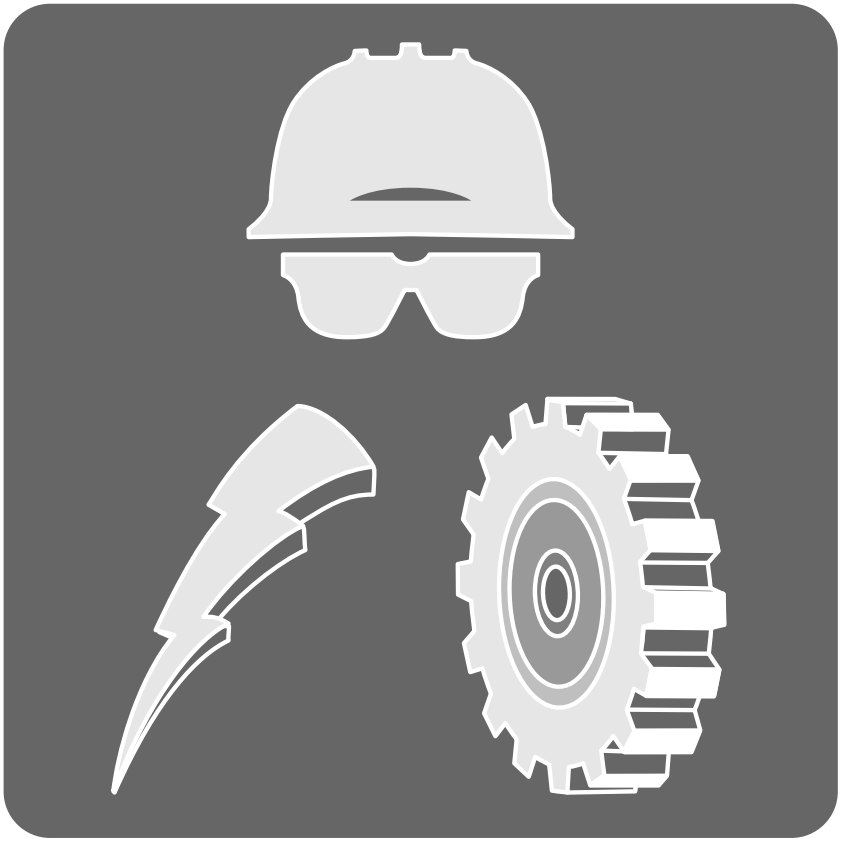
KOMATSU

P&H

Hydraulic Pump Drive (HPD)

SECTION_03–04 — Gen2



LDG2-S-V-HD-EN.0001

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Preface

This Manual is provided as a guide to personnel involved with the operation, maintenance and repair of Komatsu Mining Corp. equipment. We recommend that such personnel review and become familiar with the general procedures and information contained within this manual. In addition, we recommend that this manual be kept readily available for reference when repairs or maintenance are necessary.

Read and become familiar with this Manual and any other general safety practices before attempting any procedures.

Due to the complexities of mining equipment and the environment in which it operates, situations may arise which are not directly discussed in detail in this Manual. When such a situation arises, past experience, availability of equipment and common sense play a large part in what steps are to be taken. In addition, a Komatsu Mining Corp. service center representative is available to answer your questions and assist you upon request.

Komatsu Mining Corp. reserves the right to continually improve its products and associated documentation. Therefore, physical alterations to Komatsu equipment may not be identified in this Manual. Revisions may be frequently made to this Manual in an effort to ensure that information contained within is current as alterations occur to the equipment. If you find an error or have other feedback regarding this Manual, please contact Product Training and Publications at *Pro.Train.Pub@mining.komatsu*.

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Scope of this Publication

HPD Gearbox provides information on the gearbox lubricant, pump and circuit, and overhauling the HPD gearbox assembly.

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Safety

This publication contains special instructions that pertain to safety, operation, maintenance, and repair of the machine. Listed below are the signal words and symbols that precede these instructions and their meanings:

DANGER

The danger label indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

The warning label indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

The caution label, used with the safety alert symbol indicates a hazardous situation which, if not avoided, could result in minor or moderate injury (includes the safety alert symbol

).

CAUTION

The caution label (without safety alert symbol) is used to address practices not related to personal injury – only equipment damage.

NOTICE

The NOTICE graphic is to indicate areas of importance to the reader that are not related to personal injury or machine damage.

Safety, Warnings, and Cautions

⚠ WARNING

CRUSH HAZARD

- **Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.**
- **Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Clear all personnel from the area around the bucket and lift arms before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in some movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.**
- **Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.**

CRUSH, SHOCK, OR OTHER HAZARDS

- **Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.**

⚠ CAUTION

CHEMICAL HAZARD

- **Chemical hazard and inhalation hazard exists if the appropriate Personal Protective Equipment (PPE) is not used when using solvents and compressed air. When working with chemicals, avoid contact with them and ensure proper ventilation is adequate. Ensure all required PPE is used. Follow all local rules and regulations when working with chemicals. Failure to use proper PPE and to avoid chemical contact could cause a chemical hazard and inhalation hazard resulting in serious injury.**

Theory of Operation

The hydraulic pumps are driven by a gearbox assembly that is mechanically powered by the generator via a driveshaft. The gearbox provides areas for mounting a variety of pumps. It attaches to the generator by means of a driveshaft. Internally, the gearbox has sets of gears that drive the externally mounted pumps.

Hydraulic Pump Drive (HPD) (PTO) Gearbox Capacities and Specifications

Table 1: HPD gearbox fluid specifications

Model	Component	Capacity		Lubrication
L1350/L1850/L2350	Hydraulic PumpDrive Gearbox[1]	7 gallons	27 liters	SAE 75W-140W synthetic gear oil or SAE 80W-90W gear oil.
1 ARCTIC CONDITIONS represent a specialized field where extensive use is made of heating equipment before starting.				

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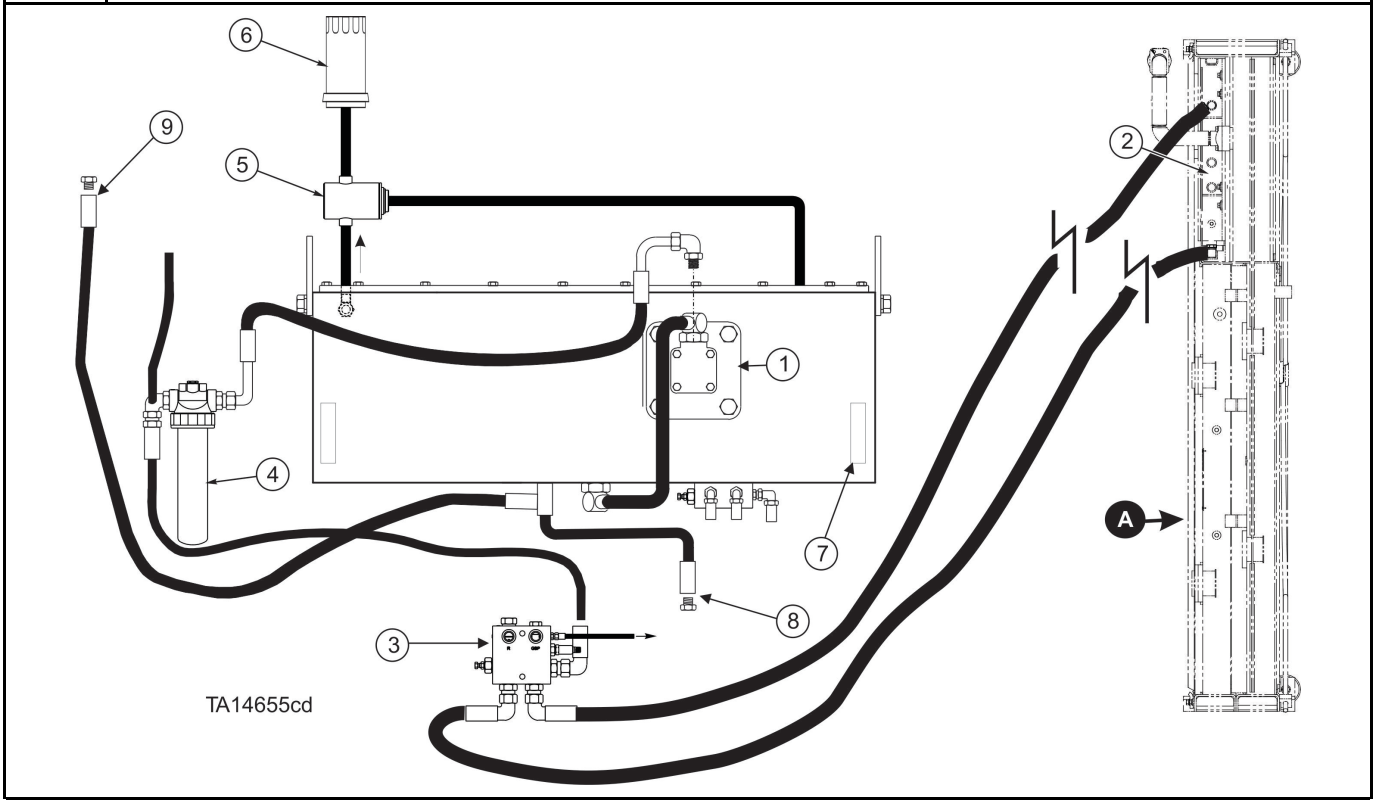
Component Description

Machines without Remote Fluid Drain and Fill Components

Table 2: HPD gearbox components (typical)

#	Component	Use / Description	Specification	Location
1.	HPD Gearbox Lubricant Pump	Vane Hydraulic Pump Pump Gearbox Lube	12 gpm (45 lpm) 0 to 200 psi	Mounted on non-drive side of HPD gearbox.
2.	Oil Cooler	Cool gearbox lubricating oil.	N/A	Mounted by radiator
3.	Sequence Valve	Pressure limiting check valve - regulates pressure flow into control valve.	200 psi (13.7 bar)	Oil Cooler Control Valve - bottom of HPD gearbox
	Check Valve	Pressure Limiting Check Valve - regulates pressure flow into oil cooler.	100 psi (6.9 bar)	Oil Cooler Control Valve - bottom of HPD gearbox
	Temperature Sending Unit	Monitors oil temperature for visual and audible alarm.	Variable	Oil Cooler Control Valve - bottom of gearbox
Not Shown	Pressure Transducer	Monitors oil pressure for visual and audible alarm.	Variable	PSI Transducer manifold. Connects to sequence valve.
4.	Oil Filter	Filter lubricating oil	Canister filter	Beside HPD
5.	Separator/Diffuser	Separates the oil from the air that comes up the breather hose when the gearbox is cold. (Air goes out the breather and oil drains back to the gearbox).	Same as planetary drive filtration separator.(different plumbing)	Mounted between gearbox and breather filter.
6.	Air Breather Filter	Air filter ventilation	Canister-type filter	Mounted behind cab on hood structure.
7	Fluid Level Sight Glass	To visually determine HPD fluid level	Two	On the non-driven side, lower corners

A	Looking down on top of radiator (radiator not to scale)



Machines with Remote Fluid Drain and Fill Components

Table 3: HPD gearbox components with remote fluid drain and fill fittings (typical)

#	Component	Use / Description	Specification	Location
1.	HPD Gearbox Lubricant Pump	Vane Hydraulic Pump Pump Gearbox Lube	12 gpm (45 lpm) 0 to 200 psi	Mounted on non-drive side of HPD gearbox.
2.	Oil Cooler	Cool gearbox lubricating oil.	N/A	Mounted by radiator
3.	Sequence Valve	Pressure limiting check valve - regulates pressure flow into control valve.	200 psi (13.7 bar)	Oil Cooler Control Valve - bottom of HPD gearbox
	Check Valve	Pressure Limiting Check Valve - regulates pressure flow into oil cooler.	100 psi (6.9 bar)	Oil Cooler Control Valve - bottom of HPD gearbox
	Temperature Sending Unit	Monitors oil temperature for visual and audible alarm.	Variable	Oil Cooler Control Valve - bottom of gearbox
Not Shown	Pressure Transducer	Monitors oil pressure for visual and audible alarm.	Variable	PSI Transducer manifold. Connects to sequence valve.
4.	Oil Filter	Filter lubricating oil	Canister filter	Beside HPD

5.	Separator/Diffuser	Separates the oil from the air that comes up the breather hose when the gearbox is cold. (Air goes out the breather and oil drains back to the gearbox).	Same as planetary drive filtration separator.(different plumbing)	Mounted between gearbox and breather filter.
6.	Air Breather Filter	Air filter ventilation	Canister-type filter	Mounted behind cab on hood structure.
7	Fluid Level Sight Glass	To visually determine HPD fluid level	Two	On the non-driven side, lower corners
8	Fluid Drain	To drain the fluid from the HPD gearbox	Some models have a remote hose with plug.	In upper and lower articulation area, inside rear frame.
9	Fluid Fill	To fill the HPD gearbox with fluid.	Some models have a remote hose with plug.	In upper and lower articulation area, inside rear frame.
A	Looking down on top of radiator (radiator not to scale)			

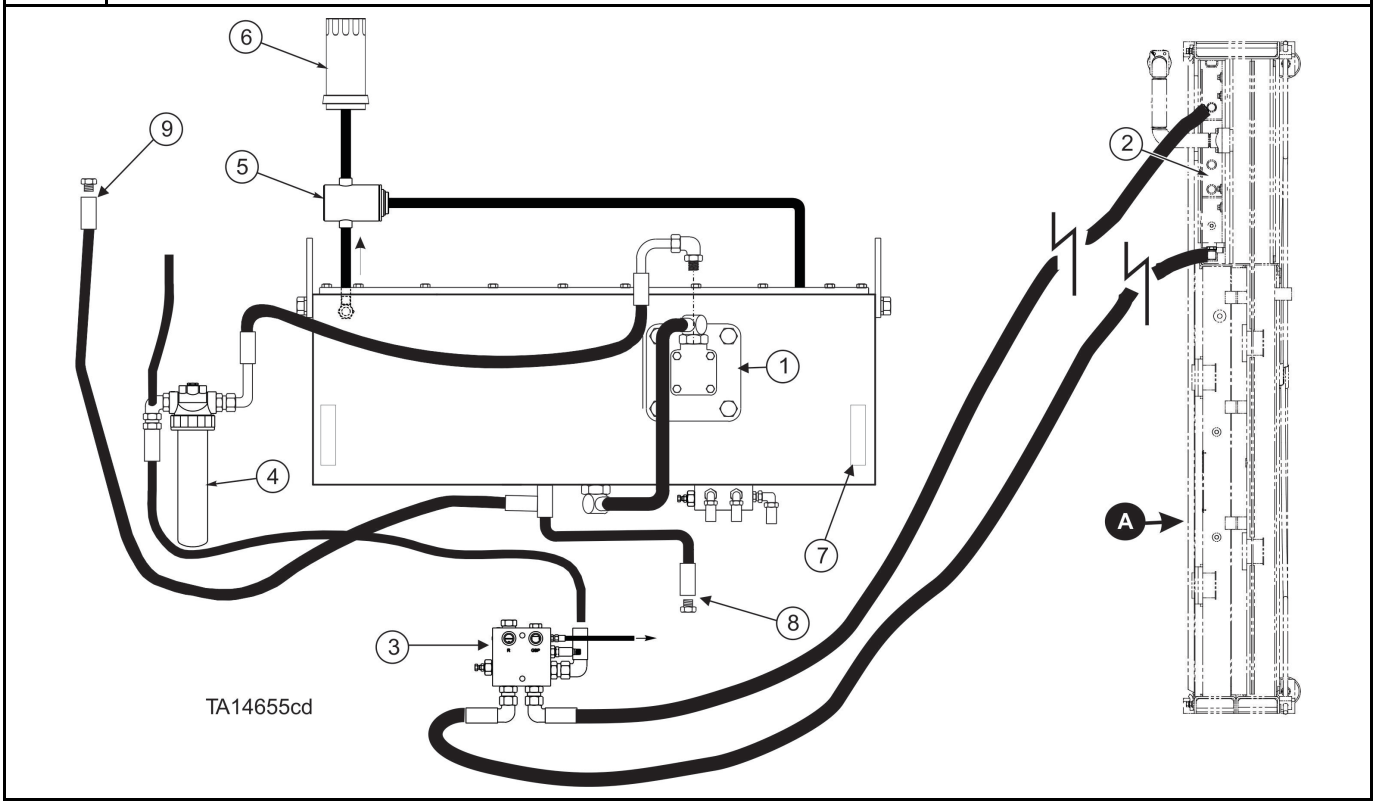
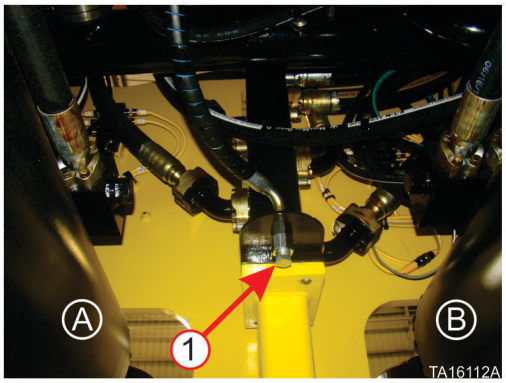
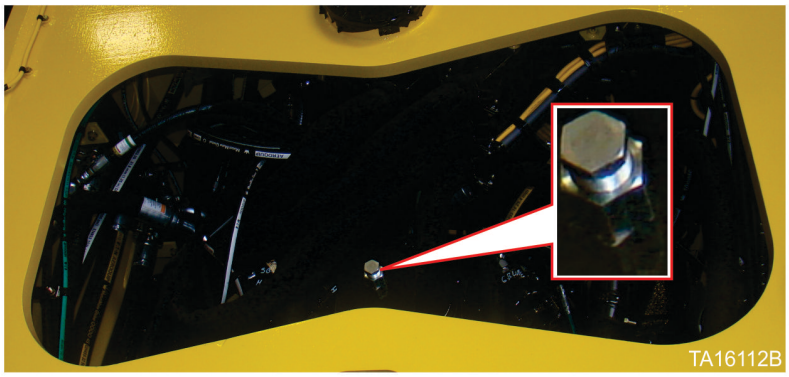


Figure 1: Remote Drain and Fill locations on HPD (optional)



1) Remote drain, **A)** Left steer cylinder,

B) Right steer cylinder, inside rear frame

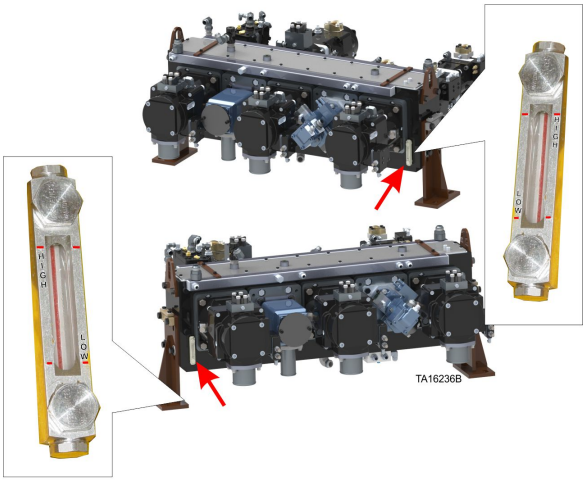


Remote fill fitting, in articulation area, rear frame

Sight Glasses

Mechanical sight glasses used to determine the oil level inside the gearbox are mounted on each side, on the non-drive end of the gearbox.

Figure 2: Sight glass with “high” (full) and “low” level indicator marks (glass shown empty).



NOTICE

Do NOT overfill the gearbox. Heat buildup can occur which could damage bearings and gears.

The “full” level is the “high” mark at the upper end of the sight glasses. Maintain the level at that mark. DO NOT overfill beyond that level. The lubricant level should be checked while close to normal operating temperature. Wait 10 minutes after stopping the engine before checking the level. This allows any residue (due to possible foaming) to drip back into the gearbox from the breather hose and strainer.

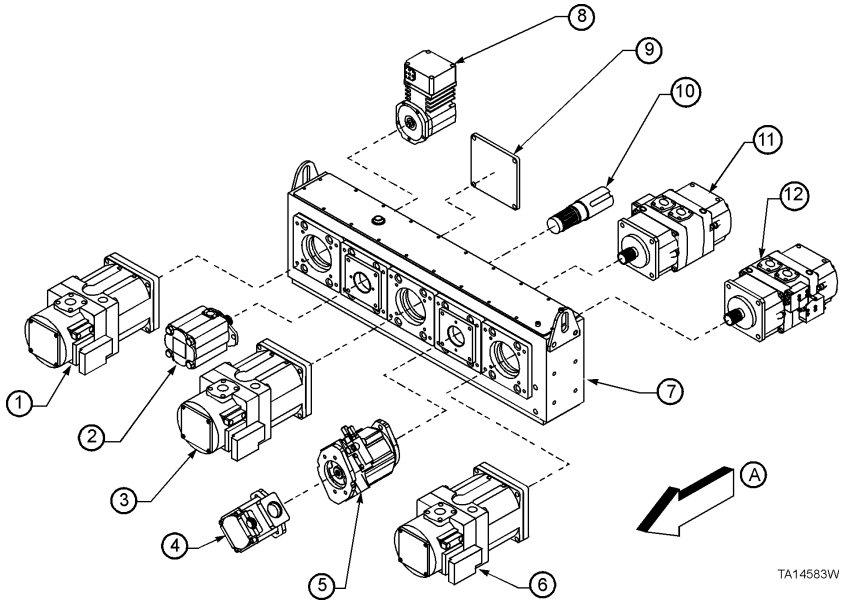
NOTICE

Overfilling the gearbox can cause fluid to be expelled from the breather causing an environmental impact.

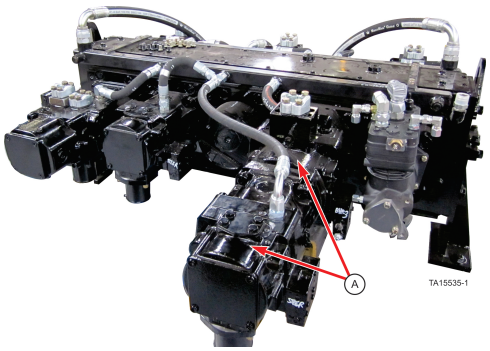
NOTICE

There are two sight glasses on the HPD: One on either end. The machine should be stopped (and shut down) on as level ground as possible (especially side-to-side) before reading the lubricant level in the sight glasses.

Figure 3: L-1350 GEN2 hydraulic pump arrangement (typical pump types are illustrated)



A) to front of loader 1) Main pump #3 **2)** Hydraulic oil cooling circuit **3)** Main pump #2, **4)** Gearbox lube **5)** Accessory pump **6)** Main pump #1 **7)** Hydraulic pump gearbox, **8)** Air compressor **9)** Cover plate **10)** Driveshaft - powered from generator **11)** Steering, **12)** Engine fan/ blower



A) Pumps NOT present on L1350, cover is installed.

