6

PART 6
POWER TAKE–OFF

Chapter 1
INDEPENDENT POWER TAKE OFF SYSTEMS

A. POWER TAKE–OFF (PTO) SYSTEMS–DESCRIPTION AND OPERATION

The power take off (PTO) enables engine power to be transferred directly to mounted or trailed equipment via a splined shaft at the rear of the tractor, Figure 1.

PTO driven equipment is designed to operate using either a 6 or 21 splined output shaft at a specified output shaft speed.

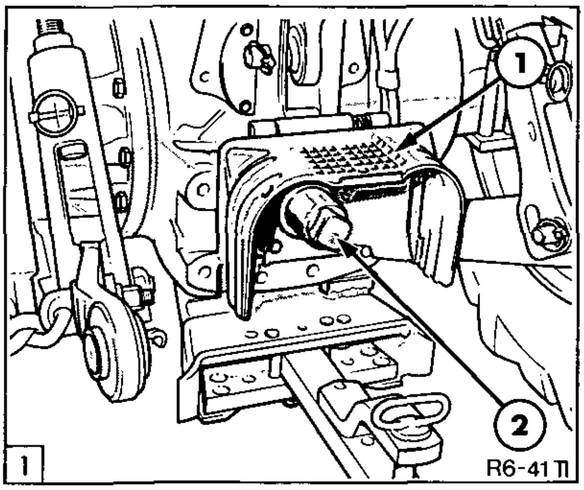
The output shaft speed must be restricted to 540 rev/min for equipment designed for use with the 6 splined shaft and 1000 rev/min for equipment designed for use with the alternative 21 splined shaft.

The types of PTO system available on Series 40 tractors fall into the following three categories:–

Single speed PTO, using the standard 6 splined output shaft for operation at 540 rev/min.

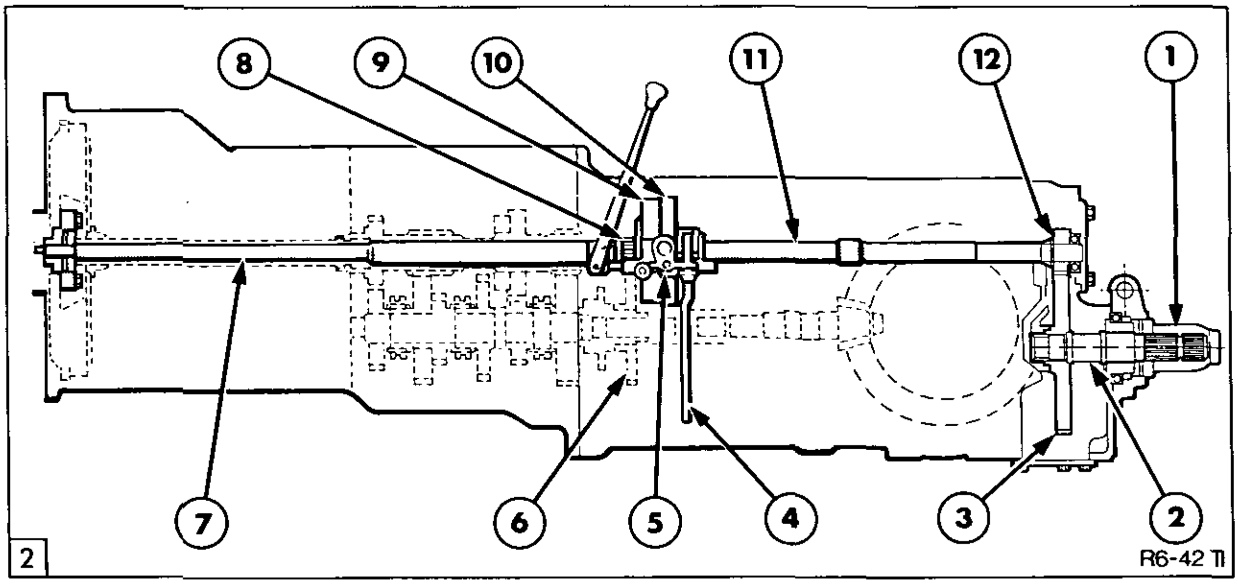
Two–speed non shiftable PTO with interchangeable 6 and 21 splined output shafts.

Two–speed shiftable PTO enabling the 6 splined output shaft to be operated at 540 rev/min at two separate engine speeds and an alternative 21 splined output shaft for operation at 1000 rev/min.



PTO Shaft

1. PTO Guard
2. PTO Shaft



Independent PTO Schematic (Single Speed Shown)

1. PTO Output Shaft Cap
2. PTO Output Shaft
3. Driven Gear
4. Oil Supply Pipe
5. PTO Valve Assembly
6. Hydraulic Pump Idler Gear
7. PTO Input Shaft
8. Hydraulic Pump Drive Gear
9. PTO Clutch Assembly
10. Brake Band
11. PTO Rear Shaft
12. Drive Gear

Single Speed PTO

Figure 2, shows in simple form the drive line from the engine to the output shaft.

The PTO input shaft passes through the transmission upper shafts and is splined at both ends into the engine flywheel and PTO clutch hubs.

The PTO rear shaft is splined into the PTO clutch and transmits drive to the output shaft drive gear.

When the PTO is engaged the friction and steel plates within the clutch assembly are clamped together, by the hydraulically operated clutch piston, transmitting drive from the flywheel to the PTO output shaft.

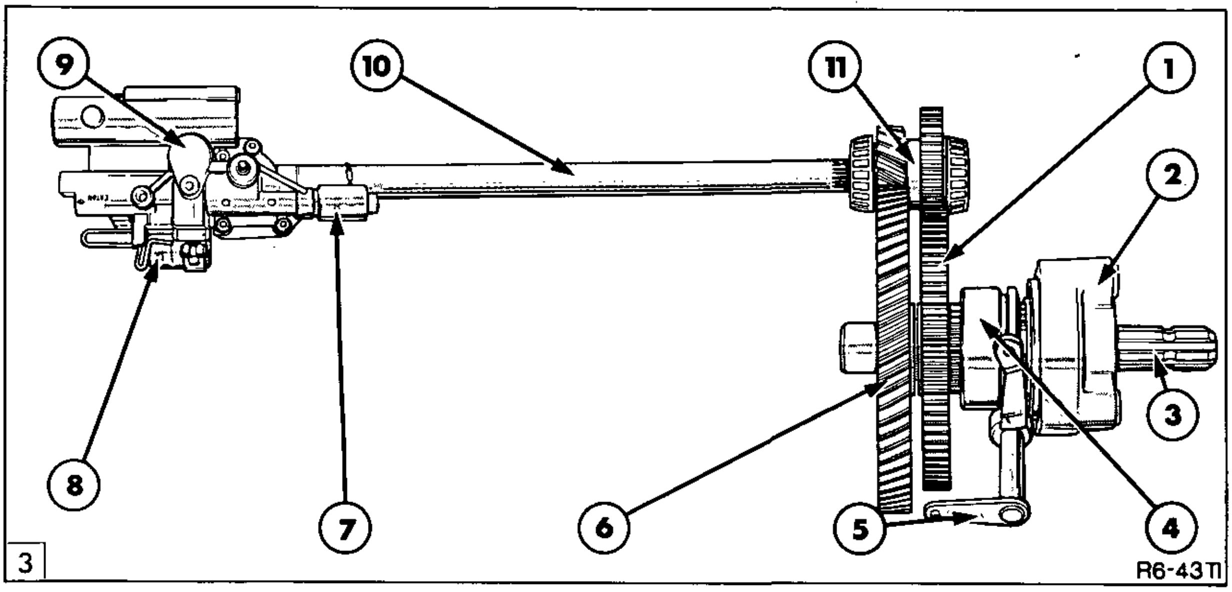
The speed of the output shaft is independent of the transmission or tractor 'ground speed' and is related directly to the speed of the engine.

The PTO clutch for single speed PTO systems, can be either mechanically or electric solenoid operated. When overhauling the clutch, reference must be made to the appropriate Description, Operation and Overhaul Sections in this Chapter.

Two Speed Shiftable PTO

The principal objective of two speed shiftable PTO is to enable operation of the 6 splined 540 rev/min shaft at two separate engine speeds, offering economy of operation at a slower engine speed.

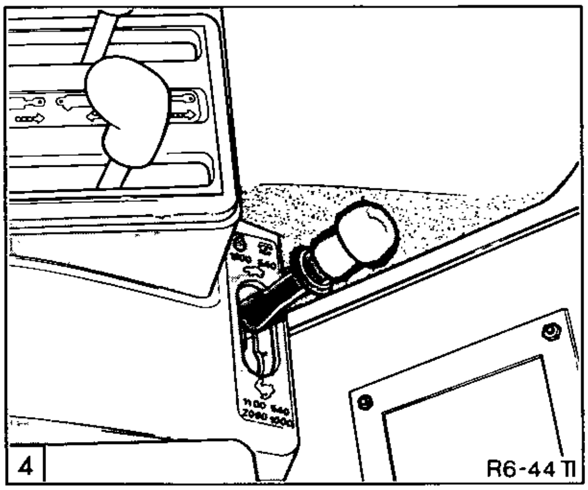
The PTO clutch for all two speed PTO systems, can be either mechanically or electric solenoid operated. When overhauling the clutch, reference must be made to the appropriate Description, Operation and Overhaul Sections in this Chapter.



Two Speed Shiftable PTO Schematic

1. 1000 rev/min Gear
2. Bearing Cap
3. Output Shaft (6 spline)
4. Sliding Coupler
5. Selector Lever
6. 540 rev/min Gear
7. Solenoid Valve
8. Clutch Assembly
9. PTO Valve Assembly
10. PTO Rear Shaft
11. Cluster Gear

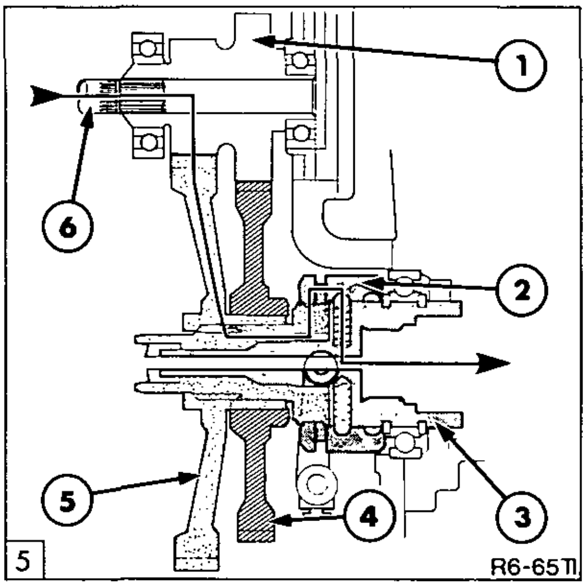
Drive from the PTO rear shaft is directed through a cluster gear and either the 540 or 1000 rev/min gear before being transmitted to the output shaft, Figure 3.



Two Speed Shiftable Selector Lever

The required output shaft speed is selected using the range selector lever mounted on the right hand side of the drivers seat, Figure 4.

When the selector lever is moved towards the 1900 rev/min engine speed position, the sliding coupler on the output shaft sleeve moves rearwards, transmitting drive from the cluster gear, through the 540 rev/min gear to the output shaft, Figure 5.

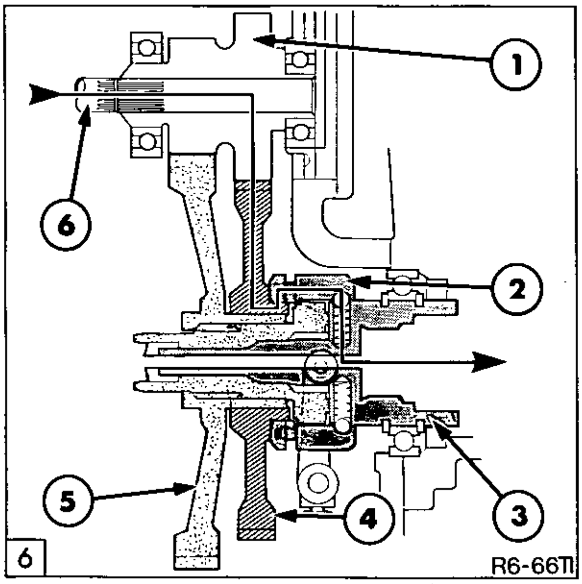


Two Speed Shiftable PTO
540 Rev/min Output Speed Power Flow

1. Cluster
2. Coupler
3. Output Shaft Sleeve
4. 1000 rev/min Gear
5. 540 rev/min Gear
6. PTO Rear Shaft

In this position when the engine speed is set to 1900 rev/min and the PTO clutch engaged, the output shaft will revolve at 540 rev/min. Decreasing the engine speed similarly reduces PTO output speed.

Moving the selector lever in the opposite direction disconnects drive through the 540 rev/min gear and connects the 1000 rev/min gear to the output shaft sleeve, Figure 6.



Two Speed Shiftable PTO
1000 Rev/min Output Speed Power Flow

1. Cluster
2. Coupler
3. Output Shaft Sleeve
4. 1000 rev/min Gear
5. 540 rev/min Gear
6. PTO Rear Shaft

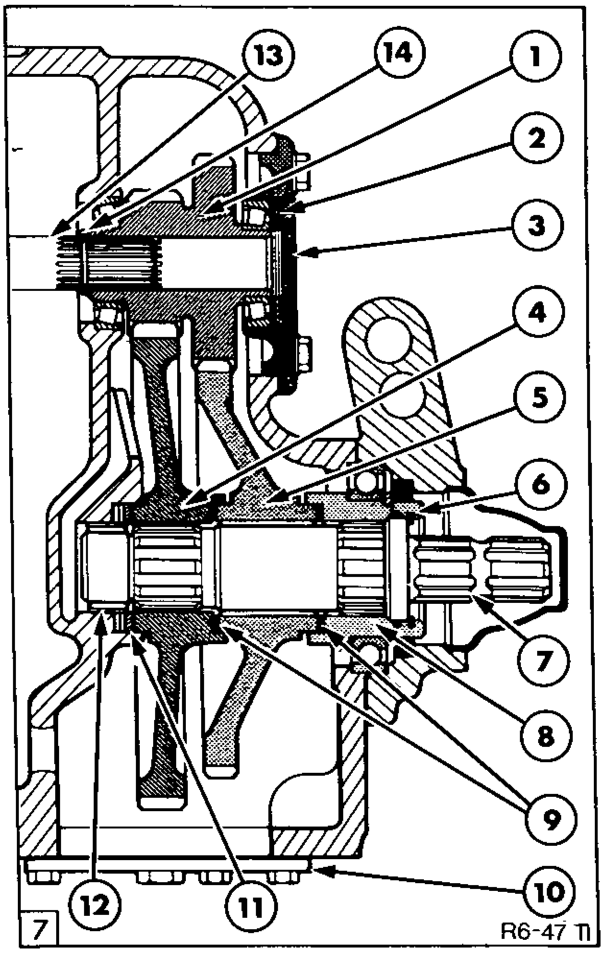
When the engine speed is set at 1135 rev/min the PTO shaft once again revolves at 540 rev/min but with less engine power offering 'Economy of Operation'.

Where it is necessary to operate equipment at 1000 rev/min the 6 splined shaft must be removed and replaced with the 21 splined version. When the engine speed is increased to 2100 rev/min the shaft will rotate at 1000 rev/min.

NOTE: *The 6 splined PTO shaft must not be operated at speeds above 540 rev/min.*

Non Shiftable Two Speed PTO

On tractors installed with the non shiftable two speed PTO, drive from the PTO rear shaft is also transferred via a cluster gear and either the 540 or 1000 rev/min gear to the output shaft.



Non Shiftable Two Speed PTO Shaft Installation

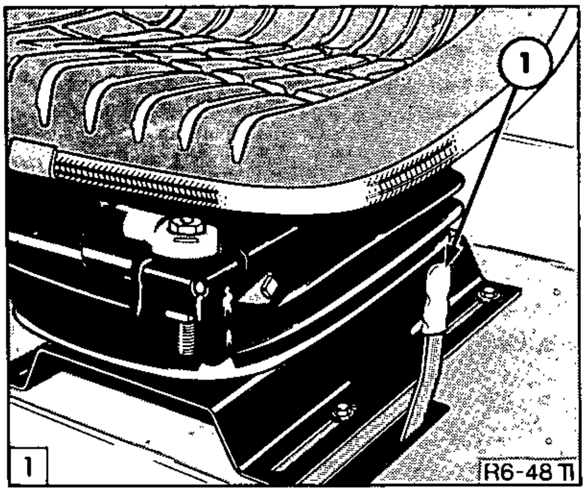
1. Drive Gear Assembly
2. Drive Gear Bearing Shims
3. Bearing Retainer
4. 540 rev/min Driven Gear
5. 1000 rev/min Driven Gear
6. Output Shaft Snap Ring
7. Output Shaft
8. Sleeve
9. Thrust Washers
10. Sump Cover Plate
11. Needle Thrust Bearing
12. Output Shaft Front Bearing
13. Upper Shaft
14. Snap Ring

When the 6 splined PTO shaft is installed, splines on the shaft engage with the 540 rev/min gear, Figure 7. This output shaft will now rotate at 540 rev/min when the engine speed is set to 2890 rev/min.

When the 21 splined shaft is installed the splines on this shaft engage with the 1000 rev/min gear enabling the output shaft to rotate at 1000 rev/min when the engine speed is set to 2050 rev/min.

NOTE: *The PTO shafts used on shiftable PTO Systems can not be installed onto tractors with the non shiftable system.*

B. MECHANICALLY OPERATED PTO CLUTCH and CONTROL VALVE– DESCRIPTION and OPERATION



PTO Selector Lever

The PTO on mechanically operated PTO clutch and control valves is engaged using a selector lever on the left hand side of the drivers seat, Figure 1. When the lever is operated, linkage between the lever and the PTO control valve spool moves the spool to the engaged or disengaged position.

PTO Clutch Disengaged

With reference to Figure 2.

When the engine is running oil flows from the rear pump (steering pump), within the hydraulic pump to the inlet port of the PTO control valve. The pressure of oil in this, the low pressure circuit, is maintained by the pressure regulating valve housed within the PTO assembly.

The low pressure hydraulic circuit operates the PTO clutch and dual power circuits (where fitted). This circuit is maintained at 130–160 lbf/in^2 (9.0–11.0 bar) when the engine is at 800 rev/min idle and the hydraulic pump is delivering 9.0–9.5 ltrs/min. When the engine speed is increased to 2100 rev/min and pump output increases, the oil pressure will increase to 170–200 lbf/in^2 (11.7–13.8 bar). Refer to Part 8, Chapter 1, for the description and operation of the low pressure hydraulic circuits.

Oil flowing through the pressure regulating valve provides lubrication to the PTO clutch and dual power circuits. The pressure of oil in these circuits is limited to a maximum of 50 lbf/in^2 (3.5 bar) by the cooler/lubrication circuit relief valve. Under normal operation and with the oil warm, this valve assumes a normally closed position.

When the PTO selector lever is in the disengaged position the control valve spool is positioned to the left, Figure 2.

Low pressure circuit oil entering the valve flows past the control valve spool to operate the brake piston. As the piston is applied the brake band tightens preventing the output shaft from turning.

When the engine stops running the pressure regulating valve closes and a groove in the valve land allows oil applied to the brake piston to return to sump, releasing the brake.

Engaging PTO Clutch

With reference to Figure 3 and Figure 4.

The control valve spool comprises of two parts connected by a link and spring which enable a feathering engagement of the clutch.

When the PTO selector lever initially starts moving to the engaged position the control valve moves to the right blocking the supply of oil from the pump, while at the same time allowing clutch brake pressure oil to return to reservoir (rear axle). This results in a 'Brake Off' and 'Clutch Off' situation, Figure 3B.

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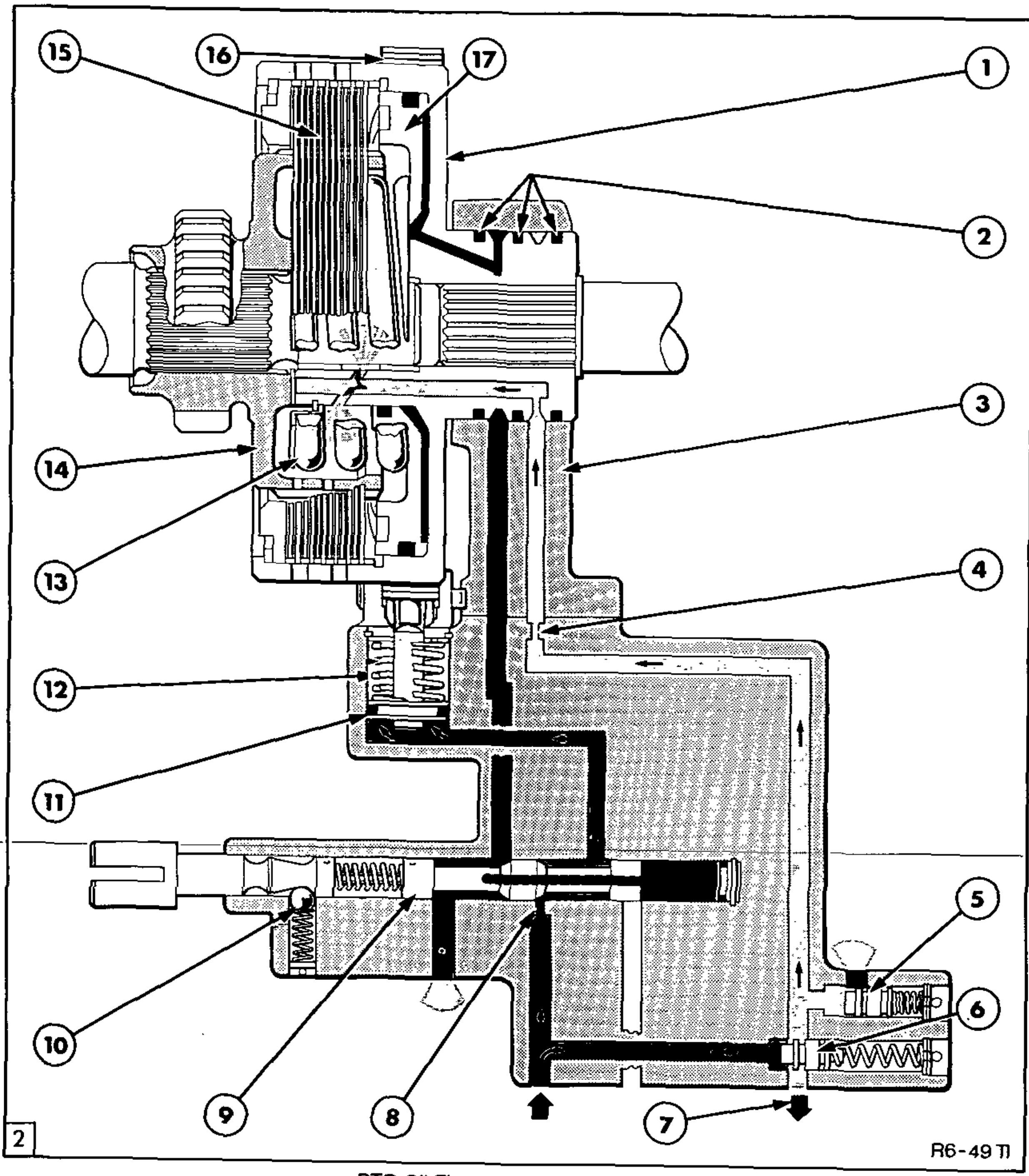
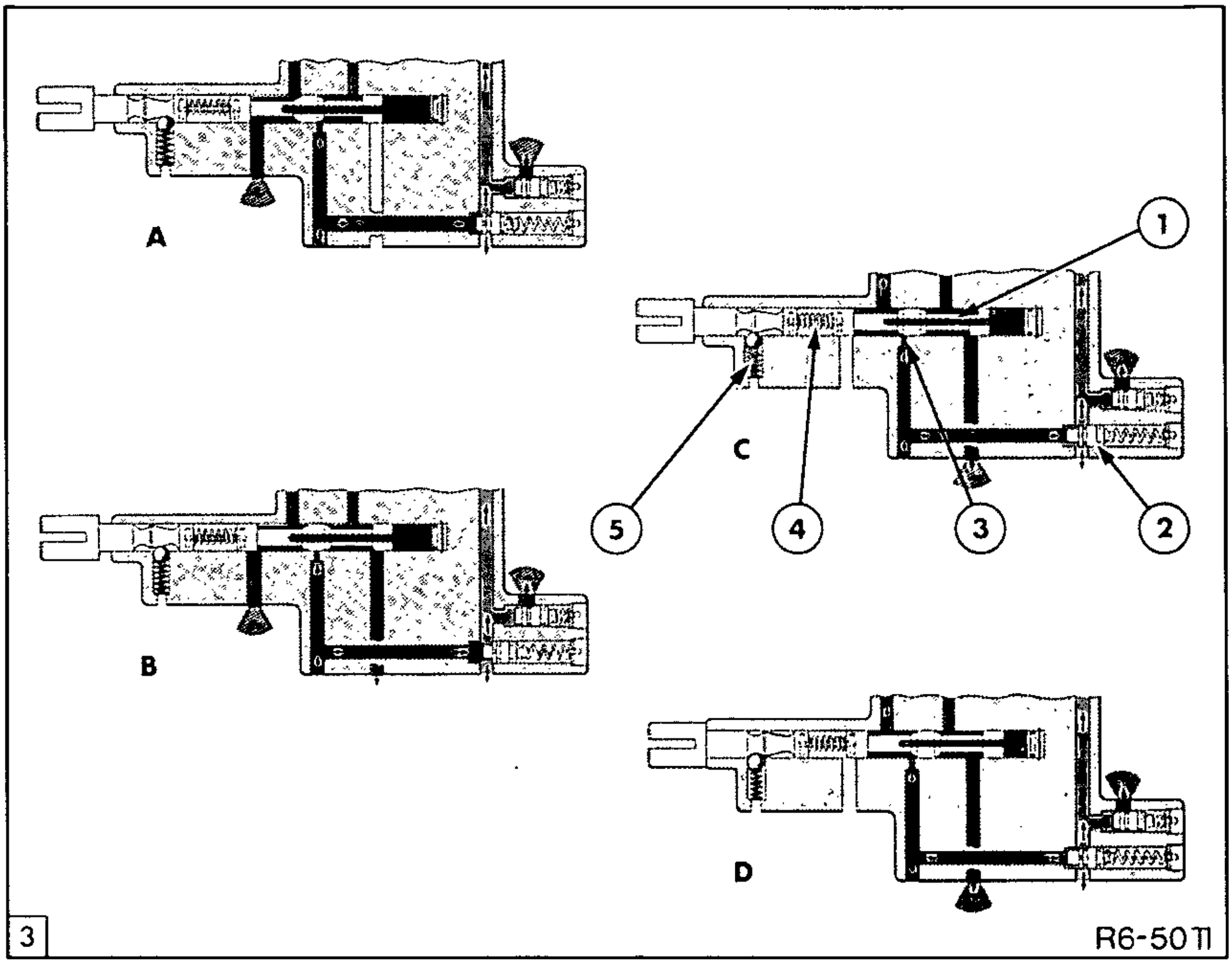


2

PTO Oil Flow – Clutch Disengaged
(Mechanically Operated PTO Control Valve)

■ Low Pressure Circuit Oil □ Lubrication Oil ■ Return to Reservoir Oil

1. Clutch Housing
2. Sealing Rings
3. Clutch Support
4. Orifice
5. Cooler/Lubrication circuit Relief Valve
6. Pressure Regulating Valve
7. Transfer Port to Oil Cooler
8. Orifice
9. Control Valve Spool
10. Detent Ball and Spring
11. Brake Piston
12. Brake Piston Return Spring
13. Clutch Piston Return Spring
14. Clutch Hub
15. Clutch Plates
16. Brake Band
17. Clutch Piston



3

PTO Clutch Engagement

'A' Brake Applied–Clutch Off
'B' Brake Off–Clutch Off
'C' Brake Off–Clutch Feathering
'D' Brake Off–Clutch Engaged

■ Low Pressure Circuit Oil
■ Lubrication Oil
■ Return to Reservoir Oil

1. Pressure Sensing Drilling
2. Pressure Regulating Valve
3. Orifice
4. Valve Spool Connecting link and Spring
5. Detent Ball and Spring

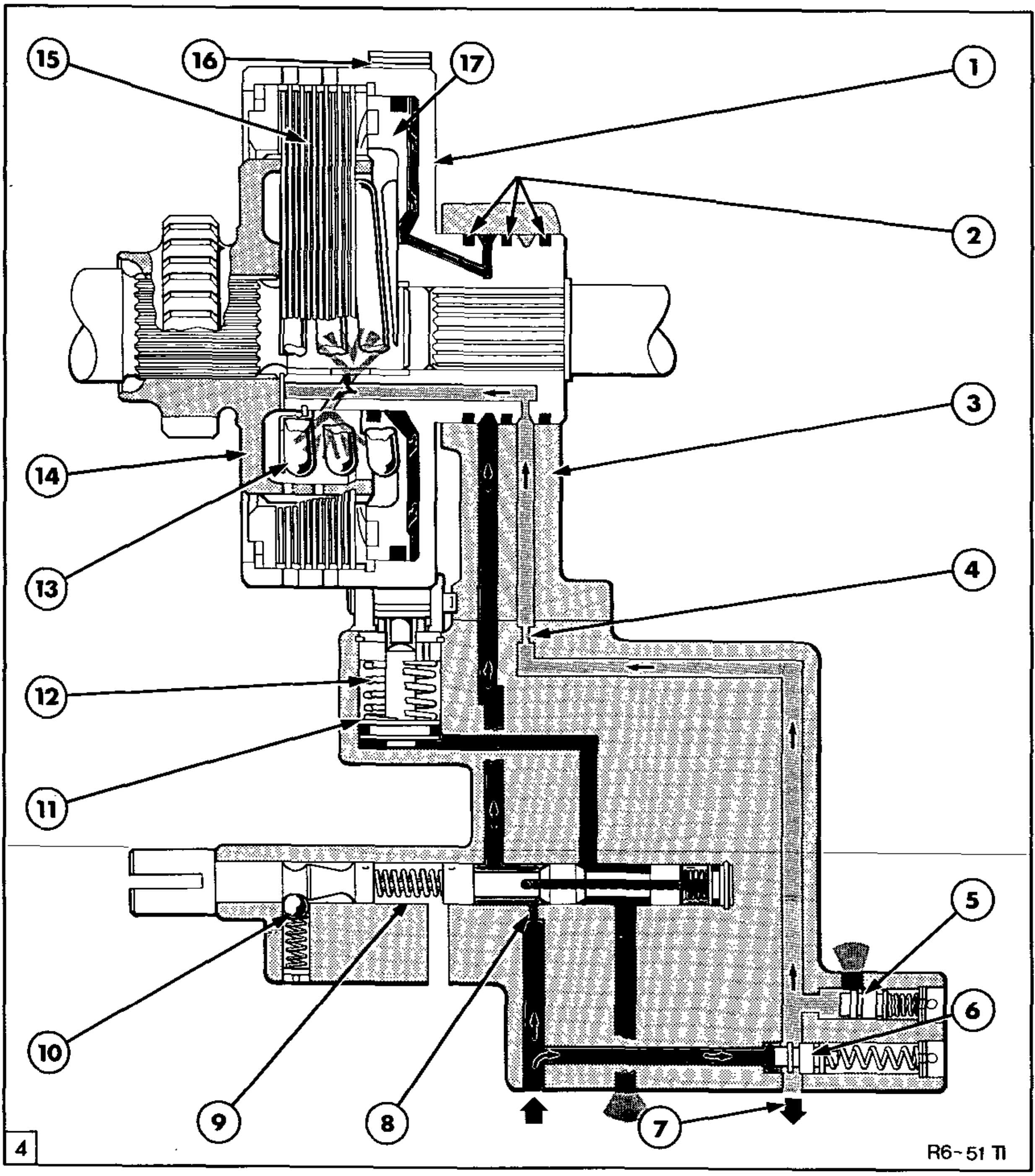
As the selector lever continues to move toward the engaged position the spool is moved further to the right uncovering the supply orifice to the clutch. A controlled oil flow now flows to the clutch and at the same time through a drilling to the right hand end of the spool.

As the pressure applied to the clutch increases the pressure rise is sensed at the right hand end of the spool. The spool will now move towards the left compressing the spring located between the two halves of the spool and also restricting flow of oil to the clutch.

This restriction of oil flow ensures a feathering of the clutch engagement in relation to the movement of the selector lever.

When the selector lever has moved to the fully engaged position the spring in the middle of the spool is fully compressed and the spool is held to the right. Further feathering against the compressed spring is now no longer possible and maximum pressure is applied to fully engage the clutch, Figure 4.

If the selector lever is moved quickly to the engaged position the orifice (item 8, Figure 4) will restrict oil flow to the clutch and subsequent shock loading engagement.



4

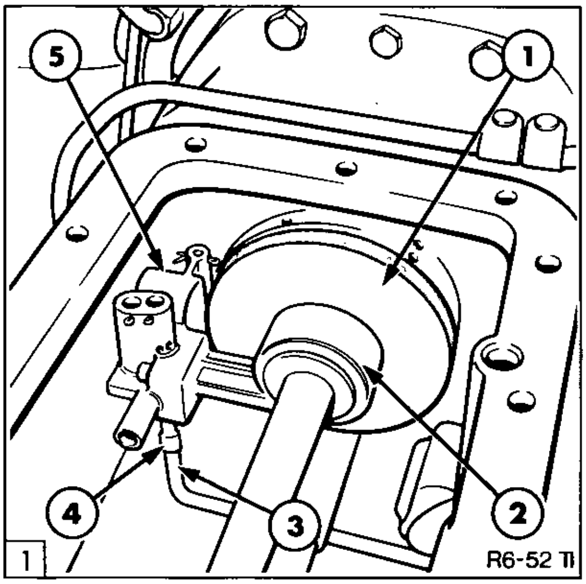
PTO Oil Flow – Clutch Engaged
(Mechanically Operated PTO Control Valve)

■ Low Pressure Circuit Oil ▨ Lubrication Oil ■ Return to Reservoir Oil

1. Clutch Housing
2. Sealing Rings
3. Clutch Support
4. Orifice
5. Cooler/Lubrication circuit Relief Valve
6. Pressure Regulating Valve
7. Transfer Port to Oil Cooler
8. Orifice
9. Control Valve Spool
10. *Detent Ball and Spring*
11. Brake Piston
12. Brake Piston Return Spring
13. Clutch Piston Return Spring
14. Clutch Hub
15. Clutch Plates
16. Brake Band
17. Clutch Piston

C. MECHANICALLY OPERATED PTO CLUTCH and CONTROL VALVE–OVERHAUL

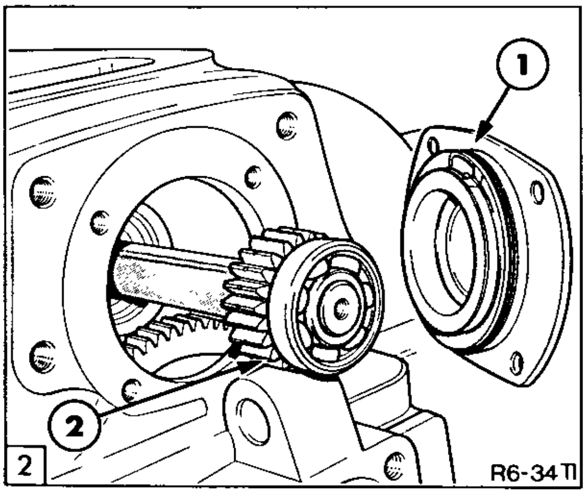
Removal



PTO Clutch and Valve Installation

1. PTO Clutch Assembly
2. PTO Clutch Support
3. Intake Tube
4. Retaining Clip
5. Control Valve

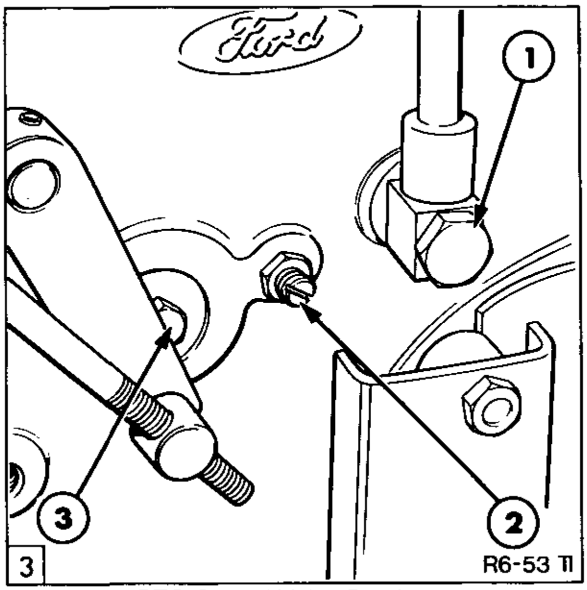
1. Remove hydraulic top cover to expose PTO clutch and valve assembly, Figure 1.



Rear Shaft and Bearing Retainer

1. Bearing Retainer
2. Rear Shaft, Gear and Bearing

2. Remove PTO rear shaft bearing retainer and withdraw shaft, bearing and drive gear, Figure 2.



PTO Control Valve Retainers

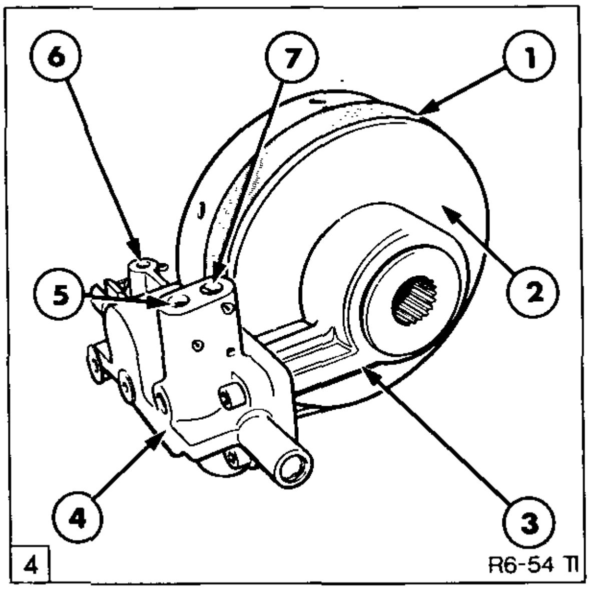
1. Oil Cooler Tube Banjo Bolt
2. Rear Locating Pin and Locknut
3. Front Locating Pin

3. Remove cooler tube banjo bolt and both locating pins, Figure 3.

4. Remove plastic transfer tube from oil cooler feed port.

5. Release intake tube retaining clip, Figure 1.

6. Slide PTO clutch assembly rearwards and disengage linkage to control valve spool.



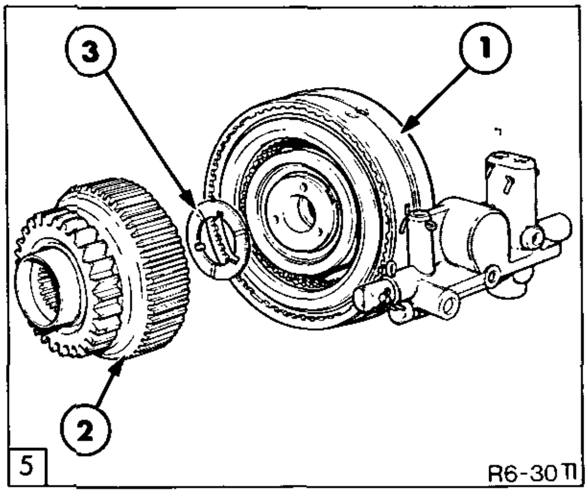
4

PTO Clutch and Valve Assembly

1. Brake Band
2. PTO Clutch Housing
3. Clutch Support
4. Valve Assembly
5. Pressure Regulating Valve
6. Control Valve Spool Detent
7. Cooler/Lubrication Circuit Relief Valve

7. Remove clutch and control valve assembly, Figure 4.

Disassembly



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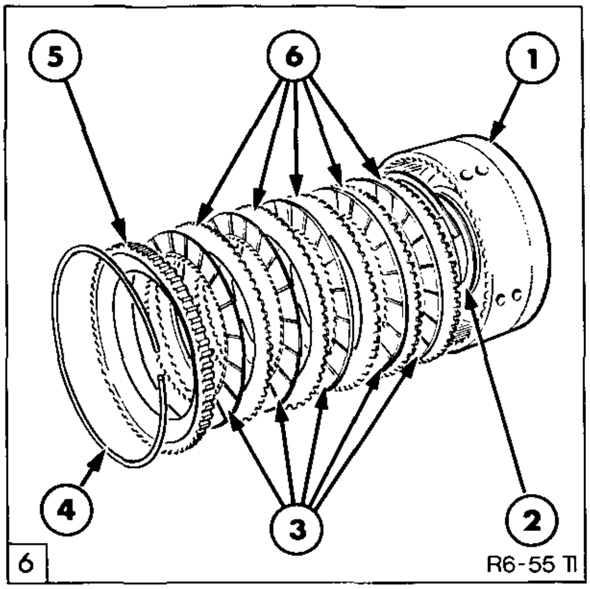
PTO Hub and Clutch Assembly

1. Clutch
2. Hub
3. Thrust Washer

1. Remove hub and thrust washer, Figure 5.

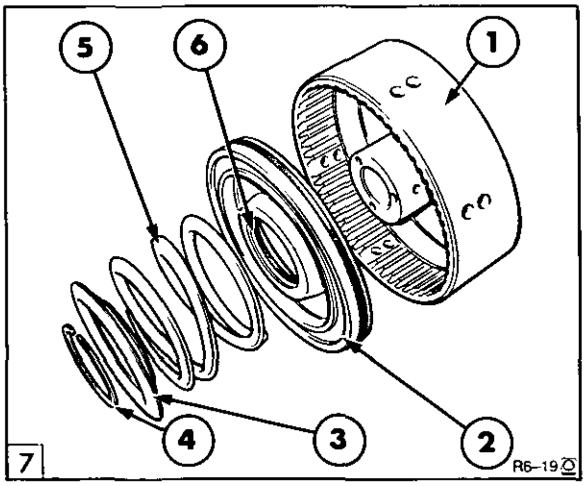


6

Clutch Housing and Drive Plates

1. Clutch Housing
2. Feathering Spring
3. Internally Splined Friction Plates (5 off)
4. Snap Ring
5. Pressure Plate
6. Externally Splined Steel Plates (5 off)

2. Slide clutch from clutch support. Remove snap ring and disassemble clutch pack, Figure 6.



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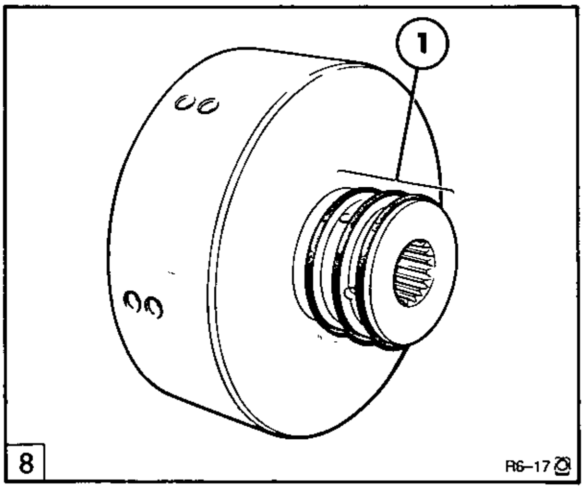
Clutch and Valve Assembly

1. Clutch Housing
2. Piston
3. Spring Keeper
4. Snap Ring
5. Return Spring
6. Piston Seals

3. Using spring compressor FT 4101 or FNH 01312 and suitable press, remove piston and return spring, Figure 7.



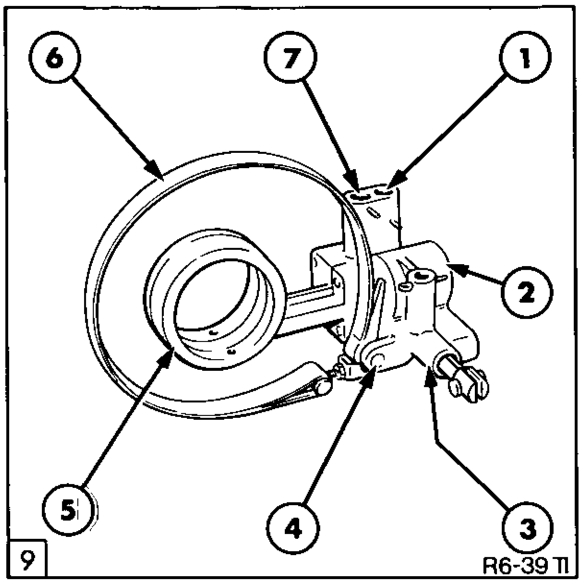
Clutch Assembly Sealing Rings

1. Cast Iron Sealing Rings (3 off)

4. Examine the cast iron sealing rings on the clutch housing, Figure 14. Replace if worn or damaged.

5. Disassemble clutch brake band assembly, Figure 9.

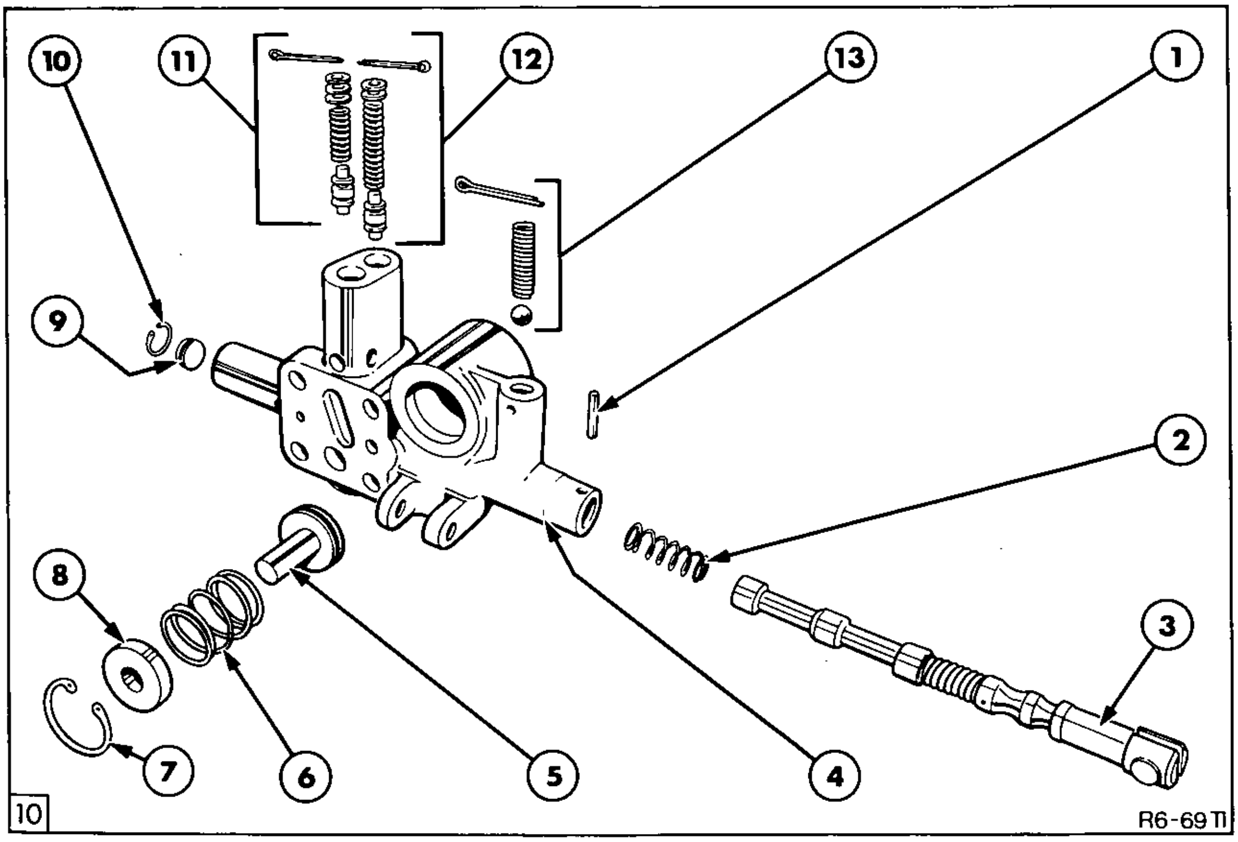
6. Separate clutch support from valve body.



PTO Control Valve and Brake Band

1. Pressure Regulating Valve
2. Brake Cylinder
3. Valve Body
4. Brake Band Securing Pin
5. Clutch Support
6. Brake Band
7. Cooler/Lubrication Circuit Relief Valve

7. With reference to Figure 10, disassemble clutch control valve components.



PTO Clutch Control Valve and Brake Components

1. Split Pin
2. Spring
3. Control Valve Spool
4. Control Valve Body
5. Brake/Piston
6. Return Spring
7. Snap Ring
8. Guide
9. Plug (chamfer facing spring)
10. Snap Ring
11. Cooler/Lubrication Circuit Relief Valve
12. Pressure Regulating Valve
13. Detent Ball and Spring

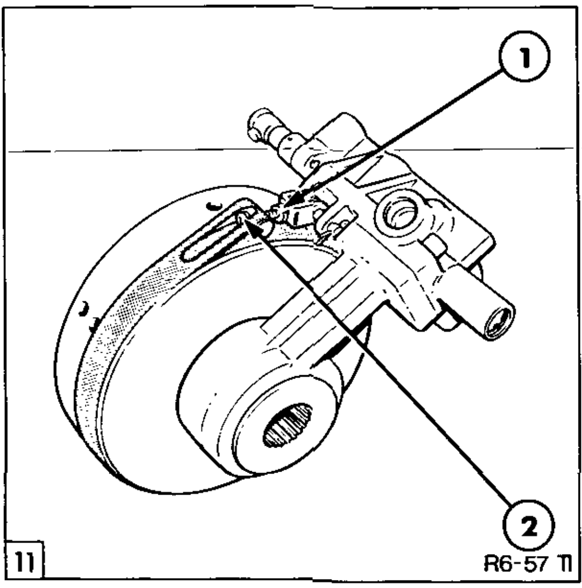
INSPECTION AND REPAIR

1. Inspect all components for wear or damage and replace as necessary.
2. Replace all 'O' ring seals.

RE–ASSEMBLY

Re–assembly follows the disassembly procedure in reverse.

1. Install pressure regulating valve with the 'V' groove land positioned **'away'** from the valve spring.
2. If PTO brake band requires replacement soak the band in rear axle oil for at least 3 minutes before installation.



Brake Adjuster

1. Locknut
2. Adjuster

3. Adjust brake band as follows:–

   Slacken locknut.

   Screw in adjuster, Figure 11, to tighten brake band, until screw torque is 9–11 lbf in (1–1.2 Nm).

   Loosen adjuster screw by 2½ turns and tighten locknut.

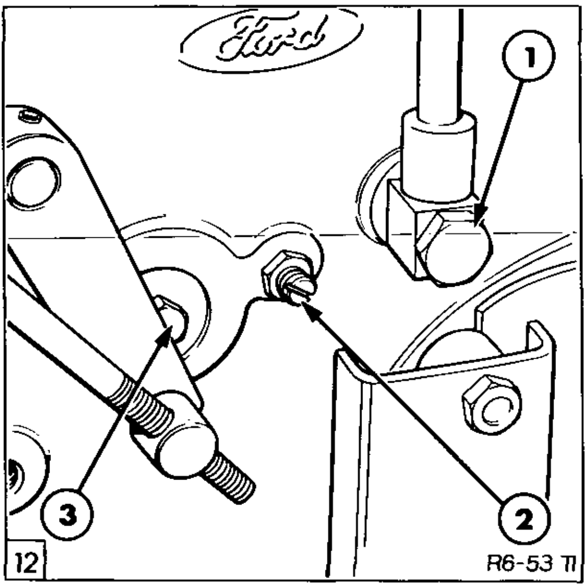
To check brake band concentricity after adjustment, hold PTO clutch and brake assembly as shown in Figure 11.

Position control valve housing at 3'o–clock. The control valve housing should fall to 6'o–clock position under its own weight.

Lightly bend band to shape if required and repeat adjustment procedure.

INSTALLATION

Installation follows removal procedure in reverse. During installation tighten locating pins as follows:–



PTO Control Valve Retainers

1. Oil Cooler Tube Banjo Bolt
2. Rear Locating Pin and Locknut
3. Front Locating Pin

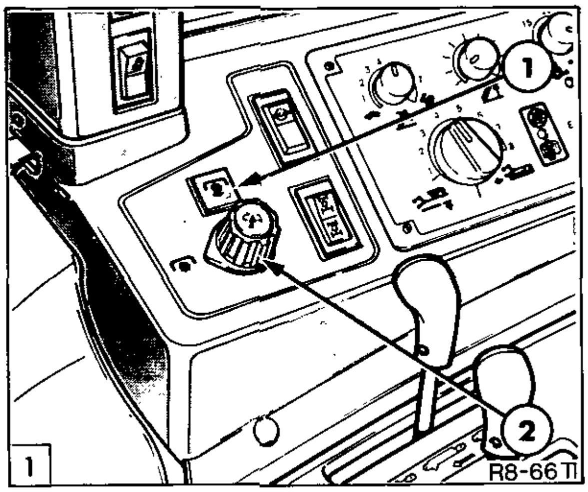
1. Install front pin and tighten to 20–26 lbf ft (27–35 Nm).

   Install rear pin and tighten to 9 lbf in (1 Nm).

   Loosen rear pin by ¼ turn and tighten locknut to 15–20 lbf ft (21–27 Nm).

   Check clutch is free to rotate.

D. SOLENOID OPERATED PTO CLUTCH AND CONTROL VALVE– DESCRIPTION AND OPERATION

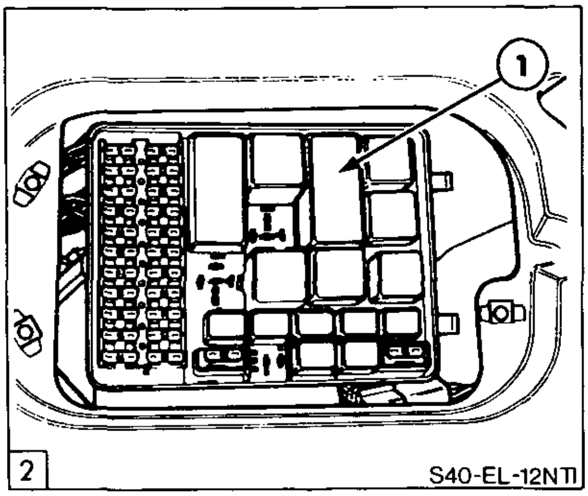


PTO Selector

1. PTO Warning Light
2. PTO Selector Knob

Tractors installed with a solenoid operated PTO clutch can be identified by the unique PTO selector knob, Figure 1. The PTO clutch is engaged by depressing and turning the knob fully clockwise.

To allow the PTO to function, the control module located in the fuse box, Figure 2, **must** receive a signal from the alternator. The module also includes an inbuilt safety feature preventing the PTO from being engaged inadvertently.



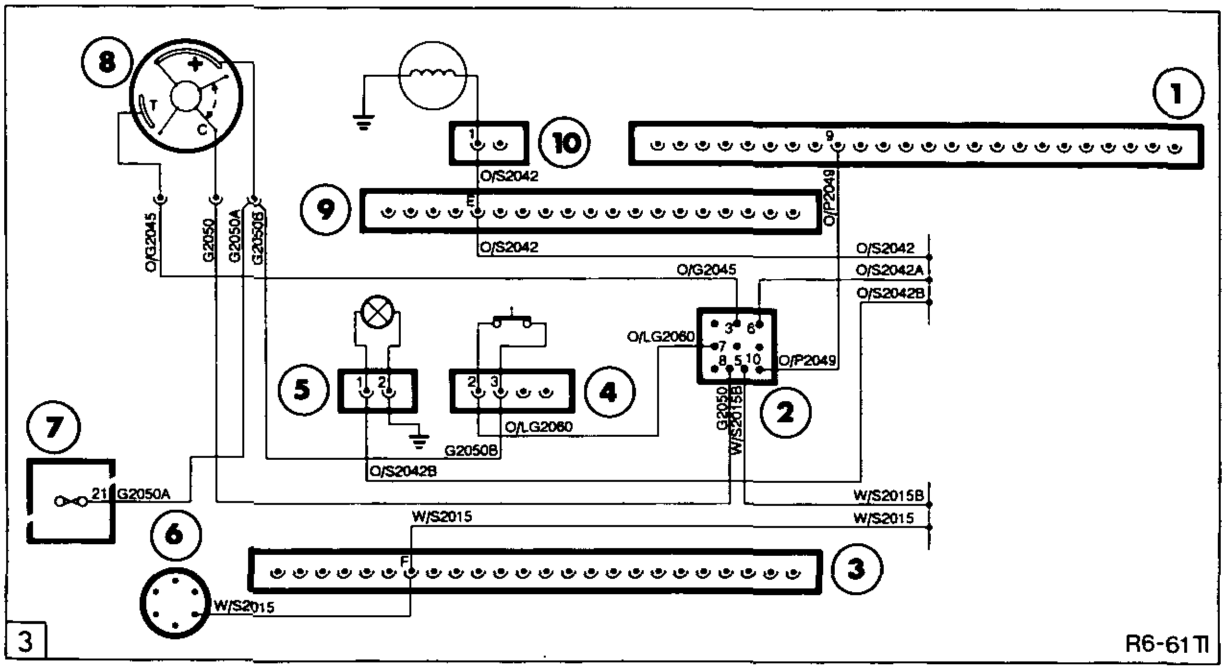
Fuse Box

1. PTO Control Module (blue)

When the engine is running a signal from the alternator 'powers up' pin 5 of the control module. Refer to Figure 3.

Initially when the selector knob is rotated to engage the PTO, the '+' terminal is connected to terminal 'T' and 12 Volts is supplied to Pin 3 in the module.

As the switch is fully rotated to the 'ON' position, terminal '+' and terminal 'C' are connected and 12 volts is supplied to pin 8 on the module.



PTO Control Valve Solenoid Operating Circuit

1. Instrument Connector J2
2. PTO Control Module
3. Main Harness Connector E1
4. 540/1000 Speed Selector Switch
5. PTO Warning Light
6. Alternator
7. 5 Amp Fuse No 21
8. PTO Switch
9. Extension Harness Connector C1
10. PTO Solenoid and Connector

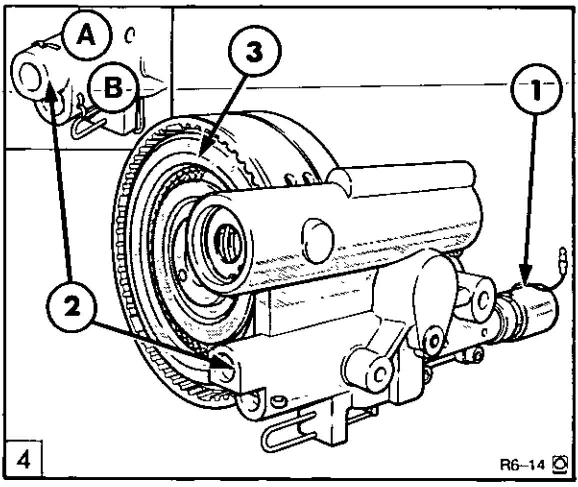
When both Pin 8 and Pin 5 are receiving a signal, Pin 3 and Pin 6 become internally connected. 12 volts is now supplied from terminal 'T' through Pin 3 and Pin 6 to energise the solenoid and commence hydraulic engagement of the clutch.

When the engine is stopped the signal from the alternator is no longer generated and the PTO is disengaged.

When the engine is re–started, to engage the PTO the selector knob must be re–set and then rotated clockwise to energise the module.

Hydraulic Operation of Solenoid Operated PTO Control Valves

The type of PTO hydraulic control valve installed on tractors is dependent on the hydraulic pump used on the tractor.



PTO Clutch and Valve Assembly

1. Solenoid
2. Valve Body
3. Clutch Pack

A* Lubrication Circuit Relief Valve
B* Low Pressure Regulating Valve
* Fitted on Tractors with Fixed Displacement Gear Type Pump Only

Tractors installed with a fixed displacement gear type pump, use low pressure and lubrication circuit regulating valves within the PTO control valve housing to limit oil pressure within these circuits, Figure 4.

Tractors fitted with the variable displacement CCLS hydraulic pump do not require these valves because circuit pressures are regulated by the pressure regulating valve within the CCLS pump and lubrication circuit relief valve within the 16 x 16 transmission control valve cover. Refer to Part 8, Chapter 1 for further details.

The lubrication circuit relief valve is not required on tractors installed with the variable displacement CCLS hydraulic pump and 12 x 12 transmission.

Never install the incorrect type of PTO valve into a tractor. The PTO valve assembly installed on tractors with fixed displacement gear type pump can be easily recognised by the presence of 'split pins' at 'A' and 'B', Figure 4.

Tractors with Fixed Displacement Gear Type Pump

With reference to Figure 5 and Figure 6.

When the engine is running oil flows from the hydraulic pump assembly to the inlet port of the PTO valve body.

Oil entering the PTO valve is regulated to a pressure of 230 lbf/in^2 (15.8 bar) by the low pressure regulating valve. Oil flowing through this valve is then further reduced in pressure by the lubrication circuit relief valve which limits the maximum pressure of oil in the lubrication circuit to 73–123 lbf/in^2 (5.3–8.5 bar) depending on engine speed. Oil in this circuit provides lubrication to the PTO clutch, transmission synchroniser, bearing and output shaft.

When the PTO is not in operation low pressure circuit oil is directed to the right hand end of the control valve, moving the spool to the left, opening the clutch pressure gallery to reservoir.

Because the spool has moved to the left, oil flows through a drilling down the centre of the spool and onto the brake piston. As the piston protrudes the brake band tightens, preventing rotation of the output shaft while the PTO is disengaged and the engine is running.

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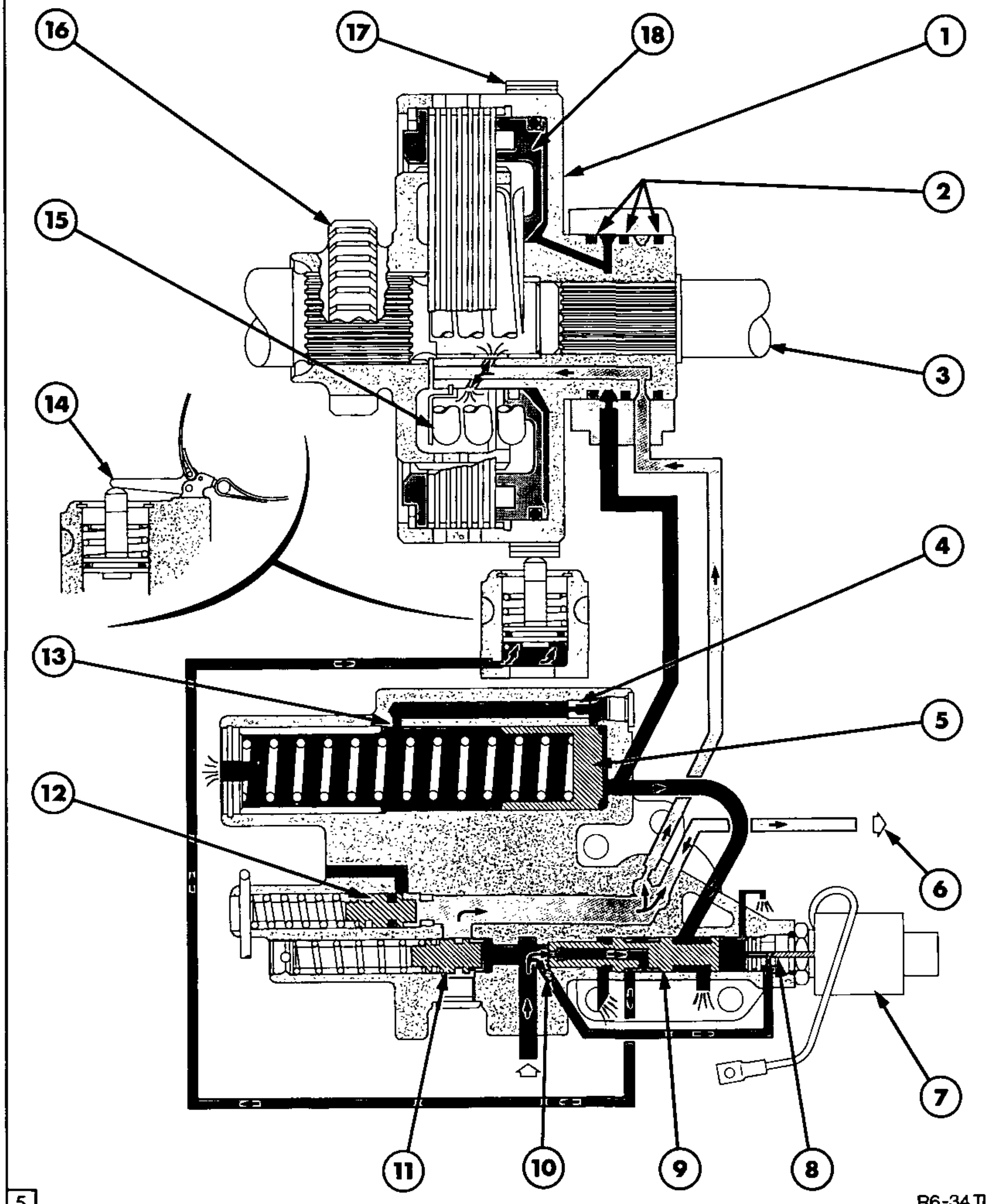


PTO Oil Flow – Clutch Disengaged
Tractors with Fixed Displacement Gear Type Hydraulic Pump and Solenoid Operated PTO Control Valve

■ Low Pressure Circuit Oil ▒ Lubrication Circuit Oil ■ Return to Reservoir Oil

1. Clutch Housing
2. Sealing Rings
3. Rear Shaft
4. Orifice
5. Feathering Valve
6. To Lubrication Circuit and Oil Cooler
7. Solenoid
8. Solenoid Plunger
9. Control Valve Spool
10. Screen
11. Pressure Regulating Valve
12. Lubrication Circuit Relief Valve
13. Bleed Port
14. Brake Piston
15. Clutch Piston Return Spring
16. Clutch Hub
17. Brake Band
18. Clutch Piston

When the PTO is switched to the engaged condition the solenoid on the end of the valve is energised causing a plunger to move forward blocking the flow of oil to the right hand end of the valve spool, Figure 6.

Because the bleed gallery at the right hand end of the valve is continually open to reservoir, oil pressure applied to the left hand end of the valve causes the spool to move to the right, releasing the pressure applied to the brake piston.

Oil flowing through the centre of the spool is now directed to the feathering valve and PTO clutch plates.

The pressure applied to the feathering valve gradually moves the feathering valve to the left, controlling the increase and gradual application of pressure to the clutch, Figure 6.

After approximately one second the feathering valve has moved to the full extent of travel, blocking any oil from returning to reservoir through the bleed port. The pressure of oil applied to the clutch will now have increased to 220–240 lbf/in^2 (15.2–16.6 bar) and the PTO clutch will be fully engaged.

Switching the PTO off, opens the solenoid allowing pressure to be applied to the right hand side of the control valve spool. The spool now moves to the left, allowing pressure applied to the clutch to return to reservoir while oil pressure applied to the brake piston stops the output shaft from revolving. Refer to Figure 5.

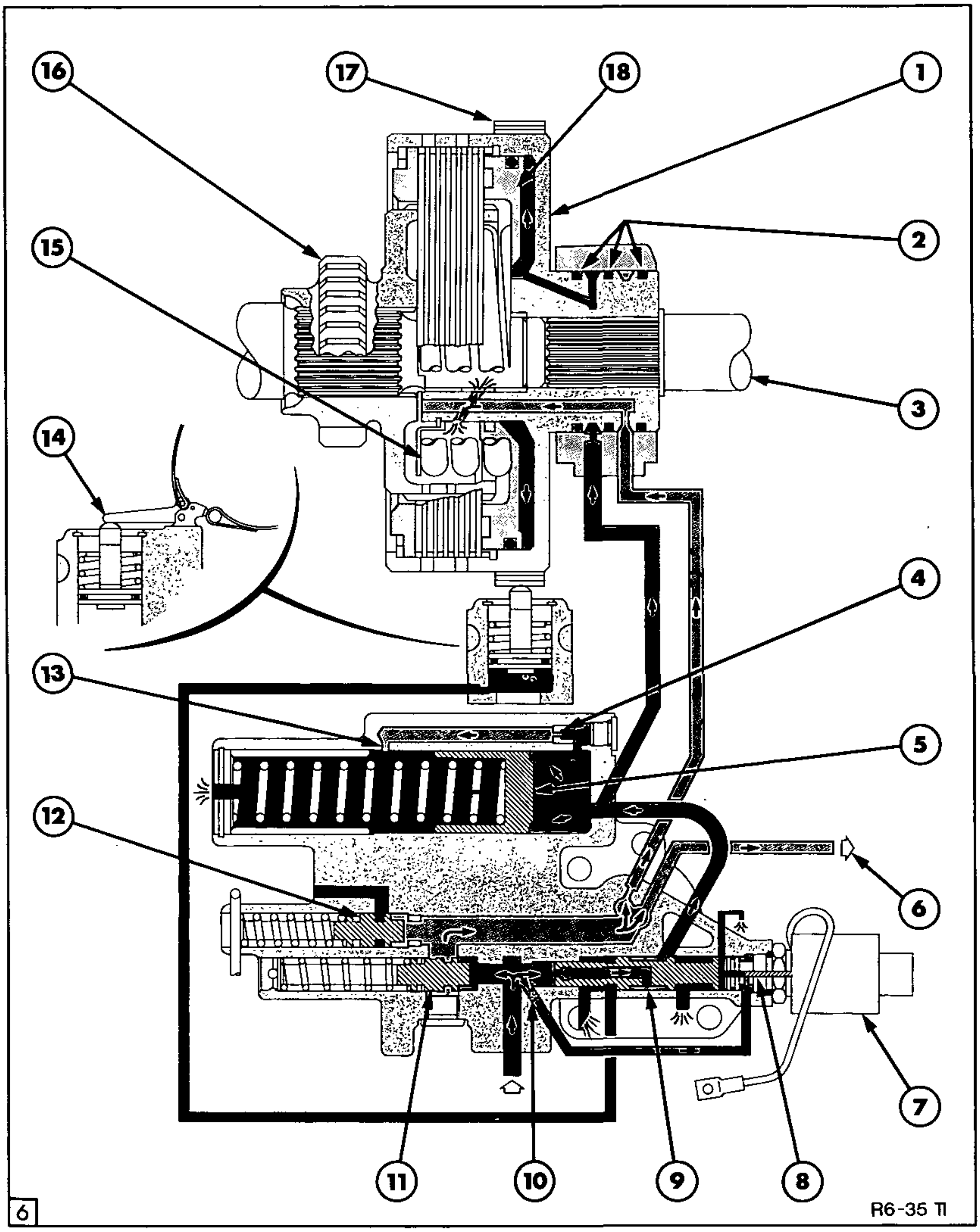
Hydraulic Operation of PTO Control Valve *for Tractors with Variable Displacement* CCLS Hydraulic Pump

On tractors installed with the variable displacement CCLS hydraulic pump their are no low pressure regulating and lubrication circuit relief valves in the PTO valve housing, Figure 7.

Low pressure circuit oil for operation of the PTO clutch is regulated by the low pressure regulating valve located on top of the pump. Oil for lubricating the PTO clutch plates, unlike the oil supply for tractors installed with the tandem gear pump, flows from the 16 x 16 transmission and is regulated by the lubrication circuit relief valve located in the transmission. Refer to Part 8, Chapters 1 and 2.

Where the tractor is installed with the variable displacement CCLS hydrauclic pump and 12 x 12 transmission, there is no lubrication circuit relief valve. The lubricating oil on this model flows directly from the cooler bypass valve to both the PTO clutch plates and transmission. synchronisers, bearings and output shaft.

Basic operation of the PTO control valve, clutch and brake is however identical to that described for the solenoid operated PTO valve used on tractors with the fixed displacement hydraulic pump.



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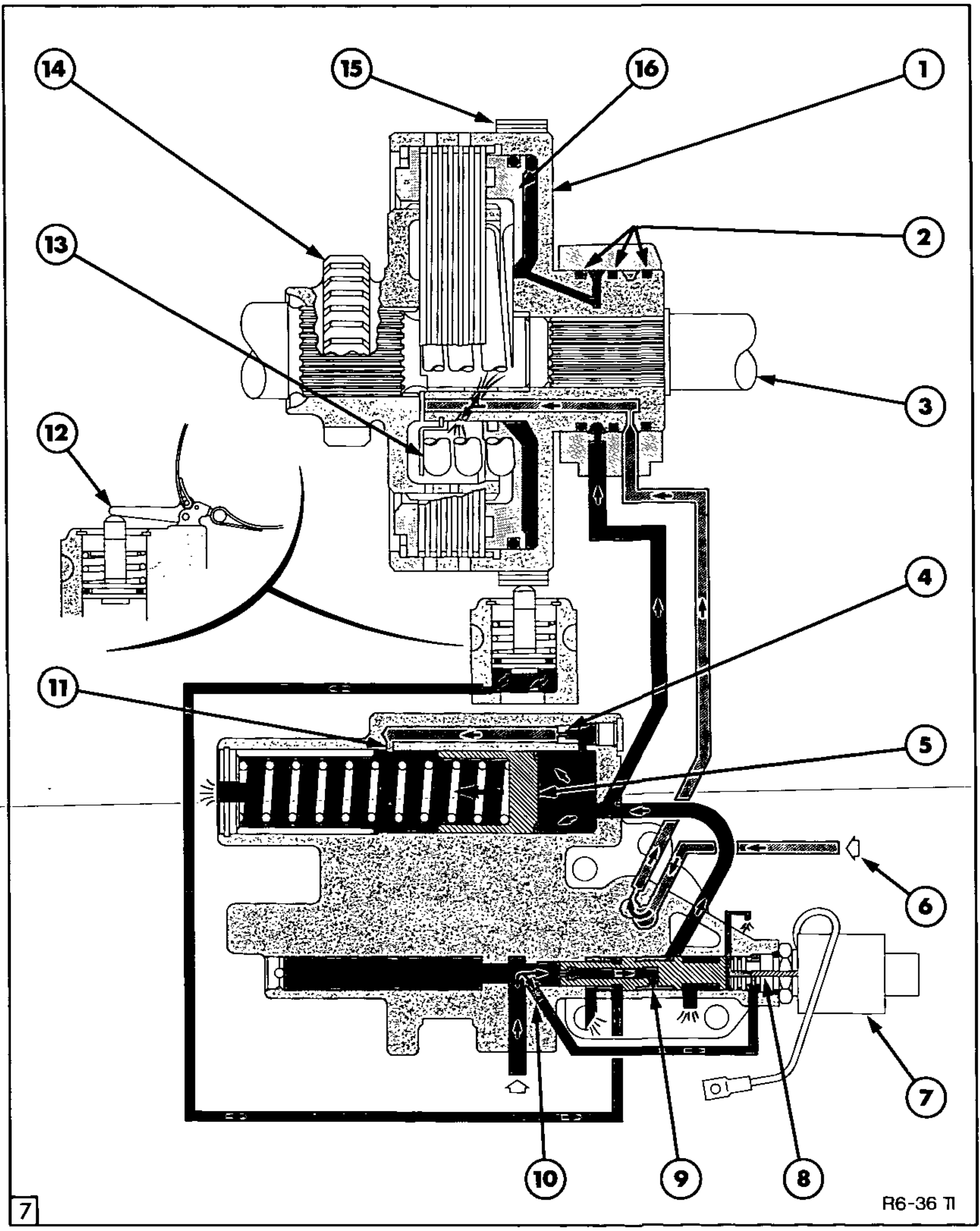
PTO Oil Flow – Clutch Engaging
Tractors with Fixed Displacement Gear Type Hydraulic Pump and Solenoid Operated PTO Control Valve

■ Low Pressure Circuit Oil ▨ Lubrication Circuit Oil ■ Return to Reservoir Oil

1. Clutch Housing
2. Sealing Rings
3. Rear Shaft
4. Orifice
5. Feathering Valve
6. To Lubrication Circuit and Oil Cooler
7. Solenoid
8. Solenoid Plunger
9. Control Valve Spool
10. Screen
11. Pressure Regulating Valve
12. Lubrication Circuit Relief Valve
13. Bleed Port
14. Brake Piston
15. Clutch Piston Return Spring
16. Clutch Hub
17. Brake Band
18. Clutch Piston

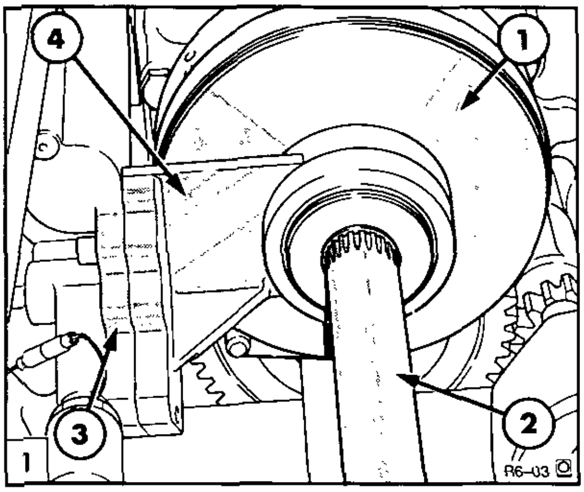


PTO Oil Flow – Clutch Engaging
Tractors with Variable Displacement CCLS Hydraulic Pump

■	Low Pressure Circuit Oil
▨	Lubrication Circuit Oil
■	Return to Reservoir Oil

1. Clutch Housing
2. Sealing Rings
3. Rear Shaft
4. Orifice
5. Feathering Valve
6. Lubrication Circuit Oil
7. Solenoid
8. Solenoid Plunger
9. Control Valve Spool
10. Screen
11. Bleed Port
12. Brake Piston
13. Clutch Piston Return Spring
14. Clutch Hub
15. Brake Band
16. Clutch Piston

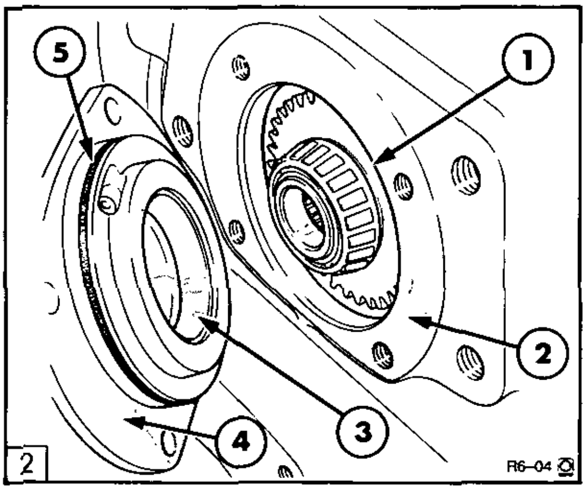
E. SOLENOID OPERATED PTO CLUTCH AND CONTROL VALVE–OVERHAUL



PTO Clutch and Valve Installation

1. PTO Clutch Assembly
2. Rear Shaft
3. Valve Body
4. Clutch Support

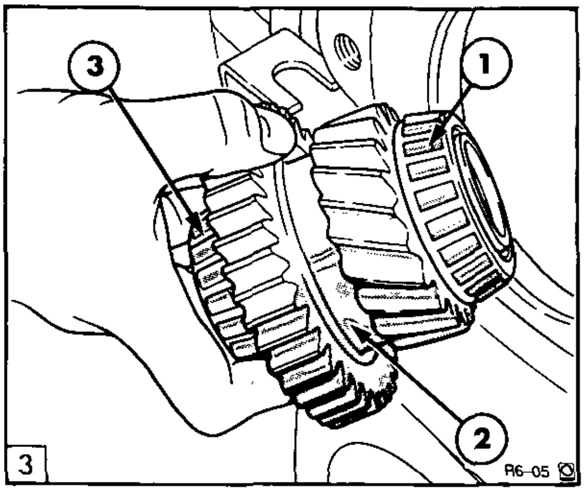
1. Remove hydraulic top cover to expose PTO clutch and valve assembly, Figure 1.



PTO Rear Shaft Bearing Retainer

1. Cluster Gear
2. Rear Axle Casing
3. Bearing Cup
4. Retainer
5. Seal

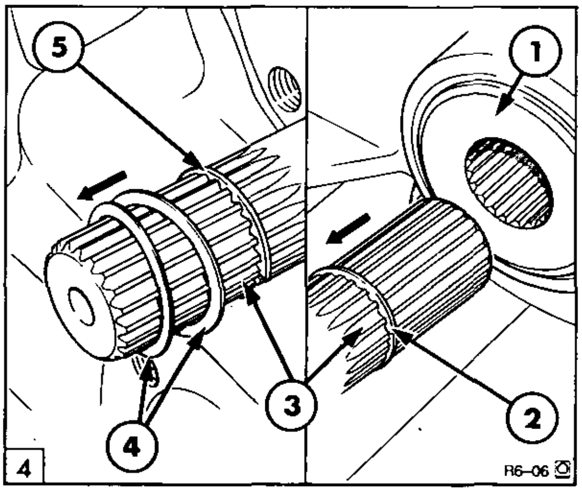
2. Remove rear shaft bearing retainer, Figure 2.



Cluster Gear Removal

1. Taper Roller Bearing
2. Cluster Gear
3. Taper Roller Bearing

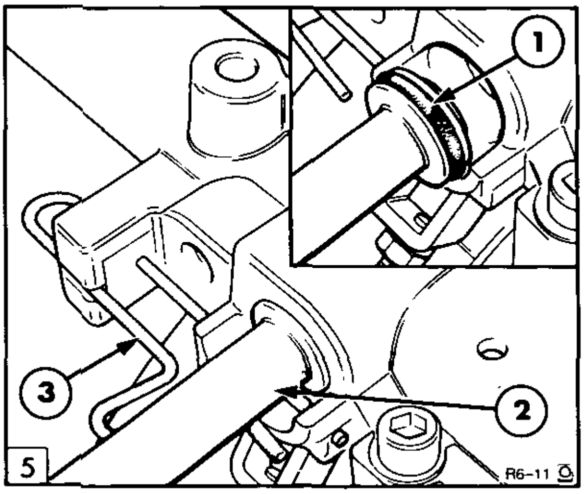
3. Withdraw cluster gear, Figure 3.



PTO Rear Shaft Removal

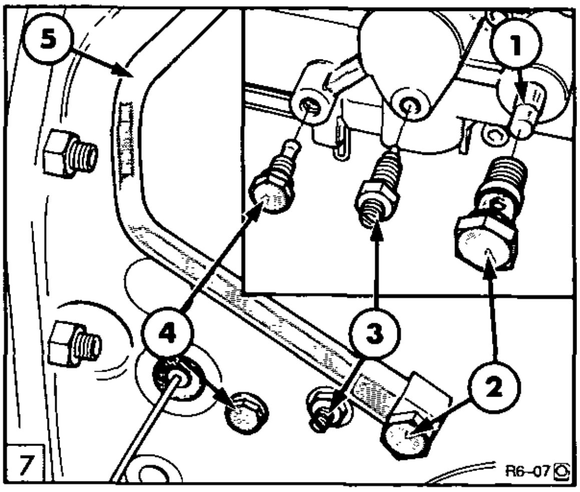
1. PTO Clutch Housing
2. Snap Ring
3. Rear Shaft
4. Shims
5. Snap Ring

4. Remove shims from rear shaft and pull shaft from tractor, Figure 4.



PTO Clutch Oil Supply Pipe

1. 'O' Ring Seal
2. Supply Pipe
3. Retaining Clip

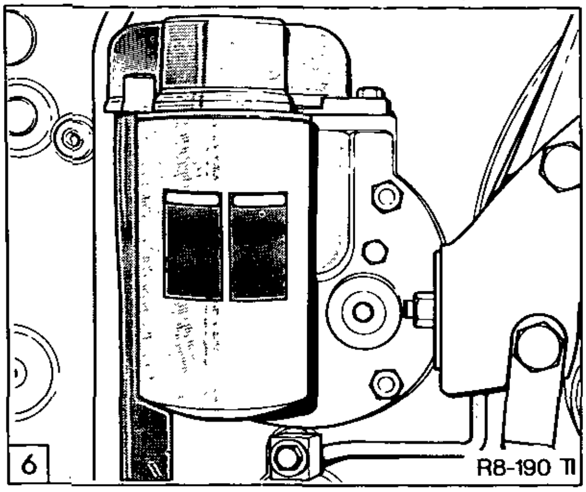


PTO Control Valve Retainers

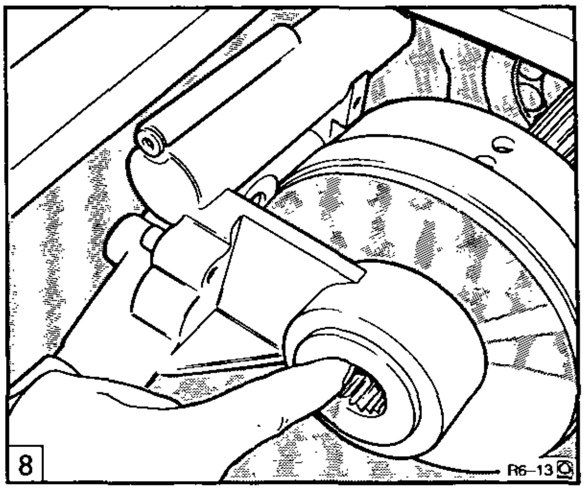
1. Plastic Transfer Tube
2. Banjo Bolt
3. Rear Retainer/Adjusting Pin
4. Front Retaining Pin
5. Lubricating Oil Pipe

5. Pull hydraulic supply pipe retaining clip, located on bottom of PTO valve and disconnect pipe, Figure 5.

7. Remove PTO retainers and banjo bolt on outside of transmission casing, Figure 7.



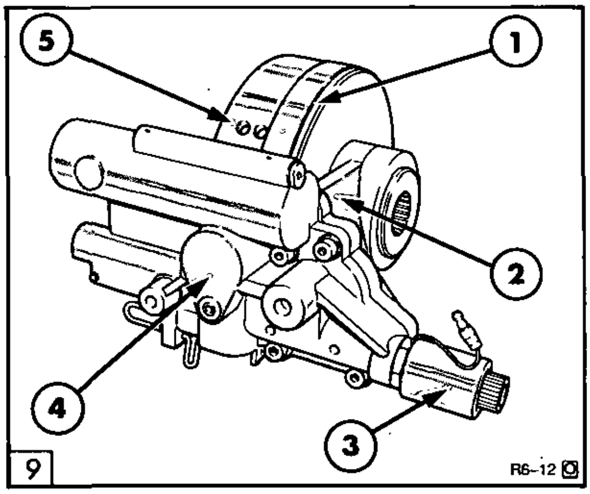
Auxiliary Engine Mounted Pump Filter



Supporting PTO Assembly for Removal of Retaining Pins

6. Where fitted, remove engine mounted gear pump filter assembly on left hand side of rear axle centre housing, Figure 6.

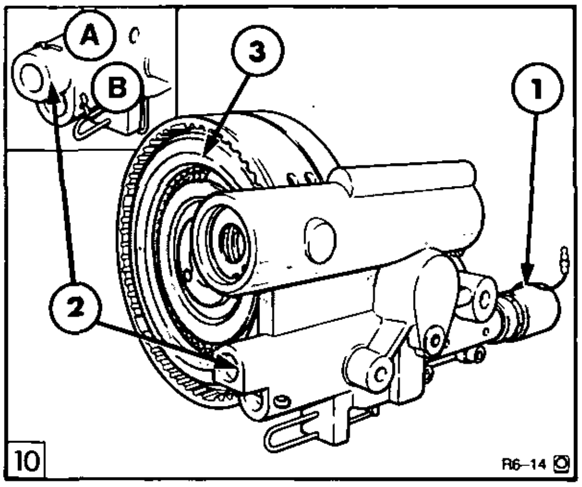
NOTE: *Support clutch with hand when removing retainers, Figure 8.*



PTO Clutch and Valve Assembly

1. Brake Band
2. Clutch Support
3. Solenoid
4. Valve Body
5. Clutch Housing

8. Remove PTO clutch, valve and hub assembly, Figure 9.



PTO Clutch and Valve Assembly

1. Solenoid
2. Valve Body
3. Clutch Pack

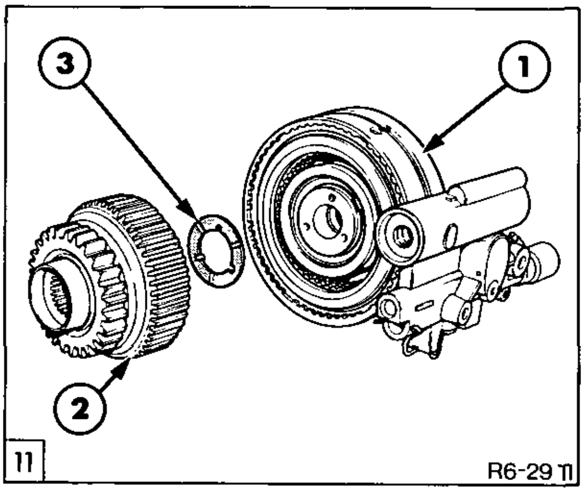
A* Lubrication Circuit Relief Valve
B* Low Pressure Regulating Valve
* Tractors Installed with Fixed Displacement Gear Type Pump Only

9. Identify type of PTO clutch and valve assembly installed, Figure 10.

NOTE: *Tractors installed with the CCLS hydraulic pump are not fitted with the low pressure regulating and lubrication circuit relief valve in bores 'A' and 'B'.*

The bore for valve 'A' is empty and bore 'B' contains a plug retained with one single split pin.

***Do Not** install the incorrect type of PTO valve assembly into a tractor.*



PTO Clutch and Valve Assembly

1. Clutch
2. Hub
3. Thrust Washer

10. Remove hub and retrieve thrust washer, Figure 11.

11. Slide clutch from clutch support.

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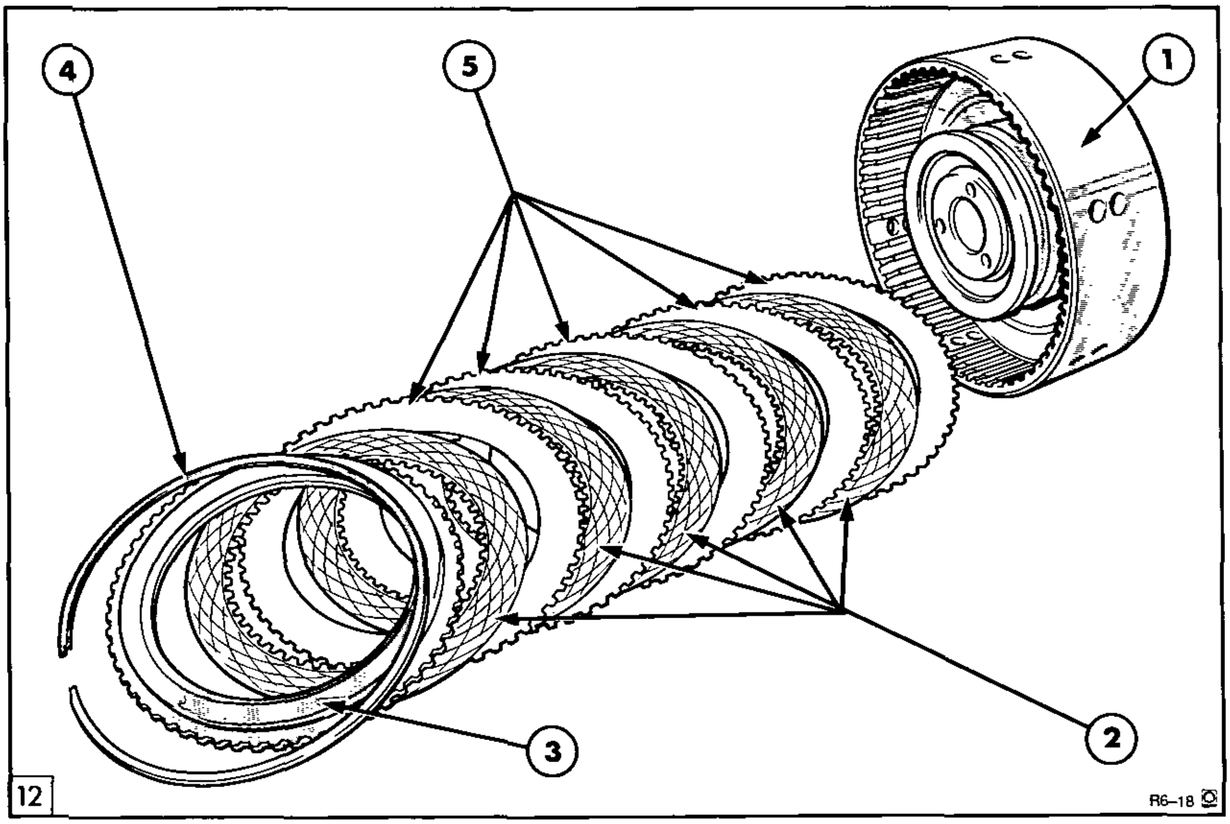
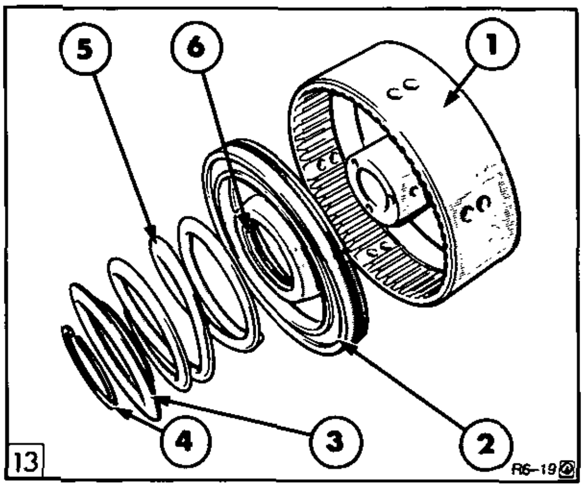


Clutch Housing and Drive Plates

1. Clutch Housing
2. Internally Splined Friction Plates (5 off)
3. Pressure Plate
4. Snap Ring
5. Externally Splined Steel Plates (5 off)

12. Remove snap ring and withdraw clutch drive plates, Figure 12.

13



Clutch and Valve Assembly

1. Clutch Housing
2. Piston
3. Spring Keeper
4. Snap Ring
5. Return Spring
6. Piston Inner Seal

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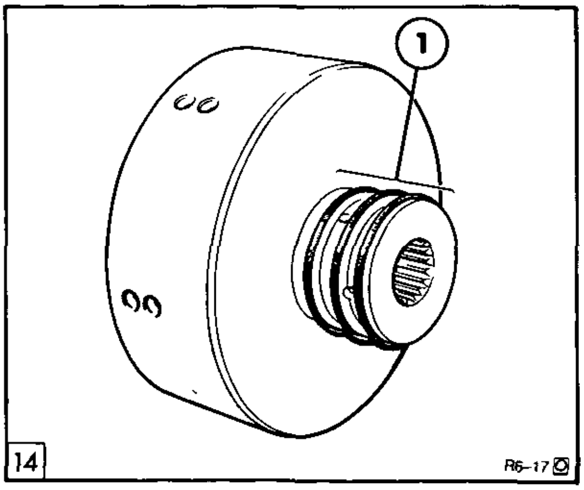
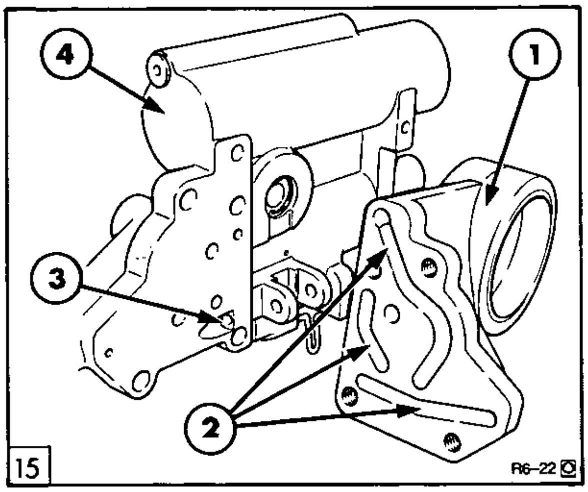


Clutch Assembly Sealing Rings

1. Cast Iron Sealing Rings (3 off)

13. Using spring compressor FT 4101 or FNH 01312 and suitable press, remove piston and return spring, Figure 13.

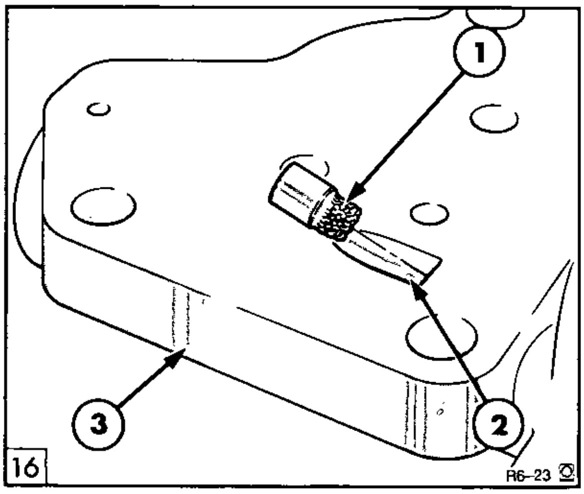
14. Examine the cast iron sealing rings on the clutch housing, Figure 14. Replace if worn or damaged.



Clutch Support and Valve Housing

1. Clutch Support
2. Oil Supply Galleries
3. Gauze Filter Location
4. Valve Body

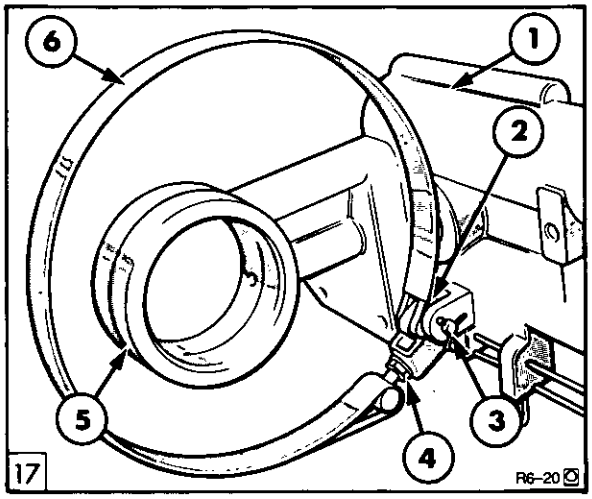
15. Separate clutch support from valve body, Figure 15.



Control Valve Pilot Line Filter

1. Screen Filter
2. Filter Seat
3. Valve Body

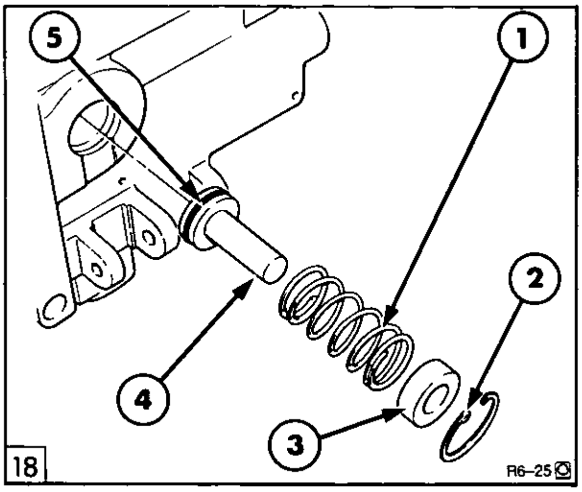
16. Remove and wash control valve pilot line fliter, Figure 16.



Clutch Brake Band

1. Valve Body
2. Brake Lever
3. Locating Pin
4. Adjuster
5. Clutch Support
6. Brake Band

17. Remove the clutch brake band, Figure 17.

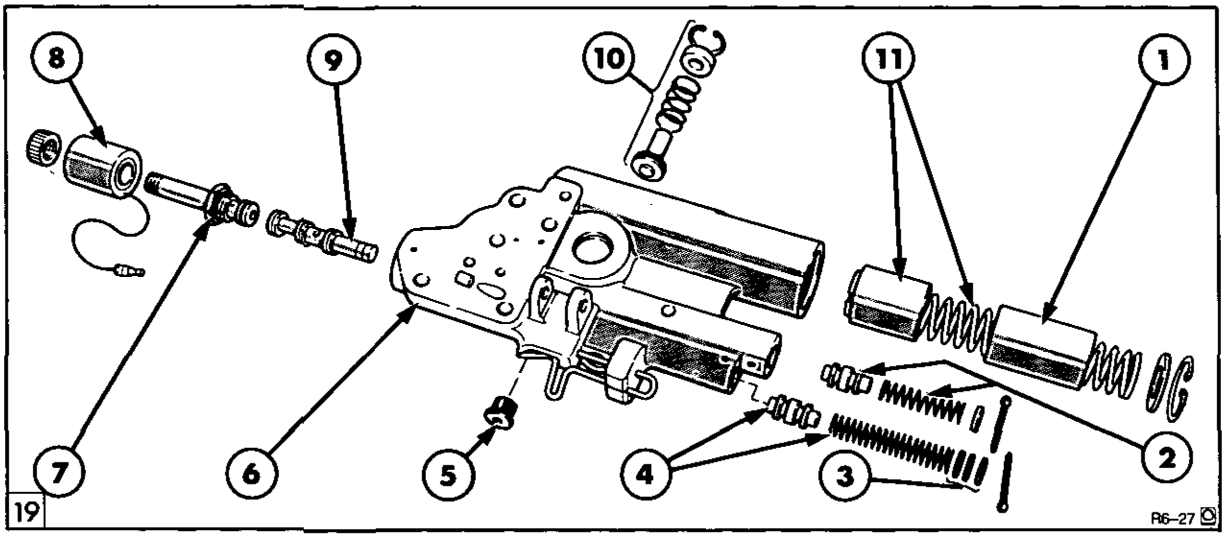


Clutch Brake Piston Components

1. Return Spring
2. Snap Ring
3. Spacer
4. Brake Piston
5. 'O' Ring Seal

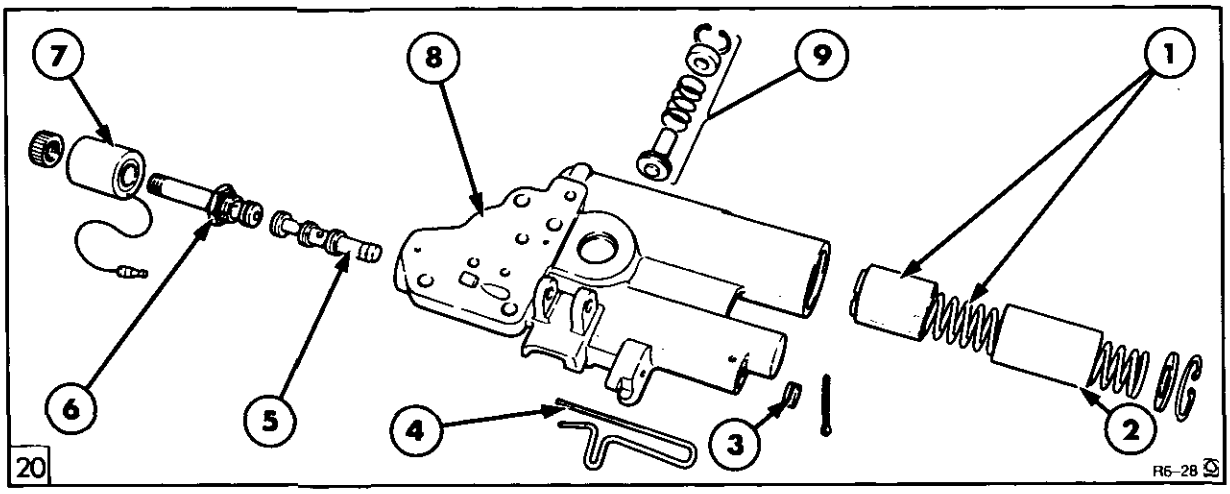
18. Remove brake piston components, Figure 18.

19. Disassemble PTO control valve assembly. See Figure 19 to Figure 23.



PTO Control Valve Assembly Tractors (with Fixed Displacement Gear Type Pump)

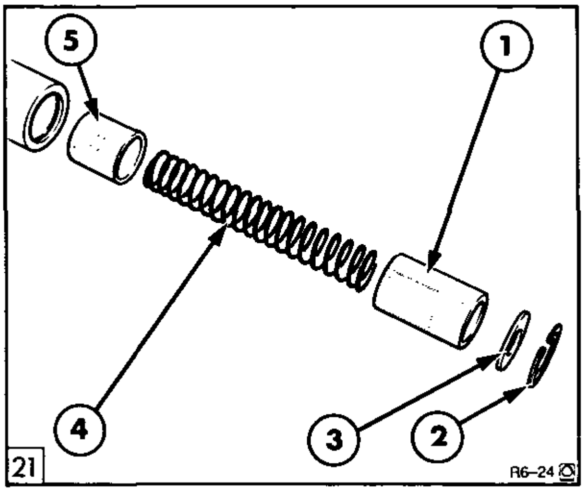
1. Sleeve
2. Lubrication Relief Valve and Spring
3. Shims
4. Regulating Valve and Spring
5. Plug
6. Valve Body
7. Solenoid Operated Pilot Valve
8. Solenoid Coil
9. Control Valve Spool
10. Brake Piston Assembly
11. Feathering Valve and Spring



PTO Control Valve Assembly (Tractors with Variable Displacement CCLS Hydraulic Pump)

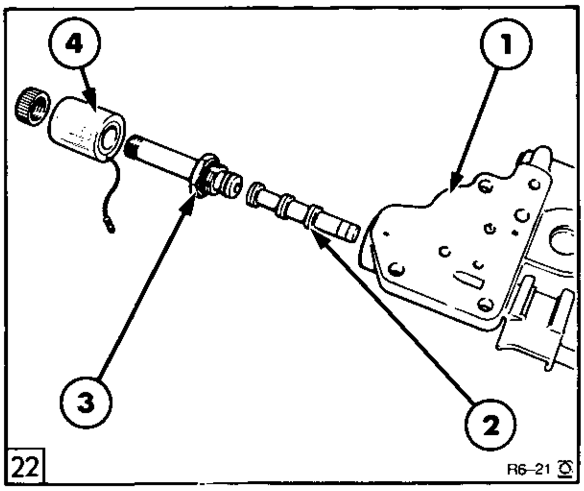
1. Feathering Valve and Spring
2. Sleeve
3. Plug
4. Oil Supply Pipe Retainer
5. Control Valve Spool
6. Solenoid Operated Pilot Valve
7. Solenoid Coil
8. Valve Body
9. Brake Piston Assembly

NOTE: *For location of feathering valve orifice refer to Figure 24.*



Feathering Valve

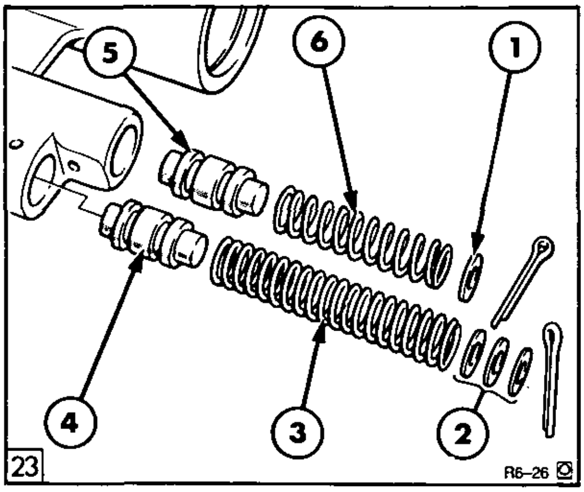
1. Sleeve
2. Circlip
3. Spacer
4. Feathering Spring
5. Feathering Piston



Control Valve and Solenoid Components

1. Valve Body
2. Control Valve
3. Pilot Valve
4. Solenoid Coil

NOTE: *The pressure regulating and lubrication circuit relief valves are only fitted on solenoid operated PTO valves installed on tractors with fixed displacement gear type hydraulic pump.*



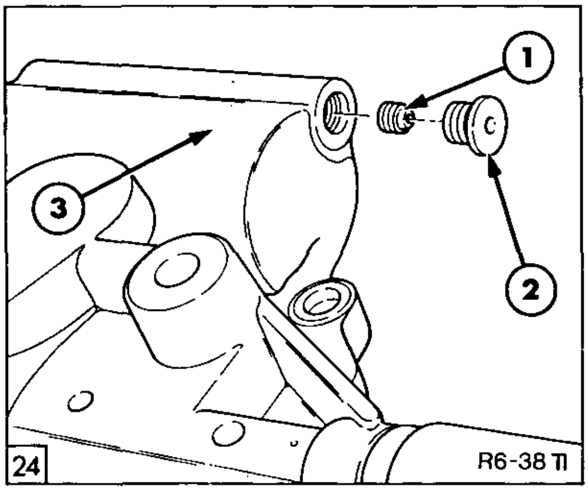
Pressure Regulating and Lubrication Circuit Relief Valves

1. Shim
2. Shims
3. Regulating Valve Spring
4. Regulating Valve
5. Lubrication Circuit Relief Valve
6. Lubrication Valve Spring

INSPECTION AND REPAIR

1. Inspect all components for wear and damage.

2. Replace all 'O' ring seals.



Feathering Valve Orifice

1. Orifice
2. Plug
3. Valve Body

3. Ensure the feathering valve orifice is free from obstruction, Figure 24.

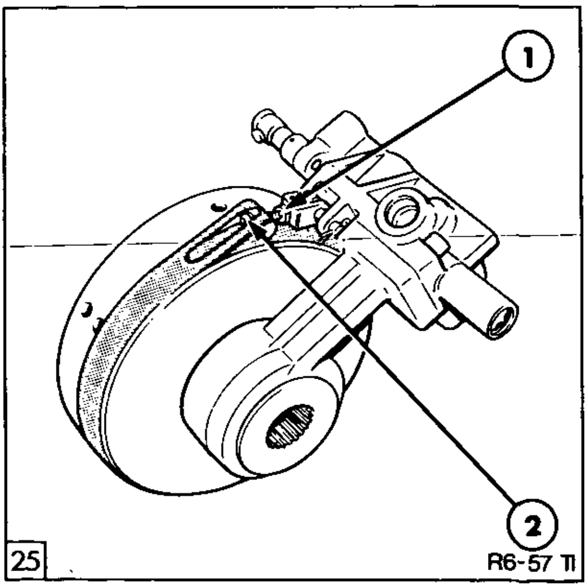
RE–ASSEMBLY

Re–assembly follows the disassembly procedure in reverse.

1. If PTO brake band requires replacement soak the band in rear axle oil for at least 3 minutes before installation.

2. Adjust brake band as follows:–

   Slacken locknut.



Brake Adjuster

1. Locknut
2. Adjuster

Screw in adjuster, refer to Figure 11, to tighten brake band until screw torque is 9–11 lbf in (1–1.2 Nm).

Loosen adjuster screw by 2½ turns and tighten locknut.

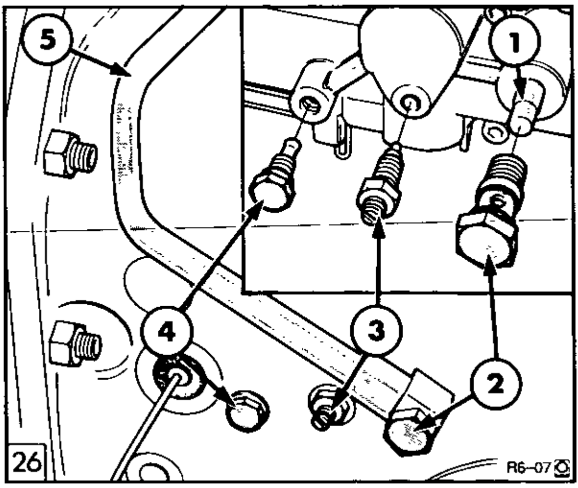
To check brake band concentricity after adjustment, hold PTO clutch and brake assembly as shown in Figure 11.

Position control valve housing at 3'o–clock. The control valve housing should fall to 6'o–clock position under its own weight.

Lightly hammer brake band to shape if required. Repeat adjustment and check procedure.

INSTALLATION

Installation follows removal procedure in reverse. During installation tighten locating pins as follows:–



PTO Control Valve Retainers

1. Plastic Transfer Tube
2. Banjo Bolt
3. Rear Retainer/Adjusting Pin
4. Front Retaining Pin
5. Lubricating Oil Pipe

1. Install front pin and tighten to 20–26 lbf ft (27–35 Nm).

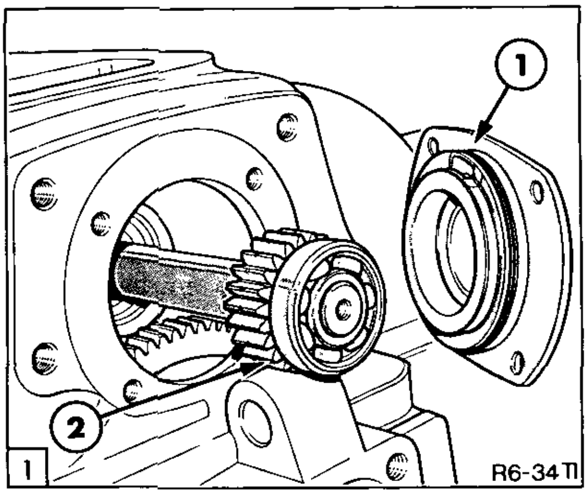
   Install rear pin and tighten to 9 lbf in (1 Nm). Check that clutch is stiff to rotate.

   Loosen rear pin by ¼ turn and tighten locknut to 15–20 lbf ft (21–27 Nm).

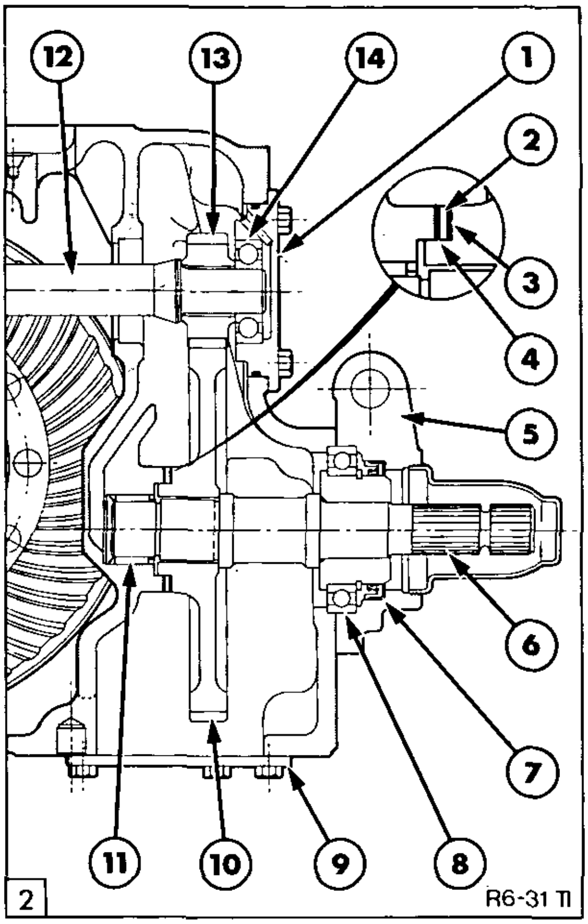
   Check clutch is free to rotate.

F. PTO SHAFTS AND GEARS–OVERHAUL

SINGLE SPEED PTO SHAFTS AND GEARS



PTO Rear Shaft and Bearing Retainer
1. Bearing Retainer
2. Rear Shaft, Gear and Bearing



Single Speed PTO Shaft Installation
1. Bearing Retainer
2. Thrust Bearing
3. Thrust Washer (thin)
4. Thrust Washer (thick)
5. PTO Bearing Retainer
6. PTO Output Shaft
7. Oil Seal
8. Bearing
9. Sump Cover
10. Driven Gear
11. PTO Shaft Front Bearing
12. Rear Shaft
13. Drive Gear
14. Bearing

REMOVAL

With reference to Figure 2.

1. Drain oil from rear axle/transmission.
2. Remove rear shaft assembly from rear of tractor, Figure 1.
3. Where fitted remove drawbar/auto pick up hitch, then remove sump cover.
4. Remove PTO bearing retainer.
5. Support the driven gear, withdraw PTO output shaft and remove gear, thrust washers and bearing.
6. Remove the front bearing, item 11 from the transmission housing.

INSPECTION

1. Inspect all components for damage and replace where necessary.
2. Replace all seals and gaskets.

RE–ASSEMBLY

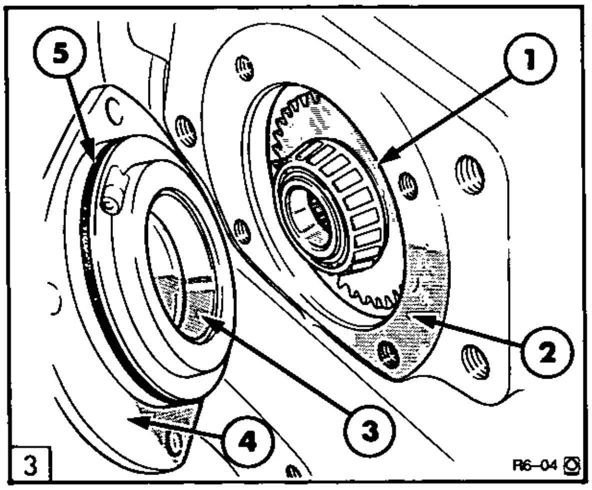
Re–assembly follows the disassembly procedure in reverse.

1. Apply sealant SP–M4G–9112 A or C to the rear shaft bearing retainer bolts and tighten to a torque of 50–60 lbf ft (65–85 Nm).
2. Tighten sump cover retaining bolts to a torque of 27–37 lbf ft (37–50 Nm)
3. Tighten the PTO shaft bearing retainer bolts to a torque of 140–170 lbf ft (190–230 Nm).

NON–SHIFTABLE TWO SPEED PTO SHAFTS AND GEARS

REMOVAL

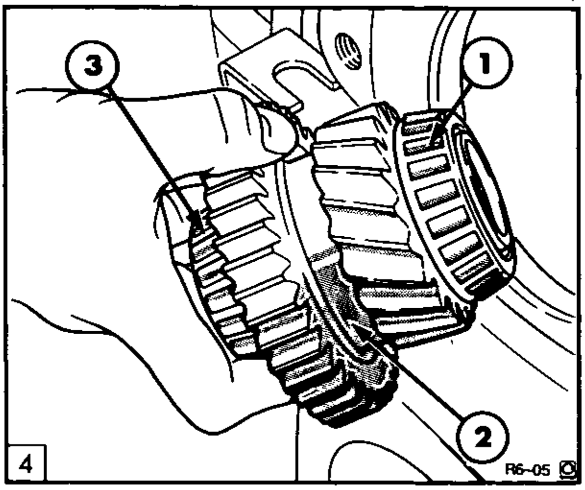
1. Drain oil from rear axle/transmission.



PTO Rear Shaft Bearing Retainer

1. Cluster Gear
2. Rear Axle Casing
3. Bearing Cup
4. Bearing Retainer
5. Seal

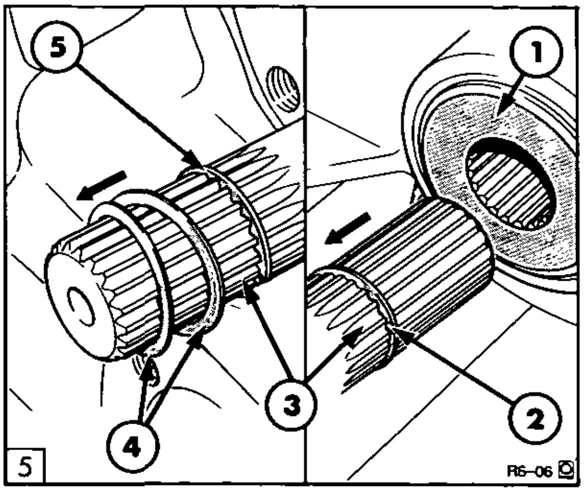
2. Remove rear shaft bearing retainer, Figure 3.



Cluster Gear Removal

1. Taper Roller Bearing
2. Cluster Gear
3. Taper Roller Bearing

3. Withdraw cluster gear, Figure 4.



PTO Rear Shaft Removal

1. PTO Clutch Hub
2. Snap Ring
3. Upper Shaft
4. Shims
5. Snap Ring

4. Remove shims from rear shaft and pull shaft from tractor, Figure 4.

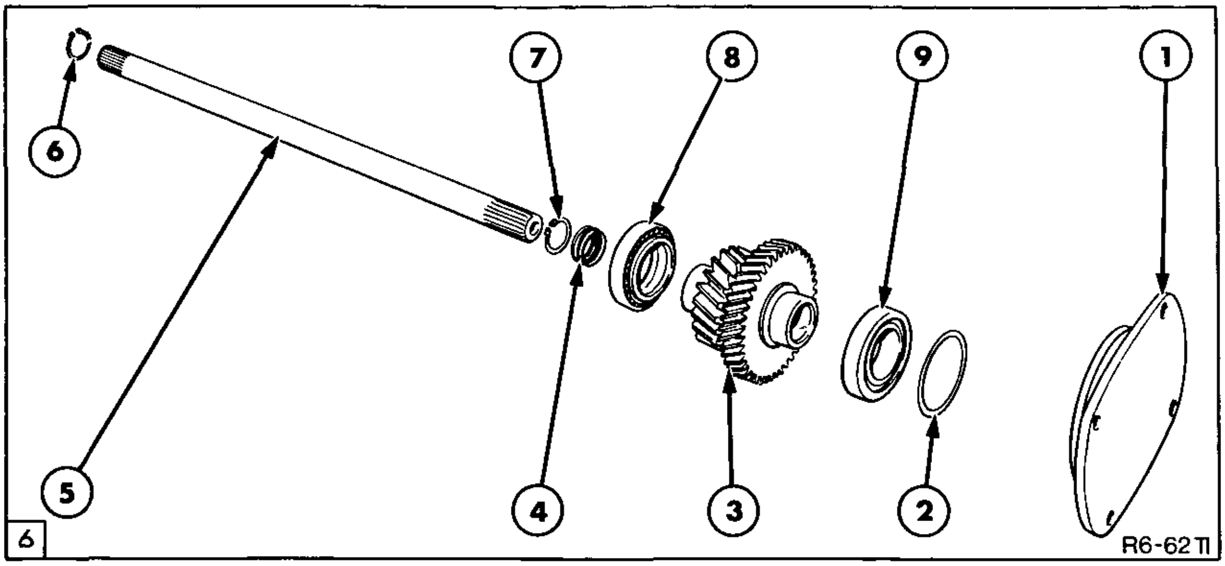
5. Where fitted remove drawbar/auto pick–up hitch.

6. Remove sump cover.

7. Remove PTO output shaft.

8. Support the driven gears and remove output shaft sleeve and bearing assembly. Refer to Figure 8. Remove driven gears and thrust washers.

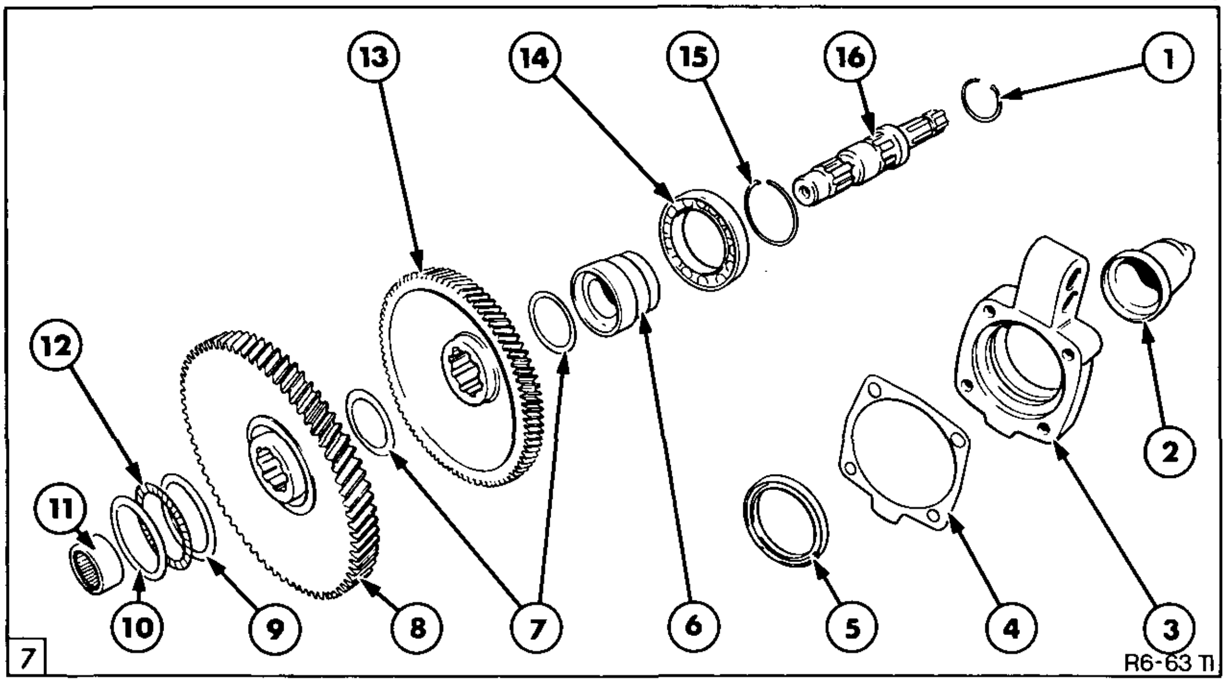
9. Remove output shaft front bearing.



6

Two Speed PTO Upper Shaft Components

1. Bearing Retainer
2. Shims (drive gear end float)
3. Drive Gear Assembly
4. Shims (rear shaft end float)
5. Upper Shaft
6. Snap Ring
7. Snap Ring
8. Bearing
9. Bearing



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Two Speed Non Shiftable PTO Output Shaft and Driven Gears

1. Output Shaft Retaining Ring
2. Output Shaft Cap
3. Output Shaft Bearing Retainer
4. Gasket
5. Output Shaft Sleeve Oil Seal
6. Output Shaft Sleeve
7. Thrust Washers
8. 540 rev/min Drive Gear
9. Thrust Washer (thin)
10. Thrust Washer (thick)
11. Output Shaft Front Bearing
12. Needle Thrust Bearing
13. 1000 rev/min Driven Gear
14. Output Shaft Rear Bearing
15. Snap Ring
16. PTO Output Shaft

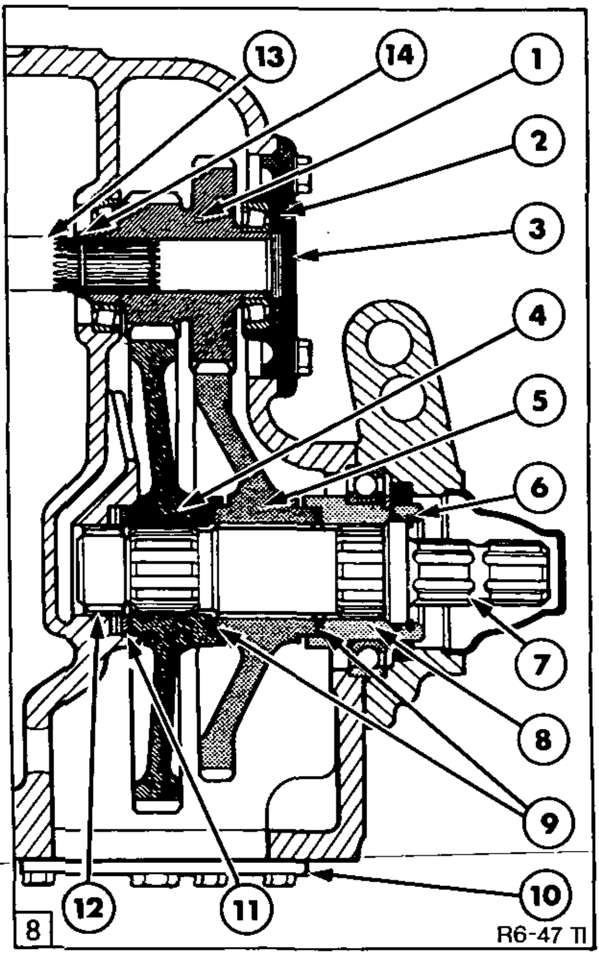
INSPECTION

With reference to Figure 6 and Figure 7.

Inspect components for wear or damage and replace as necessary.

Replace all ‘O’ rings, oil seals and gasket.

RE–ASSEMBLY



Two Speed Non Shiftable PTO Shaft Installation

1. Drive Gear Assembly
2. Shims (drive gear end float)
3. Bearing Retainer
4. 540 rev/min Driven Gear
5. 1000 rev/min Driven Gear
6. Output Shaft Retaining Ring
7. PTO Output Shaft
8. Sleeve
9. Bronze Thrust Washers
10. Sump Cover Plate
11. Thrust Washers and Bearing (see Figure 7)
12. Needle Bearing
13. Rear Shaft
14. Snap Ring and Shims

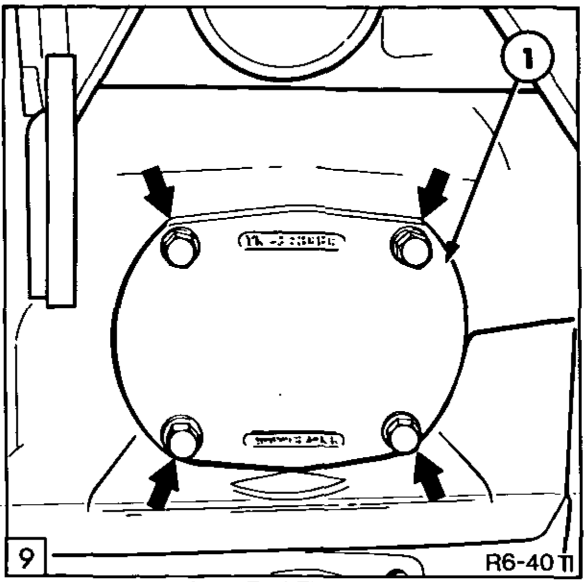
Re–assembly follows the disassembly procedure in reverse.

Re–assemble with reference to Figure 8.

If the upper shaft, drive gear assembly bearings, rear bearing retainer or rear axle centre housing has been replaced the following adjustments must be carried out.

Drive Gear End Float Adjustment

1. Locate drive gear and bearing assembly into centre housing.
2. Install approximately 0.080 in (2.0 mm) of shims behind the rear bearing cup. DO NOT fit 'O' ring seal.
3. Locate *bearing retainer* (with word 'TOP' upwards) and tighten bolts sufficiently to ensure bearings are seated.



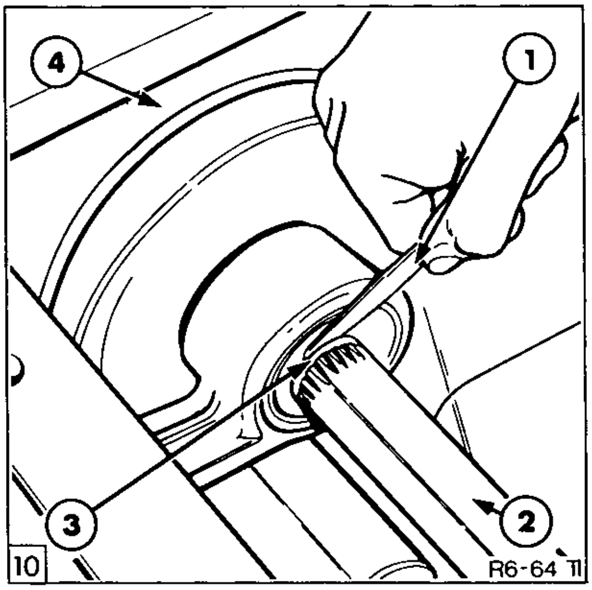
Drive Gear End Float Shimming
Feeler Gauge Locations

1. Bearing Retainer

4. Measure the gap at several locations to determine average gap, Figure 9.
5. Calculate shim thickness required:–

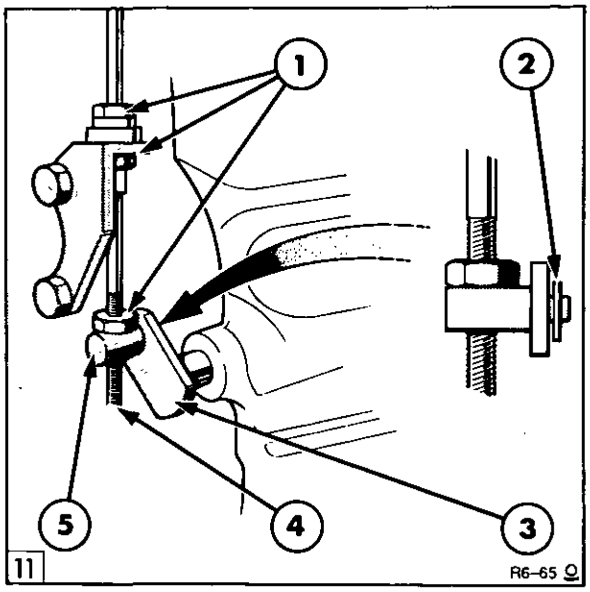
Shims thickness Installed	0.080 in	2.03 mm
Average Gap	0.014 in	0.36 mm
(subtract)	0.066 in	1.67 mm
End Float	0.004 in	0.10 mm
(subtract)	0.062 in	1.57 mm
Shims Thickness Required	**0.062 in**	**1.57 mm**

6. *Install shim thickness behind bearing* cup.
7. Install rear shaft shim(s) removed during disassembly.
8. Install bearing retainer using new 'O' ring seal.



Measuring Upper Shaft End Float

1. Feeler Gauge
2. Rear Shaft
3. Front Snap Ring
4. PTO Clutch Housing



Cable Assembly

1. Locknuts
2. Snap Ring
3. Lower Shift Lever
4. Thread
5. Pivot

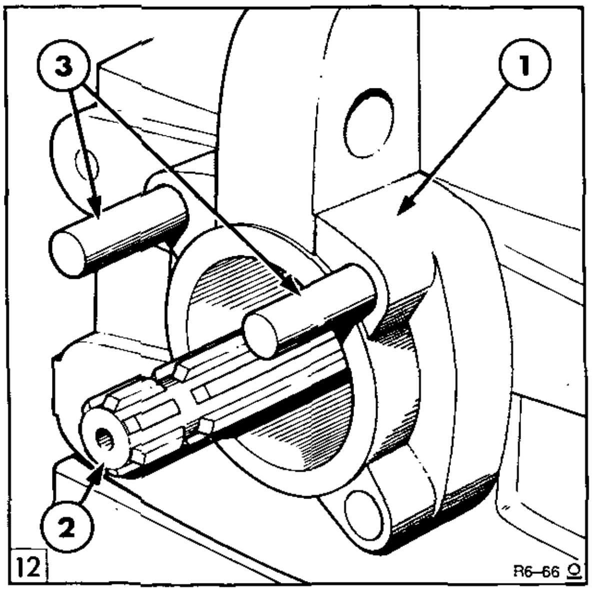
Rear Shaft End Float Adjustment

1. Using feeler gauge check upper shaft end float, Figure 10.
2. Remove/add shims Item 14, Figure 8 between rear snap ring and front bearing to achieve end float of 0.018–0.040 in (0.46–1.0 mm).

TWO SPEED SHIFTABLE PTO SHAFTS AND GEARS

REMOVAL

1. Drain rear axle and transmission.
2. Move the shift lever to 540 rev/min position and disconnect cable, Figure 11.
3. Remove rear PTO shaft using same procedure described for non–shiftable PTO shafts and gears.
4. Where fitted remove drawbar/auto pick–up hitch.
5. Remove sump cover.
6. From within the axle centre housing remove shift fork locking bolt. Refer to Figure 13.
7. Support the shift fork and withdraw the lower shift lever from centre housing. Remove fork.



Removing PTO Output Shaft

1. Output Shaft Retainer
2. PTO Output Shaft
3. Studs

8. Remove output shaft retainer bolts and install two 7 in (178 mm) long locating studs, Figure 12.

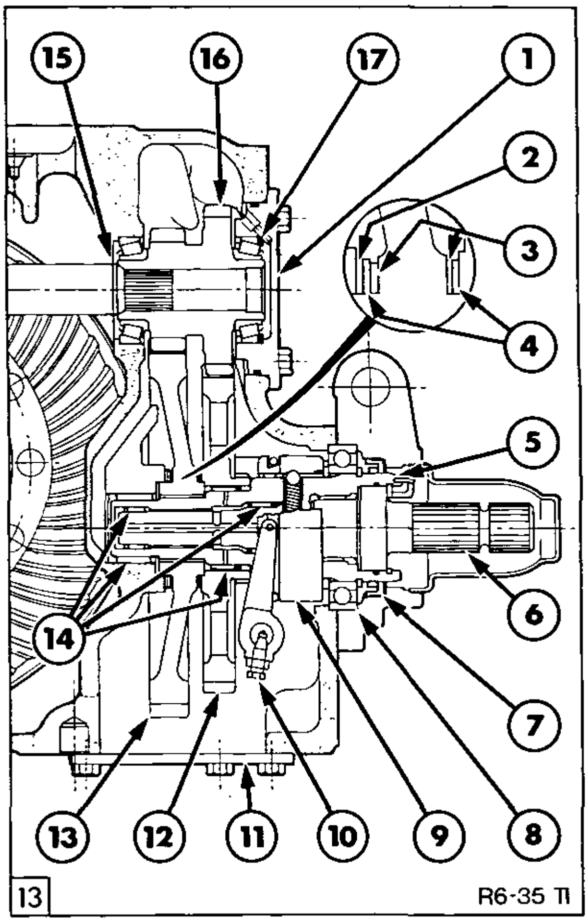
9. Supporting the gears through the bottom of the centre housing, pull the output shaft rearwards until the larger (540 rev/min) gear, thrust washers and needle roller bearings can be removed. Refer to Figure 13.

10. Continue pulling output shaft to remove smaller (1000 rev/min) gear.

NOTE: *The 540 rev/min counter shaft may remain in the centre housing. Should this occur lever back the countershaft while supporting the gears.*

11. Disassemble the output shaft and coupler assembly with reference to Figure 14.

NOTE: *When separating the coupler, wrap a clean rag around the coupler assembly to catch the detent balls and springs.*



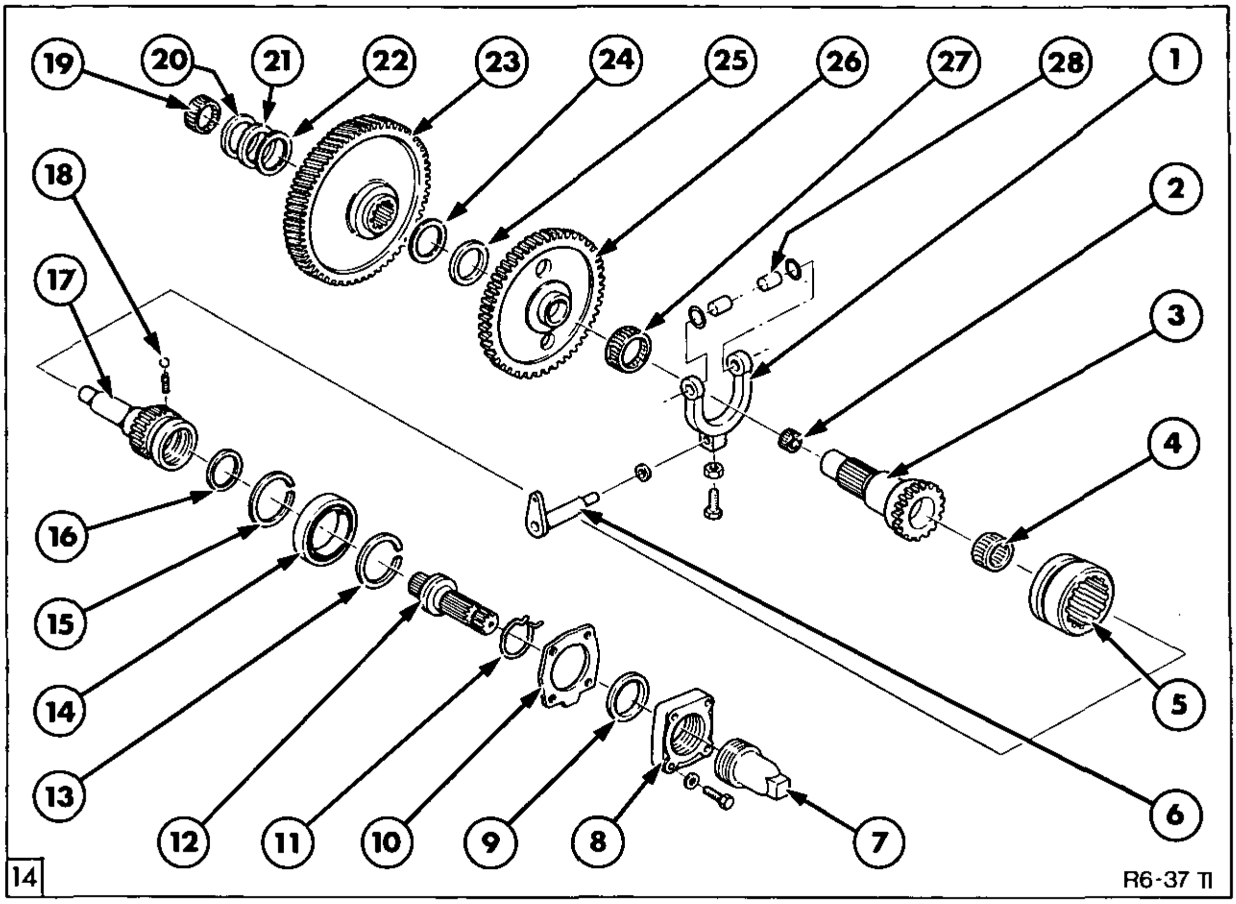
Two Speed Shiftable PTO Output Shaft and Driven Gears

1. Bearing Retainer
2. Thrust Washer (thick)
3. Thrust Washers (thin)
4. *Thrust Bearings*
5. Detent Spring and Ball
6. PTO Output Shaft
7. Oil Seal
8. Retainer and Bearing Assembly
9. Coupler
10. Shift Fork
11. Sump Cover
12. 1000 rev/min Driven Gear
13. 540 rev/min Driven Gear
14. Needle Roller Bearings
15. Rear Shaft Snap Ring and Shim(s)
16. Drive Gear Assembly
17. Shim(s) Drive Gear End Float

INSPECTION

Inspect components for wear or damage and replace as necessary. Refer to Figure 6 and Figure 14.

Replace all 'O' rings and oil seals.



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Two Speed Shiftable PTO Output Shaft and Driven Gears

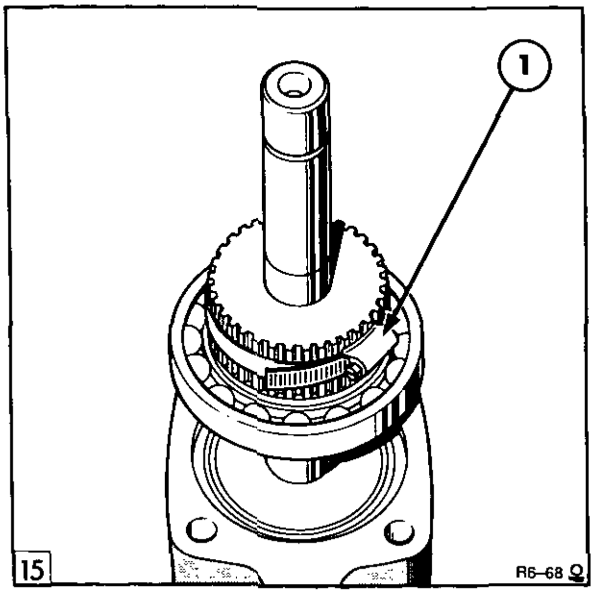
1. Shift Fork
2. Bearing
3. Sleeve
4. Bearing
5. Coupler
6. Lower Shift Lever
7. Cap
8. Output Shaft Retainer
9. Oil Seal
10. Gasket
11. Retaining Ring
12. PTO Output Shaft
13. Snap Ring
14. Bearing
15. Snap Ring
16. Oil Seal
17. Shaft
18. Detent Spring and Ball
19. Needle Roller Bearing
20. Thrust Washer (thick)
21. Thrust Bearing
22. Thrust Washer (thin)
23. 540 rev/min Driven Gear
24. Thrust Washer (thin)
25. Thrust Bearing
26. 1000 rev/min Driven Gear
27. Needle Roller Bearing
28. Pin and 'O' Ring (2 off)

RE–ASSEMBLY

Re–assembly follows the disassembly procedure in reverse.

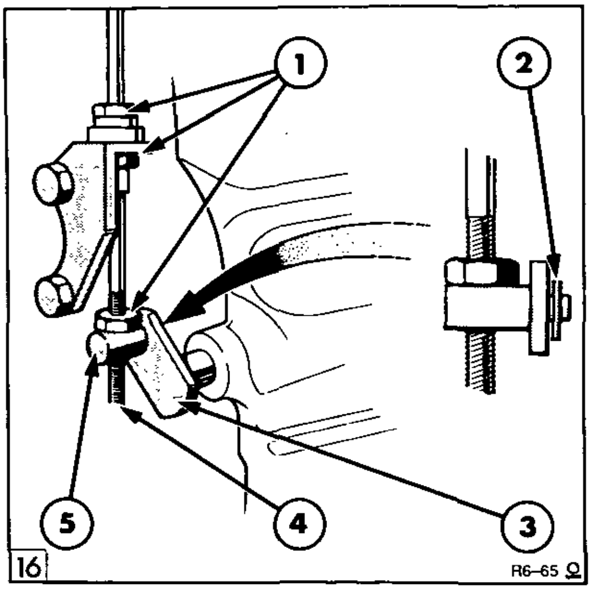
During re–assembly observe the following:–

1. If the upper shaft, drive gear assembly bearings, rear bearing retainer or rear axle centre housing has been replaced, the **Drive Gear End Float** and **Upper Shaft End Float Adjustment** as described for non shiftable two speed shafts and gears on Page 30 must be performed.
2. Install bearing Item 19, Figure 14 so that trademark on end of bearing is visible after installation into bore of rear axle centre housing.



Retaining Coupler Detent Balls and Springs

1. Clamp



Cable Assembly

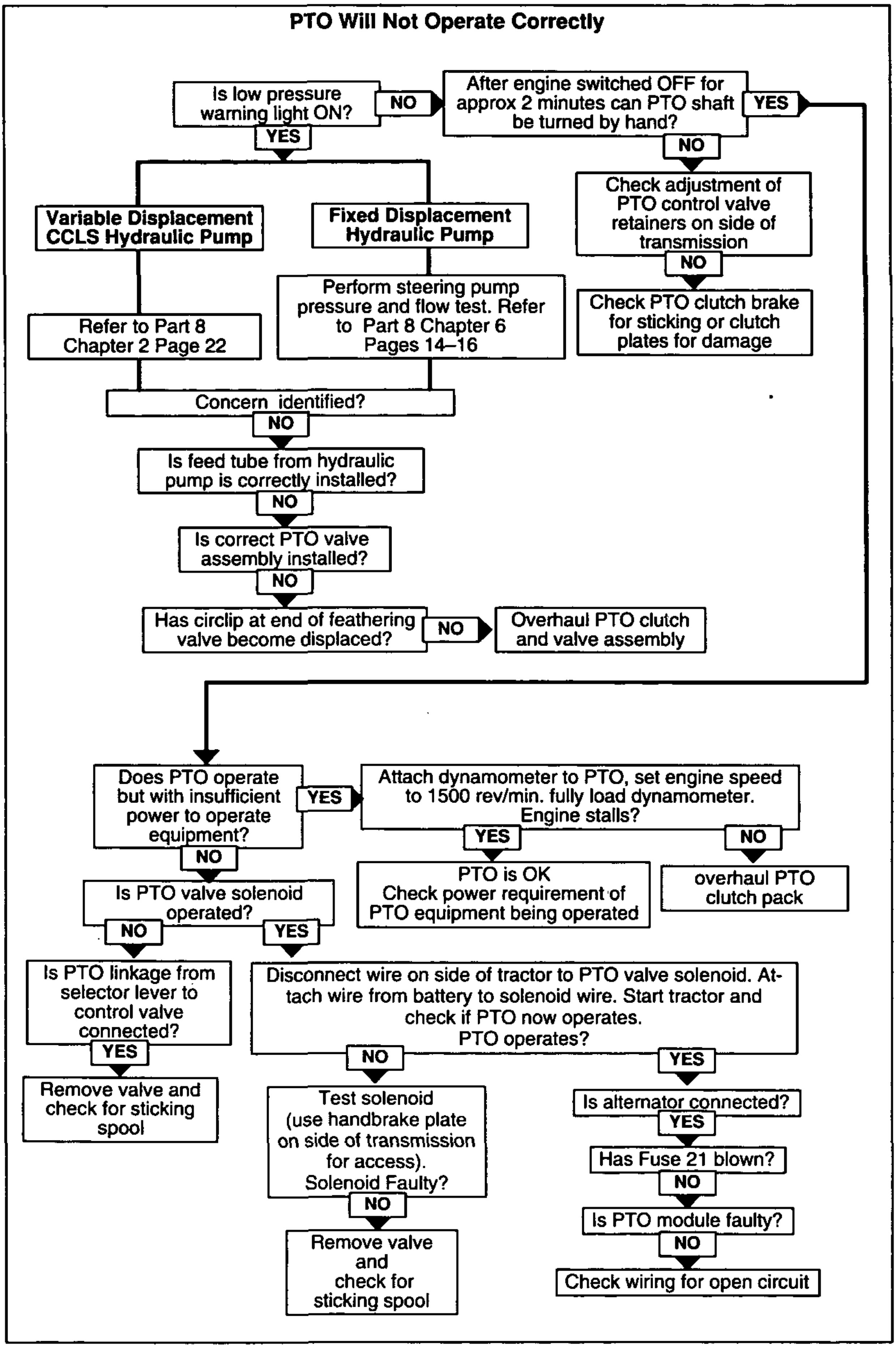
1. Locknuts
2. Snap Ring
3. Lower Shift Lever
4. Thread
5. Pivot

3. A suitable clamp may be used to assist in holding detent balls and springs during re–assembly of coupler to output shaft sleeve, Figure 15.

Cable Installation

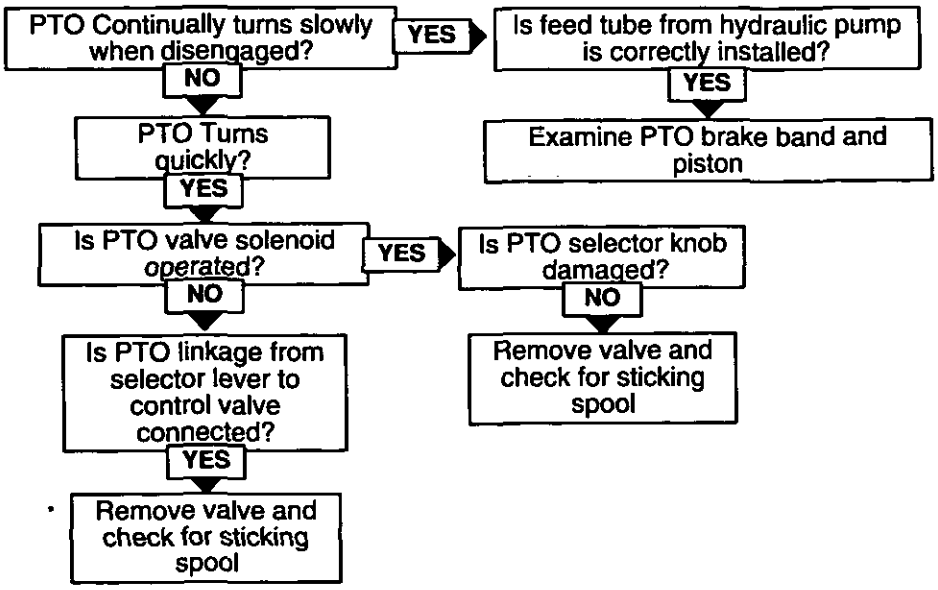
1. Move lower shift lever upwards to ensure coupler detent has engaged, Figure 16.
2. Move selector lever in cab to 540 rev/min position.
3. Install cable to lower shift lever and position pivot to mid point of threaded portion of cable.
4. Adjust cable to ensure selector lever in cab is freely located in 540 rev/min position.
5. Move selector lever to 1000 rev/min position and check that coupler detents have engaged correctly.

G. PTO – FAULT FINDING AND SPECIFICATIONS



PTO Will Not Operate Correctly

PTO Shafts Turns Continuously



SPECIFICATIONS

OPERATING PRESSURES

Refer to appropriate hydraulic pump pressure testing procedure for testing of hydraulic pressures within the PTO circuit.

Mechanically Operated PTO

Pressure Regulating Valve @ 2100 erpm	170–200 lbf/in²	11.7–13.8 bar
Lubrication Circuit Relief Valve	42–50 lbf/in²	2.9–3.5 bar

Solenoid Operated PTO with Fixed Displacement Hydraulic Pump

Pressure Regulating Valve @ 2100 erpm	220–260 lbf/in²	15.2–17.9 bar
Lubrication Circuit Relief Valve	73–123 lbf/in²	5.3–8.5 bar

Solenoid Operated PTO with CCLS Variable Displacement Hydraulic Pump

NOTE: *The pressure regulating valve for tractors installed with a variable displacement CCLS hydraulic pump is incorporated within the hydraulic pump regulating valve. The lubrication circuit relief valve is housed within the 16 x 16 transmission control valve.*

Pressure Regulating Valve @ 2100 erpm	250–280 lbf/in²	17.0–19.0 bar
Lubrication Circuit Relief Valve	80–100 lbf/in²	5.5–6.9 bar

Drive Gear End Float (2 Speed PTO Systems)

End Float	0.005 in	0.13 mm
Shim Sizes	0.001 in	0.025 mm
	0.003 in	0.076 mm
	0.005 in	0.127 mm
	0.012 in	0.305 mm
	0.020 in	0.508 mm

Rear Shaft End Float

End Float	0.018–0.40 in	0.46–1.0 mm
Shim Size	0.010 in	0.25 mm

TORQUES

Rear Shaft Bearing Retainer Bolts	48–63 lbf ft	65–85 Nm
PTO Output Shaft Bearing Retainer	140–170 lbf ft	190–230 Nm
Solenoid Valve	12–16 lbf ft	16–22 Nm
PTO Valve Location Adjuster Front Pin	20–26 lbf ft	27–35 Nm
Rear Pin (back off 1/4 turn)	9 lbf in	1 Nm
Rear Pin Locknut	15–20 lbf ft	21–27 Nm
Brake Band Adjuster (back off 2½ turns)	9–11 lbf in	1–1.2 Nm
Clutch Support Bolts	14–17 lbf ft	19–23 Nm
Sump Cover Bolts	27–37 lbf ft	37–50 Nm
Shift Fork Bolt	20–25 lbf ft	27–34 Nm

SEALER

Thread Sealer to Specification SP–M4G9112–A or C
(U.S./Canada Part No L51831/C)

7

PART 7
REAR AXLE AND BRAKES

Chapter 1
REAR AXLE

A. DESCRIPTION AND OPERATION

There are three basic types of Series 40 model rear axles. An S Model rear axle which has mechanically operated brakes and a mechanical differential lock. A Standard duty rear axle, fitted to SL model 5640, 6640, 7740 and 7840 tractors which has hydraulically operated brakes, hydraulic/electrically operated differential lock and three planetary gears. A Heavy duty rear axle, fitted to all 8240 and 8340 models which has hydraulically operated brakes, hydraulic/electrically operated differential lock, four planetary gears and larger diameter axle shafts.

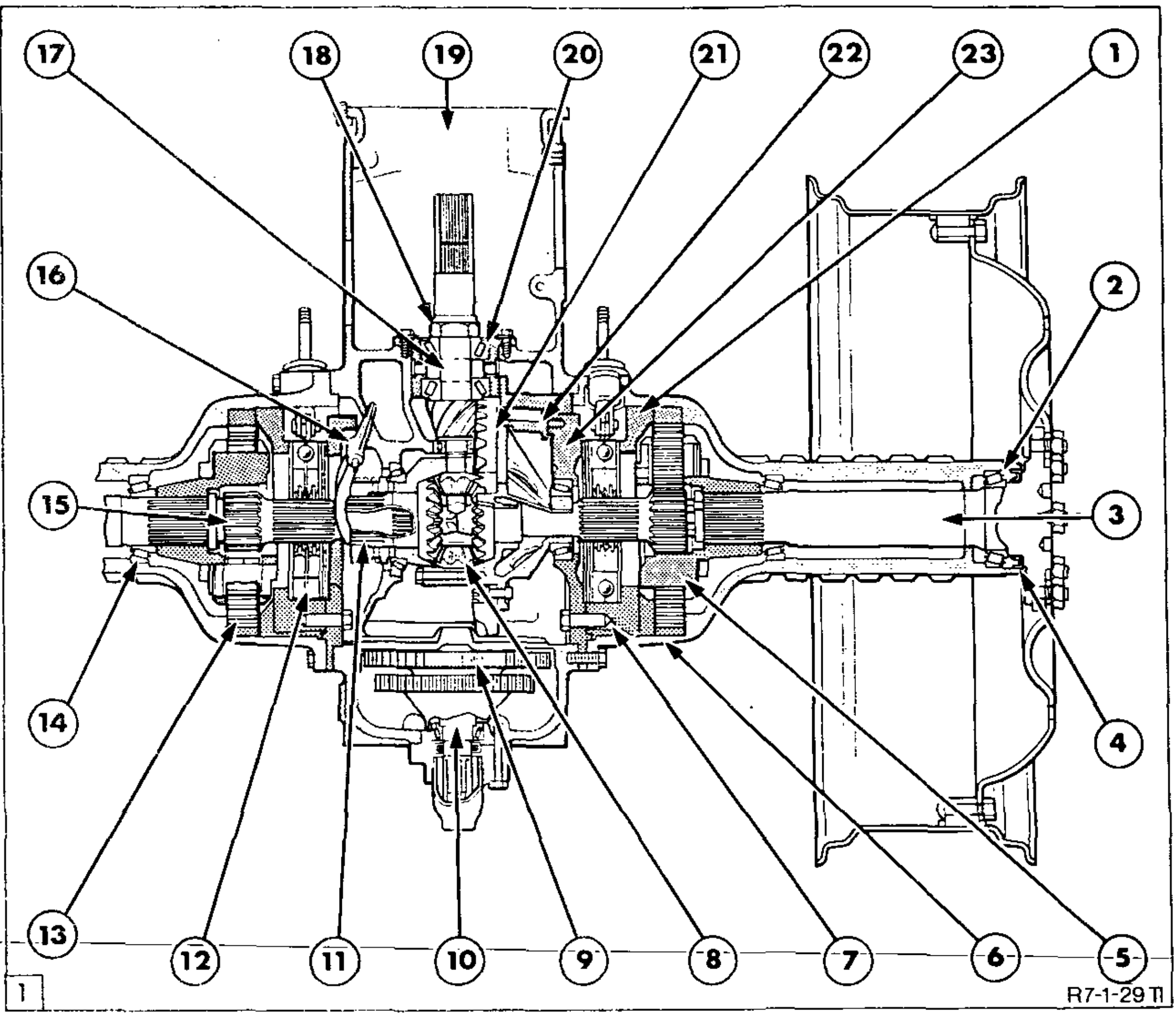
The rear axle assembly, attached to the rear of the transmission, connects the drive from the engine and gearbox to the rear wheels. Housed within the rear axle assembly are the following components:–

- Main Drive Pinion and Differential Ring Gear
- Differential
- Differential Lock Assembly
- Brakes
- Final Reduction Gears
- Axle Half Shafts
- P.T.O. Components
- Transmission Handbrake
- Hydraulic Pumps, variable displacement or Tandem Gear Pumps.

The drive from the transmission output shaft is transmitted to the spiral bevel pinion by the drive coupling. The pinion is located in the front of the rear axle housing by two pre – loaded, opposed tapered roller bearings, and meshes with the differential crown wheel ring gear.

The ring gear is riveted to the differential case assembly which is supported between taper roller bearings mounted in the rear axle housings.

NOTE: *In service the ring gear rivets are replaced by nuts and bolts.*



SL/SLE Rear Axle Assembly

1. Outer Brake Housing	13. Planet Gears
2. Axle Housing Outer Bearing	14. Axle Housing Inner Bearing
3. Axle Shaft	15. Sun Gear
4. Axle Shaft Oil Seal	16. Differential Lock Fork
5. Planet Gear Carrier	17. Drive Pinion
6. Axle Housing	18. Drive Pinion Locknut
7. Brake Torque Pin	19. Rear Axle Housing
8. Differential Assembly	20. Pinion Bearing Retainer
9. I.P.T.O Drive and Driven Gears	21. Differential Ring Gear
10. I.P.T.O Rear Shaft	22. Thrust Block
11. Differential Lock Assembly	23. Inner Brake Housing
12. Rear Wheel Brake Assembly	

A thrust block is fitted to the heavy duty axle to prevent the ring gear from flexing due to separating loads from the drive pinion. The casting of the block also ensures an adequate quantity of lubricating oil flows to the drive pinion bearings.

The axle shaft housings operate with higher oil levels than the centre housing. The left hand side of the centre housing and the right hand inner brake housing both have restrictions to maintain the increased levels, Figure 2 and Figure 3.

The differential case assembly forms two halves which are bolted together to enclose the differential spider and side gears.

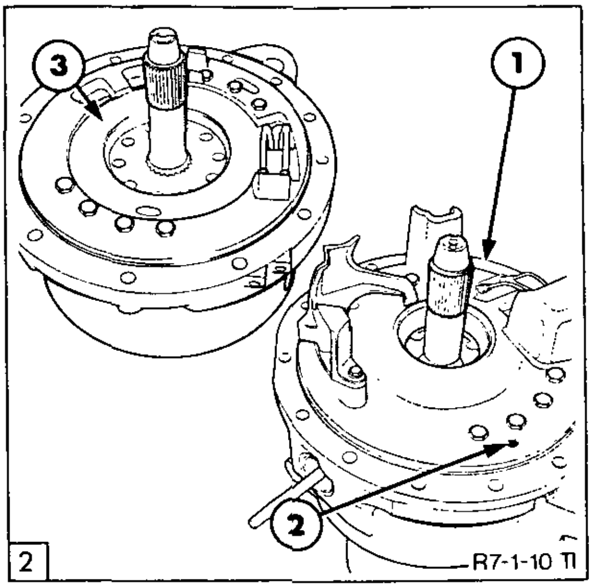
The drive from the pinion is transmitted via the ring gear and differential case assembly to the arms of the spider. Mounted on the spider are pinion gears which are in constant mesh with the two side gears.

An intermediate shaft is splined into each side gear and the brake assemblies are splined onto these shafts.

The outer end of each intermediate shaft forms the sun gear of an epicyclic final reduction gear set mounted within each axle housing.

The drive to the wheels is transmitted from the intermediate shaft to the outer shaft via the reduction gear set.

