DF Series 150 Transmission (Analog)

COMPONENT TECHNICAL MANUAL

DF Series 150 Transmissions (Analog)

23SEP03 (ENGLISH)

Funk Manufacturing Company
LITHO IN U.S.A.

Introduction

Foreword

Component Technical Manuals (CTM) are concise service guides for specific components. Component technical manuals are written as stand-alone manuals covering multiple machine applications.

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 in the manual or on the machine, be alert to the potential for personal injury.

 WARNING VEHICLE RUNAWAY HAZARD Avoid serious or fatal injury. This transmission is not a braking system. Install it only if there is a braking system capable of stopping vehicle with dead engine, disengaged transmission, or loss of hydrostatic retardation. Otherwise, vehicle may roll freely, resulting in loss of control.

IMPORTANT: Important warns of possible damage to transmission.

NOTE: To make special mention of or to record in writing useful information about the transmission.

Use this component technical manual in conjunction with the machine technical manual. See the machine technical manual for information on component removal and installation, and gaining access to the components.

This manual is divided in three parts; general information, repair, and troubleshooting and tests:

General information group offers component identification with specification information about the transmission.

Repair groups contain necessary instructions to repair the component.

Troubleshooting and test groups help you identify the majority of routine failures quickly and then allows you to perform certain tests.

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

YZ,CTM148,IFC –19–09JUL98–1/1

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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.

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Safety

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Vehicle Runaway Hazard

WARNING VEHICLE RUNAWAY HAZARD Avoid serious or fatal injury. This transmission is not a braking system. Install it only if there is a braking system capable of stopping vehicle with dead engine, disengaged transmission, or loss of hydrostatic retardation. Otherwise, vehicle may roll freely, resulting in loss of control.

YZ,WARN –19–10MAR98–1/1

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

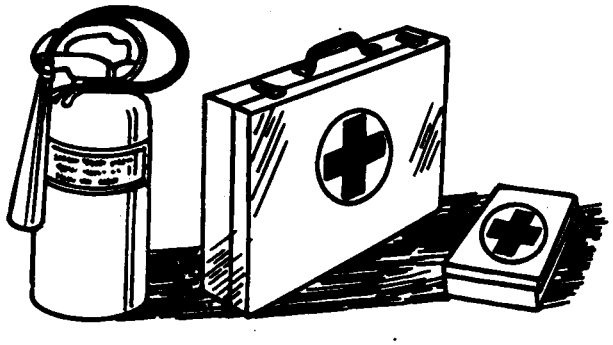
DX,FLAME –19–29SEP98–1/1

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

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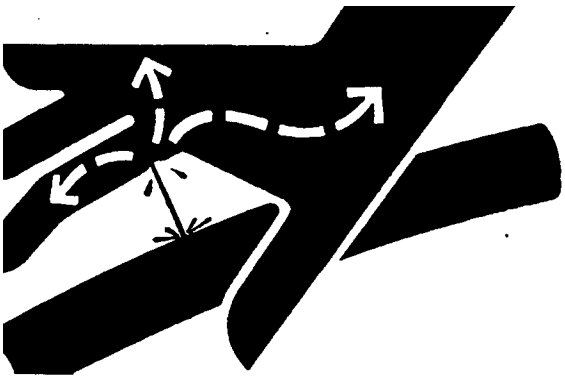
Avoid High-Pressure Fluids



X9811 –UN–23AUG88

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

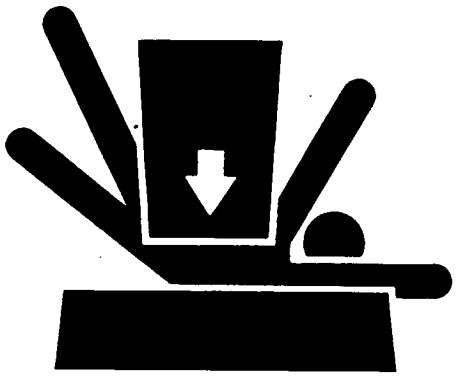
Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

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.

DX,FLUID –19–03MAR93–1/1

Support Machine Properly



TS229 –UN–23AUG88

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. If left in a raised position, hydraulically supported devices can settle or leak down.

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

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

DX,LOWER –19–17FEB99–1/1

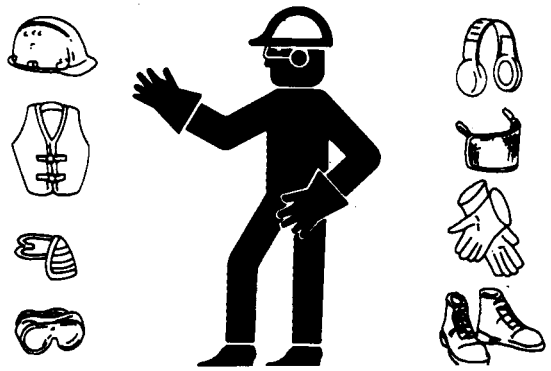
Wear Protective Clothing

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.



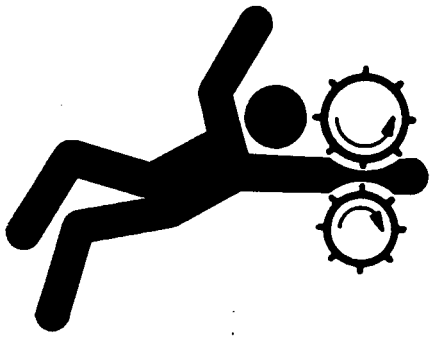
TS206 –UN–23AUG88

DX,WEAR –19–10SEP90–1/1

Service Machines Safely

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

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



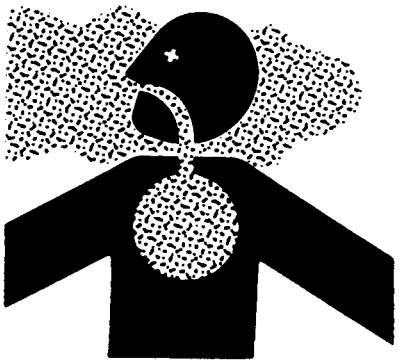
TS228 –UN–23AUG88

DX,LOOSE –19–04JUN90–1/1

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 –19–17FEB99–1/1

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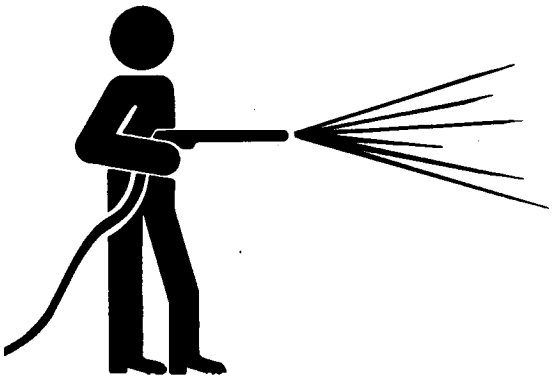
Work in Clean Area

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

Remove Paint Before Welding or Heating

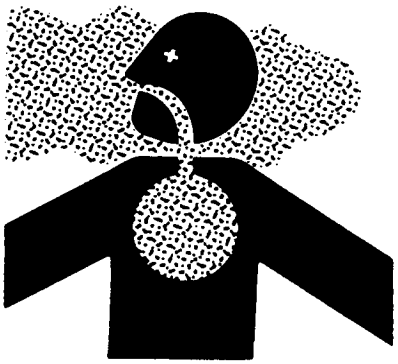
Avoid potentially toxic fumes and dust.

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

Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

Remove paint before welding or heating:

- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.



TS220 –UN–23AUG88

DX,PAINT –19–03MAR93–1/1

Avoid Heating Near Pressurized Fluid Lines

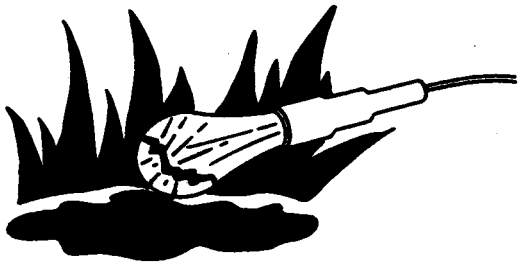
Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can be accidentally cut when heat goes beyond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

TS953 –UN–15MAY90

DX,TORCH –19–03MAR93–1/1

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.



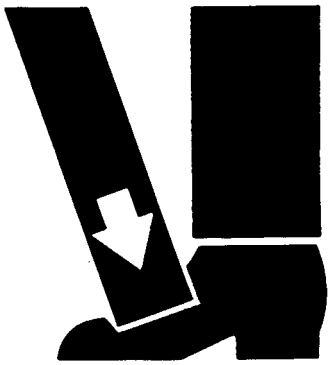
TS223 –UN–23AUG88

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

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Practice Safe Maintenance

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

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

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

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

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

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

TS218 –UN–23AUG88

DX,SERV –19–17FEB99–1/1

Use Proper Tools

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

Use power tools only to loosen threaded parts and fasteners.

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

Use only service parts meeting John Deere specifications.

TS779 –UN–08NOV89

DX,REPAIR –19–17FEB99–1/1

Dispose of Waste Properly

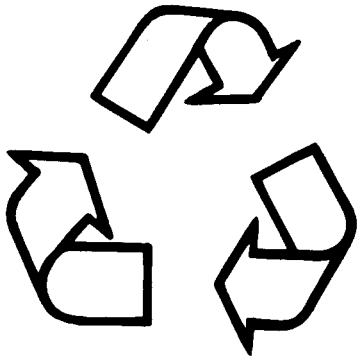
Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

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

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

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

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



TS1133 –UN–26NOV90

DX,DRAIN –19–03MAR93–1/1

Live With Safety

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

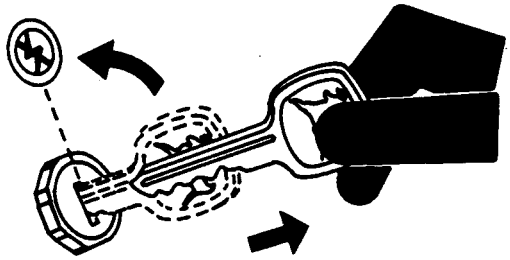
TS231 –19–07OCT88

DX,LIVE –19–25SEP92–1/1

Park Machine Safely

Before working on the machine:

- Lower all equipment to the ground.
- Stop the engine and remove the key.
- Disconnect the battery ground strap.
- Hang a "DO NOT OPERATE" tag in operator station.



TS230 –UN–24MAY89

DX,PARK –19–04JUN90–1/1

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Stay Clear of Rotating Drivelines

Entanglement in rotating driveline can cause serious injury or death.

Keep tractor master shield and driveline shields in place at all times. Make sure rotating shields turn freely.

Wear close fitting clothing. Stop the engine and be sure PTO driveline is stopped before making adjustments, connections, or cleaning out PTO driven equipment.

TS1644 –UN–22AUG95

DX,PTO –19–12SEP95–1/1

Prevent Machine Runaway

Avoid possible injury or death from machinery runaway.

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

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

TS177 –UN–11JAN89

DX,BYPAS1 –19–29SEP98–1/1

Specifications[1]

Item	Measurement	Specification
DF-150	Weight (Application Dependent)	567 Kg (1250 lbs)
DF-150	Input-to-Output	500 mm (19.69 in)
DF-150	Rating (Depending on application)	Input power(maximum) - 142 kW (190 SAE hp) Input no load speed (maximum) - 3000 rpm Turbine torque (maximum) - 1288 N•m (950 lb-ft)
DF-150	Mountings Available	Engine Midship Remote
DF-150	Clutches	Fully modulated, oil cooled, multidisc, hydraulic actuated and self-adjusting.
DF-150	Gearing	Constant mesh, in line, high contact ratio ground gears. Up to eight speeds forward and four speeds reverse.
DF-150	Oil	Hydraulic Transmission Fluid.
DF-150	Filter	Remote mounted spin-on type filter.
Transmission Operating Conditions	Maximum Input Speed	3000 rpm
	Test Input Speed	2000 rpm
	Maximum Continuous Operating Temperature	93°C (200°F)
	Maximum Intermittent Operating Temperature	115°C (230°F)
	Maximum Temperature	121°C (250°F)
	Normal Operating Temperature	65—93°C (150—200°F)
	Check Oil Level Temperature	37°C (100°F)
Pressures and Flows at Control Valve	Pump Pressure (test input speed)	1758—1965 kPa (255—285 psi)
	Pump Flow (test input speed)	87—102 L/min (23—27 gpm)
	Clutch Pressure (test input speed)	1655—1931 kPa (240—280 psi)
	Lube, In Pressure (test input speed)	138—414 kPa (20—60 psi)

[1]Weights will vary depending on installed options.

YZCTM148,10,SPC –19–10NOV98–1/1

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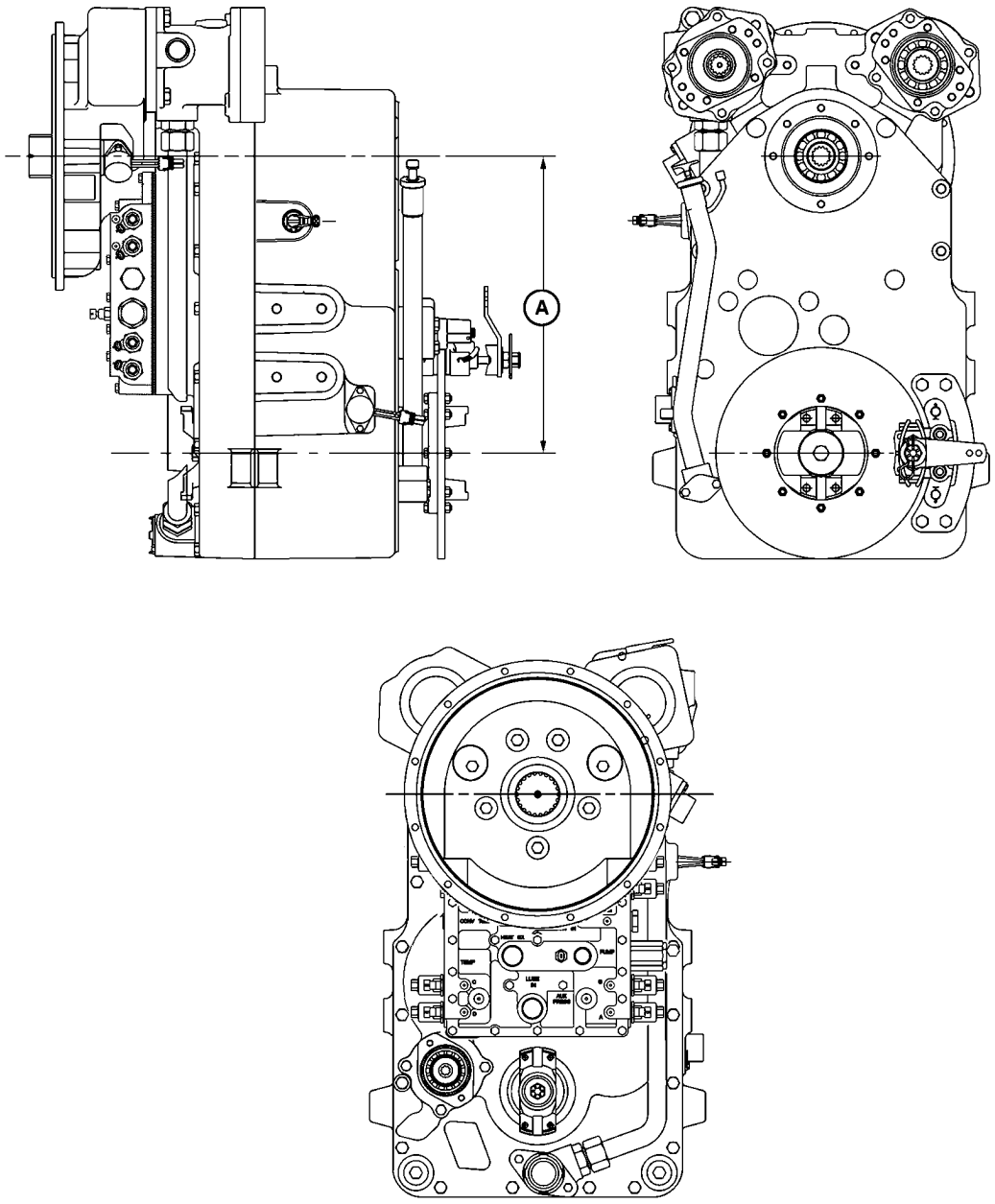
DF Series 150 Transmission

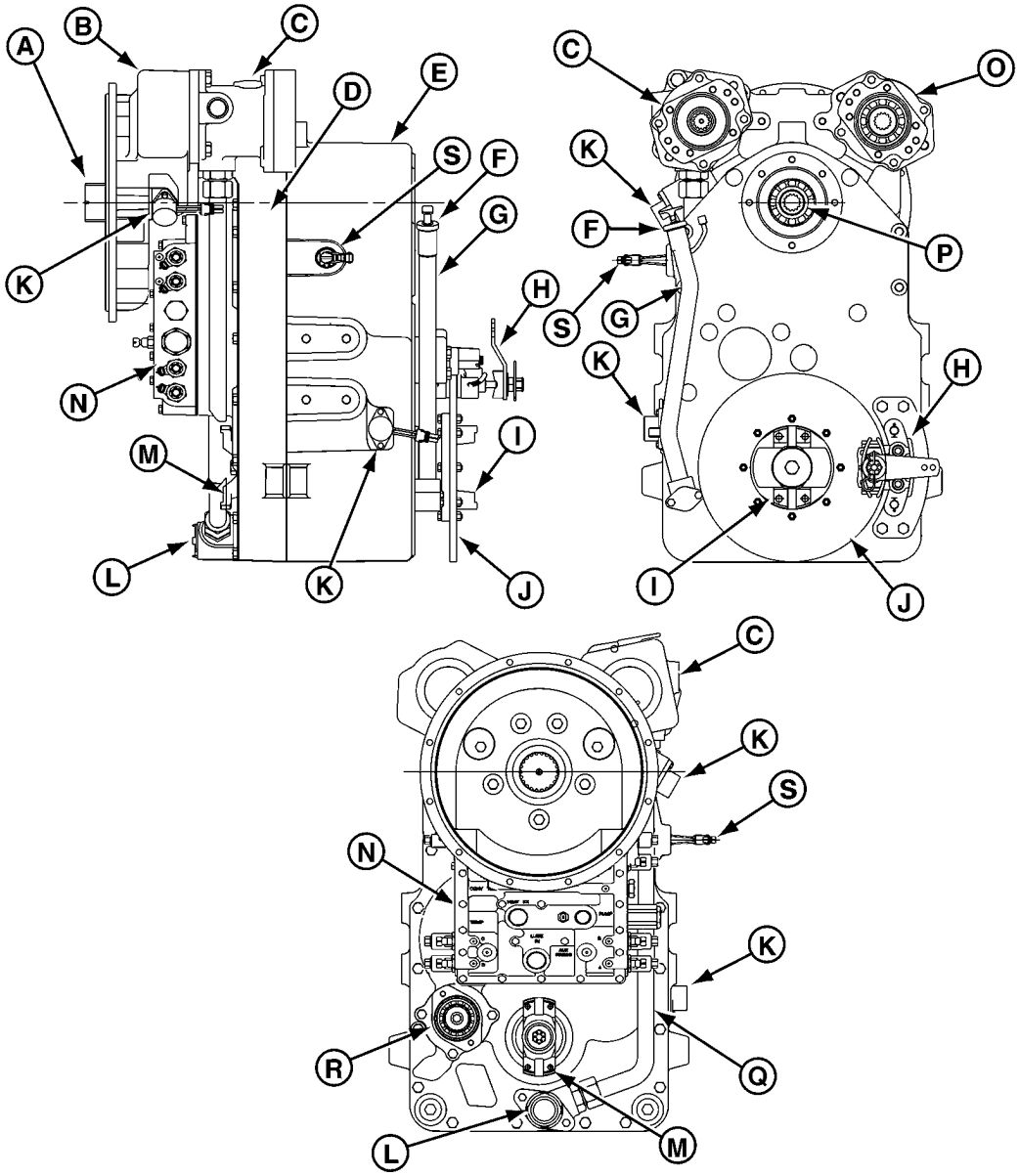


YZ1578 –UN–01DEC98

- Dimension “A” - 500 mm (19.69 in)
- Approximate weight 567 Kg (1250 lbs)

YZ,CTM148,10,16 –19–01DEC98–1/1

DF150 Direct Drive Transmission Component Identification



YZ1504 –UN–30NOV98

A—Direct drive input shaft
B—Front cover assembly
C—Charge pump group
D—Main case front housing
E—Main case rear housing
F—Dipstick gauge
G—Dipstick tube assembly
H—Disk brake caliper assembly
I—Yoke Flange
J—Brake disk
K—Magnetic pickup sensor
L—Suction screen assembly
M—Output yoke fitting
N—Control valve group
O—Auxiliary pump drive
P—First stage output shaft
Q—Suction Tube
R—Ground drive pump (Application dependent)
S—Magnetic pickup sensor

YZ,CTM148,10,7 –19–30NOV98–1/1

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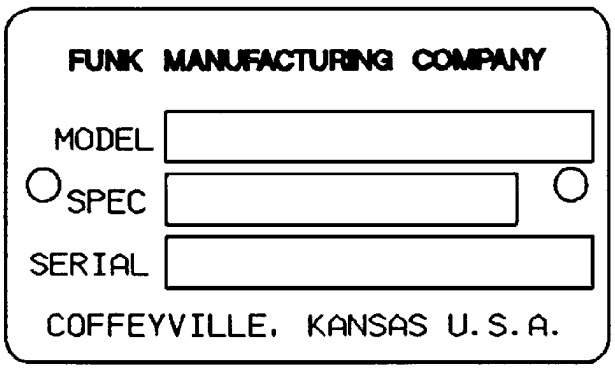
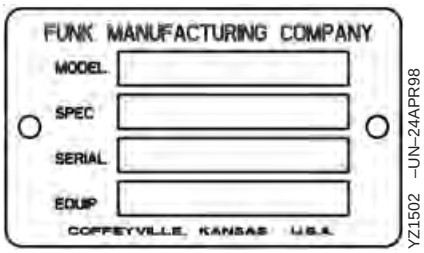
Identification and Serial Number Plates

The identification plate is located on the engine side and/or opposite engine side of the transmission main case housing. The exact location varies depending on installed options and model number. Earlier version of the DF series transmission had three lines of information. Later DF series transmission will have four lines of information on identification plate. All information on identification plate is needed when contacting FUNK concerning transmission.



YZ1503 –UN–01MAY98



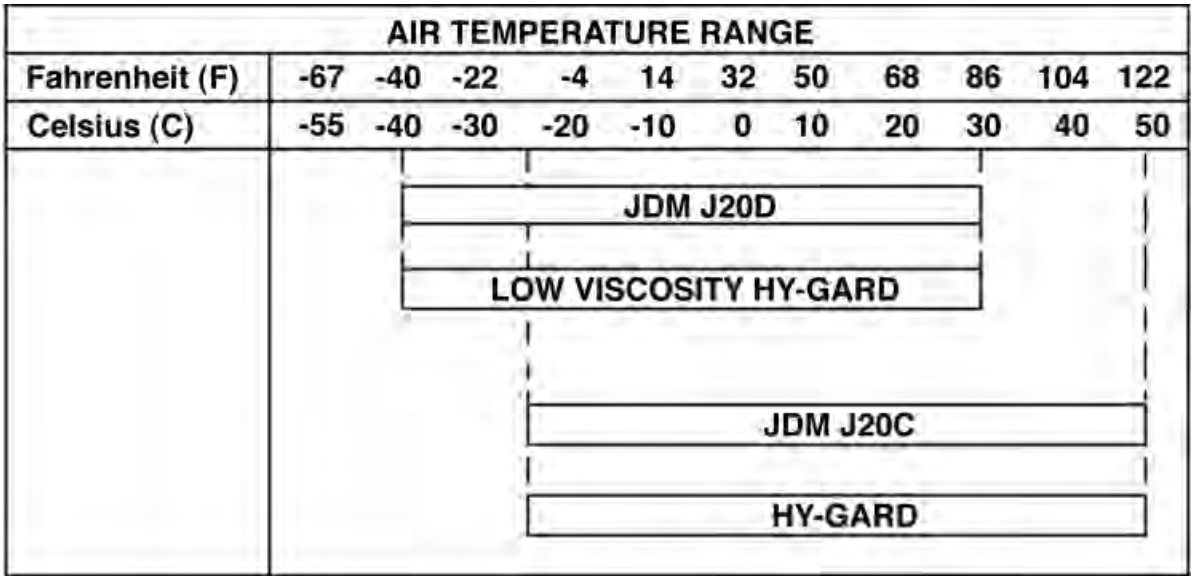
YZ1502 –UN–24APR98

Contact:

Funk Manufacturing Company
Attention: Parts Department
Industrial Park, Highway 169 North
P.O. Box 577
Coffeyville, Kansas 67337-0577
Telephone: Area Code (800)-844-1337
Ask for Parts Department
FAX:(316)-252-3253

YZ,CTM148,10,13 –19–28JUL98–1/1

Recommended Lubricants



AMBIENT AIR TEMPERATURE CHART

Select an oil viscosity, from the chart, based on the air temperature range expected between oil changes.

NOTE: The words "oil", "fluid" and "transmission fluid" are used in this manual to mean, HYDRAULIC TRANSMISSION FLUID, the operating and lubricating oil for this transmission.

Standard and Low viscosity HY-GARD® Transmission fluids are available through the John Deere dealer network worldwide. Other oils may be used if they meet one of the following:

- John Deere Standard JDM J20 C
- John Deere Standard JDM J20 D

Some fluids that contain the following additive packages have been shown to meet the specification requirements of J20 C and/or J20 D. Inclusion of the following additive packages does not constitute blanket approval of the oil for these applications.

Supplier	Additive
Chevron	Ornite OLOA 9725X
Lubrizol	Lubrizol 9990

HY-GARD is a trademark of Deere & Company.

YZ,CTM148,10,3 –19–14SEP98–1/1

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Cold Weather Operation

IMPORTANT: Viscosity grade selection is critical for cold weather operation of the transmission. Preheat procedures are required when operating transmission below the oil's MINIMUM critical temperature which is viscosity grade dependant.

NOTE: Refer to AIR TEMPERATURE RANGE chart for the MINIMUM transmission operating temperature viscosity grades.

PREHEAT TRANSMISSION FLUID WITH AUXILIARY SOURCE

Preheat the transmission fluid to the MINIMUM temperature before operating.

ALTERNATE WARM-UP PROCEDURE:

Operate transmission in neutral for approximately 20 minutes or until oil is warmed to the MINIMUM temperature.

HOT WEATHER OPERATION

Use higher viscosity grades (Refer to AIR TEMPERATURE RANGE chart) for:

Ambient temperatures consistently above 30°C (86°F).

Frequent stop-and-go driving in hot weather.

High grade climbing in hot weather.

YZ,CTM149,10,3A –19–09JUN98–1/1

Fill the Transmission with Oil

AFTER INSTALLING TRANSMISSION IN VEHICLE:

Park machine on level surface.

Engage parking brake, block wheels.

Put transmission in neutral.

Remove dipstick, the dipstick tube is the normal oil fill location.

Begin filling operation by adding 19 liters (5 gal) of recommended oil.

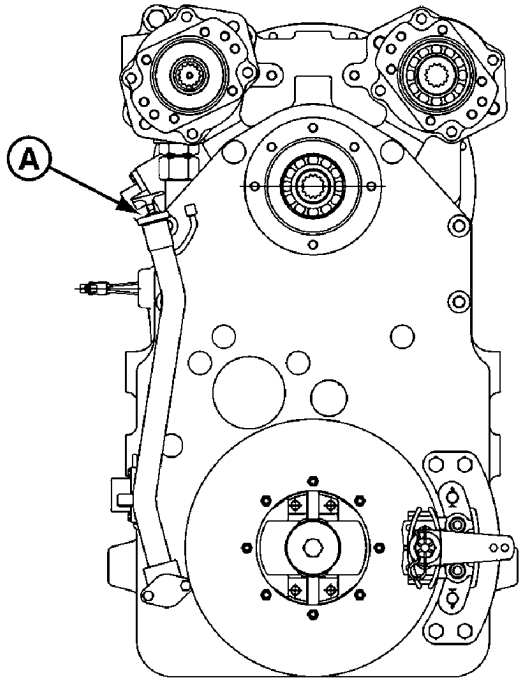
Start the engine, run at idle speed to fill oil lines.

Check oil level on dip stick with engine running at idle speed.

IMPORTANT: Do not overfill transmission. This will cause overheating. Damage to the transmission will result.

Fill transmission to the full mark on dipstick with engine running at idle speed.

Check oil level again when the transmission has reached operating temperature 38—°C (100°F).



YZ1580 –UN–30NOV98

YZ,CTM148,10,2 –19–10NOV98–1/1

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Check and Service Transmission Regularly

Routine checks will help prevent down time. The operator can aid in preventative maintenance by reporting signs of leaks or malfunctions.

The transmission 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.

NOTE: Engage park brake before checking oil level.

OIL LEVEL

IMPORTANT: The DF series transmission should always be in the neutral position before starting the engine, or when the vehicle is parked and the engine is running.

CHECK THE OIL LEVEL DAILY

Set parking brake.

Put the gear selector lever in neutral position.

Operate the engine at idle speed.

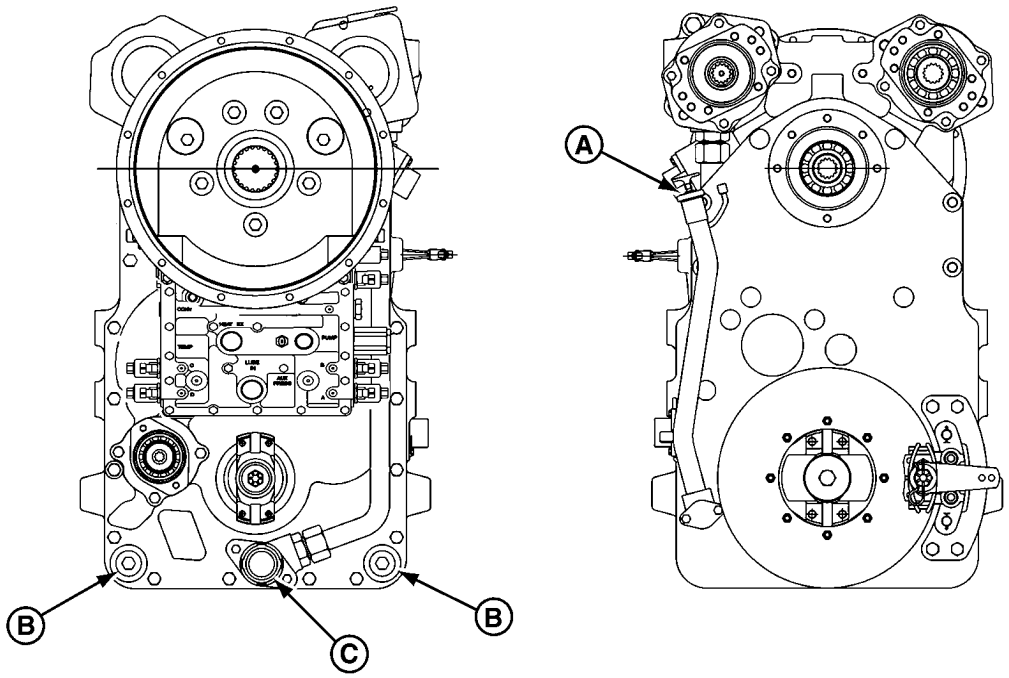
Make sure the transmission oil temperature is at 38°C (100°F).

Clean area around dipstick before removing.

Keep oil level at the “FULL” mark on the dipstick.

YZ,CTM148,10,1 –19–10NOV98–1/1

Intervals for Changing Transmission Oil and Filters



YZ1579 –UN–01DEC98

A—Dipstick B—Oil drain plug (2) C—Suction Screen

IMPORTANT: Change oil and filter after the first 50 hours of transmission operation.

The oil and filter change intervals given here are for normal service conditions. If the transmission is to be operated in severe conditions contact the Funk Service Department for additional recommendations.

FIRST OIL AND FILTER CHANGE:

Change oil and filter after first 50 hours of transmission operation.

ROUTINE OIL AND FILTER MAINTENANCE:

IMPORTANT: Some vehicles are equipped with devices to alert the operator when oil is bypassing the filter. Change the oil filter if a "Filter Bypass Signal" is indicated and the transmission is at normal operating temperature.

Change oil filter anytime the transmission is at normal operating temperature and a "Filter Bypass Signal" is indicated.

Change oil and filter anytime there are signs of contamination in the oil or the oil has a burnt odor.

Change filter at every 500 hours, change filter and oil every 1000 hours of transmission operation.

YZ,CTM148,10,4 –19–01DEC98–1/1

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Oil Analysis

Oil analysis is best used by sampling at regular intervals to establish a baseline analysis for the oil and operation conditions present. Changes from this baseline may indicate unusual wear.

IMPORTANT: Change the oil and filter if an analysis of the used transmission oil indicates any of the following limits are exceeded.

Glycol (Anti-freeze), must not exceed 0% by volume.

Water, must not exceed 0.05% by volume.

Viscosity increase at 38°C (100°F), not more than 40% over new oil value.

Total Acid Number (TAN) per ASTM D664, limit of 3.0 over new lubricant value.

YZ,CTM148,10,20 –19–28JUL98–1/1

Oil Temperature Warning Signal

If the oil temperature gauge, indicating the converter oil-out temperature, rises to 115°C (230°F) or the transmission oil temperature warning light comes on, stop the vehicle immediately. Shift to neutral and run the engine at 1000—1200 rpm.

IMPORTANT: Do not stop the engine when the transmission is overheating if the cooling system is known to be in working order.

The transmission oil temperature should soon lower to the engine water temperature, or if an air-to-oil exchanger is used, the temperature should soon lower to ambient air temperature across the heat exchanger. If the temperature does not lower, trouble is indicated.

Correct overheating problem before the vehicle is operated again.

YZ,CTM148,10,18 –19–10NOV98–1/1

Towing the Vehicle

AVOID DAMAGE TO TRANSMISSION:

Run engine at idle speed to lubricate the clutches.

- Do not exceed normal vehicle speeds while towing.

If the engine cannot be run:

- Disconnect drive line from transmission

If drive line can not be disconnected:

- Do not exceed 5 km/h (3 mph)
- Tow no further than 2 km (1 mile)

YZ,CTM148,10,17 –19–28JUL98–1/1

Put Transmission in Storage

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

The following actions will help protect the unit and component items from internal rust and corrosion damage for approximately one year, provided the transmissions are stored in a dry area:

Seal all openings with moisture-proof covers or tape.

Spray 113 mL (4 oz) of atomized NOX-RUST® VCI No. 10 oil or an equivalent into oil drain hole. This fluid is covered and approved per (MIL-P-46002 and MIL-I-23310).

Dip, spray, or brush all exposed unpainted surfaces with NOX-RUST® X-110 or an equivalent.

NOX-RUST is a trademark of Daubert Chemical Company.

YZ,CTM148,10,5 –19–28JUL98–1/1

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Remove Transmission From Storage

Wash off all external grease with a safety solvent.

Remove covers or tape from all openings.

Drain transmission completely.

Tag transmission to indicate it needs to be filled with oil after installing in vehicle.

YZ,CTM148,10,6 –19–28JUL98–1/1

Suggested Wrenching Torque for Tapered Pipe Thread[1]

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

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

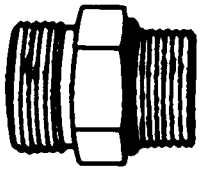
[1]SUGGESTED WRENCHING TORQUE FOR TAPERED PIPE THREAD charts meet Funk Engineering Procedures Manual Torque Specifications FEP 14.4.

CTM147,10,41 –19–25MAY98–1/1

Service Recommendations for O-Ring Boss Fittings[1]

Straight Fitting

1. Inspect O-ring boss seat for dirt or defects.
2. Lubricate O-ring with petroleum jelly. Place electrical tape over threads to protect O-ring. Slide O-ring over tape and into O-ring groove of fitting. Remove tape.
3. Tighten fitting to torque value shown on chart.



T6243AE –UN–18OCT88

[1]SERVICE RECOMMENDATIONS FOR O-RING BOSS FITTINGS chart meets Funk Engineering Procedures Manual Torque Specifications FEP 14.3.

Continued on next page

CTM147,10,40 –19–25MAY98–1/2

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Angle Fitting

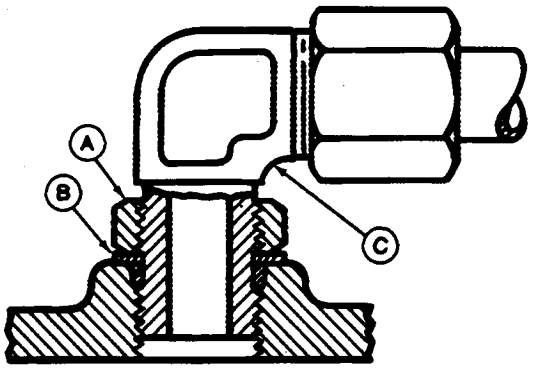
1. Back-off lock nut (A) and back-up washer (B) completely to head-end (C) of fitting.

2. Turn fitting into threaded boss until back-up washer contacts face of boss.

3. Turn fitting head-end counterclockwise to proper index (maximum of one turn).

NOTE: Do not allow hoses to twist when tightening fittings.

4. Hold fitting head-end with a wrench and tighten locknut and back-up washer to proper torque value.



T6520AB –UN–18OCT88

STRAIGHT FITTING OR SPECIAL NUT TORQUE CHART

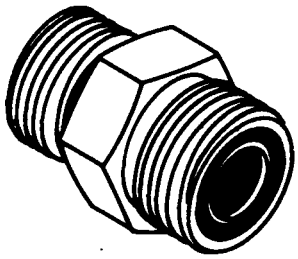
Thread Size	N•m	lb-ft
3/8-24 UNF	8	6
7/16-20 UNF	12	9
1/2-20 UNF	16	12
9/16-18 UNF	24	18
3/4-16 UNF	46	34
7/8-14 UNF	62	46
1-1/16-12 UN	102	75
1-3/16-12 UN	122	90
1-5/16-12 UN	142	105
1-5/8-12 UN	190	140
1-7/8-12 UN	217	160

NOTE: Torque tolerance is + 15% -20%.

CTM147,10,40 –19–25MAY98–2/2

Service Recommendations for Flat Face O-Ring Seal Fittings

1. Inspect the fitting sealing surfaces. They must be free of dirt or defects.
2. Inspect the O-ring. It must be free of damage or defects.
3. Lubricate O-rings and install into groove using petroleum jelly to hold in place.
4. Push O-ring into the groove with plenty of petroleum jelly so O-ring is not displaced during assembly.
5. Index angle fittings and tighten by hand pressing joint together to insure O-ring remains in place.
6. Tighten fitting or nut to torque value shown on the chart per dash size stamped on the fitting. Do not allow hoses to twist when tightening fittings.



T6243AD –UN–18OCT88

FLAT FACE O-RING SEAL FITTING TORQUE

Nominal Tube O.D.		Dash	Thread Size	Swivel Nut		Bulkhead Nut	
mm	in.	Size	in.	N•m	lb-ft	N•m	lb-ft
6.35	0.250	-4	9/16-18	16	12	5.0	3.5
9.52	0.375	-6	11/16-16	24	18	9.0	6.5
12.70	0.500	-8	13/16-16	50	37	17.0	12.5
15.88	0.625	-10	1-14	69	51	17.0	12.5
19.05	0.750	-12	1 3/16-12	102	75	17.0	12.5
22.22	0.875	-14	1 3/16-12	102	75	17.0	12.5
25.40	1.000	-16	1 7/16-12	142	105	17.0	12.5
31.75	1.250	-20	1 11/16-12	190	140	17.0	12.5
38.10	1.500	-24	2-12	217	160	17.0	12.5

NOTE: Torque tolerance is +15 -20%.

04T,90,K67 –19–01AUG94–1/1

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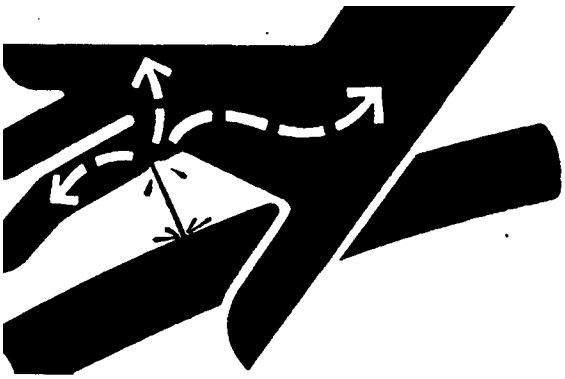
Check Oil Lines and Fittings



X9811 –UN–23AUG88

T85401 –UN–24JAN89

CAUTION: 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 may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

Check all oil lines, hoses, and fittings regularly for leaks or damage. Make sure all clamps are in position and tight. Make sure hoses are not twisted or touching moving machine parts. If abrasion or wear occurs, replace immediately.

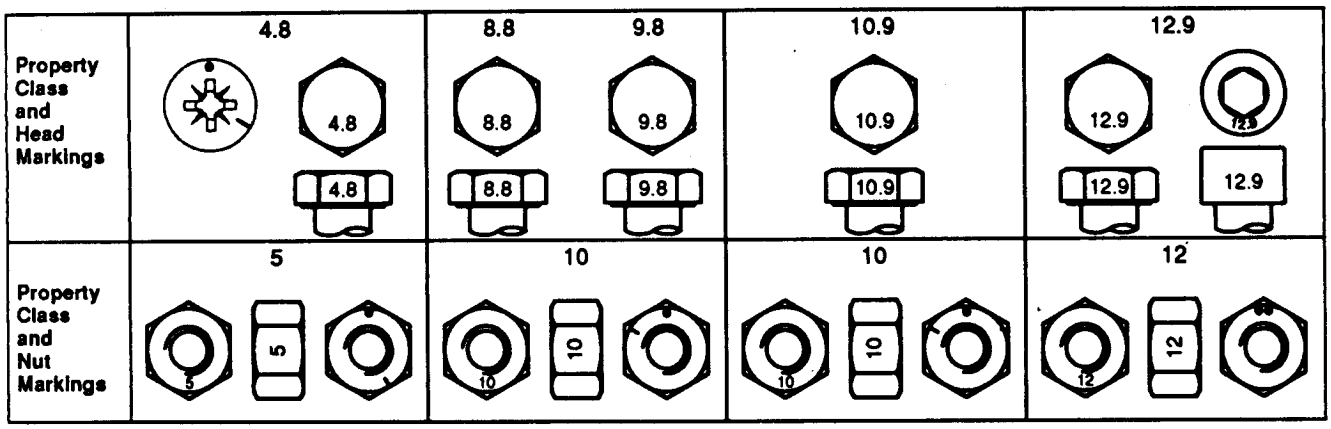
Tubing with dents may cause the oil to overheat. If you find tubing with dents, install new tubing immediately.

IMPORTANT: Tighten fittings as specified in torque chart.

When you tighten connections, use two wrenches to prevent bending or breaking tubing and fittings.

TX,90,DH1559 –19–01AUG94–1/1

Metric Bolt and Cap Screw Torque Values[1]



TS1163 –19–04MAR91

Applies to non-lubricated plain or zinc plated fasteners.

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. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class.

Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original.

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

[1]METRIC BOLT AND CAP SCREW TORQUE VALUES chart meet Funk Engineering Procedures Manual Torque Specifications FEP 14.1.

CTM147,10,42 –19–25MAY98–1/1

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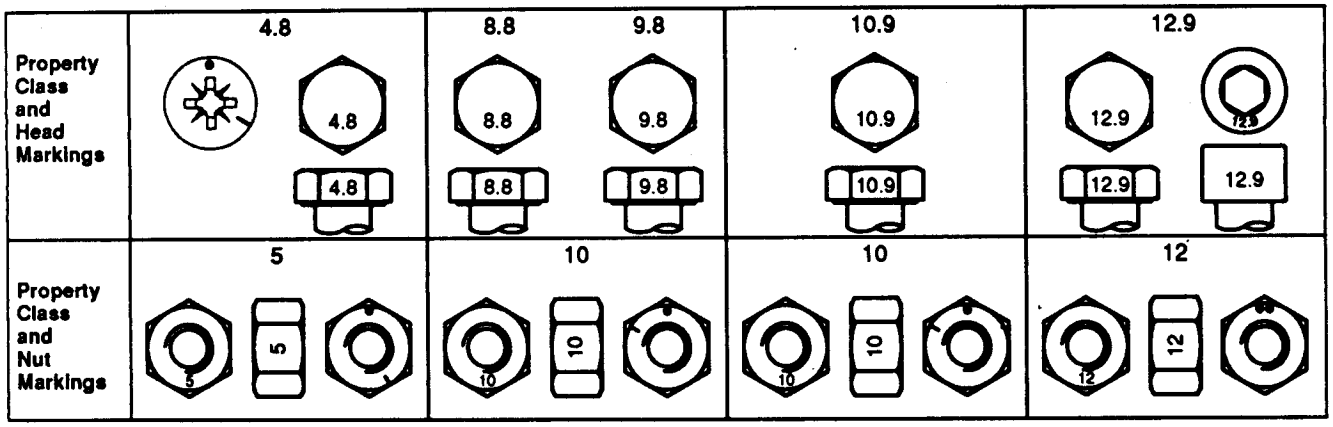
18

Unified Inch Bolt and Cap Screw Torque Values[1]



TS1163 –19–04MAR91

Applies to non-lubricated plain or zinc plated fasteners.

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

NOTE: Torque tolerance is ± 20%

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

Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class.

Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original.

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

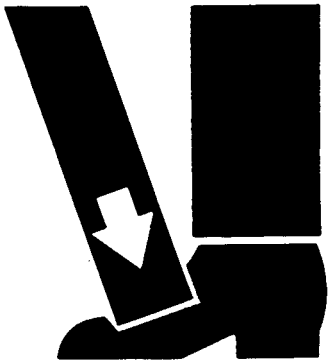
[1]UNIFIED INCH BOLT AND CAP SCREW TORQUE VALUES chart meet Funk Engineering Procedures Manual Torque Specifications FEP 14.2.

CTM147,10,43 –19–25MAY98–1/1

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

Safety Precautions

CAUTION: Do not allow any part of the body to be under the transmission while it is being lifted or after it is suspended on the repair stand. Do not exceed maximum capacities for the repair stand. Use only high grade fasteners in good condition. Personal injury could result.

This stand should be used only by qualified service technicians familiar with this equipment.

Fabricate transmission mounting adapters to specifications provided in fabricated tools, Group 99, of this manual.

Use SAE Grade 8 or better cap screws to attach adapters or mount transmission.

Make sure tapped holes in adapters and transmission are clean and not damaged.

Minimum cap screw thread engagement should be equal to 1-1/2 screw diameters.

Do not exceed the maximum capacity rating of stand.

Be sure transmission is solidly mounted before releasing from lifting device.

Never permit any part of the body to be positioned under a load being lifted or suspended. Accidental slippage may result in personal injury.

YZ,CTM148,15,2 –19–28JUL98–1/1

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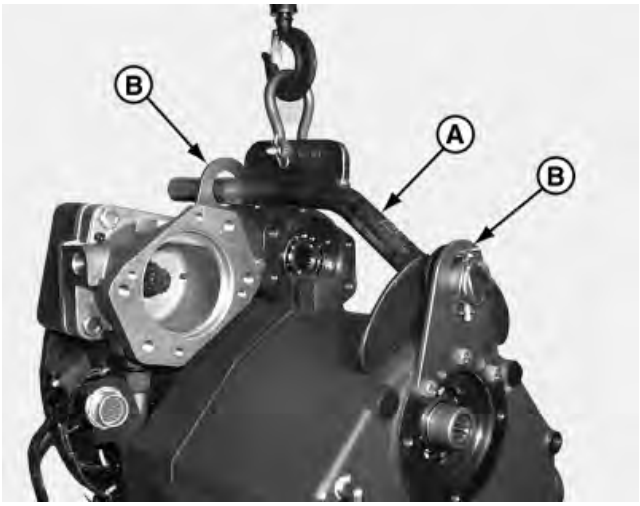
Transmission Lifting Procedure

Use a lift sling similar to (A). It should hold the transmission level without bending the lift hangers (B).



YZ1735 –UN–09JUL98

YZ,CTM148,15,3 –19–28JUL98–1/1

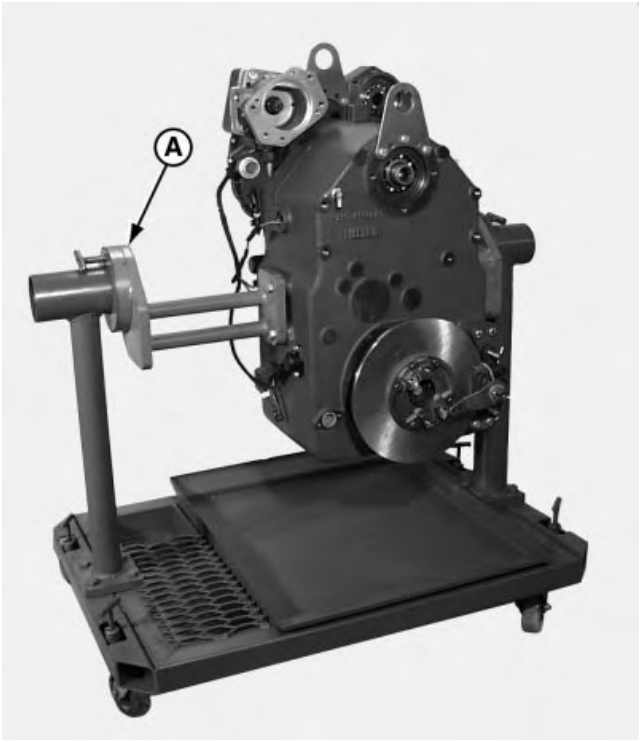
Transmission Repair Stand

NOTE: Information about the repair stand (A) can be located in group 99.

When any other stand is used, consult the Manufacturer's instructions for mounting.

Approximate dry weights[1]:

Model DF150 = 545 Kg (1250 lbs).



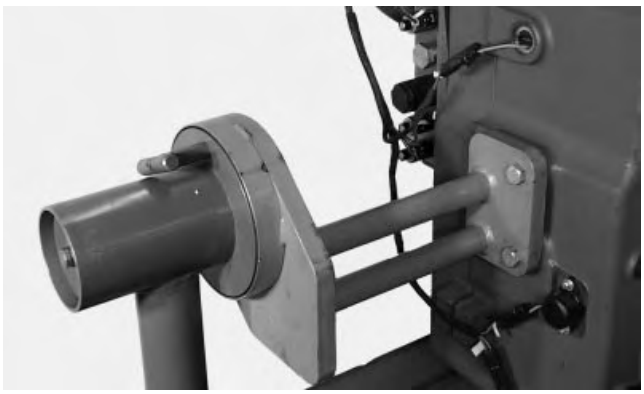
YZ1736 –UN–09JUL98

[1]*Actual weights depend on the options included.*

YZ,CTM148,15,1 –19–14SEP98–1/1

Mounting DF Series Transmission to Repair Stand

NOTE: See Group 99, "Special Tools" for Assembly Stand Plate information.



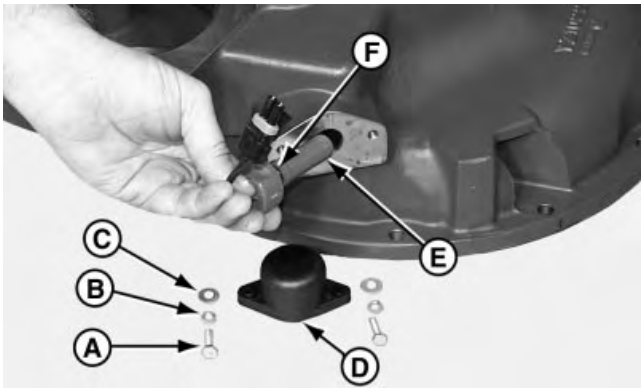
YZ1737 –UN–09JUL98

YZ,CTM148,15,4 –19–28JUL98–1/1

Remove and Install Input Housing Magnetic Pickup Sensor

1. Remove two cap screws (A), two lock washers (B), two flat washers (C), cover (D), sensor (E) and O-ring (F).
2. Clean and inspect for wear and damage.
3. **INSTALL:**

   Lubricate new o-ring and install in reverse order.



YZ1621 –UN–09JUL98

YZ,CTM148,15,6 –19–14SEP98–1/1

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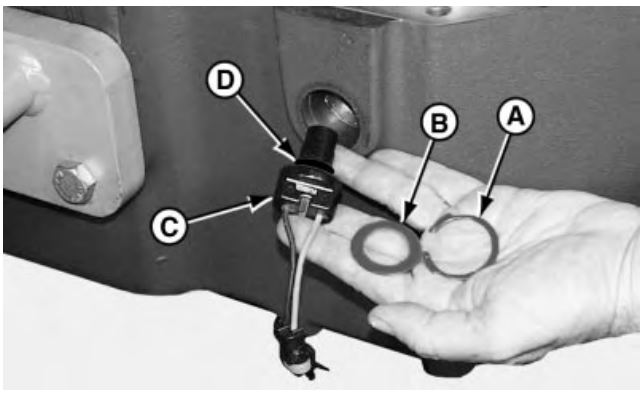
Remove and Install Cylinder Magnetic Pickup Sensor



YZ1734 –UN–09JUL98

CAUTION: Wear eye protection when removing or installing snap rings.

1. Remove snap ring (A).
2. Remove washer (B).
3. Remove magnetic sensor (C).

Install

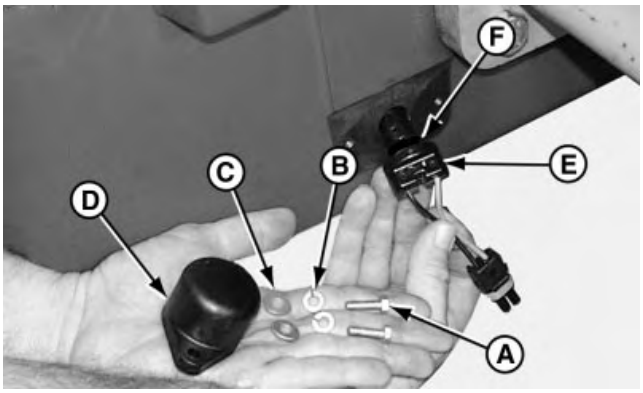
1. Lubricate new o-ring (D).
2. Install component items in reverse order.

YZ,CTM148,15,7 –19–28JUL98–1/1

Remove and Install Output Magnetic Pickup Sensor

1. Remove two cap screws (A), two lock washers (B), two flat washers (C), cover (D), sensor (E) and O-ring (F).
2. Clean and inspect for wear and damage.
3. **INSTALL:**

   Lubricate new o-ring and install in reverse order.



YZ1733 –UN–09JUL98

YZ,CTM148,15,5 –19–28JUL98–1/1

Other Material

Number	Name	Use
	Transmission fluid	All moving parts and o-rings.

YZCTM148,25,OTH –19–28JUL98–1/1

Specifications

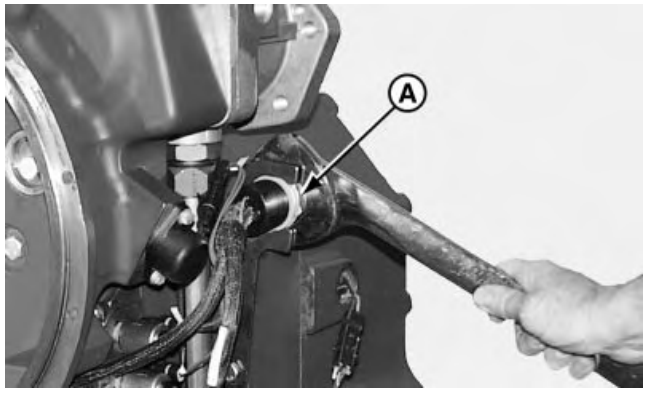
Item	Measurement	Specification
Charge pump-to-input housing cap screws.	Torque	100 N•m (74 lb-ft)
Suction manifold-to-input housing cap screws.	Torque	25 N•m (18 lb-ft)
Suction tube-to-charge pump.	Torque	190 N•m (140 lb-ft)
Suction tube-to-suction manifold.	Torque	190 N•m (140 lb-ft)
Wiring harness bracket-to-rear housing cap screw.	Torque	87 N•m (64 lb-ft)
Wiring harness connector-to-wiring harness bracket	Torque	18—27 N•m (13—20 lb-ft)

YZCTM148,25,SPC –19–14SEP98–1/1

Remove Wiring Harness

1. Loosen nut (A).

NOTE: Tag all wiring connectors before removing wiring harness.



YZ21738 –UN–09JUL98

Continued on next page

YZ,CTM148,25,20 –19–10NOV98–1/2

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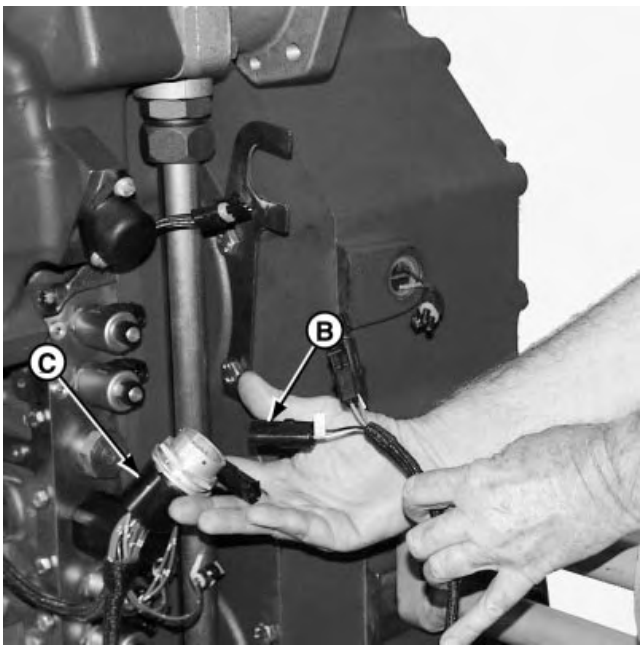
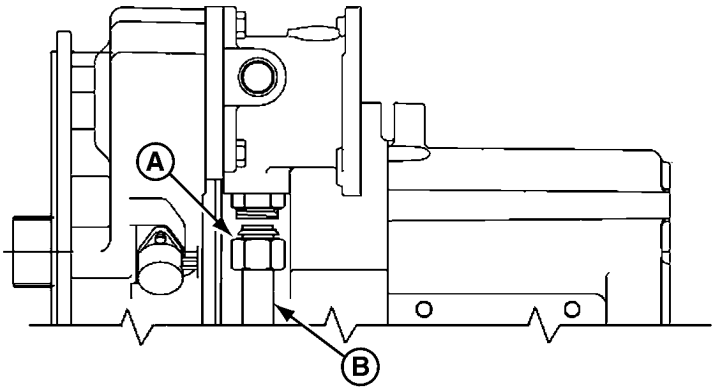
2. Unfasten all weather pack connectors (B).
3. Remove wiring harness (C).
4. Inspect for wear and damage.

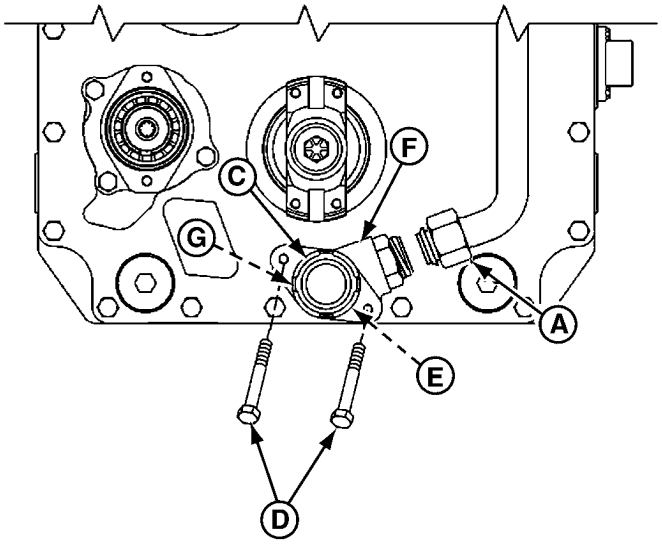


YZ1739 –UN–09JUL98

YZ,CTM148,25,20 –19–10NOV98–2/2

Disassemble Suction Tube Group





YZ728F –UN–11JUN98

A—O-ring fitting (2 used)
B—Suction tube
C—Suction screen assembly
D—Cap screw (2 used)
E—Gasket
F—Suction manifold
G—O-ring

YZ,CTM148,25,14 –19–28JUL98–1/1

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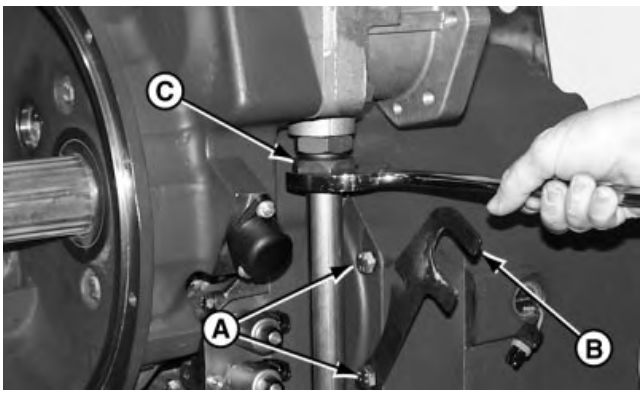
Remove Suction Tube and Oil Manifold Assembly

IMPORTANT: All oil should be drained from transmission before beginning disassembly.

NOTE: Refer to INTERVALS FOR CHANGING TRANSMISSION OIL AND FILTERS in group 10 for drain locations.

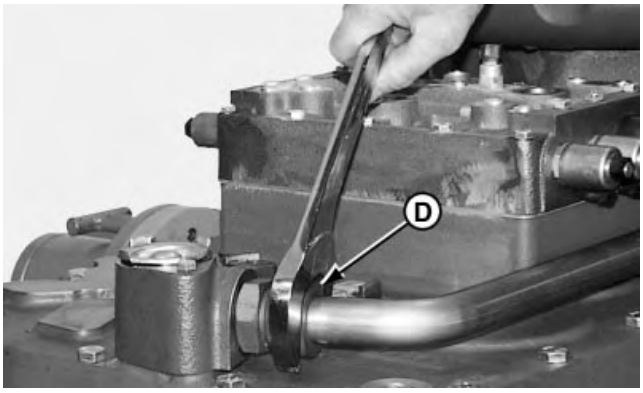
1. Loosen cap screws (A).
2. Move bracket (B).
3. Completely loosen upper O-ring fitting nut (C).



YZ1740 –UN–10JUL98

YZ,CTM148,25,1 –19–28JUL98–1/6

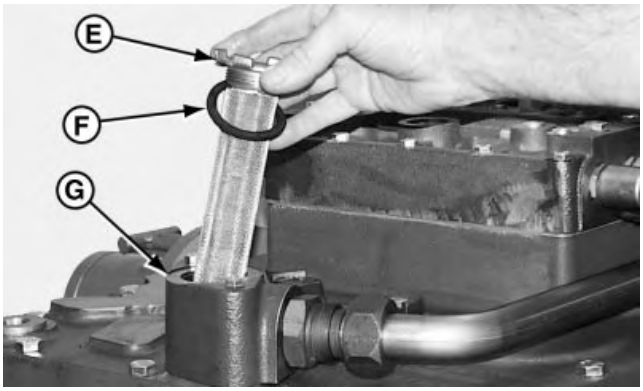
4. Completely loosen lower O-ring fitting nut (D).



