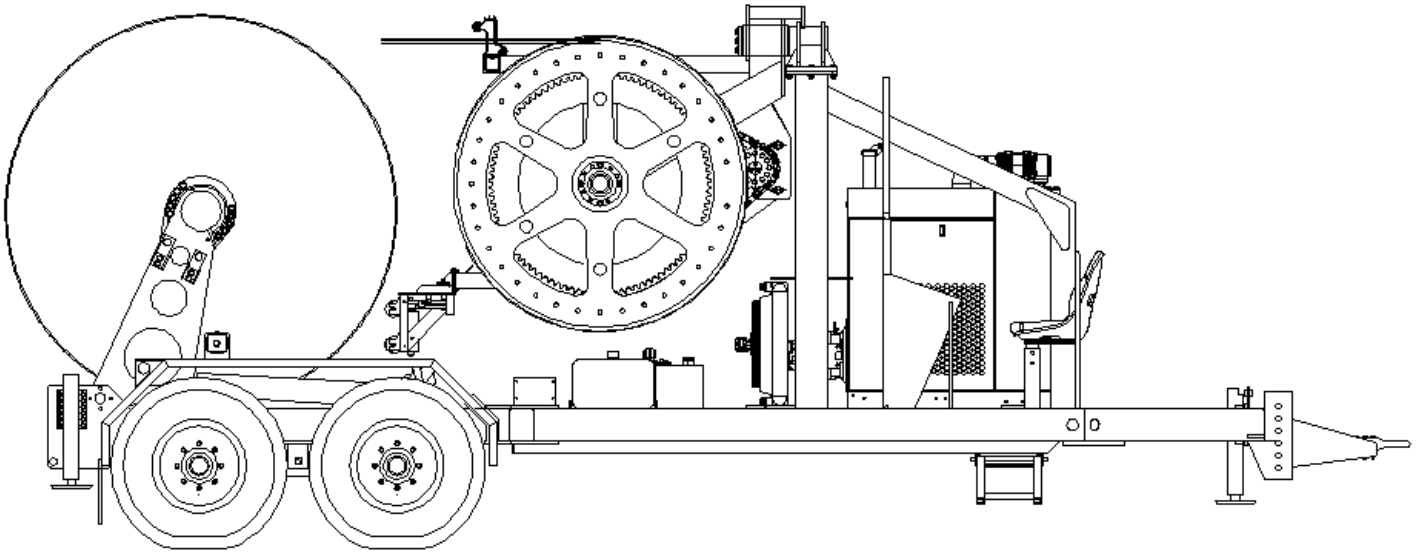
TSE INTERNATIONAL, INC.

bsi. ISO 9001 Quality Management FM 63723

Owner's Manual



Model: PTV100/72
Puller Tensioner

Serial Number 18-5073-01

www.tse-international.com
5301 Shreveport Blanchard Hwy – Shreveport, Louisiana 71107 – USA
P: 318-929-2368 F: 318-929-4853

PTV 100-72
PULLER / TENSIONER



This compact traction unit performs equally well as a puller or a tensioner and is ideal for reconductoring applications. Having the self-loading, powered reel winder as an integral part of the machine allows reels of conductor or pulling rope to be loaded and unloaded without a crane on the location.

Ability to operate equally well as a puller or a tensioner means that a unit can pull out old conductor, wind it on a scrap reel, unload it and tension out the new conductor all with one machine. For contractors or utilty companies performing a wide variety of jobs, these units have unsurpassed versatility. Whether it's stringing new conductor, reconductoring existing circuits and groundwire or wrecking out old conductors these combination units are ideal. The V-groove bullwheel permits easy handling of splicing sleeves and a wide range of conductor or rope diameters.

Conductor or pulling line is imbedded in the elastomer lined V-groove of the bullwheel. TSE's unique hydraulic system allows the operator to preset the maximum pulling tension and provides infinite linespeed and linepull control.

The machine design incorporates a pivoting bullwheel arrangement which automatically aligns the bullwheel with the point on the reel from which the conductor is being payed off. During the pulling mode the operator controls the bullwheel movement to levelwind the pulled cable onto the storage reel.

SPECIFICATIONS

Maximum continuous linepull	10,000 lbs. @ 4MPH
Maximum Intermittent linepull	11,000 lbs.
Linespeed	0-4 MPH Variable
Engine	173 HP Diesel
Bullwheel diameter	72 inches
Bottom of groove diameter	65-1/2 inches
Maximum reel size	96" X 53"
Maximum reel weight (highway)	11,000 lbs
Maximum reel weight (jobsite)	16,000 lbs

DIMENSIONS & WEIGHT

Unit Weight w/o reel	20,000 lbs. approx.
Unit dimensions (approx.)	25' 6" L, 8' 4" W, 11' 1" H

STANDARD EQUIPMENT

- Fully hydrostatic drive system.
- Infinitely variable speed and linepull control with overpull protection.
- Spring applied, hydraulic released holding brakes.
- Self loading rear mounted reel winder.
- Oscillating bullwheel for minimal fleet angle on conductor or rope.
- Centrally located console for optimum visibility.
- Tandem axle trailer mounted with electric brakes.
- Hydraulic front and rear jacks.
- Elastomer bullwheel segments.

At TSE, engineering is a process of continuous product improvement; therefore, specifications are subject to change without notice.

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5301 Shreveport-Blanchard Hwy
Shreveport, Louisiana 71107

TSE INTERNATIONAL, INC.

Toll Free: 800.825.2402
Telephone: 318.929.2368
FAX: 318.929.4853

www.tse-international.com

TSE International Inc. Warranty Policy

1. **Contact the TSE International Inc. service department to discuss problem and obtain a warranty claim number. Claim numbers will remain valid for 30 days allowing for sufficient time for submission to TSE. Warranties claimed without a valid claim number may be denied.**
2. **Please retain any defective parts for a period of 60 days. TSE reserves the right to inspect and/or evaluate any parts submitted for warranty consideration. Should TSE elect to inspect the parts, a RGA (Return Goods Authorization) number will be issued and the parts are to be returned prepaid to TSE. Items not returned within 30 days will result in the RGA closure and may result in a denial of the claim.**
3. **Warranty submission must be on the standard TSE International Inc. claim form. Claims that are not will be classified as pending until proper forms are submitted. All claims must have an estimated cost associated with each item under discrepancy.**
4. **Major subcomponents are warranted under separate manufacturer warranties. It is the responsibility of the owner/dealer of the equipment to fill out and register all subcomponent manufactures warranties. In the event of failure, arrangements can be made to deal with the subcomponent supplier directly. Examples for subcomponent manufactures are: Engines– John Deere, Cummins, Caterpillar, etc.**

Claims submitted as per above TSE International Inc. Equipment Warranty policy will be resolved within 30 days of receipt

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Recommendations for improving this publication are encouraged and should be forwarded to:

TSE INTERNATIONAL
5301 Shreveport-Blanchard Hwy.
Shreveport, Louisiana 71107

This is not a tension stringing operation procedures manual. No attempt is made or implied herein to instruct the user in methods peculiar to the individual application of the equipment described in this manual. The contents of this manual are intended as a basis of for operation, maintenance, and parts listing of the unit in its intended and anticipated use, as it stands alone in conjunction with other equipment.

The Equipment described in this manual is potentially dangerous if improperly or carelessly operated. For the protection of personnel and equipment, only competently trained operators who are critically aware of the proper procedures, operating parameters, and limitations, potential dangers, and application of this equipment should be allowed to touch the controls at any time.

PREMIUM CUSTOMER SERVICES

TSE supports its innovative products with Premium Customer Service. Our comprehensive Service Department provides TSE customers with the service, parts, and technical assistance they need to maintain their equipment in top operating condition.

For Customer Service on Your

Model PTV100/72

Serial No. 18-5073-01

PLEASE CALL 1-800-825-2402

Our People Care: Our Equipment is the Proof.

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HOW TO ORDER REPLACEMENT PARTS

In order that we may promptly send the exact replacement part required in the least amount of down time for you, the information listed below is necessary.

To order the replacement part, locate the part from the drawings in this manual and give the following information:

1. **Unit Model No. (From the plates on the unit's frame)**
2. **Unit Serial No. (From the plate on the unit's frame, will contain numbers only)**
3. **Part Number (If available)**
4. **Description (If part no. not available)**
5. **Quantity Required**

On large components such as transmissions, engines, multiple pump drives, etc., the manufacturer's serial number and spec. number is necessary to ensure receiving the proper replacement part.

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WARNING

The equipment described in this manual is neither designed nor intended for any application, alone or with in conjunction with any other equipment, that involves the lifting or moving of persons.

Safe operation of this equipment is dependent on use in compliance with the procedures outline in this section and the maintenance and inspection procedures in SECTION Ill with consideration of prevailing conditions.

The equipment described in this manual is potentially dangerous if improperly and carelessly operated. For the protection of personnel and equipment, only competently trained operators who are critically aware of the proper procedures, operating parameters and limitations, potential dangers, and application of this equipment should be allowed to touch the controls at any time.

There is potential DANGER of ELECTRICAL SHOCK when operating this machine. Ground the unit in accordance with the regulations of the using organization. Various methods of bonding, isolation and grounding can be used; a means suitable to the user should be selected and rigidly adhered to by ALL operating personnel.

Keep all shields and guards in place. Keep hands, feet and clothing away from power driven parts and moving parts. Observe all warning decals placed on the machine.

Make certain all personnel are clear of this equipment before starting engine or operation.

Before leaving the operators position, make sure that directional controls are in the neutral position and all brakes are set.

EQUIPMENT WARRANTY

TSE International Inc. (hereinafter sometimes referred to as "TSE") warrants that it will repair f.o.b. its factory, or furnish without charge f.o.b. its factory, a similar part to replace any material in its machinery which, during the earlier of 90 days after the said machinery is put into operation or six months after the date of shipment of the machinery from the plant, is proved to the satisfaction of the company to have been defective at the time it was sold, provided that all parts claimed defective shall be returned, properly identified, to TSE's factory, charges prepaid.

This Warranty to repair applies only to new and unused machinery, which, after shipment from the factory of TSE, has not been altered, changed, repaired or treated in any manner whatsoever unless such alteration, change, repair or treatment has been previously authorized in writing by TSE or has been performed by the authorized service representative of TSE.

This Warranty to repair is the only Warranty either express, implied or statutory, upon which the said machinery is sold; the companies liability in connection with this transaction is expressly limited to the repair or replacement of defective parts, all other damages and warranties, statutory or otherwise, being hereby expressly waived by the purchaser.

No representative of TSE has authority to change this Warranty or this contract in any manner whatsoever and no attempt to repair or promise to repair or improve the machinery covered by this contract by any representative of TSE shall waive any consideration of the contract or change or extend this Warranty in any manner whatsoever.

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GROUNDING EQUIPMENT AND METHODS

Grounding Equipment and Methods information is covered in the following publication:

"IEEE GUIDE TO INSTALLATION OF OVERHEAD TRANSMISSION LINE CONDUCTORS IEEE STD 524-2003"

The above publication is available through the following organization:

THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.
3 PARK AVENUE
NEW YORK, NY 10016-5997
USA

DECALS

Your equipment was shipped from the factory with the decals on the following sheet.

Should any of these decals be missing, they could prevent the proper operation and/or maintenance of the unit which may result in personal injury or property damage.

If any of these decals are missing, please contact us for a replacement.

Order the decal(s) by stating the decal description, number, and quantity.

TSE INTERNATIONAL
5301 SHREVEPORT-BLANCHARD HWY.
SHREVEPORT, LA 71107

ATTENTION: **SERVICE MANAGER**

TELEPHONE: **800-825-2402**
FAX: **318-929-4853**

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD
B	21NOV08		ITEM 32 WAS D600068	SB	JM
C	29JAN13		ITEM #32 ADDED	SB	JM
D	16JUN15		ITEM 41 & 42 ADDED.	MM	ILM
E	07DEC15		ITEM #44 ADDED	SB	JM

NOTE: ALL DECALS AND LABELS FOR TSE ARE TO BE YELLOW WITH BLACK TEXT AND BORDERS

ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY
22	D600088	1	FRONT STABILIZER – RAISE – LOWER		REF
21	D591437	4	ANCHORING LUG		REF
20	D594657	1	RATING		REF
19	D590121	1	ON LEAVING FACTORY ANTIFREEZE...		REF
18	D593256	2	LUBRICATE CHAINS		REF
17	D600091	2	WARNING – THE REEL SHAFT COLLARS		REF
16	D593045	1	GEAR OIL ONLY		REF
15	D591748	1	MAINTENANCE SCHEDULE		REF
14	D000025	1	DECAL– 12 VOLT		REF
13	D000722	1	DECAL– AW–46 PREMIUM HYD FLUID		REF
12	D000156	1	DECAL– DIESEL FUEL ONLY		REF
11	D000214	1	DECAL– THIS MACHINE IS NEGATIVE GROUND		REF
10	D000213	1	DECAL– WARNING: BEFORE USING THIS		REF
9	D000028	2	DECAL– GROUNDING BAR		REF
8	D591712	4	LUBRICATE WEEKLY		REF
7	D591821	1	CAUTION REAR STAB DOWN		REF
6	D592062	3	CAUTION, MOVING CHAINS		REF
5	D592083	1	DANGER: NEVER MOVE CONTROL . . .		REF
4	D592727	4	DANGER		REF
3	D000116	3	DECAL– CAUTION MOVING STABILIZER, KEEP		REF
2	D593006	2	CAUTION KEEP CLEAR		REF
1	D593007	1	FILTER CHANGE BOTH CARTRIDGES		REF

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UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
DIMENSIONS IN [ ] ARE MM
-TOLERANCES-

A) ANGULAR ± 1/2°
B) DECIMAL (ONE) .X ± .06
(TWO) .XX ± .02
(THREE) .XXX ± .01
C) FRACTIONAL
1. GENERAL ± 1/32
2. SAWING, FLAME CUTTING, SHEARING & BREAKING ± 1/16
3. WELDING ± 1/8

TSE INTERNATIONAL INC
Shreveport, Louisiana, United States of America

MATL CERT N/R	TITLE DECAL PACKAGE – PTV–100–72		
MATL TEST N/R	NEXT ASSEMBLY	DERIVED FROM D800003A	
WELD TEST N/R	FIRST USED ON WO	SHEET 1	OF 2
EST LBS N/A	DRAWN DY / CHECKED / APPROVED RB	5600365	REV E
ACT LBS N/A	DATE 21MAY02	SCALE 1/1	

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD

OPTIONAL DECALS

ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY
44	D600626	1	DECAL, REELSHAFT DRIVE		REF
43	D597115	2	ID NUMBERS - F001682		REF
42	D597114	1	ENGINE START-UP/ ENGINE WARM-UP		REF
41	D596693	4	CAUTION: HEARING PROTECTION MUST BE...		REF
40	D594071	1	ABS WARNING		REF
39	D000268	1	DECAL- EMERGENCY		REF
38	D000269	1	DECAL- SERVICE		REF
37	D595835	1	QUALIFIED OPERATORS ONLY		REF
36	D600300	1	ANCHORING DIAGRAM, PTV100-72		REF
35	D592064	1	WARNING-UNCOUPLING THE BREAKAWAY		REF
34	D590030	1	CAUTION		REF
33	D000021	1	DECAL- MADE IN USA		REF
32	D593689	2	DECAL, TORQUE NUTS TO 200 FT/LBS		REF
31	D000506	1	DECAL- CAUTION: DO NOT OPERATE...		REF
30	D001119	1	DECAL- TENSION/LINEPULL PTV100		REF
29	D594658	1	OPERATING INSTRUCTIONS		REF
28	D590090	1	ENGINE THROTTLE		REF
27	D600087	1	STREETSIDE STABILIZER - RAISE - LOWER		REF
26	D600086	1	CURBSIDE STABILIZER - RAISE - LOWER		REF
25	D590053	6	DANGER KEEP HANDS AWAY		REF
24	D590009	1	ENGINE START		REF
23	D600089	1	REEL CRADLE - RAISE - LOWER		REF

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SECTION II		**OPERATING INSTRUCTIONS**
SECTION III		**MAINTENANCE**
SECTION IV		**PARTS LIST**
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	8602373	GENERAL ASSEMBLY – PTV 100-72
	8601564-A	V-GROOVE BULLWHEEL MODULE ASSEMBLY
	8600890-A	V-GROOVE BULLWHEEL ASSEMBLY
	6800003-B	DRIVE ASSEMBLY – BULLWHEEL
	8800022-C	LEVELWIND ASSEMBLY
	8602374-A	ENGINE & PUMP ASSEMBLY–FT4
	8800026-B	CONTROL PANEL ASSEMBLY
	8602063	DRIVE ASSEMBLY – REEL SHAFT
	8602064-B	HYDRAULIC SCHEMATIC
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	882003-J	REEL SHAFT ASSEMBLY
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		PUMP DRIVE
		PUMP/MOTOR-SERVICE
		MOTOR - REELWINDER
		GEARBOX
		BRAKES
		AXLE

SECTION I
INTRODUTION

MODEL PTV100/72 V-GROOVE PULLER/TENSIONER

General:

The Model PTV100/72 V-GROOVE is a combination Cable Puller / Tensioner with a Self-Loading Storage Reel and a Single V-Groove Traction Drive Bullwheel powered by an Engine through Hydrostatic Drive systems. These Drives are remotely controlled from the Operator's Control Panel to provide smooth continuous, Variable Speed and Direction Control. The Operating System enables the Operator to preset the Hydraulic Pressure at any level up to the maximum, thereby maintaining the desired Line Tension.

The Trailer is equipped with Hydraulic Front Jacks, Hydraulic Rear Stabilizers, adjustable Pintle Eye Tow Hitch, Grounding Lugs, Tie-Down Loops, Highway Lighting, and Electric Trailer Brakes.



CAUTION!
WHEN THIS SIGN APPEARS ON THESE PAGES, IT INDICATES WHERE SPECIAL ATTENTION SHOULD BE PAID TO THE INSTRUCTIONS GIVEN; PERSONAL INJURY OR DAMAGE TO THE EQUIPMENT MAY OCCUR IF THE INSTRUCTIONS ARE NOT FOLLOWED.

Specifications:

APPROXIMATE DIMENSIONS (WITHOUT REEL)

Overall Length	308”
Overall Width	102”
Overall Height	133”

REEL

Maximum Flange Diameter	96”
Maximum Flange Width	53”
Maximum Reel Weight (Road Travel)	11,000 lbs.
Maximum Reel Weight (Stationary)	16,000 lbs. w/ rear jacks extended.

BULLWHEEL (LINED WITH REPLACEMENT SEGMENTS)

Diameter	72”

HYDRAULIC SYSTEM

Pumps	Variable displacement, axial piston, hydraulic
Motors	Fixed displacement, axial piston, hydraulic
Maximum System Pressure	5000 PSI
Hydraulic Fluid Reservoir Capacity	50 Gallon

UNDERCARRIAGE

Tires	12R22.5 – LR “H”
Brakes	Electric Brakes
Hydraulic Leveling Jacks	1 Front, 2 Rear
Axle	30,000 lb. Tandem
Hub	8 Studs on 275mm

ENGINE

Horsepower	173 HP
Model	John Deere FT4
Fuel	Diesel
Fuel Reservoir Capacity	40 Gallon

PERFORMANCE

Maximum Linepull	11,000 lbs
Continuous Linepull	10,000 lbs
Line Speed	0 - 4.0 mph



WARNING! THESE VALUES ARE A MAXIMUM AND MUST NOT BE EXCEEDED.

SECTION II
OPERATIONS

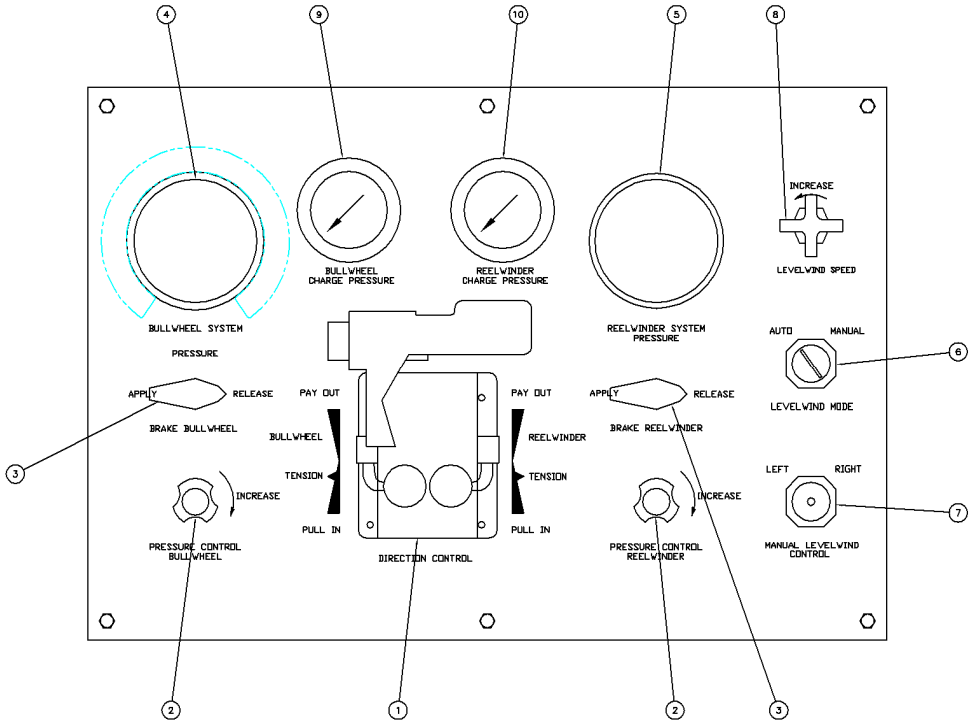
Controls:

The controls that require explanation are described below.

BEFORE OPERATING THIS EQUIPMENT FAMILIARIZE YOURSELF WITH ALL CONTROLS AND THEIR FUNCTION. FULLY TRAINED PERSONNEL SHOULD ONLY OPERATE EQUIPMENT.

See descriptions below. Corresponding numbers below references each ballooned item number on FIGURE 1.

FIGURE 1 – CONTROL PANEL



1. DIRECTIONAL CONTROLS

The Drives for the Reel and Bullwheel are controlled with individual Levers, which regulate the degree of Pump Stroke in both directions from Neutral ‘CENTER’. Movement of the Direction Control Lever ‘UP’ causes the Bullwheels or Reel Drive to ‘PAYOUT’, and movement of the Direction Control Lever ‘DOWN’ causes the Bullwheels or Reel Drive to ‘PULL IN’. The Bullwheel speed is ZERO with the Direction Control Lever in the NEUTRAL position.

2. PRESSURE CONTROLS

The Pressure Controls are used to preset the maximum Hydraulic System Pressure in each Drive. Clockwise rotation of the Pressure Control increases the Hydraulic Pressure.

3. BRAKE CONTROLS

The Brake Control Valves allow the operator to apply or release the Bullwheel and Reel Drive Failsafe Brakes.

CAUTION: NEVER OPERATE THIS FUNCTION WHEN A REEL IS INSTALLED AND MOVING. COMPONENT DAMAGE MAY OCCUR.

4. BULLWHEEL LINEPULL GAUGE

The Linepull Gauge shows the Hydraulic Working Pressure in the system. The Linepull Gauge may be used to approximate the Tension in the Conductor using the chart provided.

DO NOT EXCEED 5,000 PSI AT ANY TIME DURING PULLING, AND DO NOT EXCEED 3,500 PSI AT ANY TIME DURING TENSIONING.

5. REELWINDER PRESSURE GAUGE

The Reelwinder Pressure Gauge shows the ReelWinder Working Pressure in the system.

6. LEVELWIND MODE SELECTOR SWITCH

The Levelwind can be fully automatic or manually controlled. Put the Levelwind Mode Selector into the 'AUTO' or 'MANUAL' position for desired control. In the 'MANUAL' mode, use the manual Levelwind Direction Control to operate the Levelwind left and right. The 'MANUAL' mode is used primarily for Pulling In the conductor. The 'AUTO' mode is to be used only when tensioning.

7. LEVELWIND DIRECTION CONTROL

When operating in the 'MANUAL' mode, direction is controlled through this Joystick.

8. LEVELWIND SPEED CONTROL

By turning the valve 'IN', the speed of the pivoting Bullwheel is reduced. By turning the valve 'OUT' (COUNTER-CLOCKWISE), the speed of the pivoting Bullwheel is increased.

9. CHARGE PRESSURE GAUGE - BULLWHEEL

This gauge indicates the 'CHARGE PRESSURE' in the Hydraulic Circuit. The pressure should be approximately 300 psi.

10. CHARGE PRESSURE GAUGE - REELWINDER

This gauge indicates the 'CHARGE PRESSURE' in the Hydraulic Circuit. The pressure should be approximately 300 psi.

11. FRONT STABLIZER/JACK CONTROL

This switch is located on the front curbside of the tongue (See figure 2). It is used to raise and lower the front of the trailer.



FIGURE 2.



FIGURE 3.

12. REEL CRADLE, REAR STREETSIDE & CURBSIDE STABILIZERS

These switches are located on the curbside of the unit in front of the fender (See figure 3). They are used to raise and lower the reel cradle, curbside and streetside rear stabilizers.

13. REEL DRIVE ENGAGE/DISENGAGE (OPTIONAL)

This switch is located on the rear of the curbside fender of the unit. (See figure 4). It is used to engage or disengage the reel drive from the reel shaft. **Note: before using the switch the T-Lock pin must be removed from the shaft**



FIGURE 4.

Reel Installation

Perform the following procedures to install the reel:

a. Locate the unit on level ground.

b. Disengage the reel drive motor from the reel shaft See Figure 4.

c. Remove the cradle lock pins.

d. Remove the retainer pins from the bearing supports.

e. Lower the reel cradle. See Figure 3.

f. Remove the reel spindle from unit and install into reel to be used.

g. Secure locking collar on shaft next to reel and install Spindle Bearings.

h. Back unit into reel, or roll the reel to unit and install bearings into bearing supports.

i. Flip the latches on the bearing supports down and install retainer pins.

j. Lower the Rear Stabilizers. See Figure 3.

k. Raise the reel cradle into the stowed position. See Figure 3.

l. Engage the reel drive motor back onto the reelshaft. See Figure 4. **Note it may be necessary to rotate the reel by hand to allow the drive to engage fully.**

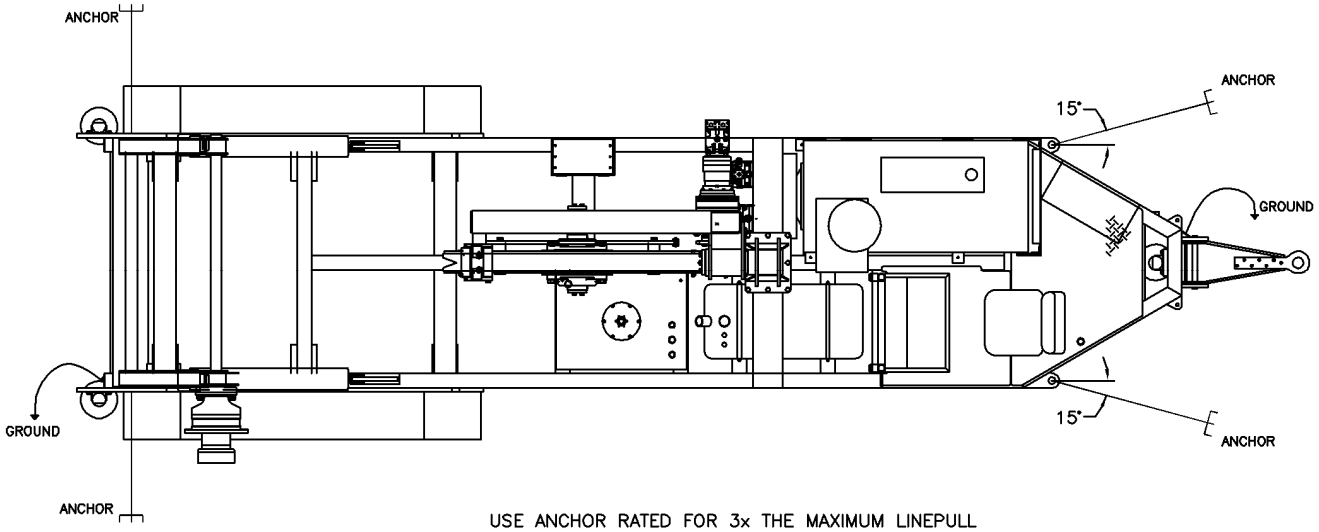
NOTE: ENSURE CABLE IS UNDERWOUND ON THE REEL FACING THE BULLWHEEL.

NOTE: FOR SMALL REELS IT MAY BE REQUIRED TO RAISE FRONT OF MACHINE.

CAUTION: IT IS EXTREMELY IMPORTANT THAT THE REAR STABILIZERS ARE DOWN BEFORE ATTEMPTING TO LOAD A REEL. FAILURE TO DO SO WILL CAUSE THE NOSE OF THE TRAILER TO LIFT. EQUIPMENT DAMAGE OR PERSONAL INJURY COULD OCCUR.

Field Set Up/Anchoring:

FIGURE 5 – ANCHORING AND GROUNDING



CAUTION: ANCHOR AND GROUND THE UNIT AS SHOWN IN FIGURE - 5:

a. The Pulling Rope or Conductor should not put side load on the rear of the Trailer. This can cause sudden sideways movement on the Trailer causing injury or equipment damage.

b. It is highly recommended to put Wheel Chocks around each Trailer tire to prevent movement of the Trailer.

PROPER GROUNDING OF EQUIPMENT IS EXTREMELY IMPORTANT

c. The machine is equipped with Grounding Bars. To protect against electrical hazards, the unit must be connected to a Ground Rod or the Electrical System NEUTRAL. Follow proper grounding procedures as required by I.E.C. and /or other applicable standards. Ground Mats and a Running Ground on the Conductor are recommended.

d. Put a hazard barrier around the perimeter of the unit to keep unauthorized personnel away from equipment in operation.

e. Perform daily inspection and preventive maintenance if required.

Pre-Start Checklist

Before starting the engine and upon completing each day's work, the controls must be set as follows:

a. Linepull Control and ReelWinder Pressure backed off.

b. Drive Brakes in 'APPLY' position.

c. Directional Controls in 'CENTER' position.

Operation:

A. PRESETTING HYDRAULIC PRESSURE

After the Engine is warmed up, test the Hydraulic System as follows:

a. Set Engine Throttle to maximum RPM.

b. Move Bullwheel Directional Control Lever slightly into the 'PULL IN' position.

c. Check reading on Bullwheel Hydraulic Gauge. If starting first 'PULL', and required Working Pressure is not known, set Bullwheel Pressure to 1500 PSI (103 BARS). Adjust the pressure with the Bullwheel Pressure Regulator Control. Turn clockwise to raise pressure or counter-clockwise to reduce pressure.

d. Return Bullwheel Directional Control Lever to the 'CENTER' position.

e. Repeat steps b - d, using the Reel Drive Directional Control Lever Gauge and Pressure Regulator Control. If required Working Pressure is unknown, set Reel Drive Pressure to 1000 PSI (69 BARS).

NOTE:
THE 1500-PSI (103 BARS) ON THE BULLWHEEL AND THE 1000-PSI (69 BARS) ON THE REEL DRIVE IS REFERRED TO AS THE PRESET PRESSURE. THE PRESET PRESSURE IS THE MAXIMUM PRESSURE THAT CAN BE EXERTED WITH THIS SETTING. OF COURSE, IF MORE OR LESS PRESSURE IS REQUIRED THE SETTING MAY BE CHANGED. ADJUSTABLE PRESET PRESSURE PERMITS A SLIGHTLY HIGHER PRESSURE THAN NEEDED TO PULL THE LINE (WORKING PRESSURE) TO BE SET INTO THE MACHINE PRIOR TO OR DURING THE PULL. THIS PROVIDES A SAFETY FACTOR IN THE EVENT OF A LOCKUP ON THE LINE. IF SUCH A LOCKUP OF RUNNING BOARD IN A BLOCK OR OTHER CAUSES SHOULD OCCUR, THE

MAXIMUM PULL WOULD BE THE PRESET PRESSURE. NORMALLY, THE PRESET PRESSURE ON THE REEL DRIVE IS THE SAME AS THE WORKING PRESSURE, BUT THE BULLWHEEL PRESET PRESSURE SHOULD BE ABOUT 200 PSI (13,8 BARS) ABOVE THE WORKING PRESSURE.

B. PULLING

When operated as a Puller, the function of the unit is to pull in the line against the resistance of the Tensioner, at the other end of the setup. The Puller regulates the maximum 'PULL' and the maximum Speed of the Line. Pulling is accomplished according to the following procedures:

a. Perform pre-start checks.

b. Preset the Hydraulic Pressure.

c. Set the Engine Speed at the Maximum rpm.

d. Release Reel Drive Brake.

e. Place Reel Drive Directional Control Lever slightly into the 'PULL-IN' position. Align the Levelwind by switching the Levelwind Mode Selector Switch (6) to 'MANUAL' position and align the Levelwind using the Joystick (7). When all slack in the line between the Reel and Bullwheel is removed, move the Reel Drive Directional Control Lever into the Full Speed 'PULL IN' position (Lever pulled completely toward the operator).

f. Release Bullwheel Brake and simultaneously move the Bullwheel Directional Control Lever slightly into the 'PULL-IN' position.

g. Increase Speed of Line as desired, by moving the Bullwheel Directional Control Lever further into the 'PULL-IN' position.

As the 'PULL' is started the Reel Drive Hydraulic Pressure Gauge will read the Preset Pressure. The Bullwheel Hydraulic Pressure Gauge will read a Low Pressure at first, but this pressure will increase as the Puller picks up the slack in the Pulling Line. If the pressure reaches the Preset Pressure, the Puller will stop moving Line. It will not stop pulling, but can only pull at the Preset Pressure. If the Puller reaches the Preset Pressure, the operator can start the Puller to pulling again by increasing the Preset Pressure on the Bullwheel. The Reel Drive Preset Pressure may also be increased, keeping it 500 PSI (34.5 bars) to 1000 PSI (69 bars) below the Bullwheel Preset pressure, except on very heavy or very light pulls. Then it may be necessary to keep the two Pressures equal.

If after the 'PULL' is started and the Working Pressure fails to reach the Preset Pressure, the operator should lower the preset pressure to about 200 PSI (13,8 Bars) above the Working Pressure. To do this he turns the Bullwheels Pressure Regulator counter-clockwise until the Puller begins to slow down, at this point he turns the Bullwheel Pressure Regulator clockwise one or two turns until the Puller regains its speed.

At the end of the 'PULL', the unit should be slowed and stopped as follows:

a. For a smooth stop, slow Puller prior to stopping by moving Bullwheel Directional Control Lever toward the 'CENTER' position.

b. To stop, move the Bullwheel Directional Control to the 'CENTER' position with one hand, then immediately set the Bullwheel Brake.

c. Set the Reel Drive Brake.

d. Return the Reel Drive Directional Control Lever to the ‘CENTER’ position.

e. Reduce Engine Speed to idle for 3-5 minutes before stopping Engine.

NOTE: IMMEDIATELY AFTER A PULL IS ONE OF THE BEST TIMES TO CHECK THE UNIT FOR WATER, OIL, OR HYDRAULIC FLUID LEAKS.

C. TENSIONING WITH BULLWHEEL

The unit can be used to create Tension in the Line as the ReelWinder at the other end of the operation pulls the Line back. Tension according to the following procedures: Perform pre-start checks.

a. Preset pressure.

b. Set Engine Speed at Maximum RPM.

c. Switch the Levelwind mode selector switch to ‘AUTOMATIC’ position.

d. Release the ReelWinder Brake.

e. Move the ReelWinder Direction Control Lever slightly to the ‘PULL IN’ direction. When all slack in the Line between the Reel and Bullwheel is removed, move the Reel Drive Directional Control Lever into the “TENSION” position.

f. Release Bullwheel Brake and simultaneously move the Bullwheel Directional Control Lever into the ‘TENSION’ position.

g. Instruct the Puller operator that you are ready for him to start the Pull.

h. As the conductor begins to move through the bullwheel, regulate the line tension of the conductor by using the Bullwheel Linepull Control. Clockwise adjustment will increase the tension; counterclockwise adjustment will decrease the tension. If the conductor starts to slip in the bullwheel it may be necessary to increase the pressure in the Reelwinder Linepull Control. Clockwise adjustment will increase the tension; counterclockwise adjustment will decrease the tension.

D. STOPPING AFTER TENSIONING

a. Instruct the Puller operator to stop first.

b. When the conductor and the bullwheel has stopped moving, set both the Bullwheel and the Reelwinder Brakes into the ‘APPLY’ position and move both of the Directional controls to the ‘NEUTRAL’ position.

c. Reduce the Engine speed to idle for several minutes before stopping.

E. TENSIONING DIRECTLY FROM THE REEL (Not threaded through Levelwind or Bullwheel)

a. Perform pre-start checks and start the engine.

b. Preset Pressure to 1500 PSI.

c. Set Engine Speed at Maximum RPM.

d. Release the Reel Drive Brake.

e. Move the Direction Control Lever into the 'TENSION' direction.

f. Instruct the Puller operator that you are ready for him to start the Pull.

g. As the conductor begins to move, regulate the line tension of the conductor by using the Reelwinder Linepull Control. Clockwise adjustment will increase the tension; counterclockwise adjustment will decrease the tension.

E. TOWING

Before towing the unit, check the following:

a. Jacks fully retracted. See Figures 2 & 3.

b. Wheel Brakes operative.

c. Lights operative.

d. Safety Chains and Breakaway Switch attached.

e. Reel Cradle in stowed position.

f. Bullwheel in the vertical position.

SECTION III
MAINTENANCE

This section contains schedules, recommendations, and procedures designed to ensure that the equipment is prepared for safe and efficient operation and to prolong the service life of the equipment. These maintenance instructions constitute basic requirements for an operational environment that is not extreme in temperature, humidity, airborne abrasives, or other conditions which would require preventative maintenance techniques to combat. The using organization is encouraged to determine preventative maintenance requirements that are the result of environmental extremes.

Service Safety Precautions

1. Before performing maintenance or repair work on any equipment, consult the manufacturer's instruction manual and follow the recommended procedures.
2. When servicing or repairing the equipment, shut down the engine unless it is required to be running for adjustment purposes.
3. Always use the proper tools for the job. Repair or replace any broken or damaged tools, including lifting equipment immediately.
4. Keep your head, hands, feet, and loose clothing away from power-driven parts.
5. Pressure can be maintained in the hydraulic circuits long after the power source and pump have been shut down. Relieve all trapped pressures before performing any service work to the hydraulic components.
6. When troubleshooting a hydraulic system for leaks, use a piece of cardboard or other material as detector rather than your hand. Pressurized hydraulic fluid escaping from a faulty component can penetrate the skin and cause serious injury.
7. Do not change the pressure setting of any hydraulic valves unless authorized instruction has been obtained.
8. Ensure that all tire and rim parts are undamaged and correctly assembled before inflating the tires.
9. Use an inflation cage, safety cables or some other safety device when inflating the tires. Do not exceed the tire manufacturer's recommended maximum pressure
10. Use caution when draining hot fluids from the machine. Splashing hot fluid can cause serious burns.
11. Ensure that the equipment is blocked so that it cannot shift or move during servicing.
12. Install all applicable safety locks before working on a piece of equipment. Disconnect electrical power before servicing electrical components.

Fire Prevention

Fires can create severe emergencies where both human life and property may be lost. Even when confined, a fire may cause very expensive damage to your equipment. Fire can strike at anytime, not only when the equipment is used, but also when lift unattended between work shifts and nobody is around to fight it.

When working in a confined environment, it is impossible to prevent combustible dust from collecting in tight corners of the machine. This dust, in itself, may not cause a fire, however, when mixed with fuel, oil or grease in a hot an confined place, it can become a fire hazard.

To reduce the chances for a fire to break out, follow the preventative instructions listed below:

1. Inspect the machine daily for potential fire hazards and make any necessary repairs up immediately.
2. Always ensure that excess grease and oil accumulation, including spillage, are cleaned up immediately.
3. Use only nonflammable cleaning agents for cleaning the machine or any machine component.
4. Store oily rags and other combustible materials in a fireproof location.
5. Before performing repair work such as welding, the area surrounding the repair location should be cleaned and a fire extinguisher positioned close by.
6. Maintain a charged fire extinguisher on or near the machine at all times and know how to use it.

Inspections

Periodic inspection of the unit according to a regular schedule will establish the normal state of the unit for personnel associated with its operation and maintenance and provide a set of consistent conditions, which will tend to highlight any occurrence of a potentially hazardous malfunction.

On a daily basis walk around the unit and look closely for any indication of the following:

1. Loose threaded connections.
2. Metal fatigue or excessive corrosion.
3. Abraded hose surfaces.
4. Hydraulic fluid leakage.
5. Possible obstruction of moving parts – especially in the drive train.

To ensure proper operation and long life of your TSE International products, use only good quality lubricants and maintain a regular maintenance schedule as recommended by TSE International and our component suppliers.

Prior to start-up of new TSE International products, all fluid levels are to be checked to ensure correct operating levels. All lubrication and maintenance points are to be inspected and lubricated as illustrated on the Lubrication and Maintenance Instructions sheet.

While TSE International recommends specific intervals, they are intended as a minimum general guide for the maintenance of the equipment. Some job conditions and/or locations may dictate more frequent service intervals than have been recommended.

LUBRICATION DATA				
LUBRICANT	**LUBRICANT INFORMATION**	**GRADES**	**TSE PART #**	**APPLICATION**
AW46	TSE STANDARD HYDRAULIC FLUID (REFER TO HYDRAULIC OIL DECAL LOCATED ON HYDRAULIC RESERVOIR TO DETERMINE WHAT HYDRAULIC FLUID IS USED IN YOUR MACHINE)	ISO 46	567851	HYDRAULIC SYSTEM FLUID
UTILITY EP #2 GREASE	MULTIPURPOSE GREASE	-	-	BEARINGS, SHAFTS, FRICTION COMPONENTS
LUBRIPLATE CHAIN & CABLE FLUID	PENETRATING FLUID	SAE 10 ISO 32	-	CHAINS, WIRE ROPES, CABLES
SPARTAN EP150	INDUSTRIAL GEAR OIL	ISO 150	-	GEARBOXES (REDUCERS) - SEE VENDOR LITERATURE FOR VARIATIONS AND AMOUNTS
SUPER MPGO 80W90	PETROLEUM OIL BLEND	-	-	PUMP DRIVES

SUGGESTED MAINTENANCE SCHEDULE

The following schedule should be carried out by qualified personnel using proper lubricants to suit environmental and operating conditions.

NOTE: THESE ARE SUGGESTED RECOMMENDATIONS ONLY. SPECIFIC SITUATIONS MAY REQUIRE A DIFFERENT LUBRICATION SCHEDULE. ALTER AS NECESSARY.

SERVICE INTERVAL	HOURS	DAILY	WEEKLY	100	150	500	1000
	MONTHS			1	2	6	12
DESCRIPTION (5)							
BEARINGS		-	-	L	-	-	O
BUSHINGS		-	-	L	-	-	-
REELSHAFT BUSHINGS		L	-	-	-	-	-
PIVOT POINTS		-	X	L	-	-	-
CHAIN DRIVES		-	-	-	-	O	-
COUPLINGS		-	-	-	-	-	X
BOLTED CONNECTIONS		X	-	-	-	-	-
HYDRAULIC PLUMBING		X	-	-	-	-	-
HYDRAULIC RESERVOIR (4)		X	-	-	-	-	-
HYDRAULIC FILTERS (2)		-	-	-	R (3)	-	-
HYDRAULIC HOSES		-	-	-	-	X	-
MISC. COMPONENTS (1)		-	L	-	-	-	-

SYMBOL	
R	REPLACE
L	LUBRICATE
X	INSPECT & CORRECT
O	CLEAN & LUBRICATE
F	FLUSH & CHANGE

1. Items such as engines, pumps, pump drives, motors, reducers, brakes, etc. on your equipment should be serviced according to the manufacturer's maintenance schedule (see outside vendor literatures)
2. Hydraulic filter part numbers and descriptions can be found in the hydraulic schematic.
3. Change after the first 50 hours of use.
4. See the decal by the Hydraulic Reservoir.
5. Certain items may not be apart of your machine and DO NOT apply.

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD

V-GROOVE PULLER/TENSIONER (PTV100-72)
-LINEPULL RATING: 10000 LB CONTINUOUS
11000 LB INTERMITTENT
-0-4 MPH PULLING SPEED
-PULLING & TENSIONING HYDRAULIC CONTROLLED
-MAXIMUM REEL ø96
-MAXIMUM REEL WIDTH 53
-MAXIMUM REEL WEIGHT CAPACITY: 11 000 LB ROAD TRAVEL
16 000 LB LIFTING
-173 HP FT4 JOHN DEERE DIESEL ENGINE
-40 GALLON FUEL TANK
-LOCKABLE STEEL BATTERY BOX
-SPRING APPLIED/HYDRAULIC RELEASED HOLDING BRAKE
-PISTON TYPE HYDRAULIC MOTOR
-FULLY HYDROSTATIC DRIVE SYSTEM
-HYDRAULIC REEL SHAFT DRIVE ENGAGE/DISENGAGEMENT
-HYDRAULIC OIL COOLER
-50 GALLON HYDRAULIC RESERVOIR
-EQUIPPED WITH REEL DRIVE DISCONNECT
-ENGRAVED PANEL, LINEPULL CHART
-HYDRAULIC PRESSURE GAUGE
-CONTROLS FOR REEL DIRECTION & SPEED, LINE-PULL/TENSION, HOLDING BRAKE
-WELDED WIRE PROTECTIVE SCREEN
-TANDEM AXLE SET WITH 30,000 LB CAPACITY, ELECTRIC BRAKES
-SAFETY CHAINS & HOOKS
-STANDARD LED HIGHWAY LIGHTING & REFLECTIVE TAPE
-REVERSIBLE PINTLE HITCH

CUSTOMER: CUSTOM TRUCK & EQUIPMENT
SERIAL NO: 18-5073-01
PAINT: TSE YELLOW

ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY
7	D600726		DECAL, TRL-16668		2
6	561071	1	384 LG - 7 CONDUCTOR CABLE		32.0FT
5	5602413		BOX, DOCUMENT STORAGE		1
4	564723		DOCUMENT HOLDER		1
3	7601123		LIGHTING DIAGRAM, 7 PT LED (PTV100/72)		1
2	5600365		DECAL PACKAGE - PTV-100-72		1
1	8602373		GEN ASSY, PTV100-72-SLRW (JD FT4)		1

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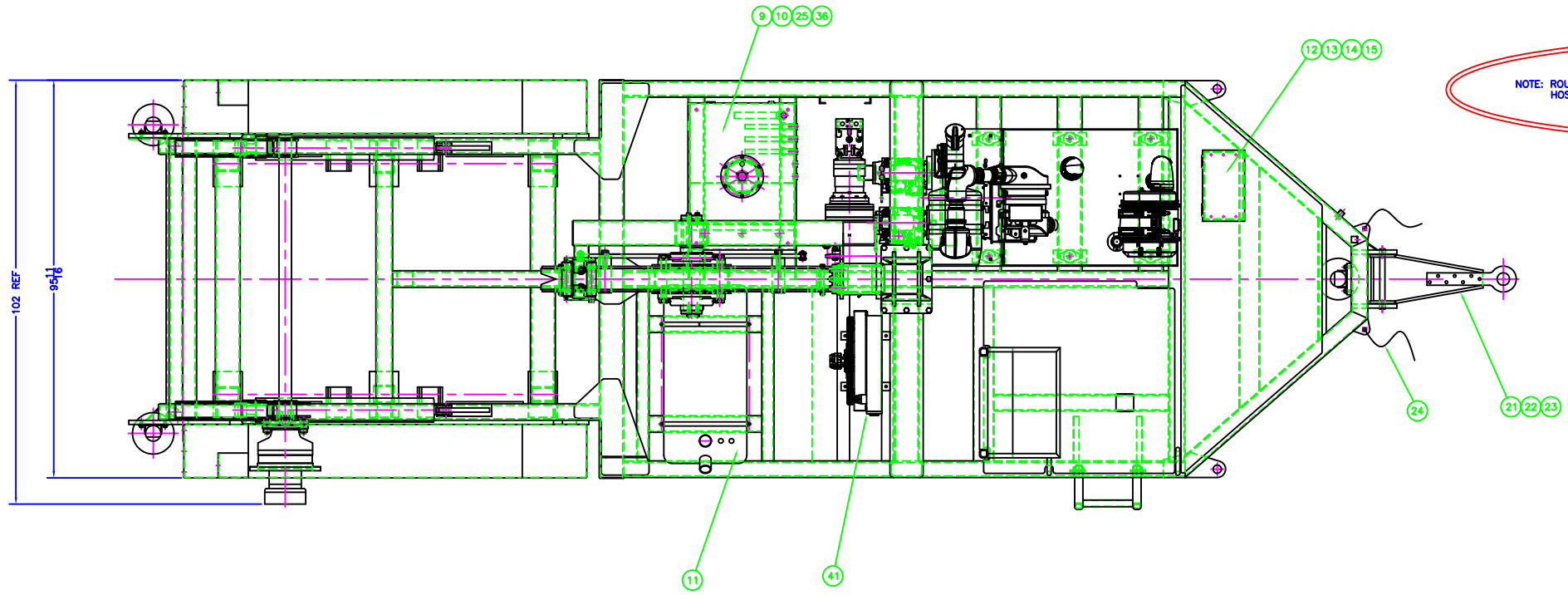
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DIMENSIONS IN [ ] ARE MM
-TOLERANCES-

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B) DECIMAL	(ONE) .X	± .06
	(TWO) .XX	± .02
	(THREE) .XXX	± .01
C) FRACTIONAL		
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2. SAWING, FLAME CUTTING, SHEARING & BREAKING		± 1/16
3. WELDING		± 1/8

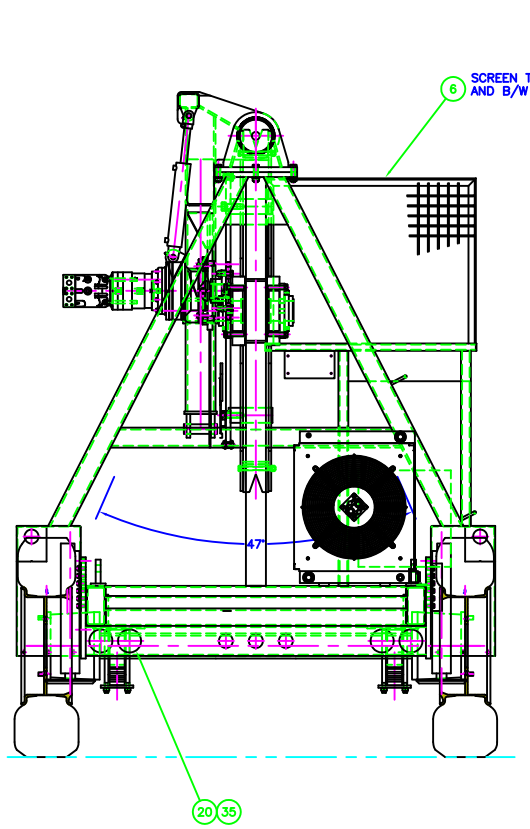
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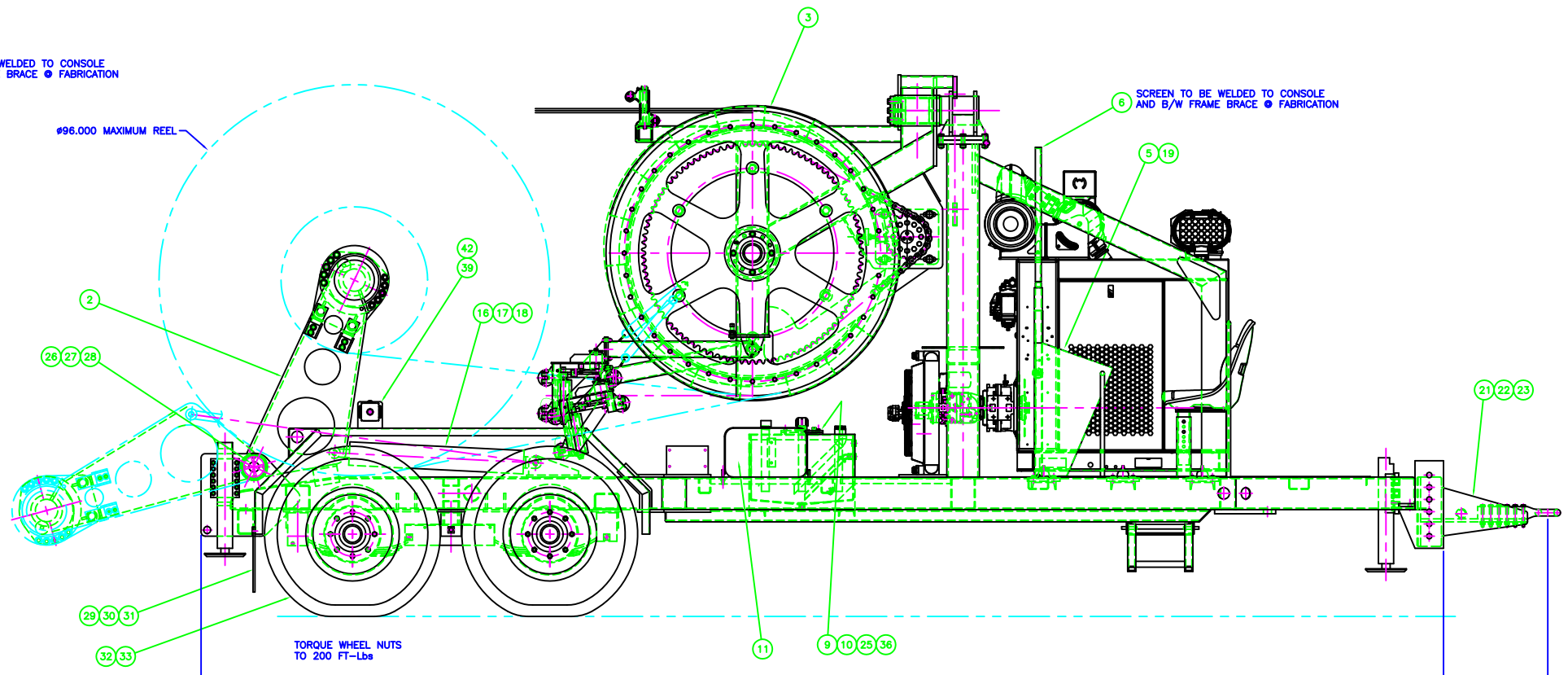
MATL CERT N/R	TITLE PTV 100/72, FINAL ASSEMBLY		
MATL TEST N/R	NEXT ASSEMBLY	DERIVED FROM F602342A	
WELD TEST N/R	FIRST USED ON WO 5073	SHEET 1	OF 1
EST LBS N/A	DRAWN SB / CHECKED / APPROVED JM	F602353	REV
ACT LBS N/A	DATE 06FEB18	SCALE 1/1	

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD



NOTE: ROUTE HOSES, ON REEL LIFT CYLINDER, DOWN LENGTH OF CYLINDER TO PREVENT HOSE DAMAGE WHEN REEL IS LOADED. SEE ENGINEERING FOR DETAILS.





SEE F.A.

ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY
42	564695	1	PANEL BOX 4 X 4		REF
41	5602557		COOLER - OIL/AIR HPV36		1
40	537544		BREAKAWAY SWITCH ASSY		1
39	5603373		MOUNT, CONTROL BOX		1
38	5600357		CABLE, CSA 14-3		75.0FT
37	5600356		CABLE, CSA 14-2		90.0FT
36		FI	HHCS 1/2-13 UNC X 1 1/4 LG C/W LW,FW,N	GR-5	4
35		FI	REFLECTIVE TAPE- 2 INCH		50FT
34	5601392		TOOLBOX, 14 X 12 X 24 - STAINLESS		1
33	6600444		WHEEL ASSEMBLY, 22.5 X 9.00		4
32	5602005		TIRE, 12.00R22.5 LR "H"		4
31		FI	HHCS 5/16-18NC X 1 LG C/W N,LW&FW	GR 5	6
30	542011		CLAMP BAR- MUDFLAP		2
29	563480		MUD FLAP		1
28		FI	1/8-27NPT STRAIGHT GREASE FITTING	STL	2
27		FI	HHCS 3/4-10NC X 1-3/4 LG C/W LW	GR 5	8
26	760147		PIVOT PIN- REEL ARM		2
25	567851		OIL, HYDRAULIC (AW-46)		65GAL
24	567487		SAFETY CHAIN		2
23	561266		HAIR PIN		3
22	561083		HITCH PIN		3
21	7600644		HITCH, TOW EYE - HEAVY		1
20		1	TRAILER LIGHTING DIAGRAM		REF
19	8602379		ELECTRICAL SCHEMATIC, PTV100-72		1
18		FI	COTTERPIN- 1/4 X 2 LG	STL	4
17	539772		PIN- REEL LIFT CYLINDER		2
16	539735		CYLINDER- REEL LIFT		2
15	6600087		BATTERY CABLE ASSEMBLY - NEGATIVE		1
14	6600088		BATTERY CABLE ASSEMBLY - POSITIVE		1
13	7600096		BATTERY BOX, 7 X 13.5 X 10		1
12	511657		BATTERY-550 CCA		1
11	5600194		FUEL TANK ASSEMBLY, 40 GAL.		1
10	8602064		HYDRAULIC SCHEMATIC PTV100/72		1
9	5601998		RESERVOIR ASSY, 50 GAL HYD.		1
8	8602063		REELSHAFT DRIVE ASSY- PTV100/72 (HYD)		1
7	882003		REEL SHAFT ASSEMBLY		1
6	6600658		SCREEN, OPERATOR - PTV100/72		1
5	8800026		CONTROL PANEL ASSEMBLY - PTV100/72		1
4	8602374		ENGINE & PUMP ASSY, FT4 - PTV100/72		1
3	8601564		BULLWHEEL MODULE ASSY - 72 IN V-GROOVE		1
2	882001		REEL LIFT ARM ASSEMBLY		1
1	8601560		FRAME ASSEMBLY, PTV100/72		1

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DIMENSIONS IN ( ) ARE MM
-TOLERANCES-

A) ANGULAR ± 1/2°
B) DECIMAL (DNO) .X ± .1
(TWO) .XX ± .02
(THREE) .XXX ± .01
C) FRACTIONAL ± 1/32
1. GENERAL
2. SAWING, FLAME CUTTING, SHEARING ± 1/16
3. WELDING ± 1/8
4. MACHINING

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Shreveport, Louisiana, United States of America

MATL CERT N/R
MATL TEST N/R
WELD TEST N/R
HT LBS N/A
ACT LBS N/A

TITLE GEN ASSY, PTV100-72-SLRW (JD-FT4)
NEXT ASSEMBLY
SERVICED FROM 8602066
FIRST USED ON MO 5061
SHEET 1 OF 1
DRAWN SB
CHECKED
APPROVED JM
DATE 25JAN18
SCALE 1/16
8602373
REV

REV	DATE	CHANGE MADE	AMENDMENTS	BY	APPD

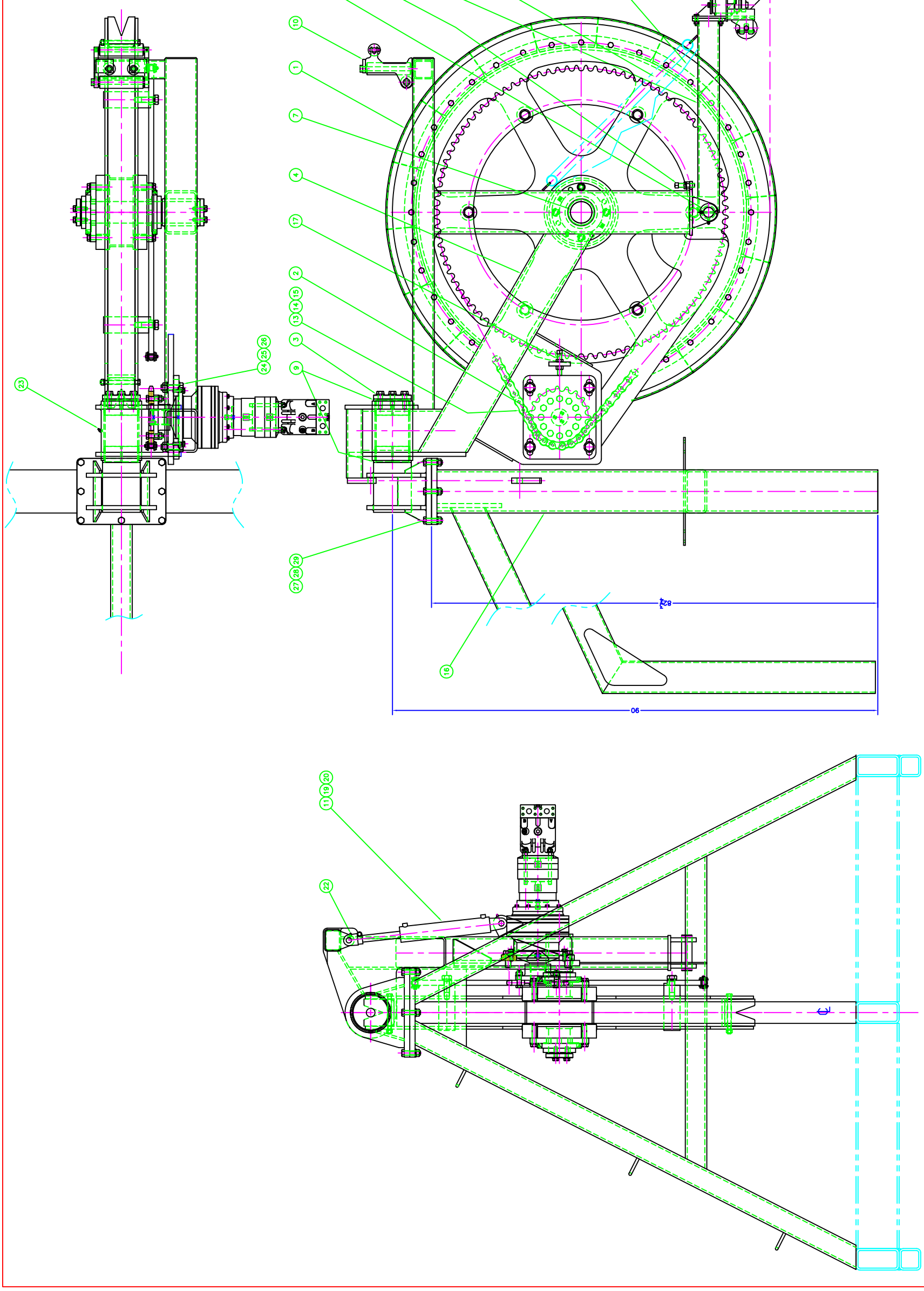
ITEM	PART NUMBER	QPCR DESC	DESCRIPTION	MATERIAL	UNIT QTY
30	561310		CHAIN, 1/4" SPECTRUM 3		4.0FT
29	181009		FLAT WASHER- 3/4 HARDENED	STL	8
28			HEX LOCK NUT 3/4-10NC	GR-5	8
27	270712		HHCS 3/4-10NC X 3 LG	GR 8	8
26		FI	HEX NUT 1-8NC	GR 5	4
25	181011		FLAT WASHER- 1 HARDENED	STL	8
24	196232		HHCS 1-8NC X 3-1/2 LG	GR 5	4
23		FI	1/8-27NPT 45° GREASE FITTING		1
22		FI	1/4-28NF STRAIGHT GREASE FITTING		2
21		FI	1/4DIA X 2-1/2LG COTTERPIN		2
20		FI	3/16DIA X 1-1/2LG COTTERPIN		4
19	565825		PIN CYLINDER 1 X 2-1/4 GRIP		2
18	565824		BRACKET EXT. SPRING		2
17		FI	3/4-10NC SQ HD SETSCREW 3LG C/W JAMNUT		2
16	86015563		FRAME, 72 B/W MODULE		1
15	217021		LINK- OFFSET ROLLER CHAIN 140 1-3/4 SP		1
14	216018		CONNECTOR LINK- CHAIN 140 1-3/4 SP		1
13	215021	1	187 1/4 LG - ROLLER CHAIN 140 1-3/4 SP		15.7FT
12	566848		SPRING, EXTENSION, 2" X 10"		2
11	560500		CYLINDER 2-1/2 BORE X 12 STROKE		1
10	76097		LEVELWIND HEAD ASSEMBLY		1
9	6800004		FLANGE BEARING - BRONZE		2
8	8800022		LEVELWIND ASSEMBLY		1
7	7800006		BULLWHEEL SHAFT ASSY - 72 INCH V-GROOVE		1
6	565823		LEVELWIND PIVOT PIN		1
5	8800021		ARM LEVELWIND HEAD		1
4	8800020		PIVOT FRAME - V-GROOVE BULLWHEEL 72		1
3	8800019		PIVOT SHAFT - V-GROOVE BULLWHEEL		1
2	6800003		DRIVE ASSEMBLY - 72 INCH V-GROOVE BULLW		1
1	8600890		V-GROOVE BULLWHEEL ASSY, 72 INCH		1

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES DIMENSIONS IN ( ) ARE MM -TOLERANCES-
A) ANGULAR ± 1/2° | B) DECIMAL ONED .X ± .06 | TWOD .XX ± .02 | THREED .XXX ± .01
C) FINISHING 1. GENERAL ± 1/32 | 2. DRILLING, FLAME CUTTING, BEARING ± 1/16 | 3. WELDING ± 1/8

TSE INTERNATIONAL INC
Shreveport, Louisiana, United States of America

MATL N/R | NEXT ASSEMBLY 8601565 | SERVICED FROM 8601304
TITLE BULLWHEEL MODULE ASSY - 72 IN V-GROOVE
TEST N/R | WELD N/R | FIRST USED 4007 | SHEET 1 OF 1
EST LBS N/A | DRAWN SSD | CHECKED | APPROVED JM
LBS N/A | DATE 26JAN12 | SCALE 1/8
REV
8601564



REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD
A	23MAR16	RFC-4751	ITEM 6 WAS SHOWN INSERTED FROM SPROCKET SIDE OF BULLWHEEL	ACL	JM

ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY
8	181009		FLATWASHER- 3/4 HARDENED	STL	8
7		FI	HHCS 3/4-10NC X 3-1/2 LG	GR 5	8
6	196319		HHCS 5/8-11NC X 7 LG CW NUT -LW.	GR 5	36
5	196270		HHCS 1-8NC X 2-1/2 LG CW LW.	GR 5	6
4	7800003		SPROCKET REWORK, 140A096		1
3	5601398		BEARING, 4" PILOTED FLANGE		2
2	P01-3000-906		BULLWHEEL SEGMENT		18
1	8600891		BULLWHEEL FAB. - 72 INCH V-GROOVE		1

Do not scale this print. Parts and assemblies may be represented in exploded or alternate positions for clarity. Dimensions govern over scale. If in doubt, ask. Any manufacturing processes, including but not limited to welding, machining, heat treating, painting, plating, etc., are the responsibility of the manufacturer. Any deviations from the drawing must be approved by TSE International, Inc. in writing before proceeding.

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
DIMENSIONS IN [ ] ARE MM
-TOLERANCES-

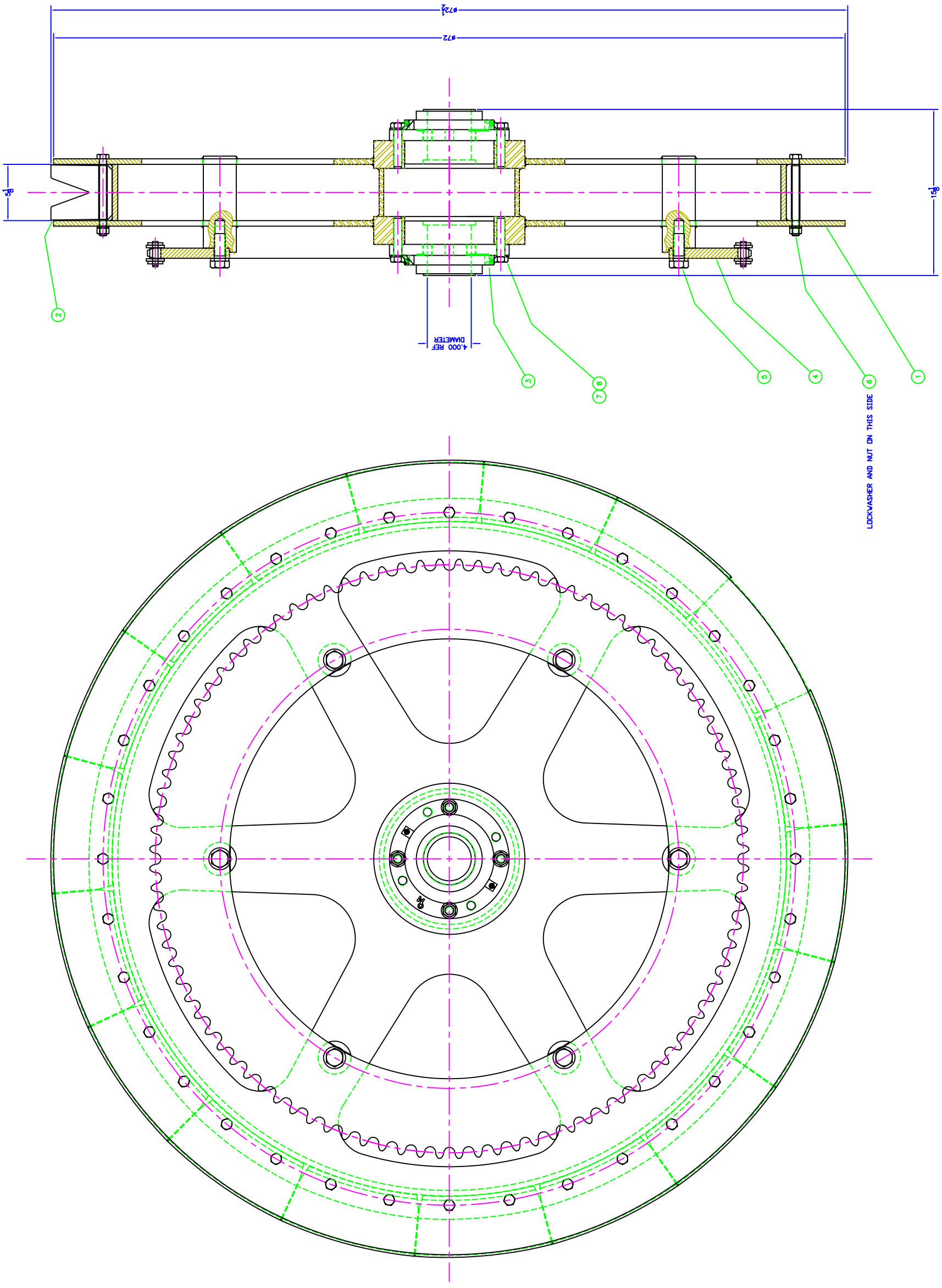
A) ANGULAR ± 1/2°
B) DECIMAL GMD .X ± .06
CTYD .XX ± .02
CTMED .XXX ± .01
C) FRACTIONAL ± 1/32
1. GENERAL
2. SAWING, FLAME CUTTING, MACHINING ± 1/16
3. WELDING ± 1/8

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Shreveport, Louisiana, United States of America

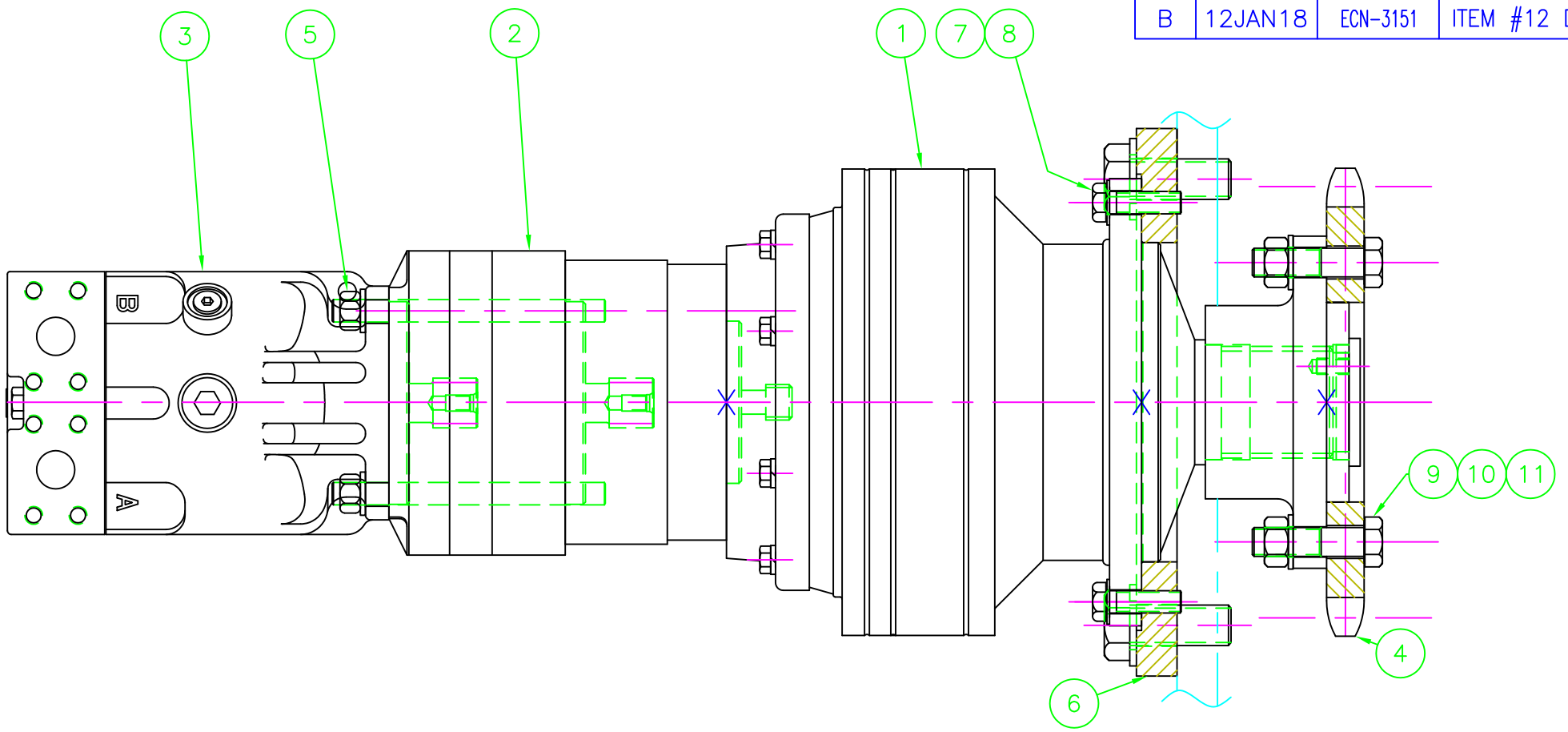
MATL N/R
FINISH N/R
HEAT N/R
TEST N/R
YIELD N/R
TEST N/R
EST
LBS 1725
LBS N/A

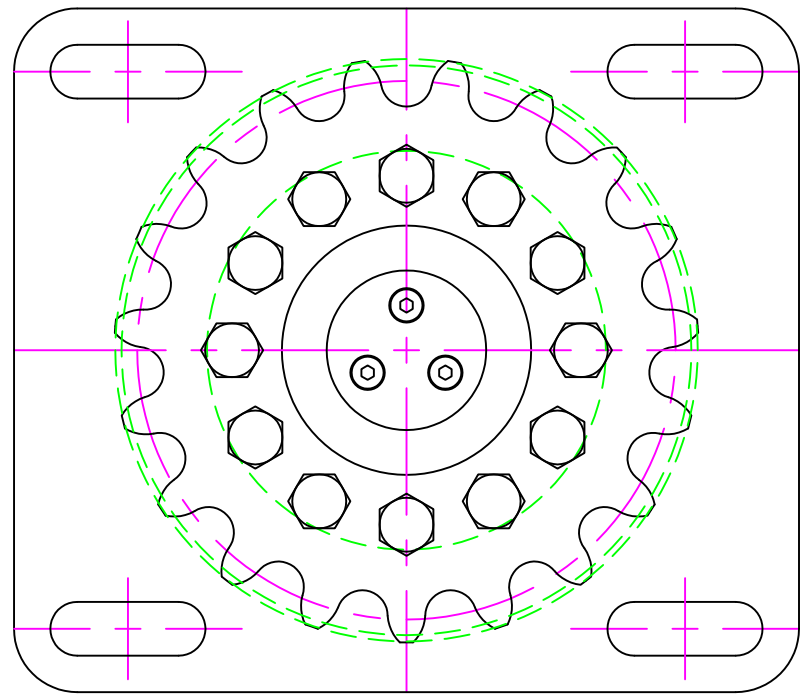
TITLE V-GROOVE BULLWHEEL ASSY, 72 INCH
NEXT ASSEMBLY
REVISED FROM 8800014
FIRST USED ON 3464
SHEET 1 OF 1
DRAWN SB
CHECKED
APPROVED JM
DATE 16MAY07
SCALE 1/4

8600890 REV A



REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD
B	12JAN18	ECN-3151	ITEM #12 DELETED; WAS 5002472	SB	JM





ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY
11	295018		HEX NUT M18-2.50	GR 8.8	12
10	296018		FLAT WASHER M18 HARDENED		12
9	281809		HHCS M18-2.50 X 70 MM LG	GR 8.8	12
8	255514		FLAT WASHER M14 HARDENED		12
7	281404		HHCS M14-2.00 X 45 MM LG	GR 8.8	12
6	7800004		MOUNTING PLATE - 306L REDUCER		1
5	551117		BRAKE MOUNT KIT- M14		4
4	6800002		SPROCKET REWORK, 140A019		1
3	551733		MOTOR,SUNSTRAND, 90M075		1
2	531351		BRAKE- HYDRAULIC		1
1	5800010		REDUCER- PLANETARY 306L222.7HZ		1

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
DIMENSIONS IN [ ] ARE MM
-TOLERANCES-

A) ANGULAR ± 1/2°
B) DECIMAL (ONE) .X ± .06
(TWO) .XX ± .02
(THREE) .XXX ± .01
C) FRACTIONAL
1. GENERAL ± 1/32
2. SAWING, FLAME CUTTING, SHEARING & BREAKING ± 1/16
3. WELDING ± 1/8

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Shreveport, Louisiana, United States of America

MATL CERT	N/R	TITLE	DRIVE ASSEMBLY - 72 IN V-GROOVE BULLW
MATL TEST	N/R	NEXT ASSEMBLY	DERIVED FROM
WELD TEST	N/R	FIRST USED ON WO 7486	SHEET 1 OF 1
EST LBS	405	DRAWN Bill / CHECKED / APPROVED ARD	6800003 REV B
ACT LBS	N/A	DATE 15JAN02	SCALE 1/4

ITEM	PART NUMBER	TYPE CODE	DESCRIPTION	MATERIAL	UNIT QTY
1	8800023		FRAME ASSEMBLY LEVELWIND HEAD		1
2	760814		ROLLER PWDT (INNER)		1
3	760815		ROLLER PWDT (OUTER)		1
4	680617		ROLLER ASSEMBLY		3
5	680637		REWORK ROLLER ASSEMBLY		2
6	516205		SEALMASTER BEARNG		4
7	565820		SHAFT, LEVELWIND ROLLER		3
8	511461		PIN- PTO LOCK		1
9		FI	5/16-18NC HHCS X 3"LG - NUT - L.W.	GR-5	5
10	564451		BRONZE BUSHING		2
11	564449		BRONZE BUSHING		2
12	541121		CLAMPING PLATE		1
13		FI	1/2-13NC HHCS X 1 1/4"LG - L.W.	GR-5	1
14	513527		SWITCH - LIMIT		2
15	514965		LEVER - ROLLER		2
16	541123		EYE BOLT		2
17	5600658		SPRING, 47/64 DIA X 4 1/16 LG		2
18		FI	1/2-13NC SQ HD SETSCREW 2"LG		2
19		FI	1/2-13NC HEX JAM NUT		2
20		FI	10-32 ROUND HEAD MACH.SCREW X 2"LG		4
21	219139	1	6 LG - CHAIN- EW COIL LINK #4		0.5FT
22		FI	3/16DIA X 1"LG COTTER PIN		1
23		FI	1/4-28NF STRAIGHT GREASE FITTING		3
24	566333		BEARING		6
25		FI	ROLL PIN, 1/8 DIA X 1 1/4 LG		2

NOTE: RETURN BEARINGS FROM ITEM 24 TO STOCK AND REPLACE WITH ITEM 24

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES DIMENSIONS IN [ ] ARE MM

-TOLERANCES-

A) ANGULAR ± 1/2°
B) DECIMAL .XXX ± .01
.XX ± .02
.X ± .04
C) FRACTIONAL ± 1/32
D) MACHINED SURFACE FINISH 125
E) BREAK EDGES 1/16 MAX

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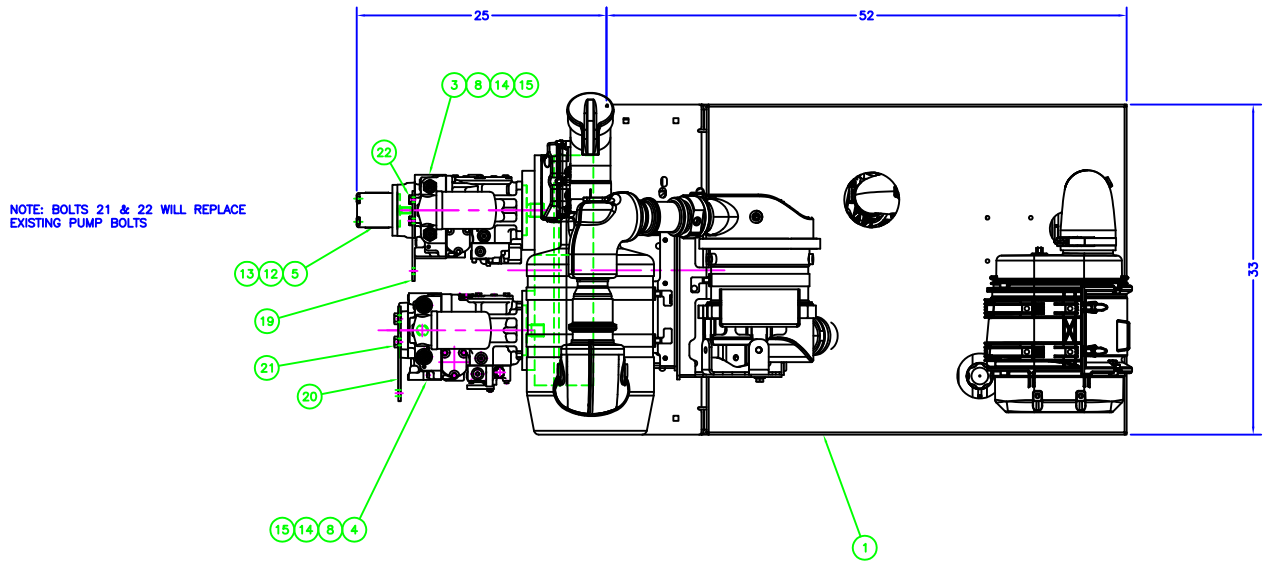
TITLE: LEVELWIND ASSEMBLY

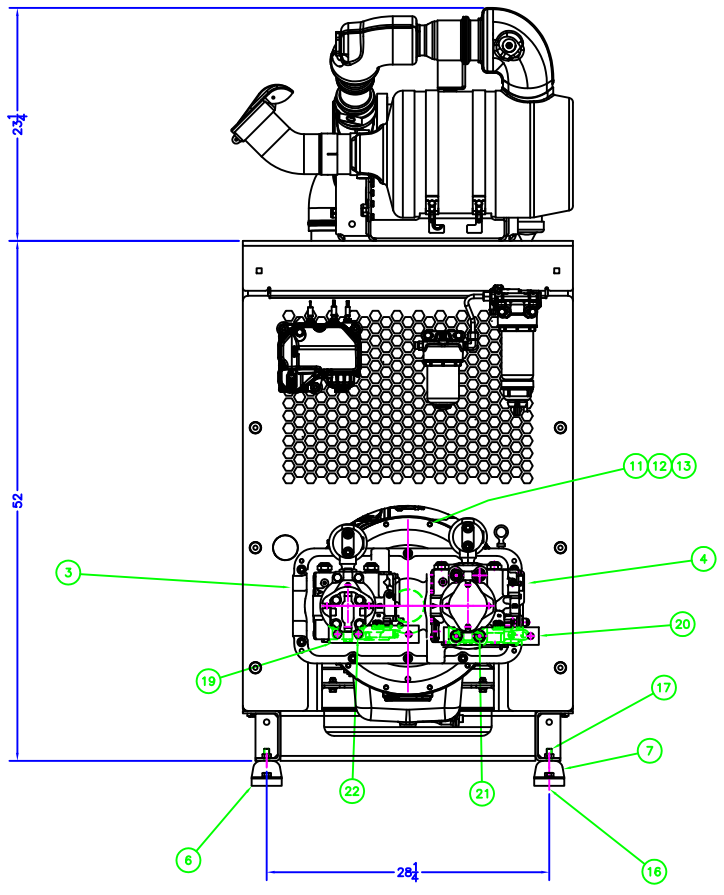
MATL	N/A	SIZE	DWG NO	REV
COAT	N/A		8800022	C
WGT	N/A	SCALE	1/2	
NEXT ASSEMBLY	N/A	WEIGHT	LBS	
USED ON	7466	PROJECT	AR60	
NEXT ASSY	N/A	DRAWN	BJE	DATE 01FEB02
VOLT	N/A	CHECKED	RJB	
PHASE	N/A	APPROVED		

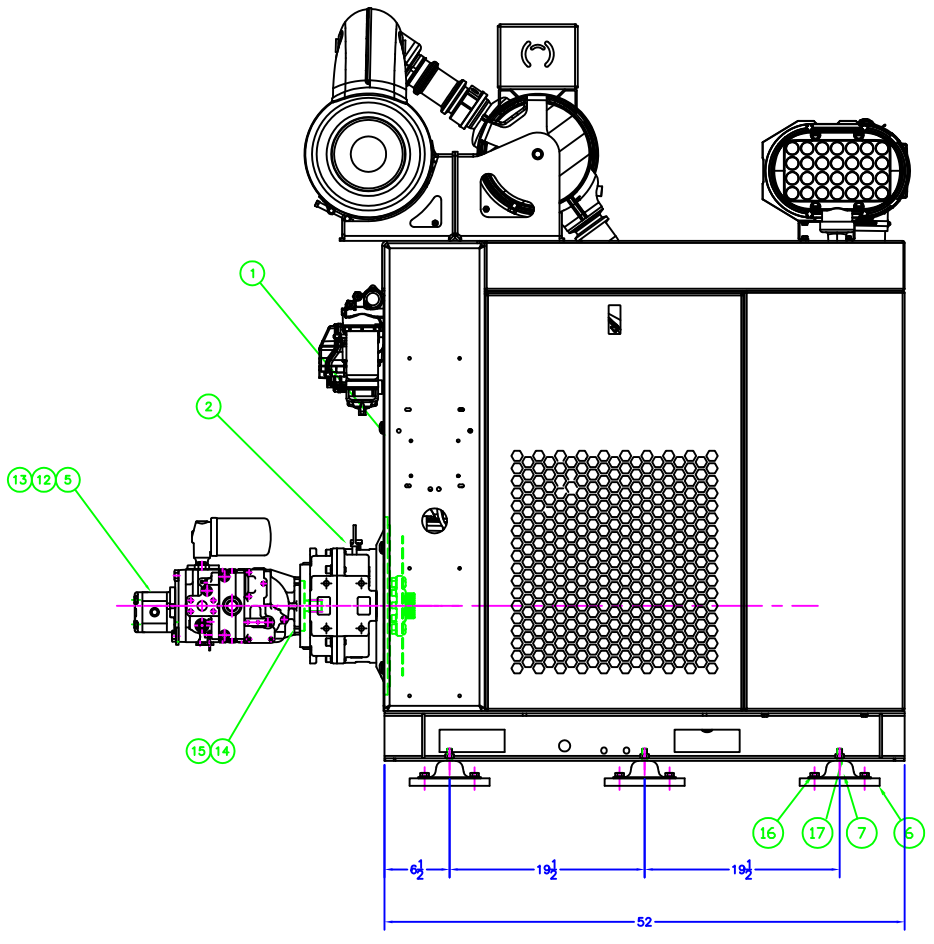
SHEET	1	OF	1

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD
A	20AUG03	RCT453,454	ITEM 4 WAS 680616; # 17 WAS 5411124	SB	
B	06OCT11	RCT6227,6228	ITEM #25 ADDED	SB	JLM
C	28AUG17	16281	IT. 8 WAS 561265	BAW	CJT

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD
A	14MAR18	ECN-3179	ITEM #2 WAS 5800011 – 1:1 RATIO	SB	JM







ITEM	PART NUMBER	UPPER REV.	DESCRIPTION	MATERIAL	UNIT QTY
22	5602449		METRIC HEX SHCS – M12 X 1.75 X 130MM		2
21	5602448		BOLT, METRIC HEX – M16 X 2.0 X 130MM		2
20	5602447		BRACKET, 9 1/2" PUMP STROKE		1
19	5602446		BRACKET, 9" PUMP STROKE		1
18	561394		ANTIFREEZE		1.0GAL
17		FI	HHCS 1/2-13NC X 1-1/4 LG C/W N&LW	GR 5	6
16		FI	HHCS 1/2-13NC X 3/4 LG C/W LW	GR 5	12
15	181006		FLAT WASHER- 1/2 HARDENED	STL	8
14	270406		HHCS 1/2-13NC X 1-1/2 LG	GR 8	8
13	181004		FLAT WASHER- 3/8 HARDENED	STL	22
12	270206		HHCS 3/8-16NC X 1-1/2 LG	GR 8	14
11	270204		HHCS 3/8-16NC X 1 LG	GR 8	8
10					
9					
8	531185		BALL JOINT		2
7	541818		ENGINE MOUNT, 1/2 BOLT		6
6	560066		ENGINE MOUNTING PLATE		6
5	5600560		PUMP, GEAR -0.88 CU.IN.		1
4	5600276		PUMP- 4.57 CID		1
3	5600275		PUMP- 3.35 CID		1
2	5601439		PUMP DRIVE, DOUBLE SAE 3 – C	1.18 INCR	1
1	5603942		ENGINE, 4045H 173 HP FT4 JOHN DEERE		1

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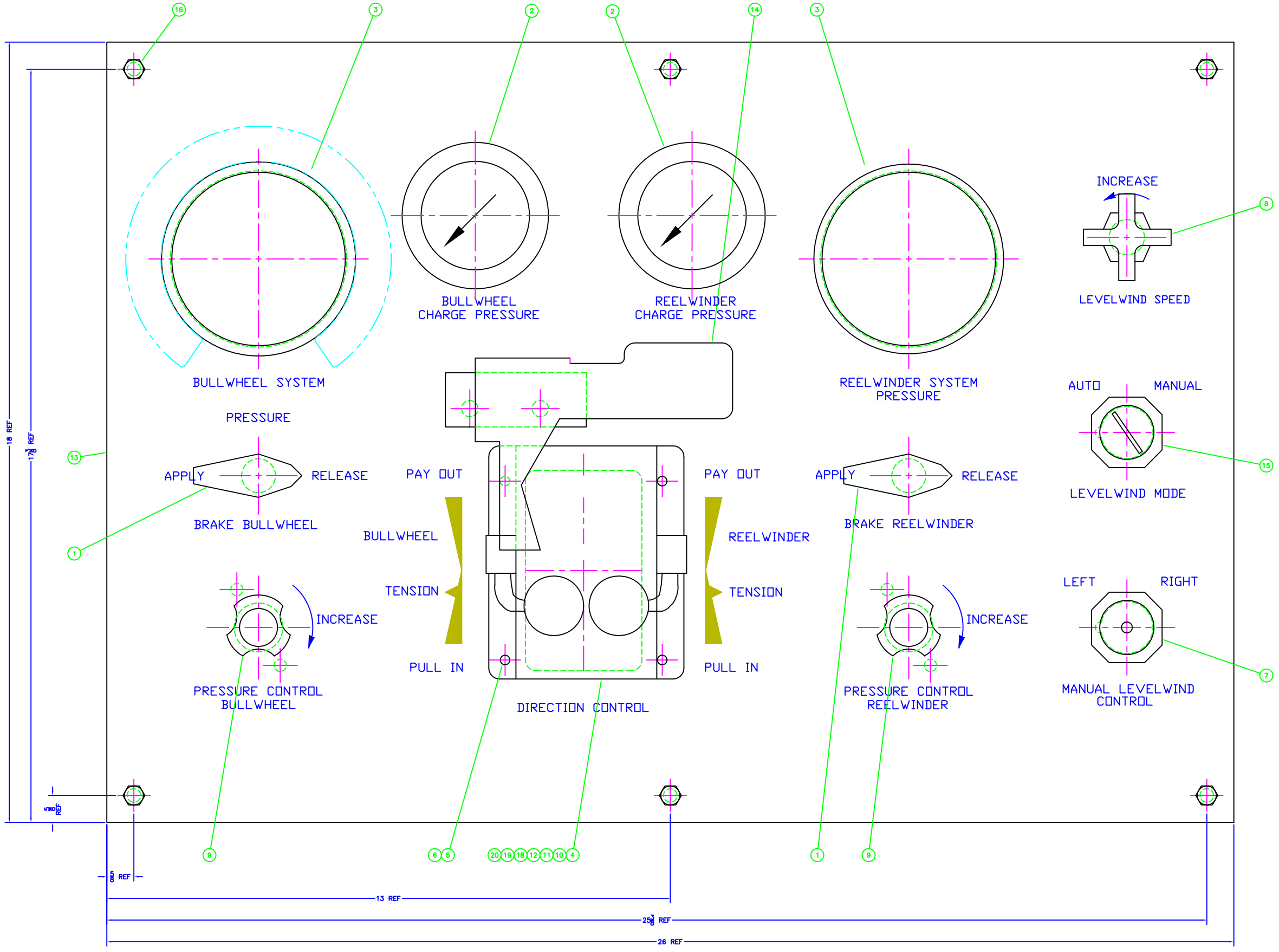
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
DIMENSIONS IN [ ] ARE MM
-TOLERANCES-
A) ANGULAR ± 1/2°
B) DECIMAL (2)ND X ± .06
(2)WD .XX ± .02
(3)RD .XXX ± .01
C) FRACTIONAL
1. GENERAL ± 1/32
2. SAWING, FLAME CUTTING, SHEARING ± 1/16
3. BREAKING ± 1/8
4. WELDING ± 1/8

TSE INTERNATIONAL INC
Shreveport, Louisiana, United States of America

MATL CERT N/R
MATL TEST N/R
WELD TEST N/R
EST LBS N/A
ACT LBS N/A

TITLE ENGINE & PUMP ASSY, FT4 – PTV100/72
NEXT ASSEMBLY 8602373
SERVED FROM 8601559
FIRST USED ON VO 5061
DRAWN SB
CHECKED
APPROVED
DATE 25JAN18
SCALE 1/8
SHEET 1 OF 1
8602374
REV A

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD
A	09MAY02	RFC1561	ITEMS 19 & 20 ADDED	SB	RB
B	22FEB10		ITEM #2 WAS 561231, QTY ONE ONLY	SB	JM



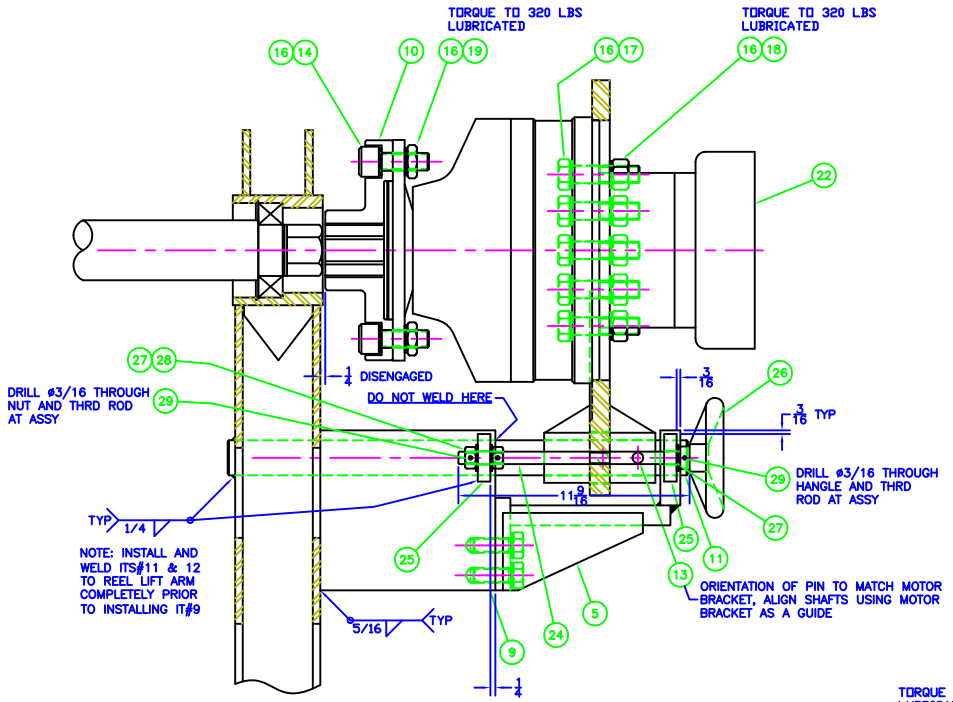
ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY
20	561180		CABLE CLAMP		2
19	561171		CABLE PIVOT		2
18	585638		CABLE, PUSH/PULL 10FT		1
17	561114		DETENT KIT		2
16		FI	HHCS 1/4-20 UNC X 5/8 LG C/W FW,LW,N	GR-5	6
15	567483		SWITCH 2 POSITION		1
14	812222		SAFETY LATCH, L.H.		1
13	761232		PANEL ENGRAVING – PTV60-54		1
12	561321		CLEVIS, 1/4-28 UNF		1
11	561147		CONTROL CABLE – 96		1
10	531185		BALL JOINT		2
9	550228		VALVE, RELIEF 0-5800 PSI		2
8	560263		VALVE- NEEDLE		1
7	541141		SWITCH, JOYSTICK		1
6		FI	HEX NUT 10-24 UNC		8
5		FI	SHCS 10-24 UNC X 5/8 LG		4
4	561112		TWIN MORSE CONTROL		1
3	561191		GAUGE, 4 DIA 0-5000 PSI		2
2	561198		GAUGE- 2-1/2" 0-600 PSI/BAR		2
1	560320		VALVE, DIRECTIONAL, 3W2P		2

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES
DIMENSIONS IN ( ) ARE MM
-TOLERANCES-
A) ANGULAR ± 1/2°
B) DECIMAL (ONE) X ± .06
(TWO) .XX ± .02
(THREE) .XXX ± .01
C) FRACTIONAL ± 1/32
1. GENERAL
2. SAWING, FLAME CUTTING, SHEARING ± 1/16
3. BREAKING
4. WELDING ± 1/8

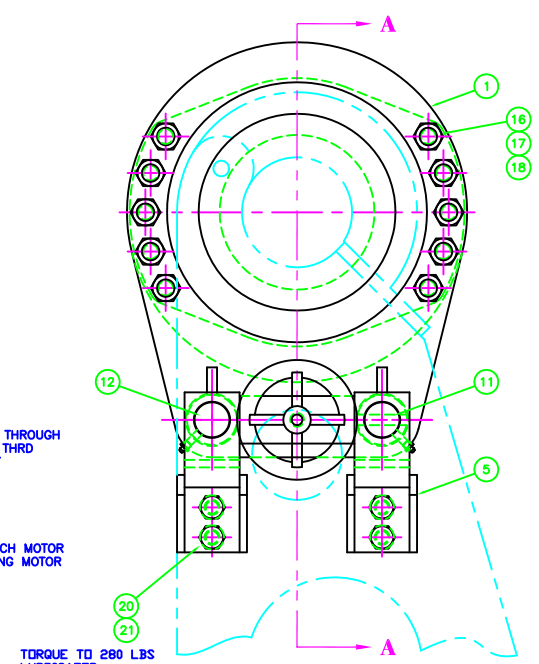
TSE INTERNATIONAL INC
Shreveport, Louisiana, United States of America

MATL CERT	N/R	TITLE	CONTROL PANEL ASSEMBLY – PTV100/72
MATL TEST	N/R	NEXT ASSEMBLY	8800016
WELD TEST	N/R	REVERSED FROM	880999
TEST LBS	N/A	FIRST USED ON	7486
ACT LBS	N/A	DRAWN	Bill
		CHECKED	
		APPROVED	
		DATE	04MAR02
		SCALE	1/1
		SHEET	1 OF 1
			8800026 REV B

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD
A	07MAR02	RFC1526	ITEM 26 WAS 567317; WAS FINE THREADS	SB	RB
B	17APR02		IT. #9 WAS 7 X 8; IT. 11 & 12 WAS 21 1/4 LG; #15 WAS 180011	SB	RB
C	12JUL02	RFC1580	ITEM 14 WAS 199856; #10 HOLES WAS 1.016; # 15 WAS 180311	SB	RB
D	05DEC03	RFC1884	IT. #10 WAS 100217	DY	
E	25AUG04	RFC2092	ITEM 30 DETAIL REVISED; 3/4 DIMENSION ADDED	SB	
F	01APR05	RFC2079,2086	IT #2 PATT REVISED; #10 – .687 WAS .438; #31 LENGTH REVISED	SB	RJB
G	07JUN06		ADDED IT 10 MACHINING DETAIL, CHAMFER IT 10 BOTH SIDES	DJ	JM
H	09SEP08	RFC2749	ITEM 24 WAS 12 1/2 LG	DJ	JM
I	04JUN09		UPDATED DWG & BOM TO HAVE PART NUMBERS FOR ALL COMPONENTS	SB	DJ
J	25AUG09		ITEM #15 & 19 DELETED; #16 WAS 181012, QTY 10; #18 QTY WAS 10	SB	
J			ITEM 21 WAS 181012	SB	JM
K	06JUL15	ECN-1732	ITEM #18 QTY WAS 20; ITEM #19 ADDED	SB	JM



SECTION A-A



ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY
29		FI	PIN– ROLL 3/16 DIA		3
28		FI	HEXNUT– 5/8–11NC	GR 5	2
27		FI	FLATWASHER– 5/8		3
26	5600315		HAND WHEEL– MACH.		1
25	5601911		BLOCK, ADJUSTMENT		2
24	5601910		ROD, ADJUSTMENT		1
23					
22	565813		MOTOR, HYD, PISTON, 2808, C/W BRAKE		1
21	194829		LOCK WASHER 3/4 NORD–LOCK	STL	4
20	270708		HHCS 3/4–10NC X 2 LG	GR 8	4
19	180310		JAM NUT 7/8–9NC	GR 2	10
18	180010		HEX NUT 7/8–9NC	GR 8	10
17	271514		HHCS 7/8–9NC X 3–1/2 LG	GR 8	10
16	194833		LOCK WASHER 7/8 M22 NORD–LOCK	STL	40
15					
14	199811		SHCS 7/8–9NC X 2–1/2 LG		10
13	539719		PIN, BALL LOCK 1/2		1
12	6600509		SHAFT, ADJUSTABLE DRIVE – PTV100/72		1
11	6600508		SHAFT, ADJUSTABLE DRIVE – PTV100/72		1
10	6600506		DRIVE HUB – PTV100/72		1
9	6600507		SPACER, ADJUSTABLE DRIVE – PTV100/72		2
8					
7					
6					
5	7600687		BRACKET, SLIDE		2
4					
3					
2					
1	7600698		DRIVE BRACKET – PTV100/72		1

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DIMENSIONS IN [ ] ARE MM
–TOLERANCES–

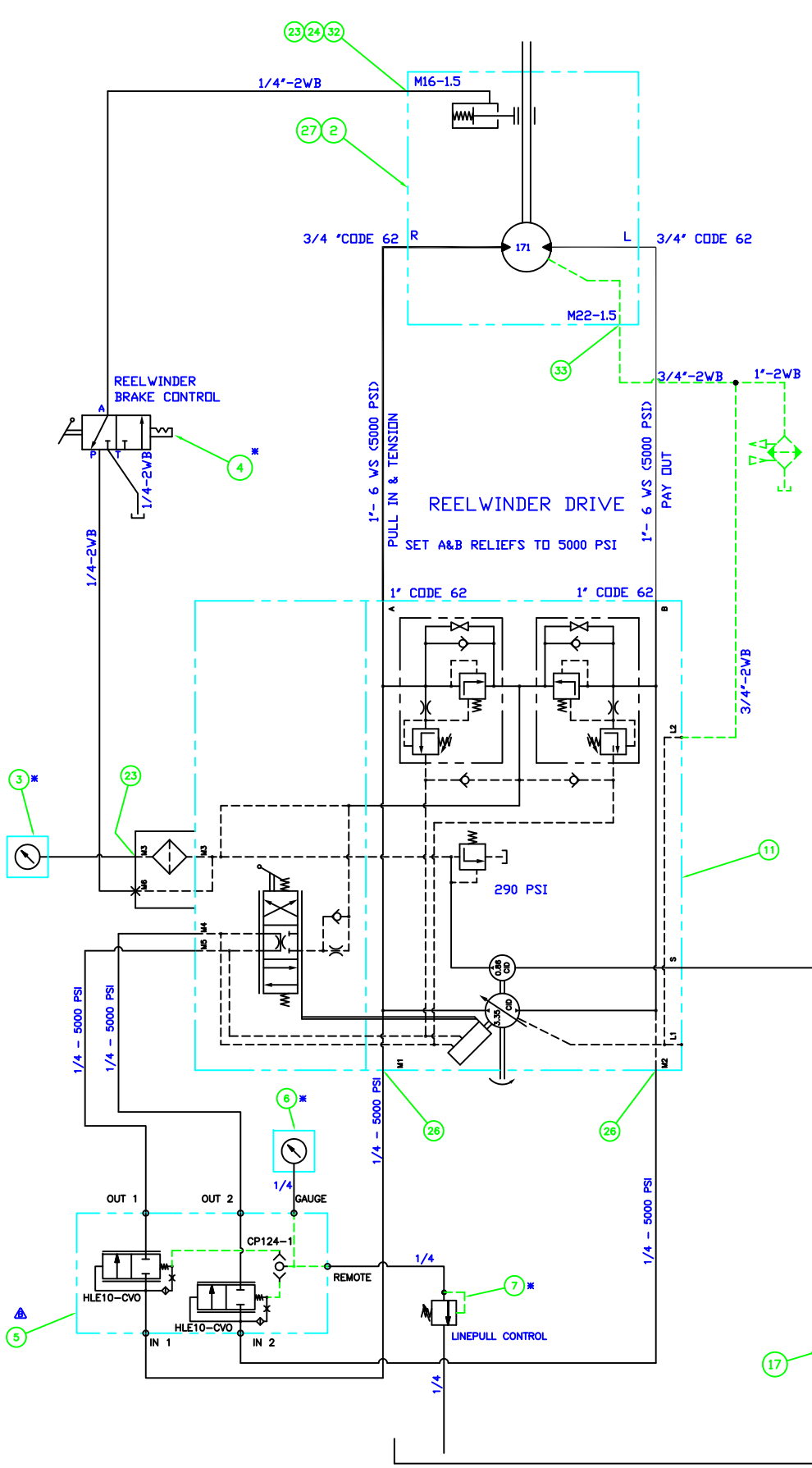
A) ANGULAR ± 1/2°
B) DECIMAL (ONE) X ± .06
(TWO) XX ± .02
(THREE) XXX ± .01
C) FRACTIONAL ± 1/32
1. GENERAL
2. SAWING, FLAME CUTTING, SHEARING ± 1/16
& BREAKING
3. WELDING ± 1/8

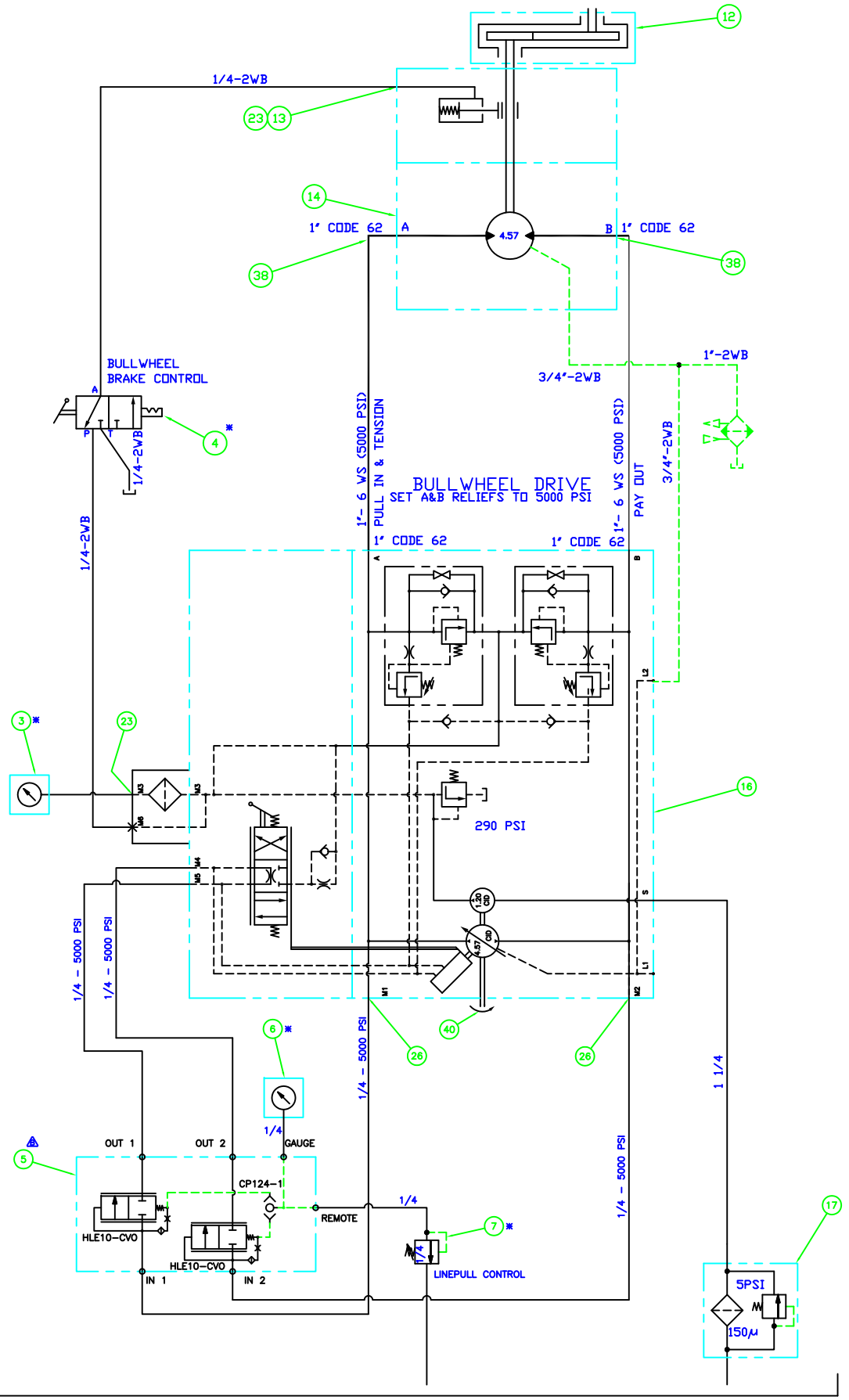
TSE INTERNATIONAL INC
Shreveport, Louisiana, United States of America

MATL CERT N/R
MATL TEST N/R
WELD TEST N/R
EST LBS N/A
ACT LBS N/A

TITLE REELSHAFT DRIVE ASSY– PTV100/72
NEXT ASSEMBLY 8800016
SERVICED FROM 882004F
FIRST USED ON VID 7486
DRAWN BH
CHECKED RJB
APPROVED
DATE 04MAR02
SCALE 1/4
SHEET 1 OF 1
8800025
REV K

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD
A	04FEB16	ECN-1700	ITEM #15 ADDED	SB	JM
B	28DEC17		ITEM #5 WAS 5603263; ITEM #15 WAS 547193, DELETED	SB	JM





* DENOTES ITEMS LOCATED IN THE CONTROL CONSOLE

ITEM	PART NUMBER	QPER DESC	DESCRIPTION	MATERIAL	UNIT QTY
40	5800011	1	PUMP DRIVE, DOUBLE, SAE 3, C		REF
39					
38	5602088		TEST POINT, 1"		2
37					
36					
35					
34					
33	549540		ADAPTER, STR, M22-1.5 X 12 JICM		1
32	549539		ADAPTER, STR., 06JICM X M16-1.5		1
31	539735	2	CYLINDER, HYD REEL CRADLE		REF
30	560500	1	CYLINDER, HYD LEVELWIND		REF
29	5601970	1	SWITCH, TEMPERATURE		REF
28	560263	1	VALVE- NEEDLE		REF
27	5600906		TEST POINT, 1620 TO SAE 6 O-RING		2
26	5602085		TEST POINT, 3/8"		4
25	541393		VALVE, COUNTERBALANCE, DUAL		2
24	433601		REDUCER, 6JICF-4JICM		1
23	5602084		TEST POINT, 1/4"		4
22	5603369	1	CYLINDER, 2.5 BORE 2 STR		REF
21	5602557	1	COOLER - OIL/AIR HPV36		REF
20	5602086		TEST POINT, 1/2"		1
19	5600560		PUMP, GEAR -0.88 CU.IN.		REF
18	690414		MANIFOLD BLOCK		1
17	5600702		FILTER, SUCTION - 150 MICRON		2
16	5600276	1	PUMP- 4.57 CID		REF
15					
14	551733	1	MOTOR,SUNSTRAND, 90M075		REF
13	531351	1	BRAKE- HYDRAULIC		REF
12	5800010	1	REDUCER- PLANETARY 306L222.7HZ		REF
11	5600275	1	PUMP- 3.35 CID		REF
10	5603372		VALVE, HYDRAULIC PVG32 - 7 BANK		1
9	548870	3	HYDRAULIC JACK		REF
8	534867		FILTER - RETURN		1
7	550228	2	VALVE, RELIEF 0-5800 PSI		REF
6	561191	2	GAUGE, 4 DIA 0-5000 PSI		REF
5	5603562		MANIFOLD, DUAL RVPL - W/ SHUTTLE		2
4	560320	2	VALVE, DIRECTIONAL, 3W2P		REF
3	561198	2	GAUGE- 2-1/2" 0-600 PSI/BAR		REF
2	565813	1	MOTOR, HYD, PISTON, 2808, C/W BRAKE		REF
1	8601562	1	ELECTRICAL SCHEMATIC, PTV100-72		REF

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DIMENSIONS ARE INCHES
DIMENSIONS IN [ ] ARE MM
-TOLERANCES-
A) ANGULAR ± 1/2°
B) DECIMAL (ONE) X ± .06
(TWO) .XX ± .02
(THREE) .XXX ± .01
C) FRACTIONAL ± 1/32
1. GENERAL
2. SAWING, FLAME CUTTING, SHEARING & BREAKING ± 1/16
3. WELDING ± 1/8

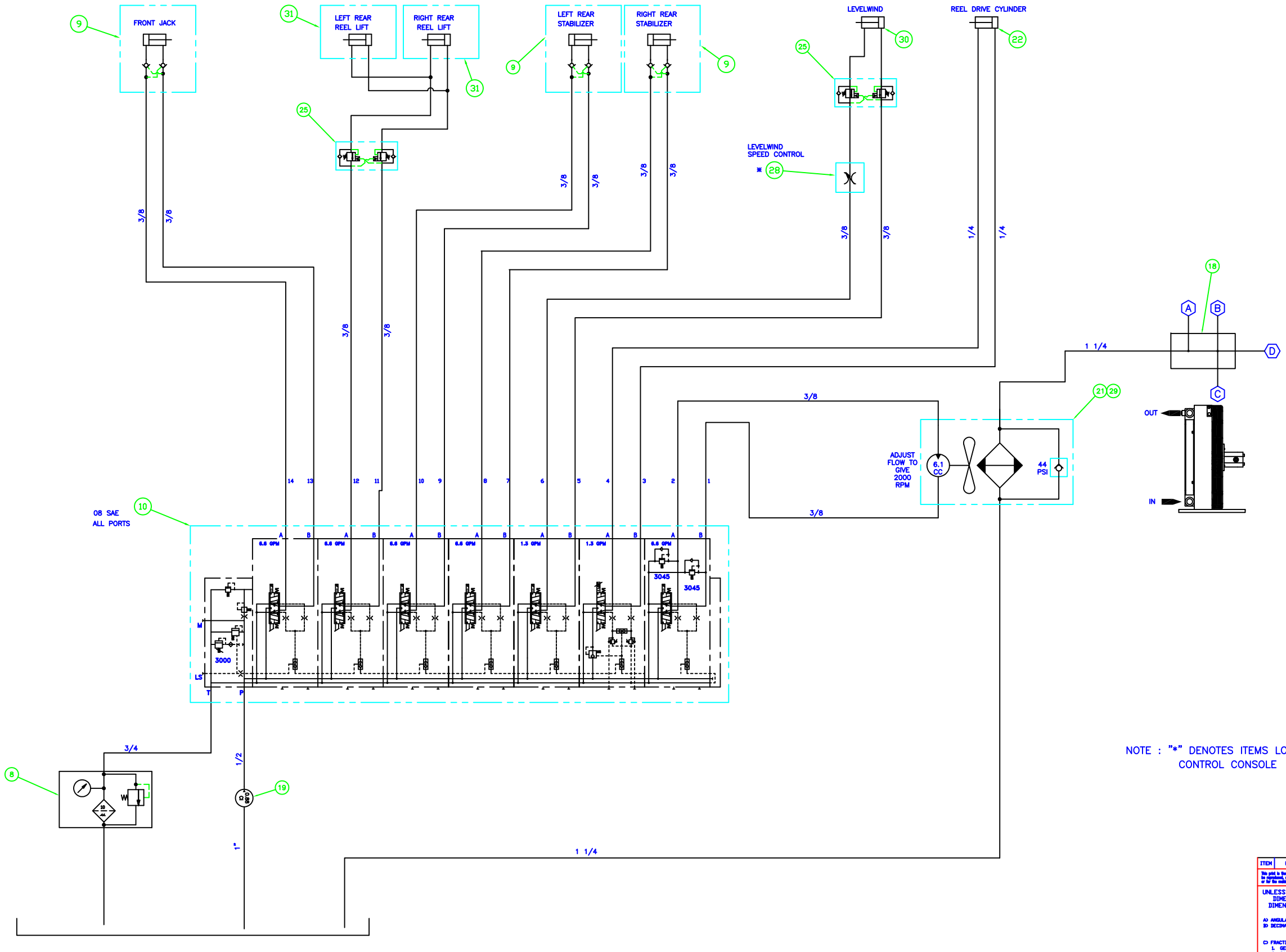
TSE INTERNATIONAL INC
Shreveport, Louisiana, United States of America

MATL CERT N/R
MATL TEST N/R
WELD TEST N/R
EST LBS N/A
ACT LBS N/A

TITLE HYDRAULIC SCHEMATIC PTV100/72
NEXT ASSEMBLY 8602066
SERVICED FROM 8601561C
FIRST USED ON NO 4723
SHEET 1 OF 2
DRAWN SB
CHECKED
APPROVED JM
DATE 07DEC15
SCALE 1/1

8602064 REV B

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APP'D



NOTE : "*" DENOTES ITEMS LOCATED IN CONTROL CONSOLE

ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY

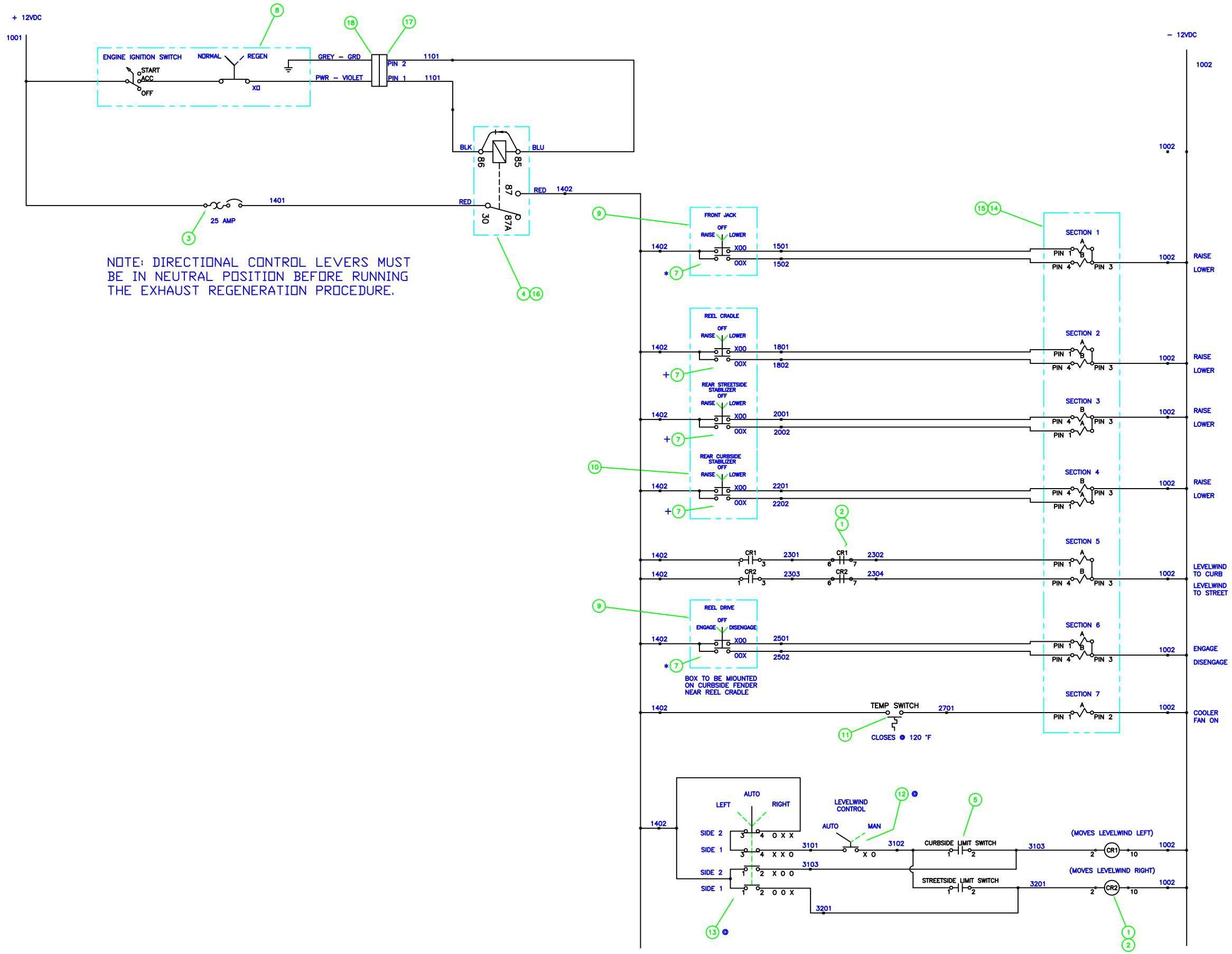
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DIMENSIONS IN [ ] ARE MM
-TOLERANCES-
A) ANGULAR ± 1/2°
B) DECIMAL (ONE) X ± .06
(TWO) .XX ± .02
(THREE) .XXX ± .01
C) FRACTIONAL ± 1/32
1. GENERAL
2. SAWING, FLAME CUTTING, SHEARING & BREAKING ± 1/16
3. WELDING ± 1/8

TSE INTERNATIONAL INC
Shreveport, Louisiana, United States of America

MATL		TITLE	HYDRAULIC SCHEMATIC PTV100/72
CERT	N/R		
MATL TEST	N/R	NEXT ASSEMBLY	8602066
WELD TEST	N/R	FIRST USED ON NO	4723
EST LBS	N/A	DRAWN	SB
ACT LBS	N/A	DATE	07DEC15
		CHECKED	
		APPROVED	
		SCALE	1/1
		REVISED FROM	8601561C
		SHEET	2 OF 2
			8602064 REV B

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APP'D



NOTES:

– + INDICATES MOUNTED IN PANEL BOX ITM # 10.
– * INDICATES MOUNTED IN PANEL BOX ITM # 9.

FOR DEERE FT4 ENGINES

ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY
18	5602554	1	CONNECTOR, DEUTSCH DT06-2S		REF
17	5602925		CONNECTOR ASSY– DEUTSCH (DT04-2P)		1
16	5603434		CONNECTOR, WEATHERPROOF – RELAY		1
15	5603372	1	VALVE, HYDRAULIC PVG32 – 7 BANK		REF
14	5602795		CONNECTOR – 4 PIN DEUTCH		7
13	541141	1	SWITCH, JOYSTICK		REF
12	567483	1	SWITCH 2 POSITION		REF
11	5601970		SWITCH, TEMPERATURE		1
10	564694		PANEL BOX, 6 X 8		1
9	564695		PANEL BOX, 4 X 4		2
8	5603942	1	ENGINE, 4045H 173 HP FT4 JOHN DEERE		REF
7	567484		SWITCH, 3 POS. SELECTOR		5
6	564468		JUCTION BOX		1
5	513527	2	SWITCH– LIMIT		REF
4	5603433		RELAY, WEATHERPROOF AUTOMOTIVE		1
3	514207		CIRCUIT BREAKER – 25A		1
2	533212		SOCKET– RELAY		2
1	533211		RELAY– DPDT 12 VDC		2

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(TWO) .XX ± .02
(THREE) .XXX ± .01
C) FRACTIONAL ± 1/32
1. GENERAL ± 1/16
2. SAWING, FLAME CUTTING, SHEARING & BREAKING ± 1/8
3. WELDING

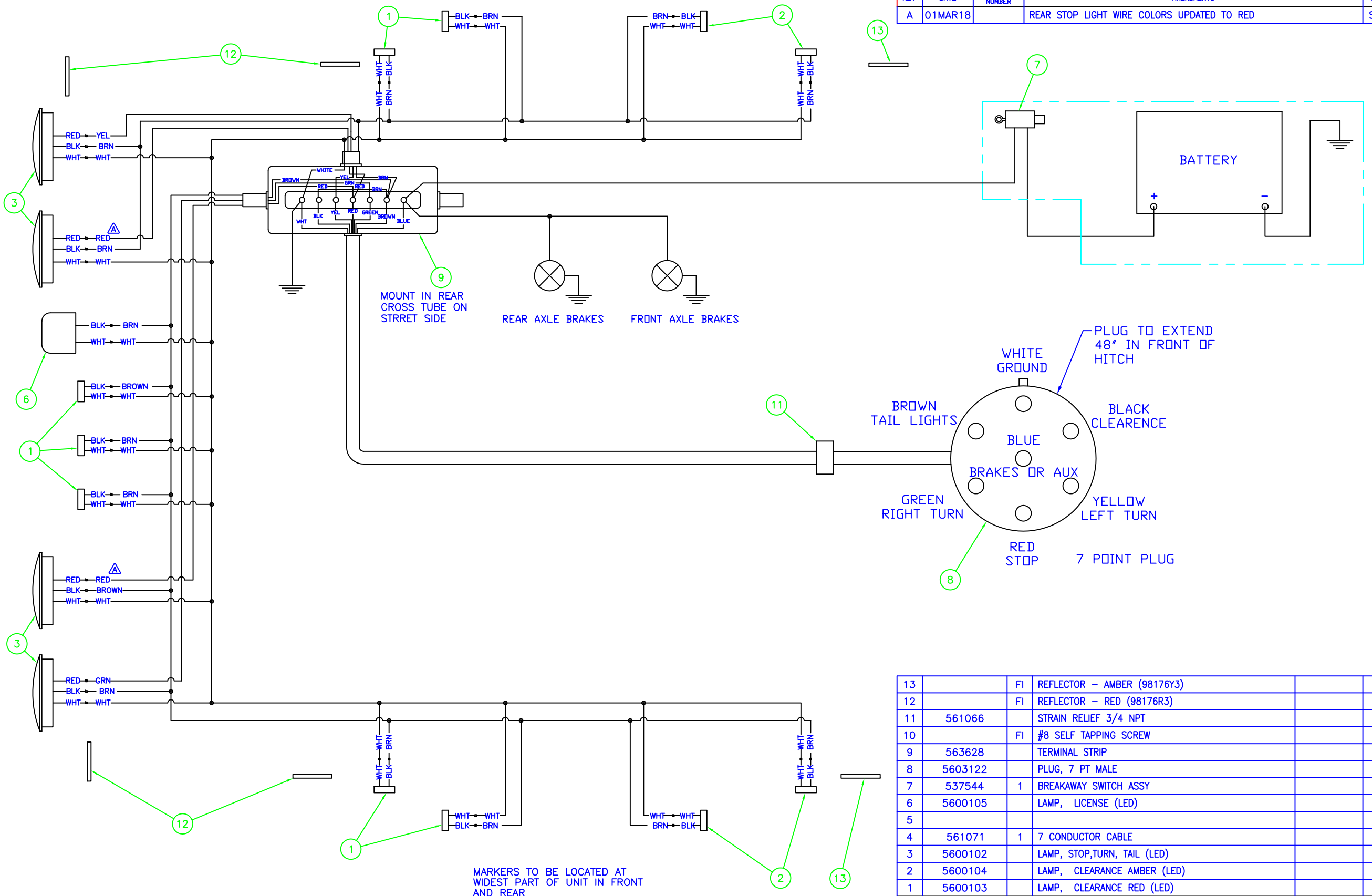
TSE INTERNATIONAL INC
Shreveport, Louisiana, United States of America

MATL CERT N/R
MATL TEST N/R
WELD TEST N/R
EST LBS N/A
ACT LBS N/A

TITLE ELECTRICAL SCHEMATIC, PTV100–72
NEXT ASSEMBLY 8602373
FIRST USED ON NO. 5061
DRAWN SB
CHECKED
APPROVED JM
DATE 07FEB18
SCALE 1/1

REVISED FROM 8602172
SHEET 1 OF 1
8602379
REV

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD
A	01MAR18		REAR STOP LIGHT WIRE COLORS UPDATED TO RED	SB	JM



ITEM	PART NUMBER	OPER DESC	DESCRIPTION	MATERIAL	UNIT QTY
13		FI	REFLECTOR – AMBER (98176Y3)		2
12		FI	REFLECTOR – RED (98176R3)		4
11	561066		STRAIN RELIEF 3/4 NPT		1
10		FI	#8 SELF TAPPING SCREW		12
9	563628		TERMINAL STRIP		1
8	5603122		PLUG, 7 PT MALE		1
7	537544	1	BREAKAWAY SWITCH ASSY		REF
6	5600105		LAMP, LICENSE (LED)		1
5					
4	561071	1	7 CONDUCTOR CABLE		REF
3	5600102		LAMP, STOP,TURN, TAIL (LED)		4
2	5600104		LAMP, CLEARANCE AMBER (LED)		4
1	5600103		LAMP, CLEARANCE RED (LED)		7

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B) DECIMAL	(ONE) .X	± .06
	(TWO) .XX	± .02
	(THREE) .XXX	± .01
C) FRACTIONAL		
1. GENERAL		± 1/32
2. SAWING, FLAME CUTTING, SHEARING & BREAKING		± 1/16
3. WELDING		± 1/8

TSE INTERNATIONAL INC
Shreveport, Louisiana, United States of America

MATL CERT	N/R
MATL TEST	N/R
WELD TEST	N/R
EST LBS	N/A
ACT LBS	N/A
TITLE	LIGHTING DIAGRAM, 7 PT LED (PTV100/72)
NEXT ASSEMBLY	F602027
DERIVED FROM	7601116
FIRST USED ON WO	4723
SHEET	1 OF 1
DRAWN	SB
CHECKED	
APPROVED	JM
DATE	07DEC15
SCALE	1/4
	7601123 REV A

REV	DATE	CHANGE NUMBER	AMENDMENTS	BY	APPD
A	12DEC01	RFQ#1489	IT. #1 WAS 68-1/2, HEX HEAD WAS 2.60"	DY	RB
B	18DEC01		ADDED BLOW UP OF IT. #1	DY	RB
C	14JAN02		IT. #12 DELETED AND IT. #10 WAS 5" X 1" WALL TUBG.	DY	
D	15JAN02	RFQ#1482	ADDED DRILL & TAP IN IT. #10 AND ADDED IT. #12	DY	RB
E	19MAR02	RFQ#1388	2.5585" DIMS. WAS 2.5590 +.001/-.000	DY	JF
F	14FEB03	RFQ#1867	REDESIGNED TO MAKE STRONGER	DY	
G	14FEB06	RFQ348	ITEM 7 & 8 HOLES SIZES REVISED; ITEM 14 ADDED	SB	JM
H	07JUN06		ITEM 1 HEX SHAFT WAS 2.213 FLAT TO FLAT	DJ	JM
I	09SEP08	RFQ246	REVISED ITEM 13 PATTERN AND CHANGED PICTORIALLY	DJ	JM
J	20JUL12	RFQ381	#1 & 2 COMBINED TO MAKE 1 PART;#7,8,13, & 14 COMBINED TO MAKE		
J			ONE PART; IT #10,11,12, & 13 COMBINED TO MAKE ONE PART	SB	JM

ITEM	PART NUMBER	CHGD DESC	DESCRIPTION	MATERIAL	UNIT QTY
10	6600673		BUSHING, IDLER - PTV100/72		1
9	610929		COLLAR- LOCKING		1
8					
7	6600674		BUSHING, DRIVE SIDE - PTV100/72		1
6	561884		RING- RETAINER EXTERNAL		1
5	561883		BEARING- SPHERICAL ROLLER		1
4	561882		RING- RETAINER INTERNAL		1
3	561255		DRIVE PIN		2
2					
1	8601666		REELSHAFT FABRICATION - PTV100/72		1

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
DIMENSIONS IN [ ] ARE MM
-TOLERANCES-

A) ANGULAR ± 1/2°
B) DECIMAL CHKD .X ± .05
CTVD .XX ± .02
CTVMED .XXX ± .01
C) FRACTIONAL ± 1/32
1. GENERAL
2. SAWING, FLAME CUTTING, MACHINING ± 1/16
3. WELDING ± 1/8

MATL N/R
FINISH
HEAT TREAT N/R
YIELD
TEST N/R
EST
LAS
LAT
LAS

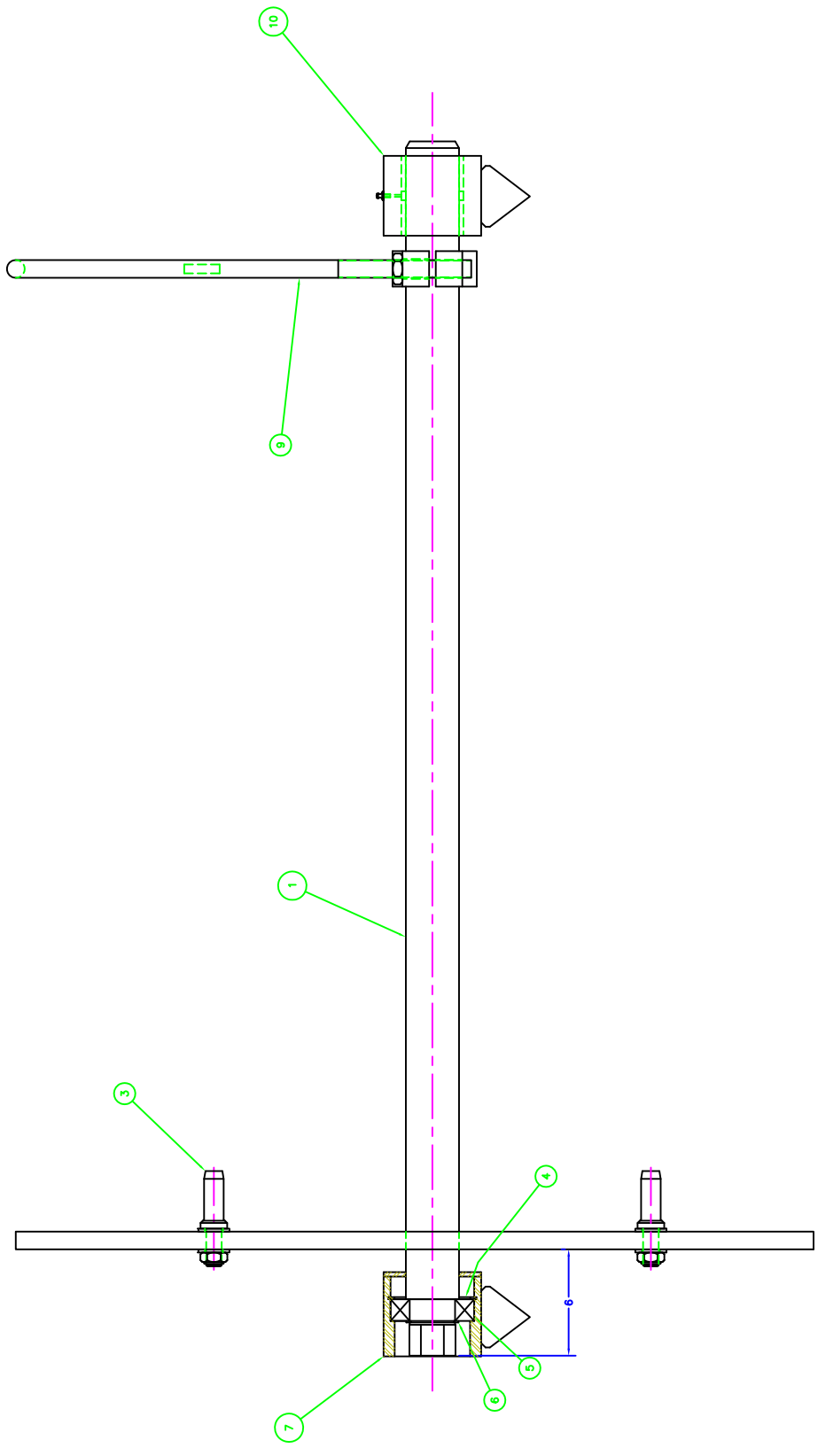
TSE INTERNATIONAL INC
Shreveport, Louisiana, United States of America

TITLE SHAFT ASSEMBLY - PTV 60-54

NEXT ASSEMBLY
FIRST USED ON MACH
DRAWN RB
CHECKED RJB
APPROVED
DATE 20MAR00
SCALE 1/4

REVISED FROM 810916
SHEET 1 OF 1
REV 1

882003 J



4.5 L OEM Diesel Engines (Final Tier 4/Stage IV Platform)



OPERATOR'S MANUAL

4.5 L OEM Diesel Engines (Final Tier 4/Stage IV Platform)

OMRG39498 ISSUE 19MAR15 (ENGLISH)

CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

If this product contains a gasoline engine:

⚠ WARNING

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

The State of California requires the above two warnings.

Additional Proposition 65 Warnings can be found in this manual.

John Deere Power Systems

PRINTED IN U.S.A.

OEM Engine and Drivetrain Warranty Registration

Why registering your OEM engine or drivetrain product is a really smart idea:[1]

Get faster service. Registering your engine or drivetrain product gives us the information we need to meet your service needs promptly and completely.

Protect your investment. You'll be kept up-to-date on engine or drivetrain product updates.

Extend your warranty. You'll be given the option to extend your coverage before your standard warranty term expires.

Stay informed. Be the first to know about new products and money-saving offers from John Deere.

NOTE: A mail-in registration form is located at the back of this manual.

You're Covered

When you buy a John Deere engine or drivetrain product you aren't just buying pistons and crankshafts and gear drives. You're buying the ability to get work done. Without downtime, without worries, and without hassles. And you're buying the assurance that if you do need help, a strong support network will be there — ready to step in.

Confidence. That's what John Deere engines, John Deere drivetrains, and John Deere Warranties are all about.

Long durations. Warranties designed to give you confidence in your engine or drivetrain product.

Worldwide support. Get service when and where you need it. John Deere has 4,000+ service locations worldwide.

Genuine John Deere parts and service. Authorized service outlets will use only new or remanufactured parts or components furnished by John Deere.

Warranty Duration

[1]Register your OEM engine or drivetrain product online and select an authorized John Deere service location. If available in your region, you'll receive information regarding new products and current money-saving offers from John Deere. Limit one money-saving offer per engine warranty registration. Not transferable. Not valid with any other offer. Offer ends 90 days from the date of issue. Some restrictions apply. See your John Deere service location for complete details.

RG24614 —UN—21OCT13

Scan this code to register your OEM engine online now and learn of current money-saving offers available to you.[1] You can also visit us directly at JohnDeere.com/warranty.

Equipment operators can't afford downtime or unexpected repairs. That's why we offer a 2-year/2,000-hour warranty, with unlimited hours in the first year, on our OEM industrial and marine engines. This warranty takes effect the date that the engine is delivered to the first retail purchaser. In addition, extended warranties are available under certain conditions. John Deere offers a variety of purchased warranties to extend the warranty period for your engine. You'll be given the option to extend your coverage before your standard warranty term expires. Be sure to register your engine or drivetrain product and take full advantage of the John Deere service and support network.

Obtaining Warranty Service

Warranty service must be requested through an authorized John Deere service outlet before the expiration of the warranty. Evidence of the engine's or drivetrain product's delivery date to the first retail purchaser must be presented when requesting warranty service. Authorized service outlets include:

- John Deere distributor
- John Deere OEM service dealer
- John Deere equipment dealer
- John Deere marine dealer

Worldwide Support Network

Visit JohnDeere.com/dealer to find the authorized engine or drivetrain service location nearest you. For complete warranty details visit JohnDeere.com/warrantystatements to view, download, or print the warranty statement for your engine or drivetrain product.

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Foreword

READ THIS MANUAL carefully to learn how to operate and service your engine correctly. Failure to do so could result in personal injury or equipment damage.

THIS MANUAL SHOULD BE CONSIDERED a permanent part of your engine and should remain with the engine when you sell it.

MEASUREMENTS IN THIS MANUAL are given in both metric and customary U.S. unit equivalents. Use only correct replacement parts and fasteners. Metric and inch fasteners may require a specific metric or inch wrench.

RIGHT-HAND AND LEFT-HAND sides are determined by standing at the drive or flywheel end (rear) of the engine and facing toward the front of the engine.

WRITE ENGINE SERIAL NUMBERS and option codes in the spaces indicated in the Record Keeping Section. Accurately record all the numbers. Your dealer also needs these numbers when you order parts. File the identification numbers in a secure place off the engine.

SETTING FUEL DELIVERY beyond published factory specifications or otherwise overpowering will result in loss of warranty protection for this engine.

CERTAIN ENGINE ACCESSORIES such as radiator, air cleaner, and instruments are optional equipment on John Deere OEM Engines. These accessories may be provided by the equipment manufacturer instead of John Deere. This operator's manual applies only to the engine and those options available through the John Deere distribution network.

NOTE: This operator's manual covers only engines provided to OEM (Original Equipment Manufacturers). For engines in Deere machines, refer to the machine operators manual.

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Engine Owner

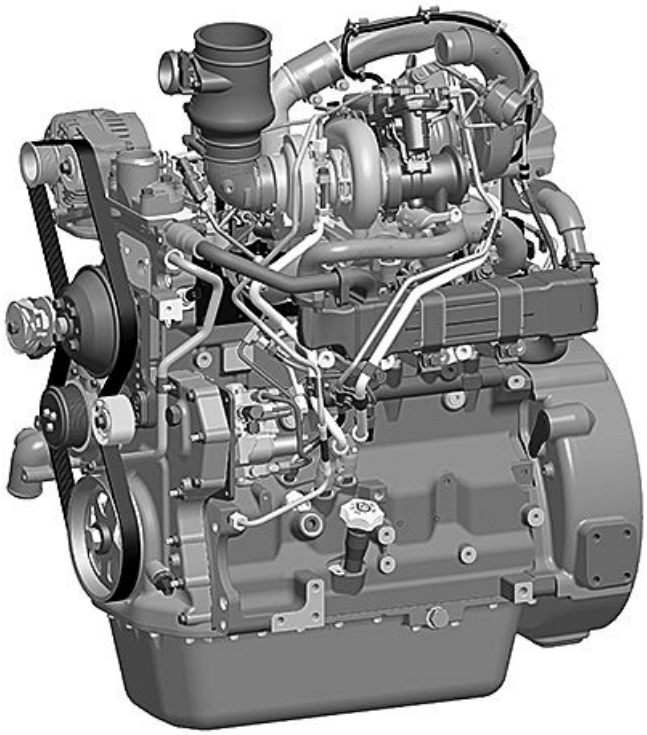
John Deere Engine Owner:

It is important for you to register your new engine for factory warranty. Registering your engine will allow your Service Dealer to verify that your warranty status should a repair be needed. The easiest way to register your engine is via the internet. To register your engine for warranty via the internet, please use the following URL: http://www.johndeere.com/enginewarranty

Your John Deere Engine Distributor or local John Deere Service Dealer will also be happy to provide this service. Engine service can be done by all Ag, C&FD, and JDPS branded dealers. To view the John Deere Service Dealer network or locate your nearest Dealer, use the following URL: http://www.johndeere.com/dealer

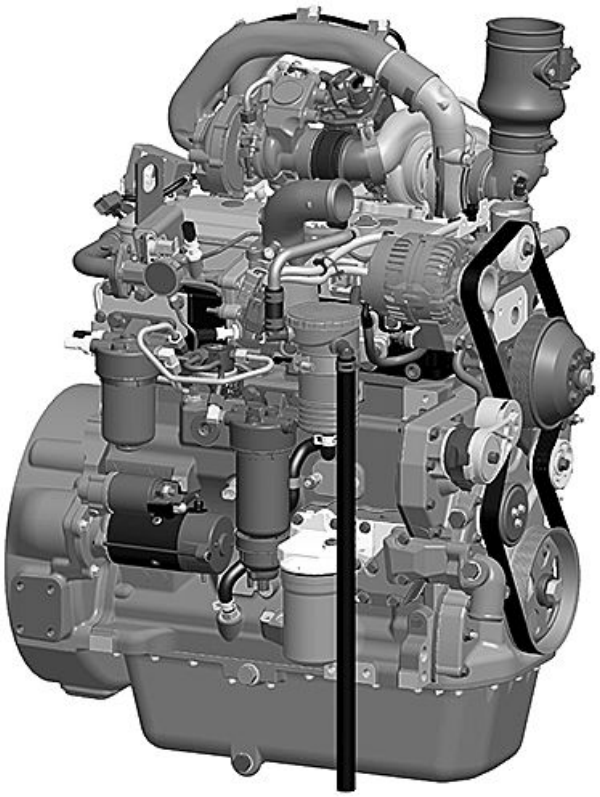
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Identification Views



RG25233 —UN—10MAR14

4045HFC09 Left View

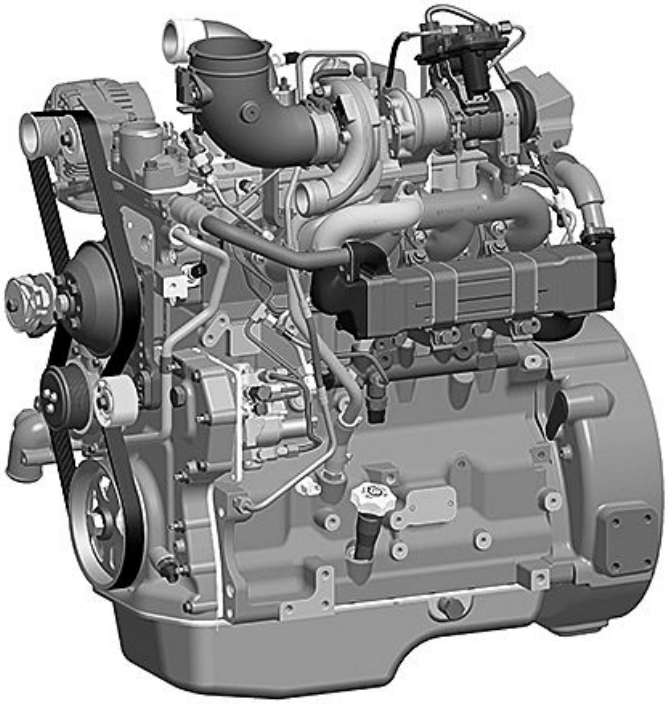


RG25234 —UN—10MAR14

4045HFC09 Right View

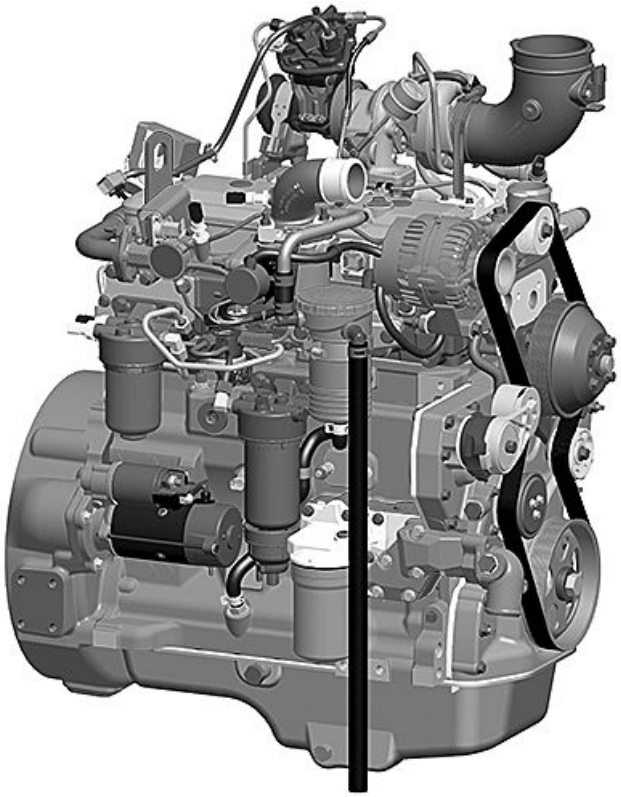
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4045HFC04 Left View

RG25231 —UN—10MAR14



4045HFC04 Right View

RG25232 —UN—10MAR14

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Trademarks

Trademarks	
AdBlue®	AdBlue is a trademark of VDA, the German Association of the Automotive Industry.
AMP®	AMP is a trademark of Tyco Electronics
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Bio Hy-Gard™	Bio Hy-Gard is a trademark of Deere & Company
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Metri-Pack®	Metri-Pack is a trademark of Delphi Connection Systems
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Oilscan™	Oilscan is a trademark of Deere & Company
Permatex®	Permatex is a trademark of Illinois Tool Works Inc.
Phoenix™	Phoenix is a trademark of Deere & Company
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PowerTech™ E	PowerTech is a trademark of Deere & Company
PowerTech™ M	PowerTech is a trademark of Deere & Company
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Scotch-Grip®	Scotch-Grip is a trademark of 3M Co.
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SERVICEGARD™	SERVICEGARD is a trademark of Deere & Company
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TeamMate™	TeamMate is a trademark of Deere & Company
TEFLON®	TEFLON is a trademark of Du Pont Co.
TMIII™	TMIII is a trademark of Deere & Company

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WINDOWS®	WINDOWS is a trademark of Microsoft Corporation

ZE59858,0000006 -19-13FEB14-2/2

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A John Deere ILLUSTRUCTION ™ Manual
Previous Editions
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Record Engine Serial Number

Each engine has a 13-digit John Deere engine serial number. The first two digits identify the factory that produced the engine:

- CD — Saran, France
- PE — Torreon, Mexico

1. The engine serial number plate (C) is located on the right-hand side of engine behind fuel filters.
2. Record all of the numbers and letters found on your engine serial number plate in the spaces provided below.
3. This information is very important for repair parts or warranty information.

