DANA SPICER®
Off-Highway Products

Service Manual

Powershift Transmission
TE27 & TE32 4-Speed Long Drop
with Full Flow Control Valve

80-1070 Rev 5/12/2014

TSM-0064
August 2012

CONTENTS

TOWING OR PUSHING

Before towing the vehicle, be sure to lift the driven axle wheels off the ground or disconnect the driveline to avoid damage to the transmission during towing.

NOTE:

Because of the design of the hydraulic system, the engine cannot be started by pushing or towing.

INTRODUCTION

Foreword

This manual has been prepared to provide the customer and maintenance personnel with information and instructions on the maintenance and repair of Dana Spicer products.

Extreme care has been exercised in the design, selection of materials, and manufacturing of these units. The slight outlay in personal attention and cost required to provide regular and proper lubrication, inspection at stated intervals, and adjustments as indicated will be reimbursed many times in low cost operation and trouble-free service.

In order to become familiar with the various parts of the product, its principle of operation, troubleshooting, and adjustments, it is urged that mechanics study the instructions in this manual carefully and use it as a reference when performing maintenance and repair operations.

Whenever repair or replacement of component parts is required, only Dana Spicer approved parts, as listed in the applicable service parts list, should be used. Use of “will fit” or non-approved parts may endanger proper operation and performance of the equipment. Dana does not warrant repair, replacement parts, or failures resulting from the use of parts which are not supplied or approved by Dana.

IMPORTANT:

ALWAYS FURNISH THE DISTRIBUTOR WITH THE SERIAL AND MODEL NUMBER WHEN ORDERING PARTS.

Safety Precautions

To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed. Proper service and repair are important to the safety of the service technician and the safe, reliable operation of the machine. If replacement parts are required, the part must be replaced with a Dana specified replacement part. NEVER use a replacement part of lesser quality.

The service procedures recommended in this manual are effective methods of performing service and repair. Some of these procedures require the use of unique tools. Accordingly, anyone who intends to use a replacement part, service procedure, or tool, which is not recommended, must first determine that neither their safety or the safe operation of the machine will be jeopardized by the replacement part, service procedure, or tool selected.

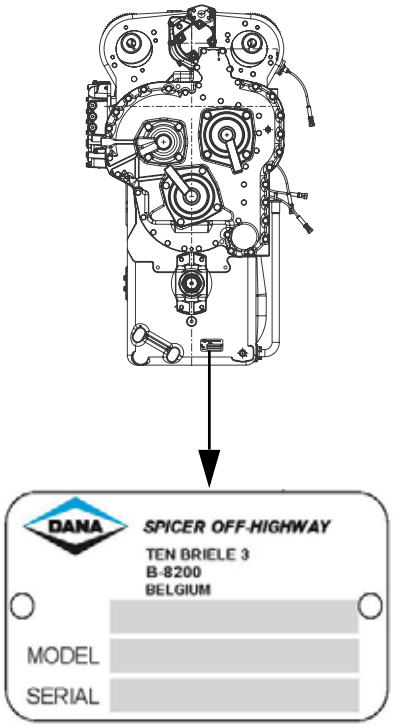
It is important to note that this manual contains various precautions that must be carefully observed in order to reduce the risk of personal injury during service or repair. Improper service or repair may also damage the unit or render it unsafe. It is important to understand that these precautions are not exhaustive. It is impossible to warn of all possible hazardous consequences that may result from following or failing to follow these instructions.

	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
	Indicates a potentially hazardous situation which, if not avoided, may result in moderate or minor injury.
	Indicates a situation which, if not avoided, may result in damage to components.

SPECIFICATIONS

Identification Tag

The nameplate contains both the model and serial number of the unit.



General Specifications

Weight (dry)	2204 lbs / 1000 kg
Length (maximum)	39.8" / 1011 mm for T models 46.8" / 1189 mm for MT models
Width (maximum)	27.7"/ 703 mm
Height (maximum)	49.6"/ 1260 mm
Oil Capacity	7.9 US gallons / 30 liters*

* *Without cooler and hydraulic lines. Consult equipment operator's manual for complete system capacity.*

Hydraulic Cooler Lines Specifications

Lines and Fittings (Minimum)	1" / 25.4 mm internal diameter
Continuous Operating Temperature	Ambient to 248°F / 120°C
Continuous Pressure	406 PSI / 28 bar continuous pressure and 595 PSI / 41 bar intermittent surges
Conformance	SAE J1019 and SAE J517, 100RI

Pressure and Temperature Specifications

Normal Operating Temperature	158–248ºF / 70–120ºC Measured at temperature check port converter out (port 71 or port 32*)
Maximum Temperature	248ºF / 120ºC
Regulator Pressure†	Vehicle in Neutral & Port 31* At 600 RPM minimum: 326.3 PSI / 22.5 bar minimum At 2650 RPM: 369.8 PSI / 25.5 bar maximum
Pump Flow†	At 1900RPM 31.5 GPM / 119.3 l/min minimum
Lube Pump Flow	At 2170 RPM selective lube 12.5 GPM / 47.2 l/min minimum
Clutch Pressure†	1st clutch: Port 41* 2nd clutch: Port 42* 3rd clutch: Port 43* 4th clutch: Port 44* Forward clutch: Port 45* Reverse clutch: Port 46* At 2200 RPM: 297.3 PSI / 20.5 bar minimum with 1st clutch activated
Filter Bypass Valve†	Set at 59.4-65.2 PSI / 4.1-4.5 bar†
Lube Pressure†	Port 34 58–80 PSI / 4.0–5.5 bar at 2200 RPM
Internal Total Leakage	At 1000 engine RPM FWD/REV: 1 GPM [4 l/min.] maximum 1st: 2.43 GPM [9.2 l/min.] maximum 2nd-3rd-4th: 1 GPM [4 l/min.] maximum Converter: 1.3–3.2 GPM [5–12 l/min.] at 1000 RPM
Safety Valve Cracking Pressure†	127.6–139.2 PSI / 8.8–9.6 bar
Converter Out Pressure†	Port 33 72.5 PSI / 5 bar minimum 2000 RPM and maximum 123.3 PSI / 8.5 bar at no load governed speed

* *Refer to "TROUBLESHOOTING" for check port identification.*

† *All pressures and flows to be measured with oil temperature 180-200ºF / 82-93ºC.*

Electrical Specifications

Proportional Valves	FWD/REV - 1st/3rd - 2nd/4th Coil Resistance: 7.25Ω at 68°F / 20°C
Selection Valves	FWD/N/REV - 1st/3rd Coil Resistance: 12V - 7.1Ω at 68°F / 20°C Coil Resistance: 24V - 28.5Ω at 68°F / 20°C
Speed Sensor	Type: Magneto resistive sensor Sensing Distance: 0–0.07"/ 0–1.8 mm Sensor Signal: Generates a square current with a fixed amplitude changing between 7 and 14 mA.
Temperature Sensor	Material: Silicon Resistance: 77°F / 25°C = 2000Ω ± 1%
Pressure Sensor	Supply Voltage: 4.5-5.5V Maximum Current: 10mA Pressure Range: 14.5-450 PSI / 1-31 bar ± 1.2% full scale (450 PSI / 31 bar) range 14.5-363 PSI / 1-25 bar ± 2.5% full scale (450 PSI / 31 bar) range 363-450 PSI / 25-31 bar

MAINTENANCE

Sump preheaters

Preheat the transmission fluid to the minimum temperature for the oil viscosity used before engine start up.

Filters

Service oil filter elements the first time at 100 hours and then every 1000 hours under normal environmental and duty cycle conditions.

Clutch Calibration

Perform automatic clutch calibration every 2000 hours.

Lubricants

Recommended Lubricants

Only Dextron® III is approved. Viscosity at 104°F [40°C] = 33 - 38 cSt; at 212°F [100°C] = 7-8 cSt.

Maintenance Intervals

Daily

Check oil level daily with engine running at idle (600 RPM) and oil at 180-200°F [82 - 93°C].

Maintain oil level at full mark.

Normal oil change interval

Drain and refill system every 1000 hours for average environmental and duty cycle conditions. Severe or sustained high operating temperature or very dusty atmospheric conditions will result in accelerated deterioration or contamination. Judgement must be used to determine the required change intervals for extreme conditions.

Every 1000 hours:

- Change oil filter element.
- Drain oil at 150–200°F [65-93°C] and refill system as follows:

1. Drain transmission.
2. Remove and discard filter.
3. Install new filter.
4. Refill transmission to FULL mark.
5. Run engine at 500 - 600 RPM to prime converter and lines.
6. Recheck level with engine running at 500 - 600 RPM and add oil to bring level to LOW mark. When oil temperature is hot 180-200°F [82.2-93.3°C] make final oil level check and adjust if necessary to bring oil level to FULL mark.

NOTE:

It is recommended that oil filter be changed after 100 hours of operation on new, rebuilt, or repaired unit.

Extended oil change interval

Extended oil service life may result when using synthetic fluids. Appropriate change intervals should be determined for each transmission by measuring oil oxidation and wear metals, over time, to determine a baseline. Wear metal analysis can provide useful information but a transmission should not be removed from service based solely on this analysis.

Servicing Machine After Component Overhaul

The transmission, torque converter, and its allied hydraulic system are important links in the driveline between the engine and the wheels. The proper operation of either unit depends greatly on the condition and operation of the other. Therefore, whenever repair or overhaul of one unit is performed, the balance of the system must be considered before the job can be considered complete.

After the overhauled or repaired transmission has been installed in the machine, the oil cooler, and connecting hydraulic system must be thoroughly cleaned. This can be accomplished in several manners and a degree of judgement must be exercised as to the method employed.

The following are considered the minimum steps to be taken:

1. Drain entire system thoroughly.
2. Disconnect and clean all hydraulic lines. Where feasible hydraulic lines should be removed from machine for cleaning.
3. Replace oil filter element.
4. The oil cooler must be thoroughly cleaned. The cooler should be “back flushed” with oil and compressed air until all foreign material has been removed. Flushing in direction of normal oil flow will not adequately clean the cooler. If necessary, cooler assembly should be removed from machine for cleaning, using oil, compressed air, and steam cleaner for that purpose.

IMPORTANT:

NEVER use flushing compounds for cleaning purposes.

5. Reassemble all components and use only type oil (See chapter 4.1.1 “Recommended lubricants”).
   Fill the transmission through filler opening until fluid comes up to FULL mark on transmission dipstick.

- Remove filler plug and fill oil until FULL mark.
- Run engine two minutes at 500 - 600 RPM to prime torque converter and hydraulic lines.
- Recheck level of fluid in transmission with engine running at idle (500 - 600 RPM).
- Add quantity necessary to bring fluid level to LOW mark on dipstick.
- Recheck with hot oil 180 – 200°F [82.2 - 93.3°C].
- Adjust oil level to FULL mark on dipstick.

6. Recheck all drain plugs, lines, connections, etc… for leaks and tighten where necessary.
7. Perform automatic calibration.

Automatic Calibration Procedure

Introduction

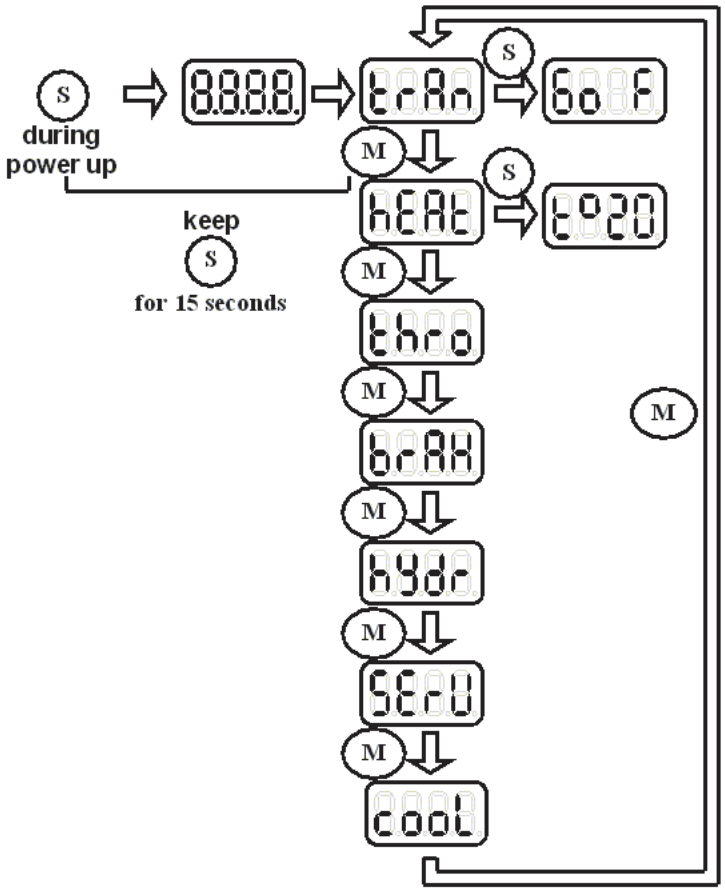
The APC200 firmware contains an automatic transmission calibration procedure, which is able to optimize the shift quality of the transmission.

An automatic calibration has to be done:

- When the vehicle is build at the OEM
- Every 2000 hours of transmission operation
- When an overhaul of the transmission is done
- When the transmission is repaired
- When the APC200 is replaced

ENTERING AUTOMATIC CALIBRATION MODE

The automatic calibration mode is entered by pressing the S-button on the APC200 display for 15 seconds during power-up.



Automatic Calibration Procedure

PERFORMING AUTOMATIC CALIBRATION

Before the automatic calibration can be started, a number of conditions need to be fulfilled:

- The parking brake on the vehicle has to be activated.
- The transmission temperature needs to be above 60°C. See the next paragraph how to use the ‘HEAT’-mode to do this in a time effective way.
- The engine speed has to be kept at around 800 rpm (± 200 rpm) during the complete calibration. If the APC200 has control over the engine, the engine speed will be adapted automatically.

1. If all the conditions mentioned above are met, the actual automatic calibration can be performed starting from the following display on the APC200:

2. To trigger the automatic calibration procedure, push the S-button once. The APC200 display readout will show:

3. The APC200 asks for the shift lever to be put in FORWARD.
   The automatic transmission calibration procedure starts. This is indicated on the APC200 display:

   ‘C1’ stands for ‘clutch 1’ being forward, while ‘M1’ stands for ‘mode 1’ of the calibration.

4. When all clutches have been calibrated, the APC200 displays:

5. At this point, the automatic calibration has completed successfully. The normal duration of a complete transmission calibration is around 15 minutes.
6. To exit the automatic calibration mode, switch off the vehicle ignition key. Make sure that the APC200 has powered down – wait for 2 seconds. Now restart the vehicle and the new tuning results will be activated automatically.

Troubleshooting

If anything different than described above appears on the APC200 display, there can be two possible reasons:

- The calibration conditions are not fulfilled (temperature is too low, parking brake switched off, the vehicle is moving, engine rpm is too high or too low).
- A calibration error has occurred during the calibration. This message starts with an ‘E’ (see “CALIBRATION CONDITION MESSAGES AND CALIBRATION ERRORS”, on page 11).

By selecting REVERSE on the shift lever, while the automatic calibration is performing, the procedure will abort the automatic calibration immediately and restart the APC200. This feature can be used when something goes wrong during the calibration procedure.

NOTE:

By aborting the automatic calibration, the calibration is not finalized and needs to be done from the beginning.

HEATING UP THE TRANSMISSION BY USING THE 'HEAT'-MODE

The 'HEAT'-mode allows to select forward / reverse while the parking brake is activated, without forcing neutral and will disable the inching and declutch function. During the heat mode the highest gear is forced – even when the shift lever is in a lower gear. This combination allows the driver to heat up the transmission by going into stall.

'HEAT'-mode can be activated in the same way automatic calibration mode is entered (see "ENTERING AUTOMATIC CALIBRATION MODE", on page 8). Once "tran" is displayed on the screen, press the M-button once to go into the "HEAT"-mode. The APC200 will display:

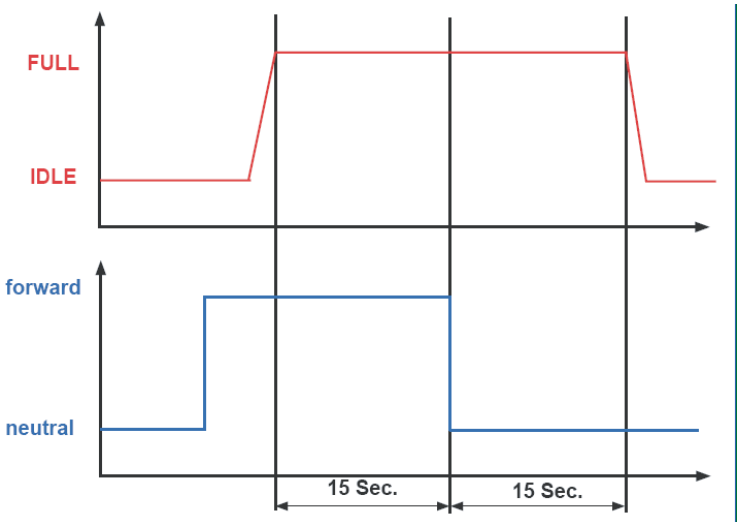
To trigger the 'HEAT'-mode, push the S-button. The APC200 will display the sump temperature:

This means the actual sump temperature of the transmission is 20°C.

Perform the following steps in order to heat up the transmission:

1. Make sure the parking brake is active and works properly.
2. Put the transmission in forward by selecting forward with the shift lever and then accelerates the engine to full throttle.
3. Keep the engine at full throttle for about 15 seconds and then put the gearbox in neutral by selecting neutral with the shift lever. Keep the engine at full throttle!
4. Keep the gearbox in neutral at full engine throttle for about 15 seconds again.
5. Release the throttle pedal and decelerate the engine to idle.
6. Go back to point 2 and repeat until the APC200 display shows a temperature above 140°F [60°C]. When the temperature is above 140°F [60°C], the temperature indication on the display starts blinking. Now switch to automatic calibration by pressing the M-button several times – until the APC200 displays "tran".

During this warm up procedure, it is possible for the converter out temperature of the transmission to exceed the maximum limit. This is a consequence of heating up the transmission using this quick procedure. When this occurs, the engine speed will be limited to half throttle when the APC200 has engine control or forcing neutral when the APC200 has no engine control. To solve this, simply leave the transmission in neutral for a minute and throttle the engine to around 1300 rpm. This will allow the heat in the converter to be evacuated. After one or two minutes, resume the heating up procedure if the transmission temperature has not reached 60°C yet.



Automatic Calibration Procedure

CALIBRATION CONDITION MESSAGES AND CALIBRATION ERRORS

This chapter gives an overview of the most common calibration condition messages. Many calibration condition messages can be corrected, however, if any calibration error messages appear, contact the OEM of the machine.

Calibration Condition Messages

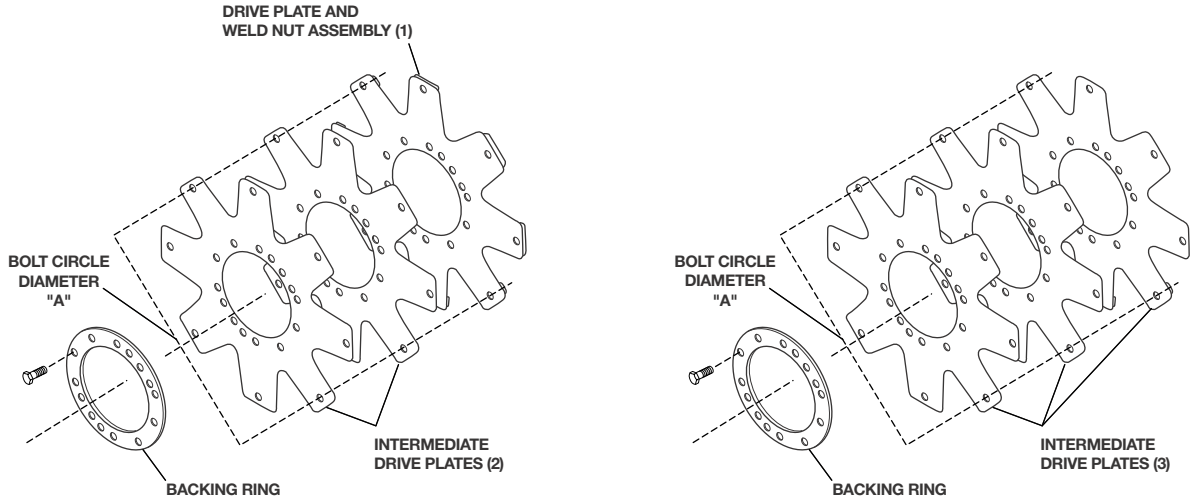
	The APC200 expects the shift lever to be in NEUTRAL, but finds it in another position. (FORWARD or REVERSE)	Put the shift lever back in NEUTRAL.
	THE APC200 expects the parking brake to be ON while it is OFF.	Put the parking brake ON.
	The APC200 has detected output speed.	Verify that the parking brake is ON and working properly. If this is already the case, keep the machine at standstill by using the brake. Once the machine has been stopped, the APC200 will ask the driver to shift to FORWARD before continuing the calibration.
	Engine RPM is to low according to the limit that is necessary for calibration.	When during the automatic transmission calibration the temperature becomes to low, the APC200 display indicates the actual transmission temperature. 
	Engine RPM is to high according to the limit that is necessary for calibration.	
	After being to low or to high, the engine RPM is coming back into the correct boundaries for calibration.	
	When during the automatic transmission calibration the temperature becomes to low, the APC200 display indicates the actual transmission temperature.	Use the M-button on the APC200 to go back to the 'HEAT' mode and the S-button to trigger this mode. Then warm-up the transmission again until the temperature is above 140°F [60°C]. Then go back to the automatic tuning mode by the M-button and trigger this one again to continue calibration.

Calibration errors

Calibration errors have the form ‘E1.xx’ or ‘E2.xx’ (example: E1.25). Please contact the OEM of the machine if an error of this form appears on the display.

DRIVE PLATE INSTALLATION

Proper identification is determined by measuring the bolt circle diameter (see dimension “A” in the illustration below) and then ordering the appropriate drive plate kit from the table.



Each kit includes: 2 Intermediate Drive Plates 1 Drive Plate & Weld Nut Assembly 1 Backing Ring 6 Mounting Capscrews 6 Lockwashers Instruction Sheet	Each kit includes: 3 Intermediate Drive Plates 1 Backing Ring 6 Mounting Capscrews 6 Lockwashers Instruction Sheet
15” [381.0 mm] diameter	15” [381.0 mm] diameter
16” [406.4 mm] diameter	16” [406.4 mm] diameter
17” [431.8 mm] diameter	17” [431.8 mm] diameter

1. Position drive plate and weld nut assembly on torque converter assembly with weld nuts toward converter.
2. Align intermediate drive plates and backing ring with holes in torque converter assembly.
3. Two dimples 180^{o} apart in backing ring must be facing outward toward engine flywheel (hollow side facing torque converter assembly).
4. Install capscrews and lockwashers. Tighten capscrews to 30-37 lbs. ft. (40-50 N•m).

NOTE:

Assembly of all plates must be completed within 15 minutes from when screws are installed. If a screw is removed for any reason it must be replaced. The adhesive left in the tapped holes must be removed with the proper tap and cleaned with solvent. Dry the hole thoroughly and use a new screw for reinstallation.

TRANSMISSION TO ENGINE INSTALLATION

1. Remove all burrs from flywheel mounting face and nose pilot bore. Clean drive plate surface with solvent. Dry thoroughly.
2. Check engine flywheel and housing for conformance to standards SAE #3 per SAE J-927 and J-1033 tolerance specifications for pilot bore size, pilot bore runout, and mounting face flatness. Measure and record engine crankshaft end play.
3. Install two 2.50” [63.5 mm] long transmission to flywheel housing guide studs in the engine flywheel housing as shown. Rotate the engine flywheel to align a drive plate mounting screw hole with the flywheel housing access hole.
4. *Install a 4.00” [101.6 mm] long drive plate locating stud .3750-24 fine thread in a drive plate nut. Align the locating stud in the drive plate with the flywheel drive plate mounting screw hole positioned in Step 3.
5. Rotate the transmission torque converter to align the locating stud in the drive plate with the flywheel drive plate mounting screw hole positioned in Step 3. Locate transmission on flywheel housing.
6. Align drive plate to flywheel and transmission to flywheel housing guide studs. Install transmission to flywheel housing screws. Tighten screws to specified torque. Remove transmission to engine guide studs. Install remaining screws and tighten to specified torque.
7. *Remove drive plate locating stud.
8. Install drive plate attaching screw and washer. Snug screw but **do not tighten**. Some engine flywheel housings have a hole located on the flywheel housing circumference in line with the drive plate screw access hole. A screwdriver or pry bar used to hold the drive plate against the flywheel will facilitate installation of the drive plate screws. Rotate the engine flywheel and install the remaining seven (7) flywheel to drive plate attaching screws. Snug screws but **do not tighten**. After all eight (8) screws are installed, tighten each capscrew to 26-29 lbs. ft. (35-39 N•m). This will require tightening each screw and rotating the engine flywheel until the full amount of eight (8) screws have been tightened to specified torque.
9. Measure engine crankshaft end play after transmission has been completely installed on engine flywheel. This value must be within 0.001” [0.025 mm] of the end play recorded in Step 2.
10. Axial force acting on flywheel is continuous 940 N / intermittent 1885 N.
11. Hose line operating requirements: Pressure lines suitable for operating from ambient to 120°C continuous operating temperature, must withstand 25 bar continuous pressure, with 50 bar intermittent surges. Reference SAE spec J-517, 100RI hydraulic hose specification. All hose lines used must be conform to SAE spec J-1019 tests and procedures for high temperature transmission oil hose. All hose lines and fitting have a 19 mm inside diameter unless noted.

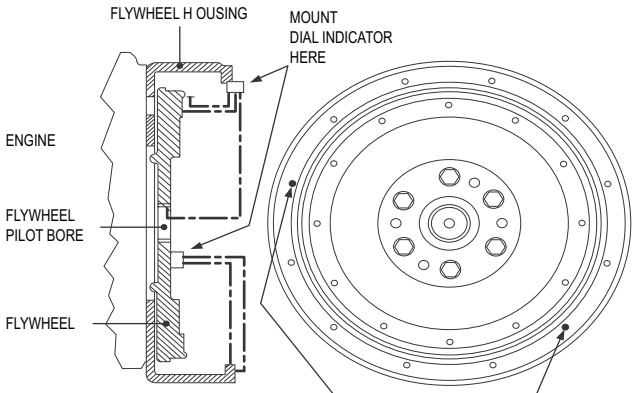
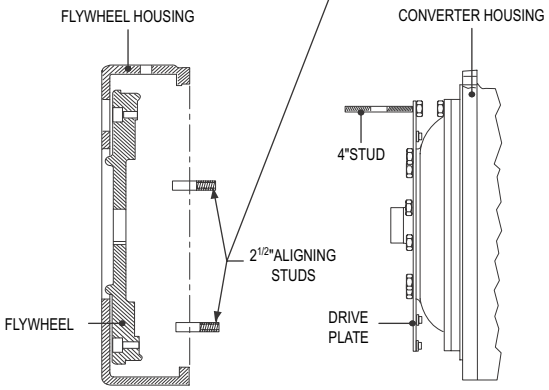


FIG. 1



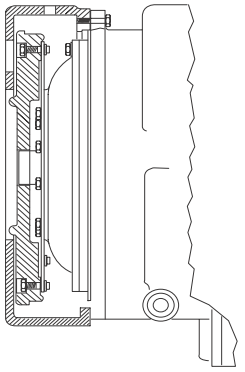


FIG. 3

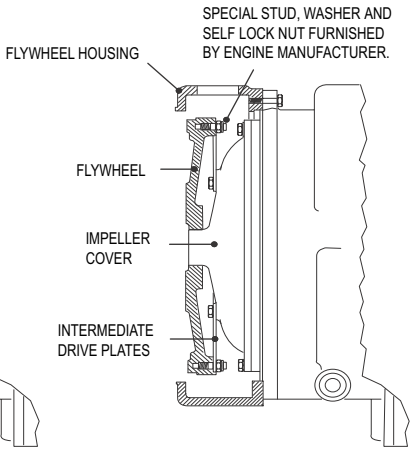


FIG.4

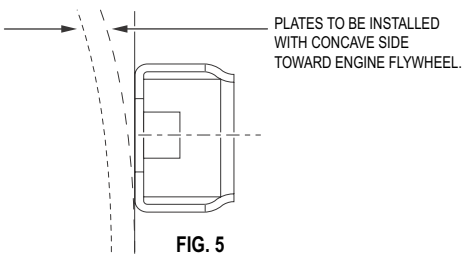


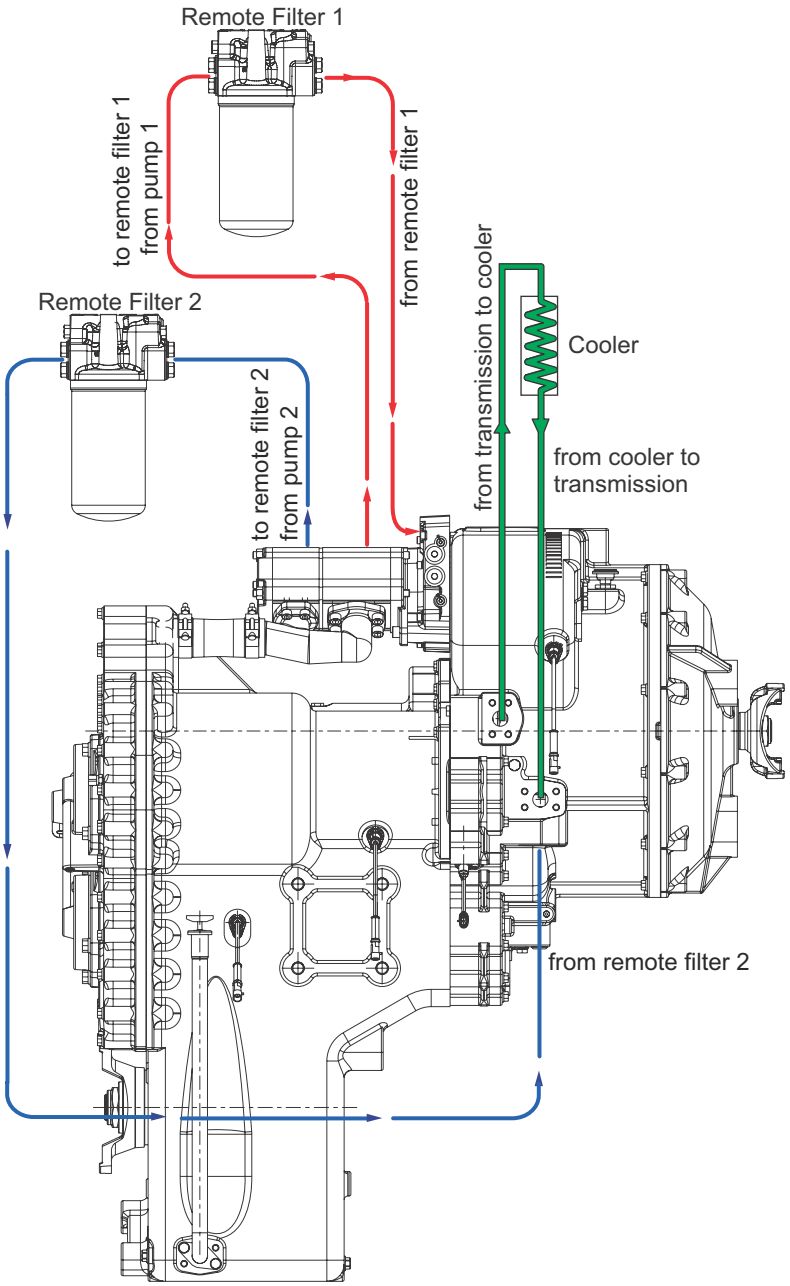
FIG. 5

* *Does not apply to units having 3 intermediate drive plates. See Figure 4.*

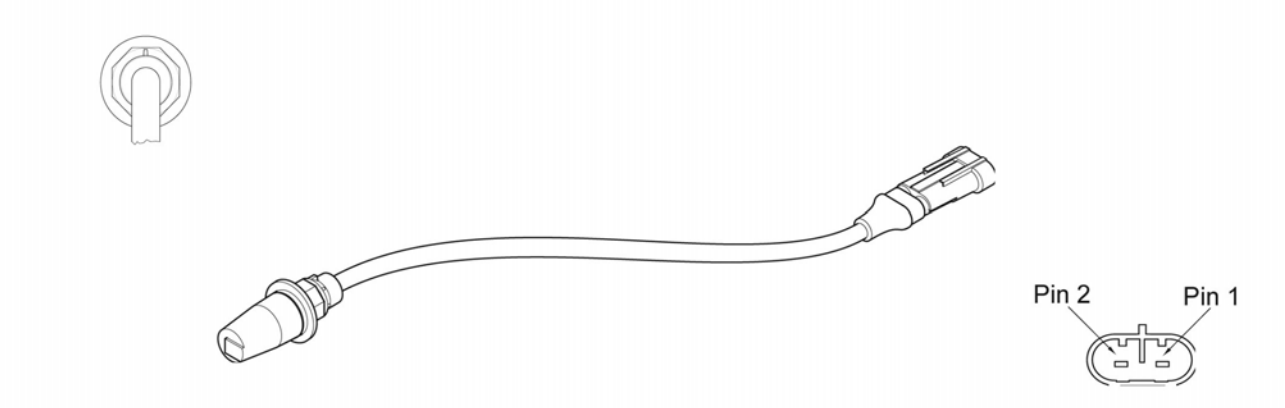
EXTERNAL PLUMBING INSTALLATION

Cooler & Filter Line Specifications

- Minimum 1" [25.4 mm] internal diameter for lines and fittings.
- Suitable for operation from ambient to 248°F [120°C] continuous operating temperature.
- Must withstand 435 PSI [30 bar] continuous pressure and with 652 PSI [40 bar] intermittent surges.
- Conforms SAE J1019 and SAE J517,100RI.



SPEED SENSOR INSTALLATION



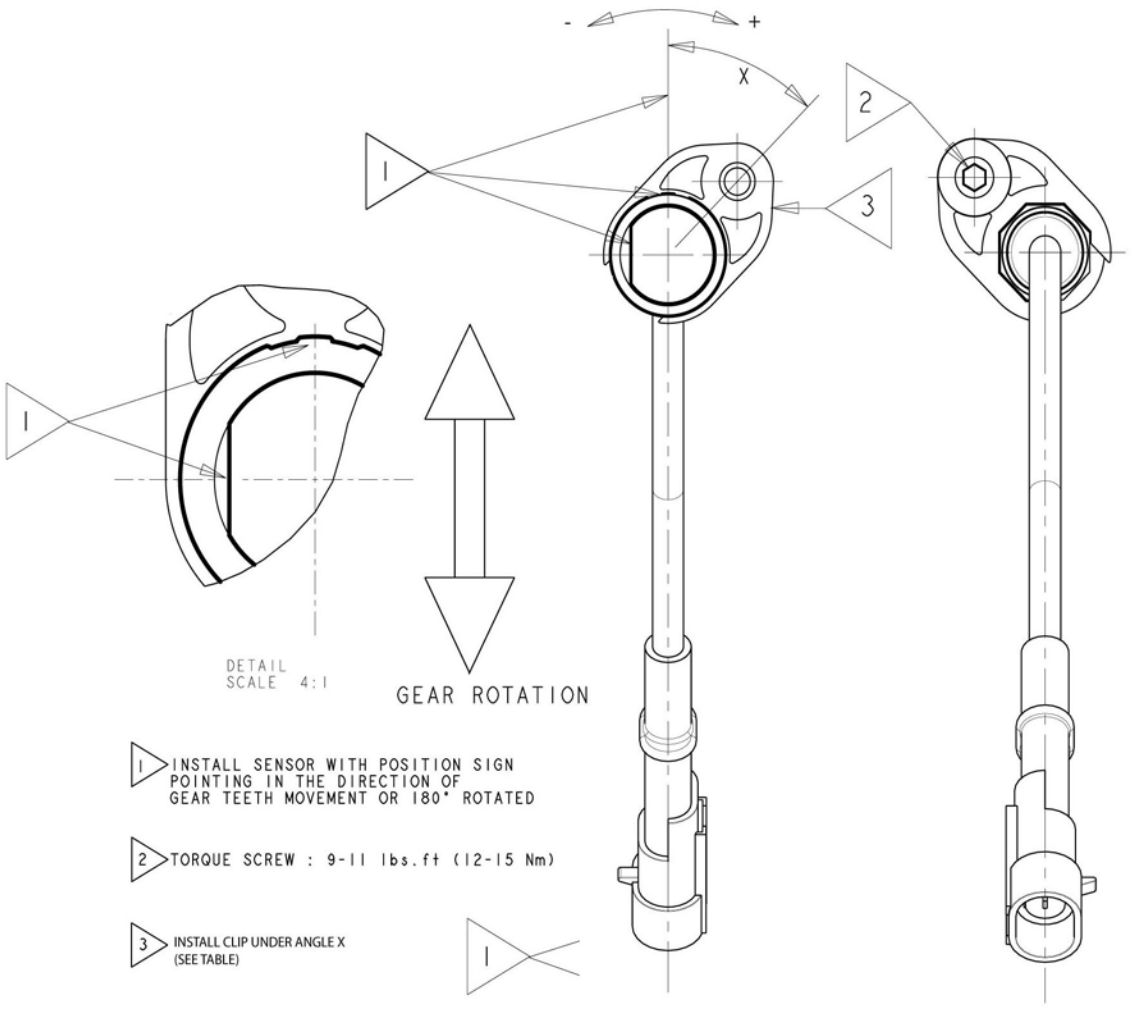
The magneto resistive sensor generates a square wave current with a fixed amplitude changing between 7 mA and 14 mA. The sensor has an integrated AMP superseal 2-pin connector. The two pins are numbered 1 and 2.

The following table shows the relation between wire color, pin number and connection.

Pin / Color	Function	Connection
1 / Brown	Current Input	Hot Wire
2 / Blue	Current Output	Ground Wire

⚠CAUTION

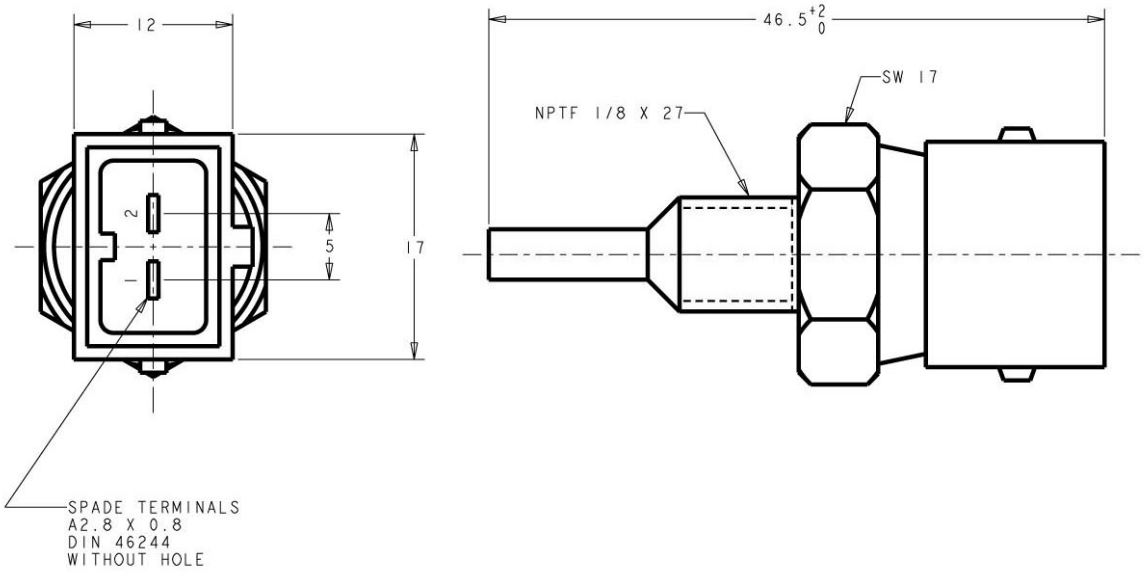
The sensor wires have a polarity. Be sure to correctly observe sensor polarities as wrong connections will deactivate the sensor!