YZ1741 –UN–10JUL98

YZ,CTM148,25,1 –19–28JUL98–2/6

5. Remove suction screen assembly (E) and gasket (F) from suction manifold (G).



YZ1742 –UN–10JUL98

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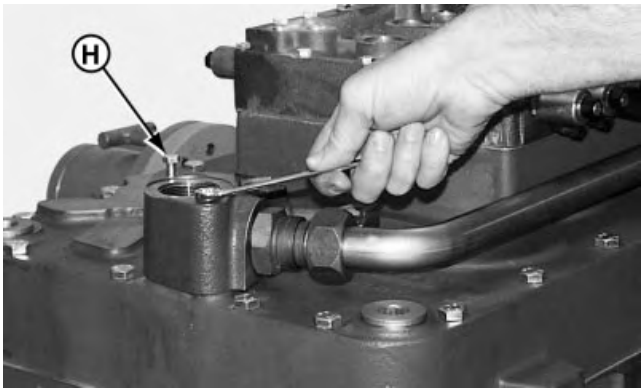
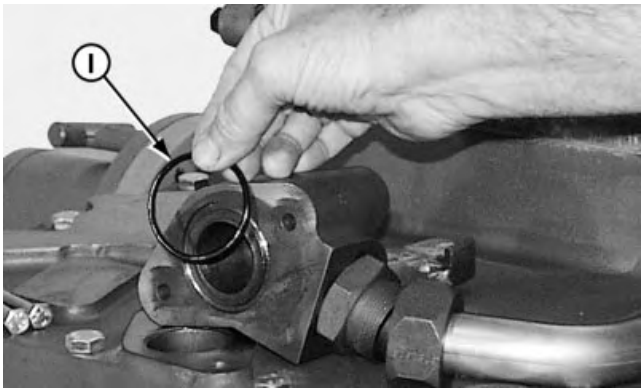
YZ,CTM148,25,1 –19–28JUL98–3/6

6. Remove two cap screws (H).



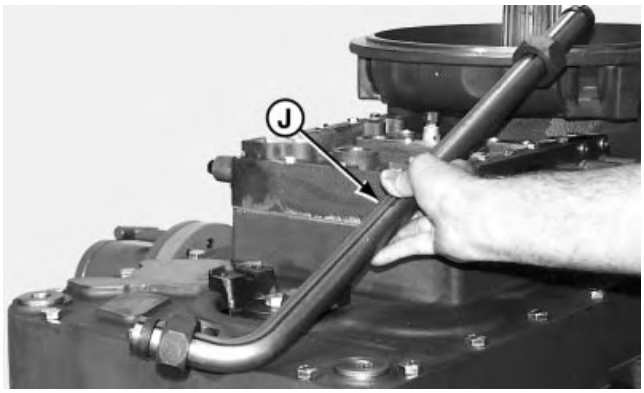
YZ,CTM148,25,1 –19–28JUL98–4/6

7. Remove and discard O-ring (I)



YZ,CTM148,25,1 –19–28JUL98–5/6

8. Remove suction tube (J) with O-ring fitting parts.
9. Clean and inspect all parts for damage.



YZ,CTM148,25,1 –19–28JUL98–6/6

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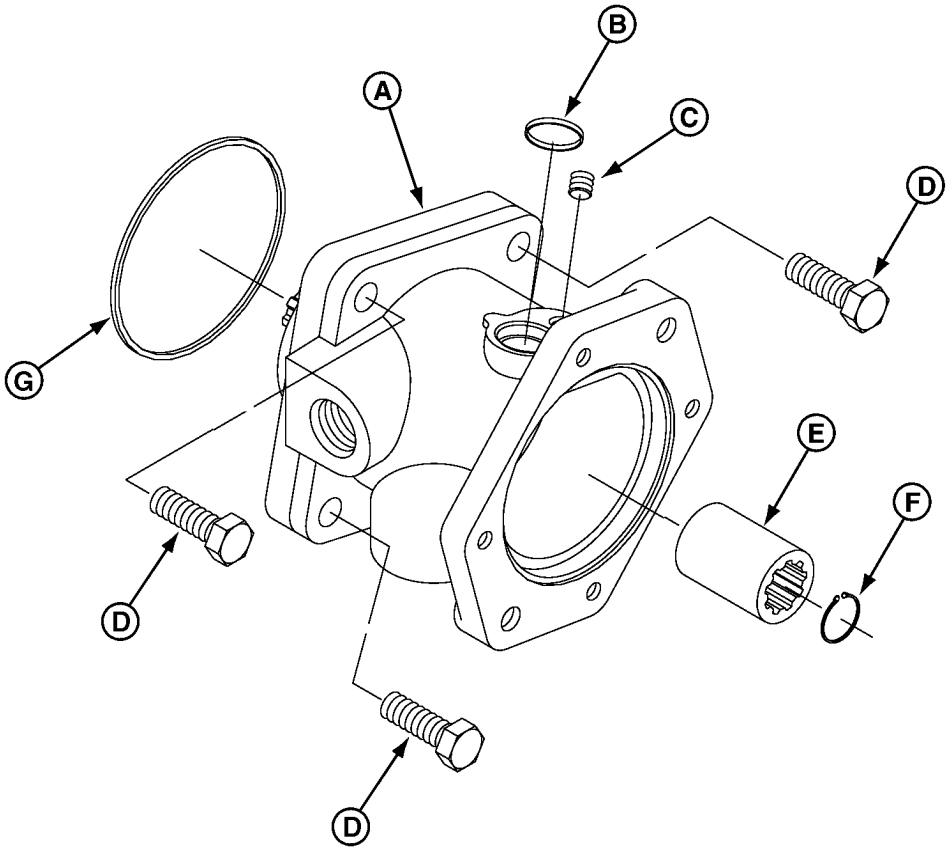
Charge Pump Group



YZ1550 –UN–15JUN98

A—Oil pump
B—Cup plug
C—Set screw
D—Cap screw M16x65 8.8 (3 used)
E—Sleeve (SAE C)
F—Snap ring
G—O-ring

THE CHARGE PUMP IS NOT REPAIRABLE. THE PUMP MUST BE REPLACED IF FOUND DEFECTIVE.

YZ,CTM148,25,4 –19–28JUL98–1/1

Remove Charge Pump Group

NOTE: Transmission is shown with the input housing engine side down.

1. Remove three cap screws (A).

CAUTION: The driven gear and support bearings may come out of the input housing when the charge pump is removed. These assemblies are a slip fit. Do not allow gear and bearing assembly to fall. Personal injury or damage could result.

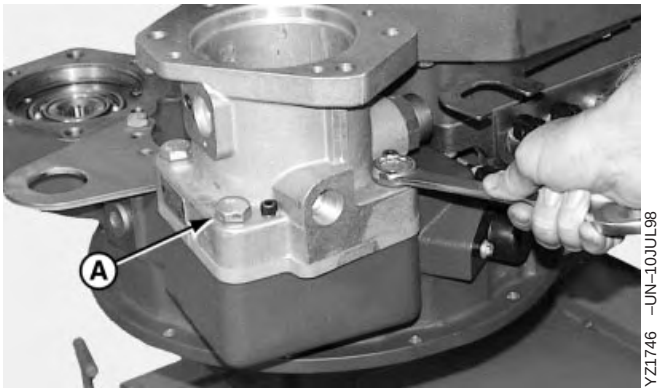
IMPORTANT: The driven gear and bearing assembly stays in the input housing and additional disassembly of the transmission is expected, remove the driven gear and bearing assembly to prevent it from falling out when the transmission is turned over.

NOTE: Refer to Group 30 (Direct Drive Input Assembly) for information on disassembling and assembling driven gear assembly (A).

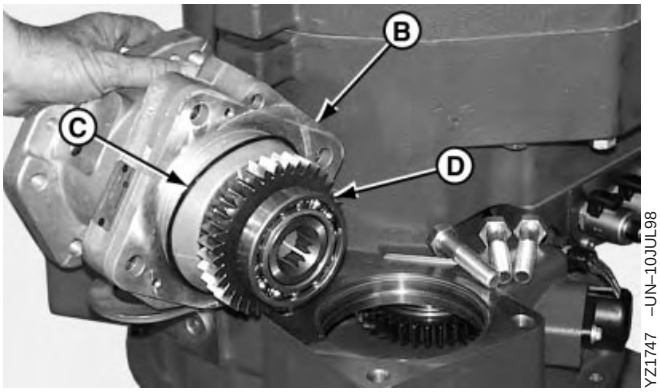
2. Remove charge pump (B) and bearing assembly (D) from input housing.

3. Remove o-ring (C).

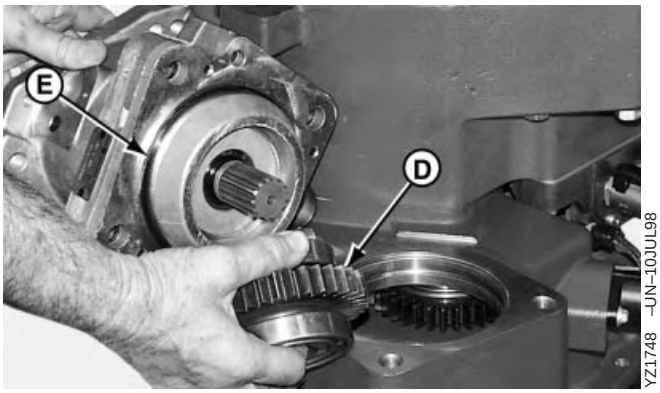
4. Discard o-ring (C).



YZ1746 –UN–10JUL98



YZ1747 –UN–10JUL98



YZ1748 –UN–10JUL98

YZ,CTM148,25,2 –19–28JUL98–1/1

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Install Charge Pump to Direct Drive Input Assembly

CAUTION: Never install idler gear assembly without installing the charge pump. The idler gear assembly is a slip fit and can fall out causing personal injury.

NOTE: The driven gear on the charge pump must mesh with the idler gear. Refer to Group 30, Direct Drive input assembly (install driven gear assemblies). The idler gear assembly can be install immediately before the charge pump or as part of the charge pump.

1. Lubricate new o-ring (C) install onto charge pump (B).

IMPORTANT: OPTIMOL OPTIMOLY PASTE WHITE T® is only suitable for paste-specific applications and cannot replace oil or grease lubrication. Do not mix with other greases, pastes or oils.

NOTE: OPTIMOLY PASTE WHITE T® is used for long-term separating and lubricating effect, prevention of fretting corrosion and avoidance of squeaking noises.

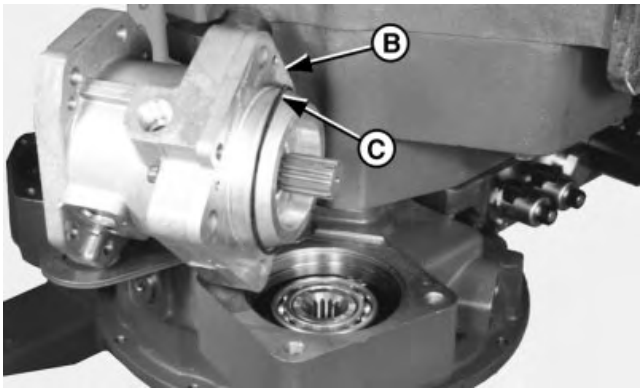
2. Apply OPTIMOLY PASTE WHITE T® to charge pump spline.

3. Install charge pump (B) into front cover.

4. Install three cap screws (A) through charge pump into front cover.

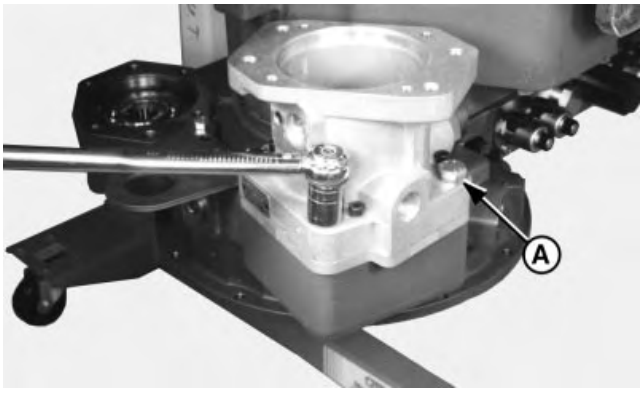
5. Tighten cap screws to 115 N•m (85 lb-ft).


YZ1521 –UN–12JUN98



YZ1520 –UN–12JUN98

YZ1807 –UN–06NOV98

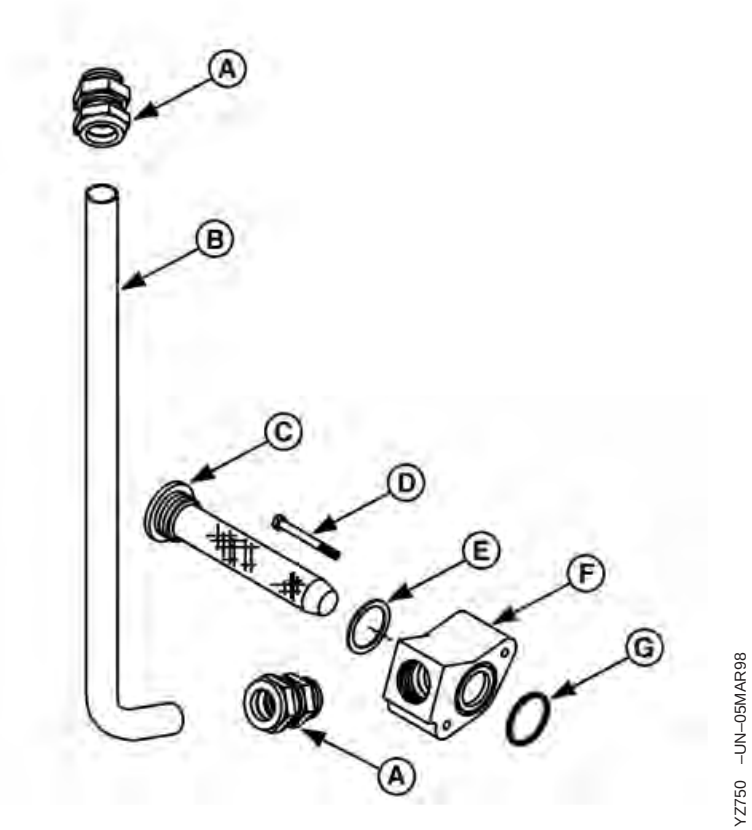


YZ1522 –UN–12JUN98

OPTIMOLY PASTE WHITE T is a trademark of Optimal Lubricants, Inc.

YZ,CTM149,25,8 –19–06NOV98–1/1

Assemble Suction Tube Group

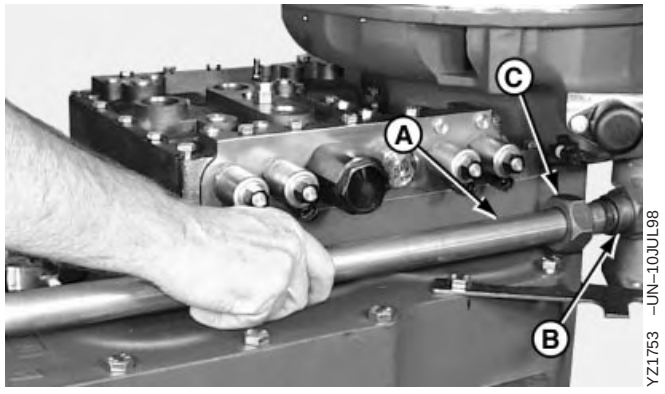


A—O-ring fitting (2 used)
B—Suction tube
C—Suction screen assembly
D—Cap screw (2 used)
E—Gasket
F—Suction manifold
G—O-ring

YZ,CTM148,25,19 –19–28JUL98–1/1

Install Suction Tube, Suction Screen Assembly and Suction Manifold

1. Insert the upper end of the suction tube (A) into the o-ring fitting half (B) in the charge pump and lightly tighten, by hand, nut (C).



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YZ,CTM148,25,5 –19–28JUL98–1/8

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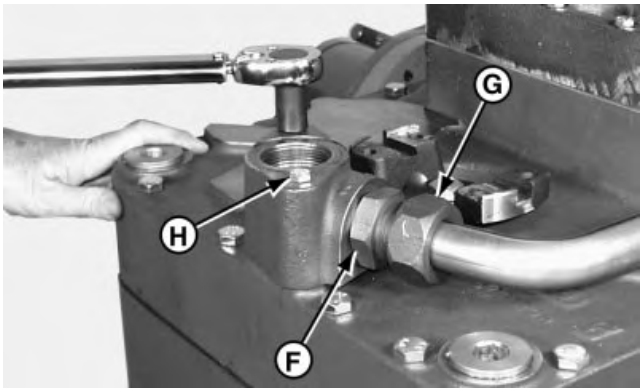
2. Lubricate and install a new O-ring (D) in the groove in the suction manifold (E).

YZ1754 –UN–10JUL98

YZ,CTM148,25,5 –19–28JUL98–2/8

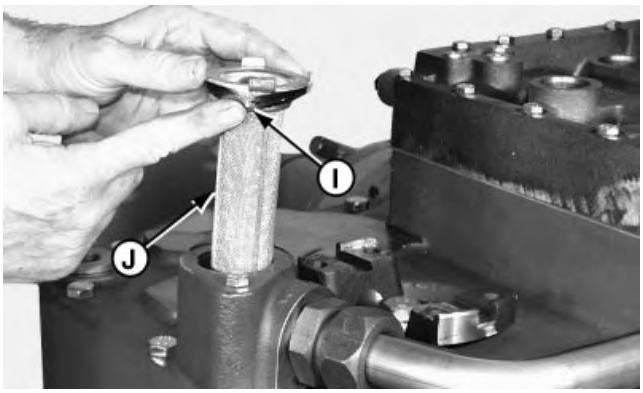
3. Place the suction manifold in its working position. Be sure O-ring stays in place.
4. Insert the lower end of the suction tube in the O-ring fitting half (F) and lightly tighten, by hand, nut (G).
5. Install two cap screws (H) and tighten to 25 N•m (18 lb-ft).



YZ1755 –UN–10JUL98

YZ,CTM148,25,5 –19–28JUL98–3/8

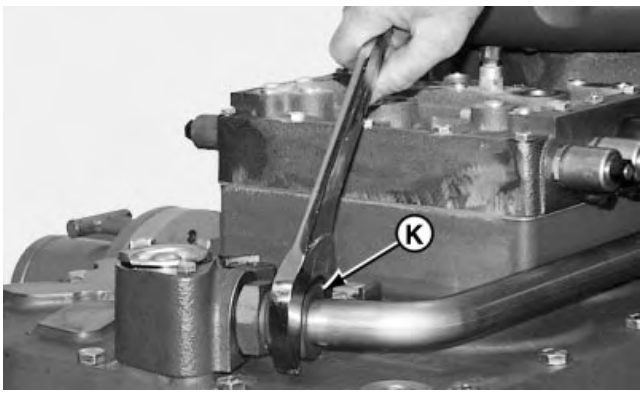
6. Lubricate gasket (I).
7. Install the suction screen assembly (J) and gasket.
8. Tighten 3/4 to one turn after gasket contacts face of suction manifold.
9. Check for leaks after operating transmission.



YZ1756 –UN–10JUL98

YZ,CTM148,25,5 –19–28JUL98–4/8

10. Tighten nut (K) to 190 N•m (140 lb-ft).



YZ1757 –UN–10JUL98

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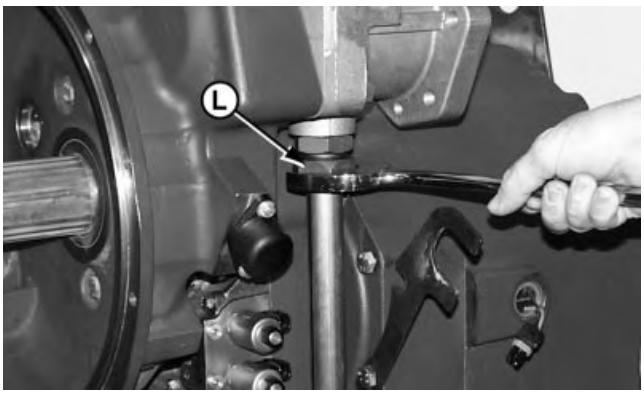
YZ,CTM148,25,5 –19–28JUL98–5/8

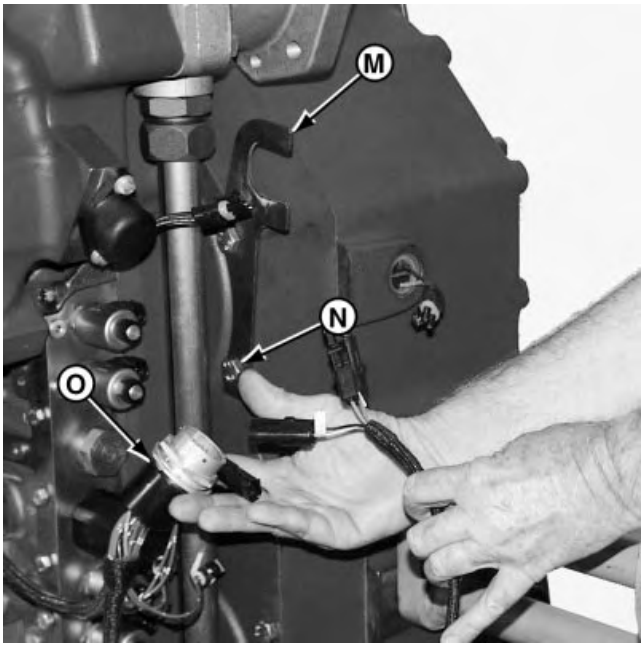
11. Tighten nut (L) to 190 N•m (140 lb-ft).



YZ,CTM148,25,5 –19–28JUL98–6/8

12. Move wiring harness bracket (M) back in place and tighten two cap screws (N) 87 N•m (64 lb-ft).

13. Install wiring harness (O). Be sure to route the harness away from moving parts, Make connections as they were before disassembly.



YZ,CTM148,25,5 –19–28JUL98–7/8

14. Place main wiring harness connector (O) in bracket.

15. Tighten nut to 18—27 N•m (13—20 lb-ft).

YZ,CTM148,25,5 –19–28JUL98–8/8

Other Material

Number	Name	Use
620 (LOCTITE®)		Oil seal
	Grease	O-ring
	Transmission fluid	All moving parts and o-rings

YZCTM148,30,OTH –19–28JUL98–1/1

Specifications

Item	Measurement	Specification
Magnetic pickup-to-input housing cap screws.	Torque	10 N•m (8 lb-ft)
Input housing assembly-to-front housing cap screws.	Torque	87 N•m (64 lb-ft)
Socket head hex plug-to-input housing.	Torque	102 N•m (75 lb-ft)
Lift bracket-to-input housing	Torque	87 N•m (64 lb-ft)
Bearing retainer cap screw-to-front housing.	Torque	37 N•m (27 lb-ft)
Direct drive input housing assembly	Weight	50 Kg (110 lbs)

YZCTM148,30,SPC –19–14SEP98–1/1

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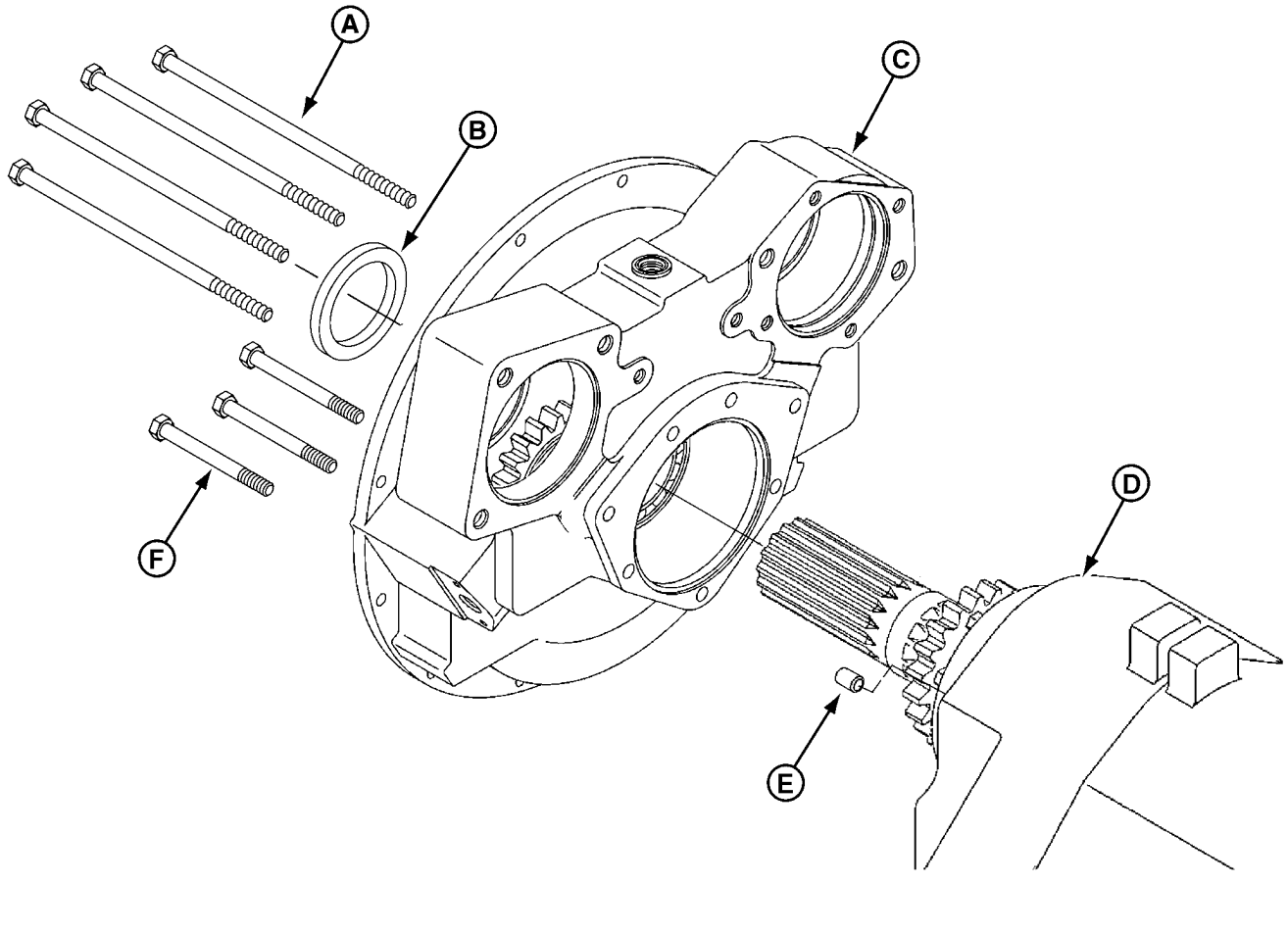
Remove Input Housing Assembly Group

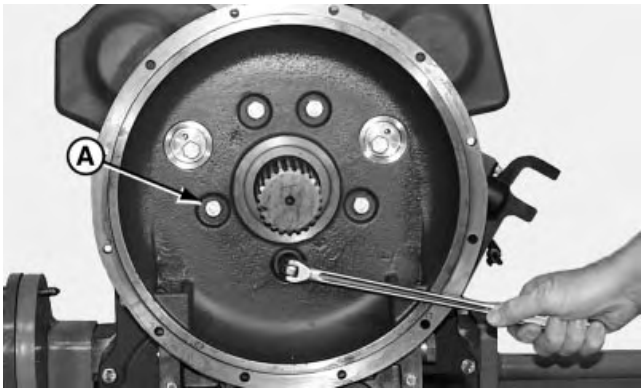


A—Hex cap screw, 12x280mm (4 used)
B—Oil seal
C—Input housing (SAE 3)
D—Transmission Assembly
E—Dowel pin
F—Hex cap screw, 12x110mm (3 used)

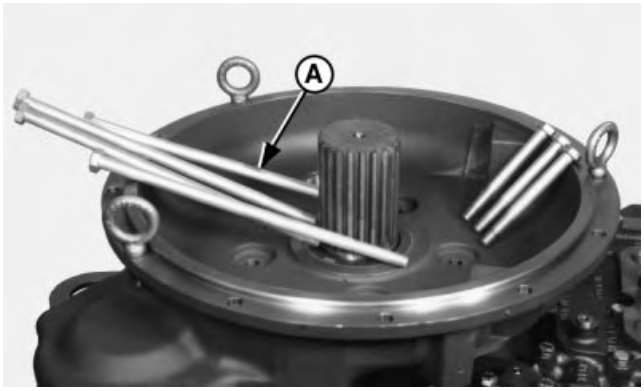
YZ,CTM148,30,26 –19–28JUL98–1/1

Remove and Disassemble Input Housing Assembly

1. Remove wiring harness.
2. Remove charge pump.
3. Position transmission with input housing assembly up.
4. Remove seven cap screws (A).



YZ1617 –UN–09JUL98



YZ729F –UN–12JUN98

YZ,CTM148,30,35 –19–28JUL98–1/3

CAUTION: Be sure the lifting device will lift the entire input housing assembly. This component weight approximately 50 kg (110 lbs.)

IMPORTANT: The lifting device must be arranged so that it lifts the input housing assembly straight up without binding or tipping.

5. Install lifting device (A).

YZ1618 –UN–09JUL98

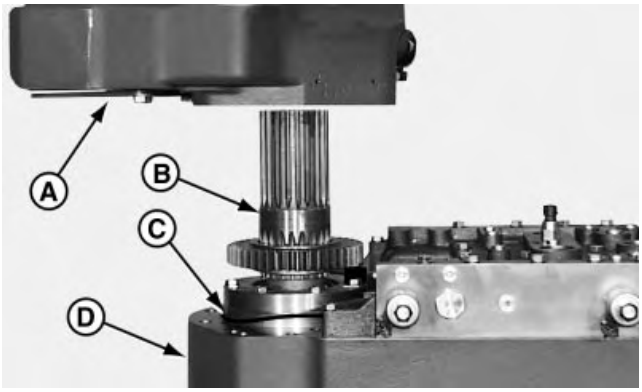
Continued on next page

YZ,CTM148,30,35 –19–28JUL98–2/3

CAUTION: Be sure the input shaft assembly (B) does not move up with the input housing assembly (A). It might fall causing damage or personal injury. Input bearing (C) will some times come up with the input housing be careful that it does not drop out.

NOTE: If the input bearing (C) stays with the input housing (A), be sure it does not fall out. It can be removed later.

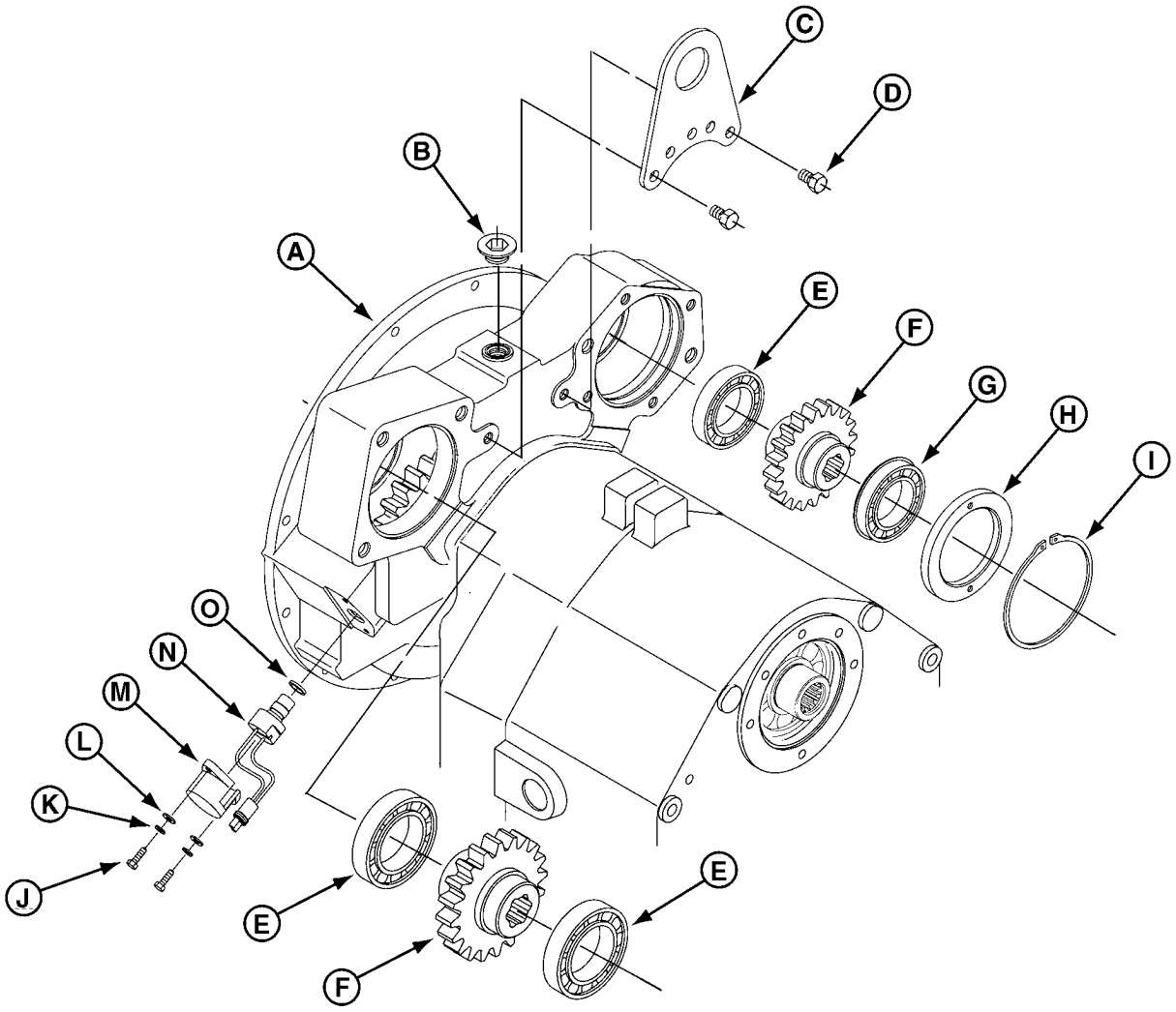
6. Carefully lift input housing assembly (A) from the transmission (E). The input shaft assembly (B), input bearing (C) and O-ring (D) should stay with the transmission (see caution and note).



YZ1619 –UN–09JUL98

YZ,CTM148,30,35 –19–28JUL98–3/3

Input Assembly



YZ704D –UN–18JUN98

A—Input housing
B—Hex socket plug
C—Lift hanger
D—Cap screw M12x20mm 8.8 (2 used)
E—Bearing (3 used)
F—Driven gear 36T
G—Bearing (with snap ring)
H—Bearing spacer
I—Snap ring
J—Cap screw M6x20mm 8.8 (2 used)
K—Lock washer (2 used)
L—Washer (2 used)
M—Magnetic pickup cover
N—Magnetic pickup sensor
O—O-ring

YZ,CTM148,30,27 –19–28JUL98–1/1

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Remove Idler Gear Shafts

1. Position input housing assembly (A) engine side up.

NOTE: Refer to group 15 for removal and installation of magnetic pickup sensor.

YZ1620 –UN–09JUL98

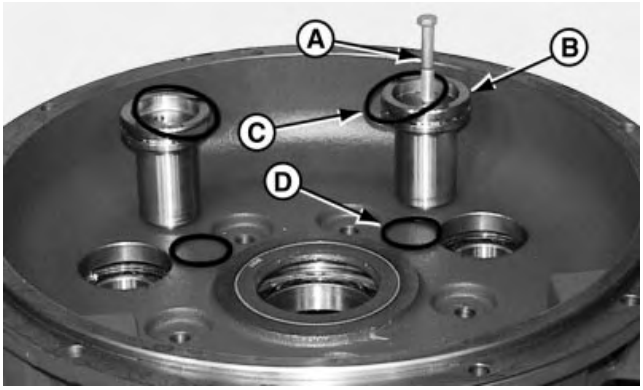
YZ,CTM148,30,2 –19–28JUL98–1/2

2. Install a bolt (A) into threaded hole in idler shaft (B). Use this bolt to pull idler shafts out of input housing. The shafts are a slip fit.

3. Remove O-ring (C) from groove in each idler shaft.

4. Remove two O-rings from bottom of each idler shaft bores.

5. Discard O-rings and inspect idler shaft for wear or damage.



YZ1622 –UN–09JUL98

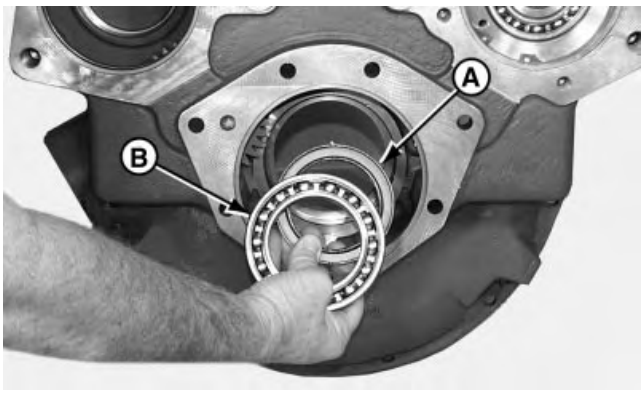
YZ,CTM148,30,2 –19–28JUL98–2/2

Remove Input Oil Seal and Ball Bearing

NOTE: If the input ball bearing (B) stayed in the input housing, remove it with the oil seal.

1. Drive the oil seal (A) down on top of the input ball bearing below. Continue driving to remove both the oil seal and the input ball bearing.
2. Remove oil seal (A) and input ball bearing (B).

YZ1623 –UN–09JUL98



YZ1624 –UN–09JUL98

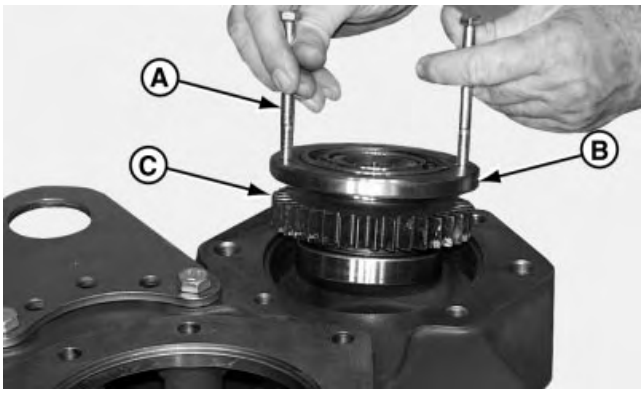
YZ,CTM148,30,3 –19–28JUL98–1/1

Remove and Disassemble Auxiliary Pump Drive Gear Assembly

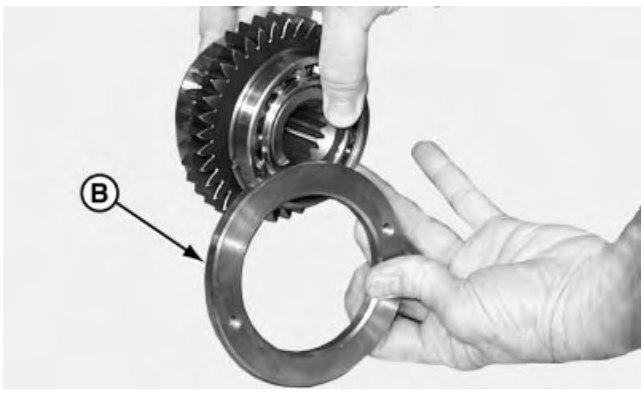
1. Install two cap screws (A) in threaded holes in the bearing spacer (B).

CAUTION: The bearing spacer (B) is not a tight fit on the bearing, do not allow the auxiliary pump drive driven gear and bearing assembly (C) to fall, causing damage or personal injury.

2. Remove the bearing spacer with the auxiliary pump drive driven gear and bearing assembly (C).
3. Remove bearing spacer (B).



YZ1625 –UN–09JUL98

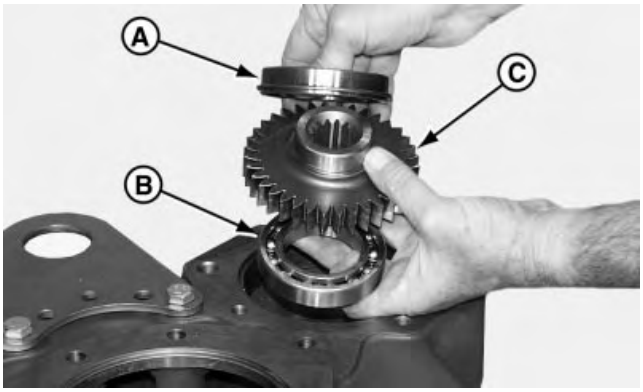


YZ1626 –UN–09JUL98

Continued on next page

YZ,CTM148,30,7 –19–28JUL98–1/2

4. Pay attention to position of the snap ring on bearing (A) for reassembly purposes. Use a puller to remove bearings (A) and (B) from driven gear (C).



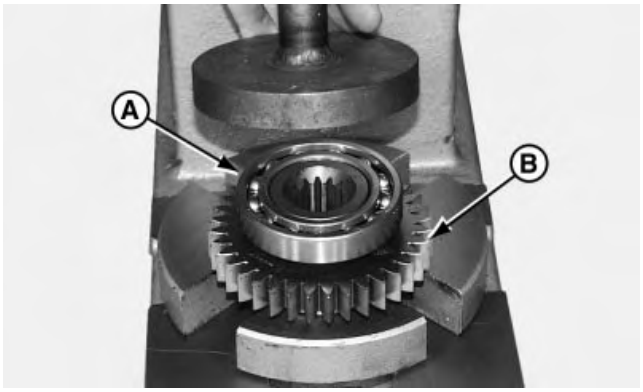
YZ1627 –UN–09JUL98

YZ,CTM148,30,7 –19–28JUL98–2/2

Assemble Auxiliary Pump Drive Driven Gear Assembly

IMPORTANT: Press only on inner race of bearing.

1. Use a press bearing installation tool to install new bottom bearing (A) on auxiliary pump drive driven gear (B).



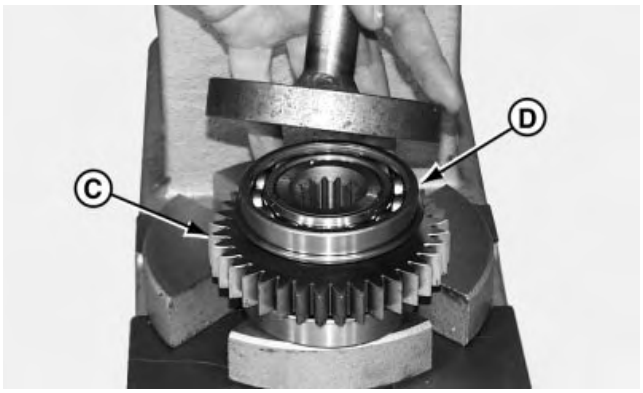
YZ1628 –UN–09JUL98

YZ,CTM148,30,8 –19–12SEP98–1/2

2. Turn driven gear (C) over and press the new top bearing with snap ring (D) onto gear.

NOTE: Install new bearing with snap ring down next to gear.

3. Set assembly aside.

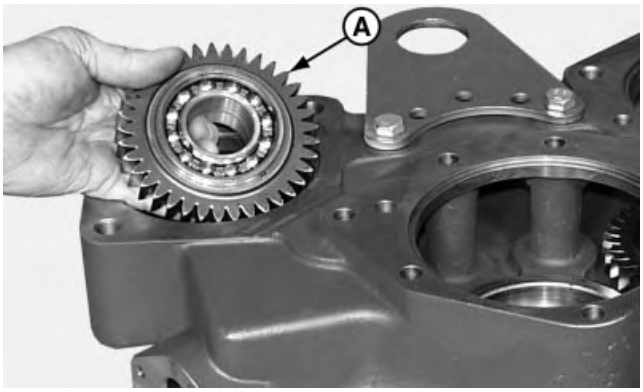


YZ1629 –UN–09JUL98

YZ,CTM148,30,8 –19–12SEP98–2/2

Remove and Disassemble Idler Gears and Bearing Assembly

1. Remove charge pump idler gear assembly (A) though charge pump ports.

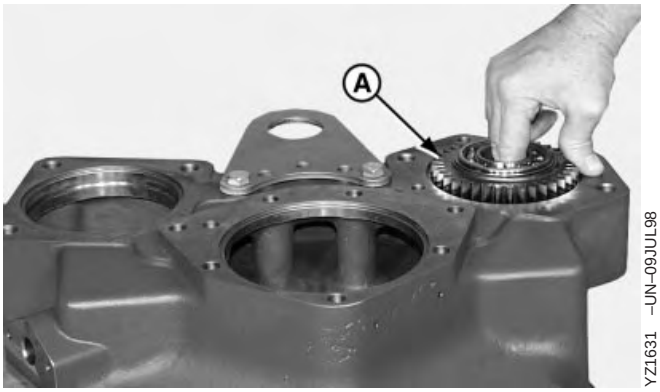


YZ1630 –UN–09JUL98

Continued on next page

YZ,CTM148,30,9A –19–28JUL98–1/4

2. Remove auxiliary pump drive idler gear and bearing assembly (A) through the auxiliary pump drive port.



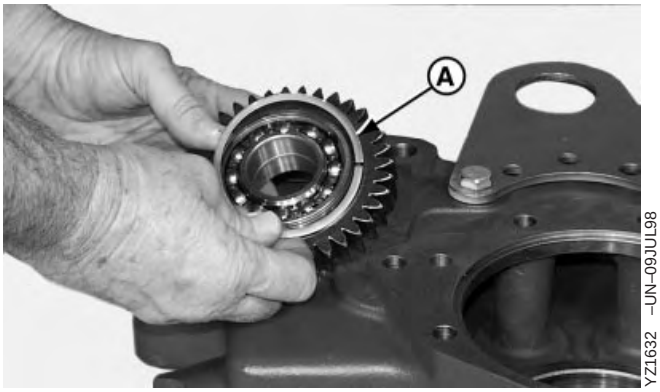
YZ1631 –UN–09JUL98

YZ,CTM148,30,9A –19–28JUL98–2/4

CAUTION: Wear safety glasses when removing or installing snap rings.

NOTE: Both right and left idler gear and bearing assemblies are disassembled in the same way.

3. Remove snap ring (A).

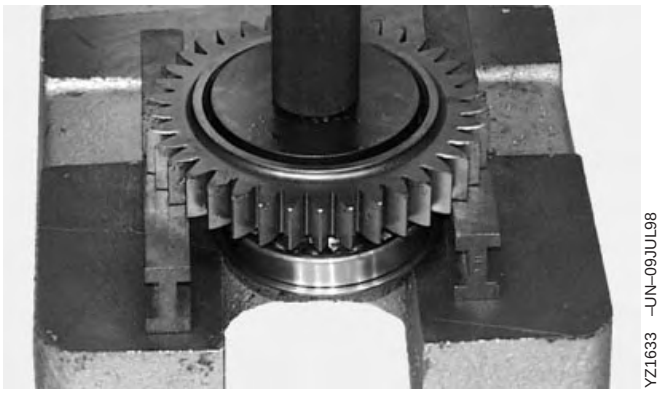


YZ1632 –UN–09JUL98

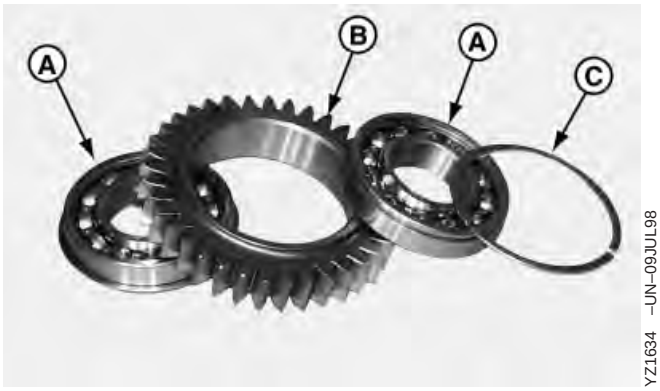
YZ,CTM148,30,9A –19–28JUL98–3/4

4. Push both bearings (A) out from the side the snap ring was removed.

A—Bearing (2 used)
B—Gear
C—Snap ring (2 used)



YZ1633 –UN–09JUL98



YZ1634 –UN–09JUL98

YZ,CTM148,30,9A –19–28JUL98–4/4

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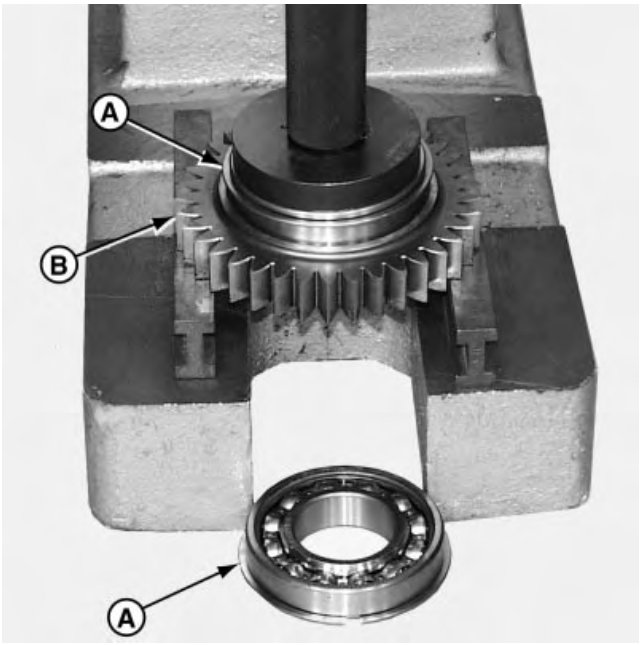
Assemble Idler Gear Assembly

NOTE: Both idler gears assemble the same. Install bearing into the idler gear correctly. Snap ring side of bearing to the outside of the gear.

1. Install new bearing (A) snap ring side of bearing to the outside of gear.

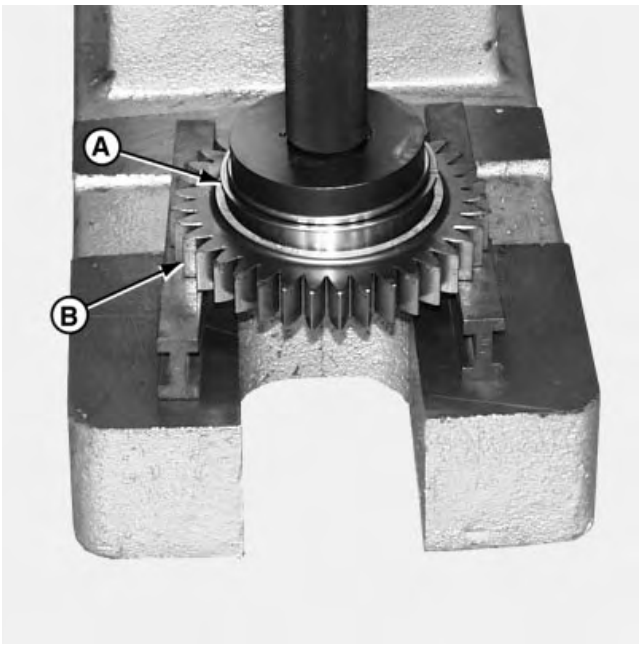


YZ1635 –UN–09JUL98

YZ,CTM148,30,10 –19–28JUL98–1/2

2. Turn idler gear over and install the second bearing.

3. Set both assemblies aside.

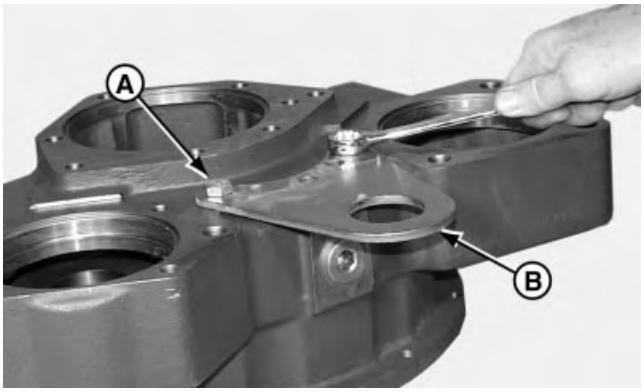


YZ1636 –UN–09JUL98

YZ,CTM148,30,10 –19–28JUL98–2/2

Remove and Install Lift Bracket

1. Remove two cap screws (A).
2. Remove lift bracket (B).

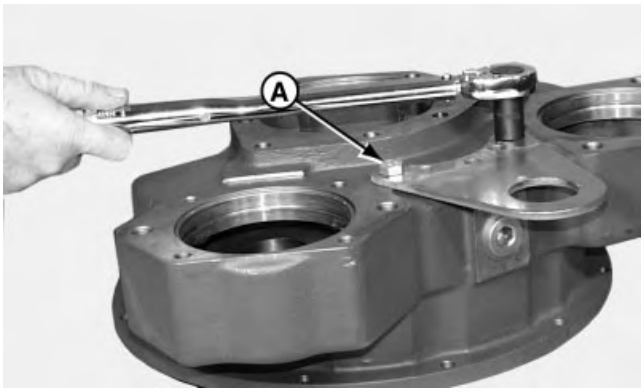


YZ,CTM148,30,36 –19–28JUL98–1/2

Install Lift Bracket

IMPORTANT: Using new cap screws, replace with the same length and grade as original equipment.

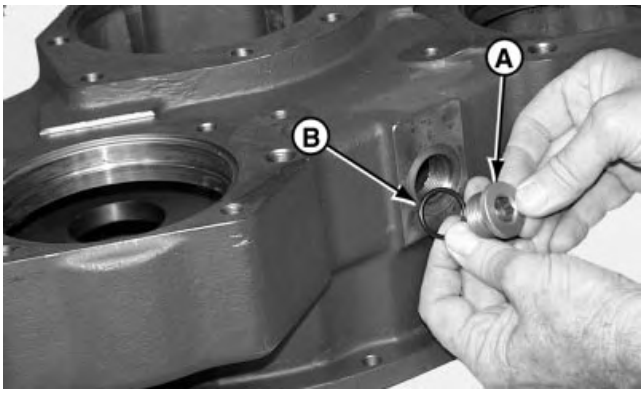
1. Install two cap screws (A).
2. Tighten cap screws to 87 N•m (64 lb-ft).



YZ,CTM148,30,36 –19–28JUL98–2/2

Remove and Install Socket Head Hex Plug

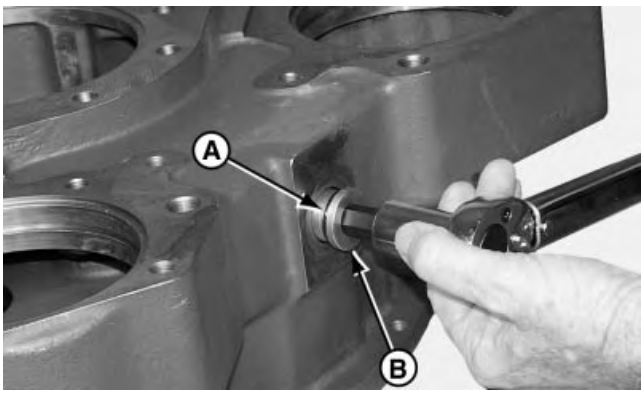
1. Remove socket head hex plug (A) and O-ring (B).
2. Discard O-ring.
3. Inspect socket head plug for damage.



YZ,CTM148,30,37 –19–28JUL98–1/2

Install Socket Head Hex Plug

1. Lubricate new O-ring (A) and install on Plug (B).
2. Install plug assembly.
3. Tighten to 102 N•m (75 lb-ft).



YZ,CTM148,30,37 –19–28JUL98–2/2

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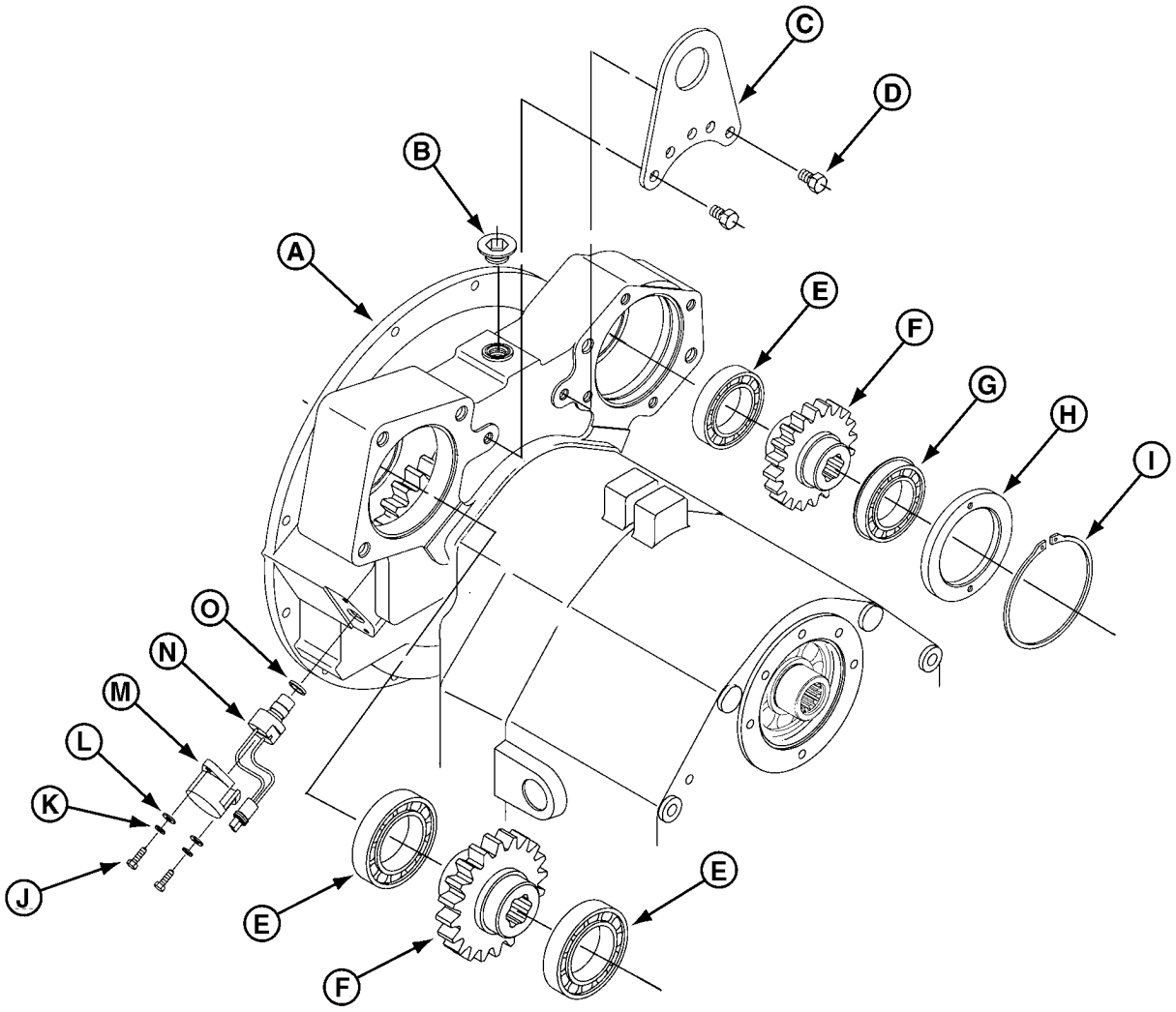
Assemble Input Assembly



YZ704D –UN–18JUN98

A—Input housing
B—Hex socket plug
C—Lift hanger
D—Cap screw M12x20mm 8.8 (2 used)
E—Bearing (3 used)
F—Driven gear 36T
G—Bearing (with snap ring)
H—Bearing spacer
I—Snap ring
J—Cap screw M6x20mm 8.8 (2 used)
K—Lock washer (2 used)
L—Washer (2 used)
M—Magnetic pickup cover
N—Magnetic pickup sensor
O—O-ring

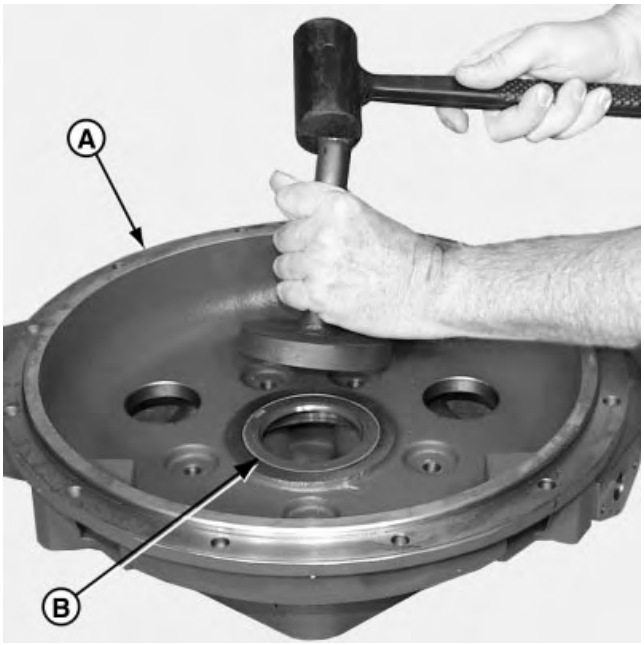
YZ,CTM148,30,30 –19–28JUL98–1/1

Install Oil Seal

1. Position input housing (A) with engine side up.

IMPORTANT: If the new oil seal is not coated on the outside diameter with a sealer, apply LOCTITE® #620.

2. Install new oil seal (B) flush with machined surface on input housing.



YZ1641 –UN–09JUL98

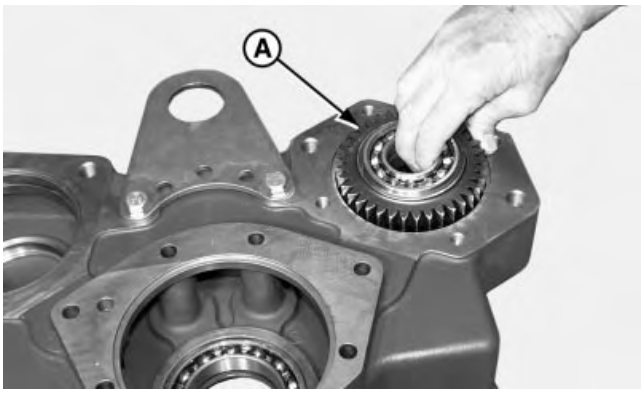
LOCTITE is a trademark of Loctite Corp.

YZ,CTM148,30,38 –19–28JUL98–1/1

Install Idler Gear and Bearing Assemblies

1. Lubricate all bearings with clean transmission fluid.

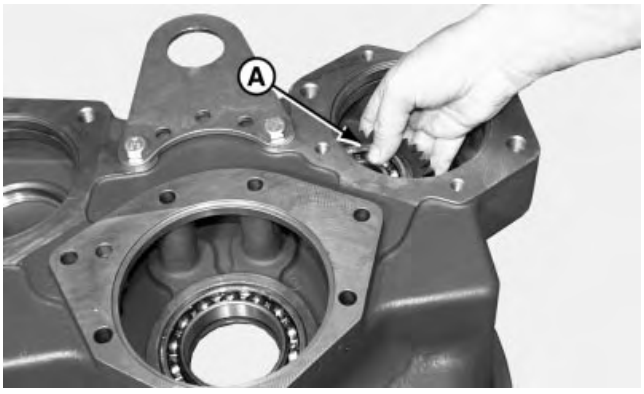
2. Place idler gear assembly (A) into auxiliary pump drive port of the input housing.



