condenser circuit. Flusher tank is empty when hose pulsing stops. Additional flushing cycles are required if system is heavily contaminated with burned oil or metal particles.

Clean compressor as follows:

- Remove compressor and measure oil drained from both manifold ports.
- Connect flusher outlet hose to inlet end of compressor discharge line using JT02102 Adapter.
- Pour 240 mL (8 fl oz) of flushing solvent into suction port and 120 mL (4 fl oz) into discharge port. Plug both ports in compressor manifold, using JT02099 and JT03194 Caps.

Flush A/C Compressor Specification

Flushing Solvent in Suction Port Volume
---------- 240 mL (8 fl oz)

Flushing Solvent in Discharge Port Volume
---------- 120 mL (4 fl oz)

- Turn compressor end for end and roll it side to side.
- Remove both plugs from manifold ports and drain solvent from compressor.
- Connect battery power to compressor clutch coil. Rotate pulley at least five revolutions to move solvent out of cylinders.
- Invert compressor. Roll end for end and side to side. Drain thoroughly.
- Repeat previous two steps at least three times.

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Divide system into two circuits:

- Condenser circuit, including inlet and outlet hoses.
- Evaporator circuit, including inlet and outlet hoses.

Condenser:

⚠ WARNING

DO NOT attempt to flush through compressor or receiver/dryer. Flushing through expansion valve is acceptable if refrigerant oil has a normal odor and appearance.

- Flush/Purge Condenser:
- Remove and discard receiver/dryer.
- Connect flusher outlet hose to inlet end of compressor discharge line using JT02102 Adapter.
- Fill flusher tank with 4 L (1gal) of solvent and fasten all connections.

Flush and Purge System Specification

Flusher Tank Capacity - - - - - - - - - - - - - - - 4 L (1 gal)

NOTE: Air pressure must be at least 620 kPa (90 psi) (6.2 bar) for flushing and purging.

Flush and Purge System Specification

Air Pressure Minimum Pressure
- - - 620 kPa (90 psi) (6.2 bar) for flushing and purging.

- Connect a supply line of moisture-free compressed air or dry nitrogen to flusher air valve.
- Open air valve to force flushing solvent into condenser circuit. Flusher tank is empty when hose pulsing stops. Additional flushing cycles are required if system is heavily contaminated with burned oil or metal particles.
- Attach a return hose and aerator nozzle to end of receiver/dryer inlet hose using JT03197 Adapter. Put nozzle in container to collect flushing solvent.

NOTE: Purging condenser circuit takes 10 - 12 minutes to thoroughly remove solvent.

- Disconnect hose from aeration nozzle to check circuit for solvent. Hold hose close to a piece of cardboard; continue purging until cardboard is dry.

See flush evaporator (See "Flush evaporator:" on page 325), if evaporator requires flushing.

If system is contaminated with burned refrigerant oil or debris, remove and bench flush evaporator. See following steps to flush evaporator through expansion valve, if oil appears normal.

Flush evaporator:

- Remove evaporator and expansion valve. **(See "Remove and Install Heater Core and Evaporator Core" on page 290 and "Remove and Install Expansion Valve" on page 289)**
- Force flushing solvent through evaporator inlet with compressed air.
- Purge system until dry.
- Install evaporator and expansion valve. **(See "Remove and Install Heater Core and Evaporator Core" on page 290 and "Remove and Install Expansion Valve" on page 289))**

Flush evaporator through expansion valve:

- Connect flusher outlet hose to connection of receiver/dryer outlet hose using JT03188 Adapter.
- Fill flusher tank with 4 L (1gal) of solvent and fasten all connections.

Flush and Purge System Specification

Flusher Tank Capacity - - - - - - - - - - - - - - - 4 L (1 gal)

NOTE: Air pressure must be at least 620 kPa (90 psi) (6.2 bar) for flushing and purging.

Flush and Purge System Specification

Air Pressure Minimum Pressure
- - - 620 kPa (90 psi) (6.2 bar) for flushing and purging

- Connect a supply line of moisture-free compressed air or dry nitrogen to flusher air valve.
- Attach a hose and aerator nozzle to compressor inlet line using JT02101 Adapter. Put nozzle in a container to collect solvent.

NOTE: Purging evaporator circuit takes 12 - 15 minutes to thoroughly remove solvent.

Disconnect hose from aeration nozzle to check circuit for solvent. Hold hose close to a piece of cardboard and continue purging until cardboard is dry.

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Install receiver-dryer. **(See "Remove and Install Receiver-Dryer" on page 288.)**

Fasten connections and mounting bracket.

Add required oil. **(See "R134a REFRIGERANT OIL INFORMATION" on page 322)**

Install compressor and connect refrigerant lines to manifold.

Connect clutch coil wire and install drive belt.

Evacuate R134a System

Follow refrigerant cautions and proper handling procedures. **(See "REFRIGERANT CAUTIONS AND PROPER HANDLING" on page 321)**

Connect refrigerant recovery system. **(See "R134a Refrigerant Recovery/Recycling and Charging Station Installation Procedure" on page 323)**

Open low-side and high-side valves on refrigerant recovery/recycling and charging station.

Follow manufacturer's instructions and evacuate system.

NOTE: Vacuum specifications listed are for sea level conditions. Subtract 3.4 kPa (34 mbar) (1 in. Hg) from 98 kPa (980 mbar) (29 in. Hg) for each 300 m (1000 ft) elevation above sea level.

Air Conditioning System Specification

Evacuate System Vacuum Subtract
- 3.4 kPa (34 mbar) (1 in. Hg) from 98 kPa (980 mbar) (29 in. Hg) for each 300 m (1000 ft) elevation above sea level

Evacuate system until low-side gauge registers 98 kPa (980 mbar) (29 in. Hg) vacuum.

Air Conditioning System Specification

Evacuate System Vacuum
- - - - - - - - - - - - - - - - - - 98 kPa (980 mbar) (29 in. Hg)

NOTE: If 98 kPa (980 mbar) (29 in. Hg) vacuum cannot be obtained in 15 minutes, test system for leaks. (See Refrigerant Leak Test in CHAPTER 7, SECTION 1 in Operation and Test Manual). Correct any leaks.

When vacuum is 98 kPa (980 mbar) (29 in. Hg), close low-side and high-side valves. Turn vacuum pump off.

If vacuum decreases more than 3.4 kPa (34 mbar) (1 in. Hg) in 5 minutes, there is a leak in system.

Air Conditioning System Specification

Evacuate System Vacuum
- - - - - - - - - - - - - - - - - - 3.4 kPa (34 mbar) (1 in. Hg)

Repair leak.

Evacuate system for 30 minutes after 98 kPa {980 mbar) (29 in. Hg) vacuum is reached.}

Close low-side and high-side valves. Stop evacuation.

Charge system. **(See Charge R134a System below.)**

Charge R134a System

⚠ WARNING

Use only Bell Equipment approved refrigerant recovery/recycling and charging stations. DO NOT mix refrigerant, hoses, fittings, components or refrigerant oils.

Follow refrigerant cautions and proper handling procedures. **(See "REFRIGERANT CAUTIONS AND PROPER HANDLING" on page 321)**

Identify refrigerant type using JT02167A refrigerant identification instrument.

Connect R134a Refrigerant Recovery/Recycling and Charging Station. **(See "R134a Refrigerant Recovery/Recycling and Charging Station Installation Procedure" on page 323)**

Evacuate system. **(See "Evacuate R134a System" on page 326)**

NOTE: Before beginning to charge air conditioning system, the following conditions must exist:
Engine STOPPED, pump must be capable of pulling at least 28.6 in. Hg vacuum (sea level). Subtract 3.4 kPa (34 mbar) (1 in. Hg) from 98 kPa (980 mbar) (29 in. Hg) for each 300 m (1000 ft) elevation above sea level.

Air Conditioning System Specification

Evacuate System Vacuum - - - - - - - - - - - - - - - - - - -
Subtract 3.4 kPa (34 mbar) (1 in. Hg) from 98 kPa (980 mbar) (29 in. Hg) for each 300 m (1000 ft) elevation above sea level.

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Follow manufacturer's instructions and charge system.

Add 1.8 kg (3.97 lb) refrigerant to system.

Air Conditioning System Specification

Air Conditioning System Refrigerant Refrigerant Quantity	1.8 kg (3.97 lb)

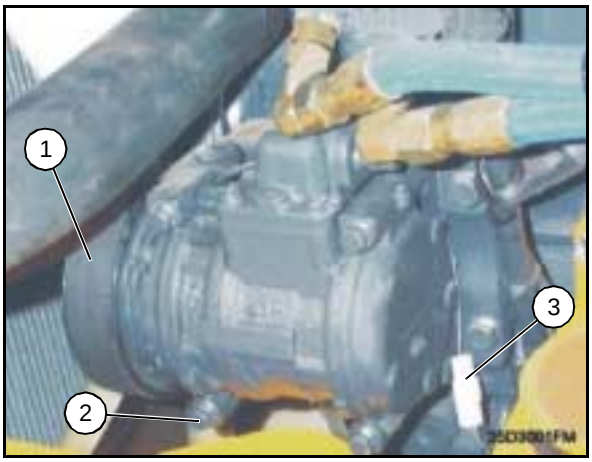
Check air conditioning for proper function. **(See Air Conditioning Operational Checks in CHAPTER 7, SECTION 3).**

Remove and Install Air Conditioner Compressor

Follow refrigerant cautions and proper handling procedures. **(See "REFRIGERANT CAUTIONS AND PROPER HANDLING" on page 321).**

Recover refrigerant. **(See "Recover R134a Refrigerant" on page 324).**

Open hood and lower bottom guard.



1. Fan Belt.
2. Cap Screw (4 used).
3. Clutch Solenoid Wire Connector.

Remove fan belt (1) from compressor pulley. **(See "FAN BELT" on page 181).**

Disconnect lines from suction and discharge ports (3 and 4). Close all openings using caps and plugs.

Disconnect compressor clutch solenoid wire connector (5).

Remove cap screws (2). Remove compressor.

Inspect, repair, or replace parts as necessary.

Before installing compressor, check oil. **(See "R134a REFRIGERANT OIL INFORMATION" on page 322).**

Install compressor. Install cap screws.

Connect clutch solenoid wire connector.

Connect lines to discharge and suction ports.

Install fan belt. **(See"FAN BELT" on page 181).**

Evacuate system. **(See "Evacuate R134a System" on page 326).**

Charge system. **(See "Charge R134a System" on page 326).**

Disassemble and Assemble Compressor Clutch

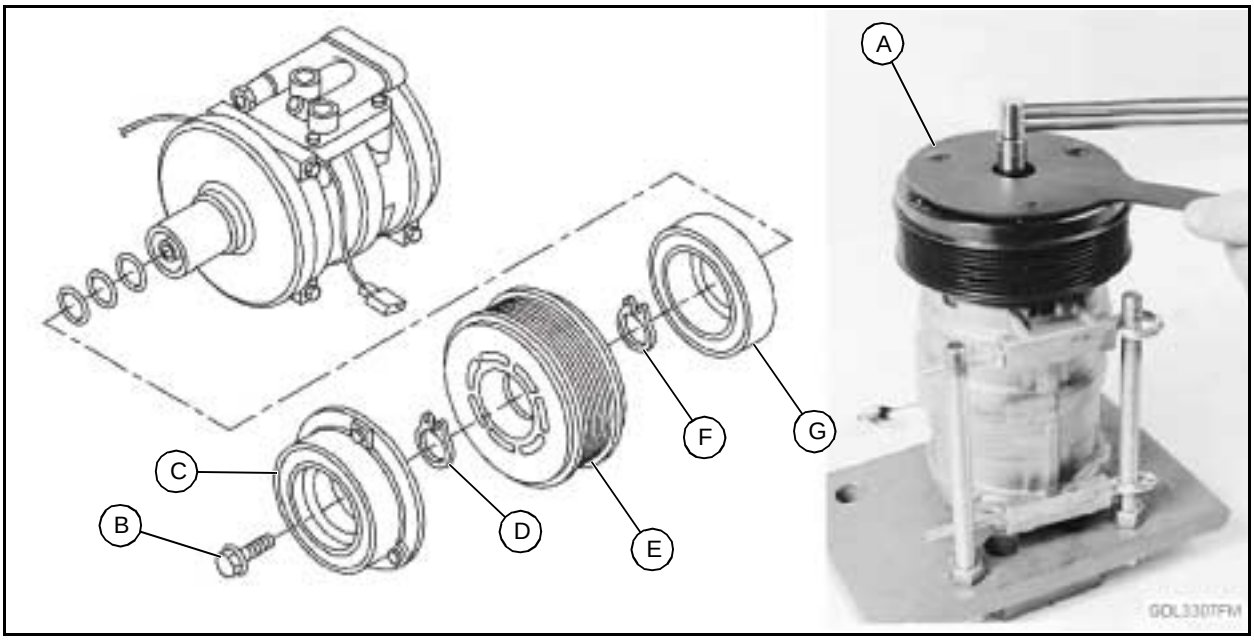
Follow refrigerant cautions and proper handling procedures. **(See "REFRIGERANT CAUTIONS AND PROPER HANDLING" on page 321).**

Remove compressor. **(See "Remove and Install Air Conditioner Compressor" on page 327).**

Install compressor on D01006AA Bench Mounted Holding Fixture.

Remove dust cover.

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A. JDG747 Compressor Clutch Spanner.
B. Clutch Shaft Bolt.
C. Clutch Hub.
D. Pulley Snap Ring.
E. Pulley.
F. Clutch Coil Snap Ring.
G. Clutch Coil.
H. Shims.

Hold clutch hub using JDG747 Compressor Clutch Spanner (A). Remove clutch shaft bolt (B).

Remove clutch hub (C). Remove shims (H) from clutch hub and save for installation.

Remove and discard snap ring (D). Remove pulley (E) using a plastic hammer or JDG220 Puller, JDG748 Jaws, and JDG771 Hub Protector.

Disconnect clutch coil lead wire. Remove and discard snap ring (F) and remove clutch coil (G).

NOTE:Bearing in pulley is NOT serviceable.

Check pulley bearing operation. Replace pulley and bearing as required.

Install clutch coil and new snap ring with flat side of snap ring down. Connect clutch coil lead wire.

Install pulley with new snap ring flat side down.

Apply grease to shims (H) and install in clutch hub.



Check pulley-to-clutch hub clearance using a dial indicator. Mount gauge to pulley as illustrated and connect a set of jumper wires from compressor to a 12V battery.

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Rotate pulley and check clearance in three equally spaced locations around clutch hub. Add or remove shims as required.

Air Conditioning Compressor Specification

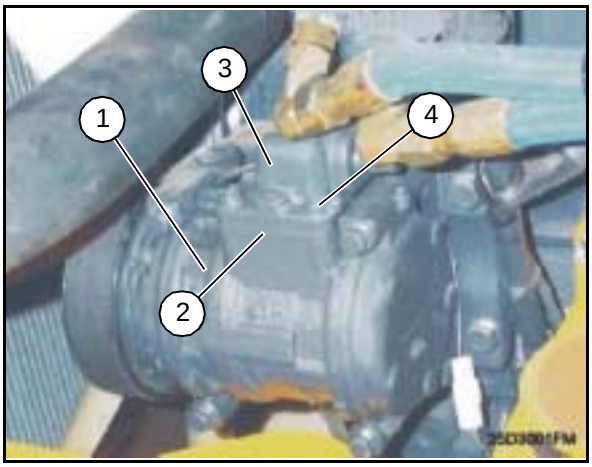
Pulley-to-Clutch Hub Clearance
- - - - - - - - - - - - - - - 0.35 - 0.65 mm (0.014 - 0.026 in.)

Install clutch hub and tighten shaft bolt to specification. Install dust cover.

Air Conditioning Compressor Specification

Clutch Hub and Shaft Bolt Torque
- 14 Nm (120 lb-in.)

Inspect Compressor Manifold



1. Compressor.
2. Manifold Seal.
3. Manifold.
4. Bolts (4 used).

Remove manifold (3) and manifold seal (2) from compressor (1).

Clean, inspect, and replace parts as necessary.

Lubricate and install manifold seal. Install manifold. Tighten bolts (4) to specification.

Inspect Compressor Manifold Specification

Manifold Bolts Torque - - - - - - - - - - - - 26 Nm (19 lb-ft)

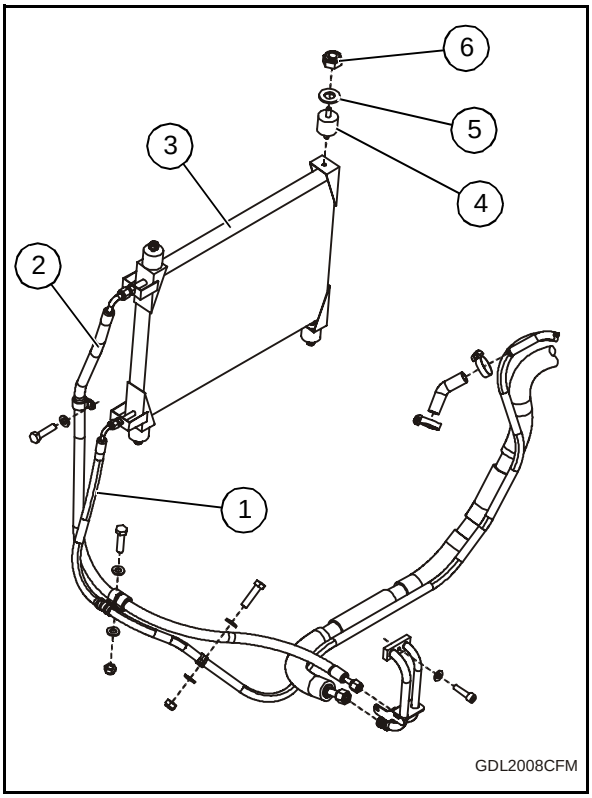
Remove and Install Condenser

NOTE: It is not necessary to remove condenser to just purge and flush system. See Flush and Purge Air Conditioner System.

Follow refrigerant cautions and proper handling procedures. **(See "REFRIGERANT CAUTIONS AND PROPER HANDLING" on page 279).**

Recover refrigerant. **(See "Recover R134a Refrigerant" on page 282).**

Remove grille and open hood.



1. Line to Receiver-Dryer.
2. Line From Compressor.
3. Condenser.
4. Condenser Mount.
5. Washer Nut.
6. Nut.

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Disconnect lines (1 and 2). Close all openings using caps and plugs.

Remove nuts and washers (5 and 6). Remove condenser (3).

Inspect, repair, and replace parts as necessary.

Before installing condenser, add refrigerant oil. **(See "R134a REFRIGERANT OIL INFORMATION" on page 280).**

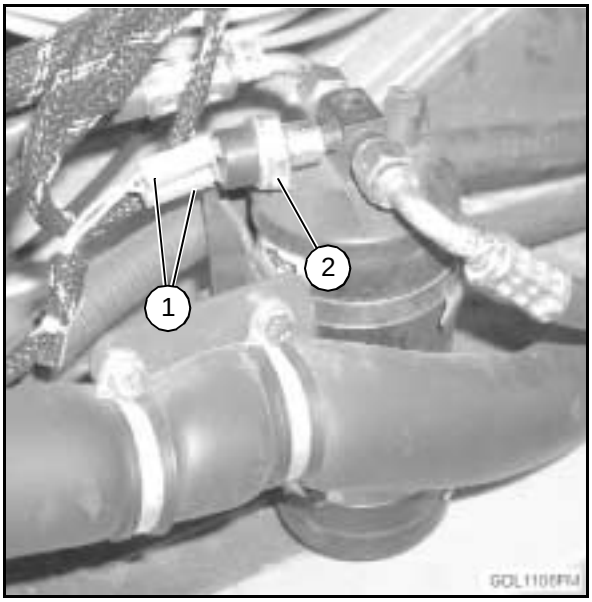
Install condenser.

Evacuate system. **(See "Evacuate R134a System" on page 284).**

Charge system. **(See "Charge R134a System" on page 284).**

Remove and Install High/Low Pressure Switch

NOTE: A valve prevents system from discharging when switch is removed.



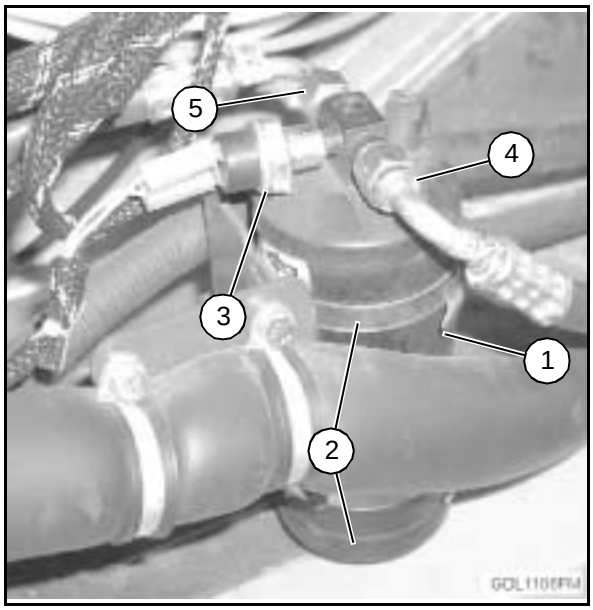
Disconnect wire leads (1) and remove pressure switch (2).

Replace parts as necessary.

Remove and Install Receiver-Dryer

Follow refrigerant cautions and proper handling procedures. **(See "REFRIGERANT CAUTIONS AND PROPER HANDLING" on page 279).**

Recover refrigerant. **(See "Recover R134a Refrigerant" on page 282).**



Disconnect wiring leads from high/low pressure switch (3).

Disconnect lines (4 - 5). Close all openings using caps and plugs.

Loosen clamps (2) to remove receiver-dryer (1).

Before installing new receiver-dryer, add refrigerant oil. **(See "R134a REFRIGERANT OIL INFORMATION" on page 280).**

Install new receiver-dryer. Tighten clamp.

Connect wiring leads and lines.

Evacuate system. **(See "Evacuate R134a System" on page 284).**

Charge system. **(See "Charge R134a System" on page 284).**

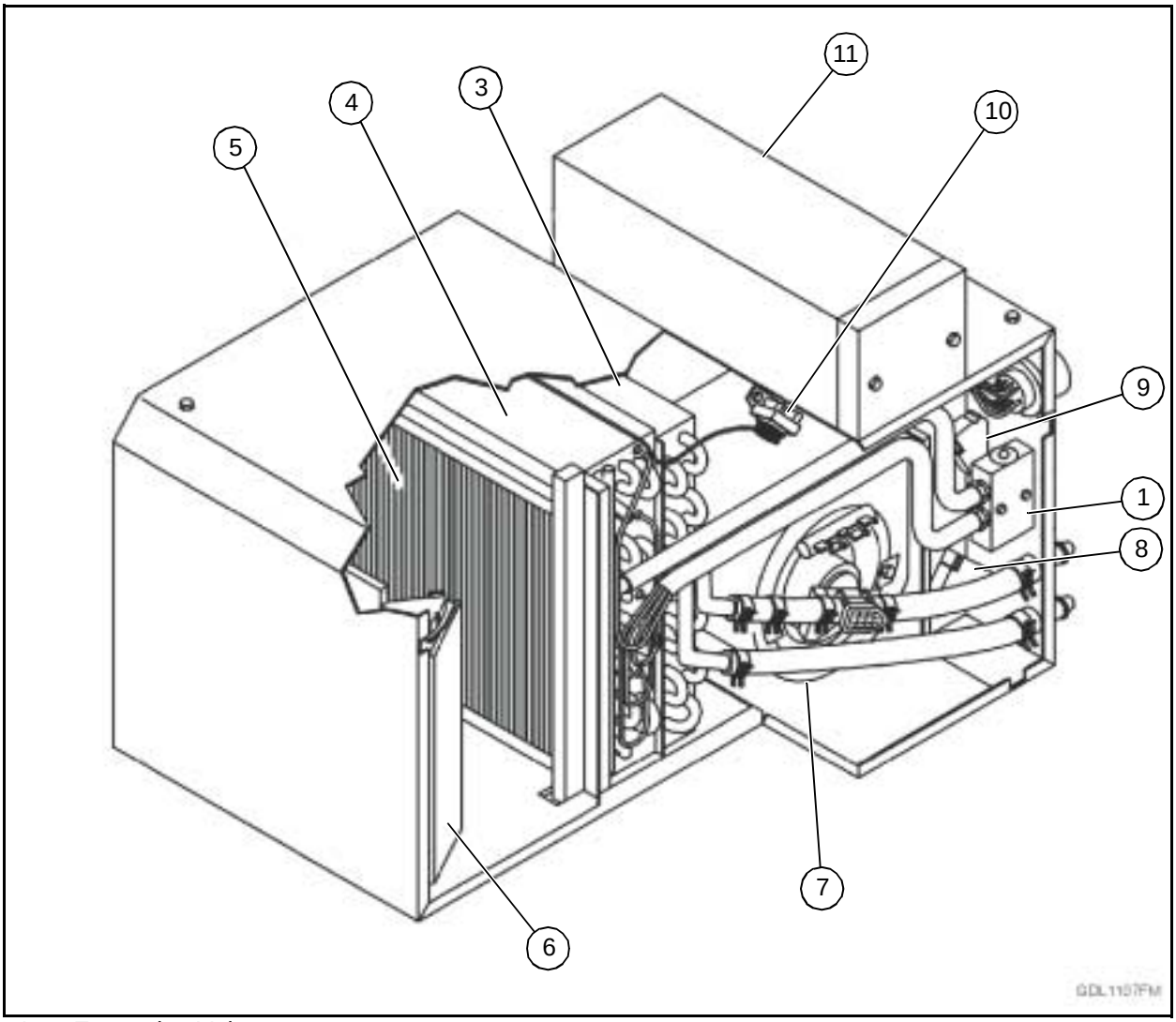
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Remove and Install Expansion Valve

Follow refrigerant cautions and proper handling procedures. **(See "REFRIGERANT CAUTIONS AND PROPER HANDLING" on page 279).**

Recover refrigerant. **(See "Recover R134a Refrigerant" on page 282).**

Remove side panel from air conditioner box.



1. Expansion Valve.
2. Heater Control Valve.
3. Heater Core.
4. Evaporator Core.
5. Air Filter.
6. Recirculating Damper.
7. Blower.
8. Floor Vent Actuator.
9. Defrost Actuator.
10. Freeze Control Switch.
11. Relay Box.

Disconnect lines and remove expansion valve (1). Close all openings using caps and plugs.

Install expansion valve and connect lines.

Install heater and air conditioner module side panel.

Evacuate system. **(See "Evacuate R134a System" on page 284).**

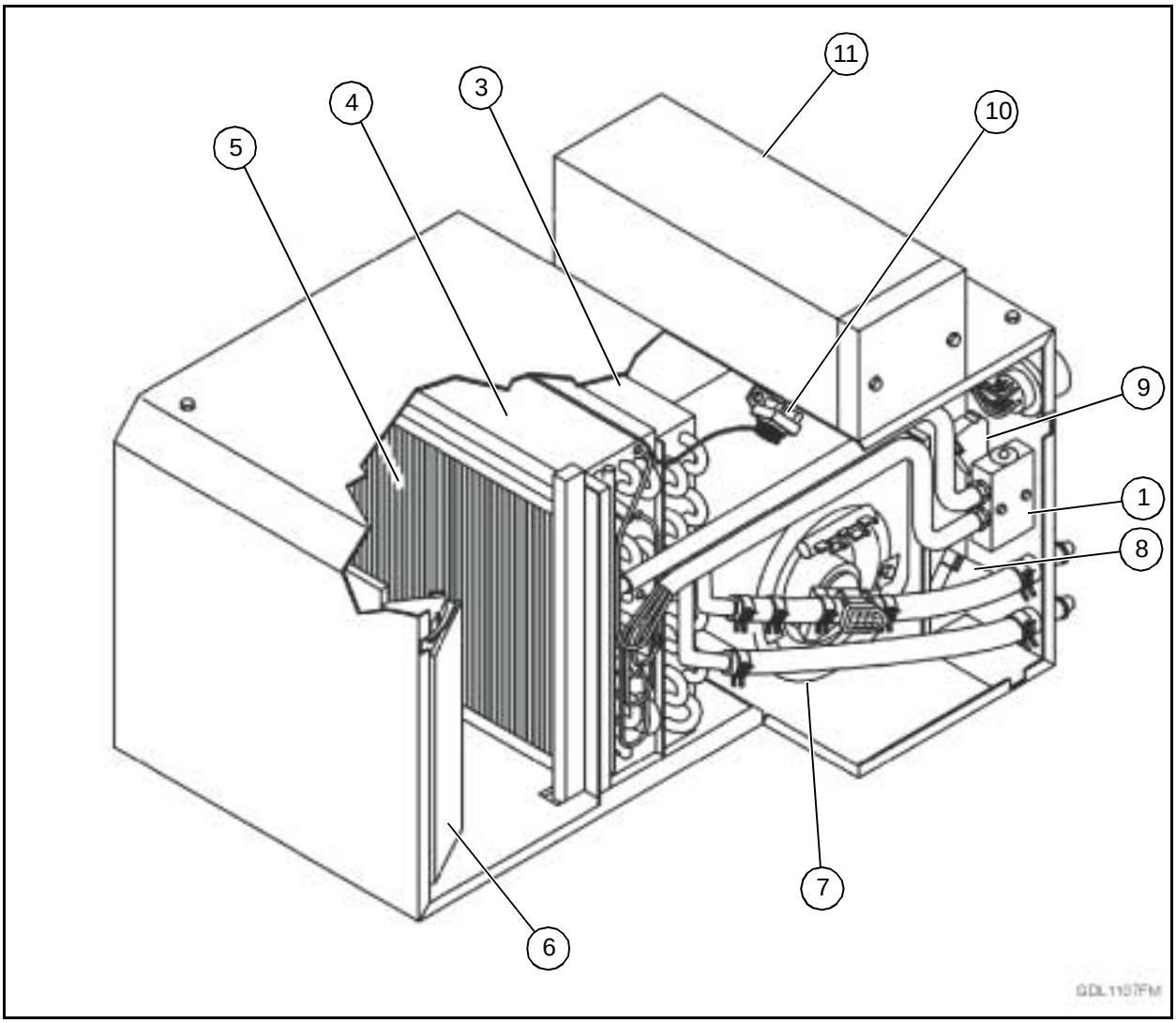
Charge system. **(See "Charge R134a System" on page 284).**

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Remove and Install Heater Core and Evaporator Core

Remove air conditioning box from machine.

- Follow refrigerant cautions and proper handling procedures. **(See "REFRIGERANT CAUTIONS AND PROPER HANDLING" on page 279).**
- Recover refrigerant. **(See R"Recover R134a Refrigerant" on page 282).**
- Drain radiator. **(See Change Engine Coolant Operator's Manual CHAPTER 11, SECTION 2).**
- Disconnect wiring connectors and air ducts from air conditioner box.
- Disconnect refrigerant lines, heater hoses, and drain tubes. Close all openings with caps and plugs.
- Remove air conditioning box from right-side compartment.



Remove heater core (3) and evaporator core (4) from air conditioner box.

- Remove side panel from air conditioner box.
- Remove tray from relay box (11) and disconnect all electrical connectors. Route wiring harness out of relay box.
- Disconnect freeze control switch (10) from top panel. Remove top panel from air conditioner box.
- Disconnect evaporator lines from expansion valve (1). Disconnect heater hoses from heater core. Close all openings with caps and plugs.
- Remove heater core and evaporator core as an assembly.
- Remove clips to disconnect evaporator core from heater core.

Repair or replace parts as necessary.

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Install heater and evaporator cores in air conditioner box.

- Before installing evaporator core, add refrigerant oil. **(See "R134a REFRIGERANT OIL INFORMATION" on page 280).**
- Install clips to connect evaporator core to heater core.
- Install heater core and evaporator core in air conditioner box as an assembly.
- Connect evaporator lines to expansion valve. Connect heater hoses to heater core.
- Install top panel. Connect freeze control switch to top panel.
- Install tray in relay box. Connect all electrical connectors.
- Install side panel on air conditioner box.