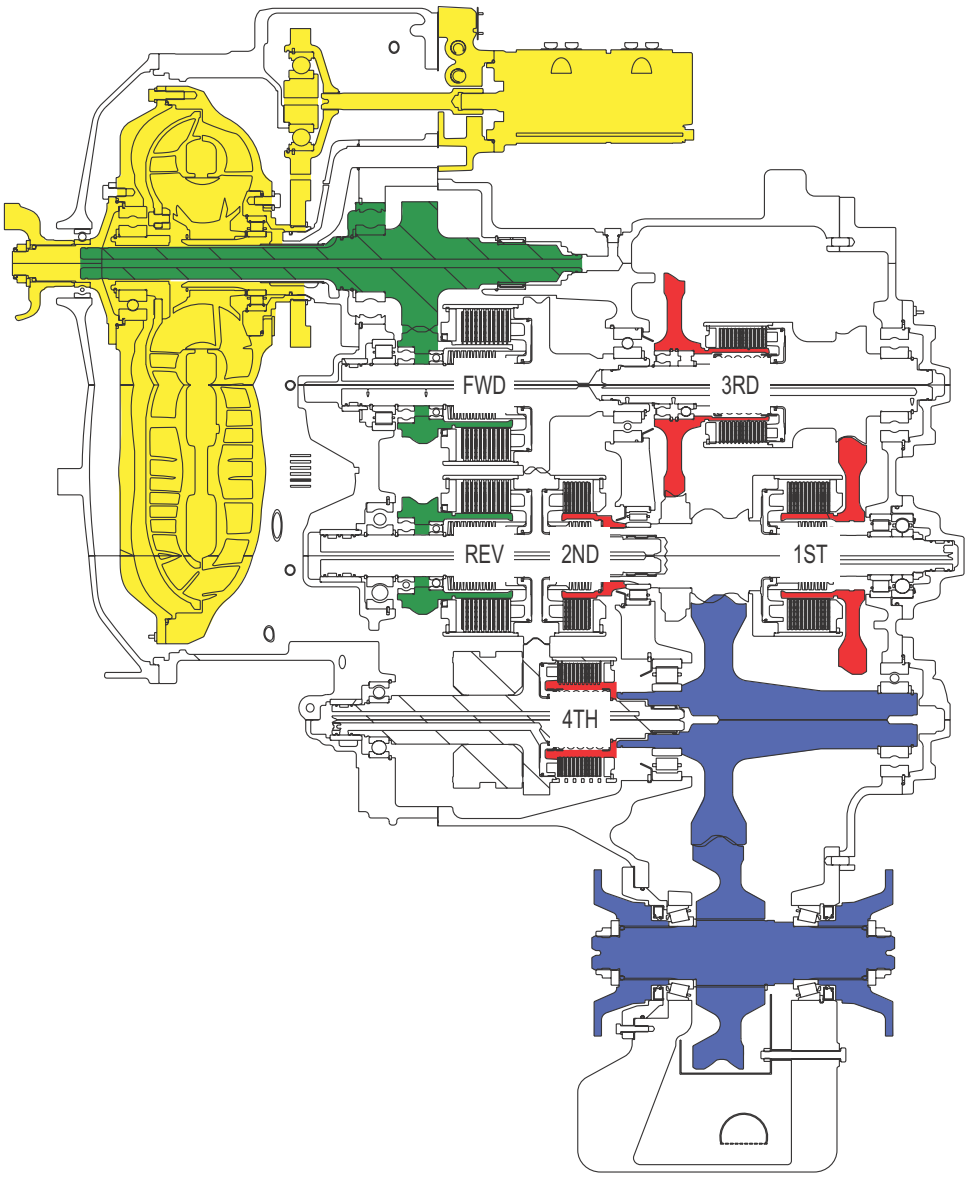
TRANSMISSION MODEL	ASSY Partnr	CONNECTOR	TYPE	X POSITION
TE27/32	4209752	AMP 2 Pins	Engine Speed	180 Degrees
	4209752	AMP 2 Pins	Drum Speed	180 Degrees
	4209750	AMP 2 pins	Output Speed	180 Degrees
	4209751	AMP 2 Pins	Turbine Speed	-90 Degrees

TEMPERATURE SENSOR INSTALLATION

MATERIAL:
STAINLESS STEEL HOUSING
BSS303 (equiv DIN 1.4305)



TRANSMISSION OPERATION



The transmission is composed of five main assemblies:

- Converter, pump drive section and pressure regulating valve
- Input shaft and directional clutches
- Range clutches
- Output section

Converter, Pump Drive, & Pressure Regulating Valve

Engine power is transmitted from the engine flywheel to the impeller through the impeller cover.

This element is the pump portion of the hydraulic torque converter and is the primary component which starts the oil flowing to the other components which results in torque multiplication. This element can be compared to a centrifugal pump that picks up fluid at its center and discharges it at the outer diameter.

The torque converter turbine is mounted opposite the impeller and is connected to the turbine shaft of the torque converter. This element receives fluid at its outer diameter and discharges it at its center.

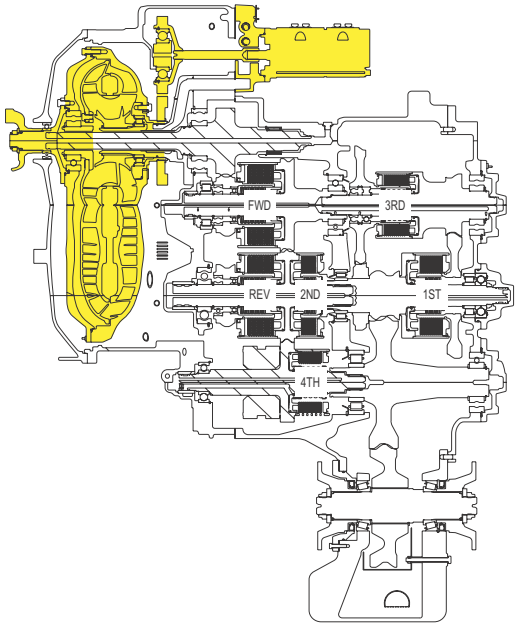
The reaction member of the torque converter is located between and at the center of the inner diameters of the impeller and turbine elements. Its function is to take the fluid which is exhausting from the inner portion of the turbine and change its direction to allow correct entry for recirculation into the impeller element.

This recirculation will make the converter to multiply torque.

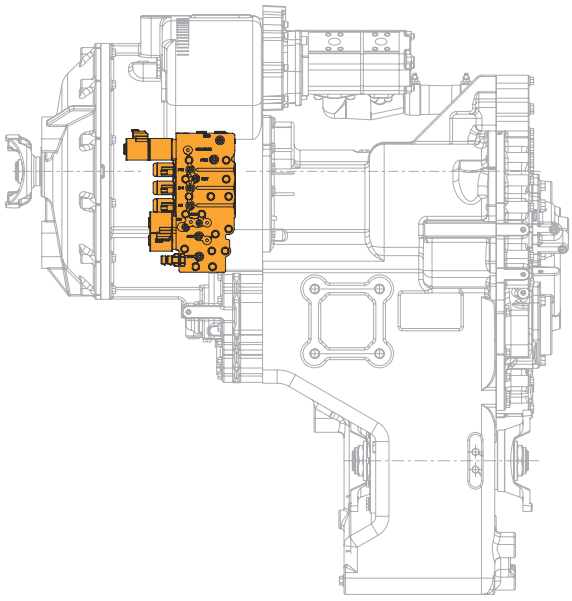
The torque multiplication is a function of the blading (impeller, turbine and reaction member) and the converter output speed (turbine speed). The converter will multiply engine torque to its designed maximum multiplication ratio when the turbine shaft is at zero RPM (stall).

Therefore, we can say that as the turbine shaft is decreasing in speed, the torque multiplication is increasing.

The hydraulic pump is connected with the pump drive gear. This pump drive gear is driven by the impeller hub gear. Since the impeller hub gear is connected with the impeller cover, the pump speed is directly related to engine speed.



CONVERTER SECTION



CONTROL VALVE

Input Shaft and Directional Clutches

The turbine shaft driven from the turbine transmits power to the directional clutches (fwd/rev).

These clutches consist of a drum with internal splines and a bore to receive a hydraulic actuated piston.

The piston is oil-tight by the use of sealing rings. The steel discs with internal splines, and friction discs with external splines, are alternated until the required total is achieved.

A back-up plate is then inserted and secured with a retainer ring. A hub with outer diameter splines is inserted into the splines of discs with teeth on the inner diameter. The discs and hub are free to increase in speed or rotate in the opposite direction as long as no pressure is present in that specific clutch.

To engage the clutch, the solenoid will direct oil under pressure through tubes and passages to the selected clutch shafts.

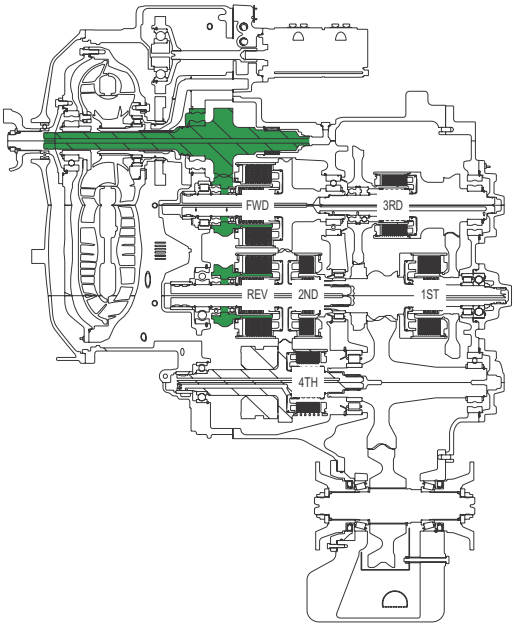
Oil sealing rings are located on the clutch shafts. These rings direct the oil through a drilled passage in the shaft to the desired clutch.

Pressure of the oil forces the piston and discs against the back-up plate. The discs with splines on the outer diameter clamping against discs with teeth on the inner diameter enables the drum and hub to be locked together and allows them to drive as one unit.

When the clutch is released, a return spring will push the piston back and oil will drain back via the shift spool, the bleed hole or holes in the clutch piston into the transmission sump.

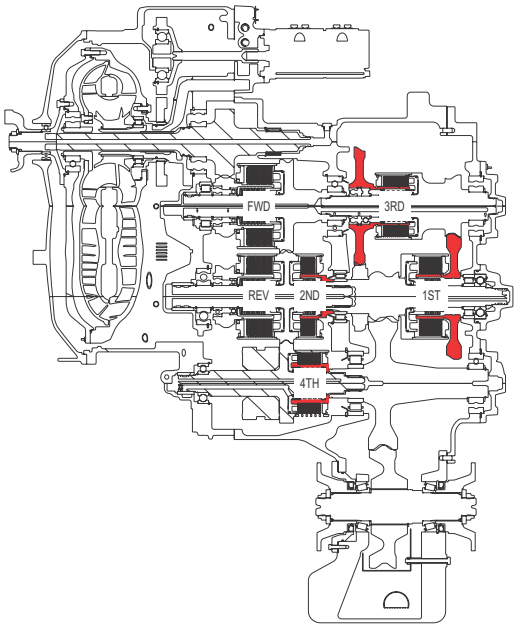
These bleed holes will only allow quick escape of oil when the pressure to the piston is released.

The engagement of all range and directional clutches is modulated and electronically controlled. This means that clutch pressure is built up gradually. This will enable the unit to make forward, reverse shifts while the vehicle is still moving and will allow smooth engagement of drive.



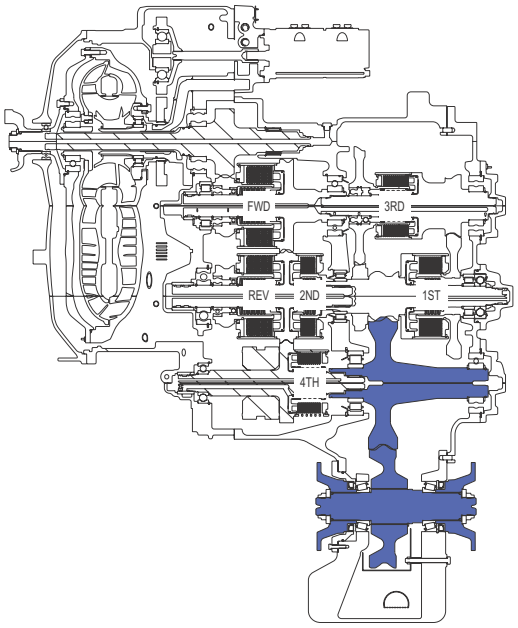
Range Clutches

Once a directional clutch is engaged, power is transmitted to the range clutches. Operation and actuation of the directional clutches is similar to the range clutches. The engagement of the directional clutches is modulated. For the 1st clutch assembly, there is an extra bleed hole to allow full drain when the pressure to the piston is released.



Output Section

With a range clutch engaged, power is finally transmitted to the output shaft. Output rotation is the same to input rotation when the forward clutch is engaged.



Transmission Controls

Refer to the Hydraulic Diagrams starting on page 24.

The transmission is controlled by a TCON ECU. This unit has a microprocessor that receives certain inputs (gear selector position, speed senors, etc.) which are processed and will give output signals to the control valve.

Operation of the Valve

Regulated pressure 319–377 PSI [22–26 bar] is directed to the proportional valve and selector valves to activate the clutches required.

When activated the proportional valve will give an output pressure curve from 0–26 bar proportional to a current from 0 mA to 1000mA. Dampers are used to dampen any hydraulic vibration.

Directional Selection

When a direction (forward or reverse) is selected, the required selector valve is activated for forward or reverse and the proportional valve will provide a pressure rise from 0 to 26 bar feeding the directional clutch with modulated pressure.

Range Selection

When 1st clutch is selected, the 1st/3rd selector valve is activated and the 1st/3rd proportional valve will provide a pressure rise from 0 to 26 bar feeding the 1st clutch with modulated pressure.

When 2nd clutch is selected, the 2nd/4th selector valve is activated, the 1st/3rd proportional valve will decrease pressure from 26 to 0 bar, thus releasing the 1st clutch in a controlled manner. At the same time the 2nd/4th proportional valve is activated and will provide a pressure curve from 0 to 26 bar, which will provide clutch overlap.

When the shift is finalized, the 1st/3rd selector valve is deactivated.

When 3rd clutch is selected, the 3rd/1st selector valve is not activated. The 2nd/4th proportional valve will decrease pressure from 26 to 0 bar, thus releasing the 2nd clutch in a controlled manner. At the same time the 1st/3rd proportional valve is activated and will provide a pressure curve from 0 to 26 bar, which will provide clutch overlap.

When the shift is finalized the 2nd/4th selector valve is deactivated.

When 4th clutch is selected, the 2nd/4th selector valve is not activated. The 1st/3rd proportional valve will decrease pressure from 26 to 0 bar, thus releasing the 3rd clutch in a controlled manner. At the same time, the 2nd/4th proportional valve is activated and will provide a pressure curve from 0 to 26 bar, which will provide clutch overlap.

Restriction Plug

The pressure line is connected to the drain line via a restricted hole. This ensures the drain line to remain air free at all times and guarantees the reliable functioning of the proportional valves.

Pressure Sensor

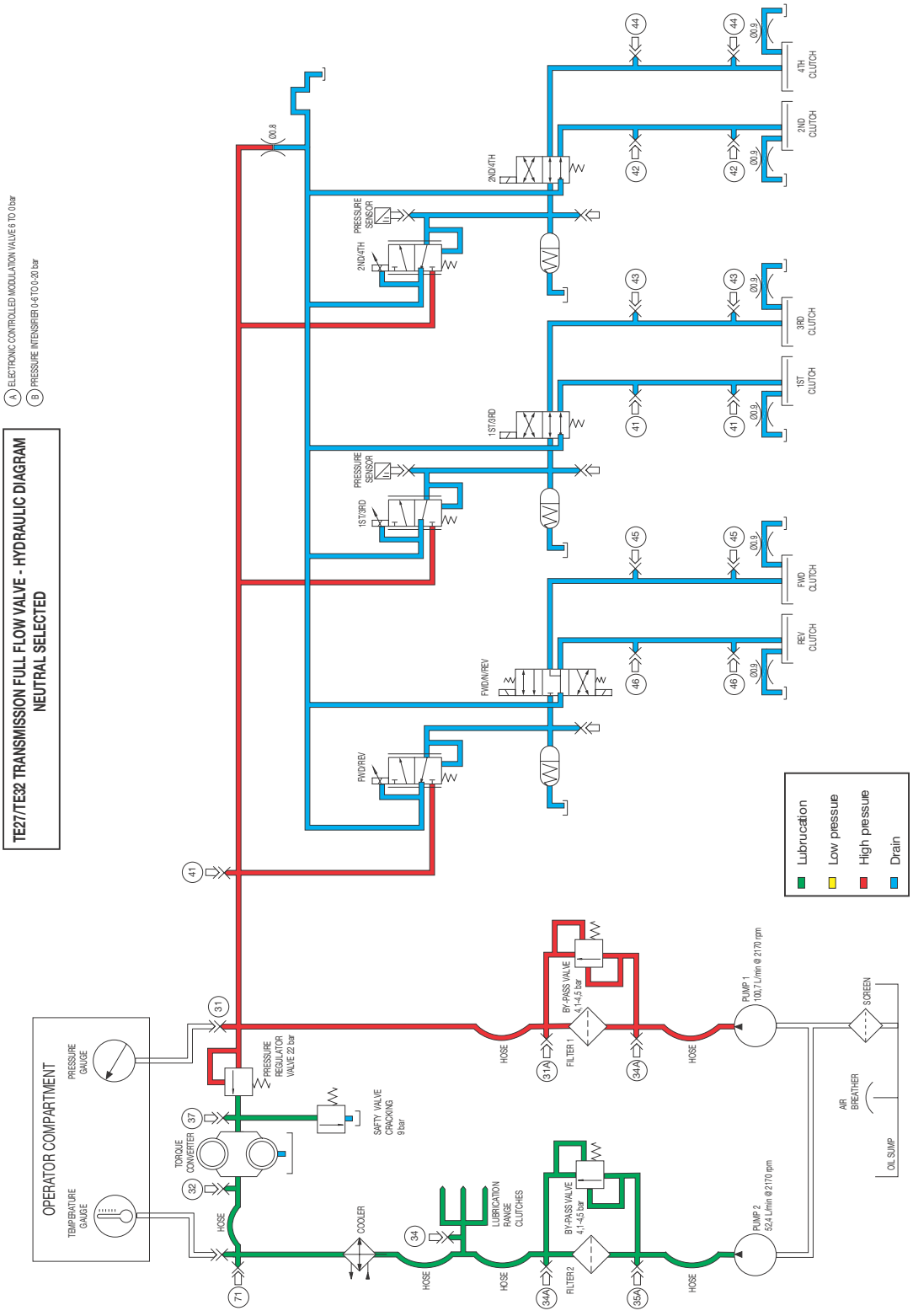
The control valve also has a pressure sensor installed to monitor overlap on range clutches.

Electric Solenoid Controls

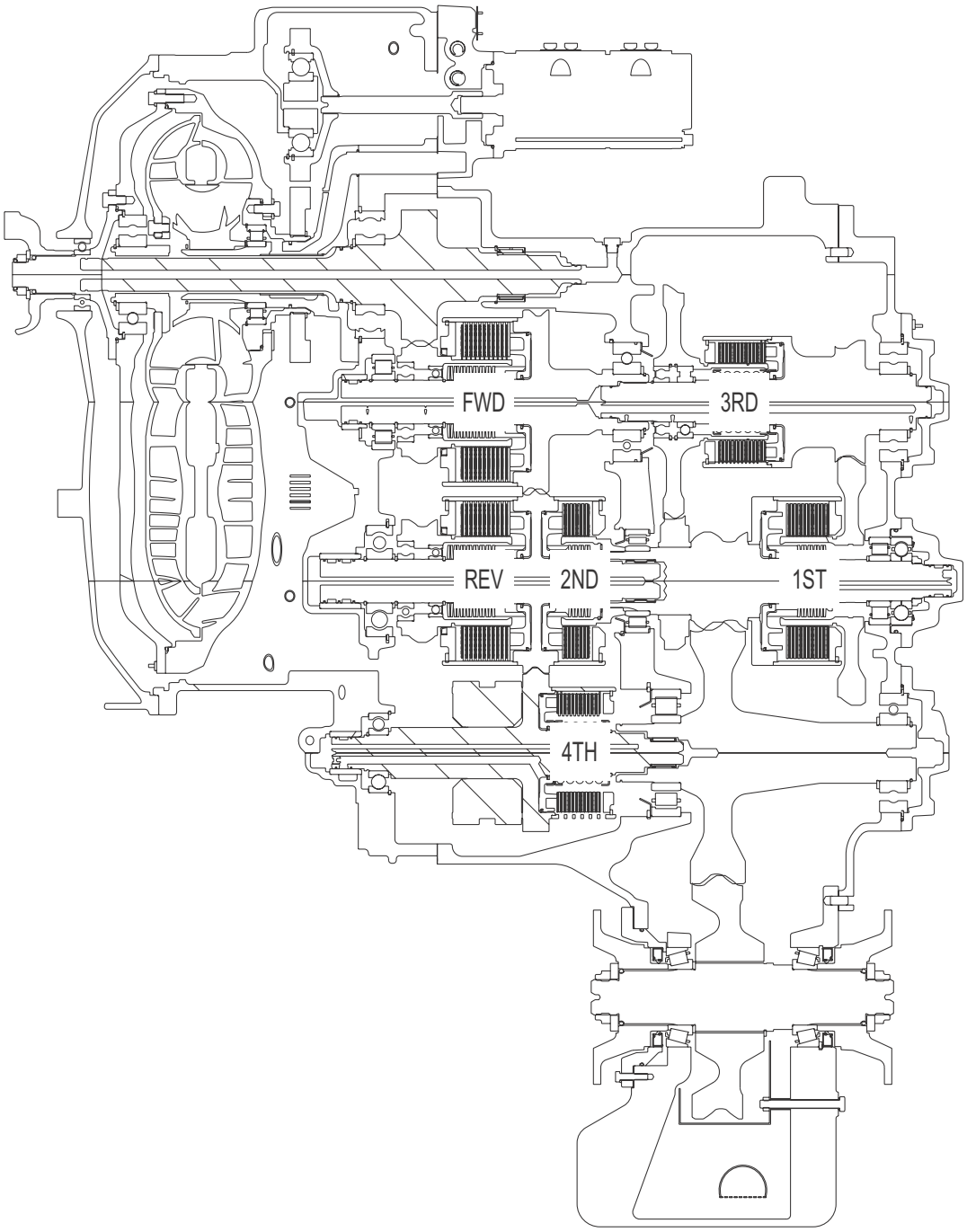
Transmission Gear	Activated Selector Valve	Activated Proportional Valve	Activated Clutches
Forward 4	FWD	FWD/REV, 2nd/4th	Forward, 4th
Forward 3	FWD	FWD/REV, 1st/3rd	Forward, 3rd
Forward 2	FWD, 2nd/4th	FWD/REV, 2nd/4th	Forward, 2nd
Forward 1	FWD, 1st/3rd	FWD/REV, 1st/3rd	Forward, 1st
Neutral 4		2nd/4th	4th
Neutral 3		1st/3rd	3rd
Neutral 2	2nd/4th	2nd/4th	2nd
Neutral 1	1st/3rd	1st/3rd	1st
Reverse 4	REV	FWD/REV, 2nd/4th	Reverse, 4th
Reverse 3	REV	FWD/REV, 1st/3rd	Reverse, 3rd
Reverse 2	REV, 2nd/4th	FWD/REV, 2nd/4th	Reverse, 2nd
Reverse 1	REV, 1st/3rd	FWD/REV, 1st/3rd	Reverse, 1st

Power Flows, Activated Solenoids, and Hydraulic Circuits

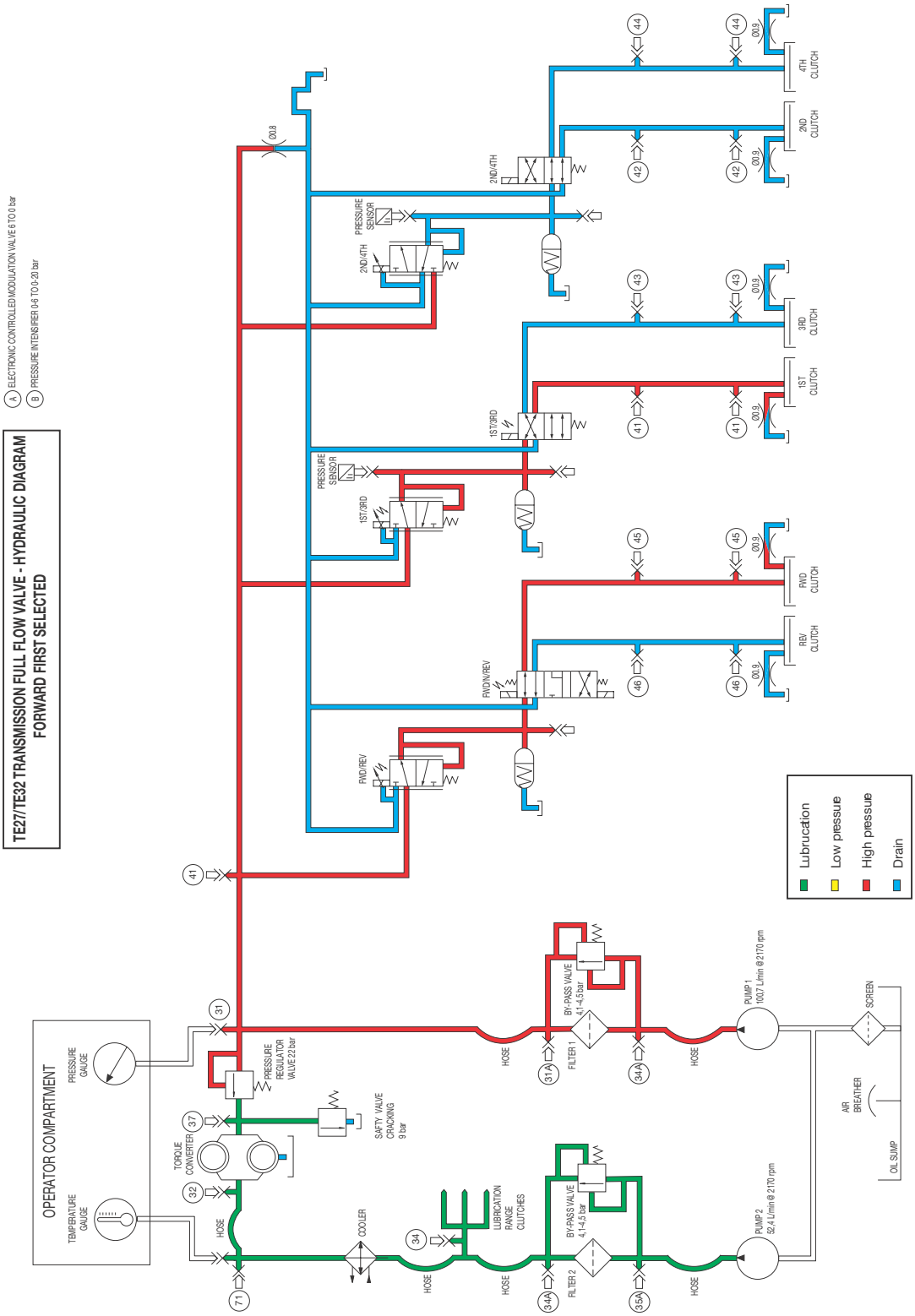
Neutral Selected



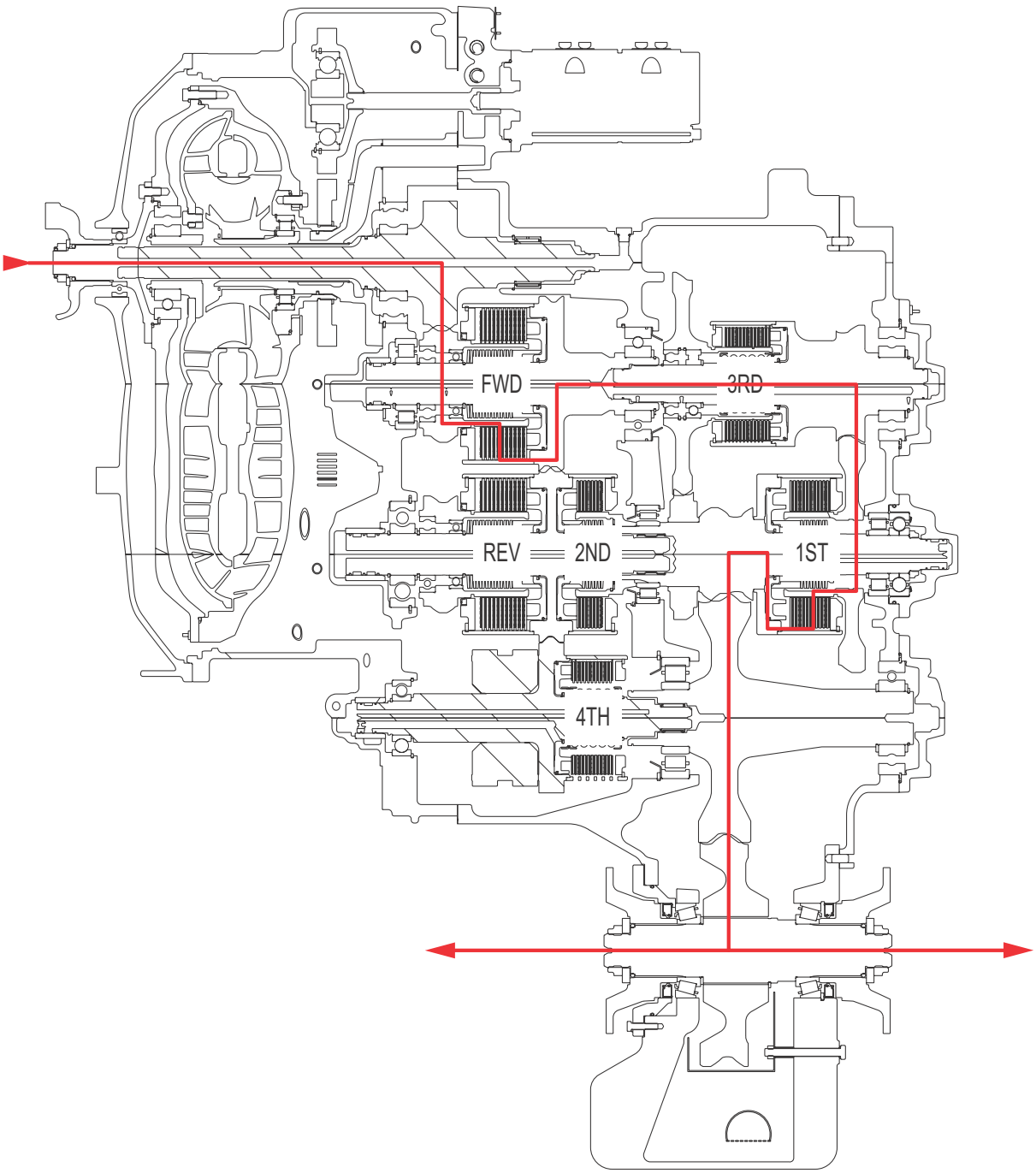
Neutral (Continued)



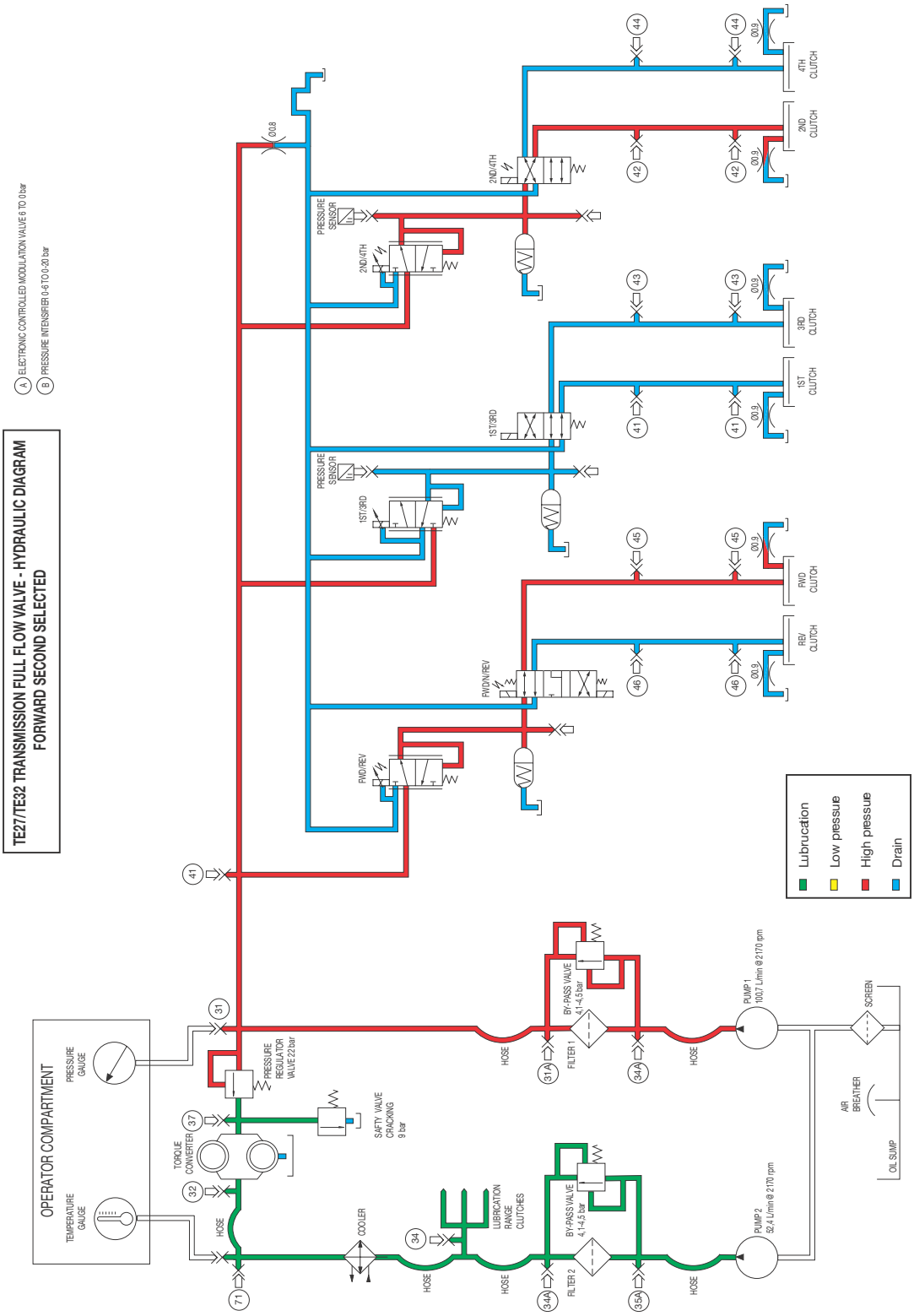
Forward 1st Speed



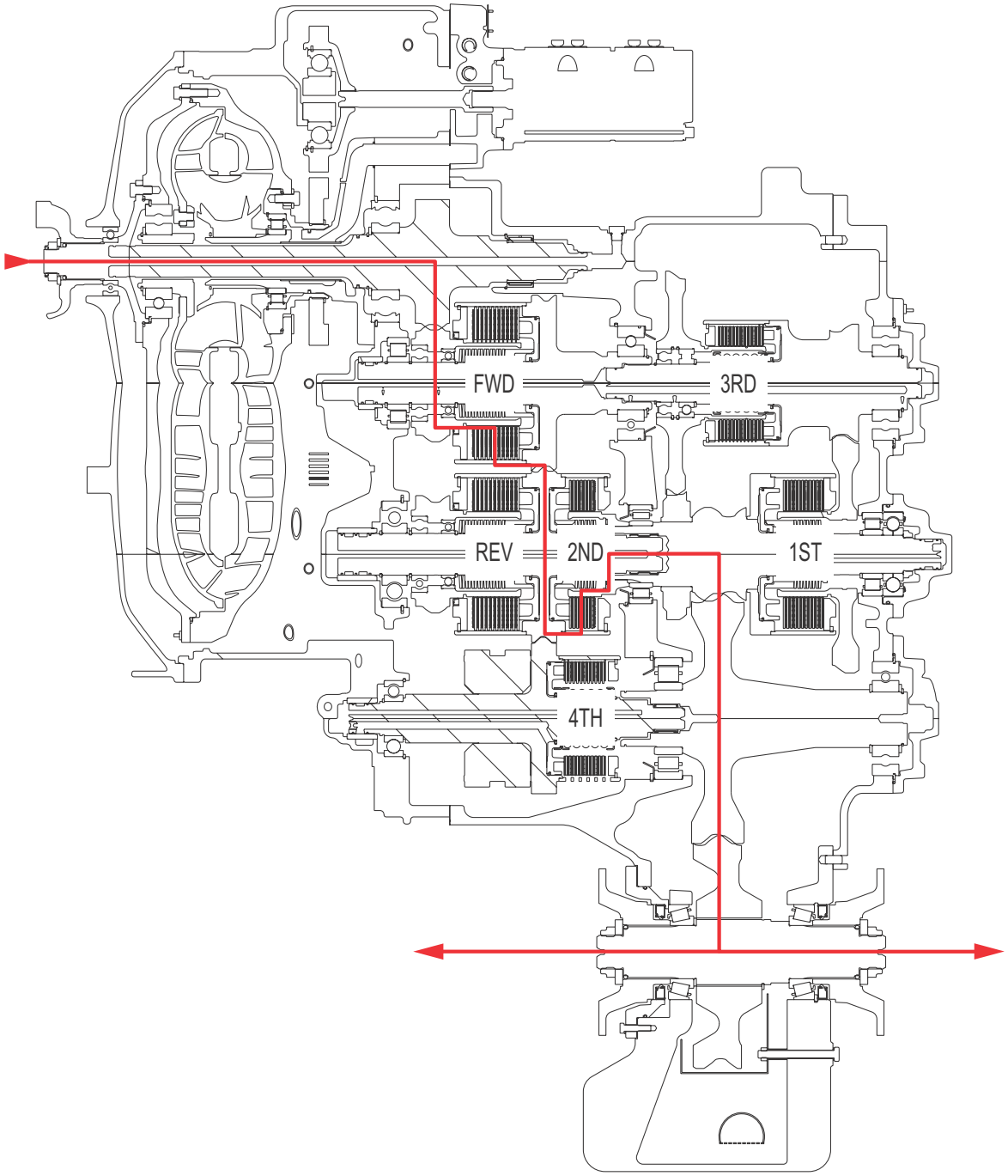
Forward 1st Speed (Continued)



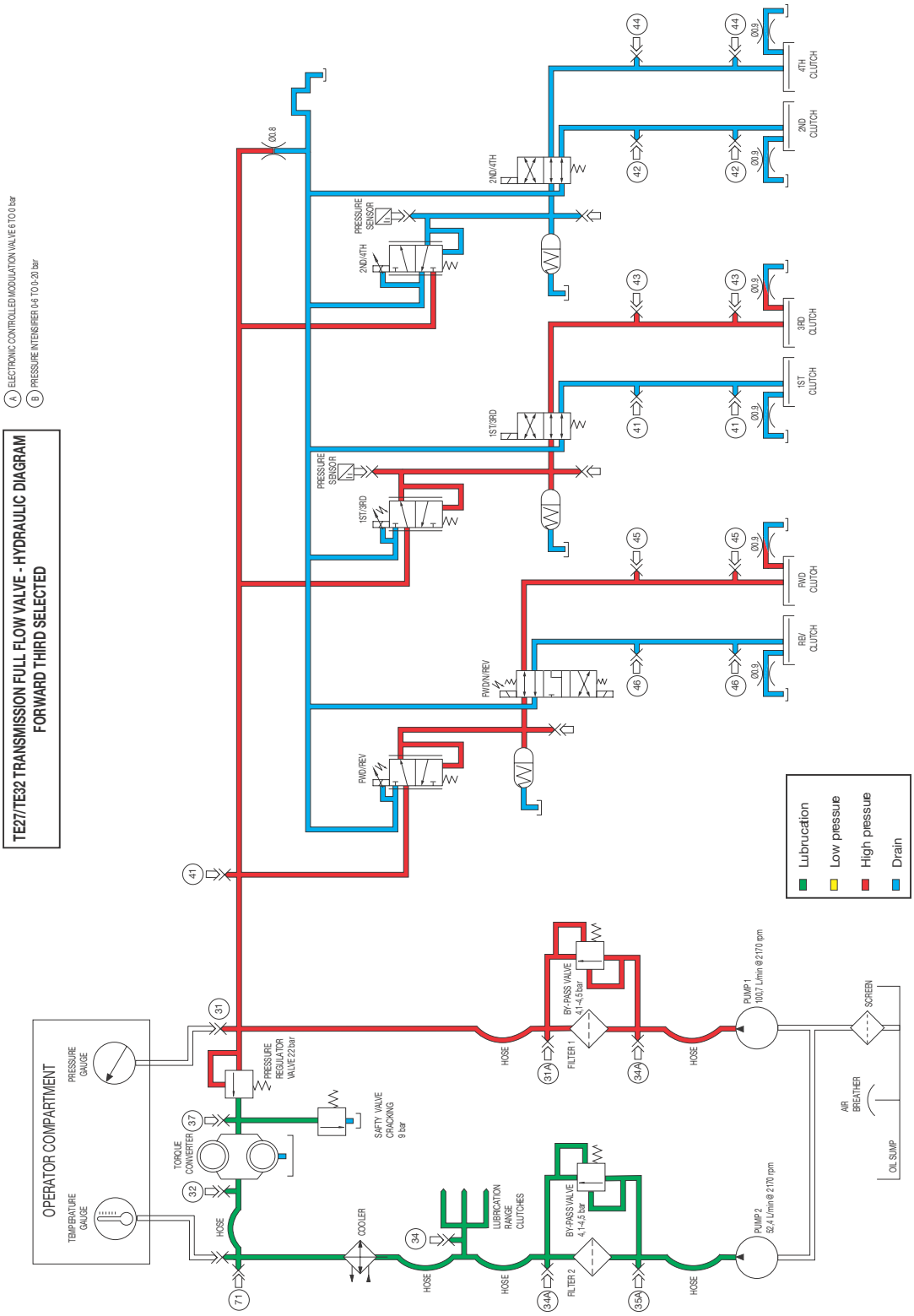
Forward 2nd Speed



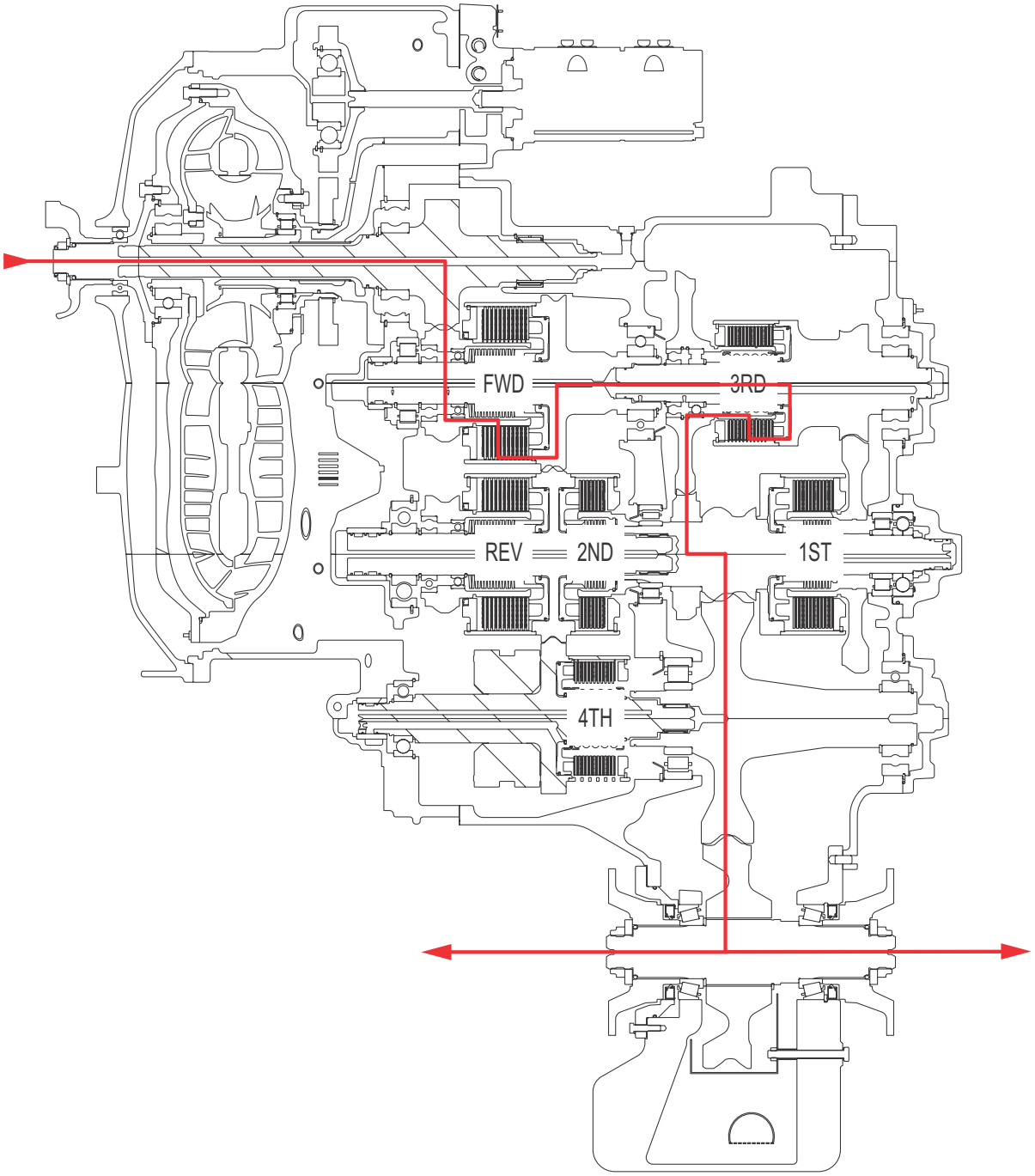
Forward 2nd Speed (Continued)