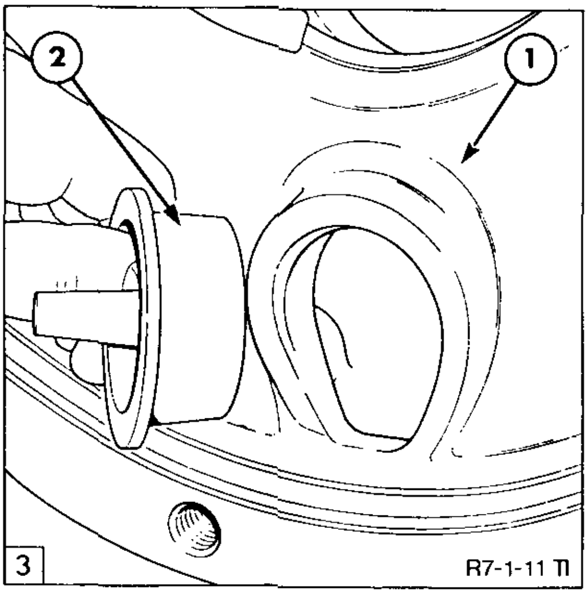
The inner ends of the outer axle shaft are splined into the planetary gear carrier. The axle shafts are supported by a taper roller bearing mounted in each axle housing.



Left and Right Hand Axle Housings

1. Right Hand Axle Housing
2. Oil Restrictor
3. Left Hand Axle Housing

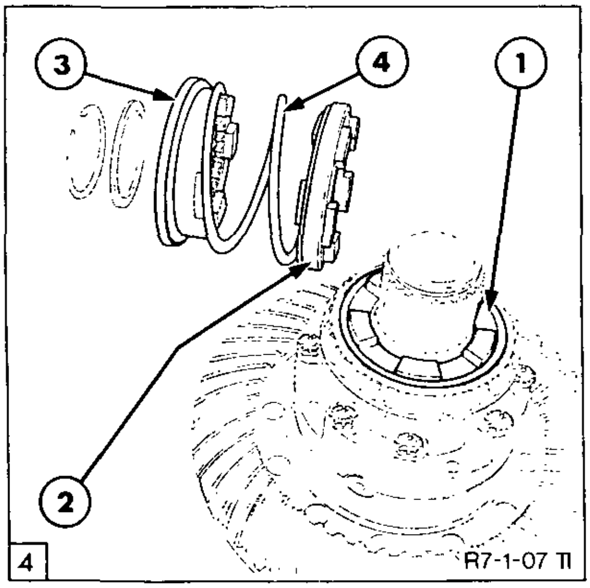
The oil provided for the I.P.T.O. and hydraulic systems is also used for lubricating the rear axle components. The differential and ring gear assembly is partially immersed in the oil to splash feed the bearings and bushings.



Left Hand Oil Restrictor

1. Rear Axle Centre Housing
2. Plastic Plug

DIFFERENTIAL LOCK



Differential Lock Exploded View

1. Differential Case
2. Differential Lock Adaptor
3. *Differential Lock Coupling*
4. Spring

When a tractor fitted with a conventional differential assembly is working in soft soil and one wheel starts to slip, all the drive is then transmitted to that wheel and traction ceases.

To overcome this slippage a differential lock is fitted on all Series 40 tractors.

The differential lock mounted to the left hand side of the crown wheel can be engaged to connect one of the side gears to the differential case assembly. This action locks the differential assembly together and provides a direct drive to both wheels.

The lock assembly consists of a sliding coupling, an adaptor and a fork and lever assembly. The sliding coupling is splined onto the protruding end of the side gear, Figure 4.

The adaptor is positioned between the coupling and the left hand differential case. A spring positioned between the coupling and the adaptor ensures the coupling only engages with the adaptor when required and the drive teeth on the adaptor and the differential case are not permanently engaged.

Operation

The fork and lever assembly is operated by either a spring controlled foot operated linkage (mechanically engaged), on the 56–7740 economy, S models or an electro hydraulic system operated by a rocker switch mounted on the instrument panel on 56–8340 SL and SLE, models.

Mechanical Engagement/Disengagement

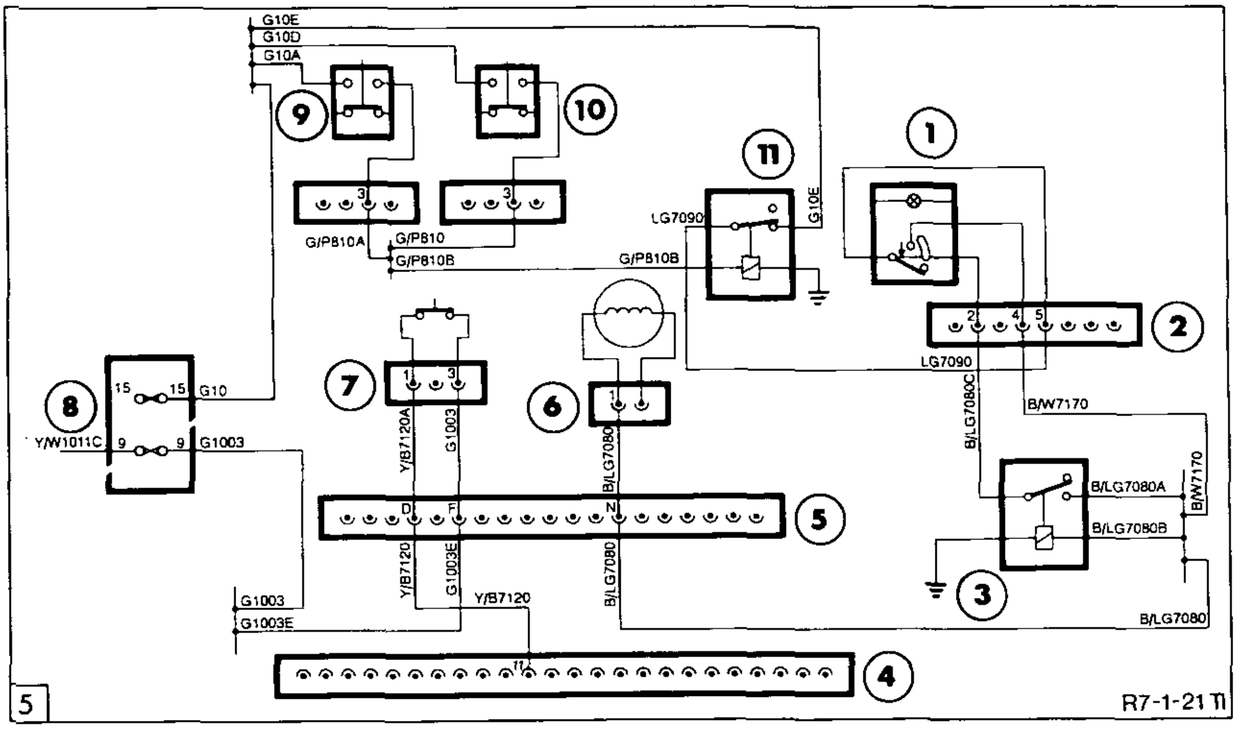
When actuated the fork forces the drive teeth of the coupling to mesh with the adaptor and thereby lock the side gear to the differential case. After the differential lock, of the mechanically engaged system, has been engaged, the foot pedal can be released.

The mechanically operated differential lock will automatically disengage when the spring pressure overcomes the side forces acting on the coupling teeth. This situation will only occur when the torque to both wheels is equal.

Electrical Engagement

With reference to Figure 5.

The positive supply to the operating switch comes from fuse 15, through relay G, item 11, via wire LG7090. Relay G is a normally closed relay as shown. To engage, the top of the switch is pressed momentarily, against spring pressure, to make the circuit. Whilst the switch is depressed, wire LG7090 is connected through the switch to wire BW7170. Wire BW7170 energizes relay A, item 3, via wire B/LG7080B. This allows power from the switch along B/LG7080C through the relay contacts via wire B/LG 7080A onto wire B/LG7080B to create a self energizing circuit. The power in wire B/LG7080A also energizes the actuating solenoid.



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Differential Lock Operation

1. Differential Lock Switch
2. Switch Connector
3. Relay A
4. Instrument Connector J2
5. Extension Harness Connector C1
6. Solenoid
7. Differential Lock Warning Light Switch
8. Fuse Box
9. Stop Lamp Switch (Right)
10. Stop Lamp Switch (Left)
11. Relay G

Electrical Disengagement

With reference to Figure 5.

1. Depressing the operating switch breaks the circuit and therefore the supply (B/LG7080C) to relay A, de–energizing the solenoid and disengaging the differential lock.
2. By depressing either brake pedal, relay G is energized, via wire G/P 810B. This opens the contacts, cutting the supply to the switch

The solenoid piston operates a switch as it moves to the engaged position. When the switch is made a dash mounted warning light is illuminated indicating that the differential lock is engaged.

FINAL REDUCTION GEAR ASSEMBLY (Planetary Gear Assembly)

To increase the torque transmitted to the rear wheels, an epicyclic reduction gear assembly is located within each of the rear axle housings. The outer end of each intermediate shaft acts as the planetary sun gear around which are located either three planet gears, as fitted to 56–7840 models or four planet gears fitted to 8240 and 8340 models. The planet gears are mounted within a carrier which is splined to the rear axle shaft.

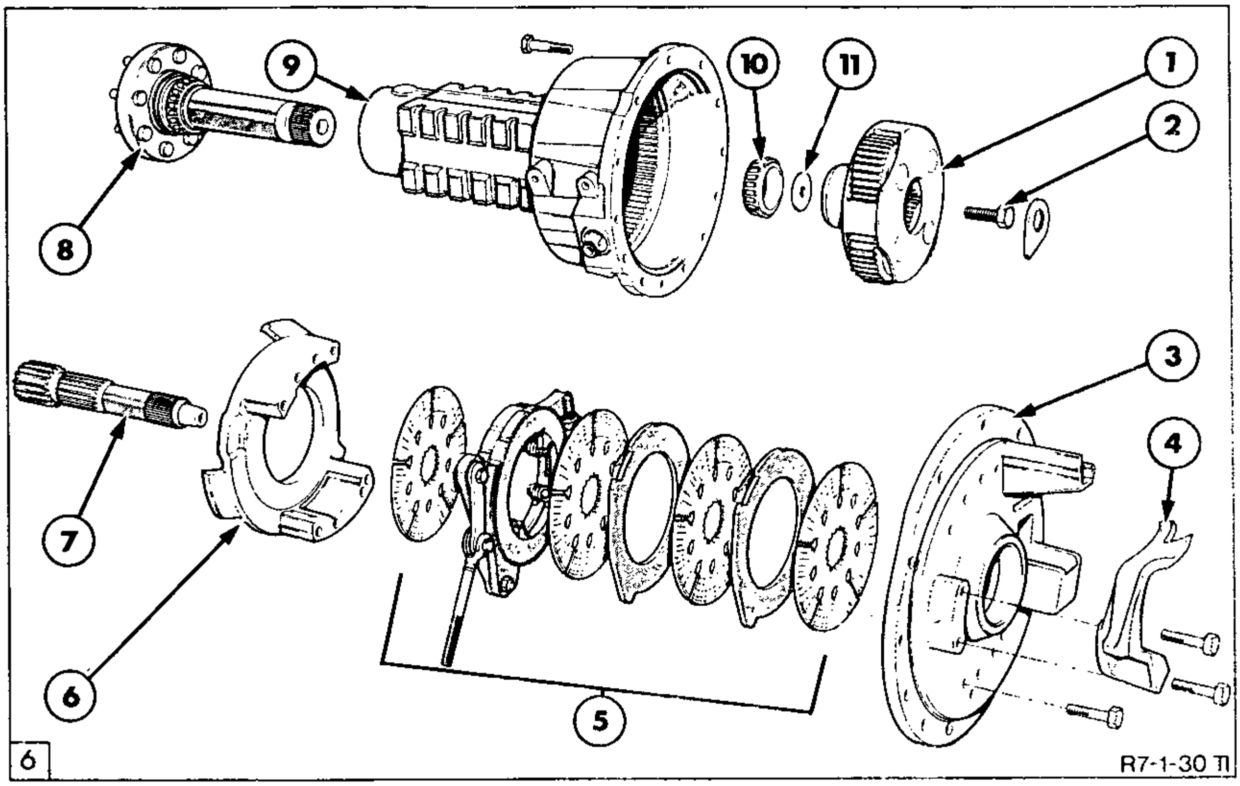
The planet gears mesh with a ring gear which is mounted within the axle housing. As the intermediate shaft gear revolves, the planet gears are forced to rotate and roll around the inside of the fixed ring gear. This action causes the planet gear carrier to rotate at a reduced speed and transmit increased torque to the rear axle and wheels.

B. FAULT FINDING

PROBLEM	POSSIBLE CAUSE	REMEDY
1. Rear Axle Noisy	1. Lack of oil 2. Incorrect oil specification 3. Worn axle bearings	1. Top up as required 2. Drain and refill with oil of correct specification 3. Disassemble and inspect bearings
2. No Drive **(NOTE:** *Refer also to 'Clutch Systems' fault finding, Part 4, Chapter 1.)*	1. Operate the differential lock, if the tractor drives this indicates a failure within an axle shaft housing assembly. If the tractor does not drive the fault may lie in the differential unit. Ensure the Clutch and transmission systems are not at fault.	
3. Differential Lock not engaging (mechanically engaged)	1. External linkage damaged or broken 2. Internal linkage, cross shaft rod, fork or pivot shaft damaged/broken 3. Damaged or broken teeth on differential lock adaptor or coupling	1. Replace/repair as required 2. Remove the HPL top cover and inspect 3. Remove differential and inspect differential lock assembly
4. Differential Lock not disengaging (mechanically engaged)	1. Spring broken between adaptor and coupling 2. Teeth of adaptor or coupling damaged/burred	1. Remove differential and replace spring 2. Remove differential and replace damaged parts
5. Differential Lock not engaging (electro–hydraulic)	1. Fuse 15 blown 2. Faulty Relays, G or A. 3. Brake switch activated 4. Rocker switch faulty 5. Solenoid faulty 6. Faulty hydraulic oil supply to solenoid assembly 7. Wiring fault 8. Internal linkage damaged/broken 9. Differential lock coupling / adaptor gear teeth damaged	1. Replace fuse 2. Replace faulty relay 3. Ensure brake switches are correctly adjusted and operating correctly 4. Replace switch 5. Replace solenoid 6. Check low pressure hydraulic circuit. Refer to Part 8, Chapter 2 or 5. 7. Locate and repair faulty wiring 8. Remove HPL top cover and inspect 9. Remove differential and replace damaged parts
6. Differential Lock not disengaging (electro–hydraulic)	1. Faulty operating switch (failed in 'ON' position) 2. Solenoid Faulty (Seized)	1. Replace switch 2. Inspect solenoid, repair or replace as required

PROBLEM	POSSIBLE CAUSE	REMEDY
6. Differential Lock not disengaging (continued) (electro–hydraulic)	3. Faulty wiring	3. Locate and repair fault in wiring
	4. Spring broken between coupling and adaptor	4. Remove differential and replace spring
	5. Damaged or broken coupling and adaptor gear teeth	5. Remove differential and replace damaged components
	6. Faulty brake pedal switch	6. Ensure switches are correctly adjusted and operating correctly

C. REAR AXLE HALF SHAFT ASSEMBLY OVERHAUL



Heavy Duty Rear Axle Half Shaft Assembly

1. Planetary Reduction Gears and Carrier
2. Carrier Retaining Bolt and Lock Tab
3. Inner Brake Housing
4. Thrust Block
5. Brake Discs and Actuator
6. Outer Brake Housing
7. Sun Gear and Shaft
8. Axle Shaft and Outer Bearing
9. Axle Shaft Housing
10. Axle Shaft Bearing, Inner
11. Shim

Operations or Repairs that can be performed with the left hand half axle removed.

Differential Operating Fork Overhaul

Left Hand Brake Plates Overhaul

Sun Gear Assembly Overhaul

Half Shaft Assembly Overhaul

Operations or Repairs that can be performed with the Right hand half axle removed.

Right Hand Brake Plates Overhaul

Sun Gear Assembly Overhaul

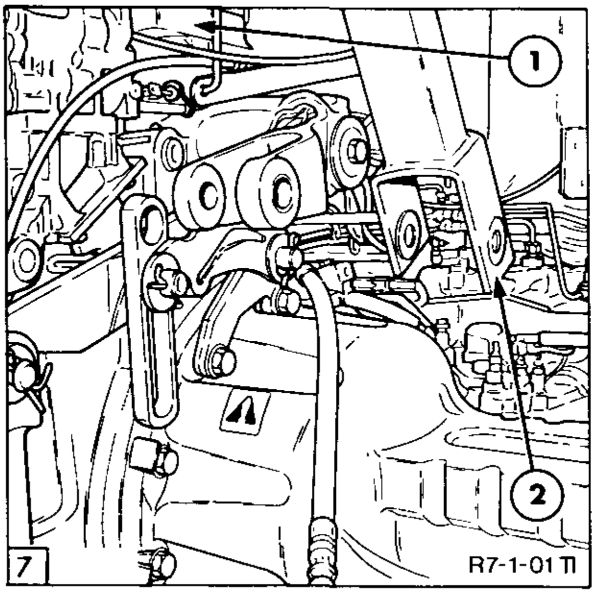
Half Shaft Assembly Overhaul

Crown Wheel and Pinion Assembly Overhaul

Differential Lock Assembly Overhaul

REMOVAL

IMPORTANT: *Prior to removal ensure vehicle is safely supported, the front wheels chocked to prevent movement and the handbrake is released.*



Cab Mount and Hydraulic Fittings Removed

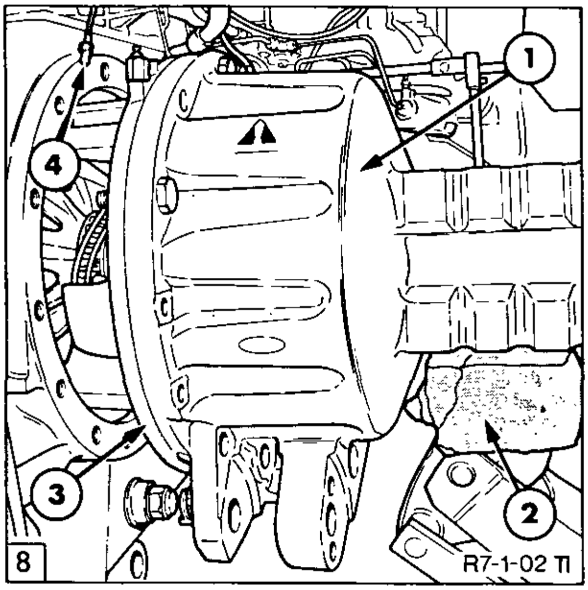
1. Support Block
2. Cab Frame Mount

1. Drain the rear axle oil from the centre housing and disconnect the hydraulic lift rods, Automatic pick up hitch tie rods, handbrake cables and either the hydraulic brake pipes or footbrake linkage, depending on axle type.

2. Remove the rear wheels, replacing the nuts onto the studs to prevent damage to the stud threads during overhaul.

3. Support the rear of the cab or platform and lift the cab or platform to right or left of vehicle, away from the half shaft to be removed, Figure 7.

4. Support the axle shaft housing on a suitable trolley jack. Remove the securing bolts and withdraw the axle housing from the tractor, Figure 8.



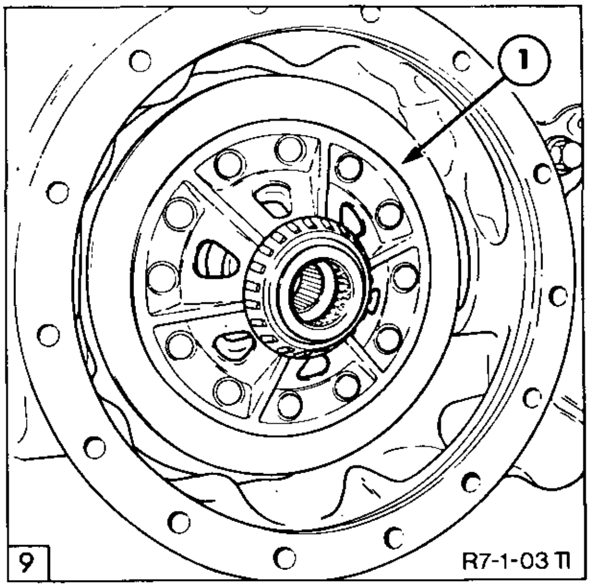
Axle Housing Removal

1. Axle Housing
2. Wooden Block
3. Brake Plate
4. Brake Pipe

DISASSEMBLY

1. Remove the large ‘O’ ring located in the inner end of the axle housing.

2. If the right hand housing has been removed, withdraw the differential assembly to prevent damage during the axle overhaul, Figure 9.



Differential Access

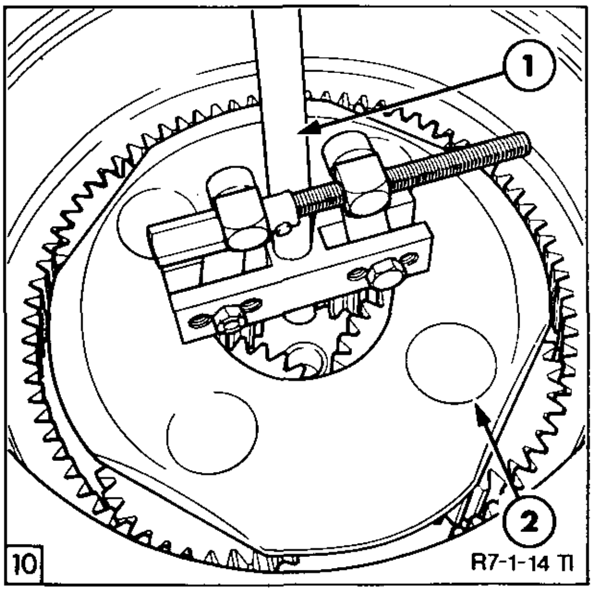
1. Differential Unit

3. Remove the two hydraulic brake tubes from the inner housing and the bolts securing the inner brake using to the axle housing then withdraw the inner brake housing from the axle housing.

4. Remove the brake friction discs and actuating disc assembly. Lift the intermediate sun gear shaft out of the axle then withdraw the outer brake housing.

5. Remove the axle shaft retaining bolt lock tab and retaining bolt.

NOTE: *It may be necessary to heat the locking tab to melt the sealant used during production.*



10

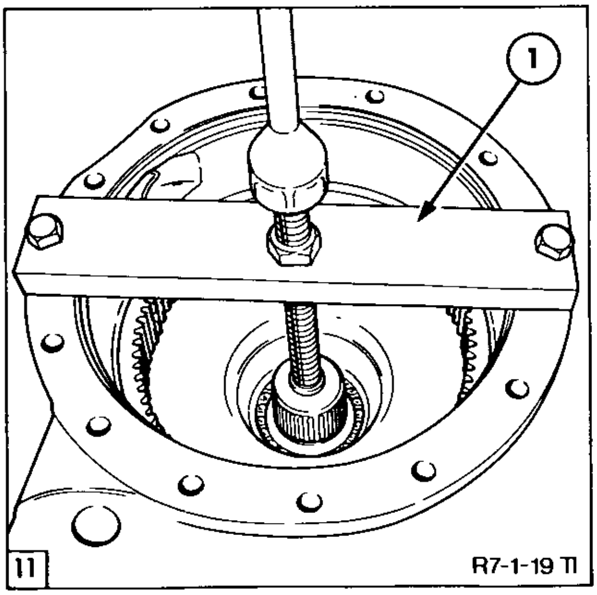
Removing The Planetary Gears and Carrier Assembly

1. Puller, Tool No. 943
2. Planetary Gears and Carrier Assembly

6. Lift and withdraw the planet gear and carrier assembly using puller, Tool No. 943, expanded under the planet gears, Figure 10. Collect the shim from underneath the carrier assembly.

WARNING: *Ensure when lifting the planetary gear and carrier assembly from the axle shaft housing that the puller is correctly positioned. Do not attempt to remove or replace the assembly without the specified puller as personal injury may result.*

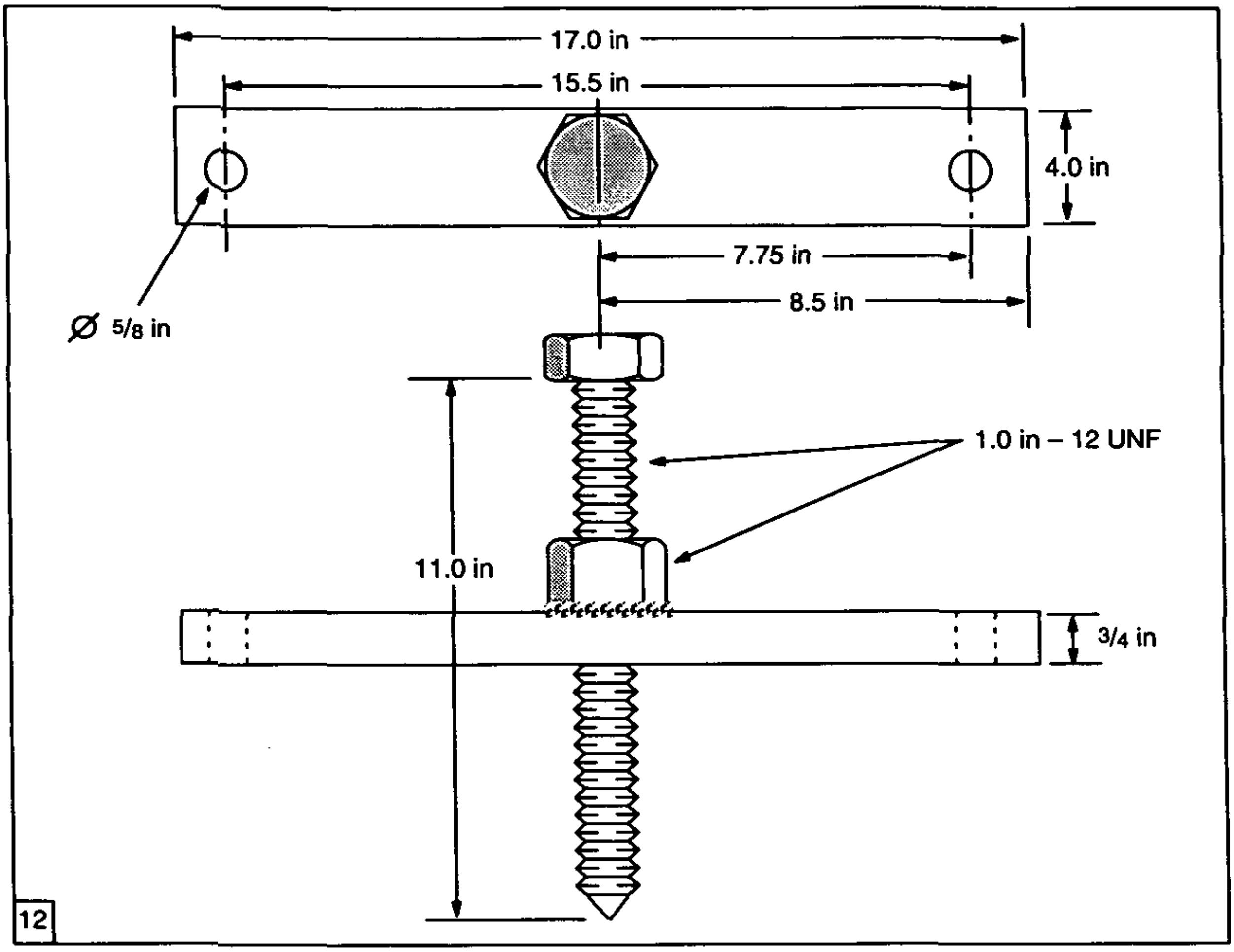
7. Remove the axle shaft from the housing. The inner bearing of SL and SLE models is a press fit onto the axle shaft and must be pressed out, Figure 11. Fabricate a suitable tool, as shown in Figure 12.



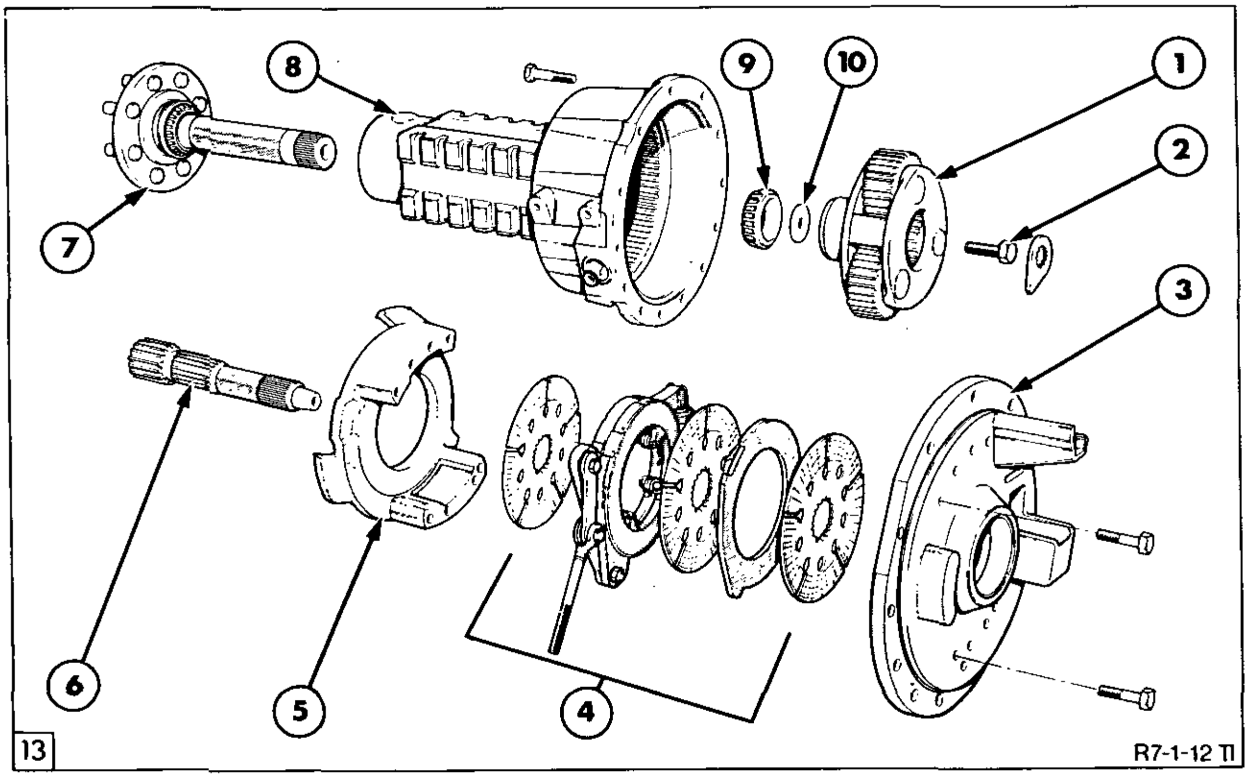
11

Removing Axle Shaft

1. Shaft Removal Tool



Axle Shaft Removal Tool



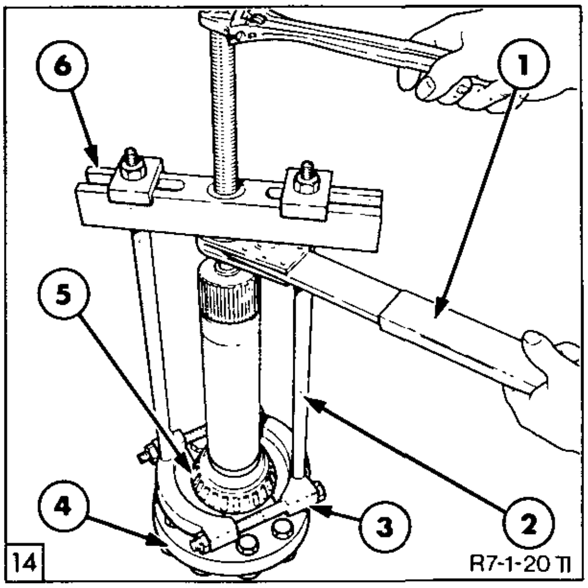
Standard Rear Axle Half Shaft Assembly

1. Planetary Reduction Gears and Carrier
2. Carrier Retaining Bolt and Lock Tab
3. Inner Brake Housing
4. Brake Discs and Actuator
5. Outer Brake Housing
6. Sun Gear and Shaft
7. Axle Shaft and Outer Bearing
8. Axle Shaft Housing
9. Axle Shaft Inner Bearing
10. Shim

INSPECTION AND REPAIR

1. Inspect all components for damage or excessive wear. Install new components as necessary.

2. If the axle shaft outer cone and roller assembly and or the shaft seal requires removal, use puller, Tool No. 938, legs, Tool No. 930B, pulling attachment, Tool No. 952 and a suitable shaft protector, Tool No. 625A, Figure 14.

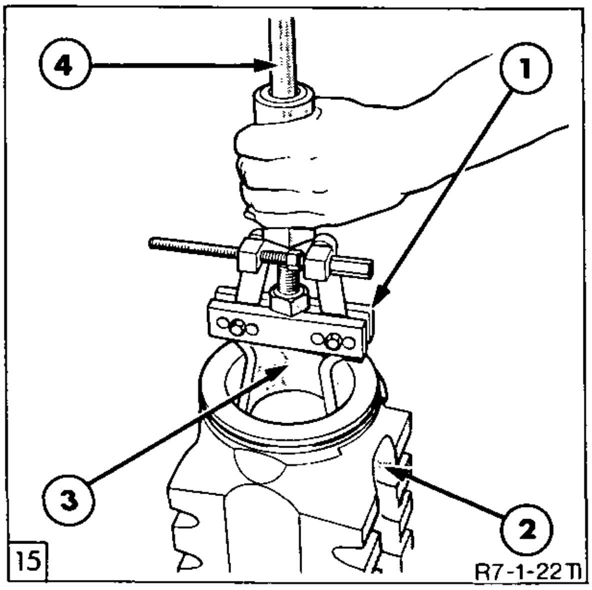


Axle Shaft Cone and Roller Assembly Removal

1. Ratchet, Tool No.P61
2. Legs, Tool No.930B
3. Pulling Attachment, Tool No.952
4. Axle Shaft
5. Cone and Roller Assembly
6. Puller, Tool No.938

3. Install the shaft seal followed by the cone bearing using suitable sleeves and a press.

4. If required, use slide hammer, Tool No. 943S and puller, Tool No. 943, to remove the bearing cup from the outer end of the axle housing, Figure 15. To replace the cup use a suitable stepped plate and a mallet, install cup until fully seated in housing.



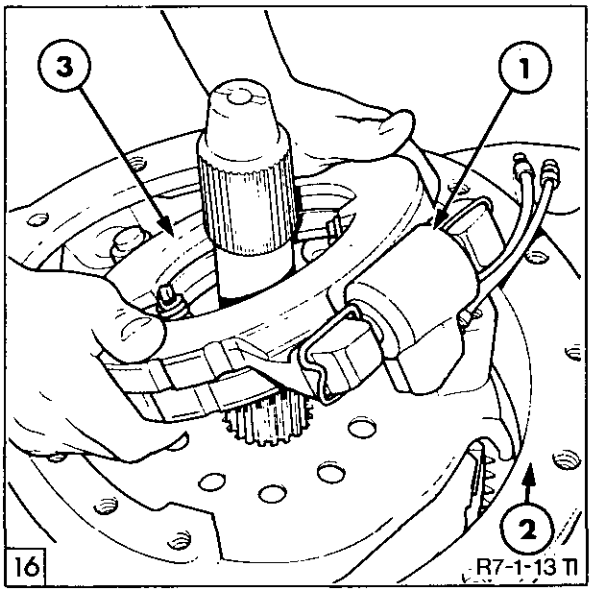
Axle Housing Bearing Cup Removal

1. Puller, Tool No.943
2. Axle Housing
3. Bearing Cup
4. Slide Hammer, Tool No.943S

RE–ASSEMBLY AND INSTALLATION

Re–assembly and installation of the rear axle shaft assembly follows the disassembly procedure in reverse, observing the following requirements:

- Ensure the brake actuators and hydraulic hoses are correctly installed. The left hand actuator pipework faces towards the wheel hub. The right hand actuator pipework faces up, towards the installer.



Brake Actuator Removal / Installation
(Left Hand Axle Housing Shown)

1. Brake Slave Cylinder
2. Axle Housing
3. Brake Actuator

- Apply a suitable wheel bearing grease to the shaft seal and cone and roller assembly.

- Prior to installation of the axle housing make the following adjustments as described under the 'Adjustments' Section of this Chapter:

  (i) Adjust the axle shaft bearing pre–load.

  (ii) Adjust the differential bearing pre–load if any of the following components have been replaced:

  - Planetary ring gear
  - Outer brake housing
  - Inner brake housing
  - Rear axle centre housing
  - Right hand axle housing

- Tighten all nuts and bolts to the correct tightening torques detailed in the *specifications*.

- Refill the rear axle with the correct grade and quantity of oil as detailed in the specifications.

- Check and where necessary, adjust the foot brakes of mechanically operated systems and the handbrake of all models.

D. PLANETARY GEAR ASSEMBLY AND AXLE HOUSING – OVERHAUL

REMOVAL

Remove the axle housing from the centre housing and withdraw the planetary gear assembly as described in the previous section.

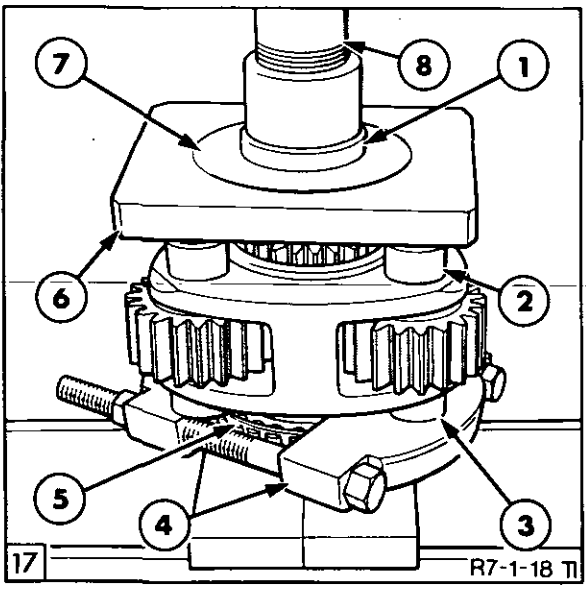
DISASSEMBLY

1. Remove the ring retaining the planet gear shafts.

2. Place the carrier assembly on a press with a suitable step plate adaptor, Tool No. 630T, under the cone and roller assembly.

NOTE: *The cone and roller assembly is only fitted to the carrier of S model tractors. The lower pulling attachment tool is not required on SL and SLE model axles.*

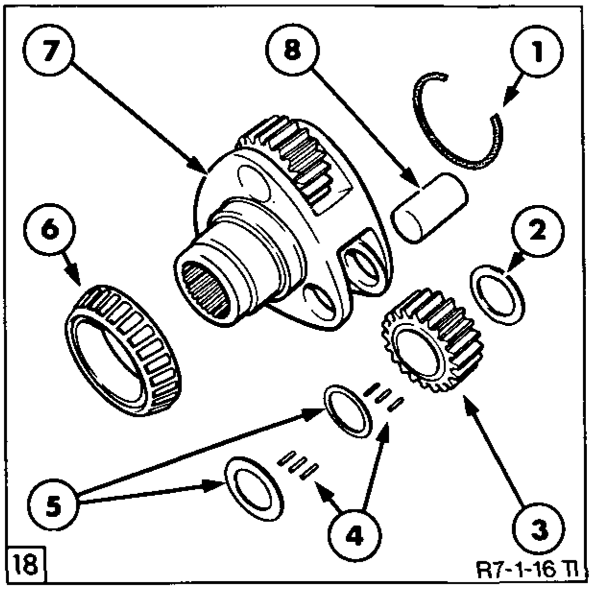
3. Using a second step plate adaptor, Tool No. 630T, three or four suitable sockets, depending on carrier type, pulling attachment, Tool No. 952, taper base, Tool No. 370 and slave ring, Tool No. CT.9056, remove the cone and planet gear shafts. Figure 17.



Planet Gear Carrier Cone and Roller Assembly Removal

1. Stop Plate Adaptor
2. Spacer or Socket
3. Planet Gear Shaft
4. Pulling Attachment
5. Bearing Assembly
6. Base Plate
7. Slave Ring
8. Hydraulic Press

4. Remove the gears from the carrier and withdraw the thrust washers and spacers, Figure 18.



Planet Gear Carrier Assembly

1. Retaining Ring
2. Thrust Washer
3. Planet Gear
4. Rollers
5. Thrust Washers
6. Cone and Roller Assembly (S Model Only)
7. Carrier
8. Planet Gear Shaft

NOTE: *Retain the needle rollers located between the planet gear shafts and the gears for use during reassembly.*

5. Use slide hammer, Tool No. 943S and puller, Tool No. 943, to remove the bearing cup located within the axle housing.

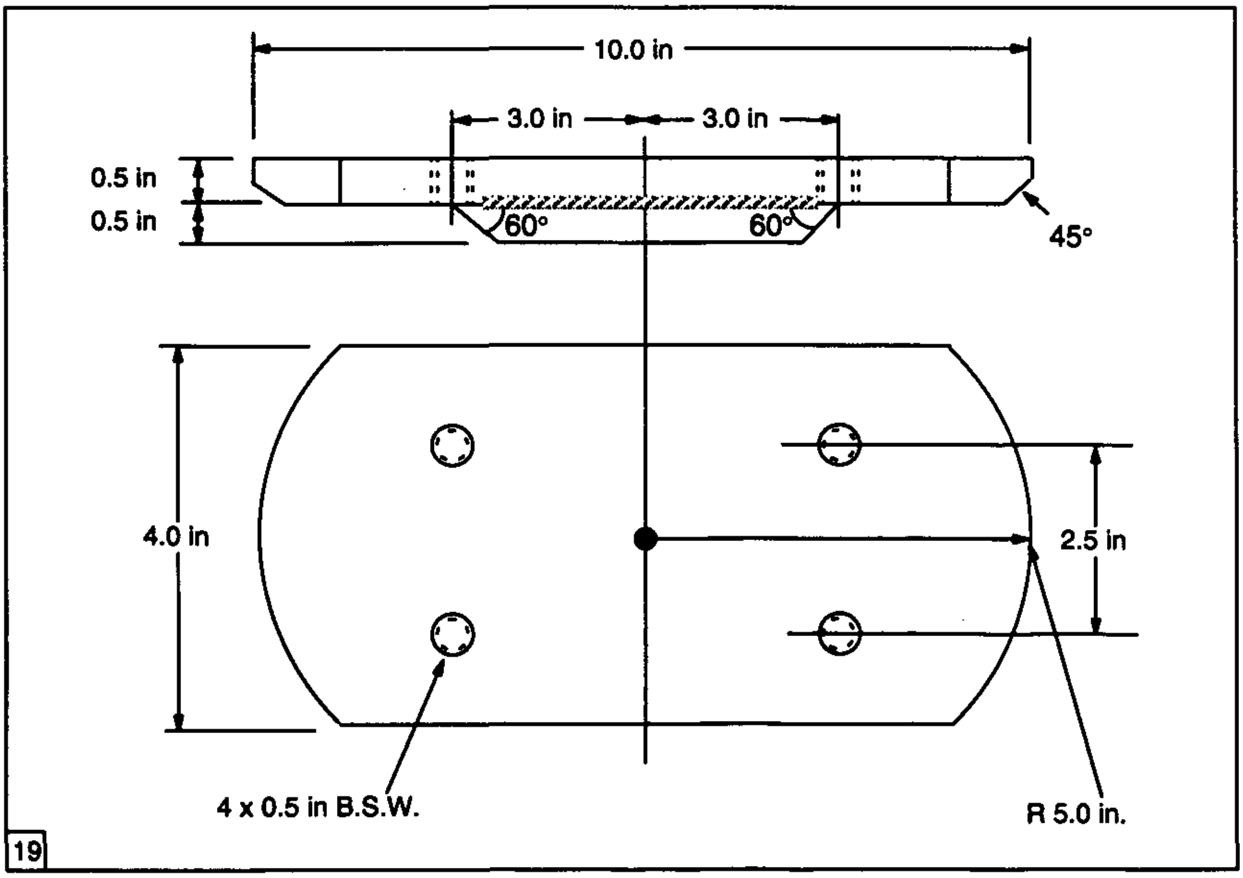
INSPECTION AND REPAIR

1. Clean and inspect all items for damage and excessive wear. Install new components where necessary.

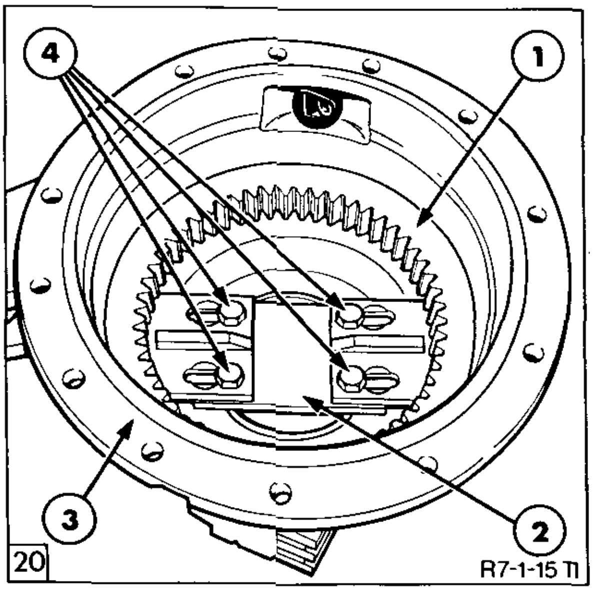
2. If the planetary ring gear requires replacement observe the following procedure:

- Remove the axle shaft from the housing.

- Fabricate a suitable plate, as shown in Figure 19, to be used in conjunction with the sliding ends of Tool No. FT4500. Insert the tool sliding ends behind the ring gear and tighten the locknuts, Figure 20.



Ring Gear Removal Adaptor Plate



Planet Ring Gear Removal

1. Planet Ring Gear
2. Remover/Replacer
3. Axle Housing
4. Tool Retaining Bolts

- Position the axle housing under an hydraulic press with the bell end of the housing on the floor. Insert a suitable bar between the remover/replacer and the head of the press ram. Press the planetary ring gear out of the housing.
- To replace the ring gear position the axle housing with the bell end upper–most.
- Place a new ring gear in the housing, position the tool on the new ring gear then press into position. Ensure the gear is seated correctly and there is no gap between the bottom of the gear and the housing shoulder.

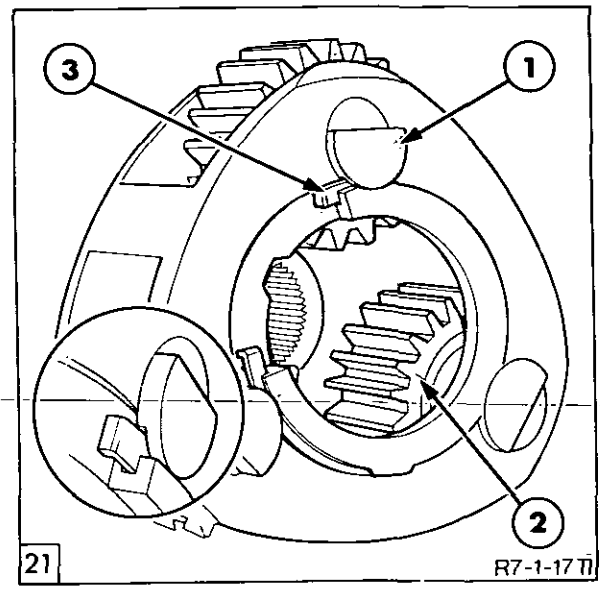
RE–ASSEMBLY

Re–assembly of the planetary gear assembly follows the disassembly procedure in reverse. On reassembly observe the following requirements:

- On reassembly of the planet gear carrier, install an equal number of rollers either side of the spacer within the gear bores.

NOTE: *There is a total of 58 rollers per planet gear.*

Use grease to retain the rollers in position whilst installing the planet gear shafts. Position the shafts with the flat portion of the shaft heads away from the centre of the carrier, Figure 21, then install the shaft retaining ring. Bend each end of the ring to ensure it maintains the correct position.



Planet Gear Carrier Ring Replacement

1. Planet Gear Shaft
2. Planet Gear
3. Retaining Ring

INSTALLATION

Installation of the planetary gear assembly follows the removal procedure in reverse. On installation ensure all bolts are correctly tightened to the torques detailed in the specifications, Section H.

E. DIFFERENTIAL AND DIFFERENTIAL LOCK ASSEMBLY – OVERHAUL

REMOVAL

1. Prior to removal, chock the front wheels and release the handbrake.
2. Drain the oil from the rear axle housing.
3. Raise and support the rear of the tractor to allow removal of the right hand wheel and right hand axle shaft housing.

4. With the axle shaft housing removed withdraw the differential assembly from the centre housing.

DISASSEMBLY

With reference to Figure 22.

1. Remove the differential lock ring from the end of the side gear. Withdraw the stop washer, coupling, spring and adaptor.

2. Mark the two halves of the differential case to facilitate correct installation on reassembly.

3. Remove the differential cone and roller assembly from the smaller half of the case. Use puller, Tool No. 1003, pulling adaptor, Tool No. 952 and step plate adaptor, Tool No. 630S/T, Figure 23.

4. Extract the differential case retaining bolts.

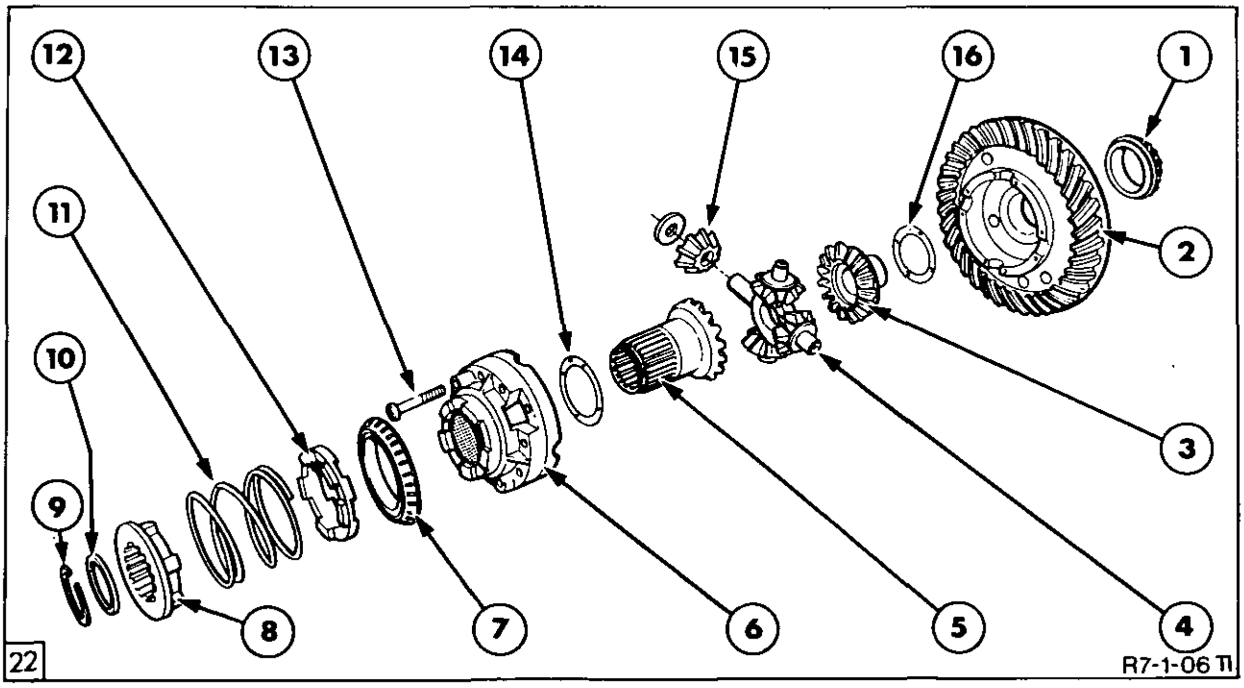
NOTE: *If the cone and roller assembly installed on the smaller half of the case does not require removal, withdrawal of the case retaining bolts may be effected by lifting the smaller half of the case and gradually removing the bolts.*

5. Separate the differential case.

6. Withdraw the thrust washer and side gear, the spider and pinion assembly and the second side gear and washer from the case.

7. Remove the cone and roller assembly on the ring gear half of the housing using puller, Tool No. 1003, pulling attachment, Tool No. 952 and step plate adaptor, Tool No. 630S.

8. Separate the pinion gears from the spider.



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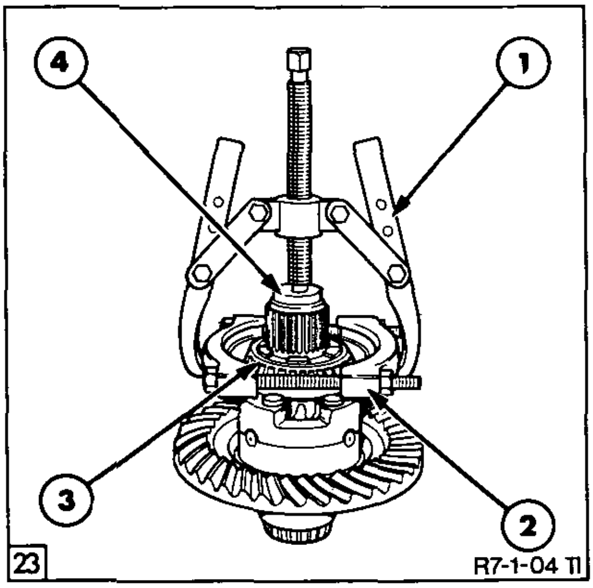
Differential Assembly

1. Cone and Roller Assembly
2. Ring Gear and Housing Assembly
3. Side Gear
4. Pinion Gear Assembly
5. Side Gear
6. Housing
7. Cone and Roller Assembly
8. Coupling
9. Retaining Ring
10. Washer
11. Spring
12. Adaptor
13. Retaining Bolt
14. Thrust Washer
15. Pinion Gear and Washer
16. Thrust Washer



Differential Cone and Roller Assembly Removal

1. Puller, Tool No. 1003
2. Pulling Attachment, Tool No. 952
3. Cone and Roller Assembly
4. Step Plate Adaptor, Tool No. 630S/T

INSPECTION AND REPAIR

1. Clean and inspect all components for damage or excessive wear. Install new components where necessary.
2. If a new differential ring gear is required, it will be necessary to drill out the rivets, installed during production and replace them with nuts and bolts, available from the Parts department. The bolts should be tightened to a torque value of 85 lbf.ft (115 Nm).

NOTE: *If the ring gear is replaced, a new matching drive pinion must also be installed. Refer to the following section, 'Drive Pinion Assembly Overhaul' of this Chapter.*

RE–ASSEMBLY

Re–assembly of the differential and differential lock follows the disassembly procedure in reverse. On re–assembly observe the following requirements:

- Coat all bearings with a suitable wheel bearing grease prior to installation.
- Tighten the differential case retaining bolts to a torque value of 68–92 lbf.ft (92–125 Nm).

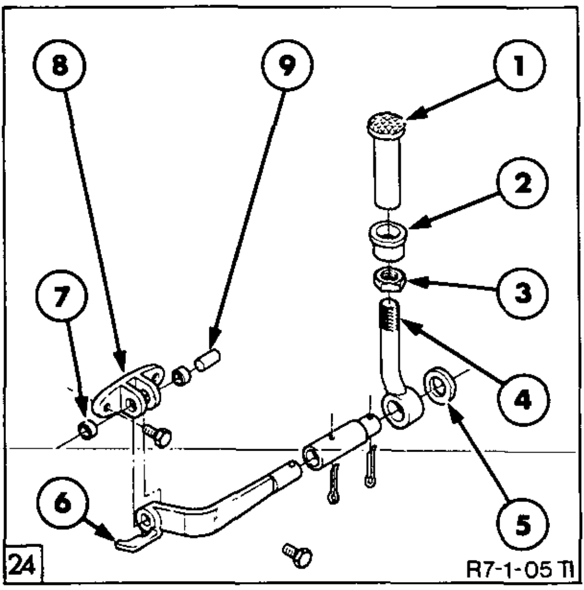
INSTALLATION

Installation of the differential and differential lock follows the removal procedure in reverse. *On installation observe the following* requirements:

- Check the differential bearing pre–load, refer to, 'Adjustments', Section G of this Chapter.

DIFFERENTIAL LOCK OPERATING LINKAGE OVERHAUL – (Mechanically Actuated)

REMOVAL



Differential Lock Linkage

1. Foot Pedal
2. Floor Panel Sleeve
3. Locknut
4. Pedal Operating Rod
5. Washer
6. Shaft Operating Rod
7. Bush – 2 off
8. Hanger
9. Hanger Pivot Pin

1. Loosen the locknut of the pedal assembly and remove the pedal assembly.
2. Remove the two bolts securing the hanger to the centre housing and withdraw the hanger and operating rods as an assembly.
3. Pull the fork operating rod from the centre housing.
4. Remove the operating rod oil seal from the centre housing if previously leaking or damaged.
5. If the operating fork requires replacement it will be necessary to remove the left hand axle shaft housing as described in Section C of this Chapter.

6. With the housing removed, remove the two bolts securing the fork pivot shaft to the centre housing and withdraw the shaft and fork as an assembly.

7. Remove the retaining ring and washer then slide the pivot shaft from the fork.

INSPECTION AND REPAIR

1. Clean and inspect all components for damage or excessive wear. Install new components where necessary.

2. If the pedal hanger bushes require renewal, observe the following procedure:

   (i) Knock the pin out of the hanger and pedal assembly then separate the pedal from the hanger.

   (ii) Use bushing kit, Tool No. 818, to remove and install the two bushings of the hanger.

   (iii) Align the pedal assembly to the hanger and replace the pin.

INSTALLATION

Installation of the differential lock operating linkage follows the removal procedure in reverse. On installation observe the following requirements:

- Tighten the differential lock fork pivot shaft retaining bolts to 42–56 lbf.ft (57–76 Nm).
- Tighten the hanger retaining bolts to 42–56 lbf.ft (57–76 Nm).
- If the rear axle housing has been removed ensure the the housing retaining bolts are tightened to 130–190 lbf.ft (176–258 Nm)
- Refill the axle with the correct grade and quantity of oil, see specifications.

F. DRIVE PINION ASSEMBLY – OVERHAUL

REMOVAL

1. Separate the tractor between the transmission and rear axle housing. Refer to the Part, 'Separating The Tractor',

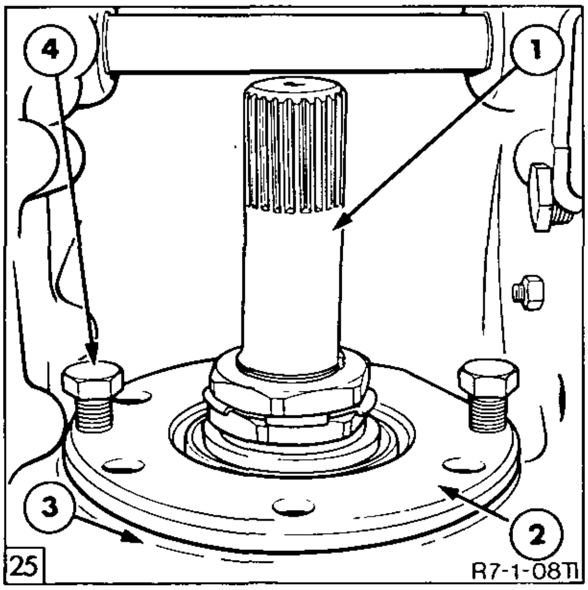
2. Remove the P.T.O. clutch housing as described in Part 6, P.T.O. Systems.

3. Where fitted, remove the transmission handbrake assembly, as detailed in Chapter 2 of this Part.

4. Remove the differential assembly as described in Section E.

5. Remove the drive pinion assembly by extracting the retaining bolts and washers and withdrawing the assembly from the housing, Figure 25.

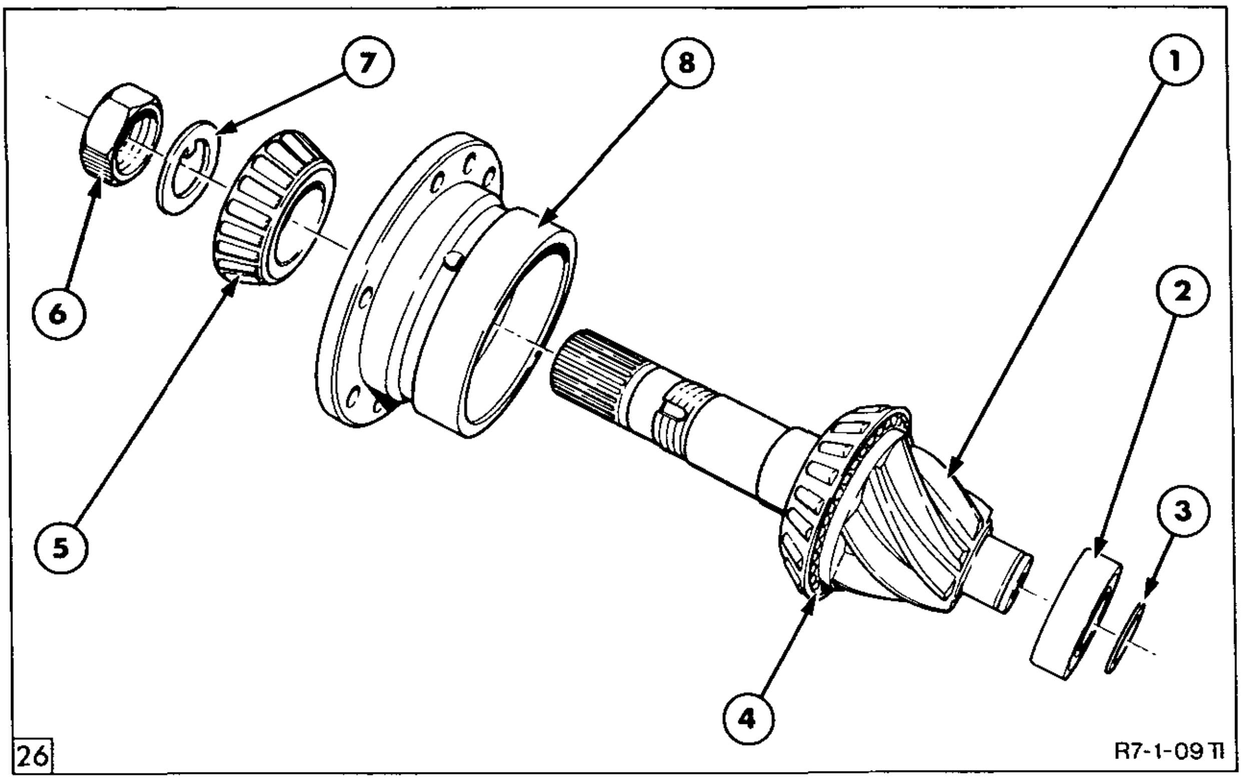
NOTE: *To facilitate removal of the drive pinion assembly, two threaded holes are provided for jacking bolts.*



Drive Pinion Assembly Removal

1. Pinion Shaft
2. Pinion Bearing Retainer
3. Rear Axle centre Housing
4. Jacking Bolt

DISASSEMBLY



Drive Pinion Assembly

1. Pinion Shaft
2. Pinion Bearing
3. Retaining Ring
4. Cone and Roller Assembly
5. Cone and Roller Assembly
6. Pinion Nut
7. Spacer
8. Pinion Assembly Housing

With reference to Figure 26.

NOTE: *There may be either a staked nut or double nut with a locking tab washer arrangement securing the pinion shaft to the bearing retainer.*

1. Remove the stake nut or double nut from the pinion shaft.

2. Slide the spacer, transmission handbrake drive gear and shims, where fitted, or the washer from the pinion shaft.

3. Use a soft headed mallet to knock the front end of the pinion shaft assembly from the bearing retainer. Lift the front cone and roller assembly from the retainer.

4. Remove the lock ring from the front of the pinion gear and pull the pinion bearing from the shaft using puller, Tool No. 1002 and pulling attachment, Tool No. 951.

5. Remove the cone and roller assembly from the shaft using puller, Tool No. 1003 and pulling attachment, Tool No. 951.

INSPECTION AND REPAIR

1. Clean then inspect all components for damage or excessive wear. Install new parts where necessary.

2. If necessary, remove the bearing cups from the retainer using slide hammer, Tool No. 943S and puller, Tool No. 943. Use step plate adaptor, Tool No. 630S and a press to install new bearing cups.

3. Use puller, Tool No. 1003, pulling attachment, Tool No. 951 and a suitable sleeve to install the rear cone and roller assembly to the pinion shaft.

RE–ASSEMBLY

NOTE: *If a new pinion shaft is to be installed a new matching differential gear must also be installed. Refer to Section E, 'Differential and Differential lock Overhaul', of this Chapter.*

Re–assembly of the drive pinion assembly follows the disassembly procedure in reverse. On reassembly observe the following requirements:

- Check the pinion bearing pre–load, see 'Adjustments', Section G of this Chapter.

INSTALLATION

Installation of the drive pinion assembly follows the removal procedure in reverse. On installation observe the following requirement:

- Tighten the bearing retainer support bolts to 100–125 lbf.ft (136–170 Nm).

G. ADJUSTMENTS

AXLE SHAFT BEARING PRE–LOAD

1. Install the axle shaft into the axle shaft housing.

2. Install the inner bearing cone and roller assembly onto the shaft. Using a suitable sized tube, tap the bearing onto the shaft. **DO NOT** fully seat the bearing into the bearing cone.

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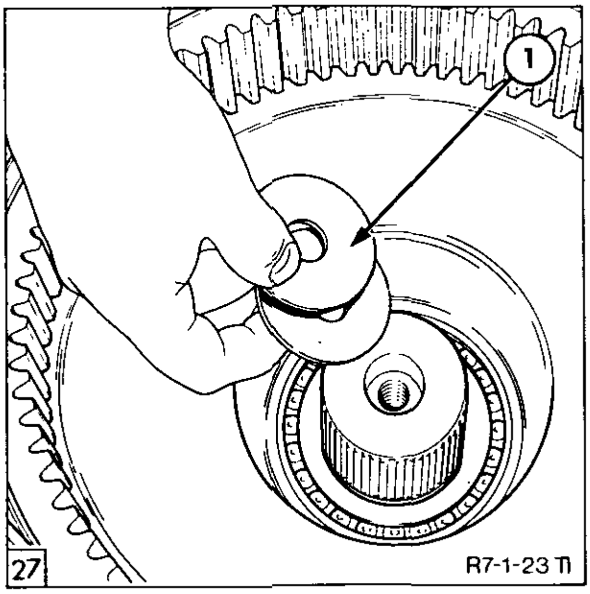

Axle Shaft Shim Location

1. Shims

3. Install the largest, (2.16 mm), spacer onto the axle shaft and install the planetary gear carrier into the housing.

4. Install and tighten the carrier retaining bolt to the correct torque value of 250–400 lbf.ft (339–542 Nm).

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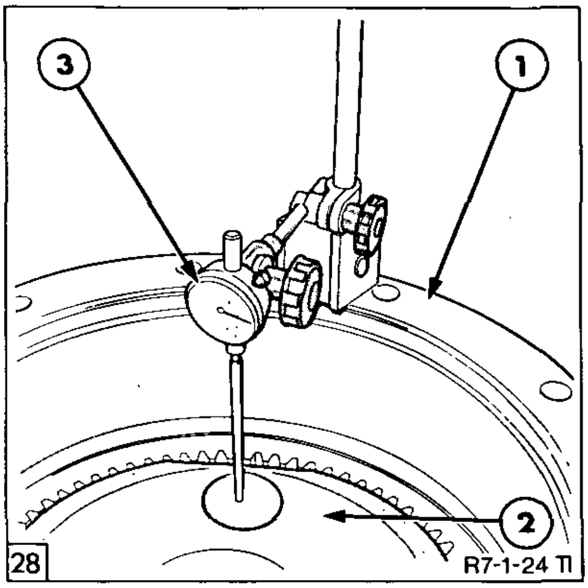


Axle Shaft Bearing Pre–Load Adjustment

1. Axle Shaft Housing
2. Planetary Carrier
3. Dial Gauge

5. Set a dial indicator, as shown in Figure 28. Zero the gauge and measure the end float by lifting the axle casing.

6. Subtract the measured end float from the size of the spacer installed. Use the resultant figure to determine, from table 1, the correct size of spacer to be installed.

EXAMPLE:

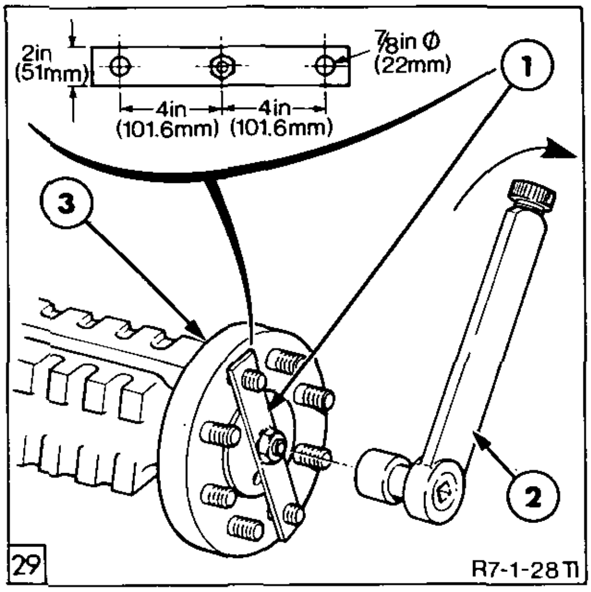
Spacer Installed	2.16 mm	0.085 in
Reading Obtained	0.66 mm	0.026 in
Resultant Figure	1.50 mm	0.059 in

From table 1, the correct size of spacer to be used is 0.053 in. (1.35 mm).

7. Remove the axle shaft retaining bolt then withdraw the planet gear carrier assembly, lock washer and large spacer.

8. Install the new selected spacer then the washer and planet gear carrier assembly and tighten the retaining bolt to a torque of 250–400 lbf.ft (339–542 mm).

9. After shimming is complete, measure the axle shaft rolling torque. Fabricate a plate to slide over the wheel studs, as shown in Figure 29, with a nut or bolt head welded in the centre. Using a suitable torque wrench, the rolling torque should be between 8.3–20.8 lbf.ft (11.6–28.2 Nm). If necessary, add shims to reduce the rolling torque or subtract shims to increase the rolling torque.



Axle Shaft Rolling Torque

1. Fabricated Plate Installed
2. Torque Wrench
3. Axle Shaft Hub Flange

10. Repeat for the second axle shaft.

Table 1:

RESULTANT FIGURE	SPACER TO BE INSTALLED
0.049–0.052 in (1.24–1.32 mm)	0.045 in (1.14mm)
0.053–0.056 in (1.35–1.42 mm)	0.049 in (1.24 mm)
0.057–0.060 in (1.45–1.52 mm)	0.053 in (1.35 mm)
0.061–0.064 in (1.55–1.63 mm)	0.057 in (1.45 mm)
0.065–0.068 in (1.65–1.73 mm)	0.061 in (1.55 mm)
0.069–0.072 in (1.75–1.83 mm)	0.065 in (1.65 mm)
0.073–0.076 in (1.85–1.93 mm)	0.069 in (1.75 mm)
0.077–0.080 in (1.96–2.03 mm)	0.073 in (1.85 mm)
0.081–0.084 in (2.06–2.13 mm)	0.077 in (1.96 mm)
0.085–0.088 in (2.16–2.24 mm)	0.081 in (2.06 mm)
0.089–0.092 in (2.26–2.34 mm)	0.085 in (2.16 mm)

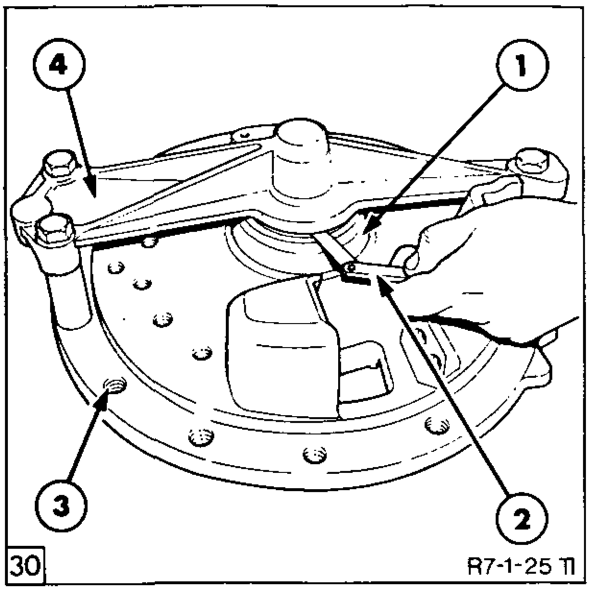
DIFFERENTIAL BEARING PRE–LOAD

The bearing pre–load is adjusted by adding or subtracting shims between the differential bearing cup and the inner brake housing. The adjustment is made to the bearing in the right hand axle shaft housing.

1. Assemble the inner brake disc into the axle shaft housing less the sun (intermediate) shaft, brake discs and actuator assembly.

2. Remove the differential bearing cup and shim from the inner brake housing.

3. Place the gauge ring of Tool No. FT.4501 into the vacant bearing location, Figure 30.



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Differential Bearing Pre–Load Adjustment

1. Gauge Ring, Tool No. FT4501 (SW7B)
2. Feeler Gauges
3. Inner brake housing
4. Gauge, Bridge Tool No. FT4501 (SW7)

4. Bolt the bridge of Tool No. FT.4501 across the inner brake housing flange, ensure the spacers are located between the flange and the tool.

5. Use feeler gauges to measure the gap between the underside of the gauge bridge and the top side of the gauge ring.

6. From Table 2 determine the initial size of shim to be used.

7. Remove the gauge bridge and gauge ring and install the selected shim and bearing.

Table 2:

GAP MEASURED	SHIM TO BE INSTALLED
0.024–0.029 in (0.61–0.74 mm)	0.038–0.040 in (0.97–1.02 mm)
0.030–0.035 in (0.76–0.87 mm)	0.044–0.046 in (1.12–1.17 mm)
0.036–0.041 in (0.91–1.04 mm)	0.050–0.052 in (1.27–1.32 mm)
0.042–0.047 in (1.07–1.19 mm)	0.056–0.058 in (1.42–1.47 mm)
0.048–0.053 in (1.22–1.35 mm)	0.062–0.064 in (1.58–1.63 mm)
0.054–0.059 in (1.37–1.50 mm)	0.068–0.070 in (1.73–1.78 mm)
0.060–0.065 (1.50–1.63 mm)	0.074–0.076 in (1.88–1.93 mm)
0.066–0.071 (1.65–1.78 mm)	0.080–0.082 in (2.03–2.08 mm)

8. When shimming is completed check the rolling torque of the differential assembly using the following procedure:

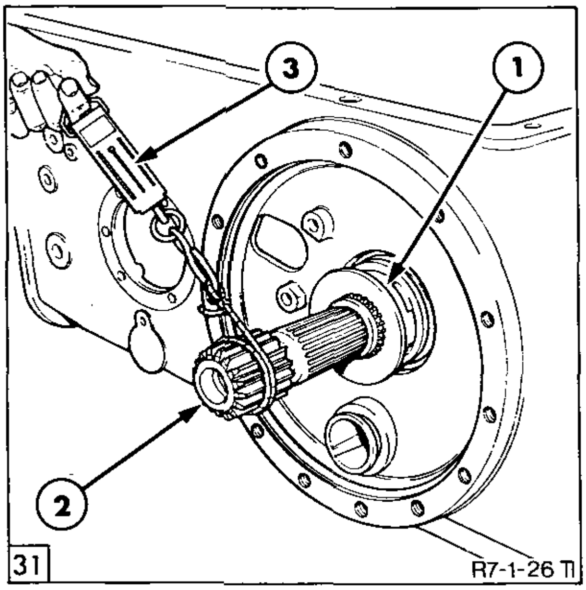
NOTE: *It is very important to perform the rolling torque check as the bridge tool will only identify the initial shim size.*

(i) Remove the left hand axle shaft housing if not already removed.

(ii) Remove the pinion and bearing retainer assembly.

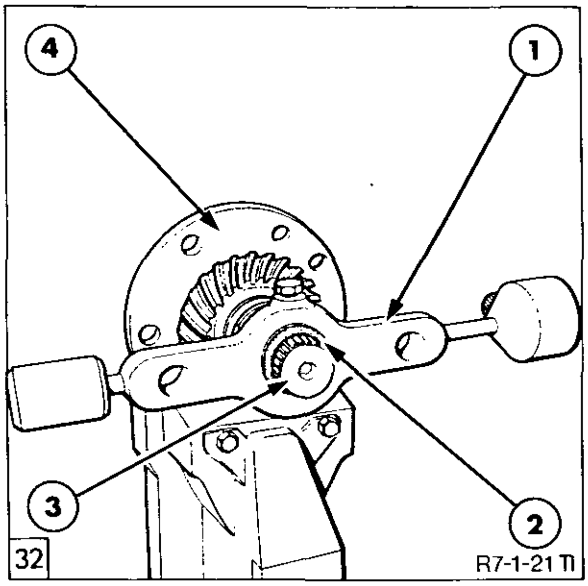
(iii) Remove the differential lock spring and slide the differential lock coupling into the engaged position.

(iv) With the differential assembly installed and the right hand inner brake housing flange bolted to the axle centre housing, install one of intermediate drive shafts into the differential assembly.



Differential Bearing Rolling Torque

1. Diff Lock Engaged with Spring Removed
2. Intermediate Shaft Installed
3. Pull Scale



Drive Pinion Pre–Load Adjustment with Tool No. FT.4062

1. Gauge Tool No. FT4062
2. Adaptor, Tool No. FT4062–2A
3. Drive Pinion Shaft
4. Bearing Retainer

(v) Wrap a length of string around the intermediate shaft and attach to a suitable pull scale, Figure 31. Measure the rolling torque whilst the shaft is rotating, not at the point where rotation begins. The rolling torque should equate to a reading of between 15–67 lbf. (7–30 Kgf.) on the pull scale.

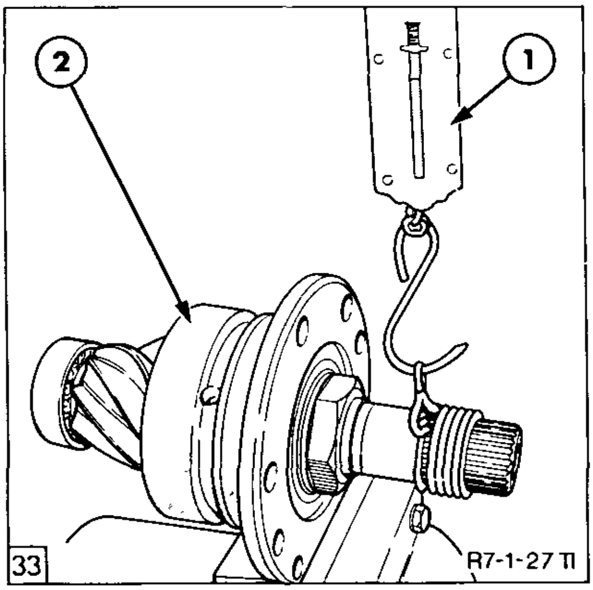
(vi) If necessary, add shims to increase the rolling torque or subtract shims to reduce the rolling torque

9. Assemble the rear axle as previously described in this Chapter.

PINION SHAFT BEARING PRE–LOAD

Prior to installation of the drive pinion and retainer assembly, check the pinion bearing pre–load as follows:

1. Lubricate the pinion bearings and locate the pinion and retainer assembly in a vice.
2. Install the adjusting (stake) nut or adjusting nut, new lock washer and locknut.
3. Using gauge, Tool No. T.4062 and adaptor, Tool No. T.4062–2A, or a suitable spring pull gauge check and adjust to obtain the correct pre–load as shown in Table 3.



Drive Pinion Pre–Load Adjustment with Spring Pull Gauge

1. Pull Scale
2. Drive Pinion Assembly

4. When the correct pre–load is obtained tighten the locknut and bend tabs on the lockwasher or stake the nut as required.

5. Re–check the pre–load.

Table 3:

Using Gauge, Tool No. FT.4602 10–17 lb.in (1.1–1.9 Nm)
Using a Spring Pull Gauge 13–23 lbf. (5.9–10.5 Kgf.)

H. SPECIFICATIONS, TIGHTENING TORQUES AND SPECIAL TOOLS

SPECIFICATIONS

MODEL (Transmission)	**56/66/7840** (8x2/16x4)	**56/66/77/7840** (12x12)	**56/66/77/7840** (16x16)	**82/8340** (16x16)
Rear Axle General :				
Planetary Gears	3	3	3	4
Ratios Spiral Bevel	5.286	5.625		
Planetary	4.5	6.0		
Overall	23.786	33.75		
Pitch Dia, Spiral Bevel	13.13 in			13.5 in
	(333.5mm)			(342.9mm)
Axle Shaft Diameter	2.7 in			3.02
	(68.58mm)			(76.5mm)
Differential Lock	Mechanical	Electro Hydraulic		
Draw Bar Pull lbs	9000	9500	9500	11700
kgms	(4082)	(4309)	(4309)	(5306)
Load Capacity lbs	12000	13800	13800	16800
kgms	(5443)	(6260)	(6260)	(7620)
Oil Specification	ESN–M2C134–D			
Oil Quantity				
Imp. Gallons	14.5	12.5	13.3	
U.S. Gallons	17.4	15.0	16.0	
Litres	66.0	56.8	60.6	

Axle Shaft Pre–Load

Axle Shaft Rolling Torque using a Torque Wrench: 8.3–20.8 lbf.ft (11.6–28.2 Nm).

Table 1:

RESULTANT FIGURE	SPACER TO BE INSTALLED
0.049–0.052 in (1.24–1.32 mm)	0.045 in (1.14mm)
0.053–0.056 in (1.35–1.42 mm)	0.049 in (1.24 mm)
0.057–0.060 in (1.45–1.52 mm)	0.053 in (1.35 mm)
0.061–0.064 in (1.55–1.63 mm)	0.057 in (1.45 mm)
0.065–0.068 in (1.65–1.73 mm)	0.061 in (1.55 mm)
0.069–0.072 in (1.75–1.83 mm)	0.065 in (1.65 mm)
0.073–0.076 in (1.85–1.93 mm)	0.069 in (1.75 mm)
0.077–0.080 in (1.96–2.03 mm)	0.073 in (1.85 mm)
0.081–0.084 in (2.06–2.13 mm)	0.077 in (1.96 mm)
0.085–0.088 in (2.16–2.24 mm)	0.081 in (2.06 mm)
0.089–0.092 in (2.26–2.34 mm)	0.085 in (2.16 mm)

Differential Bearing Pre–Load

Differential Bearing Rolling Torque using a Spring Pull Gauge: 15–67 lbf. (7–30 Kgf.)

Table 2:

GAP MEASURED	SHIM TO BE INSTALLED
0.024–0.029 in (0.61–0.74 mm)	0.038–0.040 in (0.97–1.02 mm)
0.030–0.035 in (0.76–0.87 mm)	0.044–0.046 in (1.12–1.17 mm)
0.036–0.041 in (0.91–1.04 mm)	0.050–0.052 in (1.27–1.32 mm)
0.042–0.047 in (1.07–1.19 mm)	0.056–0.058 in (1.42–1.47 mm)
0.048–0.053 in (1.22–1.35 mm)	0.062–0.064 in (1.58–1.63 mm)
0.054–0.059 in (1.37–1.50 mm)	0.068–0.070 in (1.73–1.78 mm)
0.060–0.065 (1.50–1.63 mm)	0.074–0.076 in (1.88–1.93 mm)
0.066–0.071 (1.65–1.78 mm)	0.080–0.082 in (2.03–2.08 mm)

Drive Pinion Pre–load (Rolling Torque)

Table 3:

Using Gauge, Tool No. FT.4602 10–17 lb.in (1.1–1.9 Nm)
Using a Spring Pull Gauge 13–23 lbf. (5.9–10.5 Kgf.)

TIGHTENING TORQUES

Components	lbf.ft	Nm
Axle Shaft Housing Retaining Bolts	130–190	176–258
Axle Shaft Retaining Bolt	250–400	339–542
Differential Ring Gear Retaining Nuts	85	115
Differential Case Retaining Bolts	68–92	92–125
Differential Lock Fork Pivot Shaft Retaining Bolts	42–56	57–76
Differential Lock Hanger Retaining Bolts	42–56	57–76
Inner Brake Housing Retaining Bolts	65–89	88–121
Drive Pinion Bearing Retainer Bolts	100–125	136–170
Ring Gear Thrust Block	27–37	37–50
Wheel Nuts (Disc to Hub)		
Manual Adjust Wheels	288	390
Power Adjust Wheels	525	712

SPECIAL TOOLS

DESCRIPTION	V.L. CHURCHILL LTD TOOLS	NUDAY TOOLS
Shaft Protectors	625A	9212
Step Plates	630S	9210
Step Plate Adaptor	630T	9211
Taper Base	370	–
Slave Ring	CT.9056	–
Planetary Ring Gear Remover/Replacer	FT.4500 (SW.6)	2122 (SW.6–48) 2123 (SW.6–56)
Differential Bearing Pre–Load Gauge	FT.4501 (SW.7)	2141 (SW.505)
Drive Pinion Pre–Load Gauge	T.4062	(Pull Scale)
Drive Pinion Pre–Load Gauge Adaptor	T.4062A	
Puller Legs	930B	9521
Puller	938	9506
Internal/External Puller	943	9507
Slide Hammer	943S	9567
Pulling Attachments:		
Small	951	9190
Large	952	9526
Pullers:		
Small	1001	9196
Medium	1002	9198
Large	1003	9516

PART 7
REAR AXLE AND BRAKES

Chapter 2
BRAKES

A. DESCRIPTION AND OPERATION

REAR BRAKE ASSEMBLIES

Wet disc type rear brake assemblies are located within each axle housing.

The brake actuation of S Model, 5640, 6640 and 7740 tractors is by mechanical means using a rod and linkage arrangement. 3 Brake friction discs, per side, are installed on 5640 and 6640 models, 4 Discs are standard on the 7740 and 5640 and 6640 models where 2 speed P.T.O is fitted.

SL and SLE Model, 5640, 6640, 7740 and 7840 tractors employ a hydraulically actuated braking system, which has 3 brake friction discs installed per side.

SLE Model 8240 and 8340 tractors have 4 brake friction discs, per side, as standard, also hydraulically actuated.

The brake assembly consists of internally splined brake discs in each half axle housing which sandwich an actuator assembly and an intermediate disc.

The actuator assembly consists of two plates with ramped pockets into which are located steel balls. The discs are held together by springs and are connected to the actuating lever by two links.

The actuating lever is operated by linkage connected to the brake pedals on the S–Model range. A hydraulic cylinder is mounted on the actuator assembly of SL and SLE Models.

Upon operation of the brake pedals the actuating plates rotate relative to one another, which causes the steel balls to ride up the ramped pockets forcing the actuating discs apart. As the actuating discs move apart the brake discs are forced against the brake housing to effect a braking action on the intermediate shaft.

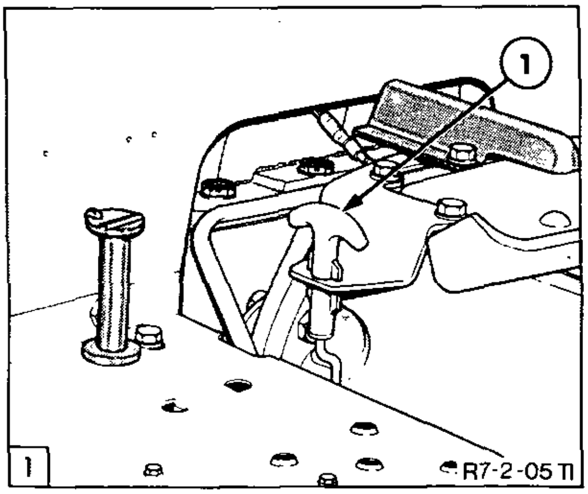
A common, compartmental, reservoir is used to provide hydraulic oil for both the hydraulic clutch and brake master cylinders.

The Master cylinders, one on each brake pedal, are push rod operated via suspended brake pedals. A bridging pipe between the two cylinders and a compensating ball and valve assembly in each master cylinder provides an automatic brake balance system which allows for some unequal brake disc wear or poorly adjusted brakes.

Handbrake Operation (SL/SLE Models)

A handbrake lever located to the left of the drivers seat on either with or less cab models is connected, via two operating cables, to the brake control rods of each rear brake assembly. When the lever is operated the brake actuators, described previously, function in the same way as if the footbrakes were operated. The brake control rods have an adjuster nut to adjust the hydraulic footbrake system.

Park Brake Latch (S Models Only)



Parking Brake – S Models Only

1. Parking Brake Latch

A park brake latch is provided on S model tractors. This consists of a ratchet assembly on the left hand brake pedal and a pull rod located to the right hand side of the transmission. To operate the latch, lock the footbrakes together, pull up the latch and rotate a quarter of a turn. When the footbrakes are applied they will lock in the applied position. To disengage rotate the latch a quarter of a turn and release and momentarily depress the footbrakes to disengage the ratchet.

Transmission Handbrake (Optional All Models)

A transmission handbrake is available in certain markets where legislation demands an entirely separate handbrake. A brake housing consisting of two dry friction discs and an actuator assembly is located on the left hand side of the rear axle centre housing. An actuating cable connects the operating lever to the housing.

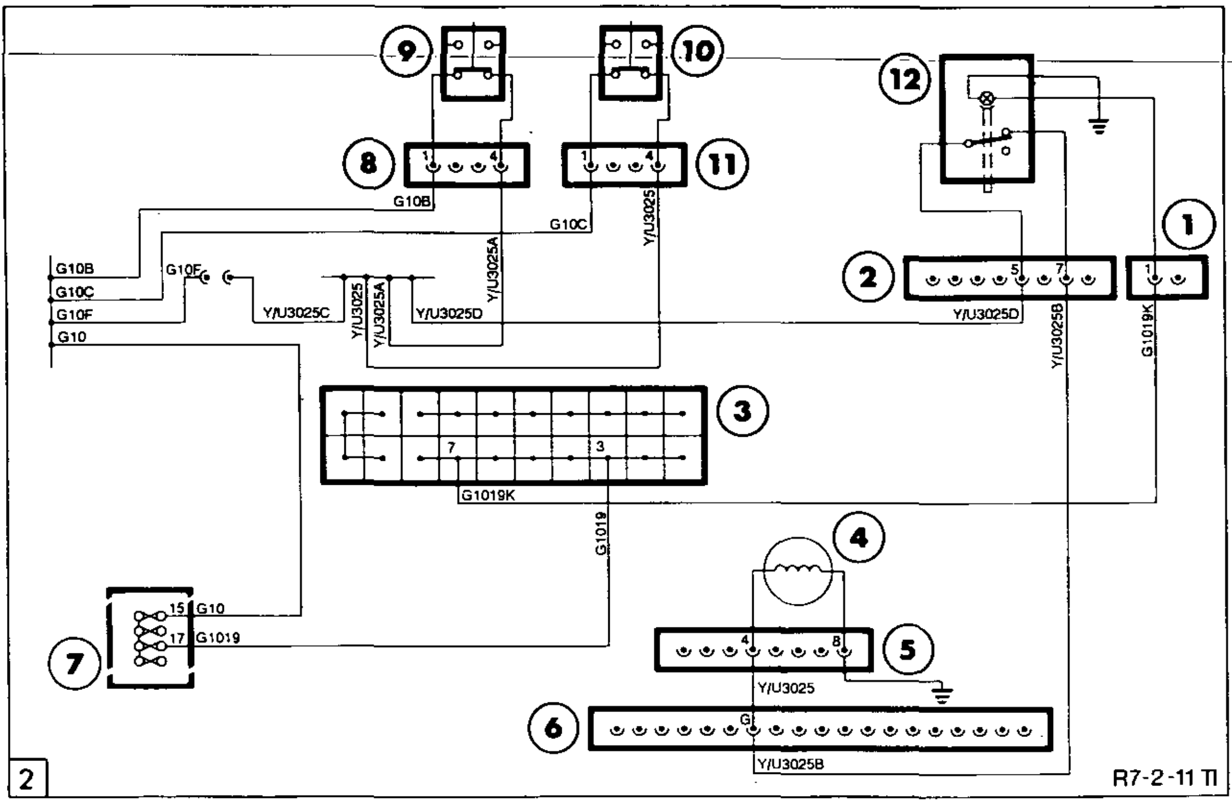
A bevel gear is splined onto the main rear axle drive pinion shaft to mesh with a driven gear mounted on the inner end of the handbrake pinion shaft. When the operating lever is lifted to the 'ON' position, the actuator forces the friction discs against the brake housing, effecting a braking action on the brake shaft, locking the main rear axle drive pinion.

FOUR WHEEL BRAKING
(Not Applicable to NASO tractors)

Four wheel braking is available on SL models (12x12 transmissions) and SLE models (16x16 transmissions) fitted with front wheel drive.

When the brake pedals are operated, both together, the electrical supply to the front wheel drive switch and hence the front wheel drive solenoid is cut, thus the front wheel drive is engaged providing the four wheel braking.

NOTE: *To avoid possible serious mechanical damage to the dog teeth of the four wheel drive unit, it is important that the brake switches are correctly adjusted to ensure that the front wheel drive becomes engaged before the rear brake assemblies start operating.*



Four Wheel Braking Electrical Circuit

1. Four Wheel Drive Switch Connector
2. Four Wheel Drive Switch Connector
3. Splice Connector
4. Solenoid
5. Solenoid Connector
6. Extension Harness Connector C1
7. Fuse Box
8. Switch Connector
9. Left Hand Brake Switch
10. Right Hand Brake Switch
11. Right Hand Brake Switch Connector
12. Four Wheel Drive Switch

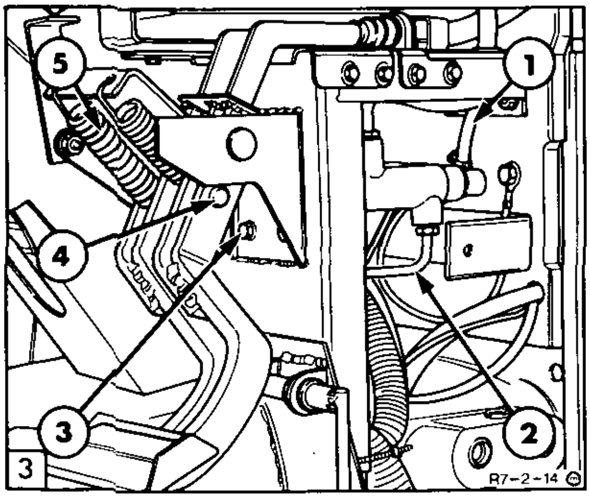
B. TROUBLE SHOOTING

TROUBLE SHOOTING

PROBLEM	POSSIBLE CAUSES	REMEDY
Excessive Pedal Travel	Brakes Require Adjustment	Adjust Brakes
Pedal Feels 'Spongy'	Air in System	Bleed Brakes
Reservoir Oil Requires Regular Topping Up	Leak In System	Check Tube Connections and Tube Condition. Check Master Cylinder Push Rod End For Oil Weepage. Check Slave Cylinders.
Unequal Braking	Brakes Badly Out of Adjustment	Adjust Brakes
	Air in one side of System	Bleed System
	Only One Brake Operating	Jack Up Tractor , Check Brake Operation, Inspect Adjustment Linkage. Slave Cylinder Seized. Sudden Loss of Oil From One Side, Inspect Tubes and Connections Inspect Brake Actuators and Brake Plates.

C. BRAKE SYSTEM COMPONENT OVERHAUL

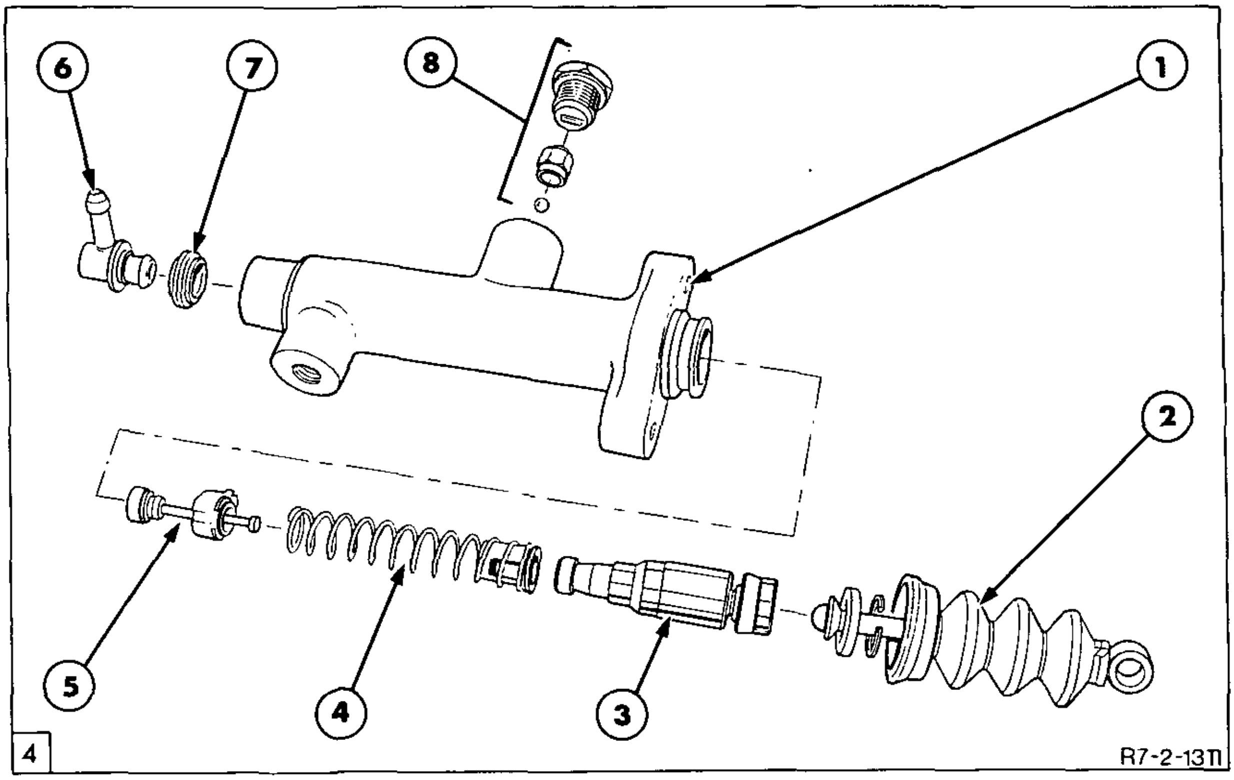
MASTER CYLINDER – Removal



Brake Master cylinder

1. Supply Tube from Reservoir
2. Outlet Tube to Slave Cylinders
3. Master Cylinder Retaining Bolt
4. Push Rod to Pedal Clevis Pin
5. Brake Pedal Return Spring

1. Remove the instrument console right hand side cover.
2. Disconnect the hose from the reservoir. Plug to prevent excessive oil loss.
3. Disconnect outlet tubes and plug.
4. Remove the brake pedal return springs and disconnect the push rods from the brake pedals.
5. Remove the four bolts securing the cylinder assemblies to the tractor bulkhead and withdraw cylinders.
6. Installation is the reversal of the removal procedure.



Master Cylinder – Exploded View

1. Master Cylinder Body
2. Push Rod and Boot Assembly
3. Spool
4. Spring and Retainer
5. Rod and Seal
6. Oil inlet Adaptor
7. Seal
8. Compensating Ball and Valve Assembly

MASTER CYLINDER – OVERHAUL

Disassembly

1. Roll back push rod rubber sleeve, remove circlip, retaining push rod and spool assembly.
2. Remove the balance tube and the system compensating balls and valves from each cylinder.
3. Gently tap the cylinder, spool end downwards, onto a firm surface to remove the spool assembly.
4. Withdraw the oil inlet adaptors and hook out end seals.
5. From the spool and spring assembly, bend back the locking tab and withdraw spring assembly. Unhook the rod and disassemble.

Inspection and Repair

1. Inspect the cylinder bore for wear, score marks or burrs. If the bore is not in perfect condition replace the cylinder assembly. Do not attempt to repair.
2. A seal kit is available in Service. When overhauling the master cylinder obtain a kit and replace **ALL** seals.
3. Coat all seals in clean brake oil prior to fitment.

IMPORTANT: *Use only the specified type of brake oil (see specifications). The oil used in this system is a 'Mineral' based oil. Use of a non specified oil may cause seal damage and a resultant brake failure.*

Reassembly

1. Reassembly is the reversal of the disassembly procedure.

BRAKE ACTUATOR AND SLAVE CYLINDER – OVERHAUL

Removal

For removal procedures of the brake assembly refer to '*Rear Axle Shaft Assembly Overhaul*' Section C, Chapter 1 of this Part.

Disassembly

With reference to Figure 5.

1. Remove the split pin and clevis pin and disconnect the brake handbrake and footbrake adjusting rod from the actuating links.

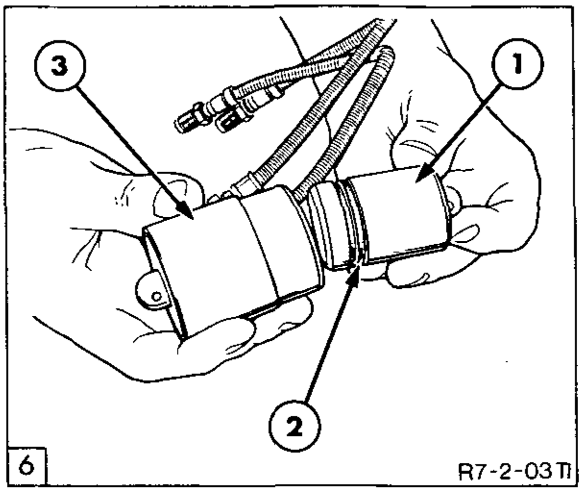
2. Unscrew and remove the nuts and bolts retaining the links to the actuating discs.

3. Unclip the springs retaining the brake master cylinder to the actuating discs and remove the cylinder.

4. Unclip and remove the four actuating disc retaining springs and separate the discs.

NOTE: *Retain the steel balls located between the actuating discs for use during re–assembly.*

5. To replace the seal of the slave cylinder or to inspect the cylinder bore, pull the piston from the cylinder assembly as shown in Figure 6.

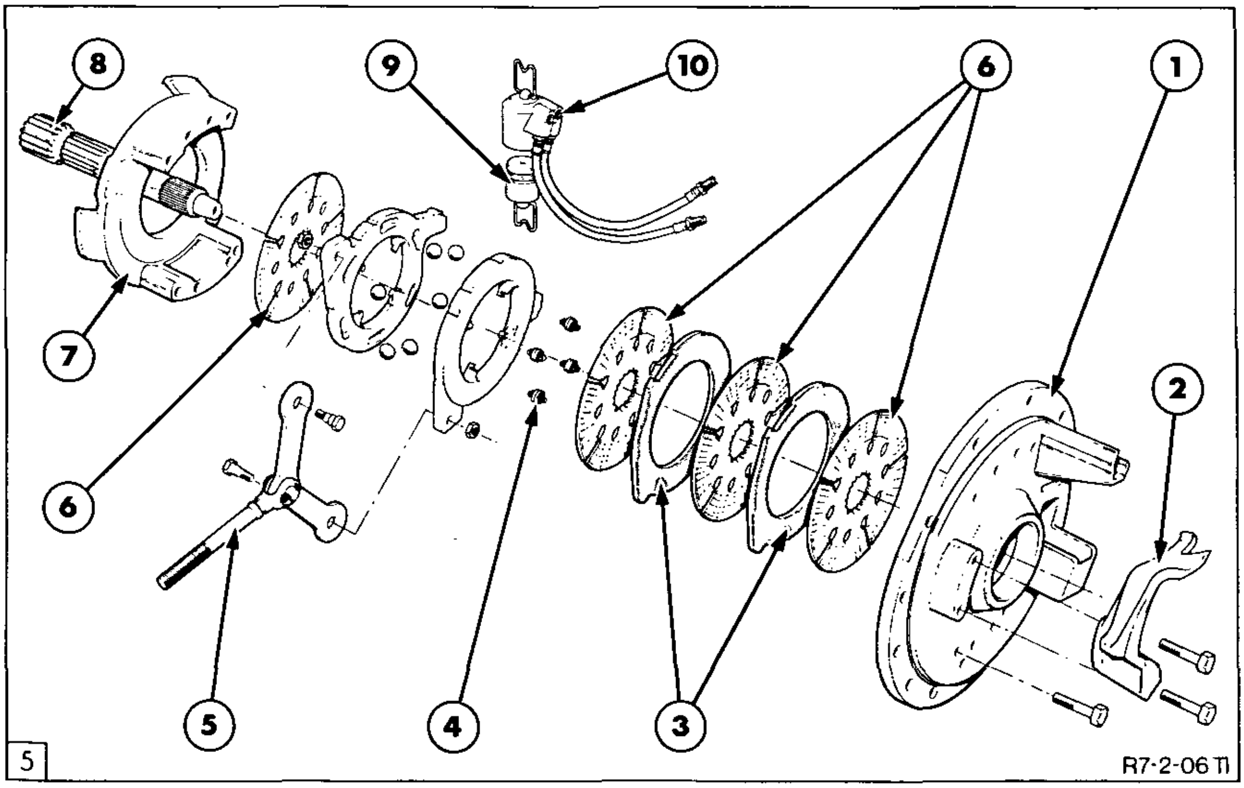


Slave Cylinder Assembly

1. Piston
2. Seal
3. Housing

Inspection and Repair

1. Clean and inspect all items for damage or excessive wear. Install new components where necessary.



Brake Assembly Components
(Heavy Duty Rear Axle Shown)

1. Inner Brake Housing
2. Thrust Block (Heavy Duty Axle Only)
3. Separator Plates, 2 Per Side Heavy Duty, 1 Per Side Standard Axle
4. Actuator Springs
5. Pull Rod Assembly
6. Brake Friction Discs. 4 Per Side Heavy Duty, 3 Per Side Standard Axle
7. Outer Brake Housing
8. Intermediate Drive Shaft
9. Slave Cylinder Piston and Seal Assembly
10. Slave Cylinder Housing

2. Inspect the slave cylinder bore for wear, score marks or burrs. If the bore is not in perfect condition replace the cylinder assembly. Do not attempt to repair.

3. A replacement seal is available in Service. When overhauling the slave cylinder the seal edge should have a pointed, sharp appearance and not rounded.

4. Prior to assembly of the piston to the cylinder coat the seal and cylinder bore in clean brake oil.

IMPORTANT: *Use only the specified type of brake oil (see specifications). The oil used in this system is a 'Mineral'-based oil. Use of a non specified oil will cause seal damage and a resultant brake failure.*

Reassembly

1. Reassembly is the reversal of the disassembly procedure.

Installation

*Installation of the brake disc follows the removal procedure in reverse, refer to '*Rear Axle Shaft Assembly Overhaul*' Section C, Chapter 1 of this Part.*

SYSTEM BLEEDING

1. Ensure the reservoir is filled up to the maximum line with the specified brake oil.

2. When bleeding a system which has been completely drained of oil, it will be necessary to prime the system. Open all the bleed screws and pump the coupled pedals several times, close the bleed screws.

3. Bleed the system using the following sequence, referring to Figure 7: A, B, and if trailer brakes are fitted, C, D and E.

NOTE: *Regularly inspect the oil level in the reservoir during bleeding. Do not allow it to empty.*

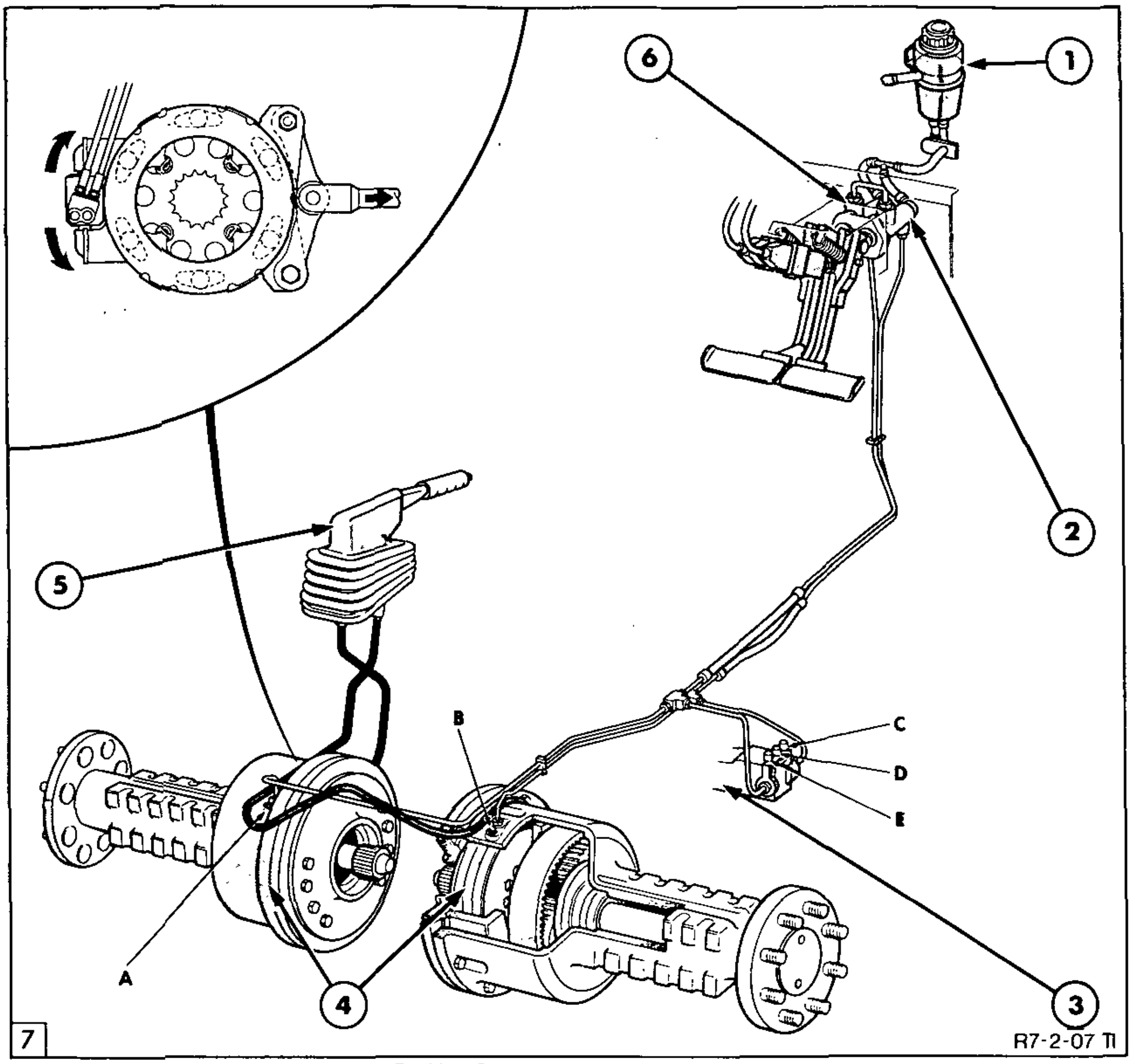
4. Install a suitable rubber tube over the bleed screw. Immerse the tube into a jar of clean and of correct specification brake oil. Position the jar above the bleed screw, this prevents possible air ingress at the bleed screw.

5. Open the bleed screw and fully stroke the coupled brake pedals several times until 'air free' oil is entering the jar.

6. With the pedals held down lock the bleed screw. Repeat procedure in the correct sequence on the remaining bleed screws, until all the air is removed from the system.

7. Check the oil level in the reservoir.

7



Braking System Component Layout

1. Reservoir
2. Right Hand Brake Master Cylinder
3. Trailer Brake Valve (where Fitted)
4. Brake Assemblies
5. Handbrake
6. Left Hand Brake Master Cylinder

A,B,C,D,E Brake Bleed Screws

BRAKE ADJUSTMENT

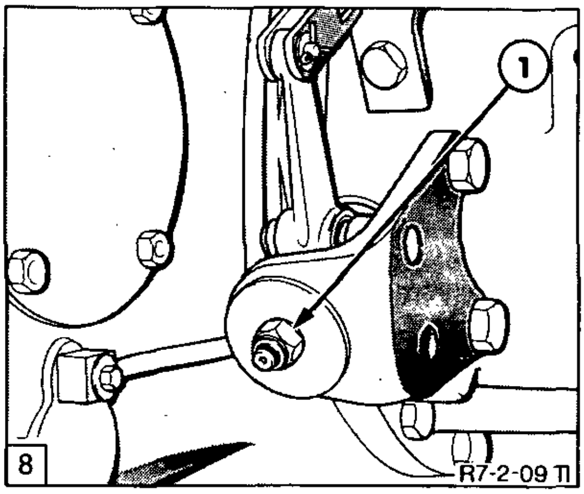
Footbrake – SL/SLE Models

1. Ensure that the handbrake cable adjustment is not affecting the footbrake adjustment. Slacken handbrake cables if necessary.

2. Raise the vehicle and support on stands.

3. On one side of the tractor tighten the adjuster nut until the wheel just locks, Figure 8. Back off the adjuster by one revolution and ensure that the wheel is free to rotate. Repeat the operation for the other wheel.

8



SL/SLE Model Footbrake Adjustment

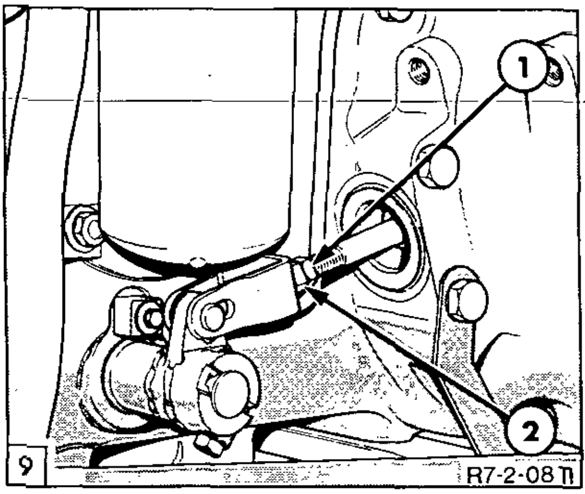
1. Adjuster Nut

Footbrake – S Models

Free play at the brake pedals should be 1.5 in. (38 mm). With the brake pedals locked together, the tractor should stop in a straight line when the brakes are applied.

1. Adjustment is made to the brake pull rods beneath the tractor. Block the wheels, front and rear, unlock the brake pedals and release the parking brake latch.

9



S Model Footbrake Adjustment

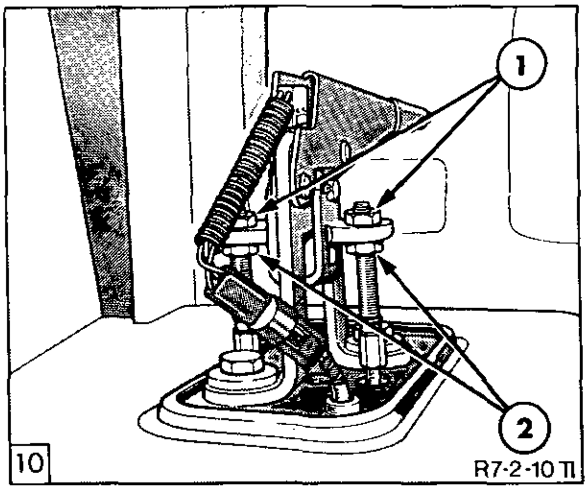
1. Locknut
2. Adjuster Nut

2. Loosen the locknut on the left hand brake pull rod, Figure 9, and turn the adjuster nut until free play at the left hand brake pedal is 1.5 in (38 mm). Tighten the locknut.

3. Repeat on the right hand brake pull rod.

Handbrake

10



Handbrake Adjustment

1. Adjuster Nuts
2. Locknuts

1. Adjust the cables equally, using the adjuster nuts, shown in Figure 10, until the wheels are locked on the 4th or 5th notch of the handbrake lever. Ensure the clevis assembly is in a balanced condition after adjustment.

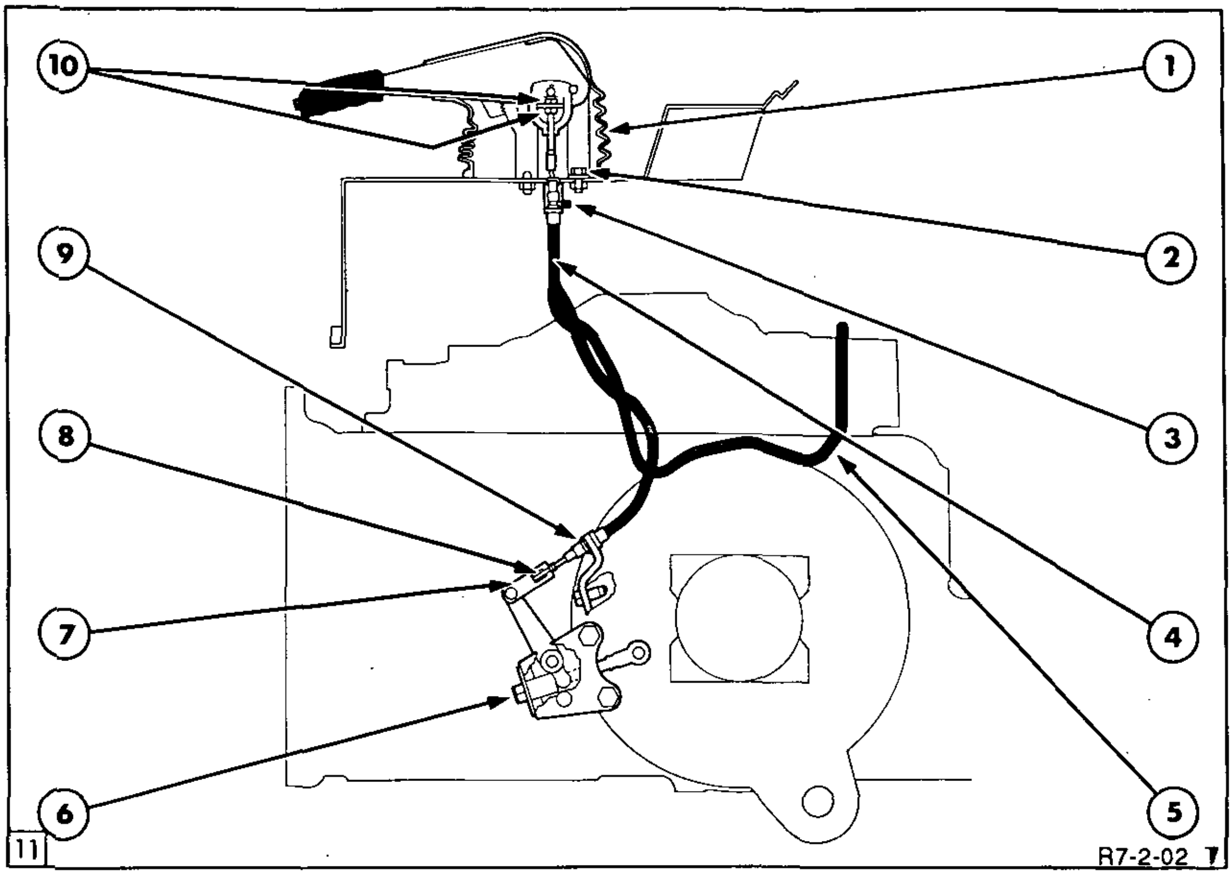
Road Test – All Models

1. With the brake pedals coupled, drive the tractor and apply the footbrakes. The tractor should stop in a straight line.

2. Repeat the procedure using the handbrake.

D. HANDBRAKE ASSEMBLY OVERHAUL

11



Handbrake Assembly

1. Protective Rubber Boot
2. Retaining Bolt – 2 off
3. Cable Retaining Screw
4. Left Hand Cable
5. Right Hand Cable
6. Footbrake Adjuster Nut
7. Clevis
8. Cable End Ferrule
9. 'C' Clip
10. Cable Adjuster and Locknuts

CABLE REMOVAL (SL/SLE Models With and Less Cab)

With reference to Figure 11.

1. Chock a wheel and release the handbrake.
2. Lift the protective rubber boot up from the floor and remove the nuts from the top of the cables.
3. From under the cab/platform, remove the cable end ferrule from the clevis and remove the 'C' clip securing the outer cable to the axle bracket.
4. Remove the upper cable retaining screw.
5. Note the cable routing and remove the cables.

HANDBRAKE LEVER REMOVAL (SL/SLE Models With and Less Cab)

With reference to Figure 11.

1. Chock a wheel and release the handbrake.
2. Lift the protective rubber boot up from the floor and remove the nuts from the top of the cables.
3. Disconnect the handbrake warning light/buzzer switch connector.
4. Remove the two bolts securing the lever to the floor and remove the lever from the vehicle.

PARKING BRAKE ASSEMBLY (S Models only)

1. Chock a wheel and release the parking brake.
2. Remove the split pin from the lower end of the lever rod and withdraw the lever and rod assembly from the tractor.

INSPECTION (All Models)

1. Inspect the cables for kinking, inner to outer cable tightness, frayed wire and outer covering damage, replace if damaged.

2. Inspect the lever and rod assembly of 'S' models, ensure the rod is not bent.
3. Inspect the ratchet mechanism of the handbrake lever, SL and SLE models and the ratchet teeth of the footbrake pedal of the S model. Replace if the teeth are worn.

INSTALLATION (All Models)

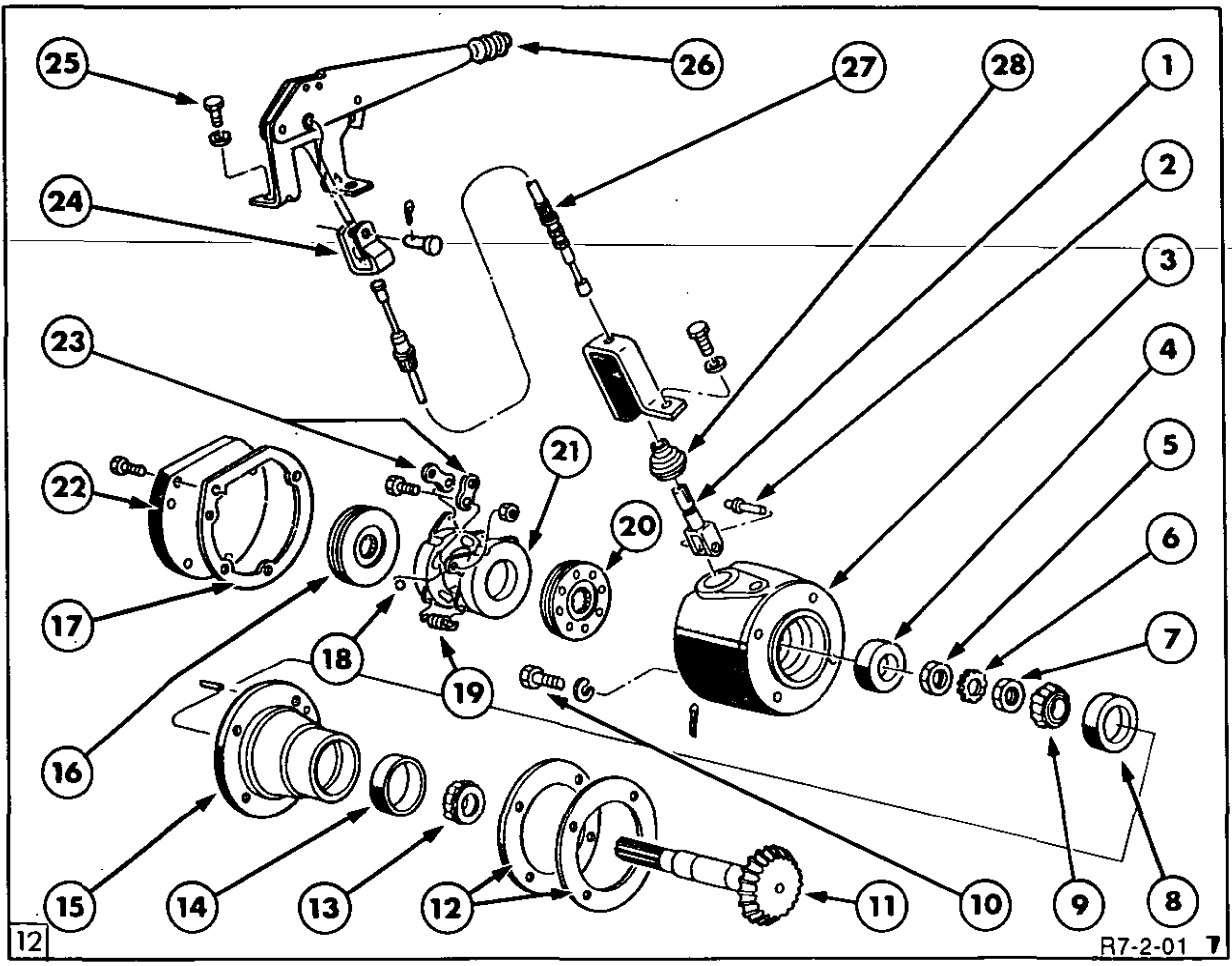
Installation of all the handbrake components is the reverse of the removal procedure observing the following points:

- Tighten the handbrake lever to floor securing bolts to a torque of 33 lbf.ft (45 Nm)
- Ensure the cable is routed correctly, avoiding moving components and without any sharp bends. Secure as required using nylon straps.
- If split pins have been removed always replace with new items.
- Ensure the footbrakes are correctly adjusted and then adjust the handbrake. Adjustment procedures are detailed in Section C of this Chapter.

TRANSMISSION HANDBRAKE ASSEMBLY

Removal

1. Chock the rear wheels and release the handbrake.
2. Slacken the cable adjuster and disconnect the cable.
3. Remove the retaining bolts and withdraw the brake housing cover plate.
4. Withdraw the outer friction disc from the housing.



Transmission Handbrake Assembly

1. Control Rod
2. Rod Retaining pin
3. Brake Housing
4. Oil Seal
5. Locknut
6. Lock Washer
7. Adjusting Nut
8. Bearing Cup
9. Cone and Roller Assembly
10. Housing Retaining Bolt
11. Driven Shaft
12. Shims
13. Cone and Roller Assembly
14. Bearing Cup
15. Retainer Assembly
16. Outer Brake Disc
17. Outer Cover Gasket
18. Actuating Disc Steel Ball
19. Actuator Spring
20. Inner Brake Disc
21. Actuator Assembly
22. Outer Cover
23. Actuator Links
24. Cable Clevis
25. Retaining Bolt
26. Handbrake Lever
27. Single Operating Cable
28. Control Rod Seal

5. Remove the four bolts retaining the housing to the axle and withdraw the housing. **NOTE:** *Place a suitable container under the brake housing assembly to catch any oil that may leak out.*

6. Pull the bearing retainer and brake shaft assembly from the housing if not previously withdrawn with the outer housing. Note the number of shims between the retainer and Centre housing to ensure correct reassembly.

DISASSEMBLY

With reference to Figure 12.

1. Remove the bolt securing the cable bracket to the housing and remove the bracket.

2. Remove the brake rod seal from the top of the housing.

3. Withdraw the actuator assembly and the inner brake disc from the housing.

4. Withdraw the retaining pin and remove the control rod from the actuator. Remove the nuts and bolts securing the actuator links and remove from the actuator plates.

5. Carefully remove both springs and separate the actuator discs. Retain the steel balls located between the discs for use on re–assembly.

6. Bend down the locking tabs then unscrew and remove the nuts from the outer end of the brake shaft. Use wrenches, Tool No. FT.2010 to facilitate nut removal.

7. Pull the brake shaft out of the bearing retainer.

NOTE: *The inner cone and roller assembly will remain on the brake shaft.*

8. Extract the brake shaft outer cone and roller assembly from the bearing retainer.

9. Using puller, Tool No. 1003 and attachment, Tool No. 951, remove the inner cone and roller assembly from the brake shaft.

INSPECTION AND REPAIR

1. Clean and inspect all components for damage or excessive wear. Replace parts as required.

2. If replacement of the retainer bearing cups is required use slide hammer, Tool No. 943S and puller Tool No. 943 to remove. Use step plate adaptor, Tool No. 630S to effect replacement.

3. If required, remove the oil seal using a suitable drift and replace using step plate adaptor, Tool No. 630S.

RE–ASSEMBLY

Re–assembly of the transmission handbrake follows the disassembly in reverse. Observe the following points during re–assembly:

- Use puller, Tool No. 1002, pulling attachment, Tool No. 951 and a suitable sleeve to install the inner cone and roller assembly on the brake shaft.
- Using gauge, Tool No. T4062, check the retainer assembly bearing pre–load. If necessary loosen or tighten the inner locknut until the correct pre–load of 12–16 lb.in. is achieved. When achieved tighten the outer locknut to a torque value of 50–100 lbf.ft (68–136 Nm) and ensure the locktab is correctly bent over, one tab over the inner nut and one tab over the outer nut.

NOTE: *If gauge, Tool No. T4062 is not available a spring balance may be used. A reading of between 20–26 lb should be achieved.*

- Check and adjust as necessary the brake shaft pinion gear to rear axle pinion gear backlash. This procedure is described below.
- Ensure the oil seal is protected during re–assembly.

TRANSMISSION HANDBRAKE PINION GEAR BACKLASH

1. Install the bearing retainer assembly into the centre housing. Ensure the pinion and gear are in full mesh.

2. Use feeler gauges to check the gap between the inner edge of the retainer and the centre housing.

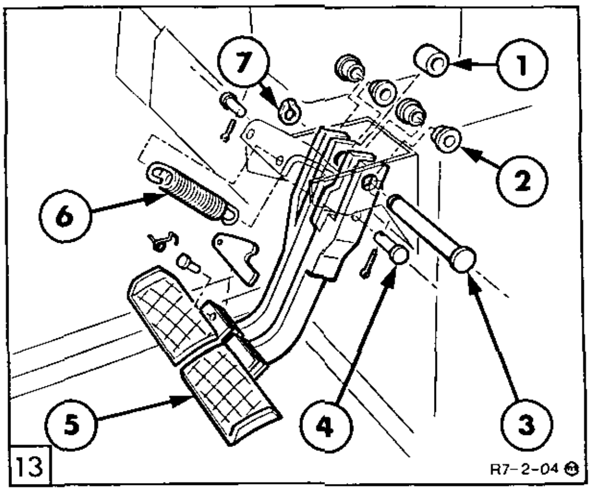
3. Use a combination of shims to equal the measured gap then add 0.013 in (0.33 mm) extra shims to obtain the required backlash.

NOTE: *Shims are available in .005 in (0.13mm) or 0.020 in (0.51 mm) sizes.*

4. On installation of the bearing retainer, install the shim pack between the retainer and centre housing.

E. BRAKE PEDALS AND LINKAGE OVERHAUL

BRAKE PEDAL REMOVAL (SL/SLE With and Less Cab)

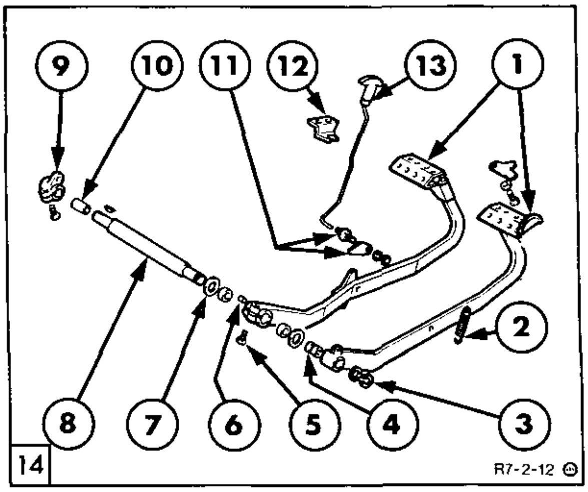


Brake Pedal Components SL/SLE Models

1. Pedal Spacer
2. Pivot Shaft Bush – 4 off
3. Pedal Pivot Shaft
4. Master Cylinder to Brake Pedal Clevis Pin
5. Brake Pedal
6. Return Spring
7. Pedal Pivot Shaft Retaining Ring

1. Remove the right hand side panel from the instrument console assembly.
2. Disconnect the two return springs from the pedal assemblies.
3. Remove the split pins and clevis pins securing the master cylinder push rods to the brake pedals.
4. Remove the circlip retaining the brake pedal pivot shaft and withdraw the shaft.
5. Collect the brake pedal spacer and remove the two brake pedals from the tractor.

BRAKE PEDAL AND LINKAGE REMOVAL (S Models)



Brake Pedal Components S Models

1. Brake Pedal Assemblies
2. Return Spring
3. Right Hand Pedal Retaining Ring
4. Bush
5. Left Hand Pedal Locking Bolt
6. Woodruff Key
7. Washers
8. Brake Pedal Cross Shaft
9. Left Hand Lever
10. Bush
11. Park Brake Pivot Arm and Pivot Post
12. Park Brake Lever Guide
13. Park Brake Lever

1. Chock the rear wheels and release the parking brake.
2. Disconnect the two return springs from the pedal assemblies, located under the floor pan.
3. Remove the split pin and clevis pin securing the right hand brake pedal to the brake pull rod clevis.
4. Remove the circlip and washer retaining the right hand pedal to the brake cross shaft and withdraw the right hand pedal assembly.
5. Remove the pinch bolt locking the left hand brake pedal to the cross shaft. Slide the pedal from the cross shaft, collecting the woodruff key if loose in the recess and washer.

6. If required the brake cross shaft may be removed using the following procedure:

- Remove the split pin and clevis pin securing the left hand operating lever to the brake pull rod clevis.
- Drain the rear axle oil.
- Pull the shaft from the centre housing using the left hand, brake operating lever.

INSPECTION AND REPAIR

1. Clean and inspect all components for damage or excessive wear. Install new components where necessary.

2. Replace the brake cross shaft oil seals if the shaft has been removed.

3. If the brake cross shaft bushes are worn:–

i) Remove the oil seals, then using puller, Tool No. 954–C remove the bushes.

ii) Use bushing kit, Tool No. 818, to install the new bushes

iii) Press new shaft oil seals into the housing with the steel face of the seals facing outwards.

iv) Ensure there are no burrs on the brake shaft then install into the centre housing.

v) Refill the rear axle with the correct grade and quantity of oil, specification ESN–M2C134–D, 14.5 imp.gallons (17.4 U.S. gallons, 66.0 litres). Check oil level with the dipstick.

RE–ASSEMBLY AND INSTALLATION

Re–assembly and installation of the brake pedals and linkage follows the removal and disassembly procedures in reverse.

On reassembly and installation observe the following requirements:

- Grease the ends of the operating rods and clevis pins with a suitable grease.
- Tighten the brake pedal and operating lever pinch bolts to a torque of 42–56 lbf.ft (57–76 Nm).
- Adjust the foot brakes and handbrake as described previously in Section C of this Chapter.

F. SPECIFICATIONS, TIGHTENING TORQUES AND SPECIAL TOOLS

SPECIFICATIONS

Service Brake

Tractor Model Component	56/66/7740 S Models	56/66/77/7840 SL/SLE Models	82/8340 SL/SLE Models
Brake Type	Wet Brakes	Wet Brakes	Wet Brakes
Brake Operation	Mechanical + Ball ramp	Hydraulic + Ball ramp	Hydraulic + Ball ramp
Brake Discs (Per Side)	3/4*	3	4
Brake Disc Total Friction Area	2452.8 cm^2/ 3270.4 cm^2	2452.8 cm^2	3270.4 cm^2

* 4 brake discs per side with 2 speed P.T.O. (Standard on 7740)

Standard Secondary Brake – SL/SLE Models
NOTE: *S Models do not have a secondary brake system.*

Brake Type	Twin cable mechanically operated using actuator assemblies of service brake.

Optional Secondary Brake – SL/SLE Models

Brake Type	Single cable, mechanically operated, dry disc, transmission handbrake
Friction Area	204.4 cm^2 (31.69 in^2)
Brake Shaft Bearing Pre–Load:	
Using gauge , Tool No. T4062	12–16 lb.in (1.4–1.7 Nm)
Using a spring balance	20–26 lb (9.1–11.8 Kg)
Bearing Retainer To Rear Axle Centre Housing Available Shims:	0.005 in (0.127 mm) & 0.020 in (0.508 mm)

Brake Hydraulics

Master Cylinder Push Rod to Plunger Clearance	0.6 mm (0.024 in) Minimum
Brake Oil	Ford Specification ESN–M6C59–A

TIGHTENING TORQUES

Components	lbf. ft	Nm
Master Cylinder Retaining Bolts	17	23
Handbrake Adjuster Locknut	20	27
Handbrake Retaining Bolts	33	45
Transmission Handbrake Housing Retaining Bolts	49	66
Transmission Handbrake Cover Bolts	32	44
Transmission Handbrake Pinion Locknut	75	102
Brake Pedal and operating Lever Pinch Bolts	49	66

SPECIAL TOOLS

DESCRIPTION	V.L. CHURCHILL LTD TOOLS	NUDAY TOOLS
Step Plates	630S	9210
Drive Pinion Pre–Load Gauge	T.4062	(Pull Scale)
Internal/External Puller	943	9507
Slide Hammer	943S	9567
Pulling Attachments:		
Small	951	9190
Pullers:		
Medium	1002	9198
Large	1003	9516
Handbrake Pinion Locknut Wrenches	FT.2010	–
Bushing Kit	818	–

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PART 8
HYDRAULIC SYSTEMS

Chapter 1
INTRODUCTION

A. INTRODUCTION

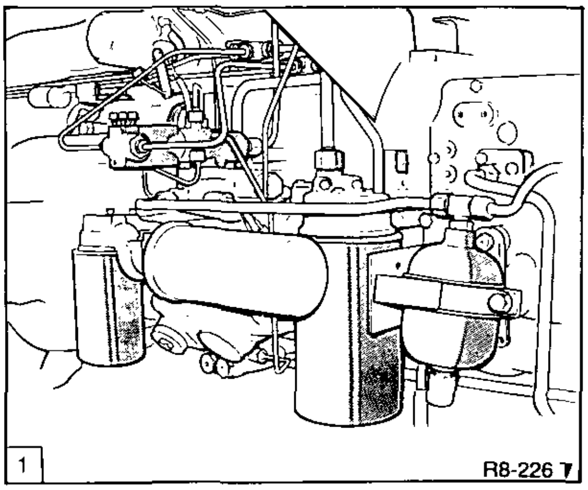
The function of the hydraulic system on Series 40 tractors is to provide hydraulic oil flow at regulated pressure for the various hydraulic circuits within the tractor.

The major hydraulically operated or lubricated components fall into the following categories of tractor build:–

- Tractors installed with a 16 x 16 transmission, hydraulic lift assembly with Electrolink™ (electronic draft control) and hydraulic pump assembly incorporating a variable displacement closed centre load sensing (CCLS) piston pump and integral fixed displacement charge and steering pumps.
- Tractors installed with a 16 x 16 transmission, top link sensing hydraulic lift assembly and hydraulic pump assembly incorporating a variable displacement closed centre load sensing piston pump and integral fixed displacement charge and steering pumps.
- Tractors installed with a 12 x 12 transmission, top link sensing hydraulic system and hydraulic pump assembly incorporating a variable displacement closed centre load sensing piston pump and integral fixed displacement charge and steering pumps.
- Tractors installed with a 12 x 12, 8 x 2 or 16 x 4 transmission, with top link sensing hydraulic lift assembly and a fixed displacement tandem gear type pump incorporating a hydraulic lift pump and steering system/low pressure circuit pump.

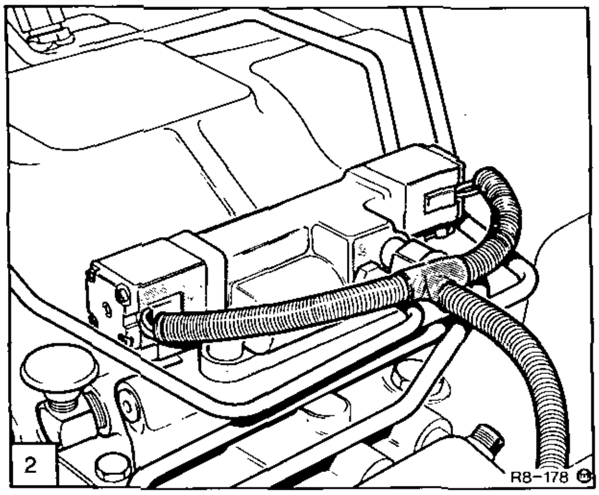
Additional options such as trailer brakes, where fitted and remote control valves are available on all model builds. An optional engine mounted hydraulic pump is available on all tractors installed with the fixed displacement tandem gear type pump.

To assist in identifying the hydraulic system installed on the tractor refer to the following illustrations.



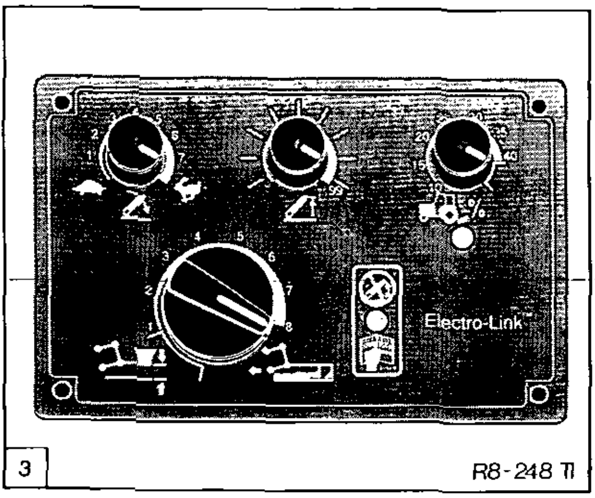
Variable Displacement Hydraulic Pump with Closed Centre Load Sensing

The hydraulic pump with closed centre load sensing (CCLS) variable displacement piston pump can be identified by the two vertical intake filters and horizontal charge pressure filter, Figure 1.



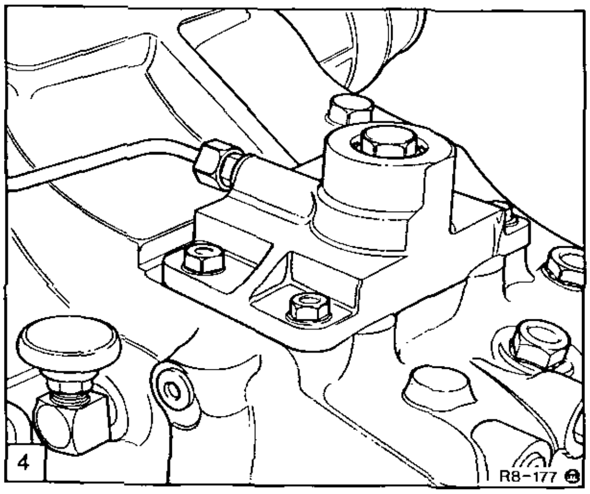
EDC Hydraulic Control Valve

Tractors installed with electronic draft control (EDC) utilise a unique solenoid operated control valve situated on top of the hydraulic lift cover, Figure 2.



EDC Control Panel
(Panel with Optional Slip Control Shown)

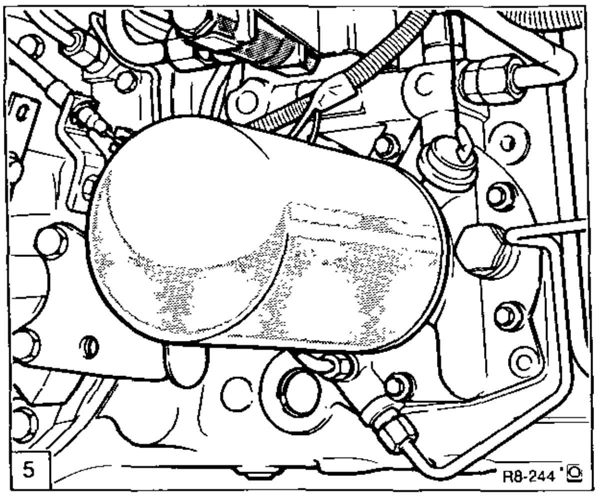
The EDC system can also be identified by the unique operators control panel, Figure 3.



Unload Valve Installation For Tractors with Top Link Sensing and Variable Displacement Hydraulic Pump

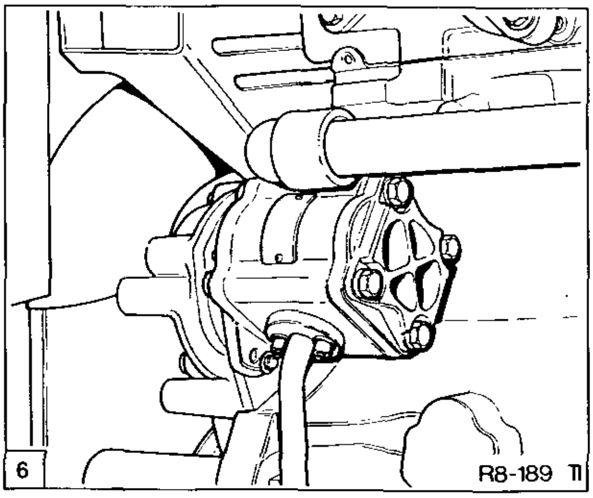
Tractors installed with the variable displacement hydraulic pump and top link sensing hydraulic system use an unload valve, installed on top of the hydraulic lift cover, Figure 4.

The unload valve used with top link sensing replaces the solenoid operated hydraulic control valve installed on tractors with electronic draft control.



Fixed Displacement Tandem Gear Type Pump

The Fixed displacement tandem gear type pump is located on the right hand side of the rear axle centre housing and incorporates a single inlet filter, Figure 5.



Auxiliary Engine Mounted Hydraulic Pump

The *auxiliary engine mounted hydraulic* pump, where fitted, is installed on the front left hand side of the tractor and is driven by the camshaft drive gear, Figure 6.

B. HYDRAULIC CIRCUIT DESCRIPTION

The circuits provided with oil by the transmission mounted hydraulic pumps can be separated into the following categories:–

Tractors With Closed Centre Load Sensing Variable Displacement Hydraulic Pump:

- High pressure circuit oil up to a maximum pressure of 2800 lbf/in^2 (193 bar) for operation of the hydraulic lift assembly, remote control valves and auxiliary hydraulic equipment, where fitted.
- Low pressure circuit oil for operation of the 16 x 16 transmission control circuits, PTO, differential lock, electronic draft control valve pilot pressure and four wheel drive circuits, where fitted.
- Hydrostatic steering system oil up to a maximum pressure of 2500 lbf/in^2 (172 bar) which is then regulated to provide low pressure oil for lubrication of the PTO and 16 x 16 transmission.

Tractors With Fixed Displacement Tandem Gear Type Pump:

- High pressure oil up to a maximum pressure of 2650 lbf/in^2 (183 bar) for operation of the hydraulic lift assembly, remote control valves and auxiliary hydraulic equipment, where fitted.
- Hydrostatic steering system oil up to a maximum pressure of 2500 lbf/in^2 (172 bar) which is then regulated to provide low pressure oil for operation of the PTO, four wheel drive disengagement system, differential lock and lubrication of 12 x 12 transmission synchronisers, bearings, output shaft and PTO.

The basic hydraulic circuits for each type of installation are shown in schematic format in Figure 7, Figure 8 and Figure 9 of this Chapter.

For a detailed description and operation of the high pressure hydraulic lift circuits on Series 40 tractors refer to the following Chapters in this Part of the Repair Manual.

For tractors installed with the variable displacement hydraulic pump and electronic draft control, refer to Chapters 2 and 3.

For tractors installed with the variable displacement hydraulic pump and top link sensing, refer to Chapters 2 and 4.

For tractors installed with fixed displacement gear type hydraulic pumps, refer to Chapter 5.

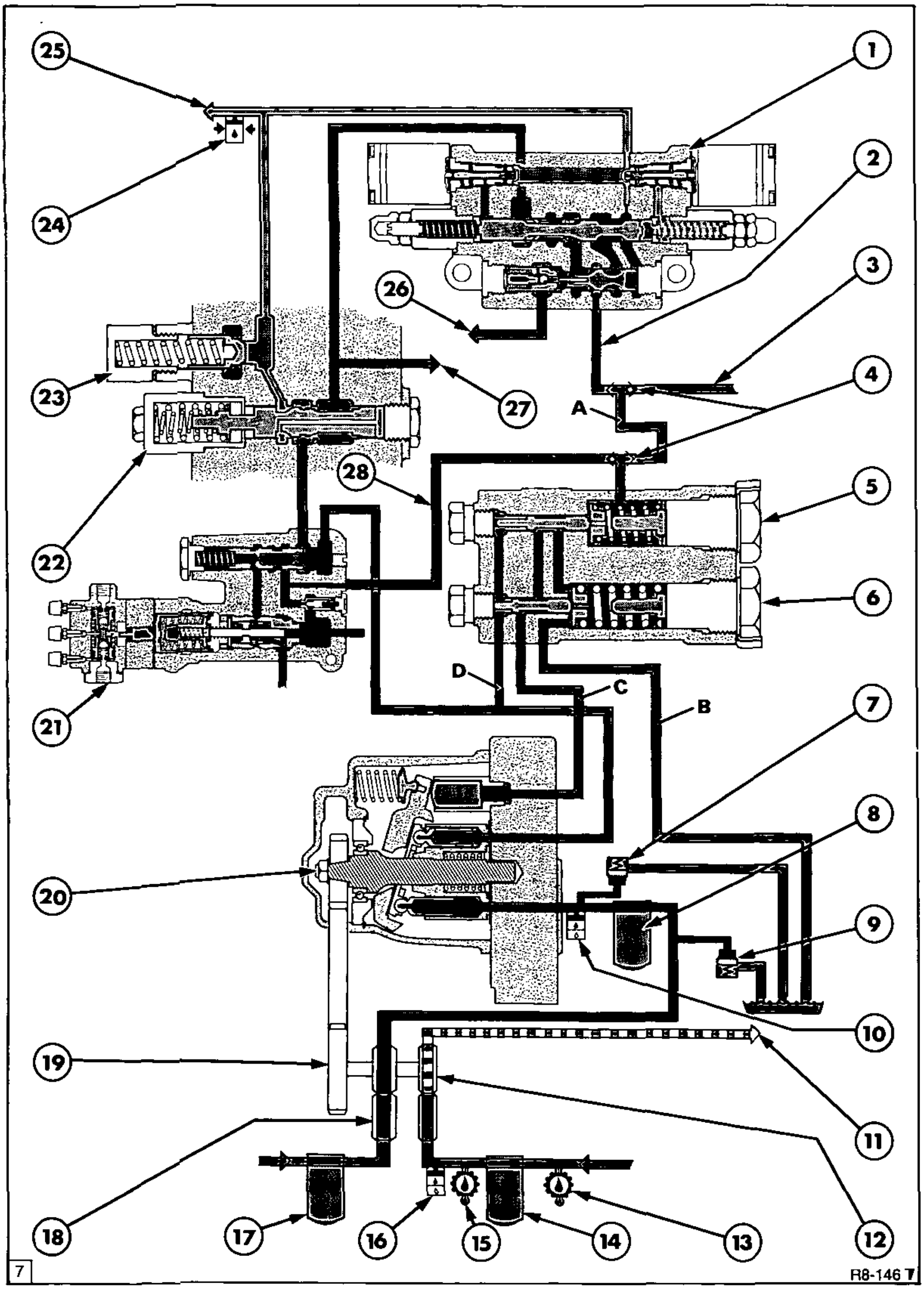
For the hydraulic operation of the transmission, PTO, differential lock, steering and four wheel drive disengagement systems, refer to the appropriate Part and Chapters of this Repair Manual which describe the operation of the component.

Figure 7

Hydraulic Circuit for Tractor with CCLS Variable Displacement Piston Pump and Electronic Draft Control

1. Electronic Draft Control Valve
2. Load Sensing Line from Electronic Draft Control Valve
3. Load Sensing Line from Remote Valves
4. Shuttle Valves
5. Flow Compensating Valve
6. Pressure Compensating Valve
7. Charge Pressure Bypass Valve
8. Charge Pressure Filter
9. Charge Pressure Filter Dump Valve
10. Low Charge Pressure Switch
11. Oil Supply to Power Steering Motor, Oil Cooler, Transmission and PTO Lubrication Circuits
12. Steering Pump
13. High Oil Temperature Switch
14. Steering Pump Inlet Filter
15. Steering Filter Low Temperature Switch
    (Prevents Blocked Steering Filter Light Working when Oil Temperature Below 40°C, 104°F)
16. Blocked Steering Filter Vacuum Switch
17. Charge Pump Inlet Filter
18. Charge Pump
19. Pump Gear Drive Train
20. Variable Displacement Piston Pump
21. Trailer Brake Valve (where fitted)
22. Pressure Regulating Valve
23. Low Pressure Circuit Safety Valve
24. Low Transmission Oil Pressure Switch
25. Low Pressure Circuit Oil Supply to PTO, Differential Lock, Transmission Control Circuits
    and Four Wheel Drive
26. To Hydraulic Lift Cylinder
27. To Remote Valves
28. Load Sensing Line from Trailer Brake Valve

A Load Sensing Line from Hydraulic Lift, Trailer Brake and Remote Control Valve Circuits
B Return to Sump Gallery from Flow and Pressure Compensating Valves
C Gallery to Swash Plate Servo Piston from Flow and Pressure Compensating Valves
D System Pressure Sensing Gallery to Flow and Pressure Compensating Valves



Hydraulic Circuit for Tractor with CCLS Variable Displacement Piston Pump and Electronic Draft Control

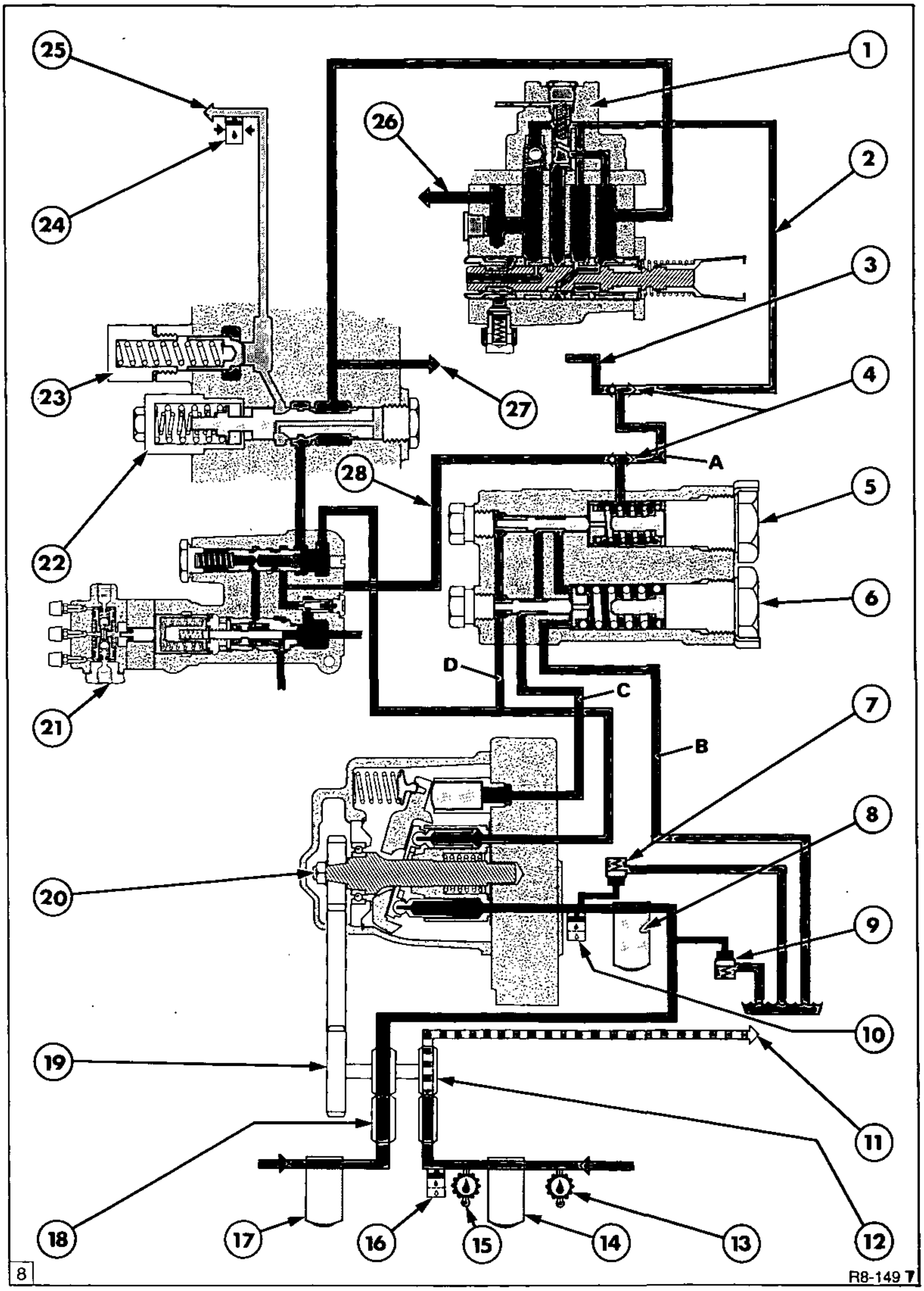
▥	Steering System Oil	■	Charge Pressure Oil @ 23–50 lbf/in² (1.6–3.4 bar)
▩	Low Pressure Circuit Oil @ 250–280 lbf/in² (17–19 bar)	■	Suction/Return to Reservoir Oil
■	System Pressure Oil		

Figure 8

Hydraulic Circuit for Tractor with CCLS Variable Displacement Piston Pump and Top Link Sensing Hydraulic Lift Assembly

1. Top Link Sensing Hydraulic Lift Unload Valve
2. Load Sensing Line from Hydraulic Lift Unload Valve
3. Load Sensing Line from Remote Valves
4. Shuttle Valves
5. Flow Compensating Valve
6. Pressure Compensating Valve
7. Charge Pressure Bypass Valve
8. Charge Pressure Filter
9. Charge Pressure Filter Dump Valve
10. Low Charge Pressure Switch
11. Oil Supply to Power Steering Motor, Oil Cooler, Transmission and PTO Lubrication Circuits
12. Steering Pump
13. High Oil Temperature Switch
14. Steering Pump Inlet Filter
15. Steering Filter Low Temperature Switch
(Prevents Blocked Steering Filter Light Working when Oil Temperature Below 40°C, 104°F)
16. Blocked Steering Filter Vacuum Switch
17. Charge Pump Inlet Filter
18. Charge Pump
19. Pump Gear Drive Train
20. Variable Displacement Piston Pump
21. Trailer Brake Valve (where fitted)
22. Pressure Regulating Valve
23. Low Pressure Circuit Safety Valve
24. Low Transmission Oil Pressure Switch
25. Low Pressure Circuit Oil Supply to PTO, Differential Lock, Transmission Control Circuits and Four Wheel Drive
26. To Hydraulic Lift Cylinder
27. To Remote Valves
28. *Load Sensing Line from Trailer Brake Valve*

A Load Sensing Line from Hydraulic Lift, Trailer Brake and Remote Control Valve Circuits
B Return to Sump Gallery from Flow and Pressure Compensating Valves
C Gallery to Swash Plate Servo Piston from Flow and Pressure Compensating Valves
D System Pressure Sensing Gallery to Flow and Pressure Compensating Valves



Hydraulic Circuit for Tractor with CCLS Variable Displacement Piston Pump and Top Link Sensing Hydraulic Lift Assembly

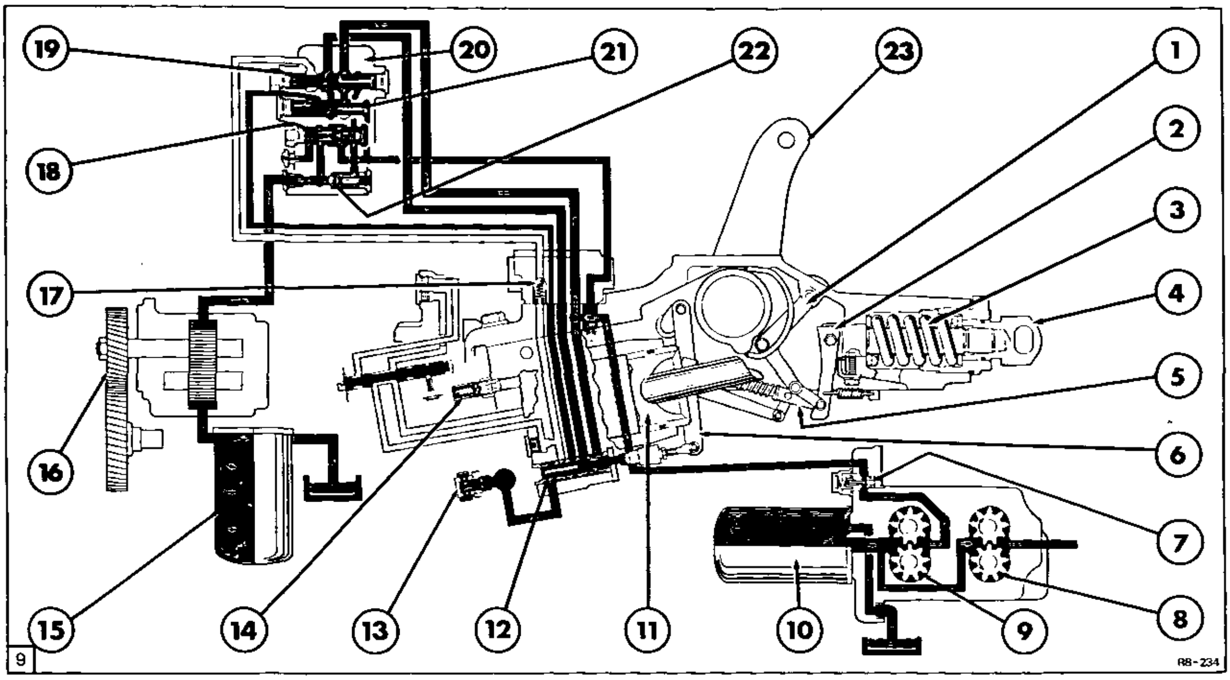
▥ Steering System Oil

■ Charge Pressure Oil @ 23–50 lbf/in² (1.6–3.4 bar)

■ System Pressure Oil

■ Suction/Return to Reservoir Oil

▒ Low Pressure Circuit Oil @ 250–280 lbf/in² (17–19 bar)



Hydraulic Circuit for Tractor with Fixed Displacement Tandem Gear Type Pump and Top Link Sensing Hydraulic Lift Assembly

1. Position Control Link
2. Selector Link
3. Draft Control Mainspring
4. Yoke
5. Selector Rod and Roller Assembly
6. Actuating Link
7. Pressure Relief Valve
8. Steering Pump
9. Transmission Mounted Hydraulic Pump
10. Pump Intake Filter
11. Lift Piston
12. Control Valve
13. Exhaust Valve
14. Lift Cylinder Safety Valve
15. Auxiliary Pump Intake Filter
16. Engine Mounted Auxiliary Hydraulic Pump
17. Check Valve
18. Combining (Sequencing) Valve
19. Flow Control Valve
20. Priority Valve Pack
21. Unload Valve
22. Check Valve
23. Lift Arms

■ Pump Pressure Oil

□ Trapped Oil

■ Suction/Return to Reservoir Oil

C. LOW PRESSURE, STEERING AND LUBRICATION HYDRAULIC CIRCUITS

Tractors Installed with Variable Displacement CCLS Hydraulic Pump

The low pressure, steering and lubrication circuits have two functions respectively:–

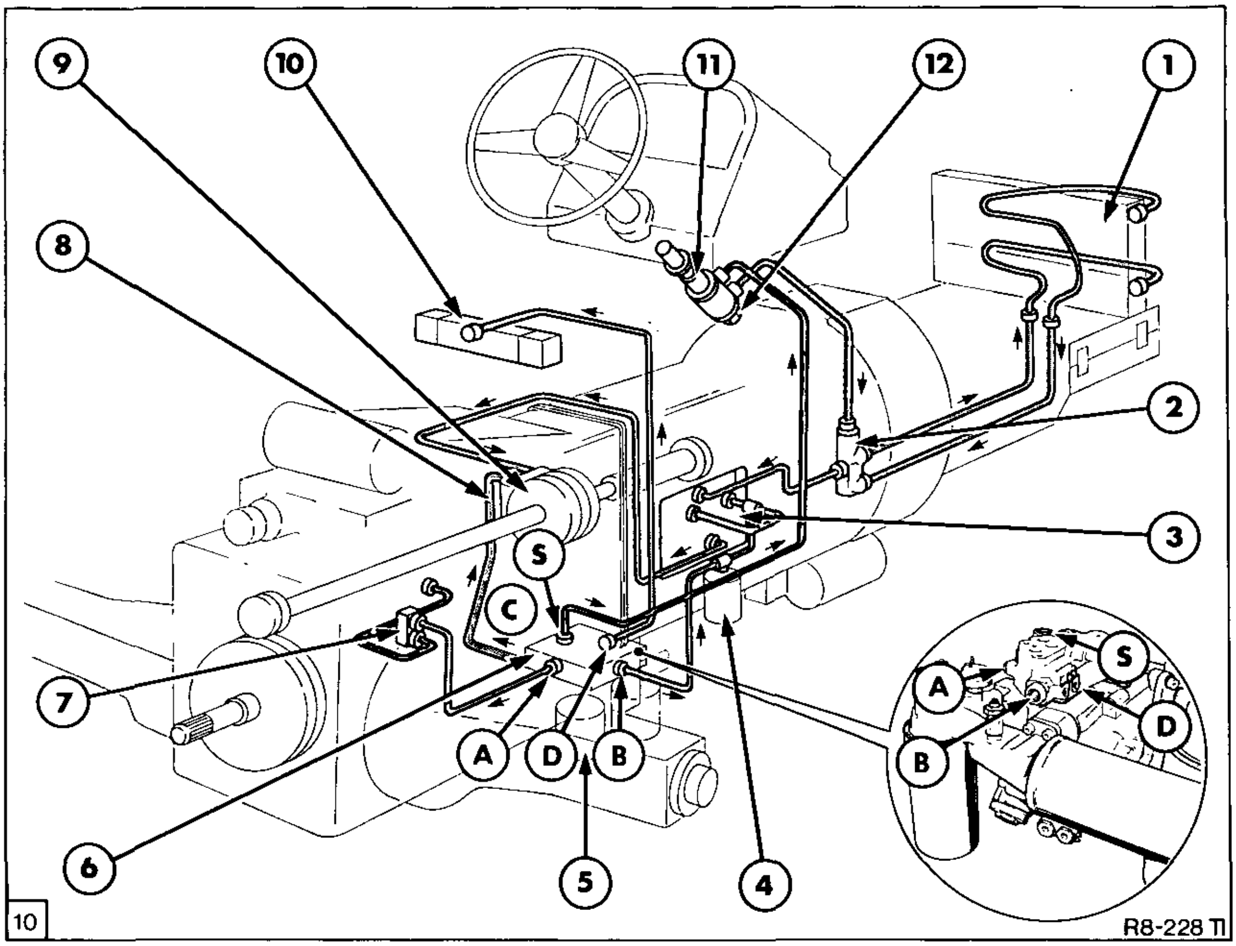
Low Pressure Circuit:
To operate the 16 x 16 transmission (where fitted), PTO, differential lock and four wheel drive disengagement system with regulated low pressure oil supplied by the variable displacement CCLS piston pump.

