Powershift Transmissions Service Manual

FUNK POWER

For complete service information also see:

1000 Series Transmission Manual.....	4005057
4000 Series LongDrop Asm/Dis Manual..	4005063
4000 Series Short Drop Asm/Dis Manual..	4005062

Funk Manufacturing Company
CTM202 (04JAN00)
LITHO IN U.S.A.
ENGLISH

4004657

Introduction

FOREWORD

This manual is written for an experienced technician. Essential tools required in performing certain service work are identified in this manual and are recommended for use.

Live with safety: Read the safety messages in the introduction of this manual and the cautions presented throughout the text of the manual.

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

Information is organized in groups for the various components requiring service instruction. At the beginning of each group are summary listings of all applicable essential tools, service equipment and tools, other materials needed to do the job, specifications, wear tolerances, and torque values.

Component Technical Manuals (CTM) are concise guides for specific machines. They are on-the-job guides containing only the vital information needed for diagnosis, analysis, testing, and repair.

DX,TMIFC –19–22MAY92–1/1

Contents

Powershift Transmissions
Group 05—Safety
Group 10—General Information
Group 15—1000 And 1700 Series Transmission
Group 20—4000 Series Transmission

INDX

All information, illustrations and specifications in this manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.

Powershift Transmissions

Contents

Page

Group 05—Safety

Warning Tag 05-1
Recognize Safety Information 05-2
Prepare for Emergencies. 05-2
Wear Protective Clothing. 05-2
Work In Ventilated Area 05-3
Work in Clean Area. 05-3
Illuminate Work Area Safely 05-3
Use Proper Lifting Equipment 05-3
Use Proper Tools 05-4
Using Special Tools 05-4
Support Machine Properly. 05-5
Handle Fluids Safely—Avoid Fires 05-5
Prevent Battery Explosions 05-6
Prevent Acid Burns 05-6
Avoid Heating Near Pressurized Fluid Lines 05-7
Avoid High-Pressure Fluids. 05-7
Live With Safety 05-8

Group 10—General Information

Specification 10-1
Abbreviations and Acronyms. 10-1
Parts Ordering Instructions 10-2
Description 10-3
Operation 10-3
Rules of Operation For 1000 And 1700 Series . . . 10-4
Service 10-5
Oil and Oil Filter Recommendations 10-6
Extended Storage 10-7
Metric Bolt And Cap Screw Torque Values 10-8
Unified Inch And Cap Screw Torque Values 10-9
Suggested Wrenching Torque For Tapered Pipe Thread[1] 10-10

Group 15—1000 And 1700 Series Transmission

Specifications 15-1
Short Drop Series 1000, And 1700 15-2
Long Drop Series 1000, And 1700 15-3
Suction Leak Test 15-4
Powershift Troubleshooting 1000, And 1700 15-5
Powershift Troubleshooting Internal Disconnect Models Only . . . 15-9
1000, And 1700 Control Valve Function and Pressure Check 15-10
Converter Installation For 1000, And 1700 Series 15-11
Converter installation Instructions 15-12

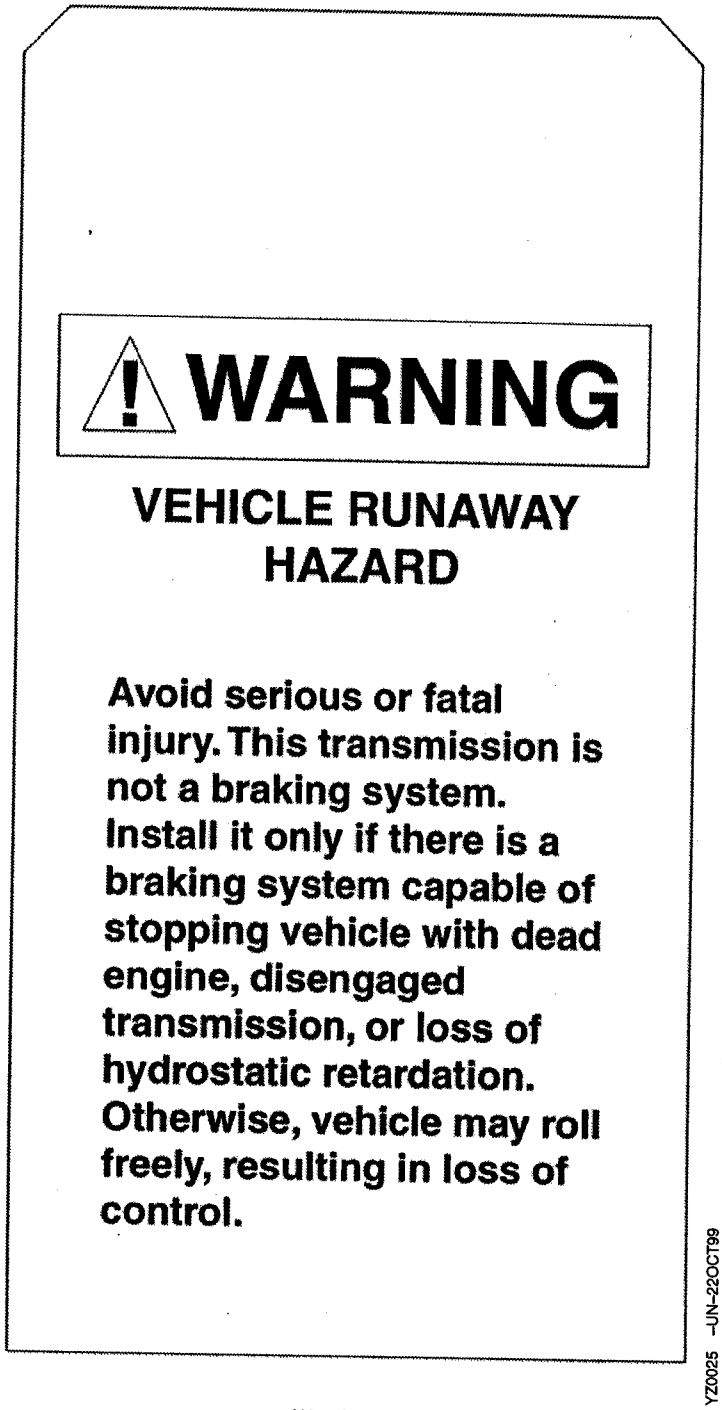
Page

Remote Oil Filter and Heat Exchanger Installation Data. 15-13
Hydraulic Circuit Range: Forward-Third 15-16

Group 20—4000 Series Transmission

Description 20-1
Operation 20-1
Rules of Operation For 4000 Series 20-2
Service 20-3
Lubricant And Oil Filter Change Intervals 20-4
Bolt-Torque-Load Specifications 20-5
4000 Series Short Drop 20-6
4000 Series Long Drop 20-7
4000 Series Control Valve Function and Pressure Check 20-8
Hydraulic Circuit 4000 Series 20-10

WARNING TAG



Warning Tag

The above tag is attached to each unit when it is shipped. It is for your protection and should not be removed until the unit has been properly serviced under the instructions of this manual.

DPSG,YZ07927,196 -19-28SEP99-1/1

05
2

RECOGNIZE SAFETY INFORMATION

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

Follow recommended precautions and safe operating practices.

T81389 –UN–07DEC88

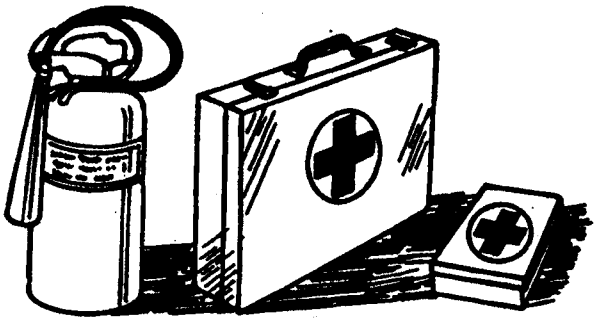
DX,ALERT –19–07DEC88–1/1

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

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



TS291 –UN–23AUG88

DX,FIRE2 –19–03MAR93–1/1

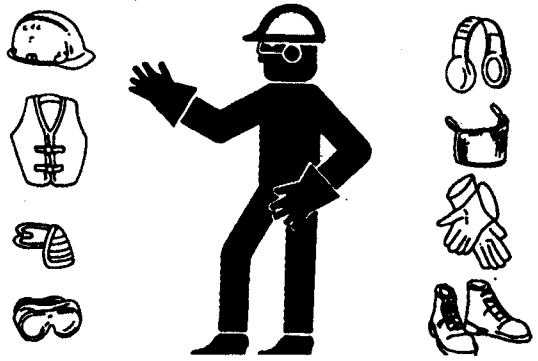
WEAR PROTECTIVE CLOTHING

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

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

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

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



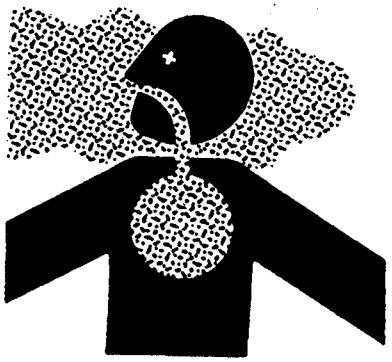
TS206 –UN–23AUG88

DX,WEAR –19–10SEP90–1/1

WORK IN VENTILATED AREA

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

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



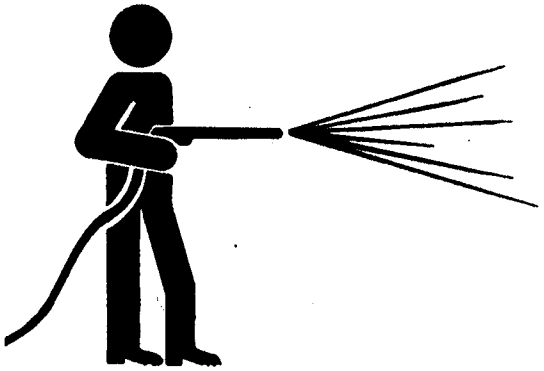
TS220 –UN–23AUG88

DX,AIR –19–23AUG88–1/1

WORK IN CLEAN AREA

Before starting a job:

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



T6642EJ –UN–18OCT88

DX,CLEAN –19–04JUN90–1/1

ILLUMINATE WORK AREA SAFELY

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

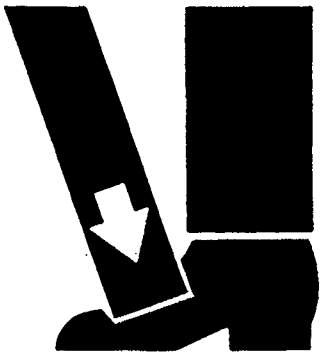
TS223 –UN–23AUG88

DX,LIGHT –19–04JUN90–1/1

USE PROPER LIFTING EQUIPMENT

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

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



TS226 –UN–23AUG88

DX,LIFT –19–04JUN90–1/1

05
4

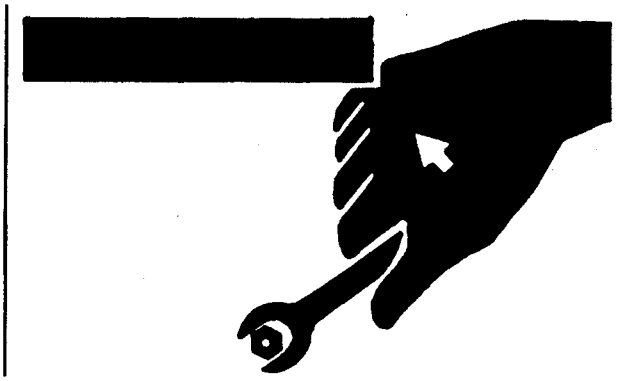
USE PROPER TOOLS

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

Use power tools only to loosen threaded parts and fasteners.