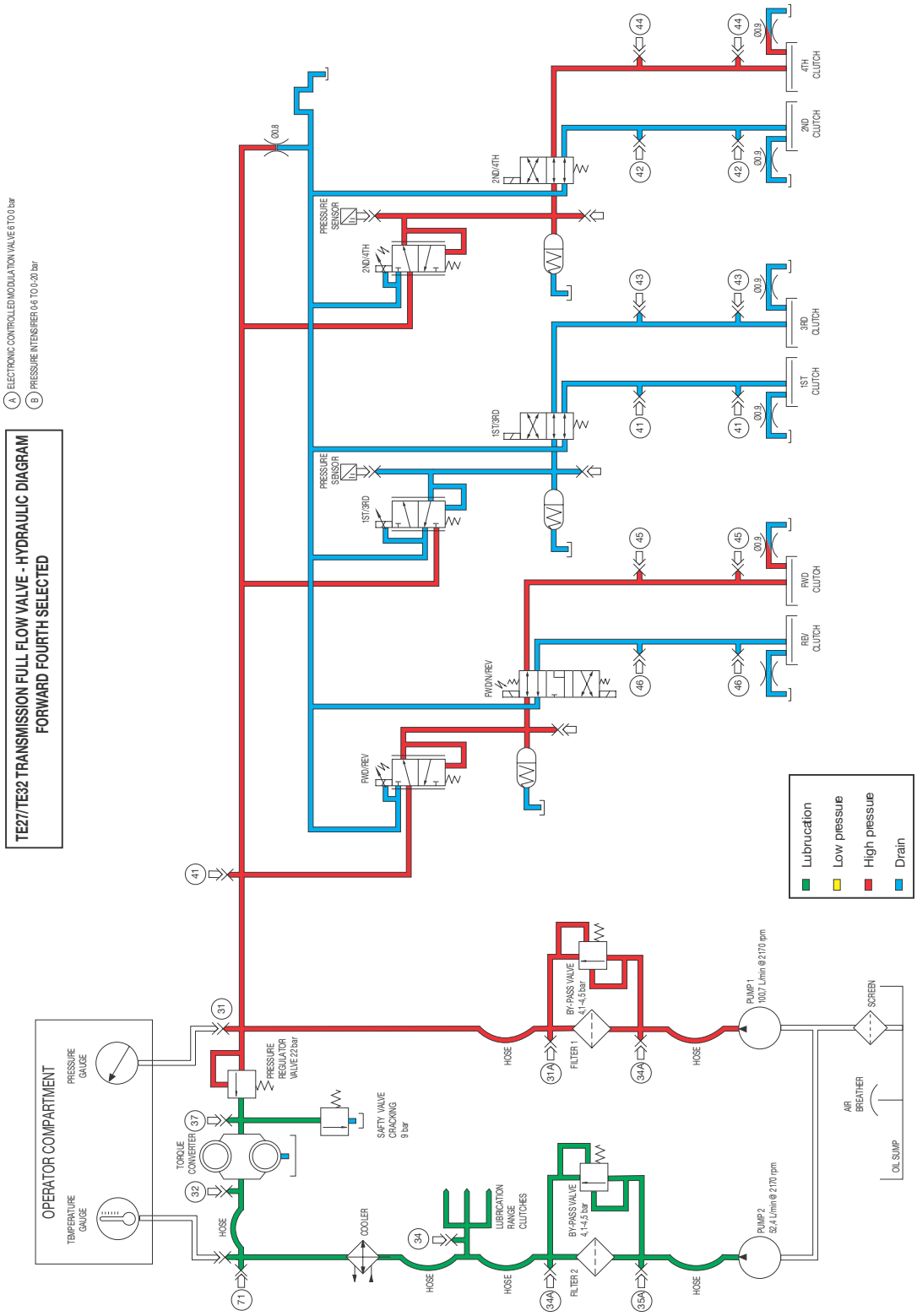
Forward 3rd Speed



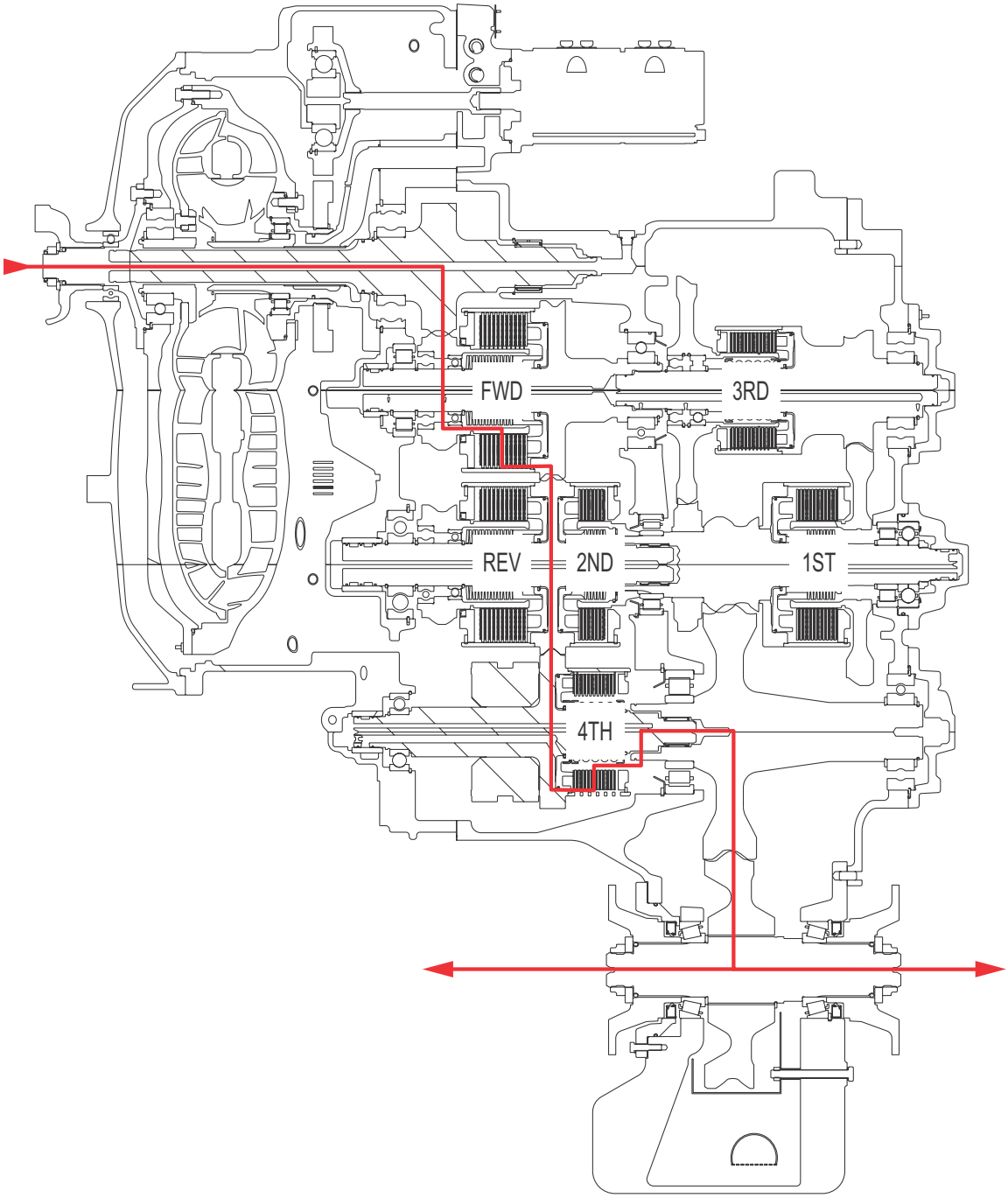
Forward 3rd Speed (Continued)



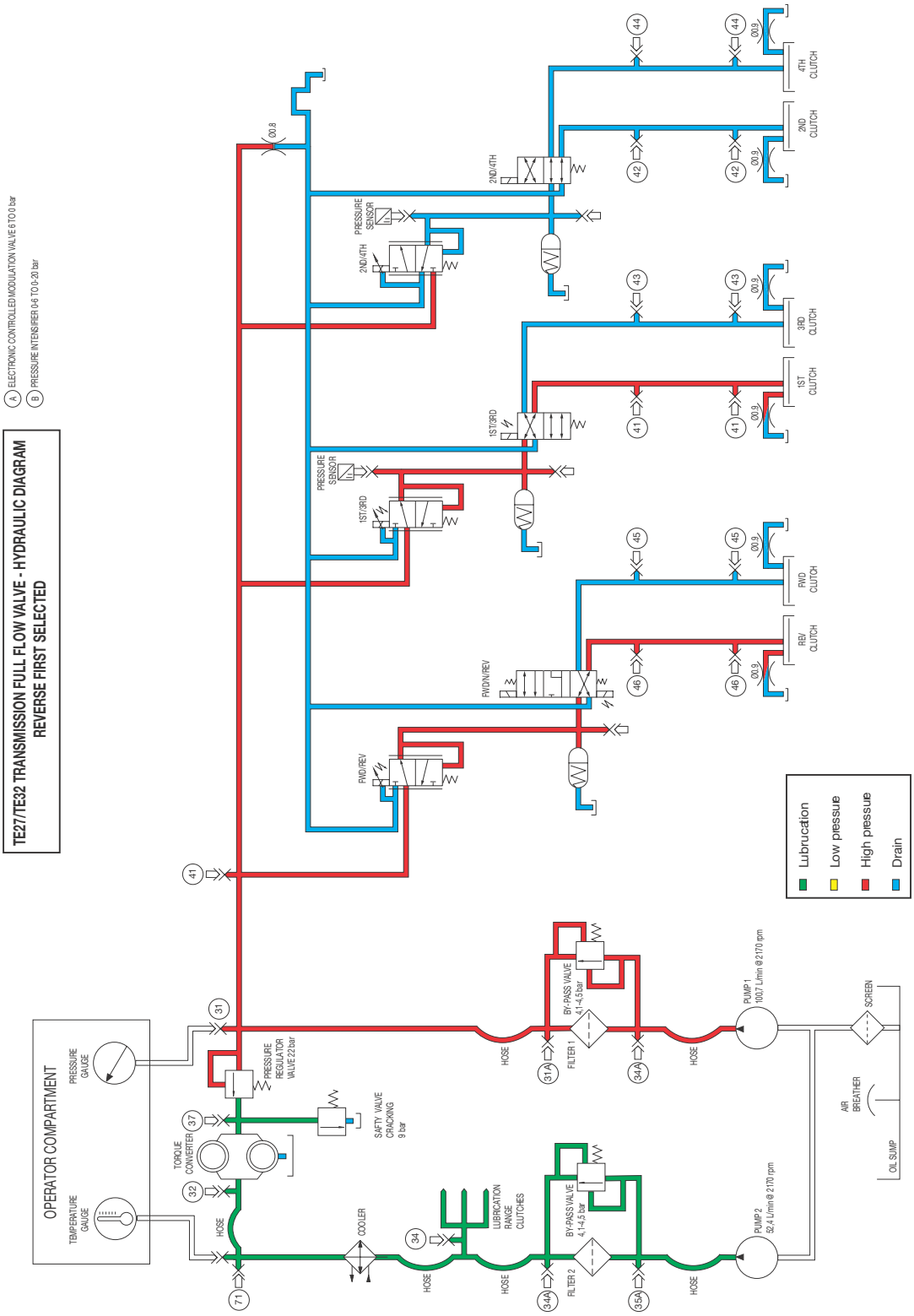
Forward 4th Speed



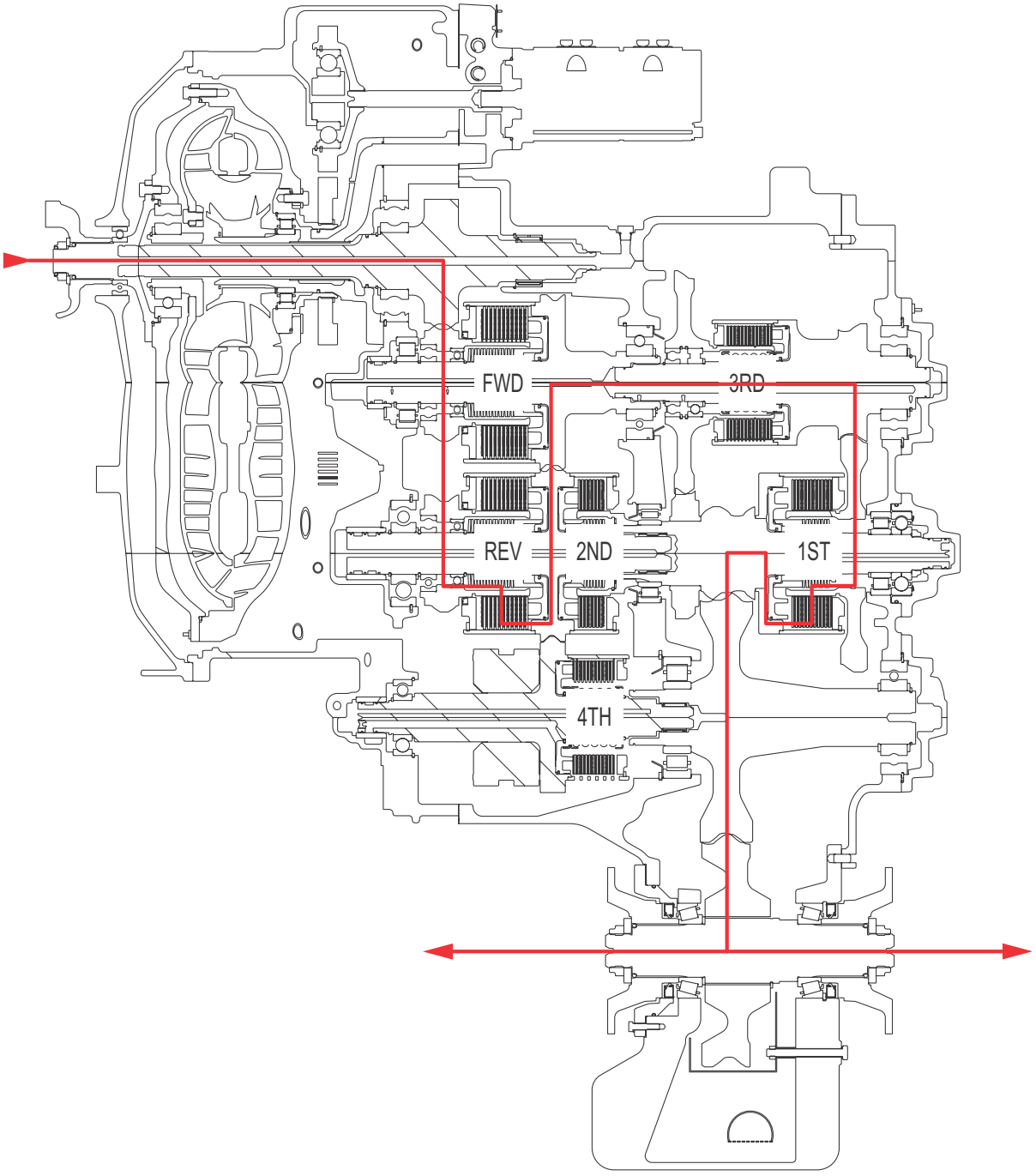
Forward 4th Speed (Continued)



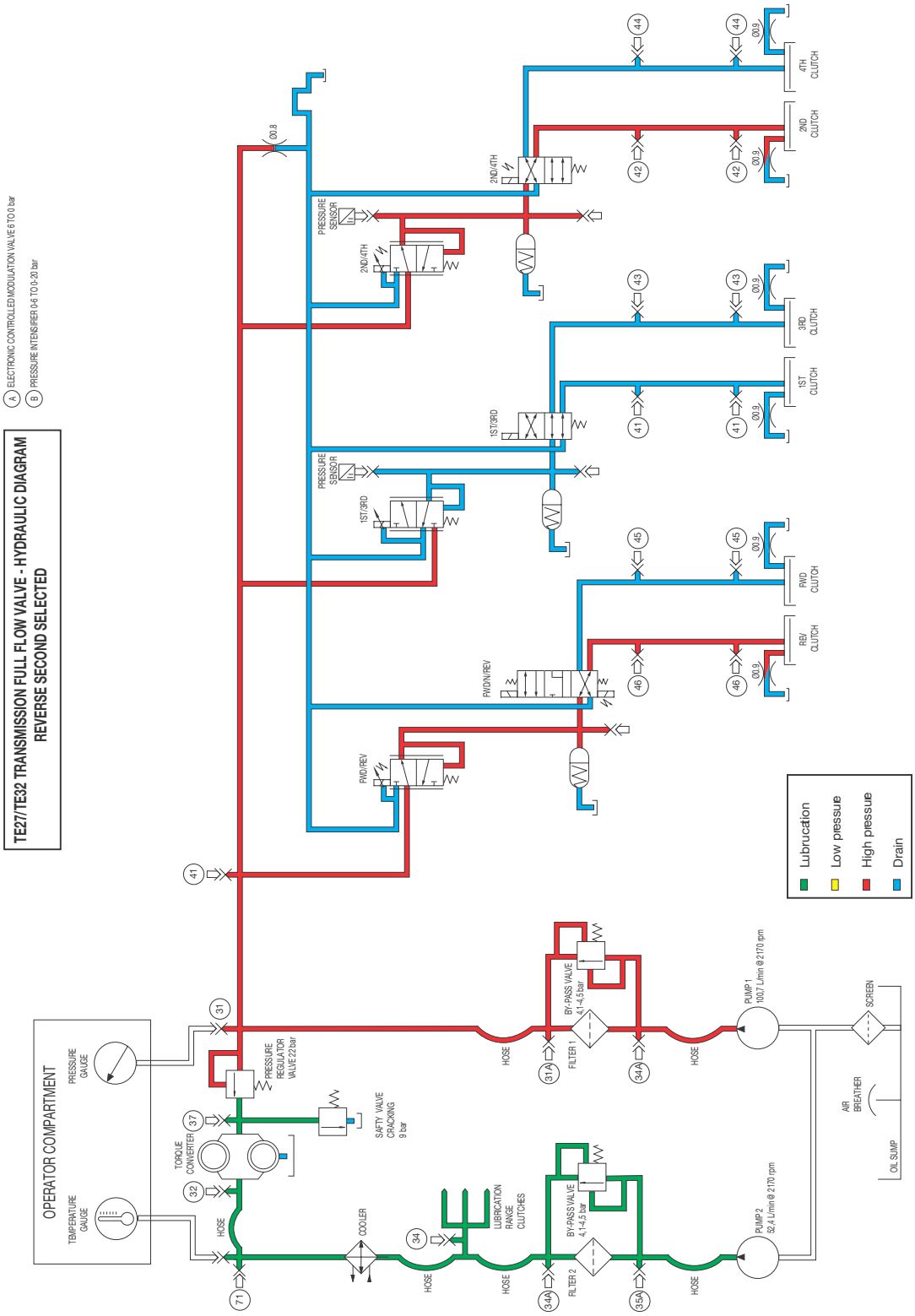
Reverse 1st Speed



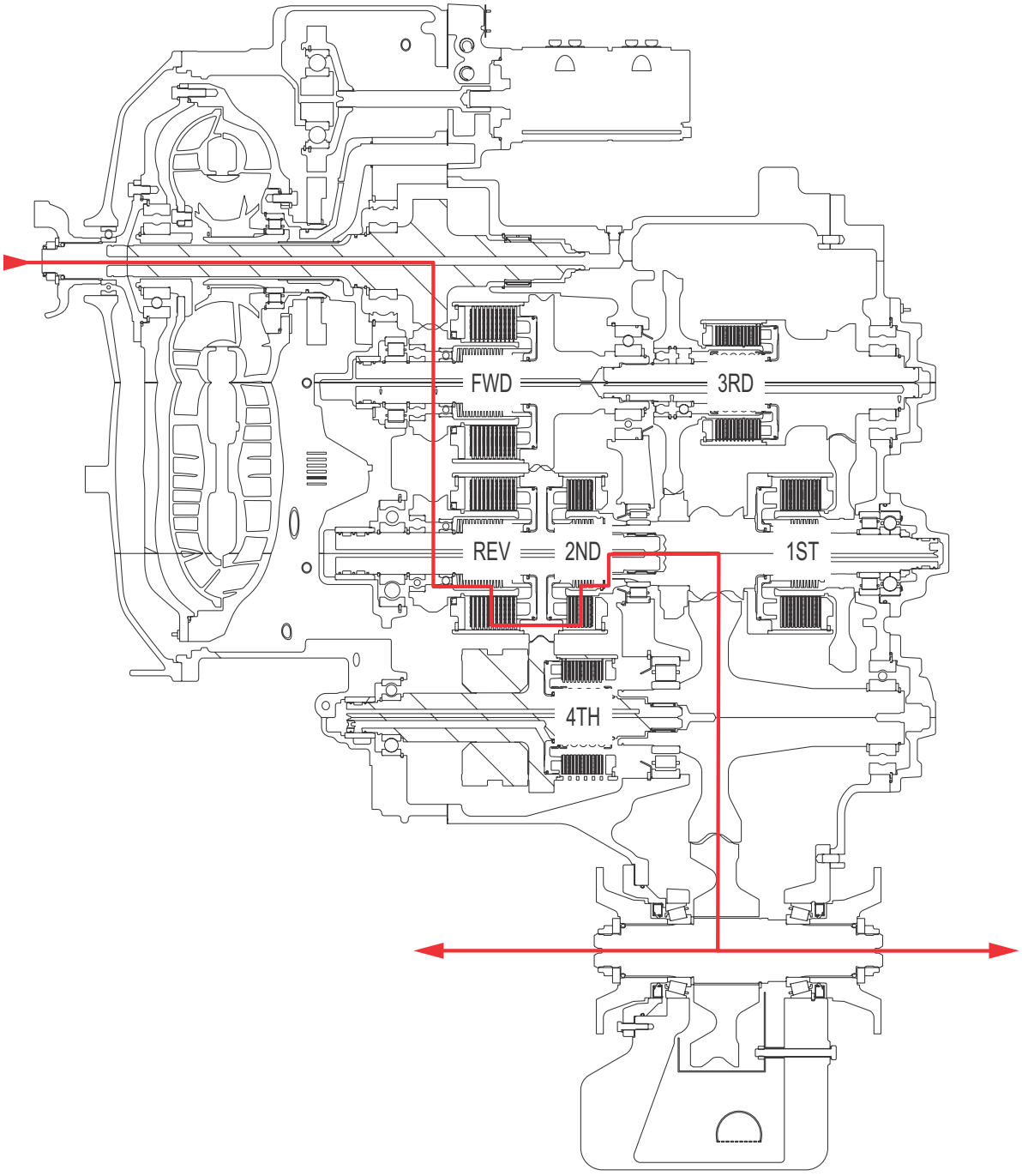
Reverse 1st Speed (Continued)



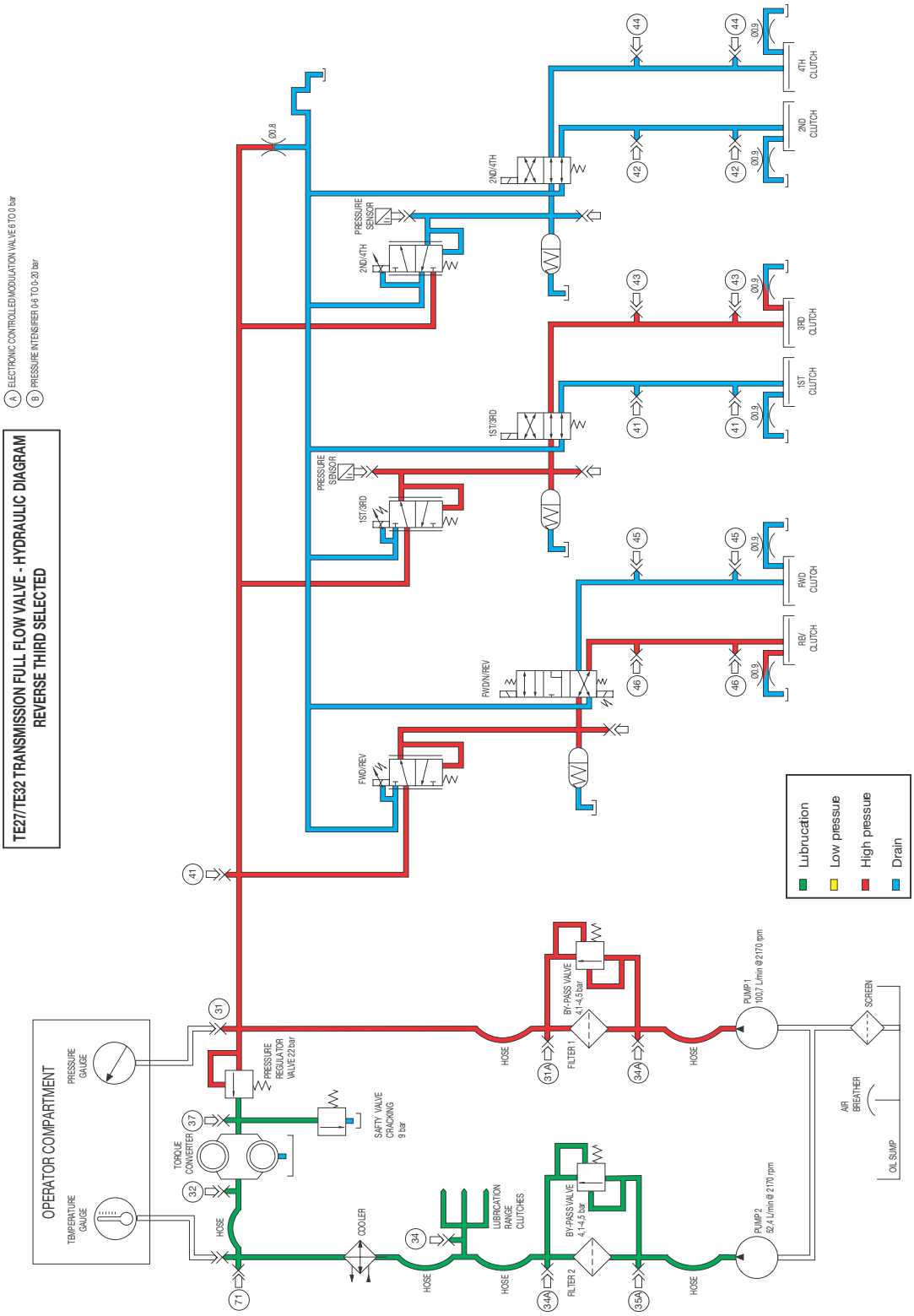
Reverse 2nd Speed



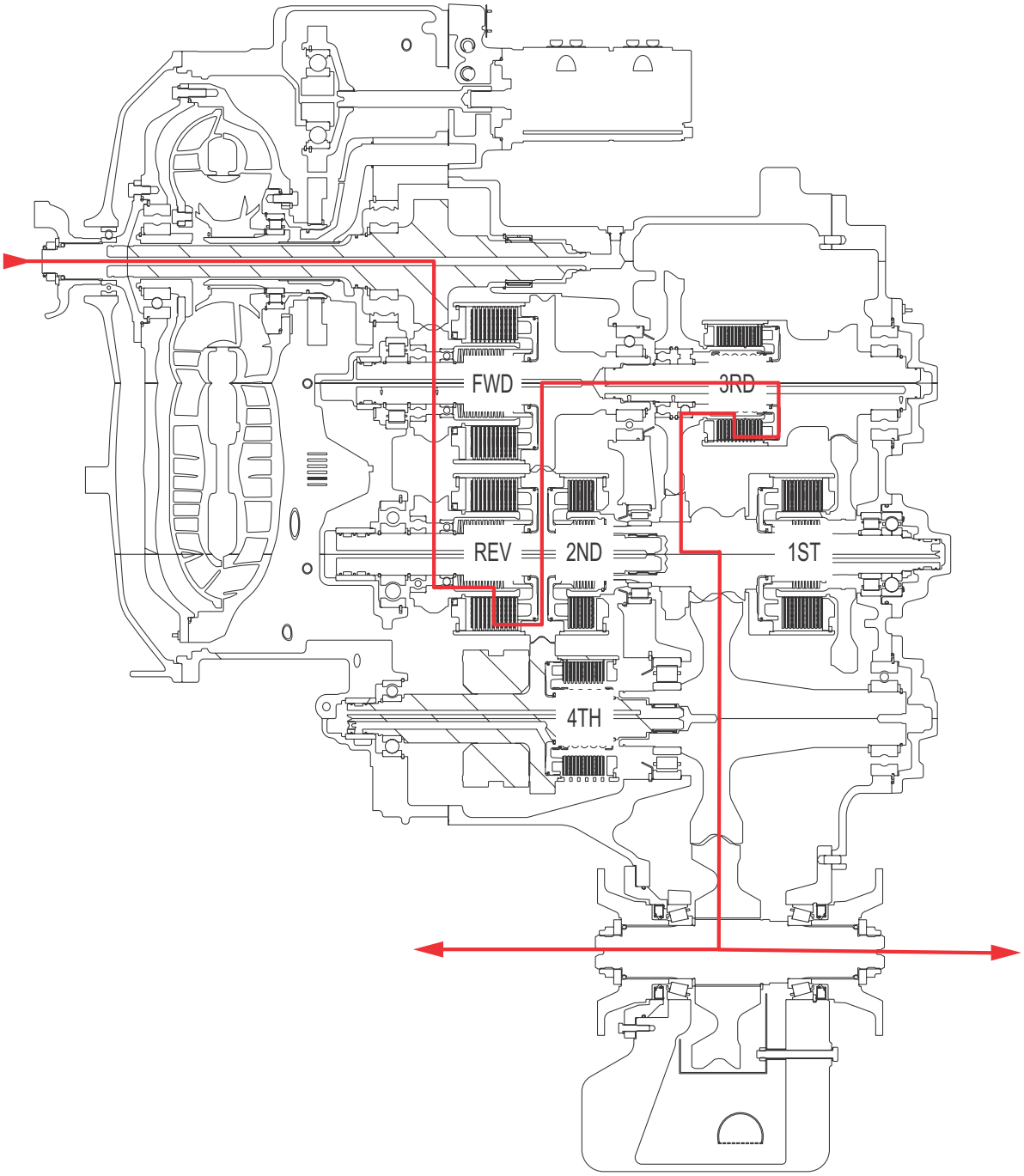
Reverse 2nd Speed (Continued)



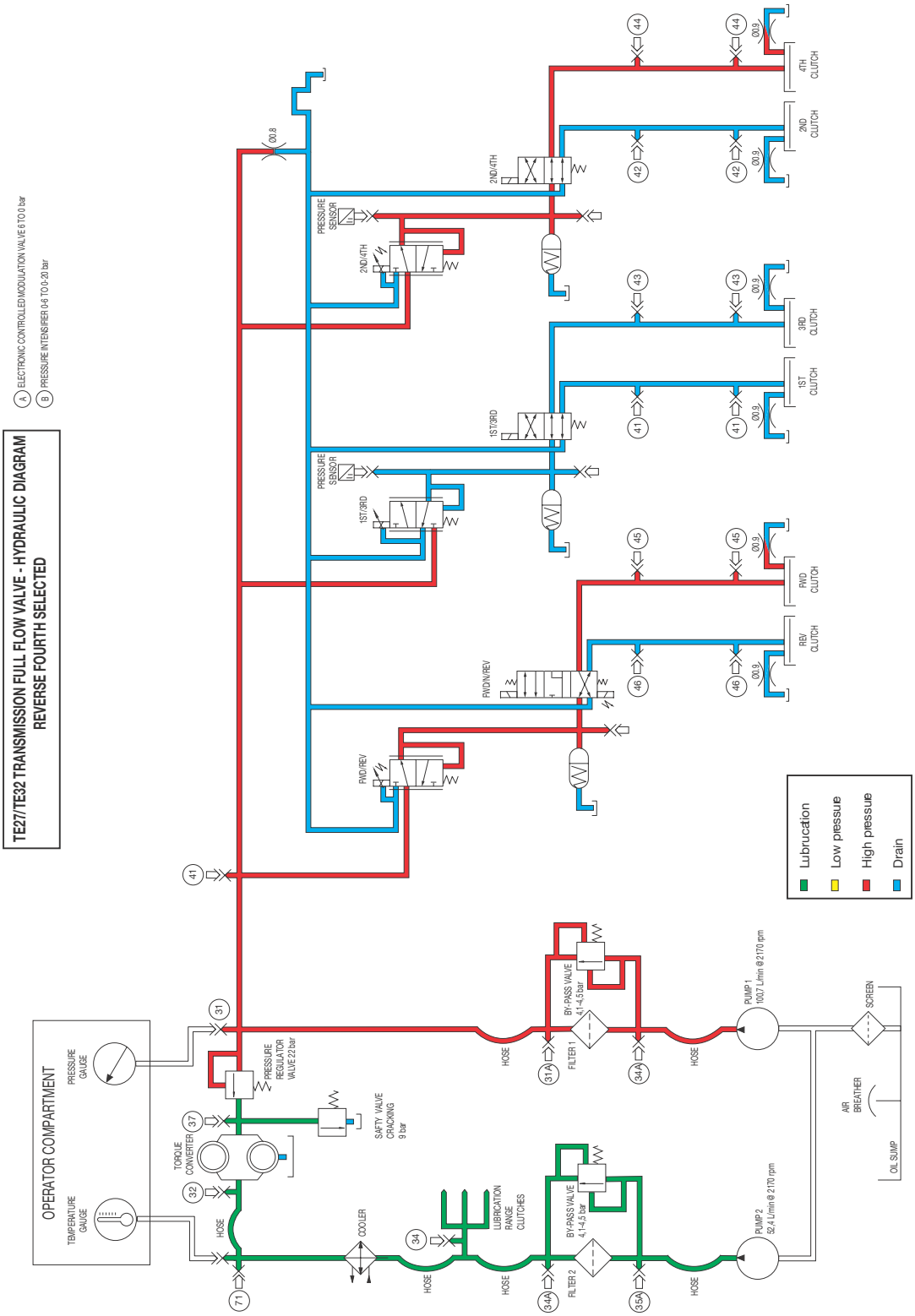
Reverse 3rd Speed



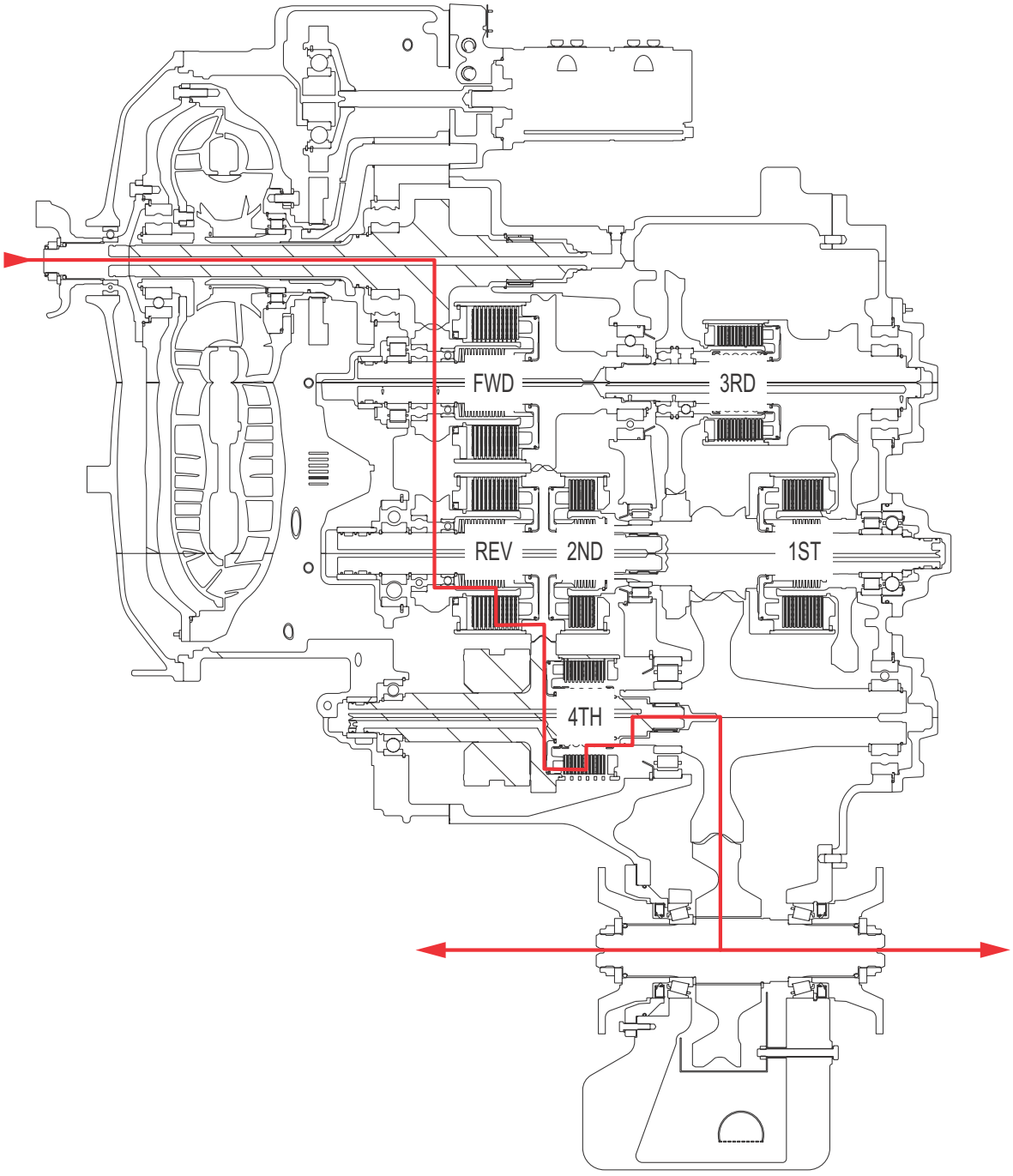
Reverse 3rd Speed (Continued)



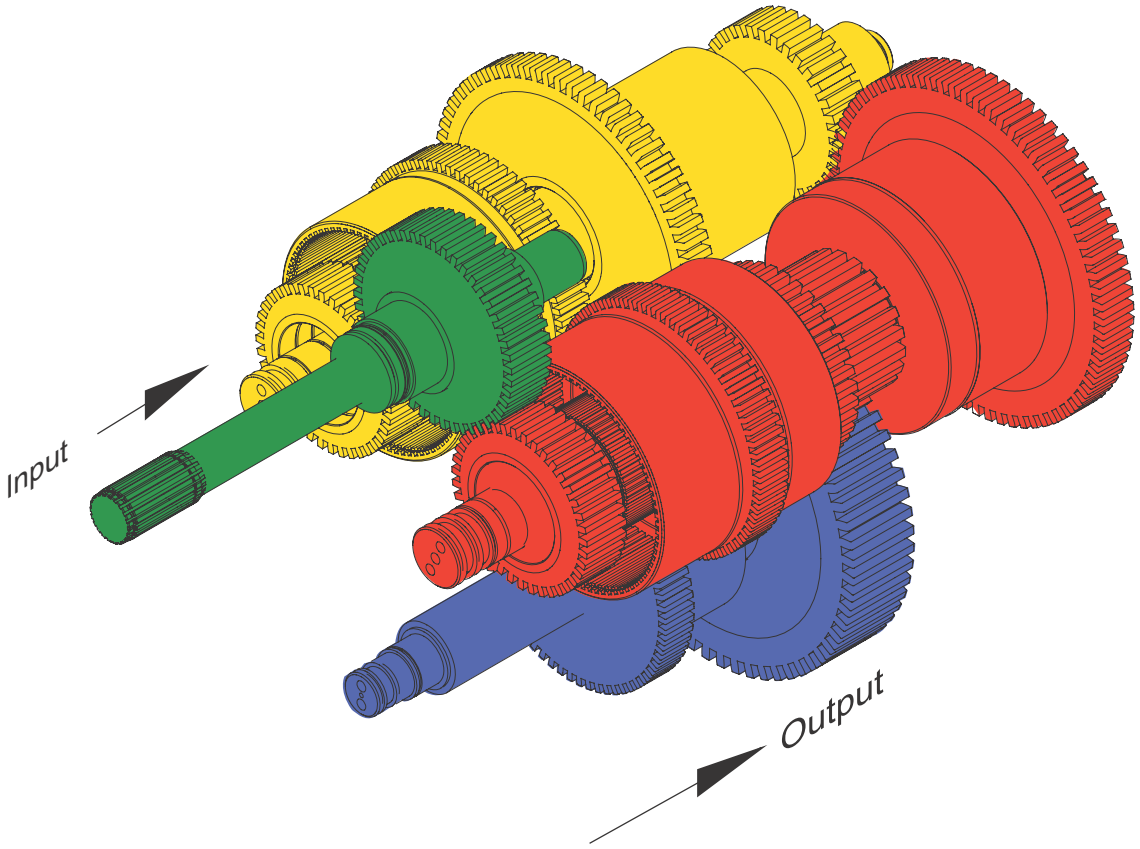
Reverse 4th Speed



Reverse 4th Speed (Continued)



Gear & Clutch Layout



TROUBLESHOOTING

The following information is presented as an aid to isolate and determine the specific problem areas in a transmission that is not functioning correctly.