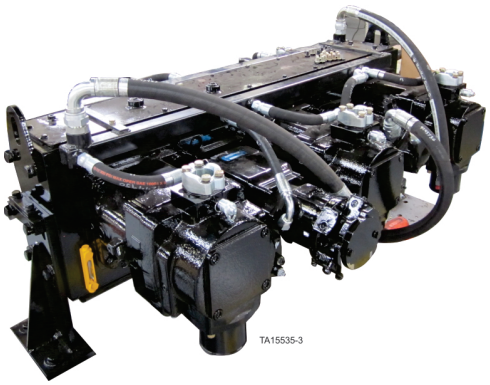
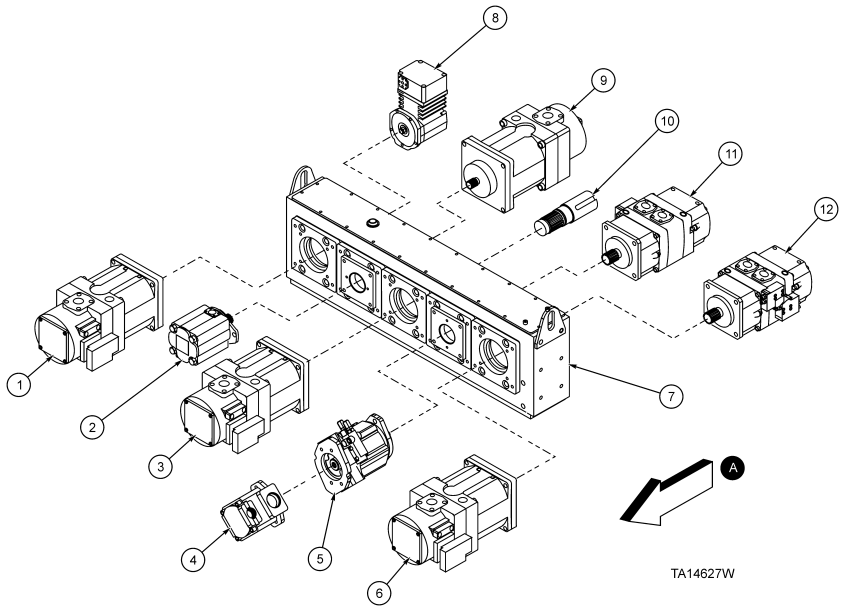
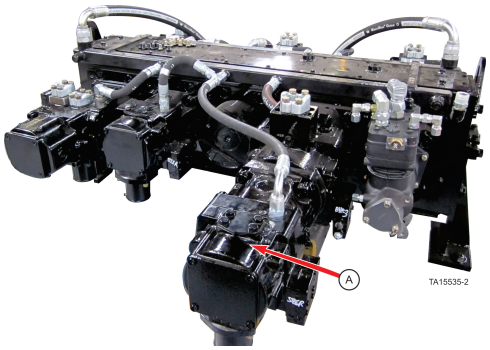
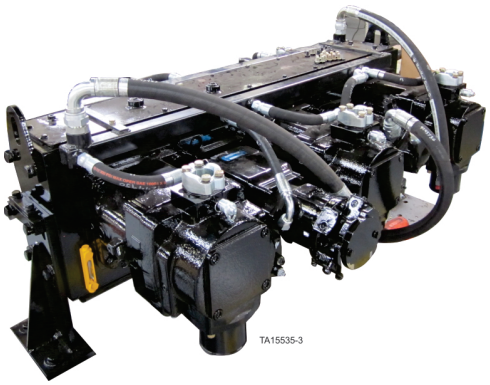


Figure 4: L-1850 hydraulic pump arrangement (machines with Tier1 or 2 engine) (typical pump types are illustrated)



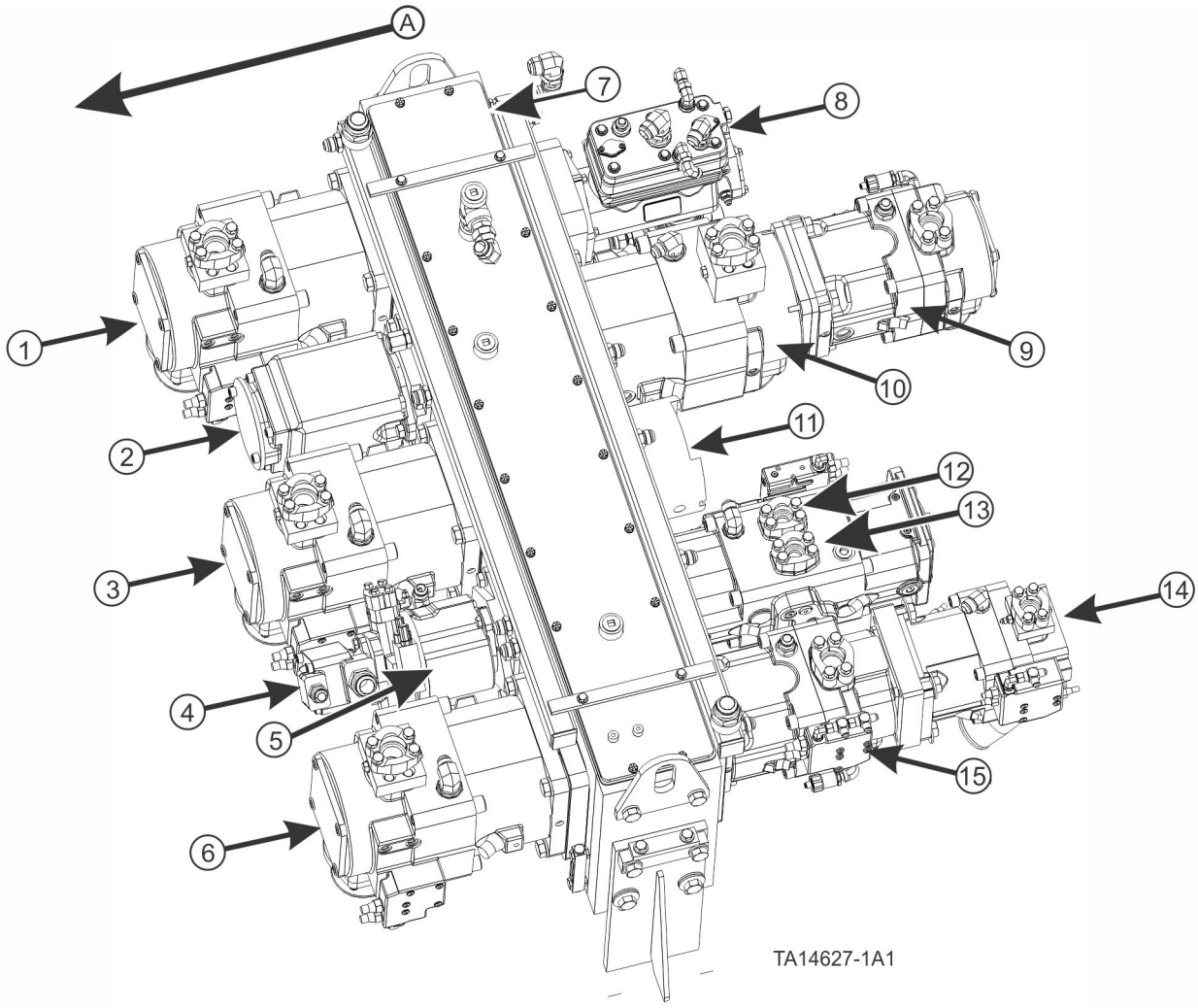


A) Pump NOT present on L1850



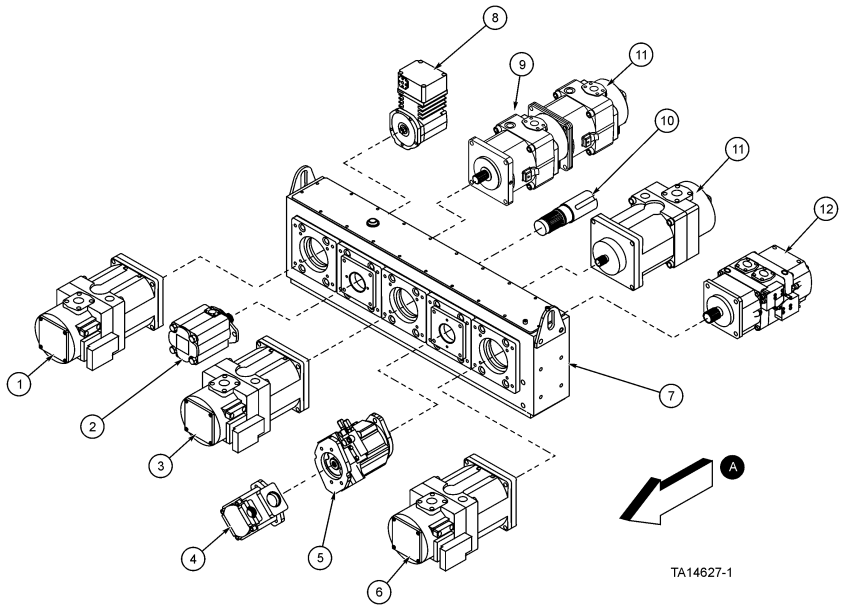
A) To front of loader **1)** Bucket hoist pump #2 **2)** Hydraulic oil cooling circuit **3)** Fast hoist pump #2, **4)** Gearbox lube **5)** Accessory pump **6)** Bucket hoist pump #1 **7)** Hydraulic pump gearbox, **8)** Air compressor **9)** Bucket hoist pump #3 **10)** Drive shaft - powered from generator, **11)** Steering **12)** Engine fan/blower

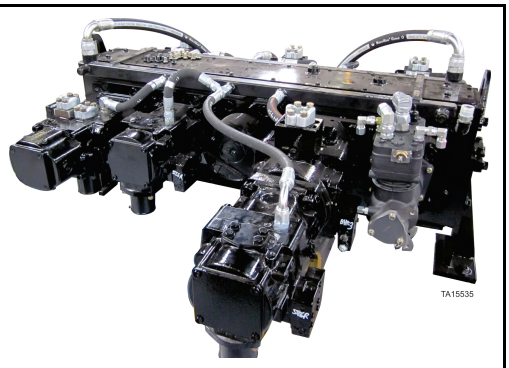
Figure 5: L-1850 Hydraulic pump arrangement for 11 blade Tier 4 engine fan (typical pump types are illustrated)

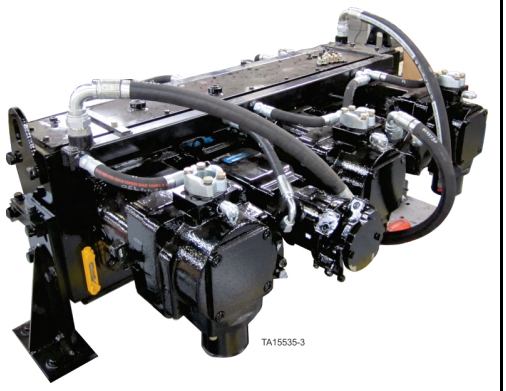


A) To Front Of Loader, **1)** Bucket/Hoist Pump#2, **2)** Hydraulic Oil Cooler Pump, **3)** Fast Hoist Pump, **4)** Gearbox Lube Pump, **5)** Accessory Pump, **6)** Bucket/Hoist Pump #1, **7)** Hydraulic Pump Gearbox, **8)** Air Compressor, **9)** Engine Fan Pump#2, **10)** Bucket/Hoist Pump#3, **11)** Drive Shaft Powered by Generator, **12)** Steering Pump B, **13)** Steering Pump A, **14)** Engine Air Blower Pump, **15**) Engine Fan Pump#1

Figure 6: L-2350 hydraulic pump arrangement (typical pump types are illustrated)







A) To front of loader **1)** Bucket hoist pump #2 **2)** Hydraulic oil cooling circuit **3)** Fast hoist pump **4)** Gearbox lube **5)** Accessory pump **6)** Bucket hoist pump #1 **7)** Hydraulic pump gearbox **8)** Air compressor **9)** Hoist and bucket **10)** Input shaft **11)** Steering pumps **12)** Engine fan/ blower

Circuit Description for HPD Gearbox Oil

Components used in the Gearbox Oil Circulation Pump circuit:

- HPD Gearbox Oil Cooler Circulation Vane Pump (approximately 18 gpm (68 lpm)
- HPD Gearbox Oil Control Valve
- Check Valve 100 psi (6.9 bar)
- Sequence Valve (pressure reducing)
- Oil Cooler (located at the radiator)
- Pressure Transducer

For description of the Gearbox Oil Circulation Pump function, the following assumptions are made:

Engine is running at high throttle (~1800 rpm), Hydraulic oil level in the hydraulic reservoir is correct, Gearbox and Control valve operation is correct.

Overview of the Gearbox Oil Circulation Pump function:

The gearbox oil circulation pump provides gearbox bearing lubrication oil and oil flow through an oil cooler. An internally mounted manifold distributes lubricating oil to the internal gearbox gears. As the gears inside the gearbox turn, part of the pressurized oil is delivered to the tapered roller bearings. The remaining oil is directed to an oil cooler that is located inside the engine radiator shroud. The pressure and temperature of the gearbox oil is monitored by LINCS with warnings and alarms generated for out of limit conditions. Mechanical sight glasses used to determine the oil level inside the gearbox are mounted on each side, on the front of the gearbox. The full level is the “high” mark at the upper end of the sight glass. DO NOT overfill.

NOTICE

The machine should be as level as possible, especially side to side, when reading the lubricant level in the sight glasses.

Detailed description of the Gearbox Oil Circulation Pump circuit:

The gearbox oil is monitored for pressure and temperature. The electrical components used are a pressure transducer (4-20ma sensor) and a temperature probe (4-20ma sensor). The pressure and temperature transducers and cables are monitored by the LINCS II control system for a high or low failure. If the oil pressure goes below 10 psi (0.069 bar) for more than 5 seconds, a red alarm is generated on the operator’s screen and an engine shutdown sequence begins. If the gearbox oil temperature goes above 205º F (96º C) for 0.5 seconds, a yellow warning is displayed on the operator’s screen.

Detailed fluid flow description of the Gearbox Oil Circulation Pump:

The gearbox oil circulation pump circulates the oil in the gearbox housing. The oil is drawn from the bottom of the gearbox. The circulation pump is a constant displacement vane pump. As the oil flows out of the pump, it is directed to a pressure filter. From the pressure filter, the oil flows to the gearbox oil control valve. The gearbox oil control valve consists of a 100 psi (6.9 bar) check valve, a sequence valve (pressure control), temperature probe, and pressure transducer. As the oil enters into the control valve it is directed to the oil cooler and the sequence valve. The oil cooler has a set amount of oil flow restriction causing the pressure from the pump to increase. The sequence valve senses this pressure and relieves excessive pressure to a return galley in the control valve. The sequence valve is set at 200 psi (13.7 bar). The return galley in the control valve has a 100 psi (6.9 bar) check valve that restricts the oil returning to the gearbox. This 100 psi (6.9 bar) back pressure oil is then directed to the pressure transducer, temperature probe, and to an oil manifold with oil tubes.

The oil manifold is located internally across the top of the gearbox.

Figure 7: Hydraulic pump drive (HPD) oil manifold (typical) location

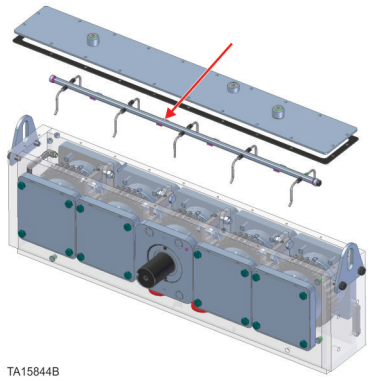
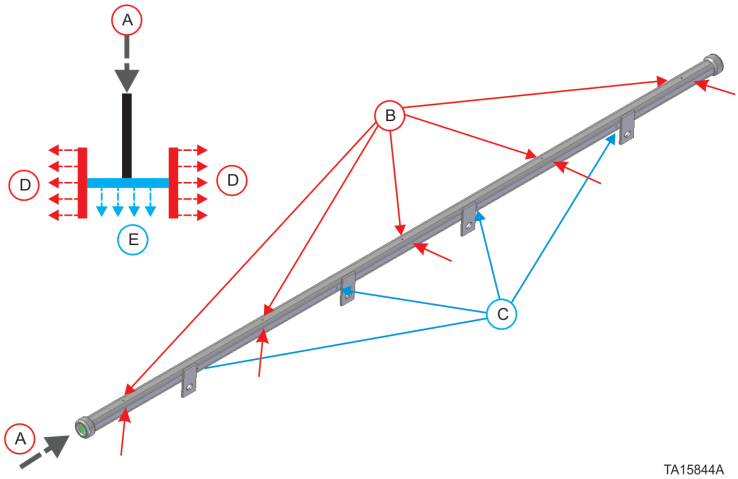
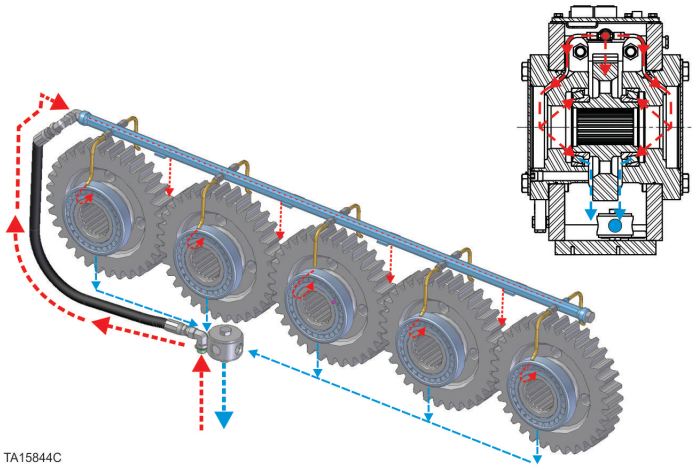


Figure 8: Hydraulic pump drive (HPD) oil manifold orifices



A) oil enters manifold, **B)** 3/32” (2.381mm) orifices on front and rear of manifold directs oil to bearings (five in front and five in rear), **C)** 3/32” (2.381mm) orifices on bottom of manifold direct oil to teeth of gears (four total), **D)** Oil is directed to bearings, **E)** Oil is directed to teeth of gears

Figure 9: Hydraulic pump drive (HPD) internal oil circulation



There are five orifices in the front, five in the rear, and four in the bottom of the manifold. The orifices are 3/32” (2.38 mm) and must not be modified. The size of the orifices is calculated to allow a set amount of oil to pass through each orifice. Tubes are connected over the orifices that direct oil to an oil galley located above each bearing in the gearbox. This oil lubricates and cools the bearings during operation. There are four orifices on the bottom of the manifold that spray oil into the teeth of each gear, for lubrication. After the oil has flowed through the bearings, or over the gear teeth, it flows back into the sump of the gearbox.

Oil that flowed through the oil cooler is cooled by the engine fan air flow. The cooled oil is then directed back to the gearbox housing where the cooled oil is combined with the rest of the gearbox oil.

CAUTION

If removing and replacing the gearbox lube pump, create a record of the seal orientation. The seal is reversed to prevent cross-contamination of gearbox lubricant and hydraulic oil.

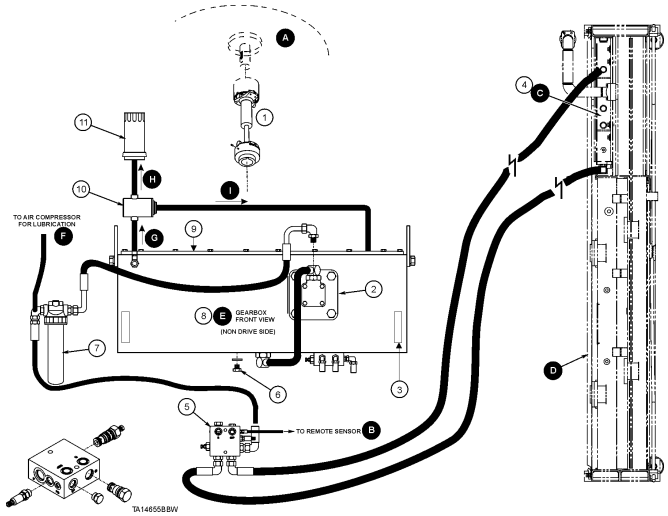
NOTICE

Some of the oil exits the gearbox filter fitting which is used to lubricate the HPD gearbox mounted air compressor.

NOTICE

Remove all paint, rust and debris from mating surfaces of all bolts 3/4" or larger and torque per specifications listed on the “Capscrew and Bolt-Nut Torque Specifications”.

Figure 10: HPD gearbox oil cooler circuit components (typical)



1. Drive shaft
2. Lube pump
3. Fluid level sight glass
4. Oil cooler (typical)
5. Control valve
6. Drain plug (Some models have a remote drain).
7. Oil filter
8. HPD gearbox (typical)
9. Fill plug
10. Separator
11. Air breather filter

A. Generator

B. To remote sensor

C. Oil cooler

D. Looking at top of radiator (not to scale)

E. Gearbox front view (non drive side)

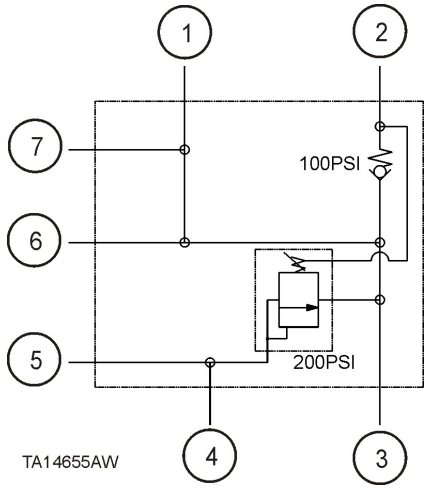
F. To air compressor for lubrication (gearbox mounted air compressors only).

G. Oil and air

H. Air

I. Oil back to gearbox

Figure 11: Hydraulic pump drive (HPD) oil cooler circuit (typical)



1. Pressure from circulation pump
2. Pressure to cooler
3. Return from cooler
4. Hydraulic pump drive manifold pressure
5. Return to hydraulic pump drive sump
6. Pressure transducer
7. Temperature transducer

Removal/Installation Procedures

HPD Gearbox Removal, Disassembly and Assembly

Safety Preparations for Task

Use the following procedure to isolate energy sources before performing any removal, replacement, or installation procedures described in this document.

WARNING

Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

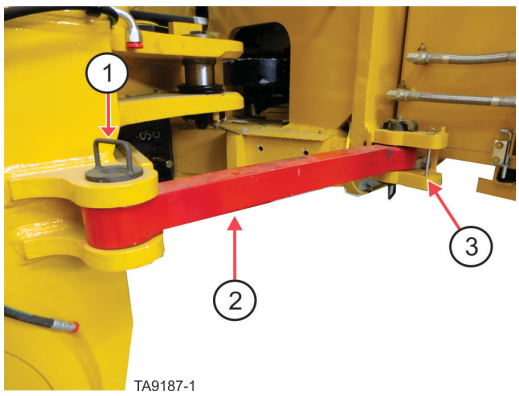
Step 1: Stop the wheel loader on flat level ground.

WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.

Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Figure 12: Frame lock in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 3: Place wheel chocks in front and behind each wheel.

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

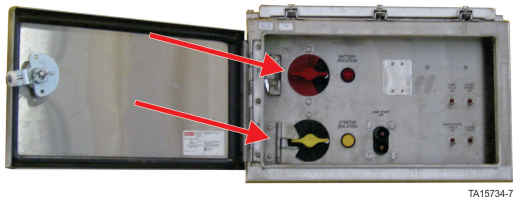
Step 6: Shut off the engine.

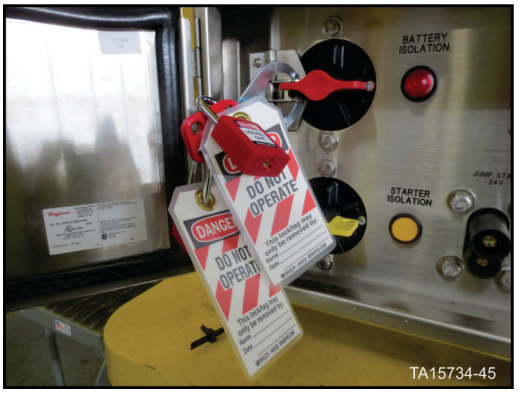
WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

Battery and Engine Isolation Switches, Additional Safety Preparations

Step 1: Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.



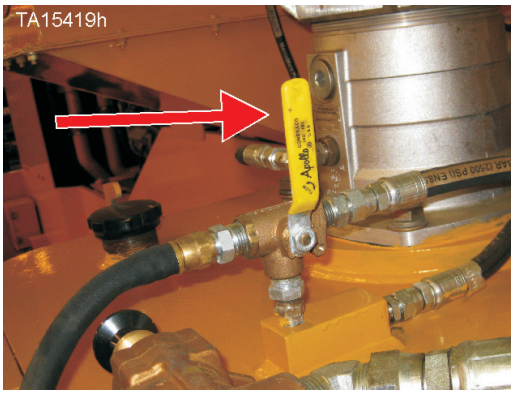


Battery Isolation Box – Battery isolation switch in OFF position with locks in place

Hydraulic Reservoir Pneumatic Pressure Relief, Additional Safety Steps

Step 1: Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir.

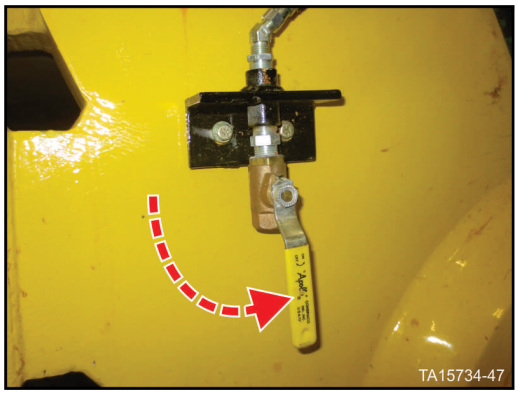
- Turn the handle to the up position as shown below.
- The air supply line from main air system will be blocked.
- The reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.



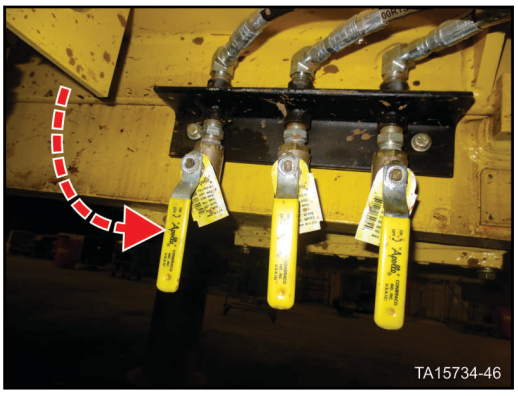
Hydraulic reservoir air valve handle UP

Compressed Air Reservoir Pressure Relief, Additional Safety Preparations

Step 1: Release the air from the various air storage reservoirs by opening all of the air bleed valves.



