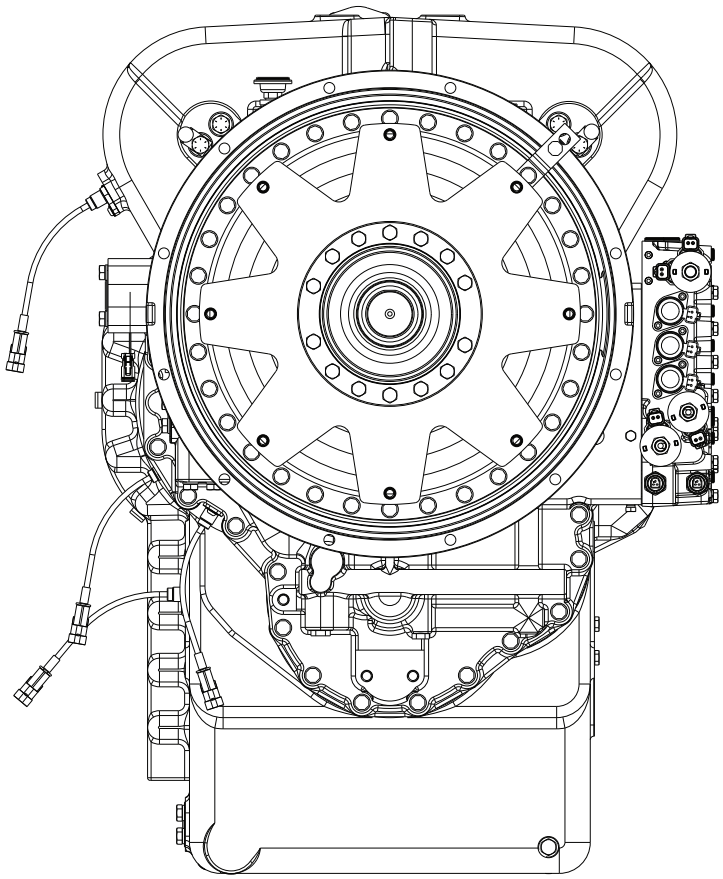
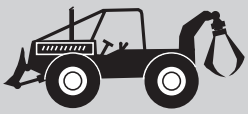
Maintenance & Service Manual

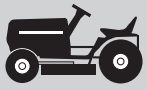
TE27 / TE32

Powershift Transmission

4 Speed
Short Drop







SPICER OFF-HIGHWAY COMPONENTS

03/2010

CD-ROM: 8100101

MANUAL: 8100102

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TOWING OR PUSHING

Before towing the vehicle, be sure to 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.

FOREWORD

This manual has been prepared to provide the customer and the maintenance personnel with information and instructions on the maintenance and repair of the **SPICER OFF-HIGWAY PRODUCTS** product.

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 such adjustments as may be 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 the mechanic studies the instructions in this manual carefully and uses it as a reference when performing maintenance and repair operations.

Whenever repair or replacement of component parts is required, only **SPICER OFF-HIGHWAY PRODUCTS** approved parts as listed in the applicable parts manual should be used. Use of “will-fit” or non-approved parts may endanger proper operation and performance of the equipment. **SPICER OFF-HIGHWAY PRODUCTS** does not warrant repair or replacement parts, nor failures resulting from the use of parts which are not supplied or approved by **SPICER OFF-HIGHWAY PRODUCTS**.

IMPORTANT

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

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 parts must be replaced by spare parts which have the same part number or with equivalent parts. DO NOT USE A SPARE PART OF LESSER QUALITY.

The service procedures recommended in this manual are effective methods for performing service and repair. Some of these procedures require the use of tools specifically designed for the purpose.

Accordingly, anyone who intends to use a spare part, service procedure or tool, which is not recommended by SPICER OFF-HIGHWAY PRODUCTS, must first determine that neither his safety nor the safe operation of the machine will be jeopardised by the spare part, service procedure or tool selected.

IMPORTANT

IT IS IMPORTANT TO NOTE THAT THIS MANUAL CONTAINS VARIOUS ‘CAUTIONS AND NOTICES’ THAT MUST BE CAREFULLY OBSERVED IN ORDER TO REDUCE THE RISK OF PERSONAL INJURY DURING SERVICE OR REPAIR, OR THE POSSIBILITY THAT IMPROPER SERVICE OR REPAIR MAY DAMAGE THE UNIT OR RENDER IT UNSAFE.

IT IS ALSO IMPORTANT TO UNDERSTAND THAT THESE ‘ CAUTIONS AND NOTICES’ ARE NOT EXHAUSTIVE, BECAUSE IT IS IMPOSSIBLE TO WARN ABOUT ALL POSSIBLE HAZARDOUS CONSEQUENCES THAT MIGHT RESULT FROM FAILURE TO FOLLOW THESE INSTRUCTIONS.

2.1 CLEANING

Clean all parts thoroughly using solvent type cleaning fluid. It is recommended that parts be immersed in cleaning fluid and moved up and down slowly until all old lubricant and foreign material is dissolved and parts are thoroughly cleaned.

CAUTION

CARE SHOULD BE EXERCISED TO AVOID SKIN RASHES, FIRE HAZARDS, AND INHALATION OF VAPOURS WHEN USING SOLVENT TYPE CLEANERS.

2.1.1 BEARINGS

Remove bearings from cleaning fluid and strike 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 bearing to avoid spinning. DO NOT SPIN BEARINGS WHEN DRYING. Bearings may be rotated slowly by hand to facilitate drying process.

2.1.2 HOUSINGS

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.

CAUTION

CARE SHOULD BE EXERCISED TO AVOID INHALATION OF VAPOURS AND SKIN RASHES WHEN USING ALKALI CLEANERS.

All parts cleaned must be thoroughly dried immediately by using moistere-free compressed air or soft lintless absorbant wiping rags, free of abrasive materials such as metal fillings, contaminated oil or lapping compound.

2.2 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.

2.2.1 BEARINGS

Carefully inspect all rollers: cages and cups for wear, chipping, or nicks to determine fitness of bearings for further use. DO NOT REPLACE A BEARING CONE OR CUP INDIVIDUALLY without replacing the mating cup or cone at the same time. After inspection, dip bearings in Automatic Transmission Fluid and wrap in clean lintless cloth or paper to protect them until installed.

2.2.2 OIL SEALS, GASKETS, etc.

Replacement of spring load oils seals, “O” rings, metal sealing rings, gaskets and snap rings is more economical when the unit is disassembled than premature overhaul to replace these parts at a future time.
Further 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 of lips of seals seriously impairs its efficiency.
When assembling new metal type sealing rings, these should be lubricated with a coat of chassis grease to stabilise rings in their grooves for ease of assembly of mating members. Lubricate all “O” rings and seals with recommended type Automatic Transmission Fluid before assembly.

2.2.3 GEARS & SHAFTS

If Magna-Flux process is available, use process to check parts. Examine teeth on all gears carefully for wear, pitting, chipping, nicks, cracks or scores. If gear teeth show spots where case hardening is worn through or cracked, replace with new gear. Small nicks may be removed with suitable hone. Inspect shafts and quills to make certain they are not sprung, bent or spline-twisted, and that shafts are true.

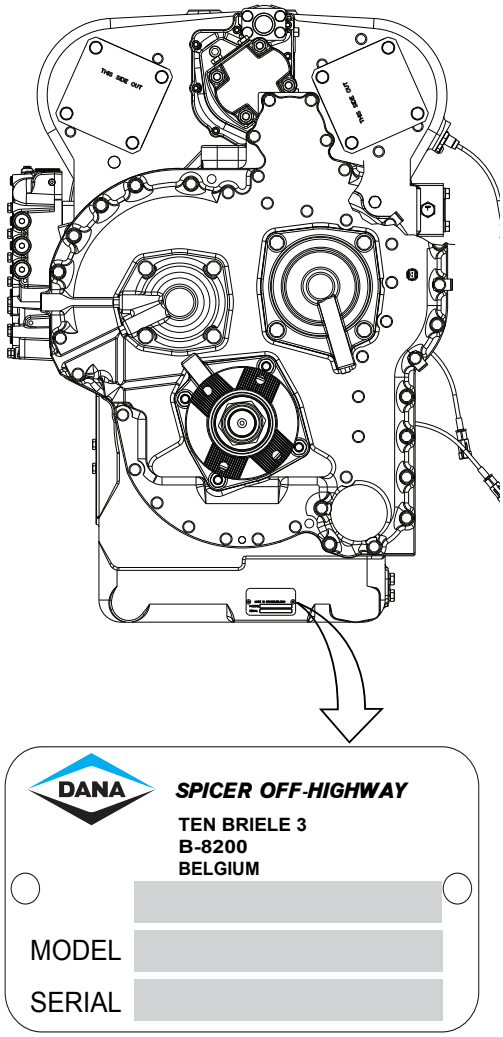
2.2.4 HOUSINGS, COVERS, etc.

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

2.3 LEGEND SYMBOLS

	Smontaggio di sottogruppi Disassembly of assembly groups
	Montaggio di sottogruppi Reassemble to from assembly group
	Smontaggio di particollari ingombranti Remove obstruction parts
	Montaggio di particollari ingombranti Reinstall - remount parts which had obstructed disassembly
	Attenzione, indicazione importante Attention! important notice
	Controllare regolare p.e. coppie, misure, pressione etc. Check - adjust e.g. torque, dimensions, pressures etc.
	T = Attrezzature speciali P = Pagina T = Special tool P = Page
	Rispettare direzione di montaggio Note direction of installation
	Controllare esaminare controllo visuale Visual inspection
	Eventualimente riutilizzable (sostituire se necessario) Possibly still serviceable, renew if necessary

	Sostituire con ogni montaggio Renew at each reassembly
	Togliere - mettere la sicura Unlock - lock e.g. split pin, locking plate, etc.
	Mettere la sicura, incollare (mastice liquido) Lock - adhere (liquid sealant)
	Evitare danni ai materiali, danni ai pezzi Guard against material damage, damage to parts
	Marchiari prima dello smontaggio (per il montaggio) Mark before disassembly, observe marks when reasembl.
	Carricare riempire (olio - lubrificante) Filling - topping up - refilling e.g. oil, cooling water, etc.
	Scarricare olio, lubrificante Drain off oil, lubricant
	Tendere Tighten - clamp ; tightening a clamping device
	Insere pressione nel circuito idraulico Apply pressure into hydraulic circuit
	Pulire To clean



3.1. IDENTIFICATION OF THE UNIT

1. Model and type of the unit
2. Serial number.

3.2. WEIGHT, DIMENSIONS, OIL CAPACITY

Weight (dry):	865 Kg [1903 lb]
Max. Length:	1011 mm [39.8”]
Max. With:	703 mm [27.7”]
Max. Heigth:	982 mm [38.7”]

Oil capacity

60 liter [15.9 US Gallon] without cooler and hydraulic lines.
Consult Operator’s manual on applicable machine for system capacity.

3.3 TIGHTENING TORQUES

3.3.1 Torque specifications for lubricated or plated screw threads

NOM. THD SIZE	GRADE 5 FINE THREAD TORQUE Lbs.ft [Nm]	GRADE 5 COARSE THREAD TORQUE Lbs.ft [Nm]
.2500	9-11 [12.2-14.9]	8-10 [10.8-13.6]
.3125	16-20 [21.7-27.1]	12-16 [16.3-21.7]
.3750	26-29 [35.2-39.3]	23-25 [31.2-33.9]
.4375	41-45 [56-61]	37-41 [50.2-55.6]
.5000	64-70 [87-95]	57-63 [77-85]
.6525	91-100 [123-136]	82-90 [111-122]
.6250	128-141 [174-191]	113-124 [153-168]
.7500	223-245 [302-332]	200-220 [271-298]
Partnumber prefix	2C	1C

NOM. THD SIZE	GRADE 8 FINE THREAD TORQUE Lbs.ft [Nm]	GRADE 8 COARSE THREAD TORQUE Lbs.ft [Nm]
.2500	11-13 [14.9-17.6]	9-11 [12.2-14.9]
.3125	28-32 [38-43.4]	26-30 [35.2-40.7]
.3750	37-41 [50.2-55.6]	33-36 [44.7-48.8]
.4375	58-64 [79-87]	52-57 [70.5-77.3]
.5000	90-99 122-134]	80-88 [108-119]
.6525	128-141 [174-191]	115-127 [156-172]
.6250	180-198 [224-268]	159-175 [216-237]
.7500	315-347 [427-470]	282-310 [382-420]
Partnumber prefix	18C-94G-96G	17C-93G-95G

3.3.1 Torque specifications for lubricated or plated screw threads (continued)

NOM. THD SIZE COARSE THREAD	GRADE 8.8 TORQUE Lbs.ft [Nm]	GRADE 10.9 TORQUE Lbs.ft [Nm]	GRADE 12.9 TORQUE Lbs.ft [Nm]
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]
Partnumber prefix	1CM -1GM	7CM-10CM-4GM	3GM

NOM. THD SIZE FINE THREAD	GRADE 8.8 TORQUE Lbs.ft [Nm]	GRADE 10.9 TORQUE Lbs.ft [Nm]	GRADE 12.9 TORQUE Lbs.ft [Nm]
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]
Partnumber prefix	2CM -5GM		

3.3.2 Elastic stop nut torque

THREAD SIZE	TORQUE
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]
M33 x 2	83-103 [112-140]

3.3.3 Torque tables for plugs (“o”-ring ports)

THREAD SIZE	TORQUE Lbs.ft [Nm]	Partnumber prefix
5/16-24	3-5 [4-7]	124K-47K
3/8-24	5-8 [7-11]	
7/16-20	7-10 [9-14]	
1/2-20	10-13 [14-18]	
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]	
15/8-12	75-85 [102-115]	
17/8-12	75-85 [102-115]	

3.3.4 Torque tables for pipe plugs

THREAD SIZE	TORQUE Lbs.ft [Nm]	Partnumber prefix
1/16-27	5-7 [7-9]	16F-40K-41K-1
1/8-27	7-10 [9-14]	10F-16F-40K-41K-2
1/4-18	15-20 [20-27]	11F-16F-40K-41K-4
3/8-18	25-30 [34-41]	11F-16F-40K-41K-6
1/2-14	30-35 [41-47]	11F-16F-40K-41K-8
3/4-10 or 14	40-45 [54-61]	11F-16F-40K-41K-12
1-11 1/2	50-55 [68-75]	11F-16F-40K-41K-16
1 1/4-11 1/2	60-65 [81-88]	11F-16F-40K-41K-20

3.3.5 Permanent metric plug torque chart

Plugs (Permanent plugs)		
Nominal Size	Torque Nm [Lbs.ft]	
M18 x 1.5 6H	34-41	[25-30]
M26 x 1.5 6H	61-68	[45-50]

3.4 PRESSURE & TEMPERATURE SPECIFICATIONS

- Normal operating temperature 70 - 120°C [158 - 248F] measured at temperature check port to cooler (port 71 or port 32 **).

- Maximum allowed transmission temperature 120°C [248 F].

- Transmission regulator pressure (*) - (neutral) - port 31 (**).
  - at 600 RPM: 22.5 bar [326.3 PSI] minimum.
  - at 2650 RPM: 25.5 bar [369.8 PSI] maximum.

- Pump flow (*)
  - System pump flow: 100.7 l/min minimum [26.60 GPM] at 2170 RPM.
  - Lube pump flow: 52.4 l/min [13.84 GPM] minimum at 2170 RPM selective lube
    84.6 l/min [22.35 GPM] maximum at 2910 RPM.

- Clutch pressures (*)
  - 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 :
  - 20.5bar [297.3PSI] minimum with 1st clutch activated.

- Filter bypass valve set at 4.1 to 4.5 bar(*) [59.4 to 65.2 PSI].

- Lube pressure (*) (port 34) - 4.0-5.5 bar [58 - 80 PSI] at 2200RPM.

- Internal total leakage at 1000 engine RPM
  - Fwd/Rev: 4l/min. [1 GPM] maximum
  - 1st: 9.2l/min [2.43 GPM] maximum
  - 2nd-3rd-4th: 4l/min [1 GPM] maximum
  - Converter: 5-12 l/min [1.3-3.2 GPM] at 1000RPM

- Safety valve : cracking pressure (*) 8.8-9.6 bar [127.6-139.2 PSI].

- To cooler (converter out) pressure (*) (port 33) 5 bar [72.5PSI] min at 2000RPM engine speed and a max of 8.5 bar [123.3 PSI] pressure at no load governed speed.

(*) All pressures and flows to be measured with oil temperature of 82 - 93° C (180 - 200F).
(**) Refer to section troubleshooting for check port identification.

3.5 ELECTRICAL SPECIFICATIONS

- Proportional valves:
  FWD/REV - 1st/3rd - 2nd/4th:
  coil resistance : 7.25 Ω at 20°C [68°F].

- Selection valves:
  FWD/N/REV - 1st/3rd - 2nd/4th:
  coil resistance : 12V - 7.1 Ω at 20°C [68°F].
  coil resistance : 24V - 28.5 Ω at 20°C [68°F].

- Speed sensor :
  - type: magneto resistive sensor.
  - sensing distance: 0 - 1,8 mm [0" - 0.07"].
  - Sensor signal: generates a square current with a fixed amplitude changing between 7-14 mA.

- Temp sensor:
  -Material: silicon
  -Resistance at 25°C [77°F] = 2000 Ω ± 1%

- Pressure sensor:
  -Supply voltage 4.5-5.5V
  -Maximum current: 10mA
  -Pressure range: 1 to 31 bar [14.5-450PSI]
  -±1.2% full scale (31bar [450PSI]) range 1 to 25 bar [14.5-363 PSI]
  -±2.5% full scale (31bar [450PSI]) range 25 to 31 bar [363-450PSI]

3.6 HYDRAULIC COOLER LINES SPECIFICATIONS

- Minimum 25.4mm [1"] internal diameter for lines and fittings.
- Suitable for operation from ambient to 120° C [248° F] continuous operating temperature.
- Must withstand 28 bar [406PSI] continuous pressure and with 41 bar [595PSI] intermittent surges.
- Conform SAE J1019 and SAE J517,100RI

4.1. OIL SPECIFICATION

4.1.1 Recommended lubricants

- Dexron* III, viscosity at 40° C [104° F]: 33 - 38 cSt
  100° C [212° F]: 7 - 8 cSt

SUMP PREHEATERS

Preheat the transmission fluid to the mimimum temperature for the oil viscosity used before engine startup.

4.1.2 Normal oil change interval

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

Drain and refill system as follows (drain with oil at 65 - 93° C [150 - 200 F°])

1. Drain transmission.
2. Remove and discard filter. Install new filter.
3. Refill transmission to FULL mark.
4. Run engine at 500 - 600 RPM to prime convertor and lines.
5. Recheck level with engine running at 500 - 600 RPM and add oil to bring level to LOW mark. When oil temperature is hot 82.2 - 93.3 °C (180- 200 F) 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 metals analysis can provide useful inforamtion but a transmission should not be removed from service based solely on this analysis.

FILTERS

Service oil filter element intervals

100hrs first time

Then every 1000 hrs under normal envirronmental and duty cycle conditions.

4.2 MAINTENANCE INTERVALS

4.2.1 Daily

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

Maintain oil level at full mark.

4.2.2Clutch calibration

Every 2000hrs perform automatic clutch calibration

* DEXRON is a registered trademark of GENERAL MOTORS CORPORATION

4.3 SERVICING MACHINE AFTER COMPONENTS 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
DO NOT USE FLUSHING COMPOUNDS FOR CLEANING PURPOSES.

5. Reassemble all components and use only type oil recommended from lubrication section. Fill transmission through filler opening until fluid comes up to the oil level check port.

   Run engine 2 minutes at 500+600 R.P.M. to prime torque converter and hydraulic lines. Recheck level of fluid in transmission with engine running at idle (500-600 R.P.M.).

   Add quantity necessary to bring fluid level to oil level check port.

   Recheck with hot oil (180-200 F) 82-93° C.

6. Recheck all drain plugs, lines, connections, etc., for leaks and tighten where necessary.

4.4 PROCEDURE FOR PERFORMING AUTOMATIC CALIBRATION

4.4.1 Introduction

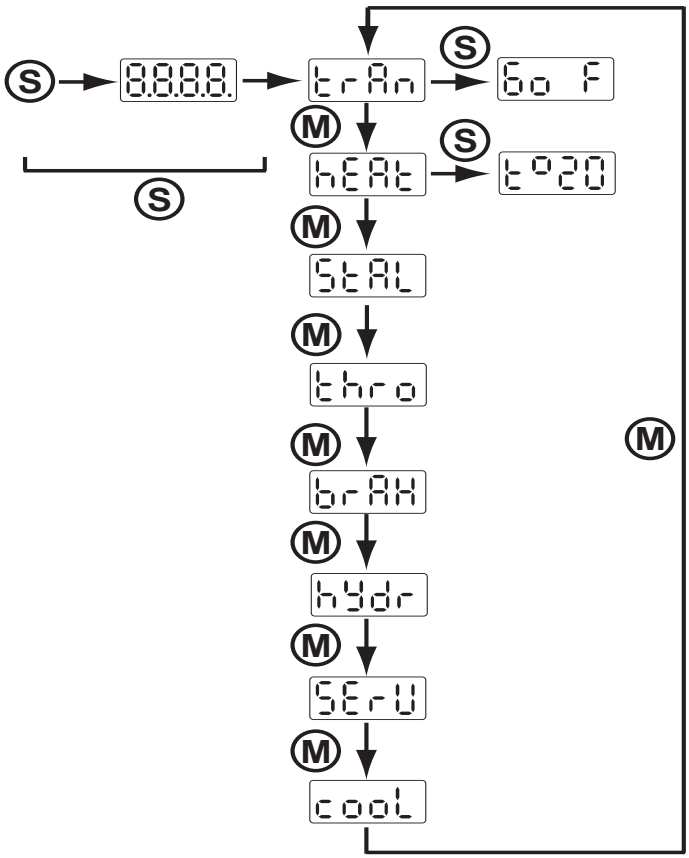
The APC200 firmware contains an automatic transmission calibration procedure, which is able to optimize the shift quality of the transmission.

An automatic calibration has to be done:

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

4.4.2 running the automatic calibration

4.4.2.1 How to enter the calibration mode



The automatic calibration mode is entered by pressing the S-button on the APC200 <display for 15 seconds during POWER-UP of the APC200 (See above figure)

4.4.3 PERFORMING AN AUTOMATIC CALIBRATION

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

- 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.

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

To trigger the automatic calibration procedure, push the S-button once. You will get this APC200-display readout:

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

the fisrt 2 characters indicates which clutch is calibrated (clutch 1 to clutch 6)
the last 2 characters indicates the calibration phase inwhich this clutch is (mode 1 or mode2)

When all clutches have been calibrated, the APC200 displays :

At this point, the automatic calibration has completed successfully. The normal duration of a complete transmission calibration is around 15 minutes.

To exit the automatic calibration mode, you should need to switch off the ignition key the vehicle. 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.

REMARK 1 :

If you get any different information on the APC200 display as described above, there can be two possible reasons:

- the calibration conditions are not fulfi lled (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 (message starting with an 'E').

For possible messages see chapter 4.4.5

REMARK 2 :
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. You can use this as an emergency procedure 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.

4.4.4 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.

The paragraph how to enter the calibration mode (see 1st paragraph), also displays how the 'HEAT'-mode can be activated. Once you see on the display "tran", you can 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.

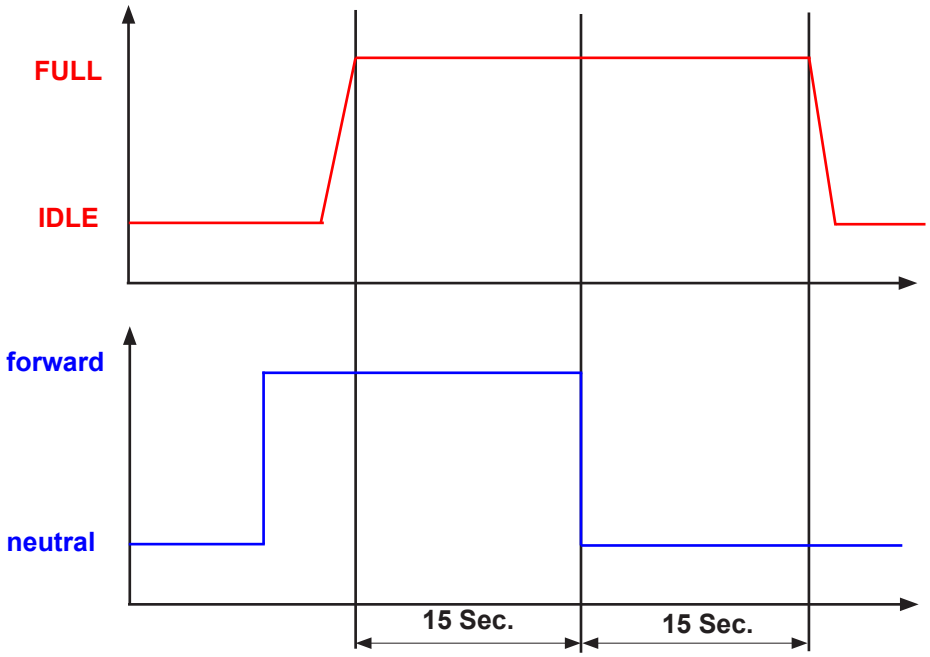
2. Put the transmission in forward by selecting forward with the shift lever and then accelerates the engine to full throttle.

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 60°C. When the temperature is above 60° C, the temperature indication on the display starts blinking. Now you can switch to the automatic calibration, by pressing the M-button for several times – until the APC200 displays “tran”.



REMARK :

During this warm up procedure, it is possible that the converter out temperature of the transmission exceeds the maximum limit. This is a consequence of heating up the transmission using this quick procedure.

When this occurs, the engine speed will be limiting 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, you can resume the heating up procedure if the transmission temperature has not reached 60 °C yet.

4.4.5 CALIBRATION CONDITION MESSAGES AND CALIBRATION ERRORS

This chapter gives an overview of the most common calibration condition messages. Normally, you will be able to repair the cause of a calibration condition message yourself. However, you will have to contact the OEM of the machine when a calibration error appears.

4.4.5.1 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 jever back in NEUTRAL
	THE APC200 expects the partking brake to be ON while it is OFF	Put the parking brake ON
	The APC200 has detected output speed	Verify that the parkiing brake is ON and working properly. If this is already the case, you will be obliged to keep the machine at standstill by using the footbrake. 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.	If the vehicle is equiped with throttle-by-wire, the engine RPM will be automatically adapted. In the other case, the driver has to change the throttle pedal position until the display looks as follows: 
	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 bounderies 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. Now you have to warm-up the transmission again until the temperature is above 60° C [140° F]. Then go back to the automatic tuning mode by the M-button and trigger this one again to continue calibration.

4.4.5.2 Calibration errors

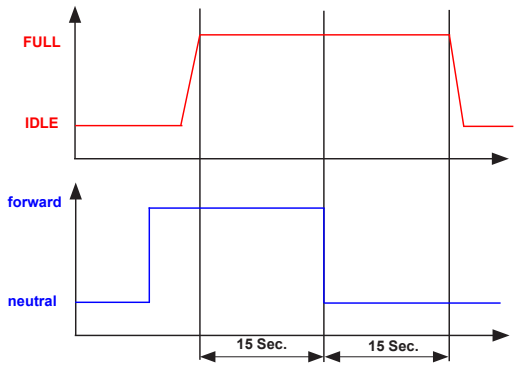
Calibration errors have the form ‘E1.xx’ or ‘E2.xx’ (example : E1.25). Please contact the OEM of the machine if an error of this form appears on the display.

4.4.6 PERFORMING A STALL TEST

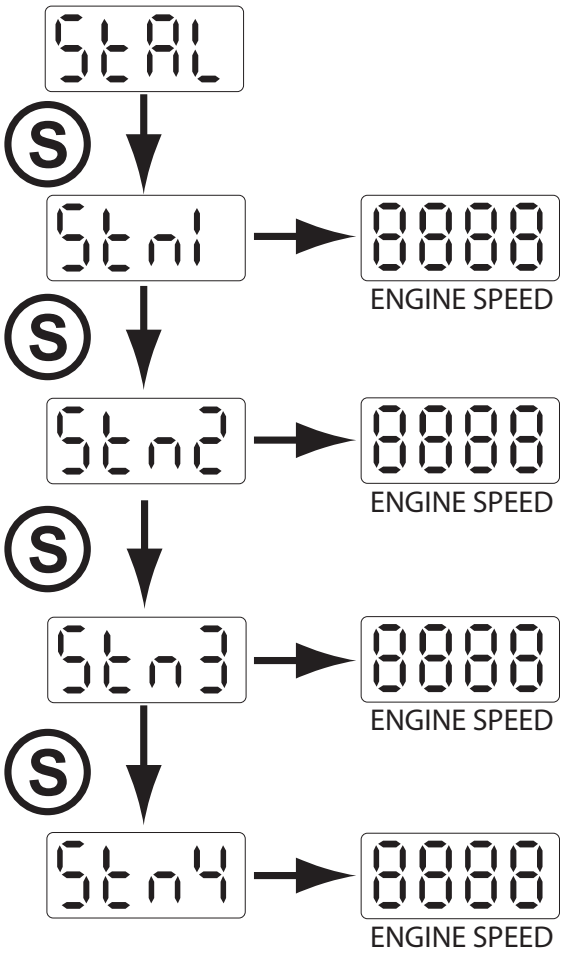
With a stall test it is possible to test clutch pack slippage or test the converter/engine stall speed in each gear.

How to Preform a stall test

1 Activate parking brake
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

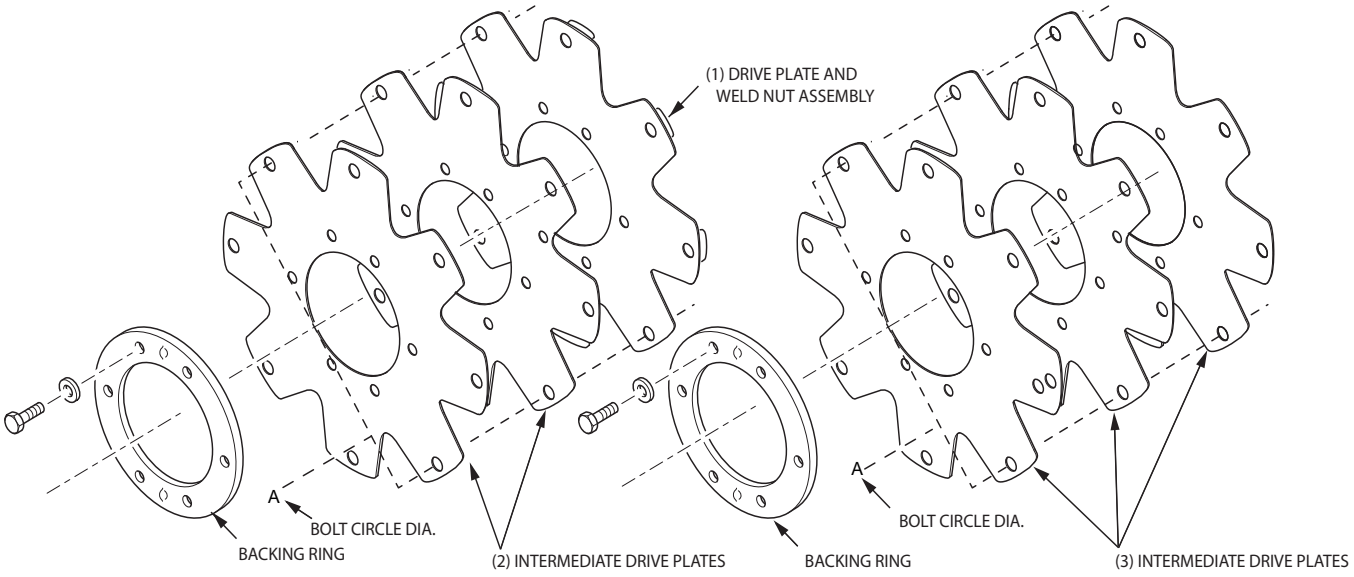


5 Select FWD or REV in the selected range gear
6 request full throttle and read the engine speed at the APC display
7 All speeds should reach approximately the same value when the transmission in ok
8 Leave the stall mode with the M button or switch-off the ignition

5.1 CONVERTER DRIVE COUPLING

Measure the “A” dimension (bolt circle diameter) and order drive plate kit listed below.