Engine Serial Number (A)

_____

Engine Model Number (B)

_____

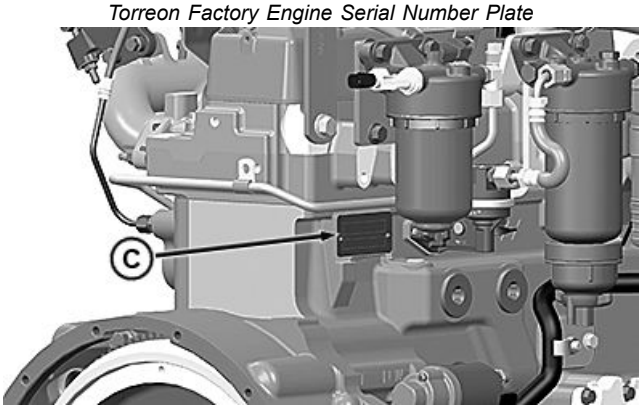
NOTE: On engine serial number (A) the seventh digit shows the emission level as follows:

- *"L" for Tier 3 / Stage IIIA engines*
- *"R" for Interim Tier 4 / Stage IIIB engines*
- *"U" for Final Tier 4/ Stage IV*



RG25229 —UN—10MAR14

Torreon Factory Engine Serial Number Plate



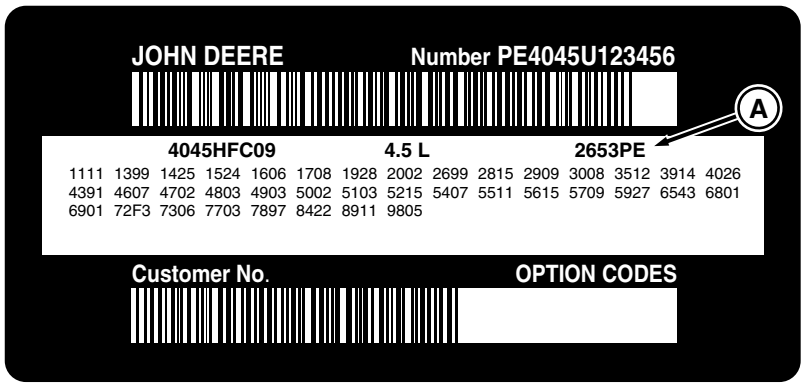
RG24816 —UN—04DEC13

Location of Engine Serial Number Plate

A—Engine Serial Number
B—Engine Model Number
C—Serial Number Plate

ZE59858,0000009 -19-28JUL14-1/1

Engine Option Codes



RG25230 —UN—12AUG14

Option Code Label Example

A—Engine Base Code

In addition to the serial number plate, OEM engines have an engine option code label affixed to the rocker arm cover. These codes indicate which of the engine options were installed on your engine at the factory. When in need of parts or service, furnish your authorized servicing dealer or engine distributor with these numbers.

The engine option code label includes an engine base code (A). This base code must also be recorded along with the option codes which may be helpful when ordering service parts or for tracking service work.

The first two digits of each option code identify a specific group, such as alternators. The last two digits of each code identify one specific option provided on your engine, such as a 24 volt, 120 Amp alternator.

If an engine is ordered without a particular component, the last two digits of that functional group option code are 99, 00, or XX. The following list shows only the first two digits of the code numbers. For future reference such as ordering repair parts, it is important to have these code numbers available. To ensure this availability, enter the third and fourth digits shown on your engine option code label in the spaces provided below.

Record engine base code (A) below, as seen on your serial number plate:

_____

Engine Option Codes—Continued

NOTE: Your engine option code label may not contain all option codes if an option has been added after the engine left the producing factory.

If option code label is lost or destroyed, consult your servicing dealer or engine distributor selling the engine for a replacement.

NOTE: These option codes are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.

Option Codes	Description	Option Codes	Description
11_____	Rocker Arm Cover	51_____	Cylinder Head with Valves
12_____	Oil Fill Inlet	52_____	Auxiliary Gear Drive
13_____	Crankshaft Pulley/Damper	53_____	Fuel Heater
14_____	Flywheel Housing	54_____	Turbocharger Air Inlet
15_____	Flywheel	55_____	Shipping Stand
16_____	High-Pressure Fuel Pump	56_____	Paint
17_____	Air Intake	57_____	Coolant Pump Inlet
19_____	Oil Pan	59_____	Oil Cooler and Filter
20_____	Coolant Pump	60_____	Add-on Auxiliary Drive Pulley
21_____	Thermostat Cover	61_____	Exhaust Filter
22_____	Thermostats	62_____	Alternator Mounting Bracket
23_____	Fan Drive	63_____	Low Pressure Fuel Line
24_____	Fan Belts	64_____	Exhaust Elbow
25_____	Fan	65_____	Turbocharger
26_____	Engine Coolant Heater	67_____	Electronic Sensors (Base Engine)
28_____	Exhaust Manifold	69_____	Engine Serial Number Plate

Continued on next page

ZE59858,000000A -19-12AUG14-1/2

Option Codes	Description	Option Codes	Description
29	Open Crankcase Ventilation System	70	Decomposition Tube
30	Starter Motor	71	SCR Converter
31	Alternator	7A	Electronic Software Option
33	DEF Line	74	Air Conditioning (A/C) Compressor (Optional)
34	DEF Tank Sender	76	Switches and Sensors
35	Fuel Filter	78	Air Compressor Mounting
36	Front Plate	79	Engine Certification
39	Thermostat Housing	81	Primary Fuel Filter and Water Separator
40	Oil Dipstick	83	Electronic Software (Vehicle Option)
41	Belt-Driven Front Auxiliary Drive	84	Electrical Wiring Harness
42	DEF Line	86	Fan Pulley
43	Starting Aid	87	Belt Tensioner
44	Timing Gear Cover with Gears	89	Exhaust Gas Recirculating (EGR) System
45	Balancer Shaft	90	Trim Options
46	Cylinder Block and Camshaft	91	Instrument Panel Wiring Harness
47	Crankshaft and Bearings	93	Emissions Label
48	Connecting Rods and Pistons	95	Special Equipment (Factory Installed)
49	Rocker Arm Assembly	98	Shipping (Engine Hanger Straps)
50	Oil Pump		

ZE59858,000000A -19-12AUG14-2/2

Record Aftertreatment Serial Numbers

Record the numbers from your aftertreatment device as shown on DPF (A and B), DOC (C and D), and SCR (E and F) serial number plates. Having these numbers recorded and kept in a safe location can aid in part ordering and assist in locating stolen items in case of theft.

DPF Part Number._____

DPF Serial Number._____

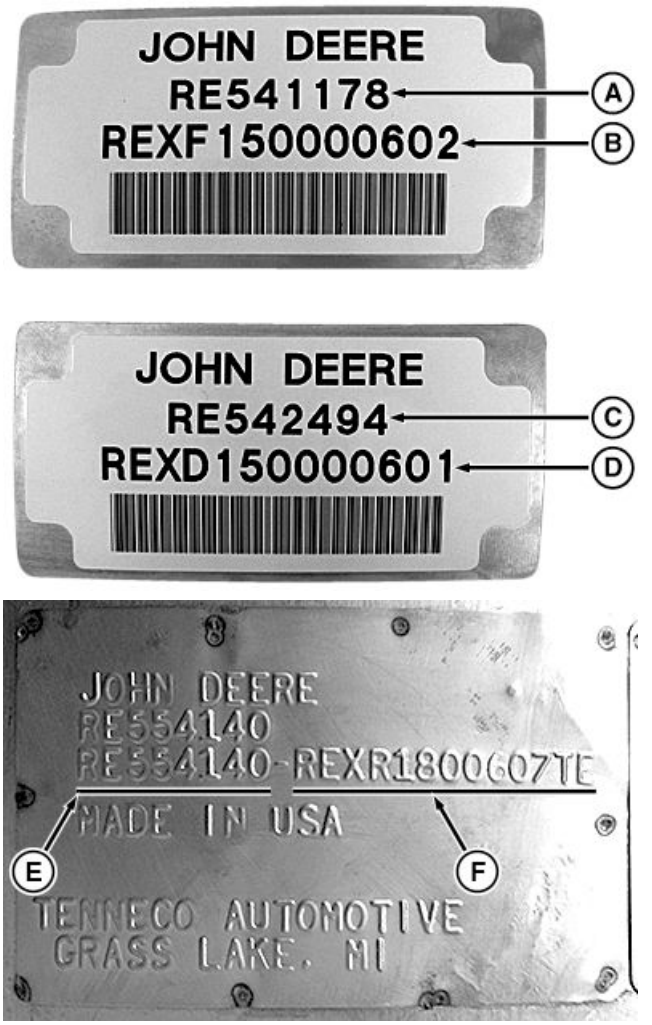
DOC Part Number._____

DOC Serial Number._____

SCR Part Number._____

SCR Serial Number._____

A—Diesel Particulate Filter Part Number
B—Diesel Particulate Filter Serial Number
C—Diesel Oxidation Catalyst Part Number
D—Diesel Oxidation Catalyst Serial Number
E—Selective Catalyst Reduction Part Number
F—Selective Catalyst Reduction Serial Number



Serial Number Plates for Aftertreatment

RK80614,0000004 -19-06AUG13-1/1

Record High-Pressure Fuel Pump Model Number

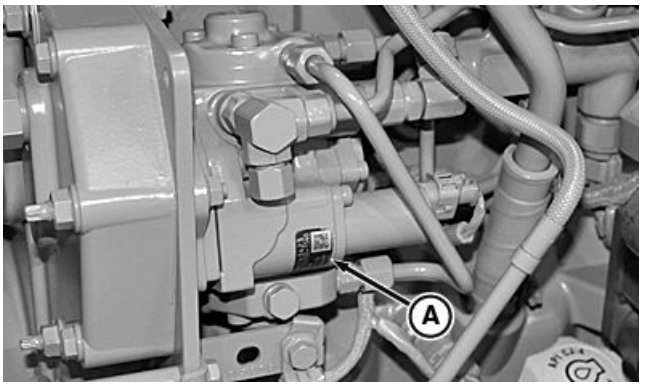
Record the high-pressure fuel pump model and serial number information found on the serial number plate (A).

Model No._____

Manufacturer's No._____

Serial No._____

A—Serial Number Plate



Record High-Pressure Fuel Pump Serial Number

ZE59858,000002C -19-28JUL14-1/1

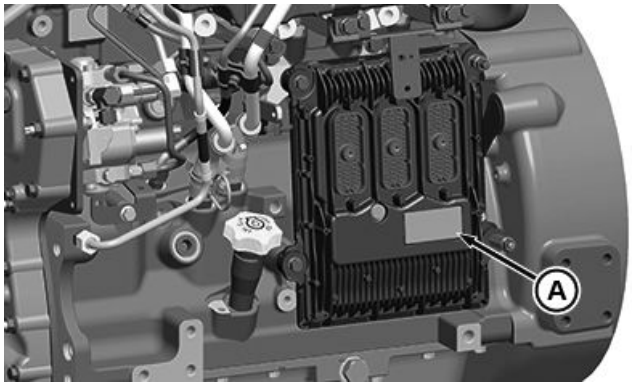
Record ECU Serial Number

Record the part number and serial number information found on the serial number label on the Engine Control Unit (ECU).

Part No._____

Serial No._____

A—Serial Number Label



RG26249 —UN—30JUL14

ZE59858,000000C -19-12AUG14-1/1

Understand Signal Words

A signal word—DANGER, WARNING, or CAUTION—is used with the safety-alert symbol. DANGER identifies the most serious hazards.

DANGER or WARNING safety signs are located near specific hazards. General precautions are listed on CAUTION safety signs. CAUTION also calls attention to safety messages in this manual.



TS187 —19—30SEP88

DX,SIGNAL -19-03MAR93-1/1

Recognize Safety Information

This is a safety-alert symbol. When you see this symbol on your machine or in this manual, be alert to the potential for personal injury.

Follow recommended precautions and safe operating practices.



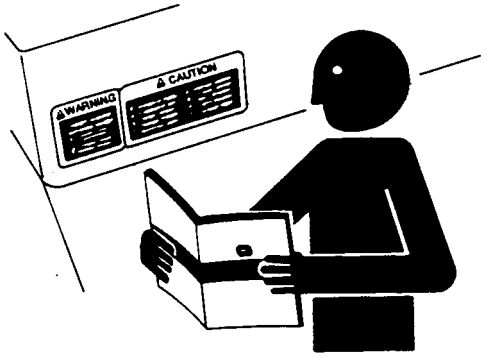
T81389 —UN—28JUN13

DX,ALERT -19-29SEP98-1/1

Replace Safety Signs

Replace missing or damaged safety signs. Use this operator's manual for correct safety sign placement.

There can be additional safety information contained on parts and components sourced from suppliers that is not reproduced in this operator's manual.



TS201 —UN—15APR13

DX,SIGNS -19-18AUG09-1/1

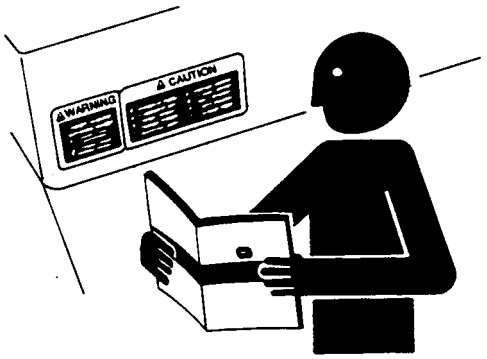
Follow Safety Instructions

Carefully read all safety messages in this manual and on your machine safety signs. Keep safety signs in good condition. Replace missing or damaged safety signs. Be sure new equipment components and repair parts include the current safety signs. Replacement safety signs are available from your John Deere dealer.

There can be additional safety information contained on parts and components sourced from suppliers that is not reproduced in this operator's manual.

Learn how to operate the machine and how to use controls properly. Do not let anyone operate without instruction.

Keep your machine in proper working condition. Unauthorized modifications to the machine may impair the function and/or safety and affect machine life.



TS201 —UN—15APR13

If you do not understand any part of this manual and need assistance, contact your John Deere dealer.

DX,READ -19-16JUN09-1/1

California Proposition 65 Warning

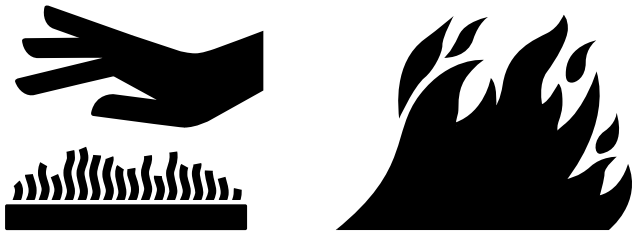
Diesel engine exhaust, some of its constituents, along with certain machine components contain or emit chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. In addition, certain fluids contained in the machine and certain products of component wear contain or emit chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

RG41061,000001F -19-12JAN10-1/1

Exhaust Filter Cleaning

Servicing machine or attachments during exhaust filter cleaning can result in serious personal injury. Avoid exposure and skin contact with hot exhaust gases and components.

During auto or manual/stationary exhaust filter cleaning operations, the engine will run at elevated idle and hot temperatures for an extended period of time. Exhaust gases and exhaust filter components reach temperatures hot enough to burn people, or ignite, or melt common materials.



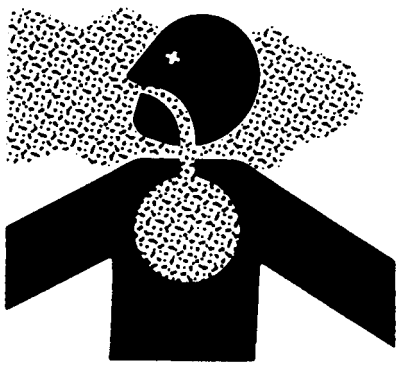
RG17488 —UN—21AUG09

DX,FILTER -19-20JAN10-1/1

Work In Ventilated Area

Engine exhaust fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.

If you do not have an exhaust pipe extension, open the doors and get outside air into the area.



TS220 —UN—15APR13

DX,AIR -19-17FEB99-1/1

Dispose of Waste Properly

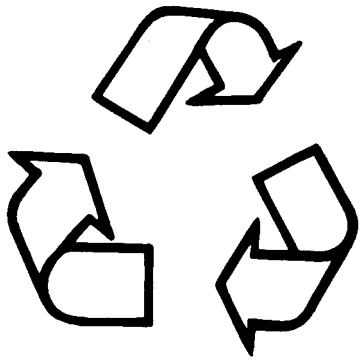
Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain, or into any water source.

Air conditioning refrigerants escaping into the air can damage the Earth's atmosphere. Government regulations may require a certified air conditioning service center to recover and recycle used air conditioning refrigerants.

Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere dealer.



TS1133 —UN—15APR13

DX,DRAIN -19-03MAR93-1/1

Prevent Machine Runaway

Avoid possible injury or death from machinery runaway.

Do not start engine by shorting across starter terminals. Machine will start in gear if normal circuitry is bypassed.

NEVER start engine while standing on ground. Start engine only from operator's seat, with transmission in neutral or park.



TS177 —UN—11JAN89

DX,BYPAS1 -19-29SEP98-1/1

Practice Safe Maintenance

Understand service procedure before doing work. Keep area clean and dry.

Never lubricate, service, or adjust machine while it is moving. Keep hands, feet , and clothing from power-driven parts. Disengage all power and operate controls to relieve pressure. Lower equipment to the ground. Stop the engine. Remove the key. Allow machine to cool.

Securely support any machine elements that must be raised for service work.

Keep all parts in good condition and properly installed. Fix damage immediately. Replace worn or broken parts. Remove any buildup of grease, oil, or debris.

On self-propelled equipment, disconnect battery ground cable (-) before making adjustments on electrical systems or welding on machine.

On towed implements, disconnect wiring harnesses from tractor before servicing electrical system components or welding on machine.



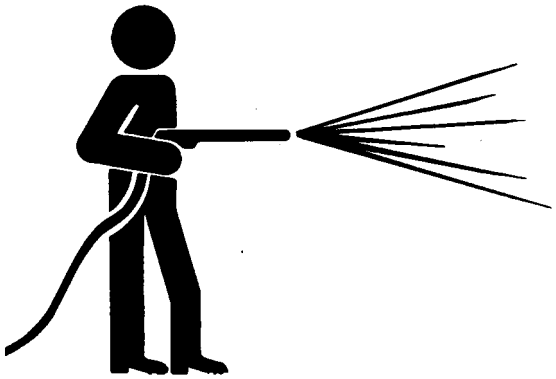
TS218 —UN—23AUG88

DX,SERV -19-17FEB99-1/1

Work in Clean Area

Before starting a job:

- Clean work area and machine.
- Make sure you have all necessary tools to do your job.
- Have the right parts on hand.
- Read all instructions thoroughly; do not attempt shortcuts.



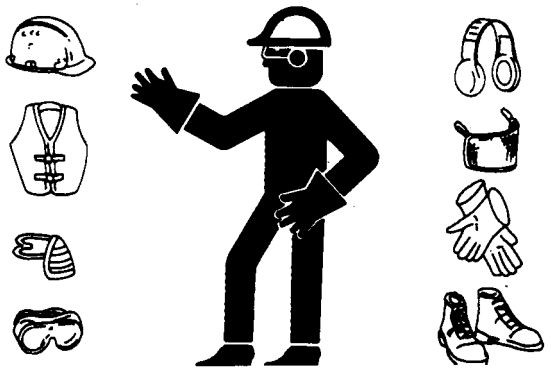
T6642EJ —UN—18OCT88

DX,CLEAN -19-04JUN90-1/1

Wear Protective Clothing

Wear close fitting clothing and safety equipment appropriate to the job.

Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.



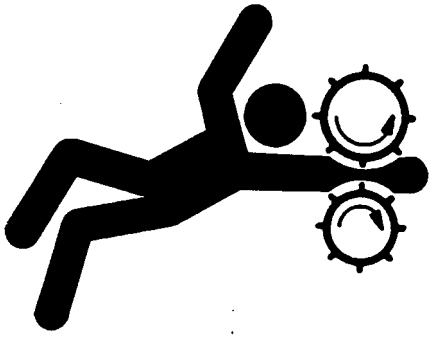
TS206 —UN—15APR13

DX,WEAR2 -19-03MAR93-1/1

Service Machines Safely

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



TS228 —UN—23AUG88

DX,LOOSE -19-04JUN90-1/1

Use Proper Tools

Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards.

Use power tools only to loosen threaded parts and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only service parts meeting John Deere specifications.



TS779 —UN—08NOV89

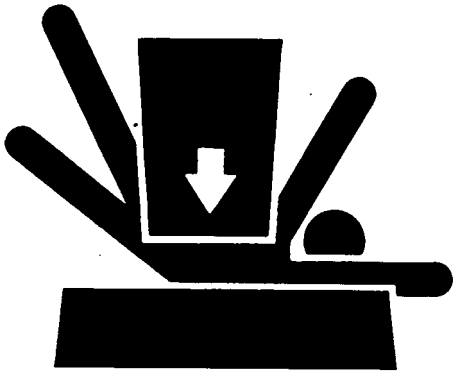
DX,REPAIR -19-17FEB99-1/1

Support Machine Properly

Always lower the attachment or implement to the ground before you work on the machine. If the work requires that the machine or attachment be lifted, provide secure support for them. If left in a raised position, hydraulically supported devices can settle or leak down.

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load. Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.

When implements or attachments are used with a machine, always follow safety precautions listed in the implement or attachment operator's manual.



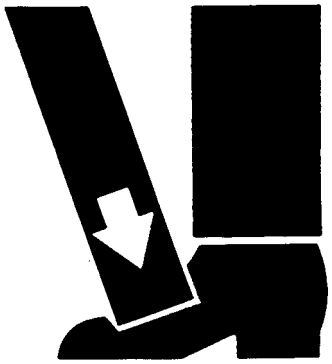
TS229 —UN—23AUG88

DX,LOWER -19-24FEB00-1/1

Use Proper Lifting Equipment

Lifting heavy components incorrectly can cause severe injury or machine damage.

Follow recommended procedure for removal and installation of components in the manual.



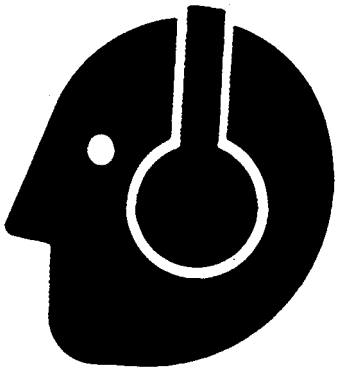
TS226 —UN—23AUG88

DX,LIFT -19-04JUN90-1/1

Protect Against Noise

Prolonged exposure to loud noise can cause impairment or loss of hearing.

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

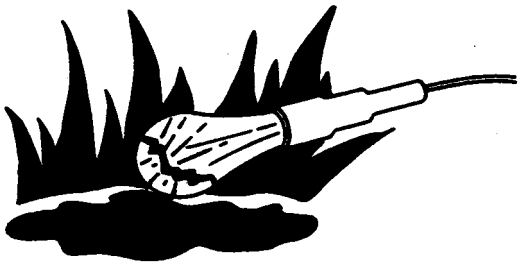


TS207 —UN—23AUG88

DX,NOISE -19-03MAR93-1/1

Illuminate Work Area Safely

Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.



TS223 —UN—23AUG88

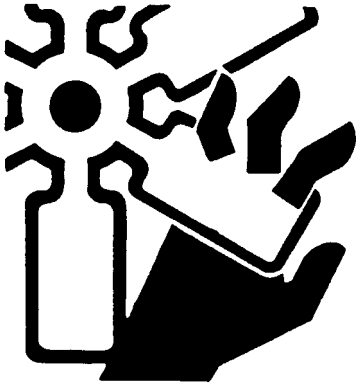
DX,LIGHT -19-04JUN90-1/1

Install All Guards

Rotating cooling system fans, belts, pulleys, and drives can cause serious injury.

Keep all guards in place at all times during engine operation.

Wear close-fitting clothes. Stop the engine and be sure fans, belts, pulleys, and drives are stopped before making adjustments, connections, or cleaning near fans and their drive components.



TS677 —UN—21SEP89

DX,GUARDS -19-18AUG09-1/1

Stay Clear of Rotating Drivelines

Entanglement in rotating driveline can cause serious injury or death.

Keep all shields in place at all times. Make sure rotating shields turn freely.

Wear close-fitting clothing. Stop the engine and be sure that all rotating parts and drivelines are stopped before making adjustments, connections, or performing any type of service on engine or machine driven equipment.



TS1644 —UN—22AUG95

DX,ROTATING -19-18AUG09-1/1

Protect Against High Pressure Spray

Spray from high pressure nozzles can penetrate the skin and cause serious injury. Keep spray from contacting hands or body.

If an accident occurs, see a doctor immediately. Any high pressure spray injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.



TS1343 —UN—18MAR92

DX,SPRAY -19-16APR92-1/1

Service Cooling System Safely

Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.



TS281 —UN—15APR13

DX,RCAP -19-04JUN90-1/1

Remove Paint Before Welding or Heating

Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Remove paint before heating:

- Remove paint a minimum of 100 mm (4 in.) from area to be affected by heating. If paint cannot be removed, wear an approved respirator before heating or welding.
- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

Do not use a chlorinated solvent in areas where welding will take place.



TS220 —UN—15APR13

Do all work in an area that is well ventilated to carry toxic fumes and dust away.

Dispose of paint and solvent properly.

DX,PAINT -19-24JUL02-1/1

Do Not Open High-Pressure Fuel System

High-pressure fluid remaining in fuel lines can cause serious injury. Do not disconnect or attempt repair of fuel lines, sensors, or any other components between the high-pressure fuel pump and nozzles on engines with High Pressure Common Rail (HPCR) fuel system.

Only technicians familiar with this type of system can perform repairs. (See your John Deere dealer.)



TS1343 —UN—18MAR92

DX,WW,HPCR1 -19-07JAN03-1/1

Avoid High-Pressure Fluids

Inspect hydraulic hoses periodically – at least once per year – for leakage, kinking, cuts, cracks, abrasion, blisters, corrosion, exposed wire braid or any other signs of wear or damage.

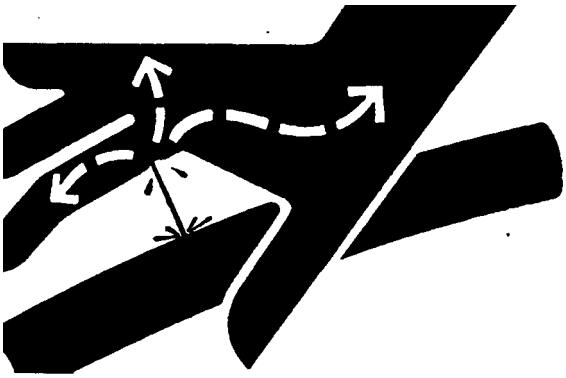
Replace worn or damaged hose assemblies immediately with John Deere approved replacement parts.

Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high-pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available in English from Deere & Company Medical Department in Moline, Illinois, U.S.A., by calling 1-800-822-8262 or +1 309-748-5636.



X9811 —UN—23AUG88

DX,FLUID -19-12OCT11-1/1

Avoid Heating Near Pressurized Fluid Lines

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can accidentally burst when heat goes beyond the immediate flame area.



TS953 —UN—15MAY90

DX,TORCH -19-10DEC04-1/1

Avoid Static Electricity Risk When Refueling

The removal of sulfur and other compounds in Ultra-Low Sulfur Diesel (ULSD) fuel decreases its conductivity and increases its ability to store a static charge.

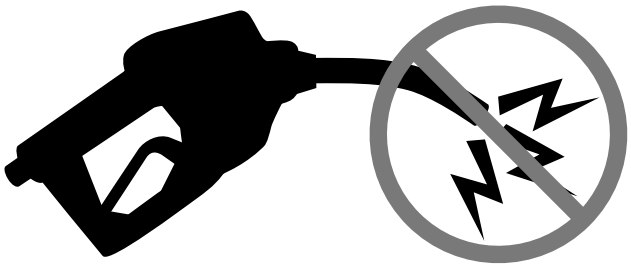
Refineries may have treated the fuel with a static dissipating additive. However, there are many factors that can reduce the effectiveness of the additive over time.

Static charges can build up in ULSD fuel while it is flowing through fuel delivery systems. Static electricity discharge when combustible vapors are present could result in a fire or explosion.

Therefore, it is important to ensure that the entire system used to refuel your machine (fuel supply tank, transfer pump, transfer hose, nozzle, and others) is properly grounded and bonded. Consult with your fuel or fuel system supplier to ensure that the delivery system is in compliance with fueling standards for proper grounding and bonding practices.



RG22142 —UN—17MAR14



RG21992 —UN—21AUG13

DX,FUEL,STATIC,ELEC -19-12JUL13-1/1

Handle Fuel Safely—Avoid Fires

Handle fuel with care: it is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks.

Always stop engine before refueling machine. Fill fuel tank outdoors.

Prevent fires by keeping machine clean of accumulated trash, grease, and debris. Always clean up spilled fuel.

Use only an approved fuel container for transporting flammable liquids.

Never fill fuel container in pickup truck with plastic bed liner. Always place fuel container on ground before refueling. Touch fuel container with fuel dispenser nozzle before removing can lid. Keep fuel dispenser nozzle in contact with fuel container inlet when filling.



TS202 —UN—23AUG88

Do not store fuel container where there is an open flame, spark, or pilot light such as within a water heater or other appliance.

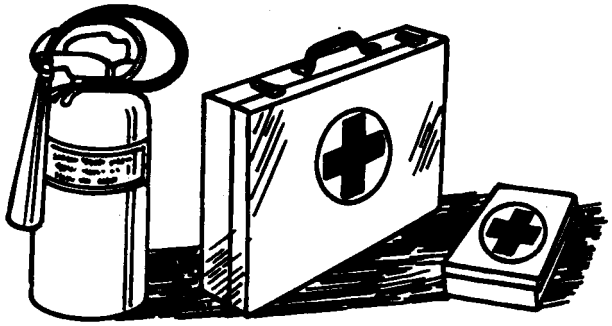
DX,FIRE1 -19-12OCT11-1/1

Prepare for Emergencies

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



TS291 —UN—15APR13

DX,FIRE2 -19-03MAR93-1/1

Handle Starting Fluid Safely

Starting fluid is highly flammable.

Keep all sparks and flame away when using it. Keep starting fluid away from batteries and cables.

To prevent accidental discharge when storing the pressurized can, keep the cap on the container, and store in a cool, protected location.

Do not incinerate or puncture a starting fluid container.

Do not use starting fluid on an engine equipped with glow plugs or an air intake heater.



TS1356 —UN—18MAR92

DX,FIRE3 -19-14MAR14-1/1

Handling Batteries Safely

Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.

Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.

Always remove grounded (-) battery clamp first and replace grounded clamp last.

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

Avoid hazards by:

- Filling batteries in a well-ventilated area
- Wearing eye protection and rubber gloves
- Avoiding use of air pressure to clean batteries
- Avoiding breathing fumes when electrolyte is added
- Avoiding spilling or dripping electrolyte
- Using correct battery booster or charger procedure.

If acid is spilled on skin or in eyes:

1. Flush skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush eyes with water for 15—30 minutes. Get medical attention immediately.

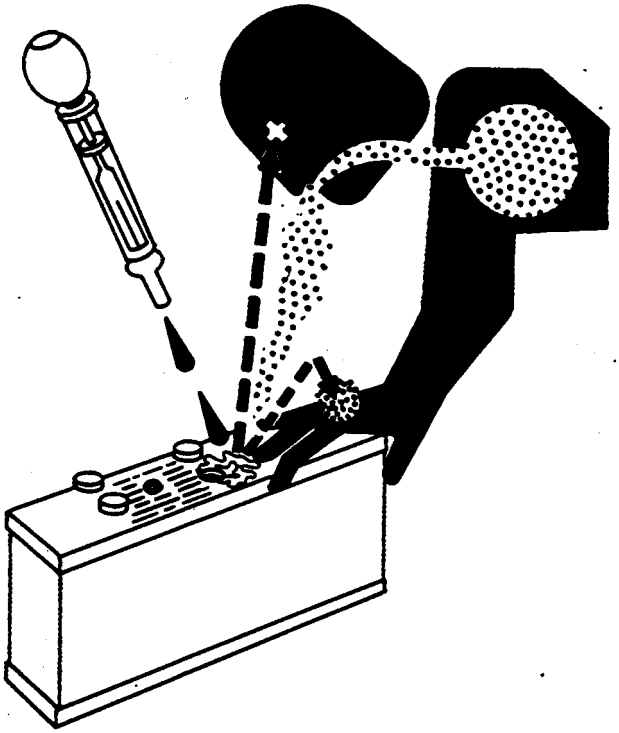
If acid is swallowed:

1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 2 L (2 qt.).
3. Get medical attention immediately.

WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. **Wash hands after handling.**



TS204 —UN—15APR13



TS203 —UN—23AUG88

DX,WW,BATTERIES -19-02DEC10-1/1

Prevent Acid Burns

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

Avoid the hazard by:

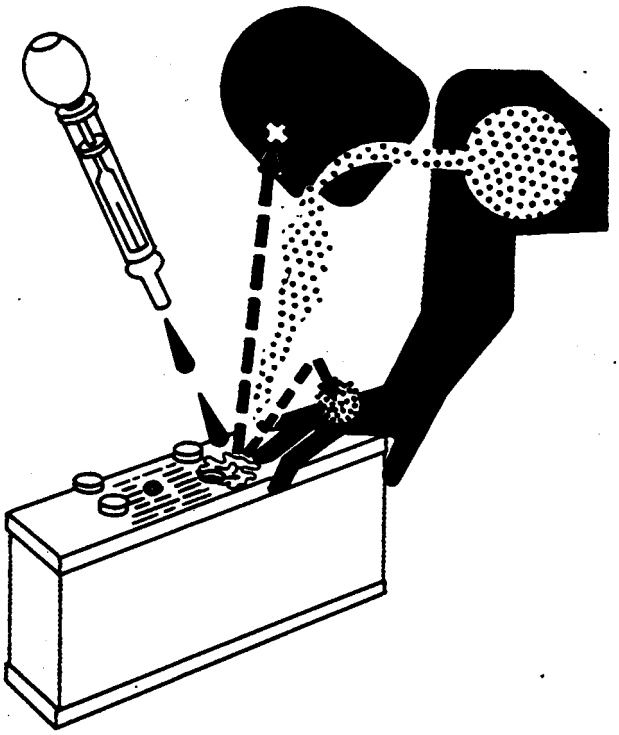
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 15—30 minutes. Get medical attention immediately.

If acid is swallowed:

1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 2 L (2 quarts).
3. Get medical attention immediately.



TS203 —UN—23AUG88

DX,POISON -19-21APR93-1/1

Prevent Battery Explosions

Keep sparks, lighted matches, and open flame away from the top of battery. Battery gas can explode.

Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.

Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).



TS204 —UN—15APR13

DX,SPARKS -19-03MAR93-1/1

Live With Safety

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.



TS231 —19—07OCT88

DX,LIVE -19-25SEP92-1/1

Diesel Exhaust Fluid (DEF) — Use in Selective Catalytic Reduction (SCR) Equipped Engines

Diesel exhaust fluid (DEF) is a high purity liquid that is injected into the exhaust system of engines equipped with selective catalytic reduction (SCR) systems. Maintaining the purity of DEF is important to avoid malfunctions in the SCR system. Engines requiring DEF shall use a product that meets the requirements for aqueous urea solution 32 (AUS 32) according to ISO 22241-1.

The use of John Deere Diesel Exhaust Fluid is recommended. John Deere Diesel Exhaust Fluid is available at your John Deere dealer in a variety of package sizes to suit your operational needs.

If John Deere Diesel Exhaust Fluid is not available, use DEF that is certified by the American Petroleum Institute (API) Diesel Exhaust Fluid Certification Program or by the AdBlue™ Diesel Exhaust Fluid Certification Program. Look for the API certification symbol or the AdBlue™ name on the container.

In some cases, DEF is referred to by one or more of these names:

- Urea
- Aqueous Urea Solution 32
- AUS 32
- AdBlue™
- NOx Reduction Agent
- Catalyst Solution

AdBlue is a trademark of VDA, the German Association of the Automotive Industry.

DX,DEF -19-13JUN13-1/1

Storing Diesel Exhaust Fluid (DEF)

CAUTION: Avoid contact with eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Reference the Materials Safety Data Sheet (MSDS) for additional information.

Do not ingest DEF. In the event DEF is ingested, contact a physician immediately. Reference the Materials Safety Data Sheet (MSDS) for additional information.

IMPORTANT: It is unlawful to tamper with or remove any component of the aftertreatment system. Do not use DEF that does not meet the required specifications or operate the engine with no DEF.

Never attempt to create DEF by mixing agricultural grade urea with water. Agricultural grade urea does not meet the necessary specifications and can damage the aftertreatment system.

Do not add any chemicals or additives to DEF in an effort to prevent freezing. Any chemicals or additives added to DEF can damage the aftertreatment system.

Never add water or any other fluid in place of, or in addition to DEF. Operating with a modified DEF or using an unapproved DEF can damage the aftertreatment system.

The following storage information is provided for reference and is to be used as a guideline only.

It is preferred to store DEF out of extreme ambient temperatures. DEF freezes at –11 °C (12 °F). Exposure to temperatures greater than 30 °C (86 °F) can degrade DEF over time.

Dedicated DEF storage containers must be sealed between uses to prevent evaporation and contamination. Containers made of polyethylene, polypropylene, or stainless steel are recommended to transport and store DEF.

Ideal conditions for storage of DEF are:

- Store at temperatures between –5 °C and 30 °C (23 °F and 86 °F)
- Store in dedicated containers sealed to avoid contamination and evaporation

Under these conditions, DEF is expected to remain useable for a minimum of 18 months. Storing DEF at higher temperatures can reduce its useful life by approximately 6 months for every 5 °C (9 °F) temperature above 30 °C (86 °F).

If unsure how long or under what conditions DEF has been stored, test DEF. See Testing Diesel Exhaust Fluid (DEF).

Long-term storage in the DEF tank (over 12 months) is not recommended. If long-term storage is necessary, test DEF prior to operating engine. See Testing Diesel Exhaust Fluid (DEF).

It is recommended to purchase DEF in quantities that will be consumed within 12 months.

DX,DEF,STORE -19-13JUN13-1/1

Refilling Diesel Exhaust Fluid (DEF) Tank

CAUTION: Avoid contact with eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Reference the Materials Safety Data Sheet (MSDS) for additional information.

Do not ingest DEF. In the event DEF is ingested, contact a physician immediately. Reference the Materials Safety Data Sheet (MSDS) for additional information.



TS1731 —UN—23AUG13

IMPORTANT: Use only distilled water to rinse components that are used to deliver DEF. Tap water can contaminate DEF. If distilled water is not available, rinse with clean tap water, then thoroughly rinse with ample amounts of DEF.

If DEF is spilled or contacts any surface other than the storage tank, immediately clean the surface with clear water. DEF is corrosive to painted and unpainted metallic surfaces and can distort some plastic and rubber components.

If DEF is filled into engine fuel tank or other fluid compartment, do not operate engine until system is properly purged of DEF. Contact your John Deere dealer immediately to determine how to clean and purge the system.

Reasonable care should be taken when refilling the DEF tank. Ensure that the DEF tank cap area is free of debris before removing the cap. Seal containers of DEF between use to prevent contamination and evaporation.

Avoid splashing DEF and do not allow DEF to come into contact with skin, eyes, or mouth.

DEF is not harmful to handle, but DEF can be corrosive to materials such as steel, iron, zinc, nickel, copper, aluminum, and magnesium. Use suitable containers to transport and store DEF. Containers made of polyethylene, polypropylene, or stainless steel are recommended.

Avoid prolonged contact with skin. In case of accidental contact, wash skin immediately with soap and water.

Keep anything used to store or dispense DEF clean of dirt and dust. Wash and rinse containers or funnels thoroughly with distilled water to remove contaminants.

If an unapproved fluid, such as diesel fuel or coolant is added to the DEF tank, contact your John Deere dealer immediately to determine how to clean and purge the system.

If water has been added to the DEF tank, a tank cleaning is necessary. See Cleaning DEF Tank in this manual. After refilling the tank, check the DEF concentration. See Testing Diesel Exhaust Fluid (DEF).

The operator must maintain appropriate DEF levels at all times. Check the DEF level daily and refill the tank as needed. The filling port is identified by a blue colored cap embossed with the DEF symbol, shown.

DX,DEF,REFILL -19-13AUG13-1/1

Testing Diesel Exhaust Fluid (DEF)

IMPORTANT: Using DEF with the correct concentration is critical to engine and aftertreatment system performance. Extended storage and other conditions can adversely alter the DEF concentration.

If DEF quality is questionable, draw a sample out of the DEF tank or storage tank into a clear container. DEF must be crystal clear with a light ammonia smell. If DEF appears cloudy, has a colored tint, or has a profound ammonia smell, it is likely not within specification. DEF in this condition should not be used. Drain tank, flush with distilled water and refill with new or good DEF. After refilling the tank, check the DEF concentration.

If the DEF passes the visual and smell test, check the DEF concentration with a handheld refractometer calibrated to measure DEF.

DEF concentration should be checked when the engine has been stored for extended periods, or if there is suspicion the engine or packaged DEF fluid has been contaminated with water.

Two approved tools are available through your John Deere dealer:

- JDG11594 Digital DEF Refractometer—A digital tool providing an easy to read concentration measurement
- JDG11684 DEF Refractometer—Low-cost alternative tool providing an analog reading

Follow instructions included with either tool to obtain the measurement.

The correct DEF concentration is 31.8—33.2% urea. If the DEF concentration is not within specification, drain the DEF tank, flush with distilled water and fill with new or good DEF. If packaged DEF is not within specification, dispose of DEF packages and replace with new or good DEF.

DX,DEF,TEST -19-13JUN13-1/1

Disposal of Diesel Exhaust Fluid (DEF)

Although there is little issue with minor spillage of DEF on the ground, large amounts of DEF should be contained. If large spills occur, contact local environmental authorities for assistance with clean-up.

If a substantial quantity of DEF is not within specification, contact the DEF supplier for assistance with disposal. Do not dump substantial quantities of DEF onto the ground or send DEF to wastewater treatment facilities.

DX,DEF,DISPOSE -19-13JUN13-1/1

Diesel Fuel

Consult your local fuel distributor for properties of the diesel fuel available in your area.

In general, diesel fuels are blended to satisfy the low temperature requirements of the geographical area in which they are marketed.

Diesel fuels specified to EN 590 or ASTM D975 are recommended. Renewable diesel fuel produced by hydrotreating animal fats and vegetable oils is basically identical to petroleum diesel fuel. Renewable diesel that meets EN 590 or ASTM D975 is acceptable for use at all percentage mixture levels.

Required Fuel Properties

In all cases, the fuel shall meet the following properties:

Cetane number of 40 minimum. Cetane number greater than 47 is preferred, especially for temperatures below –20 °C (–4 °F) or elevations above 1675 m (5500 ft.).

Cold Filter Plugging Point (CFPP) should be at least 5 °C (9 °F) below the expected lowest temperature or **Cloud Point** below the expected lowest ambient temperature.

Fuel lubricity should pass a maximum scar diameter of 0.52 mm as measured by ASTM D6079 or ISO 12156-1. A maximum scar diameter of 0.45 mm is preferred.

Diesel fuel quality and sulfur content must comply with all existing emissions regulations for the area in which the engine operates. DO NOT use diesel fuel with sulfur content greater than 10 000 mg/kg (10 000 ppm).

Sulfur content for Interim Tier 4, Final Tier 4, Stage III B, and Stage IV Engines

- Use ONLY ultra low sulfur diesel (ULSD) fuel with a maximum of 15 mg/kg (15 ppm) sulfur content.

Sulfur Content for Tier 3 and Stage III A Engines

- Use of diesel fuel with sulfur content less than 1000 mg/kg (1000 ppm) is RECOMMENDED.
- Use of diesel fuel with sulfur content 1000—2000 mg/kg (1000—2000 ppm) REDUCES the oil and filter change interval.
- BEFORE using diesel fuel with sulfur content greater than 2000 mg/kg (2000 ppm), contact your John Deere dealer.

Sulfur Content for Tier 2 and Stage II Engines

- Use of diesel fuel with sulfur content less than 2000 mg/kg (2000 ppm) is RECOMMENDED.
- Use of diesel fuel with sulfur content 2000—5000 mg/kg (2000—5000 ppm) REDUCES the oil and filter change interval.
- BEFORE using diesel fuel with sulfur content greater than 5000 mg/kg (5000 ppm), contact your John Deere dealer.

Sulfur Content for Other Engines

- Use of diesel fuel with sulfur content less than 5000 mg/kg (5000 ppm) is RECOMMENDED.
- Use of diesel fuel with sulfur content greater than 5000 mg/kg (5000 ppm) REDUCES the oil and filter change interval.

IMPORTANT: Do not mix used diesel engine oil or any other type of lubricating oil with diesel fuel.

Improper fuel additive usage may cause damage on fuel injection equipment of diesel engines.

DX,FUEL1 -19-24OCT14-1/1

Supplemental Diesel Fuel Additives

Diesel fuel can be the source of performance or other operational problems for many reasons. Some causes include poor lubricity, contaminants, low cetane number, and a variety of properties that cause fuel system deposits. These and others are referenced in other sections of this Operator's Manual.

To optimize engine performance and reliability, closely follow recommendations on fuel quality, storage, and handling, which are found elsewhere in this Operator's Manual.

To further aid in maintaining performance and reliability of the engine's fuel system, John Deere has developed a family of fuel additive products for most global markets. The primary products include Fuel-Protect Diesel Fuel Conditioner (full feature conditioner in winter and summer formulas) and Fuel-Protect Keep Clean (fuel injector deposit removal and prevention). Availability of these and other products varies by market. See your local John Deere dealer for availability and additional information about fuel additives that might be right for your needs.

DX,FUEL13 -19-07FEB14-1/1

Lubricity of Diesel Fuel

Most diesel fuels manufactured in the United States, Canada, and the European Union have adequate lubricity to ensure proper operation and durability of fuel injection system components. However, diesel fuels manufactured in some areas of the world may lack the necessary lubricity.

IMPORTANT: Make sure the diesel fuel used in your machine demonstrates good lubricity characteristics.

Fuel lubricity should pass a maximum scar diameter of 0.52 mm as measured by ASTM D6079 or ISO 12156-1. A maximum scar diameter of 0.45 mm is preferred.

If fuel of low or unknown lubricity is used, add John Deere Fuel-Protect Diesel Fuel Conditioner (or equivalent) at the specified concentration.

Lubricity of BioDiesel Fuel

Fuel lubricity can improve significantly with BioDiesel blends up to B20 (20% BioDiesel). Further increase in lubricity is limited for BioDiesel blends greater than B20.

DX,FUEL5 -19-07FEB14-1/1

Handling and Storing Diesel Fuel

CAUTION: Reduce the risk of fire. Handle fuel carefully. DO NOT fill the fuel tank when engine is running. DO NOT smoke while you fill the fuel tank or service the fuel system.

Fill the fuel tank at the end of each day's operation to prevent water condensation and freezing during cold weather.

Keep all storage tanks as full as practicable to minimize condensation.

Ensure that all fuel tank caps and covers are installed properly to prevent moisture from entering. Monitor water content of the fuel regularly.

When using BioDiesel fuel, the fuel filter may require more frequent replacement due to premature plugging.

Check engine oil level daily prior to starting engine. A rising oil level may indicate fuel dilution of the engine oil.

IMPORTANT: The fuel tank is vented through the filler cap. If a new filler cap is required, always replace it with an original vented cap.

When fuel is stored for an extended period or if there is a slow turnover of fuel, add a fuel conditioner to stabilize the fuel and prevent water condensation. Contact your fuel supplier or John Deere dealer for recommendations.

DX,FUEL4 -19-15FEB13-1/1

BioDiesel Fuel

BioDiesel fuel is comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats. BioDiesel blends are BioDiesel mixed with petroleum diesel fuel on a volume basis.

Before using fuel containing BioDiesel, review the BioDiesel Use Requirements and Recommendations in this Operator's Manual.

Environmental laws and regulations can encourage or prohibit the use of biofuels. Operators should consult with appropriate governmental authorities prior to using biofuels.

All John Deere Engines with Exhaust Filter (Released 2011 and After)

While 5% blends (B5) are preferred, BioDiesel concentrations up to a 20% blend (B20) in petroleum diesel fuel can be used. BioDiesel blends up to B20 can be used ONLY if the BioDiesel (100% BioDiesel or B100) meets ASTM D6751, EN 14214, or equivalent specification. Expect a 2% reduction in power and a 3% reduction in fuel economy when using B20.

BioDiesel concentrations above B20 can harm the engine's emission control systems and should not be used. Risks include, but are not limited to, more frequent stationary regeneration, soot accumulation, and increased intervals for ash removal.

John Deere approved fuel conditioners, which contain detergent and dispersant additives, are required when using BioDiesel blends from B10—B20, and are recommended when using lower BioDiesel blends.

All John Deere Engines Excluding Exhaust Filter (Primarily Released Prior to 2012)

While 5% blends (B5) are preferred, BioDiesel concentrations up to a 20% blend (B20) in petroleum diesel fuel can be used. BioDiesel blends up to B20 can be used ONLY if the BioDiesel (100% BioDiesel or B100) meets ASTM D6751, EN 14214, or equivalent specification. Expect a 2% reduction in power and a 3% reduction in fuel economy when using B20.

These John Deere engines can operate on BioDiesel blends above B20 (up to 100% BioDiesel). Operate at levels above B20 ONLY if the BioDiesel is permitted by law and meets the EN 14214 specification (primarily available in Europe). Engines operating on BioDiesel blends above B20 might not fully comply with or be permitted by all applicable emissions regulations. Expect up to a 12% reduction in power and an 18% reduction in fuel economy when using 100% BioDiesel.

John Deere approved fuel conditioners, which contain detergent and dispersant additives, are required when using BioDiesel blends from B10—B20, and are recommended when using lower BioDiesel blends.

BioDiesel Use Requirements and Recommendations

The petroleum diesel portion of all BioDiesel blends must meet the requirements of ASTM D975 (US) or EN 590 (EU) commercial standard.

BioDiesel users in the U.S. are strongly encouraged to purchase BioDiesel blends from a BQ-9000 Certified Marketer and sourced from a BQ-9000 Accredited Producer (as certified by the National BioDiesel Board). Certified Marketers and Accredited Producers can be found at the following website: http://www.bq9000.org.

BioDiesel contains residual ash. Ash levels exceeding the maximums allowed in either ASTM D6751 or EN14214 can result in more rapid ash loading and require more frequent cleaning of the Exhaust Filter (if present).

The fuel filter can require more frequent replacement, when using BioDiesel fuel, particularly if switching from diesel. Check engine oil level daily prior to starting engine. A rising oil level can indicate fuel dilution of the engine oil. BioDiesel blends up to B20 must be used within 90 days of the date of BioDiesel manufacture. BioDiesel blends above B20 must be used within 45 days from the date of BioDiesel manufacture.

When using BioDiesel blends up to B20, the following must be considered:

- Cold-weather flow degradation
- Stability and storage issues (moisture absorption, microbial growth)
- Possible filter restriction and plugging (usually a problem when first switching to BioDiesel on used engines)
- Possible fuel leakage through seals and hoses (primarily an issue with older engines)
- Possible reduction of service life of engine components

Request a certificate of analysis from your fuel distributor to ensure that the fuel is compliant with the specifications provided in this Operator's Manual.

Consult your John Deere dealer for approved fuel conditioners to improve storage and performance with BioDiesel fuels.

The following must also be considered if using BioDiesel blends above B20:

- Possible coking or blocked injector nozzles, resulting in power loss and engine misfire if John Deere approved fuel conditioners are not used
- Possible crankcase oil dilution (requiring more frequent oil changes)
- Possible lacquering or seizure of internal components
- Possible formation of sludge and sediments
- Possible thermal oxidation of fuel at elevated temperatures
- Possible compatibility issues with other materials (including copper, lead, zinc, tin, brass, and bronze) used in fuel handling equipment

Continued on next page

DX,FUEL7 -19-15MAY13-1/2

- Possible reduction in water separator efficiency
- Possible damage to paint if exposed to BioDiesel
- Possible corrosion of fuel injection equipment
- Possible elastomeric seal and gasket material degradation (primarily an issue with older engines)
- Possible high acid levels within fuel system
- Because BioDiesel blends above B20 contain more ash, using blends above B20 can result in more rapid ash loading and require more frequent cleaning of the Exhaust Filter (if present)

IMPORTANT: Raw pressed vegetable oils are NOT acceptable for use as fuel in any concentration in John Deere engines. Their use could cause engine failure.

DX,FUEL7 -19-15MAY13-2/2

Testing Diesel Fuel

A fuel analysis program can help to monitor the quality of diesel fuel. The fuel analysis can provide critical data such as cetane number, fuel type, sulfur content, water content, appearance, suitability for cold weather operations, bacteria, cloud point, acid number, particulate contamination, and whether the fuel meets specification.

Contact your John Deere dealer for more information on diesel fuel analysis.

DX,FUEL6 -19-14APR11-1/1

Fuel Filters

The importance of fuel filtration cannot be overemphasized with modern fuel systems. The combination of increasingly restrictive emission regulations and more efficient engines requires fuel system to operate at much higher pressures. Higher pressures can only be achieved using fuel injection components with very close tolerances. These close manufacturing tolerances have significantly reduced capacities for debris and water.

John Deere brand fuel filters have been designed and produced specifically for John Deere engines.

To protect the engine from debris and water, always change engine fuel filters as specified in this manual.

DX,FILT2 -19-14APR11-1/1

Minimizing the Effect of Cold Weather on Diesel Engines

John Deere diesel engines are designed to operate effectively in cold weather.

However, for effective starting and cold-weather operation, a little extra care is necessary. The following information outlines steps that can minimize the effect that cold weather may have on starting and operation of your engine. See your John Deere dealer for additional information and local availability of cold-weather aids.

Use Winter Grade Fuel

When temperatures fall below 0 °C (32 °F), winter grade fuel (No. 1-D in North America) is best suited for cold-weather operation. Winter grade fuel has a lower cloud point and a lower pour point.

Cloud point is the temperature at which wax begins to form in the fuel. This wax causes fuel filters to plug. **Pour point** is the lowest temperature at which movement of the fuel is observed.

NOTE: On average, winter grade diesel fuel has a lower Btu (heat content) rating. Using winter grade fuel may reduce power and fuel efficiency, but should not cause any other engine performance effects. Check the grade of fuel being used before troubleshooting for low-power complaints in cold-weather operation.

Air Intake Heater

An air intake heater is an available option for some engines to aid cold weather starting.

Ether

An ether port on the intake is available to aid cold weather starting.

CAUTION: Ether is highly flammable. Do not use ether when starting an engine equipped with glow plugs or an air intake heater.

Coolant Heater

An engine block heater (coolant heater) is an available option to aid cold weather starting.

Seasonal Viscosity Oil and Proper Coolant Concentration

Use seasonal grade viscosity engine oil based on the expected air temperature range between oil changes and a proper concentration of low silicate antifreeze as recommended. (See DIESEL ENGINE OIL and ENGINE COOLANT requirements in this section.)

Diesel Fuel Flow Additive

Use John Deere Fuel-Protect Diesel Fuel Conditioner (winter formula), which contains anti-gel chemistry, or equivalent fuel conditioner to treat non-winter grade fuel (No. 2-D in North America) during the cold-weather season. This generally extends operability to about 10 °C (18 °F) below the fuel cloud point. For operability at even lower temperatures, use winter grade fuel.

IMPORTANT: Treat fuel when outside temperature drops below 0 °C (32 °F). For best results, use with untreated fuel. Follow all recommended instructions on label.

BioDiesel

When operating with BioDiesel blends, wax formation can occur at warmer temperatures. Begin using John Deere Fuel-Protect Diesel Fuel Conditioner (winter formula) at 5 °C (41 °F) to treat BioDiesel fuels during the cold-weather season. Use B5 or lower blends at temperatures below 0 °C (32 °F). Use only winter grade petroleum diesel fuel at temperatures below -10 °C (14 °F).

Winterfronts

Use of fabric, cardboard, or solid winterfronts is not recommended with any John Deere engine. Their use can result in excessive engine coolant, oil, and charge air temperatures. This can lead to reduced engine life, loss of power and poor fuel economy. Winterfronts may also put abnormal stress on fan and fan drive components potentially causing premature failures.

If winterfronts are used, they should never totally close off the grill frontal area. Approximately 25% area in the center of the grill should remain open at all times. At no time should the air blockage device be applied directly to the radiator core.

Radiator Shutters

If equipped with a thermostatically controlled radiator shutter system, this system should be regulated in such a way that the shutters are completely open by the time the coolant reaches 93 °C (200 °F) to prevent excessive intake manifold temperatures. Manually controlled systems are not recommended.

If air-to-air aftercooling is used, the shutters must be completely open by the time the intake manifold air temperature reaches the maximum allowable temperature out of the charge air cooler.

For more information, see your John Deere dealer.

DX,FUEL10 -19-15MAY13-1/1

John Deere Break-In Plus™ Engine Oil — Interim Tier 4, Final Tier 4, Stage IIIB, and Stage IV

New engines are filled at the factory with John Deere Break-In Plus™ Engine Oil. During the break-in period, add John Deere Break-In Plus™ Engine Oil, as needed to maintain the specified oil level.

Operate the engine under various conditions, particularly heavy loads with minimal idling, to help seat engine components properly.

During the initial operation of a new or rebuilt engine, change the oil and filter between a minimum of 100 hours and maximum equal to the interval specified for John Deere Plus-50™ II oil.

After engine overhaul, fill the engine with John Deere Break-In Plus™ Engine Oil.

If John Deere Break-In Plus™ Engine Oil is not available, use an SAE 10W-30 viscosity grade diesel engine oil meeting one of the following:

- API Service Category CJ-4
- ACEA Oil Sequence E9
- ACEA Oil Sequence E6

If one of these oils is used during the initial operation of a new or rebuilt engine, change the oil and filter between a minimum of 100 hours and a maximum of 250 hours.

IMPORTANT: Do not use any other engine oils during the initial break-in of a new or rebuilt engine.

John Deere Break-In Plus™ Engine Oil can be used for all John Deere diesel engines at all emission certification levels.

After the break-in period, use John Deere Plus-50™ II or other diesel engine oil as recommended in this manual.

Break-In Plus is a trademark of Deere & Company
Plus-50 is a trademark of Deere & Company.

DX,ENOIL16 -19-15JUN10-1/1

Diesel Engine Oil — Interim Tier 4, Final Tier 4, Stage IIIB, and Stage IV

Use oil viscosity based on the expected air temperature range during the period between oil changes.

John Deere Plus-50™ II is the recommended engine oil.

Extended service intervals may apply when John Deere Plus-50™ II engine oil is used. Refer to the engine oil drain interval table and consult your John Deere dealer for more information.

If John Deere Plus-50™ II engine oil is not available, engine oil meeting one or more of the following may be used:

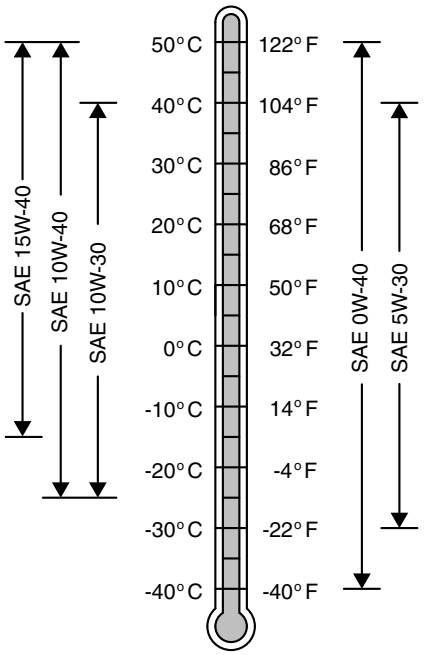
- API Service Category CJ-4
- ACEA Oil Sequence E9
- ACEA Oil Sequence E6

DO NOT use engine oil containing more than 1.0% sulfated ash, 0.12% phosphorus, or 0.4% sulfur.

Multi-viscosity diesel engine oils are preferred.

Diesel fuel quality and fuel sulfur content must comply with all existing emissions regulations for the area in which the engine operates.

IMPORTANT: Use only ultra low sulfur diesel (ULSD) fuel with a maximum sulfur content of 15 mg/kg (15 ppm).



Oil Viscosities for Air Temperature Ranges

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DX,ENOIL14 -19-15JUN10-1/1

Engine Oil and Filter Service Intervals — Interim Tier 4, Final Tier 4, Stage IIIB, and Stage IV — OEM Applications

Recommended oil and filter service intervals are based on a combination of oil pan capacity, type of engine oil and filter used, and sulfur content of the diesel fuel. Actual service intervals also depend on operation and maintenance practices.

Use oil analysis to evaluate the condition of the oil and to aid in selection of the proper oil and filter service interval. Contact your John Deere dealer for more information on engine oil analysis.

Change the oil and oil filter at least once every 12 months even if the hours of operation are fewer than the otherwise recommended service interval.

Diesel fuel sulfur content affects engine oil and filter service intervals. Higher fuel sulfur levels reduce oil and filter service intervals.

Use of diesel fuel with sulfur content less than 15 mg/kg (15 ppm) is REQUIRED.

IMPORTANT: To avoid engine damage:

- **Reduce oil and filter service intervals by 50% when using BioDiesel blends greater than B20. Oil analysis may allow longer service interval.**
- **Use only approved oil types.**

Plus-50 is a trademark of Deere & Company

Approved Oil Types

- John Deere Plus-50™ II
- “Other Oils” include API CJ-4, ACEA E9, and ACEA E6.

NOTE: The 500 hour extended oil and filter change interval is only allowed if all of the following conditions are met:

- *Engine equipped with an extended drain interval oil pan*
- *Use of diesel fuel with sulfur content less than 15 mg/kg (15 ppm)*
- *Use of John Deere Plus-50™ II oil*
- *Use of an approved John Deere oil filter*

Engine Oil and Filter Service Intervals		
	Oil Pan Size (L/kW)	
	Greater than or equal to 0.10	Greater than or equal to 0.12
John Deere Plus-50™ II	375 hours	500 hours
Other Oils	250 hours	250 hours
Oil analysis may extend the service interval of “Other Oils” to a maximum not to exceed the interval of Plus-50™ II oils.		

DX,ENOIL15,IT4,OEM -19-07FEB14-1/1

Diesel Engine Oil and Filter Service Intervals

The oil and filter service intervals in the following table should be used as guidelines. Actual service intervals also depend on operation and maintenance practices. It is suggested to use oil analysis to determine the actual useful life of the oil and to aid in selection of the proper oil and filter service interval. Change the oil and filter at least once every 12 months even if the hours of operation are fewer than the otherwise recommended service interval. Oil and filter service intervals are based on a combination of oil pan capacity and the type of engine oil and filter used.

Diesel fuel sulfur level will affect engine oil and filter service intervals.

Use of diesel fuel with sulfur content less than 0.0015% (or 15 ppm) (or 15 mg/kg) maximum limit is required.

IMPORTANT: To avoid engine damage:

- **Reduce oil and filter service intervals by 50% when using biodiesel blends greater than B20. Oil analysis may allow longer service intervals.**
- **Use only approved oil types.**

Approved Oil Types

- John Deere Plus-50™ II
- "Other Oils" include oils meeting API CJ-4, ACEA E9, or ACEA E6.

Use of other specification oils in Final Tier 4/Stage IV engines can result in premature failure.

NOTE: The 500 hour extended oil and filter change interval is only allowed if all the following conditions are met:

- *Engine equipped with an extended drain interval oil pan*
- *Use of diesel fuel with sulfur content less than 0.0015% (15 ppm) (15 mg/kg) maximum limit*
- *Use of John Deere Plus-50™ II oil*
- *Use of an approved John Deere oil filter*

		Oil Pan Option Codes							
Power Rating	Fuel Sulfur Content	1903 19BB		19AE 19BC		1923 19BA		1976 19AZ 19GK	
kW (hp)		Other Oils	John Deere Plus-50 II	Other Oils	John Deere Plus-50 II	Other Oils	John Deere Plus-50 II	Other Oils	John Deere Plus-50 II
63 (85)	≤15 ppm	250 hours	500 hours	250 hours	500 hours	250 hours	500 hours	250 hours	500 hours
74 (100)	≤15 ppm	250 hours	500 hours	250 hours	500 hours	250 hours	500 hours	250 hours	500 hours
86 (115)	≤15 ppm	250 hours	500 hours	250 hours	500 hours	250 hours	500 hours	250 hours	500 hours
93 (125)	≤15 ppm	250 hours	500 hours	250 hours	500 hours	250 hours	500 hours	250 hours	500 hours
100 (135)	≤15 ppm	250 hours	500 hours	250 hours	500 hours	250 hours	500 hours	250 hours	500 hours
104 (140)	≤15 ppm	250 hours	500 hours	250 hours	500 hours	250 hours	500 hours	250 hours	500 hours
129 (173)	≤15 ppm	250 hours	500 hours	250 hours	500 hours	250 hours	500 hours	250 hours	500 hours

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ZE59858,0000008 -19-05MAR14-1/1

Mixing of Lubricants

In general, avoid mixing different brands or types of oil. Oil manufacturers blend additives in their oils to meet certain specifications and performance requirements.

Mixing different oils can interfere with the proper functioning of these additives and degrade lubricant performance.

Consult your John Deere dealer to obtain specific information and recommendations.

DX,LUBMIX -19-18MAR96-1/1

Alternative and Synthetic Lubricants

Conditions in certain geographical areas may require lubricant recommendations different from those printed in this manual.

Some John Deere brand coolants and lubricants may not be available in your location.

Consult your John Deere dealer to obtain information and recommendations.

Synthetic lubricants may be used if they meet the performance requirements as shown in this manual.

The temperature limits and service intervals shown in this manual apply to both conventional and synthetic lubricants.

Re-refined base stock products may be used if the finished lubricant meets the performance requirements.

DX,ALTER -19-11APR11-1/1

Lubricant Storage

Your equipment can operate at top efficiency only when clean lubricants are used.

Use clean containers to handle all lubricants.

Store lubricants and containers in an area protected from dust, moisture, and other contamination. Store containers on their side to avoid water and dirt accumulation.

Make certain that all containers are properly marked to identify their contents.

Properly dispose of all old containers and any residual lubricant they may contain.

DX,LUBST -19-11APR11-1/1

Oil Filters

Filtration of oils is critically important for proper operation and lubrication. John Deere brand oil filters have been designed and produced specifically for John Deere applications.

John Deere filters adhere to engineering specifications for quality of the filter media, filter efficiency rating, strength of the bond between the filter media and the element end cap, fatigue life of the canister (if applicable), and pressure capability of the filter seal. Non-John Deere branded oil filters might not meet these key John Deere specifications.

Always change oil filters regularly as specified in this manual.

DX,FILT1 -19-11APR11-1/1

Diesel Engine Coolant (engine with wet sleeve cylinder liners)

Preferred Coolants

The following pre-mix engine coolants are preferred:

- **John Deere COOL-GARD™II**
- **John Deere COOL-GARD II PG**

COOL-GARD II pre-mix coolant is available in several concentrations with different freeze protection limits as shown in the following table.

COOL-GARD II pre-mix	Freeze Protection Limit
COOL-GARD II 20/80	-9 °C (16 °F)
COOL-GARD II 30/70	-16 °C (3 °F)
COOL-GARD II 50/50	-37 °C (-34 °F)
COOL-GARD II 55/45	-45 °C (-49 °F)
COOL-GARD II PG 60/40	-49 °C (-56 °F)
COOL-GARD II 60/40	-52 °C (-62 °F)

Not all COOL-GARD II pre-mix products are available in all countries.

Use COOL-GARD II PG when a non-toxic coolant formulation is required.

Additional Recommended Coolants

The following engine coolant is also recommended:

- John Deere COOL-GARD II Concentrate in a 40—60% mixture of concentrate with quality water.

IMPORTANT: When mixing coolant concentrate with water, do not use less than 40% or greater than 60% concentration of coolant. Less than 40% gives inadequate additives for corrosion protection. Greater than 60% can result in coolant gelation and cooling system problems.

Other Coolants

Other ethylene glycol or propylene glycol base coolants may be used if they meet the following specification:

- Pre-mix coolant meeting ASTM D6210 requirements
- Coolant concentrate meeting ASTM D6210 requirements in a 40—60% mixture of concentrate with quality water

If coolant meeting one of these specifications is unavailable, use a coolant concentrate or pre-mix coolant that has a minimum of the following chemical and physical properties:

- Provides cylinder liner cavitation protection according to either the John Deere Cavitation Test Method or a fleet study run at or above 60% load capacity
- Is formulated with a nitrite-free additive package
- Protects the cooling system metals (cast iron, aluminum alloys, and copper alloys such as brass) from corrosion

Water Quality

Water quality is important to the performance of the cooling system. Distilled, deionized, or demineralized water is recommended for mixing with ethylene glycol and propylene glycol base engine coolant concentrate.

Coolant Drain Intervals

Drain and flush the cooling system and refill with fresh coolant at the indicated interval, which varies with the coolant used.

When COOL-GARD II or COOL-GARD II PG is used, the drain interval is 6 years or 6000 hours of operation.

If a coolant other than COOL-GARD II or COOL-GARD II PG is used, reduce the drain interval to 2 years or 2000 hours of operation.

IMPORTANT: Do not use cooling system sealing additives or antifreeze that contains sealing additives.

Do not mix ethylene glycol and propylene glycol base coolants.

Do not use coolants that contain nitrites.

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DX,COOL3 -19-15MAY13-1/1

Water Quality for Mixing with Coolant Concentrate

Engine coolants are a combination of three chemical components: ethylene glycol (EG) or propylene glycol (PG) antifreeze, inhibiting coolant additives, and quality water.

Water quality is important to the performance of the cooling system. Distilled, deionized, or demineralized water is recommended for mixing with ethylene glycol and propylene glycol base engine coolant concentrate.

All water used in the cooling system should meet the following minimum specifications for quality:

Chlorides	<40 mg/L
Sulfates	<100 mg/L
Total solids	<340 mg/L
Total dissolved I hardness	<170 mg/L
pH	5.5—9.0

IMPORTANT: Do not use bottled drinking water because it often contains higher concentrations of total dissolved solids.

Freeze Protection

The relative concentrations of glycol and water in the engine coolant determine its freeze protection limit.

Ethylene Glycol	Freeze Protection Limit
40%	-24 °C (-12 °F)
50%	-37 °C (-34 °F)
60%	-52 °C (-62 °F)
Propylene Glycol	**Freeze Protection Limit**
40%	-21 °C (-6 °F)
50%	-33 °C (-27 °F)
60%	-49 °C (-56 °F)

DO NOT use a coolant-water mixture greater than 60% ethylene glycol or 60% propylene glycol.

DX,COOL19 -19-15MAY13-1/1

Operating in Warm Temperature Climates

John Deere engines are designed to operate using recommended engine coolants.

Always use a recommended engine coolant, even when operating in geographical areas where freeze protection is not required.

IMPORTANT: Water may be used as coolant *in emergency situations only.*

Foaming, hot surface aluminum and iron corrosion, scaling, and cavitation occur when water is used as the coolant, even when coolant conditioners are added.

Drain cooling system and refill with recommended engine coolant as soon as possible.

DX,COOL6 -19-15MAY13-1/1

Testing Coolant Freeze Point

The use of a handheld coolant refractometer is the quickest, easiest, and most accurate method to determine coolant freeze point. This method is more accurate than a test strip or a float-type hydrometer which can produce poor results.

A coolant refractometer is available through your John Deere dealer under the SERVICEGARD™ tool program. Part number 75240 provides an economical solution to accurate freeze point determination in the field.

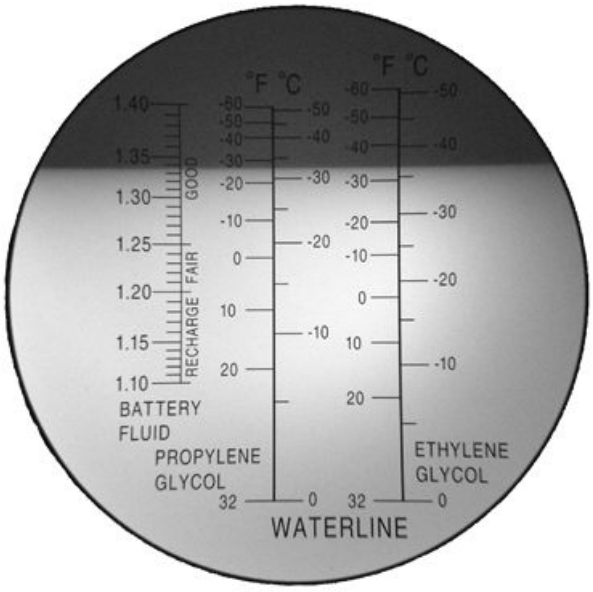
To use this tool:

1. Allow cooling system to cool to ambient temperatures.
2. Open radiator cap to expose coolant.
3. With the included dropper, collect a small coolant sample.
4. Open the lid of the refractometer, place one drop of coolant on the window and close the lid.
5. Look through the eyepiece and focus as necessary.
6. Record the listed freeze point for the type of coolant (ethylene glycol coolant or propylene glycol) being tested.



TS1732 —UN—04SEP13

SERVICEGARD™ Part Number 75240



TS1733 —UN—04SEP13

Image with a Drop of 50/50 Coolant Placed on the Refractometer Window

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DX,COOL,TEST -19-13JUN13-1/1

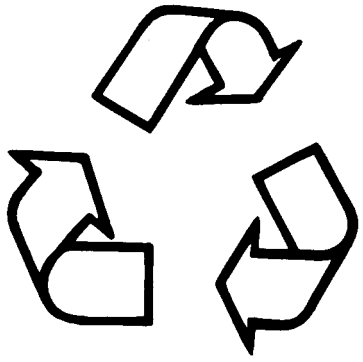
Disposing of Coolant

Improperly disposing of engine coolant can threaten the environment and ecology.

Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain, or into any water source.

Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere engine distributor or servicing dealer.



TS1133 —UN—15APR13

Recycle Waste

RG,RG34710,7543 -19-09JAN07-1/1

Instrument Panel

John Deere PowerTech™ OEM engines have an electronic control system, which has controls and gauges as shown. The following information applies only to those controls and gauges supplied by John Deere. Refer to your engine application manual for specific guidelines if John Deere-sourced controls and instrumentation are not used.

The following is a brief description of the available optional electronic controls and gauges found on John Deere provided instrument panels. Refer to manufacturer's literature for information on controls not provided by John Deere.

Instrument Panel

A — Diagnostic Gauge

The diagnostic gauge (A) allows the operator to view fuel level, DEF level, engine parameters, diagnostic trouble codes (DTCs), and other engine functions. The gauge is linked to the electronic control system and its sensors. This allows the operator to monitor engine functions and to troubleshoot the engine systems when needed.

B — Arrow Keys

The arrow keys (B) allows the operator to select menu items

C — Menu Key

The menu key (C) allow the operator to access the main menu of the diagnostic gauge.

D — Select Key

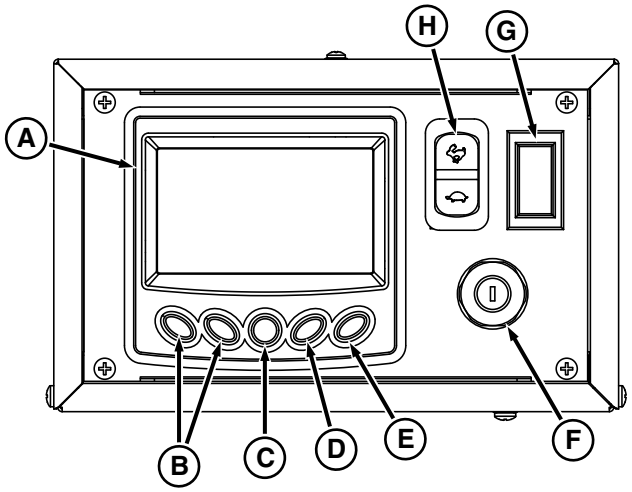
The select key (D) allows the operator to access menu items selected by the arrow keys (B) and confirm changes made by the operator.

E — Exit Key

The exit key (E) allows the operator to cancel an option and to go back to the previous menu.

F — Key Start Switch

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RG23644 —UN—27AUG13

Instrument Panel

A—Diagnostic Gauge
B—Arrow Keys
C—Menu Key
D—Select Key
E—Exit Key
F—Key Switch
G—Cover
H—Speed Select Rocker Switch

The three-position key start switch (F) controls the engine electrical system. When the key switch is turned clockwise to "START", the engine will crank. When the engine starts, the key is released and returns to the "ON" (RUN) position.

G — Cover

The cover (G) hides an expansion slot for an additional switch.

H — Speed Select Rocker Switch

The speed select switch (H) is used to bump engine speed up (+) or down (-) in small increments during operation.

BL90236,0000003 -19-19MAR14-1/1

Diagnostic Gauge — Using

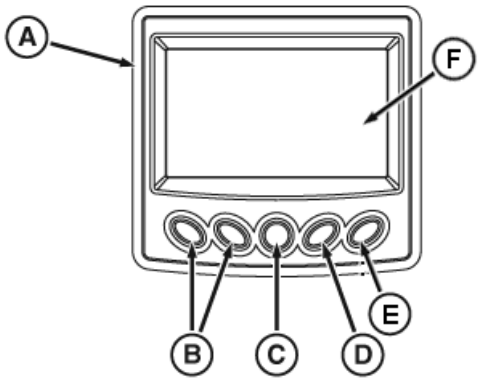
The diagnostic gauge (A) allows the operator to monitor engine functions, view diagnostic trouble codes (DTC's), and perform preliminary diagnostics. The gauge is linked to the electronic control system and sensors.

The arrow keys (B) allows the operator to scroll between menu items. The arrow keys automatically change from up and down, to left and right depending on the menu item to be selected.

The menu key (C) allows the operator to access the main menu of the diagnostic gauge. For more information see Diagnostic Gauge — Main Menu.

The select key (D) allows the operator to access menu items selected by the arrow keys (B) and confirm changes made by the operator.

The exit key (E) allows the operator to cancel an option and to go back to the previous menu.



RG23474 —UN—06JUN13

Diagnostic Gauge

A—Diagnostic Gauge
B—Arrow Keys
C—Menu Key
D—Select Key
E—Exit Key
F—Display

BL90236,0000006 -19-29JUL13-1/1

Diagnostic Gauge — Main Menu

NOTE: The engine does not need to be running to navigate the diagnostic gauge screens. If engine start up is desired, see Starting the Engine in the Engine Operation Section.

The main menu is the starting point in accessing engine information and configuring the diagnostic gauge. Press the menu key (C) to access the main menu.

Use the arrow keys (B) and select key (D) to view menu items displayed:
- User Settings
- Faults
- Exhaust Filter
- Start Options
- Service
- Utilities

Listed are examples of feature available in main menu items.

In User Settings:

- Date
- Time
- Language
- Units
- Brightness
- Ambient Light

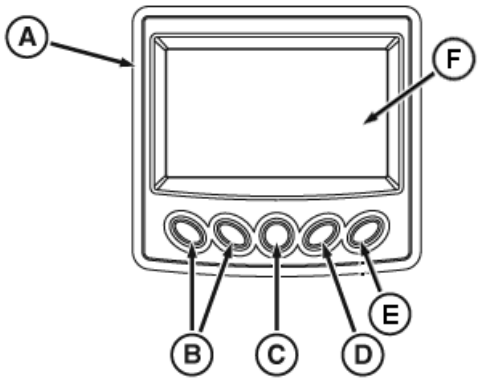
In Check Faults:

- Active fault codes
- Stored fault codes

In Exhaust Filter:

- Status
- Auto exhaust filter clean
- Disable exhaust filter clean
- Request exhaust filter clean

In Start Options:



RG23474 —UN—06JUN13

Diagnostic Gauge

A—Diagnostic Gauge
B—Arrow Keys
C—Menu Key
D—Select Key
E—Exit Key
F—Display

- Auto features
- Manual features
- Clock start
- Temperature start

In Service:

- Data list screens
- Engine hours
- Data logger
- Service reminders
- Harness diagnostics
- Component identification
- Emission system override (if equipped)

In Utilities:

- System settings
- Pressure governing
- ECU software update
- Advanced settings (password protected)

BL90236,0000001 -19-08JUL13-1/1

John Deere PowerSight

John Deere PowerSight is a web based service that allows remote access to machine data. John Deere PowerSight is accessible from a laptop, desktop or mobile device.

John Deere PowerSight works by combining a controller that includes cellular communication and GPS antennas. Machine data is collected by the controller and wirelessly transferred to a data server, where it is made available on a website.

John Deere PowerSight allows you to:

- Stay informed on machine location and hours
- Protect assets with Geofence and Curfew alerts
- Keep assets running with maintenance tracking and preventive maintenance plans
- Track and analyze machine and fuel usage
- Conduct remote machine diagnostics and programming

For more information and availability, contact an authorized John Deere dealer or servicing dealer.

BL90236,0000031 -19-13FEB14-1/1

Break-In Service

Extra care during the first 100 hours of operation results in satisfactory long-term engine performance and life. DO NOT exceed 100 hours of operation with break-in oil.

1. This engine is factory-filled with John Deere Break-In Plus™ oil. Operate the engine at heavy loads with minimal idling during the break-in period.
2. If the engine has significant operating time at idle, constant speeds, and/or light load usage, or additional oil is required in the first 100 hour period, a longer break-in period may be required. In these situations, an additional 100 hour break-in period is recommended using a new change of John Deere Engine Break-In Plus Oil and a new John Deere oil filter.
3. Check oil more frequently during engine break-in period. If oil must be added during this period, John Deere Break-In Plus Oil is preferred. See John Deere Break-In Plus™ Engine Oil — Interim Tier 4, Final Tier 4, Stage IIIB, and Stage IV in the Fuels, Lubricants, and Coolants Section for other oils allowed.

IMPORTANT: DO NOT fill above the top of the crosshatch pattern or the FULL mark, whichever is present. Oil levels anywhere within crosshatch are considered in the acceptable operating range. John Deere Break-In Plus engine oil should be used to make up any oil consumed during the break-in period.

4. During the first 20 hours, avoid prolonged periods of engine idling. If engine idles longer than 5 minutes, stop engine.
5. During the initial operation of a new or rebuilt engine with Break-In Plus, change the oil and filter between a minimum of 100 hours and a maximum of up to 500 hours (B). (Top-load oil filter illustrated.) (See Changing Engine Oil and Replacing Filter in the Lubrication & Maintenance — 500 Hours/12 Months Section.) Fill crankcase with seasonal viscosity grade oil. (See Diesel Engine Oil — Interim Tier 4, Final Tier 4, Stage IIIB, and Stage IV in the Fuels, Lubricants, and Coolants Section.)

NOTE: Some increase in oil consumption may be expected when low viscosity oils are used. Check oil levels more frequently.

If temperature is below 0 °C (32 °F), it may be necessary to use cold weather starting aids (See Cold Weather Operation in the Engine Operation Section).

If air temperature is below 0 °C (32 °F), use an engine block heater.

6. Watch coolant temperature gauge closely during engine operation. If coolant temperature rises above 113 °C (235 °F), the engine reduces power automatically. Unless temperature drops quickly, stop the engine and determine the cause before resuming operation.

   Monitor oil pressure and coolant temperature to ensure that they are within specification.

Specification	
Engine —Oil Pressure at Full Load Rated Speed	370 kPa (3.70 bar) (54 psi)
Minimum Oil Pressure at Low Idle	150 kPa (1.50 bar) (22 psi)
Coolant Temperature Range	85°–97 °C (185°–207 °F)

7. Check belt for proper seating in pulley grooves.

Break-In Plus is a trademark of Deere & Company

AT89373,0000002 -19-18AUG14-1/1

Generator Set (Standby) Applications

To assure that your engine will deliver efficient standby generator operation when needed, start engine and run at rated speed (with 50%—70% load) for 30 minutes every 2 weeks. DO NOT allow engine to run for an extended period of time with no load.

Biodiesel fuel is not recommended for standby equipment that can have minimal fuel consumption (such as standby generators, fire protection, etc.). For standby applications, use only petroleum based diesel fuel with John Deere approved fuel conditioners and additives. For fuel conditioners and additives, check with your local John Deere dealer.

Petroleum diesel fuel should not be stored in service tanks longer than two years even when using fuel additives. See your fuel distributor or John Deere dealer for more information.

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Starting the Engine

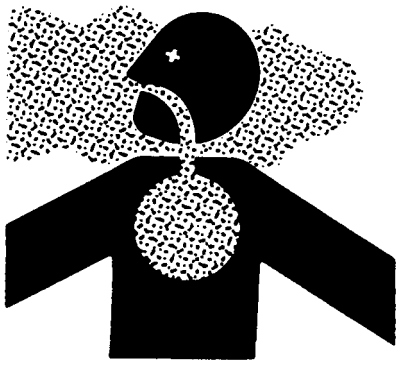
NOTE: The controls and instruments for your engine may be different from those shown here; always follow manufacturer's instructions.

The following instructions apply to the optional controls and instruments available through the John Deere Parts Distribution Network.

⚠ CAUTION: Before starting engine in a confined building, install proper outlet exhaust ventilation equipment. Always use safety approved fuel storage and piping.

NOTE: If temperature is below 0 °C (32 °F), it may be necessary to use cold weather starting aids. See Cold Weather Operation in the Engine Operation Section.

1. Perform all prestarting checks outlined in Lubrication & Maintenance/Daily Section later in this manual.



TS220 —UN—15APR13

Use Proper Ventilation

2. Open the fuel supply shutoff valve, if equipped.
3. Disengage power (or clutch if equipped) to any engine drive lines.

RK80614,000000A -19-18AUG14-1/2

4. Set high-low speed select rocker switch (H) to slow (turtle), then push in on analog throttle handle or turn full counterclockwise to set analog throttle(s) to slow speed.

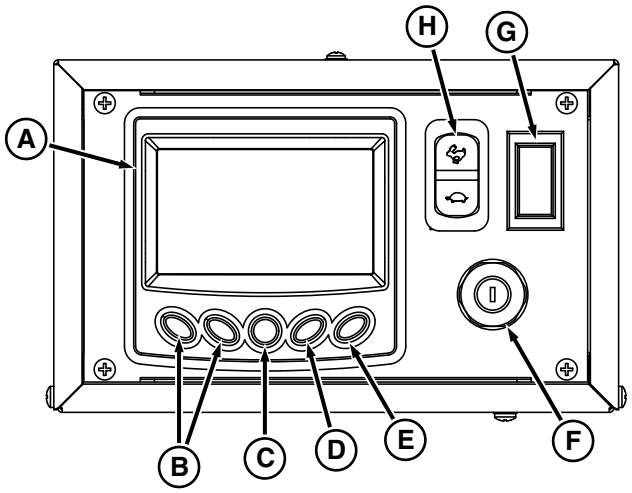
IMPORTANT: Do not operate the starter for more than 30 seconds at a time. To do so may overheat the starter. If the engine does not start the first time, wait at least 2 minutes before trying again. If engine does not start after four attempts, see Engine Troubleshooting in the Troubleshooting Section.

5. Turn the key start switch clockwise to the “ON” position. Wait until the Engine Preheater Indicator light turns off, then turn the key start switch (F) clockwise “START” position to crank the engine. In cold weather, preheater indicator light remains on longer while engine is warmed. See Cold Weather Operation in the Engine Operation Section. When the engine starts, release the key switch so that it returns to the “ON” position.

IMPORTANT: If the key switch is released before the engine starts, wait until the starter and the engine stop turning before trying again. This prevents possible damage to the starter and/or flywheel.

6. After engine starts, idle engine at not more than 1200 rpm until warm. See Warming Engine in the Engine Operation Section.

   Set either high-low speed select switch or analog throttle to slow speed, and set desired speed with remaining control. See Changing Engine Speed in the Engine Operation Section.



RG23644 —UN—27AUG13

A—Diagnostic Gauge
B—Arrow Keys
C—Menu Key
D—Select Key
E—Exit Key
F—Key Switch
G—Cover
H—Speed Select Rocker Switch

NOTE: Engine control unit (ECU) reads the higher of the high-low speed select rocker switch or the analog throttle speed settings.

7. Check all gauges for normal engine operation. If operation is not normal, stop the engine and determine the cause. For normal gauge pressures and temperatures, see Break-In Service in the Engine Operation Section.

RK80614,000000A -19-18AUG14-2/2

Normal Engine Operation

Observe engine coolant temperature and engine oil pressure. Temperatures and pressures will vary between engines and with changing operating conditions, temperatures, and loads.

Normal engine coolant operating temperature range is 85°–97 °C (185°–207 °F). If coolant temperature rises above 105 °C (221 °F), engine will reduce power automatically. Unless temperature drops quickly, stop engine and determine cause before resuming operation.

Operate the engine under a lighter load and at slower than normal speed for first 15 minutes after start-up. DO NOT run engine at slow idle.

Stop engine immediately if there are any signs of part failure. Symptoms that may be early signs of engine problems are:

- Sudden drop in oil pressure
- Abnormal coolant temperatures
- Unusual noise or vibration
- Sudden loss of power
- Excessive fuel consumption
- Excessive oil consumption
- Fluid leaks

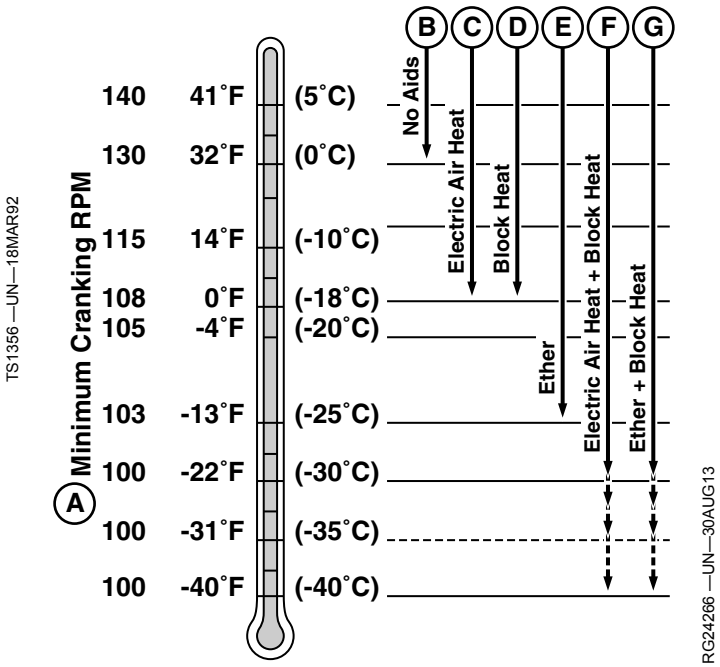
NOTE: A revving sound may be heard for an instant after starting, as the variable geometry turbocharger cycles; which is normal.

ZE59858,00000AC -19-31JUL13-1/1

Cold Weather Operation



Starting Fluid is Flammable



Cold Weather Starting Guidelines

A— Minimum Cranking RPM
B— No Aids
C— Electric Air Heat
D— Block Heat
E— Ether
F— Electric Air Heat and Block Heat
G— Ether and Block Heat

CAUTION: Ether is highly flammable. DO NOT use ether when starting an engine equipped with glow plugs or an air intake heater.

DO NOT use starting fluid near fire, sparks, or flames. DO NOT incinerate or puncture a starting fluid container.

IMPORTANT: Engines with Rear PTO -Turn off or unload all pumps, auxiliary drives, and compressors before cold weather starting to reduce drag on engine.

Engines may be equipped with a block heater, coolant heater, or fuel heater as cold weather starting aids.

Starting aids are required below 0 °C (32 °F). They will enhance starting performance above these temperatures and may be needed to start applications that have high parasitic loads during cranking and/or start acceleration to idle.

Using correct grade oil (per engine and machine operators manual) is critical to achieving adequate cold-weather cranking speed. Synthetic oils have improved flow at low temperatures

Other cold weather starting aids are required at temperatures below -25 °C (-13 °F) or at altitudes above 1500 m (5000 ft).

1. Follow steps 1—4 as listed under Starting the Engine in the Engine Operation Section, then proceed as follows according to the instrument (control) panel on your engine.

2. Use cold weather starting aids as needed. Follow supplier instructions for starting aid provided on your engine. A booster battery can be connected if needed (see Using a Booster Battery or Charger in the Engine Operation Section).

3. Engines with air intake heaters or glow plugs: Turn key ON but do not crank engine until Engine Preheat Indicator goes off.

4. Follow remaining steps 5—7 as listed under Starting the Engine in the Engine Operation Section.

Additional information on cold-weather operation is available from your authorized servicing dealer.

RK80614,000000C -19-25MAR14-1/1

Warming Engine

IMPORTANT: To assure proper lubrication, operate engine at or below 1200 rpm with no load for 1–2 minutes. Extend this period 2–4 minutes when operating at temperatures below freezing.

Engines used in generator set applications where the governor is locked at a specified speed may not have a slow idle function. Operate these engines at fast idle for 1—2 minutes before applying the load. This procedure does not apply to standby generator sets where the engine is loaded immediately upon reaching rated speed.

1. Check oil pressure gauge as soon as engine starts. If gauge needle does not rise above minimum oil pressure specification of 150 kPa (1.50 bar) (22 psi) within 5 seconds, stop the engine and determine the cause. Normal engine oil pressure is measured at rated full load speed (1800–2500 rpm) with oil at normal operating temperature of 97 °C (207 °F).

Specification

Oil Pressure—Oil Pressure at Full Load Rated Speed.....150—385 kPa (1.50—3.85 bar) (22—56 psi)

2. Watch coolant temperature gauge. Do not place engine under full load until it is properly warmed up. The normal engine coolant temperature range is 85°–97 °C (185°–207 °F).

NOTE: It is a good practice to operate the engine under a lighter load and at lower speeds than normal for the first few minutes after start-up.

ZE59858,00000AD -19-30JUL14-1/1

Idling Engine

Avoid excessive engine idling. Prolonged idling may cause the engine coolant temperature to fall below its normal range. This in turn, causes crankcase oil dilution, due to incomplete fuel combustion and permits formation of gummy deposits on valves, pistons and piston rings. It also promotes rapid accumulation of engine sludge and unburned fuel in the exhaust system.

Once an engine is warmed to normal operating temperatures, engine should be idled at slow idle speed.

Slow idle speed for this engine is set at the factory at 800 rpm for standard industrial engines and at 850 rpm for generator sets. If an engine will be idling for more than five minutes, stop and restart later.

NOTE: Generator set applications where the governor is locked at a specified speed may not have a slow idle function. These engines will idle at no load governed speed (high idle).

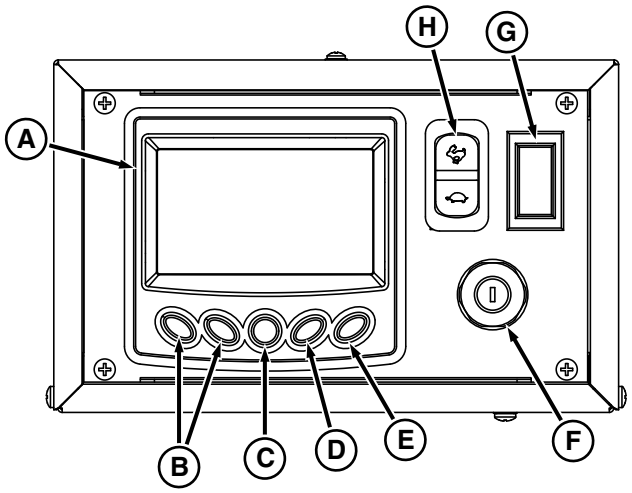
RK80614,000000E -19-11JUL13-1/1

Changing Engine Speed

NOTE: On engines with **2-position** *throttles, speeds are not adjustable. These throttles allows operation only at the preset rated speed or at idle using the single switch.*

- For slow speed, press lower half of switch (indicated by turtle symbol).
- For fast speed, press upper half of switch (indicated by rabbit symbol).
- Navigate the Diagnostic Gauge (A) to appropriate home screen. Adjust engine Set Speeds with (+) and (-) accordingly.

A—Diagnostic Gauge
B—Arrow Keys
C—Menu Key
D—Select Key
E—Exit Key
F—Key Switch
G—Cover
H—Speed Select Rocker Switch



RG23644 —UN—27AUG13

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Stopping the Engine

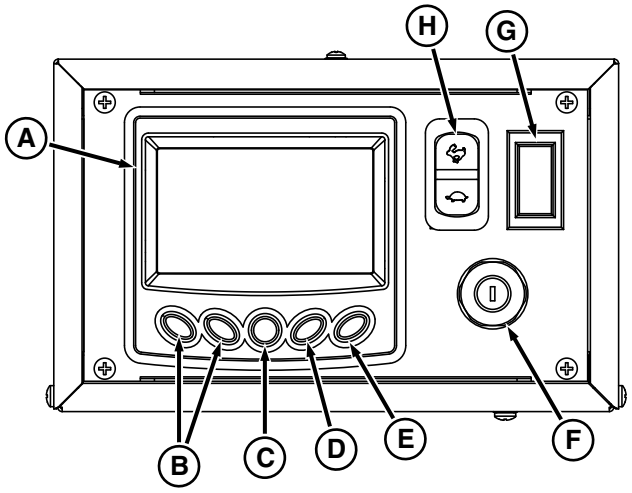
NOTE: Engines in generator set applications where the ECU is locked at a specified speed and no slow idle function is available, run engine for at least 2 minutes at fast idle and no load. If an Exhaust Filter Cleaning has just been performed, increase engine idle time to 4 minutes. If service work is going to be performed on the Exhaust Filter, increase engine idle time to 10 minutes

1. Run engine at 1000—1200 rpm for at least 2 minutes to cool. If an Exhaust Filter Cleaning has just been performed, increase engine idle time to 4 minutes. If service work is going to be performed on the Exhaust Filter, increase engine idle time to 10 minutes

   Set rpm using bump speed enable switch (H).

2. Turn key start switch (F) to “OFF” position to stop the engine. Remove ignition key.

IMPORTANT: Make sure that exhaust stack rain cap is installed when engine is not running. This will prevent water and dirt from entering engine.



RG23644 —UN—27AUG13

A—Diagnostic Gauge
B—Arrow Keys
C—Menu Key
D—Select Key
E—Exit Key
F—Key Switch
G—Cover
H—Speed Select Rocker Switch

ZE59858,00000AE -19-18AUG14-1/1

Using a Booster Battery or Charger

A 12 volt booster battery or charger can be connected in parallel with battery(ies) on the unit to aid in cold weather starting. ALWAYS use heavy-duty jumper cables.

CAUTION: Gas given off by battery is explosive. Keep sparks and flames away from battery. Before connecting or disconnecting a battery charger, turn off charger. Make last connection and first disconnection at a point away from battery. Always connect NEGATIVE (–) cable last and disconnect this cable first.

WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. **Wash hands after handling.**

IMPORTANT: Be sure that polarity is correct before making connections. Reversed polarity damages electrical system. Always connect positive to positive and negative to ground. Always use 12 volt booster battery for 12 volt electrical systems and 24 volt booster battery(ies) for 24 volt electrical systems.

1. Connect booster battery or batteries to produce the required system voltage for your engine application.

NOTE: To avoid sparks, DO NOT allow the free ends of jumper cables to touch the engine.



TS204 —UN—15APR13

Exploding Battery

2. Connect one end of jumper cable to the POSITIVE (+) post of the booster battery.
3. Connect the other end of the jumper cable to the POSITIVE (+) post of battery connected to starter.
4. Connect one end of the other jumper cable to the NEGATIVE (–) post of the booster battery.
5. ALWAYS complete the hookup by making the last connection of the NEGATIVE (–) cable to a good ground on the engine frame and away from the battery(ies).
6. Start the engine. Disconnect jumper cables immediately after engine starts. Always disconnect NEGATIVE (–) cable first.

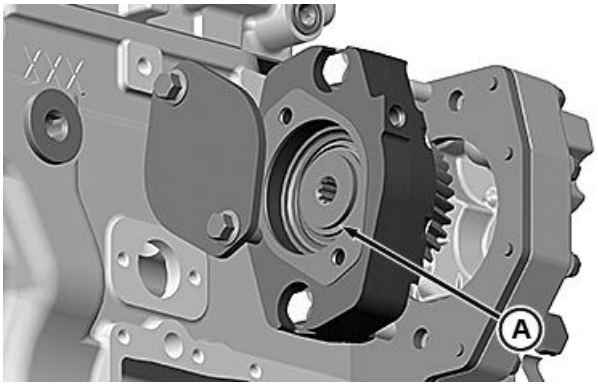
ZE59858,0000011 -19-18AUG14-1/1

Auxiliary Gear Drive Limitations

IMPORTANT: When attaching an air compressor, hydraulic pump, or other accessory to be driven by the auxiliary gear drive (engine timing gear train at front of engine), power requirements of the accessory must be limited to values listed below:

IMPORTANT: See OEM engine distributor for more information to prevent overloading the auxiliary drive. Severe engine damage could result.

SAE Drive	Continuous Power (Maximum)	Intermittent Power (Maximum)
A	30 kW (40 hp) at 2500 rpm	37 kW (50 hp) at 2500 rpm



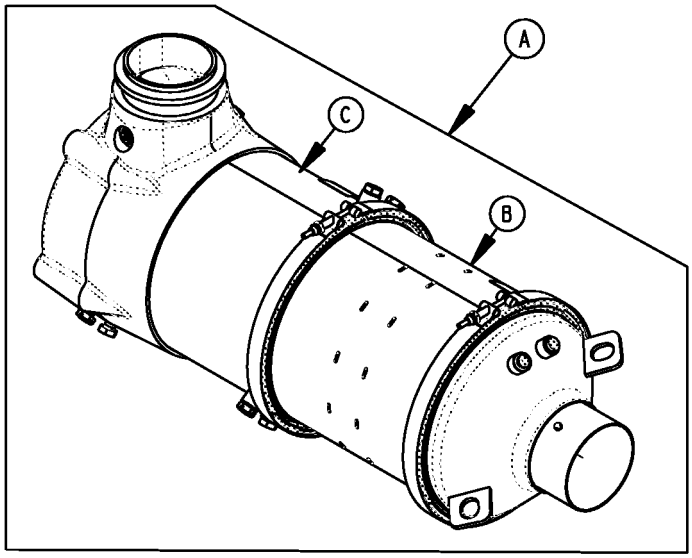
RG26299 —UN—12AUG14

Auxiliary Gear Drive

A—Auxiliary Gear Drive

ZE59858,0000012 -19-12AUG14-1/1

Exhaust Filter Cleaning and Maintenance



RE537721TMDA02 —UN—04MAR10

Exhaust Filter

A—Exhaust Filter
B—Diesel Particulate Filter (DPF)
C—Diesel Oxidation Catalyst (DOC)

The purpose of these instructions is to provide proper management of ash generated by the exhaust filter (or “filter”) along with its proper disposal.

RK80614,0000013 -19-16OCT12-1/1

Exhaust Filter — Cleaning

The Exhaust Filter, which includes the Diesel Oxidation Catalyst (DOC) and Diesel Particulate Filter (DPF), is a critical component in the engine’s emissions control system, which is required to meet governmental emissions regulations. The Exhaust Filter captures diesel particulate matter or “soot” to prevent its release into the atmosphere. This soot must be eliminated from the DPF to keep it functioning properly. The process of eliminating collected soot is carefully controlled by the Engine Control Unit (ECU) and is called “exhaust filter cleaning” or “regeneration”. During this process, a rise in exhaust temperature occurs and allows the soot to be oxidized within the DPF.

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Diesel Particulate Filter Maintenance and Service

The Exhaust Filter includes the Diesel Oxidation Catalyst and Diesel Particulate Filter (DPF). The DPF is designed to retain residual ash, which is a noncombustible result of additives used in crankcase lubrication oils and the fuel. The DPF provides many hours of maintenance free operation. At some point the DPF will require professional service to remove the accumulated ash. The exact number of hours of operation before service is required will vary depending upon the engine's power category, duty cycle and operating conditions, engine oil ash content, and fuel quality. Adhering to John Deere's recommended oil and fuel specifications will maximize the hours of operation before professional DPF service is required.

As the engine owner, you are responsible for performing the required maintenance described in your Operator's manual. The exhaust filter's dash lamp indicator or the diagnostic codes will indicate when the DPF needs ash removal service. Generally, the ash removal service interval will far exceed the EPA required minimums of 3,000 hours for engines below 175hp/130kW and 4,500 hours for engines at or above 175hp/130kW.

The removal of DPF ash must be done by removing the DPF from the machine and placing it into specialized equipment. Do not remove ash by using water or other chemicals. Removing ash by these methods may damage the material securing the DPF in its canister, resulting in the loosening of the DPF element in the canister and subjecting it to damage from vibration.

Failure to follow the approved ash removal methods may violate U.S. federal, state and local hazardous waste laws, along with damage to the DPF resulting in potential denial of the Diesel Exhaust Filter emissions warranty. It is strongly recommended you take the DPF to an authorized John Deere service location or other qualified service provider for servicing.

BL90236,0000030 -19-16DEC13-1/1

Exhaust Filter — Diesel Particulate Filter Ash Handling and Disposal

CAUTION: Your Governing Bodies Regulations may classify diesel particulate filter ash as a hazardous waste. Hazardous wastes therefore must be disposed of in accordance with all applicable Governing Bodies Regulations governing hazardous waste disposal. Only a qualified service provider should remove ash from the DPF. Personal protective equipment and clothing, maintained in a sanitary and reliable condition, should be used when handling and cleaning a DPF. See your John Deere dealer or qualified service provider for assistance.

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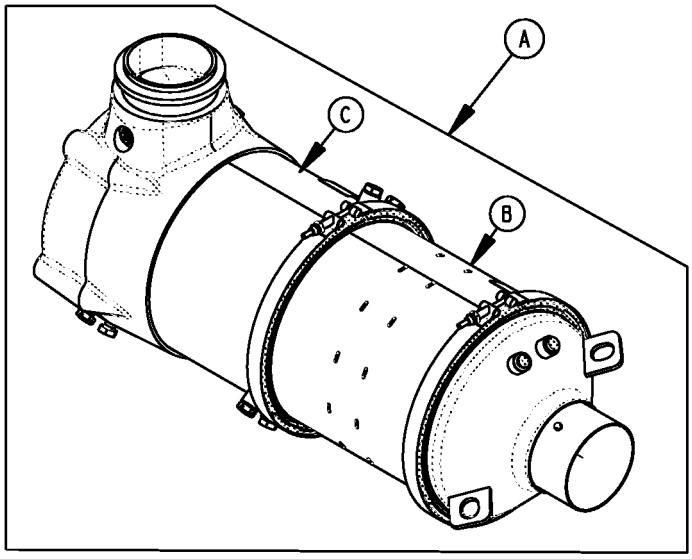
Exhaust Filter — Disposal

CAUTION: Proper management of an Exhaust Filter that has reached the end of its useful life is required, since the ash or catalyst material in the device may be classified as hazardous waste under federal, state, and/or local laws or regulations. See your John Deere dealer or qualified service provider for assistance.

RK80614,0000017 -19-21OCT13-1/1

Exhaust Filter System Overview

NOTE: Operator display icons and procedures can vary in other applications. The information contained in this section specifically applies to only OEM engines using the diagnostic gauge. If you are operating a John Deere vehicle, please see the vehicle operator manual for all exhaust filter cleaning operation information and procedures.



RE537721TMDA02 —UN—04MAR10

Diesel Exhaust Filter

A—Diesel Exhaust Filter **B—Diesel Particulate Filter (DPF)** **C—Diesel Oxidation Catalyst (DOC)**

John Deere has developed an exhaust filter consisting of a diesel oxidation catalyst (DOC) and a diesel particulate filter (DPF) specifically to meet the demands of off-highway applications. The DOC reduces carbon monoxide, hydrocarbons, and some particulate matter. The downstream DPF traps and holds particulates remaining in the exhaust stream. Trapped particles are eventually oxidized within the DPF through a process known as regeneration or exhaust filter cleaning.

Under normal machine operation and with the system in AUTO mode, the exhaust filter system requires minimal operator interaction.

To avoid unnecessary buildup of diesel particulates or soot in the exhaust filter system;

1 — Utilize the Automatic (AUTO) Exhaust Filter Cleaning mode.

2 — Avoid unnecessary idling.

3 — Use proper engine oil (See Fuels, Lubricants, and Coolants Section for recommendations).

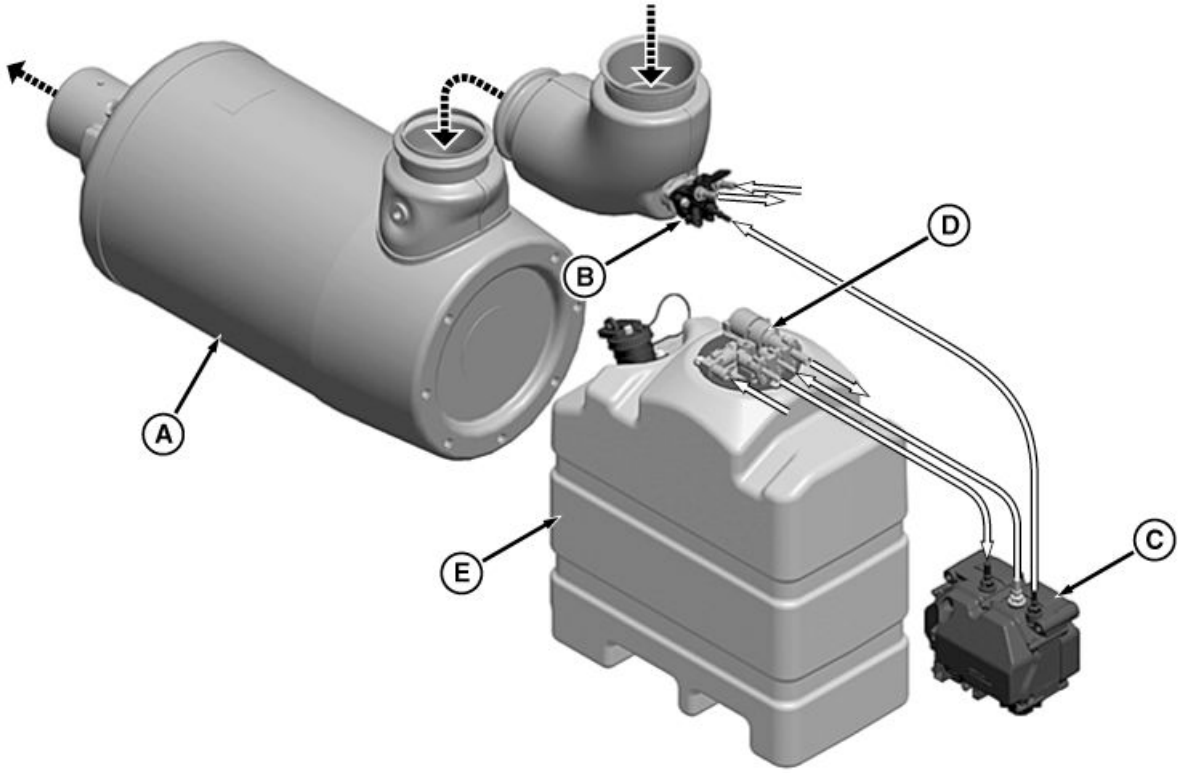
4 — Use only ultra low sulfur fuel (See Fuels, Lubricants, and Coolants Section for recommendations).

In addition to soot, ash deposits will also slowly build up in the DPF and cannot be removed through the engine exhaust filter cleaning process. To clean the ash deposits from the DPF see Diesel Particulate Filter Maintenance and Service in the Aftertreatment Section.

CAUTION: Do not power wash the filter assembly when external skin temperature of assembly exceeds 50 °C (120 °F).

RK80614,0000018 -19-28JAN13-1/1

Selective Catalytic Reduction (SCR) System Overview



SCR System

A—SCR Catalyst
B—DEF Dosing Injector
C—DEF Dosing Unit
D—DEF Tank Header Assembly
E—DEF Tank

IMPORTANT: Do not remove battery leads for at least 4 minutes after engine stops. The SCR system automatically purges itself of Diesel Exhaust Fluid (DEF) immediately after the engine is stopped. If adequate time is not allowed for lines to be purged, residual DEF can freeze and possibly damage components of the SCR system during cold-weather exposure.

In order to comply with national and local emission requirements, this engine series contains a Selective Catalytic Reduction (SCR) system. The main components of the SCR system include the SCR catalyst (A), DEF dosing injector (B), DEF dosing unit (C), DEF tank header assembly (D), and DEF tank (E). The SCR system is effective at reducing the nitrogen oxides (NOx) emissions. NOx is a major component of smog and acid rain.

During combustion, NOx molecules are formed in the exhaust. DEF is injected into the exhaust stream before the SCR catalyst. Through a chemical reaction in the SCR, NOx is converted into nitrogen and water.

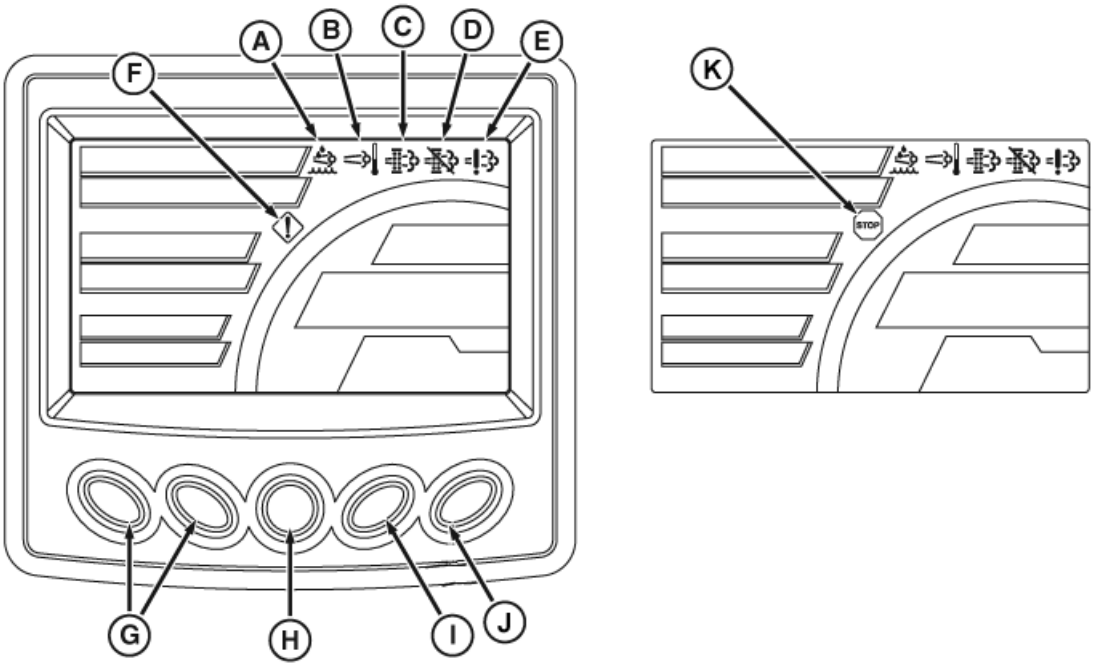
Water vapor is a normal by-product of combustion. During cold-weather operation at low exhaust temperatures, this water vapor can condense and resemble white smoke from the exhaust. This will dissipate as operating temperature increases and the water is further vaporized. This situation is considered normal.

A DEF solution begins to crystallize and freeze at -11 °C (12 °F). With climate temperatures that can range much colder than this, DEF is expected to freeze in the DEF tank. For this reason, the DEF tank contains a heating element that provides rapid thawing of DEF upon start-up. The heating element cycles to maintain fluidity during operation as needed. DEF is not dosed upon initial start-up, therefore it is not necessary to have liquid DEF at cold start-up.

If DEF quality deteriorates and it is no longer within specifications, the engine can derate. DEF should be crystal clear with a light ammonia smell. If DEF appears cloudy, has a colored tint, or has a profound ammonia smell, it is likely not within specification.

DX,SCR,OVERVIEW -19-05SEP14-1/1

Diagnostic Gauge Keys and Indicators Overview



RG23756 —UN—05JUL13

Diagnostic Gauge Indicators and Keys

A—Diesel Exhaust Fluid (DEF) Indicator
B—Engine Emissions Temperature Indicator
C—Exhaust Filter Indicator
D—Auto Cleaning Disable Indicator
E—Engine Emissions System Malfunction Indicator
F—Caution Indicator
G—Arrow Keys
H—Menu Key
I— Select Key
J—Exit Key
K—Stop Indicator

NOTE: You will never see the diagnostic gauge with all indicators illuminated at the same time (as shown). This image is only to illustrate the indicators you may see during operation.

The image above shows the keys and indicators you will see and use on the diagnostic gauge.

The diesel exhaust fluid indicator (A), engine emissions temperature indicator (B), exhaust filter indicator (C), auto cleaning disable indicator (D), engine emissions system malfunction indicator (E) and the caution indicator (F) provide the operator with visual notifications and aftertreatment system operations. The Arrow keys (G) are used to scroll up or down between options on the diagnostic gauge screen. The Menu key (H) is used to access the main menu of options from which the operator can choose. The Select key (I) is used when selecting an option on the diagnostic gauge. The Exit key (J) is used to come out from an option on the diagnostic gauge. The Stop Indicator (K) is flashed when the soot level of exhaust filter becomes extremely high and the ECU lowers the performance of engine.

RK80614,0000019 -19-05JUL13-1/1

Aftertreatment Indicators Overview

The Diesel Exhaust Fluid (DEF) indicator illuminates when the DEF is low. Fill DEF tank.

When the DEF indicator is combined with the warning indicator or stop engine indicator engine performance is reduced by the Engine Control Unit (ECU) because the DEF is below a measurable level. Fill DEF tank.

When engine emissions temperature indicator illuminates exhaust gas temperature is high, elevated idle is active, or exhaust filter cleaning is in process. The machine can be operated as normal unless the operator determines the machine is not in a safe location for high exhaust temperatures and disables auto cleaning.

When engine emissions temperature indicator is combined with the warning indicator or stop engine indicator engine performance is reduced by the ECU because the exhaust gas temperature is higher than expected. Follow Diagnostic Trouble Code (DTC) procedure or see your authorized servicing dealer.

When the exhaust filter indicator illuminates the exhaust filter cleaning is in process, aftertreatment system has a fault, or the exhaust filter is in need of cleaning and the operator has disabled auto exhaust filter cleaning. If conditions are safe, the operator should enable the auto exhaust filter clean setting or perform manual service regeneration or follow DTC procedure.

When the exhaust filter indicator is combined with the warning indicator engine performance is reduced by the ECU because there is an aftertreatment system fault or the soot level of the exhaust filter is moderately high. If conditions are safe, the operator should enable the auto exhaust filter clean function. If conditions are not safe, the operator should move the machine to a safe location and engage the auto exhaust filter cleaning mode. Perform manual service regeneration or follow DTC procedure.

When the exhaust filter indicator is combined with the stop engine indicator engine performance is further reduced by the ECU because there is an aftertreatment system fault or the soot level of the exhaust filter is extremely high. If this combination is present, see your authorized servicing dealer.

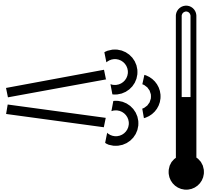
The auto cleaning disabled indicator illuminates when the operator has engaged the request to disable the auto exhaust filter cleaning function. This icon remains illuminated until the operator reengages automatic exhaust filter cleaning from the diagnostic gauge. Disabling auto mode is not recommended for any situation unless it is safety related or if the fuel tank lacks the required fuel to complete the cleaning process.

RG22487 —UN—21AUG13



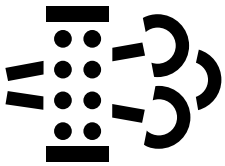
Diesel Exhaust Fluid Indicator

RG22488 —UN—21AUG13



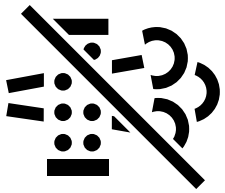
Engine Emissions Temperature Indicator

RG22489 —UN—21AUG13



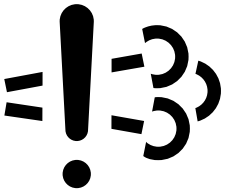
Exhaust Filter Indicator

RG22490 —UN—21AUG13



Auto Cleaning Disabled Indicator

RG22491 —UN—21AUG13



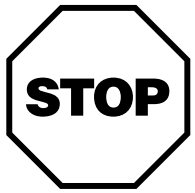
Engine Emissions System Malfunction Indicator

RG22492 —UN—21AUG13



Warning Indicator

RG22493 —UN—21AUG13



Stop Engine Indicator

The engine emissions system malfunction indicator illuminates when engine emissions are outside of normal operating range or engine emissions system fault. Follow DTC procedure or see your authorized servicing dealer

When the engine emissions system malfunction indicator is combined with the warning indicator engine performance is reduced by the ECU because the engine emissions are outside of normal operating range or engine emissions system fault. Follow DTC procedure or see your authorized servicing dealer

DX,AFTRTREAT,INDCATRS -19-12JUL13-1/1

Passive Regeneration/Natural Cleaning

Periodically, the exhaust filter will experience higher heat levels simply through the engine operating at higher loads. During these times, the higher exhaust heat will naturally clean a small amount of soot build up in the exhaust filter. Conversely, unnecessary idling can cause additional exhaust filter soot to accumulate. For the best possible engine operation which requires the least amount of operator interaction, the engine should be worked at higher load conditions whenever possible and idling should be kept to a minimum.

RK80614,000001A -19-16OCT12-1/1

Automatic (AUTO) Exhaust Filter Cleaning

NOTE: Operator display icons and procedures can vary in other applications. The information contained in this section specifically applies to only OEM engines. If you are operating a John Deere vehicle, please see the vehicle operator manual for all exhaust filter cleaning and handling information and procedures.

NOTE: When Auto or Parked exhaust filter cleaning is enabled, the exhaust temperature may be high under no load or light load conditions at certain times during the exhaust filter cleaning cycle.

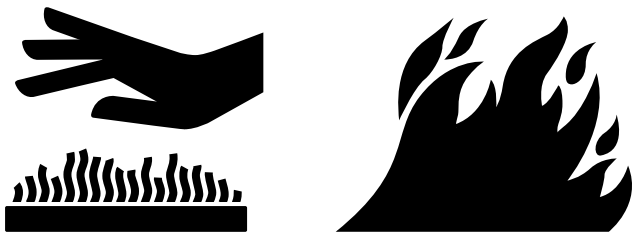
Operating the engine in AUTO Mode allows the ECU to perform intelligent exhaust filter cleaning as required. The Exhaust Filter Cleaning Indicator will illuminate when the system is actively performing an exhaust filter cleaning. During this process, the injector will inject small amounts of fuel into the exhaust stream to assist in cleaning the exhaust filter. When the exhaust filter cleaning process has completed its cycle, the cleaning indicator will automatically turn off.

CAUTION:

Servicing machine or attachments during exhaust filter cleaning can result in serious personal injury. Avoid exposure and skin contact with hot exhaust gases and components.

During auto or manual/stationary exhaust filter cleaning operations, the engine will run at elevated idle and hot temperatures for approximately 20—50 minutes. Exhaust gases and exhaust filter components reach temperatures hot enough to burn people, ignite, or melt common materials.

CAUTION: If the machine is not in a safe location for elevated exhaust temperatures, move the machine to a safe location and check for adequate fuel level before beginning the exhaust filter cleaning process. Any PTO driven devices (if equipped) should be powered off or disconnected.



RG17488 —UN—21AUG09

If the machine is not able to be moved into a safe location, the operator should temporarily disable auto exhaust filter cleaning (see Disable Exhaust Filter Cleaning in the Aftertreatment System Section). If the machine is located in a safe location, the auto mode should always be engaged.

To engage the auto exhaust filter cleaning mode:

1 — Press the Menu key on the diagnostic gauge.
2 — Press the Arrow keys to scroll up or down to EXHAUST FILTER.
3 — Press the Select key.
4 — Press the Arrow keys to scroll up or down to AUTO EXH FLT CLEAN.
5 — Press the Select key to enable auto exhaust filter cleaning.

RK80614,000001B -19-24JUL13-1/1

Manual/Parked Exhaust Filter Cleaning

NOTE: Operator display icons and procedures can vary in other applications. The information contained in this section specifically applies to only OEM engines. If you are operating a John Deere vehicle, please see the vehicle operator manual for all exhaust filter cleaning and handling information and procedures.

Manual/Parked Exhaust Filter Cleaning is an automated process initiated at the request of the operator. This process allows the system to clean the exhaust filter when the operator previously needed to engage the disable exhaust filter cleaning because of specific conditions. During the process the engine speed will be controlled by the ECU and the machine must remain parked to complete the procedure. Time required for the manual/Parked Exhaust Filter Cleaning process is dependent upon the level of exhaust filter restriction, ambient temperatures, and current exhaust gas temperature.

Complete cleaning times will very on several criteria including fuel type, oil type, duty cycle, and the number of previously aborted exhaust filter cleaning requests. Average time for a standard cleaning can range from 20-50 minutes.

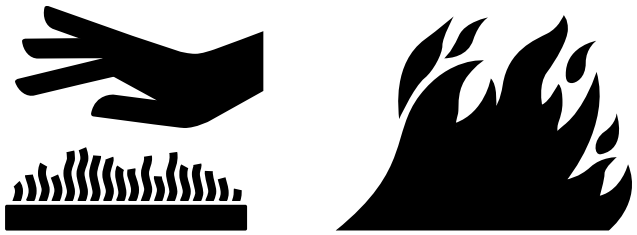
CAUTION:

Servicing machine or attachments during exhaust filter cleaning can result in serious personal injury. Avoid exposure and skin contact with hot exhaust gases and components.

During auto or manual/parked exhaust filter cleaning operations, the engine will run at elevated idle and hot temperatures for approximately 20-50 minutes. Exhaust gases and exhaust filter components reach temperatures hot enough to burn people, ignite, or melt common materials.

CAUTION: Always park the machine in a safe location and check for adequate fuel level before beginning the exhaust filter cleaning process. Any PTO driven devices (if equipped) should be powered off or disconnected.

To request a manual/parked exhaust filter cleaning:



RG17488 —UN—21AUG09

1 — Reduce engine speed to slow idle.
2 — Press the Menu key.
3 — Press the Arrow keys to scroll up or down to EXHAUST FILTER.
4 — Press the Select key.
5 — Press the Arrow keys to scroll up or down to REQUEST EXH FLT CLEAN.
6 — Press the Select key to request a manual/parked exhaust filter cleaning.
7 — Follow the directions on the display and ensure all conditions are met.
8 — Press the Select key to CONFIRM all conditions are met.

NOTE: Engine speed will be controlled by the ECU during filter cleaning.

The Exhaust filter indicator will remain off when Filter Cleaning is complete. If you are not returning the machine to service immediately after the procedure, allow the engine and the exhaust filter time to return to normal operating temperature before stopping engine. At any time during the parked procedure, the process can be canceled.

Avoid disabling the cleaning procedure unless absolutely necessary. Repeated disabling or ignoring prompts to perform a manual/parked cleaning procedure will cause additional engine power limitations and can eventually lead to dealer required service.

Utilize Exhaust Filter Cleaning AUTO mode to avoid additional service.

RK80614,000001C -19-24JUL13-1/1

Disable Exhaust Filter Cleaning

NOTE: Operator display icons and procedures can vary in other applications. The information contained in this section specifically applies to only OEM engines. If you are operating a John Deere vehicle, please see the vehicle operator manual for all exhaust filter cleaning and handling information and procedures.

NOTE: Disabling the exhaust filter cleaning request is not preferred. Disable the automatic exhaust filter cleaning only when necessary. Whenever possible, cleaning should be allowed and the diagnostic gauge should be left in the auto mode. When left in auto mode, soot buildup in the exhaust filter system will be at a minimum.

NOTE: When AUTO or PARKED/MANUAL cleaning is enabled, the exhaust temperature may be high under no load or light load conditions at certain times during the exhaust filter cleaning cycle. Disable exhaust filter cleaning in conditions where it may be unsafe for elevated exhaust temperatures.

To disable the auto exhaust filter cleaning mode:

1 — Press the Menu key on the diagnostic gauge.
2 — Press the Arrow keys to scroll up or down to EXHAUST FILTER.
3 — Press Select key.
4 — Press the Arrow keys to scroll up or down to DISABLE EXH FLT CLEAN.
5 — Press Select key to disable exhaust filter cleaning.

RK80614,000001D -19-23JUL13-1/1

Exhaust Filter Service Required

The exhaust filter cleaning procedures listed earlier in this section clean the soot from your exhaust filter. The exhaust filter also traps ash deposits over time which are not removed during an exhaust filter cleaning. When the exhaust filter has run several thousand hours, these ash deposits can restrict engine performance due to increased back pressure. To correct this situation, replace the exhaust filter or have the exhaust filter cleaned in specialized equipment. See Diesel Particulate Filter Maintenance and Service in the Aftertreatment Section.

RK80614,000001E -19-11JUL13-1/1

Restored Operation Option

NOTE: This is a European Union (EU) only option. Engine must have an EU only emission label. Option is not available for engine with EPA and EU emission label.

IMPORTANT: Operating the engine without emissions related derates could damage the aftertreatment system.

The Restored Operation Option enables a SCR equipped application to operate without emissions related derates for a specified time. After a final emission-related derate, the operator can activate the Restored Operation Option through the operator interface. Once activated, the engine can operate free of emissions-related derates for 30 minutes. The option can be activated three times, for a total of 90 minutes. To reset the Restored Operation Option for future use, the derate condition must be corrected.

DX,SCR,RESTORE,EU -19-07OCT14-1/1

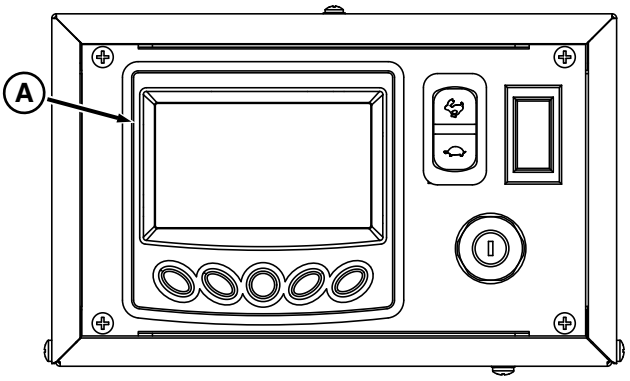
Observe Service Intervals

A repair shop or person of the owner's choosing may maintain, replace, or repair emission control devices and systems. However, warranty service must be performed by an authorized John Deere service facility except in the case of emergency.

In an emergency, where an authorized John Deere service location is not available, repairs may be performed at any available service establishment, or by the owner, using any replacement part, provided such parts are warranted by their manufacturer to be the equivalent of John Deere parts in performance and durability and the failure does not arise from the owner's failure to perform required maintenance.

Using hour meter (A) as a guide, perform all services at the hourly intervals indicated on following pages. At each scheduled maintenance interval, perform all previous maintenance operations in addition to the ones specified. Keep a record of hourly intervals and services performed, using charts provided in Lubrication and Maintenance Records section.

IMPORTANT: Recommended service intervals are for normal operating conditions. Perform maintenance at interval which occurs first, for example, either at 500 hours of operation or every 12 months. Service more often if engine operated under adverse conditions. Neglecting maintenance can result in failures or permanent damage to the engine.



RG22413 —UN—27AUG13

Hour Meter On Instrument Panel

A—Hour Meter

Perform all services at the hourly intervals. Record the services performed in the Lubrication and Maintenance Records Section. When scheduled service at any hourly level is performed, also perform all subordinate hourly level services.

Main Service	Subordinate Services				
	500 Hours	1500 Hours	3000 Hours	4500 Hours	6000 Hours
500 Hours	X				
1500 Hours	X	X			
3000 Hours	X	X	X		
4500 Hours	X	X		X	
6000 Hours	X	X	X		X

ZE59858,0000014 -19-04MAR14-1/1

Use Correct Fuels, Lubricants, and Coolant

IMPORTANT: Use only fuels, lubricants, and coolants meeting specifications outlined in Fuels, Lubricants, and Coolant Section when servicing your John Deere Engine.

Consult your John Deere Servicing Distributor or your nearest John Deere Parts Network for recommended fuels, lubricants, and coolant. Also available are necessary additives for use when operating engines in tropical, arctic, or any other adverse conditions.



RG17133 —UN—18MAY09

RK80614,0000020 -19-16OCT12-1/1

Lubrication and Maintenance Service Interval Chart

	Lubrication and Maintenance Service Intervals						
Item	Daily/Before Every Startup	500 Hours of Operation or Every 12 Months	1500 Hours of Operation	3000 Hours of Operation or Every 36 Months	4500 Hours of Operation or Every 36 Months	6000 Hours of Operation or Every 72 Months	As Required
Check Engine Oil	•						
Check Coolant Level	•						
Drain Water From Fuel Filters	•						
Check Air Cleaner Dust Valve Restriction Indicator Gauges	•						
Perform Inspection of Engine Compartment	•						
Service Fire Extinguisher		•					
Service Battery		•					
Change Engine Oil And Replace Oil Filter [a] [b]		•					
Check Coolant Pump Weep Hole		•					
Check Open Crankcase Vent (OCV) System		•					
Replace Fuel Filter Elements		•					
Check Belt Tensioner and Belt Wear		•					
Check Cooling System		•					
Pressure Test Cooling System		•					
Check Engine Speeds		•					
Check Engine Mounts		•					
Check Engine Ground Connection		•					
Change Open Crankcase Ventilation (OCV) Filter[c]			•				
Check Crankshaft Vibration Damper				•			
Adjust Engine Valve Clearance				•			
Test Glow Plugs for Continuity				•			
Change DEF Dosing Unit Filter					•		
Flush and Refill Cooling System						•	
Test Thermostats						•	
Drain Water From Fuel Filters When Alarm Sounds							•
Add Coolant							•
Clean DEF Tank							•
Pre-Start Cleaning Guide							•
Service Air Cleaner Filter Elements							•
Clean Diesel Particulate Filter [c]							•
Replace Alternator/Fan Belt							•
Check Fuses							•
Check Electrical Wiring and Connections							•
Check Air Compressors (If Equipped)							•
Check Refrigerant (A/C) Compressor (If Equipped)							•

[a] During the initial operation of a new or rebuilt engine with Break-In Plus, change the oil and filter between a minimum of 100 hours and a maximum of up to 500 hours.

[b] Service intervals depend on sulfur content of the diesel fuel, oil pan capacity, and the oil and filter used. (See Diesel Engine Oil and Filter Service Intervals in the Fuels, Lubricants, and Coolants Section.)

[c] Actual service should take place when the dash indicator light comes on or as indicated by the diagnostic gauge.

ZE59858,0000015 -19-18AUG14-1/1

Daily Prestarting Checks

Check the following items BEFORE STARTING THE ENGINE for the first time each day:

- Check engine oil level on dipstick. Fill cap/dipstick may be located on left or right side, depending on application. Add as required, using seasonal viscosity grade oil. (See Diesel Engine Oil — Interim Tier 4, Final Tier 4, Stage IIIB, and Stage IV in the Fuels, Lubricants, and Coolants Section for oil specifications.)

  NOTE: Wipe all fittings, caps, and plugs before performing any maintenance to reduce the chance of system contamination.

- Check the coolant level when engine is cold. Fill radiator or surge tank with proper coolant if level is low. (See Adding Coolant in the Service As Required Section.) Check overall cooling system for leaks.
- Check radiator for leaks and trash buildup.

  NOTE: It is normal for a small amount of coolant to weep from the coolant pump weep hole, especially as the engine cools down and parts contract. If enough coolant weeps from the engine where coolant drips from the engine, this may indicate the need to replace the coolant pump seal. Contact your engine distributor or servicing dealer for repairs.

- Check fan, alternator, and accessory drive belts for cracks, breaks or other damage.
- Loosen water drain valve on each fuel filter all the way so that the valve opens to drain water and debris as needed. Retighten valves securely.

  NOTE: Any water in fuel is drained into the bottom of the fuel filters. The operator is signaled by an amber indicator on the instrument panel. To service, see Drain Water From Fuel Filters in the Service As Required Section.

- Squeeze the automatic dust unloader valve (if equipped) on air cleaner assembly to clear away any dust buildup.
- Check air intake restriction indicator gauge and service air cleaner as required (if equipped).
- Check air intake system hoses and connections for cracks and loose clamps.
- Inspect the engine compartment. Look for fluid leaks, worn fan and accessory drive belts, loose connections, and trash buildup. Remove trash buildup and have repairs made as needed.

RK80614,0000023 -19-05FEB14-1/1

Servicing Fire Extinguisher

A fire extinguisher (A) is available from your authorized servicing dealer or engine distributor.

Read and follow the instructions which are packaged with it. The extinguisher should be inspected at least every 500 hours of engine operation or every 12 months. Once extinguisher is operated, no matter how long, it must be recharged. Keep record of inspections on the tag which comes with the extinguisher instruction booklet.

A—Fire Extinguisher



RW4918 —UN—15DEC88

Fire Extinguisher

RK80614,0000024 -19-16OCT12-1/1

Servicing Battery

CAUTION: Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.

Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.

Always remove grounded NEGATIVE (—) battery clamp first and replace it last.



TS204 —UN—15APR13

Exploding Battery

WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. **Wash hands after handling.**

IMPORTANT: Wear personal Protective Equipment while doing any type of Battery check or replacement.

1. On regular batteries, check electrolyte level. Fill each cell to bottom of filler neck with distilled water.

NOTE: Low-maintenance or maintenance-free batteries should require little additional service. However, electrolyte level can be checked by cutting the center section of decal on dash-line, and removing cell plugs. Fill each cell to bottom of filler neck with distilled water.

2. Keep batteries clean by wiping them with a damp cloth. Keep all connections clean and tight. Remove any corrosion, and wash terminals with a solution of 1 part baking soda and 4 parts water. Tighten all connections securely.

NOTE: Coat battery terminals and connectors with a mixture of petroleum jelly and baking soda to retard corrosion.

3. Keep battery fully charged, especially during cold weather. If a battery charger is used, turn off charger before connecting charger to battery(ies). Attach POSITIVE (+) battery charger lead to POSITIVE (+) battery post. Then attach NEGATIVE (—) battery charger lead to a good ground.

Continued on next page

ZE59858,0000016 -19-28JUL14-1/2

CAUTION: Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

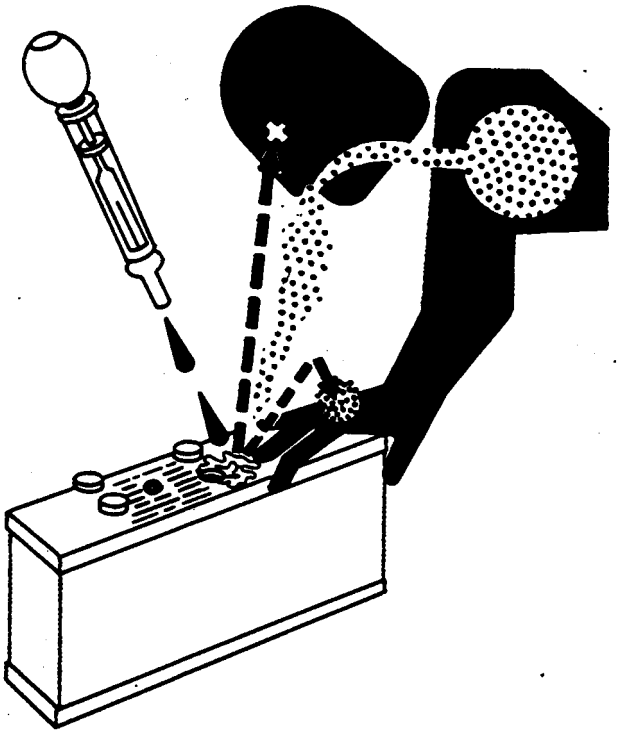
1. **Filling batteries in a well-ventilated area.**
2. **Wearing eye protection and rubber gloves.**
3. **Avoiding breathing fumes when electrolyte is added.**
4. **Avoiding spilling or dripping electrolyte.**
5. **Using proper jump start procedure.**

If you spill acid on yourself:

1. **Flush your skin with water.**
2. **Apply baking soda or lime to help neutralize the acid.**
3. **Flush your eyes with water for 10—15 minutes. Get medical attention immediately.**

If acid is swallowed:

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



TS203 —UN—23AUG88

Sulfuric Acid

In freezing weather, run engine at least 30 minutes to ensure thorough mixing after adding water to battery.

Replacement battery(ies) must meet or exceed the following recommended capacities[1] at -18 °C (0 °F):

Specification	
12-Volt System—Minimum Battery Capacity—Cold Cranking Amps	640 Minimum
Reserve Capacity (Minutes)	285 Minimum
24-Volt System—Minimum Battery Capacity—Cold Cranking Amps	570 Minimum
Reserve Capacity (Minutes)	275 Minimum

[1] Total recommended capacity based on batteries connected in series or parallel.

ZE59858,0000016 -19-28JUL14-2/2

Changing Engine Oil and Replacing Filter

IMPORTANT: Changing engine oil and filter every 500 hours or 12 months depends on the following requirements:

- **Engine equipped with an oil pan that allows capacity for this extended drain interval.**
- **Use of premium oil John Deere Plus-50, API CJ-4, ACEA E9, or ACEA E6.**
- **Perform engine oil analysis to determine the actual extended service life of API CJ-4, ACEA E9, or ACEA E6 oils.**
- **Use of the approved John Deere oil filter.**
- **Use of Ultra Low Sulfur Diesel (ULSD) fuel with sulfur content less than 0.0015% (15 mg/kg) is required.**

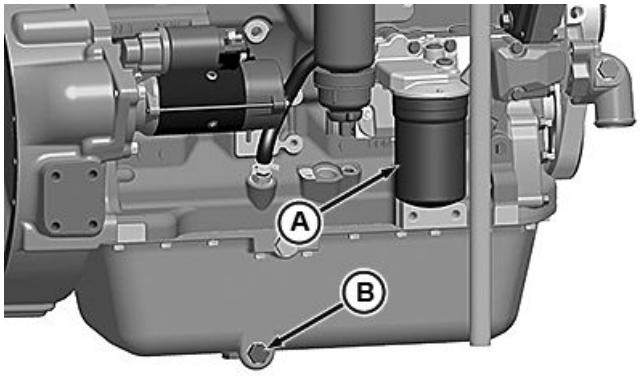
The oil and filter change interval is reduced if ANY of the above listed requirements are not followed.

NOTE: During the initial operation of a new or rebuilt engine with Break-In Plus, change the oil and filter between a minimum of 100 hours and a maximum of up to 500 hours.

NOTE: Service intervals depend on sulfur content of the diesel fuel, oil pan capacity, engine power, and the oil and filter used. For more information, see Diesel Engine Oil and Filter Service Intervals in the Fuels, Lubricants, and Coolants Section.

OILSCAN™ or OILSCAN PLUS™ is a John Deere sampling program to help you monitor machine performance and identify potential problems before they cause serious damage. OILSCAN™ and OILSCAN PLUS™ kits are available from your John Deere engine distributor or servicing dealer. Oil samples should be taken prior to the oil change. Refer to instructions provided with kit.

OILSCAN is a trademark of Deere & Company.
OILSCAN PLUS is a trademark of Deere & Company.



RG26252 —UN—30JUL14

Oil Filter

A—Oil Filter **B—Oil Pan Drain Plug**

IMPORTANT: Engine oil and metal surfaces of engine may be hot to the touch after shutdown. Use care to prevent burns.

1. Run engine approximately 5 minutes to warm up oil. Shut engine off.

NOTE: Drain plug location may vary, depending on the application.

2. Remove oil pan drain plug (B).
3. Drain crankcase oil from engine while warm.
4. Install oil pan drain plug with a new O-ring and tighten to specifications.

Specification	
Oil Pan Drain Plug (Stamped Steel Pan)—Torque	40 N·m (30 lb.-ft.)
Oil Pan Drain Plug (Cast Pan)—Torque	48 N·m (35 lb.-ft.)

Continued on next page

5. Remove oil filter. Discard oil filter.
6. Apply clean engine oil to the new filter at the inner (B) and outer (C) seals and to filter threads.
7. Wipe both sealing surfaces of the header (D and E) with a clean rag. Ensure notches in dust seal (F) are properly installed in the slots in the housing. Replace dust seal if damaged.

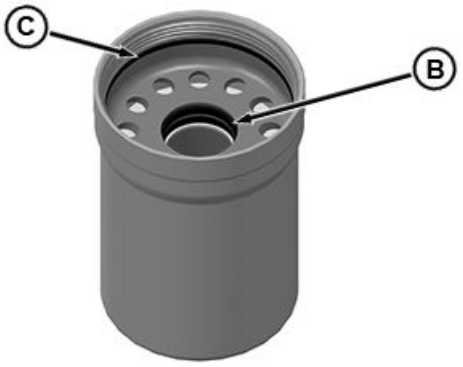
IMPORTANT: When installing filter element, HAND TIGHTEN only. A filter wrench may be used for REMOVAL ONLY. Be sure notches in dust seal (F) are properly installed in the slots in the housing.

8. Install and tighten oil filter by hand until firmly against dust seal (F). DO NOT apply an extra 3/4 to 1-1/4 turn after gasket contact, as done with standard filters.
9. Fill engine crankcase with correct John Deere engine oil through oil filler cap on either side of engine depending on engine application. (See Diesel Engine Oil — Interim Tier 4, Final Tier 4, Stage IIIB, and Stage IV in Fuels, Lubricants, and Coolant Section for determining correct engine oil.)

   To determine the correct oil fill quantity for your engine, see Engine Crankcase Oil Fill Quantities in the Specifications Section of this manual.

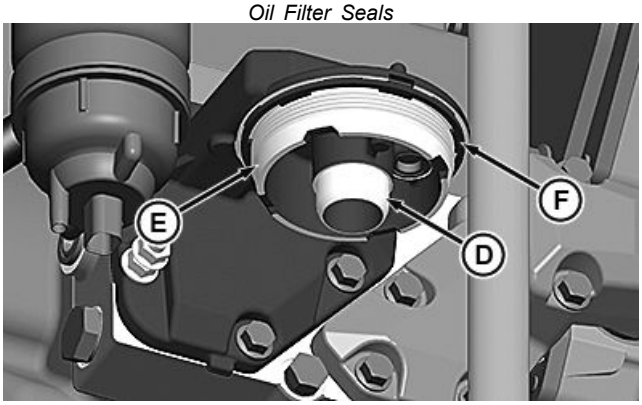
NOTE: Crankcase oil capacity may vary slightly. ALWAYS fill crankcase within crosshatch marks on dipstick. DO NOT overfill.

10. Start engine and run to check for possible leaks.
11. Stop engine and check oil level after 10 minutes. Oil level reading should be within crosshatch marks on dipstick.



RG26253 —UN—30JUL14

Oil Filter Seals



RG26254 —UN—30JUL14

Oil Filter Header

B—Inner Seal
C—Outer Seal
D—Sealing Surface On Header
E—Sealing Surface On Header
F—Dust Seal

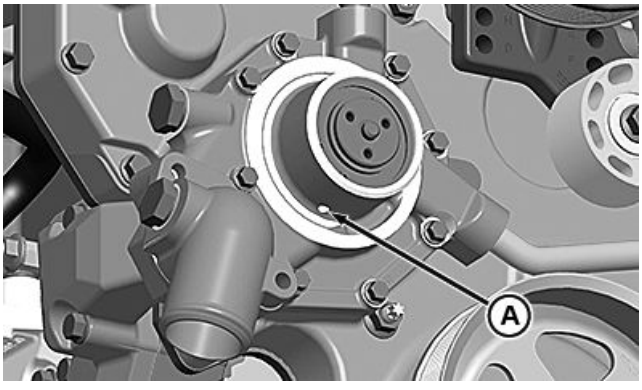
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Visually Inspecting Coolant Pump

NOTE: Cooling pump drive pulley is removed for clarity purposes.

1. Coolant leakage indicates a damaged front seal. Inspect weep hole (A) for coolant leakage.
2. Replace complete coolant pump assembly if leakage is detected. A slight weeping of coolant is normal. If enough coolant leaks from the weep hole that it drips from the engine, the coolant pump assembly should be replaced. Individual repair parts are not available.

A—Weep Hole



RG26265 —UN—30JUL14

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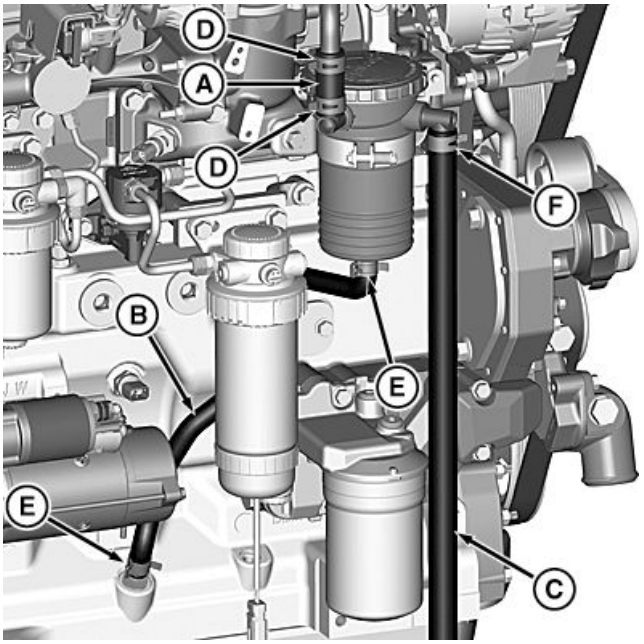
Checking Open Crankcase Vent (OCV)

Inspect OCV hoses (A, B, and C) for worn, cracked, leaking, or bulging.

Check hose clamps (D, E, and F) for good clamp tension.

Replace any worn or damaged parts.

A—OCV Inlet Hose
B—Air Outlet Hose
C—Oil Drain Hose
D—Clamp — Inlet Hose
E—Clamp — Oil Drain Hose
F—Clamp — Outlet Hose



RG20672 —UN—11JUL11

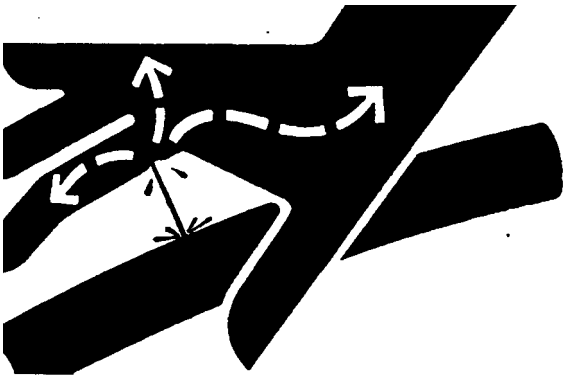
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Removing and Installing Fuel Filters

Engines are equipped with dual fuel filters: a primary filter with water bowl, and a final filter. Both filters are replaced at the same 500 hour or 12 months interval.

CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting fuel or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. To search for leaks use a piece of cardboard or paper. Do not use your hand.

If any fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type injury or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.



X9811 —UN—23AUG88

High-Pressure Fluids

IMPORTANT: Replace fuel filter elements anytime audible alarm sounds and diagnostic trouble codes (DTCs) indicate plugged fuel filters (low fuel pressure). If no alarm sounds during the 12 month or after 500 hours service interval, replace elements.

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Remove and Install Primary Fuel Filter Element

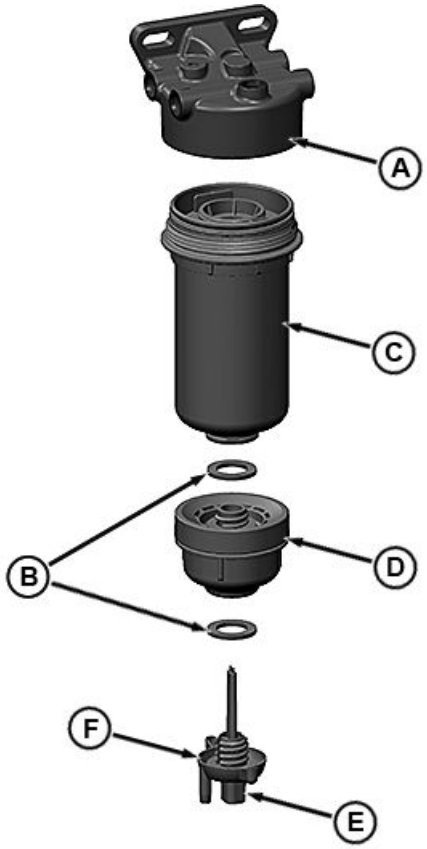
NOTE: For applications other than OEM, refer to the application operator's manual for proper servicing, hourly replacement intervals, and filter locations.

NOTE: Both the primary and the final fuel filter elements must be replaced at the same time.

1. Thoroughly clean filter header (A) and surrounding area to prevent dirt and debris from entering fuel system.
2. Connect a hose to filter drain valve (F) on bottom of filter and drain all fuel from filter canister.
3. Disconnect water-in-fuel sensor connector (E).
4. Remove fuel filter element (C).
5. Place new O-ring (B) on filter element.
6. Apply a thin film of fuel on O-ring.

IMPORTANT: Do not fill the new filter with fuel before installing. This could contaminate the fuel system with unfiltered fuel.

7. Install new filter and tighten until the top portion of the filter contacts the filter header assembly.
8. Reconnect water-in-fuel sensor connector.