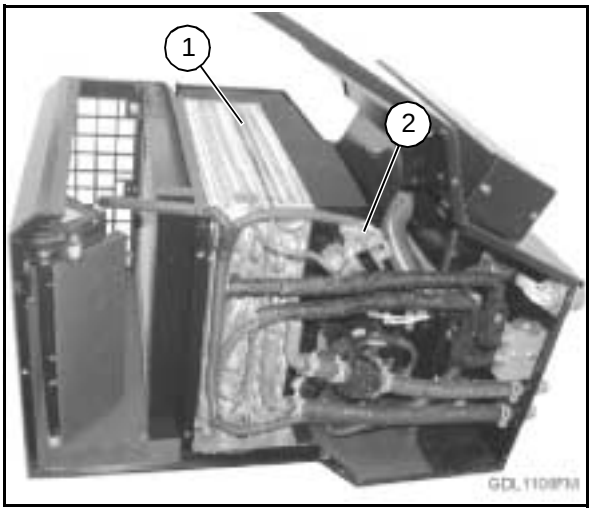
Install air conditioner box in machine.

- Connect air ducts. Connect electrical connectors.
- Connect air conditioner lines, heater hoses, and drain tubes.
- Fill radiator. **(See Change Engine Coolant Operator's Manual CHAPTER 11, SECTION 2).**
- Evacuate system. **(See "Evacuate R134a System" on page 284).**
- Charge system. **(See "Charge R134a System" on page 284).**

Remove and Install Freeze Control Switch

Remove air conditioner box from machine. **(See "Remove and Install Heater Core and Evaporator Core" on page 332).**

Remove side panel from air conditioner box.



Disconnect freeze control switch (2) from top panel. Disconnect wire leads.

Disconnect top panel from air conditioner box. Lift top panel enough to remove capillary tube from evaporator core (1).

Inspect and replace parts as necessary.

Install capillary tube in evaporator core.

Connect wire leads to freeze control switch. Install top panel. Connect freeze control switch to top panel.

Install side panel.

Install air conditioner box in machine. **(See "Remove and Install Heater Core and Evaporator Core" on page 332).**

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CHAPTER 13. SHEET METAL AND STYLING

SECTION 1. BONNET OR ENGINE ENCLOSURE

BONNET

Remove and Install Bonnet

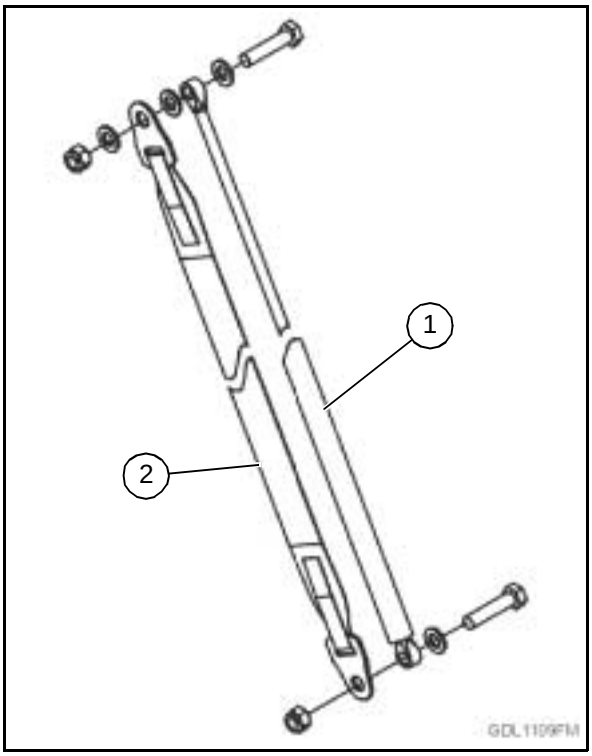
⚠ CAUTION

Component is heavy. Use hoist.

Bonnet Specification

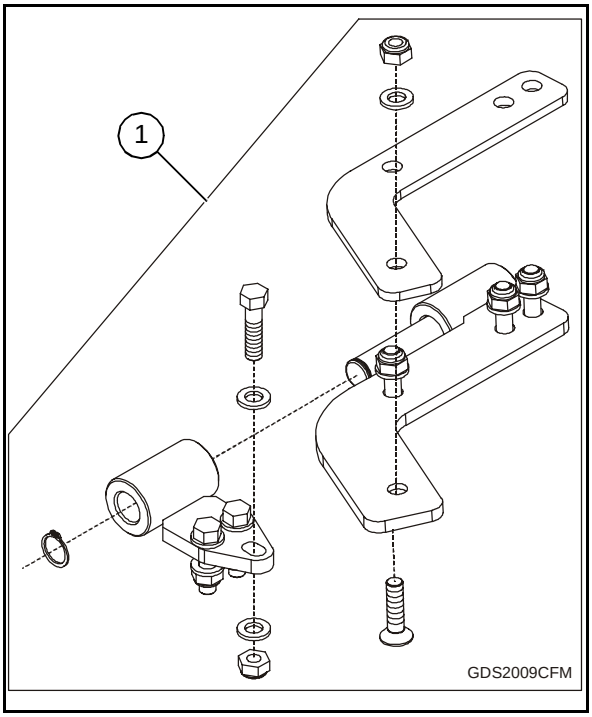
Bonnet Weight - - - - - - - - 57 kg (125 lb) approximate

Open bonnet. Secure bonnet with hoist.



Remove straps (2).

Remove struts (1).



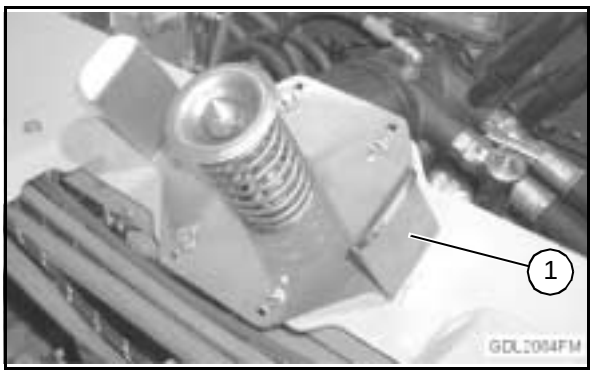
Disconnect hinge assemblies (1).

Connect hinges.

Connect straps and struts.

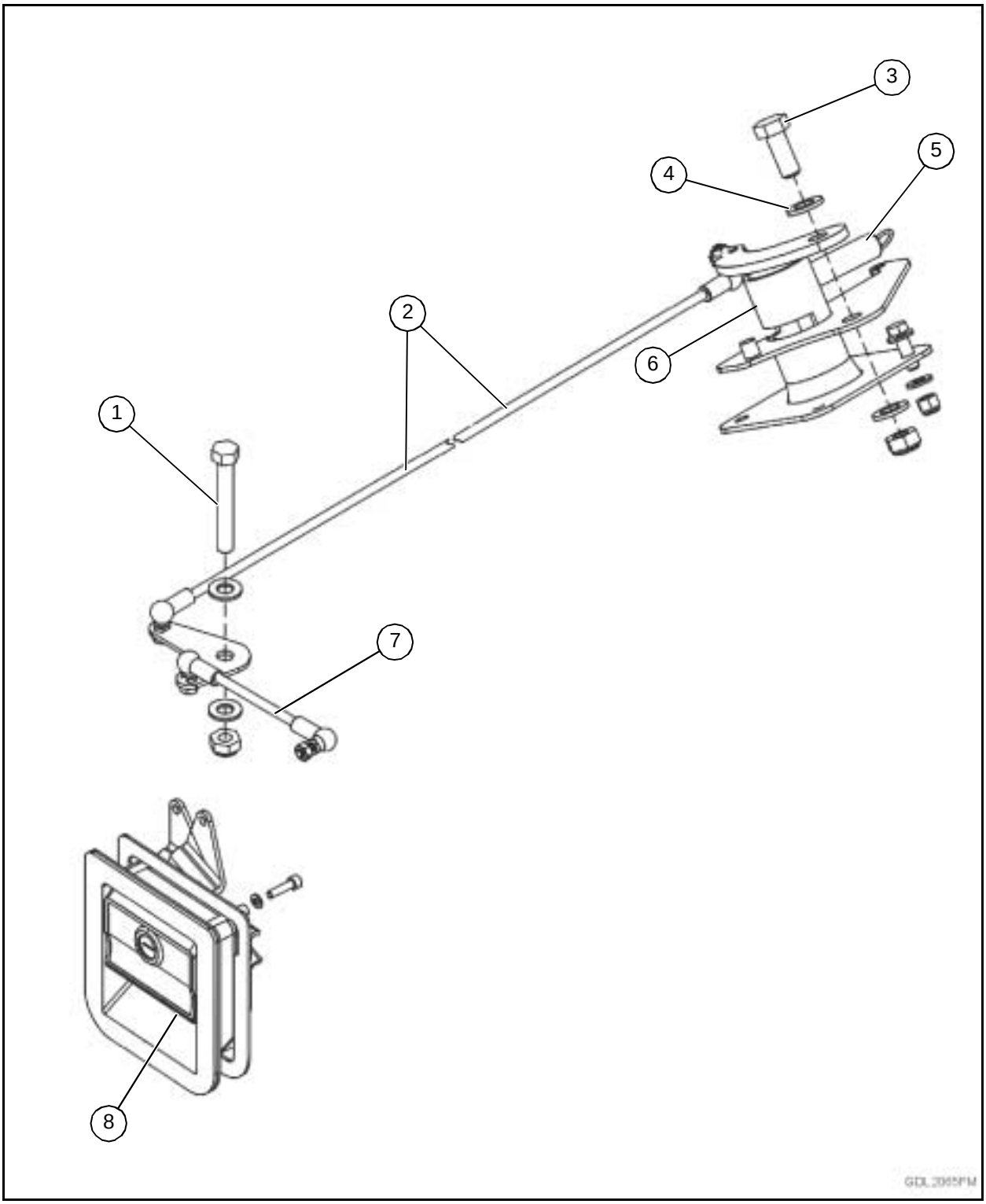
Adjust bonnet latch.

Adjust Bonnet



Remove catch pin assembly (1) from machine. Clean catch pin and strike plate.

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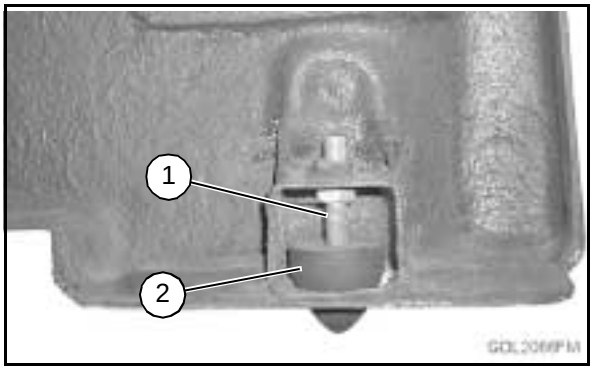
1. Linkage Pivot Cap Screw.
2. Linkage Rod.
3. Latch Arm Pivot Cap Screw.
4. Latch Arm Pin Tube.
5. Return Spring.
6. Catch Pin Tube.
7. Linkage Rod.
8. Latch Release Lever.

Adjust latch linkage.

- Adjust linkage pivot cap screw (1) and latch arm pivot cap screw (3), if necessary. Pivots should not bind or have excess free-play.
- Adjust linkage rods (7 and 2) so latch release lever (8) and latch arm (4) move smoothly through full range of motion.

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- Ensure latch arm returns to engaged position inside catch pin tube (6) when lever is released.
- Replace return spring (5), if necessary. Clean latch arm and catch pin tube.



Adjust stoppers (1) to initial setup specification.

Bonnet Specification

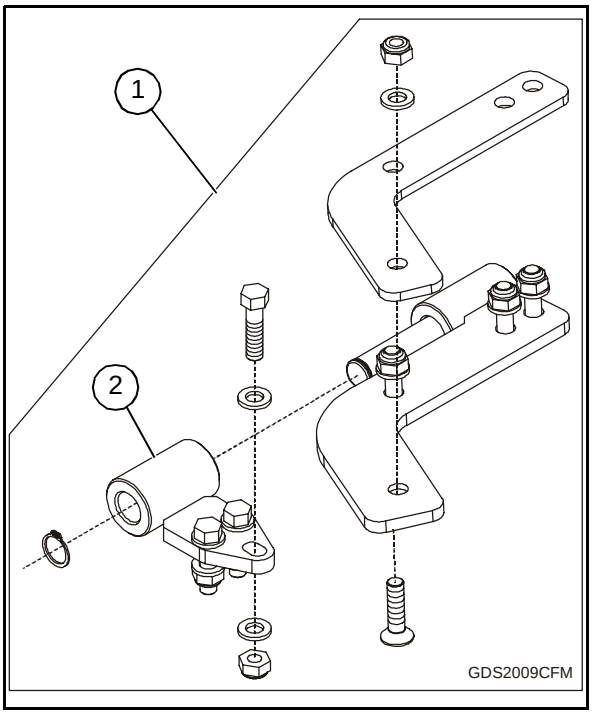
Stopper Tip-to-Bonnet Lower Surface Initial Setup Distance - 20 mm (0.8 in.)

⚠ CAUTION

Component is heavy. Use hoist.

Bonnet Specification

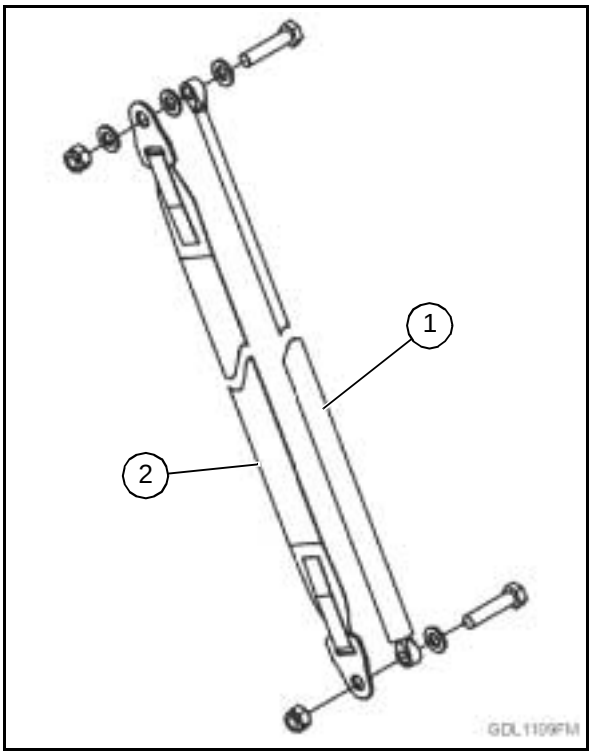
Bonnet Weight - - - - - - - - 57 kg (125 lb) approximate



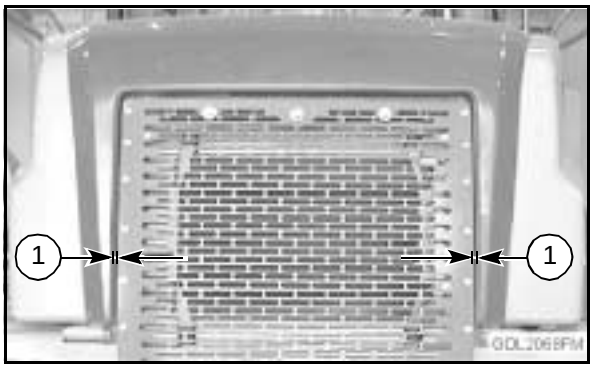
Install hinge assembly (1) on bonnet.

Lift bonnet with hoist. Install spacers and hinges to frame.

Tighten hardware enough to eliminate gaps between contact surfaces, but ensure that flanges (4 and 5) are loose enough to allow adjustment.



5. Install struts (1) and straps (2).



1. Bonnet-to-Grille Gap

Lower bonnet. Adjust bonnet left-to-right alignment. Bonnet-to-grille gaps (1) should be equal on left and right sides.

Raise bonnet slowly. Ensure that bonnet does not shift left or right. Tighten bonnet-mounted flanges of hinges.

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Lower bonnet. Adjust bonnet front-to-rear alignment.

Ensure that weather seal at bonnet rear edge aligns with mating surface on front of cab.

Front of bonnet should extend approximately 10 mm (0.4 in.) beyond front bumper surface.

Lower radiator bottom guard. Tighten frame-mounted flanges of hinges.

Raise bonnet. Install catch pin assembly.

Tighten hardware enough to eliminate gaps between contact surfaces, but ensure that assembly is loose enough on mounting surface to allow adjustment.

Move assembly to centered position.

Lubricate latch linkage, latch arm, hinges, strike plate, and catch pin with multipurpose grease or dry graphite as necessary.

Lower bonnet. Latch arm should engage catch pin.

Pull latch release lever.

Latch should move smoothly with slight resistance.

Latch arm should release catch pin.

Raise bonnet slowly. Ensure that catch pin assembly does not shift out of alignment. Tighten catch pin assembly.

Lower bonnet and engage latch.

Examine bonnet-to-frame contact. Weather seal surfaces should make even contact.

Stoppers should contact frame, but not be excessively compressed.

Adjust height of catch pin and stoppers, if necessary, and recheck.

Tighten nuts on catch pin and stoppers when adjustment is complete.

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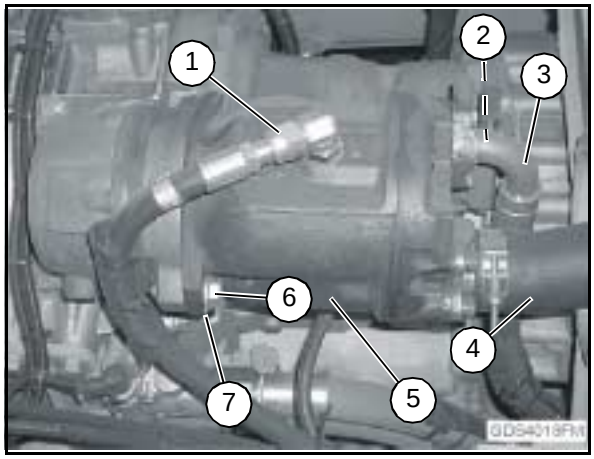
CHAPTER 14. MAIN HYDRAULIC SYSTEM

SECTION 1. HYDRAULIC SYSTEM

MAIN HYDRAULIC PUMP

Remove and Install Main Hydraulic Pump

Drain oil from hydraulic reservoir. The approximate capacity of reservoir is 78.8 L (20.8 gal).



1. Case Drain Line.
2. Hydraulic Load Sense Line.
3. Outlet Line.
4. nlet Line.
5. Main Hydraulic Pump.
6. Cap Screw (2 used).
7. Washer (2 used).

Disconnect lines (1 - 4).

⚠ CAUTION

Heavy component; use a hoist.

Main Hydraulic Pump Specification

Hydraulic Pump Weight - - - 43 kg (95 lb) approximate

Attach hoist to pump using DFT1132 Removal and Installation Tool. **(See "DFT1132 REMOVAL AND INSTALLATION TOOL" on page 383)**

Remove cap screws (6), washers (7), and main hydraulic pump (5).

Clean, repair, or replace pump as necessary.

Install pump, cap screws, and washers.

Install lines (2 - 4).

⚠ CAUTION

Pump MUST be filled with oil before starting or damage to pump will occur.

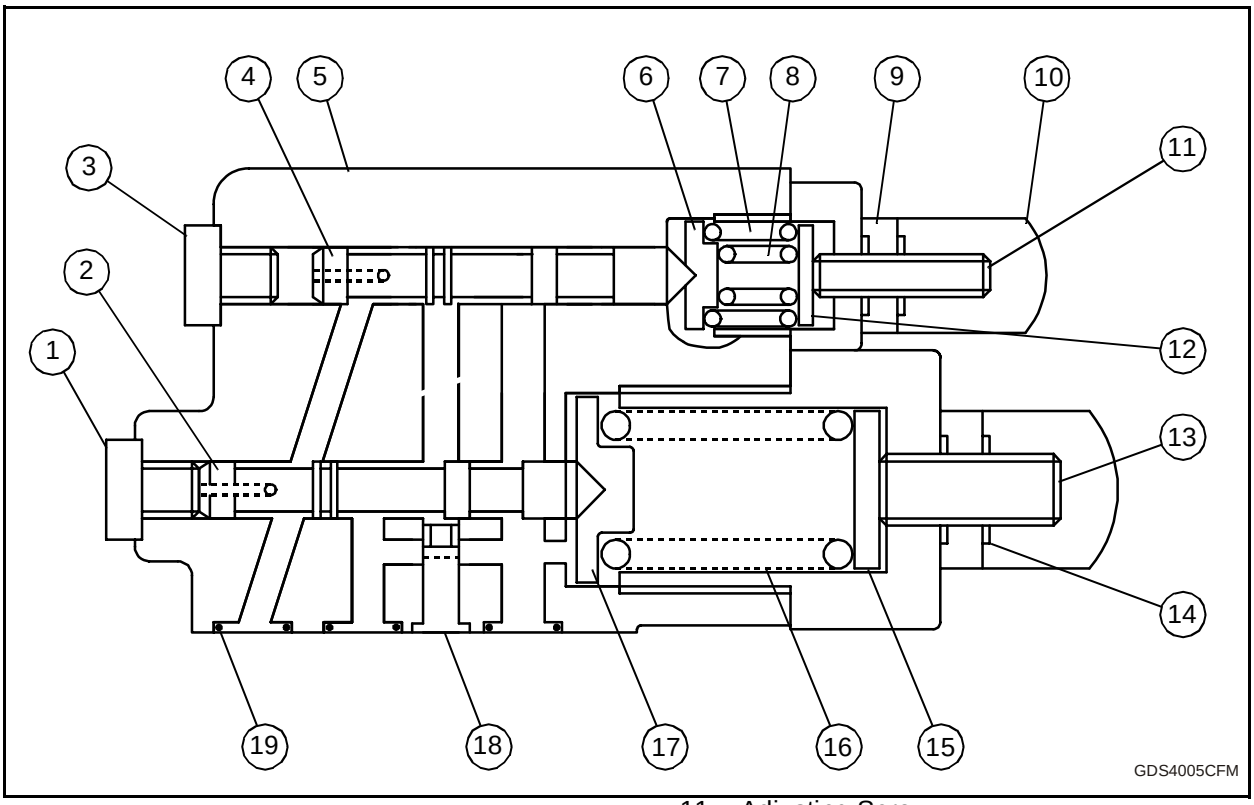
Fill pump with clean hydraulic oil through case drain port and connect line (1).

Fill hydraulic reservoir and Check Hydraulic Oil Level. **(See Operator's Manual, CHAPTER 16, SECTION 1).**

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Disassemble and Assemble

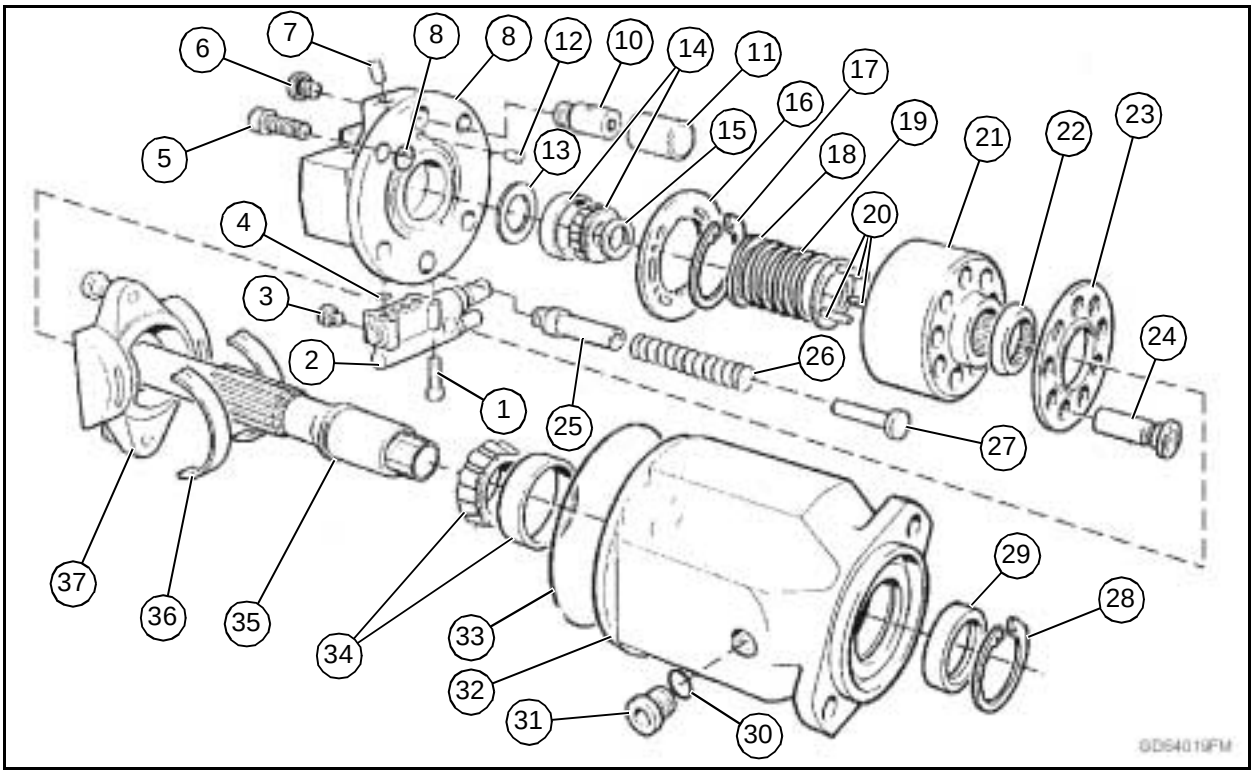
Clean and drain pump.



1. Plug.
2. Compensator Valve Spool.
3. Plug.
4. Residual Valve Spool.
5. Pump Regulator Valve.
6. Spring Guide.
7. Outer Spring.
8. Inner Spring.
9. Nut (2 used).
10. Cap (2 used).
11. Adjusting Screw.
12. Plate.
13. Adjusting Screw.
14. Sealing Washer (4 used).
15. Plate.
16. Spring.
17. Spring Guide.
18. Orifice Plug.
19. O-Ring (3 used).

Remove regulator valve. Disassemble as necessary.

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1. Cap Screw (4 used).
2. Regulator Valve.
3. Plug.
4. O-Ring (3 used).
5. Cap Screw (4 used).
6. Plug.
7. Plug.
8. O-Ring (4 used).
9. Port Plate.
10. Piston Guide.
11. Large Control Piston.
12. Dowel Pin.
13. Shim.
14. Tapered Roller Bearing Cone and Cup.
15. Spacer.
16. Distributor Plate.
17. Snap Ring.
18. Retaining Ring (2 used).
19. Spring.
20. Pin (3 used).
21. Cylinder Block.
22. Guide Ball.
23. Retainer Plate.
24. Piston (9 used).
25. Piston Guide.
26. Spring.
27. Small Control Piston.
28. Snap Ring.
29. Oil Seal.
30. O-Ring.
31. Plug.
32. Housing.
33. O-Ring.
34. Tapered Roller Bearing Cone and Cup.
35. Shaft.
36. Swash Plate Bearing (2 used).
37. Swash Plate.

Scribe an index line across port plate (9) and housing (32).

⚠ CAUTION

The distributor plate may stick to the port plate when removed. The highly machined surface on port plate, distributor plate, and cylinder block must not be damaged. Lay parts on clean, lint-free towels to protect the machined surfaces.

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Remove port plate (9), distributor plate (16), piston guide (10), large control piston (11), piston guide (25), spring (26), and small control piston (27).

Remove tapered roller bearing cone (14) and spacer (15).

Remove the rotary group (17 - 24) as an assembly.

⚠ CAUTION

Spring (19) is under compression. A press must be used to compress spring to remove snap ring (17).

Inspect cylinder block. Remove spring (19) only if replacement is necessary.

Remove drive shaft (35), swash plate (37), and bearings (36).

Remove tapered roller bearing cone (34) using a press. Remove bearing only if replacement is necessary.

Remove snap ring (28) and oil seal (29).

Clean and inspect all parts for wear and damage. Replace parts as necessary.

⚠ CAUTION

Replace all oil seals and O-rings. Old seals and O-rings will leak.

Install oil seal (29) with lip facing inside of housing. Press seal into housing just far enough to install snap ring. Apply petroleum jelly to sealing lip.

Put pump housing in vise with large opening up.

⚠ CAUTION

Apply clean oil to all internal parts as they are assembled.

Install swash plate bearings (36).

Install tapered roller bearing cone on drive shaft tight against shoulder. Install bearing cup in housing.

⚠ CAUTION

Swash plate must be installed so slipper with oil passage will line up with small control piston.

Install drive shaft and swash plate.

Move pump housing to a horizontal position.

Assemble rotary group (17 - 24). A press must be used to compress spring to install snap ring (17). Pins (20) are installed in cylinder block between retaining ring (18) and guide ball (22).

Install assembled rotary group into pump housing.

Install spacer (15) and bearing cone (14).

Install small control piston (27) and spring (26) on top of swash plate slipper with oil passage.

Install large control piston on top of swash plate slipper without oil passage.

Install shim (13) and bearing cup (14).

Install piston guides (10 and 25) and O-rings (8 and 33).

Apply a small amount of petroleum jelly on the mating surface of distributor plate and port plate.

Install distributor plate onto port plate dowel pin.

NOTE: Use index line to ensure proper installation.

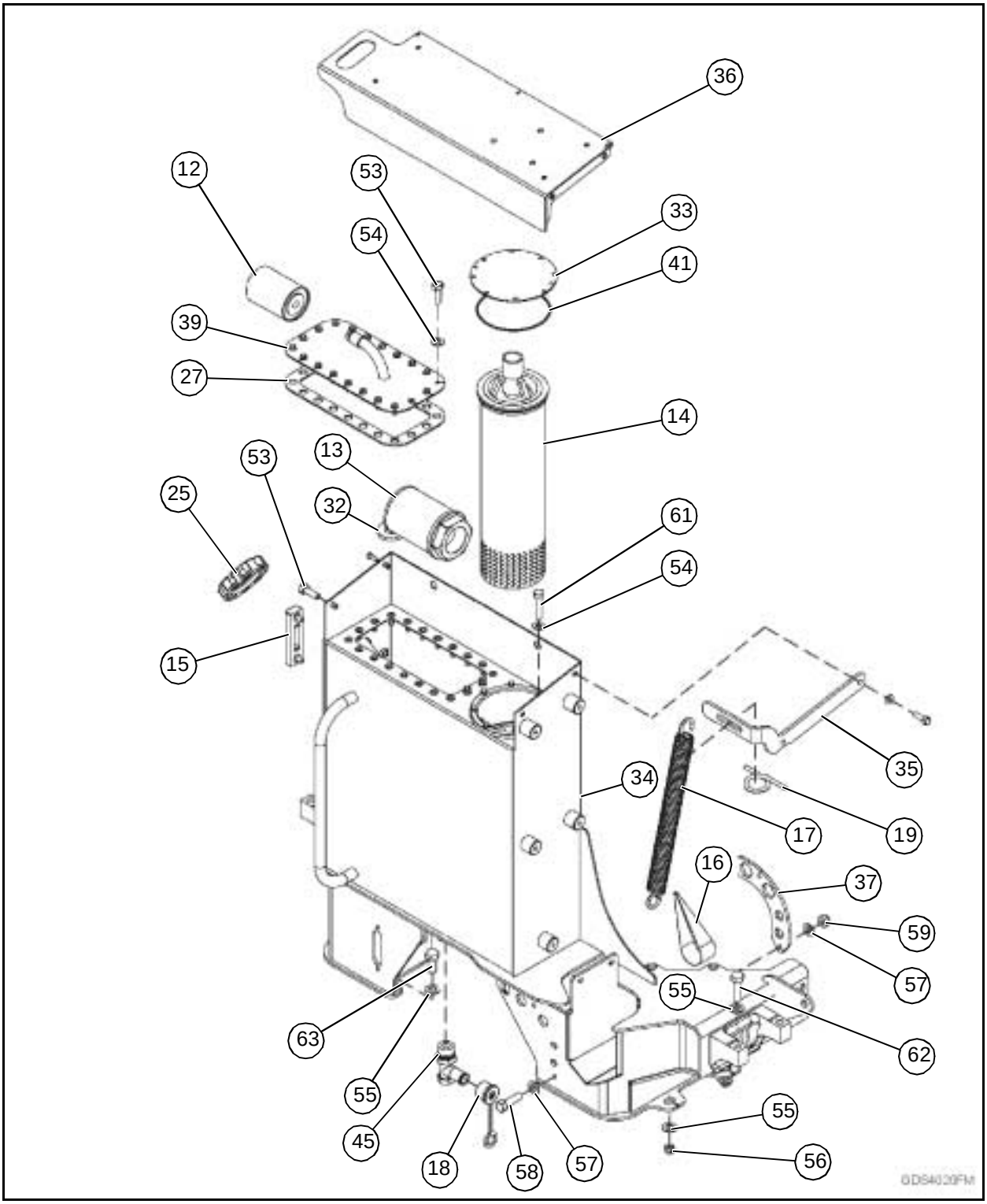
Install port plate, guiding pistons into piston guides.