Steering and Lubrication Circuit:
To operate the hydrostatic steering system and lubricate the PTO clutch assembly, transmission clutches, bearings and shafts with oil supplied by the integral fixed displacement steering pump.

Figure 10, illustrates the flow of oil from the hydraulic pumps to the low pressure, steering and lubrication hydraulic circuits on a tractor installed with a variable displacement CCLS hydraulic pump.

It can also be seen from Figure 7, that the oil supplied to the low pressure circuit is regulated at a pressure of 250–280 lbf/in^2 (17–19 bar) by the low pressure regulating valve housed on top of the pump. When this low pressure oil is directed to the transmission clutch control circuits, the pressure is further regulated within the transmission control valve. Refer to Part 5, Chapter 1, Section A, for the description and operation of the hydraulic circuits within the 16 x 16 transmission.

When the hydrostatic steering system is in operation, the pressure of oil supplied by the steering pump to the steering motor, can rise towards the maximum setting of the steering motor relief valve, which is 2100–2500 lbf/in^2



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Low Pressure Steering and Lubrication Hydraulic System Layout
(Tractors Installed with Variable Displacement CCLS Hydraulic Pump and 16 x 16 Transmission)

1. Transmission Oil Cooler
2. Cooler Bypass Valve
3. 16 x 16 Transmission Control Valve
4. Transmission Accumulator
5. Steering Pump Filter
6. Low Pressure Regulating Valve
7. Differential Lock Solenoid Valve
8. PTO Valve Supply Tube
9. PTO Clutch
10. EDC Hydraulic Control Valve
11. Steering Motor
12. Steering Motor Relief Valve

A. Differential Lock Supply (17–19 bar)
B. 16 x 16 Transmission Supply (17–19 bar) and FWD Drive Clutch Supply
C. Internal Supply to PTO Clutch
D. EDC Pilot Supply (17–19 bar)
S. Output to Steering and Lubrication Circuits

■ Steering Pump Pressure Oil

■ Low Pressure Circuit Oil

▨ Lubrication Circuit Oil

■ Return to Reservoir

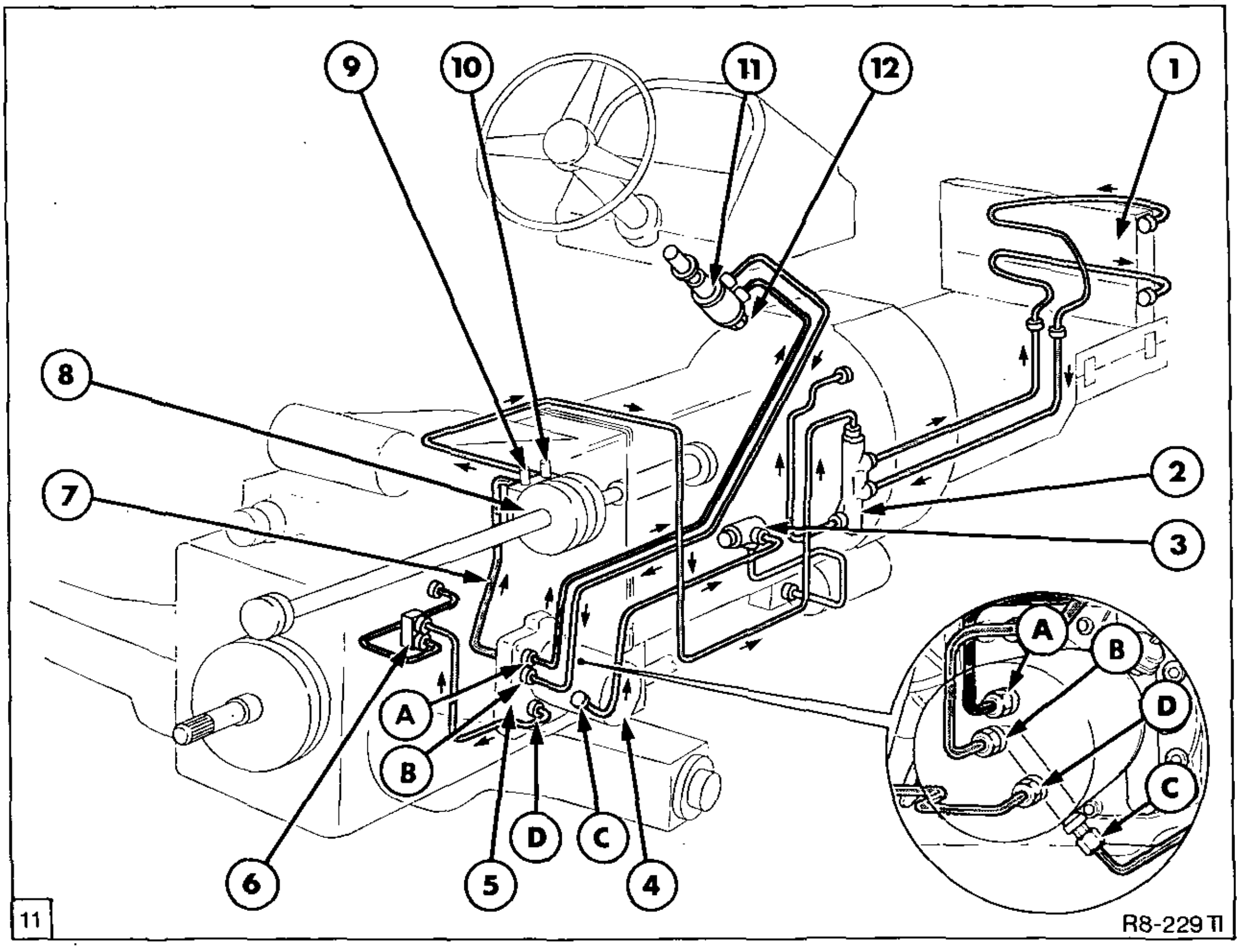
(145–172 bar) depending on tractor model.

The pressure of oil, however, on leaving the steering motor and returning via the oil cooler to the 16 x 16 transmission and PTO clutch lubrication circuits, is limited to a maximum pressure of 100 lbf/in² (7 bar) by the lubrication circuit relief valve, located within the transmission control valve.

Should the oil cooler become restricted, which would cause oil starvation to the lubrication circuits, the cooler bypass valve will operate, diverting oil directly to the lubrication circuit and bypassing the cooler.

The operating pressure of the bypass valve should the cooler become restricted is 100 lbf/in² (7 bar).

The cooler bypass valve is also thermostatically controlled enabling a proportion of the cold oil during initial start up to bypass the cooler until the nominal operating temperature of 68°C (155°F) has been reached. This feature enables a faster warm up cycle of the hydraulic oil.



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Steering, Low Pressure and Lubrication Hydraulic System Layout
(Tractors Installed with Fixed Displacement Tandem Gear Type Pump and 12 x 12 Transmission)

1. Transmission Oil Cooler
2. Cooler Bypass Valve
3. FWD Solenoid Valve
4. Tandem Pump Filter
5. Tandem Pump Body
6. Differential Lock Solenoid Valve
7. PTO Supply Tube (Internal)
8. PTO Clutch
9. Low Pressure Regulating Valve
10. Lubrication Relief Valve
11. Steering Motor
12. Steering Motor Relief Valve

A. Outlet to Steering Motor
B. Return from Steering Motor
C. Supply to Four Wheel Drive Valve
D. Supply to Differential Lock Valve

■ Steering Pump Pressure Oil

▨ Low Pressure Circuit Oil

░ Lubrication Circuit Oil

■ Return to Reservoir

Tractors Installed with Fixed Displacement Tandem Gear Type Pumps

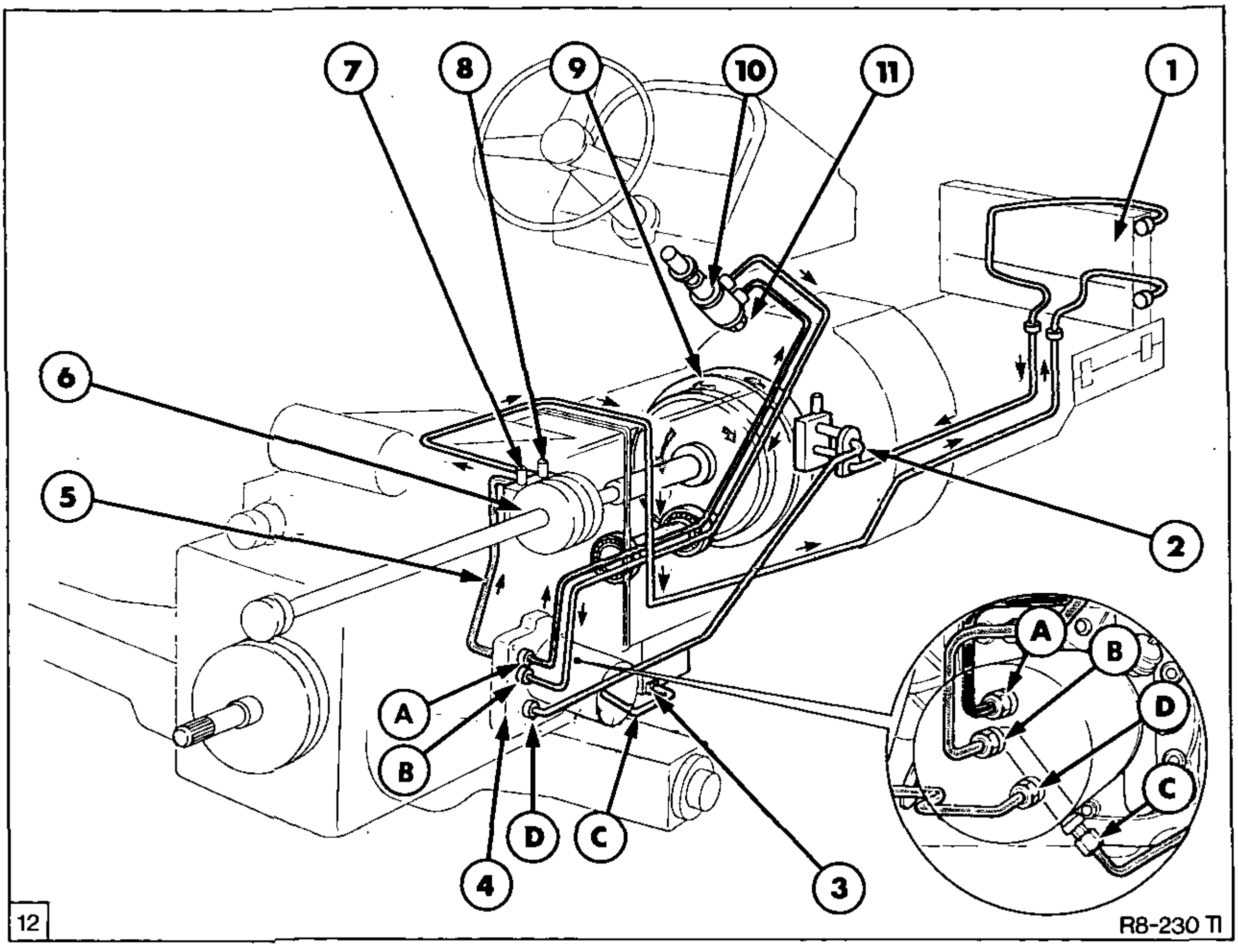
On tractors installed with the fixed displacement tandem gear type pump the oil supply for the steering, low pressure and lubrication circuits is only supplied by the steering pump within the tandem pump assembly.

Figure 11, illustrates the flow of oil from the steering pump to the steering motor, low pressure and lubrication circuits on tractors installed with the 12 x 12 transmission.

Figure 12, illustrates the flow of oil from the steering pump to the steering motor, low pressure and lubrication circuits on tractors installed with the 16 x 4 transmission.

As with tractors installed with the variable displacement CCLS hydraulic pump, the maximum pressure of oil supplied by the pump to the hydrostatic steering circuit, during steering operations, is regulated by the steering motor relief valve. This valve operates at 2100 lbf/in^2 (145 bar) on 5640–7840 two wheel drive tractors and 2500 lbf/in^2 (172 bar) on all other models.

The flow of oil on leaving the steering motor returns to the pump body for distribution to the low pressure and lubrication circuits. The pressure of oil returning from the steering motor is regulated at a pressure of 220–240 lbf/in^2 (15.2–16.6 bar) by the low pressure regulating valve in the PTO clutch



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Steering, Low Pressure and Lubrication Hydraulic System Layout
(Tractors Installed with Fixed Displacement Tandem Gear Type Pump and 16 x 4 Transmission)

1. Transmission Oil Cooler
2. Dual Power Control Valve
3. FWD Solenoid Valve
4. Tandem Pump Body
5. PTO Supply Tube (Internal)
6. PTO Clutch
7. Low Pressure Regulating Valve
8. Lubrication Relief Valve
9. Dual Power Housing
10. Steering Motor
11. Steering Motor Relief Valve

A. Outlet to Steering Motor
B. Return from Steering Motor
C. Supply to Four Wheel Drive Valve
D. Supply to Dual Power Control Valve

■ Steering Pump Pressure Oil

▩ Low Pressure Circuit Oil

░ Lubrication Circuit Oil

assembly. As the pressure is regulated, excess oil in the low pressure circuit flows through the regulating valve, into an adjacent lubrication circuit relief valve which limits the pressure of oil in the lubrication circuit to 77 lbf/in^2 (5.3 bar).

The low pressure circuit provides oil for operation of the PTO clutch, electro hydraulic differential lock (12 x 12 transmission only), dual power clutch (16 x 16 transmission only) and four wheel drive disengagement (where fitted).

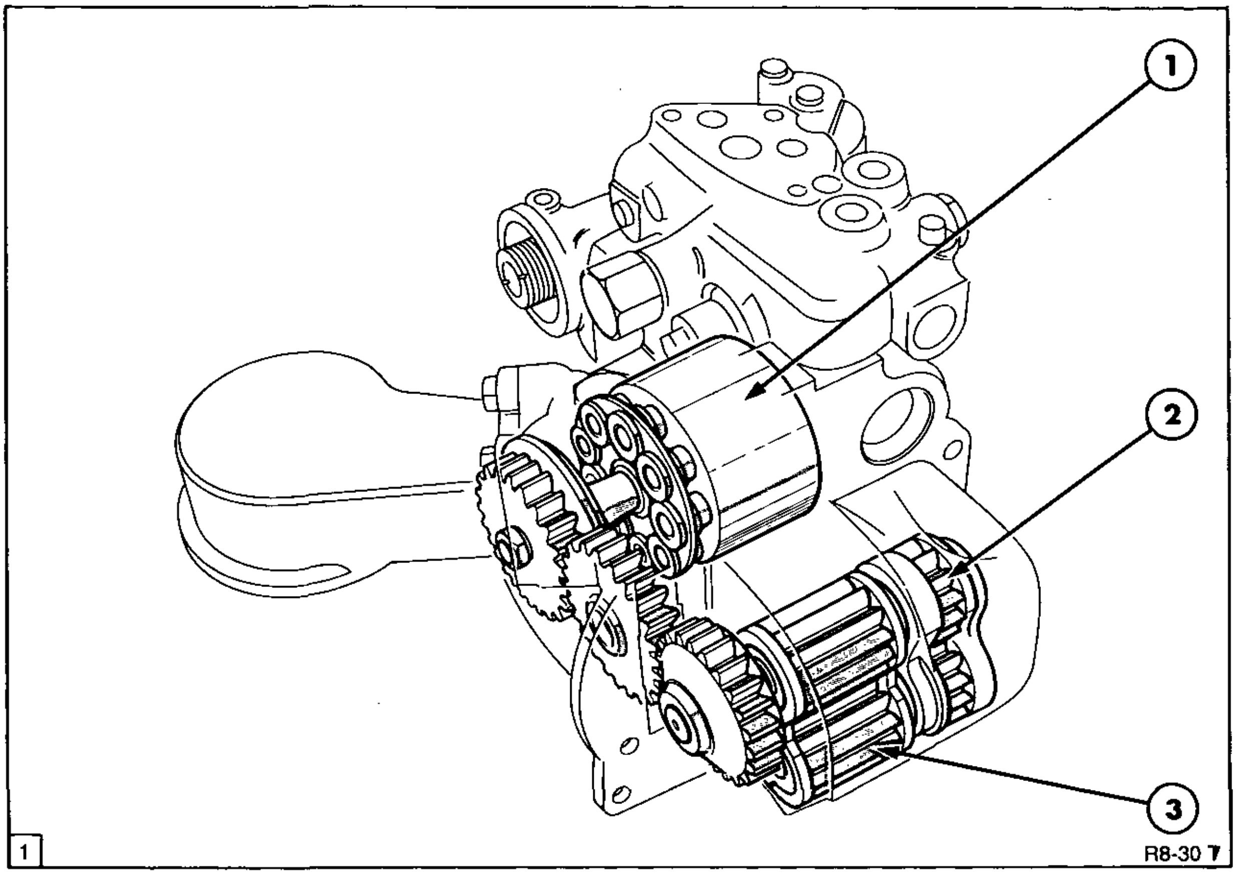
The lubrication circuit on 12x12 transmission tractors provides oil to the PTO clutch, transmission synchronisers, bearing and output shaft.

On 16 x 4 transmission tractors lubrication is provided to the dual power, transmission output shaft and PTO clutch. This is also similar to that for tractors with the 8 x 2 transmission, except that the dual power assembly is not fitted.

It will be noted in Figure 12 that the cooler bypass valve is not fitted on tractors with the 16 x 4 or 8 x 2 transmission. This valve, however, is installed on tractors with the 12 x 12 transmission and improves the oil temperature warm up in exactly the same way as described for tractors with the 16 x 16 transmission.

PART 8
HYDRAULIC SYSTEMS
Chapter 2
HYDRAULIC PUMP ASSEMBLY WITH VARIABLE DISPLACEMENT CLOSED CENTRE LOAD SENSING (CCLS)

A. DESCRIPTION AND OPERATION



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Hydraulic Pump Assembly With Variable Displacement Closed Centre Load Sensing

1. Variable Displacement Piston Type Pump
2. Fixed Displacement Gear Type Pump–Steering
3. Gear Type Charge Pump

The hydraulic pump assembly, Figure 1, is mounted on the right hand side of the rear axle centre housing and contains within its body three hydraulic pumps.

- A charge pump of the gear type, supplies oil at a charge pressure of 23–50 lb/in^2 (1.6–3.4 bar) to a variable displacement piston pump.
- A variable displacement piston type pump installed in a closed centre load sensing system, supplying oil for the requirements of the trailer brake system and the regulated pressure circuit for the power take off (PTO), differential lock, four wheel drive disengagement system, transmission control valves and remote and hydraulic lift valves.
- A fixed displacement pump of the gear type, supplying oil for operation of the hydrostatic steering system and transmission and PTO lubrication circuits.

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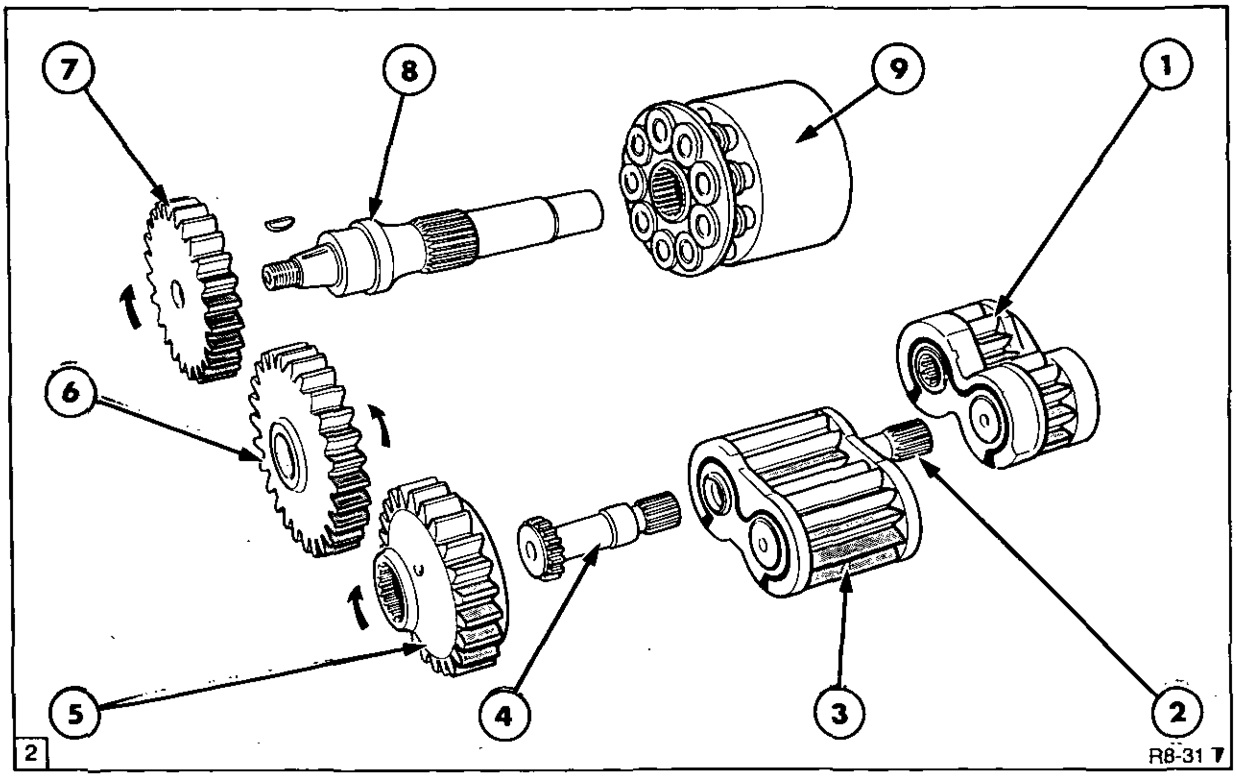

Hydraulic Pump Assembly Drive Train

1. Steering Pump (Gear Type)
2. Drive Link–Charge to Steering Pump
3. Charge Pump (Gear Type)
4. Drive Link–Drive Gear to Charge Pump
5. Charge and Steering Pump Drive Gear
6. Pump Idler Gear
7. Variable Displacement Pump Drive Gear
8. Variable Displacement Pump Drive Shaft
9. Variable Displacement Pump (Piston Type)

Illustrated in Figure 2, is the drive train for the charge and steering gear pumps and variable displacement piston pump. Note the mechanism which adjusts the swash of the pistons in the piston pump has been omitted for clarity.

All three pumping elements are driven through the charge and steering pump drive gear. This is in turn is driven by a gear on the independent power take off (P.T.O.) drive clutch hub and an idler gear mounted on the rear of the transmission.

Charge and Steering Pumps

The steering pump is mounted behind the charge pump and driven by a drive link directly connecting the two pumps.

The charge pump supplies oil to the variable displacement.piston pump while the steering pump supplies oil to the hydrostatic steering system and transmission and P.T.O. lubrication circuit.

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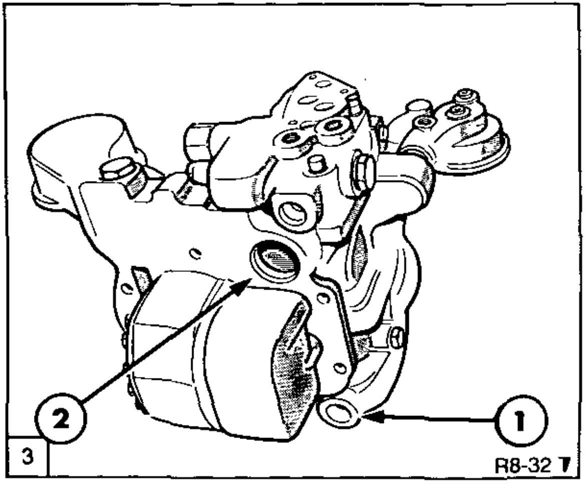


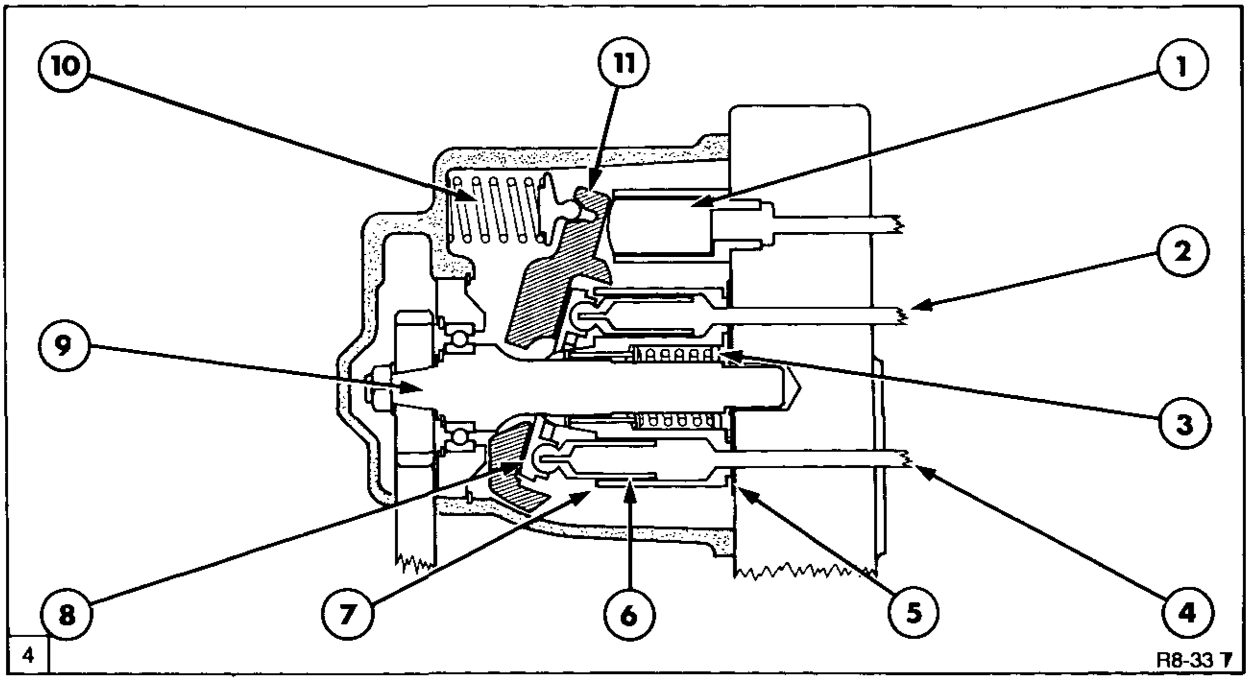
Charge and Steering Pump Intake Ports

1. Steering Pump Intake Port
2. Charge Pump Intake Port

Oil for both the charge and steering pump circuits is drawn from the rear axle centre housing using two separate intake ports, Figure 3.

External pipework links the steering pump to the steering system.

NOTE: *The relief valve for the steering system is located within the steering motor.*



Variable Displacement Piston Pump–Sectional Drawing

1. Swash Plate Servo Piston
2. Outlet Pressure Port
3. Pump Head and Slipper Pre–load Spring
4. Inlet Port
5. Port Plate
6. Piston (9 off)
7. Pump Head
8. Slipper (9 off)
9. Driveshaft
10. Swash Plate Return Springs
11. Swash Plate

Variable Displacement Piston Pump

The variable displacement piston pump with closed centre load sensing consists of:–

1. A nine element pumping head.
2. A plate mechanism to adjust piston stroke and corresponding pump output. This plate will be referred to as a swash plate.
3. A load sensing valve which monitors the requirements of the hydraulic circuits and signals the pump to increase or decrease hydraulic oil flow accordingly.

A sectional drawing of the piston pump assembly is shown in Figure 4.

The nine element pumping head is cylindrical in shape and has nine barrels, into each of which, is installed a piston. On the end of each piston is pressed a slipper which always remains in contact with the face of the swash plate located at the front of the pumping head.

The drive shaft, which is driven by the pump drive gear, rotates the pumping head in a clockwise direction, viewed from the drive end of the pump.

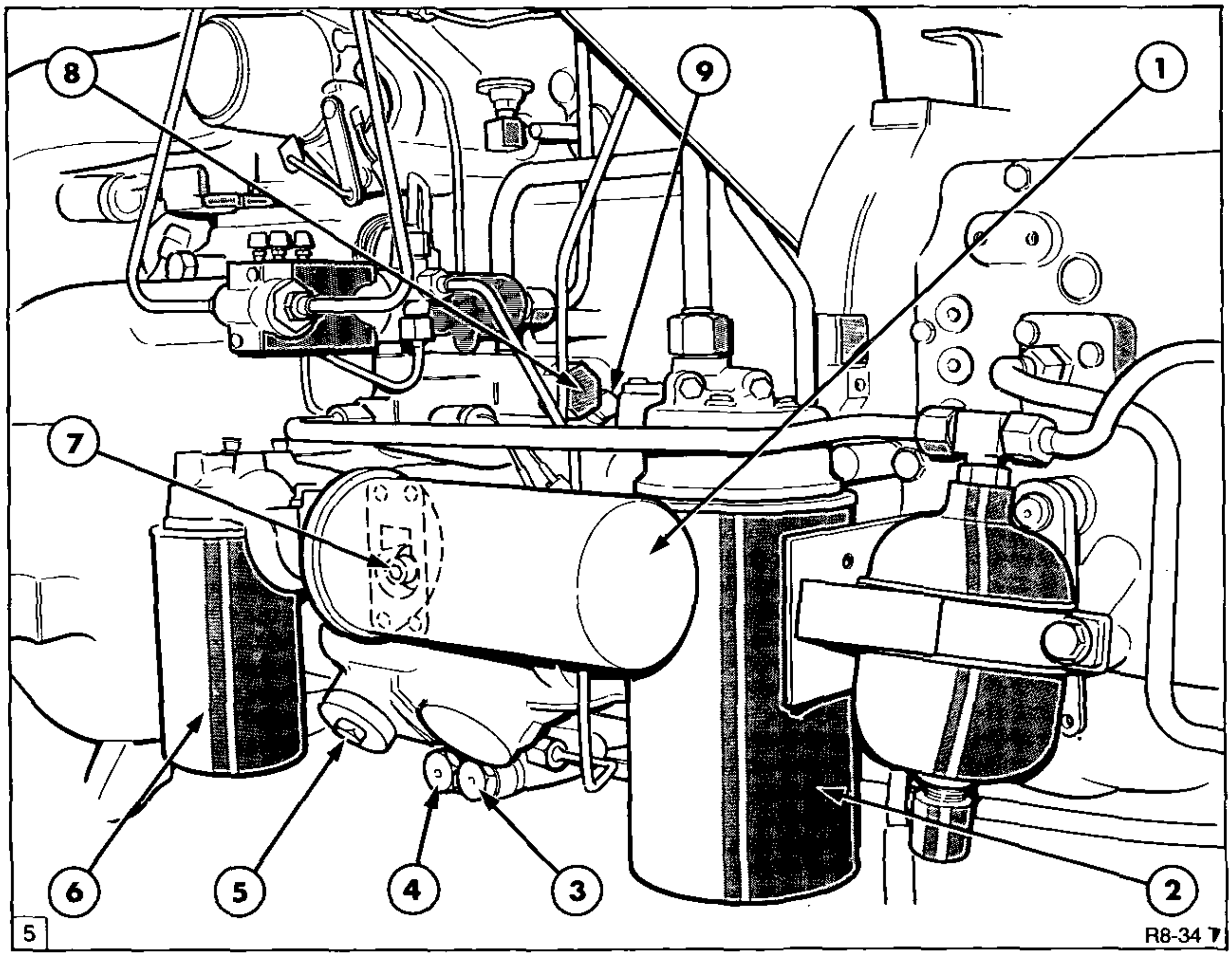
As the pumping head rotates, the pistons move in and out of their barrels, following the contour of the swash plate. For every revolution of the drive shaft each piston completes one pumping cycle.

The swash plate, which does not rotate but pivots about the front of the pumping head, is the control mechanism that limits the stroke of each piston.

Situated between the rotating pumping head and the pump housing is a double kidney ported valve plate which allows each piston barrel to be filled with oil during the inlet stroke and to expel the oil on the exhaust or power stroke. The inlet port is forcibly fed with oil supplied by the charge pump and the exhaust port discharges oil to the hydraulic circuits.

As the pumping head rotates the barrel, each piston passes over the inlet and then the outlet ports of the pump. During the inlet cycle for each piston and barrel, oil is pumped into the barrel pushing the piston forward so that it always remains in contact with the swash plate. The stroke of each piston and volume of oil charged into its barrel is dependent on the angle of the swash plate.

After a piston and barrel has completed the inlet stroke, further rotation of the head aligns the barrel with the outlet port. Oil within the barrel is then forcibly ejected by the piston through the exhaust port to the hydraulic circuits.



Hydraulic Pump Assembly–Filter and Valve Identification

1. Charge Pressure Filter
2. Charge Pump Inlet Filter
3. Flow Compensating Valve
4. Pressure Compensating Valve
5. Charge Pressure By–Pass Valve
6. Steering Pump Inlet Filter
7. Blocked charge Pressure Filter Dump Valve
8. Low Pressure Circuit Safety Valve
9. Pressure Regulating Valve

A comprehensive description and operation of the closed centre load sensing system, used to control the angle of the swash plate, is described later on in this Section using a series of hydraulic circuit diagrams.

These circuits are drawn depicting all the filters, valves and pumping elements used in the hydraulic system. To understand the circuits it is necessary to be aware of the location and principal function of each valve and filter within the pump assembly. Figure 5 illustrates the location of these items and is followed by a brief description of their principal function.

Flow Compensating Valve

The flow compensating valve controls operation of the swash plate in the variable displacement piston pump. This valve is the principal component of the load sensing system.

Pressure Compensating Valve

The pressure compensating valve works in conjunction with the flow compensating valve to restrict the maximum pressure in the variable displacement piston pump to 2700–2800 lbf/in^2 (186–193 bar).

Charge Pressure By–Pass Valve

Any excess oil supplied by the charge pump and not required by the variable displacement piston pump is returned to sump by the function of the charge pressure by–pass valve. This valve starts to operate when the pressure of oil delivered to the piston pump reaches 23 lbf/in^2 (1.6 bar). It should be noted that this is not the charge pressure but the pressure at which the by pass valve starts to 'bleed' the excess oil delivery to sump. The valve when fully open limits the charge pressure to a maximum of 50 lbf/in^2 (3.4 bar).

Charge Pressure Filter Dump Valve

The charge pressure filter dump valve is a safety relief valve for relieving excess pressure on the charge pump should the filter be restricted. This valve will begin to operate if the charge pressure exceeds 100 lbf/in^2 (7 bar).

Pressure Regulating Valve

The pressure regulating valve controls the maximum pressure of oil in the P.T.O., differential lock, four wheel drive disengagement system and transmission control circuits to 250–280 lbf/in^2 (17–19 bar) while at the same time directing high pressure system oil to the hydraulic power lift and remote valves. For detailed description and operation of this valve refer to the sub heading 'Operation of Pressure Regulating Valve' at the end of this Section.

Low Pressure Circuit Safety Valve

The low pressure circuit safety valve is a relief valve preventing pressure in the low pressure hydraulic circuit exceeding a maximum of 415 lbf/in^2 (28.6 bar).

This valve will only operate in the unlikely event that the pressure regulating valve fails to function correctly.

HYDRAULIC CIRCUIT OPERATION

The following hydraulic circuit diagrams in this Section are illustrated with the hydraulic lift assembly and lower link sensing electronic draft control system. The principal of operation of the variable displacement piston pump is, however, the same if a mechanical top link sensing hydraulic system is fitted as shown in Figure 11.

With reference to Figure 6.

The charge pressure pump draws oil through the charge pump inlet filter and passes it through the charge pressure filter. The oil then enters the variable displacement piston pump.

It should be noted that the inlet filter incorporates a by–pass valve, which is an integral part of the replaceable filter. It is, therefore, essential that the correct filter is installed at every filter change.

When the hydraulic lift and remote valves are not operating, demand by the hydraulic circuits is minimal and the only requirement of the pump is to supply oil at standby pressure, sufficient to operate the low pressure hydraulic system.

Because output of the variable displacement piston pump is always less than that of the charge pump delivery, excess oil flow supplied by the charge pump is returned to sump through the charge pressure by–pass valve.

If the charge pressure filter becomes restricted and the pressure on the inlet side of the filter reaches 100 lbf/in^2 (7 bar), the blocked filter dump valve will start to operate allowing oil to be returned directly to sump. If the charge pressure filter is fully restricted and 'full charge pump flow' has to pass over the dump valve, the pressure at the filter will be limited to a maximum of 180 lbf/in^2 (12.5 bar). provided the oil is at an operating temperature of 170°F (77°C).

Should the charge pressure at the inlet of the piston pump fall to 8–12 lbf//in^2 (0.55–0.82 bar), a warning light on the instrument panel will 'flash' indicating a low charge pressure.

The original equipment charge pressure filter contains a high performance synthetic media which results in high efficiency with low pressure drop to give maximum protection to the piston pump and hydraulic valves and to allow the required service life. It is, therefore, essential that the correct element is installed at every filter change and that the only the specific filter is used.

The steering pump similarly draws oil through an inlet filter which contains a by–pass valve which is an integral part of the replaceable filter. It is, therefore, essential that the correct filter is installed at every filter change. A dump valve, as used in the charge pump circuit is not, however, required as total output from the steering pump is directed to the steering system and transmission lubrication circuits. Should the steering filter become restricted and providing the oil temperature is above 40°C (104°F), a warning light on the instrument panel will be illuminated and a continuous audible alarm will sound.

For details of the steering and transmission lubrication circuits refer to the appropriate Steering and Transmission Parts of this Repair Manual.

Control of Variable Displacement Piston Pump when Generating Standby Pressure

With reference to Figure 6 and Figure 7.

Control of the swash plate, which regulates the output of the variable displacement piston pump, is achieved by the flow and pressure compensating valves located at the base of the pump.

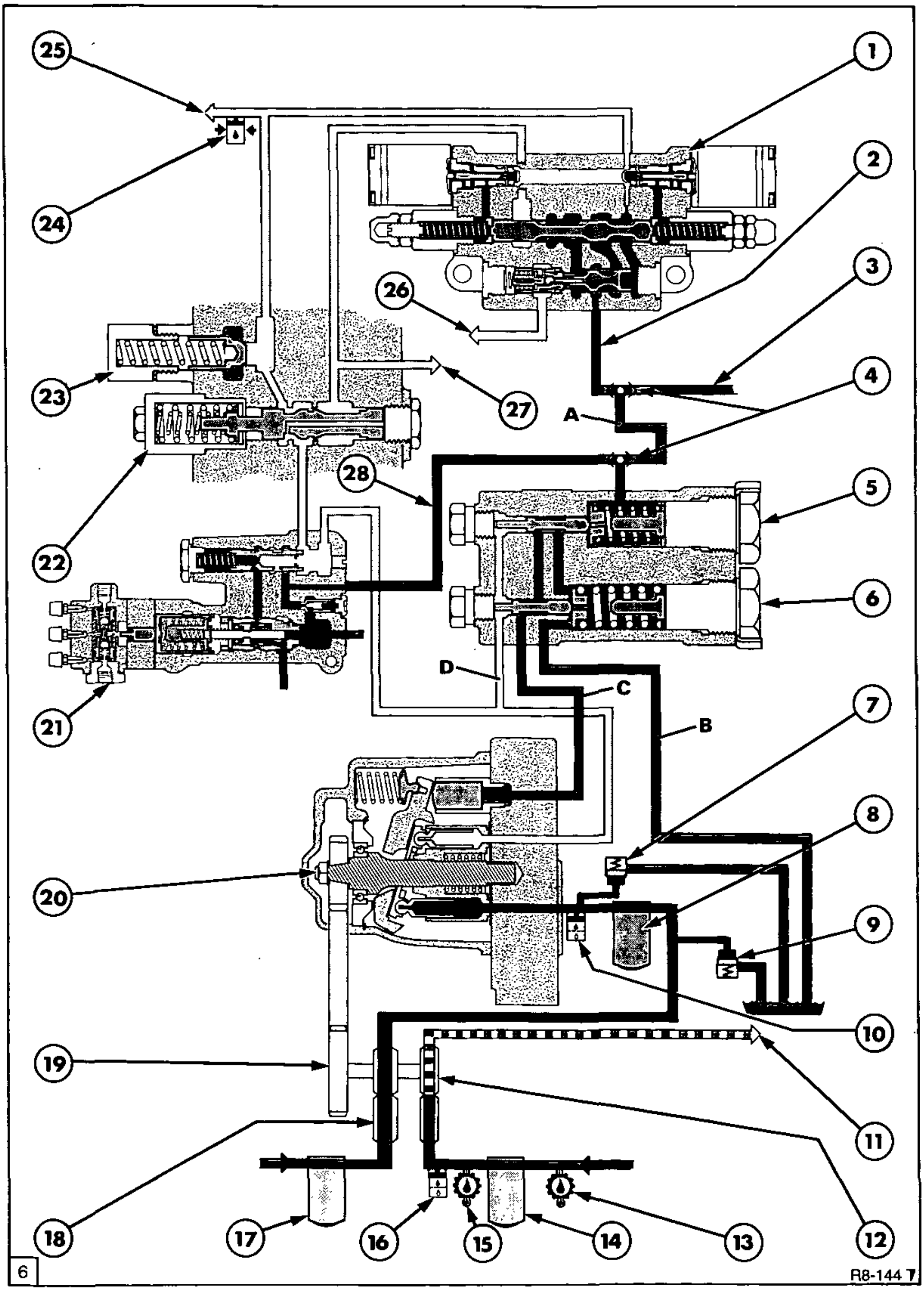
When the engine is first started, the swash plate return spring positions the swash plate for maximum output of the pump, Figure 6. During engine start up, standby pressure has not yet been generated by the pump and the flow compensating valve spool is held to the left by spring pressure. The position of the spool prevents oil pressure generated by the pump, being applied through gallery **D** to the swash plate servo piston through gallery **C**. The swash plate consequently remains in the maximum flow position until the piston pump has developed standby pressure.

Figure 6

Control of Variable Displacement Piston Pump with CCLS when Generating Standby Pressure

1. Electronic Draft Control Valve
2. Load Sensing Line from Electronic Draft Control Valve (or Unload Valve if Tractor Fitted with Top Link Sensing)
3. Load Sensing Line from Remote Valves
4. Shuttle Valves
5. Flow Compensating Valve
6. Pressure Compensating Valve
7. Charge Pressure By–Pass Valve
8. Charge Pressure Filter
9. Charge Pressure Filter Dump Valve
10. Low Charge Pressure Switch
11. Oil Supply to Power Steering Motor, Oil Cooler, Transmission and P.T.O. Lubrication Circuits
12. Steering Pump
13. High Oil Temperature Switch
14. Steering Pump Inlet Filter
15. Steering Filter Low Temperature Switch (Prevents Blocked Steering Filter Light Working when Oil Temperature Below 40°C, 104°F)
16. Blocked Steering Filter Vacuum Switch
17. Charge Pump Inlet Filter
18. Charge Pump
19. Pump Gear Drive Train
20. Variable Displacement Piston Pump
21. Trailer Brake Valve (where fitted)
22. Pressure Regulating Valve
23. Low Pressure Circuit Safety Valve
24. Low Transmission Oil Pressure Switch
25. Low Pressure Circuit Oil Supply to PTO, Differential Lock, Transmission Control Circuits and Four Wheel Drive
26. To Hydraulic Lift Cylinder
27. To Remote Valves
28. Load Sensing Line from Trailer Brake Valve

A Load Sensing Line from Hydraulic Lift, Trailer Brake and Remote Control Valve Circuits
B Return to Sump Gallery from Flow and Pressure Compensating Valves
C Gallery to Swash Plate Servo Piston from Flow and Pressure Compensating Valves
D System Pressure Sensing Gallery to Flow and Pressure Compensating Valves



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Control of Variable Displacement Piston Pump with CCLS when Generating Standby Pressure

- ▥ Steering System Oil
- ▨ Standby Pressure Oil @ Less Than 250 lbf/in^2 (17 bar)
- ■ Charge Pressure Oil @ 23–50 lbf/in^2 (1.6–3.4 bar)
- ■ Suction, Return to Reservoir and Zero Pressure Oil
- ☐ Trapped Oil

As pump output pressure increases to 310–350 lbf/in² (21–24 bar), known as standby pressure (low pressure standby), the increase in pressure is sensed in gallery **D** and applied to the end of the flow compensator spool. The spool gradually moves against the spring allowing oil flow from gallery **D** to gallery **C**, Figure 7.

The controlled pressure rise in gallery **C** operates the swash plate servo piston, changing the angle of the swash plate in relation to the pumping head. The change in angle reduces the operating stroke of the pistons and output of the pump.

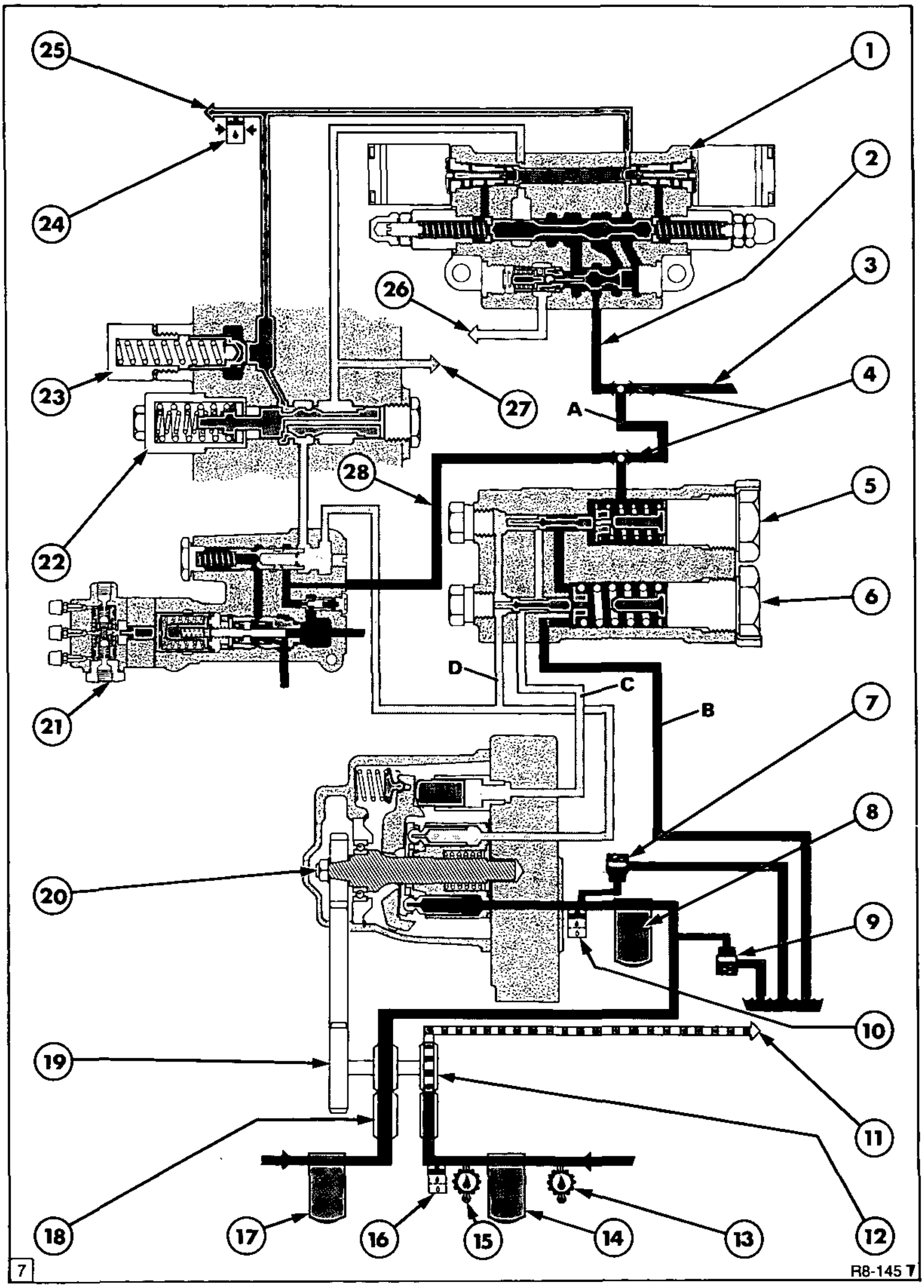
As pump output decreases and the pressure in gallery **D** reduces to less than 350 lbf/in² (24 bar), the spring in the flow compensating valve gradually moves the spool to the left opening gallery **C** to sump through gallery **B**, via the spring cavity of the pressure compensating valve. This reduces the pressure applied to the servo piston, allowing the servo piston to retract at a controlled rate under pressure from the swash plate return spring, which re–adjusts the angle of the swash plate to increase pump output.

This process where the flow compensating valve spool moves back and forth to control the pressure applied to the servo piston, continues until there is a demand by the hydraulic system to increase output to operate the hydraulic lift, remote control valves or trailer brakes (where fitted).

Figure 7
Control of Variable Displacement Piston Pump with CCLS when Regulating Standby Pressure
(Low Pressure Standby)

1. Electronic Draft Control Valve
2. Load Sensing Line from Electronic Draft Control Valve
(or Unload Valve if Tractor Fitted with Top Link Sensing)
3. Load Sensing Line from Remote Valves
4. Shuttle Valves
5. Flow Compensating Valve
6. Pressure Compensating Valve
7. Charge Pressure By–Pass Valve
8. Charge Pressure Filter
9. Charge Pressure Filter Dump Valve
10. Low Charge Pressure Switch
11. Oil Supply to Power Steering Motor, Oil Cooler, Transmission and P.T.O. Lubrication Circuits
12. Steering Pump
13. High Oil Temperature Switch
14. Steering Pump Inlet Filter
15. Steering Filter Low Temperature Switch
(Prevents Blocked Steering Filter Light Working when Oil Temperature Below 40°C, 104°F)
16. Blocked Steering Filter Vacuum Switch
17. Charge Pump Inlet Filter
18. Charge Pump
19. Pump Gear Drive Train
20. Variable Displacement Piston Pump
21. Trailer Brake Valve (where fitted)
22. Pressure Regulating Valve
23. Low Pressure Circuit Safety Valve
24. Low Transmission Oil Pressure Switch
25. Low Pressure Circuit Oil Supply to PTO, Differential Lock, Transmission Control Circuits
and Four Wheel Drive
26. To Hydraulic Lift Cylinder
27. To Remote Valves
28. Load Sensing Line from Trailer Brake Valve

A Load Sensing Line from Hydraulic Lift, Trailer Brake and Remote Control Valve Circuits
B Return to Sump Gallery from Flow and Pressure Compensating Valves
C Gallery to Swash Plate Servo Piston from Flow and Pressure Compensating Valves
D System Pressure Sensing Gallery to Flow and Pressure Compensating Valves



Control of Variable Displacement Piston Pump with CCLS when Regulating Standby Pressure (Low Pressure Standby)

▥ Steering System Oil

■ Charge Pressure Oil @ 23–50 lbf/in² (1.6–3.4 bar)

□ Standby Pressure Oil @ 310–350 lbf/in² (21–24 bar)

■ Suction/Return to Reservoir Oil

■ Low Pressure Circuit Oil @ 250–280 lbf/in² (17–19 bar)

□ Trapped Oil

□ Control Pressure Oil

Control of Variable Displacement Piston Pump when High Pressure Hydraulic Circuits are Operated

With reference to Figure 8 and Figure 9.

After the pump has reached standby pressure and the hydraulic power lift, remote valves or trailer brakes (where fitted) are operated, the pressure rise in the hydraulic circuit being operated is sensed by the load sensing line **A**. The pressure in the sensing line is now applied to the spring loaded end of the flow compensator valve.

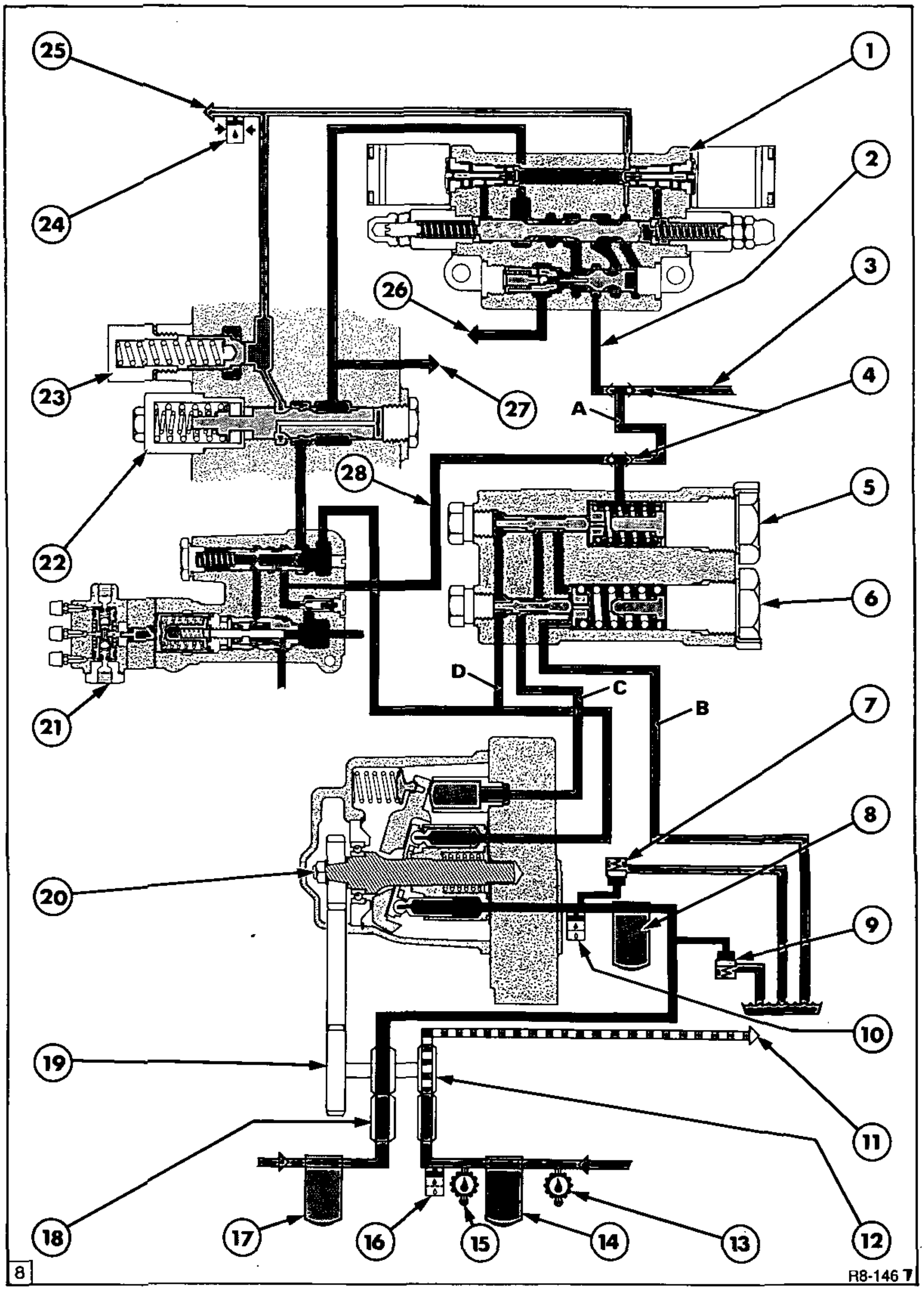
The combined pressure from the pilot line and flow compensating valve return spring causes the flow compensating spool to move against the standby pressure in gallery **D**, preventing the flow of oil to the swash plate servo piston through gallery **C**.

The movement of the spool opens gallery **C** to the return to sump gallery **B**, allowing the servo piston to retract under pressure from the swash plate return spring, which re–adjusts the angle of the swash plate to increase pump output, Figure 8.

Figure 8
Control of Variable Displacement Piston Pump with CCLS when High Pressure Hydraulic Circuits are Operated (Fast Lift)

1. Electronic Draft Control Valve
2. Load Sensing Line from Electronic Draft Control Valve (or Unload Valve if Tractor Fitted with Top Link Sensing)
3. Load Sensing Line from Remote Valves
4. Shuttle Valves
5. Flow Compensating Valve
6. Pressure Compensating Valve
7. Charge Pressure By–Pass Valve
8. Charge Pressure Filter
9. Charge Pressure Filter Dump Valve
10. Low Charge Pressure Switch
11. Oil Supply to Power Steering Motor, Oil Cooler, Transmission and P.T.O. Lubrication Circuits
12. Steering Pump
13. High Oil Temperature Switch
14. Steering Pump Inlet Filter
15. Steering Filter Low Temperature Switch (Prevents Blocked Steering Filter Light Working when Oil Temperature Below 40°C, 104°F)
16. Blocked Steering Filter Vacuum Switch
17. Charge Pump Inlet Filter
18. Charge Pump
19. Pump Gear Drive Train
20. Variable Displacement Piston Pump
21. Trailer Brake Valve (where fitted)
22. Pressure Regulating Valve
23. Low Pressure Circuit Safety Valve
24. Low Transmission Oil Pressure Switch
25. Low Pressure Circuit Oil Supply to PTO, Differential Lock, Transmission Control Circuits and Four Wheel Drive
26. To Hydraulic Lift Cylinder
27. To Remote Valves
28. Load Sensing Line from Trailer Brake Valve

A Load Sensing Line from Hydraulic Lift, Trailer Brake and Remote Control Valve Circuits
B Return to Sump Gallery from Flow and Pressure Compensating Valves
C Gallery to Swash Plate Servo Piston from Flow and Pressure Compensating Valves
D System Pressure Sensing Gallery to Flow and Pressure Compensating Valves



Control of Variable Displacement Piston Pump with CCLS when High Pressure Hydraulic Circuits are Operated (Fast Lift)

▥ Steering System Oil

■ Charge Pressure Oil @ 23–50 lbf/in^2 (1.6–3.4 bar)

■ Low Pressure Circuit Oil @ 250–280 lbf/in^2 (17–19 bar)

■ Suction/Return to Reservoir Oil

■ System Pressure Oil

As pump output increases so does the system pressure generated and applied to the end of the flow compensating spool through gallery **D**.

When the hydraulic operating cycle nears completion, eg. the hydraulic lift is raised out of the ground and the main spool in the electronic draft control valve gradually returns to the neutral position, the pressure in the load sensing line similarly begins to decrease. When the pressure generated in *gallery* **D** *is 300 lbf/in*^{2} *(21 bar) greater than* that in the load sensing gallery **A** the flow compensator spool moves back against the spring to open gallery **D** to gallery **C**. The controlled pressure rise in gallery **C** now operates the swash plate servo piston and changes the swash plate angle to reduce pump output and the speed of lift, Figure 9.

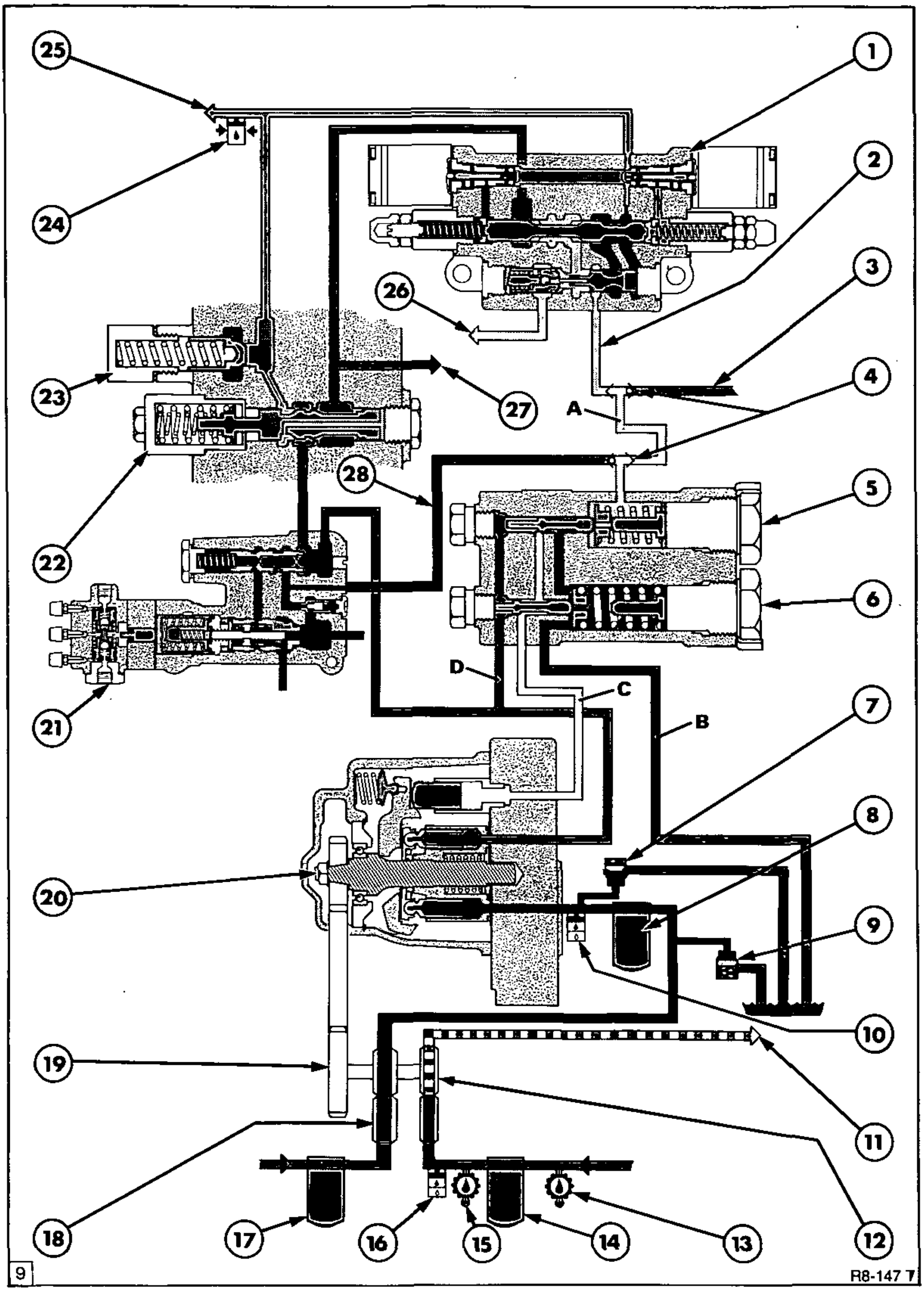
It can now be seen that the basic principle of pump control, when operating the hydraulic high pressure circuits, is similar to that for operation of the pump at standby pressure when there is no high pressure hydraulic demand. The only difference is that because the pressure in the hydraulic system circuit *being operated is sensed through the load* sensing line **A**, the pressure required to operate the flow compensating valve is higher than that for standby pressure operation.

Figure 9

Control of Variable Displacement Piston Pump with CCLS when High Pressure Hydraulic Circuits are Operated (Slow Lift)

1. Electronic Draft Control Valve
2. Load Sensing Line from Electronic Draft Control Valve (or Unload Valve if Tractor Fitted with Top Link Sensing)
3. Load Sensing Line from Remote Valves
4. Shuttle Valves
5. Flow Compensating Valve
6. Pressure Compensating Valve
7. Charge Pressure By-Pass Valve
8. Charge Pressure Filter
9. Charge Pressure Filter Dump Valve
10. Low Charge Pressure Switch
11. Oil Supply to Power Steering Motor, Oil Cooler, Transmission and P.T.O. Lubrication Circuits
12. Steering Pump
13. High Oil Temperature Switch
14. Steering Pump Inlet Filter
15. Steering Filter Low Temperature Switch (Prevents Blocked Steering Filter Light Working when Oil Temperature Below 40°C, 104°F)
16. Blocked Steering Filter Vacuum Switch
17. Charge Pump Inlet Filter
18. Charge Pump
19. Pump Gear Drive Train
20. Variable Displacement Piston Pump
21. Trailer Brake Valve (where fitted)
22. Pressure Regulating Valve
23. Low Pressure Circuit Safety Valve
24. Low Transmission Oil Pressure Switch
25. Low Pressure Circuit Oil Supply to PTO, Differential Lock, Transmission Control Circuits and Four Wheel Drive
26. To Hydraulic Lift Cylinder
27. To Remote Valves
28. Load Sensing Line from Trailer Brake Valve

A Load Sensing Line from Hydraulic Lift, Trailer Brake and Remote Control Valve Circuits
B Return to Sump Gallery from Flow and Pressure Compensating Valves
C Gallery to Swash Plate Servo Piston from Flow and Pressure Compensating Valves
D System Pressure Sensing Gallery to Flow and Pressure Compensating Valves



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Control of Variable Displacement Piston Pump with CCLS when High Pressure Hydraulic Circuits are Operated (Slow Lift)

▥ Steering System Oil

■ Charge Pressure Oil @ 23–50 lbf/in² (1.6–3.4 bar)

◩ System Pressure Oil

■ Suction/Return to Reservoir Oil

□ Control Pressure Oil

▣ Low Pressure Circuit Oil @ 250–280 lbf/in² (17–19 bar)

Limiting Maximum System Pressure of Variable Displacement Piston Pump

With reference to Figure 10.

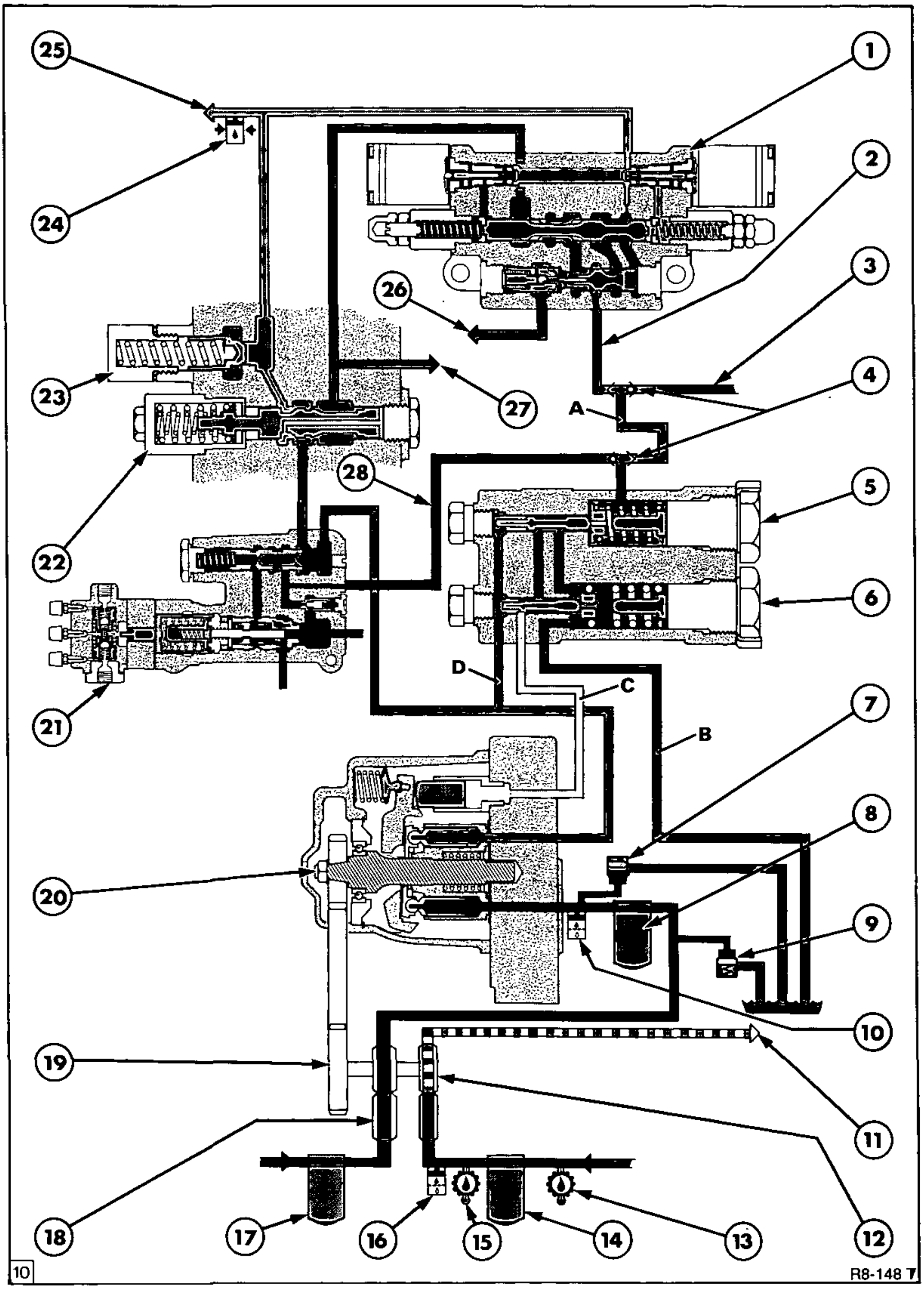
To limit the maximum output pressure of the piston pump and prevent consequential damage that may occur due to excessive pressures, a pressure compensating valve, located adjacent to the flow compensator valve, is incorporated in the swash plate control circuit. This valve limits the pressure to 2700–2800 lbf/in² (186–193 bar) and operates as follows:–

As the pressure in gallery **D** increases to 2800 lbf/in² (193 bar) the pressure compensator valve spool moves against the valve return spring and opens gallery **D** to gallery **C**. The pressure in gallery **D** is now applied to the servo piston which changes the swash plate angle to reduce pump output to minimum flow. This operating mode is referred to as high pressure standby.

Figure 10
Variable Displacement Piston Pump Assembly Operation when Limiting Maximum System Pressure
(High Pressure Standby)

1. Electronic Draft Control Valve
2. Load Sensing Line from Electronic Draft Control Valve
(or Unload Valve if Tractor Fitted with Top Link Sensing)
3. Load Sensing Line from Remote Valves
4. Shuttle Valves
5. Flow Compensating Valve
6. Pressure Compensating Valve
7. Charge Pressure By–Pass Valve.
8. Charge Pressure Filter
9. Charge Pressure Filter Dump Valve
10. Low Charge Pressure Switch
11. Oil Supply to Power Steering Motor, Oil Cooler, Transmission and P.T.O. Lubrication Circuits
12. Steering Pump
13. High Oil Temperature Switch
14. Steering Pump Inlet Filter
15. Steering Filter Low Temperature Switch
(Prevents Blocked Steering Filter Light Working when Oil Temperature Below 40°C, 104°F)
16. Blocked Steering Filter Vacuum Switch
17. Charge Pump Inlet Filter
18. Charge Pump
19. Pump Gear Drive Train
20. Variable Displacement Piston Pump
21. Trailer Brake Valve (where fitted)
22. Pressure Regulating Valve
23. Low Pressure Circuit Safety Valve
24. Low Transmission Oil Pressure Switch
25. Low Pressure Circuit Oil Supply to PTO, Differential Lock, Transmission Control Circuits
and Four Wheel Drive
26. To Hydraulic Lift Cylinder
27. To Remote Valves
28. Load Sensing Line from Trailer Brake Valve

A Load Sensing Line from Hydraulic Lift, Trailer Brake and Remote Control Valve Circuits
B Return to Sump Gallery from Flow and Pressure Compensating Valves
C Gallery to Swash Plate Servo Piston from Flow and Pressure Compensating Valves
D System Pressure Sensing Gallery to Flow and Pressure Compensating Valves



Variable Displacement Piston Pump Assembly Operation when Limiting Maximum System Pressure (High Pressure Standby)

▥ Steering System Oil

■ Charge Pressure Oil @ 23–50 lbf/in² (1.6–3.4 bar)

▨ System Pressure Oil @ 2800 lbf/in² (193 bar)

■ Suction/Return to Reservoir Oil

□ Control Pressure Oil

▩ Low Pressure Circuit Oil @ 250–280 lbf/in² (17–19 bar)

Control of Variable Displacement Pump With Top Link Sensing Hydraulic Lift

With reference to Figure 11

When a tractor installed with a variable displacement closed centre load sensing hydraulic pump is also fitted with a top link sensing hydraulic lift assembly, a special unload valve with a load sensing capability is installed on the hydraulic lift assembly.

This primary function of this valve is to signal the CCLS pump whenever the hydraulic demand of the hydraulic lift assembly changes.

Figure 6 to Figure 10 illustrate the operation of the CCLS hydraulic pump when installed on a tractor with electronic draft control. The principle of operation of the pump when the tractor is installed with a top link sensing hydraulic lift assembly is exactly the same as that for the electronic draft control system. To illustrate the similarity Figure 11 shows the installation of the top link sensing unload valve instead of the EDC hydraulic valve shown previously.

For the operation and overhaul of the top link sensing unload valve refer to the 'Hydraulic Lift Assembly With Top Link Sensing' Chapter in this Part of the Repair Manual.

Figure 11
Control of Variable Displacement Piston Pump with Top Link Sensing Hydraulic Lift Assembly Unload Valve (Fast Lift)

1. *Top Link Sensing Hydraulic Lift Unload Valve*
2. Load Sensing Line from Hydraulic Lift Unload Valve
3. Load Sensing Line from Remote Valves
4. Shuttle Valves
5. Flow Compensating Valve
6. Pressure Compensating Valve
7. Charge Pressure By–Pass Valve
8. Charge Pressure Filter
9. Charge Pressure Filter Dump Valve
10. Low Charge Pressure Switch
11. Oil Supply to Power Steering Motor, Oil Cooler, Transmission and P.T.O. Lubrication Circuits
12. Steering Pump
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15. Steering Filter Low Temperature Switch
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18. Charge Pump
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21. Trailer Brake Valve (where fitted)
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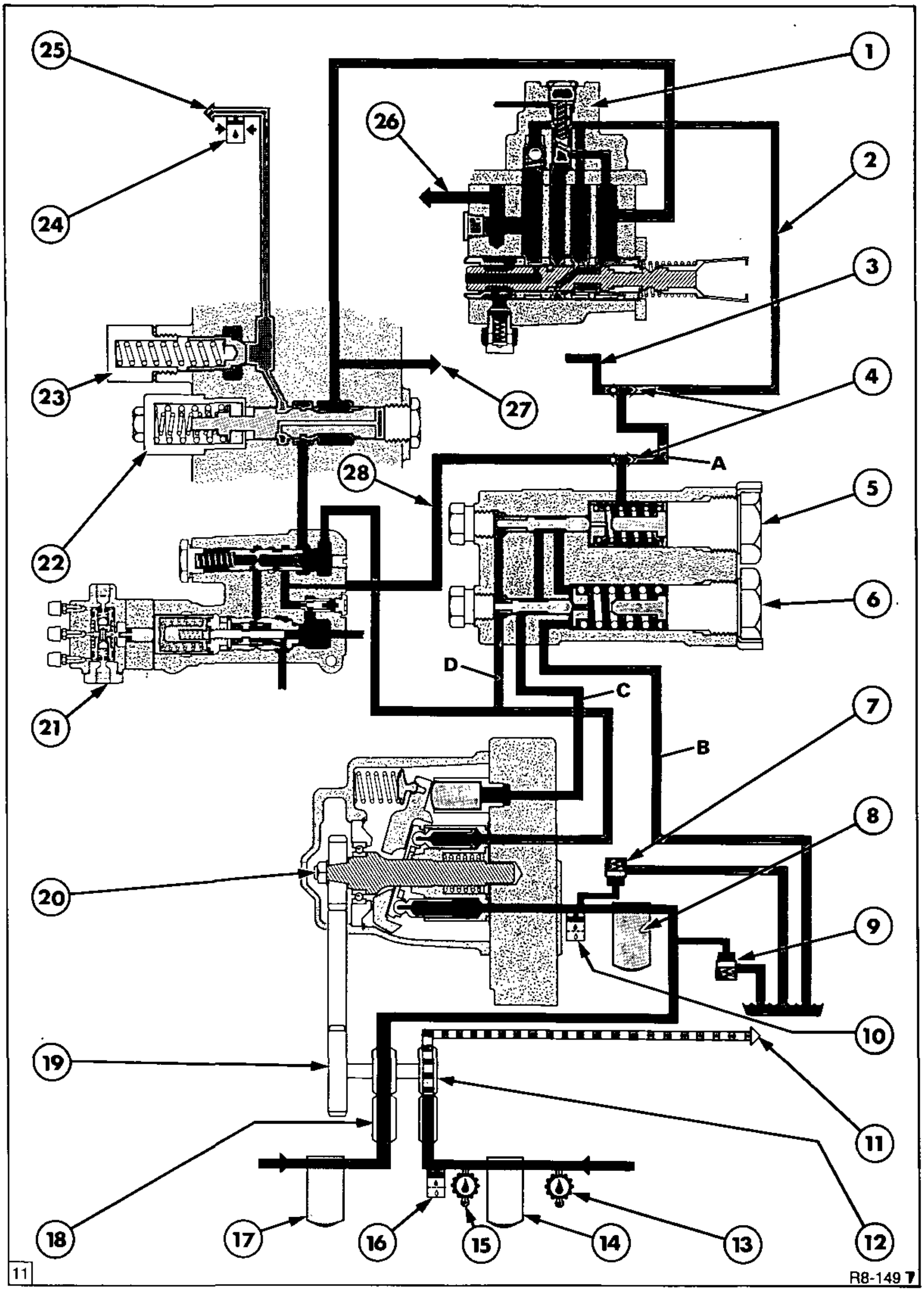
23. Low Pressure Circuit Safety Valve
24. Low Transmission Oil Pressure Switch
25. Low Pressure Circuit Oil Supply to PTO, Differential Lock, Transmission Control Circuits
    and Four Wheel Drive
26. To Hydraulic Lift Cylinder
27. To Remote Valves
28. Load Sensing Line from Trailer Brake Valve

A Load Sensing Line from Hydraulic Lift, Trailer Brake and Remote Control Valve Circuits
B Return to Sump Gallery from Flow and Pressure Compensating Valves
C Gallery to Swash Plate Servo Piston from Flow and Pressure Compensating Valves
D System Pressure Sensing Gallery to flow and Pressure Compensating Valves



Control of Variable Displacement Piston Pump with Top Link Sensing
Hydraulic Lift Assembly Unload Valve (Fast Lift)

▥ Steering System Oil

■ Charge Pressure Oil @ 23–50 lbf/in² (1.6–3.4 bar)

■ System Pressure Oil

■ Suction/Return to Reservoir Oil

■ Low Pressure Circuit Oil @ 250–280 lbf/in² (17–19 bar)

Operation Of Pressure Regulating Valve

The regulated flow of oil discharged from the variable displacement piston pump is directed to the low and high pressure hydraulic circuits via the trailer brake valve (where fitted) and the pressure regulating valve.

Because pump output is initially directed through the trailer brake valve, where fitted, the system ensures that the trailer brakes have priority over other hydraulic circuits.

The pressure regulating valve, located on the top of the pump, controls the maximum pressure of oil in the low pressure hydraulic circuit while at the same time directing high pressure system oil to the hydraulic power lift and remote control valves.

The low pressure hydraulic circuit, which is at a pressure of 250–280 lbf/in^2 (17–19 bar) operates the electronic draft control valve (where fitted), P.T.O., differential lock, four wheel drive engagement system and transmission control circuits.

With reference to Figure 12 and Figure 13, operation of the pressure regulating valve is as follows:–

Spring pressure applied to the end of the pressure regulating valve spool moves the spool to the right allowing system pressure oil from the variable displacement piston pump to flow from gallery **E** to the low pressure hydraulic circuits through gallery **F**.

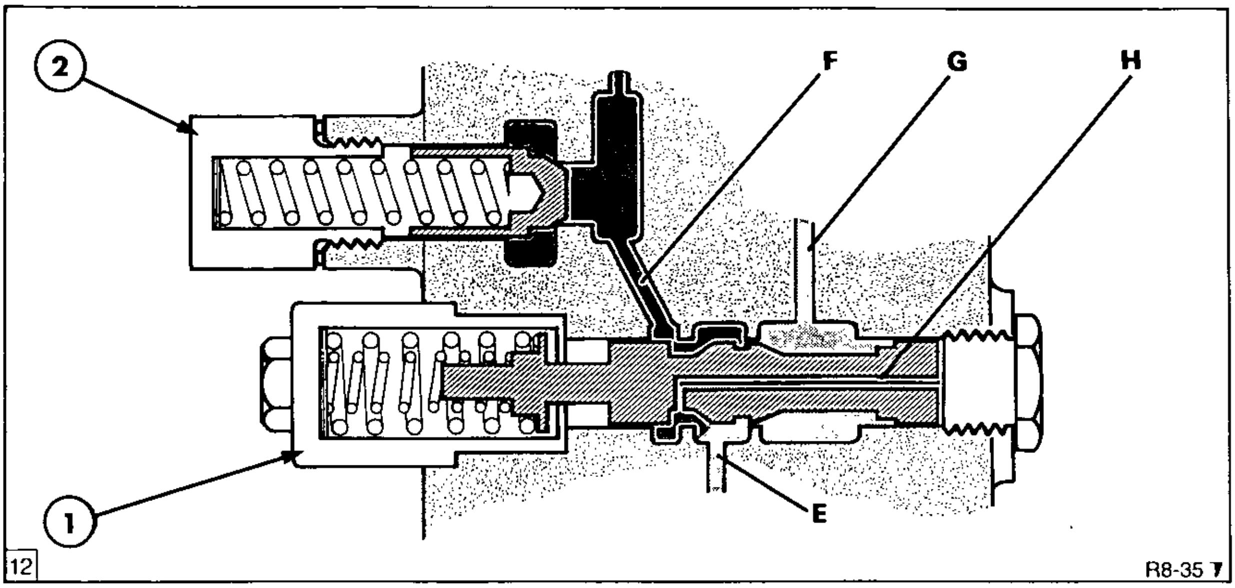
The resulting pressure in gallery **F** is sensed in the pressure sensing gallery **H** drilled through the centre of the spool. As the pressure in gallery **F** increases, the spool moves against the spring restricting the flow of oil into gallery **F** to maintain the pressure of oil in the low pressure hydraulic circuit at 250–280 lbf/in^2 (17–19 bar), while at the same time allowing system pressure oil to flow into gallery **G**.

When the high pressure hydraulic circuits are not in operation the variable displacement piston pump is on minimal delivery and the pressure regulating valve spool directs most of the flow from gallery **E** to gallery **F**, in order to maintain the low pressure hydraulic circuit pressure of 250–280 lbf/in^2 (17–19 bar), Figure 12.

When the high pressure hydraulic circuits are in operation and the variable displacement piston pump has increased delivery to satisfy demand, the spool moves almost totally against the spring in order to regulate the pressure of oil in the low pressure hydraulic circuit, .

It can now be seen that the spool moves back and forth to maintain the low pressure circuit oil at 250–280 lbf/in^2 (17–19 bar) while at the same time allowing system pressure oil to be directed to the high pressure hydraulic circuit for operation of the hydraulic lift and remote control valves.

To prevent any damage occurring due to excessive pressures in the low pressure hydraulic circuit, the low pressure circuit safety valve will operate whenever the pressure increases to 400–415 lbf/in^2 (28.6 bar). Should this occur the safety valve poppet will lift off its seat and vent the circuit to reservoir.

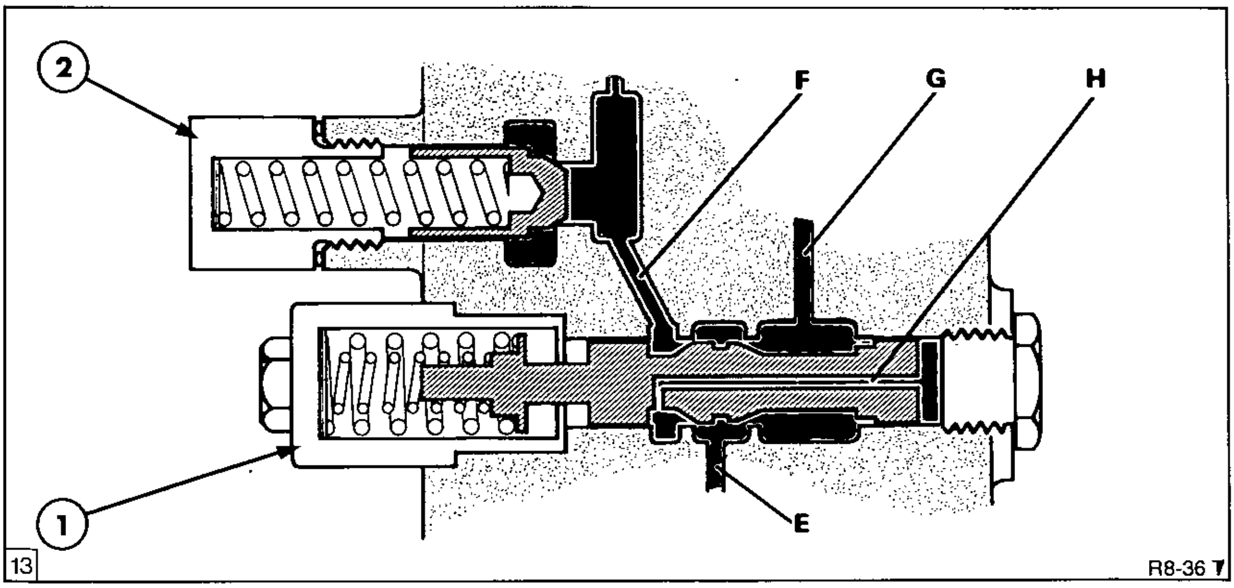


Pressure Regulating Valve and Low Pressure Circuit Safety Valve
(Low Pressure Circuit Operation)

1. Pressure Regulating Valve
2. Low Pressure Circuit Safety Valve

E System Pressure Oil from Variable Displacement Piston Pump
F To Low Pressure Hydraulic Circuit
G To High Pressure Hydraulic Circuit
H Low Pressure Circuit Sensing Gallery

░ System Pressure Oil ▨ Low Pressure Circuit Oil ■ Return to Reservoir



Pressure Regulating Valve and Low Pressure Circuit Safety Valve
(Low and High Pressure Circuit Operation)

1. Pressure Regulating Valve
2. Low Pressure Circuit Safety Valve

E System Pressure Oil from Variable Displacement Pump
F To Low Pressure Hydraulic Circuit
G To High Pressure Hydraulic Circuit
H Low Pressure Circuit Sensing Gallery

■ System Pressure Oil ▨ Low Pressure Circuit Oil ■ Return to Reservoir

B. FAULT FINDING

This fault finding section is designed to assist in identifying the cause of incorrect operation of those hydraulic systems which are supplied with oil by the variable displacement hydraulic pump assembly with closed centre load sensing (CCLS) and integral charge and steering pumps.

The following fault finding diagnostic charts detailed in this section and should be referred to when analysing concerns with the hydraulic system on the tractor.

Initial Fault Finding Check

Charge Pressure Light Flashing

Transmission Pressure Warning Light 'On'

Hydraulic Lift not Working Correctly

Power Steering not Working Correctly

Trailer Brakes not Working

Remote Control Valves not Working

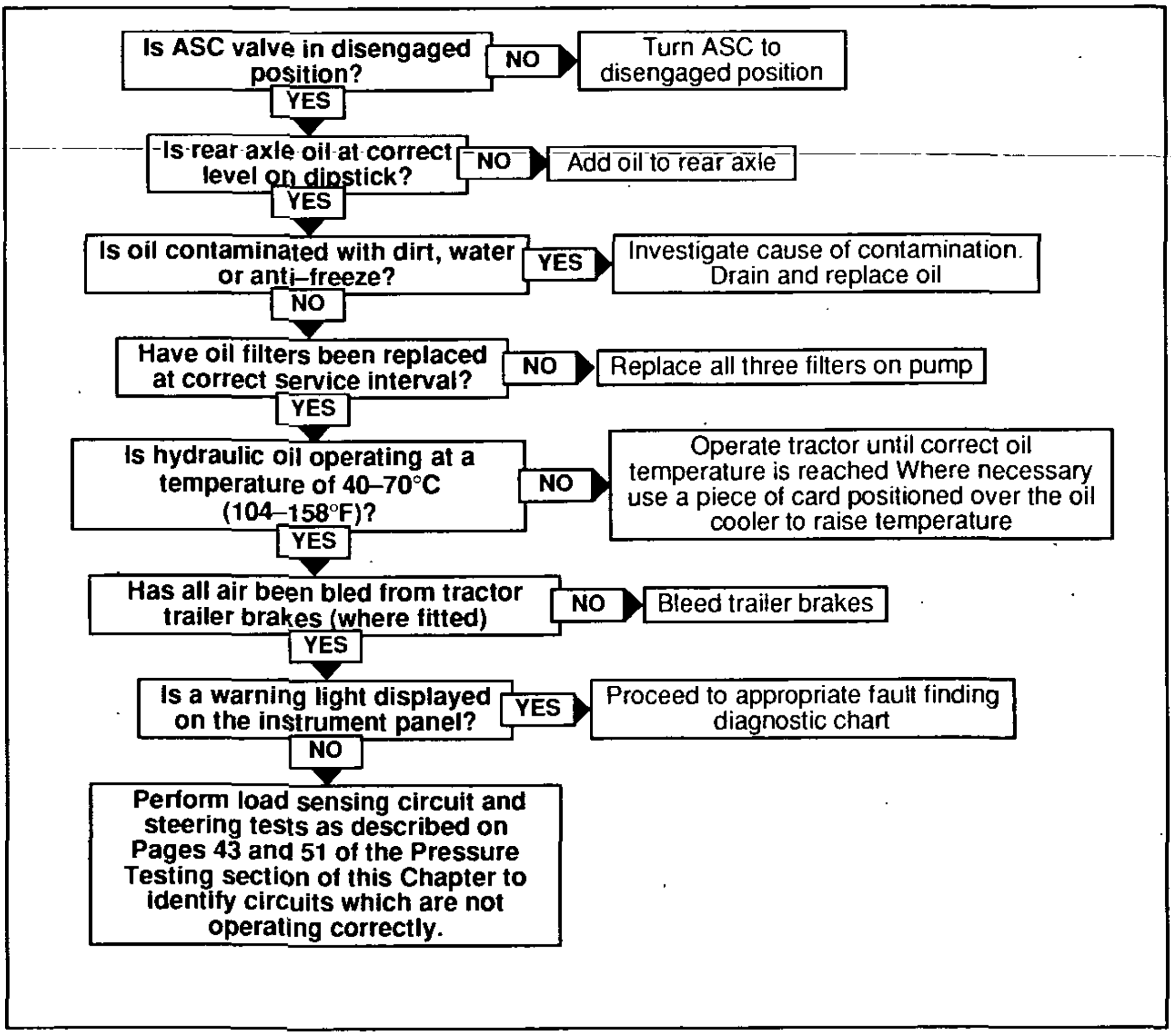
Differential lock, PTO, !6 x 16 Transmission and Four Wheel Drive Clutch Not Working (where fitted)

Before proceeding to the individual fault finding diagnostic charts it is important that reference is made to the initial check fault finding chart which may identify an obvious cause for the concern and prevent unnecessary component disassembly.

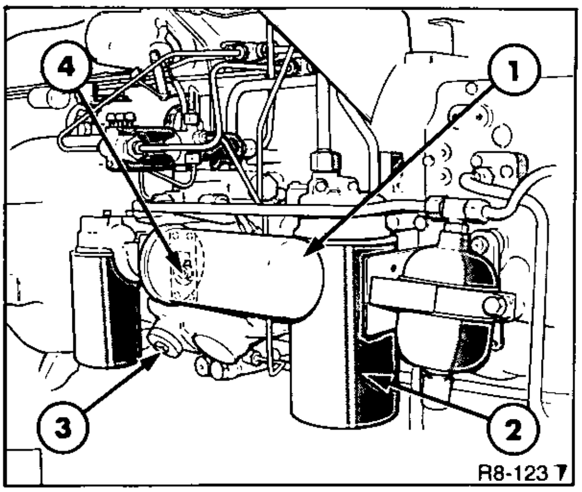
Where the fault finding specifies pressure or flow testing the pump or hydraulic circuit refer to Section D for the test procedure.

IMPORTANT: *If the steering is inoperative, their will be no lubrication to the transmission or PTO clutch and the tractor must not be run for more than 5 minutes at a maximum engine speed of 1000 rev/min.*

Initial Fault Finding Checks to be Performed Before Proceeding to General Diagnostic Procedure

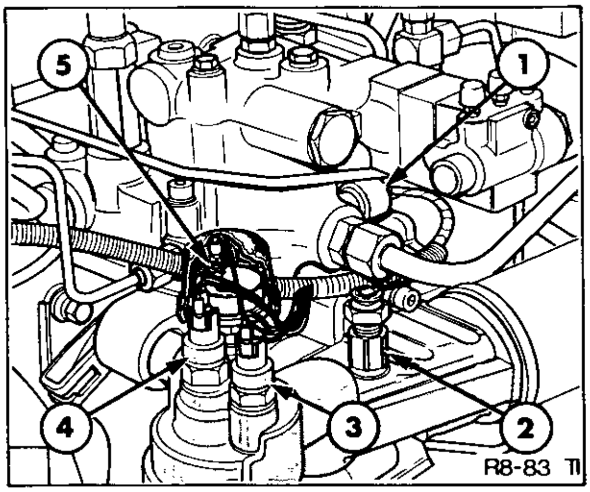


Charge Pressure Light Flashing



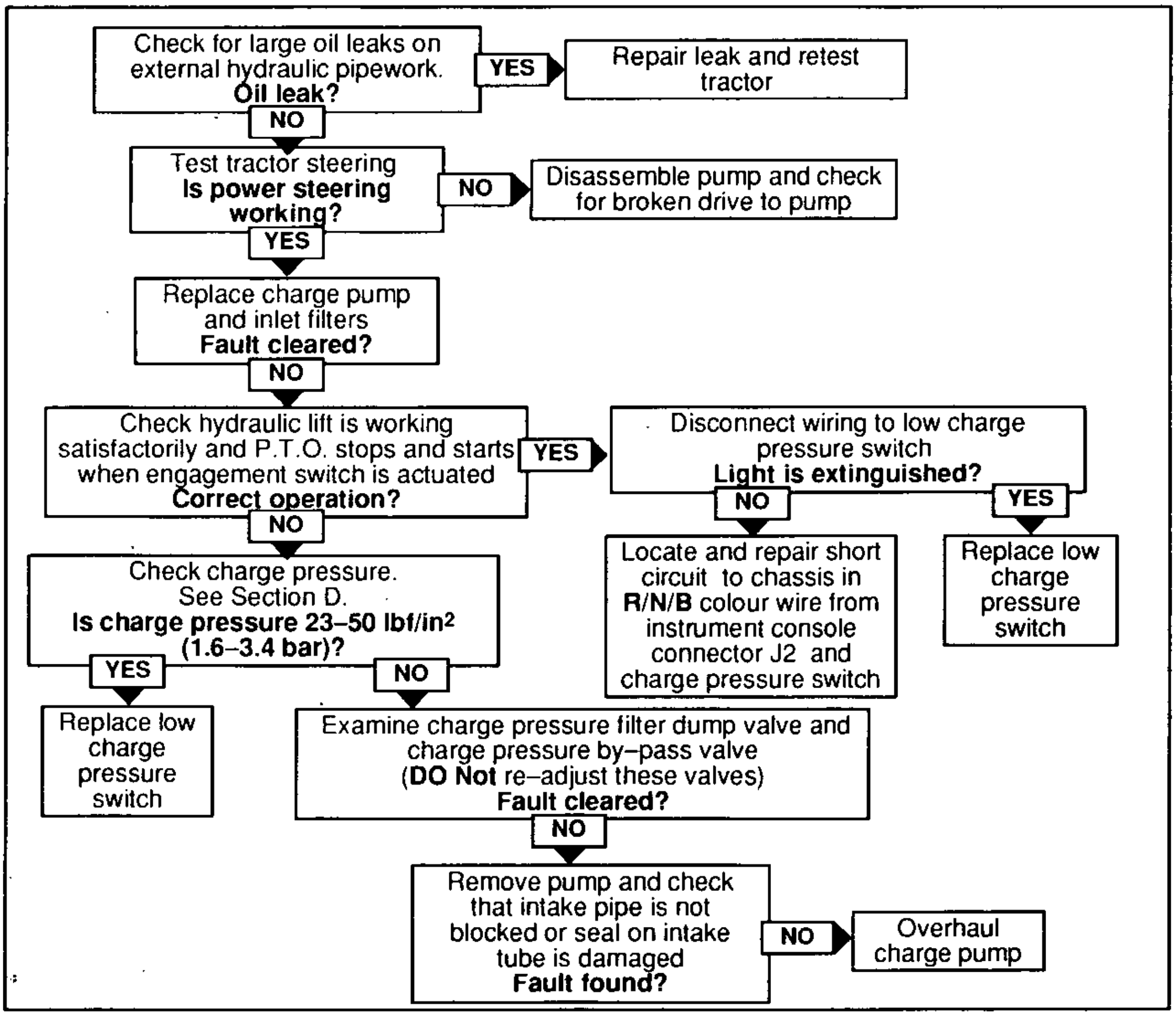
Charge Pressure Bypass and Filter Dump Valves

1. Charge Pressure Filter
2. Charge Pump Inlet Filter
3. Charge Pressure By–pass Valve
4. Charge Pressure Filter Dump Valve

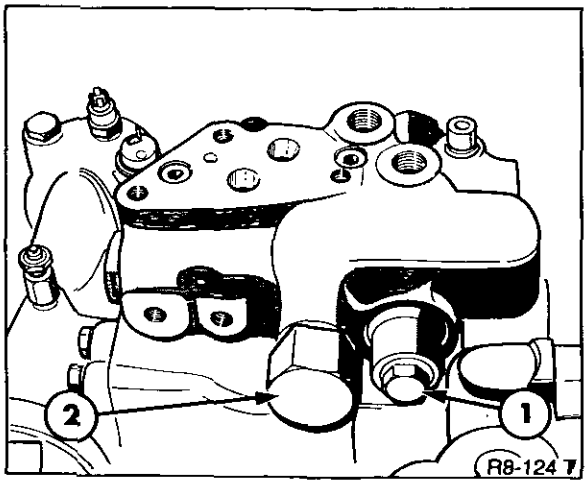


CCLS Hydraulic Pump Switch Identification

1. Low Transmission Oil Pressure Switch
2. Low Charge Pressure Switch
3. High Oil Temperature Switch
4. Steering Filter Low Temperature Switch
5. Blocked Steering Filter Vacuum Switch

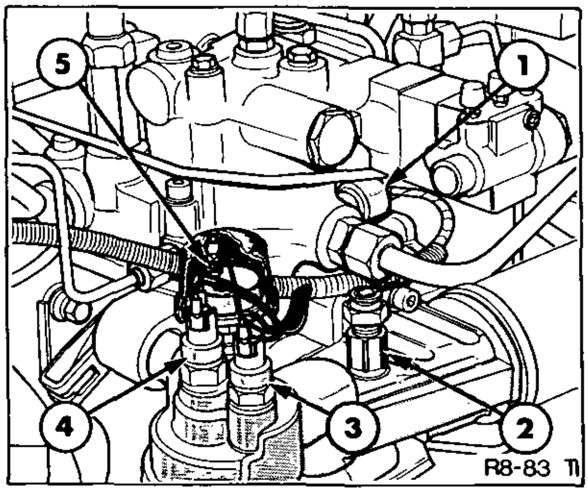


Transmission Pressure Warning Light 'ON'



Pressure Regulating Valve

1. Pressure Regulating Valve
2. Low Pressure Circuit Safety Valve



CCLS Hydraulic Pump Switch Identification

1. Low Transmission Oil Pressure Switch
2. Low Charge Pressure Switch
3. High Oil Temperature Switch
4. Steering Filter Low Temperature Switch
5. Blocked Steering Filter Vacuum Switch

Is steering working correctly?
NO → Refer to fault finding chart for steering not working
YES ↓

Disconnect wiring to low transmission oil pressure switch
Is warning light 'On'?
YES → Disconnect wiring to low flow steering/lubrication circuit pressure switch
Is warning light 'On'?
YES → check for short to chassis in **Y/O** colour wires from instrument console connector **J2** to pressure switches
NO ↓
Flow test oil cooler and check for leaks/restriction in cooler circuit
Fault found?
NO ↓
Replace low flow steering/lubrication circuit pressure switch

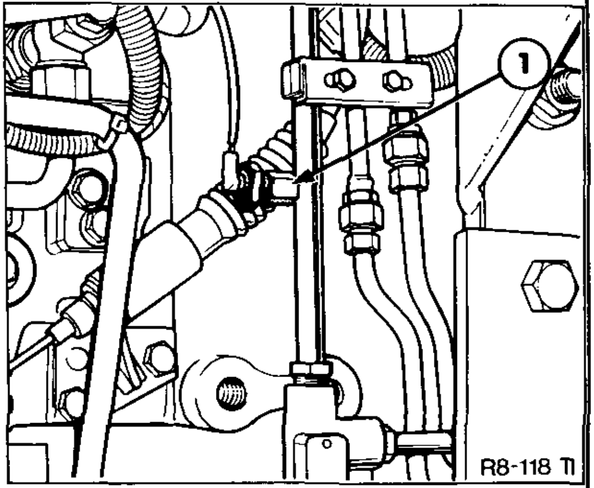
(Is warning light 'On'?) NO ↓

Perform low pressure circuit check See Section D
Is pressure 250–280 lbf/in² (17–20 bar)?
YES → Replace low transmission oil pressure switch
NO ↓

Remove and examine pressure regulating valve for sticking
Fault cleared?
NO ↓

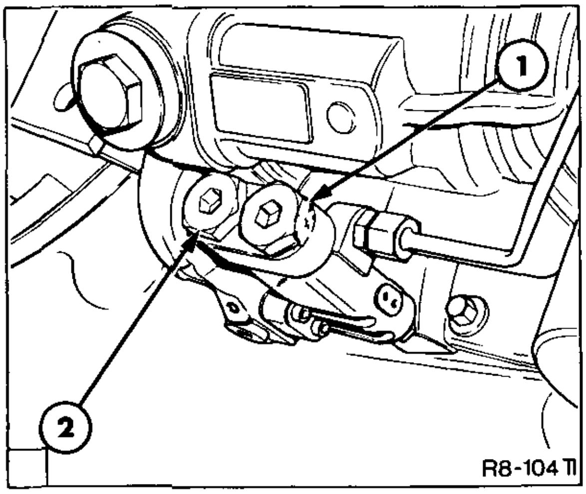
Remove and examine low pressure circuit relief valve for sticking
Fault cleared?
NO ↓

Check for large leak in PTO differential lock, 4 wheel drive and transmission pressure circuits.



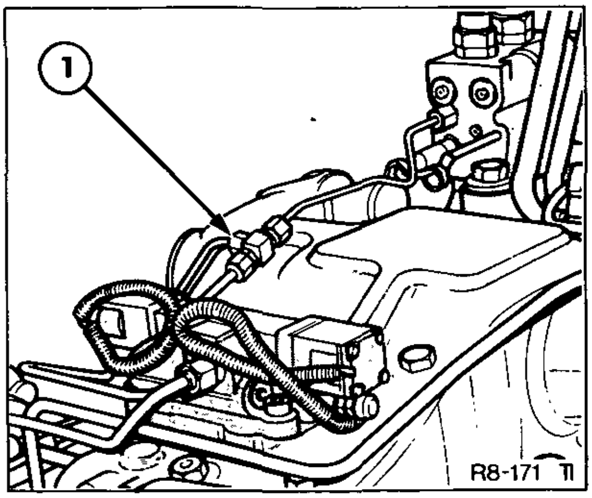
Low Flow Steering/Lubrication Circuit Pressure Switch

Hydraulic Lift Not Working Correctly



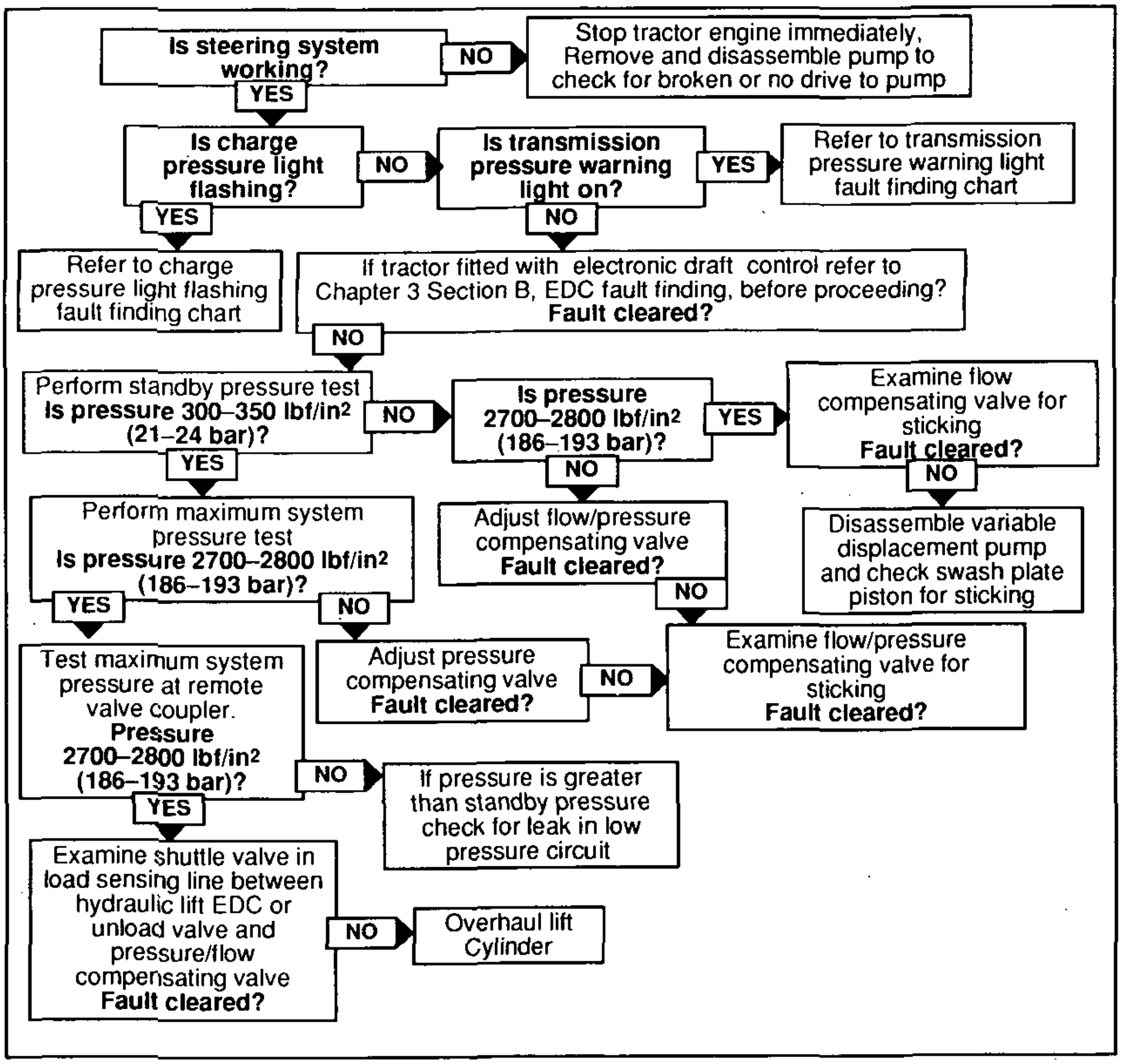
Flow and Pressure Compensating Valves

1. Flow Compensating Valve
2. Pressure Compensating Valve



Shuttle Valve Location

1. Shuttle Valve to EDC/Unload Valve and Remote Control Valves



Is steering system working?

Stop tractor engine immediately, Remove and disassemble pump to check for broken or no drive to pump

Is charge pressure light flashing?

Is transmission pressure warning light on?

Refer to transmission pressure warning light fault finding chart

Refer to charge pressure light flashing fault finding chart

If tractor fitted with electronic draft control refer to Chapter 3 Section B, EDC fault finding, before proceeding? **Fault cleared?**

Perform standby pressure test **Is pressure 300–350 lbf/in² (21–24 bar)?**

Is pressure 2700–2800 lbf/in² (186–193 bar)?

Examine flow compensating valve for sticking **Fault cleared?**

Perform maximum system pressure test **Is pressure 2700–2800 lbf/in² (186–193 bar)?**

Adjust flow/pressure compensating valve **Fault cleared?**

Disassemble variable displacement pump and check swash plate piston for sticking

Test maximum system pressure at remote valve coupler. **Pressure 2700–2800 lbf/in² (186–193 bar)?**

Adjust pressure compensating valve **Fault cleared?**

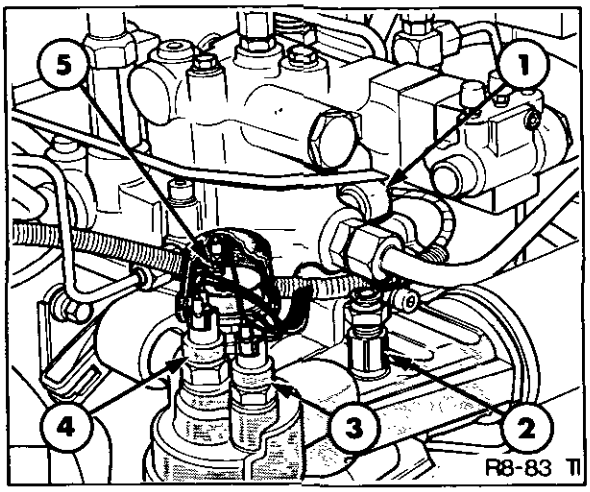
Examine flow/pressure compensating valve for sticking **Fault cleared?**

If pressure is greater than standby pressure check for leak in low pressure circuit

Examine shuttle valve in load sensing line between hydraulic lift EDC or unload valve and pressure/flow compensating valve **Fault cleared?**

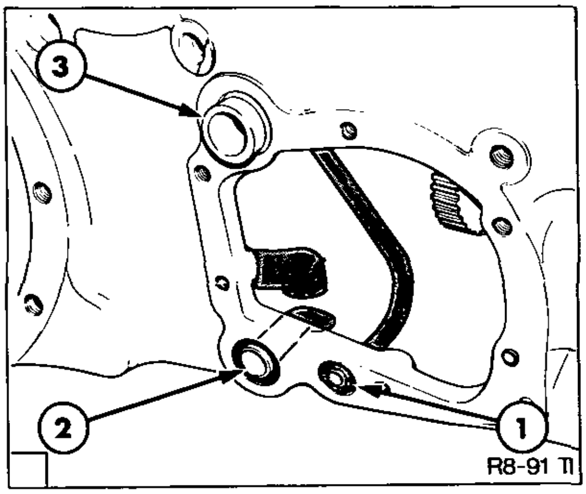
Overhaul lift Cylinder

Power Steering Not Working or Working Incorrectly



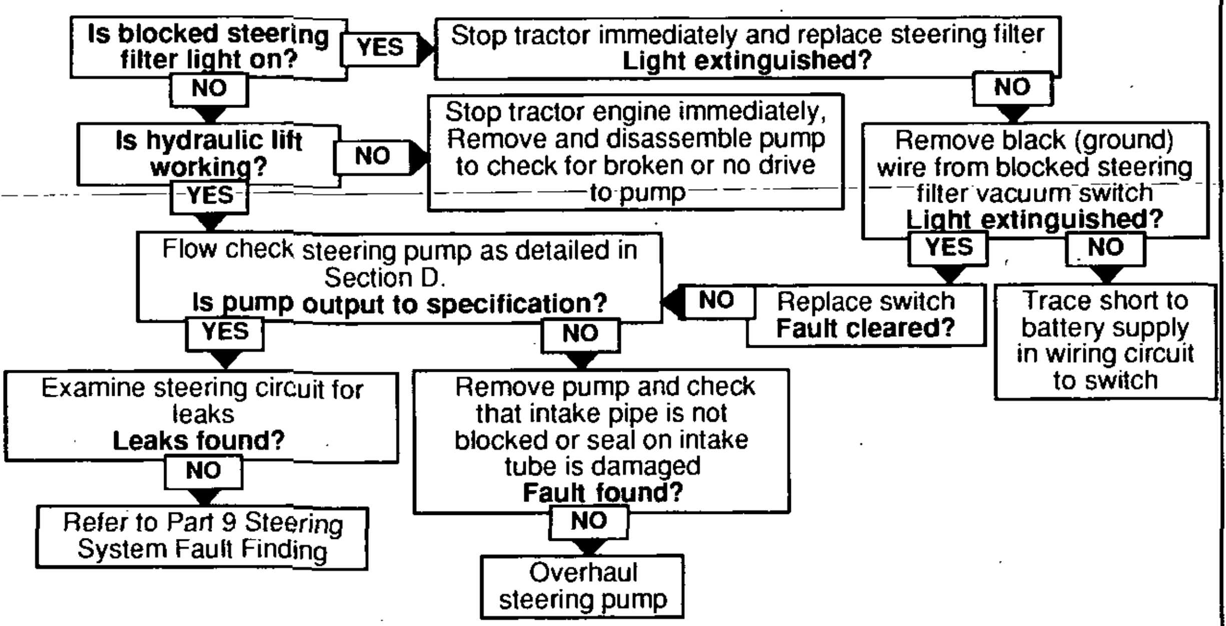
CCLS Hydraulic Pump Switch Identification

1. Low Transmission Oil Pressure Switch
2. Low Charge Pressure Switch
3. High Oil Temperature Switch
4. Steering Filter Low Temperature Switch
5. Blocked Steering Filter Vacuum Switch



Hydraulic Pump Intake Tubes

1. PTO Supply Tube
2. Steering Pump Intake Tube
3. Charge Pump Intake Tube



Is blocked steering filter light on?

YES → Stop tractor immediately and replace steering filter **Light extinguished?**

NO → Remove black (ground) wire from blocked steering filter vacuum switch **Light extinguished?**

YES → Replace switch **Fault cleared?**

NO → Trace short to battery supply in wiring circuit to switch

NO → **Is hydraulic lift working?**

NO → Stop tractor engine immediately, Remove and disassemble pump to check for broken or no drive to pump

YES → Flow check steering pump as detailed in Section D. **Is pump output to specification?**

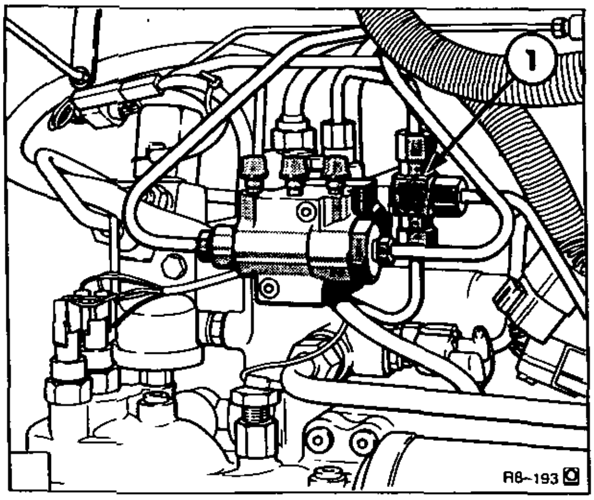
YES → Examine steering circuit for leaks **Leaks found?**

NO → Refer to Part 9 Steering System Fault Finding

NO → Remove pump and check that intake pipe is not blocked or seal on intake tube is damaged **Fault found?**

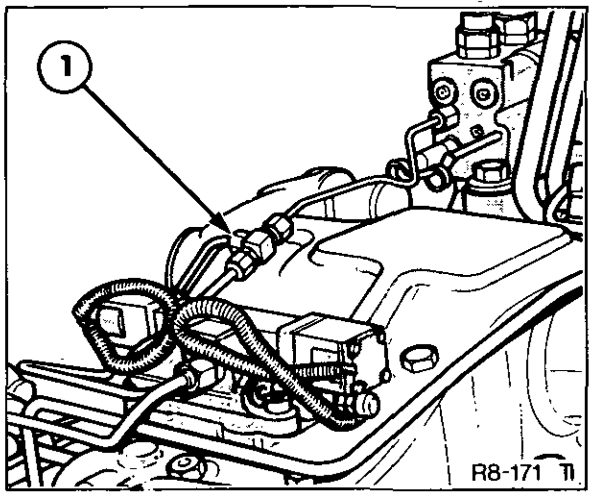
NO → Overhaul steering pump

Trailer Brakes and Remote Control Valves Not Working



Trailer Brake Shuttle Valve Location

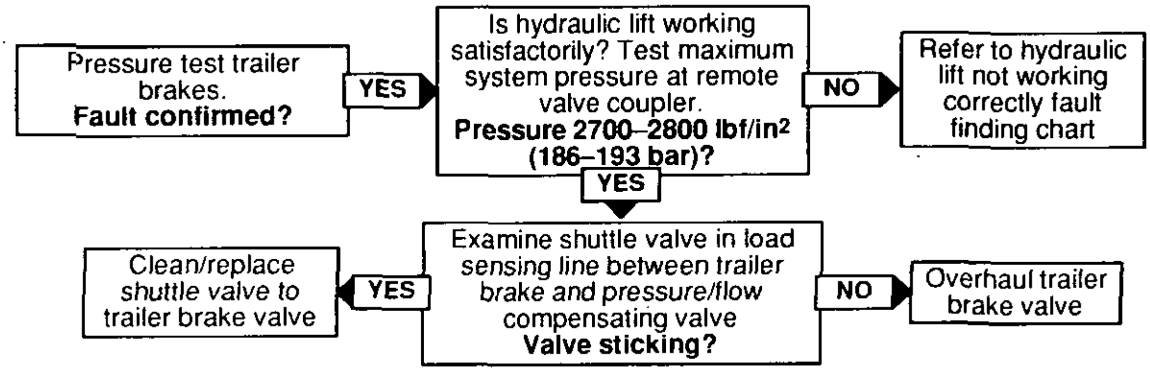
1. Trailer Brake Shuttle Valve



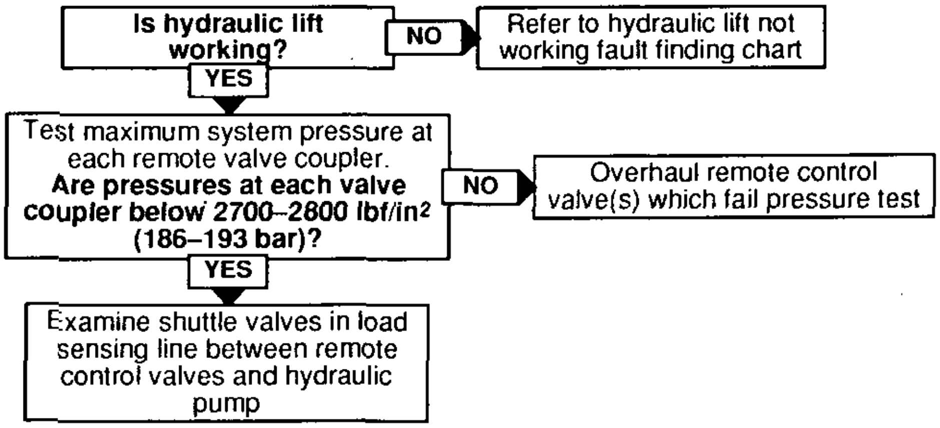
Shuttle Valve Location

1. Shuttle Valve to EDC/Unload Valve and Remote Control Valves

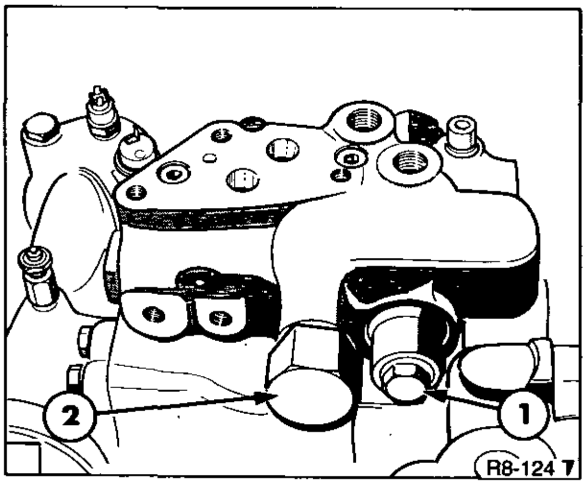
Trailer Brakes not Working



Remote Control Valves not Working



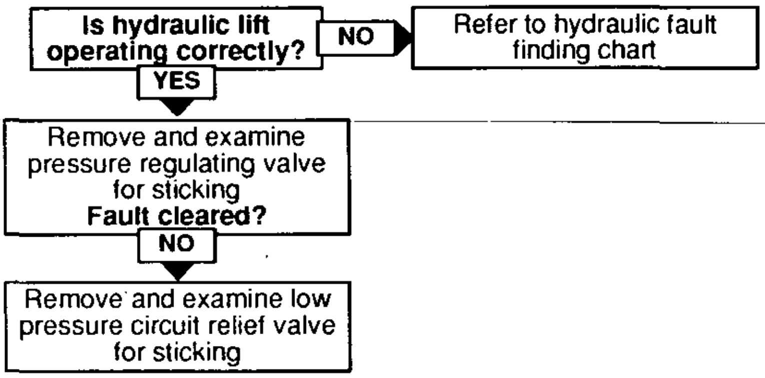
Differential Lock, PTO, 16 x 16 Transmission and Four Wheel Drive Clutch Not Working (where fitted)



Pressure Regulating Valve

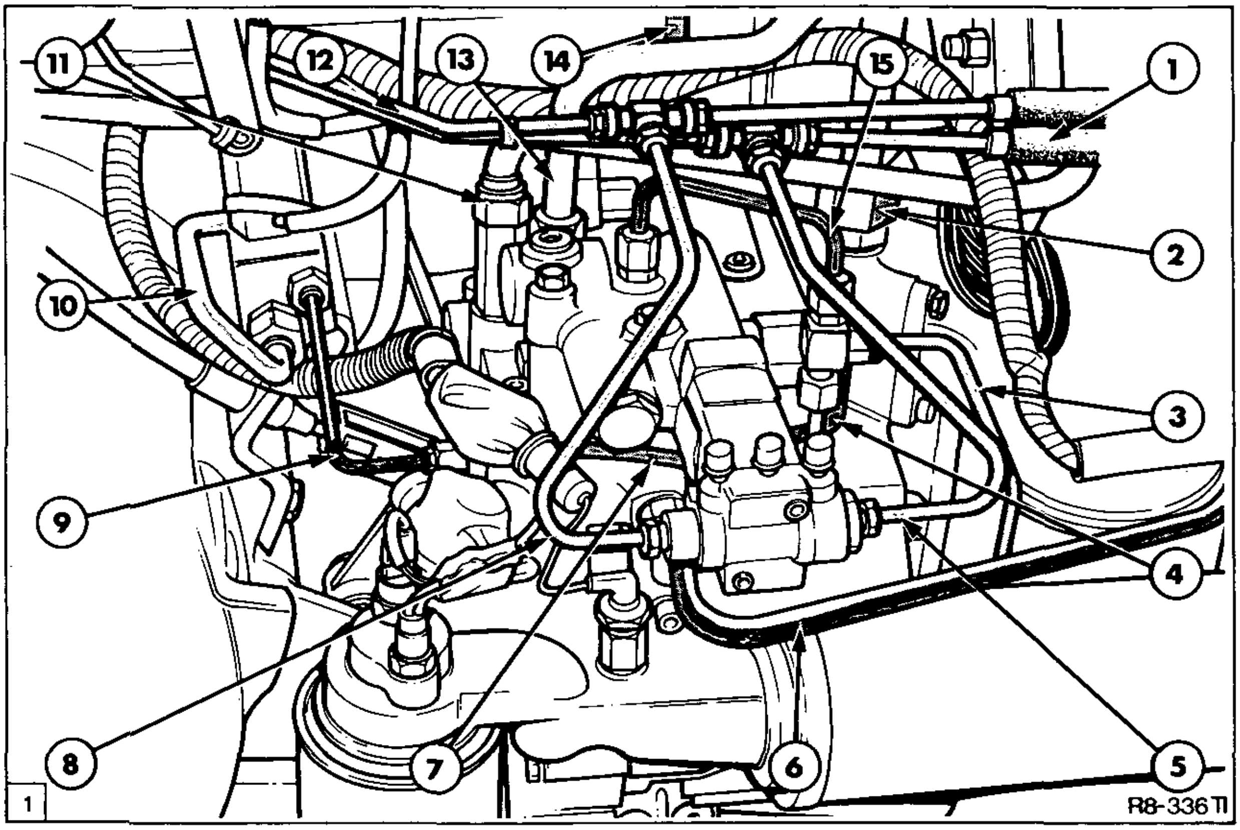
1. Pressure Regulating Valve
2. Low Pressure Circuit Safety Valve

NOTE: A fault in only one of the components listed above indicates that the Hydraulic pump with closed centre load sensing is not the cause of the concern but is due to a malfunction in the circuit or valves which operate the defective system. Use the following fault finding chart when all of the above functions fail to operate correctly



C. OVERHAUL

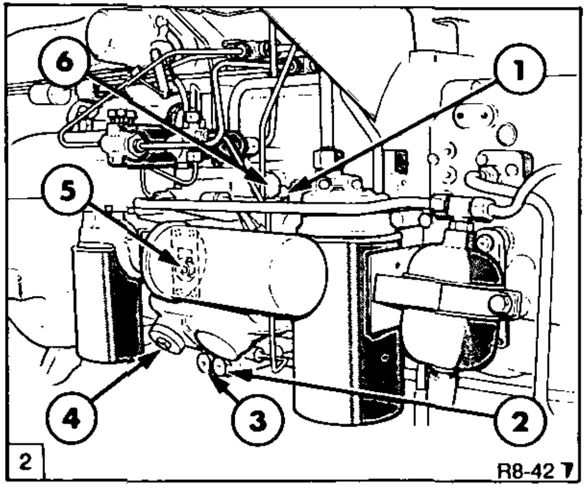
1



Installation of Variable Displacement Hydraulic Pump Assembly with Closed Centre Load Sensing

1. Tractor Brake Lines
2. Remote Valve Return
3. Load Sense Line to Flow Compensating Valve
4. Pilot Pressure to EDC Valve
5. Trailer Brake Pilot Head Sense Line (Right Hand Brake)
6. Transmission Pressure Feed
7. Load Sense Line to EDC Valve and Remote Valves
8. Trailer Brake Pilot Head Sense Line (Left Hand Brake)
9. Differential Lock Feed
10. Differential Lock Return
11. Power Steering and Transmission Lubrication Feed
12. To Rear Rear Tractor Brakes
13. Remote Valve Feed
14. Trailer Brake Feed (Connects Into Rear of Trailer Brake Valve)
15. Trailer Brake Load Sense Line

2



Valves Serviced with Pump Installed on Tractor

1. Pressure Regulating Valve
2. Flow Compensating Valve
3. Pressure Compensating Valve
4. Charge Pressure By–pass Valve
5. Charge Pressure Filter Dump Valve
6. Low Pressure Circuit Safety Valve

This procedure describes the overhaul of the complete pump assembly when removed from the tractor, however, the valves shown in Figure 2 can be serviced with the pump installed on the vehicle.

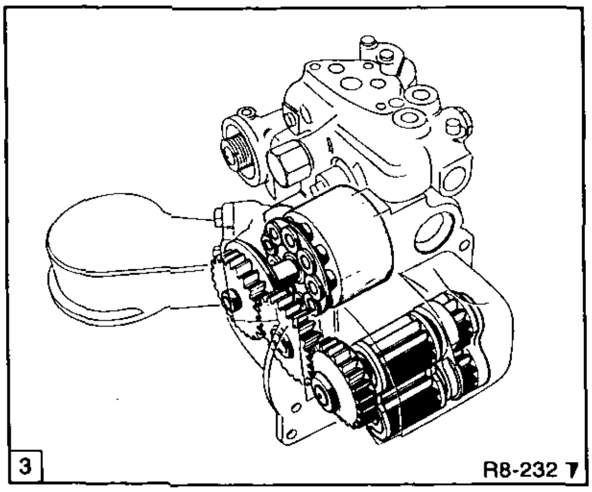
PUMP REMOVAL

1. Securely support the tractor on suitable axle stands and remove the right hand rear wheel.

2. Drain oil through rear axle.

3. Disconnect all electrical and hydraulic connections to pump. Refer to Figure 1.

4. Where fitted, remove trailer brake valve retaining bolts and separate valve from pump body. This will avoid the necessity to disconnect the tractor brake lines.



Hydraulic Pump Removed from Tractor

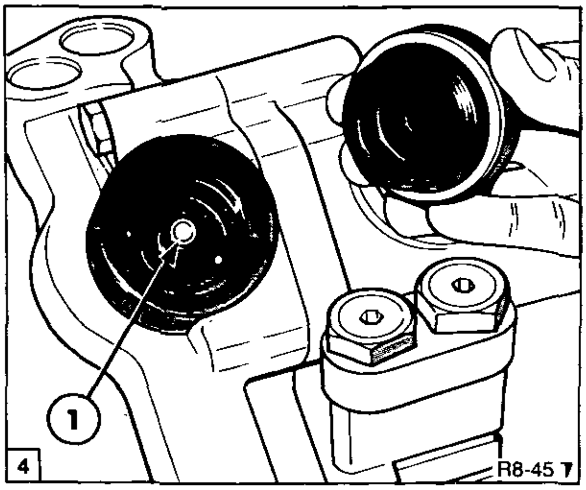
5. Remove hydraulic filters, support pump on suitable lift or trolley jack and remove from tractor, Figure 3.

WARNING: *The hydraulic pump is a heavy component and weighs 88 lbf (40 kgf). It is important that it is securely supported when being removed from the tractor.*

REMOVAL AND DISASSEMBLY OF VALVES

1. Where fitted, remove trailer brake valve. For overhaul of valve refer to trailer brake valve Section in Part 8 of the Repair Manual.

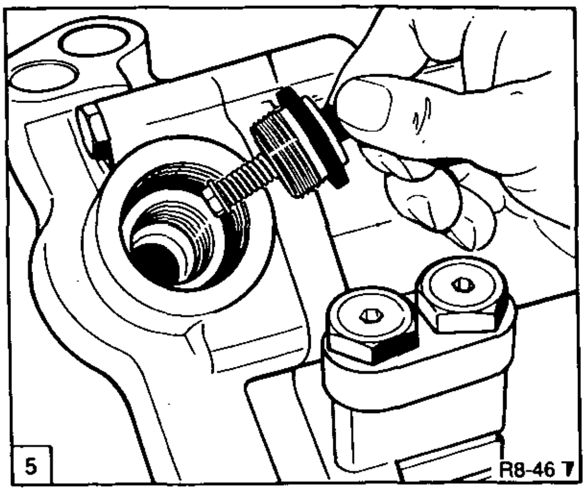
Charge Pressure By–pass Valve



Charge Pressure By–Pass Valve Installation

1. Remove plug to expose charge pressure by–pass valve, Figure 4.

2. Use Tool No 4FT.857 which engages in the peg locating holes of the valve, unscrew the charge pressure bypass valve from the pump body, Figure 5.

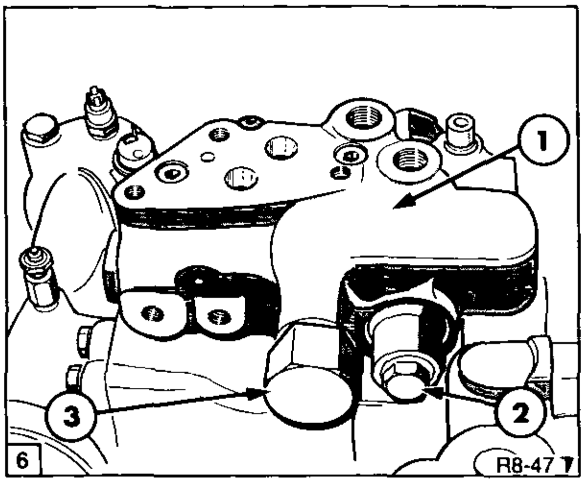


Removing Charge Pressure By–pass Valve

NOTE: *If during pressure testing the charge pressure reading was away from the specified value of 23–50 lbf/in^2 (1.6–3.4 bar) the bypass valve must be examined together with the charge pressure filter dump valve for faulty operation.* ***Do not*** *attempt to adjust the valve which is supplied as a pre–set assembly and should not be adjusted.*

Pressure Regulating and Low Pressure Circuit Safety Valves

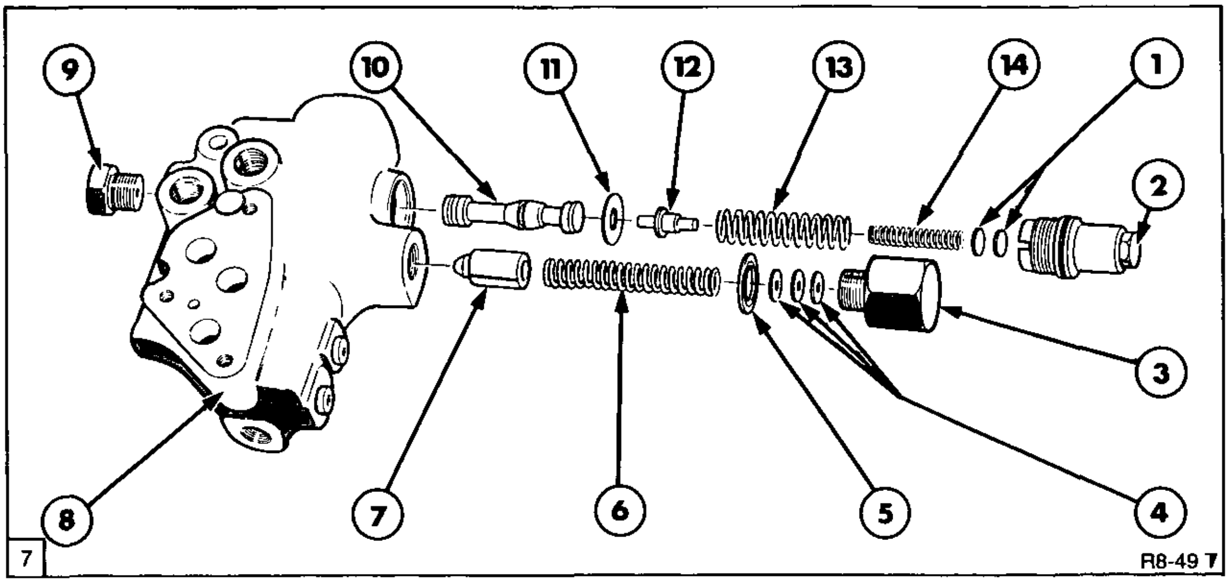
NOTE: *The pressure regulating and low pressure circuit safety valves are supplied as a pre–set assembly and should not be adjusted.*



Pressure Regulating and Low Pressure Circuit Safety Valves

1. Valve Housing
2. Pressure Regulating Valve
3. Low Pressure Circuit Safety Valve

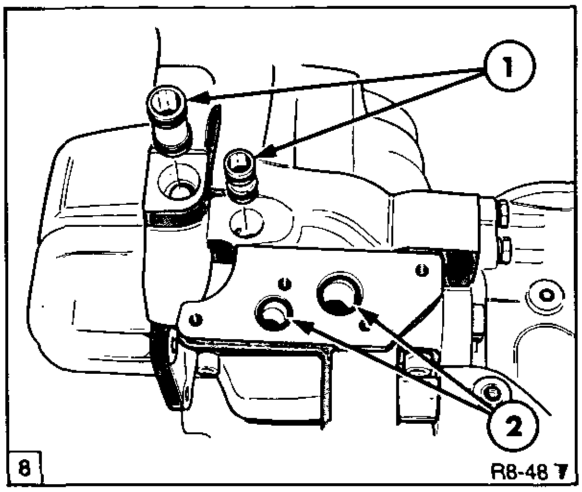
1. Remove pressure regulating and low pressure circuit safety valve housing, Figure 6.



Pressure Regulating Valve and Low Pressure Circuit Safety Valve

1. Shims
2. Pressure Regulating Valve Cap
3. Low Pressure Circuit Safety Valve Cap
4. Shims
5. Dowty Seal
6. Spring
7. Poppet
8. Housing
9. Plug
10. Pressure Regulating Valve Spool
11. Stop (washer)
12. Spring Guide
13. Spring
14. Spring

2. Carefully remove pressure reducing and low pressure circuit safety valve caps which are under pressure from the springs within the valve. Remove the valve components, Figure 7.



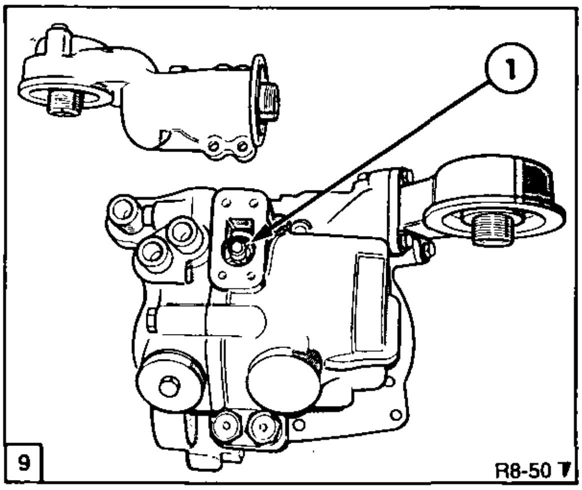
Valve Housing to Pump Oil Galleries

1. Transfer Tubes and 'O' Ring Seals
2. 'O' Rings

3. Remove transfer tubes and 'O' rings from oil galleries connecting pump and valve housings, Figure 8.

Charge Pressure Filter Dump Valve

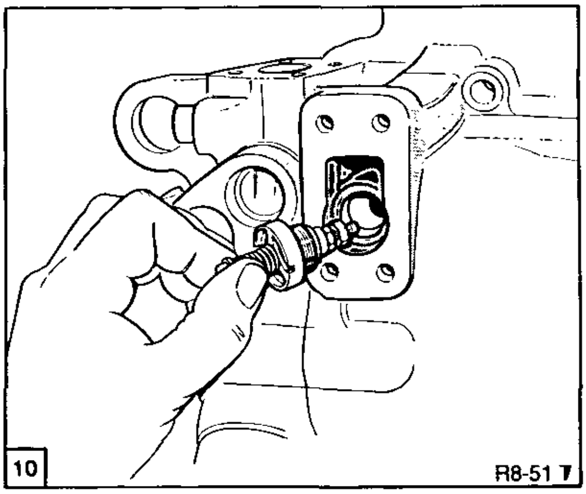
NOTE: *The valve is supplied as a pre–set assembly and should not be adjusted. Install a new valve assembly whenever the valve does not operate correctly.*



Charge Pressure Filter Dump Valve

1. Dump Valve

1. Remove charge pressure filter manifold to expose dump valve, Figure 9.

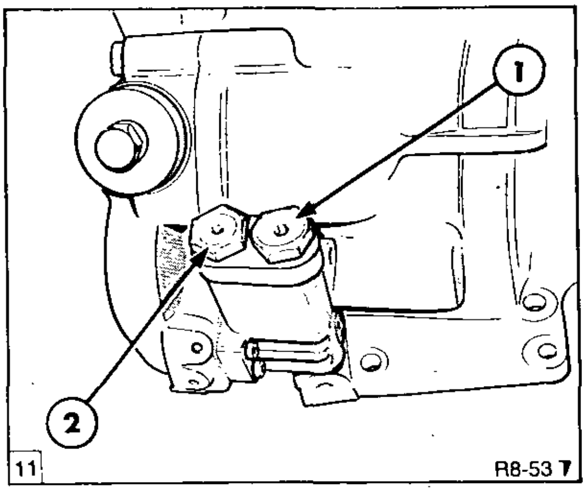


Removing Charge Pressure Filter Dump Valve

2. Using Tool No 4FT.857 which engages in *the two slots in the valve body unscrew* and remove valve. Refer to Figure 10.

Pressure and Flow Compensator Valve

1. Remove housing containing pressure and flow compensating valves, Figure 11.
2. Remove the tamper proof caps, carefully unscrew each adjuster and remove the component parts, Figure 12.

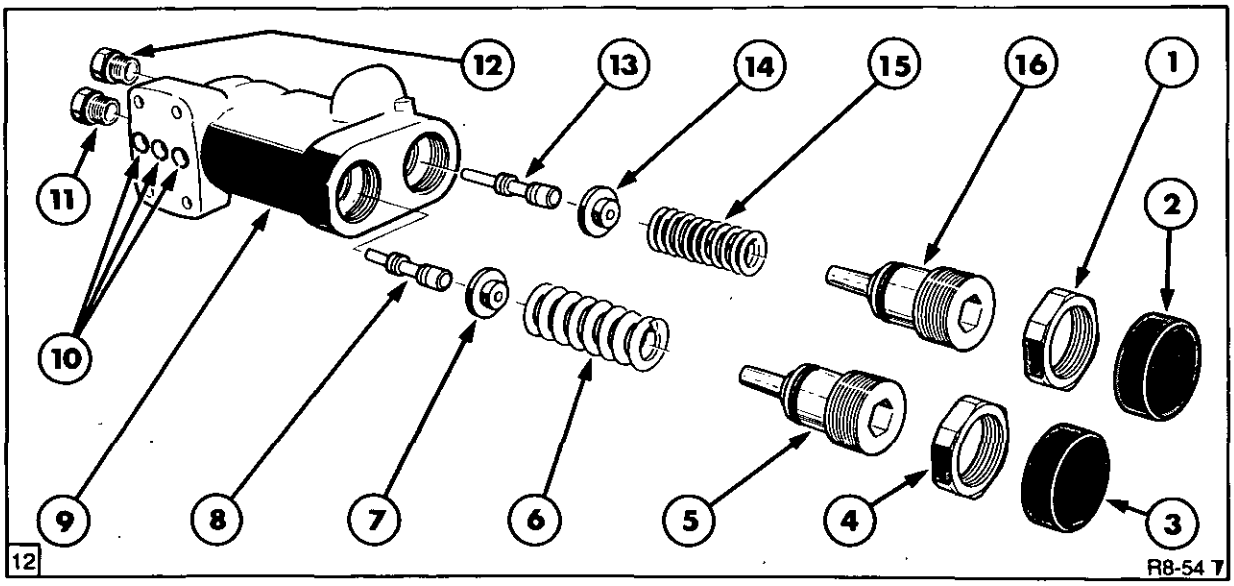


Pressure and Flow Compensating Valves
1. Flow Compensating Valve
2. Pressure Compensating Valve

3. To ensure correct re–assembly keep the component parts for each valve separate.

NOTE: *The stem on the flow compensating spool is longer than that on the pressure compensating spool*

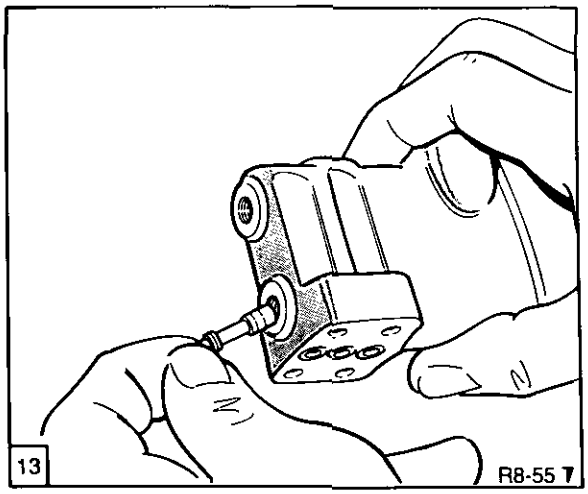
IMPORTANT: *Due to extreme spring pressure within valves DO NOT remove rear plugs until the adjusters have been removed.*



Flow and Pressure Compensating Valves
1. Locknut
2. Tamperproof Cap
3. Tamperproof Cap
4. Locknut
5. Adjuster and 'O' Ring Seal
6. Spring
7. Seat
8. Pressure Compensator Spool
9. Housing
10. 'O' Ring Seals
11. Plug and 'O' Ring
12. Plug and 'O' Ring
13. Flow Compensating Spool
14. Seat
15. Spring
16. Adjuster and 'O' Ring Seal

INSPECTION AND RE–ASSEMBLY OF VALVES

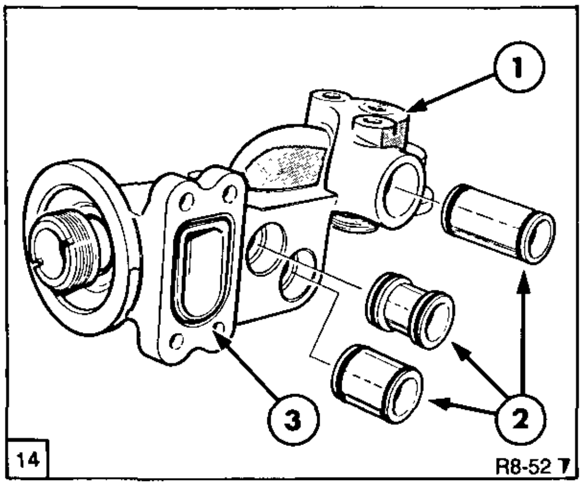
Re–assembly of the valves follows the removal procedure in reverse. On re–assembly observe the following:–



Installing Pressure and Flow Compensating Spools

1. To aid re–assembly of pressure and flow compensating valves, the spools should be inserted into the rear of the housing, Figure 13.

- Wash all components in a suitable solvent.
- Examine all components for wear or damage. If the spools are damaged it is necessary to replace the complete valve assembly.
- Lubricate all parts with clean hydraulic oil.
- Replace all 'O' ring seals and lubricate with petroleum jelly.
- Refer to Figure 14 for installation of transfer tubes in charge pressure filter manifold.

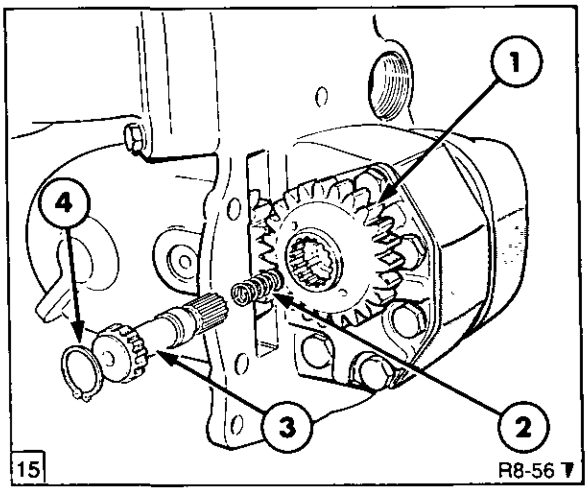


Charge Pressure Filter Manifold

1. Manifold
2. Transfer Tubes and 'O' Rings Seals
3. Seal

- Pressure test the pump and adjust the pressure and flow compensating valves to the correct specification as detailed in Section D of this Chapter.
- Tighten all plugs and locknuts to the correct torque as detailed in Section E.

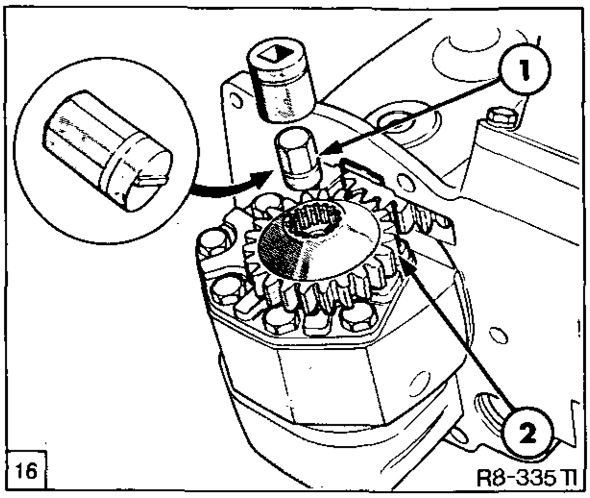
DISASSEMBLY OF CHARGE AND STEERING PUMPS



Charge Pump Drive Gear

1. Drive Gear
2. Spring
3. Driveshaft
4. Snap Ring

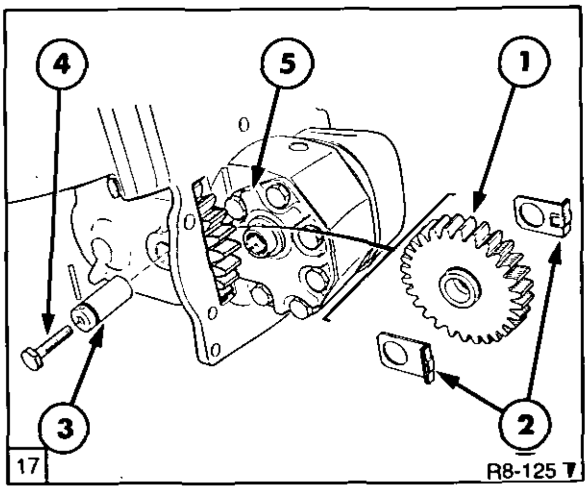
1. Push in driveshaft to allow removal of snap ring. Withdraw driveshaft and small spring, Figure 15.



16 R8-335 TI

Removing Charge Pump Drive Gear
1. Special Tool 4FT.856
2. Drive Gear

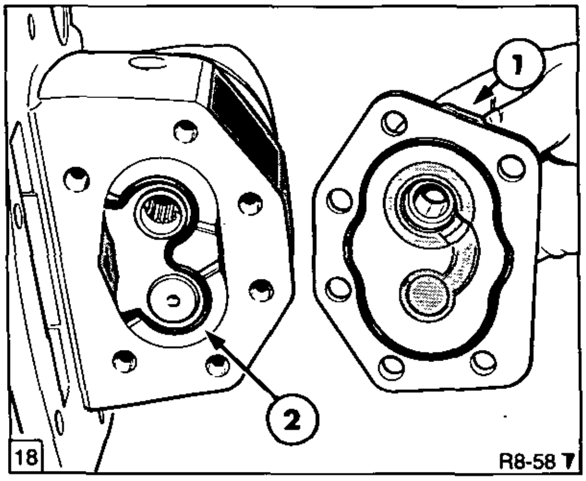
2. Using special Tool 4FT.856, engaged in slot in gear retainer and an impact wrench to break loctite seal on the retainer thread, unscrew the retainer which will at the same time 'jack' the gear from the cover support plate, Figure 16.



17 R8-125 T

Gaining Access to Cover Support Plate Bolts
1. Idler Gear
2. Thrust Plates
3. Shaft and Roll Pin
4. M8 x 1.25 Bolt
5. Cover Support Plate

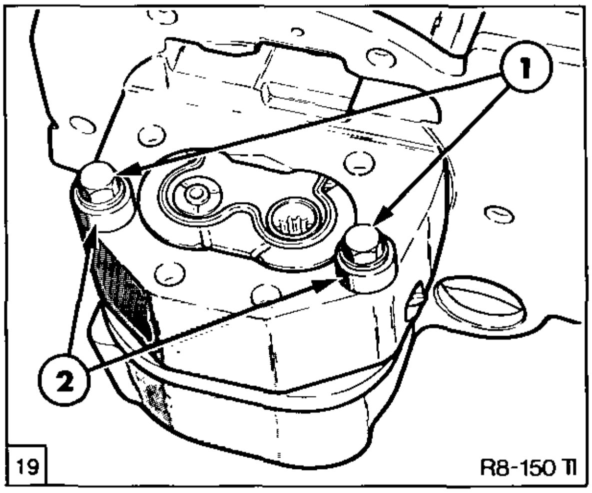
3. Remove idler gear shaft roll pin and using an M8 x 1.25 bolt, withdraw shaft. Figure 17.



18 R8-58 T

Removing Cover Support Plate
1. Cover Support Plate
2. Charge Pump

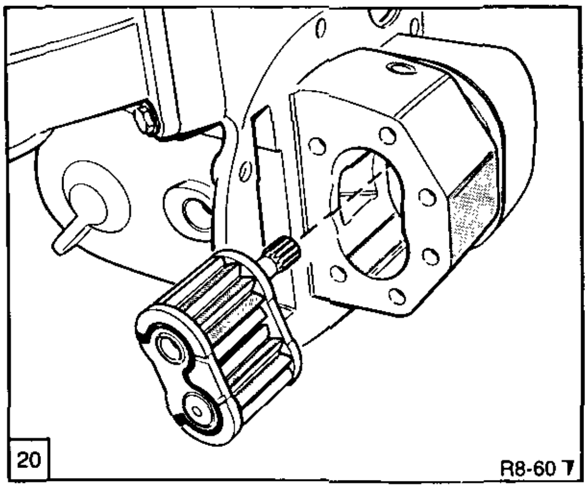
4. Remove the cover support plate, Figure 18 then withdraw idler gear and thrust washers, Figure 17.



19 R8-150 TI

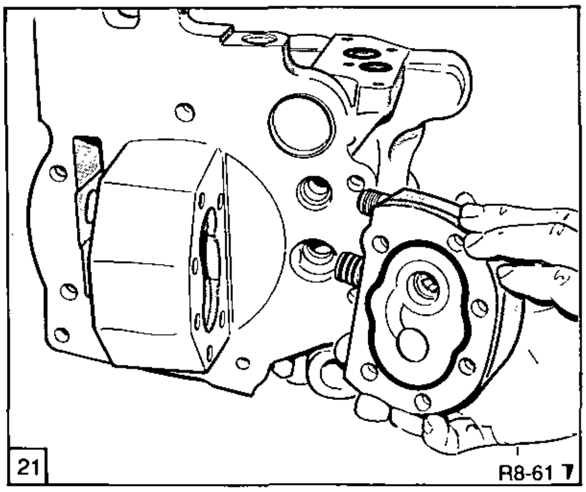
Clamping Steering Pump to Charge Pump
1. Bolts
2. 15mm Spacers

5. Place 15mm spacers under the bolt heads of two of the cover support plate bolts previously removed and use these bolts to re–clamp the steering pump to the charge pump body, Figure 19.



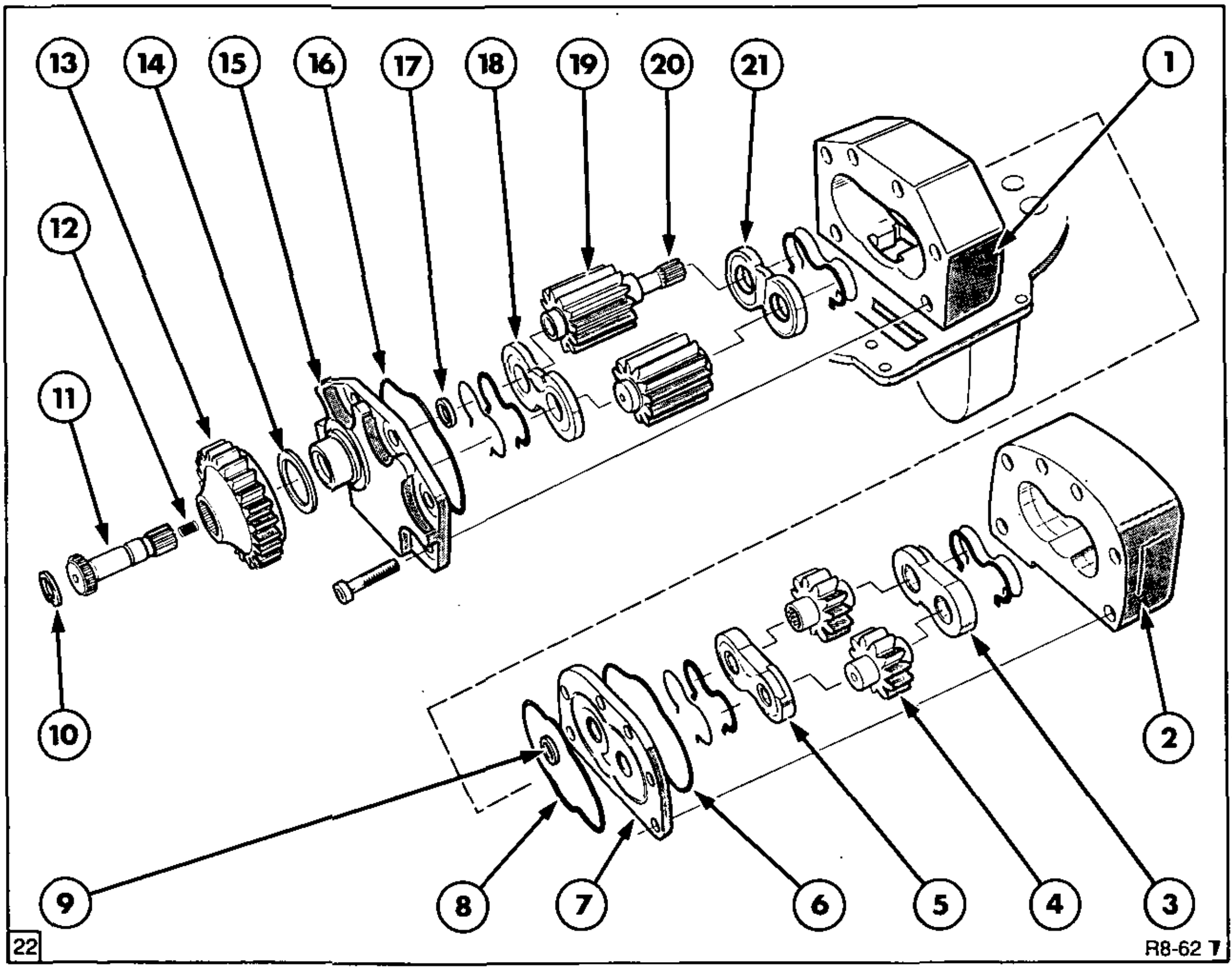
Removing Charge Pump

6. Remove charge pump gears and bearings, Figure 20.



Removing Steering Pump Assembly

7. Remove clamping bolts and pull steering pump assembly from main pump housing, Figure 21



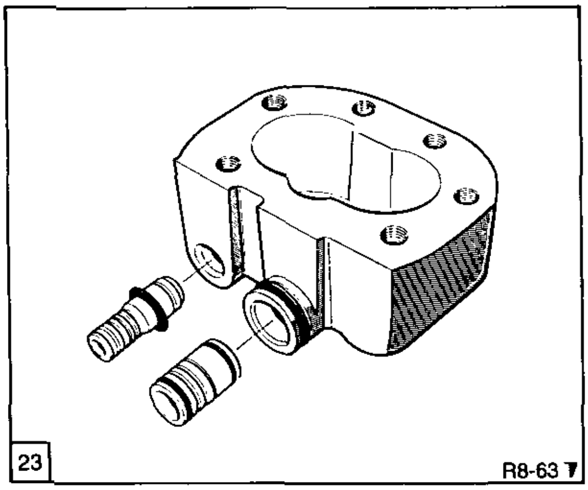
Charge and Steering Pump Assembly–Exploded View

1. Charge Pump Housing
2. Steering Pump Housing
3. Bearing Block and Seals
4. Steering Pump Gears
5. Bearing Block and Seals
6. Seal
7. Sandwich Plate
8. Seal
9. Oil Seal
10. Snap Ring
11. Drive Link
12. Spring
13. Drive Gear and Bearing
14. Washer
15. Cover Support Plate
16. Seal
17. Oil Seal
18. Bearing Block and Seals
19. Charge Pump Gears
20. Drive Link
21. Bearing Block and Seals

8. Prior to disassembly and to ensure correct re–assembly mark all charge and steering pump components on a non critical area with a felt pen. Separate pumps with reference to Figure 22.

The drive link is fixed in the charge pump driven gear with an internal snap ring. It is not recommended to separate these items.

INSPECTION AND REPAIR OF CHARGE AND STEERING PUMPS



Steering Pump Housing Transfer Tubes

1. Pull transfer tubes from steering pump housing, Figure 23.

2. Wash all components in a suitable solvent and dry thoroughly.

3. Examine each bearing block for wear. Light score marking should be removed by placing a sheet of '0' grade emery paper, lubricated with paraffin, on a truly flat surface, then polish the bearing face using a light rotary motion. Bushes within the bearing blocks may show a bronze colour but are worn beyond acceptable limits if the bronze colour can be seen over the full length of the bush.