One valve on right side of front frame near hoist cylinder ball cap



Three valves on right side of rear frame under hydraulic reservoir

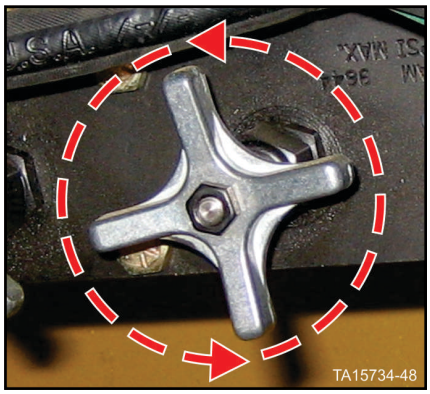
Open air reservoir bleed valves

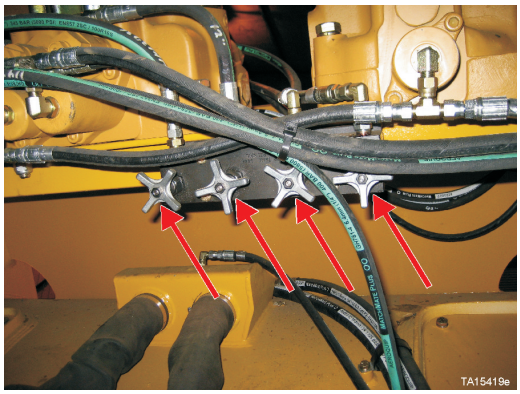
Hydraulic Hoist and Bucket Circuit Pressure Relief, Additional Safety Preparations

Step 1: Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.

Step 2: Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.

Step 3: Open the valve completely and leave it open during this procedure.





Hoist and bucket circuit hydraulic pressure bleed down valves

Removal

The illustrations in this section show a TYPICAL gearbox being removed/installed. Some models have fewer pumps than what is shown. The following instructions are similar for all models.

NOTICE

Removal and installation of the HPD gearbox requires either a truck-mounted crane or overhead crane of sufficient height and capacity to lift the hood assembly, the combined (cooling air system, air filtration unit, and blower assembly,) and the gearbox with pumps attached.

Table 4: Typical weights for components

Item/Equipment	LBS.	KGS.
Hood Structure (Without Attachments such as Fire System, etc)	2,000	908
Cooling Air System/Air Filtration Unit/Blower	4,000	1,815
Hydraulic Pump Gearbox (L1350) (without pumps)	2,300	1,044
Hydraulic Pump Gearbox (L1350) (with pumps)	4,000	1,815
Hydraulic Pump Gearbox (L1850) (without pumps)	2,300	1,044
Hydraulic Pump Gearbox (L1850) (with pumps)(Tier 1 or 2 engine)	4,700	2,132
Hydraulic Pump Gearbox (L1850) (with pumps)(Tier4 engine)	5,000	2,268
Hydraulic Pump Gearbox (L2350) (without pumps)	2,300	1,044
Hydraulic Pump Gearbox (L2350) (with pumps)	5,000	2,268

Step 1: Release hydraulic reservoir air pressure with the manual air release valve located on top of the hydraulic reservoir.

Step 2: Remove the catwalk grating and cross-member anchoring grating behind the operator's cab.

Step 3: Remove the front hood structure.

Figure 13: Hoisting of hood assembly

Step 4: Remove central air blower assembly and KLENZ™ air filtration unit.

CAUTION

Wooden cribbing is required to support the KLENZ™ air filtration unit and blower to ensure no damage is done to housings or tubing when the units are removed from the machine. Remove the KLENZ™ air filtration and blower assembly as a unit. Position the assembly on wooden cribbing to ensure no damage occurs to tubing or housings. Securely cover all openings to prevent ingression of dirt or debris.

Figure 14: Hoisting of KLENZ™ and blower assembly

Figure 15: KLENZ™ and blower assembly supported by cribbing - 1 of 3

Figure 16: KLENZ™ and blower assembly supported by cribbing - 2 of 3

Figure 17: KLENZ™ and blower assembly supported by cribbing - 3 of 3

Step 5: Disconnect drive shaft U-joint from hydraulic pump drive.

Step 6: Tag and disconnect the hoses from the hydraulic pumps. Then cap the openings to prevent foreign material from entering.

Step 7: Remove the bolts, flatwashers, and lockwashers securing the mounting structures to the frame of the loader.

Step 8: Attach a suitable hoist to the eye brackets and lift the gearbox clear of the loader and into a prepared area.

HPD Gearbox Disassembly

Refer to illustration (select appropriate model) “HPD gearbox assembly" at the end of this document unless otherwise noted.

Step 1: Remove the bolts, nuts, and lockwashers to allow the hydraulic pumps to be removed along with the associated O-rings and adapter sleeves.

NOTICE

Do not disassemble retainer, bearing and input shaft unless inspection reveals excessive wear.

Step 2: Remove hose connections to disconnect the HPD air filter.

Step 3: Provide a suitable container, then remove the plug and drain the gearbox oil. The hydraulic pump drive oil capacity is:

- L1350/L1850/L2350: 7 gallons (26.5 liters).

Step 4: Remove bolts and lockwashers securing cover plate structure. Remove cover plate and gasket.

Step 5: Disconnect tube assembly from tube manifold structure.

Step 6: Disconnect and remove the tube manifold structure by removing bolts and lockwashers.

NOTICE

Do not disassemble the tube manifold structure unless inspection reveals damage.

Step 7: Remove hose assemblies to disconnect the oil filter assembly.

NOTICE

Make record of or mark each bearing housing as to its location so as not to confuse the positioning during disassembly.

Step 8: Remove the bolts and lock washers to allow removal of the output bearing housings with O-rings.

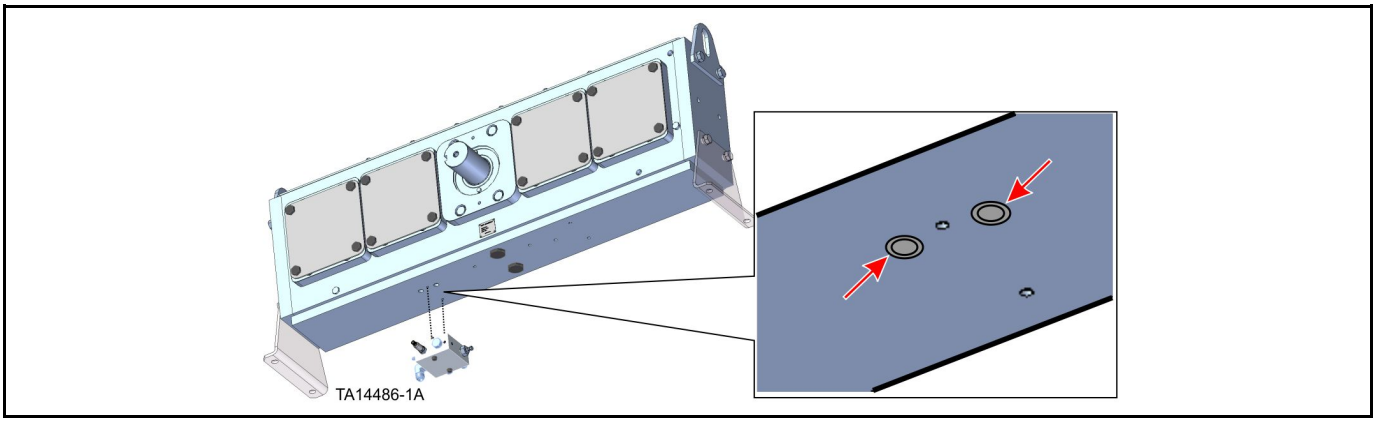
Step 9: The bearing races must be pressed from the housings.

Step 10: Remove the drive gears.

Inspection

1. Check all the bearings for excessive play, pitting or discoloration. Replace any found defective.
2. Inspect the gears for broken or worn teeth, pitting, discoloration, or damaged splines. Replace any found defective.
3. Inspect all splined components for wear or damage. Replace any found worn beyond serviceability.
4. If gear failure has occurred, check the housings for cracks.
5. Inspect the two holes under the gearbox oil cooler control valve attached to the bottom of the gearbox.
   - If the holes have grooves cut into the box, weld up the O-ring grooves surrounding the holes and machine flat.
   - If a spacer plate exists between the control valve and the gearbox, discard the plate, weld up the O-ring grooves around the holes and machine flat.

Figure 18: Holes in gearbox must have the surrounding O-ring grooves welded up and machined smooth



1. Clean all parts in solvent and dry.

⚠ CAUTION

Chemical hazard and inhalation hazard exists if the appropriate Personal Protective Equipment (PPE) is not used when using solvents and compressed air. When working with chemicals, avoid contact with them and ensure proper ventilation is adequate. Ensure all required PPE is used. Follow all local rules and regulations when working with chemicals. Failure to use proper PPE and to avoid chemical contact could cause a chemical hazard and inhalation hazard resulting in personal injury.

2. Check all machined parts for cleanliness, burrs, etc. Clean/deburr, if required.
3. Be sure to flush all oil passageways to eliminate any debris from causing a gear or bearing failure.
4. Install a new oil filter element and breather filter element as listed on illustration "HPD GEARBOX COMPONENT SPECIFICATIONS.").
5. Lubricate all gears, splines, and bearings prior to installation.
6. Check to ensure that all parts are available and gathered at assembly area.

Assembly and Shimming for Proper Bearing Endplay

Step 1: Install three .020 shims (.060 total) to bearing output housings on the side opposite of the input shaft of the gearbox. Refer to figures below.

Figure 19: Three .020 shims to be installed to rear output bearing housingFigure 24. Installation of shims (.060) to rear output bearing housings

Step 2: Apply LUBRIPLATE 630-AA assembly grease (or equivalent) to the O-rings before installing to the output bearing housings.

Figure 20: Lubriplate 630-AA Specifications

Type of soap	Lithium
N.L.G.I. #	1
Worked penetration range @ 77º F (25º C)	300/330
ASTM dropping point, ºF	380
Mineral oil viscosity SUS @ 100º F (38º C)	750
Non-corrosive extreme pressure & lubricity additives	YES
Water resistant	YES
Color	OFF-TAN

Figure 21: Installation of O-ring to rear output bearing housing

Step 3: Apply LUBRIPLATE 630-AA assembly grease (or equivalent) to the O-ring and to the openings in the gearbox for the bearing output housings as shown below.

Figure 22: Application of assembly grease to gearbox

Step 4: Hoist the first gear and bearing assembly into the gearbox.

Step 5: Replace any socket head capscrews with SAE Grade 8 bolts.

Step 6: Verify that the proper washers (.217” thick and hardened) are used under the bolts.

Step 7: Align the gear and bearing assembly with the bearing output housing.

Step 8: Install the output housing retaining bolts and flat washers. The threads on these bolts must be sealed to prevent oil leaks.

Figure 23: Installation of rear output bearing housing

NOTICE

DO NOT lubricate these bolts with 30W motor oil or any other lubricant. Do not apply Teflon tape, Teflon based thread sealant or any thread locking compound.

Apply 410-3739 LOCTITE RC 569 Hydraulic Thread Sealant compound to the threads.

Torque the bolts to 361 ft lbs (489 N•m).

Step 9: Leave the gear and bearing assembly suspended from the hoist so that it can be positioned into the front output bearing housing.

Step 10: Install .040 shims to the front output bearing housings.

NOTICE

Shimming is done from the front side of the gearbox. DO NOT install O-ring at this time. The .040 shims are a starting point to use to calculate whether shims need to be added or removed to get bearing endplay to within the allowable tolerance of .004 to .006. The front output bearing housing must be removed for final placement of the shims and then reinstalled with the O-ring in place.

Step 11: Lubricate the gearbox opening for the bearing output housing with LUBRIPLATE 630-AA assembly grease.

Step 12: Place the bearing output housing into the opening and use the hoist to position the gear and bearing assembly into the output bearing housing with the bearing seated in the race.

Figure 24: Installation of front output bearing housing with .040 shims in place

Step 13: Install the retaining bolts at this time with no lubricant or thread sealer on the threads. Use a ½" impact, set on high, with 120 psi air pressure. This will provide approximately 315 lbs. of torque. Use of a torque wrench is not required at this stage of the assembly.

Step 14: Install all gears in the same manner.

Step 15: Install the brace bars, then torque bolts and self-locking nuts to 282 ft lbs (382 N•m).

NOTICE

The brace bars must be assembled in the proper location or the oil gallery rail will not fit properly.

Figure 25: Installation of brace bars

Step 16: Place a magnetic base dial indicator on the backside of the gearbox with the probe against the inside bearing race.

Figure 26: Magnetic base dial indicator in position to read bearing end play

Step 17: From the front of the gearbox, place two pry bars on each side of the top front side of the first gear and pry the gear towards the rear of the gearbox.

Figure 27: Gear pried toward rear of gearbox

Step 18: Hold the gear with the pry bars while a second person zeros the dial indicator.

Step 19: Move to the rear of the gearbox. Place the pry bars in position to pry the gear towards the front of the gearbox.

Figure 28: Gear pried toward rear of gearbox to measure bearing end play

Step 20: Have the second person read the dial indicator and record the reading.

Step 21: Remove the front output bearing housing and place the appropriate shims to get the bearing endplay to within .004 to .006.

Figure 29: Removal of front output bearing housing for shim adjustment

NOTICE

This may require more than one removal and installation of the bearing output housing with different thicknesses of shims before the final allowable endplay is reached.

When the front output bearing housing is removed to adjust the shims, it is essential to either have a second person hold the gear and bearing assembly or place suitable blocking between the gear and the gearbox housing to prevent the gear and bearing assembly from falling forward out of the rear output bearing housing. The gear and bearing assembly must be held in this position until the front output bearing housing is reinstalled.

Step 22: Reinstall the output bearing housing and recheck the bearing endplay. If it is not within the allowable tolerance of .004 to .006 remove the output bearing housing and adjust the shims as needed and replace the output bearing housing and check endplay again.

Step 23: Once the correct shims have been determined, remove the output bearing housing and install the O-ring. Lubricate the O-ring and opening in the gearbox with LUBRIPLATE and install the output bearing housing.

Step 24: Install the bolts with LOCTITE RC569 thread sealant compound on the threads of the retaining bolts. Torque to 361 ft lbs (489 N•m).

Step 25: Repeat this procedure for each gear assembly.

NOTICE

Perform the complete shimming procedure for each gear. The first gear shims may not be the same required for the other gears.

Step 26: After shimming each gear and bearing assembly, turn the gears by hand. They should turn freely with no binding.

Installation of Manifold Tube Assembly

NOTICE

Some gearboxes were equipped with an improperly manufactured manifold tube structure assembly which had straight 1/4" O.D. tubes. The correct manifold tube structure assembly has curved 1/4" O.D. tubes that deliver oil to the bearings in a more efficient manner by extending into the hole above the bearing. The only straight tube is located over the input shaft. The entire manifold assembly must be replaced if it is necessary to change to the curved 1/4" tubes. The curved 1/4" O.D. tubes cannot be installed on the manifold originally equipped with straight 1/4" O.D. tubes.

Figure 30: Incorrect manifold tube assembly with straight tubes

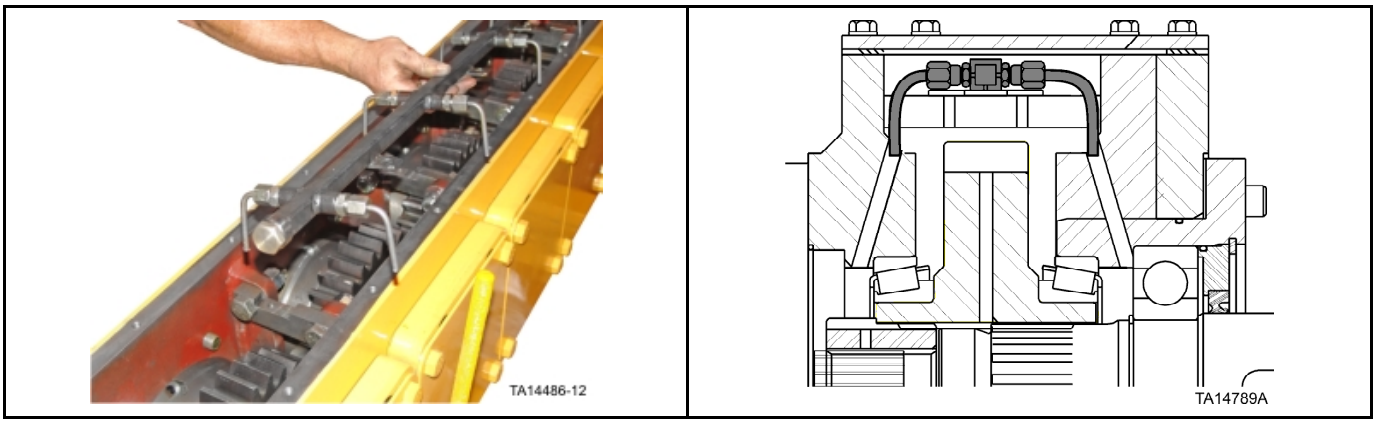
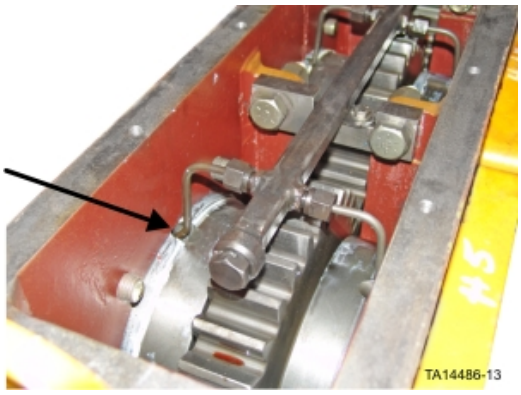
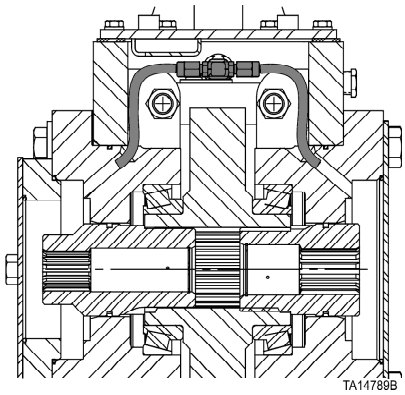


Figure 31: Correct manifold tube assembly with curved tubes





1. Install manifold tube structure assembly.

NOTICE

Some gearboxes were equipped with a steel supply tube to the manifold assembly. The supply line is a hose on current gearboxes as shown in figure below. It is not necessary to change this tube unless it is leaking or damaged.

2. Install hose to manifold tube assembly. It is critically important that the 90˚ fitting is attached and tightened to the manifold tube assembly so that the hose cannot make contact with the gear. Refer to illustration below.

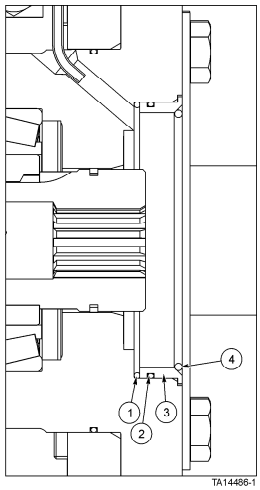
Figure 32: Correct hose installation to manifold tube assembly to avoid damaging hose

1. Install the lid on the box. Do not use RTV sealant on the gasket for the lid as it can come loose and clog filter and oil passages.

Installation of O-Rings and Spacer O-Ring

Two of the pumps have a smaller pilot diameter than the gearbox bearing housing so adapter sleeves (#3 below) are used. Two new O-rings (#1 and #2 below) are needed to seal each adapter sleeve (one in the center OD O-ring groove of the adapter and one as a spacer in the bore of the bearing housing where the adapter seats. The pump O-ring (#4 below) fits the pilot bore and seals against the chamfered edge of the adapter.

Figure 33: Side view illustration of sleeve installation with spacer O-ring



1. Spacer O-ring
2. Adapter sleeve O-ring
3. Adapter sleeve
4. Pump O-ring

Step 1: Place O-ring into output bearing housing as shown.

Figure 34: Installation of spacer O-ring into output bearing housing

Completed installation of spacer O-ring.

Step 2: Install O-ring to sleeve and apply LUBRIPLATE 630-AA assembly grease to the O-ring and sleeve.

Figure 35: Application of assembly grease to sleeve O-ring and sleeve.

Step 3: Place the sleeve square into the opening in the output bearing housing.

Figure 36: Placement of sleeve square into output bearing housing.

Step 4: Use a rubber mallet to drive the sleeve into the housing against the O-ring. The outer edge of the sleeve should be flush with the outer face of the output bearing housing.

Figure 37: Installation of sleeve into output bearing housing

Step 5: Install O-ring to the pump and apply LUBRIPLATE 630-AA assembly grease to the O-ring.

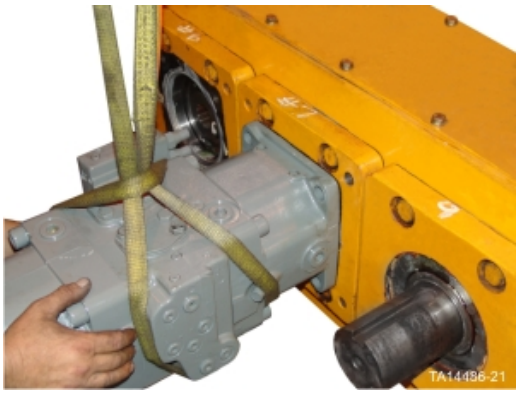
Figure 38: Application of assembly grease to pump O-ring and pump.

Step 6: Attach a sling to the pump and hoist the pump into mounting position on the output bearing housing.

NOTICE

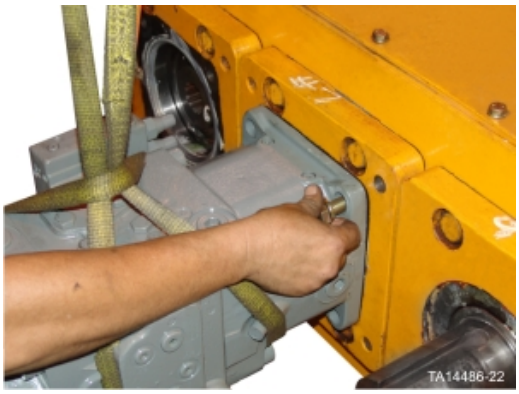
There will be a slight gap between the pump and the face of the output bearing housing when the pump is first put into mounting position. Installation of the pump retaining bolts will close this gap and provide proper sealing of the pump to the gearbox.

Figure 39: Installation of pump to gearbox.



Step 7: Lubricate pump retaining bolts on the threads and under the heads with 30W motor oil. Install retaining bolts and flat washers and torque to 361 ft lbs (489 N•m)

Figure 40: Installation of pumps retaining bolts & flat washers



Installation and Alignment of Gearbox to Generator

Safety Preparations for Task

Use the following procedure to isolate energy sources before performing any removal, replacement, or installation procedures described in this document.

⚠ WARNING

Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

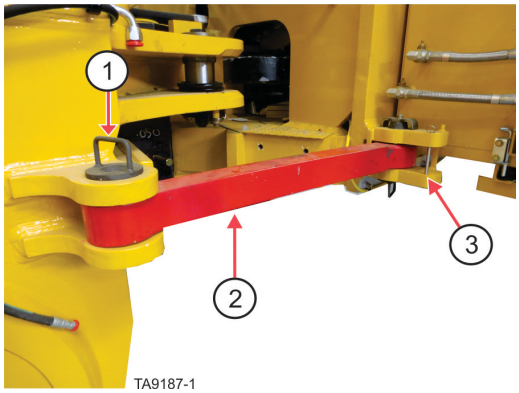
Step 1: Stop the wheel loader on flat level ground.

⚠ WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.

Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Figure 41: Frame lock in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 3: Place wheel chocks in front and behind each wheel.

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

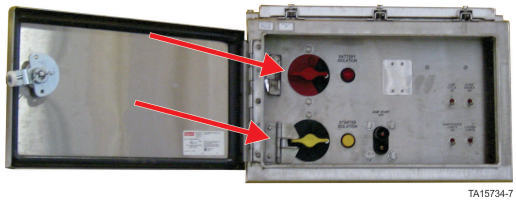
Step 6: Shut off the engine.