When troubleshooting a “transmission” problem, it should be kept in mind that the transmission is only the central unit of a group of related powertrain components. Proper operation of the transmission depends on the condition and correct functioning of the other components of the group. Therefore, to properly diagnose a suspected problem in the transmission, it is necessary to consider the transmission fluid, charging pump, torque converter, transmission assembly, oil cooler, filter, connecting lines, and controls, including the engine, as a complete system.

By analyzing the principles of operation together with the information in this section, it should be possible to identify and correct any malfunction which may occur in the system.

Transmission Problems

TE27/30 (power shift with torque converter transmission) troubles fall into four general categories:

1. Mechanical problems.
2. Hydraulic problems.
3. Electrical problems.
4. Controller problems

In addition to the mechanical and electrical components, all of which must be in the proper condition and functioning correctly, the correct functioning of the hydraulic circuit is most important. Transmission fluid is the “life blood” of the transmission. It must be supplied in an adequate quantity and delivered to the system at the correct pressures to ensure converter operation, to engage and hold the clutches from slipping, and to cool and lubricate the working components.

Troubleshooting Procedures

Input Shaft and Directional Clutch Problems

Stall Test

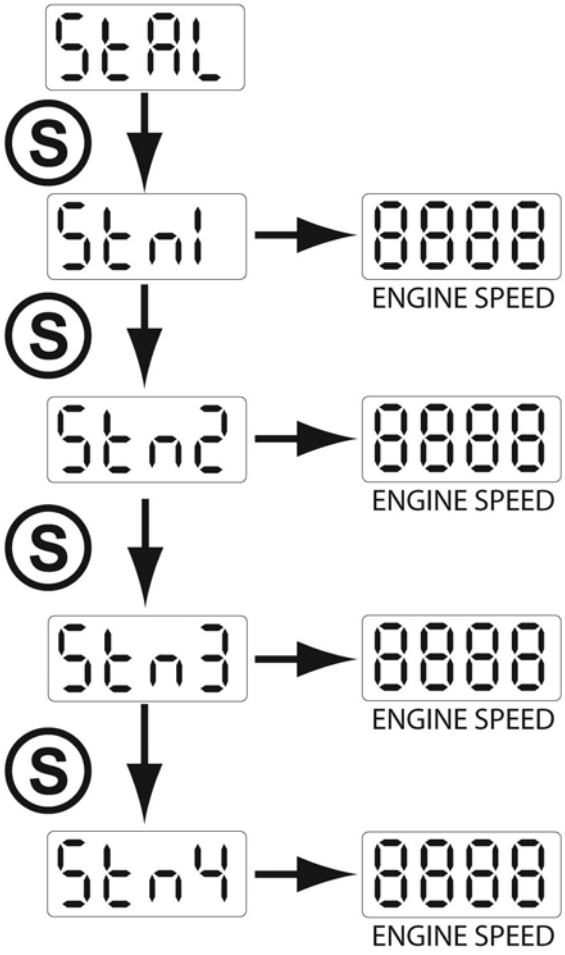
⚠CAUTION

NEVER operate the converter at stall condition longer than 30 seconds at one time, shift to neutral for 15 seconds and repeat the procedure until desired temperature is reached. Excessive temperature 250°F [120°C] maximum will cause damage to transmission clutches, fluid, converter, and seals.

A stall test to identifies transmission, converter, or engine problems.

Use following procedure:

1. Put the vehicle against a solid barrier, such as a wall and/or apply the parking brake, block the wheels.
2. Activate calibration mode during power up and holding the S button for 15 seconds.
3. Select "STAL" using the M button.
4. Select the requested range gear with the S button.



5. Select FWD or REV in the selected range gear.
6. Once the oil temperature reaches 158°F [70°C] check maximum stall speed at full throttle in all gears.
7. The figure obtained should be within 50 RPM as mentioned in the vehicle handbook and should be equal in all gears. Between gears, allow the converter outlet temperature to cool down to 158°F [70°C] by selecting neutral.
8. Exit the stall mode with the M button or switch off the ignition.

If maximum stall speed measured is below specifications, it could indicate an engine or converter problem.

If maximum stall speed measured is above specifications, it could indicate slipping clutches.

Transmission Pressure Checks

Transmission problems can be isolated by the use of pressure tests. When the stall test indicates slipping clutches, then measure clutch pack pressure to determine if the slippage is due to low pressure or clutch plate friction material failure.

In addition, converter charging pressure and transmission lubrication pressure can also be measured.

Mechanical and Electrical Checks

Prior to checking any part of the system for hydraulic function (pressure testing), the following mechanical and electrical checks should be made:

- Check the parking brake and inching pedal for correct adjustment.
- Be sure all lever linkage is properly connected and adjusted in each segment and at all connecting points.
- The controls are actuated electrically. Check the wiring and electrical components.
- Be sure that all components of the cooling system are in good condition and operating correctly. The radiator must be clean to maintain the proper cooling and operating temperatures for the engine and transmission. Air clean the radiator, if necessary.
- The engine must be operating correctly. Be sure that it is correctly tuned and adjusted to the correct idle and maximum no-load governed speed specifications.

Hydraulic Checks

Also, before checking the transmission clutches, torque converter, charging pump, and hydraulic circuit for pressure and rate of oil flow, it is important to make the following transmission fluid check:

Check oil level in the transmission. The transmission fluid must be at the correct (full level). All clutches and the converter and its fluid circuit lines must be fully charged (filled) at all times.

⚠CAUTION

The transmission fluid must be at operating temperature of 180 - 200°F [82 - 93 °C] to obtain correct fluid level and pressure readings. NEVER attempt to make these checks with cold oil.

To raise the oil temperature to this specification it is necessary to either operate (work) the vehicle or run the engine with the converter at “stall” ((see “Stall Test”, on page 43)).

⚠DANGER

Be careful the vehicle does not move unexpectedly when operating the engine and converter at stall rpm.

Troubleshooting Guide

Refer to the following troubleshooting guide for the diagnosis of typical transmission troubles.

Low Clutch Pressure

Cause	Remedy
Low oil level	Fill to proper level
Clutch pressure regulating valve stuck open	Clean valve spool and housing
Faulty charging pump	Replace pump
Broken or worn clutch shaft or piston sealing rings	Replace sealing rings
Clutch piston bleed valve stuck open	Clean bleed valves thoroughly

Low Charging Pump Output

Cause	Remedy
Low oil level	Fill to proper level
Suction screen plugged	Clean suction pump
Defective charging pump	Replace pump

Overheating

Cause	Remedy
Worn oil sealing rings	Remove, disassemble, & rebuild converter assembly
Worn charging pump	Replace charging pump
Low oil level	Fill to proper level
Dirty oil cooler	Clean cooler
Restriction in cooler lines	Change cooler lines

Noisy Converter

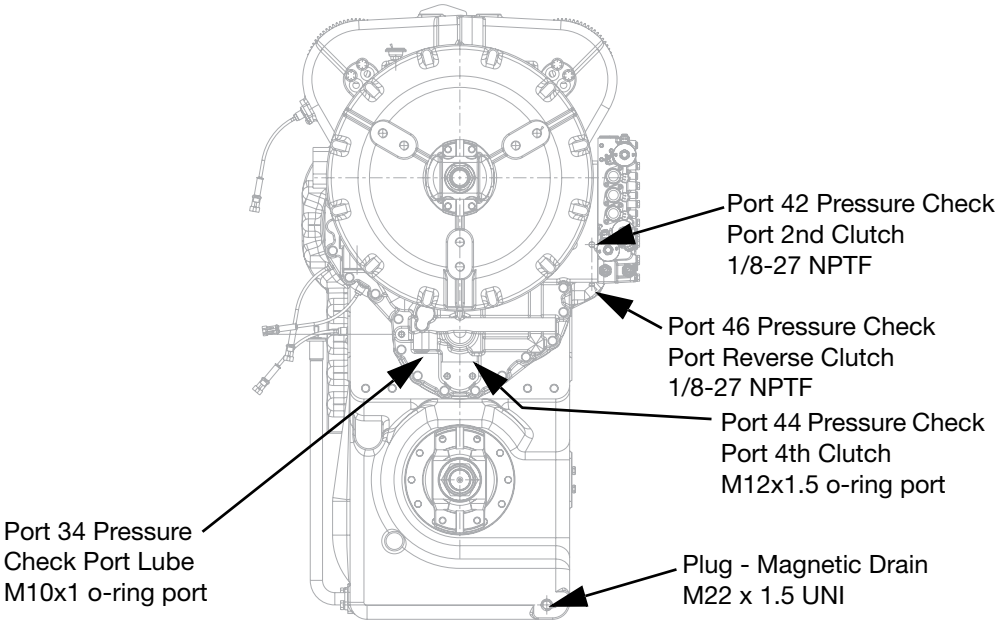
Cause	Remedy
Worn charging pump	Replace charging pump
Worn or damaged bearings	A complete disassembly will be necessary to determine which bearing is faulty
Defective charging pump	Replace pump

Lack of Power

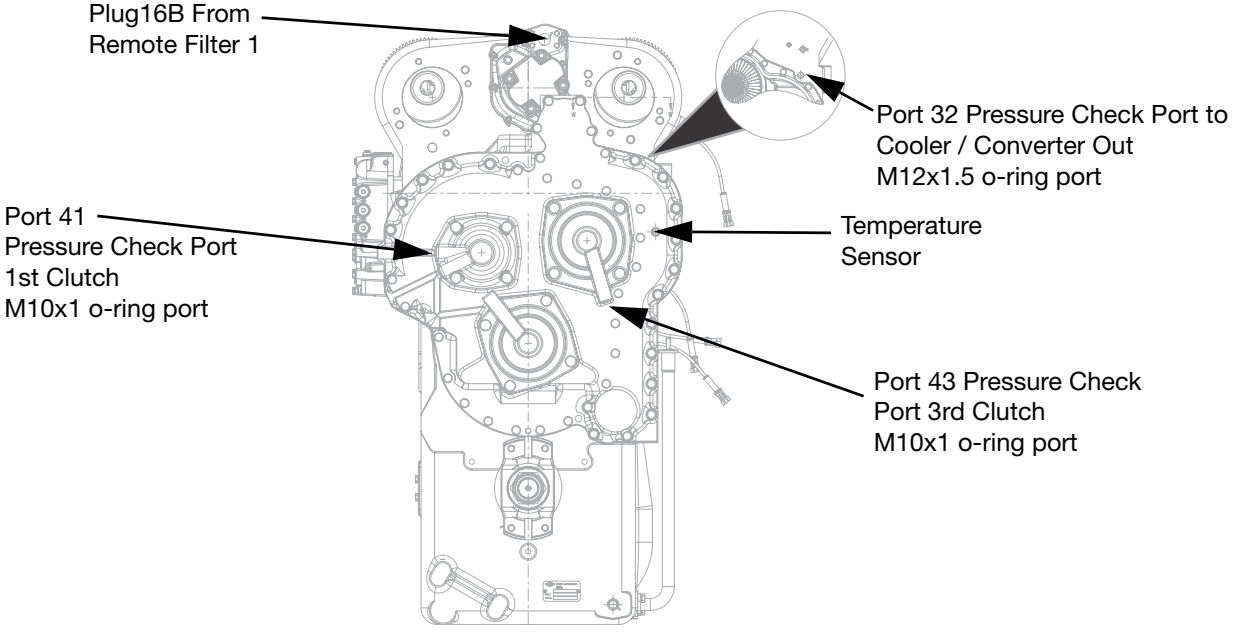
Cause	Remedy
Low engine RPM at converter stall	Tune engine check governor
See the Overheating section above and make same checks	Make corrections as explained in “Overheating”

Check Points

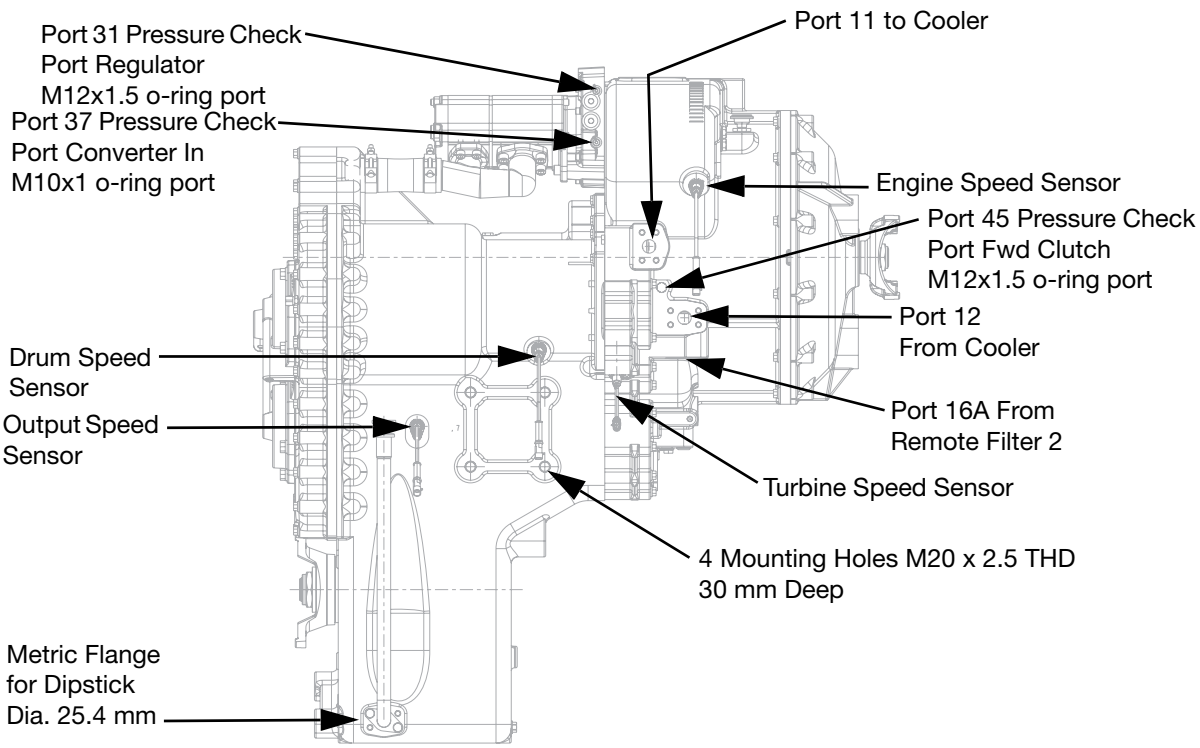
Front View



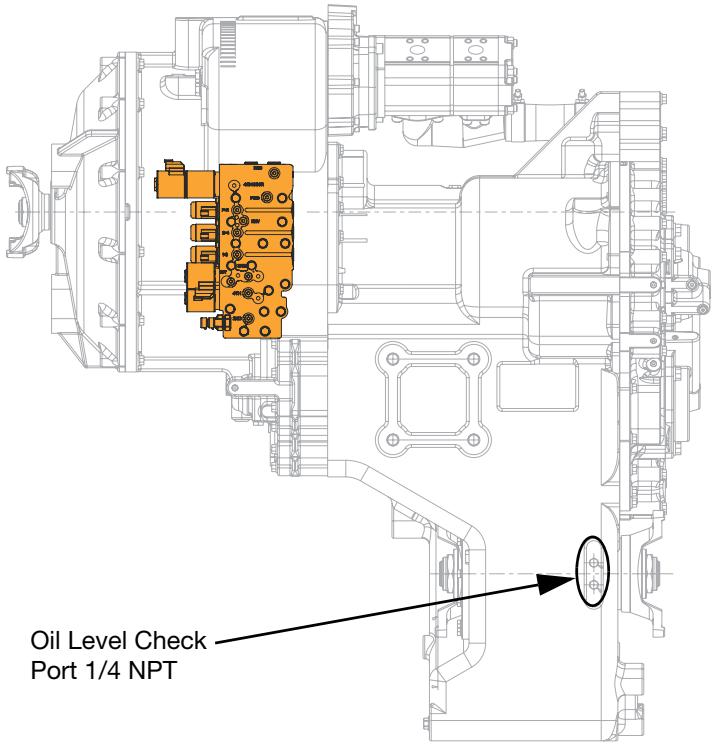
Rear View



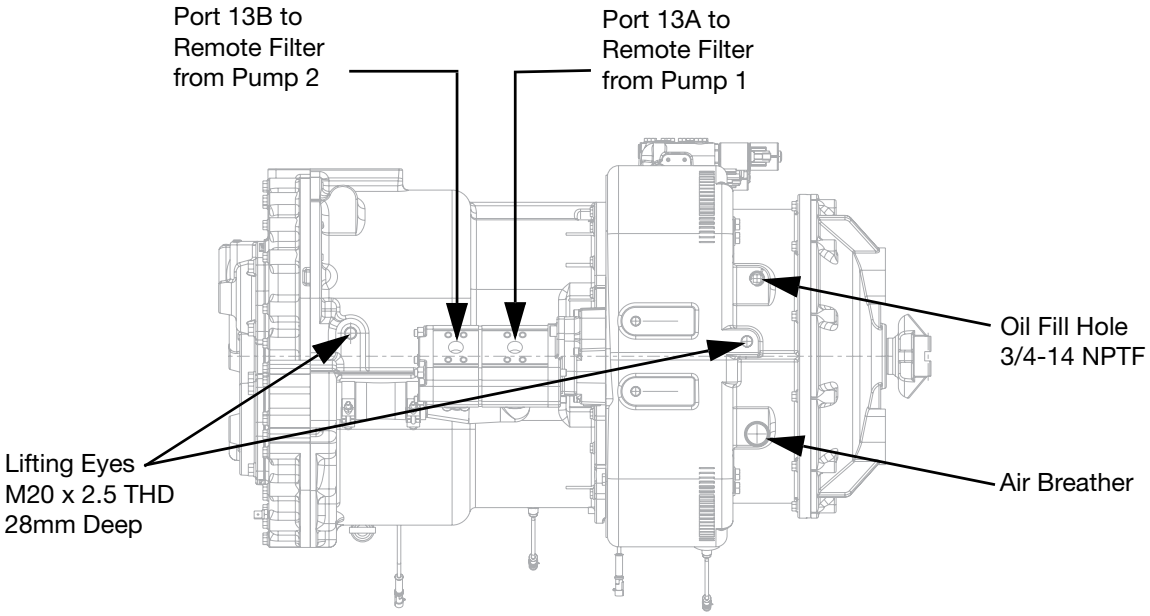
Right View



Left View



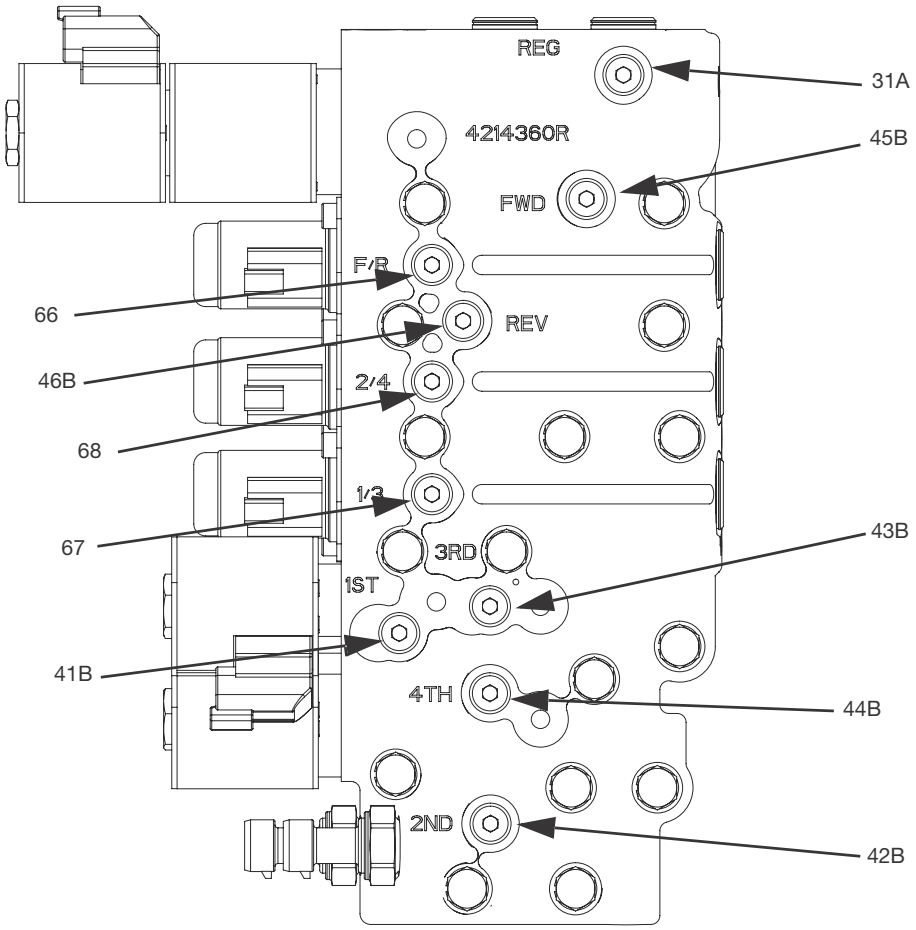
Top View


Port 13B to
Remote Filter
from Pump 2
Port 13A to
Remote Filter
from Pump 1
Oil Fill Hole
3/4-14 NPTF
Lifting Eyes
M20 x 2.5 THD
28mm Deep
Air Breather

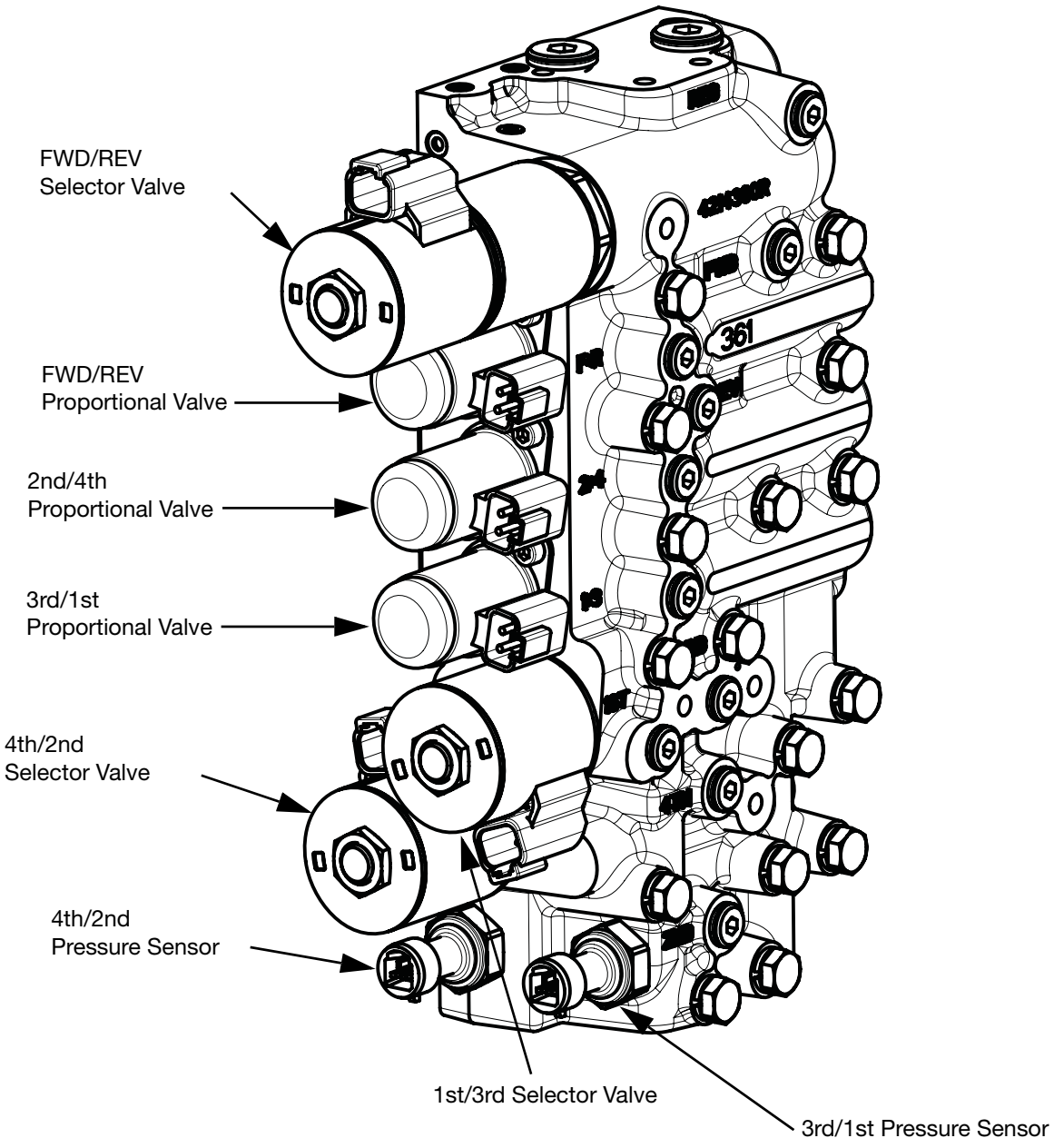
Checkports*

31A	System Pressure
41B	1st Clutch Pressure
42B	2nd Clutch Pressure
43B	3rd Clutch Pressure
44B	4th Clutch Pressure
45B	FWD Clutch Pressure
46B	REV Clutch Pressure
66	FWD/REV Regulated Pressure
67	1st / 3rd Regulated Pressure
68	2nd / 4th Regulated Pressure

* All M10x1 o-ring ports



Full Flow Valve Components



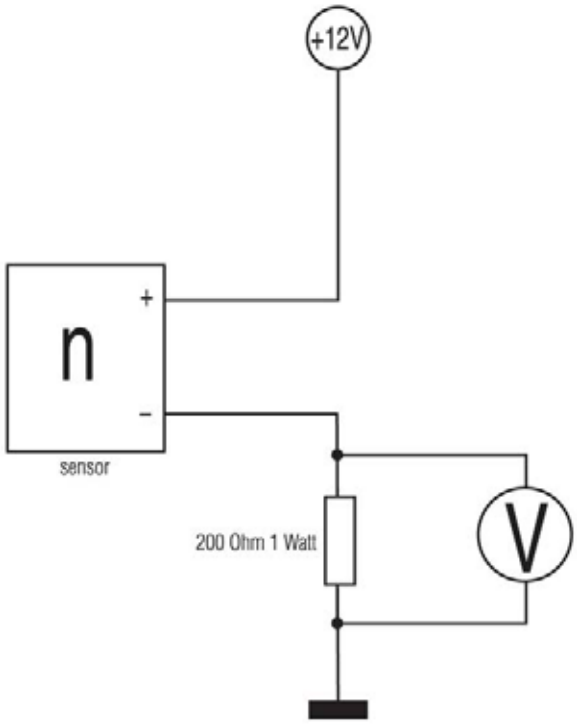
Speed Sensor Static Standalone Test

In order to be able to sense the currents, a series resistor of e.g. 200 W must be used. This resistor is integrated in the controller, but when the sensor is to be used, it must be connected externally.

The idea is to connect the sensor to an external power source and measure the DC voltage across the series resistor.

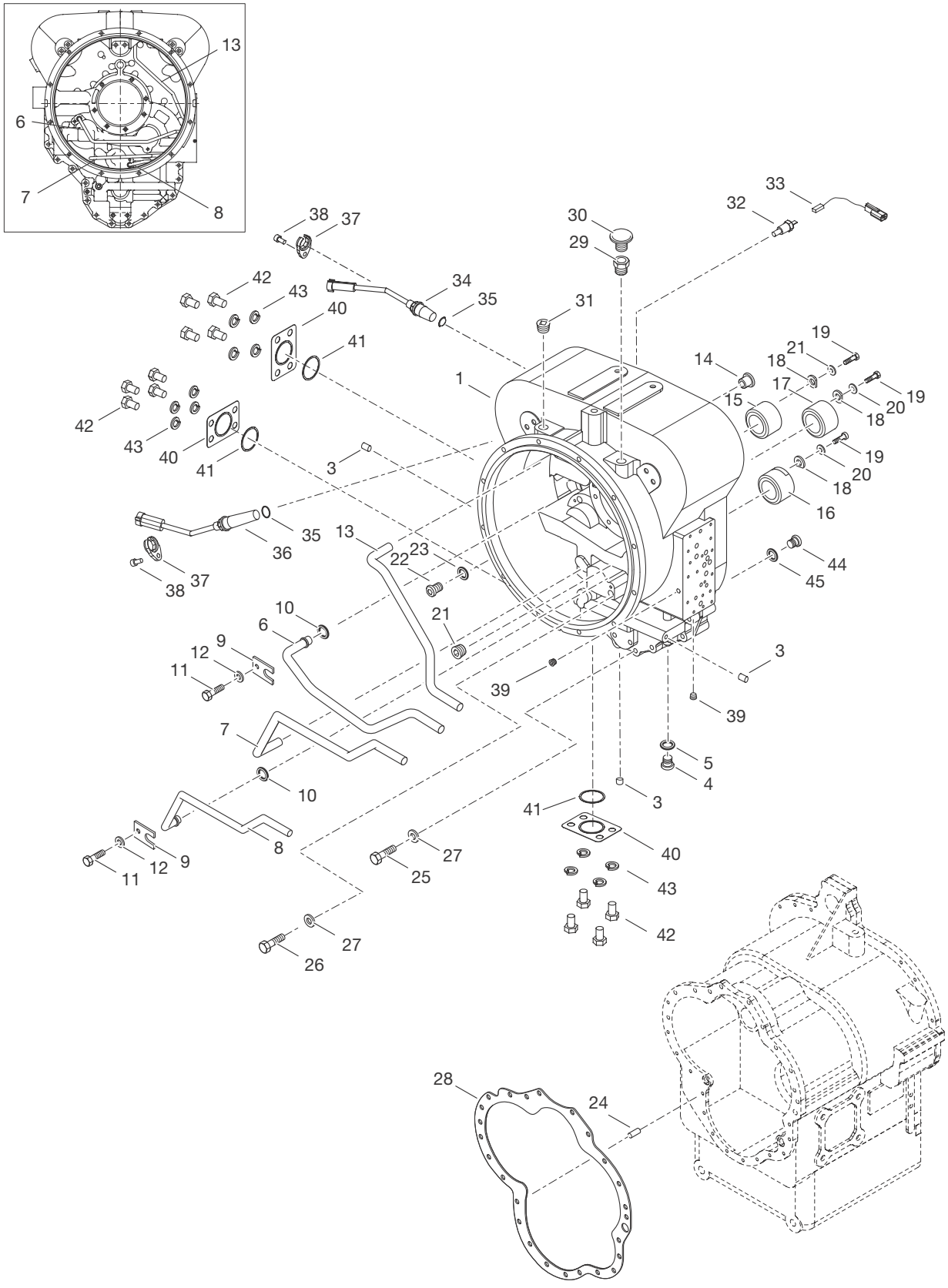
The voltage reading should be either 1.2V (from the 7mA ± 1mA current level) or 2.6 –3.0V (for the 14mA ± 1mA current level).

If the teeth can be moved slowly, distinct toggling between the two levels should be noticed.



EXPLODED VIEWS

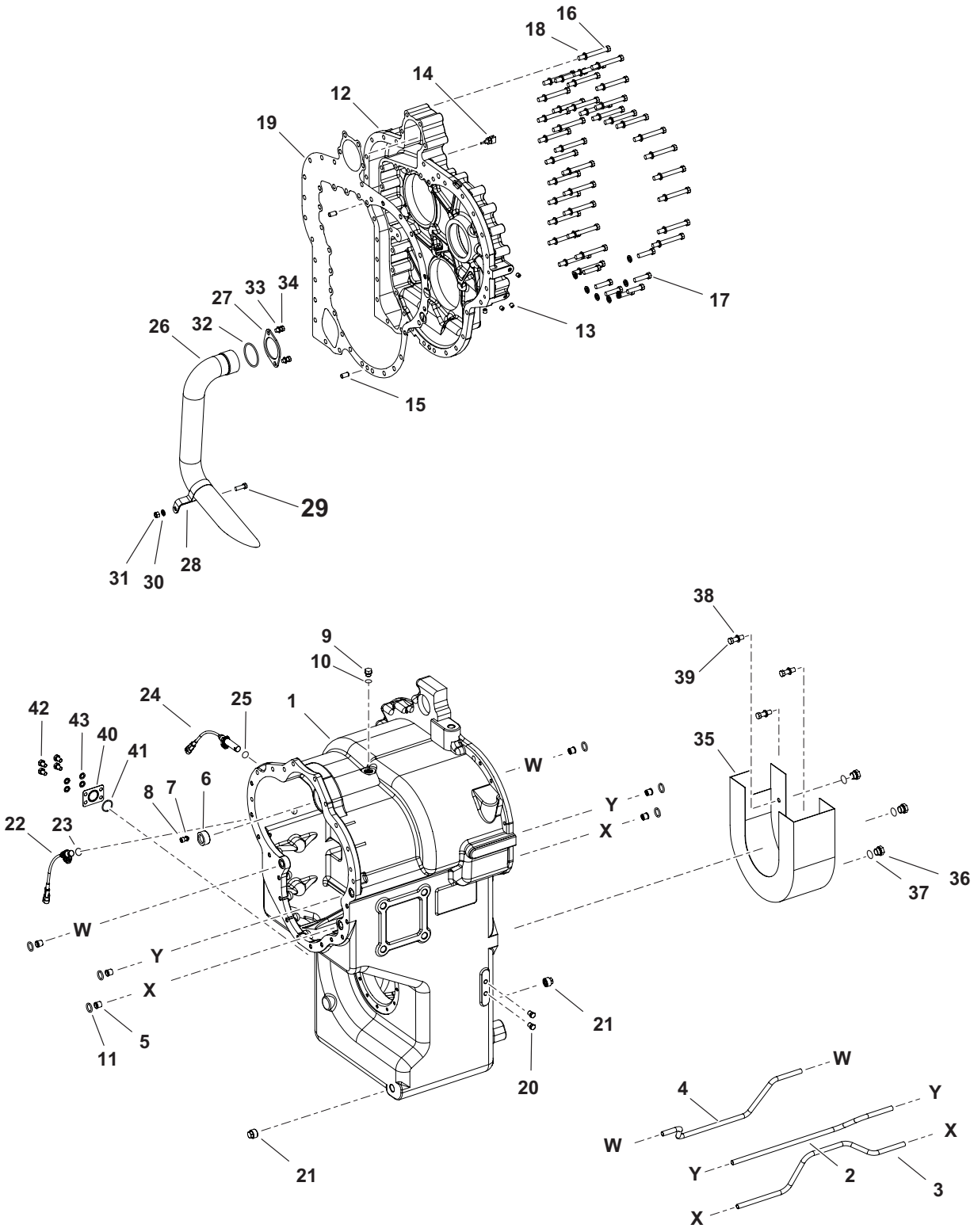
Converter Housing Group



ITEM	DESCRIPTION	QTY
1	Torque Converter Housing	1
2	Not Illustrated	1
3	Plug - Expansion	3
4	Plug	1
5	O-ring	1
6	Tube	1
7	Tube	1
8	Tube	1
9	Clip	2
10	O-ring	2
11	Capscrew	2
12	Lockwasher	2
13	Tube	1
14	Sleeve	1
15	Sleeve	1
16	Sleeve	1
17	Sleeve	1
18	Washer	3
19	Capscrew	3
20	Lockwasher	3
21	Plug	1
22	Plug	2

ITEM	DESCRIPTION	QTY
23	O-ring	2
24	Pin - Dowel	2
25	Capscrew	14
26	Capscrew	9
27	Lockwasher	23
28	Gasket - Converter-To-Transmission-Case	1
29	Bushing	1
30	Breather - Air	1
31	Plug	1
32	Sensor - Speed	1
33	O-ring	1
34	Sensor - Speed	1
35	O-ring	1
36	Plug	2
37	Cover - Split Flange	3
38	O-ring	3
39	Capscrew	12
40	Lockwasher	12
41	Plug	1
42	O-ring	1
43	Not Used in This Model	

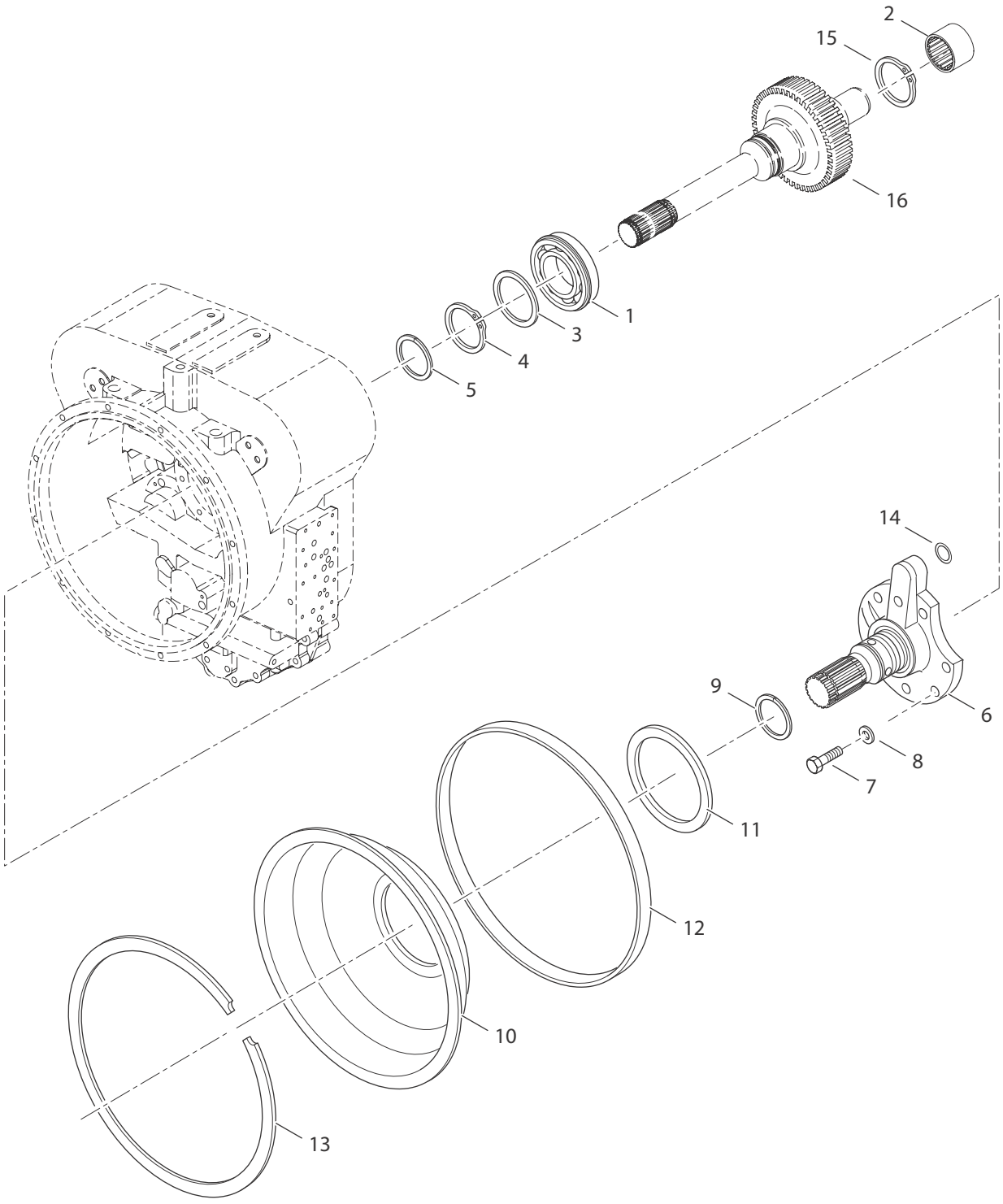
Transmission Case & Rear Cover Group



ITEM	DESCRIPTION	QTY
1	Case - Transmission	1
2	Tube - 1st Speed Clutch Pressure	1
3	Tube - Low Shaft Rear Bearing Lube	1
4	Tube - 3rd Speed Clutch Pressure	1
5	Sleeve - Pressure and Lube Tube	6
6	Not Used in This Model	
7	Not Used in This Model	
8	Not Used in This Model	
9	Plug	1
10	O-ring	1
11	O-ring	6
12	Cover - Rear Assembly	1
13	Plug	4
14	Sensor - Temperature	1
15	Pin	2
16	Capscrew	37
17	Capscrew	7
18	Lockwasher	44
19	Gasket - Rear Cover	1
20	Plug - Oil Level	2
21	Plug - Magnetic Drain	2
22	Sensor - Speed	1