YZ1643 –UN–09JUL98

YZ,CTM148,30,5 –19–28JUL98–1/3

3. Slide the idler gear assembly (A) into its position between the auxiliary pump port and the input shaft bore.



YZ1644 –UN–09JUL98

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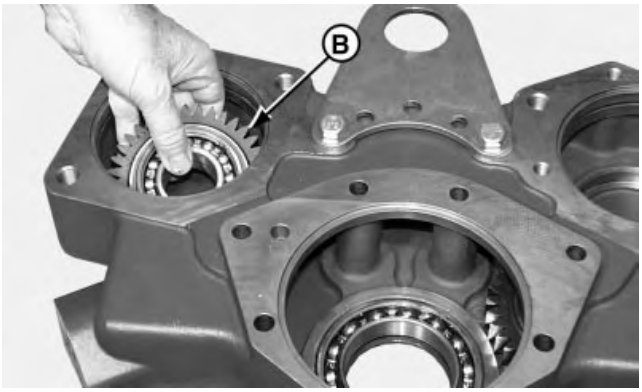
YZ,CTM148,30,5 –19–28JUL98–2/3

4. Place the other idler gear assembly (B) into its position between the charge pump port and the input shaft bore.



YZ,CTM148,30,5 –19–28JUL98–3/3

Install Idler Shafts

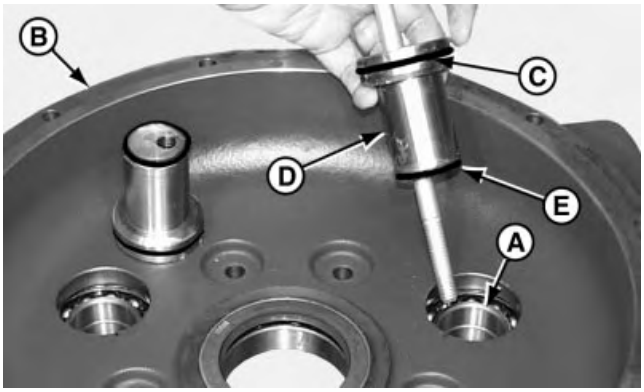
NOTE: The through hole in the idler shafts (D) must line up with the through hole in the input housing (B). Use one of the long input housing cap screws (F) to guide alignment of the shaft.

1. Align the bearing bore in the idler gear assembly (A) with the idler shaft bore in the input housing (B).
2. Lubricate the O-ring (C) with grease and install in the groove on the idler shaft (D).
3. Use grease to hold O-ring (E) to the bottom of the idler shaft during installation (also see the alternate installation procedure 4.)
4. **ALTERNATE O-RING INSTALLATION PROCEDURE**

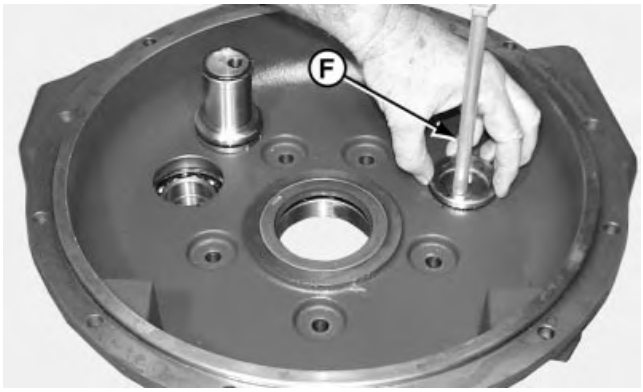
   Lubricate O-ring (E) with grease and place in position at the bottom of the idler shaft bore in the input housing.
5. Align the through hole in the idler shaft with through hole in the input housing by inserting one of the long input housing attaching cap screws (F) through both parts.
6. Push the idler shaft through the idler gear assembly and into the input housing. Be sure both O-ring stay in place.
7. Install the other idler shaft (G) in the same way.

IMPORTANT: Both idler gears must turn.

8. Remove the cap screws that were used as alignment guides.



YZ1646 –UN–09JUL98



YZ1647 –UN–09JUL98

YZ1648 –UN–09JUL98

YZ,CTM148,30,14 –19–28JUL98–1/1

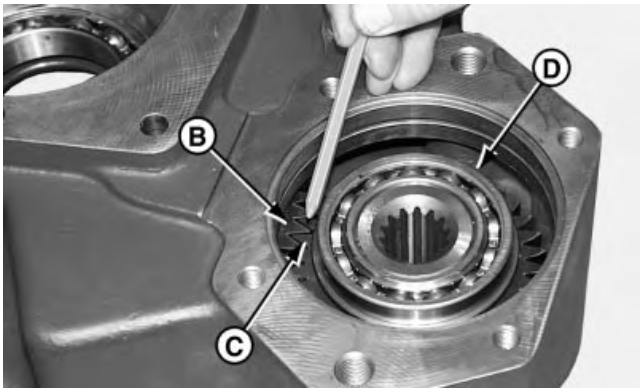
Install Auxiliary Pump Drive Gear

1. Lubricate both bearings with clean transmission fluid.
2. Install auxiliary pump drive gear assembly (A) snap ring up in pump drive port.

YZ1649 –UN–09JUL98

YZ,CTM148,30,6 –19–28JUL98–1/4

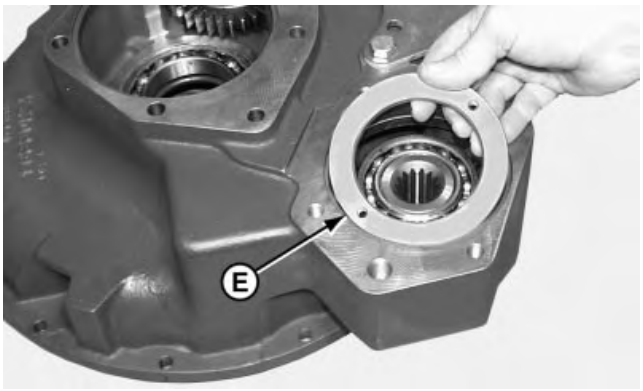
3. Align gear teeth (B) and (C).
4. Push auxiliary pump drive gear assembly (D) into bore in front cover.



YZ1650 –UN–09JUL98

YZ,CTM148,30,6 –19–28JUL98–2/4

5. Install bearing spacer (E).

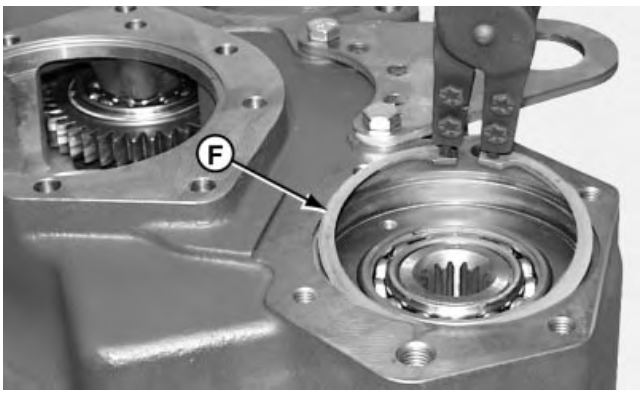


YZ1651 –UN–09JUL98

YZ,CTM148,30,6 –19–28JUL98–3/4

CAUTION: Wear eye protection when removing or installing snap rings. Personal injury to self or bystanders could result.

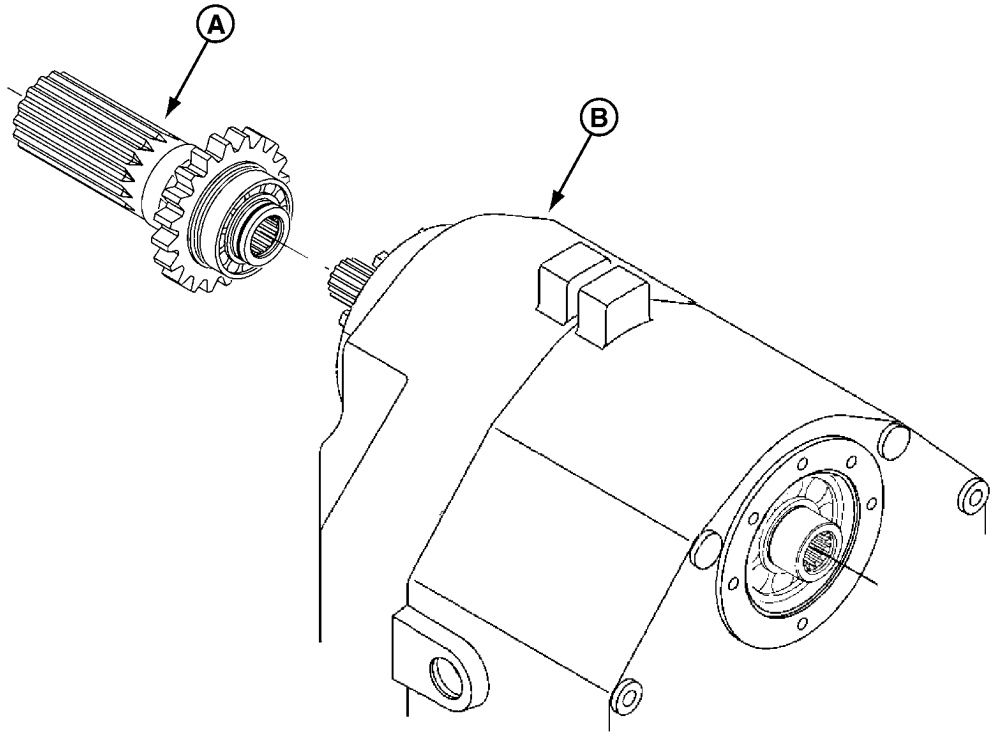
6. Install snap ring (F) in groove.



YZ1652 –UN–09JUL98

YZ,CTM148,30,6 –19–28JUL98–4/4

Input Shaft Assembly



YZ1553 –UN–18JUN98

A—Input shaft assembly **B—Transmission assembly**

YZ,CTM148,30,39 –19–28JUL98–1/1

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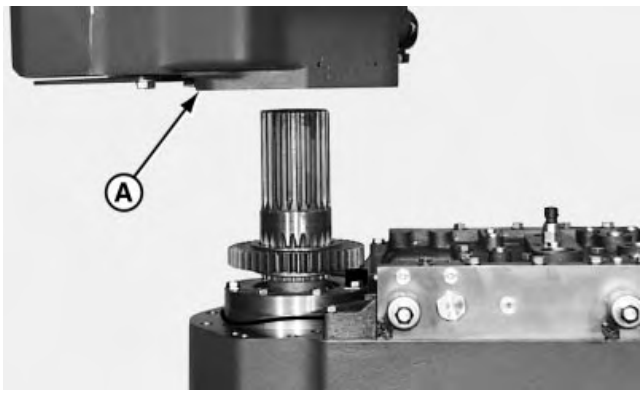
Remove and Disassemble Input Shaft Assembly

CAUTION: Be sure the input shaft assembly (B) does not come up with the input housing assembly (A). It could fall and cause damage or personal injury.

The input bearing will usually come up with the input housing assembly. Do not let it fall out before it can be safely removed.

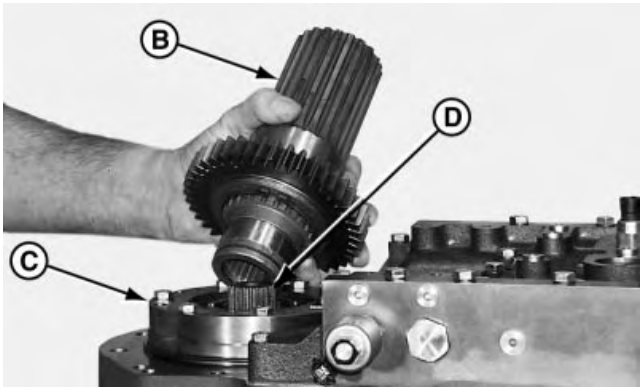
1. Remove the input housing assembly (A).



YZ1654 –UN–09JUL98

CAUTION: Do not allow the coupling shaft (D) to fall if it comes up with the input shaft assembly.

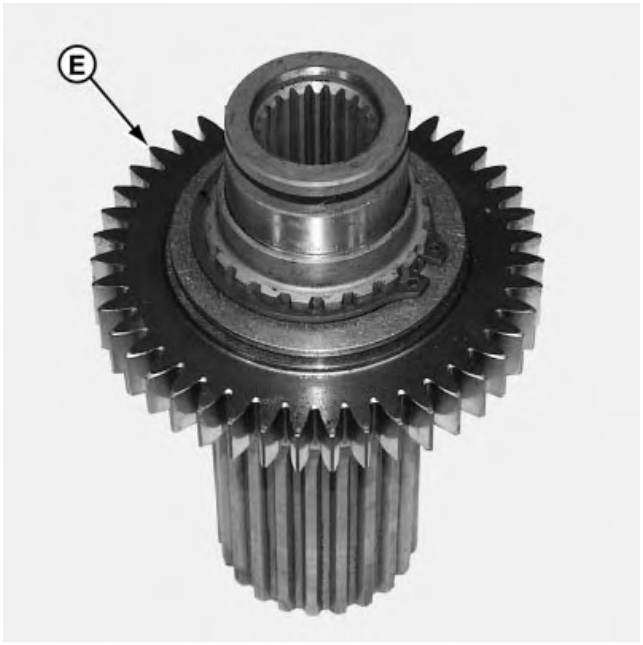
2. Lift input shaft assembly (B) from bearing retainer (C).



YZ1655 –UN–09JUL98

YZ,CTM148,30,16 –19–28JUL98–1/6

3. Place input assembly (E) with snap ring up.



YZ1656 –UN–09JUL98

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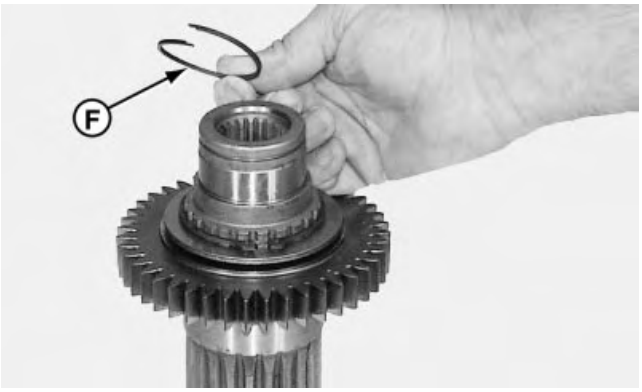
YZ,CTM148,30,16 –19–28JUL98–2/6

4. Remove and discard seal ring (F).

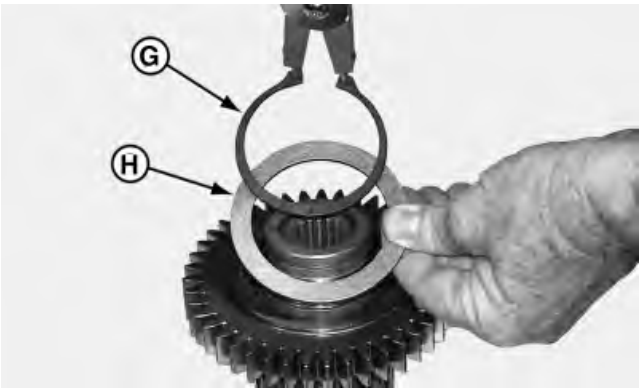


YZ,CTM148,30,16 –19–28JUL98–3/6

CAUTION: Wear safety glasses when removing or installing snap ring.

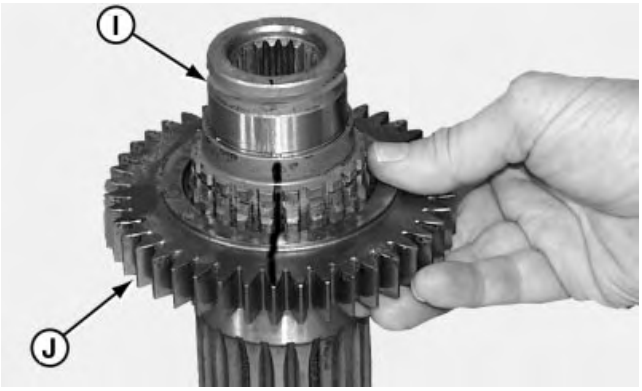
5. Remove snap ring (G).

6. Remove thrust race (H).



YZ,CTM148,30,16 –19–28JUL98–4/6

7. Mark input shaft (I) and gear (J) for reassembly.



YZ,CTM148,30,16 –19–28JUL98–5/6

8. Remove gear from input shaft.

9. Inspect all parts for wear and damage.

YZ,CTM148,30,16 –19–28JUL98–6/6

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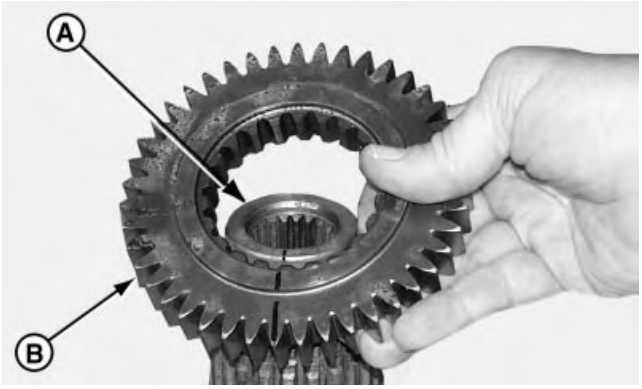
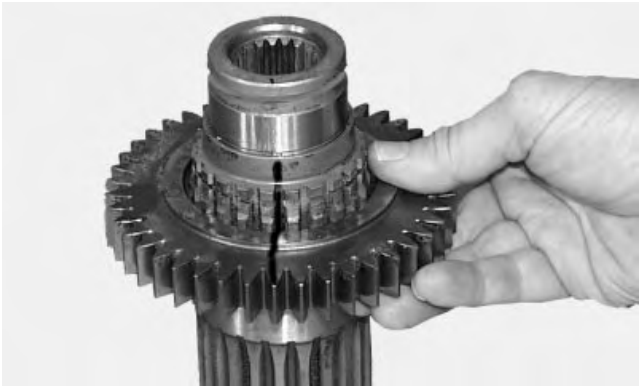
Assemble Input Shaft

1. Align marks made on input shaft (A) and gear (B).



YZ,CTM148,30,17 –19–28JUL98–1/4

2. Install gear on input shaft.

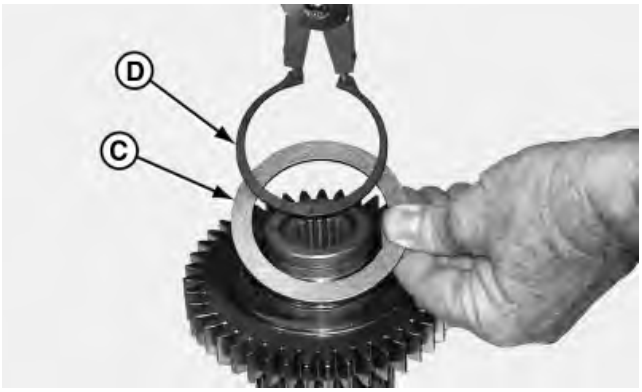


YZ,CTM148,30,17 –19–28JUL98–2/4

3. Install thrust race (C).

CAUTION: Wear safety glasses when removing or installing snap rings.

4. Install snap ring (D).

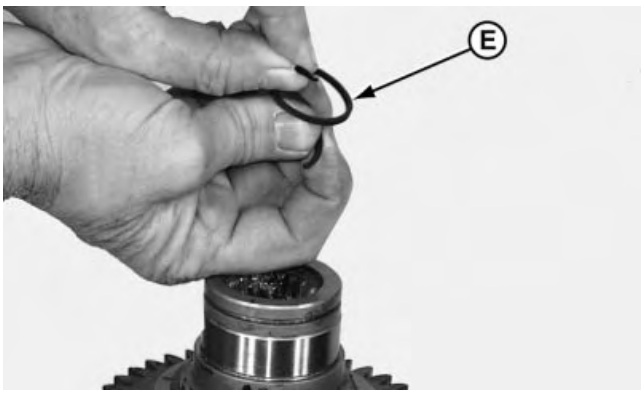


Continued on next page

YZ,CTM148,30,17 –19–28JUL98–3/4

IMPORTANT: Always use new seal rings. The seal rings must be sized to fit the shaft groove tightly to prevent damage during installation. Check that seal ring is in place and sized immediately before assembly.

5. Size the seal ring (E) by twisting in a tight circle, approximately 25 mm (1 in) in diameter.
6. Apply grease to the seal ring and seal surfaces.
7. Install seal ring (E).

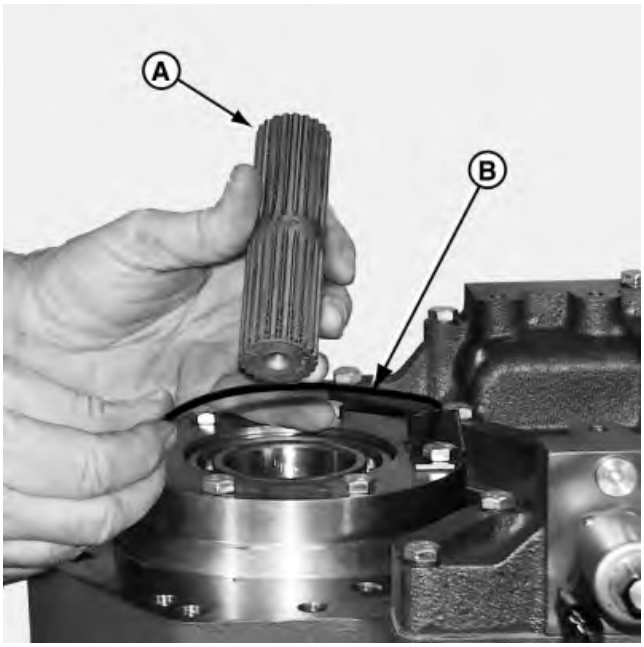


YZ1667 –UN–09JUL98

YZ,CTM148,30,17 –19–28JUL98–4/4

Remove Coupling Shaft and Retainer

1. Remove coupling shaft (A).
2. Remove O-ring (B).



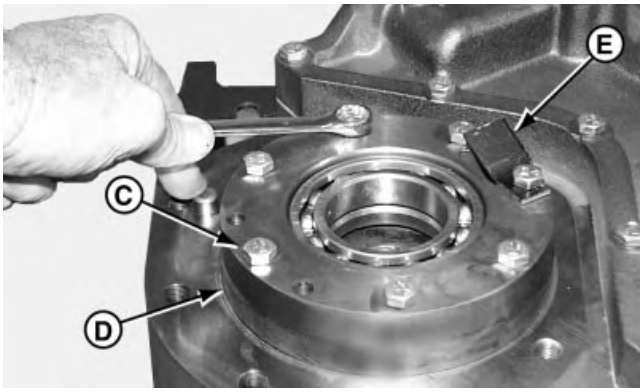
YZ1661 –UN–09JUL98

Continued on next page

YZ,CTM148,30,22 –19–28JUL98–1/4

IMPORTANT: Note the placement of the oil deflector (E). This part must be installed correctly for the transmission to function and lubricate properly.

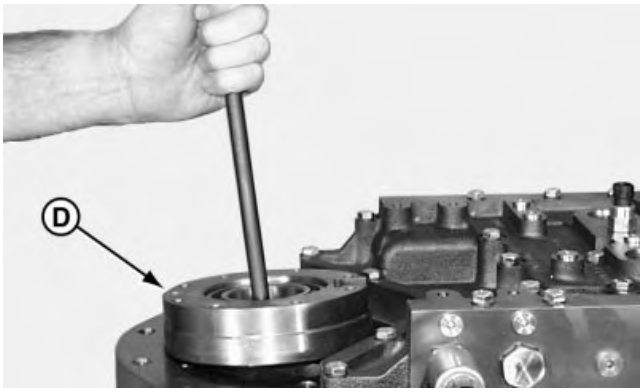
3. Remove seven cap screws (C) and oil deflector from bearing retainer assembly (D).



YZ,CTM148,30,22 –19–28JUL98–2/4

IMPORTANT: Do not scratch or damage the inside diameter of the bearing retainer. The input shaft seal ring surface will be damaged.

4. Remove bearing retainer (D).



YZ,CTM148,30,22 –19–28JUL98–3/4

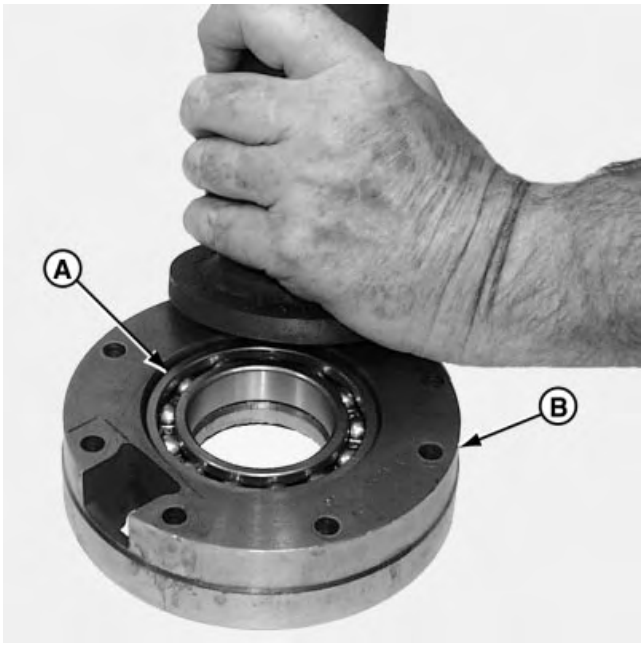
5. Use a soft drift to remove bearing (A). Do not damage retainer (B).

YZ,CTM148,30,22 –19–28JUL98–4/4

Assemble and Install Bearing Retainer

IMPORTANT: This bearing installs below flush. Firmly seated on the bottom of the bearing bore.

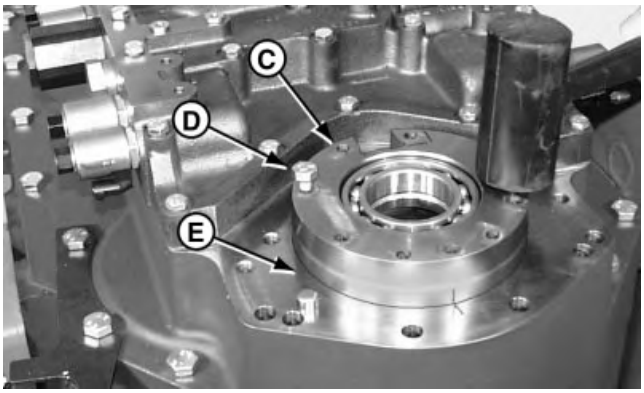
1. Install new bearing (A).



YZ1670 –UN–09JUL98

YZ,CTM148,30,33 –19–28JUL98–1/6

2. Install retainer with bearing (C). Use one of the attaching cap screws (D) to help align through holes in retainer with threaded holes in transmission front housing (E).

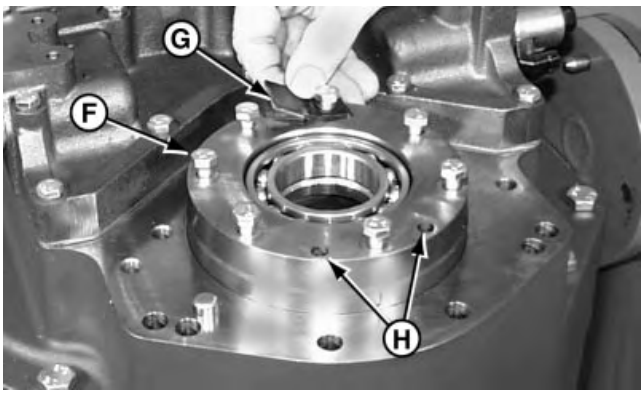


YZ1671 –UN–09JUL98

YZ,CTM148,30,33 –19–28JUL98–2/6

NOTE: There are two holes (H) in the retainer that are oil passages, not attaching holes.

3. Install seven cap screws (F) and deflector (G).



YZ1672 –UN–09JUL98

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YZ,CTM148,30,33 –19–28JUL98–3/6

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24

IMPORTANT: Pay attention to the placement of the oil deflector (G).

4. Install the oil deflector (G) as shown in the photograph.

5. Lubricate bearing with clean transmission fluid.

YZ1673 –UN–09JUL98

YZ,CTM148,30,33 –19–28JUL98–4/6

6. Tighten cap screws (F) to 37 N•m (27 lb-ft). Besure the oil deflector stays in its proper position.

YZ1674 –UN–09JUL98

YZ,CTM148,30,33 –19–28JUL98–5/6

7.

Lubricate the O-ring (J) with grease.

NOTE: O-ring must sit flat against front housing.

8. Install O-ring on bearing retainer.

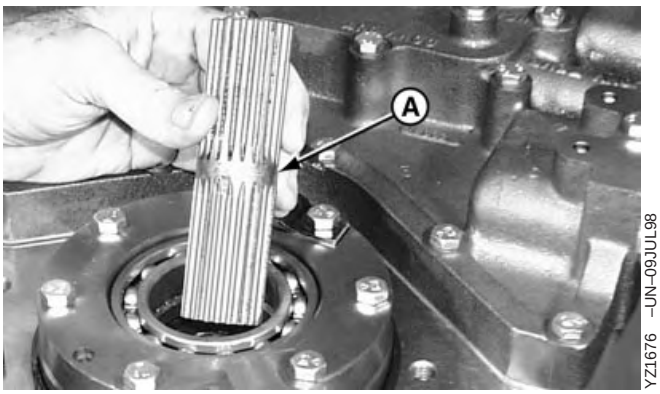
YZ1675 –UN–09JUL98

YZ,CTM148,30,33 –19–28JUL98–6/6

Install Coupling Shaft

1. Lubricate coupling shaft (A) with clean transmission fluid.
2. Install coupling shaft into transmission first stage shaft.

NOTE: Both ends of the shaft are the same.



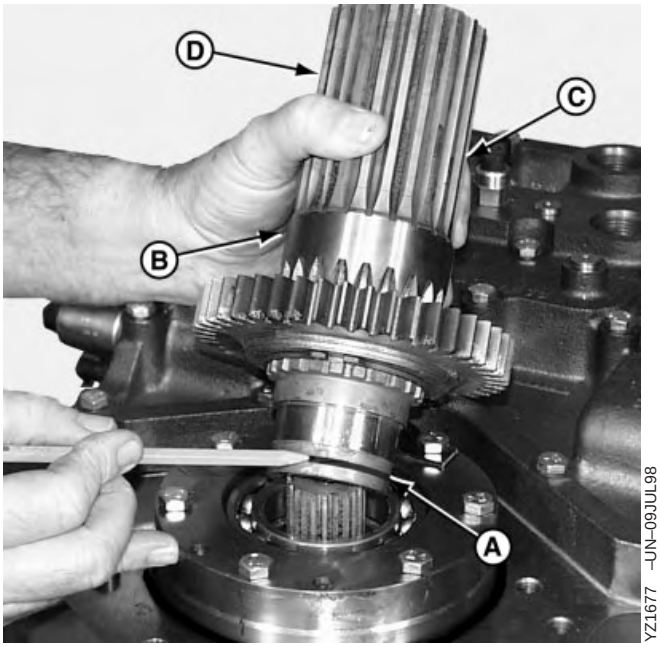
YZ,CTM148,30,34 –19–28JUL98–1/1

Install Input Shaft Assembly and Input Ball Bearing

IMPORTANT: Immediately before installing the input shaft assembly, check that the seal ring (A) is in place, sized and lubricated.

NOTE: Refer to ASSEMBLE INPUT SHAFT in this group for more information about sizing seal rings.

1. Check that the seal ring (A) is in place, sized and lubricated with grease.
2. Lubricate with grease the seal area (B) and the shaft splines (C).
3. Install the input shaft assembly (D).
4. Lubricate input ball bearing (E) with clean transmission fluid.
5. Install new ball bearing (B).



YZ,CTM148,30,12 –19–12SEP98–1/1

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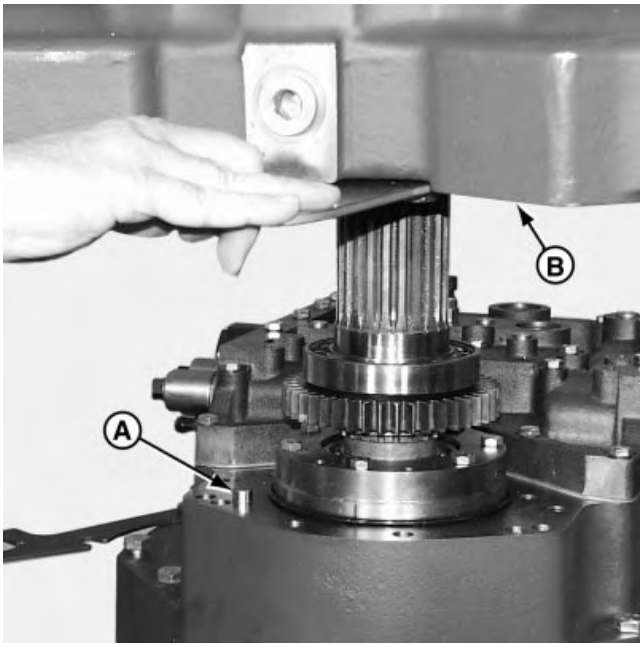
Install Input Housing Assembly

IMPORTANT: Dowel pin (A) must be installed. If left out, transmission will be damaged.

1. Check for dowel pin (A), if not in place, install dowel pin.

IMPORTANT: The input housing assembly and the transmission must be level to avoid damage to the oil seal as it moves over the input shaft spline.

2. Slowly lower the input housing assembly (B) onto front housing, input bearing and dowel pin.

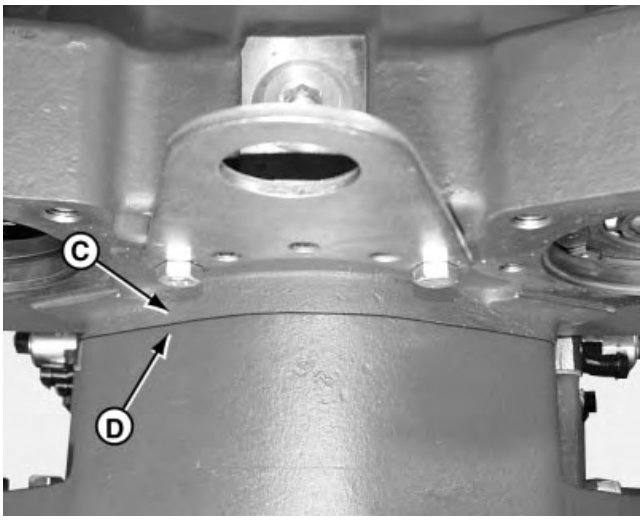


YZ1679 –UN–09JUL98

YZ,CTM148,30,41 –19–28JUL98–1/5

NOTE: Front housing (D) must mount flush with input housing assembly (C).

3. Check input housing (C).



YZ1680 –UN–17JUL98

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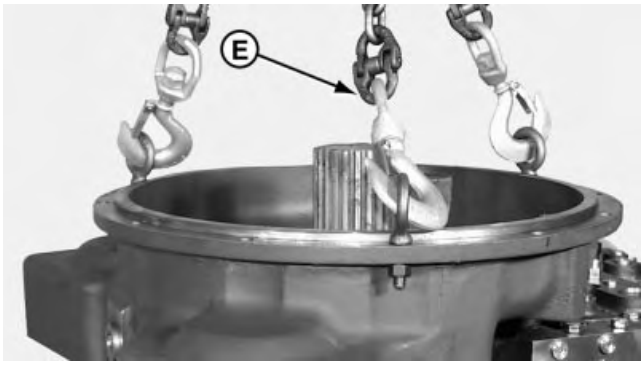
YZ,CTM148,30,41 –19–28JUL98–2/5

4. Remove lifting tooling (E).



YZ1681 –UN–17JUL98

YZ,CTM148,30,41 –19–28JUL98–3/5

5. Install seven cap screws (F).

YZ1682 –UN–17JUL98

YZ,CTM148,30,41 –19–28JUL98–4/5

6. Tighten cap screws (F) to 87 N•m (64 lb-ft).

YZ1683 –UN–09JUL98

YZ,CTM148,30,41 –19–28JUL98–5/5

Other Material

Number	Name	Use
	Transmission Fluid	All moving parts and o-rings.

YZCTM148,35,OTH –19–28JUL98–1/1

Specifications

Item	Measurement	Specification
Control valve-to-front housing cap screw (27).	Torque	40 N•m (30 lb-ft)
Proportional valve nut-to-proportional solenoid assembly (8).	Torque	1.7—2.8 N•m (15—25 lb-in)
7/16-20 plug-to-valve housing (12).	Torque	12 N•m (9 lb-ft)
9/16-18 plug-to-valve housing (2).	Torque	25 N•m (18 lb-ft)
Temperature sensor-to-valve housing.	Torque	16 N•m (12 lb-ft)
Proportional valve-to-valve housing (8).	Torque	16—20 N•m (12—15 lb-ft)
Main regulator assembly-to-valve housing.	Torque	142 N•m (105 lb-ft)
Relief valve assembly-to-valve housing.	Torque	102 N•m (75 lb-ft)
Valve assembly	Weight	25 Kg (55 lbs)

CTM148,35,SPC –19–14SEP98–1/1

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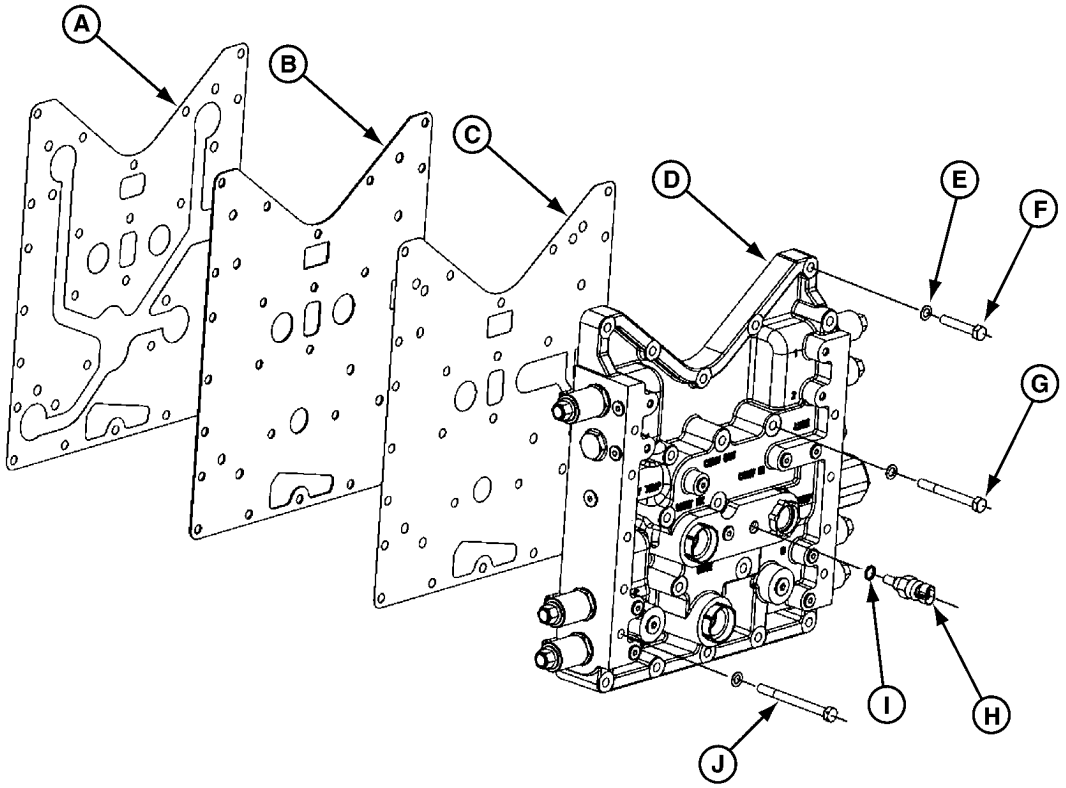
Control Valve Group



YZ713A –UN–10MAR98

A—Gasket
B—Plate
C—Gasket
D—Valve Assembly
E—Flat Washer (27 used)
F—Cap screw M8x45 10.9 (5 used)
G—Cap screw M8x75 10.9 (13 used)
H—Temperature Sender
I—O-ring
J—Cap screw M8x90 10.9 (9 used)

YZ,CTM148,35,6 –19–28JUL98–1/1

Remove Control Valve Group

1. Tag all electrical connections.
2. Remove wiring harness.
3. Remove charge pump group.
4. Remove input housing group.

REMOVE TEMPERATURE SENSOR

Remove temperature sensor.

INSTALL TEMPERATURE SENSOR

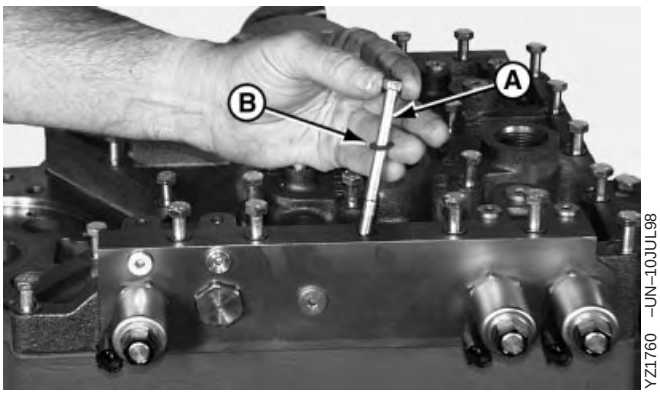
Install temperature sensor and tighten to 24—27 N•m (18—20 lb-ft).

IMPORTANT: Do not allow any of the flat washers (B) to fall into control valve assembly or transmission openings. The transmission may not operate properly or damage may result.

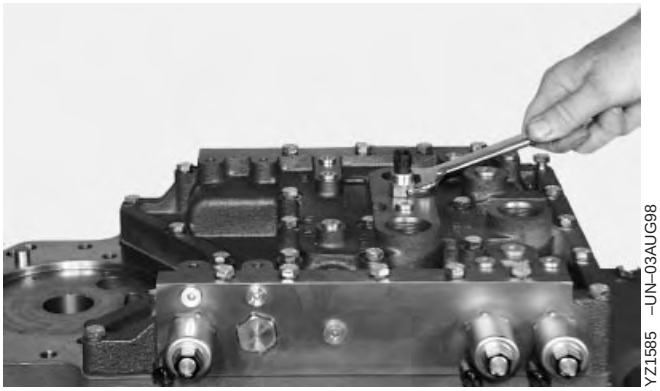
5. Remove 27 cap screws (A) and flat washers (B).

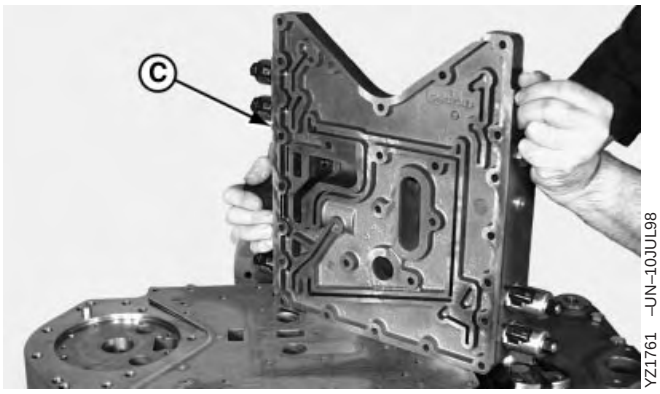
CAUTION: Approximate weight of valve assembly is 25 Kg (55 lbs).

6. Remove valve assembly (C).



YZ1760 –UN–10JUL98


YZ1585 –UN–03AUG98



YZ1761 –UN–10JUL98

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YZ,CTM148,35,2 –19–28JUL98–1/2

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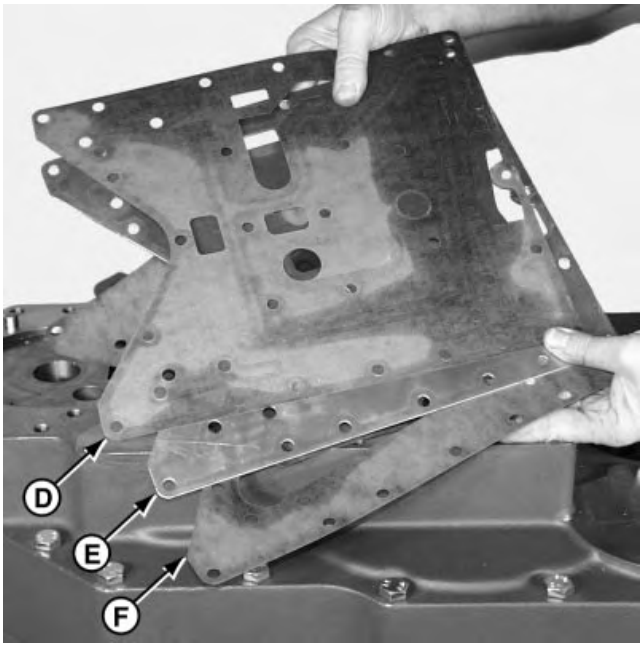
7. Remove and discard gasket (D).

IMPORTANT: Do not bend plate (E).

8. Remove plate (E).

9. Remove and discard gasket (F).

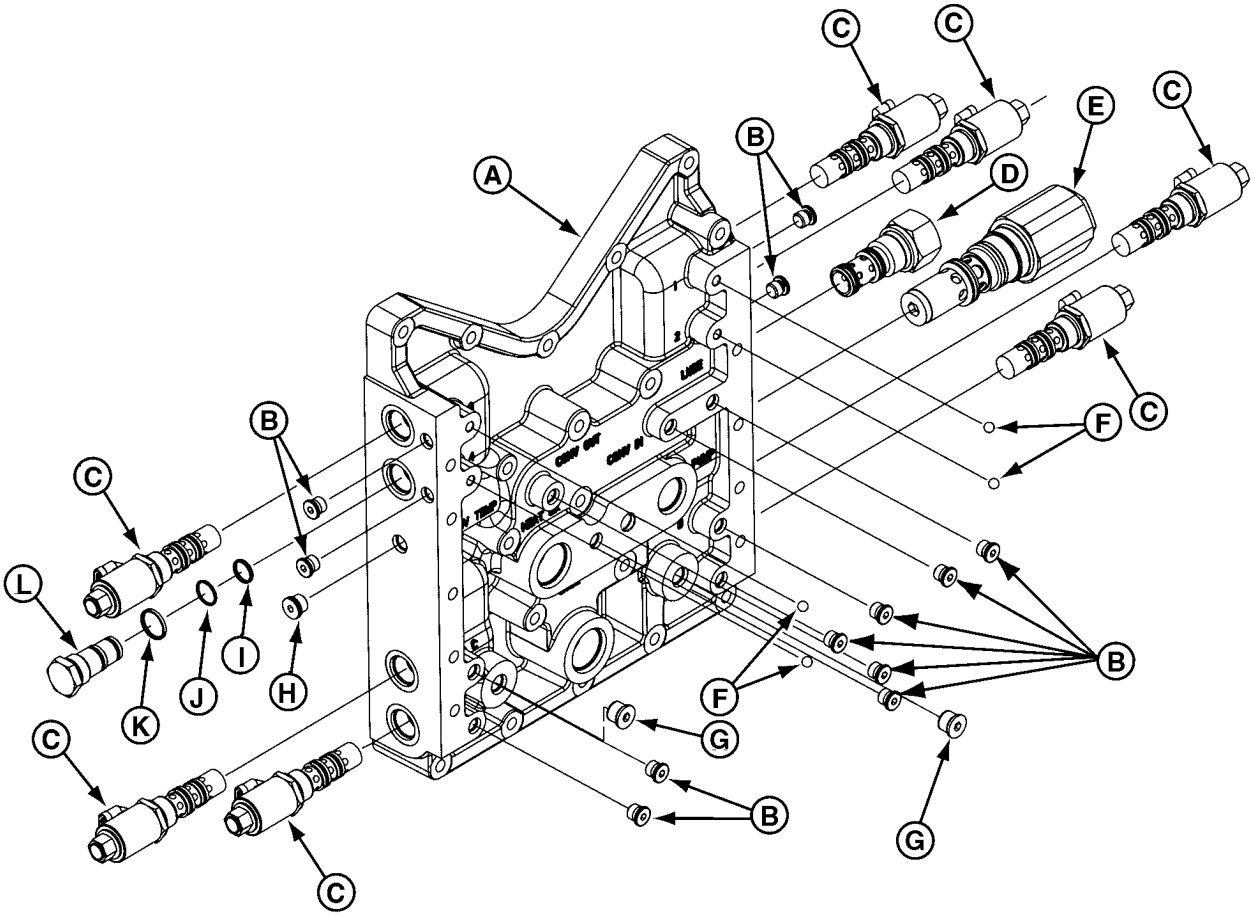
10. Clean and inspect all gasket surfaces.



YZ1762 –UN–10JUL98

YZ,CTM148,35,2 –19–28JUL98–2/2

Disassemble and Assemble Control Valve



YZ714A –UN–10MAR98

A—Valve Housing
B—Hex Socket Plug 7/16-20 (12 used)
C—Proportional 12 or 24 Volt Valve (7 used)
D—90 Relief Valve
E—Main Regulator Assembly
F—Steel Ball 9/32 (4 used)
G—Hex Socket Plug 9/16-18 (2 used)
H—Plug
I—O-ring
J—O-ring
K—O-ring
L—Proportional Solenoid Plug

THE CARTRIDGE TYPE VALVES USED IN THIS ASSEMBLY ARE NOT USER REPAIRABLE. ANY VALVE FOUND TO BE DEFECTIVE MUST BE REPLACED AS A UNIT.

IMPORTANT: Cartridge valves require a O-rings. When assembling valves grease all O-rings. Use only new O-rings. Install new O-rings onto cartridge type valve.

USE THE DRAWINGS PROVIDED AS GUIDES FOR FURTHER DISASSEMBLY AND ASSEMBLY OF THE CONTROL VALVE.

YZ,CTM148,35,7 –19–28JUL98–1/1

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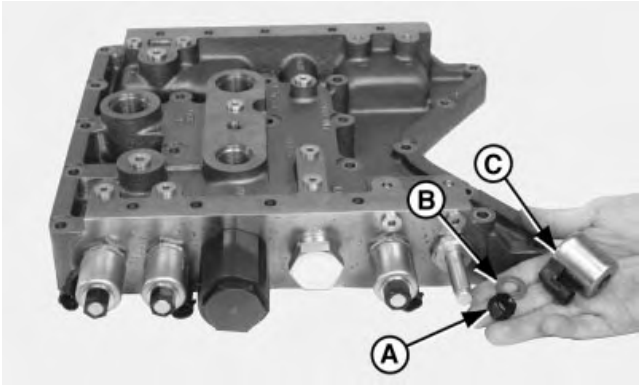
Disassemble Valve Assembly

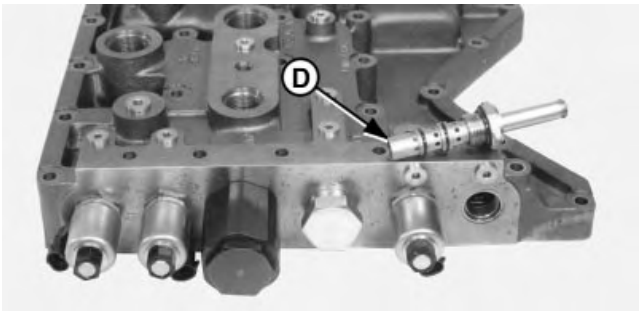
PROPORTIONAL SOLENOID

1. Remove nut (A), washer (B) and coil (C) from proportional solenoid.



CTM148,35,3 –19–10NOV98–1/2

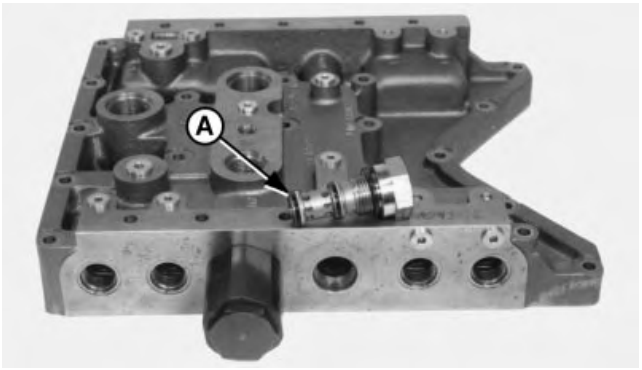
2. Remove proportional valve (D).
3. Inspect for contamination.



CTM148,35,3 –19–10NOV98–2/2

Remove 90 Relief Valve

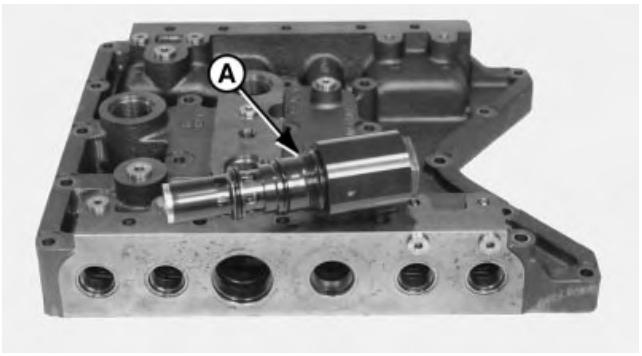
1. Remove 90 relief valve (A).
2. Inspect for wear and contamination.



CTM148,35,4 –19–10NOV98–1/1

Remove Main Regulator Assembly

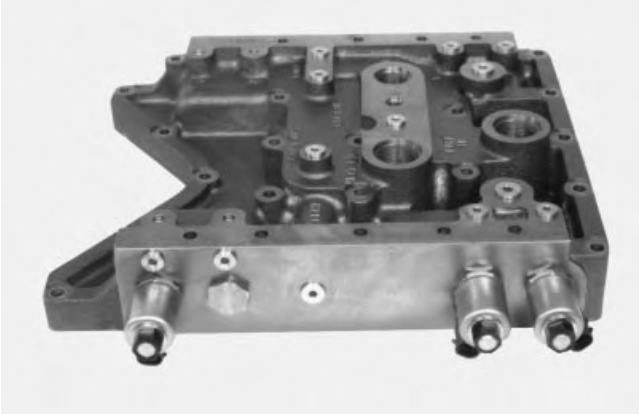
1. Remove main regulator assembly (A).
2. Inspect for contamination.



CTM148,35,5 –19–28JUL98–1/1

Remove Proportional Plug

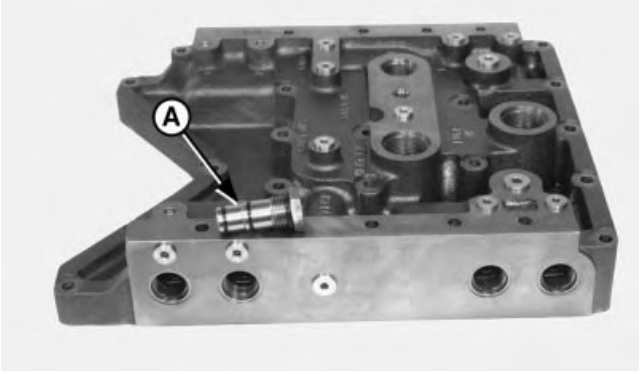
1. Remove solenoid assemblies.



YZ1535 –UN–13JUN98

CTM148,35,6 –19–28JUL98–1/2

2. Remove proportional plug (A).
3. Inspect for contamination.

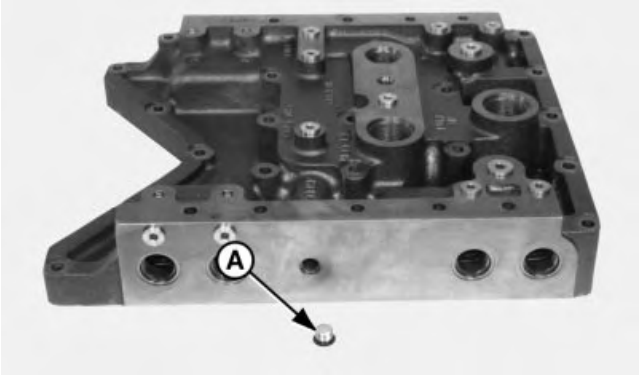


YZ1536 –UN–13JUN98

CTM148,35,6 –19–28JUL98–2/2

Remove Plug

1. Remove plug (A).
2. Inspect for contamination.



YZ1537 –UN–13JUN98

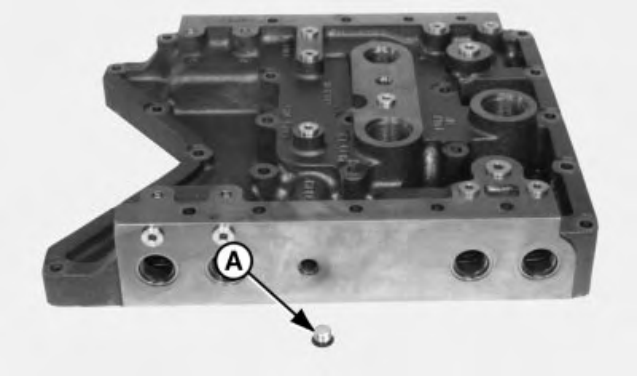
CTM148,35,7 –19–28JUL98–1/1

Install Plug

1. Lubricate new o-ring.
2. Install new o-ring onto plug.

CTM148,35,8 –19–28JUL98–1/2

3. Install plug (A).
4. Tighten plug to 12 N•m (9 lb-ft).



YZ1537 –UN–13JUN98

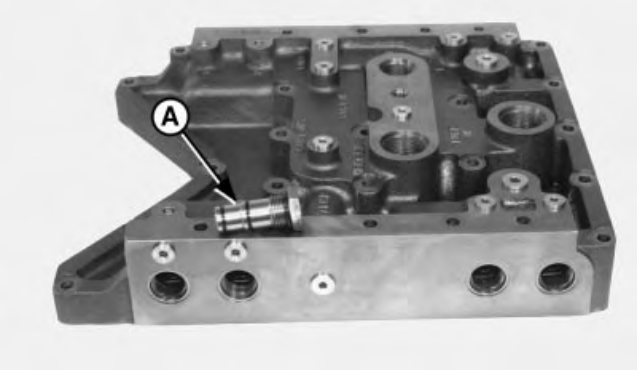
CTM148,35,8 –19–28JUL98–2/2

Install Proportional Plug

1. Lubricate new o-rings (3).
2. Install new o-rings onto proportional plug.

CTM148,35,10 –19–28JUL98–1/2

3. Install proportional plug (A).
4. Tighten proportional plug.



YZ1536 –UN–13JUN98

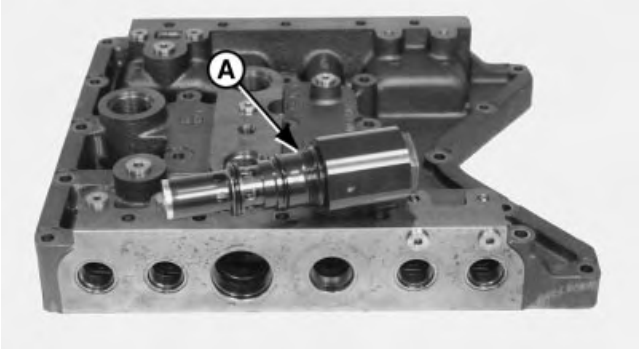
CTM148,35,10 –19–28JUL98–2/2

Install Main Regulator Assembly

1. Lubricate new o-rings (2).
2. Install new o-rings.

CTM148,35,12 –19–28JUL98–1/2

3. Install main regulator assembly (A).
4. Tighten main regulator assembly 142 N•m (105 lb-ft).

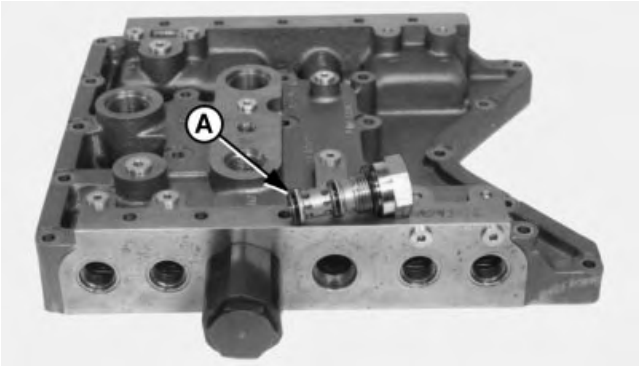


YZ1534 –UN–13JUN98

CTM148,35,12 –19–28JUL98–2/2

Install Relief Valve

1. Lubricate new o-rings (3).
2. Install new o-rings (A).
3. Install relief valve.
4. Tighten relief valve 102 N•m (75 lb-ft).

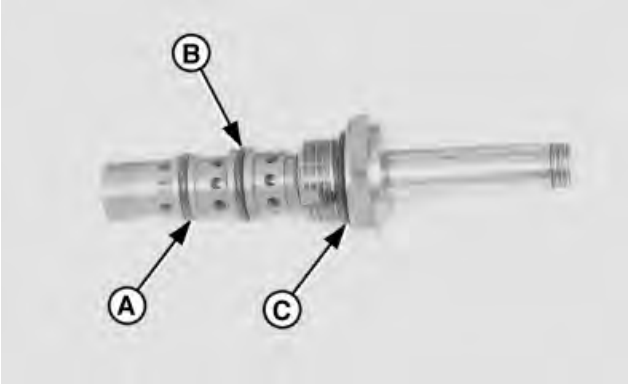


YZ1533 –UN–13JUN98

CTM148,35,13 –19–28JUL98–1/1

Install Proportional Solenoid Assembly

1. Install new o-ring's (A), (B) and (C) onto proportional valve.



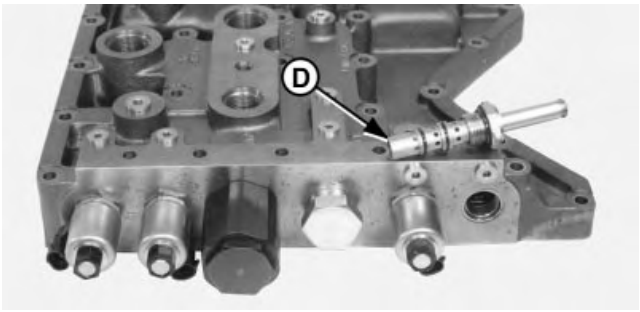
YZ327 –UN–24SEP96

Continued on next page

CTM148,35,15 –19–23SEP03–1/4

2. Install proportional valve (D) into valve housing.

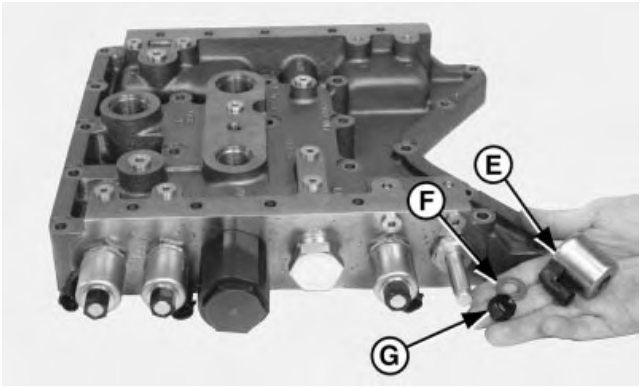
3. Tighten proportional valve 16—20 N•m (12—15 lb-ft).