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

Use only service parts meeting John Deere specifications.



DX,REPAIR –19–04JUN90–1/1

USING SPECIAL TOOLS

Faulty or broken tools can result in serious injury. When constructing tools, use proper, quality materials and good workmanship.

Do not weld tools unless you have the proper equipment and experience to perform the job.

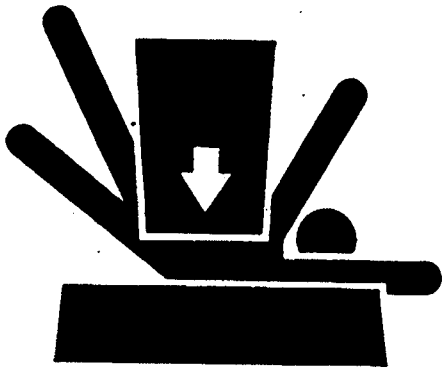
Special Tools

DPSG,YZ07927,121 –19–06JUL99–1/1

SUPPORT MACHINE PROPERLY

Always lower the attachment or implement to the ground before you work on the machine. If you must work on a lifted machine or attachment, securely support the machine or attachment.

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



TS229 –UN–23AUG88

DX,LOWER –19–04JUN90–1/1

HANDLE FLUIDS SAFELY—AVOID FIRES

When you work around fuel, do not smoke or work near heaters or other fire hazards.

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

Do not store oily rags; they can ignite and burn spontaneously.

TS227 –UN–23AUG88

DX,FLAME –19–04JUN90–1/1

05
6

PREVENT BATTERY EXPLOSIONS

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

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

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

TS204 –UN–23AUG88

DX,SPARKS –19–03MAR93–1/1

PREVENT ACID BURNS

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

Avoid the hazard by:

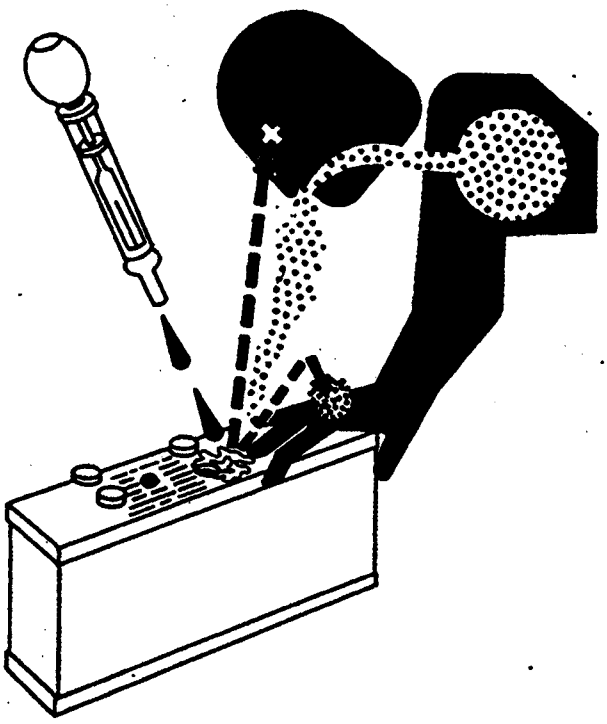
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

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

If acid is swallowed:

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



TS203 –UN–23AUG88

DX,POISON –19–21APR93–1/1

AVOID HEATING NEAR PRESSURIZED FLUID LINES

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

TS953 –UN–15MAY90

DX,TORCH –19–03MAR93–1/1

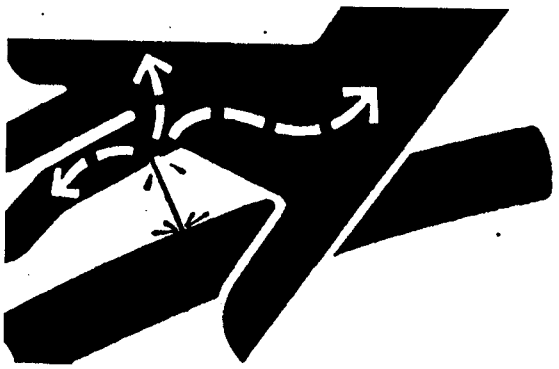
AVOID HIGH-PRESSURE FLUIDS

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

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

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

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



X9811 –UN–23AUG88

DX,FLUID –19–03MAR93–1/1

05
8

LIVE WITH SAFETY

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

TS231 –19–07OCT88

DX,LIVE –19–25SEP92–1/1

SPECIFICATION

Item	Measurement	Specification
Maximum operating oil temperature	Temperature	107°C (225 °F)
Oil	First time fill is "dependent" upon supplied cooler and hoses to cooler.	18.93 Liters (5 Gallons)
Oil type	Recommended Lubricants	See "SERVICE" this group.
Oil filter	First time	After 500 hours refer to "OIL AND FILTER RECOMMENDATIONS" in this group.
Ambient temperature	Commercial and Military	Refer to "SERVICE" in this group.

DPSG,YZ07927,181 –19–24SEP99–1/1

ABBREVIATIONS AND ACRONYMS

- **°C**: Degrees Celsius. 1 unit is 1/100th of the difference between the temperature of melting ice and boiling water at standard temperature and pressure.
- **CTM**: Component Technical Manual
- **°F**: Degrees Fahrenheit. 1 unit is 1/80th of the difference between the temperature of melting ice and boiling water at standard temperature and pressure.
- **FEPM**: Funk Engineering Procedures Manual
- **RTV**: Room Temperature Vulcanizing

DPSG,YZ07927,209 –19–20OCT99–1/1

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PARTS ORDERING INSTRUCTIONS

Should repair parts be required, please specify the model, specification and serial numbers of your unit as well as the name and number of the parts accompanying your purchase order.

This information tag is attached to your unit.

You may write to:

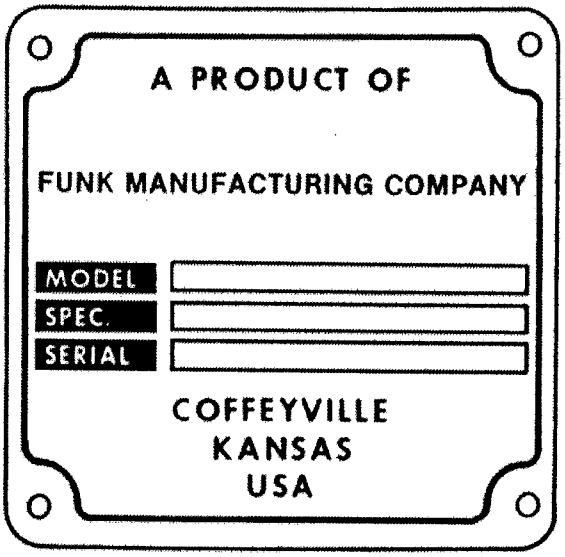
- Funk Manufacturing Company
  Attn.: Parts Department
  Industrial Park, Hwy. 169 N.
  P.O. Box 577
  Coffeyville, KS 67337-0577

Or Telephone:

- (316) 251-3400 or 800-844-1337
  Ask for Customer Service Representative.

Fax:

- (316) 252-3252 For Units
  (316) 252-3253 For Service Parts



YZ1873 –UN–24JUN99

Identification Tag

DPSG,YZ07927,195 –19–28SEP99–1/1

DESCRIPTION

The 4000, 1700 and 1000 series powershift transmissions all operate on the same principle, the difference being the horsepower rating. However, the 4000 series, having a different pump and valve body, has different pressure ranges that are described in a separate section.

The 1000, and 1700 series are forward and reverse transmissions, with the option of 3, 4 or 6 speeds in either direction. Forward motion, reverse motion, and the speeds are obtained through the use of hydraulically actuated multiple disc clutches. These clutches are power absorbing members that can be engaged at full engine power. Shifting under full engine power makes these models a full power shift for the forward and reverse motion in all speeds.

The clutches in these units are hydraulically applied and spring released. Because the clutches are hydraulically controlled, there is automatic compensation for normal wear, which eliminates the need for adjustment. Each clutch has paper graphitic friction plates and polished steel reaction plates.

The power from the engine is transmitted to the transmission through a torque converter. The use of the torque converter has two distinct advantages; (1) The converter is essentially a fluid drive, there being no direct mechanical connection through it. This feature creates a very smooth and shock-free drive eliminating engine stalling and lugging. (2) The converter multiplies torque during heavy pull-down loads. When loads are light, the converter transmits the engine power directly at almost engine speeds, and there is no torque multiplication. The net result is an action like a transmission, with infinitely variable and automatic speed ratios. The need for shifting gears, although present, is greatly reduced.

DPSG,YZ07927,182 –19–24SEP99–1/1

OPERATION

Like all mechanical equipment, the powershift transmission will need attention and servicing. Routine checks will help prevent down time.

Because the unit operates "in" oil, and "by" oil, most of the maintenance is concerned with oil replenishment and oil cleanliness. The type of service and operating conditions shall determine the maintenance interval. However, as previously stated, it is especially important that the oil be kept clean.

DPSG,YZ07927,183 –19–24SEP99–1/1

10 4

RULES OF OPERATION FOR 1000 AND 1700 SERIES

1. Check oil level daily, with engine at idle, in neutral and at operating temperature. Make sure the area around oil level check plug is clean before removing plug.
2. The transmission should always be in the neutral position before starting the engine, or when the vehicle is parked and the engine is running.
3. If the vehicle is to be towed, it will be necessary to run the engine at idle speed to lubricate the clutches.
4. If the oil temperature gauge, which is the converter oil out temperature, rises above 121°C (250° F) or the warning light comes on, stop the vehicle immediately. Shift to neutral and run the engine at 1000-1200 rpm. The temperature should drop rapidly to the engine water temperature. If the temperature does not drop, trouble is indicated. The trouble should be determined before the vehicle is operated again. Overheating generally occurs due to working in too high of a gear ratio.

Converter—Specification

Oil Out Temperature ..... 121°C (250° F)

5. Do not shut off engine when unit is overheating.
6. Pressure checks at control valve.

Pressure Checks at Control Valve—Specification

Temperature ..... 37.7 °C (140°F are made at approximately)

7. Normal clutch pressure at 2000 rpm.

Clutch Pressure at 2000 rpm—Specification

Pressure..... 1068 kPa (150 psi) to 1240 kPa (180 psi)

8. Converter charge pressure at 2000 rpm.

Converter Charge Pressure at 2000 rpm—Specification

Pressure..... 276 kPa (40 psi) to 482 kPa (70 psi)

DPSG,YZ07927,184 –19–24SEP99–1/1

SERVICE

COMMERCIAL POWERSHIFT AIR TEMPERATURE RANGE	
Prevailing Ambient Temperature	**Oil Specifications**
Above–23°C (-10°F)	Hydraulic Transmission Fluid.
Below -23°C (-10°F)	Hydraulic transmission flluid, type C-3 or C-4 (except grade 30) auxiliary preheat required to raise temperature in the sump to a temperature above -23°C (-10°F).
Above 0°C (32°F)	Hydraulic transmission fluid type C-3 or C-4, or type C-3 grade 30.