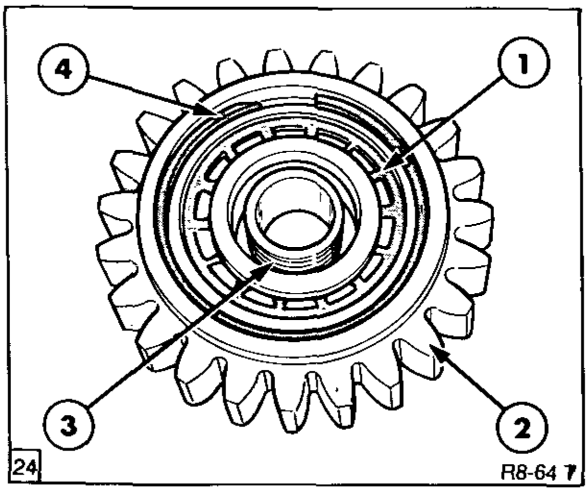
4. Inspect pump bodies for wear and damage. It is normal for gears to cut a light track on the inlet side of the body bore and providing the depth of the track does not exceed 0.004 in (0.10 mm), the body is re–usable. Using an internal micrometer measure the body at the bearing location and then at the track position to assess the track depth.

5. Examine pump gears for scored or worn side faces, journals and damaged teeth. Lightly scored side faces may be renovated by sandwiching emery paper between the gear face and a scrap bearing and rotating the gear.

NOTE: *If pump gears or bearing blocks are worn and require replacement the worn pumping element must be replaced as an assembly.*

IMPORTANT: *Whilst servicing the pump gears, particular attention must be paid to the following points:*

- *The width of each gear set must be within 0.0002 in. (0.005 mm) of each other to ensure satisfactory pump efficiency.*
- *Journals must be within 0.0005 in. (0.013 mm) of each other.*
- *Gear faces must be flat. This feature may be checked by blueing a bearing face and rotating against the gear. This check will also reveal any sharp edges on the teeth.*



Charge Pump Drive Gear

1. Bearing
2. Drive Gear
3. Idler Gear Retainer
4. Retaining Ring

6. Install new seals and 'O' rings.

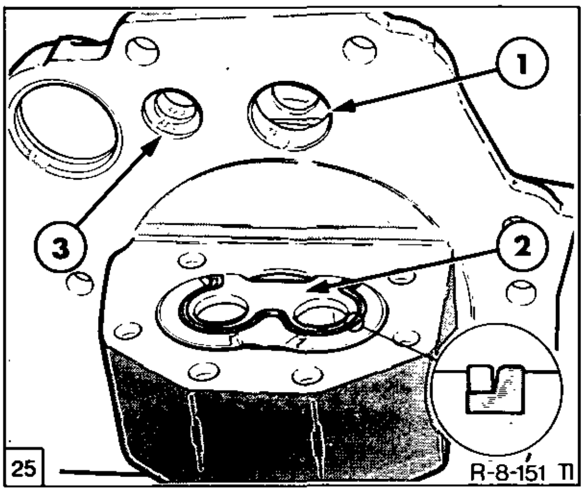
7. Examine bearing in pump drive gear and replace if worn or damaged by removing retaining ring, Figure 24.

RE–ASSEMBLY OF CHARGE AND STEERING PUMPS

IMPORTANT: *The charge and steering pumps must be re–assembled using the following procedure. Attempts to deviate from this procedure may lead to incorrect assembly and damage of the pumps.*

When assembling the pump observe the following:–

- Lubricate all parts with hydraulic oil.
- Install new seals and 'O' rings and coat with petroleum jelly.



Installing Charge Pump Bearing Block

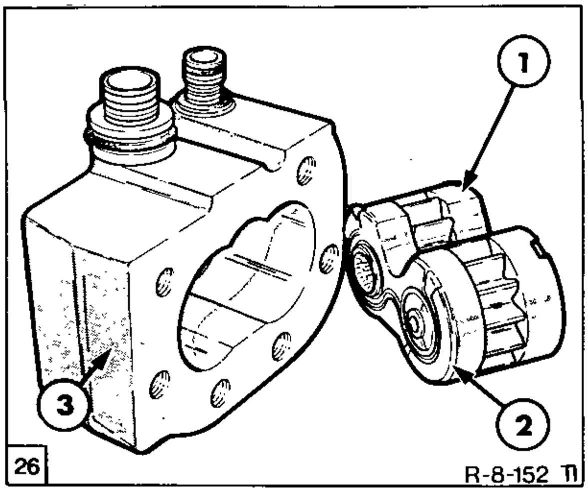
1. Steering Pump Inlet Port
2. Bearing Block
3. Steering Pump Outlet Port

1. Apply petroleum jelly to the charge pump bearing block bore and steering pump ports. Refer to Figure 25.

2. Position new seals in the charge pump bearing block and install the block in the charge pump housing, Figure 25. When installing the seals ensure that the plastic back–up seal is correctly positioned in the rubber seal.

3. Fit the transfer tubes into the steering pump housing.

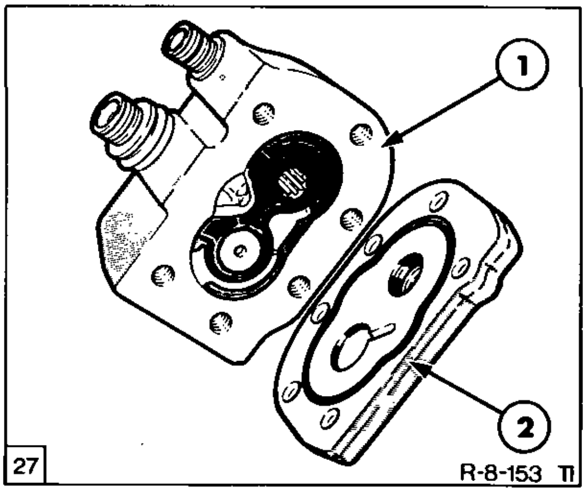
4. Install new seals into the steering pump bearing blocks and re–assemble the steering pump. **Ensure** that the bearing block with a **'radiused edge'** is installed at the bottom of the steering pump body bore Figure 26.



Installing Steering Pump Bearing and Gear Assembly

1. Bearing Block (Sharp Edged)
2. Bearing Block (Radiused Edged)
3. Steering Pump Body

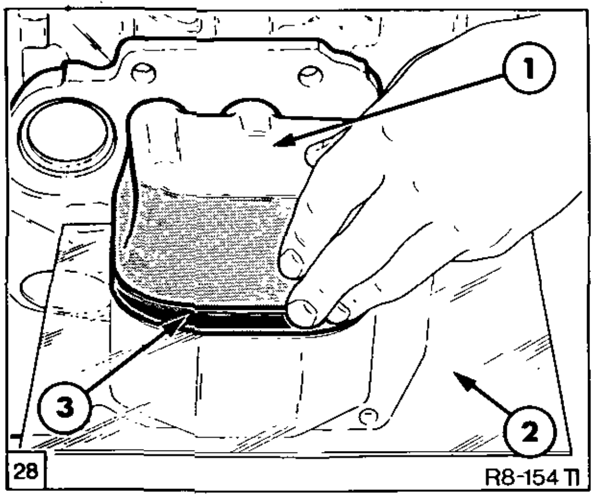
NOTE: *Only one of the two bearing blocks used in the steering pump is radiused on the corner edge. Installation of the sharp edged radius block at the bottom of the bore will prevent correct re–assembly and cause damage to the pump.*



Installing Sandwich Plate

1. Steering Pump Assembly
2. Sandwich Plate

5. Position the sandwich plate onto the steering pump, Figure 27.

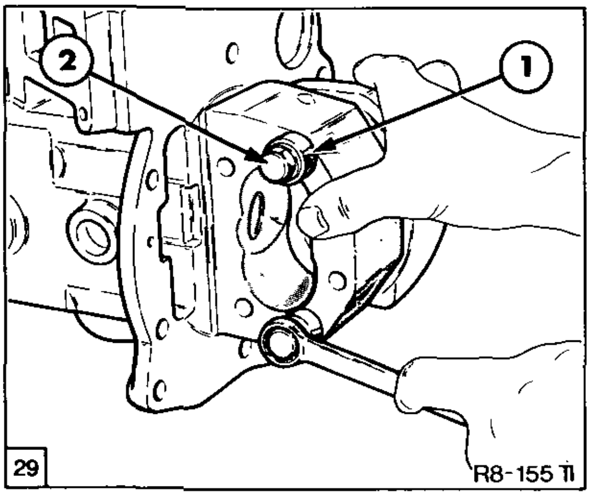


Installing Steering Pump
1. Steering Pump
2. Plastic Sheet
3. Sandwich Plate

6. Position a tough flexible plastic sheet over the face of the charge pump. (This sheet will prevent the seals in the pump assembly being displaced when installing the steering pump).

7. Place the steering pump onto the charge pump housing and push the steering pump forward until the transfer tubes fully engage in the charge pump housing, Figure 28.

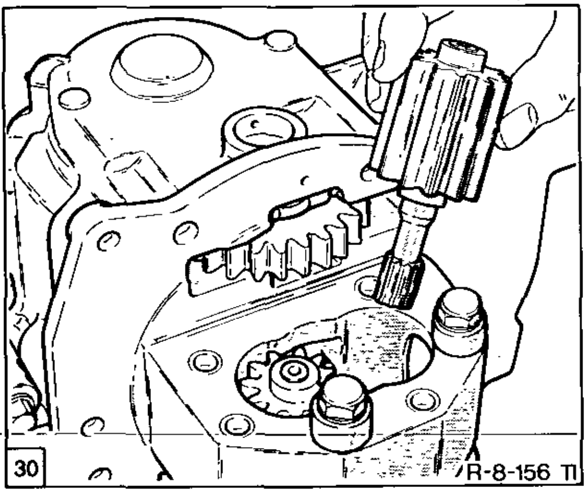
8. Slide the plastic sheet away from the pump.



Clamping Steering Pump to Charge Pump Housing
1. 15mm Spacer
2. Cover Support Plate Bolt (M15 x 100mm)

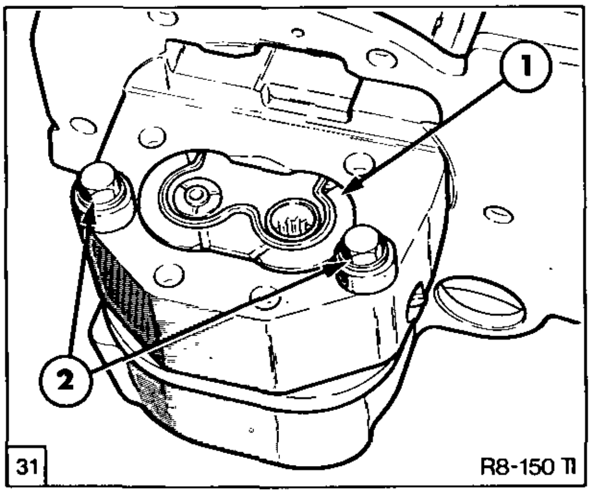
9. Using two cover support plate bolts with 15mm spacers placed under their heads, align and clamp the sandwich plate and steering pump to the charge pump housing. When the pump is aligned the bolts should be tightened sufficiently to clamp the pump bodies together, Figure 29.

NOTE: *The spacers ensure the pump face is not damaged when the bolts are tightened. If difficulty is experienced in aligning the bolts to the threaded holes in the steering pump body, alignment bolts can be manufactured by turning a point onto the end of two M15 x 100mm long bolts and using these to align and clamp the pump body.*



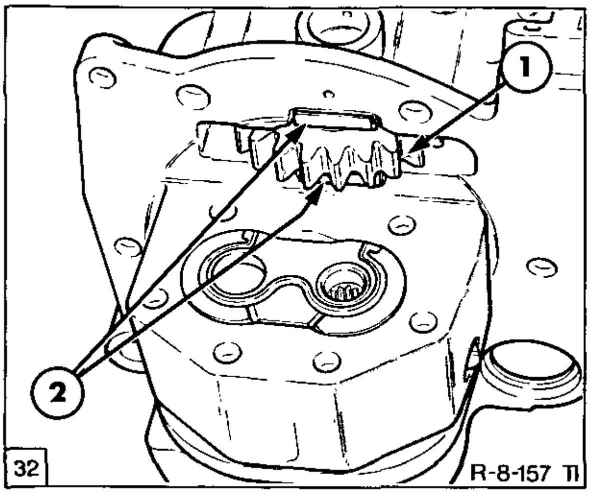
Installing Charge Pump Gears

10. Install the charge pump drive and driven gears, Figure 30 and lubricate using oil to Ford Specification ESN M2C134 D.



Charge Pump Bearing Block Installation
1. Bearing Block
2. Clamping Bolts

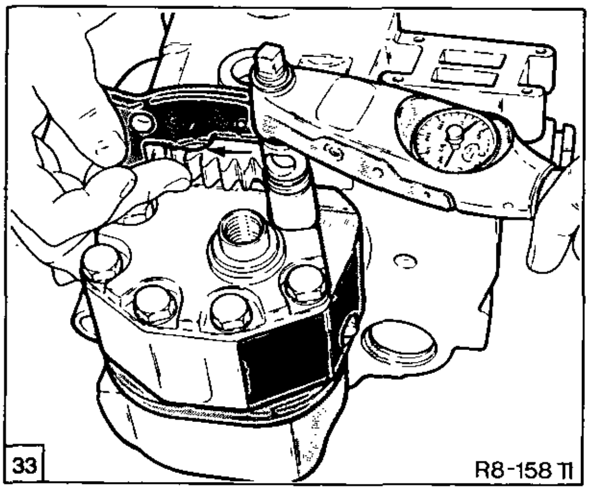
11. Install the charge pump bearing block, Figure 31.



Installing Idler Gear

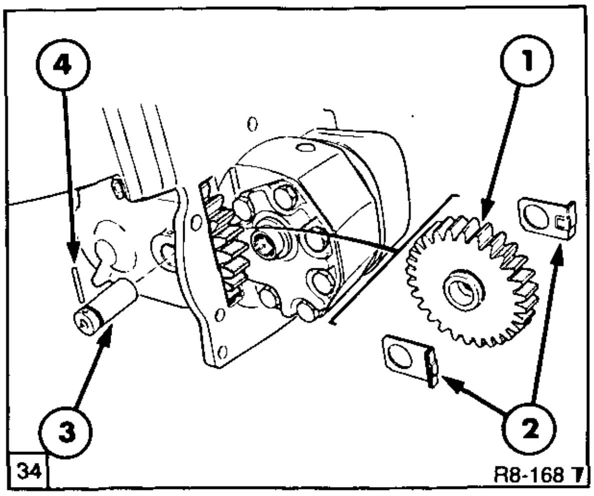
1. Idler Gear
2. Thrust Plates

12. Remove cover support plate clamping bolts and install idler gear and thrust plates, Figure 32. Do not install the idler gear shaft.



Installing Cover Support Plate

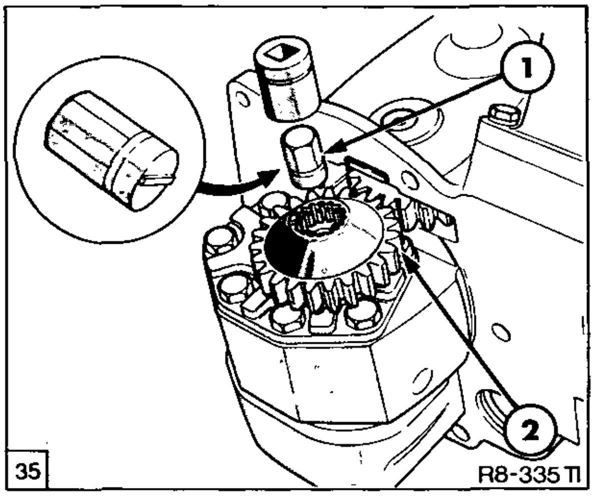
13. Install the cover support plate and tighten the retaining bolts to a torque of 30–37 lbf ft 40–50 Nm), Figure 33.



Idler Gear Shaft Installation

1. Idler Gear
2. Thrust Plates
3. Idler Shaft and 'O' Ring Seal
4. Roll Pin

14. Install the idler shaft and roll pin. Refer to Figure 34.



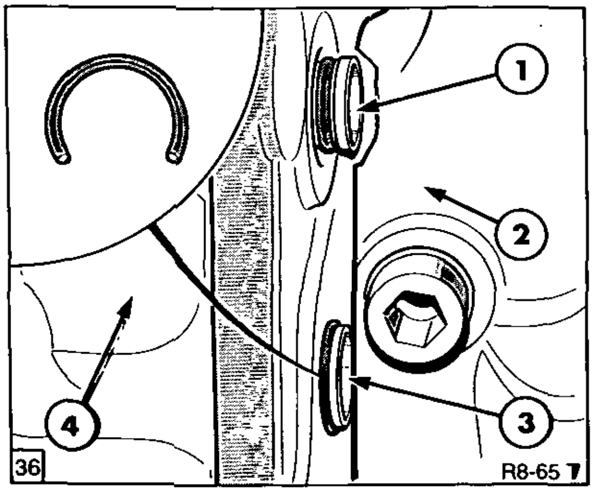
Installing Charge Pump Drive Gear

1. Tool No 4FT.856
2. Drive Gear

15. Apply one drop of loctite 242 to the threads in the drive gear and bearing assembly. Using drive gear tightening tool 4FT.856, Figure 35, tighten the gear to the cover support plate until a torque of 26–33 lbf ft (35–45 Nm) is achieved.

DISASSEMBLY OF VARIABLE DISPLACEMENT PISTON PUMP

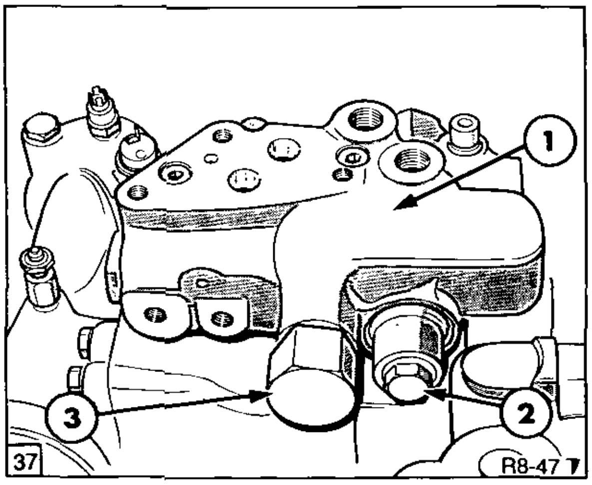
If it is desirable to disassemble the variable displacement piston pump without removing the charge and steering pump, disconnect the steering pump oil gallery transfer tubes from the piston pump housing as detailed in Step 1 below.



Steering to Piston Pump Housing Transfer Tubes

1. Transfer Tube
2. Piston Pump Housing
3. Transfer Tube Retained by 'C' Clip
4. Steering Pump

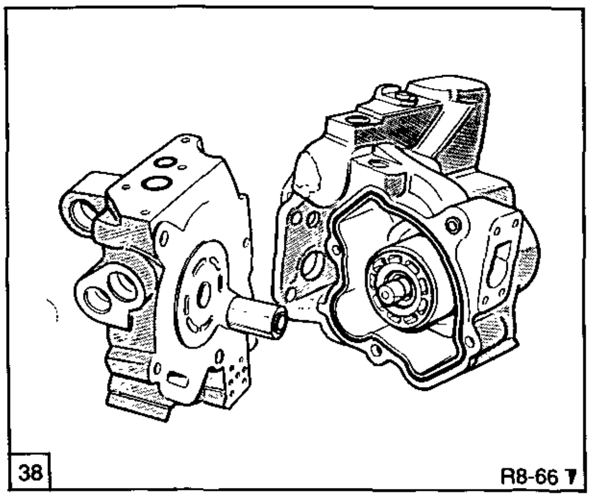
1. Remove the 'C' clip from the larger of the two sleeves connecting steering pump oil galleries to piston pump housing. Disengage sleeves from piston pump housing by using a screwdriver to ease each of the sleeves toward the steering pump. Refer to Figure 36.



Pressure Regulating Valve Housing

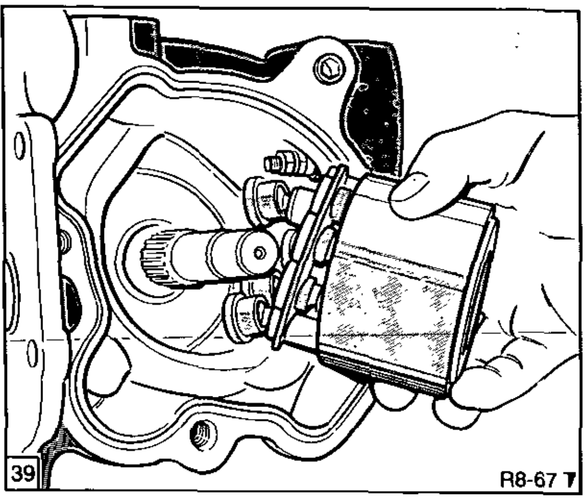
1. Valve Housing
2. Pressure Regulating Valve
3. Low Pressure Circuit Safety Valve

2. Remove pressure regulating valve housing, Figure 37.



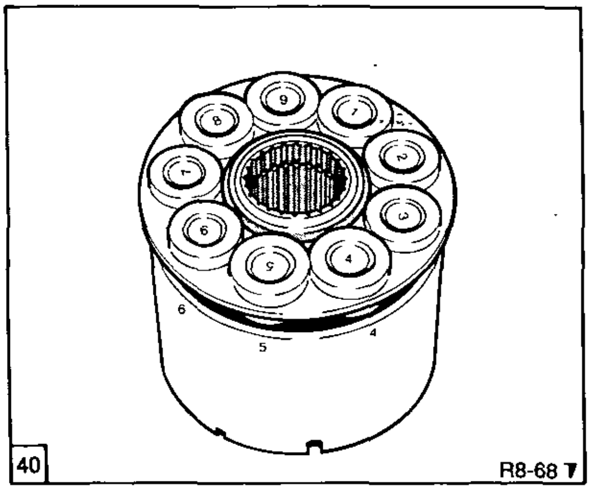
Separating Variable Displacement Piston Pump Housing

3. Remove four bolts and separate the two sections of variable displacement piston pump housing, Figure 38.



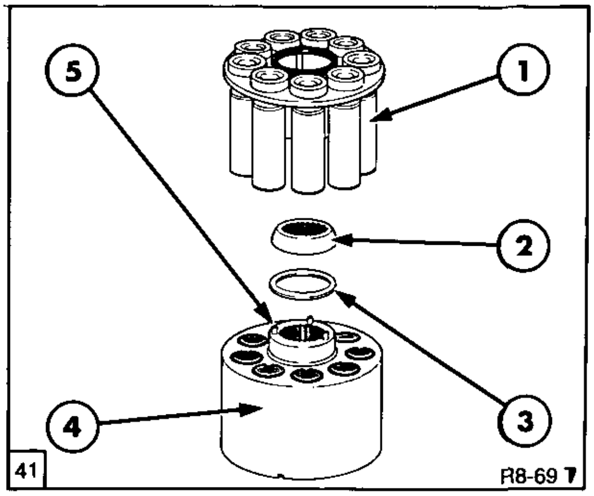
Removing Pumping Head

4. Remove pumping head assembly, Figure 39.



Identifying Pistons and Slippers to Barrels

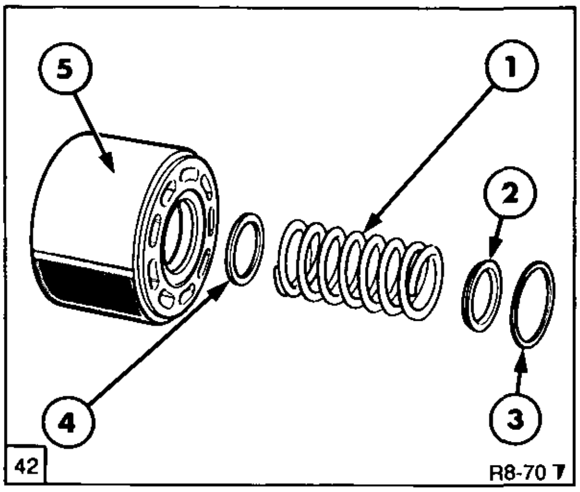
5. Using a suitable marker identify each piston and slipper to their corresponding barrel in the pumping head, Figure 40.



Pumping Head Slipper Assembly

1. Pistons and Slippers
2. Cone
3. Washer
4. Pumping Head
5. Pins (3 off)

6. Separate pistons and slippers, Figure 41.

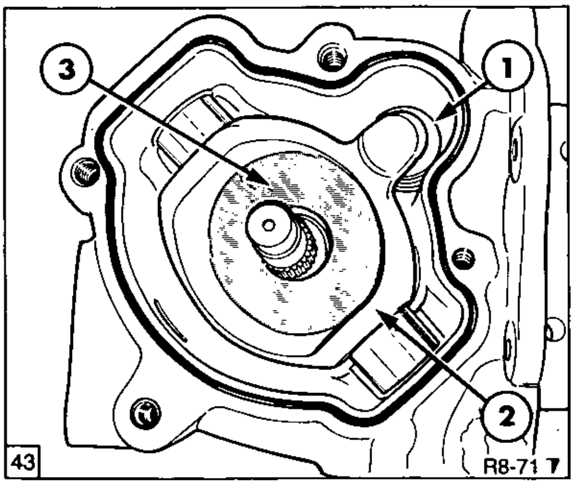


Pumping Head Spring Assembly

1. Spring
2. Collar
3. Retaining Ring
4. Washer
5. Pumping Head

7. If necessary disassemble the spring assembly within the pumping head by compressing the collar against the spring and removing the retaining ring Figure 42.

IMPORTANT: *Due to high spring pressure of pumping head spring assembly take care when removing retaining ring.*

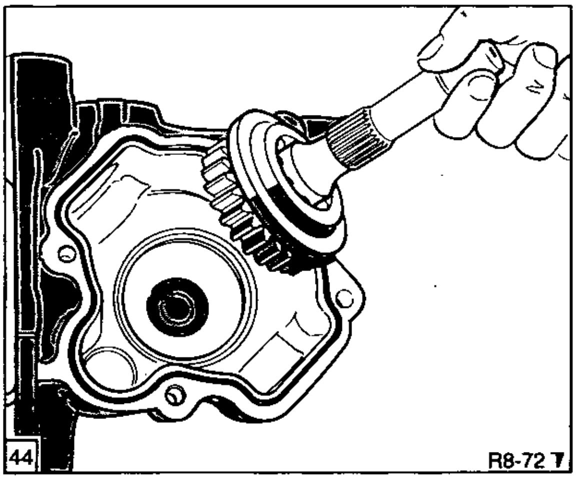


Swash Plate Installed

1. Swash Plate Return Spring
2. Swash Plate
3. Thrust Plate

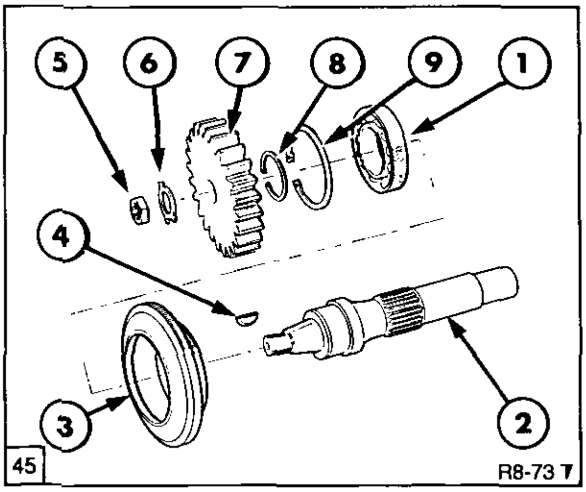
8. Remove swash plate, thrust plate and return spring. Refer to Figure 43.

NOTE: *The bearings on the swash plate can be a tight fit in their locating bores of the pump housing. Under these circumstances it may be necessary to tap the face of the pump housing casting against a clean flat wooden bench in order to release the swash plate from the housing.*



Removing Driveshaft Assembly

9. Remove snap ring and withdraw pump driveshaft assembly, Figure 44.



Pump Driveshaft and Gear Assembly

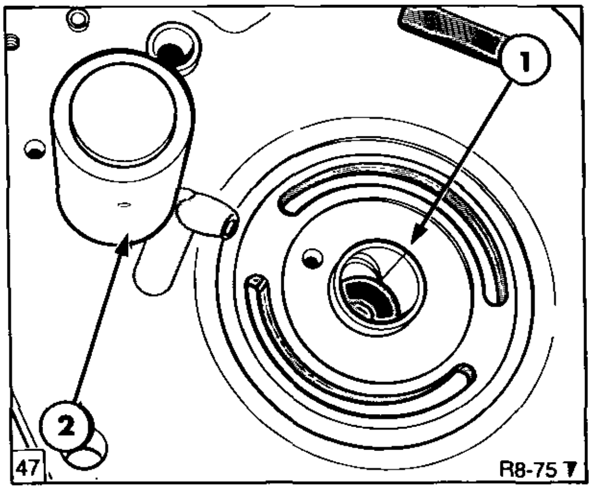
1. Bearing
2. Shaft
3. Plate
4. Woodruff Key
5. Nut
6. Washer
7. Gear
8. Snap Ring
9. Snap Ring

10. Separate the pump driveshaft and gear assembly, Figure 45.

INSPECTION

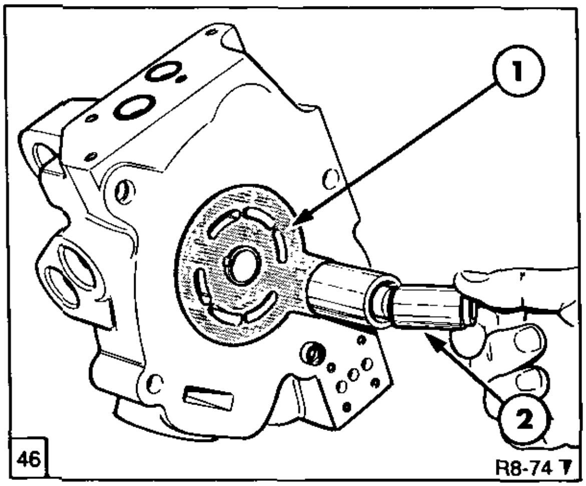
1. Wash all components in a suitable solvent and dry thoroughly.

2. Check that the lubrication orifice in the idler gear shaft is unrestricted



Pump Cover and Bush

1. Bush
2. Swash Plate Servo Piston



Port Plate and Servo Piston

1. Port Plate
2. Swash Plate Servo Piston

11. Remove swash plate servo piston, Figure 46.

12. Inspect the port plate for damage but do not remove plate unless replacement is required.

3. Examine driveshaft locating bush in pump cover, Figure 47. If the bush is worn or damaged the pump cover and bush must be replaced as an assembly.

4. Examine all components for wear or damage. If the pistons or slippers are worn the complete assembly should be replaced.

RE–ASSEMBLY

Re–assembly follows the disassembly procedure in reverse. On re–assembly observe the following:–

- Apply loctite 242 to threads of pump driveshaft gear and tighten the gear retaining nut to a torque of 86–90 lbf ft (117–123 Nm).
- Install new seals and ‘O’ rings.
- Lubricate all parts with hydraulic oil and coat all seals and ‘O’ rings with petroleum jelly.

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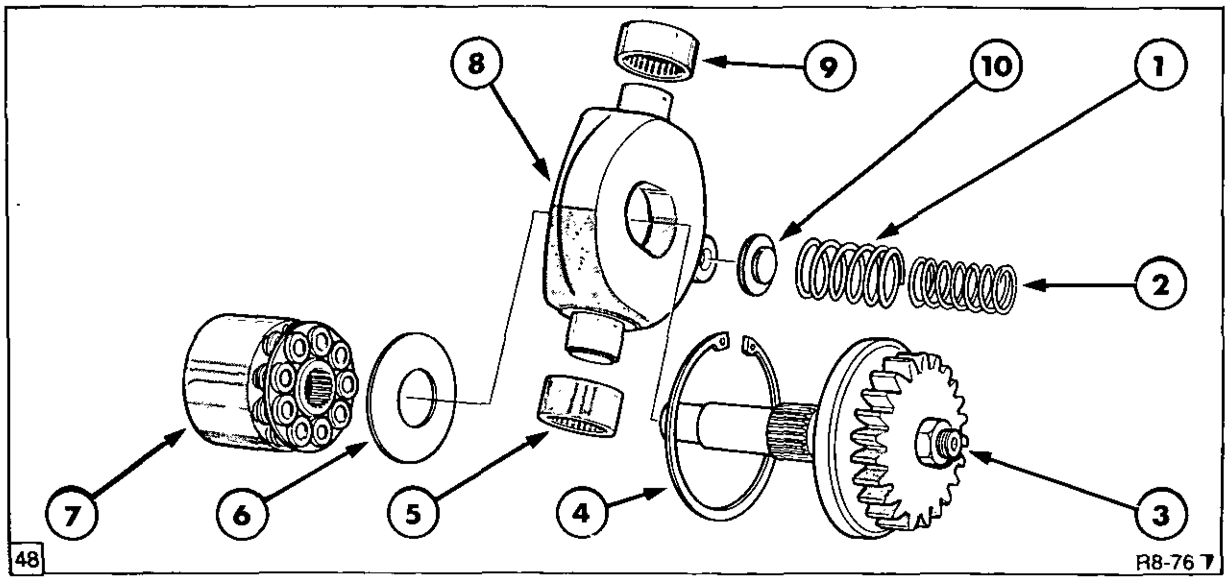

Piston Pumping Head and Swash Plate Installation

1. Spring
2. Spring
3. Driveshaft Assembly
4. Snap Ring
5. Bearing
6. Thrust plate
7. Pumping Head Assembly
8. Swash Plate
9. Bearing
10. Spring Seat

- Refer to Figure 48 to assist in installing the driveshaft and swash plate assembly.

- To assist in re–assembly of pumping head apply petroleum jelly to the cone and washer.

- When installing pumping head onto driveshaft, ensure that splines on both the driveshaft and pumping head are aligned. Apply pressure to the base of the pumping head to ensure that the spring within the head reacts against the piston and slippers. If when applying pressure the resistance of the spring can not be felt it is an indication that the cone and washer have been displaced during assembly.

- Tighten all bolts to the correct torque. See Specifications, Section E.

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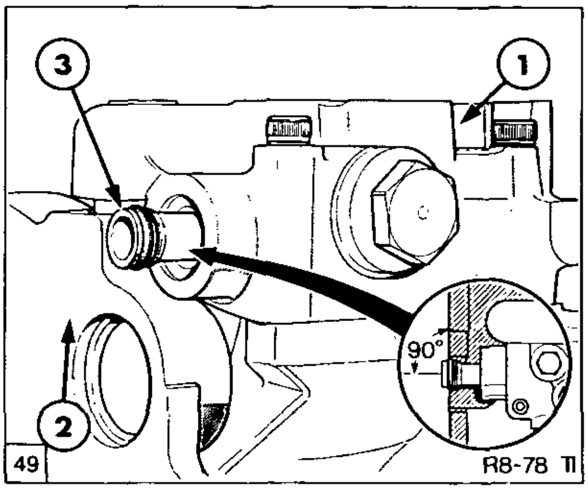


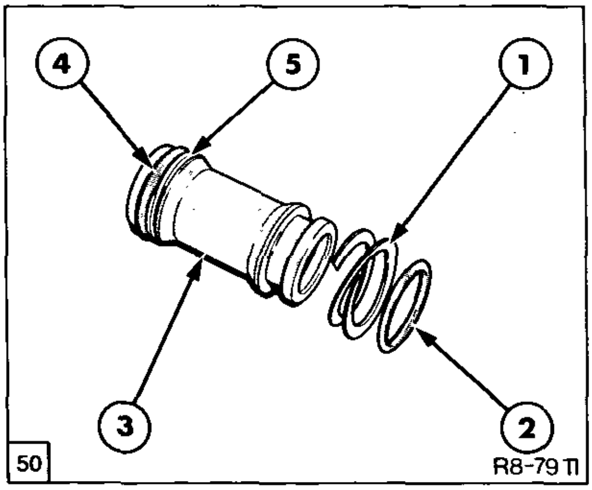
Valve Housing Alignment

1. Valve Housing
2. Pump Mounting Face
3. Transfer Tube

- When installing pressure regulating and low pressure circuit safety valve housing, accurately position the housing at 90° to pump mounting face, Figure 49. This is necessary to ensure that during installation the transfer tube engages with the locating oil gallery in the transmission housing.

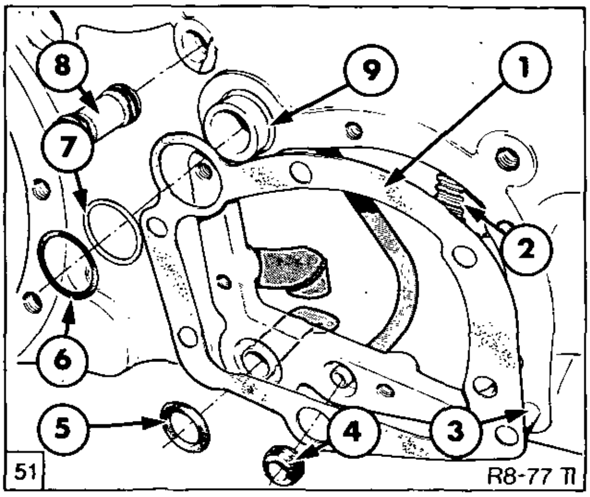
INSTALLATION

Installation follows the removal procedure in reverse. During installation observe the following:–



Transfer Tube

1. Washer
2. 'O' Ring
3. Tube
4. 'O' Ring
5. Washer



Preparation for Installing Pump

1. Gasket
2. Idler Gear
3. Dowel
4. Seal (PTO Feed Tube)
5. Seal (Steering Pump Intake Tube)
6. 'O' Ring
7. Washer
8. Transfer Tube
9. Charge Pump Intake Tube (Retained with a Wire Ring)

- Fit new seals and washers to the transfer tube Figure 50.

NOTE: *There are two designs of transfer tube. The tube shown in Figure 50 is that for tractors installed with a hydraulic lift assembly. On those special builds where a hydraulic lift assembly is not fitted the transfer tube is blanked off at one end.*

- Ensure seals and washers on the steering, charge pump and PTO tubes in rear axle centre housing are correctly fitted. Refer to Figure 51.

NOTE: *The charge pump intake tube is locked in position in the rear axle centre housing by a wire locking ring attached to the end of the tube.*

- Ensure steering pump intake tube is correctly located.

- Push the transfer tube into the rear axle centre housing, fit a new gasket and install the pump.

- Tighten all bolts to the correct torque. See Specifications Section E.

- Refill the rear axle/transmission with 13.3 Imp Galls (16.0 US Galls, 60.6 Litres) of oil to Ford Specification ESN M2C 134 D.

Pressure test the pump after installation as described in Section D and test drive tractor for correct operation.

D. PRESSURE TESTING

This Section describes the procedure for pressure testing tractors installed with the variable displacement hydraulic pump with closed centre load sensing and integral charge and steering pumps. The procedure also includes the test procedure for checking steering relief valve, remote control valves and trailer brakes where fitted.

The pressure test values quoted in this procedure make allowances for time in service, however the values quoted in Section E Specifications are for new components.

Improved access to the test ports on the hydraulic pump can be achieved by supporting the tractor on suitable axle stands and removing the right hand rear wheel.

⚠ **WARNING:** *To prevent inadvertant movement of the tractor during pressure testing the following precautions must be taken.*

Remove fuse No 15 from the fuse panel.

If the tractor is fitted with four wheel drive disconnect the driveshaft coupling at the front axle pinion.

This precaution will prevent inadvertant movement of the tractor if the transmission gear shift levers are moved into the engaged position while performing the pressure tests.

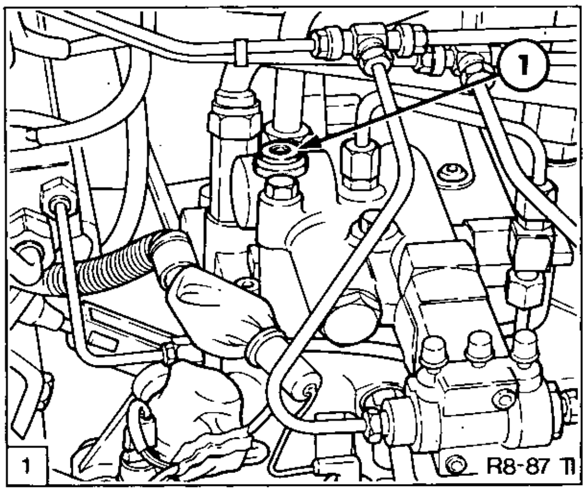
IMPORTANT: *Before performing any flow or pressure checks it is important that the oil in the transmission or rear axle is at an operating temperature of 75°C (170°F). The method of achieving this temperature is detailed in steps 3–10 of the procedure for testing charge pressure.*

⚠ **WARNING:** *To avoid burning yourself with high temperature oil always warm the oil to temperature after installing all the test equipment.*

Load Sensing Circuit Test

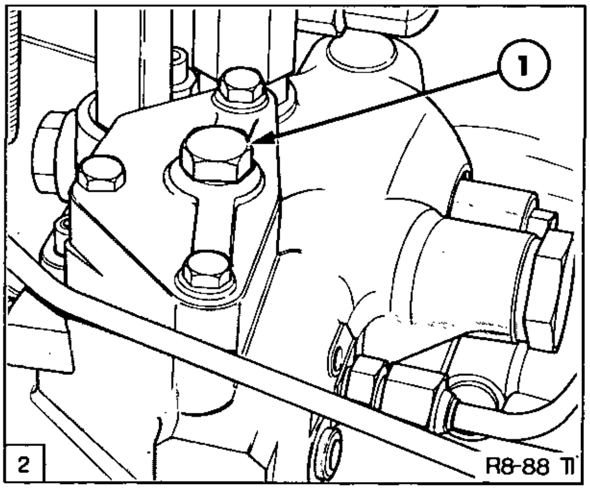
This test should be performed before proceeding to other pressure tests, as it will help to identify any concerns related to hydraulic circuits which are not caused by a fault within the hydraulic pump assembly.

The test will check operation of the hydraulic circuits and load sensing lines to the trailer brake, hydraulic lift, remote control valves and trailer brake, where fitted.



System and Standby Pressure Test Port
(Tractors fitted with Trailer Brakes)

1. Plug

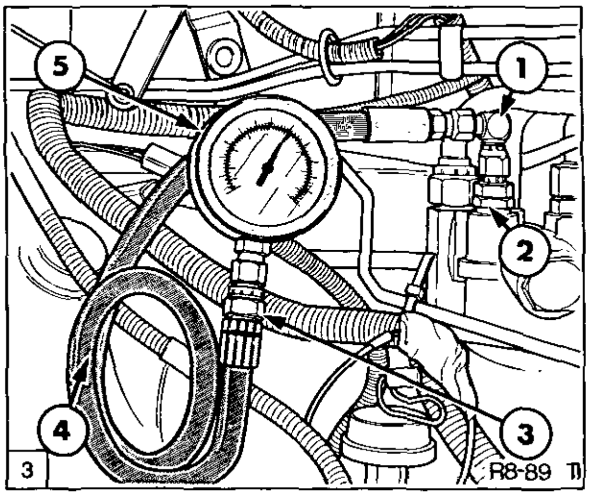


System and Standby Pressure Test Port
(Tractors fitted less Trailer Brakes)

1. Plug

1. Remove system and standby pressure test plug, Figure 1 or Figure 2.

NOTE: *The thread size of the standby pressure test port is M14 x 1,5.*



Load Sensing Circuit Test Gauge Installation

1. Elbow 86246–S36
2. Adaptor 4FT.851 (M14x1,5–7/16 JIC)
3. Adaptor FT. 8503–8 or FNH 0705
4. Test Hose E1NN F493 AA Finis Code 3936707
5. Pressure Gauge FT. 8503A

2. Install the 0–6000 lbf/in² (0–414 bar) pressure gauge FT. 8503A, Figure 3.

NOTE: *This test can be performed with a 0–3000 lbf/in² (0–207 bar) pressure gauge if available.*

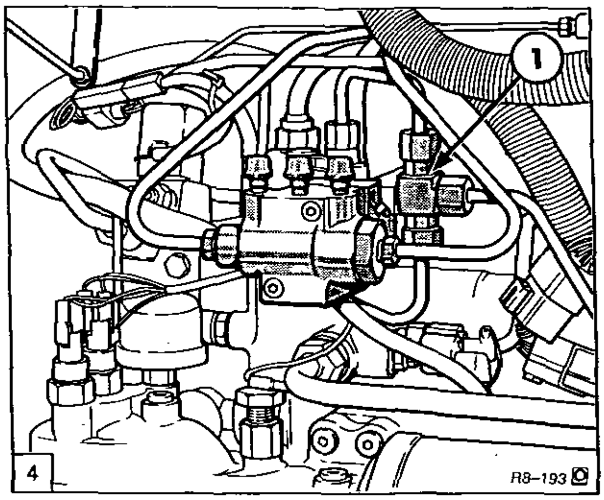
3. Set the engine speed to 1500 rev/min.

4. Operate in turn the hydraulic lift, each remote control valve and the trailer brakes (where fitted). As each circuit is put under load the pressure reading should increase from 300–360 lbf/in² (21–25 bar) up to a maximum of 2825 lbf/in² (195 bar). When operating the trailer brake the pressure will rise to a maximum of 2140 lbf/in² (148 bar).

If the tractor is known to have a hydraulic malfunction and this test registers a pressure increases for at least one, but not all, of the hydraulic circuits being tested it is an indication that the concern is probably **not** related to the hydraulic pump.

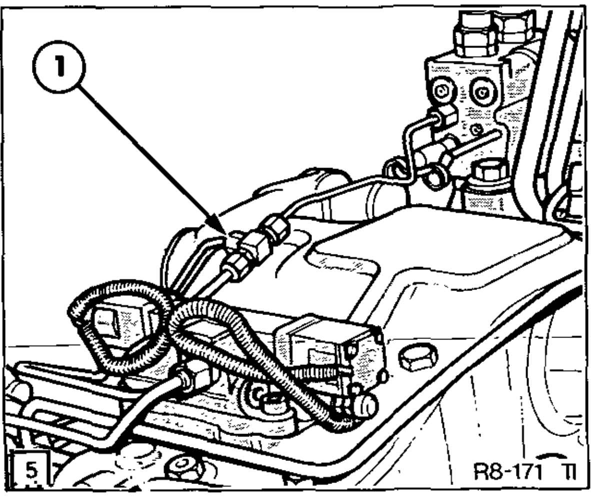
Should this occur the shuttle valves in the load sensing line of the circuit not producing a pressure increase should be examined for sticking in an open position prior to continuing with the pump pressure test.

For the location of the shuttle valves refer to Figure 4 and Figure 5.



Load Sensing Line Shuttle Valves
(Adjacent to Trailer Brake Valve)

1. Shuttle Valve to Trailer Brake Valve, Hydraulic Lift Control/Unload Valve, and Remote Control Valve)



Load Sensing Line Shuttle Valves Adjacent to Hydraulic Lift Cover

1. Shuttle Valve To Remote Control Valve and Hydraulic Lift EDC Control/Unload Valve (Where Fitted)

If the trailer brake valve pressure reading is incorrect examine the shuttle valve adjacent to the trailer brake valve.

If the hydraulic lift pressure reading is incorrect, examine the shuttle valve leading to the hydraulic lift control valve, (EDC valve or unload valve as fitted) and the shuttle valve adjacent to the trailer brake valve, where fitted.

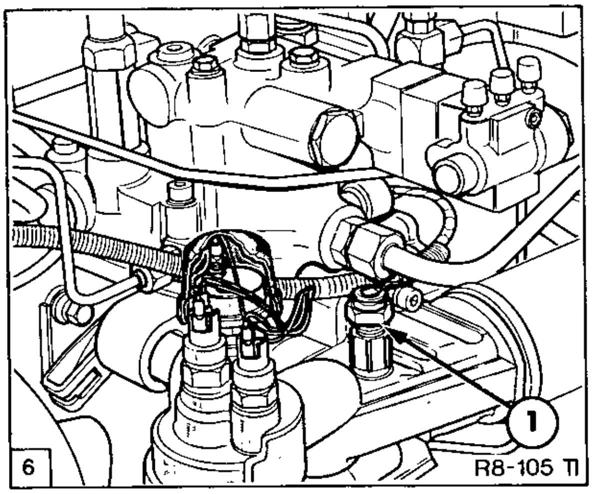
If the remote control valve pressure readings are incorrect examine all shuttle valves.

NOTE: *Shuttle valves are also located within each of the remote valves installed on the tractor.*

If the shuttle valves are not sticking, attention should also be given to the hydraulic valves and components within the circuit that does not operate correctly.

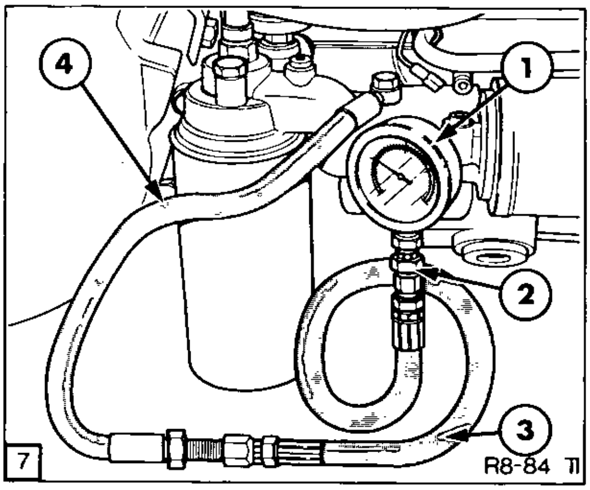
Charge and Variable Displacement Piston Pump Pressure Testing

Charge Pressure Test



Charge Pressure Switch

1. Remove charge pressure switch, Figure 6.

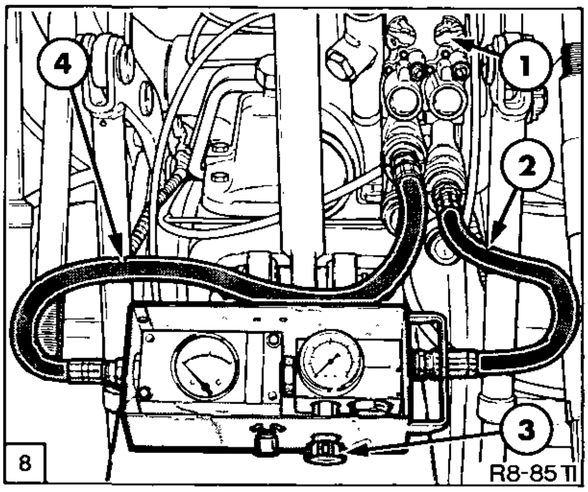


Checking Charge Pressure

1. Pressure Gauge FT. 4096
2. Adaptor FT. 8503–8
3. Test Hose E1NN F493 AA Finis Code 3936707
4. Test Hose E0NN 2N353 AB
   Finis Code 3926717

2. Install 0–100 lbf/in^2 (0–6.6 bar) pressure gauge FT. 4096, Figure 7.

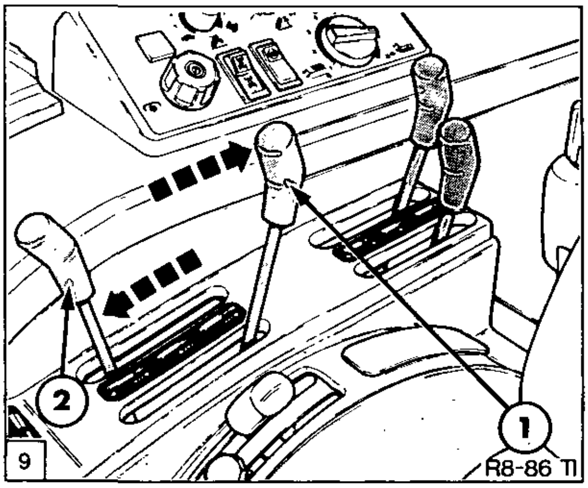
NOTE: *The thread size of the charge pressure switch port is M10 x 1.*



Installation of Flow Meter

1. Flow Control Knob
2. Return Hose to Remote Control Valve
3. Flowmeter Load Valve
4. Supply Hose to Flowmeter

3. Using remote control valve couplers, install inlet hose of flow meter into lift coupler of left hand side inner remote control valve. Install return hose from flow meter into lift coupler of right hand side *outer remote control valve, Figure 8.*
4. Set flow control knob on remote control valves to minimum flow.
5. Ensure load valve on flow meter is fully open.
6. Blank oil cooler with a piece of card. Start engine and set engine speed to 2100 rev/min.



Setting Remote Control Valves to Raise and Float

1. Right Hand Inner Remote Control Valve Lever (Blue)–Extend Position
2. Right Hand Outer Remote Control Valve Lever (Green)–Float Position

7. Push green handled remote control valve operating lever fully forward to 'float' position. (This lever operates the remote control valve receiving oil from the flow meter), Figure 9.

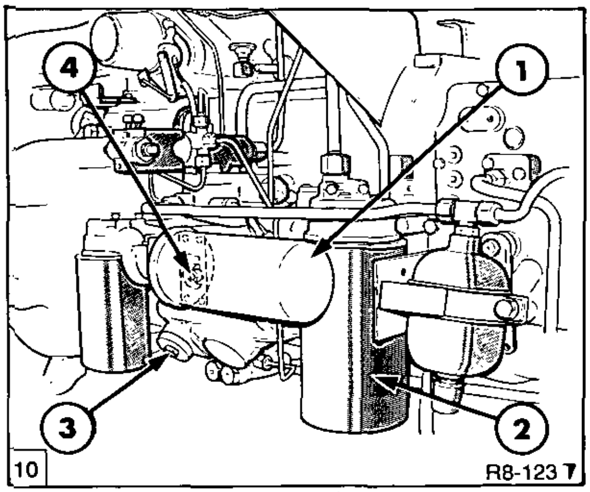
8. Pull blue handled remote control valve operating lever fully rearwards to cylinder extend position. (This lever operates the remote control valve supplying oil to the flow meter).

9. After ensuring that flow meter is measuring oil flow correctly, set remote control valve flow knobs to maximum flow.

10. Adjust load valve on flow meter until hydraulic oil is at pressure of 2000 lbf/in² and allow engine to run until hydraulic oil is at an operating temperature of 75°C (170°F).

11. Open load valve on flowmeter and set engine speed to 1500 rev/min.

12. Move blue handled remote control valve lever between cylinder extend and neutral positions while observing the pressure gauge readings. The pressure reading should not vary outside 23–50 lbf/in² (1.6–3.4 bar).



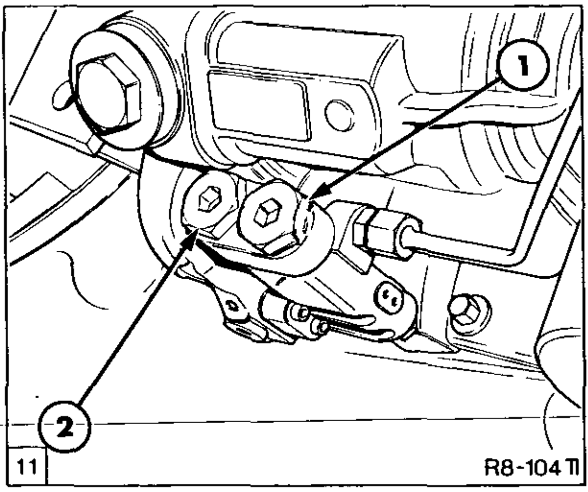
Charge Pump Valves and Filter

1. Charge Pressure Filter
2. Charge Pump Inlet Filter
3. Charge Pressure Bypass Valve
4. Charge Pressure Filter Dump Valve

Pressure readings conforming to the specified values, confirm that the charge pump inlet filter, charge pump, charge pressure bypass valve and charge pressure filter dump valve, are working correctly, Figure 10.

Maximum System Pressure Test (High Pressure Standby)

1. With flow meter installed as for the charge pressure test, set engine speed to 1500 rev/min. Using an assisstant to hold blue remote control valve lever in extend position, slowly close load valve on flow meter. Observe on the flow meter or pressure gauge installed for the load sensing circuit test, the maximum pressure recorded. The pressure reading should be between 2675–2825 lbf/in² (184–195 bar).



Flow and Pressure Compensating Valves

1. Flow Compensating Valve
2. Pressure Compensating Valve

Pressure readings conforming to the specified values, confirm that the pressure compensating valve is working correctly.

If the pressure reading is marginally away from specification, remove the tamperproof cap, loosen the locknut on the pressure compensating valve adjuster and adjust the pressure.

If a maximum system pressure of only 310–350 lbf/in² (21–24 bar) is recorded and the load sensing valves are not sticking, examine the flow and pressure compensating valves for sticking in an open position.

Fit new tamperproof cap(s) after adjustment has been completed.

Swash Plate Servo Piston Test

1. Perform maximum system pressure test then fully open the load valve on the flow meter.

2. Observe the pressure on the flowmeter or load sensing circuit test pressure gauge.

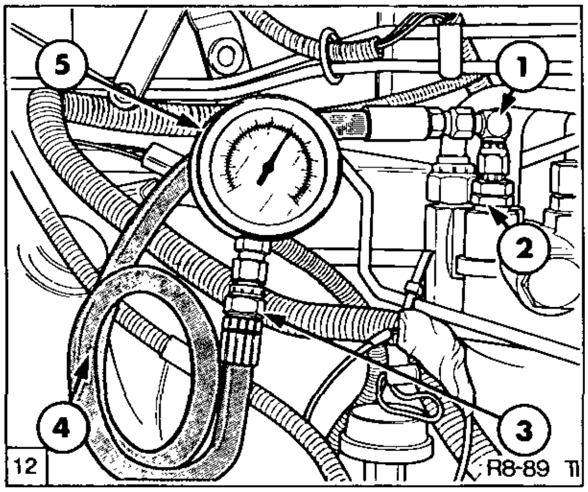
If the pressure drops from maximum system pressure to approximately 400 lbf/in² the servo piston is operating correctly. The reduction in pressure is also an indication that standby pressure is correct. Where it is necessary to accurately confirm the standby pressure value perform the Standby Pressure test using the 0–600 lbf/in² (0–42 bar) pressure gauge FT. 4100 as described on page 48.

Standby Pressure and Maximum System Pressure Observation Test

This test will demonstrate the hydraulic pump changing from standby to maximum system pressure and can be performed without the use of a flowmeter. This test **must only** be performed with a pressure gauge capable of measuring higher than 0–3000 lbf/in² *(0–217 bar), otherwise damage to the gauge* will occur.The high pressure gauge used in this test prevents accurate measurement of low pressure standby.

1. Ensure the 0–6000 lbf/in² (0–414 bar) pressure gauge FT. 8503A as required for performing the load sensing circuit test, described on Page 43, is installed in the system and standby pressure test port. Refer to Figure 12.

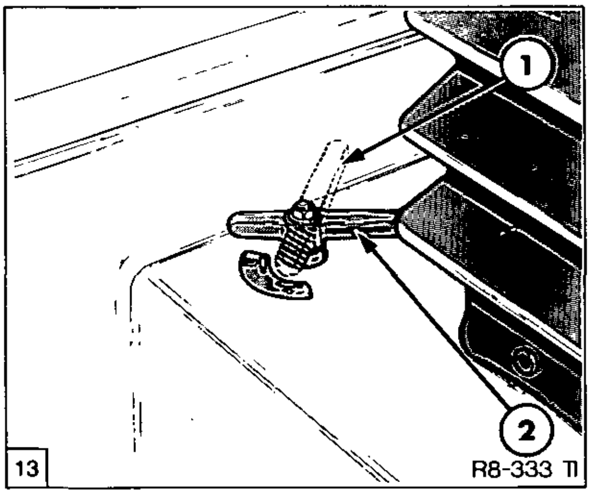
2. Ensure remote control valve levers are in **'Neutral'** position. Move the lift control lever and lift arms to the lower position and ensure the tractor footbrake is **NOT** being applied.



Standby and Maximum System Pressure Observation check

1. Elbow 86246–S36
2. Adaptor 4FT.851 (M14 x 1,5–$^7/_{16}$ JIC)
3. Adaptor FT. 8503–8 or FNH 0705
4. Test Hose E1NN F493 AA Finis Code 3936707
5. Pressure Gauge FT. 8503A

3. Set engine speed to 1500 rev/min and observe pressure reading. The pressure recorded should be between 300–360 lbf/in² (21–25 bar) and is the standby pressure.



ASC Selector Lever

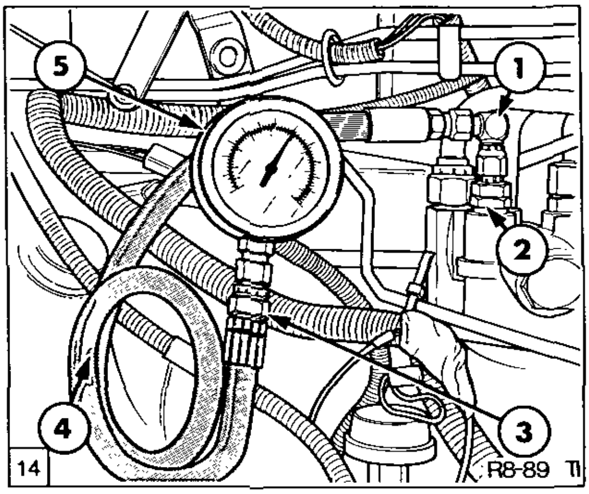
1. ASC Engaged
2. ASC Disengaged

4. Turn Auxiliary Services Control (ASC) to engaged position, Figure 13.

5. Pull lift control lever to raise position and record pressure. Pressure reading should increase to 2675–2825 lbf/in² (184–195 bar) and is the maximum system pressure.

Standby Pressure Test (Low Pressure Standby)

This test procedure will enable an accurate reading of the standby pressure to be recorded.



Checking Standby Pressures

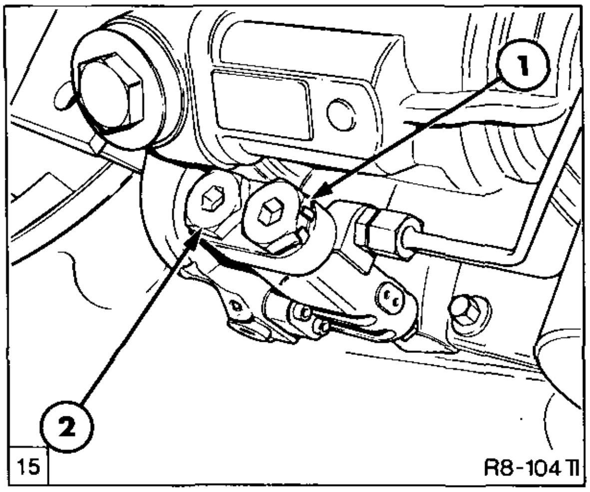
1. Elbow 86246–S36
2. Adaptor 4FT.851 (M14x1,5–7/16 JIC)
3. Adaptor FT. 8503–8 or FNH 0705
4. Test Hose E1NN F493 AA Finis Code 3936707
5. Pressure Gauge FT. 4100

1. *Remove the pressure gauge installed for* the load sensing circuit pressure test and install a 0–600 lbf/in² (0–42 bar) pressure gauge FT. 4100 in its place, Figure 14.

2. Ensure remote control valve levers are in **'Neutral'** position and tractor footbrake is not being applied.

IMPORTANT: ***Do Not*** *operate the hydraulic lift, remote valves or tractor brakes. If these circuits are operated the standby pressure can increase towards the maximum system pressure of 2800 lbf/in², resulting in damage to the pressure gauge.*

3. Vary engine speed between 1000–2100 rev/min and observe pressure reading. The pressure recorded should be between 300–360 lbf/in² (21–25 bar).



Flow and Pressure Compensating Valves

1. Flow Compensating Valve
2. Pressure Compensating Valve

If the pressure reading is marginally away from specification, remove the tamperproof cap, loosen the locknut on the flow compensating valve adjuster and adjust the pressure.

If the reading is high examine the flow compensating valve spool for sticking, Figure 15.

Fit new tamper proof cap(s) after adjustment has been completed.

If the reading is low and the charge pressure is to Specification, the concern may be due to *a large leak in the low pressure circuit, refer to* low pressure circuit test.

Variable Displacement Piston Pump Flow (Output)

1. With flow meter installed as for the charge pressure test, increase engine speed to 2100 rev/min.

2. Engage P.T.O., disengage four wheel drive and ensure transmission is in neutral and that the tractor clutch pedal is not being depressed.

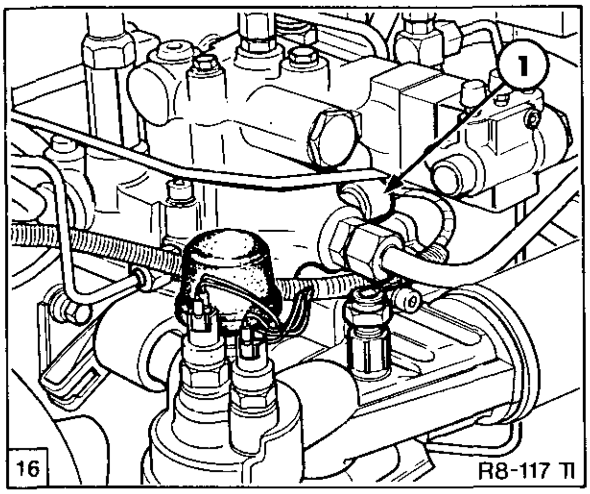
3. Slowly close load valve on flow meter until a pressure of 2500 lbf/in² (172 bar) is observed on the flow meter pressure gauge.

4. Record pump flow (output).

If pump flow is less than 16 U.S Gals/min (13 Imp Gals/min 60 Ltrs/min) and the following low pressure circuit test is to specification the pump must be overhauled.

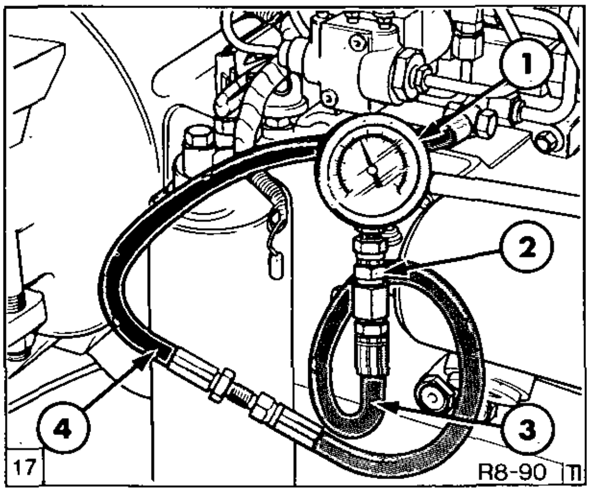
Low Pressure Circuit Test

This pressure test will check that oil at a minimum pressure of 250 lbf/in² (17 bar) is being directed by the pressure regulating valve to the low pressure circuits which operate the P.T.O., differential lock, four wheel drive disengagement system, electronic draft control valve and 16 x 6 transmission clutches, where fitted.



Transmission Pressure Switch

1. Remove transmission pressure switch, Figure 16.



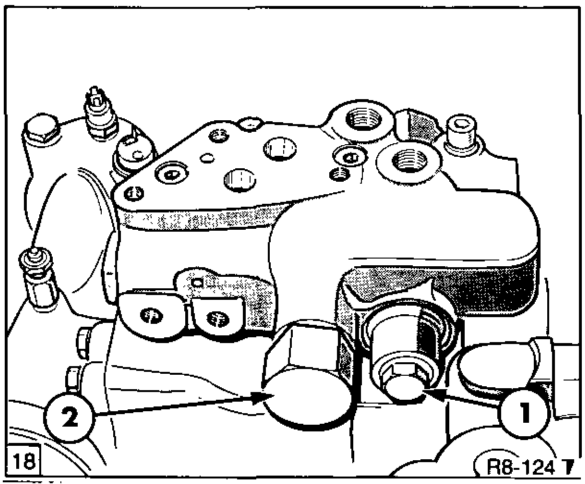
Low Pressure Circuit Test

1. Pressure Gauge FT. 4100
2. Adaptor FT. 8503–8 or FNH 00705
3. Test Hose E1NN F493 AA Finis Code 3936707
4. Test Hose E0NN 2N353 AB
   Finis Code 3926717

2. Install 0–600 lbf/in² (0–42 bar) pressure gauge FT. 4100, Figure 17.

3. Set engine speed to 1500 rev/min.

4. Observe pressure reading. Pressure recorded should be between 250–280lbf/in² (17–19 bar).



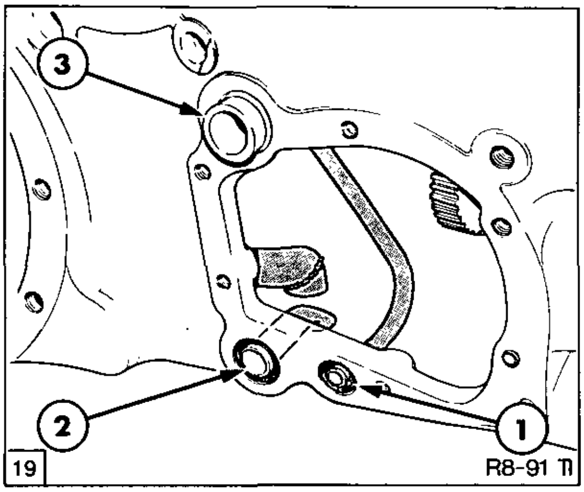
Pressure Regulating and Low Pressure Safety Valves

1. Pressure Regulating Valve
2. Low Pressure Circuit Safety Valve

If the pressure reading is marginally away from specification re–shim the pressure regulating valve. One shim represents a change in pressure of 5 lbf/in² (0.35 bar).

If the pressure reading is considerably away from specification examine the pressure regulating valve for sticking, Figure 18.

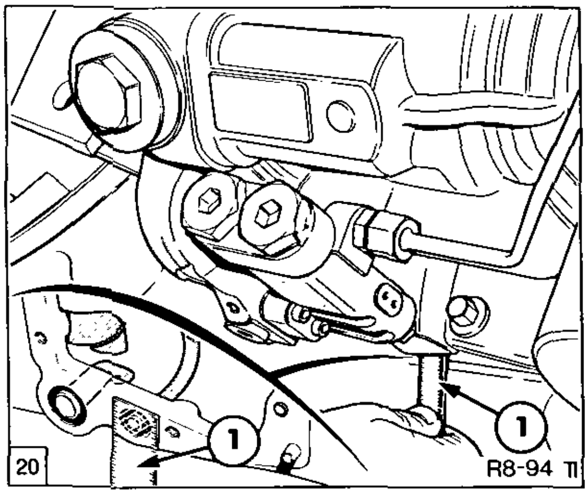
If the pressure regulating valve is functioning correctly, examine the low pressure circuit safety valve for sticking in 'Open' position.



Hydraulic Pump Intake and Feed Tubes

1. P.T.O. Clutch Feed Tube
2. Steering Pump Intake Tube
3. Charge Pump Intake Tube

5. If no fault can be found, loosen the pump body and place a piece of 0.010 in (0.25mm) shim steel over the pump outlet port to the PTO clutch feed tube Refer to Figure 19 and Figure 20.

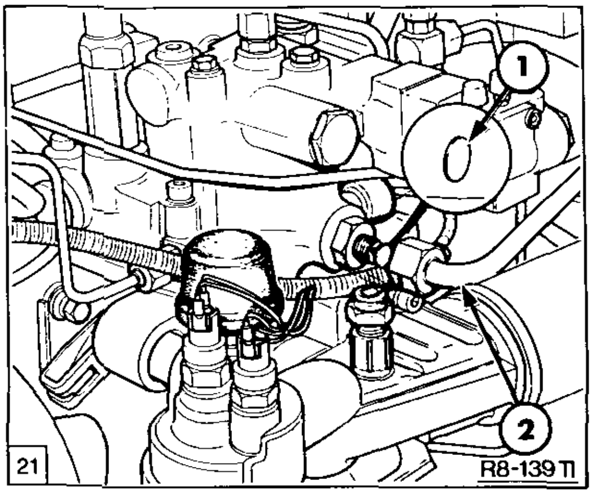


Shim Steel Positioned Over PTO Clutch Feed Tube

1. 0.010 in (0.25mm) Shim Steel

6. Ensure the shim steel is positioned between the pump flange and mounting face gasket, then tighten the pump retaining bolts sufficiently to hold the shim steel in position without a leakage of oil Figure 20. (Do Not over–tighten the bolts or damage may occur to the pump mounting flange). Re–check the pressure in the low pressure circuit.

If the reading is now correct, check for a large leak on the P.T.O. circuit which may be due to the feed pipe and sealing washer being incorrectly fitted, the wrong P.T.O. valve fitted or a large leak in the P.T.O. clutch.



Positioning Blanking Shim in Feed Tube to Transmission

1. Blanking Shim
2. Feed Tube To Transmission

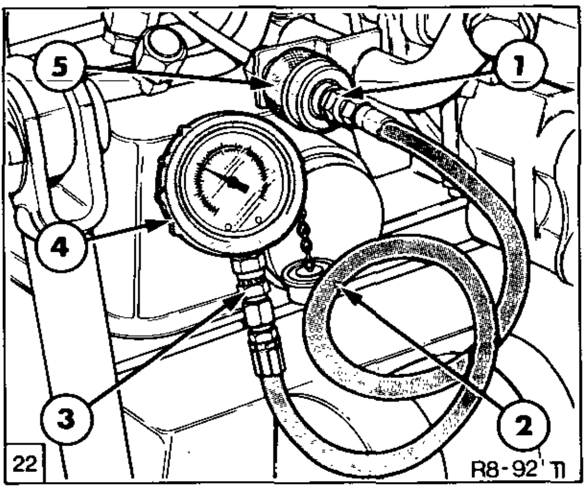
7. *If the low pressure readings are still below* specified value disconnect the feed tube to the transmission, Figure 21 and install a $^{11}/_{16}$ in (18 mm) blanking shim in the tube. Reconnect the tube and re–test the low pressure circuit.

If the reading is now to specification a leakage is occurring within the transmission clutch circuits.

If no fault can be found and standby pressure test was to specification re–shim the pressure regulating valve to the correct pressure.

Trailer Brake Valve Pressure Test

1. Connect 0–6000 lbf/in^2 (0–414 bar) pressure gauge FT.8503A to trailer brake coupler, Figure 22.
2. Set engine speed to 1500 rev/min.
3. Depress right hand brake pedal. There should be no reading on the pressure gauge.
4. Depress left hand brake pedal. There should be no reading on the pressure gauge.



Trailer Brake Pressure Test

1. Adaptor 4FT.854
2. Test Hose E1NN F493 AA Finis Code3936707
3. Adaptor FT. 8503–8 or FNH 00705
4. Pressure Gauge FT.8503A
5. *Trailer Brake Coupler*

5. Couple together and depress both brake pedals. The reading on the pressure gauge should increase as the brake pedals are depressed harder. The pressure recorded, depending on pedal effort, should increase up, to a maximum pressure of 2140 lbf/in^2 (147 bar).
6. Release brake pedals. Pressure should reduce to zero.

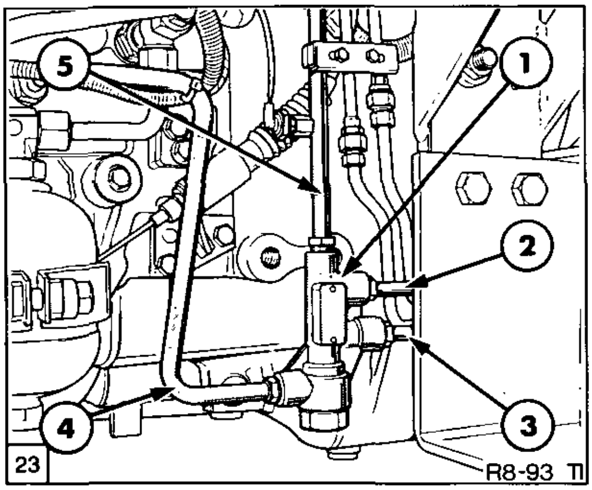
Steering Pump

There is no relief valve in the steering pump. The following practical test will determine if steering pump output is sufficient to allow satisfactory operation of the steering system.

Steering Test

1. Set engine speed to 1000 rev/min.
2. Turn steering quickly from lock to lock. If steering is operating correctly the reaction of the steering should be immediate with no time delay between turning the steering wheel and movement of the wheels. At full lock the relief valve in the steering motor should be heard to blow and the engine speed should drop to approximately 970 rev/min.

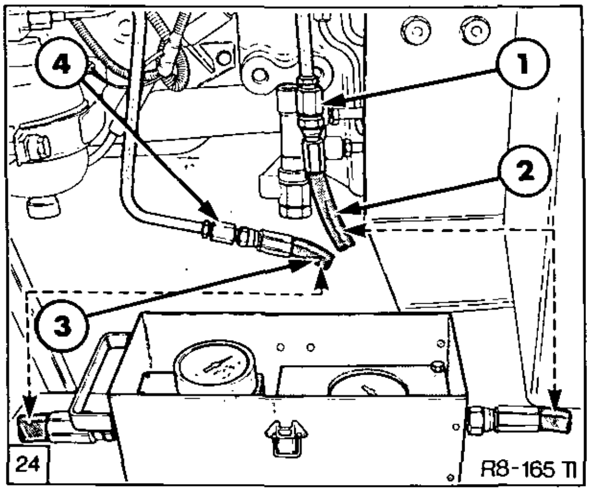
Steering Pump Flow Test



Oil Cooler Bypass Valve

1. Bypass Valve
2. Oil Cooler Feed Tube
3. Oil Cooler Return
4. To Transmission/Rear Axle Lubrication Circuits
5. Feed Tube Steering Motor to Bypass Valve

1. Disconnect and remove oil cooler bypass valve, Figure 23.
2. Plug feed and return tubes to oil cooler to prevent contamination and loss of oil.



Flow Testing Steering Pump

1. Adaptor 4FT. 852
2. Supply Hose to Flowmeter
3. Flowmeter Return Hose
4. Adaptor 4FT. 852

3. Using Adaptors 4FT.852 install flowmeter between tube from steering motor and tube to transmission/rear axle lubrication circuits, Figure 24.

NOTE: *Adaptors 4FT.852 are suitable for installing 3/4 in JIC hoses to flowmeter. If hoses of a different size are used with the flowmeter, suitable adaptors with a female thread size of 3/4–18 UNS on one end will be required.*

4. **'Ensure'** flowmeter load valve is fully open, Figure 24.

IMPORTANT: *If the flowmeter load valve remains closed damage will occur to the steering pump.*

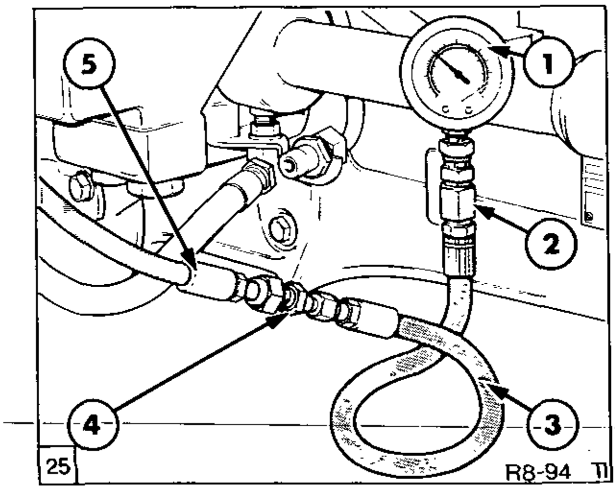
5. Set engine speed to 2100 rev/min and turn steering onto full left hand lock. Hold steering on full lock so that steering motor relief valve can be heard to 'blow'.
6. Record pump flow.

If pump flow is less than 8.2 U.S Galls/min (6.8 Imp Galls/min 31 Ltrs/min) the steering pump requires overhaul.

Steering Relief Valve Pressure Test

IMPORTANT: *There is no relief valve in the steering pump and the following pressure tests must only be performed as specified below. Failure to observe this precaution may result in severe damage to the steering and lubrication circuit hydraulic pump.*

1. Turn steering onto full left hand lock.
2. Disconnect left hand turn feed hose at steering cylinder.



Power Steering Circuit Pressure Test

1. Pressure Gauge FT. 8503A
2. Adaptor FT. 8503–8 or FNH 00705
3. Test Hose E1NN F493 AA Finis Code 3936707
4. Adaptor 4FT.853 (11/16 x 16UN to $^7/_{16}$ JIC)
5. Left Hand Turn Steering Hose

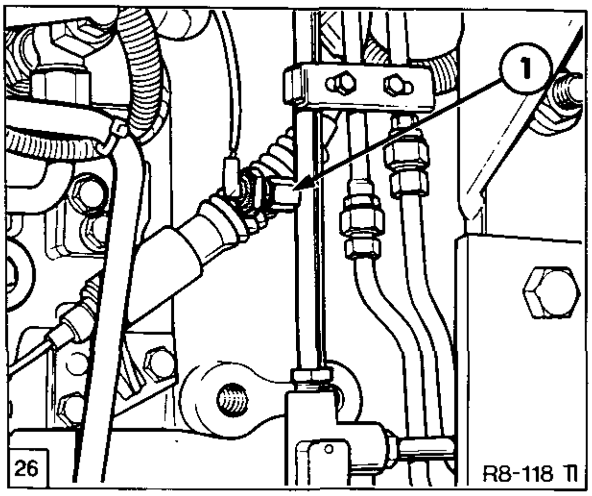
3. Install 0–6000 lbf/in^2 pressure gauge FT. 8503A, Figure 25.
4. Start tractor and set engine speed to 1000 rev/min. Turn steering wheel to the left with a pull of approximately 5 lbf and observe the pressure reading.

The pressure reading for all 5640–7840 2WD tractors should be 2220–2370 lbf/in^2 (153–163 bar). The pressure reading for all other tractors should be 2620–2770 lbf/in^2 (180–191 bar).

If the steering test was satisfactory but the pressure readings are away from specification the relief valve in the steering motor must be replaced. Refer to Part 9, Front Axle and Steering.

Oil Cooler and Lubrication Circuit Pressure Test

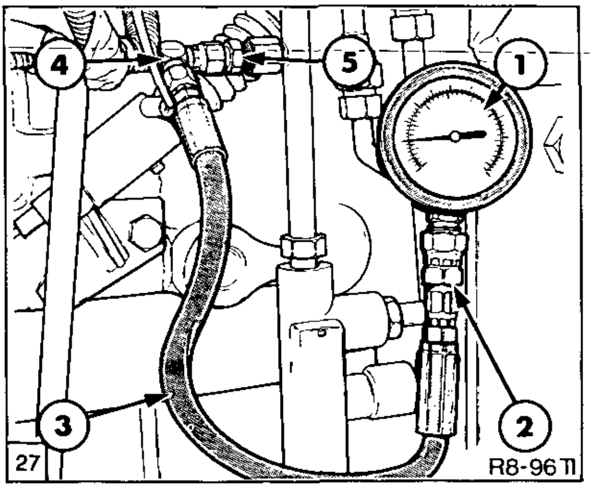
IMPORTANT: *To obtain correct pressure readings in this test it is important that the temperature of the oil in the transmission/rear axle must be 75°C (170°F).*



Low Flow Steering/Lubrication Circuit Pressure Switch

1. Pressure Switch

1. Remove low flow steering/lubrication circuit pressure switch, Figure 26.



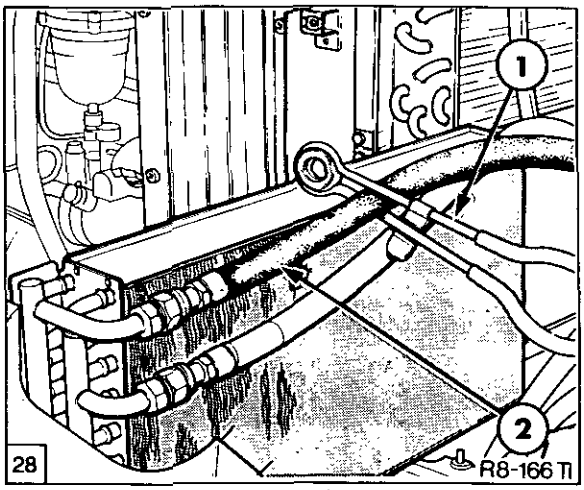
Oil Cooler and Bypass Valve Pressure Test

1. Pressure Gauge FT. 8616 or FNH 06653
2. Adaptor FT. 8503–8
3. Test Hose E1NN F493 AA Finis Code 3936707
4. Elbow 86246–S36
5. Adaptor 4FT. 850 ($^1/_4$–18NPSF to $^7/_{16}$–20 JIC)

2. Install 0–400 lbf/in^2 pressure gauge FT. 8616, Figure 27.
3. Set engine speed to 2100 rev/min and observe pressure reading. A pressure of 80–100 lbf/in^2 should be recorded.

IMPORTANT: *If a pressure reading was not observed stop the tractor immediately because lubrication oil is not being supplied to the transmission.*

4. Return engine speed to idle.



Restricting Flow to Oil Cooler

1. Hose Clamp
2. Oil Cooler Inlet Hose

5. Using a hose clamp restrict the flow of oil through the cooler inlet hose, Figure 28.
6. Set engine speed to 2100 rev/min and observe pressure reading. The pressure reading should be approximately 100 lbf/in^2.
7. Remove hose clamp restriction from oil cooler hose and observe pressure reading. The pressure reading should decrease to approximately 80 lbf/in^2.

The pressure reading of 100 lbf/in^2 followed by a reduction to approximately 80 lbf/in^2 indicates that when the oil cooler inlet hose was restricted the cooler bypass valve was operating correctly.

If the cooler bypass valve is not to specification refer to the Oil Cooler and Cooler By–pass Valve Chapter in this Part of Repair Manual.

The reduction in pressure when the cooler inlet hose restriction was removed indicates that the oil cooler is not blocked.

E. SPECIFICATIONS AND SPECIAL TOOLS

Variable Displacement Closed Centre Load Sensing Swash Plate Pump with Integral Charge and Steering Pumps

Charge Pump

Type	Gear Type Pump
Minimum Output @ 2100 eng rev/min (New Pump)	24 US Galls/min, (20 Imp Galls/min, 90 ltrs/min) @ 90 lbf/in^2 (6.2 bar)
Charge Pressure Filter Dump Valve	Crack open @ 100 lbf/in^2 (6.9 bar) Fully open @ 180 lbf/in^2 (12.4 bar)
Charge Pressure	minimum 23 lbf/in^2 (1.6 bar) @ 2100 rev/min and variable displacement pump 'On' load Maximum 50 lbf/in^2 (3.4 bar) @ 2100 rev/min and variable displacement pump 'Off' load
Charge Pressure Switch	Close @ 8–12 lbf/in^2 (0.55–0.82 bar) Making charge pressure warning light flash

Variable Displacement Closed Centre Load Sensing Pump

Type	Variable Piston Pump (Swash Plate Controlled)
Minimum Output @ 2100 eng rev/min (New Pump)	20 US Galls/min, (16.6 Imp Galls/min, 76 Ltrs/min) @ 2550 lbf/in^2 (176 bar)
Standby Pressure (Low Pressure Standby)	310–350 lbf/in^2 (21–24 bar)
Maximum System Pressure (High Pressure Standby)	2700–2800 lbf/in^2 (186–193 bar)
Low Pressure Hydraulic Circuit Pressure Regulating Valve	250–280 lbf/in^2 (17–19 bar)
Low Pressure Circuit Safety Valve	Crack open @ 290 lbf/in^2 (20 bar) Fully open @ 415 lbf/in^2 (29 bar)
Low Transmission Oil Pressure Switch (Tractors with 16 x 16 transmission only)	Close @ 210–220 lbf/in^2 (14.5–15.2 bar) making low transmission oil pressure warning light come 'On' Open @ 240–250 lbf/in^2 (16.5–17.2 bar) Making low transmission oil pressure warning light go 'Off'
Low Transmission Oil Pressure Switch (Tractors with 12 x 12 transmission only)	Close @ 80 lbf/in^2 (5.5 bar) Making low transmission oil pressure warning light come 'On' Open @ 120 lbf/in^2 (8.3 bar) Making low transmission oil pressure warning light go 'Off'
High Oil Temperature Switch	Close @ 104–110°C (219–230°F)

Steering Pump

Type	Gear Type Pump
Minimum Output @ 2100 eng rev/min (New Pump)	9.2 US Galls/min (7.7 Imp Galls/min 34.8 Ltrs/min) @ 2600 lbf/in^2 (169 bar)
Maximum Operating Pressure	2600 lbf/in^2 (207 bar)
Blocked Steering Filter Vacuum Switch	Close @ 18 in Hg. making blocked steering filter warning light come 'On' providing oil temperature is above 42–48°C (107–118°F)
Low Steering Oil Temperature Switch	Close @ 42–48°C (107–118°F)

THREAD SEALANT

To Ford Specification–ESE M4G 140–A (loctite 542).
Applied to pump driveshaft gear retaining nut.

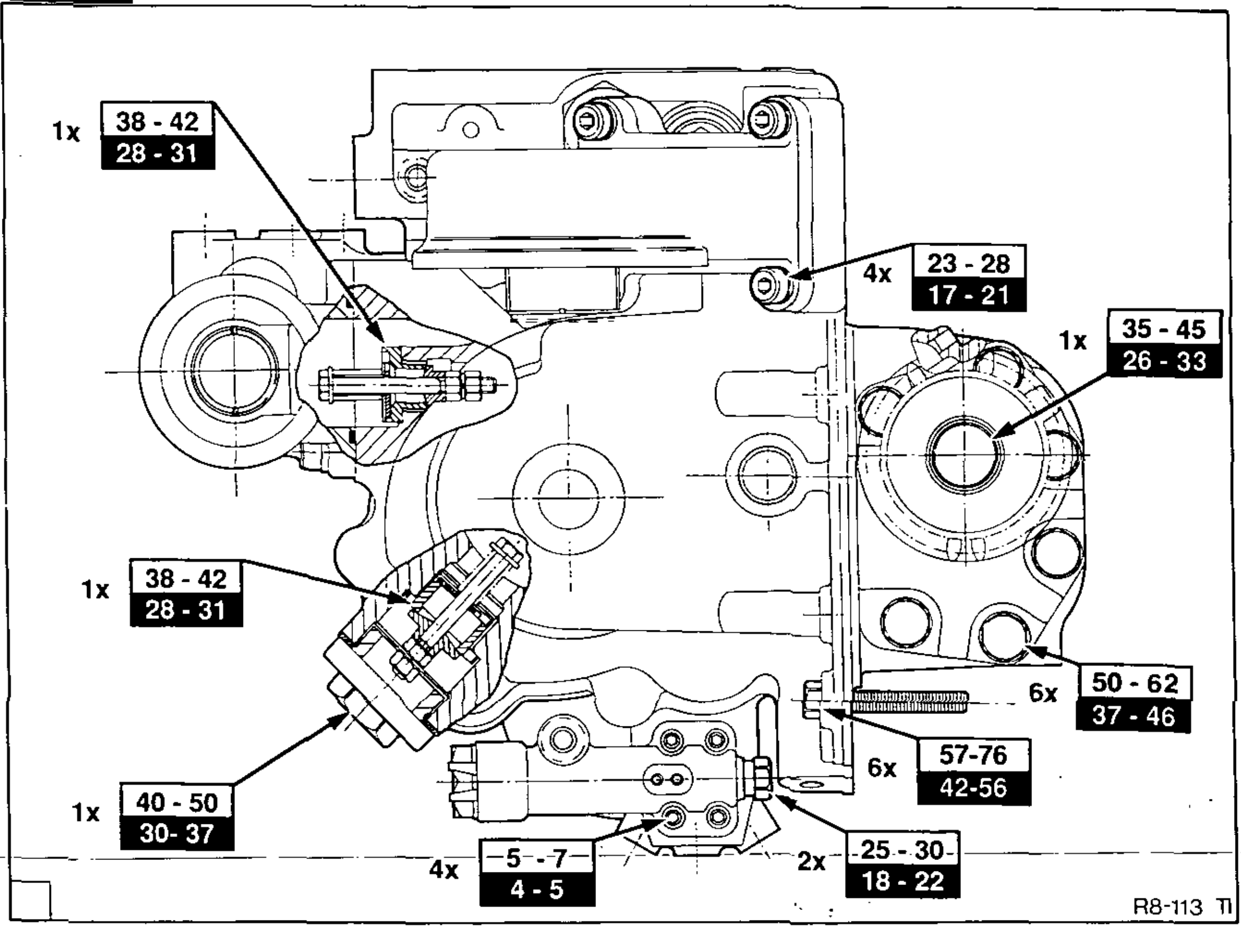
SPECIAL TOOLS

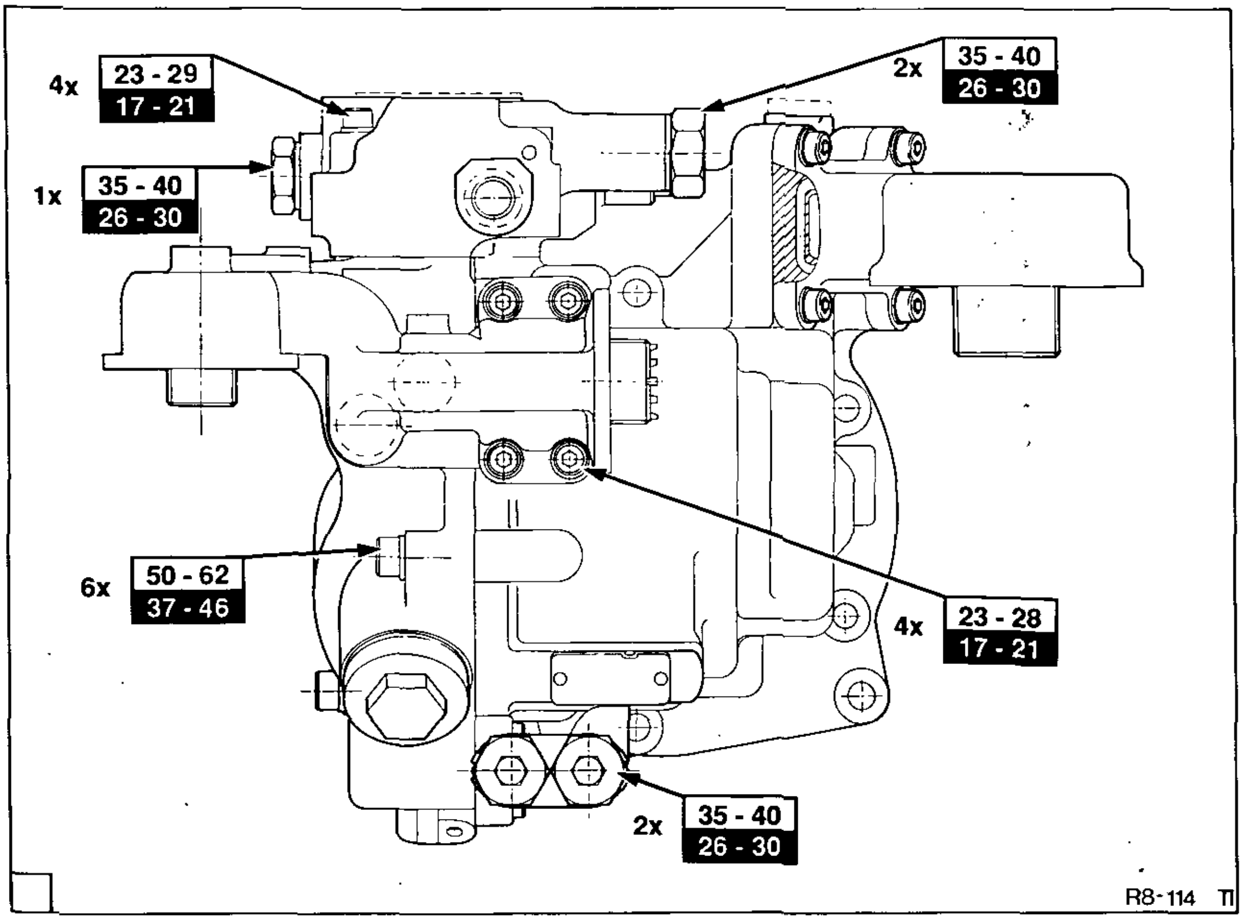
DESCRIPTION	TOOL NUMBER	
	V.L. Churchill	FNH Part No (America only)
Pressure Gauge 0–100 lbf/in^2 (0–6.6 bar)	FT. 4096	FNH 02026
Pressure Gauge 0–600 lbf/in^2 (0–42 bar)	FT. 4100	FNH 02027
Pressure Gauge 0–6000 lbf/in^2 (0–414 bar)	FT. 8503A	FNH 02028
Pressure Gauge 0–400 lbf/in^2 (0–30 bar)	FT. 8616	FNH 06653
Elbow–Standby Pressure Test	86246–S36	
Adaptor–Pressure Test	FT. 8503–8	FNH 0705
Adaptor–By–pass Valve Pressure Test	4FT.850 ($^{1}/_{4}$"–18NPSF male–$^{7}/_{16}$" JIC male)	
Adaptor–Standby Pressure Test	4FT.851 (M14 x 1.5 male–$^{7}/_{16}$" JIC male)	
Adaptor–Steering Flow Test	4FT.852 ($^{3}/_{4}$"–18UNS female–$^{3}/_{4}$" JIC male)	
Adaptor–Steering Pressure Test	4FT.853 ($^{11}/_{16}$"–16UN to $^{7}/_{16}$" JIC male)	
Adaptor* –Trailer Brake Pressure Test	4FT.854 (M18–1.5 male to $^{7}/_{16}$" JIC male)	
Charge Pump Drive Gear Extractor	4FT.856	
By–pass and Dump Valve Extractor	4FT.857	
Flowmeter	MS. 820A or suitable equivalent	FNH 02755
Flowmeter Hoses	Procure locally to suit flowmeter used	
Adaptor–Hose to Flowmeter	Procure locally to suit flowmeter used	
Test Hose–Pressure Testing	Part No E1NN F493 AA (finis code 3936707)	
Test Hose–Pressure Testing	Part No E0NN 2N353 AB (finis code 3926717)	
Hose Clamp	Procure or manufacture locally	
Remote Control Valve Connectors	Procure through Ford New Holland to suit hoses	

*Or suitable M18x1.5 male adaptor to suit test hose on pressure gauge if E1NN F493 AA not used

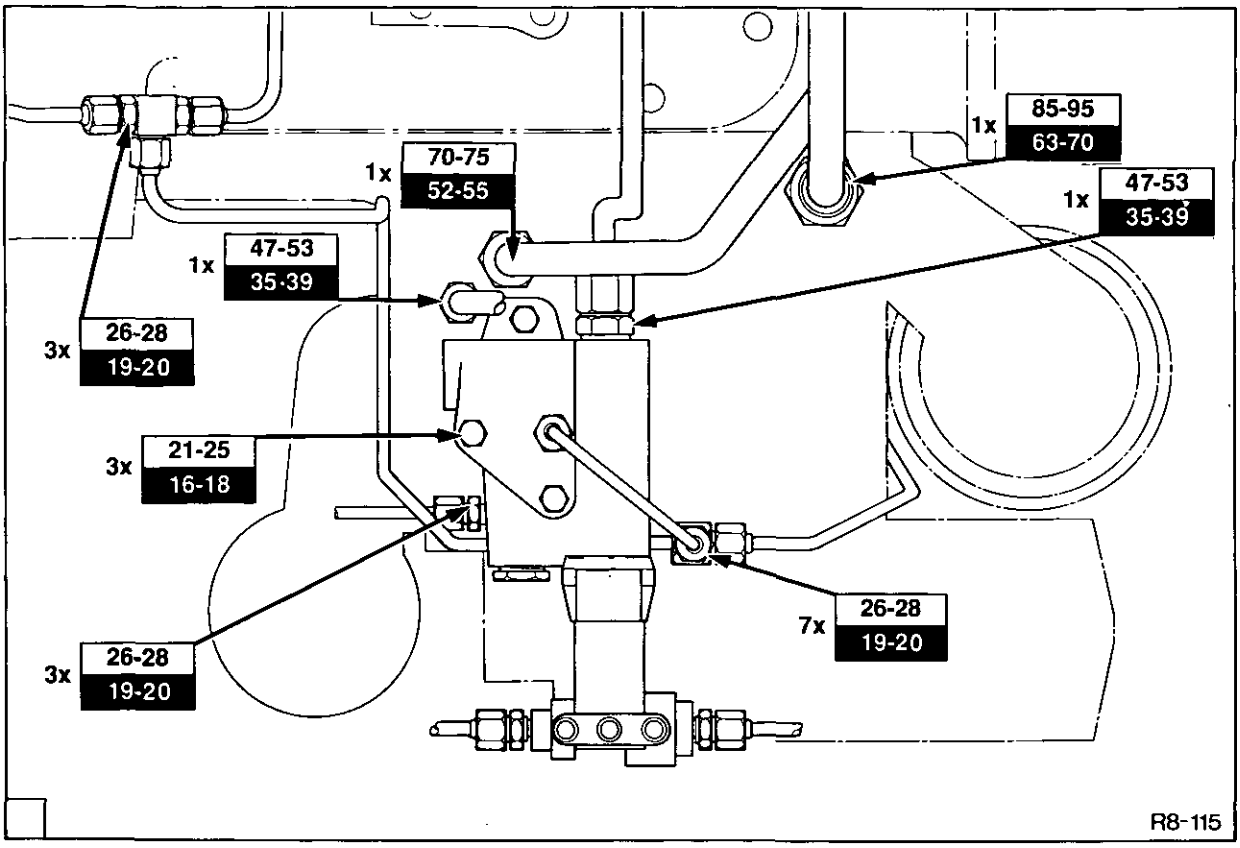
TORQUES

□ = Nm
■ = lbf ft





Hydraulic Connections



Plan View of Variable Displacement Hydraulic Pump Tube Connections

PART 8
HYDRAULIC SYSTEMS
Chapter 3
HYDRAULIC LIFT ASSEMBLY WITH ELECTROLINK™ FOR TRACTORS WITH VARIABLE DISPLACEMENT CLOSED CENTRE LOAD SENSING HYDRAULIC PUMP

NOTE: *From September 1993 the 16x16 Quad Mod transmission was introduced into production together with a new micro processor and revised electronic draft control error codes. These new error codes are identical to those published for tractors installed with the 12x12 Dual Power transmission and fixed displacement gear type pump as detailed in Part 8, Chapter 9, Section B.*

When servicing tractors installed with the new 16x16 Quad Mod transmission refer to Part 8, Chapter 9, Section B for the appropriate error codes and fault finding procedures applicable to this latest design of tractor.

⚠ **CAUTION:** *Observe the following precautions when arc welding on tractors installed with electronic draft control*

- Where possible, disconnect the part or implement to be arc welded from the tractor.
- Disconnect both battery cables from the battery. Isolate the cable ends to avoid contact with each other and the tractor.
- Position the welder earth (ground) clamp as close to the welding area as possible.
- If welding is to be carried out in close proximity to the electronic draft control micro computer then the micro computer should be removed from the tractor.
- Never allow welding cables to lay on, near or across any electrical wiring or electronic component while welding is in progress.

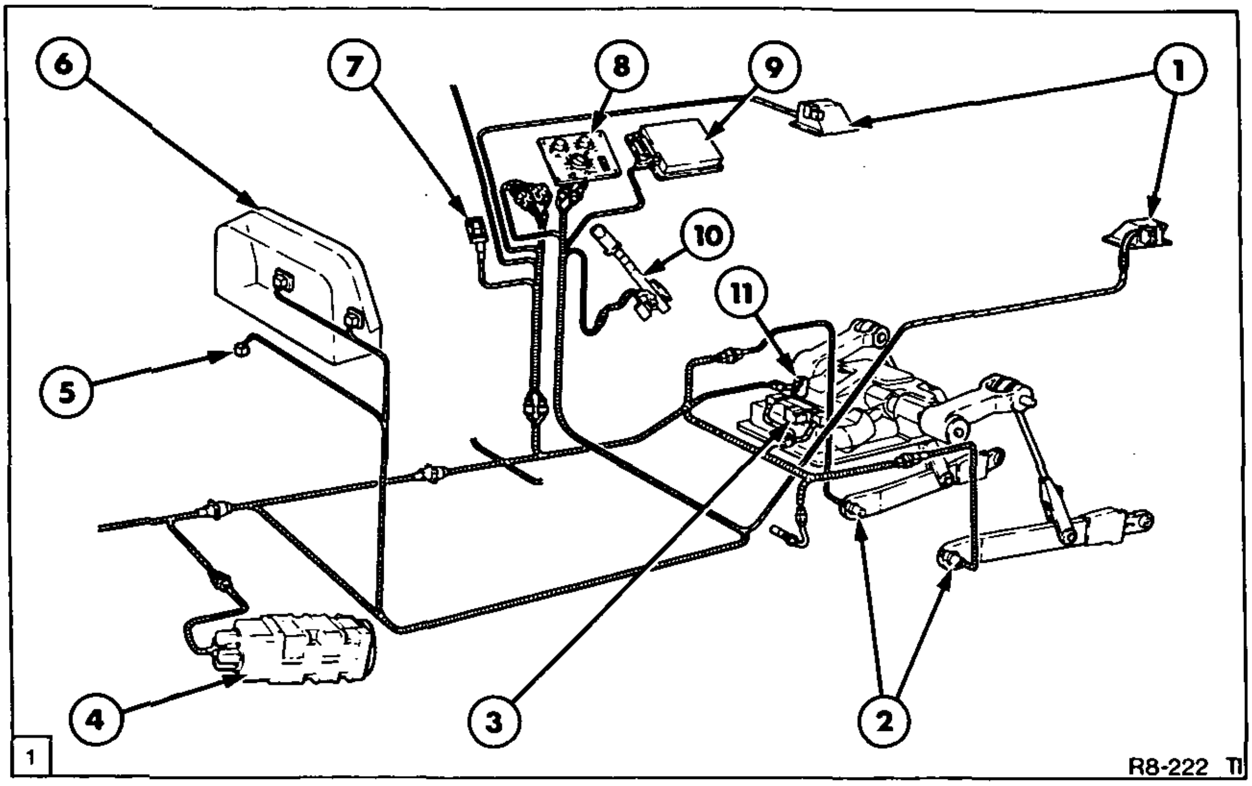
A. HYDRAULIC LIFT ASSEMBLY WITH ELECTROLINK (ELECTRONIC DRAFT CONTROL)–DESCRIPTION AND OPERATION

General

The objective of a tractor draft control system is to provide a means of accurately controlling the soil penetration depth of a fully or semi mounted implement. One method of providing fixed depth control is to take advantage of the fact that draft loading increases with implement depth. If a fixed implement draft is maintained a fixed implement depth will result, providing tractor speed and type of soil being worked remain constant.

In addition to providing draft control, it is also necessary to provide a system where the implement or hydraulic links can be maintained at a position relative to the tractor regardless of draft on the implement. This method of maintaining the implement position is called position control.

On Series 40 tractors control of implement draft can be achieved by either mechanical or electrical means. This Chapter describes the operation of both position and draft control when controlled electronically.



Hydraulic Lift Assembly with Electronic Draft Control

1. External Lift Lower Switch
2. Load Sensing Pins
3. Hydraulic Control Valve
4. Performance Monitor Radar
5. Service Diagnostic Connector
6. Instrument Panel
7. Fast Raise/Lower Switch
8. Hydraulic Control Panel
9. Micro Computer
10. Lift Control Lever
11. Lift Arm Position Sensing Potentiometer

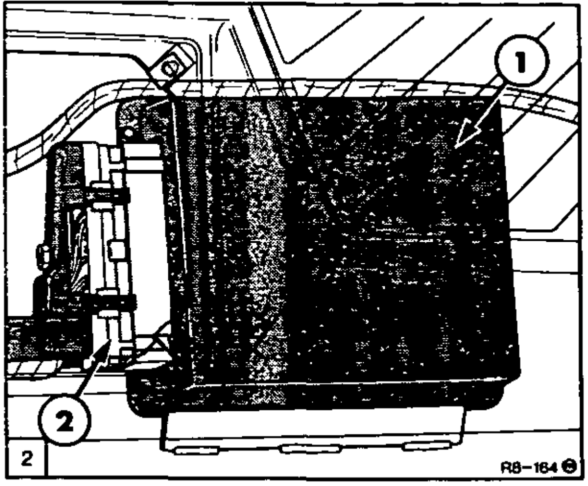
The principle of ElectroLink, hereinafter called electronic draft control, is to sense draft variations through two sensor pins in the lower links and using a micro computer translate these variations to the hydraulic system to raise and lower the links, maintaining a constant draft loading.

The smoothness and accuracy provided during operation gives this system a clear advantage over conventional mechanical systems.

Figure 1, details the principle component parts of the hydraulic lift assembly with electronic draft control.

Micro Computer

The EEC IV micro computer is the management system for the hydraulic lift assembly with electronic draft control and is also used to control the electronic functions of the 16 x 16 Electro Shift transmission.



Micro Computer

1. Micro Computer
2. Multipin Connector

The micro computer, Figure 2, is housed in a protective casing in the control console and connects to the electrical harness via a multi–pin connector. The micro computer contains no serviceable parts and requires direct replacement when faulty.

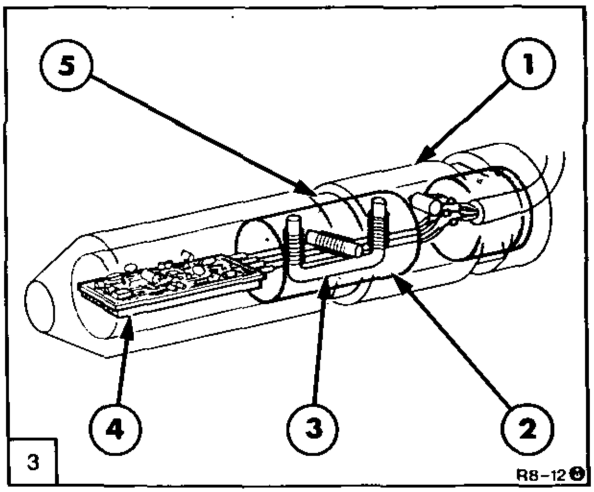
While the electronic draft control and 16 x 16 electro–shift transmission share the same micro computer both, systems operate independently. It is, therefore, possible for a tractor to be installed with a micro computer but not equipped for electronic draft control.

The micro computer receives electronic signals from the operator controls, lift arm position sensing potentiometer and lower link load sensing pins which it then converts to an input signal to the hydraulic lift, solenoid operated control valve.

In addition to controlling the hydraulic system the micro computer has a self diagnostic capability. When the micro computer senses that the system is not functioning correctly an error code is displayed along with the 'Read Your Manual' symbol in a flashing mode on the instrument panel. For a full list of error codes refer to "Section B Fault Finding and Repair" in this Chapter.

Load Sensing Pins

The load sensing pins sense draft variations applied by an implement on the lower links.

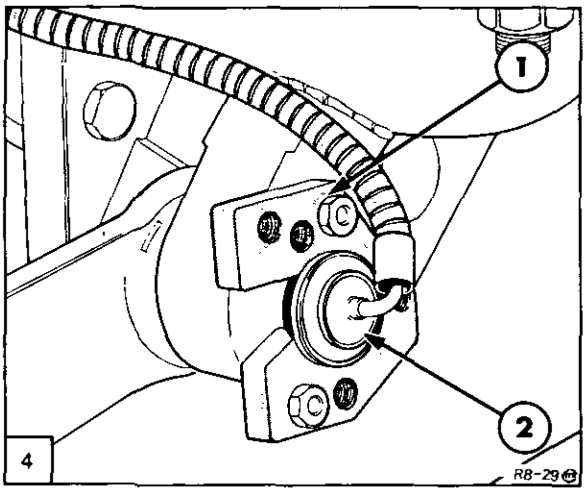


Load Sensing Pin

1. *Metal Tube*
2. Load Sensing Core
3. Wire Coil (3 off)
4. Circuit Board
5. Waisted Section

Each load sensing pin, Figure 3, consists of a hollow metal tube containing a circuit board and load sensing core. Within the core material are three wire coils supported by metal rods. The coils are energised by the 8.5 volt supply and create a stable pattern of magnetic flux within the core.

The outer casing of the pin is made from a metal with unique electromagnetic properties. When the metal is subjected to a shear force, which is centered on the waisted section of the pin, the natural magnetism of the pin casing changes, which distorts the magnetic flux pattern of the core and is *transformed into an electrical output signal.* This signal which is proportional to the draft load acting on the implement is then received by the micro computer.

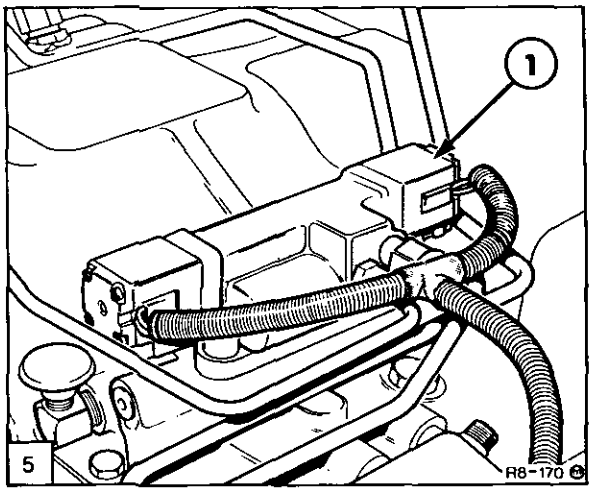


Load Sensing Pin Installation

1. Clamp
2. Load Sensing Pin

To ensure that the load sensing pins only sense draft forces and not forces due to the weight of the implement, they are designed to only react to shear forces in the horizontal plane. It is, therefore, essential that the pin cannot be incorrectly fitted and this is achieved by using a special clamp which ensures correct installation, Figure 4.

Hydraulic Lift Assembly Control Valve



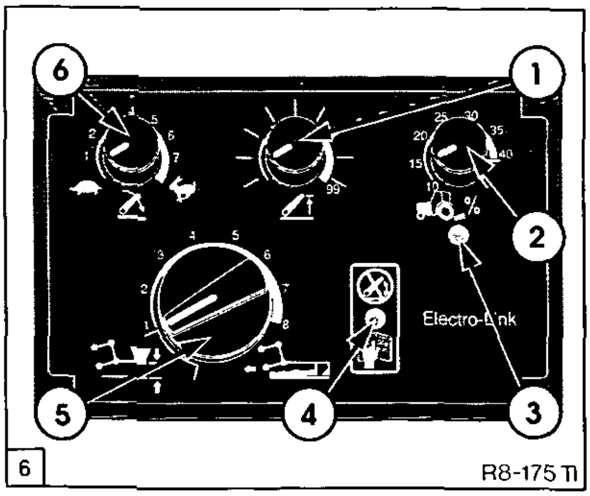
Hydraulic Control Valve Installation

1. EDC Hydraulic Control Valve

The hydraulic lift assembly control valve is a proportional solenoid operated valve located on top of the hydraulic lift assembly, Figure 5. The valve responds to pulse width modulated signals from the micro computer to direct pump pressure oil, to and from the hydraulic lift cylinder, *in direct proportion to* the degree of lift required.

CONTROLS

The electronic draft and position control system is operated from a console to the right of the operator's seat, Figure 6. Each of the variably adjustable controls is directly attached to a potentiometer whose change in resistance, when operated, is sensed by the micro computer and contributes to the input signal which operates the hydraulic control valve.



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Hydraulic Control Panel

1. Height Limit Control
2. Slip Limit Control (option)
3. Slip Limit 'On' Indicator
4. Status Indicator
5. Position/Draft Sensitivity Knob
6. Drop Rate Control Knob

The function of each of the controls is as follows:–

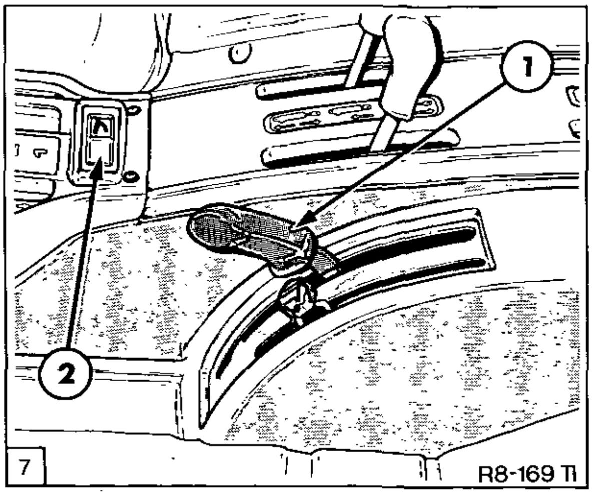
The position/draft sensitivity knob selects full position control, maximum draft control or a mixture of the two allowing selectable sensitivity in draft control according to operating needs.

The drop rate control is provided to limit the rate of drop of the hitch and functions whenever the implement is raised out of the ground.

The height limit control restricts the maximum height the lift arms can be raised, to prevent large implements from striking the rear of the cab or platform. This control restricts the lift height when either the lift control lever or external lift/lower switches are used.

The slip limit control (where fitted) limits the amount of wheel slip. The indicator light is illuminated when the lift arms are responding to an excessive slip condition.

The status indicator is flashed when a malfunction identified by the micro computer occurs in the system. The status indicator is continuously illuminated when the hitch is disabled.



7 R8-169 TI

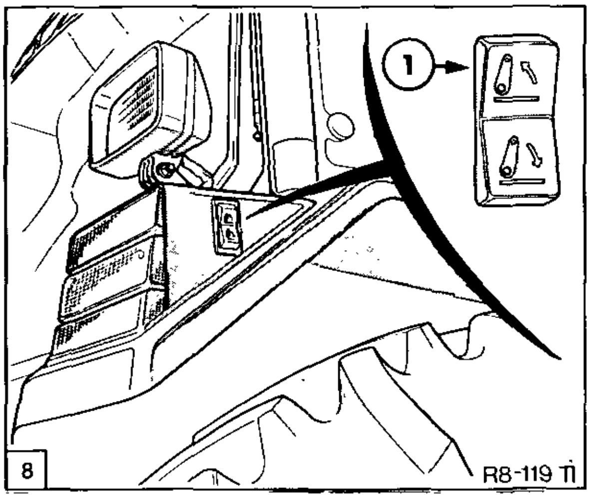
Hydraulic Lift Controls

1. Lift Control Lever
2. In Cab Fast Raise/Lower Switch

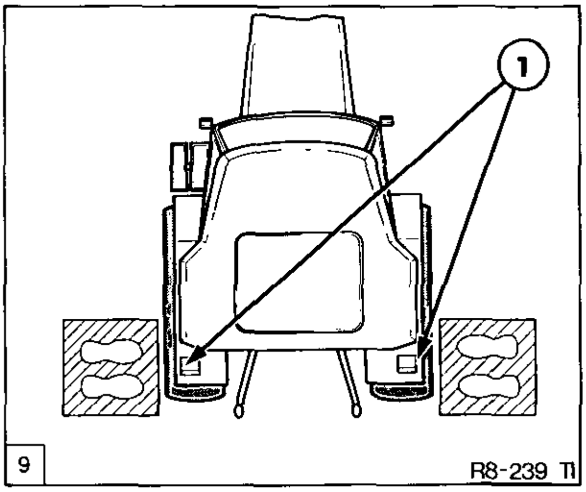
As with mechanical draft control hydraulic systems, the raising and lowering of the lift arms is controlled by a lever in the control console to the right hand side of the operator's seat, Figure 7. The lift control lever is of a low effort type having only an electronic coupling to the hydraulic system in the form of a potentiometer.

A rocker switch, Figure 7, is also provided permitting the operator to rapidly raise and lower the implement to the limits set using the height limit control and lift control lever, without moving the position of the lever. Pressing the top of the switch raises the implement while pressing the bottom lowers it. When the switch is in the raised position, the maximum height of the hydraulic lift links is controlled by the height limit control. When the switch is in the lower position, raising and lowering of the links is controlled by the lift control lever.

NOTE: *The raise/lower switch will not lower the implement if the tractor speed is greater than 15 MPH (24 km/h).*



Rear Fender External Lift/Lower Switch
1. Three Position Fender Switch



Fender Switch Operating Positions
1. Fender Switch Location

Pushing the lever fully forward to the lowered position and beyond the mechanical detent in the quadrant activates two external switches on the rear fenders, Figure 8.

These switches allow the hydraulic linkage to be raised and lowered by the operator while standing beside the tractor, so aiding attachment and detachment of implements.

For safety reasons, this feature only works when the lift control lever is pushed fully forward and beyond the mechanical stop in the quadrant.

To exit the external lift control switch mode the lift control lever must be moved from the external enable region and the hitch captured by the lift control lever.

When raising or lowering an implement using the external switches the speed of lift/lowering is non adjustable and automatically controlled by the micro computer, to compensate for variations in implement weight, battery voltage and hydraulic pressure.

When using the external switches to operate the hydraulic lift the following precautions must be observed.

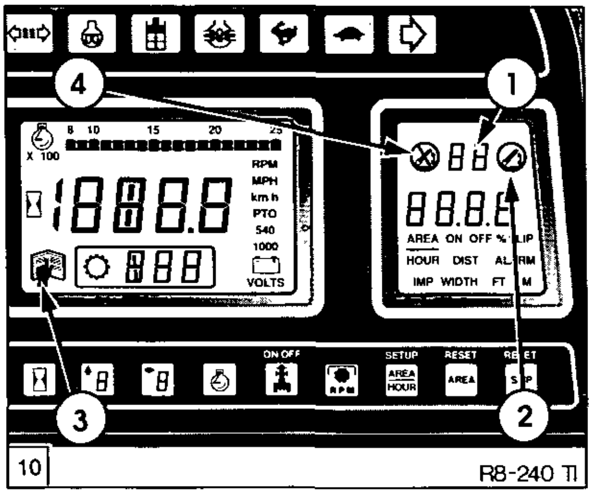
Never operate the external switches while standing:

- *Directly behind the tractor or tyres*
- *Between the lower links*
- *On or near the implement*

Never extend arms, legs, any other part of the body or any object into the area near the 3–point linkage or implement while operating the external switch.

Never have an assistant working the opposite set of controls. When moving to the opposite set of controls, move around the tractor or implement. Do ***not*** *cross between the implement and tractor.*

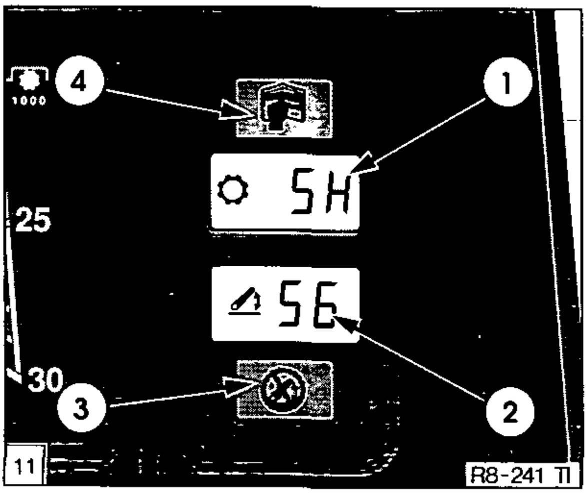
In addition to the operator controls a series of liquid crystal displays (LCD's) or warning lights indicating the operating condition of the electronic draft control system are provided within the instrument panel.



Electronic Instrument Panel

1. Implement Position/Diagnostic Repair Code (LCD)
2. Hitch Enabled Symbol (LCD)
3. 'Read Your Manual' Symbol (LCD)
4. Hitch Disabled Symbol (LCD)

Figure 10, illustrates the LCD displays incorporated in the fully electronic instrument panel.



Analogue Electronic Instrument Panel

1. Malfunction Warning Light
2. Implement Position/Diagnostic Repair Code (LCD)
3. Hitch Disabled Warning Light
4. 'Read Your Manual' Light

Figure 11, illustrates the LCD/warning light displays incorporated in the analogue electronic instrument panel.

The function of these displays are as follows:–

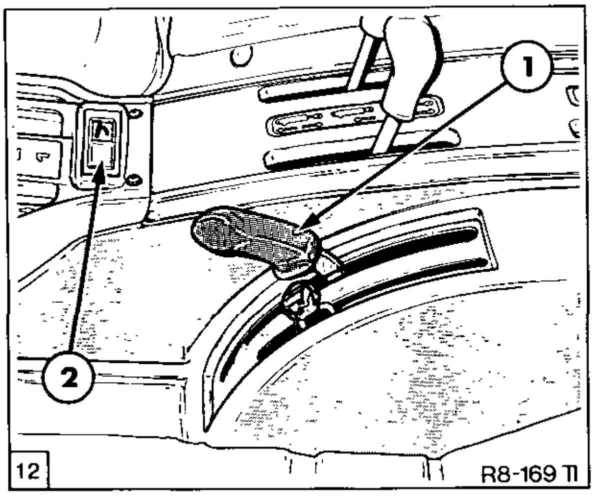
Implement Position/Diagnostic Repair Code

The digital display on the instrument panel indicates the position of the lower links over a scale of '0' to '99'. A display of '0' indicates that the links are fully lowered and a display of '99' indicates they are fully raised. On tractors with electronic instrument panel the hitch enabled symbol will be illuminated when the hitch is in phase with the lift control lever.

A secondary function of this digital display is that in the event of a fault occurring in the electrical or hydraulic system circuits, a two–digit diagnostic repair code will be displayed in a flashing mode. For details of the repair codes refer to Section B of this Chapter–Electronic Draft Control Fault Finding and Repair.

The 'hitch disabled' warning light/LCD symbol signifies that the lift control lever position does not correspond to the position of the lower links and that unintentional movement of the lower links cannot occur. The 'hitch disabled' warning will display if:–

- The lift control lever has been inadvertently moved with the engine stopped.
- The lift control lever has been pushed fully forward in order to transfer control of the hydraulic power lift to the external switches.

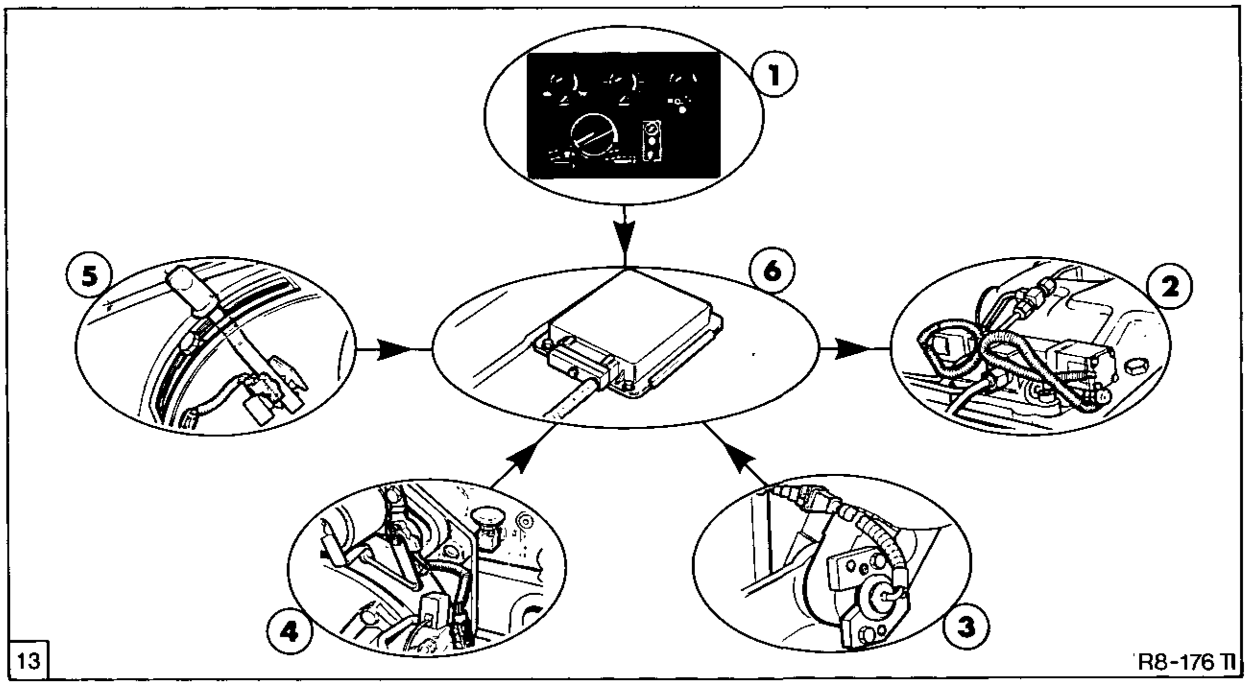


Hydraulic Lift Controls

1. Lift Control Lever
2. In Cab Fast Raise/Lowers Switch

NOTE: *To put the lift control lever back into phase with the lower links position, put the raise /lower' switch, Figure 12, in the lower position, pull the lever fully rearwards and push forward again, more slowly, to allow the lift linkage to lower.*

Re–aligning the position of the lift control lever to the lift arms is termed 'capturing' the lift.



Position/Draft Control Schematic

1. Position/Draft Sensitivity Mix Control on Operator Control Panel
2. Solenoid Operated Hydraulic Control Valve
3. Implement Draft Feedback Signal from Load Sensing Pins
4. Hydraulic Lift Arm Position Feedback Signal from Lift Arm Position Sensing Potentiometer
5. Lift Control Lever
6. Micro Computer (Computes Input Signal to Solenoid Operated Hydraulic Control Valve)

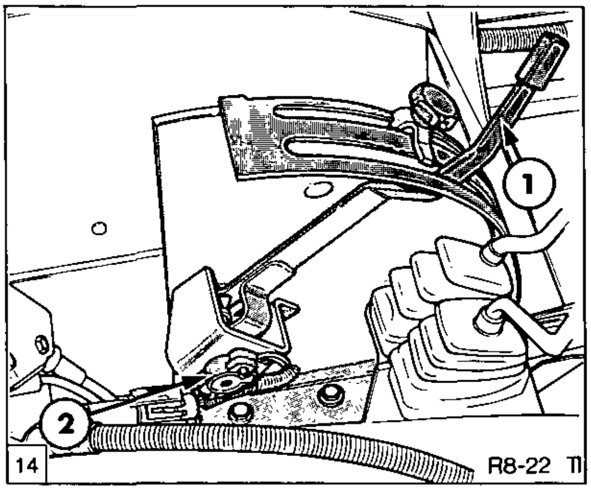
OPERATION

Figure 13, illustrates in a block schematic form the flow of electronic signals to and from the hydraulic system, to raise and lower the hydraulic lift in accordance with operator position and draft control requirements.

The electronic draft and position control system is operated from a console to the right of the operator's seat.

Electronic signals to the micro computer for raising and lowering the hydraulic lift assembly in accordance with position and draft control requirements, are received from four main sources. These are the lift control lever, the lift arm position sensing potentiometer, the two load sensing draft control pins in the lower links and the draft/position sensitivity controls on the hydraulic control panel.

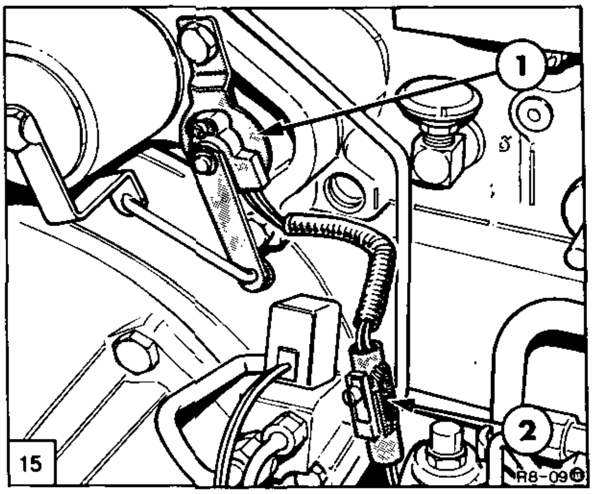
Additional signals from the drop rate and maximum lift height controls and wheel slip control (where fitted) also contribute towards the computation of the input signal.



Lift Control Lever Potentiometer

1. Lift Control Lever
2. Potentiometer

When the lift control lever is operated to raise or lower the lift arms the resistance of the potentiometer at the base of the lift control lever, Figure 14, changes and is sensed by the micro computer. The computer now transmits a signal to the appropriate raise or lower solenoid on the hydraulic lift control valve, which directs oil to raise or lower the hydraulic lift.



Lift Arm Position Sensing Potentiometer
1. Potentiometer
2. Connector

A position feedback signal is received from the lift arm position sensing potentiometer, mounted on the right hand lift arm, Figure 15. The control signal from the micro computer to the appropriate raise or lower solenoid on the hydraulic lift assembly control valve is turned 'Off' when the lift arms have moved to the desired position.

In addition to raising and lowering the implement *the lift control lever also* automatically generates a draft command. The further forward the lever is pushed the greater the draft load which is commanded.

During operation of the tractor, assuming that draft control has been selected, draft forces imposed by the implement through the lower links are sensed by the two special load sensing pins. Dependent on these draft loadings electrical signals from each of the pins are also directed to the micro computer. The computer averages the signals from both pins and transmits a revised pulse width modulated signal to the appropriate hydraulic control valve solenoid to raise or lower the hydraulic lift, maintaining the constant draft loading selected by the operator using the lift control lever.

When the position/draft selector knob is set to full position control, No 1 on the scale, full position control is selected and the draft loads on the implement, as sensed by the lift pins, have no effect on the control of the hydraulic lift. At the other extreme, when the position/draft mix knob is set to the maximum draft sensitivity setting, No. 8 on the scale, the draft loads on the implement have maximum effect on the control of the hydraulic lift. Intermediate setting of the position/draft mix varies the draft sensitivity between the maximum and minimum limits.

To increase the degree of control of the lift arms when they are being raised to the top of their travel and prevent the hitch from driving hard against the mechanical stops, the micro computer automatically and gradually *adjusts the draft control sensitivity from that* set by the operator to maximum position control. Because the implement would be raised out of the ground at this point of lift the automatic change from draft to position control has no effect on the use of the implement.

When the hydraulic lift is being lowered the computer also takes into consideration the setting of the drop rate sensitivity knob and adjusts the value of the signal to the control valve lower solenoid accordingly to maintain the desired rate of lowering. When the implement is in the ground, the drop rate control is disabled. Thus the implement may be lowered to the ground in accordance with the drop rate setting and yet still respond properly to draft variations once the ground has been contacted.

When the lift control lever is moved to the *maximum raise position the setting of the* height limit control governs the maximum height to which the hydraulic lift arms can be raised.

When a tractor is operated in draft control and under poor traction conditions the situation can arise where as the tyres slip, the ground speed and draft forces on the load sensing pins also reduce. The reduction in draft forces signals the micro computer to increase the implement to a depth which can ultimately stop the tractor from moving.

On tractors equipped with the 'limited slip' option this condition is overcome by the micro computer comparing tractor ground speed and axle speed to calculate wheel slip. When wheel slip exceeds the pre–set limit set by the operator using the slip limit control, the micro computer raises the lift arms irrespective of draft loading until the wheel slip decreases. *As long as slip is less than the limit set by the* operator the lift will operate in the normal Electronic Draft Control manner.

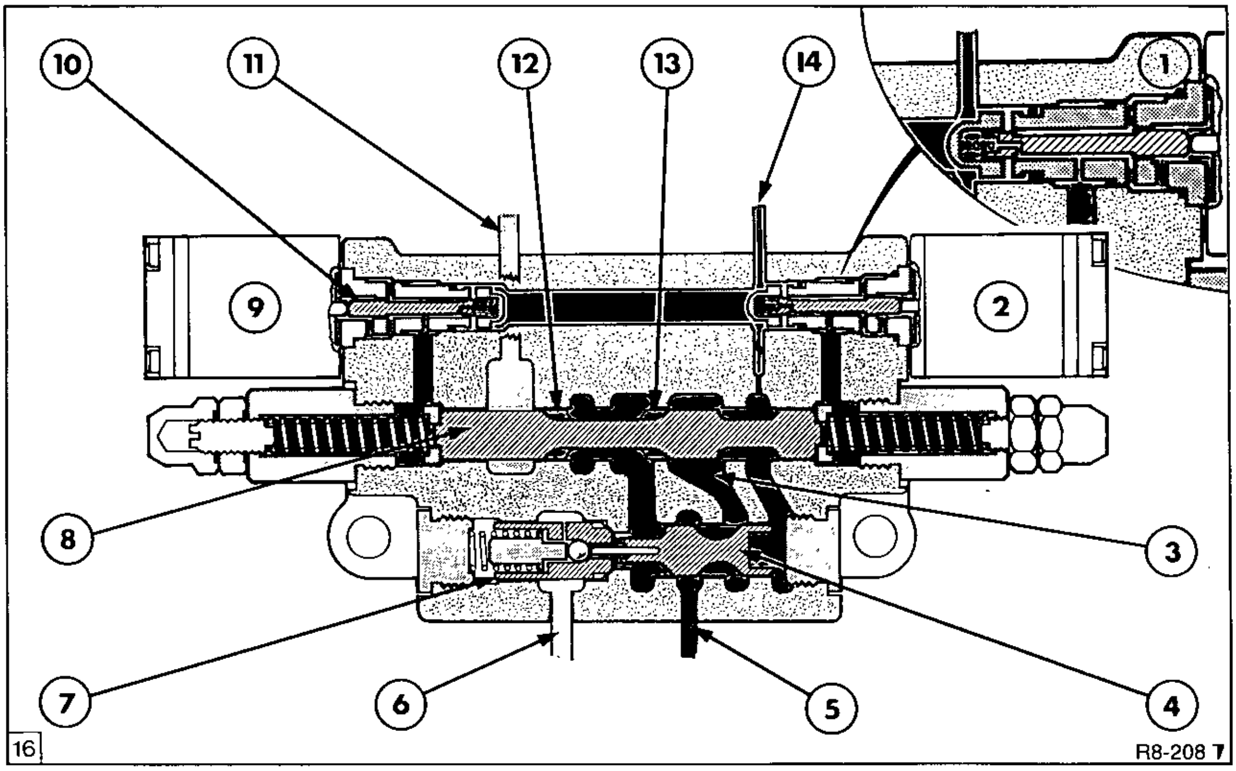
In the event of failure of either the lift control lever, lift arm position sensing potentiometer or height limit control potentiometer, the hydraulic lift can still be operated by the external switches on the rear fenders.

Operation Of Hydraulic Lift Assembly Control Valve

The following description on the operation of the hydraulic lift control valve refers to controlling the lift using the lift control lever. The same principal of valve operation, however also applies when the hydraulic lift is responding to neutral, raise or lower signals from the external fender switches or load sensing pins in the hydraulic lower links.

The solenoids on either end of the hydraulic control valve, respond to the pulse width modulated signals from the micro computer and direct oil from the hydraulic pump to and from the hydraulic lift cylinder in direct proportion to the rate of lift required.

The solenoid on the left hand end of the valve causes the lift arms to raise and similarly the solenoid on the right hand end causes the arms to lower. Because the solenoids are actuated with a variable voltage drive a controlled flow of oil to the lift cylinder is provided.



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Electronic Draft Control Hydraulic Lift Control Valve Operation–Neutral

1. Pilot Spool
2. Solenoid (Raise)
3. Return to Reservoir Port
4. Load Sensing Valve
5. Load Sensing Line To Variable Displacement Pump
6. To Hydraulic Lift
7. Load Check Valve
8. Main Spool
9. Solenoid (Lower)
10. Pilot Spool
11. Pump system Pressure Inlet
12. Main Spool Inlet Metering Land
13. Main Spool Return To Reservoir Metering Land
14. Pilot Pressure Inlet

▨	Pump System Pressure Oil (Variable)	▩	Pilot Pressure Oil 265 lbf/in² (18 bar)
■	Return to Reservoir Oil	□	Trapped Oil

Neutral

When the hydraulic lift arms are held in a stationary position, the hydraulic lift control valve is in 'Neutral' and the micro computer is not sending raise or lower signals to the control valve solenoids. In the neutral condition the spring force applied to each end of the main spool holds the spool in a central position, preventing oil flow from the pump to the hydraulic lift, Figure 16.

In this situation both the pilot line, which supplies oil from the hydraulic pump at a pilot pressure of 250–280 lbf/in² (17–19 bar), to operate the control valve spool and the load sensing line which senses hydraulic pump demand are open to reservoir. The hydraulic lift load check valve remains seated, trapping oil in the hydraulic lift cylinder to maintain the lift arms in a stationary position.

Refer to the variable displacement pump section of this Repair Manual for the description and operation of the closed centre load sensing system.

Raising

The speed of raise of the hydraulic lift is automatically controlled by the micro computer. The following paragraphs describe the operation of the valve in the raise sequence and is followed by a description of how the valve controls the speed of raise by metering the flow of oil to the hydraulic lift cylinder.

In simple terms, when the lift control lever is moved to raise the hydraulic lift, a signal is sent to the raise solenoid on the control valve. The armature in the solenoid reacts to the signal and the pilot spool is moved to the left, allowing pilot pressure from the hydraulic pump to be applied to the end of the main spool, Figure 17.

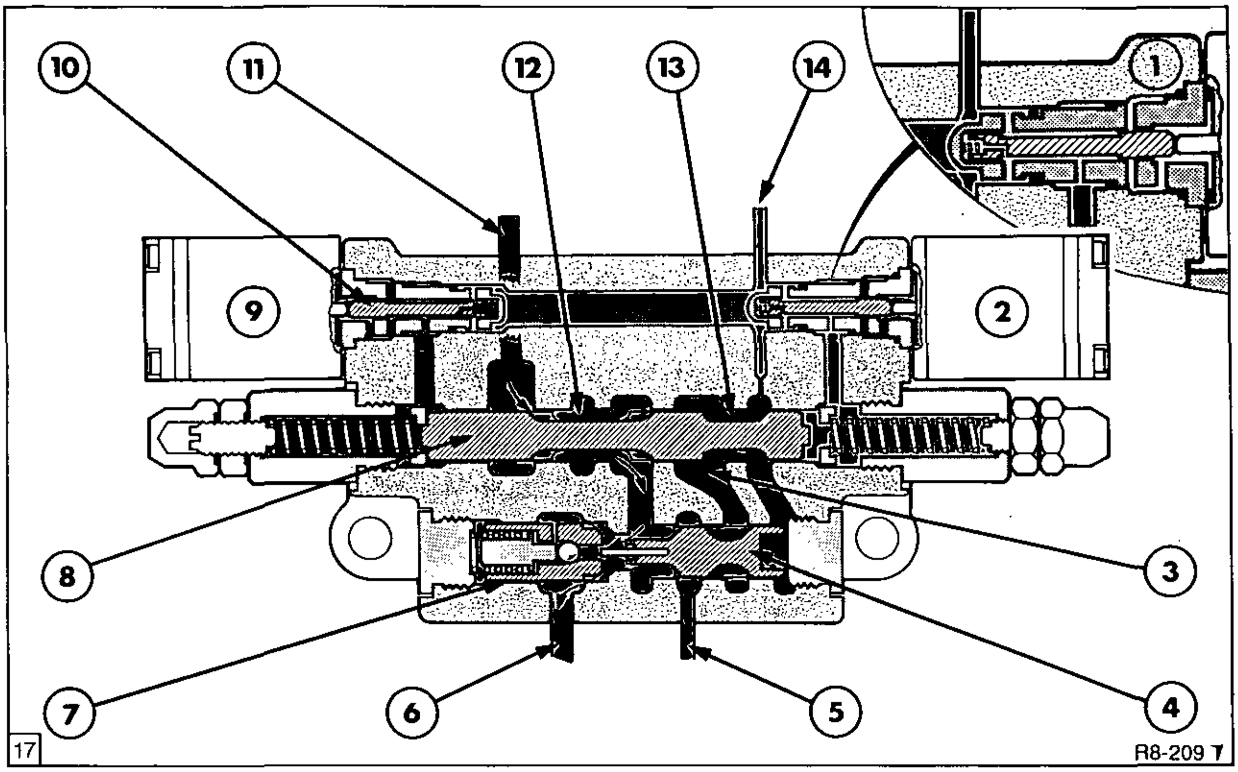
The pilot pressure applied to the end of the main spool moves the spool to the left directing oil from the hydraulic pump, across the inlet metering land to the load check and load sensing valves. As pressure in the gallery feeding these valves increases the load sensing valve moves to the right, closing the load sensing line return to reservoir port and allowing the pressure of the metered oil flow to be sensed in the load sensing line. The pressure in the load sensing line is now applied to the flow compensating valve in the variable displacement pump which signals the pump to increase output. Refer to "Chapter 1 Variable Displacement Hydraulic Pump Assembly with Closed Centre Load Sensing" for a description and operation of the pump installed on tractors fitted with Electronic Draft Control.

The resulting rise in pressure of the metered oil due to the increase in pump output, opens the load check valve, permitting the metered system pressure oil to flow into the lift cylinder and raise the arms of the hydraulic lift assembly.

When the lift arms have moved to the desired position, the lift arm position sensing potentiometer on the right hand lift arm, signals the micro computer to switch off the signal to the raise solenoid. The pilot spool now moves to the right, preventing pilot pressure from being applied to the end of the main spool. The main spool moves back to the 'neutral' position, Figure 16, preventing pump pressure oil from being applied to the load check valve.

Because the main spool has now returned to the neutral position, the load check valve closes and the load sensing valve, under pressure of oil returning to reservoir, moves to the right, opening to reservoir the load sensing line from the hydraulic pump.

The load check valve has now trapped the oil in the lift cylinder, holding the lift arms in the desired position, while the pressure in the load sensing line can 'bleed' off to reservoir, signalling the variable displacement pump to reduce output.



17

Electronic Draft Control Hydraulic Lift Control Valve Operation–Modulated Raise

1. Pilot Spool
2. Solenoid (Raise)
3. Return to Reservoir Port
4. Load Sensing Valve
5. Load Sensing Line to Variable Displacement Pump
6. To Hydraulic Lift
7. Load Check Valve
8. Main Spool
9. Solenoid (Lower)
10. Pilot Spool
11. Pump system Pressure Inlet
12. Main Spool Inlet Metering Land
13. Main Spool Return to Reservoir Metering Land
14. Pilot Pressure Inlet

■ Pump System Pressure Oil (Variable)

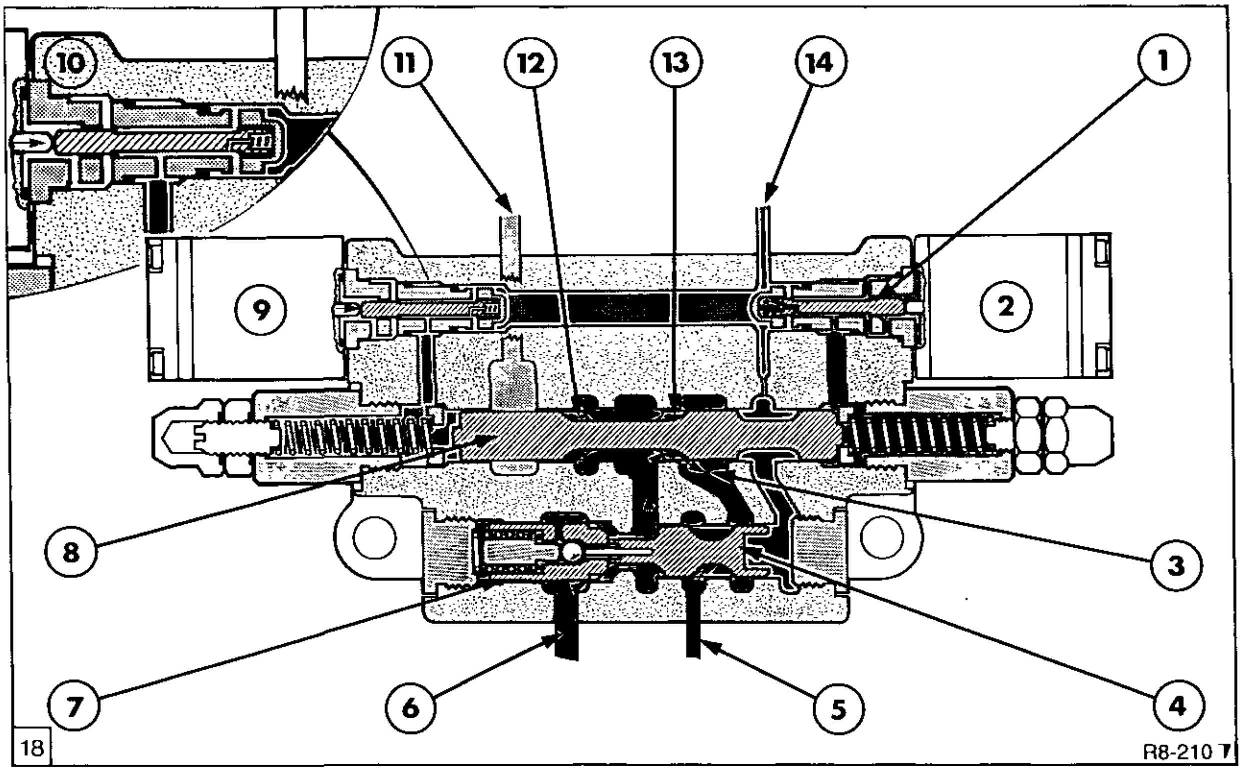
■ Pilot Pressure Oil 265 lbf/in^2 (18 bar)

■ Return to Reservoir Oil

The speed of raise of the hydraulic lift is automatically controlled by the micro computer which modulates the signals to the raise solenoid proportionally to the degree of raise required.

The modulated signal automatically and continually varies the raise solenoid pilot spool movement and consequently the pilot pressure applied to the end of the main spool. Because movement of the main spool is dependent on the pressure applied on its end face, it can be seen that the modulated pilot pressure causes the main spool to oscillate and continually 'meter' the flow of oil from the system pressure inlet port across the main spool inlet metering land, Figure 17.

Due to the restriction and consequential pressure drop caused by the metering land, the metered flow of oil varies the speed of lift in accordance with the size and frequency of the modulated input signals to the raise solenoid.



Electronic Draft Control Hydraulic Lift Control Valve Operation–Lowering

1. Pilot Spool
2. Solenoid (Raise)
3. Return to Reservoir Port
4. Load Sensing Valve
5. Load Sensing Line to Variable Displacement Pump
6. To Hydraulic Lift
7. Load Check Valve
8. Main Spool
9. Solenoid (Lower)
10. Pilot Spool
11. Pump system Pressure Inlet
12. Main Spool Inlet Metering Land
13. Main Spool Return to Reservoir Metering Land
14. Pilot Pressure Inlet

▨ Pump System Pressure Oil (Variable)

■ Pilot Pressure Oil 265 lbf/in^2 (18 bar)

■ Return to Reservoir Oil

Lowering

When the lift control lever is moved to lower the hydraulic lift, a signal is sent to the lower solenoid on the control valve. As the armature in the solenoid reacts to the signal, the pilot spool is to the right allowing pilot pressure from the hydraulic pump to be applied to the left hand end of the main spool, Figure 18. As the main spool moves towards the right, pilot pressure is applied to the right hand face of the load sensing valve, causing the valve to move to the left, unseating the ball in the load check valve.

The oil trapped behind the check valve can now vent to reservoir and the load sensing valve continues to move forward, unseating the load check valve poppet. The pressurised oil in the lift cylinder now returns to reservoir across the return to reservoir metering land on the main spool, allowing the lift arms to lower at a controlled speed.

The speed of lower on the hydraulic system is pre–set by the operator and automatically maintained by the micro computer which modulates the signal to the control valve lower solenoid in accordance with the implement drop rate selected on the operator control panel. The modulated input signal continually varies the lower solenoid pilot spool movement and consequently the pressure applied to the end of the main spool. Because movement of the main spool is dependent on the pilot pressure applied on its end face, the main spool continually oscillates and meters the flow of oil from the lift cylinder, across the return to reservoir metering land of the main spool, giving a controlled rate of lowering.

B. FAULT FINDING AND REPAIR

Fault finding should be carried out in a logical and methodical fashion. A few minutes spent understanding the system and analysing the complaint can save considerable time.

An essential piece of equipment for checking electronic systems is a good quality multi–meter with an input impedance of at least 20,000 ohms which can measure voltage, current and resistance.

IMPORTANT: *Care should be exercised when using the instrument. In particular, resistance measurements MUST NOT be made on electronic modules unless otherwise directed as this could damage their internal circuitry. When measuring the continuity of wiring or sensors/switches, it is necessary to isolate the electronic micro computer.*

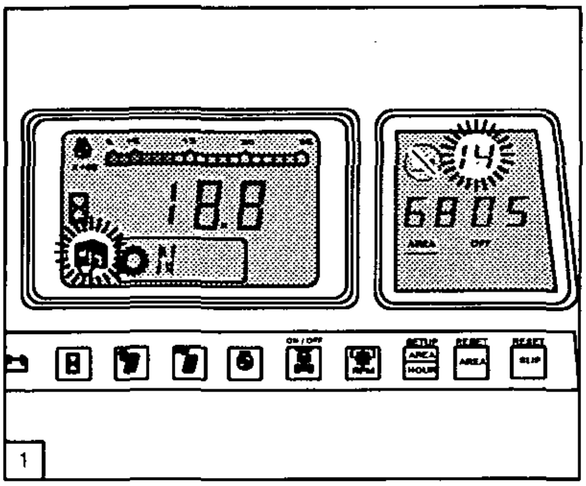
When working with a multi–meter it is good practice to work from a higher range downwards to avoid damaging the instrument.

IMPORTANT: *Where it is found necessary to clean the multi–pin connector in the system a Contact Spray should be used. DO NOT USE ANY OTHER METHOD FOR CLEANING THE TERMINALS.*

Do not use a cleaner that contains Trichloroethylene which will dissolve the plastic part of the connector. It is preferable to use a cleaner with a FREON TF base.

The multi–pin connector used in the system is specially designed and is locked onto the micro computer using a bolt to ensure that positive connections are established. It is, therefore, necessary to ensure that contacts and connectors are clean and free from contaminants.

The electronic draft control system installed on 40 Series tractors has a self diagnostic fault finding capability for electronically detected failure modes. The micro computer constantly monitors all input signals from the Electronic Draft Control system for possible failures. The input signals, which are tested for error conditions, are heavily filtered to improve error detection reliability. Additionally, the output devices are tested each time the tractor is started.



Electronic Draft Control Error Code Display
(Electronic Instrument Panel Shown)

Any failures detected by the micro computer are displayed as a flashing two digit error code on the performance monitor LCD implement position display along with the 'Read Your Manual' symbol Figure 1.

Each failure has a unique numerical error code which has also been allocated a priority rating. Should more than one failure occur simultaneously, the error code with the highest priority is displayed until repaired. The error code numbers allocated to each detected failure, do not reflect the priority order of display

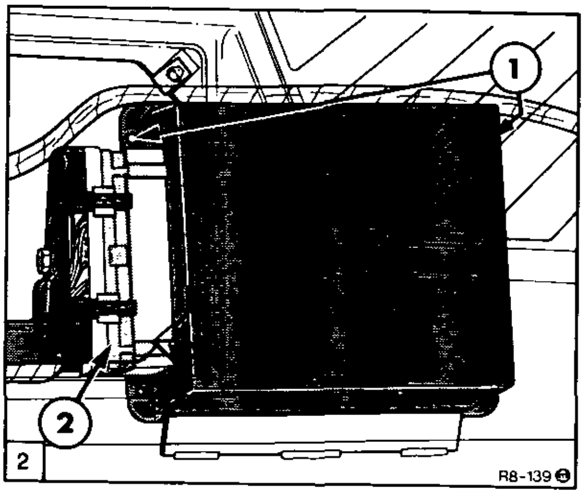
Individual fault finding charts for each error code that the micro computer can detect are included in this section and should be referenced whenever a fault is identified. An index of the error codes displayed is shown on Page 18.

In order to identify the location of each connector referenced in the fault diagnosis procedure, refer to the illustrations at the end of this Chapter.

The operator will often blame the microcomputer for all faults related to the system, although in the majority of instances the problem will have occurred in either the connectors, the potentiometers, or the wiring.

Prior to performing checks for continuity or short circuit, a visual inspection of the wiring to identify any obvious damage is recommended.

NOTE: *Upon completion of each repair it is necessary to turn the key–start switch 'On' and 'Off' to clear the code from the digital display and confirm that the repair was successful.*



Micro Computer Installation

1. Retaining Screws
2. Multipin Connector

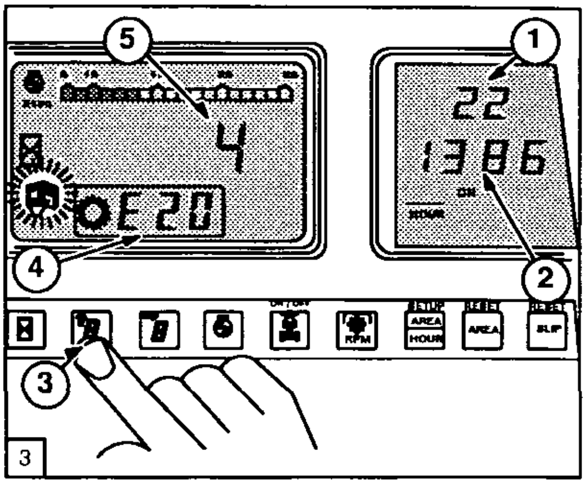
Where the fault finding procedure specifies the replacement of a radar assembly it is recommended that the radar is first of all replaced with a unit from another tractor. This will act as a simple check to verify that the radar is defective and eliminate the need to order expensive parts which may not need replacing.

Where it is required to replace the micro computer it is necessary to remove the retaining screws on the top left and right hand corners of the computer casing, Figure 2. Access to the left hand screws is achieved by removing the EDC control panel, the right hand screw is accessed by loosening the plastic trim under which the micro computer is housed.

In instances where an error code has not been displayed, it is possible that the cause is related to a hydraulic or mechanical failure which the micro computer may not be able to detect. Reference should, therefore, be made to the fault finding chart at the rear of this section for malfunctions not detected by the micro computer. If the cause of concern cannot be identified, refer to the Closed Centre Load Sensing Hydraulic Pump Fault Finding procedure in Chapter 2.

Error Code Recovery

The electronic instrument panel has a feature which stores and recalls the last ten error codes and the operating hours at which they occurred. This feature is useful in establishing a record of the last time that a particular error occurred on the tractor. To enter the Error Code Recovery System proceed as follows:–

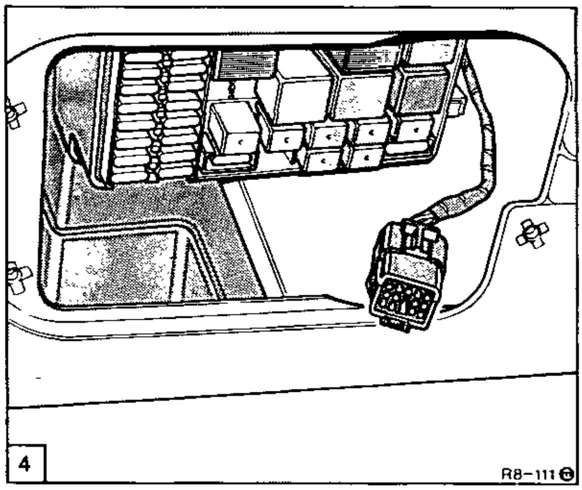


Error Code Recovery

1. Electronic Draft Control (EDC) Error Code
2. Hours of Error Occurrence
3. Digit Set Button
4. 16 x 16 Transmission Error Code
5. Electronic Instrument Cluster (EIC) Error Code

1. Hold down the DIGIT SET button on the electronic instrument panel and turn the key–start switch 'ON', Figure 3. **Do Not** start the engine. The Read Your Manual symbol will flash and the most recent error to have occurred on the tractor will be displayed on the appropriate instrument panel display together with the hours at which the error last occurred.
2. Press the Digit set button and the next most recent error code will occur. This procedure can be repeated until a maximum of the last 10 error codes have been displayed.

SERVICE DIAGNOSTIC MENU SYSTEM



Service Diagnostic Connector

A service diagnostic connector Figure 4 is provided on all tractors installed with the 16 x 16 transmission and electronic draft control system. This connector allows access to a menu system, which is displayed on the instrument panel and provides information to both the service technician and designers.

The procedure for entering this menu mode is described below, however, it should be recognised that certain aspects of the menus displayed are for the use of Design Engineers and are not for use by the Service Technician.

The EDC menus accessed through the connector are as follows:–

HH	Entry into menu mode
H1*	EDC valve calibration Test
H2*	EDC valve calibration
H3*	System configuration values
H4	Software revision display
H5	Switch diagnostic mode
H6*	Right hand load sensing pin signal
H7*	Left hand load sensing pin signal
H8	Non–volatile memory reset
H9*	Analog input data display

*Menu's for factory use only.

H5–Switch Diagnostic Mode

The switch diagnostic mode allows a simple method of checking the continuity of switches on both the electronic draft control hydraulic system and 16 x 16 transmission gear selector switches.

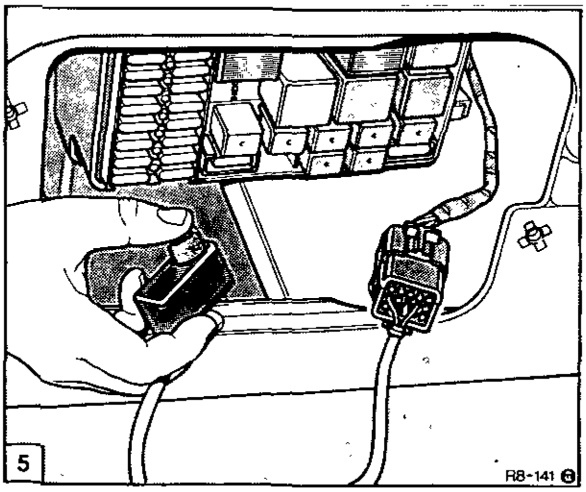
The switches on the EDC hydraulic system which can be checked using this switch are:–

In cab fast raise/lower switch

External lift/lower fender switches

To enter the menu system and switch diagnostic mode 'H5' proceed as follows:–

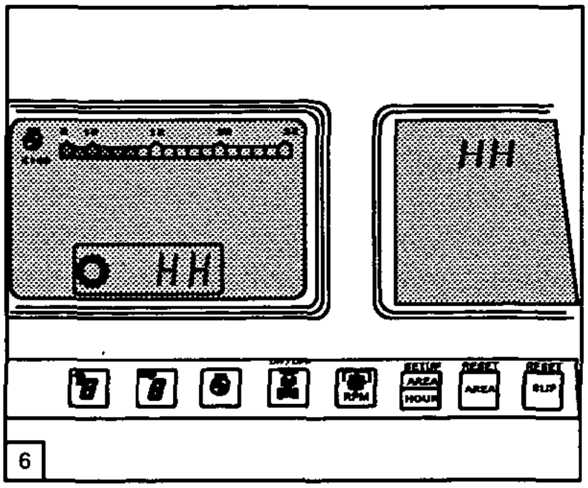
1. Locate service diagnostic connector which is next to the fuse panel.



5

Diagnostic Switch Connected into Diagnostic Connector

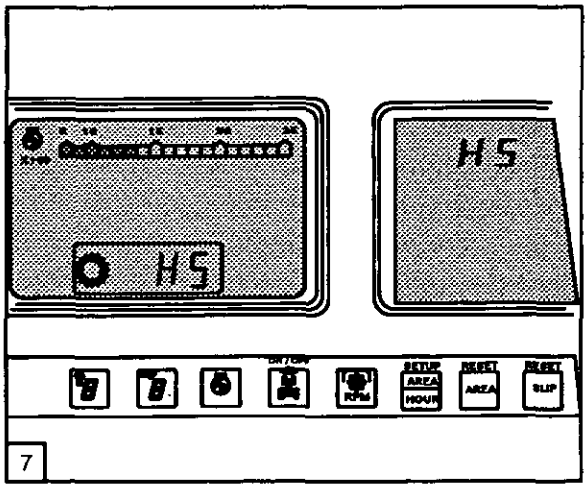
2. *Connect diagnostic switch special tool* 4FT.950 into diagnostic socket, Figure 5.