Note three (3) kits have two (2) intermediate drive plates and one (1) drive plate and weld nut assembly. Three (3) kits with three intermediate drive plates.



“A” Dimension (Bolt circle diameter)

- 15” (381.0 mm) diameter
- 16” (406.4 mm) diameter
- 17” (431.8 mm) diameter

Each kit will include the following parts:
- 2 Intermediate drive plates
- 1 Drive plate and weld nut assembly
- 1 Backing ring
- 6 Mounting screws
- 6 Lock washers
- 1 Instruction sheet

“A” Dimension (Bolt circle diameter)

- 15” (381.0 mm) diameter
- 16” (406.4 mm) diameter
- 17” (431.8 mm) diameter

Each kit will include the following parts:
- 3 Intermediate drive plates
- 1 Backing ring
- 6 Mounting screws
- 6 Lock washers
- 1 Instruction sheet

Position drive plate and weld nut assembly on torque converter assembly with welded nuts toward converter. Align intermediate drive plates and backing ring with holes in torque converter assembly.

Note:

Two dimples 180° apart in backing ring must be out (Toward the engine flywheel).
Install cap screws and washers. Tighten 40 - 50 Nm [30 to 37 lbft] torque.

5.2 TRANSMISSION TO ENGINE INSTALLATION PROCEDURE

1. Remove all burrs from flywheel mounting face and nose pilot bore. Clean drive plate surface with solvent.

2. Check engine flywheel & housing for conformance to standard SAE No. 3 per SAE J927 and J1033 tolerance specifications for pilot bore size, pilot bore runout and mounting face flatness. Measure and record engine crankshaft end play (Fig. 1).

3. Install two 63,50 mm (2.50") 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 (Fig. 2).

*4. Install a 101,60 mm (4.00") 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 No. 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 No. 3. Locate transmission on flywheel housing.

Aligning 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.

*6. Remove drive plate locating stud.

7. 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.

Torque each one according to torque specifications. 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.

8. Measure engine crankshaft end play after transmission has been completely installed on engine flywheel. This value must be within 0,025 mm (0.001") of the end play recorded in step No. 2.

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

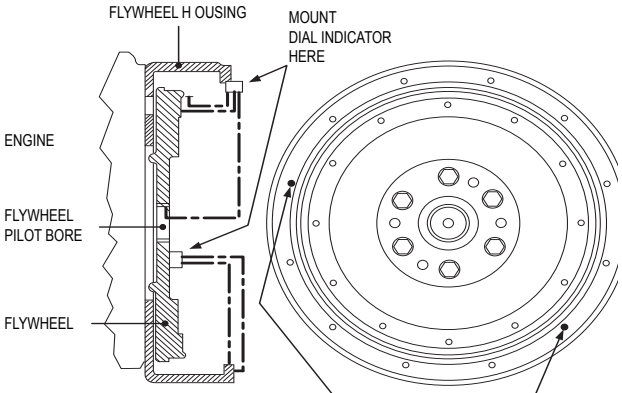


FIG. 1

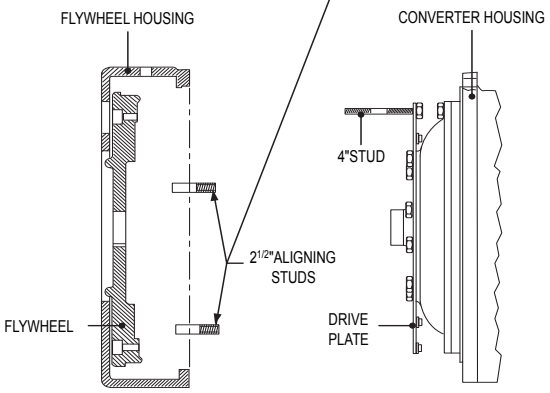


FIG. 2

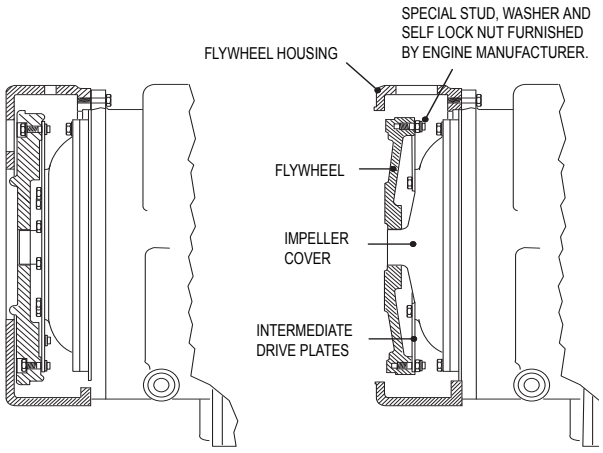


FIG. 3 FIG.4

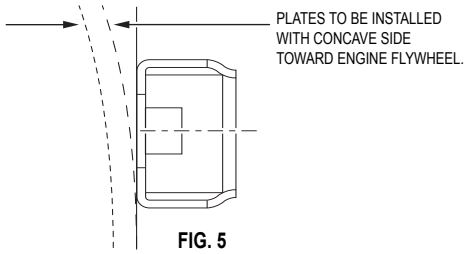
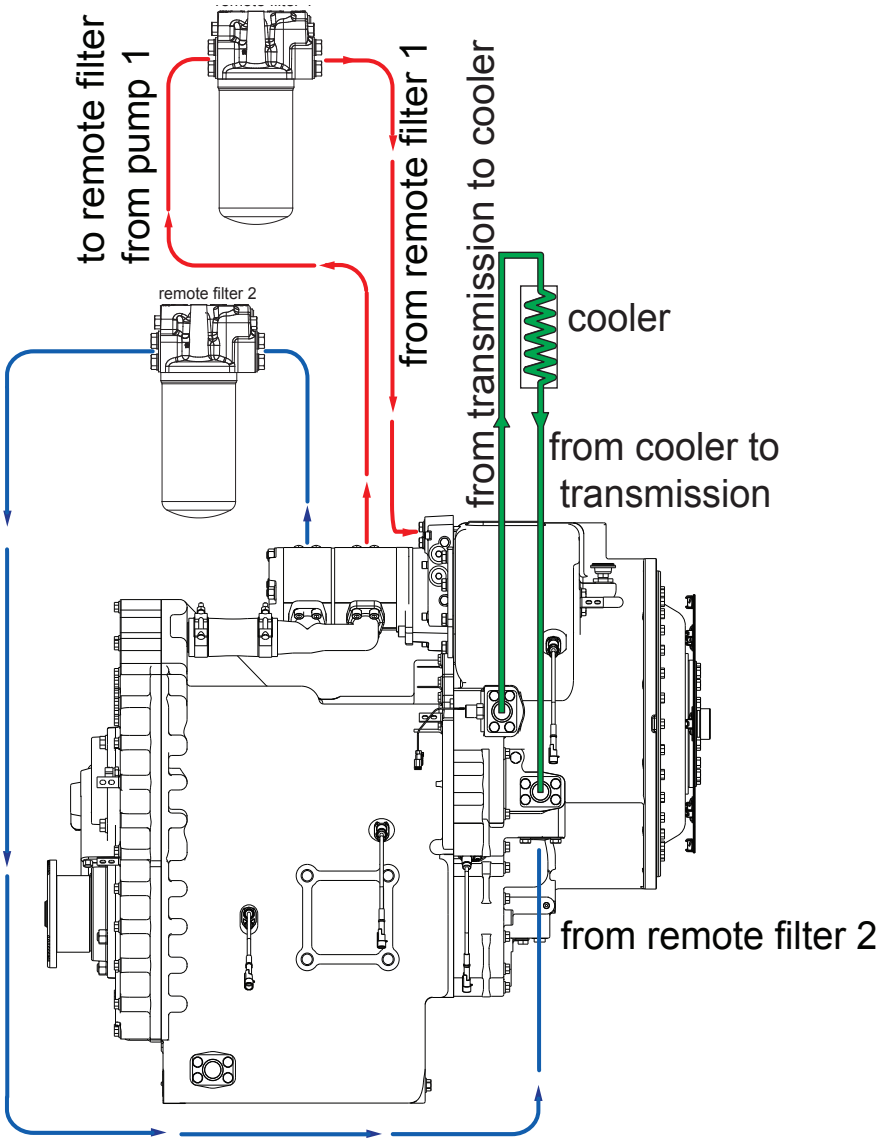


FIG. 5

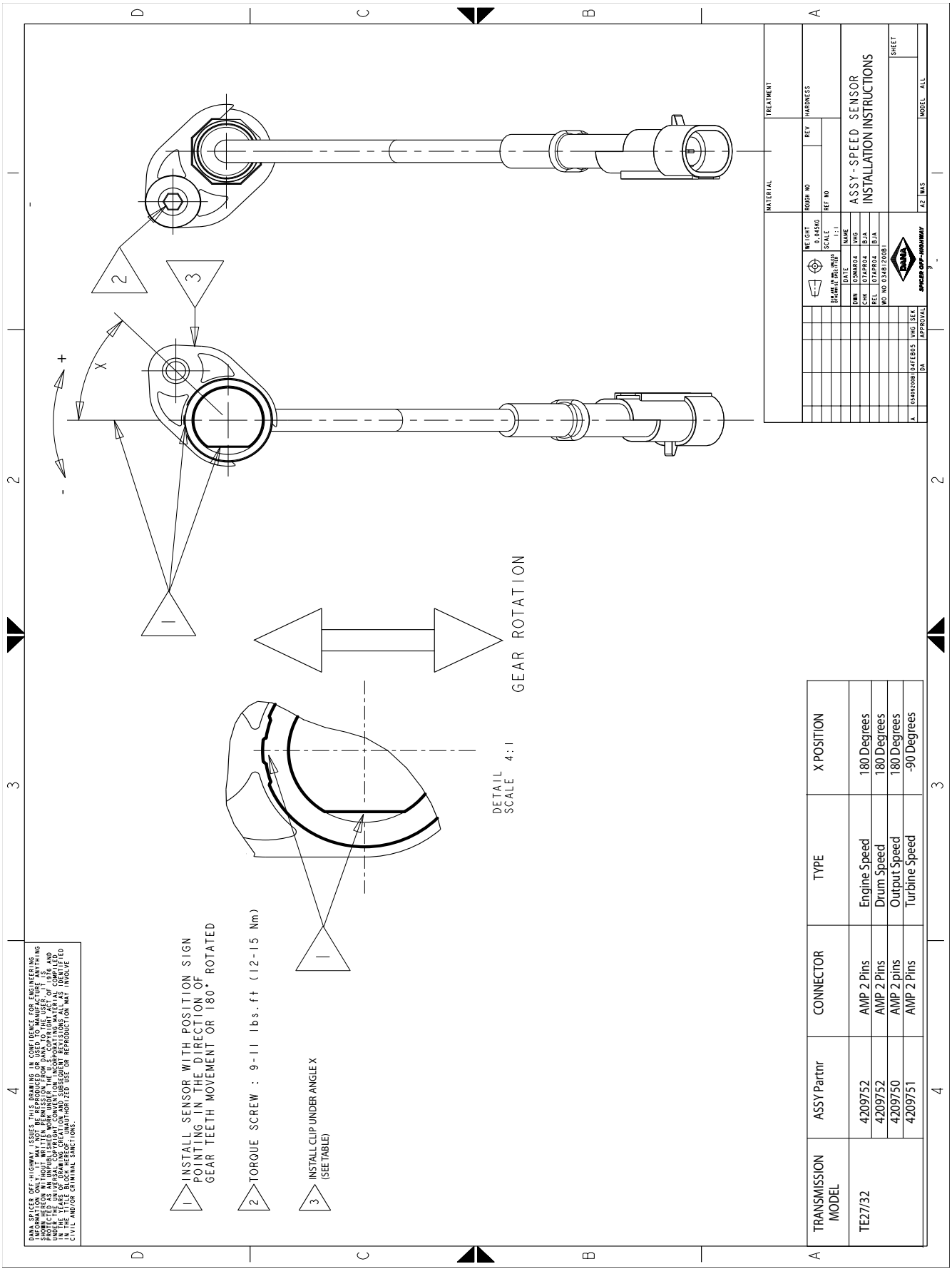
5.3 EXTERNAL PLUMBING



5.3.1 Cooler & filter lines specifications

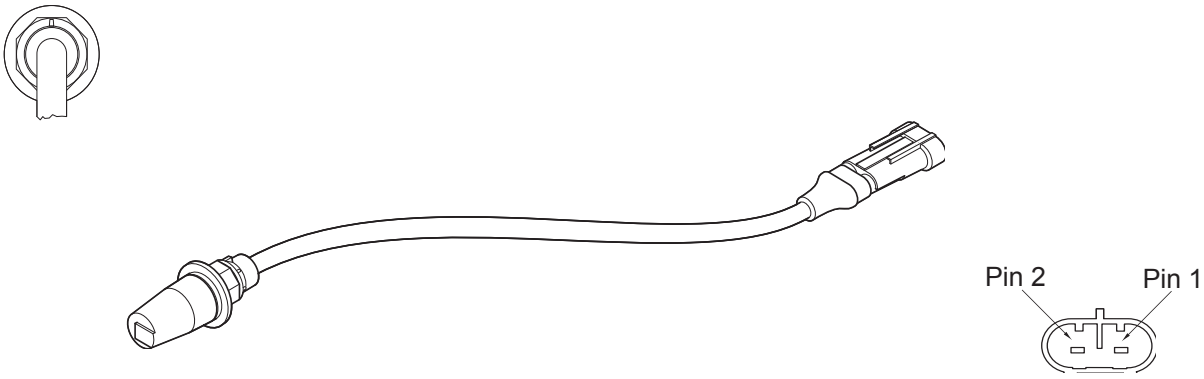
- Minimum 25.4 mm [1.0 inch] internal diameter for lines and fittings.
- Suitable for operation from ambient to 120° C [248° F] continuous operating temperature.
- Must withstand 30 bar [435psi] continuous pressure and with 40 bar [652 psi] intermittent surges.
- Conform SAE J1019 and SAE J517,100RI.

5.4 SPEED SENSOR INSTALLATION



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

5.4 SPEED SENSOR INSTALLATION (CONTINUED)



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. Following table shows the relation between wire colour, pin number and connection.

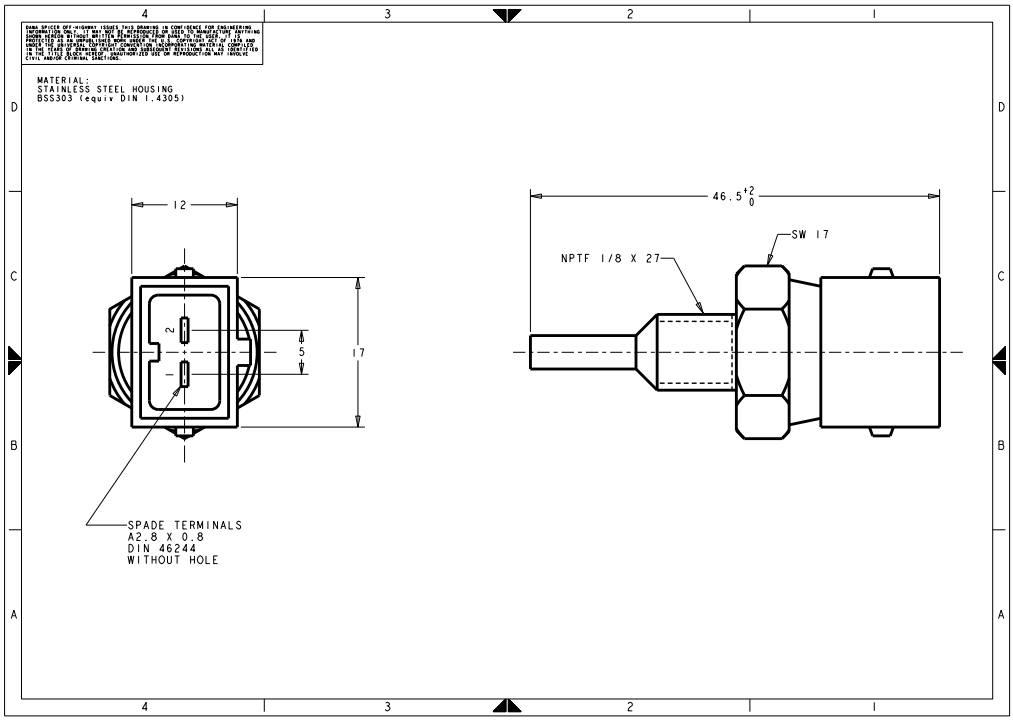
COLOUR	PIN NUMBER	FUNCTION	CONNECTION
BROWN	1	Current input	Hot wire
BLUE	2	Current output	Ground wire

Note

THE SENSOR WIRES HAVE A POLARITY.

BE SURE TO CORRECTLY OBSERVE SENSOR POLARITIES, AS WRONG CONNECTIONS WILL DEACTIVATE THE SENSOR !

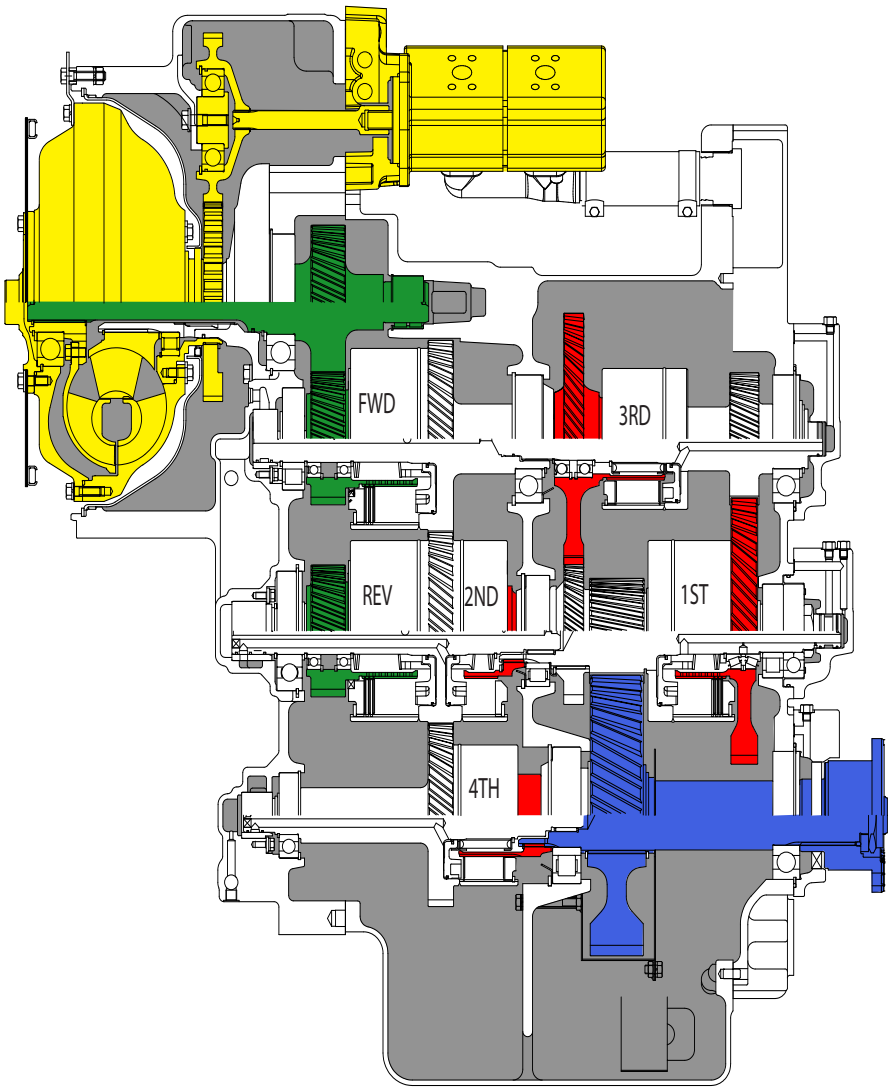
5.5 TEMPERATURE SENSOR INSTALLATION



6.1 THE TRANSMISSION ASSEMBLY

Basically the transmission is composed of five main assemblies:

1. The converter, pump drive section and pressure regulating valve.
2. The input shaft and directional clutches.
3. The range clutches.
4. The output section.
5. The transmission control valve.



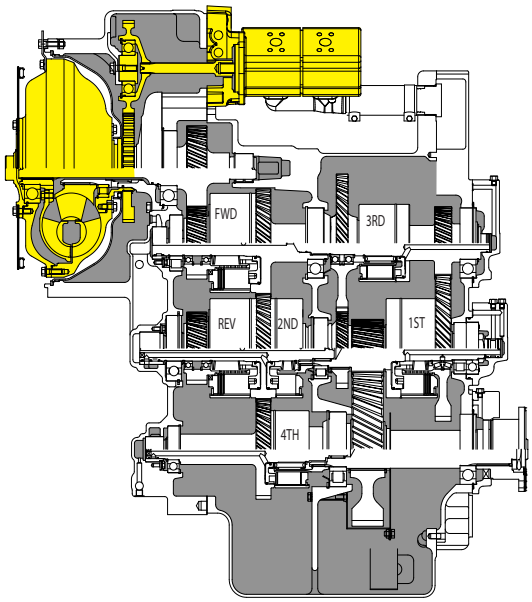
6.1.1 The converter, pump drive section and pressure regulating valve

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 centre 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 centre.
The reaction member of the torque converter is located between and at the centre 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.

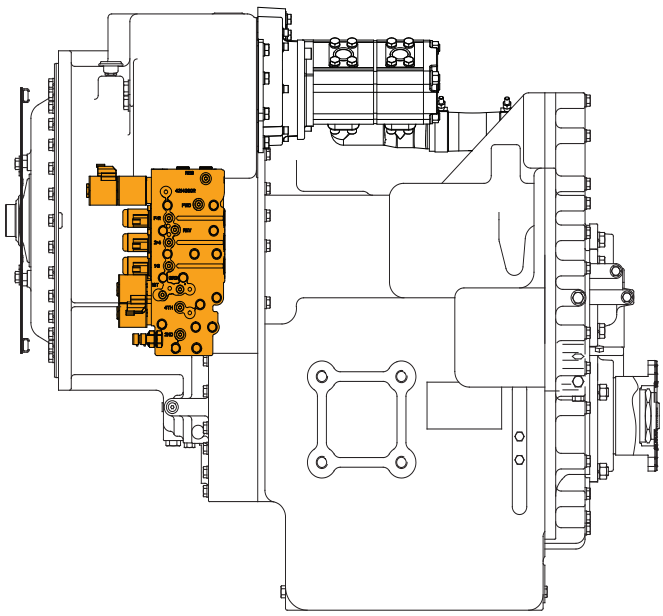
This recirculation will make the converter to multiply torque.
The torque multiplication is function of the blading (impeller, turbine and reaction member) and the converter output speed (turbine speed). The converter will multiply engine torque to its designed maximum multiplication ratio when the turbine 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 in direct relation with the engine speed.



CONVERTER SECTION



CONTROL VALVE

6.1.2 The 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.

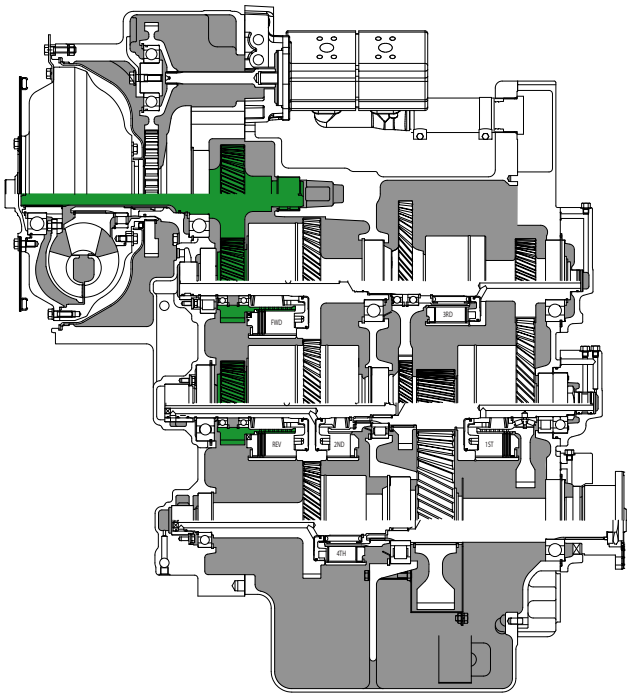
Oil sealing rings are located on the clutch shafts. These rings direct the oil through a drilled passage in the shaft to the desired clutch.

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.

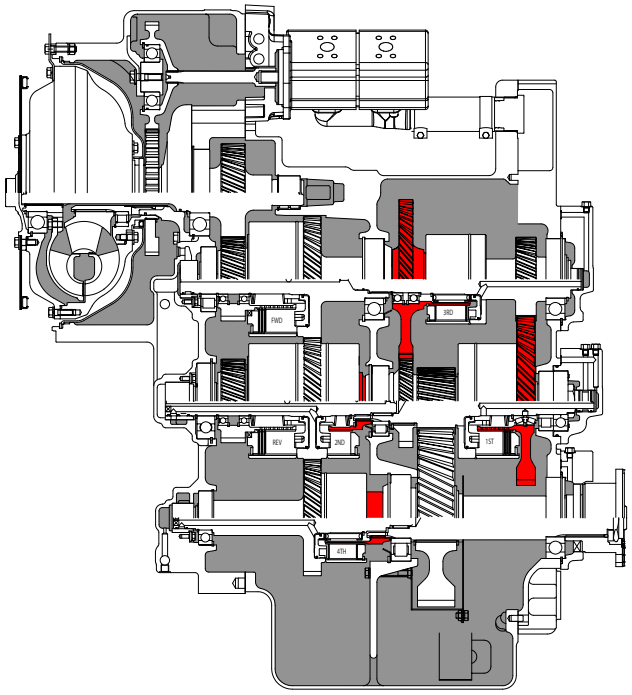
The engagement of all range and directional clutches is modulated and electronically controlled. This means that clutch pressure is built up gradually. This will enable the unit to make forward, reverse shifts while the vehicle is still moving and will allow smooth engagement of drive.



INPUT SECTION

6.1.3 The range clutches

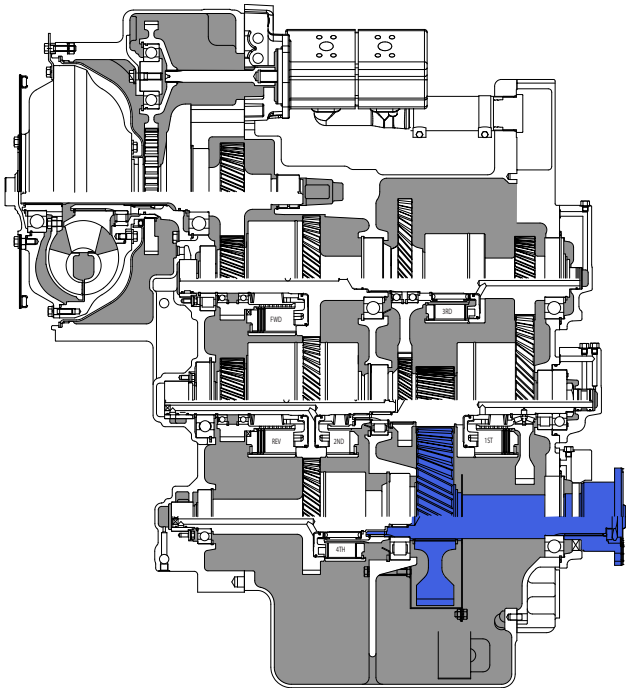
Once a directional clutch is engaged power is transmitted to the range clutches.
Operation and actuation of the directional clutches is similar to the range clutches.
The engagement of the directional clutches is modulated.
For the 1st clutch assembly there is an extra bleed hole to allow full drain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



RANGE CLUTCH-

6.1.4The output section

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



OUTPUT SECTION

6.2 THE TRANSMISSION CONTROLS (REFER TO HYDRAULIC DIAGRAM)

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

Operation of the valve

Regulated pressure 22 - 26 bar [319 - 377 PSI] 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 to 26 bar [0-87PSI] 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 actevated 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.