MILITARY POWERSHIFT AIR TEMPERATURE RANGE	
Prevailing Ambient Temperature	**Oil Specifications**
Above -23°C (-10°F)	MIL-L-2104 Grade 10 to latest specification or Hydraulic Transmission Fluid Type C-3.
-17.8°C (0°F) to -53.9°C (-65°F)	MIL-L-10295 to latest specification.
-53.9°C	**IMPORTANT: Do not use MIL-L-10295 when the ambient temperature is consistently above -23.3°C (-10°F).** If auxiliary preheating equipment is available and the sump temperature can be raised to -23.3°C (-10°F) it is recommended that MIL-L-2104 Grade 10 oil be used. When changing to oil of different grade, thoroughly flush system with grade oil to be used before refilling.

The type of service and operating conditions will determine the maintenance interval. However, it is recommended that the oil level be checked weekly, at the same time checking for oil leaks. Because the lubrication system is the heart of the unit, it is especially important that the oil be kept clean.

It is recommended the oil and oil filter be changed whenever the oil shows traces of contamination, or the effects of high operating temperature evidenced by discoloration or strong odor.

If the oil in the system has become contaminated with metal particles, all the components of the system (oil lines, oil pump, oil filter, control valve, clutches, converter, heat exchanger) must be thoroughly cleaned. Generally this means a tear down of the unit. The metal particles in the oil is evidence of a damaged part.

DPSG,YZ07927,185 –19–24SEP99–1/1

10 6

OIL AND OIL FILTER RECOMMENDATIONS

IMPORTANT: Oil fill amounts are application dependent. "Length of hoses" and "size of cooler" will detemine amount of oil to be put into the unit. The recommendations below serve as a begining amount.

When servicing the unit for the first time after vehicle installation and / or after repair, the unit is filled as follows:

1. Fill the unit with engine off.

First time fill—Specification

Recommended lubricant..... 18.93 liters (5 gallons)

2. Start engine and run at idle speed to let the hydraulic system charge.
3. With the engine at idle speed.

Oil—Specification

Finish filing unit to full level..... 2.84 liters (3 quarts)

Each unit will vary with each application.

NOTE: The oil level is always checked with the engine running at idle speed and the Shift-O-Matic™ in neutral at operating temperature.

OIL AND FILTER:

- **20 Hours** - New or overhauled unit drained and refilled with new fluid. (Do not use a flushing fluid.)
- **250 Hours** - Operation in severe dust, sand, or in underground environment.
- **375 Hours** - Operation in normal off-highway conditions, rapid changes in ambient or unit temperature, or in the presence of chemical fumes.
- **500 Hours** - Operation in clean environment. (hard surface roads, minimum dust, etc.)

Continued on next page

When changing the oil, the dirty oil should be drained while the unit is warm, examining for contamination. Keep all controls properly lubricated. If the radiator of the vehicle is drained for winter storage, the heat exchanger on the transmission must also be drained.

DPSG,YZ07927,210 –19–29OCT99–2/2

EXTENDED STORAGE

STORAGE OF TRANSMISSION:

This procedure applies to those transmissions and components that have been tested according to Funk Manufacturing test specifications and have had the fluid drained from them prior to shipment.

The following will protect the unit or component from internal rust and or corrosion damage for approximately one (1) year, provided they are stored under shelter.

INTERNAL PRESERVATION:

1. Seal **ALL** openings with moisture proof covers or tape.
2. Spray (4) ounces of atomized NOX RUST VCI No. 10 oil into drain hole. This fluid is covered and approved per (MIL-P-46002 and MIL-I-23310).

EXTERNAL PRESERVATION:

1. Dip, spray, or brush **ALL** exposed unpainted surfaces with NOX RUST X-110. This includes shafts, flanges, seals, etc.
   NOX RUST X-110 meets MIL-C-16173 Grade 4 specifications.

Nox Rust is purchased from:

- Daubert Chemical Company
  1200 Jorie Boulevard
  Oak Brook, IL 60521
  (312) 990-4600

RESTORING UNITS TO SERVICE:

1. Wash off **ALL** external grease with solvent.
2. Remove covers or tape from all openings.
3. Fill the unit with Funk Manufacturing approved transmission fluid.

DPSG,YZ07927,186 –19–27SEP99–1/1

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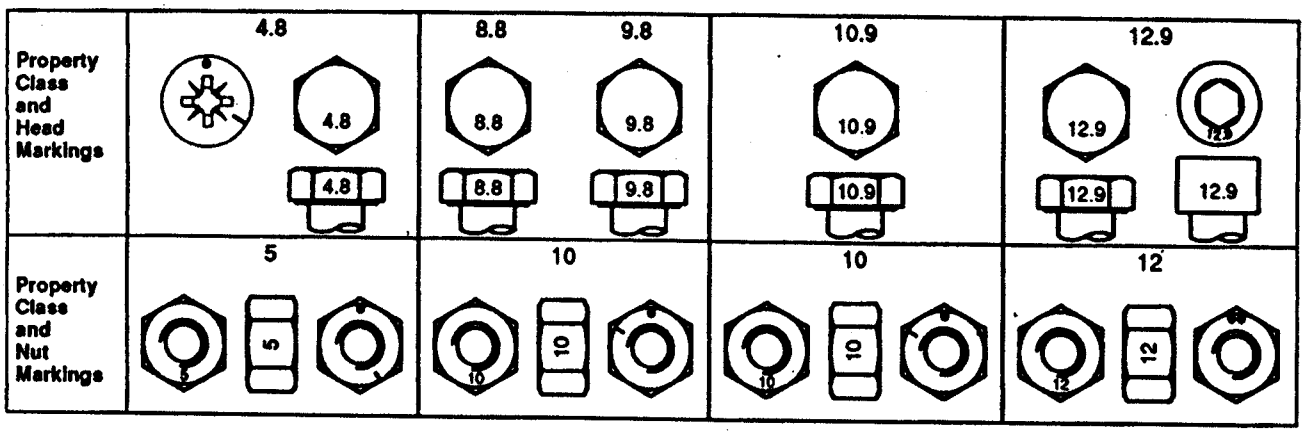
METRIC BOLT AND CAP SCREW TORQUE VALUES



TS1163 –19–04MAR91

Metric

Applies to non-lubricated plain or zinc plated fasteners.

FEPM METRIC TORQUE SPECIFICATIONS 14.1					
Size	-	Class 8.8		Class 10.9	
-	-	N •m	lb-ft	N•m	lb-ft
M5	-	6.1	4.5	9.0	6.6
M6	-	10.4	7.7	15.3	11.3
M8	-	25	19	37	27
M10	-	50	37	73	54
M12	-	87	64	128	94
M14	-	139	102	204	150
M16	-	216	160	318	234
M20	-	435	321	620	457
M24	-	730	555	1072	790
M30	-	1450	1103	2129	1570
M36	-	2533	1927	3721	2744

NOTE: Torque tolerance is ± 20%

Do not use these values if a different torque value or tightening procedure is given for a specific application.

METRIC BOLT AND CAP SCREW TORQUE VALUES chart meets Funk Engineering Procedures Manual (FEPM) Torque Specifications.

DPSG,YZ07927,14 –19–30APR99–1/1

UNIFIED INCH AND CAP SCREW TORQUE VALUES

SAE Grade and Head Markings	NO MARK	1 or 2[b]	5	5.1	5.2	8	8.2
SAE Grade and Nut Markings	NO MARK	2	5			8	

TS1162 –19–04MAR91

FEPM INCH TORQUE SPECIFICATIONS 14.2				
Size	Grade 5		Grade 8	
-	N•m	lb-ft	N•m	lb-ft
1/4-20	11.1	8.2	16	11.6
1/4-28	12.8	9.4	18	13.3
5/16-18	23	16.9	32	23.9
5/16-24	25	18.7	36	26.4
-	-	-	-	-
3/8-16	41	30	57	42
3/8-24	46	34	65	48
7/16-14	65	48	92	68
7/16-20	73	54	103	76
-	-	-	-	-
1/2-13	99	73	140	103
1/2-20	111	82	159	117
9/16-12	144	106	202	149
9/16-18	160	118	225	166
5/8-11	198	146	280	206
5/8-18	224	165	316	233
3/4-10	350	258	495	365
3/4-16	392	289	554	408
-	-	-	-	-
7/8-9	566	417	799	589
7/8-14	624	460	881	649
1-8	848	625	1199	884
1-12	928	684	1312	967

Applies to non-lubricated plain or zinc plated fasteners.

DPSG,YZ07927,20 –19–11MAY99–1/1

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SUGGESTED WRENCHING TORQUE FOR TAPERED PIPE THREAD[1]

FEPM TORQUE SPECIFICATIONS 14.4		
TAPERED PIPE THREAD WITH SEALANT CHART		
Thread Size	**N• m**	**lb-ft**
1/16-27 UNF	15	10
1/8-27 UNF	20	15
1/4-18 UNF	25	20
3/8-18 UNF	35	25
1/2-14 UNF	45	35
3/4-14 UNF	60	45
1-11 1/2 UN	75	55
1-1/4-11 1/2 UN	95	70
1-1/2-11 1/2 UN	110	80
2-11 1/2 UN	130	95

FEPM TORQUE SPECIFICATIONS 14.4		
TAPERED PIPE THREAD WITHOUT SEALANT CHART		
Thread Size	**N•m**	**lb-ft**
1/16-27 UNF	20	15
1/8-27 UNF	25	20
1/4-18 UNF	35	25
3/8-18 UNF	45	35
1/2-14 UNF	60	45
3/4-14 UNF	75	55
1-11 1/2 UN	90	65
1-1/4-11 1/2 UN	110	80
1-1/2-11 1/2 UN	130	95
2-11 1/2 UN	160	120

[1] SUGGESTED WRENCHING TORQUE FOR TAPERED PIPE THREAD charts meet Funk Engineering Procedures Manual Torque Specifications FEP 14.4.