YZ1532 –UN–13JUN98

CTM148,35,15 –19–23SEP03–2/4

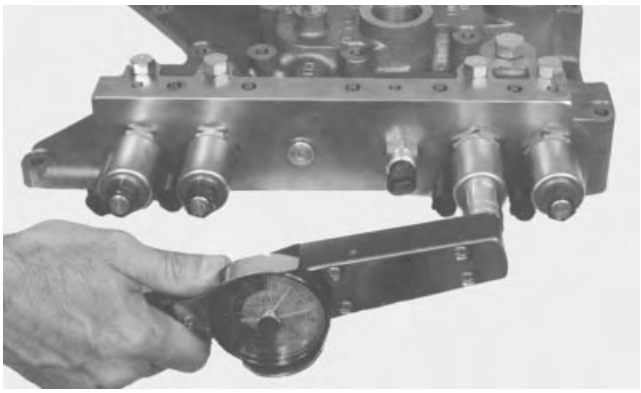
4. Install coil (E), washer (F) and nut (G) onto proportional valve.



YZ1538 –UN–13JUN98

CTM148,35,15 –19–23SEP03–3/4

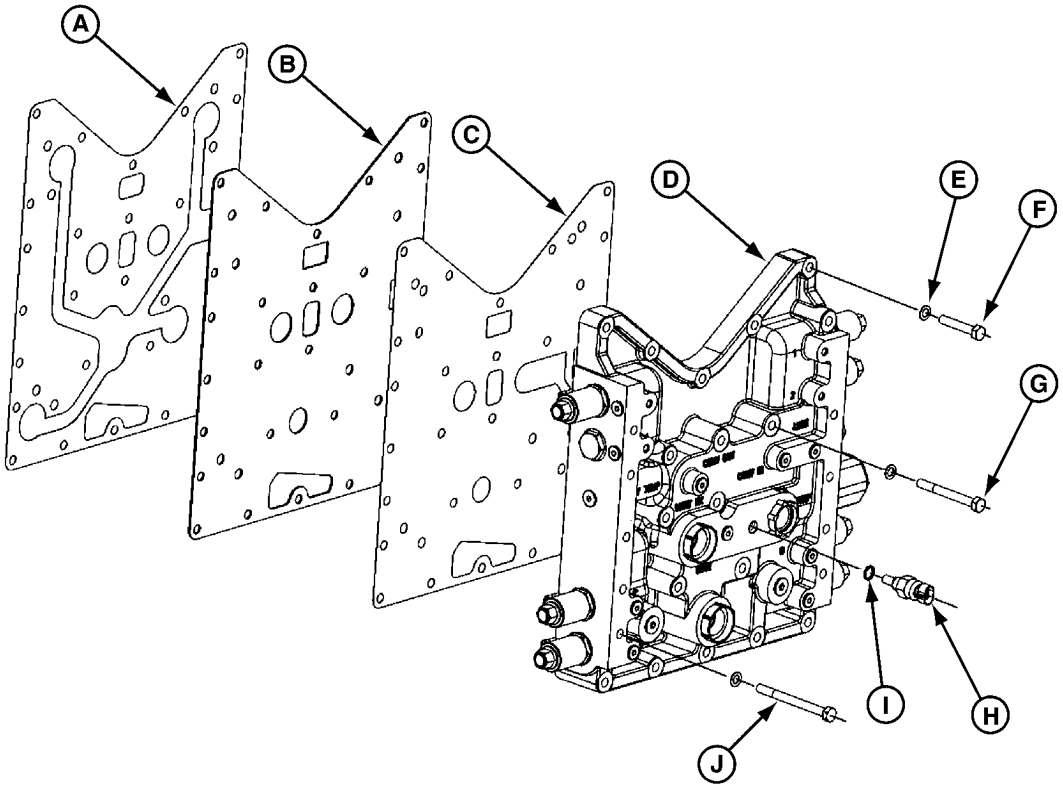
5. Tighten nut 4.5—6.3 N•m (40—60 lb-in).



YZ328 –UN–25APR97

CTM148,35,15 –19–23SEP03–4/4

Install Control Valve Group



YZ713A –UN–10MAR98

A—Gasket
B—Plate
C—Gasket
D—Valve Assembly
E—Flat Washer (27 used)
F—Cap screw M8x45 10.9 (5 used)
G—Cap screw M8x75 10.9 (13 used)
H—Temperature Sender
I—O-ring
J—Cap screw M8x90 10.9 (9 used)

IMPORTANT: The gaskets and metal plate must be installed correctly. The first gasket is cut out to the shape of the casting on the front housing. The second gasket is cut out to the shape of the metal plate and has a boot-like shape cut out of it.

1. Install gasket (A).
2. Install plate (B).
3. Install gasket (C).
4. Install valve assembly (D).
5. Install cap screws (F), (G) and (J) and washers (E). Observe tightening sequence and torque specifications given in this section.

YZ,CTM148,35,12 –19–28JUL98–1/1

Install Gaskets and Plate to Front Housing to Front Housing Valve Surface

IMPORTANT: There are two (2) gaskets and a plate that go between the valve assembly and front housing. The first gasket is cut out to the shape of the casting on the front housing. The second gasket is cut out to the shape of the metal plate and has a boot-like shape cut out of it.

NOTE: Guide pins used are bolts with heads removed. Guide pins length will need to be long enough for removal after placing valve housing assembly onto front housing.

1. Install two guide pins (A).

IMPORTANT: Gasket must match opening in front housing.

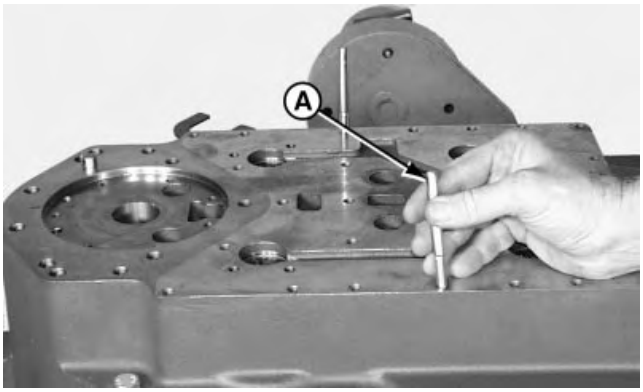
2. Place and fit new gasket (B) onto front housing using guide pins (A) as holders.

IMPORTANT: Opening in plate must match opening in gasket.

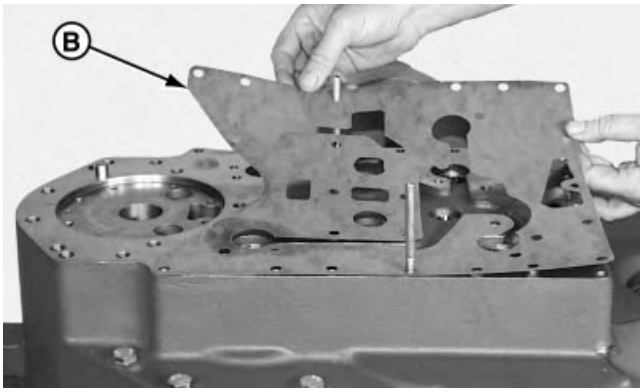
3. Place plate (C) over the guide pins and onto gasket (B).

IMPORTANT: Cut out opening in gasket must match opening in plate.

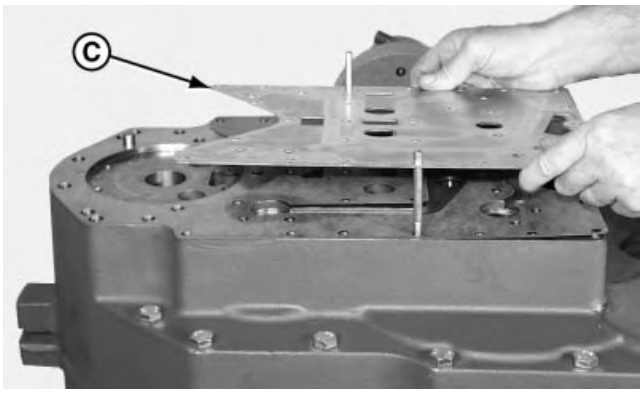
4. Place new gasket (D) over guide pins onto plate (C).



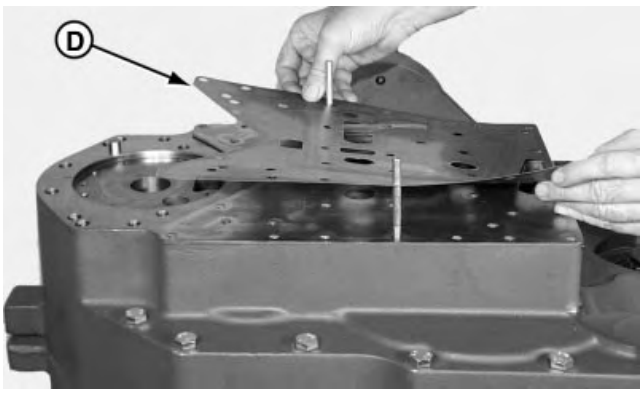
YZ1765 –UN–10JUL98



YZ1763 –UN–10JUL98



YZ1764 –UN–10JUL98



YZ1766 –UN–10JUL98

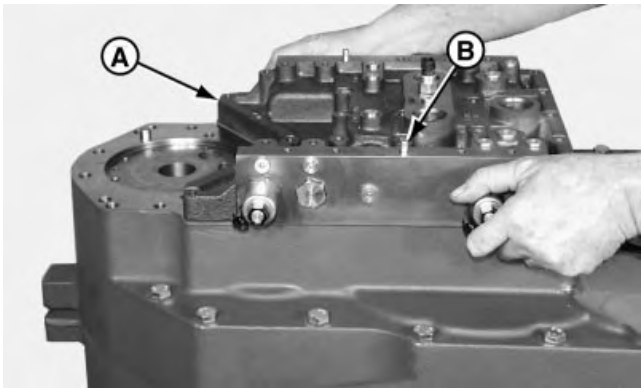
CTM148,35,17 –19–28JUL98–1/1

Install Control Valve Assembly

CAUTION: The valve assembly weighs approximately 25 Kg (55 lbs).

NOTE: Guide pins (B) must be long enough to remove after installing valve assembly.

1. Install valve assembly (A).
2. Remove guide pins (B).



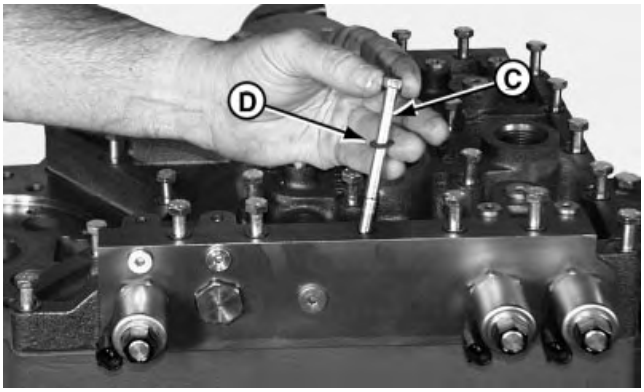
YZ1767 –UN–10JUL98

CTM148,35,19 –19–28JUL98–1/3

IMPORTANT: The 27 cap screws (C) that attach the control valve are three different lengths. Use proper length cap screws for each cap screw hole.

Do not allow washers to fall into any opening in valve assembly or transmission openings.

3. Install 27 cap screws (C) and flat washers.

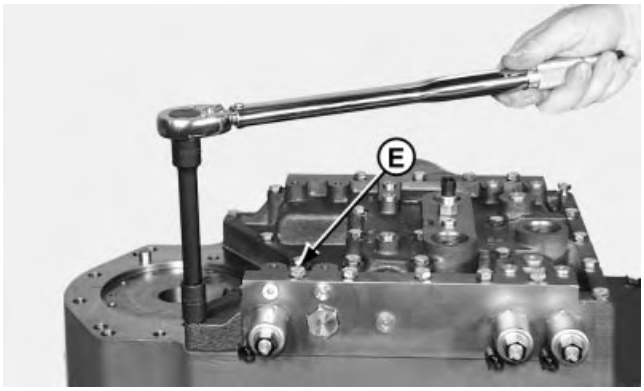


YZ1768 –UN–10JUL98

CTM148,35,19 –19–28JUL98–2/3

IMPORTANT: Tighten cap screws (E) evenly in sequence as directed by instructions in, "CAP SCREW TIGHTENING SEQUENCE AND TORQUE SPECIFICATIONS" found in this section.

4. Tighten cap screws to torque specifications and tightening sequence in this section.
5. Tighten cap screws (E) to 40 N•m (30 lb-ft).



YZ1769 –UN–10JUL98

CTM148,35,19 –19–28JUL98–3/3

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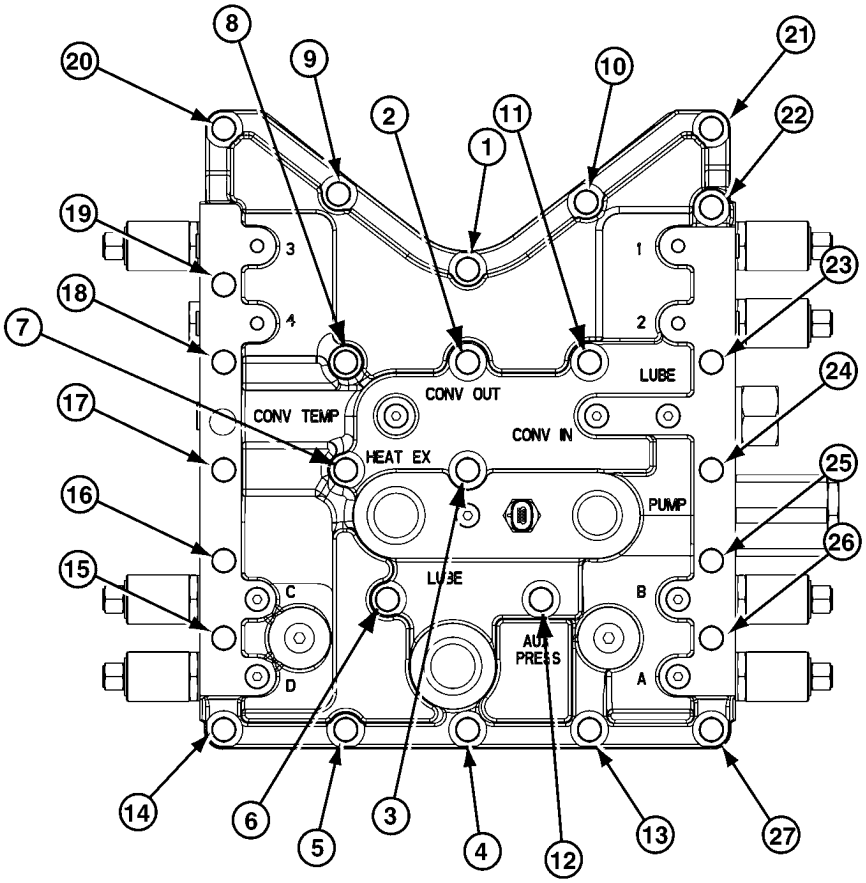
Cap Screw Tightening Sequence and Torque Specifications



YZ735A –UN–10MAR98

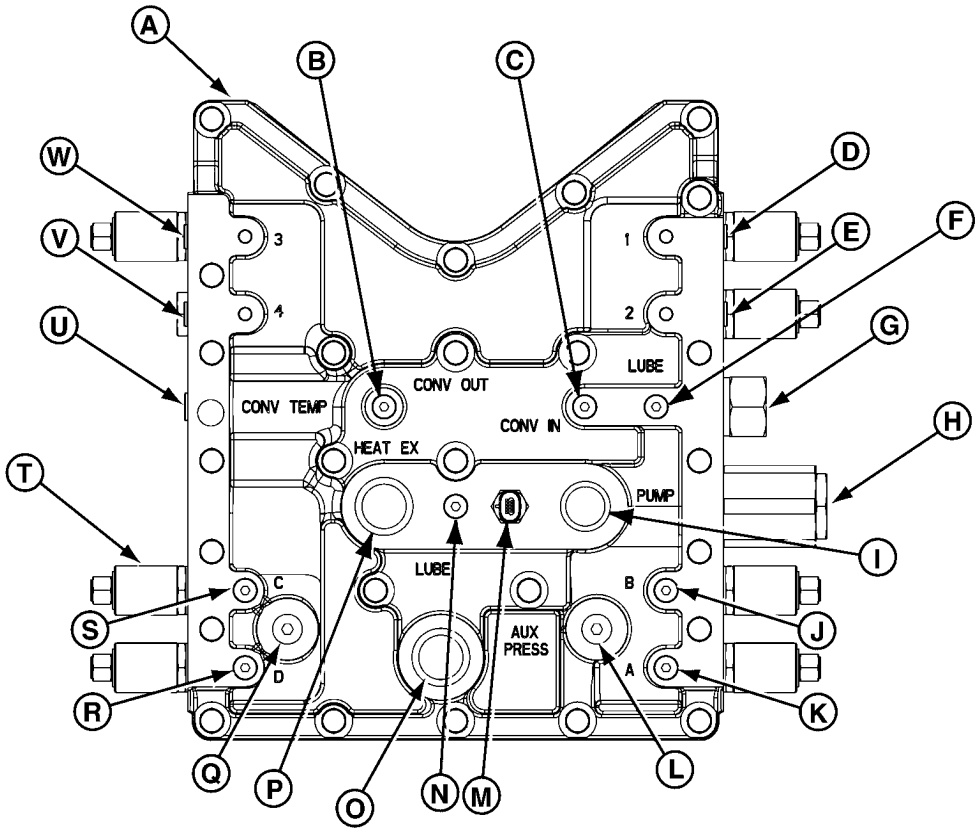
Tighten cap screws in rotational sequence represented by call outs.

1. First rotational sequence tighten all cap screws to 40 N•m (30 lb-ft).
2. Repeat step 1.

CONTROL VALVE CAP SCREW TORQUE SPECIFICATIONS.....40 N•m (30 lb-ft)

YZ,CTM148,35,10 –19–28JUL98–1/1

Pressure and Temperature Check Ports (Without Wet Brake)



YZ734A –UN–13MAR98

A—Valve Housing
B—Converter Out Pressure Check Port
C—Converter In Pressure Check Port
D—Clutch 1 Pressure Check Port
E—Clutch 2 Pressure Check Port
F—Lube Pressure Check Port
G—Converter Relief
H—Pressure Regulator
I—Pump In Port
J—Clutch B Check Port
K—Clutch A Check Port
L—Auxiliary Pressure Source
M—Temperature Sensor
N—System Pressure Check Port
O—Lube In Port
P—Oil Out To Heat Exchanger
Q—Auxiliary Pressure Source
R—Clutch D Check Port
S—Clutch C Check Port
T—Solenoid Assembly
U—Converter Out Temperature
V—Clutch 4 Check Port
W—Clutch 3 Check Port

Operating Conditions

Engine speed at 2000 rpm

Transmission temperature range at 65—93°C (150°—200°F).

Pump flow 87—102 L/min (23—27 gpm) at 1655—1931 kPa (255—280 psi).

Port Pressures

In neutral

- Converter in 60—115 psi (see footnote)[1]
- Converter out 40—90 psi
- Lube 40—60 psi

[1]In neutral, "Converter In" pressure should always be higher than Lube pressure.

Continued on next page

In gear

- Lube 20—40 psi

Following is identification of ports as they are marked on the valve body casting.

Ports marked 1, 2, 3 and 4 are Direction Clutch Ports.

- 1 and 2 are forward clutches.
- 3 and 4 are reverse clutches.

Ports marked A, B, C and D are Speed Clutch Ports.

NOTE: All check ports are 7/16-20 UNF SAE O-ring, unless otherwise specified.

YZ,CTM148,35,3 –19–28JUL98–2/2

Other Material

Number	Name	Use
	Transmission fluid	All moving parts and o-rings.
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Oil seal

LOCTITE is a trademark of Loctite Corp.

YZCTM148,40,OTH –19–28JUL98–1/1

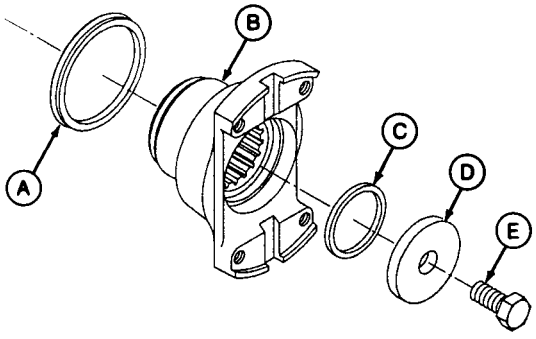
Specifications

Item	Measurement	Specification
Front housing-to-rear housing cap screws.	Torque	87 N•m (64 lb-ft)
Front housing.	Weight	120 Kg (265 lbs.)
1 5/8 Plug	Torque	190 N•m (140 lb-ft)

YZCTM148,40,SPC –19–14SEP98–1/1

Output Yoke

A—V-ring seal
B—Yoke
C—O-ring
D—Yoke washer
E—Cap screw



YZ,CTM148,40,1 –19–28JUL98–1/1

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40
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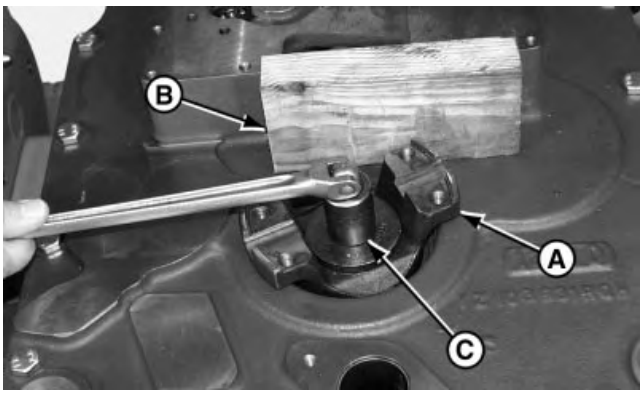
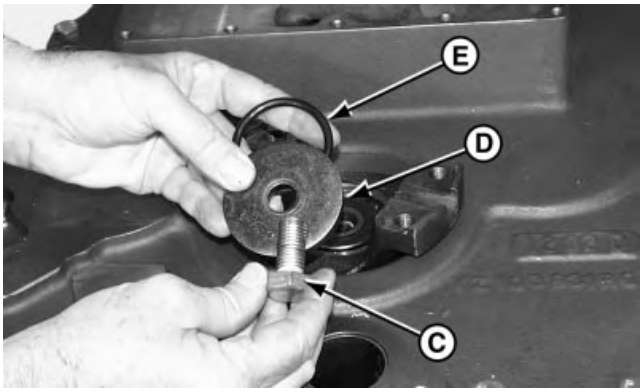
Remove Output Yoke

NOTE: Output yoke will turn when removing cap screw. Place block of wood or similar object between yoke and housing to aid in removing output yoke assembly.

1. Loosen cap screw (C).
2. Remove cap screw (C) washer (D) and O-ring (E).
3. Remove output yoke (A).



YZ1703 –UN–09JUL98

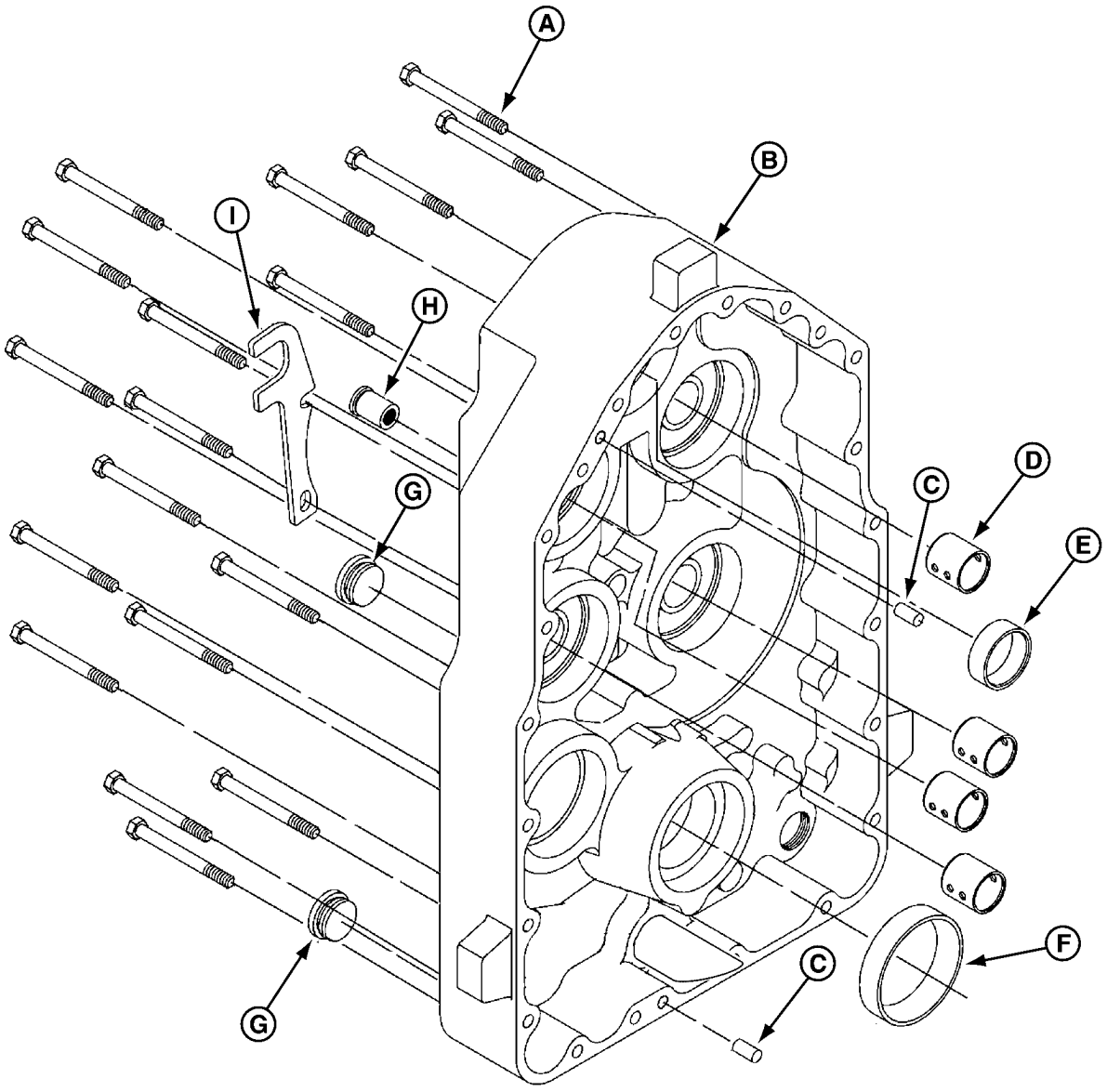


YZ1704 –UN–09JUL98

YZ1705 –UN–09JUL98

YZ,CTM148,40,17 –19–28JUL98–1/1

Disassemble and Assemble Front Housing



YZ1582 –UN–25JUL98

A—Hex Flange Bolts 12x120mm (18 used)
B—Front Housing (DF250)
C—Bore Sleeve (4 used)
D—Input Bushing
E—Dowel Pin (2 used)
F—Bearing Cup
G—Plug with O-ring (2 used)
H—Lube Relief Valve Assembly
I—Bracket

YZ,CTM148,40,18 –19–28JUL98–1/1

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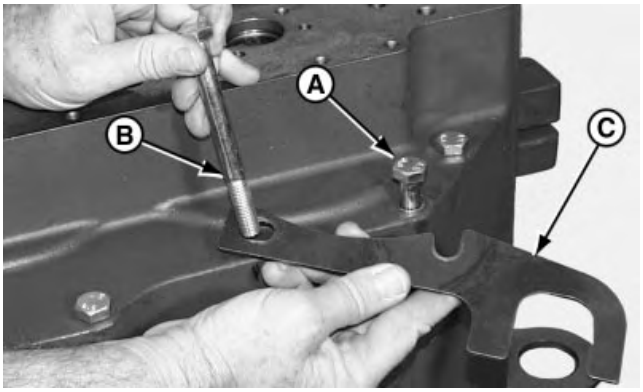
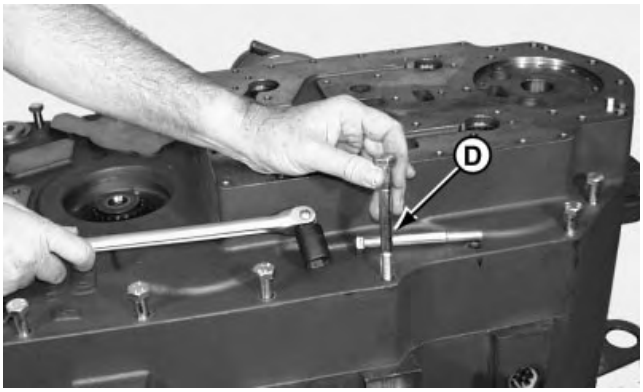
Remove Cap Screws and Wiring Connector Bracket From Front Housing

1. Loosen cap screw (A).
2. Remove cap screw (B).
3. Remove wiring connector bracket (C).



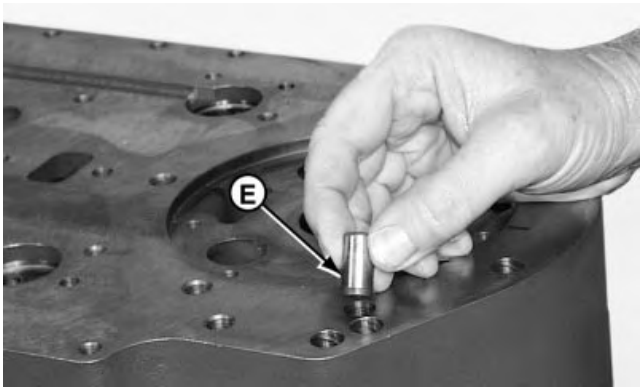
YZ,CTM148,40,19 –19–28JUL98–1/3

4. Remove remaining cap screws (D).



YZ,CTM148,40,19 –19–28JUL98–2/3

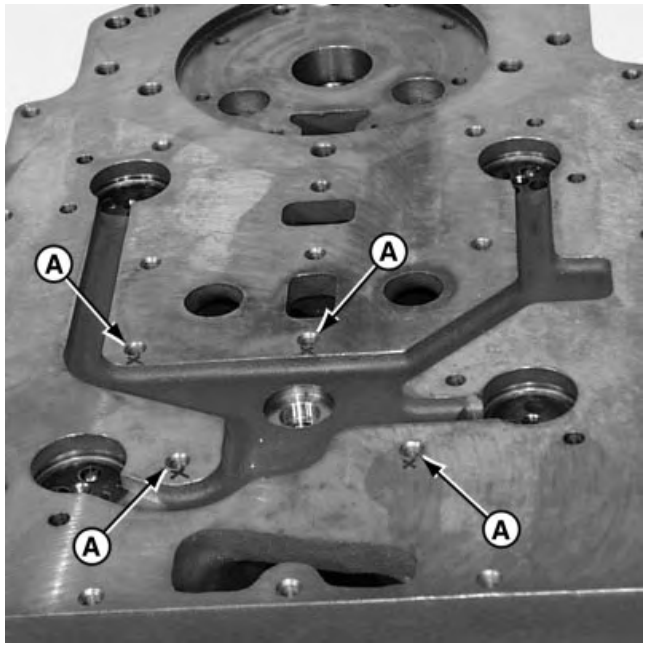
5. Remove dowel pin (E) if loose.



YZ,CTM148,40,19 –19–28JUL98–3/3

Install Front Housing Lifting Tool

1. Use four threaded holes (A) in the front housing to attach lifting tool.

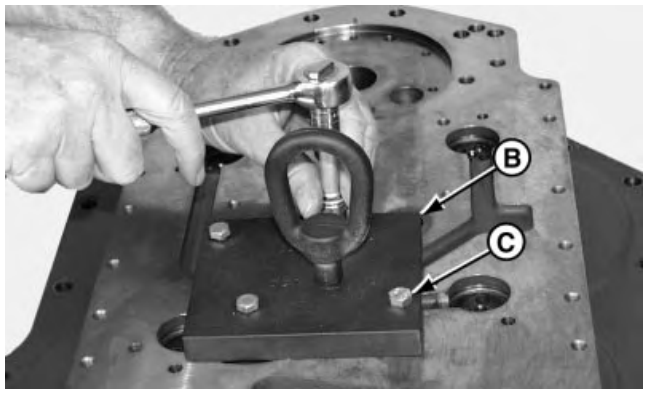


YZ1709 –UN–09JUL98

YZ,CTM148,40,13 –19–28JUL98–1/3

CAUTION: Use four high grade fasteners (C) of the correct length to attach the lifting tool to the front housing.

2. Position lifting tool (B).



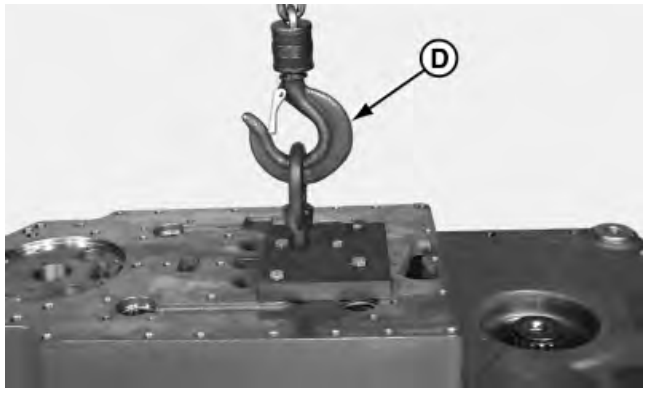
YZ1710 –UN–09JUL98

YZ,CTM148,40,13 –19–28JUL98–2/3

3. Install four cap screws (C).

CAUTION: The front housing assembly weighs approximately 120 Kg (265 lbs).

NOTE: Use a hoist with a safety hook (D) when removing the front housing.



YZ1711 –UN–09JUL98

YZ,CTM148,40,13 –19–28JUL98–3/3

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40
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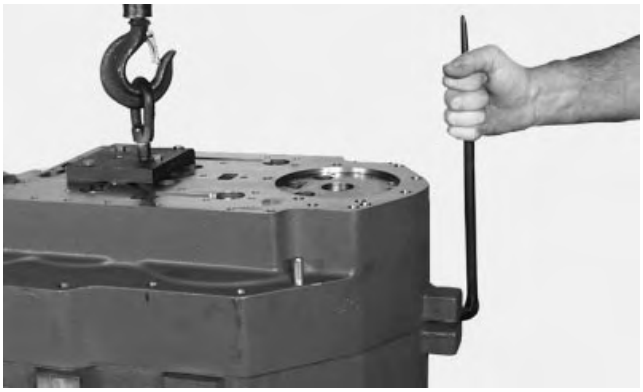
Remove Front Housing



YZ,CTM148,40,24 –19–28JUL98–1/4

IMPORTANT: Pry on the housings to loosen the gasket seal, use lugs provided on the front and rear housings.

CAUTION: The front housing assembly weighs approximately 120 Kg (265 lbs.) Do not allow any part of the body under the front housing assembly.

1. Remove front housing.

YZ,CTM148,40,24 –19–28JUL98–2/4

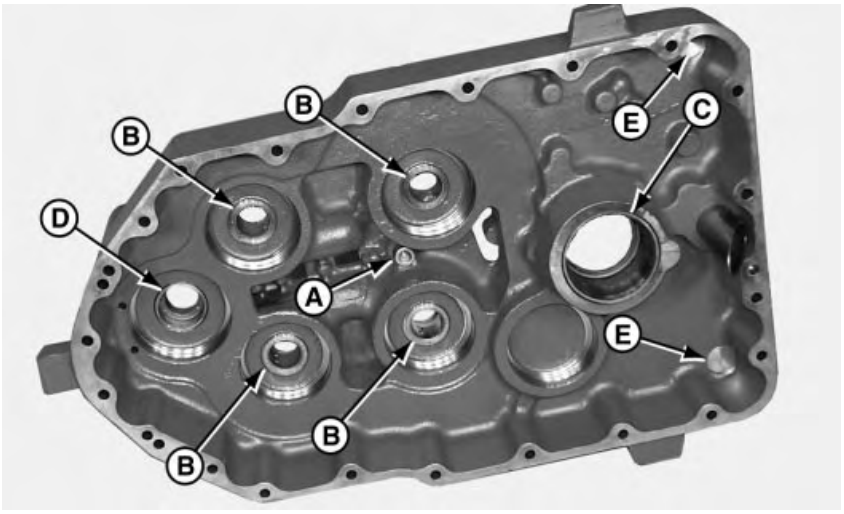
2. Remove and discard gasket (C).

YZ,CTM148,40,24 –19–28JUL98–3/4

3. Check for two dowel pins (D).

YZ,CTM148,40,24 –19–28JUL98–4/4

Disassemble the Front Housing Assembly



YZ1716 –UN–09JUL98

A—Lube relief valve
B—Bore sleeve (4 used)
C—Bearing cup
D—Input bushing
E—Plug with O-ring (2 used)

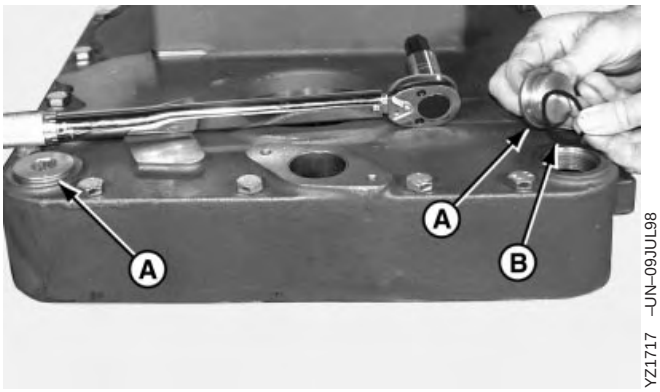
YZ,CTM148,40,2 –19–28JUL98–1/2

Remove Plug with O-Ring

1. Remove two plugs (A) with O-rings.
2. Remove O-rings (B) and discard.

Install Plug with O-Ring

1. Lubricate new O-rings.
2. Install new O-rings.
3. Install plugs with O-rings.
4. Tighten to 190 N•m (140 lb-ft).



YZ1717 –UN–09JUL98

YZ,CTM148,40,2 –19–28JUL98–2/2

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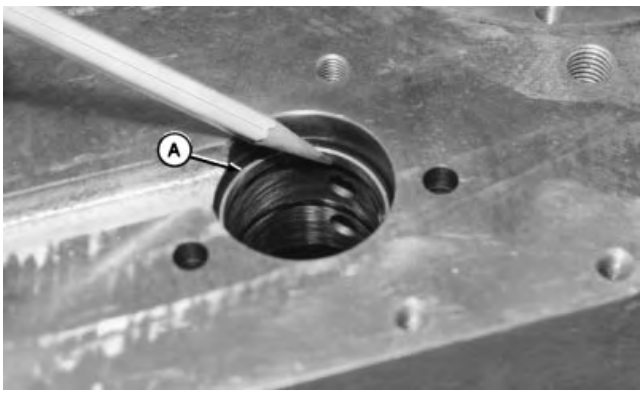
8

Remove Bore Sleeves

1. Inspect bore sleeves (A) for wear or damage.

NOTE: See group 99, special tools.

2. Remove bore sleeves from front side of front housing.



YZ610 –UN–19MAR98

YZ611 –UN–19MAR98

YZ,CTM148,40,5 –19–28JUL98–1/1

Install Bore Sleeves

1. Position front housing with bearing bore side up.

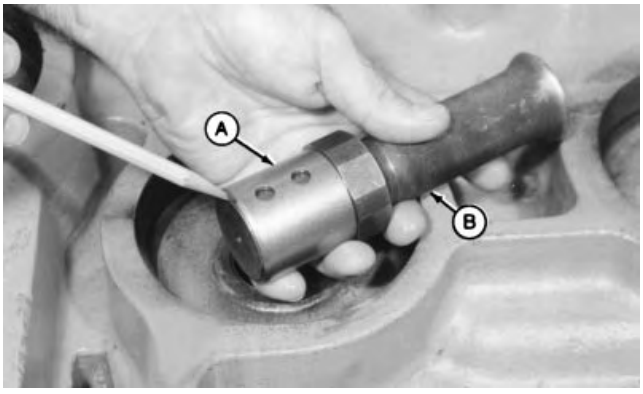
YZ617 –UN–19MAR98

YZ,CTM148,40,6 –19–28JUL98–1/3

IMPORTANT: Install bore sleeves with the internal chamfer up.

2. Place bore sleeve (A) onto driving tool (B) with outside diameter chamfer of bore sleeve to end of tool.

NOTE: See group 99, special tools.



YZ618 –UN–19MAR98

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YZ,CTM148,40,6 –19–28JUL98–2/3

3. Install bore sleeve flush with shoulder.

YZ,CTM148,40,6 –19–28JUL98–3/3

Remove Lube Relief Valve

1. Position front housing with bearing bore side up.

YZ,CTM148,40,7 –19–28JUL98–1/2

2. Remove lube relief valve (A).

NOTE: See group 99, special tools.

YZ,CTM148,40,7 –19–28JUL98–2/2

Install Lube Relief Valve

1. Position front housing with bearing bore side down.

Continued on next page

YZ,CTM148,40,8 –19–28JUL98–1/2

2. Install new lube relief valve (A).

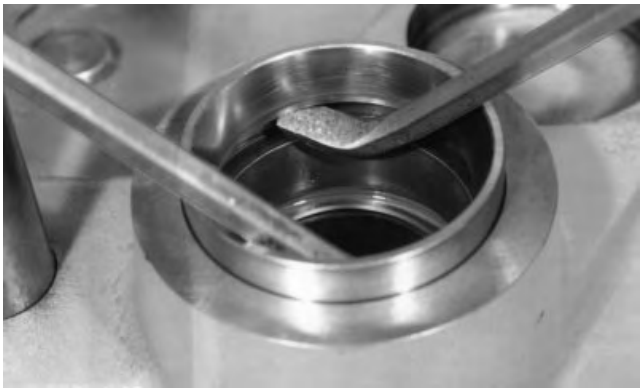
NOTE: See group 99, special tools.

YZ612 –UN–19MAR98

YZ,CTM148,40,8 –19–28JUL98–2/2

Remove Bearing Cup

Remove bearing cup.

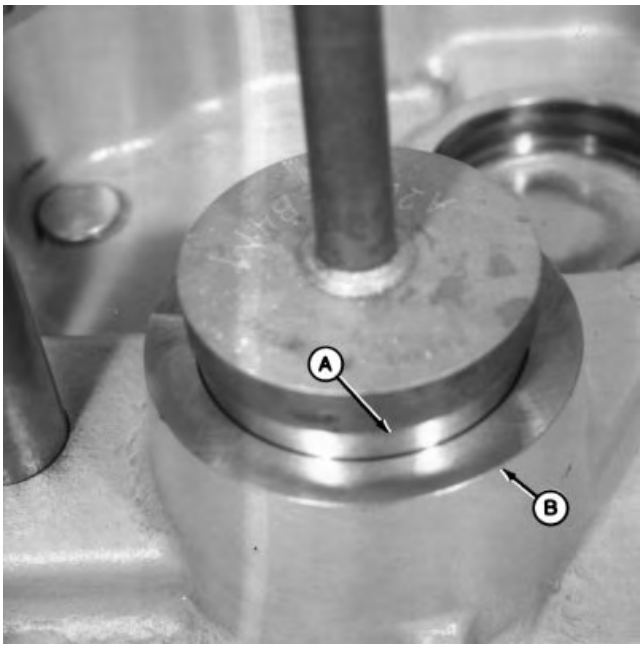


YZ620 –UN–19MAR98

YZ,CTM148,40,9 –19–28JUL98–1/1

Install Bearing Cup

Install new bearing cup (A).

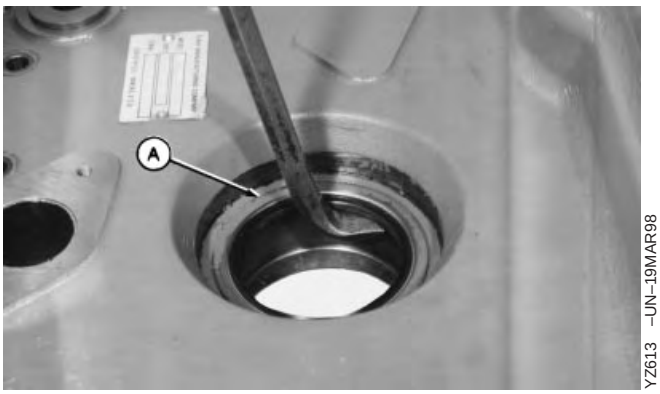


YZ621 –UN–19MAR98

YZ,CTM148,40,10 –19–28JUL98–1/1

Remove Oil Seal

Remove oil seal (A).



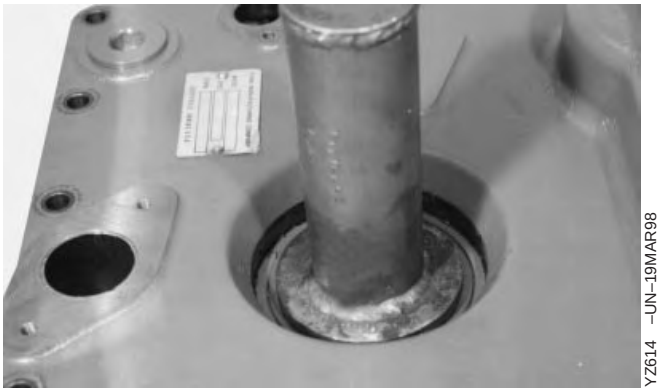
YZ,CTM148,40,12 –19–28JUL98–1/1

Install Oil Seal

NOTE: Apply LOCTITE® #242 or equivalent to outside diameter of oil seal before installation.

Install new oil seal flush with shoulder.

LOCTITE is a trademark of Loctite Corp.



YZ,CTM148,40,14 –19–28JUL98–1/1

Prepare Rear Housing and Gear Group for Assembly with Front Housing

1. Clean gasket surfaces on front and rear housings.

IMPORTANT: Check for both dowel pins (D). If not in place they must be installed before jointing front and rear housing.

2. Install dowel pins (D).

YZ,CTM148,40,15 –19–14SEP98–1/3

3. Install new gasket (C).

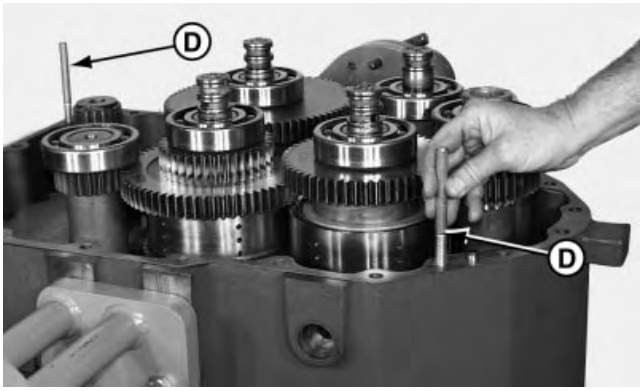
Continued on next page

YZ,CTM148,40,15 –19–14SEP98–2/3

IMPORTANT: Use guide pins (D) to align the front and rear housings. Failure to install guide pins will cause damage to seal rings.

NOTE: Guide pins (D) must be long enough to reach through the front housing and be removed after front housing is in place.

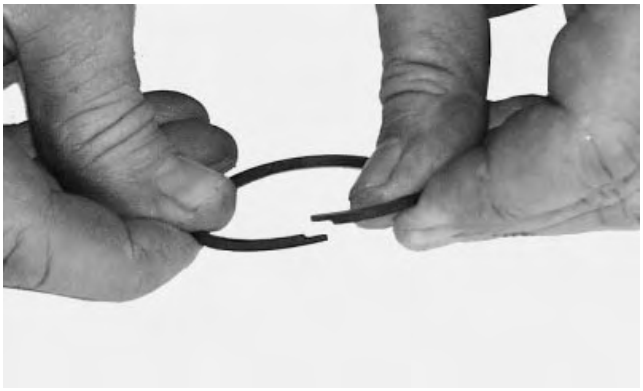
4. Install two guide pins (D).



YZ1718 –UN–09JUL98

YZ,CTM148,40,15 –19–14SEP98–3/3

Install Seal Rings and Lubricate



YZ1719 –UN–09JUL98

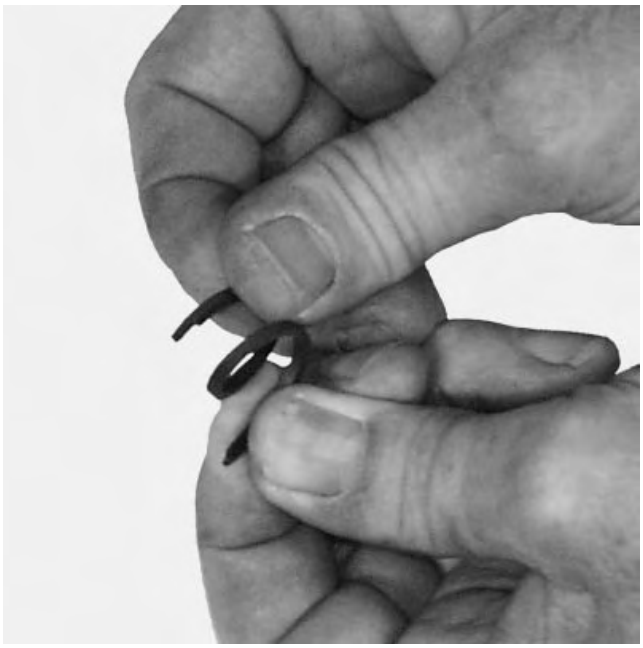
YZ,CTM148,40,20 –19–28JUL98–1/7

IMPORTANT: The seal ring ends overlap and must fit together.

IMPORTANT: Use new seal rings.

NOTE: For shaft assemblies twist seal rings 19 mm (3/4 inch). For first stage shaft twist seal ring 25 mm (1 inch).

1. Twist seal ring into tight circle, approximately 25 mm (1 inch).

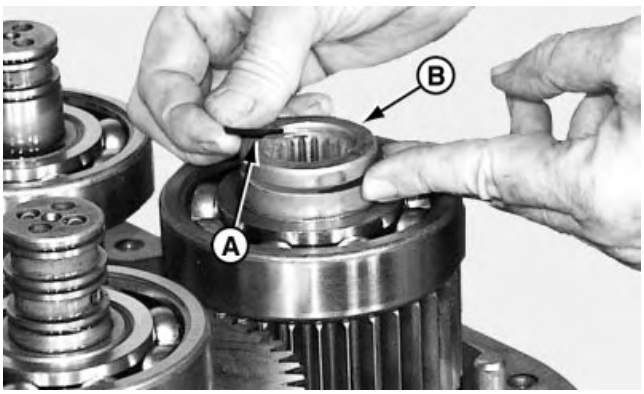


YZ1720 –UN–09JUL98

Continued on next page

YZ,CTM148,40,20 –19–28JUL98–2/7

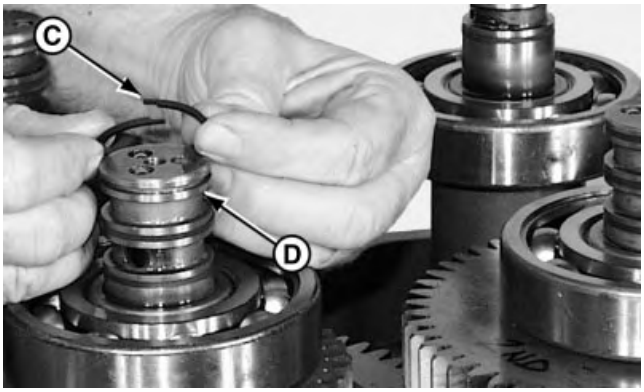
2. Install seal ring (A) on first stage shaft (B).



YZ1721 –UN–09JUL98

YZ,CTM148,40,20 –19–28JUL98–3/7

3. Install as required either two or three seal rings (C) on clutch shaft assemblies.



YZ1722 –UN–09JUL98

YZ,CTM148,40,20 –19–28JUL98–4/7

4. Lubricate all seal rings.

5. Check seal rings for proper fit in the grooves, in clutch shaft assemblies.

6. Rotate seal rings so that the end gaps are approximately 120 degrees apart.

YZ1723 –UN–09JUL98

YZ,CTM148,40,20 –19–28JUL98–5/7

7. Lubricate all bearings with clean transmission fluid.

YZ1724 –UN–09JUL98

Continued on next page

YZ,CTM148,40,20 –19–28JUL98–6/7

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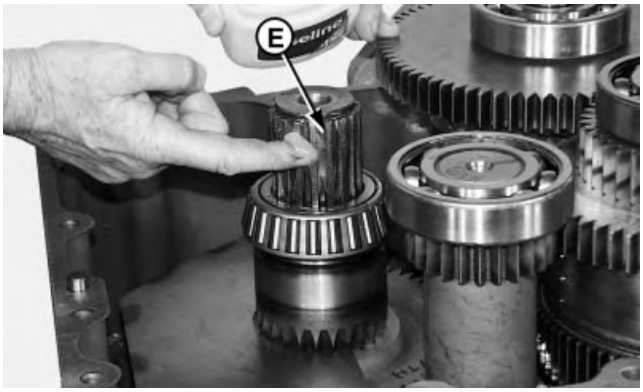
8. Apply grease to the yoke spline (E) on the output stage shaft.



YZ1725 –UN–09JUL98

YZ,CTM148,40,20 –19–28JUL98–7/7

Install Front Housing

CAUTION: Front housing weight is approximately 120 kg (265 lbs).

CAUTION: Use four high grade fasteners of the correct length to attach the lifting tool to the front cover.

1. Attach lifting tool (B).

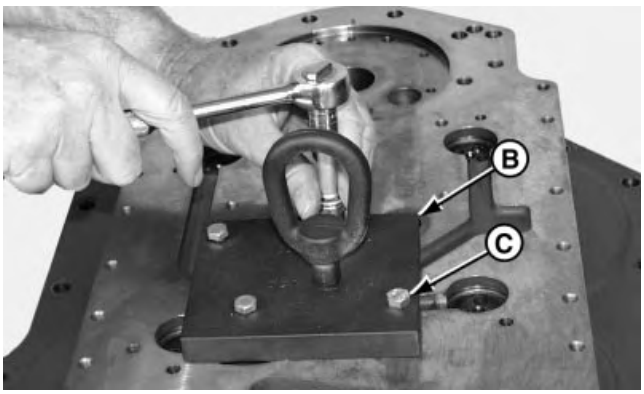
CAUTION: Do not allow any part of the body under the front housing assembly. Personal injury is possible.

IMPORTANT: Use guide pins to prevent damage to seal rings.

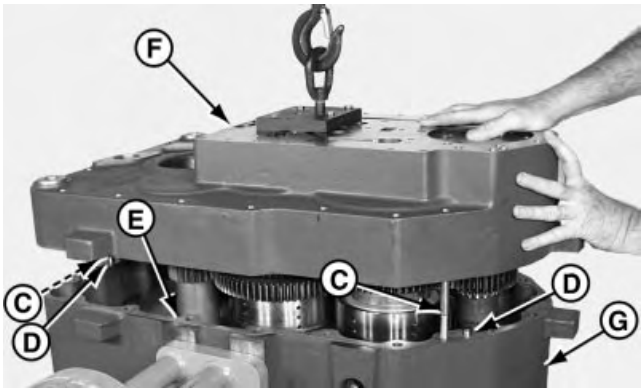
2. Install guide pins (C).
3. Check for dowel pins (D), gasket (E) is flat on rear housing surface.
4. Lower front housing assembly (F) onto clutch shaft assemblies and onto rear housing.

IMPORTANT: Do not attempt to mate front and rear housing together using cap screw fasteners. If the housings do not close up completely without force there is a problem condition that must be corrected.

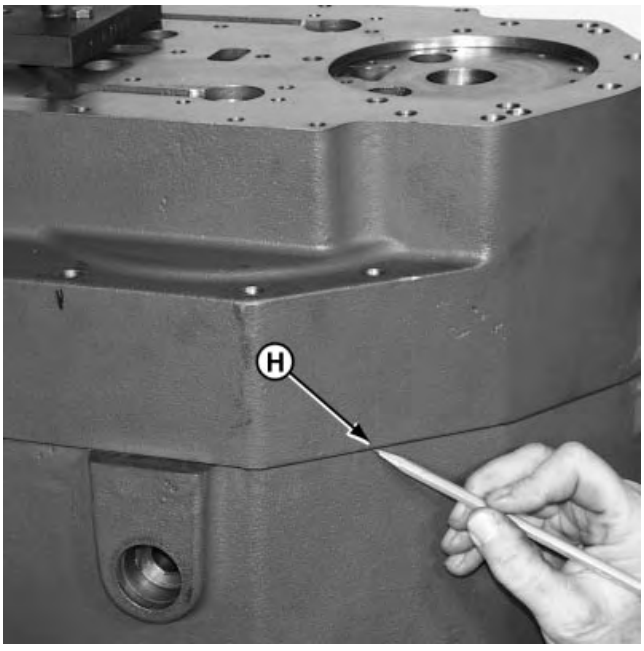
5. Check front housing is level with rear housing (H).



YZ1710 –UN–09JUL98



YZ1726 –UN–09JUL98



YZ1727 –UN–09JUL98

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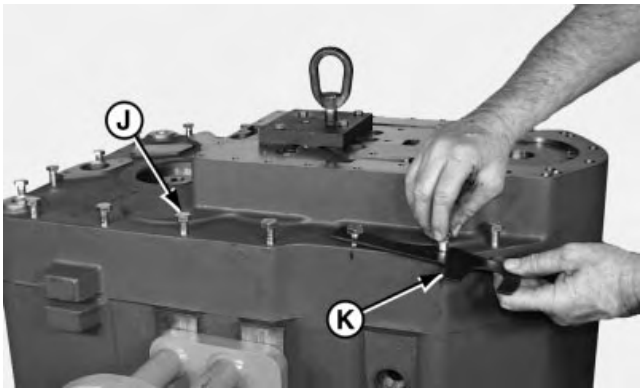
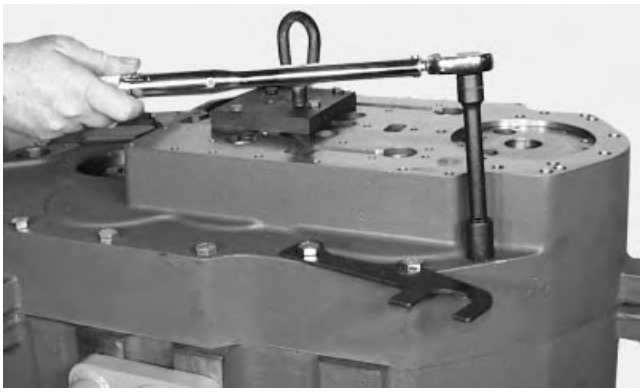
YZ,CTM148,40,22 –19–23SEP03–1/4

6. Install hex flange bolts (J) and wiring harness bracket (K).



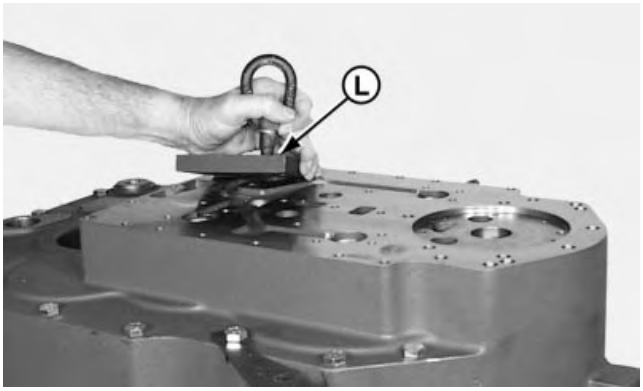
YZ,CTM148,40,22 –19–23SEP03–2/4

7. Tighten hex flange bolts to 122 N•m (90 lb-ft).



YZ,CTM148,40,22 –19–23SEP03–3/4

8. Remove lifting tool (L).



YZ,CTM148,40,22 –19–23SEP03–4/4

Install Output Yoke

1. Lubricate the seal and seal surfaces on the output yoke (A).

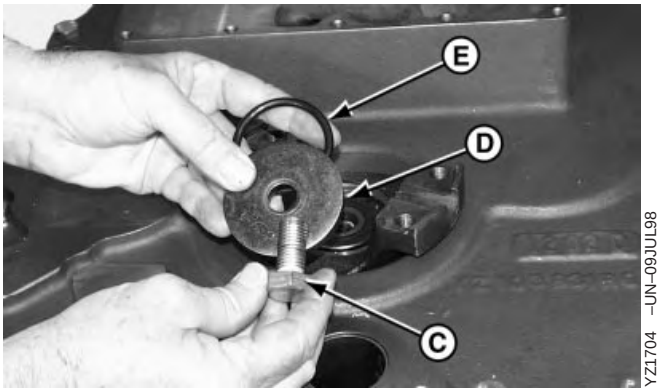
Continued on next page

YZ,CTM148,40,23 –19–12SEP98–1/4

2. Install output yoke (A).

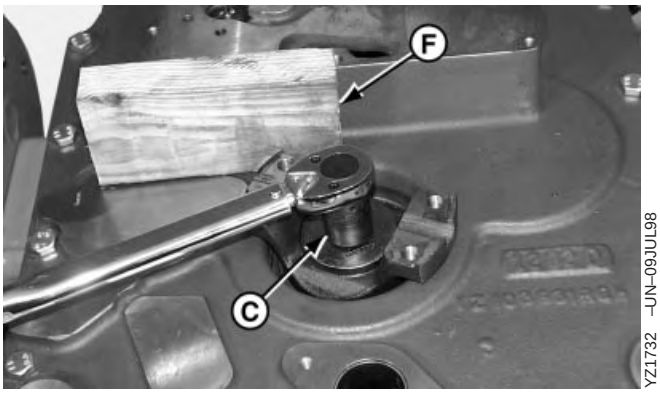
YZ,CTM148,40,23 –19–12SEP98–2/4

3. Lubricate new O-ring (E).
4. Install new O-ring (E).
5. Install washer (D).
6. Install cap screw (C).



YZ,CTM148,40,23 –19–12SEP98–3/4

7. Use a block of wood (F) to keep output yoke from turning.
8. Tighten cap screw (C) to 215 N•m (159 lb-ft).



YZ,CTM148,40,23 –19–12SEP98–4/4

Other Material

Number	Name	Use
	Transmission fluid	All moving parts and o-rings.