RG26246 —UN—14AUG14

Replace primary fuel filter

A—Primary Fuel Filter Header
B—O-rings
C—Primary Fuel Filter Element
D—Sediment Bowl
E—Water-in-Fuel Sensor Connector
F—Drain Valve

Continued on next page

ZE59858,000001A -19-14AUG14-2/3

Remove and Install Secondary Fuel Filter Element

NOTE: For applications other than OEM, refer to the application operator's manual for proper servicing, hourly replacement intervals, and filter locations.

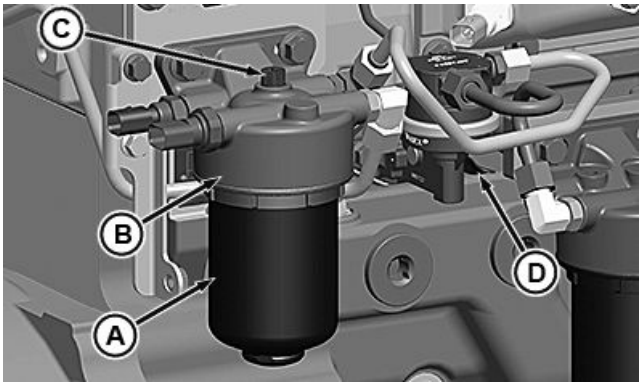
1. Thoroughly clean filter header (B) and surrounding area to prevent dirt and debris from entering fuel system.
2. Loosen and remove fuel filter element (A).
3. Apply a thin film of fuel on packing.

IMPORTANT: Do not fill the new filter with fuel before installing. This could possibly contaminate the fuel system with unfiltered fuel.

4. Install new filter and tighten until the top portion of the filter contacts the filter header assembly.

NOTE: For electronic fuel pump: To prime the fuel system before starting engine. Turn ignition key to ON for 60 seconds.

NOTE: For mechanical fuel pump: To prime the fuel system before starting engine. Open bleed vent screw, pump primer lever until fuel flows out of bleed vent screw, then tighten bleed vent screw securely.



RG26322 —UN—13AUG14

Replace Secondary Fuel Filter Element

A—Secondary Fuel Filter Element
B—Secondary Fuel Filter Header
C—Bleed Vent Screw
D—Primer Lever

ZE59858,000001A -19-14AUG14-3/3

Checking Belt Wear

NOTE: While belt is loosened, inspect pulleys and bearings. Rotate and feel for hard turning or any unusual sounds. If pulleys or bearings need replacement, see your John Deere dealer.

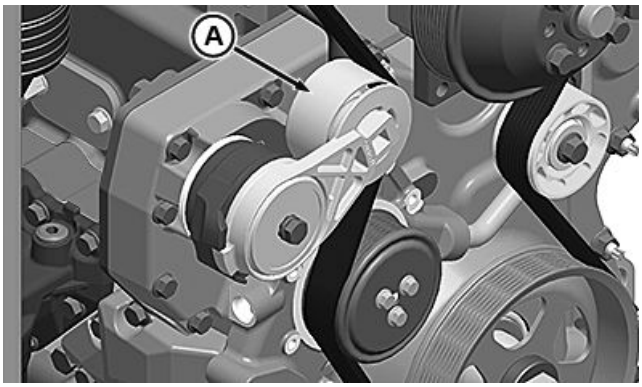
The belt tensioner is designed to operate within the limit of arm movement provided by the cast stops when correct belt length and geometry are used.

Visually inspect cast stops on belt tensioner (A) assembly.

If the tensioner stop on swing arm is hitting the fixed stop, check mounting brackets (alternator, belt tensioner, idler pulley, etc.) and the belt length.

- Verify belt grooves mate correctly with all pulleys
- Inspect for excessive cracks
- Inspect for glazing
- Inspect for tears or cuts

Replace belt as needed based on wear and belt condition. Use correct belt routing during installation (see Replacing Fan Belt in the Service As Required Section).



RG26255 —UN—30JUL14

A—Belt Tensioner Assembly

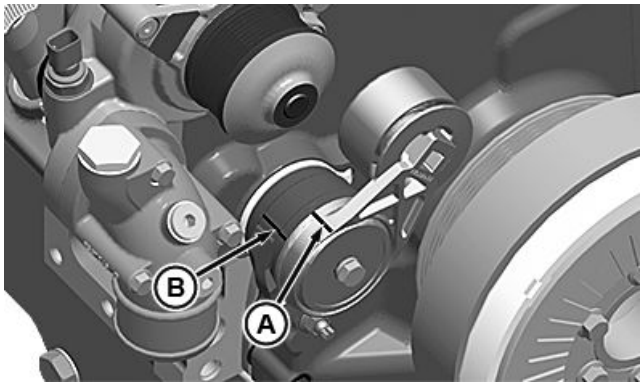
ZE59858,000001B -19-30JUL14-1/1

Checking Tensioner Spring Tension

A belt tension gauge will not give an accurate measure of the belt tension when automatic spring tensioner is used. Measure tensioner spring tension using a torque wrench and procedure outlined below:

1. Release tension on belt using a long-handled 1/2 inch drive tool in tensioner arm. Remove belt from pulleys.
2. Release tension on tensioner arm and remove drive tool.
3. Put a mark (A) on swing arm of tensioner as shown.
4. Measure 21 mm (0.83 in.) from mark (A) and put a mark (B) on tensioner mounting base.

A—Mark **B—Mark**



RG24039 —UN—07AUG13

Checking Belt Tension Spring Tension

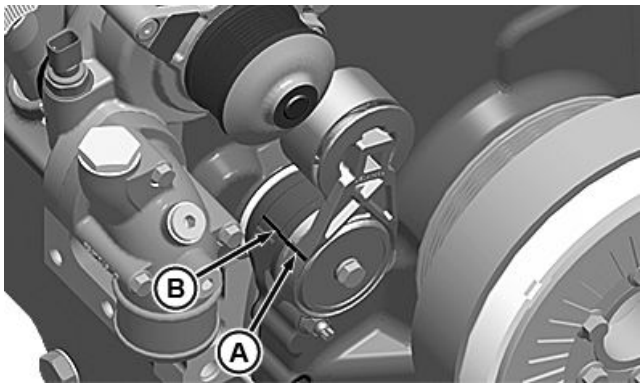
ZE59858,000001C -19-29JUL14-1/2

5. Rotate the swing arm using a torque wrench until marks (A and B) are aligned.
6. Record torque wrench measurement and compare with specification below. Replace tensioner assembly as required.

Specification

Spring—Tension..... 18—22 N·m (13—16 lb.-ft.)

A—Mark **B—Mark**



RG24040 —UN—07AUG13

Checking Belt Tensioner Spring Tension

ZE59858,000001C -19-29JUL14-2/2

Checking Cooling System

⚠ CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

IMPORTANT: Air must be expelled from cooling system when system is refilled. Loosen temperature sending unit fitting at rear of cylinder head or plug in thermostat housing to allow air to escape when filling system. Retighten fitting or plug when all the air has been expelled. Cooling system must be free of air by time engine coolant temperature reaches 80 °C (176 °F) or damage to EGR cooler (if equipped) may result.



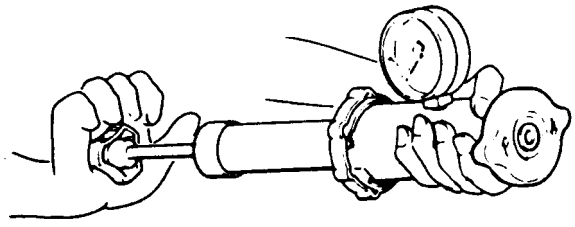
TS281 —UN—15APR13

High Pressure Fluids

1. Check entire cooling system for leaks. Tighten all clamps securely.
2. Thoroughly inspect all cooling system hoses for hard, flimsy, or cracked conditions. Replace hoses if any of the above conditions are found.

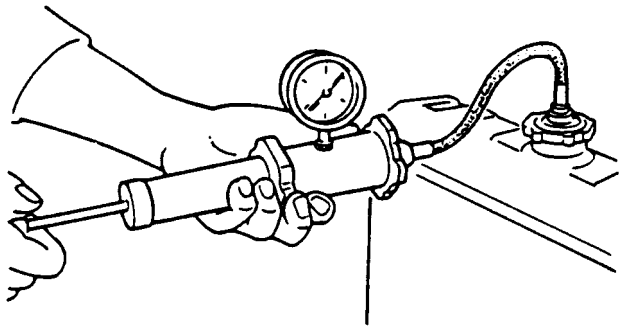
RK80614,000002D -19-11JUL13-1/1

Pressure Testing Cooling System



Test Radiator Cap

RG6557 —UN—20JAN93



RG6558 —UN—20JAN93

Test Cooling System

⚠ CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. To relieve pressure before completely removing, slowly remove pressure cap and allow pressure to relieve before completely removing cap.

Test Radiator Cap

1. Remove radiator cap and attach to D05104ST Tester, or similar, as shown.
2. Pressurize cap to following specifications.[1]. Gauge should hold pressure for 10 seconds within the normal range if cap is acceptable.

Specification	
Radiator Cap—Maximum Pressure	124 kPa (1.24 bar) (18 psi)

If gauge does not hold pressure, replace radiator cap.

3. Remove the cap from gauge, turn it 180°, and retest cap. This verifies that the first measurement was accurate.

Test Cooling System for Leaks

NOTE: Engine should be warmed up to test overall cooling system for leaks.

[1]Test pressures recommended are for all Deere OEM cooling systems. On specific vehicle applications, test cooling system and pressure cap according to the recommended pressure for that vehicle.

1. Allow engine to cool, then carefully remove radiator cap.
2. Fill radiator with coolant to the normal operating level.

IMPORTANT: DO NOT apply excessive pressure to cooling system; doing so may damage radiator and hoses.

3. Connect gauge and adapter to radiator filler neck, or expansion tank. Pressurize cooling system to the following specifications[1].

Specification	
Cooling System—Maximum Pressure	124 kPa (1.24 bar) (18 psi)

4. With pressure applied, check all cooling system hose connections, radiator, and overall engine for leaks.

If leakage is detected, correct as necessary and pressure test system again.

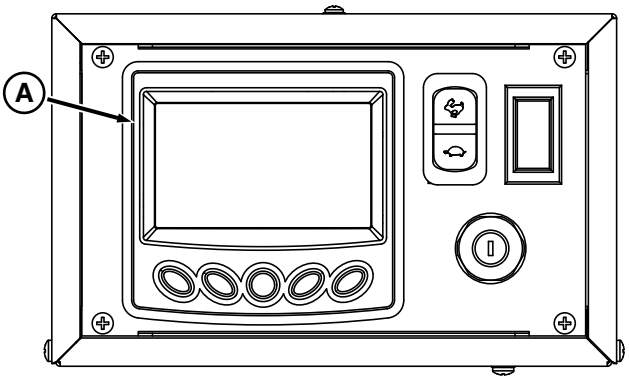
If no leakage is detected, but the gauge indicated a drop in pressure, coolant may be leaking internally within the system or at the block-to-head gasket. Have your servicing dealer or distributor correct this problem immediately.

ZE59858,00000B9 -19-26AUG13-1/1

Checking and Adjusting Engine Speeds

Use tachometer on the diagnostic gauge (A) to verify engine speeds. (See Engine Power and Speed Rating Specifications in the Specifications Section for engine speed specifications.) If engine speed adjustment is required, see your authorized servicing dealer or engine distributor.

A—Diagnostic Gauge



RG22413 —UN—27AUG13

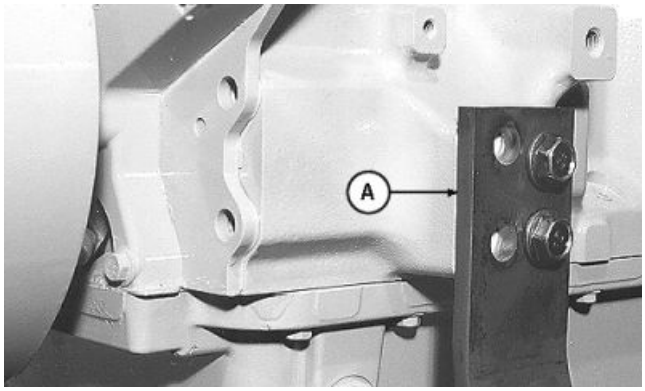
RK80614,0000030 -19-16DEC13-1/1

Checking Engine Mounts

Engine mounting is the responsibility of the Original Equipment Manufacturer. Follow manufacturer's guidelines for mounting specifications.

IMPORTANT: Use only Grade SAE 8 or higher grade of hardware for engine mounting.

1. Check the engine mounting brackets (A), vibration isolators, and mounting bolts on support frame and engine block for tightness. Tighten as necessary.
2. Inspect overall condition of vibration isolators, if equipped. Replace isolators, as necessary, if rubber has deteriorated or mounts have collapsed.



Engine Mounting

RG9905 —UN—06JAN99

A—Mounting Bracket

RK80614,0000031 -19-11JUL13-1/1

Checking Engine Ground Connection

Check engine ground connection to be sure that it is secure and clean. This will prevent electrical arcing which can damage engine.

Verify engine to frame ground.

Verify battery ground to frame.

Verify Engine Control Unit to ground (Remote Mount).

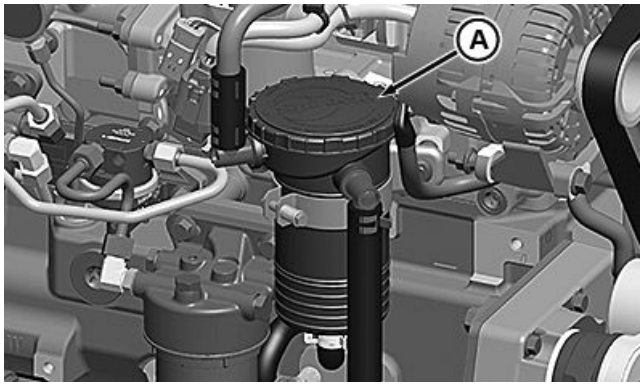
RK80614,0000033 -19-11JUL13-1/1

Changing Open Crankcase Ventilation (OCV) Filter

Service checks of the OCV include checking and/or replacement of worn, cracked, leaking, or bulging hoses and for good clamp tension on all hose ends.

Expectation for minimal service interval will be at least 1500 hours or when the service indicator light comes on or as indicated by the diagnostic gauge.

1. Remove cap (A).
2. Remove OCV filter from canister. Discard old OCV filter.
3. Install new OCV filter.
4. Install cap (A).



RG26250 —UN—30JUL14

Changing OCV

A—Cap

ZE59858,000001E -19-30JUL14-1/1

Checking Crankshaft Vibration Damper

IMPORTANT: The vibration damper is not repairable, and should only be replaced due to unexpected failure or at engine rebuild.

- Grasp vibration damper with both hands and attempt to turn it in both directions. If rotation is felt, damper is defective and should be replaced.
- Visually inspect vibration damper for cracks or damage.
- Visually inspect viscous damper for leaks.
- Visually inspect viscous damper for dents or bends in housing.

ZE59858,00000CF -19-22AUG13-1/1

Adjusting Valve Clearance

CAUTION: To prevent accidental starting of engine while performing valve adjustments, always disconnect NEGATIVE (—) battery terminal.

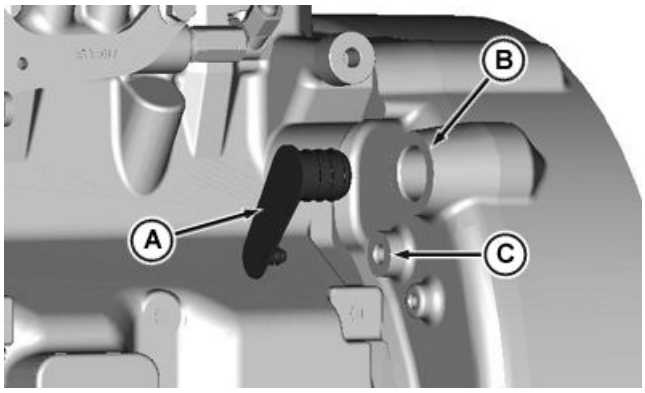
IMPORTANT: Valve clearance MUST BE checked and adjusted with engine COLD.

1. Remove rocker arm cover and crankcase ventilation tube.
2. Remove plastic plug (A) from engine timing/rotation hole (B) and timing pin hole (C).

IMPORTANT: Visually inspect contact surfaces of bridges, and rocker arm wear pads. Check all parts for excessive wear, breakage, or cracks. Replace parts that show visible damage.

Rocker arms that exhibit excessive valve clearance should be inspected more thoroughly to identify damaged parts.

3. Install JDG820 flywheel turning tool and JDG1571 timing pin.
4. Rotate engine with the flywheel turning tool until locking pin engages timing hole in flywheel.



RG20536 —UN—03JUN11

Bores to Insert Flywheel Turning Tool and Locking Pin

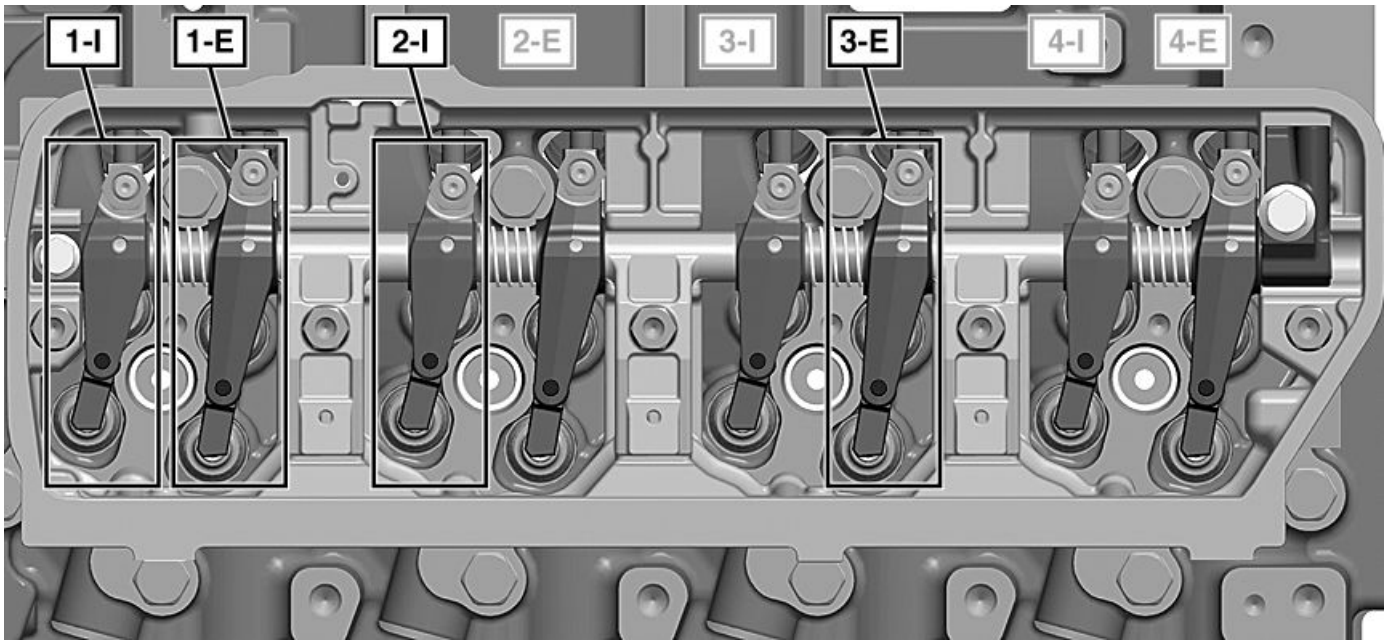
A—Plastic Plug
B—Flywheel Turning Tool Bore
C—Locking Pin Bore

NOTE: If the rocker arms for No. 1 (front) cylinder are loose, the engine is at No. 1 top dead center.

NOTE: If the rocker arms for No. 4 (rear) cylinder are loose, the engine is at No. 4 top dead center. Rotate the engine one full revolution (360°) to No. 1 top dead center.

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ZE59858,000001F -19-13AUG14-1/4

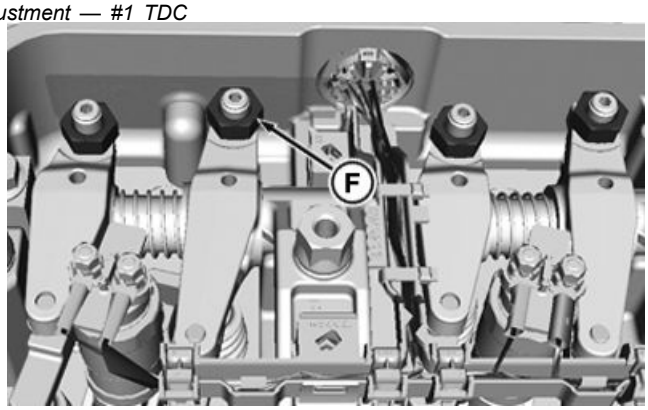


RG20492 —UN—24JUN11

Valve Clearance Adjustment — #1 TDC

5. With engine locked at “TDC” of No. 1 piston compression stroke, use a bent feeler gauge to check valve clearance on No. 1 and 3 exhaust and No. 1 and 2 intake valves. Loosen lock nut (F) on rocker arm adjusting screw. Turn adjusting screw with a 4 mm hex key until feeler gauge slips with a slight drag. Hold the adjusting screw from turning and tighten lock nut to specifications

Specification	
Intake Valve Clearance (Rocker Arm-to-Valve Bridge With Engine Cold)—Clearance	0.46 mm (0.018 in.)
Exhaust Valve Clearance (Rocker Arm-to-Valve Bridge With Engine Cold)—Clearance	0.53 mm (0.021 in.)
Valve Adjusting Screw Lock Nut—Torque	27 N·m (20 lb.-ft.)



RG25615 —UN—24APR14

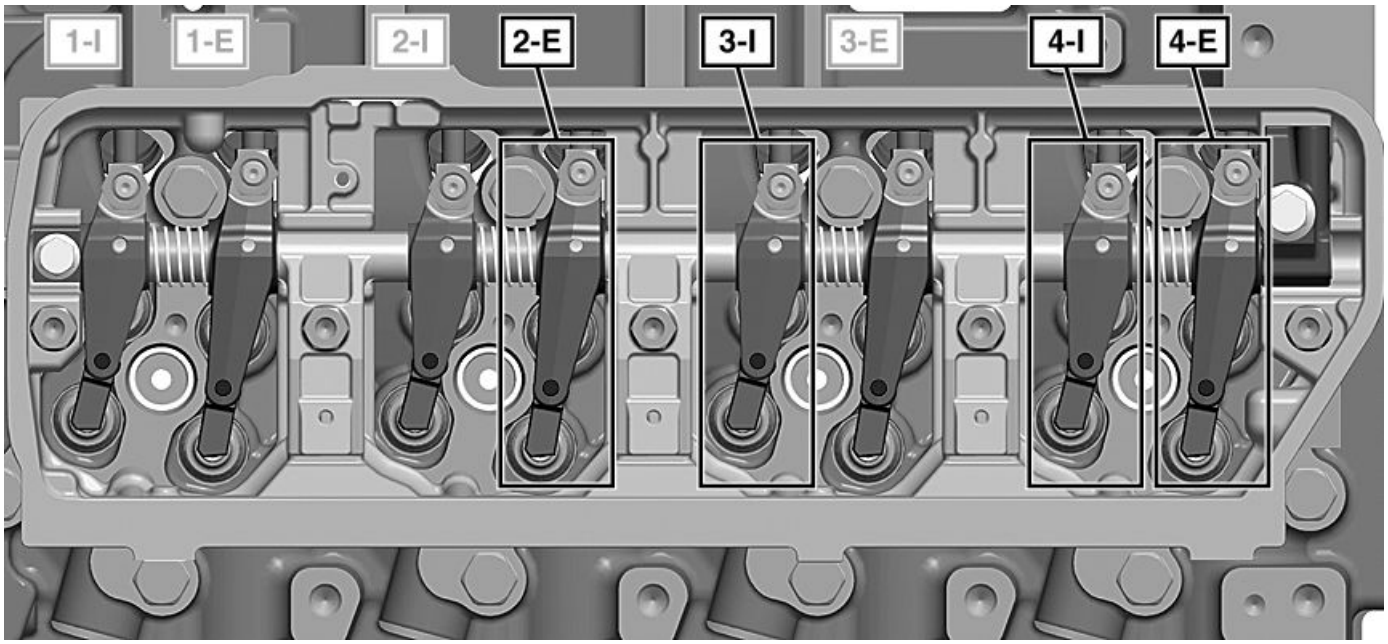
Rocker Arm Lock Nut

F—Lock Nut

Recheck clearance again after tightening lock nut. Readjust clearance as necessary.

Continued on next page

ZE59858,000001F -19-13AUG14-2/4



Valve Clearance Adjustment — #4 TDC

6. Rotate flywheel 360° until No. 4 piston is at “TDC” of its compression stroke. Rocker arms for No. 4 piston should be loose.
7. Check and adjust valve clearance to the same specifications on for No. 2 and 4 exhaust and No. 3 and 4 intake valves.

ZE59858,000001F -19-13AUG14-3/4

8. Install rocker arm cover gasket.

IMPORTANT: When reinstalling rocker arm cover, inspect gasket for damage prior to reusing.

9. Tighten cap screws to specifications, in the sequence shown.

Specification	
Rocker Arm Cover Cap Screws—Torque	11 N·m (97 lb.-in.)

10. Install vent tube to rocker arm cover.



Rocker Arm Cap Screws Tightening Sequence

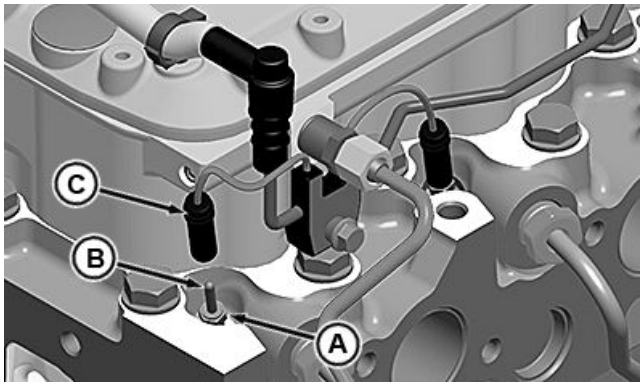
ZE59858,000001F -19-13AUG14-4/4

Testing Glow Plugs for Continuity

CAUTION: To prevent accidental starting of engine while performing this test, always disconnect NEGATIVE (—) battery terminal.

1. Remove glow plug wiring harness connector (C).
2. Using a multimeter, check resistance from terminal (B) to the outer body of glow plug (A).
   If resistance is more than 10 Ohms, the glow plug is damaged and must be replaced.
3. If needed, install new glow plugs and torque to specifications.

Specification	
Glow Plug—Torque	15 N·m (133 lb.-in.)



RG26311 —UN—13AUG14

Check Glow Plug

A—Glow Plug
B—Terminal
C—Harness Connector

ZE59858,0000020 -19-13AUG14-1/1

Access DEF Dosing Unit

See your application manual for information on accessing the DEF dosing unit.

ZE59858,000008D -19-23AUG13-1/1

Changing Diesel Exhaust Fluid (DEF) Dosing Unit Filter

CAUTION: Avoid contact with eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Reference the Materials Safety Data Sheet (MSDS) for additional information.

IMPORTANT: If DEF is spilled or contacts any surface other than the storage tank, immediately clean the surface with clear water. DEF is corrosive to painted and unpainted metallic surfaces and can distort some plastic and rubber components.

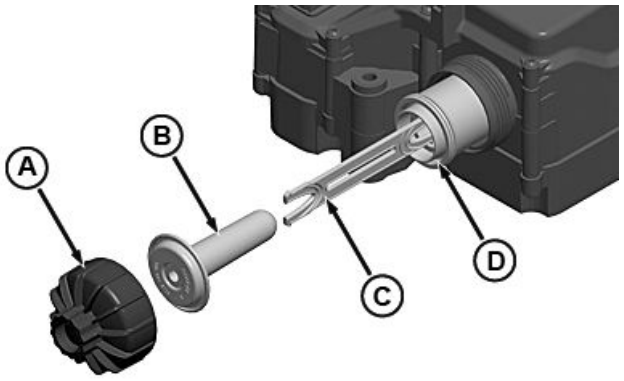
Spilled DEF, if left to dry or if only wiped away with a cloth, leaves a white residue. Improperly cleaned DEF spill can interfere with diagnosis of Selective Catalytic Reduction (SCR) system leakage problems.

NOTE: Servicing DEF dosing unit filter may require removing additional covers or components. See Access DEF Dosing Unit for location information.

1. Remove DEF dosing unit filter cover (A).
2. Remove and discard DEF dosing unit filter equalizing element (B).
3. Insert “Black” end of DEF dosing unit filter tool (C) into DEF dosing unit filter (D) until CLICK is felt or heard indicating DEF dosing unit filter tool is fully engaged.

NOTE: A tool such as a screwdriver can be inserted into DEF dosing unit filter tool slot to assist removal.

4. Pull DEF dosing unit filter tool and DEF dosing unit filter from DEF dosing unit. Discard DEF dosing unit filter and DEF dosing unit filter tool.



RG22534 —UN—21MAR13

DEF Dosing Unit Filter

A—DEF Dosing Unit Filter Cover
B—DEF Dosing Unit Filter Equalizing Element
C—DEF Dosing Unit Filter Tool
D—DEF Dosing Unit Filter

5. Clean DEF dosing unit threads and mating surfaces with distilled water.
6. Lubricate new DEF filter O-rings with clean engine oil. Carefully insert DEF dosing unit filter into DEF dosing unit.
7. Install new DEF dosing unit filter equalizing element into DEF dosing unit filter.
8. Install DEF dosing unit filter cover and tighten to specifications.

Specification	
DEF Dosing Unit Filter Cover—Torque	23 N·m (204 lb.-in.)

DX,DEF,CHANGE,FILT -19-12JUL13-1/1

Flushing and Refilling Cooling System

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly remove the pressure cap and allow pressure to relive before completely removing cap.

NOTE: If COOL-GARD II is not used, the drain interval is reduced to 2000 hours or 24 months of operation.

1. Pressure test entire cooling system and pressure cap if not previously done. (See Pressure Testing Cooling System in the Lubrication & Maintenance — 500 Hours/12 Months Section.
2. Slowly open the engine cooling system filler cap or radiator cap to relieve pressure and allow coolant to drain faster.



High-Pressure Fluids

TS281 —UN—15APR13

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ZE59858,0000021 -19-12AUG14-1/2

NOTE: Drain coolant from the lowest point in the cooling system. This location will vary by application.

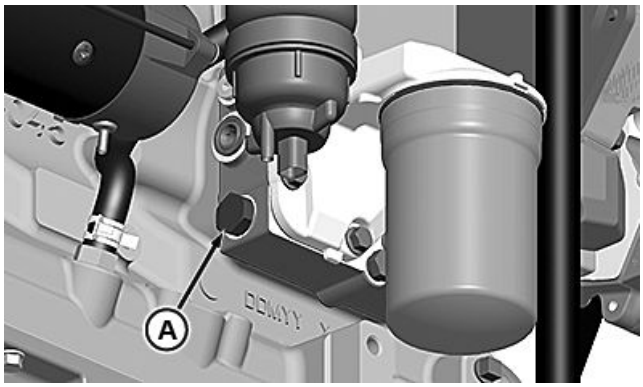
3. Drain all coolant from engine block.
4. Open radiator drain valve. Drain all coolant from radiator.
5. Remove thermostats at this time, if not previously done. Install cover (without thermostats and seals) and tighten socket head cap screws to specifications.

Specification	
Thermostat Cover — Socket Head Cap Screws—Torque	73 N·m (54 lb.-ft.)

6. Close all drain valves after coolant has drained.

CAUTION: Do not run engine longer than 10 minutes. Doing so may cause engine to overheat which may cause burns when radiator water is draining.

7. Fill the cooling system with clean water. Run the engine about 7 minutes to stir up possible contaminates or foreign particles.
8. Stop engine, pull off lower radiator hose and remove radiator cap. Immediately drain the water from system before contaminates or foreign particles settle.
9. After draining water, close drain valves. Install radiator cap, radiator hose, and clamp. Fill the cooling system with clean water and a heavy duty cooling system cleaner such as Restore or Restore Plus. Follow manufacturer's directions on label.
10. After cleaning the cooling system, drain cleaner and fill with water to flush the system. Run the engine about 7 minutes. Stop engine, remove radiator cap and drain water.
11. Close all drain valves on engine and radiator.
12. Perform Testing Thermostat Opening Temperature in the Lubrication & Maintenance — 6000 Hours/72 Months Section.



RG26298 —UN—12AUG14

Engine Block Coolant Drain Plug—Right Side of Engine

A—Right Side of Engine Block Coolant Drain Plug

13. Install thermostats using a new gasket. Tighten thermostat cover socket head cap screws to specifications.

Specification	
Thermostat Cover — Socket Head Cap Screws—Torque	73 N·m (54 lb.-ft.)

14. Add coolant to surge tank (See application manual for coolant volume).

Specification	
4.5 L Engine—Coolant Capacity (Excluding Radiator)	8.5 L (9 qt.)

15. Run engine until it reaches operating temperature. This mixes the solution uniformly and circulates it through the entire system. The normal engine coolant temperature range is 85—103 °C (185—217 °F).
16. After running engine, check coolant level and entire cooling system for leaks.
17. Inspect the fan belt for wear and check belt tension. (See Checking Belt Wear in the Lubrication & Maintenance — 500 Hours/12 Months Section.

ZE59858,0000021 -19-12AUG14-2/2

Testing Thermostat Opening Temperature

Removing Thermostats

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. DO NOT drain coolant until it has cooled below operating temperature. Always loosen radiator pressure cap or drain valve slowly to relieve pressure.



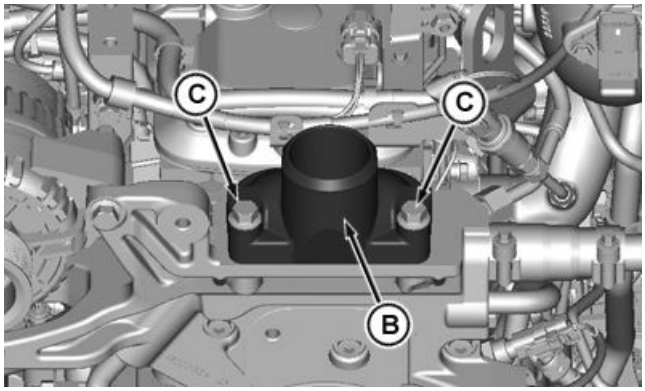
TS281 —UN—15APR13

High Pressure Fluids

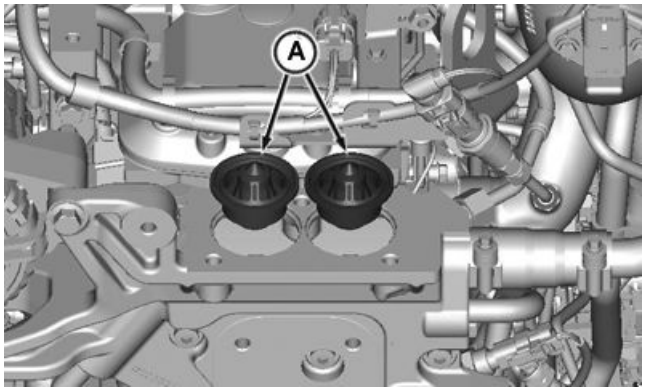
ZE59858,0000022 -19-18AUG14-1/4

1. Visually inspect area around thermostat housing for leaks.
2. Remove radiator pressure cap and partially drain cooling system.
3. Remove three cap screws (C) and thermostat cover (B) clean and check cover for cracks or damage.
4. Remove both thermostats (A) from the housing.

A—Thermostats (2 Used)
B—Thermostat Cover
C—Cap Screws (3 Used)



RG20113 —UN—18MAR11



RG20112 —UN—18MAR11

Removing Thermostats

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ZE59858,0000022 -19-18AUG14-2/4

Testing Thermostats Opening Temperature

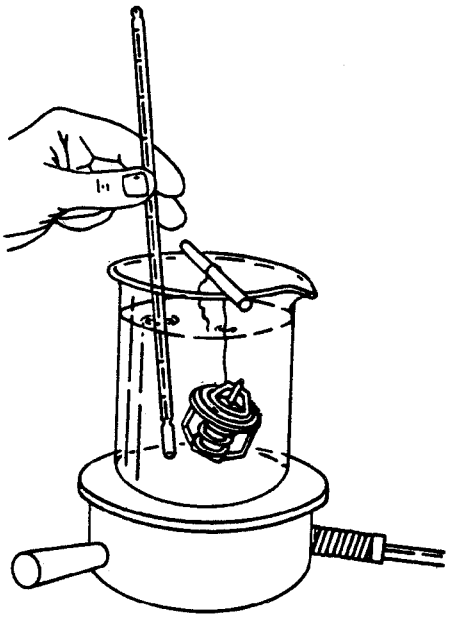
NOTE: Perform the following test for both thermostats.

1. Visually inspect thermostats for corrosion or damage. Replace as a matched set, as necessary.

CAUTION: DO NOT allow thermostat or thermometer to rest against the side or bottom of container when heating water. Either may rupture if overheated.

2. Suspend thermostat and a thermometer in a container of water.
3. Stir the water as it heats. Observe opening action of thermostat and compare temperatures to specifications.

NOTE: Due to varying tolerances of different suppliers, initial opening and full open temperatures may vary slightly from specified temperatures.



RG5971 —UN—23NOV97

Testing Thermostat Opening Temperature

Specification	
Thermostat Opening—Temperature	85 °C—97 °C (185 °F—207 °F)

4. Remove thermostat and observe its closing action as it cools. In ambient air the thermostat should close completely. Closing action should be smooth and slow.
5. If any thermostat is defective, replace both thermostats.

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ZE59858,0000022 -19-18AUG14-3/4

Installing Thermostats

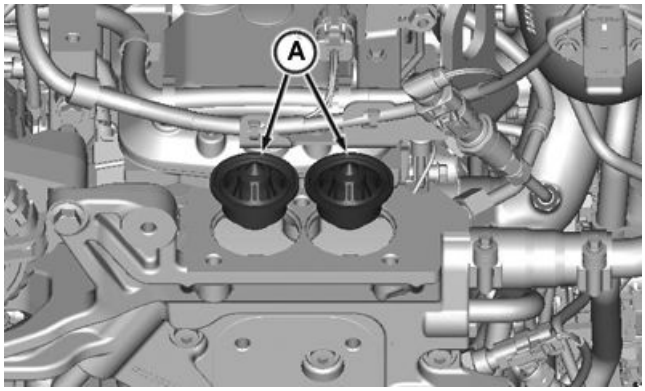
1. Install new rubber seal for each thermostat (A).
2. Install thermostats into housing (D).
3. Install thermostat cover (B) and tighten thermostat cover cap screws (C) to specifications.

Specification	
Thermostat Cover Cap Screw—Torque	73 N·m (54 lb.-ft.)

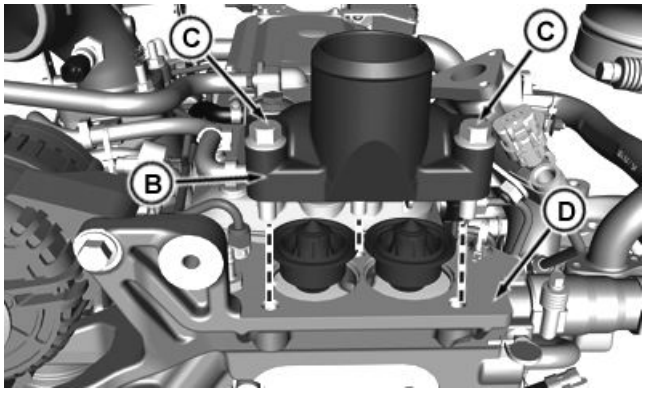
4. Fill cooling system and check for leaks.

IMPORTANT: Air must be expelled from cooling system when refilled.

A—Thermostats
B—Thermostat Cover
C—Cap Screws (3 Used)
D—Thermostat Housing



RG20112 —UN—18MAR11



RG25248 —UN—12MAR14

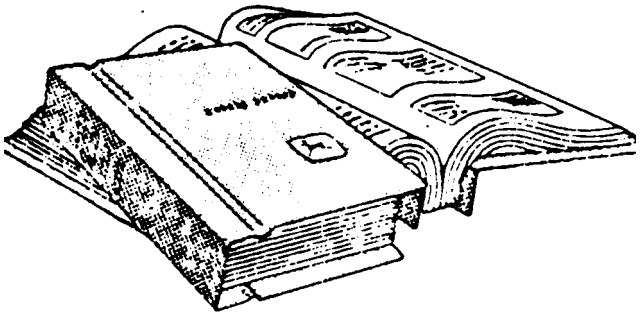
Installing Thermostats

ZE59858,0000022 -19-18AUG14-4/4

Service As Required

Additional Service Information

This is not a detailed service manual. If you want more detailed service information, contact your John Deere dealer or engine distributor.



RG4624 —UN—15DEC88

Component Technical Manuals

RK80614,0000038 -19-16OCT12-1/1

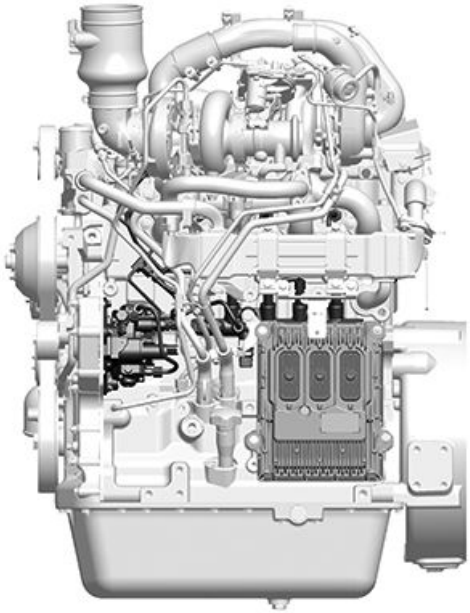
Do Not Modify Fuel System

IMPORTANT: Modification or alteration of the high-pressure fuel pump, the injection timing, or the fuel injectors in ways not recommended by the manufacturer will terminate the warranty obligation to the purchaser.

In addition, tampering with fuel system which alters emission-related equipment on engines may result in fines or other penalties, per EPA regulations or other local emission laws.

Do not attempt to service fuel pump, fuel rail, or fuel injectors yourself. Special training and special tools are required. (See your authorized servicing dealer or engine distributor.)

Avoid seizure of internal precision parts in high-pressure fuel pump or fuel injection rail. Never steam clean or pour cold water on pump or rail while these components are warm from operation.



RG26251 —UN—30JUL14

Fuel System

ZE59858,0000023 -19-30JUL14-1/1

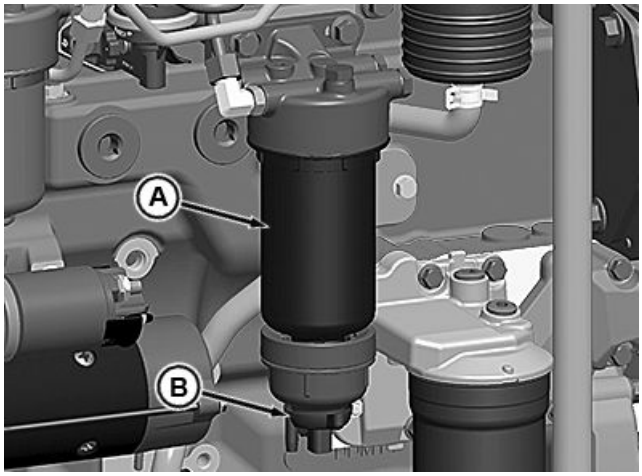
Drain Water From Fuel Filters

The primary fuel filter (A) is equipped with a sensor that detects the presence of water in the fuel filter element. This sensor will illuminate the “STOP ENGINE” warning light on the diagnostic gauge and also sound an audible alarm. A Diagnostic Trouble Code (DTC) will be displayed on the diagnostic gauge.

ALWAYS STOP ENGINE IMMEDIATELY and drain water from the primary fuel filter (A) when these warnings occur.

1. Loosen drain valve (B) to drain water and debris as needed.
2. Retighten valve securely.

NOTE: Replace fuel filter elements when amber indicator on instrument panel lights up AND Diagnostic Trouble Code (DTC) in diagnostic gauge window indicates plugged fuel filters (“low fuel pressure”). To replace fuel filter elements, see Removing and Installing Fuel Filters in the Lubrication & Maintenance — 500 Hours/12 Months Section.



RG26256 —UN—30JUL14

Drain Water From Fuel Filters

A—Primary Fuel Filter **B—Drain Valve**

ZE59858,0000024 -19-30JUL14-1/1

Adding Coolant

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to relieve pressure before removing completely.

IMPORTANT: Never pour cold liquid into a hot engine, as it may crack cylinder head or block. DO NOT operate engine without coolant for even a few minutes.

DO NOT use any other stop-leak additives in the cooling system. Leaks should be permanently repaired as quickly as possible.

Coolant level should be kept between the MIN COLD and MAX COLD marks on surge tank. Add coolant as follows:

1. Remove surge tank cap.

IMPORTANT: When adding coolant to the system, use the appropriate coolant solution. (See Diesel Engine Coolant (engine with wet sleeve cylinder liners) in the Fuels, Lubricants, and Coolants Section for mixing of coolant ingredients before adding to system.)

Do not overfill cooling system. A pressurized system needs space for heat expansion without overflowing.

2. Fill surge tank until coolant level is at the MAX COLD mark on surge tank.
3. Reinstall surge tank cap.



TS281 —UN—15APR13

High Pressure Fluids

ZE59858,00000D6 -19-05FEB14-1/1

Cleaning Diesel Exhaust Fluid (DEF) Tank

CAUTION: Avoid contact with eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Reference the Materials Safety Data Sheet (MSDS) for additional information.

IMPORTANT: If DEF is spilled or contacts any surface other than the storage tank, immediately clean the surface with clear water. DEF is corrosive to painted and unpainted metallic surfaces and can distort some plastic and rubber components.

Spilled DEF, if left to dry or if only wiped away with a cloth, leaves a white residue. Improperly cleaned DEF spill can interfere with diagnosis of Selective Catalytic Reduction (SCR) system leakage problems.

If foreign material or fluid has been added to the DEF tank, drain the DEF tank, flush, and fill with new DEF.

If DEF quality is in question, pull a sample out of the DEF tank and place into a clear container. DEF should be crystal clear with a light ammonia smell. If DEF appears cloudy, has a colored tint or has a profound ammonia smell, it is likely not within specification. DEF in this condition should not be used.

1. Remove drain plug (if equipped), and drain or siphon bad DEF from DEF tank.

NOTE: Cleaning can take place with DEF tank installed or removed.

2. Clean DEF tank with new DEF.

   DEF must pass visual, smell, and concentration checks before the engine can be ran. See Diesel Exhaust Fluid (DEF) – For Use In Selective Catalytic Reduction (SCR) Equipped Engines in the Fuels, Lubricants, and Coolants Section for more information.

3. Drain or siphon DEF tank.

NOTE: Repeat steps 2—3 until DEF tank has been cleaned.

4. Change DEF dosing unit filter.
5. Install drain plug in DEF tank, if removed. Install DEF tank, if removed.
6. Fill DEF tank with new DEF.
7. Check DEF concentration with DEF refractometer, such as JDG11594 or JDG11684. The correct DEF concentration is 31.8% — 33.2%. See your authorized dealer for more information.
8. If DEF is not within specification, does not appear clear, or does not have a slight ammonia smell, contact your authorized dealer.

DX,DEF,CLEANTANK -19-12JUL13-1/1

Pre-Start Cleaning Guide

IMPORTANT: Before cleaning machine, allow ample time for hot surfaces to cool.

IMPORTANT: Do not direct high-pressure spray from hose output directly at or close to electrical connections and sensors.

Rigorous cleaning as needed is recommended. Clean more frequently during heavy machine use, and when weather conditions are dry.

- Check enclosed areas daily. Clean the engine and other enclosed areas of equipment to remove debris and any buildup of oil and grease. Keep the engine and engine compartment free of combustible material.
- Check for debris buildup daily on and around intake systems, exhaust systems, and intercooler piping systems. Verify that there are no holes or leaks in intake or exhaust systems. Do not allow debris to build up near hot exhaust components. Verify that hot exhaust components are cleaned as often as environmental conditions require.
- Inspect cooling system daily to determine whether cooling system needs cleaning. Visible buildup of residue that blocks airflow may degrade machine performance and requires more frequent cleaning depending on environmental conditions.
- Inspect difficult to observe areas daily as conditions may require additional cleaning care to remove debris.
- Check for oil and fuel leaks daily. Replace or repair any sources of leaks, including gaskets, seals, breather tubes, fittings, and fluid lines.

Maintenance and Service Reminders

- Keep surfaces free of grease and oil.
- Clean up after hydraulic and other fluid leaks.
- Fuel Lines — Check for leaks, cracks, and kinks that require service before use.
- Fuel Pumps — Check fittings, especially compression ring couplings, for cracks and leaks.
- Fuel Injectors — Check pressure and return lines for signs of leaks.
- When servicing fuel filter or draining water separator, avoid fuel spills. Immediately clean up any fuel spill.
- Handle transmission and power steering fluids with care. Immediately clean up any spills, especially around fill points.
- Check for transmission case venting system seepage, transmission case leakage, power steering cylinder leakage, or power steering line leakage.
- Check for loose electrical connectors, damaged wiring, corrosion, and poor connections.

ZE59858,0000009 -19-20MAY13-1/1

Replacing Air Filter Element

IMPORTANT: ALWAYS REPLACE primary air cleaner element when air filter restriction indicator shows a vacuum of 625 mm (25 in.) H_2O, is torn, or visibly dirty.

NOTE: This procedure applies to John Deere 2-stage radial seal air cleaner kits. Refer to manufacturers' instructions for servicing air cleaners not supplied by John Deere.

1. Unlatch and remove dust cap/cover (A) of air cleaner.
2. Move end of filter (B) back and forth gently to break seal.
3. Pull filter (B) off outlet tube and out of housing.
4. Thoroughly clean all dirt from inside housing and from outlet bore.

IMPORTANT: Remove secondary (safety) element (C) ONLY for replacement. DO NOT attempt to clean, wash, or reuse secondary element. Replacement of secondary element is usually necessary ONLY when primary element has a hole in it.

5. To replace secondary element (C), pull filter element out gently. Immediately replace secondary element with new element to prevent dust from entering air intake system.
6. Install new primary filter element. Apply pressure by hand at outer rim of filter.

IMPORTANT: Do NOT use latches on cover to force filter into air cleaner. Using cover to force filter will damage cleaner housing.

7. Close housing with dust unloader valve aimed down and latch latches.

IMPORTANT: Whenever the air cleaner has been serviced or cover has been removed, ALWAYS fully depress the air filter restriction indicator reset button (if equipped) to assure accurate readings.

8. If equipped, fully depress air filter restriction indicator reset button and release to reset indicator.



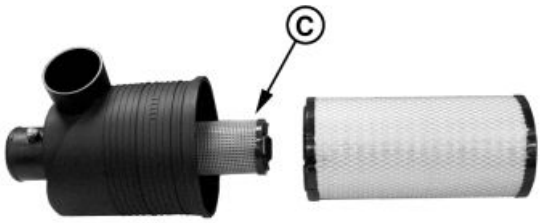
RG11321A —UN—08SEP00

Dust Cap/Cover



RG11322A —UN—08SEP00

Primary Filter Element



RG11327A —UN—08SEP00

Secondary Filter Element

A—Dust Cap/Cover
B—Primary Filter Element
C—Secondary Filter Element

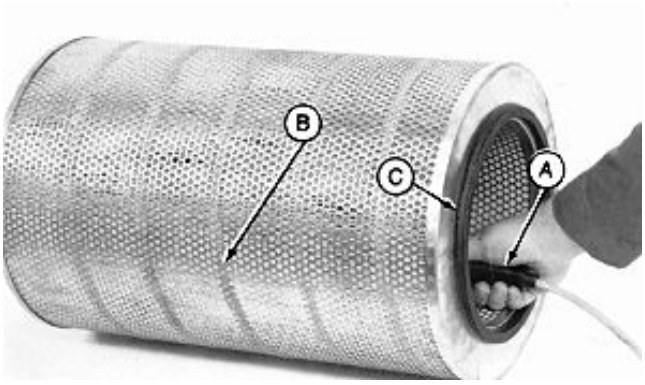
ZE59858,0000113 -19-26AUG13-1/1

Inspecting Primary Air Filter Element

1. Hold a bright light (A) inside element and check carefully for holes. Discard any element which shows the smallest hole or rupture.
2. Be sure outer screen (B) is not dented. Vibration would quickly wear a hole in filter.
3. Be sure filter gasket (C) is in good condition. If gasket is damaged or missing, replace element.

IMPORTANT: Air cleaner MUST BE DRY before storing in plastic bag.

If the filter is to be stored for later use, place it in a plastic bag to protect it from dust and damage.



RW4768 —UN—15DEC88

Inspecting Primary Air Filter Element

A—Light
B—Outer Screen
C—Gasket

RK80614,000003D -19-16OCT12-1/1

Air Filter Element Storage

IMPORTANT: Air cleaner element MUST BE DRY before storing in plastic bag.

Seal element in a plastic bag and store in shipping container to protect against dust and damage.

RK80614,000003F -19-26AUG13-1/1

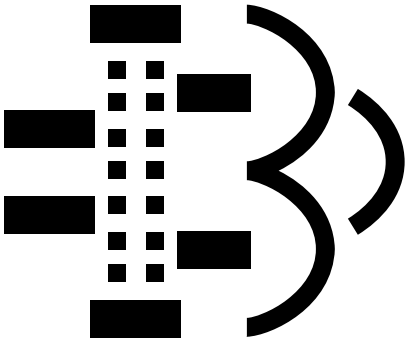
Cleaning the Exhaust Filter

The exhaust filter will require maintenance periodically. Some of the maintenance will be transparent to the operator. During continuous heavy loads and other conditions, the engine may create enough heat to naturally remove accumulated soot in the exhaust filter. When the exhaust filter has accumulated higher levels of soot, the display panel may request (depending on predefined user settings) an exhaust filter cleaning. During this request, the equipment is required to be located or moved to a suitable location with adequate ventilation.

To the right are symbols which may be seen on the operator interface.

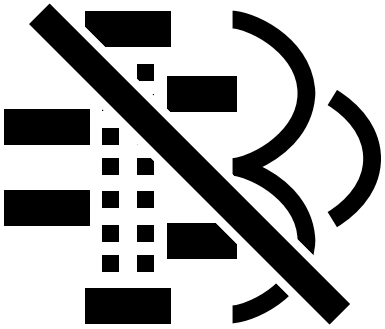
IMPORTANT: The area above and surrounding the engine during a manual exhaust filter cleaning should be free of any flammable objects as temperatures can reach as high as 550 °C (1022 °F).

NOTE: For more information on the operator interface icons or exhaust filter cleaning procedures, please see the Aftertreatment System Section of this Manual, or the corresponding Component Technical Manual (CTM).



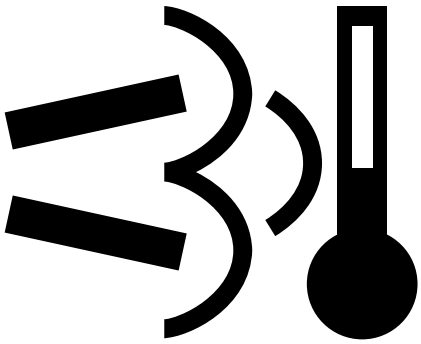
RG16860 —UN—01APR10

Exhaust Filter Cleaning is Needed



RG16861 —UN—01APR10

Exhaust Filter Cleaning is Disabled



RG16862 —UN—01APR10

Emission System Temperature is High or Exhaust Filter Cleaning is Underway

RK80614,0000040 -19-10JUN13-1/1

Replacing Fan Belt

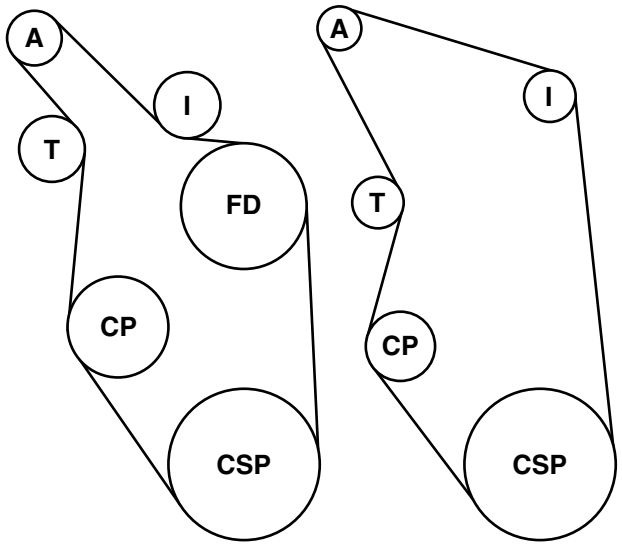
See Checking Tensioner Spring Tension in the Lubrication & Maintenance — 500 Hours/12 Months Section for additional information on the belt tensioner.

1. Inspect belt for cracks, fraying, or stretched out areas. Replace if necessary.
2. To replace belt with automatic tensioner, release tension on belt using a long handled 1/2 inch drive tool in square hole in end of tensioner arm.
3. Remove poly-vee belt from pulleys and discard belt.

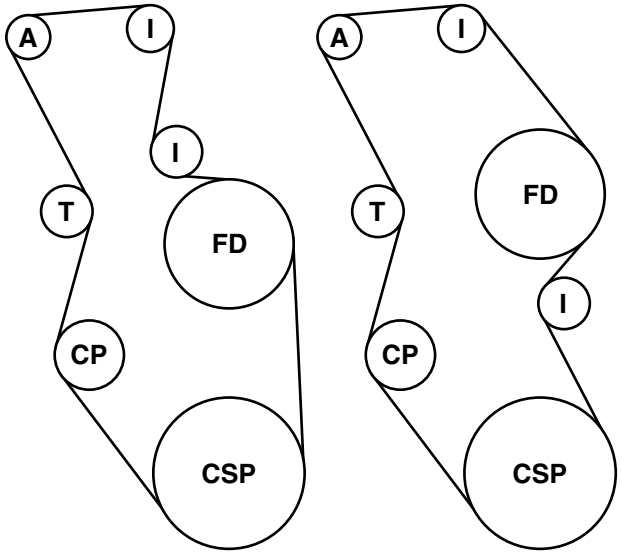
NOTE: While belt is removed, inspect pulleys and bearings. Rotate and feel for hard turning or any unusual sounds. If pulleys or bearings need replacement, see your John Deere dealer.

4. Install new belt, making sure that belt is correctly seated in all pulley grooves. Text on belt (such as John Deere or part number) should be readable when standing at the front of the engine looking back toward the rear. Refer to belt routing at right for your application.
5. Apply tension to belt with tensioner. Remove drive tool.
6. Install fan guard if removed.
7. Start engine and check belt alignment.

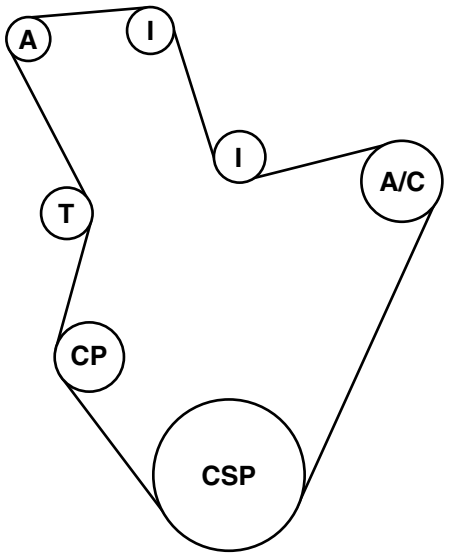
A—Alternator
A/C— Refrigerant Compressor
CSP—Crankshaft Pulley
FD—Fan Drive
I— Idler Pulley
T—Tensioner
CP—Coolant Pump



RG26257 —UN—30JUL14



RG26258 —UN—30JUL14



RG26259 —UN—30JUL14

AT89373,0000003 -19-30JUL14-1/1

Checking Fuses

Check the following fuses located in the control panel wiring harness. Replace defective fuses.

- Control Panel fuse — 30 Amp
- JD Link fuse — 10 Amp
- ECU fuse — 25 Amp (3 used)
- TVP fuse — 30 Amp

See 4.5 L Wiring Diagram 10 in the Troubleshooting Section.

ZE59858,0000025 -19-18AUG14-1/1

Checking Electrical Wiring And Connections

Check for loose or corroded wiring and connectors. Tighten connections or replace wiring as needed. See your authorized servicing dealer for repairs.

RK80614,0000043 -19-16OCT12-1/1

Bleeding Fuel System

NOTE: Normally the fuel system on these engines is self-priming and self-bleeding, and does not require a bleeding procedure by the operator.

If engine will not start after filter changes, turn ignition key ON for 60 seconds to prime the fuel system. It may be necessary to turn the key off and on again to reprime the system before starting.

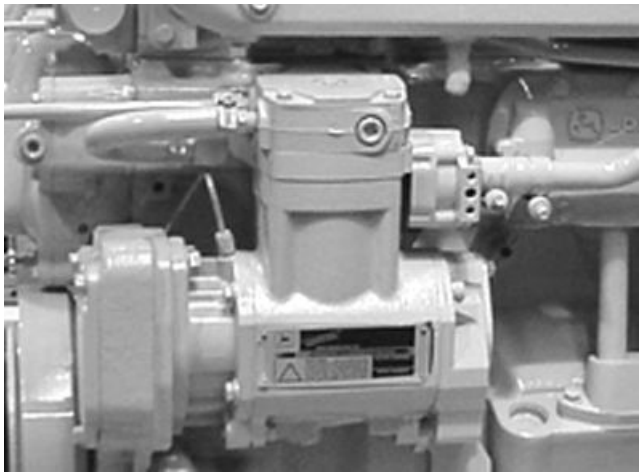
RK80614,0000044 -19-16OCT12-1/1

Checking Air Compressors (If Equipped)

Air compressors are offered as options with John Deere OEM engines to provide compressed air to operate air-powered devices like vehicle air brakes.

Air compressors are engine-driven piston types. They are either air cooled or cooled with engine coolant. The compressors are lubricated with engine oil. The compressor runs continuously as gear or spline driven by the auxiliary drive of the engine but has “loaded” and “unloaded” operating modes. This is controlled by the vehicle's air system (refer to vehicle technical manual for complete air system checks and services).

See your John Deere engine distributor or servicing dealer for diagnostic and troubleshooting information. If diagnosis leads to an internal fault in the compressor, replace the complete compressor as a new or remanufactured unit.



RG12738 —UN—07NOV02

Air Compressor (Optional)

RK80614,0000045 -19-16OCT12-1/1

Checking Refrigerant (A/C) Compressor (If Equipped)

Contact your authorized servicing dealer for any service or repairs to the air conditioning system.

RK80614,0000046 -19-16OCT12-1/1

General Troubleshooting Information

Troubleshooting engine problems can be difficult. An engine wiring diagram is provided in this section to help isolate electrical problems on power units using John Deere wiring harness and instrument (gauge) panel.

Later in this section is a list of possible engine problems that may be encountered accompanied by possible causes and corrections. The illustrated diagrams and troubleshooting information are of a general nature; final design of the overall system for your engine application may be different. See your engine distributor or servicing dealer if you are in doubt.

A reliable program for troubleshooting engine problems should include the following basic diagnostic thought process:

- Know the engine and all related systems.
- Study the problem thoroughly.
- Relate the symptoms to your knowledge of engine and systems.
- Diagnose the problem starting with the easiest things first.
- Double-check before beginning the disassembly.
- Determine cause and make a thorough repair.
- After making repairs, operate the engine under normal conditions to verify that the problem and cause was corrected.

NOTE: All engines have electronic control systems which may send diagnostic trouble codes to signal problems (see Diagnostic Trouble Codes (DTCs) — Operation in the Troubleshooting Section).

1. *If fault codes are present, perform the suggested corrective actions.*
2. *If this does not correct the engine problem, contact your servicing dealer.*
3. *If engine has problems but no fault codes are displayed, see Engine Troubleshooting in the Troubleshooting Section for problems and solutions.*

EP89502,0000001 -19-16SEP13-1/1

Diagnostic Trouble Codes (DTCs) — Listing

NOTE: Not all of these codes are used in all engine applications.

NOTE: Not all DTCs are listed below. See your application technical manual for more information.

There are several possible combinations of SPN and FMI codes. To use the table below, first write down the SPN and FMI codes you received from the engine diagnostic gauge. Locate each SPN and its associated definition. In the same way, locate the FMI and its associated definition.

FMI Code	FMI Name
0	Extremely High
1	Extremely Low
2	Invalid
3	Out of Range High
4	Out of Range Low
5	High Resistance
6	Low Resistance
7	Mismatch
8	Signal Missing
9	Loss of Communication
10	Change Abnormal
11	Activated
12	Error
13	Fault
14	Incorrect Message
15	Slightly High
16	Moderately High
17	Slightly Low
18	Moderately Low
19	Communication Error
31	Condition Exists

SPN Code	SPN Name
27	EGR Valve Position Signal
51	Air Throttle Actuator Position Signal
94	Low Pressure Fuel Pressure Signal
97	Water-in-fuel Signal
100	Engine Oil Pressure Signal
101	Crankcase Pressure
102	Manifold Air Pressure Signal
103	VGT Speed Signal
105	Manifold Air Temperature Signal
107	Air Filter Pressure Differential
108	Barometric Pressure Signal
109	Engine Coolant Pressure Signal
110	Engine Coolant Temperature Signal
111	Engine Coolant Level Alarm Switch
157	Fuel Rail Pressure Signal
158	ECU Power Down
168	Unswitched Battery Voltage
174	Fuel Temperature Signal
189	Engine Speed Derate
190	Engine Speed
412	EGR Temperature Signal
611	Injector Drive #1
612	Injector Drive #2
613	Fuel Pressure Control Valve Drive
629	ECU EEPROM
636	Camshaft Position Signal
637	Crankshaft Position Signal
651	Injector #1
652	Injector #2

Continued on next page

SPN Code	SPN Name
653	Injector #3
654	Injector #4
655	Injector #5
656	Injector #6
695	Unapproved Engine Speed Request
970	External Shutdown Switch
1075	Low Pressure Fuel Pump Data
1136	ECU Temperature Signal
1172	Intake Air Temperature
1176	Intake Air Pressure
1180	Calculated VGT Turbine Inlet Temp
1209	Exhaust Manifold Pressure Signal
1347	Fuel Pump Pressure Control Valve 1
1348	Fuel Pump Pressure Control Valve 2
1321	Engine Starter Control Circuit
1569	Engine Power Derate
1761	DEF Tank Fuel Level Signal
2002-2253	Source Address 2-253
2629	Fixed Turbo Comp Outlet Temp Signal
2630	Charge Air Cooler Outlet Temp Signal
2659	EGR Flow Signal
2790	Fixed Turbocharger Comp Outlet Temp
2791	EGR Valve Drive Circuit
2795	VGT Calibration Version
2797	Injector High Voltage Supply #1
2798	Injector High Voltage Supply #2
3031	DEF Tank Fluid Temp Signal
3216	DPF Outlet NOx
3226	SCR Outlet NOx
3246	DPF Outlet Temperature
3251	DPF Differential Pressure Signal
3361	DEF Dosing Injector Signal
3464	Air Throttle Actuator Drive Circuit
3509	Sensor Supply #1 Voltage
3510	Sensor Supply #2 Voltage
3511	Sensor Supply #3 Voltage
3512	Sensor Supply #4 Voltage
3513	Sensor Supply #5 Voltage
3514	Sensor Supply #6 Voltage
3597	Injector Power Supply Voltage
3719	Calculated Soot Level
3720	Calculated Ash Level
3936	DPF Fault Occurrences
4334	DEF Dosing Unit Outlet Pressure
4341	DEF Dosing Unit Pressure line Heater
4343	DEF Dosing Unit Supply Line Heater
4345	DEF Dosing Unit Return Line Heater
4360	SCR Inlet Temperature
4363	SCR Outlet Temperature
4364	SCR Catalyst Conversion Efficiency
4366	DEF Tank Heater Coolant Valve
4376	Reversing Valve

Continued on next page

ZE59858,0000026 -19-04MAR14-2/3

SPN Code	SPN Name
4490	Intake Air Humidity
4765	DOC Inlet Temp
4766	DOC Outlet Temp
4795	DPF Missing
5018	DOC Fault Occurrences
5125	Sensor Supply #7 Voltage
5126	Sensor Supply #8 Voltage
5127	Sensor Supply #9 Voltage
5298	DOC Efficiency
5435	DEF Dosing Unit Pump
5571	HPCR Pressure Relief Valve
5743	SCR Temperature Module
5745	DEF Dosing Unit Heater
522494	Intake Air Sensor Communication
522495	Exhaust Filter Temp Module

NOTE: Diagnostic gauge on instrument panel may also display text for communication faults, such as “CAN Bus FAILURE”. Contact your servicing dealer.

ZE59858,0000026 -19-04MAR14-3/3

Diagnostic Trouble Codes (DTCs) — Operation

SPN/FMI CODES

Stored and active diagnostic trouble codes are output on the diagnostic gauge on the Deere electronic instrument panel according to the J1939 standard as a two-part code as shown on the tables on the following pages.

The first part is a Suspect Parameter Number (SPN) followed by a Failure Mode Identifier (FMI) code. In order to determine the exact failure, both parts (SPN and FMI) of the code are needed.

The SPN identifies the system or the component that has the failure; for example SPN 000110 indicates a failure in the engine coolant temperature circuit.

The FMI identifies the type of failure that has occurred; for example FMI 03 indicates value above normal. Combining SPN 000110 with FMI 03 yields a fault code “engine coolant temperature input voltage too high”. A corrective action will also be displayed, “check sensor and wiring”. If this check does not solve the engine fault, contact your servicing dealer.

Always contact your servicing dealer for help in correcting unsolved diagnostic trouble codes which are displayed for your engine.

RK80614,000004A -19-26AUG13-1/1

Intermittent Fault Diagnostics

Intermittent faults are problems that periodically “go away”. A problem such as a terminal that intermittently doesn't make contact can cause an intermittent fault. Other intermittent faults may be set only under certain operating conditions such as heavy load, extended idle, etc. When diagnosing intermittent faults, take special note of the condition of wiring and connectors, since a high percentage of intermittent problems originates here. Check for loose, dirty, or disconnected connectors. Inspect the wiring routing, looking for possible shorts caused by contact with external parts (for example, rubbing against sharp sheet metal edges). Inspect the connector vicinity, looking for wires that have pulled out of connector terminals, damaged connectors, poorly positioned terminals, and corroded or damaged splices and terminals. Look for broken wires, damaged splices, and wire-to-wire shorts. Use good judgment if component replacement is thought to be required.

NOTE: The engine control unit (ECU) is the component LEAST likely to fail.

Suggestions for diagnosing intermittent faults:

- If diagnostic charts on preceding pages indicate that the problem is intermittent, try to reproduce the operating conditions that were present when the diagnostic trouble code (DTC) set.
- If a faulty connection or wire is suspected to be the cause of the intermittent problem: clear DTCs, then check the connection or wire by wiggling it while watching the diagnostic gauge to see if the fault resets.

Possible causes of intermittent faults:

- Faulty connection between sensor or actuator harness.
- Faulty contact between terminals in connector.
- Faulty terminal/wire connection.
- Electromagnetic interference (EMI) from an improperly installed 2-way radio, etc., can cause faulty signals to be sent to the ECU.

NOTE: Refer to wiring diagrams later in this section as a guide to connections and wiring.

RK80614,000004C -19-26AUG13-1/1

Engine Troubleshooting

NOTE: Before troubleshooting the engine, first retrieve any fault codes on the diagnostic gauge display and perform the corrective actions. If any problems remain, use the following charts to solve engine problems.

Symptom	Problem	Solution
Engine Will Not Crank	Low battery output voltage or discharged battery	Charge or replace batteries.
	Loose or corroded connections	Clean and tighten connections.
	Faulty start circuit relay	See your authorized John Deere engine distributor or servicing dealer.
	Blown fuse	Replace fuse.
	Defective main switch or start safety switch	Repair switch as required.
	Starter solenoid defective	Replace solenoid.
	Starter defective	Replace starter.
Starter Cranks Slowly	Low battery output voltage or discharged battery	Charge or replace batteries.
	Too high viscosity crankcase oil	Drain crankcase oil and replace with correct viscosity oil.
	Loose or corroded connections	Clean and tighten connections.
Hard to Start or Will Not Start	Engine starting under load	Disengage PTO.
	Improper starting procedure	Review starting procedure.
	Exhaust restricted	Check and correct exhaust restriction.
	No fuel	Check fuel tank.
	Air in fuel line	Bleed fuel lines.
	Poor fuel quality	Drain fuel and replace with proper grade and quality of fuel for operating condition.
	Water, dirt, or air in fuel system	Drain, flush, fill, and bleed fuel system.
	Fuel filter restricted or full of water	Replace fuel filter or drain water from fuel filter.
	Dirty or faulty fuel injectors	See your authorized John Deere engine distributor or servicing dealer.
	Electronic fuel system problem	See your authorized John Deere engine distributor or servicing dealer.

Continued on next page

Symptom	Problem	Solution
	Cold weather	Use cold weather starting aids. See Cold Weather Operation in the Engine Operation Section.
	Too high viscosity crankcase oil	Drain crankcase oil and replace with correct viscosity oil.
	Electronic Control System Problem or Basic Engine Problem	See your authorized John Deere engine distributor or servicing dealer.
Engine Misfiring or Runs Irregularly	Poor fuel quality	Incorrect fuel/dirty fuel
		Test fuel, drain water from fuel bowl.
	Restricted fuel filter	Replace fuel filter element.
	Water, dirt, or air in fuel system	Drain, flush, fill, and bleed fuel system.
	Low coolant temperature	Remove and check thermostat.
	Dirty or faulty fuel injectors	See your authorized John Deere engine distributor or servicing dealer.
	Electronic fuel system problem	See your authorized John Deere engine distributor or servicing dealer.
	Electronic Control System problem or basic engine problem	See your authorized John Deere engine distributor or servicing dealer.
Lack of Engine Power	Intake air restriction	Service air cleaner.
	Exhaust restricted	Check and correct exhaust restriction.
	Poor fuel quality	Drain fuel and replace with proper grade and quality of fuel for operating condition.
	Restricted fuel filter	Replace fuel filter elements.
	Engine overloaded	Reduce engine load.
	Improper crankcase oil	Drain crankcase oil and replace with correct viscosity oil.
	Low coolant temperature	Remove and check thermostat.
	Improper valve clearance	Adjust valve clearance. See Adjusting Valve Clearance in the Lubrication & Maintenance — 3000 Hours/36 Months.
	Dirty or faulty fuel injectors	See your authorized John Deere engine distributor or servicing dealer.

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Symptom	Problem	Solution
	Turbocharger not functioning properly	See your authorized John Deere engine distributor or servicing dealer.
	Air leak in engine intake or exhaust manifold	Check intake and exhaust manifold gaskets and manifolds; repair as required. See your authorized John Deere engine distributor or servicing dealer.
	Engine is in derate due to DTC	See your authorized John Deere engine distributor or servicing dealer.
	Electronic Control System problem or basic engine problem	See your authorized John Deere engine distributor or servicing dealer.
Engine Idles Poorly	Poor fuel quality	Drain fuel and replace with proper grade and quality of fuel for operating condition.
	Electronic control system problem or basic engine problem	See your authorized John Deere engine distributor or servicing dealer.
Excessive Fuel Consumption	Engine overloaded	Reduce engine load.
	Air cleaner restricted or dirty	Replace air cleaner element as required.
	Compression too low	Determine cause of low compression and repair as required.
	Leaks in fuel supply system	Locate source of leak and repair as required.
	Improper type of fuel	Drain fuel and replace with proper grade and quality of fuel for operating condition.
	Poor fuel quality	Drain fuel and replace with proper grade and quality of fuel for operating condition.
	Improper valve clearance	Adjust valve clearance. See Adjusting Valve Clearance in the Lubrication & Maintenance — 3000 Hours/36 Months.
	Dirty or faulty fuel injectors	See your authorized John Deere engine distributor or servicing dealer.
	Electronic fuel system problem	See your authorized John Deere engine distributor or servicing dealer.
	Electronic Control System problem or basic engine problem	See your authorized John Deere engine distributor or servicing dealer.

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Symptom	Problem	Solution
	Turbocharger not functioning properly	Inspect turbocharger. See your authorized John Deere engine distributor or servicing dealer.
	Low engine temperature	Remove and check thermostat.
Fuel in Oil	Restricted fuel return line	Check and fix fuel return lines.
	Engine load too light	Increase engine load
	Leaking fuel injectors	See your authorized John Deere engine distributor or servicing dealer.
Low-Pressure Fuel System — Fuel Pressure Low	Restricted fuel filter	Replace fuel filter.
	Restricted fuel line	Locate restriction, repair as required.
	Faulty transfer pump	See your authorized John Deere engine distributor or servicing dealer.
	Faulty high-pressure fuel pump	Remove fuel pump, repair/replace pump as required. See your authorized John Deere engine distributor or servicing dealer.
Abnormal Engine Noise	Worn main or connecting rod bearings	Determine bearing clearance. See your authorized John Deere engine distributor or servicing dealer.
	Excessive crankshaft end play	Check crankshaft end play. See your authorized John Deere engine distributor or servicing dealer.
	Loose main bearing caps	Check bearing clearance; replace bearings and bearing cap screws as required. See your authorized John Deere engine distributor or servicing dealer.
	Worn connecting rod bushings and piston pins	Inspect piston pins and bushings. See your authorized John Deere engine distributor or servicing dealer.
	Scored pistons	Inspect pistons. See your authorized John Deere engine distributor or servicing dealer.
	Worn timing gears or excess backlash	Check timing gear back lash. See your authorized John Deere engine distributor or servicing dealer.

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Symptom	Problem	Solution
	Excessive valve clearance	Check and adjust valve clearance. See Adjusting Valve Clearance in the Lubrication & Maintenance 3000 Hours/36 Months Section.
	Worn camshaft lobes	Inspect camshaft. See your authorized John Deere engine distributor or servicing dealer.
	Worn rocker arm shaft(s)	Inspect rocker arm shafts. See your authorized John Deere engine distributor or servicing dealer.
	Worn valve guides	Check valve guides for wear. See your authorized John Deere engine distributor or servicing dealer.
	Damaged valve retainers	Inspect retainer and retainer locks for excessive wear. See your authorized John Deere engine distributor or servicing dealer.
	Loose or worn rocker arms	Inspect rocker arms for wear. See your authorized John Deere engine distributor or servicing dealer.
	Bent pushrods	Inspect pushrods for straightness and check contact ends for wear and damage. See your authorized John Deere engine distributor or servicing dealer.
	Broken valve springs	Inspect valve springs. See your authorized John Deere engine distributor or servicing dealer.
	Bent connecting rods	Inspect connecting rod and cap for damage. See your authorized John Deere engine distributor or servicing dealer.
	Worn flywheel	Inspect flywheel and ring gear for damage. See your authorized John Deere engine distributor or servicing dealer.
	Loose flywheel	Check flywheel mounting screw. See your authorized John Deere engine distributor or servicing dealer.
	Excessive piston to liner clearance	Check and adjust piston liner clearance. See your authorized John Deere engine distributor or servicing dealer.

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Symptom	Problem	Solution
	Excessive thrust bearing clearance	Check and adjust thrust bearing clearance. See your authorized John Deere engine distributor or servicing dealer.
	High oil viscosity	Drain engine oil and refill with correct viscosity engine oil
Turbocharger "Screams"	Leak in intake air system	Check air system for loose clamps, damaged tubes, charged air cooler leaks, and intake manifold gasket leaks; repair as required. See your authorized John Deere engine distributor or servicing dealer.
Turbocharger Noise or Vibration *NOTE: Variable geometry turbocharger recycles after starting engine, causing a momentary revving sound in the engine. This is normal.* *Do not confuse the whine heard during run down with noise which indicates a bearing failure.*	Bearings not lubricated (insufficient oil pressure)	Determine cause of lack of lubrication; repair as required. See your authorized John Deere engine distributor or servicing dealer.
	Air leak in engine intake or exhaust manifold	Check intake and exhaust manifold gaskets and manifolds; repair as required. See your authorized John Deere engine distributor or servicing dealer.
	Improper clearance between turbine wheel and turbine housing	Inspect turbocharger; repair/replace as required. See your authorized John Deere engine distributor or servicing dealer.
	Broken blades (or other wheel failures)	Inspect turbocharger; repair/replace as required. See your authorized John Deere engine distributor or servicing dealer.
Engine has reached Service Only Soot Level	Auto Filter cleaning is disabled for an extended period of time	Enable exhaust filter cleaning.
	Frequent engine shut downs occurred while auto cleaning was in process	Let engine run for 30 min to clean the exhaust filter.
	Interlock switches are not properly set to allow DPF recovery/Regeneration to occur	Machine must be stationary (Parked). Engine speed must be above the minimum setpoint. Any PTO driven device must be shut off. Engine load must be stable.
SCR High NOx Outlet	DEF tank is low	Fill DEF tank with new DEF.

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Symptom	Problem	Solution
	Fluid other than DEF has been added to the DEF tank	Drain, flush, and fill DEF tank with new DEF. See Cleaning Diesel Exhaust Fluid (DEF) Tank in the Service As Required Section.
Engine Emits White Smoke	Engine compression too low	Determine cause of low compression and repair as required. See your authorized John Deere engine distributor or servicing dealer.
	Defective thermostat(s) (does not close)	Test thermostats; replace thermostats as required.
	Coolant entering combustion chamber (failed cylinder head gasket or cracked cylinder head)	Repair or replace as required. See your authorized John Deere engine distributor or servicing dealer.
	Electronic Control System problem or basic engine problem	See your authorized John Deere engine distributor or servicing dealer.
	Improper type of fuel	Drain fuel and replace with proper grade and quality of fuel for operating condition.
	Poor fuel quality	Drain fuel and replace with proper grade and quality of fuel for operating condition.
	Low engine temperature	Warm up engine to normal operating temperature.
	Defective thermostat.	Remove and check thermostat.
	Defective fuel injectors	See your authorized John Deere engine distributor or servicing dealer.
Engine Emits Black, Gray or Blue Smoke	Engine overloaded	Reduce engine load.
	Engine burning oil	See your authorized John Deere engine distributor or servicing dealer.
	Air cleaner restricted or dirty	Replace air cleaner element as required.
	Electronic control system problem or basic engine problem	See your authorized John Deere engine distributor or servicing dealer.
	Exhaust filter is cracked or damaged	See your authorized John Deere engine distributor or servicing dealer.
	Improper type of fuel	Use proper fuel.
	Fuel injectors dirty	See your authorized John Deere engine distributor or servicing dealer.

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Symptom	Problem	Solution
	Electronic Control System problem or basic engine problem	See your authorized John Deere engine distributor or servicing dealer.
	Turbocharger not functioning properly	See your authorized John Deere engine distributor or servicing dealer.
Engine Overheats	Air cleaner restricted or dirty	Replace air cleaner element as required.
	Lack of coolant in cooling system	Fill cooling system to proper level. Check radiator and hoses for loose connections or leaks.
	Low engine oil level	Check oil level. Add oil as required.
	Radiator core dirty	Clean cooling system as required.
	Cooling system needs flushing	Flush coolant system. (See Flushing And Refilling Cooling System in the Lubrication & Maintenance — 6000 Hours/72 Months Section.)
	Engine overloaded	Reduce engine load.
	Loose or defective fan belt	Check automatic belt tensioner and belts. Replace as required. (See Checking Tensioner Spring Tension in the Lubrication & Maintenance — 500 Hours/12 Months Section.)
	Defective or wrong type of thermostats	Test thermostat opening temperature, replace thermostats as required.
	Damaged cylinder head gasket	Replace cylinder head gasket. See your authorized John Deere engine distributor or servicing dealer.
	Leak at cylinder head gasket	Replace cylinder head gasket. See your authorized John Deere engine distributor or servicing dealer.
	Defective coolant pump	Replace coolant pump. See your authorized John Deere engine distributor or servicing dealer.
	Defective radiator cap	Replace radiator cap as required.
	Defective temperature gauge or sender	Check coolant temperature with thermometer and replace, if necessary.
	Incorrect grade of fuel	Use correct grade of fuel.

Continued on next page

Symptom	Problem	Solution
Coolant Temperature Below Normal	Defective thermostat(s)	Test thermostats, replace thermostats as required.
	Defective temperature gauge or temperature sender	Check gauge, sender, and connections.
Coolant in Crankcase	Cylinder head gasket defective	Replace cylinder head gasket. See your authorized John Deere engine distributor or servicing dealer.
	Cylinder head or block cracked	Locate crack, repair/replace components as required. See your authorized John Deere engine distributor or servicing dealer.
	Cylinder liner seals leaking	Remove and inspect cylinder liners. See your authorized John Deere engine distributor or servicing dealer.
	Pitted cylinder liners	Remove and inspect cylinder liners. See your authorized John Deere engine distributor or servicing dealer.
	Leaking oil cooler	Pressure test oil cooler, repair/replace as required. See your authorized John Deere engine distributor or servicing dealer.
	Defective oil cooler O-rings	Remove and inspect oil cooler O-rings, replace as required. See your authorized John Deere engine distributor or servicing dealer.
	EGR cooler system leaking	Pressure test EGR cooler system, repair/replace as required. See your authorized John Deere engine distributor or servicing dealer.
	Faulty coolant pump seal; weep hole plugged; coolant leaking through bearing	Replace coolant pump seals. See your authorized John Deere engine distributor or servicing dealer.
Low Oil Pressure	Low crankcase oil level	Fill crankcase to proper oil level.
	Faulty pressure sensor	Replace sensor. See your authorized John Deere engine distributor or servicing dealer.
	Restricted oil cooler or filter	Remove and inspect oil cooler. See your authorized John Deere engine distributor or servicing dealer.

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Symptom	Problem	Solution
	Excessive oil temperature	Remove and inspect oil cooler. See your authorized John Deere engine distributor or servicing dealer.
	Defective oil pump	Remove and inspect oil pump. See your authorized John Deere engine distributor or servicing dealer.
	Incorrect oil	Drain crankcase and refill with correct oil.
	Oil pressure regulating valve failure	Remove and inspect oil pressure regulating valve. See your authorized John Deere engine distributor or servicing dealer.
	Restricted oil pump screen or cracked pick-up tube	Remove oil pan and clean screen/replace pick-up tube.
	Excessive main or connecting rod bearing clearance	Determine bearing clearance. See your authorized John Deere engine distributor or servicing dealer.
	Crankcase oil level too high	Check engine oil level and drain as necessary.
High Oil Pressure	Improper oil classification	Drain crankcase and refill with correct oil.
	Faulty pressure sensor	Replace sensor. See your authorized John Deere engine distributor or servicing dealer.
	Oil pressure regulating valve failure	Remove and inspect oil pressure regulating valve. See your authorized John Deere engine distributor or servicing dealer.
	Stuck or damaged filter bypass valve	Remove and inspect filter bypass valve. See your authorized John Deere engine distributor or servicing dealer.
	Stuck or damaged oil cooler bypass valve	Remove and inspect oil cooler bypass valve. See your authorized John Deere engine distributor or servicing dealer.
Excessive Oil Consumption	Too low viscosity crankcase oil	Drain crankcase and refill with correct viscosity oil.
	Crankcase oil level too high	Drain oil until oil level is correct.

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Symptom	Problem	Solution
	External oil leak(s)	Determine source of oil leak(s) and repair as required.
	Excessive oil pressure	See **High Oil Pressure**
	Oil control rings not seated	See your authorized John Deere engine distributor or servicing dealer.
	Oil control rings worn or broken	Replace piston rings. See your authorized John Deere engine distributor or servicing dealer.
	Restricted crankcase vent tube	Clean vent tube, verify that crankcase oil level is not too high.
	Defective turbocharger	See your authorized John Deere engine distributor or servicing dealer.
	Scored cylinder liners or pistons	Remove and inspect cylinders and liners; replace as required. See your authorized John Deere engine distributor or servicing dealer.
	Worn valve guides or stems	Inspect and measure valve stems and valve guides; repair as required. See your authorized John Deere engine distributor or servicing dealer.
	Piston ring grooves excessively worn	Remove and inspect pistons. See your authorized John Deere engine distributor or servicing dealer.
	Piston rings sticking in ring grooves	Remove and inspect pistons. See your authorized John Deere engine distributor or servicing dealer.
	Insufficient piston ring tension	Remove and inspect pistons. See your authorized John Deere engine distributor or servicing dealer.
	Piston ring gaps not staggered	Remove and inspect pistons. See your authorized John Deere engine distributor or servicing dealer.
	Front and/or rear crankshaft oil seal faulty	Replace oil seals. See your authorized John Deere engine distributor or servicing dealer.
Undercharged Electrical System	Excessive electrical load from added accessories	Remove accessories or install higher output alternator. See your authorized John Deere engine distributor or servicing dealer.

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Symptom	Problem	Solution
	Excessive engine idling	Increase engine rpm when heavy electrical load is used.
	Poor electrical connections on battery, ground strap, starter, or alternator	Inspect and clean as necessary.
	Defective battery	Test batteries.
	Defective alternator	Test charging system.
Battery Used Too Much Water	Cracked battery case	Check for moisture and replace as necessary.
	Defective battery	Test battery.
	Battery charging rate too high	Test charging system.
Batteries Will Not Charge	Loose or corroded connections	Clean and tighten connections.
	Sulfated or worn-out batteries	Replace batteries.
	Stretched belt or defective belt tensioner	Adjust belt tension or replace belts.
Starter and Hourmeter Functions; Rest of Electrical System Does Not Function	Blown fuse	Replace fuse.
Entire Electrical System Does Not Function	Faulty battery connection	Clean and tighten connections.
	Sulfated or worn-out batteries	Replace batteries.
	Blown fuse	Replace fuse.

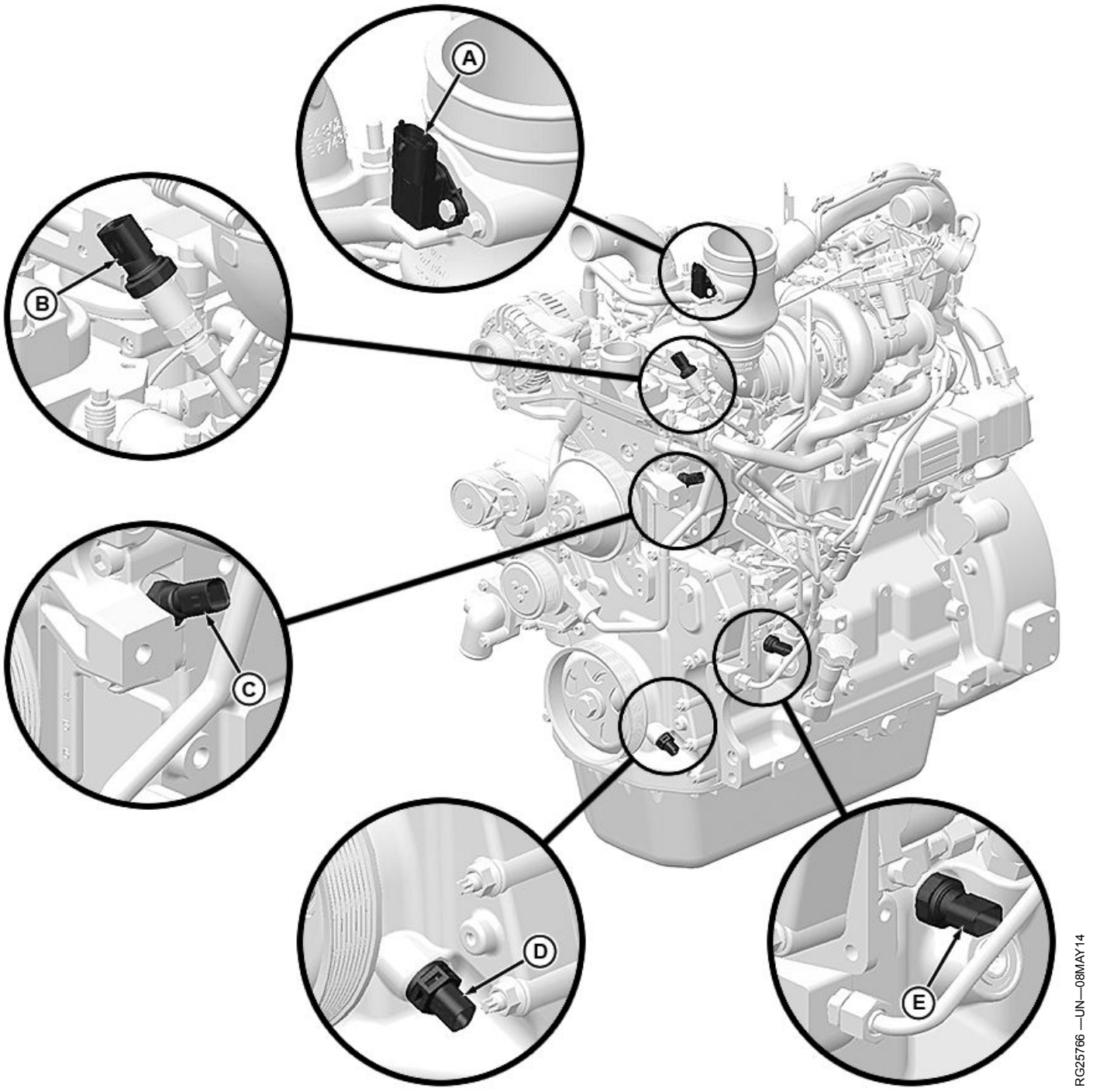
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Precautions for Electrical System When Steam Cleaning Engine

IMPORTANT: Do not steam clean any electrical or electronic components while steam cleaning the engine as it could damage sensitive parts.

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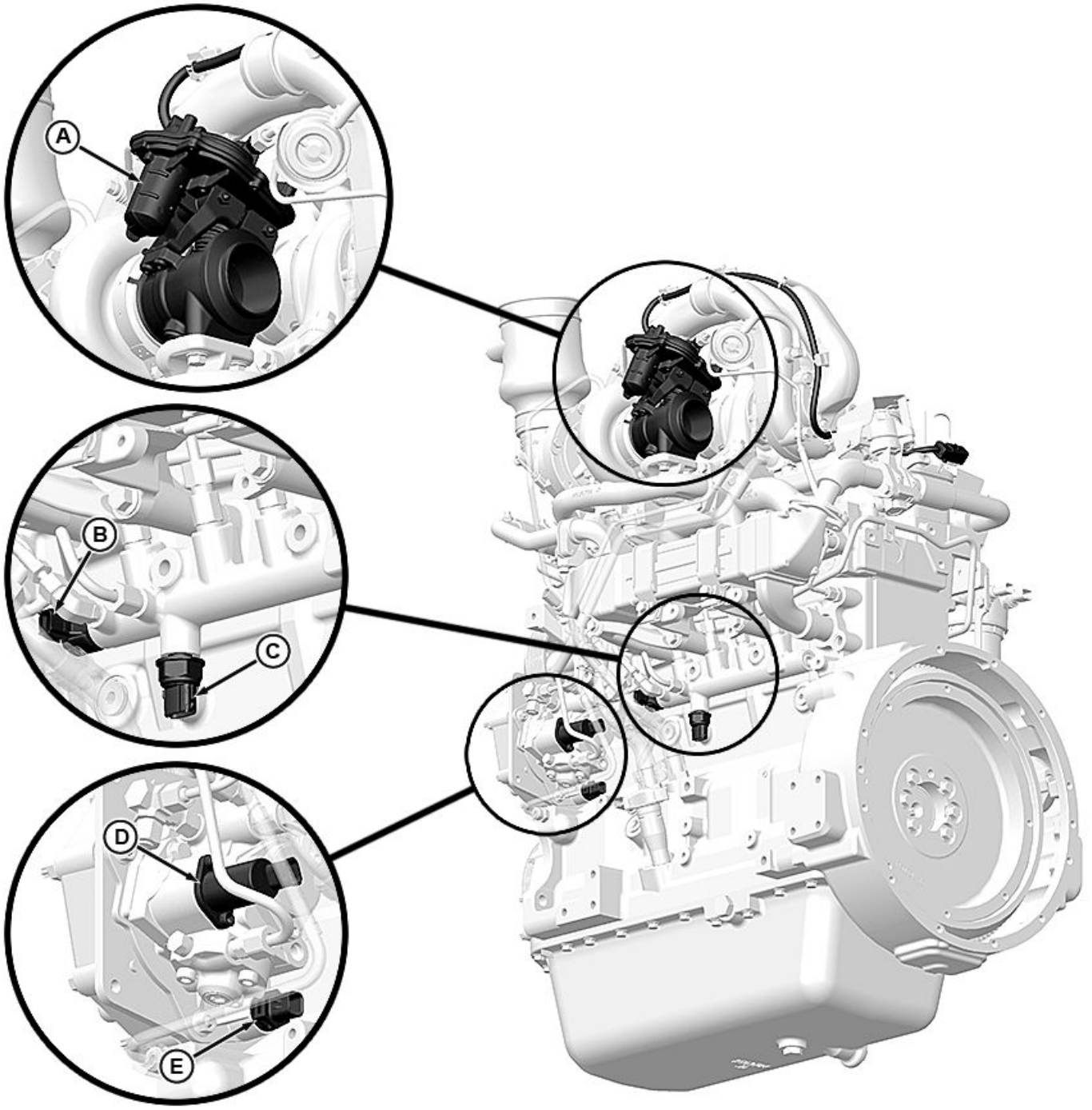
Engine Wiring Harness Layout



A—Intake Air Sensor
B—Exhaust Manifold Pressure Sensor
C—Engine Coolant Temperature Sensor
D—Crankshaft Position Sensor
E—Engine Oil Pressure Sensor

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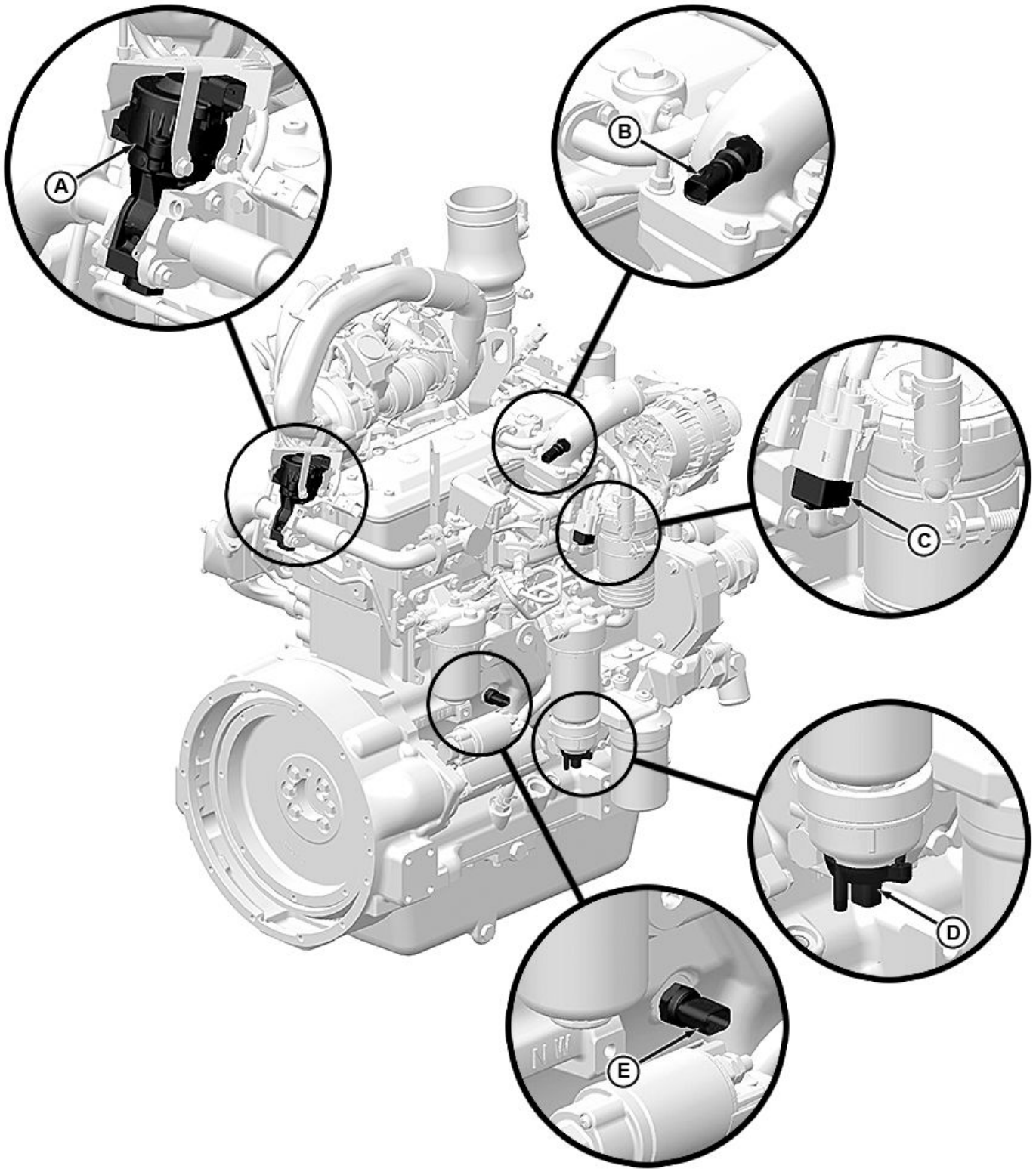
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A—Exhaust Throttle Actuator
B—Fuel Rail Pressure Relief Valve
C—Fuel Rail Pressure Sensor
D—Suction Control Valve
E—Camshaft Position Sensor

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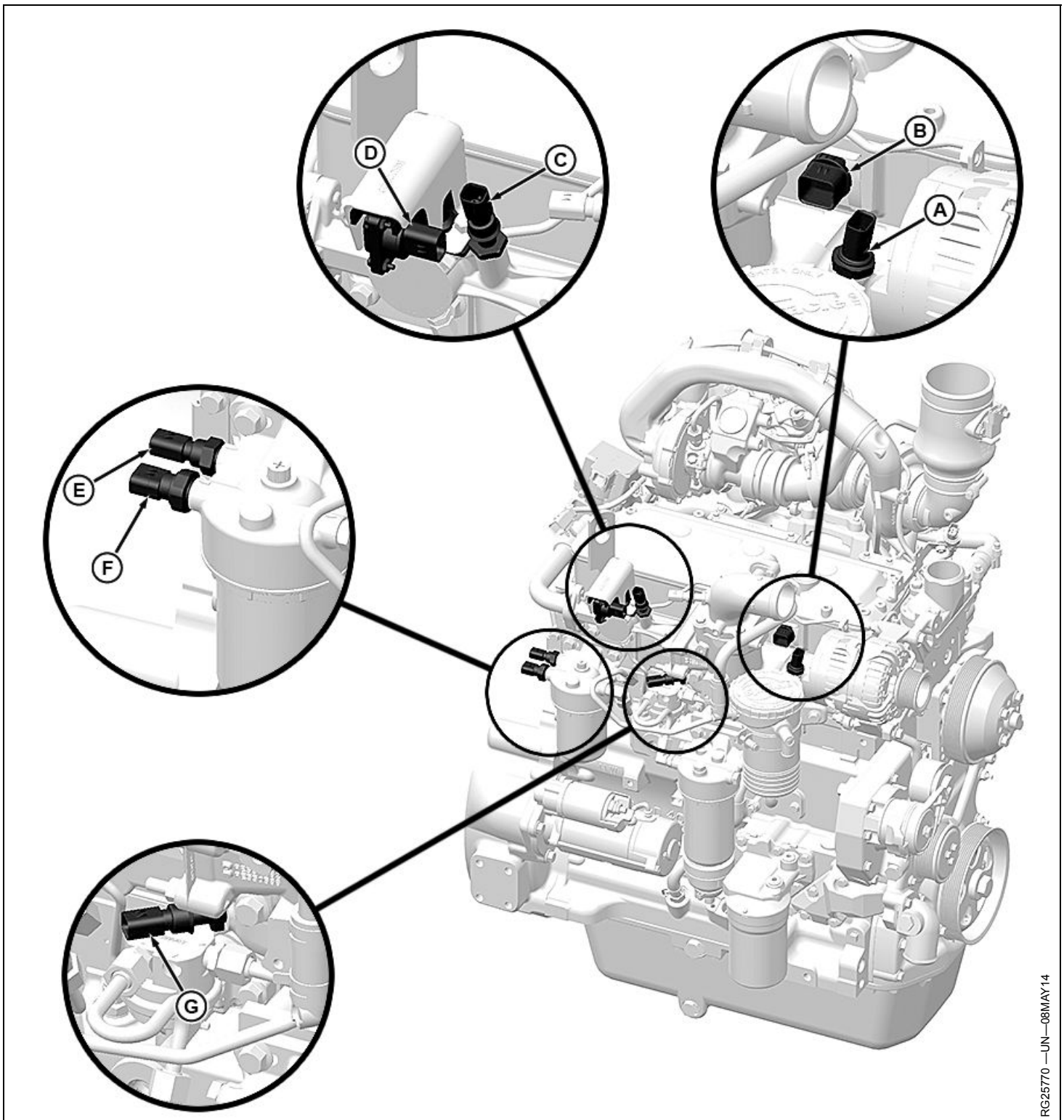
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A—EGR Valve
B—Charge Air Cooler Outlet Temperature Sensor
C—Cold Start Aid Relay
D—Water-In-Fuel (WIF) Sensor
E—Crankcase Pressure Sensor

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A—Manifold Air Pressure Sensor
B—Fuel Injector Harness Connector
C—EGR Temperature Sensor
D—EGR Flow Sensor
E—Fuel Temperature Sensor
F—Low-Pressure Fuel Pressure Sensor
G—Manifold Air Temperature Sensor

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Precautions For Welding

Remove paint before welding or heating (see Safety Section in this manual for more information on paint removal and high-pressure lines).

CAUTION: Avoid potentially toxic fumes and dust. Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch. Do all work outside or in a well ventilated area. Dispose of paint and solvent properly. If you sand or grind paint, avoid breathing the dust by wearing an approved respirator. If you use solvent or paint stripper, remove with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area before welding. Allow fumes to disperse at least 15 minutes before welding or heating.

IMPORTANT: Welding on the engine is NOT ALLOWED. If welding must be performed on the machine, follow these precautions.

IMPORTANT: High currents or electrostatic discharge into electronic components from welding may cause permanent damage.

1. Remove paint from the area to be welded and ground cable clamp location.

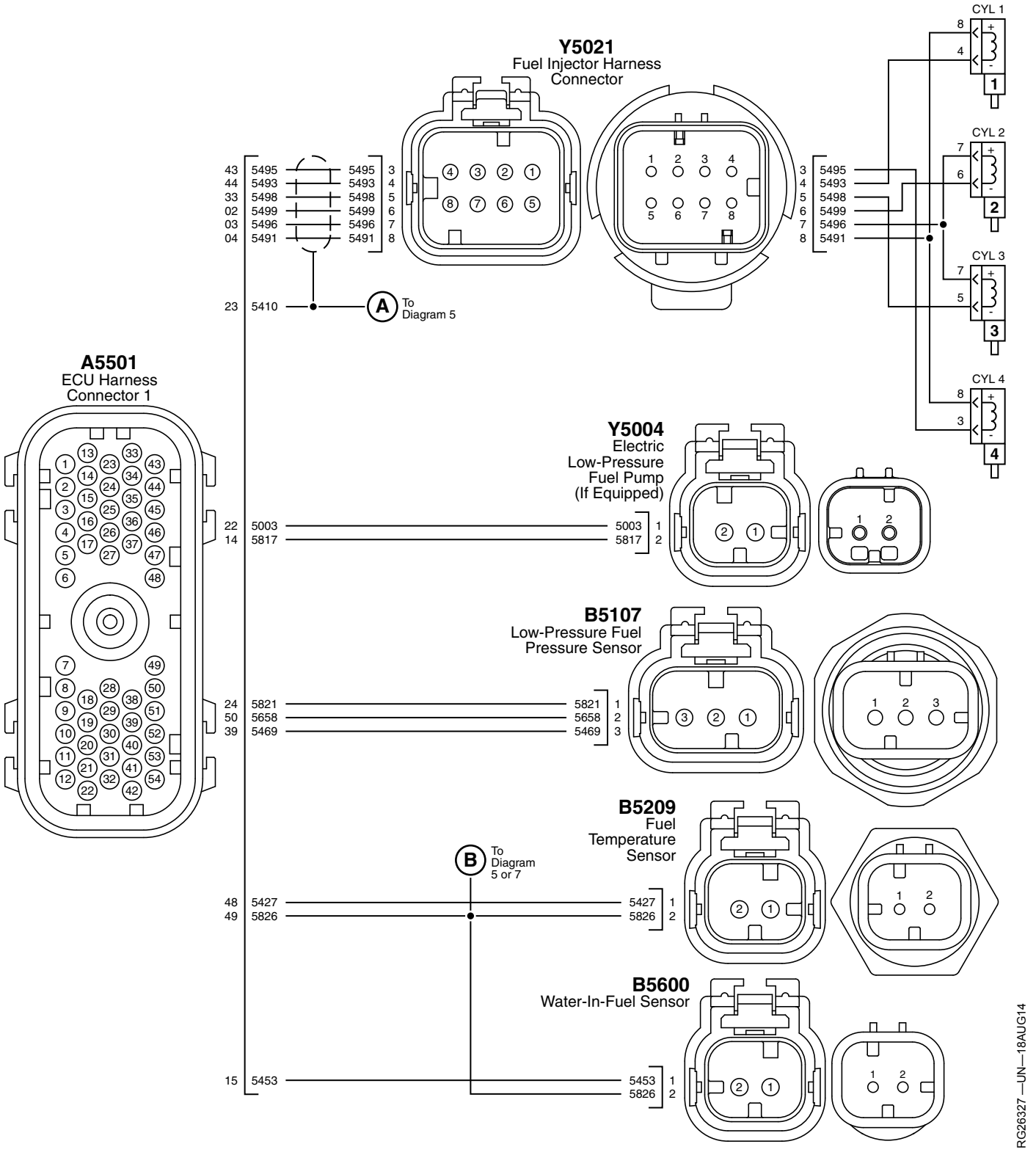


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2. Disconnect the negative (-) battery cable(s).
3. Disconnect the positive (+) battery cable(s).
4. Disconnect connectors from ECU.
5. Clear or move any wiring harness sections away from the welding area.
6. Welding on engine components is not allowed.
7. Never connect the welder ground to any engine component or engine driven components that may be connected to the engine.
8. After welding, reverse steps 2—4.

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4.5 L Wiring Diagram 1



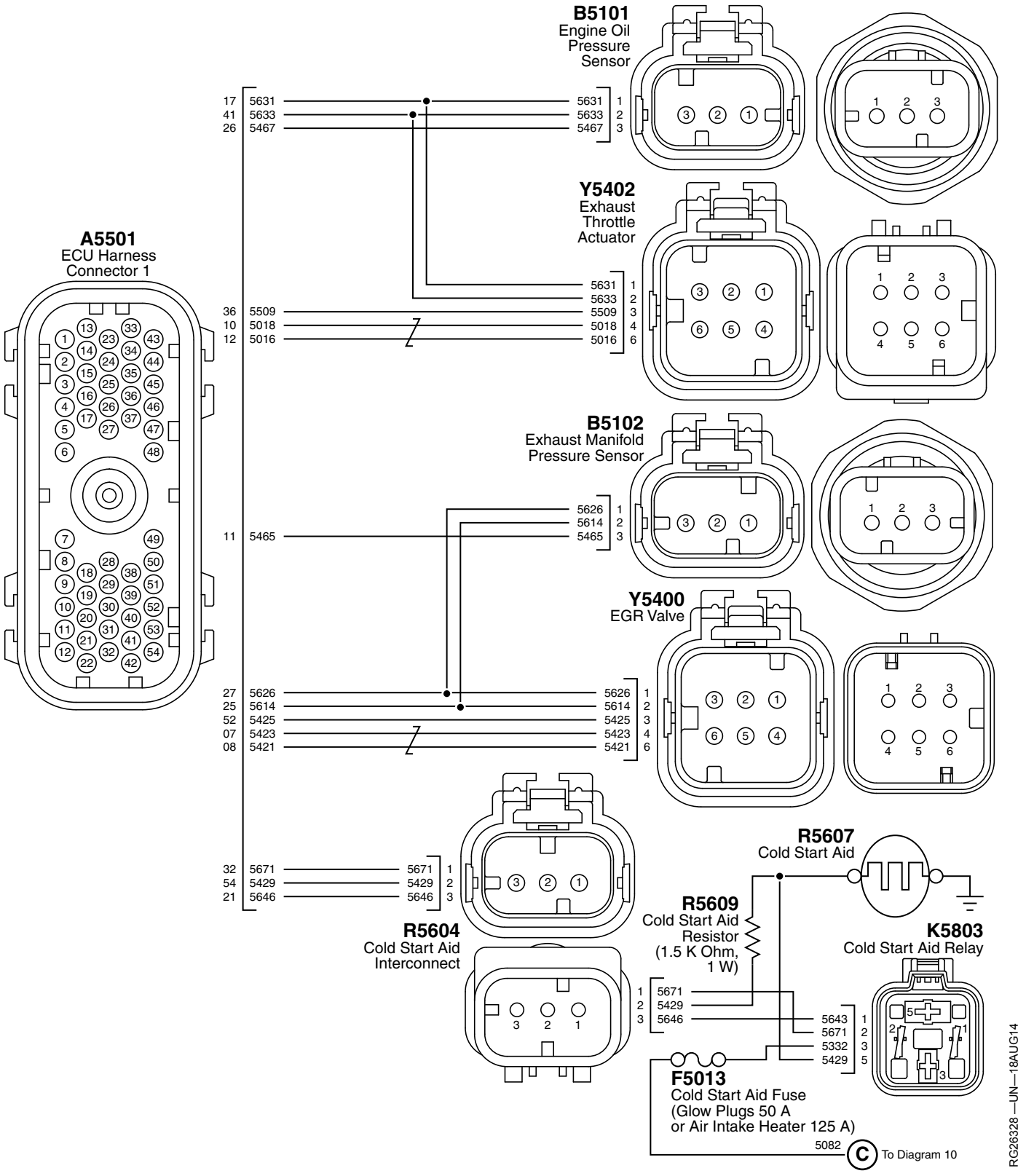
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A— To 4.5 L Wiring Diagram 5
A5501— ECU Harness Connector 1
A5501-02— [5499 White] Injector #2 Pulse
A5501-03— [5496 Blue] Injector #2 and #3 Power
A5501-04— [5491 Brown] Injector #1 and #4 Power
A5501-14— [5817 Violet] Low-Pressure Fuel Pump Return
A5501-15— [5453 Orange] Water-In-Fuel Sensor Signal
A5501-22— [5003 Orange] Low-Pressure Fuel Pump Power
A5501-23— [5410 Black] Wiring Shield
A5501-24— [5821 Brown] 5 V Sensor Supply #6b Positive
A5501-33— [5498 Gray] Injector #3 Pulse
A5501-39— [5469 White] Low-Pressure Fuel Pressure Sensor Signal
A5501-43— [5495 Green] Injector #4 Pulse
A5501-44— [5493 Orange] Injector #1 Pulse
A5501-48— [5427 Violet] Fuel Temperature Sensor Signal
A5501-49— [5826 Blue] Sensor Return #10
A5501-50— [5658 Gray] Sensor Return #6
B— To 4.5 L Wiring Diagram 5 or 4.5 L Wiring Diagram 7
B5107— Low-Pressure Fuel Pressure Sensor
B5209— Fuel Temperature Sensor
B5600— Water-In-Fuel Sensor
CYL 1— Cylinder 1
CYL 2— Cylinder 2
CYL 3— Cylinder 3
CYL 4— Cylinder 4
Y5004— Electric Low-Pressure Fuel Pump (If Equipped)
Y5021— Fuel Injector Harness Connector

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4.5 L Wiring Diagram 2



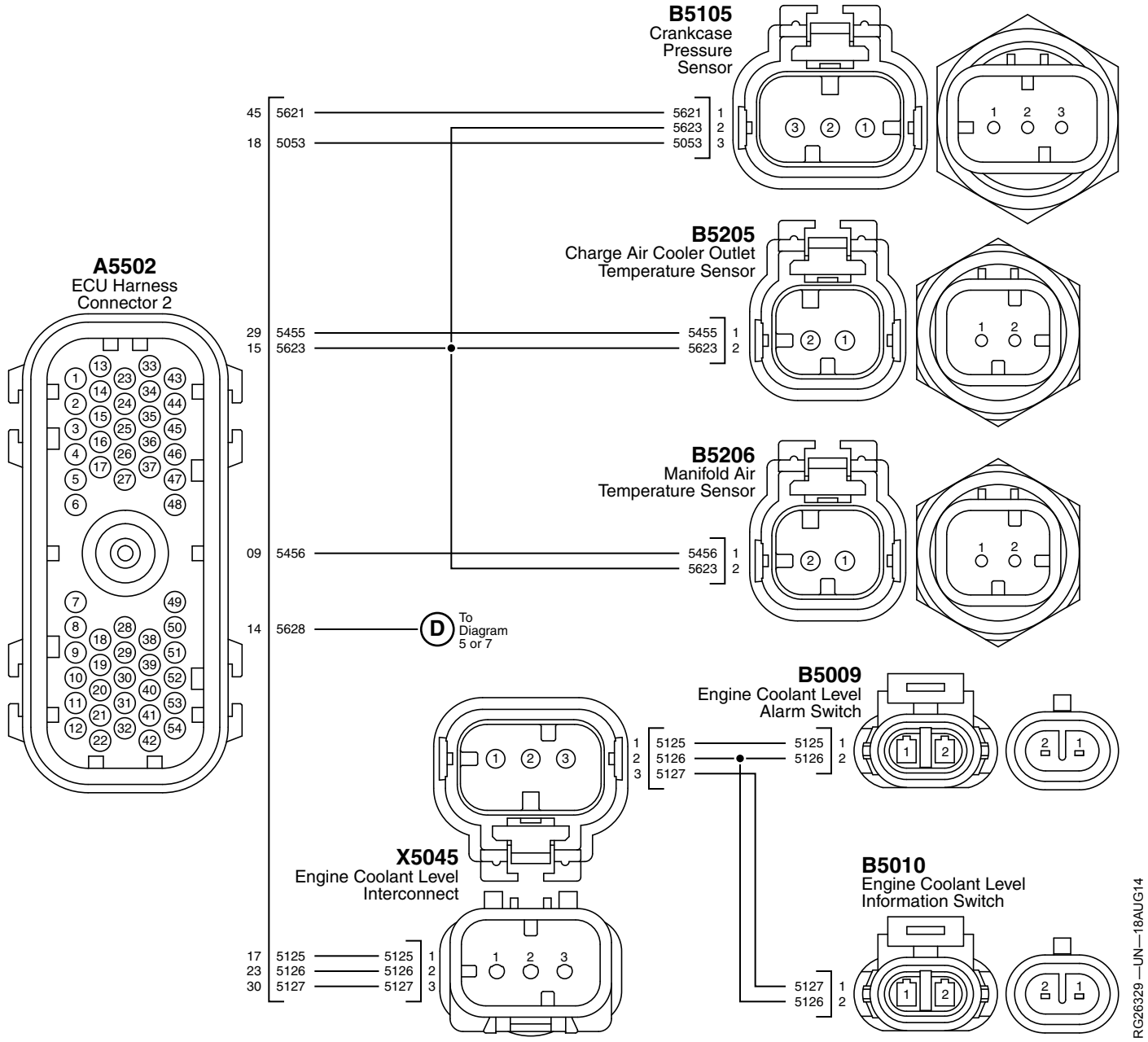
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A5501— ECU Harness Connector 1
A5501-07— [5423 Orange] EGR Valve Drive Negative
A5501-08— [5421 Brown] EGR Valve Drive Positive
A5501-10— [5018 Gray] Exhaust Throttle Actuator Drive Negative
A5501-11— [5465 Green] Exhaust Manifold Pressure Sensor Signal
A5501-12— [5016 Blue] Exhaust Throttle Actuator Drive Positive
A5501-17— [5631 Brown] 5 V Sensor Supply #3 Positive
A5501-21— [5646 Blue] Sensor Return #1
A5501-25— [5614 Yellow] 5 V Sensor Supply #6 Return
A5501-26— [5467 Violet] Engine Oil Pressure Sensor Signal
A5501-27— [5626 Blue] 5 V Sensor Supply #6a Positive
A5501-32— [5671 Brown] Cold Start Aid Drive Positive
A5501-36— [5509 White] Exhaust Throttle Actuator Position Signal
A5501-41— [5633 Orange] 5 V Sensor Supply #3 Return
A5501-52— [5425 Green] EGR Valve Position Sensor Signal
A5501-54— [5429 White] Cold Start Aid Signal
C— [5082 Red] Battery Power Positive To 4.5 L Wiring Diagram 10
B5101— Engine Oil Pressure Sensor
B5102— Exhaust Manifold Pressure Sensor
F5013— Cold Start Aid Fuse (Glow Plugs 50 A or Air Intake Heater 125 A)
K5803— Cold Start Aid Relay
R5604— Cold Start Aid Interconnect
R5607— Cold Start Aid
R5609— Cold Start Aid Resistor (1.5 K Ohm, 1 W)
Y5400— EGR Valve
Y5402— Exhaust Throttle Actuator

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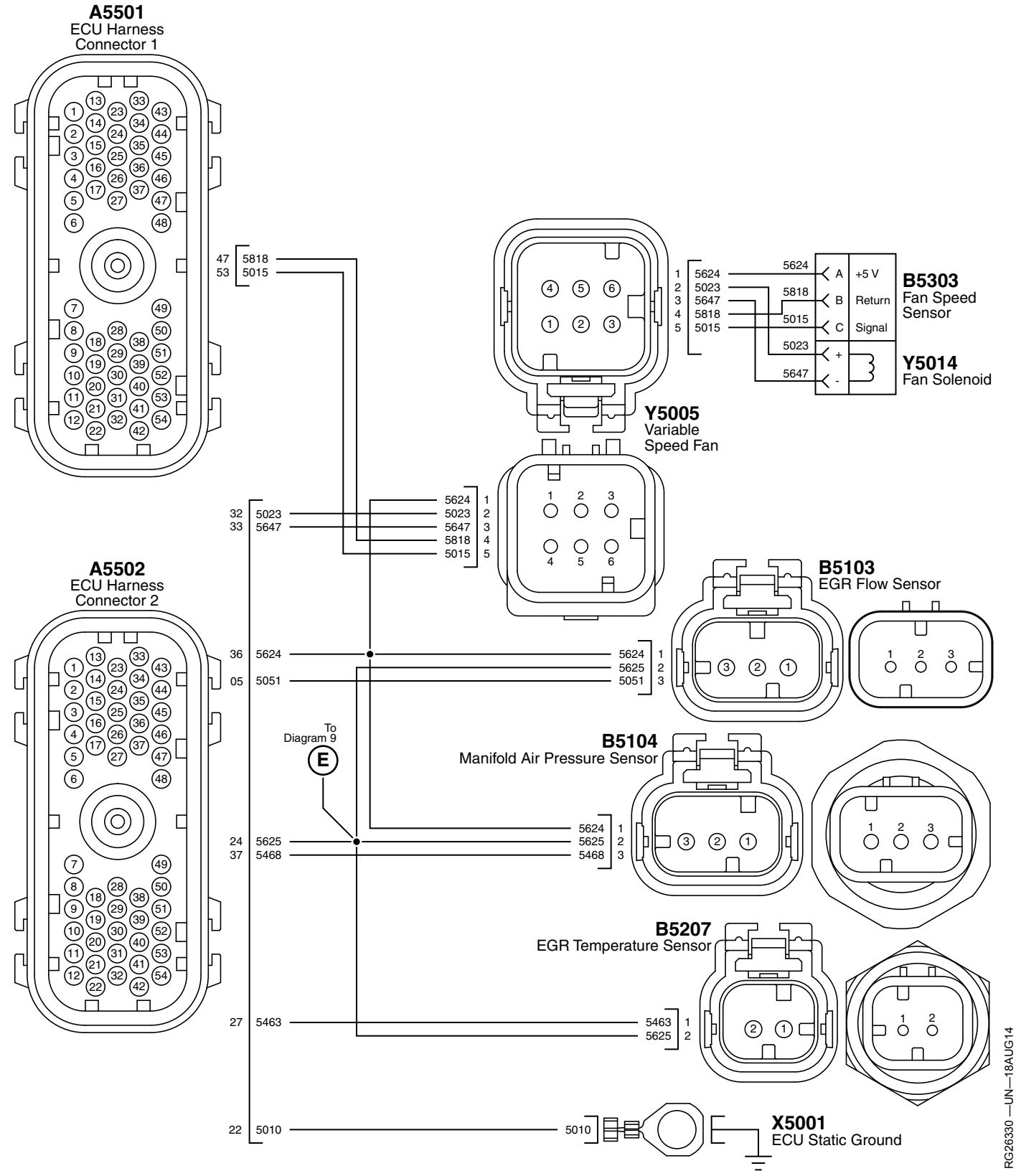
4.5 L Wiring Diagram 3



A5502— ECU Harness Connector 2
A5502-09— [5456 Blue] Manifold Air Temperature Sensor Signal
A5502-14— [5628 Gray] Sensor Return #2
A5502-15— [5623 Orange] 5 V Sensor Supply #2 Return
A5502-17— [5125 Green] Engine Coolant Level Alarm Switch Signal
A5502-18— [5053 Orange] Crankcase Pressure Sensor Signal
A5502-23— [5126 Blue] Sensor Return #7
A5502-29— [5455 Green] Charge Air Cooler Outlet Temperature Sensor Signal
A5502-30— [5127 Violet] Engine Coolant Level Information Switch Signal
A5502-45— [5621 Brown] 5 V Sensor Supply #2 Positive
B5009— Engine Coolant Level Alarm Switch
B5010— Engine Coolant Level Information Switch
B5105— Crankcase Pressure Sensor
B5205— Charge Air Cooler Outlet Temperature Sensor
B5206— Manifold Air Temperature Sensor
D— To 4.5 L Wiring Diagram 5 or 4.5 L Wiring Diagram 7
X5045— Engine Coolant Level Interconnect

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4.5 L Wiring Diagram 4



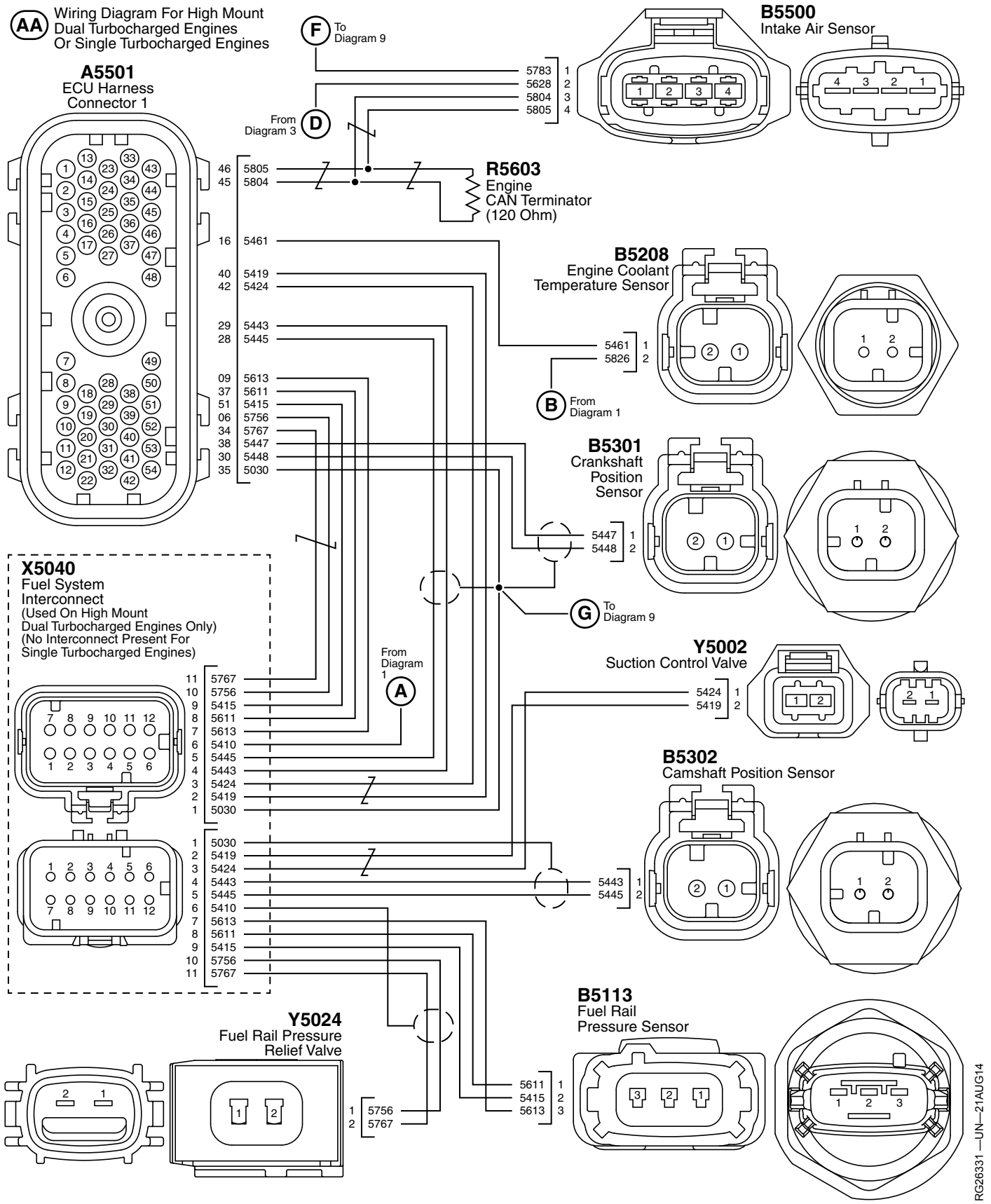
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A5501— ECU Harness Connector 1
A5501-47— [5818 Gray] Fan Speed Return
A5501-53— [5015 Green] Fan Speed Sensor Signal
A5502— ECU Harness Connector 2
A5502-05— [5051 Brown] EGR Flow Sensor Signal
A5502-22— [5010 Black] ECU Static Ground
A5502-24— [5625 Green] 5 V Sensor Supply #7 Return
A5502-27— [5463 Orange] EGR Temperature Sensor Signal
A5502-32— [5023 Orange] Variable Speed Fan Drive Positive
A5502-33— [5647 Violet] Variable Speed Fan Drive Negative
A5502-36— [5624 Yellow] 5 V Sensor Supply #7 Positive
A5502-37— [5468 Gray] Manifold Air Pressure Sensor Signal
B5103— EGR Flow Sensor
B5104— Manifold Air Pressure Sensor
B5207— EGR Temperature Sensor
B5303— Fan Speed Sensor
E— To 4.5 L Wiring Diagram 9
X5001— ECU Static Ground
Y5005— Variable Speed Fan
Y5014— Fan Solenoid

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4.5 L Wiring Diagram 5



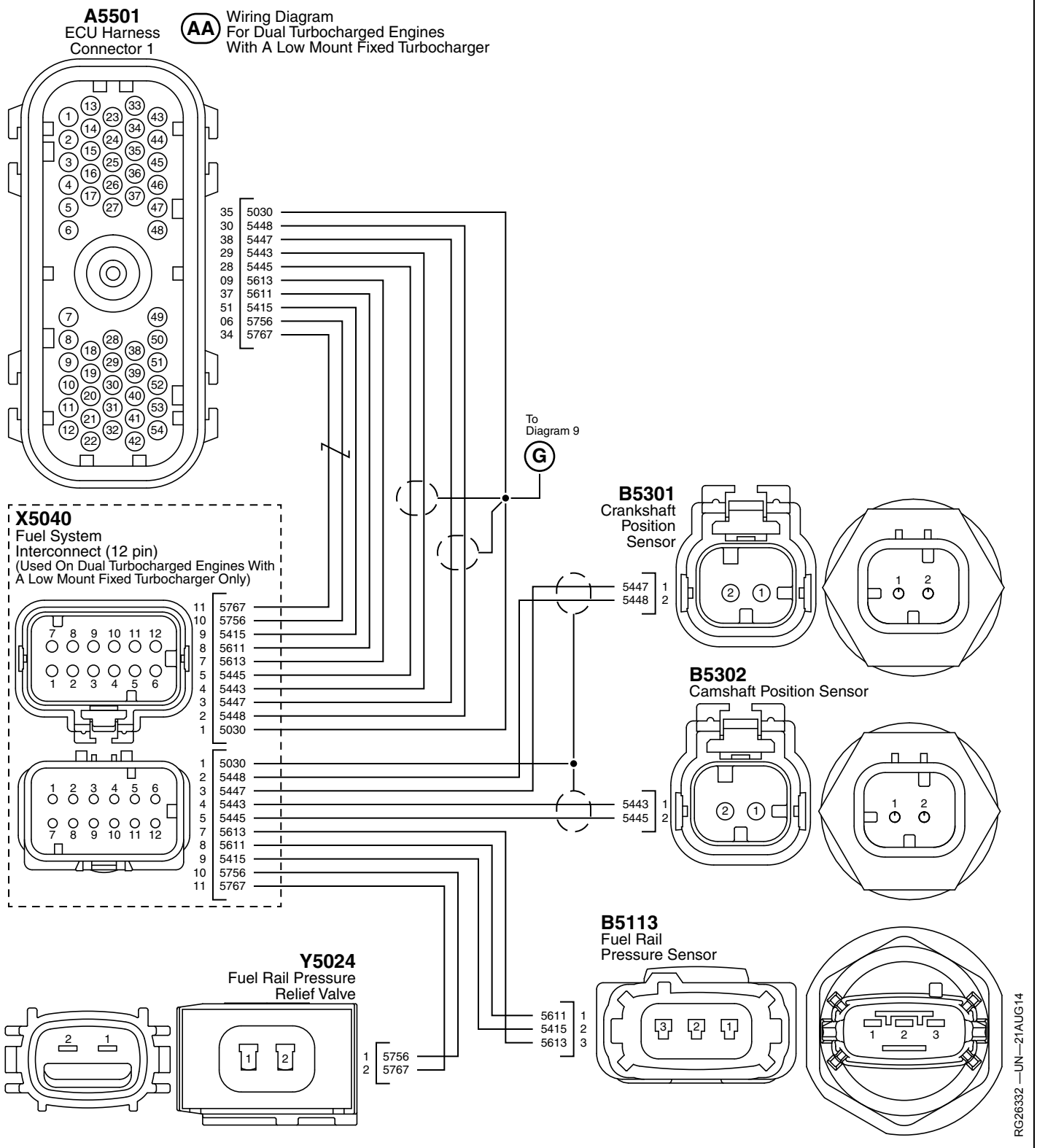
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A— [5410 Black] Wiring Shield From 4.5 L Wiring Diagram 1
AA— Wiring Diagram For High Mount Dual Turbocharged Engines Or Single Turbocharged Engines
A5501— ECU Harness Connector 1
A5501-06— [5756 Blue] Fuel Rail Pressure Relief Valve Drive Positive
A5501-09— [5613 Orange] 5 V Sensor Supply #1 Return
A5501-16— [5461 Brown] Engine Coolant Temperature Sensor Signal
A5501-28— [5445 Green] Camshaft Position Sensor Signal
A5501-29— [5443 Orange] Camshaft Position Sensor Return
A5501-30— [5448 Gray] Crankshaft Position Sensor Return
A5501-34— [5767 Violet] Fuel Rail Pressure Relief Valve Drive Negative
A5501-35— [5030 Black] Wiring Shield
A5501-37— [5611 Brown] 5 V Sensor Supply #1 Positive
A5501-38— [5447 Violet] Crankshaft Position Sensor Signal
A5501-40— [5419 White] Suction Control Valve Drive Negative
A5501-42— [5424 Yellow] Suction Control Valve Drive Positive
A5501-45— [5804 Yellow] Engine CAN High
A5501-46— [5805 Green] Engine CAN Low
A5501-51— [5415 Green] Fuel Rail Pressure Sensor Signal
B— [5826 Blue] Sensor Return #10 From 4.5 L Wiring Diagram 1
B5208— Engine Coolant Temperature Sensor
B5113— Fuel Rail Pressure Sensor
B5301— Crankshaft Position Sensor
B5302— Camshaft Position Sensor
B5500— Intake Air Sensor
D— [5628 Gray] Sensor Return #2 From 4.5 L Wiring Diagram 3
F— [5783 Orange] 12 V Sensor Supply To 4.5 L Wiring Diagram 9
G— To 4.5 L Wiring Diagram 9
R5603— Engine CAN Terminator (120 Ohm)
X5040— Fuel System Interconnect (Used On High Mount Dual Turbocharged Engines Only) (No Interconnect Present For Single Turbocharged Engines)
Y5002— Suction Control Valve
Y5024— Fuel Rail Pressure Relief Valve

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4.5 L Wiring Diagram 6



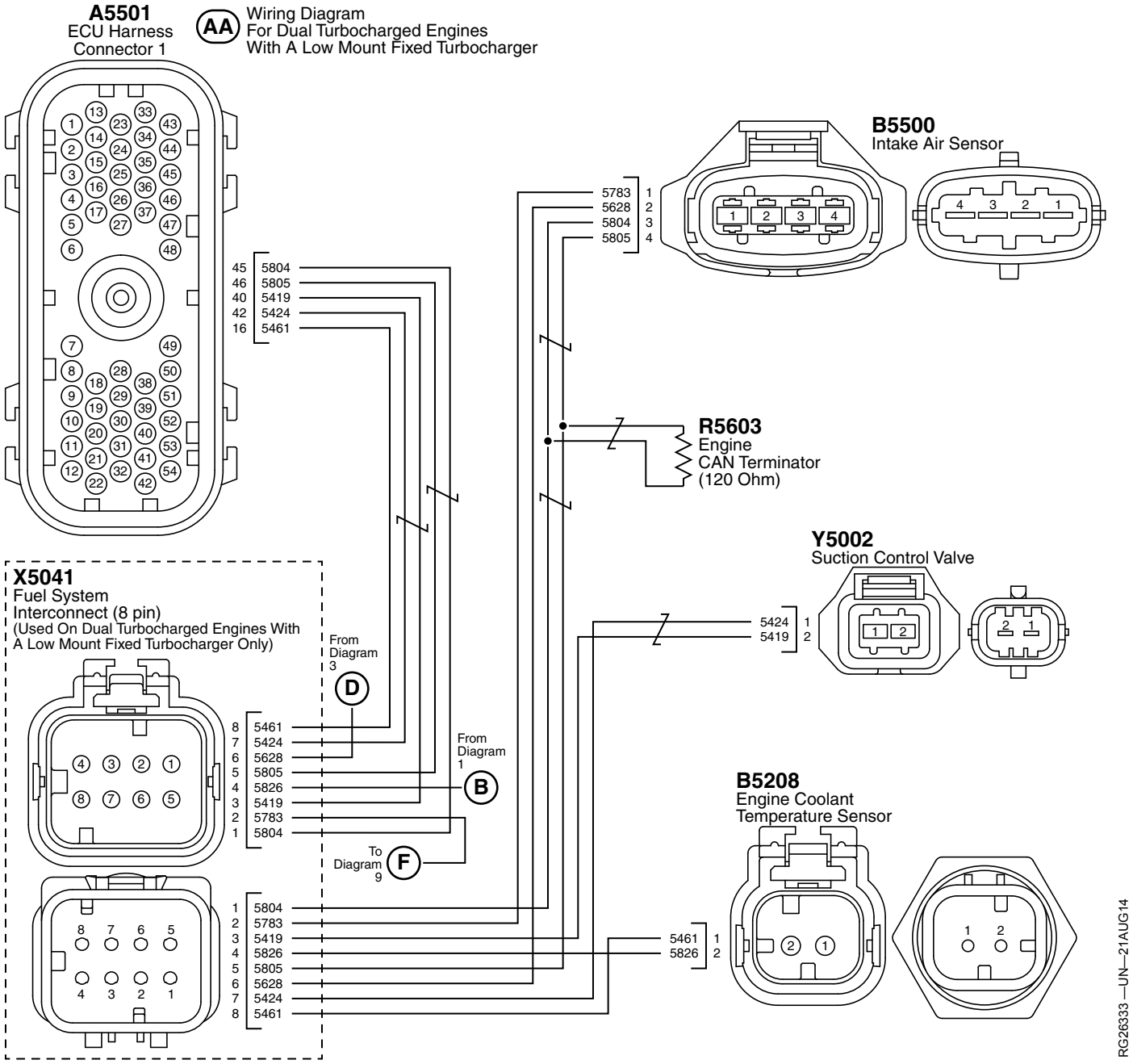
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AT89373,0000018 -19-21AUG14-1/2

AA— Wiring Diagram For Dual Turbocharged Engines With A Low Mount Fixed Turbocharger
A5501— ECU Harness Connector 1
A5501-06— [5756 Blue] Fuel Rail Pressure Relief Valve Drive Positive
A5501-09— [5613 Orange] 5 V Sensor Supply #1 Return
A5501-28— [5445 Green] Camshaft Position Sensor Signal
A5501-29— [5443 Orange] Camshaft Position Sensor Return
A5501-30— [5448 Gray] Crankshaft Position Sensor Return
A5501-34— [5767 Violet] Fuel Rail Pressure Relief Valve Drive Negative
A5501-35— [5030 Black] Wiring Shield
A5501-37— [5611 Brown] 5 V Sensor Supply #1 Positive
A5501-38— [5447 Violet] Crankshaft Position Sensor Signal
A5501-51— [5415 Green] Fuel Rail Pressure Sensor Signal
B5113— Fuel Rail Pressure Sensor
B5301— Crankshaft Position Sensor
B5302— Camshaft Position Sensor
G— To 4.5 L Wiring Diagram 9
X5040— Fuel System Interconnect (12 pin) (Used On Dual Turbocharged Engines With A Low Mount Fixed Turbocharger Only)
Y5024— Fuel Rail Pressure Relief Valve

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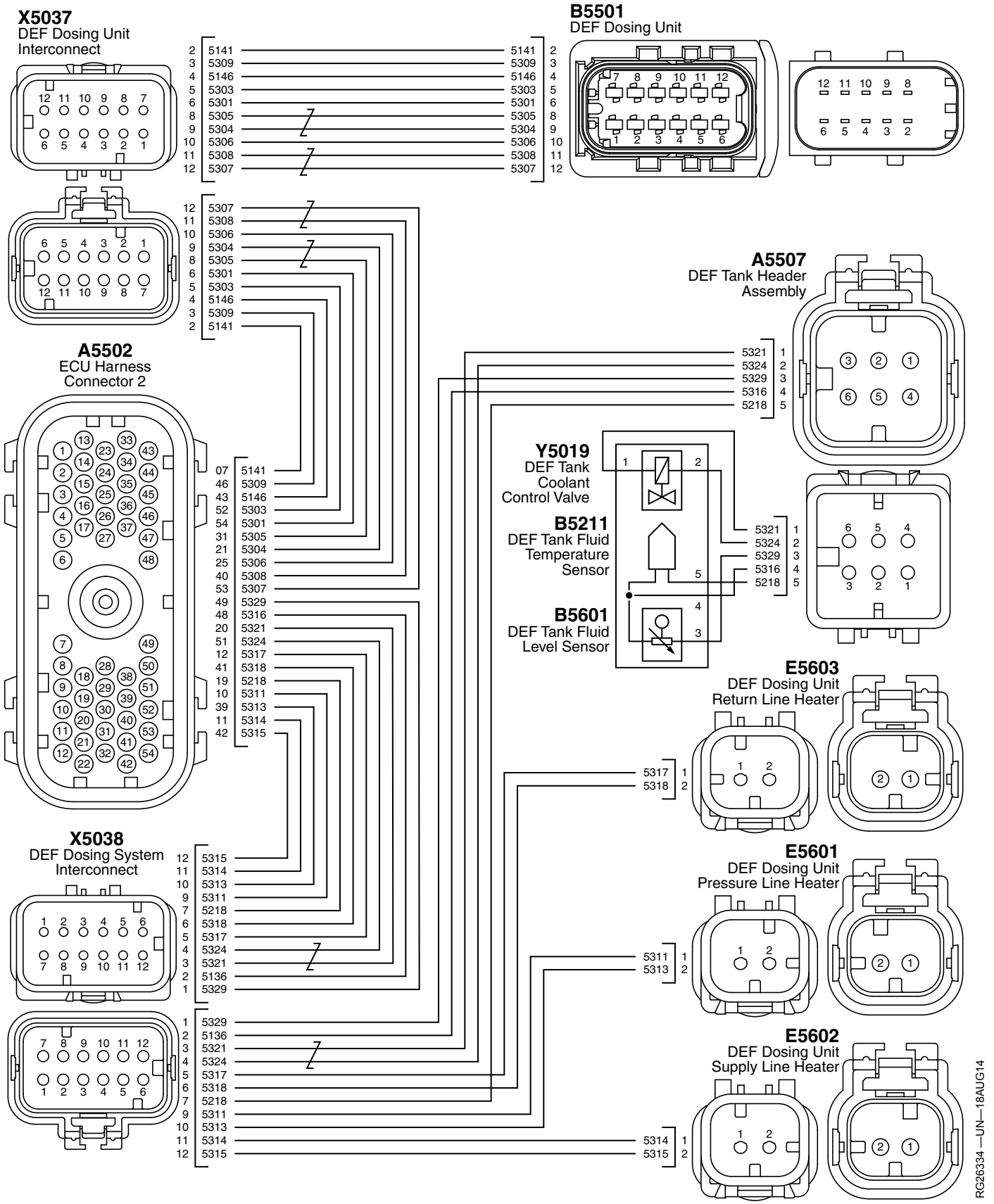
4.5 L Wiring Diagram 7



AA— Wiring Diagram For Dual Turbocharged Engines With A Low Mount Fixed Turbocharger
A5501— ECU Harness Connector 1
A5501-16— [5461 Brown] Engine Coolant Temperature Sensor Signal
A5501-40— [5419 White] Suction Control Valve Drive Negative
A5501-42— [5424 Yellow] Suction Control Valve Drive Positive
A5501-45— [5804 Yellow] Engine CAN High
A5501-46— [5805 Green] Engine CAN Low
B— [5826 Blue] Sensor Return #10 From 4.5 L Wiring Diagram 1
B5208— Engine Coolant Temperature Sensor
B5500— Intake Air Sensor
D— [5628 Gray] Sensor Return #2 From 4.5 L Wiring Diagram 3
F— [5783 Orange] 12 V Sensor Supply To4.5 L Wiring Diagram 9
R5603— Engine CAN Terminator (120 Ohm)
X5041— Fuel System Interconnect (8 pin) (Used On Dual Turbocharged Engines With A Low Mount Fixed Turbocharger Only)
Y5002— Suction Control Valve

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4.5 L Wiring Diagram 8



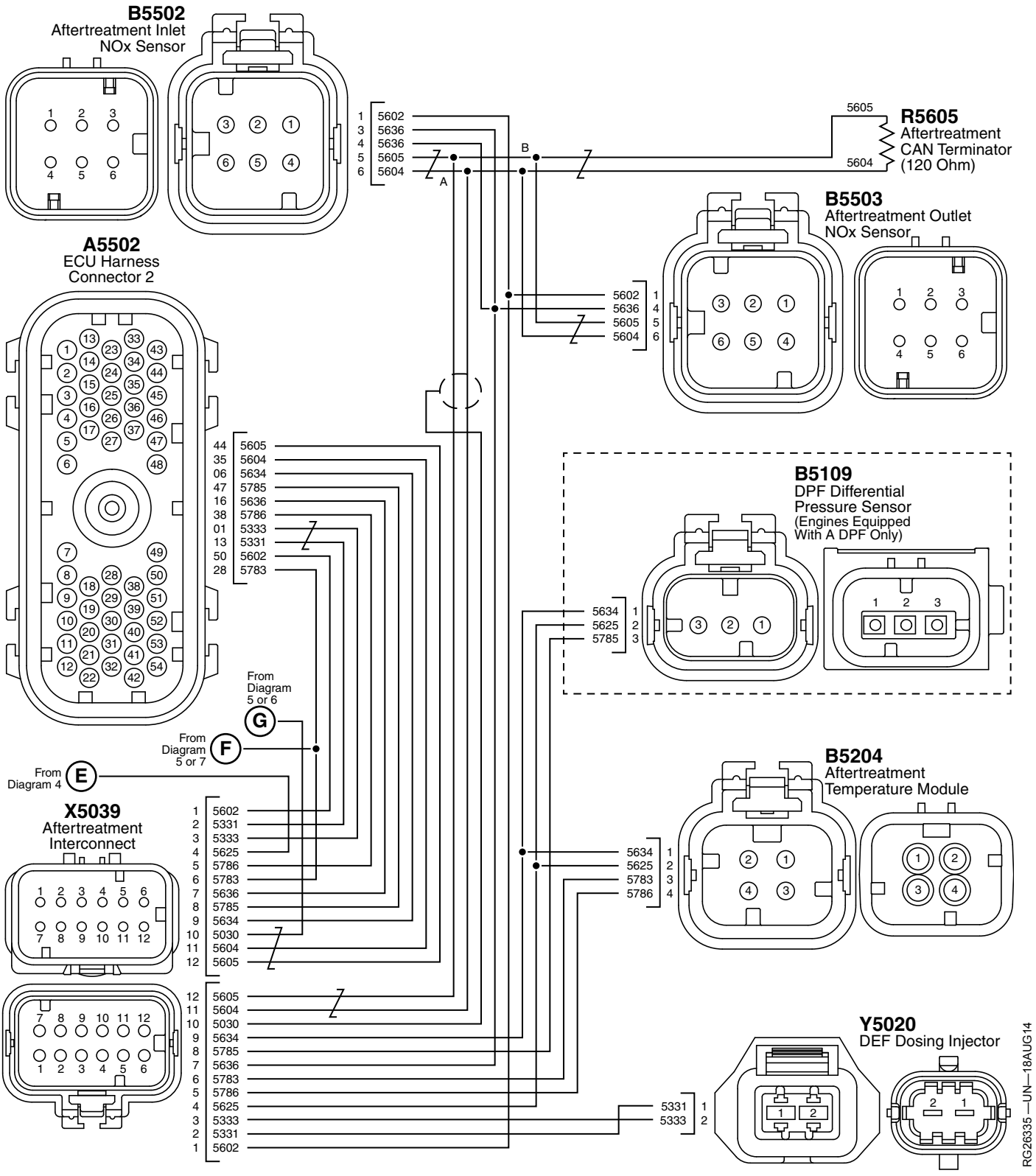
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A5502— ECU Harness Connector 2
A5502-07— [5141 Brown] 5 V Sensor Supply #8b Positive
A5502-10— [5311 Brown] DEF Dosing Unit Pressure Line Heater Positive
A5502-11— [5314 Yellow] DEF Dosing Unit Supply Line Heater Positive
A5502-12— [5317 Violet] DEF Dosing Unit Return Line Heater Positive
A5502-19— [5218 Gray] DEF Tank Fluid Temperature Signal
A5502-20— [5321 Brown] DEF Coolant Control Valve Drive Positive
A5502-21— [5304 Yellow] DEF Dosing Unit Pump Drive Positive
A5502-25— [5306 Blue] DEF Dosing Unit Pump Position Signal
A5502-31— [5305 Green] DEF Dosing Unit Pump Drive Negative
A5502-39— [5313 Orange] DEF Dosing Unit Pressure Line Heater Negative
A5502-40— [5308 Gray] DEF Dosing Unit Reversing Valve Drive Negative
A5502-41— [5318 Gray] DEF Dosing Unit Return Line Heater Negative
A5502-42— [5315 Green] DEF Dosing Unit Supply Line Heater Negative
A5502-43— [5146 Blue] Sensor Return #13
A5502-46— [5309 White] DEF Dosing Unit Pressure Sensor Signal
A5502-48— [5136 Blue] Sensor Return #14
A5502-49— [5329 White] DEF Tank Fluid Level Sensor Signal
A5502-51— [5324 Yellow] DEF Coolant Control Valve Drive Negative
A5502-52— [5303 Orange] DEF Dosing Unit Heater Negative
A5502-53— [5307 Violet] DEF Dosing Unit Reversing Valve Drive Positive
A5502-54— [5301 Brown] DEF Dosing Unit Heater Positive
A5507— DEF Tank Header Assembly
B5211— DEF Tank Fluid Temperature Sensor
B5501— DEF Dosing Unit
B5601— DEF Tank Fluid Level Sensor
E5601— DEF Dosing Unit Pressure Line Heater
E5602— DEF Dosing Unit Supply Line Heater
E5603— DEF Dosing Unit Return Line Heater
X5037— DEF Dosing Unit Interconnect
X5038— DEF Dosing System Interconnect
Y5019— DEF Tank Coolant Control Valve