DPSG,YZ07927,8 –19–30APR99–1/1

SPECIFICATIONS

Item	Measurement	Specification
Drive Plate Assembly-to-Engine Flywheel	Torque	65 N•m (48 lb-ft).
Converter-to-Drive Plate Assembly (113/4)	Torque	36 N•m (26.4 lb-ft).
Converter-to-Drive Plate Assembly (123/4 and 13)	Torque	36 N•m (26.4 lb-ft).
Clutch	Pressure	1068—1240 kPa (155—180 psi)
Converter	Pressure	276—482 kPa (40—70 psi)
Converter By-Pass Valve	Pressure	551 kPa (80 psi)

DPSG,YZ07927,197 –19–30SEP99–1/1

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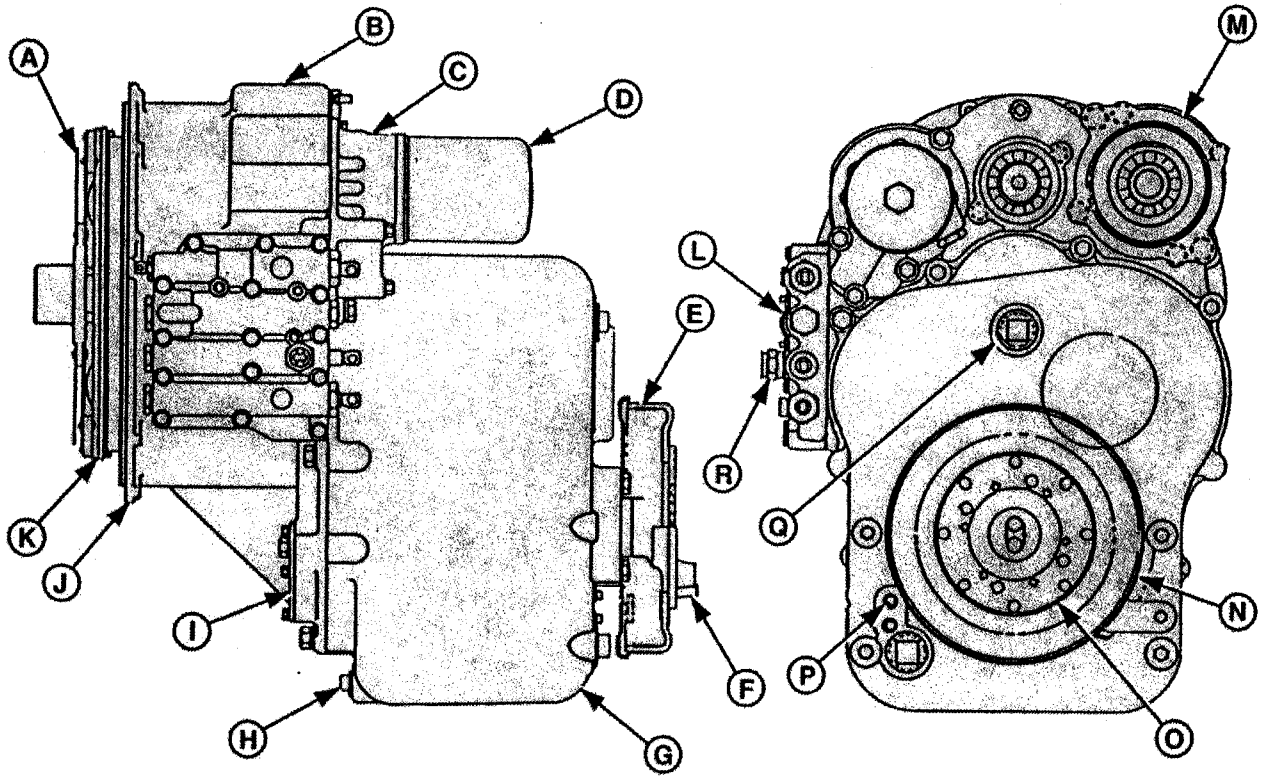
SHORT DROP SERIES 1000, AND 1700

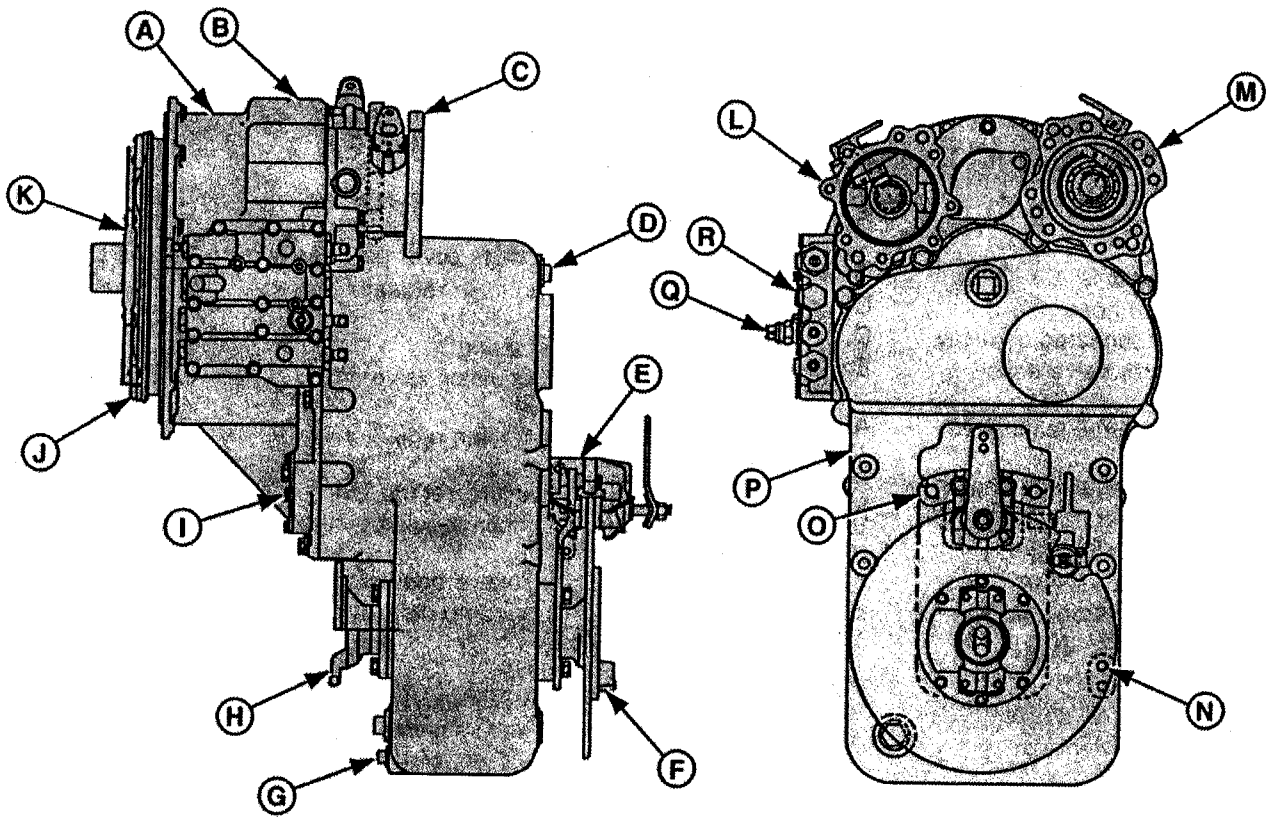


Short Drop 1000, and 1700

A—Drive Plate
B—Serial Tag Location
C—Primary Pump
D—Transmission Mounted Filter
E—Parking Brake
F—Output Yoke
G—Main Case
H—Oil Drain Plug
I—Sump Tube Screen Location
J—Front Cover
K—Converter
L—Control Valve
M—Auxiliary Pump Mount
N—Parking Brake
O—Output Flange
P—Oil Level
Q—Oil Fill Location
R—Neutral Start Switch

DPSG,YZ07927,211 –19–29OCT99–1/1

LONG DROP SERIES 1000, AND 1700



YZ0027 –UN–13DEC99

Long Drop 1000, and 1700

A—Front Cover
B—Serial Tag
C—Primary Charge Pump (Requires Remote Mount Filter)
D—Oil Fill Plug
E—Parking Brake
F—Output Yoke
G—Magnetic Oil Drain Plug
H—Output Yoke
I—Sump Tube and Screen Location
J—Converter
K—Drive Plate
L—Primary Pump With Disconnect
M—Auxiliary Pump Mount
N—Oil Level Located On Front Side
O—Parking Brake
P—Main Case
Q—Neutral Start Switch
R—Control Valve

DPSG,YZ07927,212 –19–29OCT99–1/1

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SUCTION LEAK TEST

Some indications of a suction leak includes:

- Erratic oil pressure. Look for rapid fluctuation of gauges.
- Pump and filter hoses jumping.
- Excessive air entrainment in the transmission oil.
- A long prime time (time elapsed from engine start to an indication of pump pressure).

1. Fill to normal level with transmission fluid.
2. Install a 21 bar (2068 kPa) (300 psi) pressure gauge in the pressure port.
3. Start the engine.
4. See if there is an indication of erratic oil pressure.
5. If any of the above conditions are corrected by this procedure, a suction leak exists.

NOTE: Check suction tube fitting.

IMPORTANT: Drain the transmission to the correct level after the test. Failure to do so will result in poor performance and over heating.

6. Drain the transmission to proper level.

DPSG,YZ07927,213 –19–29OCT99–1/1

POWERSHIFT TROUBLESHOOTING 1000, AND 1700

Symptom	Problem	Solution
Erratic oil pressure.	Low oil level.	Add oil to proper level.
	Suction tube fitting	Replace O-ring fitting.
	Suction manifold O-ring not sealing.	Replace O-ring.
	Foreign object in suction port.	Remove object and check for other contamination.
Excessive oil pressure.	Sticking main regulator valve.	Replace main regulator valve.
	Faulty spring.	Replace main regulator valve.
Low oil pressure in all gears.	Sticking main regulator valve.	Replace main regulator valve.
	Control valve body gasket leaking.	Replace gaskets.
	Charge pump defective.	Replace pump.
	Internal disconnect seal damage or installed incorrectly.	Replace seal and install correctly.
	Faulty main regulator valve.	Replace regulator assembly.
	Control valve body cracked.	Replace control valve body.
Low pressure in one gear but all right in other gears.	Contaminated proportional solenoid.	Replace proportional solenoid. *Check suction screen for contamination.
	Broken wire to one solenoid, or dirty connection.	Repair wire.
	Broken seal ring on input end of clutch assembly.	Replace seal ring.
	Bore sleeve worn.	Replace bore sleeves.
	Outer or inner piston seal leaking.	Replace seals.

Continued on next page

Symptom	Problem	Solution
Transmission System Pressure is Low (One or Two Gears)	Failed transmission control valve	Inspect transmission control valve for external leakage, Remove control valve. Inspect or replace gasket (See group 35)
	Leakage in clutch piston or seal ring.	Air check to confirm leak.
	Solenoid valve malfunction	Check for a transmission fault code on monitor, then check solenoids using monitor diagnostics.
Filter or filter oil lines blow out.	Hose bends too sharp.	Reroute hoses.
	Defective hose.	Replace hose.
	Main regulator valve faulty.	Change valve and change filter and oil.
	System plumbing incorrect.	Correct plumbing.
	Filter O-ring faulty.	Replace filter
Foaming Oil	Incorrect type of oil	Change oil
	High oil level	Transmission overfilled or hydraulic pump seal leaking.
	Low oil level	Add oil (See Group 10)
	Air leak on suction side of pump	Check oil pickup tube on inside of transmission.
Blows oil out of breather or dipstick tube.	Transmission over filled with oil.	Establish proper oil level. Check front seal on auxiliary driven hydraulic pump if equipped.
	Converter seal ring damaged.	Remove transmission and install new seal ring on converter hub.
Oil leaking from engine flywheel and/or weep hole in transmission bell housing.	Converter front cover seal leaking.	Replace seal.