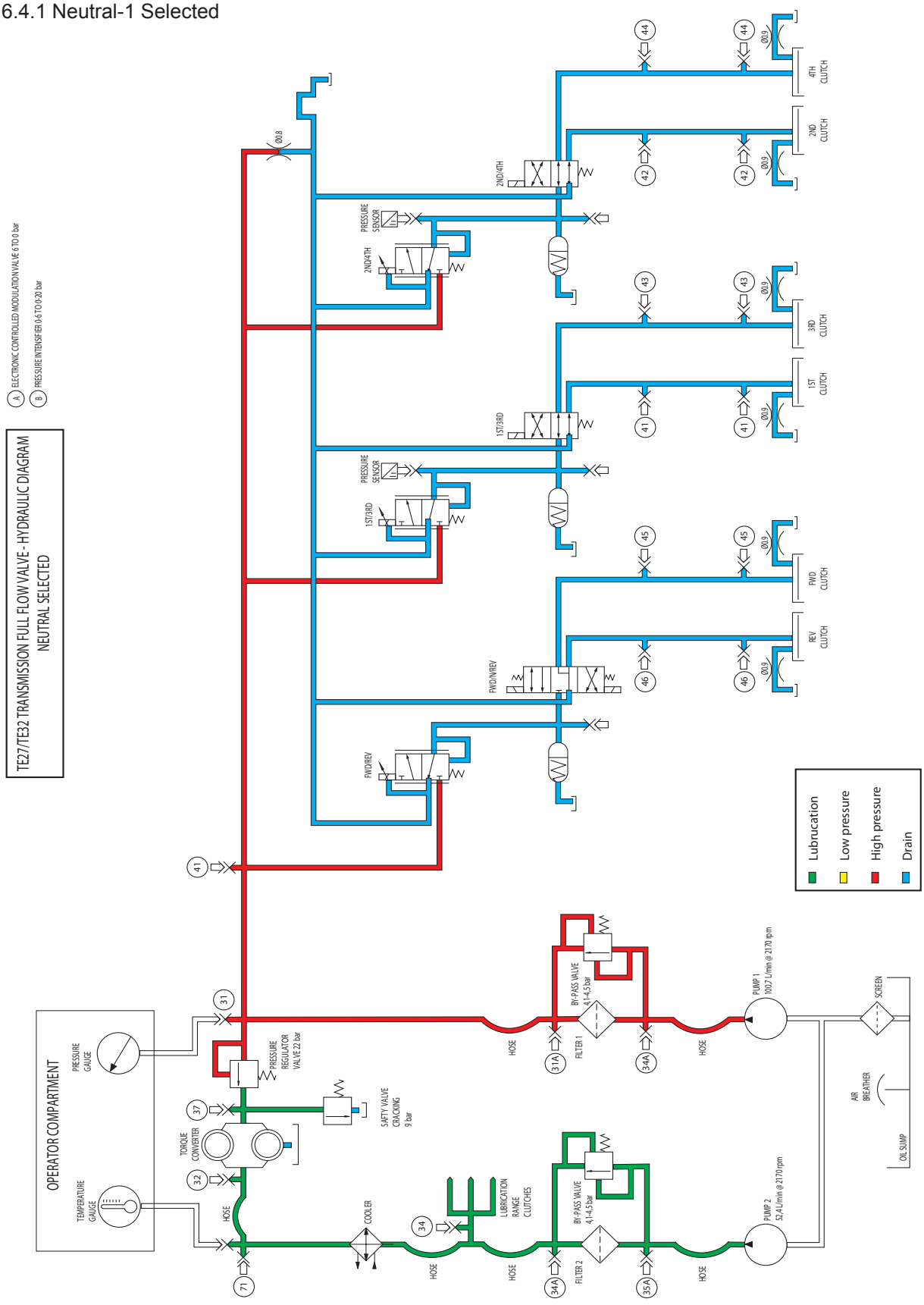
Pressure sensor
The control valve also has a pressure sensor installed to monitor overlap on range clutches

6.3 ELECTRIC SOLENOID CONTROLS

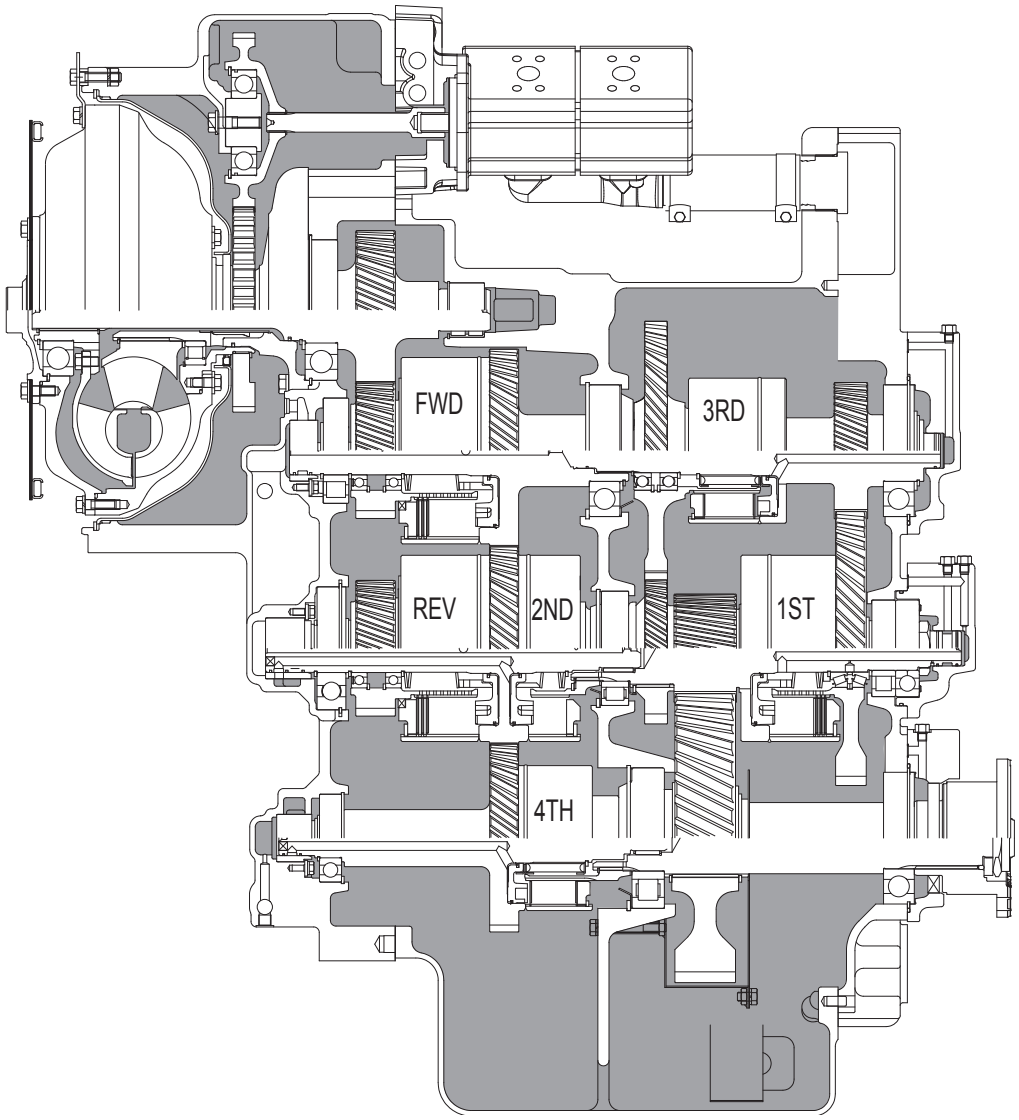
selected gear	Activated Selector valve	Activated Proportional valve	Activated clutches
Forward 4	FWD	FWD/REV - 2nd/4th	Forward, 4th
Forward 3	FWD	FWD/REV -1st/3rd	Forward, 3rd
Forward 2	FWD - 2nd/4th	FWD/REV - 2nd/4th	Forward, 2nd
Forward 1	FWD - 1st/3rd	FWD/REV -1st/3rd	Forward, 1st
Neutral 4		2nd/4th	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, 3nd
Reverse 2	REV - 2nd/4th	FWD/REV - 2nd/4th	Reverse, 2nd
Reverse 1	REV - 1st/3rd	FWD/REV -1st/3rd	Reverse, 1st

6.4 POWERFLOWS, ACTIVATED SOLENOIDS AND HYDRAULIC CIRCUIT

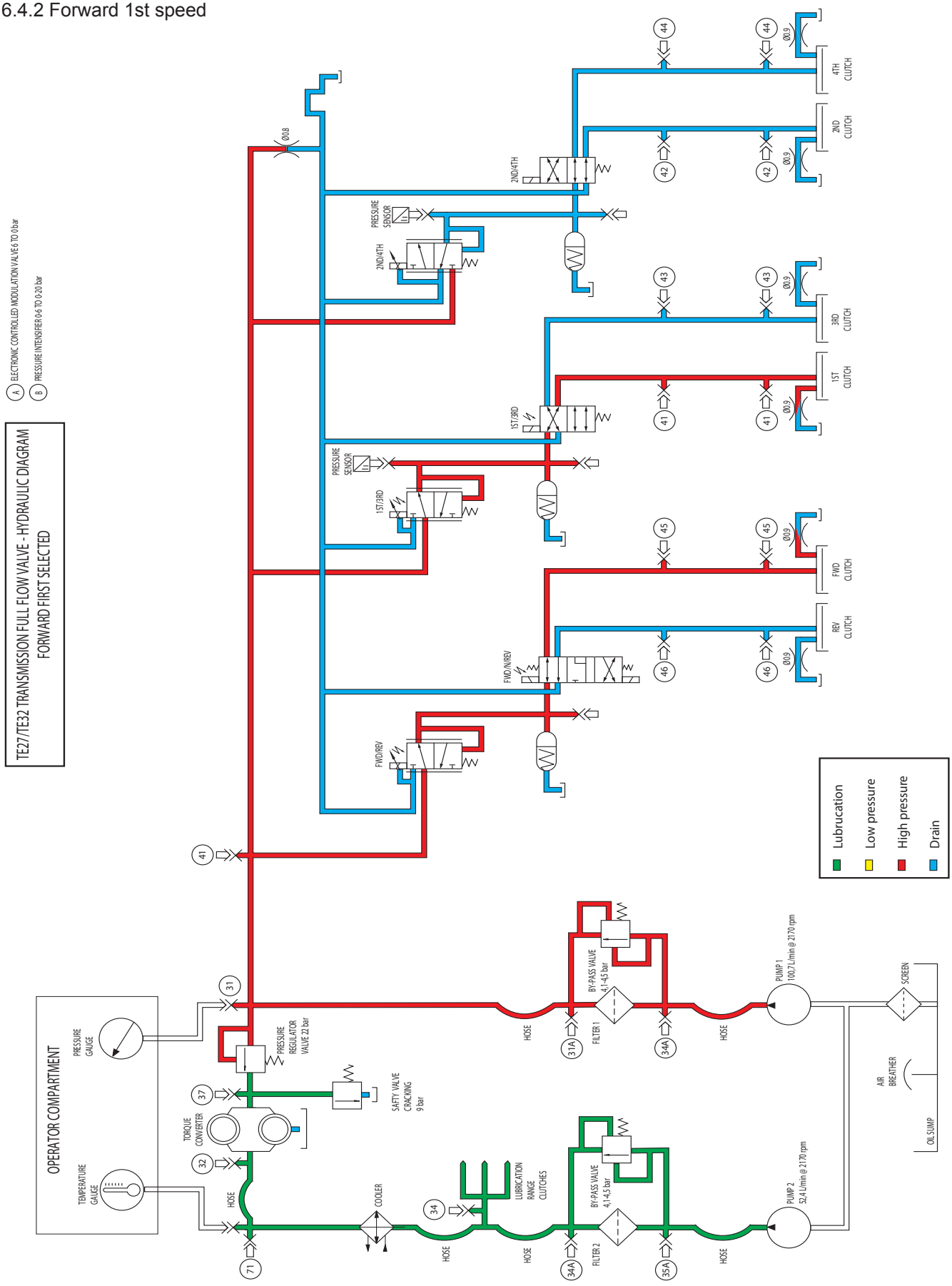
6.4.1 Neutral-1 Selected



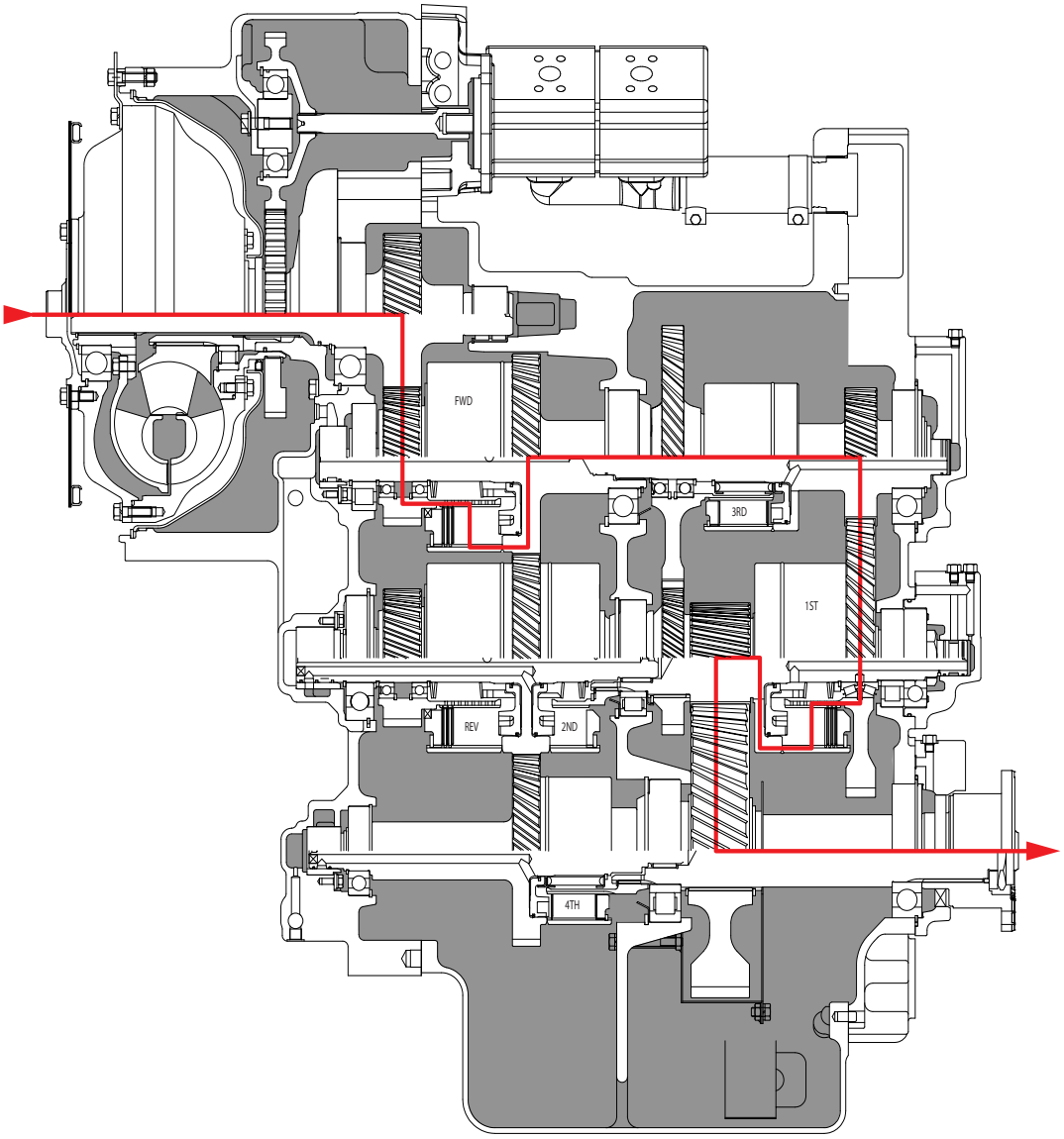
6.4.1 Neutral-1 (Continued)



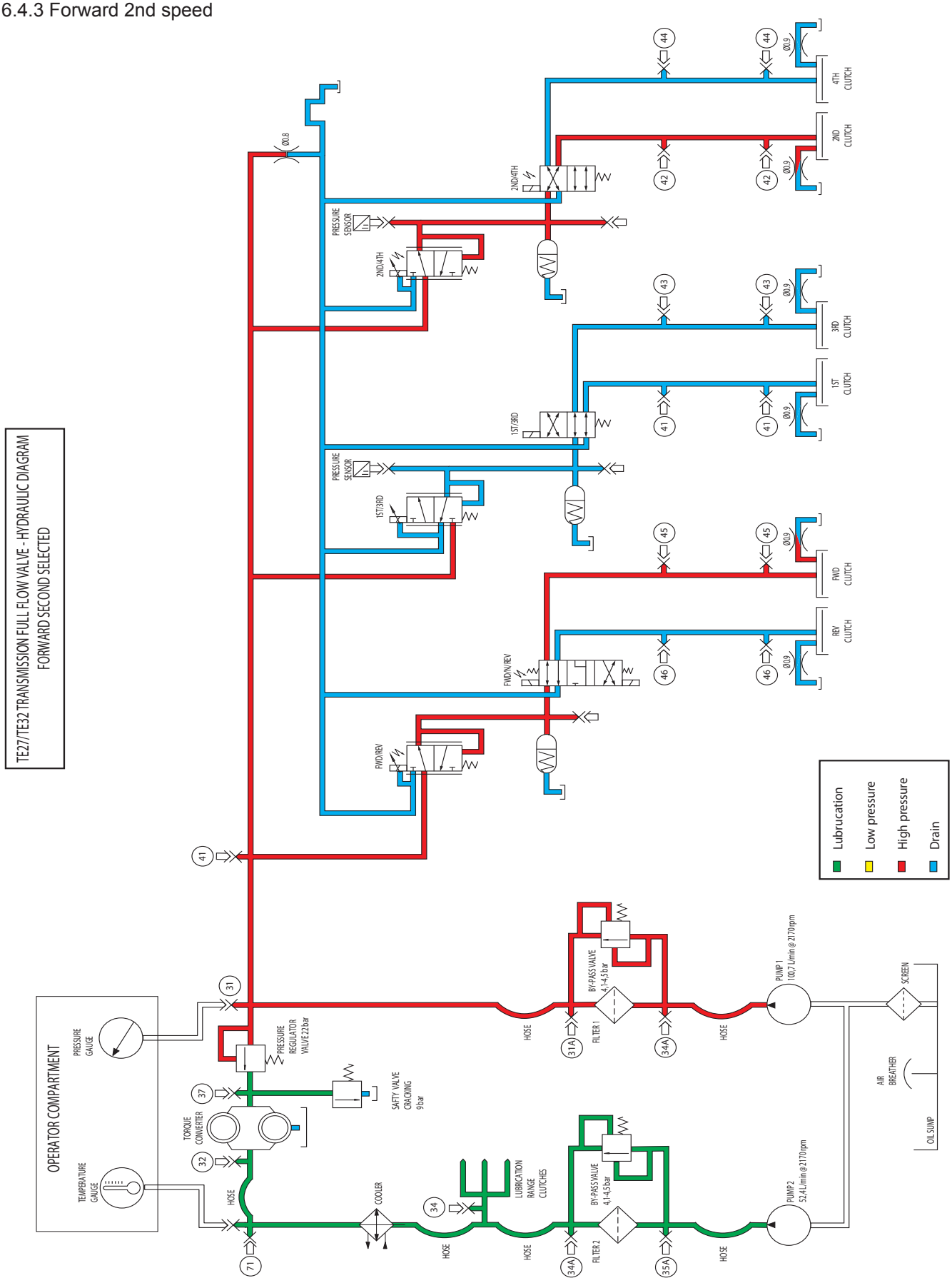
6.4.2 Forward 1st speed



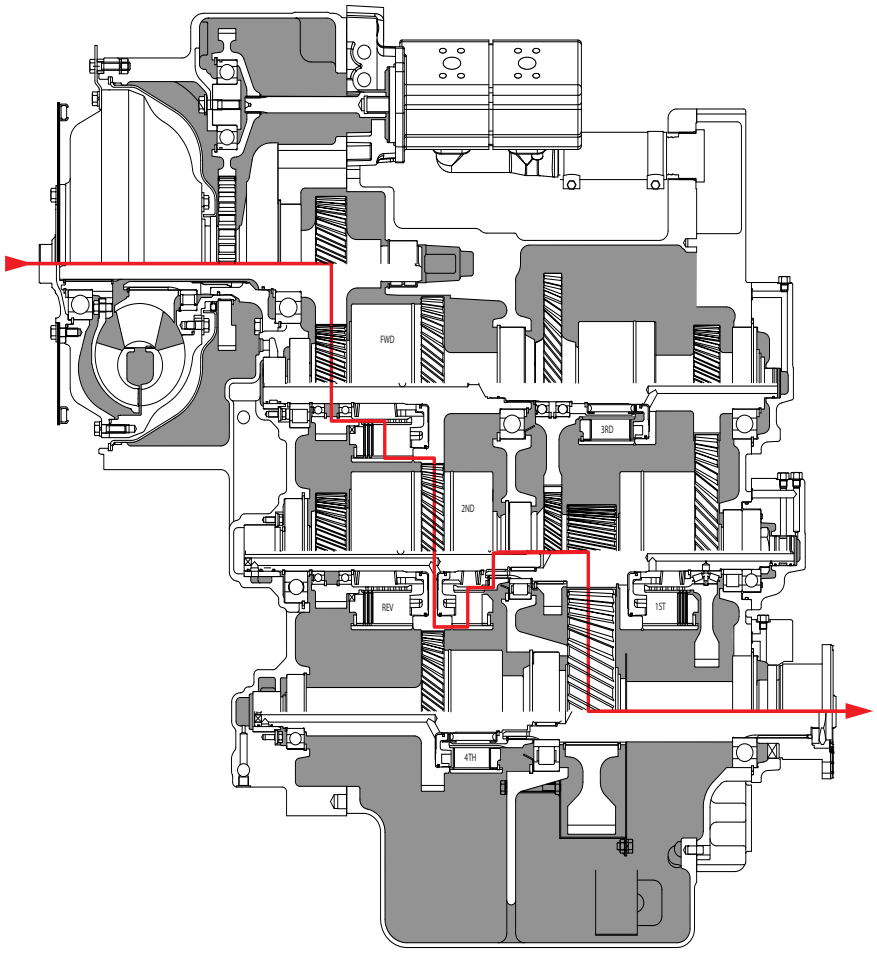
6.4.2 Forward 1st speed (continued)



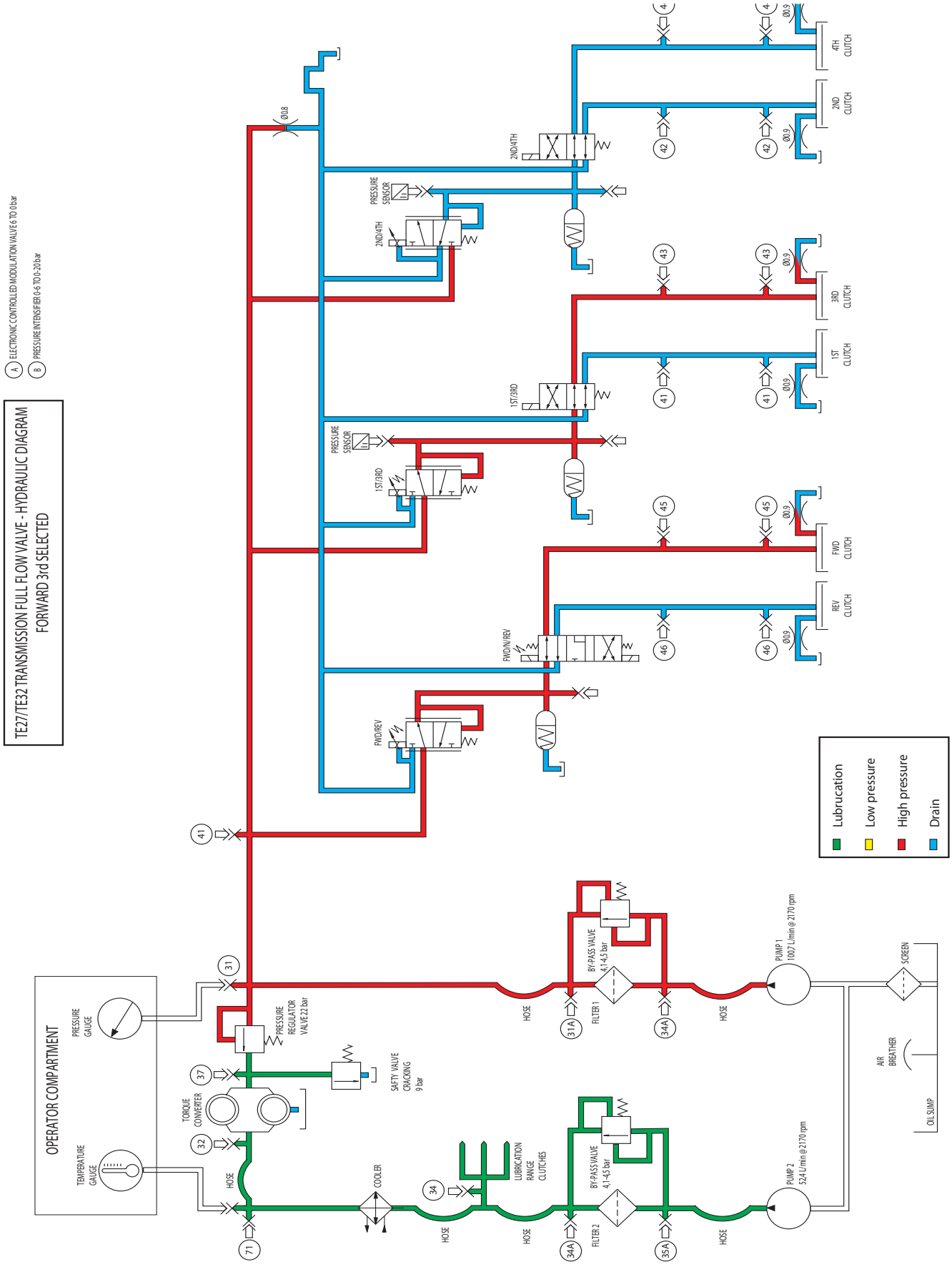
6.4.3 Forward 2nd speed



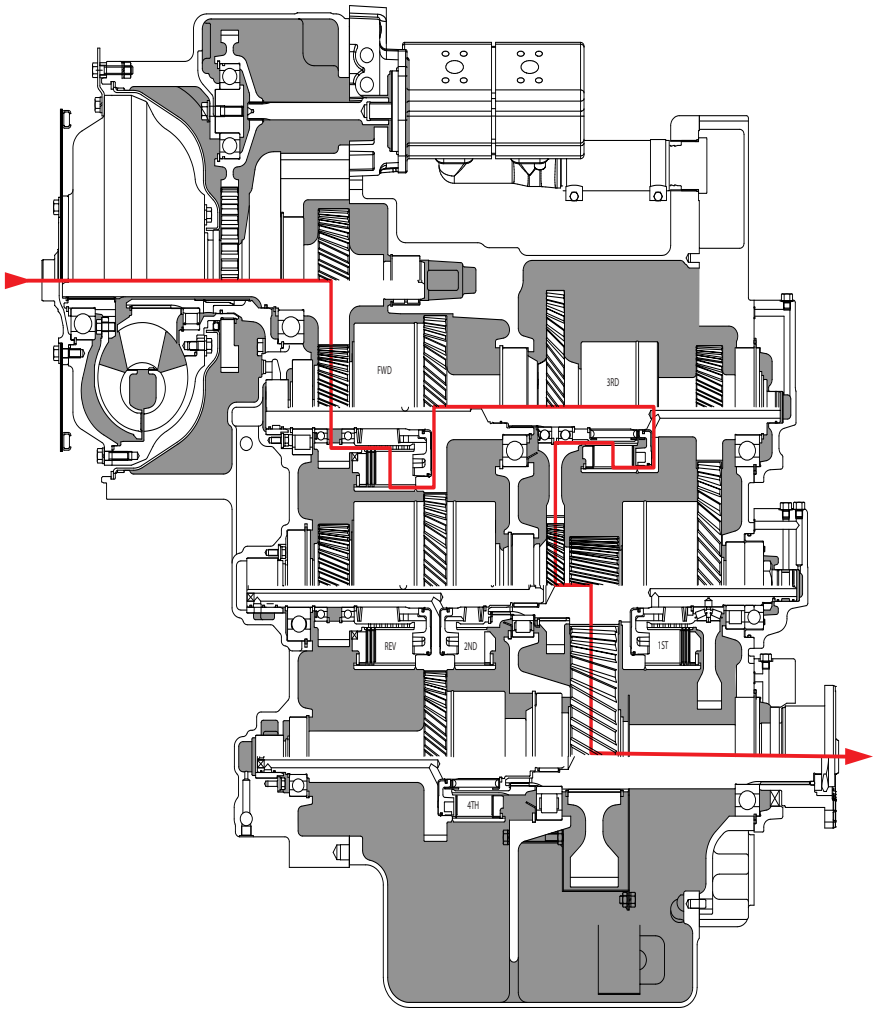
6.4.3 Forward 2nd speed (continued)



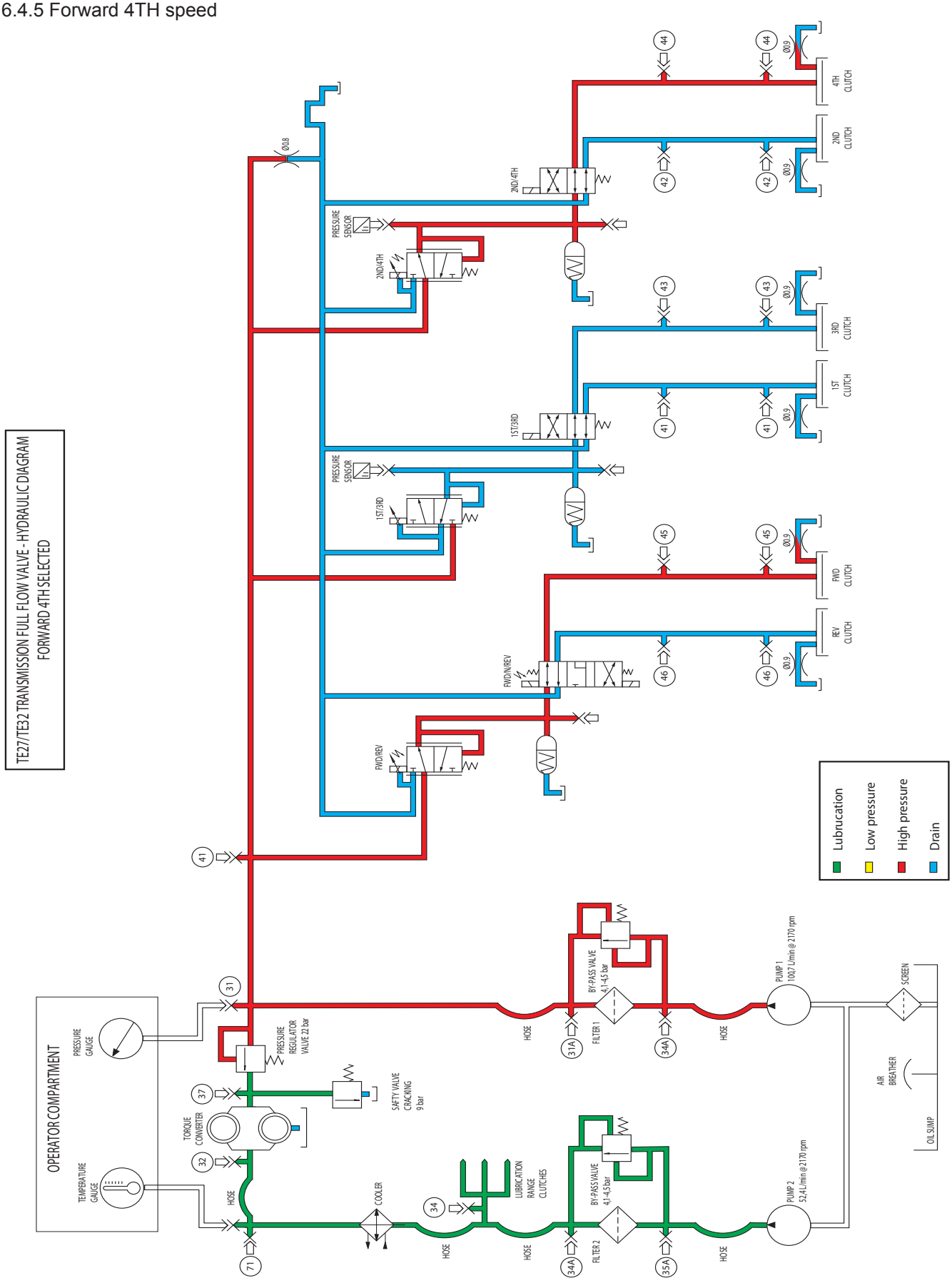
6.4.4 Forward 3rd speed



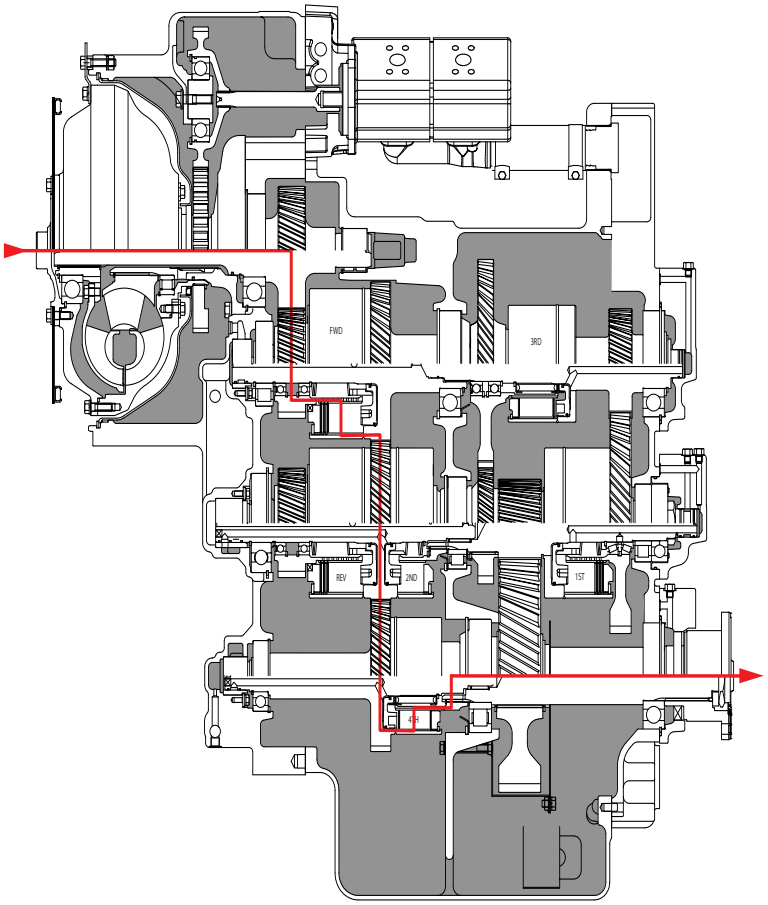
6.4.4 Forward 3rd speed (continued)