6

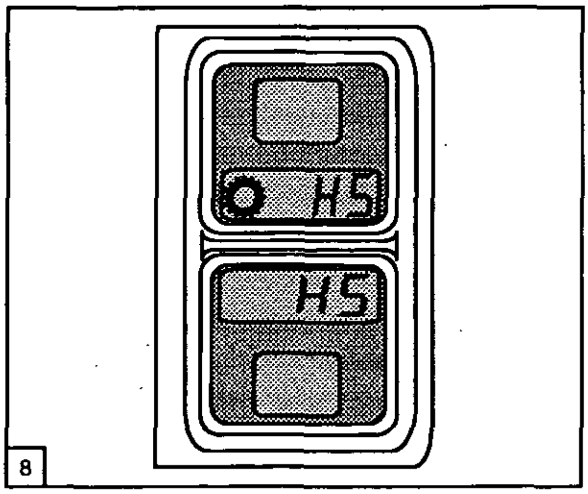
Instrument Panel Display 'HH'
(Electronic Instrument Panel Shown)

3. Turn key–start switch 'On', the display on instrument panel will show 'HH', Figure 6.



7

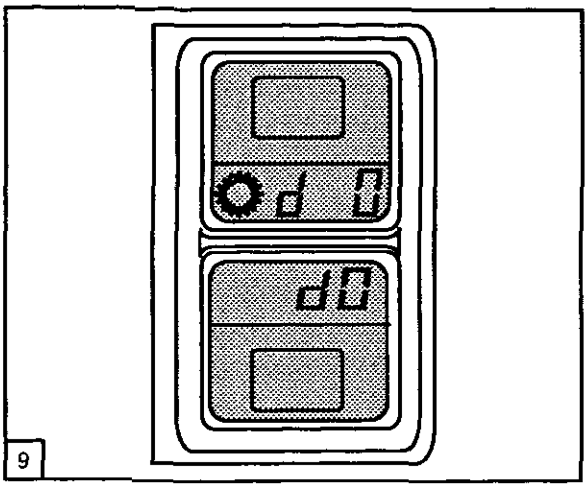
Instrument Panel Display 'H5'
(Electronic Instrument Panel Shown)



8

Instrument Panel Display 'H5'
(Analogue Electronic Instrument Panel Shown)

4. Depress the button on the diagnostic switch 'five times' until the display on the *instrument panel changes to* 'H5', Figure 7 or Figure 8.



9

Instrument Panel Display 'd0'
(Analogue Electronic Instrument Panel Shown)

5. After a maximum period of 4 seconds the display will again change to 'd0', Figure 9. This is the switch diagnostic mode.

6. Depressing either the in cab fast raise/lower switch or external fender switches will cause the numbers on the display to change as follows indicating that the switch being tested is operating correctly.

d1	Fender switch operating correctly in lower position.
d2	Fender switch operating correctly in raise position.
d3	In cab fast raise/lower switch operating correctly from raise to lower.
d4	In cab fast raise/lower switch operating correctly from lower to raise.

The switch diagnostic mode also enables the diagnosis of the switches related to the shift control levers on the 16 x 16 transmission. For details on the checking of these switches refer to the 16 x 16 Transmission Part of this Repair Manual.

7. Turn key–start switch 'Off'.

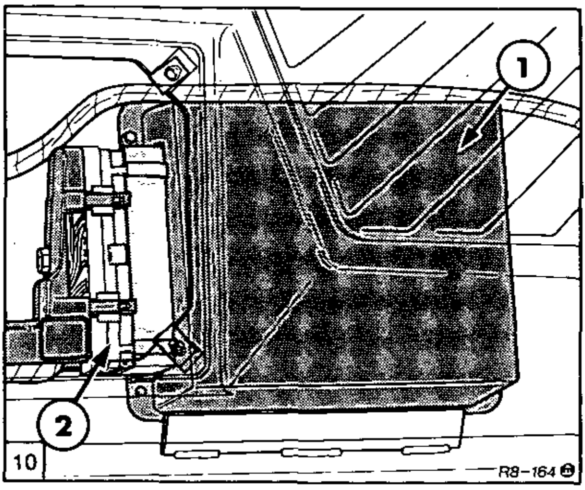
8. Disconnect diagnostic switch and replace connector cover.

H8–EEC IV Microcomputer Memory Reset Procedure

Whenever the fault finding procedure specifies that it is necessary to replace or reset the microcomputer, the following 'Memory reset' procedure must be followed.

If the 'Memory Reset' procedure is not performed the operator may experience that the hydraulic lift arms will not raise or lower to the maximum limits of travel, or engage the mechanical stop at the top of its travel, before the lift control lever has been moved to the fully raised position.

To reset the memory proceed as follows:–



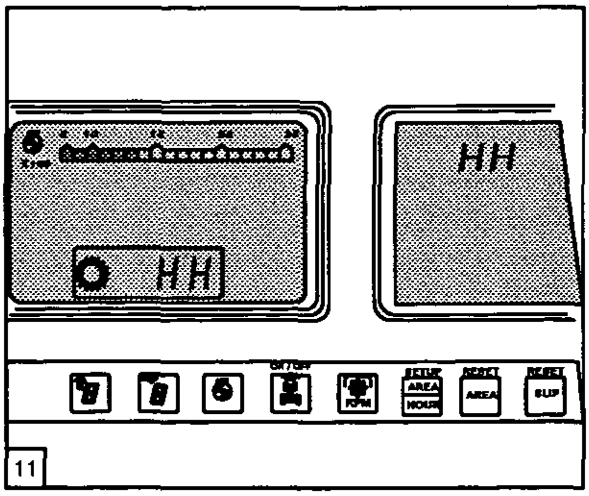
10

Micro Computer Connector E3

1. Micro computer
2. Multipin Connector E3

1. Ensure micro computer connector E3 is connected, Figure 10.

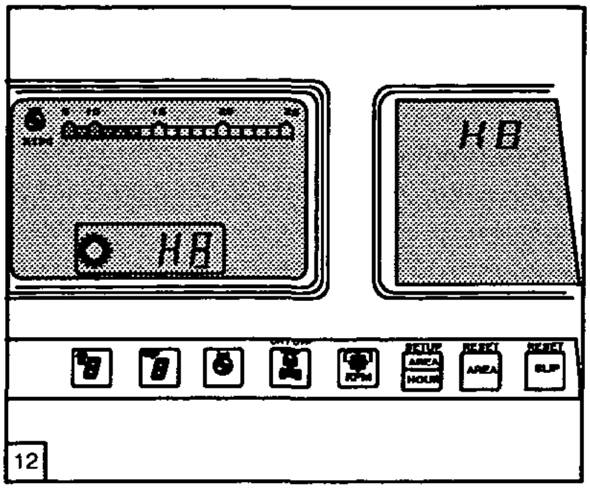
2. Locate service diagnostic connector which is next to the fuse panel and connect diagnostic switch Special Tool 4FT.950. Refer to Figure 5.



11

Instrument Panel Display 'HH'

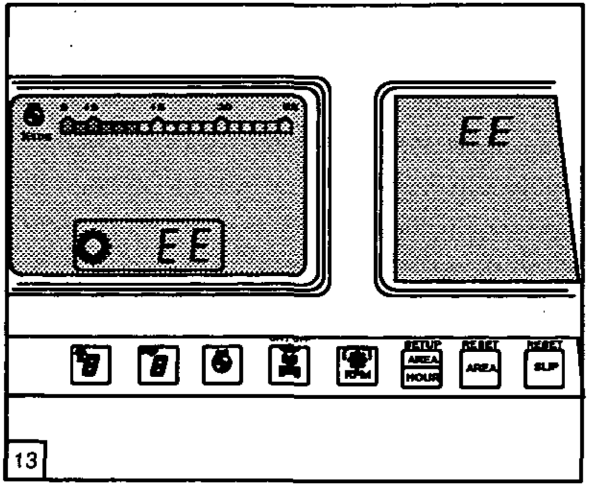
3. Turn key–start switch 'On', the display on instrument panel will show 'HH', Figure 11.



12

Instrument Panel Display 'H8'

4. Depress the button on the diagnostic switch tool eight times until the display on the instrument panel changes to 'H8', Figure 12.



13

Instrument Panel Display 'EE'

5. Wait for approximately 4 seconds for the micro computer to select the memory erase routine. The instrument panel display will change from 'H8' to 'EE', Figure 13 and then return back to 'HH'.

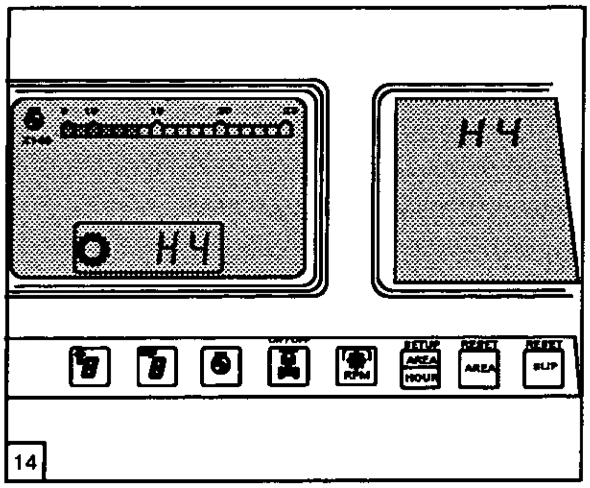
6. Turn key–start switch 'Off'.

7. Disconnect diagnostic switch and replace connector cover.

8. Start tractor and perform autocalibration procedure as detailed in Error Code 24.

H4–Software Revision Display

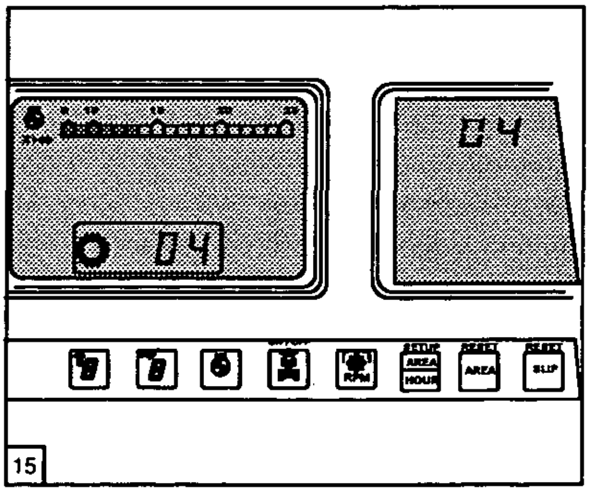
The software revision display menu H4 displays the level of software installed on the tractor. This information will not normally be required by the Service Technician but can if required be obtained as follows:



14

Instrument Panel Display 'H4'

1. Install the diagnostic switch, turn the keystart switch 'On' and depress the switch four times, until the display panel changes from 'HH' to 'H4', Figure 14.



15

EEC IV Software Revision Number
(Revision No. 4 Illustrated)

2. After 4 seconds the display will momentarily change to display the software revision number, Figure 14 and then revert bak to the 'HH' menu mode.

3. Turn key–start switch 'Off', disconnect diagnostic switch and replace cover.

ELECTRONIC DRAFT CONTROL ERROR CODES

The following error codes can be displayed on the tractor performance monitor digital display screen, to identify errors that have occurred on the electronic draft control hydraulic system. Should an error occur, reference should be made to the appropriate page of the fault finding procedure. Where the procedure specifies a wiring check, the letters shown in parenthesis on the fault finding charts indicate the colour of the wire attached to the pin.

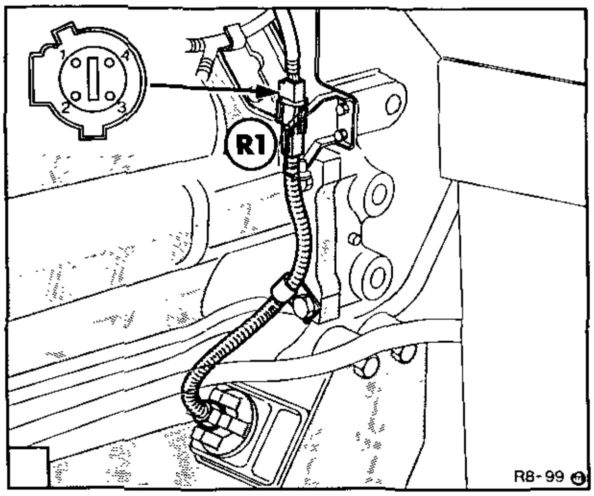
To identify the location of the connectors in the fault diagnostic procedure an overall illustration of the harness layout and connectors applicable to the electronic draft control system is provided on Page 52 of this Section.

A complete wiring diagram of the electronic draft control circuit is also provide on Page 54 and should be referenced when tracing short or open circuits in the system.

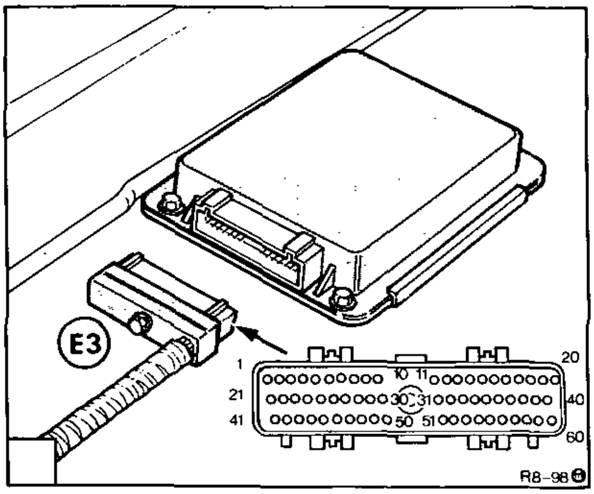
Error Code	Error Description	Page
Code 2	Poor or No Signal From Tractor Performance Monitor Radar	20
Codes 3, 4 and 5	Speed Sensor Errors	21
Codes 6 and 7	Slip Control Potentiometer or Circuit Failed	22
Code 8	Raise/Work Switch Failure	23
Code 8	Raise/Work Switch Failure	24
Code 9	Both External Lift/Lower Fender Switches are being Operated Simultaneously	25
Code 9	Both External Lift/Lower Fender Switches are being Operated Simultaneously	26
Codes 10 and 11	Height Limit Control Potentiometer Failed	27
Codes 12 and 13	Drop Rate Potentiometer Failed	28
Codes 14 and 15	Right Hand Load Sensing Pin or Circuit Failed	29
Codes 16 and 17	Left Hand Load Sensing Pin or Circuit Failed	30
Code 18	Both Load Sensing Pins Disconnected	31
Codes 19 and 20	Incorrect Load Sensing Pin Supply Voltage	32
Codes 21 and 22	Position/Draft Sensitivity Control Potentiometer or Circuit Failed	33
Code 23	Control Panel Disconnected	34
Code 24	Perform Hydraulic Lift Autocalibration	35
Codes 25 and 26	Lift Control Lever Potentiometer Disconnected or Circuit Failed	38
Codes 27 and 28	Lift Arm Position Sensing Potentiometer Disconnected or Circuit Failed	39
Code 29	Hydraulic Control Valve Shorted or Open Circuit	40
Code 30	Signal Ground Failure to Operator Control Console	41

Error Code 2 Poor or No Signal From Tractor Performance Monitor Radar

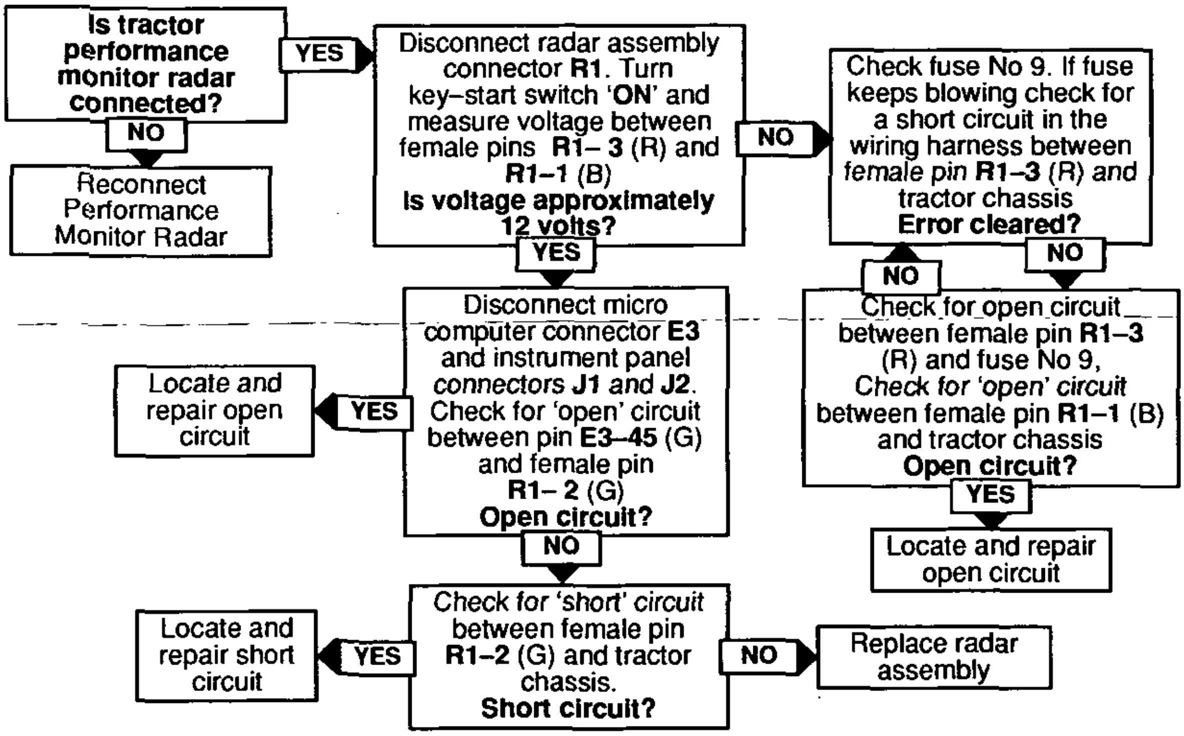
For EDC wiring diagram and connector location refer to end of this Section



Performance Monitor Radar



Micro Computer Connector



Is tractor performance monitor radar connected?

YES → Disconnect radar assembly connector **R1**. Turn key–start switch '**ON**' and measure voltage between female pins **R1– 3** (R) and **R1–1** (B) **Is voltage approximately 12 volts?**

NO → Reconnect Performance Monitor Radar

12 volts? NO → Check fuse No 9. If fuse keeps blowing check for a short circuit in the wiring harness between female pin **R1–3** (R) and tractor chassis **Error cleared?**

Error cleared? NO → Check for open circuit between female pin **R1–3** (R) and fuse No 9, *Check for 'open' circuit* between female pin **R1–1** (B) and tractor chassis **Open circuit?**

Open circuit? NO → (back to) Check fuse No 9

Open circuit? YES → Locate and repair open circuit

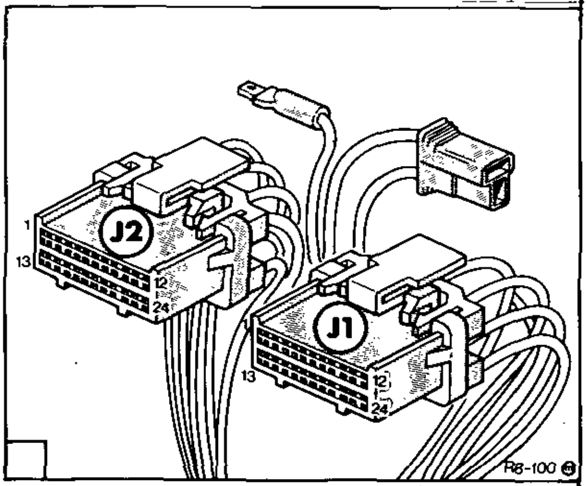
12 volts? YES → Disconnect micro computer connector **E3** and instrument panel *connectors* **J1** *and* **J2**. Check for 'open' circuit between pin **E3–45** (G) and female pin **R1– 2** (G) **Open circuit?**

Open circuit? YES → Locate and repair open circuit

Open circuit? NO → *Check for 'short' circuit* between female pin **R1–2** (G) and tractor chassis. **Short circuit?**

Short circuit? YES → Locate and repair short circuit

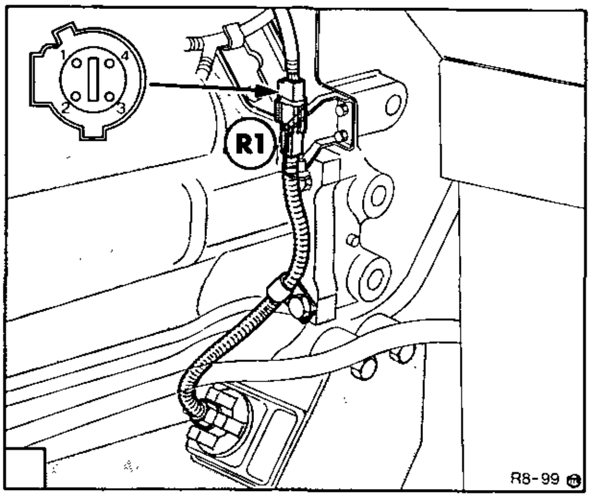
Short circuit? NO → Replace radar assembly



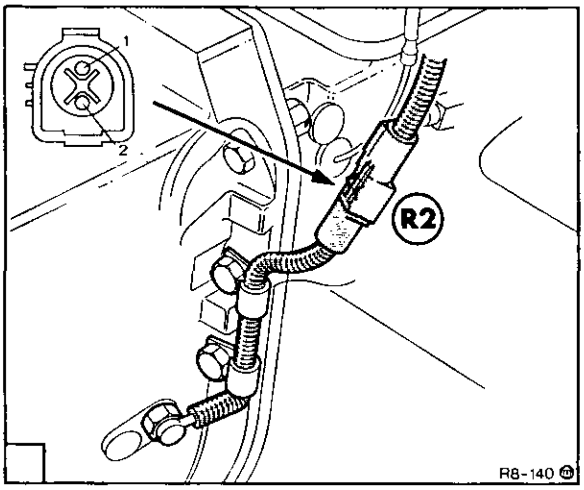
Electronic Instrument Panel Connectors

Error Codes 3, 4 and 5 Speed Sensor Errors

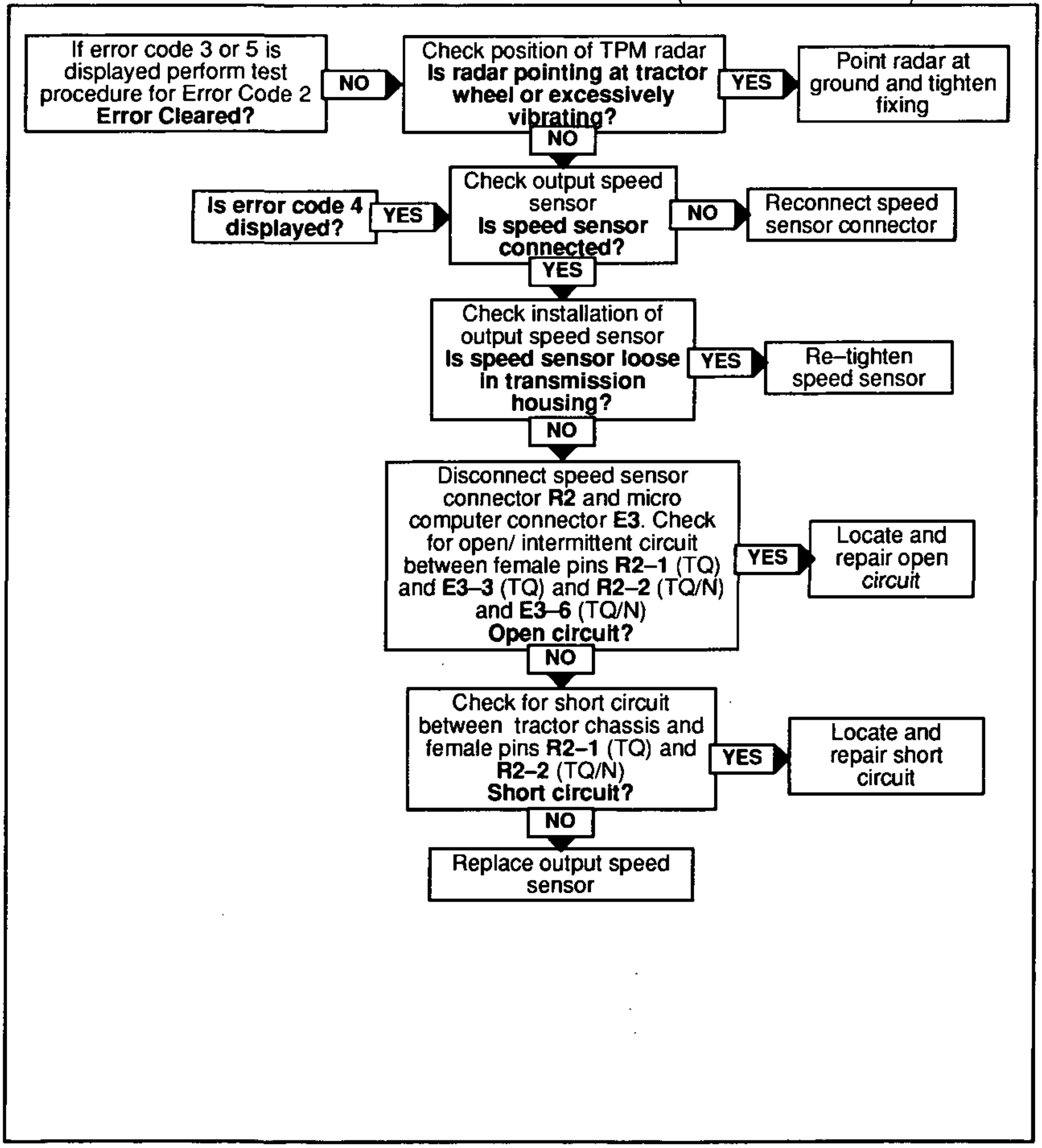
For EDC wiring diagram and connector location refer to the end of this Section



Performance Monitor Radar

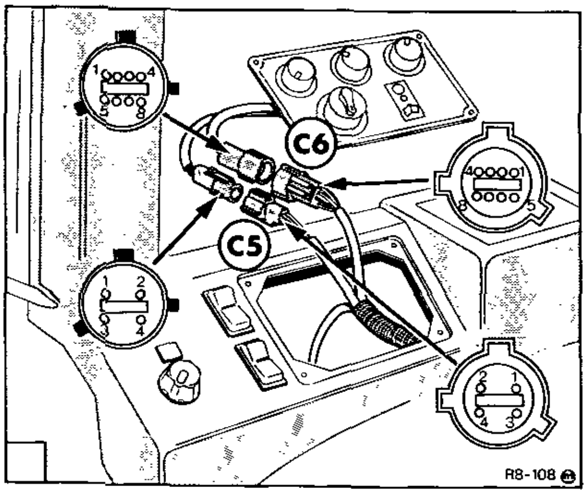


Transmission Output Speed Sensor
(Left Hand Side of Tractor)

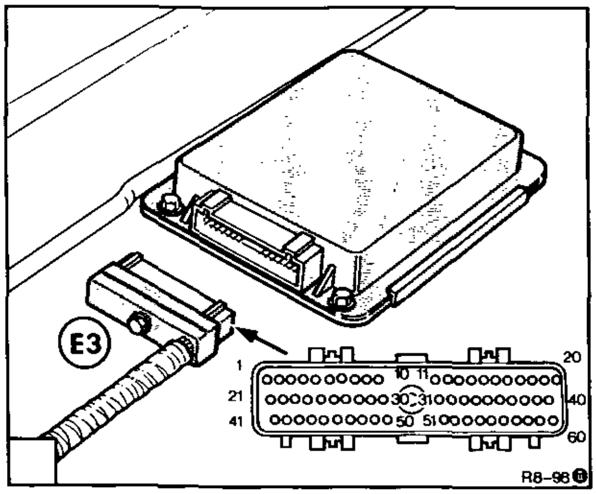


Error Codes 6 and 7 Slip Control Potentiometer or Circuit Failed

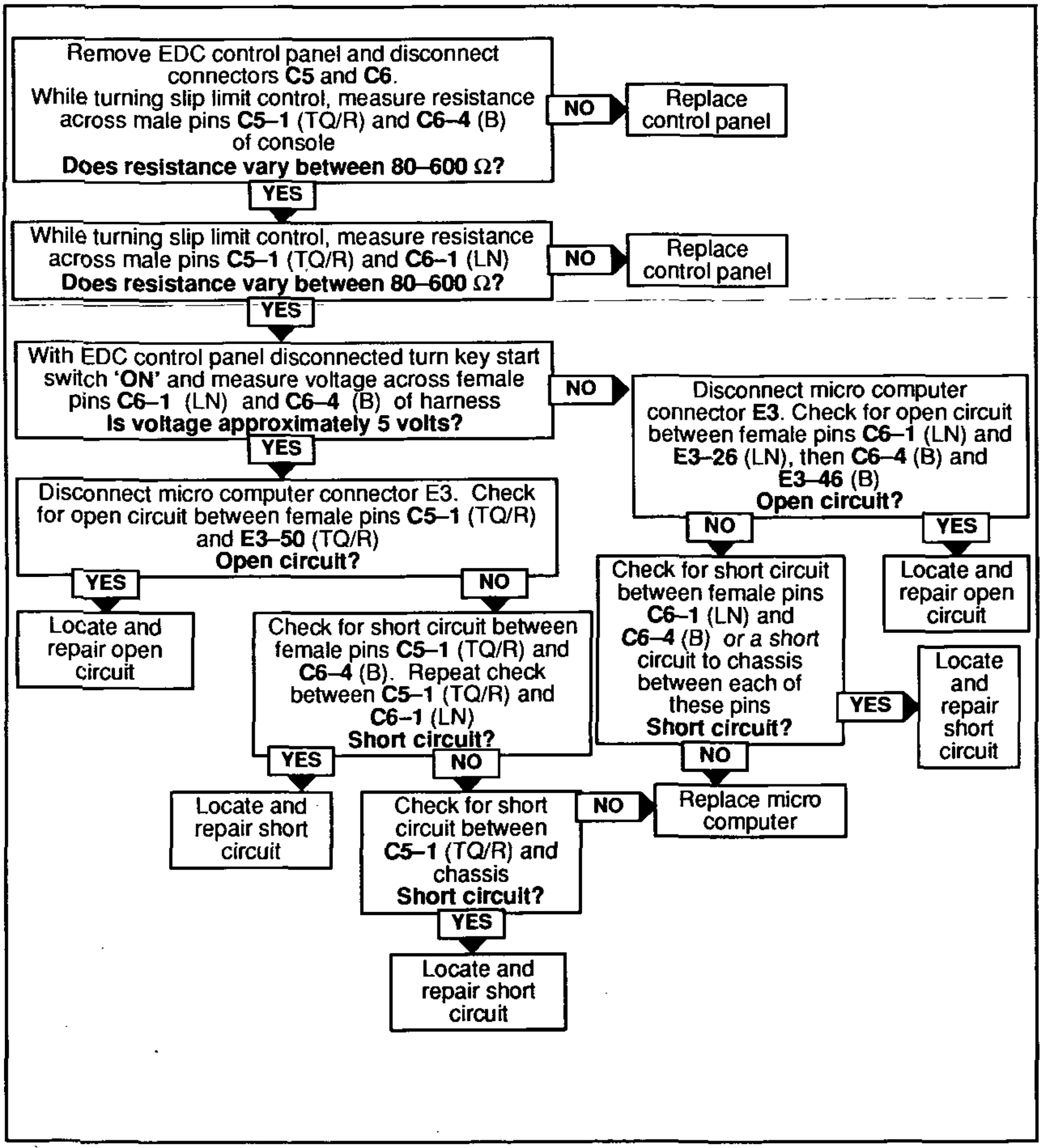
For EDC wiring diagram and connector location refer to the end of this Section



EDC Control Panel Connectors



Micro Computer Connector



Remove EDC control panel and disconnect connectors **C5** and **C6**.
While turning slip limit control, measure resistance across male pins **C5–1** (TQ/R) and **C6–4** (B) of console
Does resistance vary between 80–600 Ω?

NO → Replace control panel

YES ↓

While turning slip limit control, measure resistance across male pins **C5–1** (TQ/R) and **C6–1** (LN)
Does resistance vary between 80–600 Ω?

NO → Replace control panel

YES ↓

With EDC control panel disconnected turn key start switch **'ON'** and measure voltage across female pins **C6–1** (LN) and **C6–4** (B) of harness
Is voltage approximately 5 volts?

NO → Disconnect micro computer connector **E3**. Check for open circuit between female pins **C6–1** (LN) and **E3–26** (LN), then **C6–4** (B) and **E3–46** (B)
Open circuit?

- YES → Locate and repair open circuit
- NO → Check for short circuit between female pins **C6–1** (LN) and **C6–4** (B) or a short circuit to chassis between each of these pins
Short circuit?
  - YES → Locate and repair short circuit
  - NO → Replace micro computer

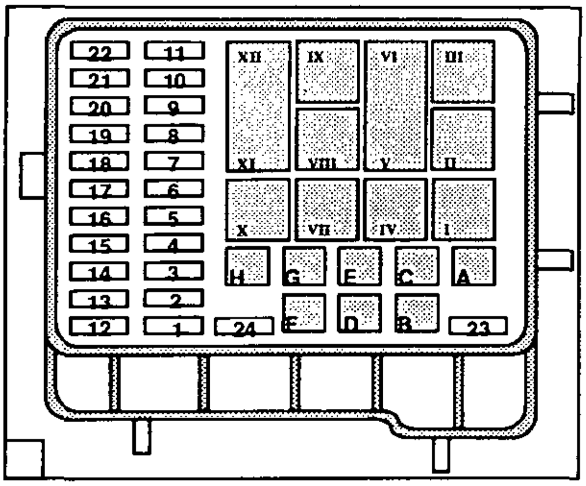
YES ↓

Disconnect micro computer connector E3. Check for open circuit between female pins **C5–1** (TQ/R) and **E3–50** (TQ/R)
Open circuit?

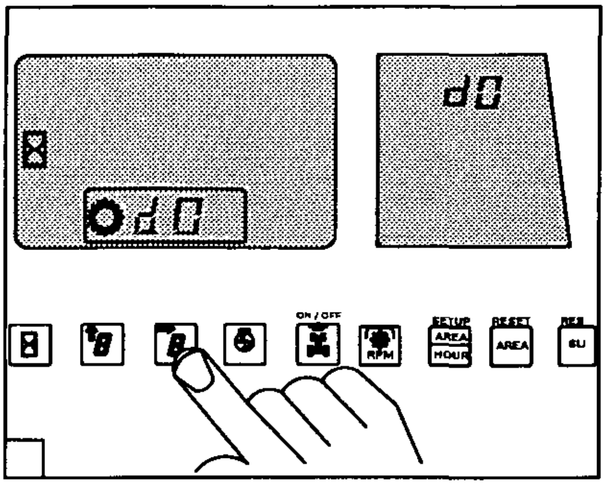
- YES → Locate and repair open circuit
- NO → Check for short circuit between female pins **C5–1** (TQ/R) and **C6–4** (B). Repeat check between **C5–1** (TQ/R) and **C6–1** (LN)
Short circuit?
  - YES → Locate and repair short circuit
  - NO → Check for short circuit between **C5–1** (TQ/R) and chassis
Short circuit?
    - NO → Replace micro computer
    - YES → Locate and repair short circuit

Error Code 8 Raise/Work Switch Failure

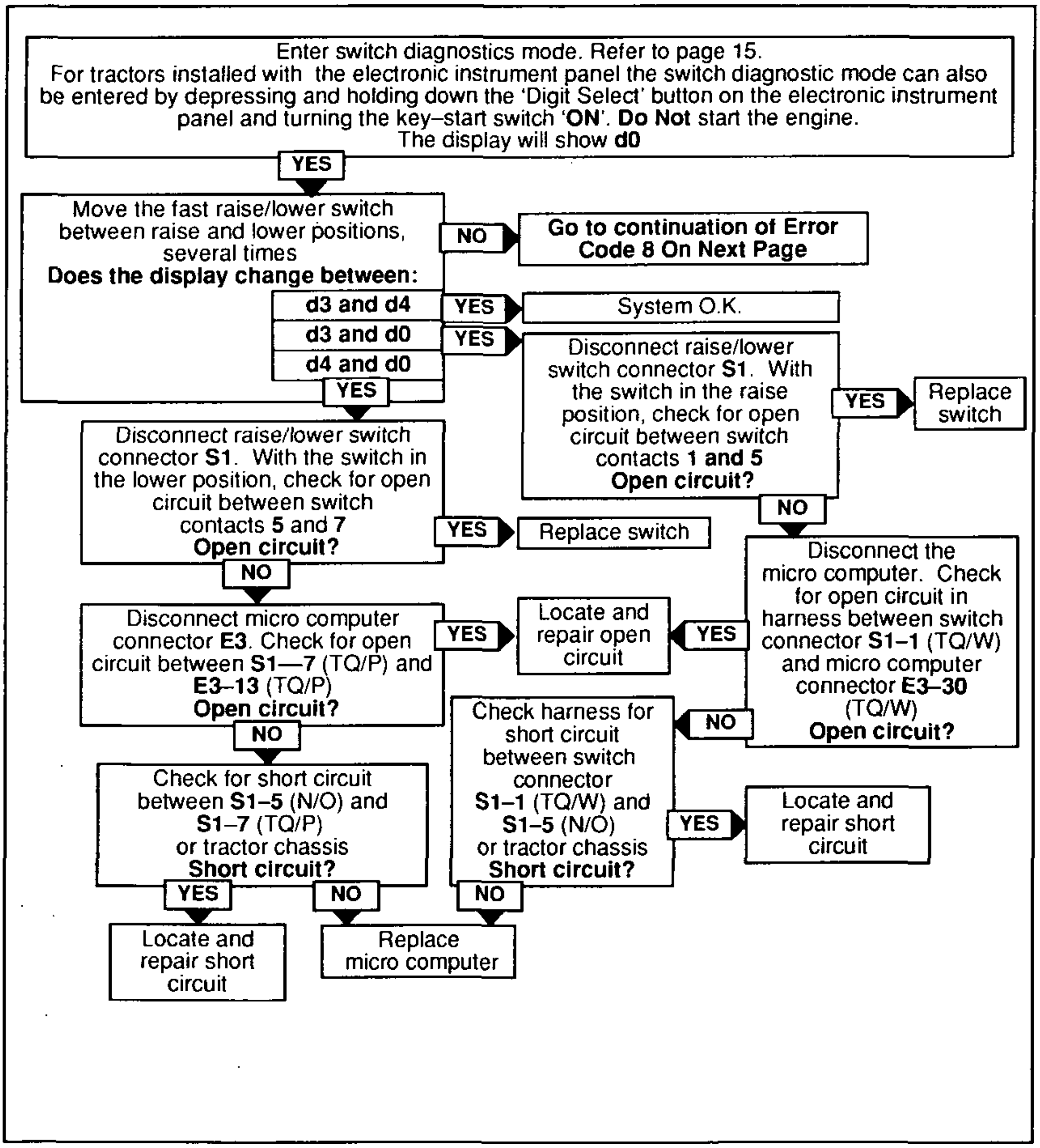
For EDC wiring diagram and connector location refer to the end of this Section



Fuse Panel



Entering Switch Diagnostic Mode
on Electronic Instrument Panel



Enter switch diagnostics mode. Refer to page 15.
For tractors installed with the electronic instrument panel the switch diagnostic mode can also be entered by depressing and holding down the 'Digit Select' button on the electronic instrument panel and turning the key–start switch '**ON**'. **Do Not** start the engine.
The display will show **d0**

Move the fast raise/lower switch between raise and lower positions, several times
Does the display change between:

Go to continuation of Error Code 8 On Next Page

d3 and d4 — — System O.K.

d3 and d0 —

Disconnect raise/lower switch connector **S1**. With the switch in the raise position, check for open circuit between switch contacts **1 and 5**
Open circuit?

Replace switch

Disconnect the micro computer. Check for open circuit in harness between switch connector **S1–1** (TQ/W) and micro computer connector **E3–30** (TQ/W)
Open circuit?

Locate and repair open circuit

Check harness for short circuit between switch connector
S1–1 (TQ/W) and
S1–5 (N/O)
or tractor chassis
Short circuit?

Locate and repair short circuit

Replace micro computer

d4 and d0 —

Disconnect raise/lower switch connector **S1**. With the switch in the lower position, check for open circuit between switch contacts **5** and **7**
Open circuit?

Replace switch

Disconnect micro computer connector **E3**. Check for open circuit between **S1—7** (TQ/P) and **E3–13** (TQ/P)
Open circuit?

Locate and repair open circuit

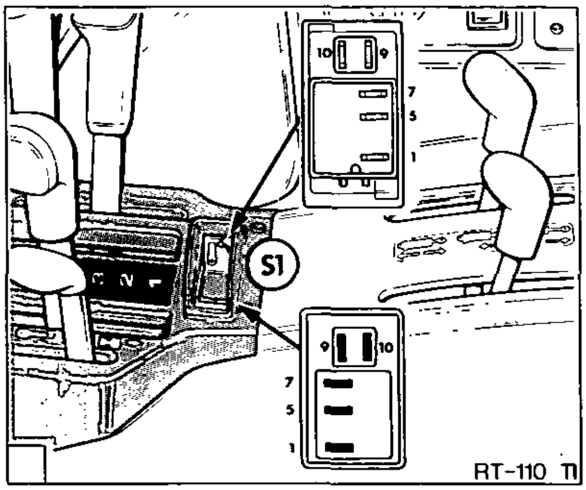
Check for short circuit between **S1–5** (N/O) and
S1–7 (TQ/P)
or tractor chassis
Short circuit?

Locate and repair short circuit

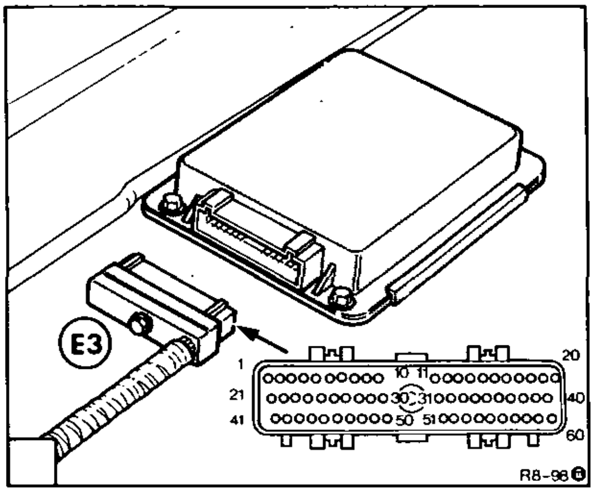
Replace micro computer

Error Code 8 Raise/Work Switch Failure

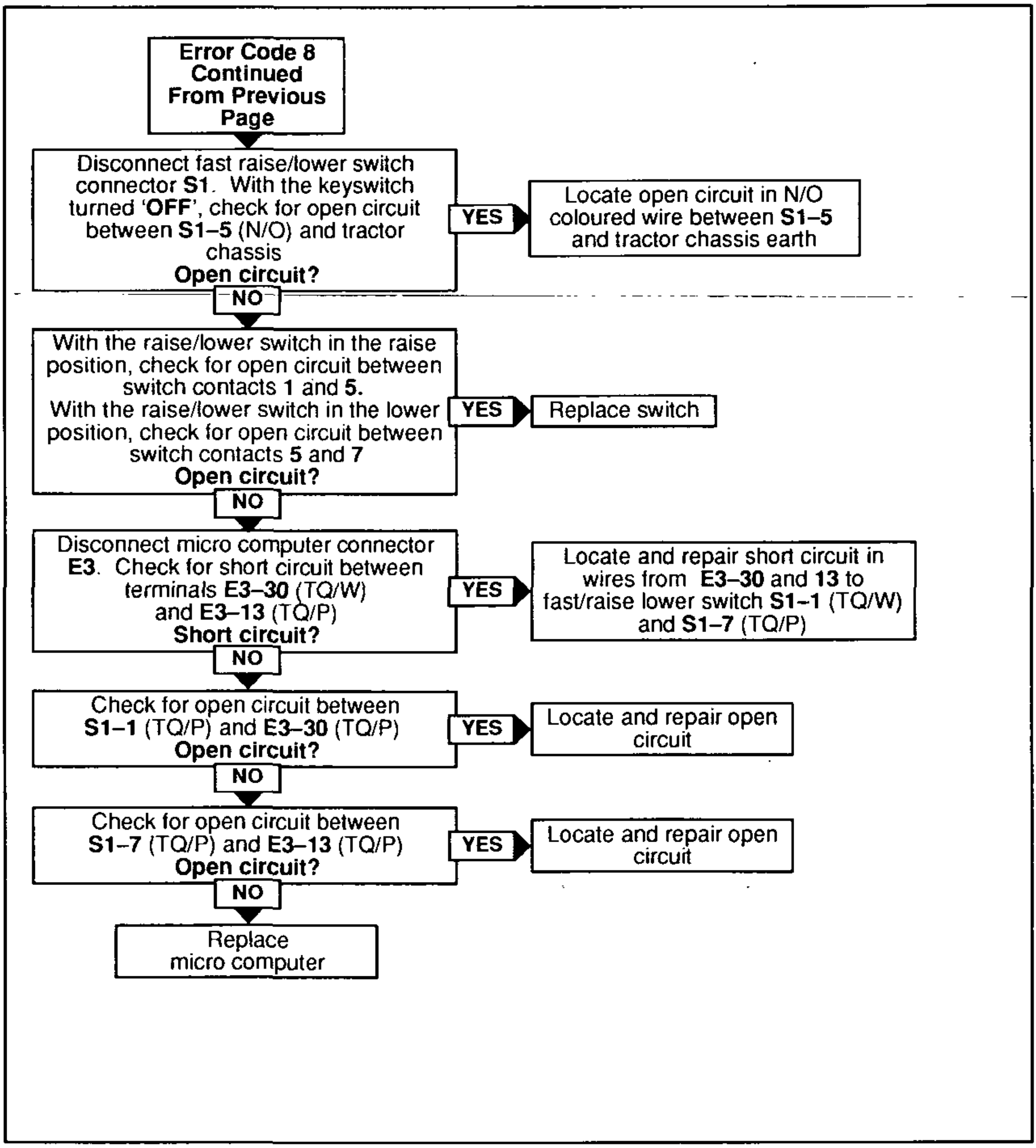
For EDC wiring diagram and connector location refer to the end of this Section



Fast Raise/Lower Switch



Micro Computer Connector



Error Code 8 Continued From Previous Page

Disconnect fast raise/lower switch connector **S1**. With the keyswitch turned '**OFF**', check for open circuit between **S1–5** (N/O) and tractor chassis
Open circuit?

YES → Locate open circuit in N/O coloured wire between **S1–5** and tractor chassis earth

NO ↓

With the raise/lower switch in the raise position, check for open circuit between switch contacts **1** and **5.**
With the raise/lower switch in the lower position, check for open circuit between switch contacts **5** and **7**
Open circuit?

YES → Replace switch

NO ↓

Disconnect micro computer connector **E3**. Check for short circuit between terminals **E3–30** (TQ/W) and E3–13 (TQ/P)
Short circuit?

YES → Locate and repair short circuit in wires from **E3–30** and **13** to fast/raise lower switch **S1–1** (TQ/W) and **S1–7** (TQ/P)

NO ↓

Check for open circuit between **S1–1** (TQ/P) and **E3–30** (TQ/P)
Open circuit?

YES → Locate and repair open circuit

NO ↓

Check for open circuit between **S1–7** (TQ/P) and **E3–13** (TQ/P)
Open circuit?

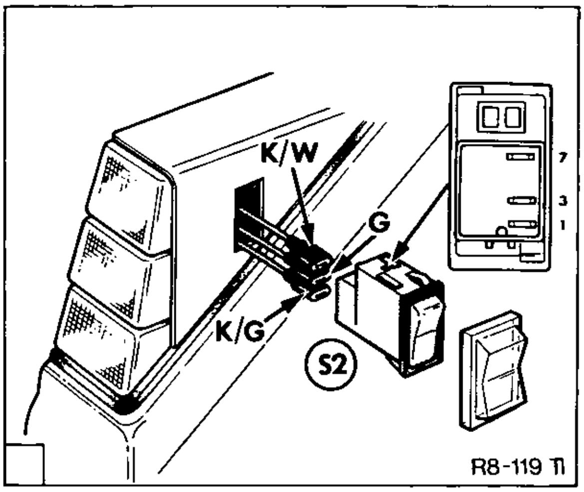
YES → Locate and repair open circuit

NO ↓

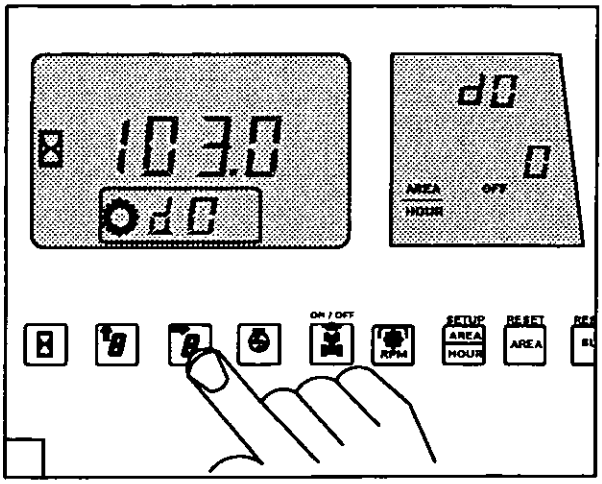
Replace micro computer

Error Code 9 Both External Lift/Lower Fender Switches Are Being Operated Simultaneously

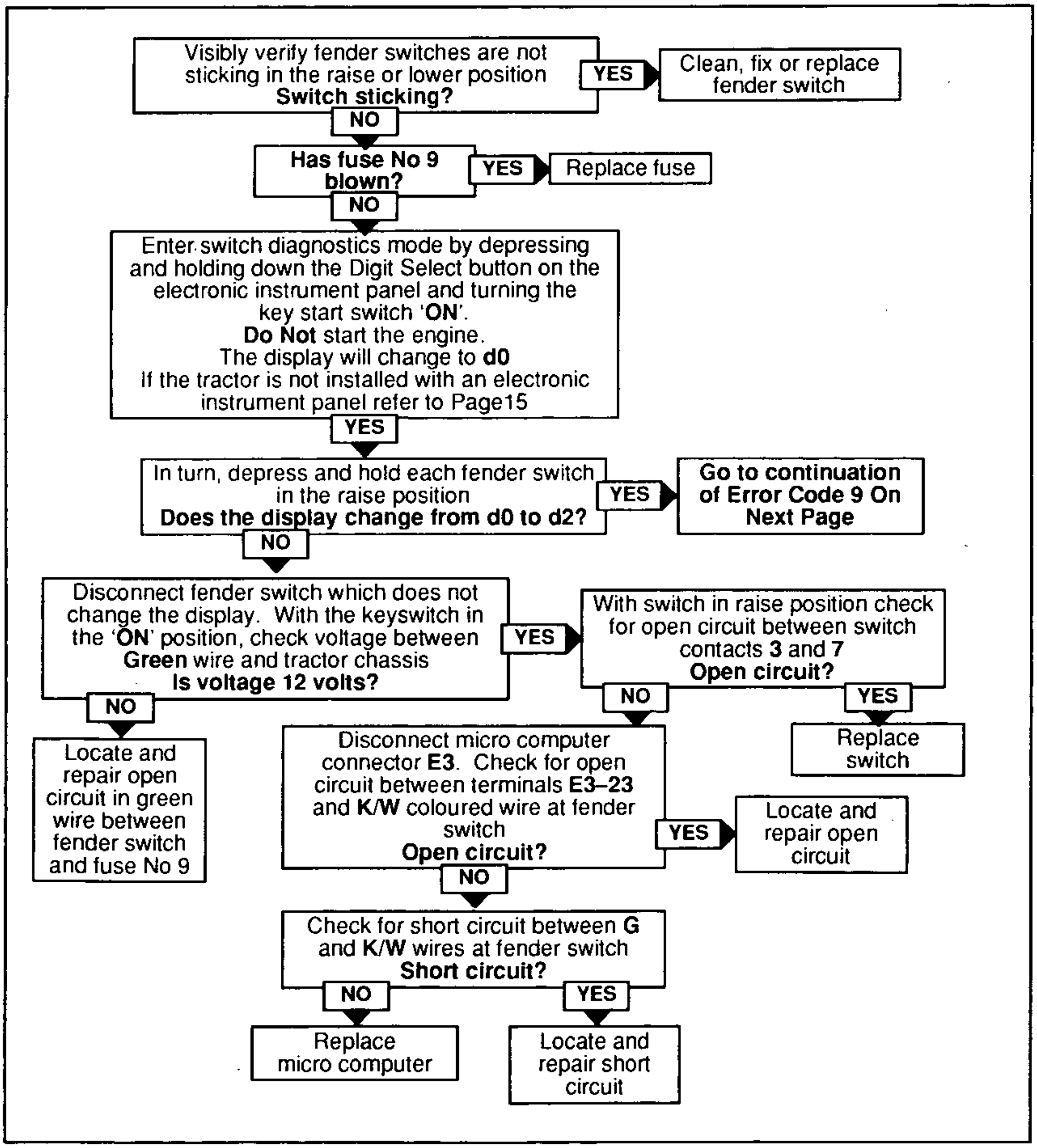
For EDC wiring diagram and connector location refer to the end of this Section



Fender Switch



Entering Switch Diagnostic Mode



Visibly verify fender switches are not sticking in the raise or lower position **Switch sticking?**

- YES → Clean, fix or replace fender switch
- NO ↓

Has fuse No 9 blown?

- YES → Replace fuse
- NO ↓

Enter switch diagnostics mode by depressing and holding down the Digit Select button on the electronic instrument panel and turning the key start switch '**ON**'. **Do Not** start the engine. The display will change to **d0** If the tractor is not installed with an electronic instrument panel refer to Page15

- YES ↓

In turn, depress and hold each fender switch in the raise position **Does the display change from d0 to d2?**

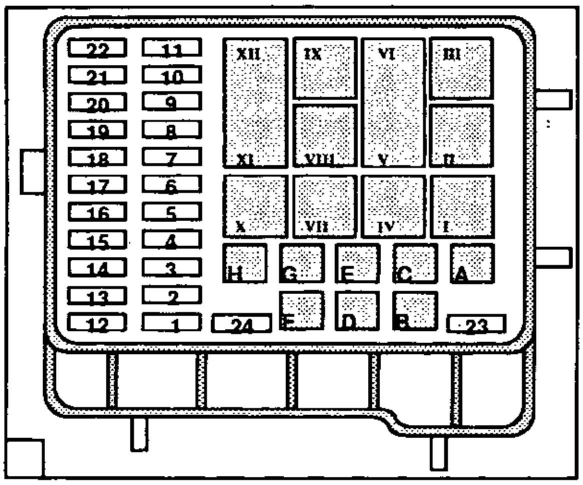
- YES → **Go to continuation of Error Code 9 On Next Page**
- NO ↓

Disconnect fender switch which does not change the display. With the keyswitch in the '**ON**' position, check voltage between **Green** wire and tractor chassis **Is voltage 12 volts?**

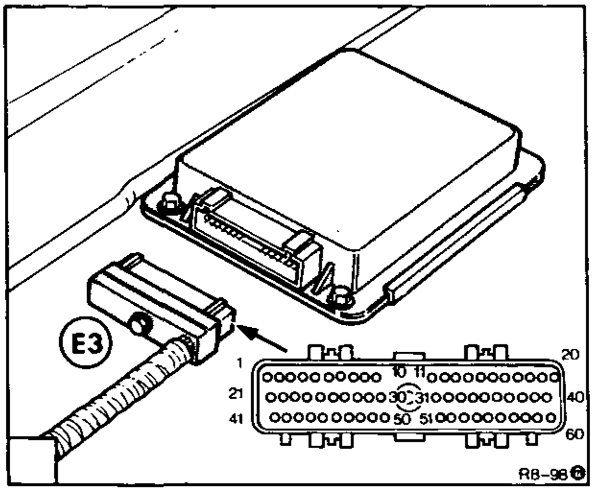
- NO → Locate and repair open circuit in green wire between fender switch and fuse No 9
- YES → With switch in raise position check for open circuit between switch contacts **3** and **7** **Open circuit?**
  - YES → Replace switch
  - NO → Disconnect micro computer connector **E3**. Check for open circuit between terminals **E3–23** and **K/W** coloured wire at fender switch **Open circuit?**
    - YES → Locate and repair open circuit
    - NO → Check for short circuit between **G** and **K/W** wires at fender switch **Short circuit?**
      - NO → Replace micro computer
      - YES → Locate and repair short circuit

Error Code 9 Both External Lift/Lower Fender Switches Are Being Operated Simultaneously

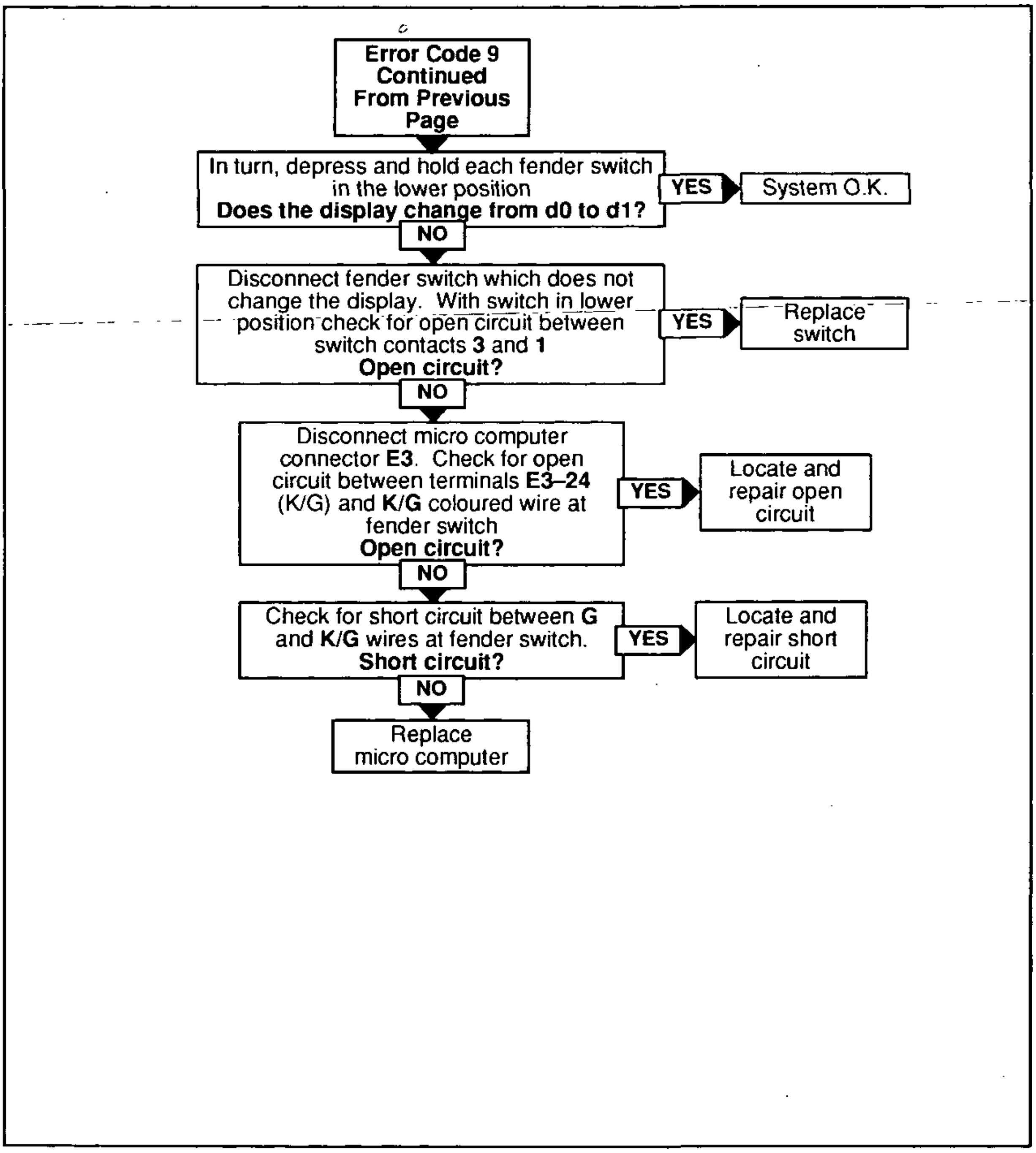
For EDC wiring diagram and connector location refer to the end of this Section



Fuse Panel



Micro Computer Connector



Error Code 9 Continued From Previous Page

In turn, depress and hold each fender switch in the lower position **Does the display change from d0 to d1?**

YES – System O.K.

NO

Disconnect fender switch which does not change the display. With switch in lower position check for open circuit between switch contacts **3** and **1** **Open circuit?**

YES – Replace switch

NO

Disconnect micro computer connector **E3**. Check for open circuit between terminals **E3–24** (K/G) and **K/G** coloured wire at fender switch **Open circuit?**

YES – Locate and repair open circuit

NO

Check for short circuit between **G** and **K/G** wires at fender switch. **Short circuit?**

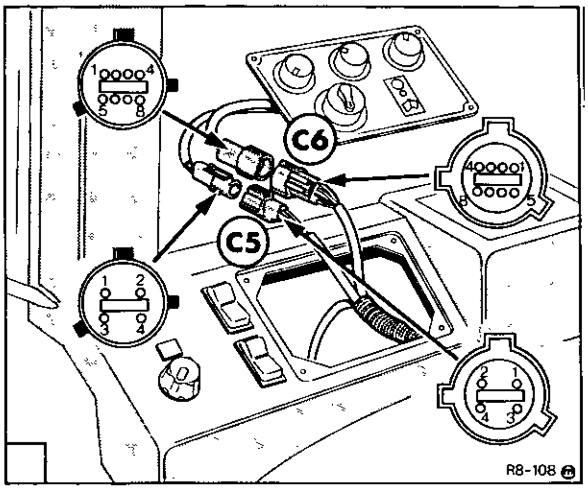
YES – Locate and repair short circuit

NO

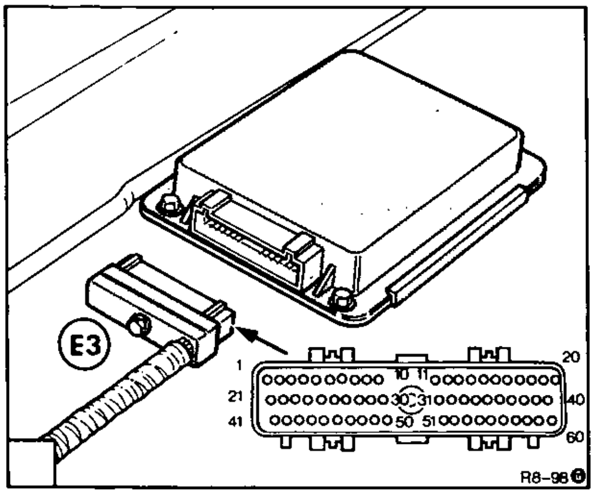
Replace micro computer

Error Codes 10 and 11 Height Limit Control Potentiometer Failed

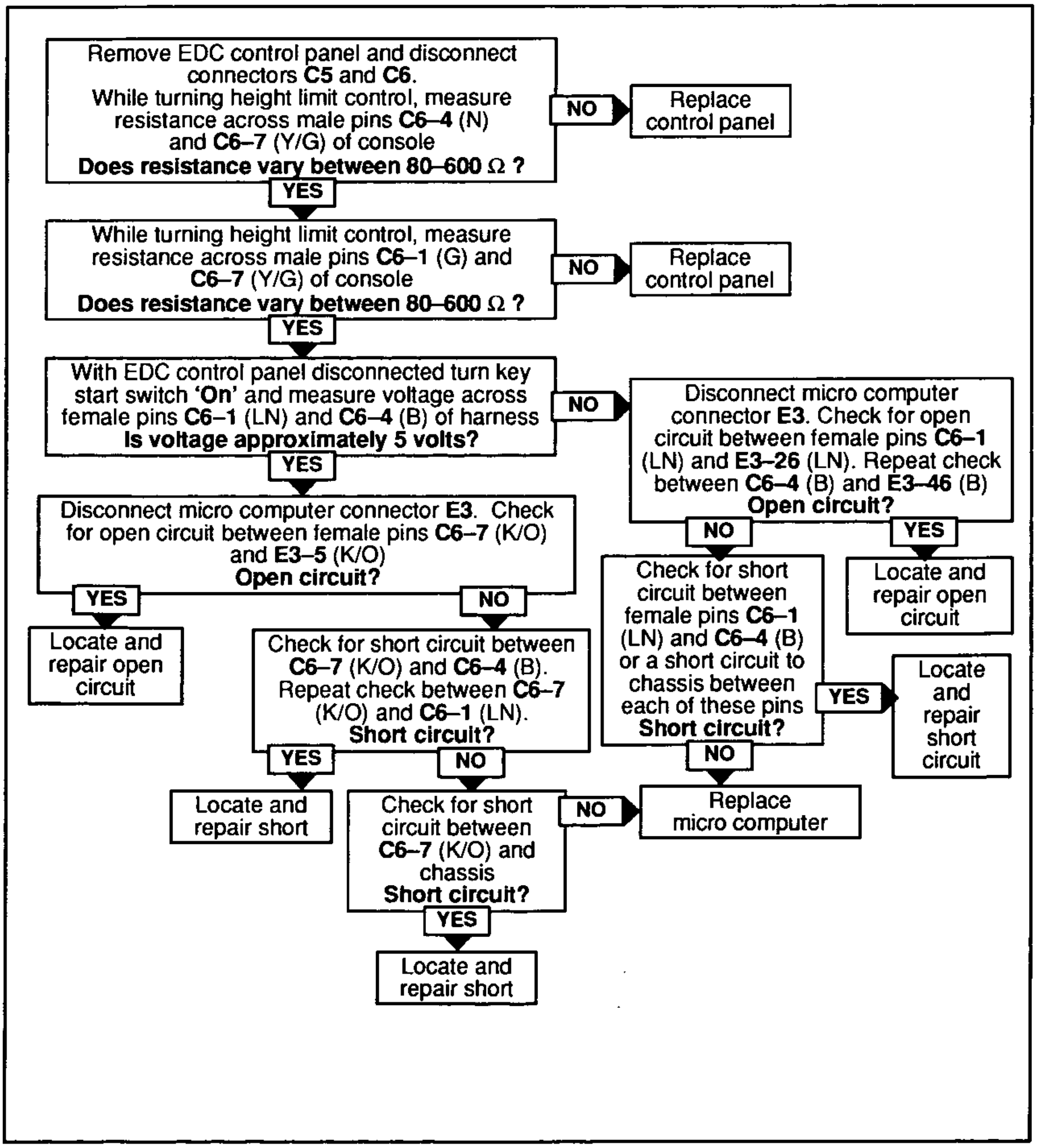
For EDC wiring diagram and connector location refer to the end of this Section



EDC Control Panel Connectors



Micro Computer Connector



Remove EDC control panel and disconnect connectors **C5** and **C6**.
While turning height limit control, measure resistance across male pins **C6–4** (N) and **C6–7** (Y/G) of console
Does resistance vary between 80–600 Ω ?

Replace control panel

While turning height limit control, measure resistance across male pins **C6–1** (G) and **C6–7** (Y/G) of console
Does resistance vary between 80–600 Ω ?

Replace control panel

With EDC control panel disconnected turn key start switch **'On'** and measure voltage across female pins **C6–1** (LN) and **C6–4** (B) of harness
Is voltage approximately 5 volts?

Disconnect micro computer connector **E3**. Check for open circuit between female pins **C6–1** (LN) and **E3–26** (LN). Repeat check between **C6–4** (B) and **E3–46** (B)
Open circuit?

Disconnect micro computer connector **E3**. Check for open circuit between female pins **C6–7** (K/O) and **E3–5** (K/O)
Open circuit?

Check for short circuit between female pins **C6–1** (LN) and **C6–4** (B) or a short circuit to chassis between each of these pins
Short circuit?

Locate and repair open circuit

Locate and repair open circuit

Check for short circuit between **C6–7** (K/O) and **C6–4** (B). Repeat check between **C6–7** (K/O) and **C6–1** (LN).
Short circuit?

Locate and repair short circuit

Locate and repair short

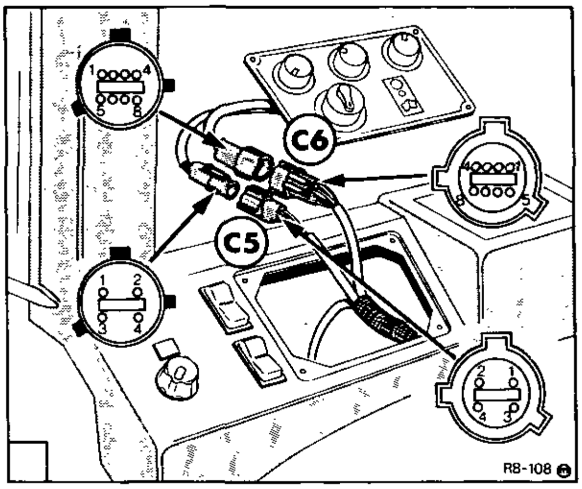
Check for short circuit between **C6–7** (K/O) and chassis
Short circuit?

Replace micro computer

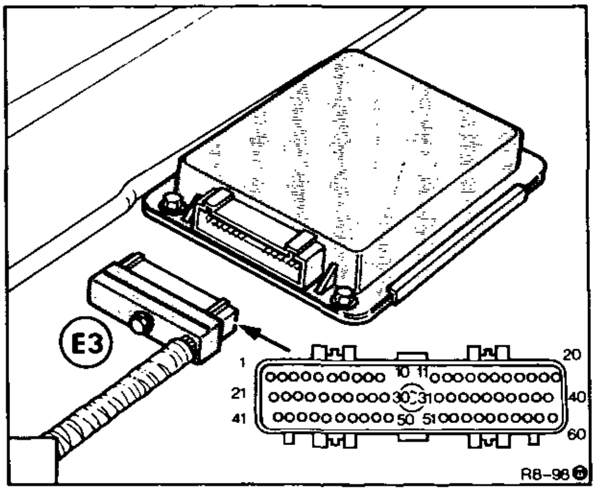
Locate and repair short

Error Codes 12 and 13 Drop Rate Potentiometer Failed

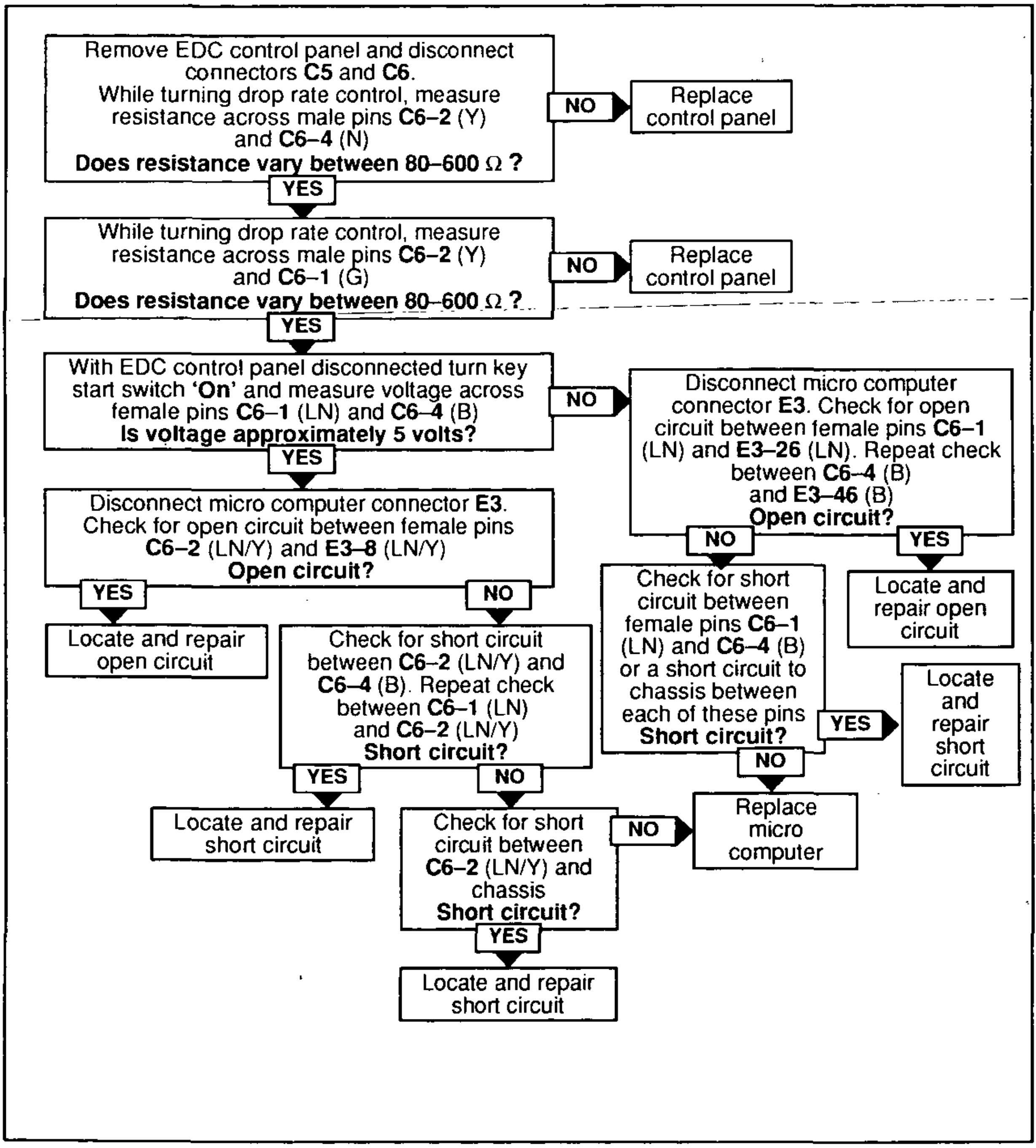
For EDC wiring diagram and connector location refer to the end of this Section



EDC Control Panel Connectors

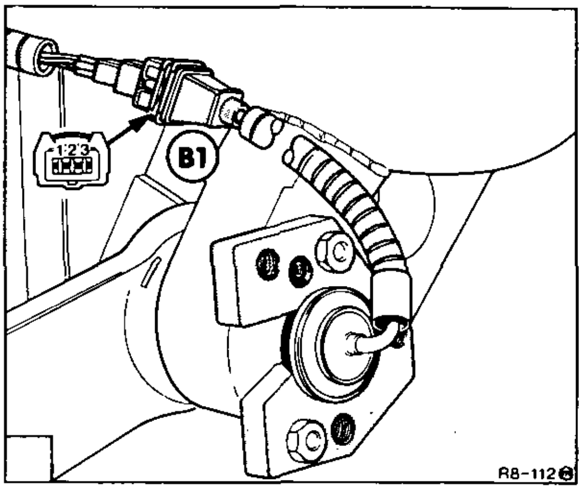


Micro Computer Connector

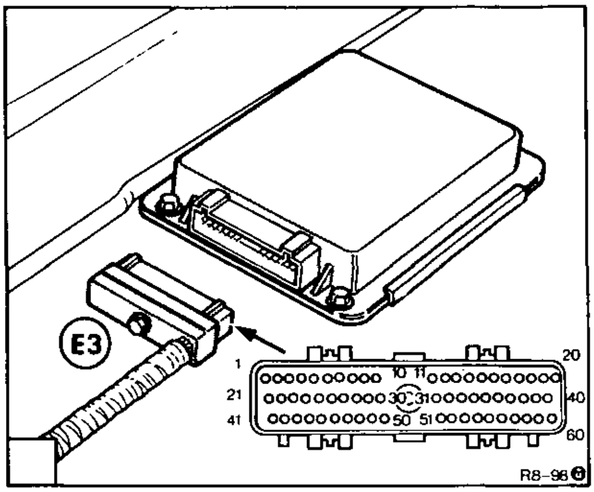


Error Codes 14 and 15 Right Hand Load Sensing Pin or Circuit Failed

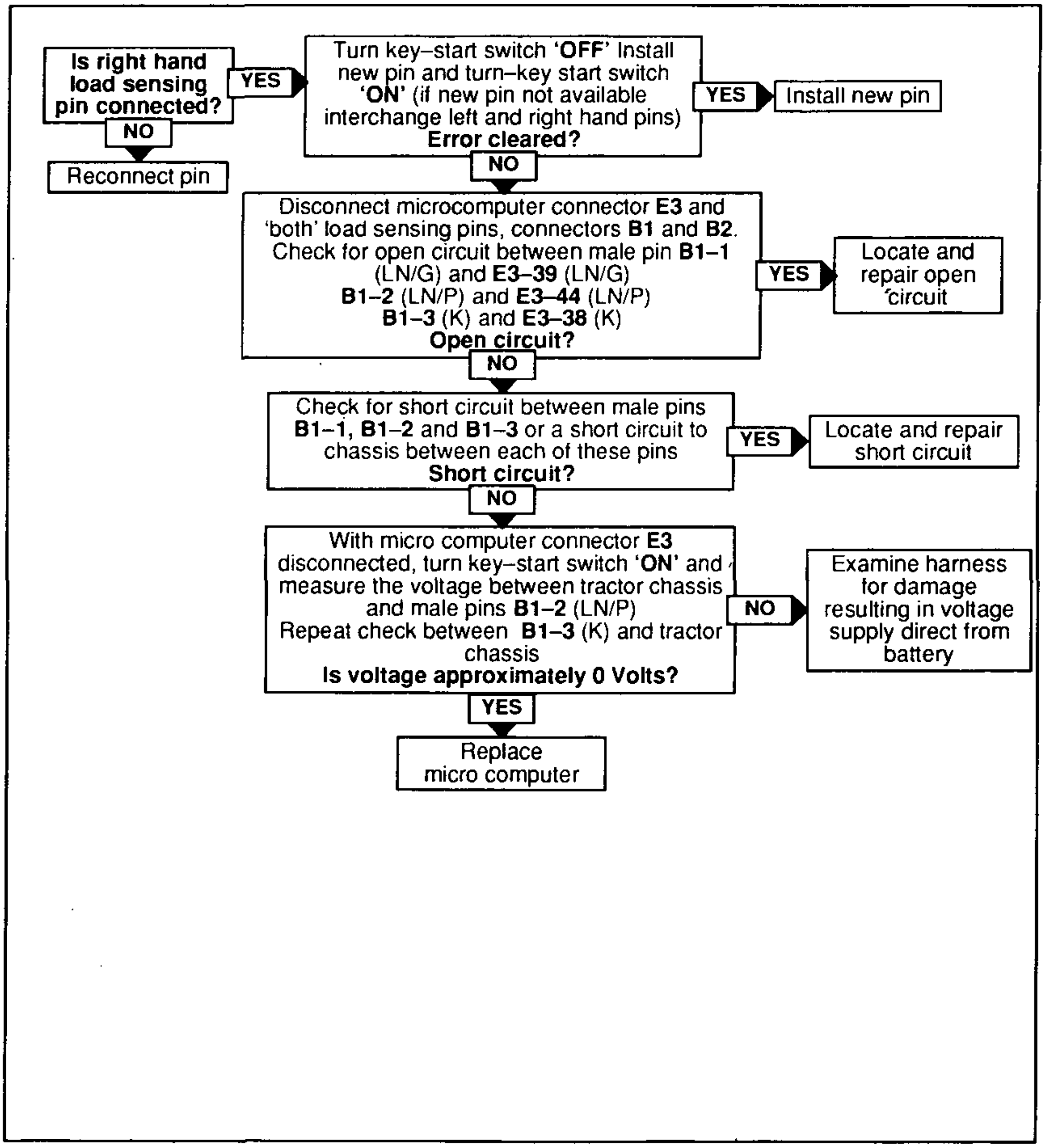
For EDC wiring diagram and connector location refer to the end of this Section



Right Hand Load Sensing Pin



Micro Computer Connector



Is right hand load sensing pin connected?

NO: Reconnect pin

YES: Turn key–start switch **'OFF'** Install new pin and turn–key start switch **'ON'** (if new pin not available interchange left and right hand pins) **Error cleared?**

YES: Install new pin

NO: Disconnect microcomputer connector **E3** and 'both' load sensing pins, connectors **B1** and **B2**. Check for open circuit between male pin **B1–1** (LN/G) and **E3–39** (LN/G) **B1–2** (LN/P) and **E3–44** (LN/P) **B1–3** (K) and **E3–38** (K) **Open circuit?**

YES: Locate and repair open circuit

NO: Check for short circuit between male pins **B1–1**, **B1–2** and **B1–3** or a short circuit to chassis between each of these pins **Short circuit?**

YES: Locate and repair short circuit

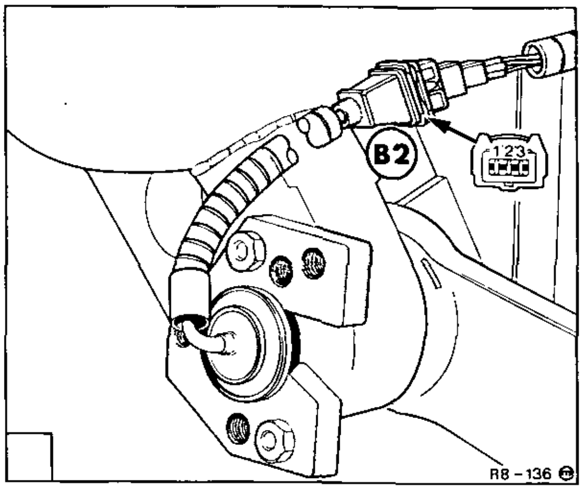
NO: With micro computer connector **E3** disconnected, turn key–start switch **'ON'** and measure the voltage between tractor chassis and male pins **B1–2** (LN/P) Repeat check between **B1–3** (K) and tractor chassis **Is voltage approximately 0 Volts?**

NO: Examine harness for damage resulting in voltage supply direct from battery

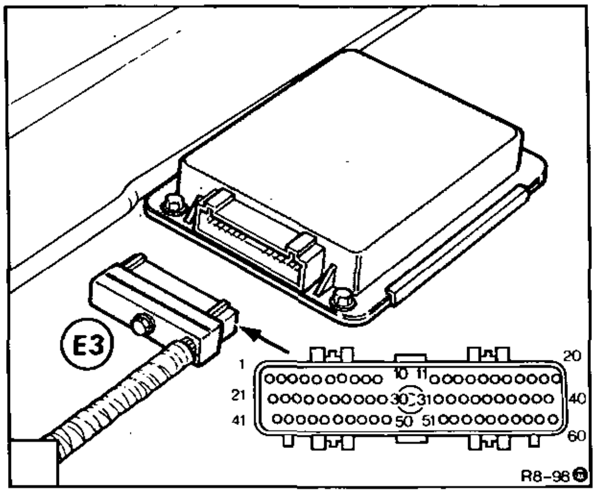
YES: Replace micro computer

Error Codes 16 and 17 Left Hand Load Sensing Pin or Circuit Failed

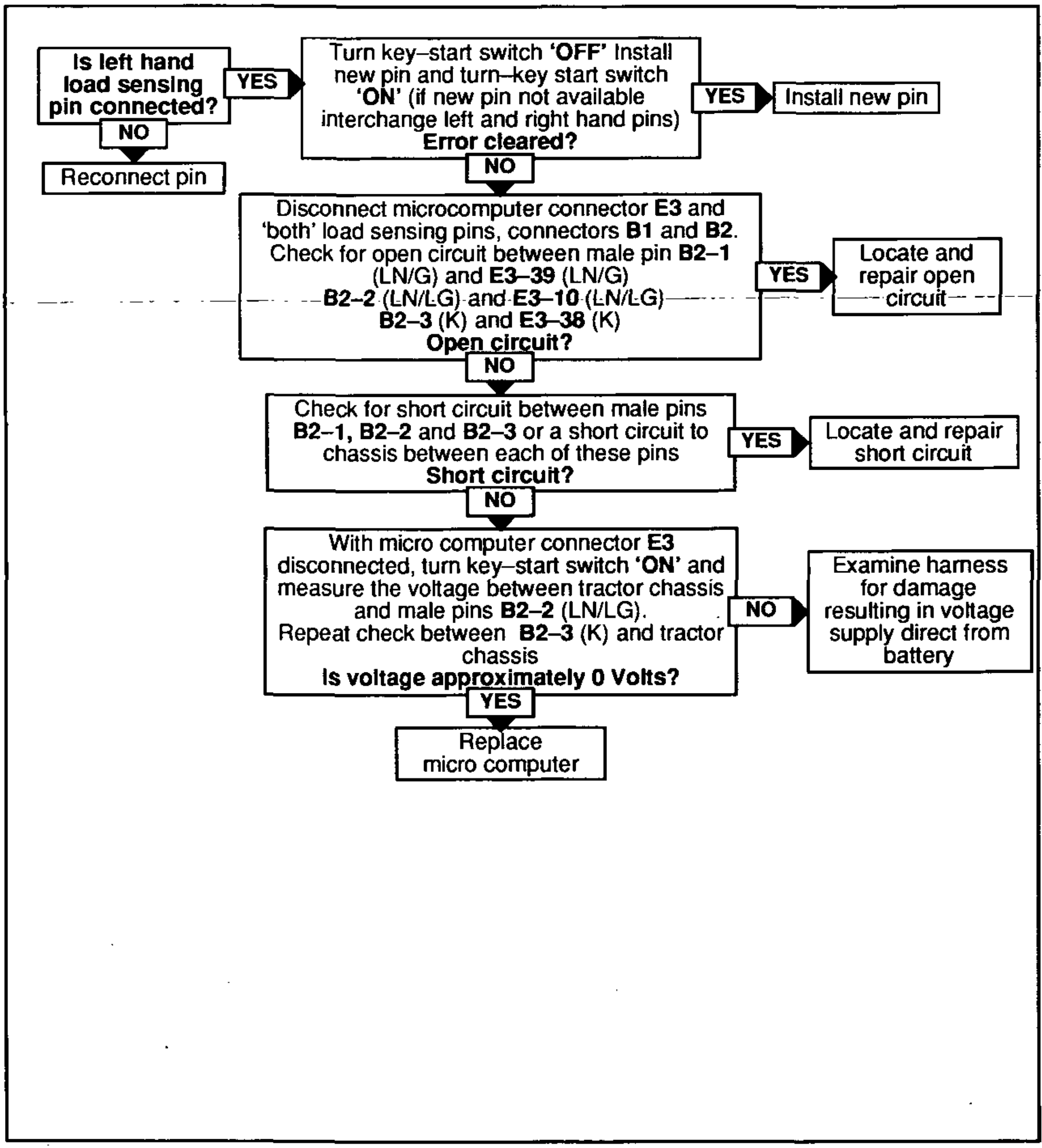
For EDC wiring diagram and connector location refer to the end of this Section



Left Hand Load Sensing Pin



Micro Computer Connector



Is left hand load sensing pin connected?

NO → Reconnect pin

YES → Turn key–start switch **'OFF'** Install new pin and turn–key start switch **'ON'** (if new pin not available interchange left and right hand pins) **Error cleared?**

YES → Install new pin

NO → Disconnect microcomputer connector **E3** and 'both' load sensing pins, connectors **B1** and **B2**. Check for open circuit between male pin **B2–1** (LN/G) and **E3–39** (LN/G) **B2–2** (LN/LG) and **E3–10** (LN/LG) **B2–3** (K) and **E3–38** (K) **Open circuit?**

YES → Locate and repair open circuit

NO → Check for short circuit between male pins **B2–1, B2–2 and B2–3** or a short circuit to chassis between each of these pins **Short circuit?**

YES → Locate and repair short circuit

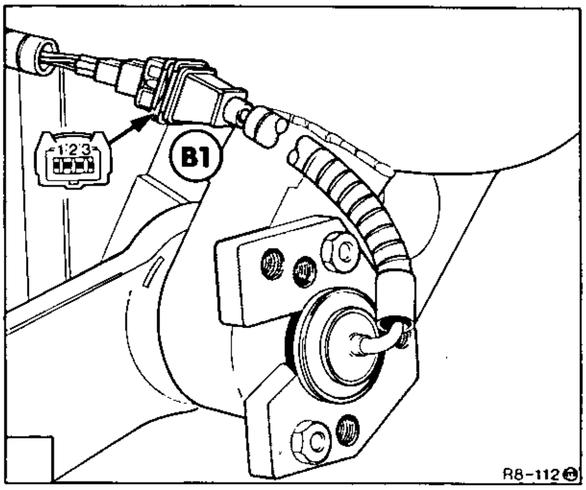
NO → With micro computer connector **E3** disconnected, turn key–start switch **'ON'** and measure the voltage between tractor chassis and male pins **B2–2** (LN/LG). Repeat check between **B2–3** (K) and tractor chassis **Is voltage approximately 0 Volts?**

NO → Examine harness for damage resulting in voltage supply direct from battery

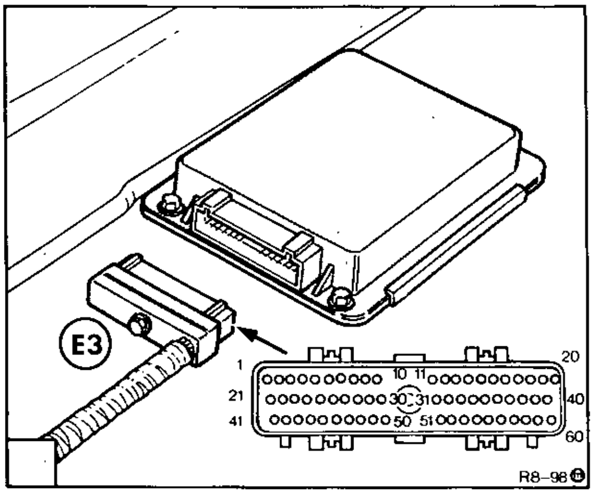
YES → Replace micro computer

Error Code 18 Both Load Sensing Pins Disconnected

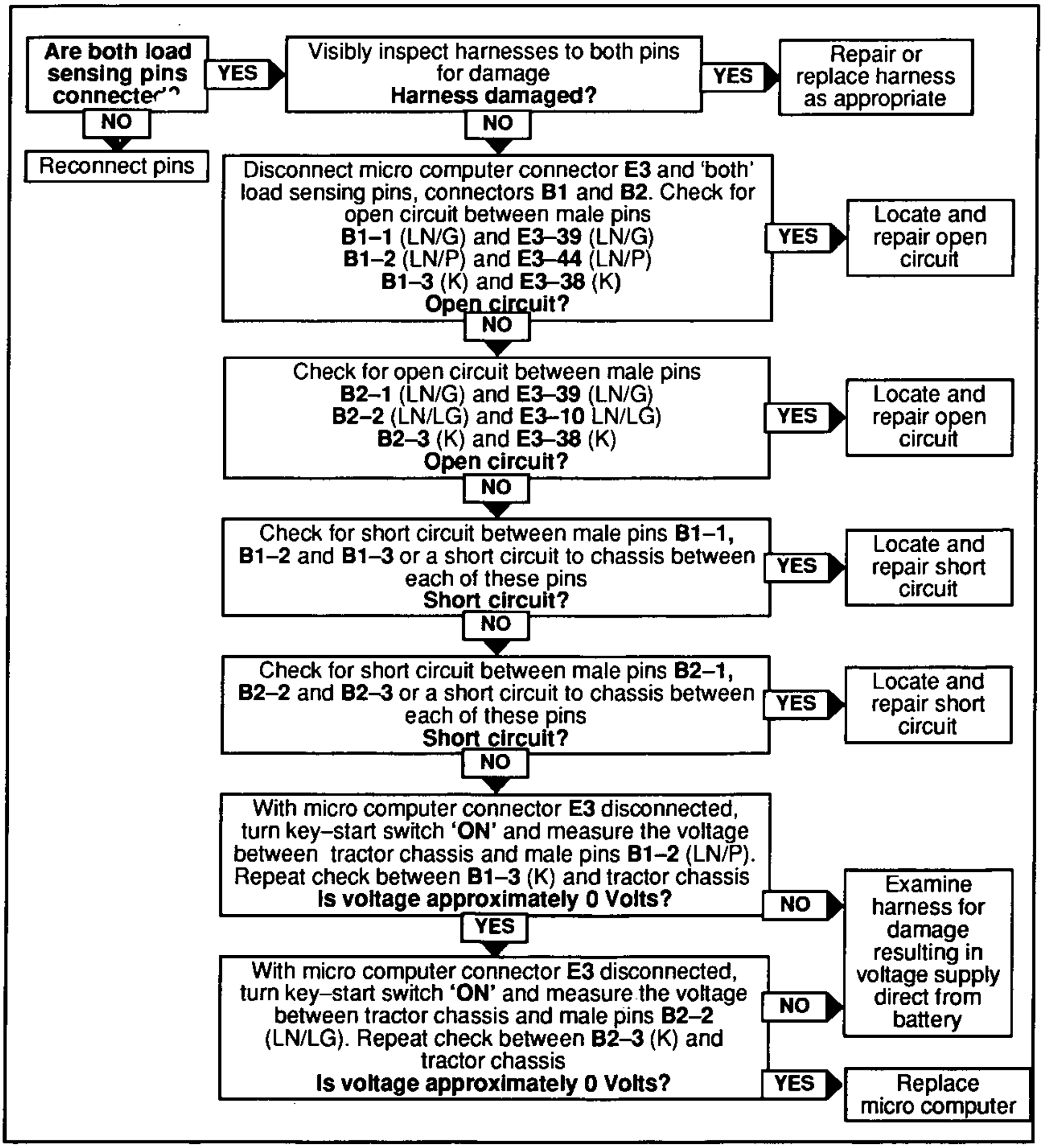
For EDC wiring diagram and connector location refer to the end of this Section



Load Sensing Pins (Right Hand Pin Shown)



Micro Computer Connector



Are both load sensing pins connected?
YES → Visibly inspect harnesses to both pins for damage **Harness damaged?**
NO → Reconnect pins

Visibly inspect harnesses to both pins for damage **Harness damaged?**
YES → Repair or replace harness as appropriate
NO ↓

Disconnect micro computer connector **E3** and 'both' load sensing pins, connectors **B1** and **B2**. Check for open circuit between male pins
B1–1 (LN/G) and **E3–39** (LN/G)
B1–2 (LN/P) and **E3–44** (LN/P)
B1–3 (K) and **E3–38** (K)
Open circuit?
YES → Locate and repair open circuit
NO ↓

Check for open circuit between male pins
B2–1 (LN/G) and **E3–39** (LN/G)
B2–2 (LN/LG) and **E3–10** LN/LG)
B2–3 (K) and **E3–38** (K)
Open circuit?
YES → Locate and repair open circuit
NO ↓

Check for short circuit between male pins **B1–1**, **B1–2** and **B1–3** or a short circuit to chassis between each of these pins
Short circuit?
YES → Locate and repair short circuit
NO ↓

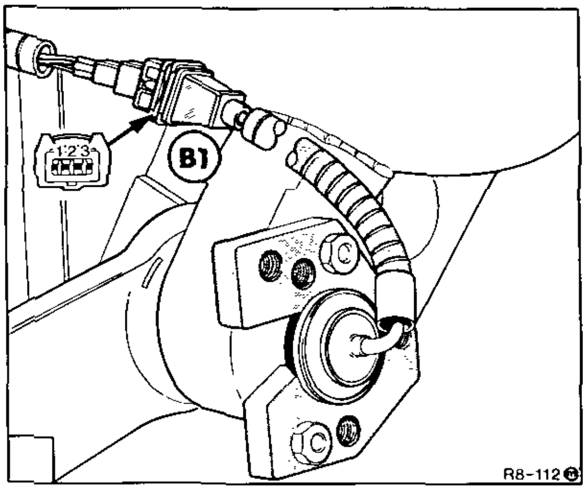
Check for short circuit between male pins **B2–1**, **B2–2** and **B2–3** or a short circuit to chassis between each of these pins
Short circuit?
YES → Locate and repair short circuit
NO ↓

With micro computer connector **E3** disconnected, turn key–start switch **'ON'** and measure the voltage between tractor chassis and male pins **B1–2** (LN/P). Repeat check between **B1–3** (K) and tractor chassis
Is voltage approximately 0 Volts?
NO → Examine harness for damage resulting in voltage supply direct from battery
YES ↓

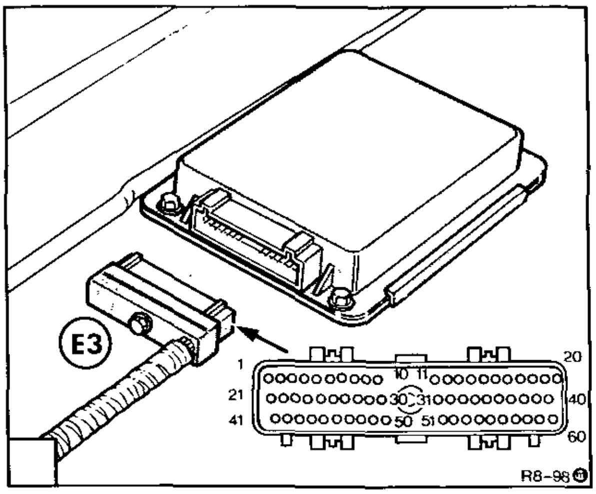
With micro computer connector **E3** disconnected, turn key–start switch **'ON'** and measure the voltage between tractor chassis and male pins **B2–2** (LN/LG). Repeat check between **B2–3** (K) and tractor chassis
Is voltage approximately 0 Volts?
NO → Examine harness for damage resulting in voltage supply direct from battery
YES → Replace micro computer

Error Codes 19 and 20 Incorrect Load Sensing Pin Supply Voltage

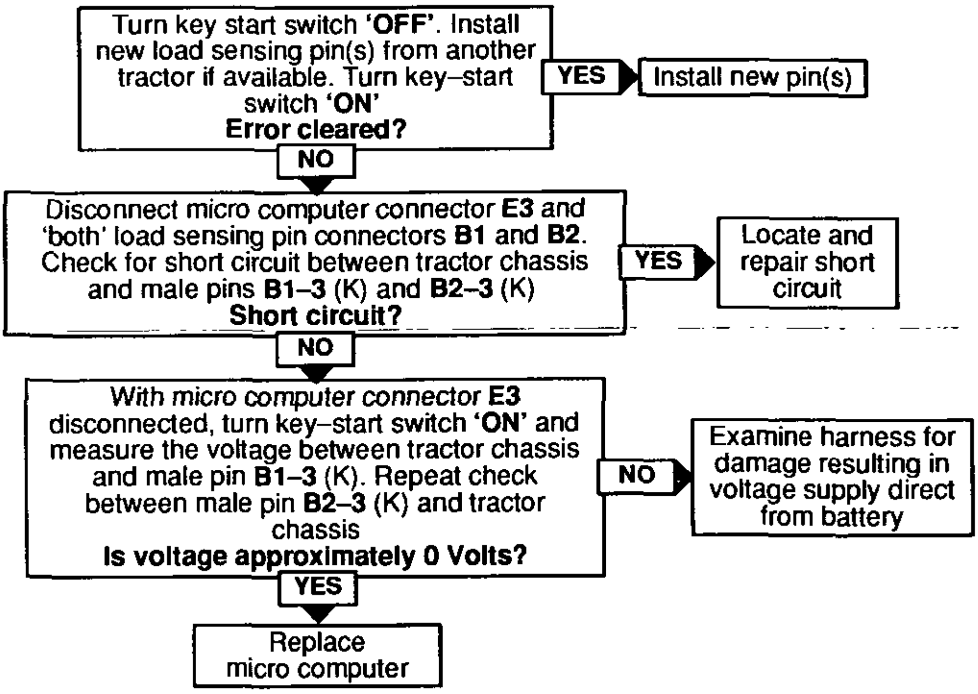
For EDC wiring diagram and connector location refer to the end of this Section



Load Sensing Pin (Right Hand Pin Shown)



Micro Computer Connector



Turn key start switch **'OFF'**. Install new load sensing pin(s) from another tractor if available. Turn key–start switch **'ON'**
Error cleared?

YES → Install new pin(s)

NO ↓

Disconnect micro computer connector **E3** and 'both' load sensing pin connectors **B1** and **B2**. Check for short circuit between tractor chassis and male pins **B1–3** (K) and **B2–3** (K)
Short circuit?

YES → Locate and repair short circuit

NO ↓

With micro computer connector **E3** disconnected, turn key–start switch **'ON'** and measure the voltage between tractor chassis and male pin **B1–3** (K). Repeat check between male pin **B2–3** (K) and tractor chassis
Is voltage approximately 0 Volts?

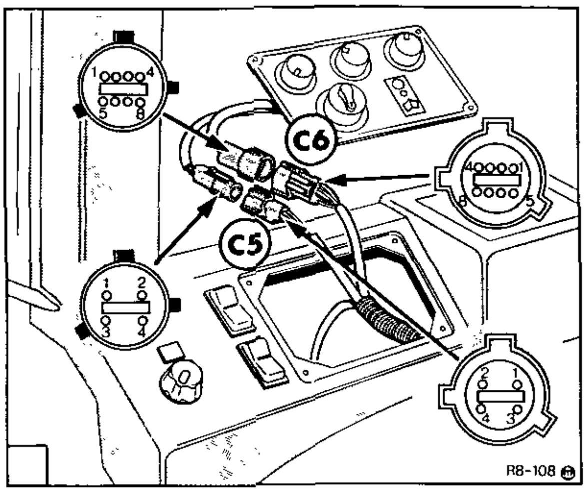
NO → Examine harness for damage resulting in voltage supply direct from battery

YES ↓

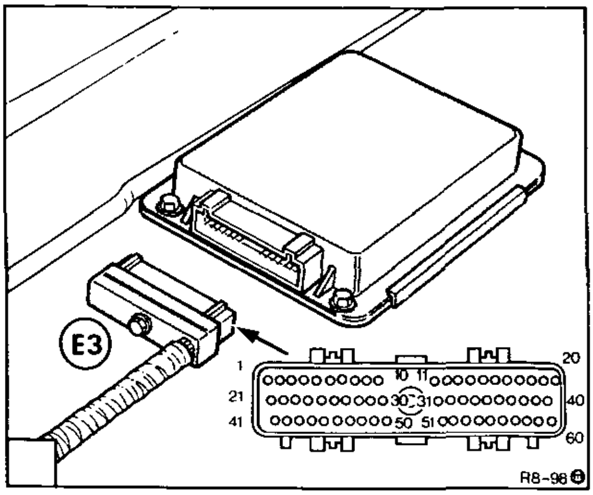
Replace micro computer

Error Codes 21 and 22 Position/Draft Sensitivity Control Potentiometer or Circuit Failed

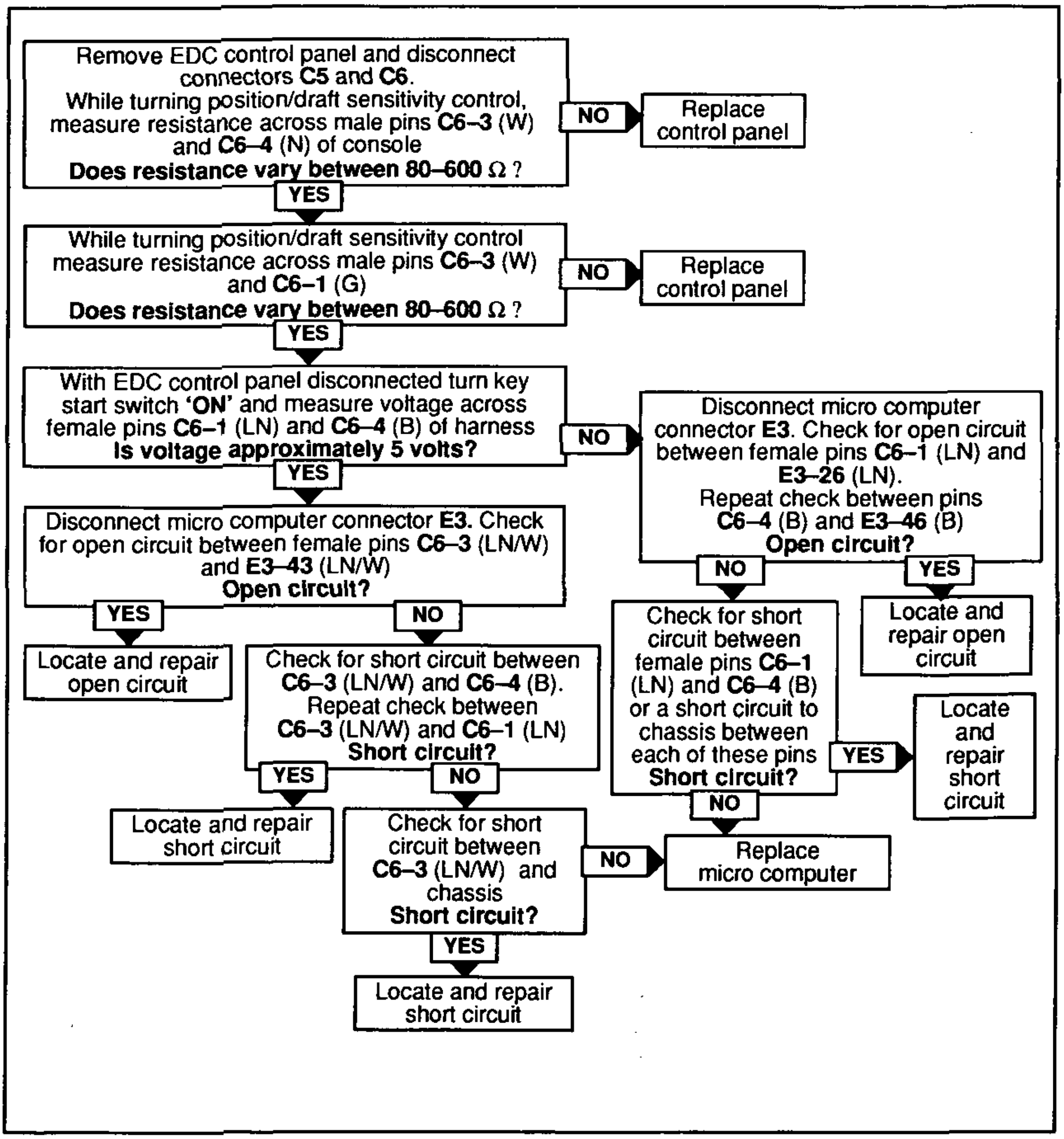
For EDC wiring diagram and connector location refer to the end of this Section



EDC Control Panel Connectors



Micro Computer Connector



Remove EDC control panel and disconnect connectors **C5** and **C6**. While turning position/draft sensitivity control, measure resistance across male pins **C6–3** (W) and **C6–4** (N) of console **Does resistance vary between 80–600 Ω** ?

NO → Replace control panel

YES ↓

While turning position/draft sensitivity control measure resistance across male pins **C6–3** (W) and **C6–1** (G) **Does resistance vary between 80–600 Ω** ?

NO → Replace control panel

YES ↓

With EDC control panel disconnected turn key start switch **'ON'** and measure voltage across female pins **C6–1** (LN) and **C6–4** (B) of harness **Is voltage approximately 5 volts?**

NO → Disconnect micro computer connector **E3**. Check for open circuit between female pins **C6–1** (LN) and **E3–26** (LN). Repeat check between pins **C6–4** (B) and **E3–46** (B) **Open circuit?**

- YES → Locate and repair open circuit
- NO → Check for short circuit between female pins **C6–1** (LN) and **C6–4** (B) or a short circuit to chassis between each of these pins **Short circuit?**
  - YES → Locate and repair short circuit
  - NO → Replace micro computer

YES ↓

Disconnect micro computer connector **E3**. Check for open circuit between female pins **C6–3** (LN/W) and **E3–43** (LN/W) **Open circuit?**

- YES → Locate and repair open circuit
- NO → Check for short circuit between **C6–3** (LN/W) and **C6–4** (B). Repeat check between **C6–3** (LN/W) and **C6–1** (LN) **Short circuit?**
  - YES → Locate and repair short circuit
  - NO → Check for short circuit between **C6–3** (LN/W) and chassis **Short circuit?**
    - YES → Locate and repair short circuit
    - NO → Replace micro computer

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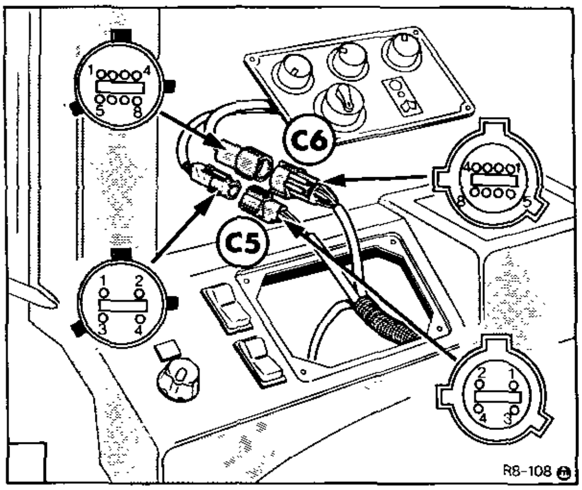
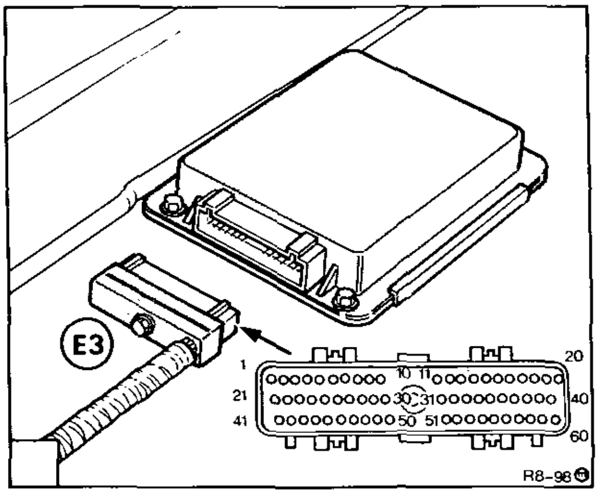
Error Code 23 Control Panel Disconnected

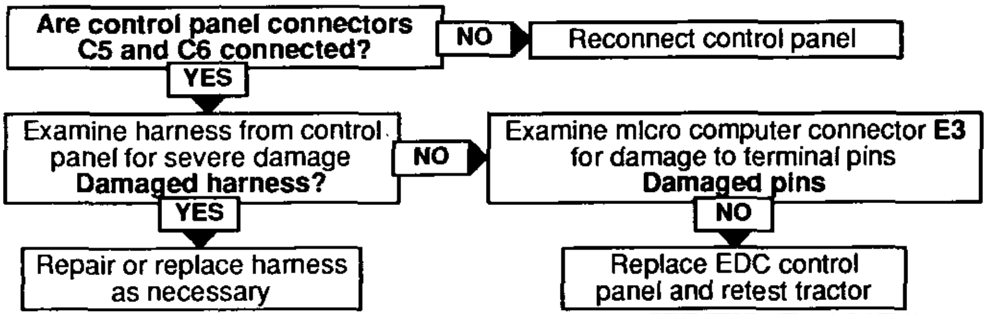
For EDC wiring diagram and connector location refer to the end of this Section



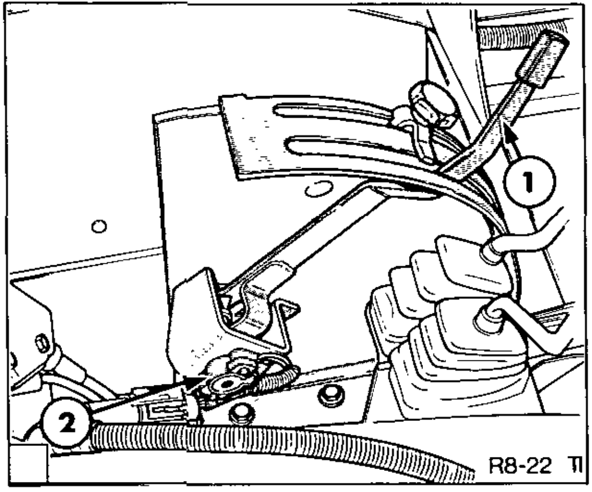
EDC Control Panel Connectors



Micro Computer Connector



Error Code 24 Perform Hydraulic Lift Autocalibration

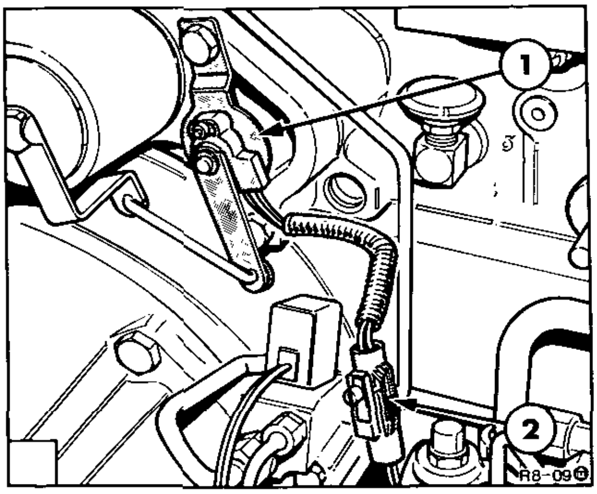


Lift Control Lever Potentiometer

1. Lift Control Lever
2. Potentiometer

This procedure is required whenever any of the following situations have occurred while the key–start switch was turned **'ON'**:–

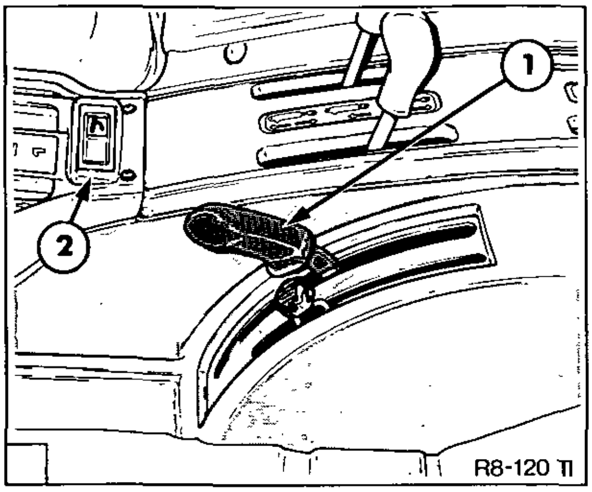
- The position sensing potentiometer on the right hand lift arm has been replaced.
- The micro computer has been replaced or its memory has been reset as detailed on Page 14 of this Chapter.
- The potentiometer on the lift control lever has been replaced.



Lift Arm Position Sensing Potentiometer

1. Potentiometer
2. Connector

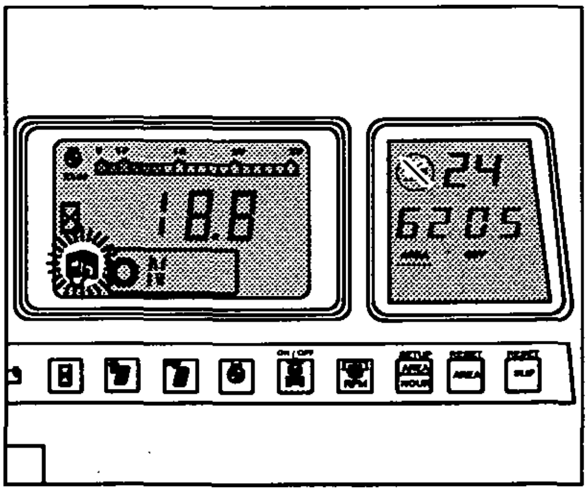
If Error Code 24 does not automatically appear after replacement of these potentiometers, or the operator is aware that *the system is not operating correctly*, the hydraulic lift system must be artificially put into the the Error Code 24 situation as follows:–



Hydraulic Lift Control Lever

1. Lift Control Lever
2. In Cab Raise/Lower Switch

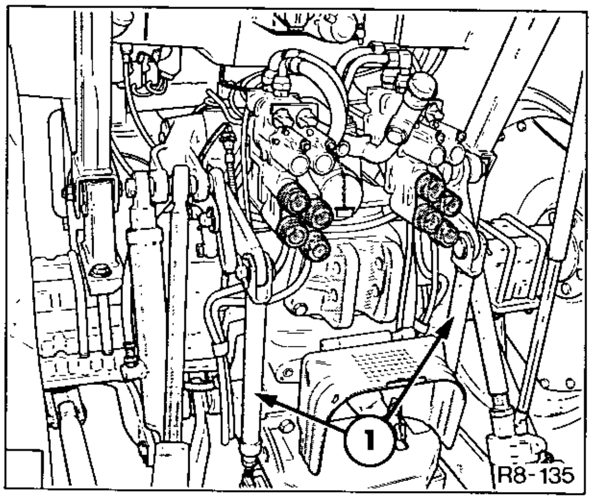
1. Press the bottom of the in cab raise/lower switch to select the lowering position.
2. Turn the key–start switch 'ON' but **Do Not** start the engine.
3. Disconnect and then reconnect the connector to either the lift control lever or position sensing potentiometers. Error code 25 or 27 will be displayed.



Error Code 24 Display
(Electronic Instrument Panel Shown)

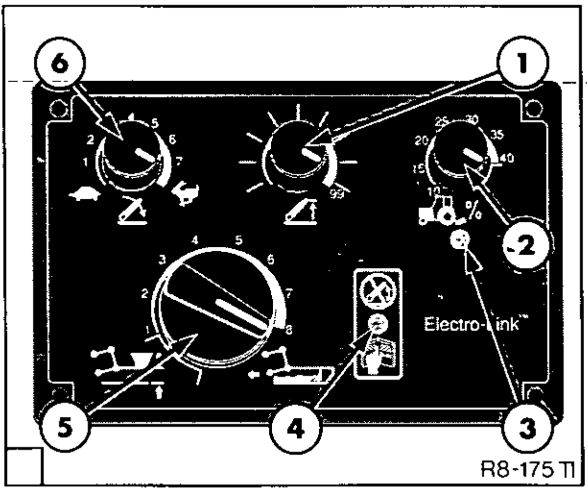
4. Turn key–start switch 'OFF' and then 'ON'. Error code 24 will now be displayed and the 'Read your Owners Manual' and 'Lift Disabled Symbols' will flash. The system must now be autocalibrated as *described in the following autocalibration* procedure.

AUTOCALIBRATION PROCEDURE



Automatic Pick–Up Hitch Lift Rods

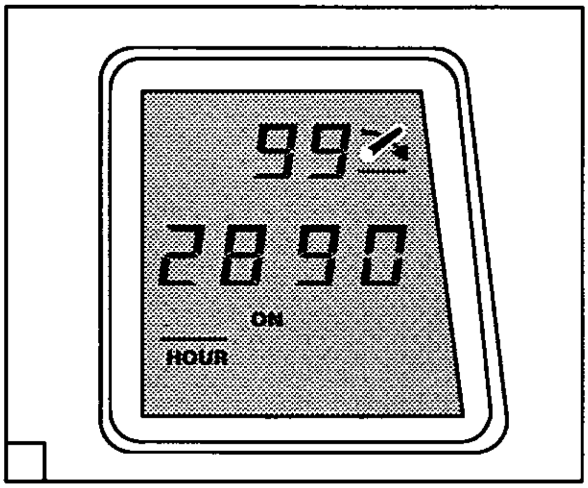
1. Disconnect vertical rods from hanger on automatic pick–up hitch (where fitted). This will allow the lift arms to raise to their maximum position.



Hydraulic Control Panel

1. Height Limit Control
2. Slip Limit Control
3. Slip Limit 'On' Indicator
4. Status Indicator
5. Position/Draft Sensitivity Knob
6. Drop Rate Control Knob

2. Turn all the EDC operator controls fully clockwise and set in cab raise/lower switch to lowering.
3. Start engine and set the engine speed to 1100 rpm.
4. Slowly move the lift control lever back and forth through its entire range until the "Hitch Disabled" symbol disappears.



Lift Height Position '99'

5. Pull the lift control lever back to the fully raised position and allow the lift to fully raise, at which point the relief valve (pressure compensating valve) in the hydraulic pump will momentarily operate. When the lift is at the top of its travel the digital display(s) will indicate a lift position of "99". This procedure calibrates the position sensing potentiometer on the right hand lift control arm and the potentiometer at the base of the lift control lever, for the 'Full Raise' condition of the hydraulic lift.
6. Move the lift control lever fully forward and past the mechanical detent. The "Lift Disabled" symbol will be displayed.
7. Slowly move the lift control lever rearwards until the "Lift Disabled" symbol disappears.
8. Move the lift control lever forward until it is against the mechanical detent.
9. Allow the lift arms to lower, the digital display will now indicate a lift position of "0".

The position sensing potentiometers are now calibrated for the hydraulic lift in the fully lowered condition. If the hydraulic valve has not been calibrated the lift arms may not be able to achieve position 0 or 99. Should this occur, repeat steps 8 and 9.

10. Using the lift control lever, slowly raise the hydraulic lift until the display shows a value between **70–90**. Leave the lift control lever in this position while the system carries out three automatic calibrations. This will start after a few seconds and will be observed as a slight raising followed by a slight lowering of the lift arms. This will be repeated automatically two more times over a period of approximately one minute.

11. Once the cycle has been completed, pull the lift control lever rearwards to raise the arms completely and ensure that "99" is shown on the display.

12. Reconnect and adjust the rod on the automatic pick–up hitch as follows:–

    Move the lift control lever forward to allow the lift arms to fall slowly, then quickly move the lift control lever fully forward to activate the external switches on the rear fenders.

    Reconnect the pick–up hitch lift rods.

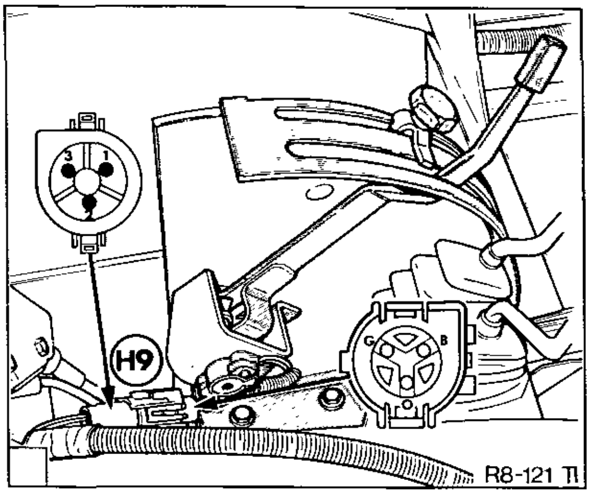
    Adjust the length of the lift rods so that when the hydraulic lift is fully raised using the external fender switches, the lift rods are slightly loose.

    Check that the automatic pick–up hitch operates correctly.

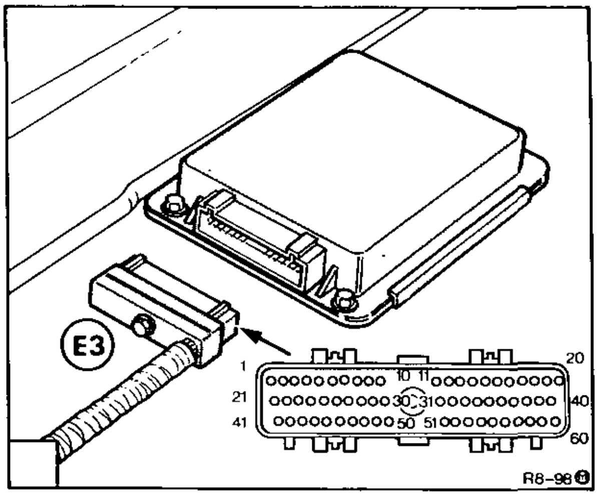
13. Capture the hydraulic lift with the lift control lever.

Error Codes 25 and 26 Lift Control Lever Potentiometer Disconnected or Circuit Failed

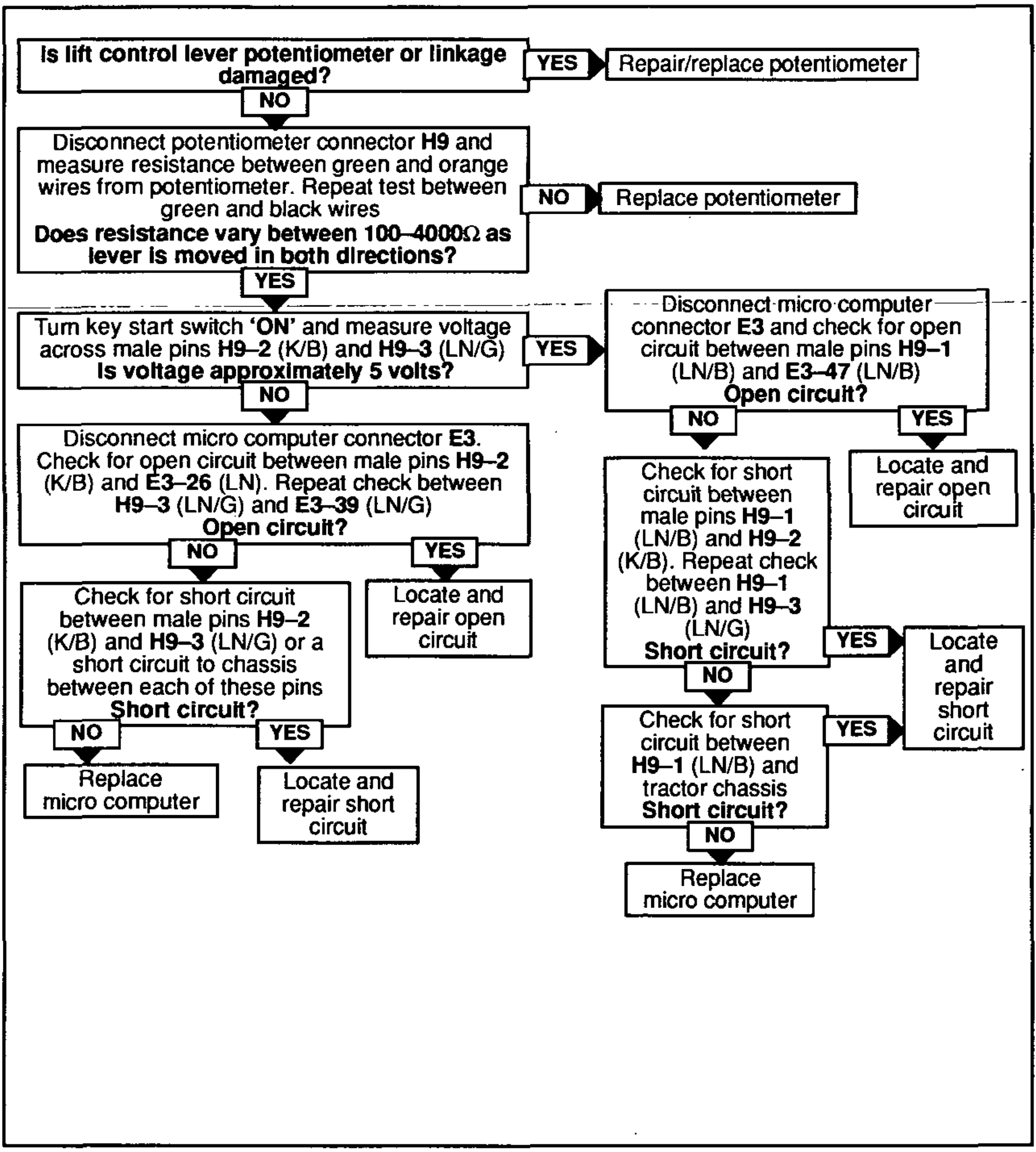
For EDC wiring diagram and connector location refer to end of this Section



Lift Control Lever Potentiometer



Micro Computer Connector



Is lift control lever potentiometer or linkage damaged?

YES → Repair/replace potentiometer

NO ↓

Disconnect potentiometer connector **H9** and measure resistance between green and orange wires from potentiometer. Repeat test between green and black wires
Does resistance vary between 100–4000Ω as lever is moved in both directions?

NO → Replace potentiometer

YES ↓

Turn key start switch **'ON'** and measure voltage across male pins **H9–2** (K/B) and **H9–3** (LN/G)
Is voltage approximately 5 volts?

YES → Disconnect micro computer connector **E3** and check for open circuit between male pins **H9–1** (LN/B) and **E3–47** (LN/B)
Open circuit?

- YES → Locate and repair open circuit
- NO → Check for short circuit between male pins **H9–1** (LN/B) and **H9–2** (K/B). Repeat check between **H9–1** (LN/B) and **H9–3** (LN/G)
  Short circuit?
  - YES → Locate and repair short circuit
  - NO → Check for short circuit between **H9–1** (LN/B) and tractor chassis
    Short circuit?
    - YES → Locate and repair short circuit
    - NO → Replace micro computer

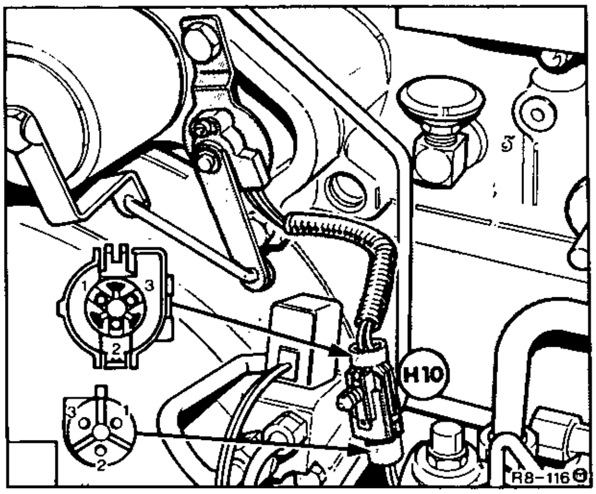
NO ↓

Disconnect micro computer connector **E3**. Check for open circuit between male pins **H9–2** (K/B) and **E3–26** (LN). Repeat check between **H9–3** (LN/G) and **E3–39** (LN/G)
Open circuit?

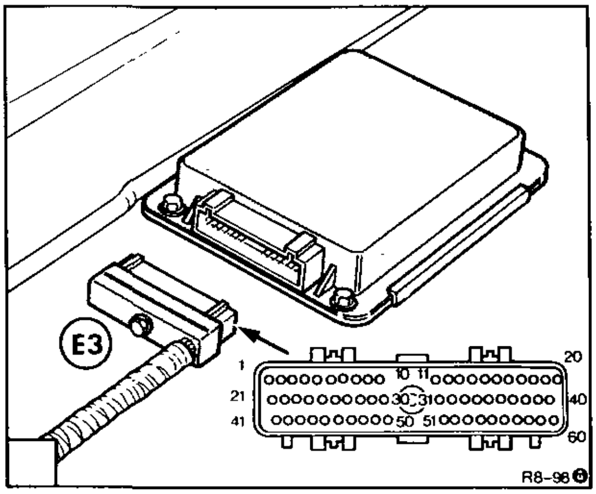
- YES → Locate and repair open circuit
- NO → Check for short circuit between male pins **H9–2** (K/B) and **H9–3** (LN/G) or a short circuit to chassis between each of these pins
  Short circuit?
  - NO → Replace micro computer
  - YES → Locate and repair short circuit

Error Codes 27 and 28 Lift Arm Position Sensing Potentiometer Disconnected or Circuit Failed

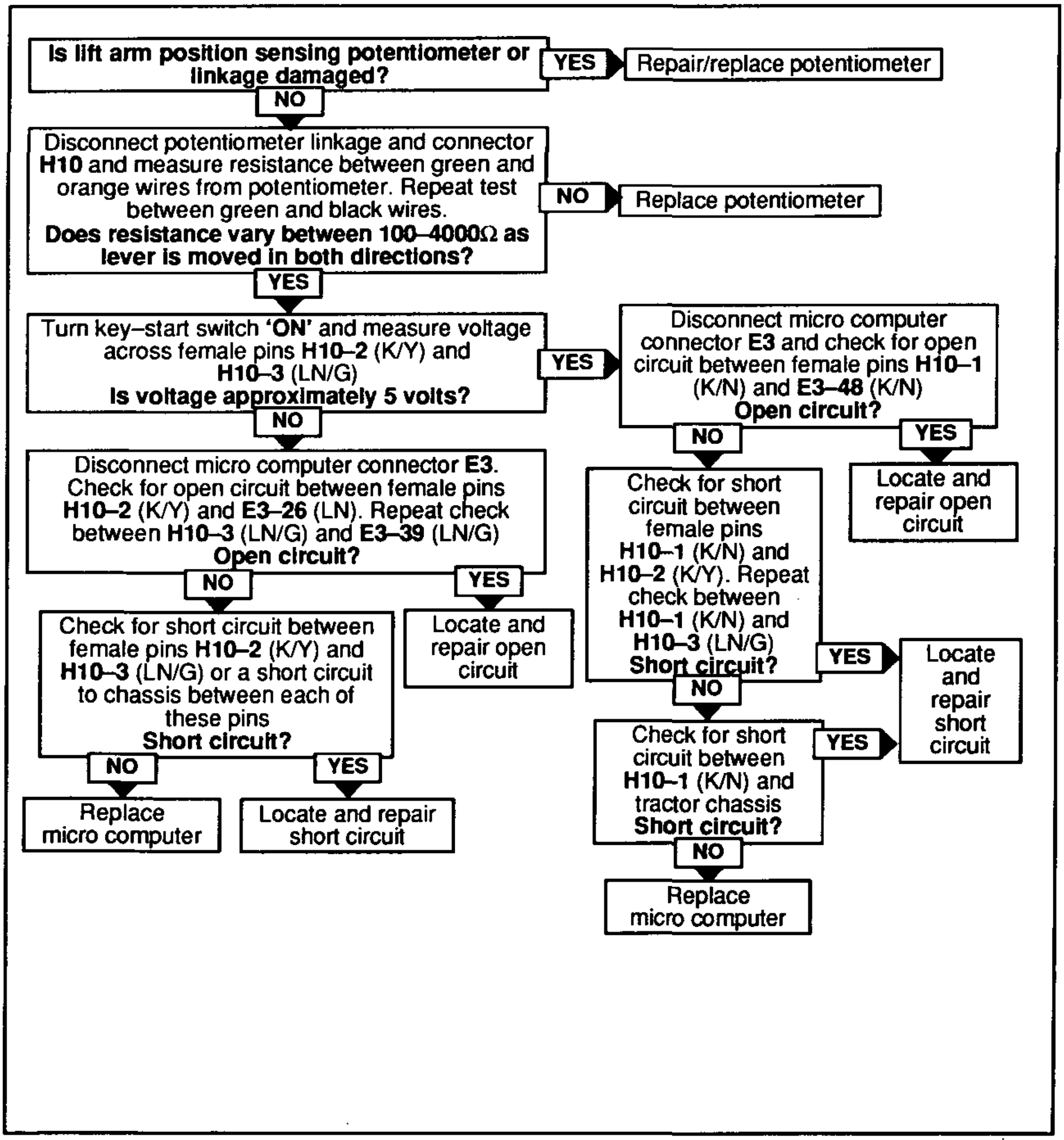
For EDC wiring diagram and connector location refer to end of this Section



Lift Arm Position Sensing Potentiometer



Micro Computer Connector



Is lift arm position sensing potentiometer or linkage damaged?

YES → Repair/replace potentiometer

NO ↓

Disconnect potentiometer linkage and connector **H10** and measure resistance between green and orange wires from potentiometer. Repeat test between green and black wires. **Does resistance vary between 100–4000Ω as lever is moved in both directions?**

NO → Replace potentiometer

YES ↓

Turn key–start switch **'ON'** and measure voltage across female pins **H10–2** (K/Y) and **H10–3** (LN/G) **Is voltage approximately 5 volts?**

YES → Disconnect micro computer connector **E3** and check for open circuit between female pins **H10–1** (K/N) and **E3–48** (K/N) **Open circuit?**

- YES → Locate and repair open circuit
- NO → Check for short circuit between female pins **H10–1** (K/N) and **H10–2** (K/Y). Repeat check between **H10–1** (K/N) and **H10–3** (LN/G) **Short circuit?**
  - YES → Locate and repair short circuit
  - NO → Check for short circuit between **H10–1** (K/N) and tractor chassis **Short circuit?**
    - YES → Locate and repair short circuit
    - NO → Replace micro computer

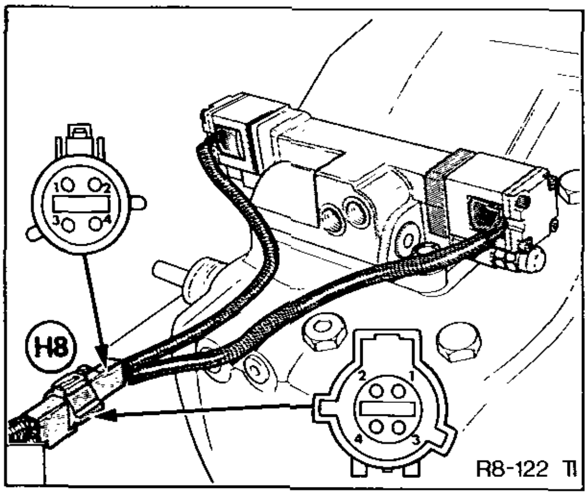
NO ↓

Disconnect micro computer connector **E3**. Check for open circuit between female pins **H10–2** (K/Y) and **E3–26** (LN). Repeat check between **H10–3** (LN/G) and **E3–39** (LN/G) **Open circuit?**

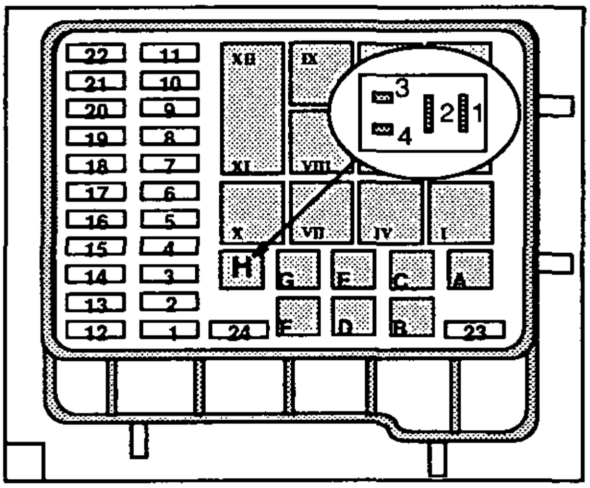
- YES → Locate and repair open circuit
- NO → Check for short circuit between female pins **H10–2** (K/Y) and **H10–3** (LN/G) or a short circuit to chassis between each of these pins **Short circuit?**
  - NO → Replace micro computer
  - YES → Locate and repair short circuit

Error Code 29 Hydraulic Control Valve Shorted or Open Circuit

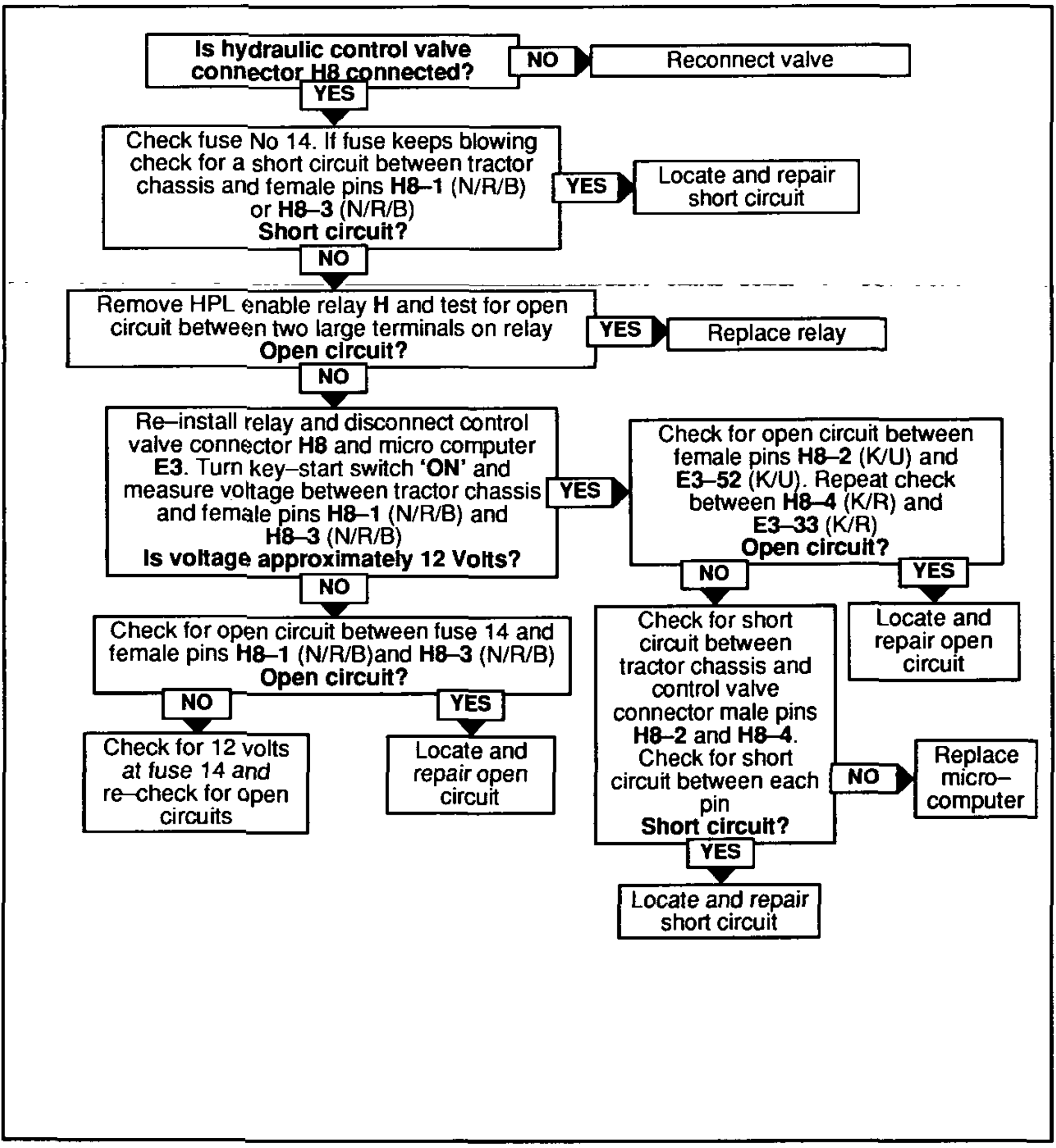
For EDC wiring diagram and connector location refer to end of this Section



Hydraulic Control Valve



Fuse Panel and HPL Enable Relay



Is hydraulic control valve connector H8 connected?

NO → Reconnect valve

YES → Check fuse No 14. If fuse keeps blowing check for a short circuit between tractor chassis and female pins **H8–1** (N/R/B) or **H8–3** (N/R/B) **Short circuit?**

YES → Locate and repair short circuit

NO → Remove HPL enable relay **H** and test for open circuit between two large terminals on relay **Open circuit?**

YES → Replace relay

NO → Re–install relay and disconnect control valve connector **H8** and micro computer **E3**. Turn key–start switch **'ON'** and measure voltage between tractor chassis and female pins **H8–1** (N/R/B) and **H8–3** (N/R/B) **Is voltage approximately 12 Volts?**

YES → Check for open circuit between female pins **H8–2** (K/U) and **E3–52** (K/U). Repeat check between **H8–4** (K/R) and **E3–33** (K/R) **Open circuit?**

YES → Locate and repair open circuit

NO → Check for short circuit between tractor chassis and control valve connector male pins **H8–2** and **H8–4**. Check for short circuit between each pin **Short circuit?**

NO → Replace micro–computer

YES → Locate and repair short circuit

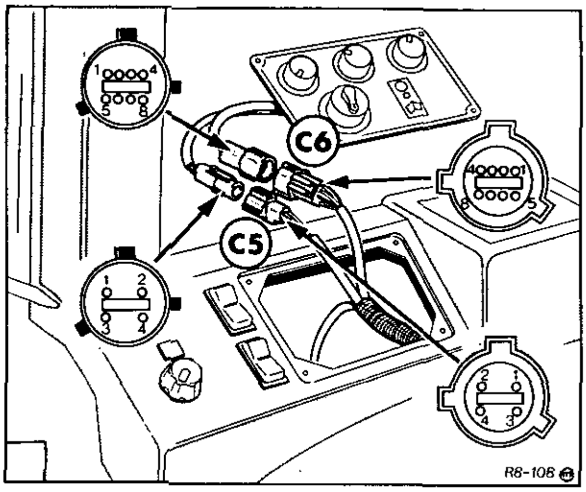
NO → Check for open circuit between fuse 14 and female pins **H8–1** (N/R/B)and **H8–3** (N/R/B) **Open circuit?**

NO → Check for 12 volts at fuse 14 and re–check for open circuits

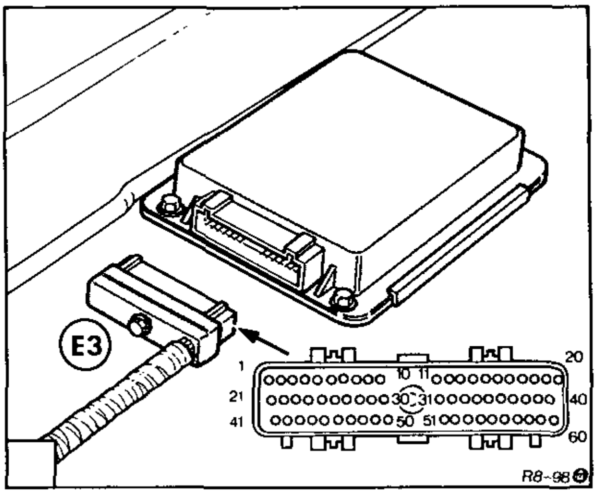
YES → Locate and repair open circuit

Error Code 30 Signal Ground Failure to Operator Control Console

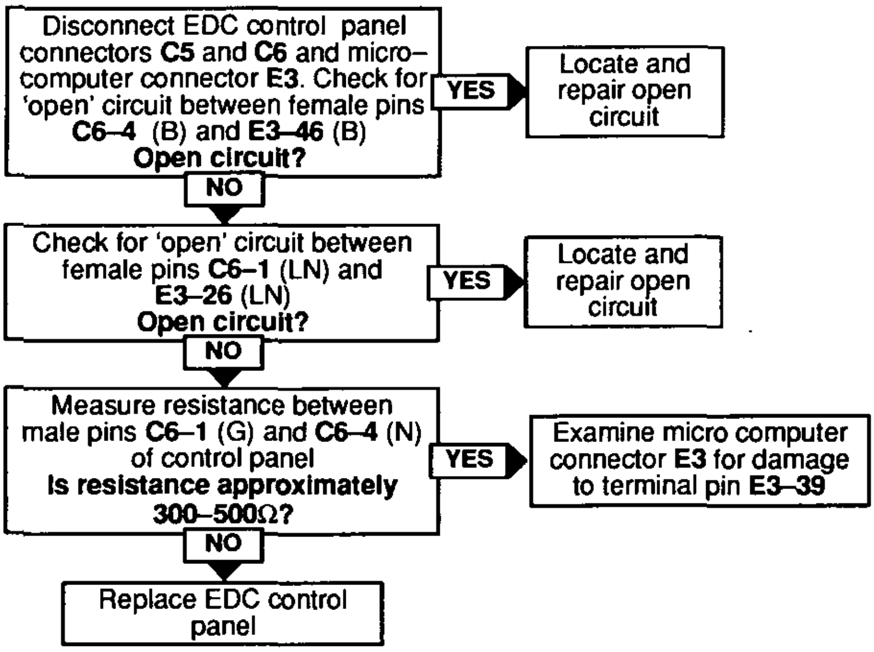
For EDC wiring diagram and connector location refer to end of this Section



EDC Control Panel Connectors



Micro Computer Connector



Disconnect EDC control panel connectors **C5** and **C6** and micro-computer connector **E3**. Check for 'open' circuit between female pins **C6–4** (B) and **E3–46** (B) **Open circuit?**

YES: Locate and repair open circuit

NO: Check for 'open' circuit between female pins **C6–1** (LN) and **E3–26** (LN) **Open circuit?**

YES: Locate and repair open circuit

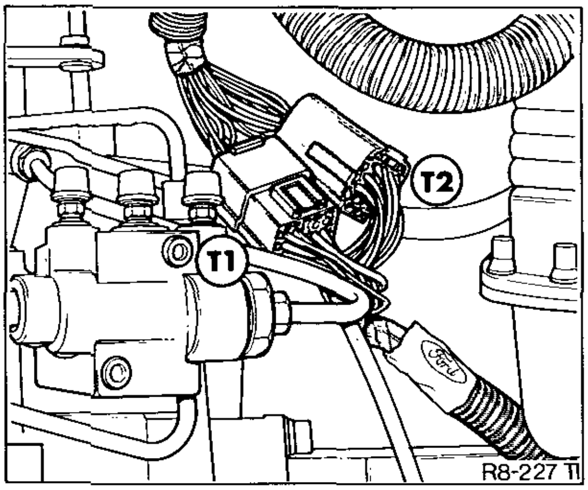
NO: Measure resistance between male pins **C6–1** (G) and **C6–4** (N) of control panel **Is resistance approximately 300–500Ω?**

YES: Examine micro computer connector **E3** for damage to terminal pin **E3–39**

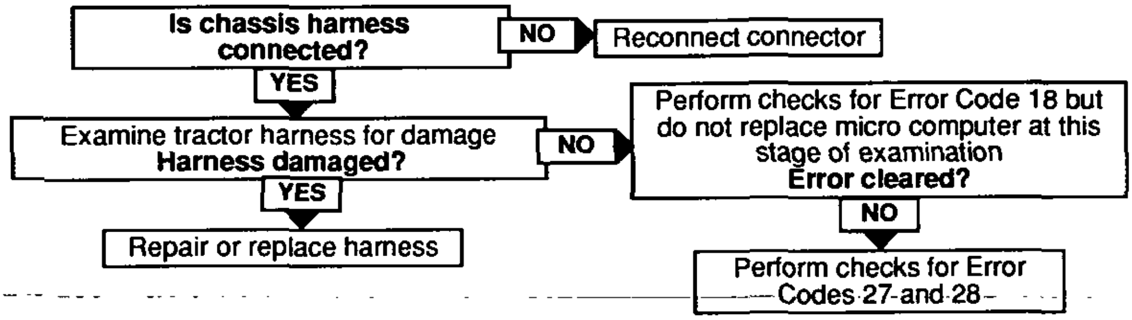
NO: Replace EDC control panel

Error Code 31 Chassis Harness Disconnected

For EDC wiring diagram and connector location refer to end of this Section



Chassis Harness Connectors



Is chassis harness connected?

NO → Reconnect connector

YES → Examine tractor harness for damage **Harness damaged?**

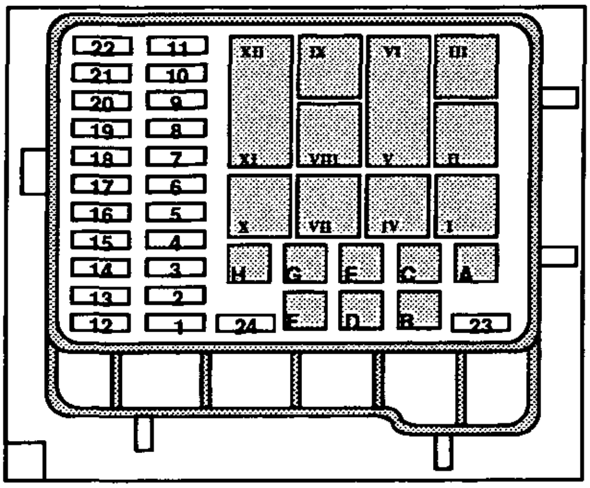
YES → Repair or replace harness

NO → Perform checks for Error Code 18 but do not replace micro computer at this stage of examination **Error cleared?**

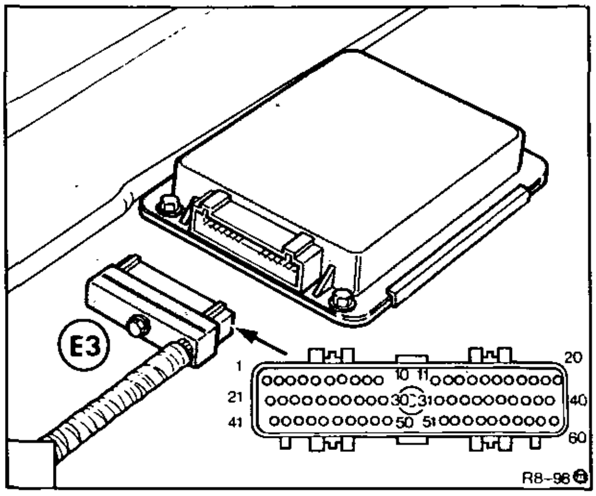
NO → Perform checks for Error Codes 27 and 28

Error Code 32 Keep Alive Power Supply Failed

For EDC wiring diagram and connector location refer to end of this Section

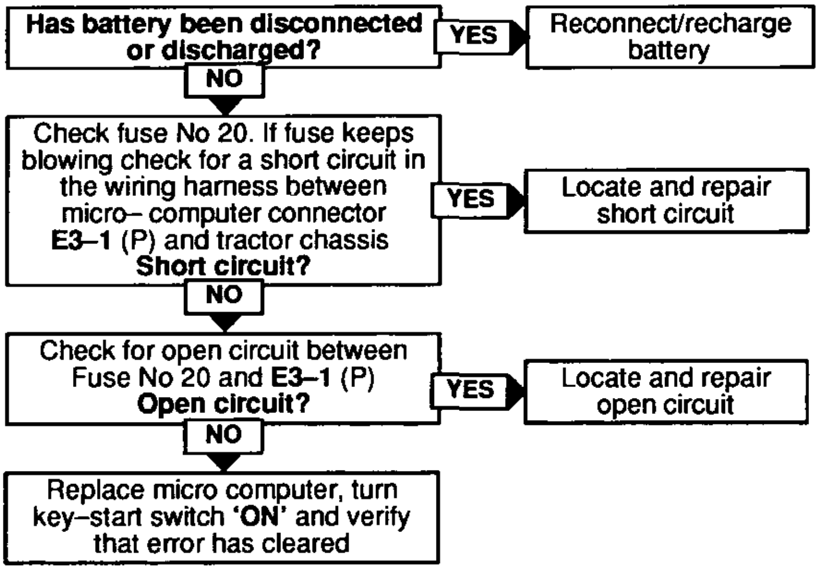


Fuse Panel



Micro Computer Connector

The keep alive memory (KAM) stores the calibration parameters for the electronic draft control system. A back up set of parameters are also stored in a micro chip, located in the micro computer and known as the non volatile memory. This error code is self rectifying but will occur each time the key–start switch is turned 'On', if the check items listed below occur.



Has battery been disconnected or discharged?
YES → Reconnect/recharge battery
NO ↓

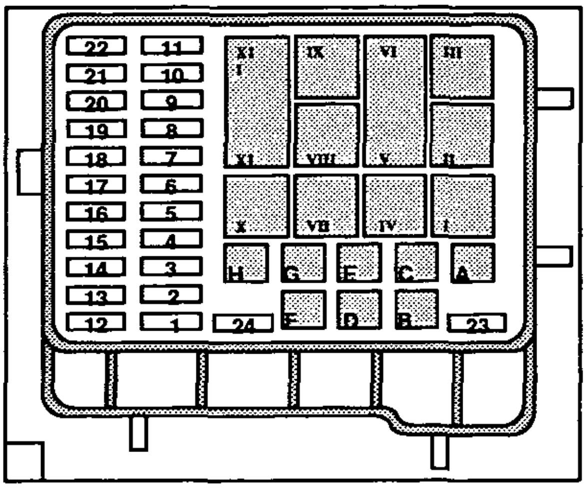
Check fuse No 20. If fuse keeps blowing check for a short circuit in the wiring harness between micro– computer connector **E3–1** (P) and tractor chassis **Short circuit?**
YES → Locate and repair short circuit
NO ↓

Check for open circuit between Fuse No 20 and **E3–1** (P) **Open circuit?**
YES → Locate and repair open circuit
NO ↓

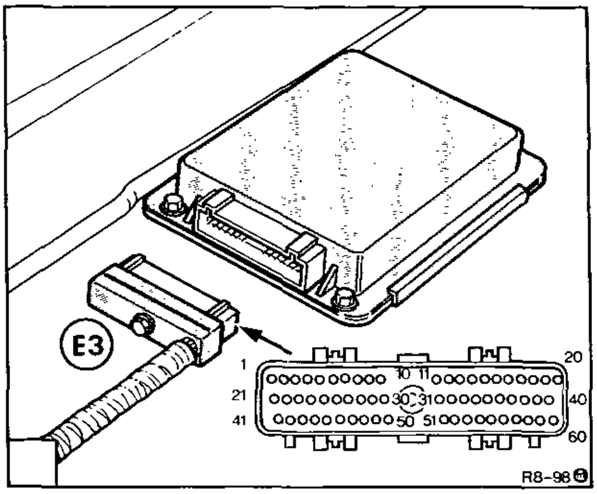
Replace micro computer, turn key–start switch **'ON'** and verify that error has cleared

Error Code 56 Hydraulic Lift Disabled due to Failure

For EDC wiring diagram and connector location refer to end of this Section



Fuse Panel



Micro Computer Connector

This error code will be displayed if the micro computer detects that the hydraulic lift arms are lowering when a lower command has not been given.

Start the tractor and position the hydraulic lift so that the implement position display reads approximately 50. Remove fuse No 14 and start the tractor engine **Do the hydraulic lift arms move?**

YES → Overhaul hydraulic control valve and inspect spools for sticking in lowering position

NO ↓

With fuse 14 removed, disconnect micro computer connector **E3**. Check for short circuit between **E3–33** (K/R) and tractor chassis **Short circuit?**

YES → Locate and repair short circuit

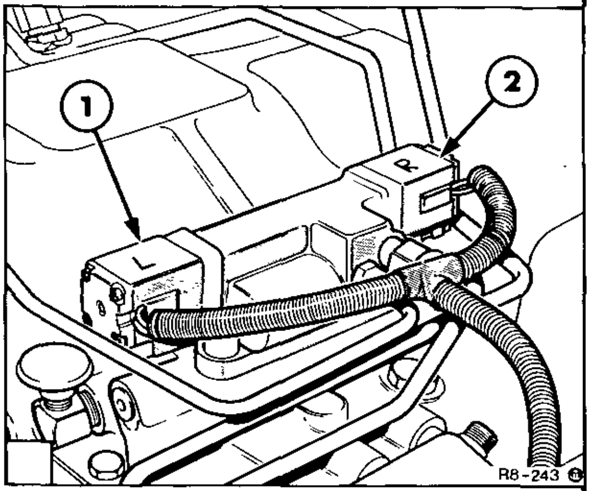
NO ↓

If error code 56 is occurring intermittently and the hydraulic lift arms appear to lower at the time the error occurs, check for intermittent short circuit between **E3–33** (K/R) and tractor chassis **Intermittent short circuit found?**

YES → Locate and repair short circuit

NO ↓

Check that the hydraulic control valve lower solenoid wires are not rubbing against the solenoid case causing a short circuit

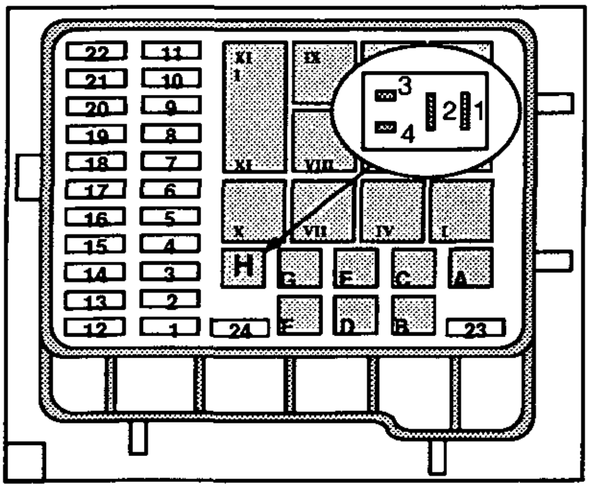


Hydraulic Control Valve Solenoids

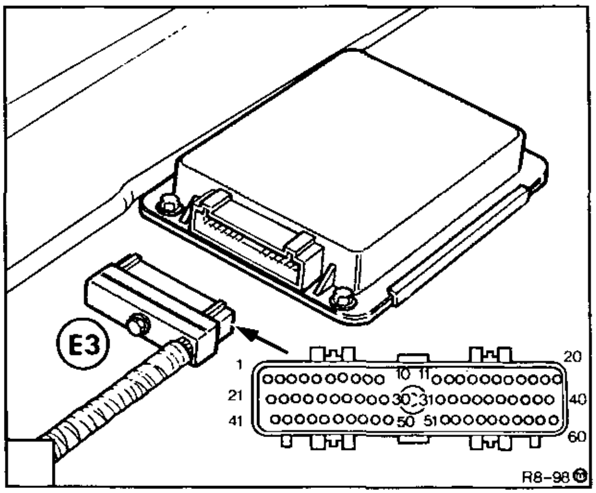
1. Lower Solenoid
2. Raise Solenoid

Error Code 57 EDC Hydraulic Valve Power Supply Relay Failure

For EDC wiring diagram and connector location refer to end of this Section



Fuse Panel and HPL Enable Relay



Micro–computer Connector

Remove the HPL enable relay **H**. Turn key–start switch **'ON'** **Is Error Code 57 replaced by Error Code 29?**

NO → Locate and repair short circuit to battery voltage of N/R/B coloured wire between enable relay terminal **3** in fuse panel and hydraulic control valve solenoids

YES ↓

Disconnect micro–computer connector **E3** Check for short circuit between pins **E3–32** (N/S/B) and tractor chassis **Short Circuit?**

YES → Locate and repair short circuit

NO ↓

Remove HPL enable relay **H**, turn key–start switch **'ON'** and measure voltage between enable relay terminal **3** and **4** in fuse box **Is Voltage Approximately 12 Volts?**

YES → Replace HPL enable relay

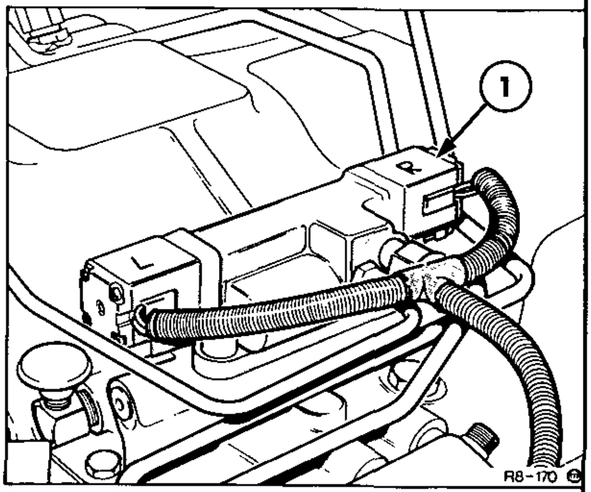
NO ↓

Check for open circuit between **E3–32** (N/S/B) and enable relay terminal **3** in fuse box **Open Circuit?**

YES → Locate and repair open circuit

NO ↓

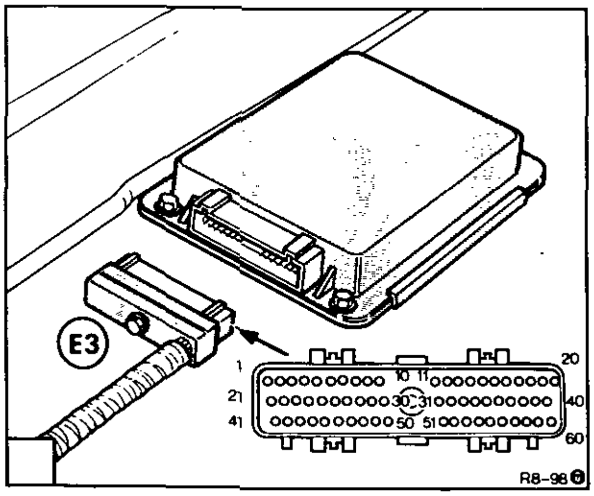
Locate and repair open circuit between enable relay terminal **4** in fuse box and tractor chassis



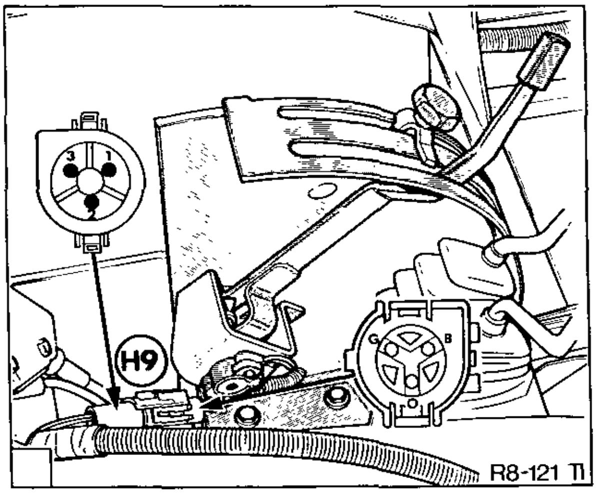
Hydraulic Control Valve

Error Code 58 Sensor Ground Failure

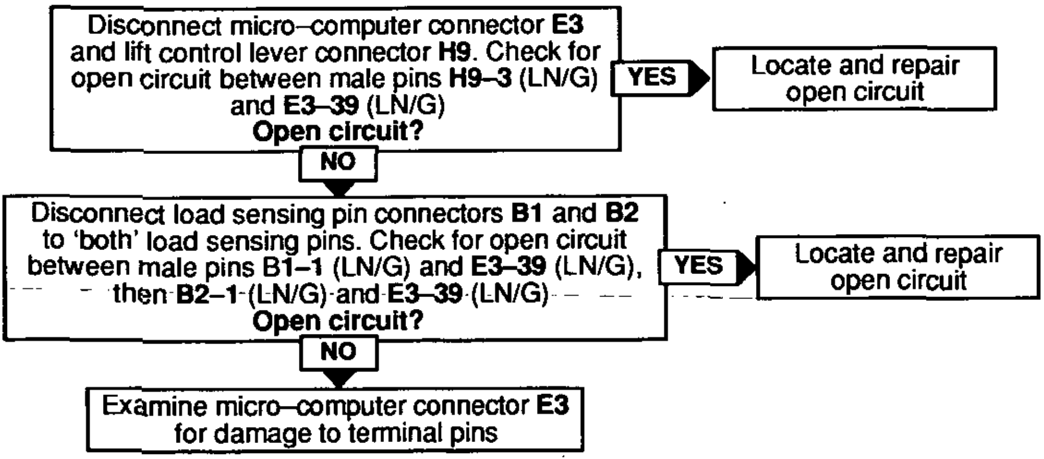
For EDC wiring diagram and connector location refer to end of this Section



Micro–Computer Connector



Lift Control Lever Connector



Disconnect micro–computer connector **E3** and lift control lever connector **H9**. Check for open circuit between male pins **H9–3** (LN/G) and **E3–39** (LN/G)
Open circuit?