Continued on next page

Symptom	Problem	Solution
	Converter hub seal or O-ring damaged.	Replace seal.
	Converter not properly positioned within bell housing, causing converter and seal to leak.	Check engine flywheel offset dimensions and converter pilot bushing length against vehicle manufacture standards.
Vehicle will not move	Fault code problem	Check fault codes to define problem.
	Voltage to wrong solenoids on control valve. (See schematic.)	Check wiring and connectors.
	Converter damage.	Rebuild converter.
	No voltage to all solenoids.	Check wiring, controller and connectors.
	Voltage to more than two solenoids.	Check wiring and controller.
	Proportional solenoid stuck.	Replace solenoid.
	Failed shift switch	Check that basic display window shows correct gear when shift switch is moved.
Low or no converter pressure (Converter in pressure).	Converter bypass valve defective.	Replace converter bypass valve.
	Converter hub seal ring not sealing.	Replace seal ring.
	Check converter offset dimension.	Correct offset dimension.
Excessive noise.	Charge pump defective.	Replace pump.
	Excessive backlash in gear train.	Replace bearings and inspect for defective gears.
	Auxiliary driven pump bad.	Remove pump and check for noise.
	Worn parts or damage in transmission	Remove transmission suction screen. Inspect for metal particles.

Continued on next page

Symptom	Problem	Solution
	Low or no lube	Do converter-out and lube pressure test.
Machine "Creeps" In Neutral	Warped disks and plates in two pack of transmission.	Check transmission
	Control valve leakage	Do transmission leakage test
	Plugged screen on solenoid valve	Remove solenoid valve and clean.
Transmission Clutch Slippage	Low oil level	Add oil (See Group 10)
	Wrong oil grade	Change oil (See Group 10)
	Restricted transmission pump suction screen.	Remove and clean screen (See Group 25)
	Leak in transmission control valve or gasket	Remove valve and inspect gaskets (See Group 35).
	Low transmission pump flow due to worn pump	Do transmission pump flow test.
	Stuck solenoid valve	Check wiring to solenoid valve.
		Remove and inspect solenoid valve.
Transmission overheating.	Converter stalling.	Shift to lower gear.
	Oil level too high.	Establish proper oil level. Check front seal on auxiliary driven hydraulic pump if equipped.
	Engine overheating.	Check engine coolant.
	Water lines defective on heat exchanger.	Replace lines.
	Heat exchanger dirty.	Clean heat exchanger.
	Clutch slipping.	Check clutch pressure.

Continued on next page

Symptom	Problem	Solution
Transmission pressure checks okay, but has no power and possibly overheating.	Converter sprag clutch damaged or installed wrong.	Disassemble and inspect converter.
	Converter relief valve broken.	Replace relief valve.

DPSG,YZ07927,215 –19–02NOV99–5/5

POWERSHIFT TROUBLESHOOTING INTERNAL DISCONNECT MODELS ONLY

Symptom	Problem	Solution
Four wheel drive will not engage.	Solenoid stuck open. Voltage applied all the time.	Repair or replace solenoid. Check wiring diagram and connectors.
	Damaged or missing disconnect retainer spring.	Replace or install disconnect retainer spring.
	Bleed port blocked.	Check for proper installation of gasket and solenoid cap or contamination.
Four wheel drive will not disengage.	No power to solenoid, solenoid inoperative.	Check for electric power to solenoid - check wiring and connectors if OK, replace solenoid.
	Check valve installed backwards.	Install check valve properly.

DPSG,YZ07927,214 –19–02NOV99–1/1

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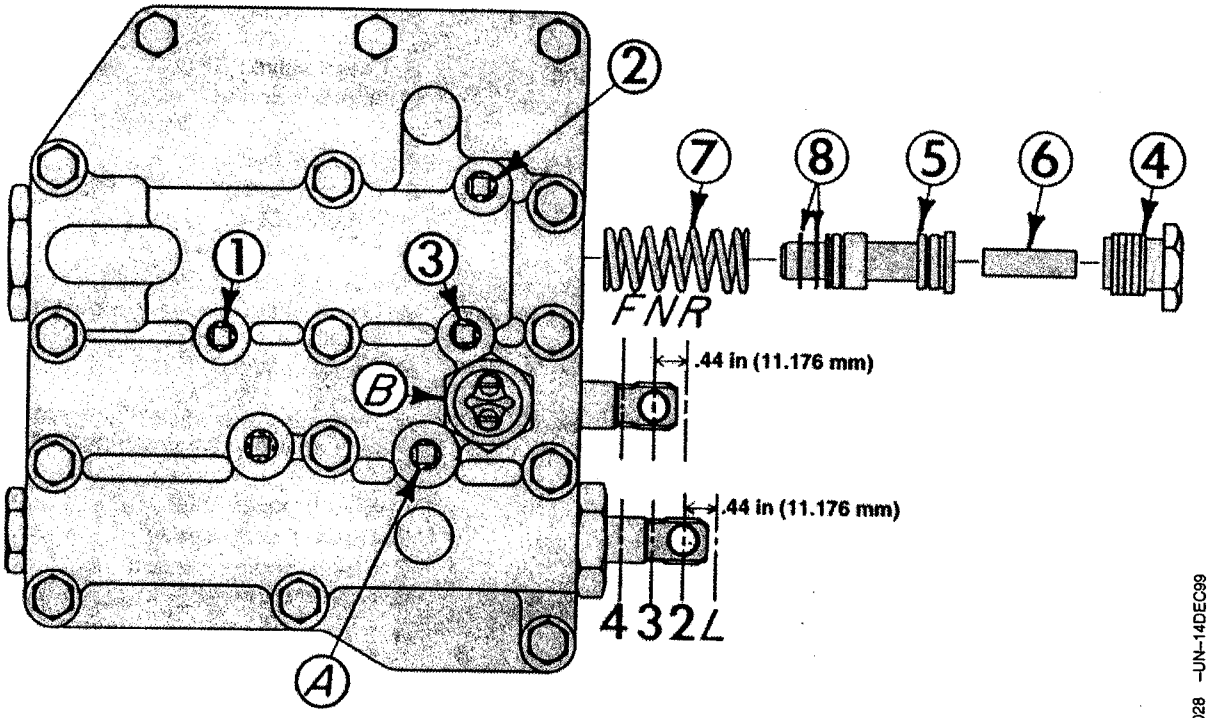
1000, AND 1700 CONTROL VALVE FUNCTION AND PRESSURE CHECK



Control Valve 1000, and 1700

A—Port "A" Reverse warning switch for long (18-5/8 in) drop.
B—Port "B" Neutral start switch.
1—Clutch Pressure Port
2—Pump Pressure Port
3—Converter Pressure Port
4—Cap
5—Pressure Regulator Valve
6—Dowel Pin
7—Spring
8—Spacer Ring

The pressure checks are to be made with the transmission oil temperature at 37.7°C to (140°F).

CLUTCH PRESSURE

1. Install a 1378 kPa (200 psi) gauge in Port (1).
2. Run engine at approximately 2000 rpm.
3. Engage each speed clutch forward and reverse, the clutch pressure should be within the span of 1068—1240 kPa (155—180 psi) for all clutches.
4. If all clutches have low pressure, the pressure regulator valve should be checked, and adjusted if necessary.
5. Remove cap (4) and remove the pressure regulator valve (5), dowel pin (6) and spring (7).
6. Check valve (5) to be sure it works freely in the valve body.
7. The pressure can be raised by adding the 4001651 spacer ring (8) as required, on the end of the valve next to the spring (7).

CONVERTER CHARGE PRESSURE

1. Install a 689 kPa (100 psi) gauge in Port (3).
2. Run engine at approximately 2000 rpm.
3. The pressure should be within the span of 276—482 kPa (40—70 psi).

DPSG,YZ07927,216 -19-02NOV99-1/1

CONVERTER INSTALLATION FOR 1000, AND 1700 SERIES

Series 1000, and 1700 transmissions are shipped with a small parts bag attached to the unit with a copy of this memo and the following parts included.

ATTACHED PARTS BAG

1. The following parts are for attaching the drive plate assembly to the engine flywheel:
   Eight 3/8-16 x 3/4 in. Hex head H.T.
   Eight Lock washers 3/8 Medium Spring.
2. The following group is for attaching the converter to the drive plate assembly.
   Eight cap screws 5/16 N. F. x 1 1/4 in. socket head H. T.
   Eight Washer, half round 11/16 in. Diameter x 1/8 in. thick.
3. The following group is for attaching the converter to the drive plate assembly with 12 3/4 and 13 in. converters.
   Eight Cap screw 5/16-24 x 2 3/4 socket head H.T.
   Eight Washers, Half round 11/16 in. Diameter x 1/8 in. thick.

DPSG,YZ07927,217 –19–02NOV99–1/1

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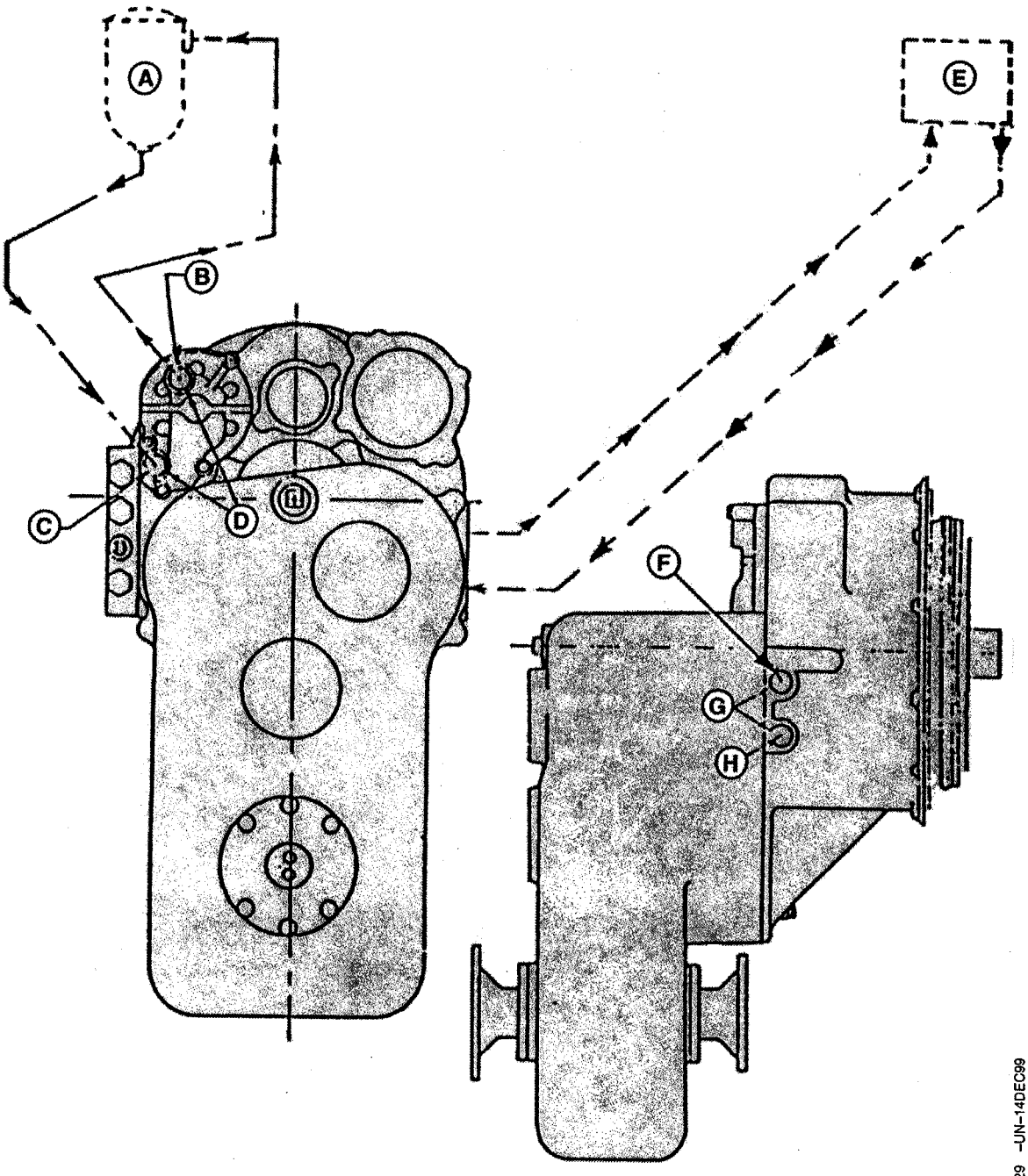
CONVERTER INSTALLATION INSTRUCTIONS

1. Remove drive plate assembly and converter from unit by pulling straight out.
2. Attach drive plate assembly to the engine flywheel using cap screw and lock washers provided in parts bag. Refer to "Converter Installation For All Series" Step 1.
3. Attach converter to the drive plate assembly using the socket head cap screws and the half round washers provided in the parts bag. Refer to "Converter Installation For All Series" Step 2. The half round washer is used under the head of the socket head cap screw.
4. Center the converter hub gear seal ring in its groove, grease will help hold ring in position.
5. Align nut with converter and mate together.