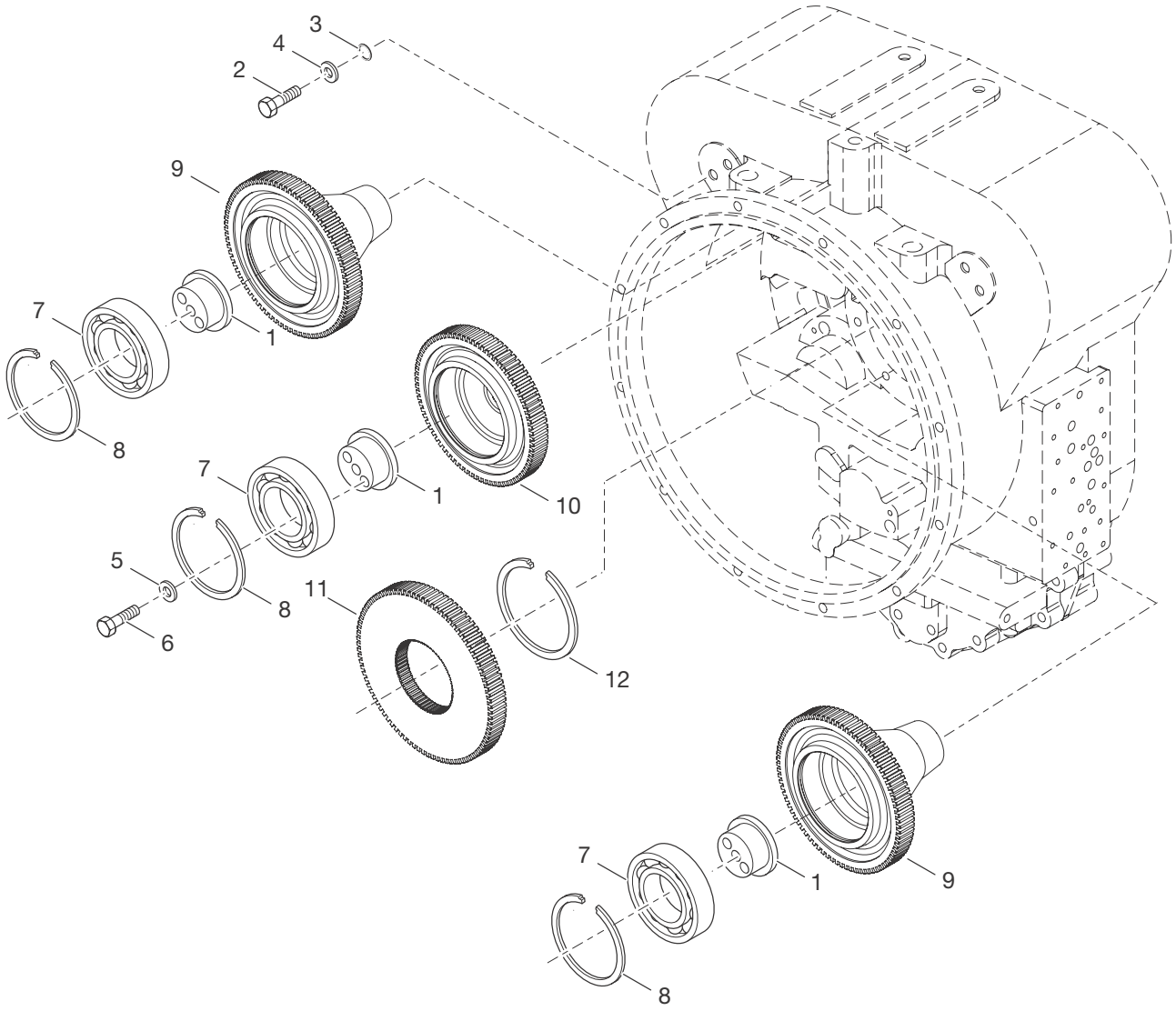
ITEM	DESCRIPTION	QTY
23	O-ring	1
24	Sensor - Speed	1
25	O-ring	1
26	Tube - Suction Assembly	1
27	Flange - Suction Tube	1
28	Clamp - Suction Tube	1
29	Capscrew	1
30	Lockwasher	1
31	Nut	1
32	O-ring	1
33	Lockwasher	2
34	Screw - Retainer Washer	2
35	Baffle	1
36	Not Used in This Model	
37	Not Used in This Model	
38	Washer - Seal	3
39	Capscrew	3
39A	Spacer - Baffle	3
40	Cover - Split Flange	1
41	O-ring	1
42	Capscrew	4
43	Lockwasher	4

Turbine Shaft Group



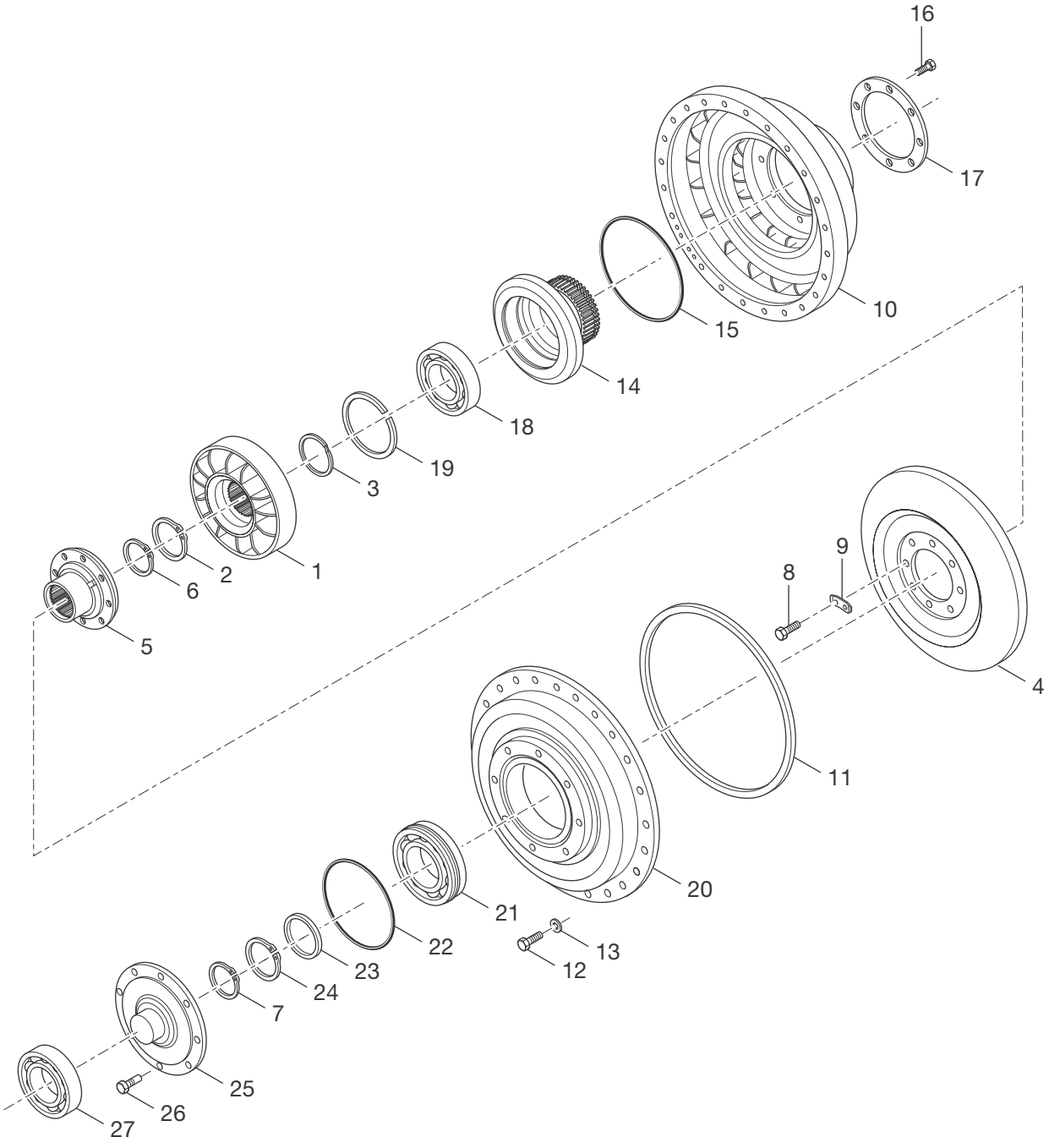
ITEM	DESCRIPTION	QTY
1	Bearing - Turbine Shaft Front	1
2	Bearing - Turbine Shaft Rear	1
3	Spacer - Front Bearing	1
4	Snap Ring	1
5	Ring - Piston	1
6	Stator Support Assembly	1
7	Screw - Stator Support	7
8	Lockwasher	7
9	Ring - Piston	1
10	Baffle - Oil	1
11	Seal - Oil	1
12	Ring - Oil Baffle Seal	1
13	Ring - Oil Baffle Retaining	1
14	O-ring	1
15	Snap Ring	1
16	Turbine Shaft	1

Charging Pump Drive Group



ITEM	DESCRIPTION	QTY
1	Support - Pump Drive Bearing	2
2	Capscrew - Bearing Support	4
3	Washer - Plain	4
4	Washer - Seal	4
5	Lockwasher	2
6	Capscrew - Bearing Support	2
7	Bearing - Pump Drive Gear	2
8	Snap Ring	2
9	Gear - Auxiliary Pump Drive	2
10	Gear - Charge Pump Drive	1
11	Gear - Impeller Hub	1
12	Snap Ring	1
13	Support - Pump Drive Bearing	1
14	Snap Ring	1
15	Bearing - Ball	1

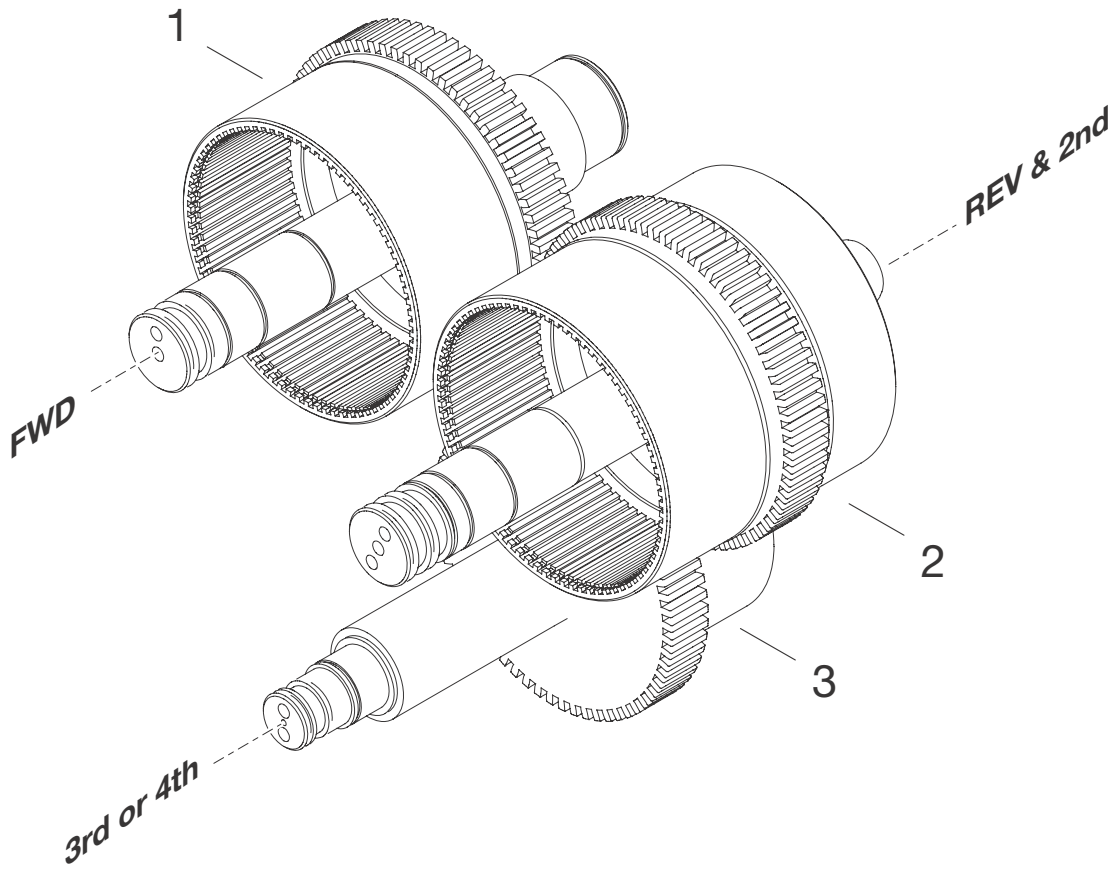
Torque Converter Assembly Group



ITEM	DESCRIPTION	QTY
1	Member - Reaction	1
2	Snap Ring	1
3	Spacer - Reaction Member	1
4	Turbine	1
5	Hub - Turbine	1
6	Snap Ring	1
7	Snap Ring	1
8	Capscrew	10
9	Locktab	5
10	Impeller	1
11	O-ring	1
12	Screw	32
13	Lock washer	32
14	Hub - Impeller	1

ITEM	DESCRIPTION	QTY
15	O-ring	1
16	Screw	8
17	Ring - Impeller Hub Backing	1
18	Bearing	1
19	Snap Ring	1
20	Cover - Impeller	1
21	Bearing - Turbine Hub	1
22	O-ring	1
23	Spacer	1
24	Snap Ring	1
25	Shaft - Input	1
26	Screw	8
27	Bearing - Ball	1

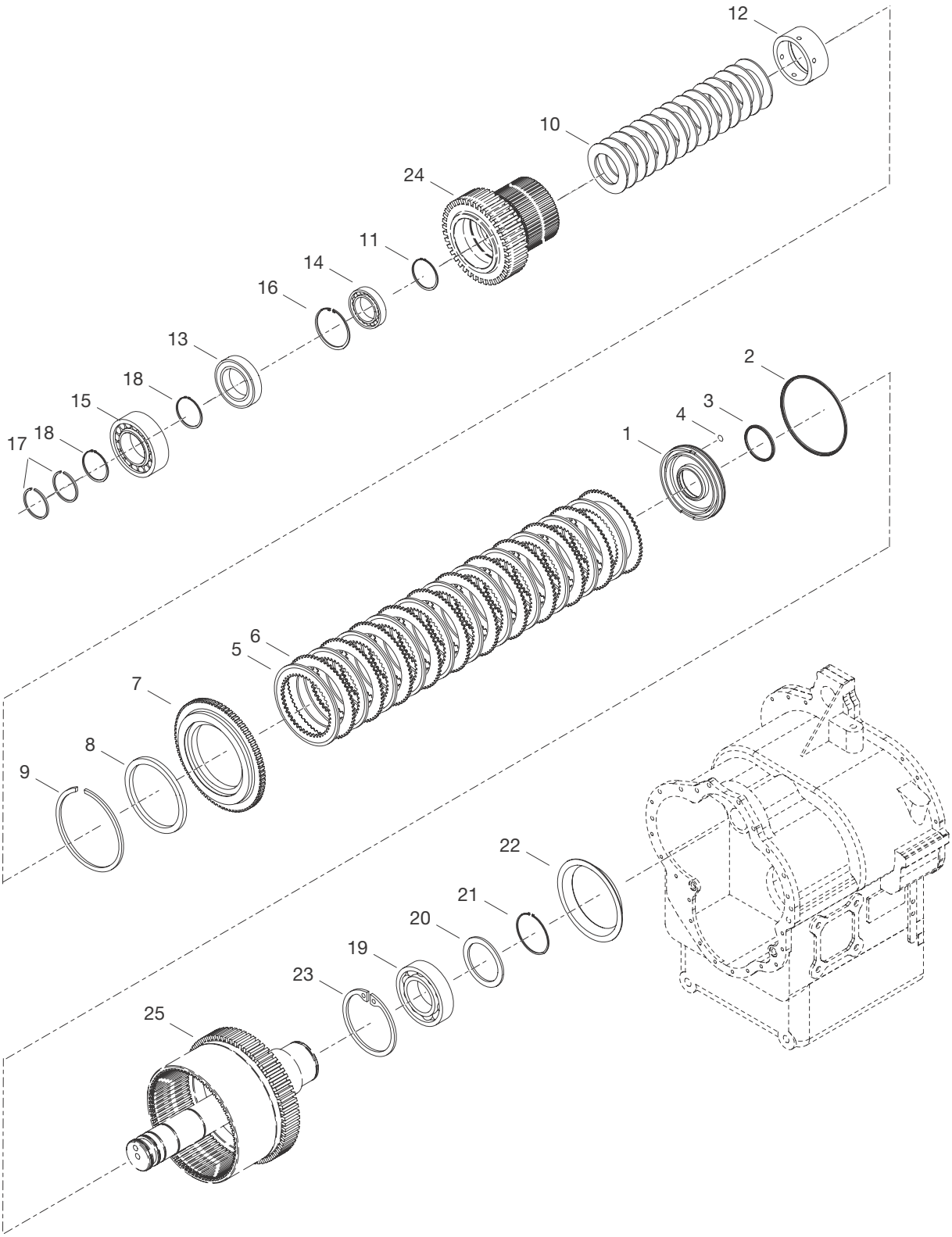
Forward, Reverse/Second, & Third or Fourth Clutch Shaft Assembly



Forward, Reverse/Second, & Third or Fourth Clutch Shaft Assembly

ITEM	DESCRIPTION	QTY
1	Fwd Shaft Drum Assembly	1
2	Rev/2nd Shaft Drum Assembly	1
3	4rd Shaft Drum Assembly on 4 Speed	1

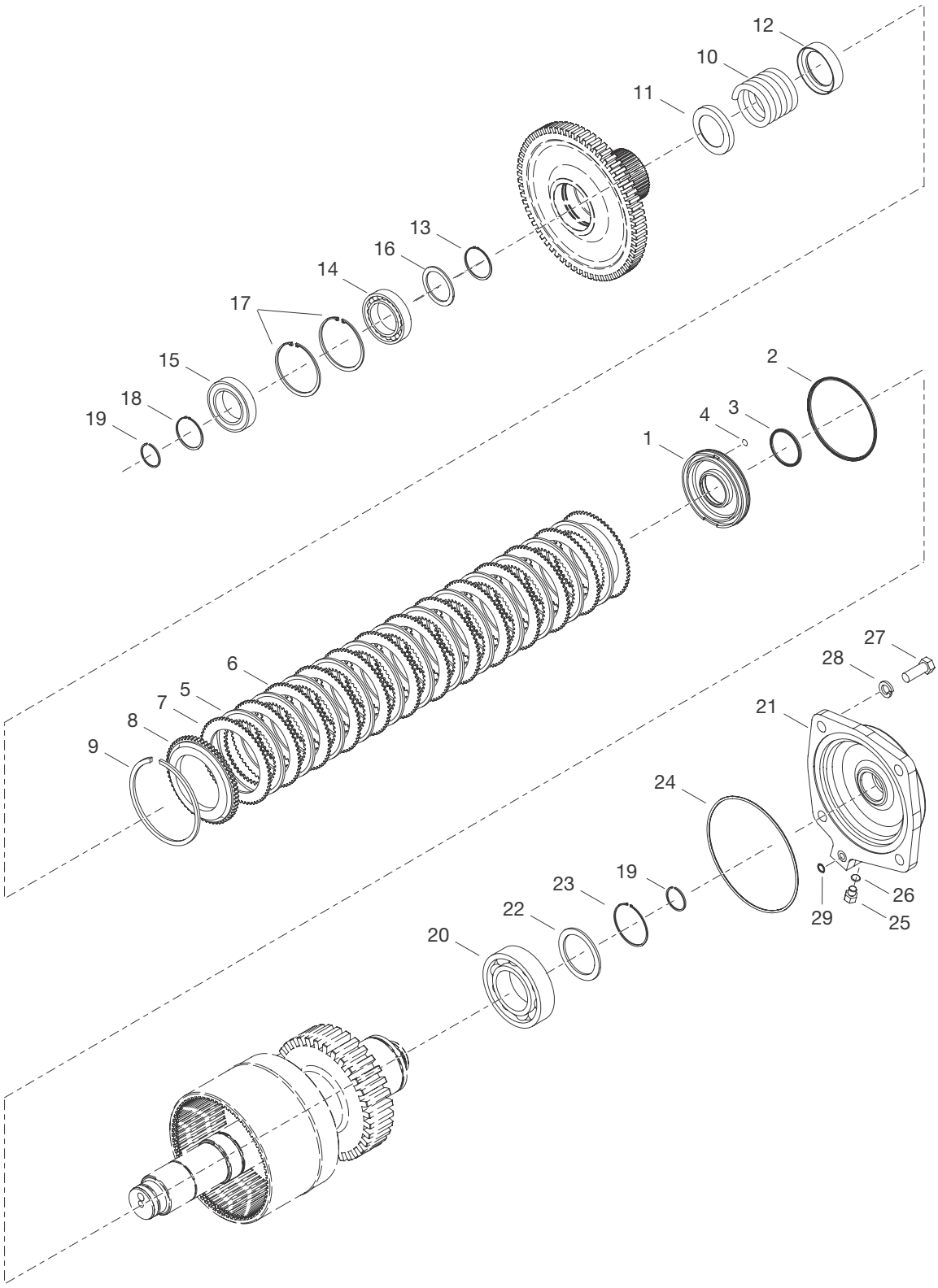
Forward Clutch Shaft Group



ITEM	DESCRIPTION	QTY
1	Piston	1
2	Seal - Piston Outer	1
3	Seal - Piston Inner	1
4	Screen*	1
5	Disc - Clutch Inner	11
6	Disc - Clutch Outer	11
7	Plate - End	1
8	Seal	1
9	Snap Ring	1
10	Washer - Belleville (Not as illustrated)	1
11	Ring - Retaining	1
12	Sleeve - Selective Lube	1
13	Bearing - Clutch Driven Gear	1
14	Bearing - Rear	1
15	Bearing	1
16	Ring - Retaining	1
17	Ring - Piston	2
18	Ring - Retaining	2
19	Bearing	1
20	Spacer	1
21	Snap Ring	1
22	Retainer - Oil	1
23	Snap Ring	1
24	Clutch Driven Gear	1
25	Shaft - Forward Clutch	1

* *Not Sold Separately*

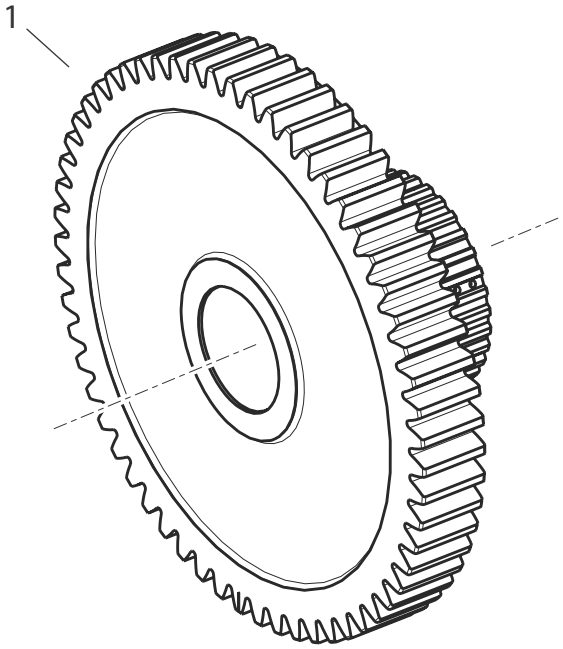
Third Clutch Shaft Group



ITEM	DESCRIPTION	QTY
1	Piston	1
2	Seal - Piston Outer	1
3	Seal - Piston Inner	1
4	Screen*	1
5	Disc - Clutch Inner	11
6	Disc - Clutch Outer	11
7	Disc - Clutch Outer Half	2
8	Plate - End	1
9	Snap Ring	1
10	Washer - Belleville	15
11	Spacer - Clutch Piston	1
12	Retainer - Spring	1
13	Ring - Retainer	1
14	Bearing	1
15	Bearing	1
16	Washer	1
17	Snap Ring	2
18	Snap Ring	1
19	Ring - Piston	2
20	Bearing	1
21	Cap - 3rd Speed Shaft Rear Bearing	1
22	Spacer	1
23	Snap Ring	1
24	O-ring	1
25	Plug	1
26	O-ring	1
27	Capscrew	4
28	Lockwasher	4
29	O-ring	1

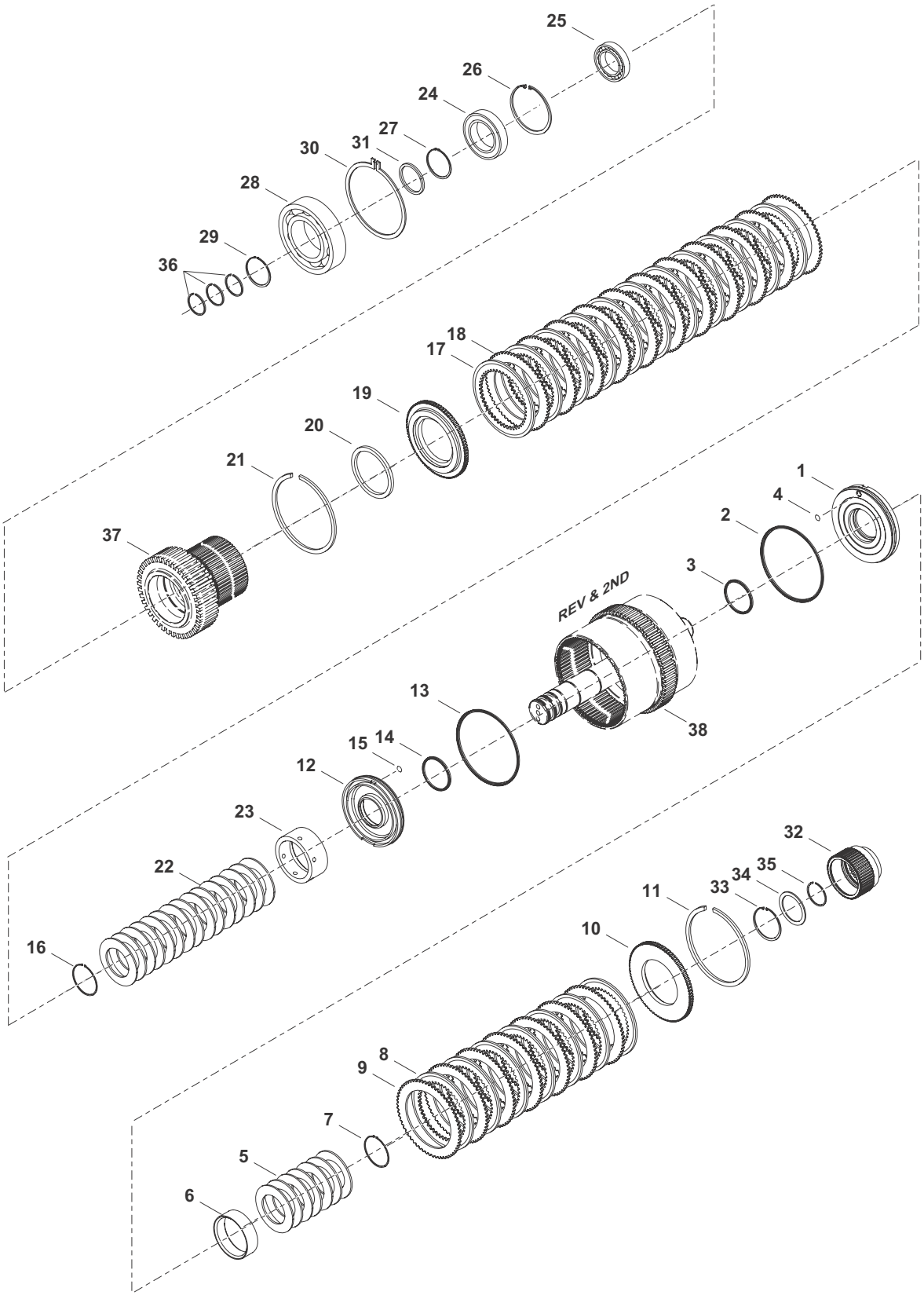
* *Not Sold Separately*

Third Speed Gear Group



ITEM	DESCRIPTION	QTY
1	Gear - 3rd Speed 64T	1

Reverse/Second Clutch Shaft Group



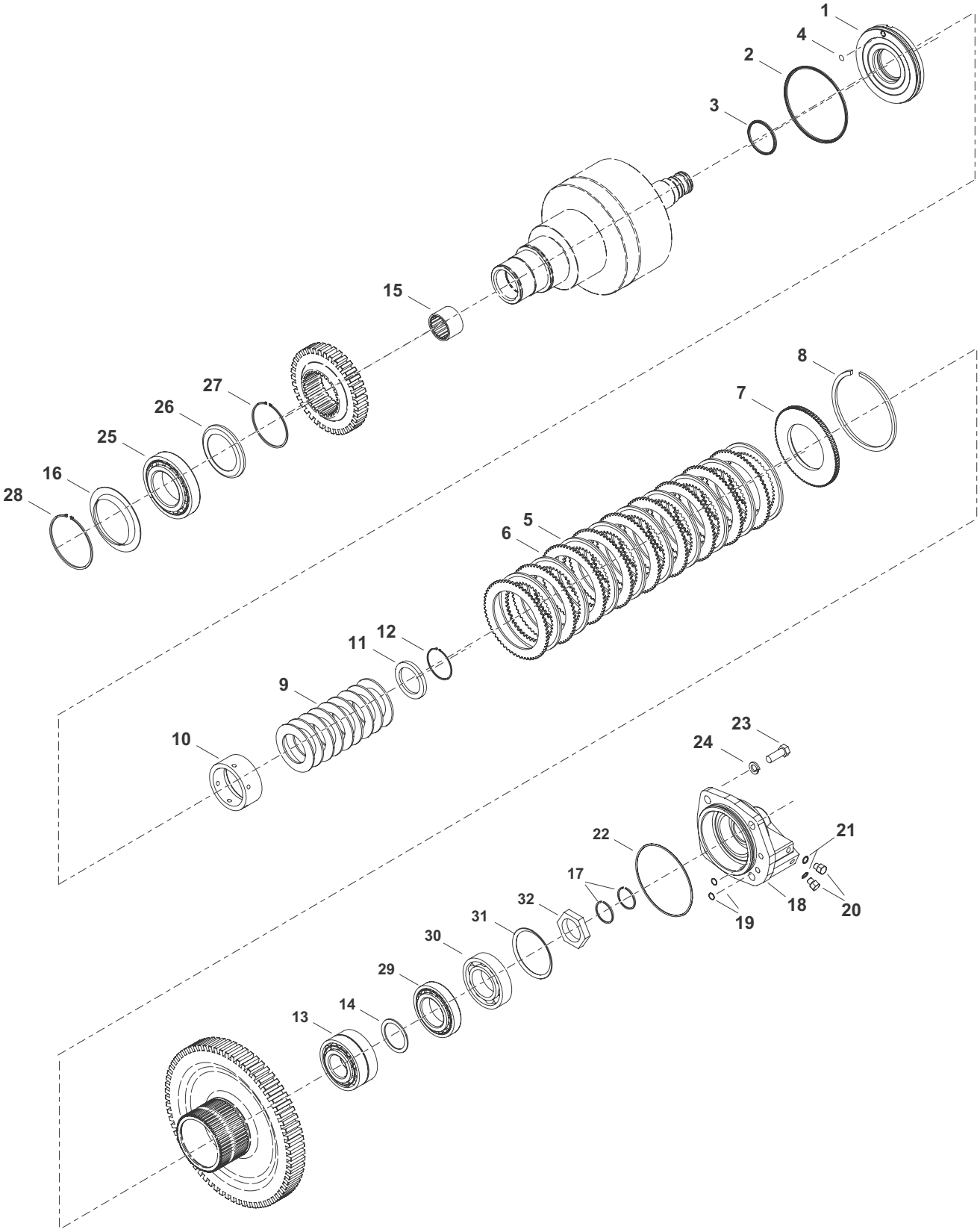
Reverse/Second Clutch Shaft Group

ITEM	DESCRIPTION	QTY
1	Piston	1
2	Seal - Clutch Piston Outer	1
3	Seal - Clutch Piston Inner	1
4	Screen*	1
5	Washer - Belleville	7
6	Spacer - Clutch Piston	1
7	Ring - Retaining	1
8	Disc - Clutch Inner	7
9	Disc - Clutch Outer	7
10	Plate - End	1
11	Snap Ring	1
12	Piston	1
13	Seal - Clutch Piston Outer	1
14	Seal - Clutch Piston Inner	1
15	Screen*	1
16	Ring - Retaining	1
17	Disc - Clutch Inner	11
18	Disc - Clutch Outer	11
19	Plate - End	1

ITEM	DESCRIPTION	QTY
20	Seal	1
21	Snap Ring	1
22	Washer - Belleville	15
23	Spacer - Clutch Piston	1
24	Bearing	1
25	Bearing	1
26	Ring - Retaining	1
27	Ring - Retaining	1
28	Bearing	1
29	Ring - Retaining	1
30	Ring	1
31	Washer - Bearing Thrust	1
32	Hub - 2nd Clutch Disc	1
33	Snap Ring	1
34	Retainer	1
35	Snap Ring	1
36	Ring - Piston	3
37	Gear - Clutch Driven	1
38	Reverse/2nd Clutch Shaft	1

* *Not Sold Separately*

First Shaft Group

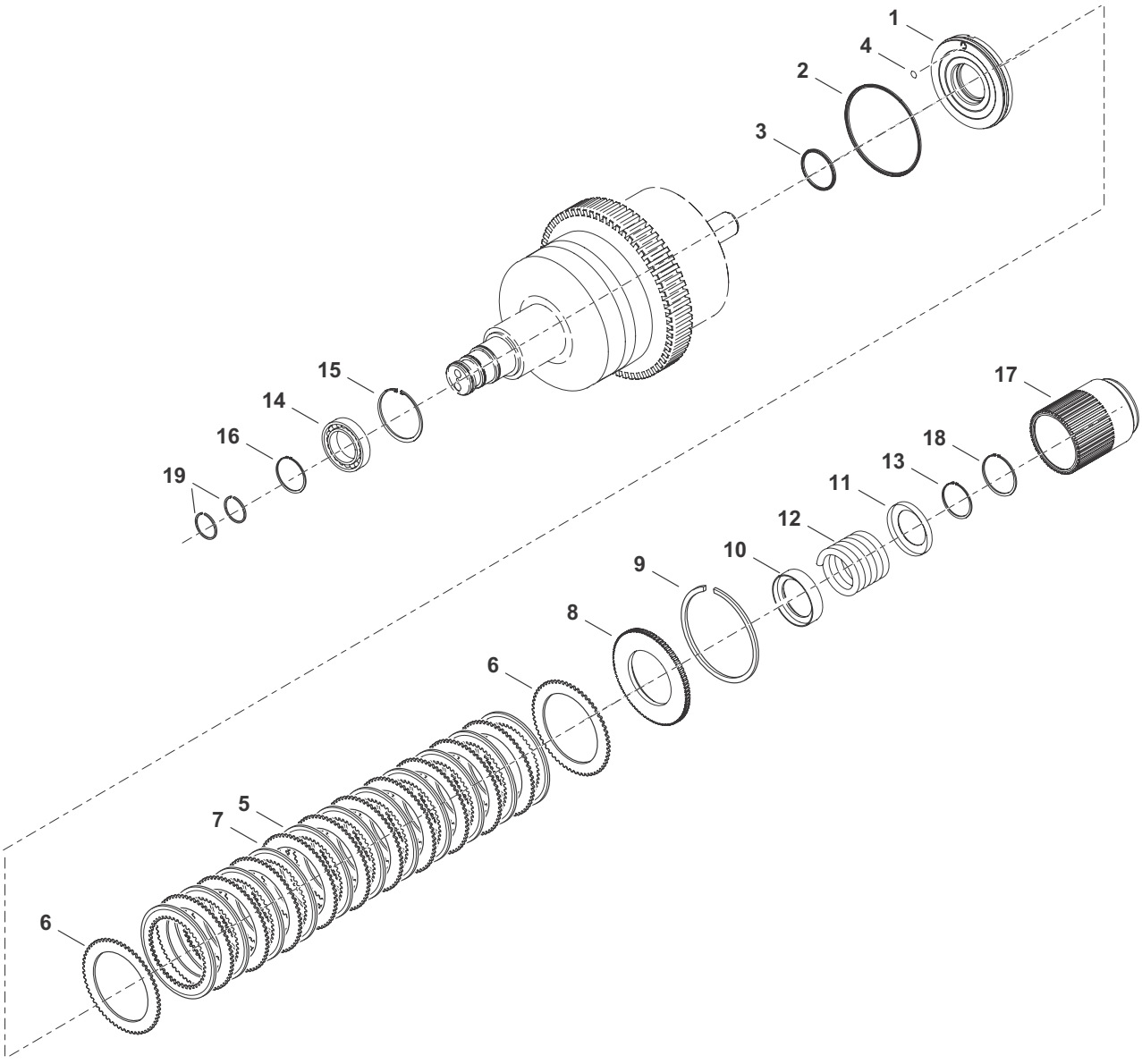


ITEM	DESCRIPTION	QTY
1	Piston	1
2	Seal - Piston Outer	1
3	Seal - Piston Inner	1
4	Screen*	1
5	Disc - Clutch Inner	11
6	Disc - Clutch Outer	11
7	Plate - End	1
8	Snap Ring	1
9	Washer - Belleville	9
10	Spacer - Clutch Piston	1
11	Retainer - Spring	1
12	Ring - Retainer	1
13	Bearing	1
14	Washer	1
15	Bearing	1
16	Retainer - Oil	1

ITEM	DESCRIPTION	QTY
17	Ring - Piston	2
18	Cap - Bearing	1
19	O-ring	1
20	Plug	2
21	O-ring	2
22	O-ring	1
23	Capscrew	4
24	Lock washer	4
25	Bearing	1
26	Spacer - Bearing	1
27	Snap Ring	1
28	Snap Ring	1
29	Bearing	1
30	Bearing	1
31	Spring - Disc	1
32	Nut	1

* *Not Sold Separately*

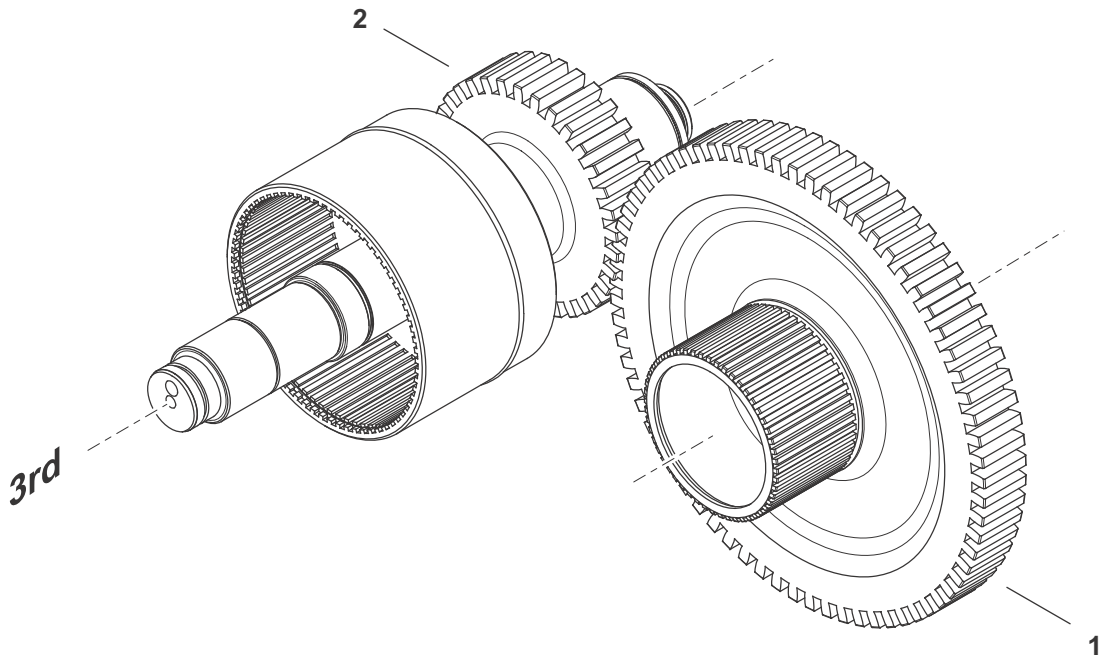
Fourth Clutch Shaft Group



ITEM	DESCRIPTION	QTY
1	Piston	1
2	Seal - Piston Outer	1
3	Seal - Piston Inner	1
4	Screen*	1
5	Disc - Clutch Inner	11
6	Disc - Clutch Outer Half	2
7	Disc - Clutch Outer	10
8	Plate - End	1
9	Snap Ring	1
10	Spacer - Clutch Piston	1
11	Retainer - Spring	1
12	Spring	1
13	Ring - Retainer	1
14	Bearing	1
15	Snap Ring	1
16	Snap Ring	1
17	Hub	1
18	Snap Ring	1
19	Ring - Piston	2