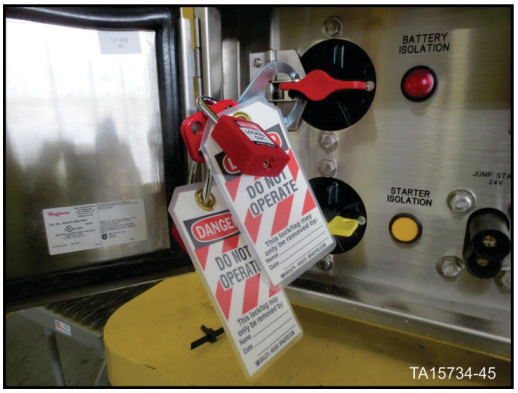
WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

Battery and Engine Isolation Switches, Additional Safety Preparations

Step 1: Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.



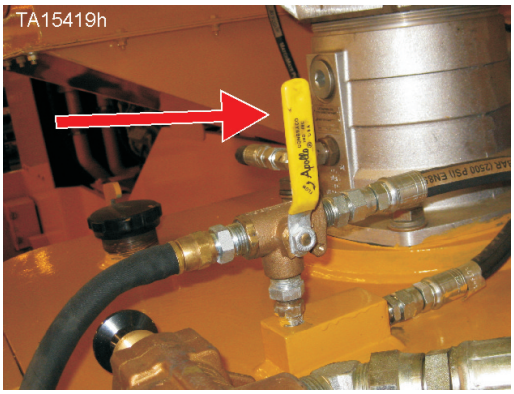


Battery Isolation Box – Battery isolation switch in OFF position with locks in place

Hydraulic Reservoir Pneumatic Pressure Relief, Additional Safety Steps

Step 1: Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir.

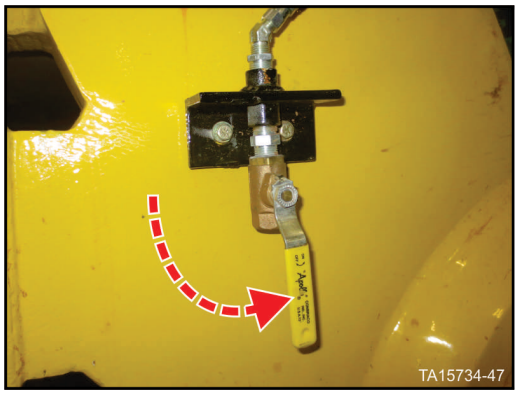
- Turn the handle to the up position as shown below.
- The air supply line from main air system will be blocked.
- The reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.



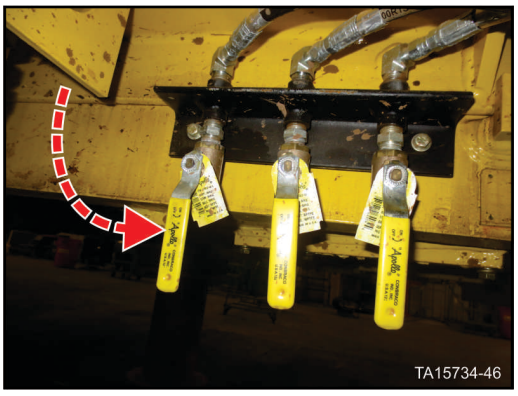
Hydraulic reservoir air valve handle UP

Compressed Air Reservoir Pressure Relief, Additional Safety Preparations

Step 1: Release the air from the various air storage reservoirs by opening all of the air bleed valves.



One valve on right side of front frame near hoist cylinder ball cap



Three valves on right side of rear frame under hydraulic reservoir

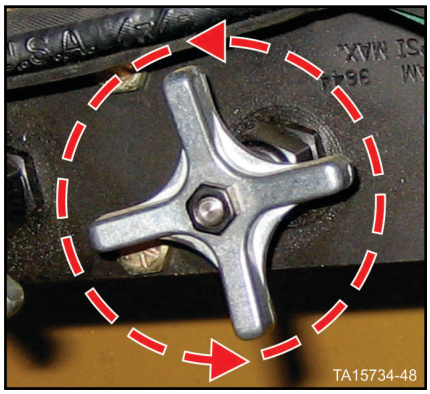
Open air reservoir bleed valves

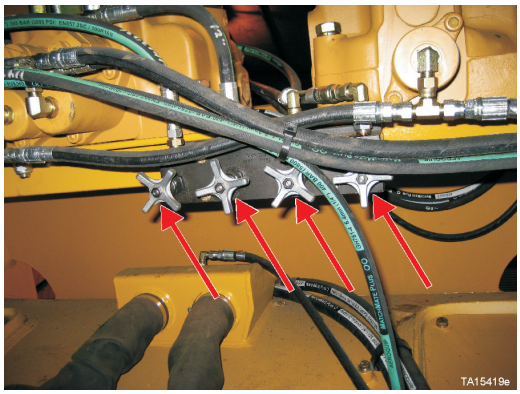
Hydraulic Hoist and Bucket Circuit Pressure Relief, Additional Safety Preparations

Step 1: Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.

Step 2: Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.

Step 3: Open the valve completely and leave it open during this procedure.





Hoist and bucket circuit hydraulic pressure bleed down valves

Installation

Refer to illustration “L1350/L1850/L2350 HPD gearbox drive shaft installation".

Step 1: Hoist gearbox into mounting position in machine.

Step 2: Fill HPD gearbox with recommended oil.

Model	Component	Capacity		Lubricant
L1350/L1850/ L2350	Hydraulic Pump Drive Gearbox[2]	7 gallons	27 liters	SAE 75W-140W synthetic gear oil or SAE 80W-90W gear oil.

1 ARCTIC CONDITIONS represent a specialized field where extensive use is made of heating equipment before starting.

2 Refer to Section 3 of this manual. The hydraulic pump drive gearbox is factory equipped with synthetic oil.

Step 3: Attach gearbox mounts to machine with bolts and washers.

CAUTION

Extreme caution must be exercised to ensure proper alignment of the gearbox to the generator or component damage could occur. Refer to illustration "L1350/L1850/L2350 HPD gearbox drive shaft installation".

Step 4: Install the drive hub on the generator output shaft.

NOTICE

INSULATED COMPONENTS – It is CRITICALLY IMPORTANT to install insulated components as shown in illustration "Generator insulated components". Note that the laminated retainer key has a specific installation orientation. When installed in the proper orientation, the material is approximately the same strength as a steel key. Orientation of all insulated components is further illustrated in "Installed components cross section".

Before beginning the alignment process, the diameters of the drive and driven hubs must be determined. Because of manufacturing tolerances, the hubs could be of different diameters. If different, allowance must be made for the alignment tolerances.

Before beginning alignment process, refer to "Alignment and Misalignment", following this procedure.

Drive Shaft Installation Procedure

Step 1: Install the driven hub on the gearbox input shaft.

Step 2: Attach hoisting device to lifting eyes and hoist gearbox into mounting position.

Horizontal Alignment

Ensure the gearbox is parallel with the generator.

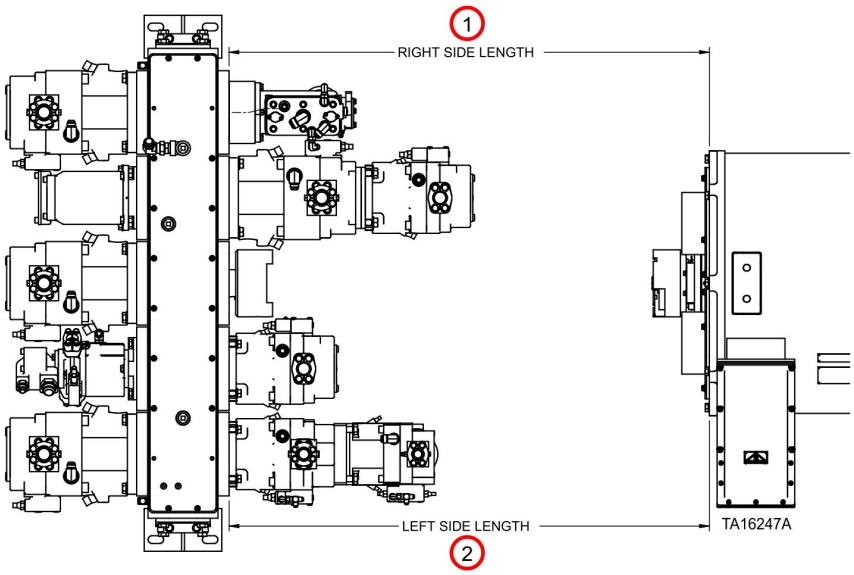
Step 1: Measure the distance from the generator end-bell to the bearing housings in the gearbox structure. Do not measure to the case drain tube or the top cover, measure only to the welded structure or adapter plates of the gearbox.

Step 2: Take two measurements either side of the drive shaft, as far apart as possible.

Step 3: Adjust the gearbox to ensure the left and right measurements are equal within ±1/8" (3.175 mm).

Step 4: Install the gearbox mount bolts. Torque bolts to Grade 8 specifications per the “Capscrew and Bolt-Nut Torque Specifications” chart.

Figure 42: Horizontal Gearbox Alignment Measurements



1. Right side length, **2.** Left side length

Vertical Alignment

NOTICE

The following procedure specifies the method to measure vertical alignment with a straight edge and ruler. If a digital protractor with adequate accuracy is available, refer to “Digital Protractor Measurement Method.

Step 1: Confirm that the generator and gearbox hubs are of equal diameter.

Step 2: Place a straight edge at the 12 O’clock position on the Generator Hub as per **Error! Reference source not found.**. Measure the gap between the straight edge and the Gearbox Hub. Record the dimension as ‘A’.

NOTICE

If the Gearbox shaft is higher than the Generator shaft, instead place the straight edge at the 12 O’clock position on the Gearbox Hub and measure the gap between straight edge and the Generator Hub.

Step 3: Place a straight edge at the 6 O'clock position on the Gearbox Hub as per **Error! Reference source not found.**. Measure the gap between the straight edge and the Generator Hub. Record the dimension as 'B'.

NOTICE

If the Gearbox shaft is higher than the Generator shaft, instead place the straight edge at the 6 O'clock position on the Generator Drive Hub and measure the gap between straight edge and the Gearbox Hub.

NOTICE

Dimensions "A" and "B" should be the same.

Step 4: If generator and gearbox hubs are not of equal diameter, use equation "1" shown below to determine if the equivalent vertical offset between shaft axes.

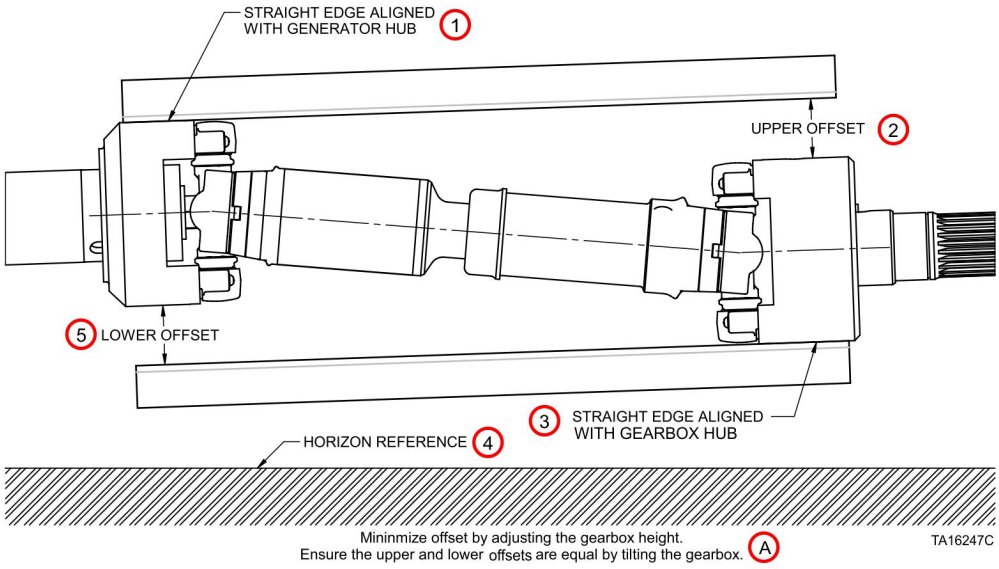
Step 5: Dimensions 'UPPER OFFSET' and 'LOWER OFFSET' after equation "1" shown below must be within 1/32" (0.794 mm) to ensure the generator and gearbox shafts are adequately parallel.

Figure 43: Equation 1

$$\text{VERTICAL MISALIGNMENT} = \frac{\text{DIAMETER Gearbox Hub}}{2} - \frac{\text{DIAMETER Generator Hub}}{2} - \frac{\text{UPPER OFFSET} + \text{LOWER OFFSET}}{2}$$

TA16269

Figure 44: Side View showing method for determining vertical alignment

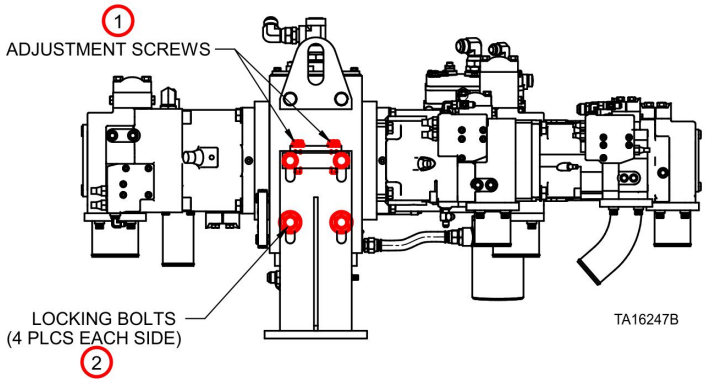


1. Straight edge aligned with generator hub, **2.** Upper offset, **3.** Straight edge aligned with gearbox hub, **4.** Horizon reference, **5.** Lower offset, **A.** Minimize offset by adjusting the gearbox height. Ensure the upper and lower offsets are equal by tilting the gearbox.

Step 6: If adjustment is required:

- Loosen the locking bolts on the gearbox mounts.

Figure 45: Gearbox Locking and Adjustment Screws



1. Adjustment screws, **2.** Locking bolts – 4 places each side

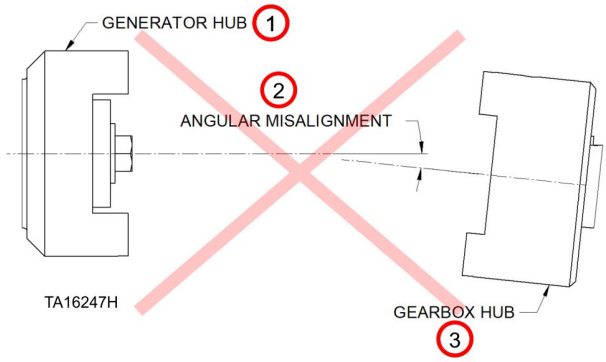
- Utilize the adjustment screws to bring the generator and gearbox shafts into parallel alignment.
- While maintaining the generator and gearbox shafts parallel, adjust the height of the gearbox to the maximum upper and lower offsets. Most models can be adjusted to within 1/16” (1.59 mm) vertical offset; however some models such as L1350 with MTU Tier 2 engines will have the gearbox adjustment at maximum.

CAUTION

It is critical that the generator and gearbox shafts remain parallel, regardless of the vertical offset, to ensure driveline vibration is minimized.

- It is critical that the generator and gearbox shafts remain parallel, regardless of the vertical offset, to ensure driveline vibration is minimized.

Figure 46: Minimize Angular Misalignment between Generator and Gearbox axis



1. Generator hub, **2.**Angular misalignment, **3.** Gearbox hub

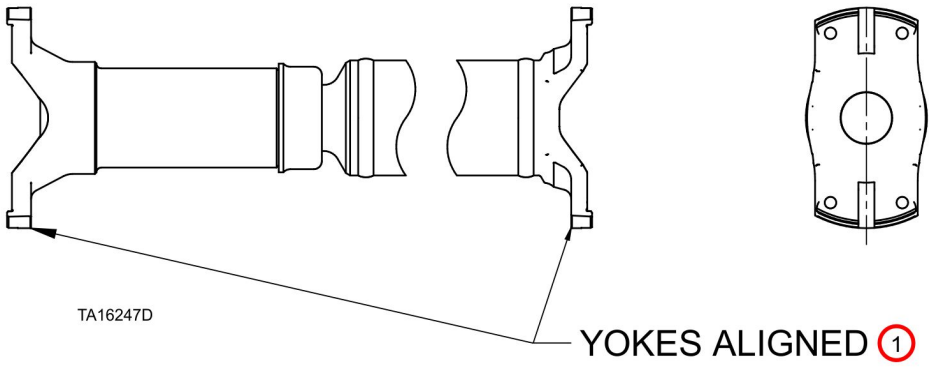
Step 7: Repeat Steps 1 through 5 to verify alignment.

Step 8: Torque the locking bolts to Grade 8 specifications per the “Capscrew and Bolt-Nut Torque Specifications” chart.

Install Driveshaft

Step 1: Inspect the drive shaft to ensure it is assembled correctly, the input and output yokes should be aligned in the same plane as shown in Figure “Proper Drive Shaft Assembly”.

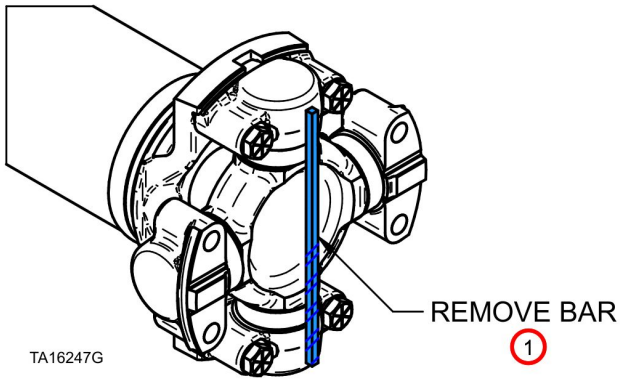
Figure 47: Proper Drive Shaft Assembly (U-Joints not shown for clarity)



1. Yokes aligned

Step 2: Remove the retainer bars from the U-joints on the drive shaft. This cross piece may contact the head of the retainer bolt and could compromise the insulation.

Figure 48: Remove Retainer Bars



1. Remove bar

Step 3: Lift the drive shaft into position and move the driven hub until it meets with the drive shaft end. Secure the driven hub in place.

Step 4: Secure the U-joint bolts into the drive hub and driven hub. Tighten the bolts to 90-ft. lbs. (122 N•m), lubricated with 30-W motor oil on the threads and under the heads.

Step 5: If the drive shaft spline and crosses are greaseable, purge with an appropriate grease per manufactures recommendations. Drive Shafts are typically a maintenance free design.

Digital Protractor Measurement Method

For most machine configurations, the input and output angles should be close to zero. On certain models and engine configurations, these angles will be much higher. Attempt to reduce these input/output angles towards zero by adjusting the height of the gearbox – ensuring that the axis of the generator and gearbox hubs remain as close to parallel as possible.

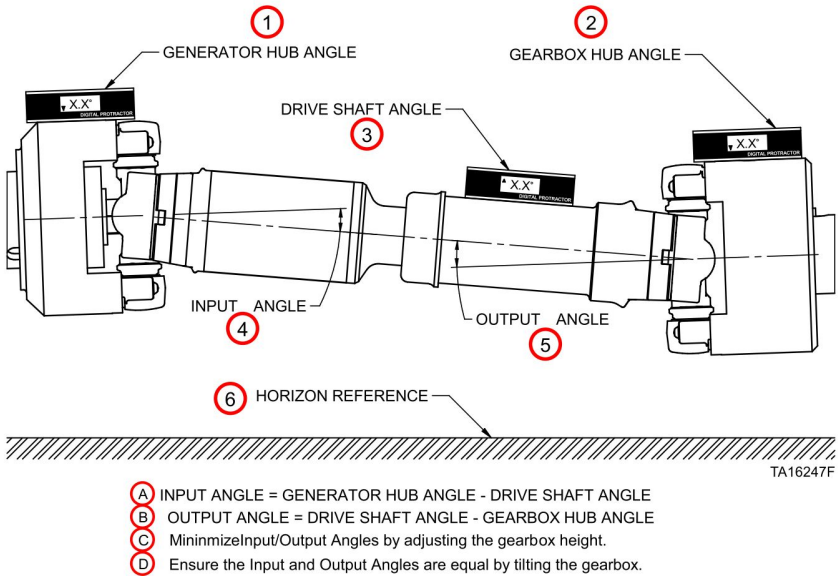
- Digital / Spirit Level protractor measurements are taken relative to the horizon.
- Ensure the measurement device has sufficient accuracy to achieve reliable alignment. Typically, mechanical angle measurement devices have accuracy tolerances of , which is unacceptable for this purpose.
- The goal is to ensure the Input and Output drive angles are equal. If equality is not achievable, ensure the angles are within 0.5 Degree (including an allowance for measurement accuracy).

$$INPUT\ ANGLE = DRIVE\ SHAFT\ ANGLE - GENERATOR\ HUB\ ANGLE$$
$$OUTPUT\ ANGLE = GEARBOX\ HUB\ ANGLE - DRIVE\ SHAFT\ ANGLE$$
$$ANGULAR\ ALIGNMENT = \ GEARBOX\ HUB\ ANGLE - GENERATOR\ HUB\ ANGLE$$

NOTICE

ANGULAR ALIGNMENT = MEASUREMENT ACCURACY must be within ± 0.5° tolerance

Figure 49: Digital Protractor Measurement

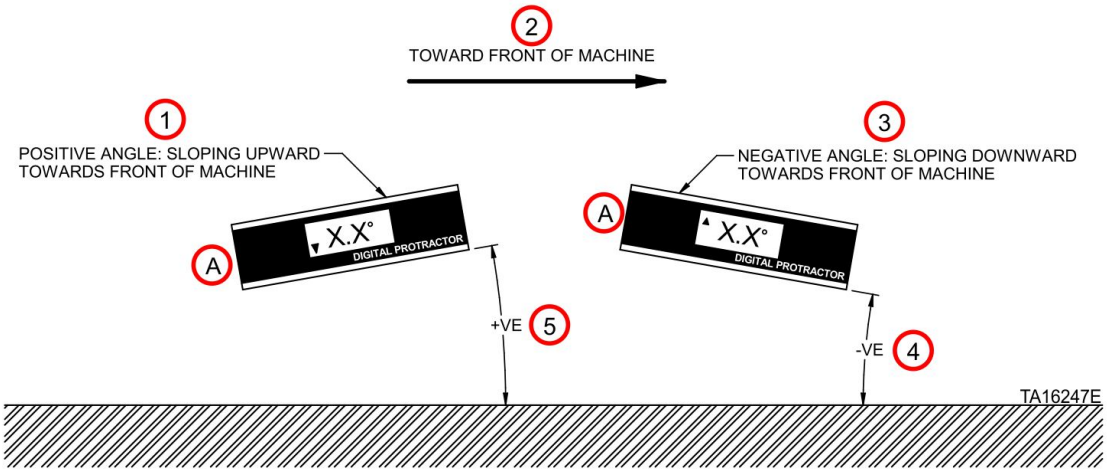


1. Generator hub angle, **2.** Gearbox hub angle,**(3.** Drive shaft angle, **4.** Input angle, **5.** Output angle, **6.** Horizon reference, **A.** Input angle=Generator hub angle – drive shaft angle, **B.** Output angle = drive shaft angle – gearbox hub angle, **C.** Minimize input/output angles by adjusting the gearbox height. **D.** Ensure the input and output angles are equal by tilting the gearbox.

When taking angular measurements, take note whether the measurement has a Positive or Negative inclination. This procedure uses the convention:

- Positive Inclination: Sloping upward toward front of machine
- Negative Inclination: Sloping downward toward front of machine

Figure 50: Measurement Inclination Convention



1. Positive angle sloping upward towards front of machine, **2.** Toward front of machine, **3.** Negative angle sloping downward towards front of machine. **4.** -VE, (5. +VE **A.** Digital protractor

CAUTION

To simplify the calculations, the protractor may be 'zeroed out' on the Generator Hub to account for the angle of the power unit relative to the ground.

Completing the Installation

Step 1: Attach hoisting device to lifting eye on the KLENZ™ filtration unit and blower assembly, and then hoist assembly into position.

Step 2: Reinstall mount bolts, nuts and washers that secure blower assembly to adapter structure and air filtration unit to mount structure. Torque bolts, to Grade 8 specifications, per the "Capscrew and Bolt-Nut Torque Specifications".

Step 3: Install flex duct and hose clamp between filter assembly and blower assembly.

Step 4: Reconnect all hoses to applicable pumps.

Step 5: Reconnect hydraulic lines to blower motor.

Step 6: Refill the hydraulic reservoir to the full mark on the reservoir sight gauge. Refer to Section 04 for instructions on filling the hydraulic reservoir.

Step 7: Close manual air release valve on top of hydraulic reservoir.

Step 8: Bleed all hydraulic pumps.

CAUTION

Failure to bleed each hydraulic pump following service or repair of the hydraulic system can result in pump failure or shortened pump life due to a dry-start condition at machine start up.