NOTE: To aid in installation, the stator support tube spline, the input shaft spline, and converter hub gear seal ring should be lightly greased.

DPSG,YZ07927,218 -19-03NOV99-1/1

REMOTE OIL FILTER AND HEAT EXCHANGER INSTALLATION DATA



Oil Filter/Heat Exchanger

A—Remote Oil Filter Ref.
B—Outlet to Oil Filter
C—Inlet from Oil Filter
D—1 1/16-12, J.I.C. Thds.
E—Remote Heat Exchanger ref.
F—Outlet to Heat Exchanger
G—1 1/16-12, J.I.C. Thds.
H—Inlet from Heat Exchanger

Continued on next page

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14

HEAT EXCHANGER DATA	
Number of pleats	66
Total paper area	718 sp. in.
Bypass valve setting	25 PSID ± 2 PSI (differential acros filter) 4 PSI Differential between cracking and full open.
Maximum pressure differential between inlet and outlet	80 PSID
Maximum operating pressure	400 PSI
Operating Temperature	-10°F to 250°F
Compatible fluids	Mineral base hydraulic fluids only
Weight	Approximately, 2 1/2 lbs. (Base and filter)
Results of constant flow mulitpass filtration performance test per ANSI/b93-31-1973	
Flow	20 gallons/minutes of test fluid conforming to MIL-H-5606 at 100°F
AC Fine test dust	17.21 grams to terminal pressure drop of 25 PSI

Item	Measurement	Specification
Heat Exchanger Data	Pressures and flows	1250 B.T.U. per minute / 100 hp dissipate required. 10 psi maximum oil pressure drop across heat exchanger. 150 psi maximum working pressure

NOTE: Use Hose with minimum I.D. of 3/4 in when connecting to remote oil filter or heat exchanger.

DPSG,YZ07927,219 –19–03NOV99–2/2

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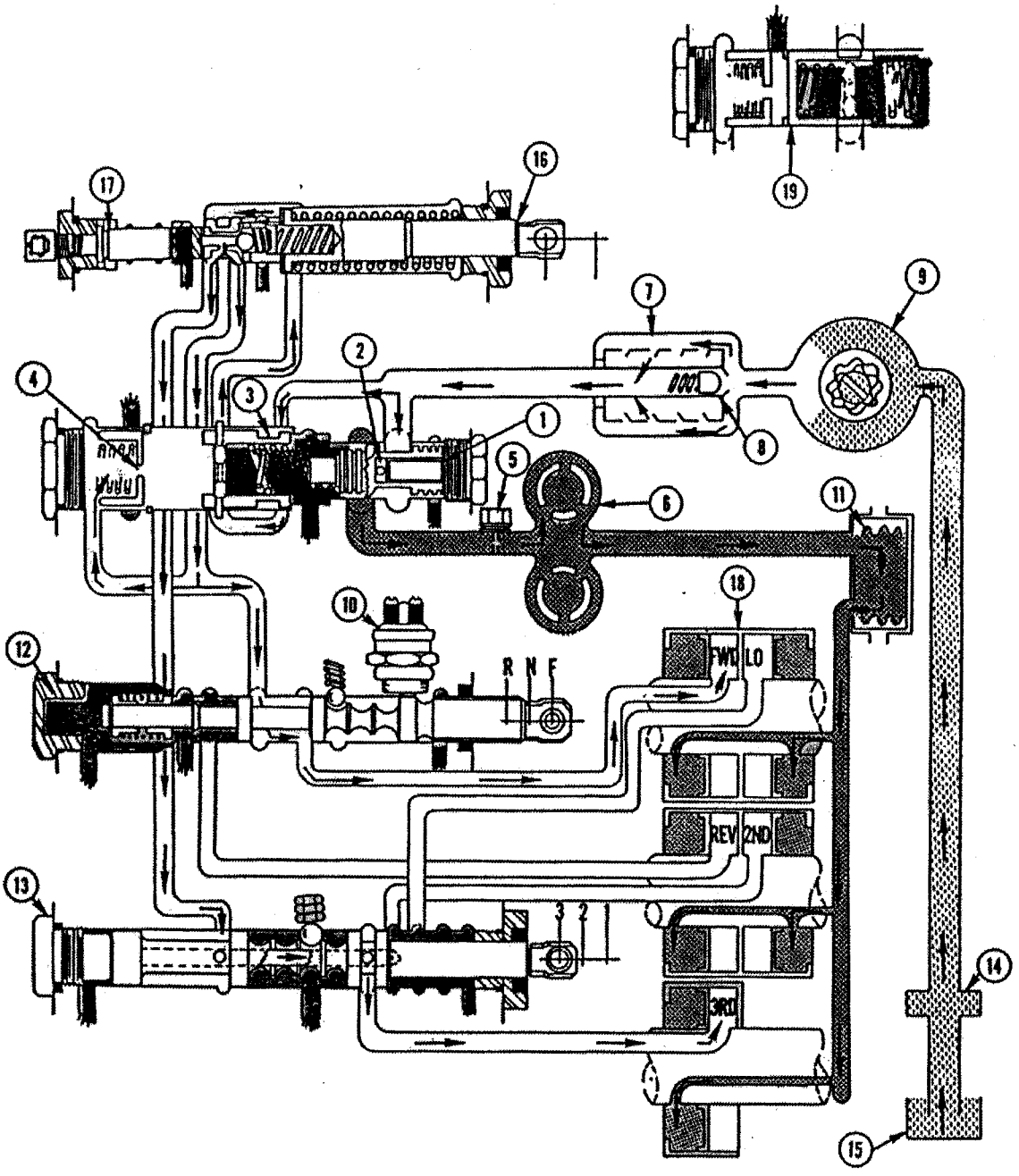
HYDRAULIC CIRCUIT RANGE: FORWARD-THIRD



Hydraulic Circuit/Forward-Third

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A—Main Pressure Regulator
B—Main Orifice
C—By-Pass Orifice
D—Modulator Orifice
E—Converter By-Pass Valve 551 kPa (80 PSI)
F—Converter
G—Filter
H—Filter By-Pass Valve
I—Pump
J—Neutral Starter Switch
K—Heat Exchanger
L—Directional Control Valve
M—Range Control Valve
N—Screen
O—Sump
P—Feathering Valve
Q—Brake Cut-Off
R—Clutches
S—Modulator Valve By-Pass Position

DPSG,YZ07927,221 –19–04NOV99–2/2

DESCRIPTION

The series 4000 Power Shift Transmission is a forward and reverse transmission, with three speeds in either direction. Forward motion, reverse motion, and the three speeds are obtained through the use of hydraulically actuated multiple disc clutches. These clutches are power absorbing members that can be engaged at full engine power. Shifting under full power makes this model a full power shift for the forward and reverse motion in all three speeds.

The clutches in this unit are hydraulically applied and spring released. Because the clutches are hydraulically controlled, there is automatic compression for normal wear which eliminates the need for adjustment. Each clutch used paper graphitic friction plates and polished steel reaction plates.

The power from the engine is transmitted to the transmission through a torque converter. The use of the torque converter has two distinct advantages: (1) The converter is essentially a fluid drive, there being no direct mechanical connection through it. The feature creates a very smooth and shock-free drive eliminating engine stalling and lugging. (2) The converter multiplies torque during heavy pull down loads. When loads are light the converter transmits the engine power directly at almost engine speeds, and there is no torque multiplication. The net result is an action like a transmission, with infinitely variable and automatic speed ratios. The need for shifting gears, although present, is greatly reduced.

DPSG,YZ07927,222 –19–04NOV99–1/1

OPERATION

Like all mechanical equipment, the power shift transmission will need attention and servicing. Routine checks will help prevent down time. The operator can aid in preventative maintenance by reporting weak or borderline malfunctions.

Because the unit operates "in" and "by" oil, most of the maintenance is concerned with oil replenishment and oil cleanliness. The type of service and operating conditions shall determine the maintenance interval. However, as previously stated, it is especially important that the oil be kept clean

DPSG,YZ07927,223 –19–04NOV99–1/1

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RULES OF OPERATION FOR 4000 SERIES

1. Check oil level daily, with engine at idle speed and transmission in neutral. Make sure the area around oil level check plug is clean before removing plug.
2. The transmission should always be in the neutral position before starting engine, or when the vehicle is parked and the engine is running.
3. If the vehicle is to be towed, it will be necessary to run the engine at idle speed to lubricate the clutches.
4. Normal operating oil temperature.

Normal Operating Oil—Specification

Temperature ..... 71.1°C (160°F)

5. Converter oil out temperature, rises above 121.1°C (250°F) or the warning light comes on, stop the vehicle immediately.

Maximum Oil Temperature—Specification

Temperature ..... 121.1°C (250°F)

Shift to neutral and run the engine at 1000-1200 rpm. The Temperature should drop rapidly to the engine water temperature. If the temperature does not drop, trouble is indicated. The trouble should be determined before the vehicle is operated again. Overheating generally occurs due to working in too high of a gear ratio. Shifting to a lower gear will help eliminate overheating.

6. Do not shut off engine when unit is overheating.
7. Pressure checks at control valve.

Pressure Checks at Control Valve—Specification

Temperature ..... 82.2 °C (180°F are made at approximately)

8. Normal clutch pressure at 2000 rpm.

Clutch Pressure at 2000 rpm—Specification

Pressure..... 1688 kPa (240 PSI) to 1723 kPa (255 psi)

9. Pump pressure at 2000 rpm.

Pump Pressure at 2000 rpm—Specification

Pressure..... 1688 kPa (245 PSI) to 1757 kPa (255 psi)

10. Converter by-pass pressure at 2000 rpm.

Converter By-Pass Pressure at 2000 rpm—Specification

Pressure..... 207 kPa (30 PSI) to 276 kPa (40 PSI)

DPSG,YZ07927,224 –19–04NOV99–1/1

SERVICE

COMMERCIAL POWERSHIFT AIR TEMPERATURE RANGE	
Prevailing Ambient Temperature	**Oil Specifications**
Above–23°C (-10°F)	Hydraulic Transmission Fluid. Type C-3 (except Grade 30)
Below -23°C (-10°F)	Hydraulic transmission flluid, type C-3 (except grade 30) auxiliary preheat required to raise temperature in the sump to a temperature above -23°C (-10°F).
Above 0°C (32°F)	Hydraulic transmission fluid type C-3, or type C-3 grade 30.