Tighten cap screws using a crisscross pattern.

Install O-rings (4) and pump regulator valve.

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HYDRAULIC RESERVOIR



12. Breather Element.
13. Strainer.
14. Filter.
15. Level Gauge.
16. Line Support.
17. Spring.
18. Cap.
19. Spring.
25. Filler Cap.
27. Gasket.
32. Magnet.
33. Cover.
34. Hydraulic Reservoir.
35. Bracket.

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36. Guard.
37. Plate.
39. Cover.
41. O-Ring.
45. Drain Valve.
53. Cap Screw (27 used).
54. Washer (37 used).
55. Washer (10 used).
56. Lock Nut (4 used).
57. Washer (8 used).
58. Cap Screw (2 used).
59. Lock Nut (4 used).
61. Cap Screw (8 used).
62. Cap Screw (4 used).
63. Cap Screw (2 used).

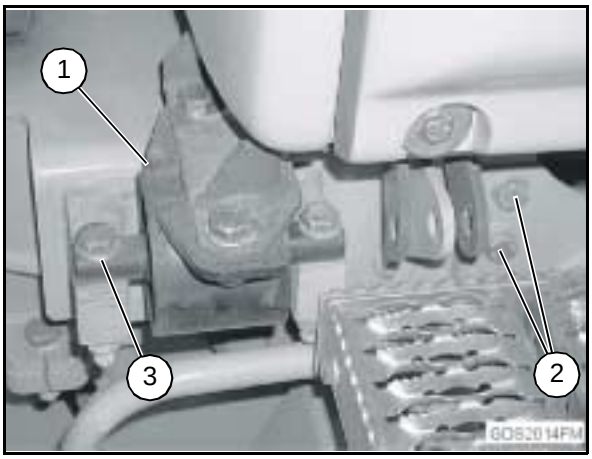
Remove and Install

Drain oil from hydraulic reservoir. The approximate capacity of reservoir is 78.8 L (20.8 gal).

Tilt Cab. **(See Operator's Manual, CHAPTER 7, SECTION 1).**

Label and disconnect all lines connected to reservoir and reservoir base.

Remove and Install Muffler and Exhaust Pipes as nesessary. **(See "Remove and Install Muffler and Exhaust Pipes" on page 243.)**



1. Rear Cab Mount (2 used).
2. Fender Mounting Cap Screw (4 used).
3. Reservoir-To-Frame Mounting Cap Screw 6 used).

Lower cab. Support rear of cab with hoist and remove both rear cab mounts (1).

Remove fender mounting cap screws (2) from reservoir base.

Remove reservoir-to-frame mounting cap screws (3).

⚠ CAUTION

Heavy component, use a hoist.

Remove hydraulic reservoir using a hoist.

Repair or replace reservoir as necessary.

Position reservoir on frame and install reservoir and fender mounting cap screws.

Install rear cab mounts.

Tilt cab.

Remove and Install Muffler and Exhaust Pipes. **(See "Remove and Install Muffler and Exhaust Pipes" on page 243)**

Connect all lines.

Lower cab.

Fill hydraulic reservoir and Check Hydraulic Oil Level. **(See Operator's Manual, CHAPTER 16, SECTION 1).**

SUCTION STRAINER

Remove and Install

Drain oil from the hydraulic reservoir. The approximate capacity of reservoir is 78.8 L (20.8 gal).

Remove top hydraulic reservoir cover.

Remove suction strainer from fitting.

Clean or replace suction strainer as necessary.

Install suction strainer and reservoir cover.

Fill hydraulic reservoir and Check Hydraulic Oil Level. **(See Operator's Manual, CHAPTER 16, SECTION 1).**

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HYDRAULIC SYSTEM MANIFOLD ASSEMBLY

Remove and Install Bin Control Valve

Fully lower dump body.

Install articulation lock bar.

Stop engine.

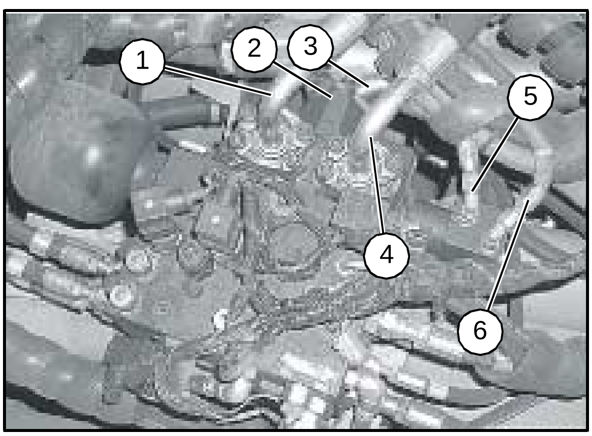
Discharge brake accumulator pressure.

Relieve pneumatic pressure.

Turn off battery disconnect switch. **(See Prepare Machine for Maintenance Operator's Manual, CHAPTER 7).**

Tilt Cab. **(See Operator's Manual, CHAPTER 7, SECTION 1).**

Drain oil from hydraulic reservoir. The approximate capacity of reservoir is 78.8 L (20.8 gal).



1. Work Port B Line.
2. Nut (3 used).
3. Return Port T2 Line.
4. Work Port A Line.
5. Pneumatic Port XA Line.
6. Pneumatic Port XB Line.

Label and disconnect lines (1 and 3 - 6).

Remove nuts (2) and loosen cap screws on underside of hydraulic system manifold, if necessary. Remove dump body control valve.

Remove shims and O-rings from between valve sections.

Clean, inspect, and replace parts as necessary.

Install O-rings and shims.

Install dump body control valve. Install nuts and tighten to specification.

Hydraulic System Manifold Assembly Specification

Manifold Assembly Tie Bolt Nut Torque -80 Nm (59 lb-ft)

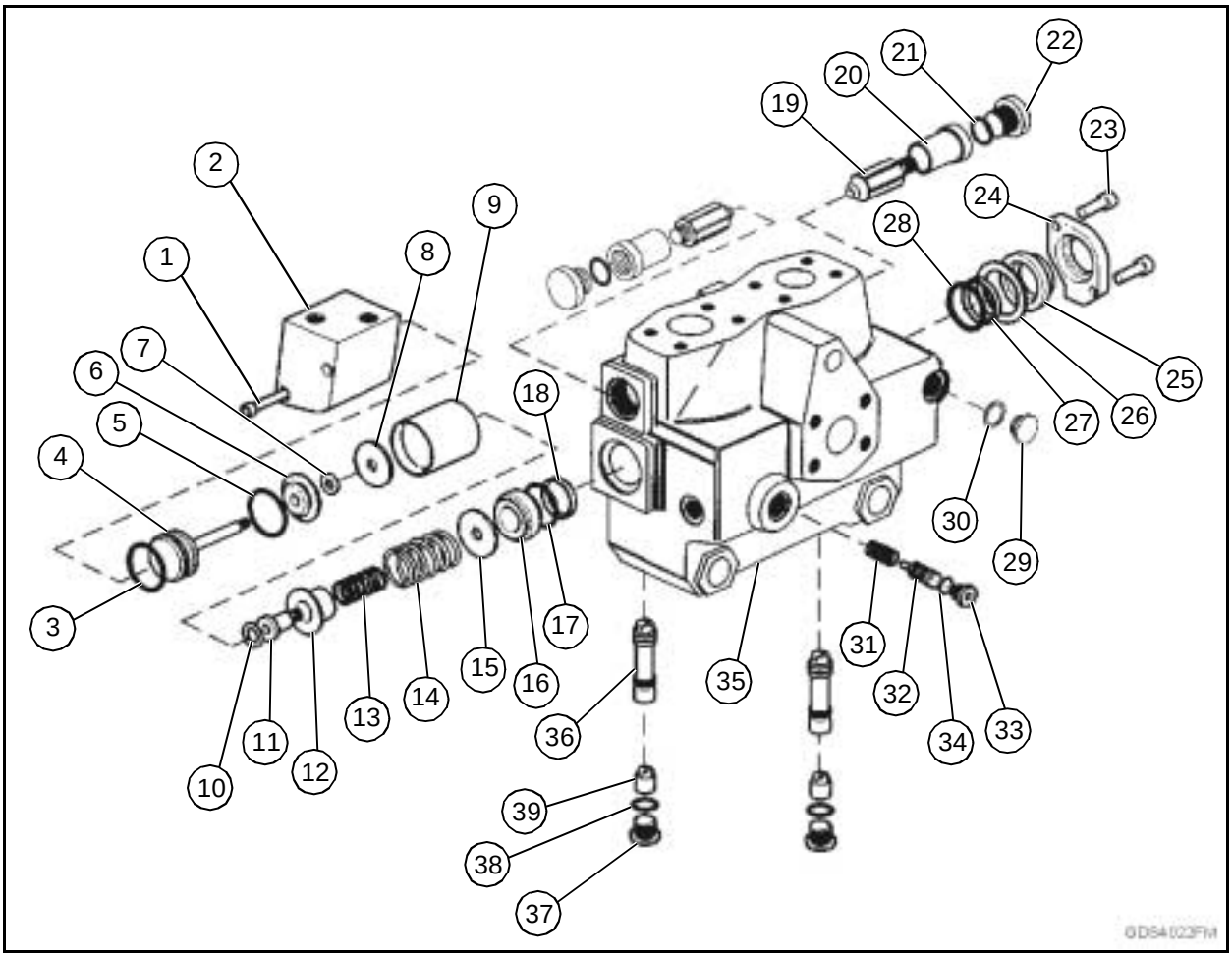
Tighten cap screws on underside of hydraulic system manifold.

Connect hydraulic and pneumatic lines.

Fill hydraulic reservoir and Check Hydraulic Oil Level. **(See Operator's Manual , CHAPTER 16, SECTION 1).**

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Disassemble and Assemble Dump Body Control Valve



1. Cap Screw (2 used).
2. Air Cylinder Housing.
3. O-Ring.
4. Piston.
5. O-Ring.
6. Piston.
7. O-Ring.
8. Disk.
9. Sleeve.
10. Washer.
11. Retainer.
12. Guide.
13. Spring.
14. Spring.
15. Disk.
16. Seat.
17. O-Ring.
18. Seal.
19. Poppet (2 used).
20. Sleeve (2 used).
21. O-Ring (2 used).
22. Cap (2 used).
23. Cap Screw (2 used).
24. Retainer.
25. Wiper.
26. Seal.
27. Backup Ring.
28. O-Ring.
29. Plug.
30. O-Ring.
31. Spring.
32. Spool.
33. Plug.
34. O-Ring.
35. Housing.
36. Spool (2 used).
37. Plug (2 used).
38. O-Ring (2 used).
39. Spacer (2 used).

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Clean and inspect parts for wear or damage.

Disassemble valve as shown.

⚠ CAUTION

Replace all seals and O-rings. Old seals and O-rings will leak.

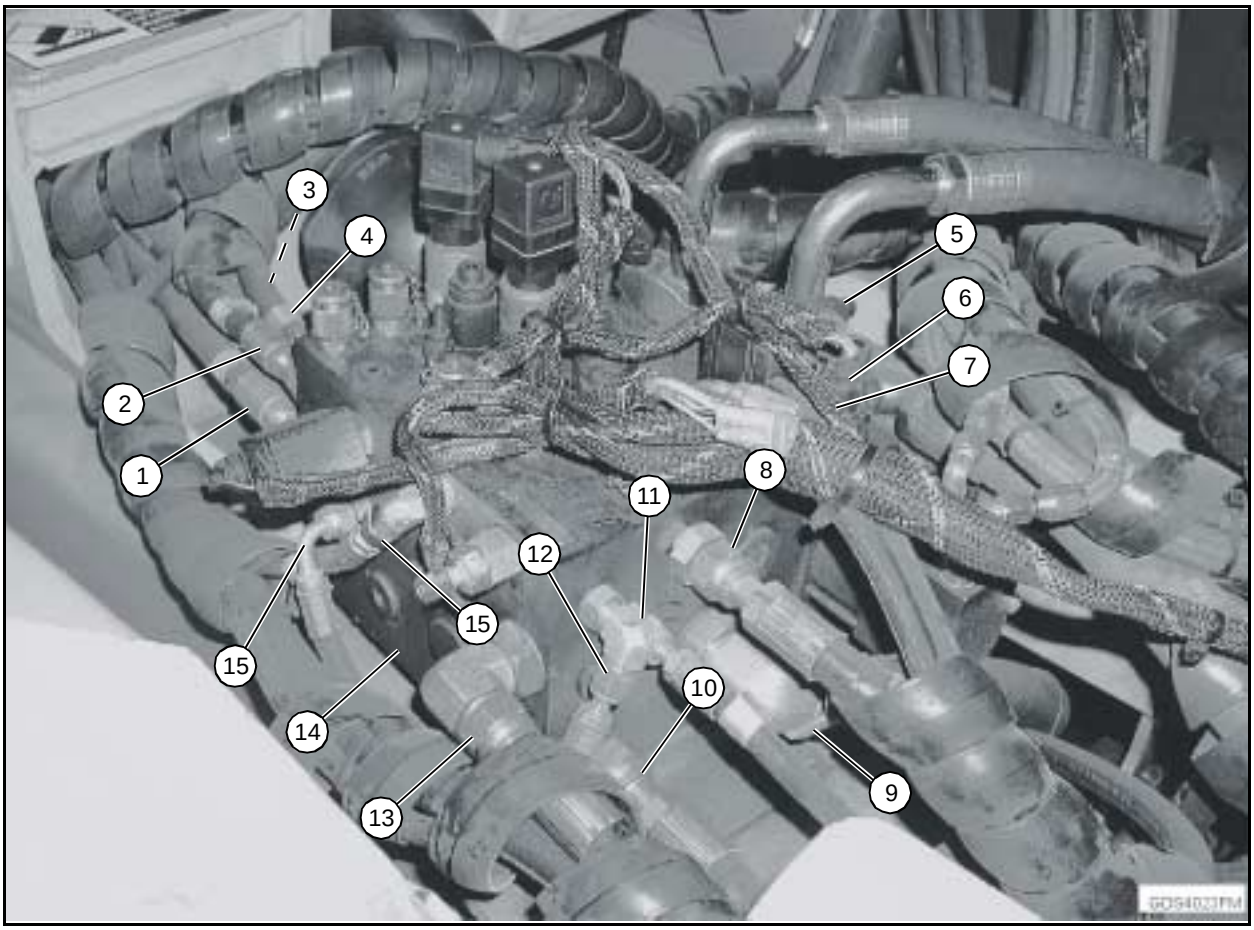
Valve housing and main spool are a matched set. If either is found worn or damaged they must be replaced as a matched set.

NOTE: Apply petroleum jelly to seals and O-rings before installation.
Apply clean hydraulic oil to all internal parts before assembling.

Assemble parts (1 - 39).

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Remove and Install Hydraulic System Manifold



1. Port A6 Line.
2. Port B6 Line.
3. Port A5 Line.
4. Port B5 Line.
5. Nut (3 used).
6. Bin Control Valve.
7. Electrical Harness.
8. Port P2 Line.
9. Port P1 Line.
10. Port T3 Line.
11. Port L2 Line.
12. Port L1 Line.
13. Port P3 Line.
14. Hydraulic System Manifold.
15. Port L3 Line.
16. Port M4 Line.

Remove and Install Hydraulic System Manifold

Fully lower dump body, install articulation lock bar, and stop engine.

Discharge brake accumulator pressure, and relieve pneumatic pressure.

Turn battery disconnect switch to **OFF**.

⚠ CAUTION

Component is heavy. Use hoist.

Hydraulic System Manifold Assembly Specification

Hydraulic System Manifold Weight - 36 kg (80 lb) approximate

Remove cap screws from bottom of hydraulic system manifold and remove manifold from machine.

Repair or replace hydraulic system manifold as necessary.

Install hydraulic system manifold in machine. Install cap screws in bottom of manifold, but do not tighten.

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Install shims and O-rings between valve sections. Install dump body control valve. Tighten cap screws at bottom of manifold.

Hydraulic System Manifold Assembly Specification

Manifold Assembly Tie Bolt Nut Torque -80 Nm (59 lb-ft)

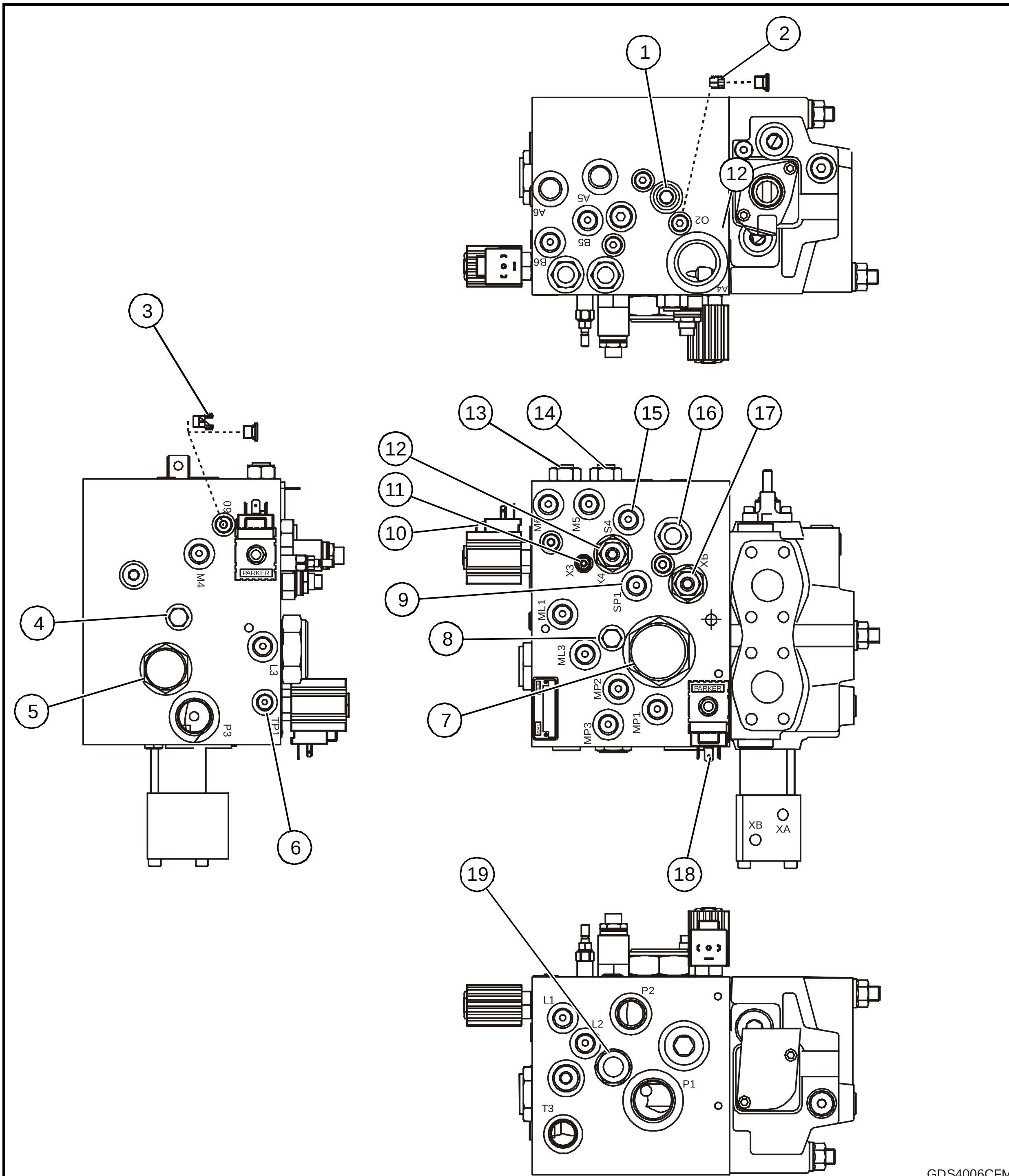
Install accumulator.

Connect hydraulic lines.

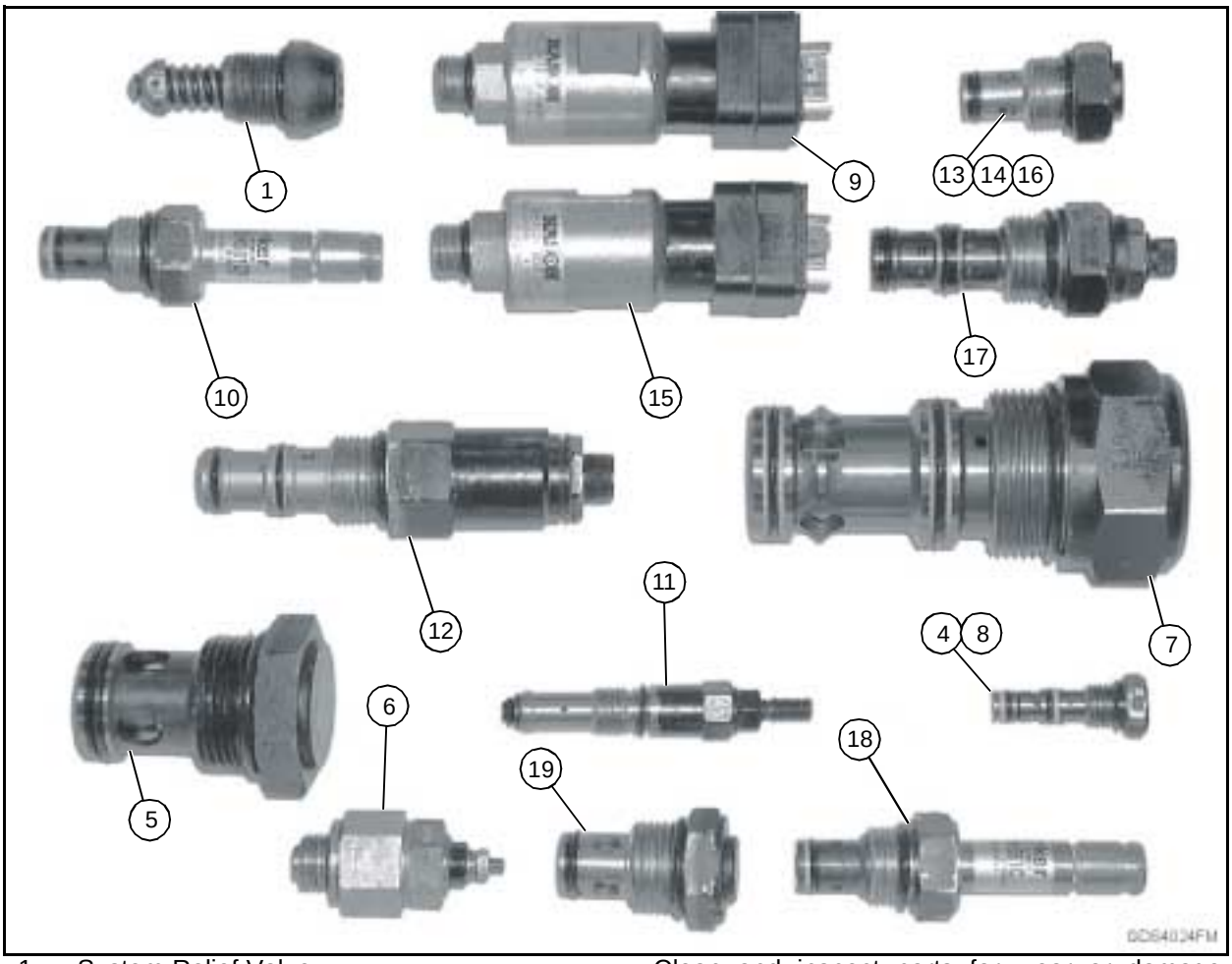
Connect electrical harness.

Fill hydraulic reservoir and Check Hydraulic Oil Level. **(See Operator's Manual, CHAPTER 16, SECTION 1).**

Disassemble and Assemble Hydraulic System Manifold



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1. System Relief Valve.
2. Orifice 2.5 mm.
3. Orifice 0.7 mm.
4. Shuttle Valve.
5. Check Valve.
6. Hydraulic Temperature Sensor.
7. Priority Valve.
8. Shuttle Valve.
9. Pressure Switch.
10. Solenoid Valve.
11. Relief Valve.
12. Accumulator Charge Valve.
13. Check Valve.
14. Check Valve.
15. Pressure Switch.
16. Check Valve.
17. Pressure Reducing Valve.
18. Solenoid Valve.
19. Check Valve.

Disassemble hydraulic system manifold as shown.

⚠ CAUTION

Replace all backup rings and O-rings. Old backup rings and O-rings will leak.

Clean and inspect parts for wear or damage. Replace as necessary.

NOTE: Apply petroleum jelly to backup rings and O-rings before installation. Apply clean hydraulic oil to all internal parts before assembling.

Assemble parts (1 - 19). Tighten all components to specification.

Disassemble and Assemble Hydraulic System Manifold Specification

System Relief Valve Torque - - - - - - - - 60 Nm (44 lb-ft)
Orifice (2) 2.5 mm Torque - - - - - - - - - 3 Nm (27 lb-in.)
Orifice (3) 0.7 mm Torque - - - - - - - - - 3 Nm (27 lb-in.)
Shuttle Valve (4 and 8) Torque - - - - - 10 Nm (89 lb-in.)
Check Valve (5) Torque - - - - - - - - - - 100 Nm (70 lb-ft)
Priority Valve Torque - - - - - - - - - - - 140 Nm (103 lb-ft)
Solenoid Valve (10 and 18) Torque - - - 30 Nm (22 lb-ft)
Relief Valve Torque - - - - - - - - - - - - - 30 Nm (22 lb-ft)
Accumulator Charge Valve Torque - - - 60 Nm (44 lb-ft)
Check Valve (13, 14 and 16) Torque - - 30 Nm (22 lb-ft)
Pressure Reducing Valve Torque - - - - 60 Nm (44 lb-ft)
Check Valve (19) Torque - - - - - - - - - - 65 Nm (48 lb-ft)

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CHAPTER 15. PNEUMATIC SYSTEMS

SECTION 1. PUMPS AND DRIVES

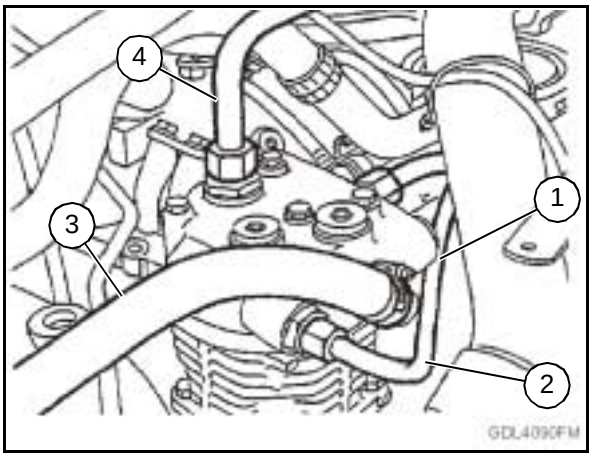
AIR COMPRESSOR

Remove and Install Air Compressor

Remove fuel supply pump. **(See "REMOVE AND INSTALL FUEL SUPPLY PUMP" on page 163).**

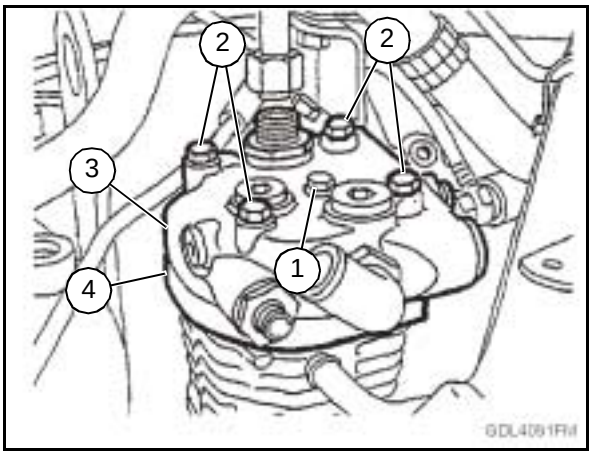
Remove timing case cover and discard gasket. **(See "Remove and Install Timing Case Cover" on page 115).**

Remove Cylinder Head And Intermediate Plate Assemblies



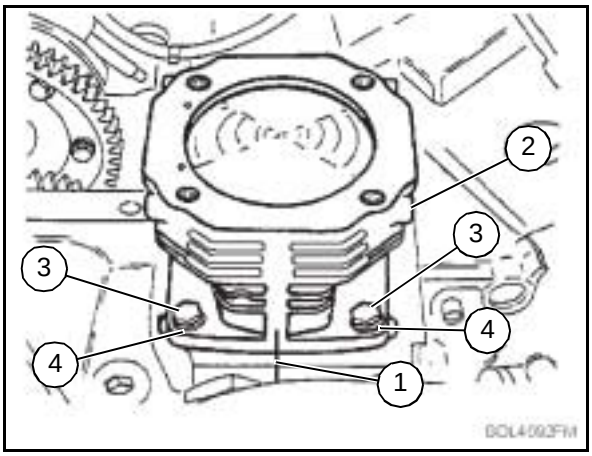
Disconnect coolant supply line (1) and coolant return line (2). Close all openings with caps and plugs.

Disconnect compressed air line (3) and suction line (4).



Remove cap screws (1 and 2). Remove cylinder head and intermediate plate assembly (3 and 4).

Remove Cylinder

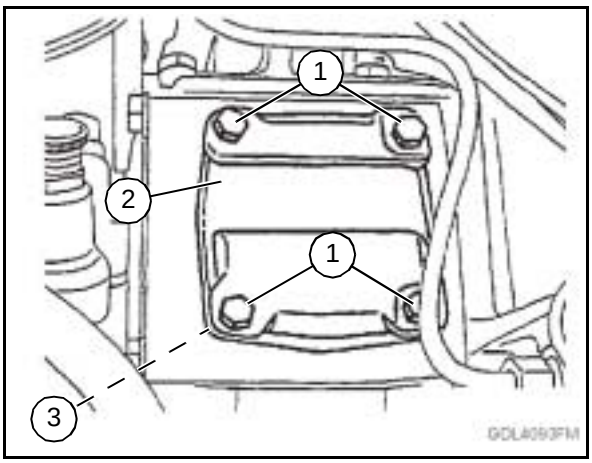


Scribe a line (1) to mark position of cylinder (2) relative to engine block.

Remove cap screws and washers (3 and 4).

Remove cylinder (2).

Remove Side Cover



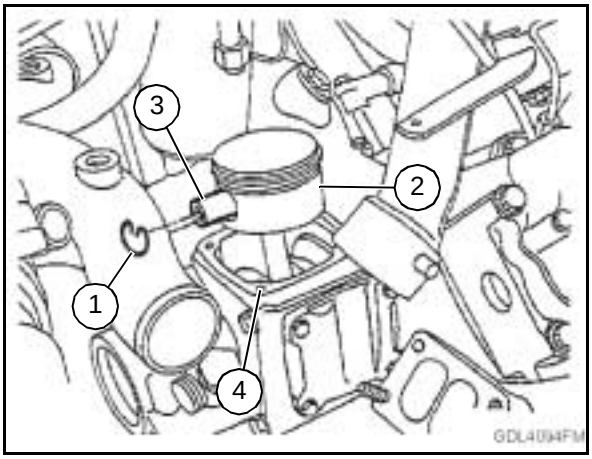
Remove cap screws (1).

Remove side cover (2).

Remove and discard gasket (3).

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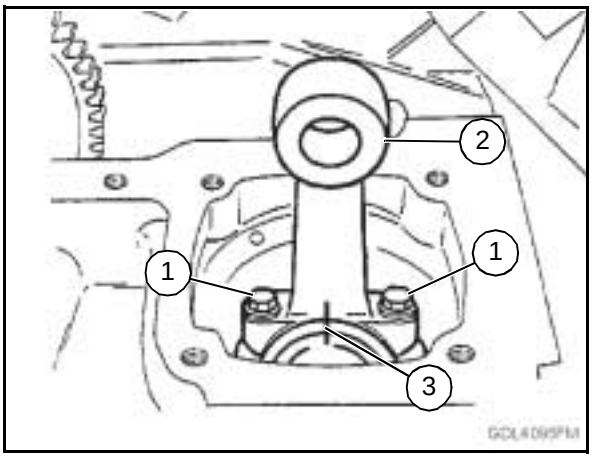
Remove Piston And Connecting Rod



Remove snap rings (1) from piston (2).