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4.5 L Wiring Diagram 9



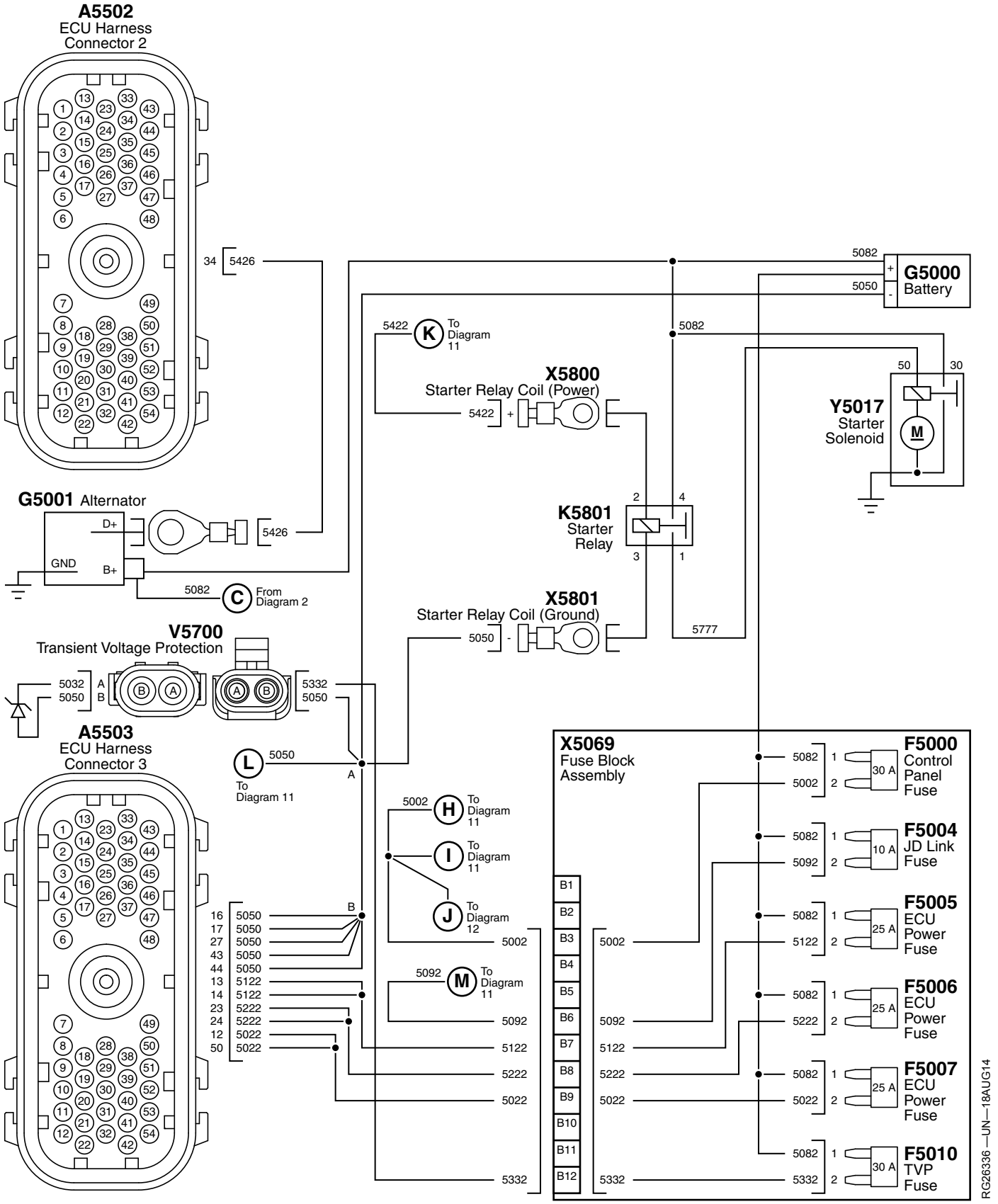
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A5502— ECU Harness Connector 2
A5502-01— [5333 Orange] DEF Dosing Injector Drive Negative
A5502-06— [5634 Yellow] 5 V Sensor Supply #8a Positive
A5502-13— [5331 Brown] DEF Dosing Injector Drive Positive
A5502-16— [5636 Blue] 5 V Sensor Supply #8 Return
A5502-28— [5783 Orange] 12 V Sensor Supply
A5502-35— [5604 Yellow] Aftertreatment CAN High
A5502-38— [5786 Blue] Aftertreatment Temperature Sensor Signal
A5502-44— [5605 Green] Aftertreatment CAN Low
A5502-47— [5785 Green] DPF Differential Pressure Sensor Signal
A5502-50— [5602 Red] Switched Power
B5109— DPF Differential Pressure Sensor (Engines Equipped With A DPF Only)
B5204— Aftertreatment Temperature Module
B5502— Aftertreatment Inlet NOx Sensor
B5503— Aftertreatment Outlet NOx Sensor
E— [5625 Green] 5 V Sensor Supply #7 Return From 4.5 L Wiring Diagram 4
F— [5783 Orange] 12 V Sensor Supply From 4.5 L Wiring Diagram 5 or 4.5 L Wiring Diagram 7
G— [5030 Black] Wiring Shield From 4.5 L Wiring Diagram 5 or 4.5 L Wiring Diagram 6
R5605— Aftertreatment CAN Terminator (120 Ohm)
X5039— Aftertreatment Interconnect
Y5020— DEF Dosing Injector

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4.5 L Wiring Diagram 10



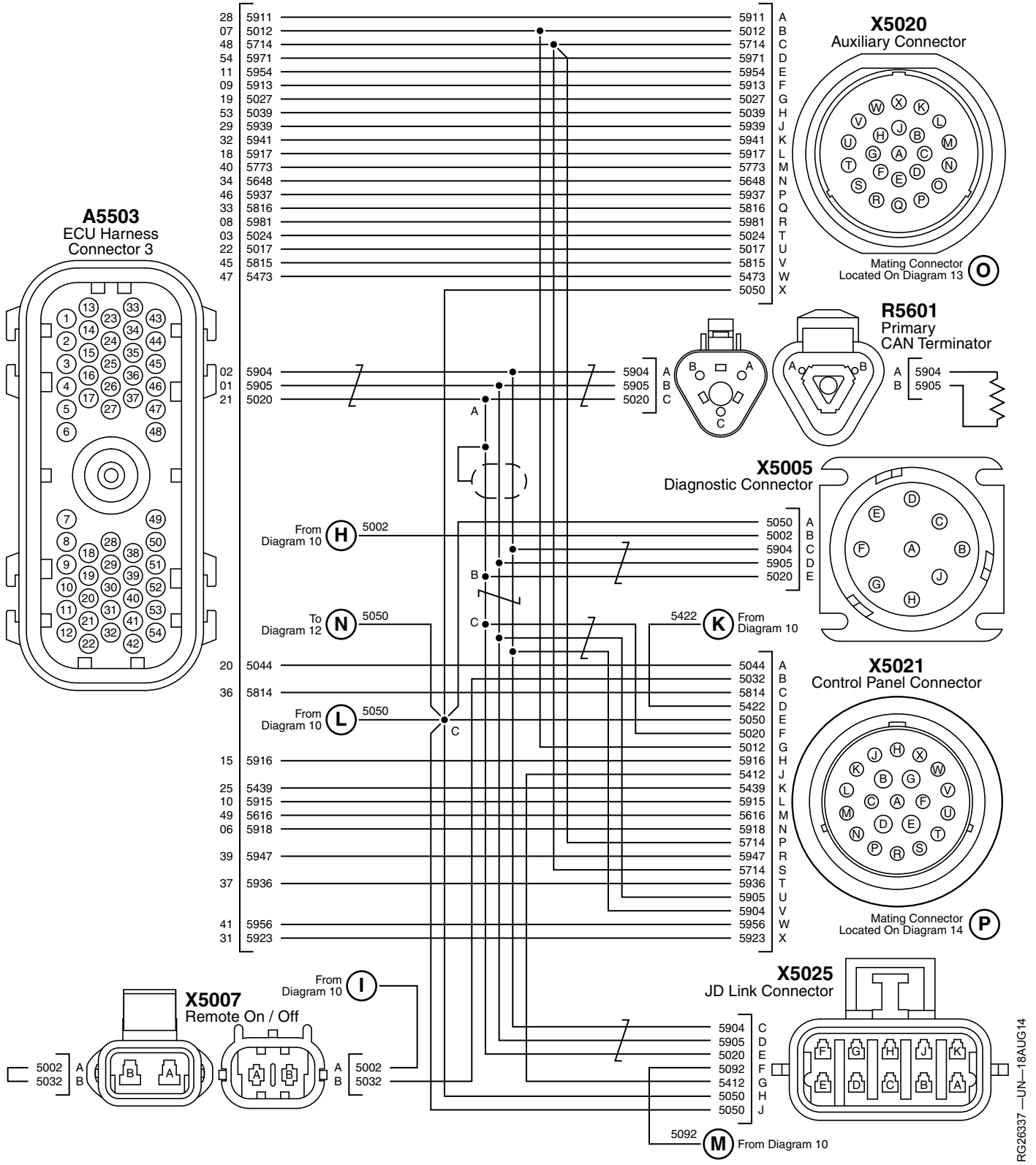
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A5502— ECU Harness Connector 2
A5502-34— [5426 Blue] Alternator Excitation
A5503— ECU Harness Connector 3
A5503-12— [5022 Red] ECU Power Positive
A5503-13— [5122 Red] ECU Power Positive
A5503-14— [5122 Red] ECU Power Positive
A5503-16— [5050 Black] Battery Negative
A5503-17— [5050 Black] Battery Negative
A5503-23— [5222 Red] ECU Power Positive
A5503-24— [5222 Red] ECU Power Positive
A5503-27— [5050 Black] Battery Negative
A5503-43— [5050 Black] Battery Negative
A5503-44— [5050 Black] Battery Negative
A5503-50— [5022 Red] ECU Power Positive
C— [5082 Red] Battery Power Positive From 4.5 L Wiring Diagram 2
F5000— Control Panel Fuse (30 A)
F5004— JD Link Fuse (10 A)
F5005— ECU Power Fuse (25 A)
F5006— ECU Power Fuse (25 A)
F5007— ECU Power Fuse (25 A)
F5010— Transient Voltage Protection Fuse (30 A)
G5000— Battery
G5001— Alternator
H— [5002 Red] Control Panel Unswitched Power To 4.5 L Wiring Diagram 11
I— [5002 Red] Control Panel Unswitched Power To 4.5 L Wiring Diagram 11
J— [5002 Red] Control Panel Unswitched Power To 4.5 L Wiring Diagram 12
K— [5422 Red] Start To 4.5 L Wiring Diagram 11
K5801— Starter Relay
K5801-1— [5777 Violet] Starter Excitation
L— To 4.5 L Wiring Diagram 11
M— [5092 Red] JD Link Unswitched Power To 4.5 L Wiring Diagram 11
V5700— Transient Voltage Protection
X5069— Fuse Block Assembly
X5069-B12— [5332 Red] Battery Power Positive
X5800— Starter Relay Coil (Power)
X5801— Starter Relay Coil (Ground)
Y5017— Starter Solenoid

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4.5 L Wiring Diagram 11



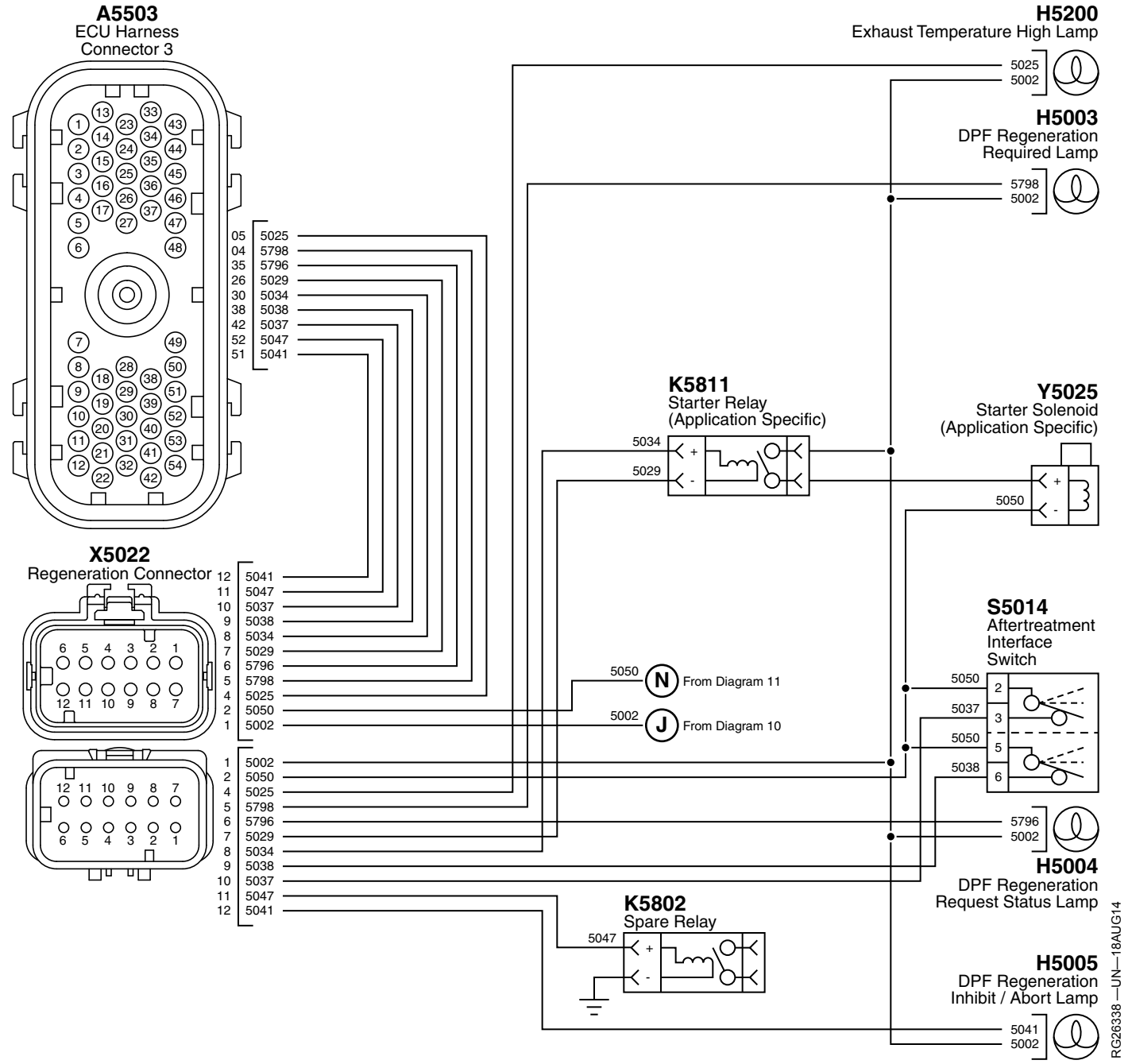
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A5503— ECU Harness Connector 3
A5503-01— [5905 Green] Primary CAN Low
A5503-02— [5904 Yellow] Primary CAN High
A5503-03— [5024 Yellow] Remote Throttle
A5503-06— [5918 Gray] Shutdown Override Switch
A5503-07— [5012 Red] Key Switch
A5503-08— [5981 Brown] PWM Throttle/Alternator Feedback
A5503-09— [5913 Orange] Secondary Throttle
A5503-10— [5915 Green] Primary Throttle
A5503-11— [5954 Yellow] Cruise On Switch
A5503-15— [5916 Blue] Warning Lamp
A5503-18— [5917 Violet] Cruise Remote
A5503-19— [5027 Violet] Air Filter Switch
A5503-20— [5044 Yellow] Wait to Start Lamp
A5503-21— [5020 Black] Primary CAN Shield
A5503-22— [5017 Violet] AC High Pressure Switch
A5503-25— [5439 White] Tachometer
A5503-28— [5911 Brown] 5 V Sensor Supply #5 Positive
A5503-29— [5939 White] External Derate Switch
A5503-31— [5923 Orange] Bump Enable Switch
A5503-32— [5941 Brown] External Shutdown Switch
A5503-33— [5816 Blue] Cruise Brake Switch
A5503-34— [5648 Gray] Sensor Return #5
A5503-36— [5814 Yellow] 5 V Sensor Supply #4 Return
A5503-37— [5936 Blue] Cruise Resume/Bump Down Switch
A5503-39— [5947 Violet] Digital Throttle
A5503-40— [5773 Orange] Spare Driver Positive
A5503-41— [5956 Blue] Set Accelerator/Bump Up Switch
A5503-45— [5815 Green] AC Compressor
A5503-46— [5937 Violet] Isochronous Governor
A5503-47— [5473 Orange] Stop Lamp
A5503-48— [5714 Yellow] 5 V Sensor Supply #5 Return
A5503-49— [5616 Blue] 5 V Sensor Supply #4 Positive
A5503-53— [5039 White] Vehicle Speed Input
A5503-54— [5971 Brown] Cruise Cancel/Resume Switch
K— [5422 Red] Start From 4.5 L Wiring Diagram 10
L— [5050 Black] Battery Negative From 4.5 L Wiring Diagram 10
M— [5092 Red] JD Link Unswitched Power From 4.5 L Wiring Diagram 10
H— [5002 Red] Control Panel Unswitched Power From 4.5 L Wiring Diagram 10
I— [5002 Red] Control Panel Unswitched Power From 4.5 L Wiring Diagram 10
N— To 4.5 L Wiring Diagram 12
O— Mating Connector Located On 4.5 L Wiring Diagram 13
P— Mating Connector Located On 4.5 L Wiring Diagram 14
R5601— Primary CAN Terminator
X5005— Diagnostic Connector
X5007— Remote On/Off
X5020— Auxiliary Connector
X5021— Control Panel Connector
X5021-B— [5032 Red] Fused Unswitched Power
X5021-J— [5412 Red] Accessory
X5025— JD Link Connector

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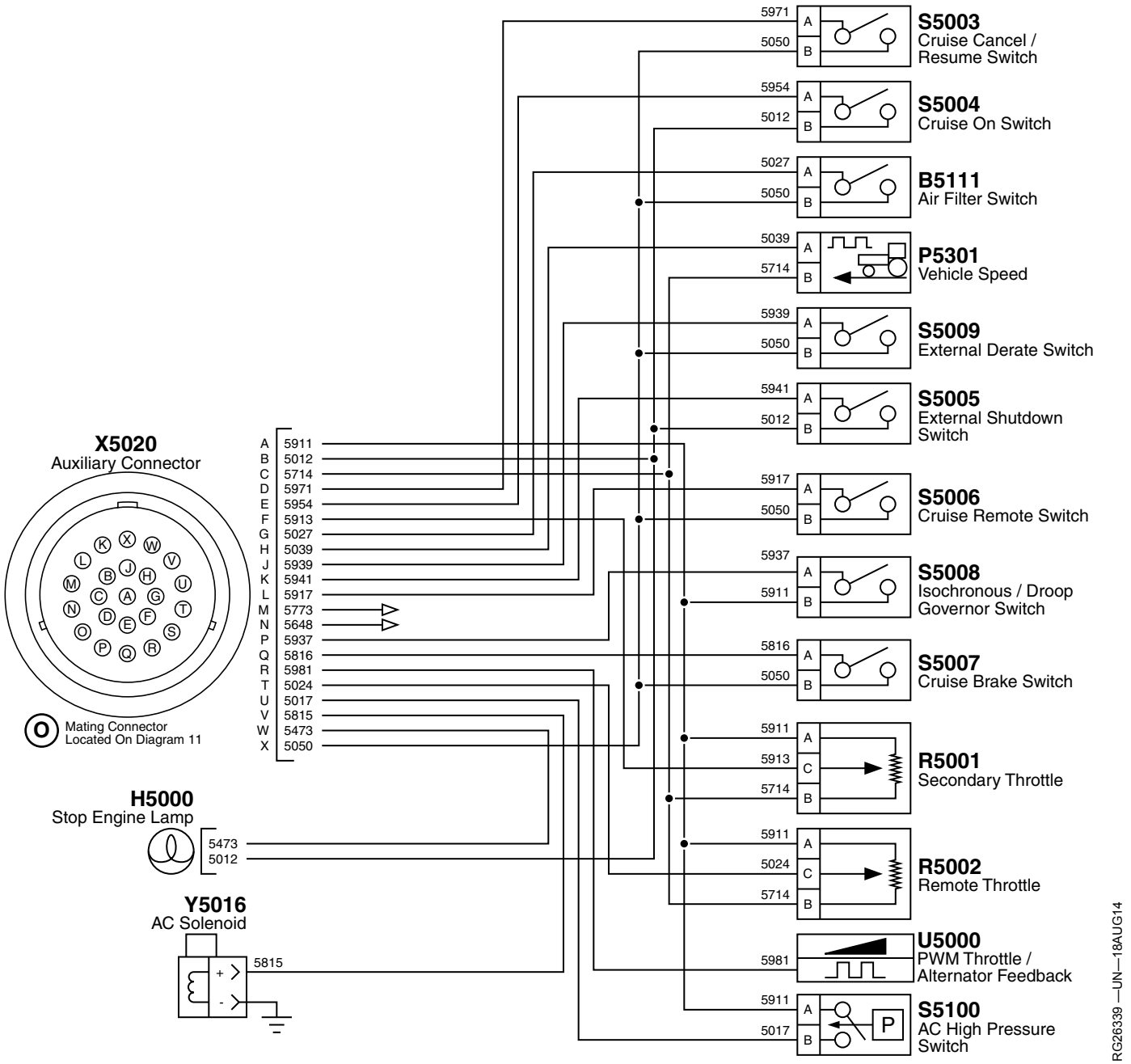
4.5 L Wiring Diagram 12



A5503— ECU Harness Connector
A5503-04— [5798 Gray] DPF Regeneration Required Lamp
A5503-05— [5025 Green] Exhaust Temperature High Lamp
A5503-26— [5029 White] Starter Relay Control Negative
A5503-30— [5034 Yellow] Starter Relay Control Positive
A5503-35— [5796 Blue] DPF Regeneration Status Lamp
A5503-38— [5038 Gray] DPF Regeneration Request Switch
A5503-42— [5037 Violet] DPF Regeneration Inhibit/Abort Switch
A5503-51— [5041 Brown] DPF Regeneration Inhibit/Abort Lamp
A5503-52— [5047 Violet] Spare Driver Positive
H5003— DPF Regeneration Required Lamp
H5004— DPF Regeneration Request Status Lamp
H5005— DPF Regeneration Inhibit/Abort Lamp
H5200— Exhaust Temperature High Lamp
J— [5002 Red] Control Panel Unswitched Power From 4.5 L Wiring Diagram 10
K5811— Starter Relay (Application Specific)
K5802— Spare Relay
N— [5050 Black] Battery Negative From 4.5 L Wiring Diagram 11
S5014— Aftertreatment Interface Switch
X5022— Regeneration Connector
Y5025— Starter Solenoid (Application Specific)

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4.5 L Wiring Diagram 13



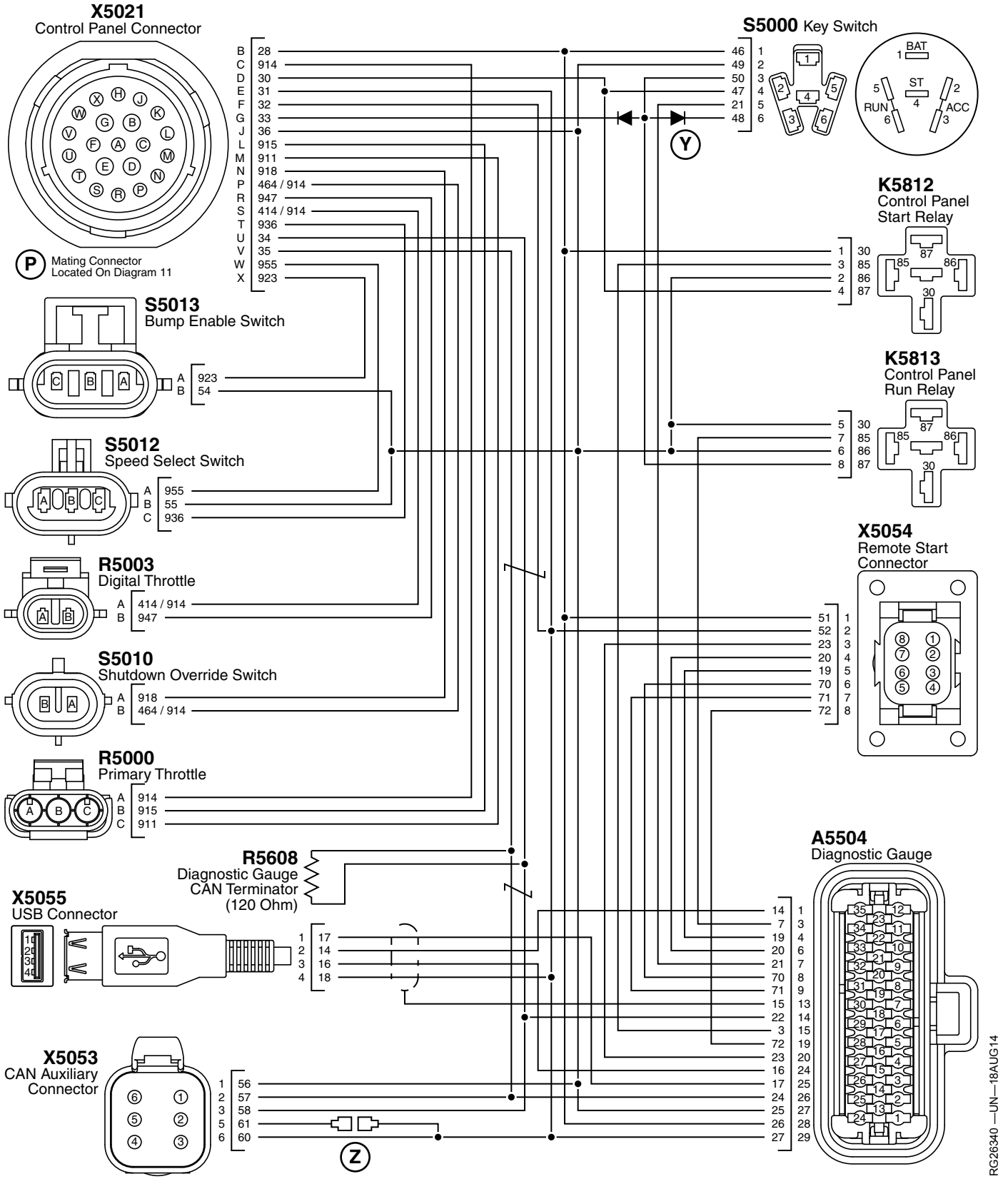
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B5111— Air Filter Switch
H5000— Stop Engine Lamp
O— Mating Connector Located On 4.5 L Wiring Diagram 11
P5301— Vehicle Speed
R5001— Secondary Throttle
R5002— Remote Throttle
S5003— Cruise Cancel/Resume Switch
S5004— Cruise On Switch
S5005— External Shutdown Switch
S5006— Cruise Remote Switch
S5007— Cruise Brake Switch
S5008— Isochronous/Droop Governor Switch
S5009— External Derate Switch
S5100— AC High Pressure Switch
U5000— PWM Throttle/Alternator Feedback
X5020— Auxiliary Connector
X5020-A— [5911 Brown] 5 V Sensor Supply #5 Positive
X5020-B— [5012 Red] Key Switch
X5020-C— [5714 Yellow] 5 V Sensor Supply #5 Return
X5020-D— [5971 Brown] Cruise Cancel/Resume Switch
X5020-E— [5954 Yellow] Cruise On Switch
X5020-F— [5913 Orange] Secondary Throttle
X5020-G— [5027 Violet] Air Filter Switch
X5020-H— [5039 White] Vehicle Speed Input
X5020-J— [5939 White] External Derate Switch
X5020-K— [5941 Brown] External Shutdown Switch
X5020-L— [5917 Violet] Cruise Cancel/Resume Switch
X5020-M— [5773 Orange] Spare Driver Positive
X5020-N— [5648 Gray] Sensor Return #5
X5020-P— [5937 Violet] Isochronous Governor
X5020-Q— [5816 Blue] Cruise Brake Switch
X5020-R— [5981 Brown] PWM Throttle/Alternator Feedback
X5020-T— [5024 Yellow] Remote Throttle
X5020-U— [5017 Violet] AC High Pressure Switch
X5020-V— [5815 Green] AC Compressor
X5020-W— [5473 Orange] Stop Lamp
X5020-X— [5050 Black] Battery Negative
Y5016— AC Solenoid

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4.5 L Wiring Diagram 14



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A5504— Diagnostic Gauge
A5504-1— [14 White] USB D Negative
A5504-3— [7 White] Run Return
A5504-4— [19 White] Pre-Start Alarm
A5504-6— [20 White] Remote Stop
A5504-7— [21 White] Manual Input Signal
A5504-8— [70 White] Fuel Level Signal
A5504-9— [71 White] Interlock Signal
A5504-13— [15 White] USB Shield
A5504-15— [3 White] Start
A5504-19— [72 White] Auxiliary Input
A5504-20— [23 White] Remote Start
A5504-24— [16 White] USB D Positive
A5504-25— [17 White] USB VBus
K5812— Control Panel Start Relay
K5813— Control Panel Run Relay
P— Mating Connector Located On 4.5 L Wiring Diagram 11
R5000— Primary Throttle
R5003— Digital Throttle
R5608— Diagnostic Gauge CAN Terminator (120 Ohm)
S5000— Key Switch
S5010— Shutdown Override Switch
S5012— Speed Select Switch
S5013— Bump Enable Switch
X5021— Control Panel Connector
X5021-B— [28 White] Fused Unswitched Power
X5021-C— [914 White] 5 V Sensor Supply #4 Return
X5021-D— [30 White] Start
X5021-E— [31 White] Battery Negative
X5021-F— [32 White] Primary CAN Shield
X5021-G— [33 White] Key Switch
X5021-J— [36 White] Accessory
X5021-L— [915 White] Primary Throttle
X5021-M— [911 White] 5 V Sensor Supply #4 Positive
X5021-N— [918 White] Shutdown Override Switch
X5021-P— [464/914 White] 5 V Sensor Supply #5 Return
X5021-R— [947 White] Digital Throttle
X5021-S— [414/914 White] 5 V Sensor Supply #5 Return
X5021-T— [936 White] Cruise Resume/Bump Down Switch
X5021-U— [34 White] Primary CAN Low
X5021-V— [35 White] Primary CAN High
X5021-W— [955 White] Set Accelerator/Bump Up Switch
X5021-X— [923 White] Bump Enable Switch
X5053— CAN Auxiliary Connector
X5054— Remote Start Connector
X5055— USB Connector
Y— Starter Switch Diodes
Z— Gauge Backlight Quick Disconnect

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Engine Storage Guidelines

IMPORTANT: Special considerations should be taken prior to storage when using BioDiesel. See BioDiesel Fuel in the Fuels, Lubricants, and Coolant Section.

1. John Deere engines can be stored outside for up to three months with no long-term preparation if covered by a waterproof covering. No outside storage is recommended without a waterproof covering.
2. John Deere engines can be stored in a standard overseas shipping container for up to three months with no long-term preparation.
3. John Deere engines can be stored inside for up to six months with no long-term preparation.
4. John Deere engines expected to be stored more than six months **must** have long-term storage preparation. See Preparing Engine for Long-Term Storage in the Storage Section.

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Preparing Engine for Long-Term Storage

IMPORTANT: Any time the engine is not used for over six months, the following recommendations for storing it and removing it from storage helps to minimize corrosion and deterioration.

IMPORTANT: Long-term storage is not advised when using BioDiesel. For storage longer than one year, use straight hydrocarbon fuel.

If BioDiesel must be used it is recommended the blend not exceed B7 and a high-quality fuel stabilizer be used. Storage should not exceed one year.

For more information see BioDiesel Fuel in the Fuels, Lubricants, and Coolants Section.

NOTE: The following storage preparations are used for long-term engine storage up to one year. After that, the engine should be started, warmed up, and retreated for an extended storage period.

1. Change engine oil and replace filter. Used oil does not give adequate protection. Add 30 mL of rust preventive oil to the engine crankcase for every 1 L of engine oil, or 1 oz of rust preventative oil per 1 qt. of engine oil. This rust preventive oil should be an SAE 10 oil with 1%-4% morpholine or equivalent vapor corrosion inhibitor.
2. Replace air cleaner.
3. Draining and flushing of cooling system is not necessary if the engine is only stored for less than one year. However, for extended storage periods of a year or longer, it is recommended that the cooling system be drained, flushed, and refilled. Refill with appropriate coolant. See Diesel Engine Coolant (engine with wet sleeve cylinder liners) in the Fuels, Lubricants, and Coolants Section.
4. Prepare a solution of diesel fuel and rust preventive oil in a temporary container, add 78 mL of rust preventive oil per 1 L of diesel fuel, 10 oz. of rust preventive oil per 1 gal. of diesel fuel.
5. Remove existing lines and plugs as required. Run a temporary line from the temporary container to the engine fuel intake before the fuel filters, and another temporary line from the fuel return to the temporary container, so rust preventive oil solution is circulated through the injection system during cranking.

IMPORTANT: Do not operate starter more than 30 seconds at a time. Wait at least 2 minutes for starter to cool before trying again.

6. Crank the engine several revolutions with starter. Do not allow the engine to start. This allows rust preventive oil solution to circulate.

   See your authorized dealer for the proper procedure for your application.
7. Remove temporary lines installed in Step 5 and replace any lines or plugs previously removed.
8. Loosen (or remove) and store fan and alternator poly-vee belt.
9. Remove and clean batteries. Store them in a cool, dry place and keep them fully charged.
10. Disengage the clutch for any driveline.
11. For extended storage periods of a year or longer, drain or siphon DEF fluid from DEF tank.
12. Clean the exterior of the engine with salt-free water and touch up any scratched or chipped painted surfaces with a good quality paint.
13. Coat all exposed bare metal surfaces with grease or corrosion inhibitor if not feasible to paint.
14. Seal all openings on engine with plastic bags and tape.
15. Store the engine in a dry protected place. If engine must be stored outside, cover it with a waterproof canvas or other suitable protective material and use a strong waterproof tape.

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Removing Engine from Long-Term Storage

NOTE: The following storage removal procedure is used for long-term engine storage up to one year. After that, the engine should be started, warmed up, and retreated for an extended storage period.

Refer to the appropriate section for detailed services listed below or have an authorized servicing dealer or engine distributor perform unfamiliar services.

1. Remove all protective coverings from engine. Unseal all openings in engine and remove covering from electrical systems.
2. Remove grease from all exposed metal surfaces.
3. Remove the batteries from storage. Install batteries (fully charged) and connect the terminals.
4. Install fan and alternator poly-vee belt, if removed.
5. Fill fuel tank.
6. If drained, fill DEF tank with new DEF.

   If not drained, DEF must pass visual, smell, and concentration checks before the engine can be ran. See Diesel Exhaust Fluid (DEF) — Use in Selective Catalytic Reduction (SCR) Equipped Engines in the Fuels, Lubricants, and Coolants Section for more information.
7. Perform all appropriate prestarting checks. See Daily Prestarting Checks in the Lubrication & Maintenance — Daily Section for more information.

IMPORTANT: DO NOT operate starter more than 30 seconds at a time. Wait at least 2 minutes for starter to cool before trying again.

8. Crank engine for 20 seconds with starter. Do not allow the engine to start. Wait 2 minutes and crank engine an additional 20 seconds to assure bearing surfaces are adequately lubricated.

   See your authorized dealer for the proper procedure for your application.
9. Start engine and run at low idle and no load for 15 minutes.
10. Shut engine off. Change engine oil and replace filter.
11. Warm up engine and check all gauges before placing engine under load.
12. On the first day of operation after storage, check overall engine for leaks and check all gauges for correct operation.

NOTE: If using BioDiesel blends after long-term storage, frequency of fuel filter plugging can increase initially.

RK80614,0000062 -19-21OCT13-1/1

General OEM Engine Specifications

ITEM	UNIT OF MEASURE	4045HFC09 4045HFG09	4045HFC04 4045HFG04
General Data			
Number of Cylinders		4	4
Bore	mm (in.)	106 (4.2)	106 (4.2)
Stroke	mm (in.)	127 (5.0)	127 (5.0)
Displacement	L (cu in.)	4.5 (275)	4.5 (275)
Compression Ratio		17.2:1	17.0:1
Aspiration		Air-To-Air Aftercooled, Turbocharged	Air-To-Air Aftercooled, Turbocharged
Engine Firing Order		1-3-4-2	1-3-4-2
Valves Per Cylinder		2 Intake 2 Exhaust	2 Intake 2 Exhaust
Valve Clearance (Cold)	mm (in.)	Intake — 0.46 (0.018) Exhaust — 0.53 (0.021)	Intake — 0.46 (0.018) Exhaust — 0.53 (0.021)
Physical Dimensions			
Length	mm (in.)	870 (34.4)	870 (34.4)
Width	mm (in.)	635 (25)	650 (25.6)
Height	mm (in.)	1130 (44.5)	1050 (41.3)
Weight	kg (lb.)	570 (1257)	550 (1213)
Performance Data			
Power and Speed Ratings		See Engine Power And Speed Rating Specifications in the Specifications Section.	See Engine Power And Speed Rating Specifications in the Specifications Section.
Lubrication System			
Crankcase Oil Fill Capacity		See Engine Crankcase Oil Fill Quantities in the Specifications Section.	See Engine Crankcase Oil Fill Quantities in the Specifications Section.
Oil Pressure At Rated Speed (2400 rpm), Full Load With Oil Warmed to 97 °C (207 °F) 15W40 Oil	kPa (Bar) (psi)	385 (3.85) (56)	370 (3.70) (54)
Oil Pressure At Low Idle (Minimum)	kPa (Bar) (psi)	150 (1.50) (22)	150 (1.50) (22)
Cooling System			
Thermostat Start To Open Temperature	°C (°F)	85 (185)	85 (185)
Thermostat Fully Open Temperature	°C (°F)	97 (207)	97 (207)
Recommended Radiator Pressure Cap	kPa (Bar) (psi)	103—124 (1.03—1.24) (15—18)	103—124 (1.03—1.24) (15—18)
Fuel System			
ECU Level		L34	L34
Fuel Injection Type		HPCR	HPCR
Primary Fuel Filter		10 micron	10 micron
Secondary Fuel Filter		2 micron	2 micron
Electrical System			
Battery Capacities 12-Volt System	CCA	640	640
Reserve Capacity 12-Volt System	Minutes	285	285
Battery Capacities 24-Volt System	CCA	570	570
Reserve Capacities 24-Volt System	Minutes	275	275
Air System			

Continued on next page

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ITEM	UNIT OF MEASURE	4045HFC09 4045HFG09	4045HFC04 4045HFG04
Maximum Air Intake Restriction	kPa (Bar) (psi)	12 (3.0) (0.44)	12 (3.0) (0.44)
Maximum Exhaust Back Pressure	kPa (Bar) (psi)	30 (7.5) (1.09)	30 (7.5) (1.09)

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Engine Power and Speed Rating Specifications

NOTE: Engine speeds listed are preset to factory specification for application. Therefore, speeds may vary depending upon specific vehicle application requirements. Refer to your machine operator's manual for engine speeds that are different from those preset at the factory.

ELECTRONIC SOFTWARE OPTION CODES 12V	ELECTRONIC SOFTWARE OPTION CODES 24V	POWER RATING AT RATED SPEED WITHOUT FAN kW (hp)	RATED SPEED[a] (rpm)	SLOW IDLE (rpm)	FAST IDLE[b] (rpm)
Industrial Units — 4045HFC04					
7AUD	7AUE	104 (140)	2200	800	2400
7AUF[c]	7AUH[c]	100 (134)	2400	800	2600
7AUJ	7AUK	93 (125)	2400	800	2600
7AUL	7AUM	93 (125)	2200	800	2400
7AUN	7AUP	86 (115)	2400	800	2600
7AUQ	7AUR	86 (115)	2200	800	2400
7AUS[c]	7AUT[c]	74 (100)	2400	800	2600
7AUU	7AUV	74 (100)	2400	800	2600
7AUW[c]	7AUX[c]	74 (100)	2200	800	2400
7AUY	7AUZ	74 (100)	2200	800	2400
7AVA[c]	7AVB[c]	63 (84)	2400	800	2600
7AVC	7AVD	63 (84)	2400	800	2600
7AVE[c]	7AVF[c]	63 (84)	2200	800	2400
7AVG	7AVH	63 (84)	2200	800	2400
Industrial Units — 4045HFC09					
7ASP	7AST	129 (173)	2400	800	2600
7ASU	7ASV	129 (173)	2200	800	2400
7ASW[c]	7ASX[c]	116 (155)	2400	800	2600
7ASY	7ASZ	116 (155)	2400	800	2600
7ATA[c]	7ATB[c]	116 (155)	2200	800	2400
7ATC	7ATD	116 (155)	2200	800	2400
7ATE[c]	7ATF[c]	104 (140)	2400	800	2600
7ATG	7ATH	104 (140)	2400	800	2600
7ATJ[c]	7ATK[c]	104 (140)	2200	800	2400
7ATL	7ATM	104 (140)	2200	800	2400
7ATN[c]	7ATP[c]	93 (125)	2400	800	2600
7ATQ	7ATR	93 (125)	2400	800	2600
7ATS[c]	7ATT[c]	93 (125)	2200	800	2400
7ATU	7ATV	93 (125)	2200	800	2400
Generator Sets — 4045HFG09					
7ATW	7ATX	124 (166)	1800	1800	—
7ATY	7ATZ	105 (140)	1800	1800	—
Generator Sets — 4045HFG04					
7AVJ	7AVK	99 (133)	1800	1800	—
7AVL	7AVM	80 (107)	1800	1800	—
7AVN	7AVP	67 (90)	1800	1800	—

[a] Generator set engines usually run at 1500 rpm (50 Hz) or 1800 (60 Hz) when operating under load depending on cycles of AC current.
[b] Parasitic loads and ECU settings can change the fast idle speed. See your authorized John Deere engine distributor or servicing dealer for more information.
[c] These Industrial engines have a power bulge which allows for INTERMITTENT operation above rated power.

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Engine Crankcase Oil Fill Quantities

To determine the option code for the oil fill quantity of your engine, refer to the engine option code label affixed to the rocker arm cover. The first two digits of the code (19) identify the oil pan option group. The last two digits of each code identify the specific oil pan on your engine.

The following table lists engine crankcase oil fill quantities, including oil filter:

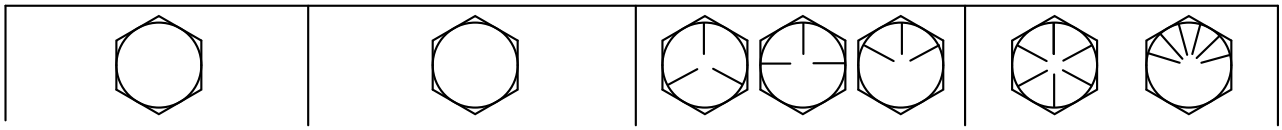
Oil Pan Option Code(s)	Crankcase Oil Capacity L (qt)
1903	13 (13.7)
1923	15 (15.9)
1976	20.5 (21.7)
19AE	14.7 (15.5)
19AZ	20.5 (21.7)
19BA	15 (15.9)
19BB	13 (13.7)
19BC	14.7 (15.5)
19GK	20.5 (21.7)

NOTE: Crankcase oil capacity may vary slightly from amount shown. ALWAYS fill crankcase to within crosshatch on dipstick. DO NOT overfill.

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Unified Inch Bolt and Screw Torque Values

TS1671 —UN—01MAY03



Bolt or Screw Size	SAE Grade 1				SAE Grade 2[a]				SAE Grade 5, 5.1 or 5.2				SAE Grade 8 or 8.2			
	Lubricated[b]		Dry[c]		Lubricated[b]		Dry[c]		Lubricated[b]		Dry[c]		Lubricated[b]		Dry[c]	
	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.
1/4	3.7	33	4.7	42	6	53	7.5	66	9.5	84	12	106	13.5	120	17	150
													N·m	lb.-ft.	N·m	lb.-ft.
5/16	7.7	68	9.8	86	12	106	15.5	137	19.5	172	25	221	28	20.5	35	26
									N·m	lb.-ft.	N·m	lb.-ft.				
3/8	13.5	120	17.5	155	22	194	27	240	35	26	44	32.5	49	36	63	46
			N·m	lb.-ft.	N·m	lb.-ft.	N·m	lb.-ft.								
7/16	22	194	28	20.5	35	26	44	32.5	56	41	70	52	80	59	100	74
	N·m	lb.-ft.														
1/2	34	25	42	31	53	39	67	49	85	63	110	80	120	88	155	115
9/16	48	35.5	60	45	76	56	95	70	125	92	155	115	175	130	220	165
5/8	67	49	85	63	105	77	135	100	170	125	215	160	240	175	305	225
3/4	120	88	150	110	190	140	240	175	300	220	380	280	425	315	540	400
7/8	190	140	240	175	190	140	240	175	490	360	615	455	690	510	870	640
1	285	210	360	265	285	210	360	265	730	540	920	680	1030	760	1300	960
1-1/8	400	300	510	375	400	300	510	375	910	670	1150	850	1450	1075	1850	1350
1-1/4	570	420	725	535	570	420	725	535	1280	945	1630	1200	2050	1500	2600	1920
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2140	1580	2700	2000	3400	2500
1-1/2	990	730	1250	930	990	730	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

Torque values listed are for general use only, based on the strength of the bolt or screw. DO NOT use these values if a different torque value or tightening procedure is given for a specific application. For plastic insert or crimped steel type lock nuts, for stainless steel fasteners, or for nuts on U-bolts, see the tightening instructions for the specific application. Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Replace fasteners with the same or higher grade. If higher grade fasteners are used, tighten these to the strength of the original. Make sure fastener threads are clean and that you properly start thread engagement. When possible, lubricate plain or zinc plated fasteners other than lock nuts, wheel bolts or wheel nuts, unless different instructions are given for the specific application.

[a] Grade 2 applies for hex cap screws (not hex bolts) up to 6 in. (152 mm) long. Grade 1 applies for hex cap screws over 6 in. (152 mm) long, and for all other types of bolts and screws of any length.

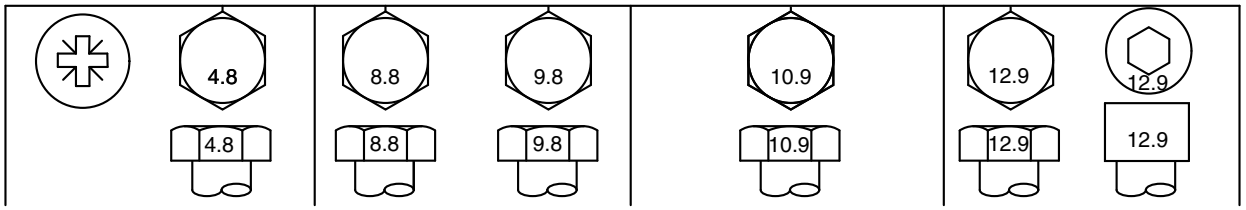
[b] "Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or 7/8 in. and larger fasteners with JDM F13C, F13F or F13J zinc flake coating.

[c] "Dry" means plain or zinc plated without any lubrication, or 1/4 to 3/4 in. fasteners with JDM F13B, F13E or F13H zinc flake coating.

DX,TORQ1 -19-12JAN11-1/1

Metric Bolt and Screw Torque Values

TS1670 —UN—01MAY03



Bolt or Screw Size	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated[a]		Dry[b]		Lubricated[a]		Dry[b]		Lubricated[a]		Dry[b]		Lubricated[a]		Dry[b]	
	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.
M6	4.7	42	6	53	8.9	79	11.3	100	13	115	16.5	146	15.5	137	19.5	172
									N·m	lb.-ft.	N·m	lb.-ft.	N·m	lb.-ft.	N·m	lb.-ft.
M8	11.5	102	14.5	128	22	194	27.5	243	32	23.5	40	29.5	37	27.5	47	35
			N·m	lb.-ft.	N·m	lb.-ft.	N·m	lb.-ft.								
M10	23	204	29	21	43	32	55	40	63	46	80	59	75	55	95	70
	N·m	lb.-ft.														
M12	40	29.5	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	46	80	59	120	88	150	110	175	130	220	165	205	150	260	190
M16	100	74	125	92	190	140	240	175	275	200	350	255	320	235	400	300
M18	135	100	170	125	265	195	330	245	375	275	475	350	440	325	560	410
M20	190	140	245	180	375	275	475	350	530	390	675	500	625	460	790	580
M22	265	195	330	245	510	375	650	480	725	535	920	680	850	625	1080	800
M24	330	245	425	315	650	480	820	600	920	680	1150	850	1080	800	1350	1000
M27	490	360	625	460	950	700	1200	885	1350	1000	1700	1250	1580	1160	2000	1475
M30	660	490	850	625	1290	950	1630	1200	1850	1350	2300	1700	2140	1580	2700	2000
M33	900	665	1150	850	1750	1300	2200	1625	2500	1850	3150	2325	2900	2150	3700	2730
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2770	4750	3500

Torque values listed are for general use only, based on the strength of the bolt or screw. DO NOT use these values if a different torque value or tightening procedure is given for a specific application. For stainless steel fasteners or for nuts on U-bolts, see the tightening instructions for the specific application. Tighten plastic insert or crimped steel type lock nuts by turning the nut to the dry torque shown in the chart, unless different instructions are given for the specific application.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class. Replace fasteners with the same or higher property class. If higher property class fasteners are used, tighten these to the strength of the original. Make sure fastener threads are clean and that you properly start thread engagement. When possible, lubricate plain or zinc plated fasteners other than lock nuts, wheel bolts or wheel nuts, unless different instructions are given for the specific application.

[a] *"Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or M20 and larger fasteners with JDM F13C, F13F or F13J zinc flake coating.*

[b] *"Dry" means plain or zinc plated without any lubrication, or M6 to M18 fasteners with JDM F13B, F13E or F13H zinc flake coating.*

DX,TORQ2 -19-12JAN11-1/1

Lubrication and Maintenance Records

Using Lubrication and Maintenance Records

Refer to specific Lubrication and Maintenance Section for detailed service procedures.

1. Keep a record of the number of hours you operate your engine by regular observation of hour meter.
2. Check your record regularly to learn when your engine needs service.
3. DO ALL the services within an interval section. Write the number of hours (from your service records) and the date in the spaces provided. For a complete listing of all items to be performed and the service intervals required, refer to the quick-reference chart near the front of the Lubrication and Maintenance Section.

IMPORTANT: The service recommendations covered in this manual are for the accessories that are provided by John Deere. Follow manufacturer's service recommendations for servicing engine driven equipment not supplied by Deere.

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Daily (Prestarting) Service

NOTE: See Daily Prestarting Checks in the Lubrication & Maintenance — Daily Section for detailed procedures.

Check engine oil level.

Check coolant level.

Drain water from fuel filters.

Check air cleaner dust unloader valve and air filter restriction indicator, if equipped.

Perform visual walk around inspection.

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500 Hours of Operation or Every 12 Months Service

Service fire extinguisher.

Service battery.

Change engine oil and filter. [1] [2]

Check coolant pump.

Check open crankcase vent (OCV) system.

Remove and replace fuel filter elements.

Check belt wear.

Check belt tensioner.

Check cooling system.

Pressure test cooling system.

Check engine speeds.

Check engine mounts.

Check engine ground.

Hours									
Date									
Hours									
Date									
Hours									
Date									
Hours									
Date									

[1] During the initial operation of a new or rebuilt engine with Break-In Plus, change the oil and filter between a minimum of 100 hours and a maximum of up to 500 hours.
[2] Service intervals depend on sulfur content of the diesel fuel, oil pan capacity, and the oil and filter used. (See Diesel Engine Oil and Filter Service Intervals in the Fuels, Lubricants, and Coolants Section.)

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1500 Hours of Operation Service

Change open crankcase ventilation (OCV) filter.

Hours									
Date									
Hours									
Date									
Hours									
Date									
Hours									
Date									

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3000 Hours of Operation or Every 36 Months Service

Check crankshaft vibration damper.

Testing glow plugs for continuity.

Adjust valve clearance.

Hours									
Date									
Hours									
Date									
Hours									
Date									
Hours									
Date									

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4500 Hours of Operation or Every 36 Months Service

Change DEF dosing unit filter.

Hours									
Date									
Hours									
Date									
Hours									
Date									
Hours									
Date									

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6000 Hours of Operation or Every 72 Months Service

Flush cooling system.

Test Thermostats.

Hours									
Date									
Hours									
Date									
Hours									
Date									
Hours									
Date									

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Service as Required

Drain water from fuel filters when alarm sounds.

Add coolant.

Clean DEF tank.

Pre-Start Cleaning Guide.

Service air cleaner.

Clean exhaust filter.

Replace fan-alternator belt.

Check fuses.

Check electrical wiring and connectors.

Check air compressor (if equipped). (See your John Deere dealer.)

Check Refrigerant (A/C) compressor (if equipped). (See your John Deere dealer.)

Hours									
Date									
Hours									
Date									
Hours									
Date									

ZE59858,00000E1 -19-12AUG14-1/1

John Deere Warranty in OEM Applications

Overview

This section focuses on John Deere engines marketed in products manufactured by companies other than John Deere or its affiliates, and on John Deere repower engines in all applications. Herein appears the original warranty applicable to the engine as delivered to the retail purchaser on or after 1 May 2010. The following is information about the warranty and warranty service.

NOTE: "John Deere" means John Deere Power Systems with respect to users in the United States, John Deere Limited with respect to users in Canada, and Deere & Company or its subsidiary responsible for making John Deere equipment in other countries where the user is located.

Promptly register your engine online at https://www.johndeere.com/enginewarranty

or

Mail or FAX the registration form found in this manual to John Deere as indicated on the form.

When Warranty Service Is Needed

The nearest dealer stands ready with genuine parts and trained and equipped personnel should the need arise. If following the Operator's Manual delivered with the engine/machine are not adequate to correct an engine problem, contact the nearest John Deere service dealer for assistance. Authorized engine service dealers can be found at: https://www.johndeere.com/ (click on "Dealer Locator").

NOTE: When requesting warranty service, the purchaser must be prepared to provide proof that the engine is within the warranty period.

The following information is always required: Engine serial number, date of delivery, engine owner, name and location of dealer and specific person contacted, date of contact, nature of engine problem, and outcome of the service dealer contact.

Given that normally it is the dealer contacted who in the end will provide the service required, maintaining a purchaser-dealer relationship of mutual respect from the beginning is always helpful.

Privacy Notice

At John Deere your privacy is important to us. We collect, use, and disclose your personal information in accordance with the John Deere privacy statement. For instance, we collect, use, and disclose your personal information to provide you with the products and services that you request; to communicate with you as our customer (examples include warranty and product improvement programs) and to meet safety and legal requirements; and for marketing and promotional purposes. Sometimes, we may ask our John Deere affiliates, dealers, or business partners to do work for us which involves your information. For complete details on your privacy rights and to obtain a copy of the John Deere Privacy Statement, please visit our website at https://www.johndeere.com/.

Warranty Duration

Unless otherwise provided in writing by John Deere, John Deere makes the following warranty to the first retail purchaser and each subsequent purchaser (if purchase is made prior to the expiration of applicable warranty) of each John Deere new off-highway engine marketed as part of a product manufactured by a company other than John Deere or its affiliates and on each John Deere engine used in an off-highway repower application:

- 12 months, unlimited hours of use, or
- 24 months and before the accumulation of 2000 hours of use.

NOTE: In the absence of a functional hourmeter, hours of use will be determined on the basis of 12 hours of use per calendar day.

Warranty Coverage

This warranty applies to the engine and to integral components and accessories sold by John Deere, and delivered to the first retail purchaser on or after 1 May 2010.

All John Deere-warranted parts and components of John Deere engines which, as delivered to the purchaser, are defective in materials and/or workmanship will be repaired or replaced, as John Deere elects. Warrantable repairs will be made without charge for parts or engine repair labor, including reasonable labor costs to remove and reinstall non-engine parts or components of the equipment in which the engine is installed. If required, reasonable labor costs for engine removal and reinstallation will also be included. All coverage is based on the defect appearing within the warranty period as measured from the date of delivery to the first retail purchaser.

Obtaining Warranty Service

Warranty service must be requested of the nearest authorized John Deere engine service outlet before the expiration of the warranty. An *authorized* service outlet is a John Deere engine distributor, a John Deere engine service dealer, or a John Deere equipment dealer selling and servicing equipment with an engine of the type covered by this warranty. (See When Warranty Service is Needed above.)

Authorized service outlets will use only new or remanufactured parts or components furnished or approved by John Deere.

NOTE: Authorized engine service locations are listed on the Internet at https://www.johndeere.com/ (Click on "Dealer Locator".)

Continued on next page

At the time of requesting warranty service, the purchaser must be prepared to present evidence of the date of delivery of the engine.

John Deere reimburses authorized service outlets for limited travel expenses incurred in making warranty service repairs in non-John Deere applications when travel is actually performed. The limit, as of the date of publication of this booklet, is US$400.00 (US$500.00 if engine is marine) or equivalent. **If distances and travel times are greater than reimbursed by John Deere, the service outlet will charge the purchaser for the difference.**

Warranty Exclusions

John Deere's obligations will not apply to components and accessories which are not furnished or installed by John Deere, nor to failures caused by such items, except as required by law.

Purchaser's Responsibilities

The cost of normal maintenance and depreciation.

Periodic cleaning of the diesel particulate filter (DPF).

Consequences of negligence, misuse, or accident involving the product, or improper application, installation, or storage.

Consequences of service performed by someone other than an authorized John Deere engine service outlet.

Consequences of any product modification or alteration not approved by John Deere, including, but not limited to, tampering with engine fuel and air delivery systems.

Consequences of failure of non-product components.

Consequences of fuels, lubricants, or coolants that fail to meet the specifications and requirements listed in the Operator's Manual.

The effects of cooling system neglect as manifested in cylinder liner or cylinder block cavitation ("pitting, "erosion", "electrolysis").

Any premium for overtime labor requested by the purchaser.

Costs of transporting the product or the equipment in which it is installed to and from the location at which the warranty service is performed, if such costs are in excess of the travel reimbursement payable to the dealer had the warranty service been performed at the product's location.

Costs incurred in gaining access; for example, overcoming physical barriers such as walls, fences, floors, decks, or similar structures impeding access to the product, rental of cranes or similar, or construction of ramps or lifts or protective structures for product removal and reinstallation.

Incidental travel costs including meals, lodging, and similar, and any travel time or mileage costs in excess of the maximum allowance.

Service outlet costs incurred in solving or attempting to solve non-warrantable problems.

Services performed by a party other than an authorized John Deere service dealer.

Charges by dealers for initial start-up and inspection deemed unnecessary by John Deere when an Operator's Manual is supplied with the product are followed.

Costs related to interpretation or translation services.

No Representations or Implied Warranty

Where permitted by law, neither John Deere nor any company affiliated with it makes any guaranties, warranties, conditions, representations or promises, express or implied, oral or written, as to the nonoccurrence of any defect or the quality of performance of its engines other than those set forth in this booklet, and DOES NOT MAKE ANY IMPLIED WARRANTY OR CONDITIONS OF MERCHANTABILITY OR FITNESS otherwise provided for in the Uniform Commercial Code or required by any Sale of Goods Act or any other statute. This exclusion includes fundamental terms. In no event will a John Deere engine distributor or engine service dealer, John Deere equipment dealer, or John Deere or any company affiliated with John Deere be liable for incidental or consequential damages or injuries including, but not limited to, loss of profits, loss of crops, rental of substitute equipment or other commercial loss, damage to the equipment in which the engine is installed or for damage suffered by purchaser as a result of fundamental breaches of contract or breach of fundamental terms, unless such damages or injuries are caused by the gross negligence or intentional acts of the foregoing parties.

Remedy Limitation

The remedies set forth in this warranty are the purchaser's exclusive remedies in connection with the performance of, or any breach of guaranty, condition, or warranty in respect of new John Deere engines. In the event the above warranty fails to correct purchaser's performance problems caused by defects in workmanship and/or materials, purchaser's exclusive remedy shall be limited to payment by John Deere of actual damages in an amount not to exceed the cost of the engine.

No Seller's Warranty

No person or entity, other than John Deere, who sells the engine or product in which the engine has been installed makes any guaranty or warranty of its own on any engine warranted by John Deere unless it delivers to the purchaser a separate written guaranty certificate specifically guaranteeing the engine, in which case John Deere shall have no obligation to the purchaser. Neither original equipment manufacturers, engine or equipment distributors, engine or equipment dealers, nor any other person or entity, has any authority to make any representation or promise on behalf of John Deere or to modify the terms or limitations of this warranty in any way.

Continued on next page

Replacement Parts Warranty

John Deere and John Deere Reman parts and components (excluding replacement engines) installed during engine warranty service are warranted for the remaining warranty period of the engine or the applicable warranty term for the installed service part, whichever is greater. A new or remanufactured engine replacing a failed engine under warranty is warranted for 90 days or the remaining warranty period of the original engine, whichever is greater.

Warranty Transfer

The remainder of the original engine warranty and the emissions control-related warranty may be transferred to a subsequent owner of the engine. The Engine Warranty Transfer card should be used to report the transfer to John Deere. If a card is not available, contact your Dealer or simply send the following Information to JDPS Warranty Administration at Diesel-US@JohnDeere.com.

1. The complete 13-character engine serial number.
2. The name and mailing address of the original purchaser.
3. Delivery date to the original purchaser.
4. Hours at the time of transfer.
5. Date of transfer to the new owner.
6. Name and mailing address of the new owner.
7. How the engine/drivetrain being used, i.e., what equipment it powers, by manufacturer and model.
8. Equipment it powers, by manufacturer and model.

Purchased Extended Warranty

Extended warranty may be purchased on most engines in many areas of the world. John Deere engine distributors and equipment dealers, and dealers of manufacturers using John Deere engines in their products, have details. John Deere may also be contacted at U.S.A. fax number 1-319-292-5844, or in Europe fax number 33.2.38.84.62.66.

Emissions Warranties

Emissions warranties appear in the Operator's Manual furnished with the engine/machine. **(Warning: Statutes providing severe penalties for tampering with emissions controls may apply at the user's location.)** John Deere may also be contacted at U.S.A. fax number 1-319-292-5844; or in Europe fax number 33.2.38.84.62.66.

Local Warranty Requirements

Warranties required by local statutes will be furnished by the seller.

Option Codes (Engine Manufacturing Configuration)

When in need of engine replacement parts, your authorized John Deere service dealer will need to know the corresponding "Option Codes" for your engine. The option code label on the engine rocker arm cover may become damaged over time. By recording the four-digit codes when the engine is new, and storing this manual where it can be found when parts are needed, fast, accurate parts ordering and service will be assured. (See Engine Option Codes in the Record Keeping Section).

Should there be a question about an engine option code, note the engine serial number and call 1-800-JDENGINE from the U.S.A. or Canada, or fax U.S.A. number 1-319-292-5844; or E-mail at diesel-us@johndeere.com, Attention: Warranty Administration; or in Europe fax number 33.2.38.84.62.66, or E-mail at saranservice@johndeere.com.

Registering The Engine For Warranty

Completion and submission of the John Deere Engine Warranty Registration form (cut out sheet found in this manual) is very important. John Deere will not deny warranty service on an engine within its warranty period if the engine has not been registered. However, registering your engine will assure your servicing dealer that the engine is within the warranty period.

The easiest way to register your engine is via the Internet. Go to website https://www.johndeere.com/enginewarranty You can use the sheet in this manual to gather the information needed to register the warranty.

NOTE: Information provided on the form must be legible!

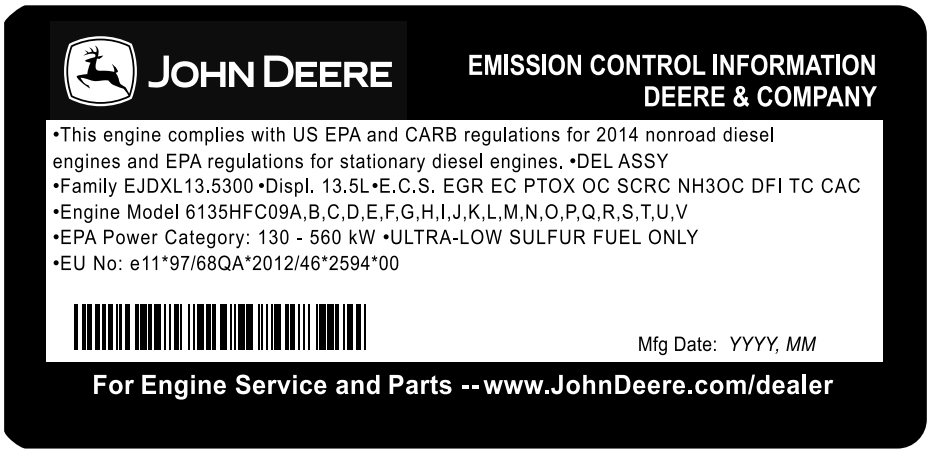
Typing is preferred, but legible handwritten reports are acceptable. "Block" numbers and Roman alphabet letters should be used. For example: 1,2,3,4 and A, B, C, D.

All requested information should be given. Much of it contributes to reports, including those required by governments.

The purchaser's telephone number or E-mail address allows John Deere to make contact should there be questions concerning the registration. The purchaser should sign and date the form.

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Emissions Control System Certification Label



RG24291 —UN—18SEP13

Engine Emissions Label

CAUTION: Statutes providing severe penalties for tampering with emissions controls may apply to the user or dealer.

The emissions warranty applies to those engines marketed by John Deere that have been certified by the United States Environmental Protection Agency (EPA) and/or California Air Resources Board (CARB); and used in the United States and Canada in Non-road equipment. The presence of an emissions label like the one shown signifies that the engine has been certified with the EPA and/or CARB. The EPA and CARB warranties only apply to new engines having the certification label affixed to the engine and sold as stated above in the geographic areas. The presence of an EU number signifies that the engine has been certified with the European Union countries per Directive 97/68/EC. The EPA and/or CARB emissions warranties do not apply to the EU countries.

The emissions label has applicable US EPA and/or CARB regulatory year. The regulatory year determines which warranty statement is applicable to engine. See “EPA Non-road Emissions Control Warranty Statement—Compression Ignition” and “CARB Non-road Emissions Control Warranty Statement—Compression Ignition”. For additional regulatory year warranty statements, see www.JohnDeere.com or contact the nearest John Deere service dealer for assistance.

Emission Control System(s) Laws

The U.S. EPA and California ARB prohibit the removal or rendering inoperative of any device or element of design installed on or in engines/equipment in compliance with applicable emission regulations prior to or after the sale and delivery of the engines/equipment to the ultimate purchaser.

DX,EMISSIONS,LABEL -19-01AUG14-1/1

EPA Non-road Emissions Control Warranty Statement—Compression Ignition

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JOHN DEERE

U.S. AND CANADA EMISSION CONTROL WARRANTY STATEMENT
YOUR WARRANTY RIGHTS AND OBLIGATIONS

To determine if the John Deere engine qualifies for the additional warranties set forth below, look for the "Emissions Control Information" label located on the engine. If the engine is operated in the United States or Canada and the Emissions Control information label states: "This engine complies with US EPA regulations for nonroad and stationary diesel engines", or "This engine conforms to US EPA nonroad compression-ignition regulations", refer to the "U.S. and Canada Emission Control Warranty Statement." If the engine is operated in California, and the label states: "This engine complies with US EPA and CARB regulations for nonroad diesel engines", or "This engine conforms to US EPA and California nonroad compression-ignition emission regulations", also refer to the "California Emission Control Warranty Statement."

Warranties stated on this certificate refer only to emissions-related parts and components of your engine. The complete engine warranty, less emissions-related parts and components, is provided separately. If you have any questions about your warranty rights and responsibilities, you should contact John Deere at 1-319-292-5400.

JOHN DEERE'S WARRANTY RESPONSIBILITY

John Deere warrants to the ultimate purchaser and each subsequent purchaser that this off-road diesel engine including all parts of its emission-control system was designed, built and equipped so as to conform at the time of the sale with Section 213 of the Clean Air Act and is free from defects in materials and workmanship which would cause the engine to fail to conform with applicable US EPA regulations for a period of five years from the date the engine is placed into service or 3,000 hours of operation, whichever first occurs.

Where a warrantable condition exists, John Deere will repair or replace, as it elects, any part or component with a defect in materials or workmanship that would increase the engine's emissions of any regulated pollutant within the stated warranty period at no cost to you, including expenses related to diagnosing and repairing or replacing emission-related parts. Warranty coverage is subject to the limitations and exclusions set forth herein. Emission- related components include engine parts developed to control emissions related to the following:

Air-Induction System
Fuel System
Ignition System
Exhaust Gas Recirculation Systems
Aftertreatment Devices
Crankcase Ventilation Valves
Sensors
Engine Electronic Control Units

EMISSION WARRANTY EXCLUSIONS

John Deere may deny warranty claims for malfunctions or failures caused by:

- Non-performance of maintenance requirements listed in the Operator's Manual
- The use of the engine/equipment in a manner for which it was not designed
- Abuse, neglect, improper maintenance or unapproved modifications or alterations
- Accidents for which it does not have responsibility or by acts of God

The off-road diesel engine is designed to operate on diesel fuel as specified in the Fuels, Lubricants and Coolants section in the Operators Manual. Use of any other fuel can harm the emissions control system of the engine/equipment and is not approved for use.

To the extent permitted by law John Deere is not liable for damage to other engine components caused by a failure of an emission-related part, unless otherwise covered by standard warranty.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. REMEDIES UNDER THIS WARRANTY ARE LIMITED TO THE PROVISIONS OF MATERIAL AND SERVICES AS SPECIFIED HEREIN. WHERE PERMITTED BY LAW, NEITHER JOHN DEERE NOR ANY AUTHORIZED JOHN DEERE ENGINE DISTRIBUTOR, DEALER, OR REPAIR FACILITY OR ANY COMPANY AFFILIATED WITH JOHN DEERE WILL BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Emission_CI_EPA (18Dec09)

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DX,EMISSIONS,EPA -19-12DEC12-1/2

JOHN DEERE

U.S. AND CANADA EMISSION CONTROL WARRANTY STATEMENT
YOUR WARRANTY RIGHTS AND OBLIGATIONS

To determine if the John Deere engine qualifies for the additional warranties set forth below, look for the "Emissions Control Information" label located on the engine. If the engine is operated in the United States or Canada and the Emissions Control information label states: "This engine complies with US EPA regulations for nonroad and stationary diesel engines", or "This engine conforms to US EPA nonroad compression-ignition regulations", refer to the "U.S. and Canada Emission Control Warranty Statement." If the engine is operated in California, and the label states: "This engine complies with US EPA and CARB regulations for nonroad diesel engines", or "This engine conforms to US EPA and California nonroad compression-ignition emission regulations", also refer to the "California Emission Control Warranty Statement."

Warranties stated on this certificate refer only to emissions-related parts and components of your engine. The complete engine warranty, less emissions-related parts and components, is provided separately. If you have any questions about your warranty rights and responsibilities, you should contact John Deere at 1-319-292-5400.

JOHN DEERE'S WARRANTY RESPONSIBILITY

John Deere warrants to the ultimate purchaser and each subsequent purchaser that this off-road diesel engine including all parts of its emission-control system was designed, built and equipped so as to conform at the time of the sale with Section 213 of the Clean Air Act and is free from defects in materials and workmanship which would cause the engine to fail to conform with applicable US EPA regulations for a period of five years from the date the engine is placed into service or 3,000 hours of operation, whichever first occurs.

Where a warrantable condition exists, John Deere will repair or replace, as it elects, any part or component with a defect in materials or workmanship that would increase the engine's emissions of any regulated pollutant within the stated warranty period at no cost to you, including expenses related to diagnosing and repairing or replacing emission-related parts. Warranty coverage is subject to the limitations and exclusions set forth herein. Emission- related components include engine parts developed to control emissions related to the following:

Air-Induction System
Fuel System
Ignition System
Exhaust Gas Recirculation Systems
Aftertreatment Devices
Crankcase Ventilation Valves
Sensors
Engine Electronic Control Units

EMISSION WARRANTY EXCLUSIONS

John Deere may deny warranty claims for malfunctions or failures caused by:

- Non-performance of maintenance requirements listed in the Operator's Manual
- The use of the engine/equipment in a manner for which it was not designed
- Abuse, neglect, improper maintenance or unapproved modifications or alterations
- Accidents for which it does not have responsibility or by acts of God

The off-road diesel engine is designed to operate on diesel fuel as specified in the Fuels, Lubricants and Coolants section in the Operators Manual. Use of any other fuel can harm the emissions control system of the engine/equipment and is not approved for use.

To the extent permitted by law John Deere is not liable for damage to other engine components caused by a failure of an emission-related part, unless otherwise covered by standard warranty.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. REMEDIES UNDER THIS WARRANTY ARE LIMITED TO THE PROVISIONS OF MATERIAL AND SERVICES AS SPECIFIED HEREIN. WHERE PERMITTED BY LAW, NEITHER JOHN DEERE NOR ANY AUTHORIZED JOHN DEERE ENGINE DISTRIBUTOR, DEALER, OR REPAIR FACILITY OR ANY COMPANY AFFILIATED WITH JOHN DEERE WILL BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Emission_CI_EPA (18Dec09)

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DX,EMISSIONS,EPA -19-12DEC12-2/2

CARB Non-road Emissions Control Warranty Statement—Compression Ignition

Emissions Control Warranty Statement 2013 through 2015

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JOHN DEERE

CALIFORNIA EMISSIONS CONTROL WARRANTY STATEMENT
YOUR WARRANTY RIGHTS AND OBLIGATIONS

To determine if the John Deere engine qualifies for the additional warranties set forth below, look for the “Emission Control Information” label located on the engine. If the engine is operated in the United States or Canada and the engine label states: “This engine complies with US EPA regulations for nonroad and stationary diesel engines”, or “This engine complies with US EPA regulations for stationary emergency diesel engines”, refer to the “U.S. and Canada Emission Control Warranty Statement.” If the engine is operated in California, and the engine label states: “This engine complies with US EPA and CARB regulations for nonroad diesel engines” also refer to the “California Emissions Control Warranty Statement.”

Warranties stated on this certificate refer only to emissions-related parts and components of your engine. The complete engine warranty, less emission-related parts and components, is provided separately. If you have any questions about your warranty rights and responsibilities, you should contact John Deere at 1-319-292-5400.

CALIFORNIA EMISSIONS CONTROL WARRANTY STATEMENT:

The California Air Resources Board (CARB) is pleased to explain the emission-control system warranty on 2013 through 2015 off-road diesel engines. In California, new off-road engines must be designed, built and equipped to meet the State’s stringent anti-smog standards. John Deere must warrant the emission control system on your engine for the periods of time listed below provided there has been no abuse, neglect or improper maintenance of your engine.

Your emission control system may include parts such as the fuel injection system and the air induction system. Also included may be hoses, belts, connectors and other emission-related assemblies.

John Deere warrants to the ultimate purchaser and each subsequent purchaser that this off-road diesel engine was designed, built, and equipped so as to conform at the time of sale with all applicable regulations adopted by CARB and is free from defects in materials and workmanship which would cause the failure of a warranted part to be identical in all material respects to the part as described in John Deere's application for certification for a period of five years from the date the engine is delivered to an ultimate purchaser or 3,000 hours of operation, whichever occurs first for all engines rated at 19 kW and greater. In the absence of a device to measure hours of use, the engine shall be warranted for a period of five years.

EMISSIONS WARRANTY EXCLUSIONS:

John Deere may deny warranty claims for failures caused by the use of an add-on or modified part which has not been exempted by the CARB. A modified part is an aftermarket part intended to replace an original emission-related part which is not functionally identical in all respects and which in any way affects emissions. An add-on part is any aftermarket part which is not a modified part or a replacement part.

In no event will John Deere, any authorized engine distributor, dealer, or repair facility, or any company affiliated with John Deere be liable for incidental or consequential damage.

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DX,EMISSIONS,CARB -19-01AUG14-1/8

JOHN DEERE'S WARRANTY RESPONSIBILITY:

Where a warrantable condition exists, John Deere will repair or replace, as it elects, your off-road diesel engine at no cost to you, including diagnosis, parts or labor. Warranty coverage is subject to the limitations and exclusions set forth herein. The off-road diesel engine is warranted for a period of five years from the date the engine is delivered to an ultimate purchaser or 3,000 hours of operation, whichever occurs first. The following are emissions-related parts:

Air Induction System

- Intake manifold
- Turbocharger
- Charge air cooler

Fuel Metering system

- Fuel injection system

Exhaust Gas Recirculation

- EGR valve

Catalyst or Thermal Reactor Systems

- Catalytic converter
- Exhaust manifold

Emission control labels

Particulate Controls

- Any device used to capture particulate emissions
- Any device used in the regeneration of the capturing system
- Enclosures and manifolding
- Smoke Puff Limiters

Positive Crankcase Ventilation (PCV) System

- PCV valve
- Oil filler cap

Advanced Oxides of Nitrogen (NOx) Controls

- NOx absorbers and catalysts

SCR systems and urea containers/dispensing systems

Miscellaneous Items used in Above Systems

- Electronic control units, sensors, actuators, wiring harnesses, hoses, connectors, clamps, fittings, gasket, mounting hardware

Any warranted emissions-related part scheduled for replacement as required maintenance is warranted by John Deere for the period of time prior to the first scheduled replacement point for the part. Any warranted emissions-related part not scheduled for replacement as required maintenance or scheduled only for regular inspection is warranted by John Deere for the stated warranty period.

OWNER'S WARRANTY RESPONSIBILITIES:

As the off-road diesel engine owner you are responsible for the performance of the required maintenance listed in your Operator's Manual. John Deere recommends that the owner retain all receipts covering maintenance on the off-road diesel engine, but John Deere cannot deny warranty solely for the lack of receipts or for the owner's failure to ensure the performance of all scheduled maintenance. However, as the off-road diesel engine owner, you should be aware that John Deere may deny you warranty coverage if your off-road diesel engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

The off-road diesel engine is designed to operate on diesel fuel as specified in the Fuels, Lubricants and Coolants section in the Operators Manual. Use of any other fuel may result in the engine no longer operating in compliance with applicable emissions requirements.

The owner is responsible for initiating the warranty process, and should present the machine to the nearest authorized John Deere dealer as soon as a problem is suspected. The warranty repairs should be completed by the authorized John Deere dealer as quickly as possible.

Emissions regulations require the customer to bring the unit to an authorized servicing dealer when warranty service is required. As a result, John Deere is NOT liable for travel or mileage on emissions warranty service calls.

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Emissions Control Warranty Statement 2013 through 2015

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JOHN DEERE

CALIFORNIA EMISSIONS CONTROL WARRANTY STATEMENT
YOUR WARRANTY RIGHTS AND OBLIGATIONS

To determine if the John Deere engine qualifies for the additional warranties set forth below, look for the “Emission Control Information” label located on the engine. If the engine is operated in the United States or Canada and the engine label states: “This engine complies with US EPA regulations for nonroad and stationary diesel engines”, or “This engine complies with US EPA regulations for stationary emergency diesel engines”, refer to the “U.S. and Canada Emission Control Warranty Statement.” If the engine is operated in California, and the engine label states: “This engine complies with US EPA and CARB regulations for nonroad diesel engines” also refer to the “California Emissions Control Warranty Statement.”

Warranties stated on this certificate refer only to emissions-related parts and components of your engine. The complete engine warranty, less emission-related parts and components, is provided separately. If you have any questions about your warranty rights and responsibilities, you should contact John Deere at 1-319-292-5400.

CALIFORNIA EMISSIONS CONTROL WARRANTY STATEMENT:

The California Air Resources Board (CARB) is pleased to explain the emission-control system warranty on 2013 through 2015 off-road diesel engines. In California, new off-road engines must be designed, built and equipped to meet the State’s stringent anti-smog standards. John Deere must warrant the emission control system on your engine for the periods of time listed below provided there has been no abuse, neglect or improper maintenance of your engine.

Your emission control system may include parts such as the fuel injection system and the air induction system. Also included may be hoses, belts, connectors and other emission-related assemblies.

John Deere warrants to the ultimate purchaser and each subsequent purchaser that this off-road diesel engine was designed, built, and equipped so as to conform at the time of sale with all applicable regulations adopted by CARB and is free from defects in materials and workmanship which would cause the failure of a warranted part to be identical in all material respects to the part as described in John Deere's application for certification for a period of five years from the date the engine is delivered to an ultimate purchaser or 3,000 hours of operation, whichever occurs first for all engines rated at 19 kW and greater. In the absence of a device to measure hours of use, the engine shall be warranted for a period of five years.

EMISSIONS WARRANTY EXCLUSIONS:

John Deere may deny warranty claims for failures caused by the use of an add-on or modified part which has not been exempted by the CARB. A modified part is an aftermarket part intended to replace an original emission-related part which is not functionally identical in all respects and which in any way affects emissions. An add-on part is any aftermarket part which is not a modified part or a replacement part.

In no event will John Deere, any authorized engine distributor, dealer, or repair facility, or any company affiliated with John Deere be liable for incidental or consequential damage.

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DX,EMISSIONS,CARB -19-01AUG14-3/8

JOHN DEERE'S WARRANTY RESPONSIBILITY:

Where a warrantable condition exists, John Deere will repair or replace, as it elects, your off-road diesel engine at no cost to you, including diagnosis, parts or labor. Warranty coverage is subject to the limitations and exclusions set forth herein. The off-road diesel engine is warranted for a period of five years from the date the engine is delivered to an ultimate purchaser or 3,000 hours of operation, whichever occurs first. The following are emissions-related parts:

Air Induction System

- Intake manifold
- Turbocharger
- Charge air cooler

Fuel Metering system

- Fuel injection system

Exhaust Gas Recirculation

- EGR valve

Catalyst or Thermal Reactor Systems

- Catalytic converter
- Exhaust manifold

Emission control labels

Particulate Controls

- Any device used to capture particulate emissions
- Any device used in the regeneration of the capturing system
- Enclosures and manifolding
- Smoke Puff Limiters

Positive Crankcase Ventilation (PCV) System

- PCV valve
- Oil filler cap

Advanced Oxides of Nitrogen (NOx) Controls

- NOx absorbers and catalysts

SCR systems and urea containers/dispensing systems

Miscellaneous Items used in Above Systems

- Electronic control units, sensors, actuators, wiring harnesses, hoses, connectors, clamps, fittings, gasket, mounting hardware

Any warranted emissions-related part scheduled for replacement as required maintenance is warranted by John Deere for the period of time prior to the first scheduled replacement point for the part. Any warranted emissions-related part not scheduled for replacement as required maintenance or scheduled only for regular inspection is warranted by John Deere for the stated warranty period.

OWNER'S WARRANTY RESPONSIBILITIES:

As the off-road diesel engine owner you are responsible for the performance of the required maintenance listed in your Operator's Manual. John Deere recommends that the owner retain all receipts covering maintenance on the off-road diesel engine, but John Deere cannot deny warranty solely for the lack of receipts or for the owner's failure to ensure the performance of all scheduled maintenance. However, as the off-road diesel engine owner, you should be aware that John Deere may deny you warranty coverage if your off-road diesel engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

The off-road diesel engine is designed to operate on diesel fuel as specified in the Fuels, Lubricants and Coolants section in the Operators Manual. Use of any other fuel may result in the engine no longer operating in compliance with applicable emissions requirements.

The owner is responsible for initiating the warranty process, and should present the machine to the nearest authorized John Deere dealer as soon as a problem is suspected. The warranty repairs should be completed by the authorized John Deere dealer as quickly as possible.

Emissions regulations require the customer to bring the unit to an authorized servicing dealer when warranty service is required. As a result, John Deere is NOT liable for travel or mileage on emissions warranty service calls.

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DX,EMISSIONS,CARB -19-01AUG14-4/8

Emissions Control Warranty Statement 2016 through 2018

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JOHN DEERE

CALIFORNIA EMISSIONS CONTROL WARRANTY STATEMENT
YOUR WARRANTY RIGHTS AND OBLIGATIONS

To determine if the John Deere engine qualifies for the additional warranties set forth below, look for the “Emission Control Information” label located on the engine. If the engine is operated in the United States or Canada and the engine label states: “This engine complies with US EPA regulations for nonroad and stationary diesel engines”, or “This engine complies with US EPA regulations for stationary emergency diesel engines”, refer to the “U.S. and Canada Emission Control Warranty Statement.” If the engine is operated in California, and the engine label states: “This engine complies with US EPA and CARB regulations for nonroad diesel engines” also refer to the “California Emissions Control Warranty Statement.”

Warranties stated on this certificate refer only to emissions-related parts and components of your engine. The complete engine warranty, less emission-related parts and components, is provided separately. If you have any questions about your warranty rights and responsibilities, you should contact John Deere at 1-319-292-5400.

CALIFORNIA EMISSIONS CONTROL WARRANTY STATEMENT:

The California Air Resources Board (CARB) is pleased to explain the emission-control system warranty on 2016 through 2018 off-road diesel engines. In California, new off-road engines must be designed, built and equipped to meet the State’s stringent anti-smog standards. John Deere must warrant the emission control system on your engine for the periods of time listed below provided there has been no abuse, neglect or improper maintenance of your engine.

Your emission control system may include parts such as the fuel injection system and the air induction system. Also included may be hoses, belts, connectors and other emission-related assemblies.

John Deere warrants to the ultimate purchaser and each subsequent purchaser that this off-road diesel engine was designed, built, and equipped so as to conform at the time of sale with all applicable regulations adopted by CARB and is free from defects in materials and workmanship which would cause the failure of a warranted part to be identical in all material respects to the part as described in John Deere's application for certification for a period of five years from the date the engine is delivered to an ultimate purchaser or 3,000 hours of operation, whichever occurs first for all engines rated at 19 kW and greater. In the absence of a device to measure hours of use, the engine shall be warranted for a period of five years.

EMISSIONS WARRANTY EXCLUSIONS:

John Deere may deny warranty claims for failures caused by the use of an add-on or modified part which has not been exempted by the CARB. A modified part is an aftermarket part intended to replace an original emission-related part which is not functionally identical in all respects and which in any way affects emissions. An add-on part is any aftermarket part which is not a modified part or a replacement part.

In no event will John Deere, any authorized engine distributor, dealer, or repair facility, or any company affiliated with John Deere be liable for incidental or consequential damage.

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DX,EMISSIONS,CARB -19-01AUG14-5/8

JOHN DEERE'S WARRANTY RESPONSIBILITY:

Where a warrantable condition exists, John Deere will repair or replace, as it elects, your off-road diesel engine at no cost to you, including diagnosis, parts or labor. Warranty coverage is subject to the limitations and exclusions set forth herein. The off-road diesel engine is warranted for a period of five years from the date the engine is delivered to an ultimate purchaser or 3,000 hours of operation, whichever occurs first. The following are emissions-related parts:

Air Induction System

- Intake manifold
- Turbocharger
- Charge air cooler

Fuel Metering system

- Fuel injection system

Exhaust Gas Recirculation

- EGR valve

Catalyst or Thermal Reactor Systems

- Catalytic converter
- Exhaust manifold

Emission control labels

Particulate Controls

- Any device used to capture particulate emissions
- Any device used in the regeneration of the capturing system
- Enclosures and manifolding
- Smoke Puff Limiters

Positive Crankcase Ventilation (PCV) System

- PCV valve
- Oil filler cap

Advanced Oxides of Nitrogen (NOx) Controls

- NOx absorbers and catalysts

SCR systems and urea containers/dispensing systems

Miscellaneous Items used in Above Systems

- Electronic control units, sensors, actuators, wiring harnesses, hoses, connectors, clamps, fittings, gasket, mounting hardware

Any warranted emissions-related part scheduled for replacement as required maintenance is warranted by John Deere for the period of time prior to the first scheduled replacement point for the part. Any warranted emissions-related part not scheduled for replacement as required maintenance or scheduled only for regular inspection is warranted by John Deere for the stated warranty period.

OWNER'S WARRANTY RESPONSIBILITIES:

As the off-road diesel engine owner you are responsible for the performance of the required maintenance listed in your Operator's Manual. John Deere recommends that the owner retain all receipts covering maintenance on the off-road diesel engine, but John Deere cannot deny warranty solely for the lack of receipts or for the owner's failure to ensure the performance of all scheduled maintenance. However, as the off-road diesel engine owner, you should be aware that John Deere may deny you warranty coverage if your off-road diesel engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

The off-road diesel engine is designed to operate on diesel fuel as specified in the Fuels, Lubricants and Coolants section in the Operators Manual. Use of any other fuel may result in the engine no longer operating in compliance with applicable emissions requirements.

The owner is responsible for initiating the warranty process, and should present the machine to the nearest authorized John Deere dealer as soon as a problem is suspected. The warranty repairs should be completed by the authorized John Deere dealer as quickly as possible.

Emissions regulations require the customer to bring the unit to an authorized servicing dealer when warranty service is required. As a result, John Deere is NOT liable for travel or mileage on emissions warranty service calls.

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DX,EMISSIONS,CARB -19-01AUG14-6/8

Emissions Control Warranty Statement 2016 through 2018

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JOHN DEERE

CALIFORNIA EMISSIONS CONTROL WARRANTY STATEMENT
YOUR WARRANTY RIGHTS AND OBLIGATIONS

To determine if the John Deere engine qualifies for the additional warranties set forth below, look for the “Emission Control Information” label located on the engine. If the engine is operated in the United States or Canada and the engine label states: “This engine complies with US EPA regulations for nonroad and stationary diesel engines”, or “This engine complies with US EPA regulations for stationary emergency diesel engines”, refer to the “U.S. and Canada Emission Control Warranty Statement.” If the engine is operated in California, and the engine label states: “This engine complies with US EPA and CARB regulations for nonroad diesel engines” also refer to the “California Emissions Control Warranty Statement.”

Warranties stated on this certificate refer only to emissions-related parts and components of your engine. The complete engine warranty, less emission-related parts and components, is provided separately. If you have any questions about your warranty rights and responsibilities, you should contact John Deere at 1-319-292-5400.

CALIFORNIA EMISSIONS CONTROL WARRANTY STATEMENT:

The California Air Resources Board (CARB) is pleased to explain the emission-control system warranty on 2016 through 2018 off-road diesel engines. In California, new off-road engines must be designed, built and equipped to meet the State’s stringent anti-smog standards. John Deere must warrant the emission control system on your engine for the periods of time listed below provided there has been no abuse, neglect or improper maintenance of your engine.

Your emission control system may include parts such as the fuel injection system and the air induction system. Also included may be hoses, belts, connectors and other emission-related assemblies.

John Deere warrants to the ultimate purchaser and each subsequent purchaser that this off-road diesel engine was designed, built, and equipped so as to conform at the time of sale with all applicable regulations adopted by CARB and is free from defects in materials and workmanship which would cause the failure of a warranted part to be identical in all material respects to the part as described in John Deere's application for certification for a period of five years from the date the engine is delivered to an ultimate purchaser or 3,000 hours of operation, whichever occurs first for all engines rated at 19 kW and greater. In the absence of a device to measure hours of use, the engine shall be warranted for a period of five years.

EMISSIONS WARRANTY EXCLUSIONS:

John Deere may deny warranty claims for failures caused by the use of an add-on or modified part which has not been exempted by the CARB. A modified part is an aftermarket part intended to replace an original emission-related part which is not functionally identical in all respects and which in any way affects emissions. An add-on part is any aftermarket part which is not a modified part or a replacement part.

In no event will John Deere, any authorized engine distributor, dealer, or repair facility, or any company affiliated with John Deere be liable for incidental or consequential damage.

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Continued on next page

DX,EMISSIONS,CARB -19-01AUG14-7/8

JOHN DEERE'S WARRANTY RESPONSIBILITY:

Where a warrantable condition exists, John Deere will repair or replace, as it elects, your off-road diesel engine at no cost to you, including diagnosis, parts or labor. Warranty coverage is subject to the limitations and exclusions set forth herein. The off-road diesel engine is warranted for a period of five years from the date the engine is delivered to an ultimate purchaser or 3,000 hours of operation, whichever occurs first. The following are emissions-related parts:

Air Induction System

- Intake manifold
- Turbocharger
- Charge air cooler

Fuel Metering system

- Fuel injection system

Exhaust Gas Recirculation

- EGR valve

Catalyst or Thermal Reactor Systems

- Catalytic converter
- Exhaust manifold

Emission control labels

Particulate Controls

- Any device used to capture particulate emissions
- Any device used in the regeneration of the capturing system
- Enclosures and manifolding
- Smoke Puff Limiters

Positive Crankcase Ventilation (PCV) System

- PCV valve
- Oil filler cap

Advanced Oxides of Nitrogen (NOx) Controls

- NOx absorbers and catalysts

SCR systems and urea containers/dispensing systems

Miscellaneous Items used in Above Systems

- Electronic control units, sensors, actuators, wiring harnesses, hoses, connectors, clamps, fittings, gasket, mounting hardware

Any warranted emissions-related part scheduled for replacement as required maintenance is warranted by John Deere for the period of time prior to the first scheduled replacement point for the part. Any warranted emissions-related part not scheduled for replacement as required maintenance or scheduled only for regular inspection is warranted by John Deere for the stated warranty period.

OWNER'S WARRANTY RESPONSIBILITIES:

As the off-road diesel engine owner you are responsible for the performance of the required maintenance listed in your Operator's Manual. John Deere recommends that the owner retain all receipts covering maintenance on the off-road diesel engine, but John Deere cannot deny warranty solely for the lack of receipts or for the owner's failure to ensure the performance of all scheduled maintenance. However, as the off-road diesel engine owner, you should be aware that John Deere may deny you warranty coverage if your off-road diesel engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

The off-road diesel engine is designed to operate on diesel fuel as specified in the Fuels, Lubricants and Coolants section in the Operators Manual. Use of any other fuel may result in the engine no longer operating in compliance with applicable emissions requirements.

The owner is responsible for initiating the warranty process, and should present the machine to the nearest authorized John Deere dealer as soon as a problem is suspected. The warranty repairs should be completed by the authorized John Deere dealer as quickly as possible.

Emissions regulations require the customer to bring the unit to an authorized servicing dealer when warranty service is required. As a result, John Deere is NOT liable for travel or mileage on emissions warranty service calls.

Emission_CI_CARB (13Jun14)

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Engine Registration

OEM Engine and Drivetrain Warranty Registration

Why registering your OEM engine or drivetrain product is a really smart idea:[1]

Get faster service. Registering your engine or drivetrain product gives us the information we need to meet your service needs promptly and completely.

Protect your investment. You'll be kept up-to-date on engine or drivetrain product updates.

Extend your warranty. You'll be given the option to extend your coverage before your standard warranty term expires.

Stay informed. Be the first to know about new products and money-saving offers from John Deere.

NOTE: A mail-in registration form is located at the back of this manual.

You're Covered

When you buy a John Deere engine or drivetrain product you aren't just buying pistons and crankshafts and gear drives. You're buying the ability to get work done. Without downtime, without worries, and without hassles. And you're buying the assurance that if you do need help, a strong support network will be there — ready to step in.

Confidence. That's what John Deere engines, John Deere drivetrains, and John Deere Warranties are all about.

Long durations. Warranties designed to give you confidence in your engine or drivetrain product.

Worldwide support. Get service when and where you need it. John Deere has 4,000+ service locations worldwide.

Genuine John Deere parts and service. Authorized service outlets will use only new or remanufactured parts or components furnished by John Deere.

Warranty Duration

[1]Register your OEM engine or drivetrain product online and select an authorized John Deere service location. If available in your region, you'll receive information regarding new products and current money-saving offers from John Deere. Limit one money-saving offer per engine warranty registration. Not transferable. Not valid with any other offer. Offer ends 90 days from the date of issue. Some restrictions apply. See your John Deere service location for complete details.

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Scan this code to register your OEM engine online now and learn of current money-saving offers available to you.[1] You can also visit us directly at JohnDeere.com/warranty.

Equipment operators can't afford downtime or unexpected repairs. That's why we offer a 2-year/2,000-hour warranty, with unlimited hours in the first year, on our OEM industrial and marine engines. This warranty takes effect the date that the engine is delivered to the first retail purchaser. In addition, extended warranties are available under certain conditions. John Deere offers a variety of purchased warranties to extend the warranty period for your engine. You'll be given the option to extend your coverage before your standard warranty term expires. Be sure to register your engine or drivetrain product and take full advantage of the John Deere service and support network.

Obtaining Warranty Service

Warranty service must be requested through an authorized John Deere service outlet before the expiration of the warranty. Evidence of the engine's or drivetrain product's delivery date to the first retail purchaser must be presented when requesting warranty service. Authorized service outlets include:

- John Deere distributor
- John Deere OEM service dealer
- John Deere equipment dealer
- John Deere marine dealer

Worldwide Support Network

Visit JohnDeere.com/dealer to find the authorized engine or drivetrain service location nearest you. For complete warranty details visit JohnDeere.com/warrantystatements to view, download, or print the warranty statement for your engine or drivetrain product.

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Mail-In Registration

OEM Engine and Drivetrain Warranty Registration

Register your OEM engine or drivetrain product online at JohnDeere.com/warranty or fax this from to John Deere at 319-292-5844.

PURCHASER INFORMATION*: Type or print in BLOCK letters

Company Name: _____

First Name: _____

Last Name: _____

Email: _____

Telephone: _____

Country: _____

Street Address: _____

City / State / Prov: _____

Zip / Postal Code: _____

PURCHASER TYPE:

- □ Commercial
- □ Federal Government
- □ State / Province
- □ County
- □ City / Town / Village
- □ Armed Forces
- □ National Account
- □ Residential
- □ Farm
- □ Very Large Fleet (>74)
- □ Large Fleet (25-74)
- □ Medium Fleet (10-24)
- □ Small Fleet (<10)

EQUIPMENT TYPE:

- □ Agriculture
- □ Earth Moving
- □ Forestry
- □ Generator Set (Industrial / Marine)
- □ Industrial Moveable
- □ Marine Propulsion
- □ Material Handling
- □ Municipal / Utility Commercial
- □ On-Highway
- □ Road and Miscellaneous Construction
- □ Rail Maintenance
- □ Other

Purchase's Signature: _____

PRODUCT AND EQUIPMENT INFORMATION

Product Serial Number: _____

Date Delivered: _____

Amount of Use: (Hours / Miles) _____

New or Used: _____

* Use of Information: All personal information obtained with this registration is subject to the John Deere privacy policy. It will be used for the purpose of offer fulfillment and may be used to provide you with additional information about John Deere products and services. For complete details on your privacy rights and to obtain a copy of the John Deere Privacy Statement, visit www.JohnDeere.com/privacy.

Cut out to mail in registration card

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Mail-In Registration

MAILING INFORMATION
(Return Address)

_____
_____
_____
_____

John Deere Power Systems
P.O. Box 5100
Waterloo, IA 50704-5100
USA

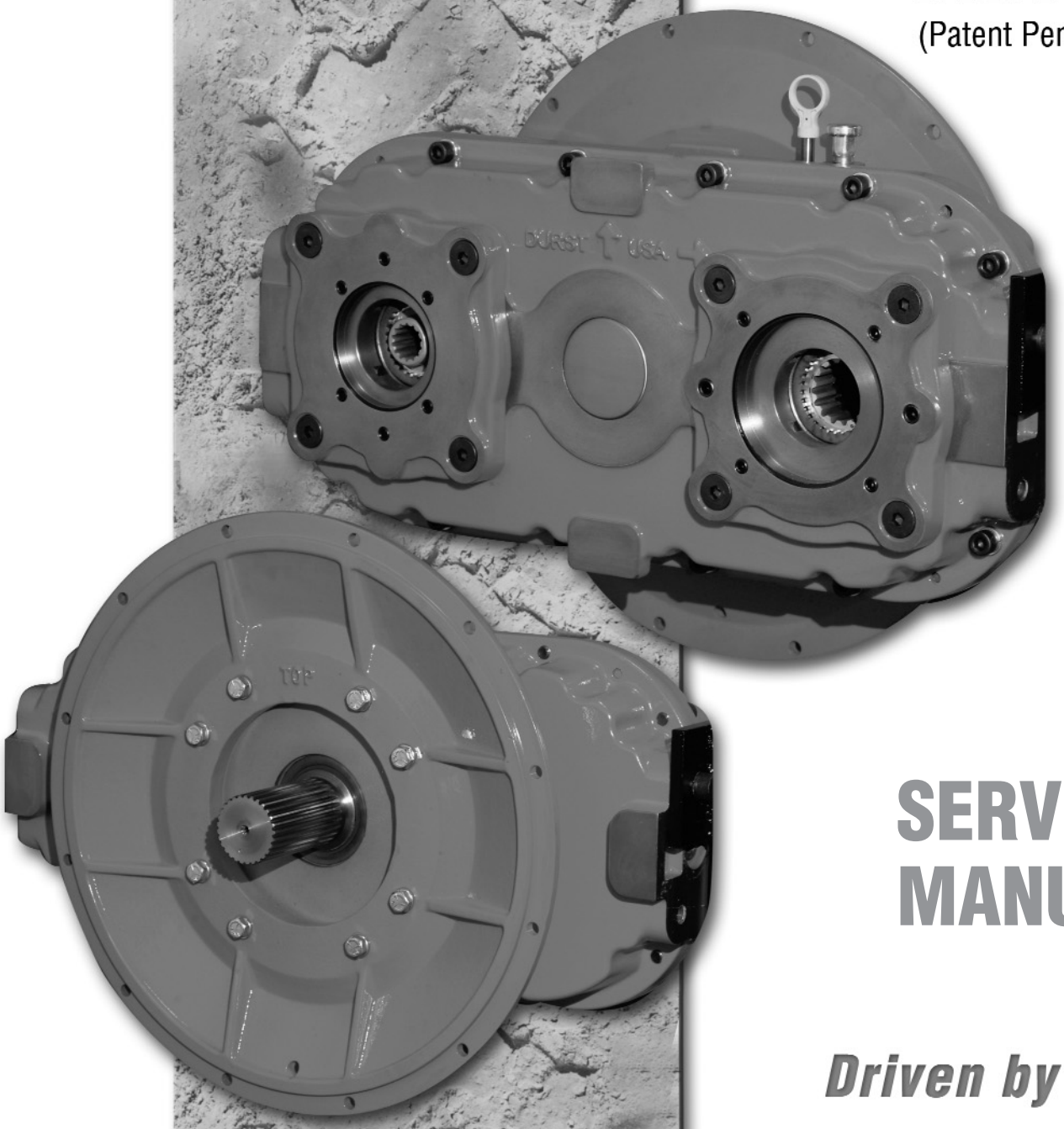
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DURST

Next Generation

HYDRAULIC PUMP DRIVES

(Patent Pending)



SERVICE MANUAL

Driven by DURST

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IMPORTANT INFORMATION

CAUTION

Please Read Carefully

Upon receipt of product, immediately inspect for any indication of rough handling or damage in transit. This includes but is not limited to: scuffed paint, broken or damaged containers, broken or cracked housings, bent shafts, metal deformation, or shift in alignment of components. Any evidence of damage or missing parts should be reported immediately to the carrier and a claim entered.

CAUTION
DO NOT
OPERATE

All units are shipped without oil! DO NOT OPERATE until unit has been filled to the proper level with the specified oil grade. Failure will occur if bearings and gears are not properly lubricated. Refer to Lubrication and Oil Filling Instructions.

The following WARNING and CAUTION information is supplied to the Buyer for their protection and to provide the Buyer with years of trouble free and safe operation of your REGAL-BELOIT CORPORATION product.

Read ALL instructions prior to operating pump drive. Injury to personnel or pump drive failure may be caused by improper installation, maintenance or operation.

WARNING

- Written authorization from REGAL-BELOIT CORPORATION or its divisions/subsidiaries is required to operate or use pump drives in man lift or people moving devices.
- Check to make certain application does not exceed the allowable load capacities published in the current catalog.
- Buyer shall be solely responsible for determining the adequacy of the product for any and all uses to which Buyer shall apply the product. The application by Buyer shall not be subject to any implied warranty of fitness for particular purpose.
- For safety, Buyer or user should provide protective guards over all shaft extensions and any moving apparatus mounted thereon. The user is responsible for checking all applicable safety codes in their area and providing suitable guards. Failure to do so may result in bodily injury and/or damage to equipment.
- Hot oil can cause severe burns. Use extreme care when removing lubrication plugs and vents.
- Make certain that the power supply is disconnected before attempting to service or remove any components. Lockout the power supply and tag it to prevent unexpected application of power.
- **TORSIONAL VIBRATIONS**, emanating from many modern diesel engines, can cause severe damage to power train components, resulting in premature failure. To insure the integrity of the power transmission system, a torsional vibration analysis should be performed and suitable vibration dampening components utilized, when indicated by the analysis. Durst is not responsible for damage or failure resulting from diesel engine generated torsional vibrations.

CAUTION

- Lifting supports including eyebolts are to be used for vertically lifting the gearbox only and no other associated attachments or motors.
- If the pump drive cannot be located in a clear and dry area with access to adequate cooling air supply, precautions must be taken to avoid the ingestion of contaminates such as water, and the reduction in cooling ability due to exterior contaminates.
- Mounting bolts should be routinely checked to ensure that the unit is firmly anchored for proper operation. Refer to Table 1 for proper torque specifications when tightening bolts.

In the event of the resale of any of the goods, in whatever form, Resellers/Buyers will include the following language in a conspicuous place and in a conspicuous manner in a written agreement covering such sale:

> The manufacturer makes no warranties or representations, express or implied, by operation of law or otherwise, as to the merchantability or fitness for a particular purpose of the goods sold hereunder. Buyer acknowledges that it alone has determined that the goods purchased hereunder will suitably meet the requirements of their intended use. In no event will the manufacturer be liable for consequential, incidental or other damages. Even if the repair or replacement remedy shall be deemed to have failed of its essential purpose under Section 2-719 of the Uniform Commercial Code, the manufacturer shall have no liability to Buyer for consequential damages.

Resellers/Buyers agree to also include this entire document including the warnings and cautions above in a conspicuous place and in a conspicuous manner in writing to instruct users on the safe usage of the product.

This information should be read together with all other printed information supplied by Durst.

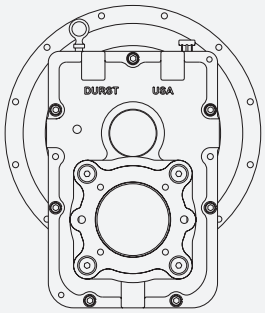
MODEL IDENTIFICATION

A Durst name plate is mounted on every pump drive that is assembled at the factory. This nameplate provides the part number, the ratio and basic description, unit serial number, date unit was assembled, and recommended oil type. Do not paint over, remove, or tamper with the name-plate, as this is the only type of identification for warranty repairs or replacement parts.

If the Durst name plate has been destroyed the following charts can be used to determine the model description.

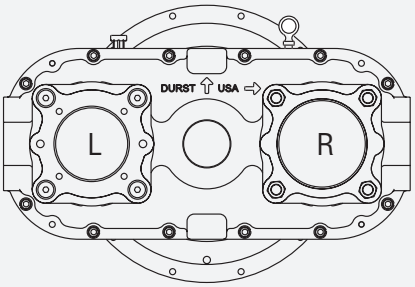
NOMENCLATURE FOR CLUTCH ASSEMBLIES

1PD06



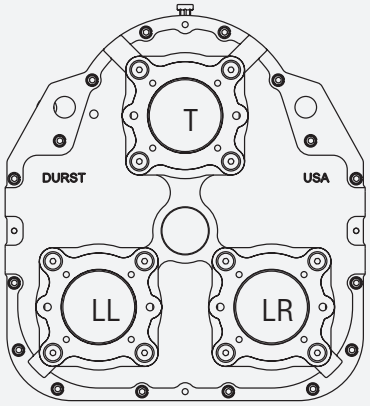
1PD06 1.32I 343-CCH-LS

2PD06, 2PD08, 2PD10



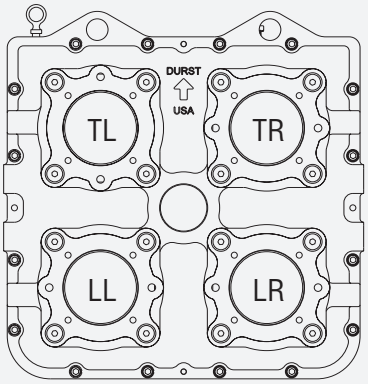
2PD08 1.40D 343-CCH-DDH-RS
L R

3PD06, 3PD08, 3PD10



3PD06 1.29I 223-CCH-CCH-CCH-NS
T LL LR

4PD08, 4PD09, 4PD11



4PD08 1:1 111-CCV-CCH-CCH-CCH-LS
TL TR LL LR

2PD06 1.32 D 343-CCH-CCH-LS

Model

Ratio

I = Increaser
D = Decreaser

CLUTCH HOUSING
1 = SAE #1
2 = SAE #2
3 = SAE #3

CLUTCH STAND-OFF
1 = SP214 .....1.00 in.
2 = SP211 .....1.56 in.
3 = Not Available
4 = C111.....1.56 in.
5 = C110.....2.12 in.

PILOT BEARING
1 = 3.94 Dia. (for SP214)
2 = 3.15 Dia. (for SP214)
3 = 2.83 Dia. (all others)

S = Standard Assy.
N = Non-Standard
V = Vertical / Inverted
X = Special

L = Dipstick on Left Side
R = Dipstick on Right Side
N = No Dipstick

H = Pad Mounted Horizontally
V = Pad Mounted Vertically

PUMP PAD OPTIONS

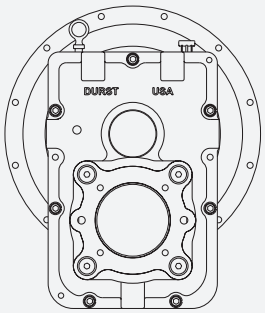
A = SAE A	D2 = SAE D (2 bolt)
B = SAE B	E = SAE E
C = SAE C	F = SAE F
D = SAE D	

PUMP SPLINE ADAPTER

A = SAE A, 9T-16/32	D = SAE D, 13T-8/16
B = SAE B, 13T-16/32	F = SAE F, 15T-8/16
BB = SAE BB, 15T-16/32	21 = 21T-16/32
C = SAE C, 14T-12/24	23 = 23T-16/32
CC = SAE CC, 17T-12/24	27 = 27T-16/32

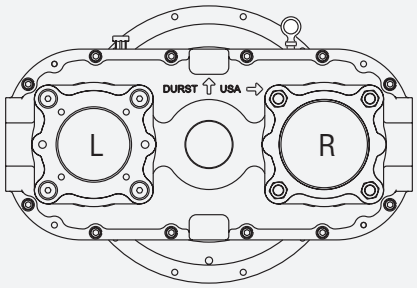
NOMENCLATURE FOR DRIVE PLATE ASSEMBLIES

1PD06



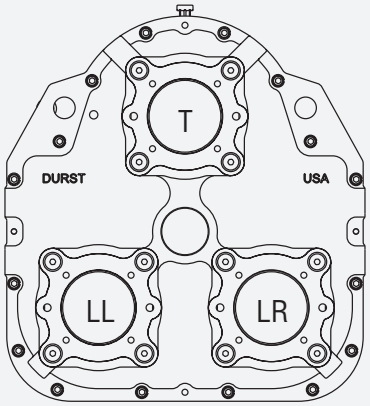
1PD06 1.32I D33-CCH-LS

2PD06, 2PD08, 2PD10



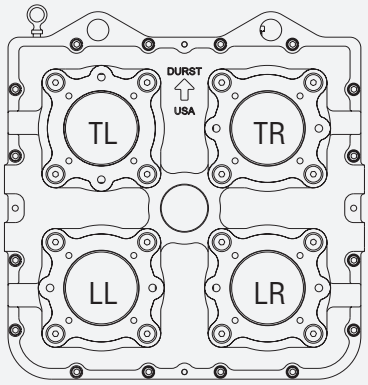
2PD08 1.40D N23-CCH-DDH-RS
L R

3PD06, 3PD08, 3PD10



3PD06 1.29I D22-CCH-CCH-CCH-NS
T LL LR

4PD08, 4PD09, 4PD11



4PD08 1:1 D11-CCV-CCH-CCH-CCH-LS
TL TR LL LR

ENGINE ADAPTER HOUSING
1 = SAE #1
2 = SAE #2
3 = SAE #3
4 = SAE #4

WITH DRIVE PLATE
1 = SAE 14
2 = SAE 11.5
3 = SAE 10
4 = SAE 8

NO DRIVE PLATE
1 = 29T-12/24 Shaft
2 = 20T-10/20 Shaft
3 = 15T-8/16 Shaft
4 = 2.50 Dia. Keyed Shaft
5 = 2.25 Dia. Keyed Shaft

D = With Drive Plate
N = No Drive Plate/ Shaft ONLY

2PD06 1.32 D D 1 1 - C C H - C C H - L S

Model

Ratio

I = Increaser
D = Decreaser

S = Standard Assy.
N = Non-Standard
V = Vertical / Inverted
X = Special

L = Dipstick on Left Side
R = Dipstick on Right Side
N = No Dipstick

PUMP PAD OPTIONS
A = SAE A
B = SAE B
C = SAE C
D = SAE D
D2 = SAE D (2 bolt)
E = SAE E
F = SAE F

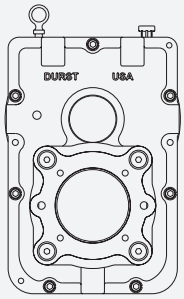
PUMP SPLINE ADAPTER

A = SAE A, 9T-16/32	D = SAE D, 13T-8/16
B = SAE B, 13T-16/32	F = SAE F, 15T-8/16
BB = SAE BB, 15T-16/32	21 = 21T-16/32
C = SAE C, 14T-12/24	23 = 23T-16/32
CC = SAE CC, 17T-12/24	27 = 27T-16/32

H = Pad Mounted Horizontally
V = Pad Mounted Vertically

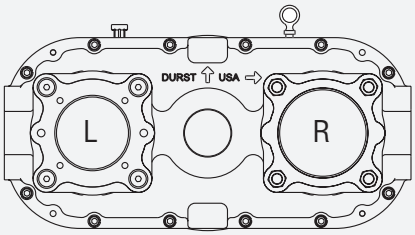
NOMENCLATURE FOR INDEPENDENT INPUT ASSEMBLIES

1PD06



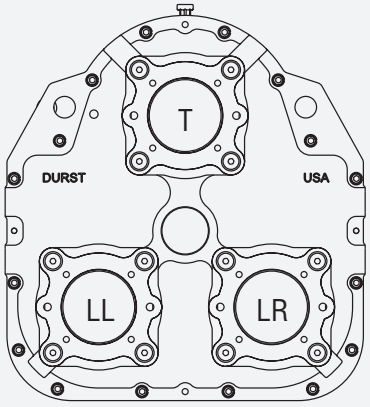
1PD06 1.32I 003-CCH-LS

2PD06, 2PD06, 2PD08, 2PD10



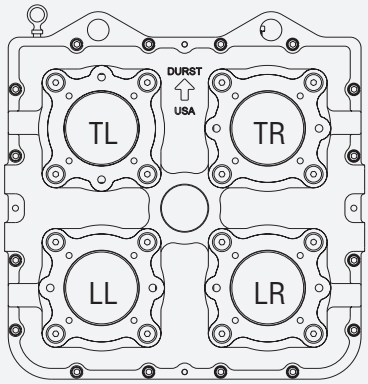
2PD08 1.40D 001-CCH-DDH-RS
L R

3PD06, 3PD08, 3PD10



3PD06 1.29I 002-CCH-CCH-CCH-NS
T LL LR

4PD08, 4PD09, 4PD11



4PD08 1:1 007-CCV-CCH-CCH-CCH-LS
TL TR LL LR

2PD06 1.32 D 003 - C C H - C C H - L S

Model

Ratio

I = Increaser
D = Decreaser

INDEPENDENT INPUT
001 = 1810 Companion
002 = 1610 Companion
003 = 2.50 Dia. Keyed Shaft
004 = 2.25 Dia. Keyed Shaft
005 = 29T-12/24 Shaft
006 = 20T-10/20 Shaft
007 = 15T-8/16 Shaft
008 = Special Shaft

S = Standard Assy.
N = Non-Standard
V = Vertical / Inverted
X = Special

PUMP PAD OPTIONS
A = SAE A
B = SAE B
C = SAE C
D = SAE D
D2 = SAE D (2 bolt)
E = SAE E
F = SAE F

PUMP SPLINE ADAPTER
A = SAE A, 9T-16/32
B = SAE B, 13T-16/32
BB = SAE BB, 15T-16/32
C = SAE C, 14T-12/24
CC = SAE CC, 17T-12/24
D = SAE D, 13T-8/16
F = SAE F, 15T-8/16
21 = 21T-16/32
23 = 23T-16/32
27 = 27T-16/32

L = Dipstick on Left Side
R = Dipstick on Right Side
N = No Dipstick

H = Pad Mounted Horizontally
V = Pad Mounted Vertically

ABOUT YOUR NEW DURST PUMP DRIVE

The New Durst pump drives incorporate some of the features from both the previous Terrell and Hub City designs as well as many new and simplistic features. The Durst pump drive now incorporates class 10 spur gears that run on heavy duty ball bearings. Because ball bearings do not require shimming the assembly of a pump drive is drastically simplified. This also allows for the bearing to be contained within the housing halves. The key feature about this is that any adapter can be changed out without disturbing the gears or bearings in the gear box. This also allows for the box to be split to service gears and bearings without having to remove the adapters.

SPLINES

The Durst pump drives have a 29T-12/24 internal spline on the gears. This allows for a spline adapter to be used on any SAE pump shaft. Because the pump shaft is no longer integral with the gear, if the pump is changed or replaced, a new gear is not required. A 29T-12/24 spline significantly reduces wear on both the gears and spline adapters.

OIL CIRCULATION

Extensive testing was done on each Durst pump drive gear box to optimize the quantity of oil in each box at each ratio. The new Durst pump drives no longer have the need for Iso-Lube ports. Instead the Durst pump drives have special oil port locations and oil directing ribs that causes the oil to flow into the pump pad area, lubricating the spline adapters and bearings without the need for external pumps. Oil volume is critical to make this feature work and the oil level should be checked frequently.

PUMP PADS

The Durst pump pads have been simplified and no longer contain the bearing cup. Pump pads can now be removed without disrupting the internal workings and alignment of the bearings and gears inside the gear box. As mentioned above the Durst pump pads no longer feature the Iso-Lube ports. Oil flows into the pump pad area and then patented cast in recesses causes the oil to flow across the spline for wet spline operation.

INPUT SHAFT

The input shaft of the Durst pump drive is integral with the input gear through a 29T-12/24 spline. The input shaft is contained within the gear box and allows the drive plate or torsional coupling to be free on the input shaft, which reduces misalignment stresses from the engine flywheel and the gear box. Due to the modular design of the gear box the input shaft can be removed and/or replaced without disturbing the internal workings of the gear box.

DRIVE PLATE

The Durst pump drive now uses a four disk drive plate. By using 4 thin disks the drive plate becomes slightly wider and increases the rating. Thin disks are much more flexible and when multiple disks are put together they absorb more engine vibrations than a single thick disk. As mentioned in the Input Shaft section the drive plate is no longer captured on the input shaft, instead it is able to automatically adjust if any engine flywheel misalignment occurs. These changes result in smoother operation and longer gear box life.

INSTALLATION INSTRUCTIONS

INSTALLATION OF DURST PUMP DRIVES

There are 3 types of standard inputs that are available with the Durst pump drive models.

DRIVE PLATE DRIVEN

This unit mounts directly to the engine flywheel. Use extreme care when mounting the drive plate to the engine flywheel to avoid preloading the crankshaft bearings.

1) Install the drive plate onto the engine flywheel, drive plate hub is to face AWAY from the engine. Bolt the drive plate to the engine flywheel, see Table 1 (page 33) for proper torque specifications when tightening bolts.

2) Check drive plate run out. Total TIR should not exceed 0.008".

3) Apply Silver Streak #200S to external splines and slide the input shaft of the pump drive into the drive plate hub splines until the pump drive engine adapter seats completely into the engine flywheel housing. Torque all mounting bolts per Table 1 (see page 33).

INDEPENDENT SHAFT DRIVEN

This unit is designed to be driven with a short coupled drive line connection to the input shaft. The input shaft **WILL NOT accept any overhung loads** (i.e. Belt Sheaves, sprockets, or severely angled drive lines). For over-hung load applications, contact Durst Engineering.

CLUTCH DRIVEN

This unit mounts directly to the engine flywheel through an over center clutch. The clutch is primarily used for disconnecting the pump drive during engine start up. Each clutch includes a separate installation parts and service manual.

1) The clutch is not preset at the factory and can only be adjusted after being mounted to the engine.

2) Check the engine crankshaft endplay prior to installing the clutch driven pump drive.

3) Mount the clutch drive ring to the engine flywheel. Refer to the clutch service manual for the proper bolt torques.

4) Slide the clutch drive plates into the drive ring and pilot bearing into the engine flywheel, until the clutch housing fully seats with the engine flywheel housing. Torque mounting bolts according to Table 1 (see page 33).

⚠CAUTION Do not use the engine adapter mounting bolts to seat the pump drive engine adapter or pump drive clutch housing onto the engine flywheel housing. This may reduce engine crankshaft endplay and may result in premature damage or failure of crankshaft bearings.

Always check engine crankshaft endplay after installing the drive plate or clutch to engine flywheel. Refer to engine manufacturer's endplay specifications.

MOUNTING PROCEDURES FOR DURST PUMP DRIVES

The pump drive is to be supported on a rigid foundation using the mounting holes provided in the pump drive housing. Inadequate mounting foundation may result in misalignment or excessive stress on the pump drive housing. This can cause undue noise, overheating, and possible failure. Durst pump drive gear boxes can be mounted in several positions to be more adaptive to the customer's application.

Note: To prevent loosening and misalignment, bolts must be tightened to the recommended torques specs shown in Table 1 (see page 33).

2PD06, **2PD08**, and **2PD10** pump drives can be mounted horizontally or vertically.★

★ Refer to arrows that are cast into the housings for mounting direction.

1PD06, **3PD06**, **3PD08**, and **3PD10** pump drives can be mounted normal or inverted.

4PD08, **4PD09**, and **4PD11** pump drives can ONLY be mounted in the normal orientation.

CAUTION **Failure to mount boxes in the specified orientations will cause premature failure!**

INSTALLATION OF HYDRAULIC PUMPS TO DURST PUMP DRIVES

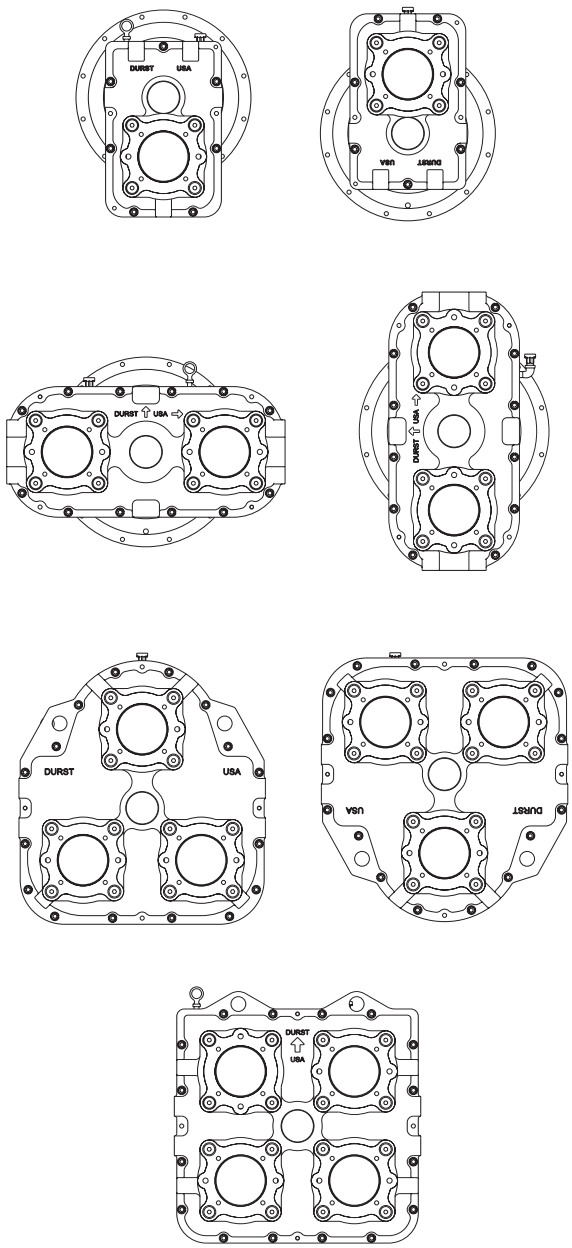
The pump pads on the Durst pump drives offer two or four bolt mountings, which can be mounted vertically or horizontally to provide the customer a wide range of hydraulic pump mounting options.

1) Lubricate the included o-ring with oil and install it onto the hydraulic pump pilot.

CAUTION **Due to an internal oil lubrication system do NOT apply any grease, or spline lubricant as this will contaminate the oil.**

2) Align the splines of the hydraulic pump to the spline adapter. DO NOT use the hydraulic pump mounting bolts to seat the hydraulic pump onto the pump pad. Refer to the hydraulic pump manufactures specification for proper bolt torques.

NOTE: O-rings must be replaced anytime the hydraulic pumps are removed from the gear box.



REPAIR & REBUILDING INSTRUCTIONS

DISASSEMBLY INSTRUCTIONS

1) Make certain that the power supply is disconnected before attempting to service or remove any components. Lockout the power supply and tag it to prevent unexpected application of power.

2) Drain oil while the unit is still warm.

WARNING Hot oil can cause severe burns. Use extreme care when removing lubrication plugs and vents!

3) Properly support the pump drive and remove all retaining bolts from the pump drive engine adapter, then remove all frame mounting bolts.

NOTE: Hydraulic pumps may remain connected, however it is recommended, for ease of disassembly and cleaning parts, that the pumps be removed.

4) If replacing the pump pads, remove the cap screws or nuts. Use a large screwdriver to evenly pry the pump pads loose of the gear box. Be careful to lift the pump pads evenly to avoid damaging the pilot.

CAUTION To avoid oil leaks, all o-rings are to be replaced any time the pump pad is removed.

5) To access the input shaft retaining ring, remove the expansion plug. Remove the retaining ring from the input drive shaft and slide the shaft out of the engine adapter side (see Figure A).

NOTE: The expansion plug must be replaced any time it is removed.

Tip: Use a rubber or wooden mallet to unseat the shaft o-ring from the input gear.

6) Once the input drive shaft is removed, place the pump drive on a flat surface with the pump pads facing up. Remove the two (2) dowel pins and all the cap screws before attempting to separate the housing halves. Use the cap screws in the threaded separating holes to split the housing halves. Slightly tap the output housing with a wooden mallet to release the bearings and gears from the bearing bores (see Figure B).

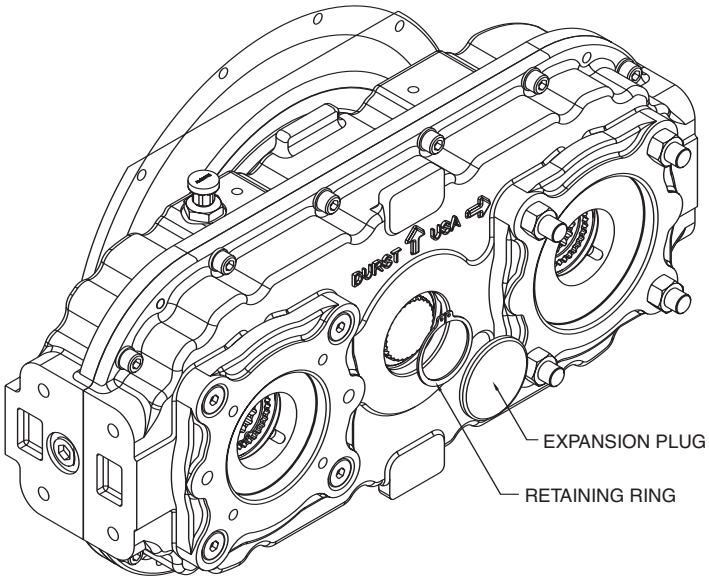


Figure A

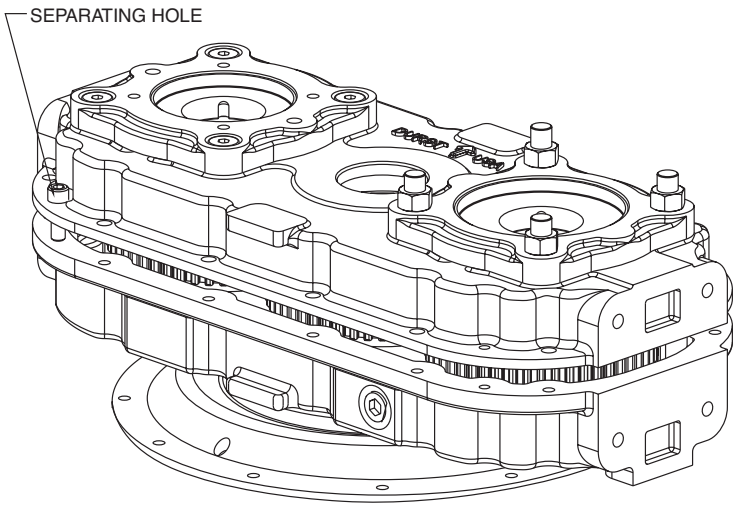


Figure B

7) Evenly lift the output housing half, being careful not to lift any of the gears. Inspect the gears and bearings for any defects, wear, or contamination before removal. To remove the gears and bearings, swiftly and evenly lift from the housing. This can be done by hand as the bearings are a slip fit (see Figure C).

WARNING When rotating gears keep hands and fingers clear from the gear mesh.

8) With all of the gears removed, drive the input seal out towards the engine adapter. It is required to change the input seal any time the input gear has been removed from the housing.

9) To remove the bearings from the gears, use a gear puller or Arbor press (see Figure D).

NOTE: Bearings MUST be replaced any time they have been removed from the gear.

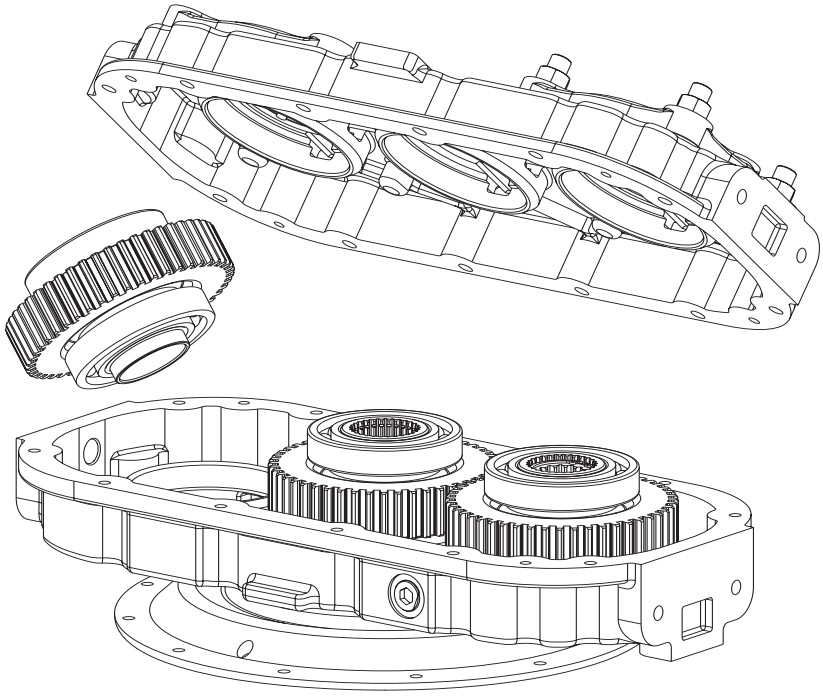


Figure C

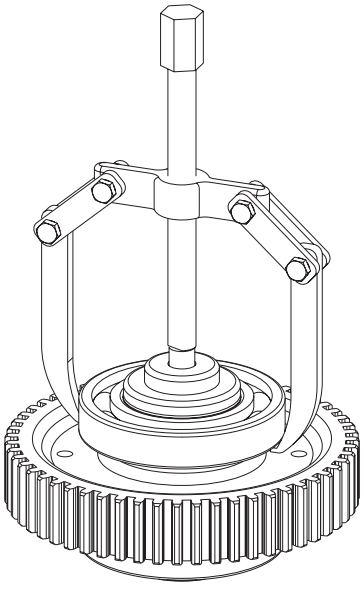


Figure D

REASSEMBLY INSTRUCTIONS

Before reassembling the pump drive gear box, make sure that both housings have been cleaned and inspected. Because of the modular design of the Durst pump drives, the adapter groups can be either installed after the gear box has been assembled or left on during assembly.

1) Install the bearing onto the gear with the shield FACING the gear and the open ball bearing facing out (see Figure E).

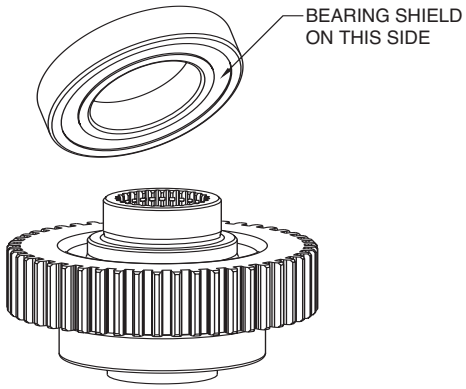


Figure E

CAUTION For proper oil flow it is mandatory that the bearing shield is facing toward the gear!

2) Use a flat razor blade to scrape residual sealant from the sealing surfaces of both housing halves. Then inspect both housings for any contaminates or visual defects. With a clean towel or rag wipe the housings clean.

3) The gears have retaining ring grooves on the output side and a seal lip on the input side. Install the gears into the housing half with the input side of the gear facing down, or to where the engine adapter would be attached (see Figure F).

Tip: Apply a small coat of oil to the outside of the bearing to allow gear and bearing to slide into housing easier.

4) Place approximately a 1/8" bead of Loctite 587 or equivalent sealant, along the sealing surface of the input housing half.

CAUTION Applying too much sealant to sealing surfaces may cause excessive sealant to break loose inside gear box and damage gears, bearings, or splines.

5) Place the output housing half together with the input housing. Both housings must be orientated in the same direction for the dowel pin holes to line up properly (see Figure G).

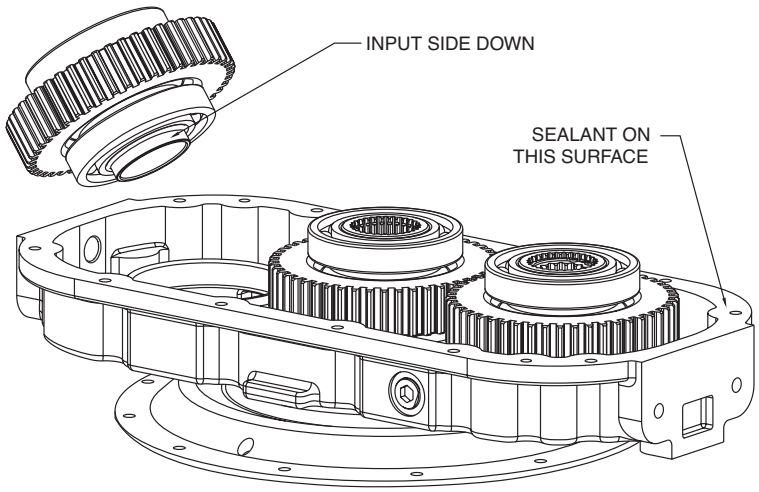


Figure F

6) Press in the two (2) dowel pins to insure proper alignment. Evenly install and tighten the cap screws. Refer to Table 1 (see page 33) for proper torque specifications.

7) Turn over the assembled gear box to install the input seal. Apply a small coat of oil to the gear surface to allow the seal to properly seat. Apply a thin coat of Loctite 609 to the seal O.D. and press into place, .060" below flush with the gear. Pressing the seal too far will create a leak or possibly block oil to the bearings (see Figure H).

CAUTION **Do not use sharp objects for pressing in seals. Press only on the outer edge of the seal to keep from bending or damaging the seal casing.**

8) To install the dipstick, upright the gear box. Apply Loctite 609 to the dipstick tube and insert the dipstick tube until the expanded neck bottoms out on the gear box housing. In all cases (except 1PD06) make certain that the second hole is plugged with a 012326 expansion plug. Note that the 1PD06 has only one dipstick location on the left side.

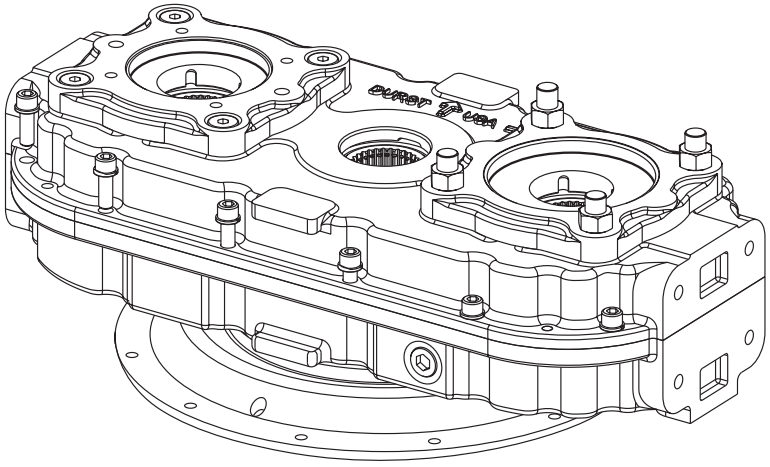


Figure G

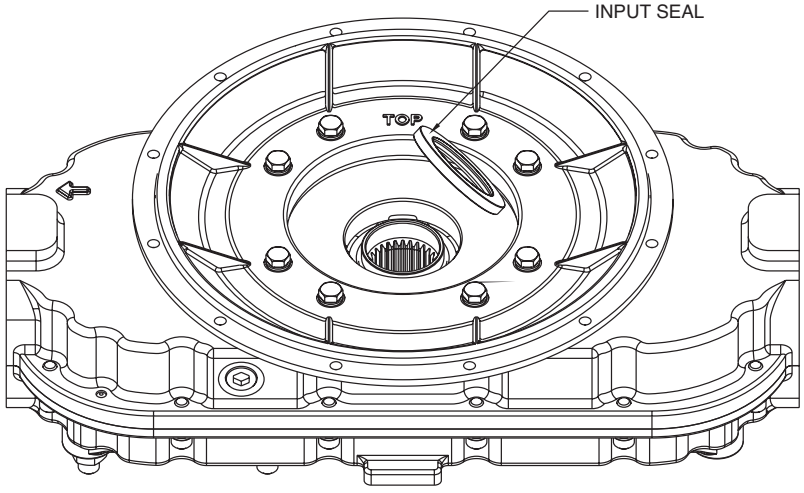


Figure H

LUBRICATION AND OIL FILLING INSTRUCTIONS

Oil flow and circulation in a gear box is one of the most important features to give all internal parts the maximum life. The Durst pump drive design incorporates several key features from previous designs. ISO-LUBE is no longer necessary due to strategically placed oil ports and ribs. When filled to the proper level, oil will be circulated within the box to each set of bearings, and across all the pump splines for smooth operation. Because the pump spline adapters and the input shaft are exposed to the oil within the pump drive, do not apply grease or any type of corrosion prevention materials to the splines, as these will contaminate the gear box oil.

All Durst pump drives are shipped without oil. Verify that the drain plug is tightened to 50ft.lbs.

1) Fill pump drive gear box to MAX oil level on dipstick or to the oil level plug.

CAUTION **DO NOT over fill, as this will result in overheating and possible failure of the pump drive!**

2) It is recommended to change oil after the first 500 hours or 3 months of service, which ever occurs first. Thereafter, and under normal operating conditions Durst recommends that the oil be changed every 1000 hours or 6 months of service.

3) Stop engine before attempting to check or add oil.

4) Clean around dipstick and oil fill hole before checking or adding oil.

5) Drain oil while the unit is still warm.

WARNING **Hot oil can cause severe burns. Use extreme care when removing lubrication plugs and vents!**

6) Inspect and clean magnetic drain plug for contamination or metal particles before replacing.

OIL CAPACITY

The following charts indicate the quantity of oil that a NEW box requires. When changing the oil some residual is left in the box, this will require less oil to fill the box than what is shown below. Only fill to the MAX oil level on the dipstick or to the oil level plug otherwise overheating may occur.

Maximum Operating oil temp for all standard oils: 210°F (99°C)

Maximum Operating oil temp for all synthetic oils: 250°F (121°C)

RECOMMENDED OIL LUBRICANT GRADE

Below -10°F	Mobile SHC 630 Synthetic or equivalent
-10°F to 100°F	80w-90 or EP90 (APL-GL-5)
Above 100°F	Mobile SHC 630 Synthetic or equivalent

6 INCH GEAR CENTERS

1PD06 Normal Mounting	
Ratio	**Oil Capacity**
1.67 Inc.	2.88 Qts. / 2.75 Liters
1.57 Inc.	
1.48 Inc.	3.00 Qts. / 2.84 Liters
1.40 Inc.	
1.32 Inc.	
1.25 Inc.	
1.18 Inc.	
1:1	2.75 Qts. / 2.60 Liters
1.18 Dec.	
1.25 Dec.	
1.32 Dec.	
1.40 Dec.	
1.48 Dec.	
1.57 Dec.	
1.67 Dec.	

1PD06 Inverted Mounting	
Ratio	**Oil Capacity**
1.67 Inc.	2.18 Qts. / 2.06 Liters
1.57 Inc.	
1.48 Inc.	2.31 Qts. / 2.18 Liters
1.40 Inc.	
1.32 Inc.	
1.25 Inc.	
1.18 Inc.	
1:1	2.31 Qts. / 2.18 Liters
1.18 Dec.	
1.25 Dec.	
1.32 Dec.	
1.40 Dec.	
1.48 Dec.	
1.57 Dec.	
1.67 Dec.	2.43 Qts. / 2.30 Liters

2PD06 Normal Mounting	
Ratio	**Oil Capacity**
1.67 Inc.	3.25 Qts. / 3.07 Liters
1.57 Inc.	
1.48 Inc.	2.88 Qts. / 2.73 Liters
1.40 Inc.	3.13 Qts. / 2.96 Liters
1.32 Inc.	3.50 Qts. / 3.31 Liters
1.25 Inc.	
1.18 Inc.	3.50 Qts. / 3.31 Liters
1:1	3.62 Qts. / 3.43 Liters
1.18 Dec.	
1.25 Dec	
1.32 Dec.	2.75 Qts. / 2.60 Liters
1.40 Dec.	3.13 Qts. / 2.96 Liters
1.48 Dec.	3.25 Qts. / 3.07 Liters
1.57 Dec.	
1.67 Dec.	2.38 Qts. / 2.25 Liters

2PD06 Vertical Mounting	
Ratio	**Oil Capacity**
1.67 Inc.	3.10 Qts. / 2.93 Liters
1.57 Inc.	
1.48 Inc.	3.60 Qts. / 3.41 Liters
1.40 Inc.	3.60 Qts. / 3.41 Liters
1.32 Inc.	2.20 Qts. / 2.08 Liters
1.25 Inc.	
1.18 Inc.	2.30 Qts. / 2.18 Liters
1:1	3.0 Qts. / 2.84 Liters
1.18 Dec.	2.75 Qts. / 2.60 Liters
1.25 Dec.	
1.32 Dec.	2.60 Qts. / 2.46 Liters
1.40 Dec.	
1.48 Dec.	2.50 Qts. / 2.36 Liters
1.57 Dec.	
1.67 Dec.	2.80 Qts. / 2.65 Liters

3PD06 Normal Mounting	
Ratio	**Oil Capacity**
1.52 Inc.	
1.36 Inc.	
1.29 Inc.	
1.17 Inc.	
1:1	3.75 Qts. / 3.54 Liters
1.17 Dec.	
1.29 Dec.	
1.36 Dec.	

3PD06 Inverted Mounting	
Ratio	**Oil Capacity**
1.52 Inc.	3.63 Qts. / 3.43 Liters
1.36 Inc.	
1.29 Inc.	
1.17 Inc.	
1:1	3.31 Qts. / 3.13 Liters
1.17 Dec.	
1.29 Dec.	
1.36 Dec.	3.25 Qts. / 3.08 Liters

Note: All oil capacities are approximate. Refer to Lubrication and Oil Filling Instructions when adding or changing oil.

8 INCH GEAR CENTERS

2PD08 Normal Mounting	
Ratio	**Oil Capacity**
1.40 Inc.	4.00 Qts. / 3.79 Liters
1.34 Inc.	
1.23 Inc.	
1:1	4.00 Qts. / 3.79 Liters
1.23 Dec.	
1.34 Dec.	
1.40 Dec.	4.00 Qts. / 3.79 Liters

3PD08 Normal Mounting	
Ratio	**Oil Capacity**
1.40 Inc.	5.50 Qts. / 5.20 Liters
1.34 Inc.	
1.23 Inc.	
1:1	5.25 Qts. / 4.96 Liters
1.23 Dec.	
1.34 Dec.	
1.40 Dec.	5.00 Qts. / 4.73 Liters

4PD08 Normal Mounting	
Ratio	**Oil Capacity**
1.40 Inc.	4.25 Qts. / 4.00 Liters
1.34 Inc.	
1.23 Inc.	
1:1	4.38 Qts. / 4.14 Liters
1.23 Dec.	
1.34 Dec.	
1.40 Dec.	4.00 Qts. / 3.78 Liters

2PD08 Vertical Mounting	
Ratio	**Oil Capacity**
1.40 Inc.	
1.34 Inc.	
1.23 Inc.	
1:1	
1.23 Dec.	
1.34 Dec.	
1.40 Dec.	

3PD08 Inverted Mounting	
Ratio	**Oil Capacity**
1.40 Inc.	3.43 Qts. / 3.25 Liters
1.34 Inc.	
1.23 Inc.	
1:1	3.25 Qts. / 3.08 Liters
1.23 Dec.	
1.34 Dec.	
1.40 Dec.	3.43 Qts. / 3.25 Liters

9 INCH GEAR CENTERS

4PD09 Normal Mounting	
Ratio	**Oil Capacity**
1.40 Inc.	6.75 Qts. / 6.39 Liters
1.30 Inc.	
1.20 Inc.	
1:1	6.50 Qts. / 6.15 Liters
1.20 Dec.	
1.30 Dec.	
1.40 Dec.	6.0 Qts. / 5.68 Liters

Note: All oil capacities are approximate. Refer to Lubrication and Oil Filling Instructions when adding or changing oil.

10.5 INCH GEAR CENTERS

2PD10 Normal Mounting	
Ratio	**Oil Capacity**
1.38 Inc.	4.50 Qts. / 4.25 Liters
1.29 Inc.	
1.21 Inc.	5.25 Qts. / 4.97 Liters
1:1	6.00 Qts. / 5.68 Liters
1.21 Dec.	5.25 Qts. / 4.97 Liters
1.29 Dec.	
1.38 Dec.	5.25 Qts. / 4.97 Liters

3PD10 Normal Mounting	
Ratio	**Oil Capacity**
1.38 Inc.	10.50 Qts. / 9.94 Liters
1.29 Inc.	
1.21 Inc.	
1:1	8.25 Qts. / 7.80 Liters
1.21 Dec.	
1.29 Dec.	
1.38 Dec.	

2PD10 Vertical Mounting	
Ratio	**Oil Capacity**
1.38 Inc.	4.50 Qts. / 4.25 Liters
1.29 Inc.	
1.21 Inc.	
1:1	4.50 Qts. / 4.25 Liters
1.21 Dec.	
1.29 Dec.	
1.38 Dec.	4.50 Qts. / 4.25 Liters

3PD10 Inverted Mounting	
Ratio	**Oil Capacity**
1.38 Inc.	6.25 Qts. / 5.91 Liters
1.29 Inc.	
1.21 Inc.	
1:1	5.75 Qts. / 5.44 Liters
1.21 Dec.	
1.29 Dec.	
1.38 Dec.	5.50 Qts. / 5.20 Liters

11.3 INCH GEAR CENTERS

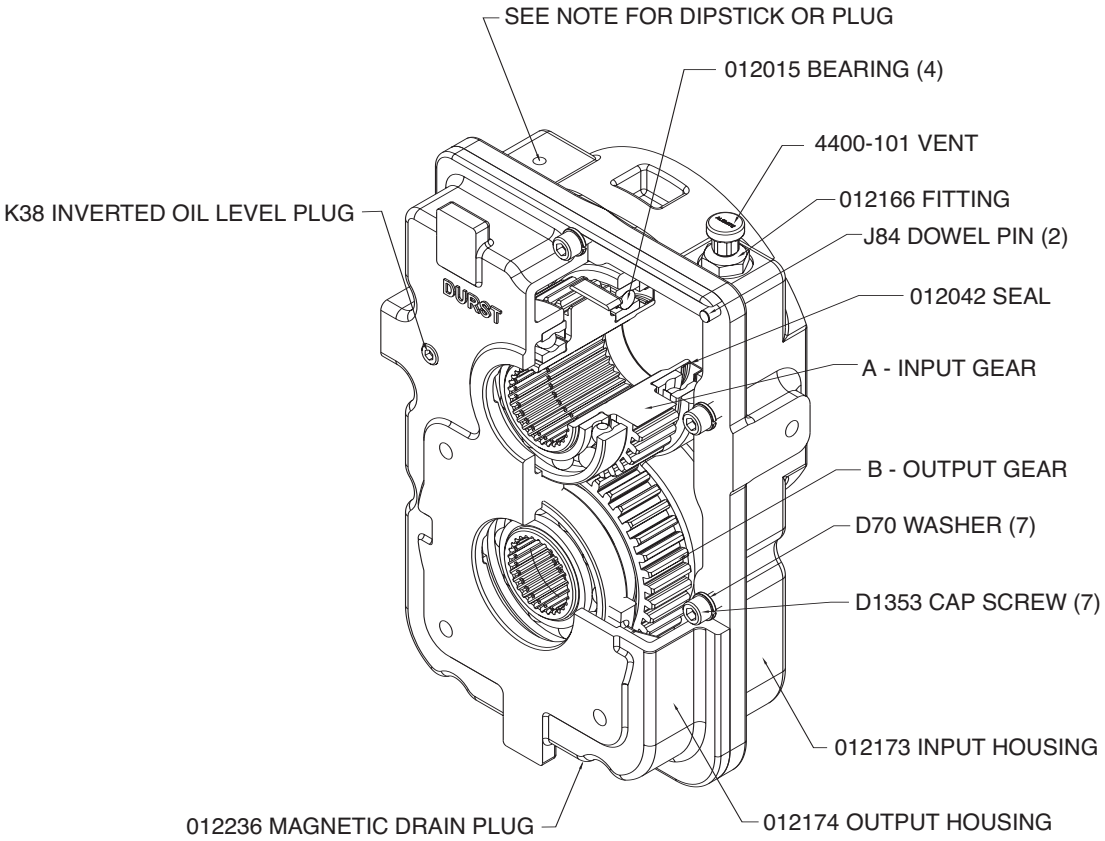
4PD11 Normal Mounting	
Ratio	**Oil Capacity**
1.39 Inc.	7.25 Qts. / 6.86 Liters
1.31 Inc.	
1.16 Inc.	
1:1	7.50 Qts. / 7.10 Liters
1.16 Dec.	
1.31 Dec.	
1.39 Dec.	6.25 Qts. / 5.91 Liters.

Note: All oil capacities are approximate. Refer to Lubrication and Oil Filling Instructions when adding or changing oil.

PART NUMBER CHARTS FOR MODULAR GEAR BOXES & ADAPTERS

Due to the modular design of the new pump drives, the number of parts needed to build any model is significantly reduced. The following charts contain a parts list for all the options and service parts for this pump drive line.