6.4.5 Forward 4TH speed



6.4.5 Forward 4th speed (continued)



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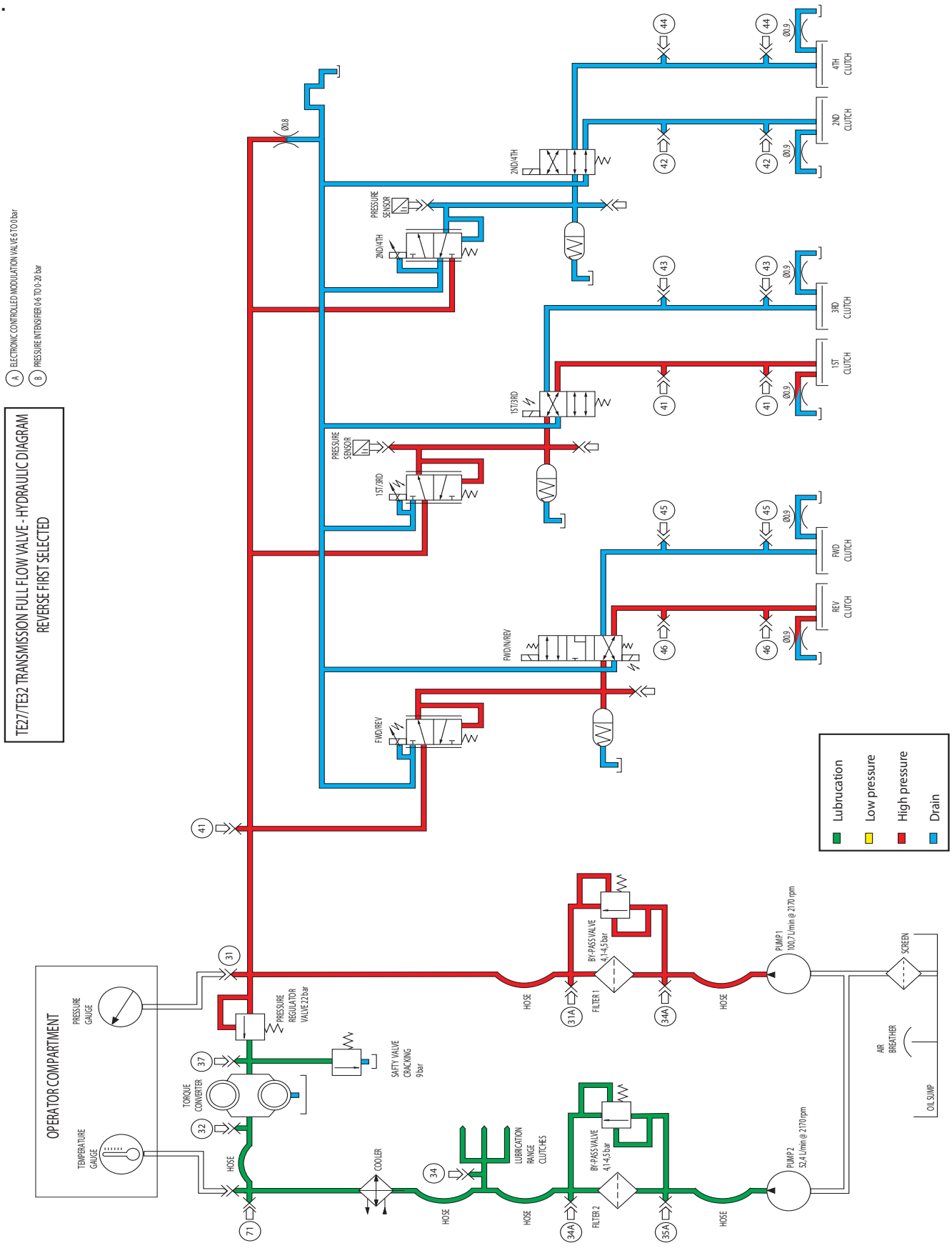
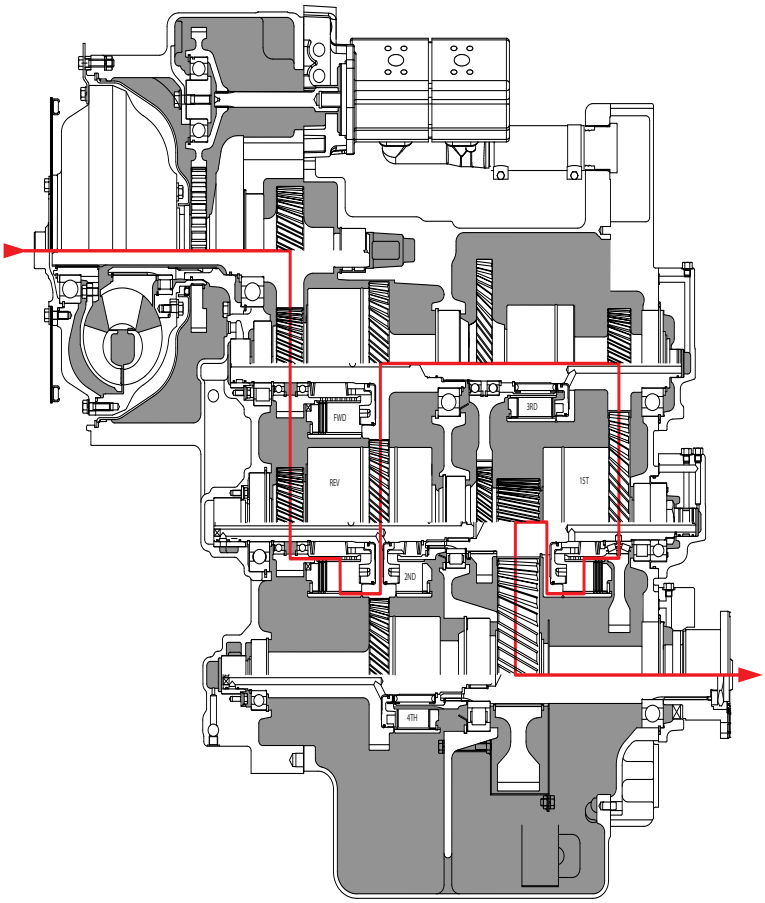
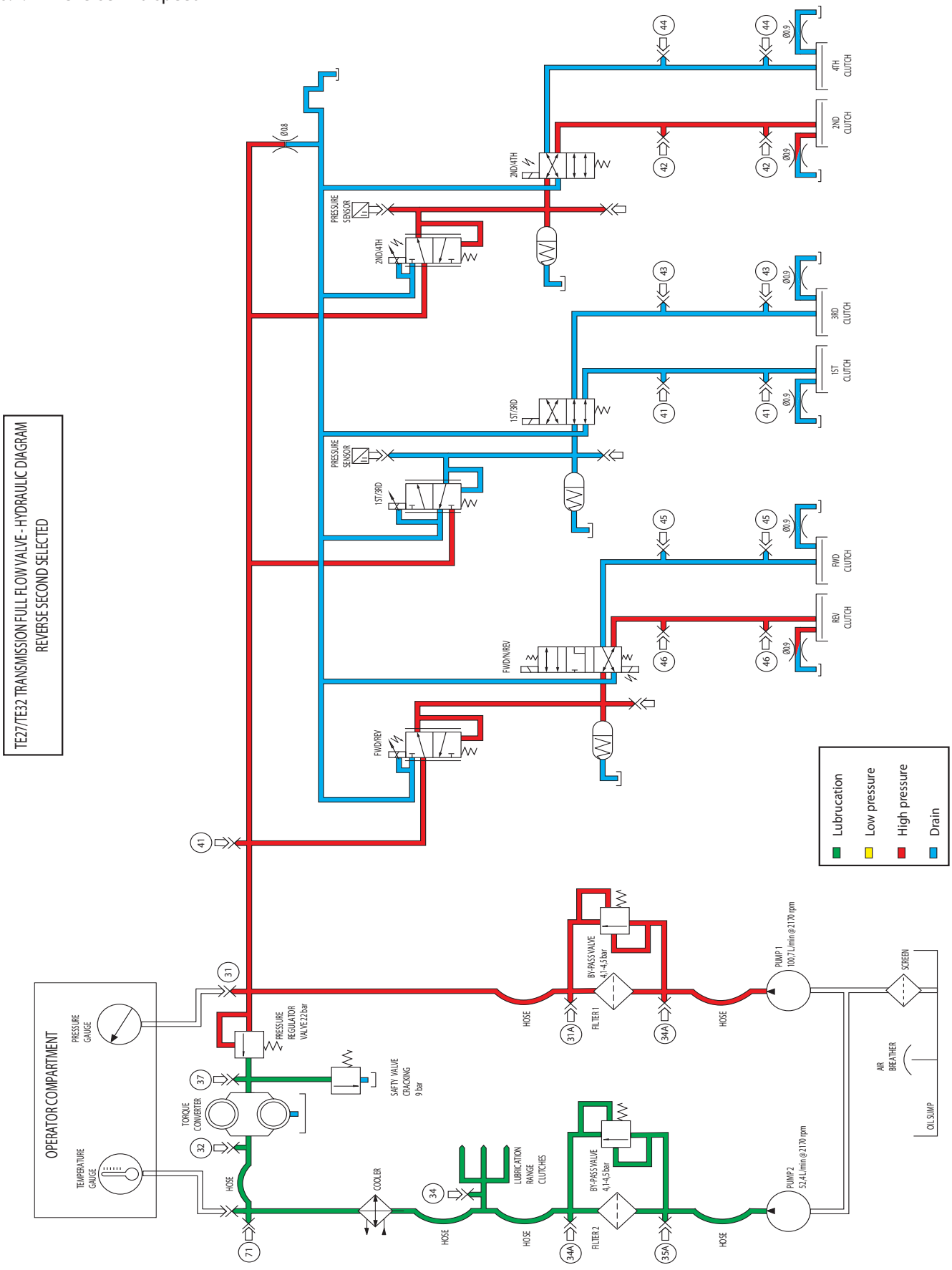

TE27/TE32 TRANSMISSION FULL FLOW VALVE - HYDRAULIC DIAGRAM
REVERSE FIRST SELECTED
A ELECTRONIC CONTROLLED MODULATION VALVE 6 TO 0 bar
B PRESSURE INTENSIFIER 0-6 TO 0-20 bar
Lubrication
Low pressure
High pressure
Drain
OPERATOR COMPARTMENT
PRESSURE GAUGE
TEMPERATURE GAUGE
PRESSURE REGULATOR VALVE 22 bar
SAFETY VALVE CRACKING 9 bar
TORQUE CONVERTER
COOLER
LUBRICATION RANGE CLUTCHES
BY-PASS VALVE 4.1-4.5 bar
FILTER 1
FILTER 2
PUMP 1 100.7 L/min @ 2170 rpm
PUMP 2 52.4 L/min @ 2170 rpm
SCREEN
AIR BREATHER
OIL SUMP
HOSE
2ND/4TH
1ST/3RD
FWD/REV
PRESSURE SENSOR
4TH CLUTCH
2ND CLUTCH
3RD CLUTCH
1ST CLUTCH
FWD CLUTCH
REV CLUTCH
Ø0.8
Ø0.9

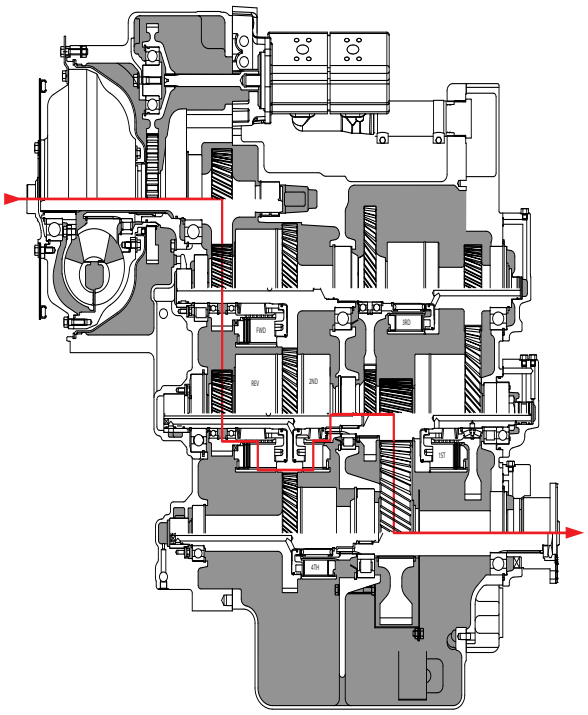
6.4.6 Reverse 1st speed



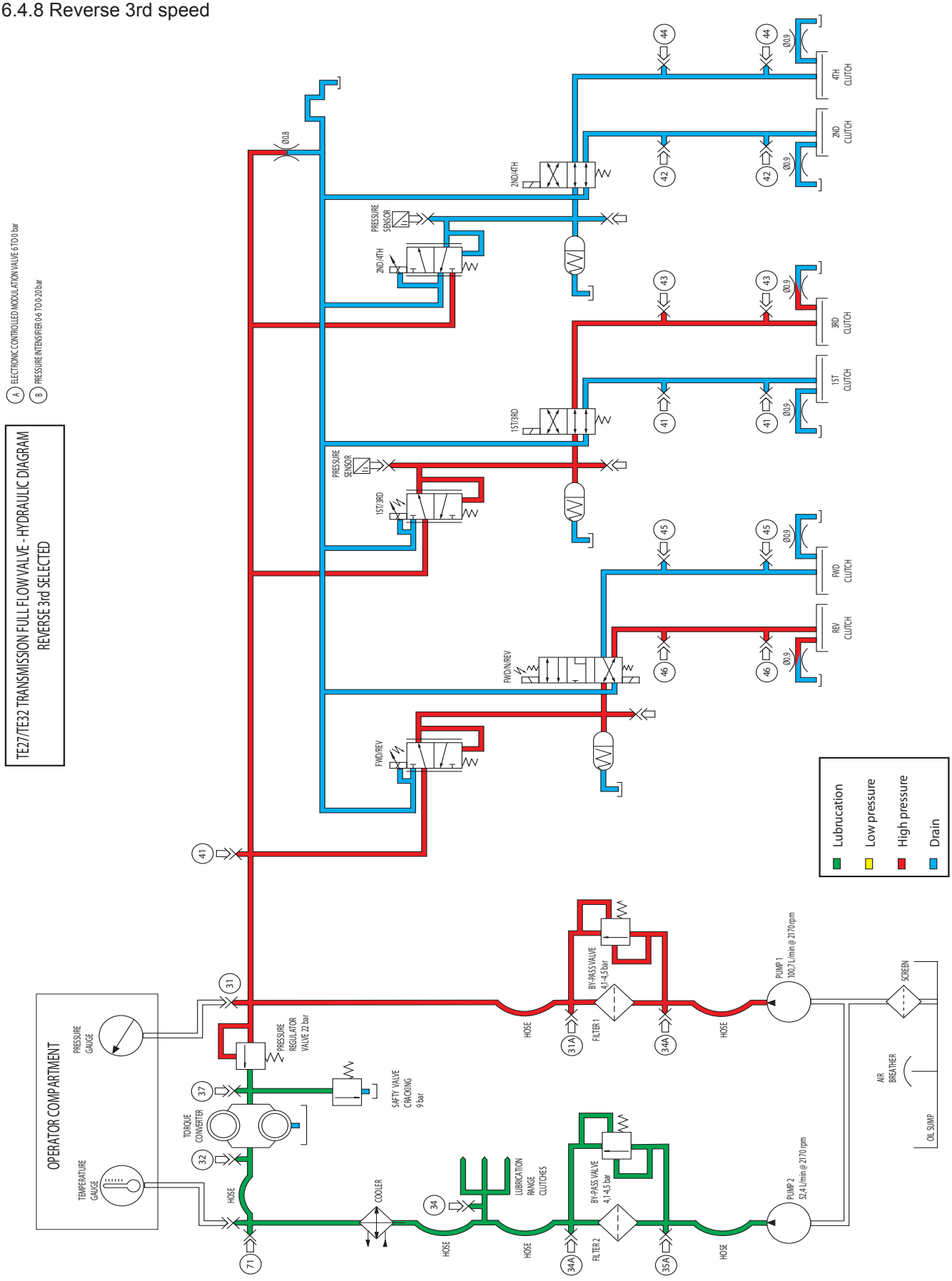
6.4.7 Reverse 2nd speed



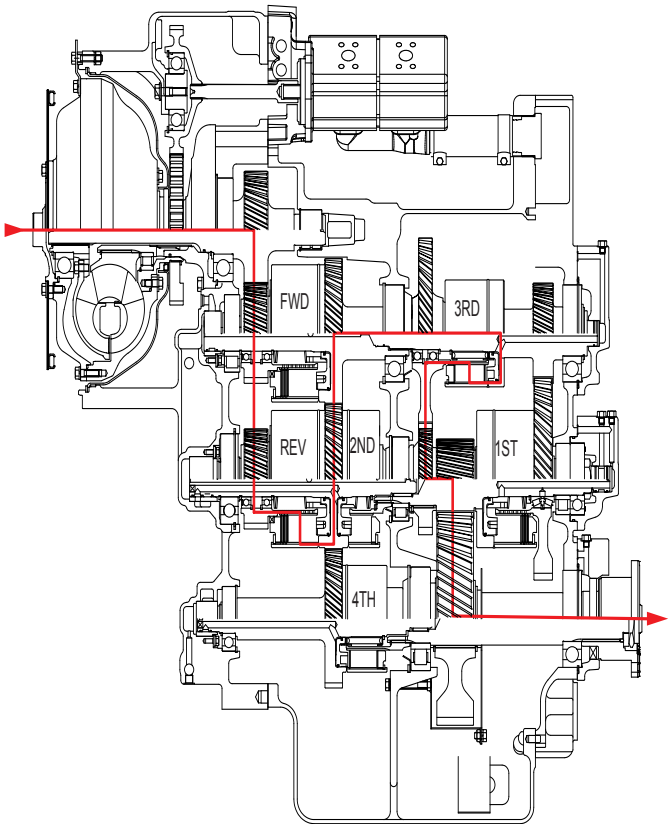
6.4.7 Reverse 2nd speed (continued)



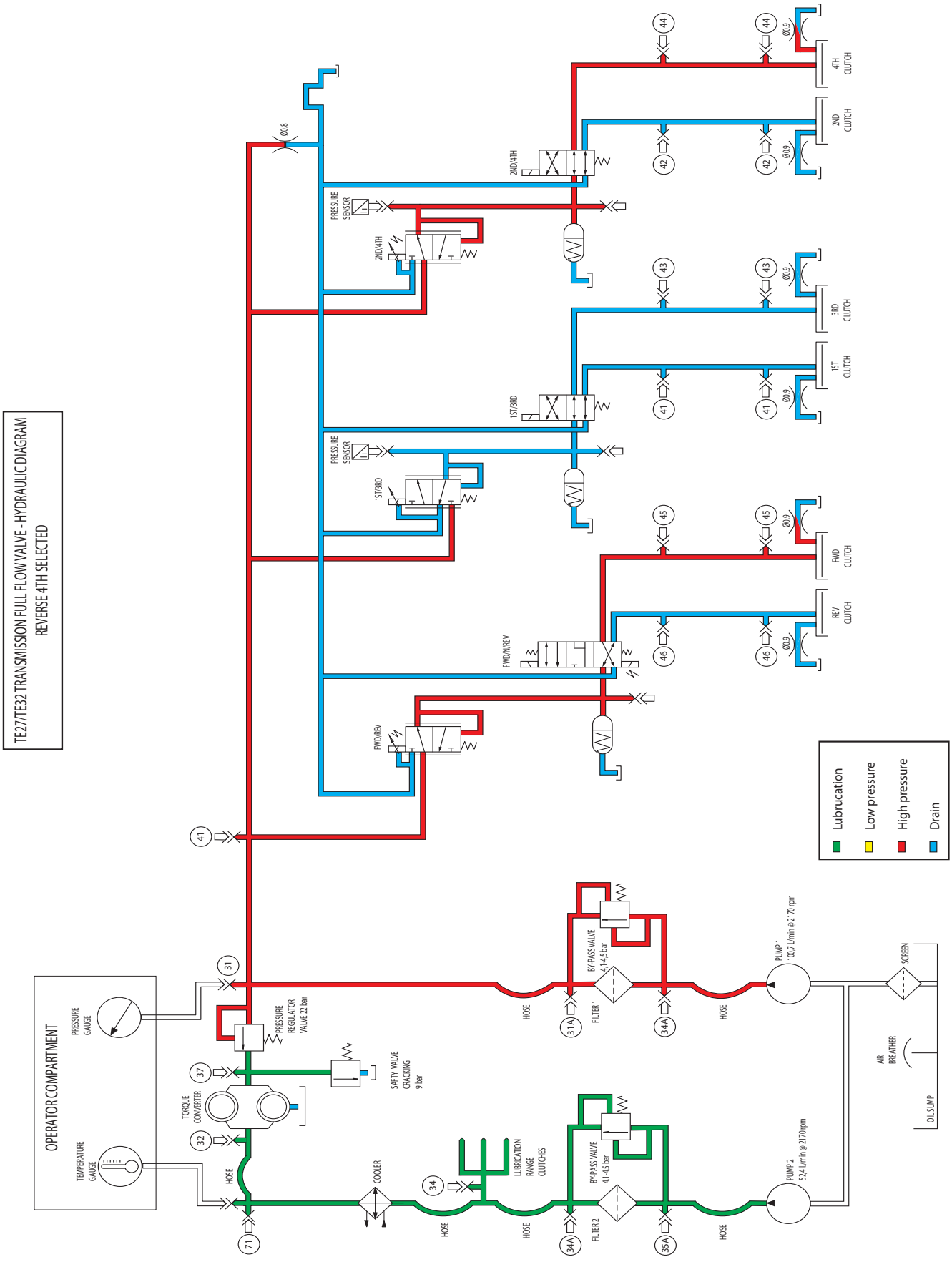
6.4.8 Reverse 3rd speed



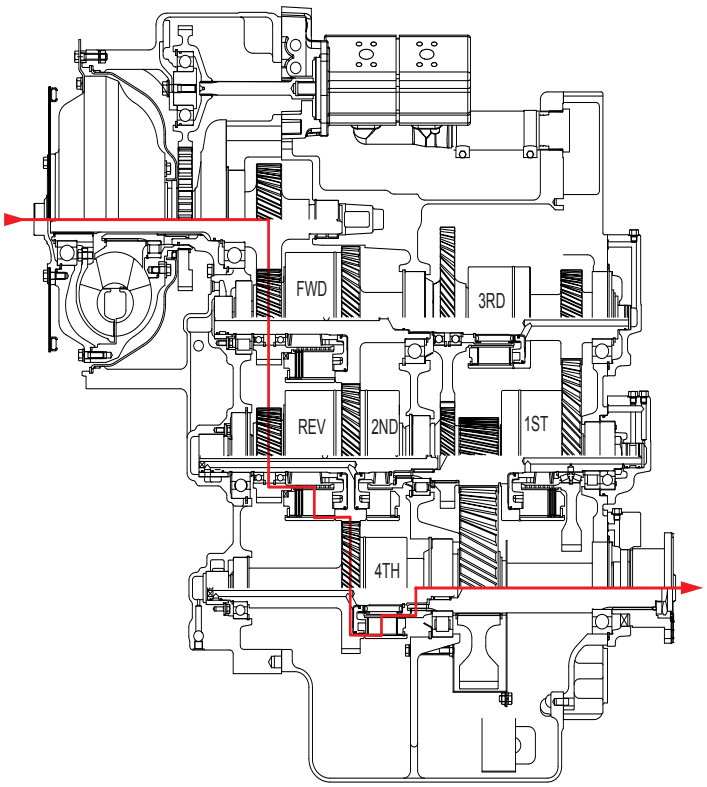
6.4.8 Reverse 3rd speed (continued)



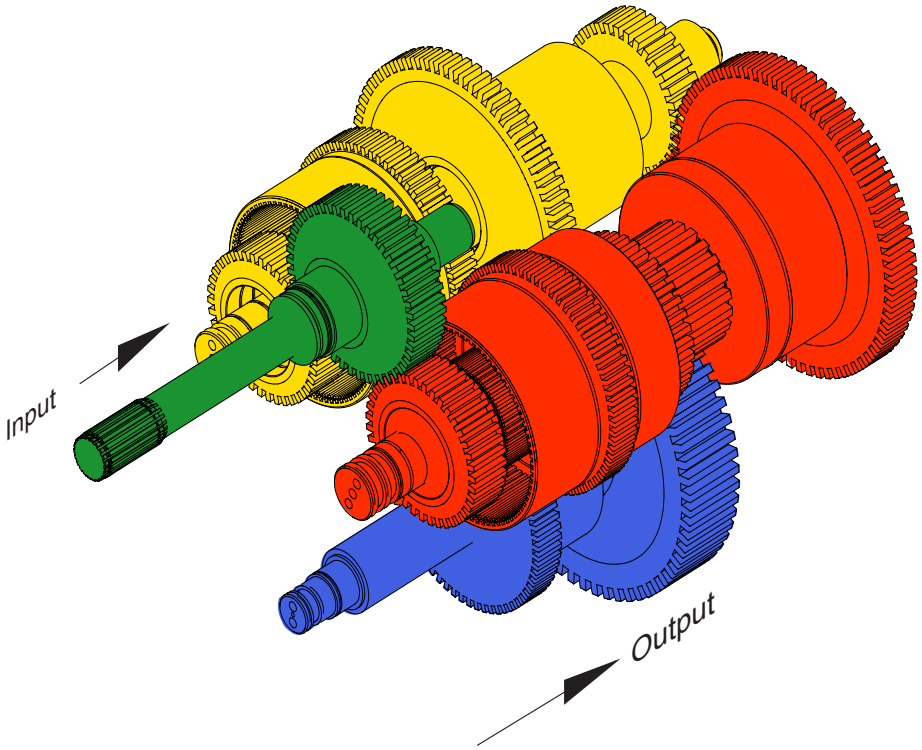
6.4.9 Reverse 4TH speed



6.4.9 Reverse 4TH speed (continued)



6.5 GEAR AND CLUTCH LAYOUT



7 TROUBLESHOOTING GUIDE

The following information is presented as an aid to isolate and determine the specific problem area 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.

Therfore, 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 analysing 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.

7.1 THE TRANSMISSION

TE27/32 powershift transmission with torque converter troubles fall into four general categories:

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

In addition to the mechanical and electrical components, all of which must be in 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.

7.2 THE INPUT SHAFT AND DIRECTIONAL CLUTCHES

7.2.1 PERFORMING A STALL TEST

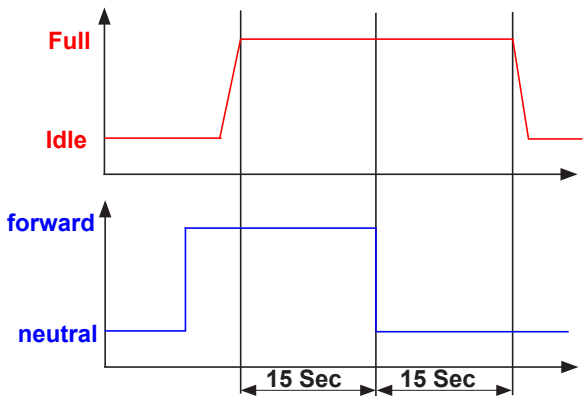
A stall test identifies transmission, converter or engine problems.

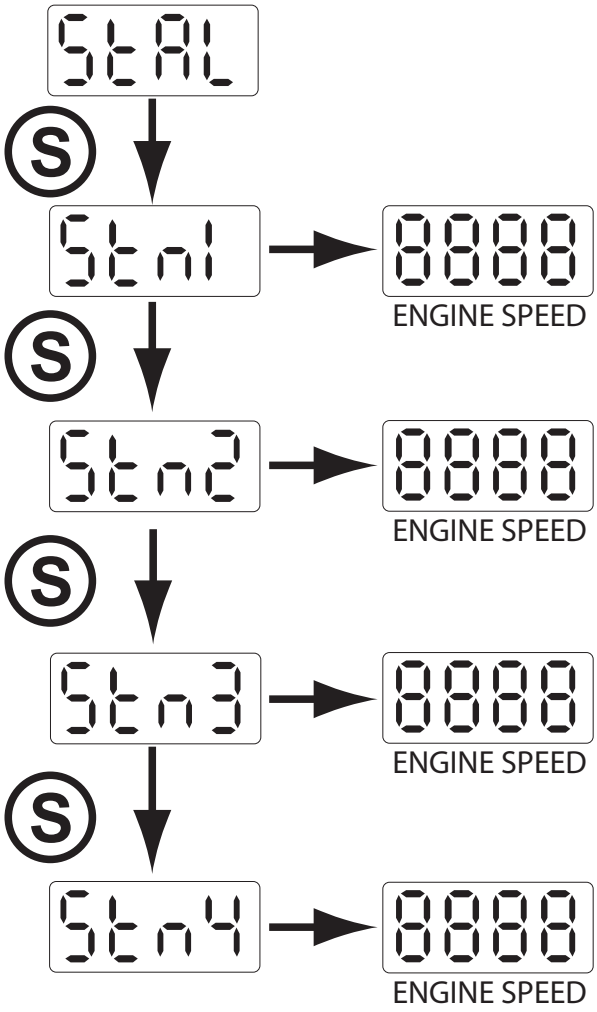
Use the following procedure:

With a stall test it is possible to test clutch packslippage or test the converter/engine stall speed in each gear.