YZCTM148,45,OTH –19–01AUG98–1/1

Specifications

Item	Measurement	Specification
Output group	Weight	30 Kg (65 lbs.)
Clutch stages less output stage.	Weight	272 Kg (600 lbs.)
Oil trough-to-rear housing cap screws.	Torque	25 N•m (18 lb-ft)
Clutch assemblies	Clutch plate-to-clutch plate retainer clearance	2.79 mm—5.59mm (.110—.220 in)
Clutch gear	End play	.25 mm (.010 in)

YZCTM148,45,SPC –19–14SEP98–1/1

Remove Output Group

1. Remove two cap screws (A) holding oil trough assembly (B).

YZ1770 –UN–10JUL98

Continued on next page

YZ,CTM148,45,1 –19–14SEP98–1/2

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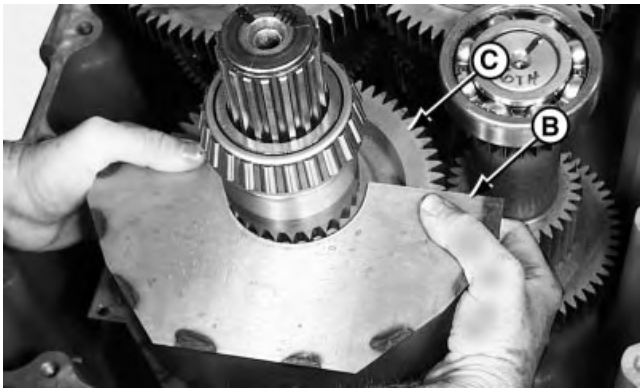
CAUTION: The output group weighs approximately 30 Kg (65 lbs).

The oil trough has sharp edges. Personal injury could occur.

2. Remove output group (C) and oil trough (B).

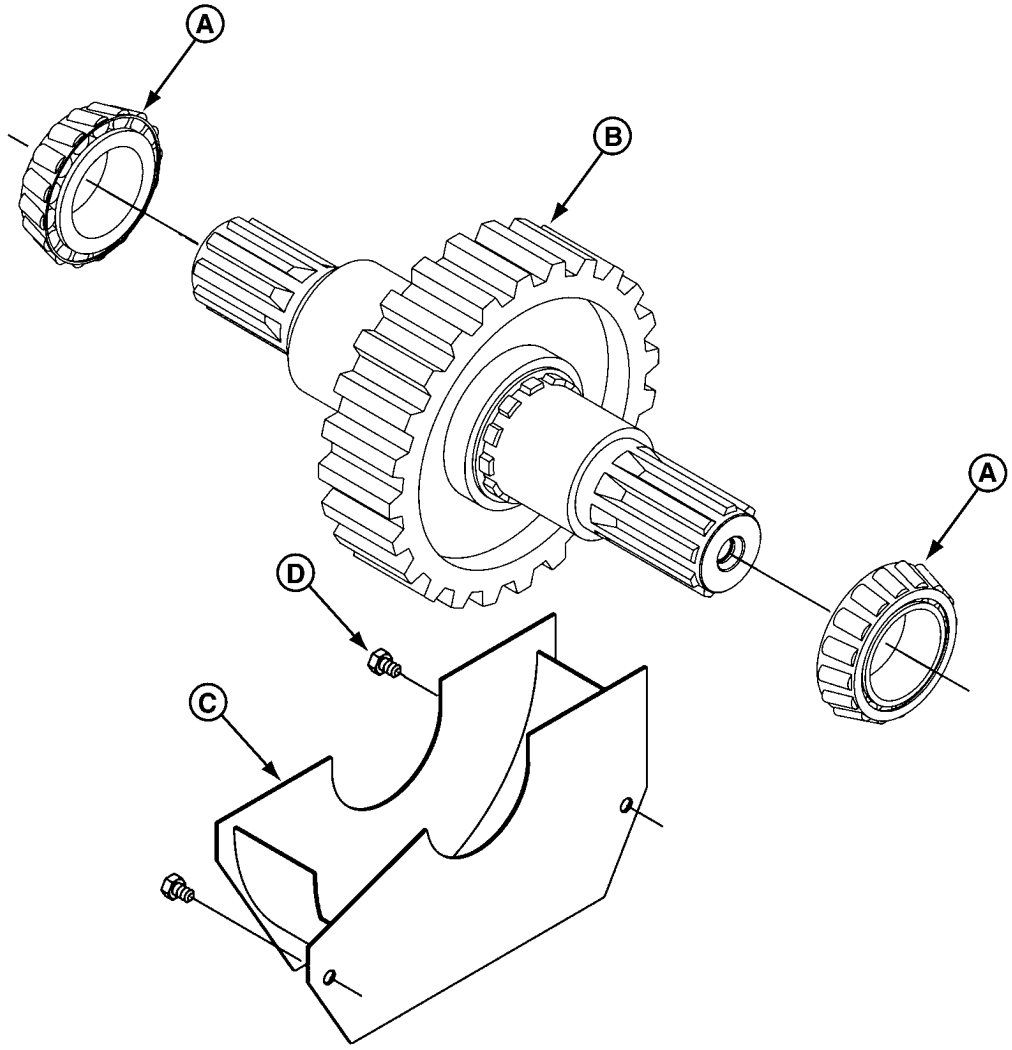
NOTE: Oil trough must be removed with the output group.



YZ17771 –UN–10JUL98

YZ,CTM148,45,1 –19–14SEP98–2/2

Output Group and Oil Trough



YZ796A –UN–12MAR98

A—Bearing cone (2 used)

B—Seventh stage output shaft gear assembly

C—Oil trough assembly

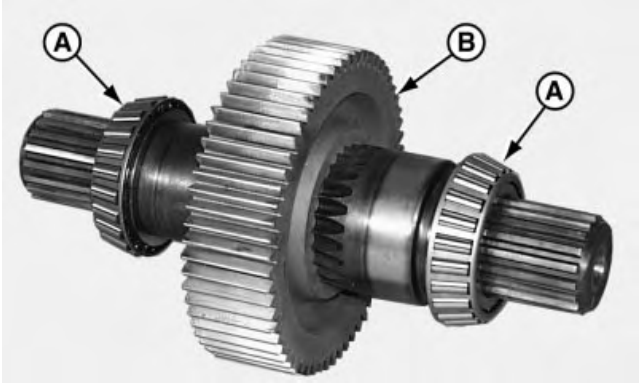
D—Cap screw M8x12 8.8 (2 used)

YZ,CTM148,45,13 –19–12SEP98–1/1

Disassemble Output Group

IMPORTANT: Do not attempt to remove gear from shaft. This is a permanent assembly. Damage to parts will result.

Remove bearing cones (A).



YZ1772 –UN–10JUL98

Assemble Output Group

1. Install new bearing cones (A).
2. Lubricate two new bearings with clean transmission fluid.

YZ,CTM148,45,2 –19–01AUG98–1/1

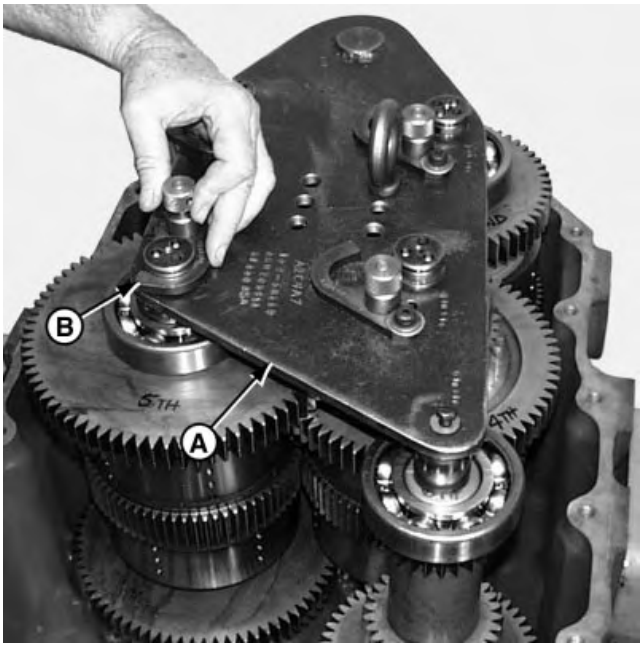
Remove All Clutch Stage Assemblies

CAUTION: Approximate weight of all clutch stage assemblies is 272 Kg (600 lbs).

IMPORTANT: Lift all clutch stage assemblies at one time using lift tool.

NOTE: See group 99 for special tools.

1. Install lift tool (A).
2. Lock holders (B) into place.



YZ1773 –UN–10JUL98

Continued on next page

YZ,CTM148,45,4 –19–01AUG98–1/8

3. Install bolt (C) into sixth stage assembly.

4. Lift all clutch stage assemblies from rear housing.

YZ,CTM148,45,4 –19–01AUG98–2/8

IMPORTANT: If more that one threaded hole is provided in the lifting tool. Use the hole designed for the model of transmission being repaired.

5. Install lifting eye (D).

Continued on next page

YZ,CTM148,45,4 –19–01AUG98–3/8

6. Use hoist with safety latch (E).

NOTE: It may be necessary to shake the stages loose. Grasp the chain between the hoist and the lifting tool and forcefully move it back and forth.

7. Lift shaft stage assemblies.

YZ1776 –UN–10JUL98

YZ,CTM148,45,4 –19–01AUG98–4/8

CAUTION: Weight is approximately 272 Kg (600 lbs). Do not allow any part of the body under stage assemblies.

Place shaft stage assemblies in center of work table to prevent personal injury.

8. Place stages on work table.

YZ1777 –UN–10JUL98

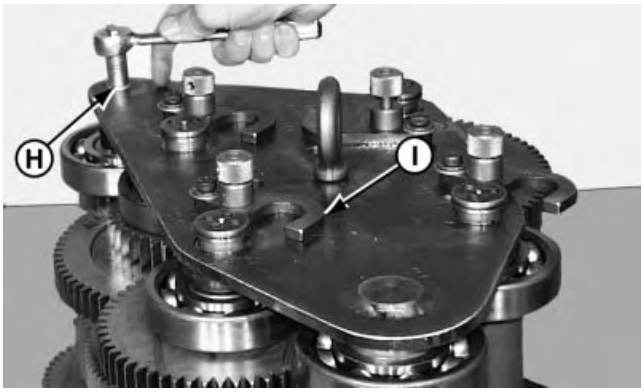
Continued on next page

YZ,CTM148,45,4 –19–01AUG98–5/8

IMPORTANT: Do not remove lifting tool until a strap has been placed around the group of assemblies.

9. Remove cap screw (H).

10. Move four retainers (I) out of grooves in clutch shafts.



YZ1778 –UN–10JUL98

YZ,CTM148,45,4 –19–01AUG98–6/8

11. Place a strap (J) around the gear ratio group to prevent any of the stages from falling.

12. Remove the lifting tool (K).

YZ1779 –UN–10JUL98

Continued on next page

YZ,CTM148,45,4 –19–01AUG98–7/8

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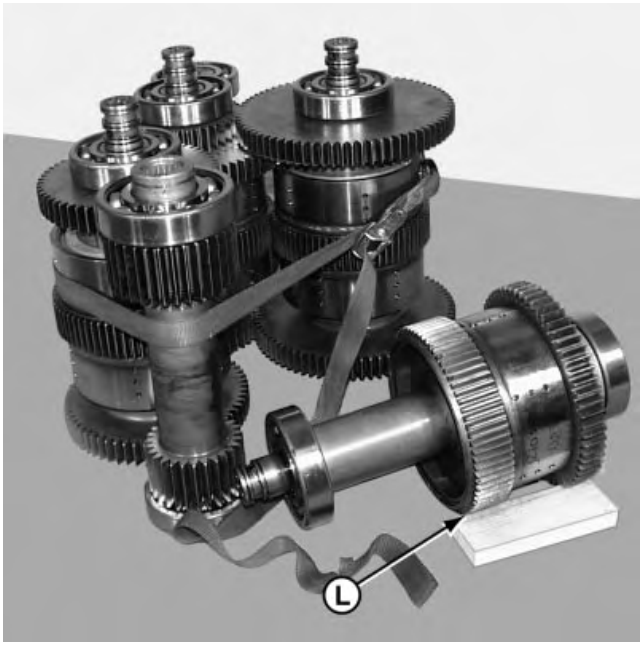
CAUTION: Do not allow the stages to fall or to roll off the work surface.

13. Block stages (L) as they are removed to prevent them from rolling.



YZ1780 –UN–10JUL98

YZ,CTM148,45,4 –19–01AUG98–8/8

Disassemble First Stage Assembly

1. Remove and discard Seal Ring (A).
2. Remove Bearing (B).
3. Remove Bearing (C).
4. Inspect first stage shaft assembly (C).

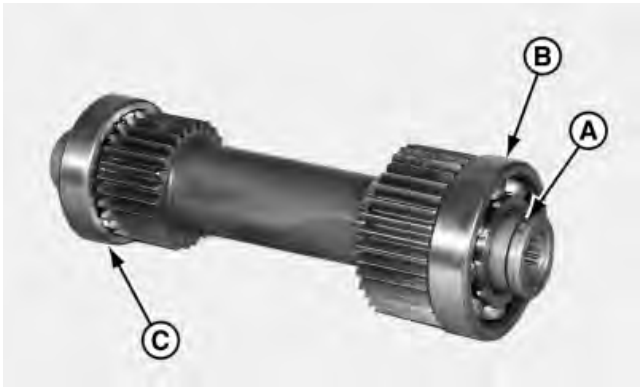
Assemble First Stage Assembly

NOTE: Press only on inner race of bearing.

1. Install new bearing (B).
2. Install new bearing (C).

NOTE: Refer to Sizing Seal Rings in this group.

3. Install new seal ring (A).
4. Lubricate ball bearings.



YZ1781 –UN–10JUL98

YZ,CTM148,45,17 –19–01AUG98–1/1

Disassemble Sixth Stage Assembly

1. Remove ball bearing (A).
2. Remove bearing inner race (B).

Assemble Sixth Stage Assembly

1. Install new ball bearing (A).
2. Install new bearing inner race (B).
3. Lubricate all bearings with clean transmission fluid.

YZ1782 –UN–10JUL98

YZ,CTM148,45,7 –19–01AUG98–1/1

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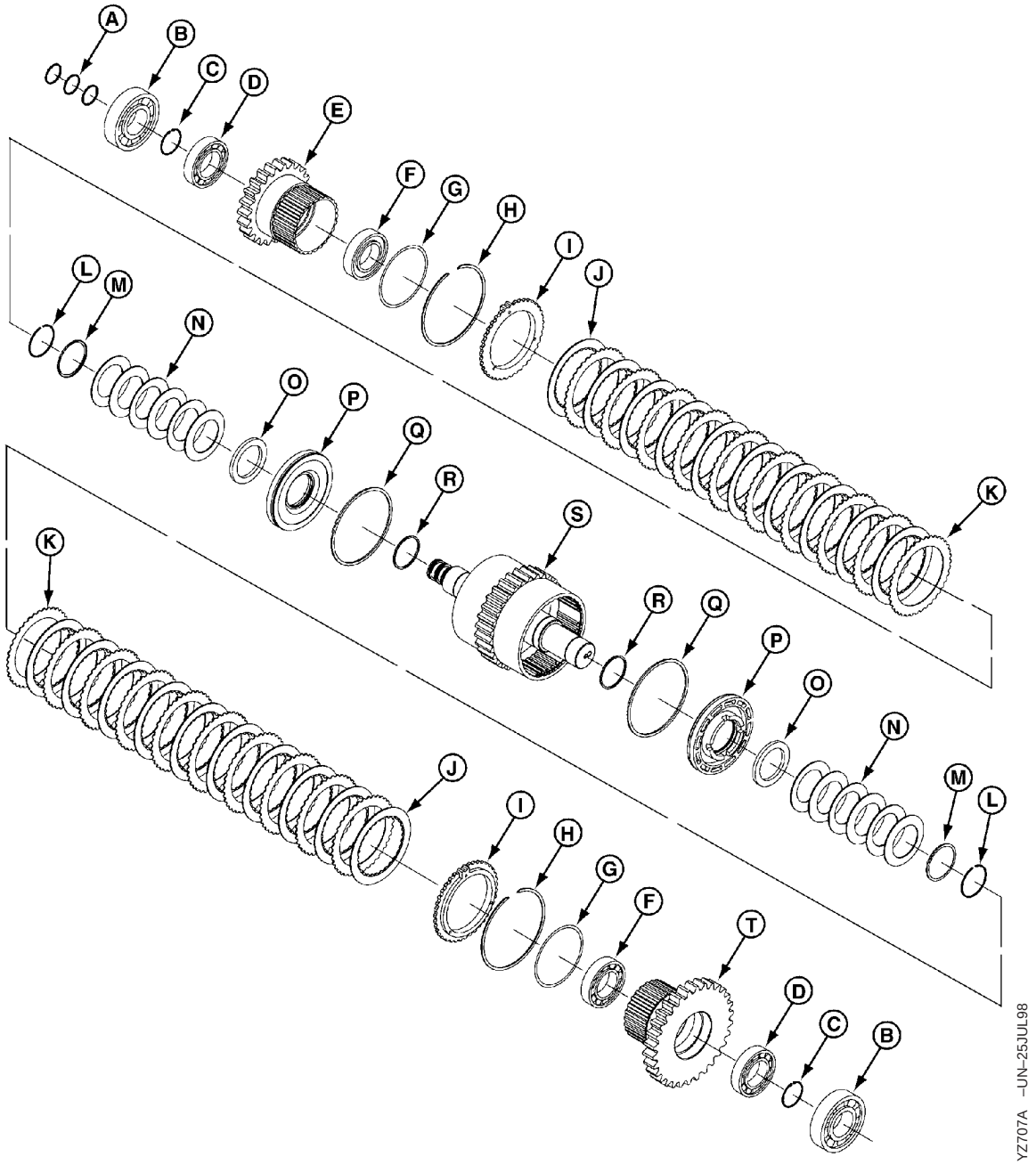
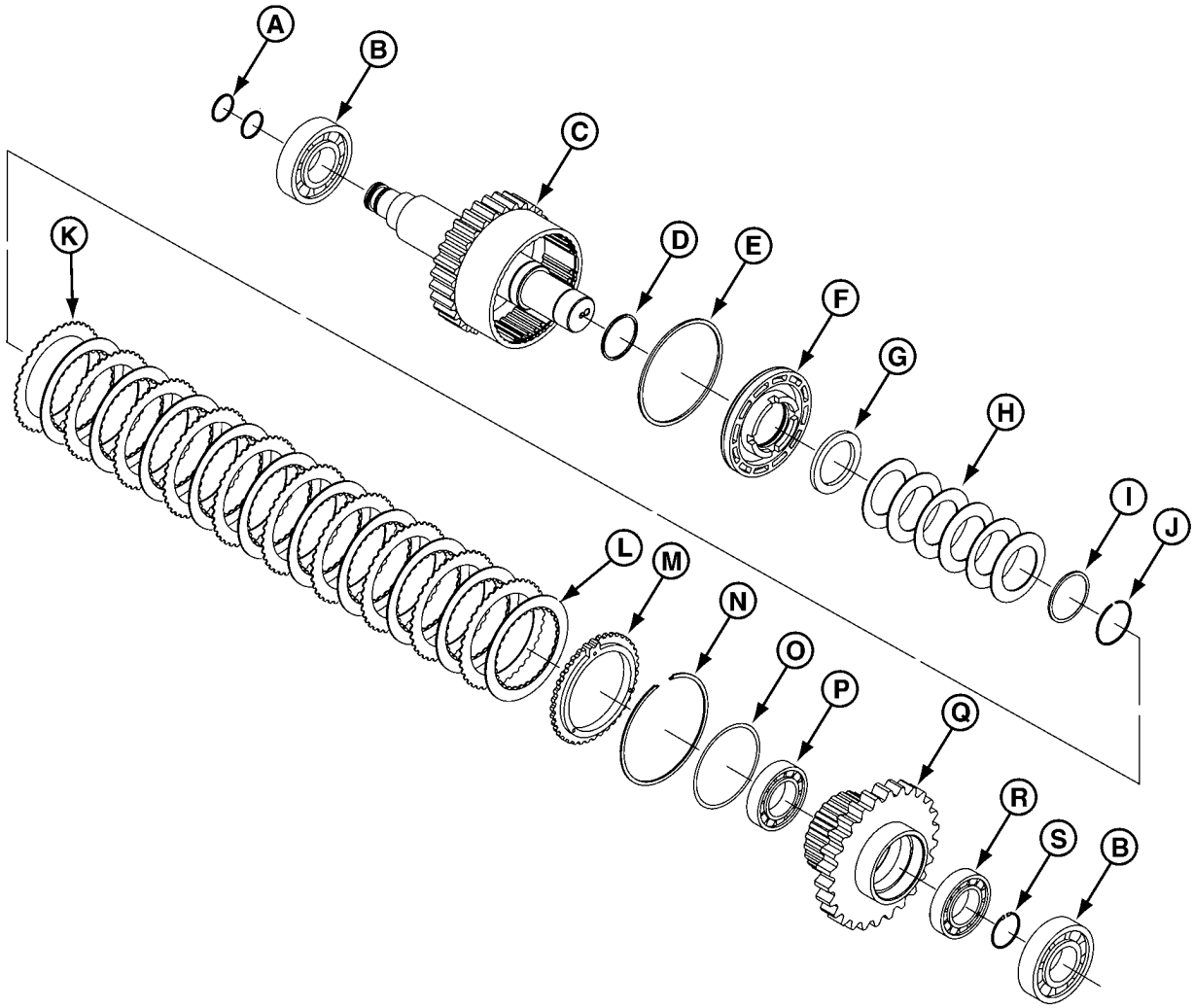
Second Stage Clutch Assembly



A—Seal Ring (3 used)
B—Ball Bearing (2 used)
C—Retaining Ring (2 used)
D—Bearing (2 used)
E—2nd Clutch 54T Gear
F—Bearing (2 used)
G—O-ring (2 used)
H—Snap ring (internal),(2 used)
I—Clutch Plate Retainer (2 used)
J—Clutch Plate (20 used)
K—Clutch Separator Plate (20 used)
L—Retainer Ring (2 used)
M—Snap Ring Retainer (2 used)
N—Clutch Return Spring (12 used)
O—Lube Shutoff Washer (2 used)
P—Clutch Piston (2 used)
Q—Piston Outer Seal (2 used)
R—O-ring (2 used)
S—2nd Stage Shaft Assembly
T—61T Clutch Gear (2nd and 3rd stage)

YZ,CTM148,45,16 –19–01AUG98–1/1

Third Stage Clutch Assembly



YZ708A –UN–25JUL98

A—Seal Ring (2 used)
B—Ball Bearing (2 used)
C—3rd Stage Shaft Assembly
D—O-ring
E—Piston Outer Seal
F—Clutch Piston
G—Lube Shutoff Washer
H—Clutch Return Spring (6 used)
I—Snap Ring Retainer
J—Retaining Ring
K—Clutch Separator Plate (10 used)
L—Clutch Plate (10 used)
M—Clutch Plate Retainer
N—Snap Ring
O—O-ring
P—Bearing
Q—61T Clutch Gear (2nd and 3rd stage)
R—Bearing
S—Retaining Ring

YZ,CTM148,45,38 –19–01AUG98–1/1

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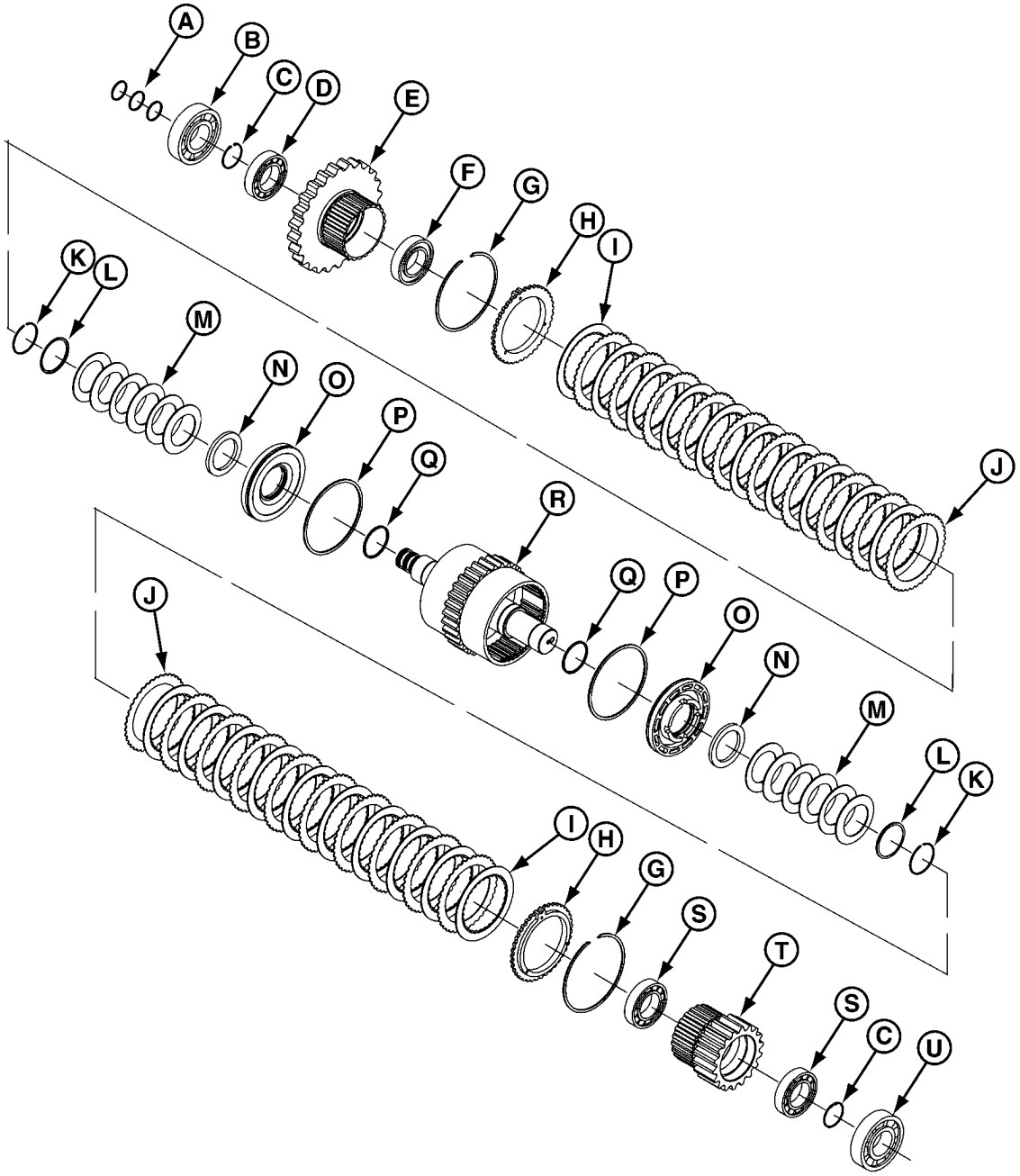
Fourth Stage Clutch Assembly



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YZ,CTM148,45,40 –19–12SEP98–1/2

A—Seal ring (3 used)
B—Bearing (2 used)
C—Snap ring (2 used)
D—Bearing
E—4th clutch assembly gear
F—Bearing (2 used)
G—Snap ring (2 used)
H—Clutch plate retainer (2 used)
I—Clutch plate (20 used)
J—Clutch separator plates (20 used)
K—Retaining ring (2 used)
L—Snap ring retainer (2 used)
M—Clutch retainer spring (12 used)
N—Lube shutoff piston (2 used)
O—Clutch piston (2 used)
P—Piston outer seal (2 used)
Q—O-ring (2 used)
R—4th and 5th stage shaft assembly
S—Ball bearing w/Bronze cage (2 used)[1]
T—38th clutch gear
U—Bearing

[1]Application Dependent

YZ,CTM148,45,40 –19–12SEP98–2/2

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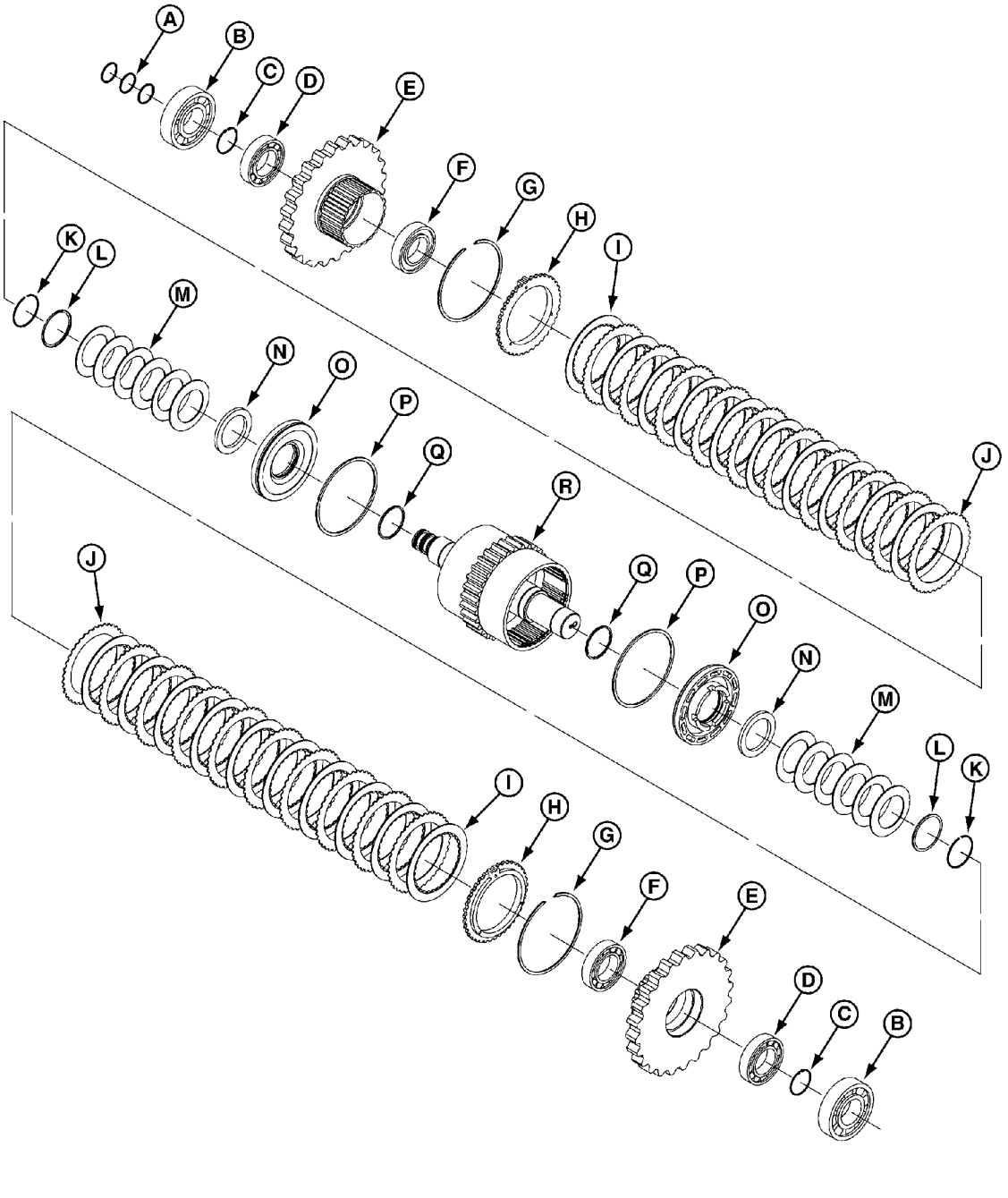
Fifth Stage Clutch Assembly



A—Seal ring (3 used)
B—Bearing (2 used)
C—Snap ring (2 used)
D—Bearing (2 used)
E—86T clutch gear (2 used)
F—Bearing (2 used)
G—Snap ring (2 used)
H—Clutch plate retainer (2 used)
I—Clutch plate (20 used)
J—Clutch separator plate (20 used)
K—Retaining ring (2 used)
L—Snap ring retainer (2 used)
M—Clutch retainer spring (12 used)
N—Lube shutoff washer (2 used)
O—Clutch piston (2 used)
P—Outer piston seal (2 used)
Q—O-ring (2 used)
R—4th and 5th stage shaft assembly

YZ,CTM148,45,39 –19–01AUG98–1/1

Disassemble Clutch Stage Assembly

All clutch stage assemblies in the DF series transmission assemble and disassemble in the same manner. In this manual we show the disassembly and assembly of the second stage clutch.

YZ638 –UN–19MAR98

YZ,CTM148,45,25 –19–01AUG98–1/19

1. Remove three TEFLON® seal rings.

YZ639 –UN–19MAR98

TEFLON is a trademark of Du Pont Co.

Continued on next page

YZ,CTM148,45,25 –19–01AUG98–2/19

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16

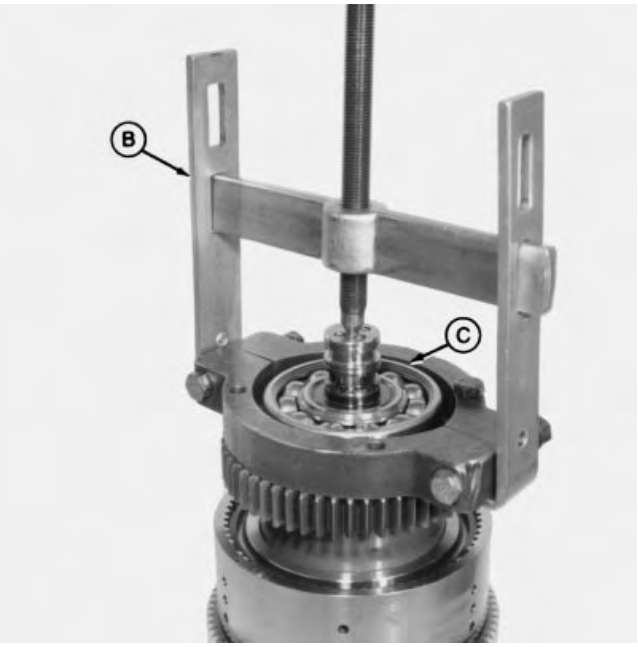
2. Install bearing removal tool (A).

YZ640 –UN–19MAR98

YZ,CTM148,45,25 –19–01AUG98–3/19

3. Install gear puller (B) onto bearing removal tool.

4. Remove bearing (C) from shaft assembly.



YZ641 –UN–19MAR98

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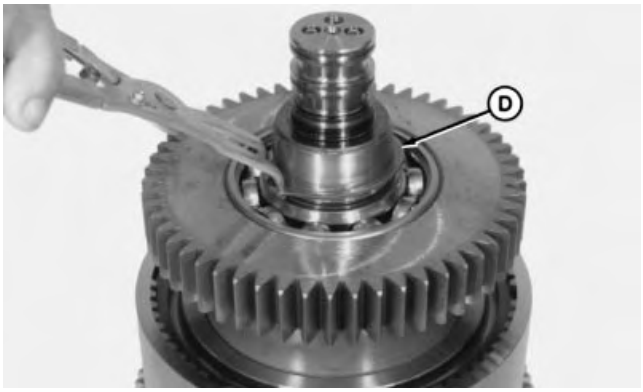
YZ,CTM148,45,25 –19–01AUG98–4/19

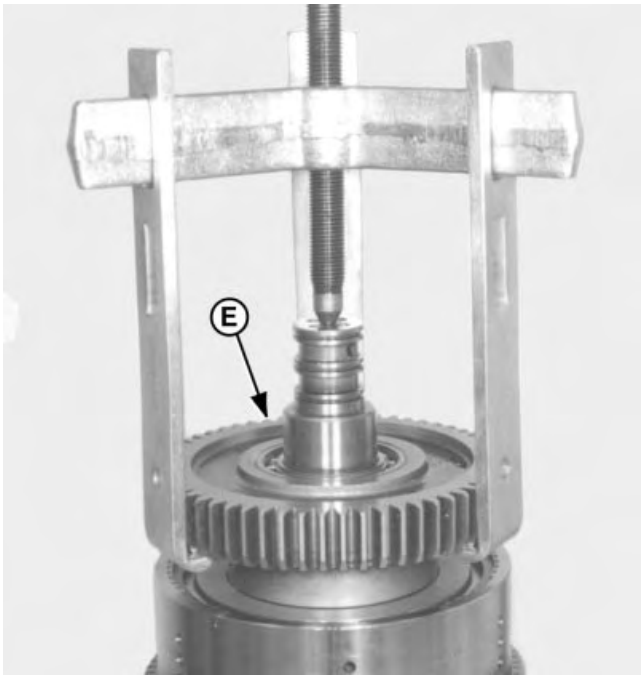
5. Remove snap ring (D) from shaft assembly.
6. Install gear puller.



YZ642 –UN–19MAR98

YZ,CTM148,45,25 –19–01AUG98–5/19

7. Remove clutch gear (E).



YZ404A –UN–12MAR98

Continued on next page

YZ,CTM148,45,25 –19–01AUG98–6/19

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18

8. Remove bearing (A).

YZ849A –UN–12MAR97

YZ,CTM148,45,25 –19–01AUG98–7/19

IMPORTANT: Fourth stage clutch gear (clutch A) must use special bearings. Use only approved bronze caged bearings[1].

YZ1587 –UN–07AUG98

[1]*Application dependent*

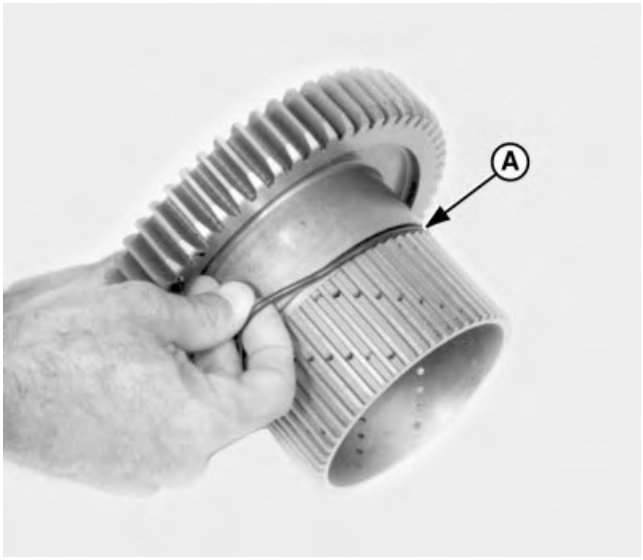
Continued on next page

YZ,CTM148,45,25 –19–01AUG98–8/19

NOTE: O-ring (A) is directional clutch only. Speed clutch will not have an o-ring.

9. Remove o-ring (A).

10. Inspect for wear and damage.



YZ429 –UN–19APR97

YZ,CTM148,45,25 –19–01AUG98–9/19

CAUTION: Wear eye protection when removing snap ring.

11. Remove snap ring (A).

YZ644 –UN–19MAR98

Continued on next page

YZ,CTM148,45,25 –19–01AUG98–10/19

IMPORTANT: Fourth stage clutch gear (clutch A) must use special bearings. Use only approved bronze caged bearings[1].

YZ1588 –UN–07AUG98

[1]*Application dependent*

YZ,CTM148,45,25 –19–01AUG98–11/19

12. Turn shaft assembly over. Remove all clutch and separator plates.

YZ645 –UN–19MAR98

Continued on next page

YZ,CTM148,45,25 –19–01AUG98–12/19

13. Turn shaft assembly over.

14. Install puller.

15. Remove ball bearing and discard bearing.

YZ647 –UN–19MAR98

YZ,CTM148,45,25 –19–01AUG98–13/19

16. Place shaft assembly on press.

17. Use press tool (B) to compress clutch return springs.

NOTE: See group 99 for special tools.

YZ648 –UN–19MAR98

Continued on next page

YZ,CTM148,45,25 –19–01AUG98–14/19

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18. Remove snap ring (C).

YZ649 –UN–19MAR98

YZ,CTM148,45,25 –19–01AUG98–15/19

IMPORTANT: Pay attention to the assembly of the clutch return springs. They must be reassembled in the same way.

19. Lift out snap ring, retaining ring, and clutch return springs.

YZ650 –UN–19MAR98

Continued on next page

YZ,CTM148,45,25 –19–01AUG98–16/19

20. Remove lube shutoff washer.

YZ651 –UN–19MAR98

YZ,CTM148,45,25 –19–01AUG98–17/19

CAUTION: Wear eye protection when removing piston from cylinder. If cylinder is damaged DO NOT place hand on top of piston.

21. Apply air pressure through oil passage to force piston from shaft assembly.

YZ652 –UN–19MAR98

Continued on next page

YZ,CTM148,45,25 –19–01AUG98–18/19

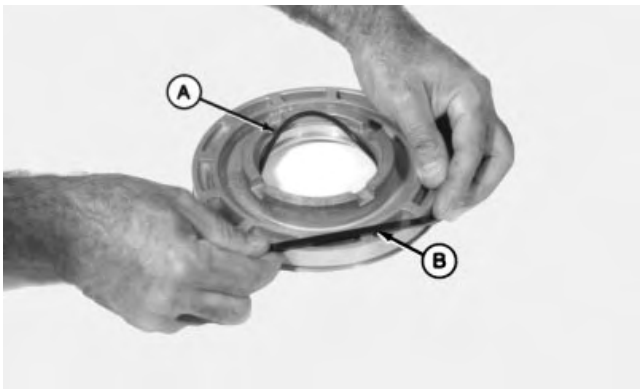
22. Remove piston from cylinder.
23. Remove O-ring and piston outer seal from piston.
24. Inspect all parts.

YZ653 –UN–19MAR98

YZ,CTM148,45,25 –19–01AUG98–19/19

Assemble Clutch Stage Assembly

1. Install new O-ring (A).
2. Install new piston outer seal (B).



YZ655 –UN–19MAR98

Continued on next page

YZ,CTM148,45,34 –19–12SEP98–1/15

3. Install clutch piston (C).

4. Install lube shutoff washer (D).

YZ656 –UN–19MAR98

Continued on next page

YZ,CTM148,45,34 –19–12SEP98–2/15

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IMPORTANT: Install clutch return springs (A) correctly. Use the photograph as a guide.

5. Install clutch return springs (A).

YZ853 –UN–20MAR97

YZ657 –UN–19MAR98

Continued on next page

YZ,CTM148,45,34 –19–12SEP98–3/15

6. Place press tool (B) over shaft.
7. Place snap ring retainer (C) and retaining ring (D) over shaft.

YZ659 –UN–19MAR98

YZ,CTM148,45,34 –19–12SEP98–4/15

8. Compress clutch return springs.
9. Install retaining ring (E).
10. Release pressure on clutch return springs slowly, be sure snap ring retainer is properly positioned.

YZ660 –UN–19MAR98

Continued on next page

YZ,CTM148,45,34 –19–12SEP98–5/15

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NOTE: Clutch separator plates are all steel with external spline teeth. Clutch plates have a lining material on the face and internal spline teeth. Lubricate and install one plate at a time. First install a clutch separator plate then a clutch plate. Continue until all plates are installed.

11. Install clutch separator plate (A).
12. Install clutch plate (B).

    Repeat steps 11 and 12 until all plates are installed.

YZ661 –UN–19MAR98

YZ,CTM148,45,34 –19–12SEP98–6/15

13. Install clutch plate retainer (A).

YZ662 –UN–19MAR98

Continued on next page

YZ,CTM148,45,34 –19–12SEP98–7/15

CAUTION: Wear eye protection when installing snap ring.

14. Install snap ring (B).

NOTE: Check that clutch and separator plates are not in a bind. Clearance between clutch plate and clutch plate retainer must be 2.79—5.59 mm (.110—.220 in).

YZ663 –UN–19MAR98

YZ,CTM148,45,34 –19–12SEP98–8/15

IMPORTANT: Clutch plate splines must be aligned before installing bearings on shaft assembly to avoid clutch plate damage.

15. Use clutch gear assembly to align clutch plates and separator plates.

16. After aligning clutch plates remove clutch gear assembly.

YZ664 –UN–19MAR98

Continued on next page

YZ,CTM148,45,34 –19–12SEP98–9/15

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approved bronze caged bearings[1].

17.Install new bearing with seal side of bearing toward clutch plates.

YZ665 –UN–19MAR98

[1]*Application dependent*

YZ,CTM148,45,34 –19–12SEP98–10/15

18. Press new bearing, seal side down, until bearing contacts shoulder of shaft.

YZ666 –UN–20MAR98

Continued on next page

YZ,CTM148,45,34 –19–12SEP98–11/15

19. Install clutch gear assembly (A).

IMPORTANT: Place steel ruler or sight across gear face (A) to check if clutch gear is install properly. Sighting or steel ruler will be below snap ring groove in cylinder shaft.

IMPORTANT: Fourth stage clutch gear (clutch A) must use special bearings. Use only approved bronze caged bearings[1].

Start bearing into clutch gear. DO NOT press bearing below snap ring groove in shaft. Pressing bearing too far into gear will preload bearing. This will cause the bearing to fail.

20. Place new bearing (B) on shaft, start bearing into the clutch gear assembly.

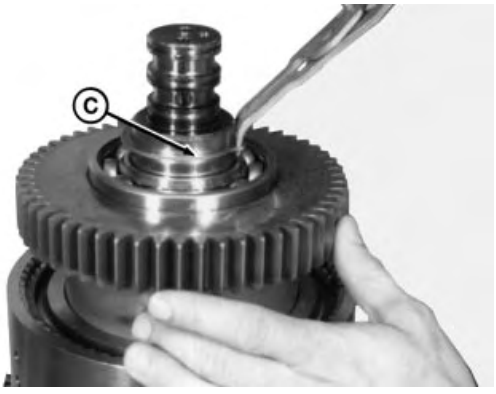
21. PARTIALLY install bearing into clutch gear hub assembly.

YZ667 –UN–19MAR98

[1]Application dependent

YZ,CTM148,45,34 –19–12SEP98–12/15

22. Position snap ring (C) on top of bearing.



YZ668 –UN–19MAR98

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YZ,CTM148,45,34 –19–12SEP98–13/15

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23. Place press tool on top of snap ring.

24. Press only on snap ring. Press until snap ring slips into snap ring groove.

YZ669 –UN–19MAR98

YZ,CTM148,45,34 –19–12SEP98–14/15

25. Install new outer bearing (D).

IMPORTANT: Check clutch gear for end play. It must have at least .25 mm (.010 in) end play.

YZ670 –UN–19MAR98

YZ,CTM148,45,34 –19–12SEP98–15/15

Sizing Seal Rings

IMPORTANT: Always use new seal rings. The seal rings must be sized to fit the shaft groove tightly to avoid damage during installation of front housing. Check and size seal rings before installation of front housing.

1. Twist seal ring into a tight circle, approximately 3/4 inch in diameter.

YZ,CTM148,45,35 –19–01AUG98–1/2

2. Install three seal rings in the ring grooves in the shaft assembly.

YZ,CTM148,45,35 –19–01AUG98–2/2

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Arrange Stages to Accept Lifting Tool

NOTE: The output group is installed separately.

Arrange stage assemblies.

- First stage assembly (A)
- Second stage assembly (B)
- Third stage assembly (C)
- Fourth stage assembly (D)
- Fifth stage assembly (E)
- Sixth stage assembly (F)

YZ1783 –UN–10JUL98

YZ1784 –UN–10JUL98

YZ,CTM148,45,36 –19–01AUG98–1/1

Install Lifting Tool

CAUTION: Weight of stage assemblies approximately 272 Kg (600 lbs).

IMPORTANT: Keep stage assemblies secured with strap until all are fitted into the lifting tool.

Use the special lifting tool to move all stages at one time.

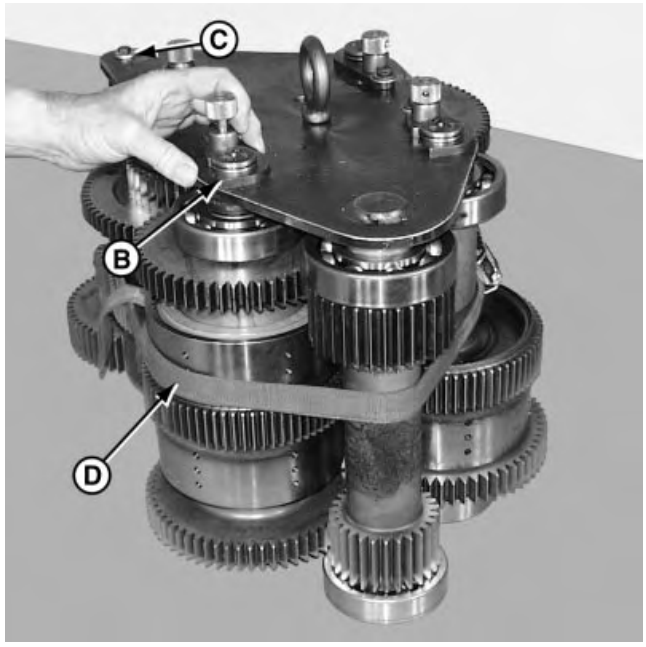
NOTE: See group 99 for special tools.

1. Install lifting tool (A).

YZ1785 –UN–10JUL98

YZ,CTM148,45,37 –19–01AUG98–1/4

2. Lock four retainers (B) in place in the grooves in the clutch shafts.
3. Install cap screw (C) in threaded hole in end of the sixth stage shaft.
4. Remove the security strap (D).



YZ1786 –UN–10JUL98

Continued on next page

YZ,CTM148,45,37 –19–01AUG98–2/4

CAUTION: Do not put your hands inside the rear housing while installing the stage assemblies.

IMPORTANT: Lubricate all bearings on the bottom of the stages, also races and bearing cups in the rear housing before lowering the stage assemblies into the rear housing.

5. Lower stage assemblies (A) into the rear housing.

IMPORTANT: All stages must be completely down in their bores or bearings.

6. Check stages; must be in bottom of rear housing bores.

YZ1788 –UN–10JUL98

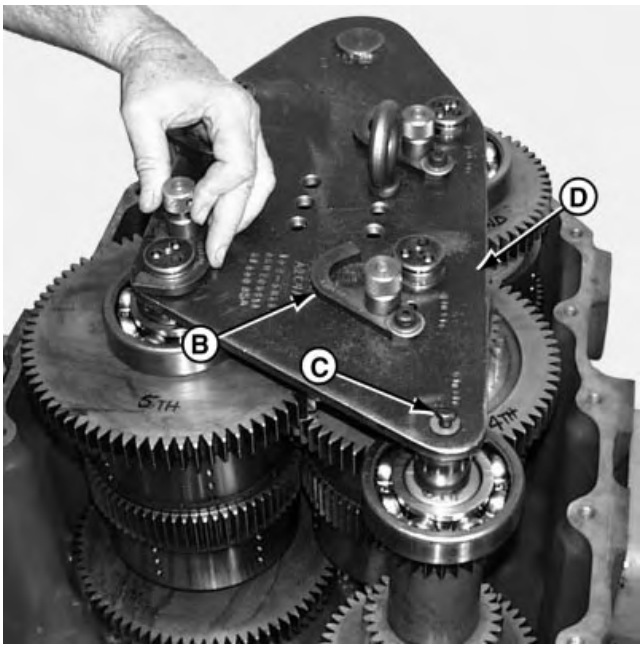
YZ,CTM148,45,37 –19–01AUG98–3/4

7. Move the four retainers (B) out of the grooves in the clutch shafts.

8. Remove cap screw (C).

9. Remove lifting tool (D).

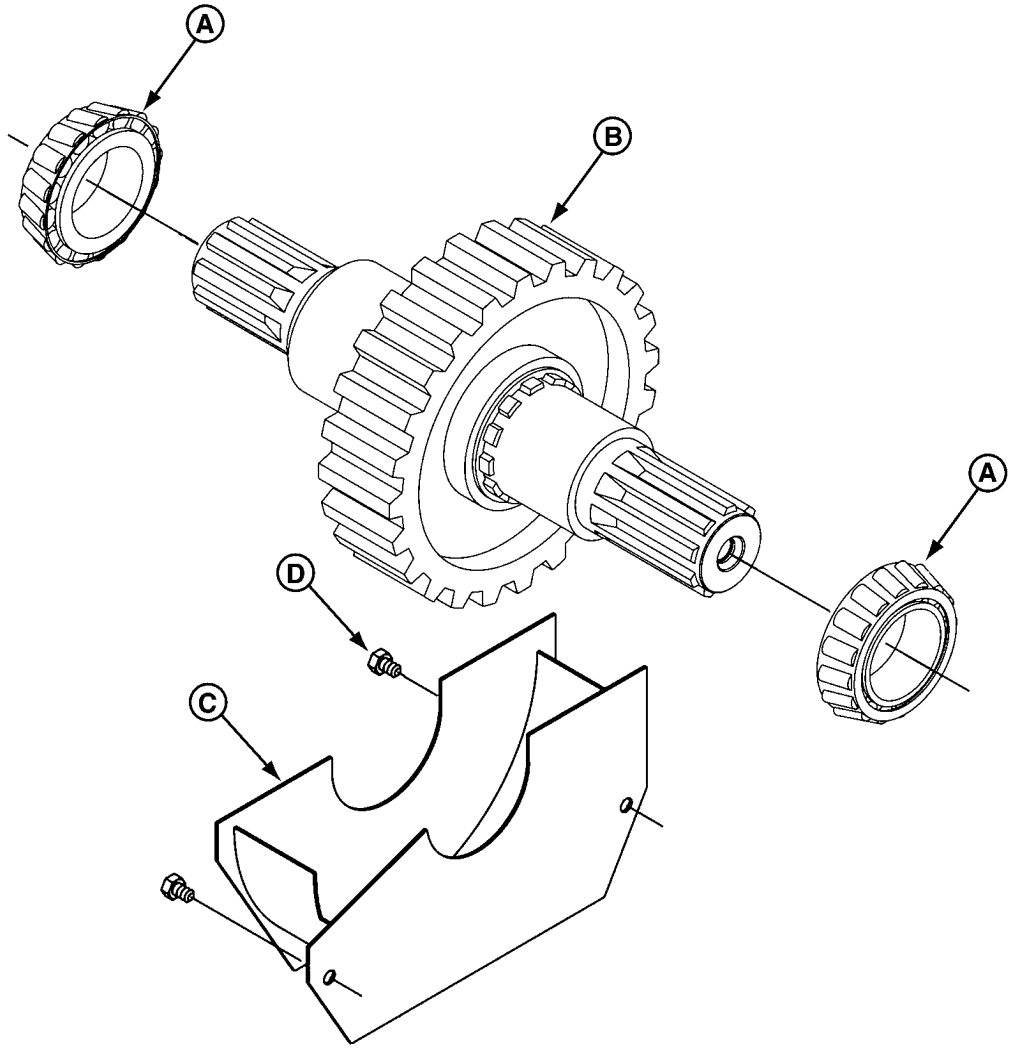
IMPORTANT: Size and install seal rings immediately before installing the front housing. Refer to "SIZING SEAL RINGS" this group for instructions.



YZ1787 –UN–10JUL98

YZ,CTM148,45,37 –19–01AUG98–4/4

Install Output Group and Oil Trough



YZ796A –UN–12MAR98

A—Bearing cone (2 used)

B—Seventh stage output shaft gear assembly

C—Oil Trough Assembly

D—Cap Screw M8x12 8.8 (2 used)

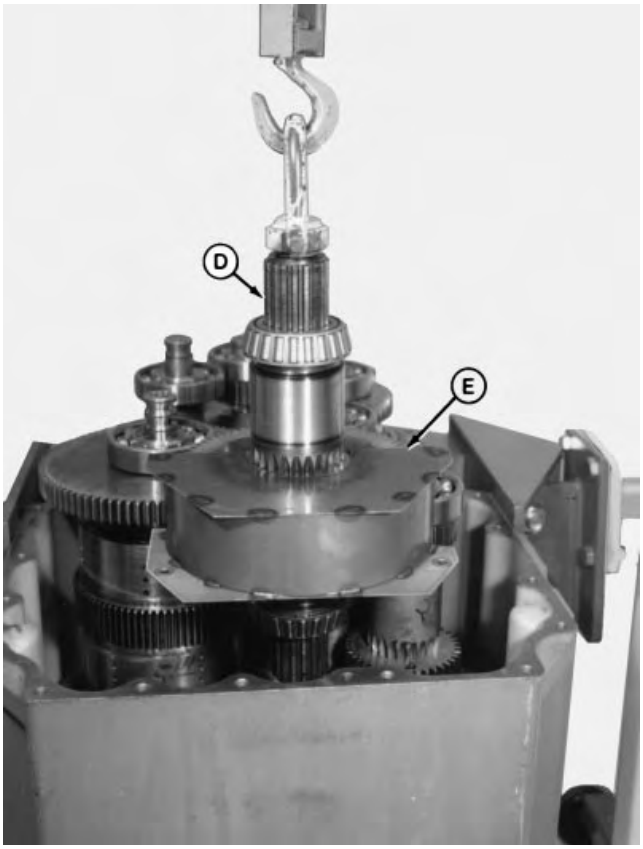
Continued on next page

YZ,CTM148,45,43 –19–01AUG98–1/3

NOTE: Be sure new bearing cup has been installed in main case rear housing. Oil bearing cup before installing output group. See group 50 (remove bearing cup).

Output group can be installed upside down. Install as shown in illustration.

1. Install output group (D) and oil trough (E) into main case rear housing.



YZ780F –UN–18JUN98

YZ,CTM148,45,43 –19–01AUG98–2/3

2. Install two cap screws (A).

3. Tighten cap screws (A) to 25 N•m (18 lb-ft).

NOTE: Ref to group 40 "INSTALL FRONT HOUSING TO REAR HOUSING" for installation of housing.

YZ778 –UN–13DEC93

YZ,CTM148,45,43 –19–01AUG98–3/3

Specifications

Item	Measurement	Specification
Lift hanger and cover-to-rear housing cap screw.	Torque	87 N•m (64 lb-ft)
Bearing retainer-to-rear housing cap screws.	Torque	25 N•m (18 lb-ft)
Dipstick tube assembly-to-front housing cap screws.	Torque	25 N•m (18 lb-ft)
Yoke-to-output shaft cap screw.	Torque	215 N•m (159 lb-ft)
Output shaft.	End play	0± .051 mm (0± .002 inch)

YZCTM148,50,SPC –19–14SEP98–1/1

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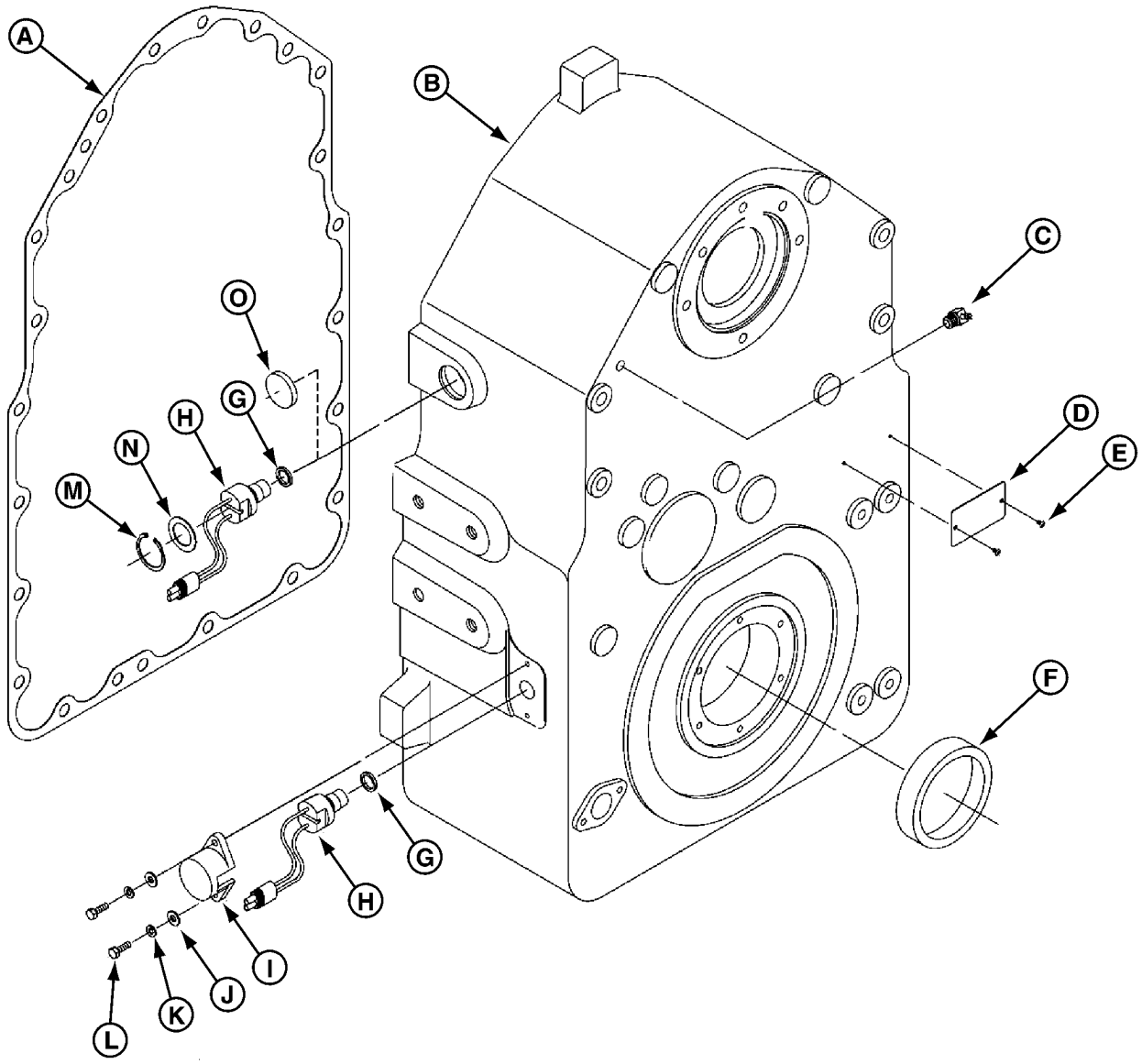
Rear Housing Component Identification (DF150)



YZ1581 –UN–24JUL98

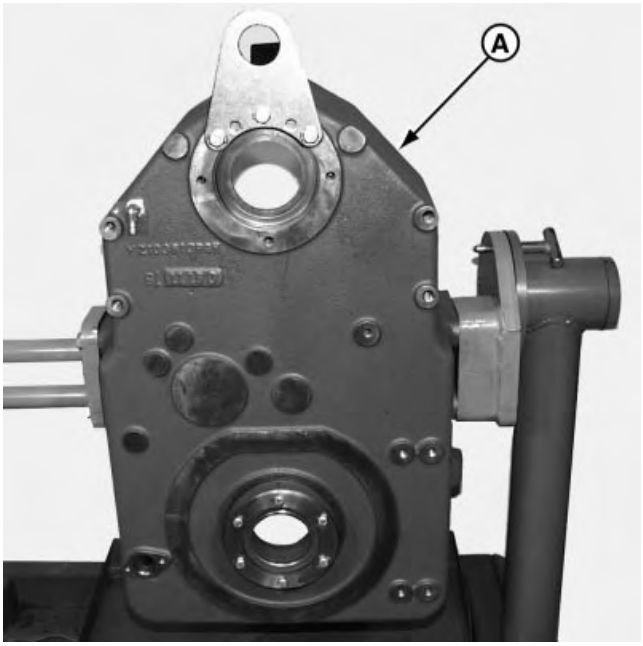
A—Gasket
B—Rear Housing (DF 150)
C—Elbow
D—Identification Plate
E—Drive Screw (2 used)
F—Bearing Cup
G—O-ring (2 used)
H—Magnetic Pickup Sensor
I—Cover
J—Washer (2 used)
K—Lock Washer (2 used)
L—Cap Screw M6x20 8.8 (2 used)
M—Snap Ring
N—Flat Washer
O—Plug (If Magnetic Pickup Sensor Not Used)

YZ,CTM148,50,14 –19–28JUL98–1/1

Rear Housing

NOTE: Refer to earlier groups in manual for removal of input housing, valve assembly, front housing and gear ratio group.

Rotate rear housing (A).