Press out piston pin (3). Remove piston (2) from connecting rod.

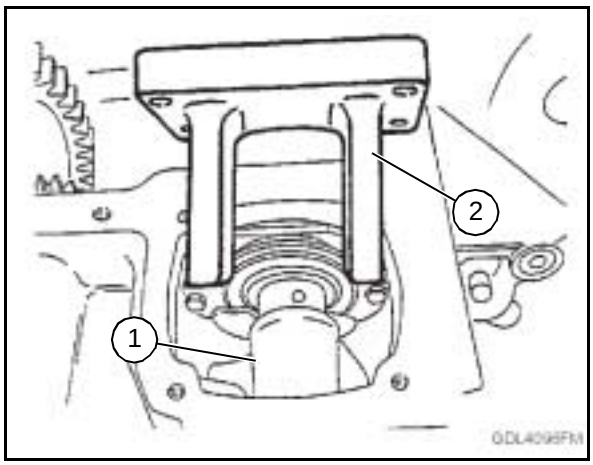
Remove and discard gasket (4).



Scribe a line (3) to mark position of connecting rod bearing relative to connecting rod and connecting rod bearing cap (2).

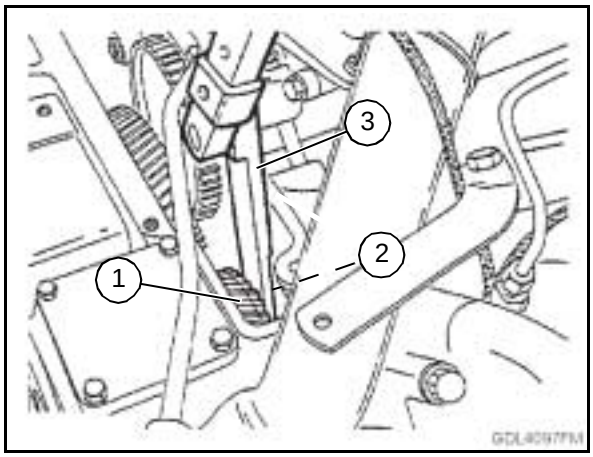
Remove cap screws (1). Remove connecting rod and connecting rod bearing cap (2).

Remove Drive Gear



Rotate crankshaft until crank pin points up.

Install JDG1500-39 Air Compressor Crankshaft Blocker (2) over crankshaft (1). Tighten cap screws.



Remove cap screw (2) on air compressor drive gear (1) using JDG1500-40 Drive Gear Wrench (3).

Remove drive gear.

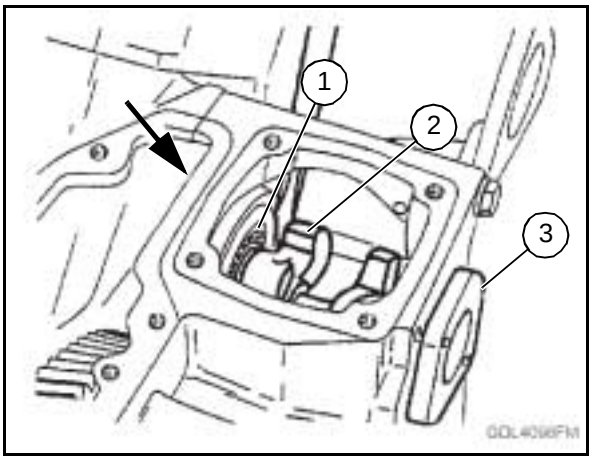
Remove JDG1500-39 Air Compressor Crankshaft Blocker.

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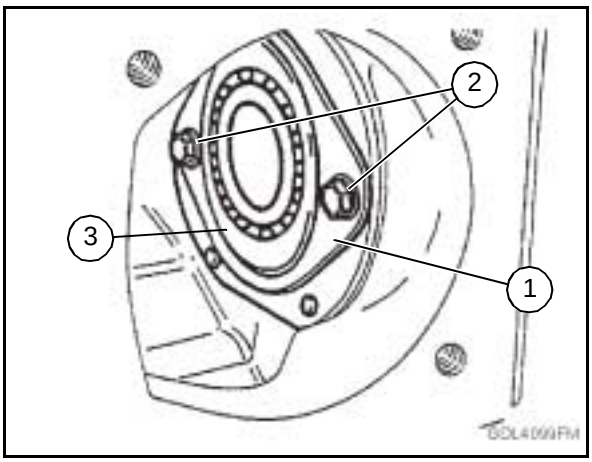
Remove Crankshaft And Bearings

⚠ CAUTION

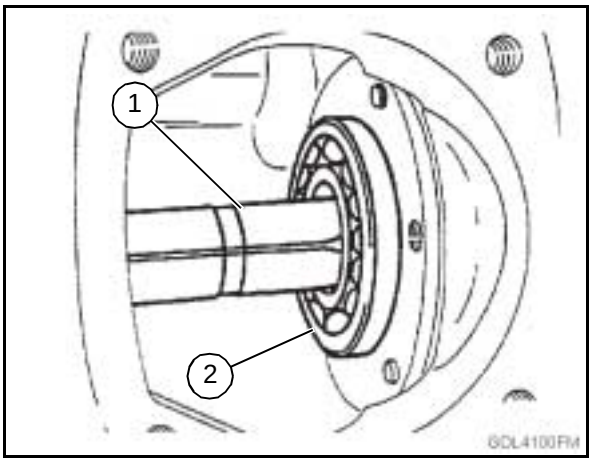
When removing the crankshaft, secure roller bearing inner ring in the timing case (arrow), to prevent it from falling out.



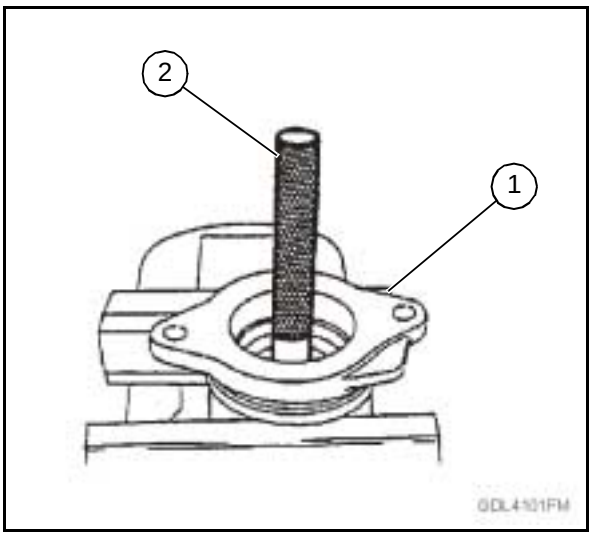
Remove flange (3) and crankshaft (2).



Remove cap screws (2) and bearing flange (1).



Using a bearing removal tool (1), remove bearing (2).

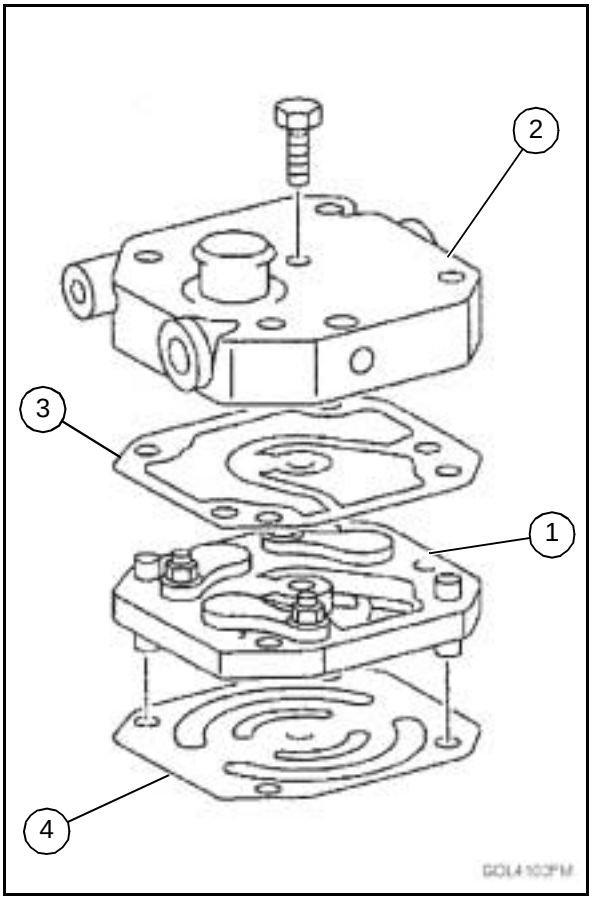


Remove O-ring from flange (1).

Using a bushing removal tool (2), remove bushing from flange (2).

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Inspect Piston Head And Intermediate Plate Assembly



Remove intermediate plate (1) from cylinder head (2).

Remove and discard intermediate plate gasket (3).

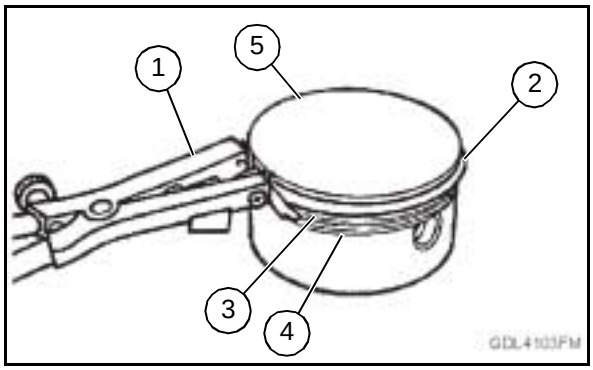
Remove and discard cylinder head gasket (4).

Inspect and replace components as necessary.

Inspect Cylinder Liner, Piston, Connecting Rod, And Crankshaft Assemblies

⚠ CAUTION

Pistons and cylinder liners are marked B, C, or D, based on diameter tolerance ranges. Always use pistons and cylinder liners with matching letter markings.



Using a piston ring expander (1), remove rings (2, 3, and 4) from piston (5).

Measure cylinder liner bore ID.

Remove and Install Air Compressor Specification

Cylinder Liner, Marking B ID - 100.000 - 100.010 mm (3.93700 - 3.93739 in.)

Cylinder Liner, Marking C ID - 100.010 - 100.020 mm (3.93739 - 3.93778 in.)

Cylinder Liner, Marking D ID- 100.020 - 100.030 mm (3.93778 - 3.93818 in.)

Measure piston OD 90° from piston pin bore.

Remove and Install Air Compressor Specification

Piston, Marking B OD - 99.925 - 99.935 mm (3.93404 - 3.93444 in.)

Piston, Marking C OD - 99.935 - 99.945 mm (3.93444 - 3.93483 in.)

Piston, Marking D OD - 99.945 - 99.955 mm (3.93483 - 3.93522 in.)

Measure pin bore ID on piston and pin OD. Subtract OD from ID to obtain clearance measurement.

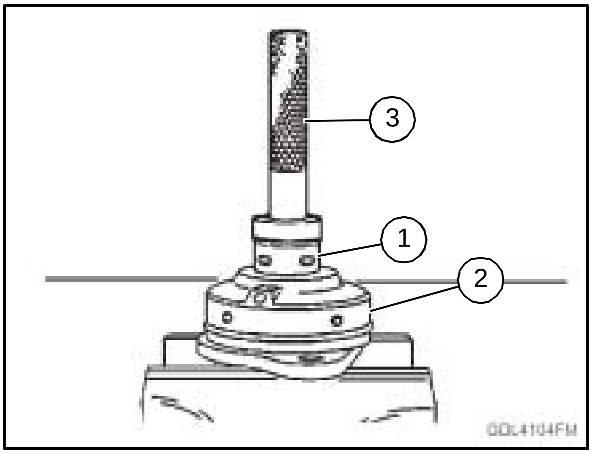
Remove and Install Air Compressor Specification

Piston Pin-to-Pin Bore Clearance - 0.003 - 0.012 mm (0.0001 - 0.0004 in.)

Replace parts as necessary.

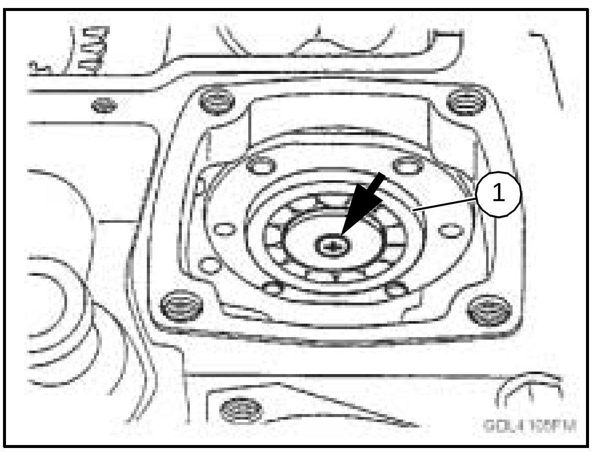
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Install crankshaft and bearings



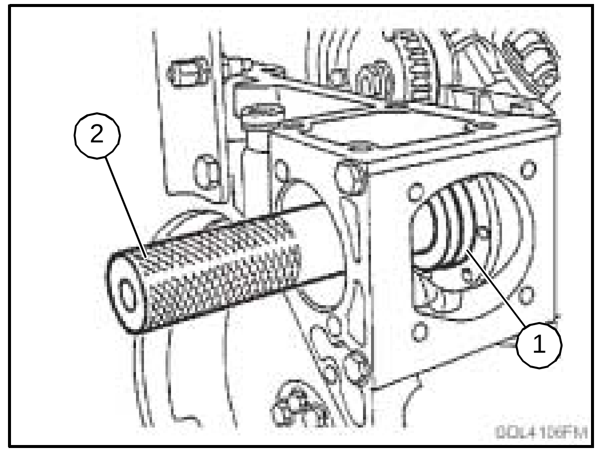
Align oil holes in bushing (1) with holes in bearing flange (2).

Using bearing installation tool (3), install bushing (1) into bearing flange (2).



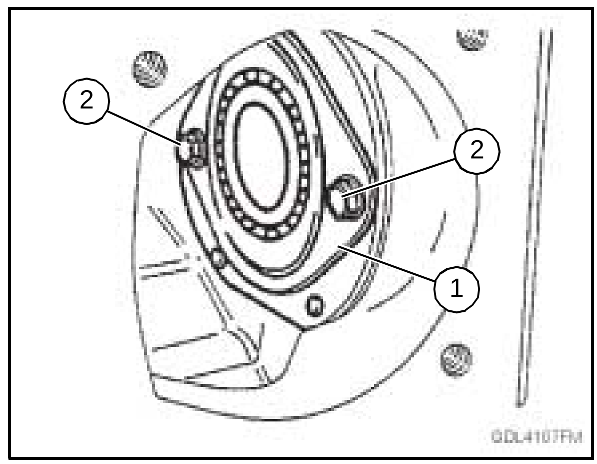
Install two cupped washers (arrow) on inner bearing (1) to protect bearing.

Install bearing so inner ring and collar face fan.



Using bearing installation tool (53), install roller bearing (31) into bearing cap.

Remove cupped washers from bearing.



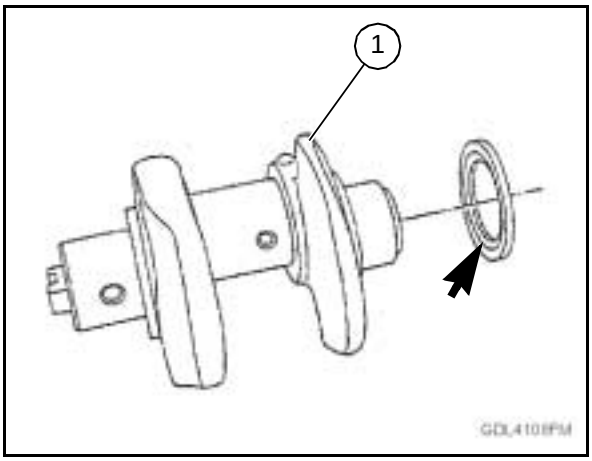
Install bearing flange (1).

Tighten cap screws (2) to specification.

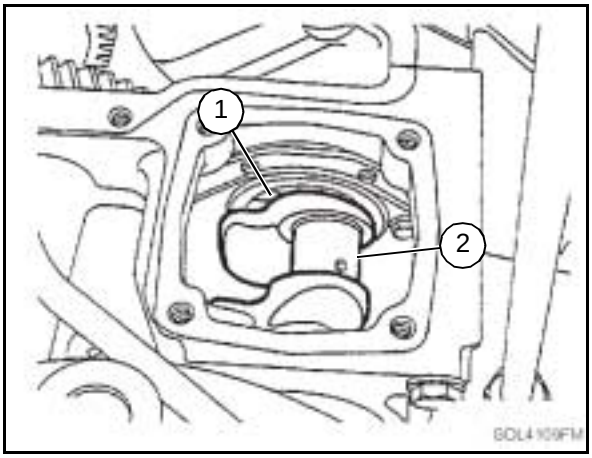
Remove and Install Air Compressor Specification

Inner Bearing Cap Cap Screw Torque --- 50 Nm (37 lb-ft)

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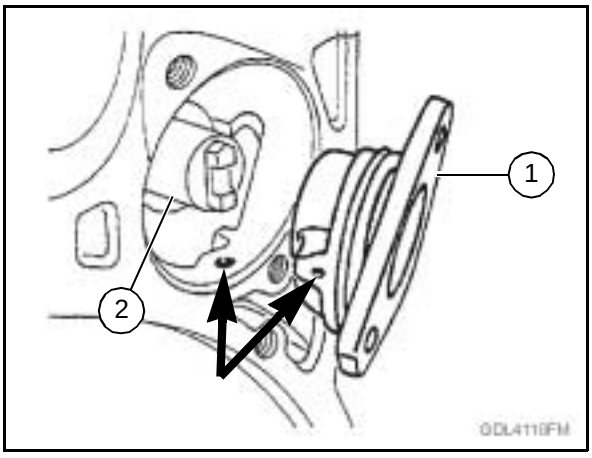
Install bearing washer (arrow) onto crankshaft (1) with chamfer facing crank pin.



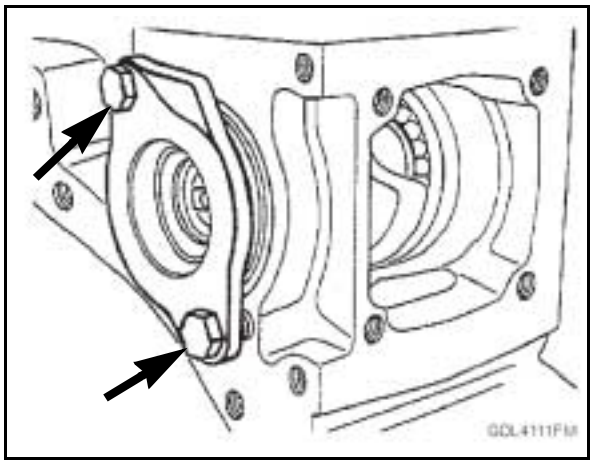
Position roller bearing (1) inner ring and install crankshaft (2).

Lubricate new O-ring and install O-ring onto bearing flange.

Lubricate bearing pilot on flange.

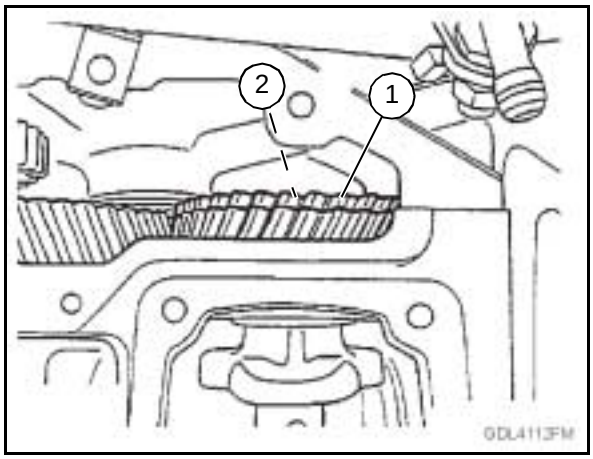


Align oil hole (arrow) on flange (1) to oil hole on housing. Install flange (1) onto crankshaft (2).



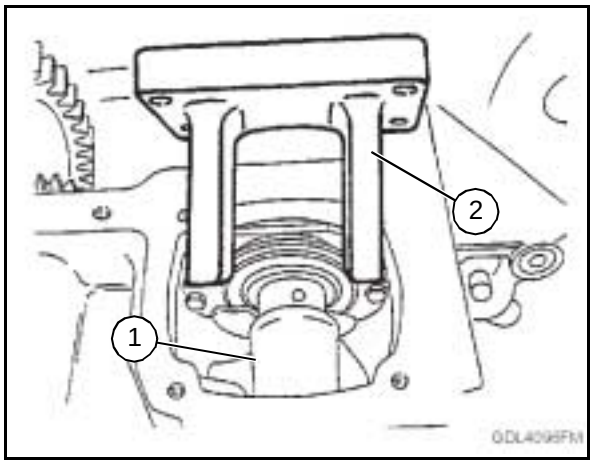
Tighten cap screws (arrows) evenly to seat bearing flange. Remove cap screws. Install caps screws evenly again.

Install Drive Gear



Install drive gear (1). Hand-tighten cap screw (2).

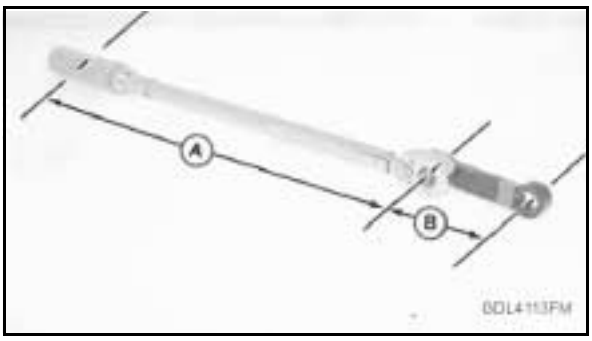
Rotate crankshaft until crank pin points up.



Install JDG1500-39 Air Compressor Crankshaft Blocker (2) over crankshaft (1). Tighten cap screws.

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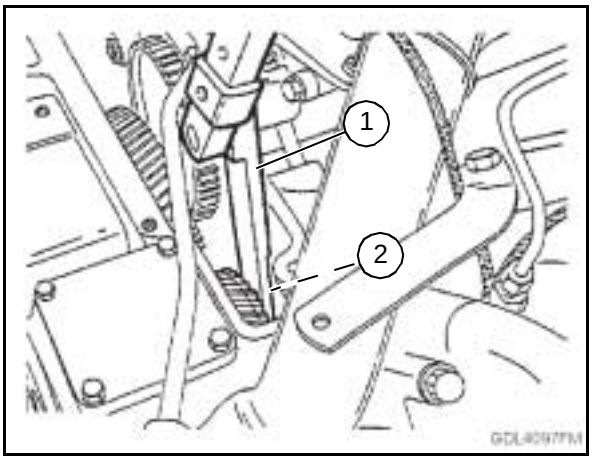
NOTE:If an adapter is fastened to the square drive of a torque wrench, it adds to the leverage distance of the wrench. In this case, the real torque applied is greater than the torque indicated by the torque wrench. Use the formula below to determine the correct torque wrench reading for the intended torque specification.



A. Leverage Distance of Torque Wrench
B. Leverage Distance of Adapter

Torque Reading on = Torque Specification x Wrench A +B

NOTE:1. Leverage distance of torque wrench is measured from center of handle to center of square drive. Leverage distance of wrench with adapter is measured parallel to beam of wrench, from center of handle to center of adapter head.
2. Always measure leverage distance parallel to beam of wrench. If wrench and adapter are assembled at an angle, leverage distance will be shorter. If adapter is assembled at 90° to beam of wrench, it does not affect leverage distance.



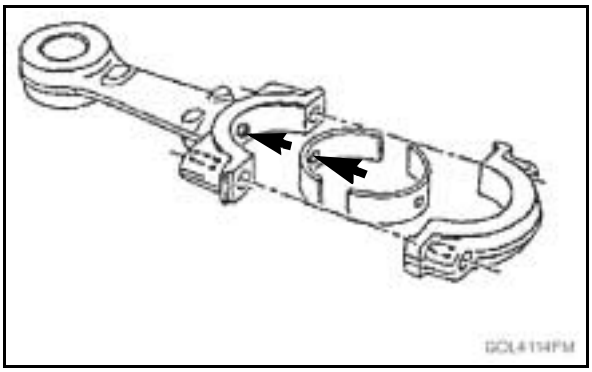
Using a torque wrench and JDG1500-40 Drive Gear Wrench (1), tighten cap screw (2) to specification.

Remove and Install Air Compressor Specification

Drive Gear Cap Screw Torque- 360 Nm (266 lb-ft) actual

Remove JDG1500-39 Air Compressor Crankshaft Blocker.

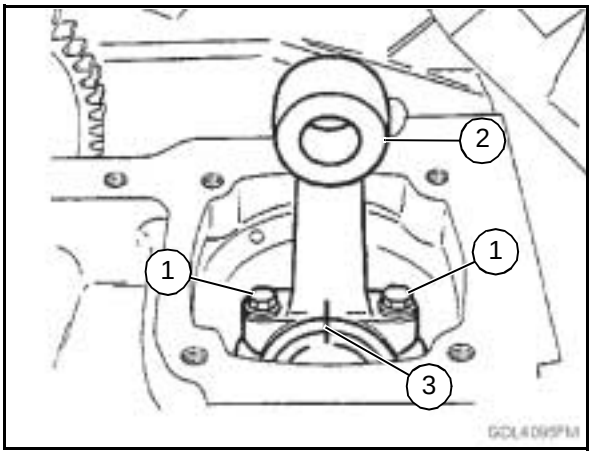
Install Connecting Rod And Piston



Lightly coat connecting rod bearings with clean oil. Install bearings into connecting rod bearing cap and connecting rod.

Ensure that oil holes (arrows) in connecting rod bearing and connecting rod align. Ensure the markings on connecting rod cap and connecting rod align.

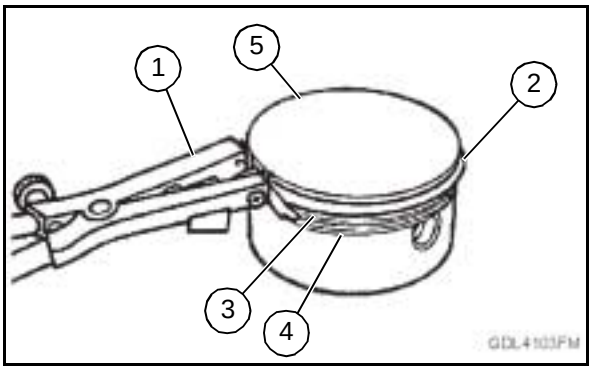
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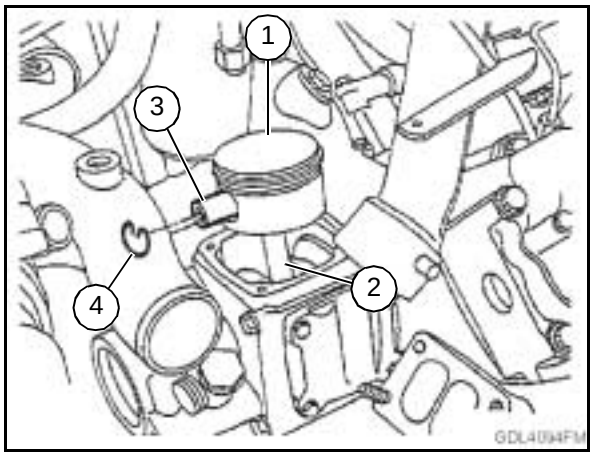
Install connecting rod (2) on crankshaft. Install cap screws (1). Tighten cap screws (1) to specification.

Remove and Install Air Compressor Specification

Connecting Rod Cap Screw Torque- 30 Nm (22 lb-ft)



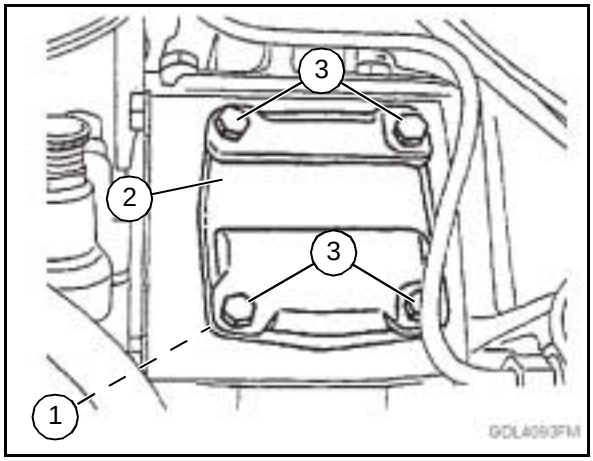
Use a piston ring expander (1) to install rings (2, 3, and 4) onto piston (5). Compression rings (3 and 4) must be installed bevel-side down.



Install piston (1) on connecting rod (2).

Lightly coat piston pin (3) with oil. Install pin. Install snap rings (4).

Install Side Cover



Install new side cover gasket (1).

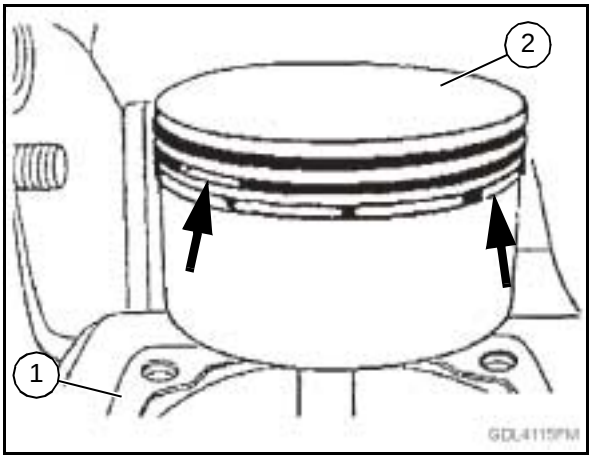
Install side cover (2). Tighten cap screws (3) to specification.

Remove and Install Air Compressor Specification

Side Cover Cap Screw Torque - - - - - - 50 Nm (37 lb-ft)

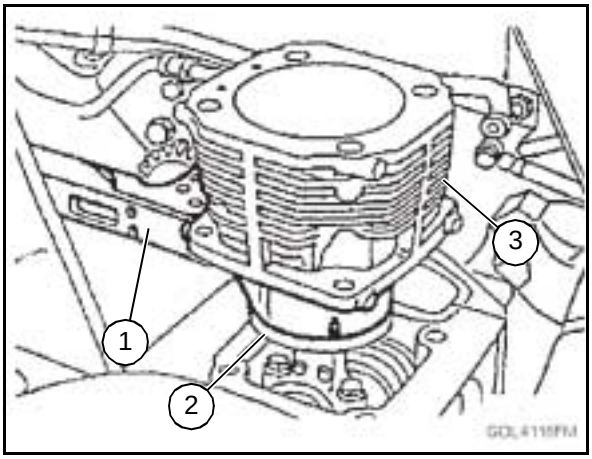
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Install Cylinder Liner



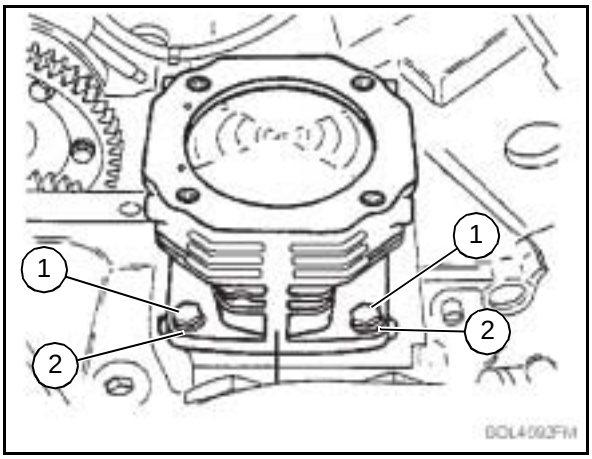
Install new cylinder liner gasket (1) onto timing case.

Lightly coat piston (2) with oil. Offset piston ring gaps by 120° (arrows).



Use a ring compressors tool (1) to compress piston rings to OD of piston (2).

Lightly coat inside of cylinder (3) with clean oil. Push cylinder (3) over piston (2). Remove ring compressor tool (1).