How to perform the stall test

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 end holding the S button for 15 seconds
3 Select "STAL" using the M buttom





5 Select FWD or REV in the selected range gear
6 Once the oil temperature reaches 70° C [158° F] check max. 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 70° C [158° F] by selecting neutral.
8 Leave the stall mode with the M button or switch-off the ignition

If max. stall speed measured is below specifications, it could indicate an engine or converter problem.
If max. stall speed measured is above specifications, it could indicate slipping clutches.

CAUTION

DO NOT 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 120° C [250° F] MAXIMUM WILL CAUSE DAMAGE TO TRANSMISSION CLUTCHES, FLUID, CONVERTER AND SEALS.

7.2.2 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.

7.2.3 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 proper cooling and operating temperatures for the engine and transmission. Air clean the radiator, if necessary.

7.2.4 Hydraulic checks

Also, before checking the transmission clutches, torque converter, charging pump and hydraulic circuit for pressure and rate of flow, it is imporatant 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.

Note:

THE TRANSMISSION FLUID MUST BE AT OPERATING TEMPERATURE OF 82 - 93° C [180 - 200° F] TO OBTAIN CORRECT FLUID LEVEL AND PRESSURE READINGS.

DO NOT 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 converter at “stall” (refer to 6.2.1 “stall test”).

Caution:

BE CAREFULL THAT THE VEHICLE DOES NOT MOVE UNEXPECTEDLY WHEN OPERATING THE ENGINE AND CONVERTER AT STALL RPM.

7.2.5 Controller (APC200): Please refer to functional description

7.3 TROUBLESHOOTING GUIDE

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

7.3.1 Low clutch pressure

Cause	Remedy
1. Low oil level.	1. Fill to proper level.
2. Clutch pressure regulating valve stuck open.	2. Clean valve spool and housing.
3. Faulty charging pump.	3. Replace pump.
4. Broken or worn clutch shaft or piston sealing rings.	4. Replace sealing rings.

7.3.2 Low charging pump output flow

Cause	Remedy
1. Low oil level.	1. Fill to proper oil level.
2. Suction screen clogged.	2. Clean suction screen.
3. Defective charging pump.	3. Replace charging pump.

7.3.3 Overheating

Cause	Remedy
1. Worn oil sealing rings	1. Remove, disassemble and rebuild converter assy.
2. Worn charging pump.	2. Replace charging pump.
3. Low oil level.	3. Fill to proper level.
4. Dirty oil cooler.	4. Clean cooler.
5. Restriction in cooler lines.	5. Change cooler lines.

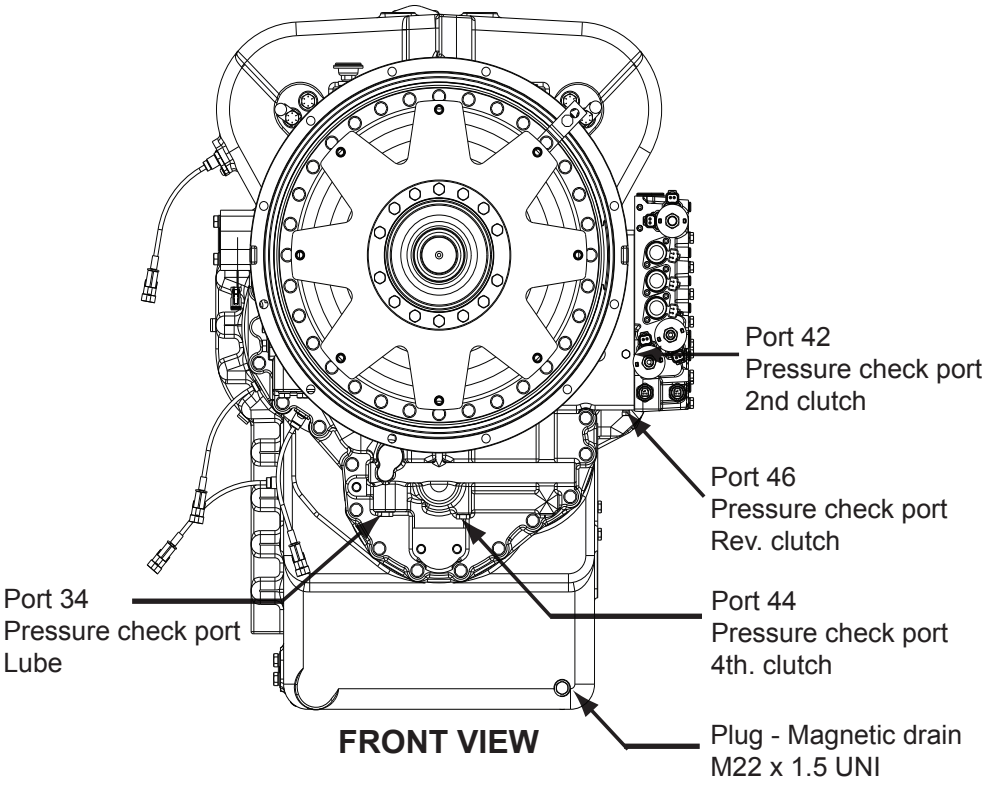
7.3.4 Noisy converter

Cause	Remedy
1. Worn charging pump.	1. Replace charging pump.
2. Worn or damaged bearings.	2. A complete disassembly will be necassary to determine which bearing is faulty.

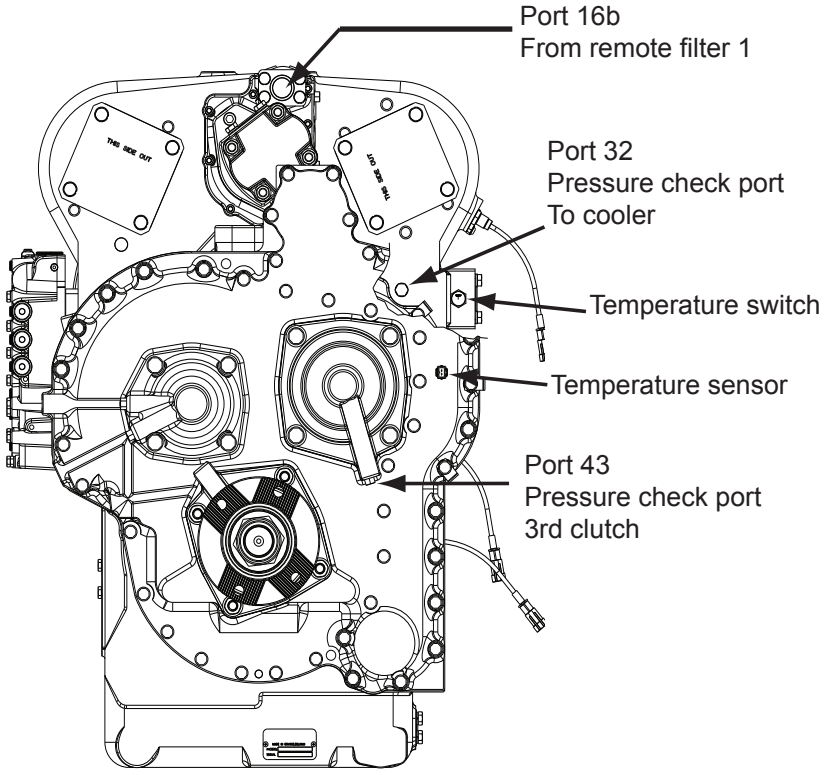
7.3.5 Lack of power

Cause	Remedy
1. Low engine RPM at converter stall.	1. Tune engine, check governor.
2. See “Overheating” and make same checks.	2. Make corrections as explained in “Overheating”.

7.4 CHECK POINTS

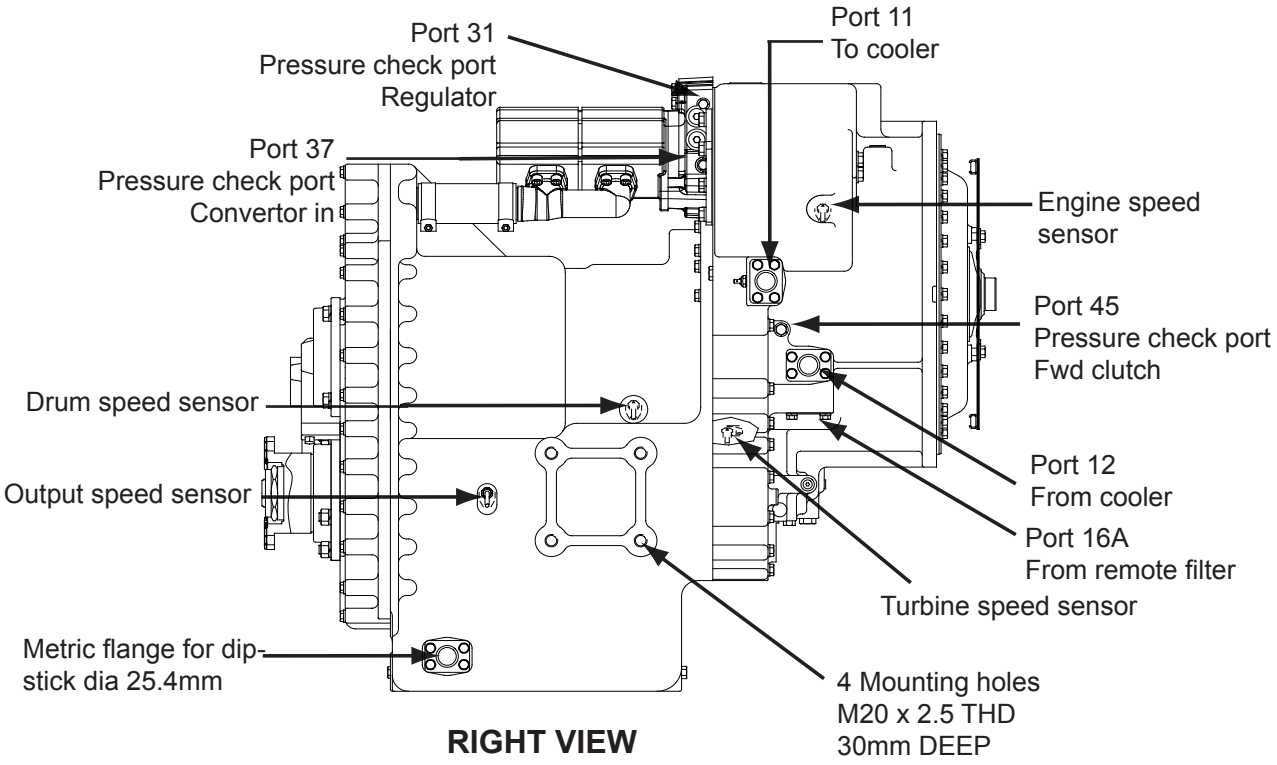


FRONT VIEW

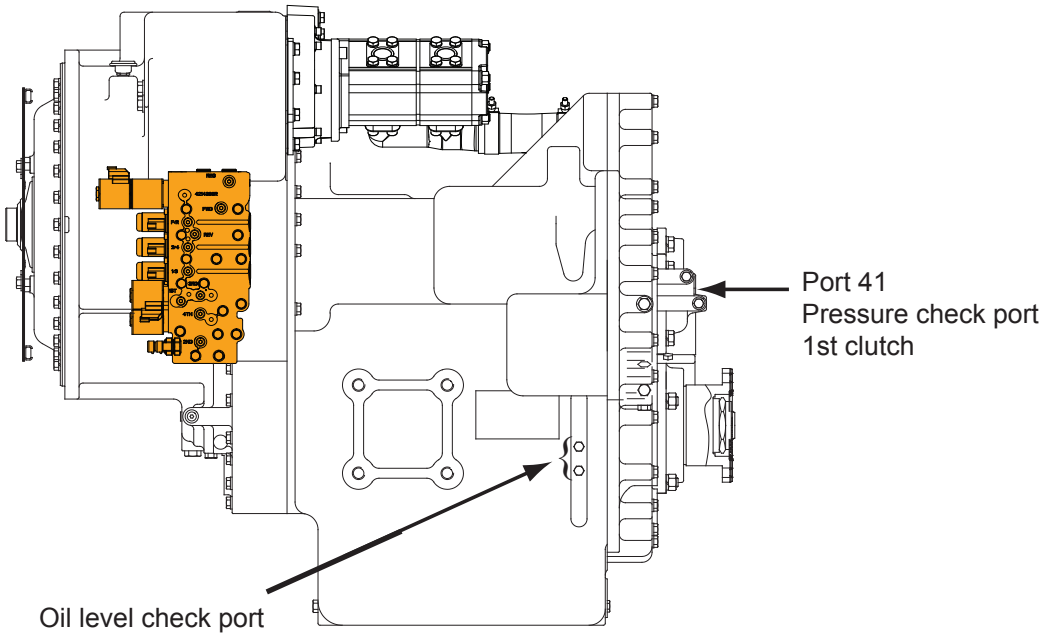


REAR VIEW

7.4 CHECK POINTS (continued)

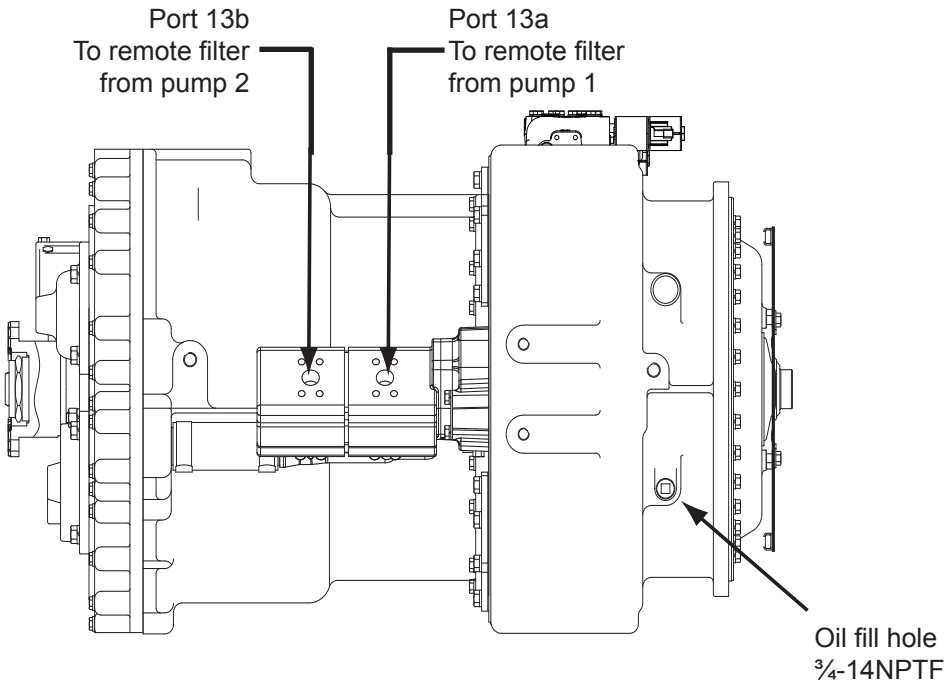


RIGHT VIEW



LEFT VIEW

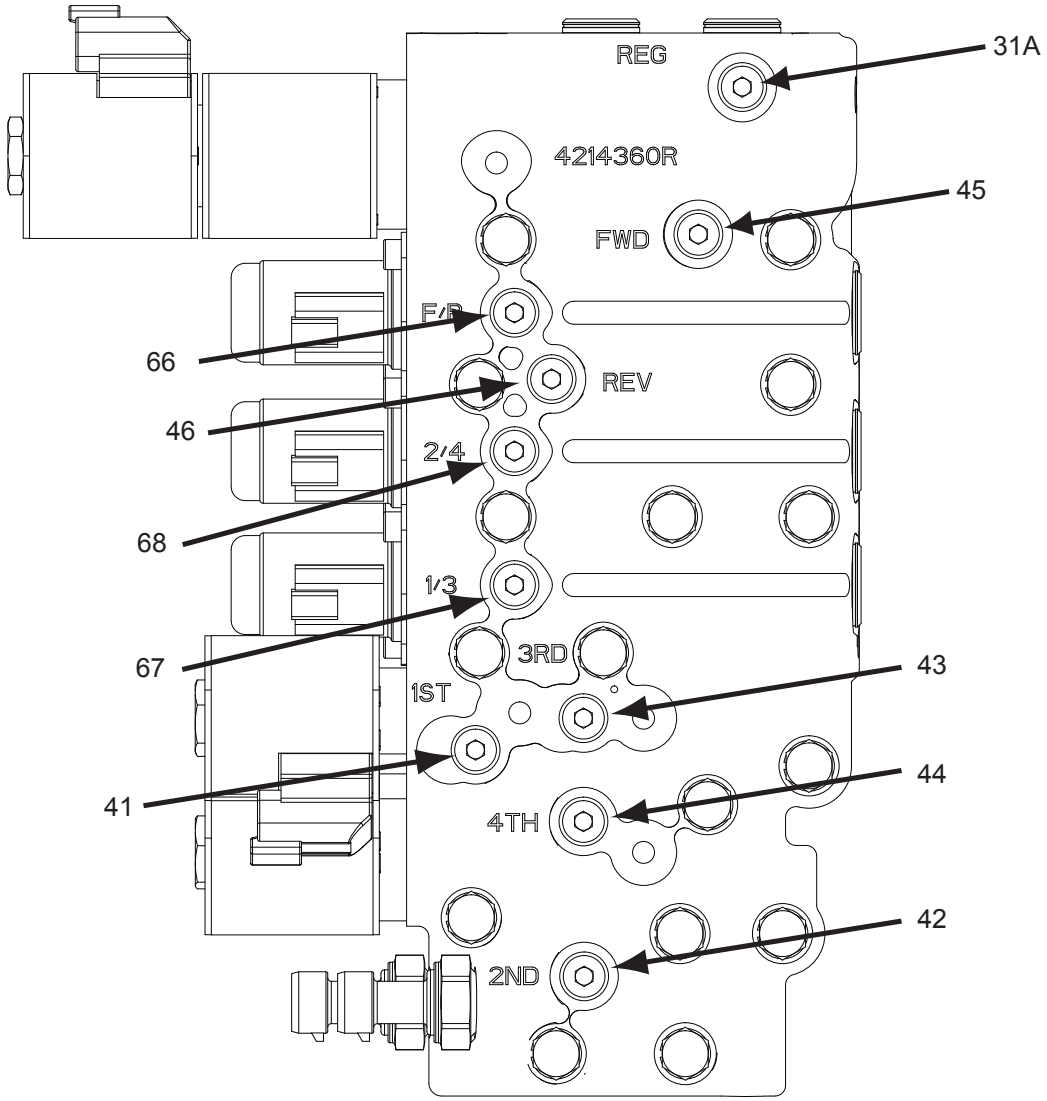
7.4 CHECK POINTS (continued)



TOP VIEW

7.4 CHECK POINTS (continued)

Checkpoint 31A ..... System pressure
Checkpoint 41..... 1st clutch pressure
Checkpoint 42..... 2nd clutch pressure
Checkpoint 43..... 3rd clutch pressure
Checkpoint 44..... 4th clutch pressure
Checkpoint 45..... FWD clutch pressure
Checkpoint 46..... REV clutch pressure
Checkpoint 66..... FWD/REV regulated pressure
Checkpoint 67..... 1st/3rd regulated pressure
Checkpoint 68..... 2nd/4th requlated pressure



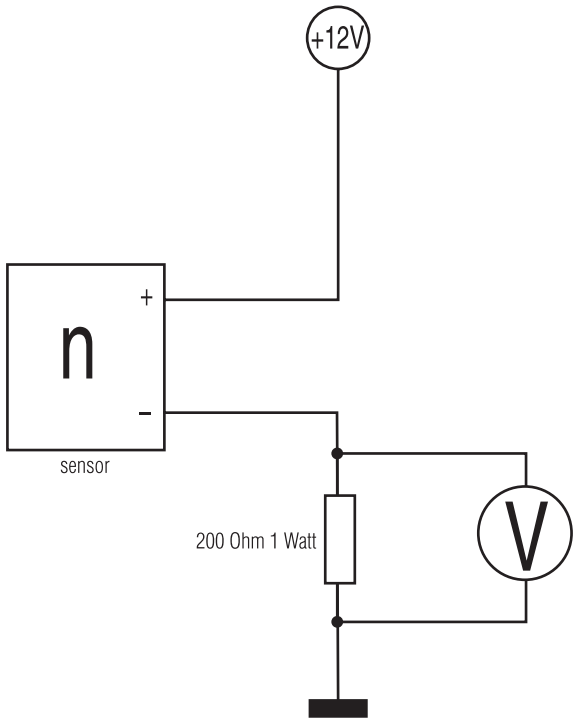
7.5 SPEED SENSOR - STATIC STANDALONE TEST

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

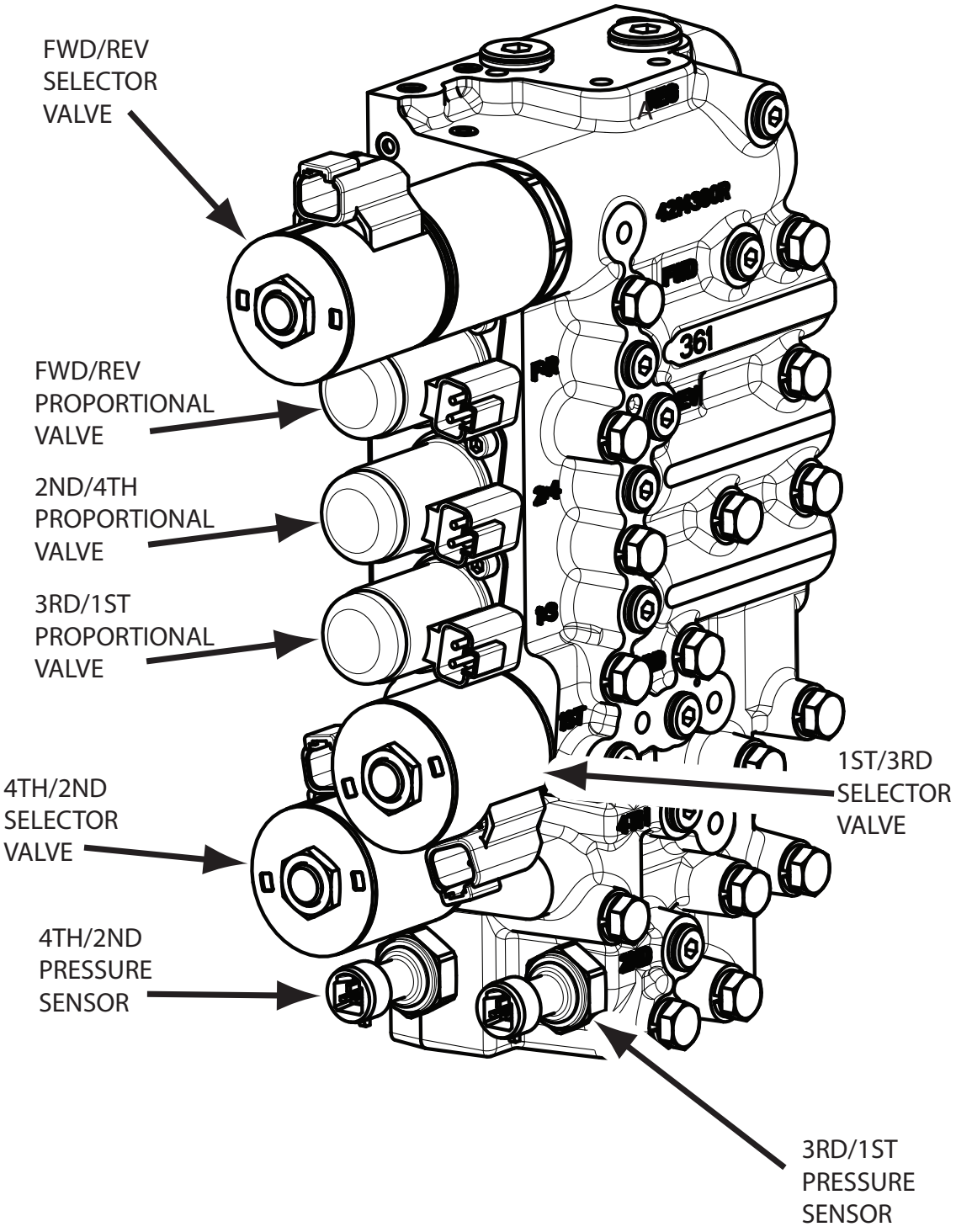
The idea is to connect the sensor to an external power source and measure the DC voltage across the series resistor.

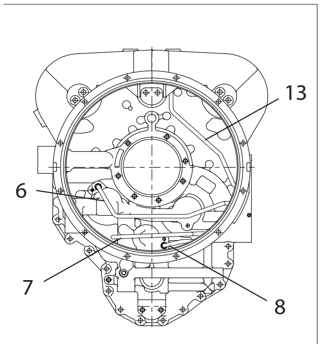
The voltage reading should be either 1.2V (from the 7mA ± 1mA current level) or 2.6 - 3.0V (for the 14mA ± 1mA current level).

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



7.6 FULL FLOW VALVE COMPONENTS

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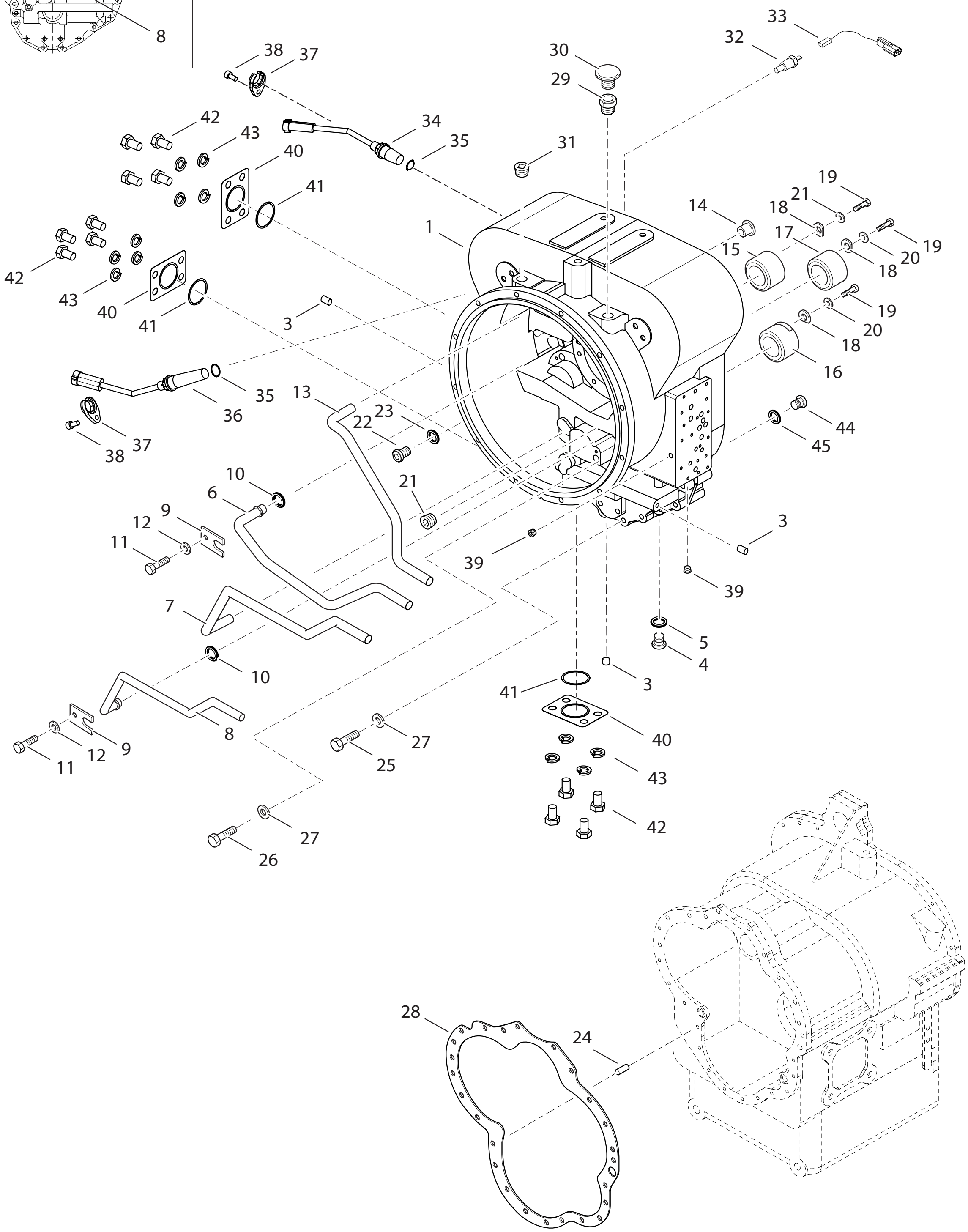
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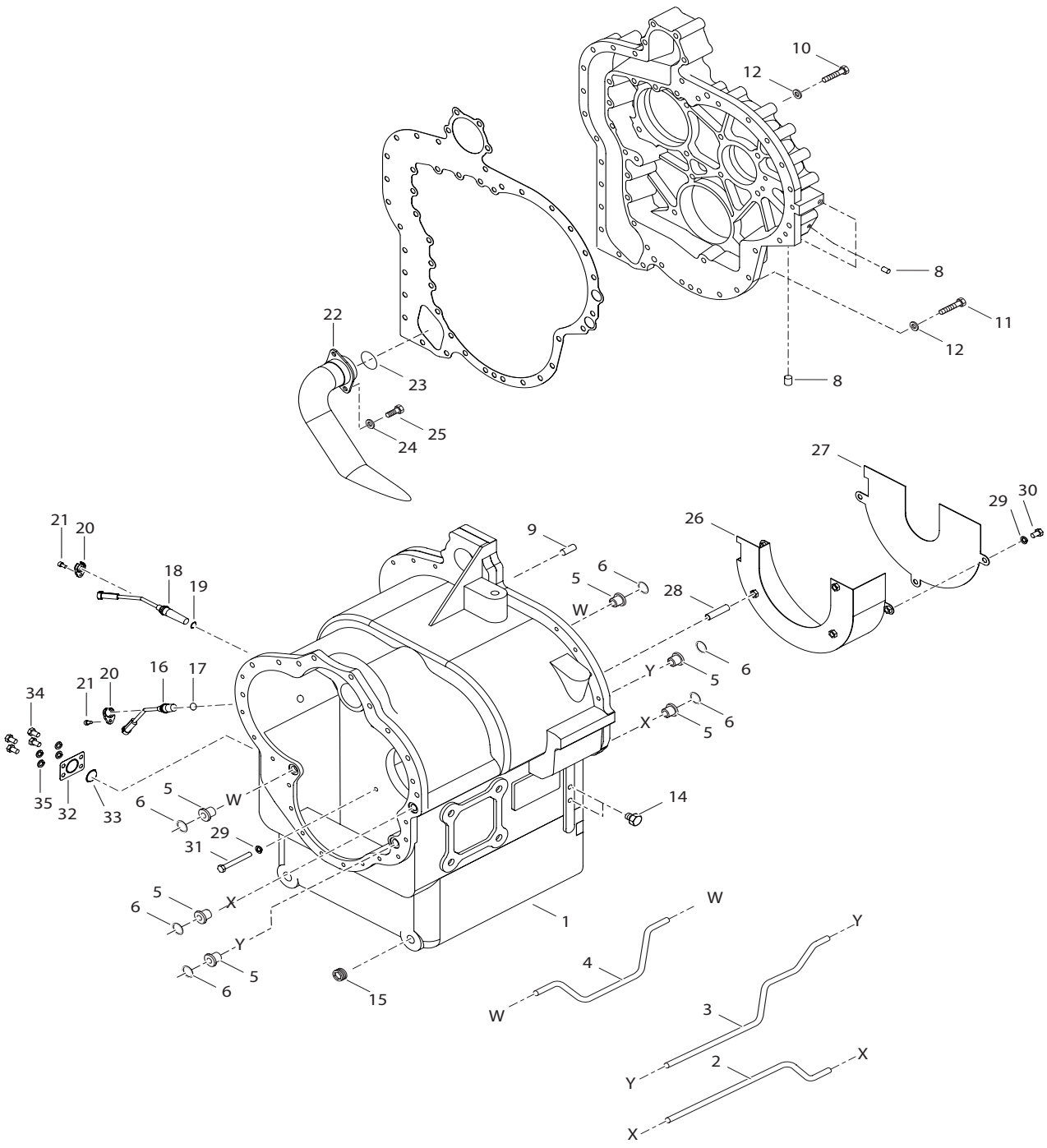
TORQUE CONVERTER GROUP