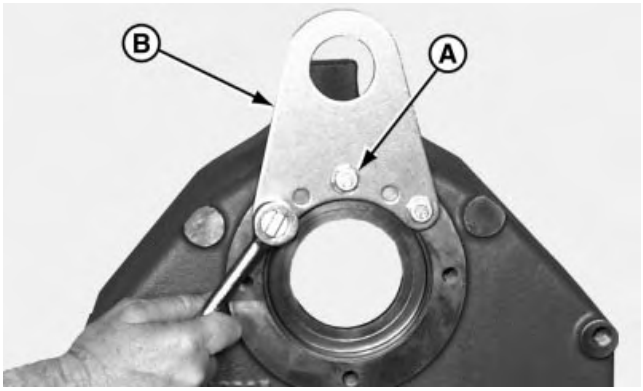


YZ1684 –UN–09JUL98

YZ,CTM148,50,1 –19–28JUL98–1/1

Remove Lift Bracket (Rear)

1. Remove three cap screws (A) and lift bracket (B).
2. Inspect lift bracket for damage.

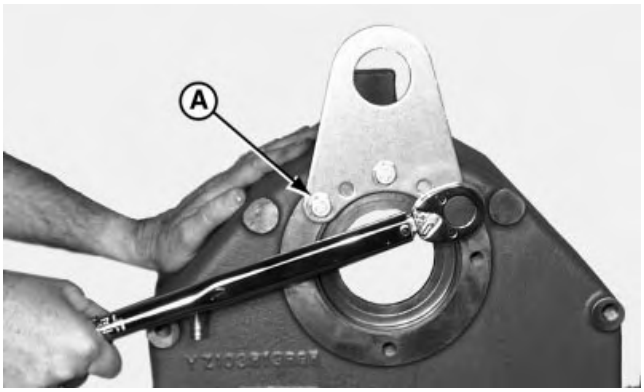


YZ1686 –UN–09JUL98

YZ,CTM148,50,2 –19–28JUL98–1/1

Install Lift Bracket (Rear)

1. Install three cap screws (A).
2. Tighten cap screws to 87 N•m (64 lb-ft).



YZ1687 –UN–09JUL98

YZ,CTM148,50,3 –19–28JUL98–1/1

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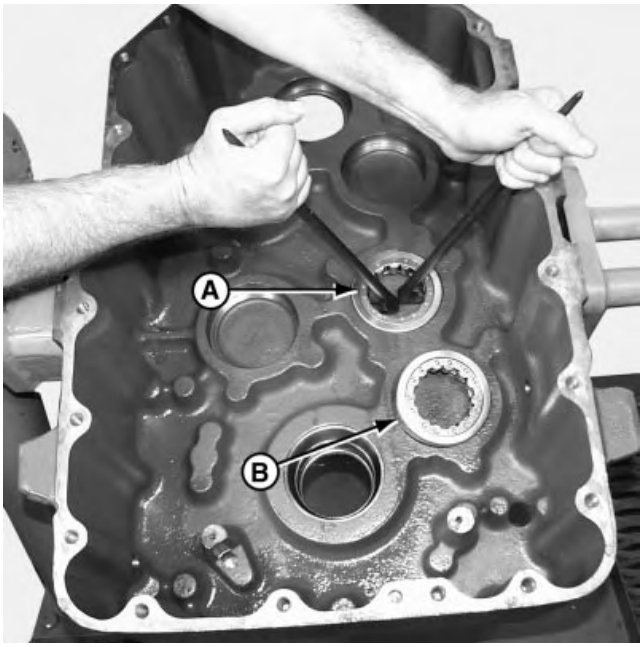
Remove Bearings (Roller)

IMPORTANT: If bearings (A) and (B) are removed from the rear housing they must be replaced with new bearings.

Use new inner races for these bearings on the fourth stage clutch assembly and the sixth stage shaft assembly.

1. Remove fourth stage bearing (A).
2. Remove sixth stage bearing (B).



YZ1688 –UN–09JUL98

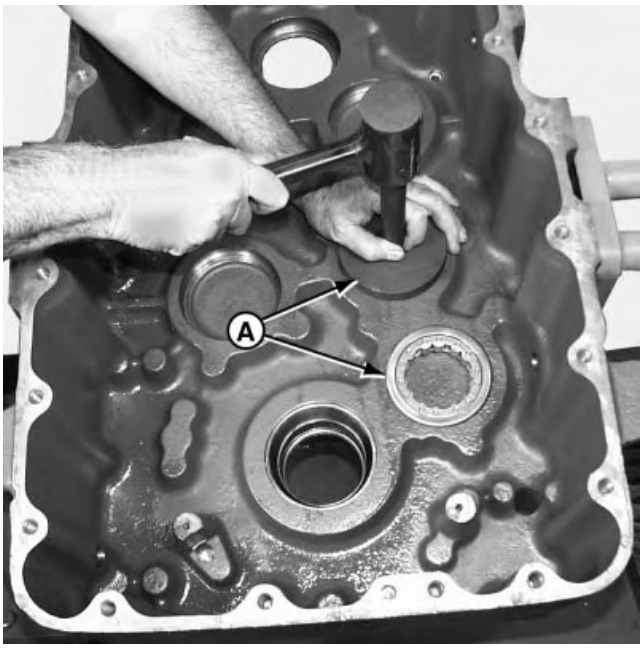
YZ,CTM148,50,15 –19–28JUL98–1/1

Install Bearings (Roller)

IMPORTANT: Use bearing installation tooling that applies force only to the outer race of the bearing.

Seat bearings (A) firmly against the bottom of the bearing bores. Do not damage the bearing cages and races during installation.

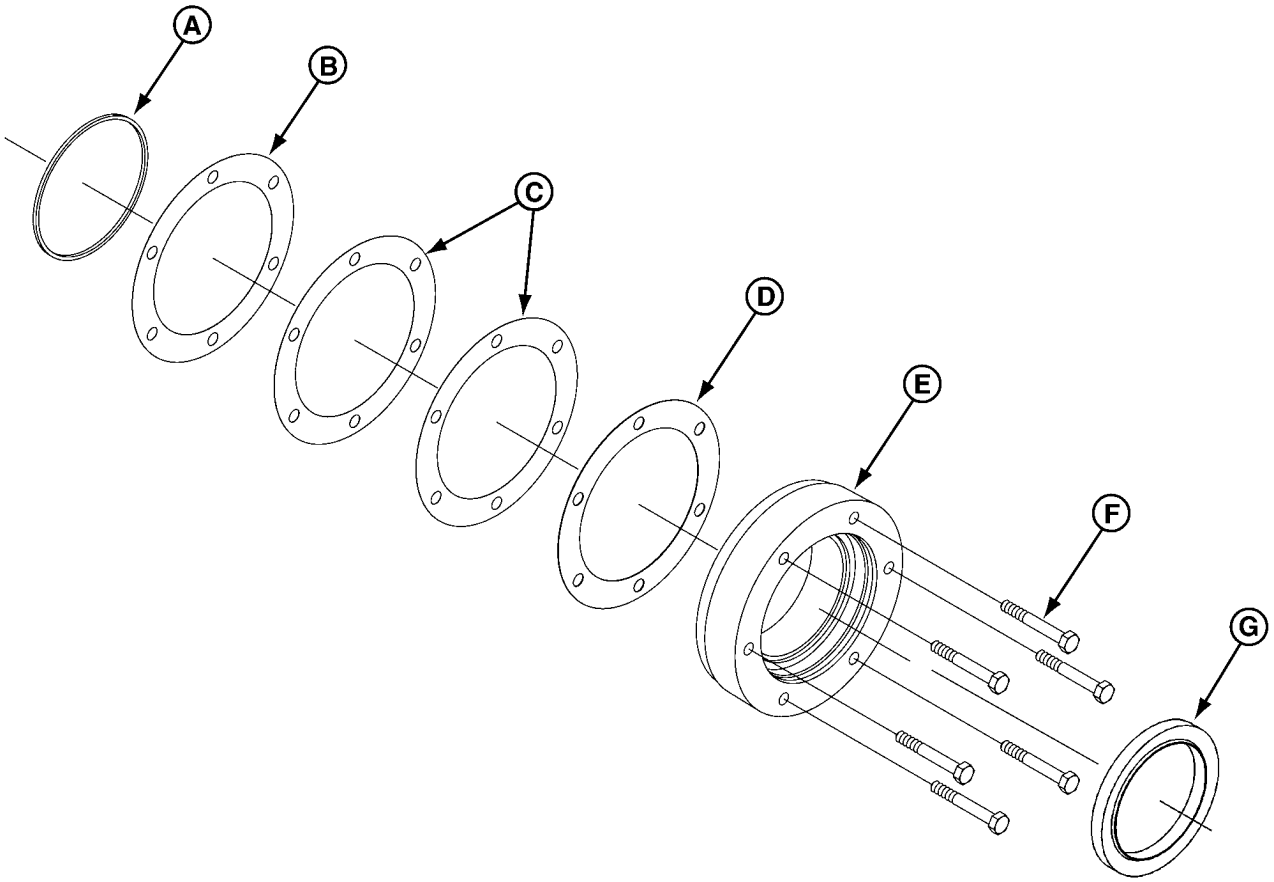
1. Lubricate bearings with clean transmission fluid.
2. Install two new bearings (A).
3. Seat bearings against the bottom of the bearings bores.



YZ1689 –UN–09JUL98

YZ,CTM148,50,16 –19–28JUL98–1/1

Remove Bearing Retainer Assembly and Shims



YZ721A –UN–13MAR98

A—O-ring
B—.51 shim (as required)
C—.18 shim (as required)
D—.13 shim (as required)
E—Bearing retainer
F—Cap screw M8x60 8.8 (6 used)
G—Oil seal

Continued on next page

YZ,CTM148,50,13 –19–28JUL98–1/3

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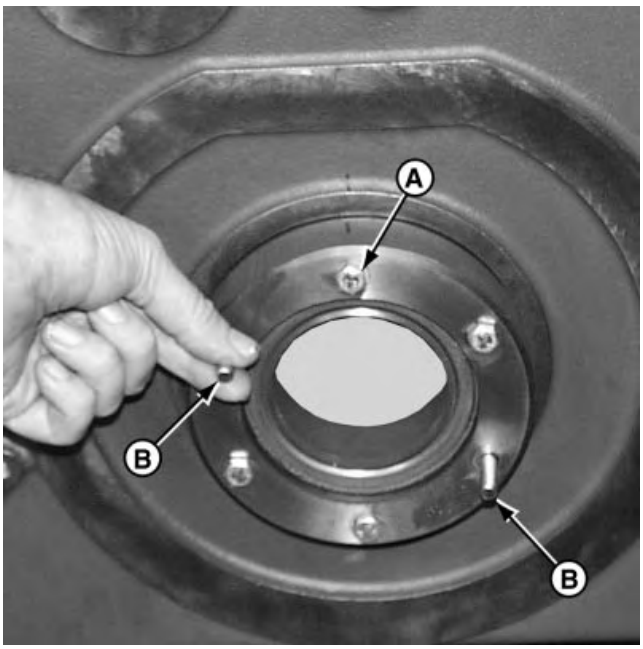
1. Position rear housing with bearing retainer up.
2. Remove two cap screws (A).
3. Install two guide pins (B).
4. Remove the remaining four cap screws.

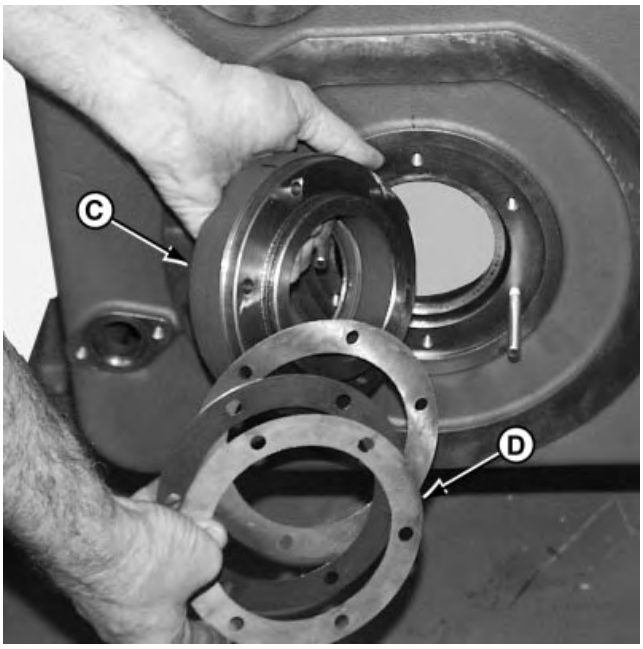


YZ1690 –UN–09JUL98

YZ,CTM148,50,13 –19–28JUL98–2/3

5. Remove bearing retainer assembly (C) and the shims (D).

NOTE: Save the shims and keep them together they may be reused if in good condition.

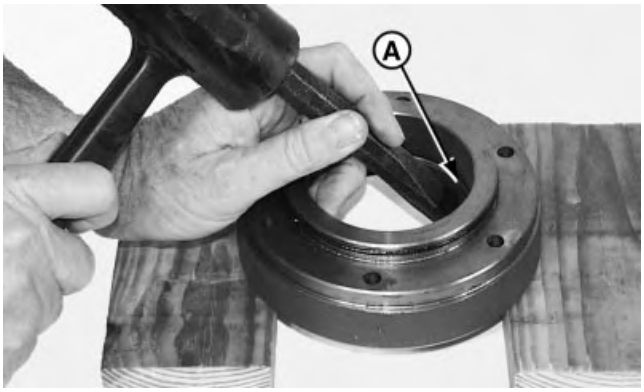


YZ1691 –UN–09JUL98

YZ,CTM148,50,13 –19–28JUL98–3/3

Remove Oil Seal From Bearing Retainer

1. Remove and discard oil seal (A).
2. Clean and inspect bearing retainer.



YZ1692 –UN–09JUL98

YZ,CTM148,50,18 –19–28JUL98–1/1

Install Oil Seal in Bearing Retainer

IMPORTANT: If the new oil seal does not have the outside diameter coated with a sealer, apply LOCTITE® #620 sealer.

1. Apply LOCTITE® #620 to outside diameter of oil seal, if not pre-coated.

LOCTITE is a trademark of Loctite Corp.

YZ,CTM148,50,6 –19–28JUL98–1/2

2. Install new oil seal (A).
3. Seat oil seal on the bottom of the bore in bearing retainer.

YZ1694 –UN–09JUL98

YZ,CTM148,50,6 –19–28JUL98–2/2

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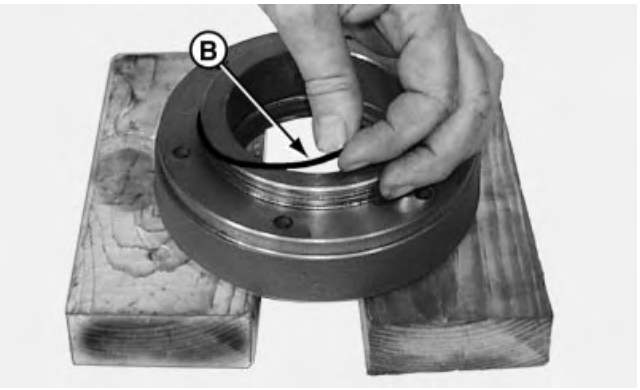
Remove O-Ring From Bearing Retainer

Remove and discard O-ring (B).

Install O-Ring on Bearing Retainer

1. Lubricate new O-ring with transmission fluid.
2. Install new O-ring (B).



YZ1693 –UN–09JUL98

YZ,CTM148,50,7 –19–28JUL98–1/1

Remove Bearing Cup From Rear Housing

1. Remove bearing cup (A).
2. Clean and inspect bearing bore in housing.

Install Bearing Cup in Rear Housing

1. Lubricate the new bearing cup with clean transmission fluid.

YZ1695 –UN–09JUL98

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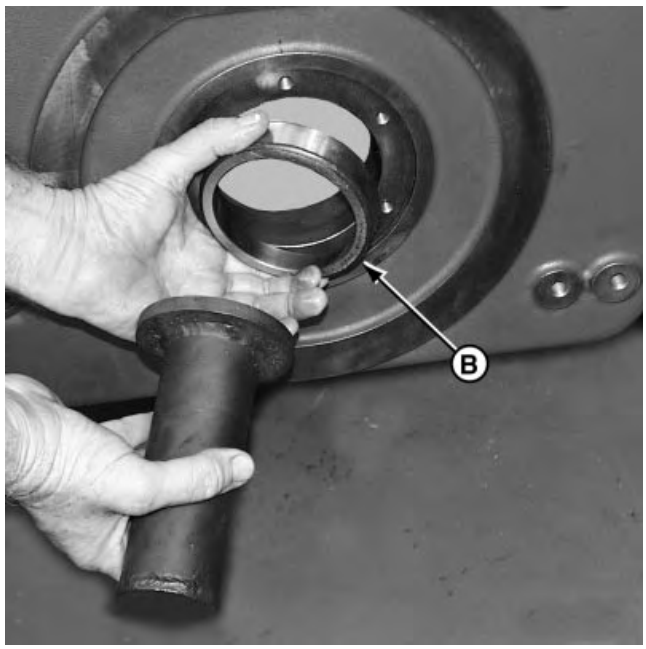
YZ,CTM148,50,5 –19–28JUL98–1/3

2. Install new bearing cup (B) 6 mm (1/4 inch) deeper than flush.

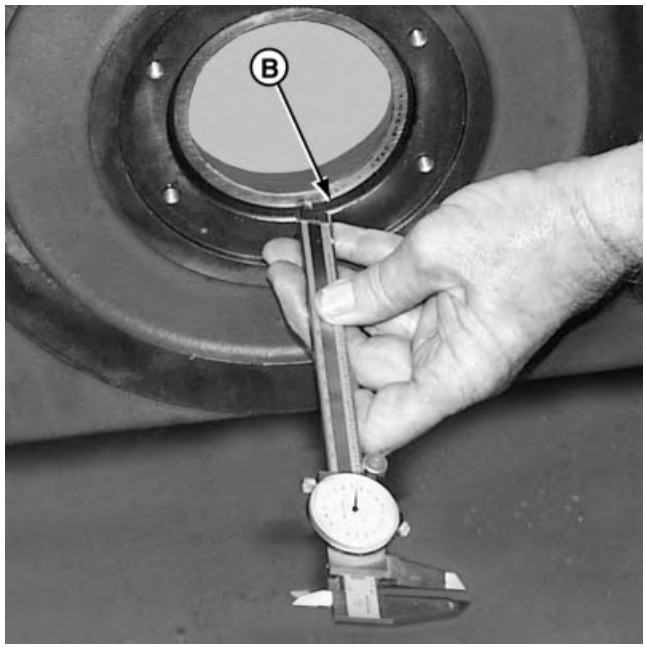


YZ1696 –UN–09JUL98

YZ,CTM148,50,5 –19–28JUL98–2/3

IMPORTANT: Set the bearing cup not more than 6mm (1/4 inch) deeper than flush with the face of the bearing bore.

NOTE: The bearing retainer and shim arrangement will set the exact depth for the bearing cup during the end play adjustment procedure.



YZ1697 –UN–09JUL98

YZ,CTM148,50,5 –19–28JUL98–3/3

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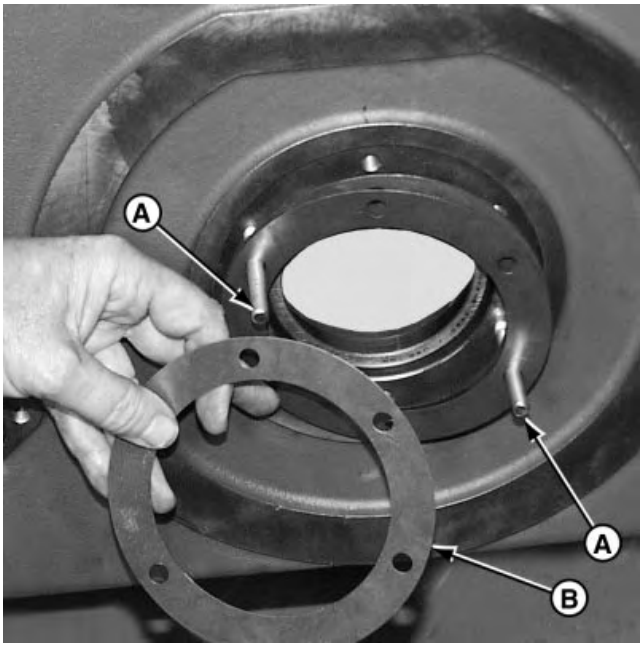
Install Bearing Retainer (Preliminary Installation, Prior to Setting Bearing End Play Output Shaft)

1. Install two guide pins (A).

NOTE: Use all original shims and one additional .254mm (.010 inch) shim for setting end play of the output stage assembly. The additional shim is to help prevent damage to the output shaft assembly tapered roller bearing during the initial assembly, before the proper shim thickness has been established.

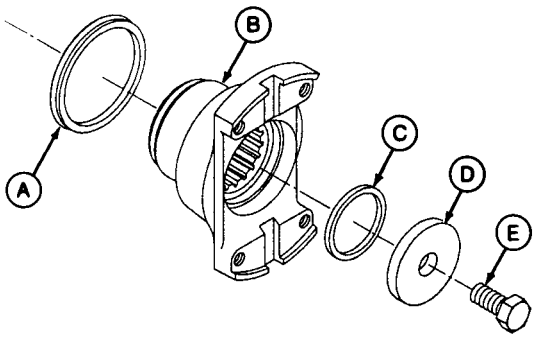
2. Place shims (B) on guide pins.



YZ1698 –UN–09JUL98

YZ,CTM148,50,8 –19–28JUL98–1/1

Setting End Play of Output Group



YZ722 –UN–05NOV93

INSTALL OUTPUT YOKE

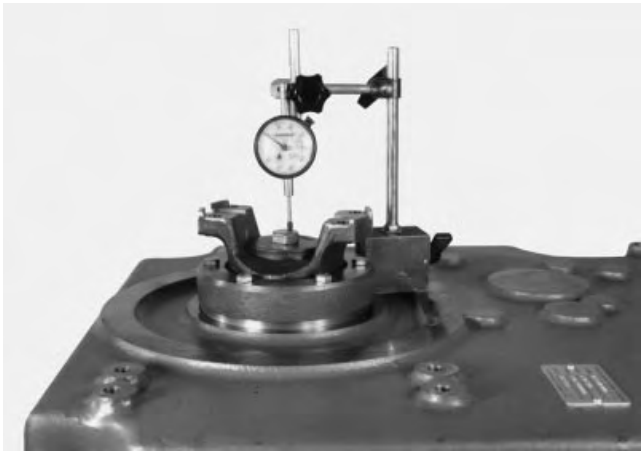
1. Install yoke (B) with V-ring seal (A) onto splined output shaft.
2. Install O-ring (C), washer (D) and cap screw (E).
3. Tighten cap screw 215 N•m (159 lb-ft).
4. **Check end play**

IMPORTANT: Check and reset output shaft end play whenever new parts are installed. Set End play at a 0 ± .051 mm (0 ± .002 in).

Check end play with dial indicator on cap screw.

Place dial indicator on cap screw.

5. Use pry bars under yoke to check end play.



YZ680F –UN–14JUN98

A—V-ring seal
B—Yoke
C—O-ring
D—Yoke washer
E—Cap screw

YZ,CTM148,50,12 –19–28JUL98–1/7

6. Remove cap screw, washer and yoke from output shaft.

YZ681F –UN–14JUN98

Continued on next page

YZ,CTM148,50,12 –19–28JUL98–2/7

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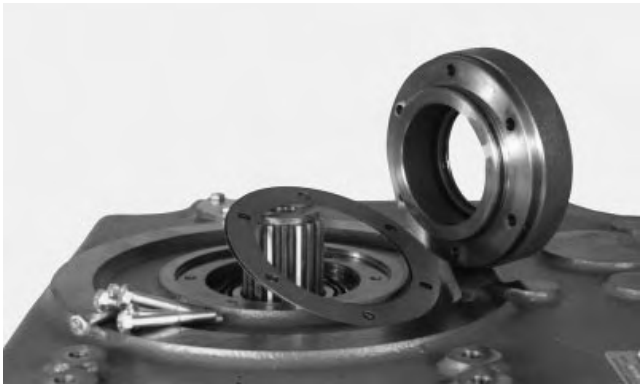
7. Remove bolts from bearing retainer.

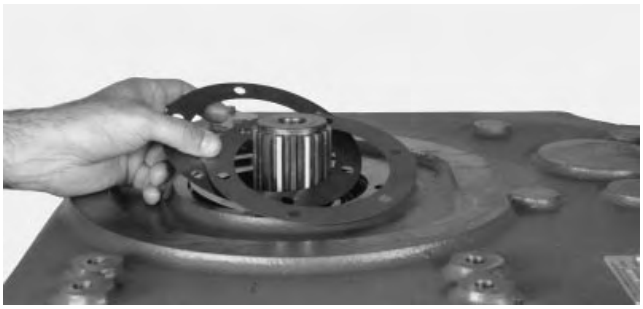
8. Remove bearing retainer from rear housing.



YZ,CTM148,50,12 –19–28JUL98–3/7

NOTE: Use guide pins for installation of shims and retainer. Shims can be .003 thickness and roll onto retainers outside diameter causing possible leak or damage to o-ring.

9. Remove or install correct amount of shims to reach a 0 ± .051 mm (0 ± .002 in) amount of end play.



YZ,CTM148,50,12 –19–28JUL98–4/7

10. Align bearing retainer bolt holes with bolt hole circle in the rear housing.

11. Install cap screws.

12. Tighten cap screws to 25 N•m (18 lb-ft).

YZ,CTM148,50,12 –19–28JUL98–5/7

13. Install yoke, O-ring, washer and cap screw.

Continued on next page

YZ,CTM148,50,12 –19–28JUL98–6/7

14. Tighten cap screw to 215 N•m (159 lb-ft).

NOTE: Refer to group 55 for installation of brake calipers.

YZ686F –UN–14JUN98

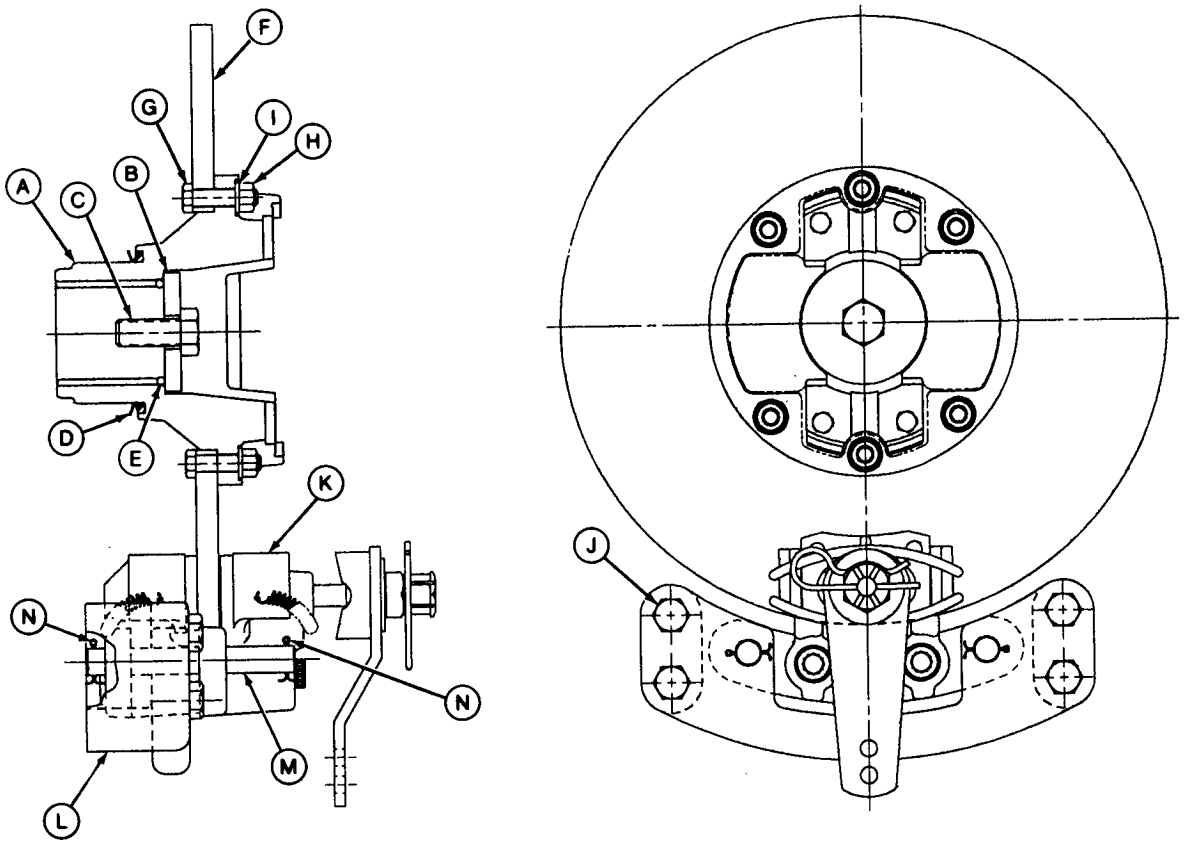
YZ,CTM148,50,12 –19–28JUL98–7/7

Specifications

Item	Measurement	Specification
Disk brake-to-yoke cap screw.	Torque	48 N•m (36 lb-ft)
Yoke flange-to-output shaft cap screw.	Torque	215 N•m (159 lb-ft)
Caliper assembly-to-brake bracket cap screw.	Torque	87 N•m (64 lb-ft)

YZCTM148,55,SPC –19–14SEP98–1/1

Disc Brake Group



YZ723 –UN–05NOV93

A—Yoke flange
B—Yoke washer
C—Cap screw
D—V-ring seal
E—O-ring
F—Brake disc
G—Cap screw (6 used)
H—Hex nut (6 used)
I—Lock washer (6 used)
J—Cap screw (6 used)
K—Caliper assembly
L—Brake bracket
M—Mount pin (2 used)
N—Cotter pin (4 used)

YZ,CTM148,55,1 –19–14SEP98–1/1

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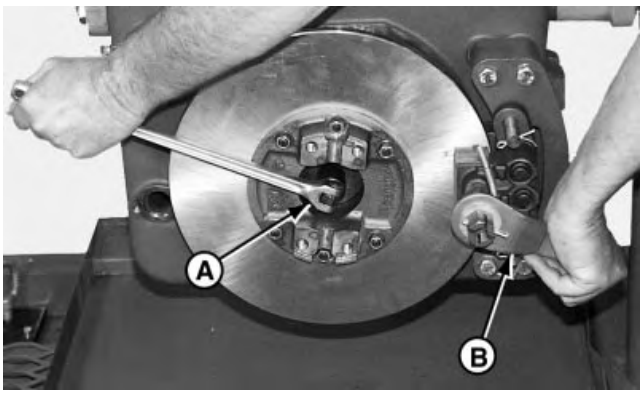
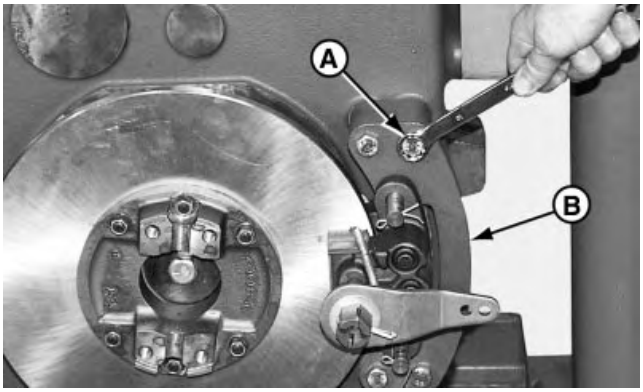
Disassemble Disc Brake

1. Loosen cap screw (A) to keep output shaft from turning.



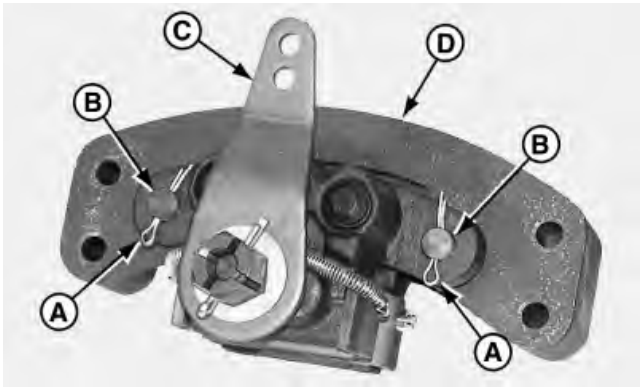
YZ,CTM148,55,9 –19–14SEP98–1/8

2. Remove four cap screws (A).
3. Remove caliper assembly and brake bracket (B) as a group.



YZ,CTM148,55,9 –19–14SEP98–2/8

4. Remove two cotter pins (A).
5. Remove two mount pins (B).
6. Remove caliper assembly (C) from brake bracket (D).



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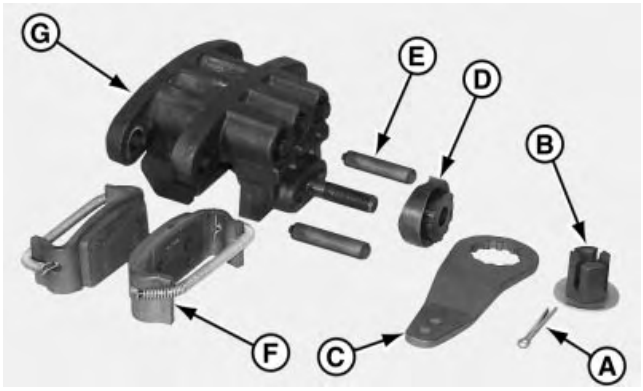
YZ,CTM148,55,9 –19–14SEP98–3/8

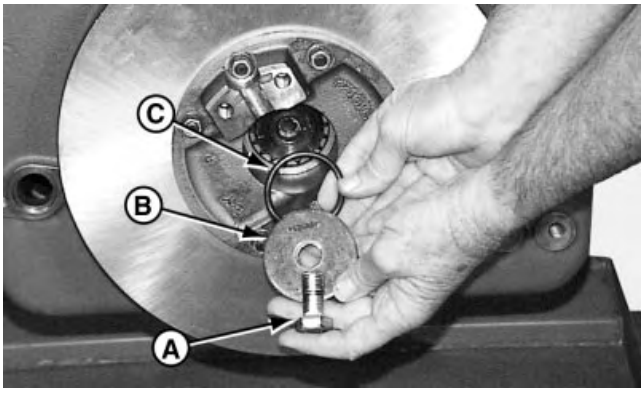
7. Remove cotter pin (A).
8. Unscrew adjusting nut (B).
9. Remove operating lever (C). Pay attention to the position of the operating lever for reassembly purposes.
10. Remove cam (D).
11. Remove two actuating pins (E).
12. Remove two brake pad and spring groups (F) from caliper assembly (G).



YZ1603 –UN–08JUL98

YZ,CTM148,55,9 –19–14SEP98–4/8

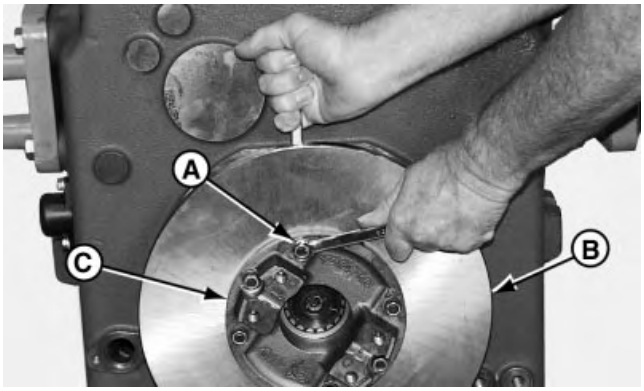
13. Remove cap screw (A), yoke washer (B), and O-ring (C).



YZ1604 –UN–08JUL98

YZ,CTM148,55,9 –19–14SEP98–5/8

14. Loosen six hex nuts (A).
15. Remove the brake disc (B) and yoke flange (C) as a group.



YZ1605 –UN–08JUL98

Continued on next page

YZ,CTM148,55,9 –19–14SEP98–6/8

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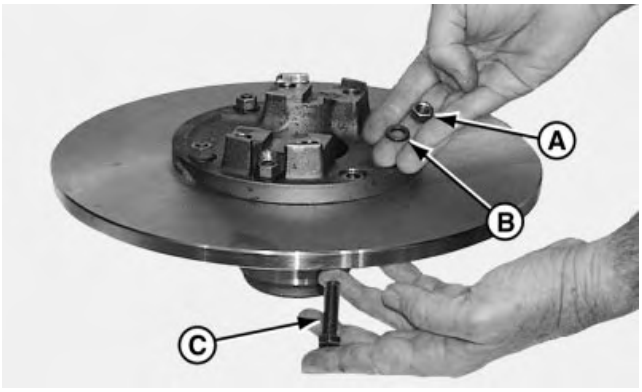
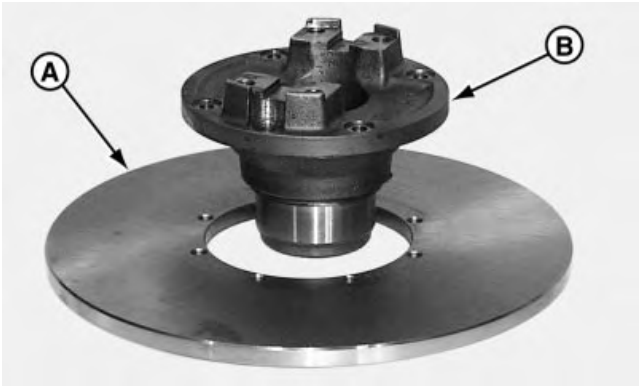
16. Remove six hex nuts (A), six lock washers (B). and six cap screws (C).



YZ,CTM148,55,9 –19–14SEP98–7/8

17. Remove brake disc (A) from yoke flange (B).

18. Inspect all parts for wear. Replace as necessary.

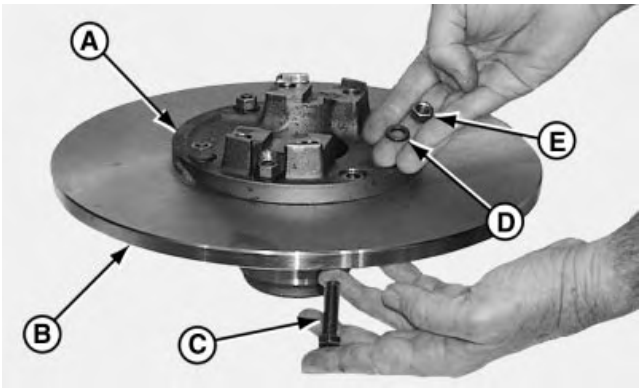


YZ,CTM148,55,9 –19–14SEP98–8/8

Assemble Disc Brake

1. Assemble yoke flange (A) and brake disc (B).

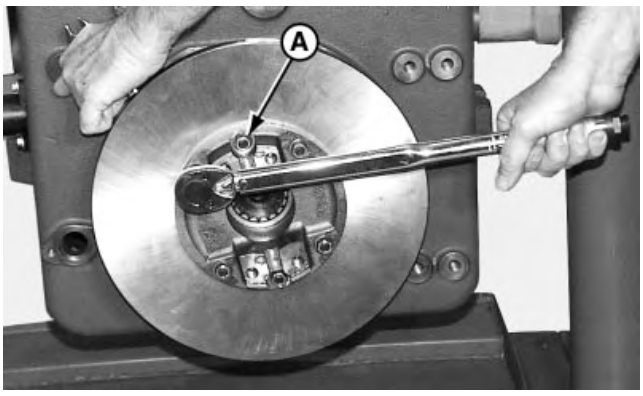
2. Install six cap screws (C), six lock washers (D), and six Hex nuts (E).



YZ,CTM148,55,16 –19–14SEP98–1/7

3. Install brake disk and yoke flange group on output shaft of transmission.

4. Tighten six cap screws (A) to 87 N•m (64 lb-ft).



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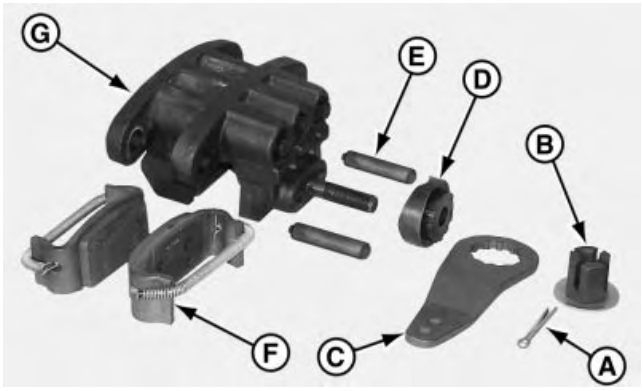
YZ,CTM148,55,16 –19–14SEP98–2/7

5. Install two brake pads and spring groups (F) to caliper assembly (G).

IMPORTANT: Make sure end of actuating pin with the shoulder is installed into the caliper assembly first.

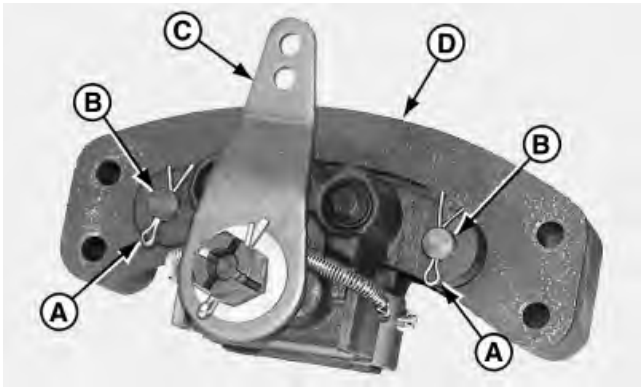
6. Install two actuating pins (E).
7. Install cam (D).
8. Install operating lever (C) in same position as when removed.
9. Install adjusting nut (B). Do not tighten. Allow enough clearance between pads and disc to prevent dragging.
10. Install new cotter pin (A).



YZ1603 –UN–08JUL98

YZ,CTM148,55,16 –19–14SEP98–3/7

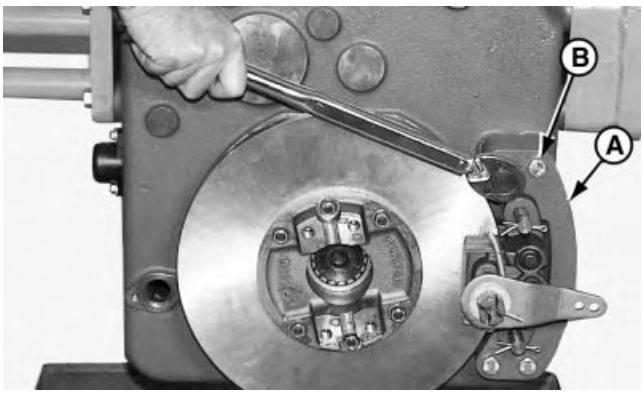
11. Install caliper assembly (C) on brake bracket (D).
12. Install two mount pins (B).
13. Install two new cotter pins (A).



YZ1614 –UN–08JUL98

YZ,CTM148,55,16 –19–14SEP98–4/7

14. Install caliper and brake bracket group (A).
15. Install four cap screws (B).
16. Tighten to 87 N•m (64 lb-ft).



YZ1610 –UN–08JUL98

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YZ,CTM148,55,16 –19–14SEP98–5/7

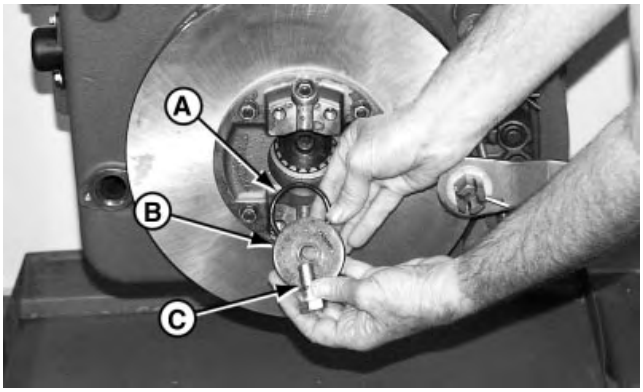
IMPORTANT: O-ring is positioned flat against the face of the output shaft.

17. Lubricate and install new O-ring (A).

IMPORTANT: The machined face of the washer must be installed next to the O-ring.

18. Install yoke washer (B).

19. Install cap screw (C).

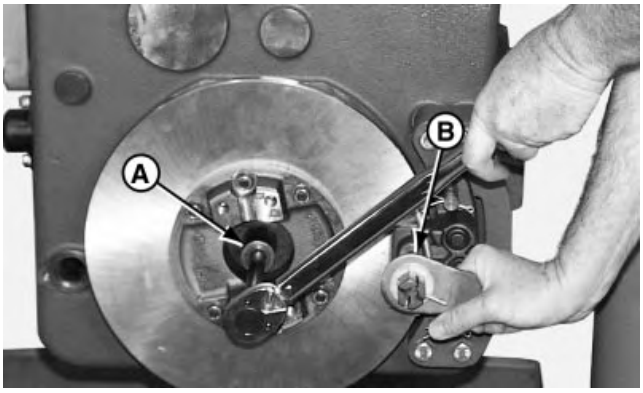


YZ1611 –UN–08JUL98

YZ,CTM148,55,16 –19–14SEP98–6/7

NOTE: Use brake caliper (B) to keep output shaft from turning.

20. Tighten cap screw to 215 N•m (159 lb-ft).

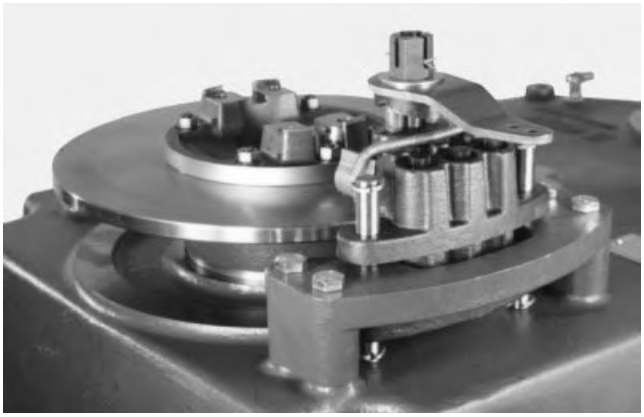


YZ1609 –UN–08JUL98

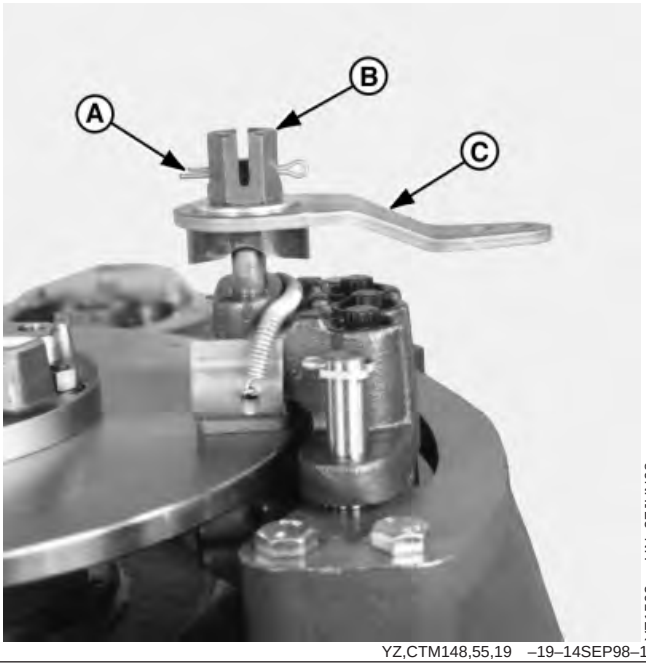
YZ,CTM148,55,16 –19–14SEP98–7/7

Remove Brake Pads

1. Remove Cotter pin (A).
2. Remove Adjusting nut (B).
3. Remove operating lever (C).



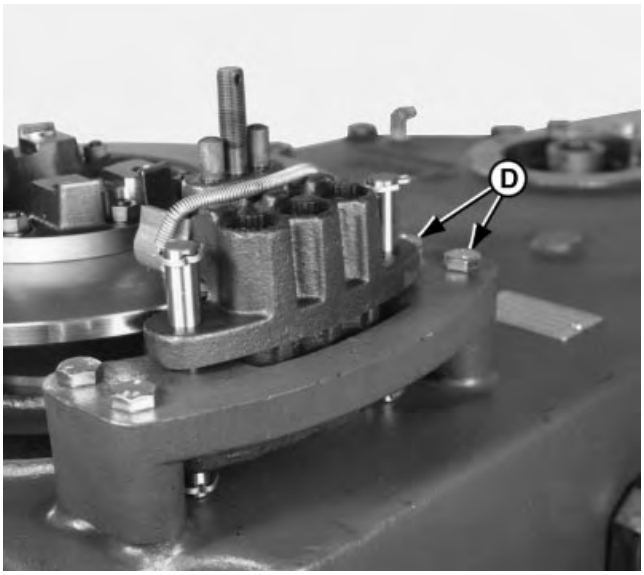
YZ1561 –UN–27JUN98



YZ1562 –UN–27JUN98

YZ,CTM148,55,19 –19–14SEP98–1/6

4. Remove cap screws (D).



YZ1563 –UN–27JUN98

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YZ,CTM148,55,19 –19–14SEP98–2/6

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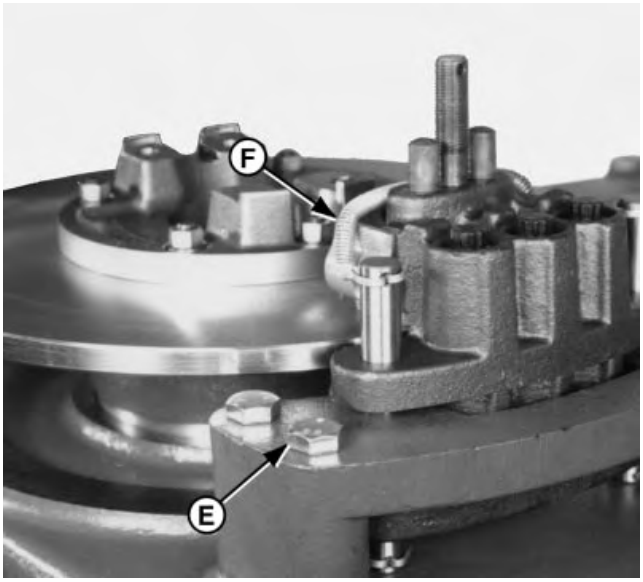
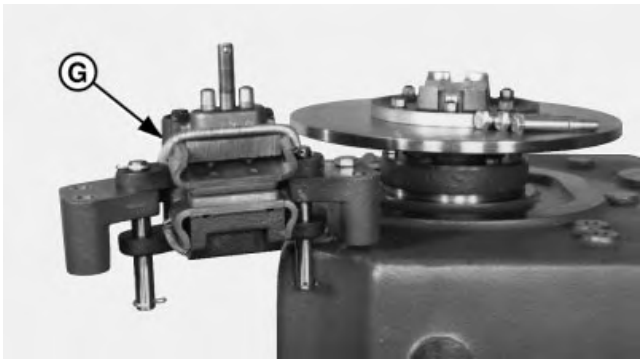
5. Lift spring (F) over bolt in brake assembly.
6. Remove cap screw (E).



YZ1564 –UN–27JUN98

YZ,CTM148,55,19 –19–14SEP98–3/6

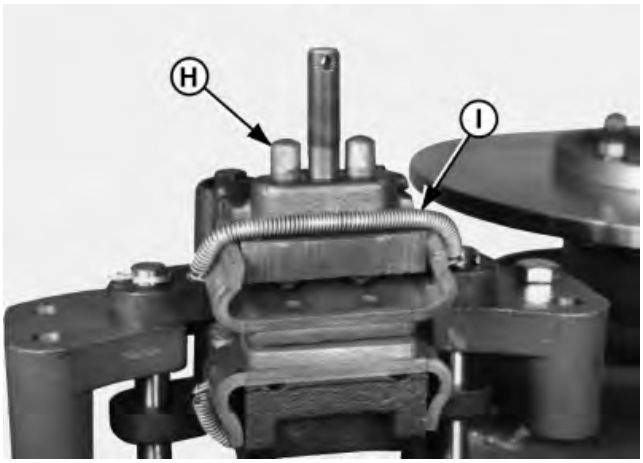
7. Swing brake assembly (G) away from brake disk.



YZ1565 –UN–27JUN98

YZ,CTM148,55,19 –19–14SEP98–4/6

8. Remove actuating pins (H).
9. Remove brake pad (I).

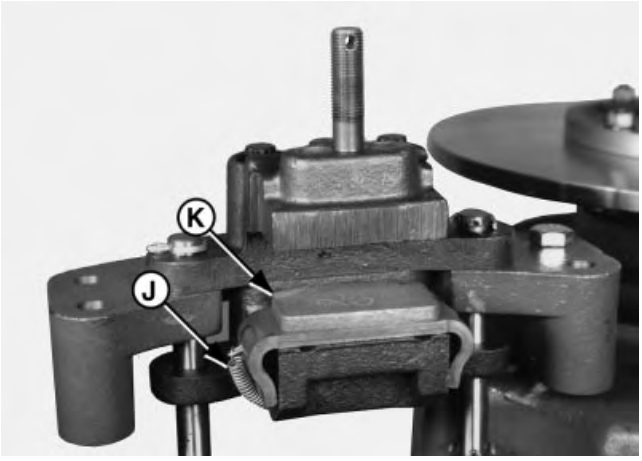


YZ1566 –UN–27JUN98

Continued on next page

YZ,CTM148,55,19 –19–14SEP98–5/6

10. Move spring (J) in front of brake assembly.
11. Lift brake pad (K) up and out to remove.
12. Inspect for wear and damage.



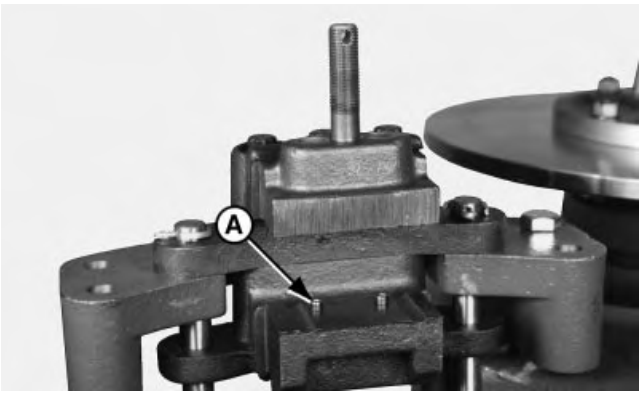
YZ1567 –UN–27JUN98

YZ,CTM148,55,19 –19–14SEP98–6/6

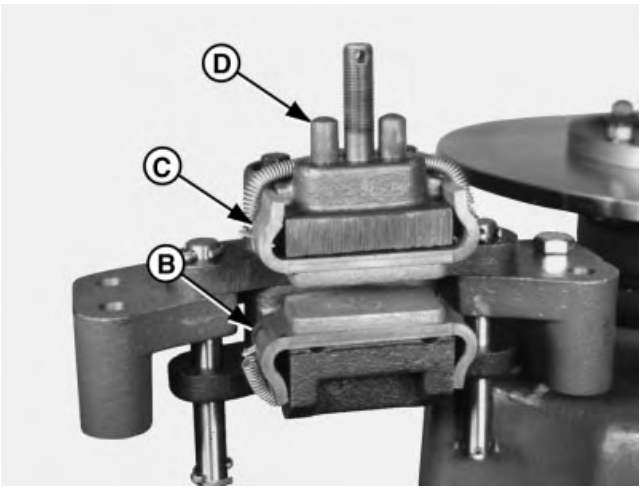
Install Brake Pads

NOTE: There are two pins located in the lower brake pad area (A) of the brake assembly. Brake pads have two holes that locate on pins.

1. Install brake pad (B) spring behind brake assembly.
2. Install brake Pad (C) with spring behind threaded shaft of brake assembly.
3. Install actuating pins (D) to locate top brake pad.



YZ1568 –UN–27JUN98

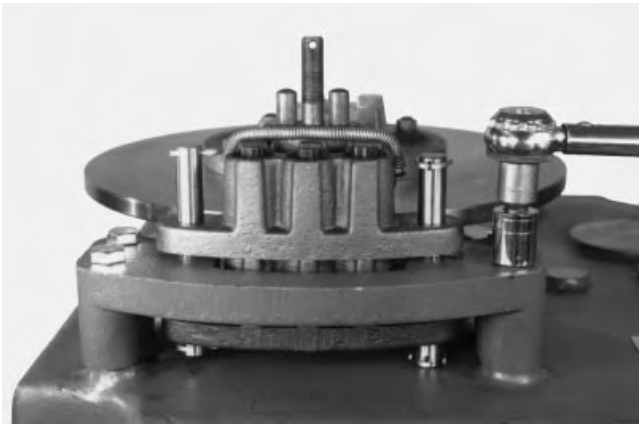


YZ1569 –UN–27JUN98

Continued on next page

YZ,CTM148,55,21 –19–14SEP98–1/3

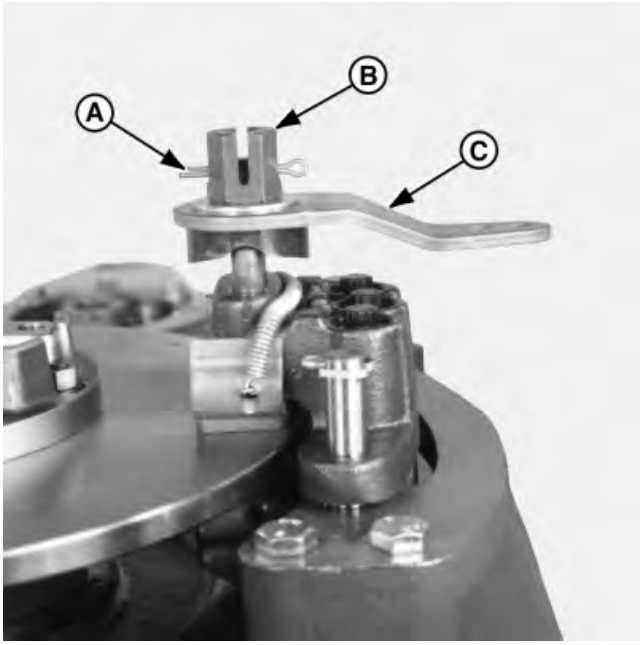
4. Swing brake assembly onto disk brake.
5. Install cap screws.
6. Tighten cap screw 87 N•m (64 lb-ft).



YZ1570 –UN–27JUN98

YZ,CTM148,55,21 –19–14SEP98–2/3

7. Install cam and lever (C).
8. Install adjusting nut (B).
9. Install cotter pin (A).



YZ1562 –UN–27JUN98

YZ,CTM148,55,21 –19–14SEP98–3/3

Group 99

IMPORTANT: The special tools listed below are required to properly service the transmission.

SPECIAL TOOLS USED IN THIS MANUAL:

- Clutch Stage Lifting tool.
- Bore Sleeve removal tool.
- Bore Sleeve installation tool.
- Transmission Repair Stand.
- Transmission Stand Mounting Brackets.
- Clutch Return Spring Compression tool.
- Front Housing Lifting tool.
- Front Housing Relief Valve tool.

Contact FUNK Manufacturing for measured drawings.