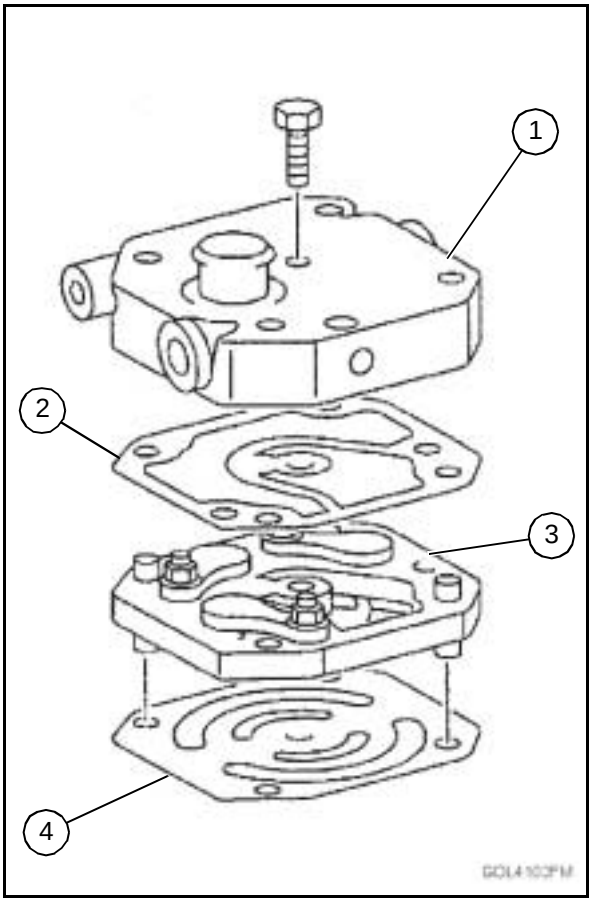


Install cap screws and washers (1 and 2). Tighten cap screws to specification.

Air Compressor Specification

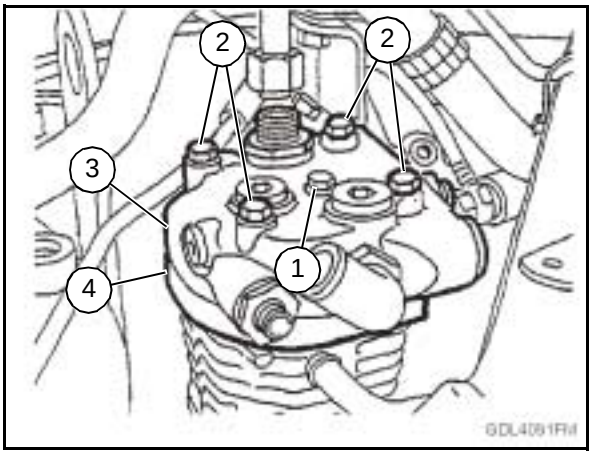
Cylinder Liner Cap Screw Torque - - - -40 Nm (30 lb-ft)

Install Cylinder Head And Intermediate Plate Assembly



Assemble cylinder head (1), intermediate plate gasket (2), intermediate plate (3), and cylinder head gasket (4). Ensure wording “Top” on head gasket (4) is toward the cylinder head (1).

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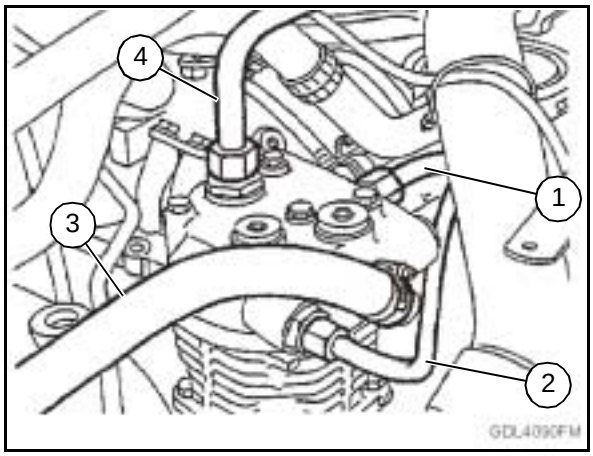


Install cylinder head and intermediate plate assembly (3 and 4). Tighten cap screws (1 and 2) to specification.

Remove and Install Air Compressor Specification

Cylinder Head-to-Cylinder Liner Cap Screw Torque - 40 Nm (30 lb-ft)

Cylinder Head-to-Intermediate Plate Cap Screw Torque - 12 Nm (9 lb-ft)



Connect compressed air line (4). Connect suction line (3).

Connect coolant supply line (1) and coolant return line (2).

Install new timing case cover gasket. Install timing case cover. **(See “Remove and Install Timing Case Cover” on page 115).**

Install fuel supply pump. **(See “REMOVE AND INSTALL FUEL SUPPLY PUMP” on page 163).**

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CHAPTER 15. PNEUMATIC SYSTEMS

SECTION 2. CONTROL VALVES

PNEUMATIC MANIFOLD

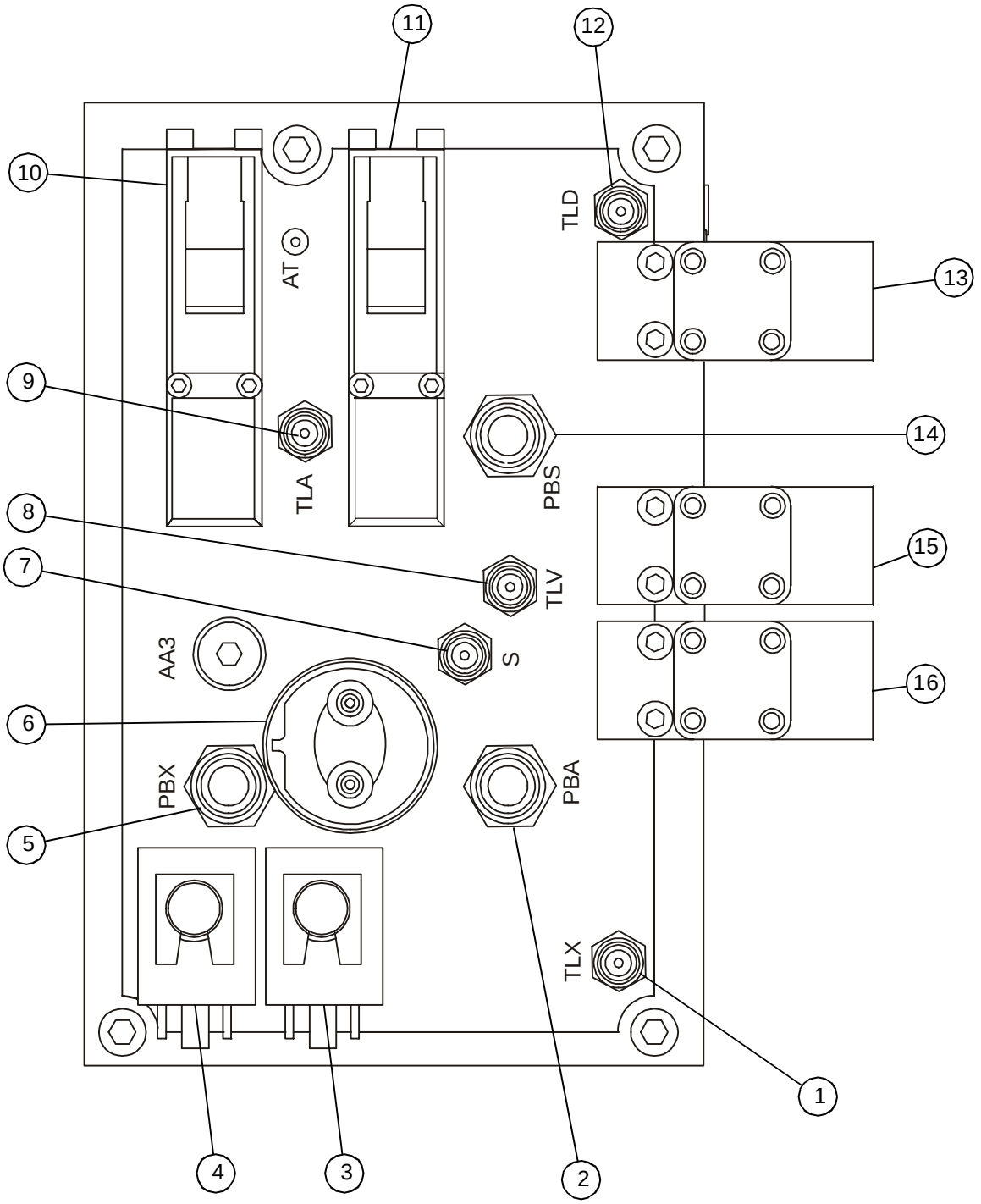
Remove and Install Pneumatic Manifold

Turn off battery disconnect switch. **(See Battery Disconnect Switch and Battery Circuit Breaker Operator's Manual, CHAPTER 2, SECTION 3).**

Relieve Pneumatic Pressure **(Operator's Manual, CHAPTER 7, SECTION 1).**

Open cab right-side compartment door.

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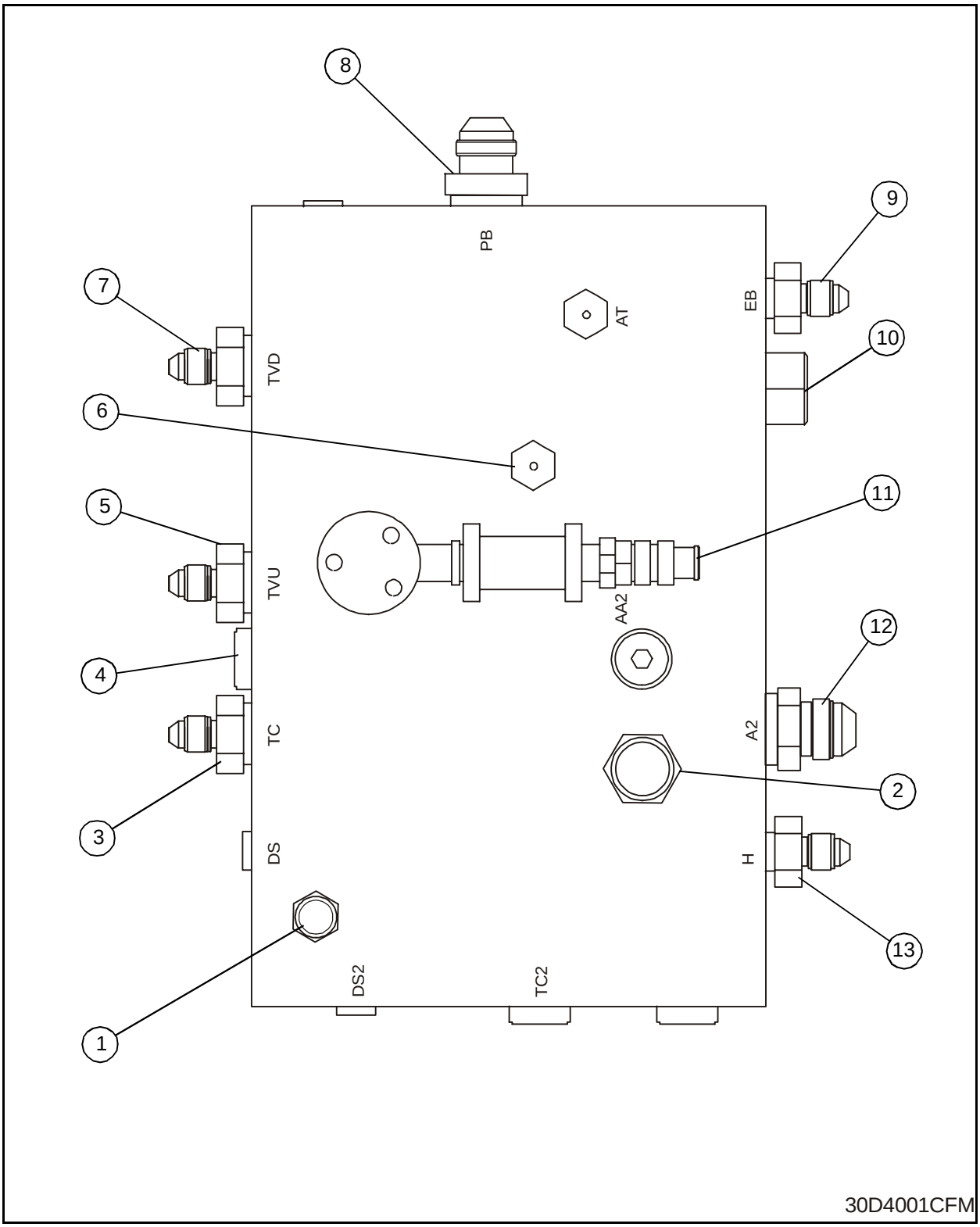
1. Body Pilot Control Valve Exhaust.
2. Park Brake Supply.
3. Inter-Axle Lock Solenoid.
4. Air Horn Solenoid.
5. Park Brake Exhaust.
6. System Air Pressure Sensor.
7. Seat Valve Supply.
8. Body Pilot Control Valve Up.
9. Body Pilot Control Valve Supply.
10. Exhaust Brake Solenoid.
11. Park Brake Solenoid.
12. Body Pilot Control Valve Down.
13. Park Brake Pressure Switch.
14. Park Brake Supply.
15. Body Up Pressure Switch.
16. Inter-Axle Lock Pressure Switch.

Disconnect wiring connectors from solenoids (3, 4, 10, and 11), sensor (6), and switches (13, 15, and 16).

Remove switches (13, 15, and 16), if necessary.

Remove socket head cap screws. Push manifold forward through cab wall.

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1. Body Pilot Control Valve Exhaust.
2. Park Brake Exhaust.
3. Inter-Axle Lock.
4. Park Brake Check Valve.
5. Body Pilot Control Valve Up.
6. Park Brake Exhaust Orifice.
7. Body Pilot Control Valve Down.
8. Park Brake.
9. Exhaust Brake.
10. Exhaust Brake Exhaust.
11. Quick Coupler.
12. Pneumatic System Supply.
13. Air Horn.

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Disconnect air lines (3, 5, 7 - 10, 12, and 13) from sides of manifold.

Disconnect remaining air lines from rear of manifold.

Inspect, repair, and replace parts as necessary.

Connect air lines to rear of manifold.

Connect air lines to sides of manifold.

Install manifold in cab wall and install socket head cap screws.

Install switches on rear of manifold, if removed.

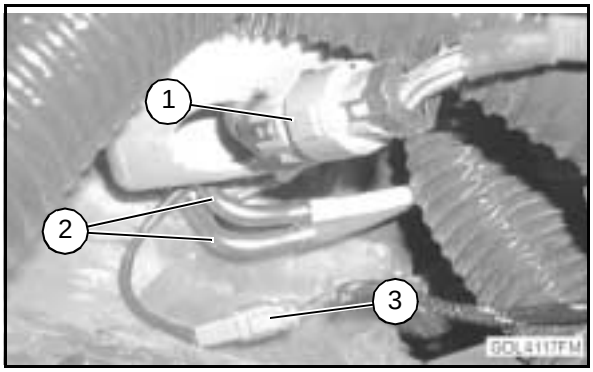
Install wiring connectors on rear of manifold.

Remove and Install Park Brake Control Valve

Turn off battery disconnect switch. **(See Battery Disconnect Switch and Battery Circuit Breaker Operator's Manual CHAPTER 2, SECTION 3).**

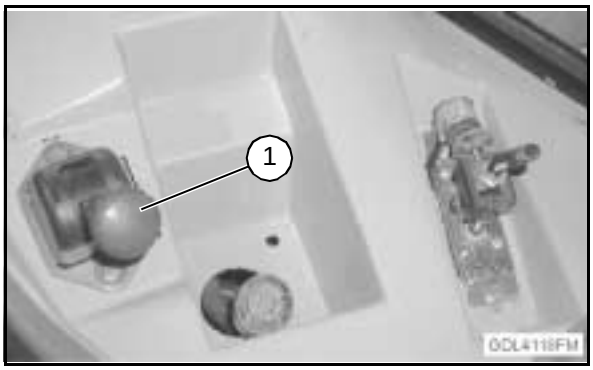
Relieve Pneumatic Pressure **(Operator's Manual CHAPTER 7, SECTION 1)**.

Open cab right-side compartment door.



Disconnect air lines (2) and wiring connectors (1 and 3).

Remove panel from dashboard.



Remove park brake control lever (1).

Inspect, repair, and replace parts as necessary.

Install lever.

Install panel on dashboard.

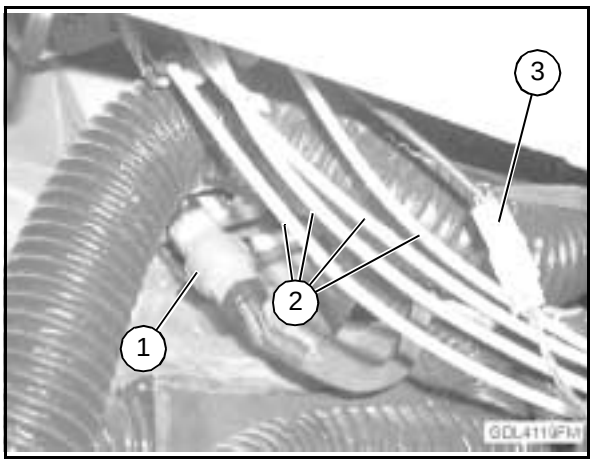
Connect wiring connectors and air lines.

Remove and Install Bin Tip Control Valve

Turn off battery disconnect switch. **(See Battery Disconnect Switch and Battery Circuit Breaker Operator's Manual CHAPTER 2, SECTION 3).**

Relieve Pneumatic Pressure **(Operator's Manual CHAPTER 7, SECTION 1).**

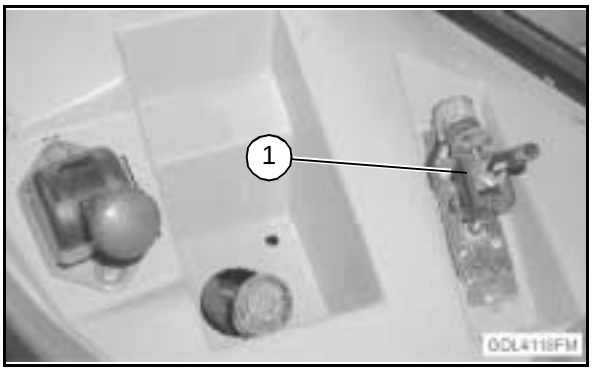
Open cab right-side compartment door.



Disconnect air lines (2) and wiring connectors (1 and 3).

Remove panel from dashboard.

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Remove body tip control lever (1).

Inspect, repair, and replace parts as necessary.

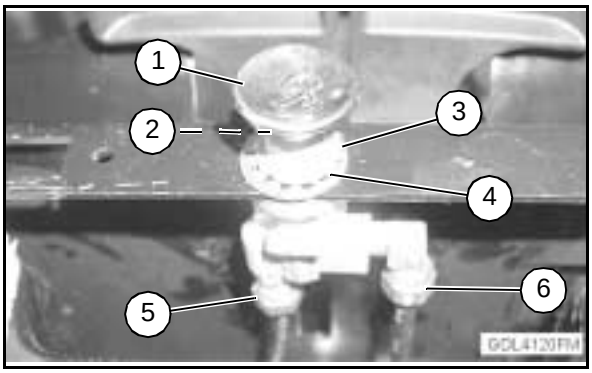
Install lever.

Install panel on dashboard.

Connect wiring connectors and air lines.

Remove and Install Seat Control Valve

Relieve Pneumatic Pressure **(Operator's Manual CHAPTER 7, SECTION 1).**



Disconnect air inlet line (5) and air spring line (6).

Loosen set screw (2) and remove knob (1).

Remove nut (3) and washer (4). Remove valve.

Replace components as necessary.

Install valve, washer, and nut.

Install knob. Tighten set screw.

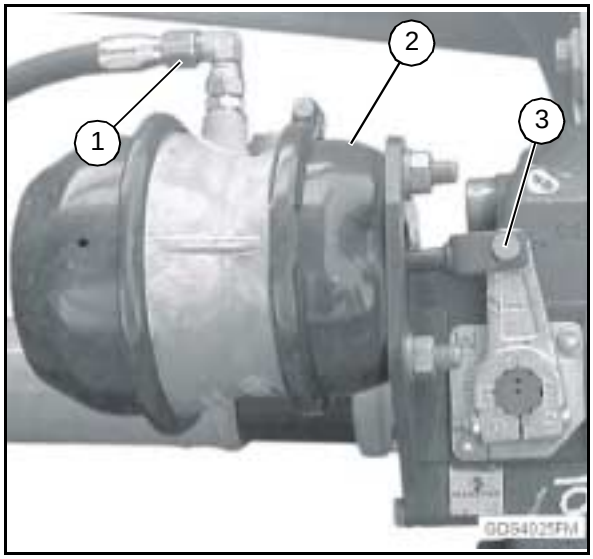
Connect lines.

Remove and Install Park Brake Actuator

Install Dump Body Prop **(Operator's Manual CHAPTER 7, SECTION 1).**

Relieve Pneumatic Pressure **(Operator's Manual CHAPTER 7, SECTION 1).**

Release park brake. **(See Mechanically Releasing Park Brake Section Operator's Manual,CHAPTER 6, SECTION 1).**



Disconnect air line (1).

Remove pin (3).

Remove nuts and washers. Remove actuator (2).

Inspect, repair, and replace parts as necessary.

Install actuator. Install washers and nuts.

Install pin.

Connect air line.

Release park brake. **(See Mechanically Releasing Park Brake, Operator's Manual, CHAPTER 6, SECTION 1).**

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CHAPTER 15. PNEUMATIC SYSTEMS

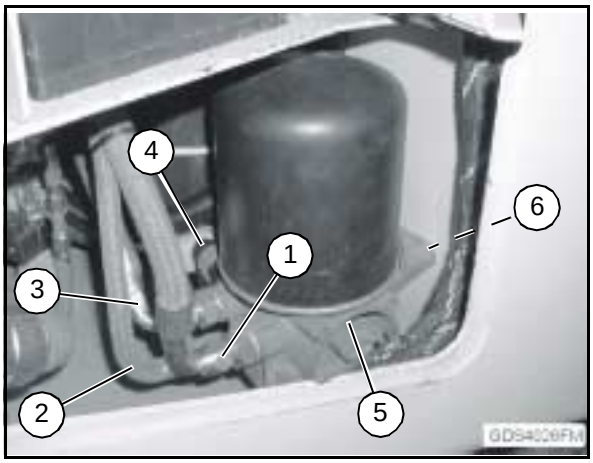
SECTION 3. RESERVOIR, FILTER AND TRAP

AIR UNLOADER VALVE WITH INTEGRAL AIR DRYER

Remove and Install Air Unloader Valve

Turn off battery disconnect switch. **(See Battery Disconnect Switch and Battery Circuit Breaker Operator's Manual CHAPTER 2, SECTION 3).**

Relieve pneumatic pressure. **(See Relieve Pneumatic Pressure Operator's Manual CHAPTER 7, SECTION 1).**



Disconnect heater wire (4).

Disconnect air lines (1 - 3).

Loosen cap screws (6).

Remove unloader valve assembly (5) from machine.

Repair or replace parts as necessary.

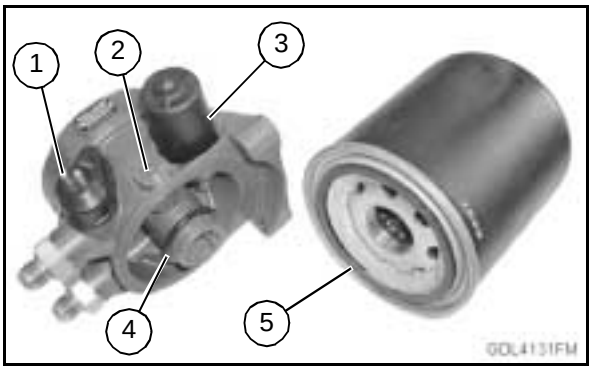
Install unloader valve assembly.

Tighten cap screws.

Connect air lines.

Connect heater wire.

Disassemble and Assemble Air Unloader Valve



Remove element (5) and O-ring (4).

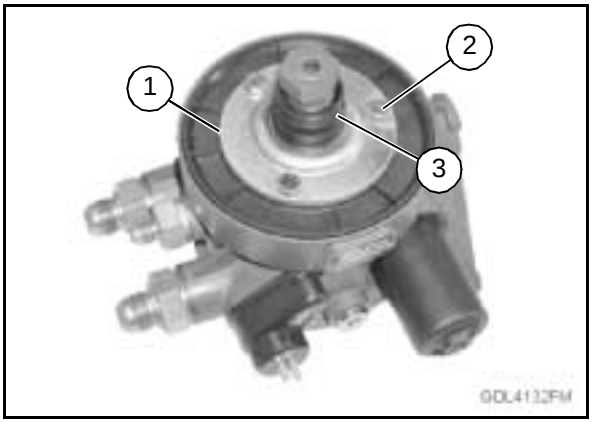
Remove heater and screw (1), if necessary.

Remove plug and sealing ring (2), if necessary.

⚠ CAUTION

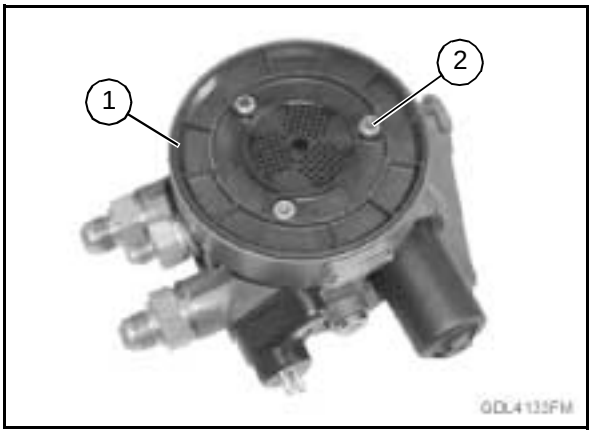
Spring is under load. Hold component securely while removing snap ring.

Remove snap ring and unloader valve spring assembly (3), if necessary.

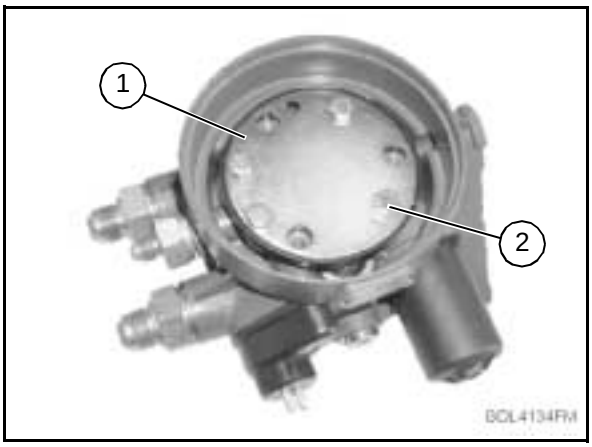


Remove cap screws (1), retaining ring (2), and drain port (3).

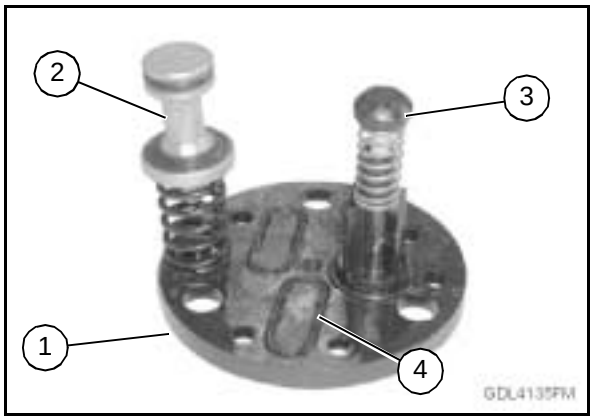
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Remove drain cover (1) and sleeves (2).



Remove cap screws (2) and retaining plate (1).



Remove valve base (1). Remove purging valve and spring (2), check valve and spring (3), and O-rings (4) from valve base.

Clean, repair, or replace parts as necessary.

Install O-rings, check valve and spring, and purging valve and spring on valve base. Install valve base.

Install retaining plate and cap screws.

Install drain cover and sleeves.

Install drain port, retaining ring, and cap screws.

Install unloader valve spring assembly and snap ring, if removed.

Install sealing ring and plug, if removed.

Install heater and screw, if removed.

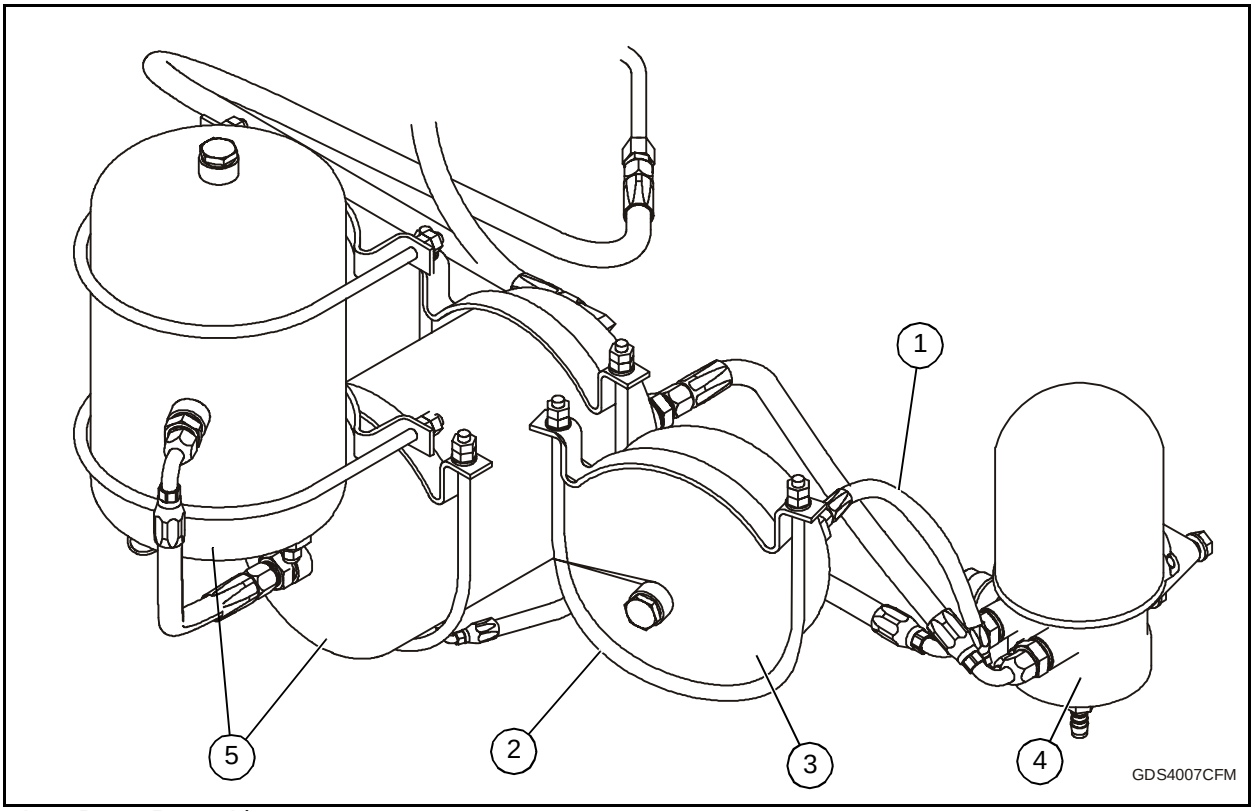
Install O-ring and element.

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Remove and Install Regeneration Air Reservoir

Relieve pneumatic pressure. **(See Relieve Pneumatic Pressure Operator's Manual CHAPTER 7, SECTON 1).**

Remove and Install Transmission Oil-to-Air Cooler **(See "REMOVE AND INSTALL TRANSMISSION OIL-TO-AIR COOLER" on page 157).**



1. Dryer Purge Line.
2. Clamp.
3. Regeneration Air Reservoir.
4. Air Dryer and Unloader Valve.
5. Air Reservoirs.

Disconnect air dryer purge line (1) from regeneration air reservoir (3).

Remove clamp (2) and remove reservoir.

Repair or replace parts as necessary.

Install reservoir and clamp.

Connect air line.