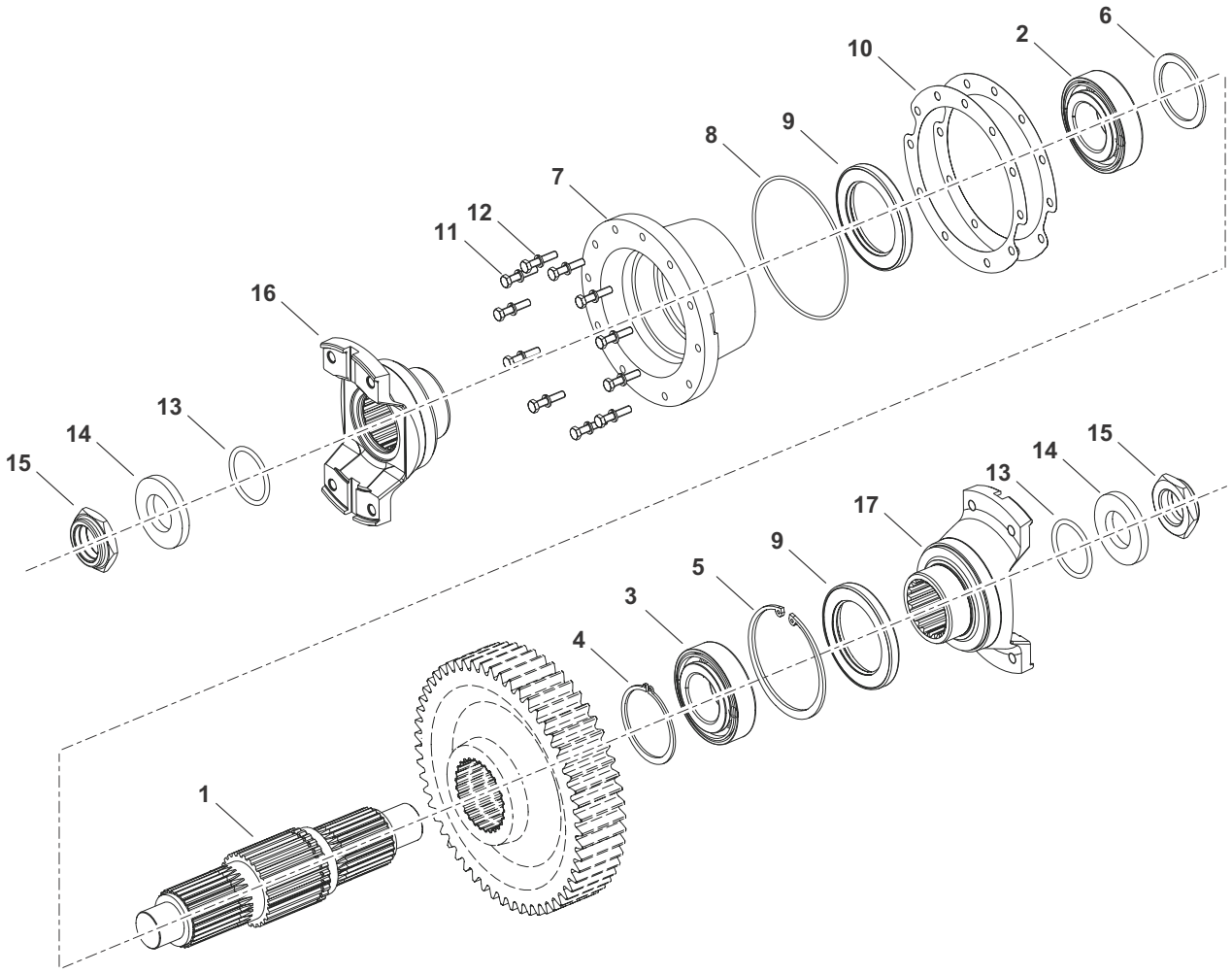
* *Not Sold Separately*

First Speed Gear Group



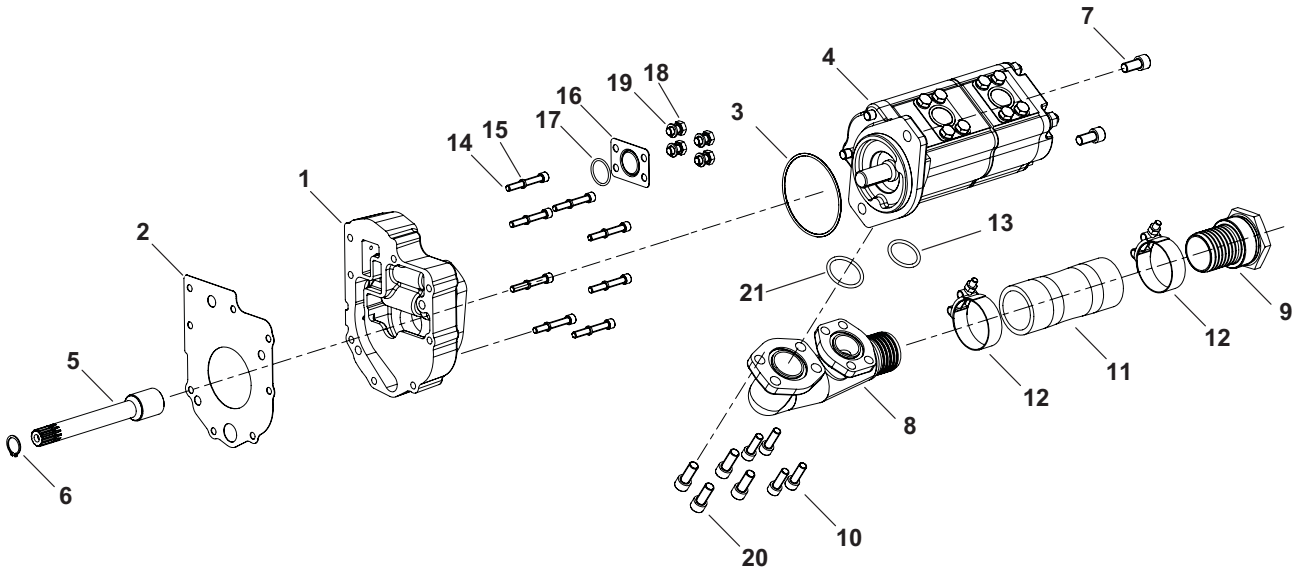
ITEM	DESCRIPTION	QTY
1	Gear - 1st Speed (69T)	1
2	Assembly - 3rd Clutch Shaft	1

Output Shaft Group



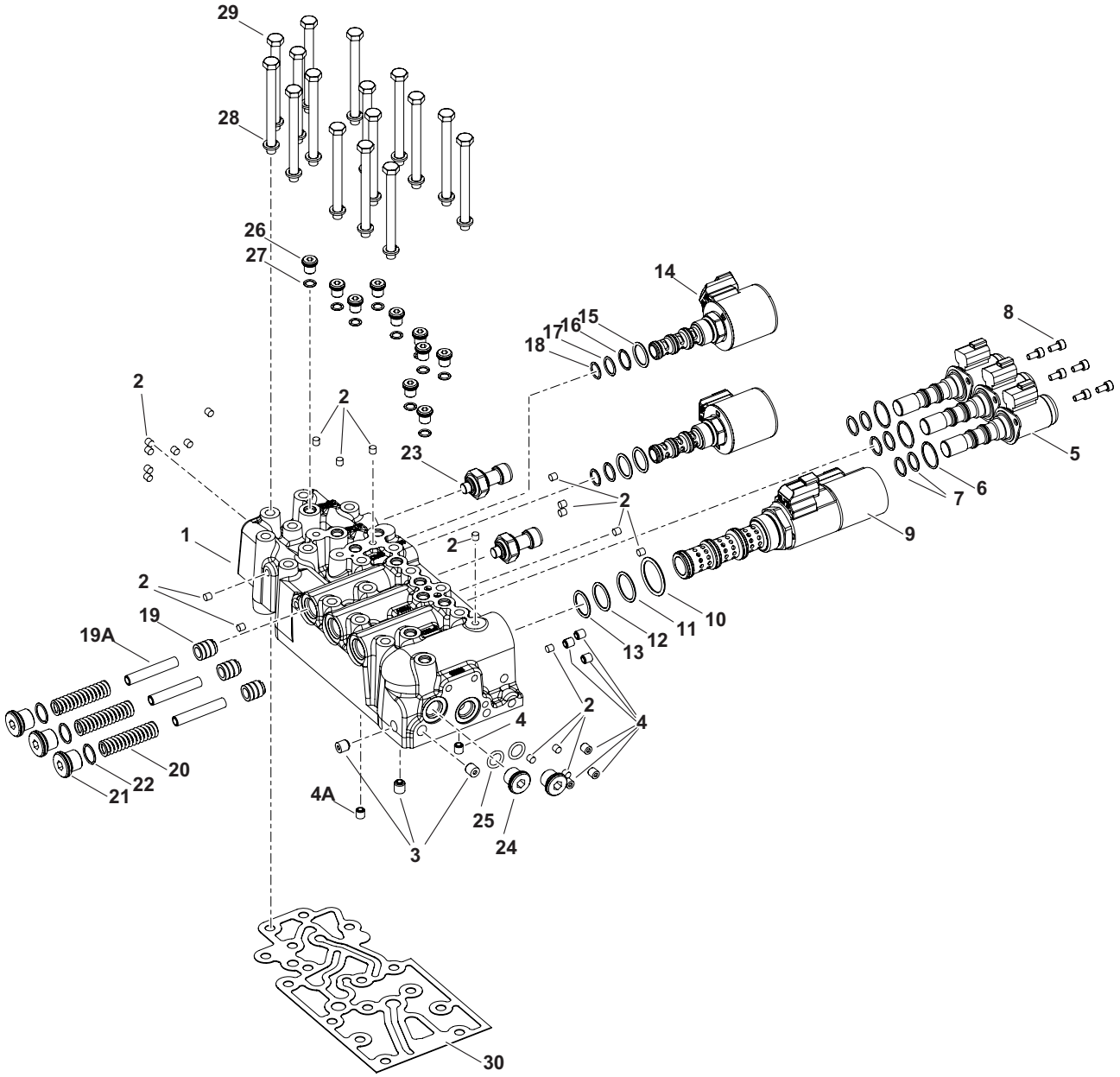
ITEM	DESCRIPTION	QTY
1	Shaft - Output	1
2	Bearing	1
3	Bearing	1
4	Snap Ring	1
5	Snap Ring	1
6	Spacer	1
7	Cap - Shimming	1
8	O-ring	1
9	Seal - Oil Output	2
10	Shims	AR
11	Capscrew	11
12	Lock washer	11
13	O-ring	2
14	Washer - Flange	2
15	Locknut	2
16	Flange - Companion	2
17	Flange - Companion	1

Regulator Valve Group



ITEM	DESCRIPTION	QTY
1	Assembly - Valve Regulator	1
2	Gasket - Valve-To-Converter-Housing	1
3	O-ring	1
4	Pump - Hydraulic	1
5	Shaft - Gear-To-Pump	1
6	Snap Ring	1
7	Screw	2
8	Adapter - Suction Tube Side	1
9	Adapter - Suction Transmission Case Side	1
10	Capscrew	4
11	Hose - Suction	1
12	Clamp - Suction	2
13	O-ring	1
14	Screw	8
15	Lock washer	8
16	Cap - Flange	1
17	O-ring	1
18	Capscrew	4
19	Lock washer	4
20	Capscrew	4
21	O-ring	1

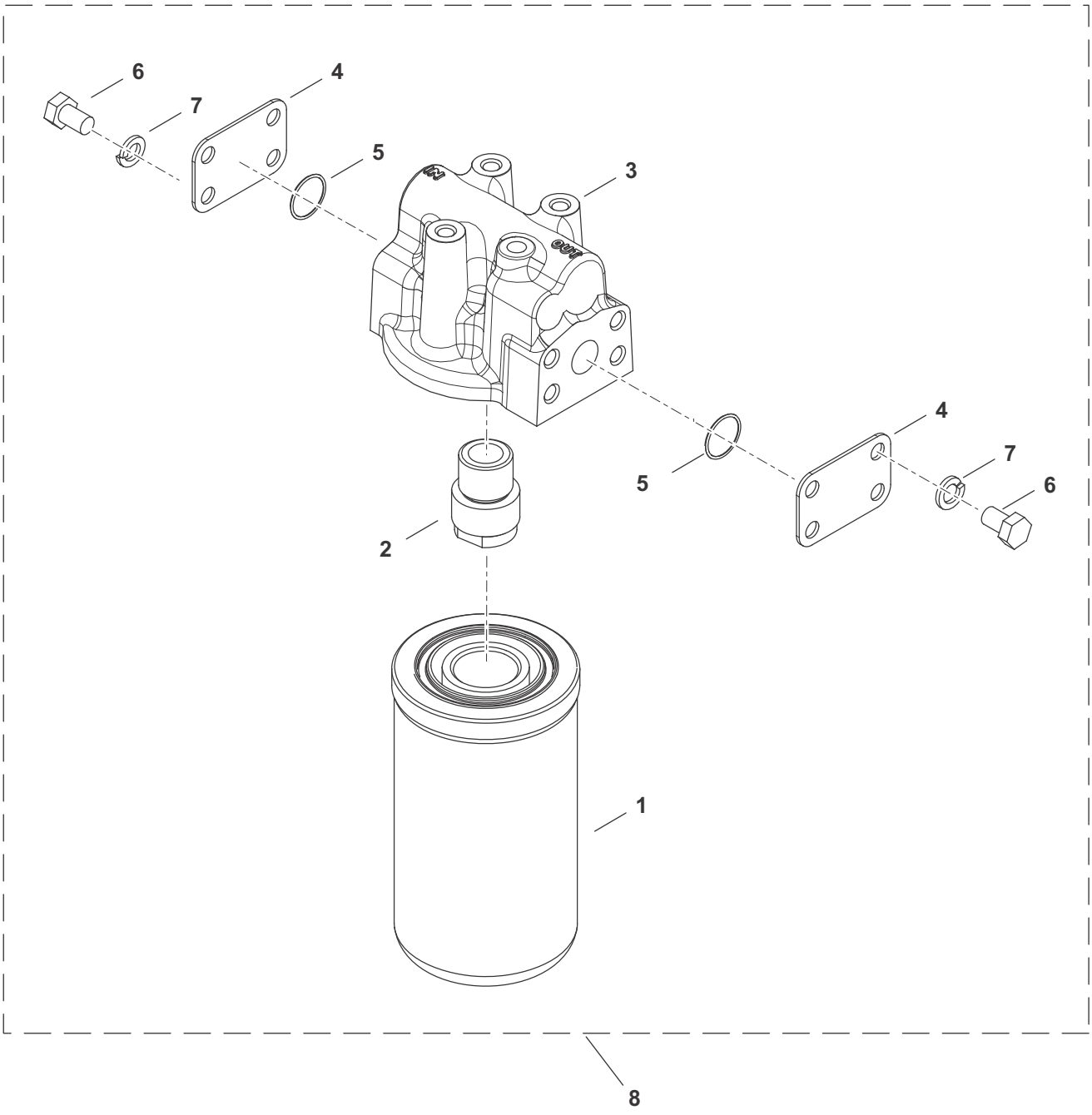
Control Valve Group



ITEM	DESCRIPTION	QTY
1	Control Valve Housing	1
2	Plug - Expansion	22
3	Plug - Expansion	3
4	Plug - Expansion	4
4A	Plug - Orifice	1
5	Valve - Solenoid	3
6	O-ring	3
7	O-ring	6
8	Capscrew	6
9	Solenoid Assembly	1
10	O-ring	1
11	O-ring	1
12	O-ring	1
13	O-ring	1
14	Solenoid Assembly	2
15	O-ring	2

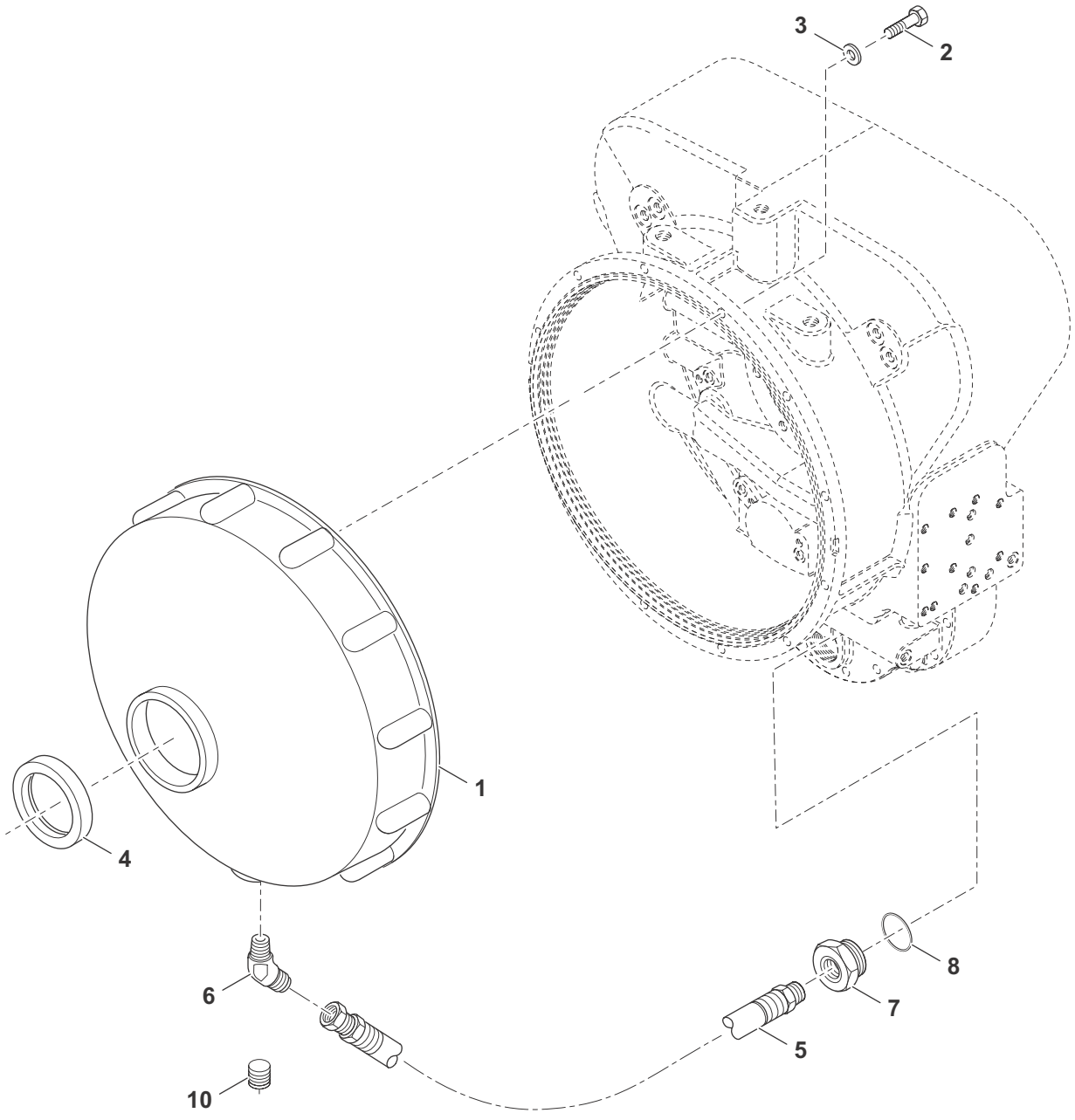
ITEM	DESCRIPTION	QTY
16	O-ring	2
17	O-ring	2
18	O-ring	2
19	Spool	3
19A	Pin - Accumulator Stop	3
20	Spring - Accumulator	3
21	Plug	3
22	O-ring	3
23	Sensor - Valve Pressure	2
24	Plug	2
25	O-ring	2
26	Plug	10
27	O-ring	10
28	Lock washer	16
29	Capscrew	16
30	Gasket	1

Remote Filter Adapter Group



ITEM	DESCRIPTION	QTY
1	Filter	1
2	Adapter - Filter	1
3	Assembly - Filter Adapter Body	1
4	Cover	1
5	O-ring	1
6	Capscrew	8
7	Lockwasher	8
8	Remote Filter Adaptor Kit Note: 2 sets are required.	1

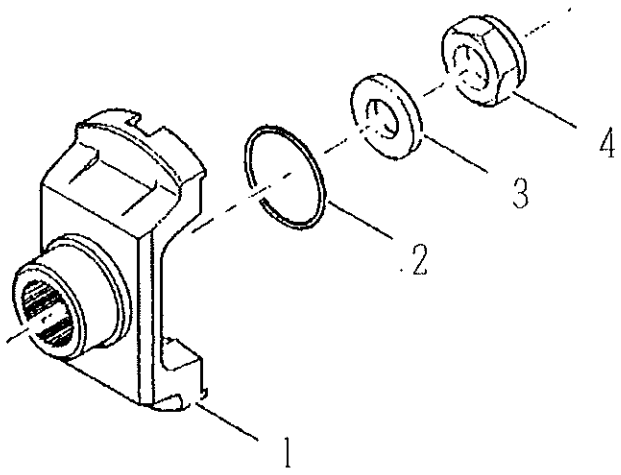
Converter Housing Cover Group



Converter Housing Cover Group

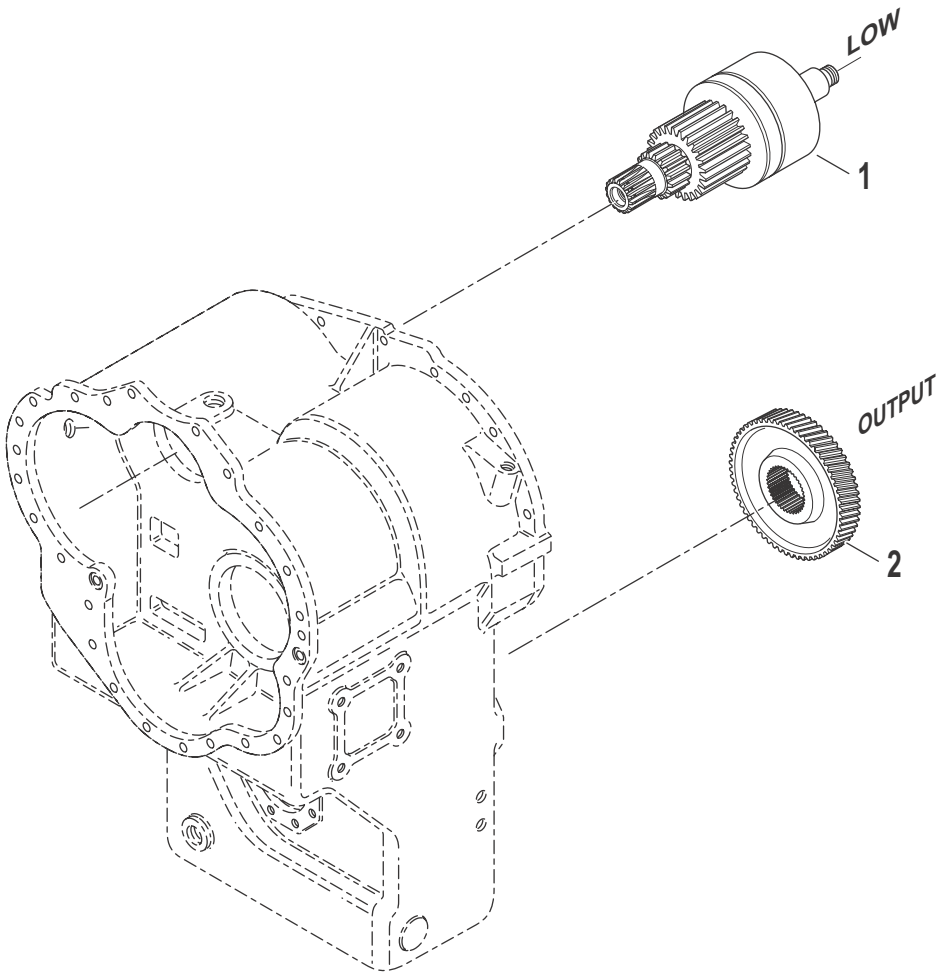
ITEM	DESCRIPTION	QTY
1	Cover - Converter Housing	1
2	Screw	12
3	Lock washer	12
4	Seal - Front Cover Oil	1
5	Hose	1
6	Not Used On This Model	
7	Not Used On This Model	
8	Not Used On This Model	
9	Not Used On This Model	
10	Plug	1

Input Flange Group



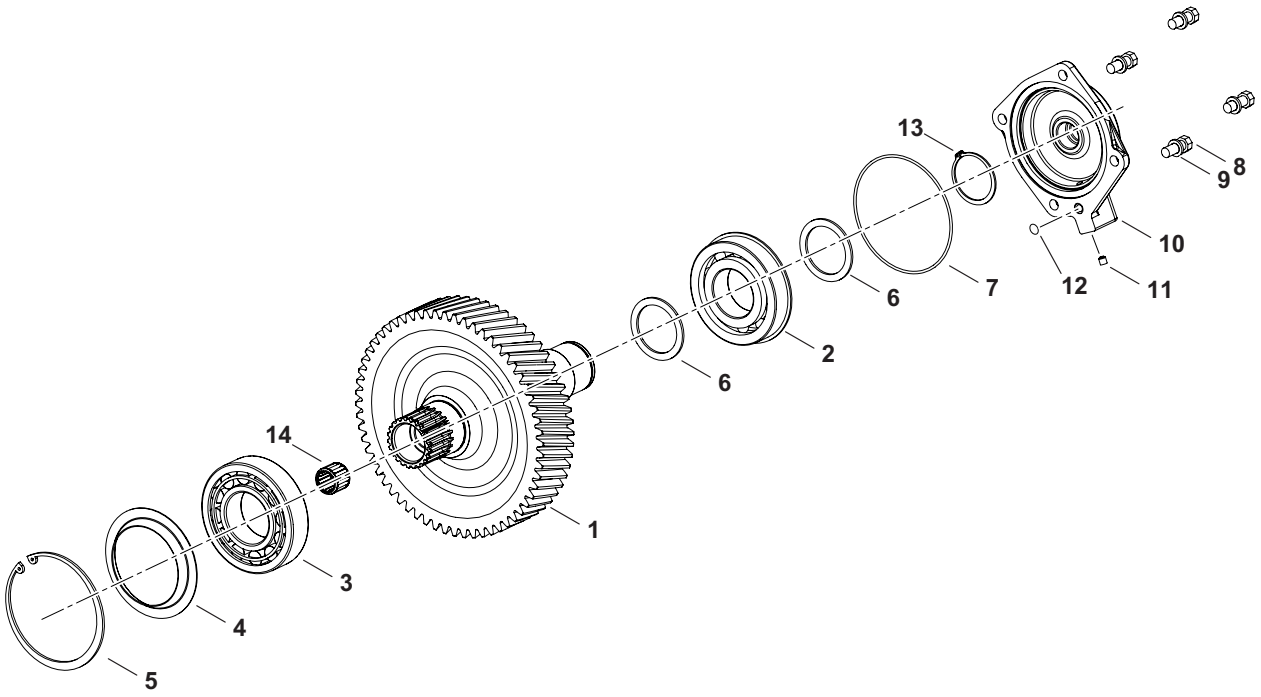
ITEM	DESCRIPTION	QTY
1	Flange - Companion	1
2	O-ring	1
3	Washer - Flange	1
4	Nut - Flange	1

Idler Shaft Gear Group



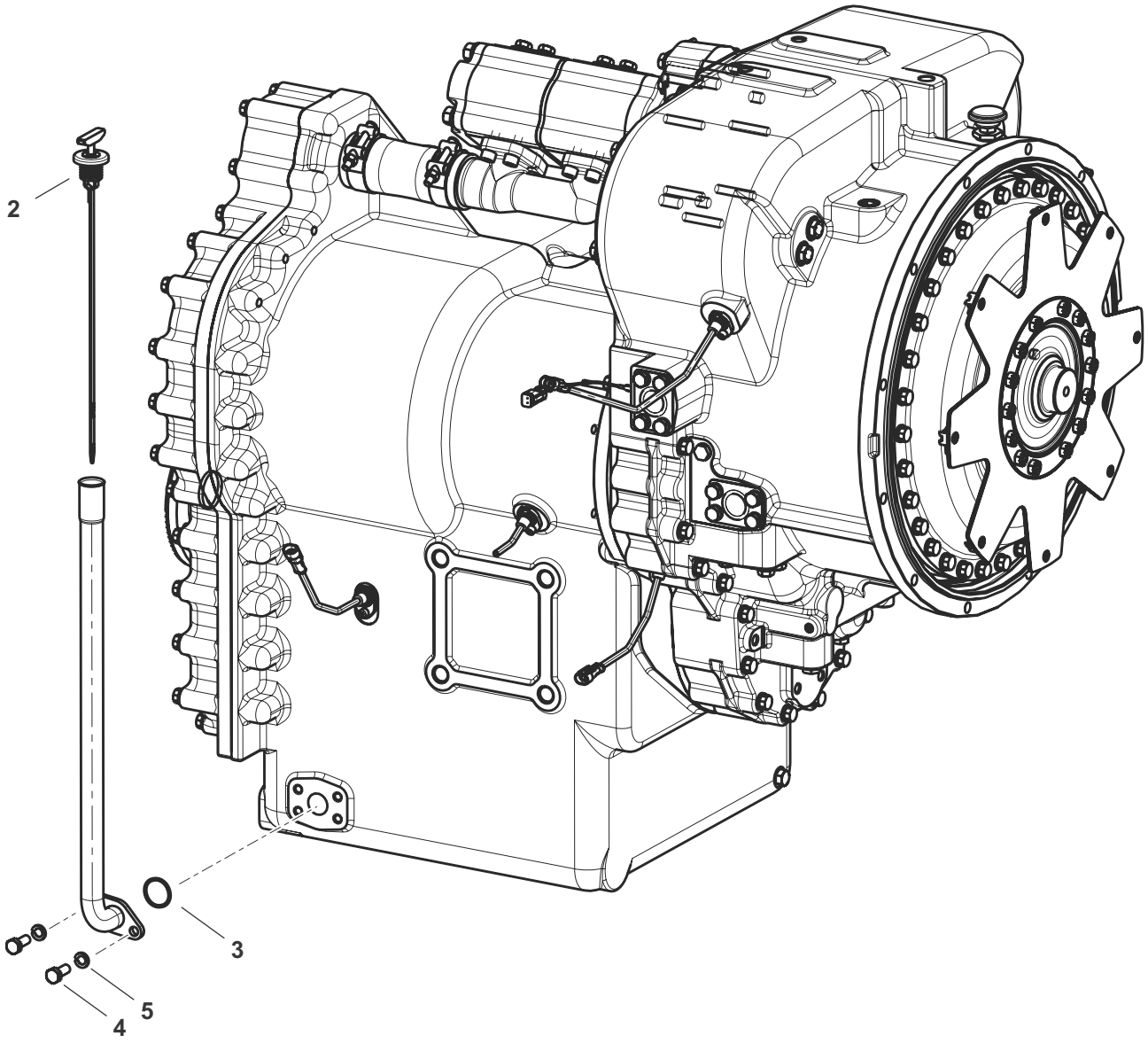
ITEM	DESCRIPTION	QTY
1	1st Speed Shaft & 3rd Driven Gear Assembly	1
2	Gear - Output (55T)	1

Idler Shaft Group



ITEM	DESCRIPTION	QTY
1	Shaft - Idler	1
2	Bearing - Ball	1
3	Bearing	1
4	Retainer - Oil	1
5	Snap Ring	1
6	Spacer - Front Bearing	2
7	O-ring	1
8	Capscrew	4
9	Lock washer	4
10	Idler Bearing Cap & Plug Assembly	1
11	Plug - Expansion	1
12	O-ring	1
13	Snap Ring	1
14	Bearing - Needle	1

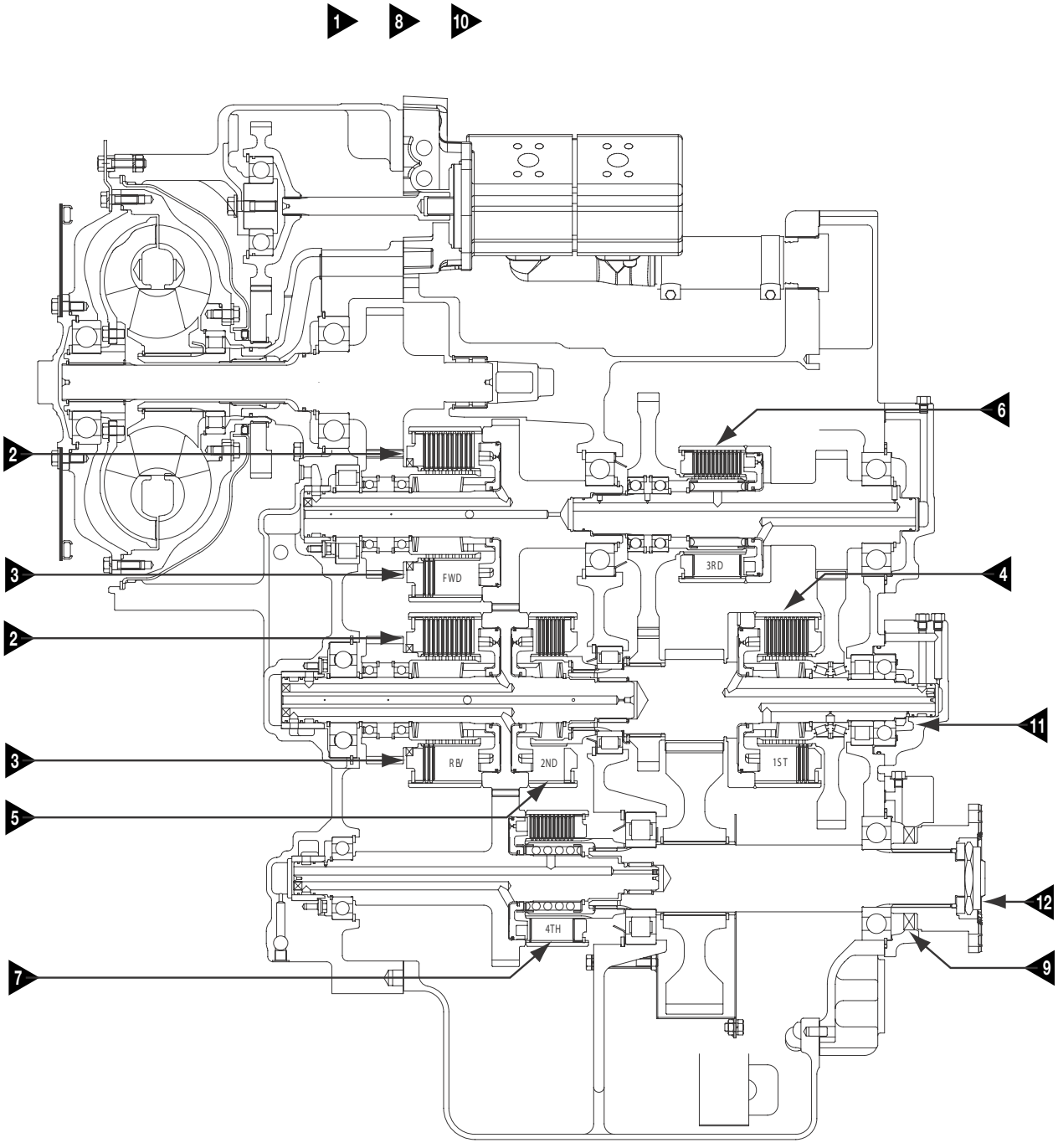
External Dipstick Group



ITEM	DESCRIPTION	QTY
1	Tube Dipstick & Flange Assembly	1
2	Dipstick	1
3	O-ring	1
4	Capscrew	2
5	Lock washer	2

INSTALLATION DIAGRAMS

Transmission Assembly Instructions



- All lead-in chamfers for oil seals, piston rings, and o-rings must be smooth and free from burrs. Inspect at assembly.
- Add some grease to o-rings before assembly.
- Add some grease to piston rings before assembly.
- Apply a thin coating of grease between seal lips on lip type seals prior to assembly
- Use only pre-coated pipe plugs. On uncoated pipe plugs, apply a light coat of LOCTITE© 592™.
- Pump must be filled up with oil prior to assembly.
- After assembly of parts using LOCTITE©, there must not be any free or excess material which might enter the oil circuit.

Refer to the picture on previous page to match step number to the transmission area where the step is performed.

1 Apply a light coat of LOCTITE© 262 or 270™ to all thru holes stud holes.

2 Teflon seals must be sized prior to assembly. Add grease to seal diameter of clutch hub before assembly.

3 **Forward and Reverse Clutch**

TE32:

11 separator discs with outer splines
11 friction discs (friction material on both side) with inner splines.

Clearance - Min. 0.23" [6.0 mm] / Max. 0.25" [6.4 mm]

TE27:

8 separator discs with outer splines
8 friction discs (friction material on both sides) with inner splines.

Clearance - Min. 0.23" [6.0 mm] / Max. 0.25" [6.4 mm]

Choose an end plate with suitable thickness to obtain this clearance.

⚠CAUTION

The separator discs in the Fwd/Rev clutches and in the 1st and 2nd clutches look similar to each other but are not the same. **NEVER mix them.**

4

1st Clutch

TE32:

11 separator discs with outer splines
11 friction discs (friction material on both side) with inner splines.

Clearance - Min. 0.17" [4.35 mm] / Max. 0.19" [4.75 mm]

TE27:

10 separator discs with outer splines
10 friction discs (friction material on both sides) with inner splines

Clearance - Min. 0.17" [4.35 mm] / Max. 0.19" [4.75 mm]

Choose an end plate with suitable thickness to obtain this clearance.

5

2nd Clutch

TE32:

7 separator discs with outer splines
7 friction discs (friction material on both side) with inner splines.

Clearance - Min. 0.10" [2.75 mm] / Max. 0.12" [3.15 mm]

TE27:

6 separator discs with outer splines
6 friction discs (friction material on both sides) with inner splines

Clearance - Min. 0.10" [2.75 mm] / Max. 0.12" [3.15 mm]

Choose an end plate with suitable thickness to obtain this clearance.

6

3rd Clutch

TE32:

12 separator discs with inner splines
11 friction discs (friction material on both side) with outer splines
2 one-sided friction discs (friction material on one side) with outer splines

Clearance - Min. 0.14" [3.5 mm] / Max. 0.16" [3.9 mm]

TE27:

9 separator discs with inner splines
8 friction discs (friction material on both side) with outer splines
2 one-sided friction discs (friction material on one side) with outer splines

Clearance - Min. 0.14" [3.5 mm] / Max. 0.16" [3.9 mm]

Choose an end plate with suitable thickness to obtain this clearance.

4th Clutch

7

TE32:

11 separator discs with inner splines
10 friction discs (friction material on both side) with outer splines
2 one-sided friction discs (friction material on one side) with outer splines

Clearance - Min. 0.12" [3.1 mm] / Max. 0.14" [3.5 mm]

TE27:

11 separator discs with inner splines
10 friction discs (friction material on both side) with outer splines
2 one-sided friction discs (friction material on one side) with outer splines

Clearance - Min. 0.12" [3.1 mm] / Max. 0.14" [3.5 mm]

Choose an end plate with suitable thickness to obtain this clearance.

8 Be sure that shielded and sealed bearings are mounted as shown.

9 Seals must be pressed in perpendicular upon shaft axis from bearing side.

10 Tighten air breather to 25–30 lbs. ft. [31–41 N•m].

11 Tighten nut to 107–118 lbs. ft. [145–160 N•m].

12 Tighten nut to 250–300 lbs. ft. [339–407 N•m].

13 Tighten two coil nuts to 5–7 lbs. ft. [6.8–9.5 N•m].

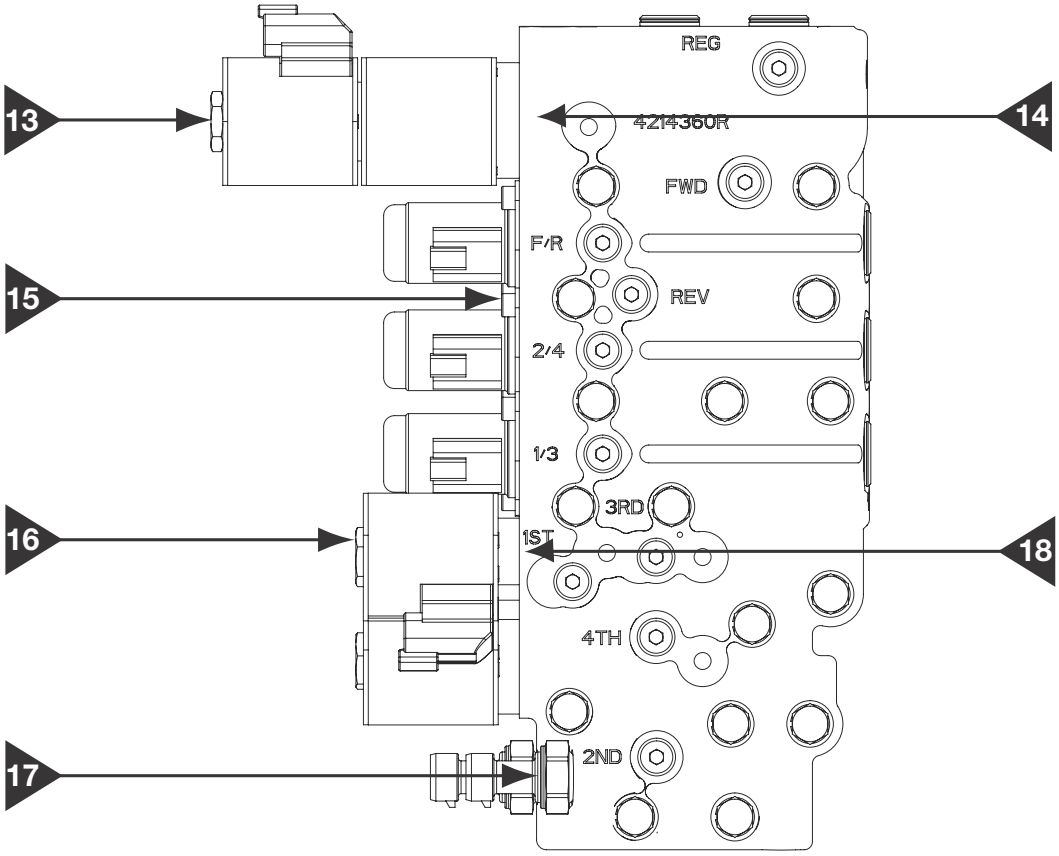
14 Tighten one valve to 39–54 lbs. ft. [53–73 N•m].

15 Tighten six screws to 3.7–4.4 lbs. ft. [5–6 N•m].

16 Tighten two coil nuts to 5–7 lbs. ft. [6.8–9.5 N•m].

17 Tighten two pressure sensors to 5–8 lbs. ft. [7–11 N•m].

18 Tighten two valves to 25–27 lbs. ft. [34–36 N•m].


13
14
15
16
17
18
REG
421436OR
FWD
F/R
REV
2/4
1/3
3RD
1ST
4TH
2ND

Control Valve Assembly Instructions

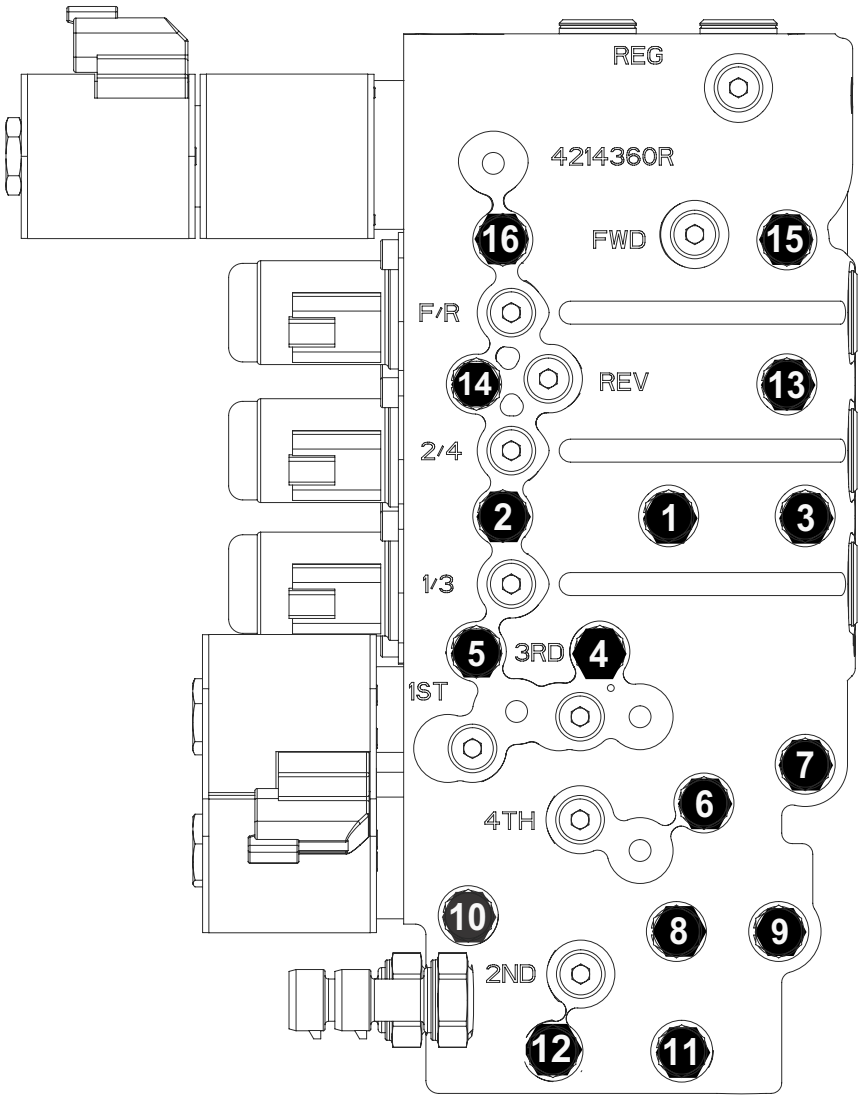
Remove the Valve

Refer to the “Cleaning and Inspection” (see page 103) section of this manual. The area around the valve must be clean and free of any foreign material.