MILITARY POWERSHIFT AIR TEMPERATURE RANGE	
Prevailing Ambient Temperature	Oil Specifications
Above -23°C (-10°F)	MIL-L-2104 Grade 10 to latest specification or Hydraulic Transmission Fluid Type C-3.
-17.8°C (0°F) to -53.9°C (-65°F)	MIL-L-10295 to latest specification.
-53.9°C	**IMPORTANT: Do not use MIL-L-10295 when the ambient temperature is consistently above -23.3°C (-10°F).** If auxiliary preheating equipment is available and the sump temperature can be raised to -23.3°C (-10°F) it is recommended that MIL-L-2104 Grade 10 oil be used. When changing to oil of different grade, thoroughly flush system with grade oil to be used before refilling.

1. When servicing the unit for the first time after vehicle installation and / or after repair, the unit is filled as follows:
   Fill the unit:

Oil—Specification

Capacity ..... 15.4 liters (4 gallons) of recommended lubricant

Start the engine and run at idle speed 500-700 RPM for one minute to let the hydraulic system charge.

With engine at idle speed, finish filing unit to the full level.

Oil—Specification

Capacity ..... 2.87 and 3.79 liters (3 and 4 quarts) varies with different applications

NOTE: The oil level is always checked with the engine running at idle speed and the transmission in neutral.

2. Lubrication recommendations, series 4000 power shift transmission.

It is recommended the oil and oil filter be changed whenever the oil shows traces of contamination, or the effects of high operating temperature evidenced by discoloration or strong odor.

If the oil in the system has become contaminated with metal particles, all the components of the system (oil lines, oil pump, oil filter, control valve, clutches, converter, heat exchanger) must be thoroughly cleaned. Generally this means a tear down of the unit. The metal particles in the oil is evidence of a damaged part.

DPSG,YZ07927,225 –19–04NOV99–1/1

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LUBRICANT AND OIL FILTER CHANGE INTERVALS

4000 SERIES TRANSMISSION

- **20 Hours** - New or overhauled unit drained and refilled with new fluid. (Do not use a flushing fluid.)
- **250 Hours** - Operation in severe dust, sand, or in underground environment.
- **375 Hours** - Operation in normal off-highway conditions, rapid changes in ambient or unit temperature, or in the presence of chemical fumes.
- **500 Hours** - Operation in clean environment. (hard surface roads, minimum dust, etc.)

When changing the oil, the dirty oil should be drained while the unit is warm, examining for contamination. Keep all controls properly lubricated. If the radiator of the vehicle is drained for winter storage, the heat exchanger on the transmission must also be drained.

DPSG,YZ07927,230 –19–10NOV99–1/1

BOLT-TORQUE-LOAD SPECIFICATIONS

BOLT-TORQUE-LOAD SPECIFICATIONS S.A.E. GRADE 5		
BOLT SIZE	LOAD	TORQUE
1/4 - 20	8,900 N (2,000 lbs.)	11 N•m (8 ft. lbs.)
1/4 - 28	10,230 N (2,300 lbs.)	14 N•m (10 ft. lbs.)
5/16 - 18	14,900 N (3,350 lbs.)	23 N•m (17 ft. lbs.)
5/16 - 24	16,460 N (3,700 lbs.)	26 N•m (19 ft. lbs.)
3/8 - 16	22,020 N (4,950 lbs.)	41 N•m (30 ft. lbs.)
3/8 - 24	24,910 N (5,600 lbs.)	47 N•m (35 ft. lbs.)
7/16 - 14	30,250 N (6,800 lbs.)	68 N•m (50 ft. lbs.)
7/16 - 20	33,580 N (7,550 lbs.)	75 N•m (55 ft. lbs.)
1/2 - 13	40,250 N (9,050 lbs.)	102 N•m (75 ft. lbs.)
1/2 - 20	45,370 N (10,200 lbs.)	115 N•m (85 ft. lbs.)
9/16 - 12	51,600 N (11,600 lbs.)	149 N•m (110 ft. lbs.)
9/16 - 18	57,830 N (13,000 lbs.)	163 N•m (120 ft. lbs.)
5/8 - 11	64,500 N (14,500 lbs.)	203 N•m (150 ft. lbs.)
5/8 - 18	72,500 N (16,300 lbs.)	230 N•m (170 ft. lbs.)
3/4 - 10	94,750 N (21,300 lbs.)	366 N•m (270 ft. lbs.)
3/4 - 16	105,870 N (23,800 lbs.)	407 N•m (300 ft. lbs.)
7/8 - 9	131,220 N (29,500 lbs.)	583 N•m (430 ft. lbs.)
7/8 - 14	144,120 N (32,400 lbs.)	644 N•m (475 ft. lbs.)
1" - 8	169,030 N (38,000 lbs.)	875 N•m (645 ft. lbs.)
1" - 12	188,160 N (42,300 lbs.)	956 N•m (705 ft. lbs.)
1" - 14	192,610 N (43,300 lbs.)	976 N•m (720 ft. lbs.)

DPSG,YZ07927,229 –19–08NOV99–1/1

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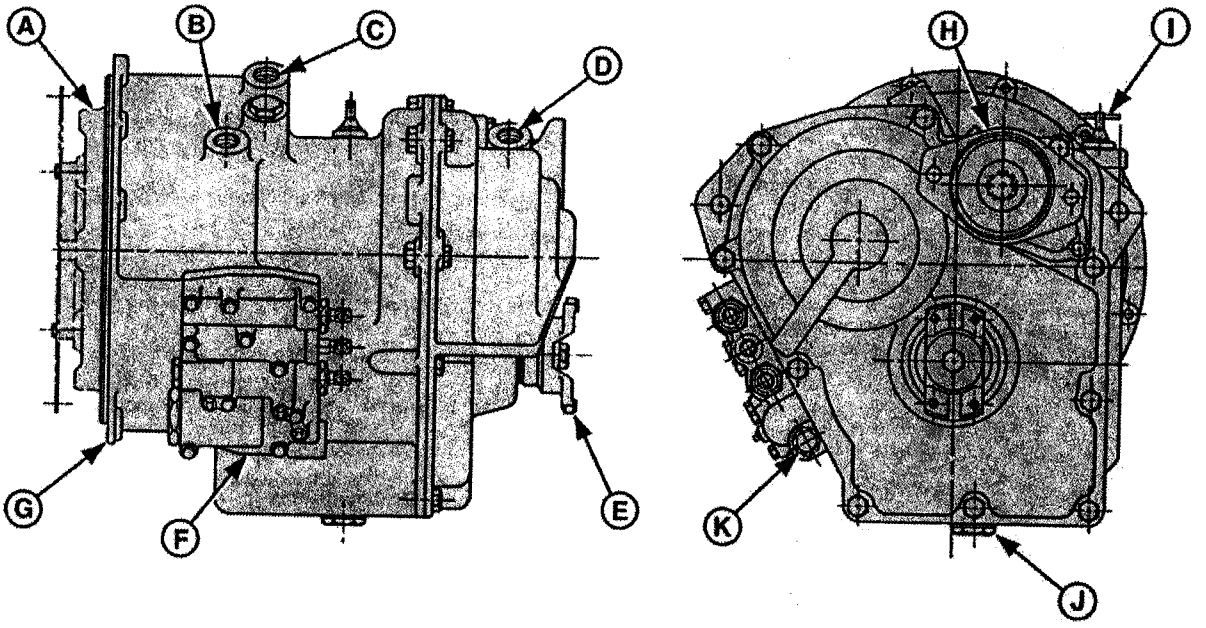
4000 SERIES SHORT DROP



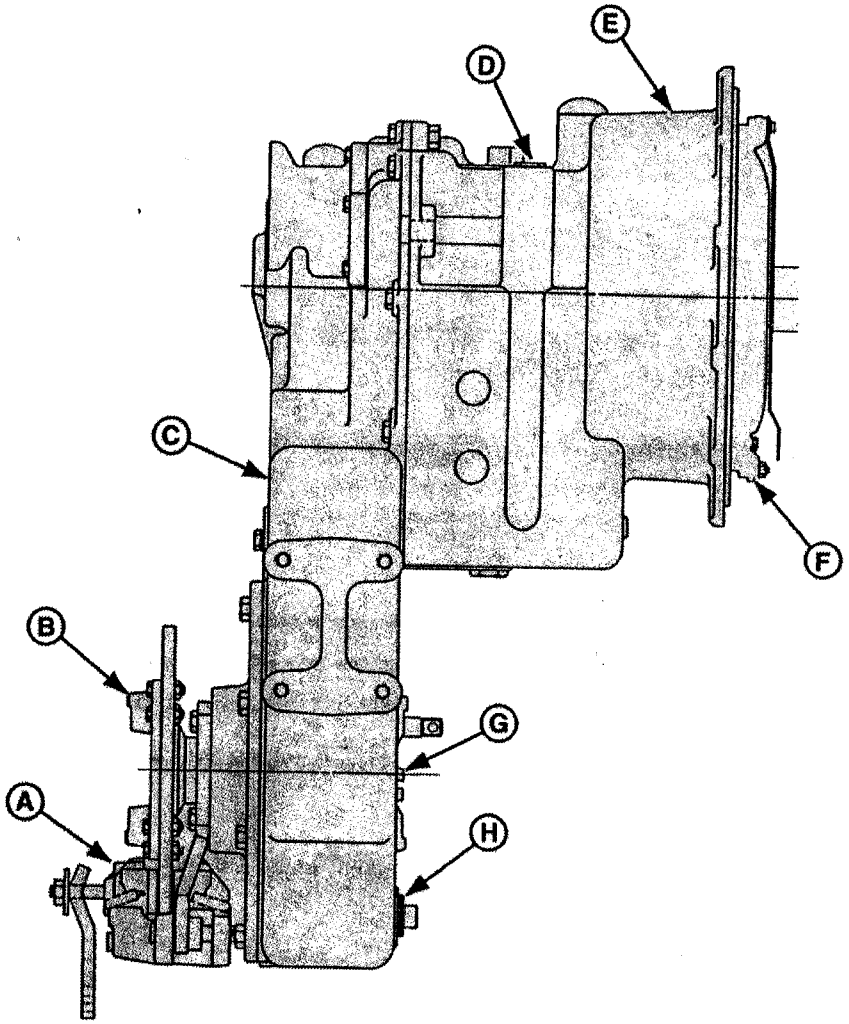
YZ0031 –UN–15DEC99

4000 Series Short Drop

A—Torque Converter and Drive Plate
B—To Lube From Heat Exchanger
C—From Converter to Heat Exchanger
D—From Pump To Filter
E—Output Yoke
F—Control Valve
G—Engine Mount (S.A.E. No. 3 or No. 4)
H—Power Take-Off Mount
I—Oil Fill and Dip Stick
J—Oil Drain
K—To Valve From Filter

DPSG,YZ07927,226 –19–08NOV99–1/1

4000 SERIES LONG DROP



YZ0032 –UN–15DEC99

4000 Series Long Drop

A—Parking Brake
B—Output Yoke
C—Main Case
D—Oil Fill
E—Front Cover
F—Converter
G—Oil Level Check
H—Oil Drain Plug