Item	Description	Qty
1	Torque Converter	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	Capscreww	3
20	Lockwasher	3
21	Plug	1
22	Plug	2
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	Switch - Temperature	1
33	Adaptor - Temperature switch	1
34	Sensor - Speed	1
35	“O” Ring	1
36	Sensor - Speed 60mm	1
37	Support - Speed sensor	2
38	Capscrew	2
39	Plug	2
40	Cover - Split flange	3
41	“O” ring	3
42	Capscrew	12
43	Lockwasher	12
44	Plug	1
45	“O” Ring	1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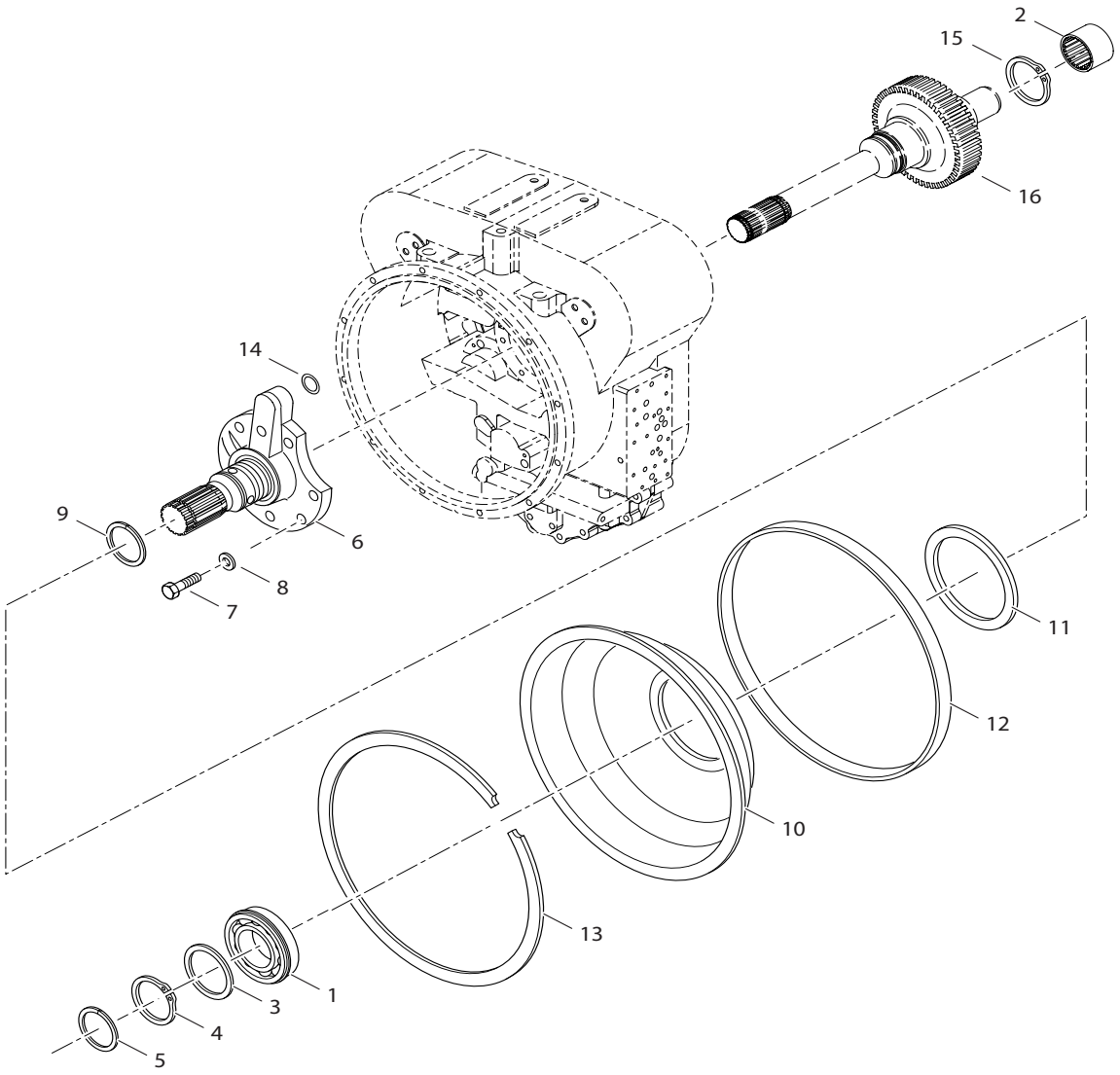
TRANSMISSION CASE & REAR COVER GROUP

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 & lubr tube	1
6	“O” ring	6
7	Cover - Rear	1
8	Plug - Expansion	1
9	Pin - Dowel	2
10	Capscrew	37
11	Capscrew	7
12	Lockwasher	44
13	Gasket - Rear cover to transmission case	1
14	Plug	2
15	Plug - Magnetic drain	1
16	Sensor - Speed assy	1
17	“O” ring	1
18	Sensor - Speed assy	1
19	‘O” ring	1
20	Support - Speed sensor	2
21	Capscrew	2
22	Tube - Suction	1
23	“O” ring	1
24	Lockwasher	2
25	Capscrew	2
26	Baffle - Oil	1
27	Cover - Oil baffle	1
28	Tube - Oil baffle	3
29	Lockwasher	6
30	Capscrew	3
31	Screw	3
32	Cover - Split flange	1
33	“O” ring	1
34	Capscrew	4
35	Lockwasher	4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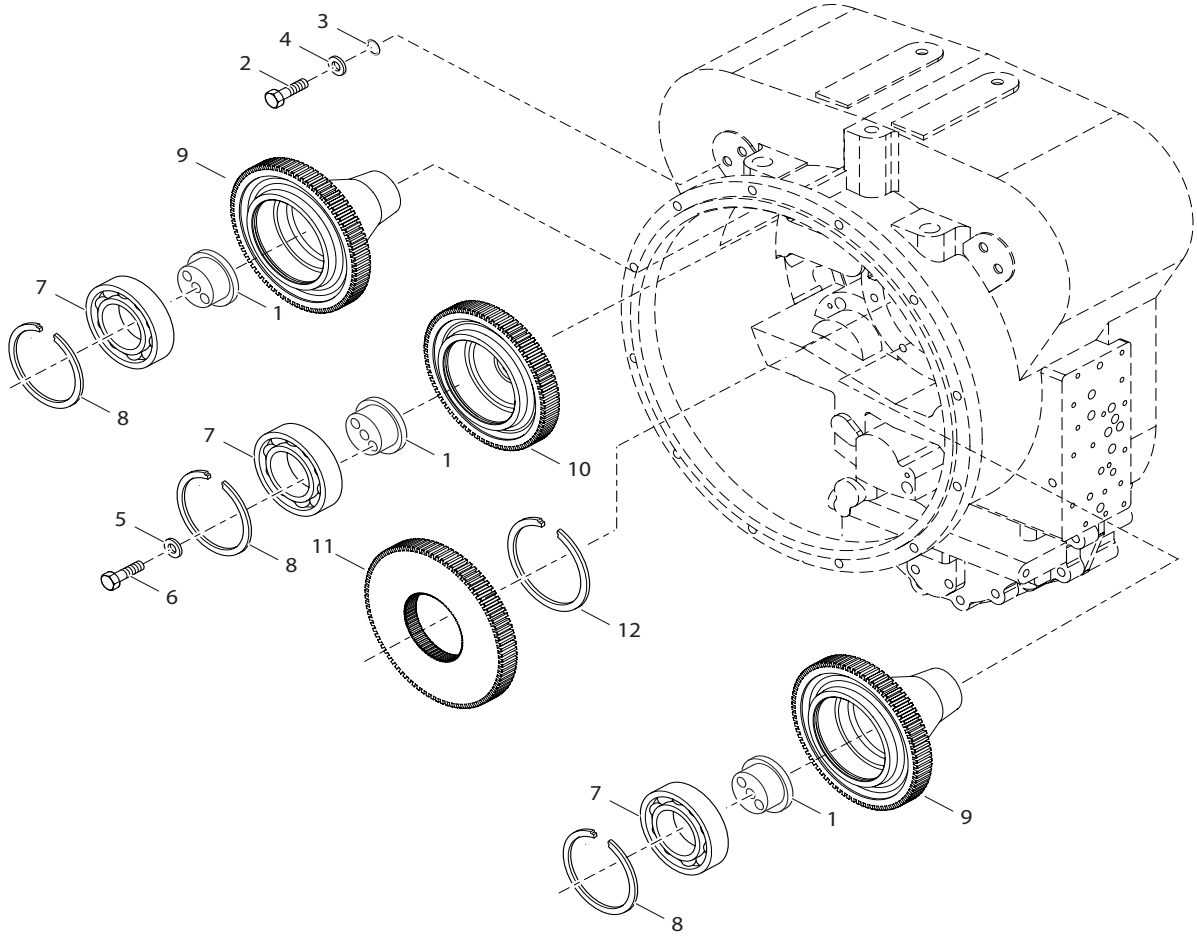
TURBINE SHAFT GROUP

Item	Description	Qty
1	Bearing - Turbine shaft front	1
2	Bearing - Turbine shaft rear	1
3	Spacer - Front bearing	1
4	Snapring	1
5	Ring - Piston	1
6	Stator support assy	1
7	Screw - Stator support	7
8	Lockwasher	7
9	Ring - Piston	1
10	Baffle - Oil	1
11	Seal - Oil baffle	1
12	Ring - Oil baffle seal	1
13	Ring - Oil baffle retaining	1
14	“O” Ring	1
15	Snapring	1
16	Turbine shaft	1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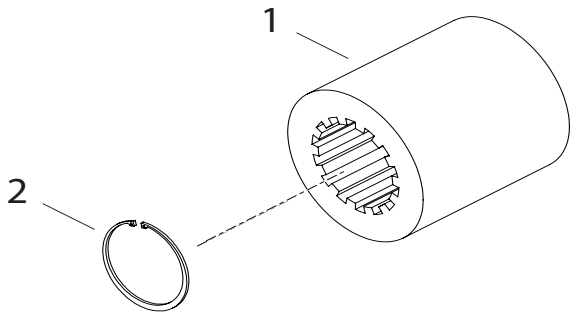
PUMP DRIVE GROUP

Item	Description	Qty
1	Support - Pump drive bearing	3
2	Screw - Bearing support	4
3	“O” Ring	4
4	Washer	4
5	Lockwasher	2
6	Screw - Bearing support	2
7	Bearing - Pump drive gear	3
8	Snapring	3
9	Gear - Aux. pump drive	2
10	Gear - Charging pump	1
11	Gear - Impeller hub	1
12	Snapring	1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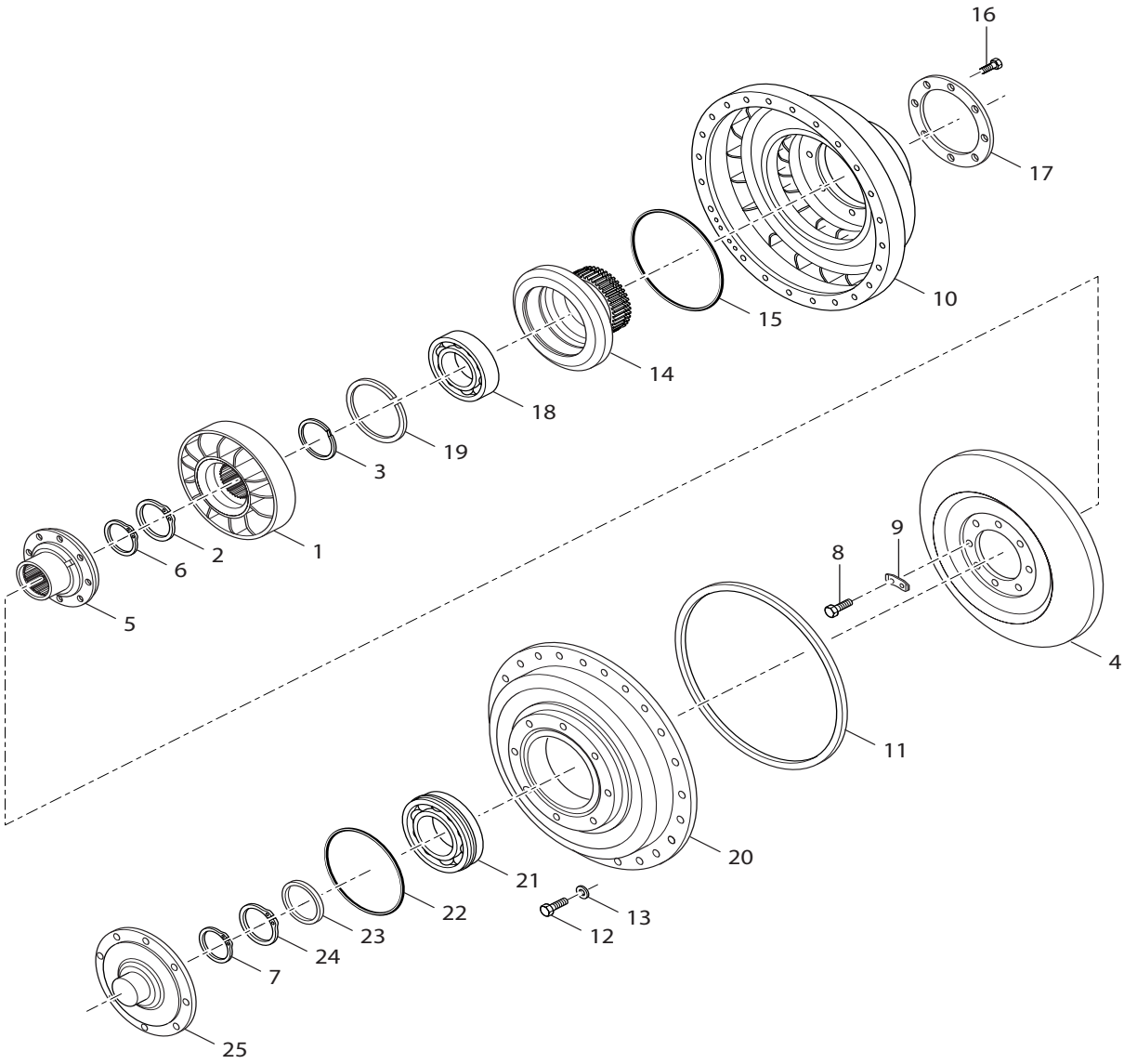
ADAPTOR SLEEVE GROUP

Item	Description	Qty
1	Sleeve - Pump drive	1
2	Snapring	1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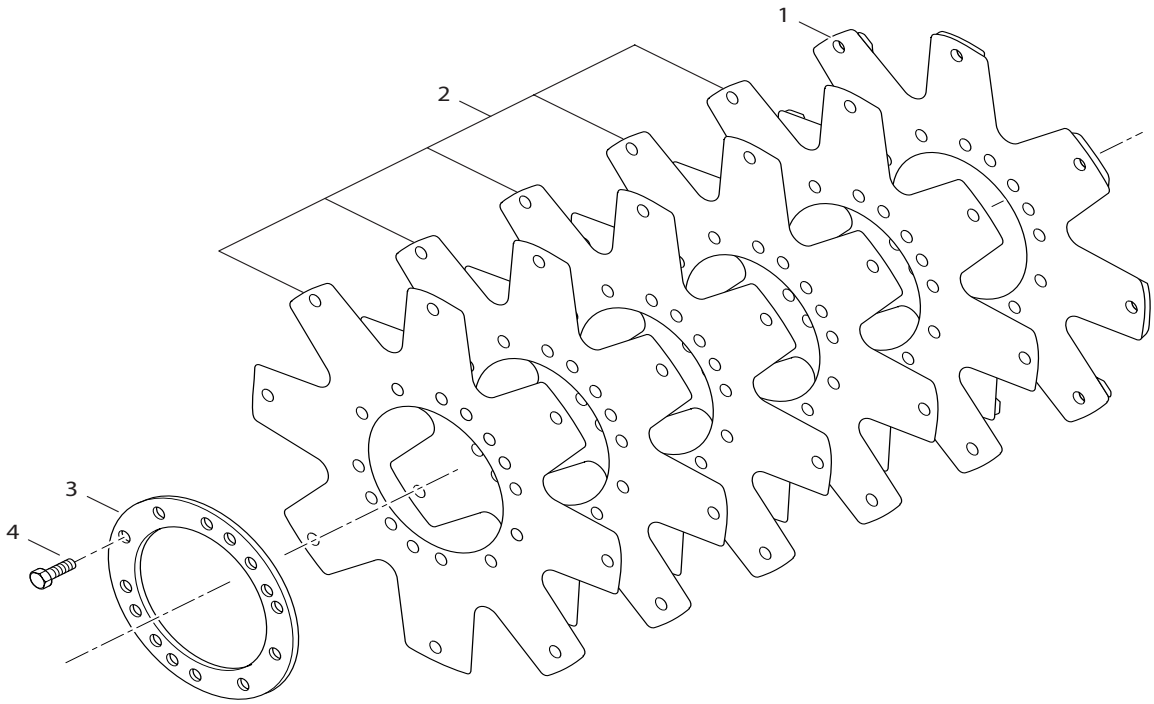
WHEEL GROUP

Item	Description	Qty
1	Member - Reaction	1
2	Snapring	1
3	Spacer - Reaction member	1
4	Turbine	1
5	Hub - Turbine	1
6	Snapring	1
7	Snapring	1
8	Screw - Turbine hub	10
9	Locktab	5
10	Impeller	1
11	“O” Ring	1
12	Screw	32
13	Lockwasher	32
14	Hub - Impeller	1
15	“O” Ring	1
16	Screw	8
17	Ring - Impeller hub dcrew backing	1
18	Bearing	1
19	Snapring	1
20	Cover - Impeller	1
21	Bearing - Turbine hub	1
22	“O” Ring	1
23	Spacer	1
24	Snapring	1
25	Hub - Impeller cover	1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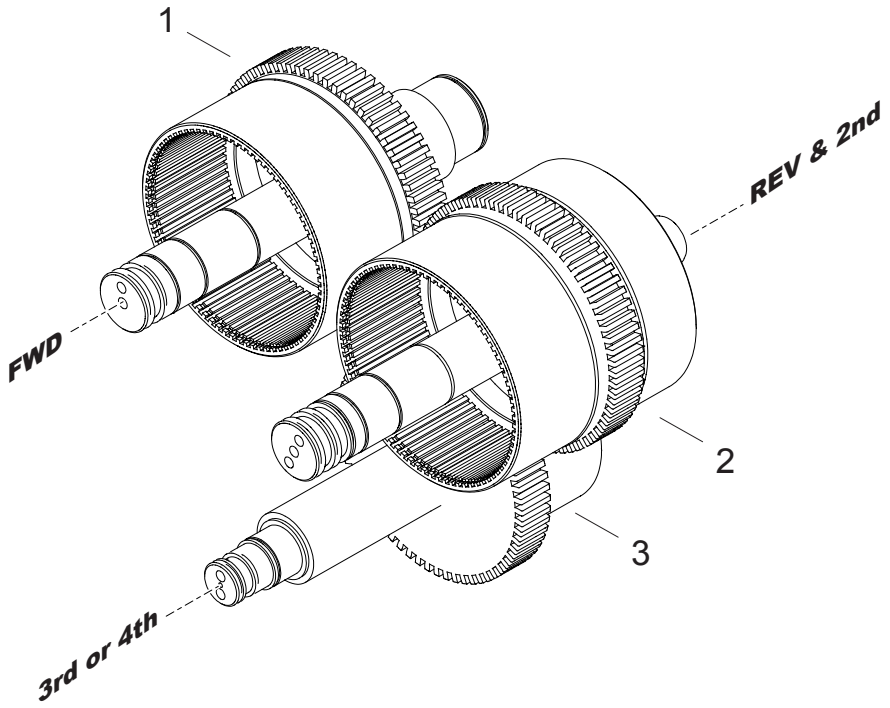
DRIVE PLATE GROUP

Item	Description	Qty
1	Assembly - Drive plate and (when used) welded nuts	1
2	Plate - Drive	5
3	Ring - Backing	1
4	Capscrew	14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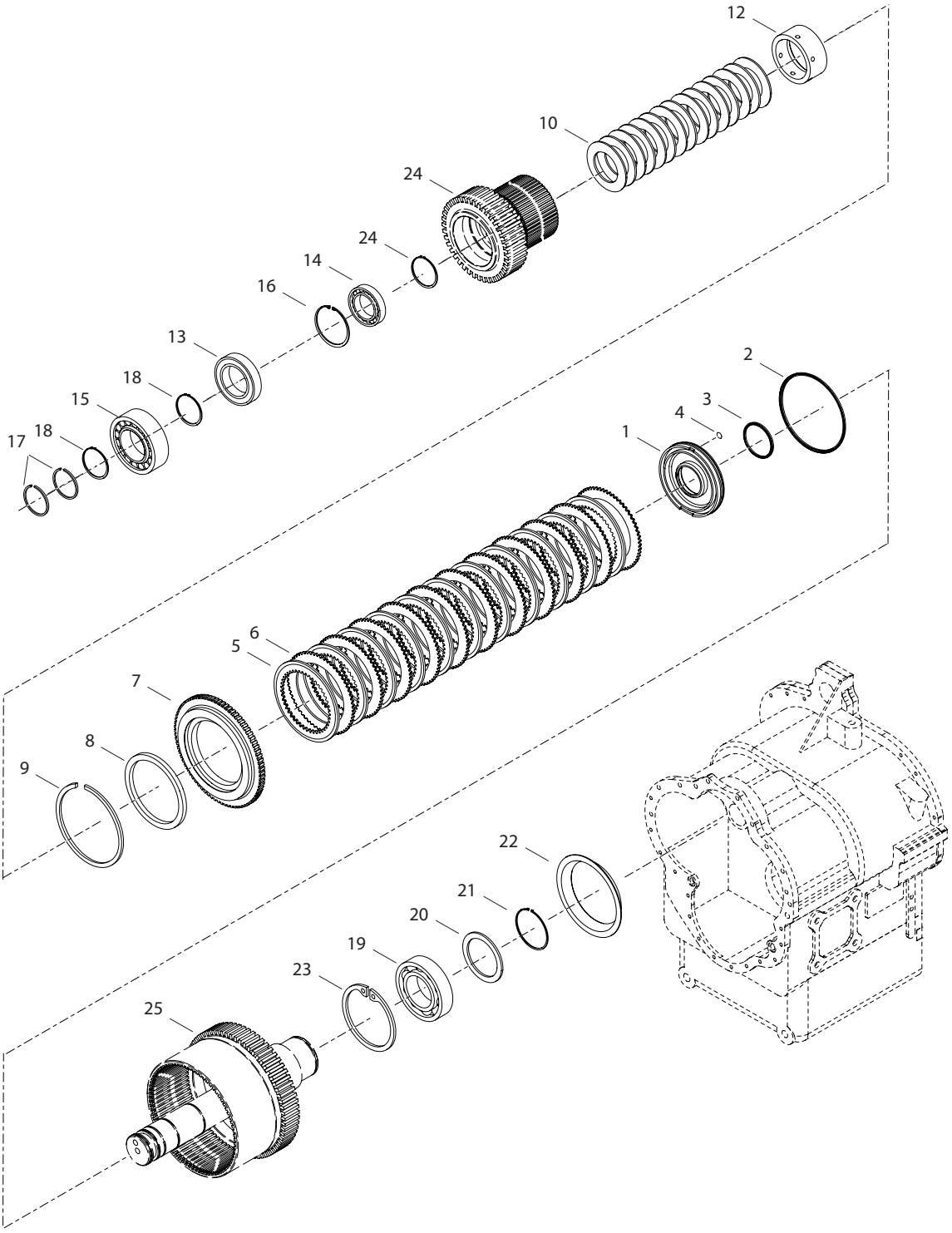
REV & 2nd
FWD
2
3
3rd or 4th

FWD & REV/2ND AND 3TH OR 4TH CLUTCH SHAFT ASSY

Item	Description	Qty
1	Fwd shaft drum assy	1
2	Rev/2nd shaft drum assy	1
3	3rd shaft drum assy on 3 speed	1
3	4th shaft drum shaft assy on 4 speed	1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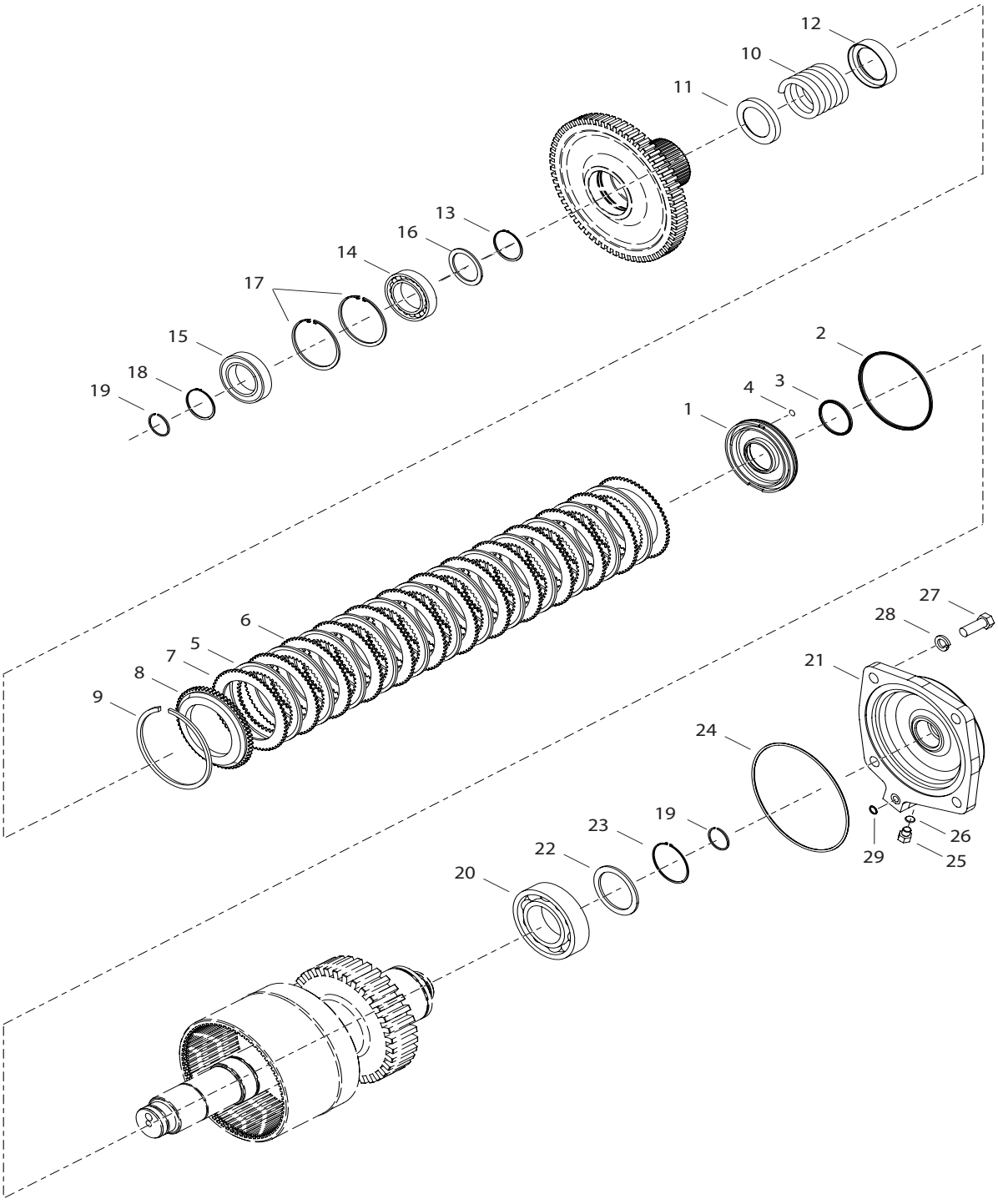
FORWARD CLUTCH SHAFT GROUP

Item	Description	Qty
1	Piston	1
2	Seal - Piston outer	1
3	Seal - Piston inner	1
4	Screen (not sold seperate	1
5	Disc - Clutch inner	11
6	Disc - Clutch outer	11
7	Plate - End	1
8	Seal	1
9	Snapring	1
10	Washer - Belleville	15
11	Ring - Retaining	1
12	Spacer - Clutch piston	1
13	Bearing - Clutch driven gear	1
14	Bearing	1
15	Bearing	1
16	Ring - Retaining	1
17	Ring - Piston	2
18	Ring - Retaining	2
19	Bearing	1
20	Spacer	1
21	Snapring	1
22	Retainer - Oil	1
23	Snapring	1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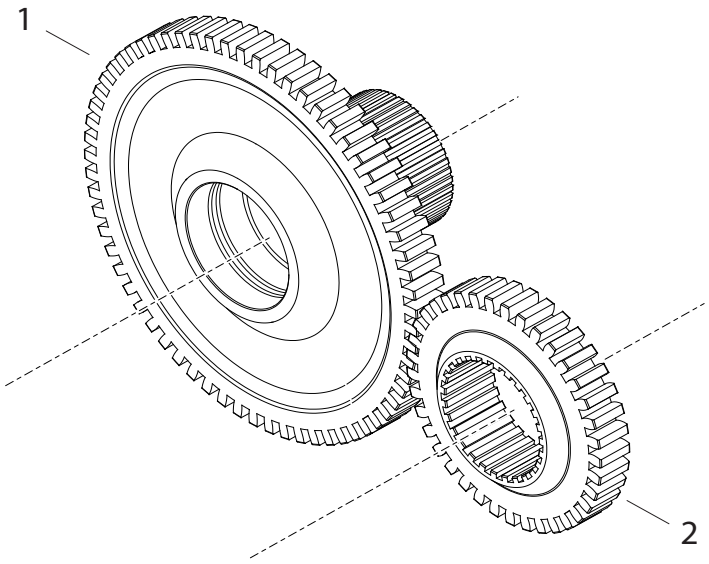
3RD SPEED CLUCTH SHAFT GROUP