Step 9: Recheck flex hose and clamp, between blower and filter assembly, for leaks.

Step 10: Reinstall the front hood structure.

Step 11: Reinstall crossmember that anchors grating.

Step 12: Reinstall grating.

Step 13: Enable machine's starting capability with the starter isolation switch and start engine.

Step 14: Check all hydraulic pumps and blower motor for hydraulic fluid leaks with engine at HI throttle.

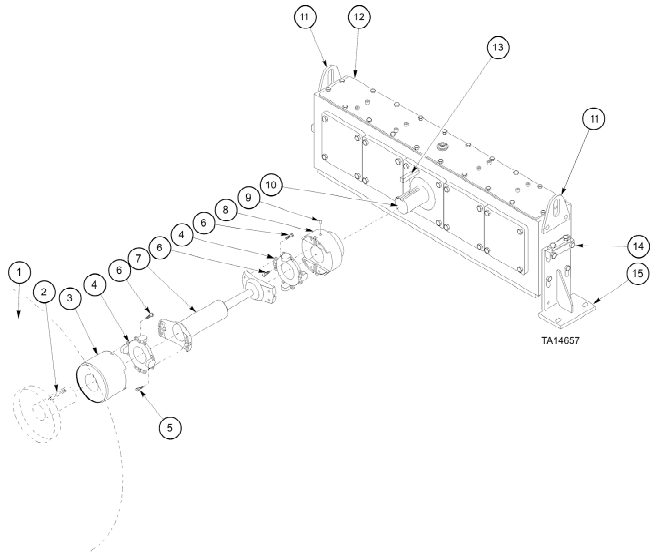
Step 15: Check for gearbox oil and hydraulic oil leaks.

Step 16: Check all clamps and air ducts for proper positioning and air leaks.

Step 17: Move frame lock to unlocked position.

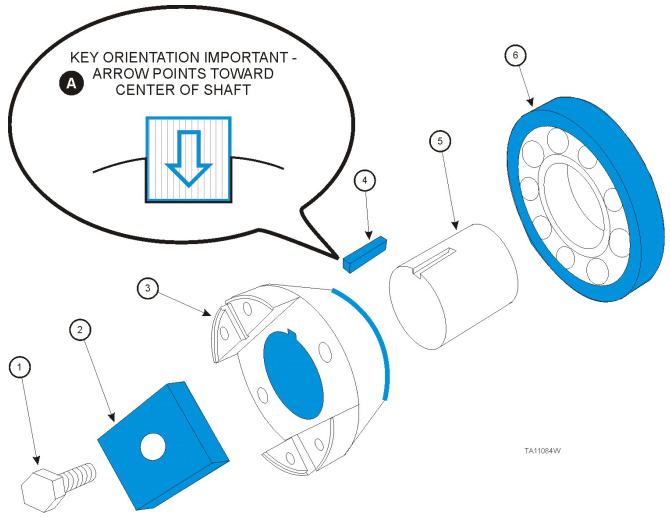
Step 18: Follow local rules and regulations to return the machine to operating condition.

Figure 51: L1350/L1850/L2350 HPD gearbox drive shaft installation



1. Generator
2. Output shaft
3. Drive hub
4. U-Joint
5. Bolt
6. Bolt
7. Drive shaft
8. Driven hub
9. Setscrew
10. Input shaft
11. Lifting eye
12. Gearbox
13. Key
14. Adjusting bar
15. Mount structure

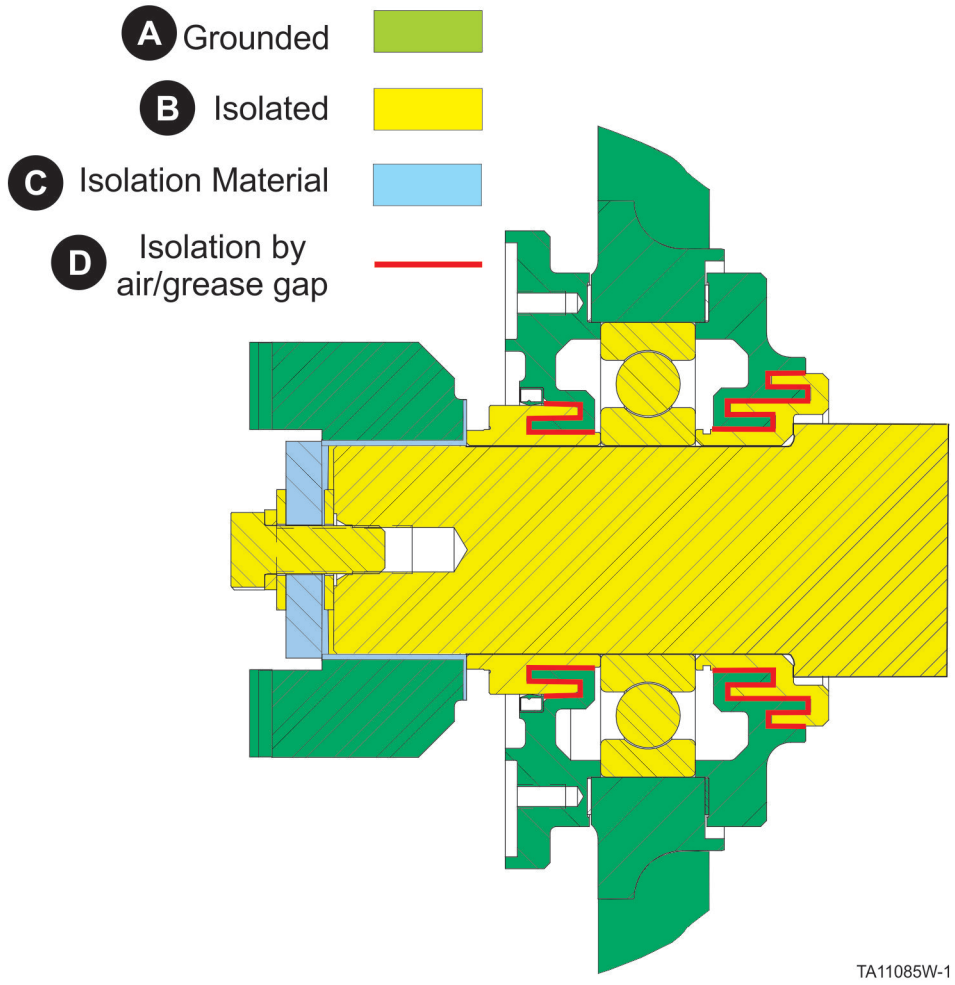
Figure 52: Generator insulated components



A) Key Orientation Important – Arrow Points Toward Center Of Shaft

1. Retainer bolt (Torque To 230 Ft/Lbs [311 N•M])
2. Insulated retainer plate
3. Insulated drive hub
4. Insulated retainer key
5. Generator drive shaft
6. Insulated bearing

Figure 53: Installed components cross section



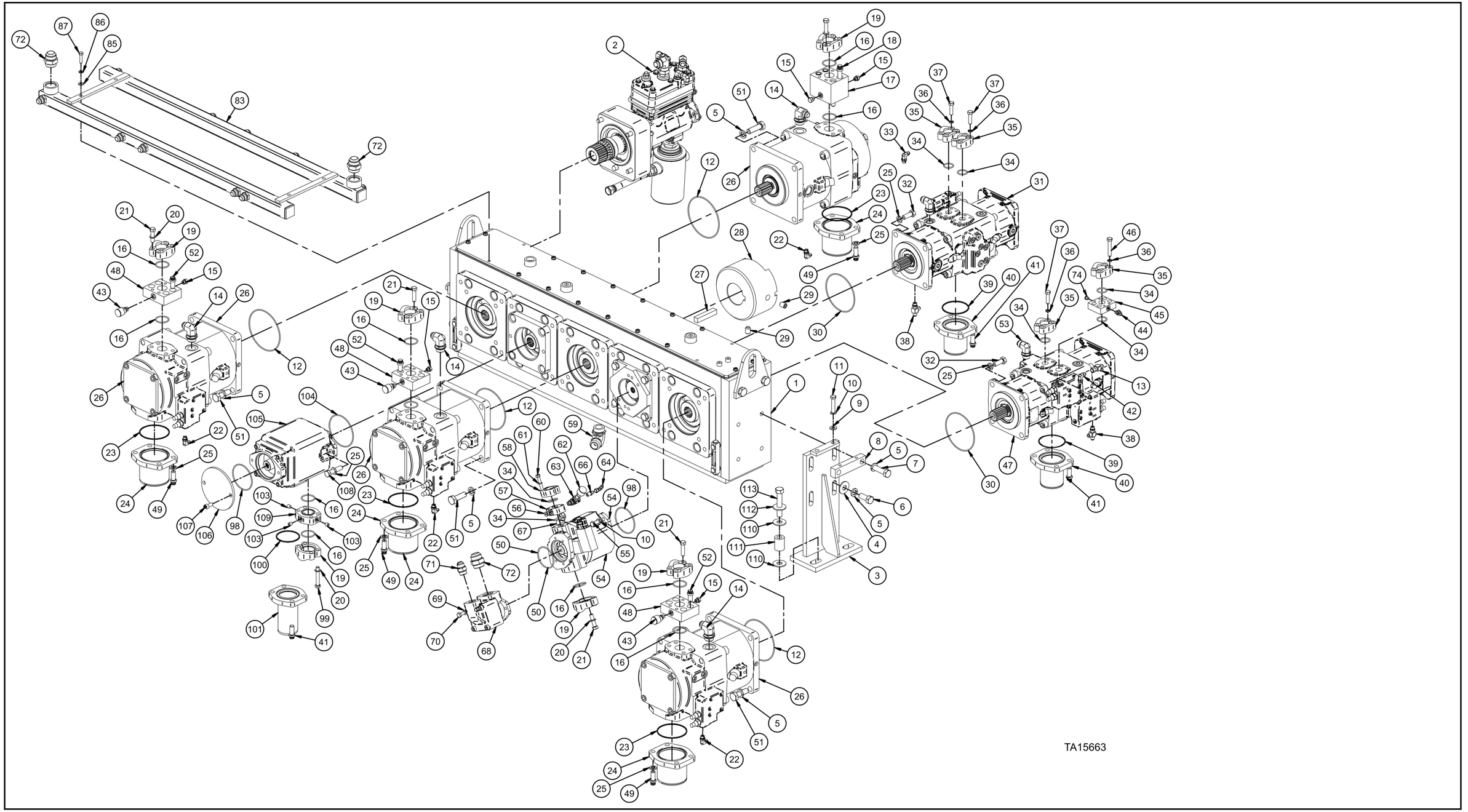
A) Grounded **B)** Isolated **C)** Isolation material **D)** Isolation by air/grease gap

Component Drawings

NOTICE

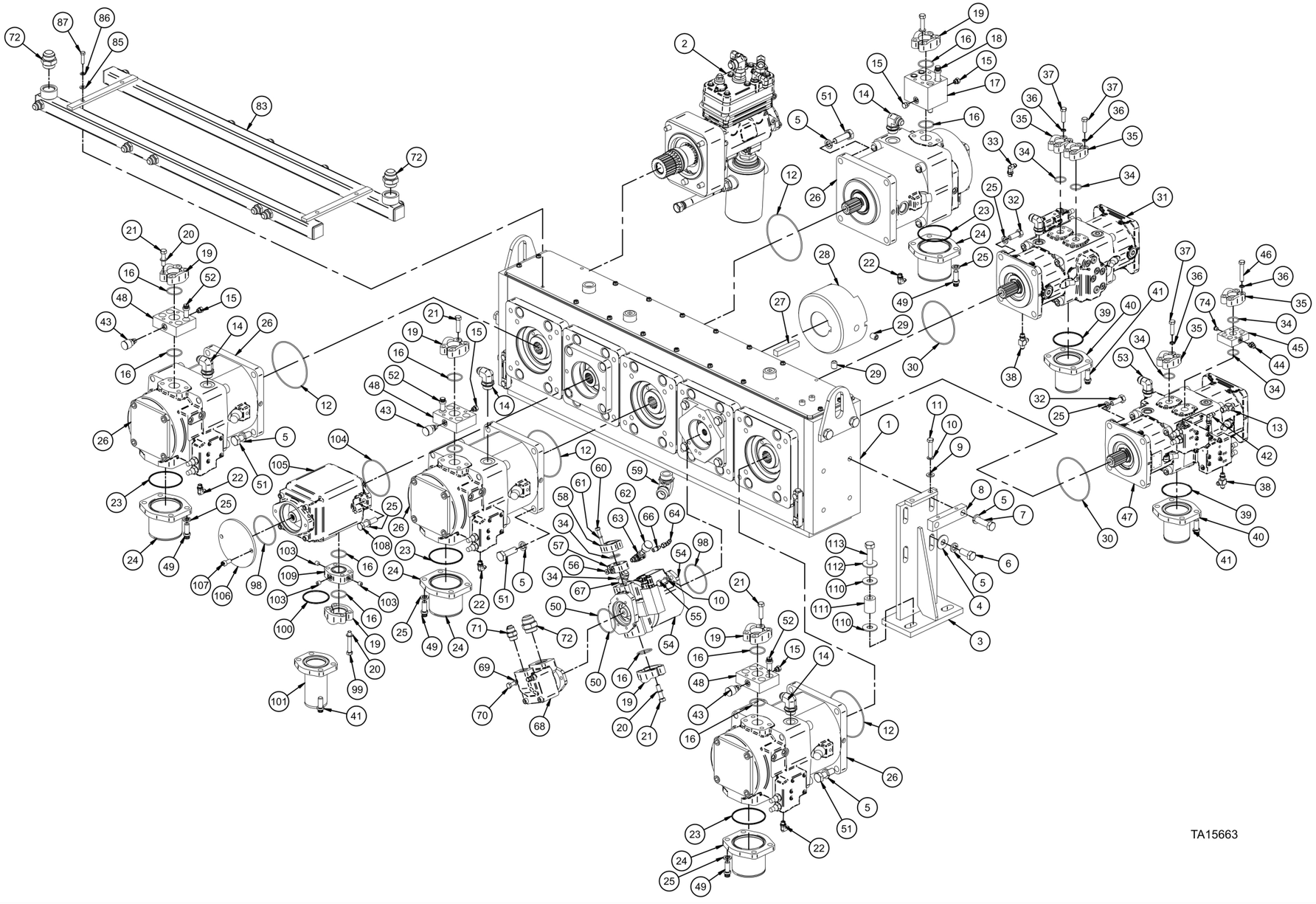
The drawings in this section are examples. For specific assembly parts and part numbers reference the Parts Manual.

Figure 54: HPD gearbox and pumps 1350 GEN2



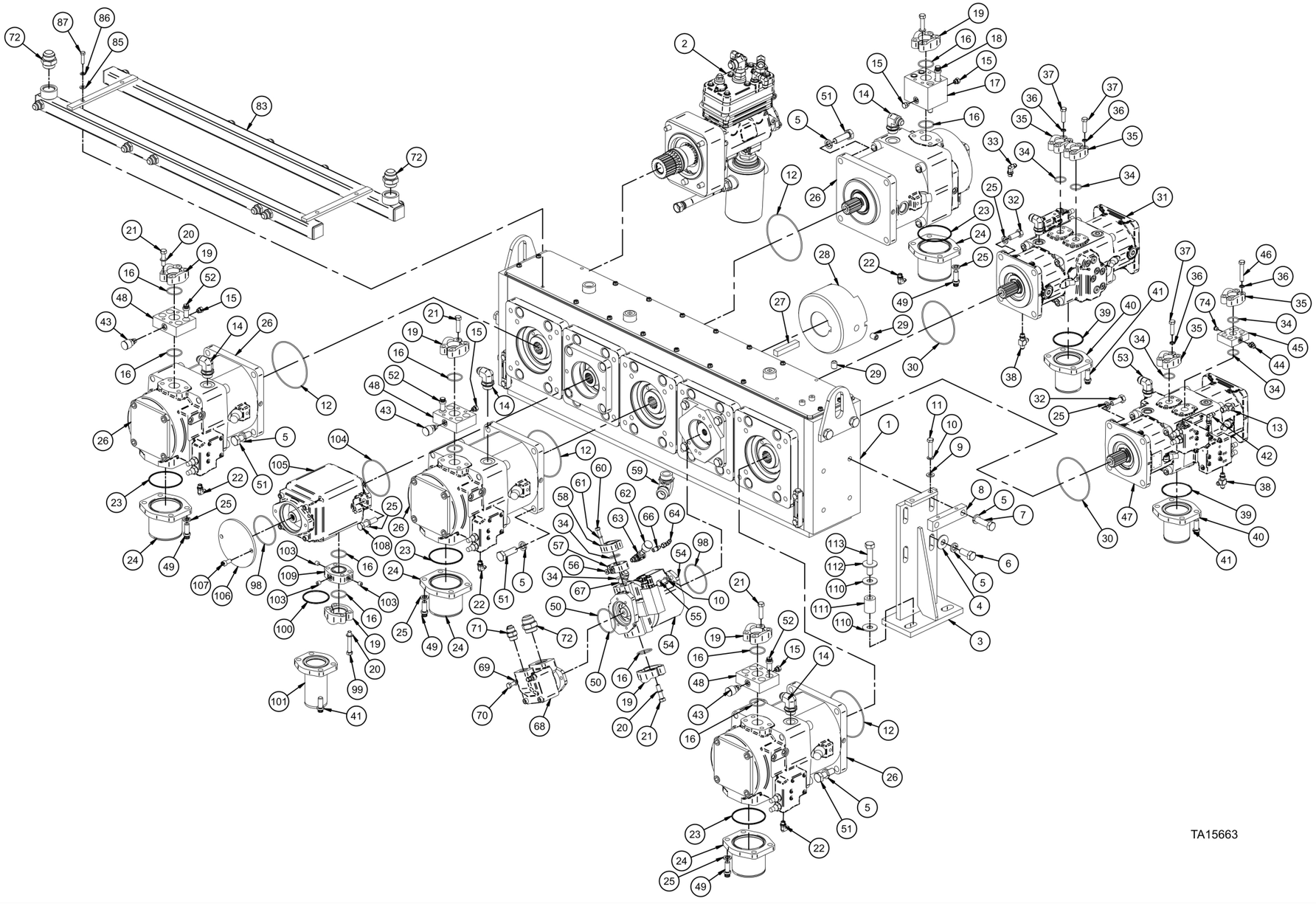
1. Gearbox And Drive Adapters Assembly	**21**. Bolt	**41**. Capscrew	**61**. Flatwasher	**81**. Flange
2. Air Compressor	**22**. Elbow	**42**. Elbow	**62**. Coupling Assembly	**82**. Plug
3. Mount Structure	**23**. Seal	**43**. Coupling Assembly	**63**. Tee	**83**. O-Ring
4. Flatwasher	**24**. Pump Inlet Adapter	**44**. Elbow	**64**. Elbow	**84**. Pump
5. Lockwasher	**25**. Lockwasher	**45**. Test Block	**65**. Not Used	**85**. Cover Plate
6. Bolt	**26**. Pump	**46**. Bolt	**66**. Adapter	**86**. Capscrew
7. Bolt	**27**. Key	**47**. Pump	**67**. Elbow	**87**. Bolt
8. Bar	**28**. Hub	**48**. Block	**68**. Pump	**88**. Test Block
9. Flatwasher	**29**. Setscrew	**49**. Capscrew	**69**. Lockwasher	**89**. Flatwasher
10. Lockwasher	**30**. O-Ring	**50**. O-Ring	**70**. Bolt	**90**. Spacer
11. Bolt	**31**. Pump	**51**. Bolt	**71**. Adapter	**91**. Flatwasher
12. O-Ring	**32**. Bolt	**52**. Capscrew	**72**. Adapter	**92**. Bolt
13. Tee	**33**. Elbow	**53**. Elbow	**73**. Plug	
14. Elbow	**34**. O-Ring	**54**. Pump	**74**. Manifold	
15. Plug	**35**. Flange Half	**55**. Bolt	**75**. Flatwasher	
16. O-Ring	**36**. Flatwasher	**56**. Plug	**76**. Lockwasher	
17. Test Block	**37**. Bolt	**57**. Test Block	**77**. Bolt	
18. Capscrew	**38**. Tee	**58**. Flange Half	**78**. O-Ring	
19. Flange Half	**39**. Seal	**59**. Elbow	**79**. Bolt	
20. Flatwasher	**40**. Flange	**60**. Bolt	**80**. Seal	

Figure 55: HPD gearbox and pumps 1350 GEN2



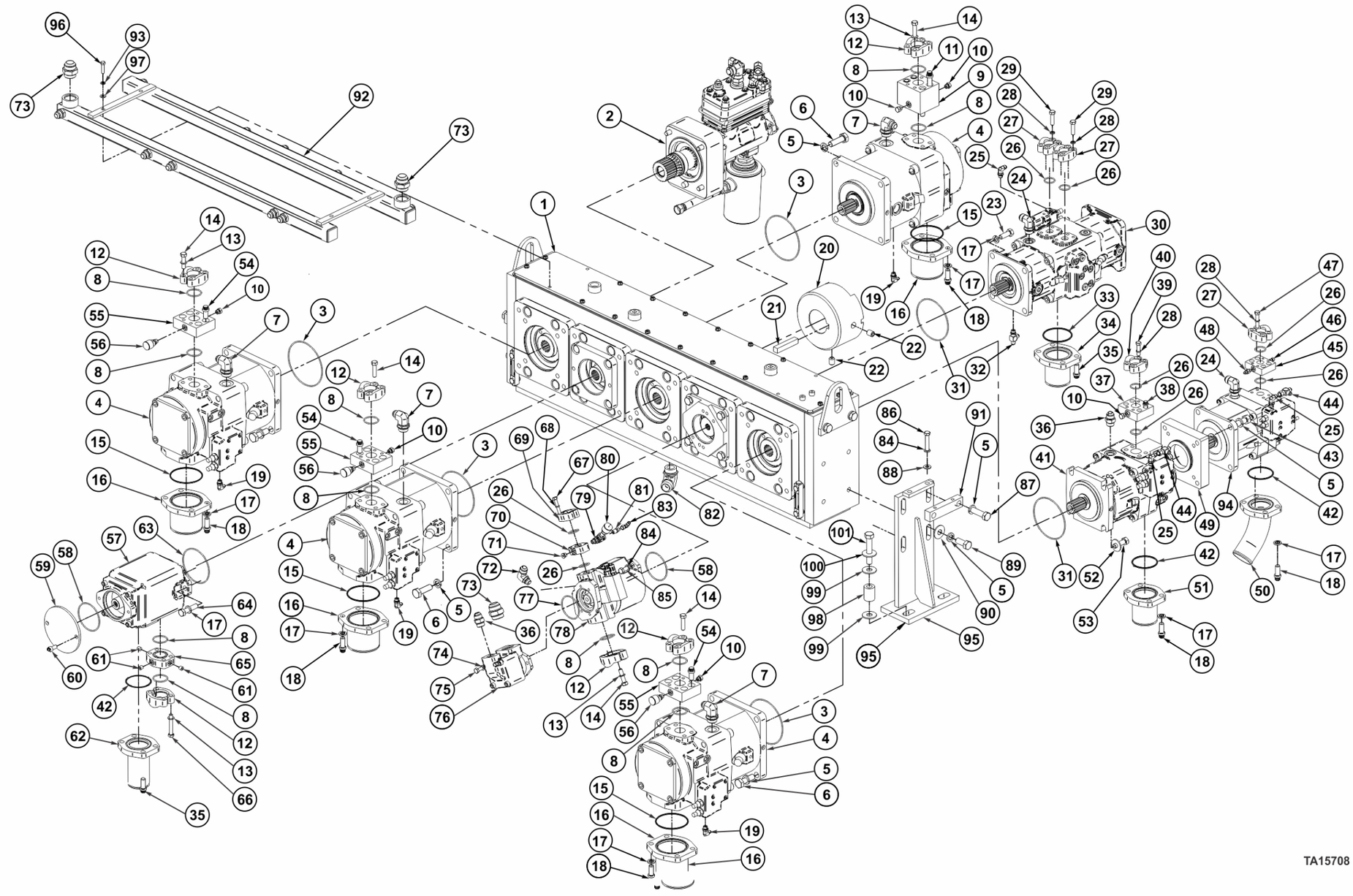
1. Gearbox And Drive Adapters Assembly	**21**. Bolt	**41**. Capscrew	**61**. Flatwasher	**81**. Flange
2. Air Compressor	**22**. Elbow	**42**. Elbow	**62**. Coupling Assembly	**82**. Plug
3. Mount Structure	**23**. Seal	**43**. Coupling Assembly	**63**. Tee	**83**. O-Ring
4. Flatwasher	**24**. Pump Inlet Adapter	**44**. Elbow	**64**. Elbow	**84**. Pump
5. Lockwasher	**25**. Lockwasher	**45**. Test Block	**65**. Not Used	**85**. Cover Plate
6. Bolt	**26**. Pump	**46**. Bolt	**66**. Adapter	**86**. Capscrew
7. Bolt	**27**. Key	**47**. Pump	**67**. Elbow	**87**. Bolt
8. Bar	**28**. Hub	**48**. Block	**68**. Pump	**88**. Test Block
9. Flatwasher	**29**. Setscrew	**49**. Capscrew	**69**. Lockwasher	**89**. Flatwasher
10. Lockwasher	**30**. O-Ring	**50**. O-Ring	**70**. Bolt	**90**. Spacer
11. Bolt	**31**. Pump	**51**. Bolt	**71**. Adapter	**91**. Flatwasher
12. O-Ring	**32**. Bolt	**52**. Capscrew	**72**. Adapter	**92**. Bolt
13. Tee	**33**. Elbow	**53**. Elbow	**73**. Plug	
14. Elbow	**34**. O-Ring	**54**. Pump	**74**. Manifold	
15. Plug	**35**. Flange Half	**55**. Bolt	**75**. Flatwasher	
16. O-Ring	**36**. Flatwasher	**56**. Plug	**76**. Lockwasher	
17. Test Block	**37**. Bolt	**57**. Test Block	**77**. Bolt	
18. Capscrew	**38**. Tee	**58**. Flange Half	**78**. O-Ring	
19. Flange Half	**39**. Seal	**59**. Elbow	**79**. Bolt	
20. Flatwasher	**40**. Flange	**60**. Bolt	**80**. Seal	