Funk Manufacturing Company
Industrial Park, Highway 169 North
P.O. Box 577
Coffeyville, Kansas 67337-0577
Telephone: (316)-252-3400 or 800-844-1377
FAX: (316)-252-3252

YZ,CTM148,99,1 –19–28JUL98–1/1

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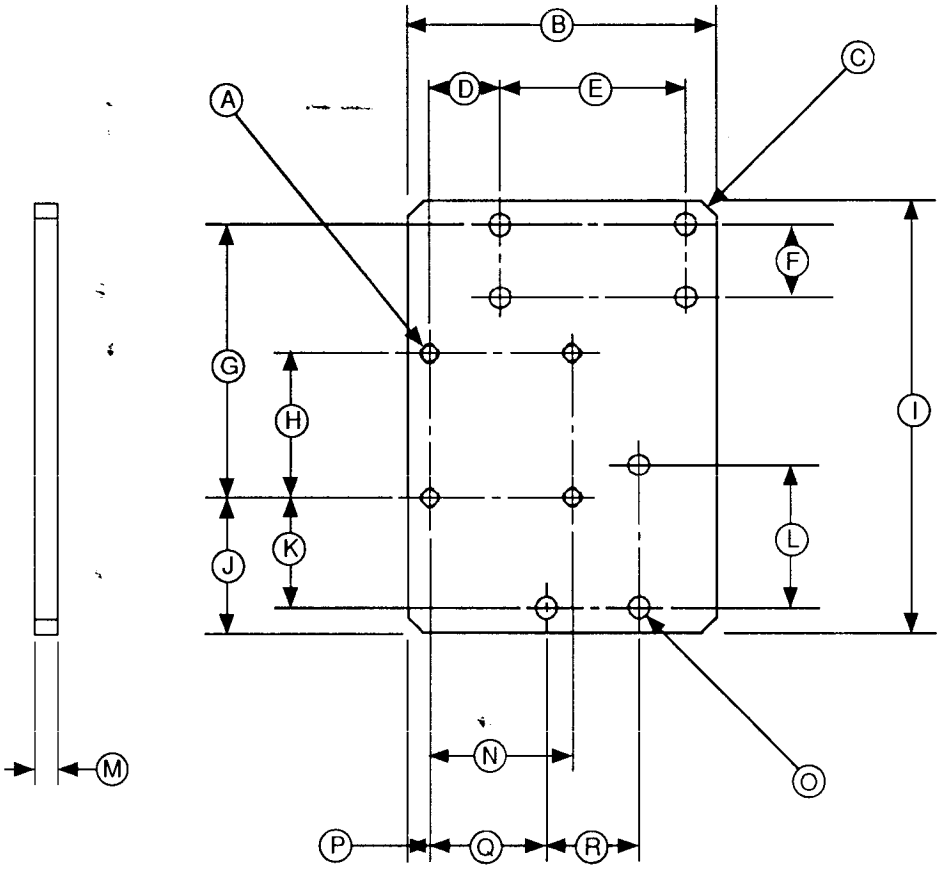
Assembly Stand Plate[1]

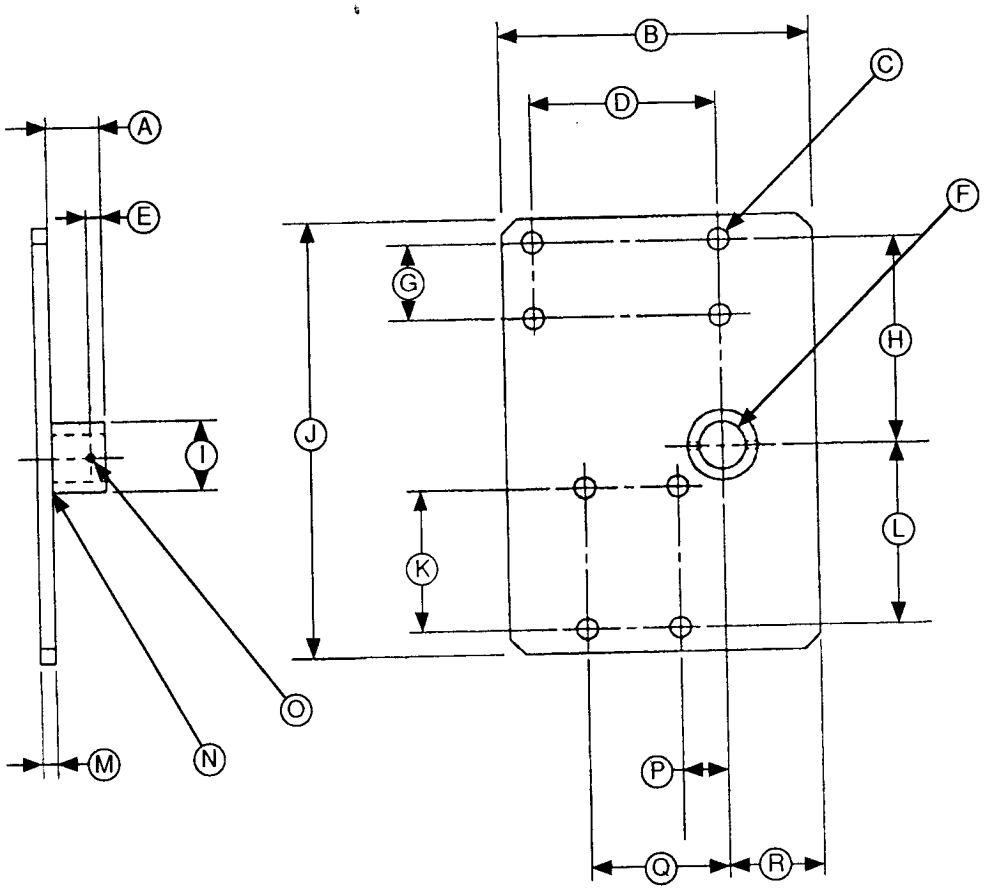


A—4X 17/32 Drill Through 5/8-11 UNC-2B Tap through
B—9.968 in. (253.187mm)
C—4x 1/2 x 45°
D—2.31 in. (58.67mm)
E—5.984 in. (151.993mm)
F—2.362 in. (59.994mm)
G—8.79 in. (223.26mm)
H—4.625 in. (117.475mm)
I—13.875 in. (98.425mm)
J—4.31 in. (109.47mm)
K—3.52 in. (89.40mm)
L—4.528 in. (115.011mm)
M—75 in. (19.05mm)
N—4.625 in. (117.475mm)
O—7x 11/16 Drill Through
P—69 in. (17.52mm)
Q—3.77 in. (95.75mm)
R—2.992 in. (75.996mm)

[1]For use with OTC stand P/N 1735

Continued on next page

YZ,CTM148,99,2 –19–28JUL98–1/2



YZ808 –UN–09JUN94

A—1.75 in. (44.45mm)
B—9.96 in. (252.98mm)
C—8X 11/16 Drill Through
D—5.984 in. (151.993mm)
E—.5 in. (12.7mm)
F—1.500—1.505 in. (38.1—38.227mm)
G—2.362 in. (59.994mm)
H—6.48 in. (164.59mm)
I—2.25 in. (57.15mm)
J—13.875 in. (352.425mm)
K—4.528 in. (115.011mm)
L—5.84 in. (148.33mm)
M—.5 in. (12.7mm)
N—.25 (6.35) radius in corner
O—17/64 Drill Through as Shown
P—1.46 in. (37.08mm)
Q—2.992 in. (75.996mm)
R—3.00 in. (76.2mm)

YZ,CTM148,99,2 –19–28JUL98–2/2

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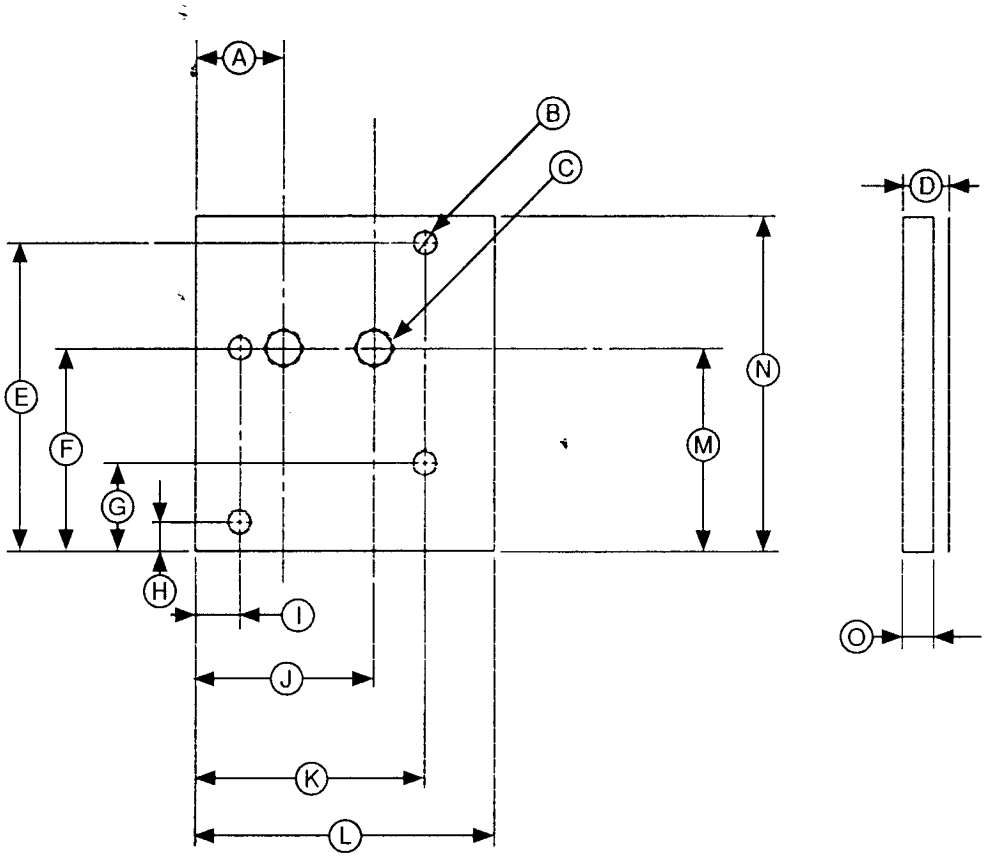
Front Housing Lifting Tool



A—1.42 in. (36.05mm)
B—4X .38 in. (9.52mm)
C—17/32 Drill Through 5/8-11 UNC
D—.75 in. maximum (19.05mm)
E—4.99 in. (126.7mm)
F—3.29 in. (83.6mm)
G—1.44 in. (36.5mm)
H—.47 in. (12mm)
I—.71 in. (18.11mm)
J—2.88 in. (73.17mm)
K—3.70 in. (94.01mm)
L—4.83 in. (122.78mm)
M—3.29 in. (83.6mm)
N—5.43 in. (138mm)
O—.50 in. minimum (12.7mm)
P—1.46 in. (37.08mm)
Q—2.992 in. (75.996mm)
R—3.00 in. (76.2mm)

NOTE: Used for lifting main case front housing.

YZ,CTM148,99,4 –19–14SEP98–1/1

Theory of Operation Clutch Actuation

Hydraulic oil pressure is directed from the proportional valve, through passages in the valve body, to a drilled passage in the main case that directs the oil pressure to the seal rings on the end of the clutch shaft. The oil pressure is transferred from the stationary housing to the rotating shaft in the area between the shaft seal rings. The oil pressure then travels down a hole in the shaft until it enters the area enclosed by clutch shaft weldment, the clutch apply piston and the piston seals. Here it acts on the piston area causing it to move toward the clutch pack, compressing the bellville piston return springs and removing the free clearance in the clutch. The piston also moves the lube shut-off washer, trapped between the piston and the bellville springs, causing it to uncover the lube holes that provide cooling oil flow to the clutch. Once the free clearance in the clutch is eliminated the piston applies pressure to the clutch plates causing the clutch to transmit torque in proportion to the oil pressure applied.

CTM149,100,5 –19–17OCT98–1/1

Gear Selection

Two clutches must be engaged in order to transmit torque from the transmission input to the transmission output shaft. In Neutral all clutches are in the released condition.

The clutches numbered “1” through “4” are referred to as directional clutches. Clutches “1” and “2” engage forward gears and clutches “3” and “4” engage reverse gears. These clutches have two passages through the shaft in order to maximize the “lube flow” to cool the clutches. These clutches have more friction surface area and a higher thermal capacity than the speed clutches. The directional clutches are used for modulation during shifting and when using the clutch pedal. The directional clutches connect the input shaft of the transmission through various ratios to the cylinder gear train and are located in the upper part of the transmission.

The clutches lettered “A”, “B”, “C” and “D” are referred to as speed clutches. The speed clutches connect the cylinder gear train to the output shaft of the transmission at various ratios. Working in conjunction with the directional clutches up to 8 speed ranges in both forward and reverse directions are possible. The speed clutches are located in the lower part of the transmission.

NOTE: The following table shows which clutches are engaged for each ratio in a eight speed forward and eight speed reverse.

	FORWARD		REVERSE	
Range	Directional	Speed	Directional	Speed
1	“1”	“A”	“3”	“A”
2	“2”	“A”	“4”	“A”
3	“1”	“C”	“3”	“C”
4	“2”	“C”	“4”	“C”
5	“1”	“B”	“3”	“B”
6	“2”	“B”	“4”	“B”
7	“1”	“D”	“3”	“D”
8	“2”	“D”	“4”	“D”

CTM149,100,7 –19–17OCT98–1/1

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Theory of Operation Hydraulic System

Oil is picked up by the transmission charge pump from the transmission sump through a suction screen. It travels through an external suction tube to the inlet side of the charge pump. The charge pump is an external gear pump with fixed clearance end plates and the gear shafts supported by bushings. The pump is driven by a gear train directly coupled to the engine and has a displacement such that it pumps 25 to 27 gpm at engine high idle speed.

From the pump the oil is directed to a filter assembly. The filter head has an internal bypass valve that bypasses oil to a dedicated port when the pressure drop across the filter element exceeds 60 psi. Bypassed oil is directed to the lube system and back to the transmission sump, not to the proportional control valves. The filter head also contains a pressure switch that can be used to alert the operator of nearing bypass conditions. This switch actuates at a pressure drop across the filter element of 50 psi.

Filtered oil from the filter assembly is directed to the valve body located on the transmission. The flow of oil is available for the proportional control valves and clutch transmission. The flow of oil is available for the proportional control valves and clutch engagement. The pressure in the system is controlled by the main regulator valve and is regulated to 270 psi at a flow of 27 gpm. A small amount of this flow leaks through the pilot orifices in the proportional control valves and past the seal rings in the shafts when a clutch is engaged. The balance of the flow is dumped by the main regulator valve to the charge circuit controlled by the flow restrictions in the heat exchanger and the lube circuits.

The heat exchanger is supplied by the vehicle manufacturer and must be able to flow up to 25 gpm oil at a pressure up to 150 psi. It should have the capacity of dissipate about 30% of the engine horsepower in a converter driven unit (15-20% for direct drive units) in heat removed from the oil. It should be sized based on the maximum ambient temperatures that the vehicle is expected to operate under.

The cooled oil returning to the valve body from the heat exchanger is directed to the lube circuit. An internal manifold in the transmission main case directs the lube oil to the ends of each of the clutch shafts. This oil flow passes through the lube shut-off washers on the engaged clutches and provides the cooling for the clutches. There is also leakage flow to the disengaged clutches to lubricate and cool them and many orifices provide flow to lubricate the bearings on these shafts. After exiting the clutch and bearings on these shafts the oil returns to the transmission sump where it is again picked up by the charge pump. If the pressure in the lube circuit exceeds 45 psi, the lube relief valve opens and dumps the excess flow to the transmission sump. This condition is normal when the transmission is in neutral with all lube shut-off washers closed and the engine is at high idle.

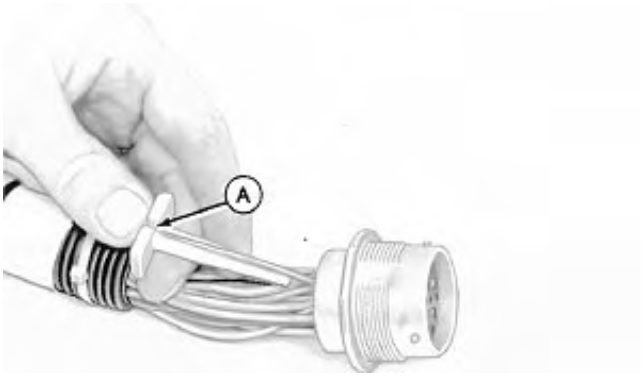
CTM149,100,8 –19–17OCT98–1/1

Replace DEUTSCH™ Connectors

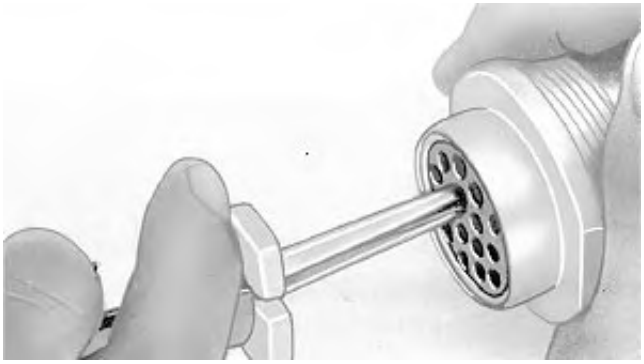
1. Select correct size extractor tool for size of wire to be removed:
   - JDG361 Extractor Tool for 12 to 14 gauge wire.
   - JDG362 Extractor Tool for 16 to 18 gauge wire.
   - JDG363 Extractor Tool for 20 gauge wire.
2. Start correct size extractor tool over wire at handle (A).
3. Slide extractor tool rearward along wire until tool tip snaps onto wire.

IMPORTANT: Do NOT twist tool when inserting in connector.

4. Slide extractor tool along wire into connector body until it is positioned over terminal contact.
5. Pull wire out of connector body, using extractor tool.



TS0124 –UN–23AUG88



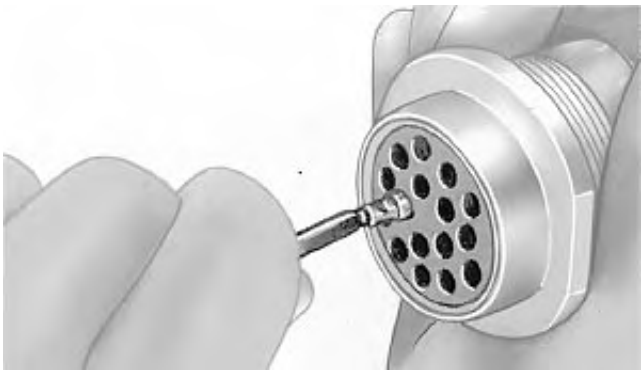
TS120 –UN–23AUG88

DEUTSCH is a trademark of the Deutsch Co.

DX,ECONN,J –19–03NOV94–1/2

IMPORTANT: Install contact in proper location using correct size grommet.

6. Push contact straight into connector body until positive stop is felt.
7. Pull on wire slightly to be certain contact is locked in place.
8. Transfer remaining wires to correct terminal in new connector.



TS122 –UN–23AUG88

DX,ECONN,J –19–03NOV94–2/2

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Replace WEATHER PACK™ Connector

IMPORTANT: Identify wire color locations with connector terminal letters.

1. Open connector body.
2. Insert JDG364 Extraction Tool over terminal contact in connector body.
3. Hold extractor tool fully seated and pull wire from connector body.

NOTE: If terminal cannot be removed, insert wire or nail through extractor tool handle and push terminal contact from connector.

TS0128 –UN–23AUG88

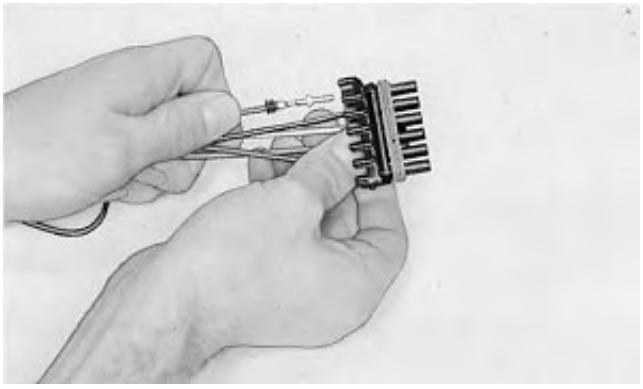
WEATHER PACK is a trademark of Packard Electric.

DX,ECONN,O –19–03NOV94–1/2

IMPORTANT: Carefully spread contact lances to assure good seating on connector body.

NOTE: Connector bodies are "keyed" for proper contact mating. Be sure contacts are in proper alignment.

4. Push contact into new connector body until fully seated.
5. Pull on wire slightly to be certain contact is locked in place.
6. Transfer remaining wires to correct terminal in new connector.
7. Close connector body.

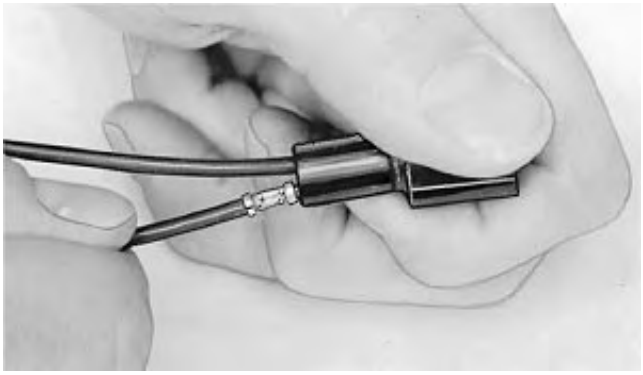


TS0130 –UN–23AUG88

DX,ECONN,O –19–03NOV94–2/2

Replace SURE-SEAL™ Connector with WEATHER PACK™ Connector

1. Pull wire to remove contact from SURE-SEAL™ connector.

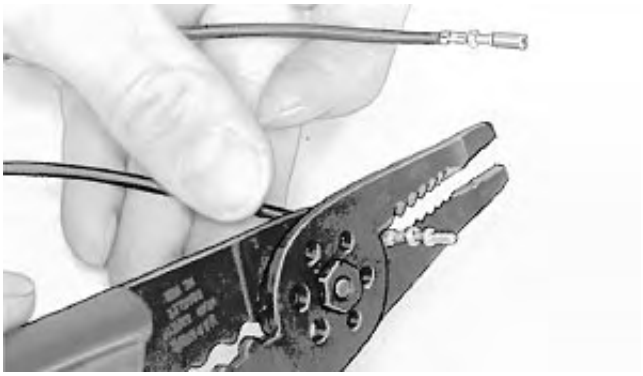


TS0131 –UN–23AUG88

SURE-SEAL is a trademark of ITT Cannon Electric.
WEATHER PACK is a trademark of Packard Electric.

DX,ECONN,S –19–04JUN90–1/3

2. Remove wire as close as possible to contact, using JDG145 Universal Electrical Plier.

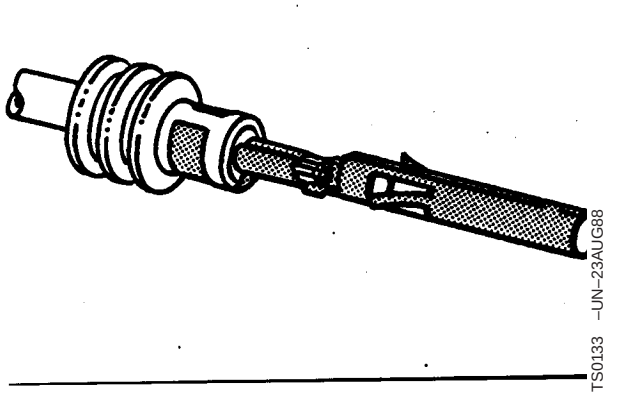


TS0132 –UN–23AUG88

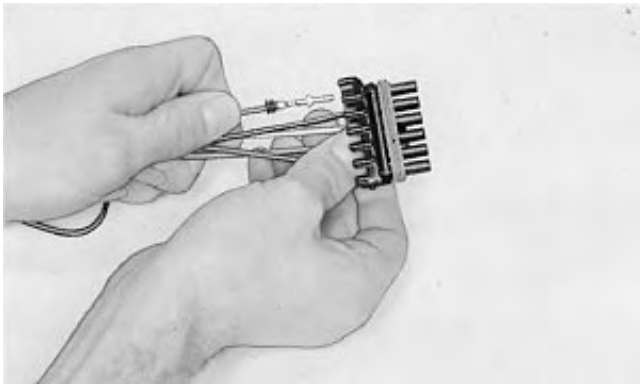
Continued on next page

DX,ECONN,S –19–04JUN90–2/3

IMPORTANT: SURE-SEAL™ and WEATHER PACK™ connector bodies are "keyed" for proper contact mating. Be sure contacts are in proper alignment. SURE-SEAL™ connectors are keyed 1, 2, 3. WEATHER PACK™ connectors are keyed A, B, C. "A" matches 1, "B" matches 2 and "C" matches 3. See component replacement stories for any exceptions on connector codes.



3. Install WEATHER PACK contact on wire. (See install WEATHER PACK Contact in this section.)
4. Push contact into WEATHER PACK connector body until fully seated.
5. Pull on wire slightly to be certain contact is locked in place.
6. Close connector body.

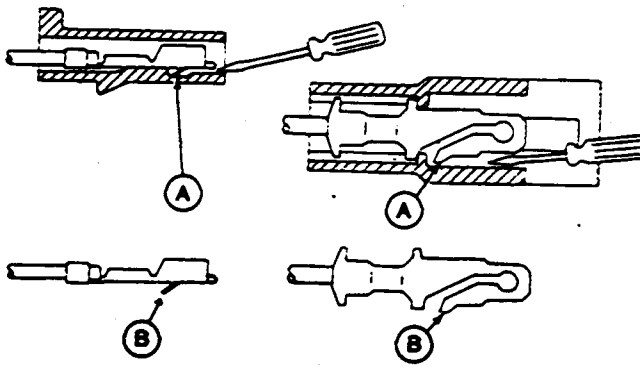


SURE-SEAL is a trademark of ITT Cannon Electric.
WEATHER PACK is a trademark of Packard Electric.

DX,ECONN,S –19–04JUN90–3/3

Remove Connector Body From Blade Terminals

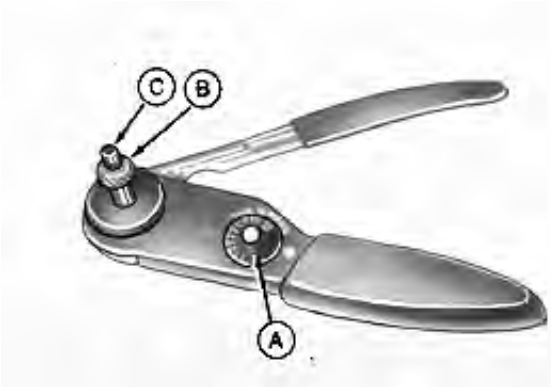
1. Depress locking tang (A) on terminal, using a small screw driver. Slide connector body off.
2. Be sure to bend locking tang back to its original position (B) before installing connector body.



DX,ECONN,V1 –19–02NOV94–1/1

Install DEUTSCH™ Contact

1. Strip 6 mm (1/4 in.) insulation from wire.
2. Adjust selector (A) on JDG360 Crimper for correct wire size.
3. Loosen lock nut (B) and turn adjusting screw (C) in until it stops.



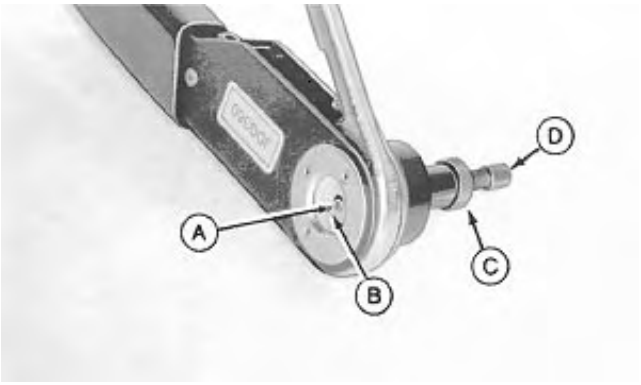
TS117 –UN–23AUG88

DEUTSCH is a trademark of the Deutsch Co.

DX,ECONN,W –19–04JUN90–1/4

IMPORTANT: Select proper size contact "sleeve" or "pin" to fit connector body.

4. Insert contact (A) and turn adjusting screw (D) until contact is flush with cover (B).
5. Tighten lock nut (C).

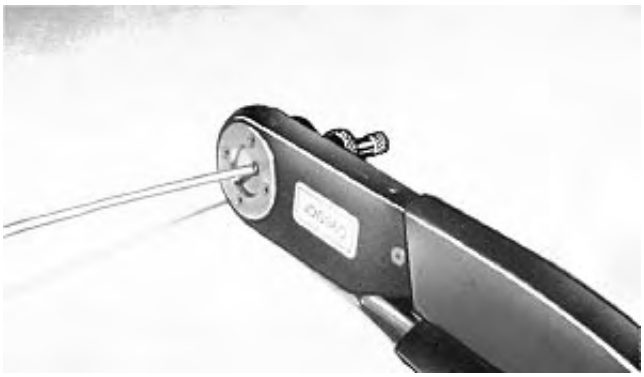


TS0134 –UN–23AUG88

DX,ECONN,W –19–04JUN90–2/4

IMPORTANT: Contact must remain centered between indentors while crimping.

6. Insert wire in contact and crimp until handle touches stop.
7. Release handle and remove contact.



TS118 –UN–23AUG88

DX,ECONN,W –19–04JUN90–3/4

IMPORTANT: If all wire strands are not crimped into contact, cut off wire at contact and repeat contact installation procedures.

NOTE: Readjust crimping tool for each crimping procedure.

8. Inspect contact to be certain all wires are in crimped barrel.

TS0135 –UN–23AUG88

DX,ECONN,W –19–04JUN90–4/4

Install WEATHER PACK™ Contact

NOTE: Cable seals are color coded for three sizes of wire:

- *Green - 18 to 20 gauge wire*
- *Gray - 14 to 16 gauge wire*
- *Blue - 10 to 12 gauge wire*

1. Slip correct size cable seal on wire.

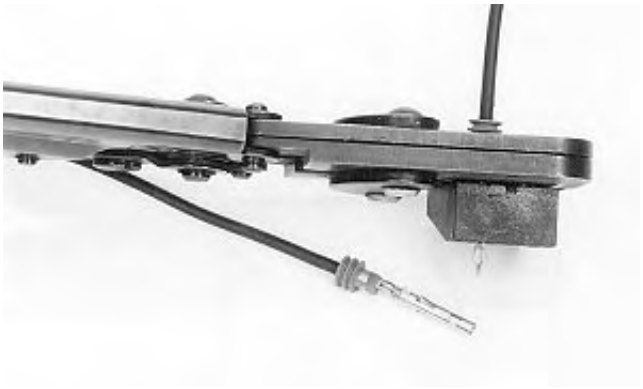
2. Strip insulation from wire to expose 6 mm (1/4 in.) and align cable seal with edge of insulation.

NOTE: Contacts have numbered identification for two sizes of wire:

- *#15 for 14 to 16 gauge wire*
- *#19 for 18 to 20 gauge wire*

3. Put proper size contact on wire and crimp in place with a "W" type crimp, using JDG783 Terminal Applicator.

TS0136 –UN–23AUG88



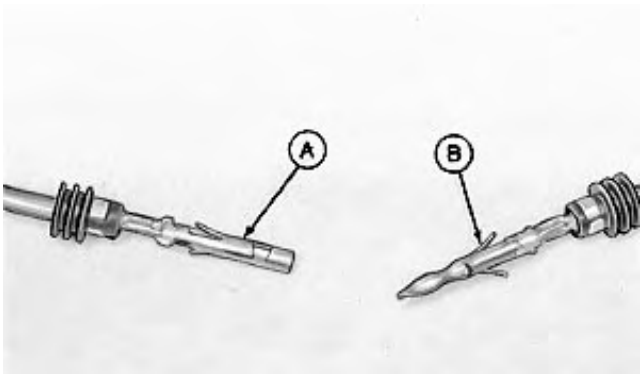
TS1623 –UN–02NOV94

WEATHER PACK is a trademark of Packard Electric.

DX,ECONN,AA –19–04JUN90–1/2

IMPORTANT: Proper contact installation for "sleeve" (A) and "pin" (B) is shown.

4. Secure cable seal to contact as shown, using JDG783 Terminal Applicator.



TS0139 –UN–02DEC88

DX,ECONN,AA –19–04JUN90–2/2

Clutch Solenoid Voltage Requirements[1]

NOMINAL VOLTAGE	12V	24V
ALLOWABLE VOLTAGE	10—14V	20—28V
CURRENT DRAW	1 AMPS	.6 AMP
CURRENT DRAW MAX.	1.2 AMPS	.7 AMPS
RESISTANCE	14 OHMS ± 3%	53 OHMS ± 3%

[1]This coil must be used with a Funk approved Transmission Control Unit. All checks must be made at the valve.

YZ,CTM148,100,6 –19–28JUL98–1/1

Test Solenoids

IMPORTANT: If a solenoid is removed from the valve, it must be installed in the same location.

NOTE: To determine the defective clutch is simply a matter of elimination. For example, if the gear selected uses solenoids 1 and A, and low pressure is indicated, select another clutch that uses one of those solenoids. If pressure is good, then the solenoid or clutch not selected is the one that is bad.

To confirm that this is the faulty circuit, select another clutch that uses this solenoid, to assure that the discrepancy is actually in this solenoid or clutch.

1. Select solenoids 1 and A.

   If low pressure exists, then solenoid or clutch 1 or A is defective.

2. Select solenoids 2 and A.

   If pressure is OK, then solenoid or clutch 1 is defective.

3. Select solenoids 1 and B.

   If low pressure exists, then this confirms solenoid or clutch 1 is defective.

YZ,CTM148,100,3 –19–28JUL98–1/1

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Solenoid Valve Operation

Before troubleshooting the electric circuit of the valve, the chart shows what solenoids are charged when that gear is selected.

DF SERIES EIGHT SPEEDS FORWARD AND FOUR REVERSE
DF 8/4

Gear Engage	Solenoid Charged
F 8th	2 and D
F 7th	1 and D
F 6th	2 and B
F 5th	1 and B
F 4th	2 and C
F 3rd	1 and C
F 2nd	2 and A
F 1st	1 and A
Neutral	
R 1st	3 and A
R 2nd	3 and C
R 3rd	3 and B
R 4th	3 and D

DF SERIES FOUR SPEEDS FORWARD AND FOUR REVERSE
DF 4/4

Gear Engage	Solenoid Charged
F 4th	2 and B
F 3rd	1 and B
F 2nd	2 and A
F 1st	1 and A
Neutral	
R 1st	3 and A
R 2nd	4 and A
R 3rd	3 and B
R 4th	4 and B

YZ,CTM148,100,4 –19–28JUL98–1/1

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.

NOTE: See PRESSURE AND TEMPERATURE CHECK PORTS (group 35) for port location.

2. Install a 21 bar (2068 kPa) (300psi) 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.

YZ,CTM148,100,2 –19–28JUL98–1/1

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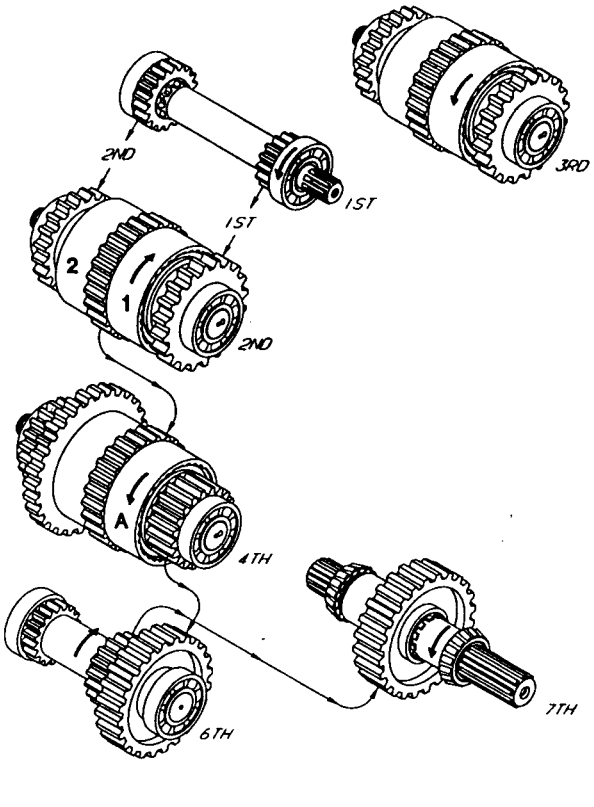
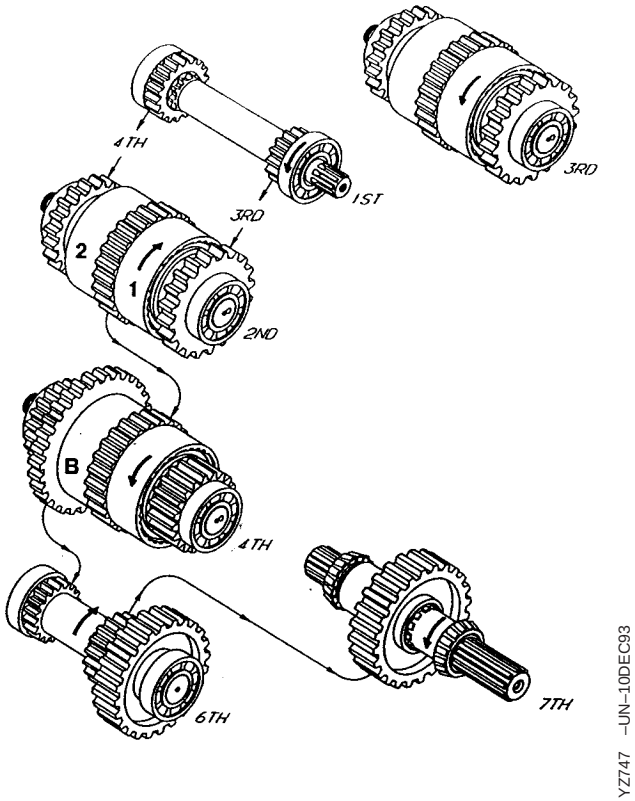
4-4 DF Power Flow Forward Speeds



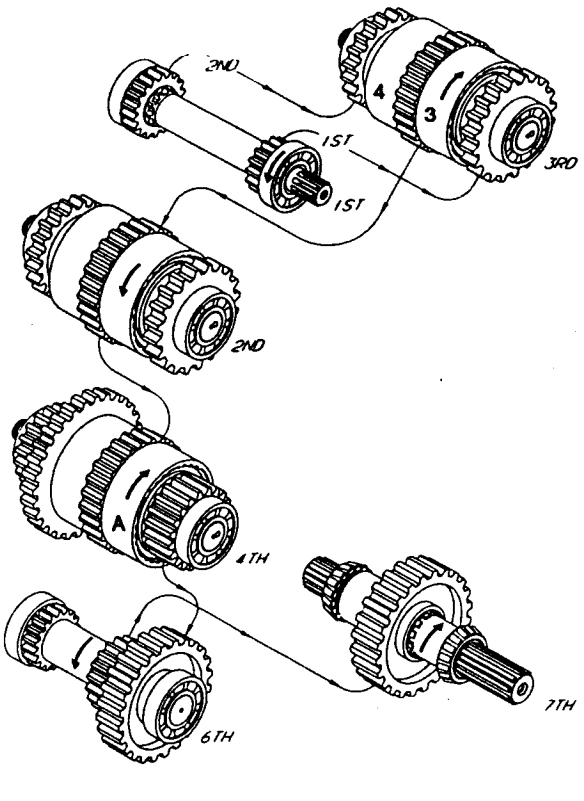
1st Gear - 1A, 2nd Gear - 2A



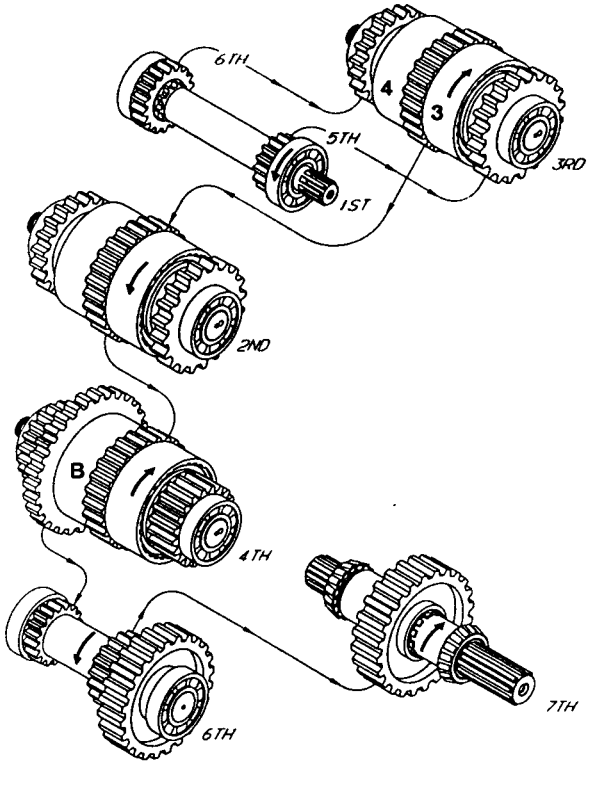
3rd Gear - 1B, 4th Gear - 2B

YZCTM148,100,10 –19–28JUL98–1/1

4-4 DF Power Flow Reverse Speeds



R1 Gear - 3A, R2 Gear - 4A



R3 Gear - 3B, R4 Gear - 4B

YZCTM148,100,11 –19–28JUL98–1/1

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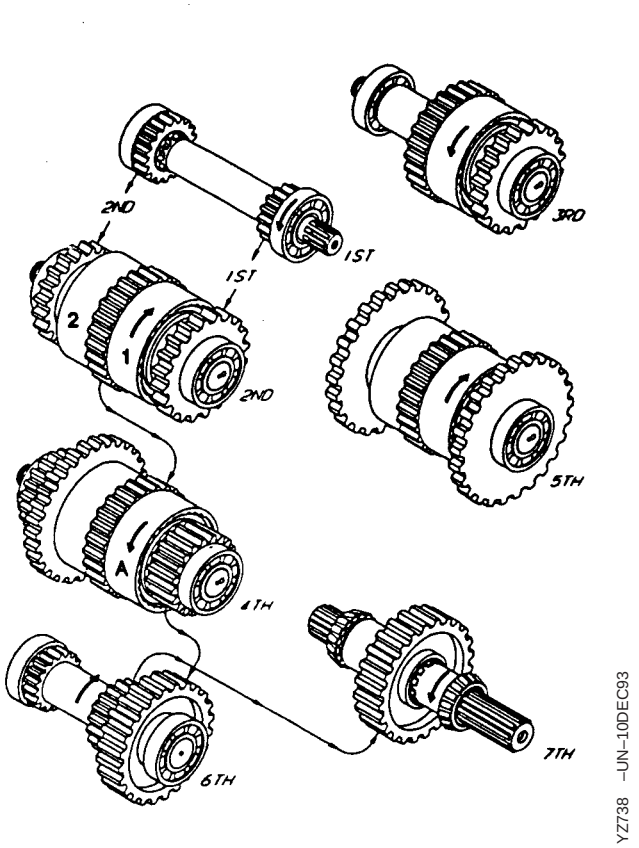
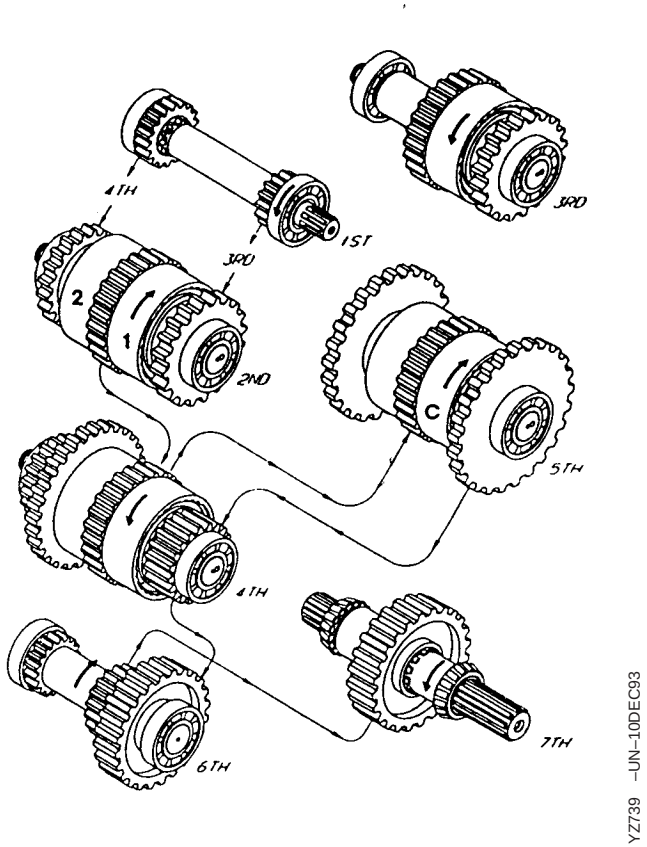
8-4 DF Power Flow Forward Speeds



1st Gear - 1A, 2nd Gear - 2A



3rd Gear - 1C, 4th Gear - 2C

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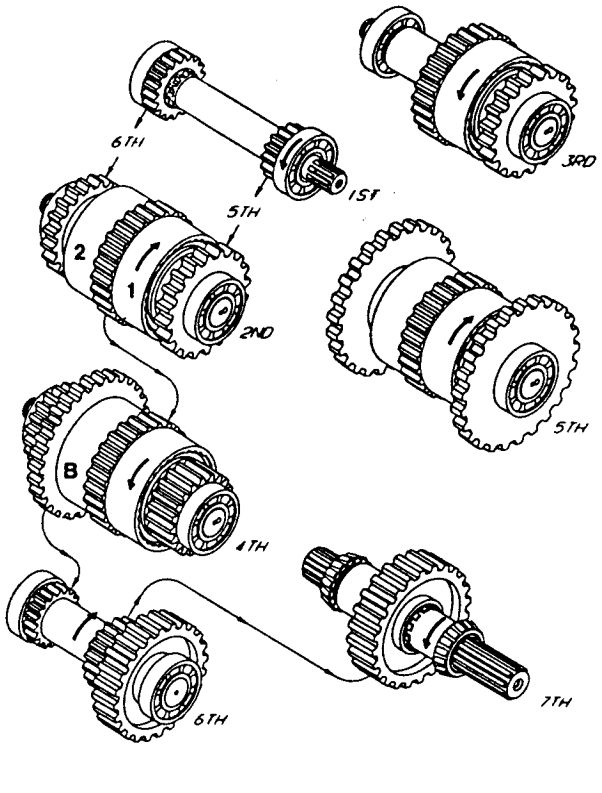
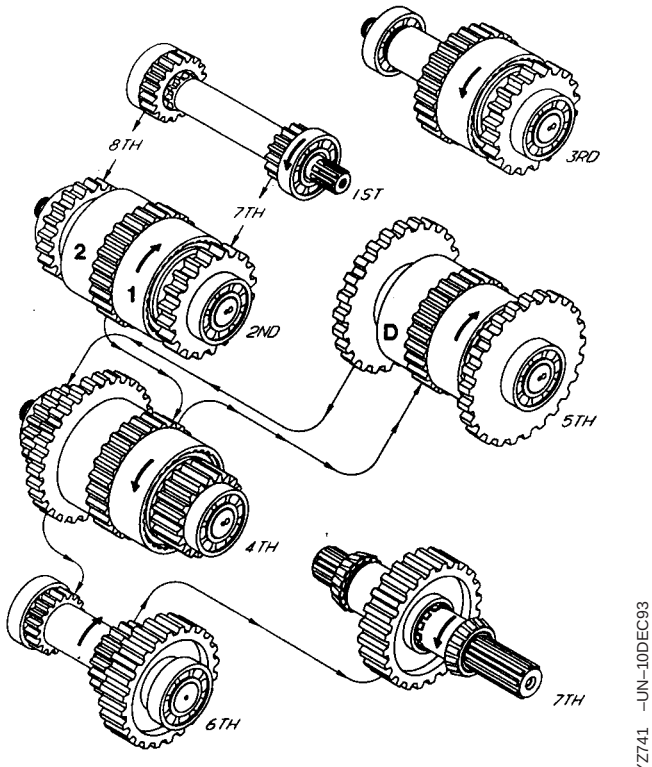
YZCTM148,100,12 –19–28JUL98–1/2



5th Gear - 1B, 6th Gear - 2B



7th Gear - 1D, 8th Gear - 2D

YZCTM148,100,12 –19–28JUL98–2/2

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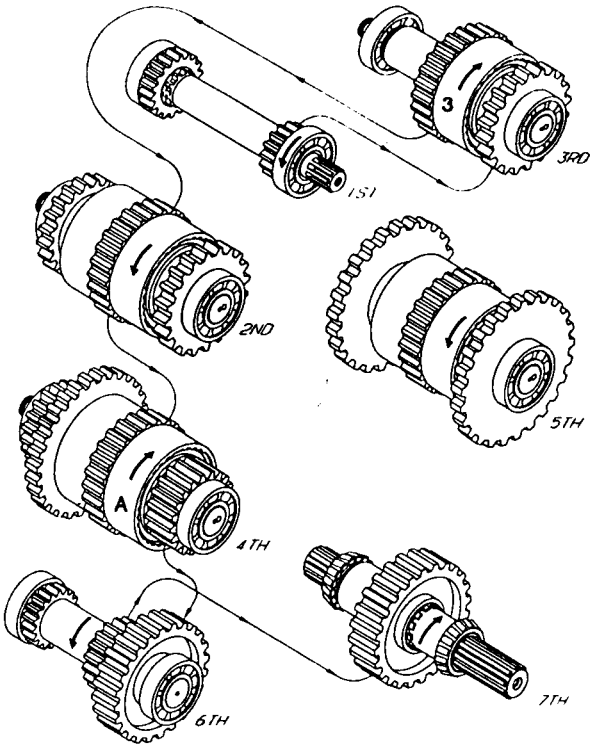
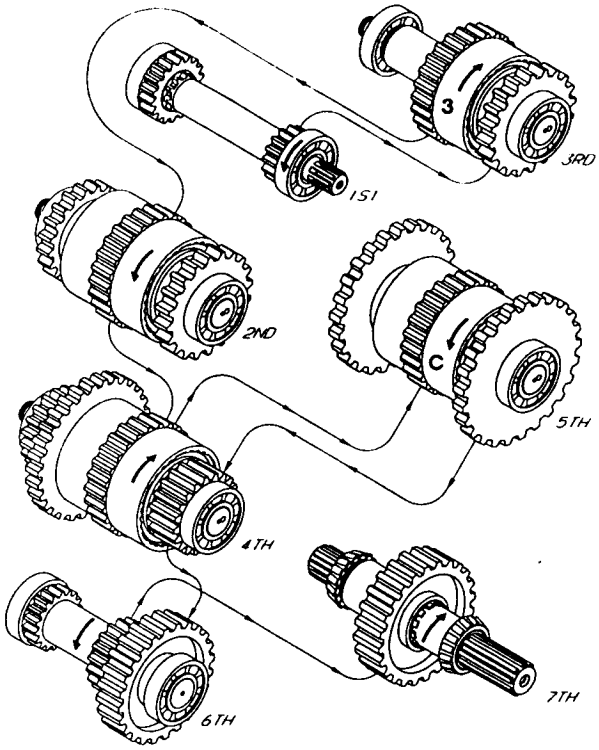
8-4 DF Power Flow Reverse Speeds



YZ742 –UN–10DEC93

R1 Gear - 3A



YZ743 –UN–10DEC93

R2 Gear - 3C

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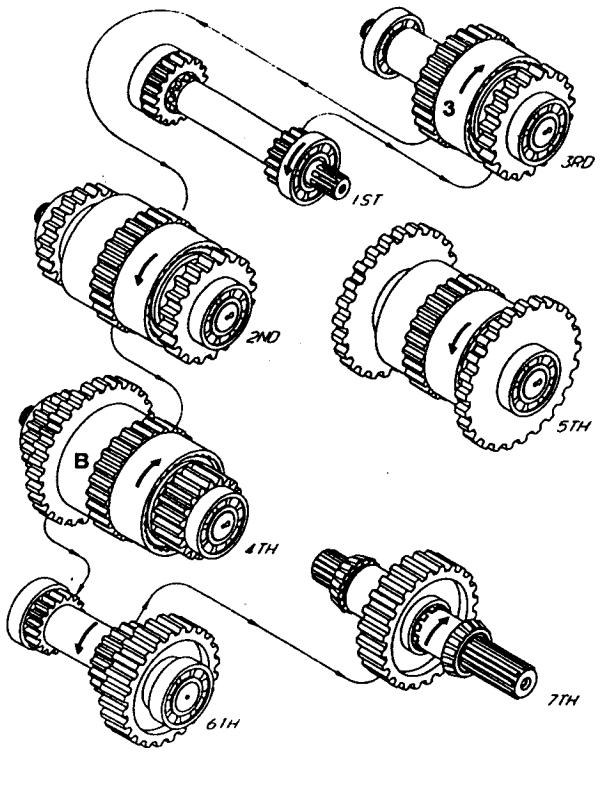
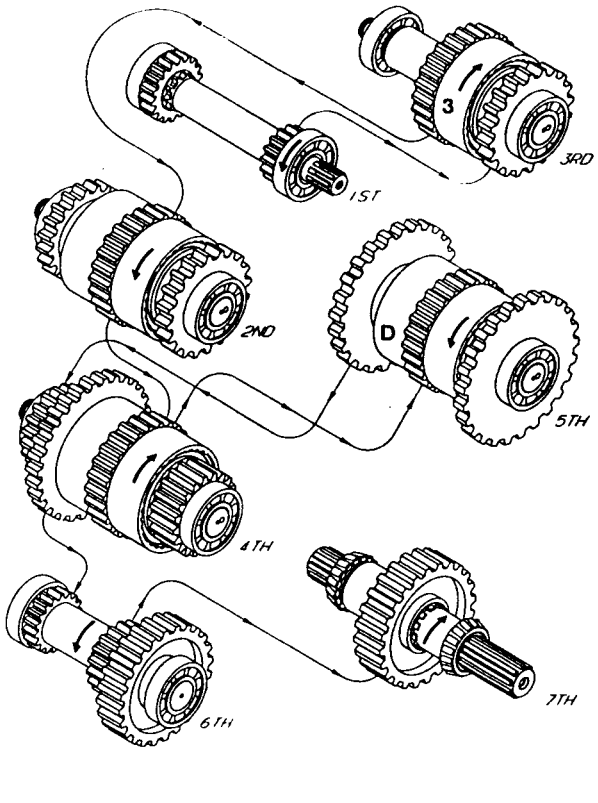
YZCTM148,100,14 –19–28JUL98–1/2



YZ744 –UN–10DEC93

R3 Gear - 3B



YZ745 –UN–10DEC93

R4 Gear - 3D

YZCTM148,100,14 –19–28JUL98–2/2

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18

Troubleshoot Transmission System Malfunctions

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.
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)

Continued on next page

Symptom	Problem	Solution
	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.
Oil leaking from engine flywheel and/or weep hole in transmission bell housing.	Converter seal ring damaged.	Remove transmission and install new seal ring on converter hub.
	Converter front cover seal leaking.	Replace seal.
	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.

Continued on next page

Symptom	Problem	Solution
	Voltage to wrong solenoids on control valve. (See schematic.)	Check wiring and connecters.
	Converter damage.	Rebuild converter.
	No voltage to all solenoids.	Check wiring, controller and connecters.
	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.
	Check Inching Pedal.	Replace Switch or wiring.
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.
	Low or no lube	Do converter-out and lube pressure test.
Machine “Creeps” In Neutral	Warped disks and plates in clutch 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)

Continued on next page

Symptom	Problem	Solution
	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.
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.

YZ,CTM148,100,1 –19–28JUL98–4/4

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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 connecters.
	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 connecters if O.K., replace solenoid.
	Check valve installed backwards.	Install check valve properly.

YZ,CTM148,100,9 –19–28JUL98–1/1

Specifications

Item	Measurement	Specification
J1 connector-to-TCU	Torque	0.8—1.5 N•m (7.1—13.3 lb-in)
J2 connector-to-TCU	Torque	0.8—1.5 N•m (7.1—13.3 lb-in)
J3 connector-to-TCU	Torque	0.8—1.5 N•m (7.1—13.3 lb-in)
Diagnostic indicator	Mounting dimensions	50.8 mm (2 in) diameter hole with 88.9 mm (3.5 in) clearance behind front face of indicator.

CTM148,105,SPC –19–14SEP98–1/1

Troubleshooting Introduction

This introduction is written to initiate an understanding of a strategy which can be used toward solving problems in the driveline system. The preferred technique used in solving problems is to exchange components. However, a very important element necessary to the timely and successful conclusion of this activity is the selection of the malfunctioning component. An understanding of the total system and an elimination process leading to the component is absolutely necessary before starting the exchange activity. The transmission system as installed consists of the following components linked together to form a functioning system.

- Electronic gear selector
- Wiring harness
- Transmission control unit (TCU)
- Magnetic pickups (Speed sensors)
- Temperature sensor
- Inching pedal (application dependent)
- Gear/Diagnostic indicator or CCD display
- Transmission control valve
- Transmission hydraulic system (pump, relief valves, lines, etc.)
- Transmission mechanical system (clutches, gears, shafts, seals, etc.)

The best strategy in a troubleshooting plan is to reduce the random exchange of components by carefully analyzing the symptoms and then conducting tests which will help determine which component in the system is likely to be the problem. The technician should use the above component list as a guide in locating the problem.

Because the TCU is a relatively complex and unfamiliar component, it is often the first component targeted for exchange. However, TCU malfunctions are relatively rare. In addition, the TCU has internal diagnostics capabilities which are usually helpful in isolating an operational problem. If the TCU responds to commands and does not provide a diagnostic code indicating an internal TCU error, the problem being internal to the TCU is unlikely.

CTM114,105,1 –19–06NOV98–1/1

Theory of Operation

YZ1571 –UN–08AUG98

The purpose of the Transmission Control Unit (TCU) is to control the functions of the transmission. Upshifting, downshifting, control of the proportional solenoids and capability to communicate with a panel mounted gear/diagnostic indicator are the main functions. The transmission's performance is determined by the various inputs to the TCU. Based upon these inputs, the TCU commands the transmission so that maximum performance can be achieved under the present operating conditions. All functions of the TCU are under software control. Park Brake Solenoid function is connected to the TCU, however it is not controlled by the TCU or software.

Operation begins when the vehicle's ignition is switched to the on position, supplying electrical power to the TCU and related system components from the vehicle's power source. The TCU now begins monitoring all inputs and outputs. If a known conflict in inputs or a fault condition is detected, the TCU will command the transmission to stay in neutral regardless of the shift lever position. A flashing error code will be displayed on the gear/diagnostic indicator, and will remain displayed until the error has been resolved and the shift lever cycled back through the neutral or park position.

If no error conditions are detected, based upon a combination of inputs from the shift lever and other applicable inputs, the TCU will select the proper transmission gear and command the transmission to shift to this gear. The gear/diagnostic indicator will now show the actual transmission gear.

The TCU Module uses electrohydraulic proportional valves to control the operation of the transmission. The solenoids controlling the transmission clutches (solenoids A through D & 1 through 4) are driven by a signal that produces proportional pressure/flow changes. During modulation, the solenoids are started out with a low duty cycle and ramped up to full on. The initial duty cycle is dependent upon several factors and is not a preset value. The process of modulating these clutches greatly enhances shift quality.

CTM114,105,2 –19–09SEP98–1/1

Calibration

Reasons to Calibrate

Matches Transmission Control Unit (TCU) to Transmission. Default clutch fill and hold values are placed in the TCU at the factory. Calibration changes these values to match a particular transmission.

Reduces Impact Of Manufacturing Tolerances. Since the clutch fill and hold values are for a particular transmission, adjustments for differences in parts due to manufacturing tolerances are automatic.

Provides For Consistency Between Machines. The calibration routine makes sure each transmission clutch starts from the same spot just prior to clutch engagement.

When to Calibrate:

1. If solenoid valve assemblies are changed.
2. After repairs involving transmission clutches.
3. If TCU is replaced.
4. If shift quality deteriorates.

CTM114,105,34 –19–09SEP98–1/1

Clutch Calibration: Four Forward Speeds and Four Reverse

For Funk Analog Valve DF150 or DF250 Series Transmissions Four Forward Speeds and Four Reverse.

IMPORTANT: Attempting to calibrate with sump temperature below minimum calibration temperature (120°F for converter drives and 90 °F for most direct drives) will trigger the "warm-up" mode. This mode will show "---" on the display as the transmission warms to the minimum calibration temperature at which time the calibration process will automatically begin. Temperatures below 50°F will result in "sump temperature too cold" error 100.

1. Bring the transmission oil temperature up to 140° to 160°F (60° to 71°C) for optimum calibration.
2. With the vehicle ignition off, apply the park brake.
3. Plug a jumper plug (which connects pin A to pin B) in the calibration plug (s16) on the vehicle harness.

IMPORTANT: Any errors that appear during calibration will cause the procedure to terminate, and you will have to start the calibration over from the beginning.

4. Power up the TCU by turning on the vehicle ignition. The display should show "CAL".
5. Start and hold the engine speed at 1600 RPM. The engine governor must hold the engine speed ± 50 RPM.
6. Move the shift handle to the Forward position.
7. During the first few seconds of the calibration process, the display will show "---" while testing the cylinder speed and response.
8. At this time the Clutch calibration process starts.

   a. Directional and Speed Clutch Holds. The display will show **C1H, C2H, C3H, C4H, CAH,** and **CBH** while acquiring the respective "hold" level of each clutch.

   b. Directional and Speed Clutch Fills. The display will show **C1F, C2F, C3F, C4F, CAF,** and **CBF** while acquiring the respective "fill" level of each clutch.
9. The display will show **END** when the routine is finished. At that time move the shift handle back to the Neutral position.
10. Shut the vehicle's ignition OFF, which will power down the TCU.
11. Remove the jumper plug from the calibration plug (S16).

    The calibration is complete.

CTM114,105,34A –19–09SEP98–1/1

Clutch Calibration: Eight Forward Speeds and Four Reverse

For Funk Analog Valve DF150 or DF250 Series Transmissions Eight Forward Speeds and Four Reverse.

IMPORTANT: Attempting to calibrate with sump temperature below minimum calibration temperature (120°F for converter drives and 90 °F for most direct drives) will trigger the "warm-up" mode. This mode will show "---" on the display as the transmission warms to the minimum calibration temperature at which time the calibration process will automatically begin. Temperatures below 50°F will result in "sump temperature too cold" error 100.

1. Bring the transmission oil temperature up to 140° to 160°F (60° to 71°C) for optimum calibration.
2. With the vehicle ignition off, apply the park brake.
3. Plug a jumper plug (which connects pin A to pin B) in the calibration plug (s16) on the vehicle harness.

IMPORTANT: Any errors that appear during calibration will cause the procedure to terminate, and you will have to start the calibration over from the beginning.

4. Power up the TCU by turning on the vehicle ignition. The display should show "CAL".
5. Start and hold the engine speed at 1600 RPM. The engine governor must hold the engine speed ± 50 RPM.
6. Move the shift handle to the Forward position.
7. During the first few seconds of the calibration process, the display will show "---" while testing the cylinder speed and response.
8. At this time the Clutch calibration process starts.

   a. Directional and Speed Clutch Holds. The display will show **C1H, C2H, C3H, CAH, CBH, CCH** and **CDH** while acquiring the respective "hold" time of each clutch.

   b. Directional and Speed Clutch Fills. The display will show **C1F, C2F, C3F, CAF, CBF, CCF** and **CDF** while acquiring the respective "fill" time of each clutch.
9. The display will show **END** when the routine is finished. At that time move the shift handle back to the Neutral position.
10. Shut the vehicle's ignition OFF, which will power down the TCU.
11. Remove the jumper plug from the calibration plug (S16).

    The calibration is complete.

CTM114,105,34B –19–09SEP98–1/1

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System Components

Required components:

1. Transmission control unit (TCU)
2. Engine speed magnetic pickup sensor (input speed)
3. Cylinder magnetic pickup sensor (MPU)
4. Output speed magnetic pickup sensor (MPU)
5. Electronic gear selector
6. Temperature Sensor
7. Gear/Diagnostic Indicator
8. Inching Pedal (Optional)
9. Proportional Valves

CTM114,105,4 –19–06NOV98–1/1

Component Functions

Basic Components

1. Transmission Control Unit

YZ1576 –UN–08AUG98

FUNCTION

The TCU is the “brain” of the system. It is responsible for the logic, computation, and decision making processes of the transmission based on calculations. How the TCU performs is determined by software programmed into the TCU’s memory. This software is developed to meet the requirements of the vehicle manufacturer, and is based on a vehicle performance analysis. It is application specific, therefore TCUs from different vehicles are not interchangeable. TCUs can only be interchanged on vehicles which are identical in all ways (same engine/drivetrain combination, same wiring, same shift lever, same vehicle voltage, etc.)

MOUNTING

The TCU must be mounted inside the vehicle cab or other enclosed area which will not exceed ambient temperature range (-40°C to +85°C). It must be mounted to ensure good electrical grounding between the TCU and the vehicle chassis, although a ground wire from battery negative to the TCU is required. It must not be mounted by any method which would isolate the TCU from the vehicle chassis. If rubber mounted for shock protection, a grounding strap must be utilized to ensure proper grounding.

Continued on next page

CTM114,105,12 –19–04NOV98–1/9

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IMPORTANT: Do not weld on vehicle with battery and TCU connected or the WARRANTY WILL BE VOID.

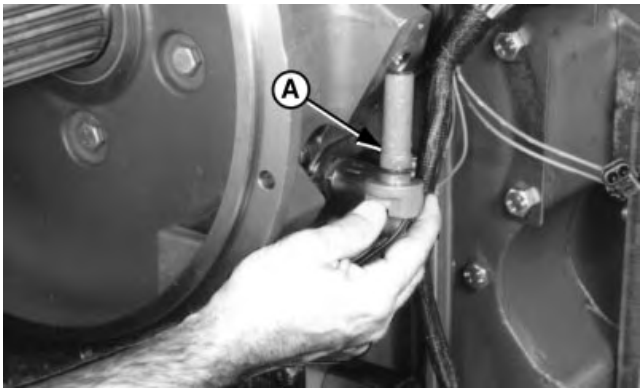
The only way to adequately protect the TCU from damage caused by high voltage and amperage is to completely remove all three wiring harness connectors (J1, J2 and J3) and any ground strap from the TCU prior to welding. Disconnecting the battery supply alone is not sufficient to protect the TCU from ground voltage feeding back through the wiring harness.

CTM114,105,12 –19–04NOV98–2/9

2. Engine Speed Magnetic Pickup Sensor (Input Speed)

The engine speed magnetic pickup (A) reads engine RPM by measuring the number of pulses per minute generated from the teeth of the charge pump idler gear, which is in mesh with the input gear.

Input RPM is calculated by pulses per minute divided by the number of teeth on the input gear.