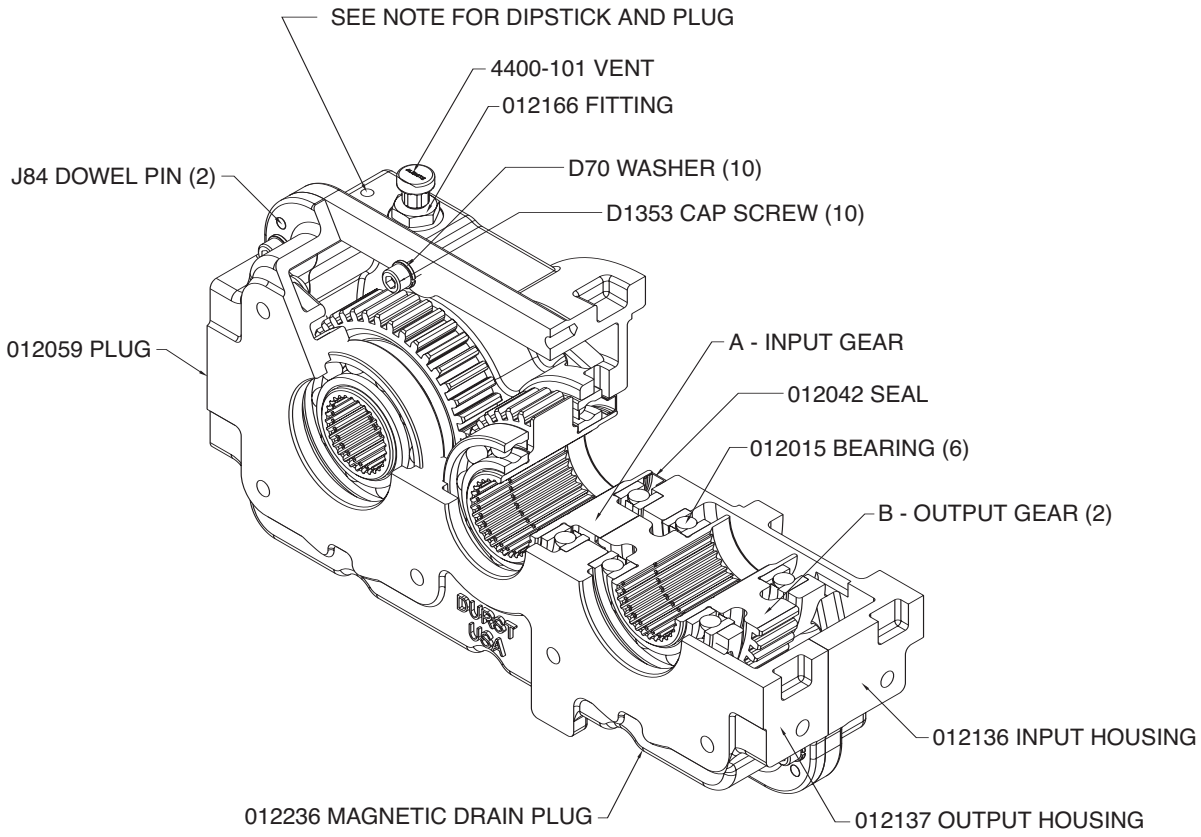
1PD06 MODULE PUMP DRIVE



The following chart lists all of the complete assembly part numbers with the prefix of "K". All of the pump drive gear boxes can be purchased as a complete kit and will come fully assembled with all of the part numbers as shown in the above figure including the gears, shown in the table to create the desired ratio. Note: Dipstick, P/N 012306, is not provided in gear box kit, but is required in all normal mounted installations, left side only. Expansion plug, P/N 012326, is not provided in gear box kit, but is required in all inverted installations. For replacement gears with bearings assembled, order gear as a kit with a "K" number (i.e. To order a 012104 gear with (2) 012015 bearings, order as K12104).

Complete Gear Box P/N	Ratio	Input Gear A	Output Gear B
K12213	1.67 Inc.	012110	012097
K12211	1.57 Inc.	012109	012098
K12209	1.48 Inc.	012108	012099
K12207	1.40 Inc.	012107	012100
K12205	1.32 Inc.	012106	012101
K12416	1.25 Inc.	012409	012408
K12203	1.18 Inc.	012105	012102
K12201	1:1	012104	012104
K12202	1.18 Dec.	012102	012105
K12415	1.25 Dec.	012408	012409
K12204	1.32 Dec.	012101	012106
K12206	1.40 Dec.	012100	012107
K12208	1.48 Dec.	012099	012108
K12210	1.57 Dec.	012098	012109
K12212	1.67 Dec.	012097	012110

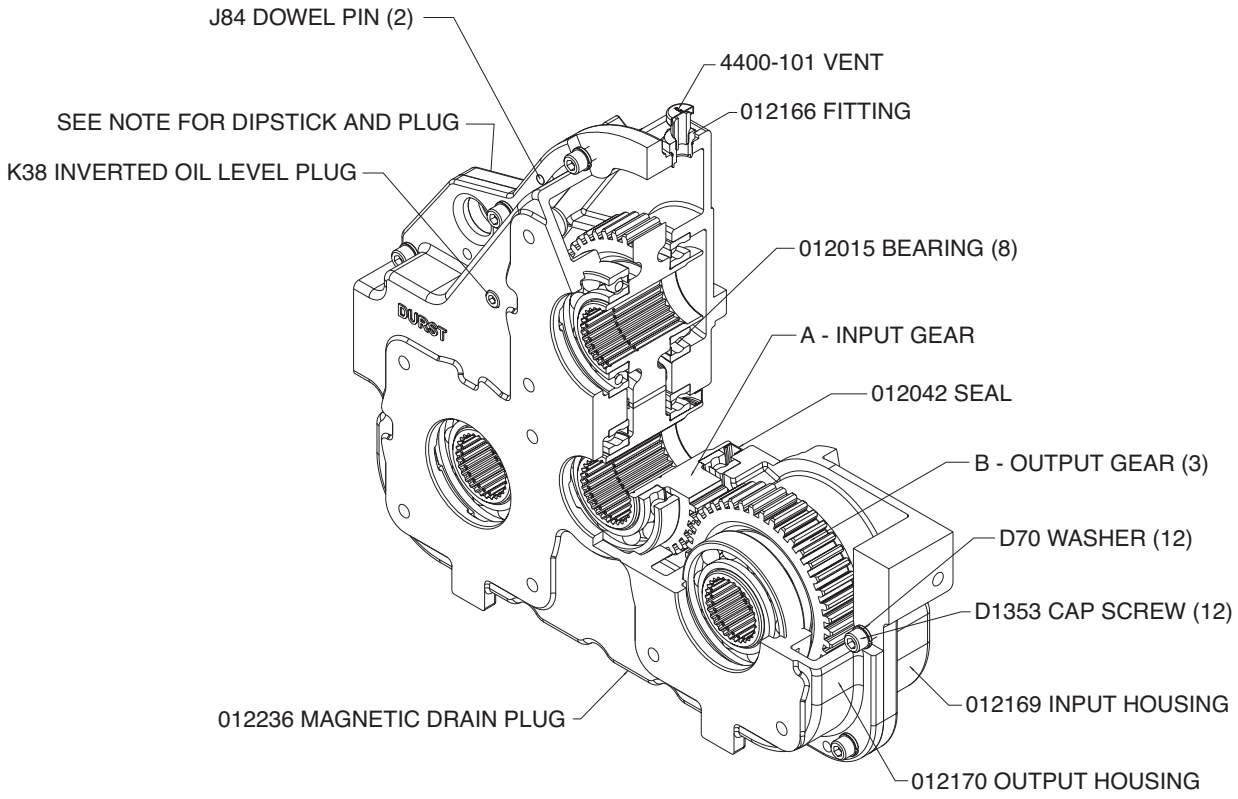
2PD06 MODULE PUMP DRIVE



The following chart lists all of the complete assembly part numbers with the prefix of "K". All of the pump drive gear boxes can be purchased as a complete kit and will come fully assembled with all of the part numbers as shown in the above figure including the gears, shown in the below table to create the desired ratio. Note: Dipstick, P/N 012307, is not provided in gear box kit, but is required in all normal mounted installations. It can be installed either left or right side. Two expansion plugs, P/N 012326, are not provided in gear box kit, but are required in all vertical installations. For replacement gears with bearings assembled, order gear as a kit with a "K" number (i.e. To order a 012104 gear with (2) 012015 bearings, order as K12104).

Complete Gear Box P/N	Ratio	Input Gear A	Output Gear B
K12226	1.67 Inc.	012110	012097
K12224	1.57 Inc.	012109	012098
K12222	1.48 Inc.	012108	012099
K12220	1.40 Inc.	012107	012100
K12218	1.32 Inc.	012106	012101
K12411	1.25 Inc.	012409	012408
K12216	1.18 Inc.	012105	012102
K12214	1:1	012104	012104
K12215	1.18 Dec.	012102	012105
K12410	1.25 Dec.	012408	012409
K12217	1.32 Dec.	012101	012106
K12219	1.40 Dec.	012100	012107
K12221	1.48 Dec.	012099	012108
K12223	1.57 Dec.	012098	012109
K12225	1.67 Dec.	012097	012110

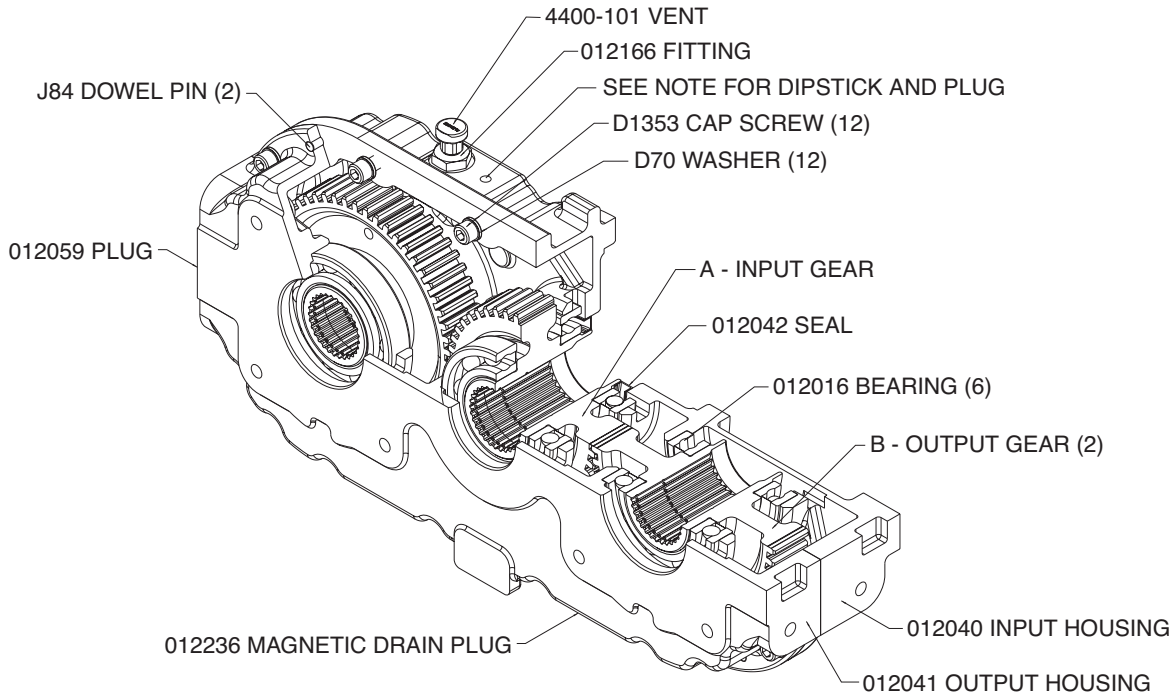
3PD06 MODULE PUMP DRIVE



The following chart lists all of the complete assembly part numbers with the prefix of "K". All of the pump drive gear boxes can be purchased as a complete kit and will come fully assembled with all of the part numbers as shown in the above figure including the gears, shown in the below table to create the desired ratio. Note: Dipstick, P/N 012308, is not provided in gear box kit, but is required in all normal mounted installations. It can be installed either left or right side. Two expansion plugs, P/N 012326, are not provided in gear box kit, but are required in all inverted installations. For replacement gears with bearings assembled, order gear as a kit with a "K" number (i.e. To order a 012105 gear with (2) 012015 bearings, order as K12105).

Complete Gear Box P/N	Ratio	Input Gear A	Output Gear B
K12235	1.52 Inc.	012111	012101
K12233	1.36 Inc.	012110	012102
K12231	1.29 Inc.	012109	012103
K12229	1.17 Inc.	012107	012104
K12227	1:1	012105	012105
K12228	1.17 Dec.	012104	012107
K12230	1.29 Dec.	012103	012109
K12232	1.36 Dec.	012102	012110

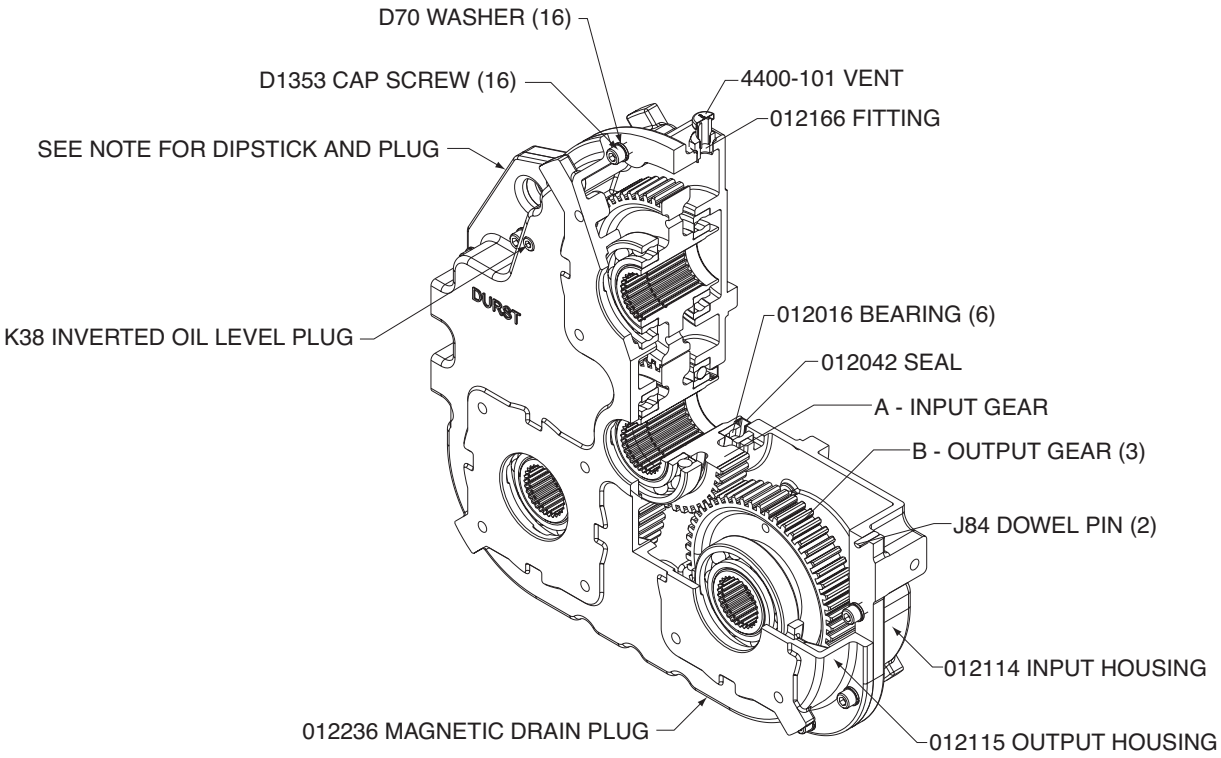
2PD08 MODULE PUMP DRIVE



The following chart lists all of the complete assembly part numbers with the prefix of "K". All of the pump drive gear boxes can be purchased as a complete kit and will come fully assembled with all of the part numbers as shown in the above figure including the gears, shown in the following table to create the desired ratio. Note: Dipstick, P/N 012260, is not provided in gear box kit, but is required in all normal mounted installations. It can be installed either left or right side. Two expansion plugs, P/N 012326, are not provided in gear box kit, but are required in all vertical installations. For replacement gears with bearings assembled, order gear as a kit with a "K" number (i.e. To order a 012010 gear with (2) 012016 bearings, order as K12010).

Complete Gear Box P/N	Ratio	Input Gear A	Output Gear B
K12092	1.53 Inc.	012049	012048
K12091	1.40 Inc.	012013	012007
K12089	1.34 Inc.	012012	012008
K12087	1.23 Inc.	012011	012009
K12085	1:1	012010	012010
K12086	1.23 Dec.	012009	012011
K12088	1.34 Dec.	012008	012012
K12090	1.40 Dec.	012007	012013

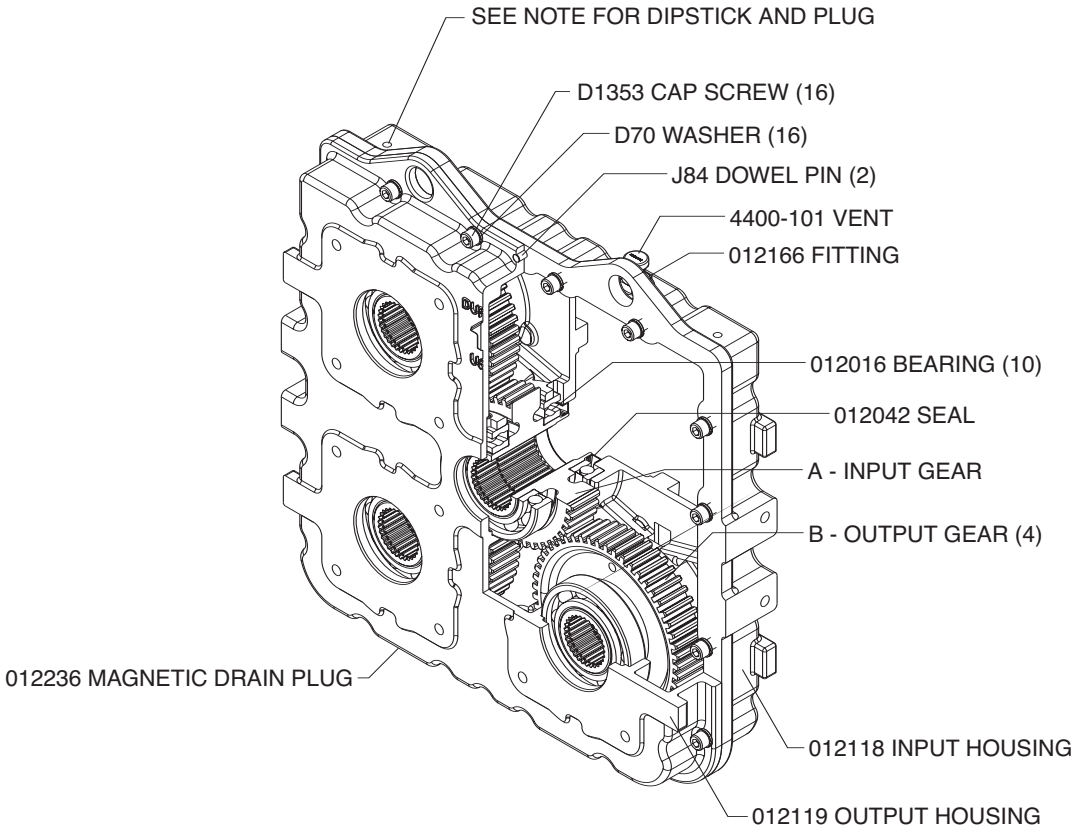
3PD08 MODULE PUMP DRIVE



The following chart lists all of the complete assembly part numbers with the prefix of "K". All of the pump drive gear boxes can be purchased as a complete kit and will come fully assembled with all of the part numbers as shown in the above figure including the gears, shown in the following table to create the desired ratio. Note: Dipstick, P/N 012294, is not provided in gear box kit, but is required in all normal mounted installations. It can be installed either left or right side. Two expansion plugs, P/N 012326, are not provided in gear box kit, but are required in all inverted installations. For replacement gears with bearings assembled, order gear as a kit with a "K" number (i.e. To order a 012010 gear with (2) 012016 bearings, order as K12010).

Complete Gear Box P/N	Ratio	Input Gear A	Output Gear B
K12130	1.53 Inc.	012049	012048
K12129	1.40 Inc.	012013	012007
K12127	1.34 Inc.	012012	012008
K12125	1.23 Inc.	012011	012009
K12123	1:1	012010	012010
K12124	1.23 Dec.	012009	012011
K12126	1.34 Dec.	012008	012012
K12128	1.40 Dec.	012007	012013

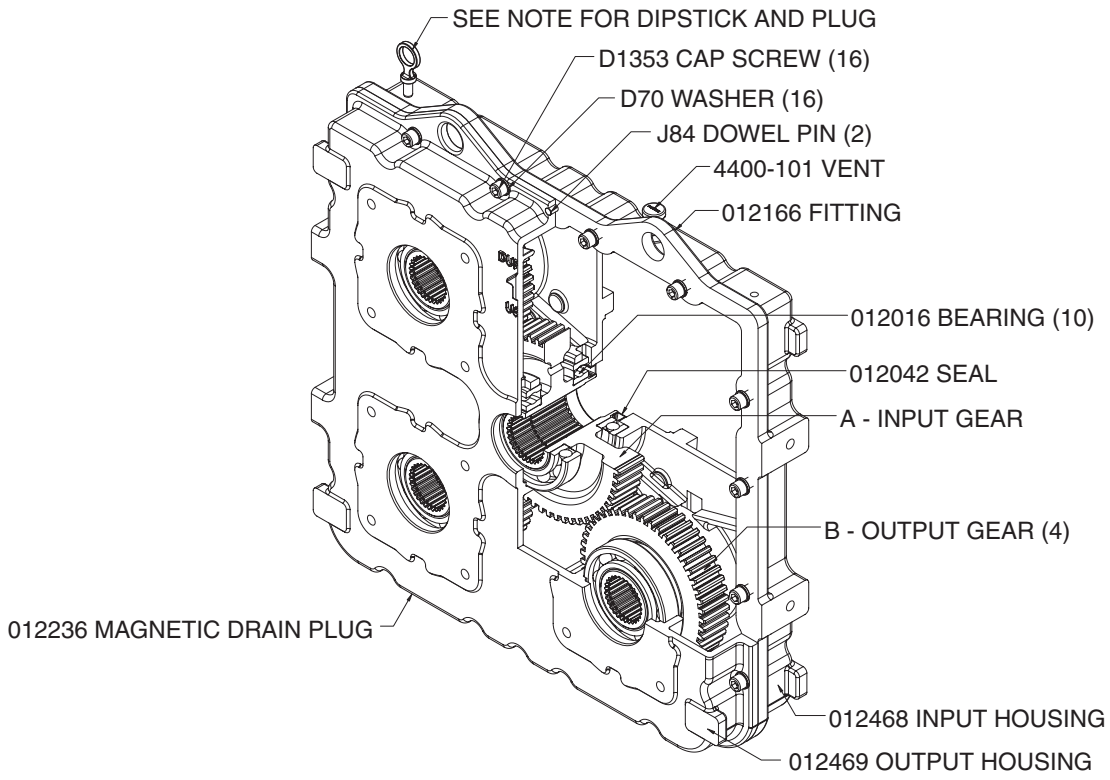
4PD08 MODULE PUMP DRIVE



The following chart lists all of the complete assembly part numbers with the prefix of "K". All of the pump drive gear boxes can be purchased as a complete kit and will come fully assembled with all of the part numbers as shown in the above figure including the gears, shown in the following table to create the desired ratio. Note: Dipstick, P/N 012309, is not provided in gear box kit, but is required in all normal mounted installations. It can be installed either left or right side. The opposite side is plugged with P/N 012326, expansion plug, provided with dipstick. For replacement gears with bearings assembled, order gear as a kit with a "K" number (i.e. To order a 012010 gear with (2) 012016 bearings, order as K12010).

Complete Gear Box P/N	Ratio	Input Gear A	Output Gear B
K12182	1.53 Inc.	012049	012048
K12181	1.40 Inc.	012013	012007
K12179	1.34 Inc.	012012	012008
K12177	1.23 Inc.	012011	012009
K12175	1:1	012010	012010
K12176	1.23 Dec.	012009	012011
K12178	1.34 Dec.	012008	012012
K12180	1.40 Dec.	012007	012013

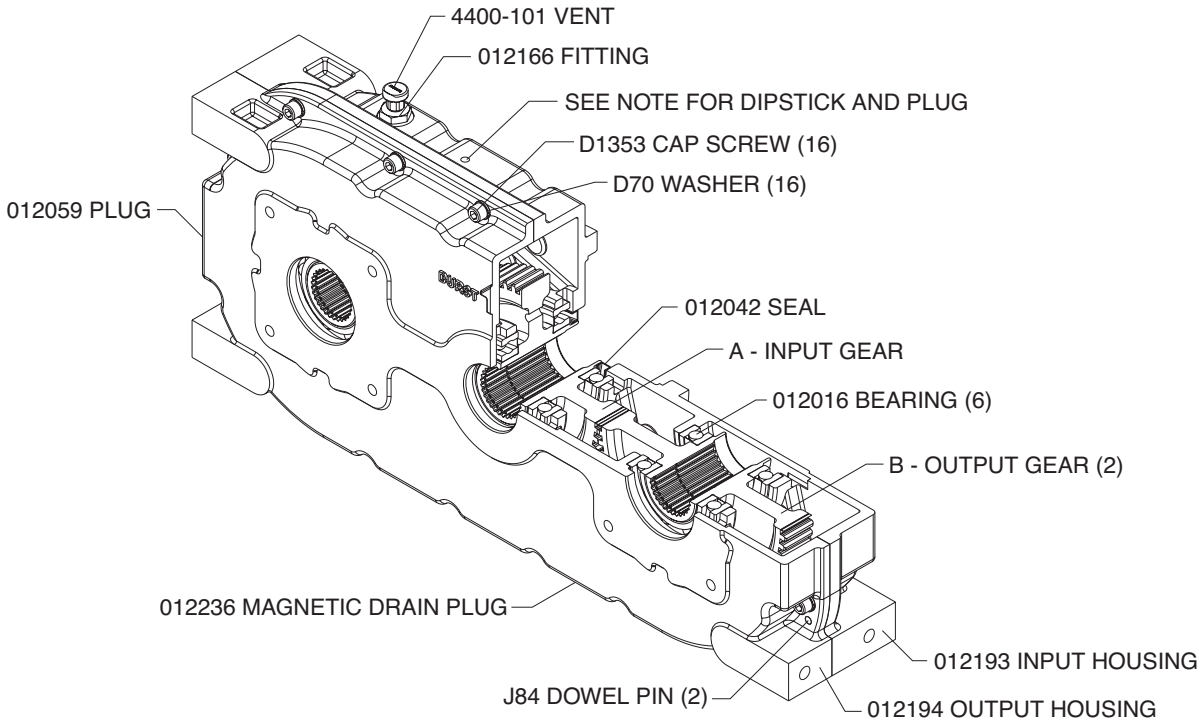
4PD09 MODULE PUMP DRIVE



The following chart lists all of the complete assembly part numbers with the prefix of "K". All of the pump drive gear boxes can be purchased as a complete kit and will come fully assembled with all of the part numbers as shown in the above figure including the gears, shown in the following table to create the desired ratio. Note: Dipstick, P/N 012527, is not provided in gear box kit, but is required in all normal mounted installations. It can be installed either left or right side. The opposite side is plugged with P/N 012326, expansion plug, provided with dipstick. For replacement gears with bearings assembled, order gear as a kit with a "K" number (i.e. To order a 012479 gear with (2) 012016 bearings, order as K12479).

Complete Gear Box P/N	Ratio	Input Gear A	Output Gear B
K12487	1.40 Inc.	012052	012476
K12485	1.30 Inc.	012480	012477
K12483	1.20 Inc.	012051	012478
K12481	1:1	012479	012479
K12482	1.20 Dec.	012478	012051
K12484	1.30 Dec.	012477	012480
K12486	1.40 Dec.	012476	012052

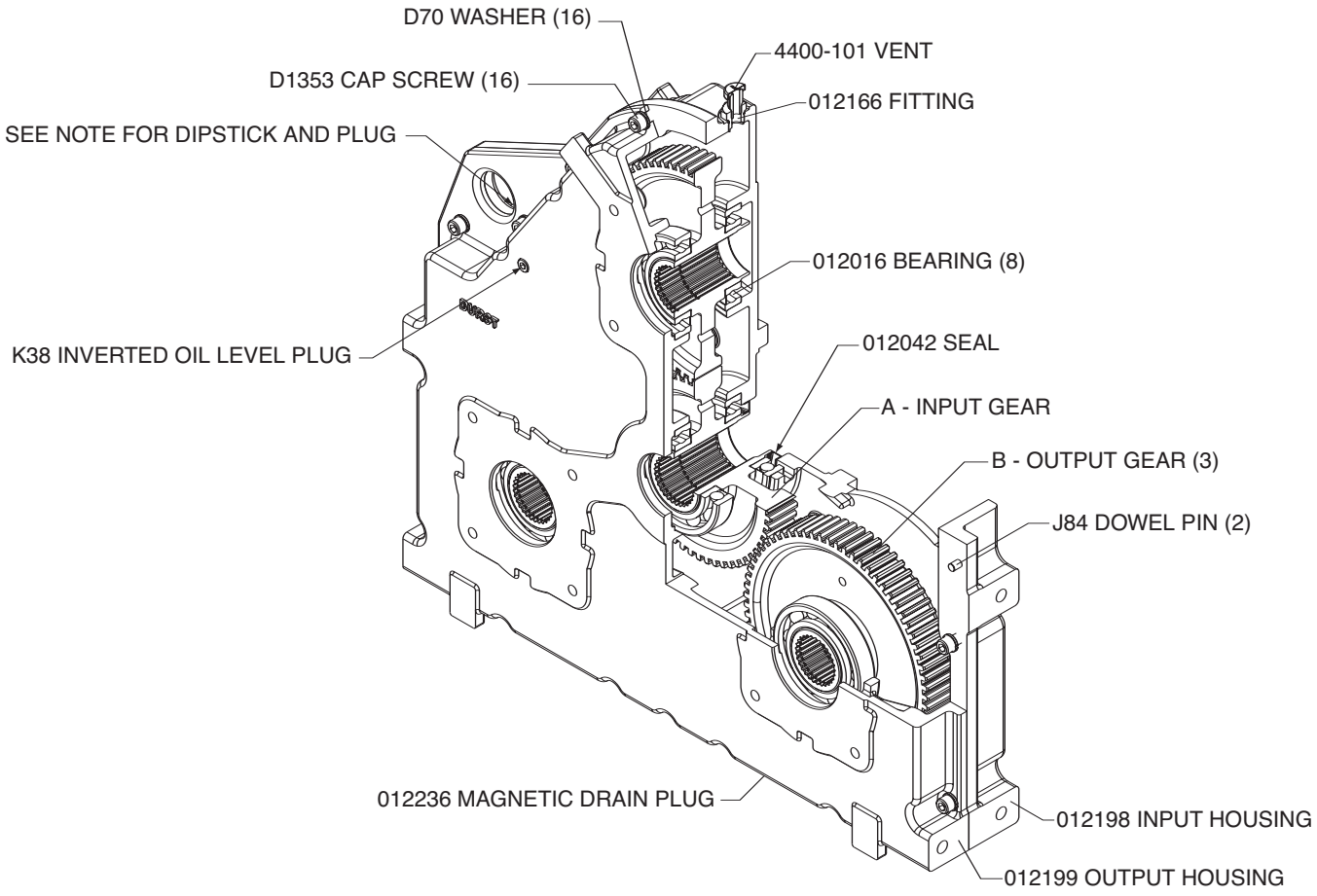
2PD10 MODULE PUMP DRIVE



The following chart lists all of the complete assembly part numbers with the prefix of "K". All of the pump drive gear boxes can be purchased as a complete kit and will come fully assembled with all of the part numbers as shown in the above figure including the gears, shown in the following table to create the desired ratio. Note: Dipstick, see chart for part number, is not provided in gear box kit, but is required in all normal mounted installations. It can be installed either left or right side. Two expansion plugs, P/N 012326, are not provided in gear box kit, but are required in all vertical installations. For replacement gears with bearings assembled, order gear as a kit with a "K" number (i.e. To order a 012052 gear with (2) 012016 bearings, order as K12052).

Complete Gear Box P/N	Ratio	Input Gear A	Output Gear B	Dipstick C
K12243	1.38 Inc.	012056	012011	012413
K12241	1.29 Inc.	012055	012012	012413
K12239	1.21 Inc.	012054	012050	012413
K12237	1:1	012052	012052	012310
K12238	1.21 Dec.	012050	012054	012413
K12240	1.29 Dec.	012012	012055	012413
K12242	1.38 Dec.	012011	012056	012413

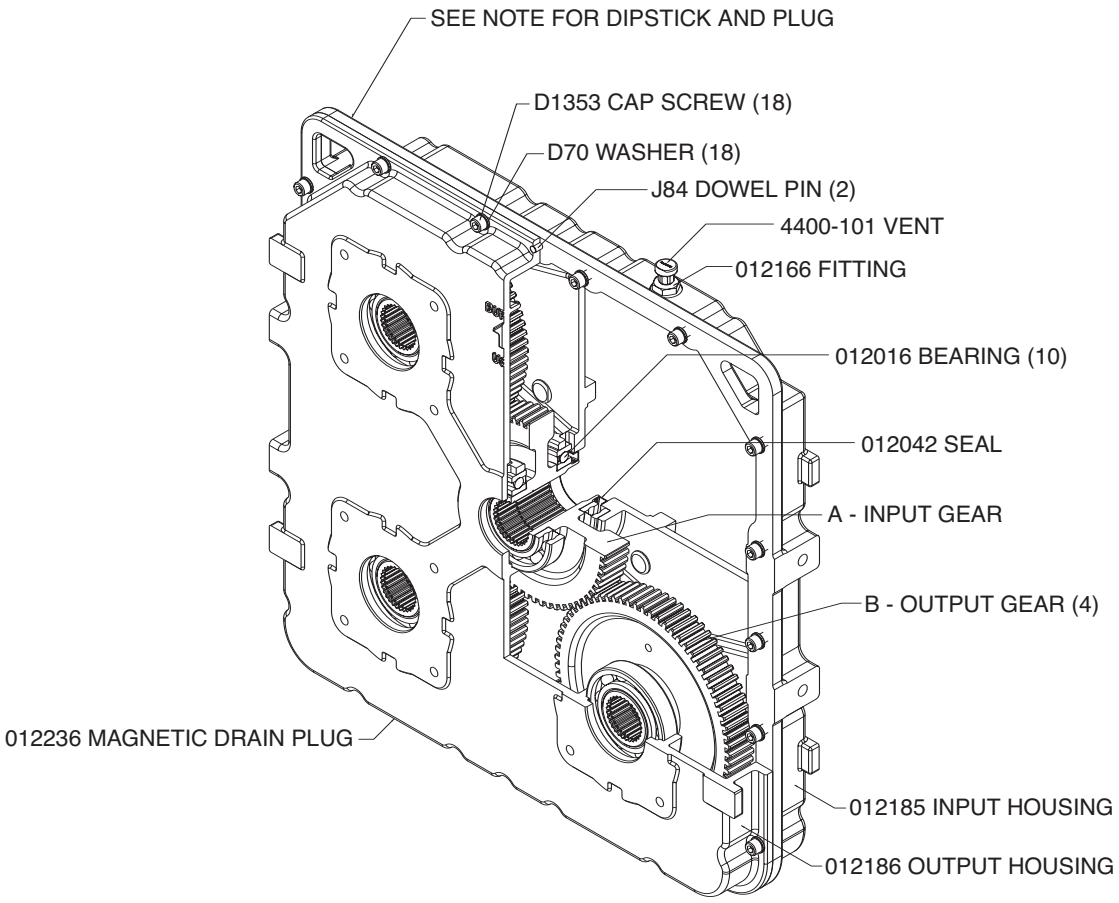
3PD10 MODULE PUMP DRIVE



The following chart lists all of the complete assembly part numbers with the prefix of "K". All of the pump drive gear boxes can be purchased as a complete kit and will come fully assembled with all of the part numbers as shown in the above figure including the gears, shown in the following table to create the desired ratio. Note: Dipstick, P/N 012311, is not provided in gear box kit, but is required in all normal mounted installations. It can be installed either left or right side. Two expansion plugs, P/N 012326, are not provided in gear box kit, but are required in all inverted installations. For replacement gears with bearings assembled, order gear as a kit with a "K" number (i.e. To order a 012052 gear with (2) 012016 bearings, order as K12052).

Complete Gear Box P/N	Ratio	Input Gear A	Output Gear B
K12250	1.38 Inc.	012056	012011
K12248	1.29 Inc.	012055	012012
K12246	1.21 Inc.	012054	012050
K12244	1:1	012052	012052
K12245	1.21 Dec.	012050	012054
K12247	1.29 Dec.	012012	012055
K12249	1.38 Dec.	012011	012056

4PD11 MODULE PUMP DRIVE



The following chart lists all of the complete assembly part numbers with the prefix of "K". All of the pump drive gear boxes can be purchased as a complete kit and will come fully assembled with all of the part numbers as shown in the above figure including the gears, shown in the following table to create the desired ratio. Note: Dipstick, P/N 012325, is not provided in gear box kit, but is required in all normal mounted installations. It can be installed either left or right side. The opposite side is plugged with P/N 012326, expansion plug, provided with dipstick. For replacement gears with bearings assembled, order gear as a kit with a "K" number (i.e. To order a 012053 gear with (2) 012016 bearings, order as K12053).

Complete Gear Box P/N	Ratio	Input Gear A	Output Gear B
K12257	1.39 Inc.	012058	012050
K12255	1.31 Inc.	012057	012051
K12253	1.16 Inc.	012056	012052
K12251	1:1	012053	012053
K12252	1.16 Dec.	012052	012056
K12254	1.31 Dec.	012057	012051
K12256	1.39 Dec.	012050	012058

PUMP SPLINE ADAPTER

The following chart lists all available spline adapters for the Durst pump drives. The spline adapters can be purchased as either complete kits or individual components.

Complete Spline Adapter Kit P/N	Pump Shaft Size	Max. Torque (in-lbs)	Spline	Spline Adapter	Retaining Ring
K12072	SAE A	517	9T-16/32	012014	012044
K12073	SAE B	1,852	13T-16/32	012017	012044
K12074	SAE BB	2,987	15T-16/32	012018	012044
K12075	SAE C	5,677	14T-12/24	012019	012044
K12076	SAE CC	10,777	17T-12/24	012020	012044
K12077	SAE D	15,057	13T-8/16	012021	012044
K12078	SAE F	24,245	15T-8/16	012022	012304
K12264	21T		21T-16/32	012261	012044
K12265	23T		23T-16/32	012262	012044
K12266	27T		27T-16/32	012263	012044

PUMP SPLINE ADAPTER INSTALLATION INSTRUCTIONS

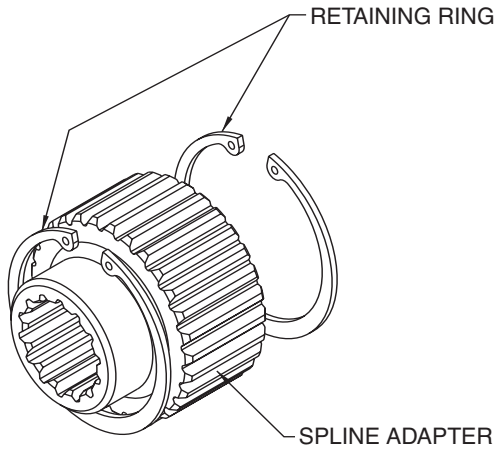


Figure J

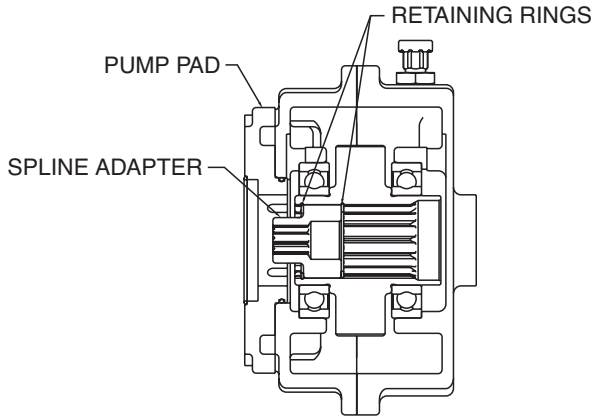


Figure K

1) Install the first retaining ring into the furthest snap ring groove of desired gear (see Figure K). Note that the SAE F spline adapter requires a different retaining ring (see chart).

2) Insert pump spline adapter into gear. Some spline adapters have a necked down spline extension. For proper spline engagement this extension is to be facing the pump pad (see Figure K).

CAUTION Due to an internal oil lubrication system do NOT apply any grease, or spline lubricant as this will contaminate the oil.

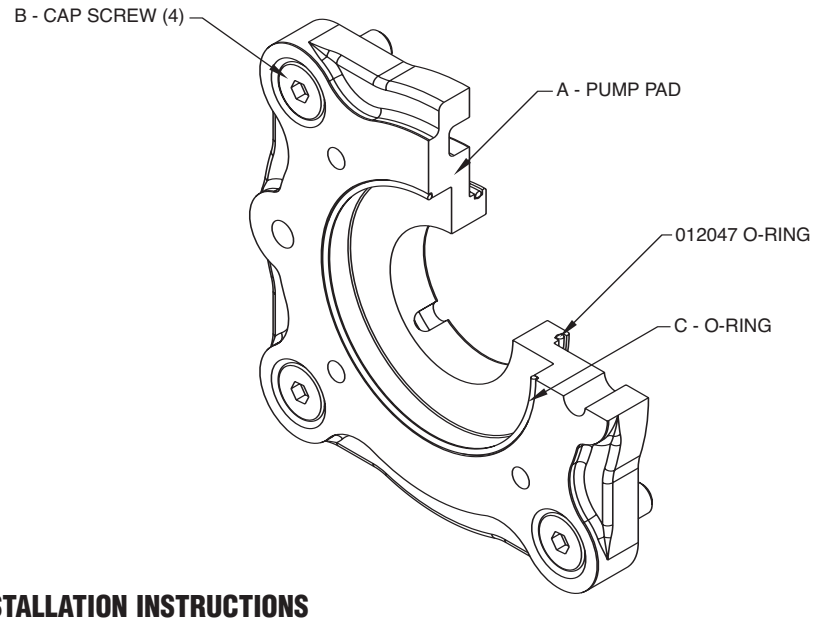
3) Install the second retaining ring into the outermost snap ring groove to contain the pump spline adapter (see Figure K).

PUMP PAD ADAPTER

The following chart lists all available pump pad adapters for the Durst pump drives. The pump pad adapters can be purchased as either complete kits or individual components.

Complete Pump Pad Adapter Kit P/N	SAE Pump Pad Size	Pump Pad A	Cap Screw B	O-Ring C
K12066	A	012023	012060	012079
K12067	B	012024	012060	012080
K12068	C	012025	012060	012081
[1]K12069	D	012026	Stud: 012065	012082
[1]K12449	D	012026	Stud: 012374	012082
[2]K12135	D2	012096	012133	012082
K12070	E	012027	012133	012083
[3]K12356	E45	012355	012133	012083
K12071	F	012028	012133	012084

NOTES:
1. Both SAE "D" kits are supplied with nut P/N 4054-302 (qty. 4). Kit #K12449 uses a 1/2" longer stud than kit #K12069. The longer stud is to be used on all hydraulic pumps with flange thicknesses greater than 1/2 inch, or when more mounting threads are desired.
2. The D2 option allows for mounting SAE D, 2-Bolt, pumps in either the horizontal or vertical position. This can also be used to mount a standard SAE D pump at 45 degrees.
3. The E45 option allows for mounting an SAE E pump at 45 degrees.



PUMP PAD ADAPTER INSTALLATION INSTRUCTIONS

1) Use fresh oil to lubricate all o-rings prior to installation.

2) Install 012047 o-ring onto pilot groove, as shown above.

3) Place pump pad onto gear box and press down until the pump pad fully seats into gear box. Due to the modular design, pump pads can be installed either horizontally or vertically.

4) Install cap screws or stud and nut if applicable. Torque bolts according to Table 1 (see page 33).

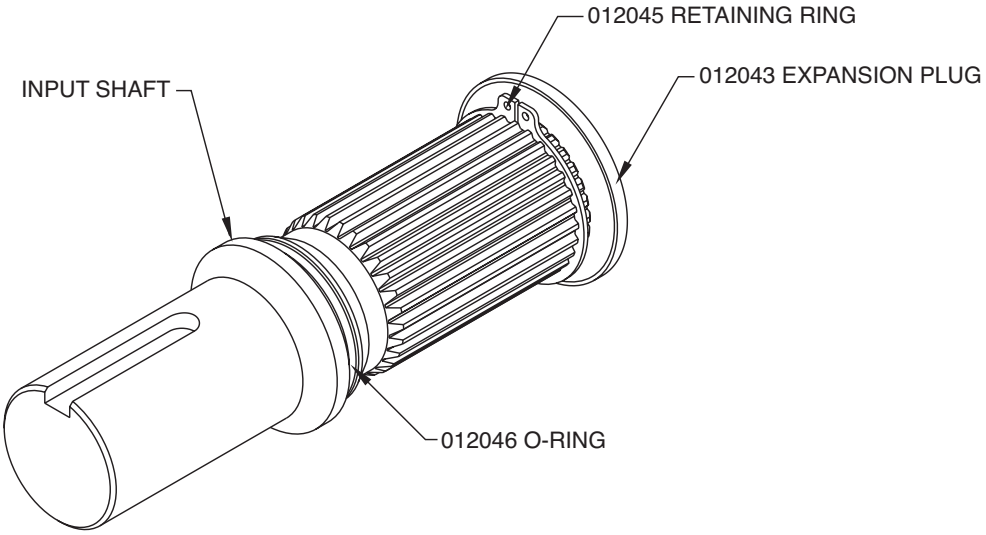
CAUTION Do not apply Loctite or any type of thread locking material to pump pad screws.

5) The "C" o-ring seals the hydraulic pump to the gear box. For installation instructions, see "Installation of Hydraulic Pumps to Durst Pump Drives" (page 7).

INPUT SHAFT OPTIONS

The following chart lists all available input shaft options for the Durst pump drives. The input shafts can be purchased as either complete kits or individual components. In most cases the input shaft can be replaced without affecting the pump pads. However, in some pump drive models, the pump pad(s) overlap the expansion plug. This requires the pump pad(s) to be removed before replacing the input shaft.

Complete Input Shaft Kit P/N	Shaft Description	Max. Torque (ft-lb)	Input Shaft
K12275	29T-12/24	2,325	012120
K12276	20T-10/20	1,790	012121
K12278	15T-8/16	1,545	012285
K12279	2.25 Dia. w/ 0.500 keyway	2,225	012122
K12280	2.50 Dia. w/ 0.625 keyway	2,325	012149
K12281	For SP214 Clutch	N/A	012190
K12282	For SP211 Clutch	N/A	012189
K12283	For C111 Clutch	N/A	012188
K12284	For C110 Clutch	N/A	012187



INPUT SHAFT INSTALLATION INSTRUCTIONS

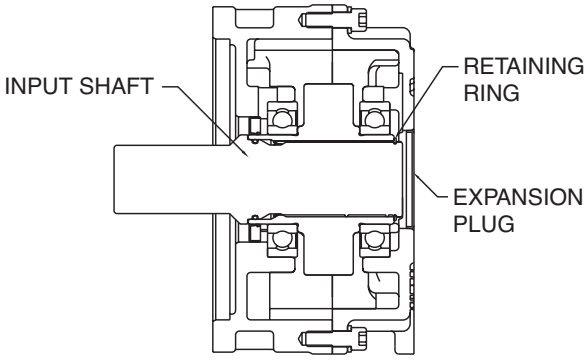
1) Use fresh oil to lubricate all o-rings prior to installation.

2) Install 012046 o-ring into shaft groove.

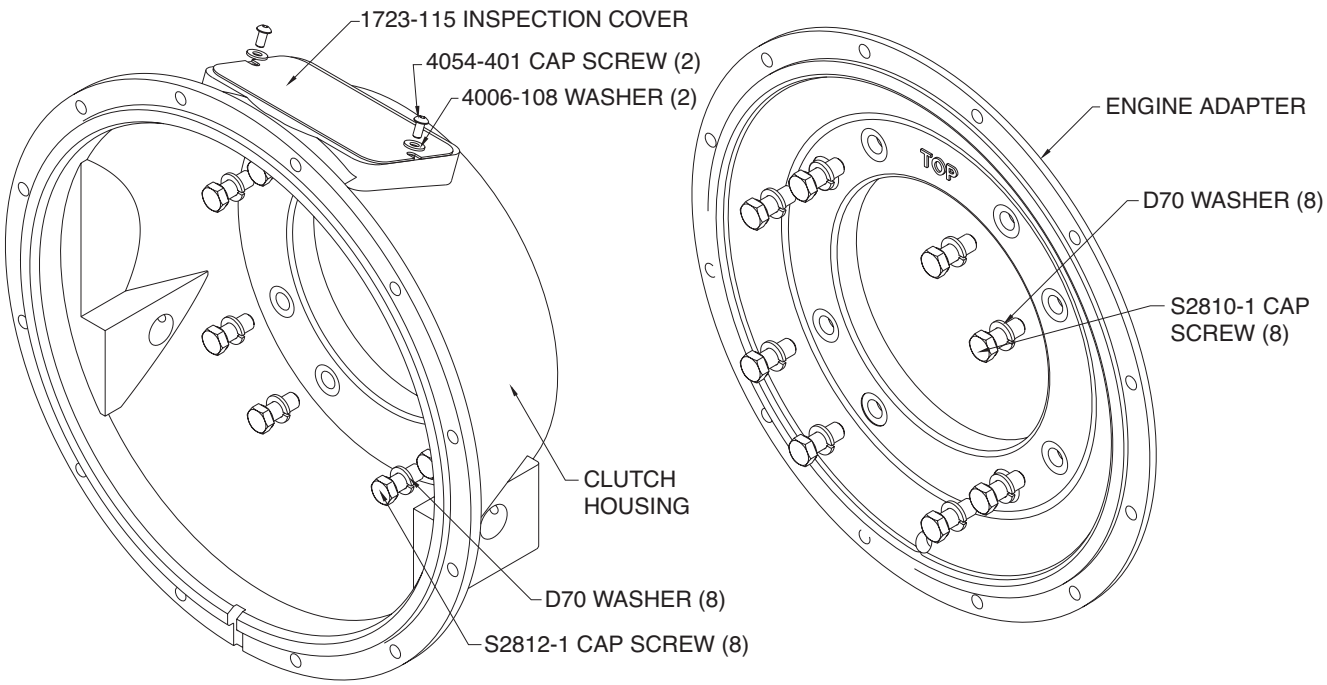
3) Insert shaft into the drive gear of the gear box until the shoulder contacts input gear.

4) Install 012045 retaining ring onto shaft through the back side of the gear box.

5) Apply a thin coat of Loctite 609 or equivalent to the O.D. of the 012043 expansion plug before installation.



CLUTCH HOUSINGS & ENGINE ADAPTERS



The following chart lists all available clutch housings and engine adapters for the Durst pump drives. The clutch housings and engine adapters can be purchased as either complete kits or individual components.

Complete Engine Adapter Kit P/N	SAE Engine Adapter	Engine Mounting Bolt Holes	Engine Adapter
K12061	1	(12) 7/16-14	012034
K12062	2	(12) 3/8-16	012035
K12063	3	(12) 3/8-16	012036
K12064	4	(12) 3/8-16	012037
Complete Clutch Housing Kit P/N	**SAE Clutch Housing**	**Engine Mounting Bolt Holes**	**Clutch Housing**
K12267	1 For SP214 Clutch	(12) 7/16-14	012158
K12268	1 For SP211 Clutch	(12) 7/16-14	012159
K12270	2 For SP211 Clutch	(12) 3/8-16	012161
K12271	2 For C111 Clutch	(12) 3/8-16	012162
K12272	2 For C110 Clutch	(12) 3/8-16	012163
K12611	3 For SP211 Clutch	(12) 3/8-16	012610
K12273	3 For C111 Clutch	(12) 3/8-16	012164
K12274	3 For C110 Clutch	(12) 3/8-16	012165

CLUTCH HOUSING & ENGINE ADAPTER INSTALLATION INSTRUCTIONS

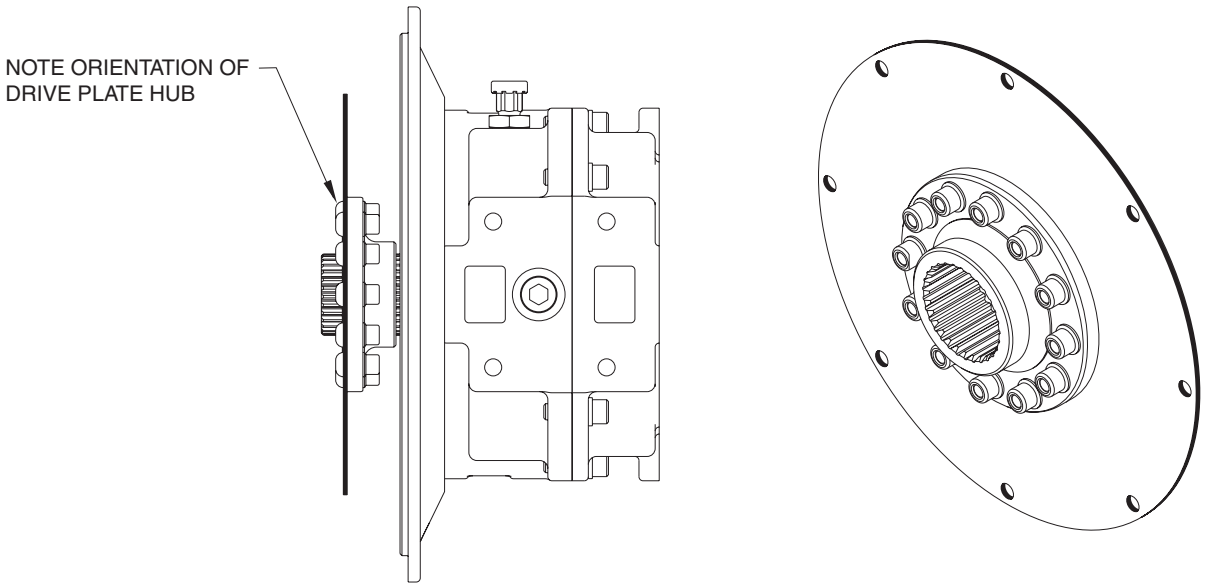
1) Place clutch housing or engine adapter onto pump drive gear box. Be sure that clutch housing or engine adapter is positioned correctly as this will locate the weep hole at the bottom and allow moisture to drain.

2) Install lock washers on to adapter mounting cap screws. Evenly tighten bolts according to Table 1 (see page 33).

DRIVE PLATE OPTIONS

The following chart lists all available drive plate options for the Durst pump drives. Drive plates are to be purchased as complete kits only.

Drive Plate Assembly	SAE Drive Plate Size	Drive Plate Offset	Tapped Engine Flywheel Holes
X12145	14	1.00	(8) 1/2-13
X12146	11.5	1.562	(8) 3/8-16
X12147	10	2.125	(8) 3/8-16
X12148	8	2.438	(6) 3/8-16



DRIVE PLATE INSTALLATION INSTRUCTIONS

1) Remove the drive plate from the Durst pump drive gear box.

2) Install the drive plate onto the engine flywheel, drive plate hub is to face AWAY from the engine. Bolt the drive plate to the engine flywheel, tighten bolts according to Table 1 (see page 33).

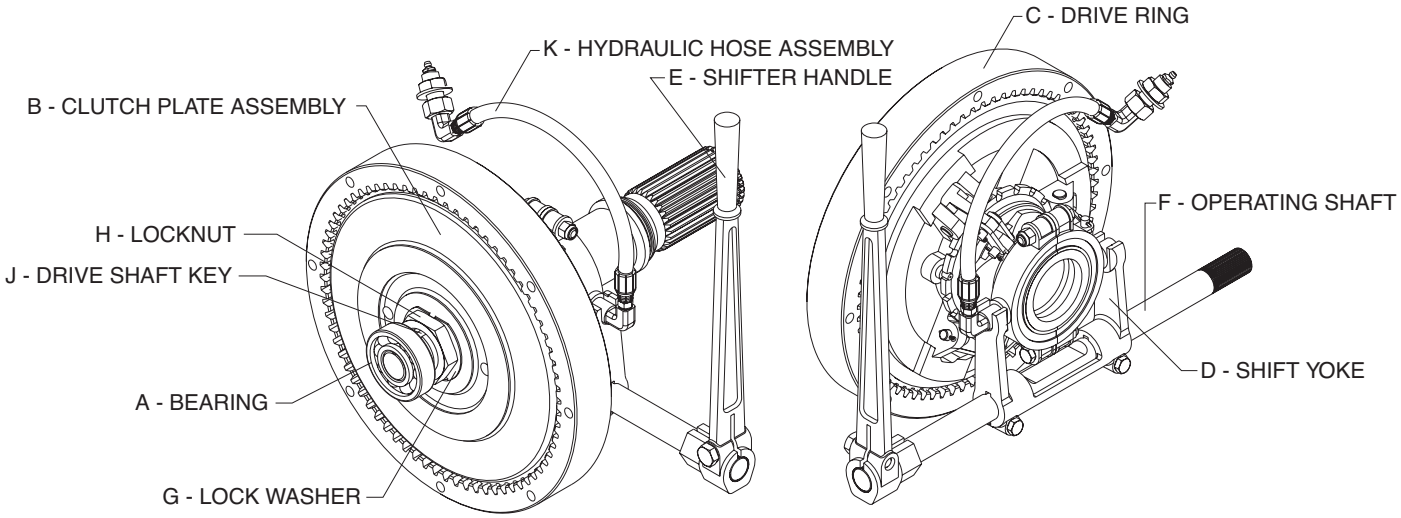
3) Check drive plate run out. Total TIR should not exceed 0.008".

4) Apply Silver Streak #200S to the external splines and slide the input shaft of the pump drive into the drive plate hub until the engine adapter seats against the engine flywheel housing.

CAUTION Do not use the engine adapter mounting bolts to seat the pump drive engine adapter housing to the engine flywheel housing. This may reduce engine crankshaft endplay and will result in premature damage or failure of crankshaft bearings.

CAUTION Always check engine crankshaft endplay after installing the flex plate to engine flywheel. Refer to engine manufacturer's endplay specifications.

CLUTCH OPTIONS



The following chart lists all available clutch options for the Durst pump drives. Clutch kits can be either purchased as complete kits or as individual components.

Component Description	Complete Clutch Housing Kit Part Numbers				
	K12288	K12289	K12290	K12291	K12292
SAE Clutch Size	SP214	SP214	SP211	C111	C110
Clutch Face Offset	1.00	1.00	1.562	1.562	2.125
Tapped Flywheel Holes	(8) 1/2-13	(8) 1/2-13	(8) 3/8-16	(8) 3/8-16	(6) 3/8-16
A – Bearing	☆4202-129	◆C2059	4202-101	4202-101	4202-101
B – Clutch Plate Assy.	4263-109	4263-109	4263-106	4263-105	4263-107
C – Drive Ring	4265-627	4265-627	4265-618	4265-619	4265-620
D – Shift Yoke	4265-634	4265-634	4265-612	4265-614	4265-614
E – Shift Handle	4265-633	4265-633	4265-613	4265-613	4265-613
F – Operating Shaft	4265-632	4265-632	4265-616	4265-615	4265-615
G – Lock Washer	4265-631	4265-631	4265-621	4265-622	4265-622
H – Lock Nut	4265-629	4265-629	4265-624	4265-623	4265-623
J – Drive Shaft Key	4273-921	4273-921	4273-409	4273-132	4273-132
K – Hydraulic Hose Assy.	4265-635	4265-635	4265-635	4265-617	4265-617

☆ 3.15 diameter pilot bearing.

◆ 3.94 diameter pilot bearing.

Note: In addition to parts listed in chart above, all kits include (2) woodruff keys, P/N 4273-507, (2) lube fittings, P/N 4400-128, and (1) zerk fitting, P/N K44.

CLUTCH INSTALLATION INSTRUCTIONS

1) Before assembling the clutch onto the Durst pump drive, position the pump drive with the input facing up. Note: The clutch housing and clutch shaft must be in place and secured (see pages 28-29).

2) Install the operating shaft into the clutch housing and shift yoke. The shift handle can be mounted on either side of the operating shaft. Tighten bolt according to Table 1 (see page 33).

Tip: Applying a light coat of oil will allow the shaft to slide into place easier.

3) Slide the shift yoke out of place and set the 4273-507 woodruffs keys into the slot on the operating shaft.

4) Move the shift yoke into place, over the woodruff keys. Shift yoke MUST be centered on the operating shaft. Tighten bolts according to Table 1 (page 33).

5) Position the clutch over the clutch housing, and install the grease hose to the clutch assembly grease port.

6) Carefully lower the clutch onto the clutch shaft and into the clutch housing. Using the shift handle, align the shift yoke with the mating tabs on the clutch assembly.

7) With the clutch installed press in the drive shaft key.

8) Place the lock washer onto the clutch shaft so that the alignment tab is setting in the clutch keyway.

9) Thread the lock nut onto the clutch shaft and tighten to 30 ft.-lbs. To tighten nut, turn an additional:

A) For SP214 and SP114 clutches: 150-180 Degrees.

B) For SP211 clutch: 120-150 Degrees.

C) For C111 and C110 clutches: 60-90 Degrees.

10) Fold over the two edges of the lock washer to the flats of the lock nut.

11) Press on support bearing to the end of the clutch shaft.

CAUTION Do not use excessive force when pressing on the support bearing, as this could damage the internal gearbox bearings and cause premature failure.

GENERAL INFORMATION

TOOLS NEEDED

- ✓ Sockets: 3/4", 5/8", 15/16", 1-1/8", 2-3/8"
- ✓ Allen Wrench: 3/8", 1/2"
- ✓ Eye Bolts: 5/8", 3/4"
- ✓ Gear Pullers (5.625" diameter min.)
- ✓ Scraper Blade
- ✓ Loctite 587, 609 or equivalent
- ✓ Wooden Mallet
- ✓ Expansion Plug Remover
- ✓ Snap Ring Pliers
- ✓ Torque Wrench
- ✓ Large Flat Head Punch
- ✓ Adjustable Open-end Wrench
- ✓ Large Screw Driver
- ✓ Seal Driver

DEFINITIONS

Warning: Means that there is a possibility of personal injury to yourself or to others.

Caution: Means that there is a possibility of damaging the gearbox or engine it is attached to.

Note: Provides general information.

Tip: Provides information that can help properly complete a specific procedure.

SAE: Society of Automotive Engineers. This group defines standards in the automotive industry to allow for interchangeability between engine and component manufacturers.

Iso-Lube: Ports located in Terrell pump pads to provide adequate oil lubrication to the pump splines.

TIR: Total Indicator Reading. This is a measurement to determine endplay on a rotating element.

Increaser Ratio: When the output gears/shafts are turning faster than the input shaft.

Decreaser Ratio: When the output gears/shafts are turning slower than the input shaft.

TABLE 1

Bolt Tightening Torques		
	Torque (ft-lb)	
Size	Gr. 5	Gr. 8
3/8-16	30	45
7/16-14	50	70
1/2-13	75	105
5/8-11	150	210
3/4-10	270	375

Plug Tightening Torques	
Size	Torque (ft-lb)
Fill, Drain & Vent Plugs	50

DURST PUMP DRIVE WARRANTY

WARRANTIES & LIMITATIONS OF LIABILITY. (a) Seller warrants to Buyer that the goods will conform to the following warranty. The goods will be commercially free from defects in materials and workmanship under normal use for a period of 1 year from the date of shipment of the goods by Seller and will conform at the date of shipment to applicable specifications, drawings and blueprints, except for departures therefrom with written approval of Buyer; provided that work performed by Seller upon blanks and other materials furnished by Buyer is excluded from this warranty. Seller shall have no liability to Buyer for cost of blanks furnished by Buyer which are damaged or spoiled during heat treat or machining operations.

(b) In the case of drives, gears and reducers manufactured by Seller, Seller warrants only that such products, when shipped, shall be capable of delivering the service rating as indicated in Seller's written documents, including quotations and catalogs as noted on such products, providing such equipment is properly installed and maintained, correctly lubricated, operating under normal conditions with competent supervision, and within the load limits for which it was sold, and provided further that the equipment is free from critical speed, tortional or other type vibration, no matter how induced.

(c) If any model or sample was provided to the Buyer, it was used merely to illustrate the general type and quality of goods and not to warrant that goods shipped would be of that type or quality.

(d) UNLESS AUTHORIZED IN WRITING BY A CORPORATE OFFICER OR VICE PRESIDENT, NO AGENT, EMPLOYEE OR REPRESENTATIVE OF SELLER HAS ANY AUTHORITY TO BIND SELLER TO ANY AFFIRMATION, REPRESENTATION OR WARRANTY CONCERNING THE GOODS SOLD UNDER THE SALES CONTRACT AND ANY SUCH AFFIRMATION, REPRESENTATION OR WARRANTY HAS NOT FORMED A PART OF THE BASIS OF THE BARGAIN AND SHALL BE UNENFORCEABLE.

(e) Seller's sole obligation under the foregoing warranties is limited to either, at Seller's option, replacing or repairing defective goods (or defective parts thereof). This warranty does not cover the cost of installation of the new or repaired goods or parts. Replacement goods or parts are warranted for the remainder of the warranty period applicable to the goods originally supplied by Seller. All claims for allegedly defective goods must be made within 10 days after Buyer learns of such alleged defects. All claims not made in writing and received by Seller within such 10 day period shall be deemed waived. Buyer shall return a sample of the alleged defective part for Seller's inspection and no other goods shall be returned to Seller within Seller's written consent. This warranty shall not extend to goods subjected to misuse, abuse, neglect, accident or improper installation or maintenance, incorrect lubrication, or goods which have been altered or repaired by anyone other than Seller or its authorized representative.

(f) THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND/OR ANY OTHER TYPE, WHETHER EXPRESS OR IMPLIED.

(g) Products not manufactured and work not performed by Seller are warranted only to the extent and in the manner that the same are warranted to Seller by Seller's vendors, and then only to the extent that Seller is reasonably able to enforce such warranty. In enforcing such warranty, it is understood Seller shall have no obligation to initiate litigation unless Buyer undertakes to pay all costs and expenses therefore, including but not limited to Attorney's fees, and indemnifies Seller against any liability to Seller's vendors arising out of such litigation;

(h) THE FOREGOING IS SELLER'S ONLY OBLIGATION AND BUYER'S EXCLUSIVE REMEDY FOR BREACH OF WARRANTY. BUYER'S FAILURE TO SUBMIT A CLAIM AS PROVIDED ABOVE SHALL SPECIFICALLY WAIVE ALL CLAIMS FOR DAMAGES OR OTHER RELIEF INCLUDING BUT NOT LIMITED TO CLAIMS BASED ON LATENT DEFECTS. IN NO EVENT SHALL BUYER BE ENTITLED TO INCIDENTAL, CONSEQUENTIAL, CONTINGENT, OR SPECIAL DAMAGES, NOR SHALL SELLER'S LIABILITY EXCEED THE PURCHASE PRICE OF THE GOODS. EVEN IF THE REPAIR OR REPLACEMENT REMEDY SHALL BE DEEMED TO HAVE FAILED OF ITS ESSENTIAL PURPOSE UNDER SECTION 2-719 OF THE UNIFORM COMMERCIAL CODE, SELLER SHALL HAVE NO LIABILITY TO BUYER FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES, SUCH AS LOST PROFITS, LOST REVENUE, DAMAGE TO OTHER EQUIPMENT OR LIABILITY OR INJURY TO A THIRD PARTY. ANY ACTION ARISING HEREUNDER OR RELATED HERETO MUST BE COMMENCED WITHIN ONE (1) YEAR AFTER THE CAUSE OF ACTION OCCURS, OR IT SHALL BE BARRED, NOTWITHSTANDING ANY STATUTORY PERIOD OF LIMITATIONS TO THE CONTRARY; AND

(i) In the event of the resale of any of the goods, in whatever form, Buyer will include the following language in a conspicuous place and in a conspicuous manner in a written agreement covering such resale: "THE MANUFACTURER MAKES NO WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, BY OPERATION OF LAW OR OTHERWISE, AS TO THE MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OF THE GOODS SOLD HEREUNDER. BUYER ACKNOWLEDGES THAT IT ALONE HAS DETERMINED THAT THE GOODS PURCHASED HEREUNDER WILL SUITABLY MEET THE REQUIREMENTS OR THEIR INTENDED USE. IN NO EVENT WILL MANUFACTURER BE LIABLE FOR CONSEQUENTIAL, INCIDENTAL OR OTHER DAMAGES."

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P/N 012530 (June, 2005)

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SAUER SUNDSTRAND

Series 90



Axial Piston Pumps and Motors Service Manual

1. Introduction

1.1 Use of This Manual

This manual includes information for the normal operation, maintenance, and servicing of the Series 90 family of hydrostatic pumps and motors. The manual includes the description of the units and their individual components, troubleshooting information, adjustment instructions, and minor repair procedures. Unit warranty obligations should not be affected if maintenance, adjustment, and minor repairs are performed according to the procedures described in this manual.

Many service and adjustment activities can be performed without removing the unit from the vehicle or machine. However, adequate access to the unit must be available, and the unit must be thoroughly cleaned before beginning maintenance, adjustment, or repair activities. Since dirt and contamination are the greatest enemies of any type of hydraulic equipment, cleanliness requirements must be strictly adhered to. This is especially important when changing the system filter and during adjustment and repair activities.

A worldwide network of Sauer-Sundstrand Authorized Service Centers is available should repairs be needed. Contact any Sauer-Sundstrand Authorized Service Center for details. A list of all Service Centers can be found in bulletin BLN-2-40527, or in brochure SAW (Ident. No. 698266).

1.2 Safety Precautions

Observe the following safety precautions when using and servicing hydrostatic products.

Loss of Hydrostatic Braking Ability

WARNING
When Series 90 units are used in vehicular hydrostatic drive systems, the loss of hydrostatic drive line power in any mode of operation (e.g. acceleration, deceleration or "neutral" mode) may cause a loss of hydrostatic braking capacity. A braking system which is independent of the hydrostatic transmission must, therefore, be provided which is adequate to stop and hold the system should the condition develop.

Disable Work Function

WARNING
Certain service procedures may require the vehicle/machine to be disabled (wheels raised off the ground, work function disconnected, etc.) while performing them in order to prevent injury to the technician and bystanders.

Fluid Under High Pressure

WARNING
Use caution when dealing with hydraulic fluid under pressure. Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury. This fluid may also be hot enough to burn. Serious infection or reactions can develop if proper medical treatment is not administered immediately.

Flammable Cleaning Solvents

WARNING
Some cleaning solvents are flammable. To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

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2. Functional Description

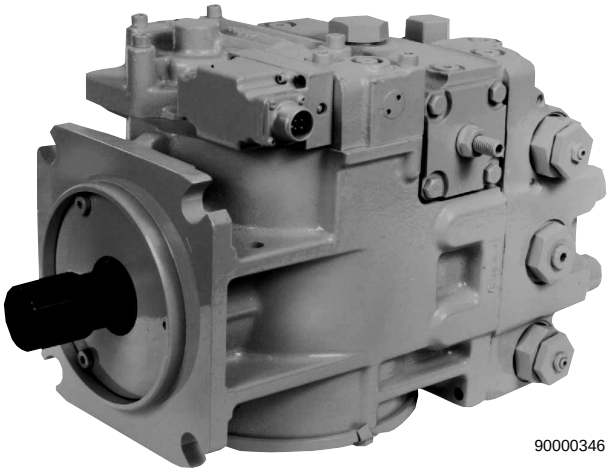
This section describes the operation of pumps, motors, and their various serviceable features. It is a useful reference for readers unfamiliar with the functioning of a specific system.

2.1 General Description and Cross Sectional Views

2.1.1 Variable Displacement Pumps

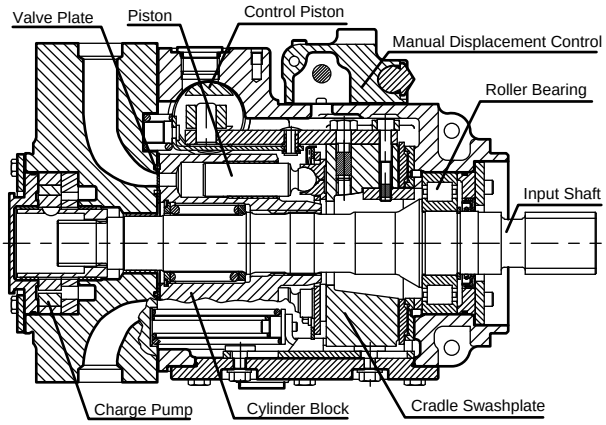
The Variable Displacement Pump (PV) is designed to convert an input torque into hydraulic power. The input shaft turns the pump cylinder which contains a ring of pistons. The pistons run against a tilted plate, called the swashplate. This causes the pistons to compress the hydraulic fluid which imparts the input energy into the hydraulic fluid. The high pressure fluid is then ported out to provide power to a remote function.

The swashplate angle can be varied by the control piston. Altering the swashplate angle varies the displacement of fluid in a given revolution of the input shaft. A larger angle causes greater displacement which yields greater output torque for a given input. A smaller angle reduces the displacement per revolution and yields greater speed for a given input.



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Series 90 Variable Displacement Pump (PV)

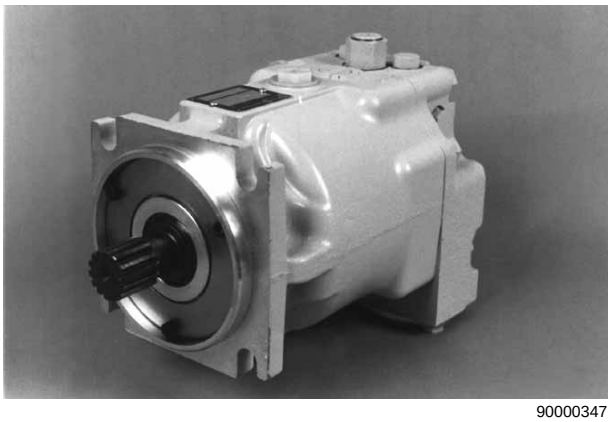


90000189

Series 90 PV Cross Section

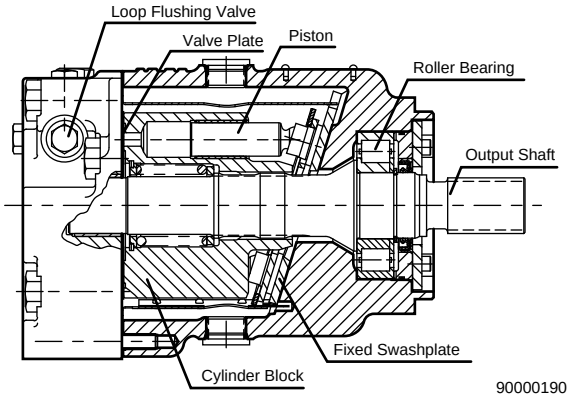
2.1.2 Fixed Displacement Motor

The Fixed Displacement Motor (MF) is designed to convert an input of hydraulic power into an output torque. It operates in the reverse manner of the pump. The high pressure hydraulic fluid enters through the input port. The fluid pressure builds behind the pistons causing them to move down the swashplate (the path of least resistance). As the piston returns up the swashplate again, the fluid is allowed to exit through the exit port. The spinning pistons are housed in a cylinder which is connected to the output shaft. The output torque can be applied to a mechanical function.



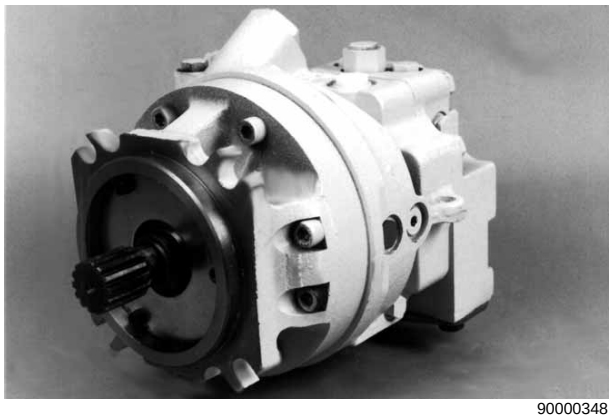
90000347

Series 90 Fixed Displacement Motor (MF)



Series 90 MF Cross Section

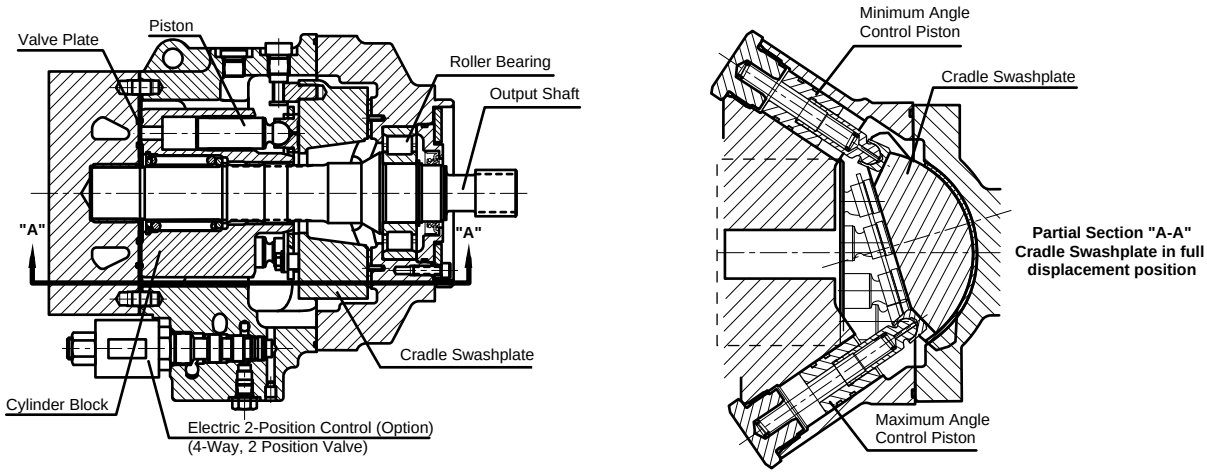
In the Fixed Displacement Motor the "swashplate" is fixed, so any variation in motor speed and torque must be made by the input mechanism, i.e. the pump.



Series 90 Variable Displacement Motor (MV)

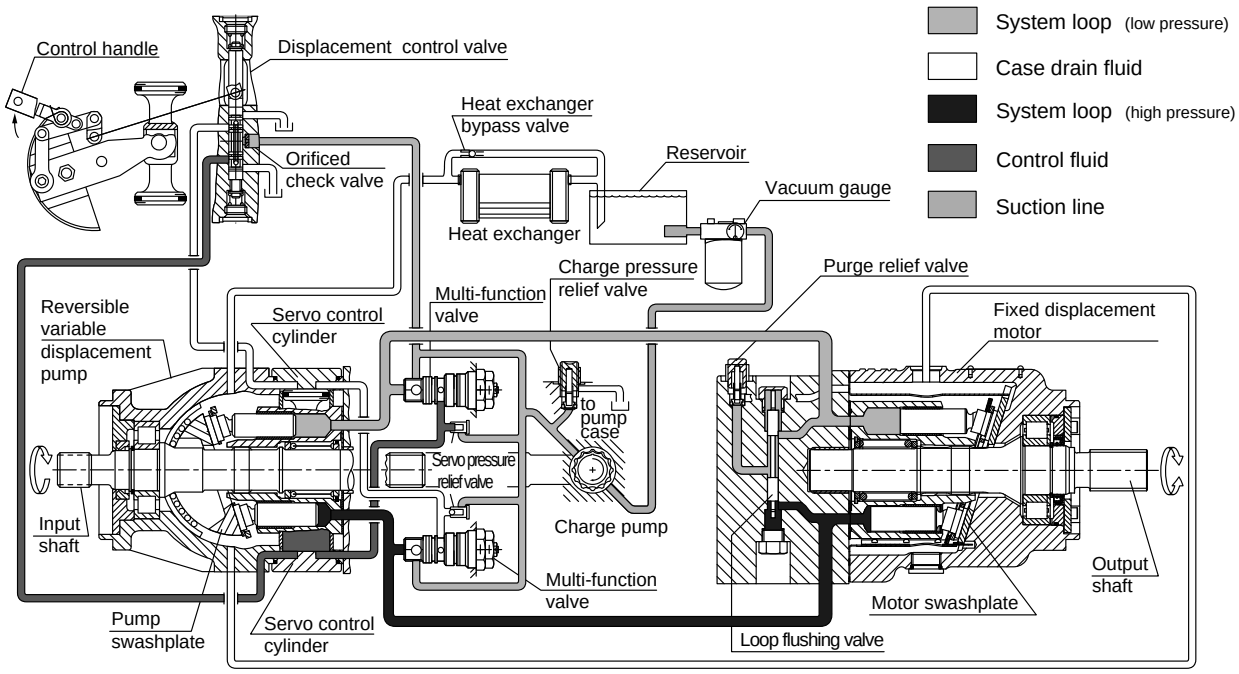
2.1.3 Variable Displacement Motor

The Variable Displacement Motor (MV) operates in the same manner as the fixed motor. However, its swashplate is not fixed; it can be switched between minimum and maximum angle to amplify torque or speed like the Variable Displacement Pump.



Series 90 MV Cross Section

2.2 The System Circuit



90000800

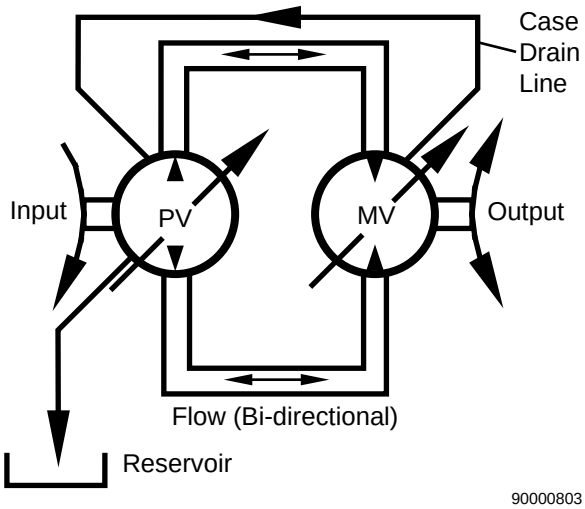
Circuit Diagram for Series 90 PV and Series 90 MF

The Basic Closed Circuit

The main ports of the pump are connected by hydraulic lines to the main ports of the motor. Fluid flows, in either direction, from the pump to the motor then back to the pump in this closed circuit. Either of the hydraulic lines can be under high pressure. The position of the pump swashplate determines which line is high pressure as well as the direction of fluid flow.

Case Drain and Heat Exchanger

The pump and motor require case drain lines to remove hot fluid from the system. The motor should be drained from its topmost drain port to ensure the case remains full of fluid. The motor case drain can then be connected to the lower drain port on the pump housing and out the top most port. A heat exchanger, with a bypass valve, is required to cool the case drain fluid before it returns to the reservoir.



90000803

Basic Closed Circuit

2.3 Common Features of Pumps and Motors

2.3.1 End Caps and Shafts

Series 90 pumps and motors can be supplied with a variety of end caps and shafts to allow for almost any configuration. For pumps, end caps are available with system ports on either side ("side ports") or both ports on one side ("twin ports"). Motors have end caps with ports on the face of the end cap ("axial ports") or both ports on one side ("twin ports"). See the Series 90 Technical Information manuals (BLN-10029 and BLN-10030) or the Series 90 Price Book (BLN-2-40588) for information on available options. **Removing the end cap will void the warranty on a Series 90 pump or motor.**

2.3.2 Speed Sensors

An optional speed sensor can be installed on Series 90 pumps and motors to provide unit speed information. The sensor reads a magnetic ring wrapped about the unit's cylinder. See Sec. 4 to locate the speed sensor port. See Sec. 8.4 and 9.6 to adjust and install the sensor.



90000810

Speed Sensor

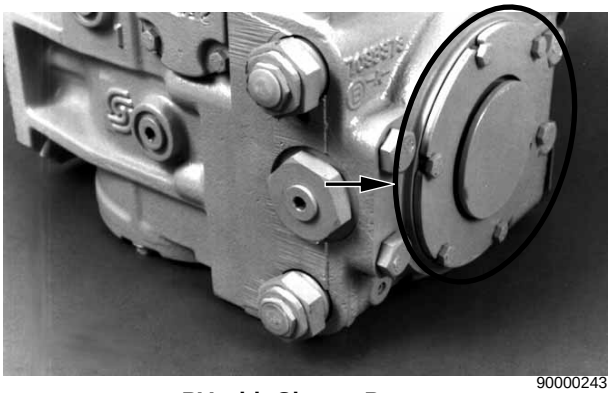
2.4 Pump Features

2.4.1 Charge Pump

The charge pump is necessary to supply cool fluid to the system, to maintain positive pressure in the main system loop, to provide pressure to operate the control system, and to make up for internal leakage. Charge pressure must be at its specified pressure under all conditions of driving and braking to prevent damage to the transmission.

The charge pump is a fixed-displacement, gerotor type pump installed in the variable displacement pump and driven off the main pump shaft. Charge pressure is limited by a relief valve (Sec. 2.4.2).

The standard charge pump will be satisfactory for most applications. However, if the charge pump sizes available for the given main pump size are not adequate, a gear pump may be mounted to the auxiliary mounting pad (Sec. 2.4.8) and supply the required additional charge flow. For repairs to the charge pump see Sec. 9.2.4.



90000243

PV with Charge Pump



90000349

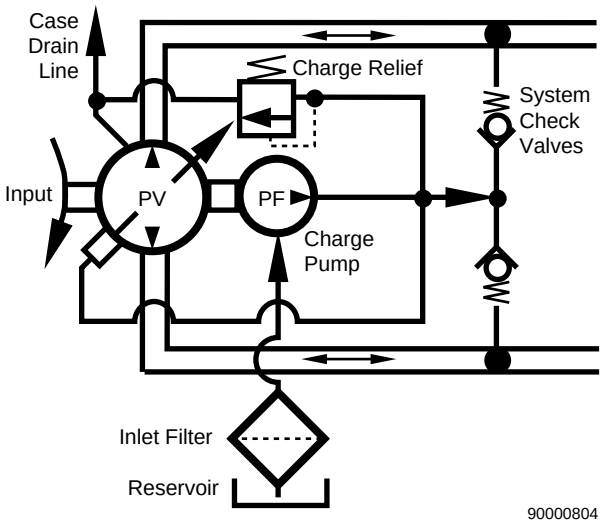
Charge Pump Components

2.4.2 Charge Relief Valve

The charge relief valve on the pump serves to maintain charge pressure at a designated level. A direct-acting poppet valve relieves charge pressure whenever it surpasses a certain level. This level is nominally set referencing case pressure at 1775 rpm. This nominal setting assumes the pump is in neutral (zero flow); in forward or reverse charge pressure will be lower. The charge relief valve setting is specified on the model code of the pump (Sec. 8.1.1). For repairs to the pump charge relief valve see Sec. 9.2.3.

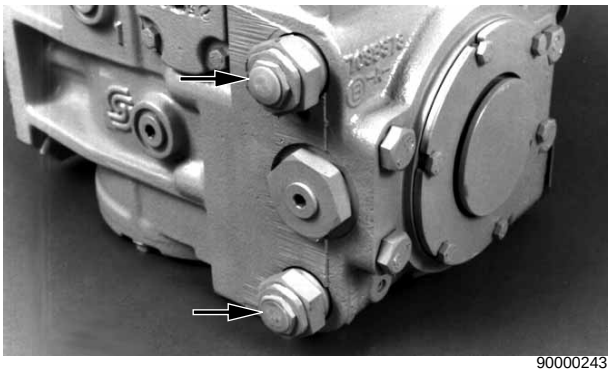
2.4.3 System Check Valves

The system check valves allow pressurized flow from the charge pump to enter the low pressure side of the loop whenever system pressure dips below a certain level. This is needed as the pump will generally lose system pressure due to leakage and other factors. Since the pump can operate in either direction, two system check valves are used to direct the charge supply into the low pressure lines. The system check valves are poppet valves located in the multi-function valve assembly (next section).



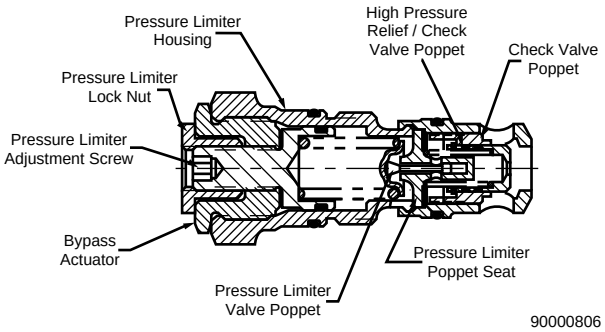
90000804

Pump Charge System



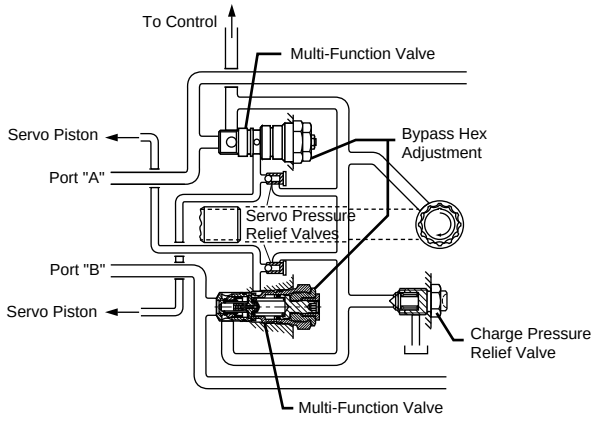
90000243

PV showing location of Multi-Function Valves



90000806

Cross Section of Multi-Function Valve



90000801

Circuit Diagram Showing Pressure Control Mechanisms

2.4.4 Multi-Function Valves

All Series 90 pumps include two multi-function valves. The multi-function valve incorporates the system check valve, the pressure limiter valve, the high pressure relief valve, and the bypass valve in a replaceable cartridge. These functions are described separately. There are two multi-function valve cartridges in each Series 90 pump to handle functions in either direction. See Secs. 8.1.2 and 9.2.1 for adjustments and repairs.

NOTE: Some multi-function valves do not include a pressure limiter valve.

2.4.5 Pressure Limiter and High Pressure Relief Valves

Series 90 pumps are designed with a sequenced pressure limiting system and high pressure relief valves. When the preset pressure is reached, the pressure limiter system acts to rapidly destroke the pump so as to limit the system pressure. For unusually rapid load application, the high pressure relief valve acts to immediately limit system pressure by cross-porting system flow to the low pressure side of the loop. The pressure limiter valve acts as the pilot for the high pressure relief valve spool. The high pressure relief valve is sequenced to operate at approximately 35 bar (500 psi) above the level that initiates the pressure limiter valve.

Both the pressure limiter sensing valves and relief valves are built into the multi-function valves (see above).

NOTE: For some applications, such as dual path vehicles, the pressure limiter function may be defeated so that only the high pressure relief valve function remains.

2.4.6 Bypass Valves

The bypass valves ("tow") can be operated when it is desired to move the vehicle or mechanical function when the pump is not running. The valve is opened by manually resetting the valve position (Sec. 8.1.3).

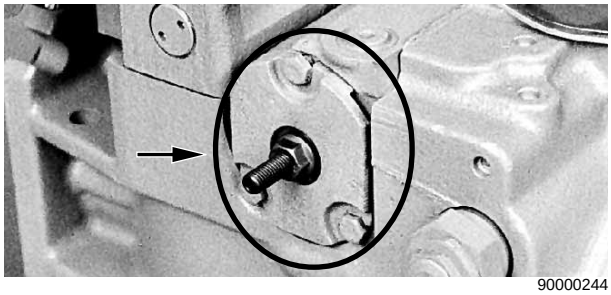
The bypass valves are built into the multi-function valves (see above).

2.4.7 Displacement Limiters

Series 90 pumps sizes 042 - 250 are designed for optional mechanical displacement (stroke) limiters. The maximum displacement of the pump can be limited in either direction.

The setting can be set as low as 0° in either direction.

For instructions on adjustment see Sec. 8.1.5.

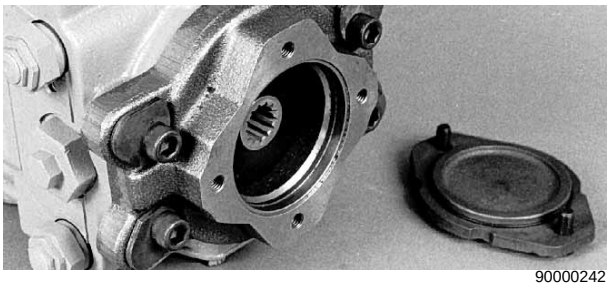


90000244

PV with Displacement Limiters

2.4.8 Auxiliary Mounting Pads

Auxiliary mounting pads are available on all Series 90 pumps. SAE A through E and H mounts are available (availability varies by pump size). This pad is used for mounting auxiliary hydraulic pumps and for mounting additional Series 90 pumps to make tandem pumps. The pads allow for full through-torque capability.



90000242

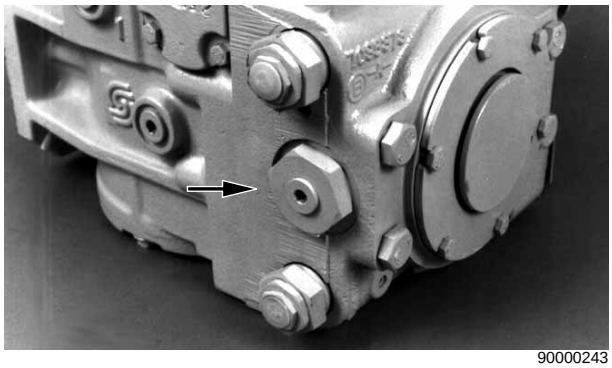
PV with Auxiliary Mounting Pad

2.4.9 Filtration Options

All Series 90 pumps are available with provisions for either suction or charge pressure filtration (integral or remote mounted) to filter the fluid entering the charge circuit. (See Sec. 6 for more information.)

Suction Filtration

The suction filter is placed in the circuit between the reservoir and the inlet to the charge pump. When suction filtration is used, a reducer fitting is placed in the charge pressure gauge port (M3). Filtration devices of this type are provided by the user.



90000243

PV with Suction Filtration
(No filtration device attached)

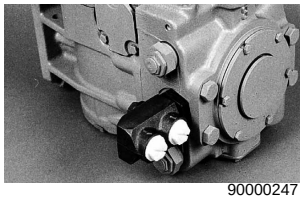
Charge Pressure Filtration

The pressure filter may be integrally mounted directly on the pump or a filter may be remotely mounted for ease of servicing.

A 200 mesh screen, located in the reservoir or the charge inlet line, is recommended when using this filtration option. A non-bypass filter is preferred on all types of filtration.

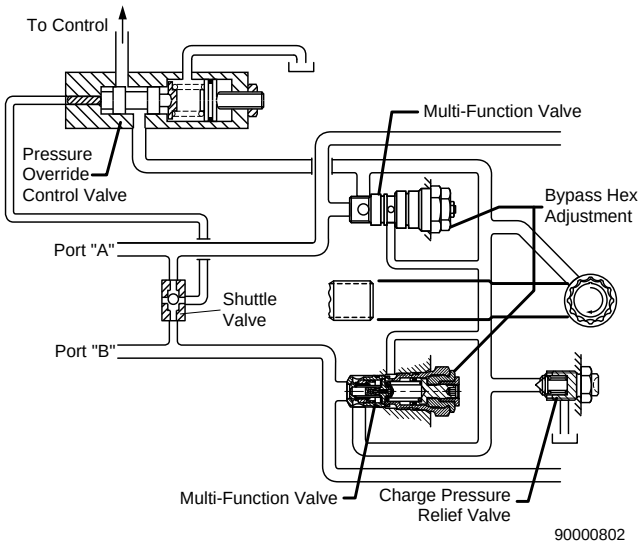


90000246



90000247

PV with Integral Charge Pressure Filtration (left)
PV with Remote Charge Pressure Filtration (right, filter attached remotely)



Pressure Override - 180 Frame Size Only

2.4.10 Pressure Override (POR) - 180 Frame Size Only

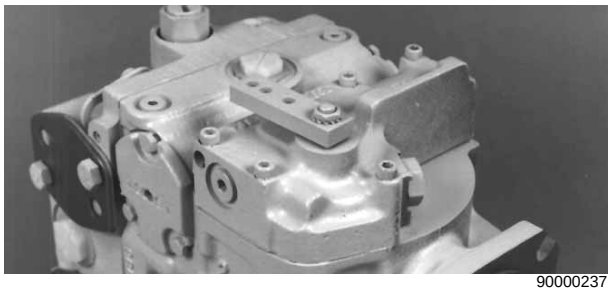
The pressure override valve (POR) modulates the control pressure to the displacement control to maintain a pump displacement which will produce a system pressure level less than or equal to the POR setting. For unusually rapid load application, the high pressure relief valve function of the multifunction valves is available to also limit the pressure level.

The pressure override consists of a three-way normally open valve which operates in series with the pump displacement control. Control supply pressure is normally ported through the pressure override valve to the displacement control valve for controlling the pump's displacement. If the system demands a pressure above the override setting, the POR valve will override the control by reducing the control pressure supplied to the displacement control. As the control pressure reduces, the internal forces tending to rotate the swashplate overcome the force of the servo pistons and allow the pump's displacement to decrease.

2.5 Pump Control Options

2.5.1 Manual Displacement Control (MDC)

The manual displacement control converts a mechanical input signal to a hydraulic signal using a spring-centered four-way servo valve. This valve ports hydraulic pressure to either side of a dual-acting servo piston. The servo piston rotates the cradle swashplate through an angular rotation of ±17°, thus varying the pump's displacement from full displacement in one direction to full displacement in the opposite direction. The MDC is designed so the angular position of the pump swashplate is proportional to the rotation of the control input shaft. For adjustments see 8.2.1; for repairs see 9.3.2, 9.3.8.

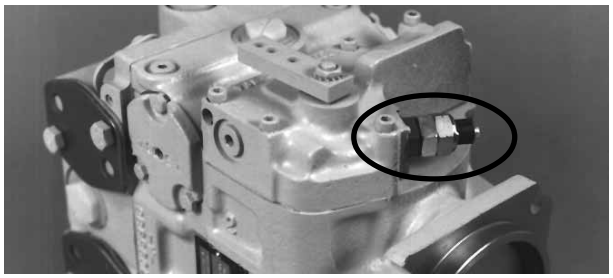


90000237

PV with Manual Displacement Control

Non-Linear MDC

The non-linear manual displacement control (photo in Sec. 8.2.2) operates in the same manner as the regular MDC except that it is designed so the change in the angular position of the pump swashplate *progressively* increases as the control input shaft is rotated toward its maximum displacement position. For adjustments see Sec. 8.2.2; for repairs see 9.3.2.



90000239

PV with Manual Displacement Control and Neutral Start Switch

Solenoid Override Valve

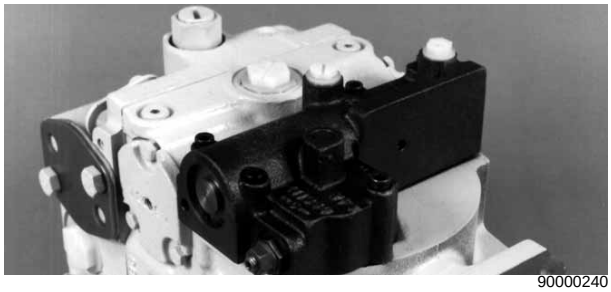
A solenoid override valve option (not shown here) is available for MDC. This safety feature will return the swashplate to zero displacement position when activated. The valve may be set in either a normally open or normally closed mode. For repairs see 9.3.3, 9.3.4.

Neutral Start Switch (NSS)

The neutral start switch is an optional feature available with MDC. When connected properly with the vehicle's electrical system, the neutral start switch ensures that the prime mover can be started only when the control is in a neutral position. For adjustments see Sec. 8.2.3.

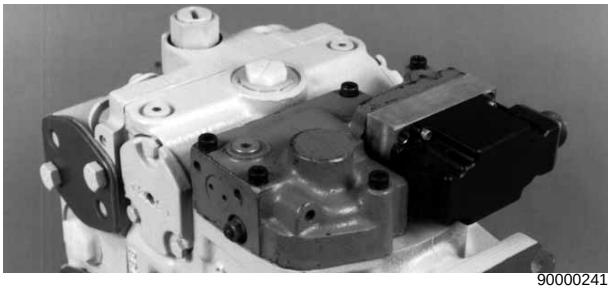
2.5.2 Hydraulic Displacement Control (HDC)

The hydraulic displacement control uses a hydraulic input signal to operate a spring-centered four-way servo valve. This valve ports hydraulic pressure to either side of a dual-acting servo piston. The servo piston rotates the cradle swashplate through an angular rotation of ±17°, thus varying the pump's displacement from full displacement in one direction to full displacement in the opposite direction. The HDC is designed so the angular position of the pump swashplate is proportional to input pressure. For adjustments see 8.2.4; for repairs see 9.3.5, 9.3.8.



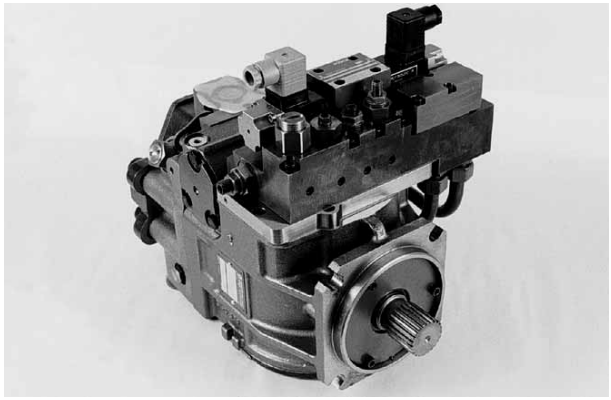
90000240

PV with Hydraulic Displacement Control



90000241

PV with Electric Displacement Control



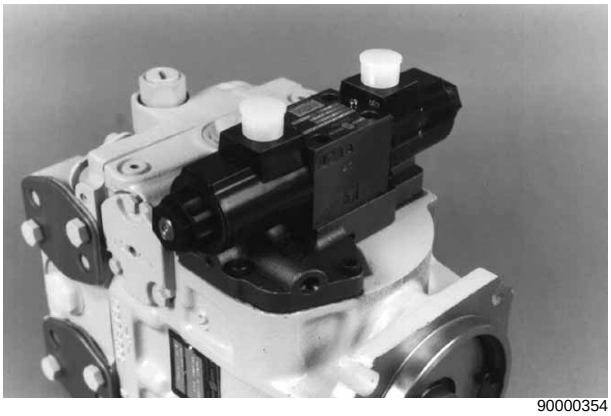
90000353

PV with Automotive Control (AC)



F000645

PV with Automotive Control Type II (AC II)



90000354

PV with 3-Position (FNR) Electric Control

2.5.3 Electric Displacement Control (EDC)

The electric displacement control is similar to the hydraulic displacement control with the input signal pressure controlled by a pressure control pilot (PCP) valve. The PCP valve converts a DC electrical input signal to a hydraulic signal which operates a spring-centered four-way servo valve. This valve ports hydraulic pressure to either side of a dual-acting servo piston. The servo piston rotates the cradle swashplate through an angular rotation of ±17°, thus varying the pump's displacement from full displacement in one direction to full displacement in the opposite direction. The control is designed so the angular position of the swashplate is proportional to the EDC input. For neutral adjustment see Sec. 8.2.4; for repairs see Sec. 9.3.5, 9.3.6, and 9.3.8.

2.5.4 Automotive Control (AC and AC II)

Automotive Control (AC) allows a vehicle to be driven in a manner similar to an automobile with an automatic transmission.

The AC control includes a three-position electric control to provide direction control.

The AC II control can be combined with a manual, hydraulic, or electric displacement control to provide both direction control and control over maximum vehicle speed. It may also be combined with a 3-position electric control to provide direction control.

2.5.5 3-Position (FNR) Electric Control

This control utilizes a 12 or 24 VDC electrically operated spool valve to port pressure to either side of the pump displacement control piston. Energizing one of the solenoids will cause the pump to go to its maximum displacement in the corresponding direction.

All functions of the three-position (FNR) electric control are preset at the factory. For repairs, see Sec. 9.3.7.

2.6 Motor Features

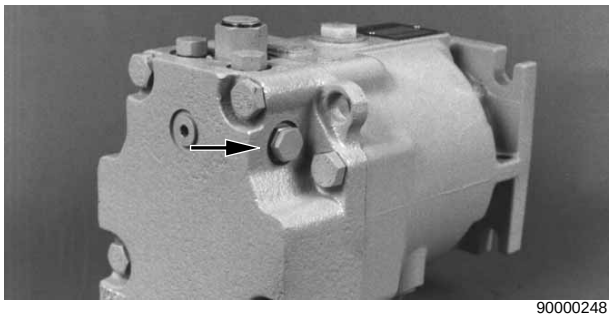
2.6.1 Motor Loop Flushing Valve and Charge Relief Valve

All Series 90 motors are designed to accommodate a loop flushing valve. The loop flushing valve is used in installations which require additional fluid to be removed from the main hydraulic circuit because of transmission cooling requirements, or unusual circuits requiring additional loop flushing to remove excessive contamination in the high pressure circuit.

A shuttle valve and charge relief valve are installed in the motor end cap to provide the loop flushing function. The shuttle valve provides a circuit between the low pressure side of the closed loop and the charge relief valve in the motor end cap.

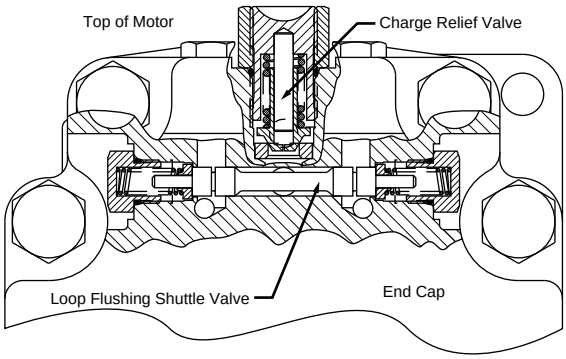
The motor charge relief valve regulates the charge pressure level only when there is a pressure differential in the main loop. The shuttle valve is spring centered to the closed position so that no high pressure fluid is lost from the circuit when reversing pressures.

For charge relief valve adjustment see Sec. 8.3.1, for repairs see Sec. 9.4.1.



90000248

MF showing location of Loop Flushing Valve



90000238

Motor Charge Relief Valve and Loop Flushing Shuttle Valve

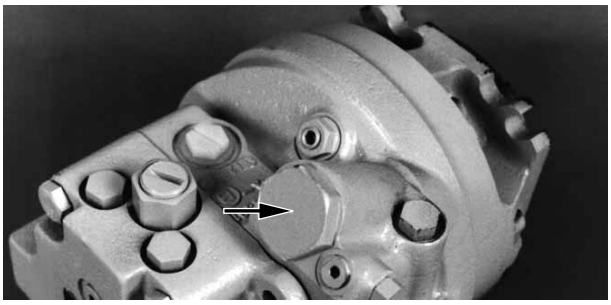
2.6.2 Variable Motor Displacement Limiters

All Series 90 variable motors include mechanical displacement (stroke) limiters. Both the maximum and minimum displacement of the motor can be limited.

The range of the settings is as follows:

	055 MV Frame	075 MV Frame
Minimum Displacement	19 - 40 cm^3 1.2 - 2.4 in^3	26 - 54 cm^3 1.6 - 3.3 in^3
Maximum Displacement	65 - 100%	65 - 100%

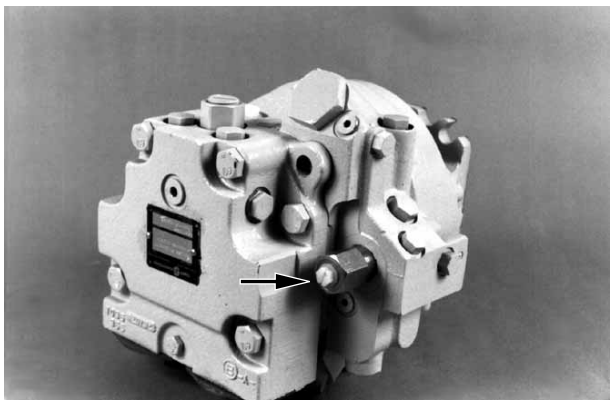
For adjustments see Sec. 8.3.2.



90000352

MV Maximum Displacement Limiter (Minimum Displacement Limiters on Opposite Side)

2.7 Variable Motor Controls



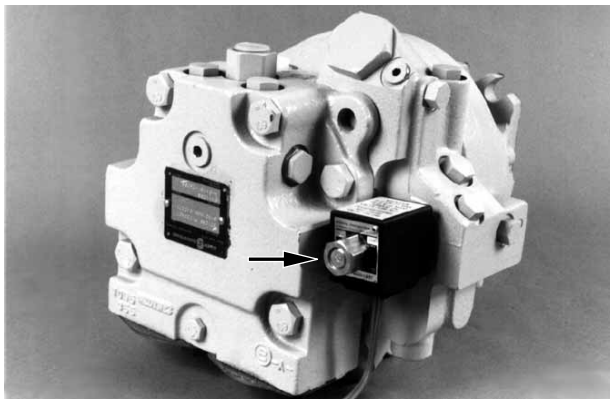
90000350

MV with Hydraulic 2-Position Control

2.7.1 Hydraulic 2-Position Control

This control utilizes a hydraulically operated three-way hydraulic valve to port system pressure to either of the motor displacement control pistons. The motor is normally held at its maximum displacement. Supplying pilot hydraulic pressure to the valve will cause the motor to go to its minimum displacement.

All functions of the hydraulic two-position control are preset at the factory. For repairs see Sec. 9.5.2 and 9.5.4.



90000351

MV with Electric 2-Position Control

2.7.2 Electric 2-Position Control

This control utilizes an electric solenoid operated three-way hydraulic valve to port system pressure to either of the motor displacement control pistons. The motor is normally held at its maximum displacement. Energizing the solenoid will cause the motor to go to its minimum displacement.

All functions of the electric two-position control are preset at the factory. For repairs see Sec. 9.5.1 and 9.5.4.

3. Technical Specifications

3.1 General Specifications

Design

Variable Pumps and Motors: Axial piston pump of variable displacement, cradle swashplate design.

Fixed Motors: Axial piston motor with fixed displacement, fixed swashplate design.

Type of Mounting (per SAE J744)

SAE flange, Size "B" mounting pad, 2 bolts
SAE flange, Size "C" mounting pad, 4 bolts
Cartridge flange, 2 bolts (for motor only)

Port Connections (See Sec. 4.2 for exact specs.)

Main pressure ports: SAE flange, Code 62
Remaining ports: SAE straight thread O-ring boss

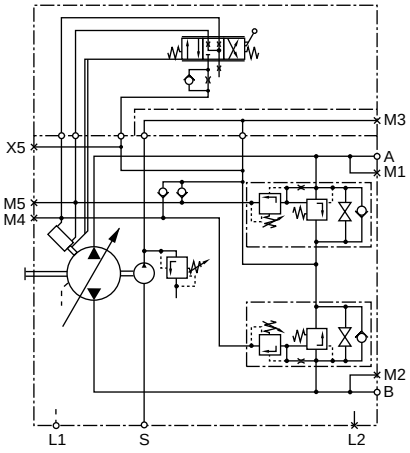
Direction of Rotation

Clockwise or counterclockwise (motors are bidirectional)

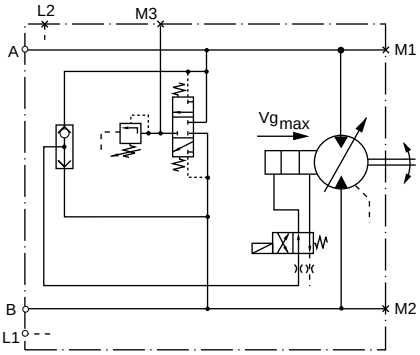
Installation Position

Installation position is discretionary. The housing must always be filled with hydraulic fluid, so note position of drain ports.

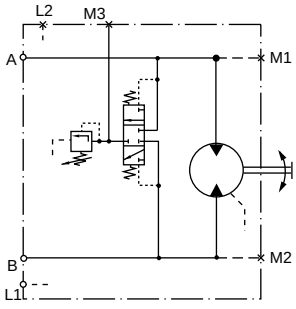
3.2 Circuit Diagrams



PV with charge pump and manual displacement control



MV with electrohydraulic two-position control



MF

90000811
90000812
90000813

3.3 Hydraulic Parameters

System Pressure Range

Maximum Pressure	480 bar	[6960 psi]
Rated Pressure	420 bar	[6000 psi]

Charge Pump Inlet Vacuum (on pumps only)

Maximum Vacuum, Continuous	0.7 bar abs	[10 in Hg]
Maximum Vacuum, Cold Start	0.2 bar abs	[25 in Hg]

Case Pressure

Maximum, Continuous	3 bar	[44 psi]
Maximum, Intermittent or Cold Start	5 bar	[73 psi]

Hydraulic Fluid

Refer to SAS publication BLN 9887 or Publication SDF (Id. No. 697581). Also refer to publication ATI-E 9101 for information relating to biodegradable fluids

Temperature Range[1]

Minimum, Intermittent or Cold Start	-40°C	[-40°F]
Maximum, Continuous	104°C	[220°F]
Maximum, Intermittent	115°C	[240°F]

Fluid Viscosity Limits

Minimum, Intermittent	5 mm^2/s	[42 SUS]
Minimum, Continuous	6.4 mm^2/s	[47 SUS]
Minimum, Optimum	13 mm^2/s	[70 SUS]
Maximum, Continuous	110 mm^2/s	[510 SUS]
Maximum, Intermittent or Cold Start	1600 mm^2/s	[7400 SUS]

Filtration

Required cleanliness level: ISO 4406 Class 18/13 or better. Refer to SAS publications BLN 9887 or Publication SDF (Id. No. 697581) and ATI-E 9201.

1. At hottest point in system, normally the case drain port. Temperature and viscosity limits must be met simultaneously.

3.4 Technical Data

Table 1 - Variable Displacement Pumps

	Dimension	030 PV	042 PV	055 PV	075 PV	100 PV	130 PV	180 PV	250 PV
Displacement (maximum)	cm^3 in^3	30.0 1.83	42.0 2.56	55.0 3.35	75.0 4.57	100.0 6.10	130.0 7.93	180.0 10.98	250.0 15.25
Minimum speed	min^{-1} (rpm)	500	500	500	500	500	500	500	500
Rated speed*	min^{-1} (rpm)	4200	4200	3900	3600	3300	3100	2600	2300
Maximum speed*	min^{-1} (rpm)	4600	4600	4250	3950	3650	3400	2850	2500
Max. attainable speed* at max. disp.	min^{-1} (rpm)	5000	5000	4700	4300	4000	3700	3150	2750
Theoretical torque at max. disp.	Nm / bar lbf•in/1000 psi	0.48 290	0.67 380	0.88 530	1.19 730	1.59 970	2.07 1260	2.87 1750	3.97 2433
Weight (Base Unit)	kg lb	28 62	34 75	40 88	49 108	68 150	88 195	136 300	154 340

Table 2 - Fixed and Variable Displacement Motors

		Dimension	030 MF	042 MF	055 MF	075 MF	100 MF	130 MF	055 MV	075 MV
Displacement (maximum)		cm^3 in^3	30.0 1.83	42.0 2.56	55.0 3.35	75.0 4.57	100.0 6.10	130.0 7.93	55.0 3.35	75.0 4.57
Displacement (minimum)		cm^3 in^3	—	—	—	—	—	—	19.0 1.16	26.0 1.59
Rated speed*	at max. disp.	min^{-1} (rpm)	4200	4200	3900	3600	3300	3100	3900	3600
	at min. disp.	min^{-1} (rpm)	—	—	—	—	—	—	4600	4250
Maximum speed*	at max. disp.	min^{-1} (rpm)	4600	4600	4250	3950	3650	3400	4250	3950
	at min. disp.	min^{-1} (rpm)	—	—	—	—	—	—	5100	4700
Max. attainable speed* at max. disp.		min^{-1} (rpm)	5000	5000	4700	4300	4000	3700	4700	4300
Theoretical torque at max. disp.		Nm / bar lbf•in/1000 psi	0.48 290	0.67 380	0.88 530	1.19 730	1.59 970	2.07 1260	0.88 530	1.19 730
Maximum flow at max. disp.		l / min gal / min	138 36.5	193 51	234 62	296 78	365 96	442 117	234 62	296 78
Max. corner power		kW hp	111 149	155 208	187 251	237 318	292 392	354 475	224 300	282 378
Weight (SAE Flange)		kg lb	11 24	15 34	20 45	26 57	34 74	45 99	39 86	44 98
Weight (Cartridge Motor)		kg lb	—	17 37	26 57	33 72	—	—	40 88	46 101

* = Refer to Series 90 Technical Information manual for definitions

4. Pressure Measurement

4.1 Required Tools

The service procedures described in this manual for Series 90 pumps and motors can be performed using common mechanic's tools. Special tools, if required are shown.

Pressure gauges should be calibrated frequently to ensure accuracy. Snubbers are recommended to protect pressure gauges.

4.2 Port Locations and Pressure Gauge Installation

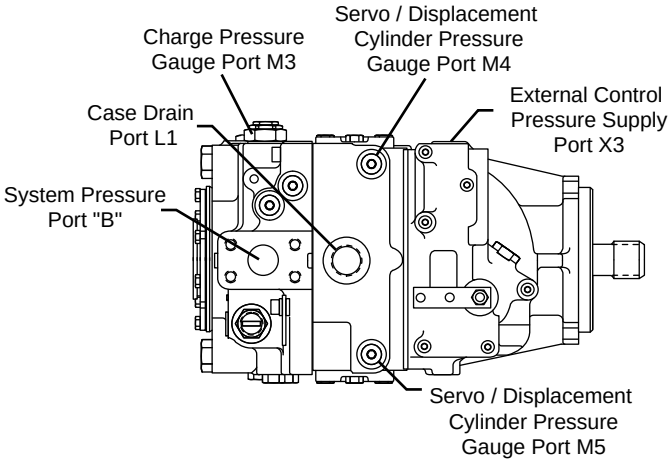
The following sections list the ports for each type of hydraulic unit. The recommended pressure gauge and fitting are also specified.

Outline drawings showing port locations follow the tables.

4.2.1 Variable Pump

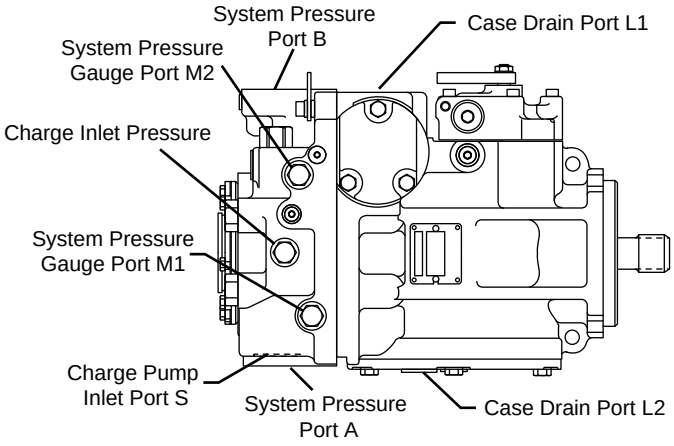
Port	Function	Recommended Gauge Size and Fitting
M1	System Pressure Port "A"	1000 bar or 10 000 psi Gauge 9/16—18 O-Ring Fitting
M2	System Pressure Port "B"	1000 bar or 10 000 psi Gauge 9/16—18 O-Ring Fitting
M3 (M6)	Charge Pressure	50 bar or 1000 psi Gauge 9/16—18 O-Ring Fitting
M4 M5	Servo Pressure	50 bar or 500 psi Gauge 9/16—18 O-Ring Fitting

Port	Function	Recommended Gauge Size and Fitting	
L1 L2	Case Pressure	10 bar or 100 psi Gauge	
		SAE O-Ring Fitting:	
		030, 042	7/8—14
		055, 075, 100	1-1/16—12
		130	1-5/16—12
		180, 250	1-5/8—12
X1 X2	HDC / EDC Pressure	50 bar or 1000 psi Gauge 7/16 — 20 O-Ring Fitting or 9/16 — 18 O-Ring Fitting	
X3	Ext. Control Pressure	50 bar or 1000 psi Gauge 9/16 — 18 O-Ring Fitting	
S	Charge Pump Inlet	Vacuum Gauge, Tee into Inlet Line	
		SAE O-Ring Fitting:	
		030, 042	1-1/16 — 12
		055, 075	1-5/16 — 12
		100, 130, 180	1-5/8 — 12
		250	1-1/2 SAE Split Flange

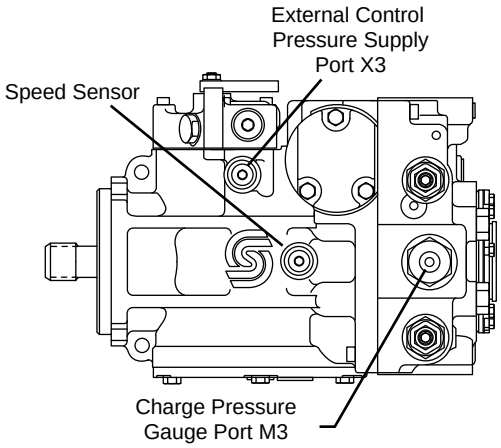


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Top View



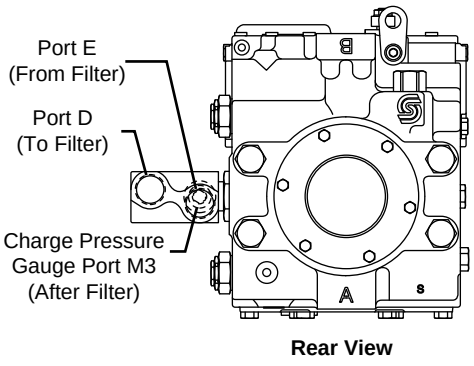
Left Side View



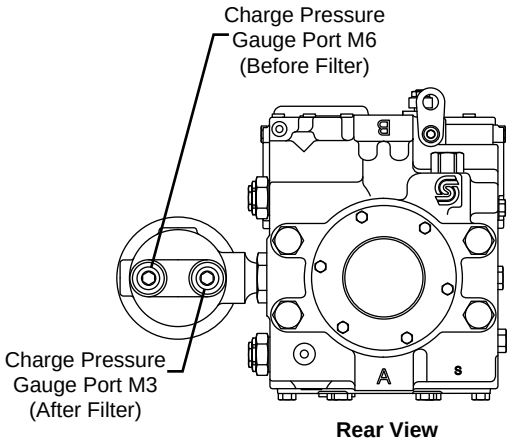
Right Side View

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90000816

PV with Side Port End Cap and Manual Displacement Control

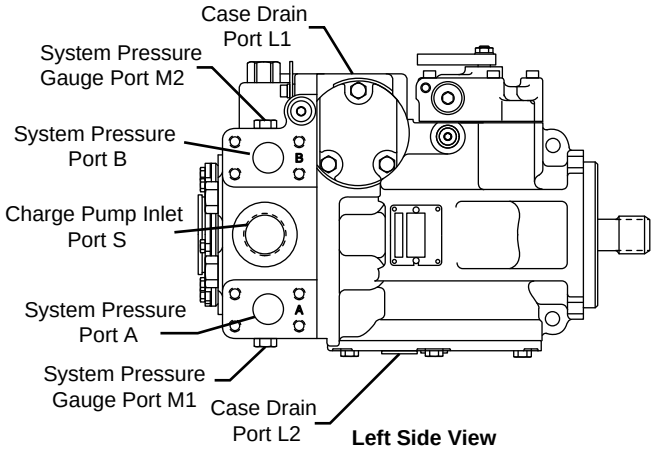


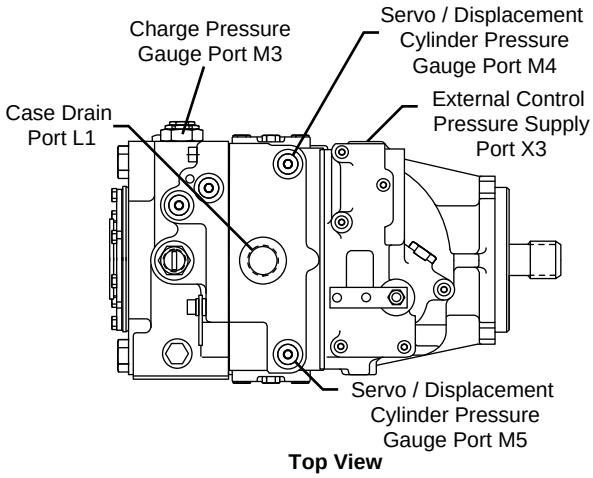
PV with Side Port End Cap and Remote Pressure Filtration



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90000818

PV with Side Port End Cap and Integral Pressure Filtration





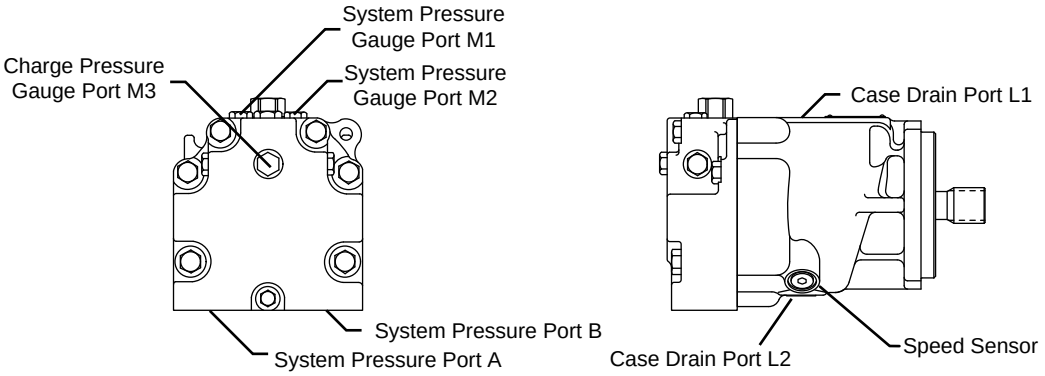
90000819
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PV with Twin Port End Cap and Manual Displacement Control

4.2.2 Fixed Motor

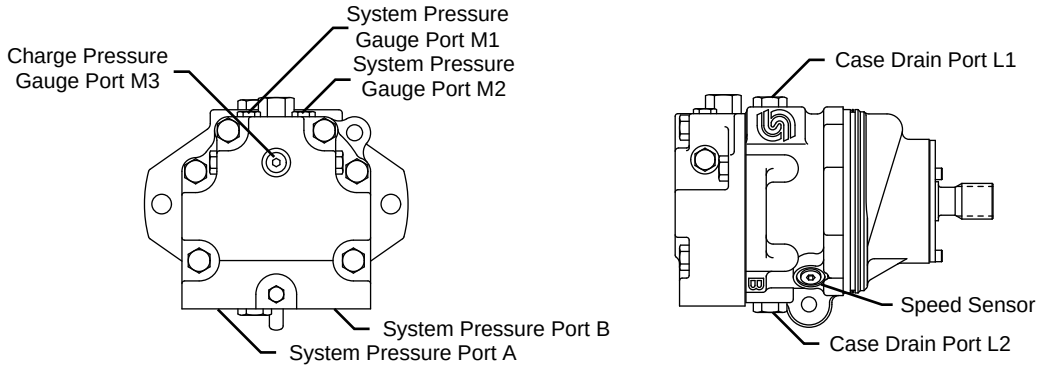
Port	Function	Recommended Gauge Size and Fitting
M1	System Pressure Port "A"	1000 bar or 10 000 psi Gauge 9/16—18 O-Ring Fitting
M2	System Pressure Port "B"	1000 bar or 10 000 psi Gauge 9/16—18 O-Ring Fitting
M3	Charge Pressure Port M3	50 bar or 1000 psi Gauge 9/16—18 O-Ring Fitting

Port	Function	Recommended Gauge Size and Fitting	
L1 L2	Case Pressure	10 bar or 100 psi Gauge	
		SAE O-Ring Fitting:	
		030, 042, 055	7/8—14
		075, 100, 130	1-1/16—12



Rear View **Left Side View**

MF with SAE Flange



Rear View **Left Side View**

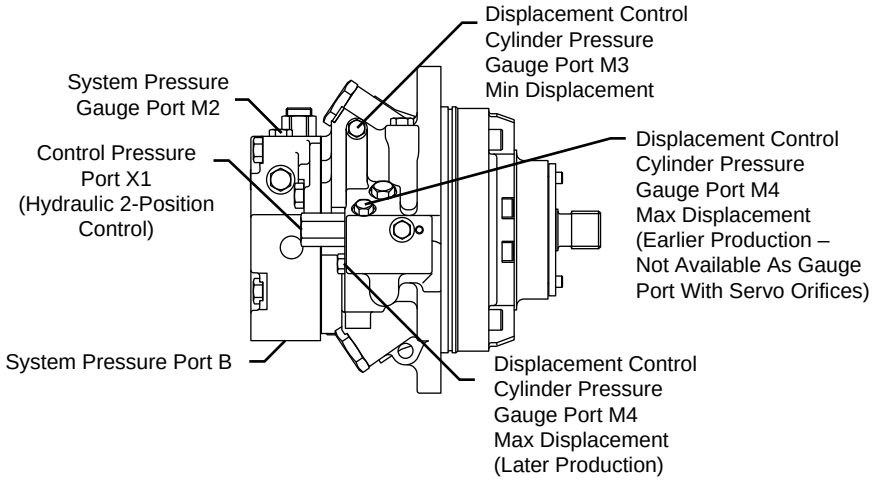
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MF with Cartridge Flange

4.2.3 Variable Motor

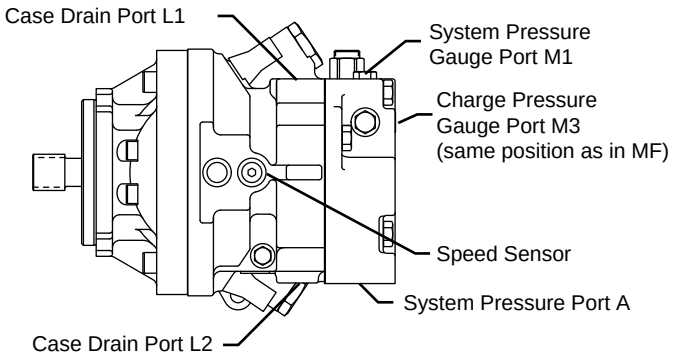
Port	Function	Recommended Gauge Size and Fitting
M1	System Pressure Port "A"	1000 bar or 10 000 psi Gauge 9/16—18 O-Ring Fitting
M2	System Pressure Port "B"	1000 bar or 10 000 psi Gauge 9/16—18 O-Ring Fitting
M3	Charge Pressure	50 bar or 1000 psi Gauge 9/16—18 O-Ring Fitting

Port	Function	Recommended Gauge Size and Fitting
M3	Disp. Cylinder Pressure Min Disp.	1000 bar or 10 000 psi Gauge 7/16—20 O-Ring Fitting
M4	Disp. Cylinder Pressure Max Disp.	1000 bar or 10 000 psi Gauge 7/16—20 O-Ring Fitting
L1 L2	Case Pressure	10 bar or 100 psi Gauge 1-1/16—12 O-Ring Fitting



Left Side View

MV with Cartridge Flange and Hydraulic 2-Position Control (SAE Flange Version Similar)



Right Side View

90000823

MV with SAE Flange (Cartridge Flange Version Similar)

5. Initial Start-Up Procedure

The following start-up procedure should always be followed when starting-up a new Series 90 installation or when restarting an installation in which either the pump or motor had been removed.

WARNING
The following procedure may require the vehicle/machine to be disabled (wheels raised off the ground, work function disconnected, etc.) while performing the procedure in order to prevent injury to the technician and bystanders. Take necessary safety precautions before moving the vehicle/machine.

Prior to installing the pump and/or motor, inspect the units for damage incurred during shipping and handling. Make certain all system components (reservoir, hoses, valves, fittings, heat exchanger, etc.) are clean prior to filling with fluid.

Fill the reservoir with recommended hydraulic fluid. This fluid should be passed through a 10 micron (nominal, no bypass) filter prior to entering the reservoir. The use of contaminated fluid will cause damage to the components, which may result in unexpected vehicle/machine movement. See the publications BLN-9887 and SDF 697581 for further related information.

The inlet line leading from the reservoir to the pump must be filled prior to start-up. Check inlet line for properly tightened fittings and make sure it is free of restrictions and air leaks.

Be certain to fill the pump and/or motor housing with clean hydraulic fluid prior to start up. Fill the housing by pouring filtered oil into the upper case drain port.

Install a 50 bar (or 1000 psi) pressure gauge in the charge pressure gauge port (see Sec. 4.2 for location) to monitor the charge pressure during start-up.

It is recommended that the external control input signal (linkage for MDC, hydraulic lines for HDC, or electrical connections for EDC) be disconnected at the pump control until after initial start-up. This will ensure that the pump remains in its neutral position.

WARNING
Do not start prime mover unless pump is in neutral position (0° swashplate angle). Take precautions to prevent machine movement in case pump is actuated during initial start up.

“Jog” or slowly rotate prime mover until charge pressure starts to rise. Start the prime mover and run at the lowest possible RPM until charge pressure has been established. Excess air may be bled from the high pressure lines through the high pressure system gauge port.

Once charge pressure has been established, increase speed to normal operating RPM. Charge pressure should be as indicated in the pump model code (see Sec. 8.1.1). If charge pressure is inadequate, shut down and determine cause for improper pressure. Refer to Troubleshooting Sec. 7.

WARNING
Inadequate charge pressure will affect the operator’s ability to control the machine.

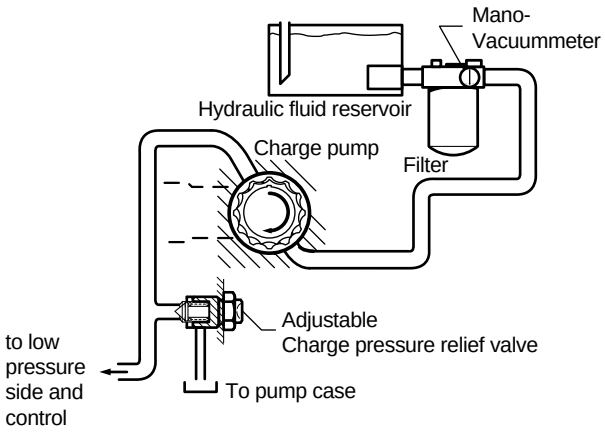
Shut down the prime mover and connect the external control input signal. Also reconnect the machine function if disconnected earlier. Start the prime mover, checking to be certain the pump remains in neutral. With the prime mover at normal operating speed, slowly check for forward and reverse machine operation.

Charge pressure may slightly decrease during forward or reverse operation. Continue to cycle slowly between forward and reverse for at least five minutes.

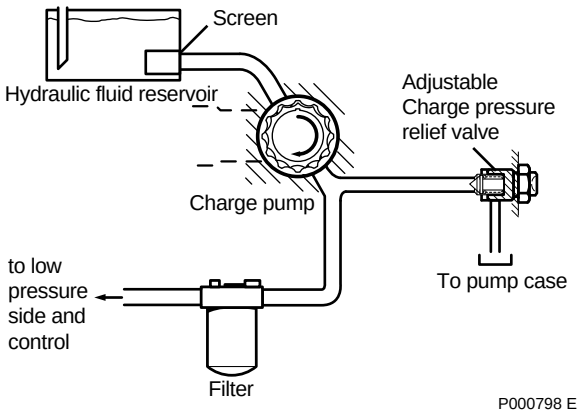
Shut down prime mover, remove gauges, and plug ports. Check reservoir level and add filtered fluid if needed.

The transmission is now ready for operation.

6. Fluid and Filter Maintenance



Suction Filtration Schematic



Charge Pressure Filtration Schematic (Partial Flow)

To ensure optimum service life of Series 90 products, regular maintenance of the fluid and filter must be performed. Contaminated fluid is the main cause of unit failure. Care should be taken to maintain fluid cleanliness while performing any service procedure.

Check the reservoir daily for proper fluid level, the presence of water (noted by a cloudy to milky appearance, or free water in bottom of reservoir), and rancid fluid odor (indicating excessive heat). If either of these conditions occur, change the fluid and filter immediately.

It is recommended that the fluid and filter be changed per the vehicle/machine manufacturer's recommendations or at the following intervals:

System with a sealed-type reservoir	2000 hours
System with a breathing-type reservoir	500 hours

It may be necessary to change the fluid more frequently than the above intervals if the fluid becomes contaminated with foreign matter (dirt, water, grease, etc.) or if the fluid has been subjected to temperature levels greater than the recommended maximum. Never reuse fluid.

The filter should be changed whenever the fluid is changed or whenever the filter indicator shows that it is necessary to change the filter.

Filters can be in either pressure filtration or suction filtration configurations. For suction filtration, filters should have a Beta-ratio of β_{10}>2. For charge pressure filtration, filters should have a Beta-ratio of β_{10}>10. See Sauer-Sundstrand publication BLN-9887 or 697581 and ATI-E 9201 for more information on filtration.

7. Troubleshooting

This section provides general steps to follow if certain undesirable system conditions are observed. Follow the steps in a section until the problem is solved. Some of the items will be system specific. For areas covered in this manual, a section is referenced. **Always observe the safety precautions listed in Sec. 1.2 and related to your specific equipment.**

7.1 "Neutral" Difficult or Impossible to Find

Item	Description	Action
1. Check input to pump control.	Input to control module is operating improperly.	Check control input and repair or replace as necessary.
2. Check pump displacement control.	Control linkages are not secure, control orifices are blocked, etc.	Adjust, repair, or replace control module as necessary (8.2 and 9.3).
3. Repair or replace pump.		Consult a Sauer-Sundstrand Authorized Service Center.

7.2 System Operating Hot

Item	Description	Action
1. Check oil level in reservoir.	Insufficient hydraulic fluid will not meet cooling demands of system.	Fill reservoir to proper level.
2. Inspect heat exchanger.	Heat exchanger not sufficiently cooling the system.	Check air flow and input air temperature for heat exchanger. Clean, repair or replace heat exchanger.
3. Check charge pressure.	Low charge pressure will overwork system.	Measure charge pressure (4.2). Inspect and adjust or replace charge relief valve (8.1.1 and 9.2.3). Or repair leaky charge pump (9.2.4).
4. Check charge pump inlet vacuum.	High inlet vacuum will overwork system. A dirty filter will increase the inlet vacuum. Inadequate line size will restrict flow.	Check charge inlet vacuum (4.2). If high, inspect inlet filter and replace as necessary. Check for adequate line size, length or other restrictions.
5. Check system relief pressure settings.	If the system relief settings are too low, the relief valves will be overworked.	Verify settings of pressure limiters and high pressure relief valves and adjust or replace multi-function valves as necessary (8.1.2, 9.2.1)
6. Check for internal leakage in motor.	Leakage will reduce low side system pressure and overwork the system.	Monitor motor case flow without loop flushing in the circuit (use defeat spool 9.4.1.3). If flow is excessive, replace motor.
7. Check system pressure.	High system pressure will overheat system.	Measure system pressure (4.2). If pressure is high reduce loads.
8. Replace transmission.		Replace pump and motor.

7.3 Transmission Operates Normally in One Direction Only

Item	Description	Action
1. Check input to pump control.	Input to control module is operating improperly.	Check control input and repair or replace as necessary.
2. Check pump displacement control.	Control linkages are not secure, control orifices are blocked, etc.	Repair or replace control module as necessary (8.2 and 9.3).
3. Interchange system pressure limiters, high pressure relief valves, and system check valves.	Interchanging the multi-function valves will show if the problem is related to the valve functions contained in the multi-function valves.	Interchange multi-function valves. If the problem changes direction, repair or replace the valve on the side that does not operate (8.1.2 and 9.2.1).
4. Check charge pressure.	If charge pressure decays in one direction the loop flushing valve may be “sticking” in one direction.	Measure charge pressure in forward and reverse (4.2). If pressure decays in one direction, inspect and repair the motor loop flushing valve (9.4.1.1).

7.4 System Will Not Operate in Either Direction

Item	Description	Action
1. Check oil level in reservoir.	Insufficient hydraulic fluid to supply system loop.	Fill reservoir to proper level.
2. Check input to pump control.	Input to control module is operating improperly.	Check control input and repair or replace as necessary.
3. Check pump displacement control.	Control linkages are not secure, control orifices are blocked, etc.	Repair or replace control module as necessary (8.2 and 9.3).
4. Ensure bypass valve(s) are closed.	If bypass valve(s) is open, the system loop will be depressurized.	Close bypass valves (8.1.3). Replace multi-function valve if defective (9.2.1).
5. Check charge pressure with pump in neutral.	Low charge pressure insufficient to recharge system loop.	Measure charge pressure with the pump in neutral (4.2). If pressure is low, go to step 6; otherwise continue with step 5.
6. Check charge pressure with pump in stroke.	Low charge pressure with the pump in stroke indicates a motor charge relief valve or system pressure relief valve may be improperly set.	Measure charge pressure with pump in stroke (4.2). If pressure is low, adjust or replace motor charge relief valve (8.3.1 and 9.4.1.2), otherwise go to step 9.
7. Inspect pump charge relief valve.	A pump charge relief valve that is leaky or set too low will depressurize the system.	Adjust or replace pump charge relief valve as necessary (8.1.1, 9.2.3)
8. Check charge pump inlet filter.	A clogged filter will undersupply system loop.	Inspect filter and replace if necessary.

(continued)

9. Check charge pump.	A malfunctioning charge pump will provide insufficient charge flow.	Repair or replace the charge pump (9.2.4). If OK go to last step.
10. Check pump displacement control.	Control linkages are not secure, control orifices are blocked, etc.	Repair or replace control module as necessary (8.2 and 9.3).
11. Check system pressure.	Low system pressure will not provide power necessary to move load.	Measure system pressure (4.2). Continue with next step.
12. Check system multi-function valves.	Defective multi-function valves will cause system pressure to be low.	Repair or replace multi-function valve(s) (9.2.1).
13. Replace transmission.		Replace pump and motor.

7.5 Low Motor Output Torque

Item	Description	Action
1. Check system pressure at motor.	Low system pressure at the motor will reduce torque.	Measure system pressure at motor (4.2). If pressure limiter setting is low, increase setting.
2. Variable motor stuck at minimum displacement.	Minimum motor displacement yields low output torque.	Check control supply pressure (4.2.3) or repair displacement control (9.5). Check motor control orifices (9.5.4).
3. Check for internal leakage.	Internal leakage will reduce system pressure.	Check for leakage in O-rings, gaskets, and other fittings (9.1.1 and others). Repair unit as required, or replace leaky unit.
4. Replace transmission.		Replace pump and motor.

7.6 Improper Motor Output Speed

Item	Description	Action
1. Check oil level in reservoir.	Insufficient hydraulic fluid will reduce motor speed.	Fill oil to proper level.
2. Check charge pressure.	Incorrect charge pressure can result in a low speed motor.	Measure charge pressure (8.1.1), adjust charge system as necessary (9.2.3 and 9.2.4).
3. Check pump output flow.	Incorrect outflow will affect output speed. Incorrect output flow indicates the swashplate is out of position.	Measure pump output flow by teeing into outflow hose. Check for proper pump speed and see that the pump is in full stroke.
4. Check variable motor displacement control.	If variable motor displacement control is not functioning correctly, variable motor swashplate may be in wrong position.	See if variable motor displacement control is responding. If not, repair or replace control (9.5).

7.7 Excessive Noise and/or Vibration

Item	Description	Action
1. Check oil in reservoir.	Insufficient hydraulic fluid will lead to cavitation.	Fill reservoir to proper level.
2. Air in system.	Air bubbles will lead to cavitation.	Look for foam in reservoir. Check for leaks on inlet side of system loop. Afterwards, let reservoir settle until bubbles are gone. Run system at low speed to move system fluid to reservoir. Repeat.
3. Check pump inlet vacuum.	High inlet vacuum will create noise. A dirty filter will increase the inlet vacuum.	Inspect and replace filter as necessary. Check for proper suction line size.
4. Inspect shaft couplings.	A loose shaft coupling will cause excessive noise.	Replace loose shaft coupling in charge pump (Sec. 9.2.4) or replace pump or motor.
5. Inspect shaft alignment.	Unaligned shafts will create excessive frictional noise.	Align shafts.

7.8 System Response is Sluggish

Item	Description	Action
1. Check oil level in reservoir.	Insufficient hydraulic fluid will reduce output pressure.	Fill reservoir to proper level.
2. Check multi-function valves' pressure settings.	Incorrect pressure settings will affect system reaction time.	Adjust or replace multi-function valves (8.1.2 and 9.2.1).
3. Check pump inlet vacuum.	High pump inlet vacuum will reduce system pressure.	Measure charge inlet vacuum (4.2). If high replace inlet filter.
4. Check prime mover speed.	Low engine speed will reduce system performance.	Adjust engine speed.
5. Check charge and control pressures.	Incorrect charge or control pressures will affect system performance.	Measure charge and control pressures and correct if necessary (4.2 and others).
6. Check system internal leakage.	Internal leakage will reduce system pressure.	Check for leakage in O-rings, gaskets, and other fittings (9.1.1 and others).
7. Replace transmission.		Replace pump and motor.

8. Inspections and Adjustments

This section offers instruction on how to perform inspections and adjustments on pump and motor components. Read through the entire related section before beginning a service activity. Refer to Sec. 4 for location of gauge ports and suggested gauge size.

8.1 Pump Adjustments

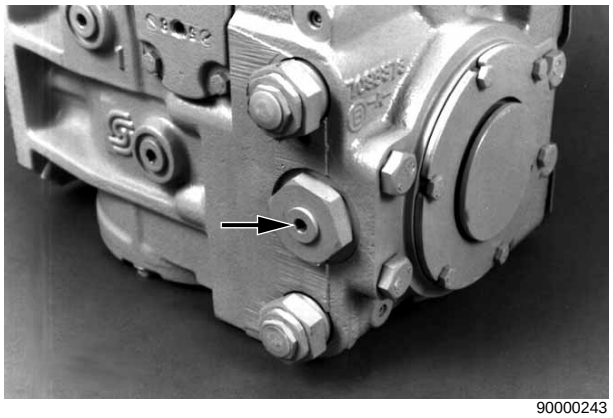
8.1.1 Charge Relief Valve Adjustment

The following procedure explains how to check and adjust the charge relief valve. (For description see Sec. 2.4.2.)

WARNING
The following procedure may require the vehicle/machine to be disabled (wheels raised off the ground, work function disconnected, etc.) in order to prevent injury to the technician and bystanders.

1. To measure pump charge pressure, install a pressure gauge in the pump charge pressure gauge port (M3). Also install a gauge to measure case pressure (tee into L1 or L2 or use servo gauge port). Operate the system with the pump in "neutral" (zero displacement) when measuring pump charge pressure.
2. The table on the following page shows the acceptable pump charge pressure range for some nominal charge relief valve settings (see sample model code at right). These pressures assume 1775 pump rpm and a reservoir temperature of 49°C (120°F), and are referenced to case pressure (see footnote on next page). Smaller displacement charge pumps will produce charge pressure readings in the lower portion of the range, while larger displacement charge pumps will produce readings in the higher portion of the range.

(continued)



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Charge Pressure Gauge Port (Reducer fitting shown - if filtration device attached, see Sec. 4.2.1 for alternate location of this port)

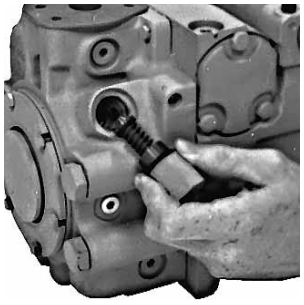
90L055 EA 1 N
6 S 3 C6 C 03
HNN 35 35 **24**

Nominal Charge Pressure Setting

Model Code on Unit Name Plate ("24 bar")

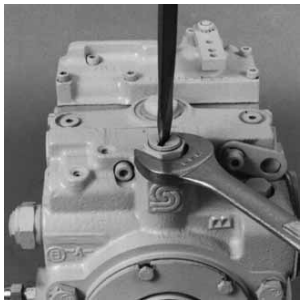
Model Code Setting	Measured Charge Pressure* (stated range ±1.7 bar [±25 psi])
20 bar	20.1 to 21.2 bar [291 to 308 psi]
24 bar	24.0 to 25.2 bar [348 to 365 psi]
28 bar	27.8 to 29.0 bar [403 to 420 psi]

NOTE: These pressures assume a pump speed of 1775 rpm. At higher pump input speeds (with higher charge flows) the charge pressure will rise over the rated setting.



90000262

Shim Adjustable Charge Pressure Relief Valve (Pump)



90000264

Screw Adjustable Charge Pressure Relief Valve (Pump)

3. Earlier production Series 90 pumps are equipped with a shim adjustable charge relief valve. Shim kits are available from Sauer-Sundstrand. Adjustment of charge pressure is accomplished by removing the plug [1 inch Hex] and changing the shim thickness behind the spring. The plug for this type of charge relief valve should be torqued to 68 Nm (50 lbf•ft).

   Later production Series 90 pumps are equipped with an external screw adjustable charge relief valve. Adjustment of the charge pressure is accomplished by loosening the lock nut (with a 1-1/16 inch hex wrench for 030 through 100 units, or a 1-5/8 inch hex wrench for 130 through 250 units), and turning the adjustment plug with a large screwdriver or a 1/2 inch hex wrench. Clockwise rotation of the plug increases the setting, and counterclockwise rotation decreases the setting (at a rate of approximately 3.4 bar (50 psi) per turn). The lock nut for this type of charge relief valve should be torqued to 52 Nm (38 lbf•ft).

4. Once the desired charge pressure setting is achieved, remove the gauges.

* This is the actual charge pressure port gauge reading minus the case pressure port gauge reading.

8.1.2 Multi-Function Valve Pressure Adjustment

Adjustment of the pressure limiter setting and the high pressure relief valve setting is accomplished simultaneously. The latter is automatically set approximately 35 bar (500 psi) above the former. For description of multi-function valve see Sec. 2.4.4.

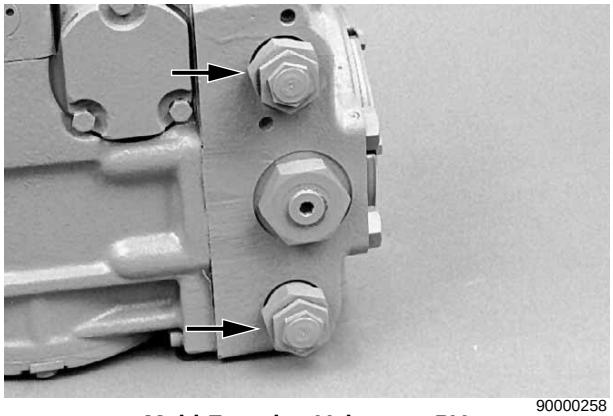
In order to adjust the pressure limiter setting, the motor output shaft must be locked so it does not rotate. This may be accomplished by locking the vehicle's brakes or rigidly fixing the work function so it cannot rotate.

WARNING
Take necessary precautions that the motor shaft remains stationary during the adjustment procedure.

1. Install two 1000 bar (or 10,000 psi) pressure gauges in the high pressure gauge ports (M1 and M2). Install a 50 bar (or 1000 psi) pressure gauge in the pump charge pressure gauge port (M3).
2. Start the prime mover and operate at normal speed.
3. Loosen locking nut (smallest hex on multi-function valve) with a 10 mm wrench for earlier 042 through 100 frame size units, a 19 mm wrench for 030 and later 042 through 100 frame size units, or a 13 mm wrench for earlier 130 frame size units.
4. Insert a 3 mm (early 042 through 100 units), 5 mm 030 and (late 042 through 100 units), or 4 mm (earlier 130 units) internal hex wrench into the pressure adjusting screw.