Figure 56: HPD gearbox and pumps Tier 1 engine (typical)



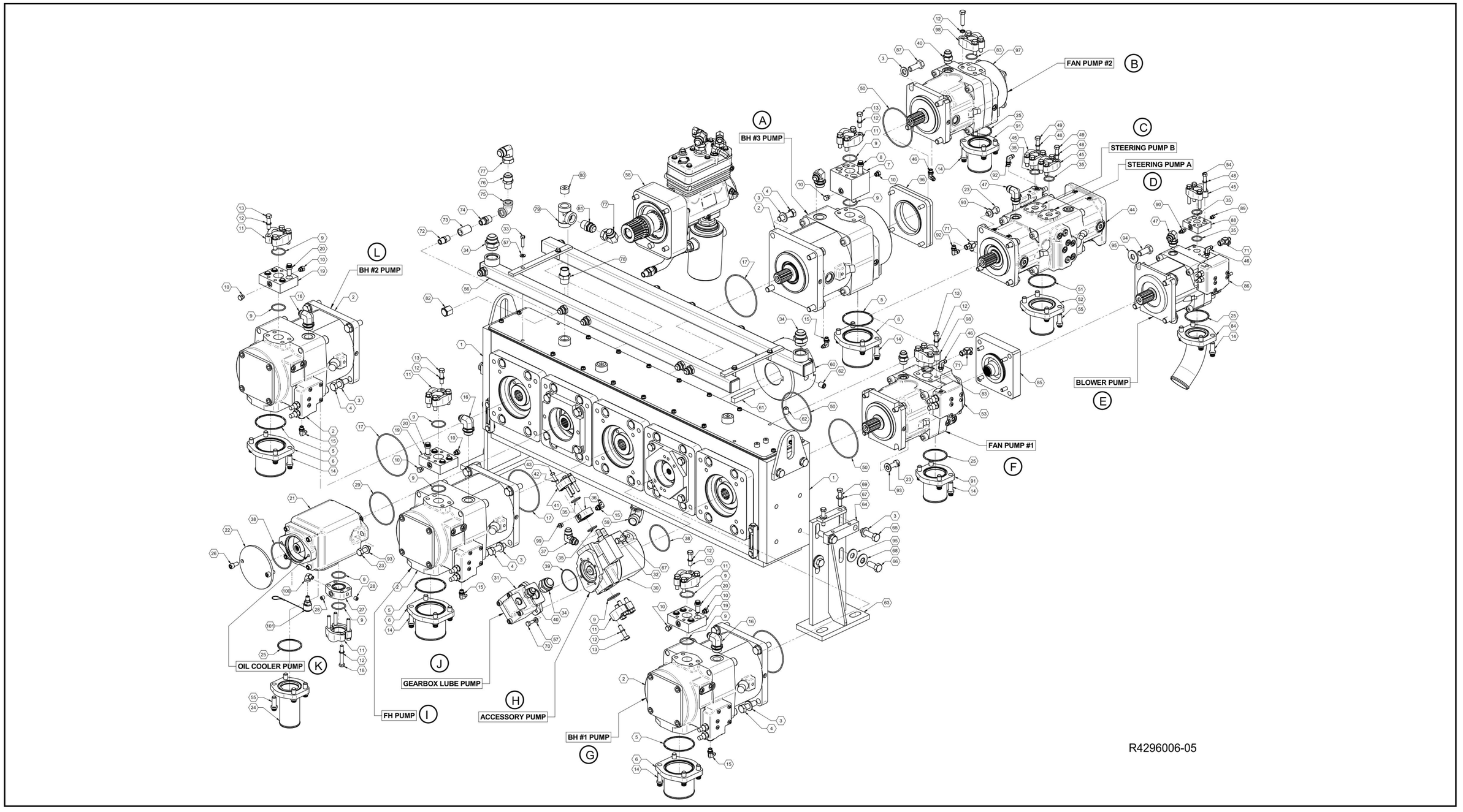
1. Gearbox And Drive Adapters Assembly	**21**. Bolt	**41**. Capscrew	**61**. Flatwasher	**81**. Flange
2. Air Compressor	**22**. Elbow	**42**. Elbow	**62**. Coupling Assembly	**82**. Plug
3. Mount Structure	**23**. Seal	**43**. Coupling Assembly	**63**. Tee	**83**. O-Ring
4. Flatwasher	**24**. Pump Inlet Adapter	**44**. Elbow	**64**. Elbow	**84**. Pump
5. Lockwasher	**25**. Lockwasher	**45**. Test Block	**65**. Not Used	**85**. Cover Plate
6. Bolt	**26**. Pump	**46**. Bolt	**66**. Adapter	**86**. Capscrew
7. Bolt	**27**. Key	**47**. Pump	**67**. Elbow	**87**. Bolt
8. Bar	**28**. Hub	**48**. Block	**68**. Pump	**88**. Test Block
9. Flatwasher	**29**. Setscrew	**49**. Capscrew	**69**. Lockwasher	**89**. Flatwasher
10. Lockwasher	**30**. O-Ring	**50**. O-Ring	**70**. Bolt	**90**. Spacer
11. Bolt	**31**. Pump	**51**. Bolt	**71**. Adapter	**91**. Flatwasher
12. O-Ring	**32**. Bolt	**52**. Capscrew	**72**. Adapter	**92**. Bolt
13. Tee	**33**. Elbow	**53**. Elbow	**73**. Plug	
14. Elbow	**34**. O-Ring	**54**. Pump	**74**. Manifold	
15. Plug	**35**. Flange Half	**55**. Bolt	**75**. Flatwasher	
16. O-Ring	**36**. Flatwasher	**56**. Plug	**76**. Lockwasher	
17. Test Block	**37**. Bolt	**57**. Test Block	**77**. Bolt	
18. Capscrew	**38**. Tee	**58**. Flange Half	**78**. O-Ring	
19. Flange Half	**39**. Seal	**59**. Elbow	**79**. Bolt	
20. Flatwasher	**40**. Flange	**60**. Bolt	**80**. Seal	

Figure 57: HPD gearbox and pumps Tier 2 engine (typical)



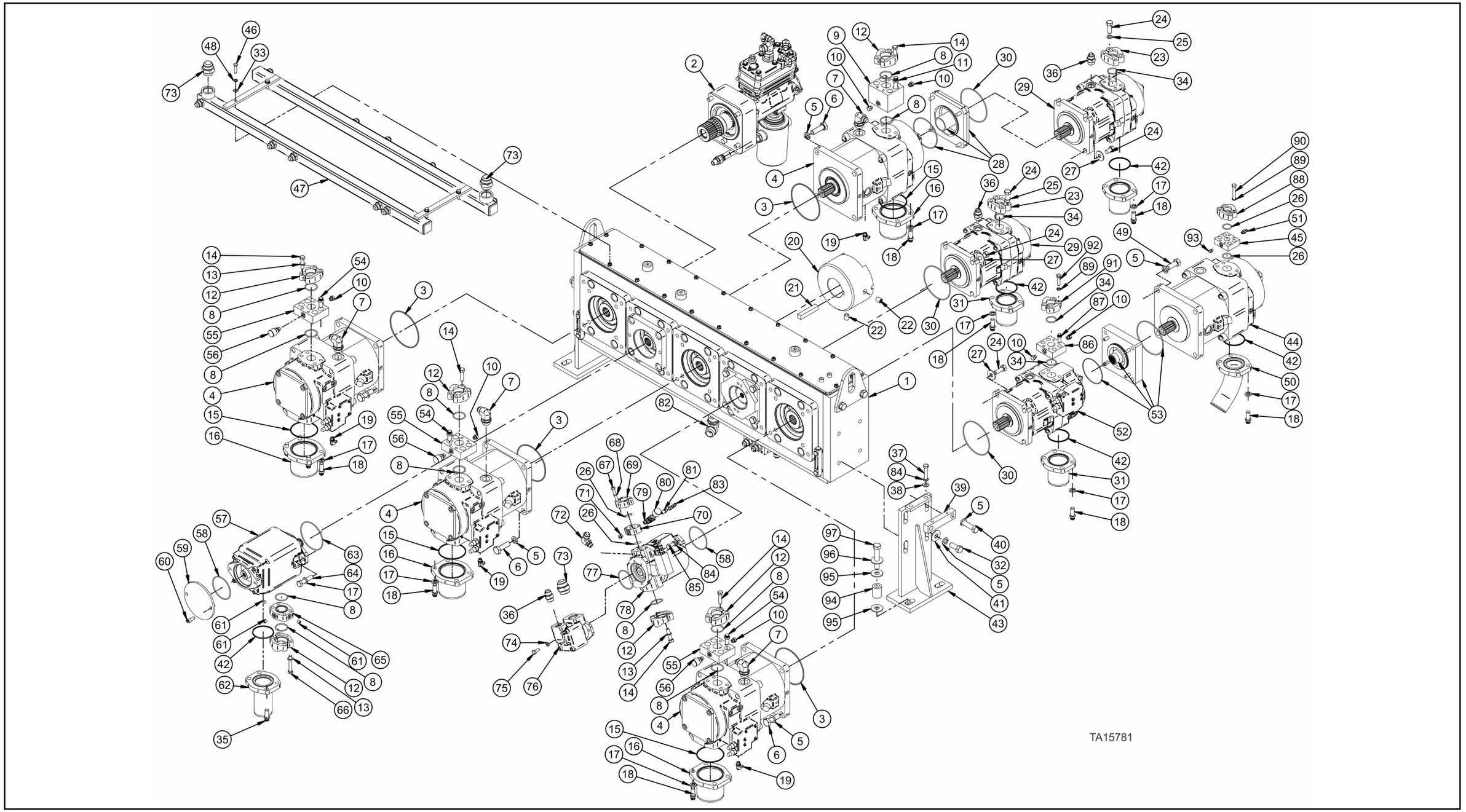
1. Gearbox And Drive Adapters Assembly	**22**. Setscrew	**43**. Bolt	**64**. Bolt	**85**. Bolt
2. Air Compressor	**23**. Bolt	**44**. Tee	**65**. Test Block	**86**. Bolt
3. O-Ring	**41**. Pump	**45**. Test Block	**66**. Bolt	**87**. Bolt
4. Pump	**42**. Seal	**46**. Plug	**67**. Bolt	**88**. Flatwasher
5. Lockwasher	**24**. Elbow	**47**. Bolt	**68**. Flatwasher	**89**. Bolt
6. Bolt	**25**. Elbow	**48**. Adapter	**69**. Flange Half	**90**. Flatwasher
7. Elbow	**26**. O-Ring	**49**. Adapter Kit	**70**. Test Block	**91**. Bar
8. O-Ring	**27**. Flange Half	**50**. Flange Structure	**71**. Plug	**92**. Manifold
9. Test Block	**28**. Flatwasher	**51**. Flange Structure	**72**. Elbow	**93**. Lockwasher
10. Plug	**29**. Bolt	**52**. Flatwasher	**73**. Adapter	**94**. Pump
11. Capscrew	**30**. Pump	**53**. Bolt	**74**. Lockwasher	**95**. Mount Structure
12. Flange Half	**31**. O-Ring	**54**. Capscrew	**75**. Bolt	**96**. Bolt
13. Flatwasher	**32**. Tee	**55**. Block	**76**. Pump	**97**. Flatwasher
14. Bolt	**33**. Seal	**56**. Coupling Assembly	**77**. O-Ring	**98**. Spacer
15. Seal	**34**. Flange	**57**. Pump	**78**. Pump	**99**. Flatwasher
16. Pump Inlet Adapter	**35**. Capscrew	**58**. O-Ring	**79**. Tee	**100**. Flatwasher
17. Lockwasher	**36**. Adapter	**59**. Cover Plate	**80**. Coupling Assembly	**101**. Bolt
18. Capscrew	**37**. Block	**60**. Capscrew	**81**. Adapter	
19. Elbow	**38**. Capscrew	**61**. Plug	**82**. Elbow	
20. Hub	**39**. Bolt	**62**. Flange	**83**. Elbow	
21. Key	**40**. Flange Half	**63**. O-Ring	**84**. Lockwasher	

Figure 58: HPD gearbox and pumps Tier 4 engine (typical)



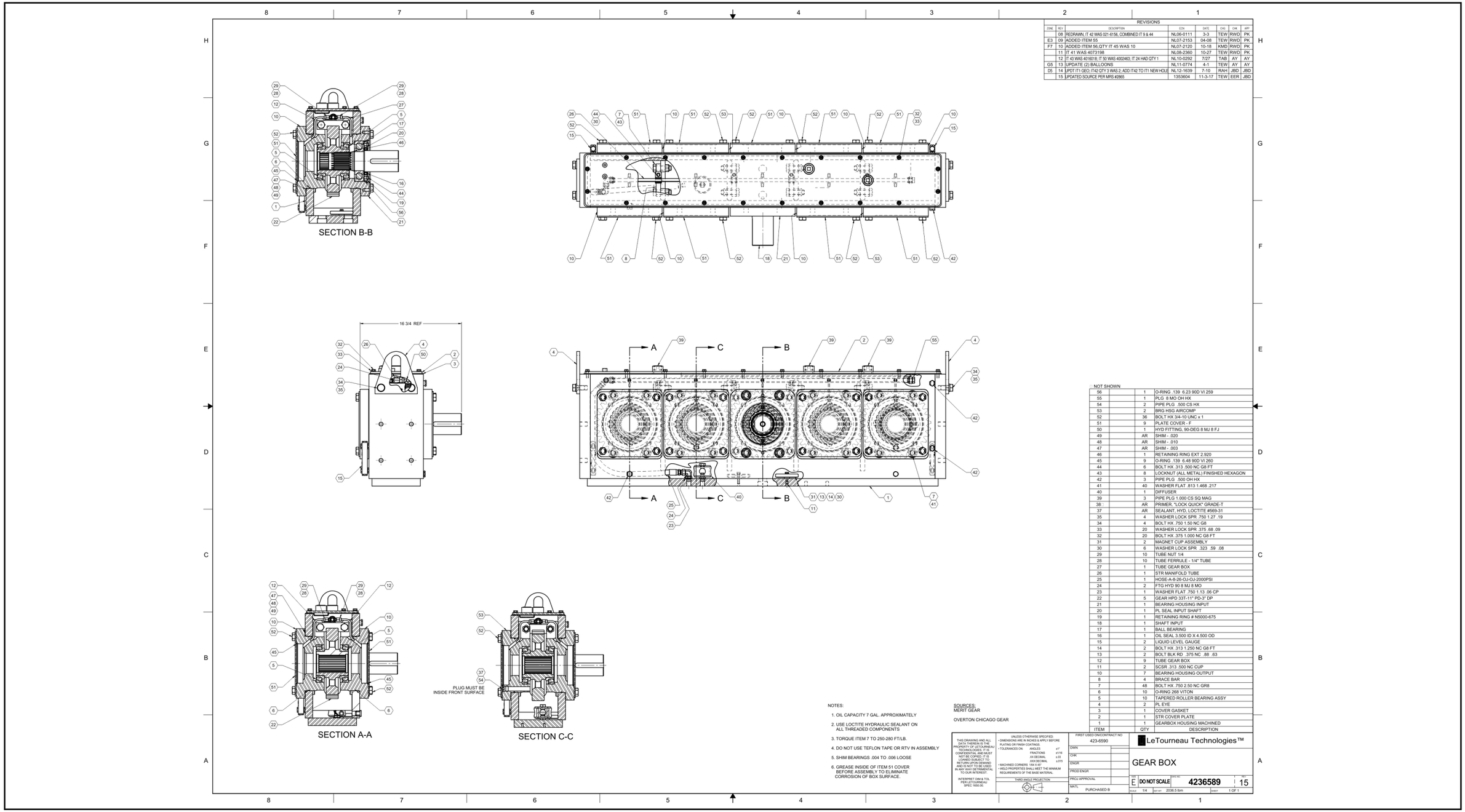
1 Gearbox And Drive Adapters Assembly	**21** Pump, Vane	**41** Flange Half	**61** Key	**81** Adapter	**A** Bucket/Hoist Pump #3
2 Pump, Piston	**22** Cover Plate	**42** Flatwasher	**62** Setscrew	**82** Nut, Cap	**B** Fan Pump #2
3 Flatwasher	**23** Bolt	**43** Bolt	**63** Mount Structure, Gearbox	**83** O-Ring	**C** Steering Pump B
4 Bolt	**24** Flange Structure, Pump	**44** Pump, Piston	**64** Bar, Adjusting	**84** Flange Structure	**D** Steering Pump A
5 Seal, Quad Ring	**25** Seal, Quad Ring	**45** Flange Half	**65** Bolt	**85** Adapter Kit	**E** Blower Pump
6 Flange Structure, Pump	**26** Capscrew	**46** Elbow	**66** Bolt	**86** Pump, Piston	**F** Fan Pump #1
7 Test Block	**27** Test Block	**47** Elbow	**67** Flatwasher	**87** Bolt	**G)**Bucket/Hoist Pump #1
8 Capscrew	**28** Plug, Pipe	**48** Flatwasher	**68** Flatwasher	**88** Test Block	**H** Accessory Pump
9 O-Ring	**29** O-Ring	**49** Bolt	**69** Bolt	**89** Plug	**I** Fast Hoist Pump
10 Plug	**30** Pump, Piston	**50** O-Ring	**70** Bolt	**90** Adapter	**J** Gearbox Lube Pump
11 Flange Half	**31** Pump Assembly, Vane	**51** Seal, Quad Ring	**71** Tee	**91** Flange Structure, Pump	**K** Oil Cooler Pump
12 Flatwasher	**32** Bolt	**52** Flange Structure, Pump	**72** Nipple, Pipe	**92** Elbow	**L** Bucket/Hoist Pump #2
13 Bolt	**33** Bolt	**53** Pump, Piston	**73** Coupling, Pipe	**93** Flatwasher	
14 Capscrew	**34** Adapter	**54** Bolt	**74** Adapter	**94** Bolt	
15 Elbow	**35** O-Ring	**55** Capscrew	**75** Elbow	**95** Flatwasher	
16 Elbow	**36** Test Block	**56** Manifold, Case Drain	**76** Adapter	**96** Adapter Kit	
17 O-Ring	**37** Elbow	**57** Flatwasher	**77** Elbow	**97** Pump, Piston	
18 Bolt	**38** O-Ring	**58** Air Compressor	**78** Nipple, Pipe	**98** Flange Half	
19 Block, Spacer	**39** O-Ring	**59** Elbow	**79** Tee	**99** Plug	
20 Capscrew	**40** Adapter	**60** Hub, Driven	**80** Plug, Pipe	**100** Elbow	
				101 Coupling Assembly, Quick	

Figure 59: HPD gearbox and pumps L2350 (typical)



1 Gearbox And Drive Adapters Assembly (Page 2.9-2.9b)	**21** Key	**41** Flatwasher	**61** Plug	**81** Adapter
2 Air Compressor	**22** Setscrew	**42** Seal	**62** Flange Structure	**82** Elbow
3 O-Ring	**23** Flange Half	**43** Mount Structure	**63** O-Ring	**83** Elbow
4 Pump	**24** Bolt	**44** Pump	**64** Bolt	**84** Lockwasher
5 Lockwasher	**25** Flatwasher	**45** Test Block	**65** Test Block	**85** Bolt
6 Bolt	**26** O-Ring	**46** Bolt	**66** Bolt	**86** Block
7 Elbow	**27** Flatwasher	**47** Manifold	**67** Bolt	**87** Capscrew
8 O-Ring	**28** Adapter Kit	**48** Lockwasher	**68** Flatwasher	**88** Flange Half
9 Test Block	**29** Pump	**49** Bolt	**69** Flange Half	**89** Flatwasher
10 Plug	**30** O-Ring	**50** Flange Structure	**70** Test Block	**90** Bolt
11 Capscrew	**31** Flange Structure	**51** Adapter	**71** Plug	**91** Flange Half
12 Flange Half	**32** Bolt	**52** Pump	**72** Elbow	**92** Bolt
13 Flatwasher	**33** Flatwasher	**53** Adapter Kit	**73** Adapter	**93** Plug
14 Bolt	**34** O-Ring	**54** Capscrew	**74** Lockwasher	**94** Spacer
15 Seal	**35** Capscrew	**55** Block	**75** Bolt	**95** Flatwasher
16 Flange Structure	**36** Adapter	**56** Coupling Assembly	**76** Pump Assembly	**96** Flatwasher
17 Lockwasher	**37** Bolt	**57** Pump	**77** O-Ring	**97** Bolt
18 Capscrew	**38** Flatwasher	**58** O-Ring	**78** Pump	
19 Elbow	**39** Bar	**59** Cover Plate	**79** Tee	
20 Hub	**40** Bolt	**60** Capscrew	**80** Coupling Assembly	

Figure 60: HPD gearbox assembly L1350/L1850/L2350 (typical)



REVISIONS							
ZONE	REV	DESCRIPTION	ECN	DATE	CHG	CHK	APP
	08	REDRAWN, IT 42 WAS 021-6156, COMBINED IT 9 & 44	NL06-0111	3-3	TEW	RWD	PK
E3	09	ADDED ITEM 55	NL07-2153	04-08	TEW	RWD	PK
F7	10	ADDED ITEM 56,QTY IT 45 WAS 10	NL07-2120	10-18	KMD	RWD	PK
	11	IT 41 WAS 4073198	NL08-2360	10-27	TEW	RWD	PK
	12	IT 43 WAS 4016018; IT 50 WAS 4002463; IT 24 HAD QTY 1	NL10-0292	7/27	TAB	AY	AY
G5	13	UPDATE (2) BALLOONS	NL11-0774	4-1	TEW	AY	AY
D5	14	UPDT IT1 QEC); IT42 QTY 3 WAS 2; ADD IT42 TO IT1 NEW HOLE	NL12-1639	7-10	RAH	JBD	JBD
	15	UPDATED SOURCE PER MRS #2865	1353604	11-3-17	TEW	EER	JBD

NOT SHOWN

ITEM	QTY	DESCRIPTION
56	1	O-RING .139 .6.23 90D VI 259
55	1	PLG .8 MO OH HX
54	2	PIPE PLG .500 CS HX
53	2	BRG HSG AIRCOMP
52	36	BOLT HX 3/4-10 UNC x 1
51	9	PLATE COVER - F
50	1	HYD FITTING, 90-DEG 8 MJ 8 FJ
49	AR	SHIM - .020
48	AR	SHIM - .010
47	AR	SHIM - .003
46	1	RETAINING RING EXT 2.920
45	9	O-RING .139 .6.48 90D VI 260
44	6	BOLT HX .313 .500 NC G8 FT
43	8	LOCKNUT (ALL METAL) FINISHED HEXAGON
42	3	PIPE PLG .500 OH HX
41	40	WASHER FLAT .813 1.468 .217
40	1	DIFFUSER
39	3	PIPE PLG 1.000 CS SQ MAG
38	AR	PRIMER, "LOCK QUICK" GRADE-T
37	AR	SEALANT, HYD, LOCTITE #569-31
35	4	WASHER LOCK SPR .750 1.27 .19
34	4	BOLT HX .750 1.50 NC G8
33	20	WASHER LOCK SPR .375 .68 .09
32	20	BOLT HX .375 1.000 NC G8 FT
31	2	MAGNET CUP ASSEMBLY
30	6	WASHER LOCK SPR .323 .59 .08
29	10	TUBE NUT 1/4
28	10	TUBE FERRULE - 1/4" TUBE
27	1	TUBE GEAR BOX
26	1	STR MANIFOLD TUBE
25	1	HOSE-A-8-26-OJ-OJ-2000PSI
24	2	FTG HYD 90 8 MJ 8 MO
23	1	WASHER FLAT .750 1.13 .06 CP
22	5	GEAR HPD 33T-11" PD-3" DP
21	1	BEARING HOUSING INPUT
20	1	PL SEAL INPUT SHAFT
19	1	RETAINING RING # N5000-675
18	1	SHAFT INPUT
17	1	BALL BEARING
16	1	OIL SEAL 3.500 ID X 4.500 OD
15	2	LIQUID LEVEL GAUGE
14	2	BOLT HX .313 1.250 NC G8 FT
13	2	BOLT BLK RD .375 NC .88 .63
12	9	TUBE GEAR BOX
11	2	SCSR .313 .500 NC CUP
10	7	BEARING HOUSING OUTPUT
8	4	BRACE BAR
7	48	BOLT HX .750 2.50 NC GR8
6	10	O-RING 268 VITON
5	10	TAPERED ROLLER BEARING ASSY
4	2	PL EYE
3	1	COVER GASKET
2	1	STR COVER PLATE
1	1	GEARBOX HOUSING MACHINED

NOTES:

1. OIL CAPACITY 7 GAL. APPROXIMATELY
2. USE LOCTITE HYDRAULIC SEALANT ON ALL THREADED COMPONENTS
3. TORQUE ITEM 7 TO 250-280 FT/LB.
4. DO NOT USE TEFLON TAPE OR RTV IN ASSEMBLY
5. SHIM BEARINGS .004 TO .006 LOOSE
6. GREASE INSIDE OF ITEM 51 COVER BEFORE ASSEMBLY TO ELIMINATE CORROSION OF BOX SURFACE.