YZ1577 –UN–01JUL98

CONNECTOR PINOUT

SIGNAL DESCRIPTION	SENSOR PIN	TRANS CONNECTOR PIN	TCU PIN
ENGINE MPU	A	J6-29	J1-B1
ENGINE MPU GND	B	J6-28	J1-C2

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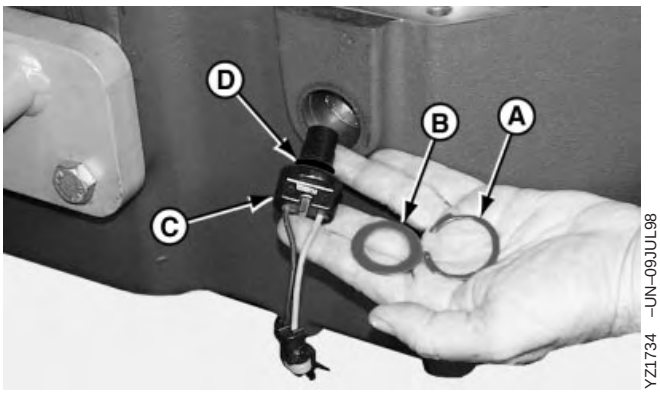
CTM114,105,12 –19–04NOV98–3/9

3. Cylinder Magnetic Pickup Sensor (MPU)

The cylinder speed magnetic pickup (C) reads cylinder RPM by measuring the number of pulses per minute generated from the teeth of the cylinder gear.

Cylinder RPM is calculated by pulses per minute divided by the number of teeth on the cylinder gear.

CONNECTOR PINOUT



YZ1734 –UN–09JUL98

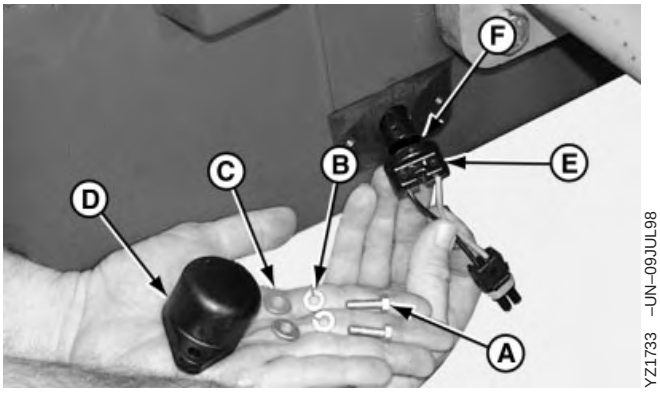
SIGNAL DESCRIPTION	SENSOR PIN	TRANS CONNECTOR PIN	TCU PIN
CYLINDER MPU	A	J6-9	J1-B2
CYLINDER MPU GND	B	J6-16	J1-C2

CTM114,105,12 –19–04NOV98–4/9

4. Output Speed Magnetic Pickup Sensor (MPU)

The output speed magnetic pickup (E) reads output RPM by measuring the number of pulses per minute generated from the teeth of the sixth stage gear. The sixth stage gear is on the same shaft as the sixth stage pinion which drives the output gear.

CONNECTOR PINOUT



YZ1733 –UN–09JUL98

SIGNAL DESCRIPTION	SENSOR PIN	TRANS CONNECTOR PIN	TCU PIN
OUTPUT MPU	A	J6-18	J1-A3
OUTPUT MPU GND	B	J6-30	J1-C2

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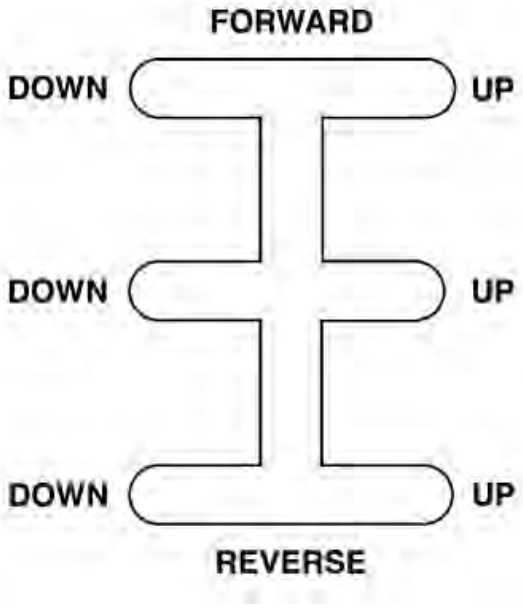
CTM114,105,12 –19–04NOV98–5/9

YZ1572 –UN–30JUN98



YZ1501 –UN–24APR98

5. Electronic Gear Selector

The electronic gear selector handle is a “Bump” handle which operates in an “I” pattern with a horizontal bar in the middle. Neutral position is in the middle of the pattern along the horizontal bar. While in neutral, the handle can be moved right to request a higher pre-selected gear or left to request a lower pre-selected gear.

The handle can be moved forward to request a forward gear or moved back to request a reverse gear.

The release ring under the handle knob must be pulled up to release the neutral lock.

The handle can be moved back to the neutral position at any time without moving the release ring under the handle knob.

When in the forward or reverse position the handle can be “bumped” to the right to request an upshift or to the left to request a downshift.

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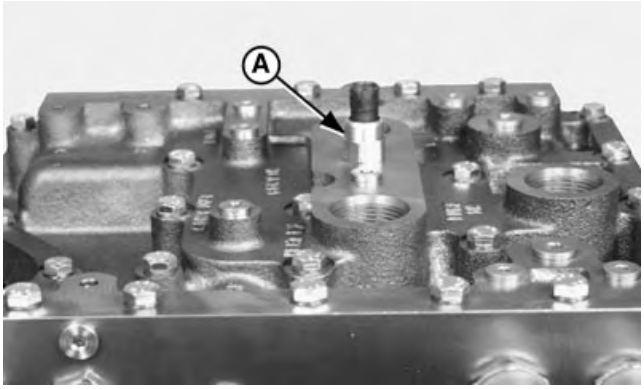
6. Temperature Sensor

The temperature sensor (A) is used to determine transmission fluid temperature.



SIGNAL DESCRIPTION	SENSOR PIN	TRANS CONNECTOR PIN	TCU PIN
TEMPERATURE SENSOR	A	J6-25	J1-C3
TEMPERATURE SENSOR GND	B	J6-24	J1-D1

CTM114,105,12 –19–04NOV98–7/9

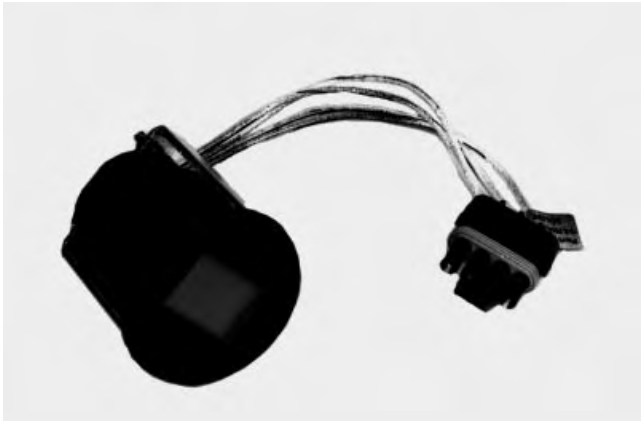
7. Gear/Diagnostic Indicator or "CCD Display"

The TCU and gear/diagnostic indicator can be used on both 12 and 24 volt applications.

CONNECTOR PINOUT

SIGNAL DESCRIPTION	CONNECTOR AND PIN	TCU PIN
+12V/+24V	S5-A	J3-A1
GROUND	S5-B	J2-F1
CCD BUS+	S5-C	J2-E2
CCD BUS-	S5-D	J2-E3

NOTE: Mounting requires a 2 inch diameter hole with 88.9 mm (3.5 in) clearance behind the front face.



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CTM114,105,12 –19–04NOV98–8/9

8. Inching Pedal (Application Dependent)

The inching pedal provides the operator with a device for controlling modulation of the transmission clutches when desired. With the pedal fully depressed, the transmission remains in neutral regardless of shift lever position. Releasing the inching pedal engages the transmission. The more the pedal is released, the more the clutches engage causing the vehicle to 'inch'. When the pedal is fully released, the transmission clutches are fully engaged.

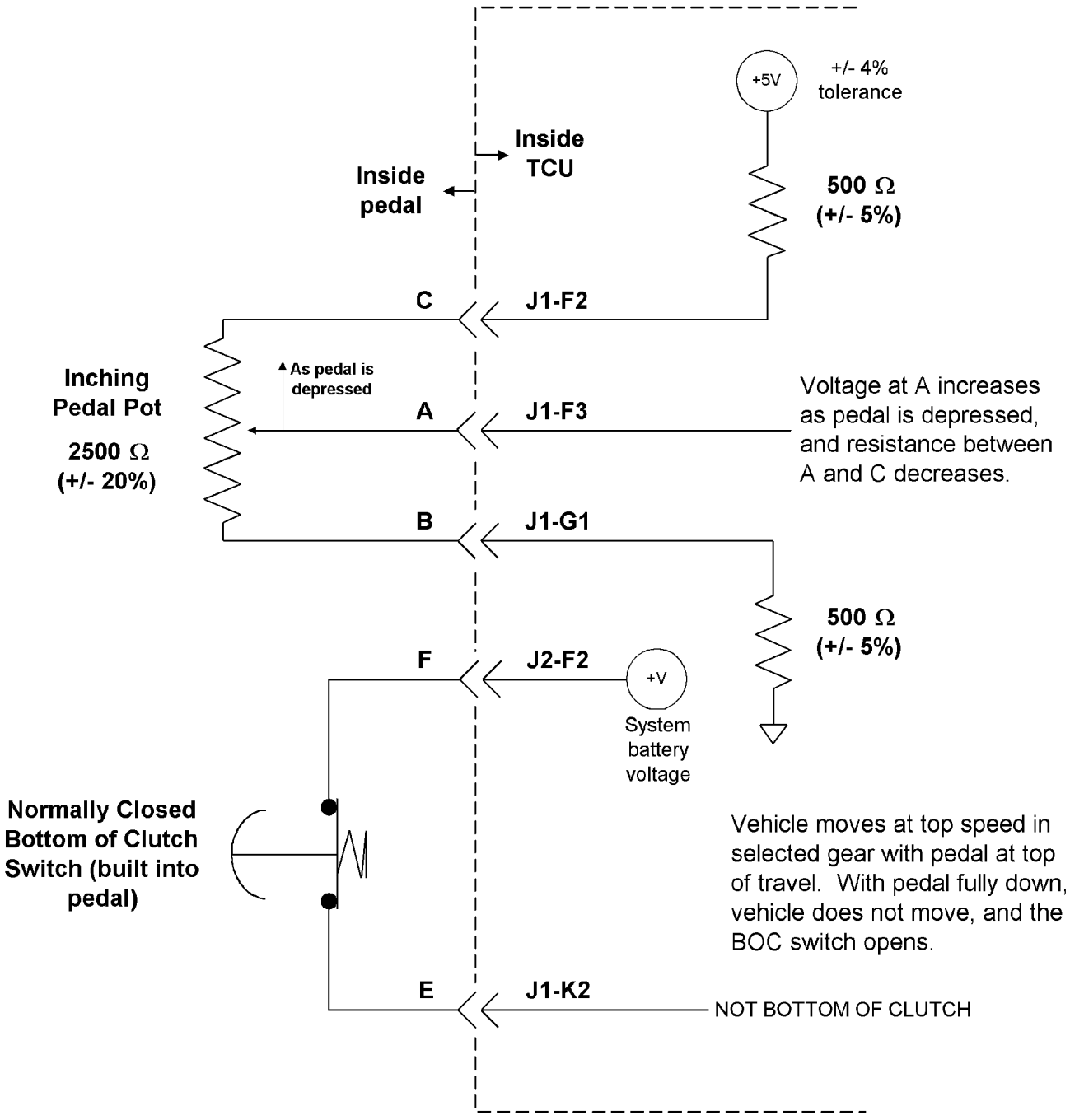
YZ1575 –UN–30JUN98

CONNECTOR PINOUT

SIGNAL DESCRIPTION	CONNECTOR/PIN	TCU PIN
VAGND (ANALOG GROUND)	T11-B	J1-G1
VAREF (ANALOG VOLTAGE REFERENCE)	T11-C	J1-F2
PEDAL POSITION	T11-A	J1-F3
TOC INPUT (TOP OF CLUTCH)		J1-K3
NOT BOC INPUT (BOTTOM OF CLUTCH)	T11-E	J1-K2
+12V/+24V	T11-F	J2-F2

CTM114,105,12 –19–04NOV98–9/9

DF Series Transmission Analog Inching



YZ1594 –UN–16MAR99

The pedal position output, or “inching” signal, comes from the 2.5K-ohm potentiometer attached to the pedal. The potentiometer’s angle changes proportionally with the degree of pedal depression. The potentiometer has an analog ground (VAGND, pin T11-B) signal and a 5V DC reference (VAREF, pin T11-C), both provided by the TCU. The pedal’s output signal to the TCU (pin T11-A) varies between the ground and reference levels. The output signal increases as the pedal is depressed.

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A normally closed switch mechanically linked to the pedal provides the “NOT BOTTOM OF CLUTCH” signal (pin T11-E) to the TCU. The switch contacts open when the pedal is fully depressed, and are closed for all other pedal positions. The TCU sees an active (+12 or +24V) signal on J1-K2 whenever the pedal is “NOT” at the bottom of its travel range.

The “TOP OF CLUTCH” signal to the TCU is present only in those applications where it is required, and where a separate switch has been installed for that purpose. (The switch is not part of the inching pedal itself.)

There is no connection to inching pedal pin D (pin T11-D).

CTM114,105,16 –19–09SEP98–2/3

The TVP (Transient Voltage Protection) Module is available in either a 12V or a 24V version, based on the vehicle battery voltage. It has two important functions:

Supply electrical power to the system.

Protect the electrical system against electrical conditions that might otherwise be potentially damaging, such as load dump and reverse battery protection.

Protection is provided only when the ignition switch is on, thus energizing an internal relay which provides an electrical connection between the vehicle battery and the protective device inside the TVP.

YZ1573 –UN–30JUN98

CTM114,105,16 –19–09SEP98–3/3

J1 Connector

NOTE: Connector pinouts reference wiring harness diagram in this group always reference the vehicle manufacturers wiring harness diagram for your application.

CONNECTOR PINOUT[1]

A1 — Main battery 1 (TCU Power, +12/24V)
A2 — Ground 1
A3 — Output magnetic pickup sensor input (frequency input)
B1 — Engine magnetic pickup sensor input (frequency input)
B2 — Cylinder magnetic pickup sensor input (frequency input)
B3 — Spare magnetic pickup sensor input (frequency input)
C1 — F Flow (input)
C2 — Magnetic pickup sensor ground
C3 — Temperature sensor (analog voltage input)
D1 — Temperature sensor ground
D2 — Rear-steer HI (voltage reference output)
D3 — Rear-steer position (analog voltage input)
E1 — Rear-steer LO (voltage reference output)
E2 — Load sense HI (voltage reference output)
E3 — Load sense (analog voltage input)
F1 — Load sense LO (voltage reference output)
F2 — Inching pedal HI (voltage reference output)
F3 — Inching pedal position (analog voltage input)
G1 — Inching pedal LO (voltage reference output)
G2 — Spare ground
G3 — Spare ground
H1 — Spare ground
H2 — UPSHIFT (Shift code E), (digital input)
H3 — DOWNSHIFT (Shift code D), (digital input)
J1 — FORWARD (digital input)
J2 — REVERSE (digital input)
J3 — Spare input (digital input)

[1]*"Input" and "Output" are defined relative to the TCU.*

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K1 — NOT PARK (digital input)
K2 — NOT BOTTOM OF CLUTCH (digital input)
K3 — TOP OF CLUTCH (digital input)
Mating connector for J1 is:

Metri-Pack 150 series 30 way sealed P2S connector

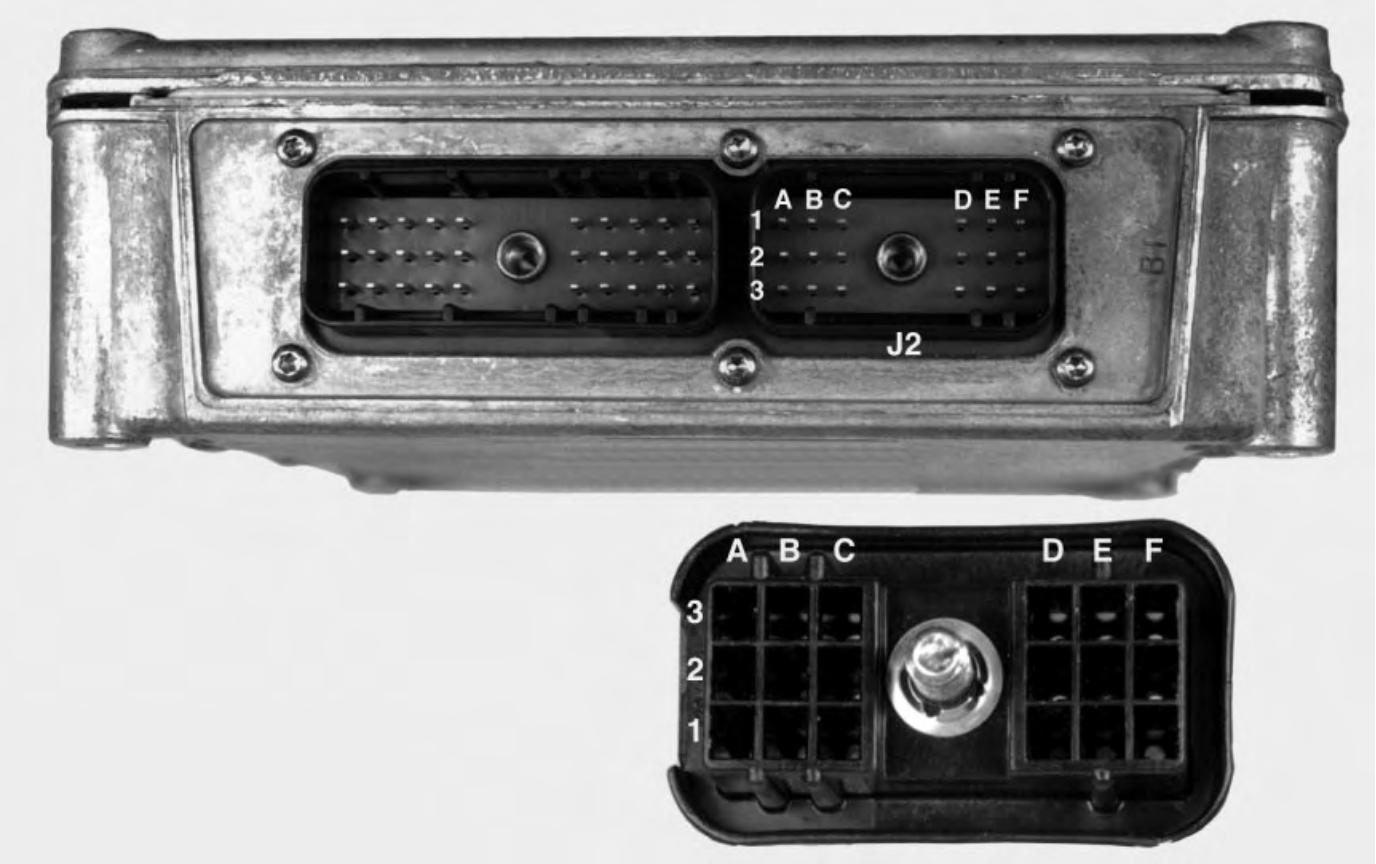
Delphi/Packard part number: 12034398

Mating terminals for J1 are Delphi/Packard terminals: 12103881

Tighten connector to TCU 0.8—1.5 N•m (7.1—13.3 lb-in)

CTM114,105,35 –19–04NOV98–2/2

J2 Connector



NOTE: Connector pinouts reference wiring harness diagram in this group always reference the vehicle manufacturers wiring harness diagram for your application.

CONNECTOR PINOUT[1]

A1 — Neutral (digital input)
A2 — Not neutral (Shift code B), (digital input)
A3 — Brake cutoff (Shift code C), (digital input)
B1 — Program (Shift code A), (digital input)
B2 — Start (digital input)
B3 — Park or park brake pressure (digital input)
C1 — Auto / manual mode select (digital input)
C2 — Calibrate (digital input)
C3 — Disconnect (digital input)
D1 — CAN HI (communication input/output)
D2 — CAN LO (communication input/output)
D3 — RS232 TxD (serial communication output)
E1 — RS232 RxD (serial communication input)
E2 — CCD Bus+ (gear / diagnostic indicator) (communication input/output)
E3 — CCD Bus- (gear / diagnostic indicator) (communication input/output)
F1 — Bus ground for communication lines
F2 — +12/24 supply voltage output (supply voltage output)
F3 — +12/24 supply voltage output (supply voltage output)

Mating connector for J2 is:

Delphi/Packard Metri-Pack 150 series 18 way sealed P2S connector

Delphi/Packard part number: 12040921

[1]*"Input" and "Output" are defined relative to the TCU.*

Continued on next page

Mating terminals for J2 are Delphi/Packard terminals: 12103881

Tighten connector to TCU 0.8—1.5 N•m (7.1—13.3 lb-in)

CTM114,105,36 –19–04NOV98–2/2

J3 Connector

NOTE: Connector pinouts reference wiring harness diagram in this group, reference the vehicle manufacturers wiring harness diagram for your application.

CONNECTOR PINOUT (APPLICATION DEPENDENT)[1]

A1 — Main battery 2 (TCU power +12/24V)
A2 — Ground 2
A3 — Solenoid 1 (PWM output)
B1 — Solenoid 1 return (current sense input)
B2 — Solenoid 2 (PWM output)
B3 — Solenoid 2 return (current sense input)
C1 — Solenoid 3 (PWM output)
C2 — Solenoid 3 return (current sense input)
C3 — Solenoid 4 (PWM output)
D1 — Solenoid 4 return (current sense input)
D2 — Solenoid A (PWM output)
D3 — Solenoid A return (current sense input)
E1 — Solenoid B (PWM output)
E2 — Solenoid B return (current sense input)
E3 — Solenoid C (PWM output)
F1 — Solenoid C return (current sense input)
F2 — Solenoid D (PWM output)
F3 — Solenoid D return (current sense input)
G1 — Solenoid E (PWM output)
G2 — Solenoid E return (current sense input)
G3 — Torque converter lock-up solenoid (PWM output)
H1 — Torque converter lock-up solenoid return (current sense input)
H2 — Disconnect solenoid (PWM output)
H3 — Disconnect solenoid return (current sense input)
J1 — Rear PTO solenoid (PWM output)
J2 — Rear PTO solenoid return (current sense input)
J3 — Front PTO solenoid (PWM output)
K1 — Front PTO solenoid return (current sense input)
K2 — Ground

[1]*"Input" and "Output" are defined relative to the TCU.*

Continued on next page

K3 — Ground
Mating connector for J3 is:

Delphi/Metri-Pack 150 series 30 way sealed P2S connector

Delphi/Packard part number: 12048455

Mating terminals for J3 are Delphi/Packard terminals: 12103881

Tighten connector to TCU 0.8—1.5 N•m (7.1—13.3 lb-in)

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J4 Connector

YZ1805 –UN–23SEP98

BUMP SHIFTER PINOUT

NOTE: Letters A through J are J6 Pinouts. Number,letter-number,letter callouts (example J3-A1) are TCU callouts.

A — J3-A1—+12/+24 out
B — J2-A2—NOT NEUTRAL (shift code B)
C — J2-A1—NEUTRAL
D — J1-H3—DOWNSHIFT (shift code D)
E — J1-H2—UPSHIFT (shift code (E)
F — J1-J2—REVERSE
G — J1-J1—FORWARD
H — H—J1-A2—Ground
J — S1-A—Neutral start

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J6 Connector

CONNECTOR PINOUT

NOTE: Numbers 1 through 31 are J6 Pinouts. Number,letter-number,letter callouts (example J3-B1) are TCU callouts.

1 — 1—J3-B1—Solenoid 1 return
2 — 2—J3-A3—Solenoid 1 output
3 — 3—J3-B2—Solenoid 2 output
4 — 4—J3-C1—Solenoid 3 output
5 — 5—J3-C3—Solenoid 4 output
6 — 6—J3-D1—Solenoid 4 return
7 — 7—J3-F3—Solenoid D return
8 — 8—J3-F2—Solenoid D output
9 — 9—J1-B2—Cylinder magnetic pickup sensor
10 — 10—J3-D2—Solenoid A output
11 — 11—J3-E2—Solenoid B return
12 — 12—J3-E1—Solenoid B output
13 — 13—J3-H2—Disconnect solenoid output
14 — 14—J3-G3—Torque converter lockup solenoid output
15 — 15—J3-B3—Solenoid 2 return
16 — 16—J1-C2—Magnetic pickup sensor ground
17 — 17—J3-D3—Solenoid A return
18 — 18—J1-A3—Output magnetic pickup sensor
19 — 19—J3-C2—Solenoid 3 return
20 — 20—J1-A1—Park brake pressure switch supply (+12/24V)
21 — 21—J2-B3—Park brake pressure switch
22 — 22—J3-F1—Solenoid C return
23 — 23—J3-E3—Solenoid C return
24 — 24—J1-D1—Temperature sensor ground
25 — 25—J1-C3—Temperature sensor
26 — 26—J3-H3—Disconnect solenoid return
27 — 27—J3-H1—Torque converter lockup solenoid return
28 — 28—J1-C2—Magnetic pickup sensor ground
29 — 29—J1-B1—Engine speed magnetic pickup sensor
30 — 30—J1-C2—Magnetic pickup sensor ground
31 — 31—J1-A2—Magnetic pickup sensor ground

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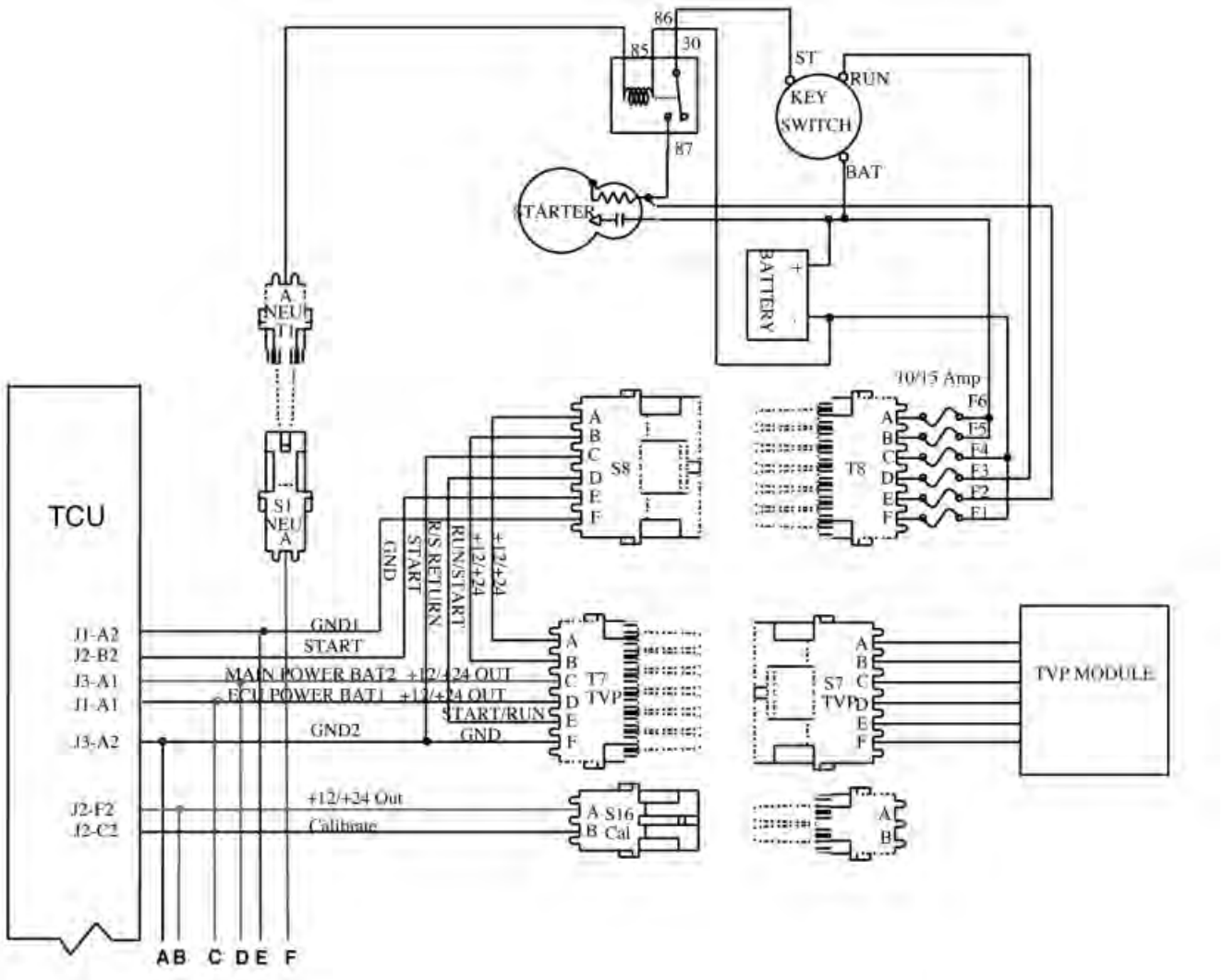
Transmission Wiring Harness 1 of 4[1]



NOTE: Letters A,B,C,D,E,F are labels to link to the next page.

[1]Wiring harness is "Application Dependent".

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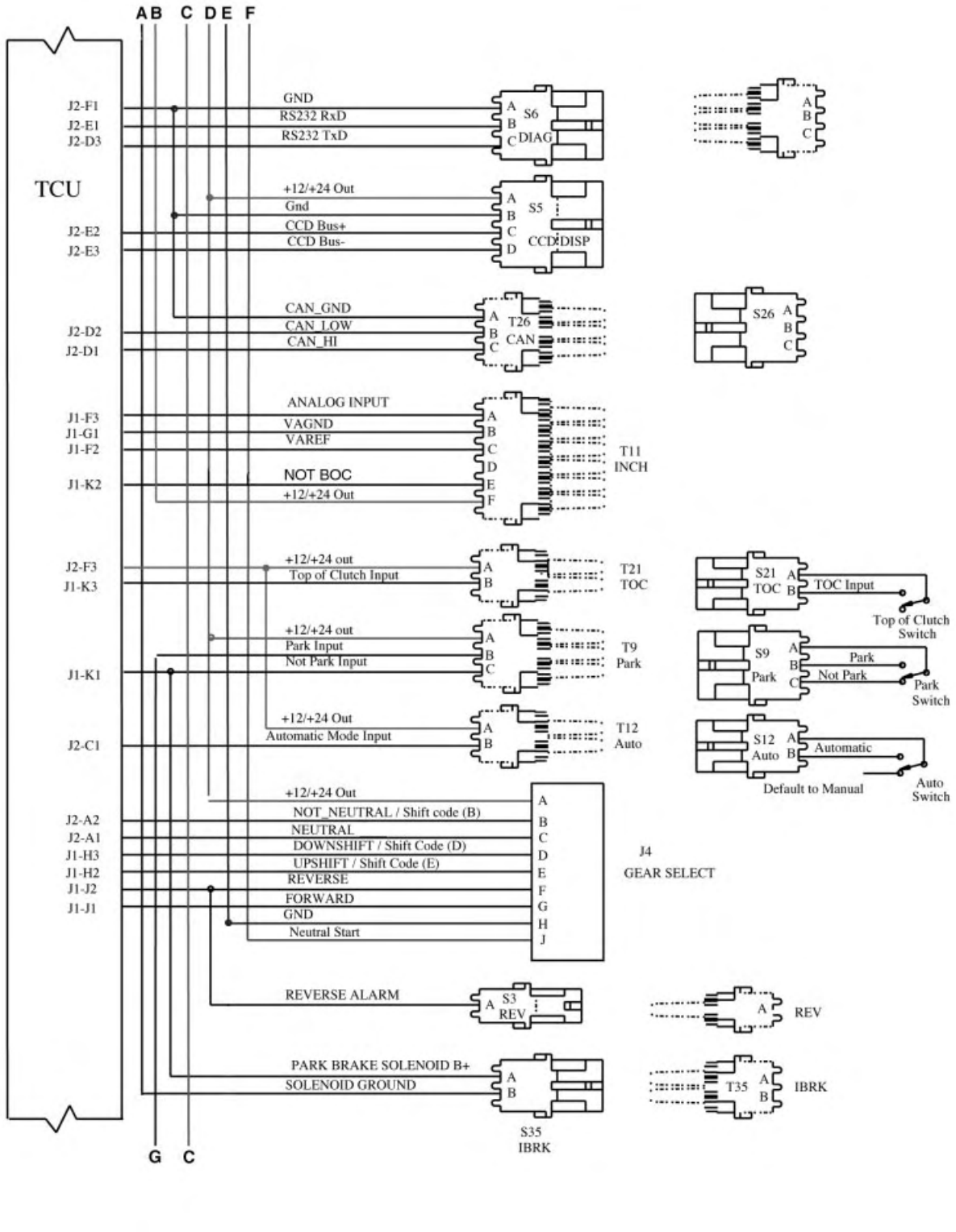
Transmission Wiring Harness 2 of 4[1]



[1]*Wiring harness is "Application Dependent".*

Continued on next page

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NOTE: The letters G,C,E link to the next page.

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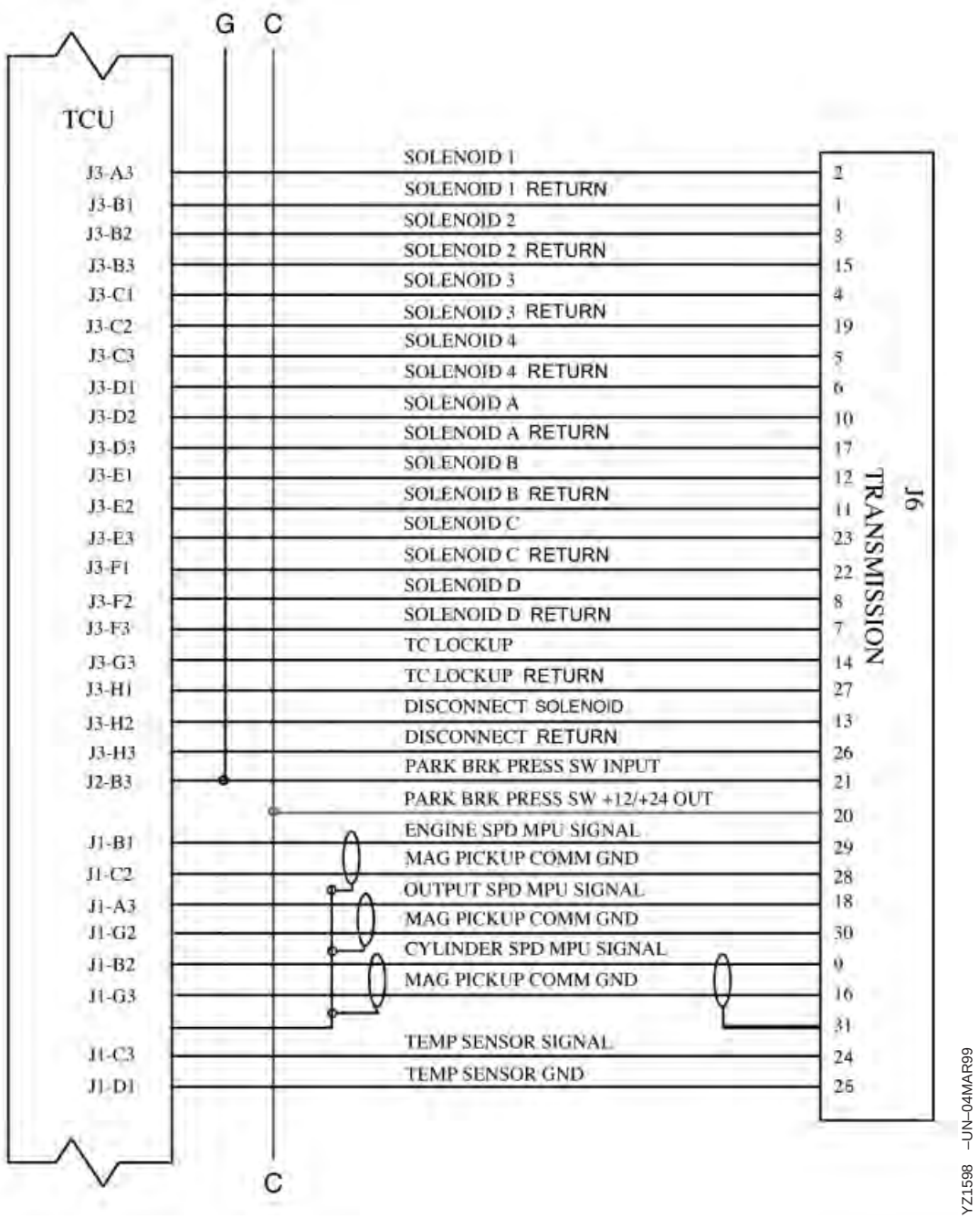
Transmission Wiring Harness 3 of 4[1]



NOTE: The letter C links to the next page.

[1]Wiring harness is "Application Dependent".

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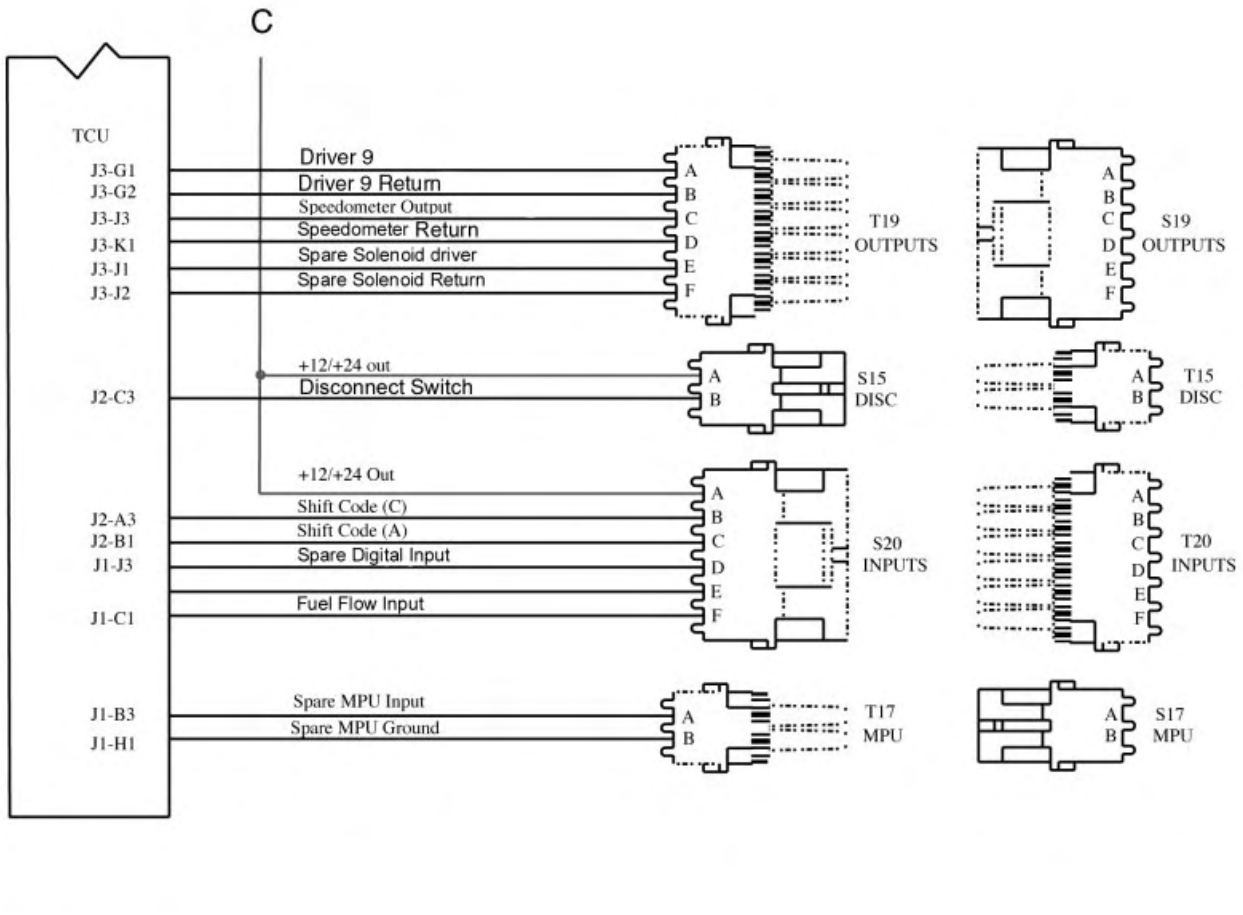
Transmission Wiring Harness 4 of 4[1]



NOTE: Letters C is a label to link the previous page.

[1]Wiring harness is "Application Dependent".

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Function of Proportional Valves

The proportional valve is pilot operated. It has a main spool that is forced in one direction by a spring and clutch pressure. In this position the valve is off, meaning that system pressure is shut off from the clutch actuation line and the clutch actuation line is open to sump to insure that there is 0 PSI in the clutch.

To apply pressure to the clutch, the spool must be moved against the spring and clutch pressure. This shuts off the opening from the clutch to the sump and opens the system pressure to the clutch. The pressure then forces the clutch piston against the friction plates and applies the clutch.

In a proportional valve the main spool is able to be forced part way open to provide a partial pressure to the clutch. In this position the system pressure is partially open to the clutch while the clutch is also partially open to sump. As the system pressure is open more, the opening to sump is shut off more, increasing pressure in the clutch.

The pilot section is the part of the valve that forces the spool open against the spring. It is a sealed chamber into which the main spool slides in and out of like a hydraulic cylinder. There are two openings into this chamber. One is a small hole which allows oil into the chamber from system pressure. The other hole allows the oil to flow out of the chamber. At this point the pressure in the pilot section is near 0 PSI and is not enough force to move the spool against the spring.

The large hole is able to be shut off by a small poppet that is normally held away from the hole by the oil exiting the cavity. It is forced shut against the outlet hole when the electric solenoid is turned on. This allows pressure to build up in the pilot section. As the pressure builds up it forces the main spool against the spring and clutch pressure on the other end and brings the valve on.

In a proportional valve the poppet in the pilot section can be controlled to any position between open and closed. The poppet is controlled to an intermediate position by a variable magnetic force from the solenoid coil. In this position it is equally opposed by the pressure in the cavity acting on the ball.

A variable force from the coil is created with a Pulse Width Modulated (PWM) signal. The PWM signal is a voltage that cycles duty cycle of 25% at a frequency of 50 cycles per second, (a 20 millisecond period) would be full voltage for 5 milliseconds and 0 volts for 15 milliseconds. In an analog valve the frequency used is high enough that the coil then “averages out” the current to some intermediate value. This average varies with the duty cycle of the PWM signal, and controls the position of the poppet. If the poppet is partially closed, the pressure in the pilot section is at an intermediate pressure between 0 PSI and system pressure. This moves the main spool to a position where the spring force and clutch pressure increases to match it, holding the main spool in a partially displaced position that provides a proportional pressure to the clutch.

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Proportional Valves

CONNECTOR PINOUT		
SIGNAL DESCRIPTION	TRANSMISSION CONNECTOR PIN	TCU PIN
SOLENOID 1	J6-2	J3-A3
SOLENOID 1 RETURN	J6-1	J3-B1
SOLENOID 2	J6-3	J3-B2
SOLENOID 2 RETURN	J6-15	J3-B3
SOLENOID 3	J6-4	J3-C1
SOLENOID 3 RETURN	J6-19	J3-C2
SOLENOID 4	J6-5	J3-C3
SOLENOID 4 RETURN	J6-6	J3-D1
SOLENOID A	J6-10	J3-D2
SOLENOID A RETURN	J6-17	J3-D3
SOLENOID B	J6-12	J3-E1
SOLENOID B RETURN	J6-11	J3-E2
SOLENOID C	J6-23	J3-E3
SOLENOID C RETURN	J6-22	J3-F1
SOLENOID D	J6-8	J3-F2
SOLENOID D RETURN	J6-7	J3-F3

DF Series Transmission Eight Speeds Forward and Four Reverse

GEAR ENGAGED	ACTIVE SOLENOIDS
F 8th	2 and D
F 7th	1 and D
F 6th	2 and B
F 5th	1 and B
F 4th	2 and C
F 3rd	1 and C
F 2nd	2 and A
F 1st	1 and A
Neutral	
R 1st	3 and A
R 2nd	3 and C
R 3rd	3 and B
R 4th	3 and D

DF Series Transmission Four Speeds Forward and Four Reverse

GEAR ENGAGED	ACTIVE SOLENOIDS
F 4th	2 and B
F 3rd	1 and B
F 2nd	2 and A
F 1st	1 and A
Neutral	
R 1st	3 and A
R 2nd	4 and A
R 3rd	3 and B
R 4th	4 and B

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System Errors

The TCU has the ability to detect various discrepancies.

Possible errors are:

- Pinched or broken wiring
- Shorted or open coils
- Bad connections
- Shorted wiring (to either ground or vehicle voltage.)
- Illogical input from the handle
- Magnetic pickup sensor failures

All errors are neutral recoverable, unless the condition causing the error prevents the TCU from detecting a legal neutral condition. After a neutral recovery, the shift lever may be placed back into a legal forward or reverse position. If the condition causing the error still exists, the error will again be detected and displayed.

CAUTION: How the TCU handles errors depends upon what type and which error has occurred. The TCU can immediately shift the transmission to neutral in the event of an error. The transmission will remain in neutral until the error has been resolved and the shift lever cycled to neutral and back to the desired position.

The TCU retains the last eight non-repeating error codes in nonvolatile memory in the order in which they have occurred. These codes are available for future retrieval.

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Analog TCU Diagnostic Codes

NOTE: The following is a list of the diagnostic codes that may be generated by the TCU.

Diagnostic Code: 20

Description: Solenoid 1 cannot get up to requested current.

Probable Cause: Open or short to ground in Solenoid 1 circuit from output pin J3-A3 to return pin J3-B1.

Diagnostic Code: 21

Description: Solenoid 2 cannot get up to requested current.

Probable Cause: Open or short to ground in Solenoid 2 circuit from output pin J3-B2 to return pin J3-B3.

Diagnostic Code: 22

Description: Solenoid 3 cannot get up to requested current.

Probable Cause: Open or short to ground in Solenoid 3 circuit from output pin J3-C1 to return pin J3-C2.

Diagnostic Code: 23

Description: Solenoid 4 cannot get up to requested current.

Probable Cause: Open or short to ground in Solenoid 4 circuit from output pin J3-C3 to return pin J3-D1.

Diagnostic Code: 24

Description: Solenoid A cannot get up to requested current.

Probable Cause: Open or short to ground in Solenoid A circuit from output pin J3-D2 to return pin J3-D3.

Diagnostic Code: 25

Description: Solenoid B cannot get up to requested current.

Probable Cause: Open or short to ground in Solenoid B circuit from output pin J3-E1 to return pin J3-E2.

Diagnostic Code: 26

Description: Solenoid C cannot get up to requested current.

Probable Cause: Open or short to ground in Solenoid C circuit from output pin J3-E3 to return pin J3-F1.

Diagnostic Code: 27

Description: Solenoid D cannot get up to requested current.

Probable Cause: Open or short to ground in Solenoid D circuit from output pin J3-F2 to return pin J3-F3.

Diagnostic Code: 28

Description: Solenoid E cannot get up to requested current.

Probable Cause: Open or short to ground in circuit from output pin J3-G1 to return pin J3-G2.

Diagnostic Code: 29

Description: Torque Converter Lock-up Solenoid cannot get up to requested current.

Probable Cause: Open or short to ground in Torque Converter Lock-up circuit from output pin J3-G3 to return pin J3-H1.

Diagnostic Code: 30

Description: Solenoid 1 cannot drop to requested current.

Probable Cause: Short to positive in Solenoid 1 circuit from output pin J3-A3 to return pin J3-B1.

Diagnostic Code: 31

Continued on next page

Description: Solenoid 2 cannot drop to requested current.

Probable Cause: Short to positive in Solenoid 2 circuit from output pin J3-B2 to return pin J3-B3.

Diagnostic Code: 32

Description: Solenoid 3 cannot drop to requested current.

Probable Cause: Short to positive in Solenoid 3 circuit from output pin J3-C1 to return pin J3-C2.

Diagnostic Code: 33

Description: Solenoid 4 cannot drop to requested current.

Probable Cause: Short to positive in Solenoid 4 circuit from output pin J3-C3 to return pin J3-D1.

Diagnostic Code: 34

Description: Solenoid A cannot drop to requested current.

Probable Cause: Short to positive in Solenoid A circuit from output pin J3-D2 to return pin J3-D3.

Diagnostic Code: 35

Description: Solenoid B cannot drop to requested current.

Probable Cause: Short to positive in Solenoid B circuit from output pin J3-E1 to return pin J3-E2.

Diagnostic Code: 36

Description: Solenoid C cannot drop to requested current.

Probable Cause: Short to positive in Solenoid C circuit from output pin J3-E3 to return pin J3-F1.

Diagnostic Code: 37

Description: Solenoid D cannot drop to requested current.

Probable Cause: Short to positive in Solenoid D circuit from output pin J3-F2 to return pin J3-F3.

Diagnostic Code: 38

Description: Solenoid E cannot drop to requested current.

Probable Cause: Short to positive in circuit from output pin J3-G1 to return pin J3-G2.

Diagnostic Code: 39

Description: Torque Converter Lock-up Solenoid cannot drop to requested current.

Probable Cause: Short to positive in Torque Converter Lock Up circuit from output pin J3-G3 to return pin J3-H1.

Diagnostic Code: 40

Probable Cause: Request for an undefined shift being made.

Diagnostic Code: 41

Probable Cause: TCU has not seen a legal neutral signal (input pin J2-A1) since initial power-up of system.

Diagnostic Code: 42

Description: Bottom of Clutch input on J1-K2 is passive.

Probable Cause: Input at J1-K2 must be connected to system voltage on applications which do not utilize inching.

Diagnostic Code: 43

Probable Cause: NOT PARK (input pin J1-K1) and PARK (input pin J2-B3) are both passive at TCU.

Continued on next page

Legal conditions are:

1. NOT PARK active and PARK passive.
2. NOT PARK passive and PARK active.

Diagnostic Code: 44

Probable Cause: NOT PARK (input pin J1-K1) and NEUTRAL (input pin J2-A1) are simultaneously passive at TCU.

Legal conditions are:

1. NOT PARK active and NEUTRAL passive.
2. NOT PARK passive and NEUTRAL active.

Diagnostic Code: 45

Probable Cause: PARK (input pin J2-B3) is active but NEUTRAL (input pin J2-A1) is passive at TCU.

Diagnostic Code: 48

Probable Cause: NOT PARK (input pin J1-K1) and PARK (input pin J2-B3) are simultaneously active at TCU.

Legal conditions are:

1. NOT PARK active and PARK passive.
2. NOT PARK passive and PARK active.

Diagnostic Code: 49

Probable Cause: Handle signal is park but PARK PRESSURE (input pin J2-B3) is passive at TCU.

Legal conditions are:

1. PARK PRESSURE signal active while shift handle is in park position.
2. PARK PRESSURE signal passive while shift handle is in gear.

Diagnostic Code: 50

Probable Cause: UPSHIFT (input pin J1-H2) and DOWNSHIFT (input pin J1-H3) are simultaneously active at TCU.

Diagnostic Code: 51

Probable Cause: FORWARD (input pin J1-J1) and REVERSE (input pin J1-J2) are simultaneously active at TCU.

Diagnostic Code: 52

Probable Cause: FORWARD (input pin J1-J1) and NEUTRAL (input pin J2-A1) and REVERSE (input pin J1-J2) are simultaneously passive at TCU.

Diagnostic Code: 54

Probable Cause: Invalid requested gear calculation.

Diagnostic Code: 56

Probable Cause: NEUTRAL (input pin J2-A1) and FORWARD (input pin J1-J1) are simultaneously active at TCU.

Legal conditions are:

1. NEUTRAL active and FORWARD passive.
2. NEUTRAL passive and FORWARD active.

Diagnostic Code: 57

Probable Cause: NEUTRAL (input pin J2-A1) and REVERSE (input pin J1-J2) are simultaneously active at TCU.

Legal conditions are:

1. NEUTRAL active and REVERSE passive.
2. NEUTRAL passive and REVERSE active.

Diagnostic Code: 58

Continued on next page

Probable Cause: START (input pin J2-B2) went active at TCU disabling internal solenoid power. START should be active only when ignition is in “START” position and starter is cranking.

Diagnostic Code: 59

Description: Invalid 5 bit selector code.

Probable Cause: Faulty gear selector/shift handle or faulty wiring between selector and TCU.

Diagnostic Code: 60

Description: Valve driver supply voltage (TCU pin J3-A1) too low.

Probable Cause: Must be above 8 volts on a 12 volt system or above 17 volts on a 24 volt system.

Diagnostic Code: 80

Probable Cause: Engine MPU signal (input pin J1-B1) missing or frequency is too low.

Diagnostic Code: 82

Probable Cause: Output MPU signal (input pin J1-A3) missing or frequency is too low.

Diagnostic Code: 84

Probable Cause: Illegal or undefined vehicle mode code.

Diagnostic Code: 85

Probable Cause: PARK (input pin J2-B3) is active but NEUTRAL (input pin J2-A1) is passive at TCU.

Diagnostic Code: 86

Probable Cause: Inching pedal TOP OF CLUTCH signal (input pin J1-K3) is active but BOTTOM OF CLUTCH (input pin J1-K2) is open.

Diagnostic Code: 87

Probable Cause: PARK (input pin J2-B3) and FORWARD (input pin J1-J1) are simultaneously active at TCU.

Diagnostic Code: 88

Probable Cause: PARK (input pin J2-B3) and REVERSE (input pin J1-J2) are simultaneously active at TCU.

Diagnostic Code: 89

Probable Cause: PARK (input pin J2-B3) and NOT PARK (input pin J1-K1) are simultaneously passive at TCU.

Diagnostic Code: 90

Probable Cause: PARK (input pin J2-B3) and NOT PARK (input pin J1-K1) are simultaneously active at TCU.

Diagnostic Code: 91

Probable Cause: Seat switch (input pin J2-C3) and NEUTRAL (input pin J2-A1) are simultaneously passive at TCU.

Diagnostic Code: 92

Probable Cause: Engine speed is at or near manufacturer’s warranty void level.

Diagnostic Code: 93

Probable Cause: CARRIER CAB and UPPER CAB inputs are simultaneously active at TCU.

Diagnostic Code: 94

Probable Cause: CARRIER CAB and UPPER CAB inputs are simultaneously passive at TCU.

Diagnostic Code: 95

Probable Cause: NEUTRAL (input pin J2-A1) is passive while switching cab modes.

Continued on next page

Diagnostic Code: 96

Probable Cause: Upper cab mode selected but transmission gear is not a legal gear range for upper cab mode.

Diagnostic Code: 97

Probable Cause: Upper cab mode selected but FORWARD NEUTRAL and REVERSE inputs are all passive at TCU.

Diagnostic Code: 98

Probable Cause: WHEELS-UP (input pin J1-H1) and WHEELS-DOWN (input pin J1-H2) are both active.

Diagnostic Code: 99

Probable Cause: Attempt to change wheels-up wheels-down mode while in an out-of-neutral condition.

Diagnostic Code: 100

Probable Cause: Sump temperature (input on J1-C3) is too low for calibration.

Diagnostic Code: 101

Probable Cause: Engine speed is too high for calibration.

Diagnostic Code: 102

Probable Cause: Engine speed is too low for calibration.

Diagnostic Code: 103

Probable Cause: Output speed detected during calibration.

Diagnostic Code: 104

Probable Cause: No cylinder speed detected during calibration.

Diagnostic Code: 105

Probable Cause: Incorrect forward cylinder speed ratio during calibration.

Diagnostic Code: 106

Probable Cause: Incorrect reverse cylinder speed ratio during calibration.

Diagnostic Code: 107

Probable Cause: Cylinder speed will not drop below the start count speed.

Diagnostic Code: 108

Error: Holding clutch pressure exceeds 90 psi.

Diagnostic Code: 109

Error: Clutch 1 fast fill time exceeds 300 ms.

Diagnostic Code: 110

Error: Clutch 2 fast fill time exceeds 300 ms.

Diagnostic Code: 111

Error: Clutch 3 fast fill time exceeds 300 ms.

Diagnostic Code: 112

Error: Clutch 4 fast fill time exceeds 300 ms.

Diagnostic Code: 113

Error: Clutch A fast fill time exceeds 300 ms.

Diagnostic Code: 114

Error: Clutch B fast fill time exceeds 300 ms.

Diagnostic Code: 115

Error: Clutch C fast fill time exceeds 300 ms.

Diagnostic Code: 116

Error: Clutch D fast fill time exceeds 300 ms.

Continued on next page

Diagnostic Code: 117

Error: Clutch hold pressure is above 90 psi.

Diagnostic Code: 118

Error: Clutch R fast fill time exceeds 300 ms.

Diagnostic Code: 119

Error: Clutch L fast fill time exceeds 300 ms.

Diagnostic Code: 120

Error: Clutch M fast fill time exceeds 300 ms.

Diagnostic Code: 121

Probable Cause: Clutch H fast fill time exceeds 300 ms.

Diagnostic Code: 127

Probable Cause: Attempt to calibrate with PARK (input pin J2-B3) input passive at TCU. Park brake must be set during calibration.

Diagnostic Code: 144

Probable Cause: Low air pressure.

Diagnostic Code: 145

Probable Cause: Analog inching voltage is too low.

Diagnostic Code: 146

Probable Cause: Temperature sensor circuit SENSE (J1-C3) or GROUND (J1-D1) shorted or open.

Diagnostic Code: 147

Probable Cause: Analog input (J1-D3) shorted or open.

Diagnostic Code: 148

Probable Cause: Analog inching voltage (J1-F3) is too high.

Diagnostic Code: 149

Probable Cause: Vehicle system voltage (J3-A1) is too high.

Diagnostic Code: 150

Probable Cause: Transmission temperature (J1-C3) is too high.

Diagnostic Code: 154

Probable Cause: Engine MPU circuit (J1-B1) open.

Diagnostic Code: 155

Probable Cause: Output MPU circuit (J1-A3) open.

Diagnostic Code: 160

Probable Cause: Cannot get shift constants from EEPROM.

Diagnostic Code: 161

Probable Cause: Group one enable low should be high.

Diagnostic Code: 162

Probable Cause: Group two enable low should be high.

Diagnostic Code: 163

Probable Cause: Group three enable low should be high.

Diagnostic Code: 164

Probable Cause: Pointer in capcom20 gets too big.

Diagnostic Code: 165

Probable Cause: Safety FET A failed OFF.

Diagnostic Code: 166

Probable Cause: Safety FET A failed ON.

Continued on next page

Diagnostic Code: 167

Probable Cause: Safety FET B failed OFF.

Diagnostic Code: 168

Probable Cause: Safety FET B failed ON.

Diagnostic Code: 169

Probable Cause: Safety FET C failed OFF.

Diagnostic Code: 170

Probable Cause: Safety FET C failed ON.

Diagnostic Code: 171

Probable Cause: Group one enable high should be low.

Diagnostic Code: 172

Probable Cause: Group two enable high should be low.

Diagnostic Code: 173

Probable Cause: Group three enable high should be low.

Diagnostic Code: 174

Probable Cause: EEPROM checksum error.

Diagnostic Code: 175

Probable Cause Code: Solenoid 11 cannot get up to requested current.

Probable Cause: Open or short to ground in circuit from output pin J3-H2 to return pin J3-H3.

Diagnostic Code: 176

Probable Cause Code: Solenoid 12 cannot get up to requested current.

Probable Cause: Open or short to ground in circuit from output pin J3-J1 to return pin J3-J2.

Diagnostic Code: 177

Probable Cause Code: Solenoid 13 cannot get up to requested current.

Probable Cause: Open or short to ground in circuit from output pin J3-J3 to return pin J3-K1.

Diagnostic Code: 178

Probable Cause Code: Solenoid 11 cannot drop to requested current.

Probable Cause: Short to positive in circuit from output pin J3-H2 to return pin J3-H3.

Diagnostic Code: 179

Probable Cause Code: Solenoid 12 cannot drop to requested current.

Probable Cause: Short to positive in circuit from output pin J3-J1 to return pin J3-J2.

Diagnostic Code: 180

Probable Cause Code: Solenoid 13 cannot drop to requested current.

Probable Cause: Short to positive in circuit from output pin J3-J3 to return pin J3-K1.

Diagnostic Code: 198

Probable Cause: CCD communications link failure between master TCU and slave TCU (CCD BUS- (J2-E3) and CCD BUS+ (J2-B2)).

Diagnostic Code: 199

Probable Cause: This is a non-functional base TCU. No application specific software has been programmed into it.

Glossary

Analog: A signal which has a continuous range of possible voltages.

Digital: A signal which consists of only two voltage levels—usually 0 volts and +5 volts. On/Off type signals are also considered to be digital.

Active: The high voltage (+12V / +24V) state of a digital input. Dependent upon vehicle system voltage.

Actual Gear: The actual physical gear of the transmission, regardless of shift lever position or controller operation.

Bus: Serial communications link which interconnects intelligent electronic modules.

Come-Home: A hardware function which allows limited vehicle motion in the event of failure of certain components.

Commanded Gear: The gear selected by the combination of the shift lever position and the state of the Forward, Reverse, Neutral, and Not Neutral inputs. The 'destination' gear.

Current Gear: The gear the controller is currently attempting to drive the transmission into by the application of commands to the valves.

Downshift Inhibit: The prohibiting of downshifting, by the TCU, to prevent harsh and abrupt shifts or possible overspeed conditions of the engine. The downshift will be inhibited until the current speed ratio will permit the shift to take place.

Fault: An abnormal condition which results in a perceived performance change or in a loss of function which may result in performance loss or system damage.

Intershift Pause Time: The minimum time delay between shifts. A value preprogrammed into the TCU.

Neutral Recoverable: The process where a detected fault is maintained and displayed by the TCU until the shift lever is cycled to neutral (park on some systems) and the TCU detects the proper combination of inputs for a legal neutral (park) condition, at which time the displayed fault will be cleared. The fault code will still be maintained in TCU memory for future recall.

Next Gear: The next gear the controller plans to enter. The next gear will become the current gear if no faults are detected and all conditions for entering the next gear are met.

Nonvolatile Memory: Memory that retains its data even though power to the system has been removed.

Passive: The low voltage (0V) state of a digital input.

Previous Direction: The direction of vehicle motion before a shuttle shift is initiated.

Previous Gear: The previous current gear.

Sequence Shift: The type of shift which consists of shifting from a gear to an adjacent gear.

Sequential Shifting: Multiple sequence shifts with no delay between shifts other than the programmed intershift pause time.

Shuttle Shift: A shift to a gear in the opposite direction of vehicle travel made by moving the shift lever between the Forward and Reverse positions.

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Abbreviations and Acronyms Used in TCU Group

TCU: Transmission Control Unit

PWM: Pulse Width Modulation

MPU: Magnetic Pickup Sensor

GND: Ground

RPM: Revolutions Per Minute

P: Park

DC: Direct Current

TOC: Top of Clutch

BOC: Bottom of Clutch

V: Volt

CYL: Cylinder

ENG: Engine

TEMP: Temperature

CAN: Controller Area Network

SOL: Solenoid

POT: Potentiometer

CCD: Chrysler Collision Detection

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