YES → Locate and repair open circuit

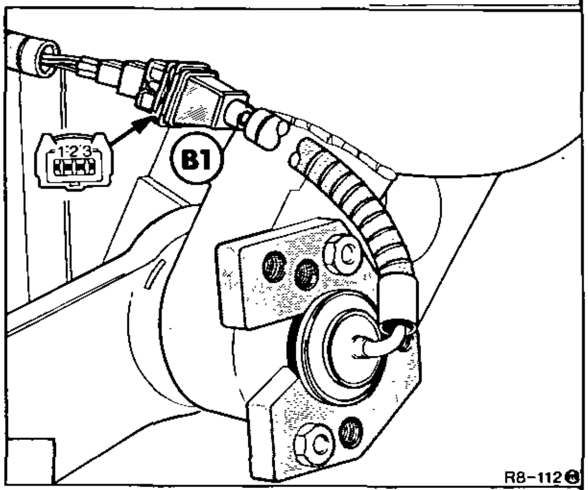
NO ↓

Disconnect load sensing pin connectors **B1** and **B2** to 'both' load sensing pins. Check for open circuit between male pins B1–1 (LN/G) and **E3–39** (LN/G), then **B2–1** (LN/G) and **E3–39** (LN/G)
Open circuit?

YES → Locate and repair open circuit

NO ↓

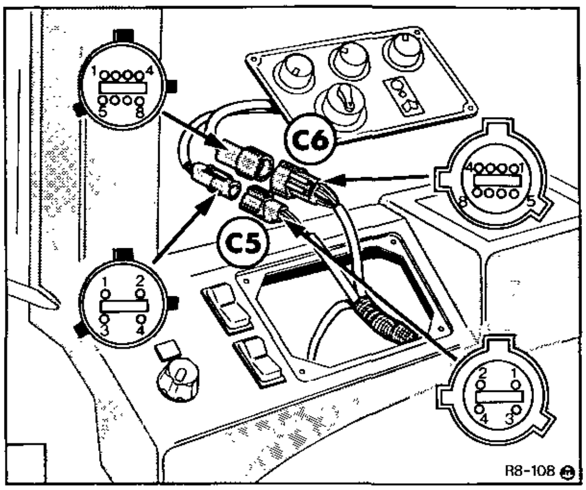
Examine micro–computer connector **E3** for damage to terminal pins



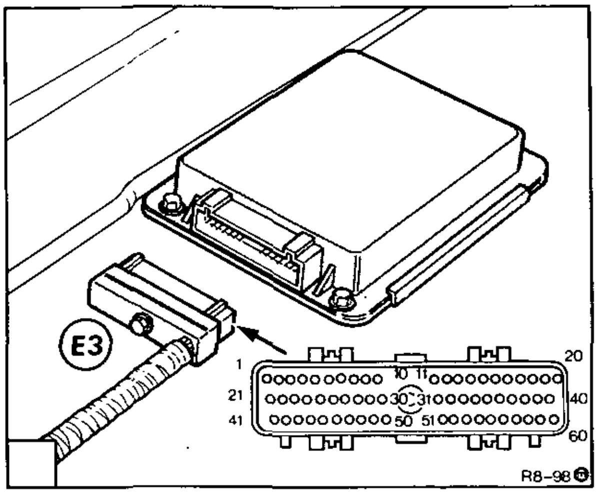
Load Sensing Pins (Right Hand Pin Shown)

Error Code 59 Micro–computer Reference Voltage Failed

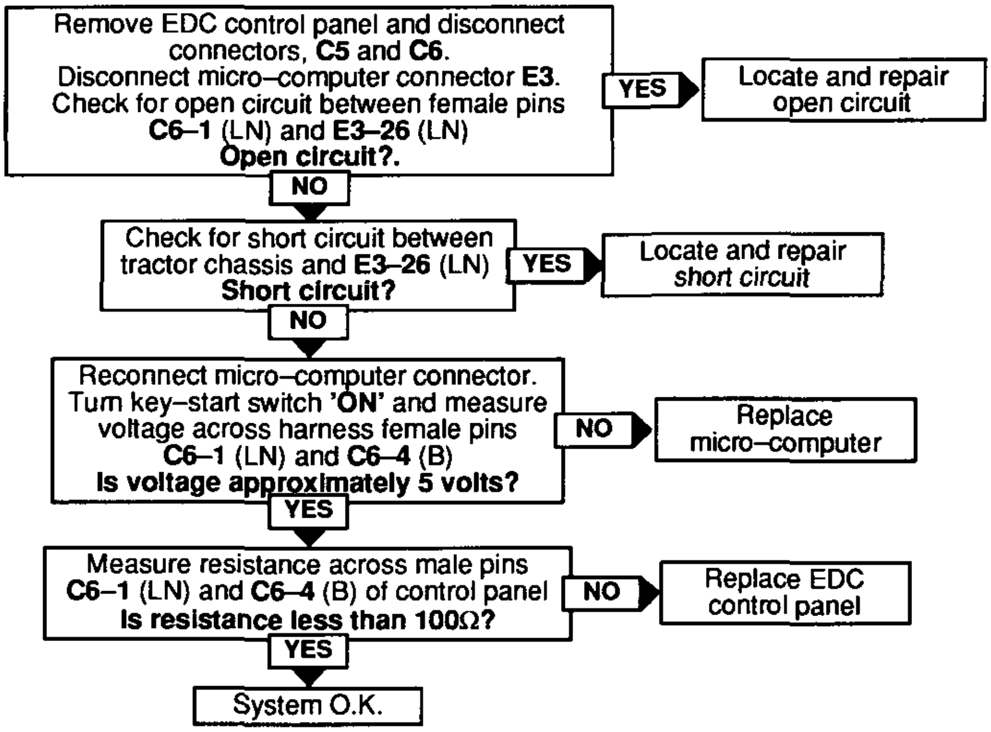
For EDC wiring diagram and connector location refer to end of this Section



EDC Control Panel Connectors

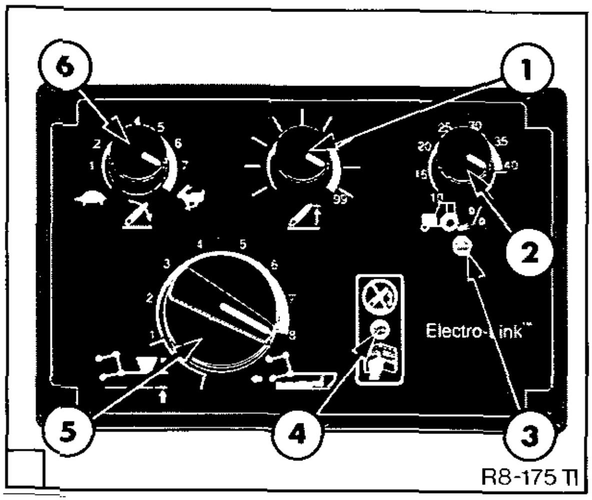


Micro–computer Connector

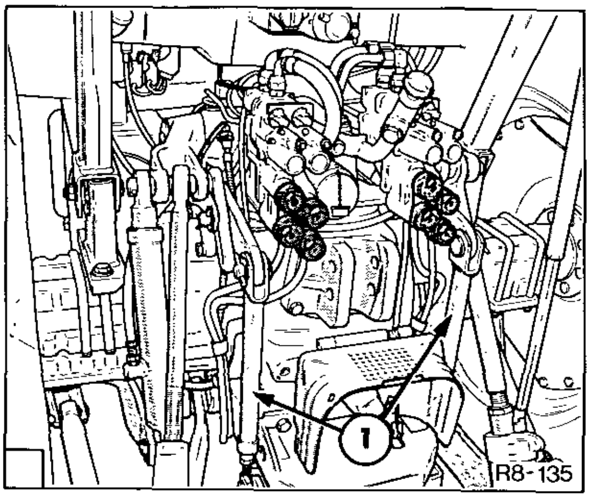


Error Codes 60, 61 and 62 EDC Hydraulic Valve Thresholds Out of Range

For EDC wiring diagram and connector location refer to end of this Section

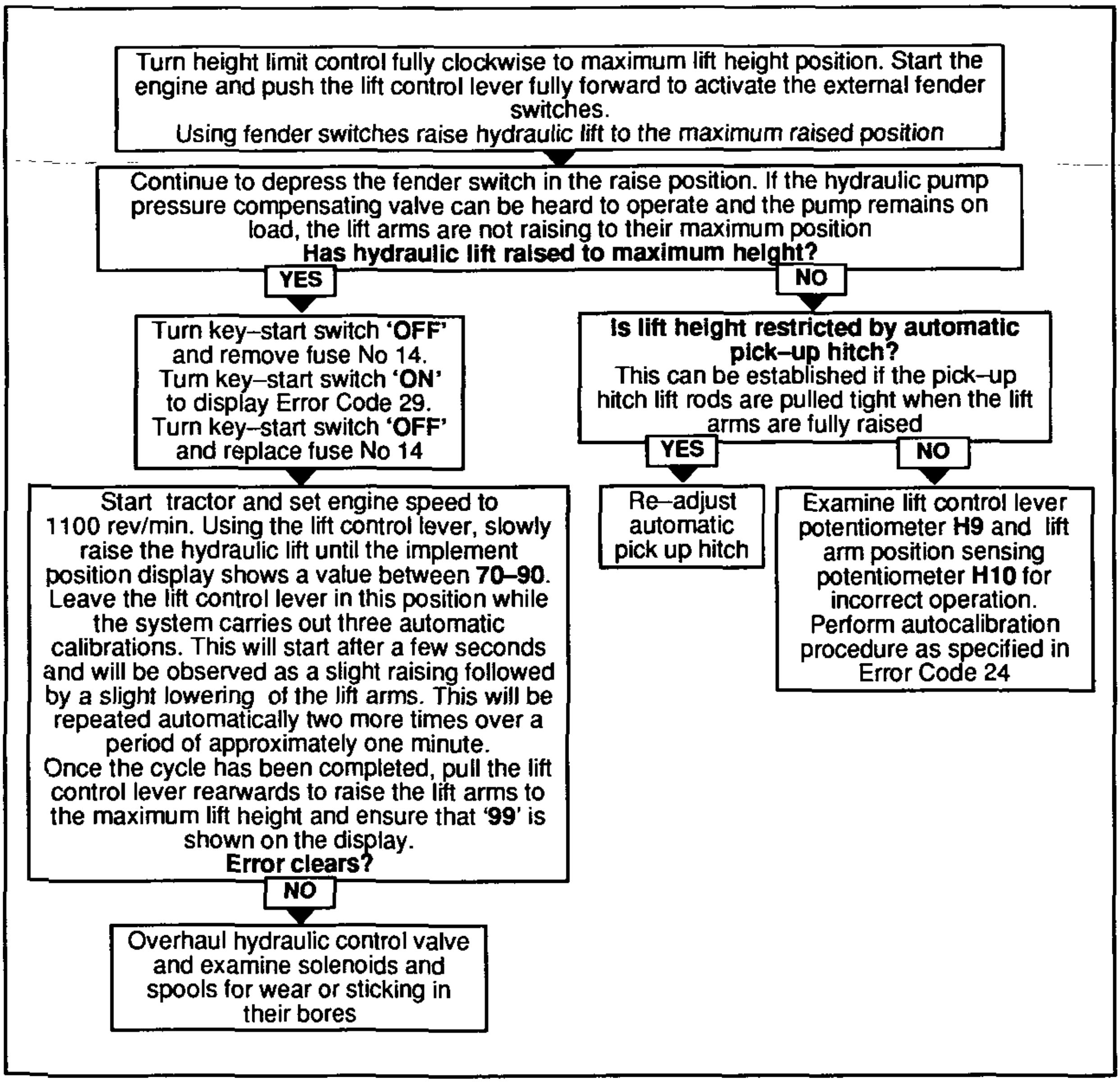


Hydraulic Control Panel



Automatic Pick Up Hitch Lift Rods

1. Height Limit Control
2. Slip Limit Control
3. Slip Limit 'On' Indicator
4. Status Indicator
5. Position/Draft Sensitivity Knob
6. Drop Rate Control Knob



Turn height limit control fully clockwise to maximum lift height position. Start the engine and push the lift control lever fully forward to activate the external fender switches.
Using fender switches raise hydraulic lift to the maximum raised position

Continue to depress the fender switch in the raise position. If the hydraulic pump pressure compensating valve can be heard to operate and the pump remains on load, the lift arms are not raising to their maximum position
Has hydraulic lift raised to maximum height?

YES

Turn key–start switch **'OFF'** and remove fuse No 14. Turn key–start switch **'ON'** to display Error Code 29. Turn key–start switch **'OFF'** and replace fuse No 14

Start tractor and set engine speed to 1100 rev/min. Using the lift control lever, slowly raise the hydraulic lift until the implement position display shows a value between **70–90**. Leave the lift control lever in this position while the system carries out three automatic calibrations. This will start after a few seconds and will be observed as a slight raising followed by a slight lowering of the lift arms. This will be repeated automatically two more times over a period of approximately one minute.
Once the cycle has been completed, pull the lift control lever rearwards to raise the lift arms to the maximum lift height and ensure that **'99'** is shown on the display.
Error clears?

NO

Overhaul hydraulic control valve and examine solenoids and spools for wear or sticking in their bores

NO

Is lift height restricted by automatic pick–up hitch?
This can be established if the pick–up hitch lift rods are pulled tight when the lift arms are fully raised

YES

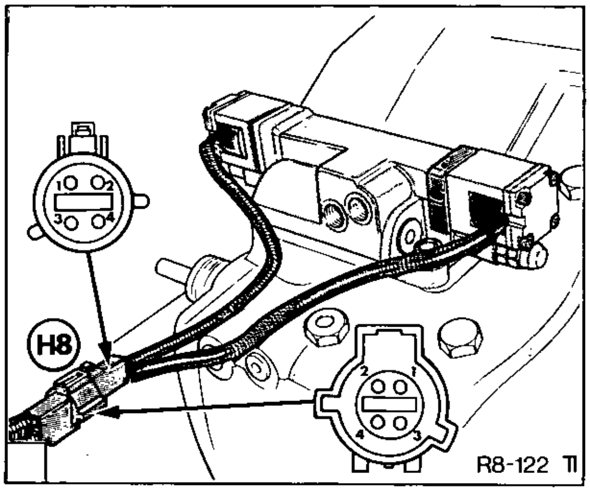
Re–adjust automatic pick up hitch

NO

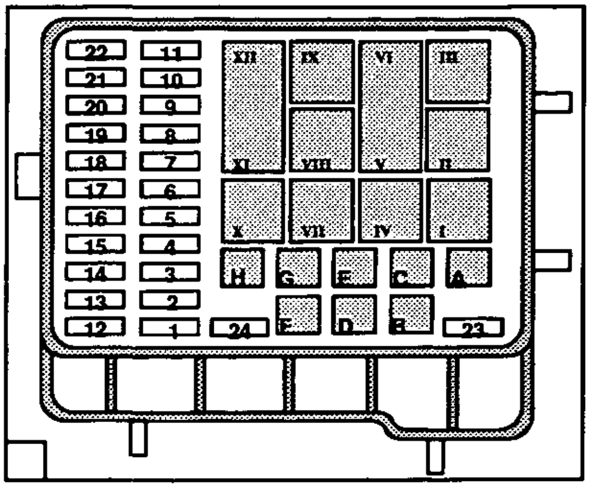
Examine lift control lever potentiometer **H9** and lift arm position sensing potentiometer **H10** for incorrect operation. Perform autocalibration procedure as specified in Error Code 24

Error Code 63 EDC Hydraulic Valve Lower Solenoid Failed

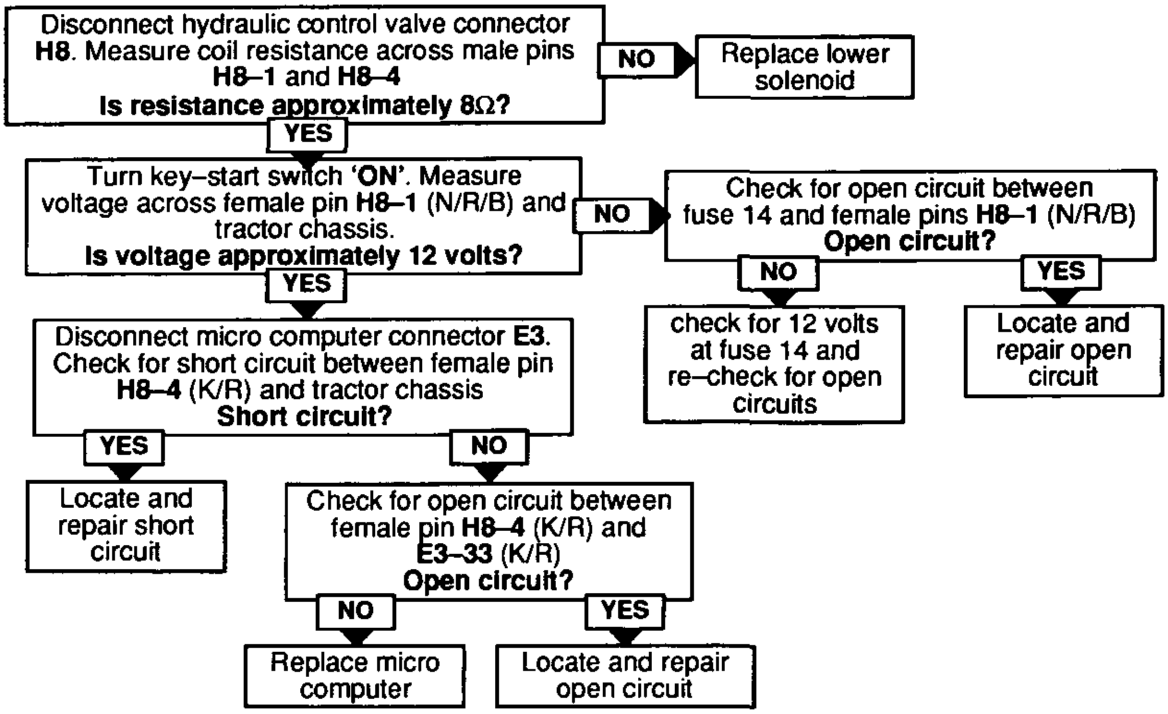
For EDC wiring diagram and connector location refer to end of this Section



Hydraulic Control Valve

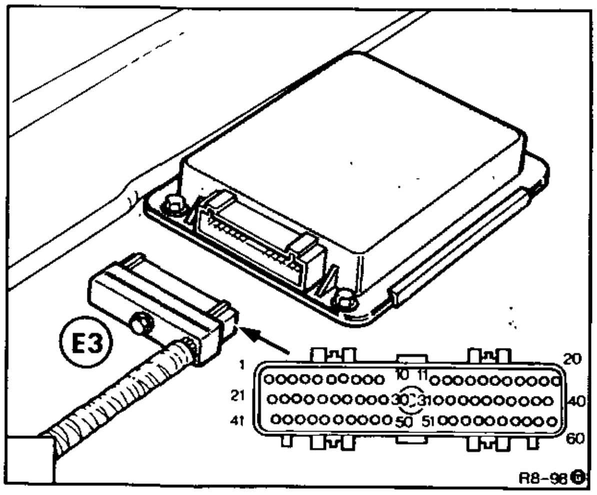


Fuse Panel



Disconnect hydraulic control valve connector **H8**. Measure coil resistance across male pins **H8–1** and **H8–4**
Is resistance approximately 8Ω?

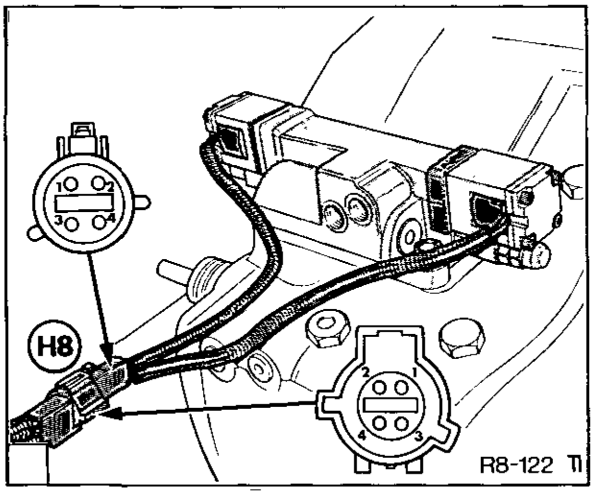
- **NO** → Replace lower solenoid
- **YES** → Turn key–start switch **'ON'**. Measure voltage across female pin **H8–1** (N/R/B) and tractor chassis.
  Is voltage approximately 12 volts?
  - **NO** → Check for open circuit between fuse 14 and female pins **H8–1** (N/R/B)
    Open circuit?
    - **NO** → check for 12 volts at fuse 14 and re–check for open circuits
    - **YES** → Locate and repair open circuit
  - **YES** → Disconnect micro computer connector **E3**. Check for short circuit between female pin **H8–4** (K/R) and tractor chassis
    Short circuit?
    - **YES** → Locate and repair short circuit
    - **NO** → Check for open circuit between female pin **H8–4** (K/R) and **E3–33** (K/R)
      Open circuit?
      - **NO** → Replace micro computer
      - **YES** → Locate and repair open circuit



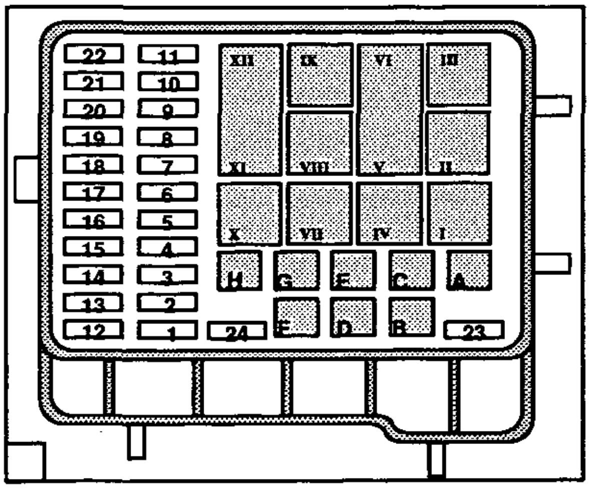
Micro Computer Connector

Error Code 64 EDC Hydraulic Valve Raise Solenoid Failed

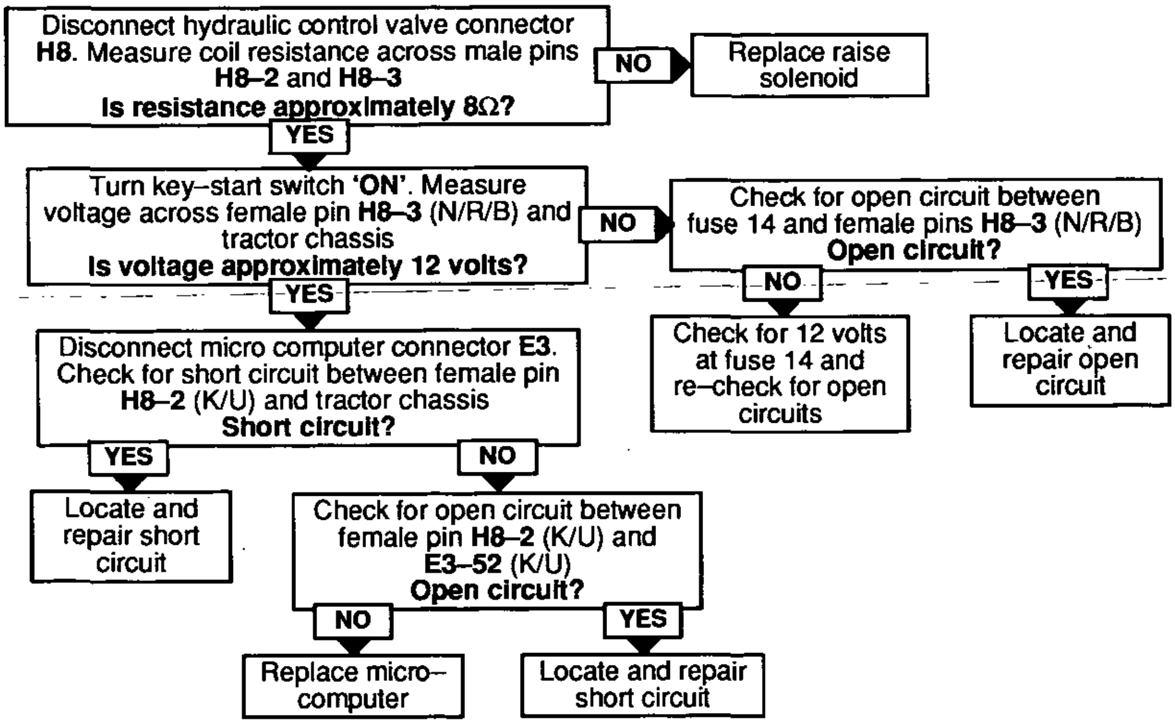
For EDC wiring diagram and connector location refer to end of this Section



Hydraulic Control Valve



Fuse Panel



Disconnect hydraulic control valve connector **H8**. Measure coil resistance across male pins **H8–2** and **H8–3**
Is resistance approximately 8Ω?

NO → Replace raise solenoid

YES → Turn key–start switch **'ON'**. Measure voltage across female pin **H8–3** (N/R/B) and tractor chassis
Is voltage approximately 12 volts?

NO → Check for open circuit between fuse 14 and female pins **H8–3** (N/R/B)
Open circuit?

NO → Check for 12 volts at fuse 14 and re–check for open circuits

YES → Locate and repair open circuit

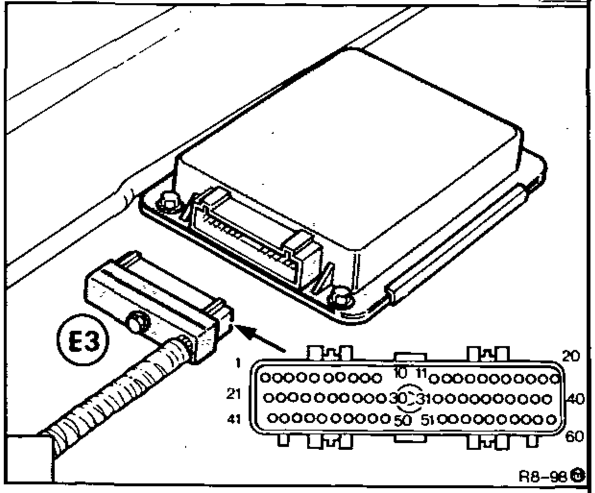
YES → Disconnect micro computer connector **E3**. Check for short circuit between female pin **H8–2** (K/U) and tractor chassis
Short circuit?

YES → Locate and repair short circuit

NO → Check for open circuit between female pin **H8–2** (K/U) and **E3–52** (K/U)
Open circuit?

NO → Replace micro–computer

YES → Locate and repair short circuit

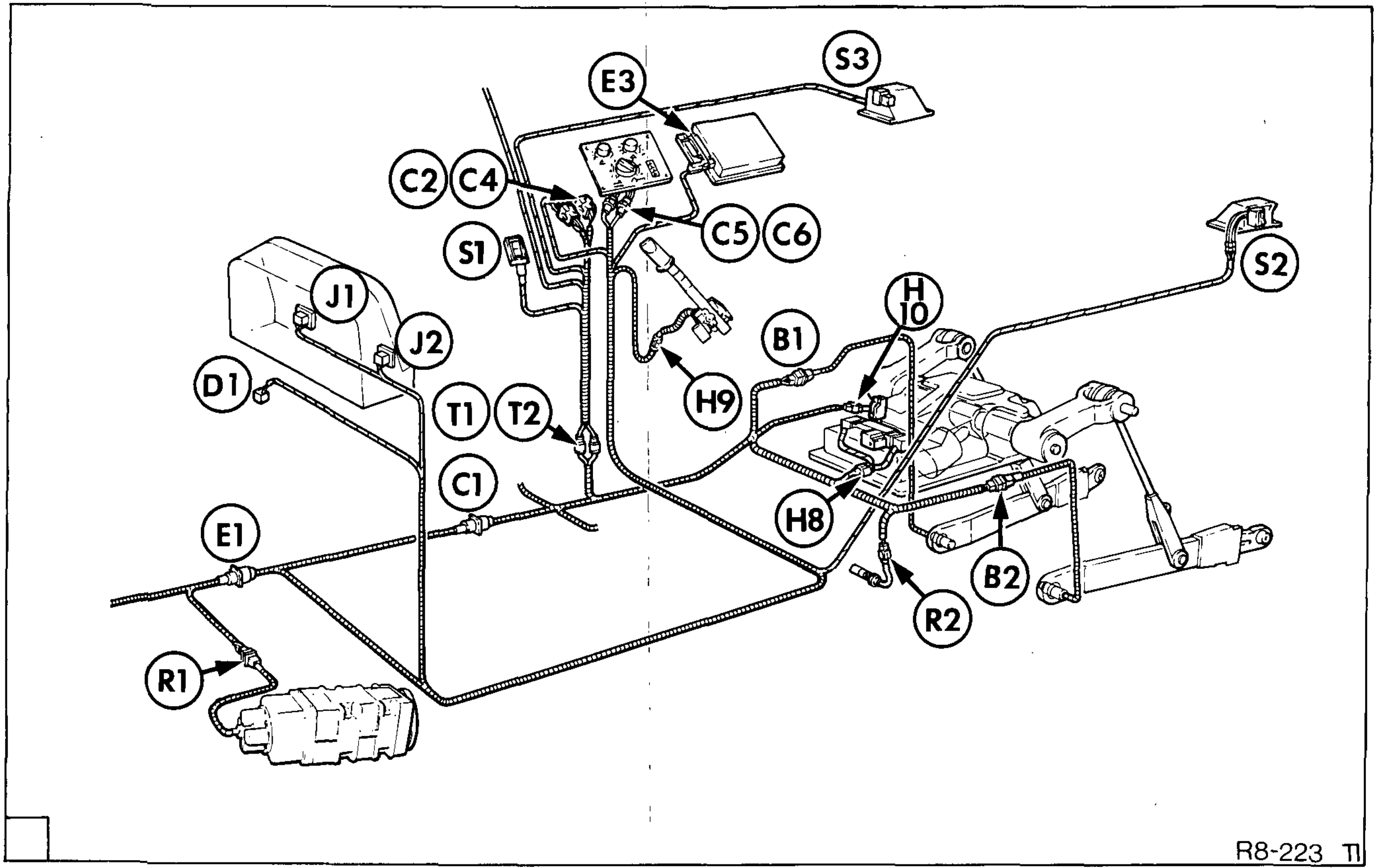


Micro Computer Connector

Fault Diagnostic Chart for Errors Not Detected by the Micro Computer

The following fault diagnostic chart relates to hydraulic or mechanical failures which are not detected by the micro–computer and for which there is no error code displayed.

SYMPTON	POSSIBLE CAUSE	DIAGNOSTIC PROCEDURE
Hydraulic lift will not operate.	**Auxiliary services (ASC) selected.**	**Ensure ASC selector lever is in disengaged position.**
	No pilot pressure to EDC hydraulic control valve.	**Perform hydraulic pump load sensing circuit check. Refer to Chapter 2 Section D "Pressure Testing of CCLS Hydraulic Pump".**
	EDC load check valve sticking,	**Disconnect EDC valve pilot pressure line and check for blockage. Examine load check valve.**
Hydraulic lift will not lower.	**Load check valve piston sticking.**	**Examine load check piston.**
	Control valve spool sticking.	**Examine spool.**
	Lowering solenoid spool sticking.	**Examine solenoid spool.**
	EDC Valve lower solenoid out of adjustment.	**Examine solenoid adjustment screw for signs of tampering**
	Dirt in control valve orifices.	**Wash valve.**
Lift arms move when not in operation/eratic operation.	**EDC valve receiving electronic signal.**	**Disconnect EDC valve connector and trace wiring fault if arms remain stationary.**
	Pilot or control valve spools sticking.	**Examine pilot and control valve spools for sticking.**
	EDC valve solenoids out of adjustment or plunger worn.	**Examine solenoid for signs of tampering, mis–adjustment or plunger wear.**
Lift arms slowly drop when held in raised position.	**Check valve leaking.**	**Examine check valve poppet ball seat for wear.**
Cannot lift heavy loads.	**Pressure compensating valve out of adjustment**	**Perform hydraulic pump pressure test. Refer to Chapter 2 Section D "Pressure Testing of CCLS Hydraulic Pump".**
	Flow compensating valve out of adjustment.	
	Pump worn.	**Flow test pump and overhaul if out of Specification.**
	No load sensing signal.	**Perform hydraulic pump load sensing circuit check.**
Hydraulic lift will not raise or lower to maximum limits of travel.	**Micro–computer incorrectly calibrated.**	**Perform memory reset and autocalibration procedure. See Error Code 24.**



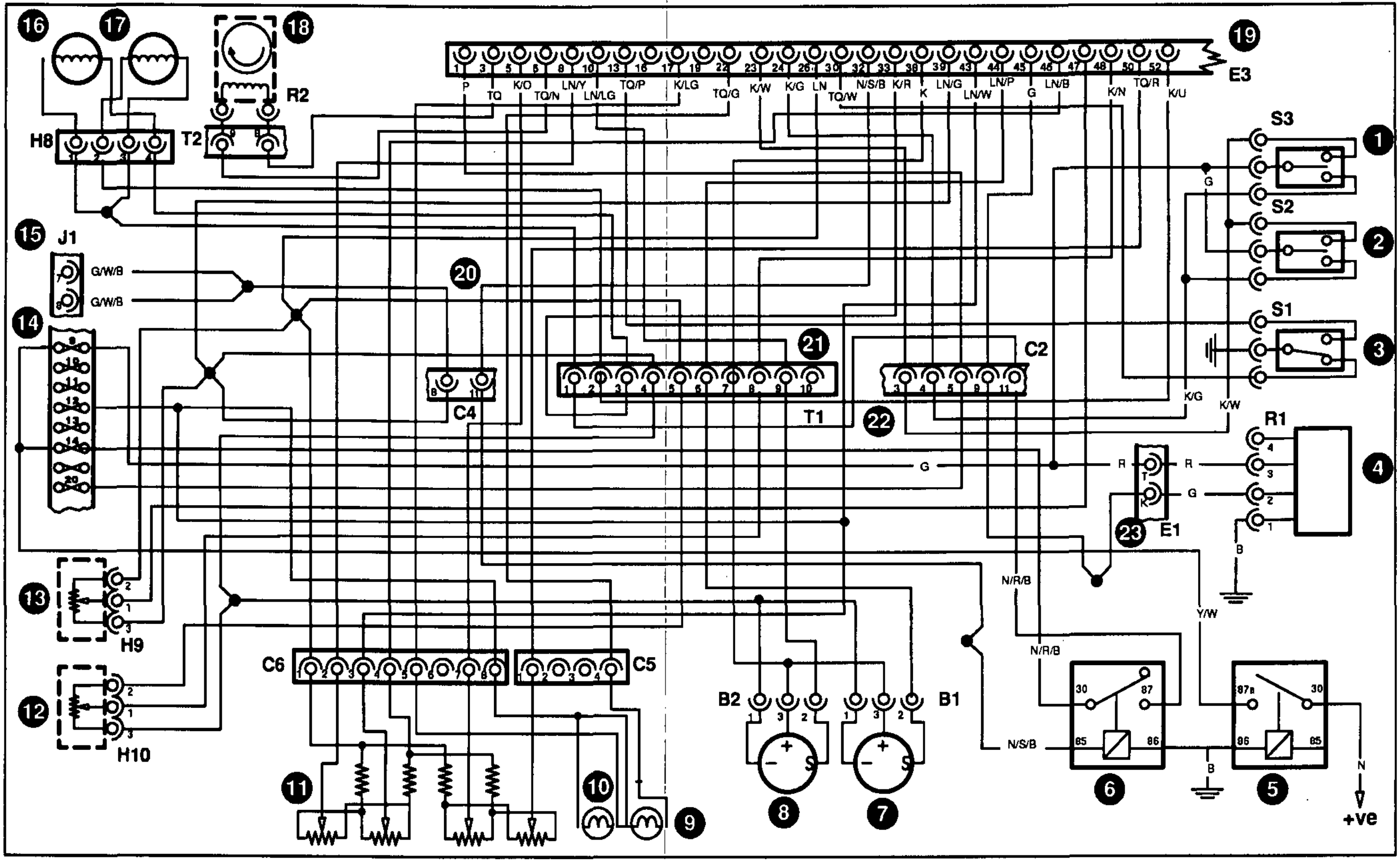
Harness Layout Diagram for Tractors with Electronic Draft Control

Harness Layout Diagram for Tractors with Electronic Draft Control

The following illustration shows the approximate location of those connectors referenced in the fault finding procedure for tractors installed with Electronic Draft Control.

For clarity, those connectors on the harnesses which are not applicable to the electronic draft control fault finding procedure have been omitted from the illustration.

B1	Load Sensing Pin Connector (Right Hand).
B2	Load Sensing Pin Connector (Left Hand)
C1	CCLS Pump Harness Connector
C2	Transmission/EDC Harness Connector
C4	Transmission/EDC Harness Connector
C5	EDC Control Panel Connector
C6	EDC Control Panel Connector
D1	Service Diagnostic Connector
E1	Engine Harness Connector
E3	Micro–Computer Connector
H9	Lift Control Lever Potentiometer
H10	Lift Arm Position Sensing Potentiometer
J1	Electronic Instrument Panel Connector
J2	Electronic Instrument Panel Connector
R1	Performance Monitor Radar
R2	Transmission Output Speed Sensor
S1	In Cab Fast Raise/Lower Switch
S2	Hydraulic Lift Fender Switch (Left Hand)
S3	Hydraulic Lift Fender Switch (Right Hand)
T1	EDC Chasis Harness Connector
T2	EDC Chasis Harness Connector



Electronic Draft Control System Wiring Diagram

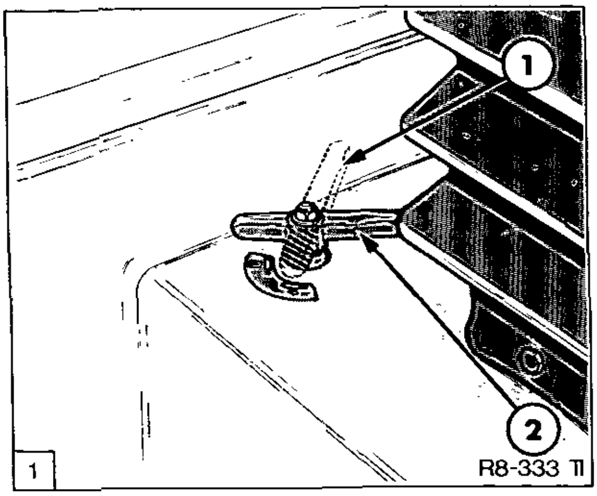
Electronic Draft Control System Wiring Diagram

1. Hydraulic Lift Fender Switch (Right Hand)
2. Hydraulic Lift Fender Switch (Left Hand)
3. In Cab Fast Raise/Lower Switch
4. Performance Monitor Radar (R1)
5. Auxillary Relay
6. Hydraulc Lift Enable Relay
7. Load Sensing Pin (Right Hand)
8. Load Sensing Pin (Left Hand)
9. Slip Limit 'On' Indicator Light
10. Hitch Disabled Warning Light
11. EDC Control Panel
12. Lift Arm Position Sensing Potentiometer
13. Lift Control Lever Potentiometer
14. Fuse Panel
15. Instrument Panel Connector J1
16. Hydraulic Control Valve Solenoid (Lower)
17. Hydraulic Control Valve Solenoid (Raise)
18. Transmission Output Speed Sensor
19. Micro–Computer Connector (E3)
20. Harness Connector (C4)
21. Harness Connector (T1)
22. Harness Connector (C2)
23. Harness Connector (E1)

NOTE: *The numbers in parenthesis relate to the connector identification numbers referenced in the fault finding procedures for each error code*

C. HYDRAULIC LIFT COVER ASSEMBLY–OVERHAUL

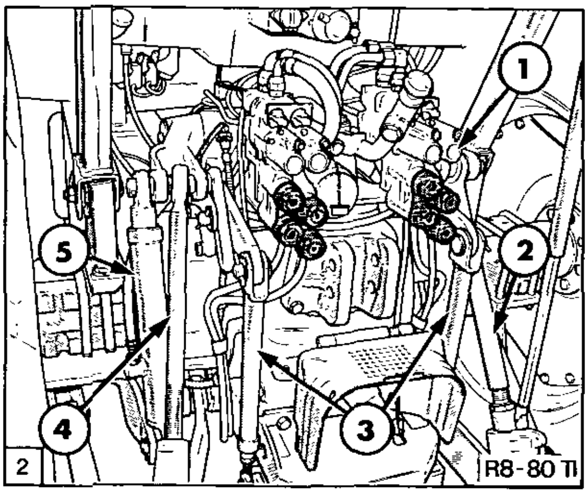
REMOVAL



ASC Selector

1. Auxiliary Services Control (ASC) Engaged
2. Hydraulic Lift Operation

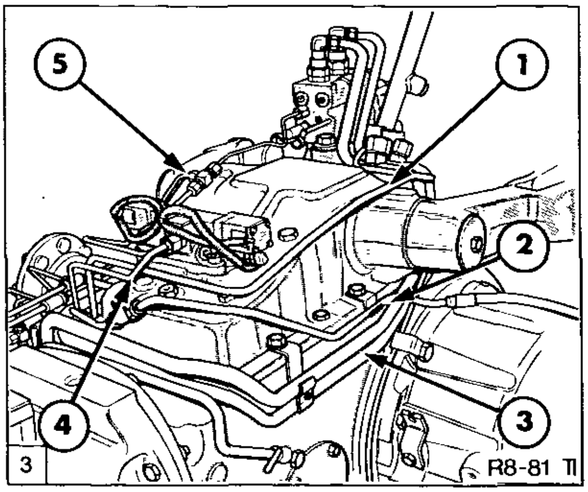
1. Lower lift arms and turn auxiliary services control knob to engaged position, Figure 1.
2. Disconnect ASC control linkage at lift cover.
3. Less Cab Tractors Only:
   Remove platform to gain access to hydraulic lift cover.



Hydraulic Lift Linkage and Remote Control Valves

1. Remote Control Valve
2. Lift Rod
3. Pick–up Hitch Lift Rods
4. Lift Rod
5. Assist Ram

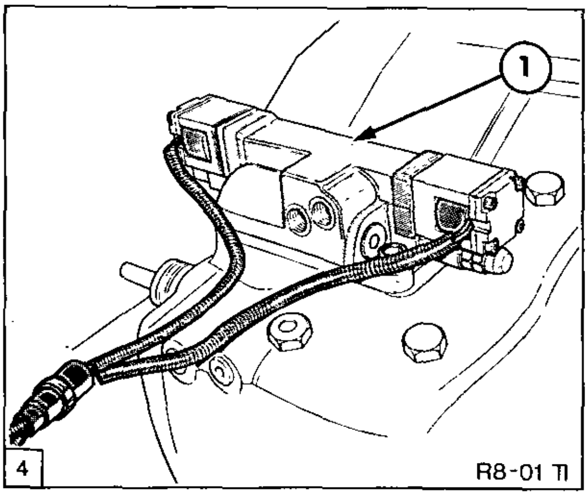
4. Disconnect hydraulic connections to assist rams (where fitted) and disconnect ram(s) from lift arms, Figure 2.
5. Disconnect lift rods from lift arms.
6. Remove remote control valves.



Hydraulic Lift Cover Installation (Less Cab Shown)

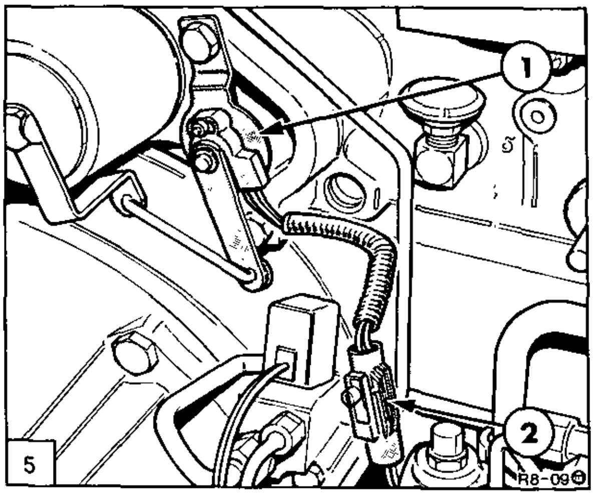
1. Trailer Brake Feed Tube
2. Assist Ram Feed Tube
3. Remote Control Valve Feed and Return Tubes
4. Pilot Pressure Tube
5. Load Sense Lines

7. Remove load sense lines to remote and hydraulic control valves, Figure 3.
8. Remove hydraulic control valve pilot pressure feed tube.
9. Remove trailer brake coupler and feed tube.
10. Remove assist ram feed tubes.
11. Remove rear axle dipstick tube retaining bolt.
12. Remove remote control valve feed and return tubes.



Hydraulic Lift Control Valve

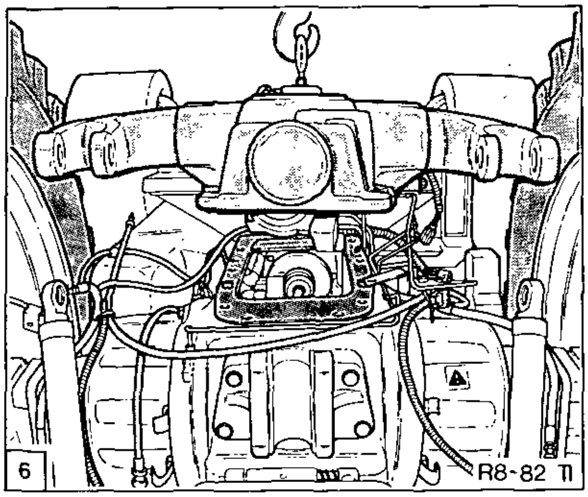
13. Remove hydraulic control (EDC) valve.
14. Remove hydraulic top cover retaining bolts.



Lift Arm position Sensing Potentiometer

1. Potentiometer
2. Connector

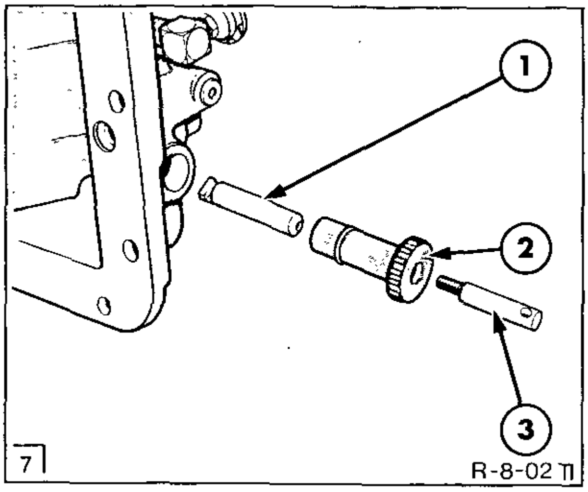
15. Disconnect connector to lift arm position sensing potentiometer, Figure 5.



Removing Hydraulic Lift Cover

16. Using suitable lifting gear remove lift cover, Figure 6.

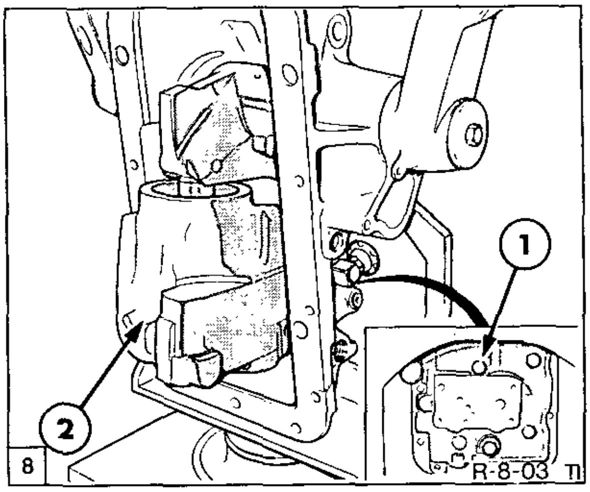
DISASSEMBLY



ASC Valve Selector Linkage

1. Selector Valve Stem
2. Knob
3. *Control Linkage Connector*

1. Pull ASC valve to engaged position. Unscrew control linkage connector, pull knob from lift cover and remove selector valve stem, Figure 7.

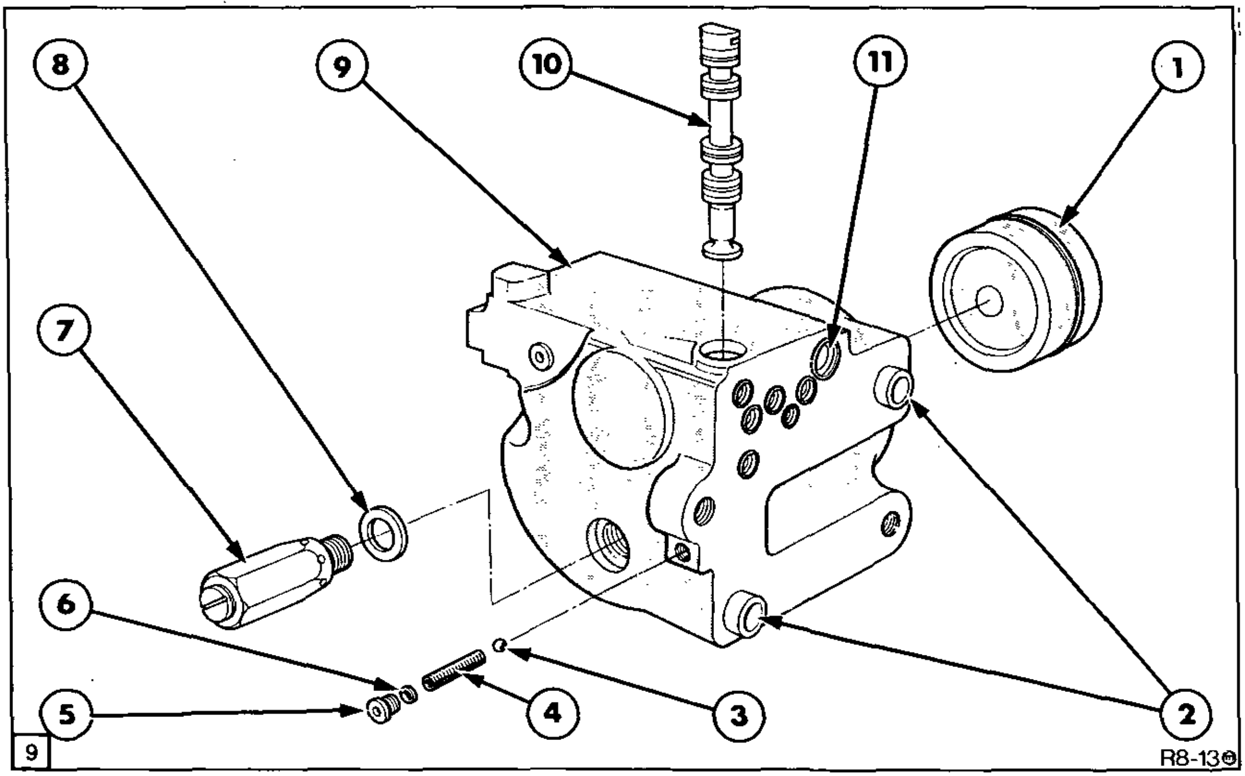


Lift Cylinder Removal

1. Lift Cylinder Retaining Bolts
2. Lift Cylinder

2. Remove four bolts securing lift cylinder to cover, Figure 8.
3. Move lift arms to raised position and carefully remove lift cylinder from locating dowels.
4. Remove lift cylinder safety valve and discard seal. Refer to Figure 9

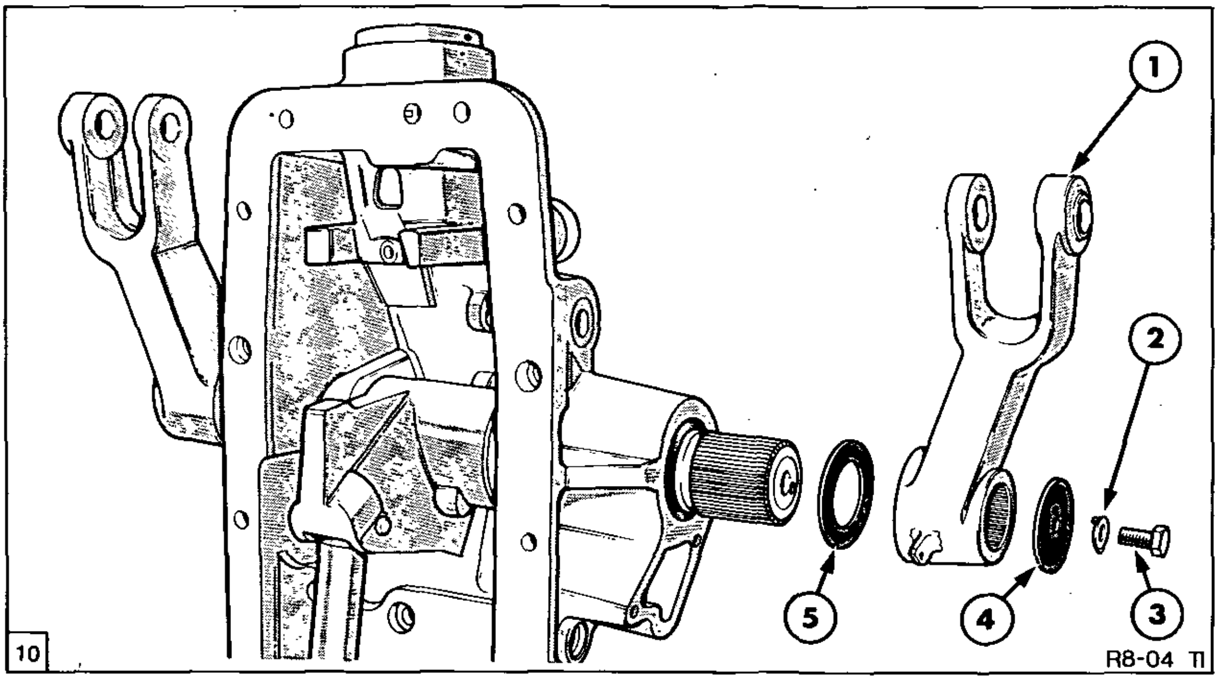
NOTE: *The lift cylinder safety valve is not serviceable.*



Hydraulic Lift Cylinder–Exploded View

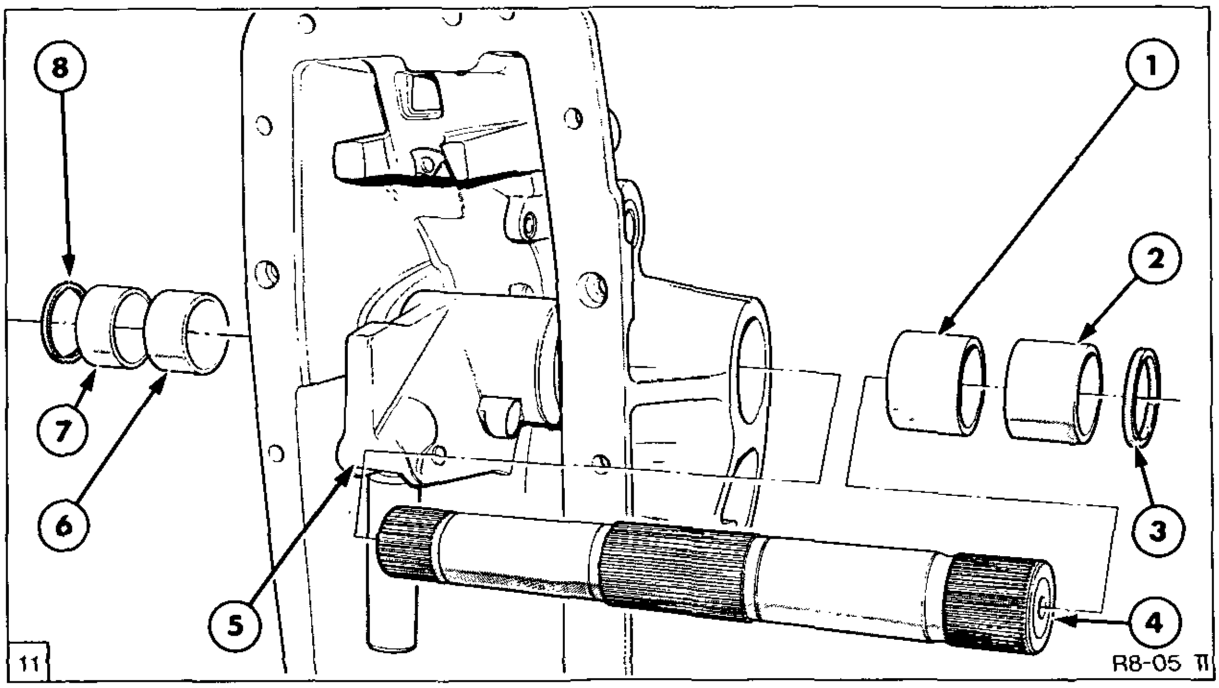
1. Piston
2. Ring Dowels
3. *Ball*
4. Spring
5. Plug
6. 'O' Ring
7. *Safety Valve*
8. Seal
9. Lift Cylinder
10. ASC Valve Spool
11. *'O' Rings (7 off)*

5. Discard 'O' rings located in counterbores of oil passages.
6. Remove ASC valve detent plug ball and spring.
7. Remove ASC valve spool.
8. Push a soft metal rod through safety valve bore and eject lift cylinder piston. Discard piston 'O' ring seal and back up ring.
9. Remove lift arms. Refer to Figure 10.



Lift Arm Assembly–Exploded View

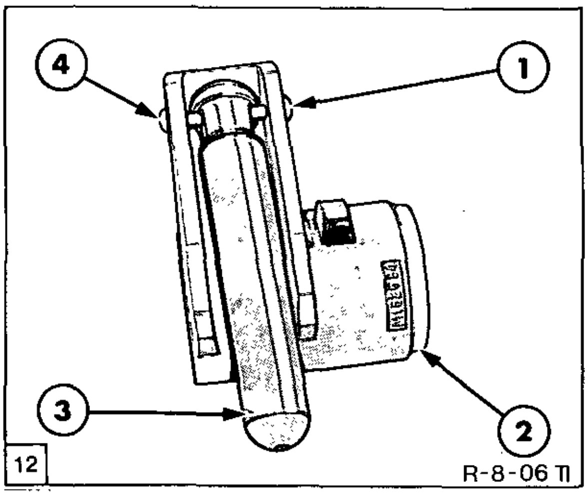
1. Lift Arm
2. Locking Washer
3. Bolt
4. Washer
5. Washer



Cross Shaft and Arm Assembly–Exploded View

1. Bush
2. Bush
3. Seal
4. Cross Shaft
5. Piston Rod and Arm Assembly
6. Bush
7. Bush
8. Seal

10. Withdraw cross shaft assembly components. Refer to Figure 11.



Piston Rod and Arm Assembly–Exploded View

1. Pin
2. Arm
3. Rod
4. Pin

11. If arm, piston rod or retaining pins are worn, separate rod and arm assembly, Refer to Figure 12. The pins are an interference fit into the arm. To remove pins use a suitable lever between rod and end face of pin.

12. Where necessary, remove remaining plugs from lift cover. Under normal circumstances the removal of these plugs is not necessary.

INSPECTION AND REPAIR

1. Wash all parts in suitable solvent.

2. Examine ASC valve and mating bore for wear, burrs or scratches. Minor damage to valve may be removed with fine abrasive. Ensure valve is thoroughly washed before re–assembly. Ensure valve moves freely in bore. Heavy scoring of bore necessitates replacement of lift cylinder.

3. Check oil passages are free from obstruction.

4. Where a new lift cylinder is required select largest ASC valve spool which when lightly lubricated, will operate in bore without binding when turned through 360° and operated over full length of stroke.

NOTE: *The ASC valve is colour coded only as a guide for matching the valve to the bore. To obtain an optimum fit a proprietary brand of metal polish may be used to lap a slightly oversize valve into the bore. Ensure all traces of polish are washed away and the components are dried prior to re–assembly. For control valve sizes refer to Specifications, Section E.*

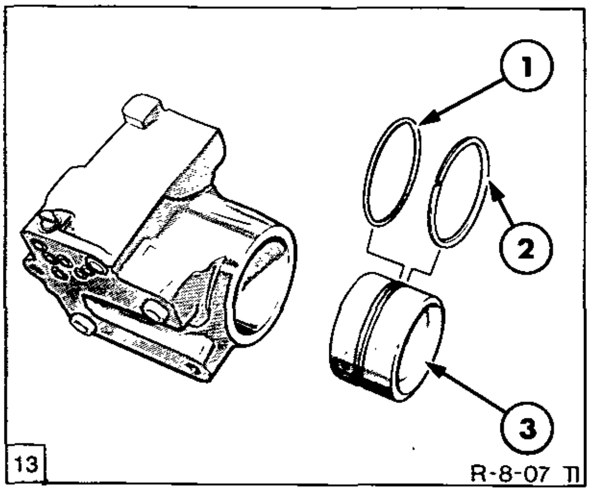
RE–ASSEMBLY AND INSTALLATION

Re–assembly and installation follows the disassembly procedure in reverse.

A master spline machined on the cross shaft ensures correct alignment of the both the lift arms and piston arm during re–assembly.

During re–assembly observe the following requirements.

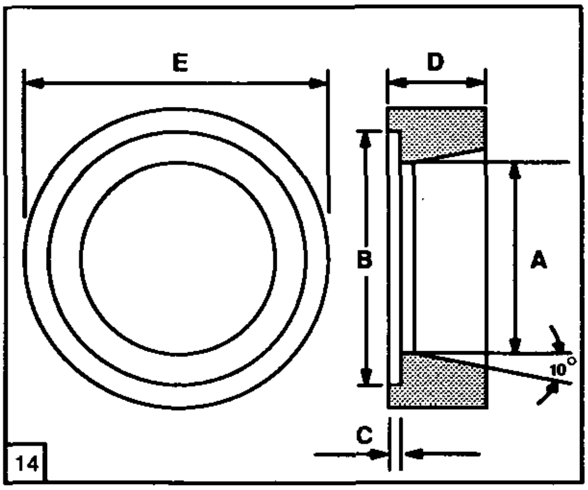
- Renew all 'O' rings and seals.



Lift Cylinder Piston Seals

1. 'O' Ring Seal
2. Back–Up Seal
3. Piston

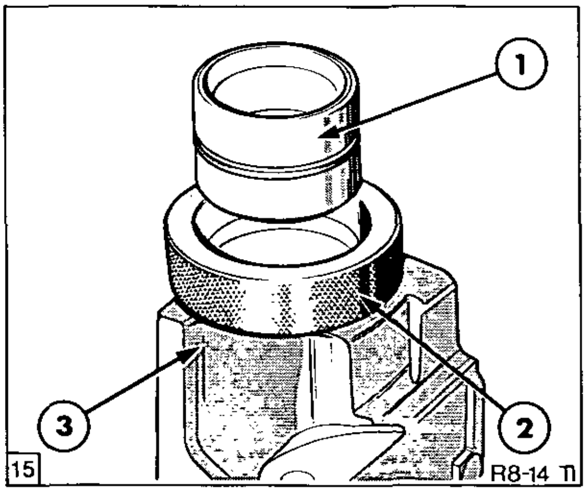
- Install piston 'O' ring seal (1) closest to closed end of piston and back–up seal (2) nearest open end of piston (3), Figure 13.



Piston Installation Guide

A. 4.126 inch (105 mm)
B. 5.25 inch (134 mm)
C. 0.12 inch (3 mm)
D. 1.62 inch (40 mm)
E. 6.0 inch (155 mm)

- To aid installation of piston into lift cylinder and prevent damage to the piston seals, a guide can be manufactured to the dimensions shown in Figure 14.



Installing Piston Into Lift Cylinder

1. Piston
2. Guide
3. Lift Cylinder

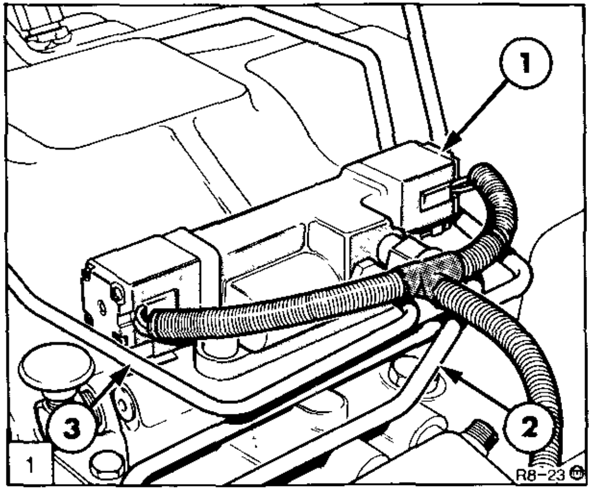
- Install piston into cylinder using guide as shown in Figure 15. If a guide is not available and installation is difficult a piston ring compressor may be used to compress the seals.

- Coat cross shaft and lip seals with grease.

- Prior to installation of the hydraulic top cover, apply a thin bead of Ford gasket sealer FP119 (Loctite 515), specification ESE–M4G234–A1 to **BOTH** sides of the hydraulic top cover gasket. The bead should be continuous around the entire face of the gasket and to a thickness of approximately 1/32 in (1mm).

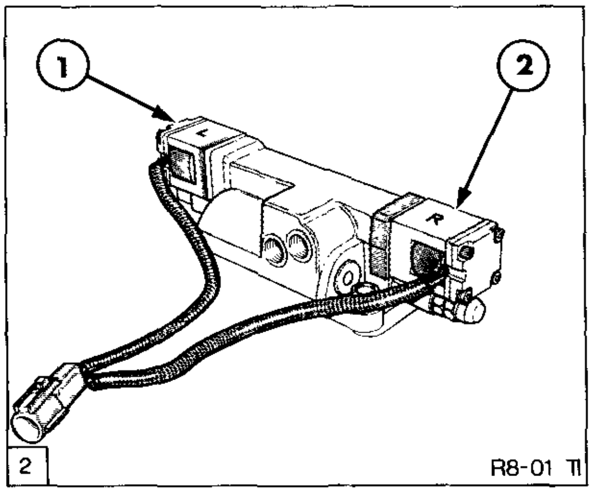
- Tighten all retaining bolts to the correct torque and apply sealant to threads where specified. See Specifications, Section E.

D. HYDRAULIC CONTROL VALVE–OVERHAUL



Hydraulic Control Valve Installation

1. Hydraulic Control Valve
2. Pilot Line
3. Load Sensing Line



Hydraulic Control Valve Solenoids

1. Lower Solenoid
2. Raise Solenoid

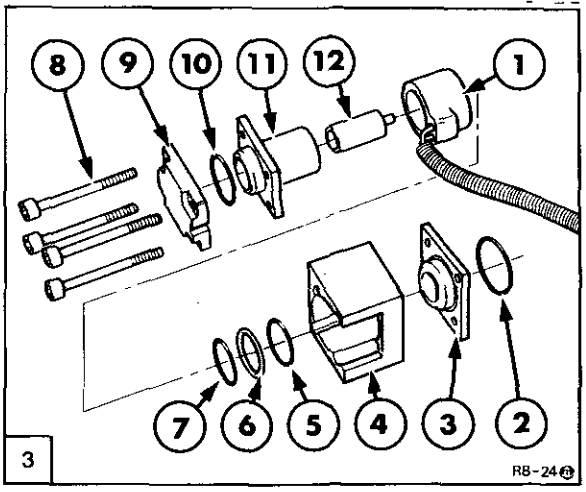
REMOVAL

1. Lower hydraulic lift arms.
2. Remove panel in cab/platform floor to gain access to hydraulic control valve, Figure 1.
3. Thoroughly clean the area around the valve prior to proceeding with the removal procedure.
4. Disconnect electrical connector to valve.
5. Disconnect pilot and load sensing lines.
6. Remove the four retaining bolts and lift the valve from the hydraulic top cover.

DISASSEMBLY

Solenoids and Pilot Spools

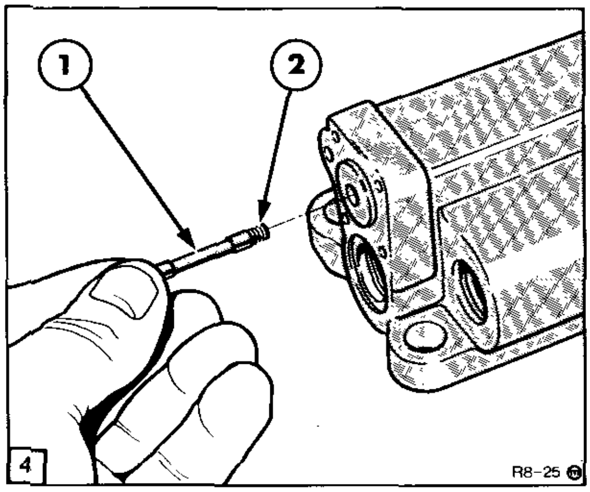
1. Identify lower and raise solenoids, to aid re–assembly, Figure 2.
2. Remove solenoids from valve.



Solenoid Components–Exploded View

1. Field Coil
2. 'O' Ring
3. Plate
4. Solenoid Body
5. 'O' Ring
6. Ring
7. 'O' Ring
8. Allen Screws
9. End Cap
10. 'O' Ring
11. Core
12. Plunger

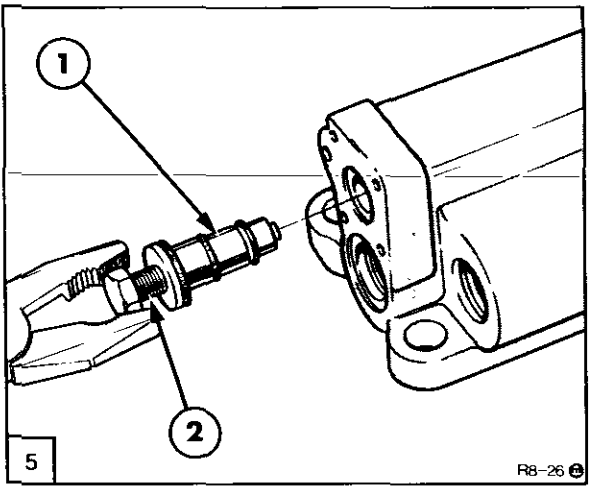
3. Separate solenoid components, Figure 3.



Pilot Spool Removal

1. Pilot Spool
2. Spring

4. Remove pilot spool and spring from pilot operated valves, Figure 4.



Removing Pilot Spool

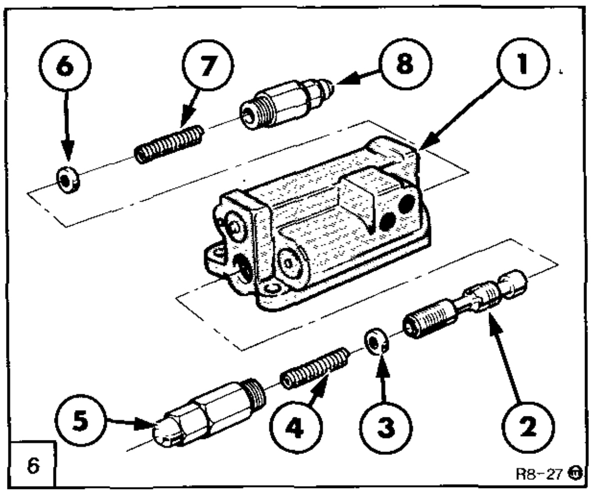
1. Pilot Spool
2. $^5/_{16}$ in Bolt

5. Insert a $^5/_{16}$ in UNF bolt into end of pilot spool. Pull pilot spool from housing, Figure 5.

Main Spool

1. Using a suitable marker identify the right and left hand adjusters in relation to the valve housing body.

IMPORTANT: *Do not disassemble or reset the adjuster assemblies. The hydraulic control valve adjustment is pre–set at the factory and ensures that the spool is correctly set for the neutral position.*

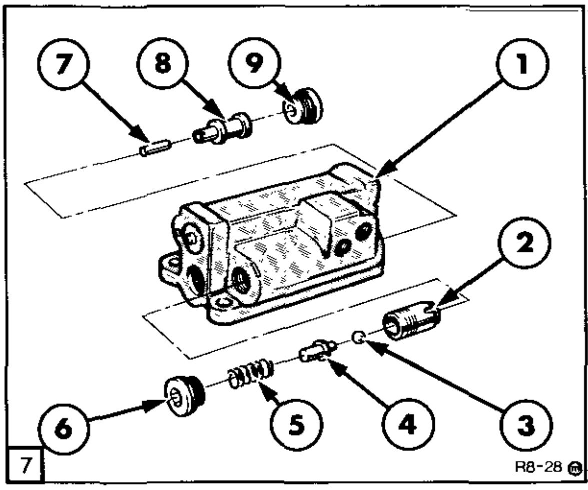


Main Spool

1. Valve Housing	5. Adjuster Assembly
2. Spool	6. Seat
3. Seat	7. Spring
4. Spring	8. Adjuster Assembly

2. Remove adjuster assemblies and withdraw spool centering springs and seats, Figure 6. Ensure that springs and seats remain matched with each adjuster.

Load Check Valve



Load Check Valve

1. Valve Housing	6. Plug and 'O' Ring
2. Poppet	7. Pin
3. Ball	8. Piston
4. Guide	9. Plug and 'O' Ring
5. Spring	

1. Remove the load check valve plugs and withdraw the load check valve components, Figure 7.

NOTE: *The pin, item 7, is rounded on one end. When re–assembling the valve ensure the rounded end of the pin is inserted into the poppet, item 2.*

INSPECTION

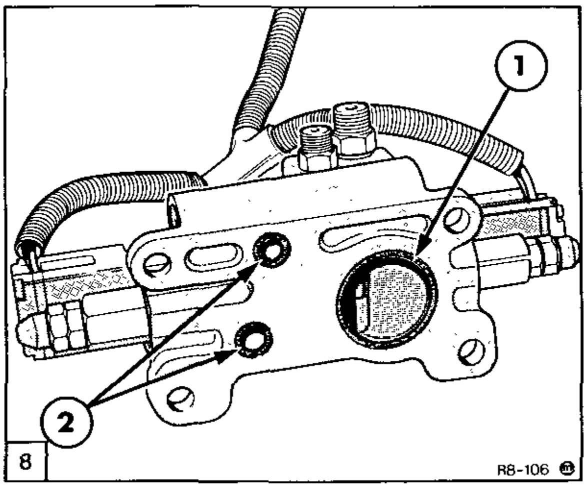
The majority of valve failures occur because of dirt and other foreign matter entering the valve causing scoring and distortion. Minor imperfections can be corrected by using fine abrasive emery cloth or fine lapping compound. *Exercise extreme care when abrasive* materials are used to ensure that all particles are removed from the valve housing.

1. Wash all parts, except solenoids, in a suitable solvent and dry with compressed air.
2. Inspect the valve housing, bores and spools for evidence of scoring or damage, paying particular attention to the condition of the highly finished surfaces in the spool and sleeve bores. If deep scores or serious pitting is observed discard the valve. Remove minor blemishes from the spools or sleeves with fine abrasive.
3. Ensure the spools move freely in their bores.
4. Discard all 'O' ring seals.

RE–ASSEMBLY and INSTALLATION

Re–assembly follows the disassembly procedure in reverse. During re–assembly observe the following:–

- Lubricate the spools with hydraulic oil.
- *install new 'O' ring seals.*
- Tighten all plugs and locknuts to the correct torque. See Specifications, Section E.
- When installing the solenoids, tighten the retaining screws gradually in a cross corner sequence to a torque of 15 lbf.in (1.7 Nm). **Do Not** overtorque the screws.



Control Valve Mounting Face 'O' Ring Installation

1. 'O' Ring
2. 'O' Rings

- Ensure 'O' ring seals are correctly located around oil galleries on mounting face of hydraulic control valve before installing the valve onto the hydraulic lift cover, Figure 8.

E. SPECIFICATIONS

MAXIMUM LIFT CAPACITY

Ford New Holland test results to OECD criteria–links horizontal, maximum hydraulic pressure:

		5640	6640	7740	7840	8240	8340
Without Assist Rams							
at link ends	lb	6350	6350	n/a	n/a	n/a	n/a
	kg	2880	2880	n/a	n/a	n/a	n/a
24 in. to rear of link ends	lb	4910	4910	n/a	n/a	n/a	n/a
	kg	2227	2227	n/a	n/a	n/a	n/a
With One Assist Ram							
at link ends	lb	9370	9370	9370	9370	n/a	n/a
	kg	4250	4250	4250	4250	n/a	n/a
24 in. to rear of link ends	lb	7080	7080	7080	7080	n/a	n/a
	kg	3211	3211	3211	3211	n/a	n/a
With Two Assist Rams							
at link ends	lb	n/a	n/a	12300	12300	13001	13001
	kg	n/a	n/a	5579	5579	5897	5897
24 in. to rear of link ends	lb	n/a	n/a	9420	9420	9957	9957
	kg	n/a	n/a	4273	4273	4516	4516

VALVE SETTINGS

Lift Cylinder Relief Valve 2850–3050 lbf/in^2 (197–210 bar)

GASKET SEALER

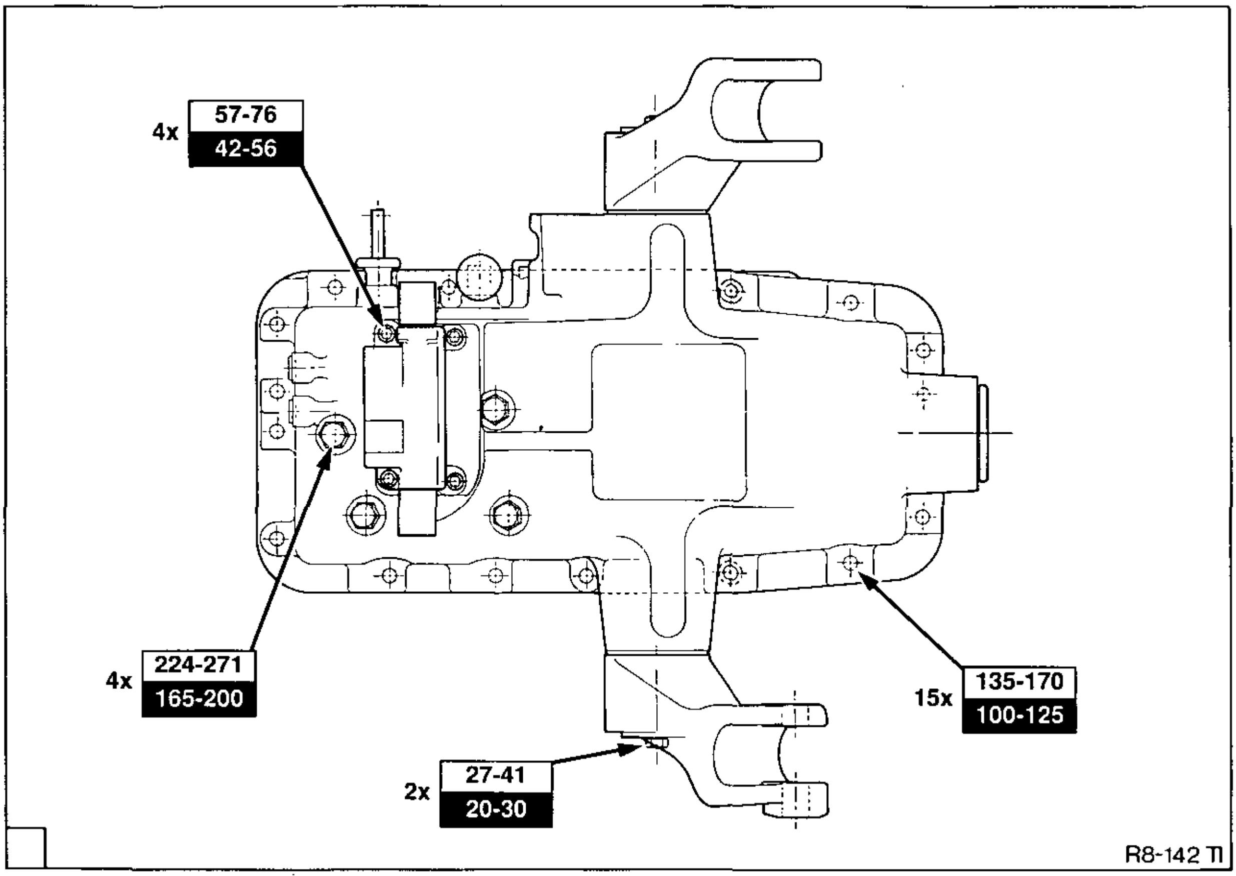
Ford Gasket Sealer FP119 (Loctite 515) to Ford Specification ESE–M4G234–A1

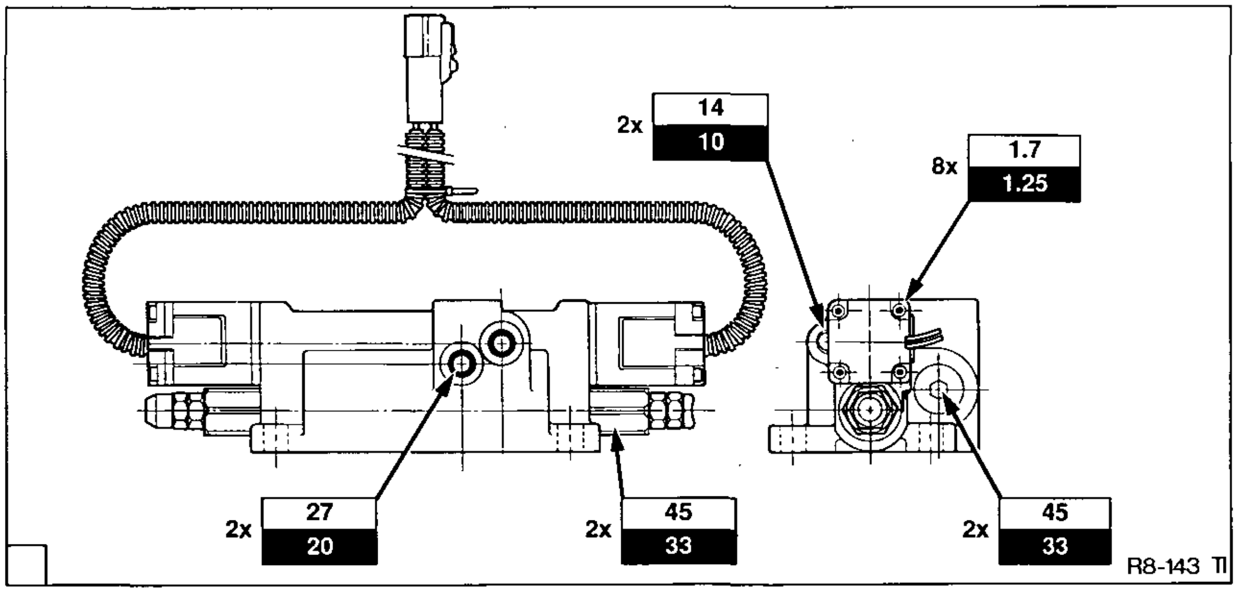
ASC CONTROL VALVE SIZES

Colour	**Inches**	**mm**
Green	.6247–.6244	15.8674–15.8598
Yellow	.6244–.6241	15.8598–15.8521
Blue	.6241–.6238	15.8521–15.8445
White	.6238–.6235	15.8445–15.8369
Blue/White	.6235–.6232	15.8369–15.8293

TORQUES

□ = Nm
■ = lbf ft

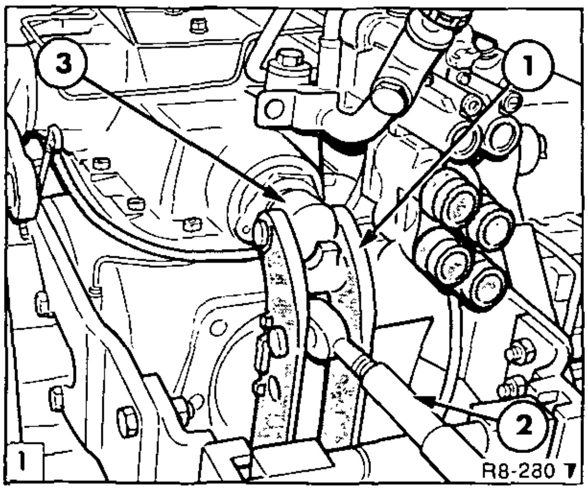




Lift Cylinder Relief Valve Torque 75–90 lbf ft (102–122Nm)

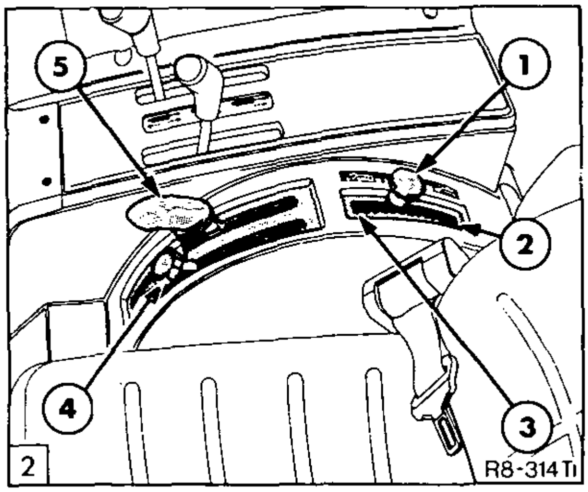
PART 8
HYDRAULIC SYSTEMS
Chapter 4
HYDRAULIC LIFT ASSEMBLY WITH TOP LINK SENSING

A. DESCRIPTION AND OPERATION



Three Point Linkage

1. Rocker
2. Top Link
3. Draft Control Yoke



Hydraulic Control Levers

1. Selector Lever
2. Position Control Setting
3. Draft Control Setting
4. Adjustable Stop
5. Lift Control Lever

'Top Link Sensing' defines a hydraulic system where draft signals applied to an implement are sensed and transmitted mechanically to the hydraulic lift draft control mechanism by the 'Top Link' of the three–point linkage, Figure 1.

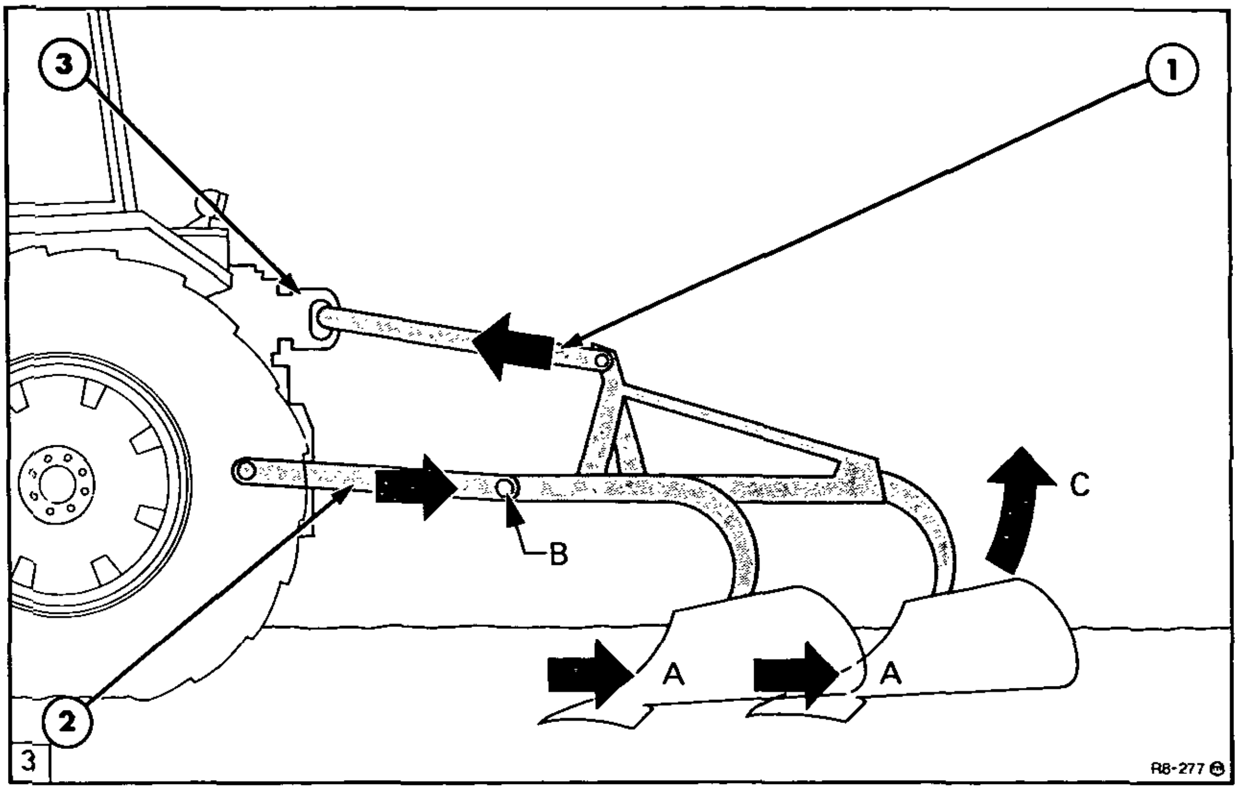
This method of sensing draft loadings differs from that of the electronic draft control system where draft forces applied to an implement are sensed electronically using load sensing pins in the lower lift links.

Implements attached to the 3 point linkage can be operated in either 'Draft' or 'Position' control using the levers positioned by the side of the drivers seat, Figure 2.

The lift control lever raises or lowers the hydraulic lift to the desired position and the selector lever enables the selection of full position control or draft control as required.

Full draft control is selected when the lever is positioned fully forward and full position control when the lever is moved fully rearwards.

The sensitivity of draft control is adjusted by the position of the selector lever. As the lever is moved away from full draft control selection to full position control the degree of draft sensitivity reduces accordingly.



The Principal Of Draft Forces Applied Through The Hydraulic Linkage

1. Top Link (In Compression)	A. Draft Forces
2. Lower Link (In Tension)	B. Lower Link Pivot Point
3. Draft Control Yoke	C. Tipping Force

Principals of Draft Control

Draft control, manages the working depth of soil engaging implements in order that the implement maintains an even pull on the tractor.

When a soil engaging implement eg. a plough is lowered into the ground, the draft forces applied to the implement as it is drawn through the soil tends to make the plough pivot about the point where it attaches to the lower links, Figure 3. If the top link were removed then the plough would tip up, but due to the top link's resistance the plough stays level in the ground. This shows that there is a compressive force pushing the top link against the tractor housing.

The draft force will alter according to the depth of work and stiffness of the ground. As the draft force increases, then so does the compressive force applied to the top link and if the draft force decreases the top link compressive force will similarly decrease.

Using the selector lever, the operator can pre–set the required amount of draft sensitivity to be maintained on the implement during work and the hydraulic system maintains this draft by raising and lowering the implement within the soil accordingly.

When the draft force increases beyond that selected, the compressive force on the top link pushes the yoke further into the hydraulic lift cover and the hydraulic system raises the implement until the required amount of draft is restored. Similarly when the draft force is less than that required the compressive force on the top link reduces allowing the yoke to *move out from the top cover. The hydraulic* system now responds and lowers the implement until the required draft force is again restored.

When position control is selected the working depth or height of an implement relative to the tractor is pre–set by the internal linkage in the hydraulic top cover and maintained irrespective of changes in implement draft. Forces sensed by the top link and applied to the draft control mainspring in the hydraulic top cover therefore have no effect on the hydraulic lift draft control mechanism.

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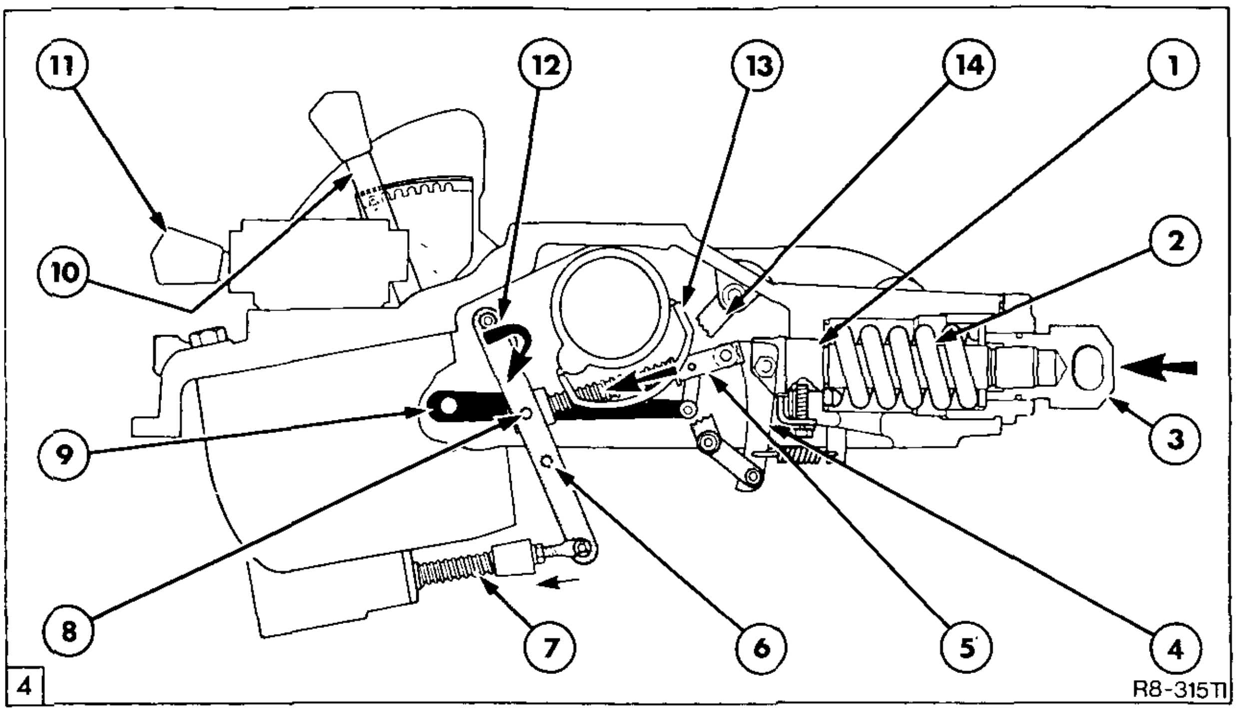


Draft Control Linkage Operation
(For Clarity Position Control Linkage is Not Shown)

1. Draft Control Mainspring Plunger
2. Draft Control Mainspring
3. Yoke
4. Selector Link
5. Control Rod and Roller Assembly
6. Stop Pin
7. Control Valve/Spring Assembly
8. Control Rod Connector
9. Selector Arm
10. Selector Lever
11. Control Lever
12. Actuating Lever
13. Position control Cam
14. Position Control Link

Draft Control Linkage Operation

The hydraulic lift control valve, located within the hydraulic top cover, is connected mechanically to the lift control lever and draft control linkage. This valve directs oil from the pump to the lift cylinder, to effect a raise condition via the unload valve or to the reservoir for a neutral or lowering cycle.

When draft control is selected and the implement draft reaction causes the yoke to move, the reaction is transferred to the lift cylinder control valve via the internal linkage, Figure 4.

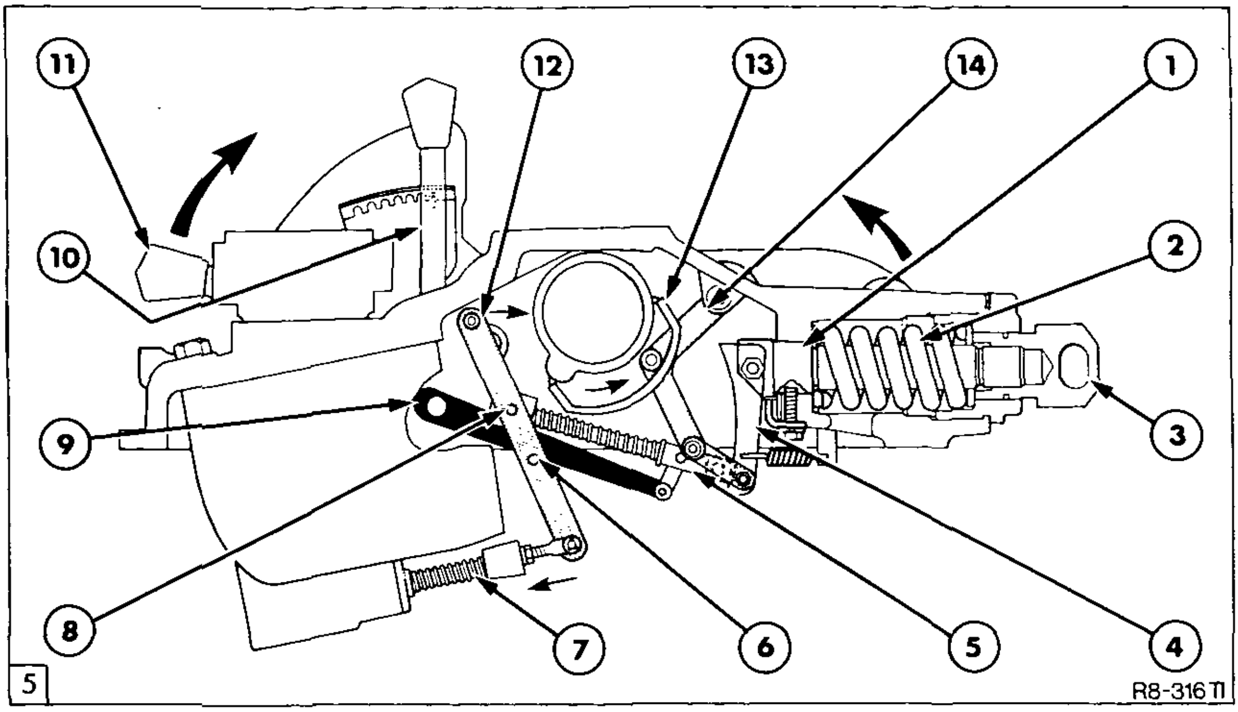
As the yoke moves the selector link similarly moves in the same direction. Therefore as the draft load increases the control rod and roller is pushed forward against the actuating lever.

The actuating lever pivots about the control lever shaft and the action of the control rod and roller pushing forward moves the control valve into the raise position. As the implement is raised and the draft loading decreases the yoke moves rearwards allowing the control rod and roller to retract and the control valve to return to the neutral position.

Should the draft loading become less than that set using the selector lever the yoke moves further rearwards and the control rod and roller allows the spring loaded control valve to move toward the lower position. The implement is now lowered further into the ground until the selected draft loading is restored and the control valve again returns to the neutral position.

It can now be seen that this correction cycle maintains the implement draft loading within the range selected with the selector lever.

When the selector lever is moved to intermediate positions between full draft and full position control, a reduced effect on the control valve is achieved whenever the top link subjects the yoke to the draft forces.



Position Control Linkage Operation
(For Clarity Draft Control Linkage is Not Shown)

1. Draft Control Mainspring Plunger
2. Draft Control Mainspring
3. Yoke
4. Selector Link
5. Control Rod and Roller Assembly
6. Stop Pin
7. Control Valve/Spring Assembly
8. Control Rod Connector
9. Selector Arm
10. Selector Lever
11. Control Lever
12. Actuating Lever
13. Position control Cam
14. Position Control Link Roller

The intermediate positions on the selector lever have therefore been introduced to permit the operator to adjust the controls in order to select the system response and control characteristics best suited to the operation being performed.

Position Control Linkage Operation

The system of Position Control enables the working depth or height of an implement, relative to the tractor, to be pre–set and maintained.

When the system selector lever is located in the highest quadrant position and position control is selected, the control rod and roller assembly is positioned with the roller aligned with the lower end of the selector link, Figure 5.

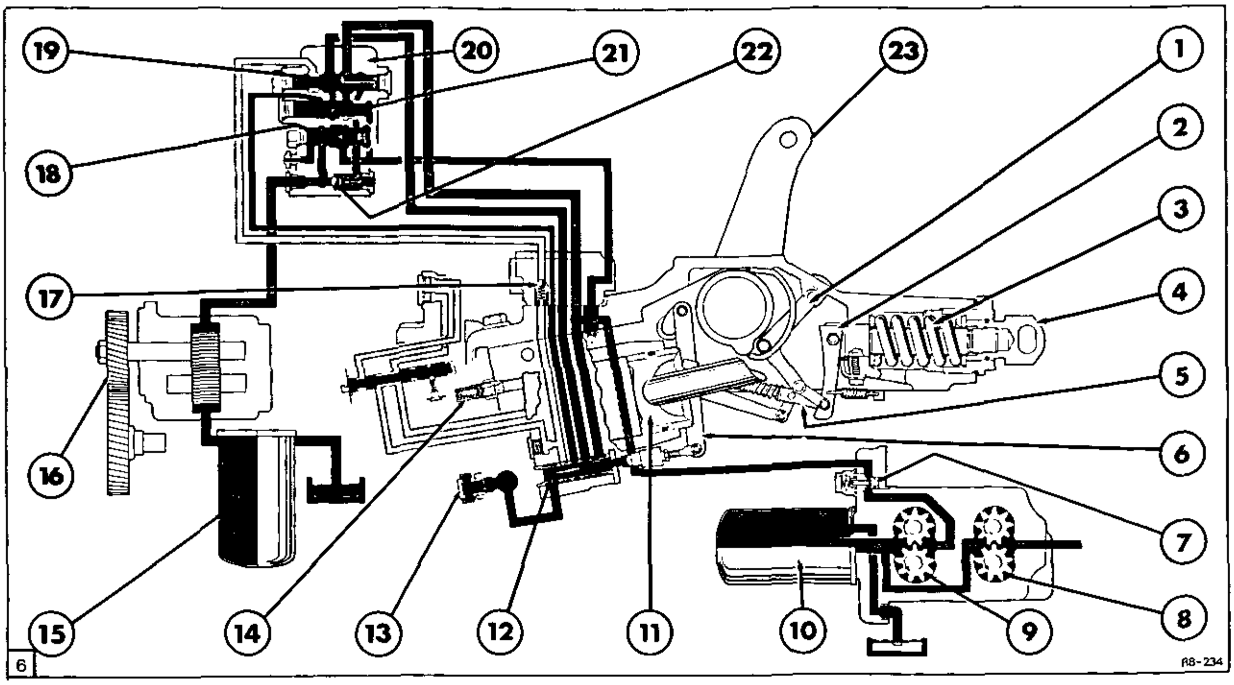
When the rod and roller assembly is in this position any variations in draft loading applied to the yoke through the top link of the three point linkage will not alter the position of the control rod and roller assembly. Consequently the position of the actuating lever and control valve remain unchanged unless the position of the hydraulic lift control lever is moved.

When the lift control lever is moved the actuating lever pivots on the control rod and moves the control valve to the raise or lower position as required.

As the lift arms move, the position control link roller rides the position control cam and moves the control rod and hence the actuating lever. When the lift arms have reached the desired position the actuating lever will have returned the control valve to neutral, preventing further movement of the lift arms.

It can now be seen that when position control is selected there is a direct relationship between the height of the lift arms and the position of the lift control lever. The relationship being maintained by the actuating lever, control rod, position control cam and position control link.

B. HYDRAULIC COMPONENTS AND CIRCUITS



Hydraulic Circuit for Tractor with Fixed Displacement Tandem Gear Type Pump and Top Link Sensing Hydraulic Lift Assembly

1. Position Control Link
2. Selector Link
3. Draft Control Mainspring
4. Yoke
5. Selector Rod and Roller Assembly
6. Actuating Link
7. Pressure Relief Valve
8. Steering Pump
9. Transmission Mounted Hydraulic Pump
10. Pump Intake Filter
11. Lift Piston
12. Control Valve
13. Exhaust Valve
14. Lift Cylinder Safety Valve
15. Auxiliary Pump Intake Filter
16. Engine Mounted Auxiliary Hydraulic Pump
17. Check Valve
18. Combining (Sequencing) Valve
19. Flow Control Valve
20. Priority Valve Pack
21. Unload Valve
22. Check Valve
23. Lift Arms

■ Pump Pressure Oil

■ Suction/Return to Reservoir Oil

□ Trapped Oil

Figure 6 shows the hydraulic circuit and components for the top link sensing hydraulic system when the tractor is fitted with a fixed displacement hydraulic pump.

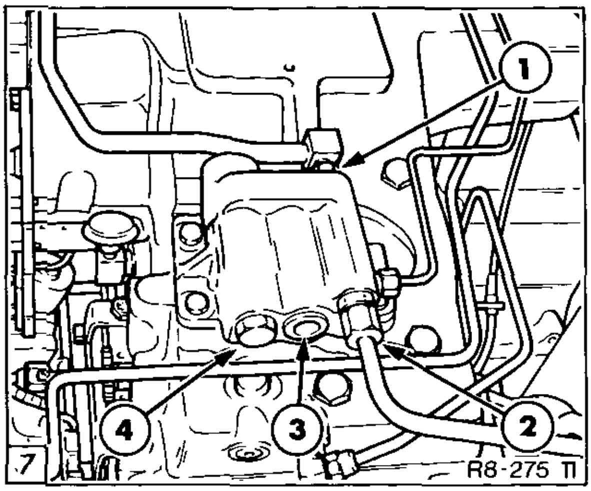
When the tractor is fitted with the variable displacement CCLS hydraulic pump the hydraulic circuit is as shown in Figure 8.

The reasons for the principal differences in the circuits are as follows:–

Tractors fitted with top link sensing may be installed with either the variable displacement closed centre load sensing hydraulic pump or the fixed displacement gear type pump.

The fixed displacement pump is more commonly installed and must be supplemented by an auxiliary engine mounted pump if two or more remote valves are also fitted.

An auxiliary engine mounted pump is **never** installed on tractors with the variable displacement CCLS pump, which is capable of providing sufficient flow to the hydraulic system and up to four remote valves.



Priority Valve Pack Installation and Location of Valves

Tractors with Fixed Displacement Hydraulic Pump

1. Auxiliary Pump Supply Check Valve
2. Combining Valve
3. Unload Valve
4. Flow Control Valve

Where the tractor is fitted with the fixed displacement hydraulic pump, a priority valve pack is required, Figure 7. This pack, located on top of the hydraulic lift cover, contains a set of valves which establish pump priority and controls the flow of oil to the lift cylinder, auxiliary equipment and remote valves.

The individual function of each of these valves are as follows:

Flow Control Valve

This valve, located in the priority valve pack, controls the flow of oil to the hydraulic lift cylinder by sensing the pressure drop through the hydraulic lift control valve. The flow control valve ensures that hydraulic oil supply priority is given to the tractor hydraulic lift demand and diverts the surplus oil to the combining valve.

Unload Valve

The unload valve is operated by oil pressure as directed by the control valve and has two positions. In the raise position the valve allows pumped oil to flow to the lift cylinder whilst in the neutral or lowering position the oil passes to the reservoir.

Combining Valve

This valve, which is only installed when remote valves are fitted, regulates the flow of oil in the remote valve circuit and combines the flow of oil from the main and auxiliary engine mounted pumps.

The function of the combining valve is to:

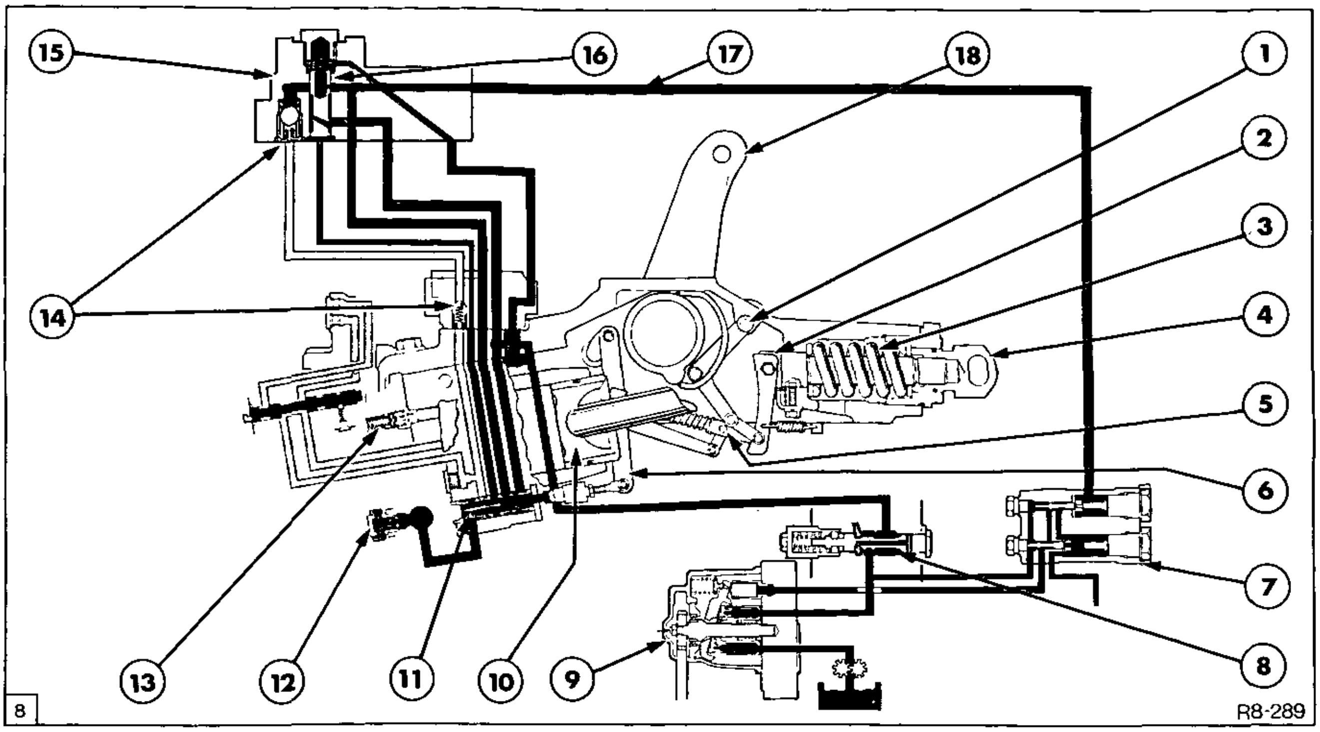
- Return main hydraulic pump and auxiliary pump flows to sump when there is no remote valve demand.
- Direct pump flows to remote valves on demand.
- Direct a proportion of the pump flow to remote valves and return surplus oil to the rear axle if the pump output exceeds remote valve circuit demand.
- Protect remote valve and auxiliary pump circuits from excess pressure.

Check Valve

Two check valves are incorporated in the priority valve pack as follows.

The first one way check valve in the auxiliary pump supply port of the priority valve pack prevents any back feed from the main hydraulic pump to the auxiliary engine mounted pump.

The second check valve in the base of the priority valve pack prevents oil flow from the lift cylinder to the flow control valve during the lift cylinder lowering, neutral or shock load conditions.



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Hydraulic Circuit For Tractor With Top Link Sensing Hydraulic Lift Assembly and Variable Displacement CCLS Hydraulic Pump

1. Position Control Link
2. Selector Link
3. Draft Control Mainspring
4. Yoke
5. Selector Rod and Roller Assembly
6. Actuating Link
7. Pressure and Flow Compensating Valve
8. Pressure Regulating Valve
9. Variable Displacement CCLS Hydraulic Pump
10. Lift Piston
11. Control Valve
12. Exhaust Valve
13. Lift Cylinder Safety Valve
14. Check Valve
15. Unload Valve Assembly
16. Unload Valve Spool
17. Load Sensing Line To Hydraulic Pump
18. Lift Arms

■ Pump Pressure Oil

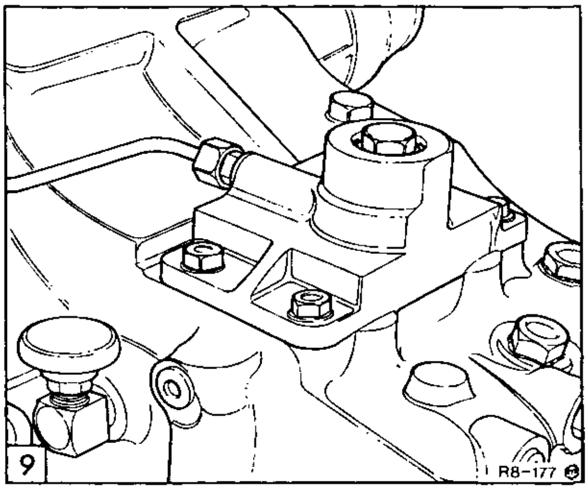
■ Suction/Return to Reservoir Oil

□ Trapped Oil

Tractors installed with the variable displacement CCLS hydraulic pump do not require the priority valve pack but use a special unload valve instead, Figure 9. The function of this single valve is to control the flow of oil to the lift cylinder and ensure a smooth initial lift.

The unload valve is also linked to the load sensing line of the variable displacement pump and signals the pump to increase or decrease output according to hydraulic demand. Refer to Figure 14 for the operation of this valve.

The exhaust valve also shown in both Figure 6 and Figure 8 is spring operated and located in the hydraulic lift cylinder. The function of this valve is to control the flow of exhaust oil from the lift cylinder and/or auxiliary equipment thereby controlling the rate of implement drop.



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Unload Valve Installation

Tractors with Variable Displacement CCLS Hydraulic Pump

HYDRAULIC OIL FLOW TRACTORS WITH FIXED DISPLACEMENT HYDRAULIC PUMP

Figure 10 to Figure 13 show the hydraulic system oil flows for neutral, lowering. slow raise and fast raise conditions on tractors equipped with the fixed displacement hydraulic pump.

These illustrations also show operation of the priority valve pack and associated valves, the function of which were described on the previous pages.

OIL FLOW IN NEUTRAL

With reference to Figure 10.

With the control valve in neutral the following functions occur:–

> The oil in the hydraulic lift cylinder is trapped and holds the cylinder in the desired position.
>
> Pump pressure oil is directed to the combining valve, located in the priority valve pack on the top of the hydraulic lift cover where it is returned to sump or supplied to the deluxe remote valves, if required.

If deluxe remote valves are not fitted the combining valve is deleted, but the same priority valve pack housing is still used.

The oil flow through the hydraulic valves with the control valve in neutral is as follows:–

Pump pressure oil enters the lift cover at gallery E and in neutral the flow control valve prevents oil from entering galleries C and D.

Pump pressure oil flows up gallery E to the flow control valve and unload valve.

The left hand end of the unload valve is open to sump via gallery C and the centre of the control valve.

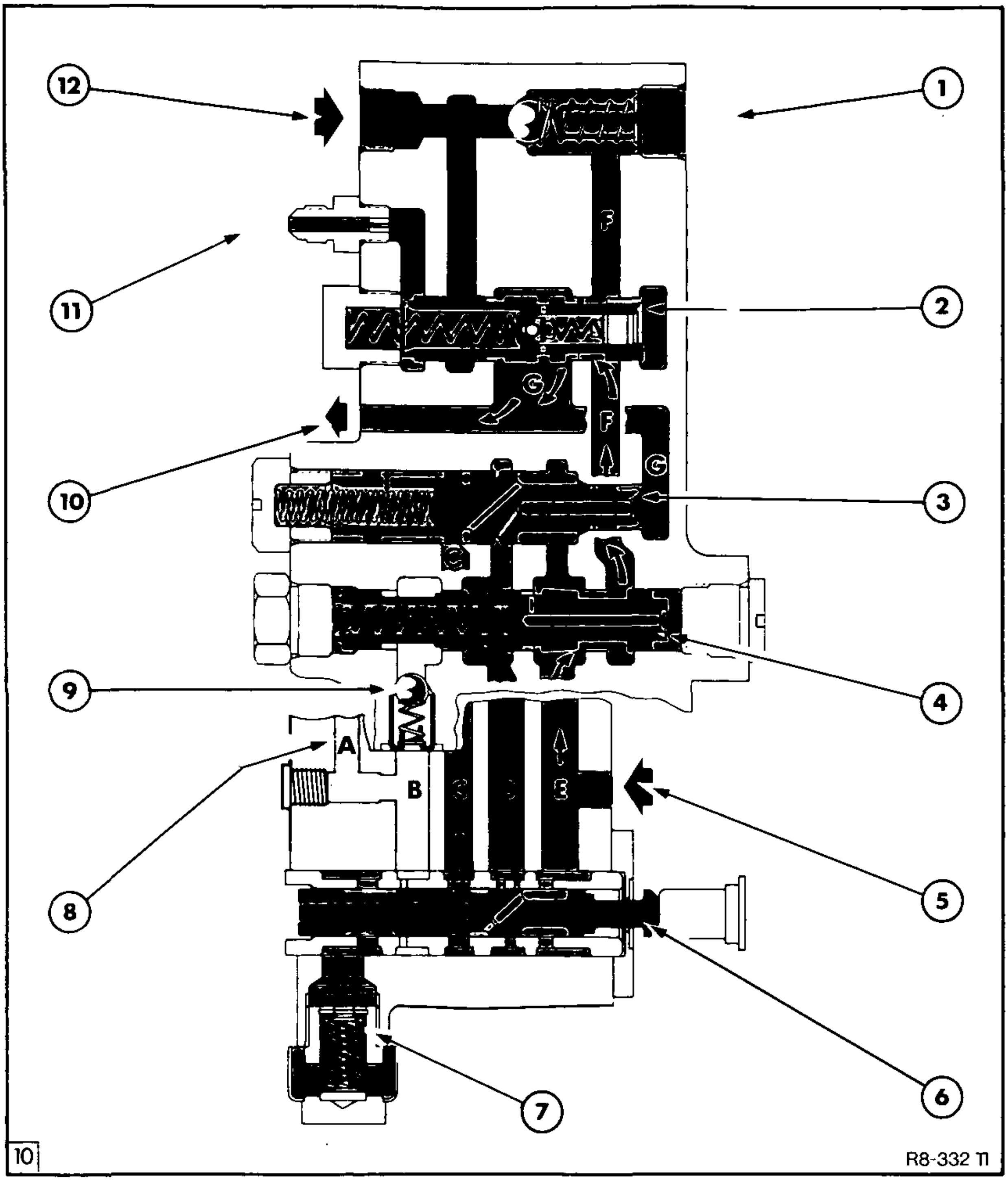
Pump pressure applied to the centre face of the unload valve spool now holds the valve to the left.

With the unload valve held to the left, gallery D and the spring loaded end of the flow control valve are also open to sump through gallery G and the smaller internal drilling in the unload valve.

Pump pressure oil in gallery E now acts on the right hand face of the flow control valve via an internal drilling, moving the valve fully to the left, allowing pump pressure oil to flow from gallery E to F.

If the deluxe remote valves are in neutral the load sensing line pressure is vented to sump through the remote valves. Pump oil in gallery F acts on the right hand face of the combining valve, moving the valve to the left allowing oil flow from gallery F to sump gallery G.

The oil in the lift cylinder remains trapped in galleries A and B by the control valve land and the check valve.



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Oil Flow in Neutral
(Tractors with Fixed Displacement Hydraulic Pump)

■ Main Pump Pressure Oil

■ Auxiliary Pump Oil

■ Exhaust Oil

□ Trapped Oil

1. To Remote Valves
2. Combining Valve (Sequencing) Valve
3. Unload Valve
4. Flow Control Valve
5. From Main Pump
6. Control Valve
7. Exhaust Valve
8. To Lift Cylinder
9. Check Valve
10. To Reservoir
11. Remote Valve Pilot Line (Load Sense Line)
12. From Auxiliary Pump

GALLERY A, To Lift Cylinder and Auxiliary Services Valve (where fitted)

GALLERY E, Main Pump Supply

GALLERY H, Auxiliary Pump Supply

GALLERY G, Return to Sump

OIL FLOW IN LOWERING

With reference to Figure 11.

With the control valve in the lowering position the following functions occur:–

Pump pressure oil is directed to the combining valve in the priority valve pack, where it is returned to sump or supplied to the deluxe remote valves if required.

Oil in the lift cylinder is released to sump through the control and exhaust valves.

Oil flow through the hydraulic valves when the control valve is in the lowering position is as follows:–

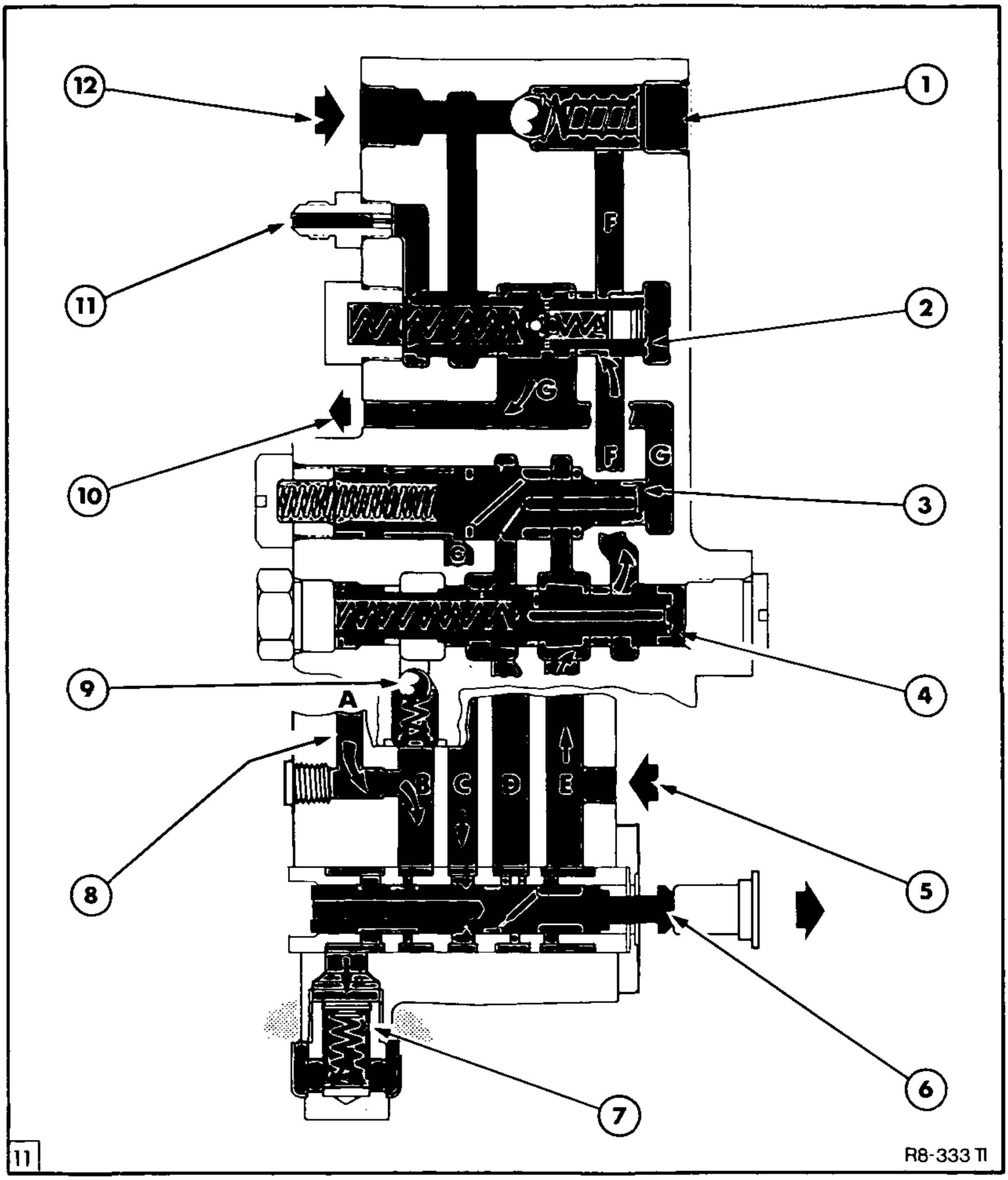
Pump pressure oil flow to sump follows the same route as described when the control valve is in neutral, entering gallery E and flowing past the flow control valve to the combining valve gallery F.

In both neutral and lowering, if there is no deluxe remote demand the pump pressure oil is returned to reservoir by the combining valve.

When the control valve is moved to the right from neutral to lowering, lift cylinder oil is allowed to flow out of gallery A and B, across the control valve to sump through the exhaust valve.

Excess lift cylinder oil flow through the exhaust valve will force the valve down against the spring, reducing the exhaust port aperture.

This action of reducing the exhaust port aperture consequently controls the lowering of the lift arms irrespective of the loading on the lift linkage.



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Oil Flow in Lowering
(Tractors with Fixed Displacement Hydraulic Pump)

■ Main Pump Pressure Oil
■ Auxiliary Pump Oil
■ Exhaust Oil
☐ Trapped Oil

1. To Remote Valves
2. Combining Valve (Sequencing Valve)
3. Unload Valve
4. Flow Control Valve
5. From Main Pump
6. Control Valve
7. Exhaust Valve
8. To Lift Cylinder
9. Check Valve
10. To Reservoir
11. Remote Valve Pilot Line (Load Sense Line)
12. From Auxiliary Pump

GALLERY A, To Lift Cylinder and Auxiliary Services Valve (where fitted)

GALLERY E, Main Pump Supply

GALLERY H, Auxiliary Pump Supply

GALLERY G, Return to Sump

OIL FLOW IN SLOW (INITIAL) RAISING

With reference to Figure 12.

When raising the hydraulic lift two conditions of raise occur referenced to as 'slow' and 'fast' raise. In both conditions the speed of lift is controlled by the number of ports around the lift control valve which are opened to allow pump pressure oil to be directed to the lift cylinder.

When the lift control lever is moved to the point where the hydraulic lift starts to raise slow lift is engaged and the following functions occur:–

Pump pressure oil is directed to:–

(i) Lift Cylinder, or

(ii) Combining Valve

The position of the control valve operates the *flow control valve which gives priority to the lift* cylinder demand and diverts the surplus oil to the combining valve

The combining valve will either return the surplus oil to reservoir or direct it to the deluxe remotes.

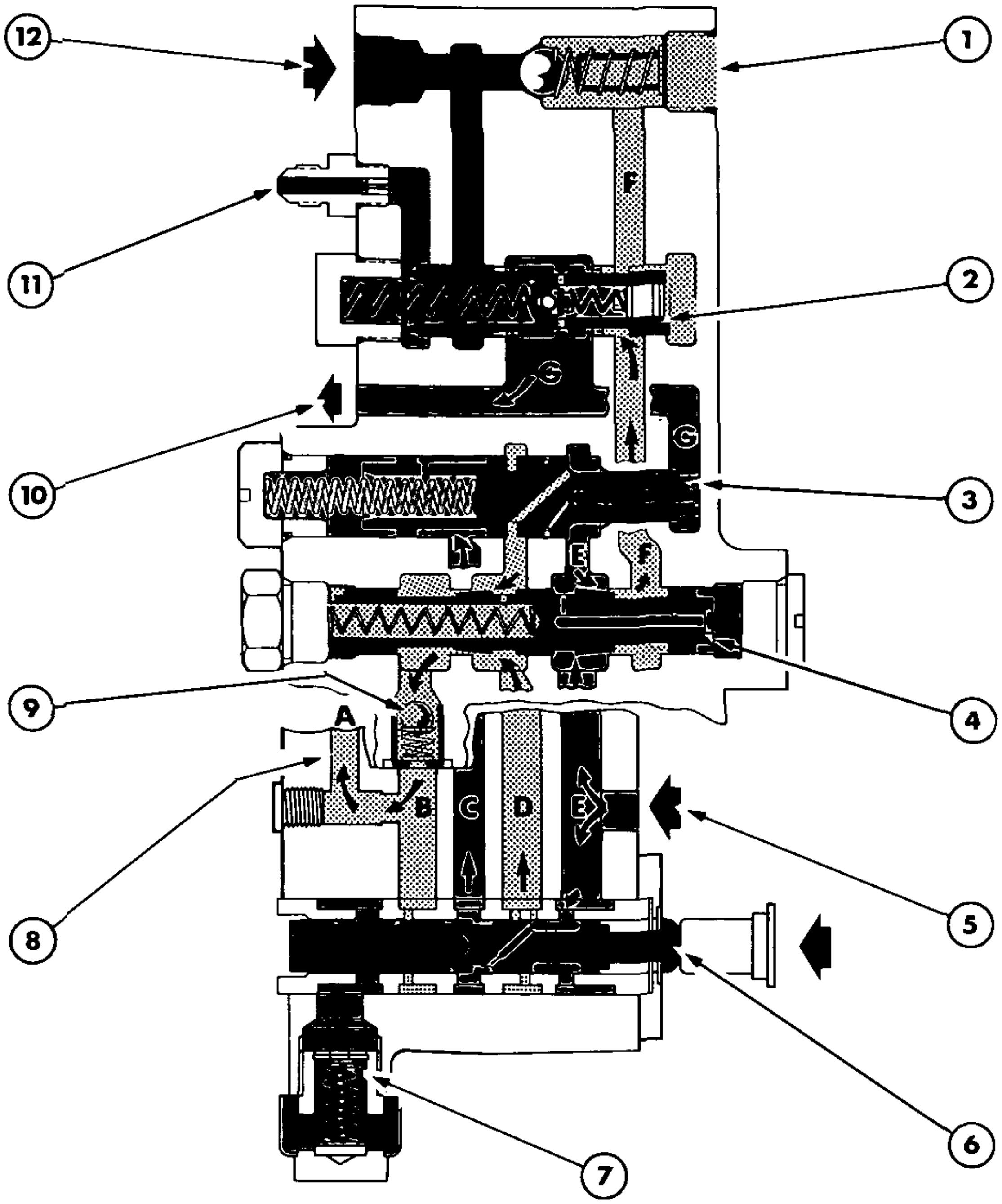
The oil flow through the hydraulic valves when the control valve in slow raising is as follows:–

The initial movement of the lift control lever moves the control valve from neutral to slow raise which allows pump pressure oil in gallery E to flow via the control valve drilling to gallery C and the left hand end of the unload valve.

The unload valve now moves fully to the right due to the combined pressure in gallery C and the spring pressure applied to the valve. *In this position the larger cross drilling in the* unload valve connects gallery E and D.

Pump pressure oil flow through the unload valve drilling is restricted to 7.6 litres/min (1.67 imp gals/min, 2 US gals/min) and effects a smooth 'initial' lift. The reduced pressure created acts on the left hand face of the flow control valve to move it to the right and the initial oil flow to the cylinder flows via the check valve through galleries B and A.

Further movement of the control valve to the left connects Gallery E to D by uncovering a series of ports in the bush. Increased pump oil flow passes into Gallery D, increasing cylinder lift speed and moving the flow control valve further to the right. reducing the oil flowing from gallery E to Gallery F.



12

R8-334 TI

Oil Flow in Slow Raising
(Tractors with Fixed Displacement Hydraulic Pump)

■	Main Pump Pressure Oil	▨	Reduced Pump Pressure Oil	■	Auxiliary Pump Oil	■	Exhaust Oil

1. To Remote Valves
2. Combining Valve (Sequencing Valve)
3. Unload Valve
4. Flow Control Valve
5. From Main Pump
6. Control Valve
7. Exhaust Valve
8. To Lift Cylinder
9. Check Valve
10. To Reservoir
11. Remote Valve Pilot Line (Load Sense Line)
12. From Auxiliary Pump

GALLERY A, To Lift Cylinder and Auxiliary Services Valve (where fitted)

GALLERY E, Main Pump Supply

GALLERY H, Auxiliary Pump Supply

GALLERY G, Return to Sump

OIL FLOW IN FAST RAISING

With reference to Figure 13

When the lift control lever is moved fully to the left and the flow control valve moves to the fast raise condition the following functions occur:–

The flow control valve gives full priority to the lift cylinder.

Operation of the deluxe remote valves would only be possible, at this point of the lift cycle if an auxiliary engine mounted pump is installed.

The oil flow through the hydraulic valves with the control valve in fast raising is as follows:–

The full movement of the lift control lever has moved the control valve to the fast raise position, passing the 'initial' and 'slow' raise positions.

All the holes in the control valve bush are now uncovered allowing increased pump flow from gallery E to gallery D.

The unload valve is held to the right by the combination of spring pressure applied to the end of the valve and oil pressure generated in gallery C as the control valve passed through the initial and slow raise condition.

Pump pressure oil flows from gallery E to D with less restriction and the pressure in gallery E, gallery D and on either face of the flow control valve are equal. The flow control valve spring now moves the valve fully to the right, closing off gallery E from gallery F.

All main pump pressure oil is diverted to the lift cylinder, giving lift cylinder priority over remote valves. Oil entering the cylinder flows past the left hand end of the flow control valve, past the check valve in Gallery B and into the lift cylinder Gallery A.

Due to the size of the ports in the flow control valve bush, the maximum pump flow to the lift cylinder is limited to approximately 6.7 Imp Galls/min (8 US Galls/min 31 ltrs/min).

As the main hydraulic pump oil does not enter Gallery F, the combining valve moves to the right, closing the return to sump Gallery G. However if an auxiliary pump is fitted, the auxiliary pump oil flow will operate the combining valve as shown in Figure 13.

OIL FLOW FROM THE OPTIONAL ENGINE MOUNTED AUXILIARY PUMP THROUGH THE COMBINING VALVE

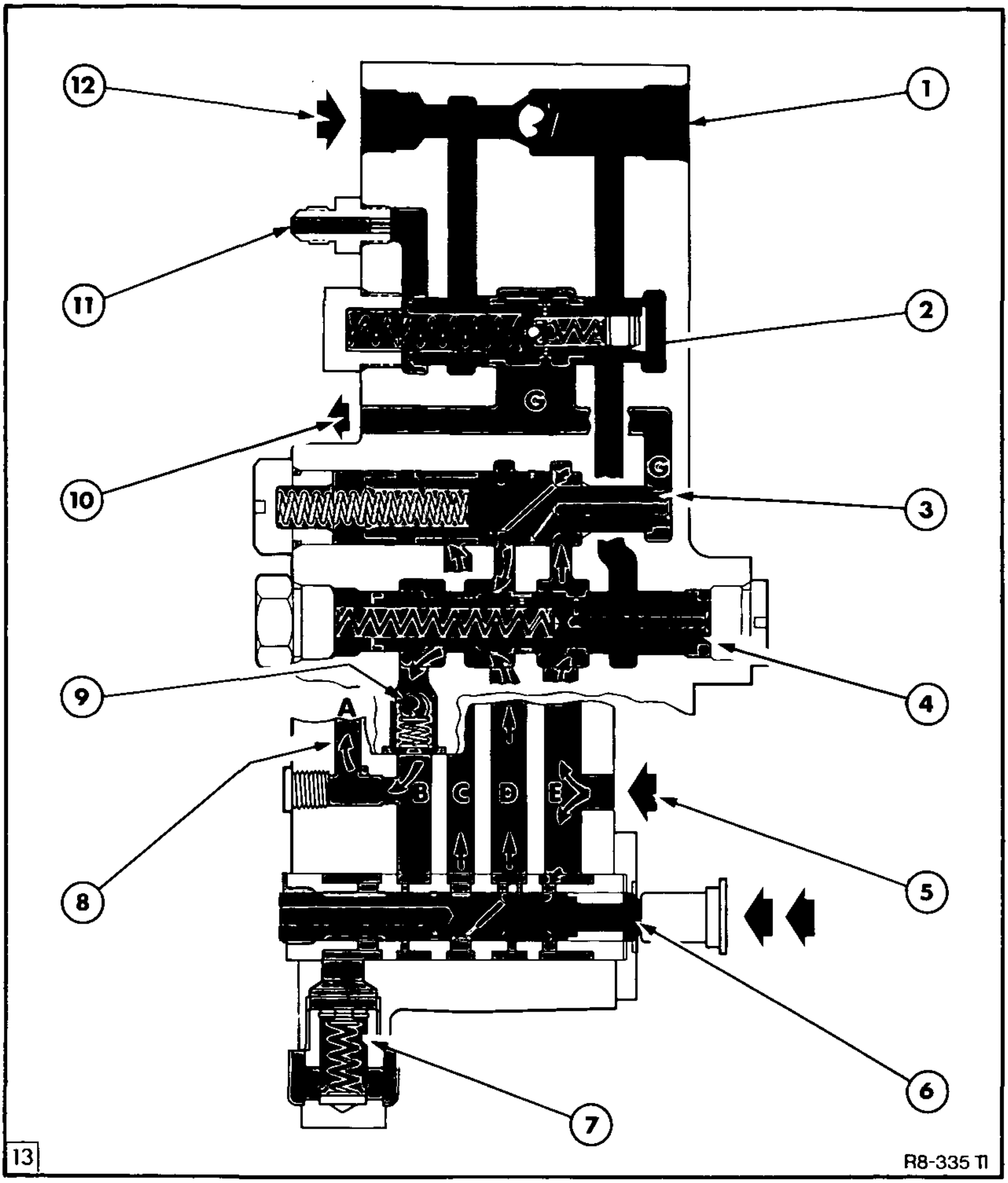
Auxiliary pump oil is used to supplement the main pump in the supply of hydraulic oil to the remove valve circuit.

When the remote valve circuit is actuated, a pilot (load sensing) signal is applied to the left–hand end of the combining valve which moves the valve to the right, progressively blocking off the connections F to G and H to G depending on the hydraulic requirements of the remote valves.

Auxiliary pump pressure oil now lifts the check valve and joins the flow of main pump oil in the remote valve feed gallery F. Refer to Figure 13.

When the remote valve circuits are in neutral and the load sense line is vented, pump oil pressure in gallery F moves the combining valve to the left allowing pump oil flow to return directly to sump through gallery G. Refer to Figure 12.

When the remote valve system is overloaded and pressure in the load sense line exceeds 2700–2750 lbf/in^2 (186–190 bar) the ball type relief valve within the combining valve spool operates venting the pressure applied to the left hand end of the spool to sump via gallery G. The change in pressure across the combining valve moves the spool to the left allowing excess flow from both pumps in galleries F and H to be exhausted to the sump via gallery G.



13

R8-335 TI

Oil Flow in Fast Raising
(Tractors with Fixed Displacement Hydraulic Pump)

■ Main Pump Pressure Oil

■ Auxiliary Pump Oil

■ Exhaust Oil

1. To Remote Valves
2. Combining Valve (Sequencing Valve)
3. Unload Valve
4. Flow Control Valve
5. From Main Pump
6. Control Valve
7. Exhaust Valve
8. To Lift Cylinder
9. Check Valve
10. To Reservoir
11. Remote Valve Pilot Line (Load Sense Line)
12. From Auxiliary Pump

GALLERY A, To Lift Cylinder and Auxiliary Services Valve (where fitted)

GALLERY E, Main Pump Supply

GALLERY H, Auxiliary Pump Supply

GALLERY G, Return to Sump

HYDRAULIC OIL FLOW FOR TRACTORS WITH VARIABLE DISPLACEMENT CCLS HYDRAULIC PUMP

As described earlier when tractors are equipped with the variable displacement CCLS hydraulic pump and top link sensing the priority valve pack used on tractors with the fixed displacement hydraulic pump is replaced with the unload valve shown in Figure 9.

OIL FLOW IN NEUTRAL

With Reference to Figure 14A

When the control valve is in neutral, pump pressure oil is prevented from entering galleries C and D.

Gallery C is open to reservoir and the sprung loaded unload valve is held in the closed position, preventing flow of oil from gallery E across the unload valve to the lift cylinder gallery A.

The load sensing line to the hydraulic pump is open to reservoir via the dump port in the valve.

The oil in the lift cylinder remains trapped in galleries A and B by the control valve land and check valve.

OIL FLOW IN LOWERING

With reference to Figure 14B

When the control valve is moved to the right from neutral to lowering, lift cylinder oil is allowed to flow out of gallery A into gallery B, across the control valve to sump through the exhaust valve.

Excess lift cylinder oil flow through the exhaust valve will force the valve down against the spring, reducing the exhaust port aperture.

This action of reducing the exhaust port aperture consequently controls the lowering of the lift arms irrespective of the loading on the lift linkage.

OIL FLOW IN RAISING

When raising the hydraulic lift two conditions of raise occur referenced to as slow and fast raise. In both conditions the speed of lift is controlled by the load sense signal to the hydraulic pump and the number of ports around the lift control valve which are opened to allow pump pressure oil to be directed to the lift cylinder.

When the lift control lever is moved to the point where the hydraulic lift starts to raise the control valve moves from the neutral to slow lift position.

When the control valve moves from the neutral to slow raise position it also passes a stage referred to as 'initial raising', Figure 14C. At this point, pump pressure oil in gallery E flows via the control valve drilling to gallery C.

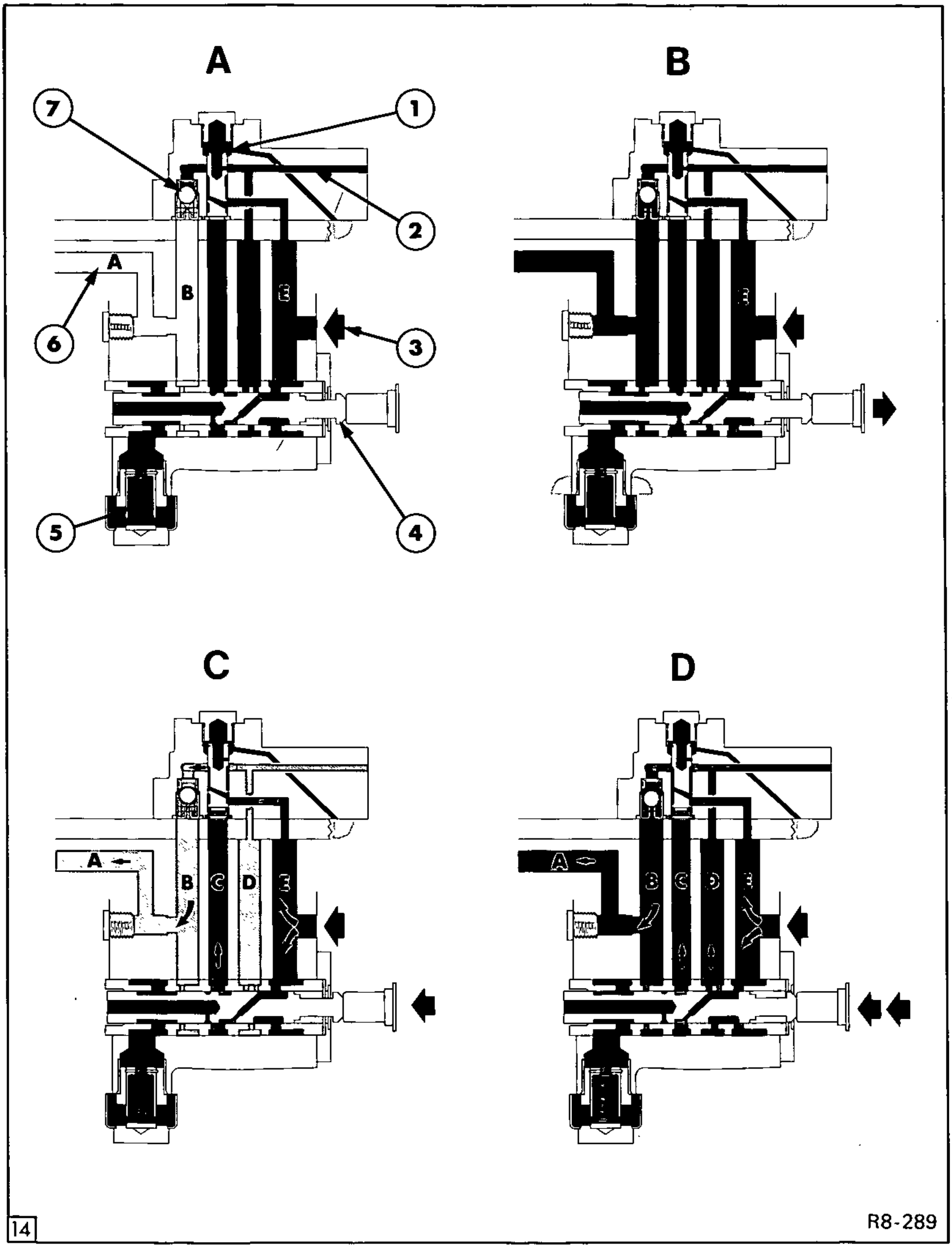
The pressure rise in Gallery C moves the unload valve against its spring, connecting gallery E, via a drilling in the unload valve, to the load sensing line. The flow of oil through the unload valve drilling, signals the pump to produce an initial flow of oil in accordance with the pressure drop through the drilling, ensuring that a smooth lift is always achieved when moving the lift control lever from the neutral to raise condition.

The control valve after passing through the initial to the slow and fast raise condition, Figure 14D, connects Gallery E and D by uncovering a series of ports in the control valve bush.

The flow of oil in Gallery E can now also flow via the control valve to Gallery D and across the unload valve and check valve to the lift cylinder Gallery A. The hydraulic lift now raises at a speed in proportion to the number of ports uncovered in the control valve bush.

When the control valve reaches the fast raise condition all the holes in the control valve bush are uncovered allowing the maximum oil flow from gallery E to Gallery D.

The pressure in gallery D is sensed by the load sense line, which signals the variable displacement CCLS pump to maintain output according to demand.



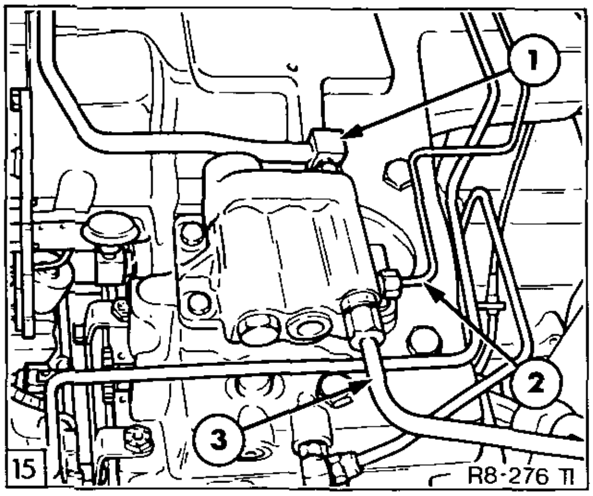
Hydraulic Oil Flow For Tractors With Variable Displacement CCLS Hydraulic Pump

■	Pump Pressure Oil	▨	Reduced Pump Pressure Oil	■	Exhaust Oil	□	Trapped Oil

A Neutral
B Lowering
C Initial Raising
D Fast Raising

1. Unload Valve Spool
2. Load Sensing Line to Hydraulic Pump
3. From Hydraulic Pump
4. Control Valve
5. Exhaust Valve
6. To Lift Cylinder
7. Check Valve

PRIORITY VALVE PACK (Tractors With Fixed Displacement Hydraulic Pump Only)

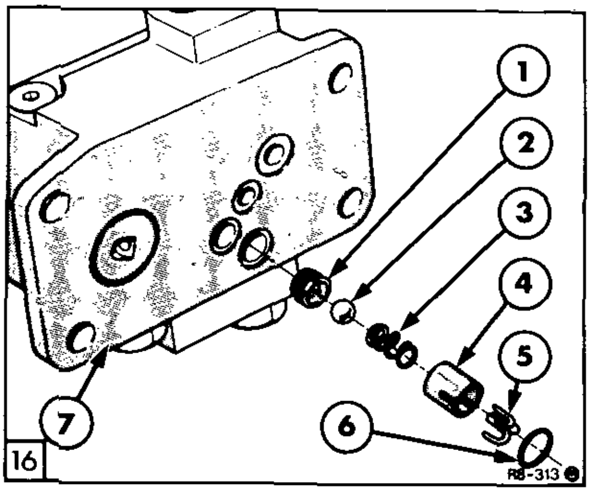


Priority Valve Pack Installation
(Tractors with Fixed Displacement Hydraulic Pump)

1. Supply To Remote Valve
2. Load Sensing (Pilot) Line
3. Supply from Auxiliary Engine Mounted Pump (Where Fitted)

REMOVAL

1. Fully lower hydraulic lift arms.
2. Less Cab Tractors:
   Remove seat to gain access to unload valve.



Lift Circuit Check Valve

1. Seat and 'O' Ring
2. Ball
3. Spring
4. Spacer
5. Cage
6. 'O' Ring
7. Housing

3. Remove priority valve pack, Figure 15.

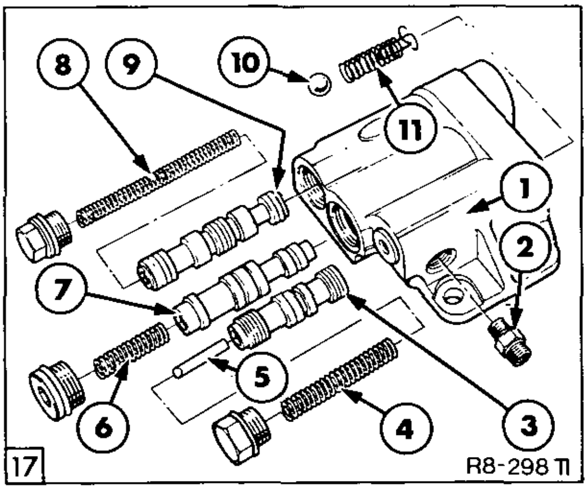
NOTE: *Ensure check valve spring and ball, item 10 and 11 in Figure 17, is not lost when remote valve feed line is disconnected.*

DISASSEMBLY

1. Remove lift circuit check valve, Figure 16. Use a suitable hook pull to seat from housing.

Note: *It is only necessary to remove seat if it is pitted or the 'O' ring seal is suspected of leaking*

2. Remove valves with reference to Figure 17 .



Priority Valve Pack Assembly

1. Priority Valve Housing
2. Pilot Line Connector (with orifice)
3. Combining (Sequencing) Valve
4. Spring
5. Filter
6. Spring
7. Unload Valve
8. Spring
9. Flow Control Valve
10. Check Valve Ball (Auxiliary Pump Circuit)
11. Check Valve Stop and Spring (Auxiliary Pump Circuit)

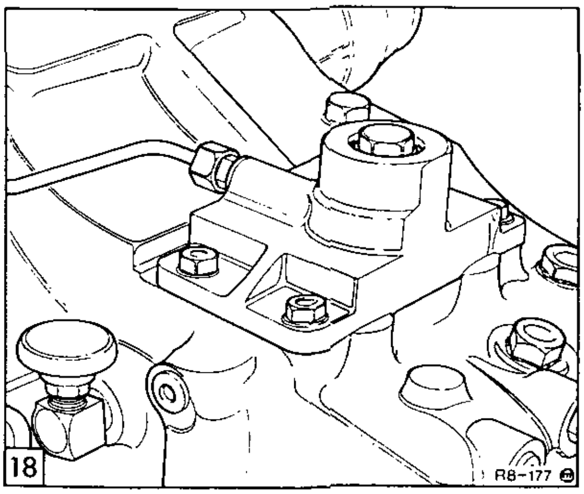
INSPECTION AND REPAIR

1. Wash all components in a suitable cleaning agent such as paraffin (kerosene), mineral spirits or a commercial cleaning solvent.
2. Examine all valves and bores for burrs and scratches. Any minor burrs or scratches may be removed with a fine abrasive.
3. Ensure that valves move freely in their bores. Heavy scoring of bores will necessitate installation of a new priority valve pack.
4. Renew all 'O' ring seals.
5. Lubricate all valves with hydraulic oil prior to re–assembly.

UNLOAD VALVE (Tractors With Variable Displacement CCLS Hydraulic Pump only)

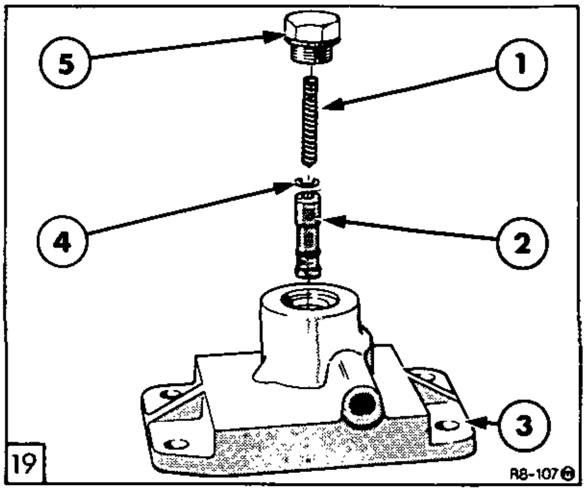
REMOVAL

1. Fully lower hydraulic lift arms.
2. Less Cab Tractors:
   Remove seat to gain access to unload valve



Unload Valve Installation

(Tractors with Variable Displacement CCLS Hydraulic Pump)



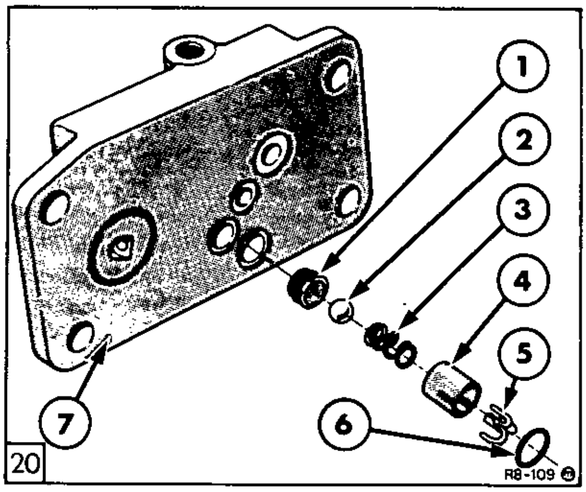
Unload Valve

1. Spring
2. Unload Spool
3. Housing
4. Retaining Ring
5. Plug and 'O' Ring

3. Remove unload valve assembly, Figure 18.

DISASSEMBLY

1. Remove unload spool, Figure 19.
2. Disassemble check valve, Figure 20.



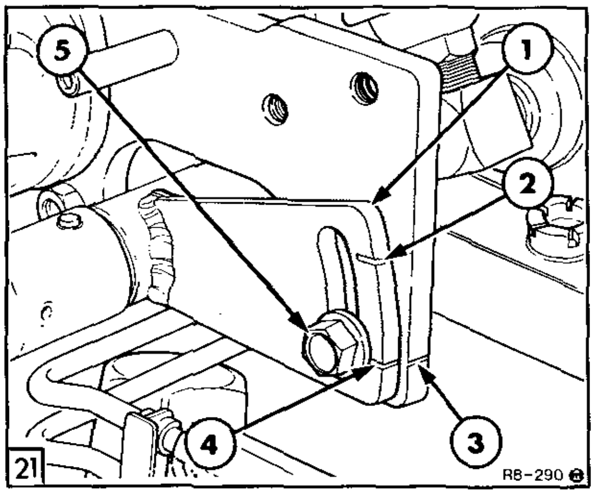
Check Valve

1. Seat and 'O' Ring
2. Ball
3. Spring
4. Spacer
5. Cage
6. 'O' Ring
7. Housing

INSPECTION AND REPAIR

1. Wash all components in a suitable cleaning agent.
2. Examine the unload valve spool and bore for burrs and scratches. Any minor burrs or scratches may be removed with a fine abrasive.
3. Ensure all parts are thoroughly washed before re–assembly. Any heavy scoring of the bore will necessitate installation of a new unload valve
4. Lubricate valve with hydraulic oil and re–assemble using disassembly procedure in reverse.
5. Renew all ‘O’ ring seals between the base of valve housing and hydraulic lift cover.

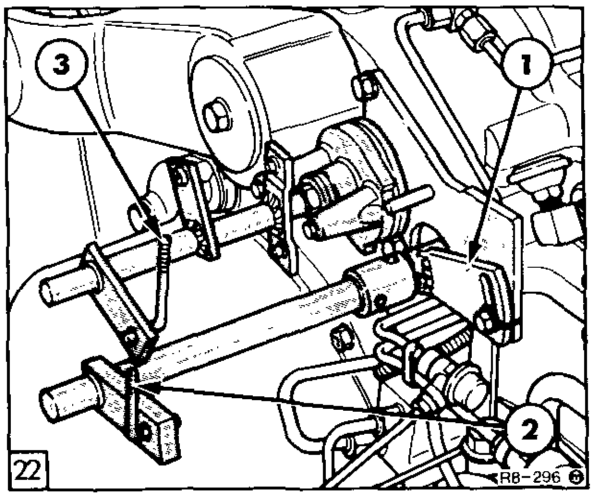
D. HYDRAULIC LIFT ASSEMBLY – OVERHAUL



21

Actuator Locked in Position Control

1. Actuator
2. Draft Control Mark on Actuator
3. Position Control Chisel Mark on Support
4. Position Control Mark on Actuator
5. Locking Bolt Part No 56520–S36
(Finis Code 3935084)



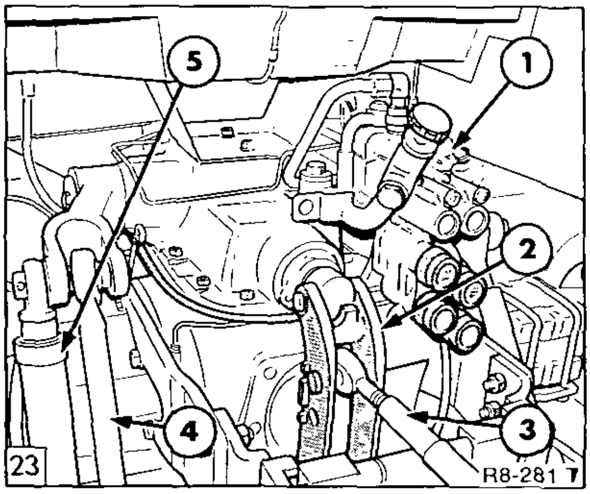
22

Hydraulic Lift Cover Linkage

1. ASC Valve (where fitted)
2. Position/ Draft Control Linkage
3. Hydraulic Lift Linkage

REMOVAL

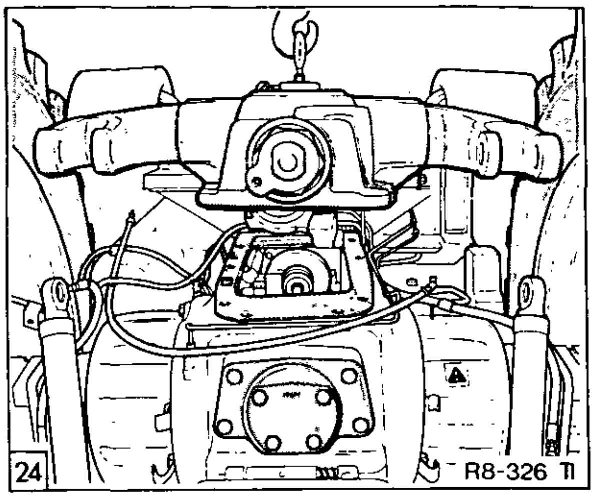
1. Lower lift arms.
2. Move selector lever to position control.
3. Ensure the position control chisel marks on the actuator align with the mark on the hydraulic lift cover support and clamp in position using a 5/16 in–18–UNC locking bolt, Figure 21.
4. Disconnect the control rods to the lift cover linkage. Refer to Figure 22.
5. Disconnect the linkage to the ASC valve (where fitted).
6. Remove top link and rocker. Refer to Figure 23.
7. Less Cab Tractors:
Remove platform to gain access to hydraulic lift cover.