SOURCES:
MERIT GEAR

OVERTON CHICAGO GEAR

INTERPRET DIM & TOL PER LETOURNEAU SPEC 1600.00

UNLESS OTHERWISE SPECIFIED:
- DIMENSIONS ARE IN INCHES & APPLY BEFORE PLATING OR FINISH COATINGS.
- TOLERANCES ON: ANGULAR ±1°; FRACTIONS ±1/16; XX DECIMAL ±.03; XXX DECIMAL ±.010
- MACHINED CORNERS .164 X 45°
- WELD PROPERTIES SHALL MEET THE MINIMUM REQUIREMENTS OF THE BASE MATERIAL.

THIRD ANGLE PROJECTION

FIRST USED ON/CONTRACT NO
423-6590

DWN
CHK
ENGR
PROG ENGR
PROJ APPROVAL
MATL: PURCHASED B

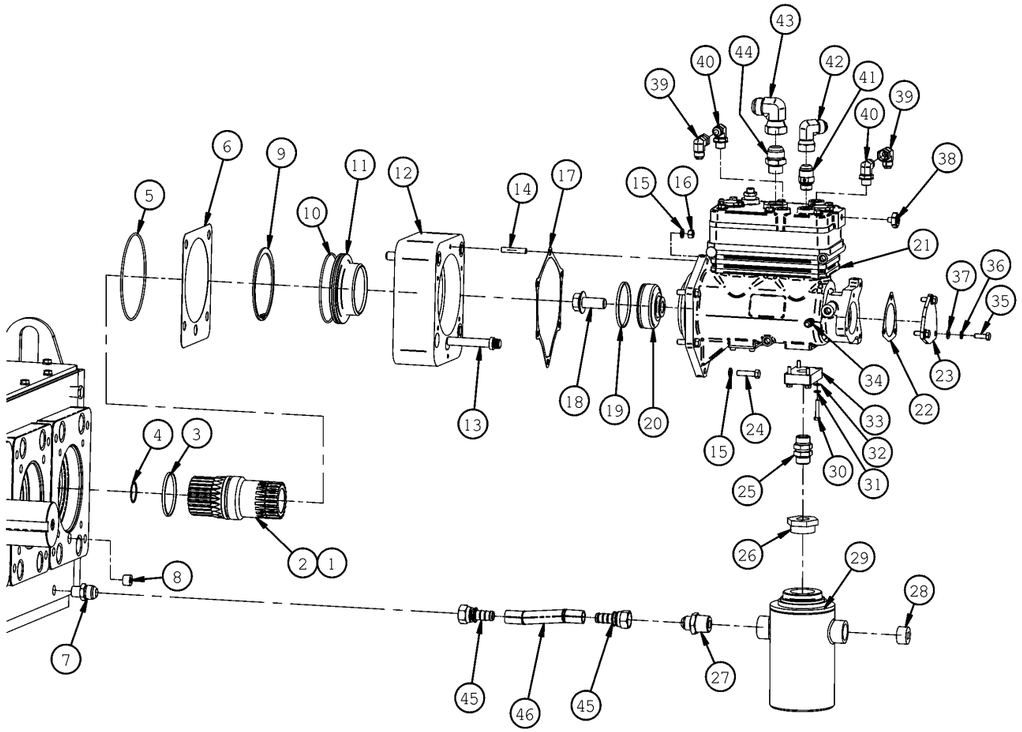
LeTourneau Technologies™

GEAR BOX

SIZE E | DO NOT SCALE | DWG NO 4236589 | REV 15

SCALE 1/4 | DO NOT SCALE 2036.5 lbm | SHEET 1 OF 1

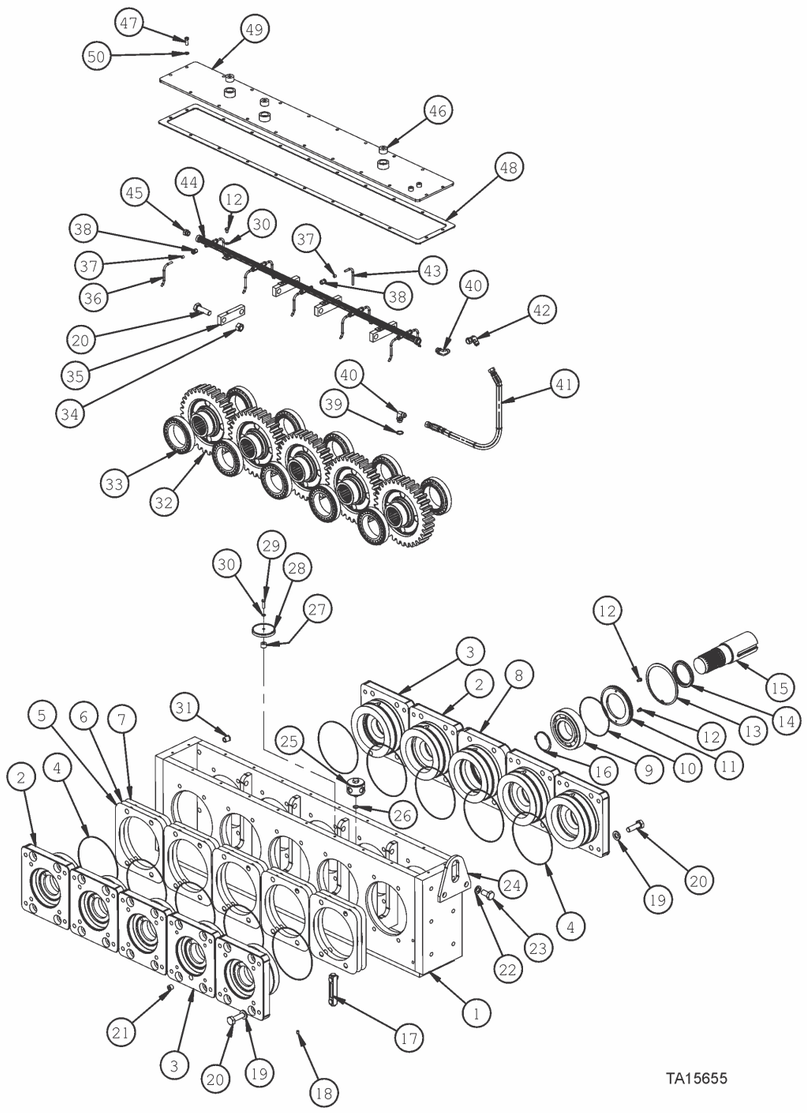
Figure 61: HPD mounted air compressor L1350/L1850/L2350 (typical)



1.Adapter Sleeve Assembly
2.Adapter Sleeve
3.Ring, Piston
4.Retaining Ring
5.O-Ring
6.Gasket, Compressor Adapter
7.Adapter
8.Plug, Pipe
9.Ring, Retainer - Internal
10.O-Ring
11. Adapter, Seal
12. Mount Adapter, Compressor
13. Capscrew
14. Stud
15. Lockwasher
16. Nut
17. Gasket
18. Bolt
19. Ring, Piston
20. Hub, Drive
21. Compressor, Air
22. Gasket, Cover
23. Cover

24. Bolt
25. Adapter
26. Reducer
27. Adapter
28. Plug, Pipe-Magnetic
29. Filter Assembly, Suction
30. Bolt
31. Lockwasher
32. Flatwasher, #12 û Special
33. Cover, Crankcase Drain
34. Adapter
35. Bolt
36. Lockwasher
37. Flatwasher
38. Valve Assembly, Check- Exhaust
39. Elbow, Swivel
40. Elbow
41. Adapter
42. Elbow, Swivel
43. Elbow,Swivel
44. Adapter
45. Adapter
46. Hose

Figure 62: HPD assembly view L1350/L1850/L2350 (typical)



1.Housing Structure, Gearbox
2.Housing, Bearing - Output
3.Housing, Bearing - Output
4.O-Ring
5.Shim
6.Shim
7.Shim
8.Housing, Bearing - Input
9.Bearing, Ball
10.O-Ring
11. Plate, Seal - Input Shaft
12. Bolt
13. Ring, Retaining - Internal
14. Seal, Oil
15. Shaft, Input
16. Ring, Retaining - External
17. Gauge, Liquid Level
18. Setscrew
19. Flatwasher
20. Bolt
21. Plug, Pipe
22. Lockwasher
23. Bolt
24. Plate, Lifting Eye
25. Diffuser

26.O-Ring
27. Block, Bolt
28. Cup Assembly, Magnetic
29. Bolt
30. Lockwasher
31. Plug, Pipe
32. Gear, HPD
33. Bearing, Roller - Tapered
34. Locknut
35. Brace Bar
36. Tube
37. Ferrule, Tube
38. Nut, Ferrule
39. Washer
40. Elbow
41. Hose Assembly
42. Elbow
43. Tube
44. Tube Structure, Manifold
45. Plug
46. Plug, Pipe-Magnetic
47. Bolt
48. Gasket, Cover
49. Cover Plate
50. Lockwasher

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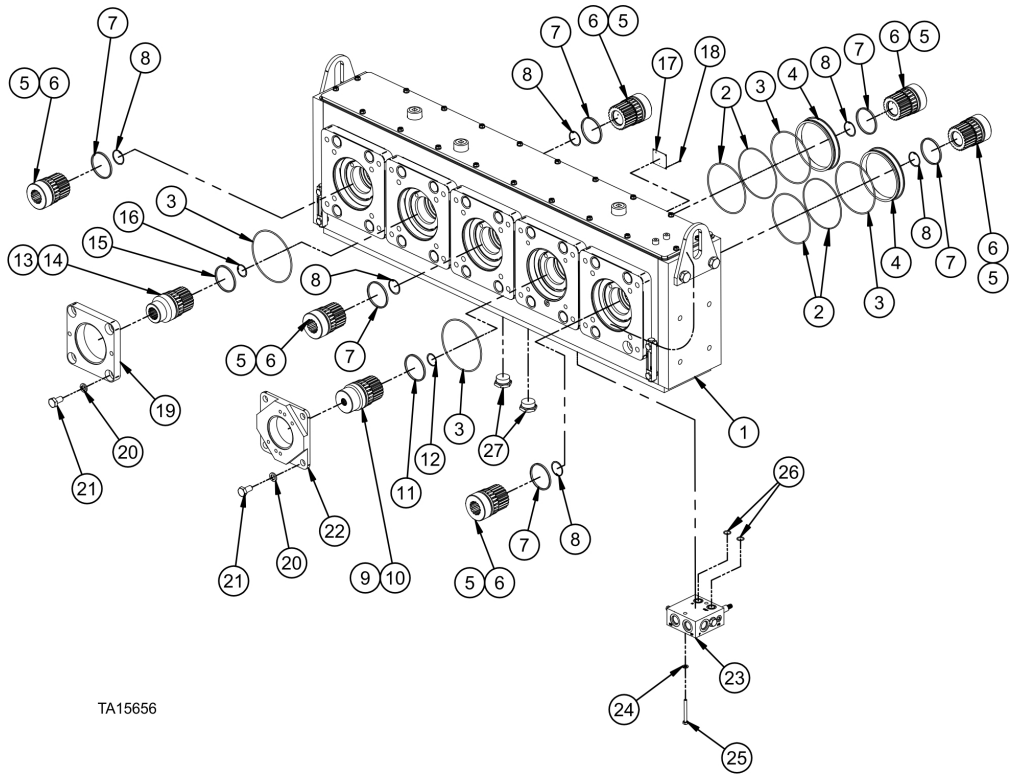
Figure 63: HPD and drive adapters L1850/L2350 (typical)



1.Gearbox Assembly	**15.**Ring
2.O-Ring	**16.**Retaining Ring
3.O-Ring	**17.**Data Plate
4.Adapter Sleeve	**18.**Screw
5.Adapter Sleeve	**19.**Adapter Plate
6.Adapter Sleeve	**20.**Lockwasher
7.Ring	**21.**Bolt
8.Retaining Ring	**22.**Adapter Mount
9.Adapter Sleeve	**23.**Valve Assembly
10. Adapter Sleeve	**24.**Lockwasher
11. Ring	**25.**Bolt
12. Retaining Ring	**26.**O-Ring
13. Adapter	**27.**Plug
14. Adapter	

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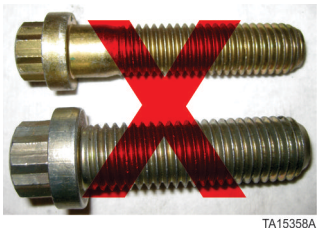
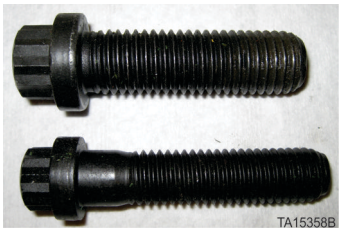
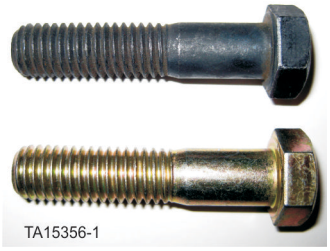
Capscrew and Bolt-Nut Torque Specifications

There are some exceptions to the torques provided on the following pages. Reduced torques are specified in the planetary drive rebuild manual, for the capscrews holding the planetary drive covers, due to a copper sealing washer under the head of the capscrew.

The torque specifications on this chart apply only to Grade 8 bolts, black or gold colored, and 12PT black-colored alloy steel capscrews. 12PT capscrews with gold-colored zinc chromate plating are excluded from these specifications and the zinc chromate 12PT capscrews should not be used on loaders or dozers. (except for planetary drive covers)

These torque values are for normal routine operations. If doing component rebuilds or any other abnormal machine component assembly/disassembly, please contact the factory for these values for specific instances.

 TA15358A	 TA15358B	 TA15356-1
Does not apply**X**	12PT Alloy Capscrew ✓	Grade 8 Bolt ✓

NOTICE

Please note the additional tables for exceptions to the torque values for items such as Lift Arm Ballcaps, Super Nuts and steering pin bolts with drilled grease passages.

Please direct any questions to Komatsu Product Support.

Standard SAE G8 and Alloy Steel and Hex Socket Capscrews

Size	Thread	GRADE 8 Fasteners		Alloy Steel 12PT. and Hex Socket Capscrews	
		USA Units lb-ft **Lubed	Metric Units N-m **Lubed	USA Units lb-ft **Lubed	Metric Units N-m **Lubed
1/4 (0.25)	20 UNC	9	13	12	16
	28 UNF	10	14	14	19
5/16 (0.3125)	18 UNC	18	25	24	33
	24 UNF	20	27	27	37
3/8 (0.375)	16 UNC	33	45	45	61
	24 UNF	37	50	50	68
7/16 (0.4375) (* See Note below)	14 UNC	52	71	70	95
	20 UNF	58	79	79	107
1/2 (0.5) (* See Note below)	13 UNC	80	109	108	146
	20 UNF	90	122	122	165
5/8 (0.625)	11 UNC	159	216	203	275
	18 UNF	180	244	230	312
3/4 (0.75)	10 UNC	282	383	361	490
	16 UNF	315	427	403	546
1 (1.0) (*** See Note below)	8 UNC	682	925	872	1182
	14 UNS	764	1,036	977	1325
1-1/8 (1.125)	7 UNC	966	1310	1235	1674
	12 UNF	1083	1468	1385	1878
1-1/4 (1.25) (**** See Note below)	7 UNC	1,363	1,848	1744	2365
	12 UNF	1,509	2,046	1930	2617
1-1/2 (1.5)	6 UNC	2,371	3,215	3033	4113
	12 UNF	2,668	3,618	3413	4628

*** See Special Torque Specifications for ROPS super nut.**

**** See page 4 for specifications for "LUBED" – engine oil on threads and shoulder.**

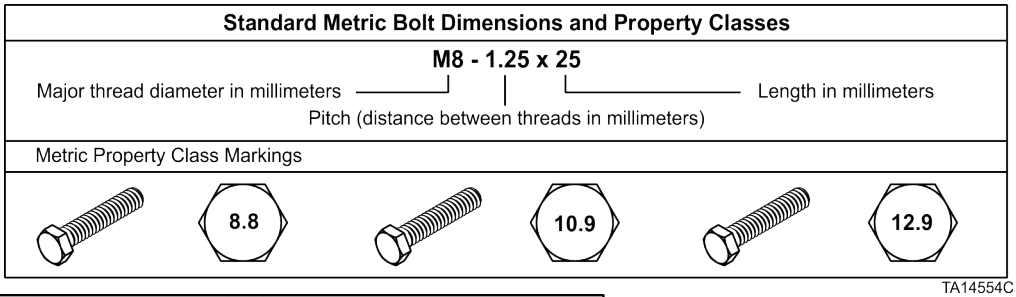
***** See Special Torque Specifications for 950/1150 steering pins.**

***** This bolt is UNS (with 14 threads per inch), it is NOT UNF. It is a unique thread count bolt.**

****** See Special Torque Specifications for loader lift arms and 1350/1850/2350 steering pins.**

Standard Metric Bolts and Grades (SAE J1701M)

Size (mm)	Pitch (mm)	Property Class 8.8		Property Class 10.9		Property Class 12.9	
		USA Units lb-ft	Metric Units N-m	USA Units lb-ft	Metric Units N-m	USA Units lb-ft	Metric Units N-m
		** Lubed	** Lubed	** Lubed	** Lubed	** Lubed	** Lubed
6	1.00	6	8	8	11	10	13
7	1.00	10	13	14	19	16	22
8	1.25	14	19	20	27	24	32
10	1.50	28	38	40	54	47	63
12	1.75	49	66	70	94	81	110
14	2.00	77	105	111	150	130	176
16	2.00	121	164	173	235	202	274
18	2.50	167	226	239	324	279	378
20	2.50	244	331	337	458	394	535
24	3.00	422	572	584	791	682	925



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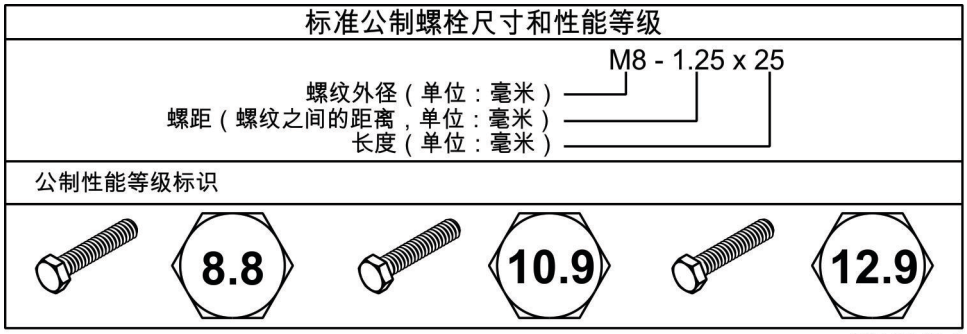

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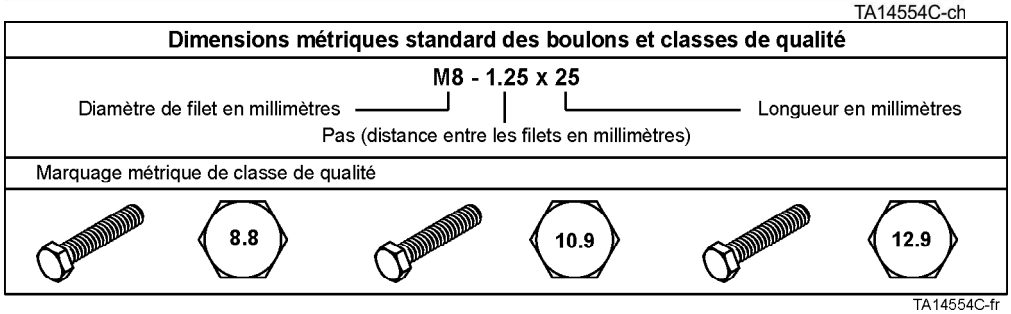

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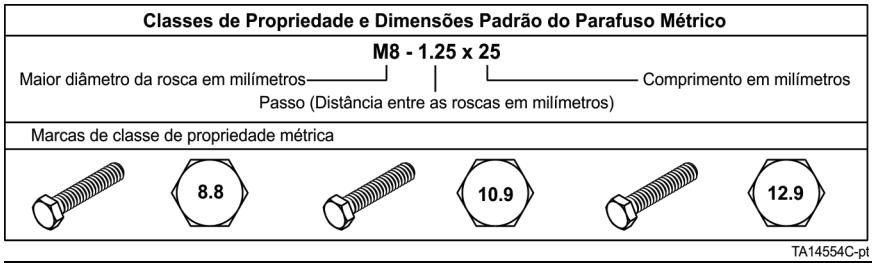

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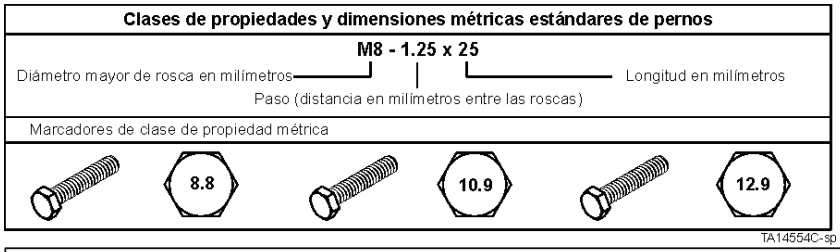
TA14554C-ru



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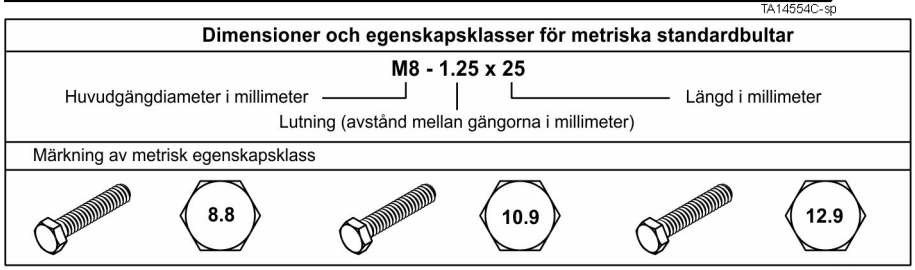

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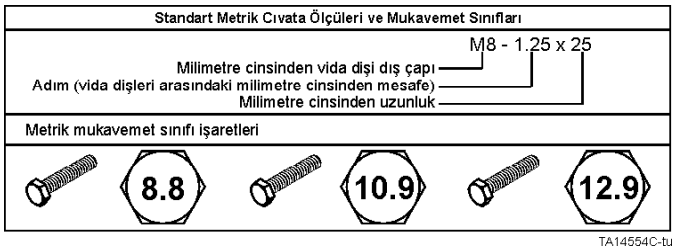


TA14554C-tu

Special Torque Specifications

Alloy Steel 12PT. Capscrew for Wheel Loader Lift Arm Ballcaps

Size	Type	Thread	USA Units lb-ft **Lubed	Metric Units N-m **Lubed	Application
1-1/4 (1.250)	12PT. capscrew F-C on head	7 UNC	1900	2577	LHD, L-950, L-1150, L-1350, L-1850, and L-2350 (Lift arm ball caps only)
1-1/4 (1.250)	12PT. capscrew B-7 on head	12 UNF	1320	1790	L-1000-L-1100 (Lift arm ball caps only)