Item	Description	Qty
1	Piston	1
2	Seal - Piston outer	1
3	Seal - Piston inner	1
4	Screen (not sold seperate)	1
5	Disc - Clutch inner	11
6	Disc - Clutch outer	11
7	Disc - Clutch outer half	2
8	Plate - End	1
9	Snapring	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	Snapring	2
18	Snapring	1
19	Ring - Piston	2
20	Bearing	1
21	Cap - 3rd speed shaft rear bearing	1
22	Spacer	1
23	Snapring	1
24	“O” Ring	1
25	Plug	1
26	“O” Ring	1
27	Capscrew	4
28	Lockwasher	4
29	“O” RIng	1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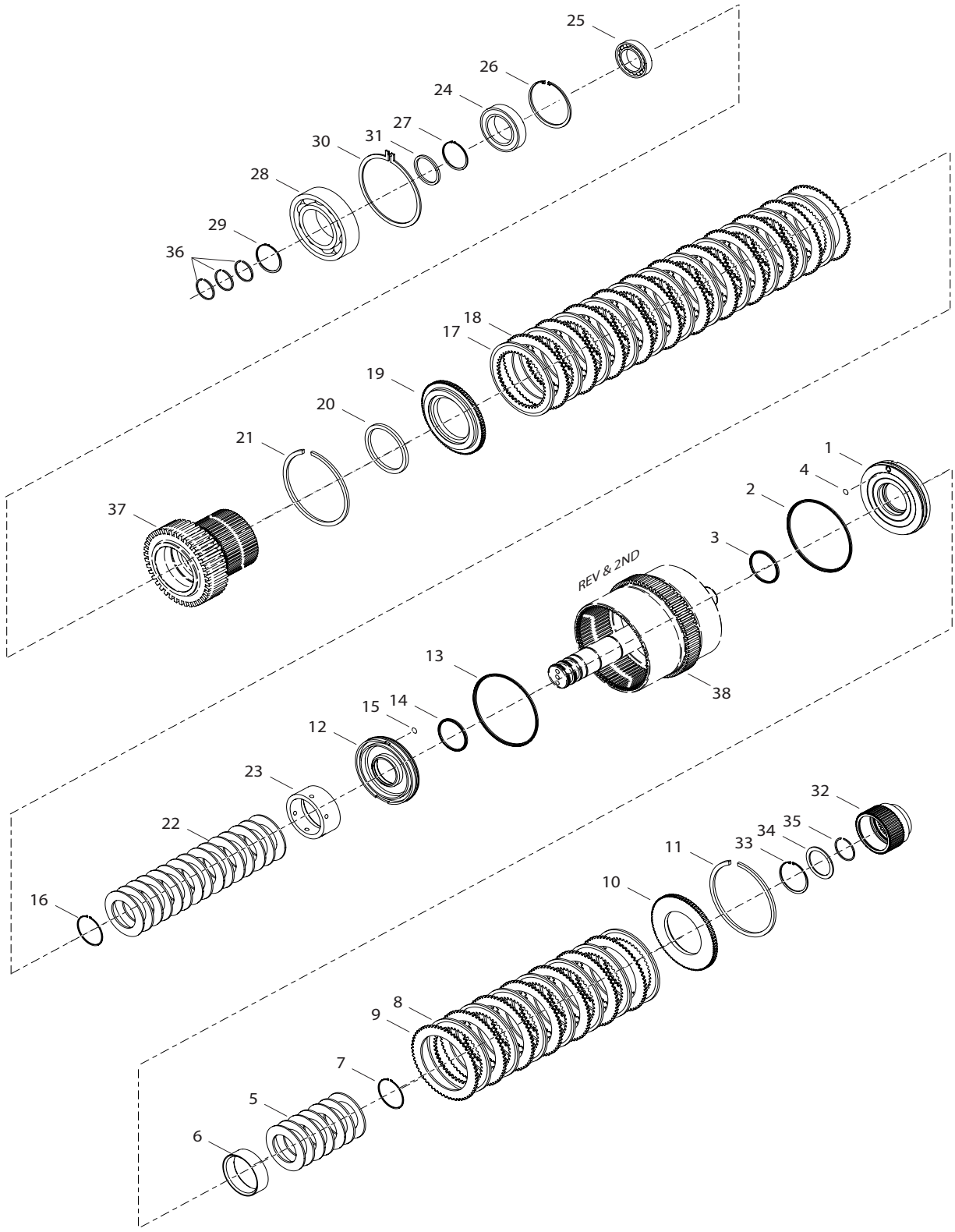
3RD SPEED GEAR

Item	Description	Qty
1	Gear - 3rd speed	1
2	Gear - 3rd speed driven	1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REV & 2ND
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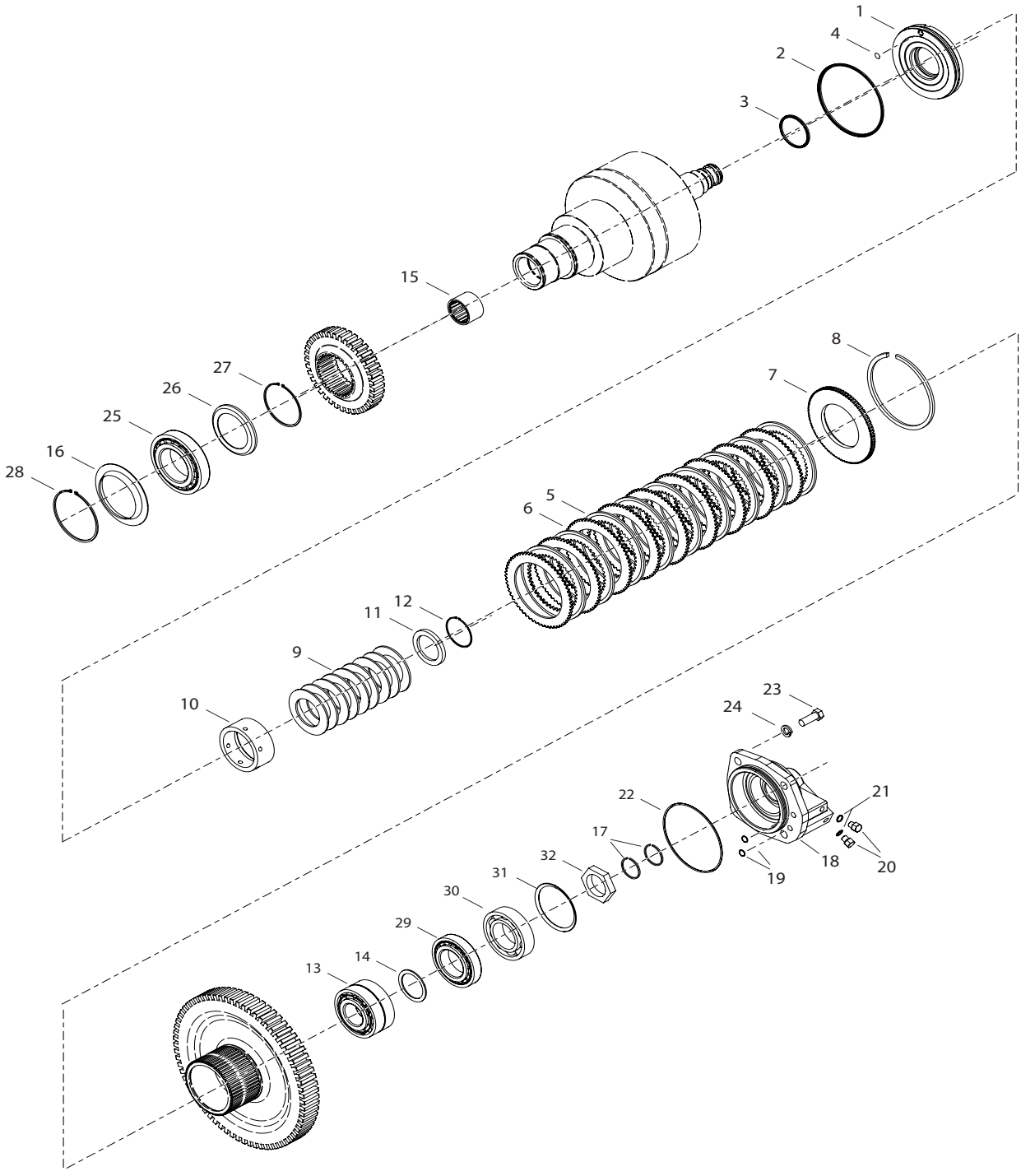
REV / 2ND SCHAFT GROUP

Item	Description	Qty
1	Piston	1
2	Seal - Clutch piston outer	1
3	Seal - Clutch piston inner	1
4	Screen (Not Sold Separate)	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	Snapring	1
12	Piston	1
13	Seal - Clutch piston outer	1
14	Seal - Clutch piston inner	1
15	Screen (Not Sold Separate)	1
16	Ring - Retaining	1
17	Disc - Clutch inner	11
18	Disc - Clutch outer	11
19	Plate - End	1
20	Seal	1
21	Snapring	1
22	Washer - Bellevile	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	Snapring	1
34	Retainer	1
35	Snapring	1
36	Ring - Piston	3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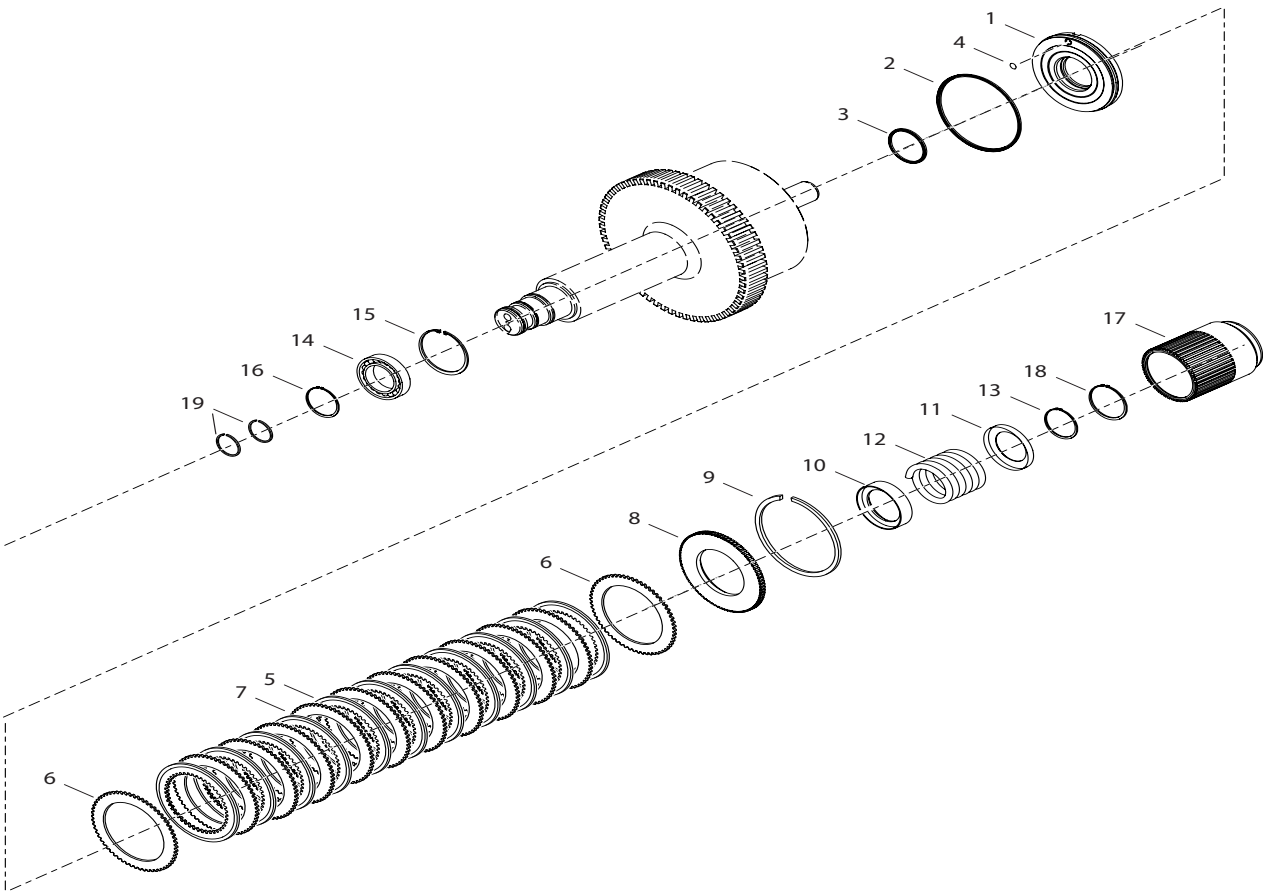
1ST SPEED CLUTCH SHAFT GROUP

Item	Description	Qty
1	Piston	1
2	Seal - Piston outer	1
3	Seal - Piston inner	1
4	Screen (not sold seperate)	1
5	Disc - Clutch inner	11
6	Disc - Clutch outer	11
7	Plate - End	1
8	Snapring	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
17	Ring - Piston	2
18	Cap - Bearing	1
19	“O” Ring	2
20	Plug	2
21	“O” Ring	2
22	“O” Ring	1
23	Capscrew	4
24	Lockwasher	4
25	Bearing	1
26	Spacer - Bearing	1
27	Snapring	1
28	Snapring	1
29	Bearing	1
30	Bearing	1
31	Spring - Disc	1
32	Nut	1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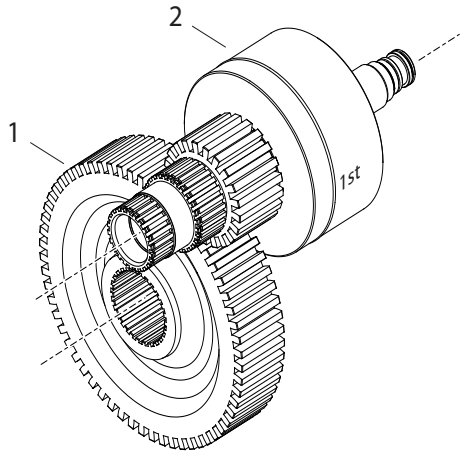
4TH SPEED CLUTCH SHAFT GROUP

Item	Description	Qty
1	Piston	1
2	Seal - Piston outer	1
3	Seal - Piston inner	1
4	Screen (not sold seperate)	1
5	Disc - Clutch inner	11
6	Disc - Clutch outer half	2
7	Disc - Clutch outer	11
8	Plate - End	1
9	Snapring	1
10	Spacer - Clutch piston	1
11	Retainer - Spring	1
12	Spring	1
13	Ring - Retainer	1
14	Bearing	1
15	Snapring	1
16	Snapring	1
17	Hub	1
18	Snapring	1
19	Ring - Piston	2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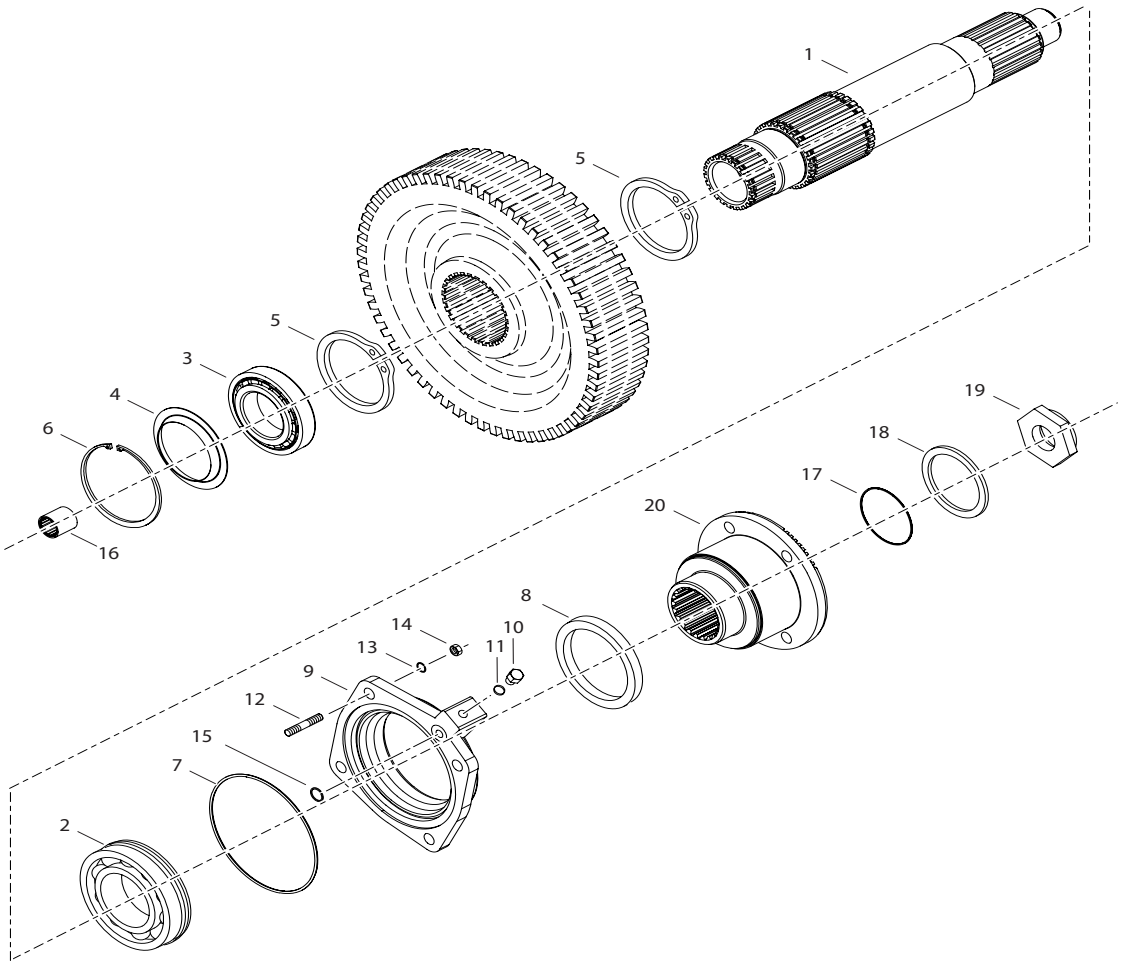
1st

1ST SHAFT GEAR GROUP

Item	Description	Qty
1	Gear - Idler	1
2	Assy - 1st speed clutch	1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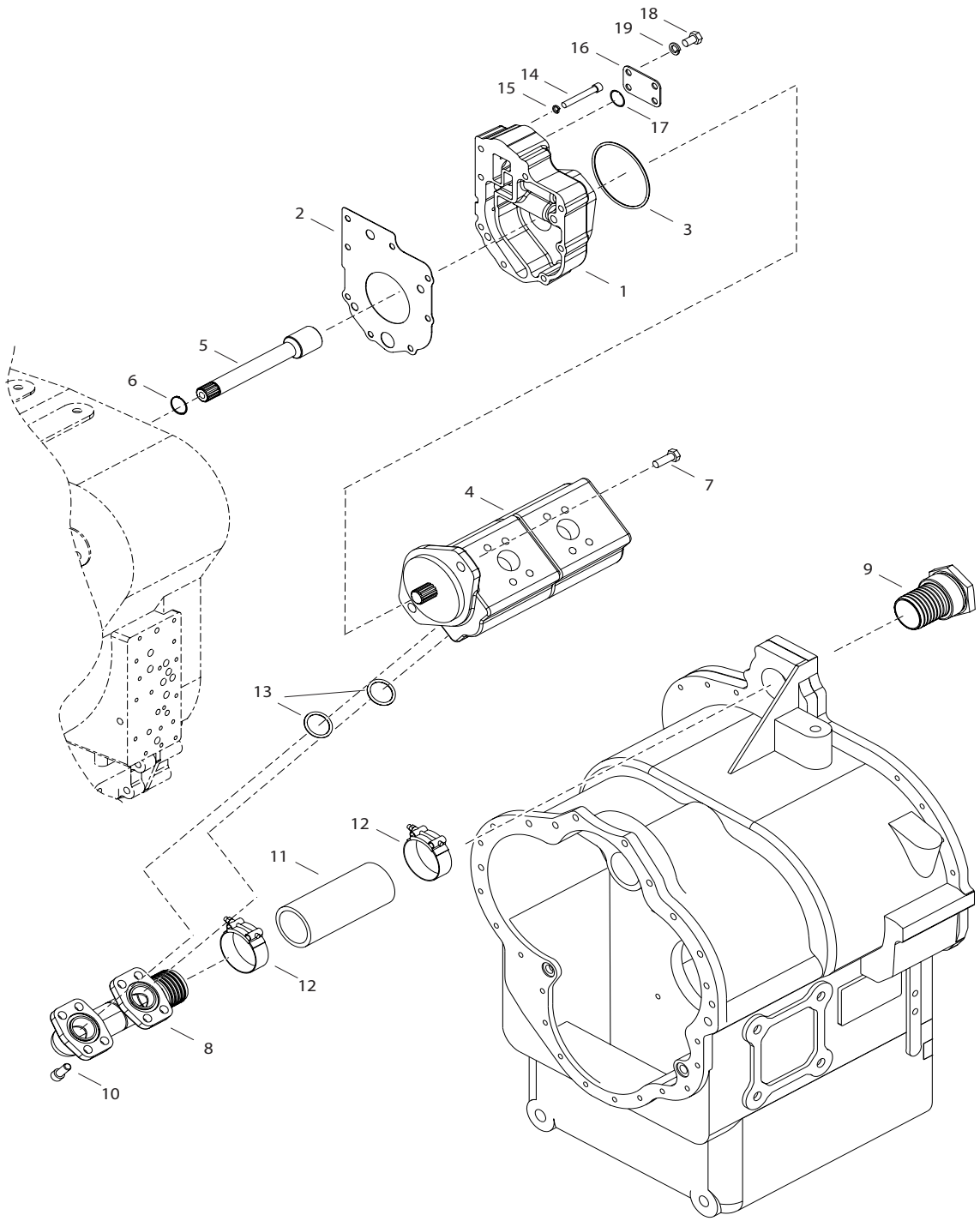
OUTPUT SHAFT GROUP

Item	Description	Qty
1	Shaft - Output	1
2	Bearing	1
3	Bearing	1
4	Retainer - Oil	1
5	Snapring	1
6	Snapring	1
7	“O” Ring	1
8	Seal - Output oil	1
9	Cap - Bearing	1
10	Plug	1
11	“O” Ring	1
12	Stud	4
13	Lockwasher	4
14	Nut	4
15	“O” Ring	1
16	Bearing	1
17	“O” Ring	1
18	Washer - Flange	1
19	Locknut	1
20	Flange	1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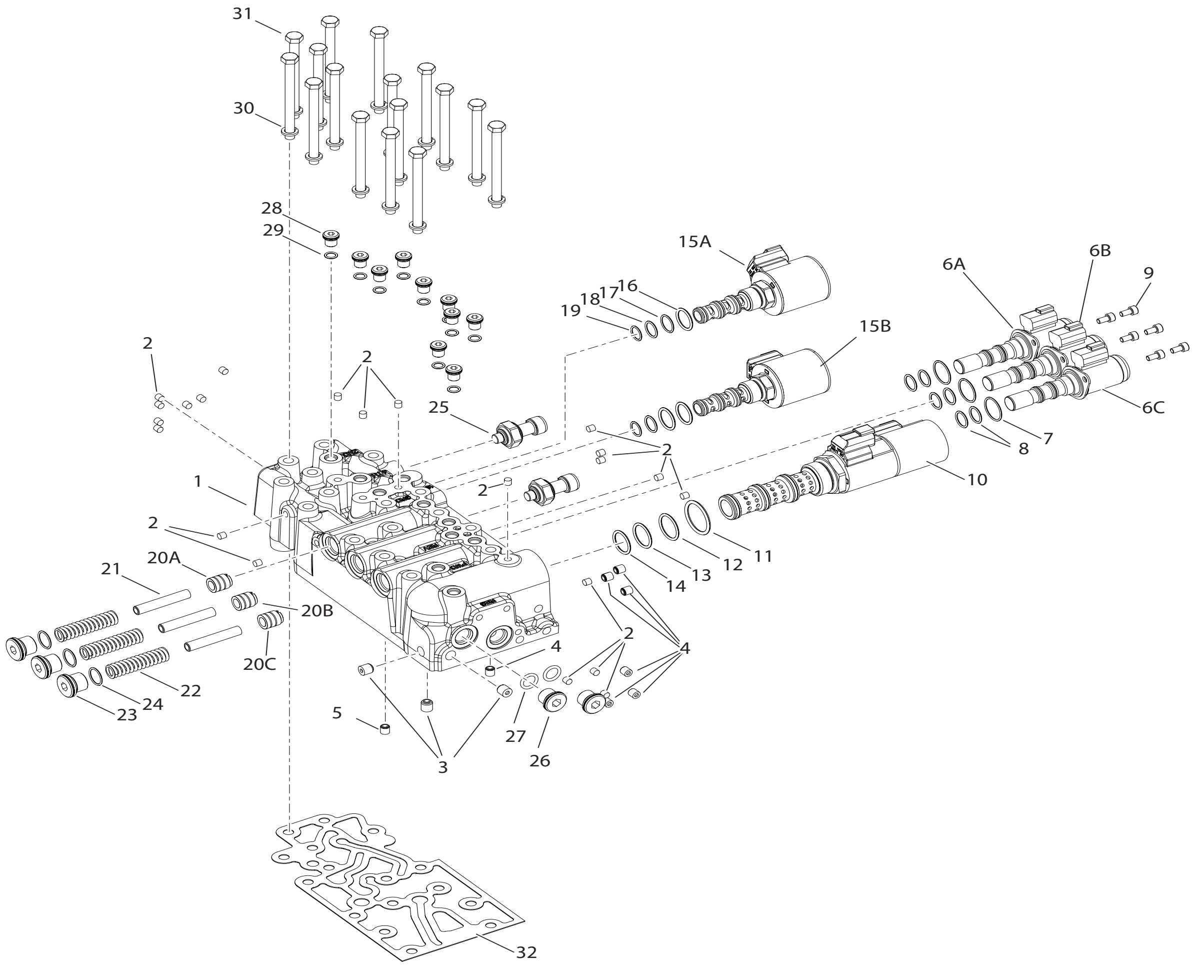
REGULATOR VALVE GROUP

Item	Description	Qty
1	Assy - 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	Snapring	1
7	Screw	2
8	Adaptor - Suction tube side	1
9	Adaptor - Suction transmission case side	1
10	Capscrew	8
11	Hose - Suction	1
12	Clamp - suction	2
13	“O” Ring	2
14	Screw	8
15	Lockwasher	8
16	Cap - Flange	1
17	“O” Ring	1
18	Capscrew	4
19	Lockwasher	4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20B
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20C
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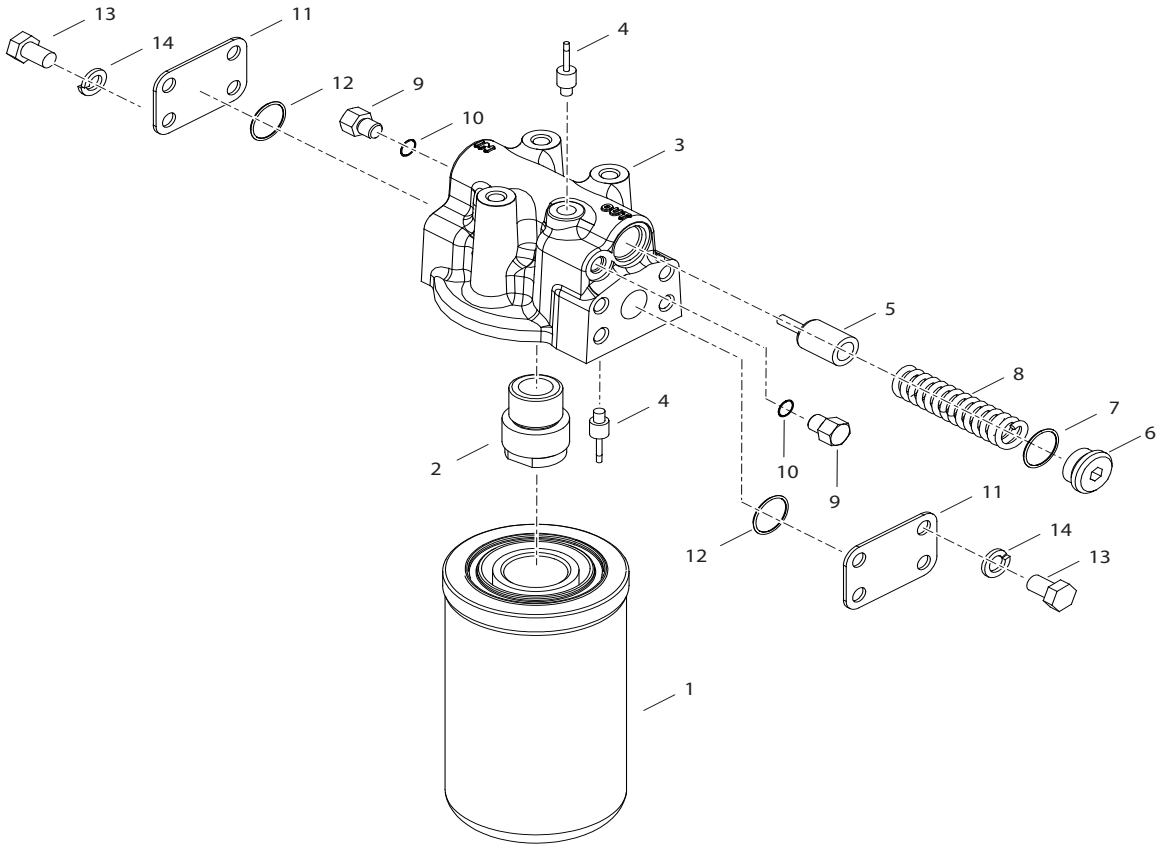
32