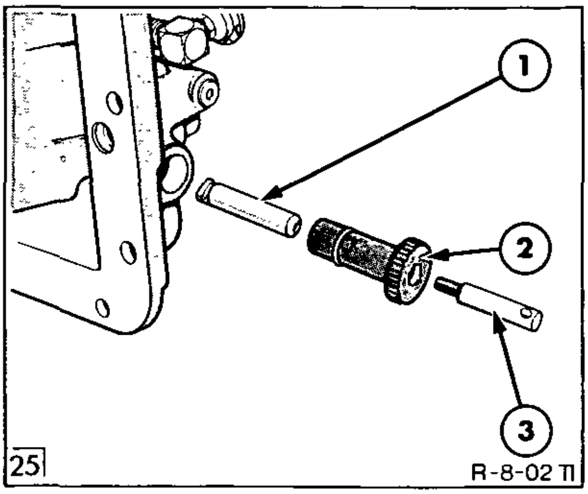
23

Hydraulic Lift and Remote Control Valves

1. Remote Control Valve
2. Rocker
3. Top Link
4. Lift Rod
5. Assist Ram



Removing Hydraulic Lift Cover



ASC Valve Selector Linkage (where fitted)

1. Selector Valve Stem
2. Knob
3. Control Linkage Connector

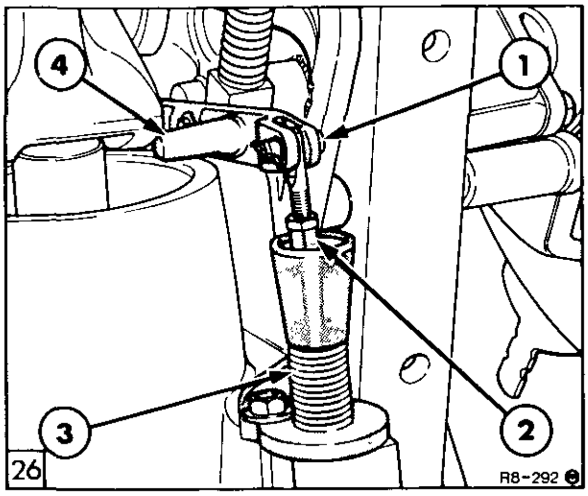
8. Disconnect assist rams hoses (where fitted).
9. Disconnect assist rams and lift rods from hydraulic lift arms.
10. Disconnect and remove remote control valve(s).
11. Remove trailer brake coupler and feed tube (where fitted).
12. Disconnect and remove priority valve pack/unload valve as fitted. Refer to Figure 15 and Figure 18.

    NOTE: *On tractors fitted with the priority valve pack be careful that the auxiliary pump supply check valve spring and ball is not ejected when disconnecting the remote valve supply tube.*

13. If the hydraulic lift assembly is being removed in order to overhaul the lift cylinder, it is recommended that the cylinder retaining bolts are **loosened** before removing the lift assembly from the tractor. **Do Not** remove these bolts.
14. Remove the lift cover retaining bolts and using suitable lifting equipment remove hydraulic lift assembly from the tractor, Figure 24.

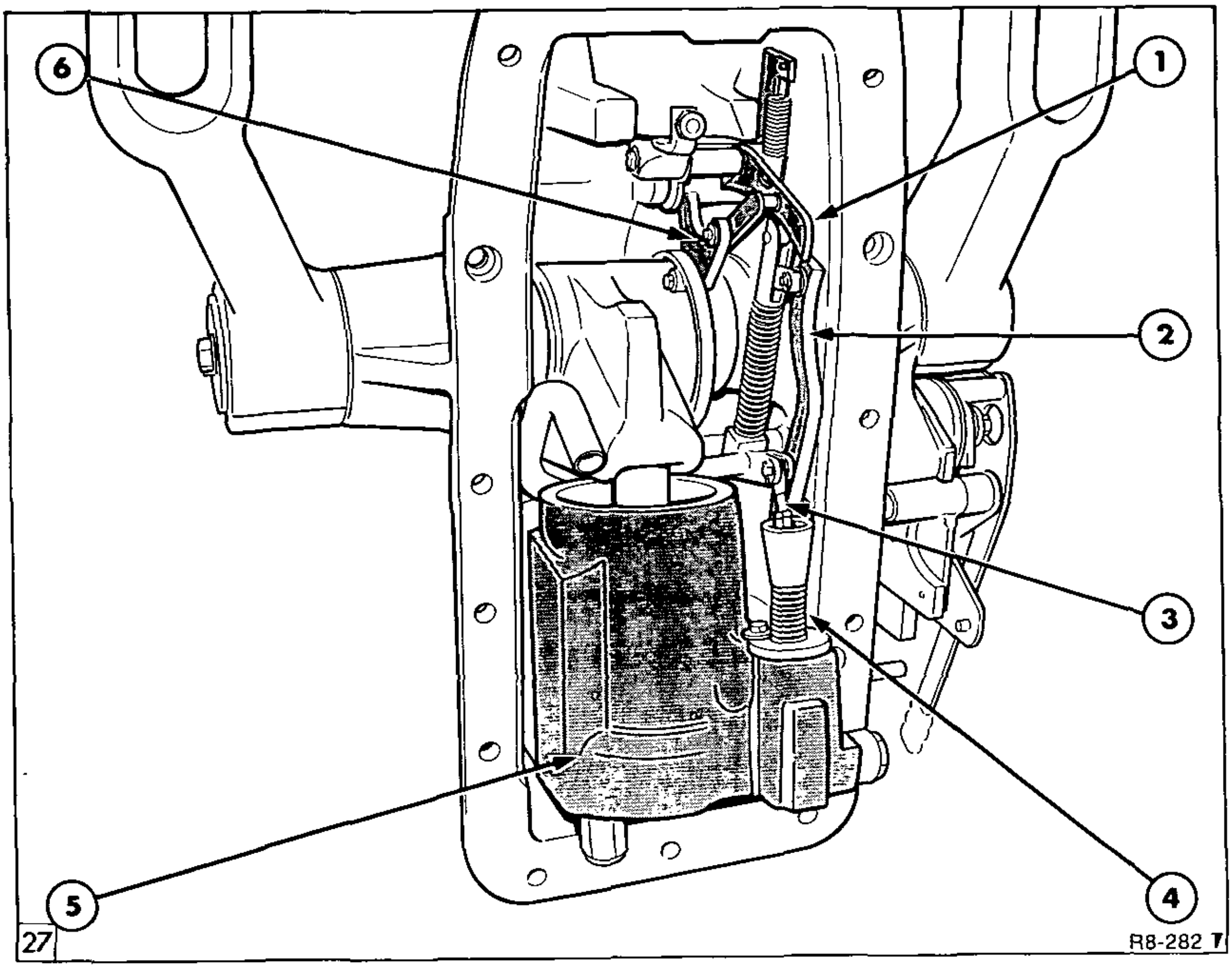
DISASSEMBLY

1. Unscrew ASC control linkage connector, pull knob from lift cover and remove selector valve stem, Figure 25.
2. Disconnect and remove control valve turnbuckle, Figure 26.



Control Valve Turnbuckle

1. Clevis Pin
2. Turnbuckle Assembly
3. Control Valve
4. Lever (Part of Control Rod, Roller and Lever Assembly)



Hydraulic Lift Cover Internal Linkage

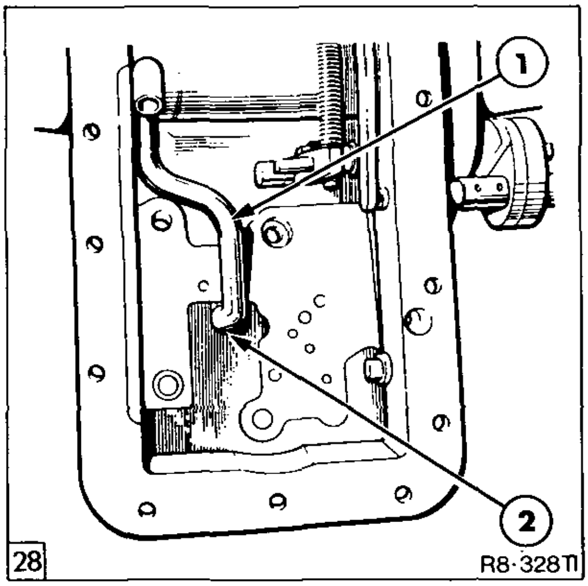
1. Selector Link
2. Selector Arm
3. Control Valve Turnbuckle
4. Control Valve
5. Lift Cylinder
6. Control Rod and Roller

3. Remove four bolts securing cylinder to lift cover.

4. Move lift arms to raised position and carefully remove cylinder from locating dowels. Refer to Figure 27.

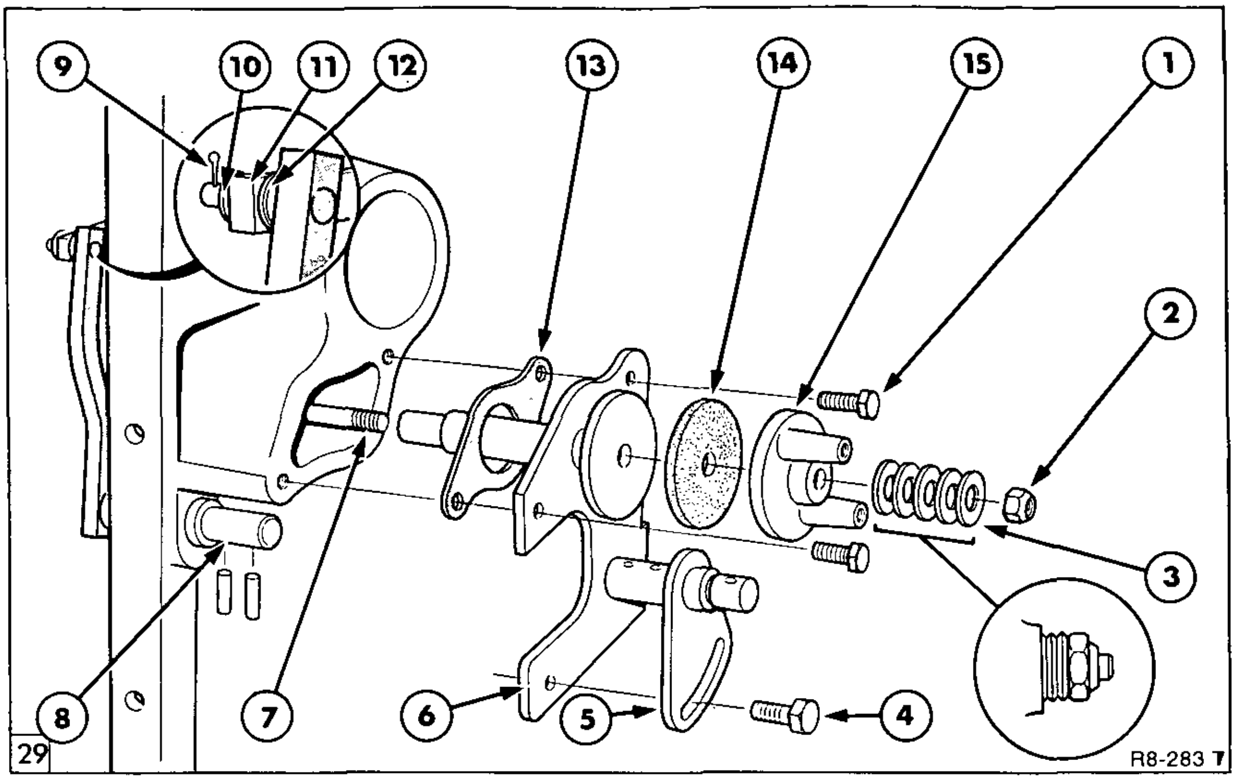
5. Remove priority/unload valve return tube, Figure 28.

6. Referencing Figure 27 to Figure 34, disassemble the hydraulic lift assembly.



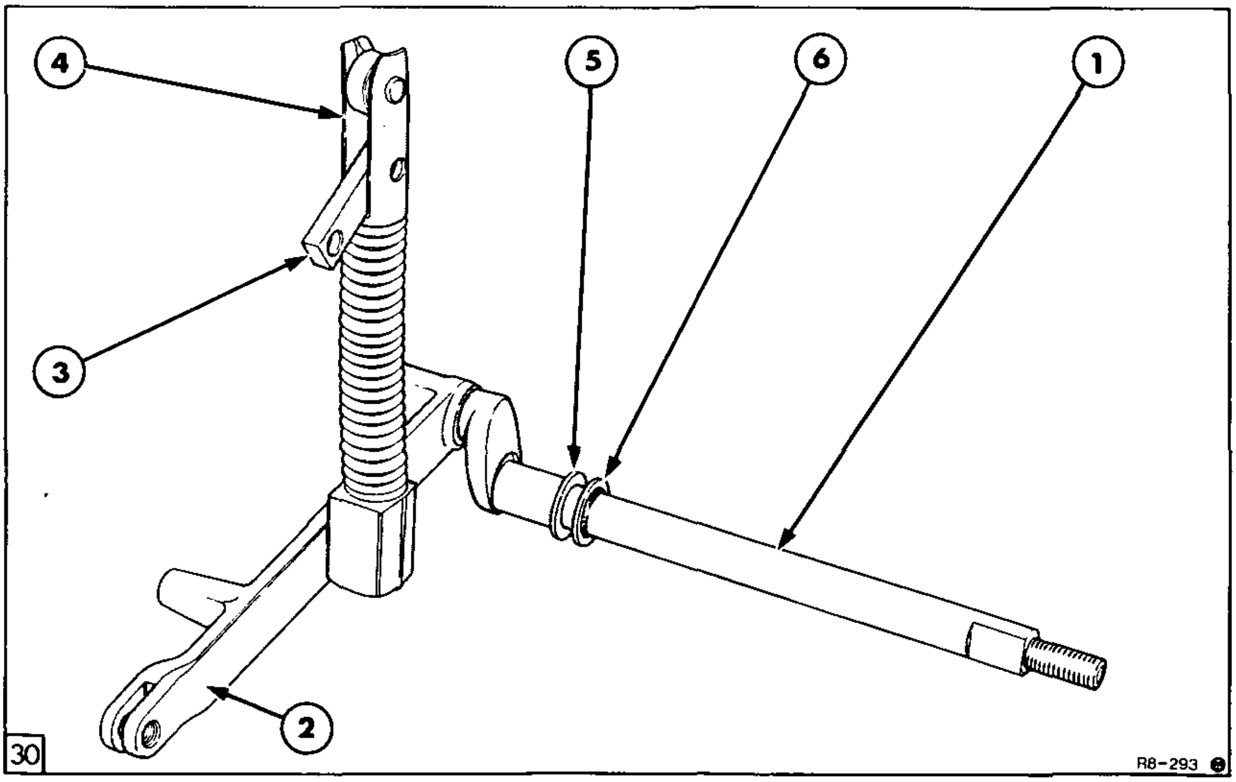
Priority/Unload Valve Return Tube

1. Return Tube
2. Return Port in Top Cover



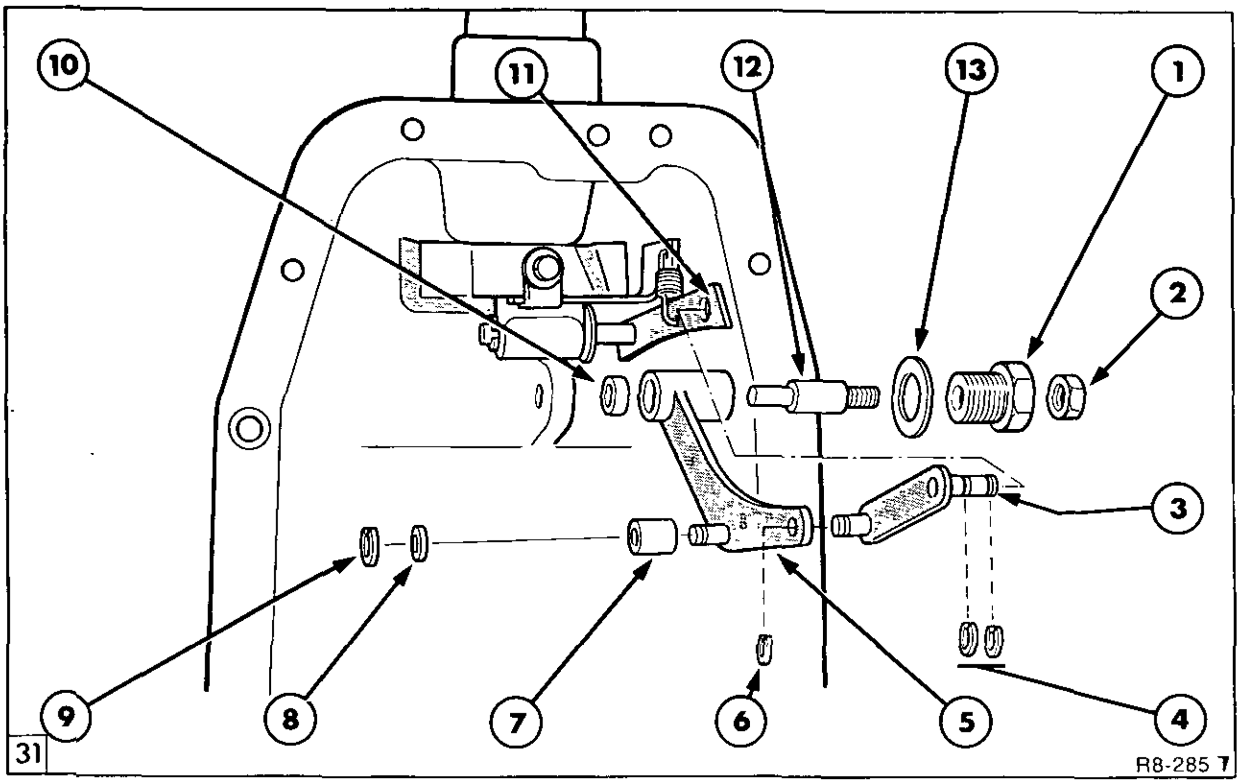
Support Assembly

1.	Bolt	6.	Support	11.	Control Rod and Roller Link
2.	Nut	7.	Control Rod and Roller Shaft	12.	Washers (2 off)
3.	Belleville Washers (5 off)	8.	Selector Lever	13.	Gasket
4.	Locking Bolt	9.	Split Pin	14.	Friction Disc
5.	Actuator	10.	Washer	15.	Body



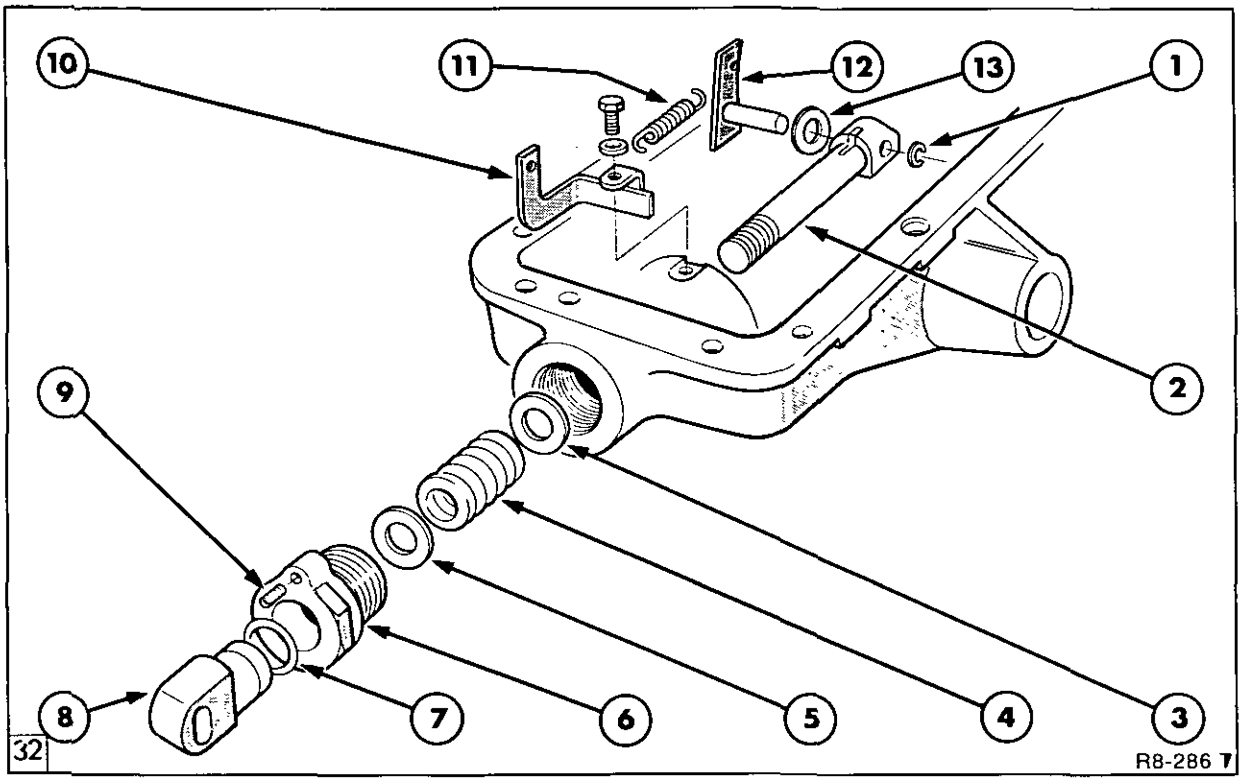
Control Rod, Roller and Lever Assembly

1.	Shaft	3.	Link	5.	Washer
2.	Lever	4.	Rod and Roller Assembly	6.	Seal



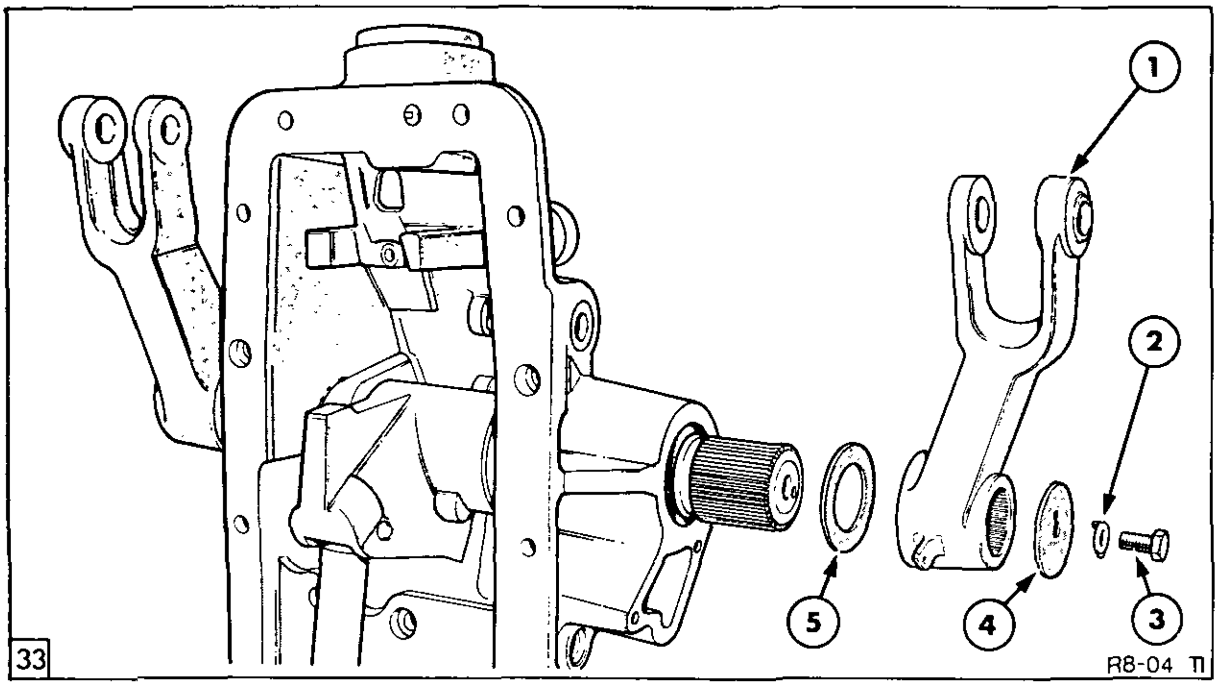
Eccentric Shaft and Selector Link Components

1. Sleeve
2. Nut
3. Link
4. Snap rings
5. Link
6. Snap Ring
7. Cam Roller
8. Spacer
9. Snap Ring
10. Spacer
11. Selector Link
12. Eccentric Shaft
13. Washer



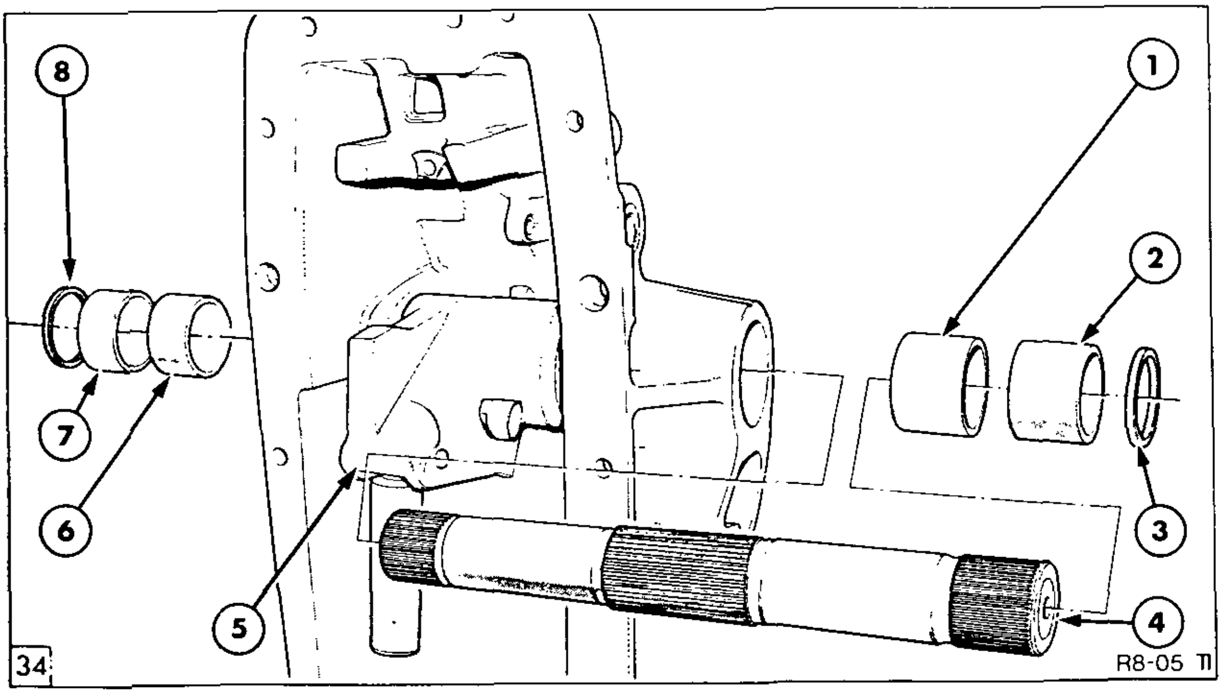
Draft Control Main Spring and Plunger

1. Snap Ring
2. Plunger
3. Washer
4. Spring
5. Washer
6. Retainer Nut
7. Seal
8. Yoke
9. Set Screw
10. Bracket
11. Spring
12. Selector Link
13. Washer



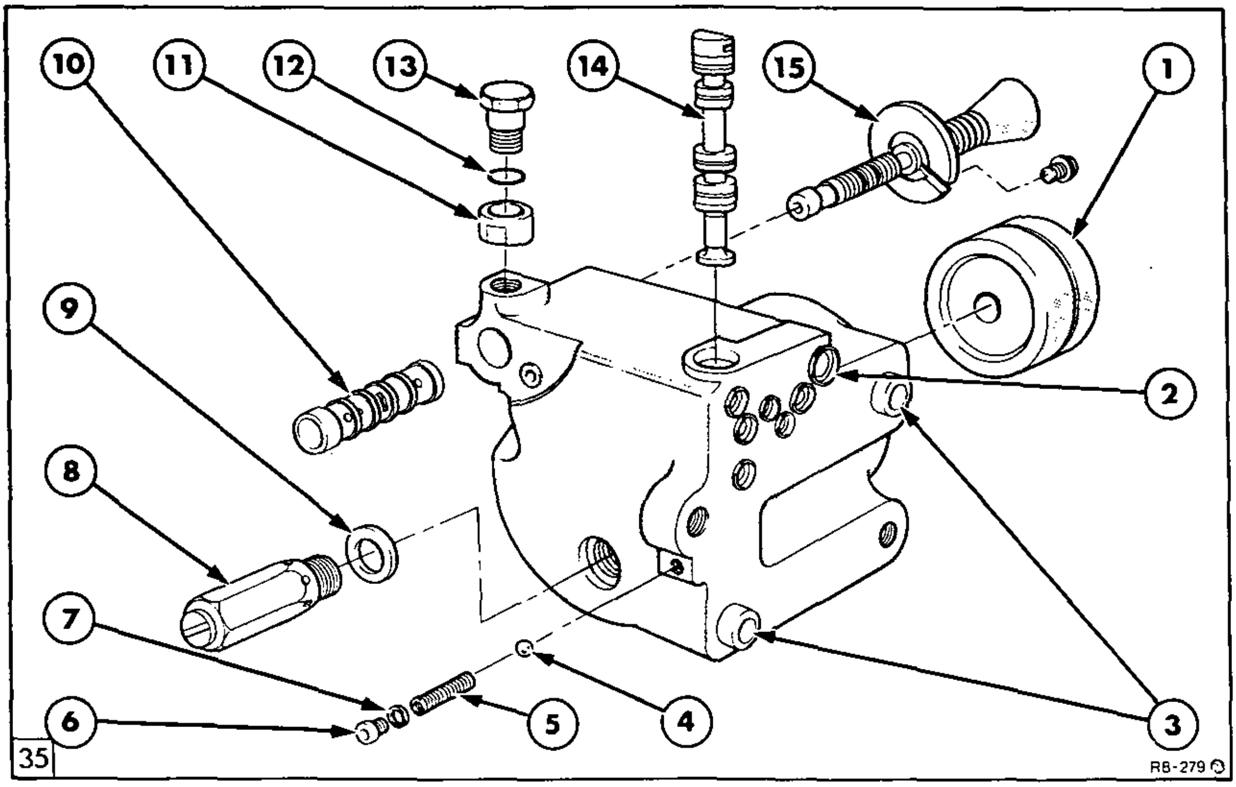
Lift Arm Assembly–Exploded View

1. Lift Arm
2. Locking Washer
3. Bolt
4. Washer
5. Thrust Washer



Cross Shaft Assembly–Exploded View

1. Bush
2. Bush
3. Seal
4. Cross Shaft
5. Piston Rod and Arm Assembly
6. Bush
7. Bush
8. Seal



Hydraulic Lift Cylinder–Exploded View

1. Piston
2. 'O' Rings (7 off)
3. Ring Dowels
4. Ball
5. Spring
6. Plug
7. 'O' Ring
8. Safety Valve
9. Seal
10. Control Valve Bush
11. Diffuser
12. 'O' Ring
13. Exhaust valve
14. ASC Valve Spool
15. Control Valve

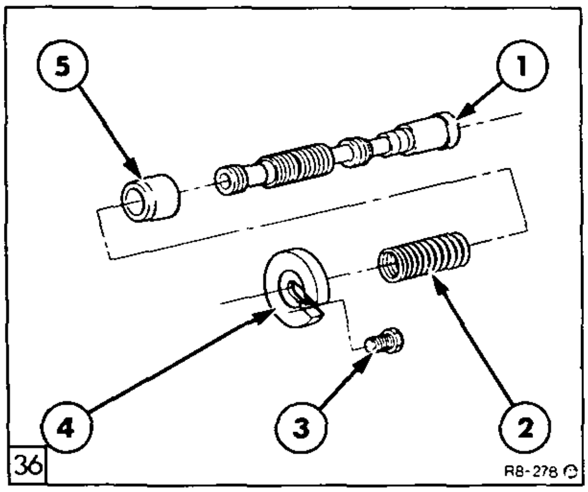
7. Disassemble lift cylinder with reference to Figure 35.

8. Use a soft metal rod inserted through safety valve bore eject lift cylinder piston.

9. Discard all 'O' rings and seals

NOTE: *The lift cylinder safety valve is not serviceable.*

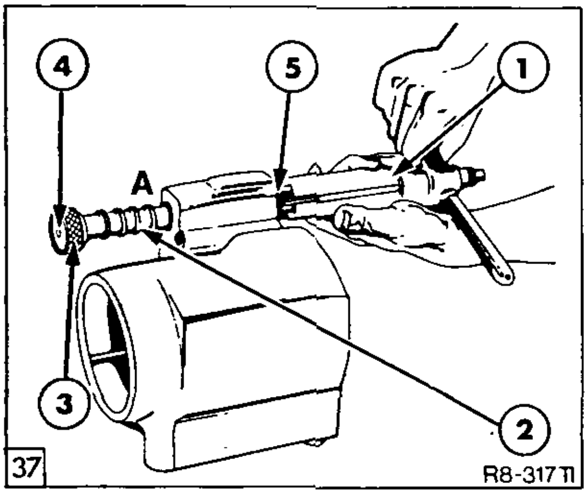
10. Disassemble the control valve with reference to Figure 36.



Lift Cylinder Control Valve

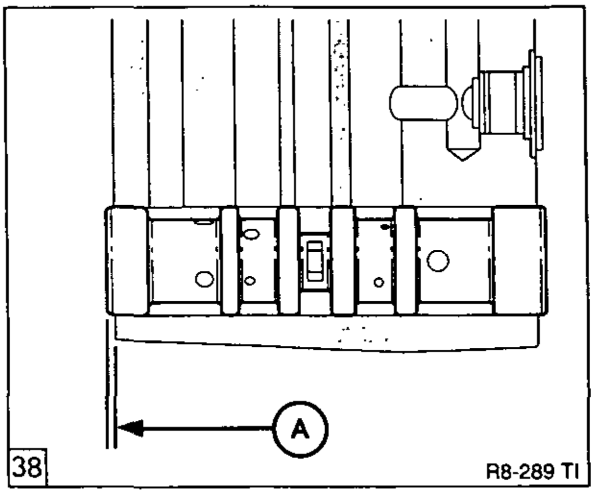
1. Spool
2. Spring
3. Bolt
4. Plate
5. Sleeve

11. Where necessary, remove remaining plugs from lift cover. Under normal circumstances the removal of these plugs is not necessary.



Installing Control Valve Bushing

A Bush Protrusion
1. Tool No FT. 8510 A or FNH 02191
2. Control Valve Bushing
3. Bushing locator Tool No FT. 8510–3 or FNH 10090
4. Extension Tool No. FT. 8510–1A
5. Guide and Stop Adaptor Tool No T. 8510 1K



Control Valve Bush Protrusion

A. 0.1–0.103 in (2.54–2.62 mm)

INSPECTION AND REPAIR

1. Wash all parts in suitable cleaning agent such as paraffin (kerosene).
2. Check oil passages are free from obstruction.
3. Examine valves and bore for wear, burrs or scratches. Minor damage to valve may be removed with fine abrasive.
4. If the control valve bushing requires replacement remove the bushing using Tool No T.8510 or FNH 02191 for North America.

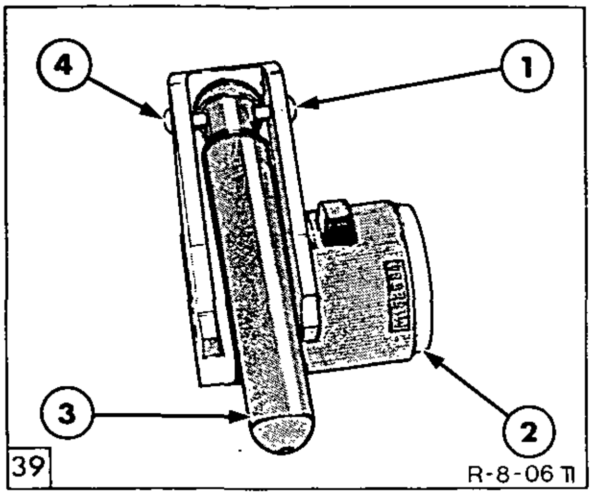
   The control valve bushing is colour coded and the original size as fitted by the factory is indicated by a colour 'spot' on the cylinder casting adjacent to the control valve bore. Always install a new bush with the same colour code markings.

   When replacing the bushing, the bush should be lubricated and drawn through the bore, Figure 37.

   When the bush contacts the inner face of the guide, remove guide and continue to draw bush through the bore until the face of bush protrudes 0.1–0.103 in (2.54–2.62 mm), beyond the rear face of the lift cylinder, Figure 38.

5. Ensure valves are thoroughly washed before re–assembly and move freely in their bores. Heavy scoring of the ASC valve bore necessitates replacement of lift cylinder.
6. Where a new lift cylinder is required select largest control valve and ASC valve spools, which when lightly lubricated, will operate in bore without binding when turned through 360° and operated over full length of stroke.

NOTE: *The control valve bushing and ASC valve bores are colour coded only as a guide for matching the valve to the bore. To obtain an optimum fit a proprietary brand of metal polish may be used to lap a slightly oversize valve into the bore. Ensure all traces of polish are washed away and the components are dried prior to re–assembly. For valve sizes refer to Specifications, Section H.*



Piston Rod and Arm Assembly

1. Pin
2. Arm
3. Rod
4. Pin

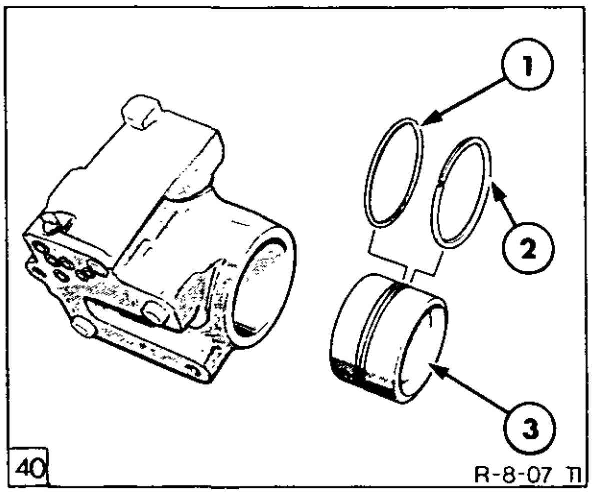
7. If arm, piston rod or retaining pins are worn, separate rod and arm assembly. Refer to Figure 39. The pins are an interference fit into the arm, to remove pins use a suitable lever between rod and end face of pin.

RE–ASSEMBLY

Re–assembly follows the disassembly procedure in reverse.

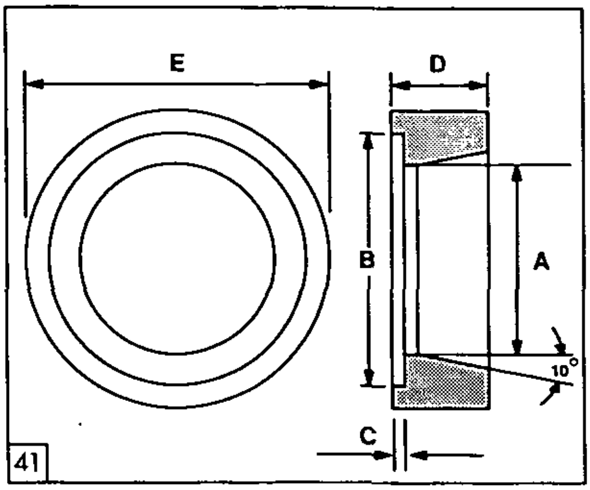
During re–assembly observe the following:

- Renew all ‘O’ rings and seals.



Lift Cylinder Piston Seals

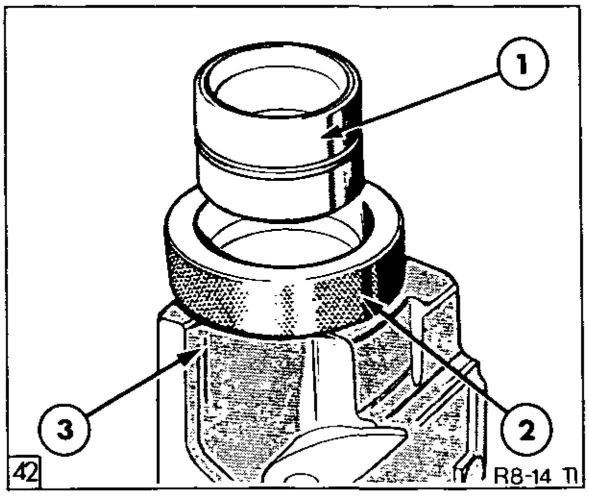
1. ‘O’ Ring Seal
2. Back–Up Seal
3. Piston



Piston Installation Guide

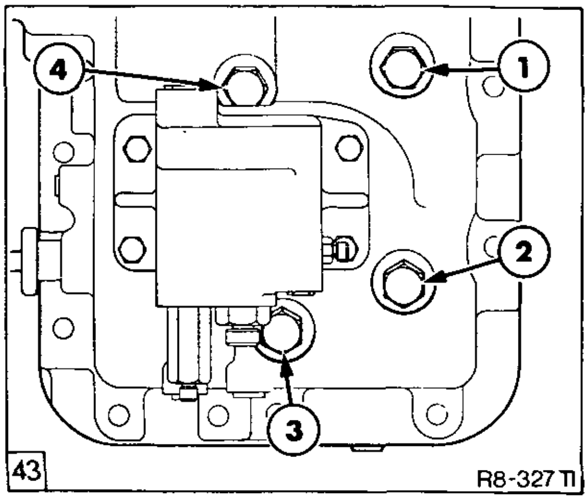
A. 4.126 inch (105 mm)
B. 5.25 inch (134 mm)
C. 0.12 inch (3 mm)
D. 1.62 inch (40 mm)
E. 6.0 inch (155 mm)

- Install piston ‘O’ ring and back–up seal as shown in Figure 40.
- To aid installation of piston into lift cylinder and prevent damage to the piston seals, a guide can be manufactured to the dimensions shown in Figure 41.
- Install piston into cylinder using guide as shown in Figure 42. If a guide is not available and installation is difficult a piston ring compressor may be used to compress the seals.



Installing Piston Into Lift Cylinder

1. Piston
2. Guide
3. Lift Cylinder



Lift Cylinder Retaining Bolt Locations
(Viewed from Top of Hydraulic Lift Cover)

1. 3 in (76 mm) Bolt
2. 2.5 in (64 mm) Bolt
3. 2.25 in (57 mm) Bolt
4. 3 in (76 mm) Bolt withThin Bolt Head

- Ensure the lift cylinder retaining bolts are installed in the correct locations and torqued to 165–200 lbf ft (224–271 Nm), Figure 43.

- Prior to installation of the cross shaft coat the shaft and lip seals with grease.

- The following torque procedure must be observed when tightening the lift arm retaining bolts.

Install the lift arms and tighten the left hand arm retaining bolt to a torque of 20–30 lbf ft (27–40 Nm). Lock the bolt in position with the tab washer. Refer to Figure 33.

Raise both lift arms and tighten the right hand arm retaining bolt sufficiently to allow the arms to lower under their own weight. Lock the bolt in position with the tab washer. **Do Not** over tighten bolts as damage to the cross shaft seals will occur.

E. INTERNAL LINKAGE ADJUSTMENTS

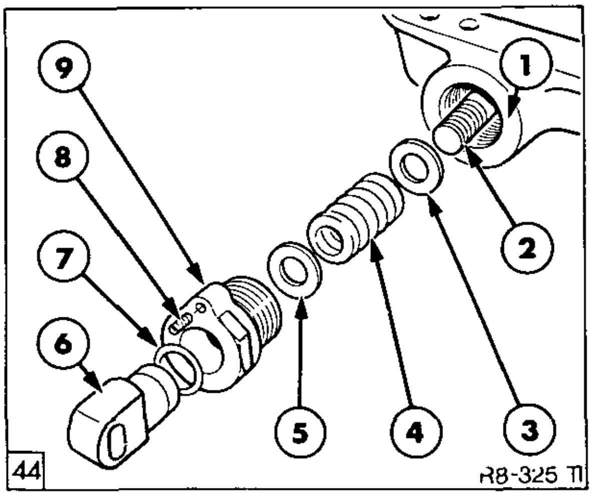
Draft Control Mainspring Adjustment

The draft control mainspring must be checked before carrying out any other adjustment.

1. Unscrew yoke to remove any pre–load on the main spring. Refer to Figure 44.

2. Turn the retainer nut clockwise until the draft control mainspring pressure is just felt then tighten the retainer nut set screw.

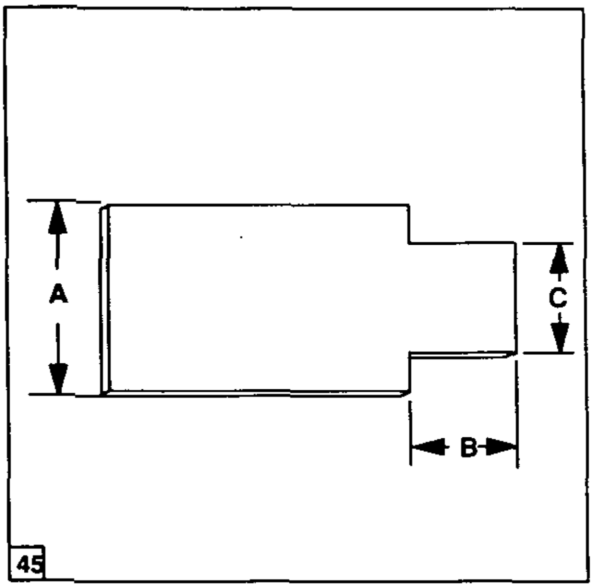
3. Screw the yoke onto the plunger until all free play is eliminated and ensure the hole in the yoke is horizontal.



Draft Control Main Spring Adjustment

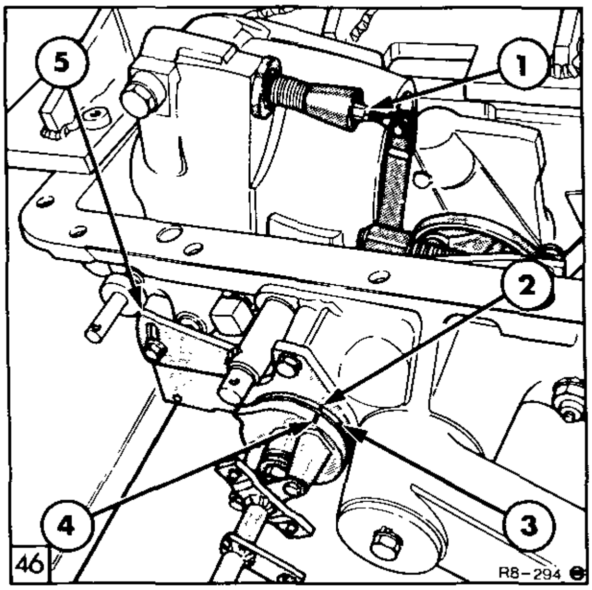
1. Hydraulic Lift Cover
2. Draft Control Plunger
3. Washer
4. Draft Control Main Spring
5. Washer
6. Yoke
7. Seal
8. Set Screw
9. Retainer Nut

Draft and Position Control Adjustments



Locally Manufactured Control Valve Setting Tool

A. 0.8 in (20 mm)
B. 0.46 in (11.7 mm)
C. 0.5 in (12 mm)



Draft Control Adjustment

1. Turnbuckle
2. Draft Control Notch on Support
3. Position Control Notch on Support
4. Notch on Body
5. Actuator Moved to Draft Control

NOTE: *The draft and position control linkage adjustments must be performed with the hydraulic lift assembly removed from the tractor*

In order to complete the position and draft control adjustments it is necessary to use a control valve setting Tool.

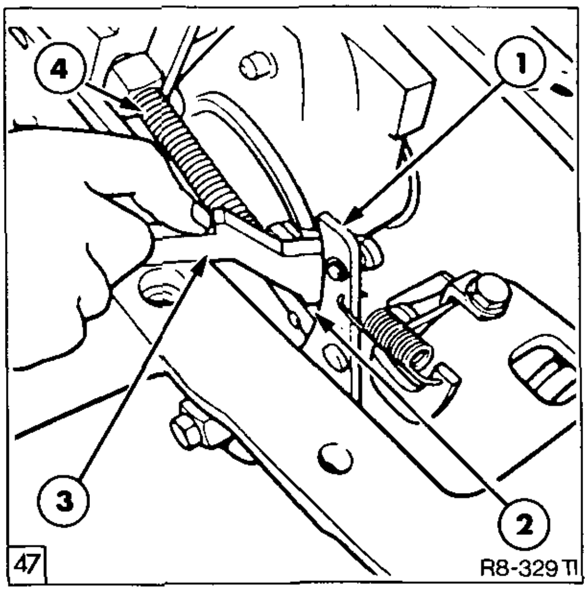
This tool is available as Tool No FNH 00014 or can be manufactured to the dimensions shown in Figure 45.

It is recommended that the tool is manufactured from 3 mm gauge plate.

Draft Control Adjustment

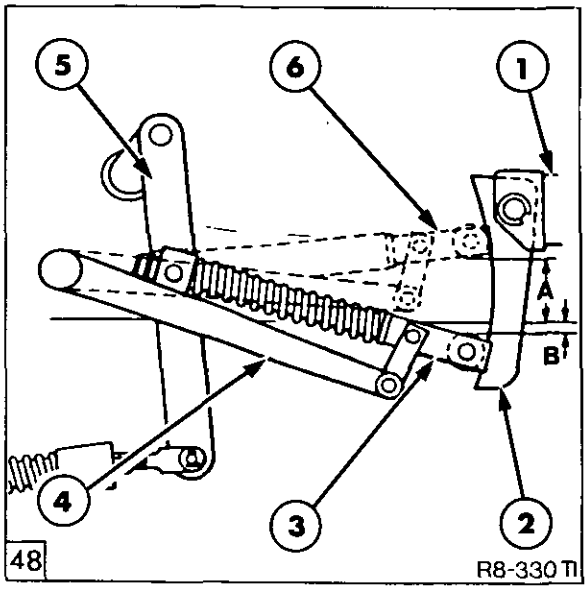
1. Place lift arms in fully lowered position.
2. Align notch on body with draft control notch on support assembly, Figure 46.
3. Move actuator to draft control position as shown in Figure 46. **Do Not** tighten the actuator locking bolt.
4. Position setting gauge Tool No FT. 8527 over the control rod roller, Figure 47.
5. Hold the roller against the setting tool and tighten the actuator locking bolt.

The setting tool will position the roller at 1.95 in (49.5 mm) from the lift cover mounting face. Refer to Figure 48.



Setting Control Rod Roller for Draft Control

1. Selector Link
2. Control Rod Roller
3. Setting Gauge, Tool No. FT.8527
4. Control Rod



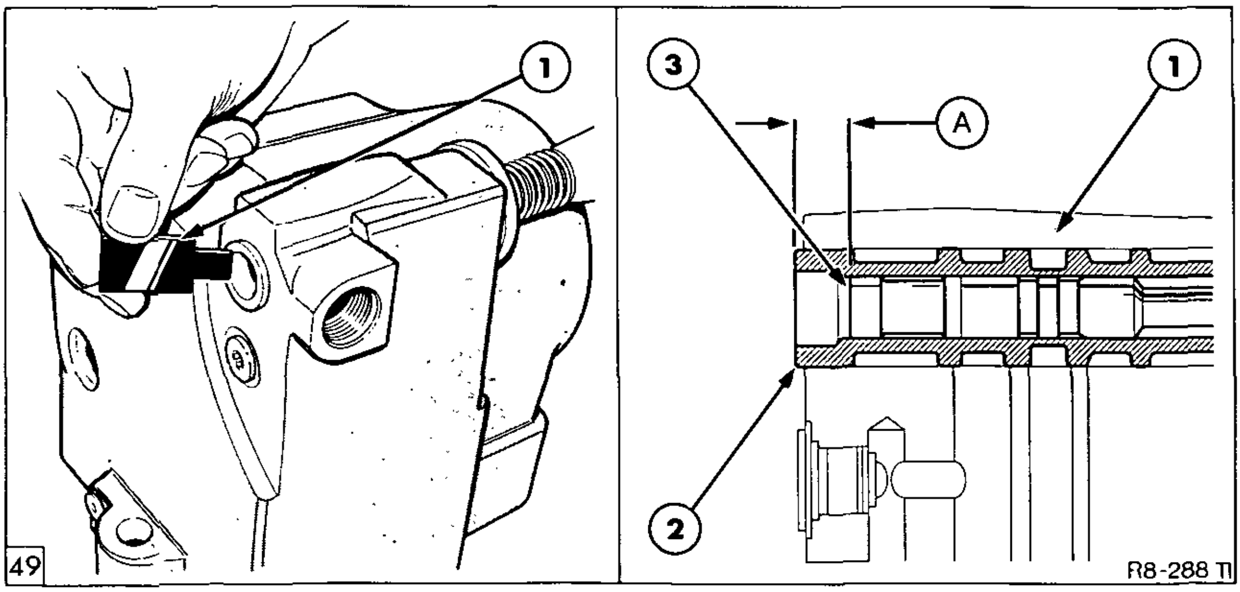
Control Rod Roller Settings for Draft and Position Control

A. 1.95 in (49.5 mm)
B. 0.03 in (0.76 mm)
1. Draft Control Mainspring Plunger
2. Selector Link
3. Control Rod and Roller Assembly in Position Control Setting
4. Selector Arm
5. Actuating Lever
6. Control Rod and Roller Assembly in Draft Control Setting

6. Apply Loctite 271 thread sealant to turnbuckle threads.

7. Position control valve setting tool onto end of the control valve bush and adjust **control valve turnbuckle** until end of spool just touches the tool. When this occurs the spool will be set at 0.46 in (11.7 mm) from the end of the bushing. Refer to Figure 49.

8. Tighten turnbuckle locknut and recheck setting.



Control Valve Adjustment

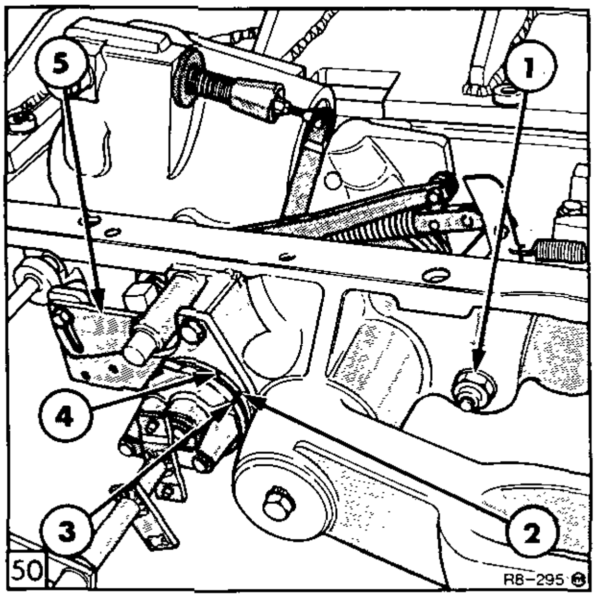
Adjusting Control Valve

1. Setting Tool FNH 00014 or Locally Manufactured Tool

Control Valve Spool Setting

A. 0.46 in (11.7 mm)
1. Lift Cylinder
2. Control Valve Bushing
3. Control Valve Spool

Position Control Adjustment



Position Control Adjustment

1. Eccentric Shaft
2. Position Control Notch on Support
3. Notch on Body
4. Draft Control Notch on Support
5. Actuator Moved to Position Control

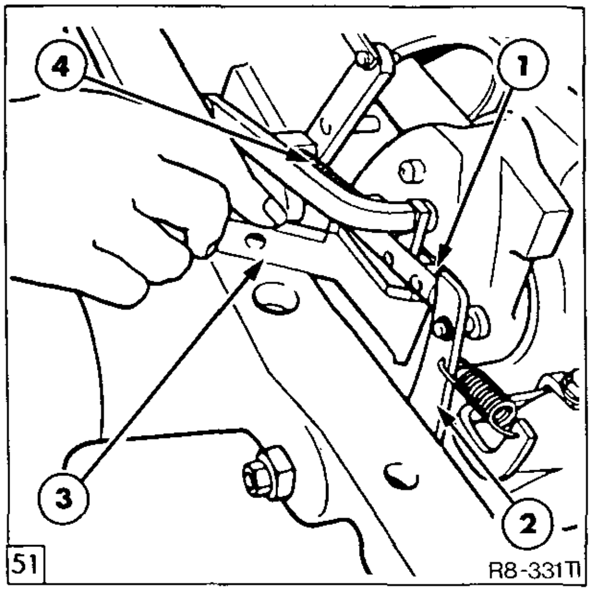
9. Ensure lift arms are still in fully lowered position.

10. Align notch on body with position control notch on support assembly, Figure 50.

11. Loosen actuator locking bolt and move actuator to position control as shown in Figure 50. **Do Not** tighten locking bolt.

1. Position setting gauge Tool No FT. 8527 under the control rod roller, Figure 51. The setting tool will position the roller at 0.03 in (0.76 mm) below the lift cover mounting face. Refer to Figure 48.

2. When roller is in position tighten the actuator locking bolt.

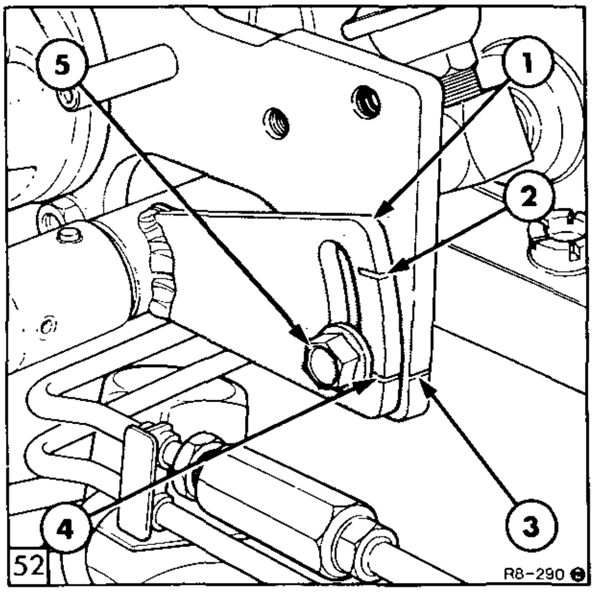


Setting Control Rod Roller for Position Control

1. Selector Link
2. Control Rod Roller
3. Setting Gauge, Tool No. FT.8527
4. Control Rod

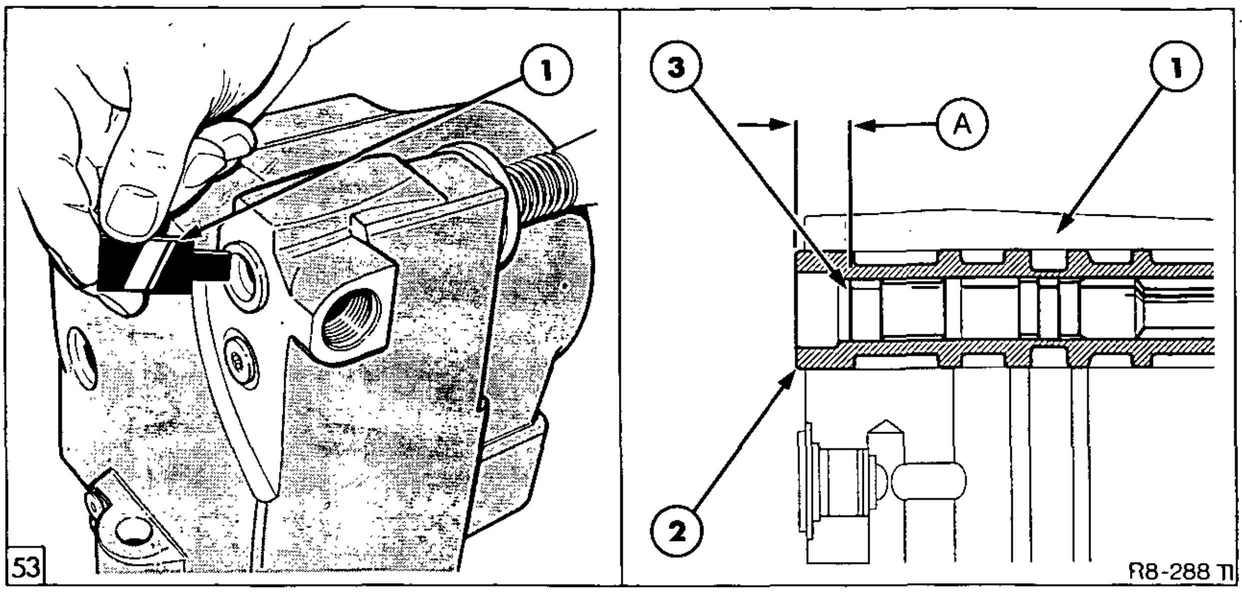
3. Using a small hacksaw, mark the support in line with the position control mark on the actuator. Refer to Figure 52.

This mark will assist in the adjustment of the external control lever linkage, should the locking bolt be inadvertently removed prior to completion of the external linkage adjustment.



Actuator Locked in Position Control

1. Actuator
2. Draft Control Mark on Actuator
3. Position Control Chisel Mark on Support
4. Position Control Mark on Actuator
5. Locking Bolt



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Control Valve Adjustment

Adjusting Control Valve

1. Setting Tool FNH 00014 or Locally Manufactured Tool

Control Valve Spool Setting

A. 0.46 in (11.7 mm)
1. Lift Cylinder
2. Control Valve Bushing
3. Control Valve Spool

4. Position the control valve setting tool onto the end of the control valve bush and turn the **eccentric shaft**, Figure 50, until the end of the spool just touches the end of the tool. When this occurs the end of the spool is set at 0.46 in (11.7 mm) from the end of the bushing. Refer to Figure 53.

5. Tighten the eccentric shaft locknut and recheck spool setting.

INSTALLATION

1. Apply a thin bead of gasket sealer FP119 (Loctite 515) to **BOTH** sides of the hydraulic top cover gasket. The bead should be continuous around the entire face of the gasket and to a thickness of approximately 1/32 in (1mm).

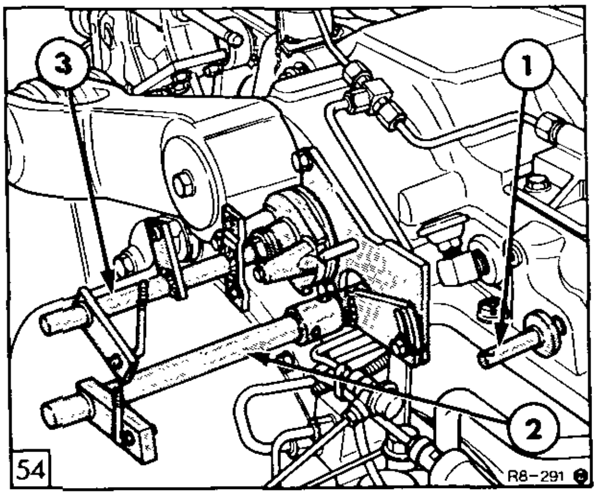
2. Install lift cover onto the rear axle centre housing and tighten retaining bolts to a torque of 100–125 lbf ft (135–170 Nm).

3. Manually raise lift arms (engine not running) and check that lift arms fall slowly under their own weight. If the arms do not fall recheck the torque applied to the lift arm retaining bolts as described on Page 29.

4. Continue to install the lift cover, linkage and cab/platform using the removal procedure in reverse.

5. Reconnect the linkage and perform external linkage adjustments as detailed in Section F.

F. EXTERNAL HYDRAULIC CONTROL LINKAGE



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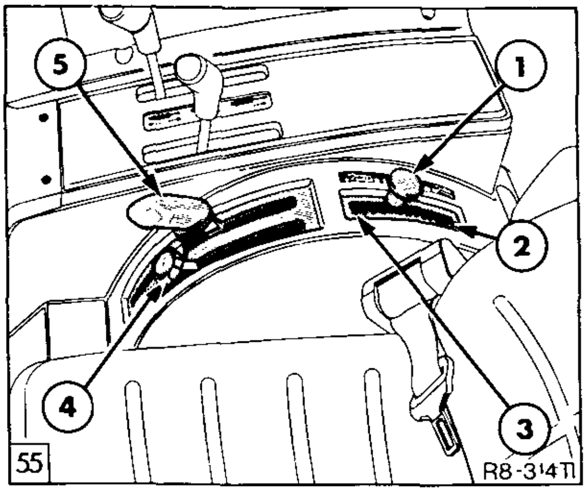
Hydraulic Lift Cover External Linkage

1. Actuator Aligned With Position Control Marks
2. Selector Lever Rod
3. Lift Control Rod



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Hydraulic Control Levers

1. Selector Lever
2. Position Control Setting
3. Draft Control Setting
4. Adjustable Stop
5. Lift Control Lever

Selector Lever Adjustment

1. Disconnect the selector lever rod at the lower end, Refer to Figure 54.
2. Ensure the position control chisel mark on the actuator aligns with the chisel mark on the lift control support. If required use a bolt to lock the actuator in position.

NOTE: *If the hydraulic lift was removed for overhaul the actuator will have been locked in position when performing the internal linkage adjustments.*

3. Place the selector lever in the position control notch. Refer to Figure 55.
4. Adjust length of selector lever rod to engage with the actuator lever. Tighten the locknuts to a torque of 8 lbf ft (11 Nm).
5. Remove the actuator locking bolt.

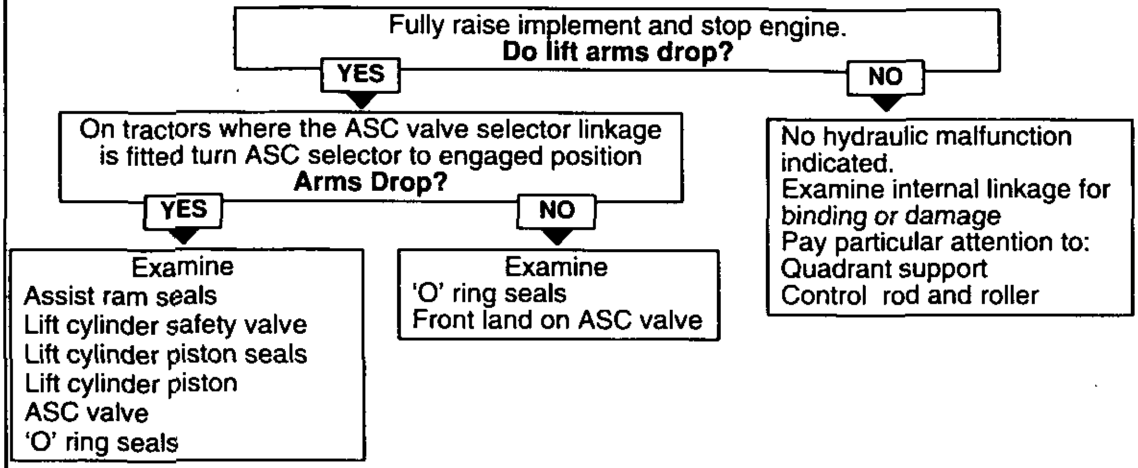
Lift Control Lever Adjustment

1. Ensure the lift arms are fully lowered.
2. Position the lift control lever 9 mm from the fully lowered position on the cab/platform quadrant.
3. Adjust length of the lift control lever connecting rod to engage with lift control linkage on the hydraulic top cover. Tighten the locknuts to a torque of 8 lbf ft (11 Nm).
4. With the engine running and lift control lever in the fully lowered position move the selector lever from position control to draft control and check that the lift arms do not lower. If the lift arms lower during this check it is an indication that one of the internal or external linkage adjustments has been performed incorrectly.

G. FAULT FINDING

Over–Correcting or Bouncing

Symptom:	Cause:
Over correcting	When the hydraulic system is in neutral, a leak exists in the trapped oil circuit.
Bouncing	Due to internal linkage binding



Fully raise implement and stop engine.
Do lift arms drop?

On tractors where the ASC valve selector linkage is fitted turn ASC selector to engaged position
Arms Drop?

Examine
Assist ram seals
Lift cylinder safety valve
Lift cylinder piston seals
Lift cylinder piston
ASC valve
'O' ring seals

Examine
'O' ring seals
Front land on ASC valve

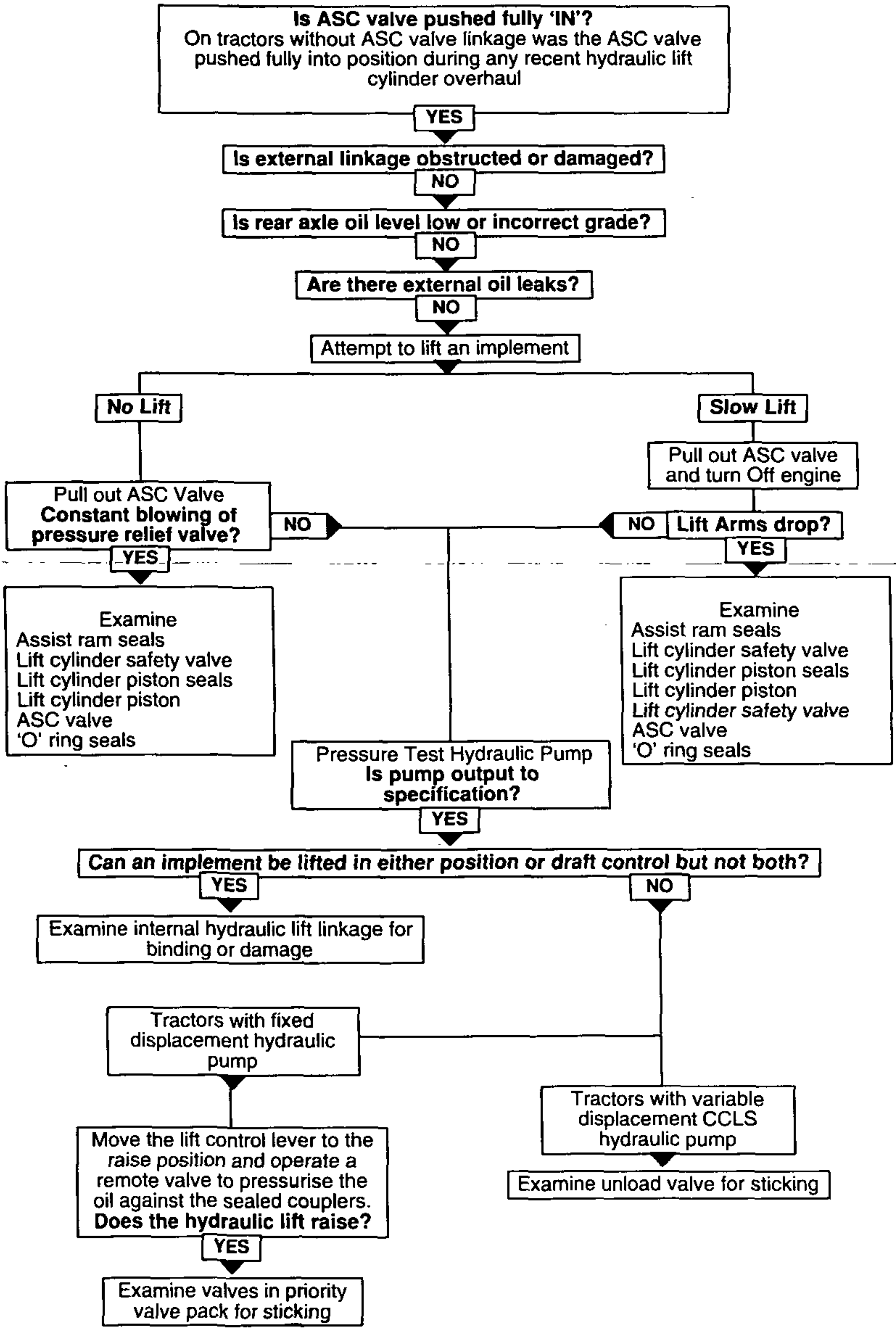
No hydraulic malfunction indicated.
Examine internal linkage for *binding or damage*
Pay particular attention to:
Quadrant support
Control rod and roller

Note: On tractors not fitted with the ASC valve selector linkage perform the checks in both the **YES** and **NO** columns.
It should also be noted that although the ASC selector linkage may not be fitted the ASC valve located in the lift cylinder will be installed and must be pushed fully into its bore.

No or Slow Lift

On Tractors with variable displacement CCLS hydraulic pump slow lift may occur if there is an excessive demand on one of the hydraulic remote valves.

Slow lift will also occur on tractors with 16 x 16 transmission if the clutch pedal is depressed when the engine speed is below 1000 rev/min.



H. SPECIFICATIONS

MAXIMUM LIFT CAPACITY

Tractors with Fixed Displacement Gear Type Hydraulic Pump @ 2650 lbf/in² (183 bar)

Test results to OECD criteria–links horizontal

		5640	6640	7740	7840	8240	8340
Without Assist Rams							
at link ends	lb	6350	6350	n/a	n/a	n/a	n/a
	kg	2880	2880	n/a	n/a	n/a	n/a
24 in. to rear of link ends	lb	4910	4910	n/a	n/a	n/a	n/a
	kg	2227	2227	n/a	n/a	n/a	n/a
With One Assist Ram							
at link ends	lb	9370	9370	9370	9370	9370	9370
	kg	4250	4250	4250	4250	4250	4250
24 in. to rear of link ends	lb	7080	7080	7080	7080	7080	7080
	kg	3211	3211	3211	3211	3211	3211
With Two Assist Rams							
at link ends	lb	n/a	n/a	12300	12300	12300	12300
	kg	n/a	n/a	5579	5579	5579	5579
24 in. to rear of link ends	lb	n/a	n/a	9420	9420	9420	9420
	kg	n/a	n/a	4273	4273	4273	4273

Tractors with Fixed Displacement Gear Type Hydraulic Pump @ 2385 lbf/in² (164 bar)

Test results to SAE criteria–links horizontal

		5640	6640	7740	7840	8240	8340
Without Assist Rams							
24 in. to rear of link ends	lb	4200	4200	n/a	n/a	n/a	n/a
	kg	1905	1905	n/a	n/a	n/a	n/a
With One Assist Ram							
24 in. to rear of link ends	lb	6210	6210	6210	6210	6210	6210
	kg	2817	2817	2817	2817	2817	2817
With Two Assist Rams							
24 in. to rear of link ends	lb	n/a	n/a	8240	8240	8240	8240
	kg	n/a	n/a	3728	3728	3728	3728

MAXIMUM LIFT CAPACITY

Tractors with Variable Displacement Closed Centre Load Sensing (CCLS) Hydraulic Pump @ 2800 lbf/in² (193 bar)

Test results to OECD criteria–links horizontal

		5640	6640	7740	7840	8240	8340
Without Assist Rams							
at link ends	lb	6712	6712	n/a	n/a	n/a	n/a
	kg	3045	3045	n/a	n/a	n/a	n/a
24 in. to rear of link ends	lb	5190	5190	n/a	n/a	n/a	n/a
	kg	2354	2354	n/a	n/a	n/a	n/a
With One Assist Ram							
at link ends	lb	9904	9904	9904	9904	9904	9904
	kg	4492	4492	4492	4492	4492	4492
24 in. to rear of link ends	lb	7484	7484	7484	7484	7484	7484
	kg	3395	3395	3395	3395	3395	3395
With Two Assist Rams							
at link ends	lb	n/a	n/a	13001	13001	13001	13001
	kg	n/a	n/a	5897	5897	5897	5897
24 in. to rear of link ends	lb	n/a	n/a	9957	9957	9957	9957
	kg	n/a	n/a	4516	4516	4516	4516

Tractors with Variable Displacement Closed Centre Load Sensing (CCLS) Hydraulic Pump @ 2800 lbf/in² (193 bar)

Test results to SAE criteria–links horizontal

		5640	6640	7740	7840	8240	8340
Without Assist Rams							
24 in. to rear of link ends	lb	4439	4439	n/a	n/a	n/a	n/a
	kg	2014	2014	n/a	n/a	n/a	n/a
With One Assist Ram							
24 in. to rear of link ends	lb	6564	6564	6564	6564	6564	6564
	kg	2978	2978	2978	2978	2978	2978
With Two Assist Rams							
24 in. to rear of link ends	lb	n/a	n/a	8710	8710	8710	8710
	kg	n/a	n/a	3950	3950	3950	3950

ASC SELECTOR VALVE SIZES

Colour	Inches	mm
Green	0.6247–0.6244	15.8674–15.8598
Yellow	0.6244–0.6241	15.8598–15.8521
Blue	0.6241–0.6238	15.8521–15.8445
White	0.6238–0.6235	15.8445–15.8369
Blue/White	0.6235–0.6232	15.8369–15.8293

CONTROL VALVE SIZES

Colour	Inches	mm
Orange	0.5928–0.5927	15.057–15.055
Green	0.5926–0.5925	15.052–15.050
Yellow	0.5923–0.5921	15.044–15.039
Blue	0.5921–0.5919	15.039–15.034
White	0.5919–0.5917	15.034–15.029

CONTROL VALVE BUSHING SIZES

Colour	Inches	mm
Green/White	1.0014–1.0012	25.436–25.430
Orange	1.0012–1.0010	25.430–25.425
Green	1.0010–1.0008	25.425–25.420
Yellow	1.0008–1.0006	25.420–25.415
Blue	1.0006–1.0004	25.415–25.410
White	1.0004–1.0002	25.410–25.405
Blue\White	1.0002–1.0000	25.405–25.400

VALVE SETTINGS

Lift Cylinder Relief Valve	2850–3050 lbf/in^2 (197–210 bar)

GASKET SEALER

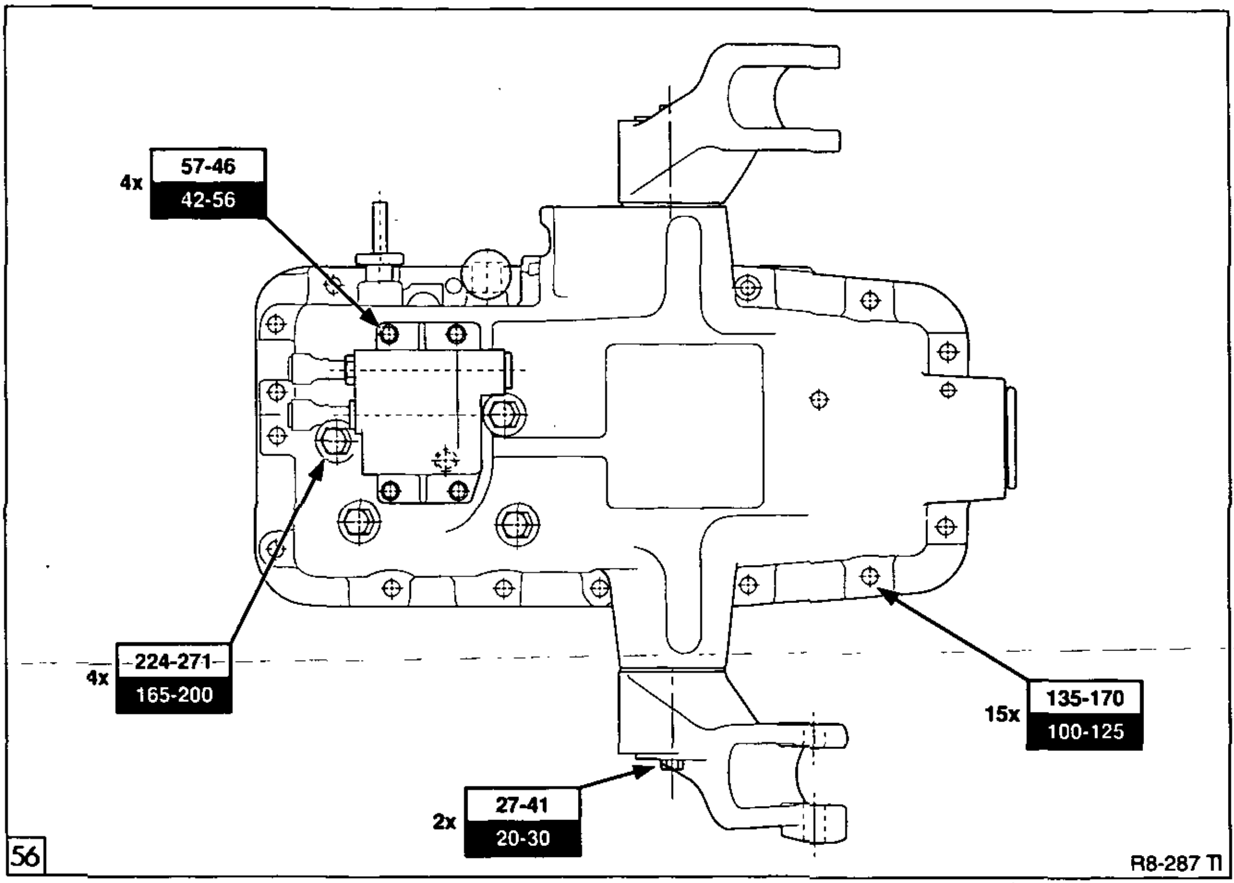
Gasket Sealer FP119 (Loctite 515) to Specification ESE–M4G234–A1

SPECIAL TOOLS

TOOL	V.L. CHURCHILL	FNH PART No (America Only)
Control Valve Bush Installer	FT. 8510	FNH 02191
Control Valve Bush Locator	FT. 8510–3	FNH 10090
Extension Tool	FT. 8510–1D	FNH 02191
Guide and Stop Adaptor	FT. 8510–1K	FNH 02191
Setting Gauge	FT. 8527	FT. 8527
Control valve Setting Tool		FNH 00014

TORQUES

☐ = Nm
■ = lbf ft



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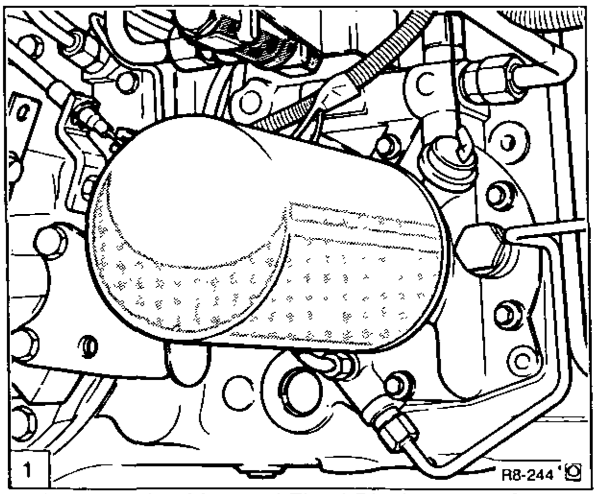
Components	lbf.ft	Nm
Lift Cylinder Relief Valve	75–90	102–122
Selector Support Bolts	42–56	57–76
Selector Body Turning Torque	7–10	9–14
Eccentric Shaft Locknut	15–20	20–27
Unload Valve Plug (CCLS Pump)	17–35	23–49
Yoke Retaining Nut Set Screw	20–25	27–34

PART 8

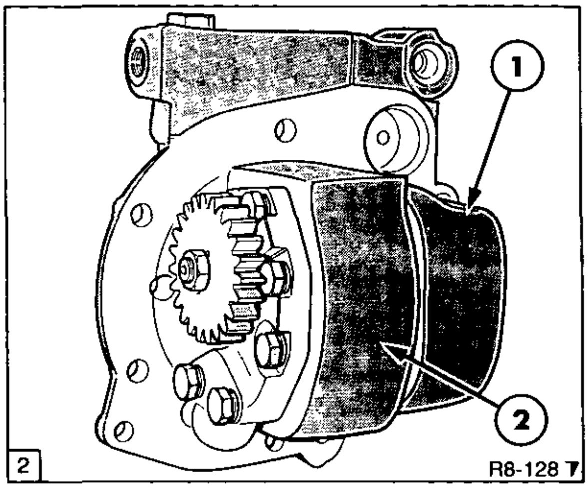
Chapter 5

FIXED DISPLACEMENT GEAR TYPE PUMPS

A. TRANSMISSION MOUNTED FIXED DISPLACEMENT TANDEM GEAR TYPE PUMP – DESCRIPTION AND OPERATION



Transmission Mounted Fixed Displacement Gear Type Pump Installation
(Tractor with 12 x 12 Transmission Shown)



Transmission Mounted Fixed Displacement Gear Type Pump Assembly

1. Steering Pump (Rear Pump)
2. Hydraulic Lift Pump (Front Pump)

The fixed displacement gear type pump is mounted on the right hand side of the rear transmission, Figure 1.

The pump housing contains two gear type pumps, mounted one behind the other. Refer to Figure 2 and Figure 3.

The front pump (as mounted on the tractor) supplies high pressure oil to the trailer brakes, hydraulic lift and remote control valve circuits and is referred to as the hydraulic lift pump.

If the tractor is installed with a trailer braking system the high pressure oil from the hydraulic lift pump flows to the trailer brake valve before continuing onto the hydraulic lift assembly. This ensures the braking system has priority over the hydraulic lift circuits.

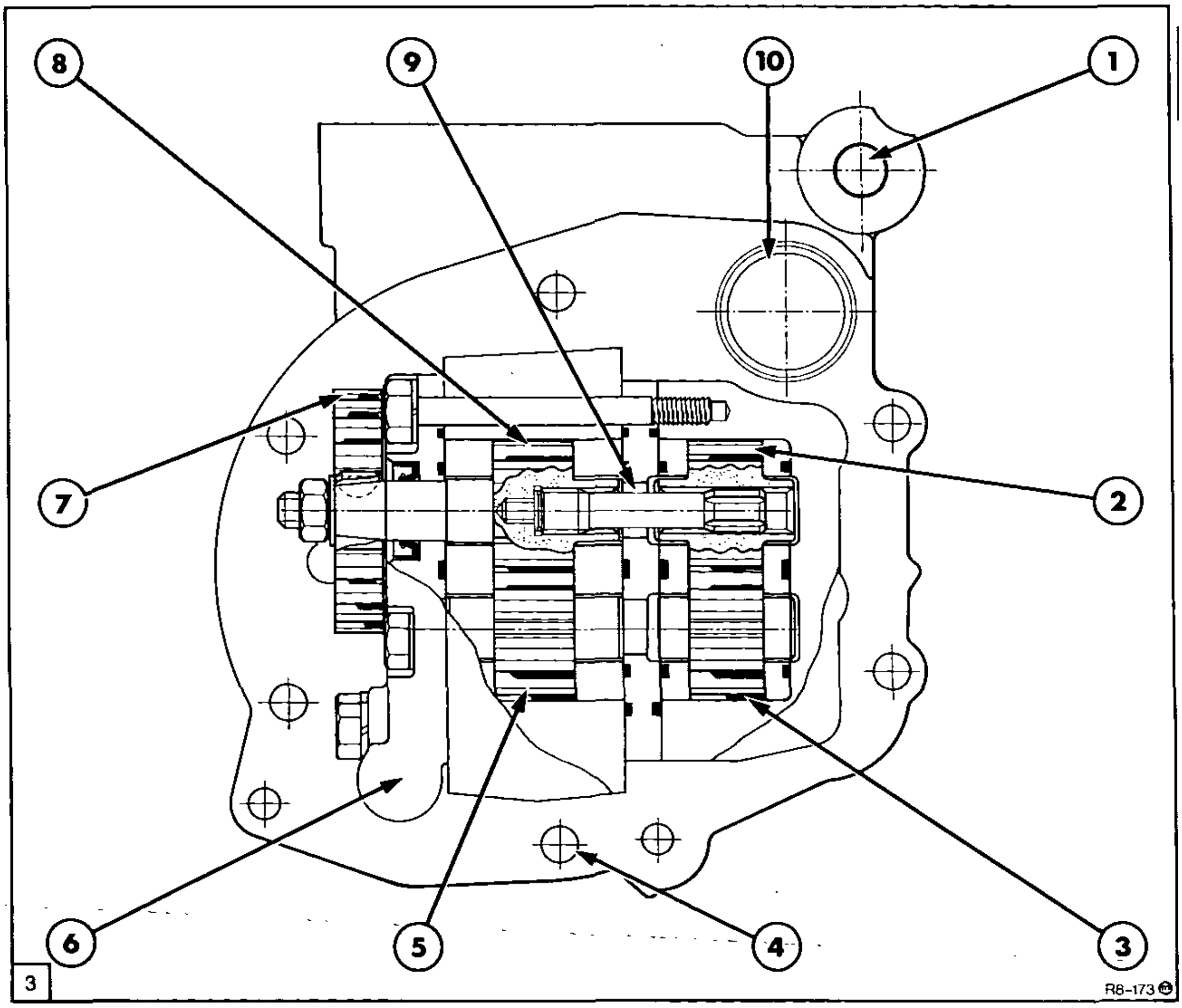
The rear pump, referred to as the steering pump, provides oil to the hydrostatic steering system and low pressure hydraulic circuits.

The low pressure hydraulic circuits operate the independent power take–off (PTO), four wheel drive disengagement, electro hydraulically operated differential lock on 12 x 12 transmissions and the dual power on 16 x 4 transmissions.

These circuits, depending on tractor build options, also provide lubrication to the PTO, dual power, 12 x 12 transmission synchronisers, bearings and output shaft and 16 x 4 or 8 x 2 transmission output shafts.

The operating pressure of these circuits is regulated by the low pressure regulating and lubrication circuit relief valves housed within the PTO assembly. Refer to the PTO Part of the Repair Manual for description and operation of these valves. For the basic operation of the low pressure hydraulic circuits refer to Chapter 1 in this Part of the Repair Manual.

Both pumps share a common full flow intake filter.



Cross Section of Transmission Mounted Fixed Displacement Gear Type Pump

1. Outlet Port to Hydraulic Lift
2. Steering Pump Drive Gear
3. Steering Pump Driven Gear
4. Outlet Port to PTO
5. Hydraulic Lift Pump Driven Gear
6. Hydraulic Lift Pump Outlet Port
7. Pump Assembly Drive Gear
8. Hydraulic Lift Pump Drive Gear
9. Drive Link
10. Pump Inlet Port (Both Pumps)

Pump Operation

The drive for the hydraulic lift pump (front pump) is taken via an idler gear driven from the PTO drive clutch hub. A drive link between both pumps, transmits the drive through to the steering pump (rear pump), Figure 3.

The pump gears in both pumps revolve at the same speed and are in constant operation whenever the engine is running. Both sets of spur gears are supported within the pump by aluminium bearing blocks, incorporating steel bushes with porous bronze and PTFE plus lead linings.

The fixed displacement gear type pump assembly is supplied with oil from the rear axle centre housing reservoir via an intake tube attached to the pump inlet port.

When the engine is running, the PTO idler gear drives the pump and oil is drawn through the inlet port and intake filter into the spaces between the teeth of the gears within each pumping unit. As the pumping gears rotate, the oil in the spaces between the gear teeth is trapped and carried between the teeth and the pump body to the pump outlet ports, where it is discharged to the hydraulic circuits.

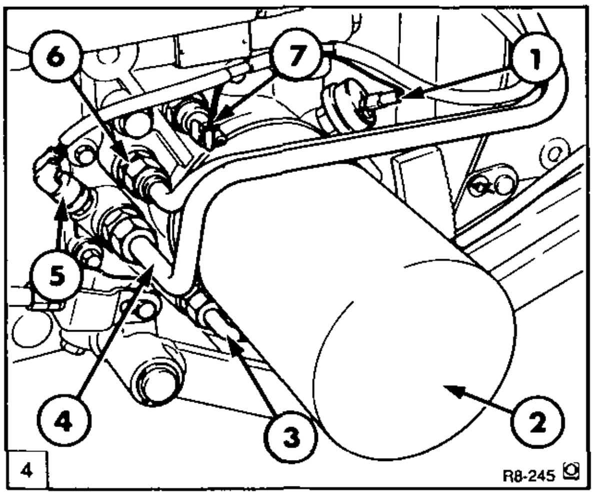
The pump inlet filter is monitored for blockage by a vacuum switch operating at a pressure of 16 in. Hg, Figure 4. The switch is also connected in series with a low oil temperature switch and warning light. If the oil temperature is above 40°C (104°F) and the filter is restricted, causing the vacuum switch to operate, the warning light on the instrument panel will illuminate.

If a tractor is fitted with the electronic instrument cluster, an extra switch to monitor high hydraulic oil temperature is also installed. This switch, where fitted, is positioned in the port immediately to the left of the low temperature switch.

The low pressure hydraulic oil supply from the steering pump is monitored by a pressure switch in the pump and operates a warning light whenever the oil pressure drops below 75–80 lbf/in². The light will extinguish when the oil pressure increases to 115–125 lbf/in².

The hydraulic lift pump is protected from excessive pressures by a pressure relief valve which operates at 2550–2650 lbf/in² (176–183 bar). The valve allows excess oil to return directly to sump whenever an overload condition occurs. This valve can be replaced without having to remove the pump from the tractor.

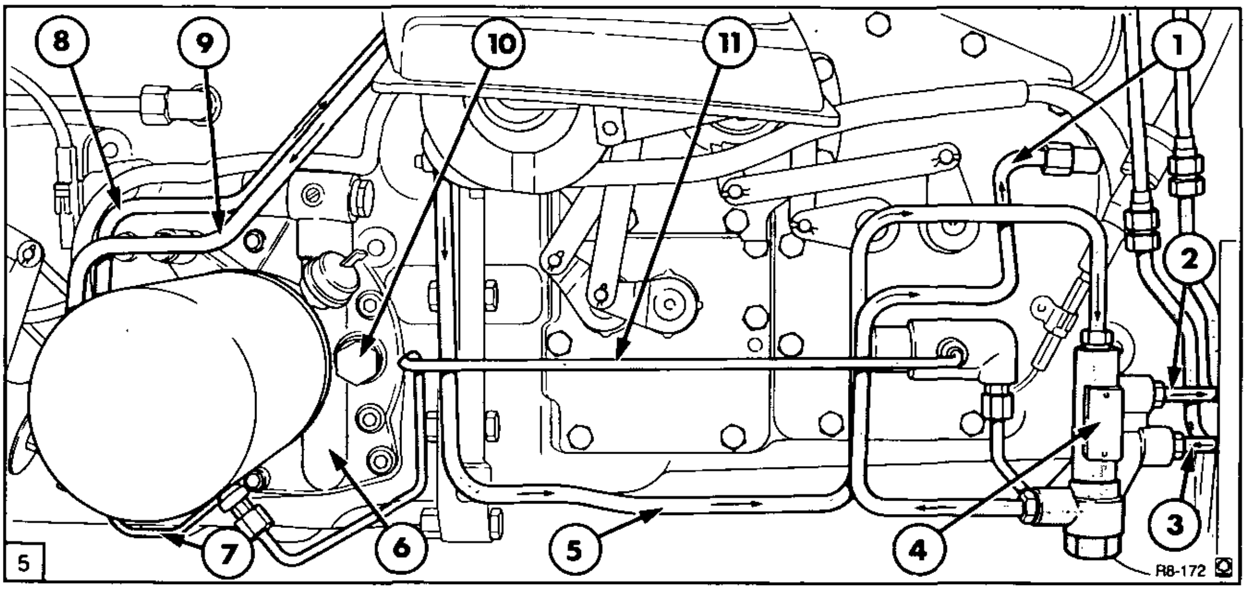
4



Fixed Displacement Gear Type Pump Installation (Tractor with 16 x 4 Transmission Shown)

1. Blocked Filter Vacuum Switch
2. Full Flow Inlet Filter with By–pass Valve
3. To Dual Power (where fitted)
4. Return from Steering Motor
5. Pressure Switch–Low Pressure Circuit
6. To Steering Motor
7. Oil Low Temperature Switch

5



Fixed Displacement Gear Type Pump Installation (Tractor with 12 x 12 Transmission Shown)

1. To Transmission Lubrication
2. To Oil Cooler
3. Return from Oil Cooler
4. Oil Cooler By–Pass Valve
5. From PTO Valve
6. Hydraulic Lift Pump Output Gallery
7. To Electro Hydraulic Differential Lock
8. To Steering Motor
9. Return from Steering Motor
10. Hydraulic Lift Pump Pressure Relief Valve
11. To Front Wheel Drive Disengagement System

The steering pump does not contain a pressure relief valve and is protected by the relief valve contained within the power steering motor.

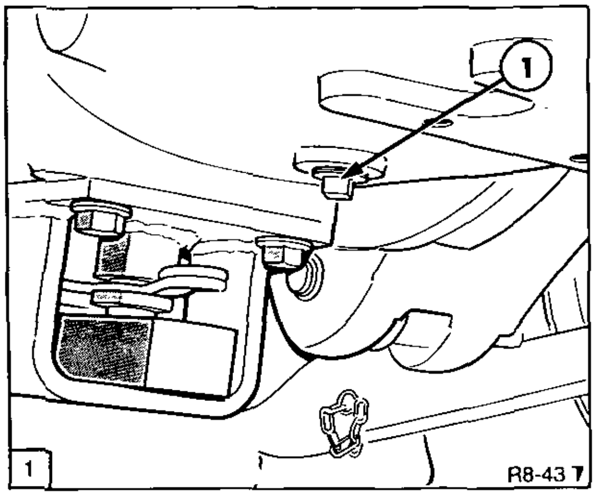
Figure 5 shows the installation of the fixed displacement gear type pump on a tractor fitted with a 12 x 12 transmission. The arrows indicate the flow of oil through the external pipework from the steering pump within the assembly.

On tractors installed with 16 x 4 or 8 x 2 transmissions the oil cooler by–pass valve is not fitted and oil flows directly from the PTO valve to the oil cooler, before providing pressure lubrication to the transmission and dual power (where fitted).

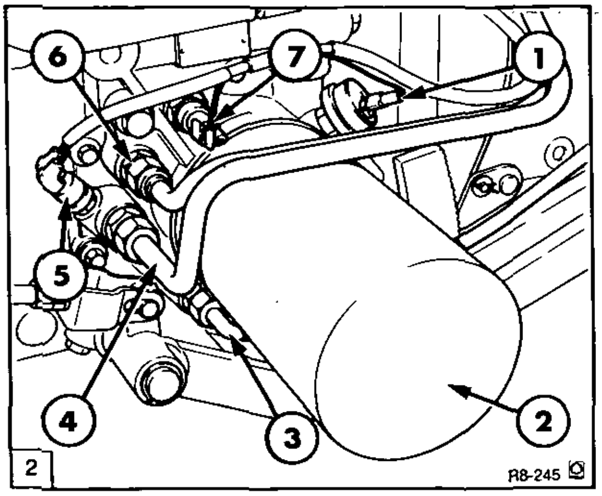
B. TRANSMISSION MOUNTED FIXED DISPLACEMENT TANDEM GEAR TYPE PUMP – OVERHAUL

Removal

1. Remove right hand rear wheel.



2. Remove rear axle drain plug, Figure 1 and drain the oil from the rear axle assembly.

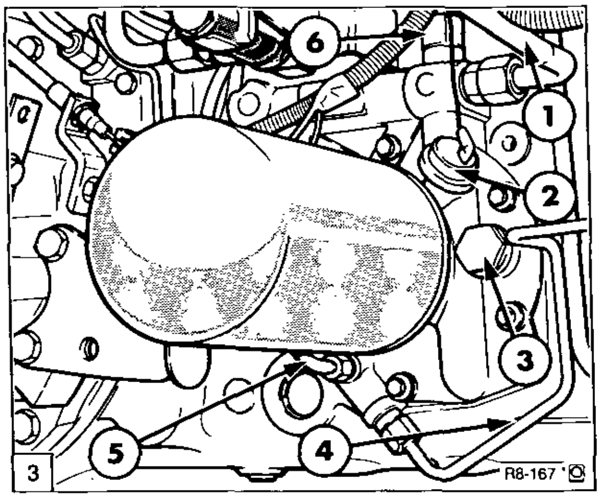


Fixed Displacement Gear Type Pump Installation
(Tractor with 16 x 4 Transmission Shown)

1. Blocked Filter Vacuum Switch
2. Full Flow Inlet Filter with By–pass Valve
3. To Dual Power (where fitted)
4. Return from Steering Motor
5. Pressure Switch–Low Pressure Circuit
6. To Steering Motor
7. Oil Low Temperature Switch

3. *Disconnect all the electrical connections* to the switches mounted on the pump, Figure 2.

4. Disconnect and plug all hydraulic pipes attached to the pump. Refer to Figure 2 and Figure 3.



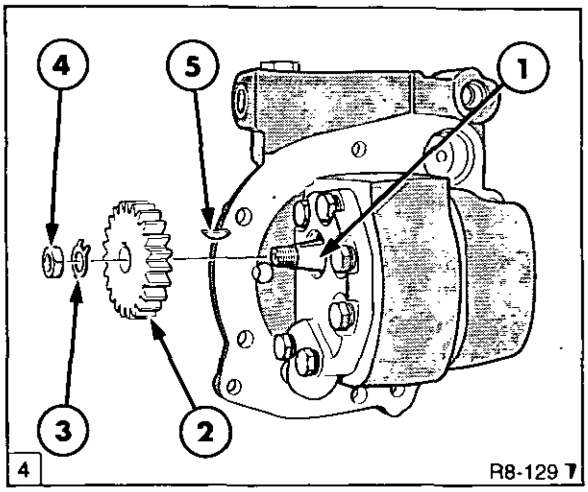
Hydraulic Pump Installation
Tractor with 12 x 12 Transmission Shown

1. Return from Trailer Brake Valve (where fitted)
2. Blocked Filter Vacuum Switch
3. Pressure Relief Valve
4. To Four Wheel Drive (where fitted)
5. To Electro Hydraulically Operated Differential Lock
6. Feed to Trailer Brake Valve (where fitted)

5. Remove pump mounting bolts and lift pump from transmission housing.

Disassembly

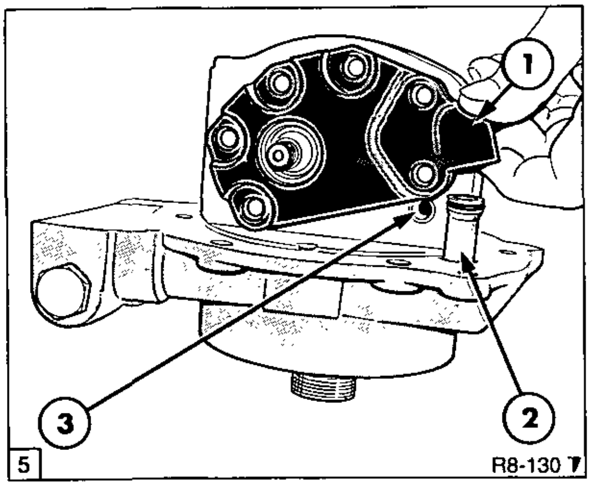
1. Remove pressure relief valve from pump. The relief valve is non adjustable and must be replaced if away from specification.



Pump Drive Gear

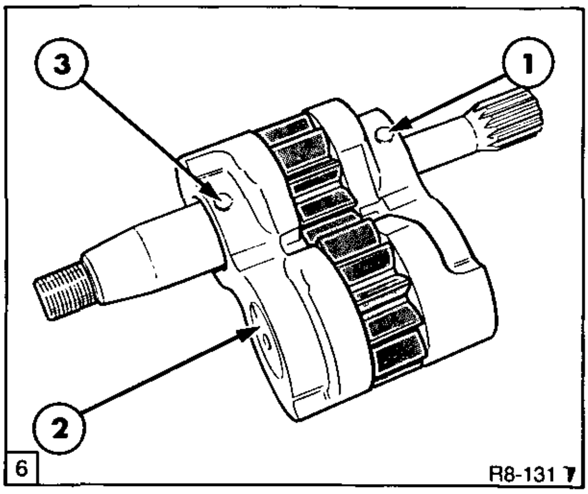
1. Drive Shaft
2. Drive Gear
3. Locking Washer
4. Nut
5. Woodruff Key

2. Remove pump drive gear, Figure 4. The gear is located on a tapered driveshaft and the use of a soft faced mallet will be required to loosen the gear from the shaft.



Removing End Cover

1. End Cover
2. Transfer Tube
3. Dowel (2 off)

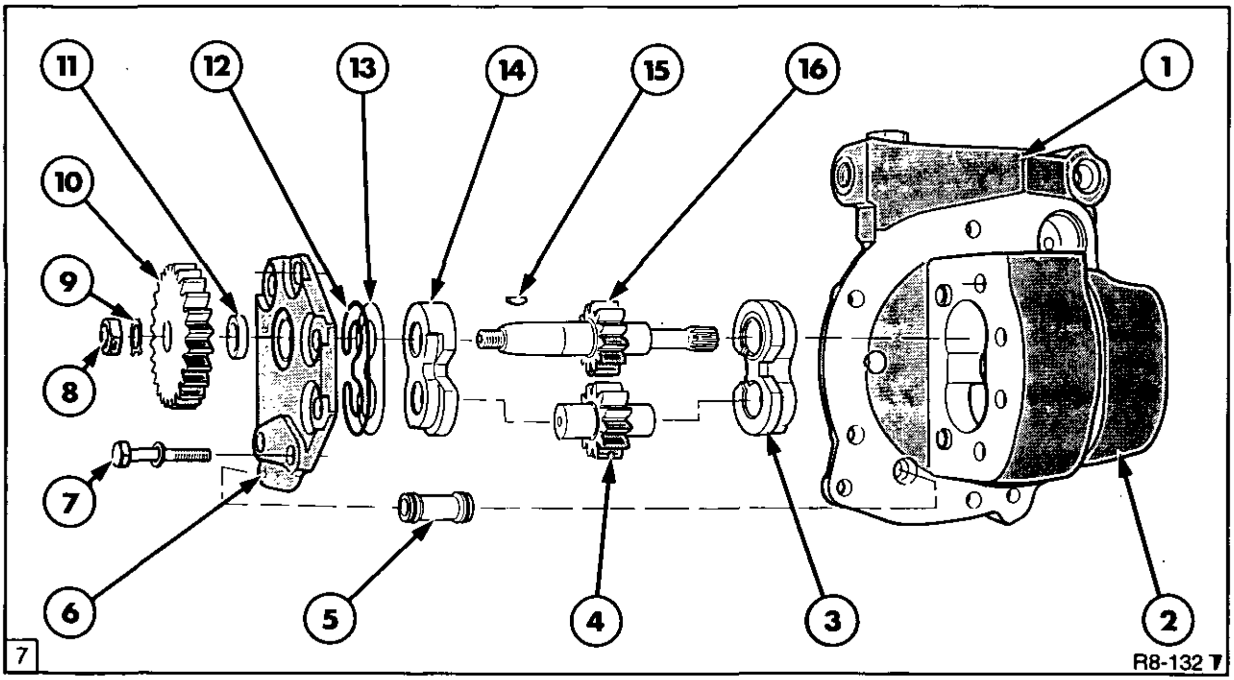


Front Pump

1. Bearing Block Identification
2. Driven Gear Identification
3. Bearing Block Identification

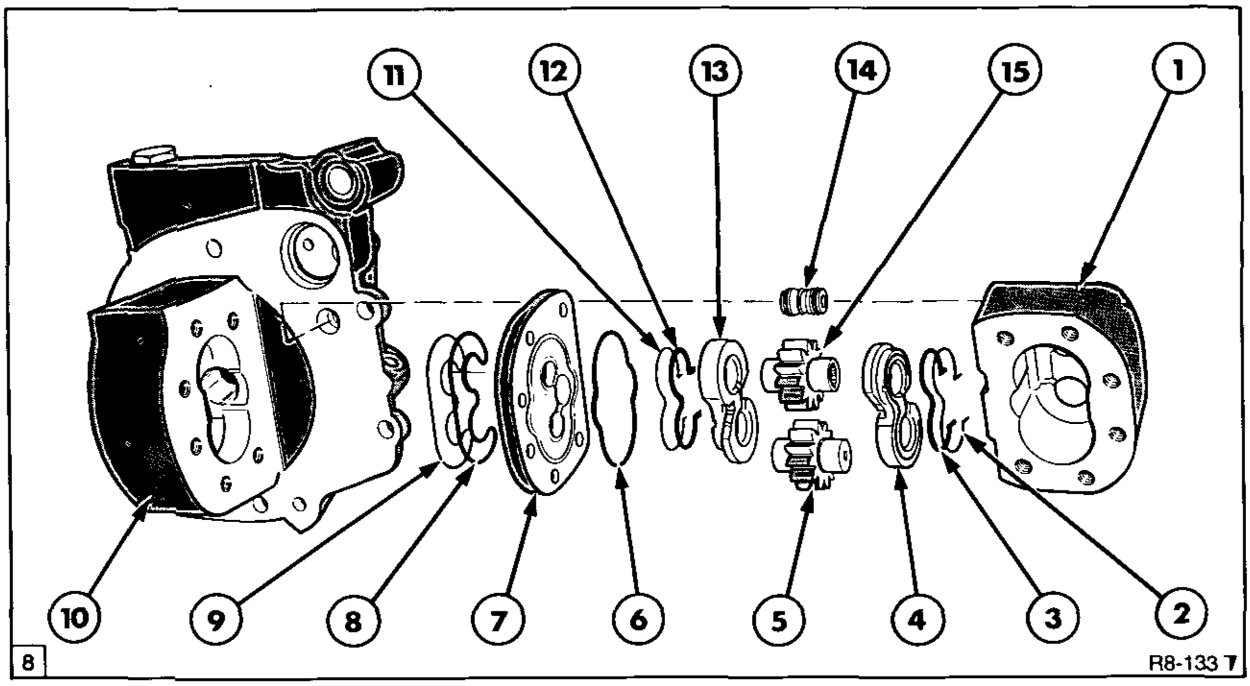
3. Remove the six pump body through bolts (4 short and 2 long).
4. Remove end cover by easing the cover forward to clear locating dowels and then tilting cover to clear transfer tube, Figure 5.
5. Remove the gears and bearing blocks from the hydraulic lift pump (front pump), Figure 7. To ensure correct re–assembly mark both the bearing blocks and driven gear on a non critical surface, Figure 6.
6. Layout the components in the order of disassembly, Figure 7. Refer to Figure 8 for location of the seals which are positioned between the sandwich plate and bearing block, item 3 in Figure 7.

NOTE: *The drive shaft and gear assembly is held together with an internal snap ring, DO NOT attempt to disassemble these parts as damage is likely to occur to snap ring and shafts.*



Hydraulic Lift Pump (Front Pump) – Exploded View

1. Pump Housing
2. Steering Pump
3. Bearing Block
4. Driven Gear
5. Transfer Tube
6. End Cover
7. Bolts (4 Long, 2 Short)
8. Nut
9. Locking Washer
10. Drive Gear
11. Oil Seal
12. Nylon Back–Up Ring
13. Seal
14. Bearing Block
15. Woodruff Key
16. Drive Shaft and Gear Assembly



8

Steering Pump (Rear Pump) – Exploded View

1. Pump Body
2. Seal
3. Nylon Backing Strip
4. *Bearing Block*
5. Driven Gear
6. Seal
7. Sandwich Plate
8. Seal
9. *Nylon Back–Up Ring*
10. Pump Housing
11. Seal
12. Nylon Backing Strip
13. Bearing Block
14. *Transfer Tube and Snap Ring*
15. Drive Gear

7. Pull the steering pump (rear pump) assembly from the pump housing and separate the components, taking care to identify the orientation of the gears and bearing blocks, Figure 8.

NOTE: *A small mark on the end face of the driven gear will assist in identification to ensure correct re–assembly.*

Inspection and Repair

1. Wash all components in a suitable solvent and allow to dry.

2. Examine each bearing block thoroughly. At major overhauls, both bearing blocks and gears should be renewed using the service repair kit. These items are not serviced separately.

3. Check bushes in bearing blocks for wear and ensure the lubrication scrolls in the bushes are free from obstruction.

4. Inspect the pump gears for wear or damage, paying attention to the bearing journals, gear teeth and side facings. To ensure maximum pump efficiency, the width of each pair of pump gears must be within 0.0002 in. (0.005 mm) of each other and the gear journals within 0.0005 in. (0.013 mm).

5. Light score marks on the gear facing areas can be removed using a sheet of '0' grade wet or dry abrasive paper lubricated with paraffin on a true flat surface. Polish the affected face using light pressure in a rotating motion. Journals may be polished to achieve free movement in the body.

6. Inspect the track cut by the gear teeth in the pump body. It is normal to see a gear track cut in the suction side of the pump body, this is made during the bedding in process by the pump manufacturer. The gear track must not however, exceed 0.004 in. (0.10 mm) depth or continue beyond the suction half of the gear aperture. A gear track beyond this specification will necessitate the installation of a new pump.

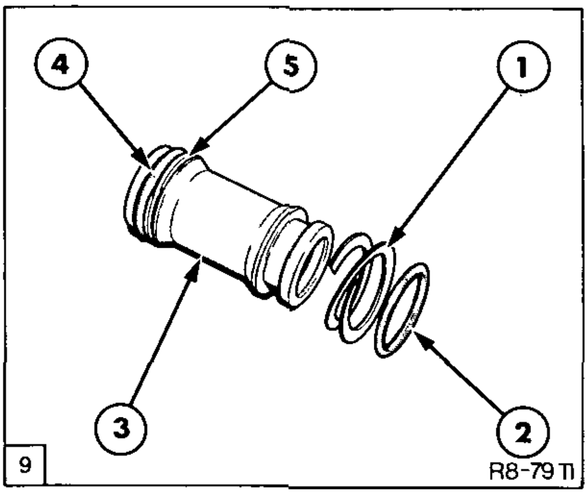
Re–Assembly

Re–assembly follows the disassembly procedure in reverse.

During re–assembly, observe the following requirements:–

- If the end cover locating dowels have been removed, new dowels must be installed with 2.54mm of dowel protruding from the pump housing.

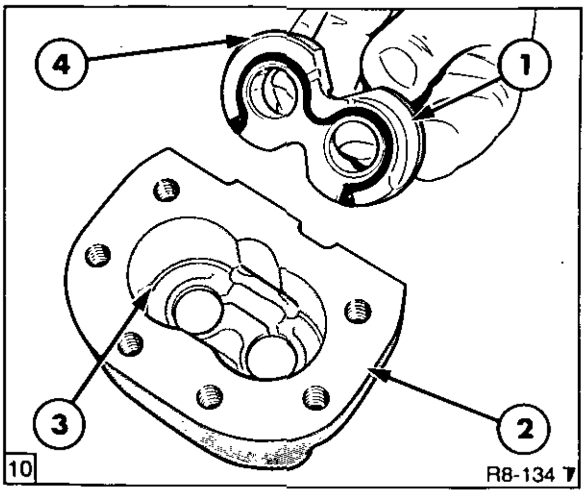
- Replace all oil seals and 'O' rings as provided in the seal kit.



Transfer Tube

1. Washer	4. 'O' Ring
2. 'O' Ring	5. Washer
3. Tube	

- Install washers and 'O' ring seals to transfer tubes. Refer to Figure 9 for typical seal installation.
- Coat all seals and 'O' rings with petroleum jelly and ensure all seals and backing strips are correctly positioned.
- Lubricate all parts with hydraulic oil to Ford specification ESN M2C134–D.
- To maintain pump efficiency it is imperative that original gears and bearings are re–assembled exactly as removed.



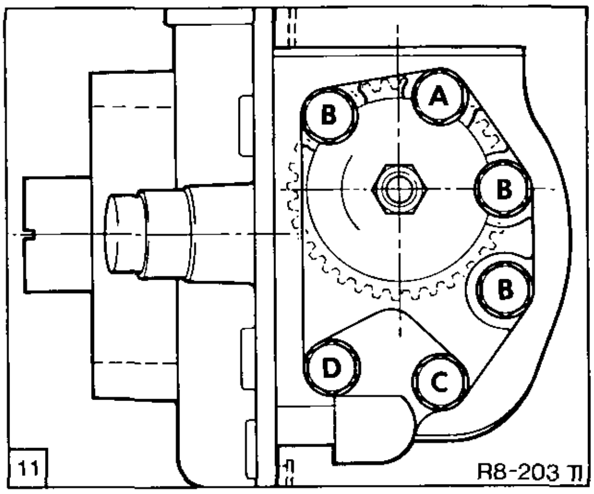
Bearing Block Installation

1. Relieved Edge
2. *Steering Pump Body*
3. Radiused Edge
4. Radiused Edge

The bearing block, item 4 in Figure 8, is manufactured with a radiused edge. During re–assembly ensure that the **'radiused edge'** is installed at the bottom of the steering pump body bore, Figure 10.

NOTE: *Only one of the two bearing blocks used in the steering pump is radiused on the corner edge. Installation of the sharp edged radius block, item 13 in Figure 8, in this position will prevent correct assembly and cause damage to the pump.*

- Pack the cavity behind the end cover input drive shaft seal with high melting point grease.



End Cover Bolt Location

A. Bolt M10 x 100 mm with Ground Shank
B. Bolt M10 x 100 mm with Dull Black Shank
C. Bolt M10 x 115 mm with Ground Shank
D. Bolt M10 x 115 mm with Dull Black Shank

- The end cover bolts installed in the pump have different shanks or bolt length. Install the correct bolts in the locations shown in Figure 11 and tighten to a torque of 37–46 lbf ft (50–62 Nm).
- Tighten the pressure relief valve to a torque of 44–50 lbf ft (60–68 Nm).
- Tighten the input drive gear nut to a torque of 37–41 lbf ft (50–55 Nm) and ensure the tab on the locking washer is locked against the pump drive gear nut.
- If the pump is not for immediate use, cap all ports prior to storage.

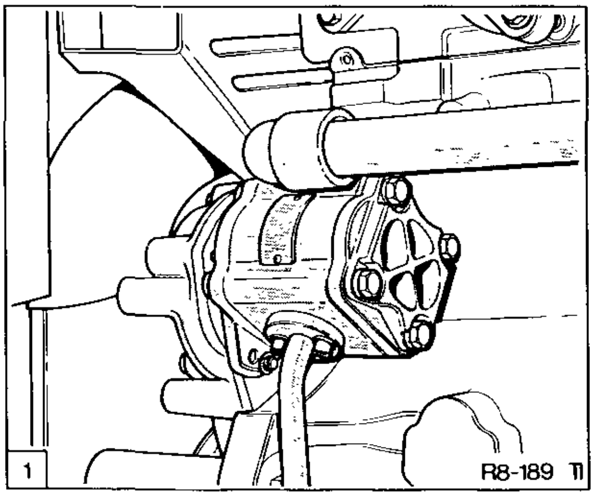
Installation

Prior to installation introduce hydraulic oil to Ford specification ESN M2C134–D into the pump suction port and rotate the gears by hand.

Installation follows the removal procedure in reverse. During installation ensure the pump to transmission housing retaining bolts are tightened to a torque of 42–56 lbf ft (57–76 Nm).

Ensure all pipe connections are tightened to the correct torque, see Specifications, Section D.

C. ENGINE MOUNTED FIXED DISPLACEMENT GEAR TYPE PUMP – DESCRIPTION AND OPERATION



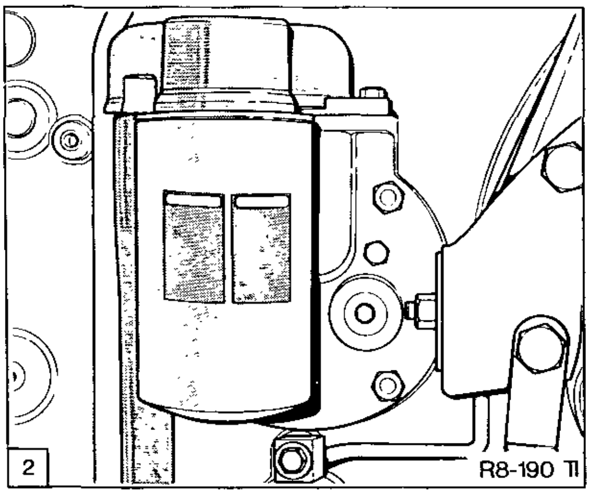
Auxiliary Engine Mounted Pump Installation

The Auxiliary engine mounted gear type pump, Figure 1, where installed, is fitted on the left hand front side of the engine and driven by the camshaft gear.

The optional engine mounted gear type pump can be installed on those tractors equipped with a transmission mounted gear type pump **and** remote control valves or auxiliary hydraulic equipment. The pump supplements the existing hydraulic oil supply provided by the transmission mounted gear type pump to the remote control valves and/or auxiliary equipment only.

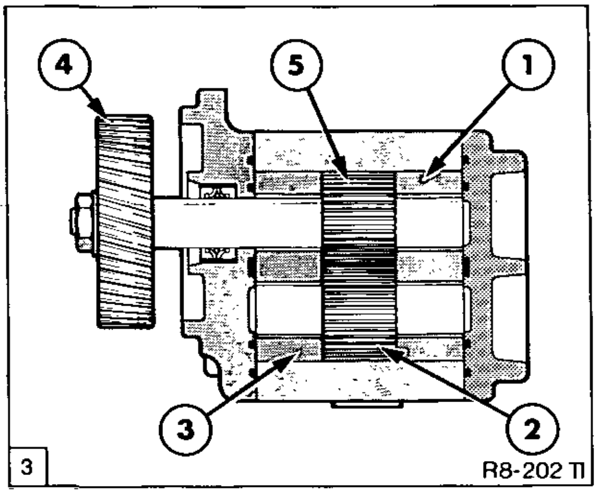
If the **remote control valves** or **auxiliary equipment** require additional oil flow to that supplied by the main hydraulic pump, then oil from the auxiliary pump is directed to these circuits. Any output from the engine mounted pump that is surplus to requirements is returned to sump using the combining valve in the priority valve pack situated on top of the hydraulic lift cover. Refer to Chapter 4 for the description and operation of this valve.

Hydraulic oil is drawn by the pump from the rear axle centre housing through an external pipe. An external pipe from the pump outlet port similarly directs the oil to the priority valve pack.



Auxiliary Engine Mounted Pump Filter

Before entering the pump the oil passes through a replaceable, full flow filter mounted on the left hand side of the rear axle centre housing, Figure 2.



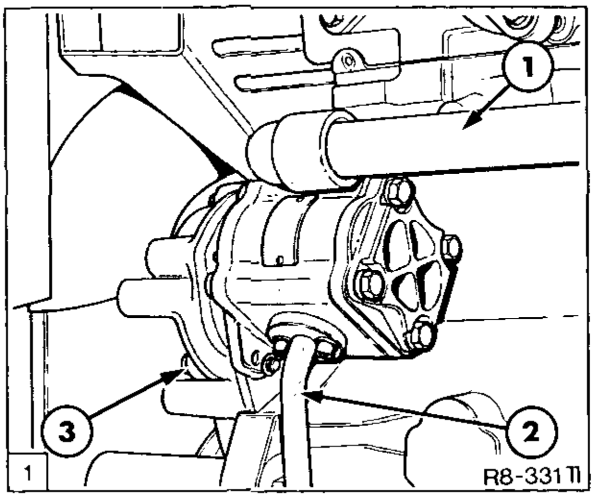
Auxiliary Engine Mounted Pump – Sectional View

1. Bearing Block
2. Driven Gear
3. Bearing Block
4. Pump Drive Gear
5. Drive Gear

A cross section of the auxiliary engine mounted pump is shown in Figure 3. The pump contains one set of spur gears which constantly rotate drawing oil through the inlet port. Oil on entering the pump, fills the spaces between the teeth of each rotating gear. As the gears continue rotating the oil is trapped and carried between the teeth and the pump body to the outlet side of the pump where it is discharged to the hydraulic circuits through the pump outlet port.

The gears in the pumps are supported in aluminium bearings incorporating steel bushes with porous bronze and PTFE plus lead linings.

D. ENGINE MOUNTED FIXED DISPLACEMENT GEAR TYPE PUMP – OVERHAUL

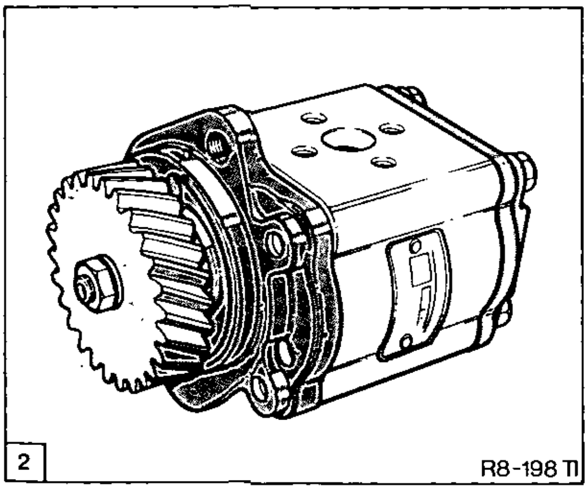


Auxiliary Pump Installation

1. Inlet Tube
2. Outlet Tube
3. Retaining Bolts

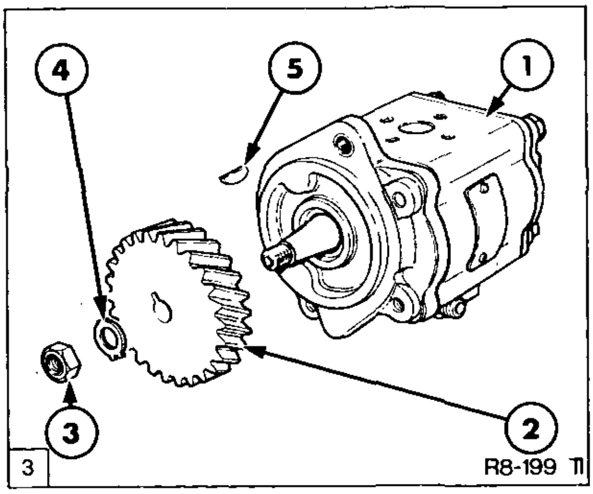
Removal

1. Remove inlet and outlet tubes to auxiliary pump, Figure 1.



Auxiliary Pump Assembly

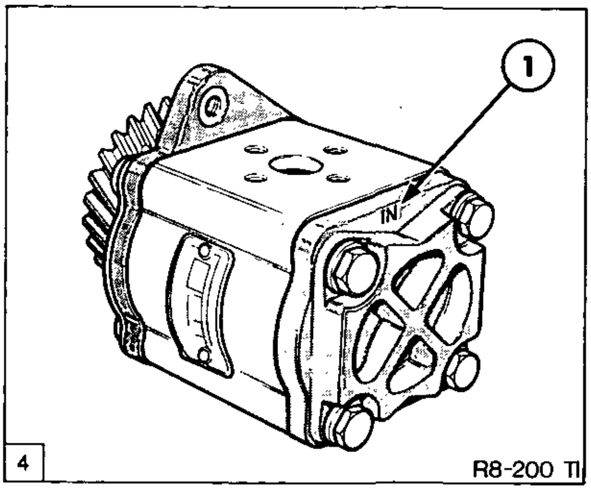
2. Remove retaining bolts and lift pump from engine, Figure 2.



Auxiliary Pump Drive Gear

1. Pump Body
2. Drive Gear
3. Nut
4. Locking Washer
5. Woodruff Key

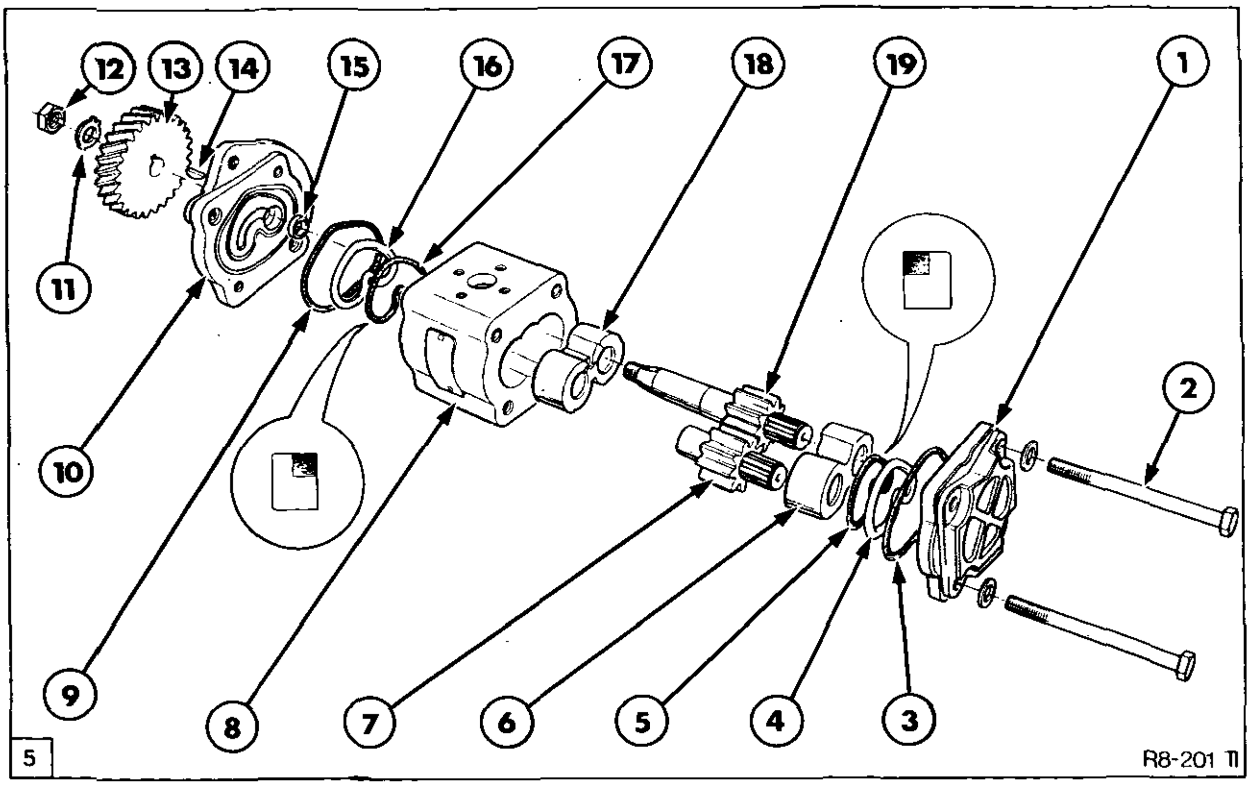
3. Remove pump drive gear, Figure 3. The gear is located on a tapered driveshaft and the use of a soft faced mallet will be required to loosen the gear from the shaft.



Rear End Cover

1. Rear End Cover Marking 'IN'

4. To ensure correct re–assembly observe the position of the 'IN' marking on the rear end cover, Figure 4.



Auxiliary Pump Gears–Exploded View

1. Rear End Cover
2. Through Bolts (4 off)
3. Seal
4. Nylon Back–up Ring
5. Seal
6. Bearing Block
7. Driven Gear
8. Pump Body
9. Seal
10. Front End Cover
11. Tab Washer
12. Nut
13. Pump Drive Gear
14. Woodruff Key
15. Seal
16. Nylon Back–up Ring
17. Seal
18. Bearing Block
19. Driveshaft and Gear

5. Remove front and rear covers and withdraw the pump gears and bearing blocks. Refer to Figure 5. Take care to identify the orientation of the gears and bearing blocks.

NOTE: *A small mark on the end face of the driven gear will assist in identification to ensure correct re–assembly.*

6. Remove the seal in the front end cover.

Inspection and Repair

1. Wash all components in a suitable solvent and allow to dry.
2. Examine each bearing block thoroughly for damage or wear. At major overhauls the bearing blocks should be renewed.
3. Inspect the pump gears for wear or damage, paying attention to the bearing journals, gear teeth and side facings. To ensure maximum pump efficiency the width of the pair of gears must be within 0.0002 in. (0.005 mm) of each other and the gear journals within 0.0005 in. (0.013 mm).
4. Light score marks on the gear facing areas can be removed using a sheet of '0' grade wet or dry abrasive paper lubricated with paraffin on a true flat surface. Polish the affected face using light pressure in a rotating motion. Journals may be polished to achieve free movement in the body.
5. Inspect the track cut by the gear teeth in the pump body. It is normal to see a gear track cut in the suction side of the pump body, this is made during the bedding in process by the pump manufacturer. The gear track must not, however, exceed 0.004 in. (0.10 mm) depth or continue beyond the suction half of the gear aperture. A gear track beyond this specification will necessitate the installation of a new pump.

Re–assembly

Re–assembly follows the disassembly procedure in reverse.

During re–assembly, observe the following requirements.

- *Replace all oil seals.*
- *Coat all seals and 'O' rings with petroleum* jelly and ensure all seals and back ups are correctly positioned.
- Lubricate all parts with hydraulic oil to Ford specification ESN M2C134–D.
- To maintain pump efficiency it is imperative that original gears and bearings are re–assembled exactly as removed during disassembly. The bearing blocks are installed with their recess against the gear faces and the relieved radiused edges towards the outlet side of the pump.
- Pack the cavity behind the lips of the front end cover drive shaft seal with high melting point grease.
- Tighten the end cover clamping bolts to a torque of 45–50 lbf ft (61–68 Nm) after lightly lubricating them.
- Tighten the drive gear retaining nut to a torque of 30–33 lbf ft (40–45 Nm) and ensure the tab on the locking washer is locked against the nut.
- If the pump is not for immediate use, cap all ports prior to storage.

Installation

Installation follows the removal procedure in reverse.

Prior to installation on the tractor introduce hydraulic oil into the suction port and rotate the gears by hand.

During installation ensure the pump retaining bolts are tightened to a torque of 42–56 lbf ft (57–76 Nm).

Tighten the inlet pipe retaining bolts to a torque of 11–15 lbf ft (15–20 Nm).

Tighten the pump outlet pipe retaining screws to a torque of 5–7 lbf ft (7–10 Nm).

E. PRESSURE TESTING

The following test procedure must be used to confirm the efficiency and output of the fixed displacement tandem gear type and auxiliary engine mounted pumps installed on Series 40 Tractors. The pressure and flow values quoted in this text are the minimum acceptable before overhaul is required and also make allowances for back pressure in the system. The values quoted in Section F. Specifications, are for new components.

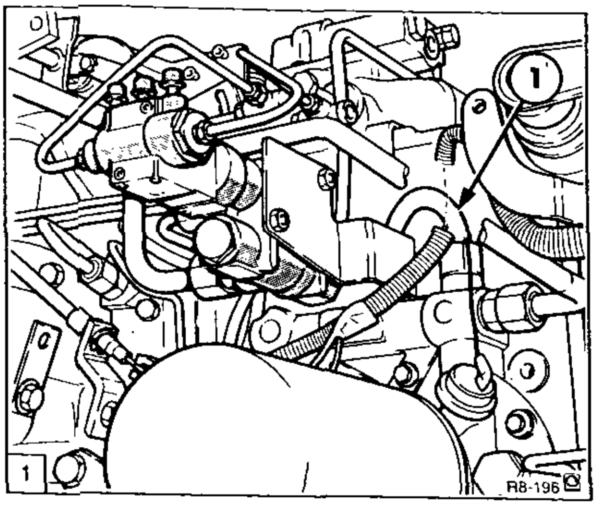
If the efficiency of the pump(s) is verified and the hydraulic lift, remote valves, PTO or other hydraulically operated systems are not operating correctly, reference must be made to the appropriate Parts/Chapters in the Repair Manual which describe the fault finding, overhaul and pressure testing of these components.

⚠ **WARNING:** *To prevent inadvertent movement of the tractor during pressure testing the following precautions must be taken:–*

- *Ensure the gear shift levers are in the neutral position.*
- *If the tractor is fitted with four wheel drive, disconnect the driveshaft coupling at the front axle pinion.*

IMPORTANT: *Before performing any flow or pressure checks it is important that the oil in the rear axle and transmission is at an operating temperature of 75°C (170°F). This can be achieved by installing the flowmeter as for flow testing the hydraulic pump and performing steps 7 and 8 of the main hydraulic pump flow test.*

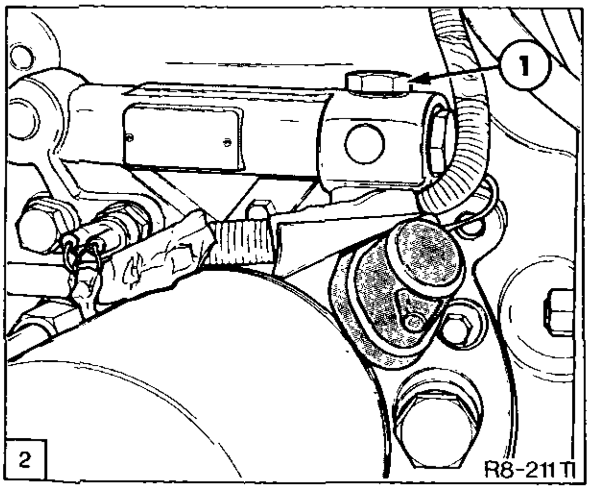
Main Hydraulic Pump Flow and Pressure Test



Trailer Brake Valve Feed Tube

1. Feed Tube

1. Tractors With Trailer Brake Only: Disconnect trailer brake valve feed tube from pump, Figure 1.

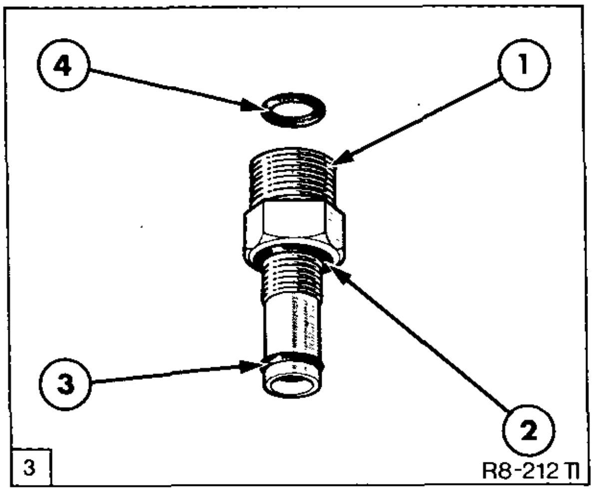


Pump Pressure Test Outlet Port
(Tractors Less Trailer Brake)

1. Plug

2. Tractors Less Trailer Brake Only: Remove plug from pump outlet port, Figure 2.

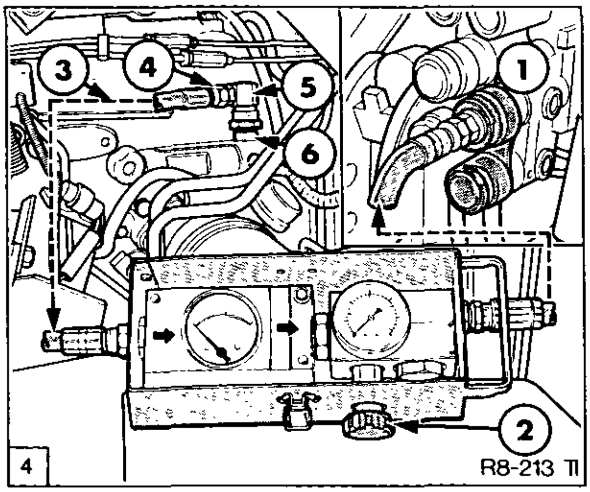
3. Install trailer brake valve adaptor Part No. F0NN–U906–CA, Finis Code 395889, Figure 3 into pump port.



Trailer Brake Valve Adaptor

1. Adaptor Part No F0NN–U906–CA (Finis Code 3958889)
2. 'O' Ring Part No F0NN–U904–DA
3. 'O' Ring Part No 87010
4. 'O' Ring Part No 87016

On tractors with trailer brakes the adaptor is already fitted to the pump.

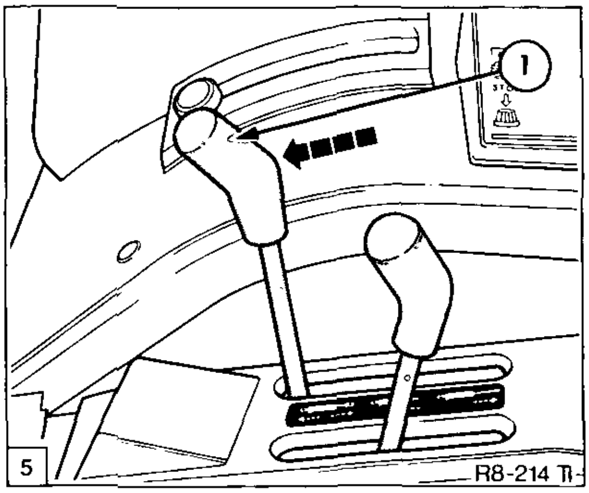


Installation of Flowmeter

1. Flowmeter Return Hose to Remote Valve (Valve Set to Float)
2. Flowmeter Load Valve
3. Flowmeter Inlet Hose
4. Adaptor 4FT.858/1
5. Adaptor 4FT.858
6. Trailer Brake Valve Adaptor

4. Attach inlet hose of flowmeter to pump outlet port and return hose into a remote valve raise port, Figure 4.

Adaptor 4FT.858/1 is provided with a 3/4 in JIC male fitting. If the hoses on the flowmeter used are not compatible with this size fitting a suitable adaptor with a 1 in–14 UNS 'O' ring face seal thread for attaching onto the pump test port is required.



Setting Remote Control Valve to Float

1. Right Hand Outer Remote Control Valve Lever (Green)–Float Position

5. Set remote valve receiving oil from flowmeter to 'float', Figure 5.

6. Ensure load valve on flowmeter is fully open.

7. Blank oil cooler with a piece of card. Start engine and set speed to 2100 rev/min.

8. Slowly close load valve until a pressure of 2000 lbf/in^2 (137 bar) *is recorded on the* flowmeter pressure gauge. Run tractor until the oil is at an operating temperature of 75°C (170°F).

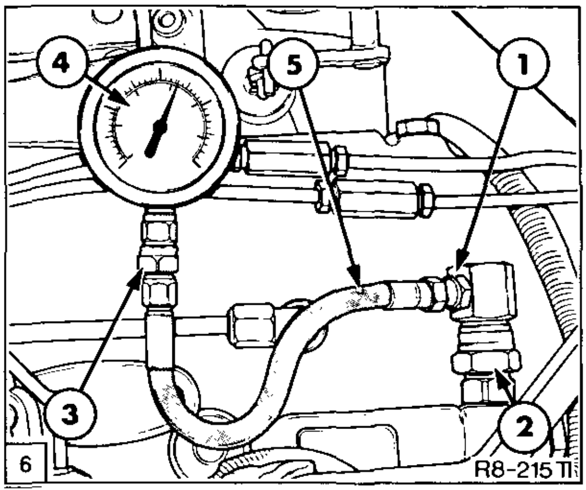
9. Slowly close the load valve on the flow meter until the pressure relief valve starts to operate and the pressure gauge reading on the flowmeter no longer increases. Record the maximum pressure reading. The pressure recorded should be between 2550–2650 lbf/in^2 (176–183 bar).

10. If the recorded pressure was away from specification replace the pump pressure relief valve and re–check the pressure.

11. If the relief valve pressure is to specification, open the load valve on the flowmeter until a pressure of 2000 lbf/in^2 (176–182 bar) is obtained and record the pump flow.

The minimum flow recorded should be 8.4 U.S. Gals/min(7.0 Imp Gals/min, 34 Ltrs/min).
If the flow is less than this value the pump must be overhauled.

Main Hydraulic Pump Pressure Test



Checking Main Hydraulic Pump Pressure

1. Adaptor 4FT. 858/2
2. Adaptor 4FT. 858
3. Adaptor FT.8503–8 or FNH 00705
4. Pressure Gauge FT.8503A
5. Test Hose E1NN–F493–AA (Finis Code 3936707)

If a flowmeter is not readily available the maximum pump pressure can be checked by installing a 0–6000 lbf/in^2 pressure gauge in place off the flowmeter, Figure 6.

Alternatively if the tractor **is not** fitted with an auxiliary engine mounted hydraulic pump the pressure gauge can be installed directly into a remote valve. Operation of the valve will then give pump pressure.

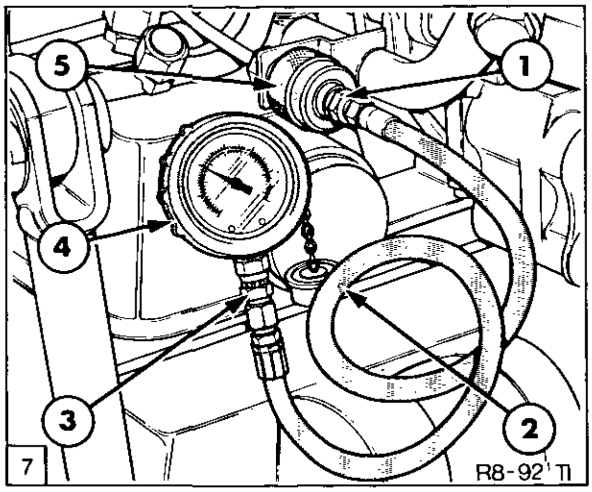
1. Start tractor and set engine speed to 2100 rev/min. Observe reading on pressure gauge.

2. Reduce the engine speed to 1200 rev/min and again observe the pressure reading.

If the readings remain within the 2550–2650 lbf/in^2 (176–183 bar) pressure specification it is an indication that the pump **does not** require an overhaul.

Trailer Brake Valve Pressure Test

If the tractor is installed with trailer brakes and the main hydraulic pump pressure and flow test is satisfactory, but the hydraulic lift only operates slowly, perform the following trailer brake valve test to determine if the concern is related to the trailer brake valve or the hydraulic lift.



Trailer Brake Pressure Test

1. Adaptor 4FT.854
2. Test Hose E1NN F493 AA (Finis Code3936707)
3. Adaptor FT. 8503–8 or FNH 00705
4. Pressure Gauge FT.8503A
5. Trailer Brake Coupler

1. Connect 0–6000 lbf/in² (0–414 bar) pressure gauge FT.8503A to trailer brake coupler, Figure 7.
2. Set engine speed to 1500 rev/min.
3. Depress right hand brake pedal. There should be no reading on the pressure gauge.
4. Depress left hand brake pedal. There should be no reading on the pressure gauge.
5. Couple together and depress both brake pedals. The reading on the pressure gauge should increase as the brake pedals are depressed harder. The pressure recorded, depending on pedal effort, should increase up to a maximum pressure of 2140 lbf/in² (147 bar).
6. Release brake pedals. Pressure should reduce to zero.

Steering Pump

The following practical test will determine if the steering pump outlet is sufficient to allow satisfactory operation of the steering system.

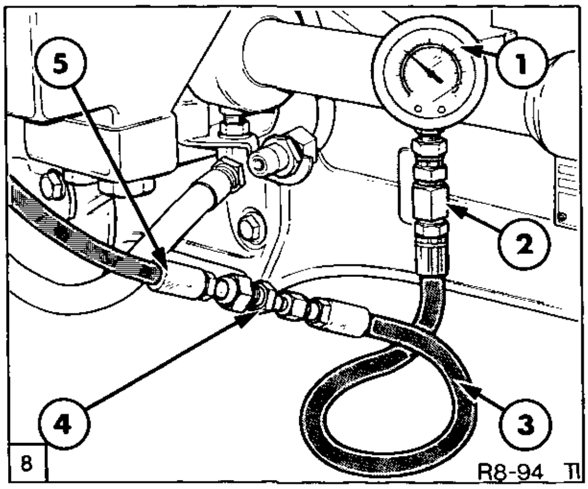
Steering Test

1. Set engine speed to 1000 rev/min.
2. Turn steering quickly from lock to lock. If steering is operating correctly the reaction of the steering should be immediate, with no time delay between turning the steering wheel and movement of the wheels. At full lock the relief valve in the steering motor should be heard to blow and the engine speed drop to approximately 970 rev/min.

Steering Relief Valve Pressure Test

IMPORTANT: *There is no relief valve in the steering pump and the following pressure test must only be performed as specified below. Failure to observe this precaution may result in severe damage to the steering pump.*

1. Turn steering onto full left hand lock.
2. Disconnect the left hand turn feed hose at the steering cylinder.
3. Install 0–6000 lbf/in² (400 bar) pressure gauge FT.8503A, Figure 8.



Power Steering Circuit Pressure Test

1. Pressure Gauge FT.8503–A
2. Adaptor FT.8503–8 or FNH 00705
3. Test Hose E1NN–F493–AA (Finis Code 3936707)
4. Adaptor 4FT.853
5. Left Hand Turn Steering Hose

4. Start tractor and set engine speed to 2100 rev/min.

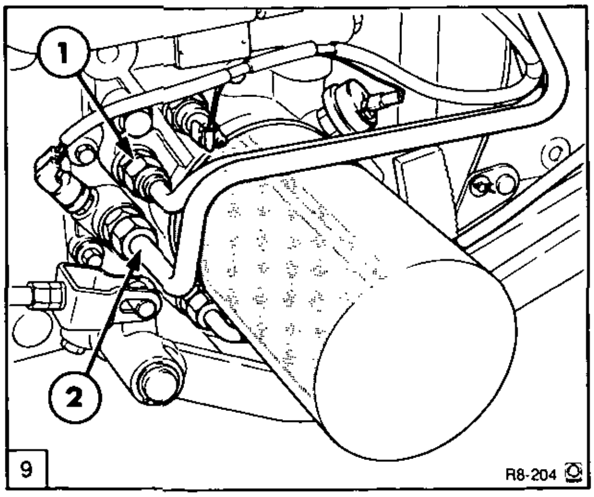
5. Using a force of approximately 5 lbf. hold steering wheel on full left hand lock and observe the pressure reading. The use of a force greater than 5 lbf. at the rim of the steering wheel may lead to slightly inaccurate readings due to the pumping action of the hydrostatic steering motor.

6. Reduce the engine speed to 1200 rev/min and again observe the pressure reading.

The pressure readings after taking into consideration system back pressure should be:–
5640–7840 2WD Tractors
2220–2370 lbf/in^2 (153–163 bar).
All 4WD and 6 cyl 82/8340 2WD Tractors
2620–2770 lbf/in^2 (180–191 bar).

If the steering test was satisfactory but the pressure readings are away from specification, the relief valve in the steering motor must be replaced. Refer to Part 9 "Front Axle and Steering".

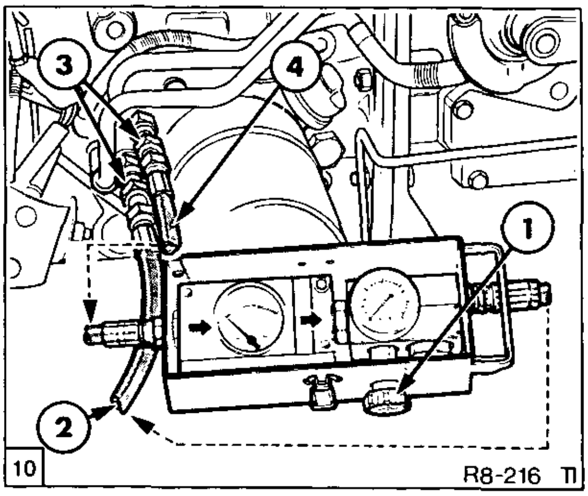
Steering Pump Flow Test



Steering Motor Feed and Return Tubes

1. Feed Tube to Steering Motor
2. Return Tube from Steering Motor

1. Disconnect feed and return tubes to steering motor, Figure 9.



Installation of Flowmeter for Steering Pump Flow Test

1. Flowmeter Load Valve
2. Return Hose from Flowmeter
3. Adaptors 4FT.859
4. Inlet Hose to Flowmeter

2. Install flowmeter, Figure 10.

NOTE: *The flowmeter used for this test must be capable of withstanding a back pressure off 300 lbf/in^2 (21 bar).*

If hoses of a different size are used with the flowmeter, suitable adaptors with a female thread size of $^{13}/_{16}$ in–*16 ORFS for installing onto the pump inlet and outlet ports will be required.*

3. **'Ensure'** flowmeter load valve is fully open.

IMPORTANT: *If the flowmeter load valve remains closed damage will occur to the steering pump.*

4. Set engine speed to 2100 rev/min and slowly close the load valve until a pressure of 2000 lbf/in^2 (138 bar) is recorded on the flowmeter pressure gauge. **DO NOT** increase the pump pressure beyond this value.

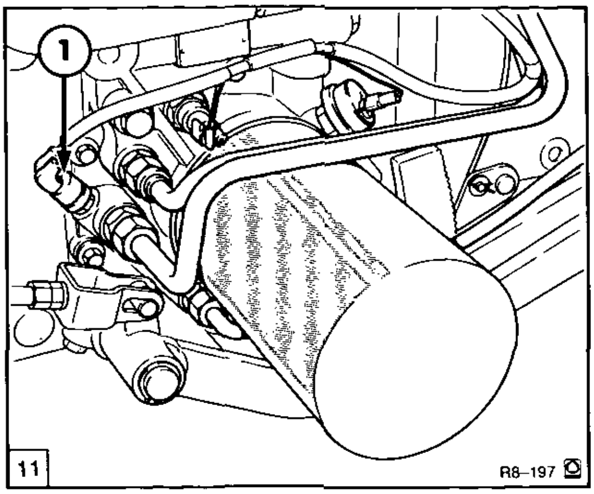
5. Record the pump flow.

If pump flow is less than 6.8 Imp gals/min (8.2 U.S. Gals/min 31 Ltrs/min) the steering pump requires overhaul.

Low and Lubrication Circuit Pressure Tests

It is important that the flow of oil on returning from the steering motor to the tandem pump for redistribution to the low pressure and lubrication circuits, is regulated to the correct specification by the pressure regulating valve and lubrication circuit relief valve in the PTO assembly. It is, therefore, recommended that when pressure testing the pump the following low and lubrication circuit pressure tests are performed.

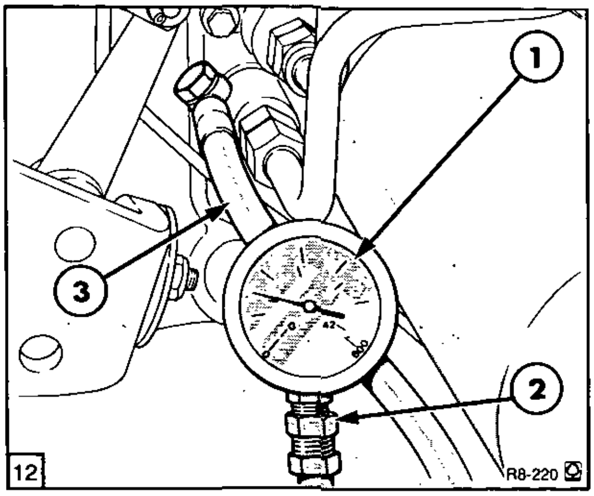
Low Pressure Circuit Test



Pressure Switch for Low Pressure Circuit

1. Pressure Switch – Low Pressure Circuit

1. Remove the pressure switch for the low pressure hydraulic circuit, Figure 11.

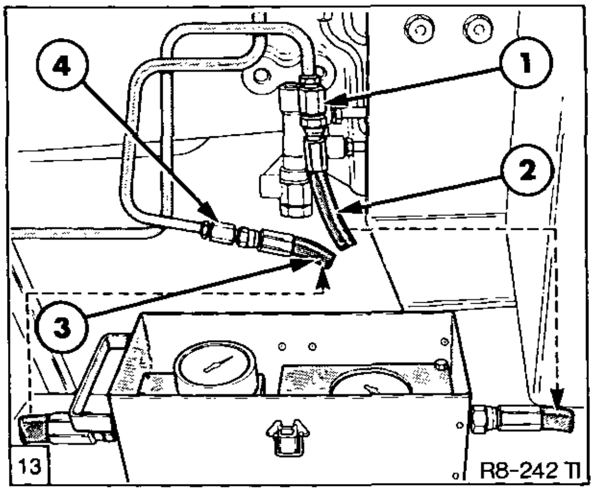


Checking Low Pressure Circuit

1. Pressure Gauge FT.8616 or FNH 06653
2. Adaptor FT.8503–8 or FNH 00705
3. Test Hoses E1NN–F493–AA (Finis Code 3936707) and E0NN–2N353 AB (Finis Code 3926717)

2. Install 0–400 lbf/in² (0–30 bar) pressure gauge, FT.8616, Figure 12.
3. Set engine speed to 2100 rev/min and observe pressure reading. A reading of 220–260 lbf/in² (15.2–17.9 bar) should be recorded.

Lubrication Circuit Pressure Test Tractors with 12 x 12 Transmission only:



Flow Testing Steering Pump

1. Adaptor 4FT. 852
2. Supply Hose To Flowmeter
3. Flowmeter Return Hose
4. Adaptor 4FT. 852

1. Carefully disconnect feed and return tubes to cooler by–pass valve and using Adaptors 4FT.852 install flowmeter, Figure 13. Take care not to damage tubes during disconnection.

NOTE: *Adaptors 4FT.852 are suitable for installing ³/₄ in JIC hoses to flowmeter. If hoses of a different size are used with the flowmeter, suitable adaptors with a female thread size of ³/₄ in–18 UNS on one end will be required.*

2. **'Ensure'** flowmeter load valve is fully open.
3. Set engine speed to 2100 rev/min and slowly close the flowmeter load valve. Record the pressure on the flowmeter gauge and then **fully open** the load valve.

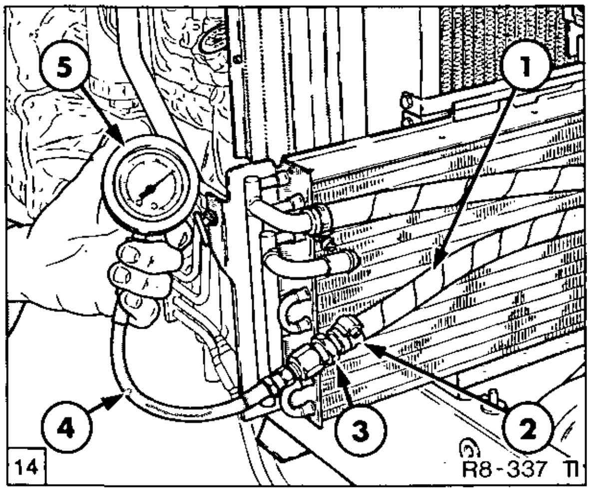
IMPORTANT: *If the flowmeter load valve remains closed the low pressure lubrication supply to the transmission shafts will cease with possible damage to the transmission.*

Depending on engine speed, the pressure should be 73–123 lbf/in² (5.0–8.5 bar).
73 lbf/in² (5.0 bar) is the minimum operating pressure of the lubrication circuit relief valve, located in the PTO valve and clutch assembly.

Lubrication Circuit Pressure Test: Tractors with 16 x 4 or 8 x 2 Transmission only:

NOTE: *The use of this method to test lubrication circuit pressure on tractors installed with 12 x 12 transmissions may result in the readings being influenced by the cooler by–pass valve installed on 12 x 12 transmission tractors. This would be particularly evident if the oil temperature was below* 75°C (170°F).

1. Operate the tractor and set the engine speed to 1000 rev/min. Stop the engine but do not re–adjust the throttle.



Lubrication Circuit Relief Valve Check
(Tractors with 16 x 4 or 8 x 2 Transmission)

1. Oil Cooler Inlet Hose
2. Hose Clamp
3. Suitable $^7/_{16}$ in JIC Adaptor to Connect Test Hose to Inlet Hose
4. Test Hose E1NN–F493–AA (Finis Code 3936707)
5. Pressure Gauge FT.8616 or FNH 06653

2. Using test hose E1NN F493 AA, adaptor FT.8503–8 and a suitable $^7/_{16}$ in JIC adaptor, which must be a tight fit inside the oil cooler inlet hose, connect the 0–400 lbf/in^2 pressure gauge FT.8616 to the cooler inlet hose, Figure 14.

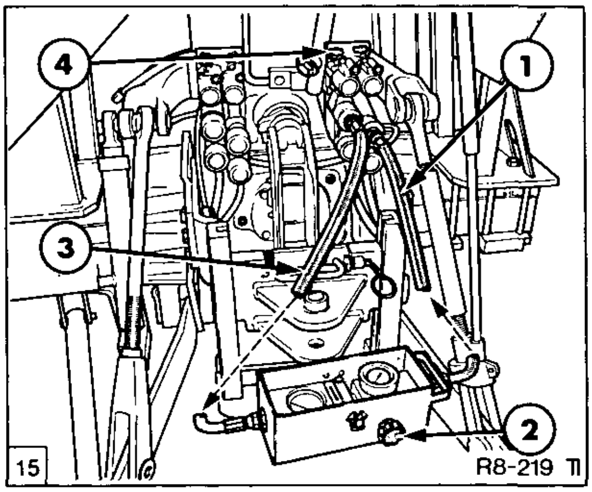
3. Using an assistant to start the engine, observe the reading on the pressure gauge. **Do Not** run the tractor longer than is necessary to observe the pressure gauge reading.

The pressure recorded should be 73–123 lbf/in^2 (5.3–8.5 bar), depending on engine speed. 73 lbf/in^2 (5.3–8.5 bar) is the minimum operating pressure of the lubrication circuit relief valve located in the PTO valve and clutch assembly.

Auxiliary Engine Mounted Pump Flow Test

NOTE: *The flowmeter used for this test must be capable of withstanding a back pressure of 300 lbf/in^2 (21 bar).*

Flow Test for Tractors with Auxiliary Services Control (ASC) Valve Option:



Installation of Flowmeter

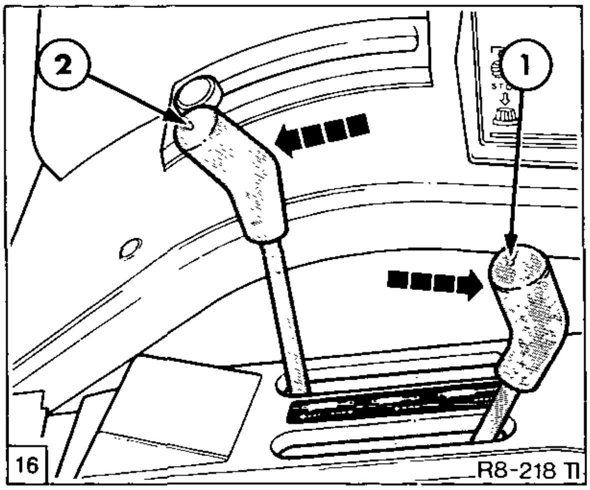
1. Return Hose to Remote Control Valve
2. Flowmeter Load Valve
3. Supply Hose to Flow Meter
4. Flow Control Knobs

1. Install inlet hose of flowmeter into lift coupler of right hand inner remote control valve and return hose of flow meter into lift coupler of right hand outer remote control valve, Figure 15.

2. Set flow control knob on remote control valves to minimum flow.

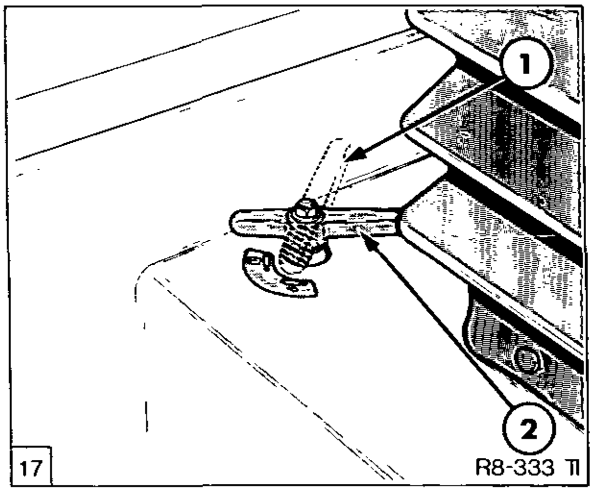
3. Ensure load valve on flow meter is fully open.

4. Set engine speed to 2100 rev/min and lower lift arms.



Setting Remote Control Valves to Raise and Float

1. Right Hand Inner Remote Control Valve Lever (Blue)–Extend Position
2. Right Hand Outer Remote Control Valve Lever (Green)–Float Position



ASC Selector Lever (where fitted)_

1. ASC Engaged
2. ASC Disengaged

5. Push green handled remote control valve operating lever fully forward to 'float' position. (This lever operates the remote control valve receiving oil from the flow meter), Figure 16.

6. Pull blue handled remote control valve lever fully rearwards to cylinder extend position. (This lever operates the remote control valve supplying oil to the flow meter).

7. Ensure that flow meter is measuring oil flow correctly then set remote control valve flow knobs to maximum flow.

8. Turn auxiliary services control (ASC) to engaged position, Figure 17.

9. Move the hydraulic lift control lever to the fully raise position which will cause the pressure relief valve in the tandem pump to operate, diverting all the hydraulic lift pump oil to reservoir.