Unscrew 16 bolts (indicated on drawing below) a few turns. When all bolts are loose, you should be able to move the valve. Replace two bolts by aligning studs. Remove the remaining 14 hex bolts and valve from the transmission case.

Install the Valve

1. Install two (2) aligning studs. Install new gasket and valve body.
2. Install fourteen (14) bolts and hand-tighten in the numerical sequence indicated on the drawing below.
3. Replace the studs by bolts.
4. Then torque all bolts twice to 15–18 lbs. ft. [20–25 N•m] in the correct sequence.
5. Recalibrate the transmission.



CLEANING AND INSPECTION

DANGER

Care should be exercised to avoid skin rashes, fire hazards, and inhalation of vapors when using solvent type and alkali cleaners.

Cleaning

Clean all parts thoroughly using solvent type cleaning fluid. It is recommended that parts be immersed in cleaning fluid and agitated slowly until parts are thoroughly cleaned of all old lubricants and foreign materials.

Thoroughly dry all cleaned parts immediately by using moisture-free compressed air or soft lint-free absorbent wiping rags free of abrasive materials such as metal filings, contaminated oil, or lapping compound.

BEARINGS

Remove bearings from cleaning fluid and strike larger side of cone flat against a block of wood to dislodge solidified particles of lubricant. Immerse again in cleaning fluid to flush out particles. Repeat above operation until bearings are thoroughly clean. Dry bearings using moisture-free compressed air. Be careful to direct air stream across bearings to avoid spinning. NEVER SPIN BEARINGS WHEN DRYING. Bearings may be rotated slowly by hand to facilitate the drying process.

HOUSINGS, COVERS, AND CAPS

Clean interior and exterior of housings, bearing caps, etc., thoroughly. Cast parts may be cleaned in hot solution tanks with mild alkali solutions, providing these parts do not have ground or polished surfaces. Parts should remain in solution long enough to be thoroughly cleaned and heated. This will aid the evaporation of the cleaning solution and rinse water. Parts cleaned in solution tanks must be thoroughly rinsed with clean water to remove all traces of alkali. Cast parts may also be cleaned with steam cleaner.

All parts cleaned must be thoroughly dried immediately by using moisture-free compressed air or soft lint-free absorbent wiping rags, free of abrasive materials such as metal filings, contaminated oil, or lapping compound.

Inspection

The importance of careful and thorough inspection of all parts cannot be overstressed. Replacement of all parts showing indication of wear or stress will eliminate costly and avoidable failures at a later date.

BEARINGS

Carefully inspect all rollers, cages, and cups for wear, chipping, or nicks to determine fitness of bearings for further use. NEVER REPLACE A BEARING CONE OR CUP INDIVIDUALLY without replacing the mating cup or cone at the same time. After inspection, dip bearings in clean light oil and wrap in clean lint-free cloth or paper to protect them until installed.

OIL SEALS, GASKETS, AND RETAINING RINGS

Replacement of spring loaded oil seals, gaskets, and retaining rings are more economical when the unit is disassembled than to risk premature overhaul to replace these parts at a future time. Loss of lubricant through a worn seal may result in failure of other more expensive parts of the assembly. Sealing members should be handled carefully, particularly when being installed. Cutting, scratching, or curling under the lip of the seal seriously impairs its efficiency. At reassembly, lubricate rings and seals with Multipurpose Lithium Grease Grade 2 for axles and Automatic Transmission Fluid for transmissions.

GEARS AND SHAFTS

If Magna-Flux or a dye penetrant process is available, use this process to check parts. Examine teeth and the ground/polished surfaces of all gears and shafts carefully for wear, pitting, chipping, nicks, cracks, or scoring. If gear teeth are cracked or show spots where case hardening is worn through, replace with new gear. Small nicks may be removed with suitable hone stone. Inspect shafts to make certain they are not sprung, bent, or have twisted splines.

HOUSINGS, COVERS, AND CAPS

Inspect housings, covers, and caps to be certain they are thoroughly cleaned and that mating surfaces, bearing bores, etc. are free from nicks or burrs. Check all parts carefully for evidence of cracks or conditions which can cause oil leaks or failures.

DISASSEMBLY & REASSEMBLY

Getting Started

⚠CAUTION

Cleanliness is of extreme importance in the repair and overhaul of the transmission. Before conducting repairs, the exterior of the unit must be thoroughly cleaned to prevent dirt and foreign debris from entering the transmission.

⚠CAUTION

When maintenance work requires welding, disconnect both connectors from the APC200 and from the control valve unit before any welding is started.

NOTE:

CLUTCH RETURN SPRING PACKS ARE CERTIFIED ACCORDING TO COMPRESSION WEIGHT SPECIFICATIONS AND ARE PRE-PACKED IN QUANTITIES TO REPAIR ONE (1) SPECIFIC CLUTCH.

The disc spring packs are to be used as complete assemblies and care should be taken not to intermix the individual disc springs with disc springs in another clutch or disc spring pack.

Each disc spring assembly is made up of selected springs to precisely match each part within this assembly. Failure to replace all piston return springs can result in unequal deflection within the spring pack. The result of this imbalance may adversely affect overall life of springs.

Transmission Case Disassembly

FIGURE 1: Front view of the TE32 transmission.

.

FIGURE 2: Remove input flange nut.

FIGURE 3: Remove input flange nut, washer, o-ring, and flange.

FIGURE 4: Remove bolts and washers securing front cover to converter housing.

FIGURE 5: Remove converter housing front cover with three (3) standard eye bolts 3/4 UNC attached to a chain.

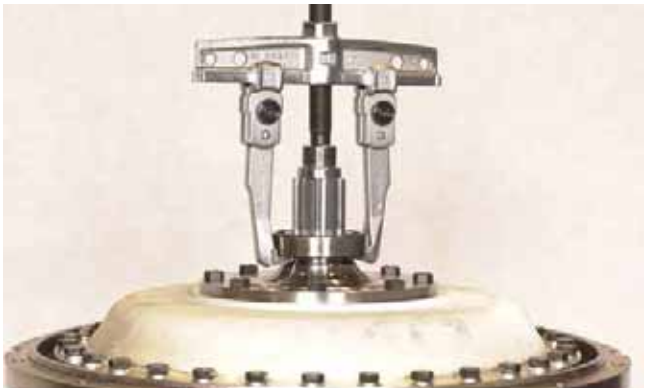


FIGURE 6: Remove input shaft support bearing.

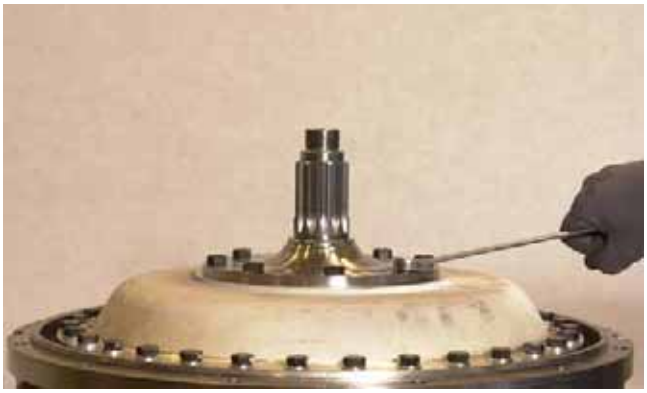


FIGURE 7: Remove input shaft support.

FIGURE 8: Remove turbine shaft outer snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 9: Remove impeller cover bolts.

FIGURE 10: Use special tool to lift impeller cover assembly. (See “Impeller Cover Lifting Hook”, on page 179,)

FIGURE 11: Remove locating ring from turbine shaft.

FIGURE 12: Remove reaction member snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 13: Remove reaction member.

FIGURE 14: Remove reaction member spacer.

FIGURE 15: Use a standard bar-style puller to remove the impeller and oil baffle.

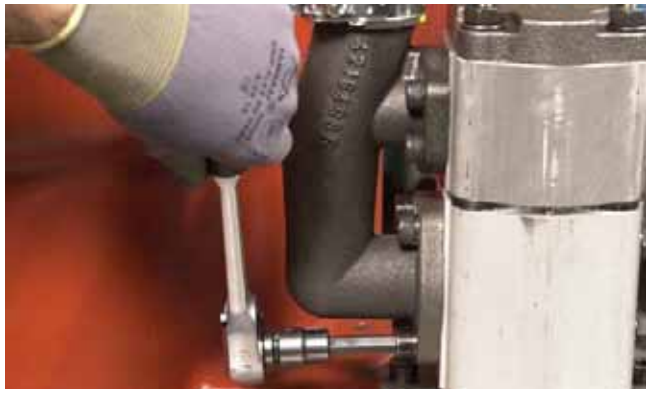


FIGURE 16: Remove suction adapter capscrews and hose clips.

FIGURE 17: Remove suction adapter assembly and o-rings.

FIGURE 18: Remove capscrews from pump manifold.

FIGURE 19: Remove pump manifold and o-ring.

FIGURE 20: Remove gear-to-pump shaft.

FIGURE 21: Remove regulator valve assembly capscrews.

FIGURE 22: Remove regulator valve assembly and gasket.

FIGURE 23: Remove pump drive blanking cover plate bolts (if fitted).

FIGURE 24: Remove pump drive blanking cover plate and gasket (if fitted).

FIGURE 25: Remove stator support assembly bolts and lockwashers.

FIGURE 26: Remove stator support assembly.

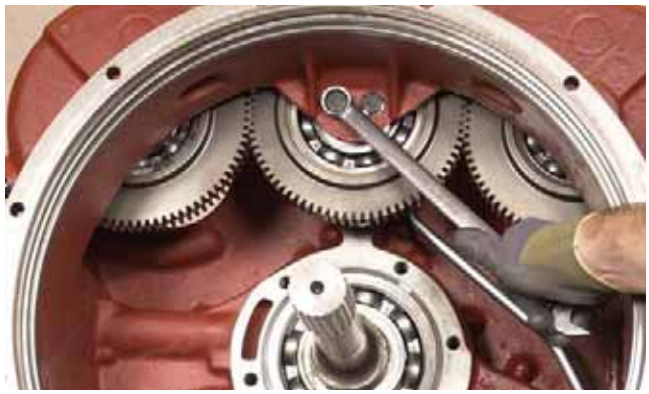


FIGURE 27: Remove pump drive idler gear bolts.

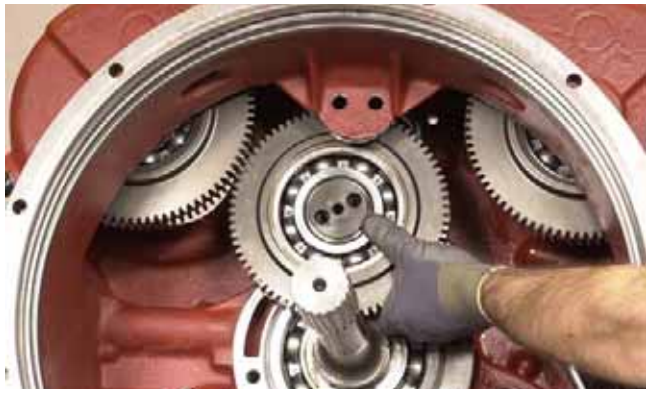


FIGURE 28: Remove pump drive idler gear, bearing, and support assembly.

FIGURE 29: Remove pump drive gear bolts.

FIGURE 30: Remove pump drive.

FIGURE 31: Remove pump drive gear bolts.

FIGURE 32: Remove pump drive.

FIGURE 33: See “Control Valve Assembly Instructions”, on page 102, for details on the disassembly of control valve.

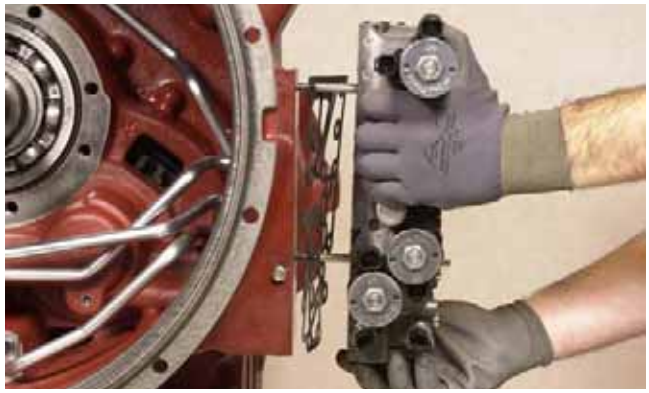


FIGURE 34: Remove control valve and gasket.

FIGURE 35: Remove all sensors from converter housing (3).

FIGURE 36: Remove converter-housing-to-transmission-case bolts and washers.

FIGURE 37: Support converter housing with chain hoist and strap. Use a soft hammer to separate converter housing from transmission case.

FIGURE 38: Converter assembly removed.

NOTE:

Reverse/ 2nd and 4th clutch drum will remain in the converter housing.

FIGURE 39: Remove snap ring from 2nd clutch hub (driven gear).

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 40: Remove retainer from 2nd clutch hub.

FIGURE 41: Remove inner snap ring from 2nd clutch hub.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 42: Remove 2nd clutch hub.

FIGURE 43: Remove snap ring from 4th clutch hub and remove hub.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 44: Remove bolts from 3rd clutch shaft rear bearing.

FIGURE 45: Remove 3rd clutch shaft rear bearing cap and o-ring.

FIGURE 46: Remove 3rd clutch shaft rear bearing cap snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 47: Remove 1st clutch shaft rear bearing cap bolts.

FIGURE 48: Remove 1st clutch shaft rear bearing cap o-rings and spring disc.

FIGURE 49: Remove nuts from idler bearing cover assembly.

FIGURE 50: Remove idler bearing cover assembly and o-ring.

FIGURE 51: Remove idler bearing snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 52: Remove transmission rear cover bolts.

FIGURE 53: Remove temperature sensor.

FIGURE 54: Use special tool to remove nut from 1st shaft. (See “Shaft Nut Socket”, on page 180.)

FIGURE 55: Remove bearing inner and outer race.

FIGURE 56: Using a hoist, remove rear cover from transmission case. Tap 3rd/1st shaft with a soft hammer to assist removal and avoid bending shaft.

FIGURE 57: Remove snap ring from 3rd shaft bearing.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 58: Remove spacer.

FIGURE 59: Using a puller, remove 3rd shaft bearing.

FIGURE 60: Shown are the 1st shaft drum assembly and idler shaft as an assembly, removed. (See “Idler & Low Shaft Lifting Hook”, on page 178.)

FIGURE 61: Remove 3rd shaft drum assembly.

FIGURE 62: Forward drum assembly removed, showing snap ring and front bearing. Snap ring sits under gear and must be removed before forward drum assembly can be hoisted.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 63: Remove forward drum assembly bearing oil retainer.

FIGURE 64: Remove 1st shaft drum assembly front bearing snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 65: Remove 1st shaft drum assembly front bearing oil retainer.

FIGURE 66: Remove 1st shaft drum assembly front bearing.

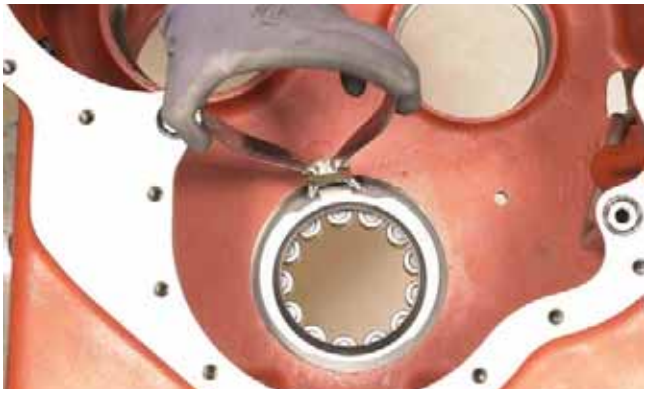


FIGURE 67: Remove idler shaft front bearing snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 68: Remove idler shaft front bearing oil retainer.

FIGURE 69: Remove idler shaft front bearing.

FIGURE 70: Remove turbine shaft bearing snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 71: Remove turbine shaft bearings (2).

FIGURE 72: Using an impact wrench, remove front output flange nut.

FIGURE 73: Remove front output flange nut, washer, and o-ring.

FIGURE 74: Remove front output flange.

FIGURE 75: Loosen front output cap bolts.

FIGURE 76: Remove front output cap and o-ring.

FIGURE 77: Remove output cap shims.

FIGURE 78: Using an impact wrench, loosen rear output flange nut.

FIGURE 79: Remove rear output flange nut, washer, and o-ring.

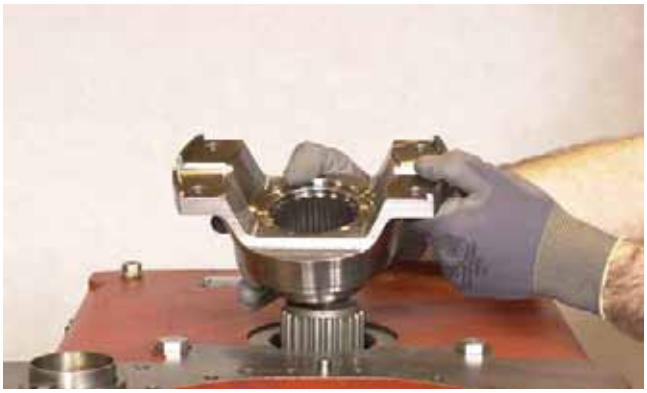


FIGURE 80: Remove rear output flange.

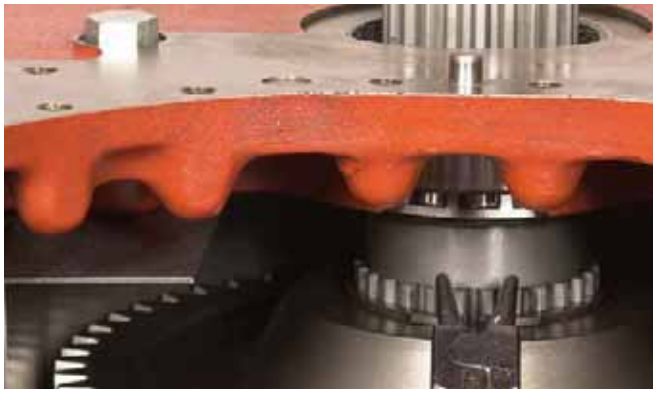


FIGURE 81: Remove output gear snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 82: Push output shaft through bearing and gear from the rear side.

FIGURE 83: Remove rear cone bearing and snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 84: Remove output gear.

FIGURE 85: Remove inside front cap bearing bolts.

FIGURE 86: Remove inside front cap.

FIGURE 87: Remove oil baffle bolts.

FIGURE 88: Remove oil baffle.

FIGURE 89: Tap rear bearing cup from case.

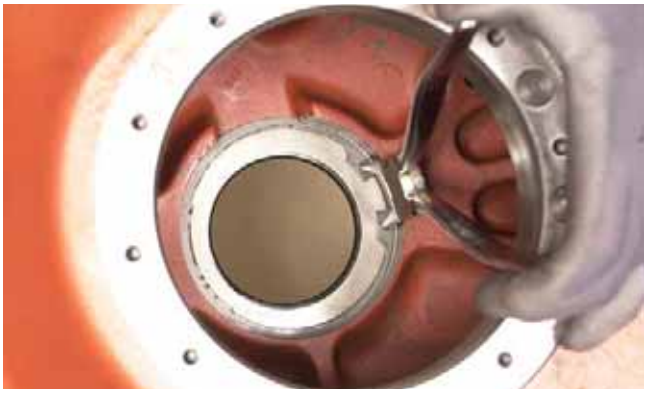


FIGURE 90: Remove oil seal snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 91: Tap rear oil seal from case.

FIGURE 92: Remove suction tube bolts (2).

FIGURE 93: Remove inside suction tube bolt and nut.

FIGURE 94: Remove suction tube assembly and o-ring.

Converter Housing Disassembly

FIGURE 95: Remove 4th drum shaft assembly snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 96: Remove 4th drum shaft assembly using special tool. (See “4th Drum Lifting Hook”, on page 181.)

FIGURE 97: Using external snap ring pliers, open Rev/2nd drum shaft assembly bearing snap ring and remove shaft assembly

using special tool. (See “2nd/Rev Drum Lifting Hook”, on page 182.)

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 98: Remove turbine shaft bearing snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 99: Using a soft hammer, tap turbine shaft and bearing assembly from converter housing.

FIGURE 100: Pry forward shaft bearing from housing as shown. Check three wear sleeves in converter housing and replace if necessary.

Reverse & Second Clutch Disassembly

Reverse Clutch Disassembly

FIGURE 101: Remove piston rings (3).

FIGURE 102: Remove bearing snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 103: Using a bearing puller, remove bearing.

FIGURE 104: Remove bearing thrust washer.

FIGURE 105: Remove clutch gear snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 106: Remove clutch gear and outer bearing as an assembly.

FIGURE 107: Remove end plate snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 108: Remove end plate and seal assembly.

FIGURE 109: Remove clutch gear inner bearing.

FIGURE 110: Remove clutch inner and outer discs.

FIGURE 111: Compress piston return springs and remove spring snap ring.

⚠WARNING

Use caution when removing snap ring.
Force of spring is 3399 N•m. Failure to comply can cause personal injury.

FIGURE 112: Remove Belleville washers.

FIGURE 113: Remove clutch piston spacer.

FIGURE 114: Remove reverse clutch piston.

2nd Clutch Disassembly

FIGURE 115: Remove 2nd clutch end plate snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 116: Remove 2nd clutch end plate.

FIGURE 117: Remove clutch inner and outer discs.

⚠CAUTION

The steel discs in the Fwd/Rev clutches and in the 1st and 2nd clutches look similar to each other but are not the same. NEVER mix them.

To ensure correct reassembly, be sure to keep the different types of discs separated and identified.

FIGURE 118: Compress return springs and remove snap ring.

⚠WARNING

Use caution when removing snap ring.
Force of spring is 2888 N•m. Failure to comply can cause personal injury.

FIGURE 119: Remove Belleville washers.

FIGURE 120: Remove clutch piston spacer (wear sleeve).

FIGURE 121: Remove clutch piston.

Reverse & Second Clutch Reassembly

Second Clutch Reassembly

FIGURE 122: Install clutch piston inner seal. Rotate piston until seal is flush with outer diameter of piston.

NOTE:

Bleed hole in the piston must be clean and free of any foreign material. Instructions for cleaning can be found in the "Cleaning and Inspection" (see page 103) section of the manual.

NOTE:

Seal must be sized before installing in clutch drum. Sizing is best accomplished by rotating clutch piston while holding a round object against the new seal.

FIGURE 123: Install clutch piston outer seal.

FIGURE 124: Install clutch piston spacer (wear sleeve).

Reverse & Second Clutch Reassembly

FIGURE 125: Install piston Belleville washers. Position first washer with large diameter of bevel toward spacer (wear sleeve). Refer to Figure 126. Alternate seven washers.

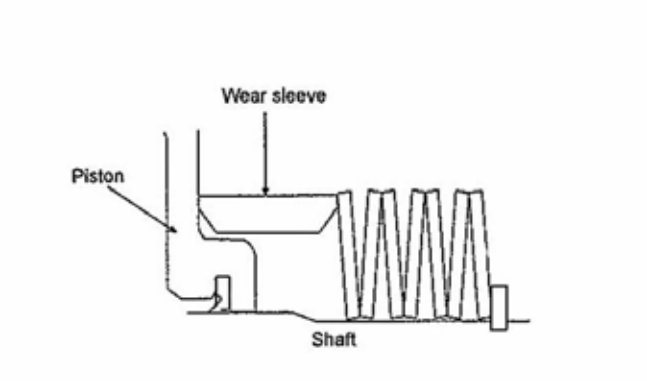


FIGURE 126: Spring and spacer position.

FIGURE 127: Compress spring and install snap ring, making sure ring is in full position in groove.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 128: Install clutch inner and outer discs into drum. Start with one steel disc against piston. Alternate friction and steel discs until proper number of discs are installed. Last disc is friction disc.

FIGURE 129: Install end plate.

FIGURE 130: Install end plate snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

Reverse Clutch Reassembly

FIGURE 131: Install clutch piston inner seal. Size as described in Figure 106.

NOTE:

Bleed hole in the piston must be clean and free of any foreign material. Instructions for cleaning can be found in the "Cleaning and Inspection" (see page 103) section of the manual.

FIGURE 132: Install clutch piston outer seal.

FIGURE 133: Install clutch piston spacer (wear sleeve).

FIGURE 134: Install clutch piston Belleville washers. Position first washer with large diameter of bevel toward spacer (wear sleeve). Alternate fifteen (15) washers. Refer to Figure 135.

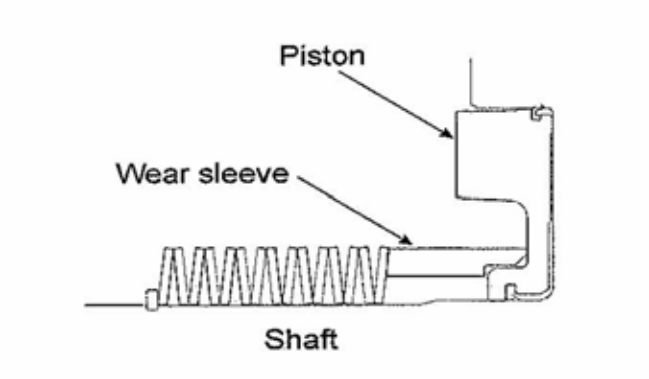


FIGURE 135: Spring and spacer position.

FIGURE 136: Compress spring and install snap ring, making sure ring is in full position in groove.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 137: Install one (1) clutch inner/outer steel disc into drum. Alternate friction and steel discs until proper number of discs are installed. First and last discs are steel.

FIGURE 138: Install new seal in end plate.

FIGURE 139: Install end plate in drum and fit end plate snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 140: Install two (2) bearings in clutch gear and warm assembly to 248°F [120°C]. Install clutch gear and hub into clutch drum. Align splines on clutch hub with internal teeth of friction discs. Tap gear into position.

⚠CAUTION

NEVER force the operation in this step. Gear splines must be aligned with internal teeth of all friction discs. Failure to comply may cause equipment damage.

FIGURE 141: Install bearing snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 142: Install outer bearing thrust washer.

FIGURE 143: Warm outer bearing to 248°F [120°C] and install on shaft with groove down as shown.

FIGURE 144: Install bearing snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 145: Install three (3) piston rings.

Forward Clutch Disassembly

FIGURE 146: Remove bearing snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 147: Remove spacer.

FIGURE 148: Remove bearing.

Forward Clutch Disassembly

FIGURE 149: Remove large snap ring from shaft.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 150: Remove two (2) piston rings.

FIGURE 151: Remove bearing snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 152: Remove bearing inner race.

FIGURE 153: Remove snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 154: Using a puller, remove clutch gear and outer bearing.

FIGURE 155: Remove end plate snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 156: Remove end plate.

FIGURE 157: Remove clutch inner and outer discs.

FIGURE 158: Remove inner bearing.

FIGURE 159: Compress return spring and remove snap ring.

⚠WARNING

Use caution when removing snap ring.
Force of spring is 3381N•m. Failure to comply can cause personal injury.

FIGURE 160: Remove Belleville washers.

FIGURE 161: Remove clutch piston spacer (wear sleeve).

FIGURE 162: Remove clutch piston.

Forward Clutch Reassembly

FIGURE 163: Install clutch piston inner seal.

NOTE:

Bleed hole in the piston must be clean and free of any foreign material. Instructions for cleaning can be found in the "Cleaning and Inspection" (see page 103) section of the manual.

FIGURE 164: Install clutch piston outer seal.

FIGURE 165: Install clutch piston spacer (wear sleeve).

FIGURE 166: Install clutch piston Belleville washers. Position first washer with large diameter of bevel toward spacer (wear sleeve). Alternate fifteen (15) washers. Refer to Figure 167.

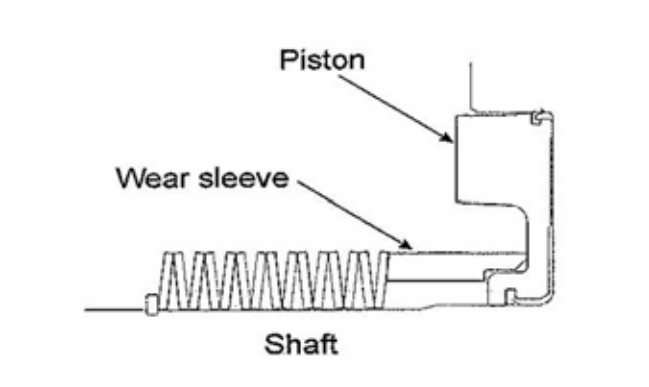


FIGURE 167: Spring and spacer position.

FIGURE 168: Compress spring and install snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 169: Install steel discs. Alternate friction and steel discs until proper number of discs are installed. First and last discs are steel.

FIGURE 170: Install new seal in end plate and install plate.

FIGURE 171: Install end plate snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 172: Install two (2) bearings in clutch gear and warm assembly to 248°F [120°C]. Install clutch gear and hub into clutch drum. Align splines on clutch hub with internal teeth of friction discs. Tap gear into position.

⚠CAUTION

NEVER force the operation in this step. Gear splines must be aligned with internal teeth of all friction discs. Failure to comply may cause equipment damage.

FIGURE 173: Install bearing snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 174: Install bearing inner race.

FIGURE 175: Install bearing snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 176: Install two (2) piston rings.

FIGURE 177: Install snap ring over shaft before fitting bearing.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 178: Warm bearing to 248°F [120°C] and install on shaft with groove down as shown.

FIGURE 179: Install spacer.

FIGURE 180: Install snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

Third Clutch Disassembly

FIGURE 181: Remove one (1) piston ring.

FIGURE 182: Remove clutch gear bearing snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 183: Remove 3rd clutch driven gear and bearing.

FIGURE 184: Remove spacer.

Third Clutch Disassembly

FIGURE 185: Remove end plate snap ring.

FIGURE 188: Compress spring and remove snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 186: Remove end plate.

FIGURE 189: Remove spring and spring retainer.

FIGURE 187: Remove clutch inner and outer discs.

FIGURE 190: Remove piston spacer.

FIGURE 191: Remove clutch piston.

Third Clutch Reassembly

FIGURE 192: Install clutch piston inner seal.

NOTE:

Bleed hole in the piston must be clean and free of any foreign material. Instructions for cleaning can be found in the "Cleaning and Inspection" (see page 103) section of the manual.

FIGURE 193: Install clutch piston outer seal and install piston into drum.

FIGURE 194: Install clutch piston spacer.

FIGURE 195: Install spring.

FIGURE 196: Install spring retainer.

Third Clutch Reassembly

FIGURE 197: Compress spring and install retainer.

FIGURE 198: Install clutch outer half disc (friction material on one side) with steel side down.

FIGURE 199: Install steel discs. Alternate friction and steel discs until proper number of discs are installed. First and last discs are steel.

FIGURE 200: Install clutch outer half disc (friction material on one side) with steel side up.

FIGURE 201: Install end plate.

FIGURE 202: Install snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 203: Install spacer.

FIGURE 204: Install gear and bearing into clutch drum by warming the assembly to 248°F [120°C]. Align splines on clutch hub with internal teeth of friction discs. Tap gear into position.

⚠CAUTION

NEVER force the operation in this step. Gear splines must be in full position with internal teeth of all inner discs. Failure to comply may cause equipment damage.

FIGURE 205: Install snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 206: Install snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 207: Install piston ring.

Fourth Clutch Disassembly

FIGURE 208: Remove piston rings.

Fourth Clutch Disassembly

FIGURE 209: Remove bearing snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 210: Using a puller as shown, remove front bearing shaft.

FIGURE 211: Remove snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 212: Remove end plate snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 213: Remove end plate.

FIGURE 214: Remove clutch inner and outer discs.

FIGURE 215: Compress spring and remove snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 216: Remove spring and spring retainer.

FIGURE 217: Remove spacer.

FIGURE 218: Remove clutch piston.

Fourth Clutch Reassembly

FIGURE 219: Install clutch piston inner seal.

NOTE:

Bleed hole in the piston must be clean and free of any foreign material. Instructions for cleaning can be found in the "Cleaning and Inspection" (see page 103) section of the manual.

FIGURE 220: Install clutch piston outer seal and install piston into drum.

FIGURE 221: Install spacer.

FIGURE 222: Install spring and spring retainer.

FIGURE 223: Compress spring and install snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 224: Install one (1) clutch outer half disc (friction material on one side) steel side down.

FIGURE 225: Install one (1) friction disc. Alternate steel and friction discs until proper number of discs are installed.

FIGURE 226: Install one (1) clutch outer half disc (friction material on one side) steel side up.

FIGURE 227: Install end plate.

FIGURE 228: Install end plate snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 229: Install snap ring over shaft (to be used when installing drum/shaft in casing).

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 230: Warm bearing to 248°F [120°C] and install on shaft.

FIGURE 231: Install bearing snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 232: Install two (2) piston rings.

First Clutch Disassembly

FIGURE 233: Remove two (2) piston rings.

FIGURE 234: Using a puller, remove gear, bearing outer race, and spacer as an assembly.

FIGURE 235: Remove bearing washer.

FIGURE 236: Remove end plate snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 237: Remove end plate.

FIGURE 238: Remove clutch inner and outer discs.

FIGURE 239: Using a bearing puller, remove lower hub taper roller bearing from shaft.

FIGURE 240: Compress Belleville washers and remove piston return spring snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 241: Remove spring retainer.

FIGURE 242: Remove Belleville washers.

FIGURE 243: Remove clutch piston spacer.

FIGURE 244: Remove clutch piston.

FIGURE 245: Turn shaft and remove outer bearing race from shaft.

FIGURE 246: Remove bearing spacer.

FIGURE 247: Remove snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 248: Remove gear.

First Clutch Reassembly

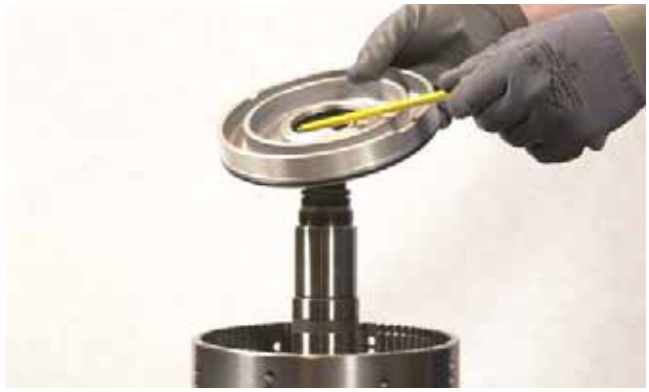


FIGURE 249: Install clutch piston inner seal.

NOTE:

Bleed hole in the piston must be clean and free of any foreign material. Instructions for cleaning can be found in the "Cleaning and Inspection" (see page 103) section of the manual.

FIGURE 250: Install clutch piston outer seal and install piston into drum.

FIGURE 251: Install clutch piston spacer (wear sleeve).

FIGURE 252: Install Belleville washers. Position first washer with large diameter of bevel toward spacer (wear sleeve). Alternate nine (9) washers. Refer to Figure 253.

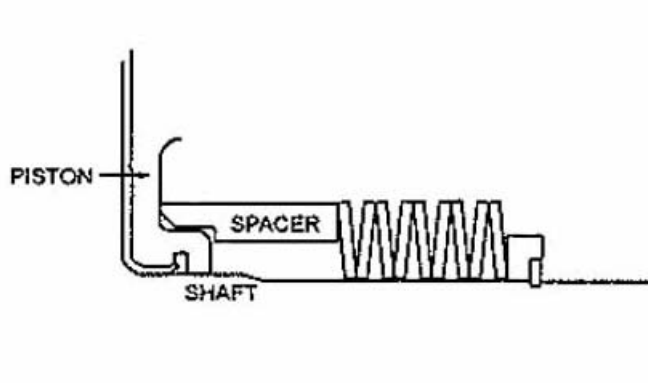


FIGURE 253: Spring and spacer position.

FIGURE 254: Install spring retainer, making sure it is fitted with stepped groove upward.

FIGURE 255: Compress return spring and install snap ring. Make sure retainer ring is in full position in groove.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 256: Install one (1) steel disc. Alternate steel and friction discs until proper number of discs are installed.

FIGURE 257: Install end plate.

FIGURE 258: Install end plate snap ring.

⚠WARNING

Use caution when installing snap ring. Failure to comply can cause personal injury.

FIGURE 259: Warm taper bearing to 248°F [120°C] and install on shaft.

FIGURE 260: Install bearing spacer.

FIGURE 261: Install clutch driven gear and hub assembly. Align splines on clutch gear hub with internal splines of friction discs.

⚠CAUTION

NEVER force the operation in this step. Gear splines must be in full position with internal teeth of all inner discs. Failure to comply may cause equipment damage.

FIGURE 262: Warm taper bearing to 248°F [120°C].

FIGURE 263: Install washer.

FIGURE 264: Warm bearing to 248°F [120°C] and install on shaft.

FIGURE 265: Install two (2) piston rings.

FIGURE 266: Turn shaft and install gear.

FIGURE 267: Install gear snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 268: Install bearing spacer.

FIGURE 269: Warm bearing to 248°F [120°C] and install on shaft.

Idler Shaft Disassembly

FIGURE 270: Remove idler shaft rear bearing snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 271: Remove idler shaft rear bearing spacer.

FIGURE 272: Using a puller, remove idler shaft rear bearing.

FIGURE 273: Remove idler shaft rear bearing spacer.

FIGURE 274: Turn shaft and, using a puller, remove bearing inner race from shaft.

Idler Shaft Reassembly

FIGURE 275: Warm bearing inner race to 248°F [120°C] and install on shaft.

FIGURE 276: Turn shaft and install idler shaft rear bearing spacer.

FIGURE 277: Warm bearing to 248°F [120°C] and install on shaft.

FIGURE 278: Install idler shaft rear bearing spacer.

FIGURE 279: Install idler shaft rear bearing snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

Turbine Shaft Disassembly

FIGURE 280: Remove piston ring.

FIGURE 281: Remove bearing snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 282: Remove front bearing spacer.

FIGURE 283: Using a hydraulic press, remove bearing.

Turbine Shaft Reassembly

FIGURE 284: Warm bearing to 248°F [120°C] and install on shaft, ensuring that snap ring groove is up as shown.

FIGURE 285: Install front bearing spacer.

FIGURE 286: Install snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 287: Install piston ring.

Impeller Disassembly

FIGURE 288: Remove impeller hub gear snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 289: Remove impeller hub gear.

FIGURE 290: Remove impeller hub bolts.

FIGURE 291: Remove impeller hub backing ring.

FIGURE 292: Remove impeller from impeller hub.

FIGURE 293: Remove impeller hub o-ring from hub.

FIGURE 294: Remove impeller hub bearing snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 295: Remove bearing from impeller hub.

Impeller Reassembly

FIGURE 296: Install bearing to impeller hub.

FIGURE 297: Install impeller hub bearing snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 298: Position new impeller hub o-ring on hub.

FIGURE 299: Position impeller on hub.

FIGURE 300: Position impeller hub backing ring.

FIGURE 301: Make sure that hub mounting surface and tapped holes are cleaned with solvent. Install self-locking screws and tighten to 58–65 lbs ft. [79–87 N•m].

NOTE:

Assembly of the hub must be completed within a fifteen-minute period from the start of screw installation. The special screw is to be used for one (1) installation only. If the screw is removed for any reason, it must be replaced. The epoxy left in the hub holes must be removed with the proper tap and the hole must be cleaned with solvent. Holes must be dried thoroughly and a new screw used for reinstallation.

FIGURE 302: Install impeller hub gear.

FIGURE 303: Install impeller hub gear snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

Impeller Cover & Turbine Disassembly

FIGURE 304: Remove turbine hub front bearing snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 305: Remove turbine hub front bearing washer.

FIGURE 306: Tap turbine hub from impeller cover.

FIGURE 307: Remove turbine hub screws and locktabs.

Impeller Cover & Turbine Assembly

FIGURE 308: Align holes in turbine and turbine hub. Position locktabs and install screws. Tighten screws to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175. Bend a corner of the locktab over a flat of the screw heads. Refer to Figure 309.

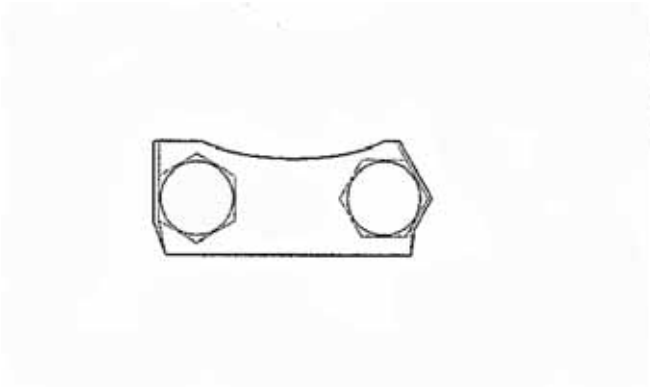


FIGURE 309: Screw heads with locktabs.