CONTROL VALVE GROUP

Item	Description	Qty
1	control valve housing	1
2	Plug-expansion	22
3	Plug-expansion	3
4	Plug - Restriction	4
5	Plug - orifice	1
6A	Proportional valve forward/reverse	1
6B	Proportional valve 2nd/4th	1
6C	Propottional valve 3rd/1st	1
7	O-ring	3
8	O-ring	6
9	Capscrew	6
10	Selector valve forward/reverse	1
11	O-ring	1
12	O-ring	1
13	O-ring	1
14	O-ring	1
15A	Selector valve 1st/3rd	1
15B	Selector valve 4th/2nd	1
16	O-ring	2
17	O-ring	2
18	O-ring	2
19	O-ring	2
20A	accumulator spool forward/reverse	1
20B	accumulator spool 2nd/4th	1
20C	accumulator spool 3rd/1st	1
21	Pin-accumulator stop	3
22	Spring	3
23	Plug	3
24	O-ring	3
25	Sensor-valve pressure	2
26	Plug	2
27	O-ring	2
28	Plug	10
29	O-ring	10
30	Lockwasher	16
31	Capscrew	16
32	Gasket	1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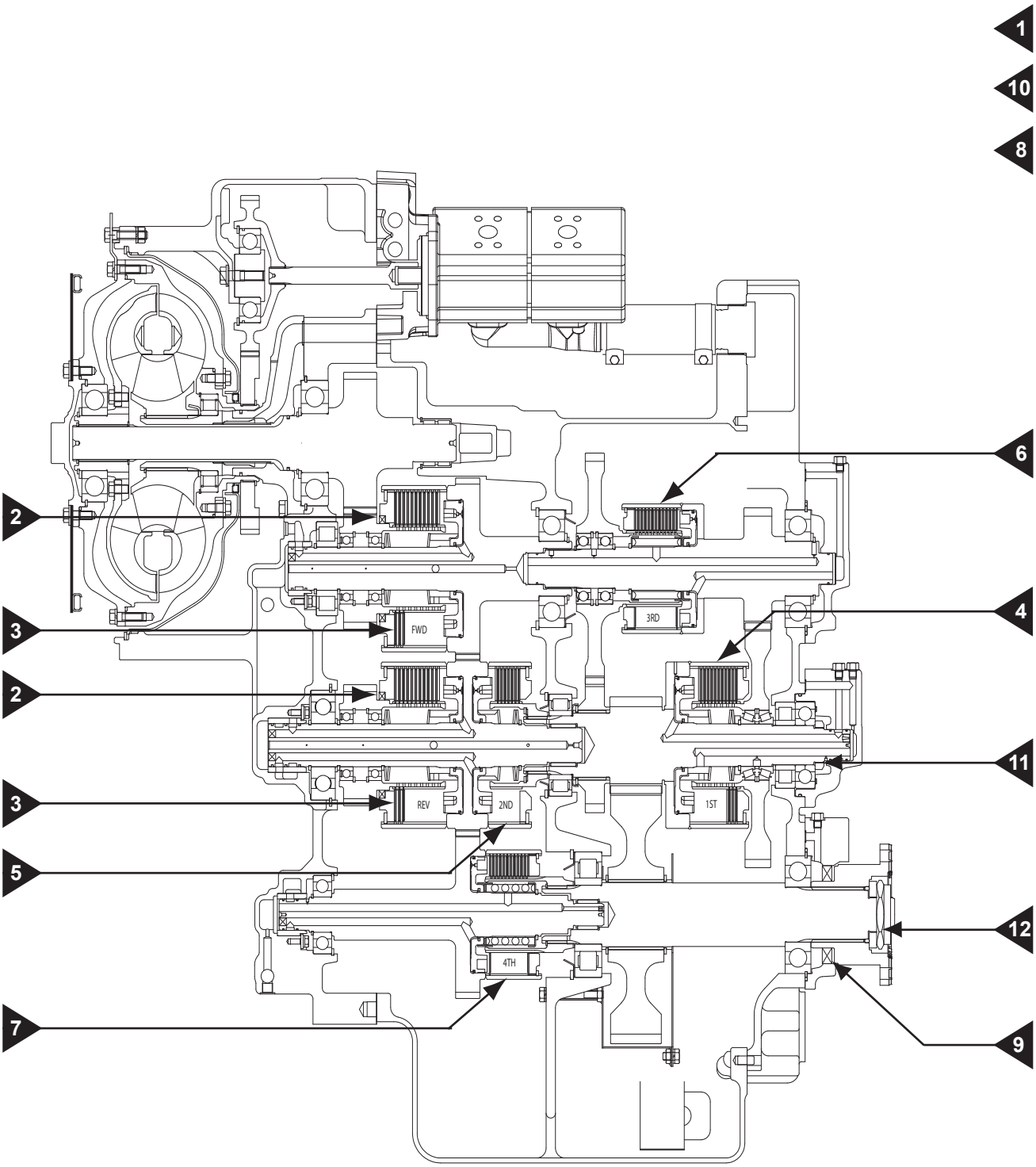
REMOTE FILTER ADAPTOR GROUP

Item	Description	Qty
1	Filter	1
2	Adapter - Filter	1
3	Assy - Filter adapter body	1
4	Plug	1
5	Spool - Safety valve	1
6	Plug	1
7	“O” Ring	1
8	Spring	1
9	Plug	2
10	“O” Ring	2
11	Cap - Flange	2
12	“O” Ring	2
13	Capscrew	8
14	Lockwasher	8

Note: 2 sets required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ASSEMBLY INSTRUCTIONS

All lead-in chamfers for oil seals, pistonrings and 0-rings must be smooth and free from burrs. Inspect at assembly.

Add some grease to 0-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 precoated 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.

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

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

3. Fwd and Rev Clutch

TE32	11 seperator plates with outer splines. 11 friction plates (friction material on both sides) with inner splines		
	Clearance	Min	6.0mm [0.23in]
		Max	6.4mm [0.25in]
TE27	8 seperator plates with outer splines. 8 friction plates (friction material on both sides) with inner splines.		
	Clearance	Min	6.0mm [0.23in]
		Max	6.4mm [0.25in]

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

⚠ CAUTION

The seperator plates for Fwd and Rev and 1st and 2nd are not the same.
DO NOT MIX PLATES WITH PLATES FROM OTHER CLUTCHES.

4. 1st Clutch

TE32	11 seperator plates with outer splines. 11 friction plates (friction material on both sides) with inner splines		
	Clearance	Min	4.35mm [0.17in]
		Max	4.75mm [0.19in]
TE27	10 seperator plates with outer splines. 10 friction plates (friction material on both sides) with inner splines.		
	Clearance	Min	4.35mm [0.17in]
		Max	4.75mm [0.19in]

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

5 2nd Clutch

TE32

7 seperator plates with outer splines.
7 friction plates (friction material on both sides) with inner splines

Clearance	Min	2.75mm [0.10in]
	Max	3.15mm [0.12in]

TE27

6 seperator plates with outer splines.
6 friction plates (friction material on both sides) with inner splines.

Clearance	Min	2.75mm [0.10in]
	Max	3.15mm [0.12in]

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

6 3rd Clutch

TE32

12 seperator plates with inner splines.
11 friction plates (friction material on both sides) with outer splines
2 1-sided friction plates (friction material on one (1) side) with outer splines.

Clearance	Min	3.5mm [0.14in]
	Max	3.9mm [0.16in]

TE27

9 seperator plates with inner splines.
8 friction plates (friction material on both sides) with outer splines.
2 1-sided friction plates (friction material on one (1) side) with outer splines.

Clearance	Min	3.5mm [0.14in]
	Max	3.9mm [0.16in]

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

7 4th Clutch

TE32

11 seperator plates with inner splines.
10 friction plates (friction material on both sides) with outer splines
2 1-sided friction plates (friction material on one (1) side) with outer splines.

Clearance	Min	3.1mm [0.12in]
	Max	3.5mm [0.14in]

TE27

11 seperator plates with inner splines.
10 friction plates (friction material on both sides) with outer splines.
2 1-sided friction plates (friction material on one (1) side) with outer splines.

Clearance	Min	3.1mm [0.12in]
	Max	3.5mm [0.14in]

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 31-41 Nm [25-30 Lbs.ft]

11 Tighten nut to 145-160 Nm [107-118 Lbs.ft]

12 Tighten nut to 339-407 Nm [250-300 Lbs.ft]

13 Tighten 2 coil nuts to 6.8-9.5 Nm [250-300 Lbs.ft]

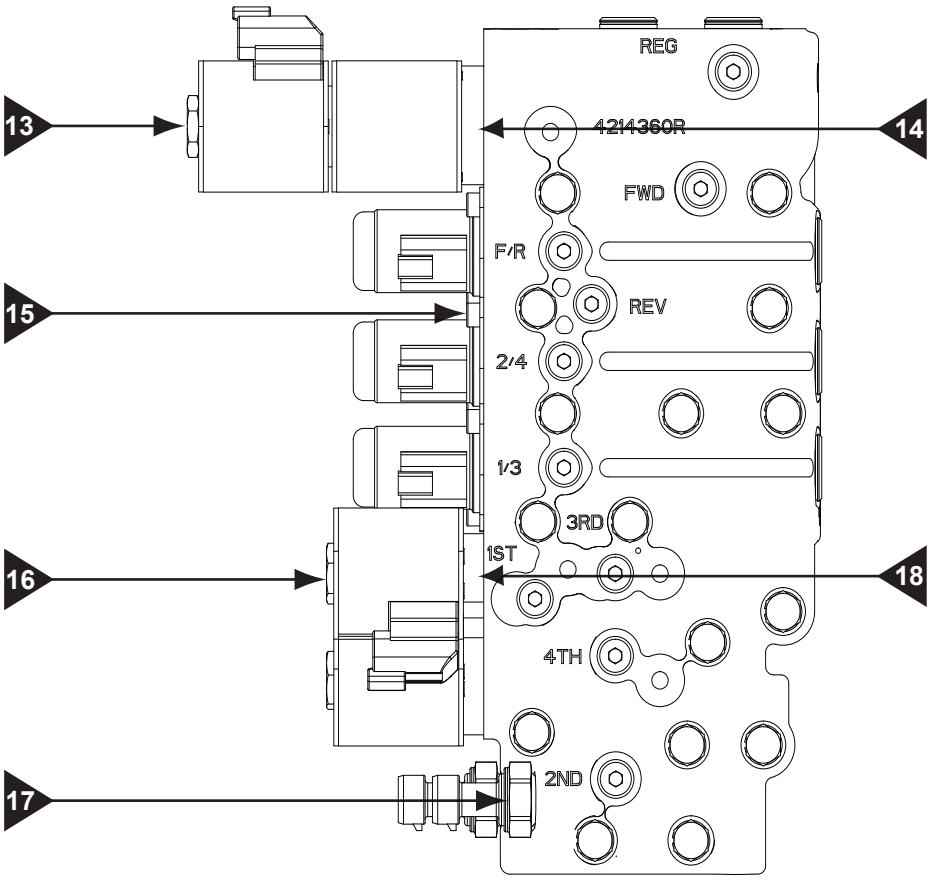
14 Tighten 1 valve to 53-73 Nm [39-54 Lbs.ft]

15 Tighten 6 screws to 5-6 Nm [3.7-4.4 Lbs.ft]

16 Tighten 2 coil nuts to 6.8-9.5 Nm [5-7 Lbs.ft]

17 Tighten 2 pressure sensors to 7-11 Nm [5-8 Lbs.ft]

18 Tighten 2 valves to 34-36 Nm [25-27 Lbs.ft]



INSTALLATION INSTRUCTIONS FOR TE27/32 VALVE

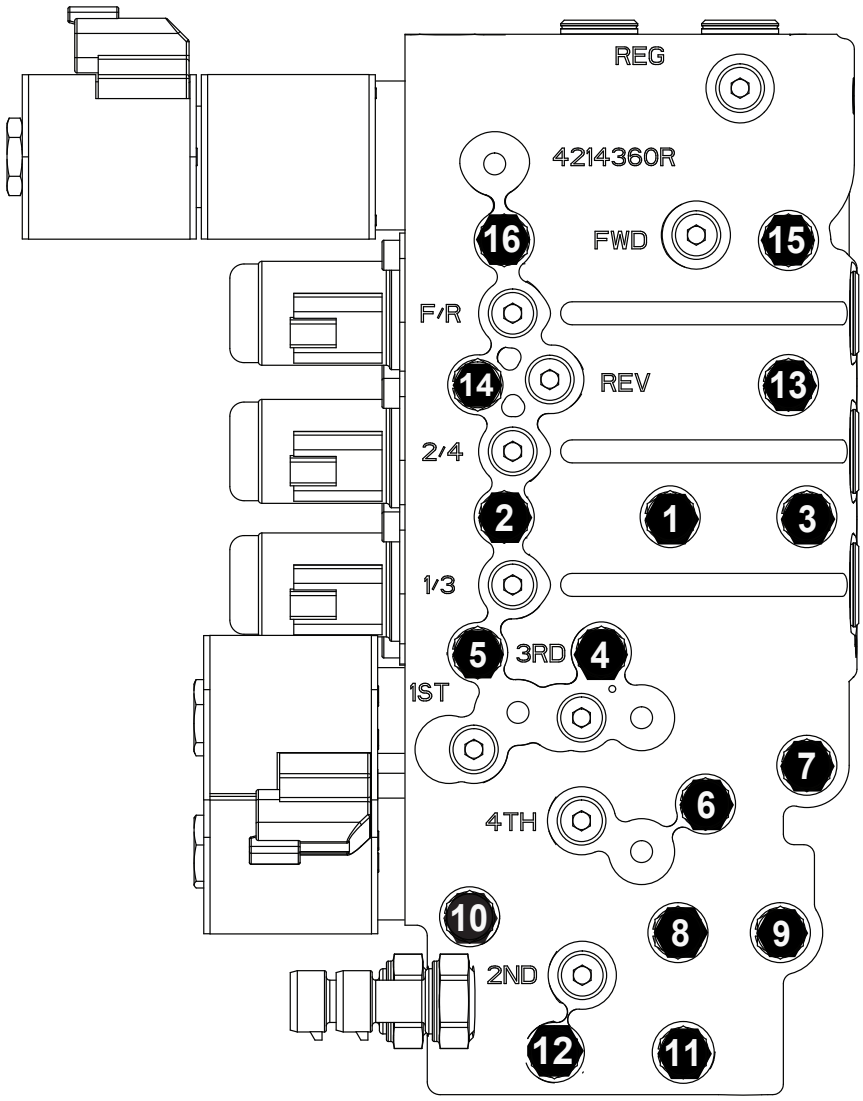
Remove the valve

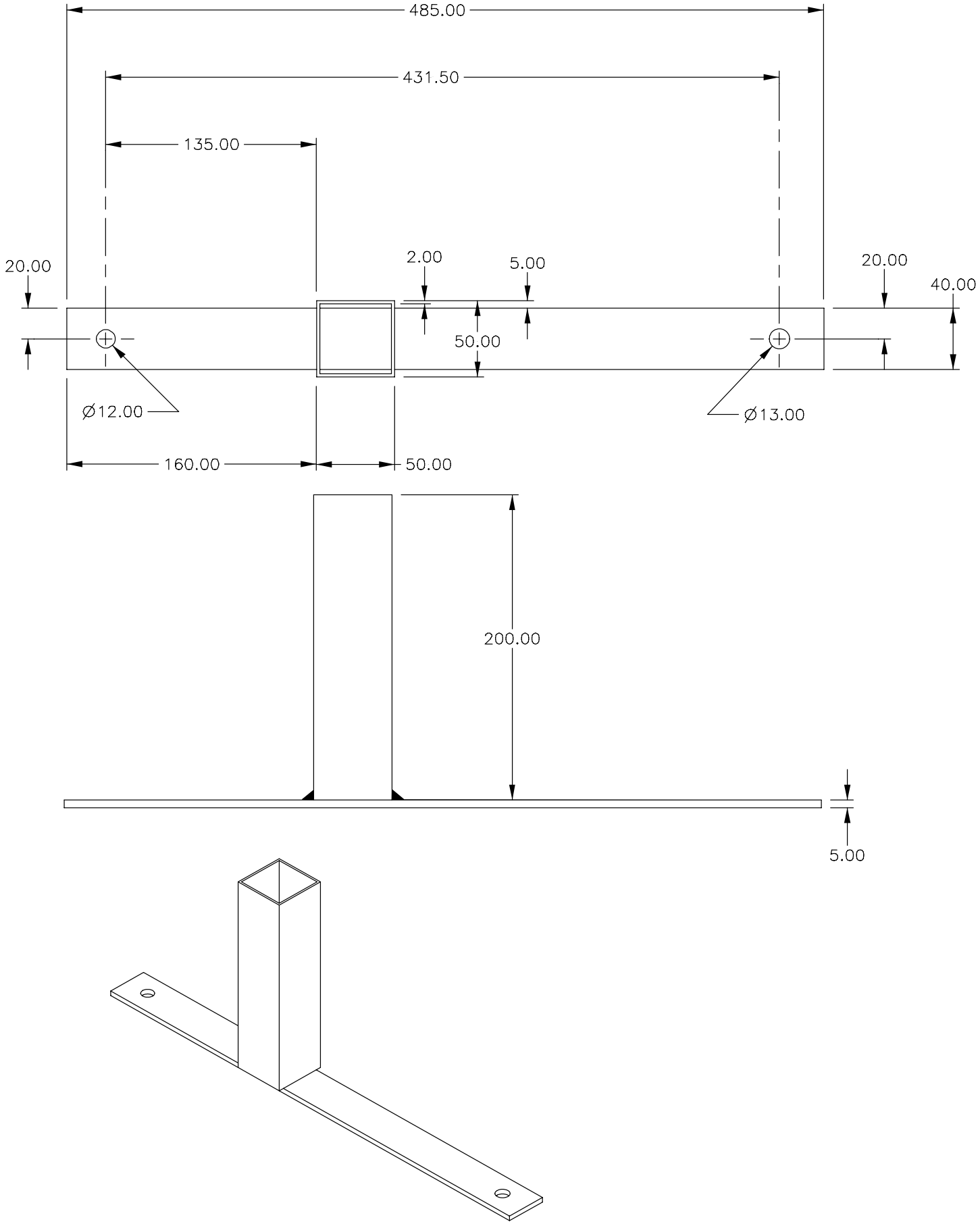
Refer to “Cleaning & Inspection” pages. The area around the valve must be clean and free of any foreign material.

Unscrew 16 bolts (marked with hexagonals on the drawing) some turns. When all bolts are loose, you should be able to move the valve. Replace 2 bolts by aligning studs. Remove the remaining 14 hex bolts and valve from the transmission case.

Install the valve

Install 2 aligning studs. install new gasket and valve body.
Install 14 bolts and handtighten according to the number sequence on the drawing, replace the studs by bolts.
Now torque all bolts twice to 20-25 Nm [15-18Lbs.ft] in the correct sequence.
Recalibrate the transmission.

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Ø12.00
Ø13.00
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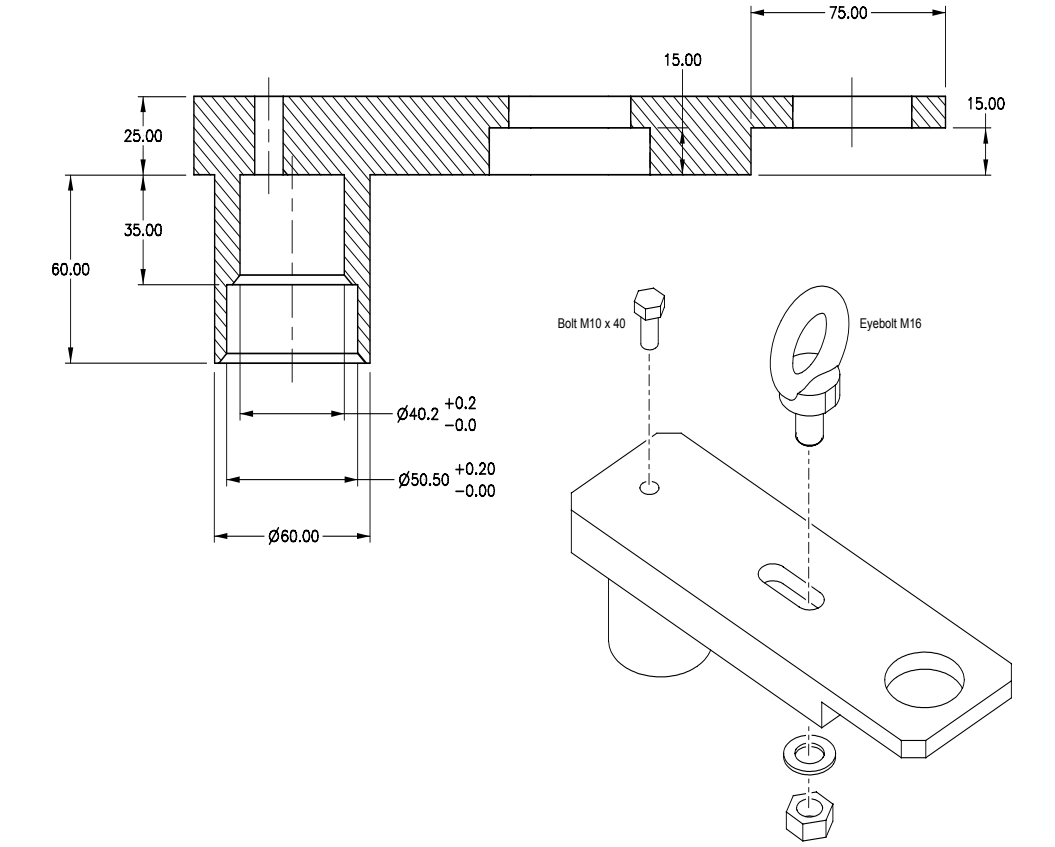
5.00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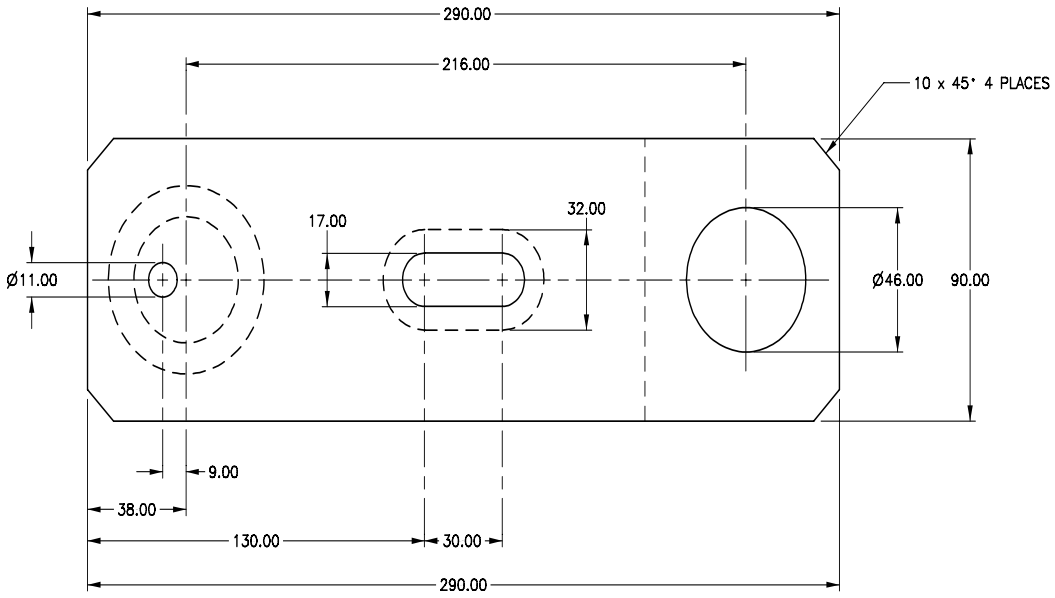
Ø50.50 +0.20 −0.00
Ø60.00
Bolt M10 x 40
Eyebolt M16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216.00
10 x 45° 4 PLACES
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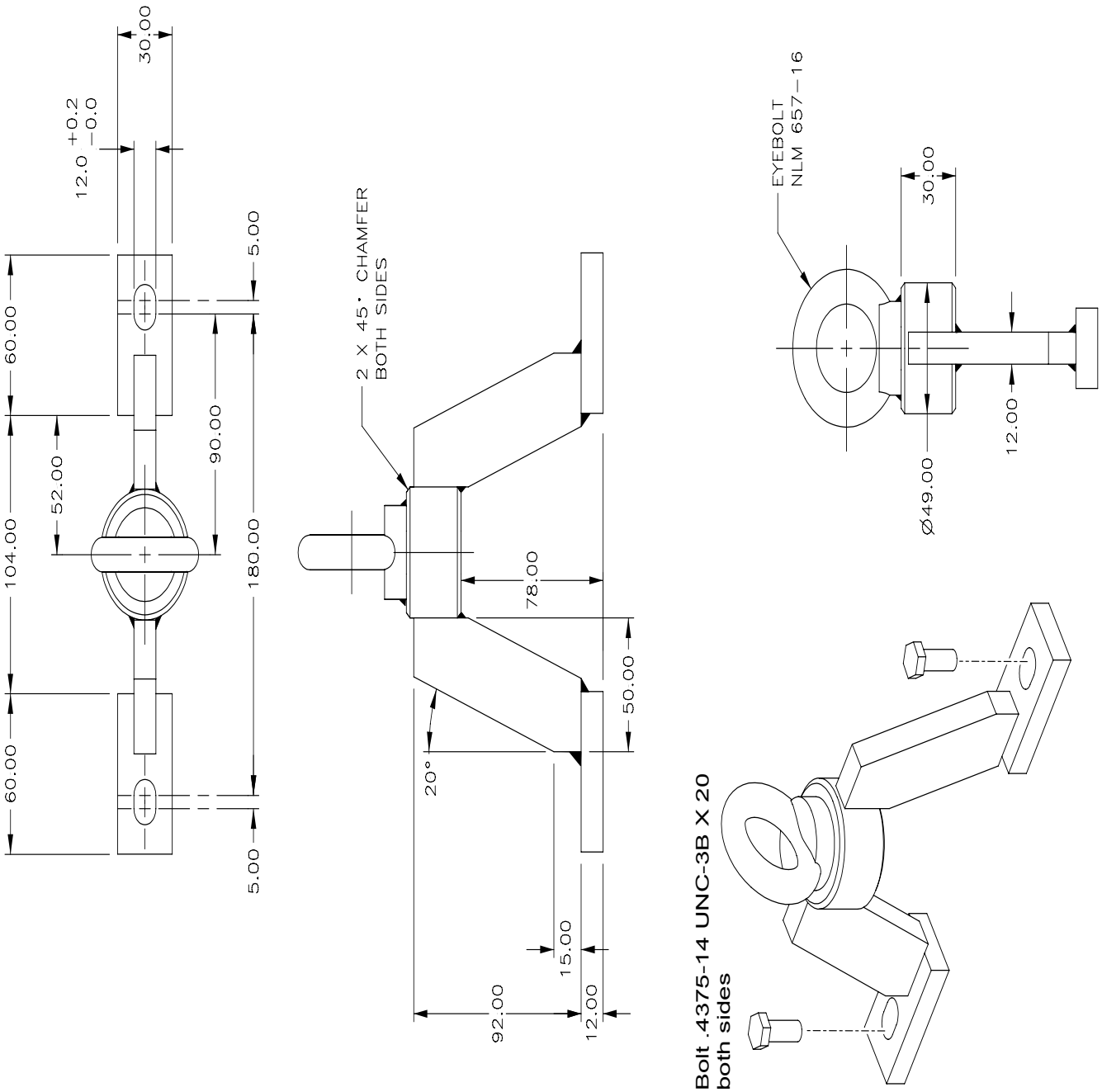
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180.00
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5.00
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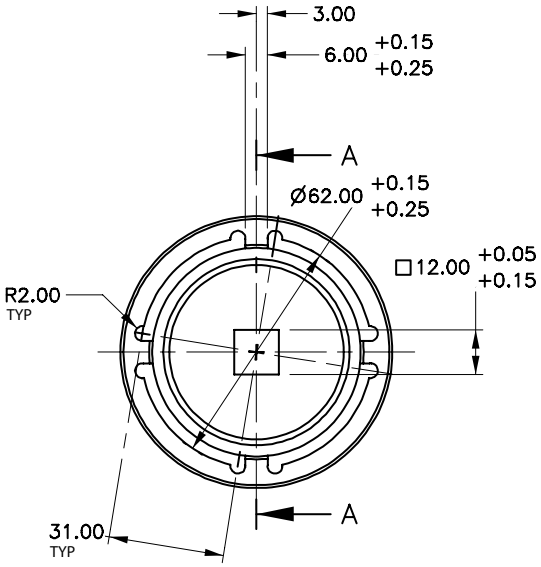
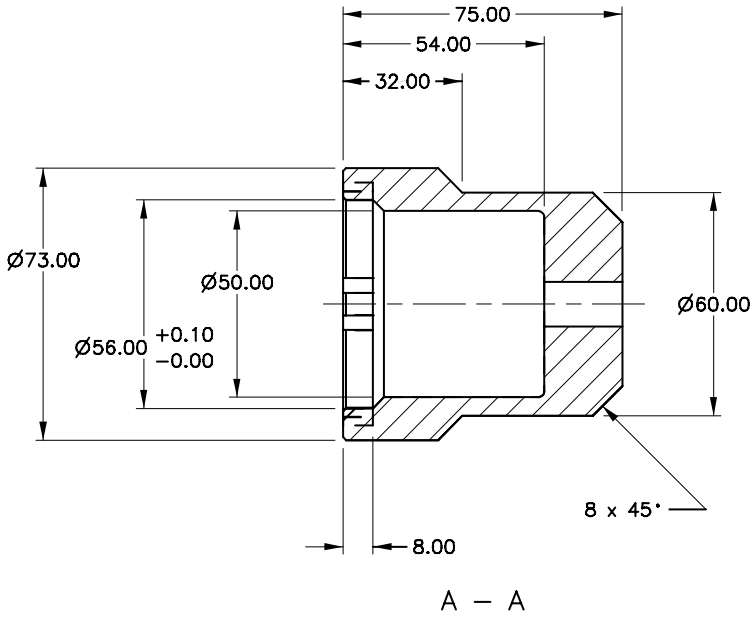
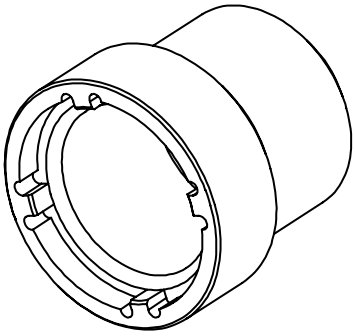
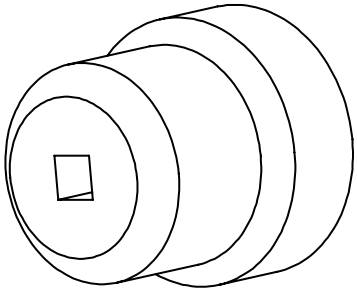
BOTH SIDES
78.00
50.00
20°
92.00
15.00
12.00
EYEBOLT
NLM 657-16
30.00
Ø49.00
12.00
Bolt .4375-14 UNC-3B X 20
both sides


3.00
6.00 +0.15 +0.25
A
Ø62.00 +0.15 +0.25
□12.00 +0.05 +0.15
R2.00
TYP
31.00
TYP
A


75.00
54.00
32.00
Ø73.00
Ø50.00
Ø56.00 +0.10 −0.00
Ø60.00
8 x 45°
8.00

A – A





APPLICATION POLICY

Capability ratings, features and specifications vary depending upon the model type of service. Applications approvals must be obtained from Spicer Off-Highway Products Division. We reserve the right to change or modify our product specifications, configurations, or dimensions at any time without notice.

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