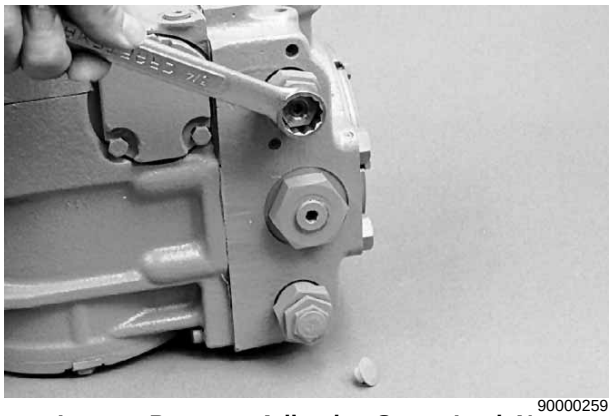
   NOTE: A plastic dust plug is installed in the adjusting screw on 030 and late 042 through 250 units.
5. The factory preset pressure limiter setting is shown on the model code as at right. It is referenced to charge pressure, so the pressure limiter setting is the difference between the high and low pressure sides of the system loop. Activate or move the control input so that pressure increases in the high pressure side of the closed circuit to the pressure limiter pressure setting. The pressure limiter setting is reached when the pressure stops increasing and remains steady at a given pressure level (as shown on the gauges).

(continued)



90000258

Multi-Function Valves on PV

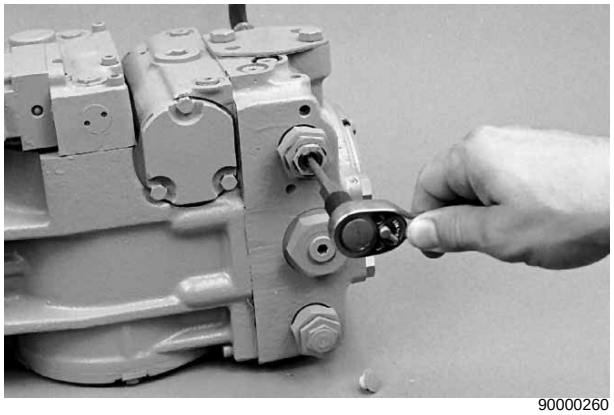


90000259

Loosen Pressure Adjusting Screw Lock Nut

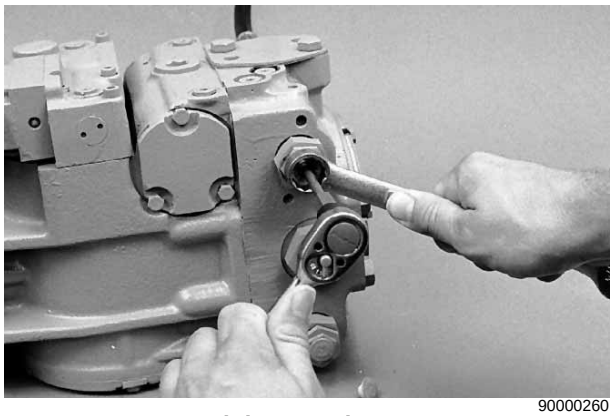
90L055 EA 1 N
6 S 3 C6 C 03
HNN **35** **35** 24

Pressure Limiter Setting
Ports A and B (differential
pressure in 10s of bars,
e.g. "35" = 350 bar)



90000260

Rotate Pressure Adjusting Screw



90000260

Tighten Lock Nut

6. Return the pump to its “neutral” (zero flow) position and adjust the pressure limiter setting by rotating the pressure adjusting screw with the internal hex wrench.

   Clockwise rotation of the pressure adjustment screw will increase the pressure setting, and counterclockwise rotation will decrease the pressure setting. Each complete rotation of the pressure adjusting screw changes the pressure setting by approximately 83 bar (1200 psi) on earlier 042 through 100 units, or by approximately 93 bar (1350 psi) on 030 and later 042 through 100 units.

7. To verify the actual pressure setting, actuate or move the control input so that the pump again develops pressure in the high pressure circuit to the newly adjusted pressure limiter pressure setting, and read the high pressure gauge. Then allow the pump to return to its “neutral” position. The pressure in the high pressure circuit should return to the charge pressure setting.

8. While holding the pressure adjusting screw stationary, tighten the pressure adjusting screw lock nut to 3 Nm (26 in•lbf) on early production units, or 16 Nm (12 ft•lbf) on late production units. **Do not over-torque.**

9. Shut down the prime mover, remove the gauges and install the gauge port plugs. Replace the plastic dust plugs (if used).

The same procedure is used for setting the pressure limit of the other multi-function valve, but the control input signal must be activated or moved in the opposite direction so that high pressure develops in the opposite side of the closed circuit.

8.1.3 Engaging the Bypass Function

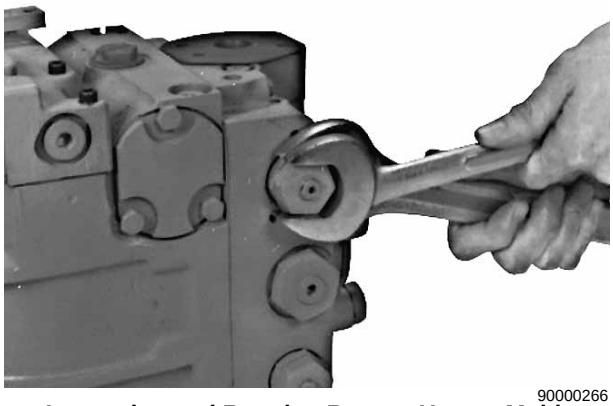
The bypass function (see Sec. 2.4.6 for description) is performed by the multi-function valve cartridges. The prime mover should be shut down when opening or closing the bypass valves.

The bypass valves on both of the multi-function valves must be opened to engaged the bypass function.

1. Using a 1-1/16 inch (030 through 100) or 1-3/8 inch (130 through 250) wrench on the middle sized hex of the multi-function valve cartridge, and a 1-1/4 inch (030 through 100) or 1-5/8 inch (130 through 250) wrench on the large hex to prevent rotation of the cartridge assembly, rotate the middle hex three revolutions counterclockwise to open the bypass valve. Do not rotate more than 3-1/2 revolutions, as additional rotation will permit external leakage.
2. For units with an MDC-type control, prior to moving the vehicle or otherwise causing the motor shaft to turn, move the control handle of the manual displacement control on the pump to the maximum full forward position. Hold the handle in this position during bypass valve operation.

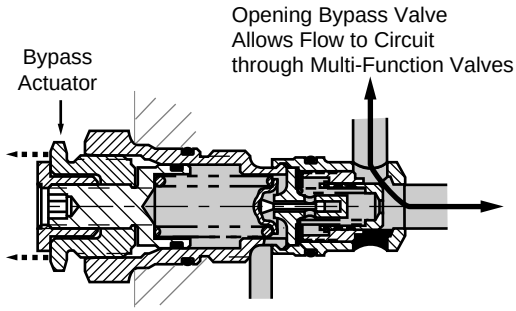
WARNING
"Tow" at extremely low speeds and for short distances only.

3. To close the bypass valve, rotate the middle hex clockwise until it is seated. Then torque the middle hex to 41 Nm (30 lbf•ft).



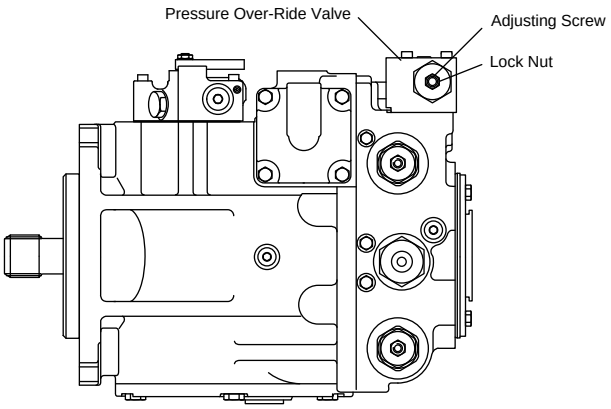
90000266

Loosening and Rotating Bypass Hex on Multi-Function Valve



90000827

Multi-Function Valve with Bypass Function Engaged



Pressure Over-Ride Valve for 180 Frame Size

8.1.4 Pressure Override (POR) Valve Pressure Adjustment (Option for 180 Frame Size)

The Pressure Override Valve is explained in Sec. 2.4.10.

1. Install two 1000 bar (or 10,000 psi) pressure gauges in the high pressure gauge ports (M1 and M2). Install a 50 bar (or 1000 psi) pressure gauge in the pump charge pressure gauge port (M3).
2. Start the prime mover and operate at normal speed.
3. With the pump operating at approximately 20% displacement, load the work function and note the pressure as the POR valve operates (pump displacement reduces to “zero”).
4. Adjustment of the pressure override setting is made by loosening the lock nut with a 9/16 inch hex wrench and turning the adjustment screw with a 3/16 inch internal hex wrench. The POR setting should be at least 50 bar (750 psi) below the high pressure relief valve setting of the multi-function valves for proper operation.
5. Following the adjustment, torque the lock nut to 43 Nm (32 lbf•ft).
6. Shut down the prime mover and remove the gauges and install the gauge port plugs.

8.1.5 Displacement Limiter Adjustment

The maximum displacement can be limited in either direction (see Sec. 2.4.7).

1. Loosen the seal lock nut retaining the displacement limiter adjusting screw.

Frame Size	Wrench Size
042 - 100	13 mm
130	17 mm
180 - 250	19 mm

2. Rotate the adjusting screw.

Frame Size	Internal Hex Wrench Size
042 - 100	4 mm
130	5 mm
180 - 250	6 mm

Rotating the adjusting screw clockwise will decrease the maximum displacement of the pump while rotating the adjusting screw counterclockwise will increase the maximum displacement.

WARNINGS
Care should be taken in adjusting displacement limiters to avoid undesirable flow or speed conditions. See Sec. 3 for speed and pressure limits.

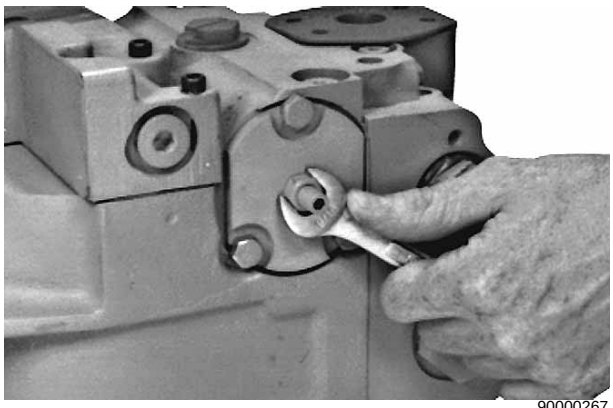
The seal lock nut must be retorqued after every adjustment to prevent an unexpected change in operating conditions and to prevent external leakage during unit operation.

3. After establishing the desired maximum displacement setting, tighten the lock nut on the adjusting screw as follows.

Frame Size	Torque
042 - 100	24 Nm [18 lbf•ft]
130	48 Nm [35 lbf•ft]
180 - 250	125 Nm [92 lbf•ft]

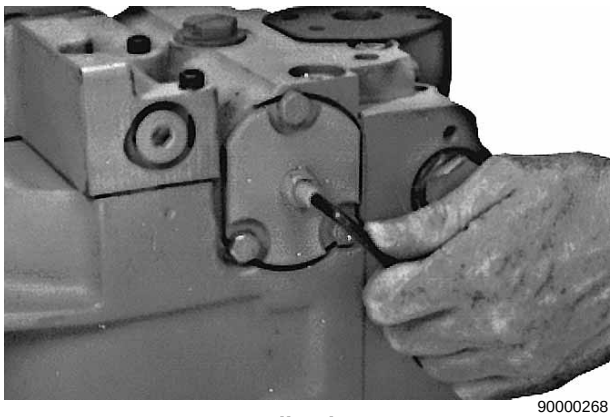
4. One turn of the adjusting screw will change the maximum displacement approximately as follows.

Frame Size	Approx Change in Disp per Rev of Adjusting Screw
030	2.8 cm^3/rev (0.17 in^3/rev)
042	3.4 cm^3/rev (0.21 in^3/rev)
055	4.0 cm^3/rev (0.25 in^3/rev)
075	5.0 cm^3/rev (0.31 in^3/rev)
100	6.0 cm^3/rev (0.37 in^3/rev)
130	9.0 cm^3/rev (0.55 in^3/rev)
180	12.5 cm^3/rev (0.76 in^3/rev)
250	17.3 cm^3/rev (1.06 in^3/rev)



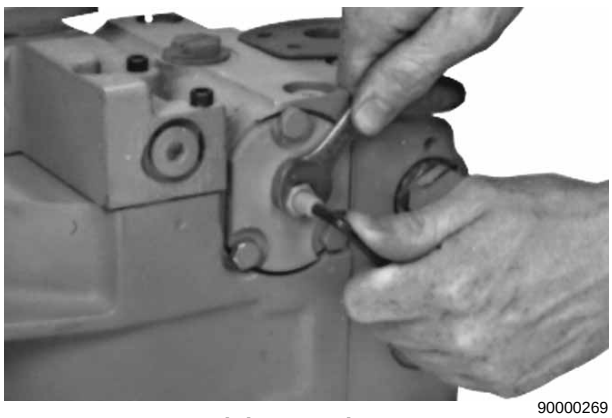
90000267

Loosen Displacement Limiter Lock Nut



90000268

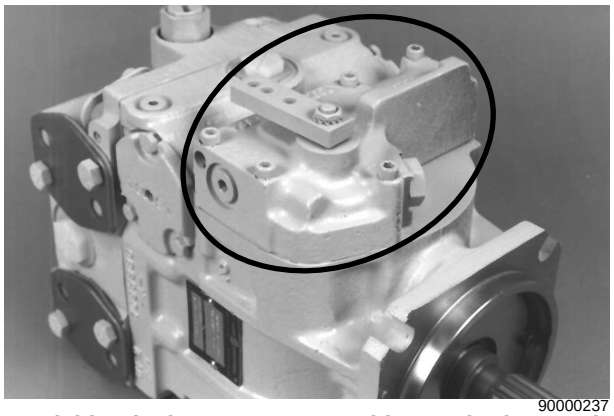
Rotate Adjusting Screw



90000269

Tighten Lock Nut

8.2 Pump Control Adjustments



90000237

Variable Displacement Pump with Standard Manual Displacement Control

8.2.1 Standard Manual Displacement Control (MDC) Adjustment

There are no adjustable elements in the manual displacement control. The control spool is held in its “neutral” position by centering springs and washers on each end of the spool. Since there is no centering spring on the control input shaft, the shaft will automatically assume the appropriate position when the control is installed on the pump.

For a functional description see Sec. 2.5.1.

8.2.2 Non-Linear Manual Displacement Control (MDC)

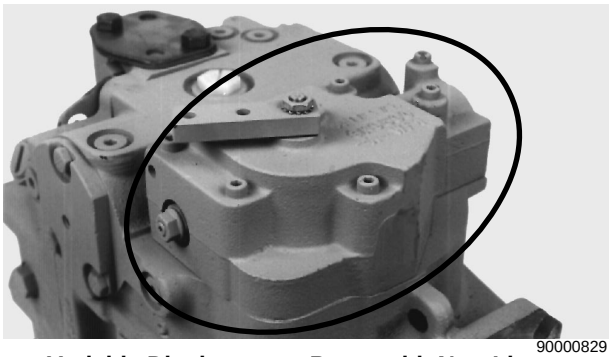
A centering spring, located on the control input shaft, locates the control shaft in its “neutral” position. A bias spring on the control spool maintains a force on the spool and the control linkage to eliminate looseness (“free-play”) in the linkage.

The “neutral” adjustment is the only adjustment that can be made on the nonlinear manual displacement control. All other functions are preset at the factory.

This adjustment must be made on a test stand or on the vehicle/machine with the prime mover operating.

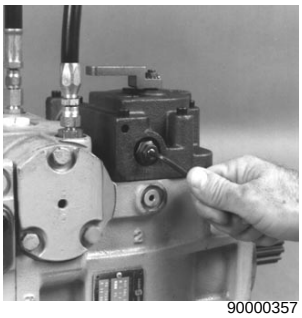
WARNING
The following procedure requires the vehicle/machine to be disabled (wheels raised off the ground, work function disconnected, etc.) in order to prevent injury to the technician and bystanders.

1. Install two 50 bar (or 1000 psi) gauges in each of the displacement control cylinder gauge ports (M4 and M5). Disconnect the external control linkage from the control handle and make certain the control shaft is in its “neutral” position. Start the prime mover and operate at normal speed.
2. Loosen the lock nut on the neutral adjusting screw with a 13 mm hex wrench.
3. Using a 4 mm internal hex wrench, rotate the neutral adjusting screw clockwise until the pressure increases on one of the pressure gauges. Note the angular position of the wrench.
4. Rotate the adjusting screw counterclockwise until the pressure increases by an equal amount on the other gauge. Note the angular position of the wrench.
5. Rotate the adjusting screw clockwise half the distance between the locations noted above. The gauges should read the same pressure (case pressure), indicating that the control is in its “neutral” position.
6. Hold the adjusting screw stationary and tighten the lock nut to 13.6 Nm (10 in•lbf). **Do not overtorque the nut.**
7. Once the neutral position is set, stop the prime mover, remove the gauges, and install the gauge port plugs. Reconnect the external control linkage.



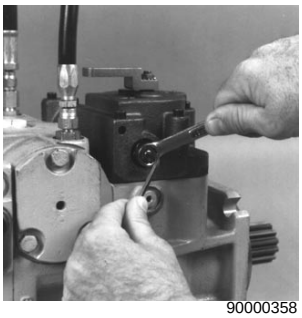
90000829

Variable Displacement Pump with Non-Linear Manual Displacement Control



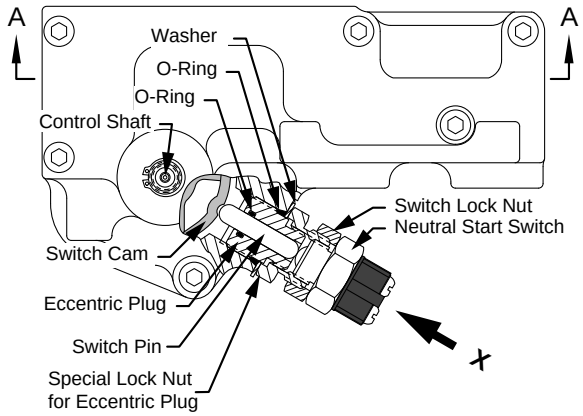
90000357

Rotate Neutral Adjusting Screw

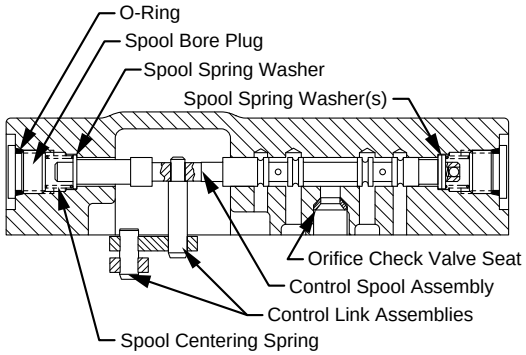


90000358

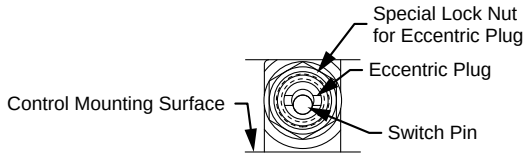
Tighten Neutral Adjusting Screw Lock Nut



MDC With Neutral Start Switch
Top View



View At Section A-A



View In Direction X
With Switch And Lock Nut Removed

90000830

Components of Standard Manual Displacement Control with Neutral Start Switch

8.2.3 MDC Neutral Start Switch (NSS) Adjustments

The neutral start switch (NSS) provides a means to prevent the system prime mover from starting while the pump control handle and control input shaft are in a position which would command the pump to go “in-stroke” in either the “forward” or “reverse” direction.

When the control input shaft is in its “neutral” position, the inner end of the switch pin moves into a slot on the eccentric cam attached to the control shaft. This allows the spring loaded NSS to close, completing the electrical starting circuit for the prime mover.

When the control input shaft is NOT in its “neutral” position, the eccentric cam moves the switch pin out of the slot. This forces the NSS to open, breaking the electrical starting circuit for the prime mover.

(continued)

The NSS must be adjusted to meet the following three requirements:

i. The distance the control handle can be turned without opening the NSS is called the “NSS deadband.” The distance the control handle can be moved without moving the control spool enough to port hydraulic fluid to the pump displacement control cylinders is called the “control deadband.” These deadbands **must** be centered in relation to each other.

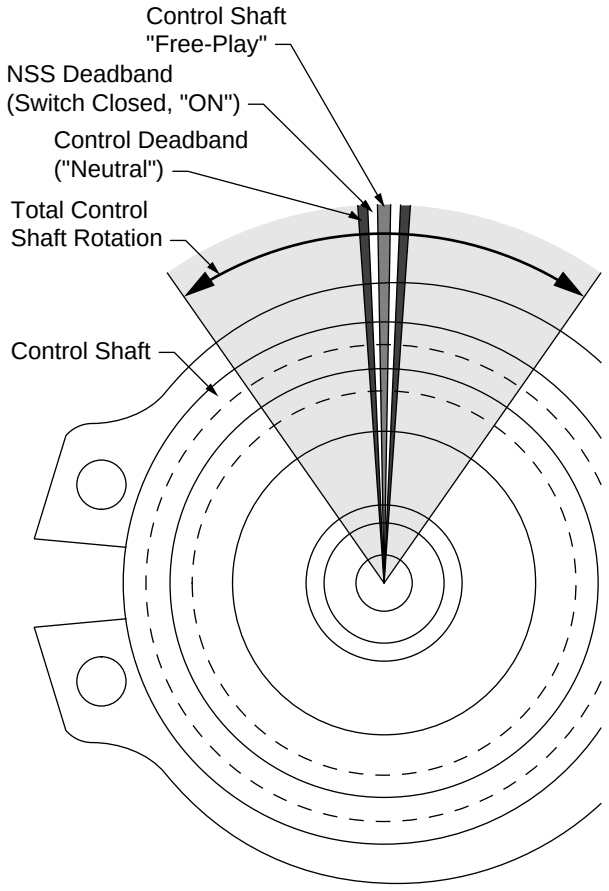
   Since the position of the control deadband cannot be adjusted, the position of the NSS deadband must be adjusted to match it. The switch pin is located in an eccentric plug which is turned to move the center of the NSS deadband.

ii. The NSS deadband must be wide enough so the NSS **will not** open within the loose area of control handle movement caused by normal operating clearances in the control linkage (control shaft “free-play”). By setting the NSS to open outside this area, the control spool springs or control shaft centering spring can always act to return the handle to “neutral” and re-close the NSS.

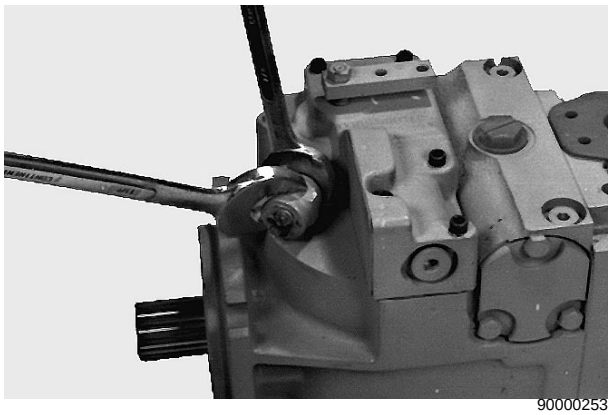
iii. The NSS deadband must be narrow enough so the NSS **will** open before the unit builds 7 bar (100 psi) differential system pressure in either direction.

   The neutral start switch is threaded into the special lock nut for the eccentric plug. Turning the NSS clockwise (CW) into the special nut will move the NSS closer to the switch cam on the control shaft, and will narrow the NSS deadband. Turning the NSS counterclockwise (CCW) out of the special nut will move the NSS farther from the switch cam on the control shaft, and will widen the NSS deadband.

(continued)

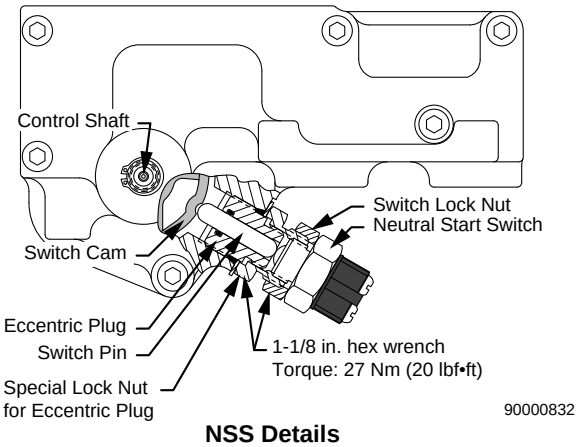


Neutral Start Switch Adjustment Requirements



90000253

Loosening the NSS Lock Nut



90000832

NSS Details



90000255

Checking Continuity of NSS

NSS Deadband Adjustment (Conditions ii & iii)

The NSS deadband must be wide enough so the NSS **will not** open within the control shaft "free-play" area, and it must be narrow enough so the NSS **will** open before the unit builds 7 bar (100 psi) differential system pressure in either direction.

1. Using two 1-1/8 inch wrenches, hold the neutral start switch from turning and loosen the locknut.
2. Disconnect the external control linkage and make certain the control shaft is in its "neutral" position.
3. Attach a continuity checker to the terminals of the switch. With the control shaft in its "neutral" position, turn the switch clockwise (CW) until electrical continuity is broken, then turn the switch counterclockwise (CCW) until electrical continuity is obtained. Turn the switch counterclockwise (CCW) an additional 1/4 turn (90°) after continuity has been obtained.
4. Hold the switch in place and tighten the locknut to 27 Nm (20 ft•lbf) torque.
5. With the continuity checker attached to the switch, rotate the control handle (or the control shaft) in each direction to assure continuity is broken when the control is not in the "neutral" position.
6. If continuity is obtained in "neutral" and satisfactorily interrupted in each direction, proceed to check the switch with the prime mover running. The switch must open **before** the unit builds 7 bar (100 psi) differential system pressure in either direction.

   If the switch opens **after** the unit builds system pressure in either direction, loosen the switch lock nut and turn the switch clockwise (CW) 1⁄12 turn (30°). Tighten the switch lock nut and recheck the switch operation. Repeat this procedure if necessary.
7. If neutral start switch operation is satisfactory, reconnect the external control linkage.
8. If continuity is not interrupted with an **equal** movement of the control handle in each direction, continue with the next section.

Neutral Start Switch Eccentric Plug Adjustment (Condition i)

The NSS deadband and the control deadband **must** be centered in relation to each other.

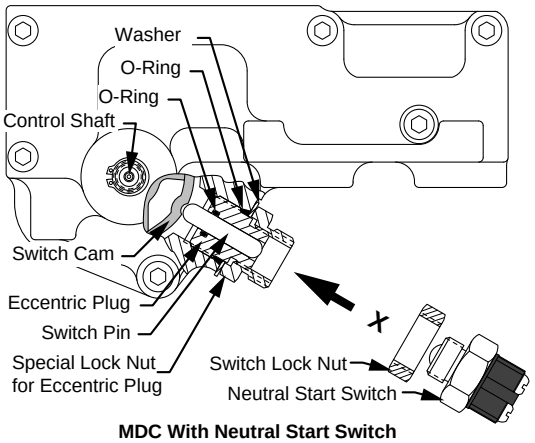
Since the position of the control deadband cannot be adjusted, the position of the NSS deadband must be adjusted to match it. The switch pin is located in an eccentric plug which is turned to move the center of the NSS deadband.

The MDC should be installed on the pump and be in its “neutral” position when adjusting the neutral start switch eccentric plug.

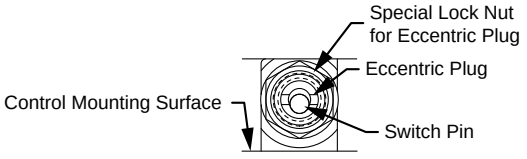
The accompanying drawing provides dimensions for an Eccentric Plug Adjustment Tool.

1. Hold the switch and eccentric plug from turning and use two 1-1⁄8 inch wrenches to loosen the locknut. Remove the neutral start switch.

CAUTION
Do not start the prime mover while the neutral start switch is removed from the control. Case pressure will force the pin out of the eccentric plug, causing oil loss.



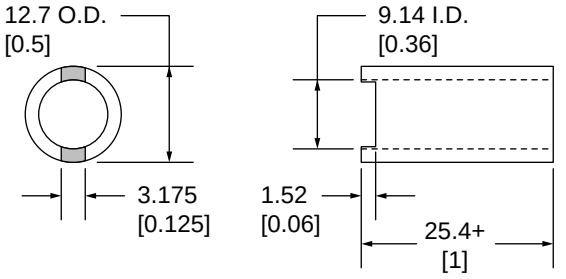
MDC With Neutral Start Switch Top View



View In Direction X With Switch And Lock Nut Removed

90000833

NSS Showing Eccentric Plug

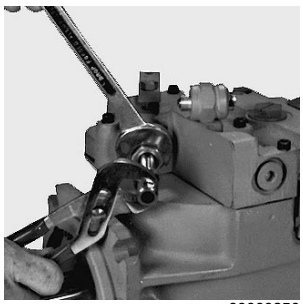


90000834

Eccentric Plug Adjustment Tool

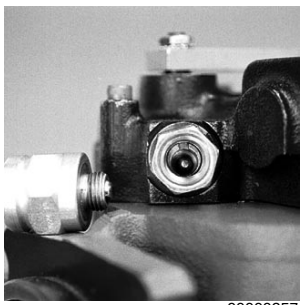
2. Note the slots on the eccentric plug for the adjustment tool. Hold the eccentric plug in place with the adjustment tool, and loosen the lock nut with a 1-1/8 inch wrench.

(continued)



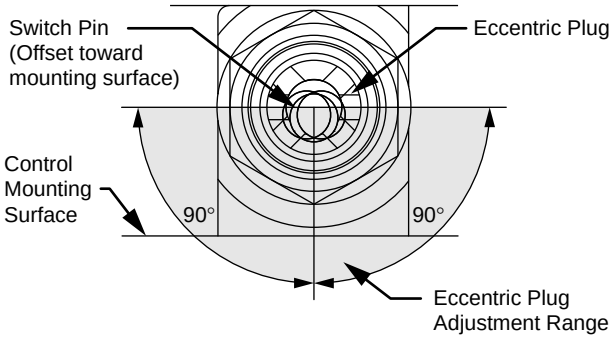
90000256

Loosen Eccentric Lock Nut

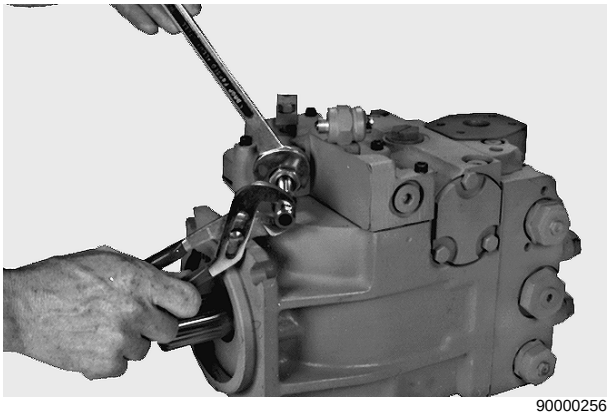


90000257

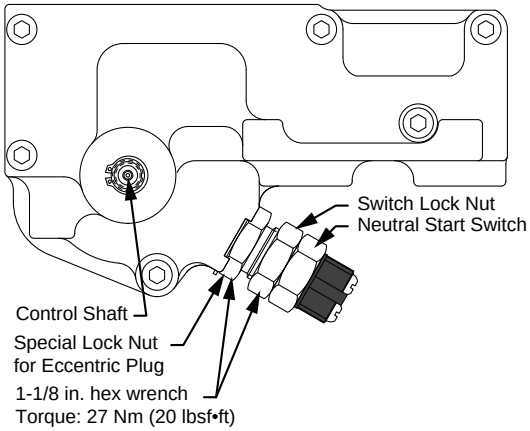
NSS Removed



Eccentric Plug Adjustment



Adjust Eccentric Plug



MDC With Neutral Start Switch
Top View

90000836

Neutral Start Switch Installed

3. Position the eccentric plug so the switch pin is offset toward the control mounting surface. This will provide the best contact between the pin and the cam on the control shaft.
4. Hold the control shaft in its “neutral” position (in the center of the control shaft “free-play” area). Locate the switch pin in the slot of the switch cam by turning the eccentric plug while checking the pin position (depth) in the plug. When the pin engages the cam slot, the pin will be at its maximum depth in the plug. Hand tighten the plug lock nut to hold the eccentric plug in position.
5. Turn the control shaft an equal amount in either direction from “neutral.” The switch pin should move out of the eccentric plug an equal distance when the control shaft is turned. Turn the eccentric plug to center the switch pin with the cam slot. Only a small amount of adjustment in either direction should be needed to center the pin.
6. While holding the eccentric plug in place, tighten the eccentric plug lock nut to 27 Nm (20 ft•lbf). Reinstall and adjust the switch as outlined in the previous section.

   NOTE: The eccentric plug normally requires between 5-1/2 and 6-1/2 turns to install into the control housing .

CAUTION
Do not turn the eccentric plug into or out of the housing beyond specifications.

7. Once the switch is correctly adjusted, hold the switch in place and tighten the locknut to 27 Nm (20 ft•lbf) torque.

(continued)

Checking Switch Continuity

Recheck switch continuity to determine whether additional adjustment of the eccentric plug is necessary.

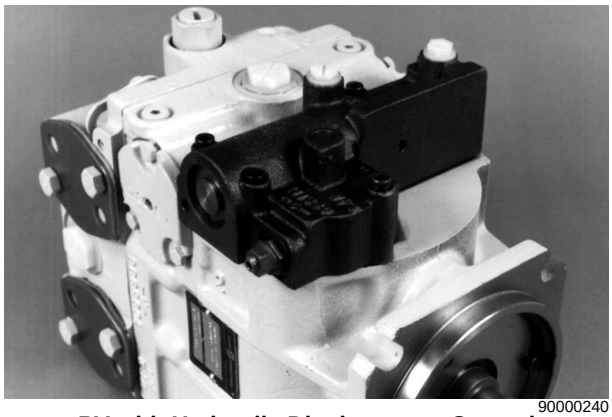
WARNING
The following procedure requires the vehicle/machine to be disabled (wheels raised off the ground, work function disconnected, etc.) in the event the pump should go into stroke during this adjustment.

1. Install two 50 bar (or 1000 psi) gauges in each of the displacement control cylinder gauge ports (M4 and M5). Attach a continuity checker to the terminals of the neutral start switch.
2. Energize the starter circuit, and start the prime mover.
3. While operating at normal speed and with the pump in its “neutral” (zero flow) position, note the pressure reading on the gauges. This reading should be noted as the base pressure.
4. Slowly move the control handle in one direction while observing the pressure gauges and the continuity checker. Continuity **must** be broken before the pressure on either gauge increases more than 0.9 bar (12 psi) from the base pressure obtained at “neutral.”
5. Slowly move the control handle in the opposite direction. Again, continuity must be broken before the gauge pressure increases more than 0.9 bar (12 psi) from base pressure.
6. Continuity must again be verified when the control is returned to neutral.
7. If continuity is not broken at base pressure plus 0 to 0.9 bar (0 to 12 psi) in either direction, stop the prime mover and readjust the eccentric plug as described in the previous section. If the pressure difference is equal in each direction but greater than 0.9 bar (12 psi), loosen the switch locknut and turn the switch clockwise 1/12 turn (30°) to increase the sensitivity. Retighten the locknut and recheck pressure differences and continuity.
8. After verifying proper control and switch operation, stop the prime mover. Remove the continuity checker and pressure gauges. Reinstall the servo pressure port plugs and reconnect the electrical leads from the machine starter circuit to the neutral start switch. Install and adjust, if necessary, the external control linkage.



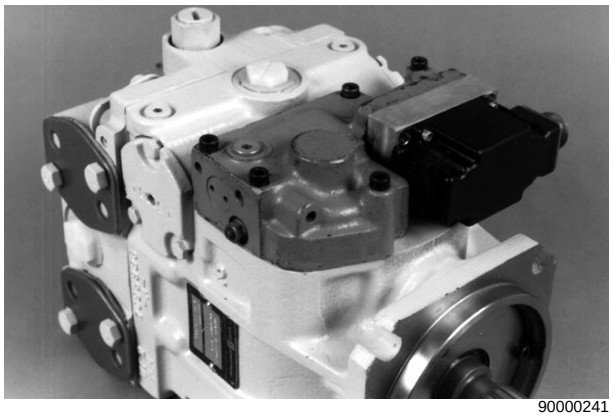
90000255

Checking Continuity of NSS (Gauges Installed in Servo Gauge Ports)



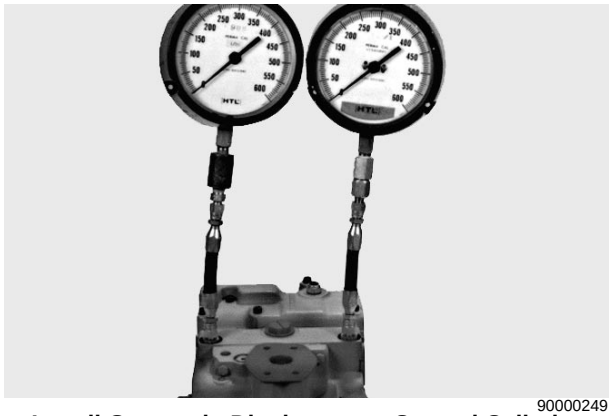
90000240

PV with Hydraulic Displacement Control



90000241

PV with Electric Displacement Control



90000249

Install Gauges in Displacement Control Cylinder Gauge Ports

8.2.4 Hydraulic Displacement Control (HDC) and Electric Displacement Control (EDC) Adjustment

The “neutral” adjustment is the only adjustment that can be made on hydraulic and electric displacement controls. All other functions are preset at the factory. For functional descriptions see Sec. 2.5.2 and 2.5.3.

This adjustment must be made on a test stand or on the vehicle/machine with the prime mover operating.

The neutral adjustment is performed by adjusting a neutral adjusting shaft (earlier production EDCs) or a neutral adjusting screw (HDCs and current production EDCs).

WARNING
The following procedure requires the vehicle/machine to be disabled (wheels raised off the ground, work function disconnected, etc.) in order to prevent injury to the technician and bystanders.

1. Install two 50 bar (or 1000 psi) gauges in each of the two displacement control cylinder gauge ports (M4 and M5). Disconnect the external control input (hydraulic or electronic) from the control. Start the prime mover and operate at normal speed.
2. Loosen the lock nut with a 17 mm hex wrench for the neutral adjusting shaft or with a 10 mm or 13 mm hex wrench for the neutral adjusting screw.

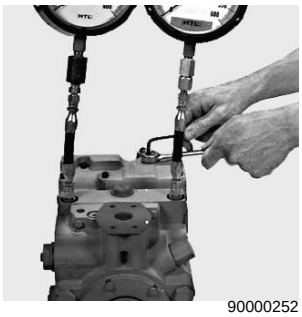
(continued)

3. Using a 5 mm internal hex wrench for the neutral adjusting shaft or a 3 mm or 4 mm internal hex wrench for the neutral adjusting screw, rotate clockwise until the pressure increases in one of the pressure gauges. Note the angular position of the wrench. Then rotate the neutral adjusting shaft or screw counterclockwise until the pressure increases by an equal amount on the other gauge. Again note the angular position of the wrench.
4. Rotate the neutral shaft or adjusting screw clockwise half the distance between the locations noted above. The gauges should read the same pressure (case pressure), indicating that the control is in its “neutral” position.
5. Hold the neutral adjusting shaft or screw stationary. Tighten the neutral shaft lock nut (early production controls) to 22 Nm (195 in•lbf). Tighten the neutral adjusting screw lock nut (later production controls) to 7 Nm (62 in•lbf) for the 6 mm screw or 13.6 Nm (120 in•lbf) for the 8 mm screw. Do not overtorque the nut.
6. Once the neutral position is set, stop the prime mover, remove the gauges, and install the gauge port plugs. Reconnect the external control input.



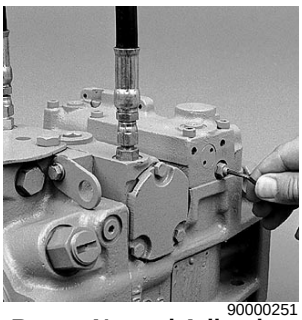
90000250

Rotate Neutral Adjusting Shaft (Early Production)



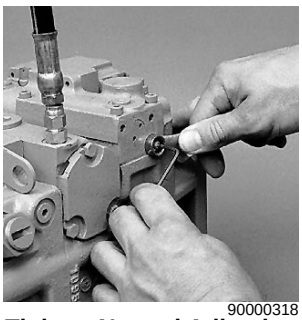
90000252

Tighten Neutral Adjusting Shaft Lock Nut (Early Production)



90000251

Rotate Neutral Adjusting Screw (Later Production)



90000318

Tighten Neutral Adjusting Screw Lock Nut (Later Production)



90000355

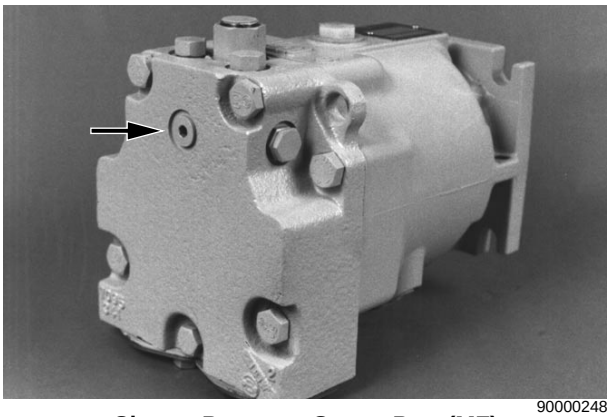
Rotate Neutral Adjusting Screw (Current Production HDC)



90000356

Tighten Neutral Adjusting Screw Lock Nut (Current Production HDC)

8.3 Motor Adjustments



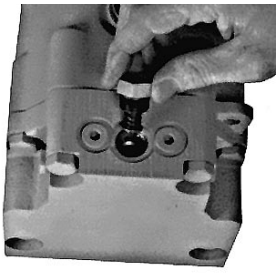
90000248

Charge Pressure Gauge Port (MF)

90M055 NC 0 N
8 N 0 C6 W 00
NNN 00 00 **24**

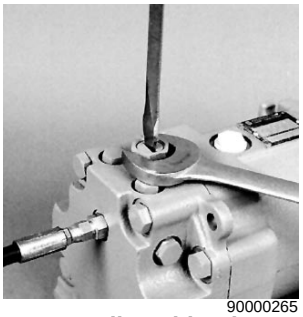
Nominal Charge Pressure Setting

e.g. “24” = 24 bar



90000263

Shim Adjustable Charge Pressure Relief Valve (Motor)



90000265

Screw Adjustable Charge Pressure Relief Valve (Motor)

8.3.1 Charge Relief Valve Adjustment

Motor charge relief is explained in Sec. 2.6.1.

1. To measure motor charge pressure, install a 50 bar (or 1000 psi) pressure gauge in the motor charge pressure gauge port (M3). Also install a gauge to measure case pressure. Operate the system with the pump in stroke (forward or reverse) when measuring motor charge pressure.
2. The following table shows acceptable motor charge pressures for some nominal charge relief valve settings (see model code at right). These pressures assume a reservoir temperature of 49°C (120°F). They are referenced to case pressure and assume a one pump/one motor system.

Model Code Setting	Motor Charge Pressure (Acceptable Range) (±1.4 bar [±20 psi])
10 bar	8.1 bar (117 psi)
18 bar	16.1 bar (233 psi)
20 bar	18.1 bar (262 psi)
24 bar	22.1 bar (320 psi)
28 bar	26.1 bar (378 psi)
30 bar	30.0 bar (435 psi)

3. Earlier production Series 90 motors are equipped with a shim adjustable charge relief valve. Shim kits are available as service items. Adjustment of the charge pressure is accomplished by removing the plug (7/8 inch hex) and changing the shim thickness behind the spring. The plug for this type charge relief port should be torqued to 68 Nm (50 ft•lbf).

   Later production Series 90 motors are equipped with an external screw adjustable charge relief valve. Adjustment of charge pressure is accomplished by loosening the lock nut (with a 1-1/16 inch hex wrench for 030 through 100 units, or a 1-5/8 inch hex wrench for 130 through 250 units), and turning the adjustment plug with a large screwdriver or a 1/2 inch hex wrench. Clockwise rotation of the plug increases the setting, and counterclockwise rotation decreases the setting (at a rate of approximately 3.4 bar [50 psi] per turn). The lock nut for this type charge relief valve should be torqued to 52 Nm (38 ft•lbf).
4. Once the desired charge pressure setting is achieved, remove the gauges.

8.3.2 Displacement Limiter Adjustment (MV)

Both the maximum and minimum displacement may be limited. For description see Sec. 2.6.2.

1. Remove the tamper resistant cap from the displacement limiter screw. Loosen the seal lock nut retaining the displacement limiter adjusting screw with a 19 mm wrench.
2. Rotate the adjusting screw with a 6 mm internal hex wrench. Rotating the maximum displacement adjusting screw clockwise will decrease the maximum displacement of the motor. Rotating the minimum displacement adjusting screw clockwise will increase the minimum displacement of the motor.

WARNINGS
Care should be taken in adjusting displacement limiters to avoid undesirable flow or speed conditions. See Sec. 3 for speed and pressure limits.

The seal lock nut must be retorqued after every adjustment to prevent an unexpected change in operating conditions and to prevent external leakage during unit operation.

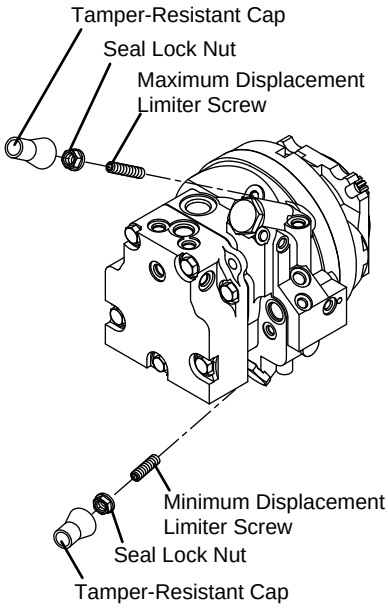
3. After establishing the desired displacement setting, tighten the lock nut on the adjusting screw to 54 Nm (40 ft•lbf). Install a new tamper resistant cap.
4. One turn of the adjusting screw will change the maximum or minimum displacement according to the following chart.

Frame Size	Approx Change in Disp per Rev of Adjusting Screw
055	5.6 cm^3 / Rev (0.34 in^3 / Rev)
075	7.1 cm^3 / Rev (0.43 in^3 / Rev)

CAUTION
The displacement limiters act as travel stops for the swashplate. Do not turn the limiter screws counterclockwise beyond the point of contact with the swashplate for either the maximum or minimum displacement position.

8.3.3 Displacement Control Adjustments

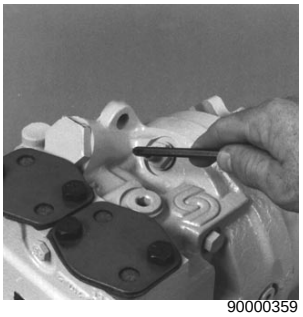
All variable motor displacement control settings do not require adjusting.



SAE Flange Version shown
(Cartridge Version similar)

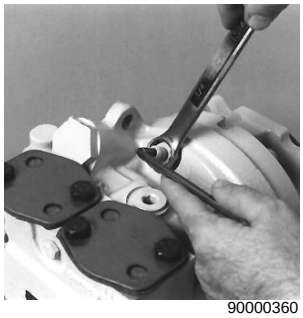
90000837

MV Displacement Limiters



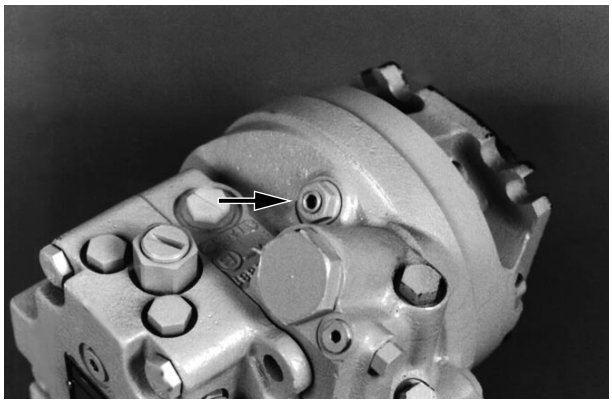
90000359

Rotate Adjusting Screw for Minimum Displacement Limiter



90000360

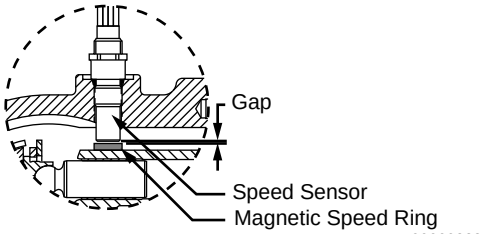
Tighten Lock Nut for Minimum Displacement Limiter



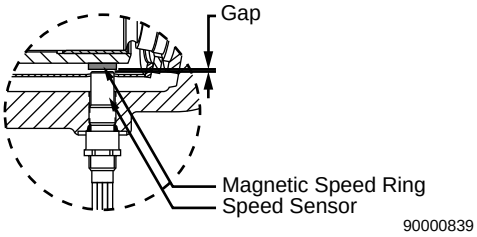
90000352

Maximum Displacement Limiter

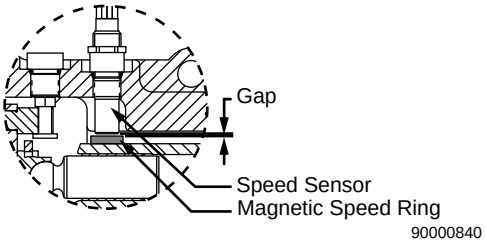
8.4 Speed Sensor Adjustment



Cross Section View of Speed Sensor in Variable Pump



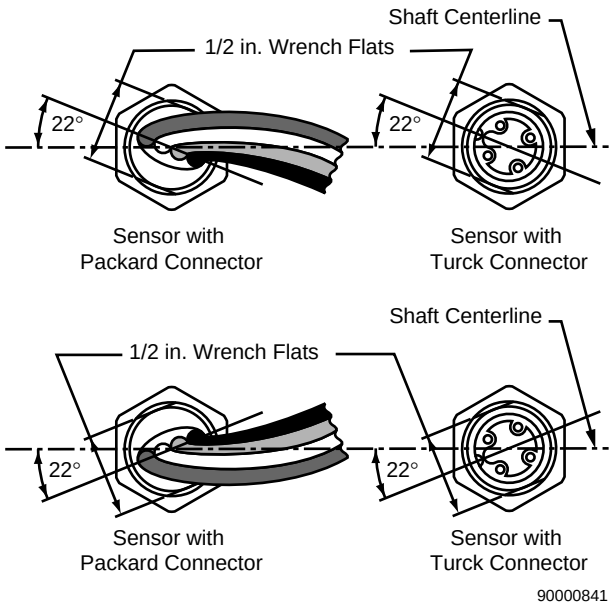
Cross Section View of Speed Sensor in Fixed Motor



Cross Section View of Speed Sensor in Variable Motor

When installing or adjusting the speed sensor on a pump or motor, it must be set at a specific distance from the speed ring on the unit's cylinder. To locate the position of the speed sensor on the unit, see Sec. 4. For a description see Sec. 2.3.2.

1. Loosen the sensor lock nut with an 11/16 inch hex wrench.
2. Turn the sensor clockwise (CW) by hand until it contacts the speed ring.



Positioning Speed Sensor Relative to Pump or Motor Shaft

3. Turn the sensor counterclockwise (CCW) 1/2 turn (180°) to establish the nominal gap of 0.71 mm (0.028 in).
4. Then turn the sensor clockwise (CW) until the wrench flats on sensor body are positioned at a 22° angle to the pump shaft center line.

   NOTE: Many adjustable wrenches have a 22° handle offset.
5. The final sensor position should be between 1/2 (180°) and 1/4 turn (90°) counterclockwise (CCW) from the point where the sensor contacts the speed ring.
6. Hold sensor in position with a 1/2 inch hex wrench while tightening the lock nut to 13 Nm (10 ft•lbf).

9. Minor Repair Instructions

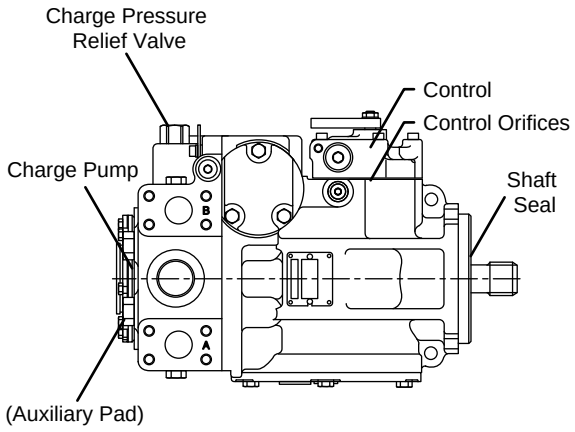
Minor repairs may be performed, following the procedures in this section, without voiding the unit warranty. Although specific models are shown, these procedures apply to all series and types of units in the Series 90 Family.

Cleanliness is a primary means of ensuring satisfactory transmission life, on either new or repaired units. Cleaning parts by using a solvent wash and air drying is adequate, providing clean solvent is used. As with any precision equipment, the internal mechanism and related items must be kept free of foreign materials and chemicals.

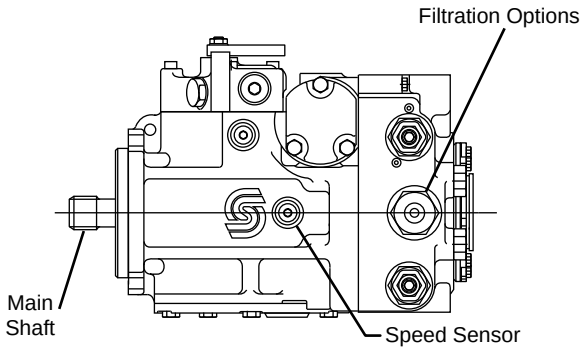
Protect all exposed sealing surfaces and open cavities from damage and foreign material.

It is recommended that all gaskets and O-rings be replaced when servicing. All gasket sealing surfaces must be cleaned prior to installing new gaskets. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly.

Hydrostatic Unit Outlines for Minor Repair Reference



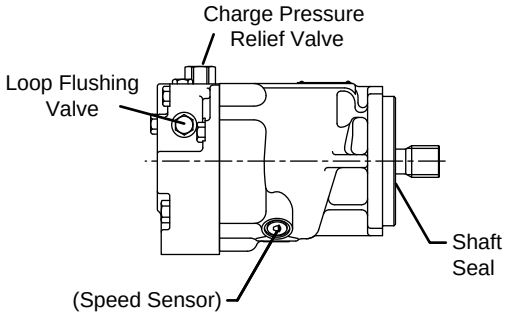
Left Side View



Right Side View

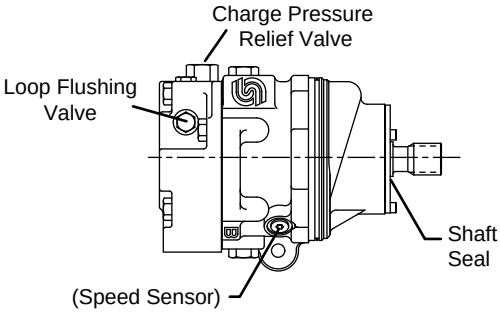
90000843

SAE Flange PV



Left Side View

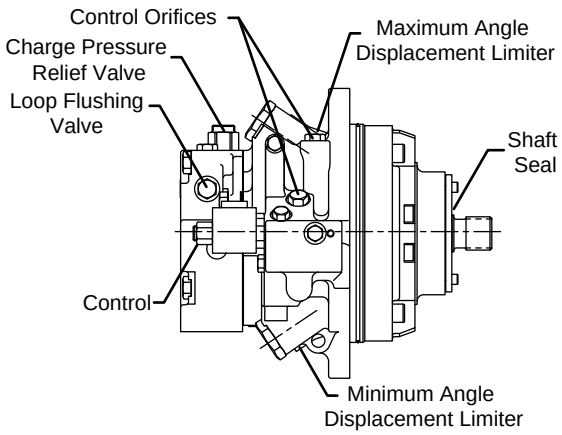
SAE Flange MF



Left Side View

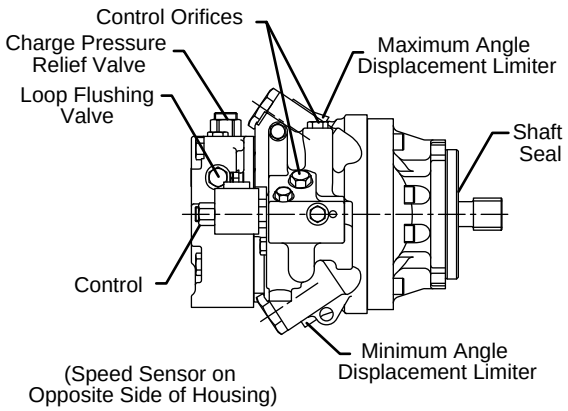
90000844

Cartridge Flange MF



Left Side View

Cartridge Flange MV



Left Side View

90000845

SAE Flange MV

9.1 Pump and Motor Minor Repair

9.1.1 Plug / Fitting Torques

If any plugs or fittings are removed from the pump or motor during servicing, they should be torqued as indicated in the accompanying table.

Always install new O-rings before reinstalling the plugs or fittings.

CAUTION
Plugs or fittings installed into aluminum housings should always be torqued to the lower values specified for internal hex plugs of the same size.

Description	Torque
7/16 — 20 O-Ring 9/16 inch Hex Wrench	20 Nm (15 lbf•ft)
7/16 — 20 O-Ring 3/16 inch Internal Hex Wrench	12 Nm (9 lbf•ft)
9/16 — 18 O-Ring 11/16 inch Hex Wrench	37 Nm (27 lbf•ft)
9/16 — 18 O-Ring 1/4 inch Internal Hex Wrench	23 Nm (17 lbf•ft)
3/4 — 16 O-Ring 7/8 inch Hex Wrench	68 Nm (50 lbf•ft)
3/4 — 16 O-Ring 5/16 inch Internal Hex Wrench	68 Nm (50 lbf•ft)
7/8 — 14 O-Ring 1 inch Hex Wrench	95 Nm (70 lbf•ft)
7/8 — 14 O-Ring 3/8 inch Internal Hex Wrench	68 Nm (50 lbf•ft)
1-1/16 — 12 O-Ring 1-1/4 inch Hex Wrench	163 Nm (120 lbf•ft)
1-1/16 — 12 O-Ring 9/16 inch Internal Hex Wrench	115 Nm (85 lbf•ft)
1-5/16 — 12 O-Ring 1-1/2 inch Hex Wrench	190 Nm (140 lbf•ft)
1-5/16 — 12 O-Ring 5/8 inch Internal Hex Wrench	129 Nm (95 lbf•ft)
1-5/8 — 12 O-Ring 1-7/8 inch Hex Wrench	224 Nm (165 lbf•ft)

9.1.2 Shaft Seal and Shaft Replacement



90000270

Remove Screws Holding Retainer Plate and Seal Carrier



90000271

Remove Seal Carrier



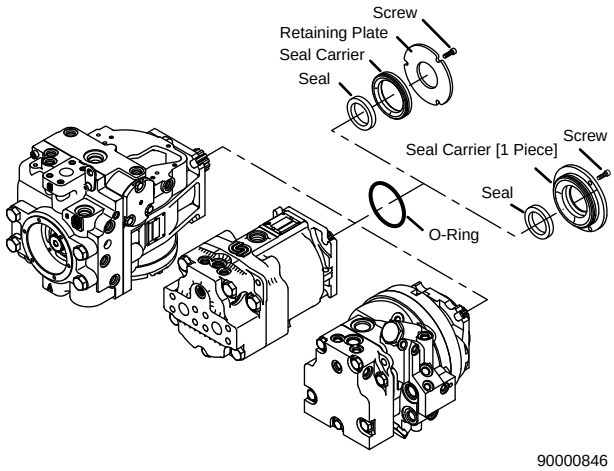
90000272

Press Out Old Seal



90000273

New Seal Installed in Carrier



90000846

Series 90 Shaft Seal Components

Lip type shaft seals are used on Series 90 pumps and motors. These seals and/or the shafts can be replaced without major disassembly of the unit. However, replacement usually requires removal of the pump or motor from the machine.

1. Position the pump with the shaft facing up.

   NOTE: If the unit is positioned horizontally when the shaft is removed, the cylinder block could move out of place, making shaft installation difficult.

2. Remove the three or four screws holding the retainer plate and seal carrier to the housing, using a 10 mm hex wrench (030 and 042 units), a 5 mm internal hex wrench (055 through 100 units), or a 6 mm internal hex wrench (130 through 250 units). Remove the retainer plate.

   NOTE: Certain earlier production units use a one piece retainer plate and seal carrier.

3. After removing the screws, the spring force on the shaft may move the seal carrier out of its bore by approximately 5 mm (1/4 inch). If the seal carrier does not move from its bore after removing the screws, pry it from its bore as shown and/or lightly tap the end of the shaft with a soft mallet.

4. Remove the O-ring from the seal carrier.

5. Place seal carrier and seal in an arbor press and press out old seal.

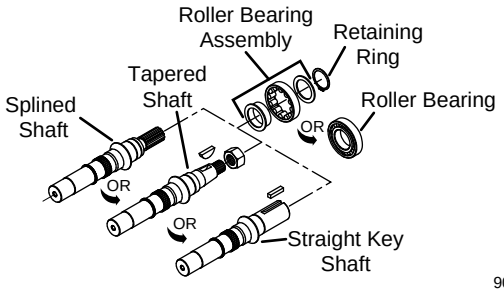
6. Inspect the seal carrier, the new seal and the O-ring for any damage or nicks.

7. Using the arbor press, press the new seal into seal carrier. Be careful not to damage the seal.

   The outside diameter of the seal may be lightly coated with a sealant (such as Loctite High Performance Sealant #59231) prior to installation. This aids in preventing leaks caused by damage to the seal bore in the seal carrier.

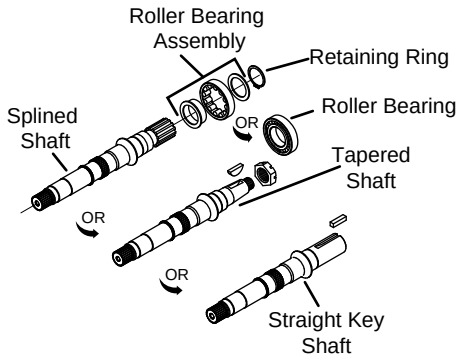
8. Inspect the sealing area on the shaft for rust, wear, or contamination. If the shaft is not being replaced proceed to step 12.
9. Remove shaft and roller bearing assembly from pump or motor. The bearing assembly can be transferred to the new shaft.
10. Remove the retaining ring that secures roller bearing assembly with a snap ring pliers. Remove the roller bearing assembly.
11. Place roller bearing assembly on new shaft and secure with the retaining ring.
12. Wrap spline or key end of shaft with plastic film to prevent damage to the sealing lip on the seal during installation.
13. Prior to assembly, lubricate the O-ring on the O.D. of the seal carrier and the I.D. of the seal with clean petroleum jelly.
14. Assemble the seal carrier and seal over the shaft and into the housing bore. Install the retainer plate (if used).
15. Install the screws and torque to 16 Nm (12 ft•lbf) for 030 through 100 pumps, 32 Nm (24 ft•lbf) for 130 through 250 pumps, 9.5 Nm (7 ft•lbf) for 055 through 100 motors, and 22.5 Nm (16.6 ft•lbf) for 130 motors.

NOTE: Torque the screws in a sequenced pattern then recheck.



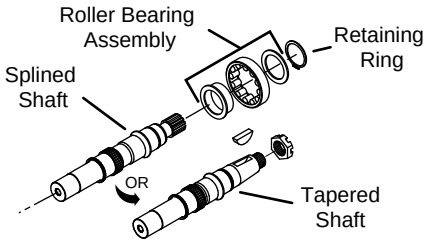
90000866

Fixed Motor Shaft Configuration



90000867

Variable Pump Shaft Configuration



90000868

Variable Motor Shaft Configuration



90000274

Install Seal Carrier



90000275

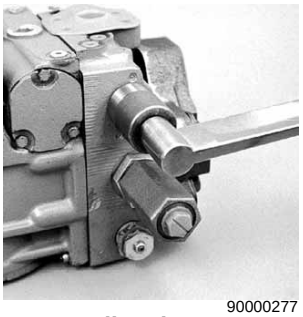
Torque Retainer Screws

9.2 Pump Minor Repairs



90000276

Remove Multi-Function Valve Cartridge



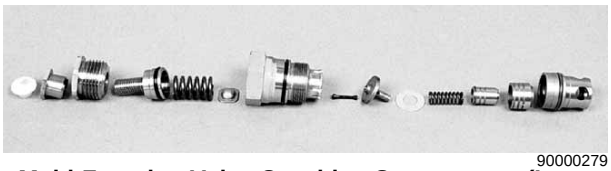
90000277

Install and Torque Cartridge



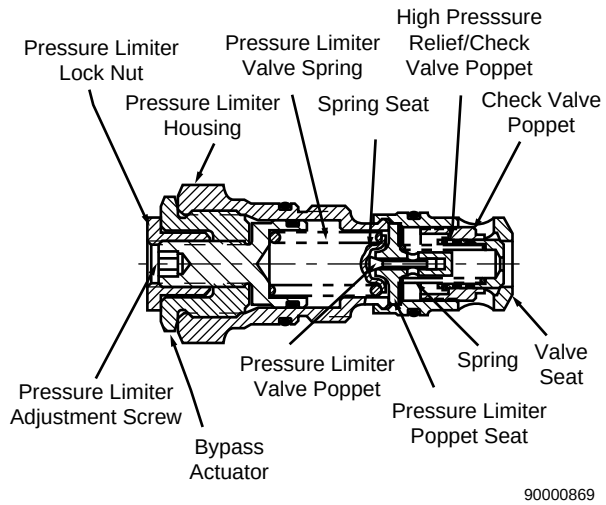
90000278

Multi-Function Valve Cartridge Components (Earlier Production)



90000279

Multi-Function Valve Cartridge Components (Later Production)



90000869

Multi-Function Valve Cartridge Sectional View

9.2.1 Multi-Function Valve Cartridges

1. The multi-function valve cartridge is removed with a 1-1/4 inch (030 through 100 pumps) or a 1-5/8 inch (130 through 250 pumps) hex wrench on the largest hex on the cartridge.
2. Inspect cartridge for damage to parts and O-rings.

   The multi-function valve cartridge may be disassembled for cleaning. However, if the pressure limiter housing assembly is disassembled, the pressure settings must be readjusted. Usually, if there is contamination problem, it will be in the valve seat assembly. If it is not necessary to clean the interior of the cartridge, proceed to step 7.

   NOTE: Multi-function valve components are not sold separately as service parts (except O-rings).
3. On early versions of the multi-function valves, the valve seat assembly is held by a retaining ring. Remove retaining ring with a snap ring pliers.

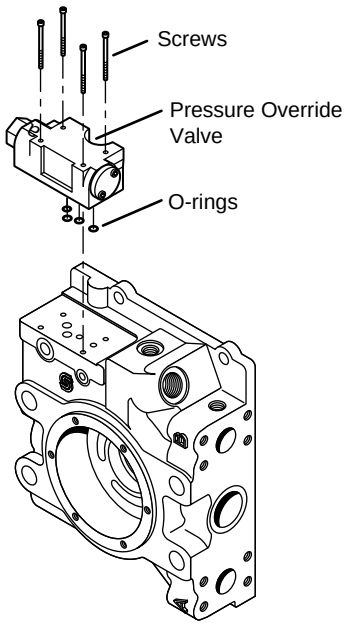
   On late versions, the valve seat section is pressed over a lip. Place the cartridge in a vise and pry the lower section off with an appropriate tool. Maintain sufficient control to prevent the contents from flying loose.
4. Remove pressure limiter lock nut and bypass actuator.
5. Unscrew the pressure limiter adjustment screw from the bypass actuator.
6. Clean and inspect all disassembled parts.
7. Reassemble with new, lightly lubricated O-rings by reversing the above procedure. For early versions assemble with the retaining ring. For late versions, place the cartridge in a vise and press on lower assembly.

CAUTION
The pressure settings must be readjusted after disassembling the pressure limiter housing of the multi-function valve cartridge (see Sec. 8.2.1)

8. Install cartridge in multi-function valve cavity and torque to 89 Nm (66 ft•lbf) for 030 through 100 pumps and 279 Nm (206 ft•lbf) for 130 through 250 pumps. **Do not overtorque the multi-function valve cartridge.**

9.2.2 Pressure Override Valve (Option for 180 Frame Size)

1. Remove the four screws attaching the pressure override valve to the pump end cap with a 5 mm internal hex wrench. Remove the O-rings.
2. Inspect valve for damage to parts.
3. Install new O-rings. Install the valve onto the pump end cap and torque the screws to 16 Nm (12 ft•lbf).



90000870

Pressure Override Valve Components

9.2.3 Charge Relief Valve

The pump charge relief valve may be shim adjustable (early models) or screw adjustable (late models).

1. Remove the shim adjustable charge relief valve plug with a 1 inch hex wrench.

   Before removing the screw adjustable relief valve plug, mark the plug, lock nut, and housing so as to approximately maintain the original adjustment when assembling. Remove the screw adjustable charge relief valve plug by loosening the lock nut with a 1–1/16 inch wrench for 030 through 100 units or a 1-5/8 inch for 130 through 250 units. Unscrew the plug with a large screwdriver or 1/2 inch hex wrench.
2. Remove the spring and relief valve poppet.
3. Inspect the poppet and mating seat in the end cap for damage or foreign material.

   When inspecting shim adjustable valves, do not alter the shims or interchange parts with another valve.
4. Install the poppet and spring. For shim adjustable valves, install the plug and torque to 68 Nm (50 ft•lbf). For screw adjustable valves, install the plug with its lock nut, aligning the marks made at disassembly, and torque the lock nut to 52 Nm (38 ft•lbf).

Check the charge pressure and adjust, if necessary (8.1.1).



90000280

Remove Charge Relief Valve (Shim Adjustable)



90000262

Shim Adjustable Charge Relief Valve



90000264

Remove Charge Relief Valve (Screw Adjustable)



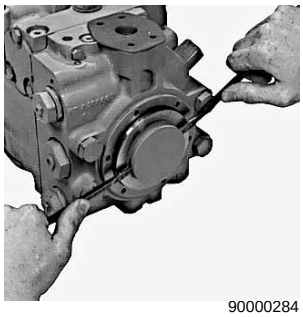
90000265

Screw Adjustable Charge Relief Valve



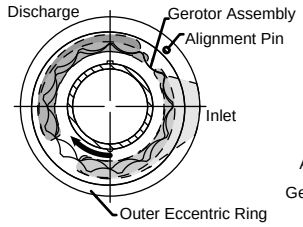
90000282

Remove Retainer Screws

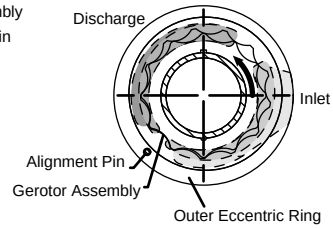


90000284

Remove Charge Pump Cover



Left Hand Rotation (Outside Looking Into Pump)



Right Hand Rotation (Outside Looking Into Pump)

90000871

Orienting Gerotor Outer Ring and Alignment Pin (CCW Rotation)

Orienting Gerotor Outer Ring and Alignment Pin (CW Rotation)

9.2.4 Charge Pump

The following procedure shows how to remove and install a charge pump.

1. For pumps with an auxiliary mounting pad, remove the four screws holding the pad to the end cap and remove the pad. Refer to the Auxiliary Mounting Pad Installation instructions (next section) for details.

   NOTE: Late production pumps may not have the smaller screws installed to secure the end cap to the pump housing when the large screws are removed. On these pumps, secure the end cap to the pump housing with a clamp to avoid gasket damage.

CAUTION
Do not allow the force of the cylinder block spring and swashplate leveler springs to separate the end cap from the pump housing. Gasket damage and external leakage may result.

2. Using a 10 mm (030 through 100 pumps) or a 13 mm (130 through 250 pumps) hex wrench, remove the six screws holding the charge pump cover retainer.
3. Remove the retainer and the charge pump cover. For pumps with an auxiliary mounting pad, remove the auxiliary drive coupling. Note the orientation of the gerotor.

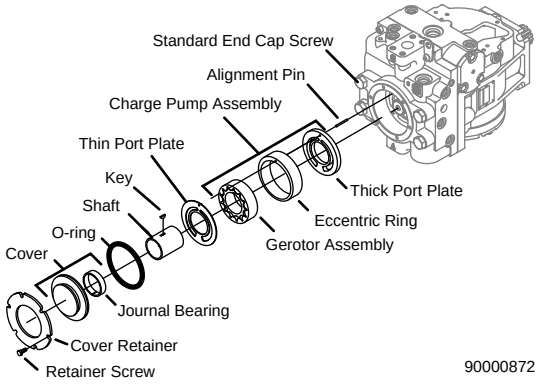
(continued)

4. Remove the charge pump shaft and charge pump drive key.
5. Remove the spacer plate(s), if present (intermediate production pumps only).

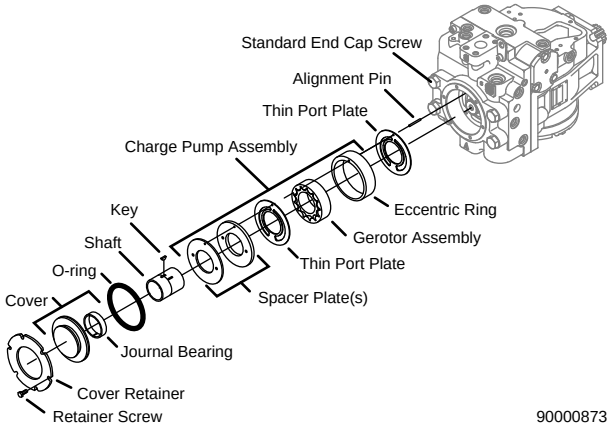
   Remove the charge pump outer port plate, if present (early and intermediate production pumps).

   Remove the charge pump gerotor assembly.
6. Remove the outer eccentric ring and alignment pin.
7. Remove the inner port plate.
8. Inspect all parts for abnormal wear or damage.

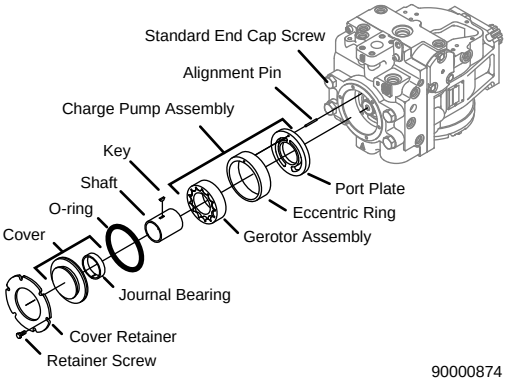
   NOTE: If a different displacement charge pump is being installed, the gerotor assembly, gerotor outer eccentric ring, and inner port plate (early and late production pumps) or outer spacer plate(s) (intermediate production pumps) must be replaced together. If different thickness port plates are used in an early production charge pump assembly, the thicker plate is the inner port plate (installed next to the pump end cap).



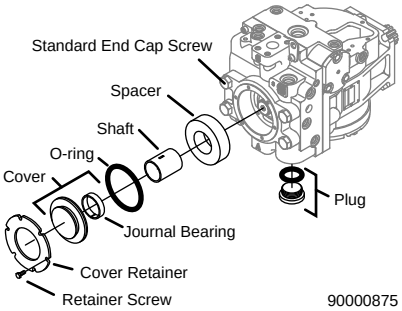
Charge Pump Components (Early Production)



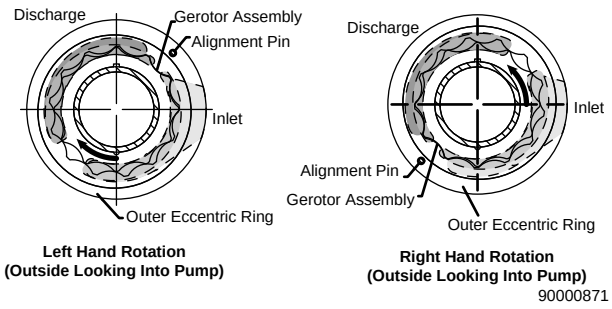
Charge Pump Components (Intermediate Production)



Charge Pump Components (Late Production)



"No Charge Pump" Components



Orienting Gerotor Outer Ring and Alignment Pin (CCW Rotation)

Orienting Gerotor Outer Ring and Alignment Pin (CW Rotation)


90000285

Install Inner Port Plate


90000286

Install Gerotor Assembly Outer Ring


90000287

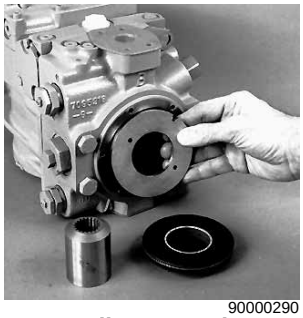
Install Alignment Pin


90000288

Install Gerotor Assembly


90000289

Install Outer Port Plate (Early and Intermediate Production Only)


90000290

Install Spacer Plate (Intermediate Production Only)

Installing the Charge Pump

Be sure to install the charge pump in the proper orientation. If unsure of charge pump rotation, refer to the model code.

*NOTE: The charge pump **rotation** is determined by the orientation of the gerotor assembly outer eccentric ring and the location of the alignment pin in the end cap.*

NOTE: Do not mix charge pump piece parts from different production periods. Always install as a complete assembly.

1. Install the inner port plate and the gerotor assembly outer ring.
2. Install the alignment pin to properly orient the port plates and outer eccentric ring for corresponding pump rotation.
3. Prior to installation, apply a small quantity of petroleum jelly to the I.D., O.D., and side faces of the gerotor assembly to provide initial lubrication.
4. Install the gerotor assembly.
5. Install the outer port plate (early production and intermediate production pumps only).
6. Install the spacer plate, if present (intermediate production pumps).

(continued)

7. Install the charge pump drive key into the charge pump shaft and retain with petroleum jelly.

   NOTE: Intermediate production 75 cc and 100 cc pumps use the same charge pump drive shaft. Two keyways are provided in the drive shaft for the charge pumps used in these units. The rear keyway (with identifier groove) is used in 75 cc pumps. The front keyway (closest to the internally splined end of the shaft) is used in 100 cc pumps.

8. Install the charge pump shaft. The internally splined end of the shaft must engage the main pump shaft.

   NOTE: The outside diameter of the internally splined end of some early production charge pump shafts was chamfered. Early production end caps may not be machined to accept a non-chamfered shaft. Always use a chamfered charge pump shaft in pumps with the early end cap.

9. For pumps with an auxiliary mounting pad, install the auxiliary drive coupling.

10. Install a new O-ring onto the non-auxiliary pad charge pump cover. (If an auxiliary pad is installed, an O-ring is not used on the cover.)

11. Carefully remove the alignment pin from the charge pump parts. Install the pin in its hole in the charge pump cover (see previous page for correct orientation) and retain with petroleum jelly. Install the cover (with alignment pin) into the end cap and aligned charge pump parts. (Take care not to damage the cover O-ring, if used.)

CAUTION
In order to avoid loss of charge pressure in pumps with an auxiliary mounting pad, always install the charge pump cover with the pad drain hole located on the same side of the end cap as the charge inlet port. Refer to Sec. 9.2.5 Auxiliary Pad Installation for details.

12. Install the charge pump cover retainer and the six hex screws and torque the screws to 13.5 Nm (10 ft•lbf) for 030 through 100 pumps, and 32 Nm (24 ft•lbf) for 130 through 250 pumps.

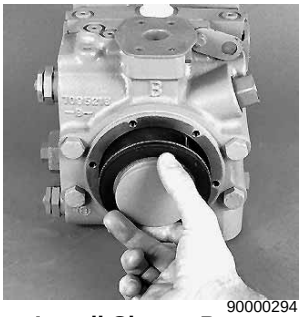
13. For pumps with auxiliary mounting pads, install the O-ring and auxiliary mounting pad adaptor onto the end cap. Refer to Sec. 9.2.5 for instructions on auxiliary pad installation.

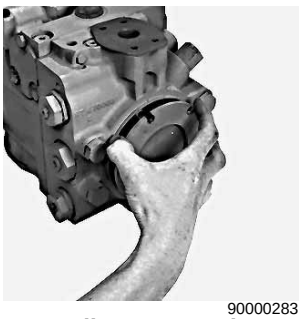


90000291
Keyways in Charge Pump Shaft (Intermediate Production 075 and 100)


90000292
Install Charge Pump Shaft


90000293
Aligning Pin Installed in Cover


90000294
Install Charge Pump Cover

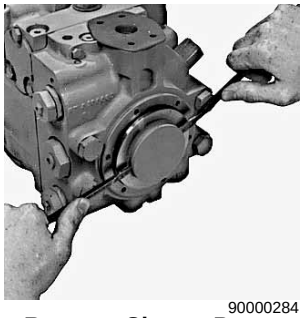

90000283
Install Cover Retainer


90000295
Torque Retainer Screws



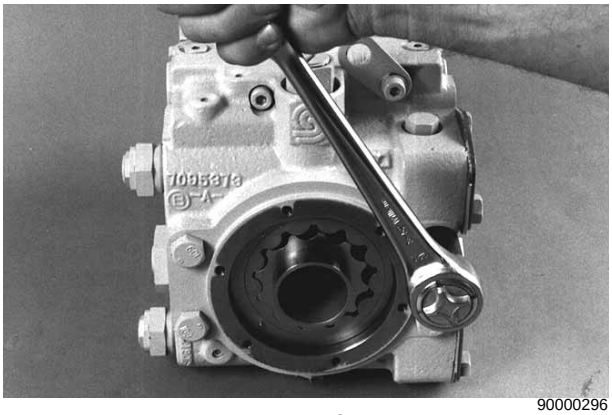
90000282

Remove Screws and Retainer



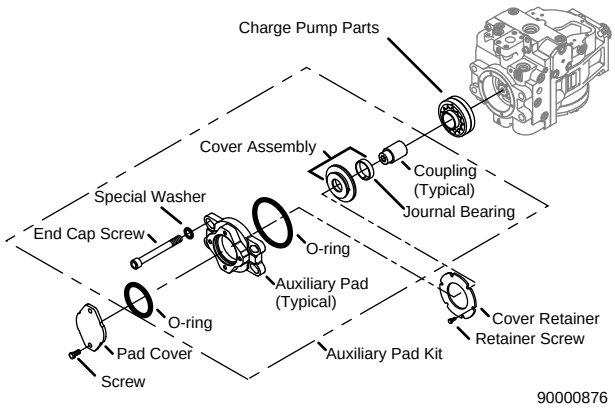
90000284

Remove Charge Pump Cover



90000296

Remove Large End Cap Screws



90000876

Auxiliary Pad Components (Typical)

9.2.5 Auxiliary Pad Installation

1. Using a 10 mm (030 through 100 pumps) or a 13 mm (130 through 250 pumps) hex wrench, remove the six screws holding the charge pump cover retainer. Remove the retainer.
2. Remove the charge pump cover and its O-ring.

   NOTE: The original charge pump cover will not be used when installing the auxiliary pad.
3. Remove the four large screws which fasten the end cap to the pump housing.

Frame Size	Hex Wrench Size	
	Internal Hex	External Hex
030 & 042 (early)	8 mm	
042 (late)	10 mm	
055		19 mm
075 & 100		24 mm
100 & 130	14 mm	
180 & 250	17 mm	

NOTE: Late production pumps may not have the smaller screws installed to secure the end cap to the pump housing when the large screws are removed. On these pumps, secure the end cap to the pump housing with a clamp to avoid gasket damage.

CAUTION
Do not allow the force of the cylinder block spring and swashplate leveler springs to separate the end cap from the pump housing. Gasket damage and external leakage may result.

4. Take care to assure the surfaces are clean and free of any foreign material or paint prior to installing the auxiliary pad.

(continued)

5. Install the auxiliary drive coupling onto the pump drive shaft spline (auxiliary drive spline must be toward the rear of the pump).
6. Carefully remove the alignment pin from the charge pump parts. Install the pin in its hole in the new charge pump cover (with hole for the auxiliary coupling) and retain with petroleum jelly. Install the new charge pump cover with alignment pin into the end cap and the aligned charge pump parts.

CAUTION
In order to avoid loss of charge pressure, always install the charge pump cover with the pad drain hole located on the same side of the end cap as the charge inlet port.

7. Install the charge pump cover retainer and the six hex screws and torque the screws to 13.5 Nm (10 ft•lbf) for 030 through 100 pumps, and 32 Nm (24 ft•lbf) for 130 through 250 pumps.
8. Install O-ring on end cap pilot.
9. Install the auxiliary mounting pad adapter on external pilot on rear of end cap.
10. Install four new large screws and washers through the mounting pad and end cap into the housing. Torque per the accompanying table.

Frame Size	Wrench Size (Internal Hex)	Torque	
		Nm	lbf•ft
030 & 042 (early)	8 mm	75	55
042 (late) & 055	10 mm	122	90
075	14 mm	256	189
100 & 130	14 mm	298	220
180 & 250	17 mm	580	429

11. Install the O-ring and flange cover or auxiliary pump.

Auxiliary Pad Conversion

To convert an auxiliary mounting pad to a different size mounting pad, use the above procedure with the following additions:

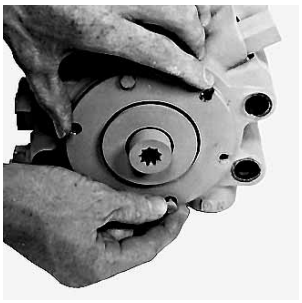
After removing the charge pump cover (step 2), remove the old auxiliary drive coupling.

After removing the four end cap retaining screws (step 3), remove the old auxiliary mounting pad adapter.


90000297
Install Drive Coupling

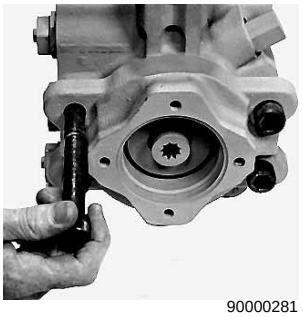

90000298-
Install Alignment Pin in Cover (CCW Rotation shown)

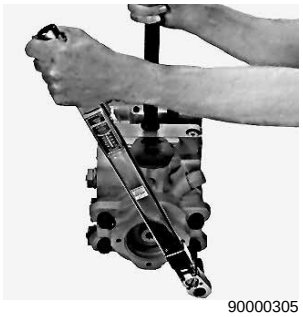

90000299
Install New Charge Pump Cover


90000300
Install Screws and Cover Retainer


90000302
Install O-Ring on End Cap Pilot

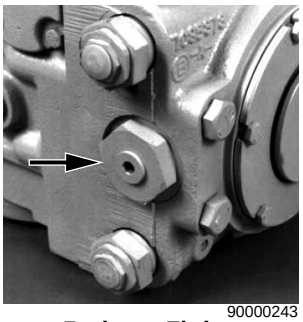

90000303
Install Auxiliary Pad Adapter


90000281
Install Auxiliary Pad Adapter Screws


90000305
Torque Pad Adapter Screws



90000310
Charge Pump Inlet



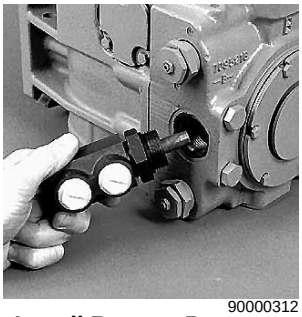
90000243
Reducer Fitting



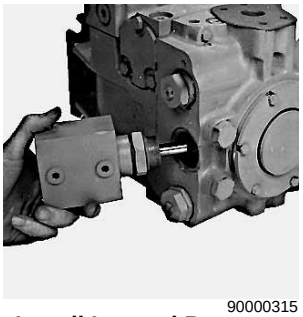
90000311
Remote Pressure Filter Manifold



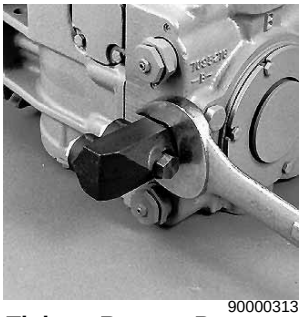
90000314
Integral Pressure Filter Head



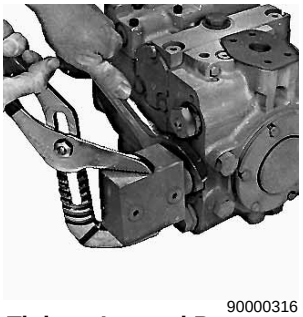
90000312
Install Remote Pressure Filter Manifold



90000315
Install Integral Pressure Filter Head



90000313
Tighten Remote Pressure Filter Manifold Lock Nut



90000316
Tighten Integral Pressure Filter Head Lock Nut

9.2.6 Filtration Options

9.2.6.1 Suction Filtration Installation

1. Install the hydraulic fitting to connect the external suction filter to the charge pump inlet port.
2. The reducer fitting (placed on the charge pressure gauge port) is installed as follows.

Frame Size	Wrench Size	Torque	
042	1–1/4"	70 Nm	[52 lbf•ft]
055 - 130	1–1/2"	122 Nm	[90 lbf•ft]
180 & 250	1–1/2"	156 Nm	[115 lbf•ft]

The gauge port plug is torqued to 27 Nm (20 ft•lbf).

9.2.6.2 Remote Charge Pressure Filtration or Integral Charge Pressure Filtration

Install either of these two filtration devices as follows.

1. Remove the reducer fitting, located at charge pressure gauge port, from pump end cap (this part will not be used).
2. Install the filter manifold or filter head into the port. The hydraulic tube should enter its mating bore in the pump end cap with a low force.
3. After rotating the filter manifold or filter head clockwise so that the threads engage with the threads in the end cap, continue to rotate it clockwise between 6 and 7 revolutions. Face manifold or head to the desired position.

CAUTION
Failure to install the filter manifold or filter head to a sufficient depth in the end cap will result in insufficient engagement of the tube in the end cap bore. This may allow unfiltered oil to bypass the filter and enter the charge system.

4. While holding the filter manifold or filter head in the desired position, tighten the swivel lock nut.

Frame Size	Wrench Size	Torque	
042	1–3/8"	70 Nm	52 lbf•ft
055 - 130	1–5/8"	122 Nm	90 lbf•ft
180 & 250	1–5/8"	156 Nm	115 lbf•ft

5. After installing the integral pressure filter head assembly, install the filter canister per the instructions on the filter canister.

9.3 Pump Controls

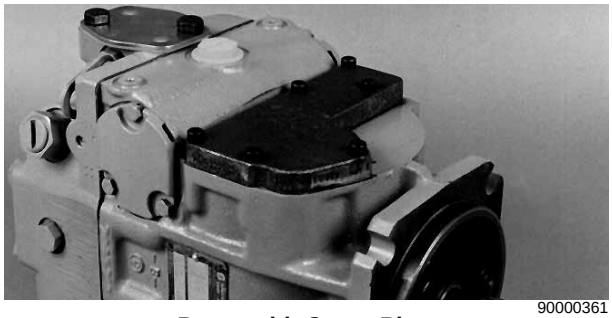
9.3.1 Cover Plate

1. Thoroughly clean external surfaces prior to removal of cover plate.
2. Using a 5 mm internal hex wrench, remove the eight cover plate mounting screws. Remove the cover plate and gasket from housing.

CAUTION
Protect exposed surfaces and cavities from damage and foreign material.

3. In preparation for installing the cover plate, place a new gasket on the housing. Place the cover plate into position and install the screws. Torque the screws to 16 Nm (12 ft•lbf).

   NOTE: A sealing washer must be installed under the head of any mounting screws that are installed into "thru" holes in the housing.



90000361

Pump with Cover Plate



90000319

Remove Mounting Screws



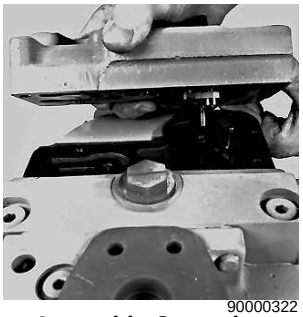
90000320

Remove Control



90000321

Inner Face of Control



90000322

Assemble Control to Linkage



90000323

Assemble Control to Pump



90000324

Torque Mounting Screws

9.3.2 Manual Displacement Control (MDC)

1. Thoroughly clean external surfaces prior to removal of control.
2. Using a 5 mm internal hex wrench, remove the eight control mounting screws. Remove the control (with orifice check valve and spring) and control gasket from housing.

CAUTION
Protect exposed surfaces and cavities from damage and foreign material.

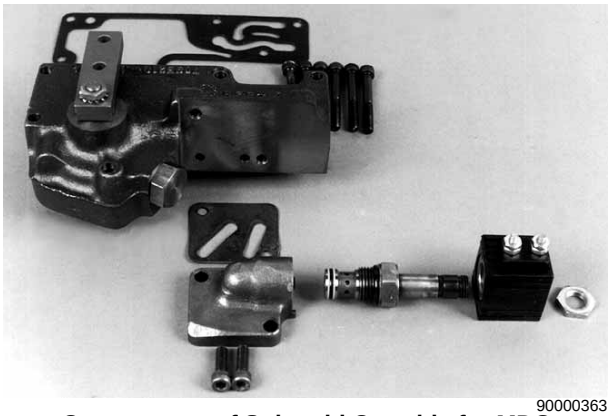
3. In preparation for installing the control, place a new gasket on the housing. Inspect to assure that the control orifice check valve and spring are in their proper position in the control.
4. While setting the control into position, engage the pin on the control linkage into the mating hole in the link attached to the swashplate.
5. With the control in position, move control lever both directions to check proper engagement of control linkage pin. Proper engagement will be indicated by centering torque as the lever is moved from center. Non-engagement of control linkage pin is indicated by lack of centering torque as the lever is moved. In case of non-engagement remove the control and repeat the above procedure.
6. Align the control gasket and install the screws. Torque the screws to 16 Nm (12 ft•lbf).

   NOTE: A sealing washer must be installed under the head of any mounting screws that are installed into "thru" holes in the housing.
7. If the control is equipped with a neutral start switch, refer to the "MDC Neutral Start Switch Adjustment" instructions in Sec. 8.2.3.

WARNING
The neutral start switch "neutral" must be readjusted after reassembling the MDC module.

9.3.3 Solenoid Override Valve for MDC

1. Thoroughly clean external surfaces prior to removal of valve.
2. Using a 5 mm internal hex wrench, remove the two screws and remove solenoid manifold from housing. Remove the old gasket.
3. The solenoid may be removed from the valve by removing the nut with a 3/4 inch hex wrench. The solenoid valve may be removed from the manifold with a 7/8 inch hex wrench.
4. When installing the solenoid valve into the manifold, the valve should be torqued to 18.6 Nm (13.8 ft•lbf). When installing the solenoid onto the valve, torque the nut to 2.8 Nm (25 in•lbf).
5. In preparation for installing the solenoid manifold, place a new gasket on the control housing. Install the manifold onto the control housing, align the gasket, and install the screws. Torque screws to 13.5 Nm (10 ft•lbf).

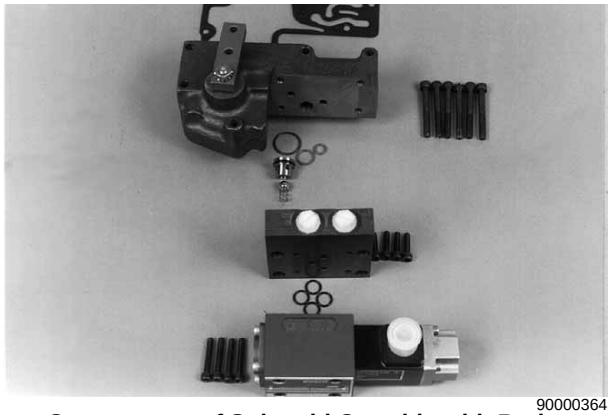


90000363

Components of Solenoid Override for MDC

9.3.4 Solenoid Override Valve for MDC with Pressure Released Brake

1. Thoroughly clean external surfaces prior to removal of valve.
2. Using a 4 mm internal hex wrench, remove the four solenoid valve mounting screws. Remove the solenoid valve (with O-rings) from the adapter plate.
3. Using a 4 mm internal hex wrench, remove the four adapter plate mounting screws. Remove the adapter plate and O-rings from the control housing.
4. Remove the check valve seat and O-ring from the control side of the adapter plate. Remove the check ball and spring.
5. Install a new O-ring on the check valve seat and reassemble the check valve spring, ball, and seat into the adapter plate.
6. Install new O-rings on the adapter plate. Place the adapter plate into position and install the screws. Torque the screws to 5.4 Nm (48 in•lbf).
7. Install new O-rings onto the solenoid valve assembly and install the solenoid valve onto the adapter plate. Install the screws and torque to 5.4 Nm (48 in•lbf).



90000364

Components of Solenoid Override with Brake Pressure Defeat for MDC



90000325

Remove Mounting Screws



90000326

Remove Control



90000327

Inner Face of Control



90000328

Assemble Control to Linkage



90000329

Install Mounting Screws



90000330

Torque Mounting Screws



90000332

PCP Components



90000334

Torque PCP Valve Screws

9.3.5 Hydraulic and Electric Displacement Controls

1. Thoroughly clean external surfaces prior to removal of control.
2. Using a 5 mm internal hex wrench, remove the eight control mounting screws. Remove the control (with orifice check valve and spring) and control gasket from housing.

CAUTION
Protect exposed surfaces and cavities from damage and foreign material.

3. In preparation for installing the control, place a new gasket on the housing. Inspect to ensure that the control orifice check valve and spring are in their proper position in the control.
4. While setting the control into position, engage the pin on the control linkage into the mating hole in the link attached to the swashplate.
5. With the control in position, move control assembly left and right to check engagement of pin in the link. Proper engagement will be indicated by an increasing resistance as the control is moved away from center position. Non-engagement of pin will be indicated by lack of spring force. In case of non-engagement, remove control and repeat the above procedure.
6. Align the control gasket and install the screws. Torque the screws to 16 Nm (12 ft•lbf).

   NOTE: A sealing washer must be installed under the head of any mounting screws that are installed into "through" holes in the housing.

9.3.6 Pressure Control Pilot (PCP) for Electric Displacement Control

1. Thoroughly clean external surfaces of control.
2. Using a 4 mm internal hex wrench, remove the four screws and remove the PCP.
3. Check surfaces for nicks or damage. Clean internal screens.
4. Install new O-rings in PCP Housing. Place PCP against EDC housing and install the screws. Torque to 5.4 Nm (48 in•lbf).

   NOTE: Do not remove black plastic cover from the aluminum plate. This is not a serviceable item and will void the product warranty.

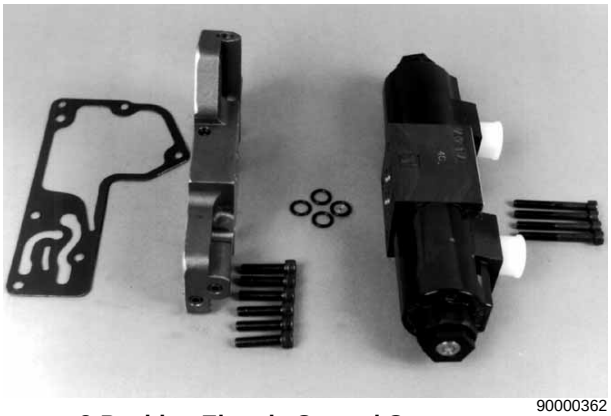
9.3.7 3-Position (FNR) Electric Control

1. Thoroughly clean external surfaces prior to removal of control.
2. Using a 4 mm internal hex wrench, remove the four solenoid valve mounting screws. Remove the solenoid valve (with O-rings and orifice) from the adapter plate.
3. Using a 5 mm internal hex wrench, remove the eight adapter plate mounting screws. Remove the adapter plate and gasket from housing.

CAUTION
Protect exposed surfaces and cavities from damage and foreign material.

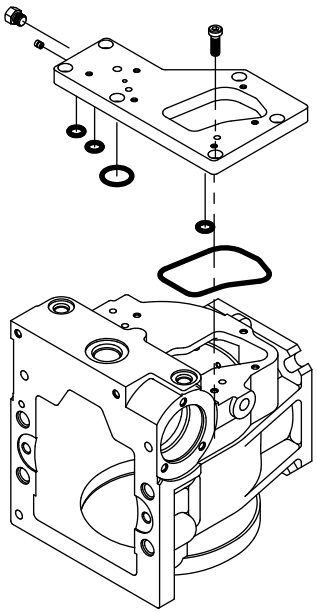
4. Inspect the orifice installed between the valve and adapter plate. This orifice MUST be installed in the case drain passage for proper pressure limiter operation.
5. In preparation for installing the adapter plate, place a new gasket on the housing. Place the adapter plate into position and install the screws. Torque the screws to 16 Nm (12 ft•lbf).

   NOTE: A sealing washer must be installed under the head of any mounting screws that are installed into "thru" holes in the housing.
6. Install new O-rings and the orifice onto the solenoid valve assembly and install the solenoid valve onto the adapter plate. Install the screws and torque to 5.4 Nm (48 in•lbf).



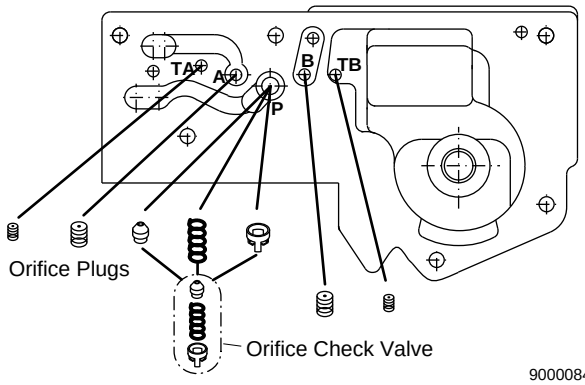
90000362

3-Position Electric Control Components



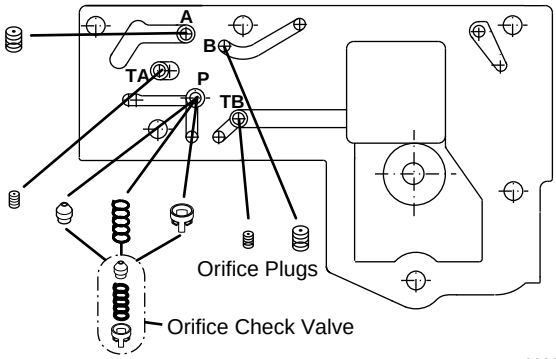
90000847

Displacement Control Adapter Plate (Early Production 130cc Pumps Only)



90000848

The Underside of an MDC Module Showing Orifice Locations



90000849

The Underside of an HDC/EDC Module Showing Orifice Locations

9.3.8 Displacement Control Components

9.3.8.1 Displacement Control Adapter Plate (Early Production 130 Pumps Only)

The screws fastening the control adapter plate to the housing have retaining compound on the threads. They are removed with a 6 mm internal hex wrench.

When installing the adapter plate, ensure the O-rings are in the proper position and torque the screws to 32 Nm (24 ft•lbf).

9.3.8.2 Displacement Control Filter Screens

If the pump is equipped with control filter screens in the pump housing (late production), they should be pressed into position (with the rounded edge of the filter screens facing the control) until they are flush to 2.0 mm (0.08 inch) below the surface of the housing.

9.3.8.3 Displacement Control Orifice Check Valve

1. Remove the control assembly as described in the instructions for the specific displacement control (9.3.2, 9.3.6, or 9.3.7).
2. The orifice check valve is located in the control assembly, at the surface of the pump housing face. Remove the spring retainer and spring from the orifice check valve cavity and then remove the orifice check valve.
3. Install the desired orifice check valve in the cavity and then install the spring and spring retainer to hold the orifice check valve in position.
4. Assemble the control onto the pump. Refer to the instructions for the specific control (9.3.2, 9.3.6, or 9.3.7).

9.3.8.4 Displacement Control Orifices

1. Remove the control assembly as described in the instructions for the specific displacement control (9.3.2, 9.3.6, or 9.3.7).
2. Orifice plugs may be located in the control assembly, at the pump housing face surface. Remove the orifice plugs with a 4 mm internal hex wrench. Note the location of each plug, do not interchange plugs. Torque the orifice plugs to 3 Nm (32 in•lbf).
3. Assemble the control onto the pump. Refer to the instructions for the specific control.

9.4 Minor Repairs - Motor

9.4.1 Loop Flushing and Charge Relief Valves

9.4.1.1 Loop Flushing Valve

1. Using an 11/16 inch wrench, remove the hex plugs and O-rings from both sides of the valve. Remove the springs, shoulder washers, and flushing valve shuttle spool. Note orientation of the washers. Remove the flushing valve spool.
2. Inspect parts for damage or foreign material.

   NOTE: Early production motors used a small diameter shuttle valve spool. Late production motors use a larger diameter spool.
3. Install flushing valve spool in end cap, then install the shoulder washers (with shoulders facing "out") and springs on each end of the spool. Install the hex plugs with O-rings, and torque to 41 Nm (30 ft•lbf) on 030 through 100 motors or 68 Nm (50 ft•lbf) on 130 motors.

9.4.1.2 Motor Charge Relief Valve

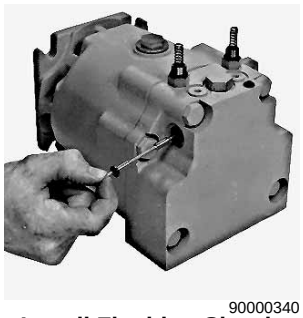
1. Remove the shim adjustable charge relief valve plug with a 7/8 inch hex wrench. Before removing the screw adjustable relief valve plug, mark the plug, lock nut, and housing so as to be able to maintain the original adjustment when assembling. Remove the screw adjustable charge relief valve plug by loosening the lock nut with a 1-1/16 inch hex wrench for 030 through 100 units, or a 1-5/8 inch hex wrench for 130 units, and unscrewing the plug with a large screwdriver or 1/2 inch hex wrench.
2. Remove the spring and valve poppet.
3. Inspect the poppet and mating seat in the end cap for damage or foreign material. When inspecting shim adjustable valves, do not alter the shims or interchange parts with another valve.
4. Install the poppet and spring. For shim adjustable valves, install the plug and torque to 68 Nm (50 ft•lbf). For screw adjustable valves, install the plug with its lock nut, aligning the marks made at disassembly, and torque the lock nut to 52 Nm (38 ft•lbf).
5. Check and adjust the charge pressure.



90000338
Remove Plugs and Springs



90000339
Remove Flushing Shuttle Spool



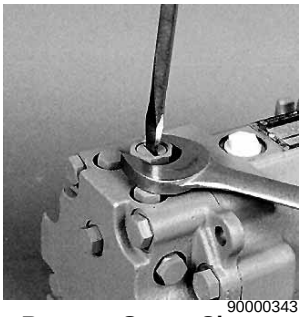
90000340
Install Flushing Shuttle Spool



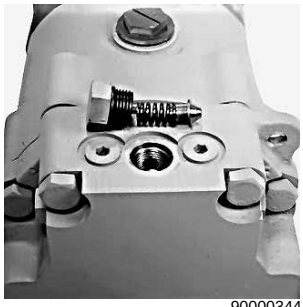
90000341
Torque Plugs



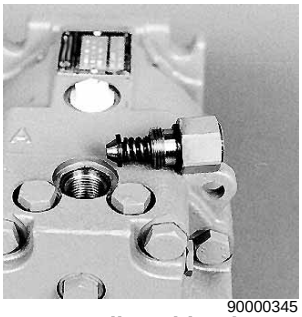
90000342
Remove Shim Charge Relief



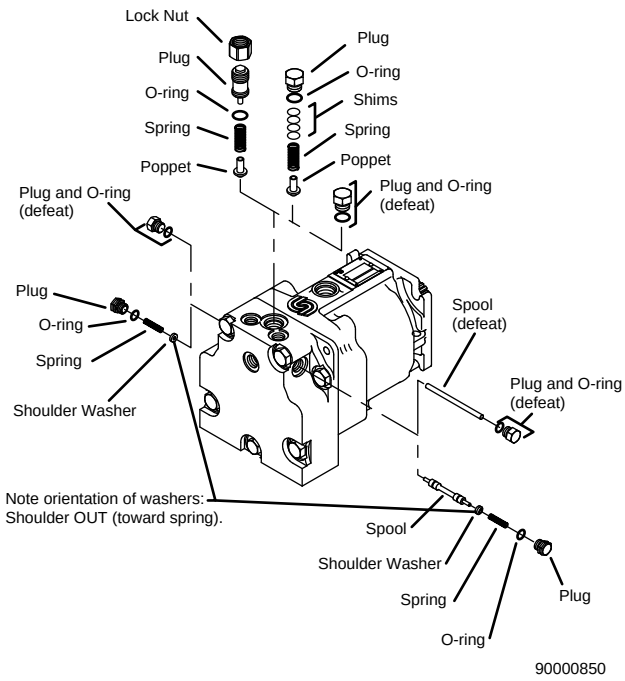
90000343
Remove Screw Charge Relief



90000344
Shim Adjustable Charge Relief Valve



90000345
Screw Adjustable Charge Relief Valve



Motor Charge Relief Valve and Loop Flushing Valve Parts

9.4.1.3 Defeating the Loop Flushing Valve

1. Remove loop flushing valve components (these parts will not be used).
2. Install defeating spool into spool bore in end cap.
3. Install hex plugs provided and torque to 41 Nm (30 ft•lbf) on 030 through 100 motors, or 68 Nm (50 ft•lbf) on 130 motors.
4. Remove charge relief valve components (these parts are not necessary).
5. Replace with the hex plug provided and torque to 41 Nm (30 ft•lbf) on 030 through 100 motors, or 68 Nm (50 ft•lbf) on 130 motors.

9.4.2 Variable Motor Displacement Limiters

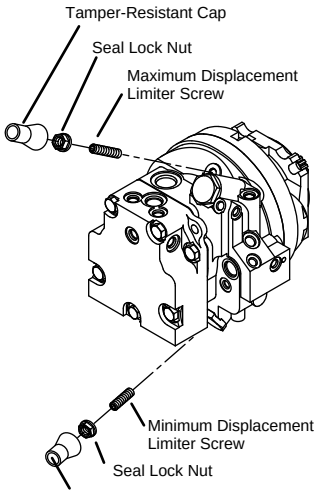
1. Remove the tamper-resistant cap from the displacement limiter. Using a 19 mm hex wrench, loosen the seal lock nut and remove the nut. Remove the limiter screw from the motor housing with a 6 mm internal hex wrench.
2. Install the limiter screw and seal lock nut. Do not install a new tamper-resistant cap until the limiter has been adjusted.
3. The displacement limiter should be initially adjusted so the motor swashplate contacts the limiter screws BEFORE it contacts the internal stops. Hold the swashplate in its maximum or minimum angle position and turn the appropriate limiter screw clockwise until it contacts the swashplate. Then turn the screw an additional 1/4 turn clockwise and torque the seal lock nut to 54 Nm (40 ft•lbf).
4. Final adjustment of the displacement limiters should be performed on a test stand. **Do not turn the limiter screws counterclockwise beyond their initial adjustment positions.**

WARNING
Care should be taken in adjusting displacement limiters to avoid undesirable speed conditions. The seal lock nut must be retorqued after every adjustment to prevent an unexpected change in operating conditions and to prevent external leakage during unit operation.

One full turn of the displacement limiter adjustment screw will change the displacement as follows:

Frame Size	Approx Change in Disp per Rev of Adjusting Screw
055	5.6 cm^3 / Rev (0.34 in^3 / Rev)
075	7.1 cm^3 / Rev (0.43 in^3 / Rev)

5. Following the final adjustment, install new tamper resistant caps.

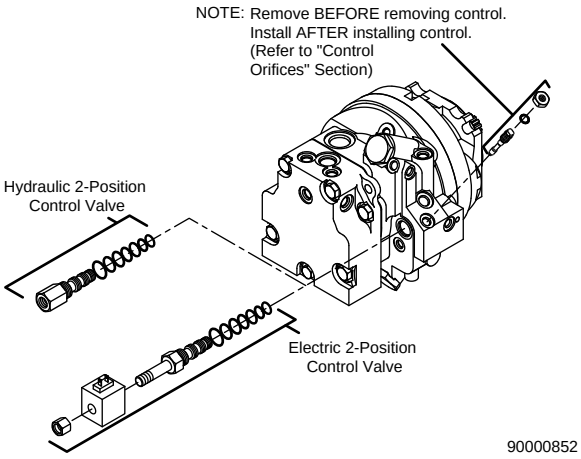


SAE Flange Version shown
(Cartridge Version similar)

90000851

MV Displacement Limiters

9.5 Variable Motor Controls



MV Control Components

9.5.1 Electrohydraulic 2-Position Control (Types NA, NB, NC, and ND)

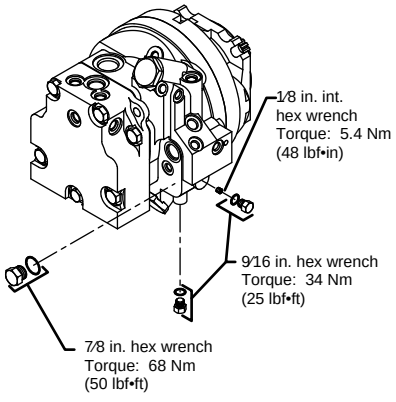
1. Thoroughly clean external surfaces prior to removal of the control.
2. Disconnect the external electrical signal connection.
3. Remove the hex nut and solenoid from the control valve.
4. Remove the orifice check valve for the maximum angle control cylinder, if equipped.
5. Remove the control valve from the motor housing.
6. Remove O-rings from the valve.
7. Install new O-rings on the control valve.
8. Install the valve into the motor housing and torque to 47 Nm (35 ft•lbf). **Do not overtorque the control valve.** Over-torquing may result in the valve spool sticking.
9. Install the solenoid onto the valve and torque the hex nut to 5 Nm (44 in•lbf). **Do not overtorque the nut.**
10. If previously removed, reinstall the orifice check valve. Reconnect the external electrical signal connection.

9.5.2 Hydraulic 2-Position Control (Type PT)

Follow the steps above, except that in step 2 a *hydraulic* signal line will be disconnected, and step 3 is not applicable.

9.5.3 Control Plugs

Remove the control plugs from the housings of earlier production motors, if necessary. Install new O-rings, reinstall, and torque.



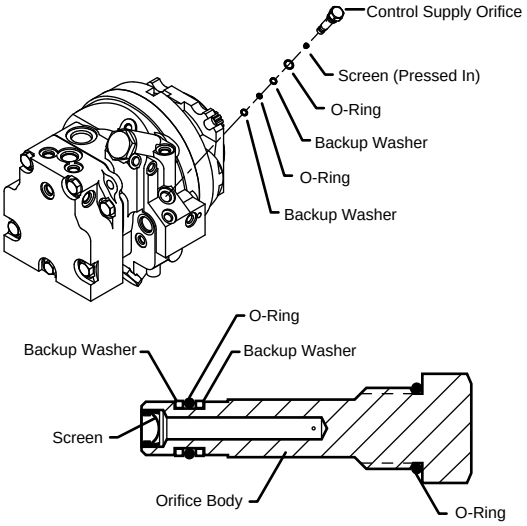
MV Control Plugs

9.5.4 Variable Motor Control Orifices

9.5.4.1 Control Supply Orifice

1. Remove the control supply orifice from the motor housing with an 11/16 inch hex wrench.
2. Remove the O-rings and the backup washers. Check that the filter screen is secure in the orifice body and that the screen and the orifice are not plugged.
3. Install new backup washers and O-rings onto the orifice body. Install the orifice into the motor housing and torque to 37 Nm (27 ft•lbf).

CAUTION
Do not interchange the control supply orifice with the minimum displacement orifice (next section).



Cross-Section View of Control Supply Orifice Assembly

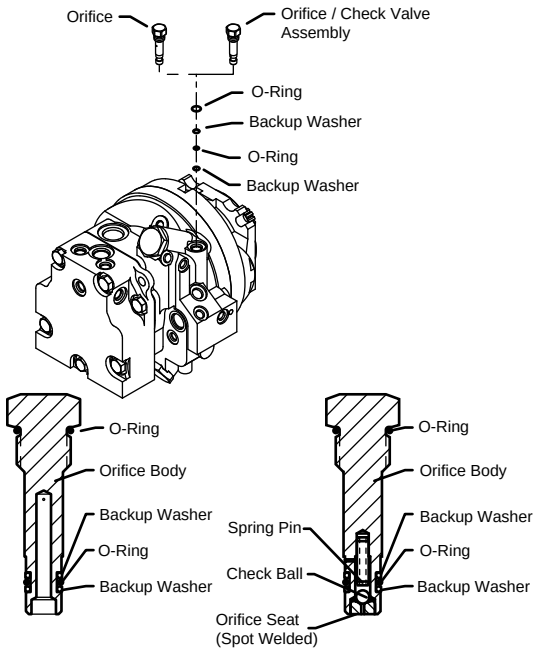
90000854

MV Control Supply Orifice

9.5.4.2 Minimum Displacement Cylinder Orifice or Orifice Check Valve

1. Remove the minimum displacement cylinder drain orifice or the orifice check valve from the motor housing with an 11/16 inch hex wrench.
2. Remove the O-rings and the backup washers. Check that the orifice is not plugged. Check that the check valve seat is secure in the body and that the check ball is free.
3. Install new backup washers and O-rings onto the orifice body. Install the orifice into the motor housing and torque to 37 Nm (27 ft•lbf).

CAUTION
Do not interchange the control supply orifice (previous section) with the minimum displacement orifice.

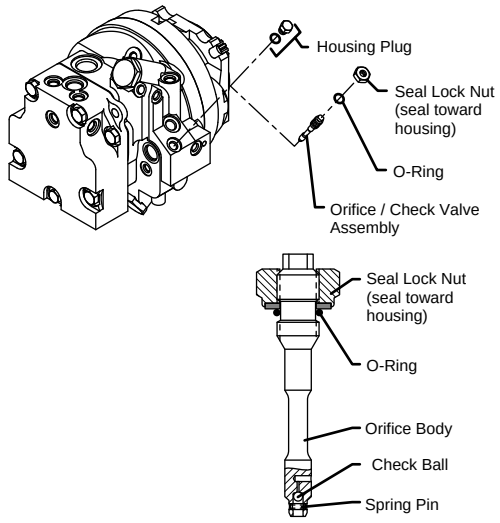


Cross-Section View of Orifice Assembly

Cross-Section View of Orifice / Check Valve Assembly

90000855

MV Minimum Displacement Orifice



Cross-Section View of Orifice / Check Valve Assembly

90000856

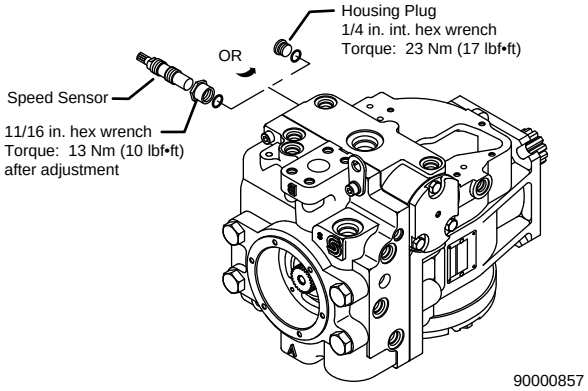
MV Maximum Displacement Orifice

9.5.4.3 Maximum Displacement Cylinder Orifice Check Valve

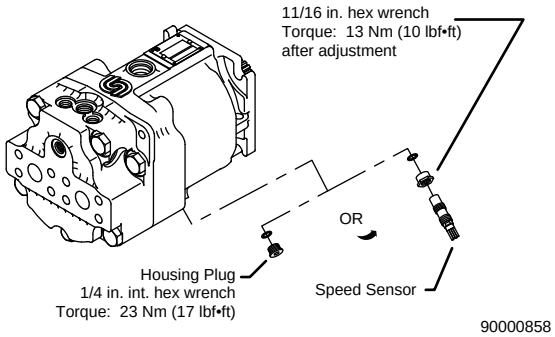
1. Remove the seal lock nut with a 3/4 inch hex wrench. Remove the maximum displacement cylinder orifice check valve from the motor housing with a 1/4 inch end wrench. Remove the O-ring. The check ball in the valve must be free.
2. Reinstall the check valve and torque to 15 Nm (11 ft•lbf). Install a new O-ring. Install the seal lock nut with the seal toward the motor housing. **Hold the check valve from turning while torquing the seal lock nut to 34 Nm (25 ft•lbf).**
3. If no orifice check valve is installed, the housing plug may be removed with a 9/16 inch hex wrench. Always install a new O-ring. Reinstall the plug and torque to 20 Nm (15 ft•lbf).

9.6 Speed Sensor

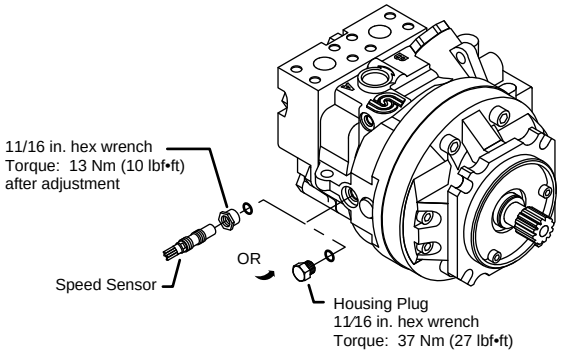
1. Remove the speed sensor by disconnecting the electrical connector, loosening the lock nut, and unscrewing the speed sensor from the pump or motor housing.
2. Always install a new O-ring before installing the sensor.
3. Reinstall the speed sensor (with lock nut and O-ring) into the housing. Adjust the gap between the sensor and the magnetic speed ring as instructed in Sec. 8.4 and torque the sensor lock nut.
4. If a speed sensor is not installed, the housing plug should be torqued as indicated in the accompanying figure.



Typical Location of Speed Sensor - PV



Typical Location of Speed Sensor - MF

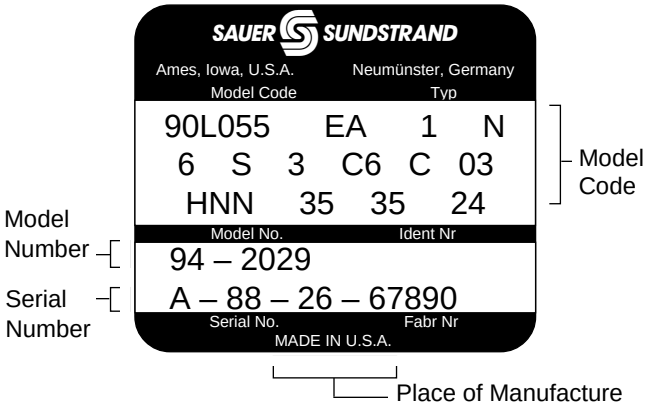


Typical Location of Speed Sensor - MV

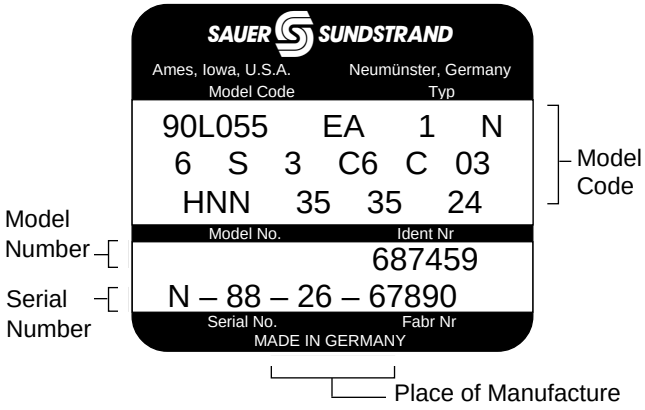
10. Exploded View Parts Drawings

10.1 Variable Pumps

10.1.1 Name Plates

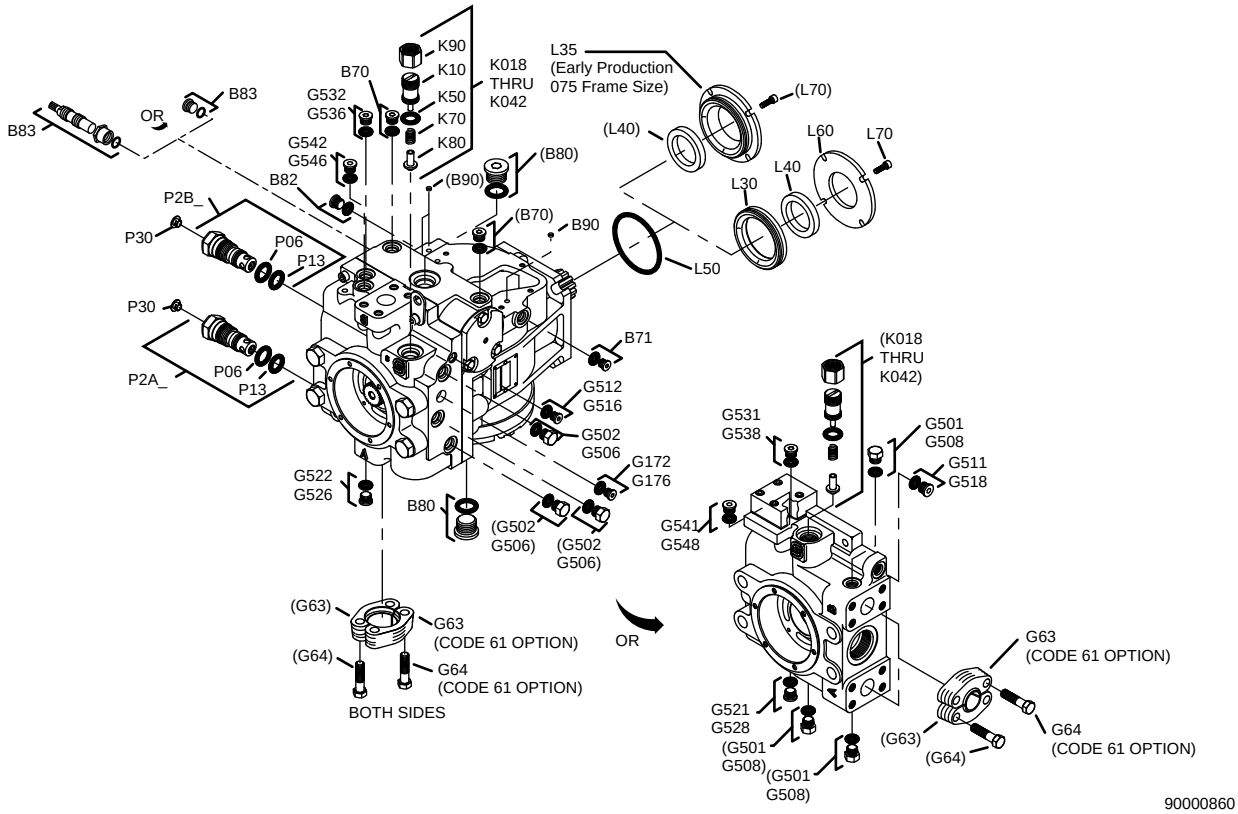


Name Plate (U.S.A. Production)

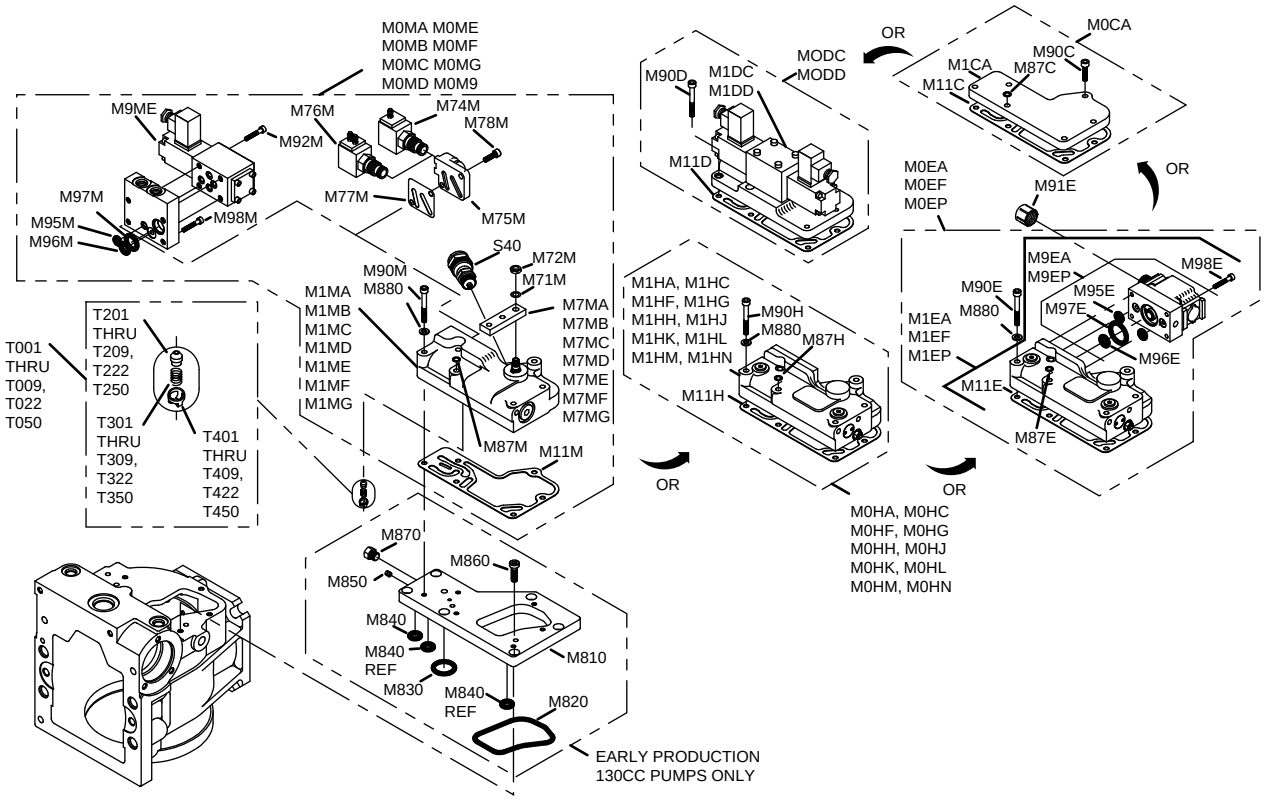


Name Plate (German Production)

10.1.2 Minor Repair Parts

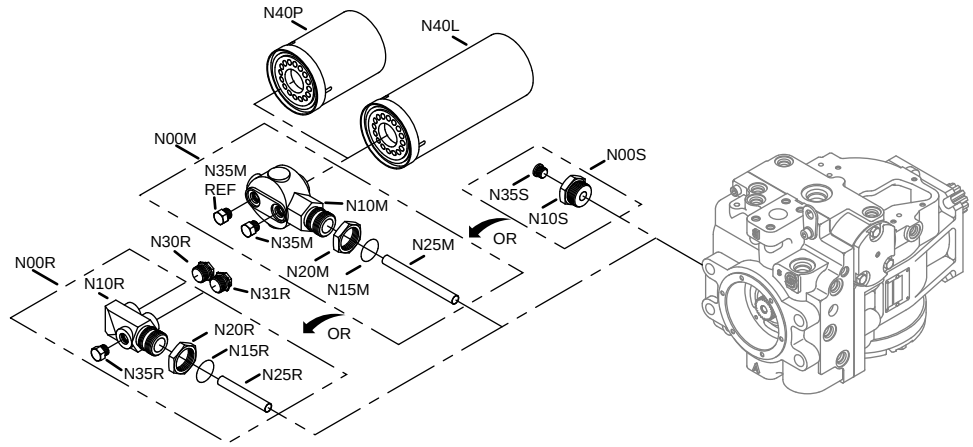


10.1.3 Controls

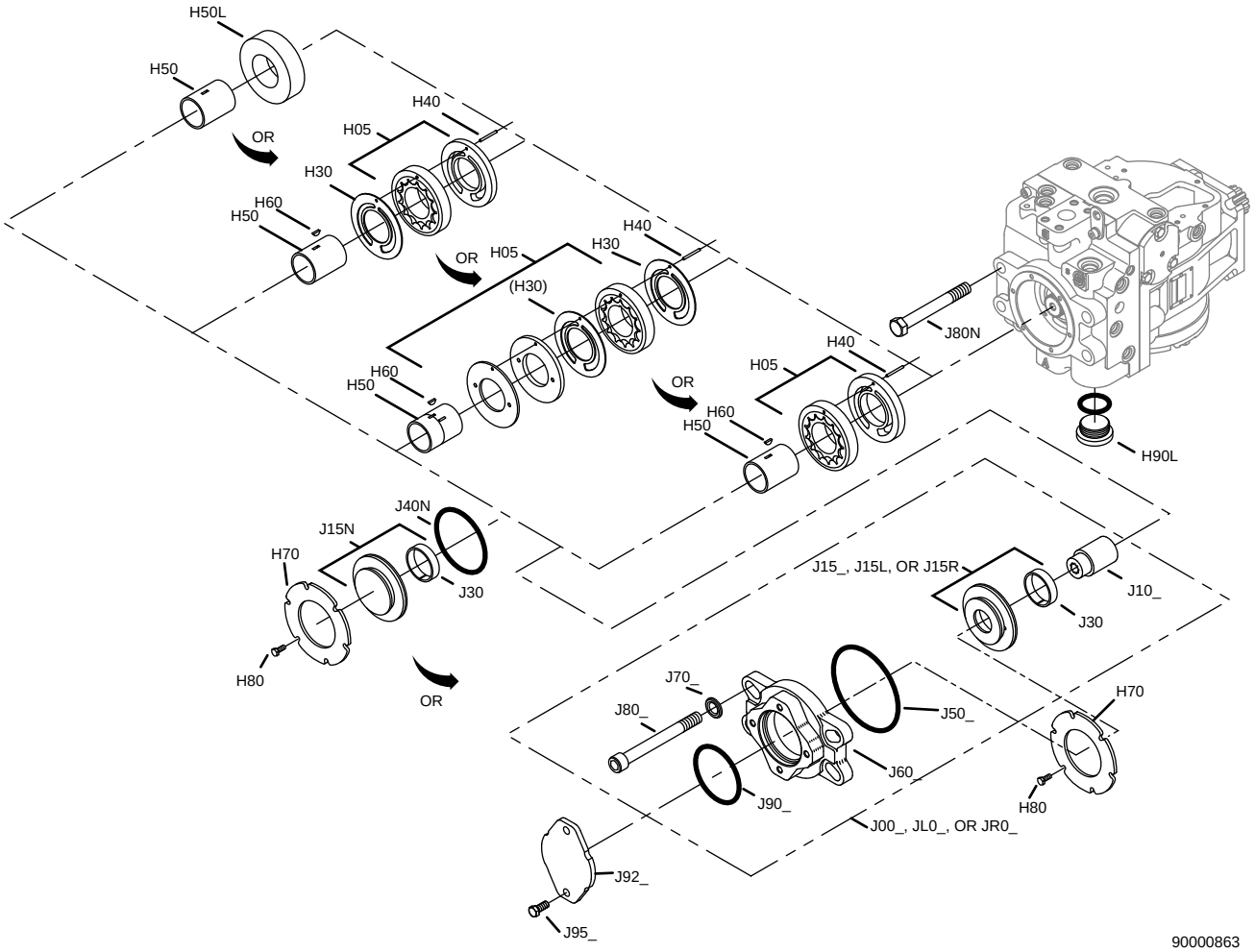


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10.1.4 Filtration Options, Charge Pump Options, Auxiliary Pad Options



90000862



90000863

10.1.5 Pump Parts List

Item	Description	Qty
B70	Plug	2
B71	Plug	1
B80	Plug	1
B82	Plug	1
B90	Control Filter Screen	3
G63	Split Clamp	4
G64	Screw - Shipping Cover	4
G172	Plug	1
G176	Plug	1
G501	Plug	3
G502	Plug	3
G506	Plug	3
G508	Plug	3
G511	Plug	1
G512	Plug	1
G516	Plug	1
G518	Plug	1
G521	Plug	1
G522	Plug	1
G526	Plug	1
G528	Plug	1
G531	Plug	1
G532	Plug	1
G536	Plug	1
G538	Plug	1
G541	Plug	1
G542	Plug	1
G546	Plug	1
G548	Plug	1
H05B-H	Kit - Charge pump	1
H05L	Spacer (No Charge pump)	1
H30	Port plate	2
H40	Pin	1
H50	Charge pump shaft	1
H60	Key	1
H70	Retaining plate	1
H80	Screw	6
H90L	Plug	1
J00A	Aux. mtg. ‘A’ flange	1
J00B	Aux. mtg. ‘B’ flange	1
J00C	Aux. mtg. ‘C’ flange	1
J00D	Aux. mtg. ‘D’ flange	1
J00T	Aux. mtg. ‘A’ flange (11T)	1
J00V	Aux. mtg. ‘B-B flange	1
J00N	Aux. mtg. flange - none	1
J10A-V	Coupling	1
J15	Charge pump cover assembly	1
J15N	Charge pump cover assembly	1
J30	Bushing	1

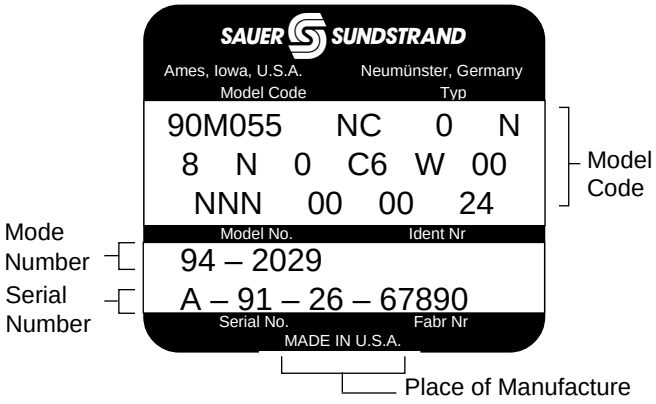
Item	Description	Qty
J50A-V	O ring	1
J60A/T	Flange adaptor	1
J60B/V	Flange adaptor	1
J60C	Flange adaptor	1
J60D	Flange adaptor	1
J70A-V	Washer	4
J80A-V	Screw	4
J80N	Screw	4
J90A-V	O ring	1
J92A-V	Cover plate	1
J95A-V	Screw	2/4
K10	Plug Assembly	1
K50	O ring	1
K70	Spring	1
K80	Poppet	1
K90	Nut	1
L30	Seal carrier	1
L35	Seal carrier	1
L40	Lip seal	1
L50	O ring	1
L60	Retainer	1
L70	Screw	3
L8	Key	1
L9	Slotted nut	1
M0CA	Control - Cover Plate Kit	1
M1CA	Cover plate	1
M11C	Control gasket	1
M87C	Washer, seal (042)	1
M90C	Screw	6
M0DC	Control kit 3 position FNR 12v	1
M0DD	Control kit 3 position FNR 24v	1
M1DC	Control 3 position FNR 12v	1
M1DD	Control 3 position FNR 24v	1
M80	Control gasket	1
M87D	Washer, seal (042)	1
M90D	Screw	6
M0EA	EDC kit w/MS connector	1
M0EP	EDC kit w/Packard connector	1
M1EA	EDC w/MS connector	1
M1EP	EDC w/Packard connector	1
M9EA	PCP type 3 oil filled (MS)	1
M9EA	PCP type 3 oil filled (Packard)	1
M80	Control gasket	1
M87E	Washer, seal (042)	1
M90E	Screw	6
M91E	Plastic cap (MS)	1
M95E	O ring	2

Item	Description	Qty
M96E	O ring	1
M97E	O ring	1
M98E	Screw	4
M0HA	HDC kit	1
M0HC	HDC kit	1
M1HA	HDC	1
M1HC	HDC	1
M80	Control gasket	1
M87H	Washer, seal (042)	1
M90H	Screw	6
M0MA	MDC w/o neutral start switch	1
M7M	Control handle	1
M71M	Washer	1
M72M	Nut	1
M80	Control gasket	1
M87M	Washer, seal (042)	1
M90M	Screw	6
M0MB	MDC w/neutral start switch	1
M7M	Control handle	1
M71M	Washer	1
M72M	Nut	1
M80	Control gasket	1
M87M	Washer, seal (042)	1
M90M	Screw	6
S40	Neutral start switch kit	1
M0MC	MDC w/sol. valve	1
M7M	Control handle	1
M71M	Washer	1
M72M	Nut	1
M74M	Solenoid valve	1
M75M	Control manifold	1
M77M	Manifold gasket	1
M78M	Screw	2
M80	Control gasket	1
M87M	Washer, seal (042)	1
M90M	Screw	6
M0MD	MDC w/sol. valve, nss	1
M7M	Control handle	1
M71M	Washer	1
M72M	Nut	1
M75M	Control manifold	1
M76M	Solenoid valve	1
M77M	Manifold gasket	1
M78M	Screw	2
M80	Control gasket	1
M87M	Washer, seal (042)	1
M90M	Screw	6
S40	Neutral start switch kit	1

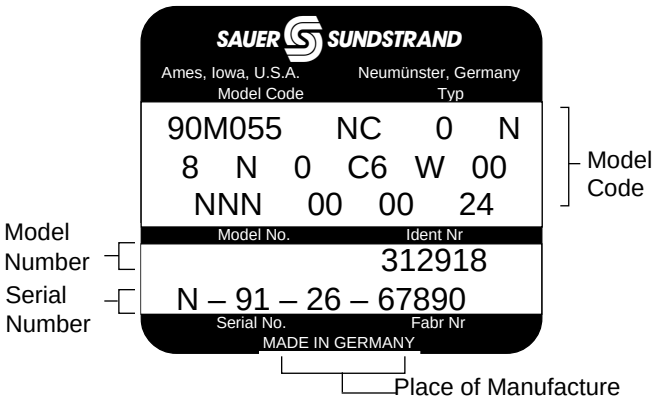
Item	Description	Qty
M810	Adapter Plate - Control (130 cc)	1
M820	O-ring (130 cc)	1
M830	O-ring (130 cc)	1
M840	O-ring (130 cc)	2
M850	Plug (130 cc)	1
M860	Screw (130 cc)	6
M870	Plug (130 cc)	1
N00M	Filtration manifold kit (Int)	1
N10M	Manifold	1
N15M	O ring	2
N20M	Nut	1
N25M	Tube	1
N30M	Plug	2
N40L	Filter	1
N40P	Filter	1
N00R	Filtration manifold kit (Rmt)	1
N10R	Manifold	1
N15R	O ring	1
N20R	Nut	1
N25R	Tube	1
N30R	Plastic plug	2
N00R	Plug	1
N00S	Filtration kit (Suction Flt)	1
N10S	Reducer fitting (Suction Flt)	1
N30S	Plug	1
P2A	Multi-function valve assembly	1
P2B	Multi-function valve assembly	1
P6	O ring	2
P13	O ring	2
P30	Plastic plug	2
T001-9	Control orifice kit	1
T201-9	Orificed check valve	1
T301-9	Spring	1
T401-9	Spring retainer	1

10.2 Fixed Motor

10.2.1 Name Plates

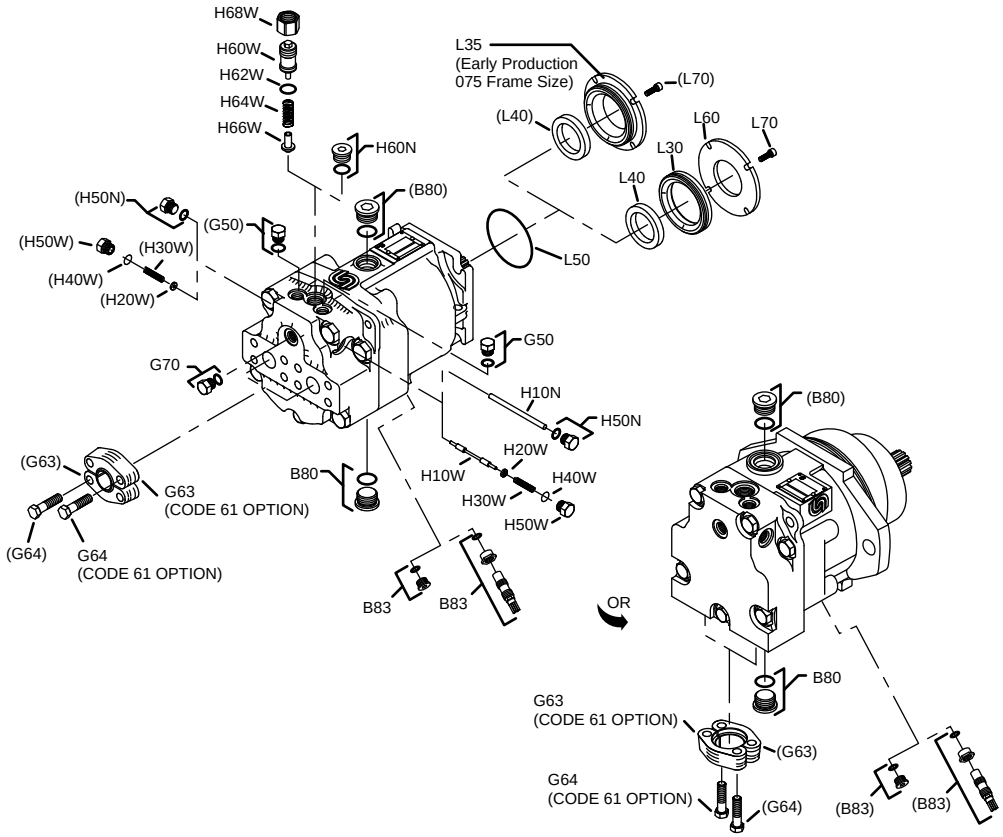


Name Plate (U.S.A. Production)



Name Plate (German Production)

10.2.2 Minor Repair Parts



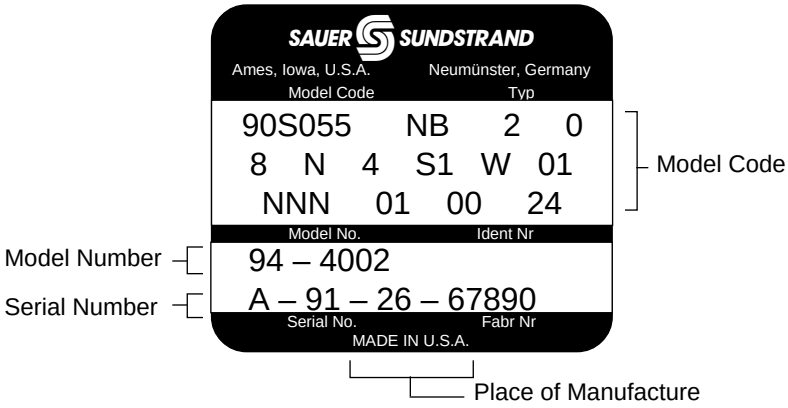
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10.2.3 Fixed Motor Parts List

Item	Description	Qty	Item	Description	Qty
B80	Plug	2	L30	Seal carrier	1
B83	Plug	1	L35	Seal carrier	1
B83	Speed sensor	1	L40	Lip seal	1
			L50	O ring	1
G50	Plug	2	L60	Retainer	1
G70	Plug	1	L70	Metric screw	3
G63	Split Clamp	4			
G64	Screw - Shipping Cover	4	L8	Key	1
			L9	Slotted nut	1
H10N	Loop flushing spool - defeat	1			
H50N	Plug	2			
H10W	Shuttle valve spool	1			
H20W	Spring guide	2			
H30W	Spring	2			
H40W	O-ring	2			
H50W	Special plug	2			
H60W	Charge relief valve plug	1			
H62W	O-ring	1			
H64W	Spring	1			
H66W	Charge relief poppet	1			
H68W	Lock nut	1			

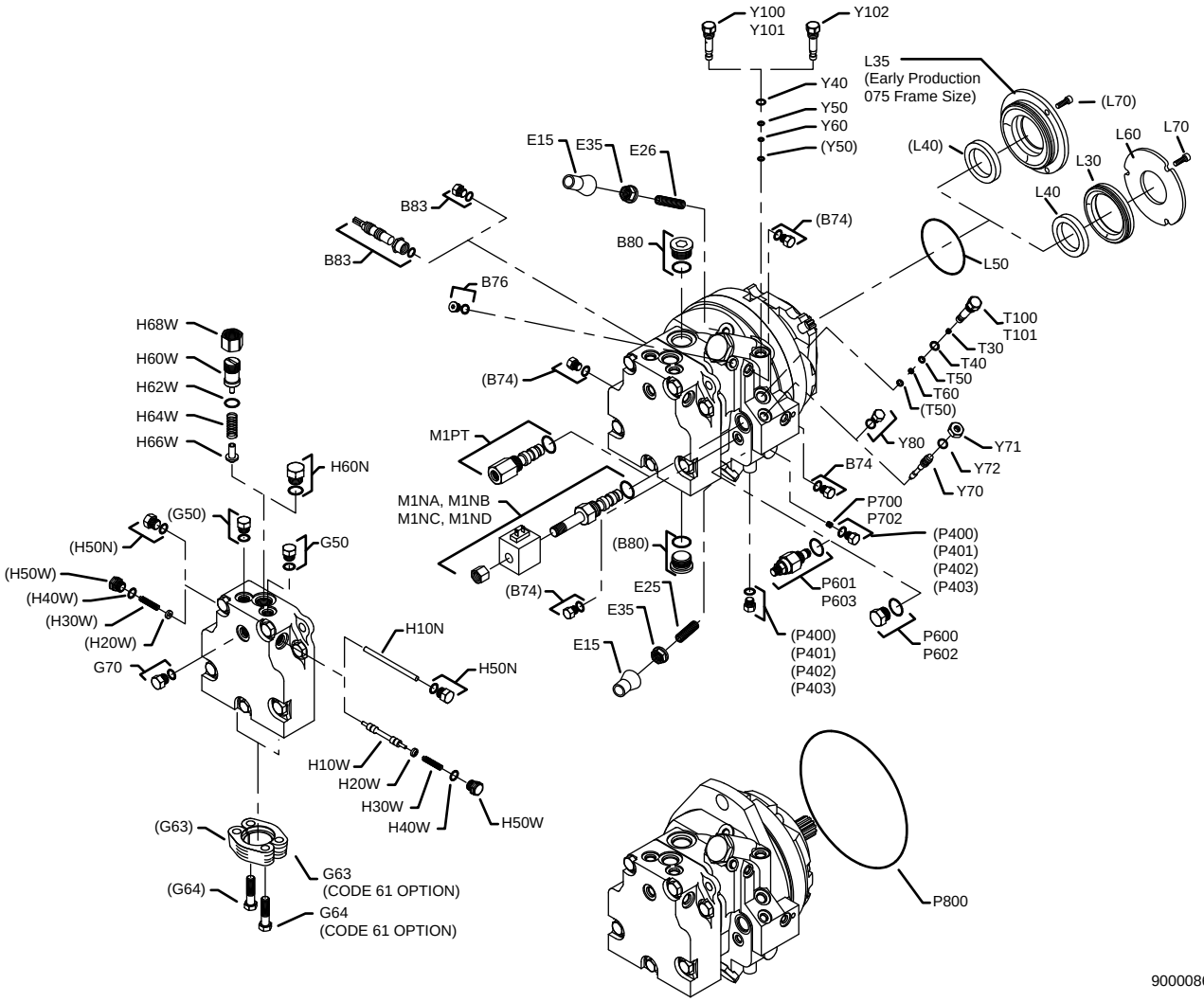
10.3 Variable Motor

10.3.1 Name Plate



Name Plate (U.S.A. Production)

10.3.2 Minor Repair Parts



10.3.3 Variable Motor Parts List

Item	Description	Qty
B74	Plug	4
B76	Plug	1
B80	Plug	2
B83	Plug	1
B83	Speed sensor	1
E15	Cap	1
E25	Set screw	1
E35	Nut - Seal Lock	1
G50	Plug	2
G63	Split flange clamp	4
G64	Shipping cover screw	4
G70	Plug	1
H10N	Loop flushing spool - defeat	1
H50N	Plug	2
H60N	Plug	1
H10W	Shuttle valve spool	1
H20W	Spring guide	2
H30W	Spring	2
H40W	O-ring	2
H50W	Special plug	2
H60W	Charge relief valve plug	1
H62W	O-ring	1
H64W	Spring	1
H66W	Charge relief poppet	1
H68W	Lock nut	1
L8	Key	1
L9	Slotted nut	1
L30	Seal carrier	1
L35	Seal carrier	1
L40	Lip seal	1
L50	O-ring	1
L60	Retainer	1
L70	Screw	3
M1N	Control valve - electric	1
M1P	Control valve - hydraulic	1
P400	Plug	2
P600	Plug	1
P601	Press compensator valve	1
P700	Special plug	1
P800	O-ring	1
T30	Filter screen	1
T40	O-ring	1
T50	Back up ring	2
T60	O-ring	1
T100	Orifice plug	1
Y40	O-ring	1
Y50	Back up ring	2
Y60	O-ring	1
Y70	Orifice check valve	1
Y71	Nut - Seal lock	1
Y72	O-ring	
Y80	Plug	1
Y100	Orifice plug	1
Y102	Orifice check valve	1

Notes

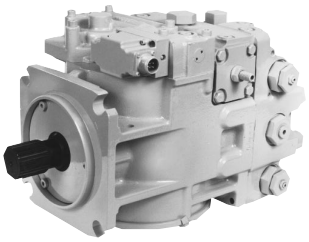
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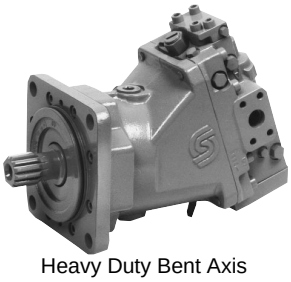
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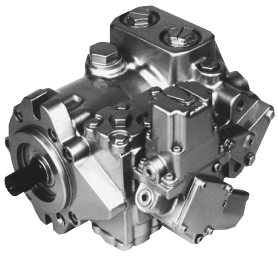
Heavy Duty Axial Piston Pumps and Motors



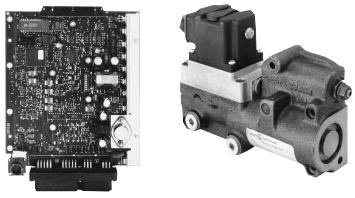
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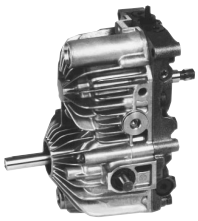
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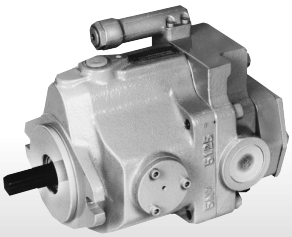
Medium Duty Axial Piston Pumps and Motors



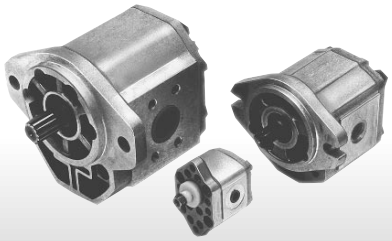
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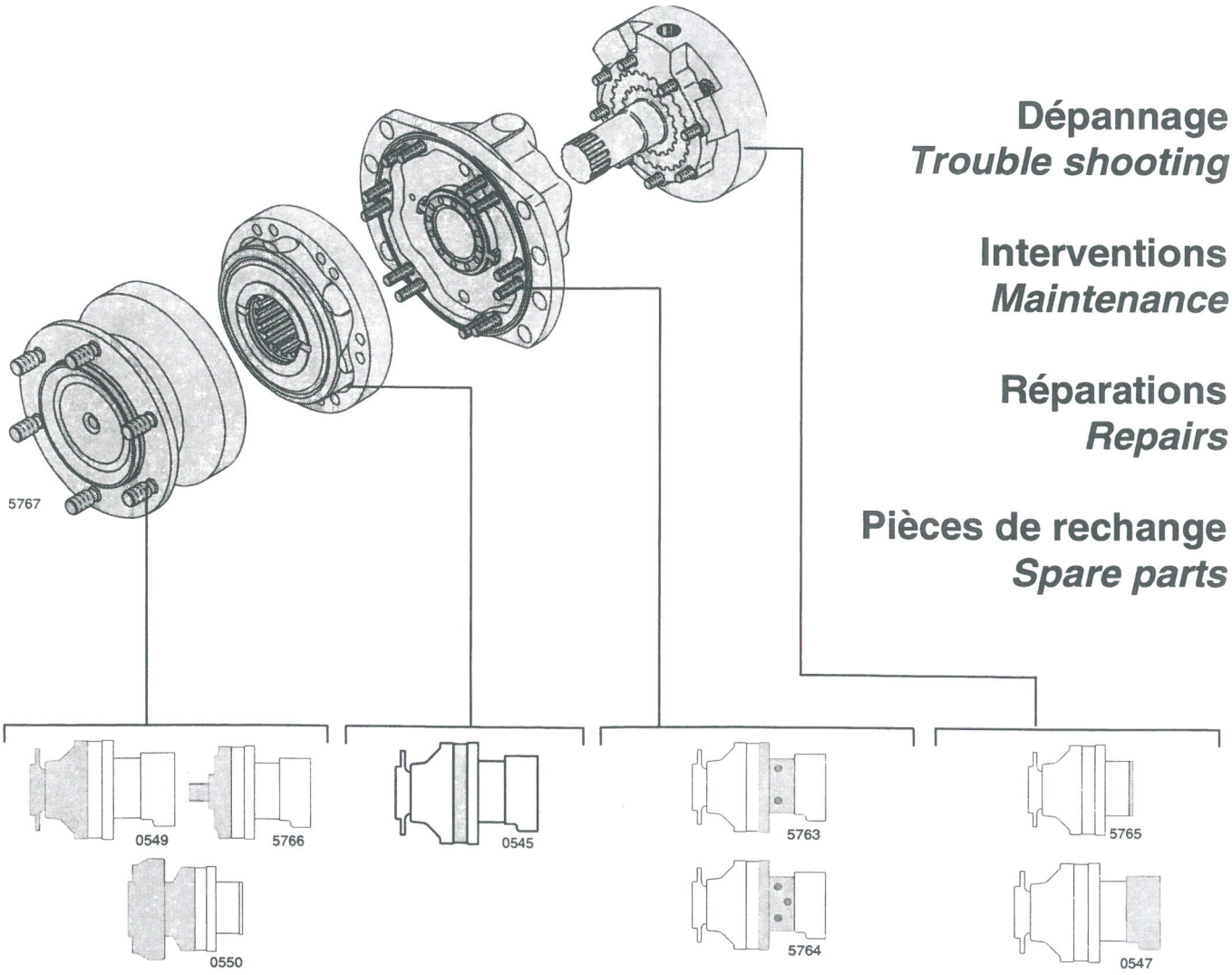
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Moteurs hydrauliques
Hydraulic motors

MS

Réparations
Repairs

	02	05	08	11	18
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POCLAIN HYDRAULICS

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Sécurité et Qualité

Avant toute intervention

- Prendre toutes les dispositions de sécurité nécessaires (hommes et matériel) en se conformer aux réglementations de sécurité en vigueur.
- Engager le frein de parking et immobiliser la machine avec des cales.
- Stopper le générateur d'énergie (moteur) du système hydraulique et déconnecter l'alimentation électrique.
- Le cas échéant, délimiter le périmètre de sécurité.
- Nettoyer l'extérieur des composants pour en retirer toute trace de boue et de graisse.
- Attendre le refroidissement et la dépressurisation complète du système hydraulique (décharger les accumulateurs).