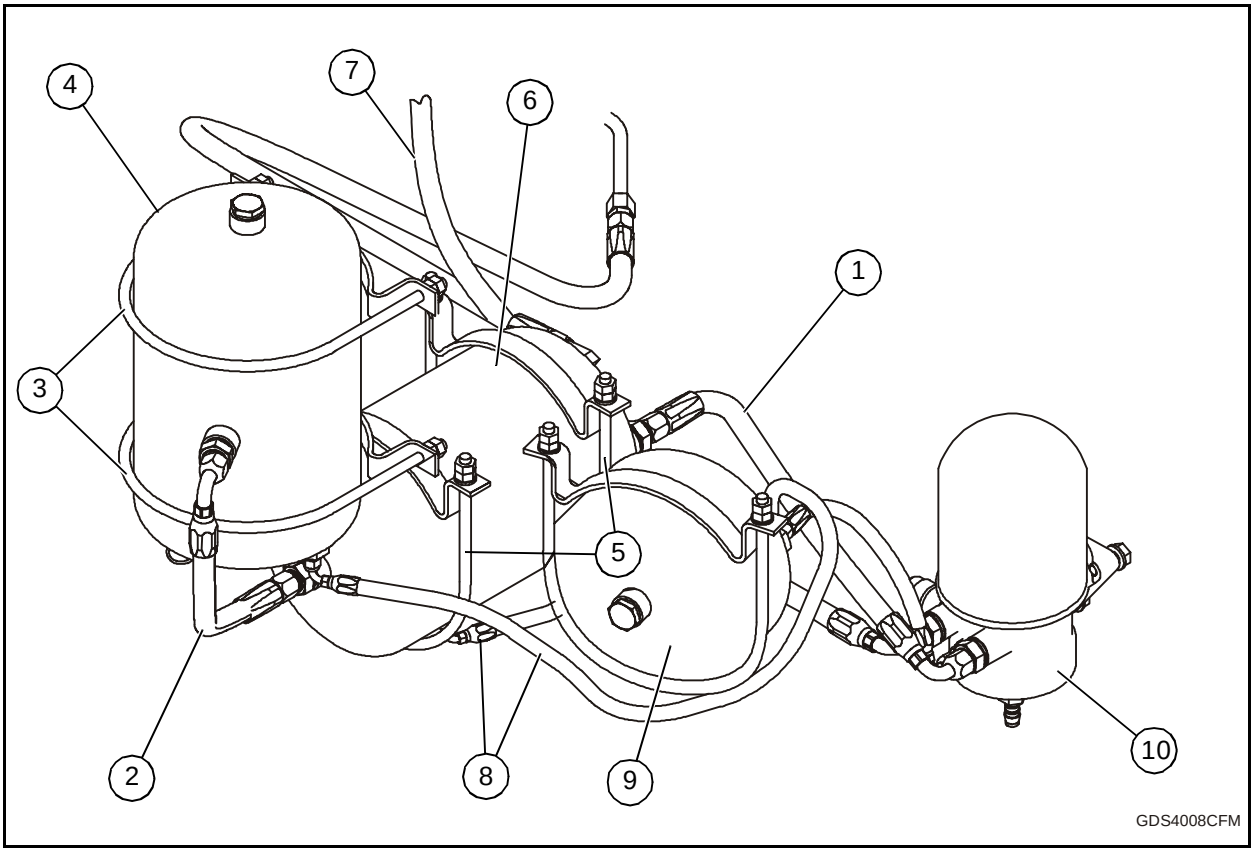
Install transmission oil cooler. **(See "REMOVE AND INSTALL TRANSMISSION OIL-TO-AIR COOLER" on page 157).**

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Remove and Install Air Reservoir

Relieve pneumatic pressure. **(See Relieve Pneumatic Pressure Operator's Manual CHAPTER 7, SECTION 1).**

Remove transmission oil cooler. **(See "REMOVE AND INSTALL TRANSMISSION OIL-TO-AIR COOLER" on page 157).**



1. Line from Air Dryer.
2. Connecting Line.
3. Clamps.
4. Reservoir.
5. Clamps.
6. Reservoir.
7. Line-to-Pneumatic Manifold.
8. Lines-to-Drain Solenoid.
9. Regenertion Air Reservoir.
10. Air Dryer and Unloader Valve.

Disconnect air lines (1and 7) from air reservoir (6).

Remove line (2).

Disconnect drain lines (8) from reservoirs.

Remove clamps (3) and remove reservoir (4).

Remove clamps (5) and remove reservoir (6).

Repair or replace as required.

Install reservoir (6) with clamps (5).

Install reservoir (4) with clamps (3).

Install line (2).

Connect lines (1, 7, and 8).

Install transmission oil cooler. **(See "REMOVE AND INSTALL TRANSMISSION OIL-TO-AIR COOLER" on page 157).**

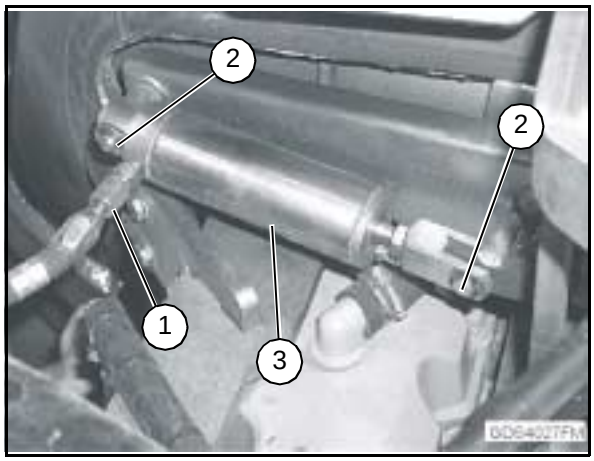
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CHAPTER 15. PNEUMATIC SYSTEMS

SECTION 4. CYLINDERS

REMOVE AND INSTALL EXHAUST BRAKE AIR CYLINDER

Relieve Pneumatic Pressure. **(See Relieve Pneumatic Pressure Operator's Manual CHAPTER 7, SECTION 1).**



Disconnect air line (1).

Remove retaining clips (2).

Remove exhaust brake cylinder (3).

Repair or replace as necessary.

Install cylinder and retaining clips.

Connect air line.

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CHAPTER 16. HAULAGE DEVICE

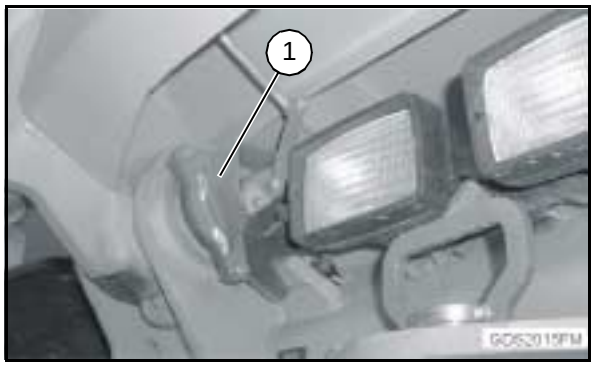
SECTION 1. FRAMES

BIN

Remove and Install Bin

Remove rear turn signals and tail and brake lights. **(See Replace Tail and Brake Light and Rear Turn Signal Operator's Manual CHAPTER 18, SECTION 2).**

Remove wiring harnesses from tail light housings.



Remove tip angle sensor (1) and linkage rod.

Remove body lift cylinders. **(See "BIN TIP CYLINDER" on page 377)**

⚠ CAUTION

Component is heavy. Use hoist.

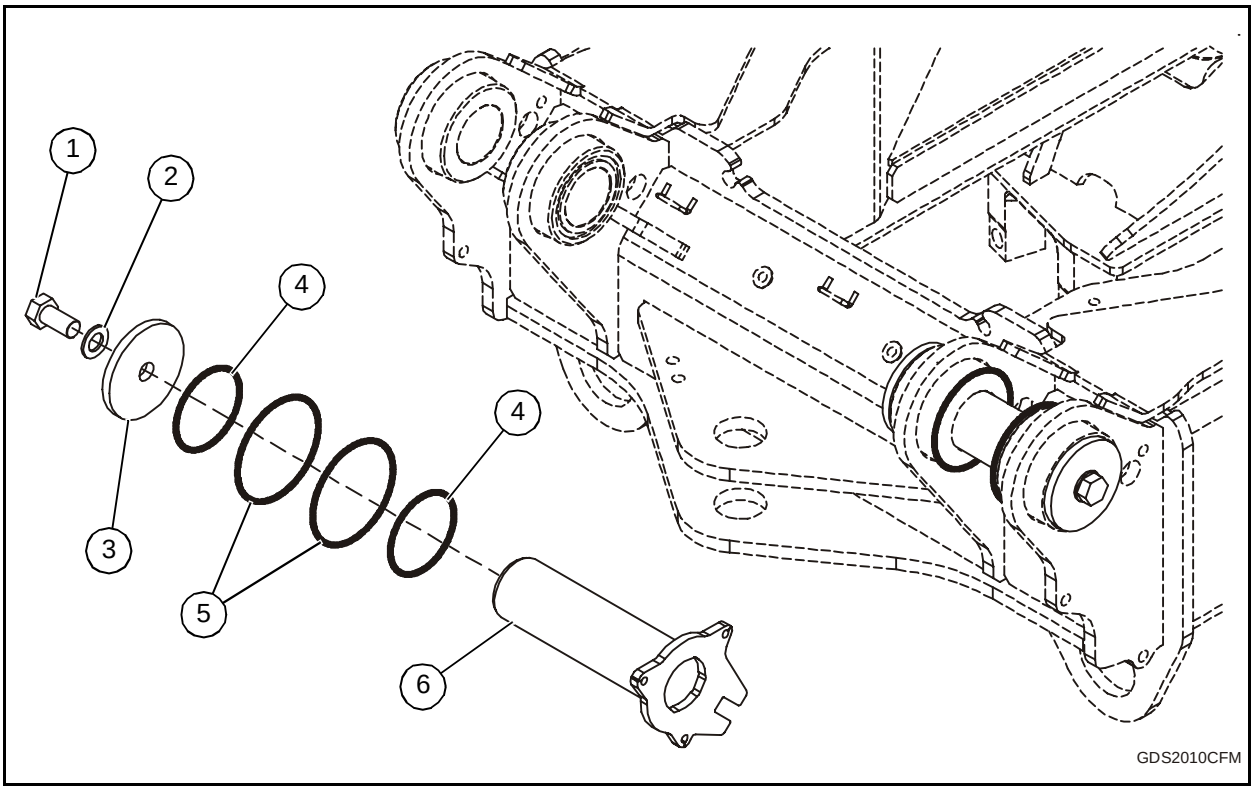
Bin Specification

B25D Bin Weight - - - - - - - - - - - - - - 2747 kg (6056 lb)

B30D Bin Weight - - - - - - - - - - - - - - 2968 kg (6543 lb)

Install lifting device on bin.

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1. Bolt (2 used).
2. Washer (2 used).
3. Retainer Plate (2 used).
4. Outer Seal Ring (4 used).
5. Inner Seal Ring (4 used).
6. Pivot Pin (2 used).

⚠ CAUTION

Avoid machine damage. Do not crush electrical components under rear edge of bin.

Remove pivot pins (6). Remove dump body from machine.

Inspect, clean, and replace hardware as necessary.

Grease pivot pins and bores. Install bin on machine. Install pivot pins.

Install body lift cylinders. **(See "BIN TIP CYLINDER" on page 377).**

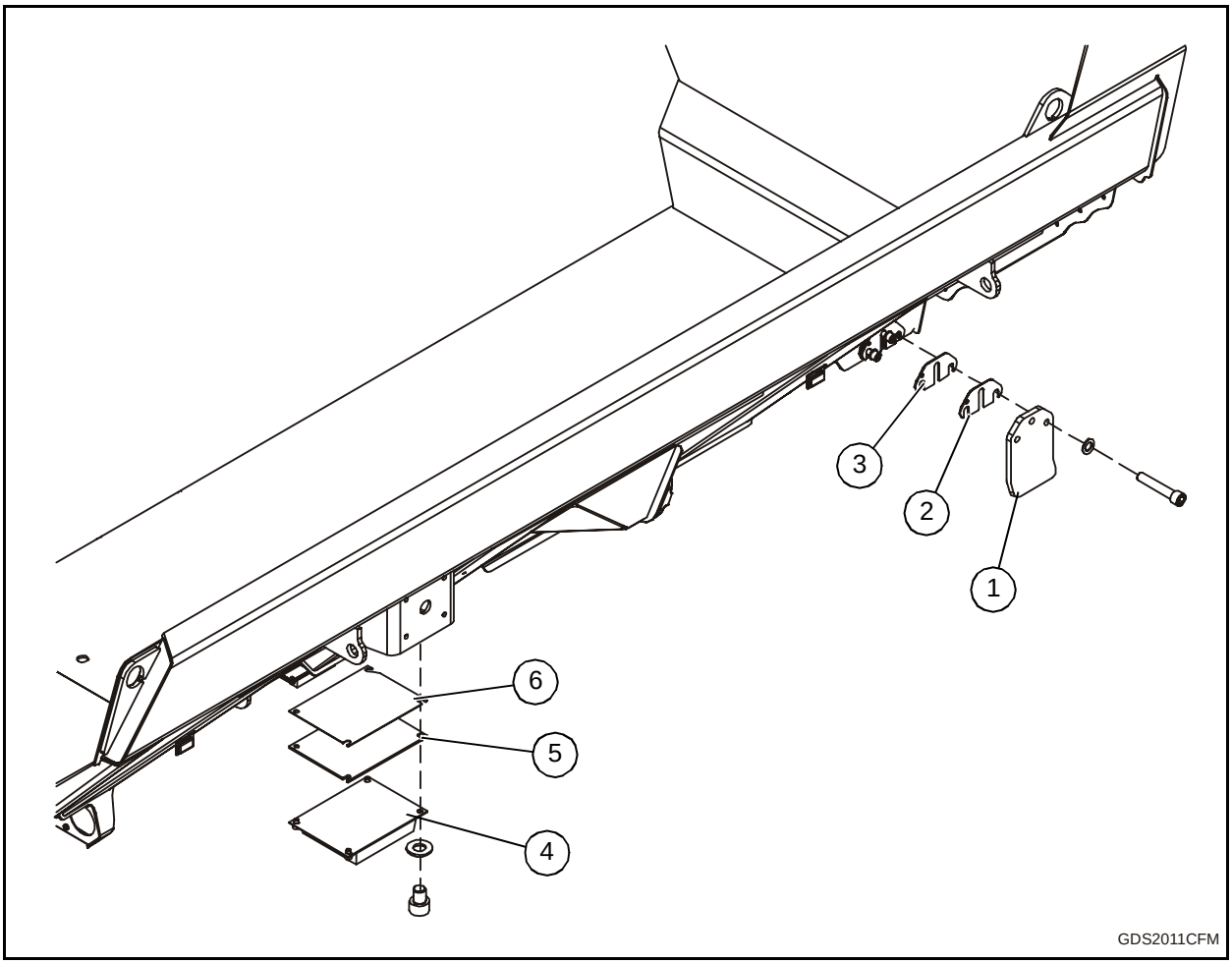
Install tip angle sensor and linkage rod.

Install wiring harnesses into tail light housings.

Install rear turn signals and tail and brake lights. **(See Replace Tail and Brake Light and Rear Turn Signal Operator's Manual, CHAPTER 17, SECTION 2).**

Align bin, if necessary.

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1. Guide Plate (2 used).
2. Guide Plate Shim, 1.6 mm (0.06 in.).
3. Guide Plate Shim, 5 mm (0.20 in.).
4. Support Pad (6 used).
5. Support Pad Shim, 1.6 mm (0.06 in.).
6. Support Pad Shim, 5.0 mm (0.20 in.)..

Align

Remove support pads (4) and shims (5 and 6) from bin. Loosen guide plates (1).

Put steel plates on top of rear frame at all support pad positions.

Body Specification

Steel Plate Thickness - - - - - - - - - - - 38 mm (1.50 in.)

Float bin onto steel plates.

Check for gaps between dump body and each steel plate. Measure and record all gaps.

Raise bin. Remove steel plates. Install support pads. Use shim plates (5 and 6) as indicated by measurements.

Float bin onto frame. Check for gaps. Add or remove shims as necessary to eliminate all gaps.

Add or remove shims (2 and 3) as necessary between bin guide plates and frame strike plates, to obtain minimum possible clearance without interference. Tighten guide plates.

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CHAPTER 16. HAULAGE DEVICE

SECTION 2. HYDRAULIC SYSTEM

BIN TIP CYLINDER

Remove and Install Bin Tip Cylinder

Install articulation lock bar. Install wheel chocks. Fully lower dump body. Discharge hydraulic pressure. **(See Prepare Machine for Maintenance Operator's Manual CHAPTER 7).**

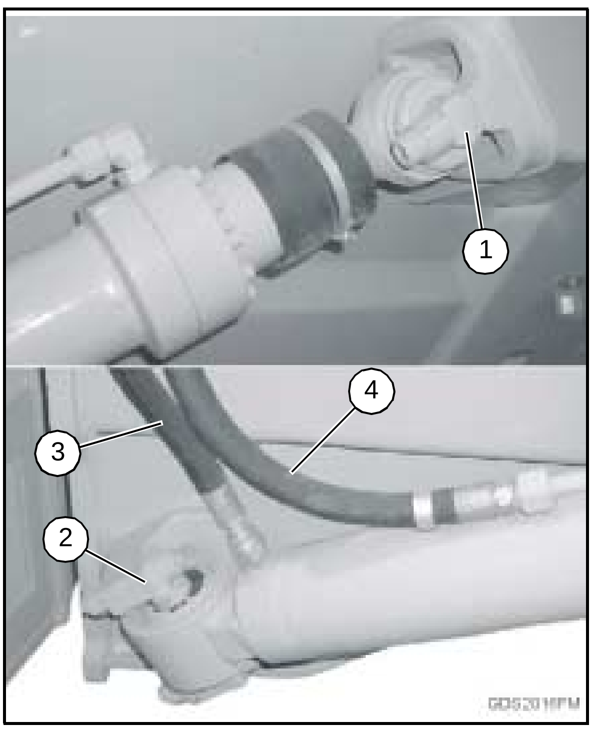
⚠ CAUTION

Component is heavy. Use hoist.

Bin Tip Cylinder Specification

Bin Tip Cylinder Weight-- 191 kg (420 lb) approximate

Support cylinder with hoist.



Disconnect hydraulic lines (3 and 4). Close all openings with caps and plugs.

Disconnect pins (1 and 2). Remove cylinder from machine.

Clean, repair, and replace parts as necessary.

NOTE: Rotate cylinder so hydraulic fittings are on top.

Install cylinder on machine. Adjust rod lengths, if necessary.

Connect hydraulic lines.

Disassemble and Assemble

⚠ CAUTION

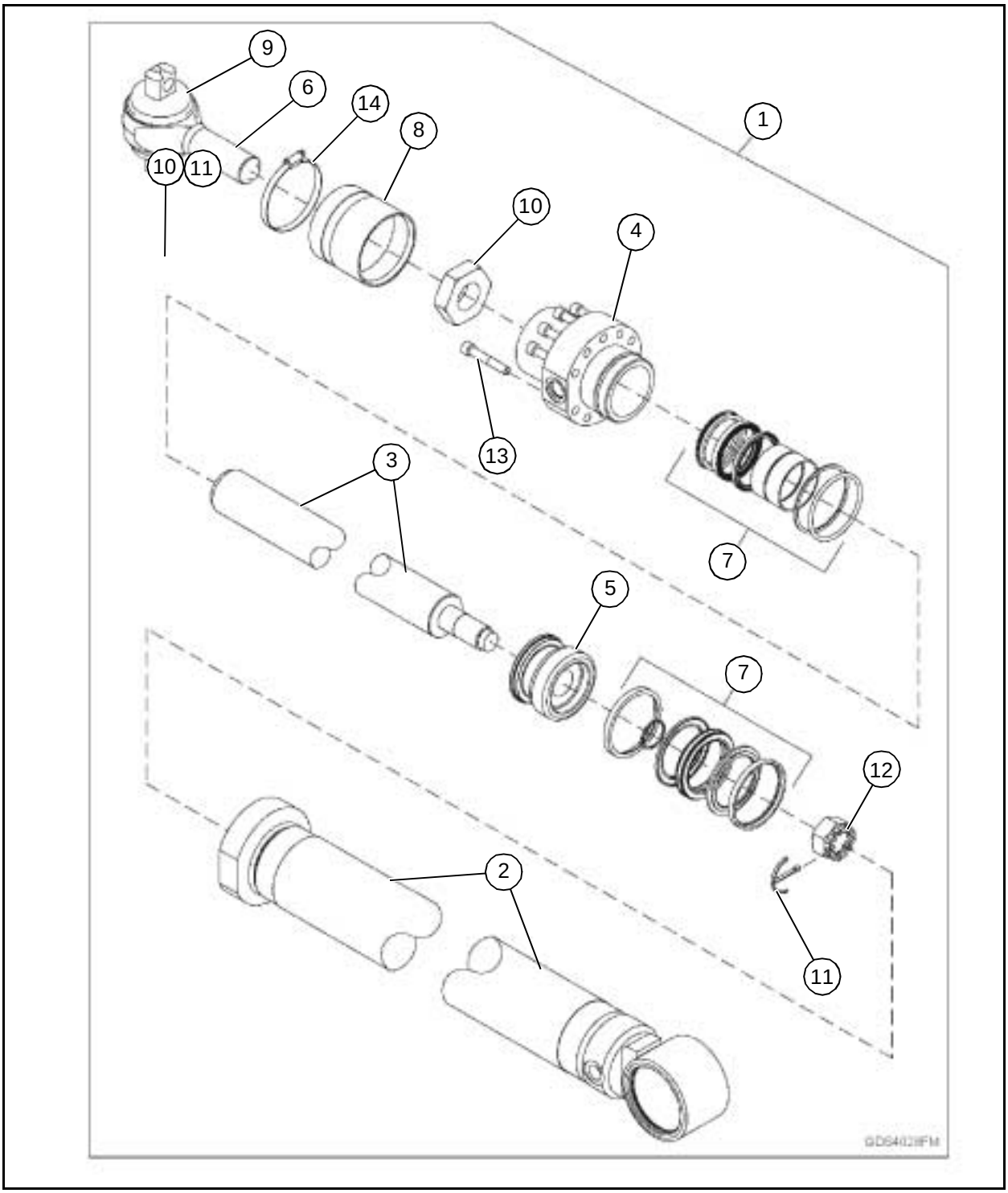
Component is heavy. Use hoist.

Bin Tip Cylinder Specification

Bin Tip Cylinder Weight --191 kg (420 lb) approximate

Install cylinder in a cylinder service stand such as JT30043 Cylinder Service Stand.

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1. Bin Tip Cylinder.
2. Barrel.
3. Rod.
4. Rod Guide.
5. Piston.
6. Rod End.
7. Seal Kit.
8. Boot.
9. Pin Bushing (2 used).
10. Lock Nut.
11. Cotter Pin.
12. Nut.
13. Socket Head Cap Screw (11 used).
14. Clamp.

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Remove clamp (14) and boot (8).

If necessary, mark threads for reassembly and remove lock nut (10) and rod end (6) from rod (3).

If necessary, replace pin bushings (9) in rod ends (6).

Remove socket head cap screws (13). Remove rod (3), rod guide assembly (4 and 7), and piston assembly (5, 7, 11, and 12) from barrel (2).

Remove and disassemble piston assembly.

Remove and disassemble rod guide assembly.

Clean, inspect, or replace parts as necessary. Replace all O-rings and seals.

⚠ CAUTION

Apply clean hydraulic oil to all rod guide and piston components during assembly.

Assemble rod guide assembly and install on rod. Ensure dust seal is installed with lip facing rod end.

Assemble piston assembly and install on rod. Apply rigid form-in-place gasket to threads of nut (12) and tighten to specification. Install cotter pin (11).

Body Lift Cylinder Specification

Piston-to-Rod Nut Torque - 500 - 550 Nm (369 - 406 lb-ft)

Install piston assembly, rod guide assembly, and rod in barrel. Align hydraulic fitting port on rod guide with hydraulic fitting port on head end of barrel. Install socket head cap screws and tighten to specification.

Body Lift Cylinder Specification

Rod Guide-to-Cylinder Barrel Socket Head Cap Screw Torque - 145 Nm (107 lb-ft)

Install rod end and lock nut on rod, if removed. Use marked threads as an initial setup guide.

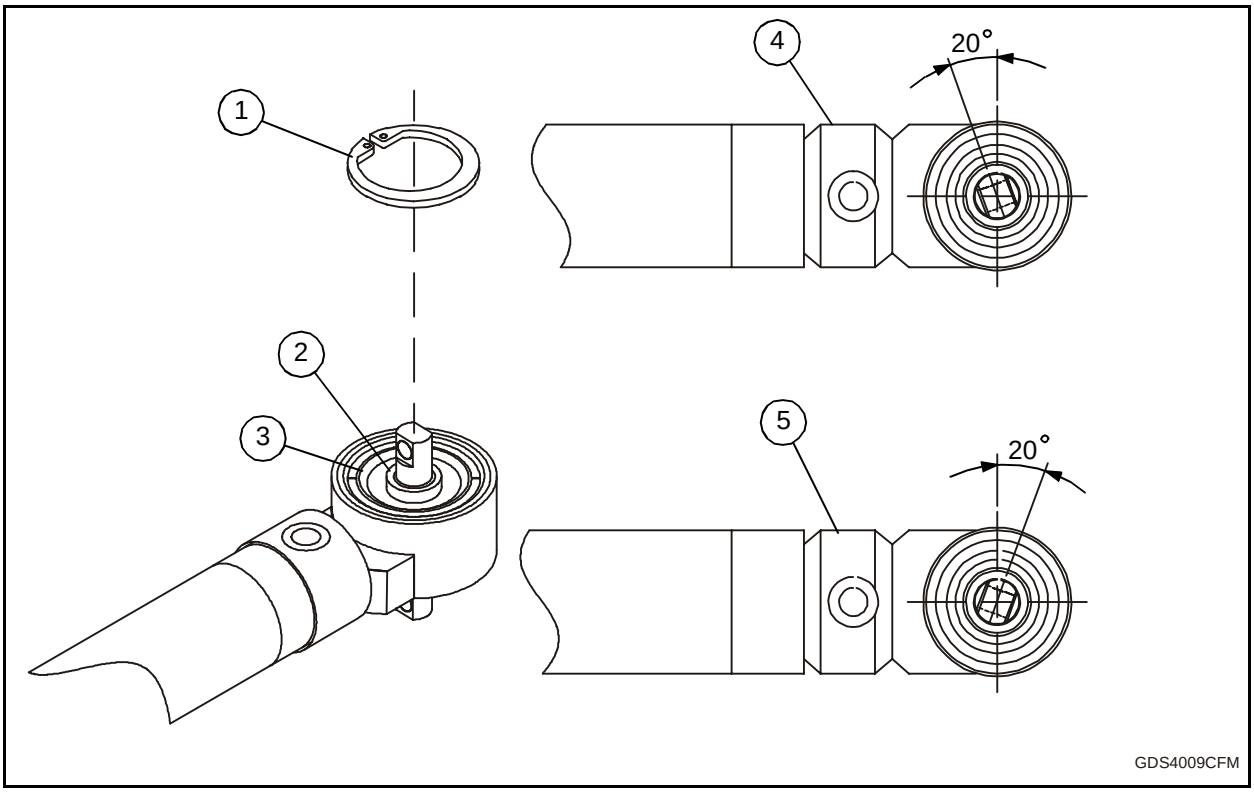
NOTE: Rod lengths are correct when there is no bin twist with cylinders fully extended.

Install cylinders on machine. Adjust rod lengths as necessary.

Install boot and clamp.

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Replace Head End Pivot Pin Bushing



1. Snap Ring.
2. Bushing.
3. Bore.
4. Left-Side Bin Tip Cylinder.
5. Right-Side Bin Tip Cylinder.

Remove snap ring (1).

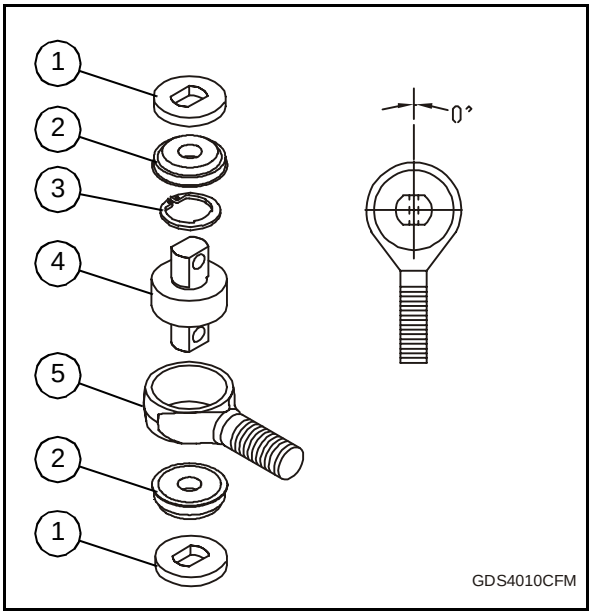
Press old bushing (2) from bore (3), using a hydraulic press.

Align new bushing on bore at proper angle, as shown for each cylinder (4 and 5).

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

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Replace Rod End Pivot Pin Bushing



1. Outer Boot (2 used).
2. Dust Seal (2 used).
3. Snap Ring.
4. Bushing.
5. Rod End.

Remove outer boots (1).

Remove dust seals (2).

Remove snap ring (3).

Press bushing (4) from bore of rod end (5), using a hydraulic press.

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

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

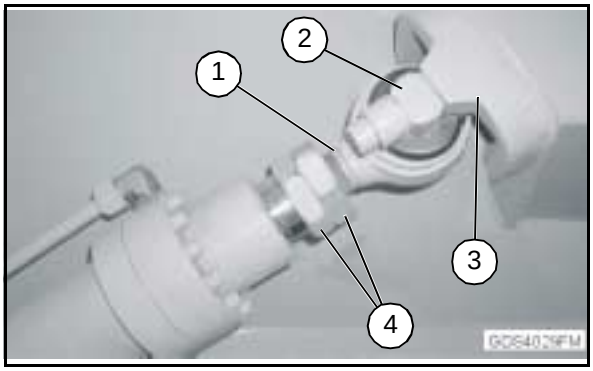
Install new dust seals. Ensure that collars of dust seals are firmly seated.

Install new outer boots.

Adjust Rod Lengths

NOTE: Rod length adjustment should be performed after bin alignment. (See "BIN" on page 373.)
Bin should be fully lowered, and cylinder rods should be fully retracted in barrels.

Attach cylinders to equipment frame at head end.



Turn rod ends (1) to adjust rod lengths until pins (2) meet mounting flanges (3). Attach pins.

Install hydraulic lines.

Slowly raise bin to full height. Observe bin for twisting when cylinders reach end of travel.

Fully lower bin.

If necessary, shorten one rod to eliminate bin twist.

Tighten nuts (4).