FIGURE 310: Center impeller cover over turbine hub. Install bearing in impeller cover and over turbine hub. Tap bearing into place.

FIGURE 311: Install spacer.

FIGURE 312: Install bearing snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

Converter Cover Disassembly

FIGURE 313: Remove oil seal.

Converter Cover Reassembly

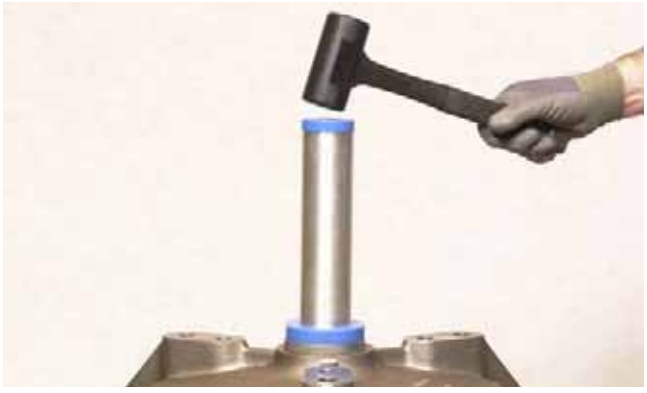


FIGURE 314: Using a standard seal driver, install the converter cover oil seal.

Pump Drive Gear Disassembly

FIGURE 315: Remove snap ring.

⚠WARNING

Use caution when removing snap ring.
Failure to comply can cause personal injury.

FIGURE 316: Remove pump drive gear bearing.

FIGURE 317: Remove bearing support.

Pump Drive Gear Reassembly

FIGURE 318: Press bearing support into bearing and install assembly into gear.

FIGURE 319: Install bearing snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

Converter Housing Reassembly

FIGURE 320: Install left and right outer auxiliary pump drive gear assemblies. Put new o-rings (4) on bolts, install bolts, and tighten to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 321: Install center charging pump drive gear assembly. Tighten bolts to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 322: Install forward speed outer roller bearing in converter housing.

FIGURE 323: From the rear of the housing, tap turbine shaft and bearing in converter housing. Tap shaft until gear shoulders are against converter housing.

FIGURE 324: From the front of the housing, install turbine shaft bearing snap ring. Tap shaft until snap ring is in full position in groove.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 325: Install new o-ring and piston ring on stator support. Position stator support assembly on turbine shaft. Turn stator support assembly to clear pump drive gear. Align support assembly holes with converter housing.

FIGURE 326: Install stator support assembly bolts and lockwashers and tighten to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 327: Spread ears on snap ring and install 2nd/Rev clutch drum assembly into converter housing.

FIGURE 328: Install 4th shaft and drum assembly converter housing.

FIGURE 329: Install 4th shaft and drum assembly snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 330: Install needle roller bearings on 2nd/Rev and 4th shafts.

Transmission Case Reassembly

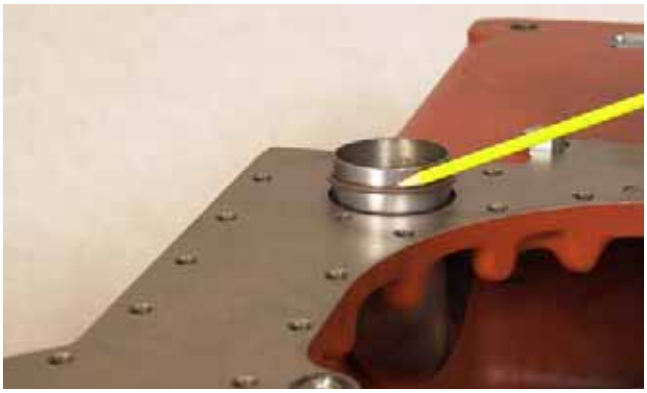


FIGURE 331: Install suction tube and o-ring into transmission case.

FIGURE 332: Install inside suction tube bolt and nut.

FIGURE 333: Install suction tube capscrews and lockwashers and tighten to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 334: Install oil baffle with LOCTITE® 262™ on threads of capscrews. Torque to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 335: Install three (3) bolts with Loctite 243.

FIGURE 336: Install inside front cap.

FIGURE 337: Install inside front cap bolts and tighten to specific torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 338: Position output gear in transmission case with long hub of gear to the rear side.

FIGURE 339: Install snap ring on output shaft.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 340: Warm rear bearing cone to 248°F [120°C] and install on output shaft.

FIGURE 341: Insert output shaft and taper bearing from rear of case and through output gear.

FIGURE 342: Install bearing cup.

FIGURE 343: Install snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 344: Install oil seal.

FIGURE 345: Install output shaft front spacer.

FIGURE 346: Install front bearing cone and warm to to 248°F [120°C].

FIGURE 347: Install front bearing cup.

FIGURE 348: Position shims on transmission case.

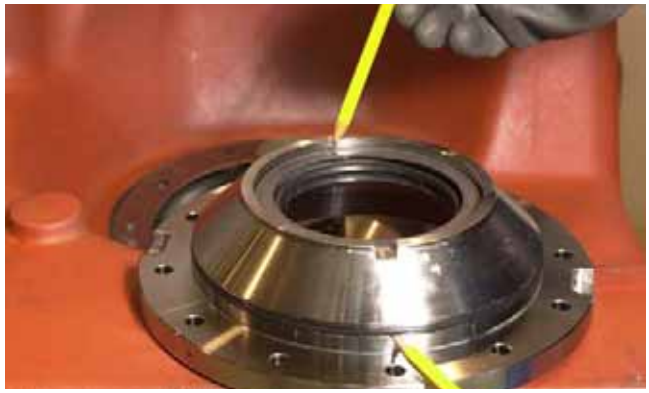


FIGURE 349: Install new o-ring and oil seal on output front cap.

FIGURE 350: Tighten bearing cap bolts to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 351: Tap and rotate output shaft to seat taper bearings. Loosen front bearing cap bolts. Using an torque wrench, determine the rolling torque of the output shaft and record. Tighten front bearing cap bolts to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175. Check rolling torque with bolts tight. Torque must be 4 - 10 lbs. in. (0.46 - 1.1 N•m) more than when bearing cap bolts were loose. Add or omit shims on the front bearing cap to achieve the proper preload.

FIGURE 352: Install front output flange.

FIGURE 353: Install o-ring, spacer, and nut.

FIGURE 354: Tighten front output flange nut to 250 - 300 lbs. ft. (339 - 407 N•m).

FIGURE 355: Install rear output flange.

FIGURE 356: Install o-ring, spacer, and nut.

FIGURE 357: Tighten rear output flange nut to 250 - 300 lbs. ft. (339 - 407 N•m).

FIGURE 358: Install idler shaft bearing.

FIGURE 361: Install 1st clutch shaft bearing.

FIGURE 359: Install idler shaft, oil retainer, and snapring. Refer to Figure 360.

FIGURE 362: Install 1st clutch shaft oil retainer and snap ring. Refer to Figure 363.

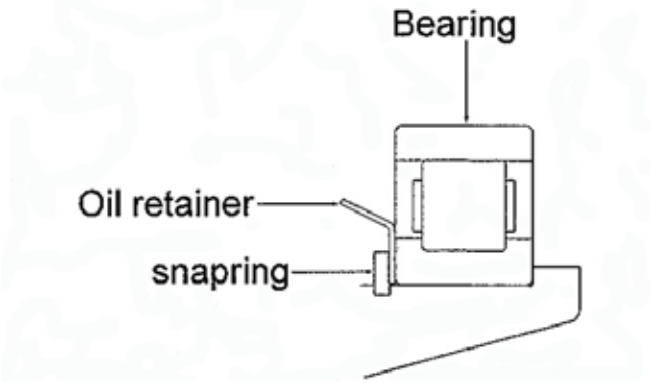


FIGURE 360: Idler shaft bearing and oil retainer position.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

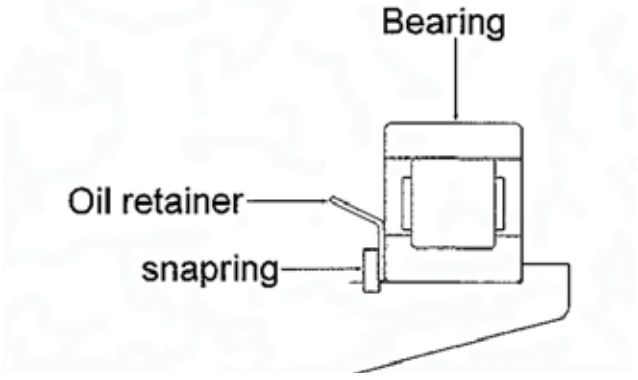


FIGURE 363: Clutch shaft bearing and oil retainer position.

FIGURE 364: Install turbine shaft needle roller bearing.

FIGURE 365: Install turbine shaft needle roller bearing snapring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 366: Install forward shaft bearing oil retainer. Refer to Figure 367.

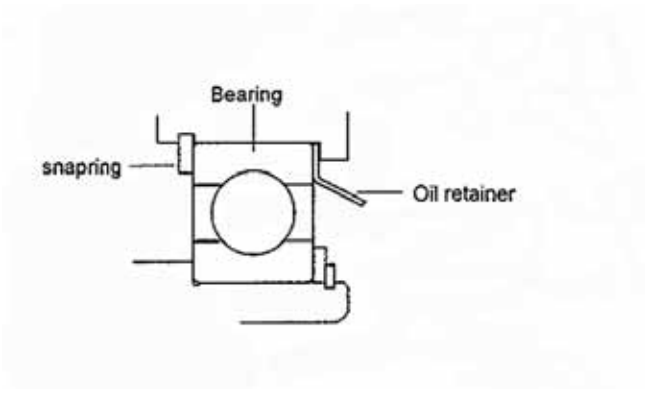


FIGURE 367: Forward shaft bearing and oil retainer position.

FIGURE 368: Install forward clutch assembly and snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 369: Install 3rd clutch assembly.

FIGURE 370: Using special tool “Idler & Low Shaft Lifting Hook” (see page 178), install idler shaft and 1st clutch assembly.

FIGURE 371: Warm 3rd shaft bearing to 248°F [120°C] and install on shaft with snap ring groove up as shown.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 372: Install spacer.

FIGURE 373: Install snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 374: Install transmission-case-to-rear-cover new gasket and o-rings.

FIGURE 375: Install two aligning studs and install transmission rear cover.

FIGURE 376: Install rear-cover-to-transmission-case bolts and tighten to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 377: Raise idler shaft slightly and install snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 378: Raise 3rd shaft slightly and install snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 379: Install bearing assembly onto 1st shaft.

FIGURE 380: Install lock nut on 1st shaft.

FIGURE 381: Using special tool “Shaft Nut Socket” (see page 180), torque lock nut to 107–118 lbs ft. [145–160 N•m].

FIGURE 382: Fit o-ring (2) to idler shaft bearing cap and install bearing cap.

FIGURE 383: Install nuts and lockwashers to bearing cap and tighten to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 384: Fit o-ring (2) to 3rd shaft bearing cap and install bearing cap.

FIGURE 385: Install nuts and lockwashers to bearing cap and tighten to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 386: Install 1st shaft bearing cap with new o-rings (3) and spring disc.

FIGURE 387: Install bolts and lockwashers to bearing cap and tighten to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 388: Install 4th clutch hub and snap ring.

⚠WARNING

Use caution when installing snap ring. Failure to comply can cause personal injury.

FIGURE 389: Install 2nd clutch hub.

FIGURE 390: Install 2nd clutch hub snap ring, spacer, and snap ring.

⚠WARNING

Use caution when installing snap ring. Failure to comply can cause personal injury.

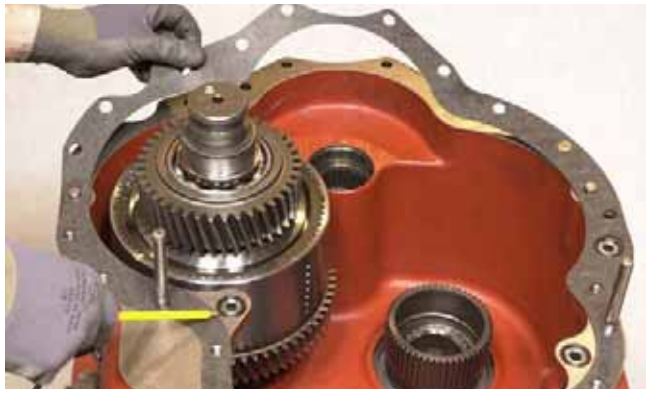


FIGURE 391: Install new converter-housing-to-transmission-case gasket and new o-rings (3).

FIGURE 392: Install alignment studs and position converter housing assembly onto studs. Install converter-housing-to-transmission-housing bolts and lockwashers and tighten to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

NOTE:

Turning output shaft will assist in aligning clutch hubs with clutch assembly.

⚠CAUTION

NEVER use bolts to pull converter and transmission housing together. Failure to comply may cause equipment damage.

FIGURE 393: Install aligning studs and install new valve gasket.

FIGURE 394: Install control valve and tighten capscrews to specified torque (refer to “TORQUE SPECIFICATIONS” on page 175), following the sequence outlined in the “Transmission Assembly Instructions” on page 97 of the manual.

FIGURE 395: Install regulator valve and new valve-to-converter-housing gasket to converter housing.

FIGURE 396: Install capscrews and tighten to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 397: Install pump drive shaft.

FIGURE 398: With new o-ring in place, install hydraulic pump assembly.

FIGURE 399: Install hydraulic pump capscrews and lockwashers and tighten to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 400: Install adapter / suction hose assembly to hydraulic pump assembly, fitting new o-rings if required.

FIGURE 401: Install capscrews and lockwashers and tighten to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 402: Tighten clamps on suction hose.

FIGURE 403: Install hydraulic pump drive shipping covers (if fitted) and install bolts and lockwashers. Tighten to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 404: Install impeller assembly.

FIGURE 405: Install impeller hub bearing inner race.

FIGURE 406: Install reaction member spacer.

FIGURE 407: Install reaction member with thin side of blades inward to impeller.

FIGURE 408: Install reaction member snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 409: Install turbine hub rear snap ring on shaft.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

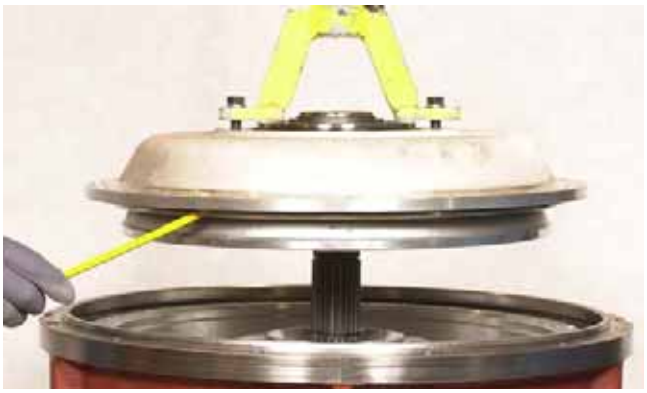


FIGURE 410: Position new o-ring on impeller cover and install cover and turbine assembly on shaft.

FIGURE 411: Install impeller cover screws and lockwashers and tighten to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 412: Install turbine snap ring.

⚠WARNING

Use caution when installing snap ring.
Failure to comply can cause personal injury.

FIGURE 413: Install input shaft support with new o-ring.

FIGURE 414: Install bolts and tighten to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 415: Warm input shaft support bearing to 248°F [120°C] and install on input shaft.

FIGURE 416: Install converter housing front cover with Loctite 515.

FIGURE 417: Install bolts and washers and tighten to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 418: Install input flange.

FIGURE 419: Install input flange o-ring, washer, and nut.

FIGURE 420: Tighten nut to specified torque. Refer to “TORQUE SPECIFICATIONS” on page 175.

FIGURE 421: Install speed sensors (3).

FIGURE 422: Install temperature sensor.

TORQUE SPECIFICATIONS

Lubricated or Plated Screws

COARSE PITCH

SIZE OF BOLT	TYPE OF BOLT			
	Grade 5		Grade 8	
	lbs. ft.	N•m	lbs. ft.	N•m
.2500	8 - 10	10.8 - 13.6	9 - 11	12.2 - 14.9
.3125	12 - 16	16.3 - 21.7	26 - 30	35.2 - 40.7
.3750	23 - 25	31.2 - 33.9	33 - 36	44.7 - 48.8
.4375	37 - 41	50.2 - 55.6	52 - 57	70.5 - 77.3
.5000	57 - 63	77 - 85	80 - 88	108 - 119
.5625	82 - 90	111 - 122	115 - 127	156 - 172
.6250	113 - 124	153 - 168	159 - 175	216 - 237
.7500	200 - 220	271 - 298	282 - 310	382 - 420

FINE PITCH

SIZE OF BOLT	TYPE OF BOLT			
	Grade 5		Grade 8	
	lbs. ft.	N•m	lbs. ft.	N•m
.2500	9 - 11	12.2 - 14.9	11 - 13	14.9 - 17.6
.3125	16 - 20	21.7 - 27.1	28 - 32	38.0 - 43.4
.3750	26 - 29	35.2 - 39.3	37 - 41	50.2 - 55.6
.4375	41 - 45	56 - 61	58 - 64	79 - 87
.5000	64 - 70	87 - 95	90 - 99	122 - 134
.5625	91 - 100	123 - 136	128 - 141	174 - 191
.6250	129 - 141	174 - 191	180 - 198	224 - 268
.7500	223 - 245	302 - 332	315 - 347	427 - 470

COARSE PITCH

SIZE OF BOLT	TYPE OF BOLT					
	Grade 8.8		Grade 10.9		Grade 12.9	
	lbs. ft.	N•m	lbs. ft.	N•m	lbs. ft.	N•m
M5 x 0.8	3.7 - 4.4	5 - 6	5.2 - 5.9	7 - 8	5.9 - 7.4	8 - 10
M6 x 1	5.9 - 7.4	8 - 10	8.9 - 11.1	12 - 15	9.6 - 11.8	13 - 16
M8 x 1.25	14.8 - 18.4	20 - 25	22.1 - 25.8	30 - 35	25.8 - 29.5	35 - 40
M10 x 1.5	29.5 - 36.9	40 - 50	44.3 - 47.9	60 - 65	47.9 - 55.3	65 - 75
M12 x 1.75	50 - 55	68 - 75	74 - 81	100 - 110	85 - 96	115 - 130
M14 x 2	81 - 92	110 - 125	111 - 129	150 - 175	133 - 155	180 - 210
M16 x 2	125 - 140	170 - 190	177 - 203	240 - 275	207 - 236	280 - 320
M20 x 2.5	236 - 266	320 - 360	332 - 369	450 - 500	387 - 443	525 - 600
M24 x 3	420 - 479	570 - 650	590 - 664	800 - 900	664 - 774	900 - 1050
M30 x 3.5	848 - 959	1150 - 1300	1180 - 1328	1600 - 1800	1364 - 1549	1850 - 2100
M36 x 4	1475 - 1660	2000 - 2250	2028 - 2323	2749 - 3149	2397 - 2729	3249 - 3699

FINE PITCH

SIZE OF BOLT	TYPE OF BOLT					
	Grade 8.8		Grade 10.9		Grade 12.9	
	lbs. ft.	N•m	lbs. ft.	N•m	lbs. ft.	N•m
M8 x 1	17 - 20	23 - 28	25 - 28	34 - 39	30 - 34	41 - 46
M10 X 1	35 - 42	47 - 57	52 - 60	71 - 81	62 - 69	84 - 94
M10 x 1,25	32 - 40	44 - 54	49 - 57	67 - 77	58 - 66	79 - 89
M12 x 1,25	60 - 68	82 - 92	89 - 96	120 - 130	105 - 116	143 - 158
M12 x 1,5	58 - 65	78 - 88	86 - 94	117 - 127	101 - 112	138 - 153
M14 x 1,5	94 - 105	128 - 143	142 - 153	193 - 208	162 - 184	220 - 250
M16 x 1,5	159 - 169	215 - 228	216 - 227	293 - 308	258 - 273	350 - 370
M18 x 1,5	221 - 236	300 - 320	319 - 330	433 - 448	369 - 398	500 - 540
M18 x 2	207 - 221	280 - 300	304 - 315	413 - 428	347 - 376	470 - 510
M20 x 1,5	302 - 332	410 - 450	439 - 476	595 - 645	503 - 559	683 - 758
M22 x 1,5	413 - 443	560 - 600	586 - 623	795 - 845	681 - 736	923 - 998
M24 x 1,5	531 - 590	720 - 800	767 - 841	1040 - 1140	882 - 992	1195 - 1345
M24 x 2	509 - 568	690 - 770	730 - 804	990 - 1090	845 - 955	1145 - 1295
M27 x 1,5	789 - 848	1070 - 1150	1129 - 1202	1530 - 1630	1308 - 1420	1175 - 1925

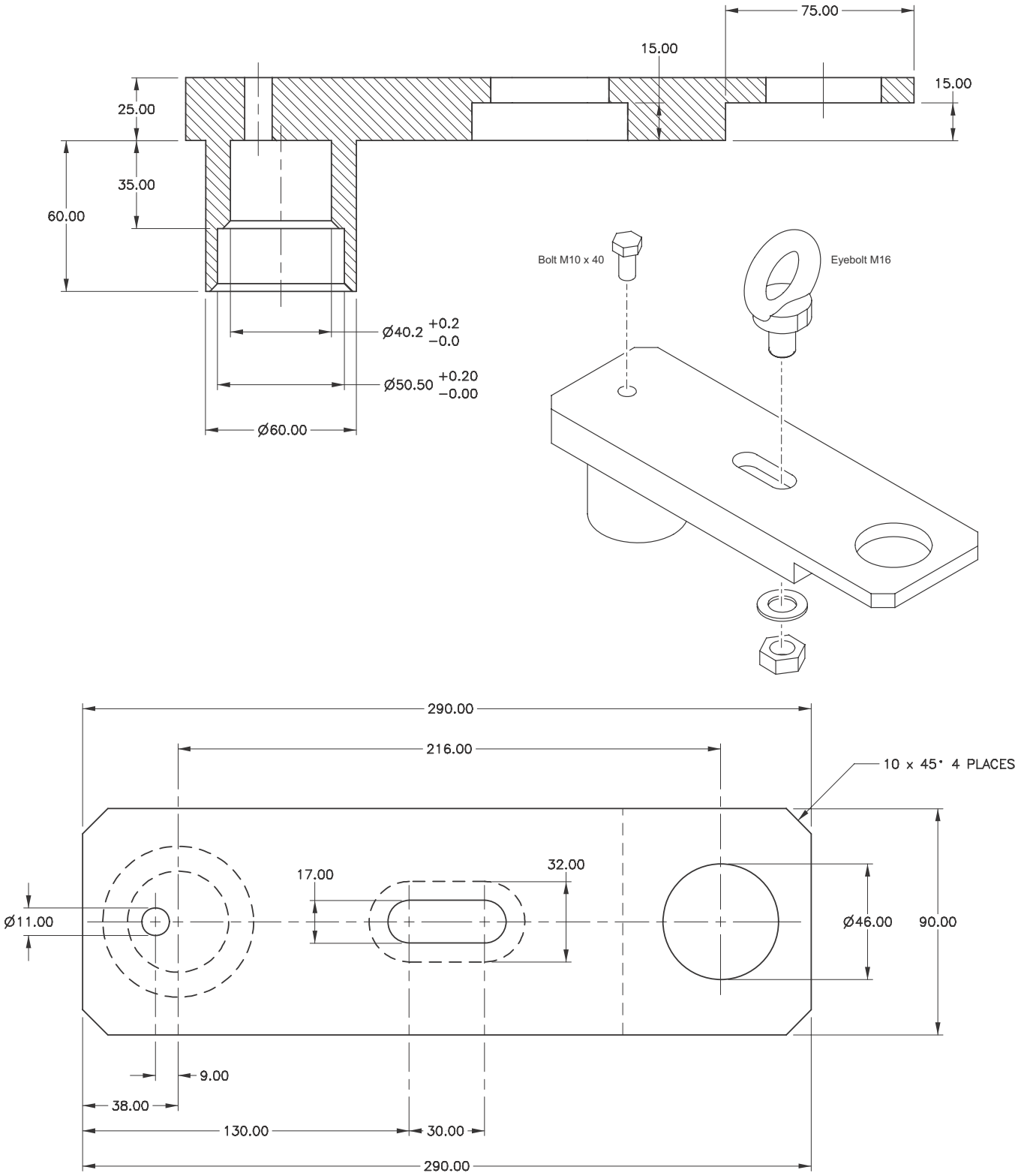
Pipe Plugs

THREAD SIZE	lbs. ft.	N•m
M10 x 1	6 - 7	8 - 10
M14 x 1.5	7 - 9	10 - 12
M18 x 1.5	25 - 30	34 - 41
M22 x 1.5	35 - 44	48 - 60
M26 x 1.5	45 - 50	61 - 68
M33 x 2	83 - 103	112 - 140

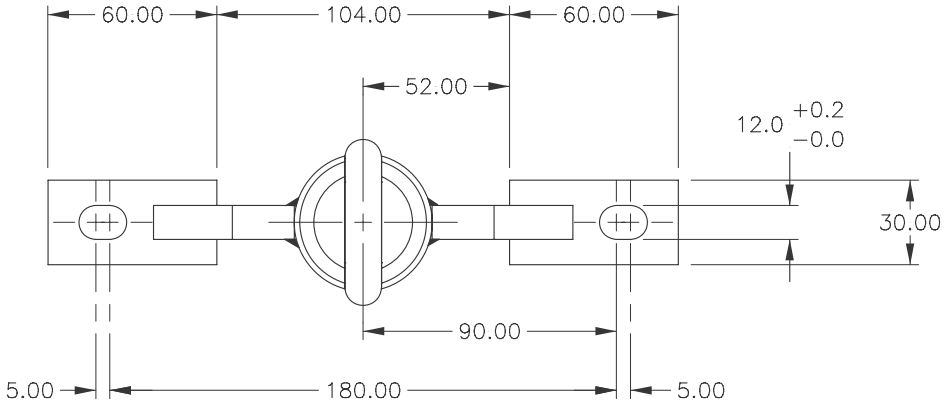
THREAD SIZE	lbs. ft.	N•m
1/16 - 27	5 - 7	7 - 9
1/8 - 27	7 - 10	9 - 14
1/4 - 18	15 -20	20 - 27
5/16 - 24	3 - 5	4 - 7
3/8 - 24	5 - 8	7 - 11
3/8 - 18	25 - 30	34 - 41
1/2 - 14	30 - 35	41 - 47
1/2 - 20	10 - 13	14 - 18
3/4 - 10	40 - 45	54 - 61
3/4 - 14	40 - 45	54 - 61
7/16 - 20	7 - 10	9 - 14
9/16 - 18	12 - 15	16 - 20
3/4 - 16	20 - 25	27 - 34
7/8 - 14	30 - 35	41 - 47
11/16 - 12	45 - 50	61 - 68
15/16 - 12	65 - 75	88 - 102
1 - 11-1/2	50 - 55	68 - 75
1-1/4 - 11-1/2	60 - 65	81 - 88
1-5/8 - 12	75 - 85	102 - 115
1-7/8 - 12	75 - 85	102 - 115

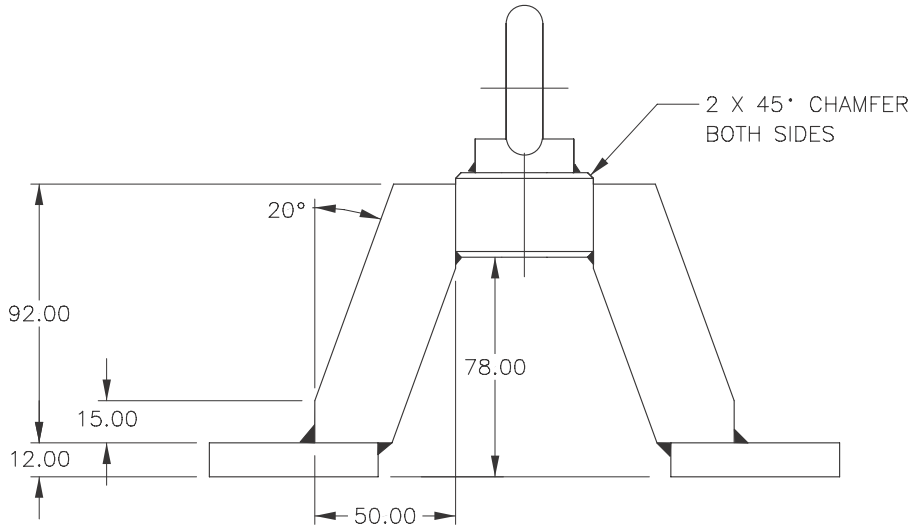
SPECIAL TOOLS

Idler & Low Shaft Lifting Hook

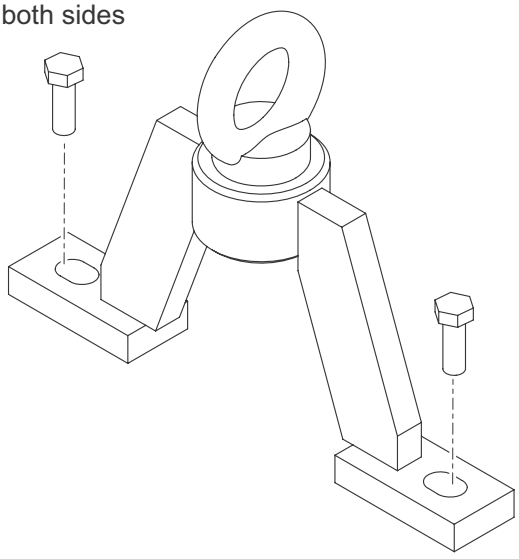


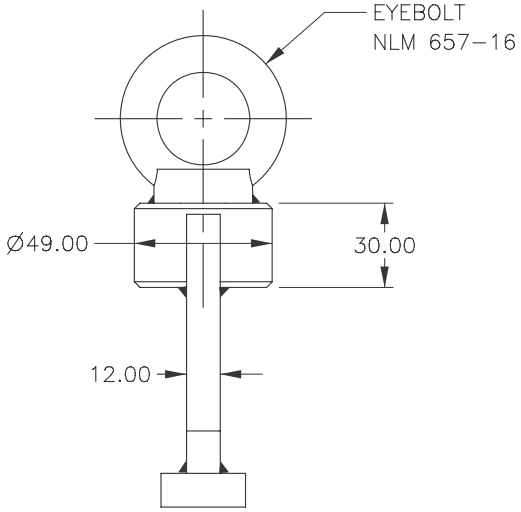
Impeller Cover Lifting Hook



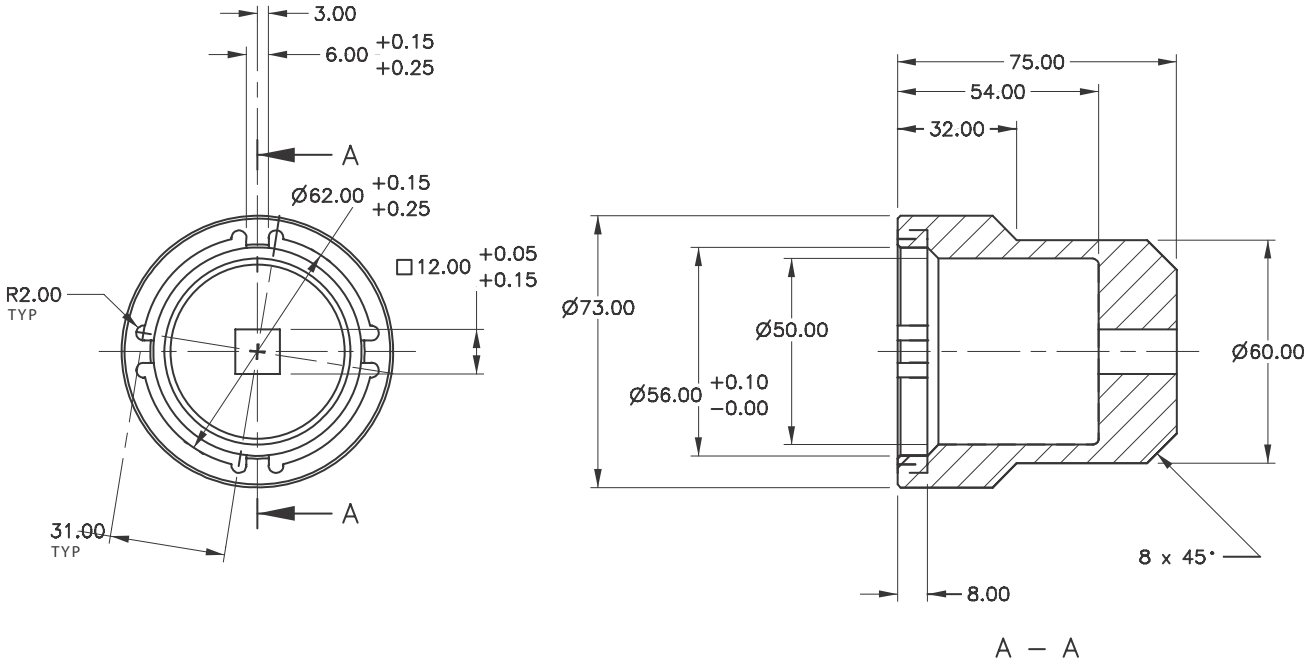


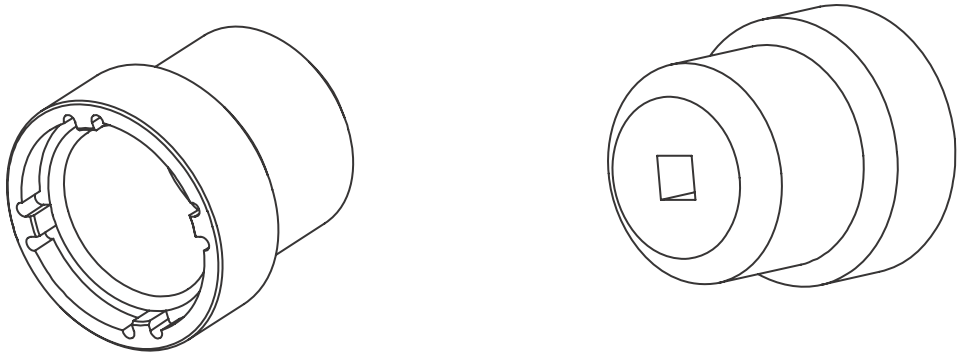
Bolt .4375-14 UNC-3B X 20
both sides



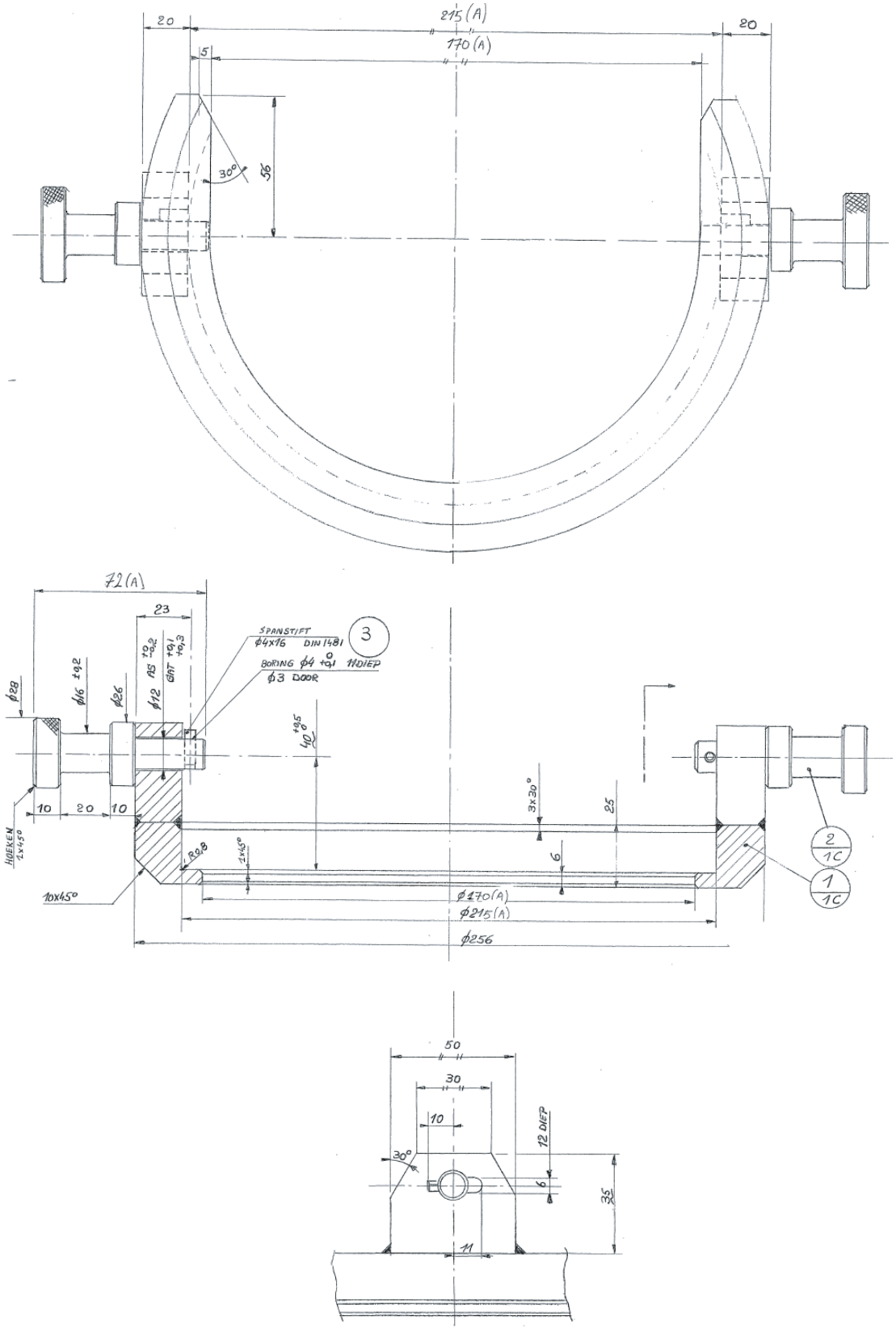


Shaft Nut Socket

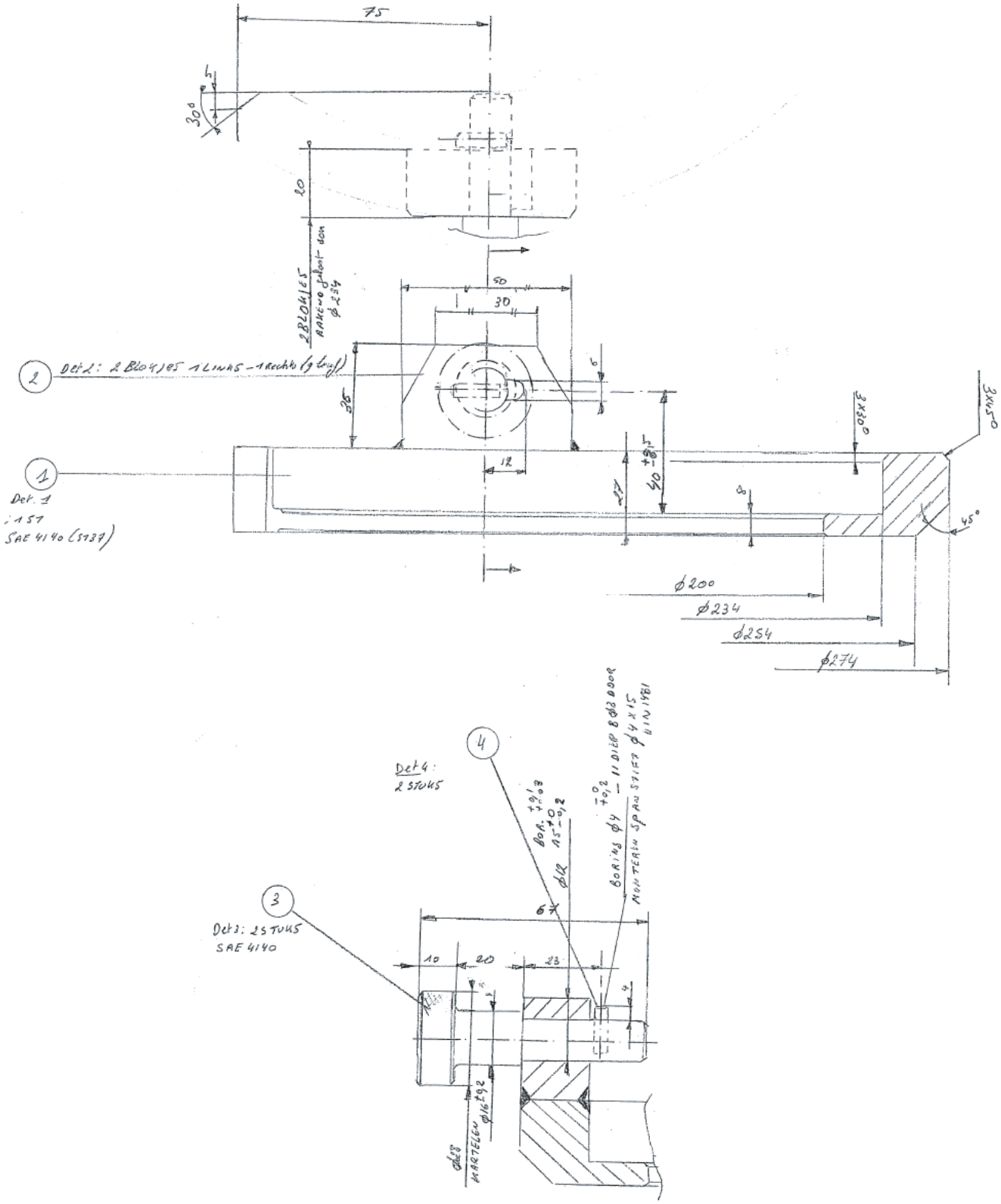




4th Drum Lifting Hook



2nd/Rev Drum Lifting Hook



For product inquiries or support,
visit www.dana.com or call 419-887-6445
For other service publications,
visit www.SpicerParts.com/literature.asp
For online service parts ordering,
visit www.SpicerParts.com/order.asp

DANA

SPICER®

Off-Highway Products