L'huile chaude ou sous pression peut provoquer des brûlures graves avec infection. Consulter un médecin en cas d'accident.

Durant l'intervention

- Certains composants sont très lourds. Les soutenir au moyen d'un dispositif de levage de capacité adéquate pour les déposer du châssis.
- La propreté est essentielle au fonctionnement des composants hydrauliques. La plupart des pièces peuvent être nettoyées au moyen d'un solvant propre.
- Durant les manutentions, protéger toutes les surfaces sensibles contre les chocs (centrages, parties frottantes, appuis, portées des joints et des roulements, etc...).
- Nettoyer ces surfaces avant remontage.
- Toujours remonter des joints neufs en éliminant systématiquement les joints démontés. Nous recommandons de graisser tous les joints avant montage.
- Huiler toutes les surfaces frottantes en y déposant un film de fluide hydraulique propre qui assurera une lubrification correcte lors du premier (re)démarrage.
- Ne jamais chauffer le fluide hydraulique qui peut s'enflammer à haute température. Certains solvants sont également inflammables. Ne pas fumer durant l'intervention.

Après intervention

Réinstaller les composants et remettre le système hydraulique en service selon les instructions figurant dans les documents suivants:

- INSTALLATION MS F/GB (ref. 677777844K)
- INSTALLATION CIRCUITS F/GB (ref. 677777831V)



Ne pas surtarer les soupapes de sécurité.

Safety and Quality

Before servicing

- *Be extremely careful to prevent personal injury and to avoid damage to material. Comply with all safety regulations.*
- *Apply the parking brake and prevent the machine from rolling with tire blocks.*
- *Stop the hydraulic system power source (engine) and disconnect the battery.*
- *If necessary, block off the safety area.*
- *Wash dirt and grease from exterior of the components.*
- *Await the complete cooling down and depressurization of the hydraulic system (accumulators must be purged).*



Hot or pressurized hydraulic fluid may cause serious burns & infections to the human body. Consult a physician in case of accident.

During servicing

- *Some hydraulic components are very heavy. Secure them with a lifting device of adequate capacity when removing from the machine frame.*
- *Cleanliness is essential to functioning of the hydraulic components. Most of the parts may be cleaned with a clean solvent.*
- *During handling, protect all sensitive surfaces from shocks (piloting and interface surfaces, thrust & bearings surfaces, seal races, etc...)*
- *Clean up these surfaces before reassembling.*
- *Always install new O-rings, seals & gaskets discarding the old ones. We recommend lubricating all seals prior to assembly.*
- *Lubricate all surfaces which have relative motion between parts by coating them with a film of clean hydraulic fluid to assure lubrication at first start.*
- *Never heat hydraulic fluid, as it may flame at high temperature. Some solvents are also flammable. Do not smoke during servicing.*

After servicing

Reinstall the components and restart the hydraulic system according to instructions defined in the following documents:

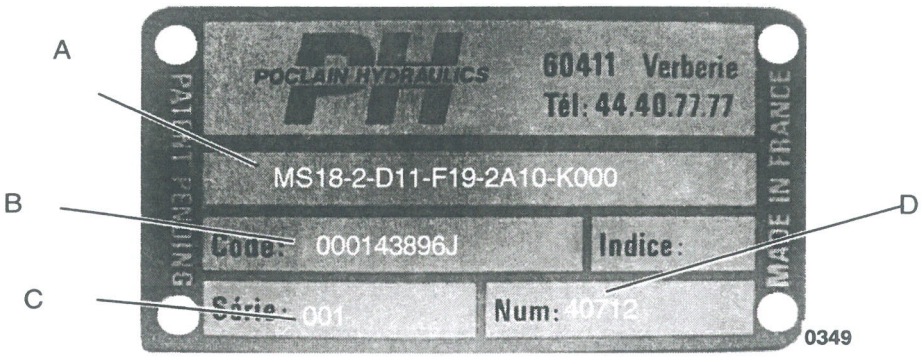
- *INSTALLATION MS F/GB (ref. 677777844K)*
- *INSTALLATION CIRCUITS F/GB (ref. 677777831V)*



Do not overset relief valves.

Identification du composant

Identification of the component



A : Désignation commerciale :
Ex : MSE18-2-D11-F19-2A10-K000

B : Code : Code Article
Ex : 000143896J

C : Série : Numéro de fabrication
Ex : 001

D : Num : Numéro d'ordre chronologique
Ex : 40712

Le Code article et le numéro d'ordre doivent être indiqués pour toute commande de pièces de rechange.

A: Commercial description:
E.g : MSE18-2-D11-F19-2A10-K000

B: Code: Part number.
E.g : 000143896J

C: Series: Manufacturing batch number.
E.g : 001

D: Num: Chronological serial number.
E.g : 40712

The part number and the chronological serial number must be specified to order spare parts.

Dépannage

DETERIORATION → LIMAILLE → DETECTION PAR LES FILTRES → PREVENTIF.....

Pannes		Causes		Remèdes
MOTEUR BRUYANT	À vide	Ronronnement régulier	Palier usagé	Procéder au remplacement du palier
		Vibrations	Desserrage des fixations, des tuyauteries	Resserrer au couple
	En charge	Claquement	Pression de gavage trop faible	Contrôler le tarage et l'état de la soupape de contre-pression.
		Cavitation	Fuites internes trop importantes	Remplacer le bloc cylindre et la distribution
LE MOTEUR NE TOURNE PAS			Le moteur n'est pas alimenté	Contrôler l'entraînement de la pompe et son alimentation
			Le circuit ne monte pas en pression	Contrôler l'état de la soupape de sécurité (régulateur)
			Fuites internes trop importantes	Remplacer le bloc cylindre et la distribution
			Le frein reste serré	Contrôler le circuit de pilotage du frein
LE MOTEUR NE TOURNE PAS A SA VITESSE NORMALE EN CHARGE			Le débit de la pompe est insuffisant	Contrôler la vitesse d'entraînement et l'état de la pompe
			Fuites internes trop importantes	Vérifier l'état du bloc cylindre et de la distribution
			La pression de fonctionnement est trop basse	Contrôler le tarage de la soupape de sécurité (régulateur)
LE MOTEUR TOURNE IRREGULIEREMENT			Le débit est irrégulier	Contrôler le débit de la pompe
			Fuites trop importantes	Vérifier l'état du bloc cylindre et de la distribution
FUITES D'HUILE EXTERNES			Pression carter trop élevée	Vérifier le circuit de drainage, et l'état du filtre
			Joints détériorés	Remplacer les joints
			Montage défectueux	Contrôler le serrage des vis d'assemblage, des vis de purge et raccordements

Trouble shooting

DAMAGE → IRON PARTICLES → DETECTION BY FILTERS → PREVENTION.....

Troubles		Causes		Remedies
NOISY MOTOR	Without load	Regular rumbling	Worm bearing support	Replace the bearing support
		Vibrations	Mountings and/or hydraulic piping becoming loose	Tighten to torque
	Under load	Clattering	Boost pressure too low	Check the setting and condition of counter-pressure valve
		Cavitation	Excessive internal leaks	Replace the cylinders- block and distribution valve assembly
THE MOTOR DOES NOT REVOLVE			No supply to the motor	Check pump drive and pump inlet
			The circuit does not reach working pressure	Check condition of safety valve (regulator)
			Excessive internal leaks	Replace the cylinders block and distribution valve assembly
			The brake stays engaged	Check the brake pilot circuit
THE MOTOR DOES NOT REVOLVE AT ITS NORMAL SPEED UNDER LOAD			Pump flow is too low	Check drive speed and condition of the pump
			Excessive internal leaks	Check condition of cylinders-block and distribution valve assembly
			Working pressure is too low	Check safety valve setting pressure (regulator)
THE MOTOR REVOLVES IRREGULARLY			Irregular flow	Check the pump flow
			Excessive leaks	Check condition of cylinders-block and distribution valve assembly
EXTERNAL OIL LEAKS			Too high casing pressure	Check the leakage circuit and filter condition
			Seals damaged	Replace seals
			Incorrect assembling	Check tightening of mounting screws, bleed screws and unions

Interventions

Remplacement du moteur

Dépose

- Éliminer la pression dans le circuit d'alimentation.
- Débrancher la tuyauterie de drainage au niveau du réservoir afin d'éviter le siphonnage de celui-ci.
- Débrancher et boucher les tuyauteries ou flexibles raccordés sur le moteur.
- Débrancher le connecteur du capteur tachy
- Démonter les vis de fixation, puis déposer le moteur.
- Vidanger le carter.

Repose

Reprendre les opérations de dépose dans l'ordre inverse.
Veuillez vous reporter aux documentations suivantes:

- INSTALLATION MS F/GB (ref: 677777844K)
- INSTALLATION CIRCUITS F/GB (réf: . 677777831V)

Maintenance

Replacing the motor

Removal

- *Release the pressure in the supply circuit.*
- *Disconnect the drain line at the tank level to avoid its siphoning.*
- *Disconnect and plug the pipes or hoses which are connected to the motor.*
- *Disconnect the speed sensor.*
- *Disconnect the mounting screws, and remove the motor.*
- *Drain the casing.*

Installation

Execute the removal operations in the reverse order.

Please refer to the following documentation brochures:

- *INSTALLATION MS F/GB (ref: 677777844K)*
- *INSTALLATION CIRCUITS F/GB (réf: . 677777831V)*

Défreinage mécanique

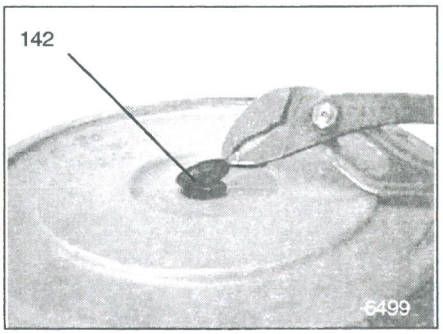
Dans certains cas de dépannage, il peut être nécessaire que le moteur soit défreiné,

- Extraire et éliminer le bouchon (142) de la coiffe de frein.

Mechanical brake release

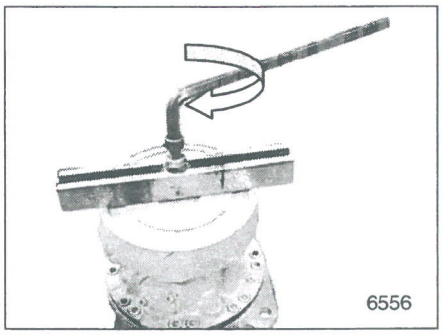
In certain service situations, it may be necessary to release the motor brake.

- *Extract and release the plug (142) from the brake cover.*



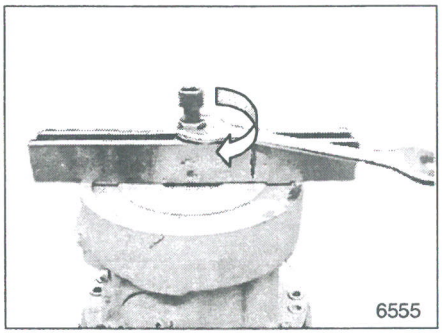
- Serrer la vis dans le piston

- *Tighten the screw in the piston*



- Puis serrer l'écrou jusqu'à ce que l'arbre du moteur tourne librement.

- *And tighten the nut until the motor shaft turns freely.*



Freins *Brakes*	Effort N	*Force [lbf]*	Couple équivalent N.m	*Equivalent torque [lbf.ft]*	Ecrou *Nut*
F02-F04	18000	*[4.000]*	42	*[30.9]*	M12
F05-F07	20000	*[4.500]*	47	*[34.6]*	M12
F08	34000	*[7.600]*	110	*[81.1]*	M16
F11	45000	*[10.000]*	140	*[103]*	M16
F12	45000	*[10.000]*	140	*[103]*	M16
F19	45000	*[10.000]*	140	*[103]*	M16

Après le défreinage, monter un bouchon (142) neuf.

After brake release, mount a new plug (142).

Contrôle de l'efficacité de frein de parking.



Pour un engin roulant, effectuer ce test sur un sol horizontal.

Pression de pilotage du frein: mini 12 bar
Maxi 30 bar.

- S'assurer que la pression d'alimentation du frein est nulle,
- Effectuer la purge du frein par la vis (112) située au niveau le plus haut,
- Alimenter le moteur jusqu'à la pression de tarage,

- L'arbre du moteur ne doit pas tourner sinon il est nécessaire de procéder au remplacement du frein:



Ne pas roder les freins multidisques.

Checking the parking brake efficiency.



For a rolling machine, make the test on a horizontal ground.

Pilot brake pressure : minimum 12 bar [174 PSI]
Maximum 30 bar [435 PSI]

Make sure that the brake supply pressure is zero,

- *Purge the brake using the screw (112) located at the highest level,*
- *Supply the motor up to the setting pressure.*

- *The motor shaft must not turn, otherwise it is necessary to replace the brake :*



Do not run multidisc brakes in.

Réparations.

Repairs.

Remplacement du joint de piston de frein.

Démontage

- Déposer le moteur.
- Mettre le moteur en appui sur le support palier.

Protéger les goujons en remontant les écrous

- Démonter et éliminer la coiffe de frein.(141)

- Extraire et éliminer le joint torique (143).

- Comprimer la rondelle élastique (108):

  - À l'aide du mandrin et de l'extracteur (voir outillage page 36) (fig 6502)
  - À l'aide du mandrin et d'une vis de classe 12.9 (voir outillage page 36)
  - À l'aide du mandrin et d'une presse (fig 6503). Respecter la force F (voir tableau page 9)

Repérer le sens de montage de l'anneau élastique.

Replacement of the O-ring of the brake piston.

Disassembly

- *Remove the motor.*
- *Place the motor on the bearing support.*

Protect the studs by reinstalling the nuts

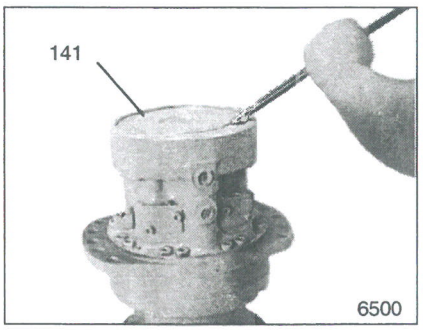
- *Remove and discard the brake cover.(141)*

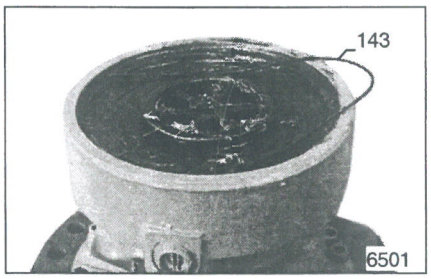
- *Extract and discard the O-ring (143).*

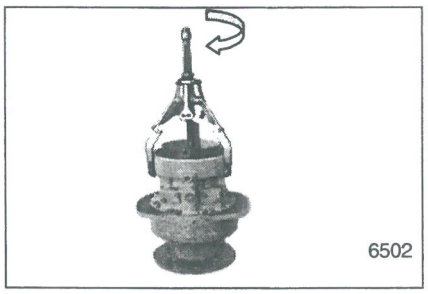
- *Compress the washer (108).*

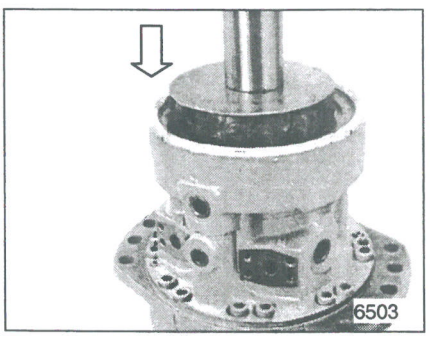
  - *Using a mandrel and an extractor (see tools page 36) (fig 6502)*
  - *Using a mandrel and a screw class 12.9 (see tools page 36)*
  - *Using a mandrel and a press (fig 6503). Respect the force F (see table page 9)*

Mark the mounting direction of the snap ring.







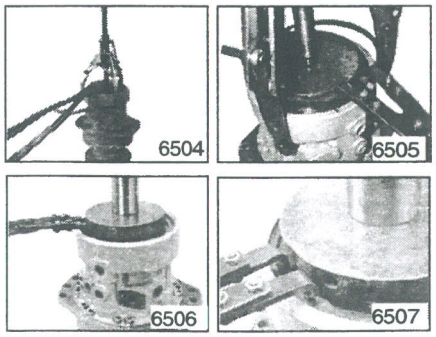


- Démonter l'anneau d'arrêt (109) à l'aide d'une pince à anneaux d'arrêt intérieur.(voir outillage 36)

  - Extracteur et pince (fig 6504 et 6505)
  - Presse et pince (fig 6506 et 6507)

- *Remove the snap ring (109) using internal snap ring pliers. (see tools 36)*

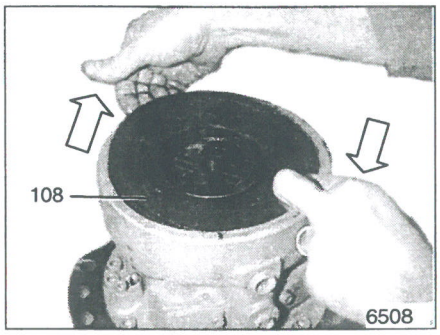
  - *Extractor and pliers (fig 6504 and 6505)*
  - *Press and pliers (fig 6506 and 6507)*



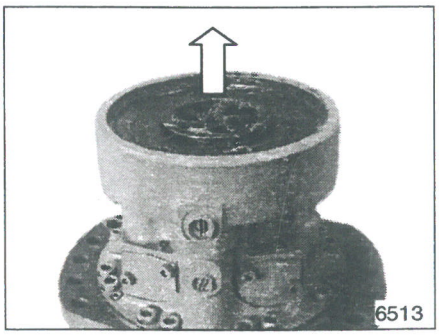
Ne pas mettre le palier en appui sur les goujons lors de la mise sous la presse.

If you use the press do not place the bearing support on the studs.

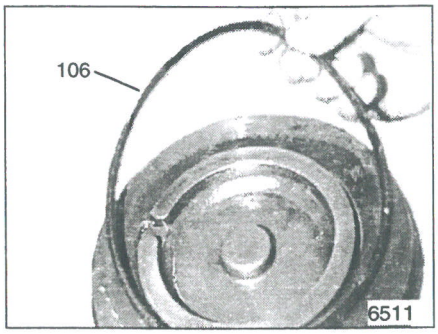
- Extraire la rondelle élastique (108).
- *Extract the washer (108).*



- Extraire le piston de frein (107).
- *Extract the brake piston (107)*



- Eliminer le joint torique (106).
- *Discard the O-ring (106).*



Remontage.

Avant le remontage, il est impératif de s'assurer de la propreté de toutes les pièces, des portées de joint et des gorges.

Toute trace de rouille, boue, eau doit être supprimée.

Enduire de graisse anti-oxydante (voir outillage page 36), les gorges, le dessus du piston de frein, la rondelle élastique, l'anneau d'arrêt, et la portée du joint de piston dans le corps de frein.

- Monter un joint torique (106) neuf sur le piston (107).

Le joint doit être serré sur le piston et non vrillé.

- Monter le piston de frein (107).

Attention au passage du joint sur la gorge de l'anneau d'arrêt.

- Monter la rondelle élastique (108).

Reassembly.

Before reassembling, it is necessary to ensure that all parts, the surface condition of the piston seal contact surface and the grooves are clean.

All traces of rust, mud, water must be removed.

Coat with anti-oxidizing grease (see tools page 36), the grooves, the top of the brake piston, the spring washer, the snap ring and the piston seal contact surface in the brake body.

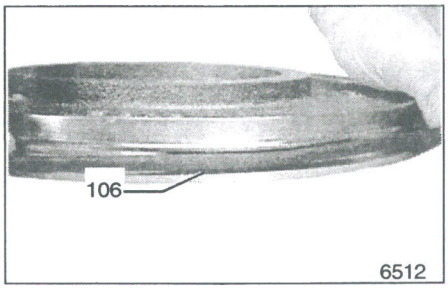
- *Install a new O-ring (106) on the piston (107).*

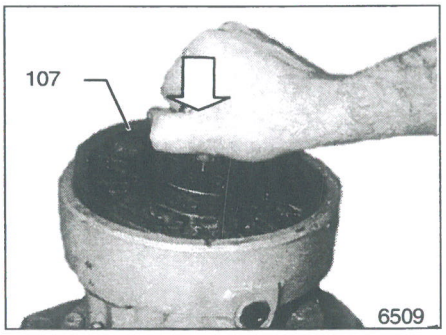
The ring should be tight on the piston and not twisted.

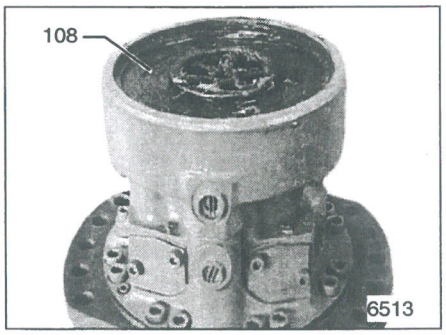
- *Install the brake piston (107).*

Take care when passing the seal over the snap ring groove.

- *Install the spring washer (108).*





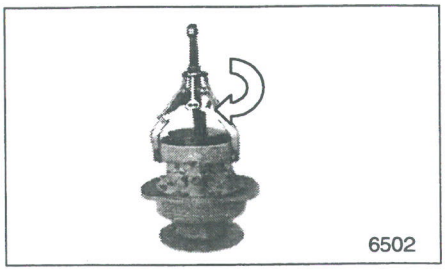


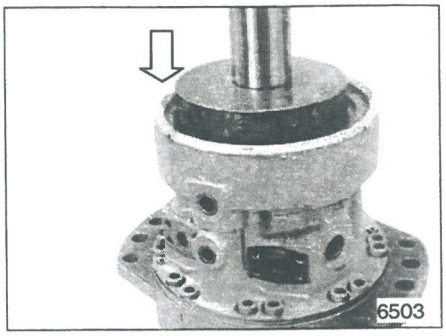
- Comprimer la rondelle élastique (108):
  - À l'aide du mandrin et de l'extracteur (voir outillage page 36) (fig 6502)
  - À l'aide du mandrin et d'une presse (fig 6503). Respecter la force F (voir tableau page 9)

Ne pas mettre le palier en appui sur les goujons lors de la mise sous la presse

- *Compress the spring washer (108).*
  - *Using a mandrel and an extractor (see tools page 36) (fig 6502)*
  - *Using a mandrel and a press (fig 6503). Respect the force F (see page 9)*

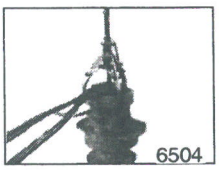
If you use the press do not place the bearing support on the studs.

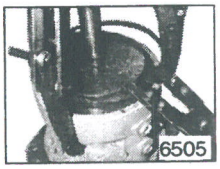

6502

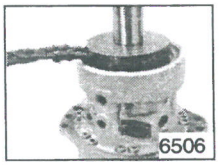

6503

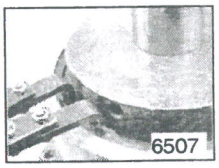
- Monter l'anneau d'arrêt (109) à l'aide d'une pince à anneaux d'arrêt intérieur suivant le repère établi au démontage. (voir outillage page 36)
  - Extracteur et pince (fig 6504 et 6505)
  - Presse et pince (fig 6506 et 6507)

- *Install the snap ring (109) using internal snap ring pliers in line with the mark made during disassembly . (see tools page 36)*
  - *Extractor and pliers (fig 6504 and 6505)*
  - *Press and pliers (fig 6506 and 6507)*


6504

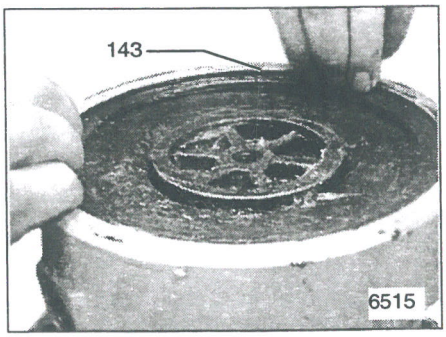

6505


6506


6507

- Monter un joint torique neuf (143) enduit de graisse anti-oxydante (voir outillage page 36) dans sa gorge.

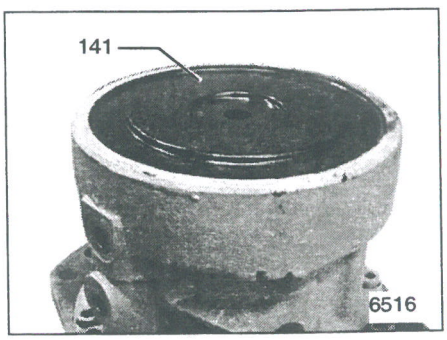
- *Install a new O-ring (143) coated with anti-oxidizing grease in its groove. (see tools page 36)*



6515

- Placer la coiffe (141) neuve sur le chanfrein d'entrée.

- *Place the new cover (141) on the entry chamfer .*



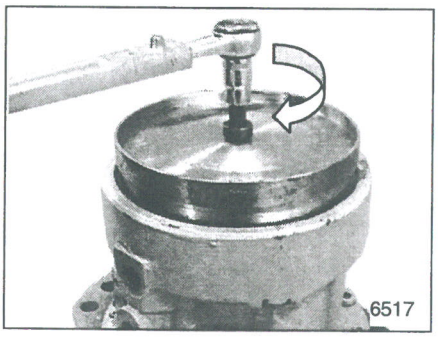
6516

- Encliqueter la coiffe à l'aide du mandrin correspondant. (voir outillage page 36)

S'assurer que le bord extérieur de la coiffe est en prise dans la gorge.

- *Click the cover into place using the right mandrel. (see tools page 36).*

Make sure that the outer edge of the cover is engaged in the groove.

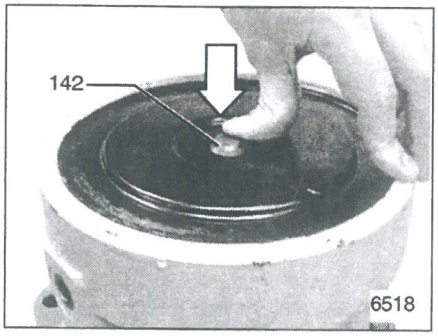


- Monter un bouchon (142) neuf.

S'assurer du bon contact entre la coiffe et la gorge du bouchon.

- *Install a new plug (142).*

Make sure about the contact between the cover and the plug groove.



- Reposer le moteur.
- *Install the motor.*

Remplacement du palier (070)

Démontage

Déposer le moteur.
Disposer le moteur en appui sur le frein ou sur la plaque de fermeture (moteur sans frein).

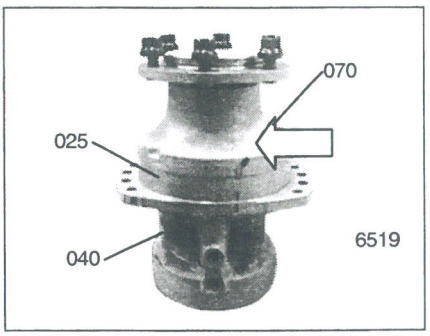
- Repérer la position du palier (070) par rapport à la came (026) et au couvercle distributeur (040).

Replacement of the bearing support (070)

Disassembly

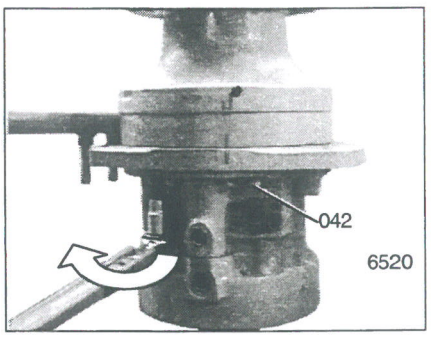
Remove the motor.
Place the motor on the brake or on the end cover (motor without brake).

- *Mark the position of the bearing support (070) in relation to the cam (026) and to the valving cover (040).*



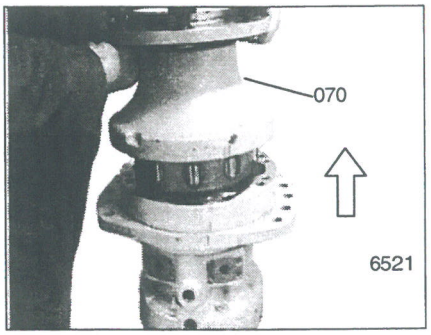
- Démonter les vis (042)

- *Remove the screws (042).*



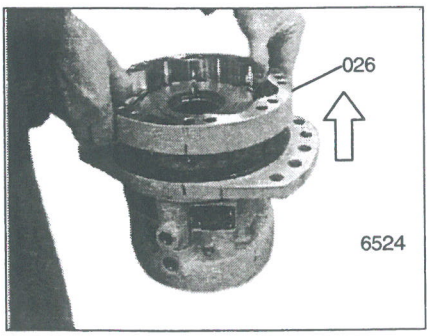
- Déposer le palier (070).

- *Remove the bearing support (070).*



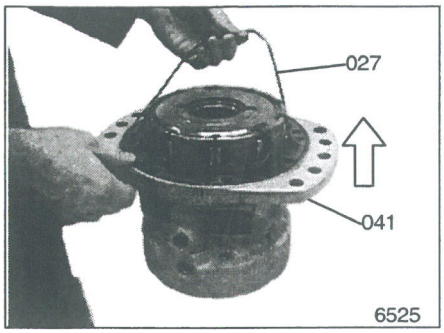
- Déposer la came (026).

- *Remove the cam (026).*



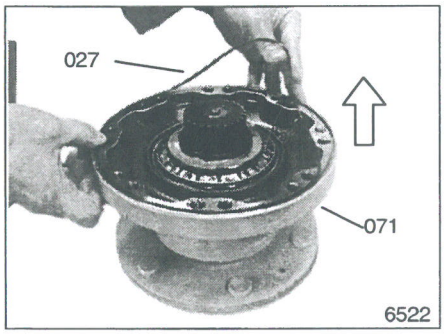
• Eliminer le joint torique (027) du couvercle (041).

• *Discard the O-ring (027) from the valving cover (041).*



• Eliminer le joint torique (027) du support palier (071).

• *Discard the O-ring (027) from the bearing support (071)*



Remontage.

Avant le remontage, il est impératif de s'assurer de la propreté de la gorge.

Toute trace de rouille, boue, eau doit être supprimée.

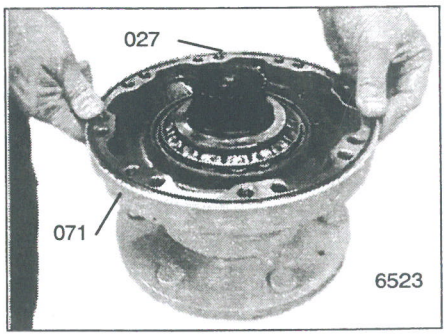
Reassembly

Before reassembling it is necessary to ensure that the groove is clean

All traces of rust, mud, water must be removed

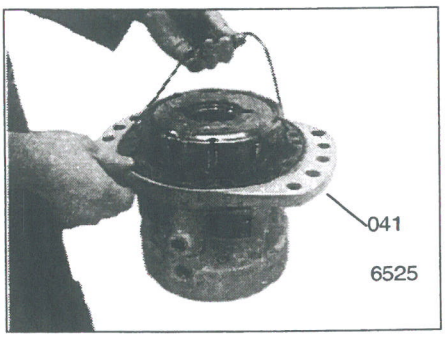
• Monter un joint torique neuf (027) enduit de graisse anti-oxydante (voir outillage page 36) dans la gorge du support palier (071)

• *Install a new O-ring (027) coated with anti-oxidizing grease (see tools page 36) in the groove of the bearing support (071).*



• Monter un joint torique neuf (027) enduit de graisse anti-oxydante (voir outillage page 36) dans la gorge du couvercle (041)

• *Install a new O-ring (027) coated with anti-oxidizing grease (see tools page 36) in the groove of the valving cover (041)*



• Monter la came (026) suivant les repères établis au démontage

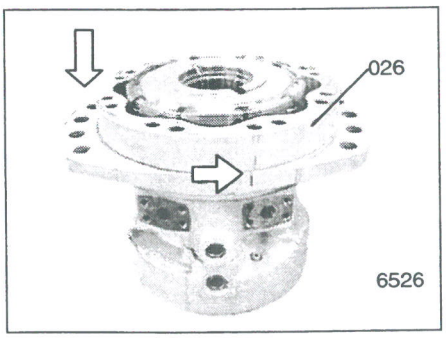
Gros chanfreins orientés côté palier

Centrer la came à l'aide de deux vis (042) diamétralement opposées.

• *Install the cam (026) in line with the marks made during disassembling*

The big chamfers oriented towards bearing support

Center the cam using two screws (042) diametrically opposite.

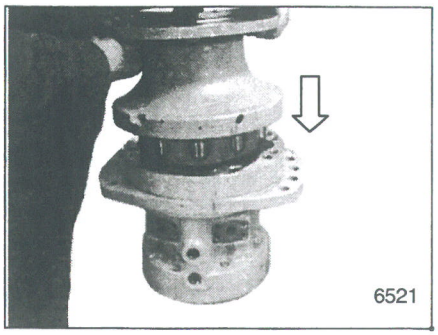


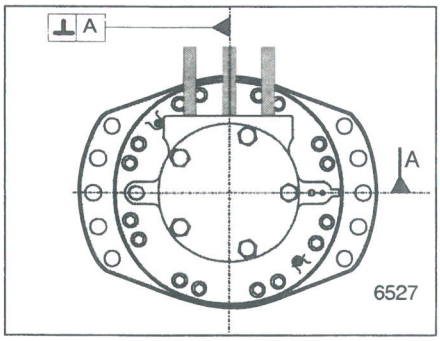
- Monter le palier

Pour les moteurs paliers les orifices doivent être perpendiculaires à l'axe de fixation du moteur. (Fig 6521)

- *Install the bearing support*

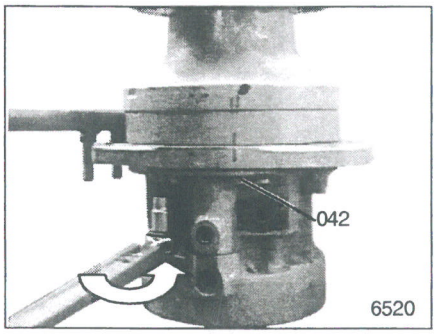
For shaft motors the ports must be perpendicular to the mounting axis of the motor. (Fig 6521)





- Monter et serrer les vis de fixations (042) au couple indiqué. (voir tableau page 38).

- *Install and tighten the mounting screws (042) to the right torque. (see table page 38).*



- Reposer le moteur.

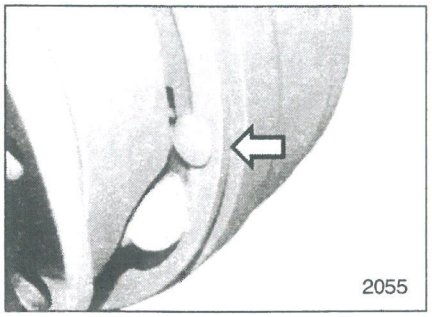
- *Install the motor.*

Remplacement des mâchoires de frein

Replacing the brake shoes.

Avant démontage il est possible de contrôler visuellement l'usure des garnitures de frein par les trous de visite.

Before disassembling it is possible to make a visual checking of the brake pads wear via the inspection ports.



Démontage

Disassembly

Le remplacement des mâchoires et des tambours doit être effectué sur chaque moteur d'un même essieu

The same repairs should be made on each motor of the same axle when replacing shoes and brake drums.

- Débloquer les écrous de fixation de la jante.
- Lever l'engin à proximité de la jante à déposer.
- Déposer la jante (pneu).
- Desserrer le frein mécanique.

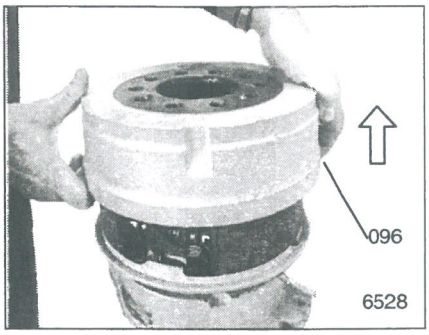
- *Loosen the wheel rim retaining nuts.*
- *Raise the machine on the side of the wheel rim to be removed.*
- *Remove the wheel rim (tyre).*
- *Release the mechanical brake.*

- Extraire le tambour (096)

- *Extract the drum (096).*

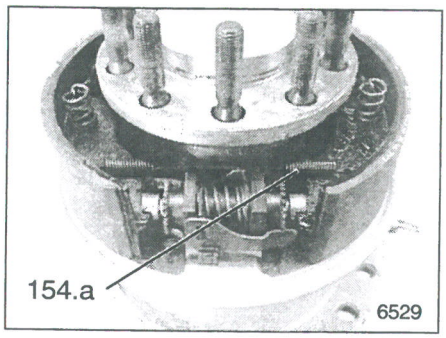
Contrôler l'état de la surface de frottement du tambour qui ne doit comporter aucune rayure profonde (0,2 mm maxi) ni d'usure anormale sinon procéder à son remplacement. (Ra 1,6 à 3,2)

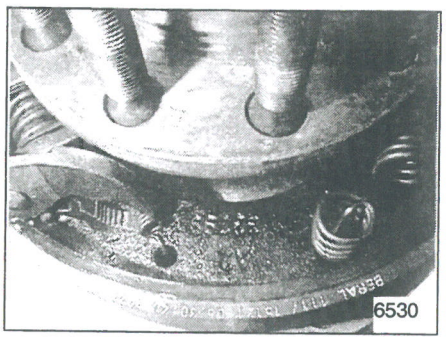
Check the friction surface condition of the drum which should show no deep scratches (deeper than 0,2 mm [0.0078 in]) nor abnormal wear. Otherwise, the brake drum should be replaced. (Ra 1.6 to 3.2)



• Démonter le ressort de rappel (154.a).

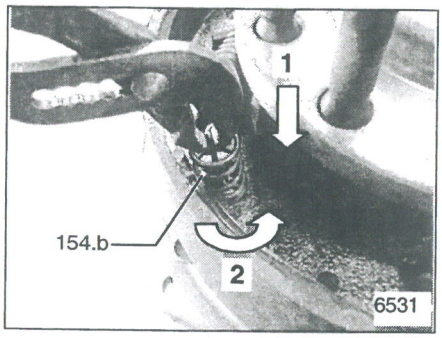
• *Remove the return spring (154.a).*





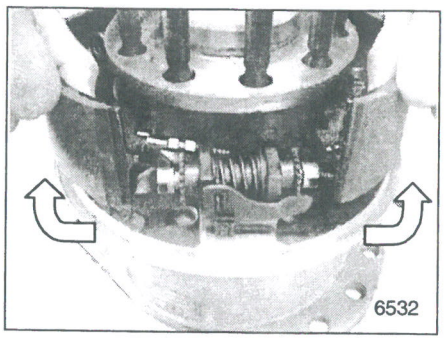
• Démonter les ressorts de maintien (154.b).

• *Remove the retention springs (154.b).*



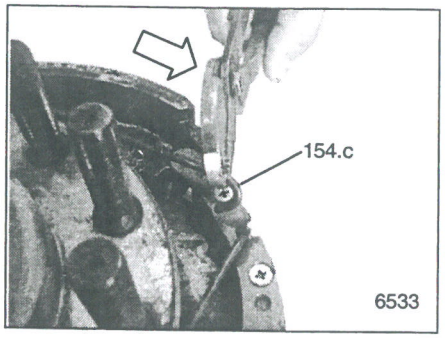
• Libérer les mâchoires du mécanisme de réglage .

• *Release the brake shoes from the regulating mechanism.*



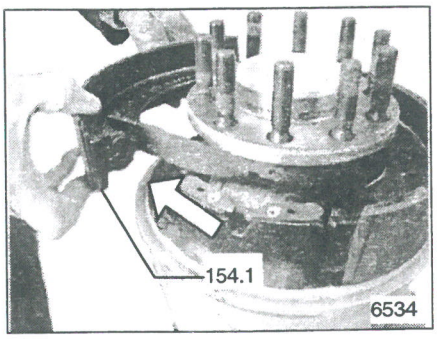
• Démonter les ressorts de rappel (154.c).

• *Remove the return springs (154.c).*



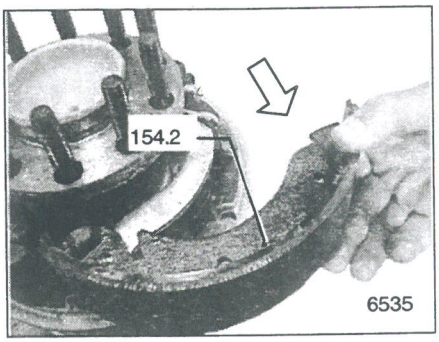
- Déposer la mâchoire (154.1)

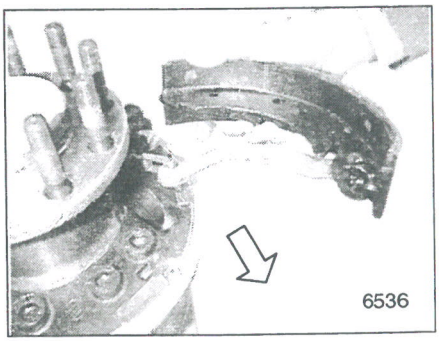
- *Remove the brake shoe (154.1)*



- Déposer la mâchoire (154.2) en libérant le levier de freinage mécanique de son câble.

- *Releasing the mechanical brake control lever from its cable, remove the brake shoe (154.2)*





Remontage

Dépoussiérer l'ensemble, s'assurer de l'étanchéité du cylindre de roue.

Contrôler l'état de la surface de frottement du tambour qui ne doit comporter aucune rayure profonde (supérieure à 0.2 mm) ni d'usure anormale sinon procéder à son remplacement.

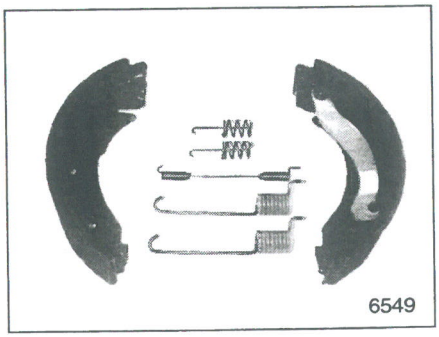
- Monter la mâchoire (154.2), en accrochant le levier de commande sur le câble de frein (098).

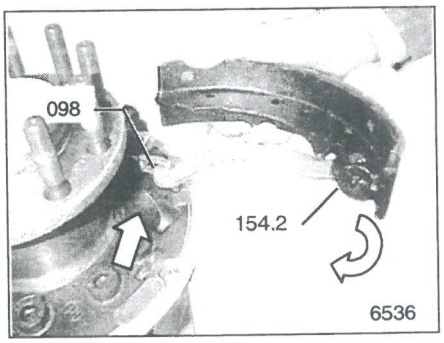
Reassembly

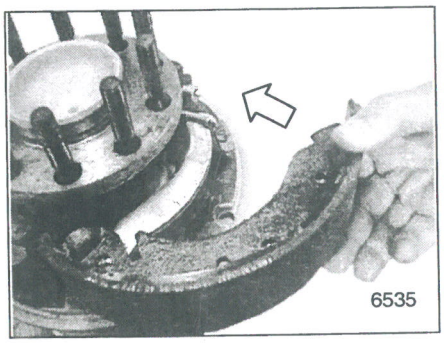
Remove all dust from the whole assembly. Make sure there are no leaks at the wheel cylinder.

Check the friction surface condition of the drum which should show no deep scratches (deeper than 0.2 mm) [0.0078in] nor abnormal wear. Otherwise, the brake drum should be replaced.

- *Attaching the control lever on the brake cable (098), install the brake shoe (154.2)*

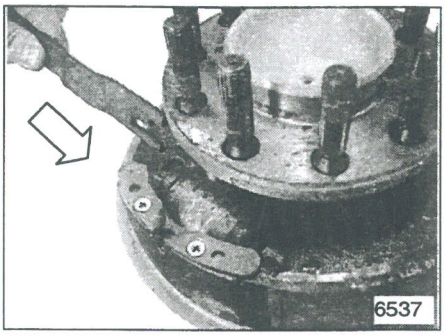


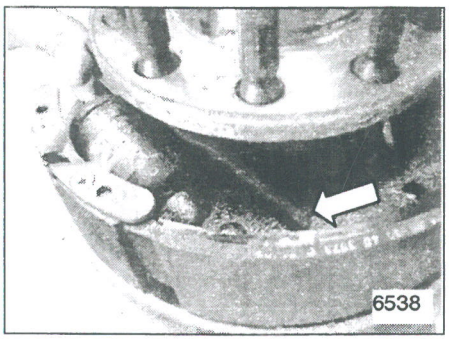




- Monter la plaque de renvoi sur la mâchoire (154.2)

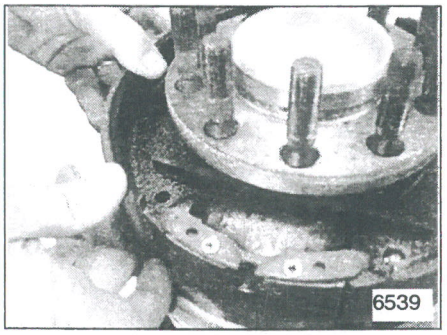
- *Mount the return plate on the brake shoe (154.2)*





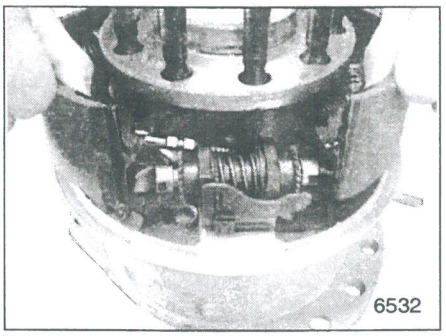
- Monter la mâchoire (154.1)

- *Install the brake shoe (154.1)*



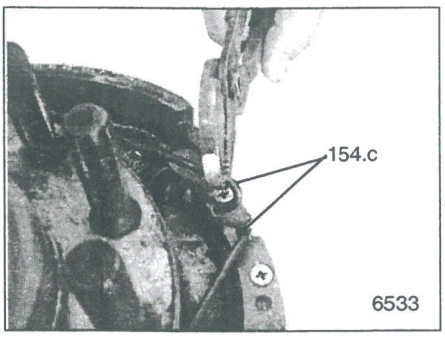
- Positionner les mâchoires sur le mécanisme de réglage.

- *Position the brake shoes on the regulating mechanism.*



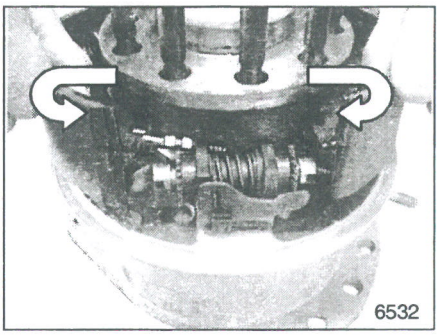
- Monter les ressorts de rappel (154.c)

- *Install the return springs (154.c)*



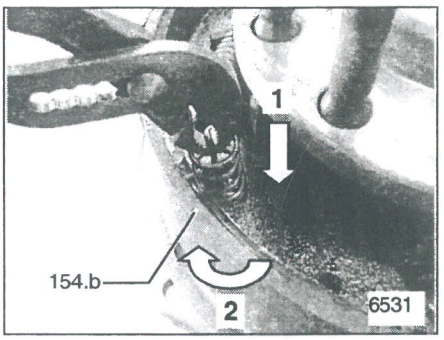
- Mettre en place les mâchoires dans le mécanisme de réglage

- *Install the brake shoes in the regulating mechanism*



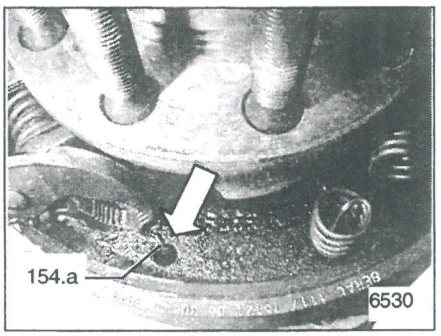
- Monter les ressorts de maintien (154.b)

- *Install the retention springs (154.b)*



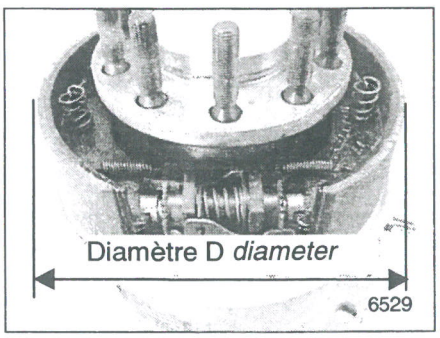
- Monter le ressort de rappel (154.a)

- *Install the return spring (154.a)*



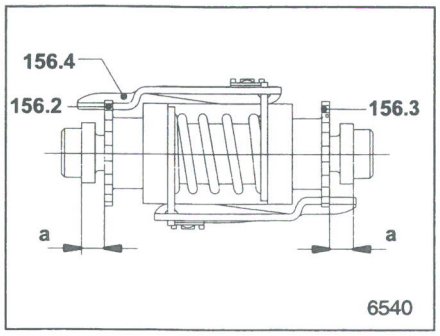
- Mesurer le diamètre D de frottement du tambour puis celui des mâchoires en place

- *Measure the brake drum friction diameter D and that of the brake shoes, which have been installed.*



• Ajuster le diamètre des mâchoires pour obtenir le jeu entre garniture et tambour à l'aide de la roue dentée (156.1) pour les freins équipés d'un dispositif de réglage mécanique ou des deux roues dentées (156.2 et 156.3) pour les freins équipés d'un dispositif de rattrapage de jeu automatique. Dans ce cas, l'action sur les roues dentées doit être symétrique (a). Dégager légèrement le levier (156.4) pour permettre cette opération.

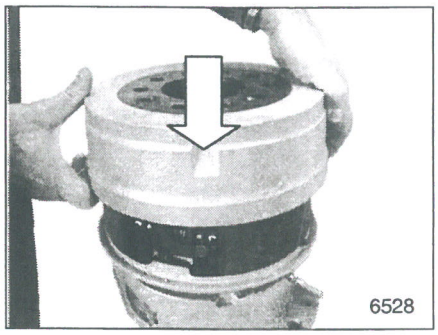
• *Adjust the brake shoes diameter to obtain correct clearance between the brake padding and the drum using the adjusting wheel (156.1) for brakes equipped with mechanical adjustment system or two adjusting wheels (156.2 and 156.3) for brakes equipped with automatic clearance adjustment. In this case, the adjusting wheels should be adjusted symmetrically (a). Release the lever slightly (156.4) to enable this operation to take place.*



Freins *Brake*	Diamètre tambour (mm) *Drum diameter [in]* nominal	maximum	Jeu total (mm) *Total clearance [in]*
250 x 60	250 *[9.84]*	252 *[9.92]*	0.55 *[0.02]*
270 x 60	270 *[10.63]*	272 *[10.70]*	0.80 *[0.03]*
325 x 80	325 *[12.79]*	327 *[12.87]*	0.80 *[0.03]*
350 x 60	350 *[13.78]*	352 *[13.85]*	0.80 *[0.03]*

• Monter le tambour, contrôler sa libre rotation.

• *Install the drum, check that it can turn freely.*



• Purger le cylindre de roue si nécessaire.

• Remonter la jante.

Voir brochure INSTALLATION MS F/GB (ref. 677777844K)

• *Bleed the wheel cylinder, if necessary.*

• *Install the wheel rim.*

See documentation INSTALLATION MS F/GB (ref 677777844K)

Remplacement de la came (026)

Démontage

Effectuer les opérations décrites à la rubrique "démontage" du chapitre "remplacement du palier" page 16

Remontage

Effectuer les opérations décrites à la rubrique "remontage" du chapitre "remplacement du palier" page 18. Il est nécessaire de respecter la position angulaire de la came dans le cas des moteurs à 2 cylindrées dont le rapport de cylindrée est différent de 2

Exemple : Moteur MS18, cylindrées 1747-1049-698
Petite cylindrée : 698 cm^3 lettre P

Moyenne cylindrée : 1 049 cm^3 lettre M

La lettre P ou M doit être située dans l'axe et vers le tiroir de changement de cylindrée, le trou borgne côté fixation de la came sur le palier.

Replacement of the cam (026)

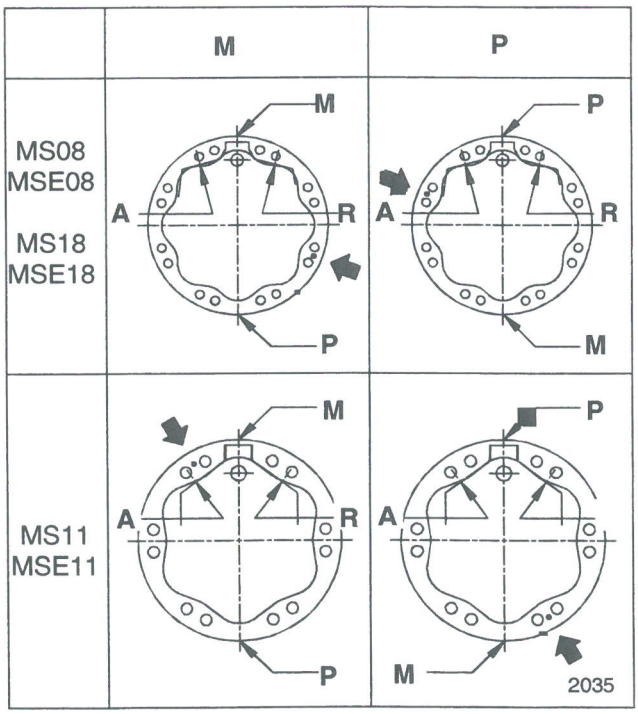
Disassembly

Do operations described in chapter "replacement of the bearing support" section "disassembly" page 16

Reassembly

Do operations described in chapter "replacement of the bearing support" section "reassembly" page 18.The angular position of the cam must be respected on dual displacement motors with a displacement ratio different from 2.

Example : Motor MS18 with displacement 1747-1049-698.
Small displacement : 698 cm^3 [42.59 cu.in] letter P
Medium displacement : 1049 cm^3 [64.01 cu.in] letter M.
The letter P or M must be located in the axis and towards the displacement change spool, with the blind hole towards the fixing of the cam on the bearing support.



Remplacement du bloc cylindre équipé (010)

Replacement of the cylinders block assembly (010)

Démontage

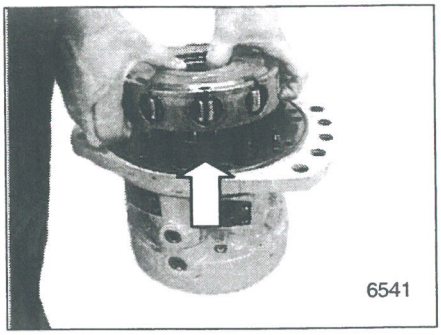
Effectuer les opérations décrites à la rubrique "démontage" du chapitre "remplacement du palier" page 16

- Après avoir démonter la came, démonter le bloc cylindre.

Disassembly

Do operations described in chapter "replacement of the bearing support" section "disassembly" page 16

- *After removing the cam, remove the cylinders block.*

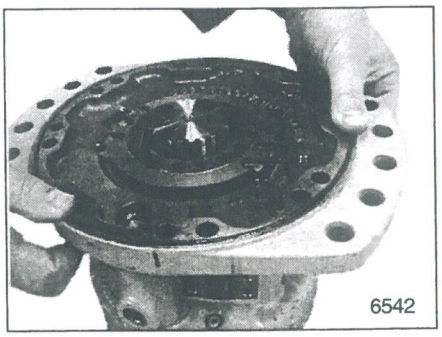


Remontage

- Monter un joint torique neuf (027)

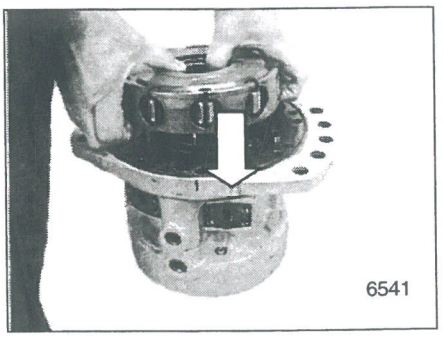
Reassembly

- *Install a new O-ring (027)*



- Monter le bloc cylindre équipé (010)

- *Install the cylinders block assembly (010)*



- Effectuer les opérations décrites à la rubrique "remontage" du chapitre "remplacement du palier" page 18.

- *Do operations described in chapter "replacement of the bearing support" section "reassembly" page 18.*

Remplacement de la glace (047).

Démontage

- Effectuer les opérations décrites à la rubrique "démontage" du chapitre "remplacement du bloc cylindre équipé (010)" page 28.

Repérer le position de la glace (047) par rapport au couvercle (041) (moteur à deux cylindrées).

- Déposer la glace (047) du couvercle (041) en faisant levier au niveau des doigts d'indexage ou de la collerette.

Protéger la glace de toute poussière.

- Extraire les ressorts (052).
- Extraire et éliminer les joints et contre joints (048) du couvercle (041).

Remontage

Toute trace de rouille, boue, eau doit être supprimée.

- Huiler, puis monter des joints toriques et contre joints neufs (048) en déformant les contres joints au minimum.

- Placer les ressorts (052) dans leur logement préalablement rempli de graisse.
- Huiler les portées de joints de la glace (047).
- Enfoncer la glace (047) dans le couvercle (041).

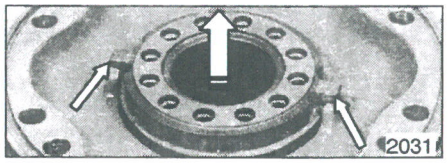
Replacement of the valving (047).

Disassembly

- *Do operations described in chapter "replacement of the cylinders bloc assembly (010)" section "disassembly" page 28.*

Mark location to the valving (047) in relation to the valving cover (041) (Dual displacement motor).

- *Separate the valving (047) from the cover (041) by levering at the indexing pins or at the flange.*



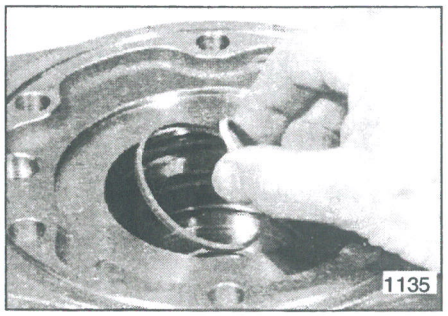
Protect the valving from dusts.

- *Remove the springs (052).*
- *Remove and discard the seals and back-up rings (048) from the cover (041).*

Reassembly

All traces of rust, mud, water must be removed.

- *Lubricate and install new seals and back-up rings (048), ensuring the back up rings are twisted as little as possible.*



- *Place the springs (052) in their housings, previously filled with grease.*
- *Lubricate the faces of the seals of the valving (047).*
- *Press the valving (047) into the cover (041).*

Respecter le sens de montage de la glace (047) par rapport au couvercle (041).

Respect the assembly sense of the valving (047) in relation to the cover (041).

Ne pas forcer lors du montage de la glace (047) dans le couvercle (041).

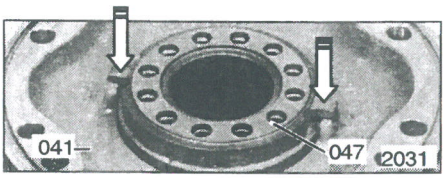
Do not force when installing the valving (047) into the cover (041).

Montage glace version 1C.

- Pas de sens de montage particulier.

Valving assembly type single displacement motor.

- *No particular assembly sense.*



Montage glace version 2C.

- Mettre la lettre choisie indiquant le sens de rotation en face du tiroir de pilotage (053).

Valving assembly type Dual displacement motor.

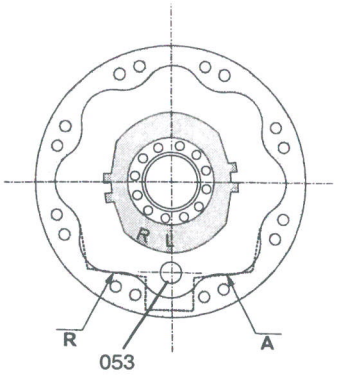
- *Write the chosen letter indicate the rotation sense in front of the displacement change spool (053).*

POSITIONNEMENT DE LA GLACE

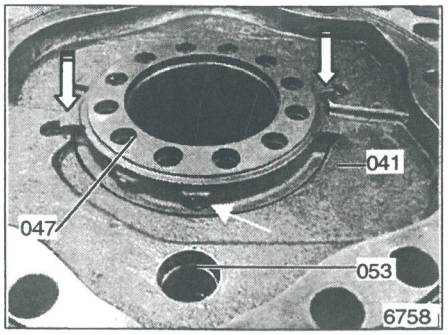
G/L Gauche

VALVING POSITIONING

G/L Left

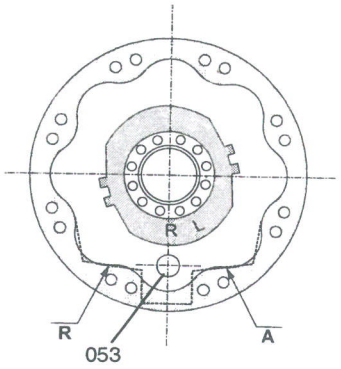


3227

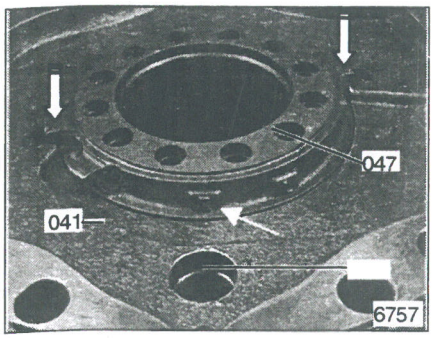


D/R Droite

D/R Right



3228



• Si il n'y a pas de lettre, réaliser l'indexage suivant les repères établis au démontage.

• *If there is no letter, do the indexing according to the marks made during disassembly.*

• Effectuer les opérations décrites à la rubrique "remontage" du chapitre "remplacement du bloc cylindre "page 28.

• *Do operations described in chapter "replacement of the cylinders block" section "reassembly" page 28.*

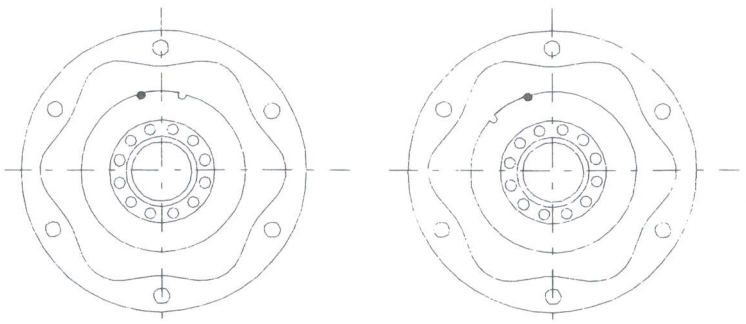
Cas des moteurs SE02 et S05 :

Situation of SE02 and S05 motors :

Moteur SE02 :
SE02 Motor :

G/L Gauche
G/L Left

D/R Droite
D/R Right

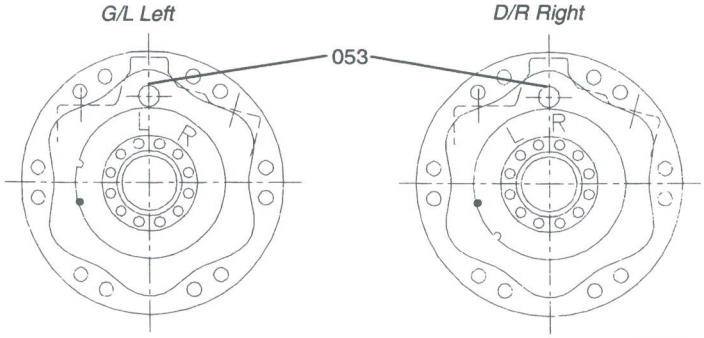


6959

Moteur S05 :
S05 Motor :

G/L Gauche
G/L Left

D/R Droite
D/R Right



6948

Remplacement du joint (045) de la plaque de fermeture

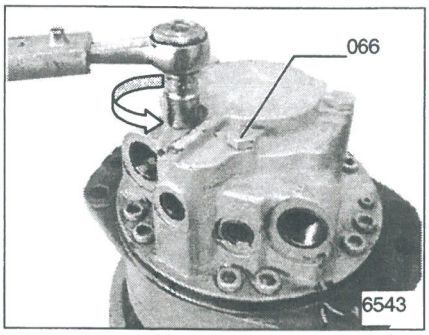
Démontage

- Disposer le moteur en appui sur le palier (écrou montés pour protéger les goujons)
- Démonter les vis (066)

Replacement of the end cover O-ring (045)

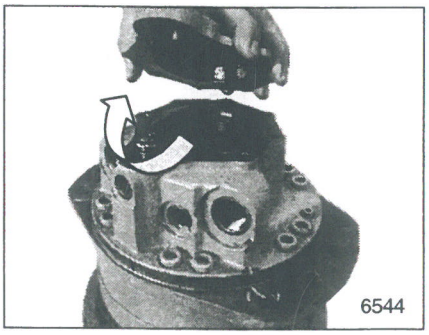
Disassembly

- *Place the motor on the bearing support (fitted with nuts for studs protection)*
- *Remove the screws (066)*



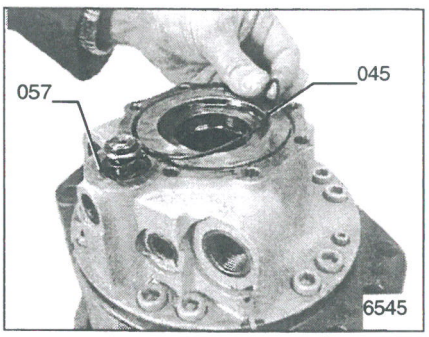
- Démonter la plaque de fermeture

- *Remove the end cover*



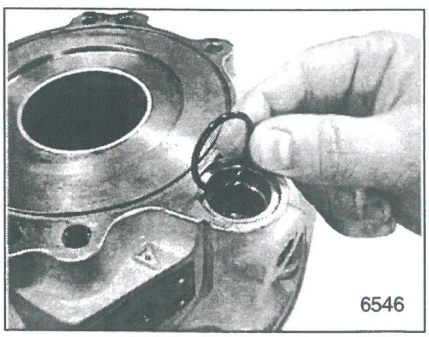
- Eliminer le joint torique (045)

- *Discard the O-ring (045)*



- Eliminer le joint torique (057) si le moteur est un 2 cylindrées

- *Discard the O-ring (057) if the motor has 2-displacement*

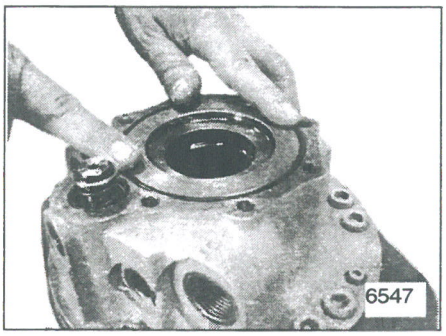


Remontage

- Monter un joint torique (045) neuf
-

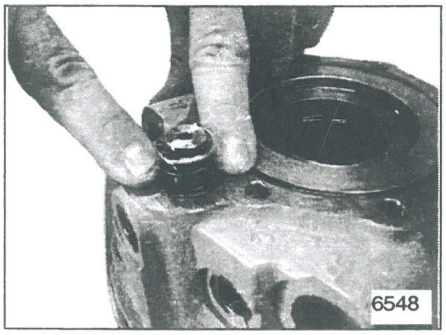
Reassembly

Install a new O-ring (045)



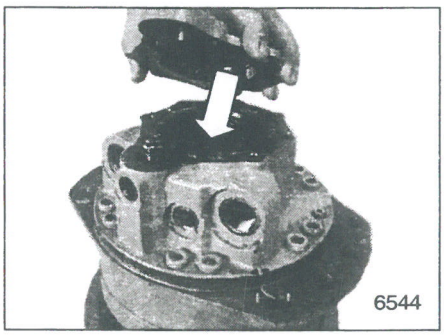
- Monter un joint torique (057) neuf si le moteur est un 2 cylindrées sinon passer à l'étape suivante

- *Install a new O-ring (057) if the motor has 2-displacement. If not go to the next section*



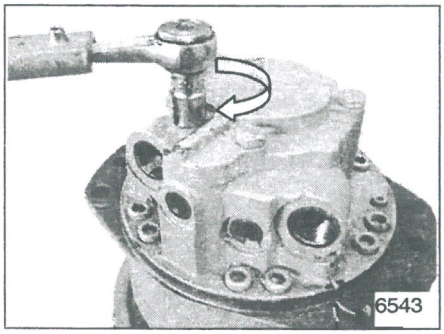
- Monter la plaque de fermeture

- *Install the end cover*



- Monter et serrer les vis (066) au couple correspondant (voir tableau page 38)

- *Install and tighten the screws (066) to the right torque (see table page 38)*



Remplacement du capteur (option)

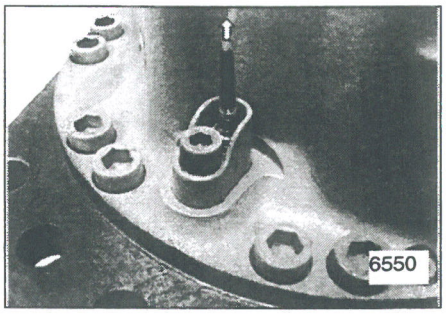
Démontage

- Débrancher le connecteur (161.3)

Replacing the sensor (optional)

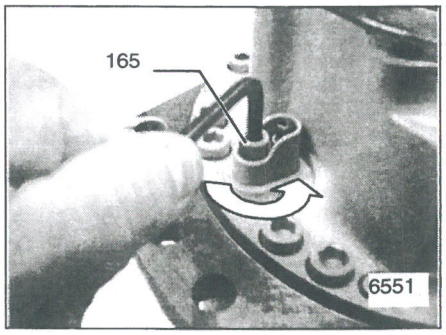
Disassembly

- *Disconnect the connector (161.3)*



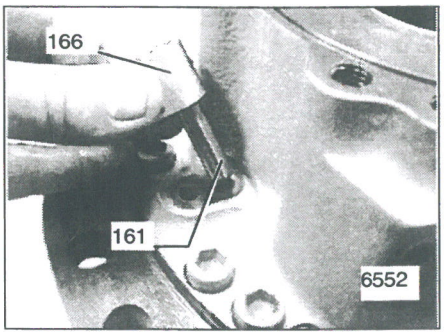
- Desserrer et démonter la vis (165)

- *Unscrew and remove the screw (165)*



- Extraire le capteur (161) avec le support (166)

- *Extract the sensor (161) with its support (166)*



Remontage

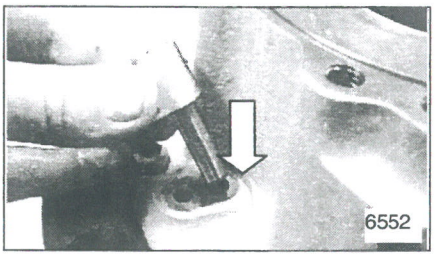
Reassembly

S'assurer de la propreté de la portée de joint (164) sur le couvercle distributeur (041)

Make sure that the seal mounting surface (164) on the valving cover (041) is clean

- Monter la rondelle frein (163) neuve et le joint (164) neuf sur le capteur (161) équipé de sa pastille de réglage (167)

- *Install the new brake washer (163) and the new seal (164) on the sensor (161) fitted with its adjusting sticker (167).*

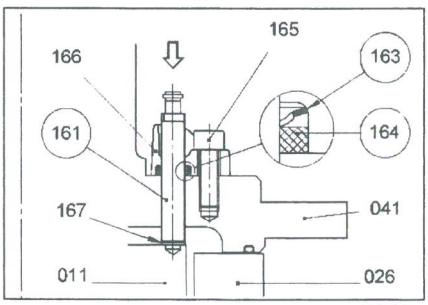


- Engager le capteur équipé dans le support (166) jusqu'à ce que le joint (164) soit dans son logement

- *Push the sensor assembly into the support (166) until the seal (164) is in its housing*

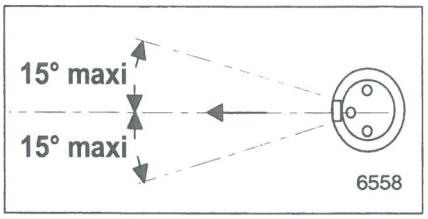
- Enfoncer le capteur dans le couvercle distributeur (041) jusqu'à venir en contact sur le bloc cylindre (011),

- *Push the sensor into the valving cover (041) until it comes in contact with the cylinders block (011),*



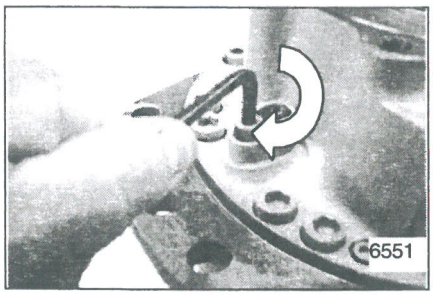
l'encoche du capteur doit être orientée vers le centre du moteur

the notch of the sensor should be oriented towards the center of the motor.



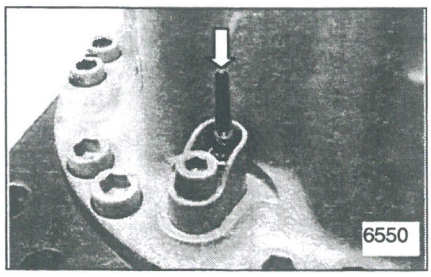
- Monter et serrer la vis (165) au couple de serrage correspondant (voir tableau page 38)

- *Install and tighten the screw (165) to the right torque (see table page 38)*

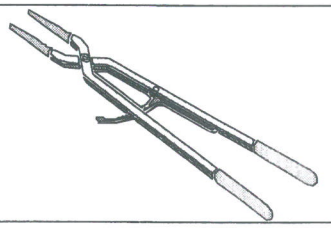
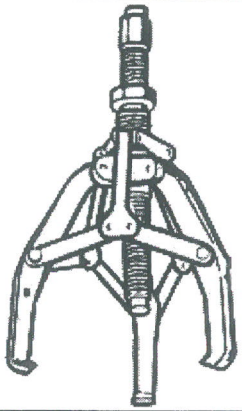


- Rebrancher le connecteur (161.3)

- *Reconnect the connector (161.3)*



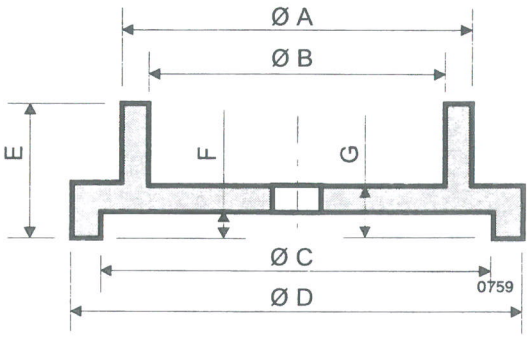
Récapitulatif outillage — *Tooling inventory*

Outillage standard		*Standard tools*	
• Clé hexagonale pour vis six pans creux		*Hollow head wrench*	5 6 8 10 12 14
• Clé hexagonale pour tête hexagonale		*Hex head wrench*	13 17 19 22 24
• Clé dynamométrique	FACOM J 250 A	*Torque wrench*	6 à 30 N.m *[4.4 to 22.1 lbf.ft]*
• Clé dynamométrique	FACOM S 250 A	*Torque wrench*	50 à 240 N.m *[35 to 175 lbf.ft]*
• Clé dynamométrique	FACOM K 250 A	*Torque wrench*	160 à 800 N.m *[120 à 600 lbf.ft]*
• Graisse anti-oxydante	Auto-top 2000 origine AGIP	*Anti-oxidizing grease*	Couleur vert fluo / *fluorescent green color*
• Pince à anneau d'arrêt intérieur	FACOM 499.32	*Internal snap ring pliers*	 0761
• Extracteur	FACOM U 20 B	*Extractor*	 6553
• Clé hexagonale pour tête hexagonale		*Hex head wrench*	13 17 19 22 24
• Clé dynamométrique	FACOM J 250 A	*Torque wrench*	6 à 30 N.m *[4.4 to 22.1 lbf.ft]*
• Clé dynamométrique	FACOM S 250 A	*Torque wrench*	50 à 240 N.m *[35 to 175 lbf.ft]*
• Clé dynamométrique	FACOM K 250 A	*Torque wrench*	160 à 800 N.m *[120 à 600 lbf.ft]*

Outillage à réaliser | *Special tools*

- Mandrin pour remonter la coiffe de frein ou pour comprimer la rondelle élastique

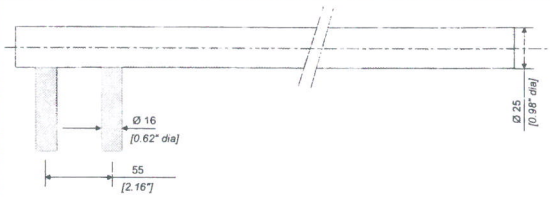
- *Mandrel for reassembling the brake cover or to compress the spring washer.*



		Ø A		Ø B		Ø C		Ø D		E		F		G	
		mm	*[inch]*	mm	*[inch]*	mm	*[inch]*	mm	*[inch]*	mm	*[inch]*	mm	*[inch]*	mm	*[inch]*
F02	M12	110	*[4.3]*	100	*[4.3]*	125	*[4.9]*	135	*[5.3]*	50	*[1.96]*	10	*[0.39]*	20	*[0.78]*
F03															
F04		125	*[4.92]*	115	*[4.52]*	151	*[5.94]*	159	*[6.25]*						
F05															
F07															
F08	M16	125	*[4.92]*	115	*[4.52]*	151	*[5.94]*	159	*[6.25]*	50	*[1.96]*	10	*[0.39]*	20	*[0.78]*
F09															
F11		190	*[7.48]*	180	*[7.08]*	205	*[8.07]*	215	*[8.46]*	50	*[1.96]*	10	*[0.39]*	20	*[0.78]*
F12															
F18										70	*[2.75]*			30	*[1.18]*
F19															
F21															

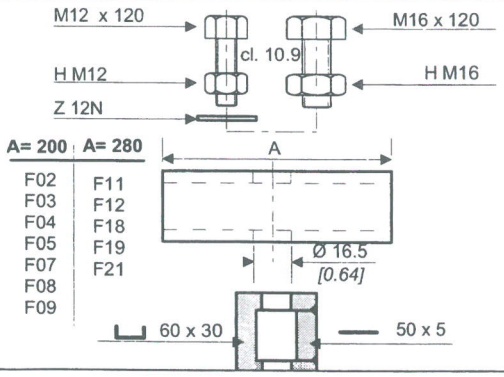
- Tube pour immobiliser le moteur

Tube to immobilize the motor



- Outillage pour défreinage mécanique.

Tools for mechanical brake release





Taille *Size*	Couples de serrage en N.m ± 10% (Suivant norme DIN 912)			*Tightening torques in [lbf.ft] ± 10%* *(According to the standard DIN 912)*		
	8.8	**10.9**	**12.9**	**8.8**	**10.9**	**12.9**
M6	10	14	17	7.5	10	12.5
M8	25	35	41	18.4	26	30
M10	49	69	83	36	51	61
M12	86	120	145	63.4	88.4	107
M14	135	190	230	100	140	170
M16	210	295	355	155	218	262
M18	290	405	485	214	299	358
M20	410	580	690	302	428	509

Liste des pièces

Repère	Désignation
● 010	Bloc cylindres équipé
012	Piston équipé Cl. 0
013	Piston équipé Cl. 1
015	Kit de réparation
● 026	Came équipée
027	Joint torique
● 040	Couvercle équipé
041	Couvercle
042	Vis
043	Rondelle d'étanchéité
044	Vis
045	Joint torique
047	Glace
048	Pochette de joints
050	Bouchon
051	Joint torique
052	Ressort
053	Tiroir
054	Rondelle
055	Anneau d'arrêt
056	Ressort
057	Joint torique
059	Goupille
● 065	Plaque de fermeture équipée
066	Vis
067	Bague d'étanchéité
● 070	Palier assemblé
071	Support palier
072	Bague d'étanchéité
073	Roulement
074	Roulement
075	Jeu de cales
076	Bague
077	Anneau d'arrêt
078	Bague d'étanchéité
079	Déflecteur
081	Support de joint
087	Clavette
090	Arbre
091	Jeu de goujons
096	Tambour de frein
097	Vis
098	Câble
099	Anneau d'arrêt
154	Mâchoire équipée
155	Cylindre équipé
156	Réglage

Spare parts list

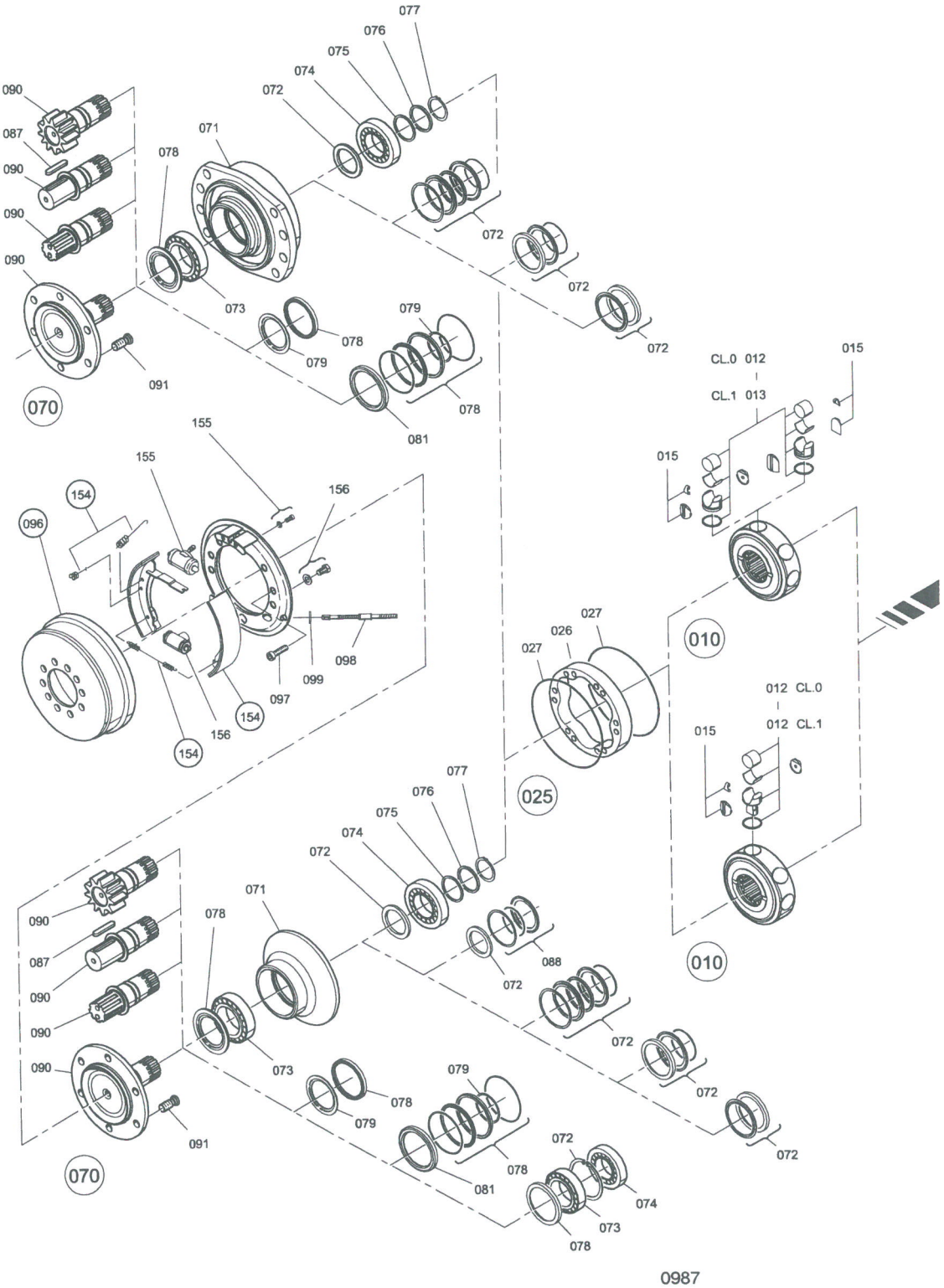
Item	*Description*
● *010*	*Cylinders-block assembly*
012	*Piston Cl 0 assembly*
013	*Piston Cl 1 assembly*
015	*Repair kit*
● *026*	*Cam assembly*
027	*O-ring*
● *040*	*Valving cover assembly*
041	*Valving cover part*
042	*Screw*
043	*Seal washer*
044	*Screw*
045	*O-ring*
047	*Valving*
048	*Seal kit*
050	*Plug*
051	*O-ring*
052	*Spring*
053	*Valve spool*
054	*Washer*
055	*Snap ring*
056	*Spring*
057	*O-ring*
059	*Pin*
● *065*	*Cover plate assembly*
066	*Screw*
067	*Sealing ring*
● *070*	*Bearing support assembly*
071	*Bearing support part*
072	*Radial lip seal*
073	*Roller bearing*
074	*Roller bearing*
075	*Set of shims*
076	*Thrust ring*
077	*Snap ring*
078	*Lip seal*
079	*Deflector*
081	*Seal support*
087	*Key*
090	*Shaft*
091	*Set of studs*
096	*Drum brake*
097	*Screw*
098	*Brake cable*
099	*Snap ring*
154	*Brake shoe sub-assembly*
155	*Brake cylinder sub-assembly*
156	*Brake adjustment*

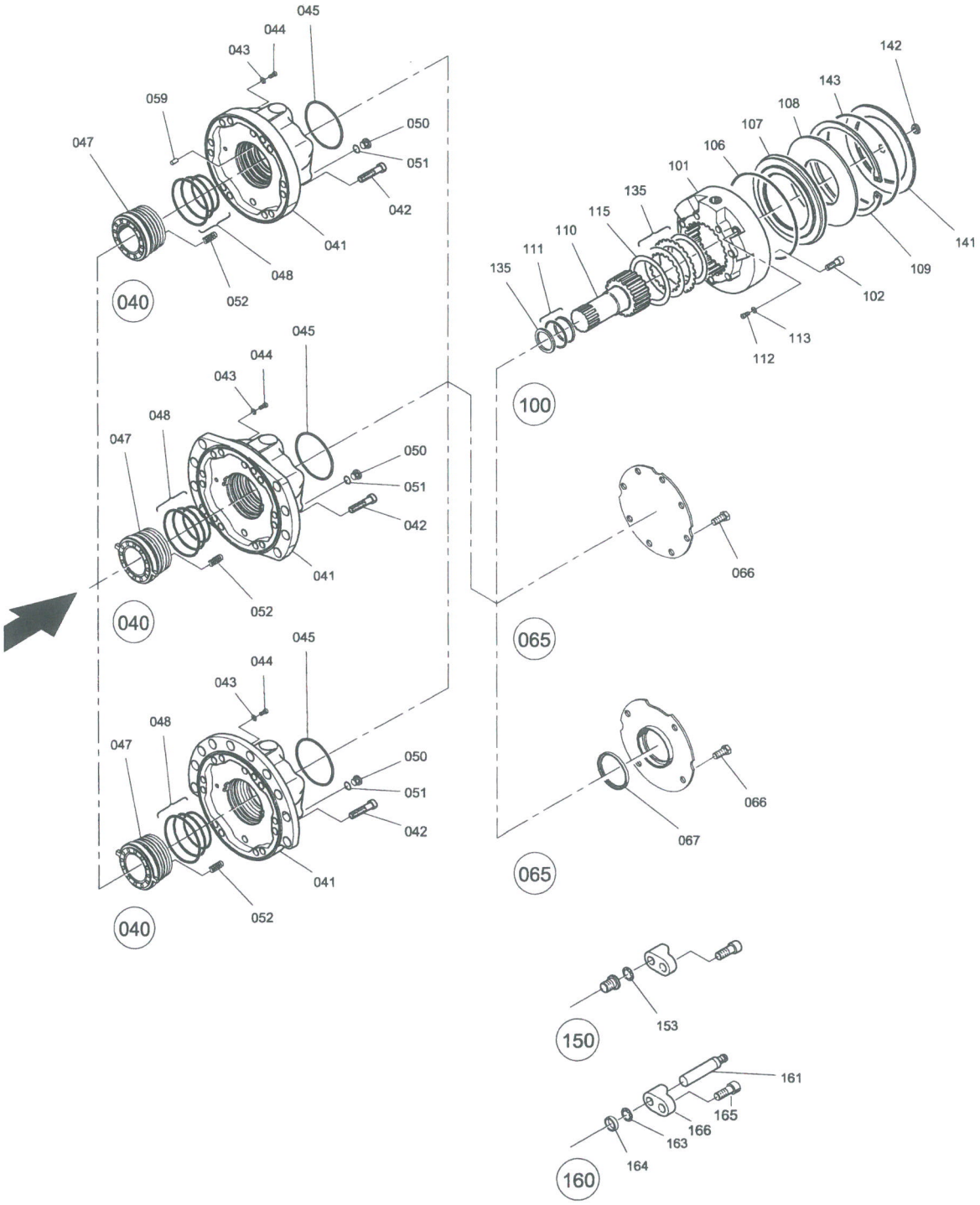
Repère	Désignation
⊙ 100	Frein équipé
101	Corps de frein
102	Vis
106	Joint torique
107	Piston
108	Rondelle élastique
109	Anneau d'arrêt
110	Arbre
111	Joint équipé
112	Vis
113	Rondelle d'étanchéité
135	Kit frein
141	Coiffe
142	Bouchon
143	Joint torique
⊙ 150	Prédisposition Tachy
152	Rondelle
153	Rondelle
⊙ 160	Capteur équipé
161	Capteur
162	Ecrou
163	Rondelle
164	Joint
⊙	Sous-ensemble vendus assemblé

Item	*Description*
⊙ *100*	*Brake assembly*
101	*Brake body*
102	*Screw*
106	*O-ring*
107	*Brake piston*
108	*Spring washer*
109	*Snap ring*
110	*Brake shaft*
111	*Seal*
112	*Screw*
113	*Sealing ring*
135	*Brake kit*
141	*Cover*
142	*Plug*
143	*O-ring*
⊙ *150*	*Speed sensor predisposition*
152	*Washer*
153	*Washer*
⊙ *160*	*Speed sensor assembly*
161	*Speed sensor part*
162	*Nut*
163	*Washer*
164	*Seal*
⊙	*Sub-assembly sold assembled*

Moteurs à 1 cylindrée MS, MSE 02-05-08-11-18.

Single displacement motors MS, MSE 02-05-08-11-18.

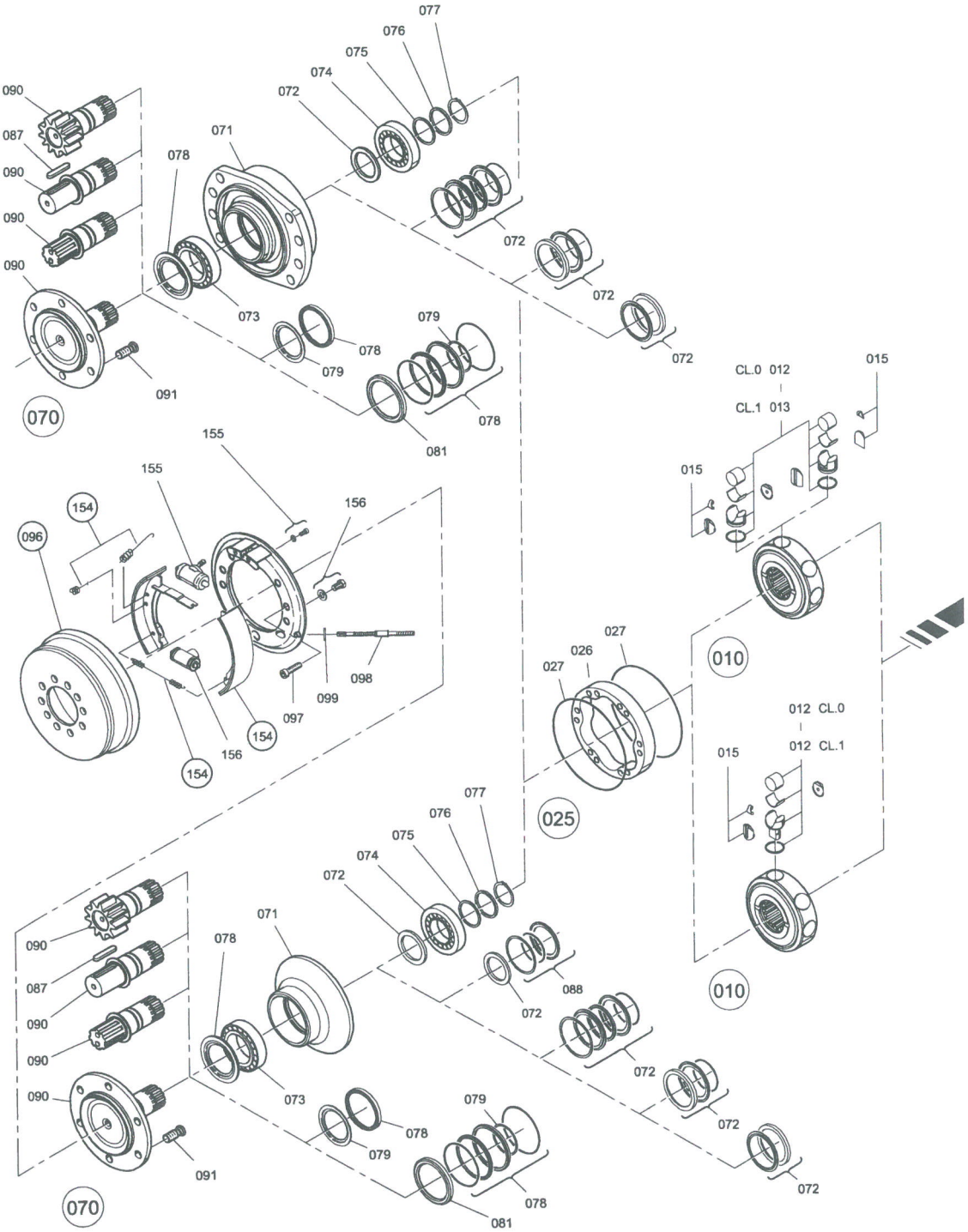




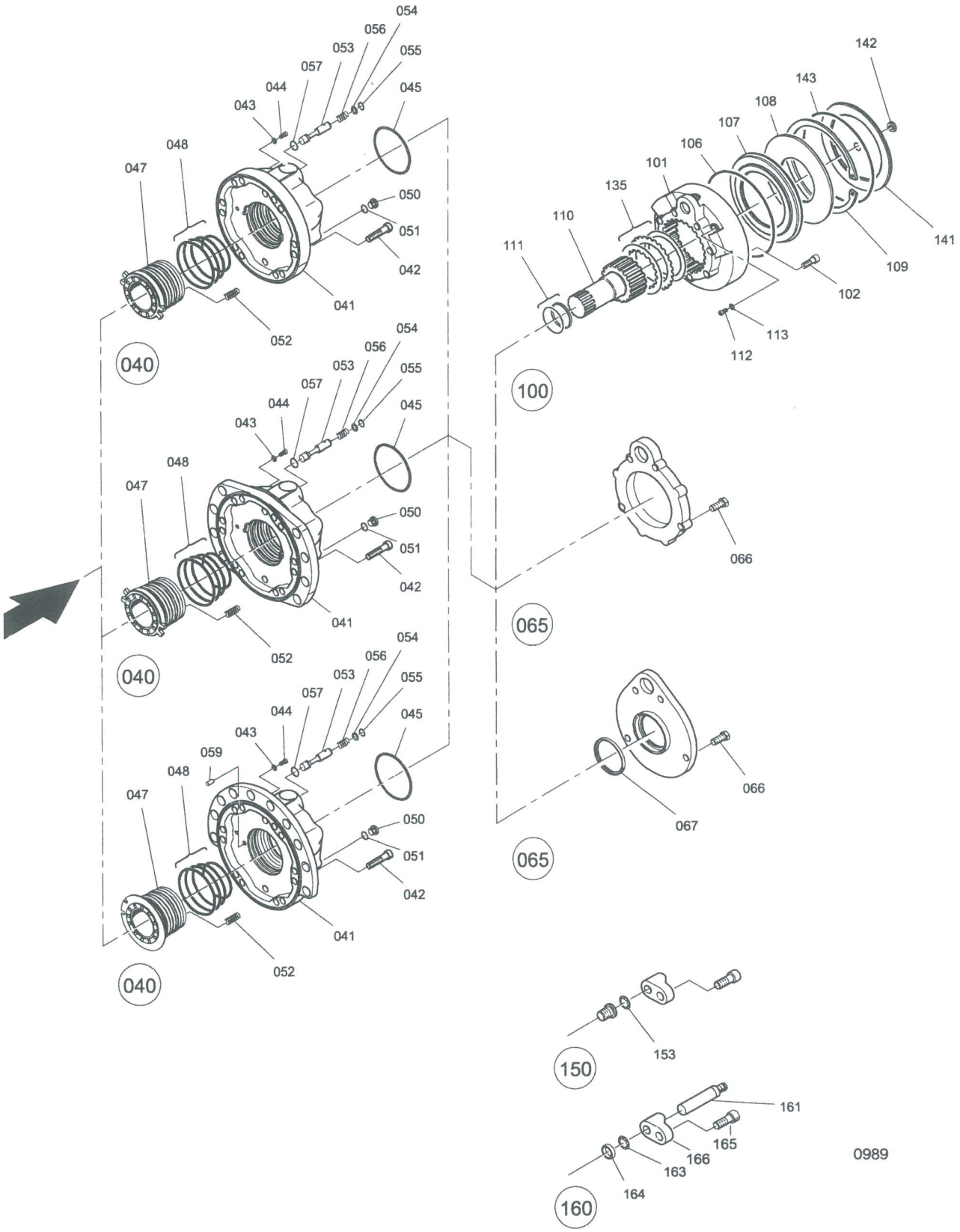
(027)+(043)+(045)+(057)+(058)+(106)+(111)+(113)+(141)+(142)+(143)+(153)+(163)=(001) Pochette de joints *Seals kit* 0988

Moteurs à 2 cylindrées MS, MSE 02-05-08-11-18.

Dual displacement motors MS, MSE 02-05-08-11-18.



0990



(027) + (043) + (045) + (057) + (058) + (106) + (113) + (141) + (142) + (143) + (153) + (163) = (001) Pochette de joints
Seals kit

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MOBILE EQUIPMENT
AND WIND ENERGY SOLUTIONS

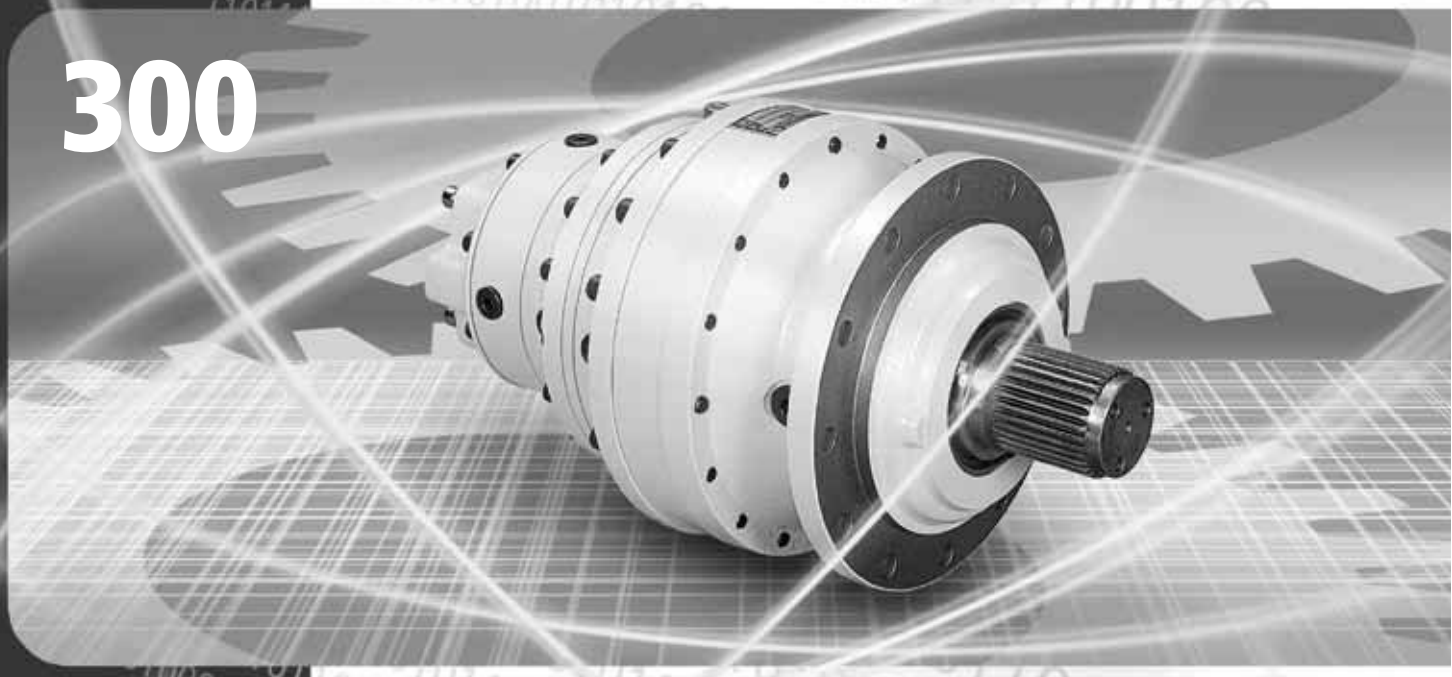
INDUSTRY PROCESS
AND AUTOMATION SOLUTIONS

BONFIGLIOLI
TRASMITAL

Installation, use and service manual

GB

300



ATEX
INCLUDED

BONFIGLIOLI

USE, INSTALLATION AND MAINTENANCE MANUAL

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Revisions

The catalogue revision list is given on page 38. The most recent versions of the catalogue are available at www.bonfiglioli.com.

1.0 - GENERAL INFORMATION

1.1 - PURPOSE OF THE MANUAL

This Manufacturer's manual provides information regarding the safe transport, handling, installation, maintenance, repair, disassembly and dismantling of the gear unit.

All information for users and designers is given in the Sales Catalogue. As well as adhering to established engineering practices, the information given in this manual must be read carefully and rigorously applied.

Failure to observe the information provided herein may result in risks to personal health and safety, as well as economic damages.

This information, provided in the Manufacturer's original language (Italian), is also available in other languages to meet legal and commercial requirements.

The documentation must be stored by a person charged to do so in a suitable location so as to be always available in good condition for consultation.

In case of loss or damage, replacement documentation must be requested directly from the Manufacturer, quoting the code of this manual.

This manual reflects the state of the art at the time of commercialisation of the gear unit.

The Manufacturer reserves the right to modify, supplement and improve the manual, without the present publication being for that reason considered inadequate.

Particularly significant sections of the manual and important specifications are highlighted by symbols whose meanings are explained below.

SYMBOLS:

DANGER - WARNING

This symbol indicates situations of danger, which if ignored, may result in serious injury to the operator.

CAUTION - ATTENTION

This symbol indicates the need to adopt specific precautions to avoid personal injury and damage, as well as economic damages.

IMPORTANT

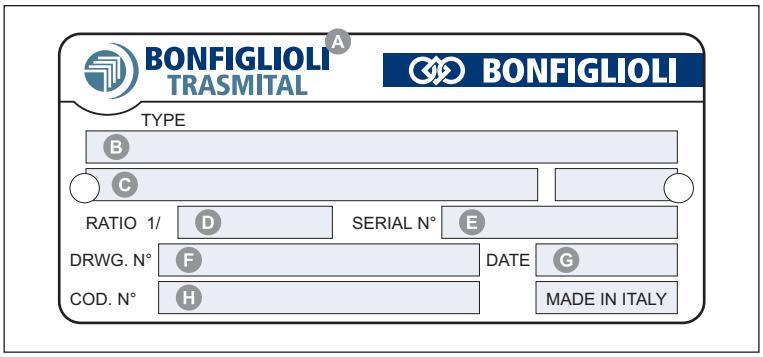
This symbol indicates important technical information.

Instructions marked by these symbols and highlighted in yellow, apply exclusively to equipment complying with "ATEX" Directive 94/9/EC.
The operations identified by these symbols must be executed by professionally qualified operators specially trained in the safety precautions required for working in potentially explosive atmospheres.
Failure to observe these instructions may result in serious safety and environmental risks.

1.2 - PRODUCT IDENTIFICATION

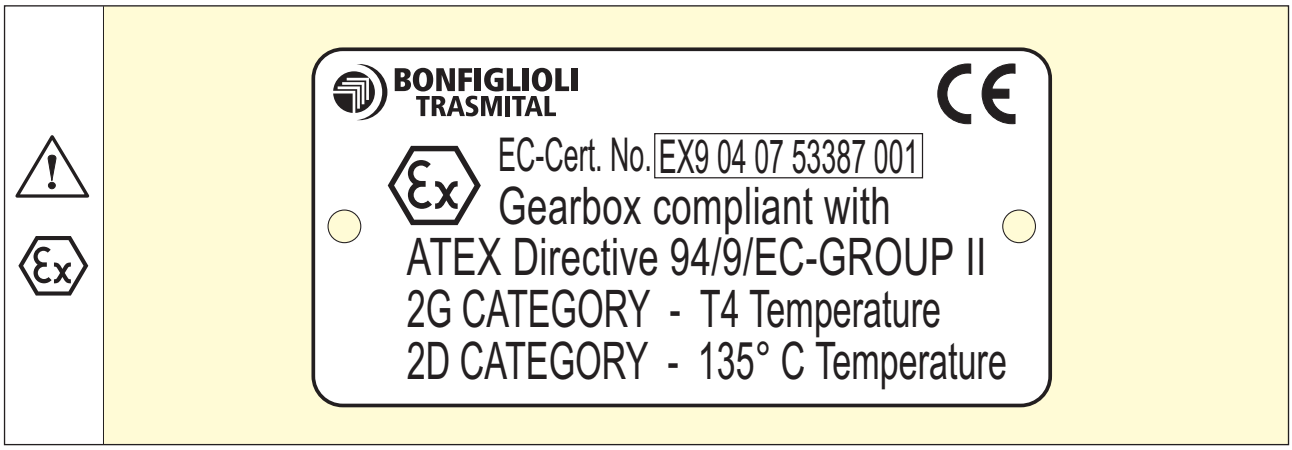
The information identifying the product is shown on its nameplate. Gearmotors are equipped with two nameplates; one on the gear unit which bears the gear unit data, and one on the motor (electric or hydraulic), bearing the motor data.
The drawing below illustrates the layout of the data.
The gear unit's identifying code is explained in the Sales Catalogue. If the gear unit is supplied fitted with an electric motor (gearmotor), all information regarding the motor is supplied in the motor manual.

Nameplate data



- A Manufacturer
- B Product identification
- C Bonfiglioli Trasmital product code
- D Reduction ratio
- E Serial number
- F Installation drawing code.
- G Date of manufacture
- H Client product code

Supplementary nameplate on ATEX-specified gear units



Readability of the nameplate

The nameplate and the information on it must be readable and, consequently must be cleaned from time to time.

Quote the nameplate data in all communications with the manufacturer, for example, when requesting spare parts, information and assistance.

1.3 - GLOSSARY AND TERMINOLOGY

Some of the frequently occurring terms used in this manual are described below to unequivocally define their meaning.

Routine maintenance
The set of operations required to preserve the functionality and efficiency of the gear unit. These operations are usually scheduled by the Manufacturer, who defines the qualifications and tasks involved.

Reactive maintenance
The set of operations required to preserve the functionality and efficiency of the gear unit. These operations are not scheduled by the Manufacturer and must be carried out by an expert maintenance technician.

Expert maintenance technician
An authorised technician with the qualifications, skills and mechanical and electrical training required to do repairs and non-routine maintenance work on the gear unit.

Overhaul
An overhaul consists in the replacement of bearings and other mechanical components which have worn to such an extent as to compromise the operation of the gear unit. An overhaul also includes verification of the condition of all gear unit components (keys, seals, gaskets, vents, etc). If any such components are damaged they must be replaced and the reason for the damage identified.

1.4 - REQUESTING TECHNICAL ASSISTANCE

For any technical service needs, contact the Manufacturer's sales network quoting the information indicated on the unit's nameplate, the approximate hours of service and the type of defect.

1.5 - MANUFACTURER'S LIABILITY

The Manufacturer declines all liability in the event of:

- use of the gear unit in contravention of local safety at work legislation
- incorrect installation, disregard or incorrect application of the instructions provided in this manual
- incorrect or defective electrical/hydraulic power supply (gearmotors)
- modifications or tampering
- work done on the unit by unqualified or unsuitable persons.

The safety of the gear unit also depends on scrupulous observance of the instructions given in this manual, and in particular:

- always operate the unit within its operating limits
- diligently observe the routine maintenance schedule
- only allow trained operators to inspect and service the unit
- only use original spare parts
- the configurations given in the gear unit catalogue are the only ones permitted
- do not attempt to use the unit in any other way
- the instructions given in this manual do not substitute but rather supplement the provisions of established safety legislation.

1.6 - CONSIGNMENT CONDITIONS

Gear units are supplied by BONFIGLIOLI TRASMITAL in the following conditions:

- Configured for installation in the mounting position specified in the purchase order.
- Not charged with lubricant and with internal components protected by a film of oil compatible with the recommended lubricant.
- All surfaces and mating parts are treated with rustproofing products.
- Mating surfaces are not painted while the unit's exterior is treated with a coat of grey water-based rustproofing primer (RAL 7042/C441). Application of a top coat is the responsibility of the Client.
- Tested to factory standards.
- Packaged suitably for the final destination.

2.0 - TECHNICAL INFORMATION

2.1 - DESCRIPTION OF THE GEAR UNIT

The gear unit, driven by an electric or hydraulic motor, has been designed and constructed for integration into an assembly of interlocking parts or mechanisms as part of a specific application.
Depending on the requirements of the application, the gear unit can be supplied in a variety of motor executions and configurations. It is capable of satisfying a range of specific requirements in the mechanical, chemical, agricultural and food industries, etc.

BONFIGLIOLI TRASMITAL supplies a range of accessories and optionals to make their products as versatile as possible. For further technical information and descriptions, refer to the corresponding Sales Catalogue.
The User is responsible for using the products recommended for installation and maintenance of

SAFETY SPECIFICATIONS OF GEAR UNITS COMPLYING WITH DIRECTIVE 94/9/EC

- unit selection must be made with a higher safety service factor
- use only synthetic lubricants (oil and grease)
- VITON® seal rings
- vent plugs with spring-loaded anti-intrusion valve
- oil plugs with aluminium washer
- oil seals with dust trap
- no metal moving parts external to the gear unit
- no plastic parts capable of building up an electrostatic charge, or, if present, duly shielded
- for installations in zones 21 and 22 the User must schedule and implement a regular cleaning programme for all surfaces and recesses to avoid dust build ups of more than 5 mm in depth.

2.2 - CONFORMITY

All gear units or gearmotors (when supplied with electric motor) are designed in compliance with the provisions of applicable Essential Health and Safety Requirements, the “Machinery Directive” 98/37/EC and, if requested, can be supplied with a Manufacturer’s Declaration - Annex IIB as provided by said Directive.
All BONFIGLIOLI gearmotor electric motors conform to the provisions of the Low Voltage Directive 73/23/EEC and the Electromagnetic Compatibility Directive 89/336/EEC.

Furthermore, if specified for use in potentially explosive atmospheres, the gear units are designed and constructed to conform with the Essential Health and Safety Requirements (EHSR) of Annex II of the ATEX Directive 94/9/EC and conform to the following classification:

- Equipment group: **II.**
- Category: Gas **2G** - Dust **2D.**
- Zone: Gas **1** - Dust **21.**
- Maximum surface temperature: temperature class **T4** for 2G and **130°C** for 2D.

2.3 - OPERATING LIMITS AND CONDITIONS

Modification of the motor execution or mounting position is only permitted if previously authorised by BONFIGLIOLI TRASMITAL’s Technical Service.

Failure to obtain said authorisation renders the ATEX certification null and void.

Ambient conditions

- Ambient temperature: min. - 20°C; max. + 40°C.
- Do not use the gear unit, if not explicitly intended for the purpose, in a potentially explosive atmosphere or where the use of explosion-proof equipment is specified.

The nameplate specifications regarding the maximum surface temperature, refer to readings taken in normal ambient and installation conditions.
Even minimal variations to said conditions (e.g. smaller mounting cabinet) may have a significant effect on the unit's heat output.

- Lighting

If the unit is to be serviced in a poorly lit area, use additional lamps and ensure that the work is done in compliance with the safety requirements of established legislation.

3.0 - SAFETY INFORMATION

3.1 - SAFETY STANDARDS

- Carefully read the instructions given in this manual and those posted directly on the gear unit, especially those regarding safety.
- Persons charged with working on the gear unit at any time in its service life must be trained specifically for the purpose with special abilities and experience in the area as well as being equipped with the appropriate tools and individual safety equipment (as per Legislative Decree 626/94). Failure to meet these requirements constitutes a risk to personal health and safety.
- The gear unit must only be used for the applications permitted by the Manufacturer. Improper use can result in risks to personal health and safety and economic damages.

The applications permitted by the Manufacturer are the industrial applications for which the gear units have been designed.

- Keep the gear unit at its maximum efficiency by following the routine maintenance schedule. Good maintenance ensures the unit's maximum performance, extended service life and continued compliance with safety regulations.
- When working on the unit in areas which are difficult to access or hazardous, ensure that adequate safety precautions have been taken for the operator and others in compliance with established legislation on health and safety at work.
- All maintenance, inspection and repairs must only be carried out by an expert maintenance technician fully familiar with the attendant hazards. It is therefore essential to implement operating procedures that address potential hazards and their prevention for the entire machine. The expert maintenance technician must always work with caution in observance of applicable safety standards.
- During operation wear only the apparel and safety equipment indicated in the User Instructions provided by the Manufacturer or stipulated by legislation on safety at work.
- Replace worn components with original spare parts. Use the lubricants (oil and grease) recommended by the Manufacturer.
- Do not dump polluting materials into the environment. Dispose of all such materials as stipulated by applicable legislation.
- After replacing lubricants clean the gear unit's surfaces and the walk-on surfaces around the work area.

If the gear unit is to be serviced in a potentially explosive atmosphere, the operator must first switch off power to the gear unit and ensure that it is out of service, as well as taking all necessary precautions against it being accidentally switched on again or its parts moving without warning.
Furthermore, all additional environmental safety precautions must be taken (e.g. elimination of residual gas or dust, etc).

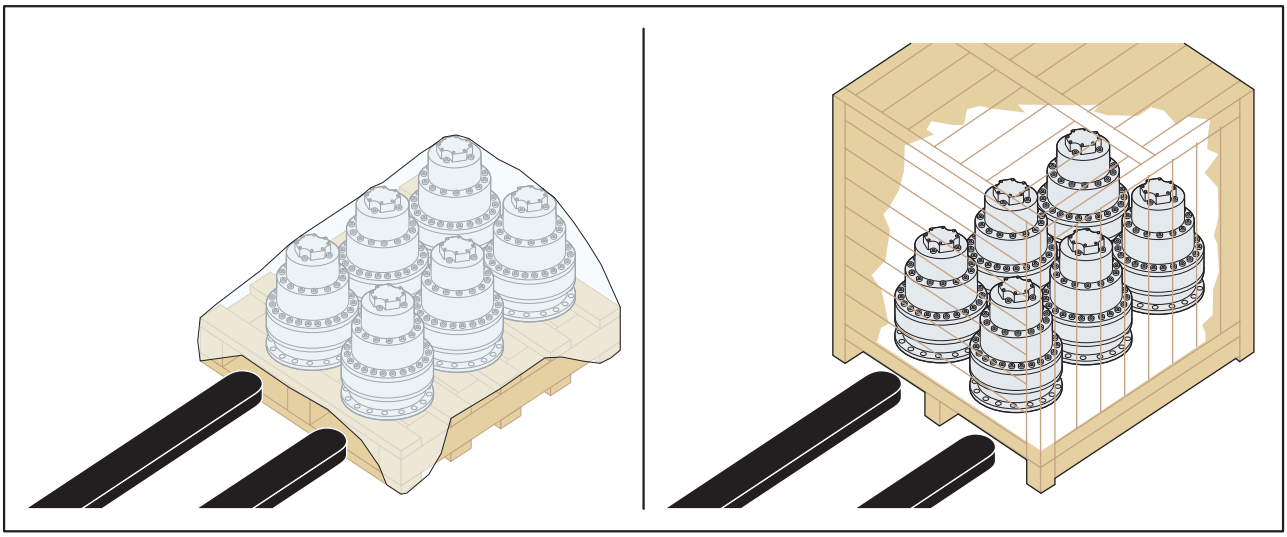
4.0 - HANDLING AND TRANSPORT

4.1 - PACKAGING

The standard packaging, if supplied and unless otherwise agreed, is not proofed against rainfall and is intended for shipping by ground and not sea, and for storage in areas which are under cover and not humid. The material can be stored in suitable conditions for a period of two years under cover at a temperature between -15 °C and +50 °C at a relative humidity not in excess of 80%. Storage in all other conditions requires specific packaging.

The most frequent types of packaging are shown in the figures below.

- Packaging on pallet with heat shrink film for ground shipping.
- Packaging in wooden crate for shipping by sea or air.



On receipt of the gear unit, make sure the delivery corresponds to the purchase order and that it is not damaged or faulty in any way.
Report any nonconformity to your BONFIGLIOLI TRASMITAL reseller.

Dispose of packaging materials as stipulated by applicable legislation.

4.2 - HANDLING INSTRUCTIONS

Handle packages as per the Manufacturer's instructions and those marked on the packages themselves. Since the weight and shape of the packages may make manual handling unfeasible, special equipment must be used to avoid damage and injury. Persons authorised for this purpose must be trained and experienced in the work in question to avoid risks to themselves and others.

The person authorised to handle the product must take all necessary precautions to safeguard his safety and that of all other persons involved.

4.2.1 - Moving the packages

- Prepare a suitable, delimited area with a level floor or surface for unloading the packages.
- Prepare the equipment required to handle the package. The lifting and handling equipment (e.g. crane or lift truck) must be of adequate capacity for the weight and size of the load, taking into account its attachment points and centre of gravity. If required, this information is indicated on the package itself. Harness heavy packages with chains, belts and steel ropes after checking that they are suitable for the weight of the load, which is always indicated.
- When handling the load keep it level to avoid tipping and instability.

4.2.2 - Moving the equipment

All the following operations must be carried out with care and caution and without sudden movements.

When lifting, use accessories such as eyebolts, screw clamps, snap hooks, straps, ropes and hooks etc. which are certified and adequate for the load in question.
The weight of the product to be lifted is given in the Sales Catalogue.

The following pages illustrate in detail the different attachment methods for the various product series, sizes and configurations described in this Manual.
The most suitable solution for lifting and handling the product in safety is indicated for each.

Symbols:

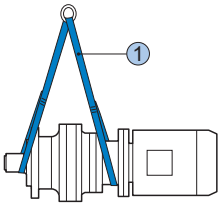
Type of lifting	**Manual**	**With mechanical equipment**	
Symbol	**M**	**A**	**B**
Approximate weight	≤ 15 Kg	> 15 Kg	
Instruction	—	Recommended method for positioning	Recommended method for handling and positioning
Warning	—	The load may be unstable	The load may sway or oscillate
Solution	—	Slide the lifting ring to align it with the load's centre of gravity as shown in the diagrams below Lock the ropes below the ring with a cable clamp or similar device so as to prevent them sliding, and lift the load Observe all precautions regarding the handling of loads	Stabilise the moving load by hand Observe all precautions regarding the handling of loads

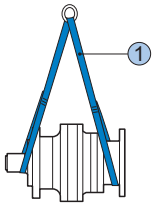
The load must not be allowed to sway by more than 15° in any direction when being lifted.
If swaying exceeds this amount, stop and repeat the lifting operation as instructed.

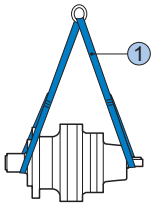
Identify the attachment points for lifting the gear unit. Refer to the diagrams given below.

A 300 L ... 316 L

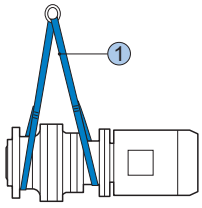
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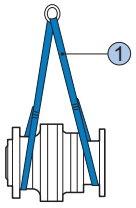


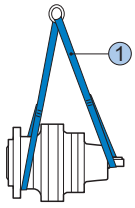




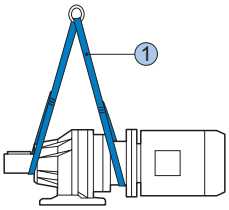
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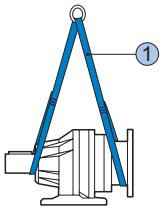


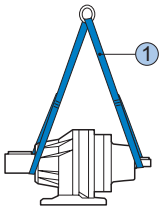




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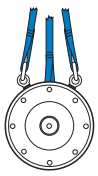


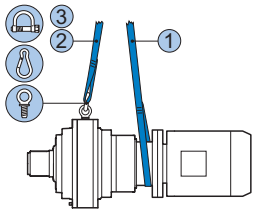


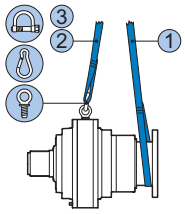


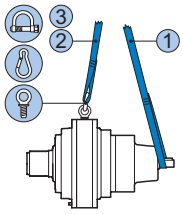
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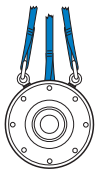


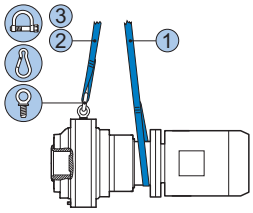


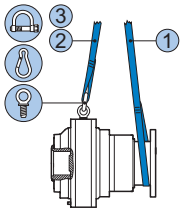


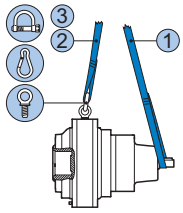


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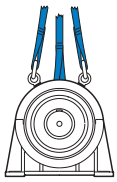


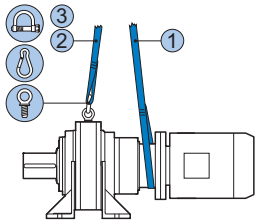


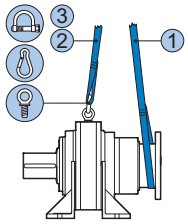


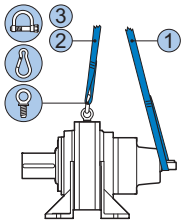


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① Ring harness

② Rope and hooks

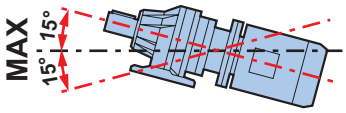
③ Open harness with eyelets

Screw clamp (use with harness)

Snap hook (use with rope)

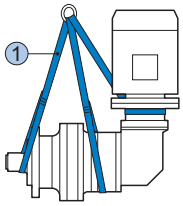
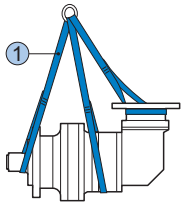
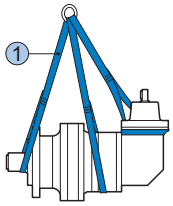
Eyebolt (already fitted on gear units 317-321)

Maximum permissible tilt during handling: 15°

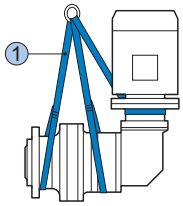
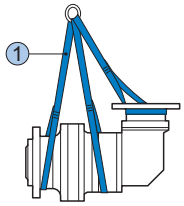
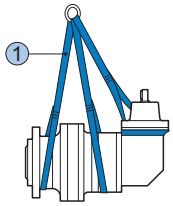


A 300 R ... 316 R

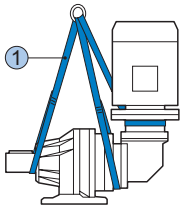
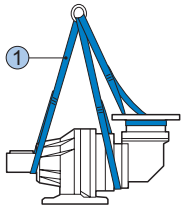
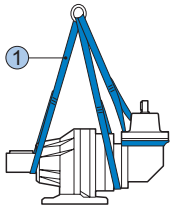
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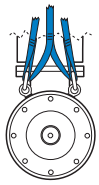
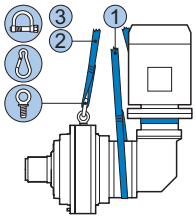
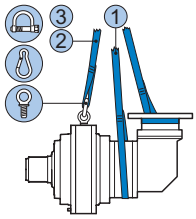
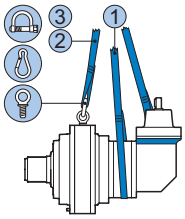




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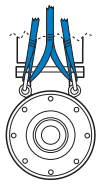
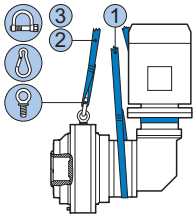
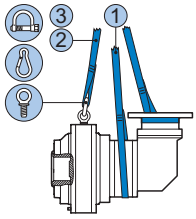
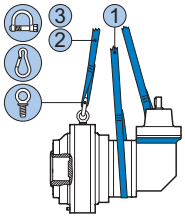




B 317 R ... 321 R

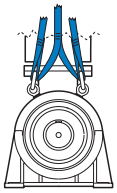
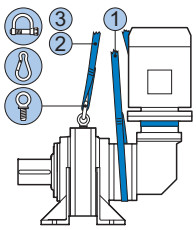
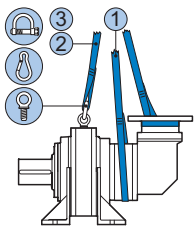
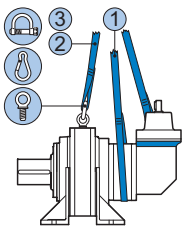
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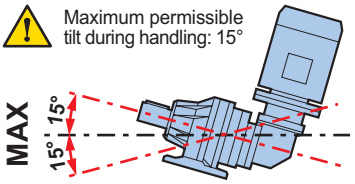
1. Ring harness
2. Rope and hooks
3. Open harness with eyelets

Screw clamp (use with harness)

Snap hook (use with rope)

Eyebolt (already fitted on gear units 317-321)

Maximum permissible tilt during handling: 15°



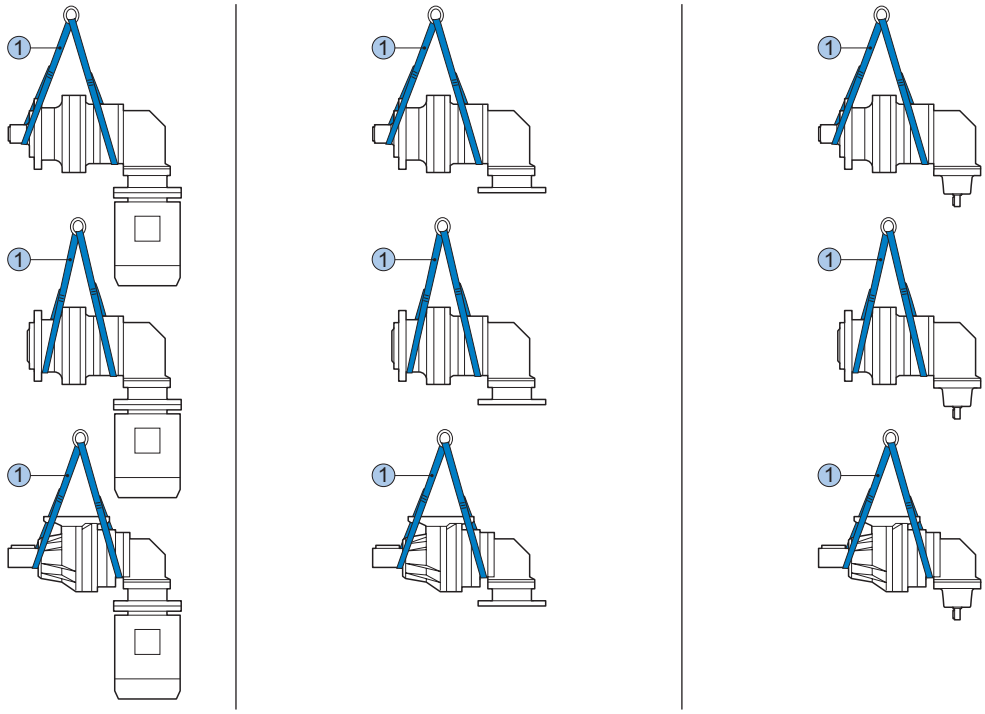
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A 300 R ... 316 R

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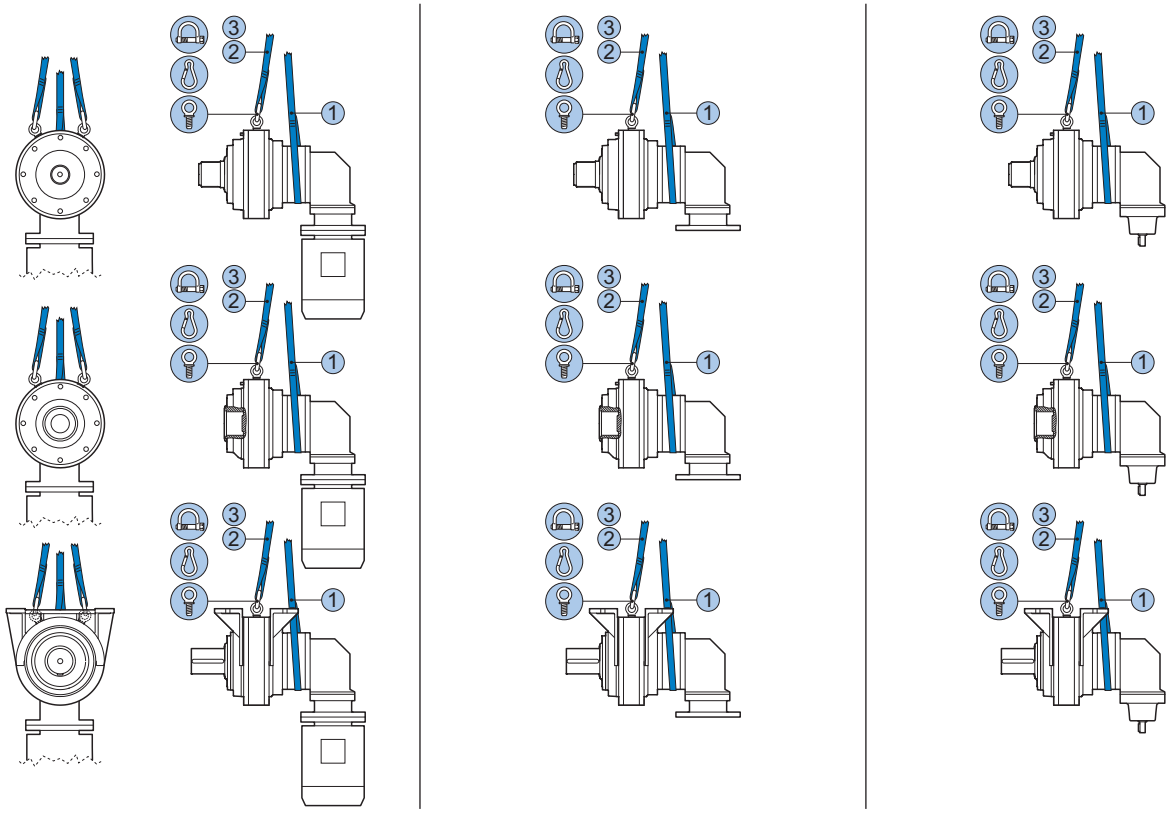


B 317 R ... 321 R

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1 Ring harness

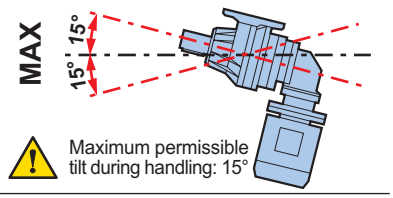
2 Rope and hooks

3 Open harness with eyelets

Screw clamp (use with harness)

Snap hook (use with rope)

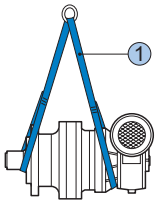
Eyebolt (already fitted on gear units 317-321)

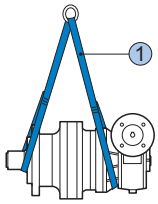


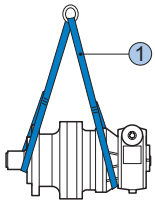
Maximum permissible tilt during handling: 15°

A 3V 00 ... 3V 16

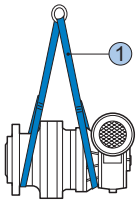
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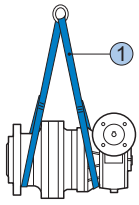


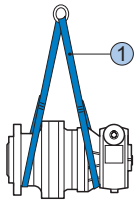




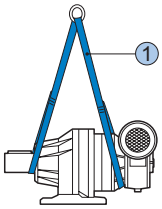
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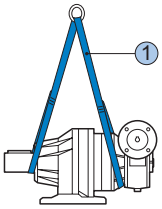


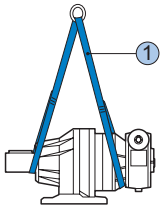




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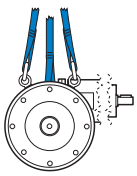


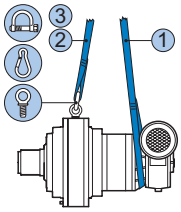


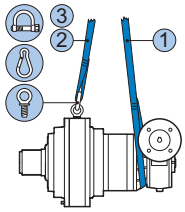


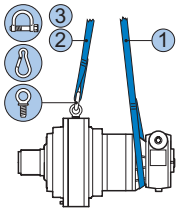
B 3V 17 ... 3V 21

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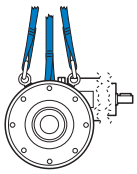


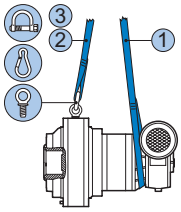


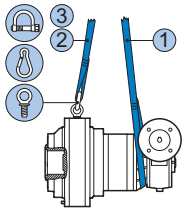


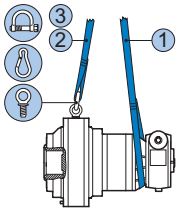


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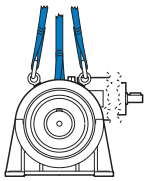


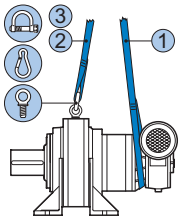


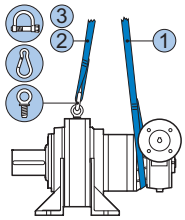


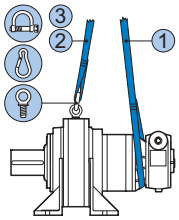


P□









① Ring harness

② Rope and hooks

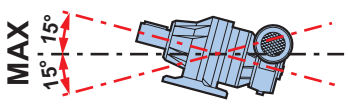
③ Open harness with eyelets

Screw clamp (use with harness)

Snap hook (use with rope)

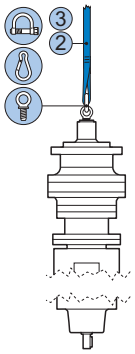
Eyebolt (already fitted on gear units 317-321)

Maximum permissible tilt during handling: 15°

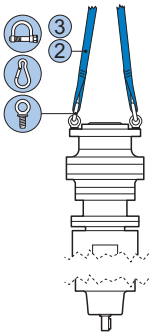


300 L ... 321 L

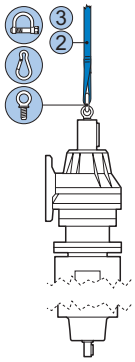
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F□

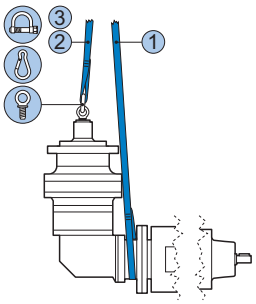


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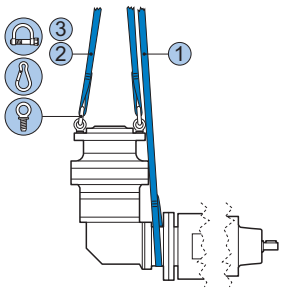


300 R ... 321 R

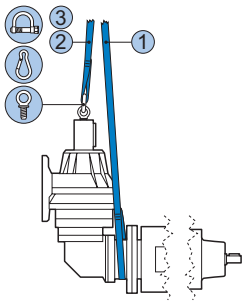
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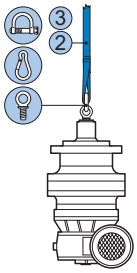


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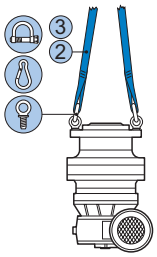


3V 00 ... 3V 21

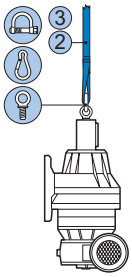
H□



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P□



① Ring harness

② Rope and hooks

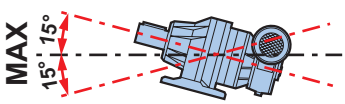
③ Open harness with eyelets

Screw clamp (use with harness)

Snap hook (use with rope)

Eyebolt (already fitted on gear units 317-321)

Maximum permissible tilt during handling: 15°



- Prepare the gear unit for lifting by attaching straps, hooks and screw clamps etc. to its attachment points. Alternatively, use a pallet to move the load. If using a crane, first lift the gear unit vertically out of its packaging.
- If using a lift truck or pallet truck, remove the packaging and insert the truck's forks at the indicated positions.
- First lift the load very slowly to check that it is stable.
- Move the gear unit to the unloading area and lower it gently into position, taking care not to tip it suddenly in transit.

If the gear unit is already equipped with an electric motor, do not use the eyebolts on the motor casing for lifting, unless expressly specified.

4.3 - STORAGE

The following recommendations should be followed when storing the gear unit.

1. Do not store the unit in excessively humid conditions or where it is exposed to the weather (do not store outdoors).
2. Do not place the gear unit directly on the ground.
3. Place the gear unit on a stable base and make sure that it is not subject to accidental displacement.
4. Store the packaged gear unit (if allowed) in accordance with the instructions on the packaging itself.

If the gear unit is to be stored for more than 6 months, the following **additional** precautions must be taken:

5. Cover all machined external surfaces with a rustproofing product such as Shell Ensis or other product with similar properties and application range.
6. Fill the unit with lubricating oil and make sure the vent plug is positioned uppermost. Before putting the unit into service, the oil used for storage must be drained and replaced with the correct quantity of recommended operating lubricant.

PRECAUTIONS to be taken when returning the gear unit to service after storage.

The output shafts and external surfaces must be thoroughly cleaned of all rustproofing product, contaminants and other impurities (use a standard commercial solvent).
Do this outside the explosion hazard area.

The solvent must not touch the seal rings as this may damage them, causing them to leak

If the oil or protective material used during storage is not compatible with the synthetic oil used during the machine's operation, the interior of the unit must be thoroughly cleaned before filling with the operating oil.

The service life of the bearing grease is reduced if the unit is stored for more than 1 year.
The bearing grease must be synthetic.

5.0 - INSTALLATION

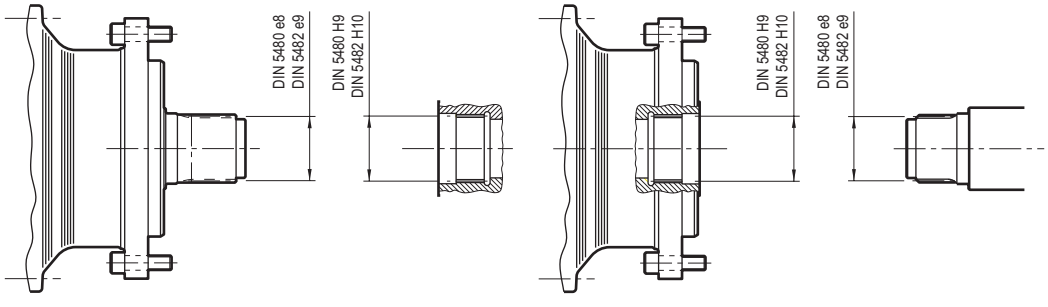
5.1 - INSTALLING THE GEAR UNIT

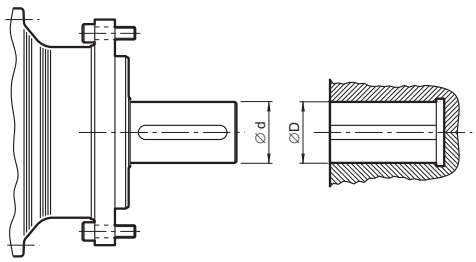
The entire installation process must be planned as early as the general design phase of the machine. The person authorised to do the work must, if necessary, set out a safety plan to protect the health and safety of all persons directly involved and apply all applicable legislation.

1. Carefully remove all packaging and protective product residue from the gear unit.
   Pay particular attention to the mating surfaces.
2. Check that the data on the nameplate correspond to those specified in the purchase order.
3. Ensure that the structure to which the gear unit is to be mounted is sufficiently robust and rigid to support its weight and operating stresses.
4. Check that the machine to which the gear unit is to be installed is switched off and cannot be accidentally switched on again.
5. Make sure all mating surfaces are flat.
6. Make sure the shaft/shaft or shaft/ bore are perfectly aligned for coupling.
7. Fit suitable guards to protect against the gear unit's external moving parts.
8. If the work environment is corrosive for the gear unit or any of its parts, follow the special precautions required for aggressive environments. In this case, contact the BONFIGLIOLI TRASMITAL sales service.
9. We recommend applying a protective paste to all gear unit/motor mating surfaces and other parts (Klüberpaste 46 MR 401 or other product with similar properties and application range) to ensure optimal coupling and protection against fretting corrosion.
10. In the case of outdoor installations fitted with an electric motor, protect the latter from direct sunlight and the weather by means of guards or a casing. Also make sure that the assembly is properly ventilated.

5.1.1 - Flanged execution

Machine the coupling counterflange on the machine to which the gear unit is to be installed.
The flanges must be plane and machined with machine tools. Connect the output shaft to the driven component as indicated in the drawings below.