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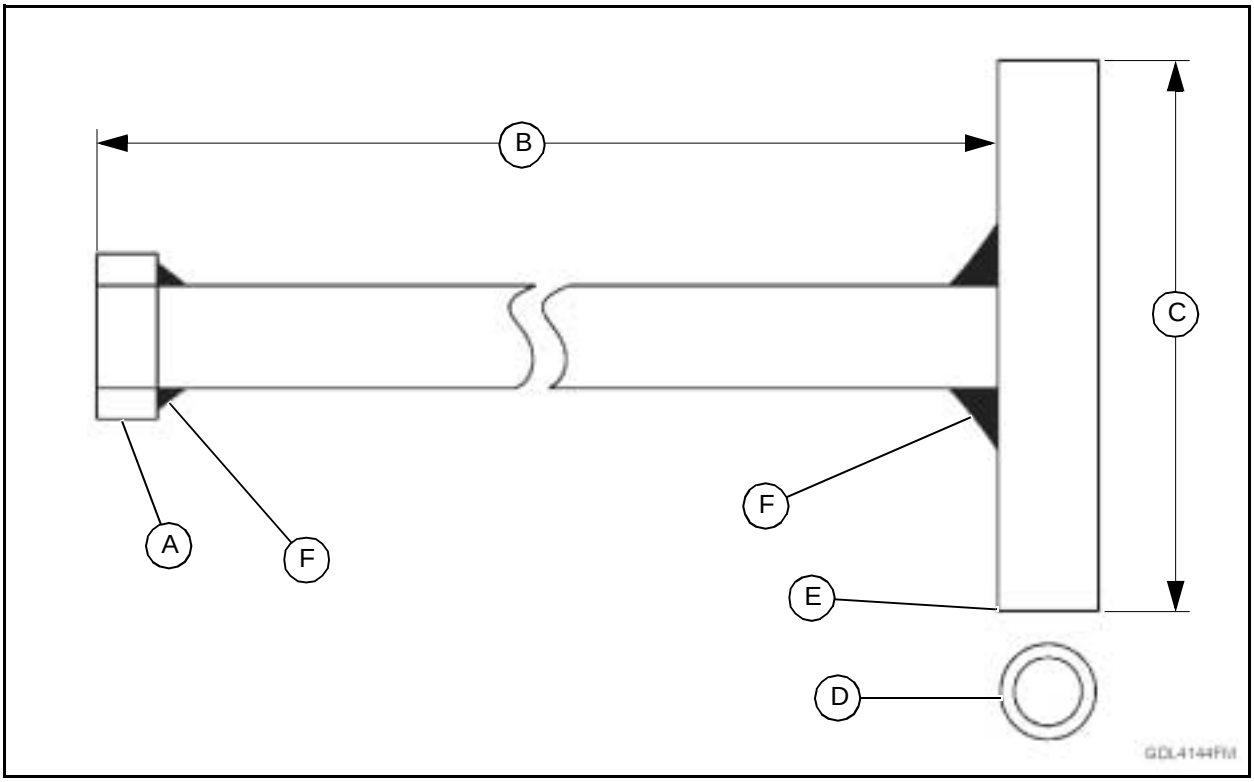
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CHAPTER 17. DEALER FABRICATED TOOLS

SECTION 1. TOOLS

DFT1132 REMOVAL AND INSTALLATION TOOL



A. M30 (1 in.) Nut.
B. 2.134 m (7 ft) Length of Pipe.
C. 457 mm (18 in.) Length of Pipe.
D. 25 mm (1 in.) ID Heavy Wall Pipe.
E. Pipe.
F. Fillet Weld.
G. Pipe.

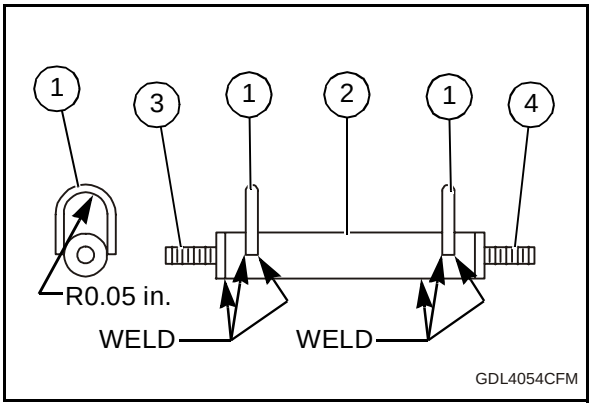
Removal and installation tool is used to remove and install the main hydraulic pump.

Material required:

- 2.591 m (8 ft x 6 in.) length of 25 mm (1 in.) ID heavy wall steel pipe.
- Fillet weld.

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DFT1178 LIFTING TOOL



Lifting tool is used to remove and install axle planetary cover.

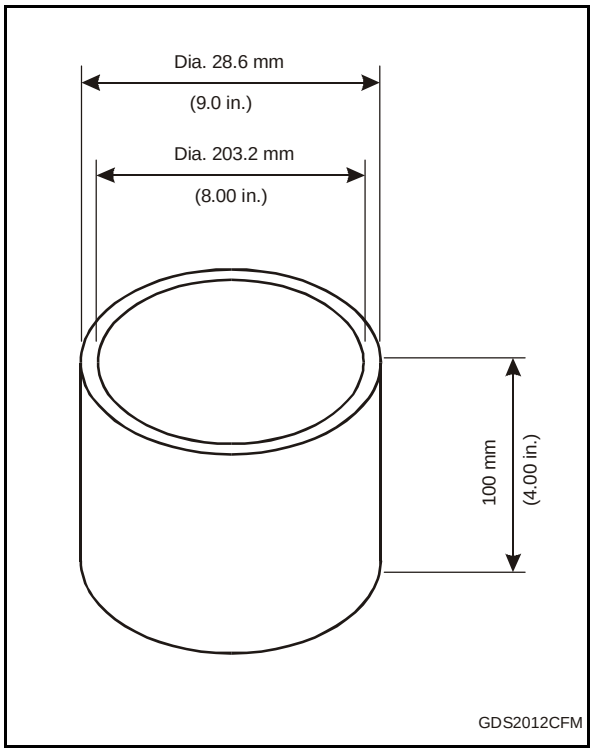
Material required:

- 3/8 in. x 7.5 in. Round Bar (2 used).
- 1.0 in. OD x 0.75 in. ID x 24 in. Pipe.
- M12 x 25 mm Cap Screw.
- M14 x 25 mm Cap Screw.

Weld cap screws to ends of pipe.

Weld round bars to pipe as shown.

DFT1233 BUSHING DRIVER



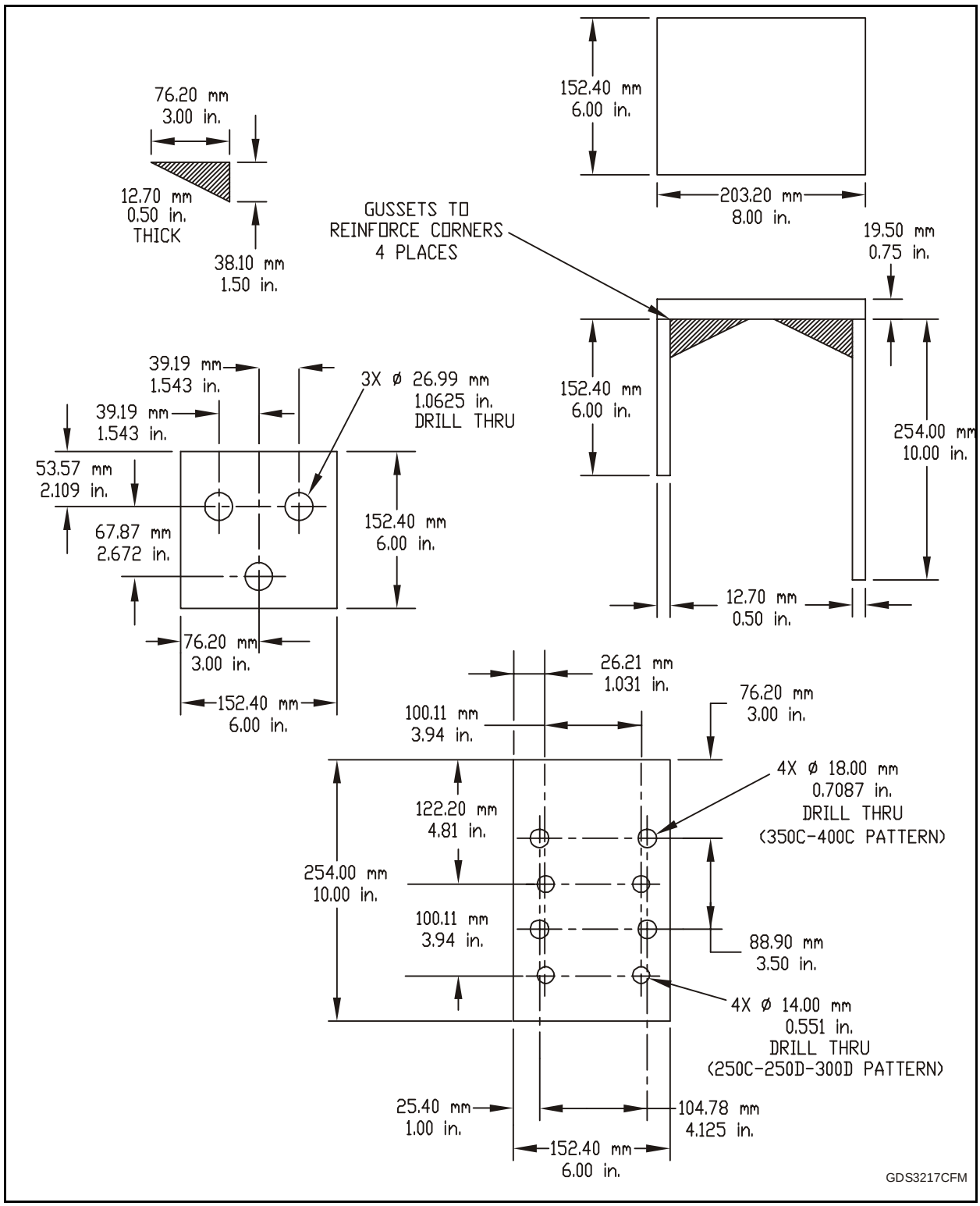
Used to install bushings into walking beams.

Material required:

- Steel pipe 228.6 mm (9.0 in.) O.D. 203.2 mm (8.00 in.) I.D. 101.6 mm (4.0 in.) Long.

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DFT1182 TRANSFER CASE MOUNTING BRACKET



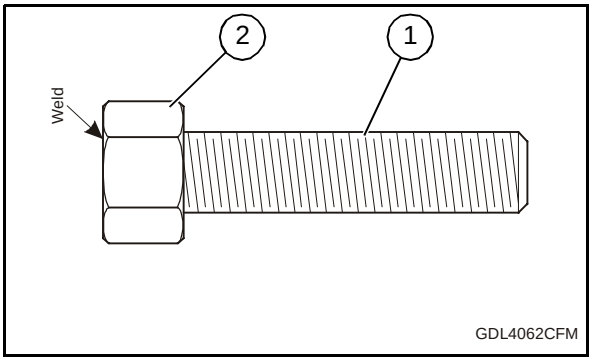
DFT 1182 Supports are used to mount transfer case on service stand.

Material required:

- 19.05 x 152.40 x 203.20 mm (0.75 x 6.00 x 8.00 in.) Mild Steel (1020) Flat.
- 12.70 x 38.10 x 152.40 mm (0.50 x 1.50 x 6.00 in.) Mild Steel (1020) Flat.
- 12.70 x 152.40 x 406.40 mm (0.50 x 6.00 x 16.00 in.) Mild Steel (1020) Flat.

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DFT1199 BUSHING PUSHER

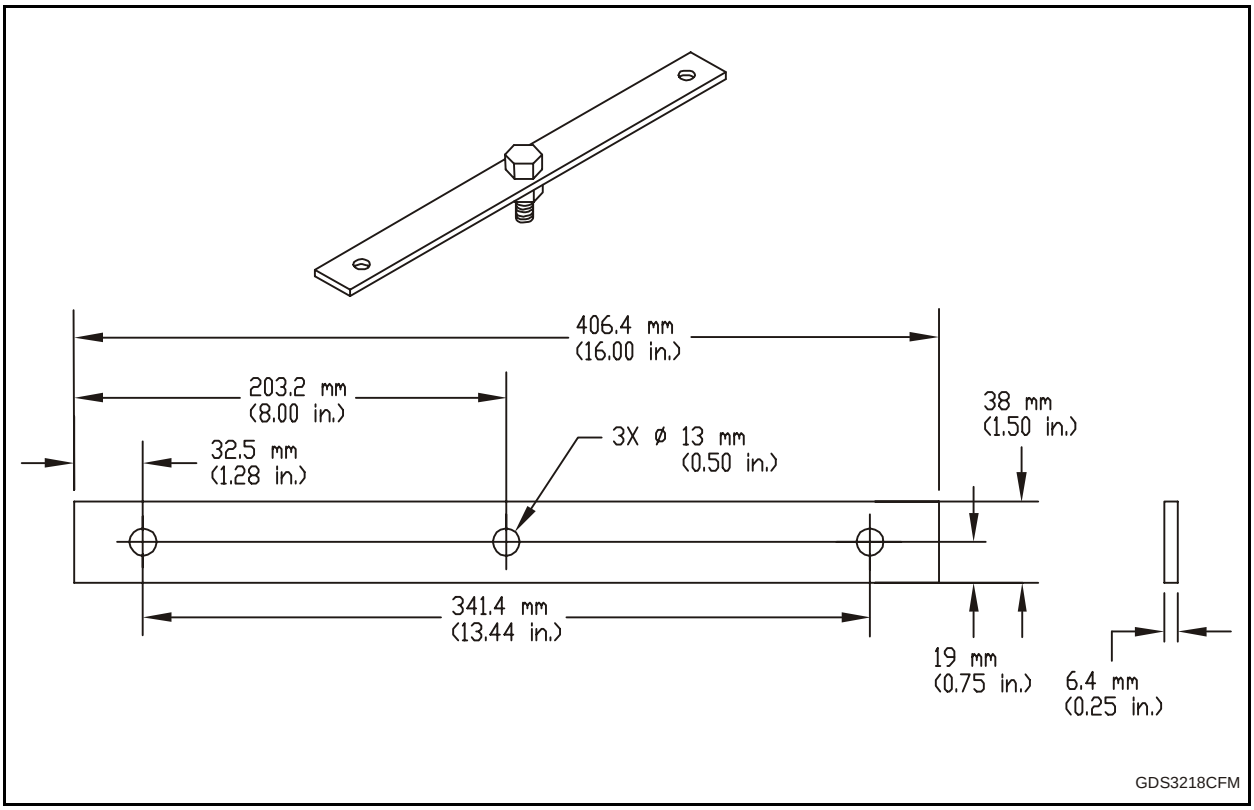


Bushing pusher is used to push the walking beam bushings off the pivot tube.

Material required:

- 1). 20 mm threaded rod 152 mm (6.0 in.) long (3 pieces).
- 2). 20 mm hex nut (3 used).

DFT1183 ROLLING DRAG TORQUE BAR



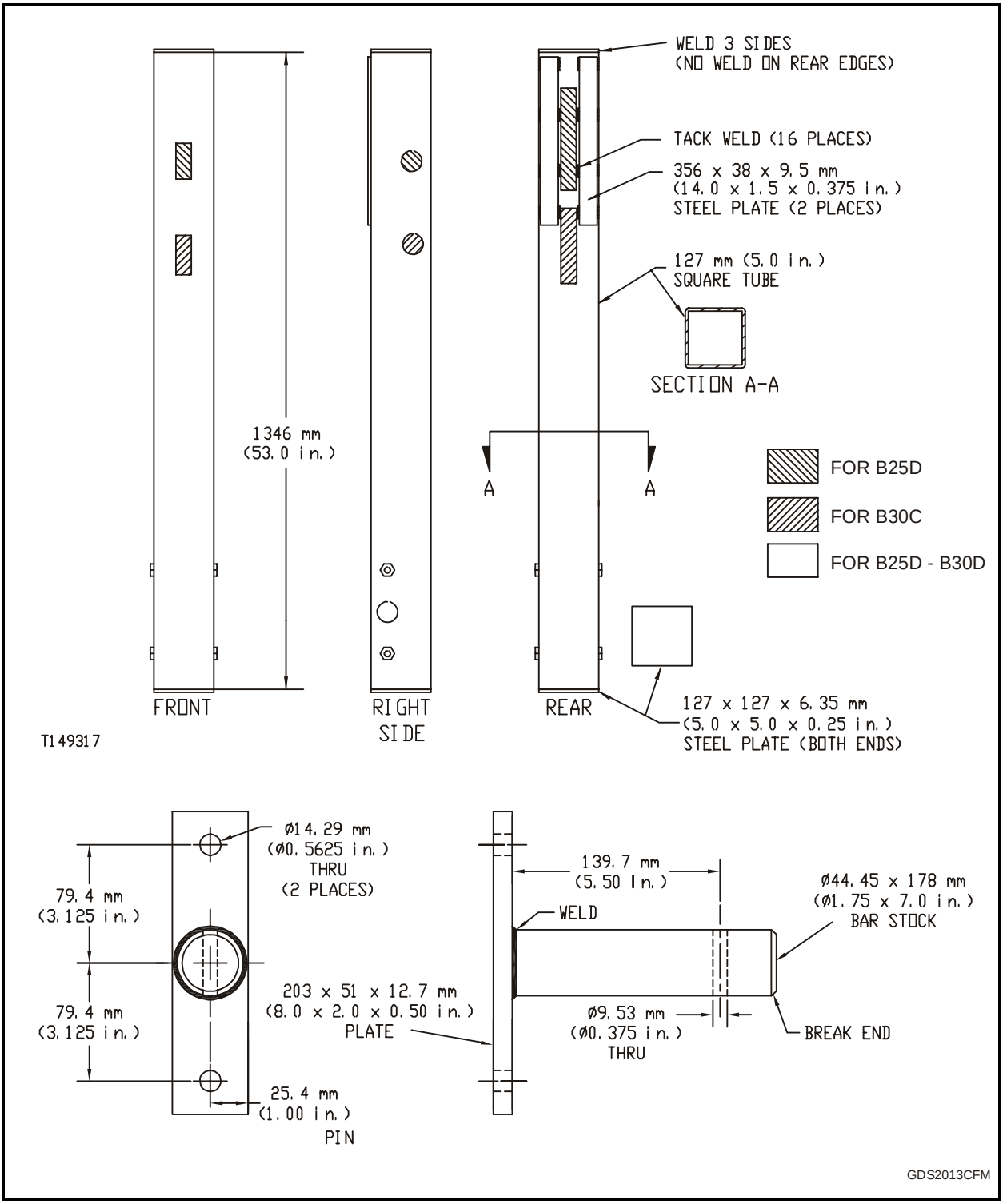
DFT1183 Rolling Drag Torque Bar is used with a torque wrench to measure rolling drag torque.

Material required:

- 6.4 x 38 x 406.4 mm (0.25 x 1.50 x 16.00 in.) Mild Steel (1020) Flat
- 0.50 x 1.25 in. Cap Screw
- 0.50 in. Nut

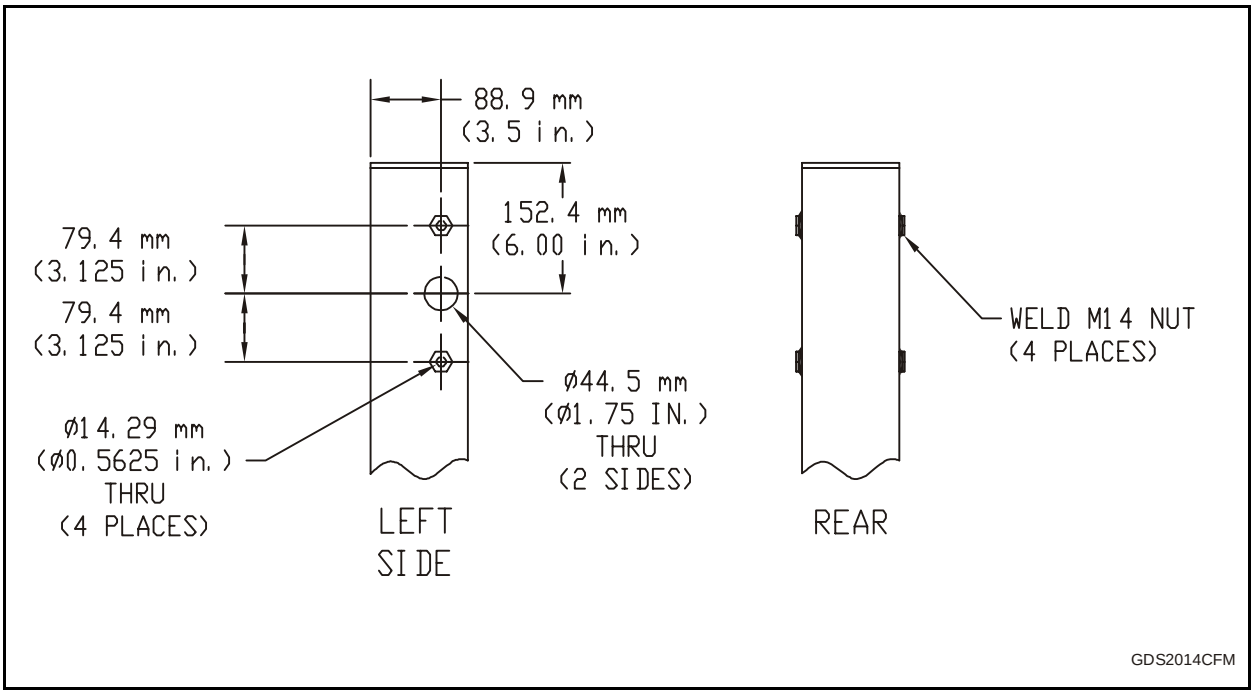
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DFT1197 FRONT SUPPORT



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Used to support front edge of engine frame on B25D and B30D Articulated Dump Trucks when separating oscillation joint or articulation joint.

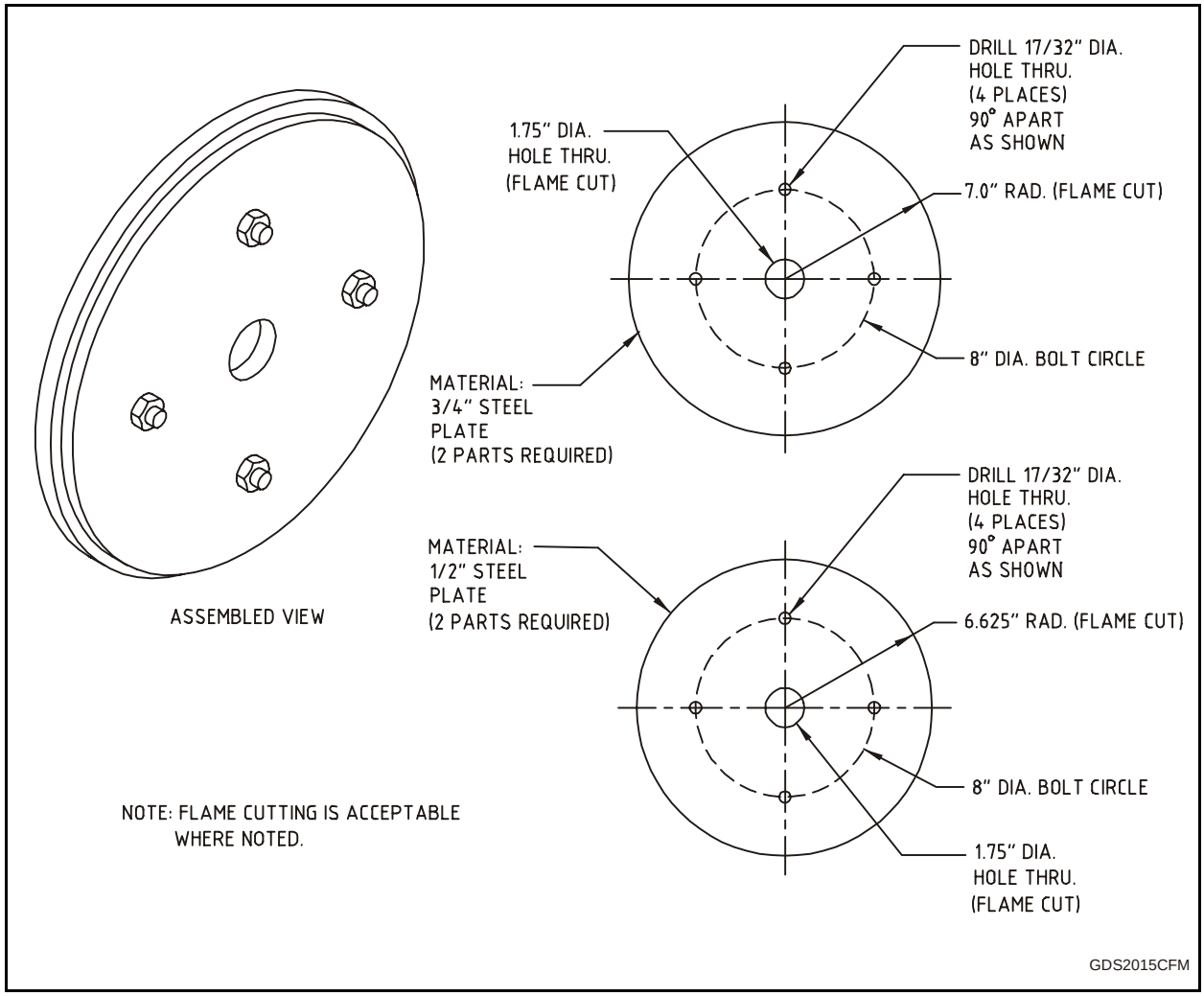
NOTE:Two DFT1197 Front Supports are required to properly support a machine.

Materials required for two tools:

- 1346.20 mm (53.00 in.) lengths of 127.00 x 127.00 x 6.35 mm (5.00 x 5.00 x 0.25 in.) Square Tube (2 used).
- 127.00 x 127.00 x 6.35 mm (5.00 x 5.00 x 0.25 in.) Mild Flat (4 used).
- 203.20 mm (8.00 in.) lengths of 50.80 x 12.70 mm (2.00 x 0.50 in.) Mild Steel (1020) Flat (2 used).
- 177.80 (7.00 in.) lengths of 44.45 mm dia. (1.75 in. dia.) Mild Steel (1020) Bar Stock (2 used).
- M14 Nuts (8 used) (B25D - B30D Only).
- M14 x 60 Cap Screws (4 used) (B25D - B30D Only).
- M14 Washers (as required) (250D-300D Only).

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DFT1198 OSCILLATION BUSHING INSTALLATION TOOL



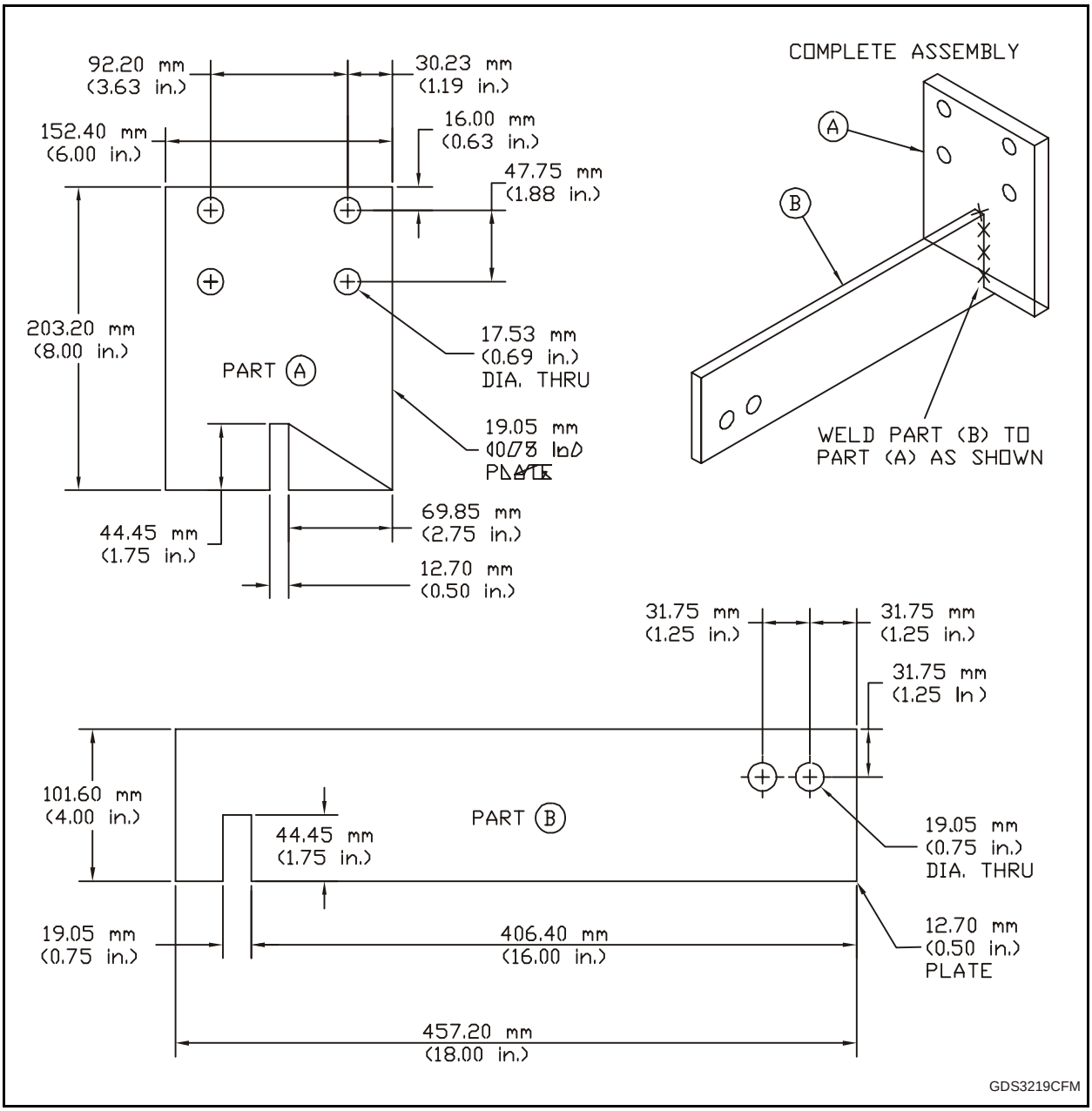
Use with 50-ton porta-power, JDG902-1 60-in. Screw and JDG902-2 Adapter Plate to install oscillation tube bushings.

Material required:

- 355.6 x 711.2 x 19 mm (14.00 x 28.00 x 0.75 in.) Mild Steel (1020) Flat
- 336.6 x 673.1 x 13 mm (13.25 x 26.50 x 0.50 in.) Mild Steel (1020) Flat
- 4 each 2.0 x 0.50 in. Cap Screws
- 4 each 0.50 in. Nuts

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DFT1226 TRANSMISSION LIFTING BRACKET



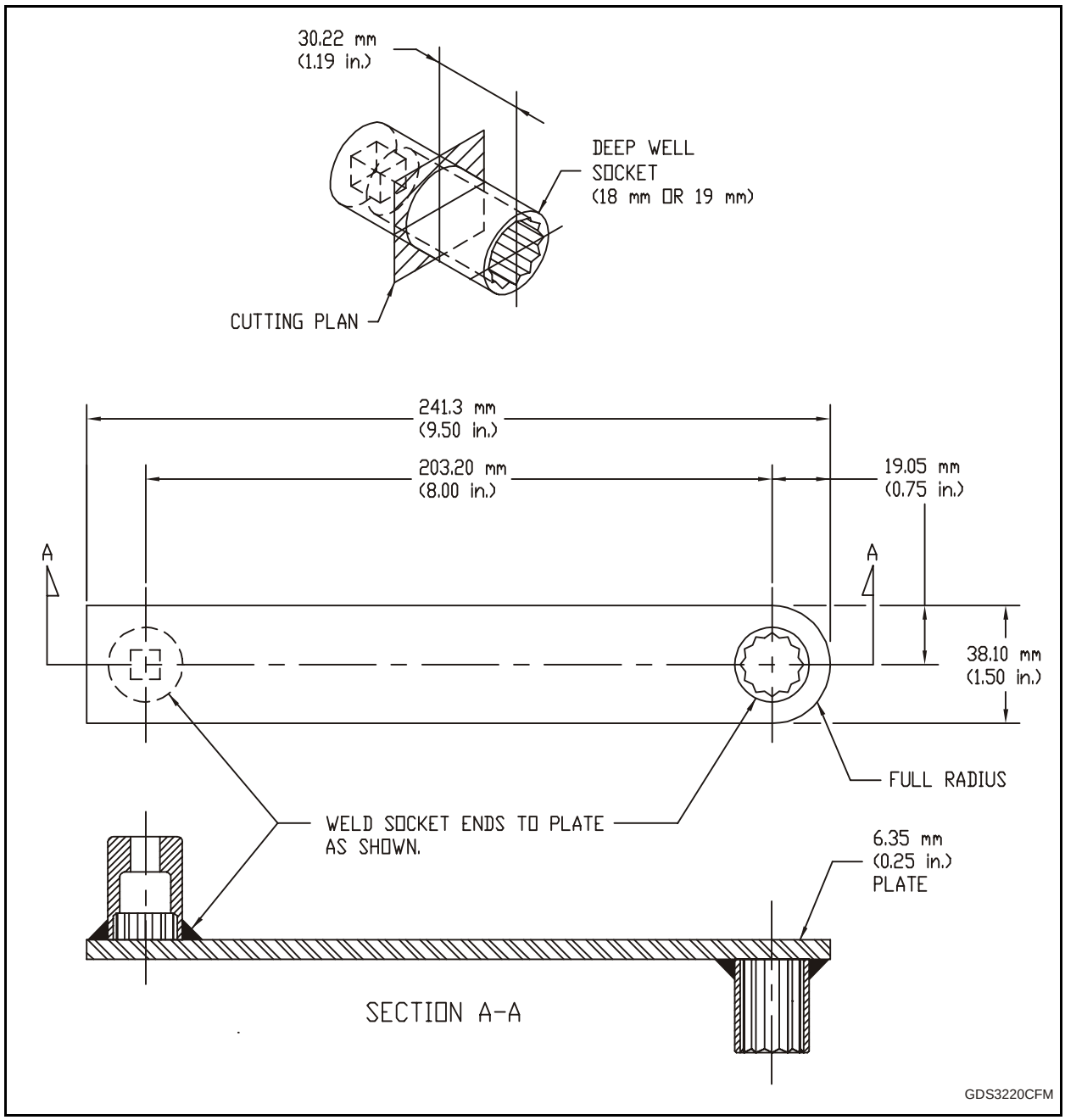
Used to support transmission housing when separating from flywheel housing.