DPSG,YZ07927,227 –19–08NOV99–1/1

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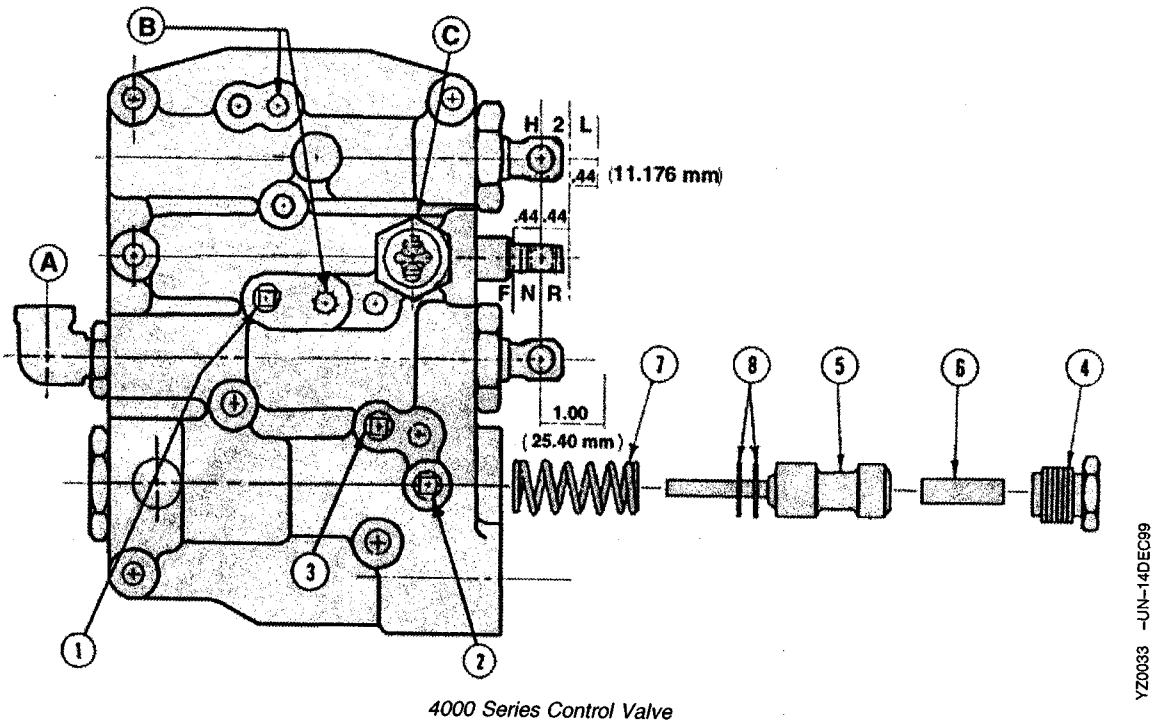
4000 SERIES CONTROL VALVE FUNCTION AND PRESSURE CHECK



4000 Series Control Valve

A—Brake Cut-Off Fitting
B—Rev. Warning Switch Location
C—Neutral Start Switch
1—Clutch Pressure Port
2—Charge Pump Pressure Port
3—Converter Pressure Port
4—Cap
5—Pressure Regulator Valve
6—Dowel Pin
7—Spring
8—Spacer Ring

The pressure checks are to be made with the transmission oil temperature at:

4000 Series Pressure Checks—Specification

Temperature ..... 37.7°C to (140°F)

CLUTCH PRESSURE

1. Install a 2067 kPa (300 psi) gauge in Port (1).
2. Run engine at approximately 2000 rpm.
3. Engage speed clutches, forward and reverse, the clutch pressure should be within:

Clutch Pressure—Specification

Pressure..... 1654—1757 kPa (240—255 psi) for all clutches

4. If all clutches have low pressure, the pressure regulator valve should be checked, and adjusted if necessary.
5. Remove cap (4) and remove the pressure regulator valve (5), dowel pin (6) and spring (7).
6. Check valve (5) to be sure it works freely in the valve body.
7. The pressure can be raised by adding the 4004245 spacer ring (8) as required, on the end of the valve next to the spring (7).

CONVERTER CHARGE PRESSURE

1. Install a 689 kPa (100 psi) gauge in Port (3).
2. Run engine at approximately 2000 rpm.
3. The pressure should be within:

Converter Charge Pressure—Specification

Pressure..... 345—620 kPa (50—90 psi)

Continued on next page

FEATHERING VALVE (IF USED)

1. Install a 2067 kPa (300 psi) gauge in Port (1)
2. Run engine at approximately 2000 rpm.
3. Pull stem to full out position (1 inch), clutch pressure:

Feathering Valve Pressure—Specification

Pressure	34.5 kPa to 51.7 kPa (5 to 7.5 psi)

BRAKE CUTOFF VALVE (IF USED)

1. Install a 2067 kPa (300 psi) gauge in Port (1)
2. Run engine at approximately 2000 rpm.
3. Apply 2239 kPa—2584 kPa (325-375 psi) to cutoff valve, clutch pressure:

Brake Cutoff Valve Pressure—Specification

Pressure	34.5—51.7 kPa (5 to 7.5 psi)

DPSG,YZ07927,216 –19–02NOV99–2/2

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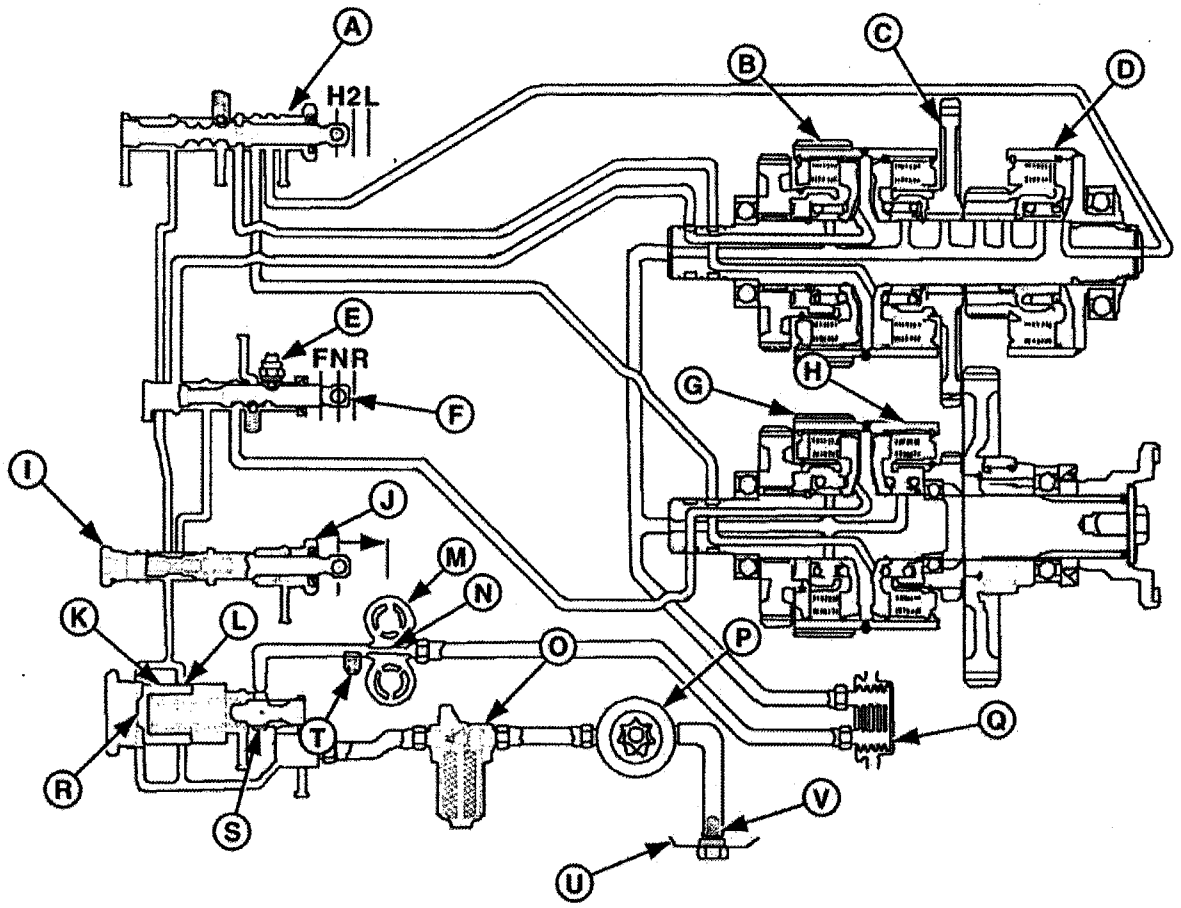
10

HYDRAULIC CIRCUIT 4000 SERIES



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4000 Series Hydraulic Circuit

A—Speed Control Valve
B—Forward Clutch
C—High Clutch
D— Low Clutch
E—Neutral Starter Switch
F—Directional Control Valve
G—Reverse Clutch
H—Second Clutch
I—Brake Cut-Off
J—Inching Control Valve
K—Accumulator Valve
L—By Pass Orifice
M—Converter
N—Converter By Pass
O—Filter
P—Pump
Q—Heat Exchanger
R—Main Orifice
S—Regulator Valve
T—Dump Valve
U—Reservoir
V—Screen

DPSG,YZ07927,228 –19–08NOV99–1/1

Index

Page

1

1000 Series
Hydraulic circuit. 15-16
1700 Series
Hydraulic circuit. 15-16

4

4000 Series
Bolt
Torque
Load. 20-5
Description 20-1
Hydraulic circuit. 20-10
Long drop 20-7
Lubricant. 20-4
Oil filter change. 20-4
Operations 20-1
Pressure check
Control valve 20-8
Rules of operation. 20-2
Service 20-3
Short drop. 20-6

C

Clutch
Pressure check 15-1
Control Valve
1000 and 1700 pressure check. 15-10
Converter
Installation instructions 15-12
Installation. 15-11
Pressure check 15-1

L

Long Drop
1000 and 1700 15-3

M

Maintenance
Oil. 10-5
Metric bolt
Torque values 10-8

Page

O

Oil
Ambient temperature. 10-5
Change 10-1
Maintenance 10-5
Oil filter, remote 15-13
Service 10-5
Suction leak test 15-4
Temperature 10-1
Type 10-1
Warning tag 05-1
recommendation 10-5
Ordering
Service parts. 10-2

P

Part
Ordering 10-2
Pressure check
1000 and 1700 15-10
4000 Series 20-8

R

Repair
Ordering 10-2

S

Short Drop
1000 and 1700 15-2
Specification
Tag 10-2
Storage
External preservation 10-7
Internal preservation 10-7
Restore to service. 10-7
Suction leak test. 15-4

T

Tag
Identification 10-2
Warning 05-1

Temperature
Oil, maximum 10-4
Test
Suction leak 15-4
Torque
Cap screw (inch) 10-9
Cap screw (metric) 10-8
Converter cap screw 15-1
Drive plate assembly cap screw 15-1
Motor adapter 10-1
Tapered pipe thread values 10-10
Unified inch 10-9
Troubleshooting
1000 and 1700 15-5
Internal disconnect 1000 and 1700 15-9

U

Unified inch
Torque values 10-9