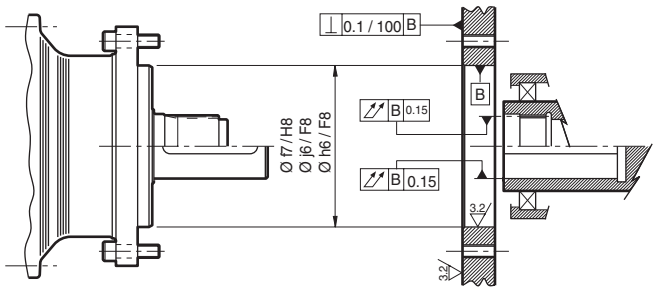
Recommended tolerances

Loose coupling		Coupling with interference	
Solid shaft	Hollow shaft	Solid shaft	Hollow shaft
Ø d h6	Ø D G7	Ø d h6	Ø D P7
Ø d k6	Ø D F7	Ø d k6	Ø D M7
Ø d m6	Ø D F7	Ø d m6	Ø D K7
Ø d r6	Ø D E7	Ø d r6	Ø D H7

For machining the spigot on the driven machine, refer to the diagrams below:

300...307 gear units - male output shaft motor execution

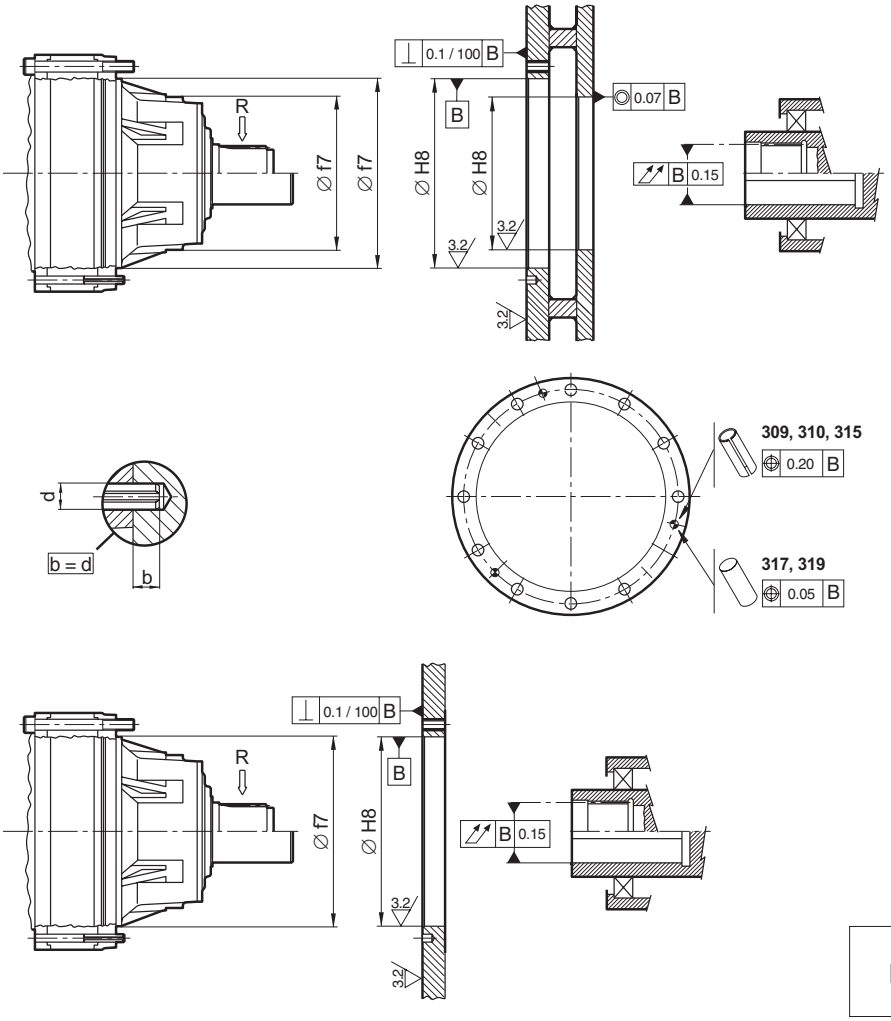
300...307



309...321 gear units - male output shaft motor execution

These gear units are fitted with two spigots. When machining the coupling flanges, one spigot may be sufficient if the output shaft is not subject to overhung loads or loads are less than 60% of the permissible load.
For heavier loads, the mounting must use both spigots on the gear unit.
If the gear unit is instead required to transmit high torque or is subject to heavy shock loads and inversions in the direction of rotation, the counterflange must be drilled to accept the spigots.
At the time of installation, move the spigots mounted on the gear unit forward into the counterflange by an amount equal to their diameter. See diagram below:

309...321

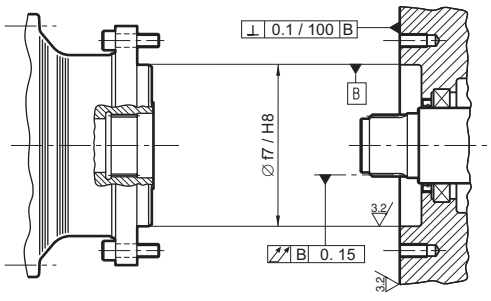


R ≥ 60% Rn

Mounting with hollow splined shaft

Ensure that the gear unit and driven shaft are aligned and that the latter is not subject to flexing during operation. See diagram below:

300...321



Flanged gear unit mounting bolts

	300	301	303	305	306	307	309	310	311	313	315	316	317	318	319	321
Bolt	M10	M10	M12	M12	M14	M16	M16	M16	M16	M20	M20	M20	M30	M24	M30	M30
Quantity	8	8	10	10	12	10	12	15	24	30	20	30	24	32	30	36
Class	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
Tightening torque (Nm)	50	50	85	85	135	200	200	200	200	400	400	400	1400	700	1400	1400

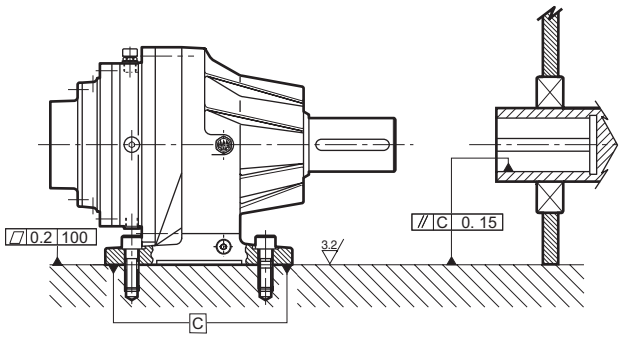
For maximum transmitted torques greater than or equal to 70% of the torque indicated as M_{2max}, and with frequent inversions of the direction of rotation, use at least class 10.9 bolts.

5.1.2 - Foot mounting

Foot-mounted motor execution

Gear units of this type must be mounted on a suitably rigid base, machined flat with a planarity error margin of no more than 0.2 mm / 100 mm.
See diagram below:

300...321



Foot-mounted gear unit mounting bolts

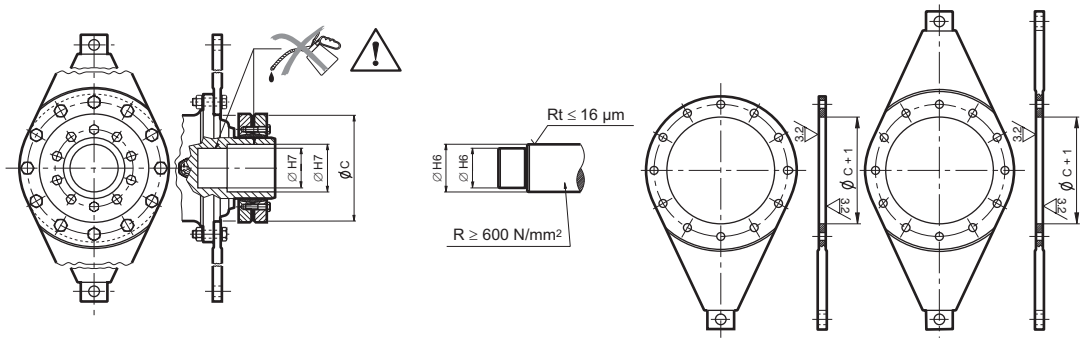
	300	301	303	305	306	307	309	310	311	313	315	316	317	318	319	321
Bolt	M16	M16	M16	M16	M20	M24	M24	M24	M30	M30	M30	M36	M30	M36	M48	M48
Quantity	4	4	4	4	4	4	4	4	4	4	8	8	8	8	4	8
Class	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
Tightening torque (Nm)	200	200	200	200	400	700	700	700	1400	1400	1400	2500	1400	2500	6000	6000

5.1.3 - Shaft mounting

Mount the torque arm with bolts of at least class 8.8 tightened to a torque of 70% of their failure stress. Clean and degrease both the internal coupling surface of the gear unit shaft and the external coupling surface of the machine's driven shaft.
Mount the shrink disk to the gear unit's shaft after lightly lubricating its entire **outer surface**. Snug down a first set of 3 bolts located at the corners of an equilateral triangle (for example: bolts in pos. 1-5-9 of the diagram below). Fit the gear unit to the driven shaft.
Tighten down the bolts (following the triangular pattern) in a circular direction, repeating the operation several times until all bolts are tightened to the torque specified in chart 2, in accordance with the type of disk/gear unit.

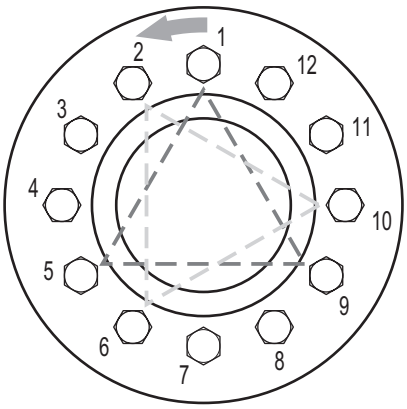
N.B.: Do not tighten down diametrically opposed bolts in sequence.

300...321



Do not use molybdenum bisulphide or any other grease, which could reduce the friction of the mating surfaces and affect the performance of the shrink disk.

300...321



Shrink disk mounting bolts

	300	301	303	305	306	307	309	310	311	313	315	316	317	318	319	321
Bolt	M6	M6	M8	M8	M10	M10	M16	M16	M16	M16	M20	M20	M20	M20	M20	M24
Quantity	8	10	12	12	9	12	8	8	10	10	12	15	18	21	24	21
Class	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Tightening torque (Nm)	12	12	30	30	58	58	250	250	250	250	490	490	490	490	490	840

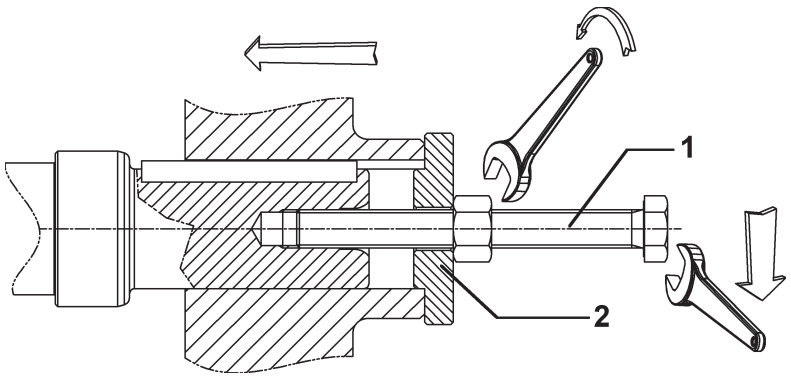
Proceed with the installation as follows:

1. Place the gear unit in the vicinity of the installation area.
2. Mount the gear unit and secure it to the structure at the points provided. The gear unit should be secured to the structure at all the mounting points (bores) on the mount provided (feet or flange).
3. Tighten down the mounting bolts and check that the service plugs are screwed down to the torques given in the chart.

Locate the closed oil plug used during shipping and replace it with the vent plug supplied in the shipment.

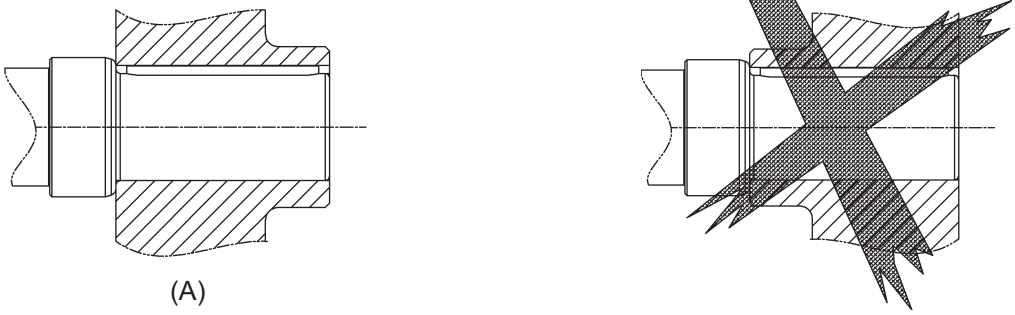
5.1.4 - Installing accessories on solid input and output shafts

Do not use hammers or other tools that might damage the gear unit's shafts or bearings when mounting external parts. Instead, proceed as illustrated in the diagram below:



Bolt (1) and spacer (2) are not included in the consignment.

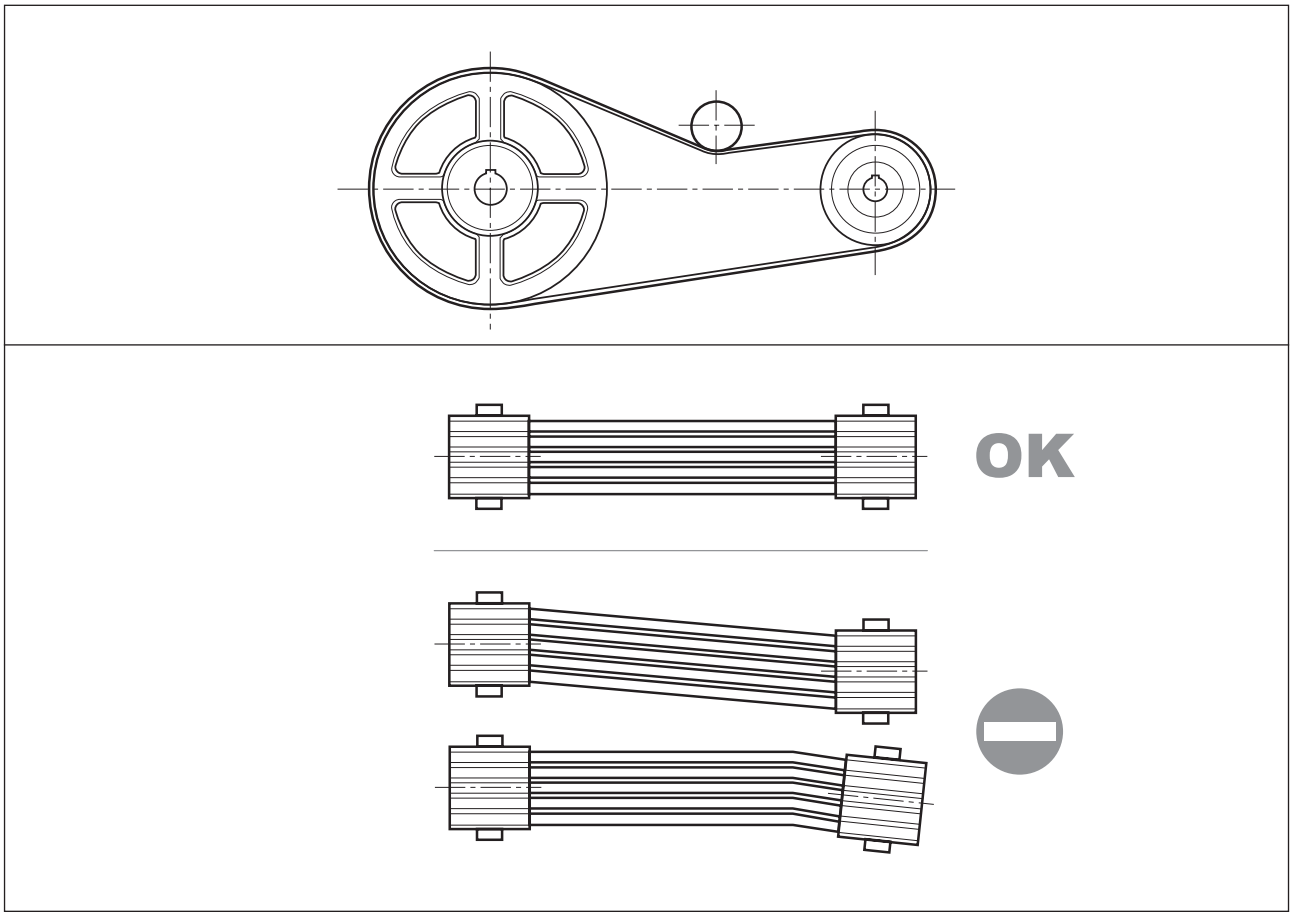
To minimise the loads on the shaft bearings, when mounting transmission mechanisms with asymmetrical hubs use the configuration shown in diagram **(A)** below:



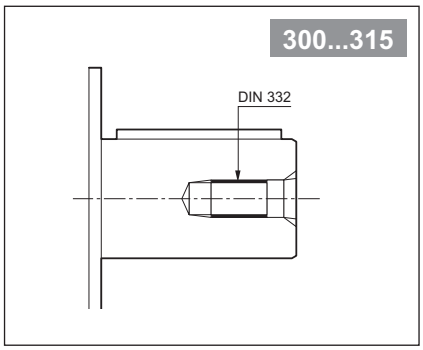
(A)

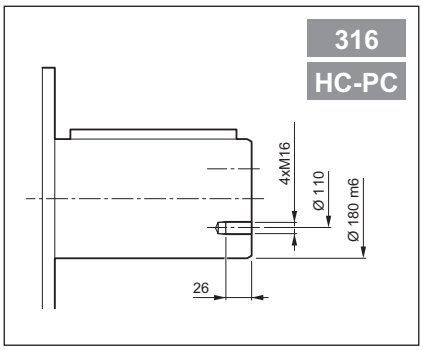
Mounting pulleys

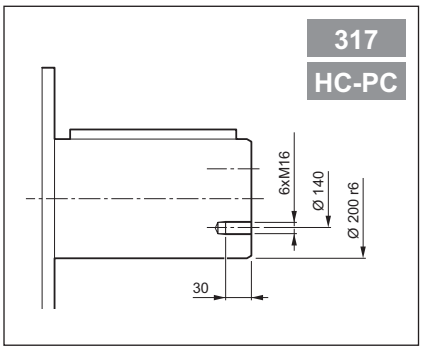
Clean all parts before installing them. When installing belt drive pulleys, the shafts must be parallel with their pulleys aligned.
Do not over tension the drive belt as this can damage the bearings.

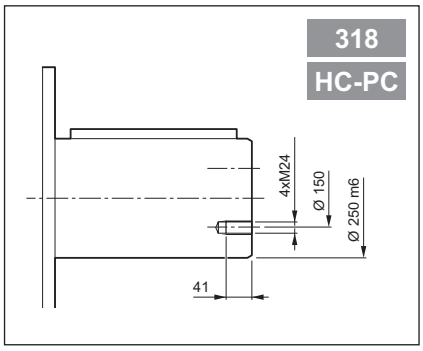


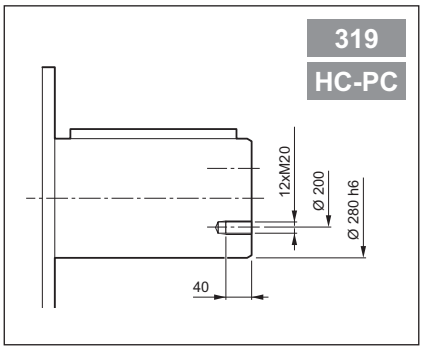
Shaft end: threads

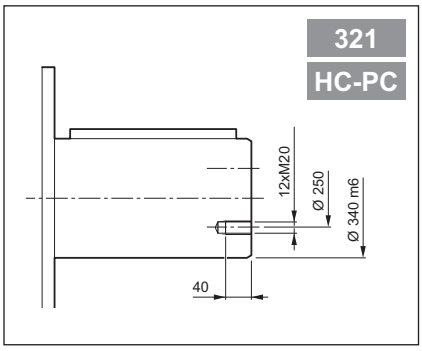








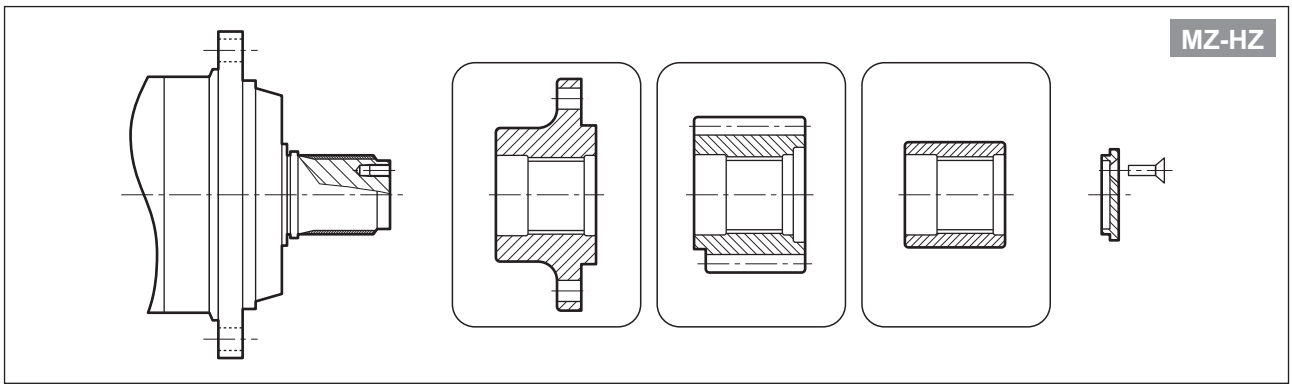




	300	301	303	305	306	307	309	310	311	313	315	316	317	318	319	321
MC	M12	M12	M20	M20	M20	M20	–	–	–	–	–	–	–	–	–	–
HC	M16	M16	M20	M20	M20	M20	M24	M24	M24	M24	M24	–	–	–	–	–
PC	M12	M16	M20	M20	M20	M20	M24	M24	M24	M24	M24	–	–	–	–	–
VK	–	–	M20	M20	M24	M24	M24	M24	M24	M30	M30	–	–	–	–	–

Installing accessories on splined shafts

Do not use hammers or other tools that might damage the gear unit's shafts or bearings when mounting external parts. Instead, proceed as illustrated in the diagram below:

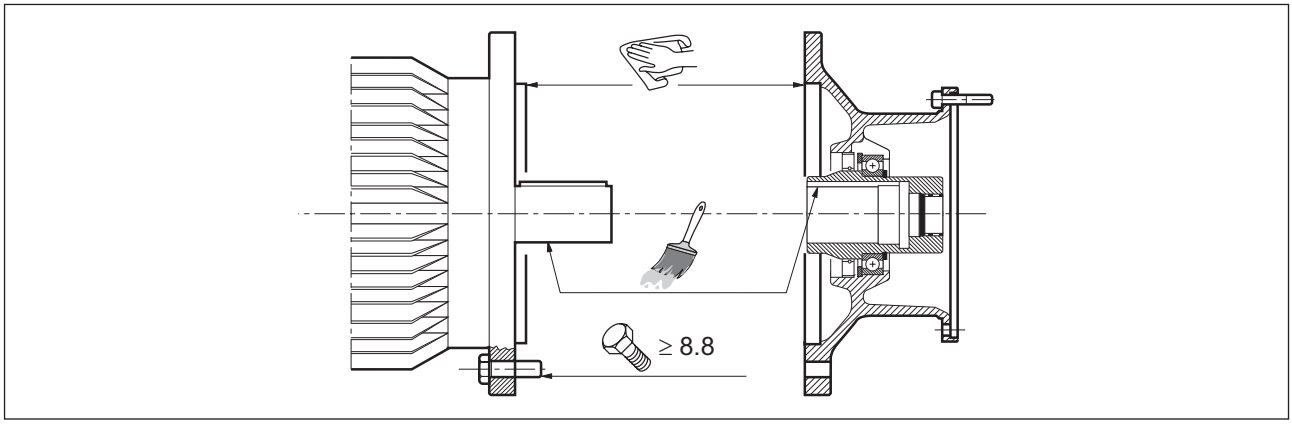


Always use the stop end plate supplied with the gear unit.

5.2 - INSTALLING THE ELECTRIC MOTOR

Further to all the precautions indicated above, when installing a standard IEC 72-1 electric motor, the following precautions must also be observed:

- Do not force the coupling and do not use inappropriate tools during assembly. Take care not to damage the flat/cylindrical coupling surfaces.
- Do not force the rotary coupling mechanisms with heavy overhung or thrust loads.
- To facilitate assembly, use a lubricating synthetic oil paste such as Klüberpaste 46 MR 401 or another product with similar properties and application range.



- **Provided all the above checks have been performed and passed and all other instructions in this manual have been strictly observed, an electric motor with ATEX rating equal to or greater than that of the gear unit may be installed, thus forming a gearmotor which itself complies with the provisions of Directive 94/9/EC.**

  If, instead, the assembly of the motor to the gear unit requires actions other than those prescribed in this Manual or one or more of the manual's prescriptions have not been satisfied, the User shall be responsible for analysing the risks attendant on this particular motor/gear unit combination. The risk analysis is in any case obligatory if the motor is powered by an inverter.

  Only in this way, and subject to self-certification by the assembler, shall the assembly, including the gear unit itself, be compliant with the requirements of Directive 94/9/EC.

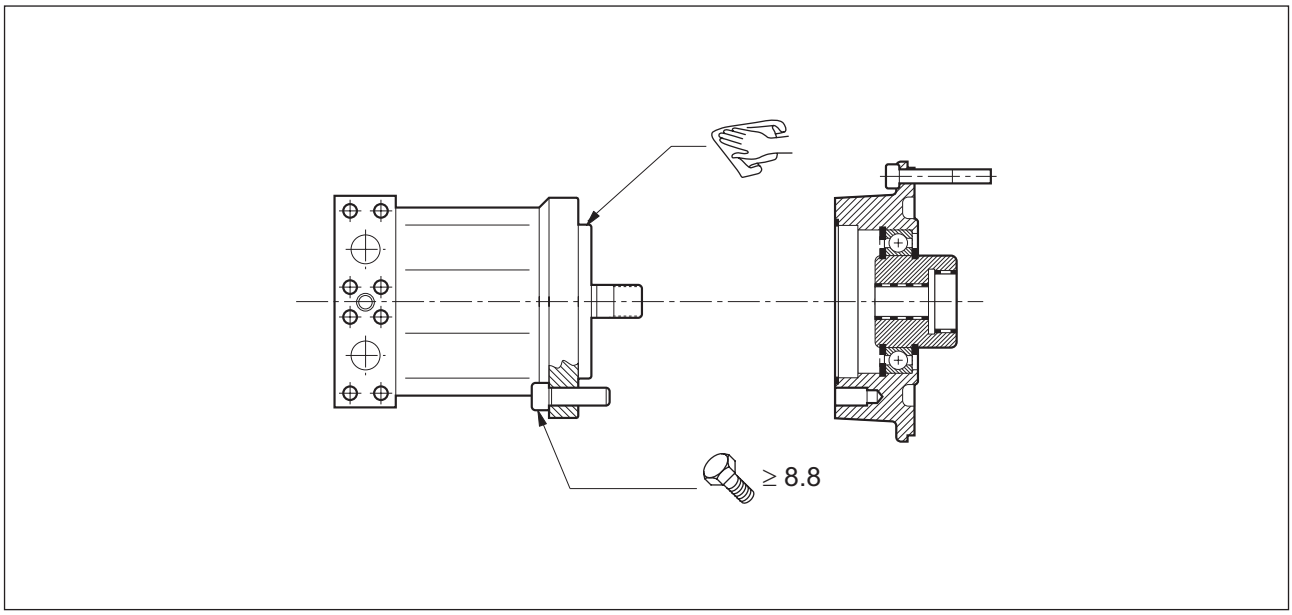
5.3 - INSTALLING THE HYDRAULIC MOTOR

Connecting the hydraulic motor

Remove the protective plug.
Hydraulic motor mountings are available in two versions:

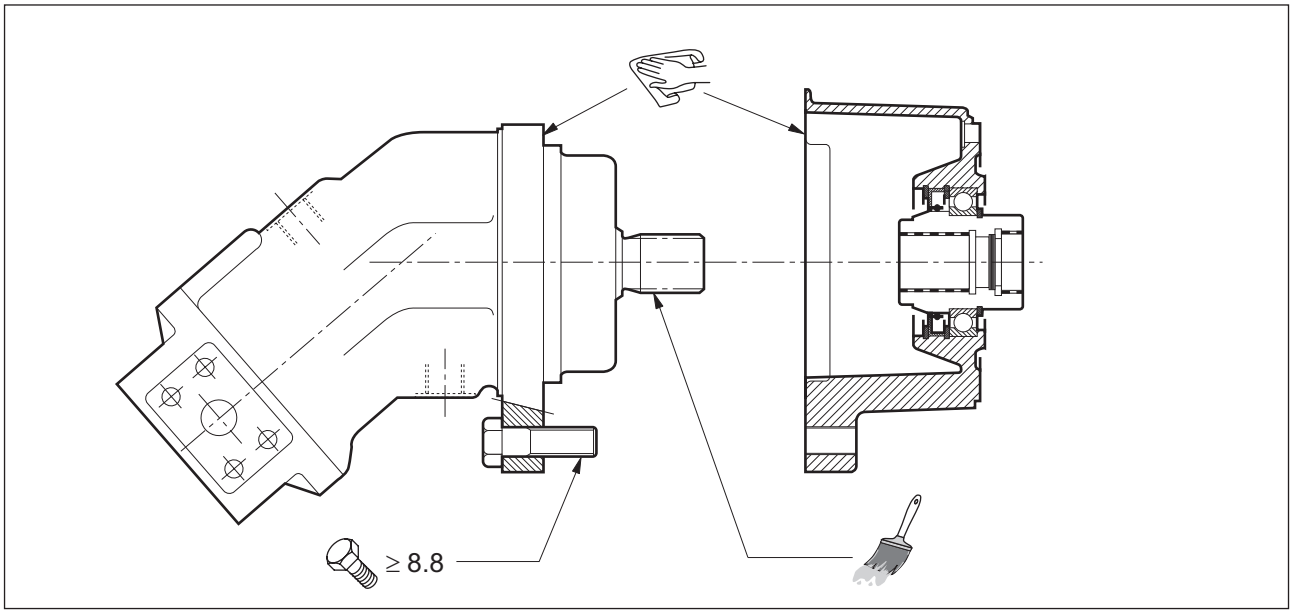
a) Version with O-ring oil gasket between motor flange and gear unit.

In this case, mount the gasket to ensure an oil tight seal between the motor and gear unit, taking care to fit it correctly in its seat without damaging it.



b) Version with gasket already mounted to the coupling.

In this case no special intervention is required to ensure an oil tight seal since this is already provided by the motor coupling. Merely smear the motor shaft with grease.
In both cases, clean the spigot and the coupling where the motor is to be fitted, fit the motor and tighten down the flange mounting bolts.
Always use bolts rated to at least class 8.8.

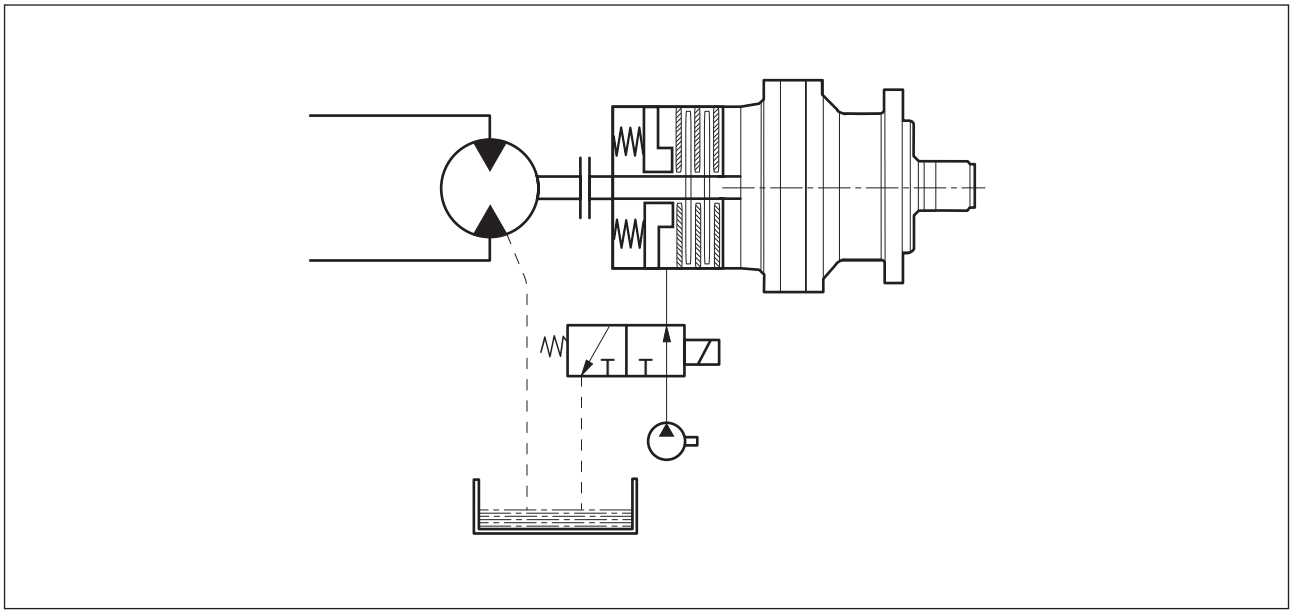


5.4 - CONNECTING THE HYDRAULIC BRAKE

On gear units designed for coupling to hydraulic motors and fitted with a brake, connect the brake control fitting to the hydraulic circuit at the time of assembly.

Start-up

The minimum pressure to release the brake (see chart) must be less than 320 bar.



Technical data

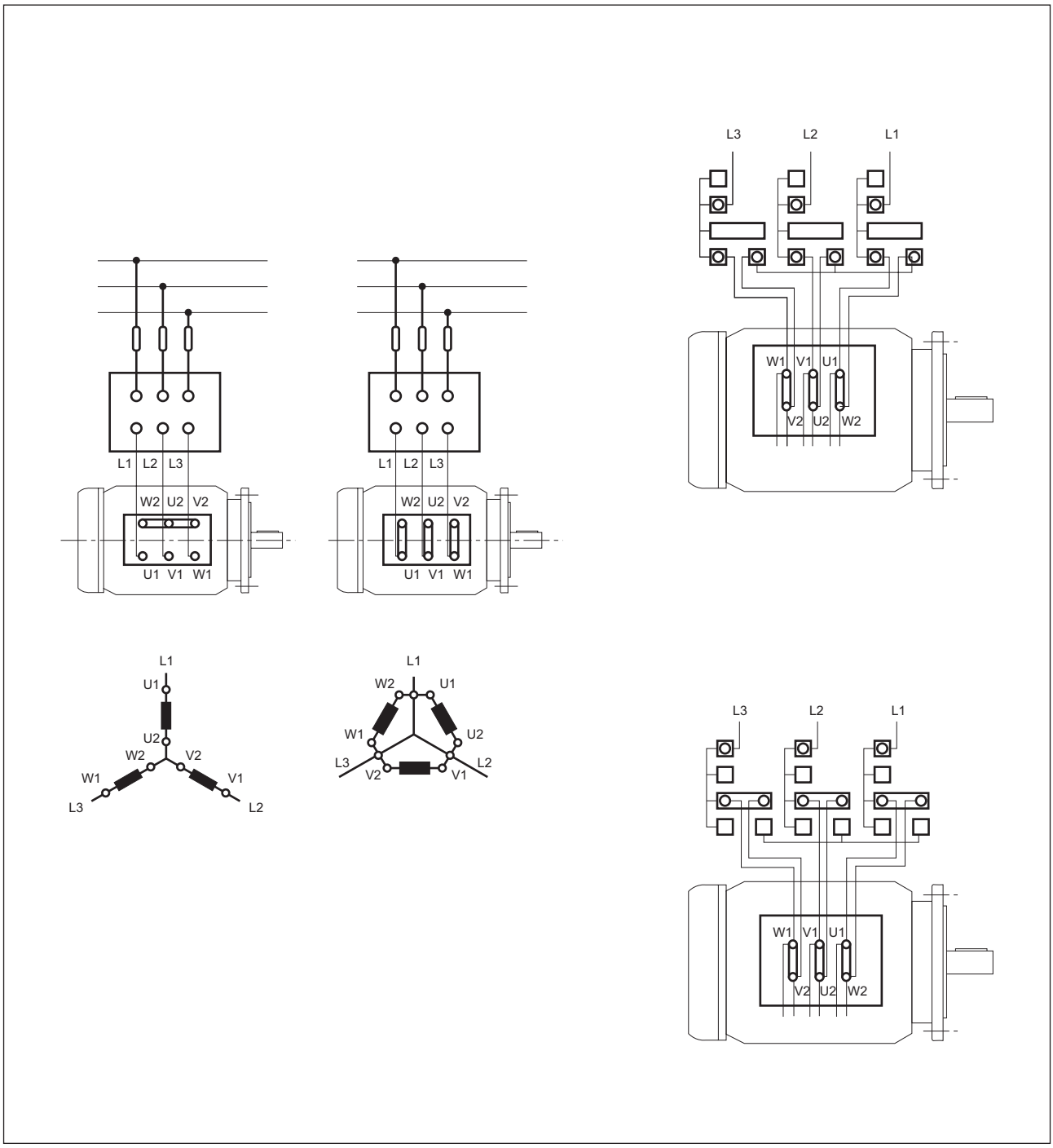
Characteristics \ Brake		4...							5...					6...					
		A	B	D	F	H	K	L	B	C	E	G	K	B	C	E	G	K	L
Braking torque	M_{bs} [daNm]	5	10	16	26	33	40	44	40	50	63	80	100	85	110	150	210	260	320
Minimum release pressure	bar	10	20	30	20	25	30	33	20	27	20	25	32	14	19	25	19	24	28
Max. pressure	bar	320																	
Weight	kg	10							18					35					

NOTE: The static torque M_{bs} is the maximum torque the brake can exert.
Under dynamic loads the braking torque is reduced. The actual M_{bs} values can vary from -5% to +15% of the rating given in the chart.

Installing the gearmotor

If a gearmotor is supplied fully assembled, follow the precautions and instructions given above when mounting to the machine.
For the electrical and hydraulic connection, refer instead to the two sample diagrams below. These are generic only since each specific installation has its own special requirements, which must be evaluated on a per case basis by the Manufacturer.

Drive with electric motor.



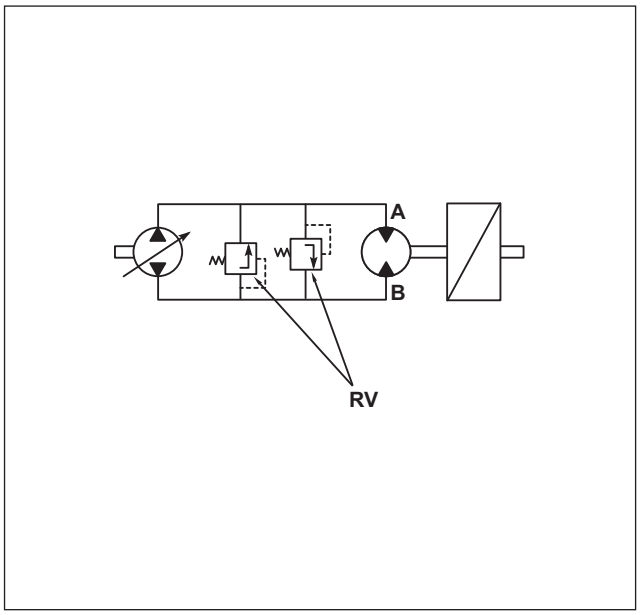
Drive with TRASMITAL MG orbital hydraulic motor

In addition to the instructions governing installation of the gear unit, the following instructions should also be observed when installing a hydraulic motor.

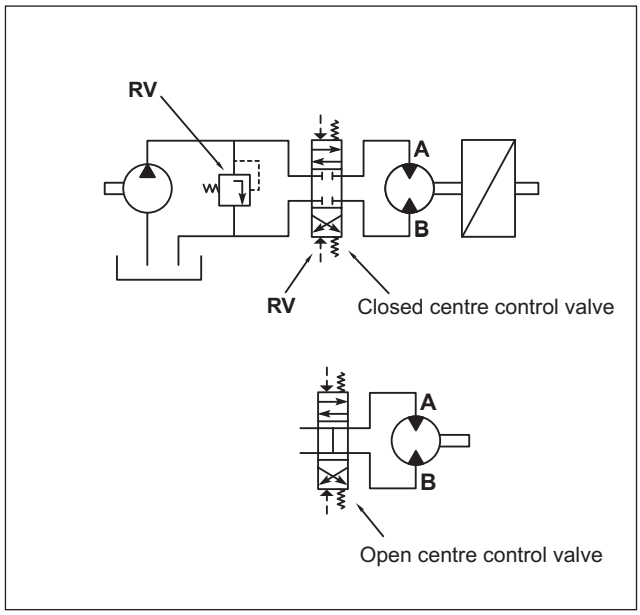
a) Connecting to the hydraulic circuit

The motor can be installed on both a closed and open loop circuit.
In the case of an open circuit installation, the solenoid valve or control valve may be of either the closed centre or open type.
The circuit line corresponding to the hydraulic motor delivery port must always be equipped with a pressure relief valve calibrated to a pressure no greater than the motor's pmax. Refer to the hydraulic circuit diagrams below.

Closed loop circuit

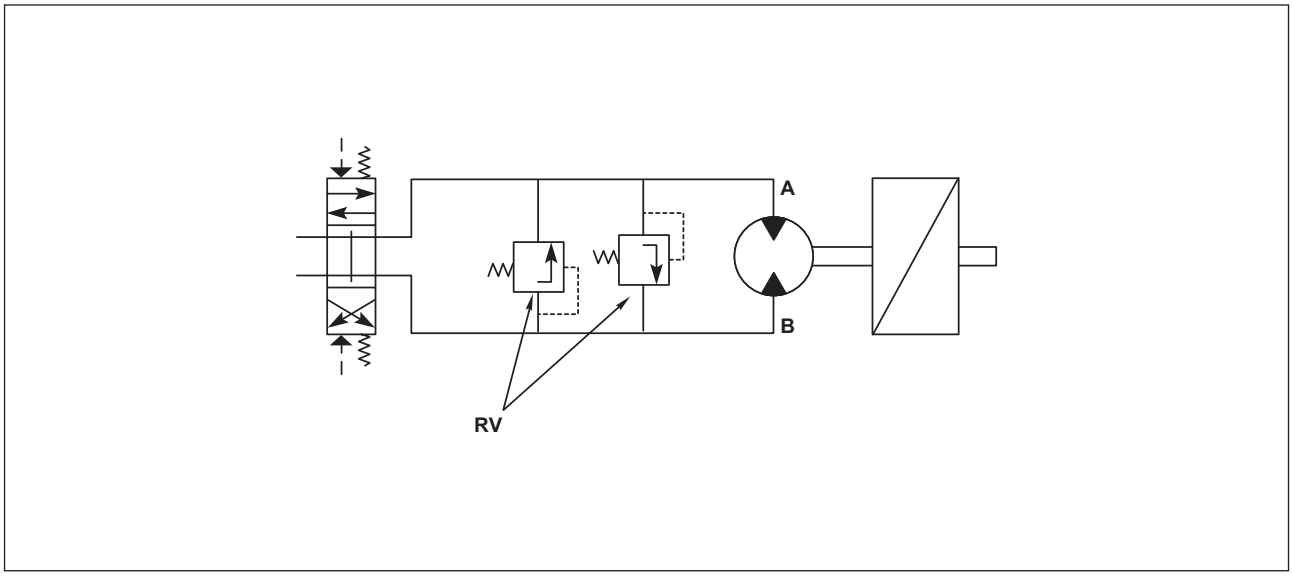


Open loop circuit



RV = pressure relief valves calibrated to pRV < pmax.

If this is not possible because the circuit must also actuate other equipment at a higher pressure, or the control valve is of the closed centre type and the motor drives components with high inertia, auxiliary pressure relief valves must be installed as close as possible to the motor.

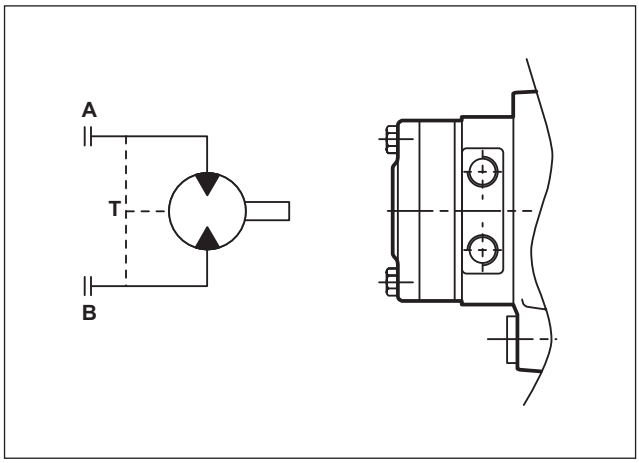


RV = pressure relief valves calibrated to pRV < pmax.

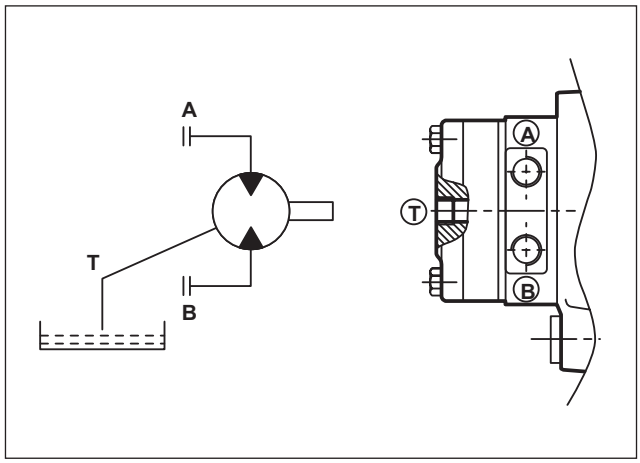
b) Connecting drain hole T

Standard motors are supplied without a drain hole. In this case the motor is equipped with internal drainage. This meets the requirements of the majority of applications with intermittent duty and an average drive pressure of less than 50% of the motor's maximum rated pressure.
When duty is continuous or intermittent with an operating percentage greater than 50% and the average drive pressure is greater than 50% of the rated maximum pressure, the motor must be ordered with external drainage and drain hole T must be connected to the tank. Refer to the diagrams below:

Internal drainage



External drainage

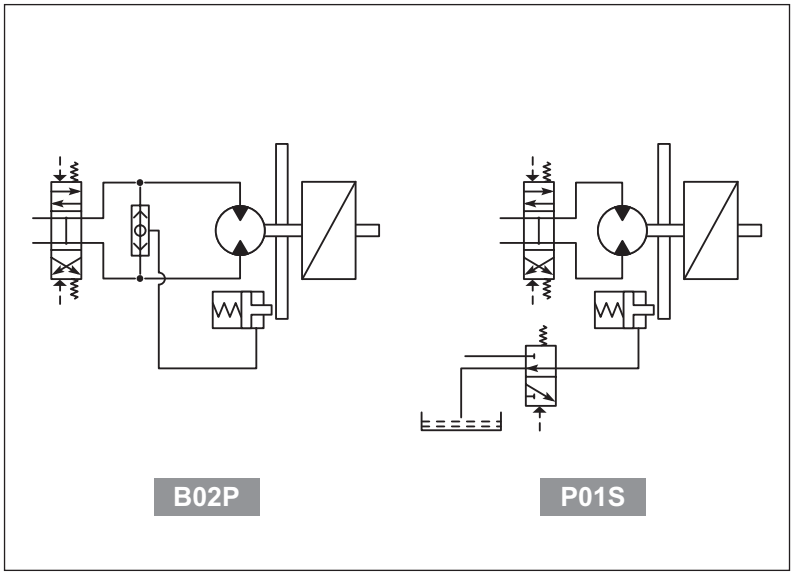


c) Brake control

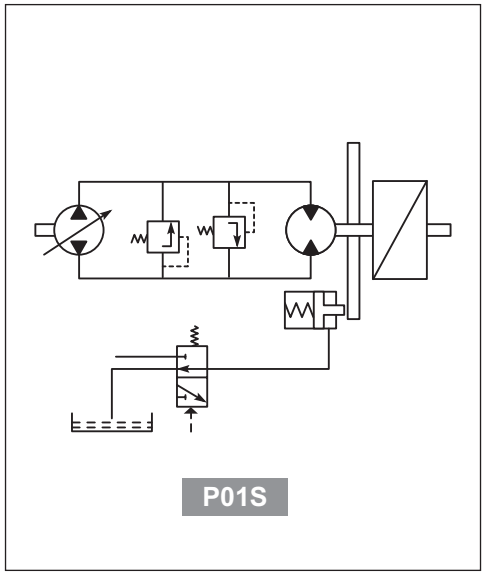
Gearmotors equipped with a brake, are available in two motor executions:
B02P or P01S.

Brake control is internal on the B02P version, and is controlled directly by the motor.
The brake control pressure must instead be supplied by an auxiliary line of the brake control circuit on the P01S version.
Refer to the diagrams below:

Closed loop circuit



Open loop circuit



d) Type of hydraulic fluid

Use hydraulic mineral fluid with viscosity ISO VG 46 (46 Cst at t = 40°C).
During operation, the fluid temperature should remain within the range +30°C to +70°C.

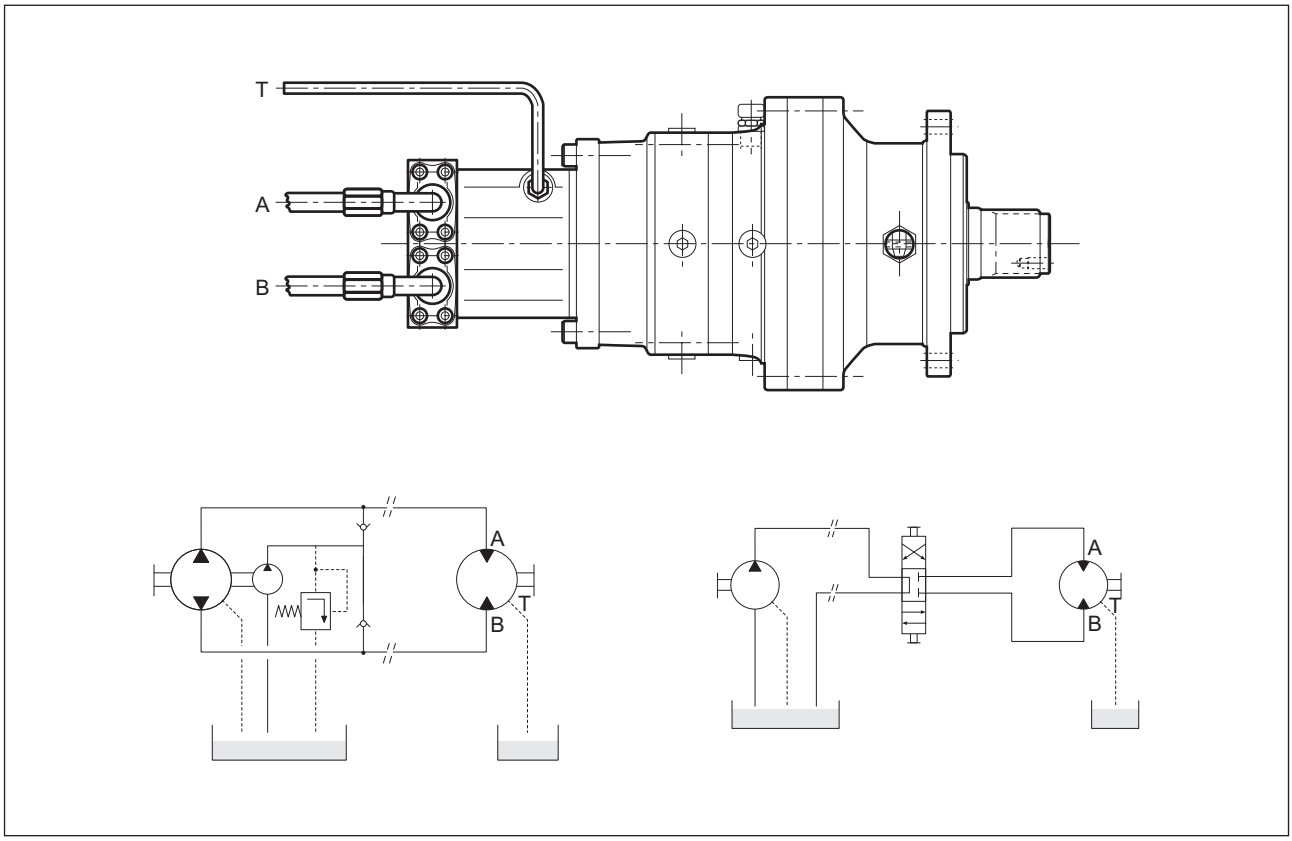
e) Filtering

To ensure the motor's reliable operation and long service life, the hydraulic circuit must be equipped with a filter capable of guaranteeing the following purity levels:

grade9 NAS 1638
grade6 SAE
grade18/15 SO DIS 4406

Drive with hydraulic motor

All motors must be charged with hydraulic fluid before being operated and during installation.
Position the drain hole so that it is positioned uppermost for charging with fluid.
Make sure the hoses are routed in such a way as to prevent the motor casing from emptying and hence, prevent air pockets from forming which may affect pump suction during operation.



A - B = Supply lines
T = Drainage

5.5 - LUBRICATION

Before starting up the gear unit, it must be charged with lubricant to the level corresponding to its specified mounting position.

The lubricant and its relative viscosity should be selected from the following chart, in accordance with the type of duty and ambient temperature.

If the gear unit is supplied ready charged with lubricant, replace the closed shipping plug with the vent plug included in the shipment before installing it.

(A1)

Plug thread	Pitch	Tightening torque [Nm]
M14	1,5	15 - 20
M16	1,5	15 - 20
M18	1,5	15 - 20
M20	1,5	20 - 30
M22	1,5	20 - 30
M24	1,5	20 - 30
M30	2	30 - 40
M42	3	40 - 50

Plug thread	Pitch	Tightening torque [Nm]
1/8"	28	10 - 15
1/4"	19	10 - 15
3/8"	19	15 - 20
1/2"	14	20 - 30
3/4"	14	20 - 30
1"	11	30 - 40

(A2)

	INDUSTRIAL INSTALLATIONS			MOBILE MACHINES	
	ISO standards .. with EP characteristics			SAE standards .. with API GL5 characteristics	
Ambient temperature	-10°C / +30°C	+10°C / +45°C	-20°C / +60°C	-20°C / +30°C	+10°C / +45°C
	ISO VG 150	**ISO VG 220**	**ISO VG 150-220**	**SAE 80W/90**	**SAE 85W/140**
AGIP	BLASIA 150	BLASIA 220	BLASIA S220	ROTRA MP	ROTRA MP
ARAL	DEGOL BG 150	DEGOL BG 220	DEGOL GS 220	GETRIEBEOL HYP	GETRIEBEOL HYP
BP-MACH	ENERGOL GR XP 150	ENERGOL GR XP 220	ENERSYN HTX 220	HYPOGEAR EP	HYPOGEAR EP
CASTROL	ALPHA SP 150	ALPHA SP 220	ALPHASYN PG 150	HYPOY	HYPOY
CHEVRON	N.L. GEAR COMPOUND 150	N.L. GEAR COMPOUND 220		UNIVERSAL GEAR LUBRICANTE	UNIVERSAL GEAR LUBRICANTE
ELF	REDUCTELF SP150	REDUCTELF SP 220	ELF ORITIS 125 MS ELF SYNTHERMA P20	TRANSELF8	TRANSELF8
ESSO	SPARTAN EP 150	SPARTAN EP 220	GLYCOLUBE 220	GEAR OIL GX	GEAR OIL GX
				PONTONIC MP	PONTONIC MP
FINA	GIRAN 150	GIRAN 220			
I.P.	MELLANA150	MELLANA220	TELESIA OIL 150	PONTIAX HD	PONTIAX HD
KLUBER	KLUBEROIL GEM1-150	KLUBEROIL GEM1-320	KLUBERSYNT GH 6-220		
Q8	GOYA 150	GOYA 220	EL GRECO 220		
MOBIL	MOBILGEAR 629	MOBILGEAR 630	SHC 630	MOBILUBE HD	MOBILUBE HD
SHELL	OMALA EP150	OMALA EP220	TIVELA OIL SA	SPIRAXHD	SPIRAX HD
TOTAL	CARTER EP 150	CARTER EP 220		TRANSMISSION TM	TRANSMISSION TM

Synthetic oil.

Brake lubrication

The hydraulic multi-disk brakes are lubricated with the same oil as the gear unit.

Only synthetic lubricants may be used on gear units conforming to European Directive 94/9/EC. Refer to the above chart for the brand and type.

6.0 - TESTING THE GEAR UNIT

The gear unit has been factory tested by the Manufacturer. Before start-up, make sure that:

- the machine incorporating the gear unit complies with the provisions of the “Machinery Directive” 98/37/EC and any other applicable safety legislation
- the gear unit’s mounting position in the installation corresponds to that prescribed and indicated on the nameplate
- the electrical power supply is suitable and operational as prescribed in EN 60204-1, and is grounded as per EN 50014
- the motor’s electric power supply corresponds to that prescribed and is within +/-5% of the rated value
- the hydraulic system is suitable and operational, and the oil in the hydraulic motor’s lubrication circuit conforms to ISO VG 46. It must be filtered with a maximum grade of 10 µm and contamination level less than or equal to class 9 as per NAS 1638 or 18/15 as per ISO/DIS 4406
- there are no signs of lubricant leaks from the plugs or gaskets
- the vent plug is not obstructed by dirt or paint
- the unit does not run noisily or with excessive vibration.

Before starting up the unit, check and make sure that:

- the unit is not assembled in a potentially explosive atmosphere (oil, acid, gas, vapour, radiation) and is free of dust build ups greater than 5 mm in depth
- during operation the gear unit is sufficiently ventilated and is not subject to radiation from external heat sources
- during operation the cooling air does not exceed 40 °C
- the oil level check and filler plugs and the vent plugs are all easily accessible
- all accessories mounted to the gear unit are ATEX certified
- gear units with hollow shafts, with or without shrink disk, have been correctly mounted as described in this manual
- the gear unit has been thoroughly cleaned after installation
- all guards are installed to prevent accidental contact between operators and the unit’s rotary moving parts, and seals are oil tight

7.0 - USING THE EQUIPMENT

Before putting the gear unit into service, the User must ensure that the plant in which it is installed complies with all applicable directives, especially those regarding health and safety at work.

The gear unit may not be used in areas and environments:

- with highly corrosive/abrasive vapours, smoke or dust.
- in direct contact with loose food products.

Danger zones and exposed persons:

The danger zone of the gear unit is the protrusion of the shaft which constitutes a hazard for exposed persons in direct contact with it (crushing, shearing, trapping). In particular, when the gear unit is operating in automatic mode in an accessible area, the shaft must be protected by a guard.

8.0 - MAINTENANCE

Maintenance and replacement work must be carried out by expert maintenance technicians trained in the observance of applicable laws on health and safety at work and the special ambient problems attendant on the installation.

Before doing any work on the unit, the operator must first switch off power to the gear unit and ensure that it is out of service, as well as taking all necessary precautions against it being accidentally switched on again or its parts moving without warning (due to suspended loads or similar external factors).
Furthermore, all additional environmental safety precautions must be taken (e.g. elimination of residual gas or dust, etc).

- Before doing any maintenance work, activate all the safety devices provided and, if necessary, inform persons working in the vicinity. Cordon off the area around the unit and prevent access to any equipment which, if activated, might be the cause of unexpected health and safety hazard.
- Replace worn components with original spare parts.
- Use the lubricants (oil and grease) recommended by the Manufacturer.
- When working on the gear unit always replace all gaskets and seals with original new ones.
- If a bearing requires replacement, it is good practice to also replace the other bearing supporting the same shaft.
- We recommend replacing the lubricating oil after all maintenance work.

The above instructions are aimed at ensuring efficient and safe operation of the gear unit.

The Manufacturer declines all liability for injury to persons and damage to components due to the use of non-original spare parts and non-routine work that modifies the safety requirements without the Manufacturer's express prior authorisation.

Refer to the specific spare parts catalogue when ordering spare parts for the gear unit.

Do not dump polluting liquids, worn parts and maintenance waste into the environment.
Dispose of all such materials as specified by applicable legislation.

- Observe the routine inspection and maintenance schedule to ensure the unit's correct operation and the effectiveness of the explosion protection.
- Always apply fresh Loctite 510 or other product with similar properties and application range to all disassembled threads.
- Before servicing or repairing internal components, allow the gear unit to cool down completely before opening the casing so as to avoid burns from parts which are still hot.
- On completion of maintenance work, make sure that all safety measures and equipment have been applied and reset.
- Clean the gear unit thoroughly after maintenance and repair work.
- On completion of maintenance, tighten all vent, filler and level plugs to their specified torques (chart A1).
- On completion of any maintenance work all seals must be refitted and sealed as prescribed.
- Regardless of the type of gear unit, whenever a seal ring is replaced its lips should be smeared with a thin layer of grease (Fluorocarbon gel 880 ITP or other product with similar properties and application range) before assembly.
- Use only original spare parts for repairs.

8.1 - ROUTINE MAINTENANCE

Keep the gear unit at its maximum efficiency by following the routine maintenance schedule. Good maintenance ensures the unit's maximum performance, extended service life and continued compliance with safety regulations.

(A3)

Frequency	Component	Type of check	Action
at start	Gear unit casing	Check that the external temperature does not exceed 75-80 °C	Stop the machine and contact Bonfiglioli Trasmital's Technical Service
after 200 hrs	Original consignment lubricant	Replace	Replace with new lubricant
	External fasteners	Check locking torque	Tighten down to specified torque
1000 hrs	External seals and gaskets	Check oil level Check for leaks by eye	Service or replace components as required
2500 hrs	Lubricant	Replace	Replace with new lubricant
5000 hrs	Gear unit seals and gaskets	Inspect carefully for wear/ageing of external seals	Replace if aged/worn

For installations in zones 21 and 22 the User must schedule and implement a regular cleaning programme for all surfaces and recesses to avoid dust build-ups of more than 5 mm in depth.

Every 1000 hrs. of operation or after 6 months:

- Measure the surface temperature at the coupling between the gear unit and motor, and at the points which are most shielded from the motor's cooling fan. The maximum temperature must not be more than 75-80°C, nor may this value be exceeded during operation.

Every 5000 hrs. of operation:

- Change the synthetic oil and bearing grease if the gear unit is not life lubricated.
- Replace all externally accessible seal rings unless this has already been done as a result of problems occurring before the scheduled maintenance deadline.



8.2 - OIL CHANGES

1. Place an adequate container under the drain plug.
2. Remove the filler and drain plugs and allow the oil to drain out.

The oil will drain better if it is warm.

3. Wait for a few minutes until all the oil has drained out, then screw the drain plug back on after first changing the plug seal.
4. Fill with new oil until it reaches the level mark. **Do not mix oils of different makes or specifications and check that the oil is highly resistant to foaming and is EP rated**.
5. Tighten down the filler plug after changing its seal.

The gear unit may be supplied with or without lubricant, as requested by the User. The quantity of charge oil required is specified in the Sales Catalogue. This specification is however, approximate, and reference must always be made to the mark on the level plug, the placement of which depends on the mounting position specified in the purchase order.

Life lubricated gear units which are not subject to external contamination do not normally require periodic lubricant changes. If the same type of oil as that already in use is not available, drain the gear unit casing completely and wash its interior thoroughly with a light solvent before refilling with the new lubricant.

If a leak is found, identify the cause of the fault and repair it before topping up the lubricant and operating the unit.

Lubricants, solvents and detergents are toxic/harmful to health:

- they may cause irritation in direct contact with the skin
- they may cause intoxication if inhaled
- they may be fatal if swallowed.

Handle them with care using suitable individual safety equipment. Do not dump them into the environment and dispose of in accordance with applicable legislation.

8.3 - CHECKING OPERATIONAL EFFICIENCY

- Remove any dust from the gear unit and motor casings.
- Check that the noise generated at continuous load does not vary. Excessive vibration or noise can indicate wear of the gear train or failure of a bearing.
- Check the power absorption and voltage against the rated values given on the motor's nameplate.
- Check the wear of the friction surfaces and braking gasket on the brake motors (if fitted) and, if necessary, adjust the gap.
- Check for lubricant leaks from the gaskets/seals, plugs and casings.
- Check all bolted couplings for wear, deformation and corrosion and tighten them down fully, but without over tightening.

8.4 - CLEANING

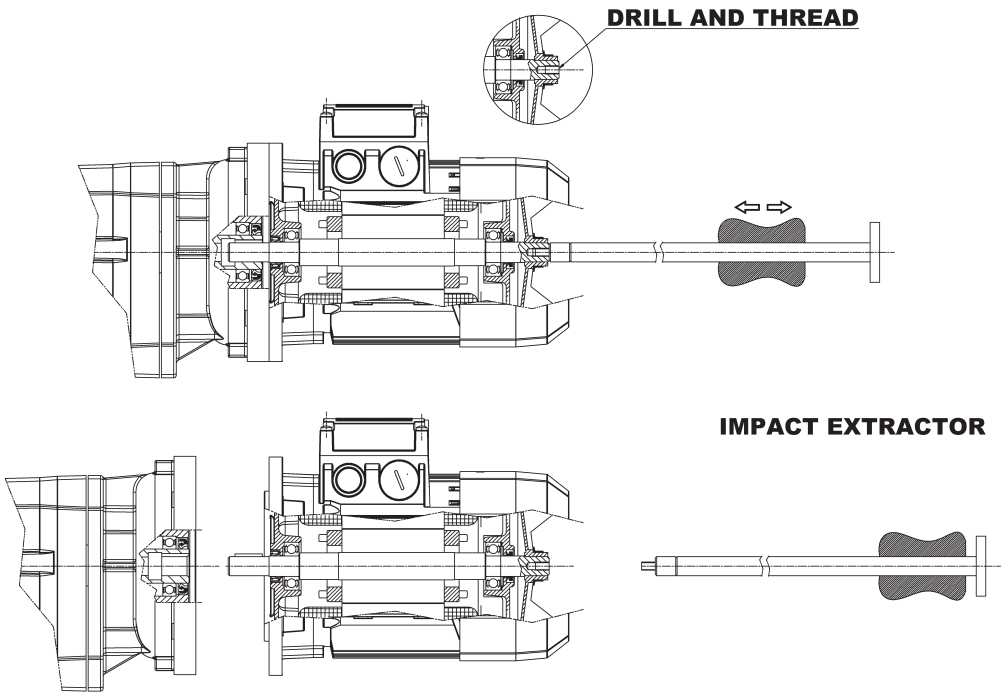
Remove all dust and process waste from the gear unit. Do not use solvents or other products that are incompatible with the unit's construction material and do not direct high pressure jets of water at the gear unit.

9.0 - REPLACING PARTS

- Immediately replace parts and components if they are not able to guarantee safe and reliable operation.
- Never improvise repairs.
- The use of non-original spare parts not only renders the warranty null and void but can jeopardise the gear unit's operation.

9.1 - REMOVING THE MOTOR

If during operation the mobile coupling between the motor and gear unit has not rusted significantly, it should be possible to remove the motor without applying excessive force.
If instead, it proves difficult to remove the motor, do not use screwdrivers or levers to apply force as this may damage the flanges and mating surfaces, but proceed as illustrated below.



1. Drill and thread the motor shaft (fan side).
2. Screw an impact extractor tool into the bore.
3. Undo the bolts fixing the motor to the gear unit.
4. Detach the motor by means of the inertial force of the extractor.

9.2 - DECOMMISSIONING THE GEAR UNIT

The unit must only be taken out of service by operators trained in the observance of applicable laws on health and safety at work.
Do not dump non-biodegradable products, lubricants and non-ferrous materials (rubber, PVC, resins, etc.) into the environment. Dispose of all such materials as stipulated by established environmental legislation.

Do not re-use parts or components which appear to be in good condition after they have been checked or replaced by qualified personnel and declared unsuitable for use.

10.0 - TROUBLESHOOTING

The following information is intended to serve as an aid in locating and eliminating defects and faults. In some cases, problems may be caused by the plant or machine to which the gear unit is assembled and hence, the cause and remedy will be described in the Manufacturer's technical documentation for the machine/plant in question.

FAULT	CAUSE	REMEDY
Bearing temperature too high	Oil level too low	Top up oil level
	Oil spent	Replace oil
	Defective bearings	Contact authorised workshop
Operating temperature too high	Oil level too high	Check oil level
	Oil spent	Replace oil
	Contaminant in oil	Replace oil
Abnormal running noise	Gears damaged	Contact authorised workshop
	Bearing axial backlash too high	Contact authorised workshop
	Bearings defective or worn	Contact authorised workshop
	Excessive load applied	Correct load to rated values given in Sales Catalogue
	Contaminant in oil	Replace oil
Abnormal noise at gear unit mounting	Mounting bolts loose	Tighten bolts to specified torque
	Mounting bolts worn	Replace bolts
Oil leaks	Oil level too high	Check oil level
	Casing/coupling seals inadequate	Contact authorised workshop
	Gaskets worn	Contact authorised workshop
Gear unit does not run or runs with difficulty	Oil viscosity too high	Replace oil (see recommended lubricant chart)
	Oil level too high	Check oil level
	Excessive load applied	Redesign drive for actual load required
Output shaft does not turn with motor running	Gears damaged	Contact authorised workshop

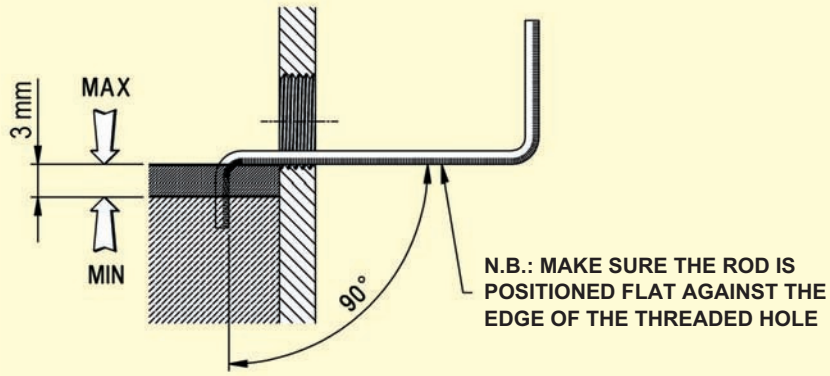
ANNEX 1 - CHECKING THE OIL LEVEL ON ATEX-SPECIFIED GEAR UNITS

Gear units are normally fitted with oil level check plugs.

To check the oil level, first identify the level plug.

- **Horizontal position**:
  Remove the plug and insert a bar of the right size in the hole and of the shape shown in the figure.
- **Vertical position**:
  Use a rod to check that the oil level is between the MIN and MAX marks, then screw the plug back in.

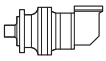
If the level is more than 3 mm below the spill level, top up and check the reason for the drop in oil level.



Gear units conforming to Directive 94/9/EC and designed for a vertical mounting position, are normally equipped with an oil expansion chamber fitted with service plugs for filling, checking the oil level and venting internal overpressure.

ANNEX 2 - LUBRICANT CHARGE QUANTITY

Type		 Mounting position		
		A	T	O
300	L1	0.6	1.0	0.9
	L2	0.9	1.3	1.2
	L3	1.2	1.6	1.5
	L4	1.5	1.9	1.8
301	L1	0.8	1.2	1.1
	L2	1.1	1.5	1.4
	L3	1.4	1.8	1.7
	L4	1.7	2.1	2.0
303	L1	1.3	2.3	2.0
	L2	1.6	2.6	2.3
	L3	1.9	2.9	2.6
	L4	2.2	3.2	2.9
305	L1	1.6	2.6	2.4
	L2	2.1	3.1	2.9
	L3	2.4	3.4	3.2
	L4	2.7	3.7	3.5
306	L1	2.5	3.5	3.2
	L2	3.3	4.3	4.0
	L3	3.6	4.6	4.3
	L4	3.9	4.9	4.6
307	L1	3.5	5.0	4.5
	L2	4.5	6.0	5.5
	L3	5.0	6.5	6.0
	L4	5.3	6.8	6.3
309	L1	4.0	5.5	5.0
	L2	5.0	6.5	6.0
	L3	5.5	7.0	6.5
	L4	5.8	7.3	6.8
310	L1	5.0	6.5	6.0
	L2	6.3	7.8	7.3
	L3	7.1	8.6	8.1
	L4	7.4	8.9	8.4
311	L1	7.0	12	10
	L2	9.0	14	12
	L3	10	15	13
	L4	10.5	15.5	13.5
313	L1	9.0	14	12
	L2	11.5	16.5	14.5
	L3	12.5	17.5	15.5
	L4	13	18	16
315	L1	15	23	19
	L2	19	27	23
	L3	21	29	25
	L4	22	30	26
316	L1	18	26	22
	L2	22	30	26
	L3	24	32	28
	L4	25	33	29
317	L1	20	35	30
	L2	26	41	36
	L3	29	44	39
	L4	30	45	40
318	L1	25	40	35
	L2	35	50	45
	L3	40	55	50
	L4	43	58	53
319	L1	35	55	45
	L2	45	65	55
	L3	50	70	60
	L4	53	73	63
321	L1	35	55	45
	L2	50	70	60
	L3	56	76	66
	L4	60	80	70

Type		 Mounting position		
		B0	U*	P*
300	R2	1.2	1.7	1.5
	R3	1.5	2.0	1.8
	R4	1.8	2.3	2.1
301	R2	1.6	2.1	1.9
	R3	1.9	2.4	2.2
	R4	2.2	2.7	2.5
303	R2	2.2	2.8	2.6
	R3	2.5	3.1	2.9
	R4	2.8	3.4	3.2
305	R2	2.5	3.1	2.9
	R3	3.0	3.6	3.4
	R4	3.3	3.9	3.7
306	R2	4.0	5.0	4.8
	R3	4.8	5.8	5.6
	R4	5.1	6.1	5.9
307	R2	6.0	8.0	7.0
	R3	7.0	9.0	8.0
	R4	7.5	9.5	8.5
309	R2	6.5	8.5	7.5
	R3	7.5	9.5	8.5
	R4	8.0	10	9
310	R3	11	13	12
	R4	12	14	13
311	R2	14	19	17
	R3	16	21	19
	R4	17	22	20
313	R2	16	21	19
	R3	19	24	22
	R4	20	25	23
315	R3	27	35	31
	R4	30	38	34
316	R3	30	38	34
	R4	33	41	37
317	R3	38	52	48
	R4	42	56	52
318	R4	48	63	58

N.B. The quantities indicated are approximate only. Fill the unit according to the position of the level plug or level rod supplied with the gear unit.

	oil [l]															
	AA - EA - FD			AF - EF - FE		AE - EE - FF		AD - ED - FA		TA - TE - TF - TD VA - VC - VF -IO		OA - OE - OF- OD QA - QE - QF- QD	
		input			input		input		input		input		input
		P(IEC)	HS		P(IEC) HS		P(IEC) HS		P(IEC) HS		P(IEC) HS		P(IEC) HS
3/V 00 L3	0.9	0.12	0.12	0.9	0.12	0.9	0.12	0.9	0.12	1.3	0.12	1.2	0.12
3/V 01 L3	1.1			1.1		1.1		1.1		1.5		1.4	
3/V 03 L3	1.6	0.25	0.25	1.6	0.31	1.6	0.31	1.6	0.38	2.6	0.31	2.3	0.25
3/V 05 L3	2.1	0.38	0.38	2.1	0.43	2.1	0.43	2.1	0.52	3.1	0.52	2.9	0.38
3/V 06 L3	3.3	0.64	0.64	3.3	0.76	3.3	0.76	3.3	0.85	4.3	0.76	4	0.76
3/V 10 L4	7.1			7.1		7.1		7.1		8.6		8.1	
3/V 07 L3	4.5	2.4	2.8	4.5	2.6	4.5	2.6	4.5	1.7	6	1.9	5.5	1.9
3/V 11 L4	10			10		10		10		15		13	
3/V 13 L4	13			13		13		13		18		16	
3/V 09 L3	5	4.3	4.5	5	3.9	5.0	3.9	5	3.0	6.5	3.5	6	3.5
3/V 10 L3	6.3			6.3		6.3		6.3		7.8		7.3	
3/V 15 L4	21			21		21		21		29		25	
3/V 16 L4	24			24		24		24		32		28	
3/V 11 L3	9	7.8	9.6	9	6.7	9	6.7	9	5.0	14	5.5	12	5.5
3/V 13 L3	12			12		12		12		17		15	
3/V 17 L4	29			29		29		29		44		39	
3/V 15 L3	19	11	15	19	8.9	19	9.4	19	7.5	27	9.5	23	9.5
3/V 16 L3	22			22		22		22		30		26	
3/V 18 L4	40			40		40		40		55		50	
3/V 19 L4	50			50		50		50		70		60	
3/V 17 L3	26	23	28	26	16.8	26	17.5	26	10.7	41	17	36	17
3/V 21 L4	56			56		56		56		76		66	

Life lubrication

	oil [l]											
	AA - EA - FD		TA - TE - TF - TD VA - VC - VF -IO		OA - OE - OF- OD QA - QE - QF- QD		AD - ED - FA		AF - EF - FE		AE - EE - FF	
3/A 00 L2	0.60	1.4	1.0	1.4	0.9	1.4	0.6	1.4	0.6	1.4	0.6	1.4
3/A 01 L2	0.80	2.3	1.2	2.3	1.1	2.3	0.8	2.3	0.8	2.3	0.8	2.3
3/A 03 L2	1.3	3.2	2.3	3.2	2.0	3.2	1.3	3.2	1.3	3.2	1.3	3.2
3/A 05 L2	1.6	4.0	2.6	4.1	2.4	4.1	1.6	4.7	1.6	5.2	1.6	4.4
3/A 06 L2	2.5	4.9	3.5	8.1	3.2	4.7	2.5	8.4	2.5	11	2.5	9.2
3/A 07 L2	3.5	6.8	5.0	8.1	4.5	12	3.5	15	3.5	18	3.5	15

Life lubrication

NOTE: In combined gear units, lubrication of the planetary stage is separate from that of the worm (3/V) or helical bevel (3/A) stages.

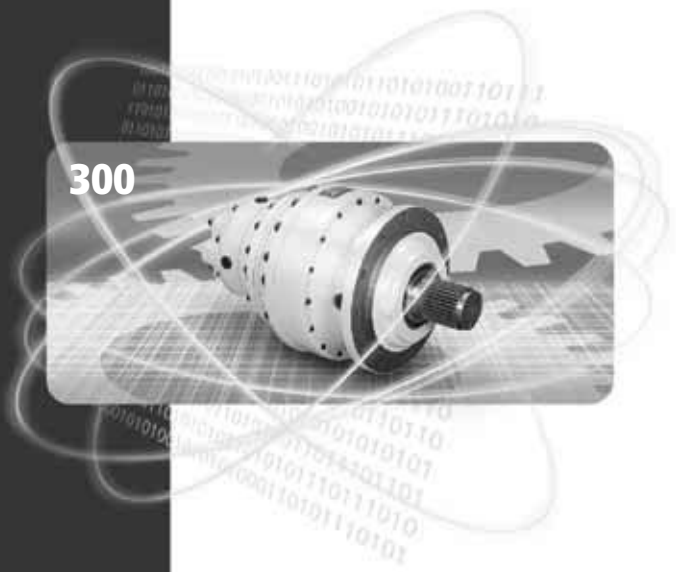
INDEX OF REVISIONS (R)

R1
31 Amended section 8.1 "Routine maintenance".

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and Wind Energy Solutions

Industry Process
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BONFIGLIOLI

BRAKE NUMBER 75628 SERVICE NOTES

Ausco PRODUCTS, INC.

ECO 22055 REV D

THE MULTI-DISC BRAKE IS A SPRING-APPLIED, HYDRAULICALLY RELEASED BRAKE. HYDRAULIC PRESSURE IS REQUIRED TO RELEASE OR "HOLD OFF" THE BRAKE. NORMAL OPERATION IS TO HAVE THE BRAKE PRESSURIZED IN THE RELEASED POSITION WITH THE VEHICLE HYDRAULIC SYSTEM RUNNING. ANY FUNCTION WHICH REDUCES THE HYDRAULIC SYSTEM BELOW THE RELEASE PRESSURE OF THE BRAKE WILL CAUSE THE BRAKE TO BE APPLIED.

CAUTION:

FOR CORRECT OPERATION, HYDRAULIC PRESSURE TO THE BRAKE MUST FALL TO ZERO PSI. ANY RESIDUAL BACK PRESSURE APPLIED TO THE BRAKE WILL DEGRADE FUNCTION AND MAY RESULT IN A HAZARDOUS CONDITION.

INSTALLATION INFORMATION:

1. ASSEMBLE BRAKE BETWEEN MOTOR AND GEARBOX. PLACE MOUNTING GASKETS ON THE MOUNTING FACES BEFORE ASSEMBLY. IF NEEDED, BRAKE SHAFT CAN BE ROTATED BY APPLYING HYDRAULIC PRESSURE TO THE PISTON INLET PORT.
2. INSERT FOUR 1/2" DIA. BOLTS (GRADE 5) THROUGH THE MOTOR FLANGE, THE GASKET, THE BRAKE, AND INTO THE THREADED HOLES IN THE GEAR REDUCER. MAKE SURE THAT THE BOLTS ARE NOT TOO LONG, SO THEY DO NOT BOTTOM OUT IN THE THREADED HOLES OF THE GEAR REDUCER.
3. TO PREVENT BINDING, RUN THE BOLTS IN ALTERNATELY UNTIL SNUG. TORQUE BOLTS TO 55-65 FT.-LBS.
   NOTE: THE SHAFTS MUST SLIDE TOGETHER FREELY. DO NOT USE THE BOLTS TO FORCE THEM TOGETHER.
4. WITH MOTOR AND BRAKE BOLTED TOGETHER INTO POSITION, CONNECT INLET HYDRAULIC LINE. BRAKE INLET IS 1/4" LINE STRAIGHT THREAD O-RING BOSS (7/16-20 UNF).

BRAKE DISASSEMBLY INFORMATION:

1. DISASSEMBLE IN THE FOLLOWING ORDER: BOLTS (ALTERNATELY), POWER PLATE, GASKET, STATIONARY DISCS, ROTATING DISCS, PRIMARY DISC, TORQUE PINS, COMPRESSION SPRINGS, AND SPRING RETAINER.
2. FURTHER DISASSEMBLY IS NOT RECOMMENDED AND SHOULD NOT BE ATTEMPTED UNLESS NECESSARY TO REPLACE THE BEARING, THE SEAL, OR THE SHAFT.
   NOTE: IF THE BEARING AND SEAL ARE REMOVED FOR ANY REASON, BOTH MUST BE REPLACED.
   2a. REMOVE SNAP RINGS AS NEEDED.
   2b. SEAL CAN BE REMOVED BY PRYING IT OUT WITH AN APPROPRIATE TOOL. TAKE CARE NOT TO DAMAGE THE BORE.
   2c. SHAFT CAN BE REMOVED BY PRESSING IT OUT WITH A SHOP PRESS.
3. REMOVE THE PISTON FROM THE POWER PLATE BY INTRODUCING LOW PRESSURE AIR (15 psi) INTO THE HYDRAULIC INLET. MAKE SURE THE PISTON IS DIRECTED AWAY FROM THE OPERATOR. DO NOT REMOVE O-RINGS AND BACKUP RINGS FROM THE O.D. AND I.D. GROOVES OF THE PISTON UNLESS REPLACEMENT IS NECESSARY, BECAUSE THEY WILL BE DAMAGED.

REF: GENERAL ASSEMBLY VIEW 8001

ASSEMBLY INFORMATION:

IMPORTANT: THERE MAY BE MORE PARTS IN A SERVICE KIT THAN YOUR BRAKE REQUIRES. CHECK THE PARTS LIST CAREFULLY FOR THE EXACT QUANTITY. SPACE THE SPRINGS AS SHOWN ON THE SPRING ORIENTATION VIEW.

USE THE REVERSE OF THE DISASSEMBLY PROCEDURE WITH THE FOLLOWING NOTES AND ADDITIONS:

1. WORN AND DAMAGED O-RINGS AND BACKUP RINGS MUST BE REPLACED PRIOR TO RE-ASSEMBLY.
2. LUBRICATE THE PISTON BORE OF THE POWER PLATE, THE PISTON, AND THE O-RINGS WITH SYSTEM HYDRAULIC FLUID PRIOR TO RE-ASSEMBLY.
3. PISTON ASSEMBLY:
   ASSEMBLE PISTON INTO POWER PLATE USING A SHOP PRESS. TAKE CARE NOT TO DAMAGE THE O-RING OR TEFLON BACKUP RINGS. VISUALLY ALIGN THE CENTER OF THE CUTOUTS IN THE PISTON WITH THE TORQUE PIN HOLES IN THE POWER PLATE.
   CAUTION: THE DEPTH THE PISTON IS INSTALLED INTO THE POWER PLATE IS CRITICAL. THE SURFACE OF THE PISTON AT THE CUTOUTS MUST BE FLUSH TO 0.120 BELOW THE SURFACE OF THE POWER PLATE, OR PISTON MAY COCK RESULTING IN A COMPLETE LOSS OF BRAKING.
4. BEARING ASSEMBLY:
   USE A SHOP PRESS TO PRESS THE BEARING ONTO THE SHAFT. PRESS ONLY ON THE INNER RACE OF THE BEARING. BEARING IS A SLIP FIT TO THE HOUSING.
5. LIP SEAL ASSEMBLY:
   LIP OF SEAL MUST FACE TOWARD THE BEARING. SEE CUTAWAY VIEW FOR SEAL ORIENTATION DETAIL.
6. ROTATING, STATIONARY, AND PRIMARY DISC ASSEMBLY:
   ROTATING DISCS MUST BE CLEAN & DRY. THE LINING MATERIAL AND MATING SURFACES OF THE STATIONARY DISCS MUST BE THOROUGHLY CLEAN AND FREE FROM DEBRIS. WORN OR SCARRED ROTATING DISCS MUST BE REPLACED.
7. INSTALL BOLTS IN THE POWER PLATE. TIGHTEN SEQUENTIALLY ONE TURN AT A TIME UNTIL POWER PLATE IS PROPERLY SEATED. TORQUE BOLTS TO 80-90 FT-LBS.

OIL FILL PROCEDURE:

UNSCREW THE TOP OIL FILL PLUG AND ADD DTE-26 OIL TO THE APPROPRIATE LEVEL.

SERVICE KIT INFORMATION:

BEARING KIT:	PK - 933 -	INCLUDES SEALS, RETAINING RINGS, AND BEARINGS.
STACK KIT:	PK - 1370 -	INCLUDES TORQUE PINS, PRIMARY, STATIONARY, ROTATING DISCS AND COMPRESSION SPRINGS.
O-RING KIT:	PK - 1368 -	INCLUDES O-RINGS, BACKUP RINGS, AND INTERNAL GASKET.
GASKET KIT:	PK - 679 -	INCLUDES EXTERIOR GASKET(S).

PRO/E W

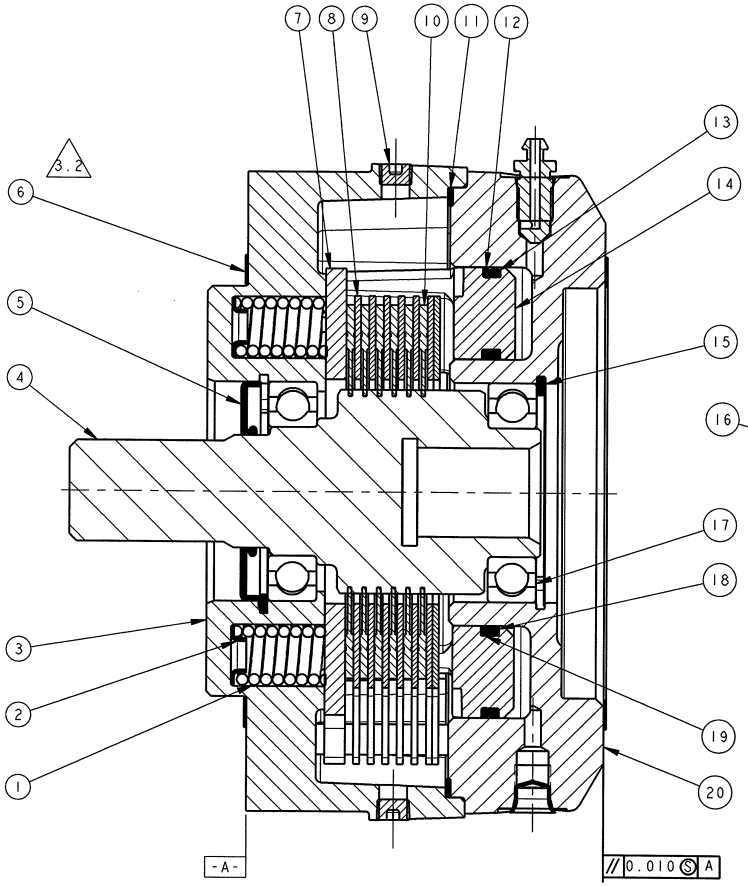
AUBCO PRODUCTS, INC. BRAKE NUMBER 75628 PARTS LIST

ECO 22055 REV D

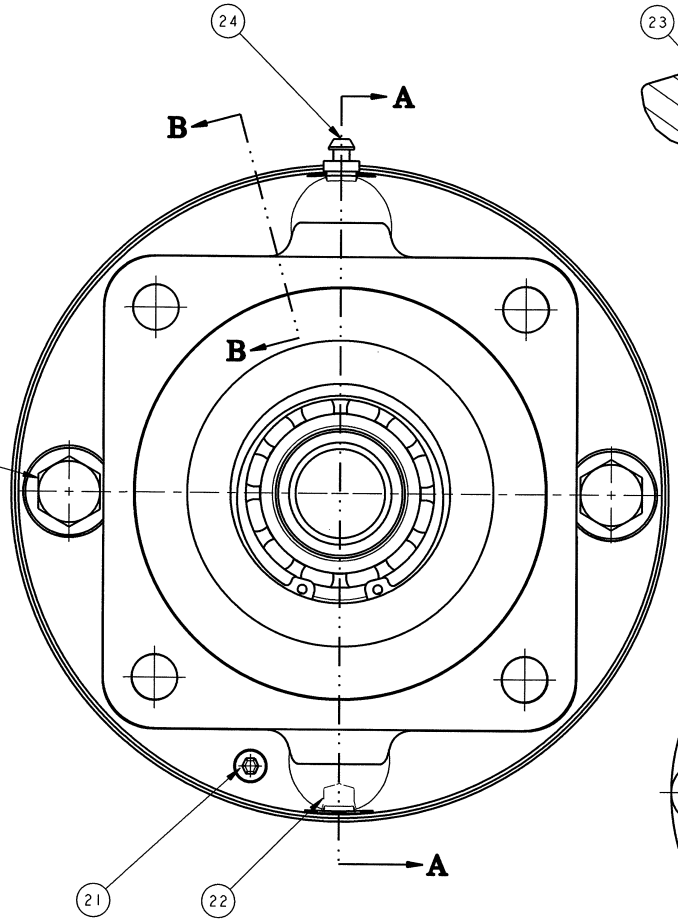
ITEM	PART	DESCRIPTION	QTY
1	36359	COMPRESSION SPRING	16
2	36367	SPRING RETAINER	1
3	75731	HOUSING	1
4	75728	SPLINED SHAFT	1
5	36342	OIL SEAL	1
6	28427	GASKET	2
7	75071	PRIMARY DISC	1
8	75072	STATIONARY DISC	7
9	75395	PIPE PLUG	2
10	74996	ROTATING DISC	6
11	73448	GASKET	1
12	27967	BACKUP RING	1
13	27808	O-RING	1
14	75724	PISTON	1
15	28285	RETAINING RING	2
16	31218	HEX FLANGE SCREW	2
17	28284	BALL BEARING	2
18	36701	O-RING	1
19	32833	BACKUP RING	1
20	36337	POWER PLATE	1
21	28811	HEX PLUG	1
22	28435	PROTECTIVE PLUG	1
23	27948	TORQUE PIN	2
24	29035	BLEEDER SCREW	1
25	75970	CAUTION TAG	1

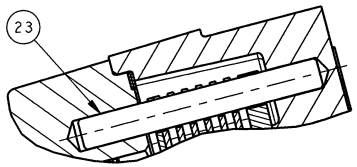
Ausco BRAKE NO. 75628 CUTAWAY VIEW

ECO 22055 REV D

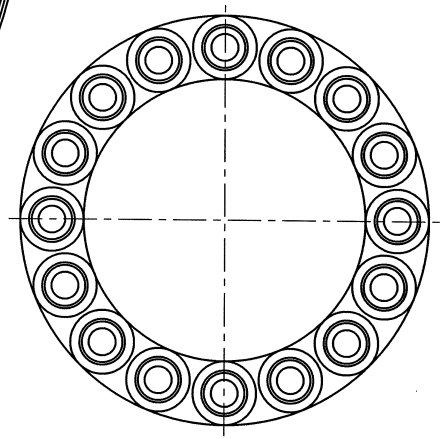


SECTION A-A





SECTION B-B

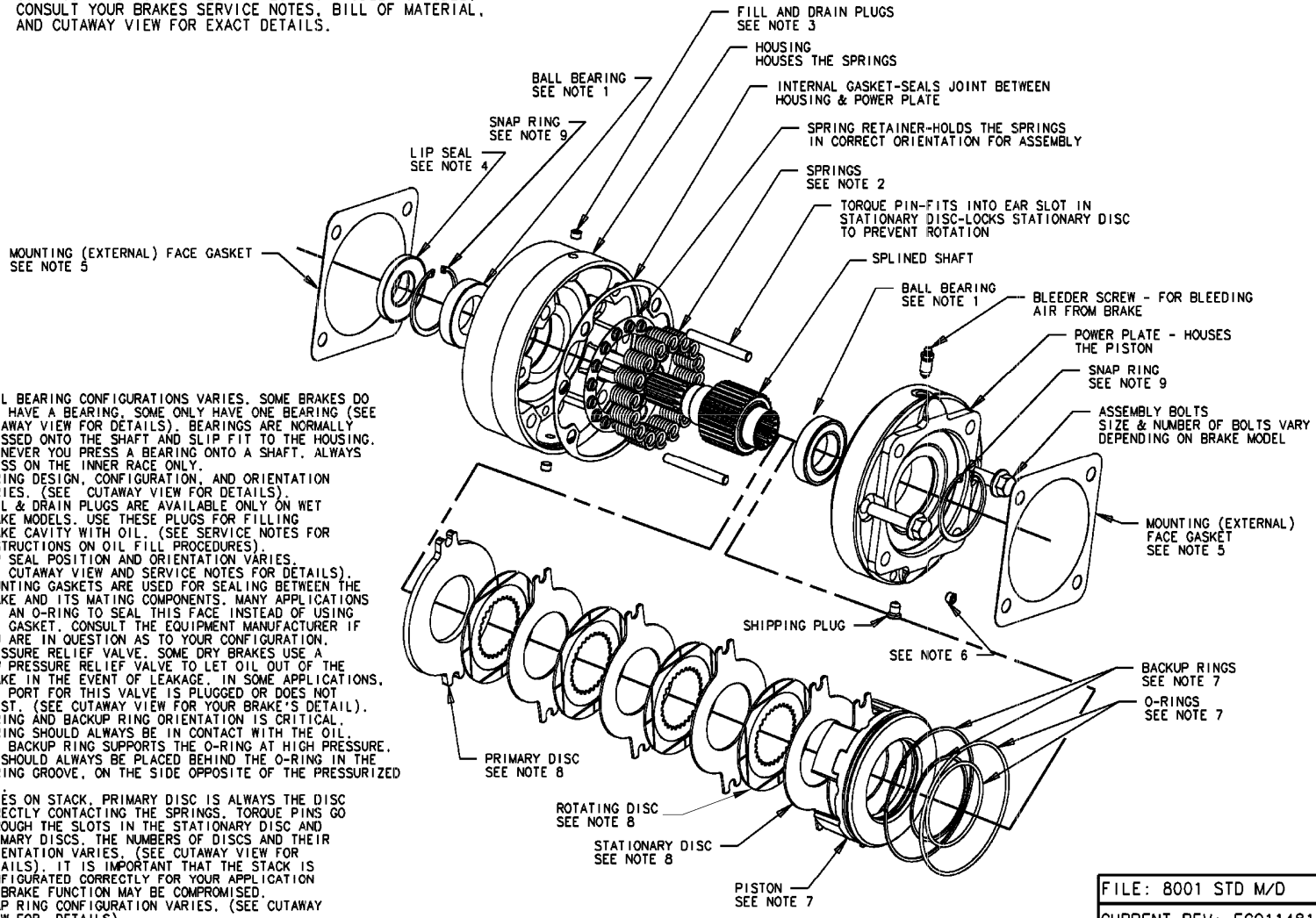


NESTED SPRING ORIENTATION

NO SCALE

STANDARD WET OR DRY MULTI-DISC BRAKES
GENERAL ASSEMBLY VIEW

NOTE: THIS DRAWING PROVIDES GENERAL GUIDELINES AND ASSEMBLY INFORMATION ON AUSCO MULTI-DISC BRAKES. CONFIGURATION OF BRAKES VARIES FROM MODEL TO MODEL. CONSULT YOUR BRAKES SERVICE NOTES, BILL OF MATERIAL, AND CUTAWAY VIEW FOR EXACT DETAILS.



NOTES:
1. BALL BEARING CONFIGURATIONS VARIES. SOME BRAKES DO NOT HAVE A BEARING, SOME ONLY HAVE ONE BEARING (SEE CUTAWAY VIEW FOR DETAILS). BEARINGS ARE NORMALLY PRESSED ONTO THE SHAFT AND SLIP FIT TO THE HOUSING. WHENEVER YOU PRESS A BEARING ONTO A SHAFT, ALWAYS PRESS ON THE INNER RACE ONLY.
2. SPRING DESIGN, CONFIGURATION, AND ORIENTATION VARIES. (SEE CUTAWAY VIEW FOR DETAILS).
3. FILL & DRAIN PLUGS ARE AVAILABLE ONLY ON WET BRAKE MODELS. USE THESE PLUGS FOR FILLING BRAKE CAVITY WITH OIL. (SEE SERVICE NOTES FOR INSTRUCTIONS ON OIL FILL PROCEDURES).
4. LIP SEAL POSITION AND ORIENTATION VARIES. (SEE CUTAWAY VIEW AND SERVICE NOTES FOR DETAILS).
5. MOUNTING GASKETS ARE USED FOR SEALING BETWEEN THE BRAKE AND ITS MATING COMPONENTS. MANY APPLICATIONS USE AN O-RING TO SEAL THIS FACE INSTEAD OF USING THE GASKET. CONSULT THE EQUIPMENT MANUFACTURER IF YOU ARE IN QUESTION AS TO YOUR CONFIGURATION.
6. PRESSURE RELIEF VALVE. SOME DRY BRAKES USE A LOW PRESSURE RELIEF VALVE TO LET OIL OUT OF THE BRAKE IN THE EVENT OF LEAKAGE. IN SOME APPLICATIONS, THE PORT FOR THIS VALVE IS PLUGGED OR DOES NOT EXIST. (SEE CUTAWAY VIEW FOR YOUR BRAKE'S DETAIL).
7. O-RING AND BACKUP RING ORIENTATION IS CRITICAL. O-RING SHOULD ALWAYS BE IN CONTACT WITH THE OIL. THE BACKUP RING SUPPORTS THE O-RING AT HIGH PRESSURE. IT SHOULD ALWAYS BE PLACED BEHIND THE O-RING IN THE O-RING GROOVE, ON THE SIDE OPPOSITE OF THE PRESSURIZED OIL.
8. NOTES ON STACK. PRIMARY DISC IS ALWAYS THE DISC DIRECTLY CONTACTING THE SPRINGS. TORQUE PINS GO THROUGH THE SLOTS IN THE STATIONARY DISC AND PRIMARY DISCS. THE NUMBERS OF DISCS AND THEIR ORIENTATION VARIES. (SEE CUTAWAY VIEW FOR DETAILS). IT IS IMPORTANT THAT THE STACK IS CONFIGURATED CORRECTLY FOR YOUR APPLICATION OR BRAKE FUNCTION MAY BE COMPROMISED.
9. SNAP RING CONFIGURATION VARIES. (SEE CUTAWAY VIEW FOR DETAILS).

FILE: 8001 STD M/D
CURRENT REV: EC011481 REV A

OPERATION MAINTENANCE SERVICE MANUAL

9,000 - 15,000 lb. Axles & Related Components





DEXTER AXLE

www.dexteraxle.com

Introduction

This manual is designed to provide information for you to understand, use, maintain, and service your trailer running gear system. Your axles are manufactured by Dexter Axle. The Dexter product line, the most complete in the industry, is the result of over 30 years of experience in the design, testing and manufacturing of trailer axles. The Dexter running gear system consists of spindles, hubs, drums, and brakes which are engineered to provide you the finest towing and stopping performance currently available in the industry today.

Two Dexter philosophies are at work to provide you the best product available and have enabled us to maintain our position of leadership. First, we operate on the theory that “there is always a better way” for a product to operate, to be manufactured, and/or to be serviced. We are constantly striving to find that better way.

Secondly, we maintain wall-to-wall production control so that all the major components of your running gear system are manufactured in Dexter facilities under our strict quality control standards. These manufactured components include the axle beam, hubs, drums, spindles, brakes, magnets, and most of the steel stampings used in the attachment of your axle to your trailer. Dexter has the most complete, state-of-the-art manufacturing facilities which enable us to provide you, the trailer owner, with the finest product possible.

For all your running gear needs...

Look first to Dexter!

Visit us at our web site
www.dexteraxle.com

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Maintenance Schedule

Item	Function Required	Weekly	3 Months or 3000 Miles	6 Months or 6000 Miles	12 Months or 12000 Miles
Brakes	Test that they are operational.		***At Every Use***		
Brake Adjustment	Adjust to proper operating clearance.		●		
Brake Magnets	Inspect for wear and current draw.			●	
Brake Linings	Inspect for wear or contamination.				●
Brake Controller	Check for correct amperage & modulation.			●	
Brake Cylinders	Check for leaks, sticking.				●
Brake Lines	Inspect for cracks, leaks, kinks.				●
Camshaft Bushings	Check for wear and breakage.			●	
Anchor Pins & Rollers	Lubricate with approved grease.			●	
Slack Adjuster Lubrication	Lubricate with approved grease.			●	
Trailer Brake Wiring	Inspect wiring for bare spots, fray, etc.				●
Breakaway System	Check battery charge and switch operation.		***At Every Use***		
Hub/Drum	Inspect for abnormal wear or scoring.				●
Wheel Bearing & Cups	Inspect for corrosion or wear. Clean & repack..				●
Seals	Inspect for leakage. Replace if removed.				●
Springs	Inspect for wear, loss of arch.				●
Suspension Parts	Inspect for bending, loose fasteners, wear.			●	
Hangers	Inspect Welds.				●
Wheel Nuts and Bolts	Tighten to specified torque values.		●		
Wheels	Inspect for cracks, dents or distortion.			●	
Tire Inflation Pressure	Inflate tires to mfg's. specifications.	●			
Tire Condition	Inspect for cuts, wear, bulging, etc.		●		

Important Safety Notice

Appropriate service methods and repair procedures are essential for the safe, reliable operation of all running gear as well as the personal safety of the individual doing the work. This manual provides general directions for performing service and repair work with tested, effective techniques. Following these guidelines will help assure reliability.

There are numerous variations in procedures, techniques, tools, parts for servicing axles, as well as in the skill of the individual doing the work. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Anyone who departs from the instructions provided in this manual must first establish that they neither compromise their personal safety nor the vehicle integrity by their choice of methods, tools, or parts.

Refer to your vehicle manufacturer's owners manual for additional procedures, techniques, and warnings prior to performing any maintenance or repairs.

⚠ CAUTION

This is the safety alert symbol. It is used to alert you to potential injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Getting Started - Setup and Adjustment

For proper performance, all new axles should have the following checked at the specified intervals:

- *Wheel Nut Torque:* at 10, 25, and 50 miles
- *Brake Adjustment:* at 200 and 3,000 miles
- *Tire pressure:* to manufacturer's requirements
- *Brake synchronization*: set brake controller per controller manufacturer’s directions

Answers to Commonly Asked Questions

Q: Why do my brakes and hubs get so hot?

A: Braking systems use friction to slow the vehicle and the energy used to retard the trailer is converted to heat. Dexter brakes are designed to operate up to extremely high temperatures during hard braking application. This heat is noticeable on the hub and drums and is to be normally expected on a properly functioning brake. If a brake is malfunctioning and running excessively hot, this can be noticed by smoking brakes or the paint burning off of the brake drum. If this occurs, refer to the brake troubleshooting diagram for your type of brake.

Q: Why do I have to adjust my brakes?

A: Brakes must be adjusted to compensate for the lining and drum wear that occurs during use of the braking system. Some brakes require manual adjustment to move the linings closer to the drum. Refer to the brake adjustment section for your style of brakes. Other brakes may have an automatic brake adjuster such as the automatic slack adjusters for air brakes.

Note: Prior to 10/96 electric and hydraulic self-adjusting brakes adjust only during hard, reverse stops. If your driving does not include these types of stops, you will have to manually adjust your brakes. Designs after 10/96 adjust both in forward and in reverse. Adjustment in reverse still requires hard stops, while adjustment in forward motion will occur through normal driving.

Q: My brake linings are cracked, do I have to replace them?

A: Usually, light cracking of the surface of a brake lining can be expected under normal use. This is not cause for replacement. However, if the lining is missing chunks, your brake linings or shoes will require replacement.

Q: Why do I have to torque my wheel nuts on my trailer and do not have to do so in my car?

A: The main reason is wheel capacity. Your entire car may weigh 3,000 lbs. which is spread over four wheels, while a 6,000 lb. trailer axle has 3,000 lbs. on a single tire and wheel. This places greater stress on the wheel/tire combination. The second reason is loading. Your car is designed to have the wheels track the arc of a turn, reducing side load on the tire and wheel. Trailers are subjected to harsh side loads, especially in double and triple axle configurations. These side loads work to flex the wheel which may cause the wheel to lose torque over time. Please follow the wheel usage instructions located later in this manual.

Q: Why can't I lock and slide my electric brakes?

A: On an unloaded trailer, you may be able to lock up your brakes if your electric brake controller is supplying full amperage to the brakes. When loaded to capacity, you may not be able to lock your brakes as electric brakes are designed to slow the trailer at a controlled rate, and not designed to lock up the wheels on a fully loaded trailer. Our brakes are designed to meet all applicable safety standards. All of our brakes will perform better after numerous burnish stops to seat the brake linings to the drums.

Q: I don't feel I have enough brakes or capacity on my axles. Can I easily upgrade?

A: Usually depending on the trailer configuration, you can upgrade your running gear to a higher capacity rating. We recommend consulting with the trailer manufacturer first before doing so.

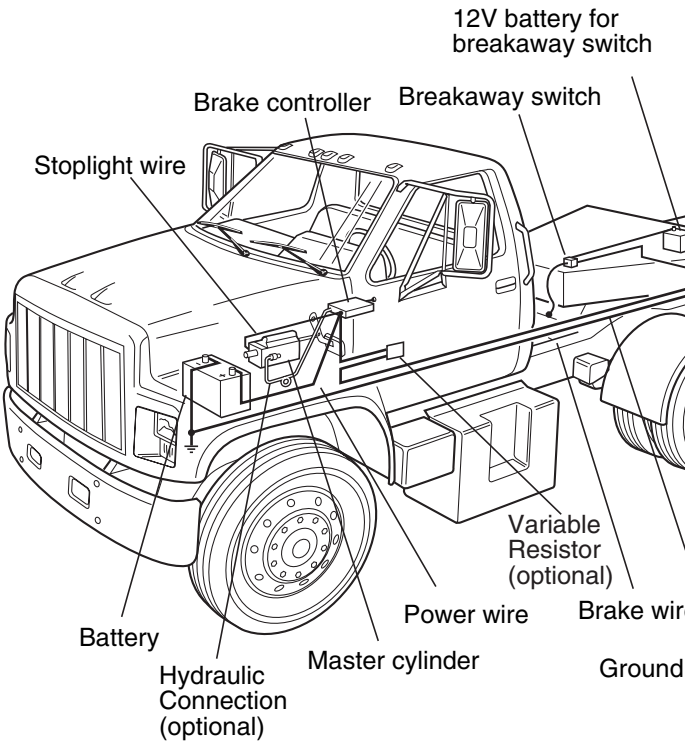
Q: Can I change my brakes from electric to hydraulic or vice versa?

A: This can be done on most axle models. We recommend contacting the trailer manufacturer prior to changing your braking system to identify any potential problems.

Electric Brakes

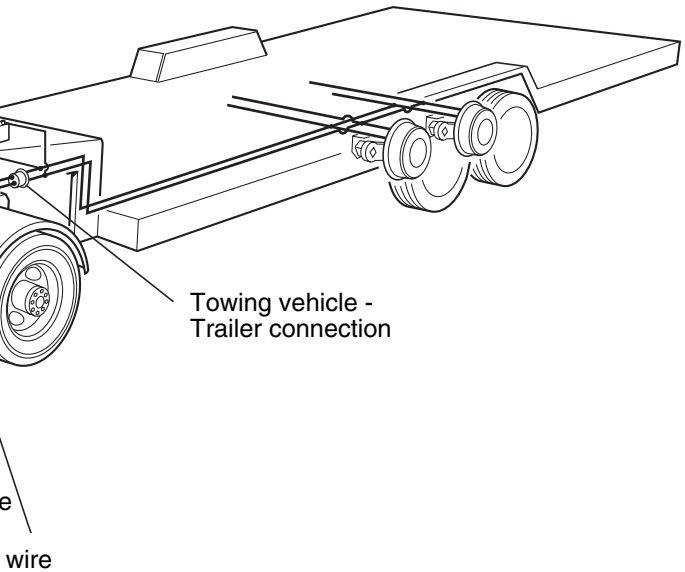
The electric brakes on your trailer are similar to the drum brakes on your automobile. The basic difference is that your automotive brakes are actuated by hydraulic pressure while your electric trailer brakes are actuated by an electromagnet. With all of the brake components connected into the system, the brake should operate as follows (see electric brake assembly illustration):

When the electrical current is fed into the system by the controller, it flows through the electromagnets in the brakes. The high capacity electromagnets are energized and are attracted to the rotating armature surface of the drums which moves the actuating levers in the direction that the drums are turning.



The resulting force causes the actuating cam block at the shoe end of the lever to push the primary shoe out against the inside surface of the brake drum. The force generated by the primary shoe acting through the adjuster link then moves the secondary shoe out into contact with the brake drum.

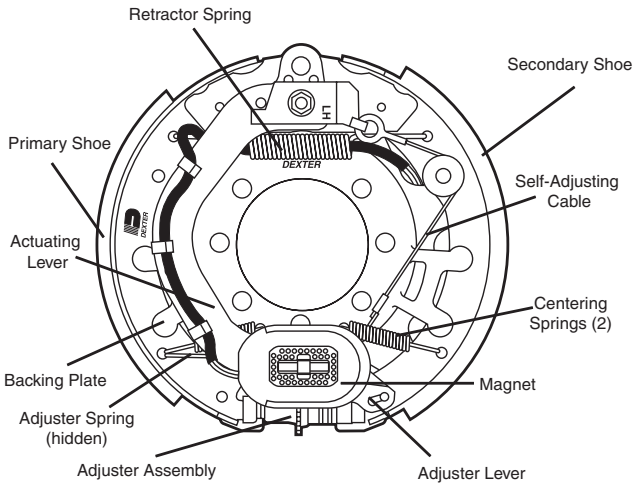
Increasing the current flow to the electromagnet causes the magnet to grip the armature surface of the brake drum more firmly. This results in increasing the pressure against the shoes and brake drums until the desired stop is accomplished.



Features

Electrically actuated brakes have several advantages over other brake actuation systems.

1. They can be manually adjusted at the controller to provide the correct braking capability for varying road and load conditions.
2. They can be modulated to provide more or less braking force, thus easing the brake load on the towing vehicle.
3. They have very little lag time from the moment the tow vehicle's brakes are actuated until the trailer brakes are actuated.
4. In an emergency situation, they can provide some braking independent of the tow vehicle.



Left hand or road side brake shown

Note: Actuating lever should always wrap around front side of axle, magnet wires should exit brake backing plate on rear side of axle.

Self Adjusting Feature *(12¼" brakes series only)*

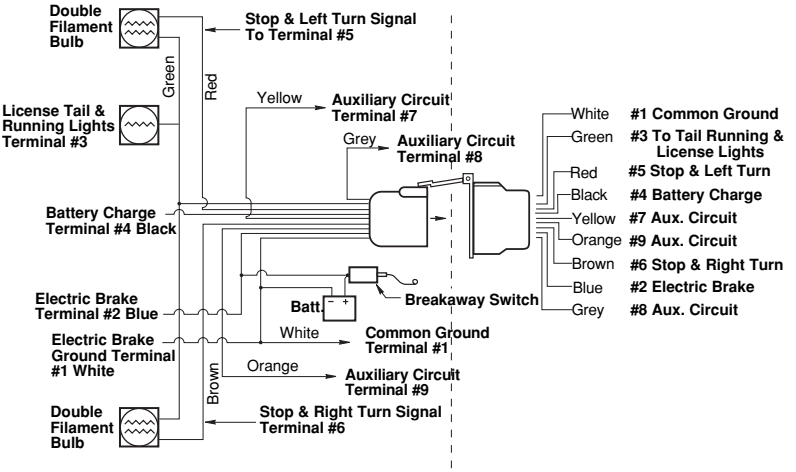
Forward self adjust electric brakes were introduced in October of 1996. This feature adjusts the brakes on both forward and reverse stops. Brake adjustment occurs when lining wear results in enough gap between the shoes and the brake drum surface. This added clearance will allow the adjuster mechanism to rotate the screw assembly at the bottom of the brake. That action expands the distance between the shoes and thus closes the gap to the drum surface.

Brake Controllers

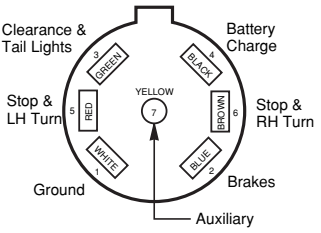
Electric brake controllers provide power to the magnets to actuate the trailer brakes. Dexter Axle offers a state-of-the-art inertial controller called the Predator Series™ DX2. This controller features a patented pendulum design which senses the deceleration of the towing vehicle and sends a proportional voltage to the electric trailer brakes. Other features include a visual gain setting for quick and easy adjustment and a digital LED display to show the voltage output. A manual override sends full voltage to the trailer brakes, regardless of gain setting, for emergency conditions and also illuminates the brake lights to warn of an impending stop.

Most electric brake controllers provide a modulation function that varies the current to the electric brakes with the pressure on the brake pedal or amount of deceleration of the tow vehicle. Electronic or timing controllers do not provide proportional modulation. These controllers tend to be inexpensive but not the best choice for optimum braking. It is important that your brake controller provide approximately 2 volts to the braking system when the brake pedal is first depressed and gradually increases the voltage to 12 volts as brake pedal pressure is increased. If the controller "jumps" immediately to a high voltage output, even during a gradual stop, then the electric brakes will always be fully energized and will result in harsh brakes and potential wheel lockup.

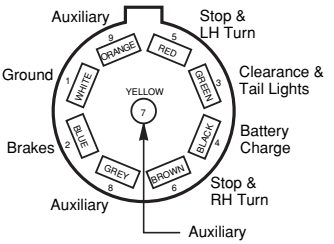
Typical Trailer Wiring



7-Circuit Receptacle



9-Circuit Receptacle



View Looking into Tow Vehicle Receptacle

How to Use Your Electric Brakes Properly

Your trailer brakes are designed to work in synchronization with your tow vehicle brakes. Never use your tow vehicle or trailer brakes alone to stop the combined load.

Your brake controller must be set up according to the manufacturer's recommendations to ensure proper synchronization between the tow vehicle and the trailer. Additionally, you may have to make small adjustments occasionally to accommodate changing loads and driving conditions.

Proper synchronization of tow vehicle to trailer braking can only be accomplished by road testing. Brake lockup, grabbiness, or harshness is quite often due to the lack of synchronization between the tow vehicle and the trailer being towed, too high of a threshold voltage (over 2 volts), or under adjusted brakes.

Before any synchronization adjustments are made, your trailer brakes should be burnished-in by applying the brakes 20-30 times with approximately a 20 m.p.h. decrease in speed, e.g. 40 m.p.h. to 20 m.p.h. Allow ample time for brakes to cool between application. This allows the brake shoes and magnets to slightly "wear-in" to the drum surfaces.

Trailer Wire Size Chart

Number of Brakes	Hitch-to-Axle Distance In Feet	Recommended Minimum Hookup Wire Size (Copper)
2		12 AWG
4	Under 30	12 AWG
4	30-50	10 AWG
6	Under 30	10 AWG
6	30-50	8 AWG

Synchronizing Your Trailer Brakes

To insure safe brake performance and synchronization, *read the brake controller manufacturer's instructions completely before attempting any synchronization procedure.*

⚠ CAUTION

Before road testing, make sure the area is clear of vehicular and pedestrian traffic. Failure to brake safely could result in an accident and personal injury to yourself and/or others.

Make several hard stops from 20 m.p.h. on a dry paved road free of sand and gravel. If the trailer brakes lock and slide, decrease the gain setting on the controller. If they do not slide, slightly increase the gain setting. Adjust the controller just to the point of impending brake lockup and wheel skid.

> *Note: Not all trailer brakes are capable of wheel lockup. Loading conditions, brake type, wheel and tire size can all affect whether a brake can lock. It is not generally considered desirable to lock up the brakes and slide the tires. This can cause unwanted flat spotting of the tires and could also result in a loss of control.*

If the controller is applying the trailer brakes before the tow vehicle brakes, then the controller adjustments should be made so the trailer brakes come on in synchronization with the tow vehicle brakes. For proper braking performance, it is recommended that the controller be adjusted to allow the trailer brakes to come on just slightly ahead of the tow vehicle brakes. When proper synchronization is achieved there will be no sensation of the trailer “jerking” or “pushing” the tow vehicle during braking.

General Maintenance - Electric Brakes

Brake Adjustment

Most Dexter 12¼" electric brakes have a self adjusting feature. If manual adjusting is required, use the following procedure:

Brakes should be adjusted (1) after the first 200 miles of operation when the brake shoes and drums have “seated,” (2) at 3,000 mile intervals, (3) or as use and performance requires. The brakes should be adjusted in the following manner:

1. Jack up trailer and secure on adequate capacity jack stands. Follow trailer manufacturer's recommendations for lifting and supporting the unit. Make sure the wheel and drum rotates freely.

⚠ CAUTION

Do not lift or support the trailer on any part of the axle or suspension system. Never go under any trailer unless it is properly supported on jack stands which have been rated for the load. Improperly supported vehicles can fall unexpectedly and cause serious injury.

2. Remove the adjusting hole cover from the adjusting slot on the bottom of the brake backing plate.
3. With a screwdriver or standard adjusting tool, rotate the starwheel of the adjuster assembly to expand the brake shoes. Adjust the brake shoes out until the pressure of the linings against the drum makes the wheel very difficult to turn.
4. Then rotate the starwheel in the opposite direction until the wheel turns freely with a slight lining drag.
5. Replace the adjusting hole cover and lower the wheel to the ground.
6. Repeat the above procedure on all brakes. For best results, the brakes should all be set at the same clearance.

Brake Cleaning and Inspection

Your trailer brakes must be inspected and serviced immediately if a loss of performance is indicated. With normal use, servicing at one year intervals is usually adequate. With increased usage, this work should be done more frequently as required. Magnets and shoes must be changed when they become excessively worn or scored, a condition which can reduce vehicle braking.

Clean the backing plate, magnet arm, magnet, and brake shoes. Make certain that all the parts removed are replaced in the same brake and drum assembly. Inspect for any loose or worn parts, stretched or deformed springs and replace as necessary.

⚠CAUTION

POTENTIAL ASBESTOS DUST HAZARD!
Some older brake linings may contain asbestos dust, which has been linked to serious or fatal illnesses. Certain precautions need to be taken when servicing brakes:

1. **Avoid creating or breathing dust.**
2. **Avoid machining, filing or grinding the brake linings.**
3. **Do not use compressed air or dry brushing for cleaning (dust can be removed with a damp brush).**

Brake Lubrication

Before reassembling, apply a light film of grease or anti-seize compound on the brake anchor pin, the actuating arm bushing and pin, and the areas on the backing plate that are in contact with the brake shoes and magnet lever arm. Apply a light film of grease on the actuating block mounted on the actuating arm.

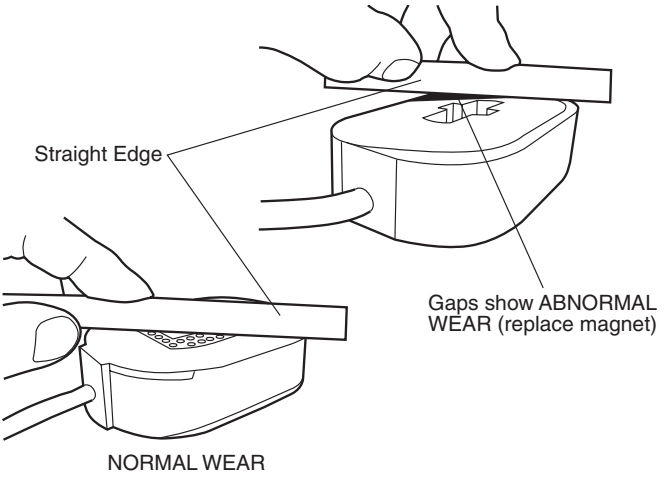
CAUTION

Do not get grease or oil on the brake linings, drums or magnets.

Magnets

Your electric brakes are equipped with high quality electromagnets that are designed to provide the proper input force and friction characteristics. Your magnets should be inspected and replaced if worn unevenly or abnormally. As indicated below, a straightedge should be used to check magnet condition. For best results, the magnet should be flat.

Even if wear is normal as indicated by your straightedge, the magnets should be replaced if any part of the magnet coil has become visible through the friction material facing of the magnet. It is also recommended that the drum armature surface be refaced when replacing magnets (see section on Brake Drum Inspection). Magnets should also be replaced in pairs - both sides of an axle. Use only genuine Dexter replacement parts when replacing your magnets.



Shoes and Linings

A simple visual inspection of your brake linings will tell if they are usable. Replacement is necessary if the lining is worn to $^{1}/_{16}$" or less. Shoes contaminated with grease or oil, or abnormally scored or gouged should also be replaced. Hairline heat cracks are normal in bonded linings and should not be cause for concern. When replacement is necessary, it is important to replace both shoes on each brake and both brakes of the same axle. This will help retain the "balance" of your brakes.



Acceptable Hairline Cracks

⚠ CAUTION

POTENTIAL ASBESTOS DUST HAZARD!
Some older brake linings may contain asbestos dust, which has been linked to serious or fatal illnesses. Certain precautions need to be taken when servicing brakes:

1. **Avoid creating or breathing dust.**
2. **Avoid machining, filing or grinding the brake linings.**
3. **Do not use compressed air or dry brushing for cleaning (dust can be removed with a damp brush).**

After replacement of brake shoes and linings, the brakes must be re-burnished to seat in the new components. This should be done by applying the brakes 20 to 30 times from an initial speed of 40 m.p.h., slowing the vehicle to 20 m.p.h. Allow ample time for brakes to cool between applications. This procedure allows the brake shoes to seat in to the drum surface.

Introduction to Troubleshooting

Proper brake function is critical to the safe operation of any vehicle. If problems are encountered with your trailer braking system, the following guide can be used to find the causes and remedies for some of the more common problems. If you are unsure or unable to resolve the problem, please contact your nearest repair facility for professional assistance.

Troubleshooting

Most electric brake malfunctions, that cannot be corrected by either brake adjustments or synchronization adjustments, can generally be traced to electrical system failure. Voltmeters and ammeters are essential tools for proper troubleshooting of electric brakes.

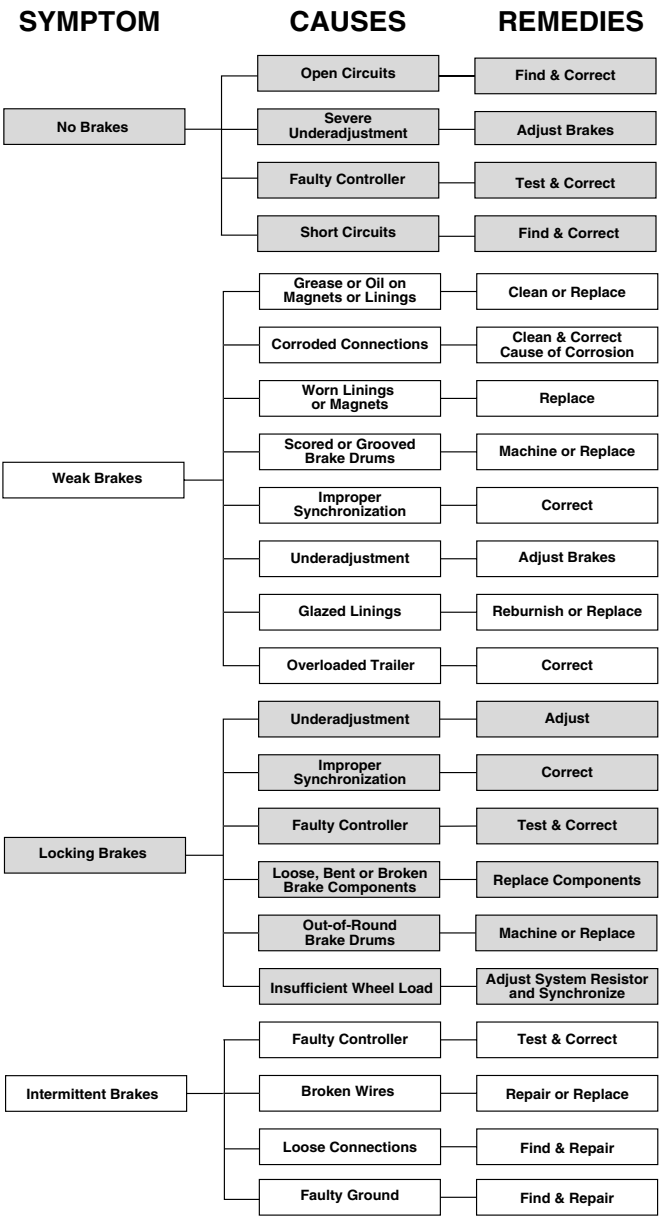
Mechanical causes are ordinarily obvious, i.e. bent or broken parts, worn out linings or magnets, seized lever arms or shoes, scored drums, loose parts, etc. Replace defective parts with genuine Dexter replacements.

Please consult the following troubleshooting charts to determine the causes and solutions for common problems found in trailer braking systems.

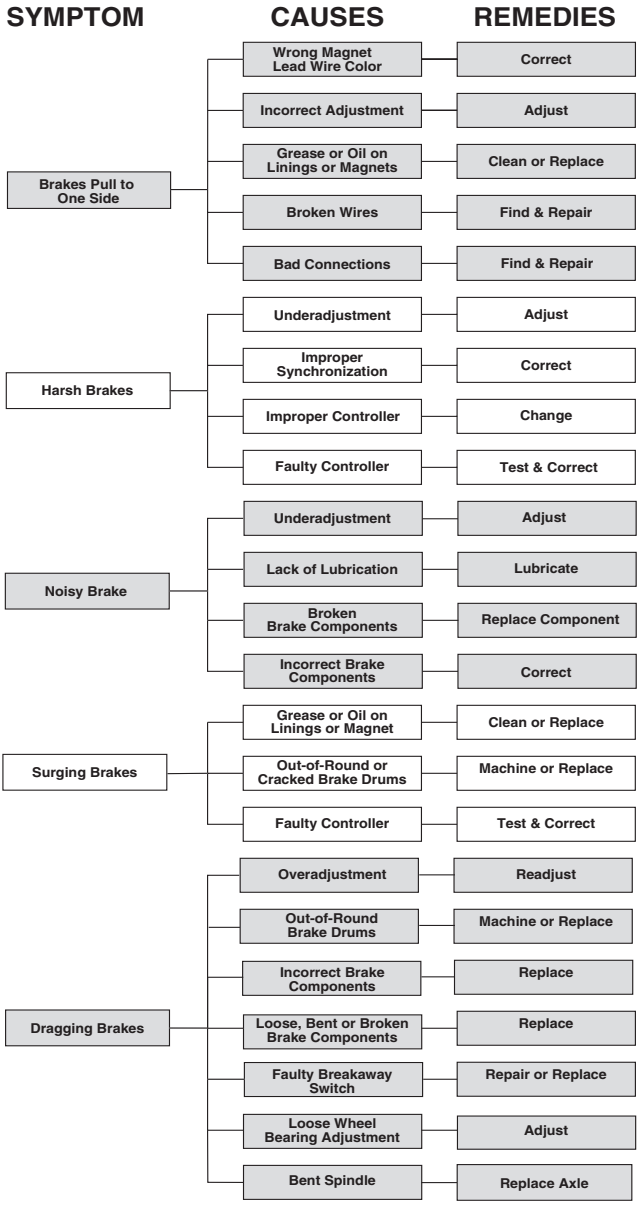
⚠ CAUTION

Best braking performance is achieved with a controller setting that is just short of wheel lock up or slide. Overly aggressive braking which results in wheel lock up and sliding, can cause a dangerous loss of control and result in personal injury or death.

Troubleshooting



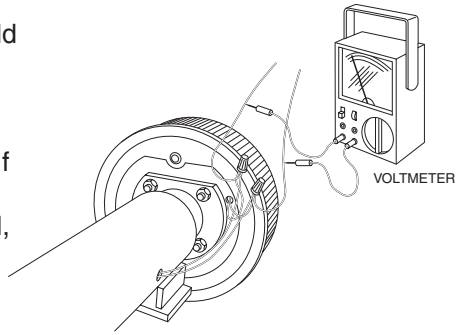
Troubleshooting



How to Measure Voltage

System voltage is measured at the magnets by connecting the voltmeter to the two magnet lead wires at any brake. This may be accomplished by using a pin probe inserted through the insulation of the wires. The engine of the towing vehicle should be running when checking the voltage so that a low battery will not affect the readings.

Voltage in the system should begin at 0 volts and, as the controller bar is slowly actuated, should gradually increase to about 12 volts. If the controller does not produce this voltage control, consult your controller manual.



The threshold voltage of a controller is the voltage applied to the brakes when the controller first turns on. Lower threshold voltage will provide for smoother braking. If the threshold voltage is too high, the brakes may feel grabby and harsh.

How to Measure Amperage

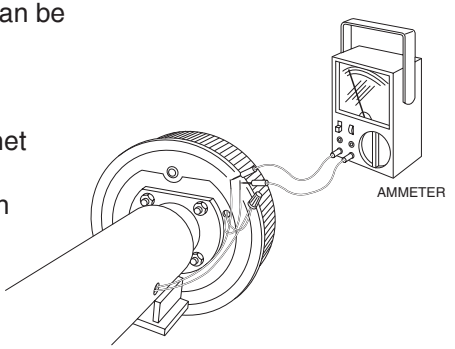
System amperage is the current flowing in the system when all the magnets are energized. The amperage will vary in proportion to the voltage. The engine of the tow vehicle should be running with the trailer connected when checking the trailer braking system.

One place to measure system amperage is at the BLUE wire of the controller, which is the output to the brakes. The BLUE wire must be disconnected and the ammeter put in series into the line. System amperage draw should be as noted in the following table. Make sure your ammeter has sufficient capacity and note polarity to prevent damaging your ammeter. With new ammeters that have inductive pickup clamps, it is not necessary to cut the blue wire.

Magnet Amperes Chart

Brake Size	Amps/ Magnet	Two Brakes	Four Brakes	Six Brakes
12 1/4 x 3 3/8	3.0	6.0	12.0	18.0
12 1/4 x 4	3.0	6.0	12.0	18.0
12 1/4 x 5	3.0	6.0	12.0	18.0

If a resistor is used in the brake system, it must be set at zero or bypassed completely to obtain the maximum amperage reading. Individual amperage draw can be measured by inserting the ammeter in the line at the magnet you want to check. Disconnect one of the magnet lead wire connectors and attach the ammeter between the two wires. Make sure that the wires are properly reconnected and sealed after testing is completed.



The most common electrical problem is low or no voltage and amperage at the brakes. Common causes of this condition are:

1. Poor electrical connections
2. Open circuits
3. Insufficient wire size
4. Broken wires
5. Blown fuses (fusing of brakes is not recommended)
6. Improperly functioning controllers or resistors

Another common electrical problem is shorted or partially shorted circuits (indicated by abnormally high system amperage). Possible causes are:

1. Shorted magnet coils
2. Defective controllers
3. Bare wires contacting a grounded object

Finding the cause of a short circuit in the system is done by isolating one section at a time. If the high amperage reading drops to zero by unplugging the trailer, then the short is in the trailer. If the amperage reading remains high with all the brake magnets disconnected, the short is in the trailer wiring.

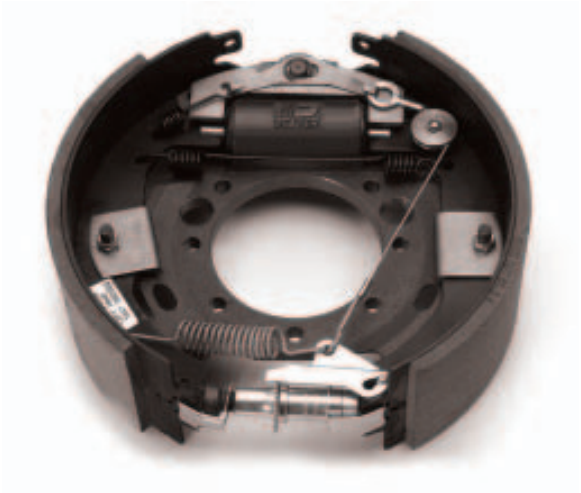
All electrical troubleshooting procedures should start at the controller. Most complaints regarding brake harshness or malfunction are traceable to improperly adjusted or non-functioning controllers. See your controller manufacturer's data for proper adjustment and testing procedures. For best results, all the connection points in the brake wiring should be sealed to prevent corrosion. Loose or corroded connectors will cause an increase in resistance which reduces the voltage available for the brake magnets.

Hydraulic Drum Brakes

The hydraulic brakes on your trailer are much like those on your automobile or light truck. The hydraulic fluid from a master cylinder is used to actuate the wheel cylinder which, in turn, applies force against the brake shoes and drum. The main difference between automotive hydraulic brakes and hydraulic trailer brakes is the trailers' actuation system. These systems respond to the braking signal from the tow vehicle and supply the required brake fluid volume and pressure to the trailer brakes.

CAUTION

The maximum operating pressure for Dexter 12¼" hydraulic brakes is 1,000 PSI.

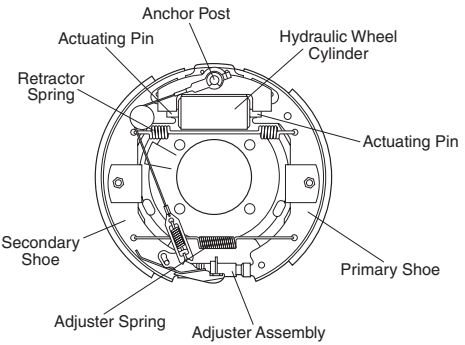


Hydraulic Brake Operation

Duo-Servo

The duo-servo brake uses a dual piston wheel cylinder to apply the brakes. This type of brake is typically used in an electric/ hydraulic, vacuum/hydraulic, or air/hydraulic system. A description of operation of this brake is as follows:

When the brakes are applied, the double-acting wheel cylinder moves the primary and secondary shoes towards the drum. The frictional force between the brake drum and lining attempts to turn the primary shoe into the secondary shoe. The secondary shoe is forced onto the anchor pin and from this point, the secondary and primary shoes attempt to "wrap around". In essence, the brake has utilized frictional force to help the applying force on both shoes.

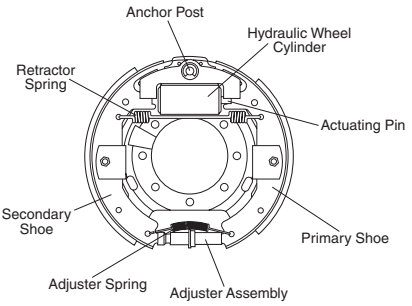


If the brakes are applied while the vehicle is backing, the shoes rotate in the direction of the drum rotation. This causes the secondary shoe to leave the anchor and causes the primary shoe to move against the anchor. Action of the brake is the same in reverse as forward.

This type of brake is normally powered by electric/hydraulic, vacuum/hydraulic or air/hydraulic systems.

Uni-Servo

This type of hydraulic brake utilizes a single acting cylinder. Upon actuation, the primary shoe is pressed against the brake drum, which causes the shoe to move in the direction of rotation. This movement in turn actuates the secondary shoe through the adjuster link assembly. Braking in reverse is significantly less effective than in the forward direction. Uni-servo brakes are normally used with surge type actuators.



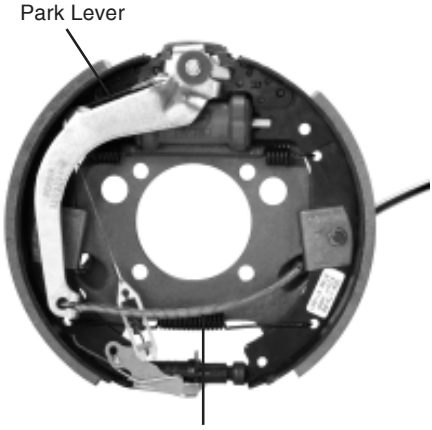
Self Adjusting Mechanism for 12¼" Hydraulic Brakes

Forward self-adjust hydraulic brakes were introduced in March, 1997. This feature adjusts the brakes on both forward and reverse stops. Brake adjustment occurs only when lining wear results in enough gap between the shoes and the drum surface. This added clearance will allow the adjuster mechanism to rotate the screw assembly at the bottom of the brake. That action expands the distance between the shoes and thus closes the gap to the drum surface.

Hydraulic Parking Brake Option

The parking feature on Dexter hydraulic brakes is cable operated. The cable end is attached to the internal parking brake lever to actuate the brake. On Dexter 12¼" brakes manufactured before February 2002, the parking cable body mounts to a support plate which is attached to the brake mounting flange. The cable end is routed through the dust shield and the brake spider to attach to the internal parking brake lever. For 12¼" brakes produced after February 2002, a short cable is installed directly into the backing plate to provide a convenient means for the trailer manufacturer to attach an appropriate operating system.

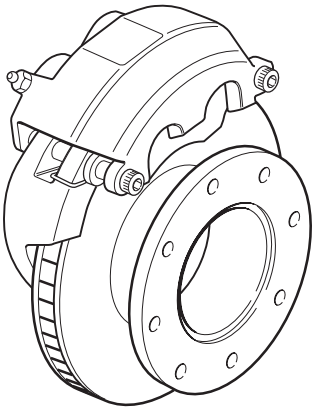
The internal parking brake lever of Dexter 12¼" brakes transfers the applied cable force through a cam mechanism. The cam mechanism generates a spreading force between the primary and secondary shoes. The shoes move toward the drum until contact is made. Friction generated between the drum and lining contact surface results in parking brake capability.



Disc Brakes

Dexter Axle manufactures two types of disc brakes, the floating caliper and the fixed caliper brake. With both styles, the disc brake uses friction pads astride a ventilated rotor which is attached to the wheel hub. When the brake is actuated, the pads are pressed against the sides of the rotor causing drag to slow the rotating disc. This action converts the kinetic energy (motion) into heat. The heat is dissipated rapidly by the ventilated disc.

The floating caliper brake uses piston(s) situated on one side of the brake rotor. Hydraulic fluid pressure pushes against the piston(s) to apply the inboard brake pad. As the inboard pad exerts force against the rotating rotor surface, the caliper moves laterally towards the trailer frame and in turn applies an equivalent force to the outboard brake pad against the rotor surface. As the lining material wears, the caliper will automatically maintain the proper lining to rotor clearance. The floating caliper design is used on Dexter 10,000 and 12,000 lb. axle models.



Disc brake effectiveness is the same going either in a forward or reverse direction. All Dexter disc brakes should be actuated with a braking system that is capable of providing a maximum hydraulic pressure of 1,600 psi.

Electric/Hydraulic Actuation Systems

To effectively operate your hydraulic trailer brakes, we recommend the Dexter E/H electro/hydraulic actuator, powered by the Predator series DX2™ electronic brake controller. These high performance hydraulic power modules will supply pressurized brake fluid to your trailer brakes in proportion to the amount of braking effort called for by the towing vehicles' deceleration rate.

CAUTION

It is the responsibility of the end user to ensure that their in-cab electronic controller is compatible with the Dexter E/H actuator. Dexter Axle attempts to provide compatibility with most controllers available, but is unable to anticipate design changes that might be introduced by the various controller manufacturers.

The E/H 1000 will supply 1,000 psi for your drum brakes and the E/H 1600 will generate 1,600 psi for maximum output from your Dexter disc brakes. The sealed, weathertight housing contains the electronics necessary to control the high pressure piston pump and proportioning valve for smooth, efficient braking.

Vacuum/Hydraulic

The basic actuation system consists of a vacuum booster, synchronizing valve, check valve and a plumbing kit which includes all lines and fittings. A vacuum supply from the engine manifold is routed to the front of the booster and the top chamber of the synchronizing valve through flexible hoses. The rear of the booster and the lower chamber of the synchronizing valve are connected by a separate line. The vacuum from the engine must pass through a normally closed check valve. The check valve keeps gas vapor out of the system and insures that the highest vacuum available will be kept in the system. With the engine running and with no brake pedal pressure, a vacuum exists throughout the system. The synchronizing valve is connected to the master cylinder hydraulic supply. When the brake pedal is

applied, the hydraulic pressure in the synchronizing valve forces a poppet to open which allows atmospheric air to enter the bottom chamber of the valve. Since this part of the valve is connected to the rear of the vacuum booster, the vacuum on this side of the booster chamber is lost. The vacuum on the front side of the booster chamber is maintained and this atmospheric/vacuum pressure differential causes a piston to move in the booster's slave cylinder. This piston applies the hydraulic pressure to the brakes through the connecting hydraulic line. When the pedal is released, the poppet in the synchronizing valve is closed, and by internal passages, the air in the rear of the booster chamber is removed. This restores a vacuum which is equal to the vacuum in the front part of the booster chamber. The pressure balance allows the slave cylinder piston to be pulled back to its original position and the hydraulic pressure to the brakes is released.

Air/Hydraulic

Air/hydraulic braking systems are commonly used when the tow vehicle has a diesel engine which does not develop manifold vacuum. The air/hydraulic tow vehicle has an air compressor mounted on the engine to supply compressed air for the braking system and other needs required by the tow vehicle trailer combination. This air is routed to a booster chamber attached to the trailer master cylinder. The air pressure multiplies hydraulic output pressure which then sends fluid to the wheel cylinders. The air over hydraulic systems are often controlled by a series of control valves and servos to insure proper braking under all conditions.

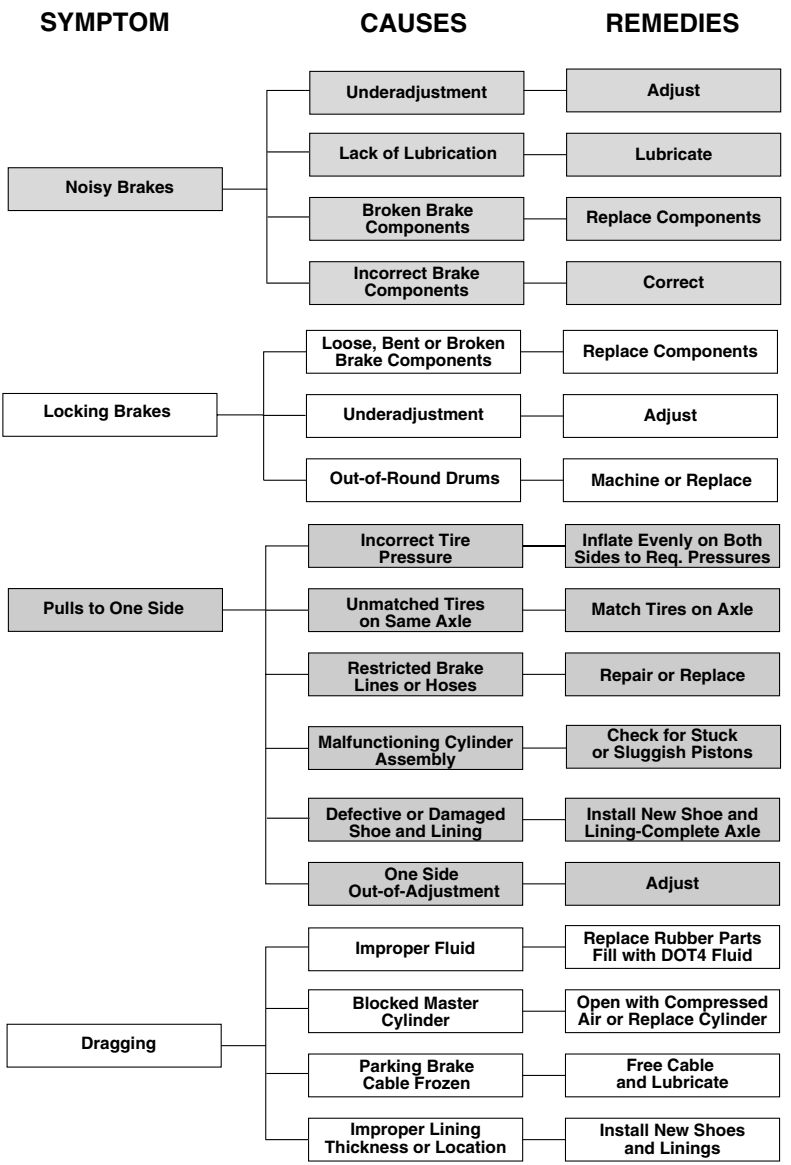
Introduction to Troubleshooting

Proper brake function is critical to the safe operation of any vehicle. A properly installed vacuum/hydraulic, electric/hydraulic, or air/hydraulic system should not require any special attention with the exception of routine maintenance as defined by the manufacturer. If problems occur, the entire tow vehicle/trailer braking system should be analyzed by a qualified mechanic. Typical problems in a hydraulic braking system are:

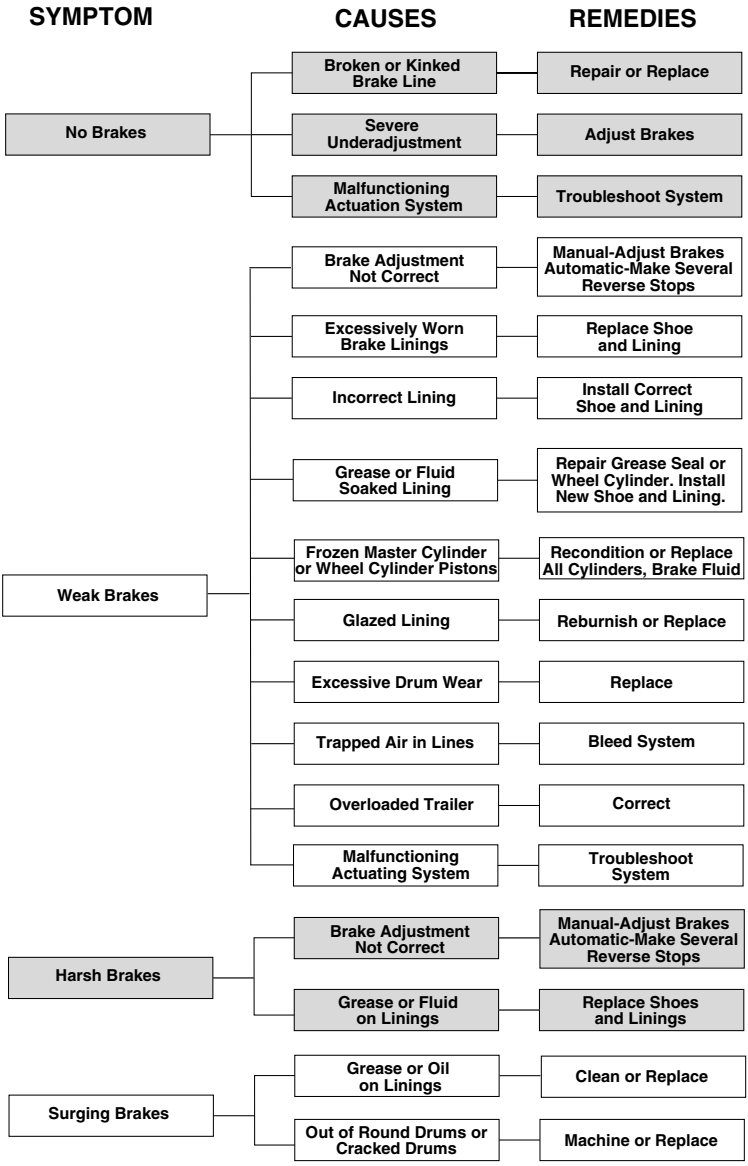
- Air or vacuum leaks
- Hydraulic system leaks
- Air in brake lines
- Water or other impurity in brake fluid
- Rusted or corroded master or wheel cylinders
- Actuation system malfunction

Please consult the following troubleshooting charts to determine the causes and solutions for common problems found in trailer braking systems.

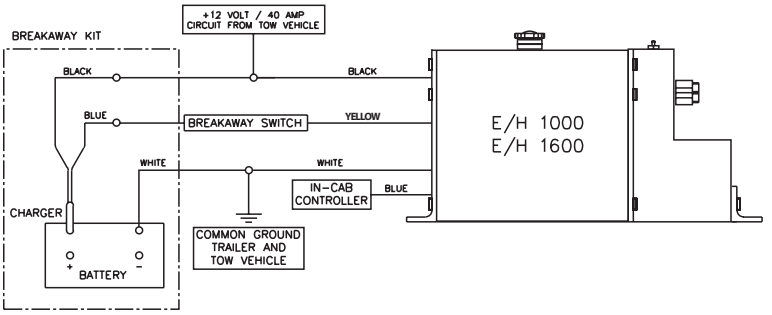
Troubleshooting



Troubleshooting



Electric/Hydraulic Troubleshooting Guide



Brakes are slow to respond

1. Re-bleed the trailer brakes and actuator.
2. If the trailer is equipped with drum brakes, readjust the drum brakes to the brake manufacture's recommended running clearance.
3. Slow response can be caused by trailer wiring that is too small.
4. For trailers where the E/H unit is located less than 10 feet from the tow vehicle, 12 gage wire is recommended for the black and white wires between the tow vehicle and the E/H unit. All other wires should be a minimum of 16 gauge.
5. For trailers where the E/H unit is located more than 10 feet from the tow vehicle, 10 gage wire is recommended for the black and white wires between the tow vehicle and the E/H unit. All other wires should be a minimum of 16 gauge.
6. Slow response can be caused by improper adjustment of the brake controller. On inertia-based electronic brake controls, adjust the pendulum (inertia sensor) to a more aggressive setting and/or increase the gain setting.

Unit will not run when the ignition is on and the brake pedal is depressed

1. Verify that the trailer and tow vehicle are wired as detailed on the electrical schematic.
2. With the ignition switch on and the brakes not applied, you should have 12-13 volts between the black and white wires on the E/H unit.
3. Clean and replace the ground between the trailer and the E/H unit.
4. Test operation of the unit using the breakaway test procedure.

Breakaway test procedure - do not leave the breakaway switch pulled for more than two minutes during any of the steps outlined below

1. Pull the breakaway switch on the trailer.
2. If the unit runs and builds pressure, that indicates the actuator is functioning properly. The problem most likely is a defective electronic brake controller in the tow vehicle or defective wiring between the tow vehicle and the E/H unit.
3. If the unit runs but will not build pressure, the problem most likely is a defective solenoid valve in the E/H unit and the actuator should be returned for repair.
4. If the unit still does not run after the breakaway battery is fully charged, verify that the voltage between the white wire and yellow wire is at least 12 volts.
5. If the voltage is less than 12 volts, either the breakaway switch or the breakaway wiring is defective.
6. If the voltage is greater than 12 volts, the E/H unit should be returned for repair.

Trailer brakes too aggressive

1. Reduce the gain setting on the in-cab electronic brake controller.

General Maintenance - Hydraulic Brakes

Drum Brake Adjustment

Most Dexter 12¼" electric brakes have a self adjusting feature. If manual adjusting is required, use the following procedure:

Brakes should be adjusted (1) after the first 200 miles of operation when the brake shoes and drums have “seated,” (2) at 3,000 mile intervals, (3) or as use and performance requires. The brakes should be adjusted in the following manner:

1. Jack up trailer and secure on adequate capacity jack stands. Follow trailer manufacturer's recommendations for lifting and supporting the unit. Make sure the wheel and drum rotates freely.

⚠ CAUTION

Do not lift or support the trailer on any part of the axle or suspension system. Never go under any trailer unless it is properly supported on jack stands which have been rated for the load. Improperly supported vehicles can fall unexpectedly and cause serious injury or death.

2. Remove the adjusting hole cover from the adjusting slot on the bottom of the brake backing plate.
3. With a screwdriver or standard adjusting tool, rotate the starwheel of the adjuster assembly to expand the brake shoes. Adjust the brake shoes out until the pressure of the linings against the drum makes the wheel very difficult to turn.
4. Then rotate the starwheel in the opposite direction until the wheel turns freely with a slight lining drag.
5. Replace the adjusting hole cover and lower the wheel to the ground.
6. Repeat the above procedure on all brakes. For best results, the brakes should all be set at the same clearance.

Most of the brake components are very similar to those used in electric brakes, and maintenance is comparable for the hub and drum, shoes and linings, and bearings. Specific maintenance activities are as follows:

Wheel Cylinders

Inspect for leaks and smooth operation. Clean with brake cleaner and flush with fresh brake fluid. Hone or replace as necessary.

Brake Lines

Check for cracks, kinks, or blockage. Flush with fresh brake fluid. Bleed system to remove all air. Replace as necessary.

Shoes and Linings

A simple visual inspection of your brake linings will tell if they are usable. Replacement is necessary if the lining is worn (to within $^{1}/_{16}$" or less), contaminated with grease or oil, or abnormally scored or gouged. Hairline heat cracks are normal in bonded linings and should not be cause for concern. When replacement is necessary, it is important to replace both shoes on each brake and both brakes of the same axle. This will help retain the "balance" of your brakes.

⚠ CAUTION

POTENTIAL ASBESTOS DUST HAZARD!
Some older brake linings may contain asbestos dust, which has been linked to serious or fatal illnesses. Certain precautions need to be taken when servicing brakes:

1. **Avoid creating or breathing dust.**
2. **Avoid machining, filing or grinding the brake linings.**
3. **Do not use compressed air or dry brushing for cleaning (dust can be removed with a damp brush).**