Material required:

- 203.20 x 152.40 x 19.05 mm (8.00 x 6.00 x 0.75 in.) Mild Steel (1020) Flat
- 101.60 x 457.20 x 12.70 mm (4.00 x 18.00 x 0.50 in.) Mild Steel (1020) Flat

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DFT 1227 FLEXPLATE TORQUE ADAPTER



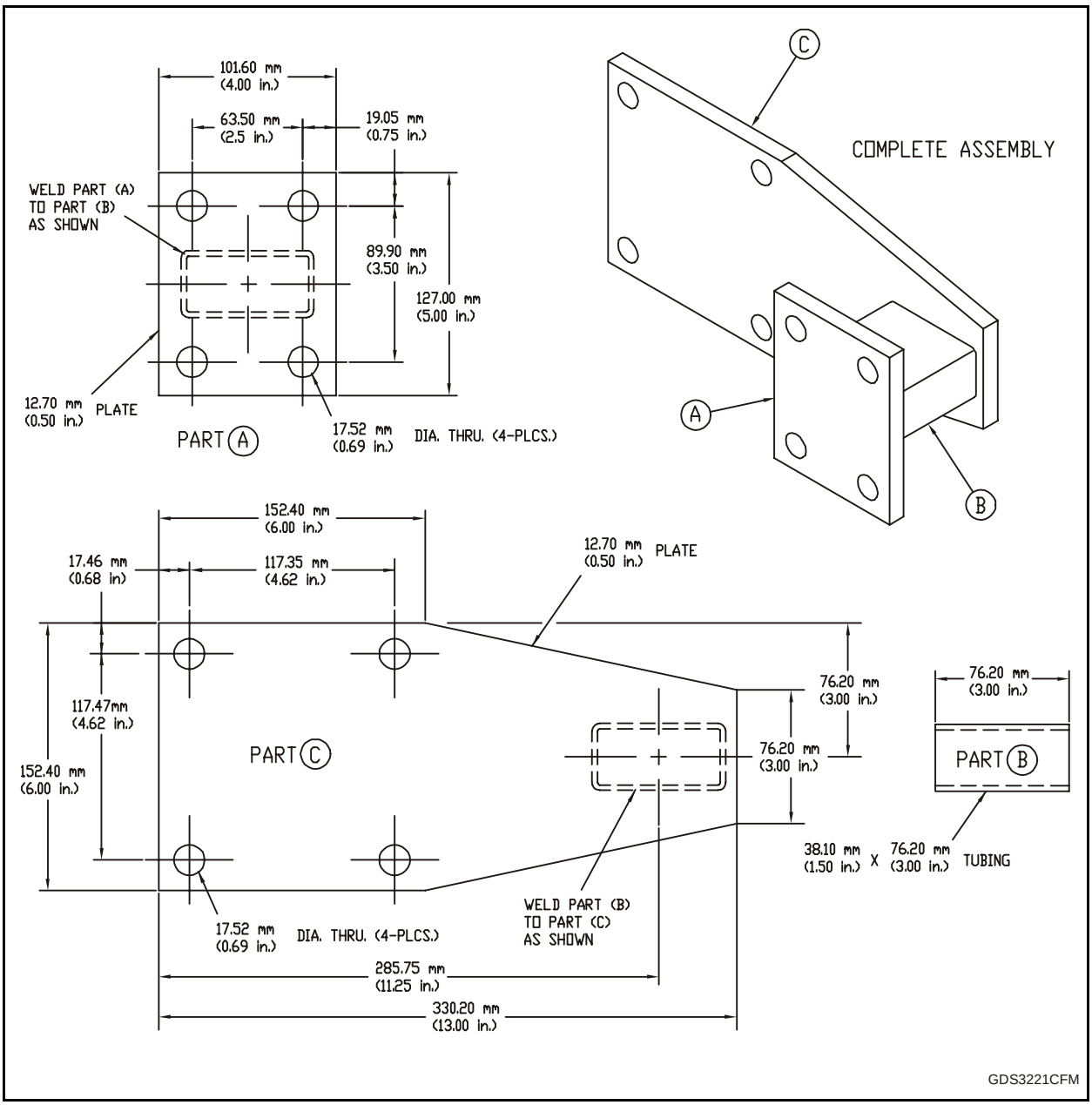
Used to remove, install, and tighten flexplate-to-torque converter cap screws.

Material required:

- 38.10 x 241.30 x 6.35 mm (1.50 x 9.50 x 0.25 in.) Mild Steel (1020) Flat
- 18 mm or 19 mm 12-Point Socket (machines will vary).

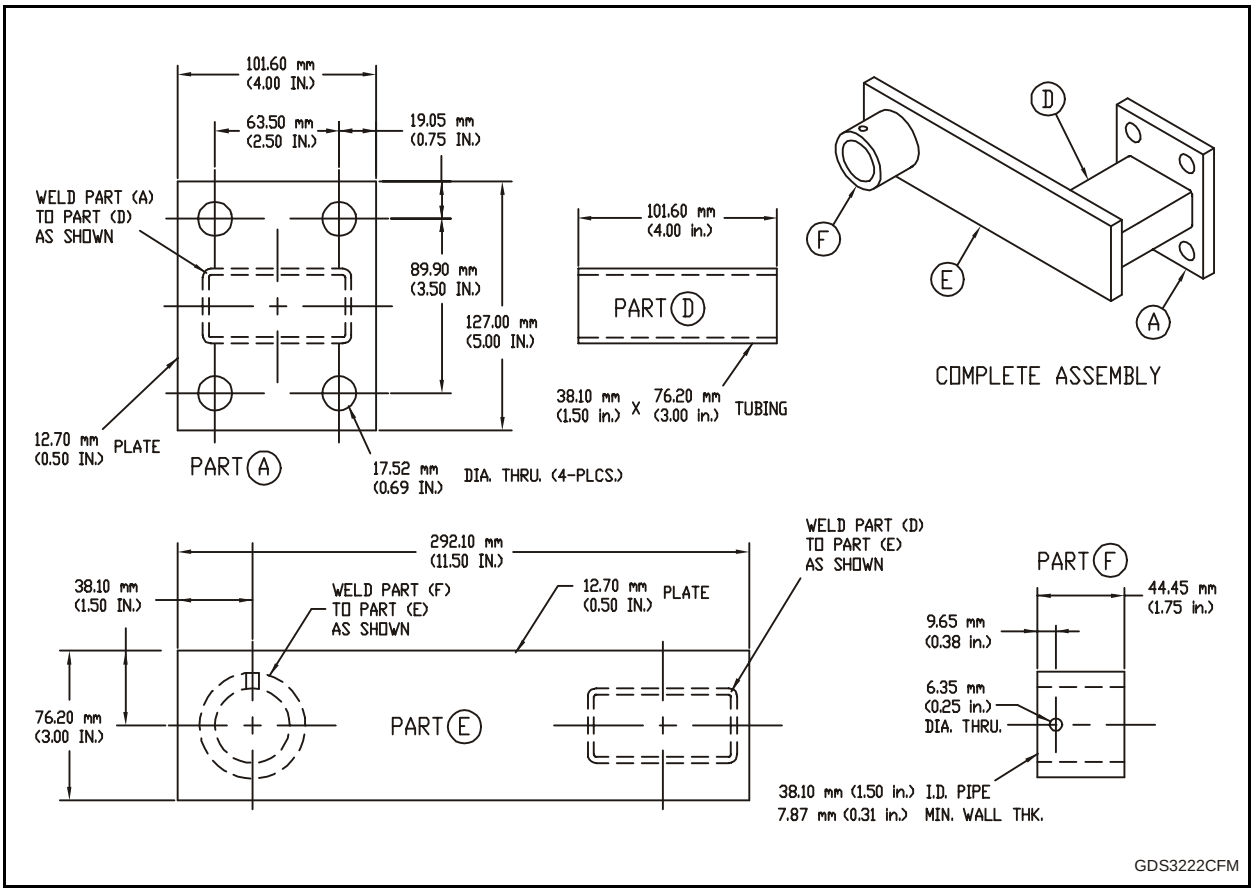
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DFT1228 TRANSMISSION MOUNT ADAPTERS



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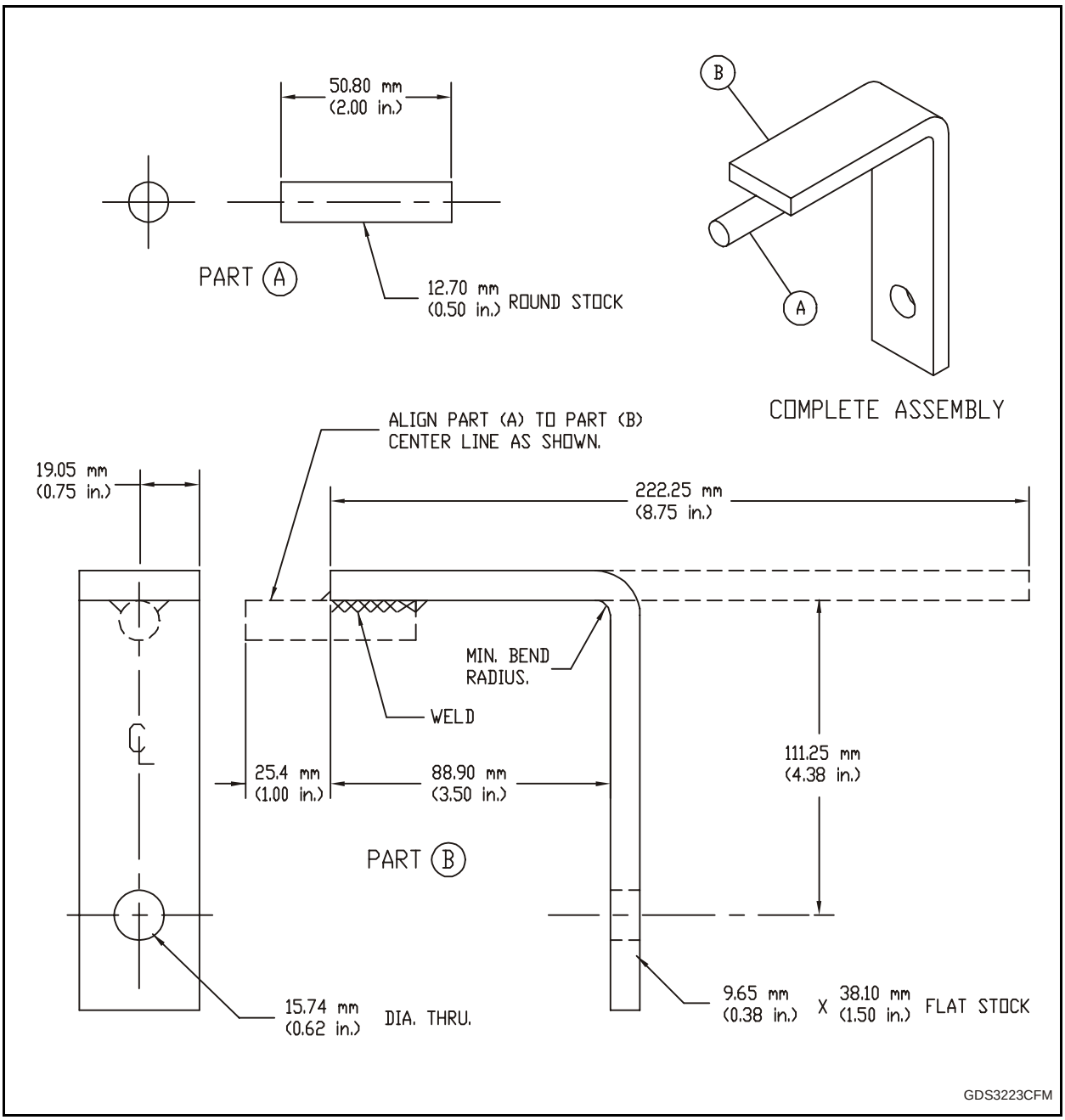
Used to install transmission in D01003AA Repair Stand.

Material required:

- 127.00 x 203.20 x 12.70 mm (5.00 x 8.00 x 0.50 in.) Mild Steel (1020) Flat
- 152.40 x 330.20 x 12.70 mm (6.00 x 13.00 x 0.50 in.) Mild Steel (1020) Flat
- 76.20 x 292.10 x 12.70 mm (3.00 x 11.50 x 0.50 in.) Mild Steel (1020) Flat
- 177.80 mm (7.00 in.) of 38.10 x 76.20 mm (1.50 x 3.00 in.) Rectangular Tube
- 44.45 mm (1.75 in.) of 38.10 mm (1.50 in.) I.D. Heavy Wall Pipe.

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DFT1229 TORQUE CONVERTER HOLDING BRACKET



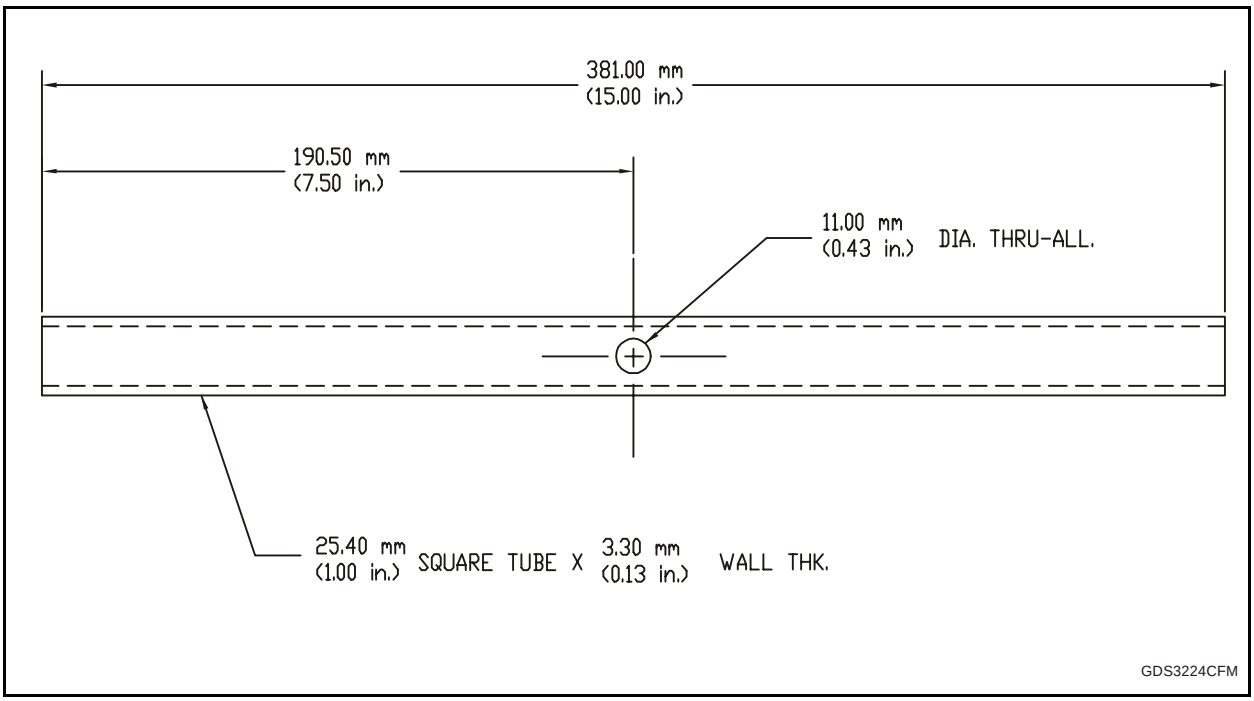
Used to retain torque converter in transmission housing while removing plug and seal for transmission disassembly.

Material required:

- 222.25 mm (8.75 in.) of 38.10 x 9.52 mm (1.50 x 0.375 in.) Mild Steel (1020) Flat
- 50.80 mm (2.00 in.) of 12.70 mm (0.50 in.) Round Stock

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DFT1230 TRANSMISSION PUMP COVER PULLER



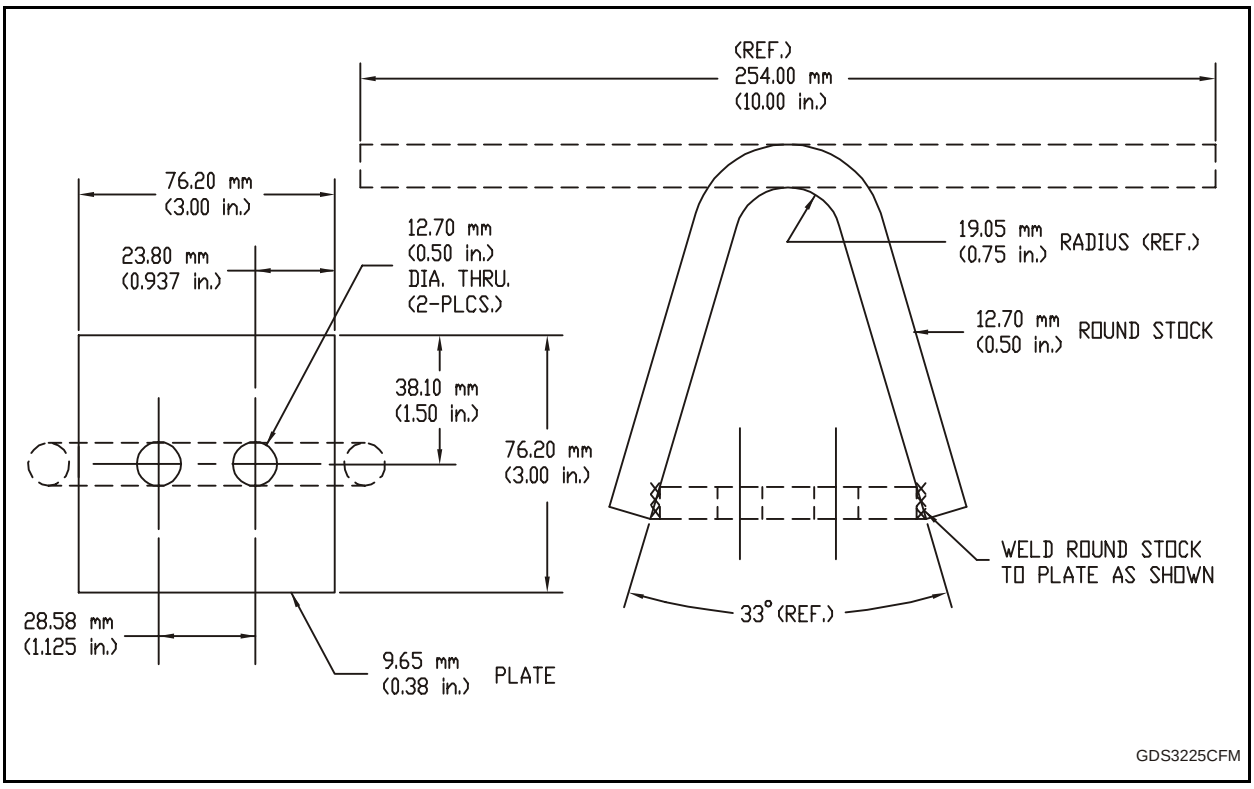
Used to remove pump cover from transmission during disassembly. Three tools are required.

Materials required:

- 381.00 mm (15.00 in.) lengths of 25.40 x 25.40 x 3.18 mm (1.00 x 1.00 x 0.125 in.) Square Tube (3 used)
- 152.40 mm (6.00 in.) lengths of M10 x 1.00 Threaded Rod (3 used)
- M10 x 1.00 Nuts (3 used)
- M10 Washers (3 used)

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DFT1231 OUTPUT ASSEMBLY LIFT BRACKET



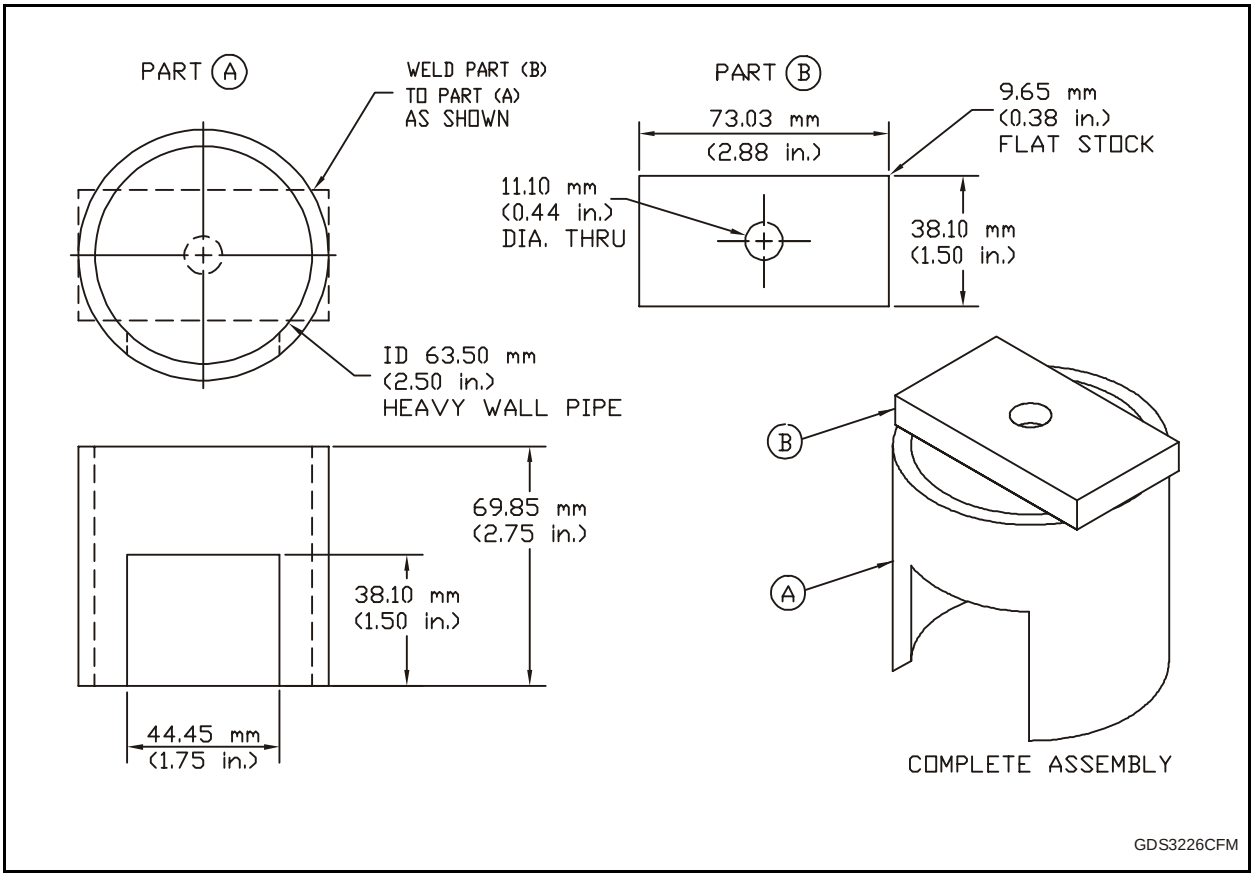
Used to lift output assembly from transmission during disassembly.

Materials required:

- 76.20 x 76.20 x 9.53 mm (3.00 x 3.00 x 0.375 in.) Mild Steel (1020) Flat
- 254.00 mm (10.00 in.) of 12.70 mm (0.50 in.) Round Stock

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DFT1232 AUXILIARY DRIVE PIN PULLER



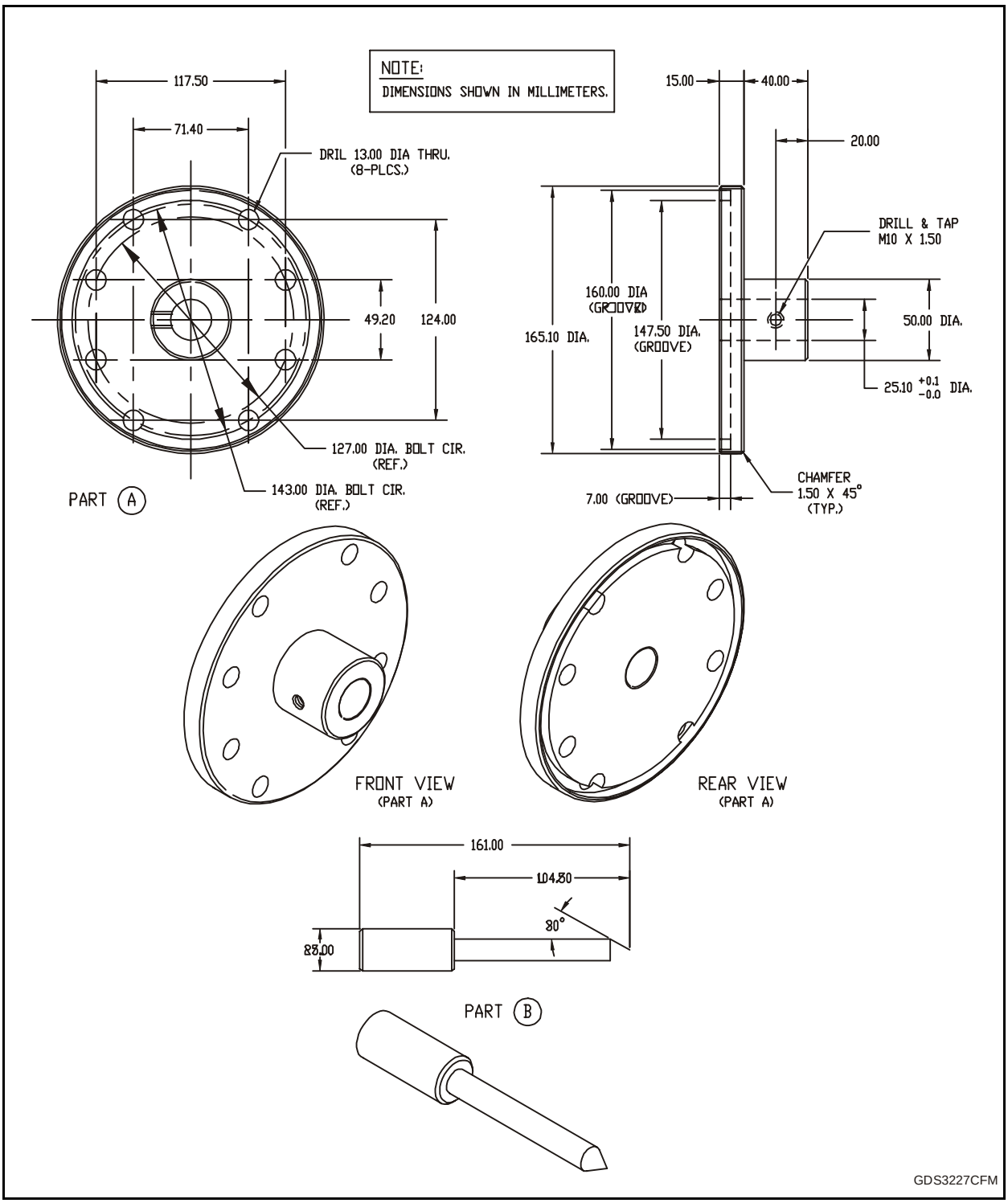
Used to pull auxiliary drive gear pin.

Materials required:

- 70 mm (2.75 in.) of 63.5 mm (2.50 in.) I.D. Heavy Wall Pipe
- 73 x 38 x 10 mm (2.875 x 1.50 x 0.375 in.) Mild Steel (1020) Flat
- 127 mm (5.00 in.) of M10 x 1.50 Threaded Rod
- M10 x 1.50 Nut
- M10 Washer

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280532 TOOL, 7C/8, 5C POINTER SET (TRANSFER CASE ALIGNMENT TOOL)



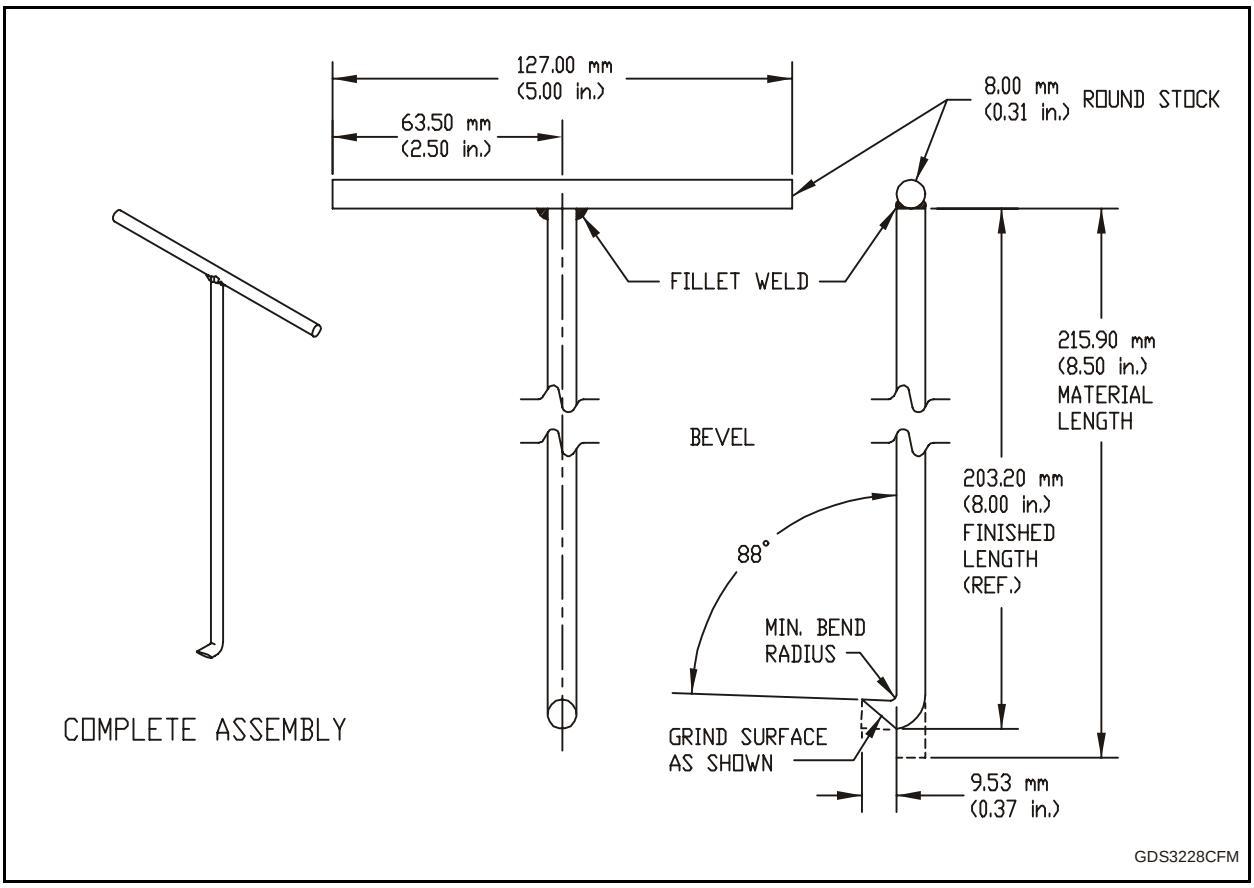
Used to align transfer case with oscillation tube drive shaft, and to align front axle with transfer case. Two tools must be used to perform an alignment.

Material required:

- 55 mm length of 170 mm Round Stock (2 used)
- 161 mm length of 25 mm Round Stock (2 used)
- M10 x 1.50 x 16 mm Set Screws (22M7147, 2 used)

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DFT1238 TRANSMISSION PLANETARY LIFTING TOOL



Used to lift transmission planetaries. Two tools are required.

Material required:

- 686 mm (27.0 in.) length of 8.0 mm (0.31 in.) Round Stock.

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