Steering Pins (Hex Head Bolt)

Size	Type	Thread	USA Units lb-ft ** Lubed	Metric Lubed N-m ** Lubed	Application
1 (1.0)	Bolt (drilled center)	8UNC	425	576	LHD, L-950, D-950, L-1150 (Steering Pins)
1-1/4 (1.250)	Bolt (drilled center)	7UNC	850	1152	L-1350, L-1850, L-2350 (Steering Pins)

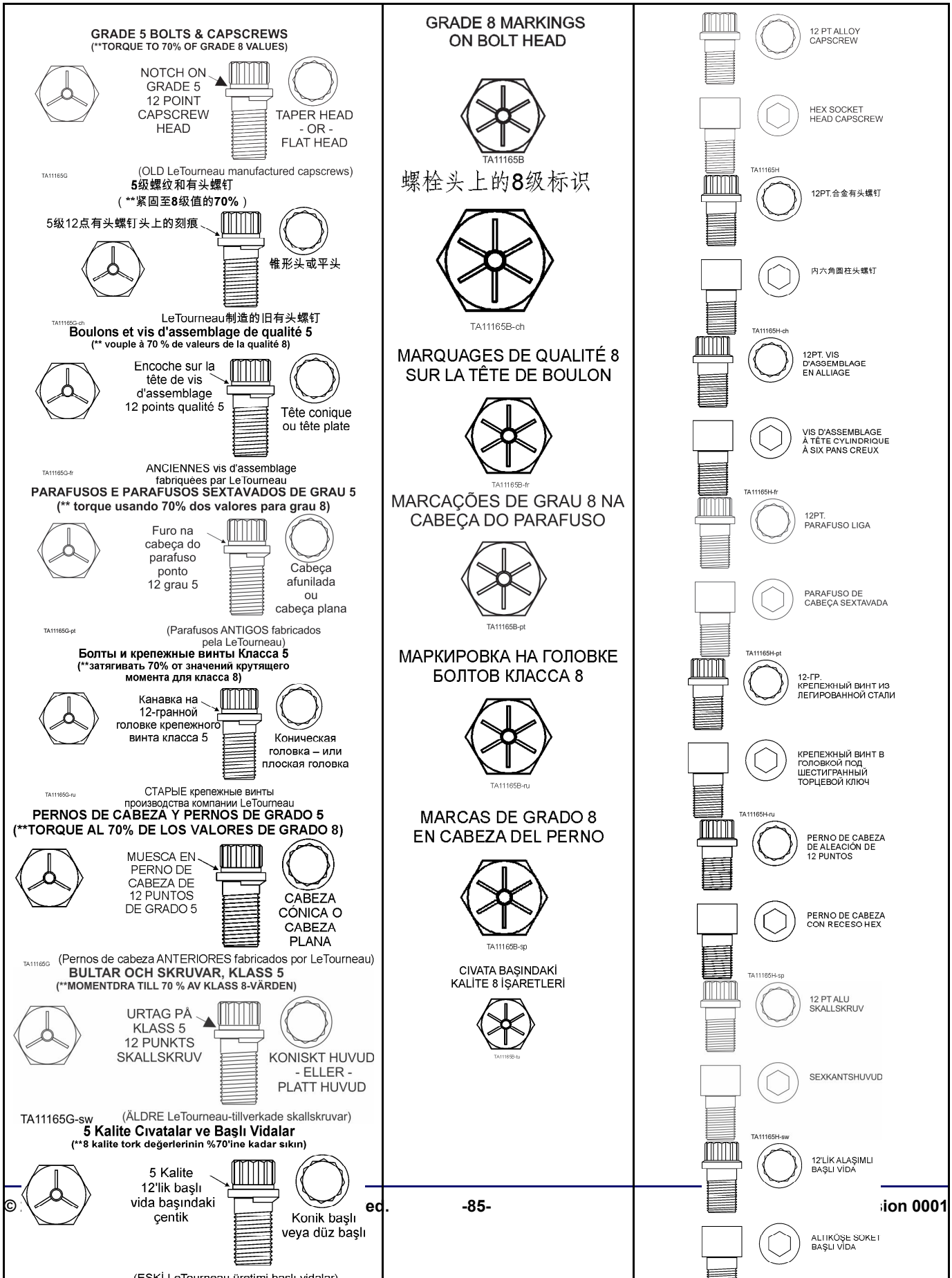
Aluminum 12pt. Capscrews used for Motor Pinion Balancing

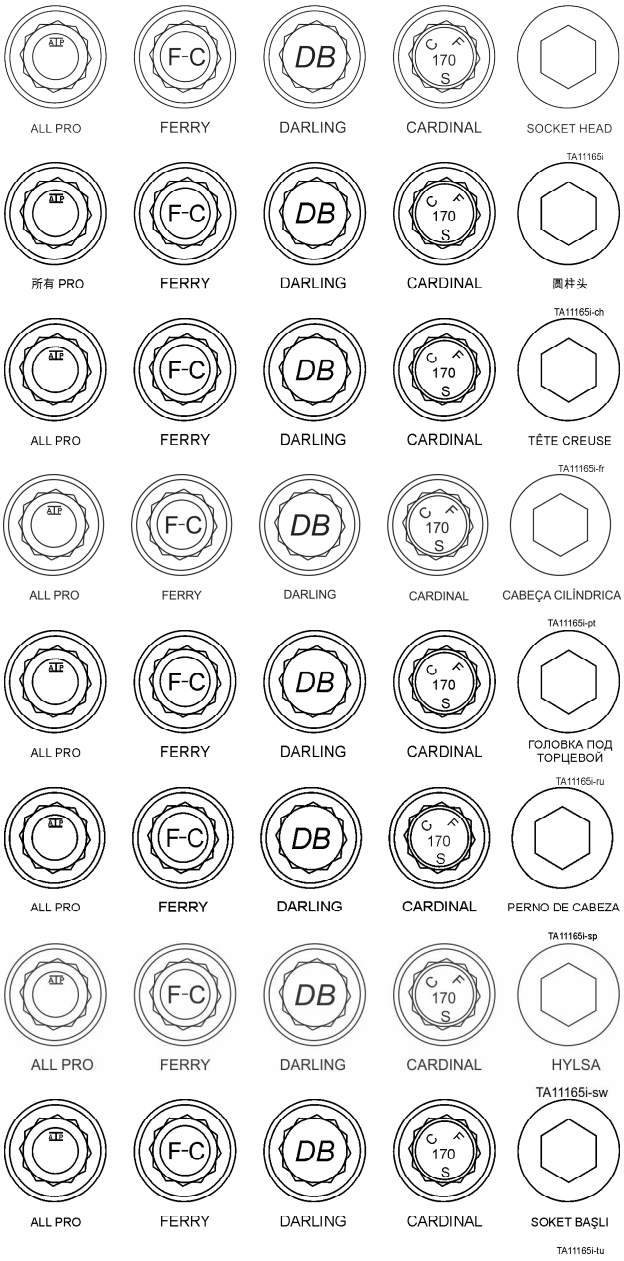
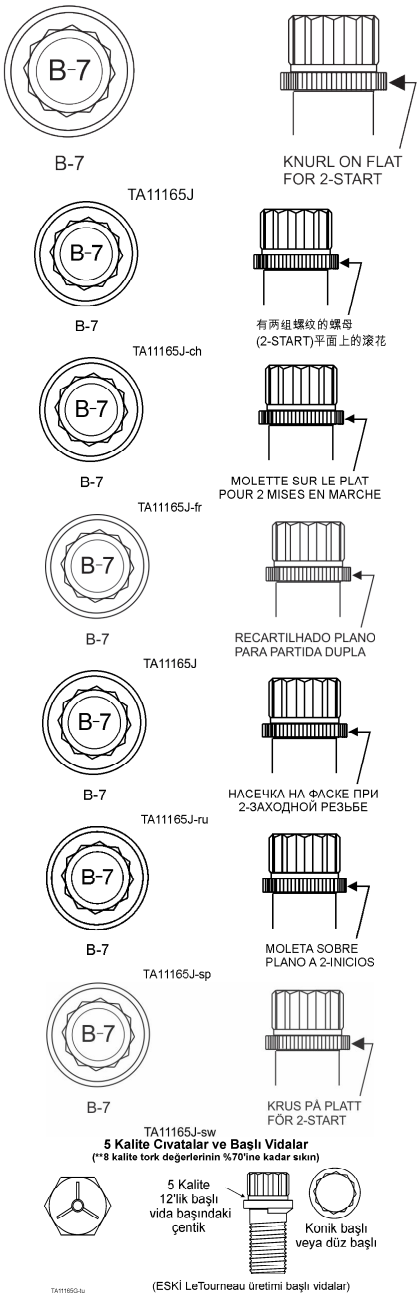
Size	Type	Thread	USA Units (lb-ft)		Metric Units (N-m)	
			Dry	**Lubed	Dry	**Lubed
¾ (0.75)	Aluminum	16 UNF	114	86	155	117
¾ (0.75)	Aluminum 2024-T4	16 UNF	150	113	203	153
15/16 (.9375)	Aluminum 6061 T6	12 NF	217	163	294	221
15/16 (.9375)	Aluminum 2024-T4	12 NF (2 START)	285	214	387	290

2-Thread (2-Start) Steel 12PT. Capscrews

Size	Type	Thread	USA Units lb-ft ** Lubed	Metric Units N-m ** Lubed
3/8 (.3750)	12PT.	24 NF	25	34
9/16 (.5625)	12PT.	18 NF	87	119
15/16 (.9375)	12PT.	14 NF	428	584
1-5/16 (1.325)	12PT.	12 NF	1216	1660

Bolt and Capscrew Markings on Head



Typical Markings on Alloy Capscrew Heads	Typical B-7, 2-Start
	

** See “Key Items” for specifications for “LUBED” – engine oil on threads and shoulder.

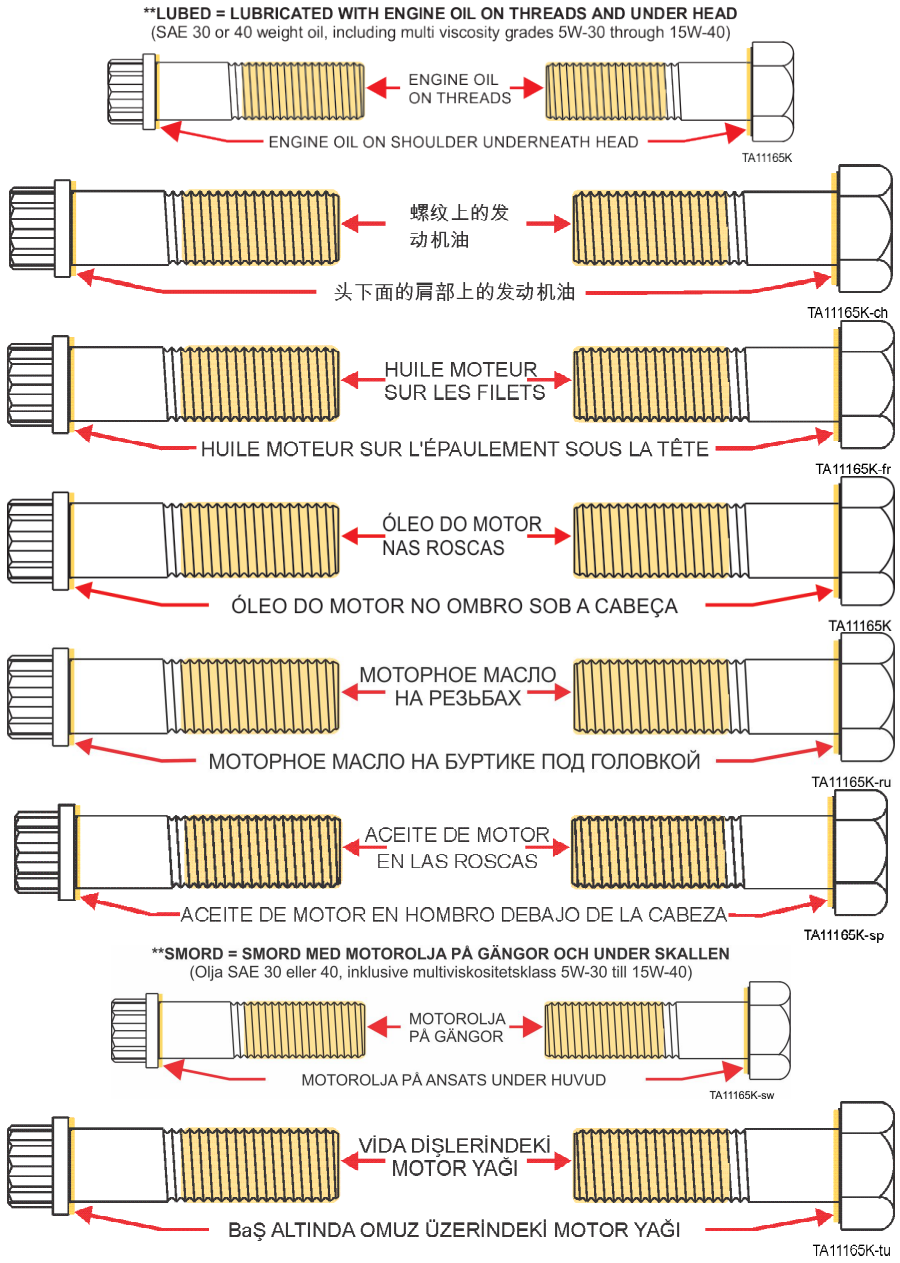
Capscrew and Bolt-Nut Torque Specifications

Key Items

- “LUBED” is defined as having the threads and under the head lubricated with engine oil. Engine oil is defined as SAE 30 or 40 weight oil, including multi viscosity grades 5W-30 through 15W-40. No other lubricant (such as anti-seize, MolyKote, copper coat, grease, etc.) is permitted unless specifically called out in a Komatsu procedure.

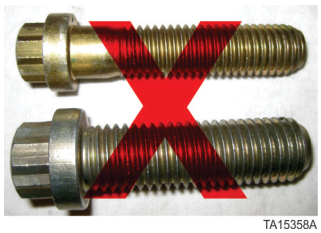
****LUBED = Lubricated with engine oil on threads and under head**

(SAE 30 or 40 weight oil, including multi viscosity grades 5W-30 through 15W-40)



NOTE: No other lubricant (such as anti-seize, never seize, MolyKote, copper coat, grease, etc.) is permitted unless specifically called out in a Komatsu procedure.

- All capscrews and bolts should be started by hand until a minimum of three (3) threads are engaged prior to any air impact equipment being used.
- If a procedure in a Rebuild Manual, Repair and Overhaul or Operating and Service Manual calls for the use of Loctite® threadlocker on the threads, the torque specification for “lubed” should be used. The threads on both the fastener and mating part should be thoroughly cleaned with a proper solvent prior to use of Loctite®. The Loctite® thread sealant should only be used on the threads - not the head.
- Certain applications in components such as drivers or lift arm ball caps may specify a FERRY brand of capscrew. Use only FERRY brand capscrews in these applications.
- Komatsu, recommends that any old 12PT. Komatsu-fabricated (fabrication was stopped many years ago) capscrew (refer to illustration under BOLT AND CAPSCREW MARKINGS ON HEAD) be replaced at the time of repair with alloy capscrews. If new capscrews are not available, then the Komatsu-fabricated capscrews should only be torqued to Grade 5 specifications (70% of Grade 8 value - lubed).
- The torque specifications on the charts on page 2 only apply to Grade 8 bolts, metric bolts and 12PT. black-colored alloy steel capscrews. Capscrews with gold-colored zinc chromate plating are excluded from these specifications and these capscrews should not be used on loaders or dozers except for driver covers.



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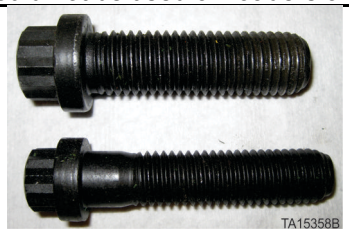
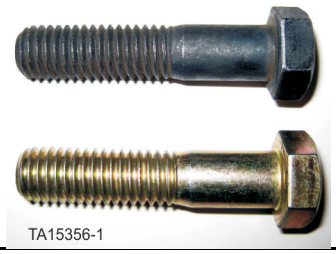


12PT Alloy Capscrew ✓



Grade 8 Bolt ✓

- CLEANING: It is mandatory to remove all paint, rust and debris from all mating surfaces, surfaces under the head of the bolt or capscrew and threads prior to installation and torquing of all bolts and capscrews.

Arrow indicates location to be cleaned

Cleaning paint and rust prior to torquing

Super Nut Specifications

Bolt size	Jack bolt size	Jack bolt thread	USA Units lb-ft *****Lubed	Metric Units N-m *****Lubed	Application
1 ¾” - 5	7/16 (0.4375)	20 UNF	68	92	Hoist Cylinder Rod Pin
2 ¼” – 4.25	½ (0.50)	20 UNF	114	155	ROPS Pin

2 ¾" - 8	**NOTICE** *Refer to Authorized Cylinder Rebuild Center*	Steering Cylinder Piston
*****NOTE:** Supernut jackbolts require P/N 427-3753 Lube JL-G from Superbolt (do not use any substitute)		

Helpful Tips for Supernuts®

Prior to Tightening:
1) Check threads of main stud: If possible, verify that the tensioners spin on prior to the installation date. If a tensioner is tight or will not thread on, try using lapping compound on the main thread and work the tensioner in a back and forth motion making small advances when the thread loosens up. If necessary, chase the studs with a die. **2) Use of spacers:** Tensioners should be positioned at the ends of the studs to minimize exposed threads and facilitate easy access to the jackbolts. A spacer (or stacked washers) can be used beneath the special hardened washer to accomplish this. A spacer will also "step over" a damaged area on a stud where years of bolting have deformed the first few threads. **3) Back the tensioner off before tightening to provide 1/16" (1.59mm) to 1/8" (3.175 mm) gap:** The additional jackbolt extension provides easy access for oiling the jackbolt tips prior to removal. This is especially beneficial for oiling when the tensioners are inverted. Note: There may be insufficient jackbolt stroke to allow this step when tensioning exceptionally long bolts or tie rods, or when closing a gap between flanges. **4) For spinning the tensioner on and off the stud:** Custom "sockets" which grip the tensioner are available. Also, two deep well sockets inserted over two jackbolt hex's at 180º apart can serve as "handles" for spinning the tensioners on and off the studs.
For Tightening:
5) To improve efficiency when using impacts: Don't wait for the socket to stall completely on a specific jackbolt before advancing to the next jackbolt. It is faster, overall, to move quickly between jackbolts. **6) Overshooting the target torque:** You may want to use 110 - 120% of the target torque for Step 3, Step 4, and for 1-2 rounds of Step 5. This may eliminate a tightening round. Be careful not to stabilize all of the jackbolts at this torque however. For long bolts or tie rods, you may want to experiment using even higher torque values. Call Superbolt before using more than 120% target torque. **7) For gasketed joints:** During gasket compression, the load is transferred to the jackbolts (i.e. stud) being tightened. Don't be concerned if some jackbolts (or tensioners) become loose during the procedure. Continue following the procedure. Don't spin down tensioners that become loose during gasket compression.
Helpful Tips For Removal
8) 1/4 turn or less!: Removing the jackbolts more than a 1/4 turn will increase the removal torque of the remaining jackbolts and you may get stuck. If this happens, you will have to retighten and start again.

9) Stuck jackbolt removal: If a jackbolt will not turn, remove, relube, and retighten a neighboring jackbolt and then try to turn it.

Air Impact Tool Selection (90 PSI (620 kPa) Air Pressure)

NOTICE

The jackbolt torque actually achieved by an air impact wrench is usually only 30 - 50% of its rated output. For minimum hand work, use an air impact with an output of 110% - 120% target torque. For maximum power, use the largest air line fitting.

Up to 70 lbs-ft (311 N•m): For 15-35 lbs-ft (67-155 N•m) use a right angle ratchet or light duty 3/8” impact. For 35-70 lbs-ft (155-311 N•m) use a heavy duty 3/8” impact.

70-100 lbs-ft (311-445 N•m): Use a light duty 1/2” impact at a reduced pressure or setting. (Be careful not to over tighten! Calibrate the impact before starting.)

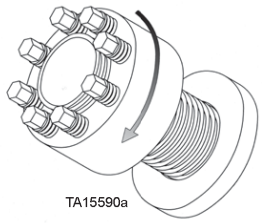
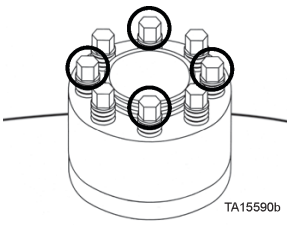
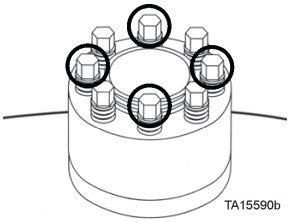
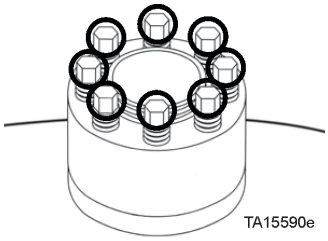
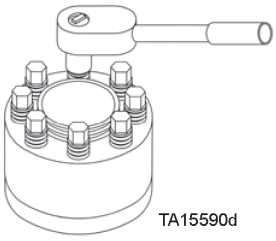
100-170 lbs-ft (445-756 N•m): For 100-130 lbs-ft (445-578 N•m) use a light duty 1/2” impact. For 130–170 lbs-ft (578-756 N•m) use a heavy duty 1/2” impact.

170-200 lbs-ft (756-890 N•m): Use a light duty 3/4” impact on low setting. Some heavy duty 1/2” impacts will also reach this range.

Over 200 lbs-ft (890 N•m): For 200-300 lbs-ft (890-1334 N•m), use a light to medium duty 3/4” impact. Over 300 lbs-ft (1334 N•m), use a heavy duty 3/4” impact.

Calibrating an air impact wrench: Tighten one jackbolt until the socket rotation stops and check the jackbolt with a torque wrench. The torque required to move the jackbolt further is the output of the impact as measured on Superbolt® tensioners.

Installation Procedure for Supernuts

 TA15590a	**Step 1:** Spin the tensioner onto the main thread until it seats against the washer. You may want to back off the tensioner slightly as mentioned in Helpful Tip #3.
 TA15590b	**Step 2:** Tighten (4) jackbolts at 90º apart (12:00, 6:00, 9:00, and 3:00) on all studs with a partial torque (30-70%). This serves to seat the flange. If using an air impact, use a reduced setting or lightly pulse and trigger at the full setting.
 TA15590b	**Step 3:** At 100% target torque, tighten the same (4) jackbolts on all studs.
 TA15590e	**Step 4:** At 100% target torque, tighten all jackbolts in a circular pattern. Do this for all studs (1 round only). See Helpful Tip #7 about using up to 120% torque.
 TA15590d	**Step 5:** Repeat 'STEP 4' until all jackbolts are stabilized (less than 10º rotation). This usually requires 2-4 additional passes. If using air tools, switch to a torque wrench when socket rotation is small. Use the torque wrench to stabilize at the target torque.

NOTICE

Product with 4 or 6 jackbolts – use a star pattern for all steps.Capscrew and Bolt-Nut Torque Specifications

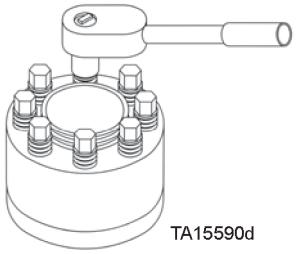
Removal Procedure for Supernuts

CAUTION

Jackbolts must be unloaded gradually. If some jackbolts are fully unloaded prematurely, the remaining jackbolts will carry the entire load and may be hard to turn. With extreme abuse, a jackbolt tip can deform, making removal difficult.

Service Under 250ºF (121ºC)

Preparation: Spray jackbolts with penetrating oil or hydraulic oil prior to start (especially if product is in corrosive environment)


TA15590d

Step 1: Loosen each jackbolt 1/8 turn following a circular pattern around the tensioner (1 round only). As you move around and get back to the first jackbolt, it will be tight again. Do this for all studs on the joint prior to the next step.

Step 2: Repeat a 2nd round as above for all studs, now loosening each jackbolt ¼ turn in a circular pattern.

Step 3. Continue loosening ¼ turn for 3rd and successive rounds until all jackbolts are loose.

NOTICE

Usually after the 3rd or 4th rounds, an impact can be used to completely extract the jackbolts, one by one. For long bolts or tie roads, additional rounds may be required before removing the jackbolts with an impact tool.

Step 4 Remove, clean and relubricate the jackbolts prior to next use with correct Superbolt lubricant (JL-G) Komatsu P/N 427-3753 (do not use any substitute).

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