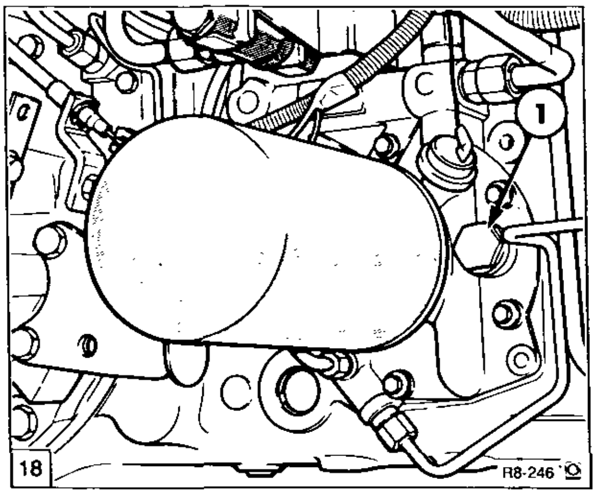
10. Adjust the load valve on the flow meter until a pressure of 2000 lbf/in^2 is obtained and record the pump flow. Move the lift control lever to the fully lowered position immediately the pump flow has been recorded.

The oil flow recorded is the output from the auxiliary engine mounted pump. If pump flow is less than 5.0 Imp gals/min (6 U.S. Gals/min 23 Ltrs/min) the pump must be overhauled.

11. Slowly close the load valve until the flowmeter pressure gauge no longer increases.

Record this value which should be in the range 2550–2900 lbf/in2 (176–200 bar). This is the operating pressure of the combining valve relief valve, in the priority valve pack on top of the hydraulic lift cover. If this pressure is low, overhaul the priority valve pack as described in Chapter 4 of this Part of the Repair Manual, before investigating further concerns with the auxiliary engine mounted pump.

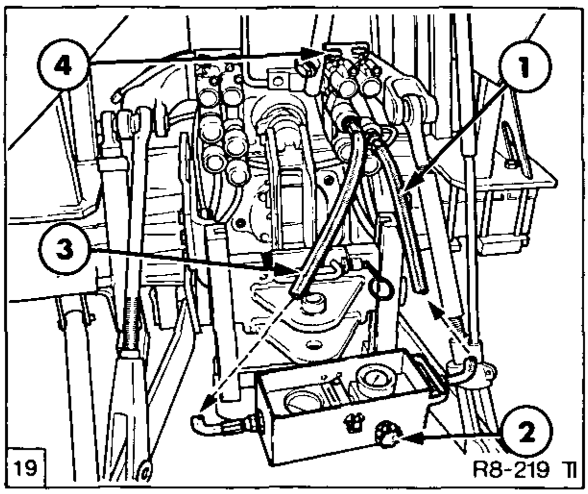
Flow Test for Tractors Not Installed with ASC Valve Option:



Installation of Flowmeter

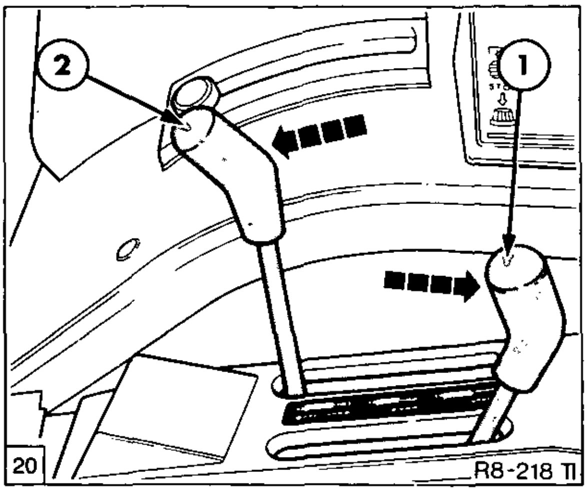
1. Pressure Relief Valve

1. Remove pressure relief valve from pump, Figure 18. Install plug Part No. D4NN–A574–C (finis code 3900652 and seal Part No. E105–GF–9 (finis code 1800812) in place of valve.
This will return all oil from the hydraulic lift pump to the reservoir.



Installation of Flowmeter

1. Return Hose to Remote Control Valve
2. Flowmeter Load Valve
3. Supply Hose to Flow Meter
4. Flow Control Knobs



Setting Remote Control Valves to Raise and Float

1. Right Hand Inner Remote Control Valve Lever (Blue)–Extend Position
2. Right Hand Outer Remote Control Valve Lever (Green)–Float Position

2. Install inlet hose of flowmeter into lift coupler of right hand inner remote control valve and return hose of flow meter into lift coupler of right hand outer remote control valve, Figure 19.
3. Set flow control knob on remote control valves to minimum flow.
4. Ensure load valve on flow meter is fully open.
5. Set engine speed to 2100 rev/min.
6. Push green handled remote control valve operating lever fully forward to 'float' position. (This lever operates the remote control valve receiving oil from the flow meter), Figure 20.
7. Pull blue handled remote control valve lever fully rearwards to cylinder extend position. (This lever operates the remote control valve supplying oil to the flow meter).
8. Ensure that flow meter is measuring oil flow correctly then set remote control valve flow knobs to maximum flow.
9. Adjust the load valve on the flow meter until a pressure of 2000 lbf/in^2 (138 bar) is obtained and record the pump flow.

   If pump flow is less than 5.0 Imp gals/min (6 U.S. Gals/min 23 Ltrs/min) the pump must be overhauled.

10. Slowly close the load valve until the reading on the flowmeter pressure gauge no longer increases.

Record this value which should be in the range 2550–2900 lbf/in2 (176–200 bar). This is the operating pressure of the combining valve relief valve, in the priority valve pack on top of the hydraulic lift cover. If this pressure is low, overhaul the priority valve pack as described in Chapter 4 of this Part of the Repair Manual, before investigating further concerns with the auxiliary engine mounted pump.

11. Remove plug from pump and re–install the pressure relief valve.

F. SPECIFICATIONS AND SPECIAL TOOLS

Fixed Displacement Gear Type Pump With Integral Steering Pump

Main Hydraulic Lift Pump

Type	Gear Type Pump
Minimum output @ 2100 engine rev/min @ 2000 lbf/in^2 (165 bar)	
New pump	7.7 Imp gals/min (9.3 U.S. Gals/min 35 Ltrs/min)
Used pump	7.0 Imp gals/min (8.4 U.S. Gals/min 32 Ltrs/min)
Pressure relief valve setting	2550–2650 lbf/in^2 (176–183 bar)

Steering Pump

Type	Gear Type Pump
Minimum output @ 2100 engine rev/min	
New pump	7.7 Imp gals/mim (9.2 U.S. Gals/min 35 Ltrs/min)
Used pump	6.8 Imp gals/min (8.2 U.S. Gals/min 31 Ltrs/min)
Steering Motor Relief Valve Setting	
5640–7840 2WD Tractors	2000–2100 lbf/in^2 (138–145 bar)
All 4WD and 6 Cyl 82/8340 2WD Tractors	2400–2500 lbf/in^2 (166–172 bar)

Auxiliary Engine Mounted Fixed Displacement Gear Type Pump

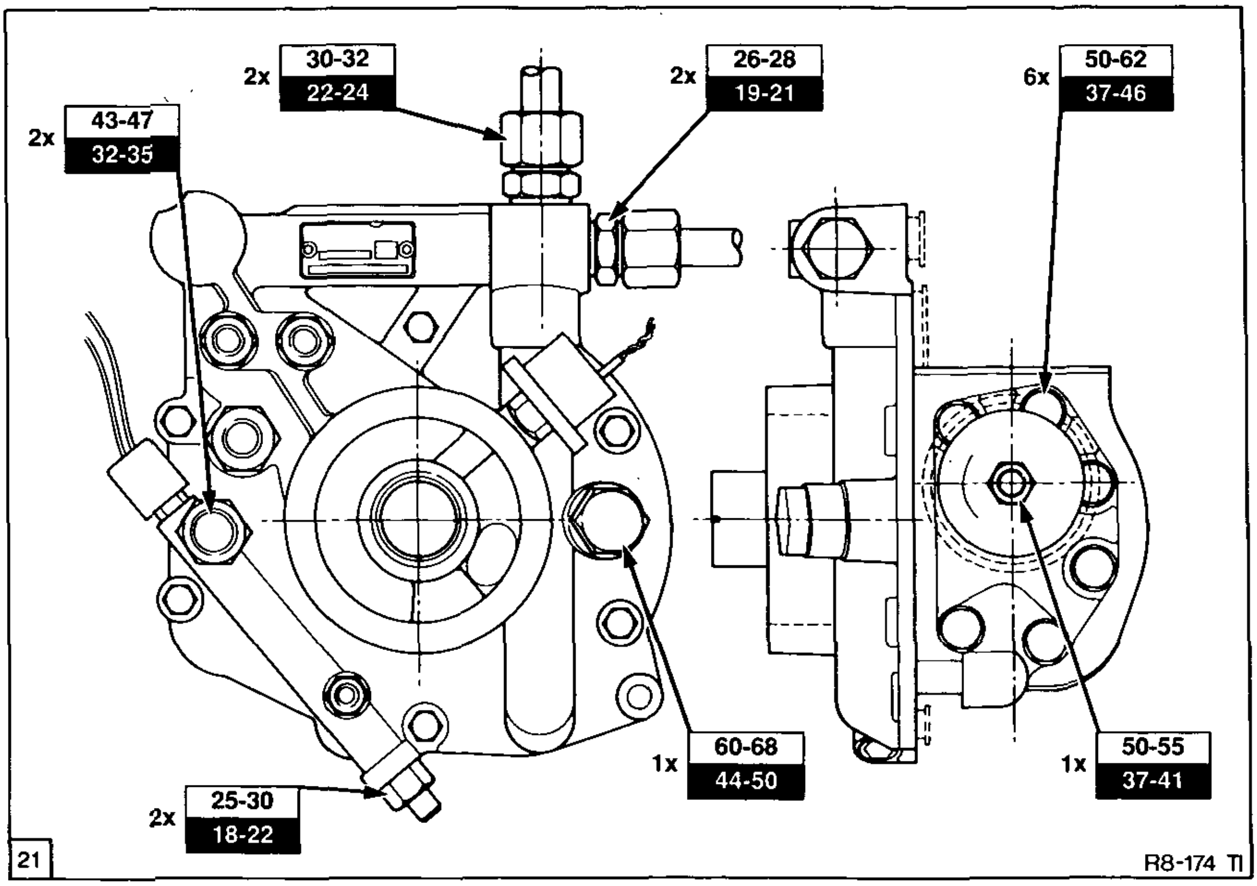
Type	Gear Type Pump
Minimum output @ 2100 engine rev/min @ 2400 lbf/in^2 (165 bar)	
New pump	7.3 Imp gals/min (8 U.S. Gals/min 33 Ltrs/min)
Used pump	5 Imp gals/min (6 U.S. Gals/min 23 Ltrs/min)

SPECIAL TOOLS

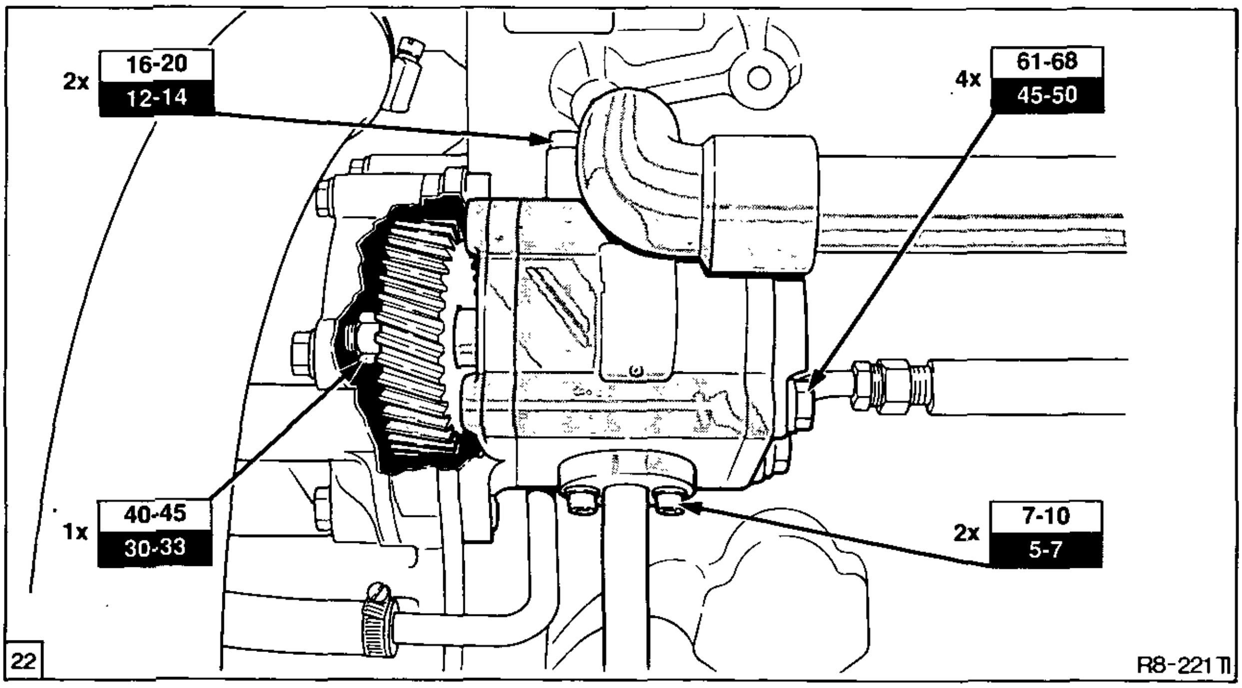
DESCRIPTION	TOOL NUMBER	
	V.L. Churchill	FNH Part No. (America only)
Pressure Gauge 0–400 lbf/in^2 (0–30 bar)	FT. 8616	FNH 06653
Pressure Gauge 0–6000 lbf/in^2 (0–414 bar)	FT. 8503A	FNH 02028
Adaptor–Pressure Test	FT. 8503–8	FNH 0705
Adaptor–Steering Flow Test	4FT.852 ($^{3}/_{4}$" x 18UNS female–$^{3}/_{4}$" JIC male)	
Adaptor–Steering Pressure Test	4FT.853 ($^{11}/_{16}$"–16UN to $^{7}/_{16}$" JIC male)	
Adaptor –Trailer Brake Pressure Test	4FT.854 (M18 –1.5 male to $^{7}/_{16}$" JIC male)	
Adaptor–Main Pump Flow/Pressure Test	4FT.858 1–14UNS Female to $^{1}/_{4}$" BSP female	
Adaptor–Main Pump Flow/Pressure Test	4FT.858/1 $^{1}/_{4}$" BSP male to $^{3}/_{4}$" JIC male	
Adaptor–Main Pump Pressure Test	4FT.858/2 $^{1}/_{4}$" BSP male to $^{7}/_{16}$" JIC male	
Adaptor–Steering Pump Flow Test	4FT.859 ($^{13}/_{16}$"–16UN female to $^{3}/_{4}$" JIC male)	
Flowmeter	MS. 820A or suitable equivalent	FNH 02755
Test Hose–Pressure Testing	Part No E1NN F493 AA (finis code 3936707)	
Test Hose–Pressure Testing	Part No E0NN 2N353 AB (finis code 3926717)	
Adaptor–Trailer Brake Valve	Part No F0NN U906 CA (finis code 3958889)	
Plug	Part No D4NN A574 C (finis code 3900652)	
Seal	Part No E105 GF 9 (finis code 1800812)	
Remote Control Valve Connectors	Procure through Ford New Holland	

TORQUES

☐	= Nm
■	= lbf ft



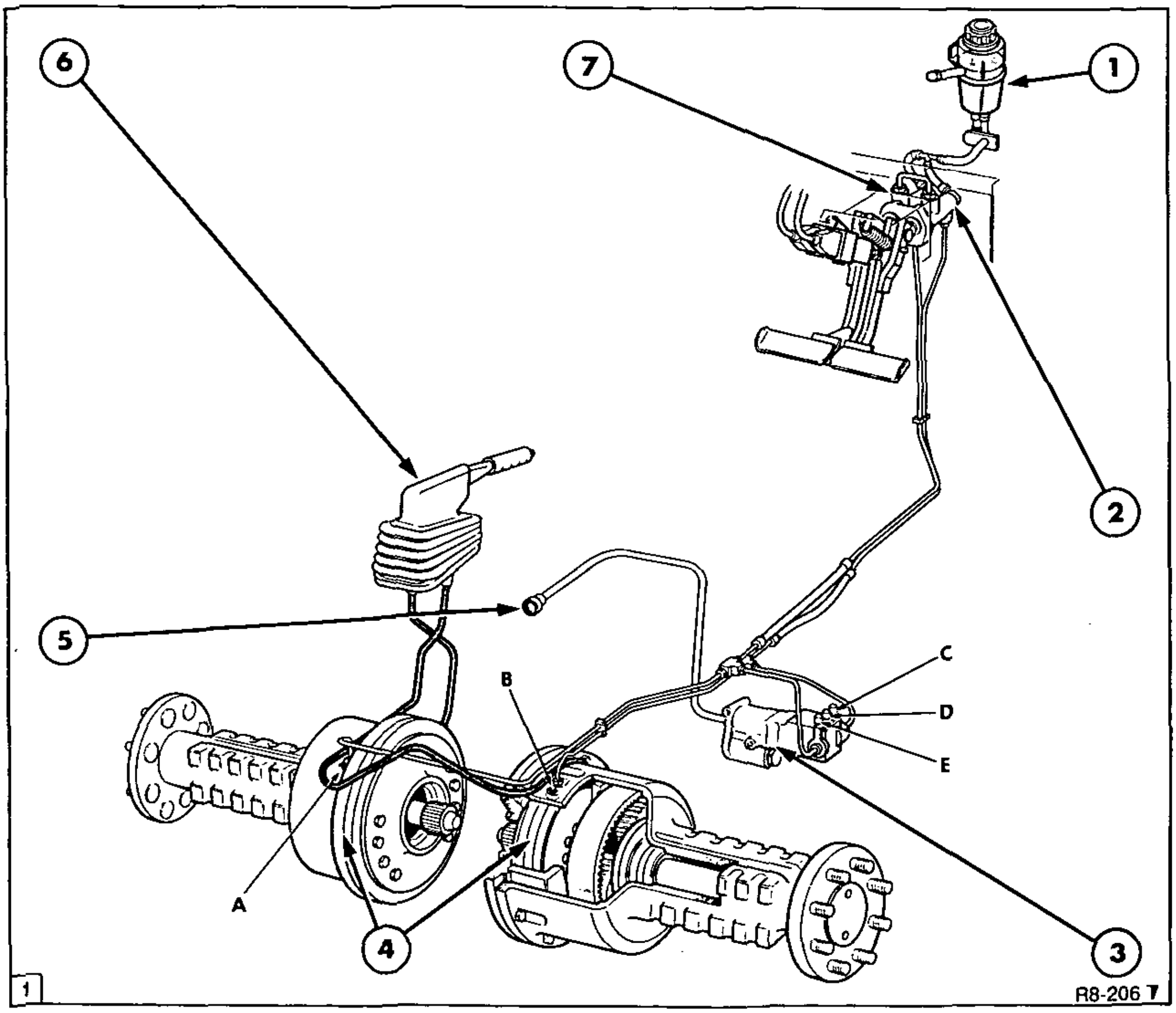
Transmission Mounted Fixed Displacement Tandem Gear Type Pump



Engine Mounted Fixed Displacement Gear Type Pump

PART 8
HYDRAULIC SYSTEMS
Chapter 6
HYDRAULIC TRAILER BRAKES

A. DESCRIPTION AND OPERATION



Tractor and Trailer Brake Layout

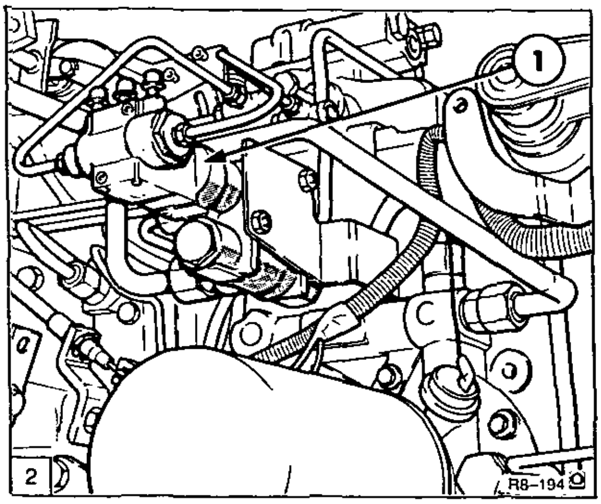
1. Tractor Brake Fluid Reservoir
2. Tractor Right Hand Brake Master Cylinder
3. Trailer Brake Valve
4. Rear Axle Wet Disc Brakes
5. Trailer Brake Line Coupler
6. Handbrake
7. Tractor Left Hand Brake Master Cylinder

A. Bleed Screw–Left Hand Brake
B. Bleed Screw–Right Hand Brake
C. Bleed Screw–Right Hand Brake Sensing Line
D. Bleed Screw–Trailer Brake Valve Pilot Head
E. Bleed Screw–Left Hand Brake Sensing Line

Ford Series 40 tractors may be fitted with an hydraulic valve, for the control of hydraulically operated trailer brakes, Figure 1.

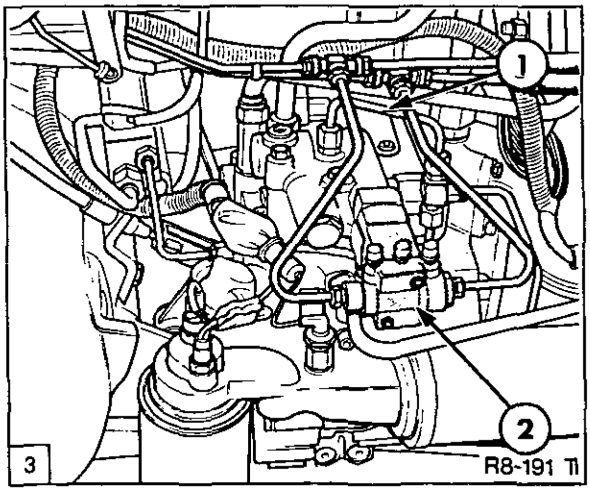
Unlike the main tractor braking system, the trailer brakes use output from the main hydraulic pump, controlled by the trailer brake valve, to apply the trailer brakes.

The trailer brake valve is connected in line between the main hydraulic pump and the tractor hydraulic circuits.



Trailer Brake Valve Installation for Tractors with Fixed Displacement Gear Type Pump

1. *Trailer Brake Valve*



Trailer Brake Valve Installation for Tractors with Variable Displacement Hydraulic Pump

1. *Load Sensing Line*
2. *Trailer Brake Valve*

Sensing lines connected between each of the tractor brake lines and a pilot head on the trailer brake valve, activate the valve to direct oil supplied by the hydraulic pump to the trailer brakes, whenever both tractor brake pedals are depressed simultaneously.

The trailer brake valve is connected to the trailer brakes by means of tubing and a unique coupling which is to the ISO/DIS 5676 standard to prevent any coupling other than the appropriate type being connected.

The trailer braking system has priority over the tractor hydraulics circuits and does not affect the function of the hydraulic system. Similarly, the hydraulic lift, remote control valve and other hydraulic circuits do not interfere with the function of the trailer brakes.

The trailer braking is proportional to the effort applied on the tractor brake pedals. Feedback is provided by the trailer brake valve to give a sense of 'feel' to the operator which aids precise braking. The pilot head ensures trailer braking only occurs when both tractor brake pedals are depressed simultaneously.

The trailer braking system can be installed on tractors with either the fixed displacement gear type hydraulic pump, or the variable displacement hydraulic pump with closed centre load sensing.

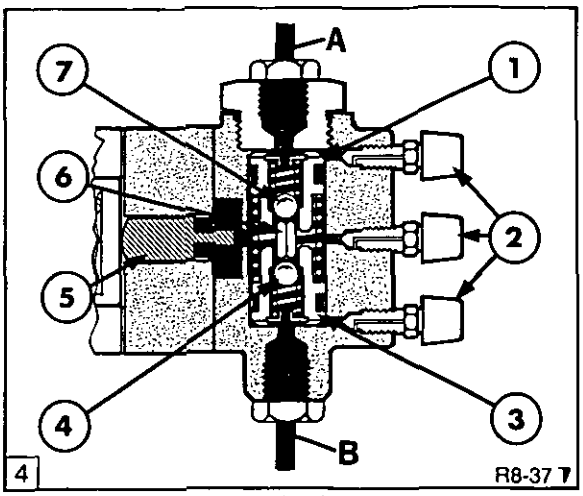
On tractors installed with the fixed displacement gear type hydraulic pump, the valve sits above the pump and is connected by metal tubing, Figure 2.

On tractors installed with the variable displacement hydraulic pump assembly with closed centre load sensing, the valve attaches directly to the top of the pump, Figure 3.

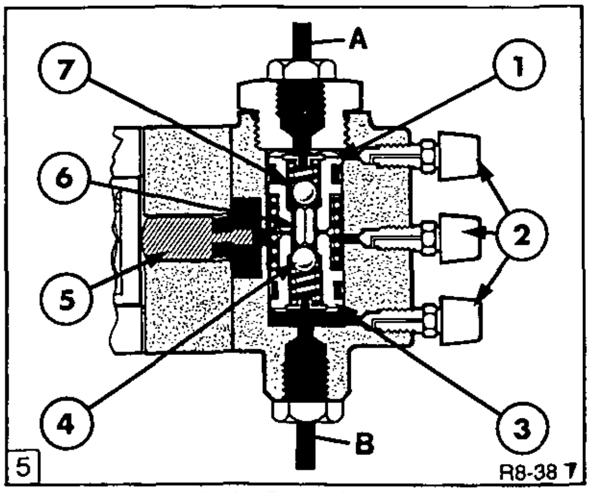
The valve design for both types of installation are similar, however, the valve installed on tractors with variable displacement closed centre load sensing pump has a load sensing capability to signal the pump when hydraulic demand by the trailer brakes is required. This facility is not required on tractors with the fixed displacement gear type pump.

TRAILER BRAKE VALVE PILOT HEAD OPERATION

The pilot head on the trailer brake valve ensures that trailer braking only occurs when both tractor brake pedals are depressed simultaneously. This is achieved by ensuring that the pilot piston, housed within the head and which activates the trailer brake valve, only functions when both pedals are depressed.



Brakes Not Applied



Single Pedal Brake Application

1. Piston
2. Bleed Screws
3. Piston
4. Ball
5. Pilot Piston
6. Plunger
7. Ball

A. Pressure from Right Hand Brake Sensing Line

B. Pressure from Left Hand Brake Sensing Line

■ Tractor Brake Sensing Line Pressure – Brake Applied

■ Zero Brake Pressure – Brake Not Applied

Brakes Not Applied

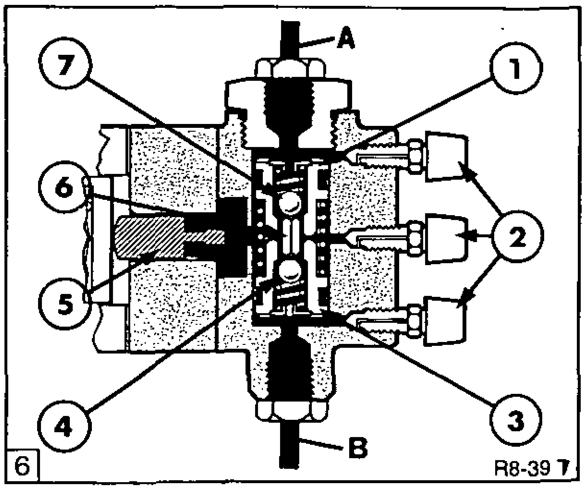
When the tractor brakes are not applied pressure is not being applied to the pilot head sensing lines, Figure 4.

Single Pedal Brake Application

When a ‘single' brake pedal is depressed, pressure is directed from the pressurised brake line to the trailer brake valve pilot head Figure 5. The pressure applied through either Port ‘A' or ‘B', depending on whether the left or right hand pedal is depressed, causes the ball in the pressurised port to seat and the piston and plunger to move forward, pushing the opposite piston off its seat. Because the ball in the pressurised port is firmly seated, the pressure in the activated brake line can not be applied to the pilot piston, so the trailer brake valve remains in the neutral position and trailer brakes are not activated.

Coupled Brake Pedal Application

When both brake pedals are depressed simultaneously, the pressure generated in the right and left hand brake lines is also applied to both Ports ‘A' and ‘B' of the brake valve pilot head.

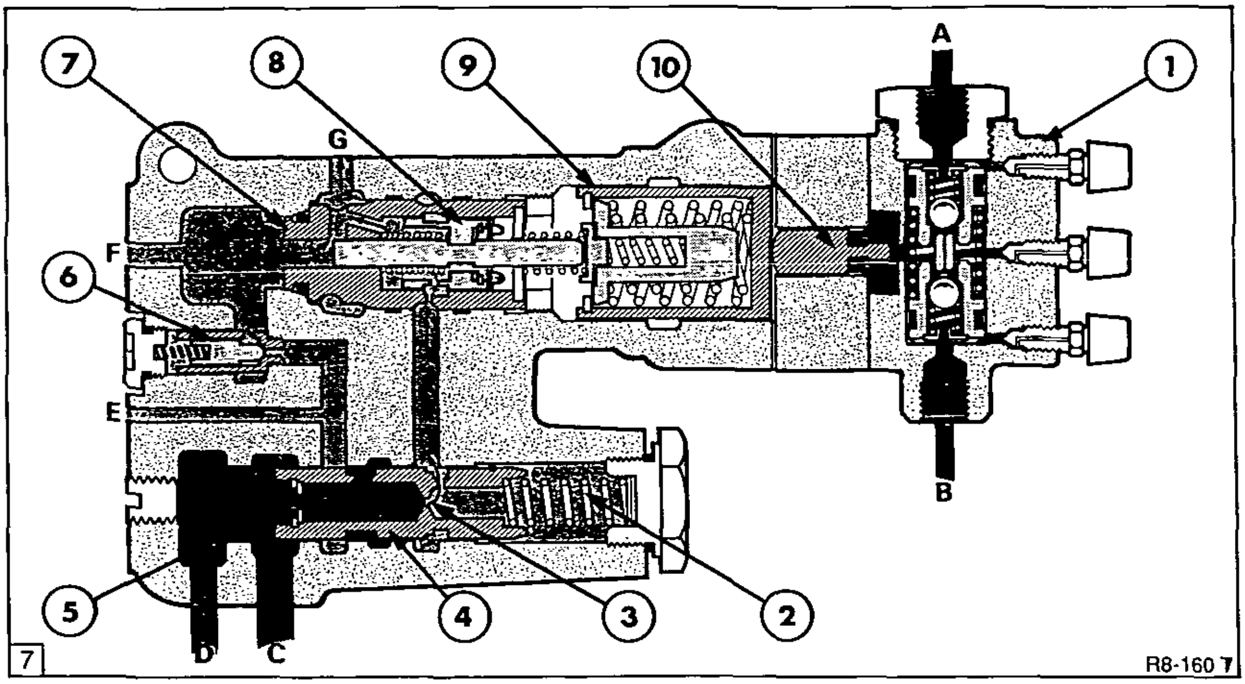


Coupled Pedal Brake Application

1. Piston
2. Bleed Screws
3. Piston
4. Ball
5. Pilot Piston
6. Plunger
7. Ball

■ Tractor Brake Sensing Line Pressure – Brake Applied

This pressure causes the piston in each port to move toward the other while the plunger, which separates the two pistons, prevents the balls within the pistons from seating, Figure 6. The brake line pressure is then applied to the pilot piston, causing this piston to move forward and activate the trailer brake valve.



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Trailer Brake Valve Operation – Brakes Released

1. Pilot Head
2. Spring
3. Drilling
4. Flow Regulating Valve
5. *Restrictor*
6. Check Valve
7. Control Valve Spool Bore
8. Control Spool and Plunger
9. Pressure Relief Element
10. *Pilot Piston*

A. Pressure from Right Hand Brake Sensing Line
B. Pressure from Left Hand Brake Sensing Line
C. Outlet Port to Hydraulic Circuit
D. Inlet Port from Hydraulic Pump
E. Load Sensing Gallery (CCLS Pump Installation only)
F. To Trailer Brakes
G. Return to Reservoir

■ Pump Pressure Oil

■ Zero Pressure Oil in Brake Sensing Lines

▨ Return to Reservoir (Sump) Oil

TRAILER BRAKE VALVE OPERATION

Brakes released

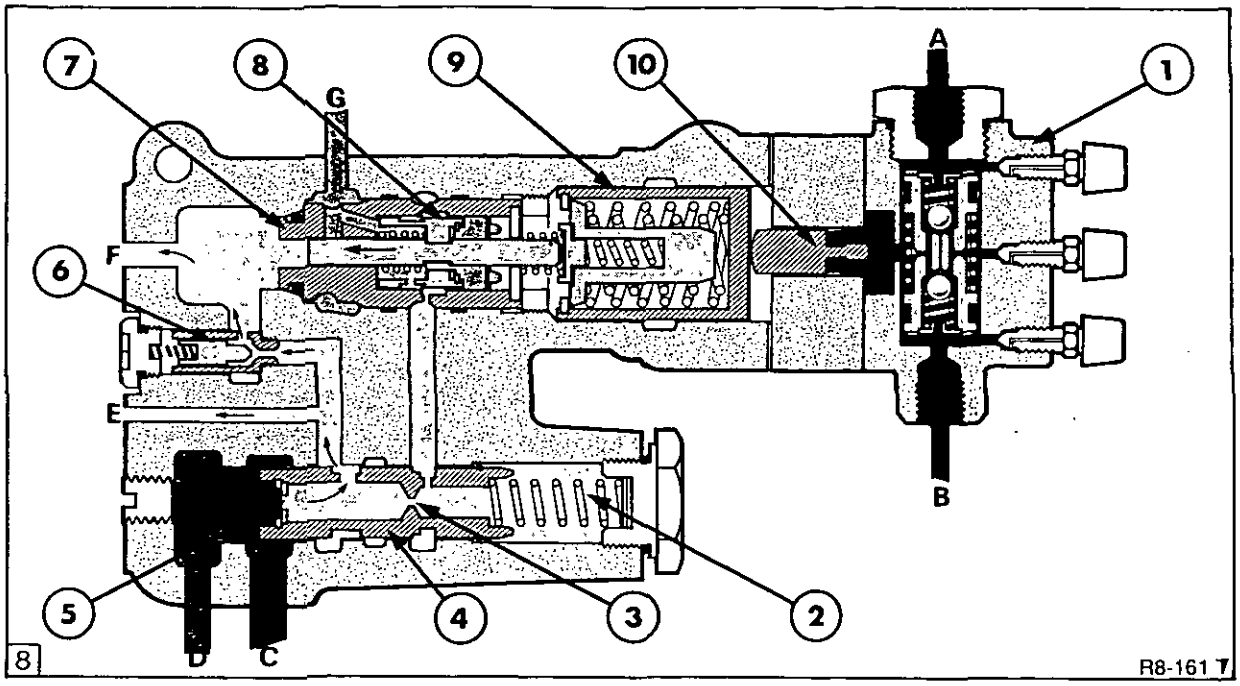
When the tractor brakes are in the released position, no pressure is being exerted in the tractor braking lines or on the pilot piston through Ports 'A' and 'B' and the valve assumes the neutral position, Figure 7.

Oil from the hydraulic pump enters into trailer brake valve Port 'D'. A small flow of oil passes from Port 'D', through the restrictor in the centre of the flow regulating valve to the control spool, which in the neutral position permits this oil to return to reservoir through Port 'G'. The oil flow through the centre of the regulating valve also has to pass through a small drilling which limits the volume of oil returning to reservoir through Port 'G'.

The flow of oil from the hydraulic pump on *reaching the restrictor in the flow regulating* valve generates a higher pressure on the pump supply side which ensures that in neutral the flow regulating valve is held against the spring pressure to permit flow of oil from the pump supply Port 'D' to the tractor hydraulic system through Port 'C'. Additionally, in neutral the flow regulating valve while held against the spring pressure, prevents supply oil at Port 'D' from flowing to the trailer brake check valve.

On tractors installed with the variable displacement hydraulic pump assembly, with closed centre load sensing (CCLS), the load sensing gallery 'E' is provided. This gallery is not pressurised when the valve is in neutral, but when subjected to pressure, signals the hydraulic pump to increase output. Refer to Chapter 2 for description and operation of the variable displacement pump with closed centre load sensing.

On tractors installed with the fixed displacement gear type pump the load sensing gallery 'E' is not required or fitted. The valve components and operation are identical in every other respect to that installed with the variable displacement load sensing pump.



Trailer Brake Valve – Brakes Being Applied

1. Pilot Head
2. Spring
3. Drilling
4. Flow Regulating Valve
5. Restrictor
6. Check Valve
7. Control Valve Spool Bore
8. Control Spool and Plunger
9. Pressure Relief Element
10. Pilot Piston

A. Pressure from Right Hand Brake Sensing Line
B. Pressure from Left Hand Brake Sensing Line
C. Outlet Port to Hydraulic Circuit
D. Inlet Port from Hydraulic Pump
E. Load Sensing Gallery (CCLS Pump Installation only)
F. To Trailer Brakes
G. Return to Reservoir

▩ Pump Pressure Oil

■ Brake Sensing Line Pressure Oil

☐ Reduced Oil Flow

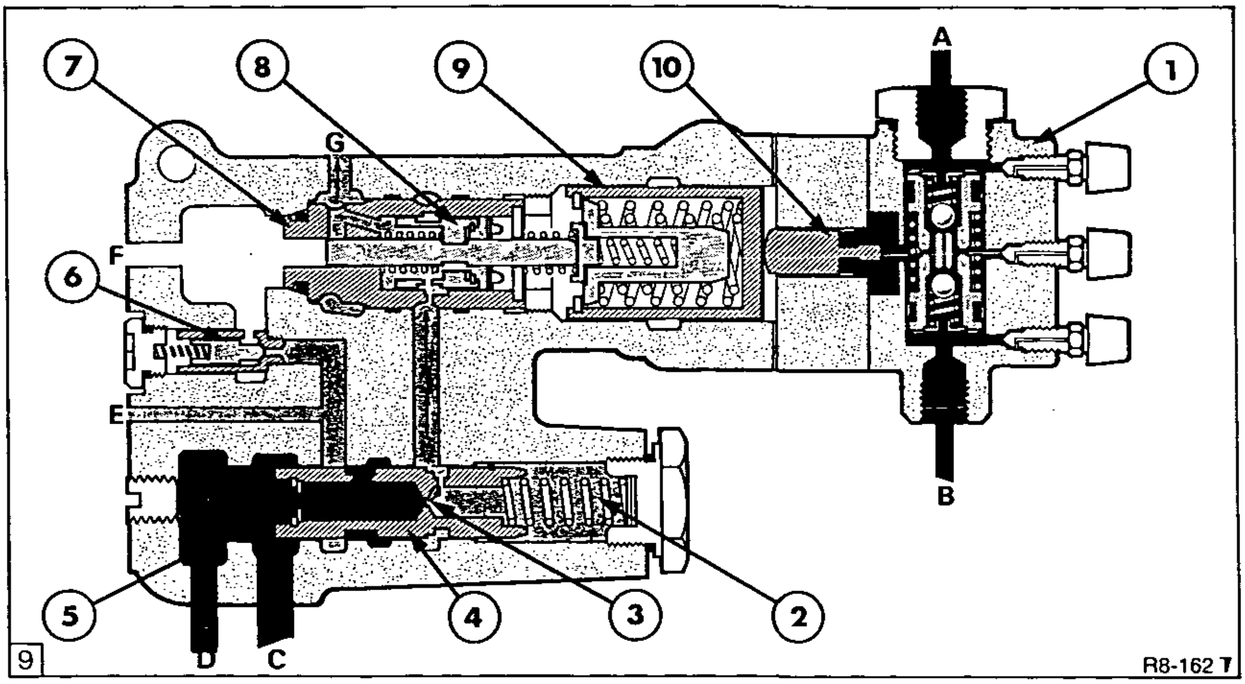
▨ Return to Reservoir (Sump) Oil

Brakes Being Applied

When both brake pedals are depressed simultaneously the pilot piston moves forward pushing against the pressure relief element, Figure 8. As the pressure relief element moves to the left the control spool and plunger similarly move to the left.

As the control spool is moved to the left the flow of oil to reservoir through Port 'G' is prevented in two stages. First the connection between the trailer brake line Port 'F' and return to reservoir Port 'G' is closed and secondly, oil passing through the centre of the flow regulating valve is prevented from returning to reservoir through Port 'G'. As oil from the hydraulic pump continues to pass through the flow regulating valve, the combination of rising oil pressure on the spring side of the valve and the spring pressure, moves the flow regulating valve to the left.

The flow regulating valve now begins to restrict the flow of oil to the tractor hydraulic system, but directs the pump supply oil to open the check valve and pass through Port 'F' to apply the trailer brakes. The orifice located in the end of the flow regulating valve limits the rate at which oil can flow through the centre of the flow regulating valve to the trailer brakes. The residual output from the pump is allowed to flow to the tractor hydraulic system.



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Trailer Brake Valve – Brakes Held

1. Pilot Head
2. Spring
3. Drilling
4. Flow Regulating Valve
5. Restrictor
6. Check Valve
7. Control Valve Spool Bore
8. Control Spool and Plunger
9. Pressure Relief Element
10. Pilot Piston

A. Pressure from Right Hand Brake Sensing Line
B. Pressure from Left Hand Brake Sensing Line
C. Outlet Port to Hydraulic Circuit
D. Inlet Port from Hydraulic Pump
E. Load Sensing Gallery (CCLS Pump Installation only)
F. To Trailer Brakes
G. Return to Reservoir

■ Pump Pressure Oil

□ Trapped Oil

■ Brake Sensing Line Pressure Oil

▨ Return to Reservoir (Sump) Oil

Brakes Held

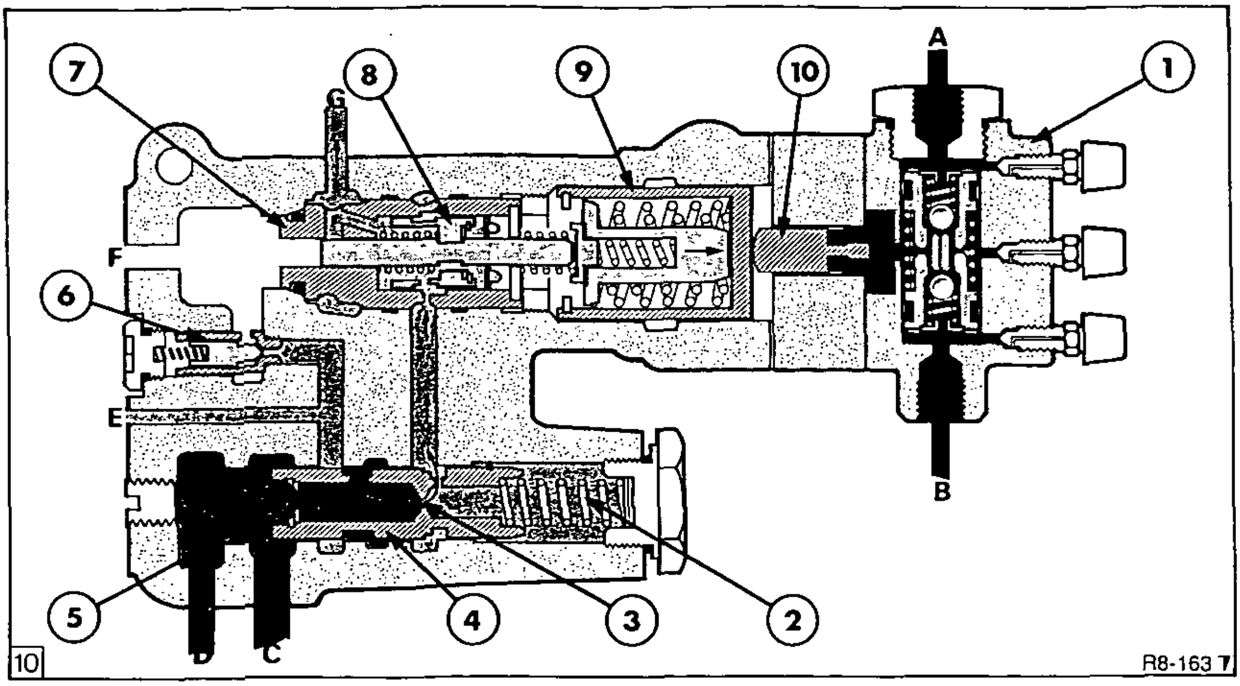
As the pressure in the trailer brake line builds up to match the pressure applied to the tractor braking system, the increase in pressure acts on the end of the control spool plunger in opposition to that pressure applied on the pilot piston from the tractor brake pressure line.

When the trailer brake line pressure has increase in accordance with the pressure applied by the brake pedals, the control spool plunger moves to the right, allowing the oil trapped on the spring side of the flow regulating valve to return to reservoir through port 'G'. Assuming a constant brake pedal pressure is being maintained this movement of the plunger is not sufficient to allow the trailer brake line to connect with the dump Port 'G'.

Because the oil on the spring side of the flow regulating valve is now open to reservoir, the valve moves to the right, preventing any further pump pressure oil from being directed over the check valve and into the trailer brake circuit, Figure 9. The oil in the trailer brakes is now trapped and maintains a constant braking pressure in accordance with the tractor brake pedal pressure.

Any increase in the pressure applied to the brake pedals will move the control spool and plunger to the left, causing the brake application cycle to be repeated until the pressure in the trailer brake circuit increases in accordance with the pressure being applied to the tractor brakes.

When the brake pedal pressure is decreased the control spool and plunger moves to the right allowing the trapped oil behind the flow regulating valve and the oil in the trailer brake circuit to return to reservoir through port 'G' as shown in Figure 7. The oil is allowed to escape to reservoir until the pressure in the trailer brake circuit once again matches the pressure applied to the brake pedals.



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Trailer Brake Valve – Brakes Applied With Maximum Brake Pedal Pressure

1. Pilot Head
2. Spring
3. Drilling
4. Flow Regulating Valve
5. Restrictor
6. Check Valve
7. Control Valve Spool Bore
8. Control Spool and Plunger
9. Pressure Relief Element
10. Pilot Piston

A. Pressure from Right Hand Brake Sensing Line
B. Pressure from Left Hand Brake Sensing Line
C. Outlet Port to Hydraulic Circuit
D. Inlet Port from Hydraulic Pump
E. Load Sensing Gallery (CCLS Pump Installation only)
F. To Trailer Brakes
G. Return to Reservoir

■ Pump Pressure Oil

□ Trapped Oil

■ Brake Sensing Line Pressure Oil

▨ Return to Reservoir (Sump) Oil

Brakes Applied with Maximum Brake Pedal Pressure

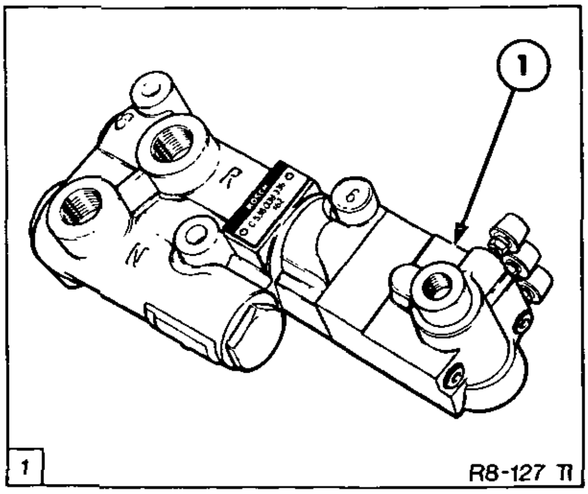
If at any time the maximum permissible trailer braking pressure of 1740–2180 lbf/in^2 (120–150 bar) is reached, for example by pressing excessively on the tractor brake pedals, an increase in braking pressure is prevented by the pressure relief element.

As pressure in the trailer braking circuit increases to the maximum permissible limit, the trailer brake circuit oil pressure forces the control spool and plunger against the springs in the pressure relief element. As the pressure relief element springs are compressed the control spool plunger moves to the right, allowing the oil trapped behind the flow regulating valve to return to reservoir through port 'G. The flow regulating valve can now move to the right and prevent any further pump system pressure oil from being directed over the check valve to the trailer brake circuit.

The pressure relief element is pre–set in manufacture by shims and must not be adjusted in service.

B. TRAILER BRAKE VALVE–OVERHAUL

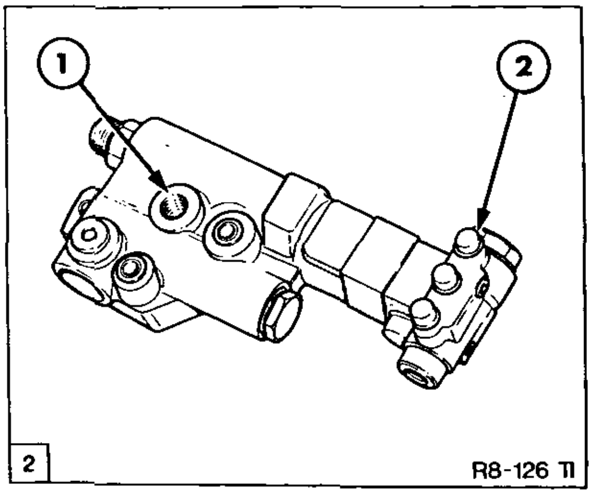
GENERAL



Trailer Brake Valve Assembly
(Fixed Displacement Gear Type Pump)

1. Pilot Head

The trailer brake valve housing and orientation of the pilot head changes according to the type of hydraulic pump fitted to the tractor. Figure 1 shows the trailer brake valve for the fixed displacement tandem gear type pump installations.



Trailer Brake Valve Assembly
(Variable Displacement CCLS Hydraulic Pump)

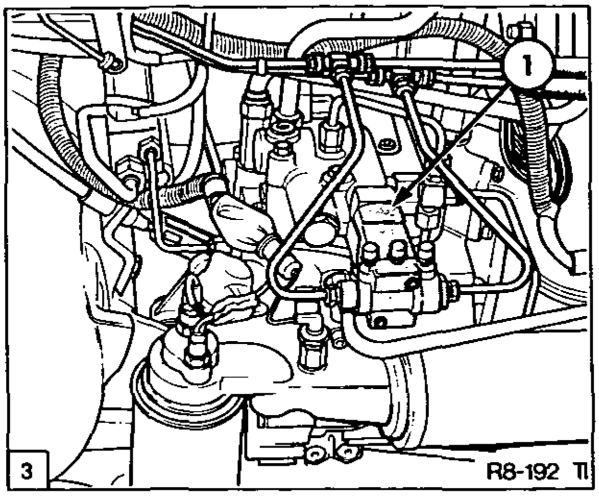
1. Load Sensing Gallery
2. Pilot Head

Figure 2 shows the trailer brake valve for tractors fitted with the variable displacement closed centre load sensing (CCLS) hydraulic pump. This valve is manufactured with a special load sensing gallery and must only be used where these pumps are fitted.

The overhaul procedure for both types of valve is however identical.

REMOVAL

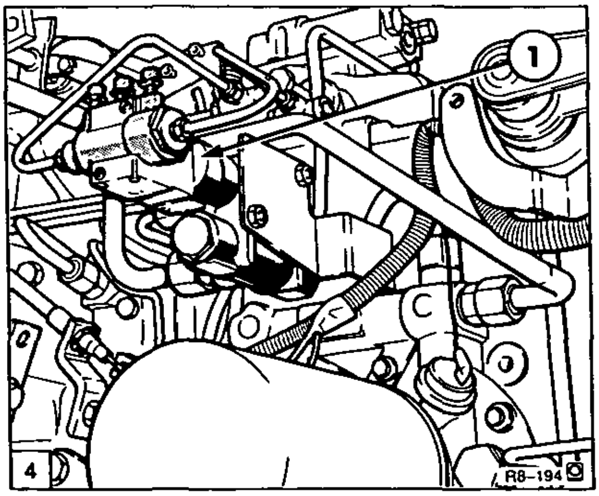
1. Clean area around trailer brake valve.



Trailer Brake Valve Installation With Variable Displacement CCLS Hydraulic Pump

1. Trailer Brake Valve

2. Disconnect hydraulic connections to valve and allow escaping oil to drain into suitable container. Refer to Figure 3 and Figure 4 for the two types of installation.

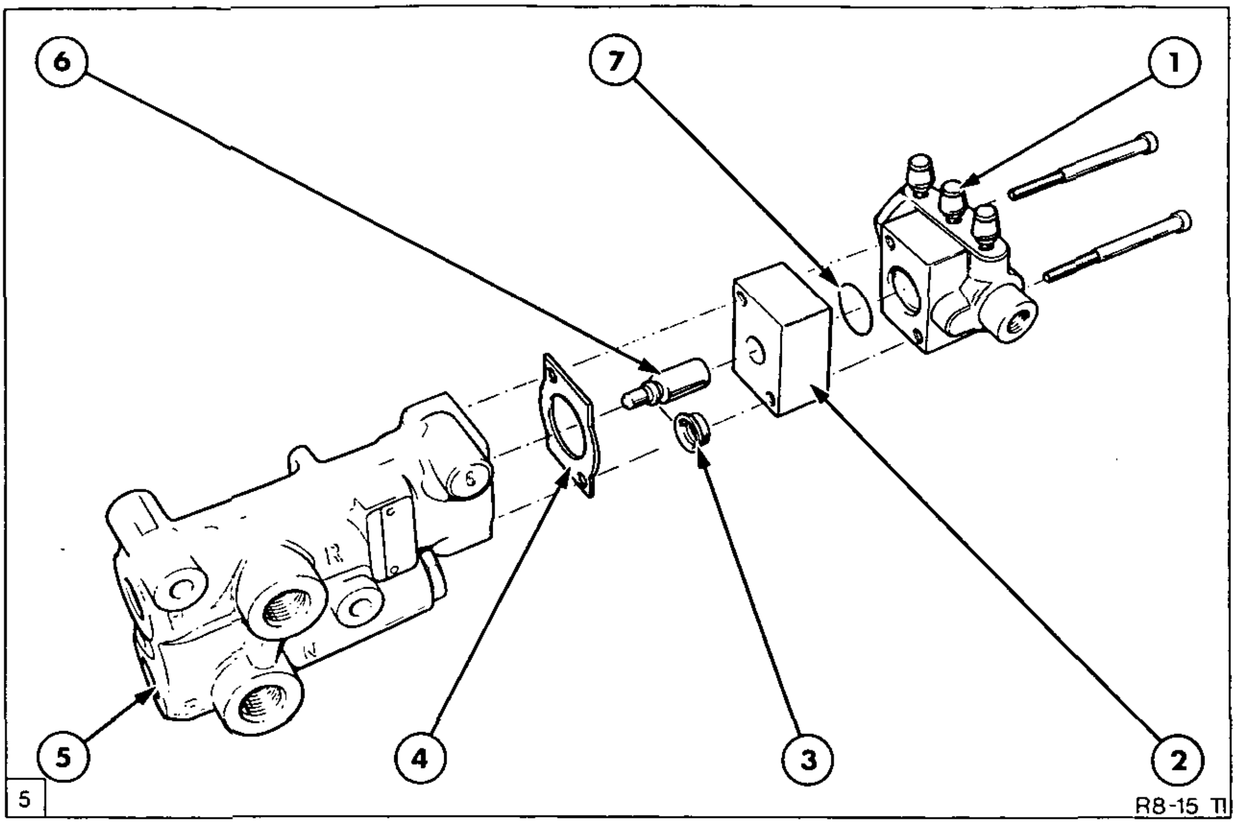


Trailer Brake Valve Installation With Tandem Gear Type Hydraulic Pump

1. *Trailer Brake Valve*

3. Remove trailer brake valve.

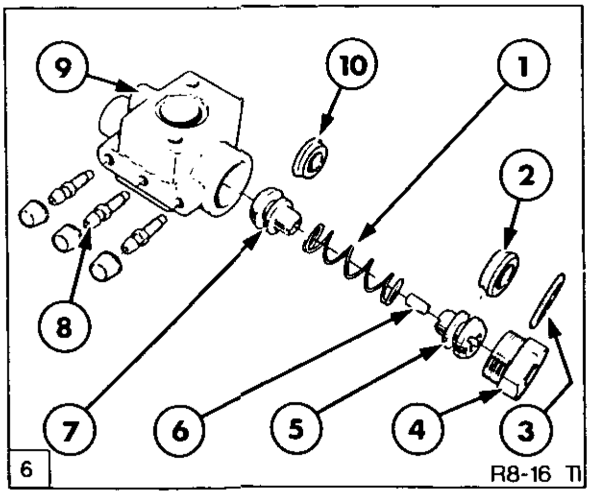
DISASSEMBLY



Pilot Head and Piston Assembly

1. Pilot Head
2. Piston Housing
3. Seal
4. Gasket
5. Trailer Brake Valve Housing
6. Piston
7. '0' Ring

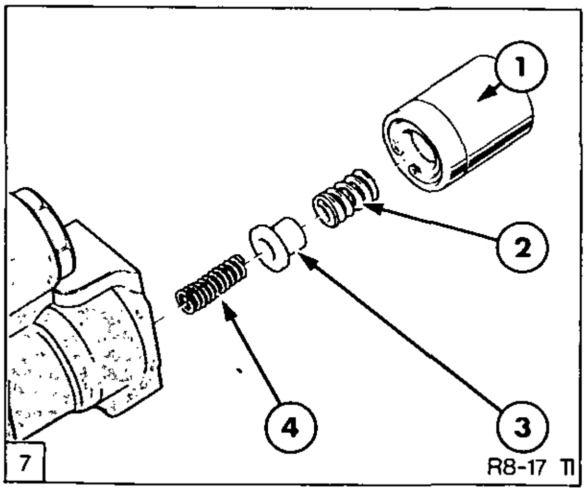
1. Remove pilot head and withdraw piston assembly, Figure 5.



Pilot Head

1. Spring
2. Piston Seal
3. '0' Ring
4. Adaptor
5. Piston Assembly
6. Plunger
7. Piston Assembly
8. Bleed Screws
9. Pilot Head
10. Piston Seal

2. Remove adaptor on end of pilot head and remove components, Figure 6.

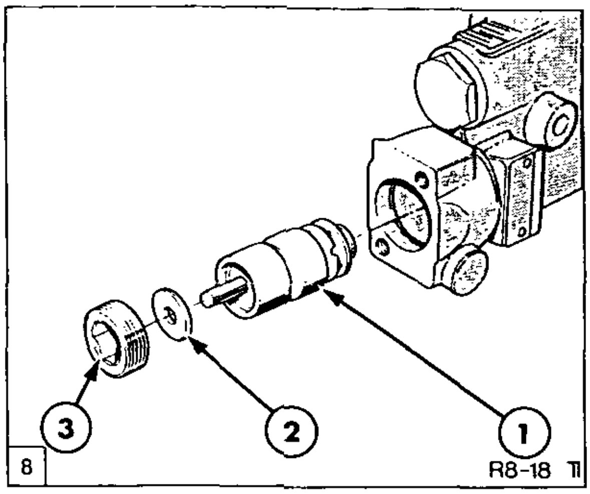


Pressure Relief Element

1. Pressure Relief Element
2. Spring
3. Seat
4. Return Spring

3. Remove pressure relief element and control valve spool return spring from valve housing. Refer to Figure 7.

NOTE: *The spring and seat locate within the relief element. It is not necessary to disassemble the pressure relief element as this is serviced as a pre–set assembly.*



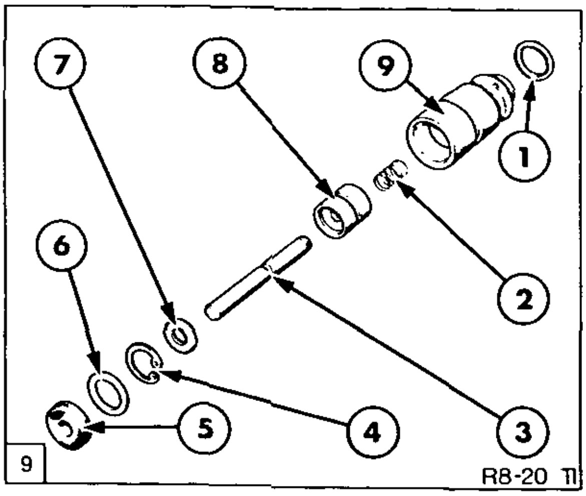
Control Valve Spool Assembly

1. Control Valve Spool
2. Back Up Washer
3. Collar

4. Remove collar retaining the control valve spool assembly. Figure 8.

NOTE: *The retaining collar may be removed by placing a 14mm nut inside the locking ring. The nut should be of sufficient length to enable a socket spanner to be placed over the nut to allow the collar to be unscrewed.*

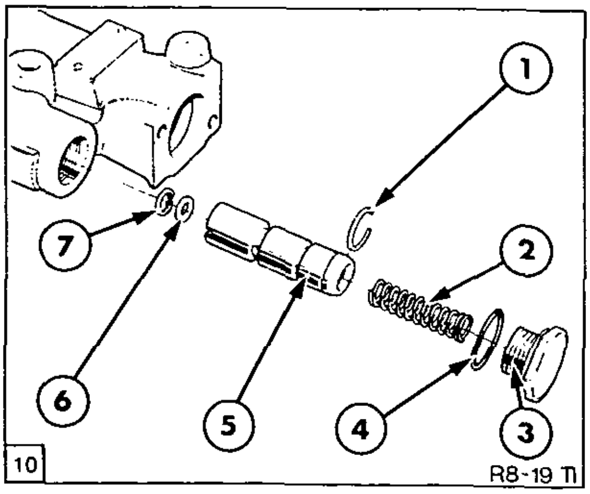
5. Using a suitable rod push control valve from housing.



Control Valve Spool Exploded View

1. 'O' Ring
2. Spring
3. Plunger
4. Snap Ring
5. Seal
6. Washer
7. Locating Ring
8. Spool
9. Control Spool Bore

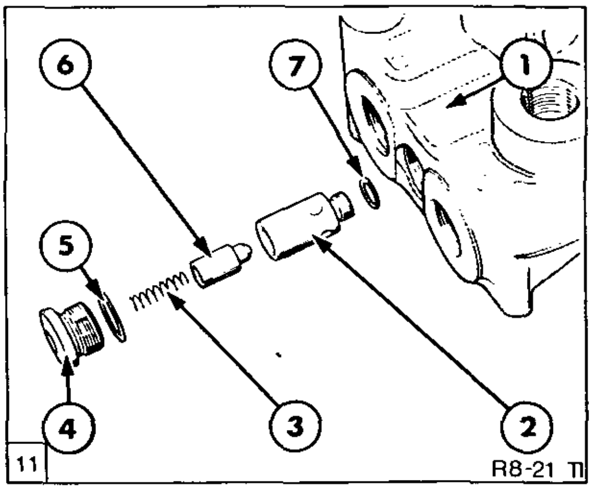
6. Pull control valve spool assembly from spool bore. Remove snap ring and disassemble spool and plunger assembly, Figure 9.



Flow Regulating Valve

1. Clip
2. Spring
3. End Cap
4. 'O' Ring
5. Spool
6. Orifice
7. Snap Ring

7. Unscrew end cap and withdraw spring and flow regulating valve spool. Remove snap ring and orifice from end of spool, Figure 10.



Check Valve Components

1. Trailer Brake Valve Housing
2. Check Valve Seat
3. Spring
4. End Cap
5. 'O' Ring Seal
6. Check Valve
7. 'O' Ring Seal

8. Remove check valve end cap and withdraw spring and check valve, Figure 11. If necessary unscrew and remove check valve seat.

INSPECTION AND REPAIR

1. Carefully examine all components and replace any item showing signs of wear or damage.

NOTE: *Two 'O' ring seals are located inside the trailer brake valve body in the control valve bore. These seals must be carefully checked and if necessary replaced.*

RE–ASSEMBLY AND INSTALLATION

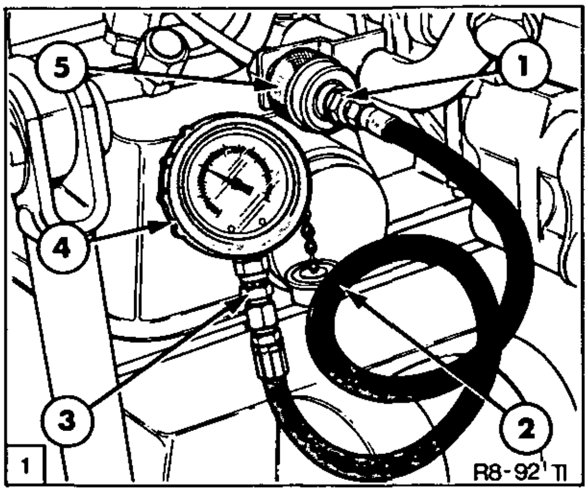
1. Re–assembly and installation follows the removal and disassembly procedure in reverse. On re–assembly observe the following requirements.

- Ensure all oil seals and gaskets are renewed.
- Tighten all bolts and fittings to the correct torque. See Specifications Section C.

2. Bleed the trailer braking system according to the following procedure:

- Ensure the brake reservoir is full.
- Open the three bleed screws on the trailer brake valve and also the right and left hand brake bleed screws on the rear axle trumpet housings.
- Couple the brake pedals together and depress the pedals 6 times to their full stroke.
- Close all bleed screws.
- Attach transparent bleed pipes to left hand rear axle bleed screw and insert the open end of the pipe into a clean glass of brake fluid to Ford Specification ESN M6C59–A.
- Open the bleed screw and slowly depress and release the coupled brake pedals until no more air is expelled with the brake fluid.
- Repeat the above procedure with the right hand brake bleed screw.
- Repeat the above procedure with the left hand, centre and right hand trailer brake valve bleed screws.
- Top up the brake reservoir to the maximum fill mark with brake fluid to Ford Specification ESN M6C59–A.

C. PRESSURE TESTING



Trailer Brake Pressure Test

1. Adaptor 4FT.854
2. Test Hose E1NN F493 AA Finis Code3936707
3. Adaptor FT. 8503–8 or FNH 00705
4. Pressure Gauge FT.8503A
5. Trailer Brake Coupler

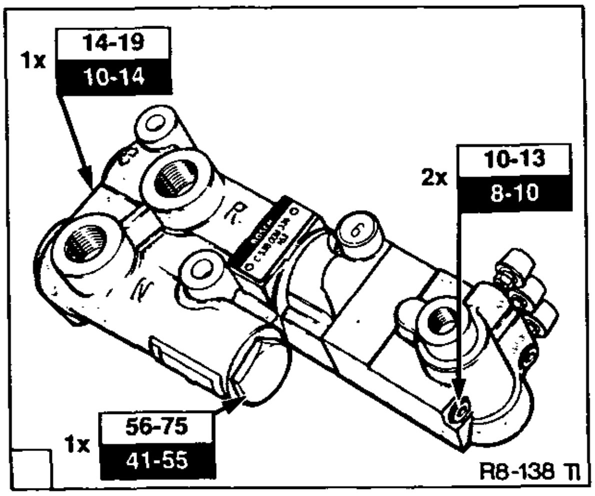
1. Connect 0–6000 lbf/in^2 (0–414 bar) pressure gauge FT.8503A to trailer brake coupling, Figure 1.
2. Set engine speed to 1500 rev/min.
3. Depress right hand brake pedal. There should be no reading on the pressure gauge.
4. Depress left hand brake pedal. There should be no reading on the pressure gauge.
5. Couple together and depress both brake pedals. The reading on the pressure gauge should increase as the brake pedals are depressed harder. The pressure should increase depending on pedal effort, until a maximum pressure of 2140 lbf/in^2 (120–150 bar) is achieved.
6. Release brake pedals. Pressure should reduce to zero.

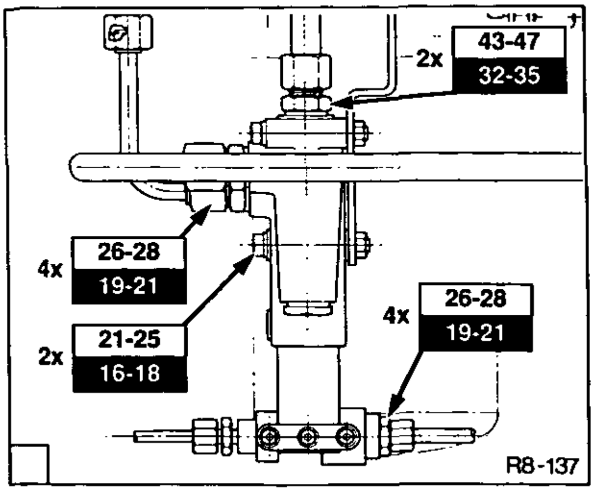
D. SPECIFICATIONS AND SPECIAL TOOLS

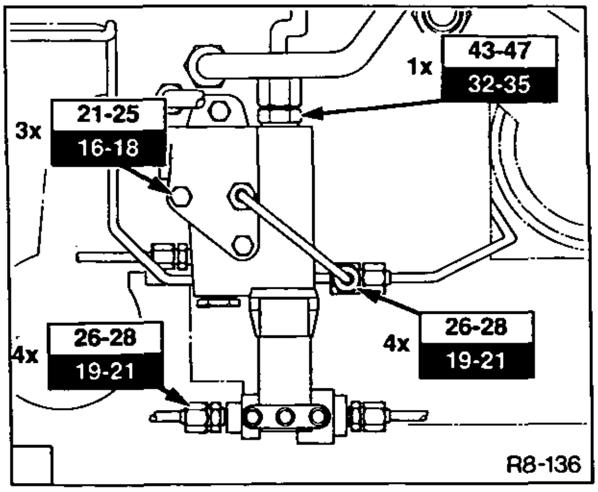
Maximum Trailer Brake Pressure	1740–2176 lbf/in^2 (120–150 bar)
Brake Reservoir Oil	Ford Specification ESN M6C59–A.

TORQUES

☐ = Nm
■ = lbf ft







SPECIAL TOOLS

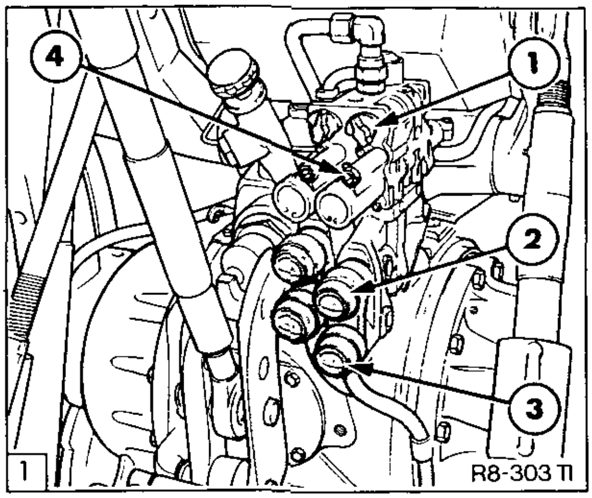
DESCRIPTION	TOOL NUMBER	
	V.L. Churchill	FNH Part No
Adaptor Trailer Brake Coupling to Test Hose	4FT.854	
Test Hose–Pressure Testing	E1NN F493 AA (finis code 3936707)	
Pressure Gauge 0–6000 lbf/in^2 (0–414 bar)	FT.8503A	FNH 02028
Adaptor–Pressure Gauge to Test Hose	FT.8503–8	FNH 0705

PART 8

HYDRAULIC SYSTEMS

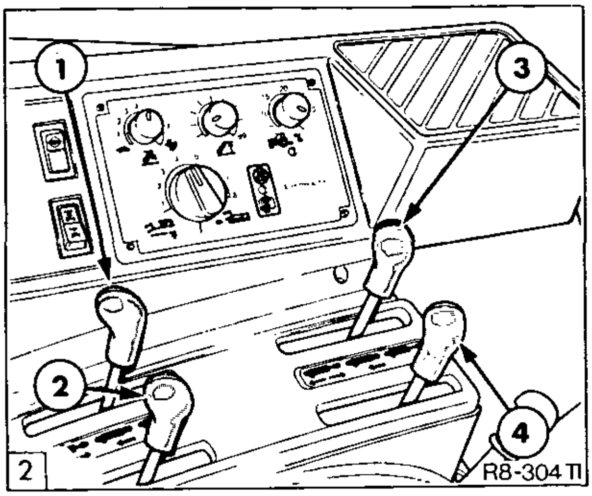
Chapter 7
REMOTE CONTROL VALVES

A. REMOTE CONTROL VALVES–DESCRIPTION AND OPERATION



Remote Control Valve Installation

1. Flow Control Knob
2. Lift Coupler
3. Lower Coupler
4. Detent Screw



Remote Control Valve Levers
(SLE Model Shown)

1. Lever For Right Hand Side Outer Valve (I–Green)
2. Lever For right Hand Side Inner Valve (II–Blue)
3. Lever For Left Hand Side Inner Valve (III–Tan)
4. Lever For Left Hand Side Outer Valve (IIII–Black)

DESCRIPTION

Ford Series 40 Tractors may be fitted with the optional closed centre load sensing remote control valves for the operation of external hydraulic services.

Remote valves are available to operate external hydraulic services, eg hydraulic cylinders and motors. Up to four remote control valves may be installed and are located at the rear of the tractor, Figure 1. The valves are mounted directly onto quick release couplers which are designed to give unrestricted flow and low back pressure.

The valves are operated by levers located by the side of the drivers seat. Refer to Figure 2.

Each remote control valve has four operating positions, as follows:–

Pull a lever back from the neutral position to extend the cylinder to which it is connected. Push the lever forward, past neutral, to retract the cylinder. Pushing the lever fully forward, beyond the 'retract' position, will select 'float' which will permit the cylinder to extend or retract freely, thereby allowing equipment such as scraper blades to float and follow the ground contour.

A detent will hold the lever in the selected extend or retract position until the remote cylinder reaches the end of the stroke when the control lever will automatically return to neutral. Alternatively, the lever may be returned to neutral manually. The lever will not return automatically from the float position or when the detent screw has been fully screwed in. Adjustment of the detent screw varies the system pressure required to return the lever automatically to the neutral position.

Each remote control valve has its own flow control knob and a pair of couplers. External equipment is simply plugged into the remote control valve couplers which are of a self sealing/locking design but will allow remote cylinder hoses to pull free if the implement should become disconnected from the tractor.

To connect auxiliary equipment to a remote control valve, ensure the connectors are clean and insert the feed and/or return hose through the appropriate coupler dust cap, ensuring the connector on the hose is fully seated into the coupler.

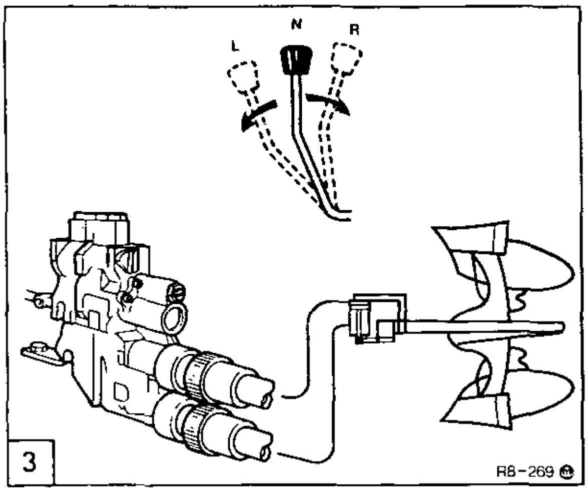
To disconnect the hoses, move the control lever to float, grip the hose a short distance from the coupler, push the hose forward, into the coupler, then quickly pull the hose to 'pop' the coupler free.

OPERATING EXTERNAL CYLINDERS AND MOTORS

The prevent damage to equipment the correct method of operation is essential.

The flow control knob (valve), fitted to each remote control valve, meters the flow of oil to the remote cylinder thus controlling the rate of response of the cylinder or motor. Turning the flow control knob anti–clockwise (hare symbol uppermost) increases the rate of flow and turning the knob clockwise (tortoise symbol uppermost) decreases the rate of flow. The use of the flow control valves, allows a choice of flow when two or more valves are used for simultaneous operations.

Double Acting Cylinder Operation



3

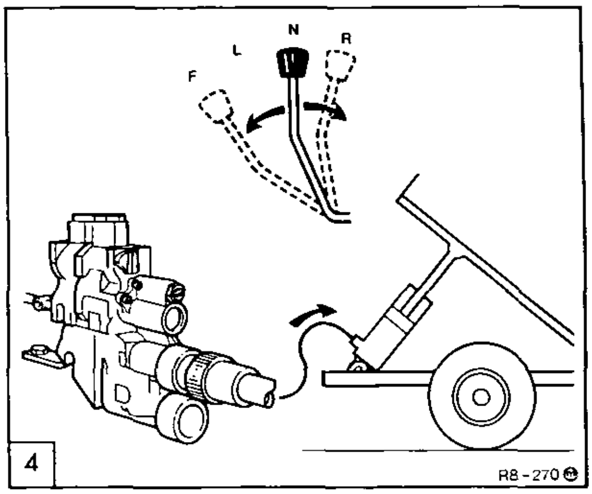
Double Acting Cylinder Operation

Connect the two hoses to the raise and lower couplers, eg. piston end of cylinder to raise coupler and rod end to lower coupler, Figure 3.

To retract cylinder move remote lever to 'lower' (L) position.

To extend cylinder move remote lever to 'raise' (R) position.

Single Acting Cylinder Operation



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Single Acting Cylinder Cylinder Operation

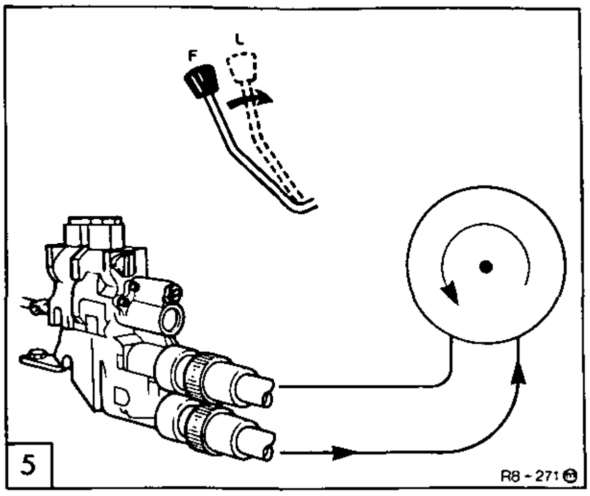
For normal single acting operation, connect hose to the raise coupler, Figure 4.

To raise (extend) cylinder move remote lever to 'raise' (R) position.

To lower (retract) cylinder move remote lever fully forward to 'float' position.

To hold cylinder move remote lever to 'neutral' position.

Hydraulic Motor Operation

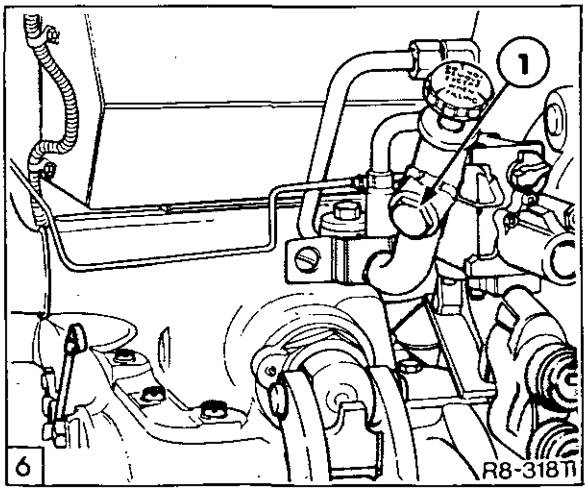


Operating a Hydraulic Motor

The hydraulic motor feed hose must be connected to the lower coupler and the return hose into the raise coupler, Figure 5.

To run the motor, push the remote valve lever to the lower (L) position. To stop the motor, push the remote valve lever fully forward to the 'float' (F) position.

NOTE: *Neutral (N) position should not be used to stop the motor as the flow of oil will be stopped instantly causing damage to the motor, unless it is fitted with a cross line circuit relief valve.*



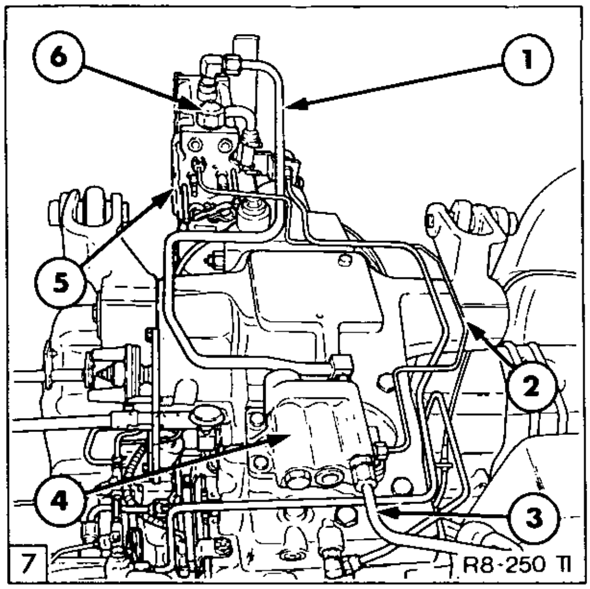
Filler Tube Return Plug

1. Return Plug (3/4 in BSPP Thread)

Alternatively, the return hose can be connected to sump through the plug in the rear axle filler tube, Figure 6.

HYDRAULIC CONNECTIONS AND COMPONENTS

Connections from the hydraulic pump to the remote valves differ according to the type of hydraulic pump installed on the tractor.



Remote Control Valve Installation
(Tractors with Fixed Displacement Pump)

1. Supply to Remote Valve
2. Load Sensing (Pilot) Line
3. Supply from Auxiliary Engine Mounted Pump
4. Priority Valve Pack (contains combining valve)
5. Remote Valve Housing
6. Return from Remote Valve

Tractors with Fixed Displacement Hydraulic Pumps

Figure 7 shows the installation of a double remote valve housing on a tractor fitted with fixed displacement hydraulic gear type pumps. A maximum of four remote valves, however, can be fitted if required.

When a tractor is fitted with fixed displacement hydraulic pumps the priority valve pack containing the combining valve is also installed.

The hydraulic lift has priority on oil supply from the fixed displacement hydraulic pump, with surplus capacity directed through the combining valve, in the priority valve pack to the remotes.

Although the oil supply from the auxiliary engine mounted pump to the priority valve pack is via external pipework, the supply from the main hydraulic pump to the priority valve pack and combining valve is through internal galleries within the hydraulic top cover.

The combining valve operates in conjunction with the remote valves and performs the following functions:–

Returns main hydraulic and engine mounted pump flow to sump (rear axle) when remotes are in neutral.

Directs the main hydraulic and engine mounted auxiliary pump flow, where fitted, to the deluxe remotes when operated.

Returns surplus pump flow to sump if pump supply exceeds demand.

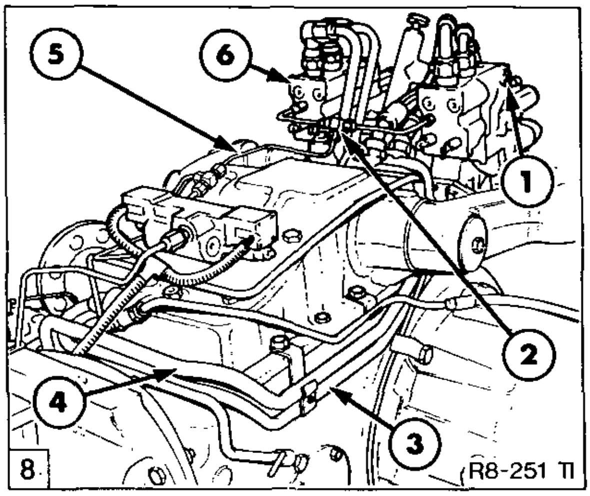
Protects engine mounted auxiliary pump and remotes from excessive pressure.

Refer to Chapter 4 for description and operation of the priority valve pack.

Tractors with Variable Displacement CCLS Hydraulic Pump

Figure 8 shows the installation of two double remote valve housings on tractors installed with the variable displacement closed centre load sensing hydraulic pump.

Tractors fitted with the variable displacement closed centre load sensing (CCLS) hydraulic pump do not require the priority valve pack and combining valve, necessary for fixed displacement hydraulic pumps installations.



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Remote Control Valve Installation
(Tractors With Variable Displacement
CCLS Hydraulic Pump)

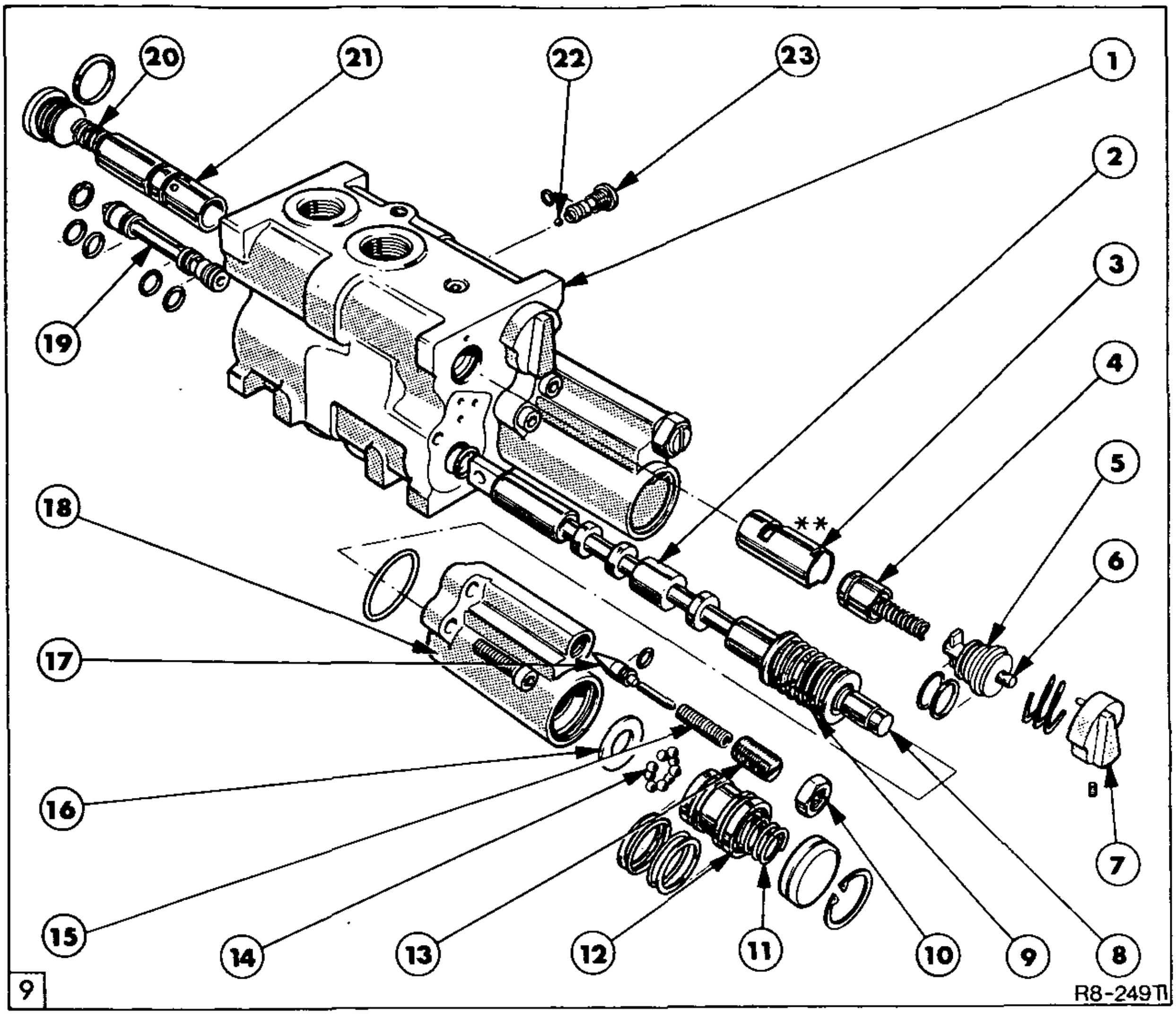
1. Double Spool Remote Valve Housing
2. Load Sense Line Priority Check Valve
3. Return From Remote Valve To Hydraulic Pump
4. Feed To Remote Valve From Hydraulic Pump
5. Load Sense Line
6. Double Spool Remote Valve Housing

On tractors fitted with the variable displacement CCLS hydraulic pump, oil required by the remote valves, flows directly from and returns to the hydraulic pump housing. This is possible because output from the pump, irrespective of the hydraulic circuit being operated, is continually adjusted according to the hydraulic demand of the tractor.

Refer to Part 8, Chapter 2 for the total description and operation of the variable displacement CCLS hydraulic pump assembly.

All Tractors

Irrespective of the type of hydraulic pump installed and to ensure that pump flow is controlled by the remote valve with the highest operating circuit pressure, priority check valves are installed in the load sensing lines between each individual remote valve.



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Double Spool Remote Control Valve

1. Valve Body
2. Spool
3. Flow Restrictor*
4. Load Check Valve
5. Flow Restrictor End Plug
6. Flow Restrictor Control Shaft
7. Flow Restrictor Control Knob
8. Detent Plunger
9. Spool Centering Spring
10. Locknut
11. Detent Piston Spring
12. Detent Piston
13. Detent Valve Spring Adjuster
14. Detent Balls (9 off)
15. Detent Regulating Valve Spring
16. Spacer
17. Detent Regulating Valve
18. Detent Housing
19. Shuttle Check Valve
20. Flow Control Spring
21. Flow Control Spool
22. Priority Check Valve Ball (double spool only)
23. Priority Check Valve Retainer

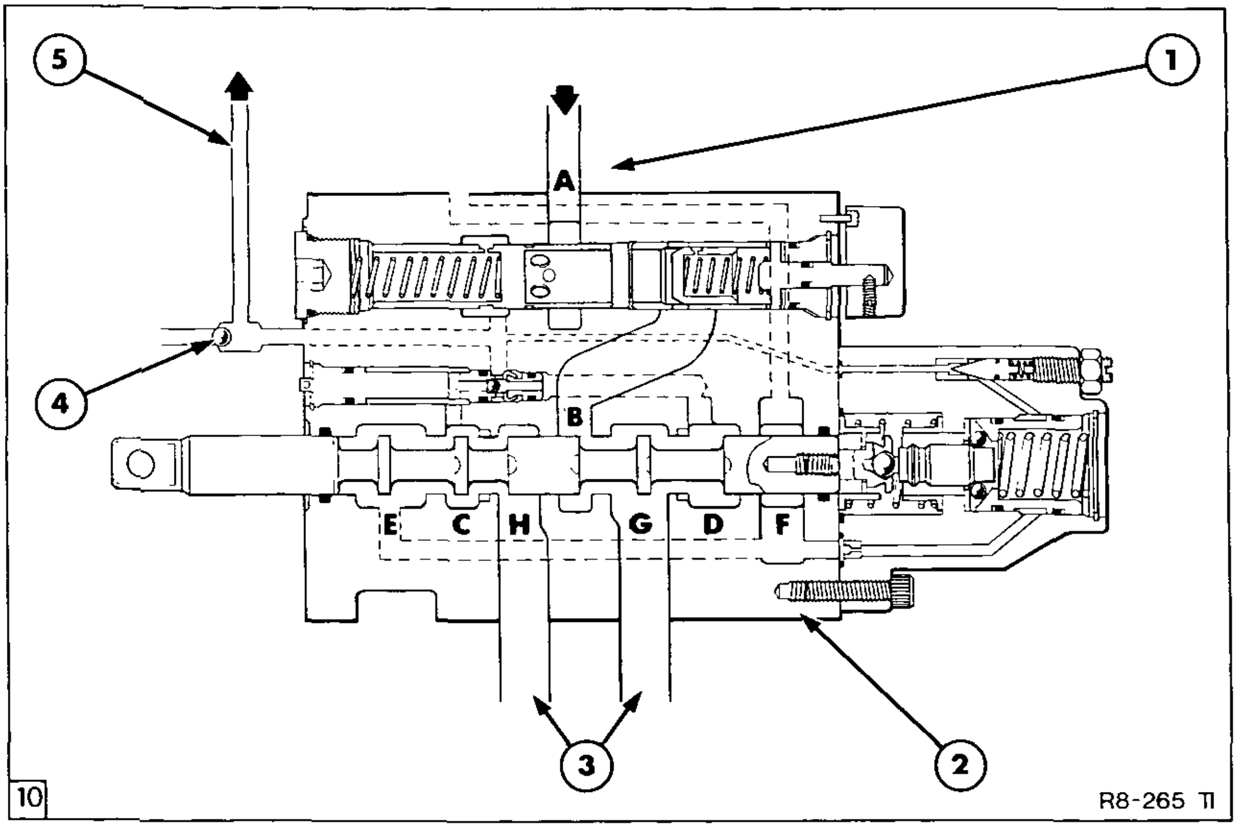
** The flow restrictor **must** be installed with the large slot positioned 180º to that shown in illustration.

Where two individual valve housings are fitted, for example if three or more remote valves are installed, a check valve is fitted at the 'Tee' joint between the load sense line for each valve. Refer to item 2, Figure 8, for the typical location of the check valve.

Where a double spool remote valve housing is fitted a check valve is also fitted between the two valves within the housing and is located as shown in Figure 9, items 22/23.

The principal components of the double spool remote control valve assembly are shown in Figure 9 and will assist in identifying the parts detailed in the oil flow diagrams used to explain the operation of the valve.

Where a single spool remote valve is installed on a tractor, The individual component parts are identical to those shown in Figure 9 for double spool assemblies.



10

Hydraulic Oil Supply to Remote Valves for Tractors Installed with Variable Displacement CCLS Hydraulic Pump

1. Supply to Remote Valve Direct from Variable Displacement CCLS Hydraulic Pump
2. Remote Control Valve Assembly
3. Lift and Drop Ports to Auxiliary Equipment
4. Load Sense Line Check Valve
5. Load Sense Line to Hydraulic Pump

The hydraulic circuits shown in Figure 11 to Figure 16, illustrate operation of the remote valves. These circuits also show operation of the combining valve used on tractors with the fixed displacement hydraulic pump.

When studying operation of the remote valves on tractors installed with the variable displacement CCLS hydraulic pump the same principle of operation applies but all reference to the combining valve should be disregarded.

On tractors with the variable displacement CCLS hydraulic pump, the oil supply to the remote valve at port 'A' comes directly from the hydraulic pump and the load sensing line connects directly to the flow compensating valve on the pump body as shown in Figure 10.

Oil Flow In Neutral

With reference to Figure 11, Page 7.

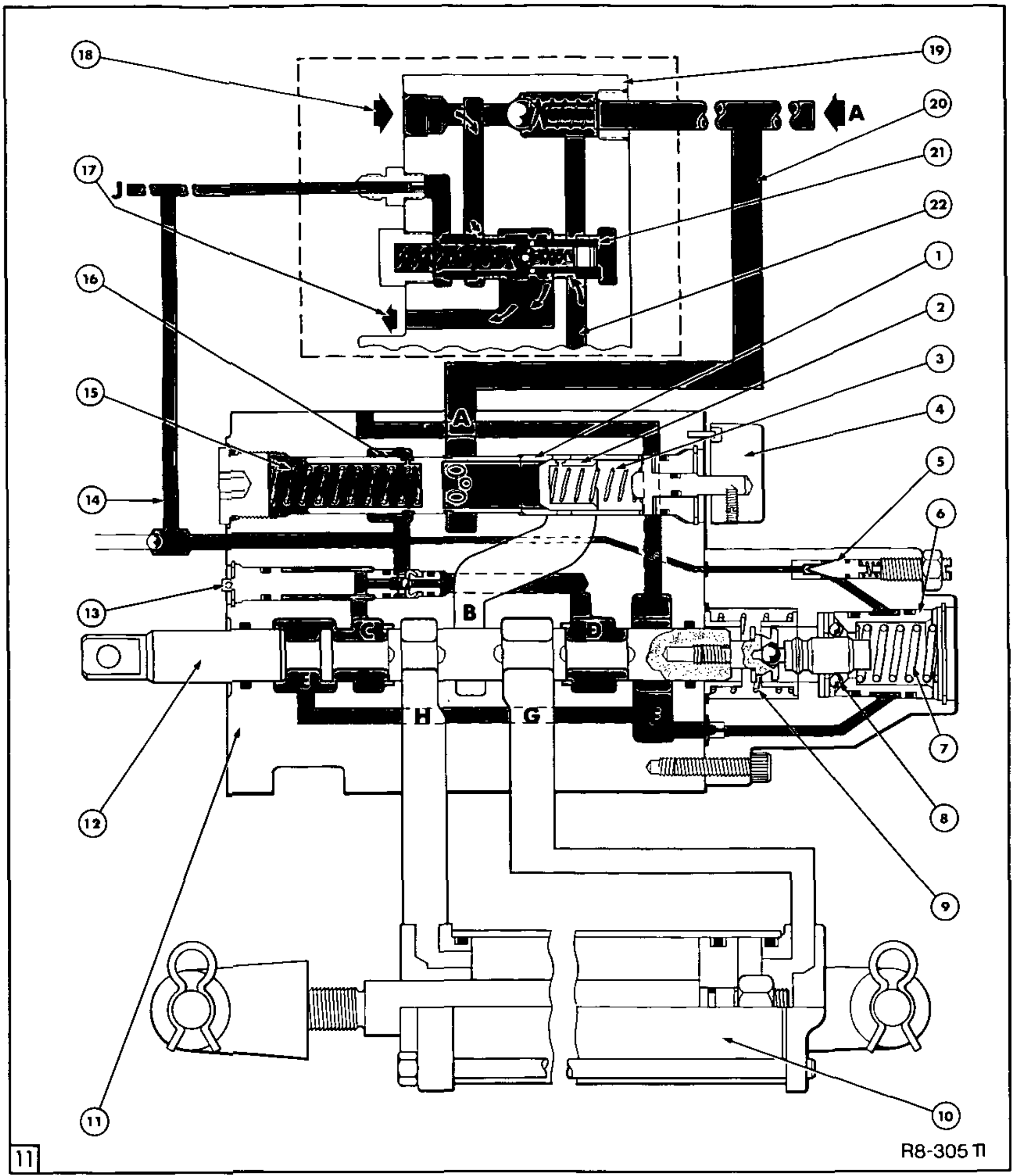
When the remote valves are in neutral the control valve spool is held in the neutral position by the centering spring and passage 'B' is blocked by the centre land of the spool.

The control valve spool also isolates lift port 'G' and drop port 'H' from supply passage 'B' and return oil galleries 'E' and 'F'. The oil in both ends of the lift cylinder is, therefore, trapped.

When the valve is in neutral galleries 'C' and 'D' connect with the return oil galleries 'E' and 'F' allowing pressure in the load sensing lines from the valve to return to sump.

On tractors with fixed displacement hydraulic pumps the combining valve moves to the left, against the spring, diverting oil flow from the pumps back to reservoir through the priority valve assembly.

On tractors with the variable displacement CCLS hydraulic pump the flow compensating valve responds to the zero pressure in the load sensing line and controls the swash plate angle to maintain the pre–set low pressure standby.



Single Remote Control Valve Operation–Neutral

■	Pump Pressure Oil	■	Exhaust Oil	☐	Trapped Oil

1. Flow Control Restrictor	12. Control valve Spool
2. Load Check Valve	13. Shuttle Check Valve
3. Check Valve Spring	14. Load Sense Line (Pilot Line)
4. Flow Control Knob	15. Flow Control Spring
5. Detent Regulating Valve	16. Flow Control Spool
6. Detent Spool	17. Return to Sump*
7. Detent Plunger and Spring	18. Auxiliary Pump Supply*
8. Detent Balls	19. Hydraulic Priority Valve Assembly*
9. Centering Spring	20. Supply to Remote Valve
10. External Cylinder	21. Combining (Sequencing) Valve*
11. Valve Body	22. Main Pump Supply via Combining Valve*

*Tractors with Fixed Displacement Hydraulic Pump Only

For Tractors Fitted with Variable Displacement CCLS Hydraulic Pump

A = CCLS Pump Supply.

J = CCLS Pump Load Sensing Line

Oil Flow In Raising

With reference to Figure 12.

When the remote valve lever is moved to the raise position, the control valve spool is moved forward and the spring loaded detent balls engage with the rear groove in the detent plunger.

Passage 'B' is now connected to lift port gallery 'G' and 'D' while drop port 'H' and gallery 'C' are connected to the return to sump oil gallery E.

When the remote control valve lever is initially moved to the raise position the pressure at gallery 'D' is equivalent to the cylinder pressure or tractor hydraulic back pressure whichever is the greatest.

The pressure oil at gallery 'D' now flows to the shuttle check valve and through the internal drilling to:

Detent Regulating Valve

Flow Control Valve Spool

Load Sensing (Pilot) Line

On tractors with fixed displacement hydraulic pumps the load sensing line pressure from gallery 'D' acts on the end of the combining valve moving the valve to the right. The return to sump port in the priority valve is now closed and the main hydraulic and auxiliary pump pressure oil is directed to the remote control valve inlet port 'A'.

On tractors with the variable displacement CCLS hydraulic pump the load sensing line signals the pump to increase flow which is directed to inlet port 'A' at the pressure required to move the load connected to port G.

Pump pressure oil flows from Port 'A' to passage 'B' through:–

(i) Flow Control Spool Holes

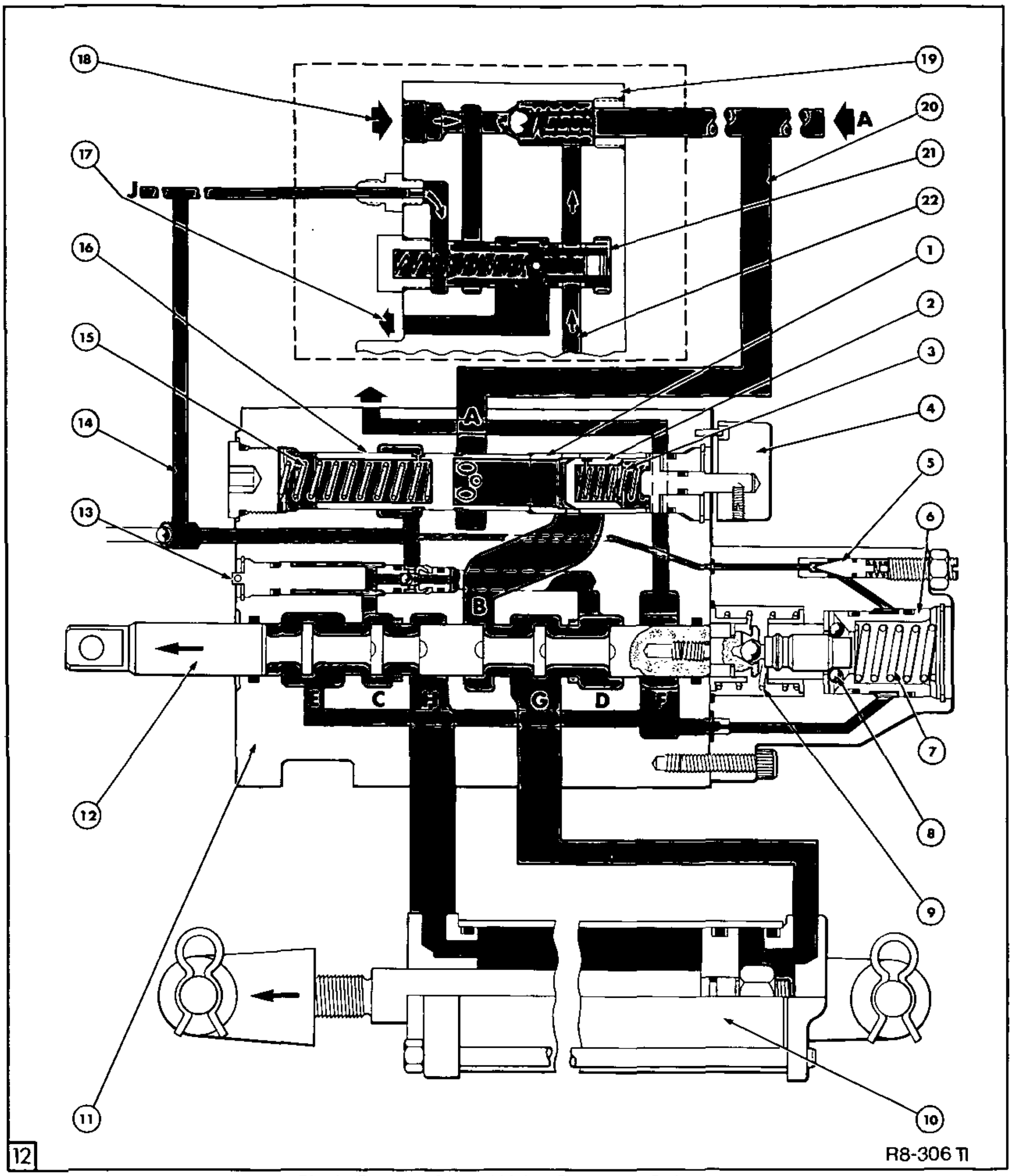
(ii) Load Check Valve

(iii) Flow Control Restrictor

The volume of oil entering passage 'B' and flowing to the lift Port 'G' is determined by the flow control restrictor setting which is manually pre–set.

Exhaust oil from the lift cylinder drop port 'H' now returns to reservoir through oil gallery 'E'.

When the cylinder is fully extended, the pump supply oil pressure increases until the detent regulating valve opens. Pump pressure oil moves the detent spool against the detent spring and releases the clamping effort of the detent balls on the end of the control valve spool. The centering spring now moves the spool back to the neutral position.



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Single Remote Control Valve Operation–Raising

▨ Pump Pressure Oil

■ Exhaust Oil

1. Flow Control Restrictor
2. Load Check Valve
3. Check Valve Spring
4. Flow Control Knob
5. Detent Regulating Valve
6. Detent Spool
7. Detent Plunger and Spring
8. Detent Balls
9. Centering Spring
10. External Cylinder
11. Valve Body
12. Control Valve Spool
13. Shuttle Check Valve
14. Load Sense Line (Pilot Line)
15. Flow Control Spring
16. Flow Control Spool
17. Return to Sump*
18. Auxiliary Pump Supply*
19. Hydraulic Priority Valve Assembly*
20. Supply to Remote Valve
21. Combining (Sequencing) Valve*
22. Main Pump Supply via Combining Valve*

*Tractors with Fixed Displacement Hydraulic Pump Only

For Tractors Fitted with Variable Displacement CCLS Hydraulic Pump

A = CCLS Pump Supply

J = CCLS Pump Load Sensing Line

Oil Flow In Lowering

With reference to Figure 13.

When the remote valve lever is moved to the lowering position the spool moves rearwards allowing the spring loaded detent balls to engage with the front groove in the detent plunger.

In the lowering position, passage 'B' is connected to drop port 'H' and gallery 'C'. Lift port 'G' is connected to gallery 'D' and return oil gallery 'F'. The connections to and from the cylinder are now reversed allowing pump flow to retract the cylinder in a similar manner to that described for raising.

The shuttle check valve allows pressure from gallery 'C' to be sensed by the load sensing line and also operate the detent regulating valve and flow control spool as previously described.

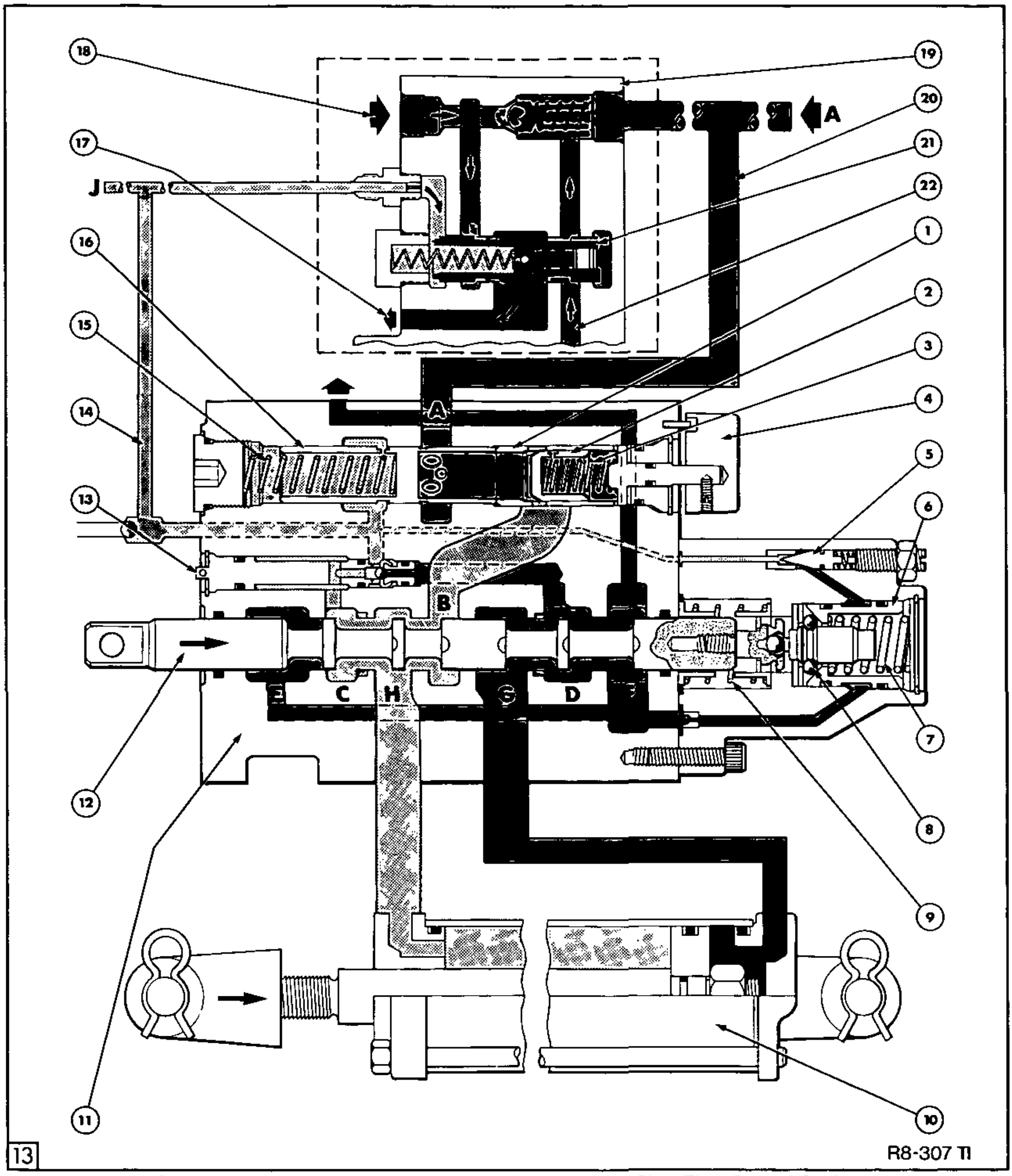
As the flow control restrictor is rotated towards slow flow, the flow control restrictor slot area which aligns with passage 'B' is reduced, restricting oil flow to passage 'B'. The degree of restriction will cause supply line pressure to increase compared to load sense line pressure.

On tractors with the fixed displacement hydraulic pump the high supply line pressure from the pump acts on the right hand end of the combining valve. The valve now moves against the combined spring and load sensing line pressure, diverting surplus pump flow to sump.

The greater the restriction set by the flow control knob, the greater the difference between the supply line and load sense line pressures and on fixed displacement pump tractors the larger the volume of oil returned to sump.

On tractors with the variable displacement CCLS hydraulic pump, the low load sense line pressure acting on the pump flow compensating valve signals the CCLS pump to adjust pump output in accordance with the tractor hydraulic circuit demands.

It can now be seen that the flow control restrictor enables the operator to vary the rate of flow through the remote valves and consequently the speed of operation of the equipment attached to the remotes.



Single Remote Control Valve Operation–Lowering with Slow Flow Control Setting

■ ▨ Reduced Oil Flow ■ Exhaust Oil

1. Flow Control Restrictor
2. Load Check Valve
3. Check Valve Spring
4. Flow Control Knob
5. Detent Regulating Valve
6. Detent Spool
7. Detent Plunger and Spring
8. Detent Balls
9. Centering Spring
10. External Cylinder
11. Valve Body
12. Control Valve Spool
13. Shuttle Check Valve
14. Load Sense Line (Pilot Line)
15. Flow Control Spring
16. Flow Control Spool
17. Return to Sump*
18. Auxiliary Pump Supply*
19. Hydraulic Priority Valve Assembly*
20. Supply to Remote Valve
21. Combining (Sequencing) Valve*
22. Main Pump Supply via Combining Valve*

*Tractors with Fixed Displacement Hydraulic Pump Only

For Tractors Fitted with Variable Displacement CCLS Hydraulic Pump

A = CCLS Pump Supply

J = CCLS Pump Load Sensing Line

Oil Flow With Cylinder Overload

With reference to Figure 14.

Under normal operating conditions excessive pressures in the remote circuits are protected by the detent regulating valve which returns the control valve spool to neutral when the external cylinder pressure becomes excessive or the cylinder reaches the end of its stroke. However if the operator overrides the detent allowing the pressure to become excessive due to an overload condition the circuit is protected as follows:–

Tractors with fixed displacement gear type pump:

When the hydraulic lift is raising and the remote valves are supplied by the auxiliary engine mounted pump, excessive cylinder pressure acting through the load sense line from drop port 'H' opens the integral combining valve relief valve reducing the pressure acting on the left hand end of the valve.

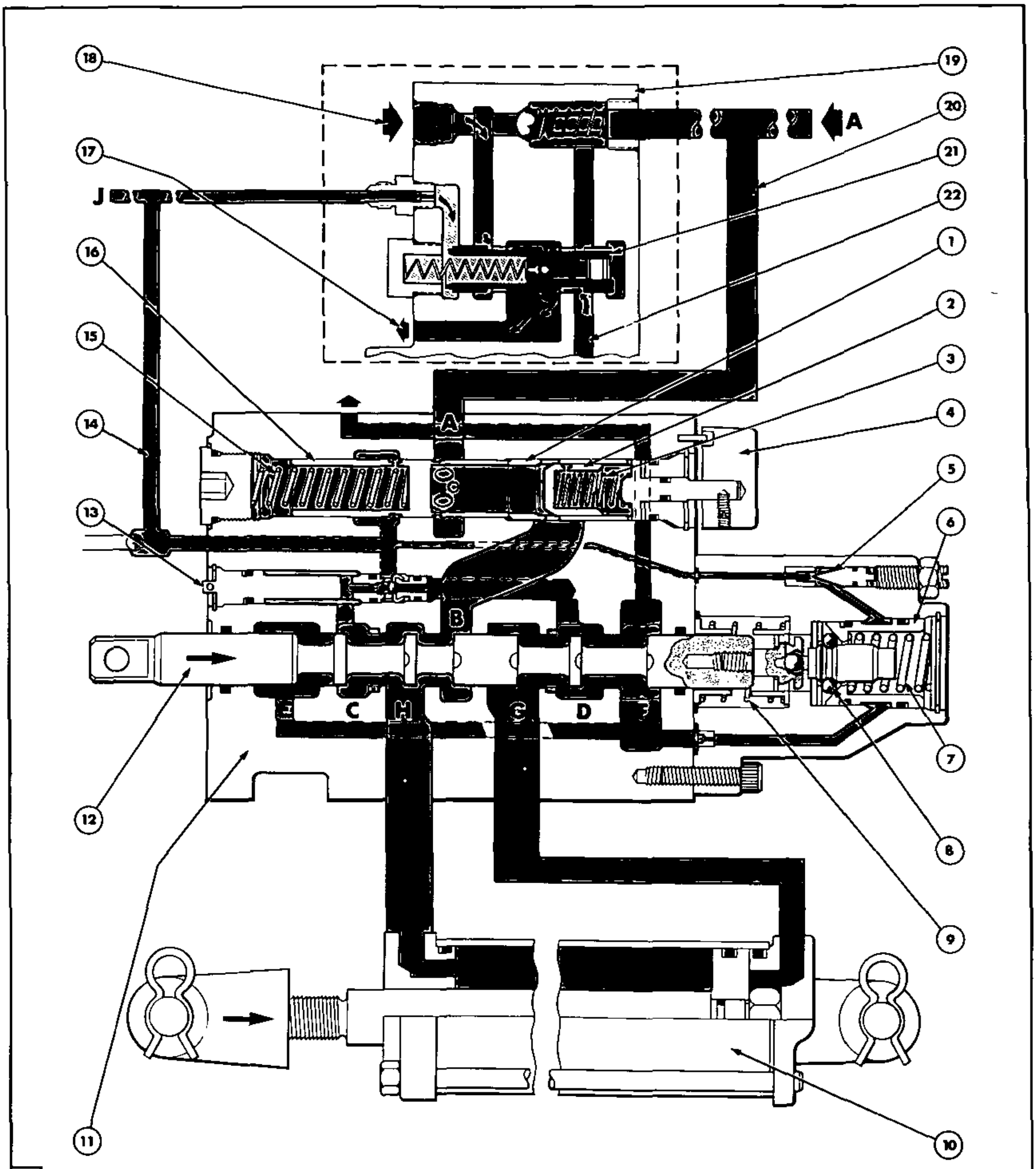
The combining valve now moves to the left, allowing the auxiliary and main hydraulic pump oil flow to return to sump, limiting maximum remote pressure to 2750 lbf/in^2 (192 bar).

Tractors with variable displacement CCLS hydraulic pump:

Excessive pressures in the circuit are automatically protected by the pressure compensating valve in the hydraulic pump.

When the pressure in the load sensing line approaches 2700 lbf/in^2 (186 bar) the pressure compensating valve opens, allowing high pressure oil to be directed to the swash plate servo piston. The servo piston consequently changes the angle of the swash plate to reduce pump flow.

Refer to Chapter 2 in this part of the Repair Manual for the operation of the variable displacement CCLS hydraulic pump.



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Single Remote Control Valve Operation–External Cylinder Overload

■ Pump Pressure Oil □ Reduced Oil Flow ■ Exhaust Oil

1. Flow Control Restrictor
2. Load Check Valve
3. Check Valve Spring
4. Flow Control Knob
5. Detent Regulating Valve
6. Detent Spool
7. Detent Plunger and Spring
8. Detent Balls
9. Centering Spring
10. External Cylinder
11. Valve Body
12. Control Valve Spool
13. Shuttle Check Valve
14. Load Sense Line (Pilot Line)
15. Flow Control Spring
16. Flow Control Spool
17. Return to Sump*
18. Auxiliary Pump Supply*
19. Hydraulic Priority Valve Assembly*
20. Supply to Remote Valve
21. Combining (Sequencing) Valve*
22. Main Pump Supply via Combining Valve*

*Tractors with Fixed Displacement Hydraulic Pump Only

For Tractors Fitted with Variable Displacement CCLS Hydraulic Pump

A = CCLS Pump Supply

J = CCLS Pump Load Sensing Line

Double Remote Valve Operation

With reference to Figure 15.

Two or more remote valves can be operated simultaneously irrespective of cylinder load.

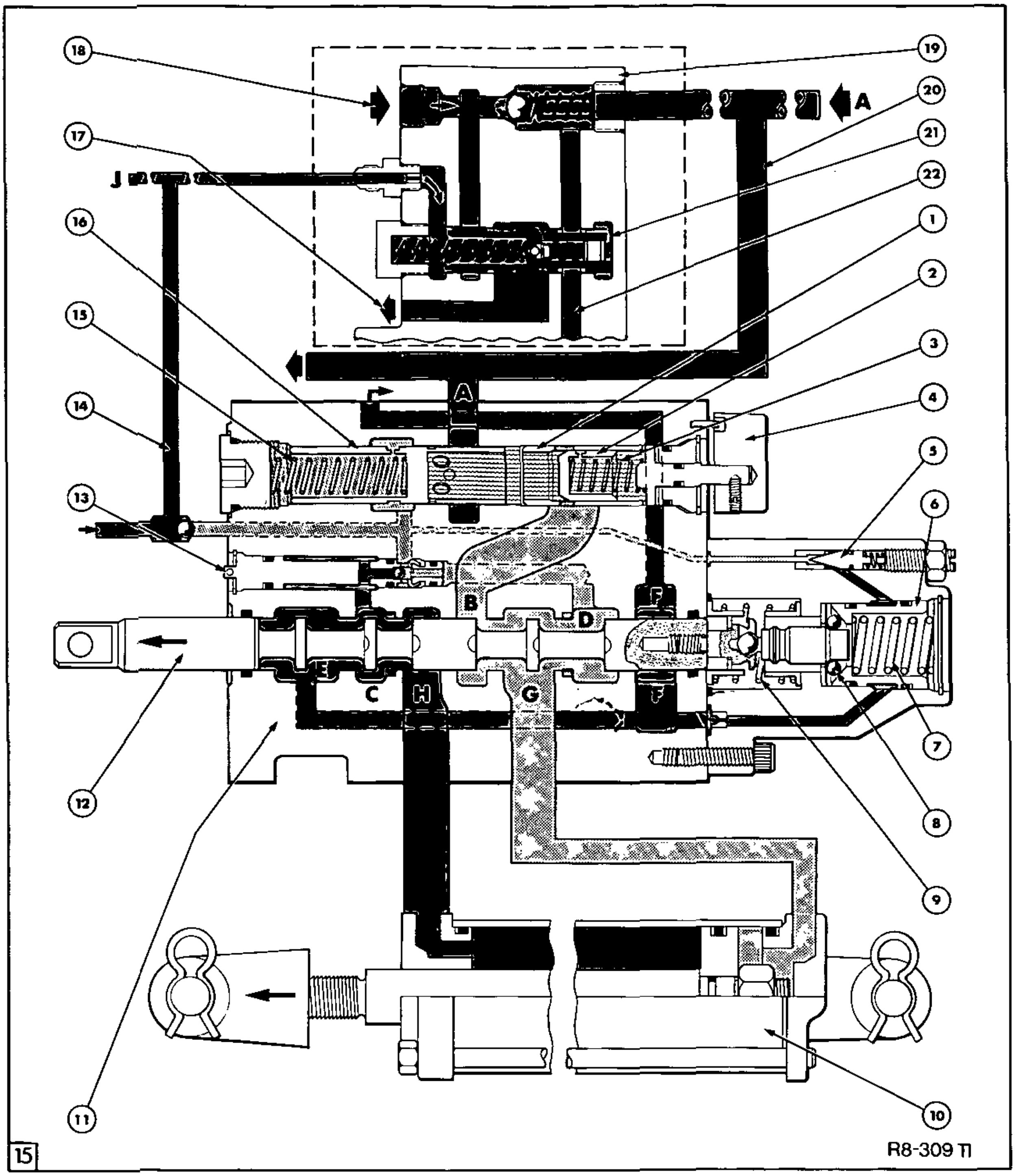
If two spools are operating a light load circuit and a heavy load circuit simultaneously, all the oil flow from the valve will attempt to flow to the light load circuit. The flow control spool will maintain pre–set flow (manual restrictor setting) to light load circuit.

It should be noted that in this condition the shuttle ball in the load sense line is pushed firmly towards the low pressure circuit, isolating the sense line from the remote valve operating under the lighter load condition.

In the double remote valve operation circuit shown in Figure 15, passage 'B' is connected through the shuttle check valve to the spring end of the flow control valve spool. The portion of the spool in port 'A' contains radial holes, through which pump oil must flow to reach passage 'B'.

If there is a large difference in the operating pressures between the two remote valve circuits being operated, an excessive amount of oil will attempt to flow from the pump, through the flow control spool and restrictor of the remote circuit operating at the lower pressure. This additional flow results in an increased pressure being generated on the right hand face of the flow control spool.

The increased pressure acting on the right hand face of the flow control spool moves the spool to the left, against both the spring and lower pressure acting on the opposite face of the spool. As the spool moves to the left, the flow control spool radial holes are progressively covered restricting and controlling oil flow from passage 'A' to the load check valve. Excessive oil flow to the light load circuit is therefore prevented while maintaining a high supply line pressure from the heavy load circuit.



15

Double Remote Control Valve Operation

■ Pump Pressure Oil
▤ Controlled Oil Flow
▨ Reduced Oil Flow
■ Exhaust Oil

1. Flow Control Restrictor
2. Load Check Valve
3. Check Valve Spring
4. Flow Control Knob
5. Detent Regulating Valve
6. Detent Spool
7. Detent Plunger and Spring
8. Detent Balls
9. Centering Spring
10. External Cylinder
11. Valve Body
12. Control Valve Spool
13. Shuttle Check Valve
14. Load Sense Line (Pilot Line)
15. Flow Control Spring
16. Flow Control Spool
17. Return to Sump*
18. Auxiliary Pump Supply*
19. Hydraulic Priority Valve Assembly*
20. Supply to Remote Valve
21. Combining (Sequencing) Valve*
22. Main Pump Supply via Combining Valve*

*Tractors with Fixed Displacement Hydraulic Pump Only

For Tractors Fitted with Variable Displacement CCLS Hydraulic Pump

A = CCLS Pump Supply
J = CCLS Pump Load Sensing Line

Oil Flow In Float

With reference to Figure 16.

The float position allows operation of single acting cylinders when lowering under light load conditions.

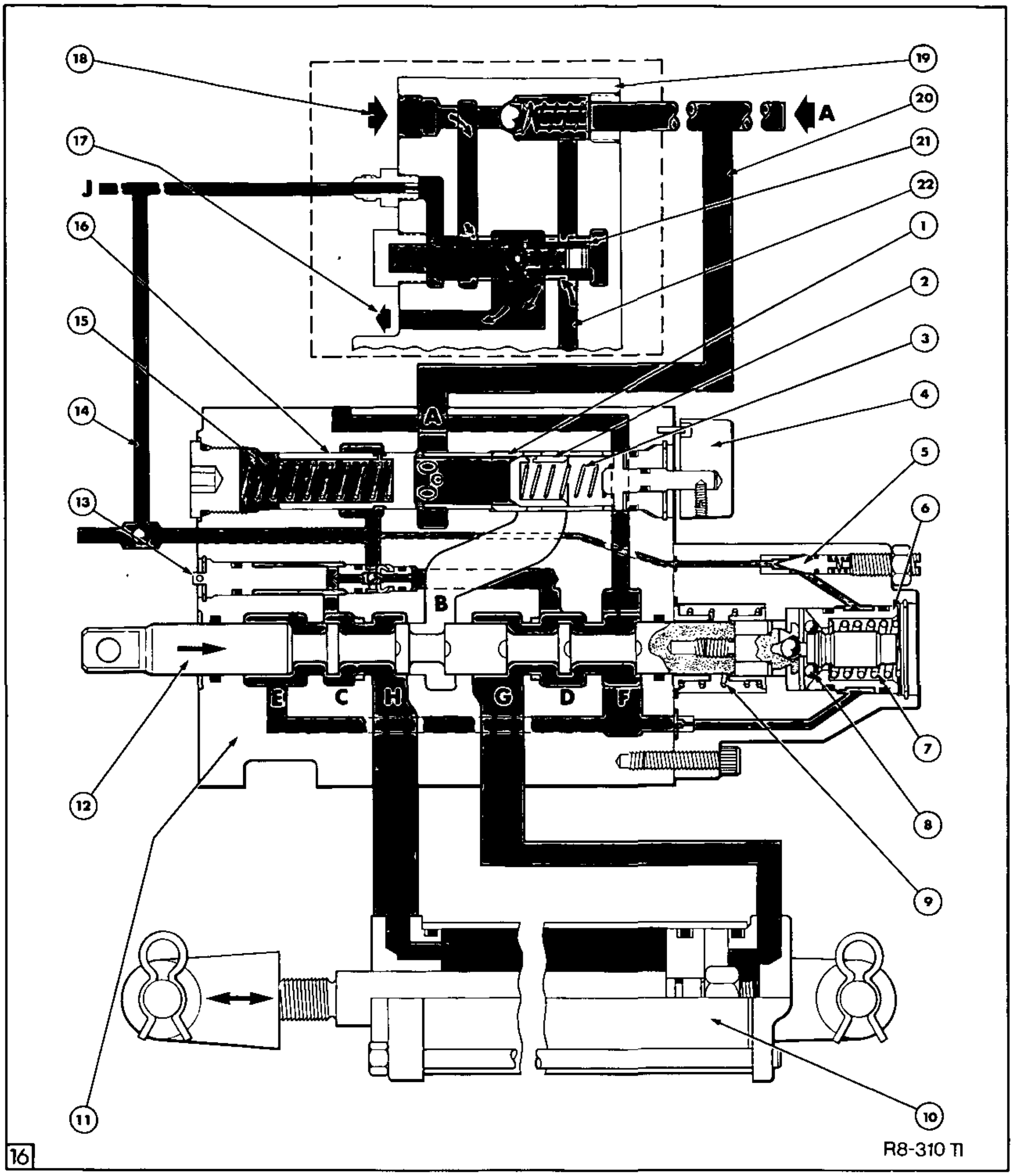
When the remote valve lever is pushed fully forward to the float position, the spool is moved fully rearward past lowering to allow the detent balls to engage with the float detent plunger groove.

The spool can only be returned to neutral manually by the operator as no pressure can be generated at the shuttle check valve to release the detent mechanism.

Lift port 'G' and drop port 'H' are connected to return galleries 'F' and 'E' allowing the remote cylinder to float and assume any position.

Galleries 'C' and 'D' are also connected to the return oil galleries 'E' and 'F', allowing only low back pressure to either side of the shuttle check valve. The load sensing line is, therefore, not pressurised and the output from the fixed displacement pump (where fitted) is returned to the rear axle by the combining valve.

On tractors with the variable displacement CCLS hydraulic pump, output is adjusted automatically in accordance with tractor hydraulic requirements, as described in Chapter 2 of this Part of the Repair Manual.



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Single Remote Control Valve Operation–Float

■ Pump Pressure Oil ■ Exhaust Oil □ Trapped Oil

1. Flow Control Restrictor
2. Load Check Valve
3. Check Valve Spring
4. Flow Control Knob
5. Detent Regulating Valve
6. Detent Spool
7. Detent Plunger and Spring
8. Detent Balls
9. Centering Spring
10. External Cylinder
11. Valve Body
12. Control Valve Spool
13. Shuttle Check Valve
14. Load Sense Line (Pilot Line)
15. Flow Control Spring
16. Flow Control Spool
17. Return to Sump*
18. Auxiliary Pump Supply*
19. Hydraulic Priority Valve Assembly*
20. Supply to Remote Valve
21. Combining (Sequencing) Valve*
22. Main Pump Supply via Combining Valve*

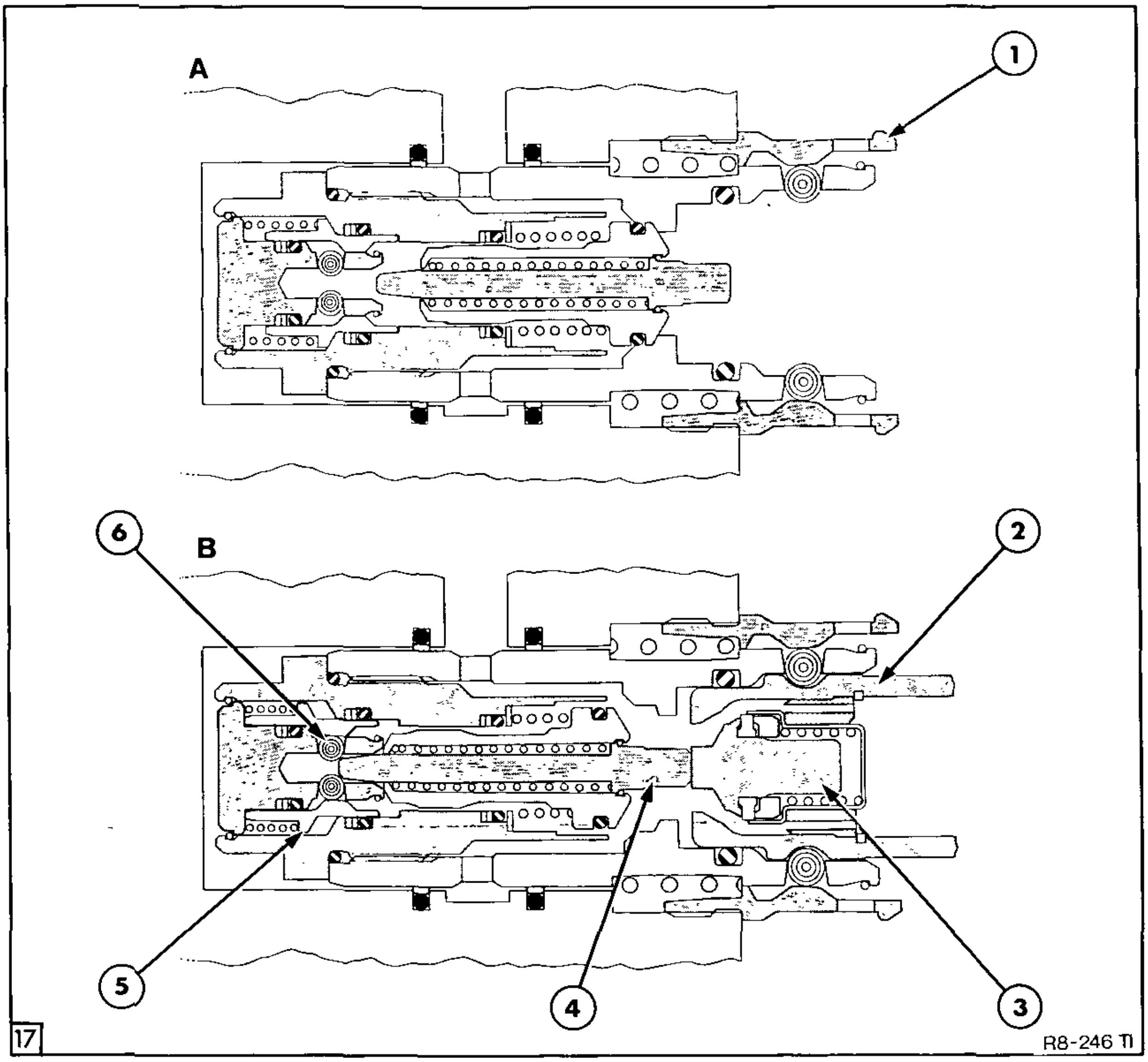
*Tractors with Fixed Displacement Hydraulic Pump Only

For Tractors Fitted with Variable Displacement CCLS Hydraulic Pump

A = CCLS Pump Supply

J = CCLS Pump Load Sensing Line

COUPLERS



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Remote Valve Coupler Operation

A Coupler Disconnected and Not Pressurised
B Coupler Connected and Pressurised

1. Coupler Assembly
2. Auxiliary Equipment Hose Connector
3. Hose Connector Check Valve
4. Probe
5. Locking Sleeve
6. Locking Balls

Figure 17, shows a cross section through the remote couplers.

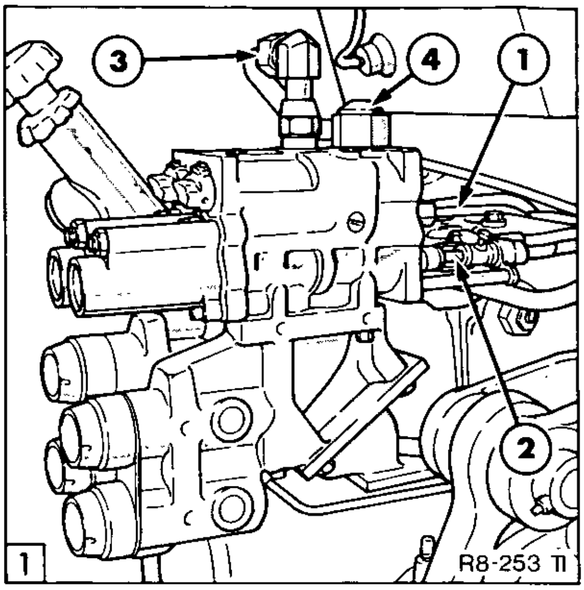
When the coupler is disconnected from the auxiliary equipment, the valve is spring loaded in the closed position.

When equipment is connected and the remote valve pressurised, high pressure oil forces the hose connector check valve off its seat and the spring loaded probe remains in contact with the face of the check valve, Stage B, Figure 17.

Oil pressure within the coupler now pushes the locking sleeve rearward, forcing the locking balls against the end of the probe, preventing the probe from moving rearwards.

With the probe locked in the forward position the hose connector check valve is held in the 'Fully Open' position even when the remote valve is working at a low operating pressure.

B. OVERHAUL



Remote Control Valve Installation
1. Load Sensing (Pilot) Line
2. Control Linkage
3. Supply Line
4. Return Line

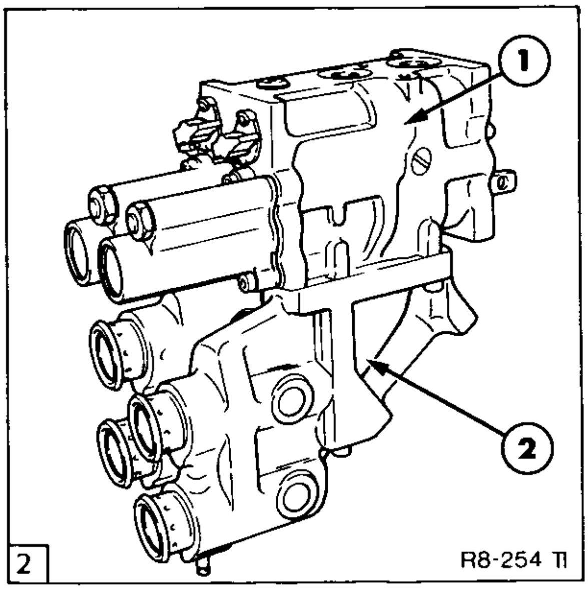
CONTROL VALVE HOUSING

REMOVAL

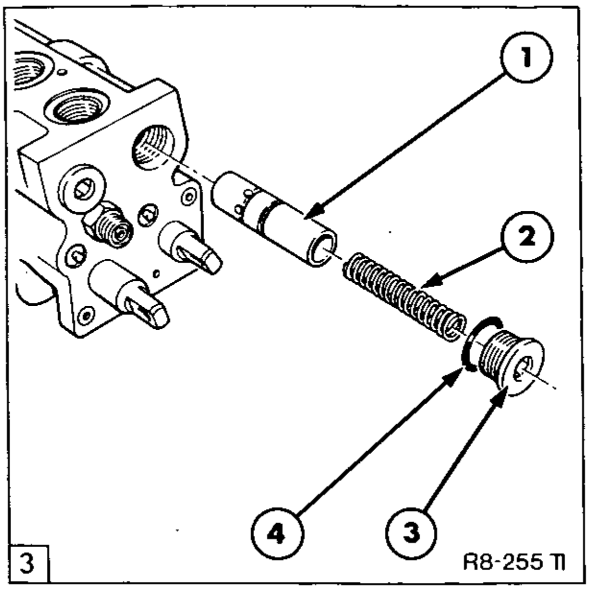
1. Disconnect the control linkage and tubes, Figure 1 and remove control valve and coupling assembly from the tractor.

DISASSEMBLY

1. Separate control valve from coupling assembly.



Remote Control Valve and Coupler Assembly
1. Remote Valve Housing
2. Coupler Assembly

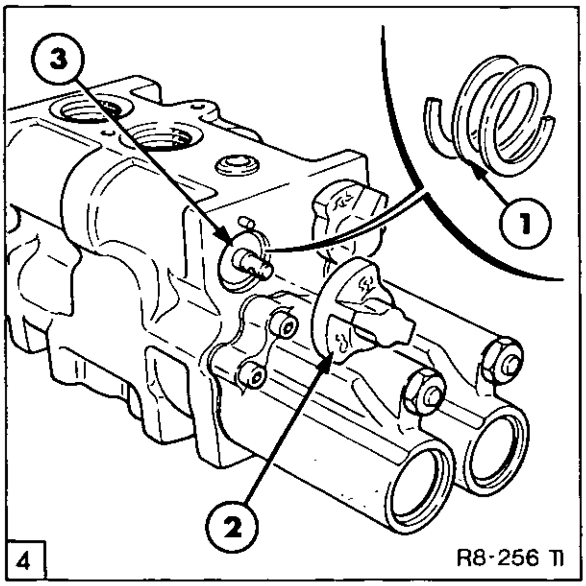


Flow Control Spool Removal
1. Spool
2. Spring
3. End Cap
4. 'O' Ring Seal

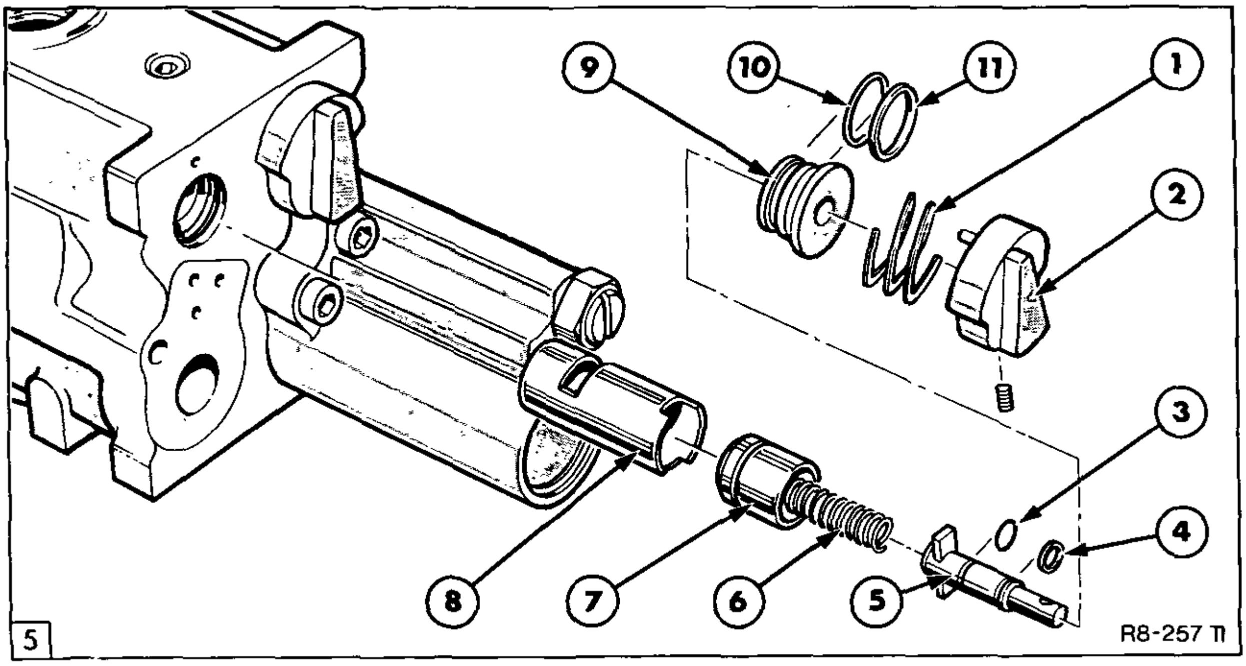
2. Remove flow control spool from rear of housing, Figure 3.

3. Remove flow control knob. push restrictor end plug as far as possible into housing and remove spiral circlip, Figure 4.

NOTE: *The plug can only be pushed into the housing by approximately 0.040 in (1 mm) and is just sufficient to allow removal of the spiral circlip.*



Flow Control Restrictor Circlip
1. Double Spiral Circlip
2. Knob
3. Restrictor End Plug

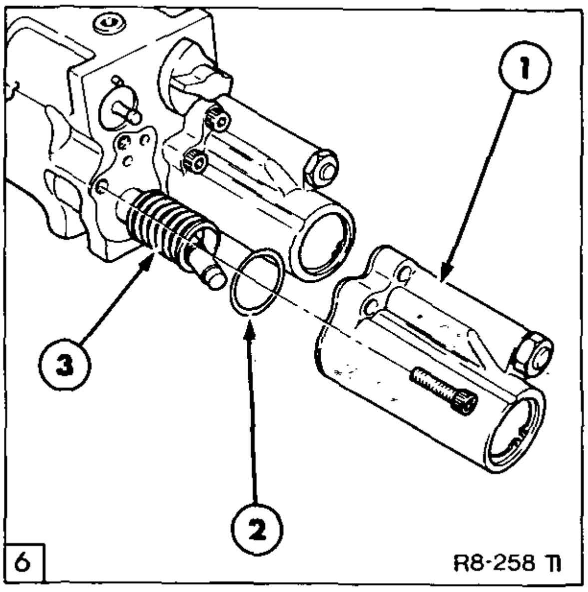


Flow Control Restrictor

1. Spiral Circlip
2. Knob
3. 'O' Ring
4. Back–up Ring
5. Shaft
6. Spring
7. Load Check Valve
8. Flow Restrictor
9. Restrictor End Plug
10. 'O' Ring
11. Back–up Ring

4. Remove flow control restrictor, Figure 5.

5. Remove fixing screws and pull detent assembly with a sharp jerk from the end of the control spool, Figure 6.



Removing Detent Assembly

1. Detent Housing
2. 'O' Ring
3. Main Spool Centering Spring

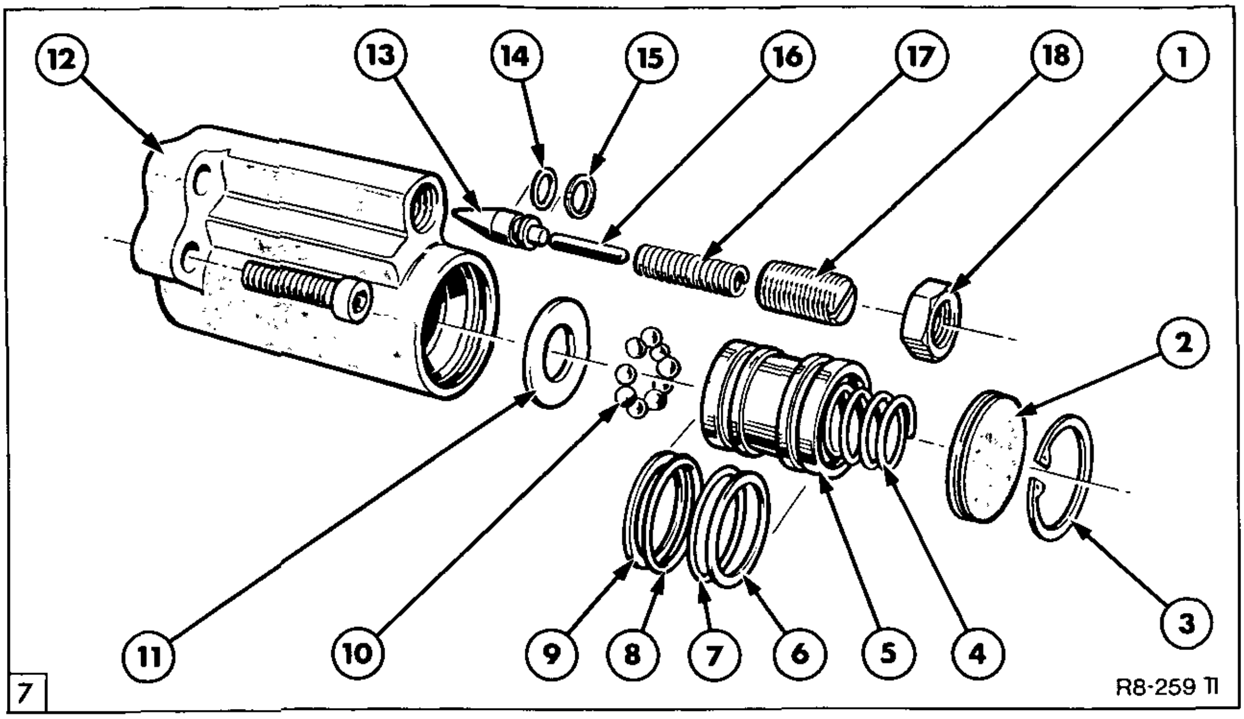
6. Using a suitable press, push end cap sufficiently into detent housing to enable removal of snap ring. Carefully release press and allow the spring within the detent housing to eject the plug, Refer to Figure 7.

7. *Disassemble detent assembly and detent regulating valve components taking care to collect the nine detent balls.*

8. Compress centering spring and remove detent plunger from shaft. Refer to Figure 8.

9. Unscrew shaft from main spool.

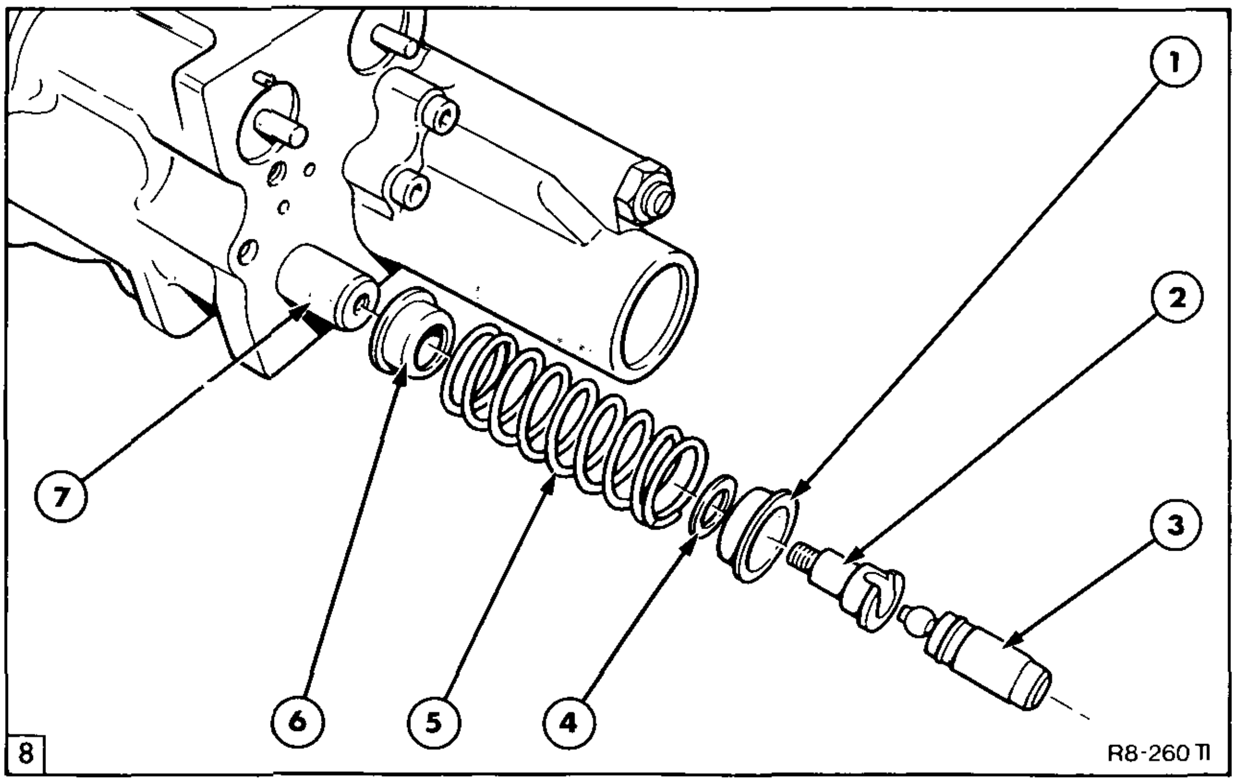
10. *To prevent damage to the housing due to paint on the linkage end of the main control spool, remove main spool from opposite end of housing to that which the centering spring was located.*



7

Detent Mechanism

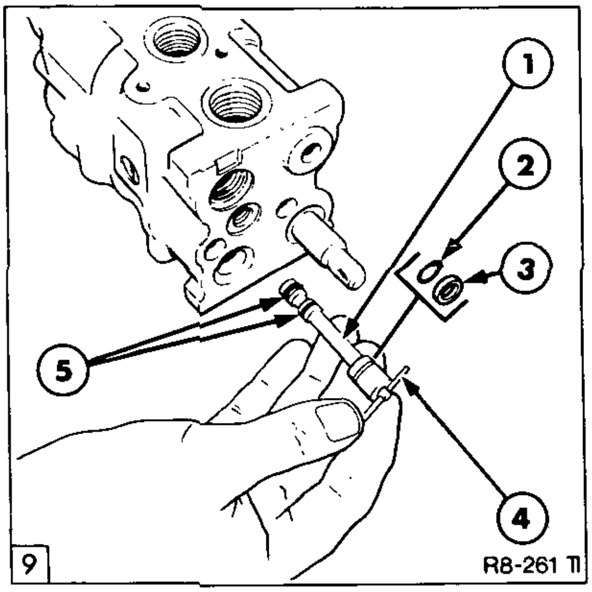
1. Lock Nut
2. End Cap
3. Snap Ring
4. Spring
5. Detent Spool
6. Back–up Ring
7. 'O' Ring
8. 'O' Ring
9. Back–up Ring
10. Detent Balls
11. Washer
12. Detent Housing
13. Valve
14. 'O' Ring
15. Back–up Ring
16. Rod
17. Spring
18. Adjuster



8

Centering Spring Assembly

1. Retainer
2. Shaft
3. Detent Plunger
4. Washer
5. Spring
6. Retainer
7. Main Spool



9

Shuttle Check Valve Removal

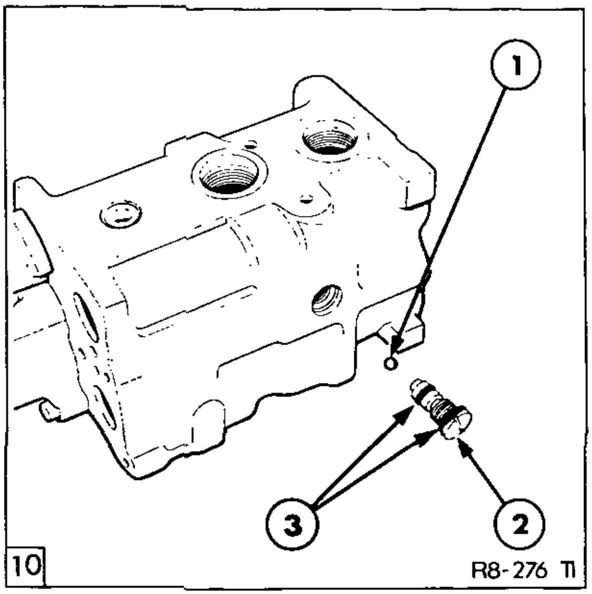
1. Shuttle Check Valve
2. 'O' Ring
3. Back–up Ring
4. Rod (to assist aemoval of valve)
5. 'O' Rings

11. Remove spiral circlip and using a small rod withdraw shuttle check valve, Figure 9.

12. Remove priority check valve, Figure 10.

INSPECTION AND RE–ASSEMBLY

1. Inspect all components for wear or damage. The main spool, flow control spool and restrictor assembly are matched to the valve body and are not available separately.



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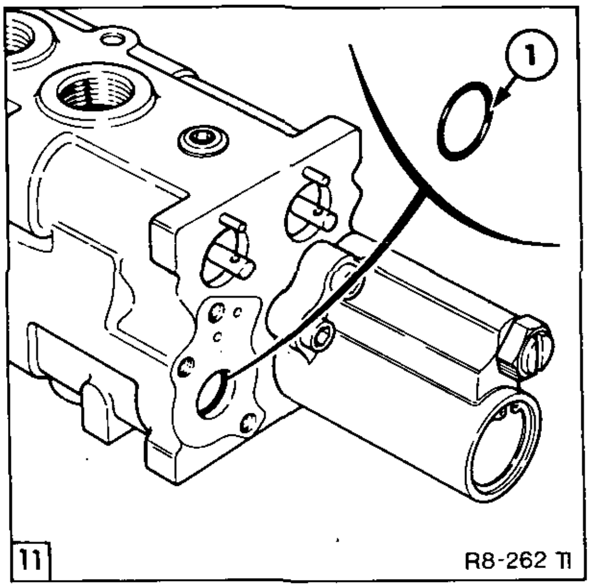
Priority Check Valve

1. Ball
2. Seat
3. 'O' Rings



11

Installing Valve Housing Main Spool 'O' Ring Seals (Step 1)

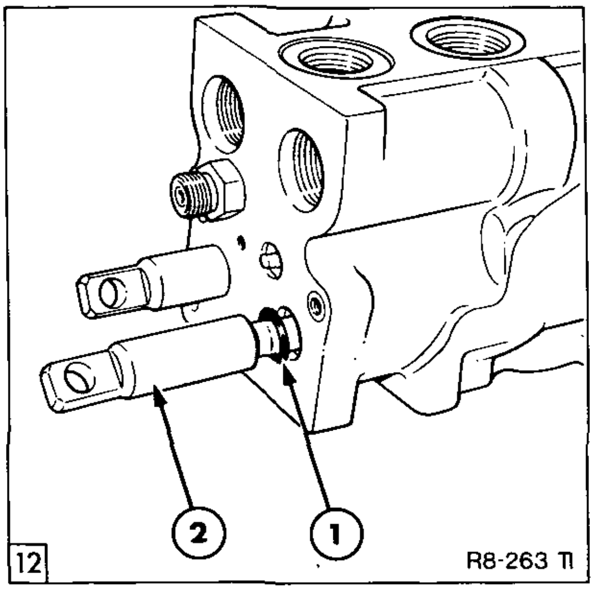
1. 'O' Ring

2. Replace all 'O' rings and back–up rings.

3. Re–assemble with reference to Figure 13 and install housing 'O' ring seals as follows:–

   Position the 'O' ring into the detent end of the housing, Figure 11.

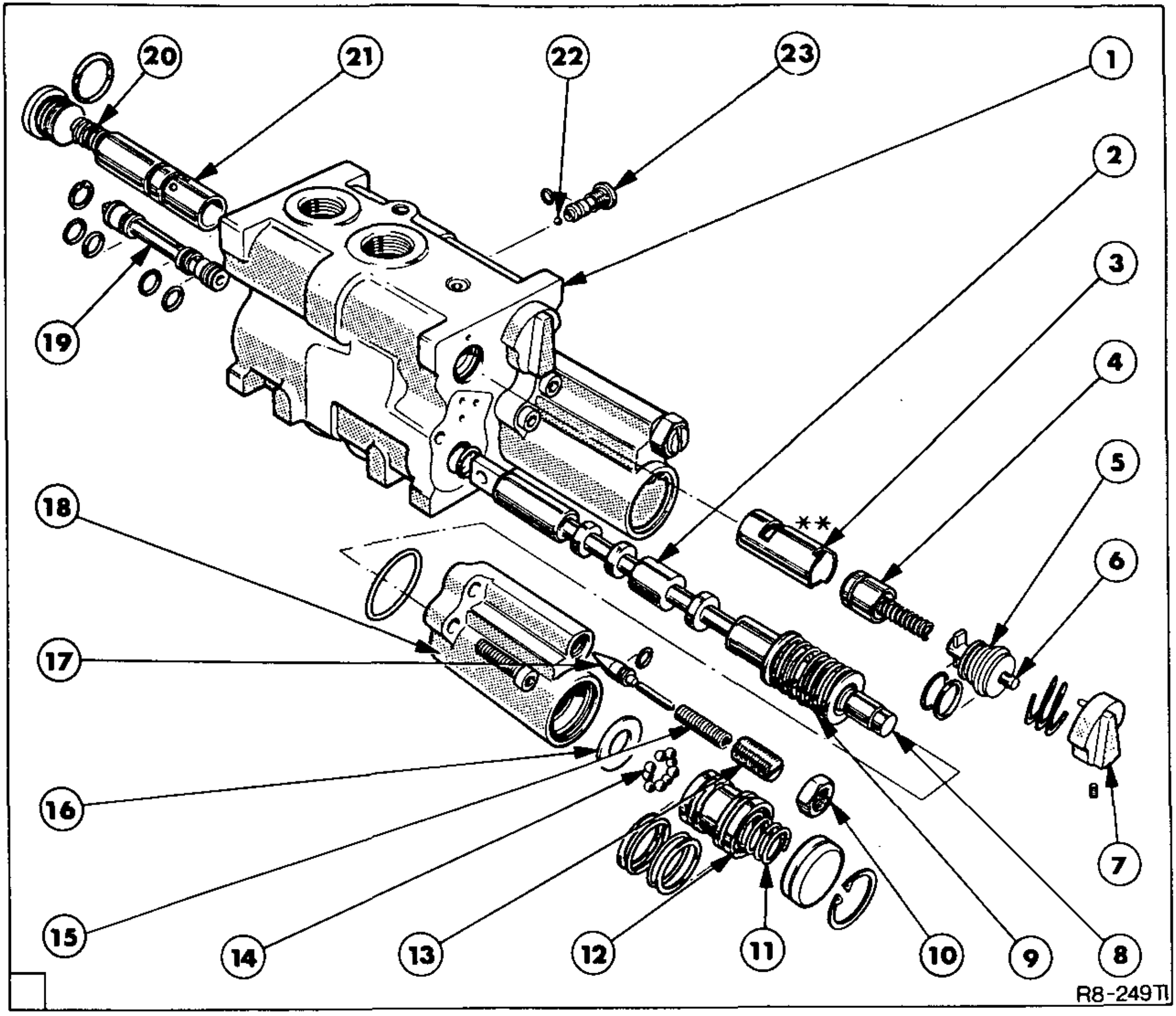
   Insert the spool from the opposite end of the housing to position shown in Figure 12, then install remaining 'O ring.



12

Installing Valve Housing Main Spool 'O' Ring Seals (Step 2)

1. 'O' Ring
2. Main Spool



Double Spool Remote Control Valve

1. Valve Body
2. Spool
3. Flow Restrictor*
4. Load Check Valve
5. Flow Restrictor End Plug
6. Flow Restrictor Control Shaft
7. Flow Restrictor Control Knob
8. Detent Shaft
9. Spool Centering Spring
10. Locknut
11. Detent Piston Spring
12. Detent Piston
13. Detent Valve Spring Adjuster
14. Detent Balls (9 off)
15. Detent Regulating Valve Spring
16. Spacer
17. Detent Regulating Valve
18. Detent Housing
19. Shuttle Check Valve
20. Flow Control Spring
21. Flow Control Spool
22. Priority Check Valve Ball (double spool only)
23. Priority Check Valve Retainer

** The flow restrictor **must** be installed with the large slot positioned 180° to that shown in illustration.

4. Apply loctite TL 242 to the thread of the detent shaft. Assemble centering spring and screw shaft onto main spool, tightening to a maximum torque of 5 lbf ft (6.7 Nm).

5. Re–connect the valve housing to the coupler assembly, ensuring that the 'O' ring seals between the coupler and valve have not been omitted. Tighten the bolts to a torque of 11–15 lbf ft (15–20 Nm).

If the remote valve couplers require overhaul refer to Page 24. It is not necessary to remove the valve assembly from the tractor in order to overhaul the couplers.

INSTALLATION

1. Assemble the valve to the tractor tightening the bolts to a torque of 20–26 lbf ft (27–35 Nm).
2. Reconnect the pipework and control lever cables.

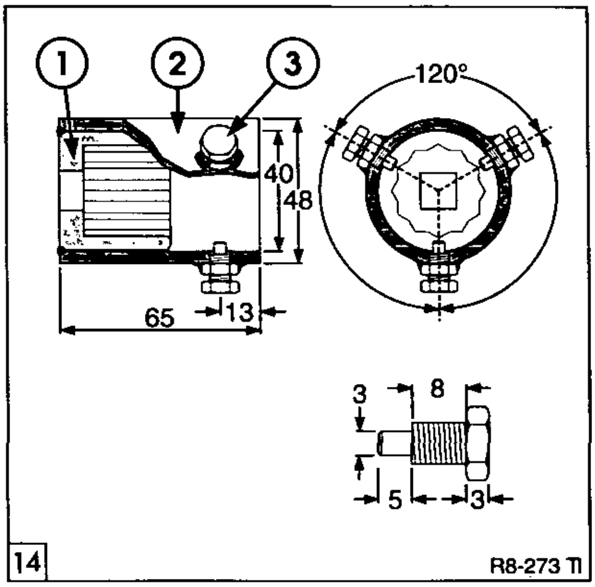
REMOTE VALVE COUPLER

DISASSEMBLY

1. Using a suitable ‘C’ spanner, Tool FNH00095 or prefabricated tool as shown in Figure 14, unscrew coupling.

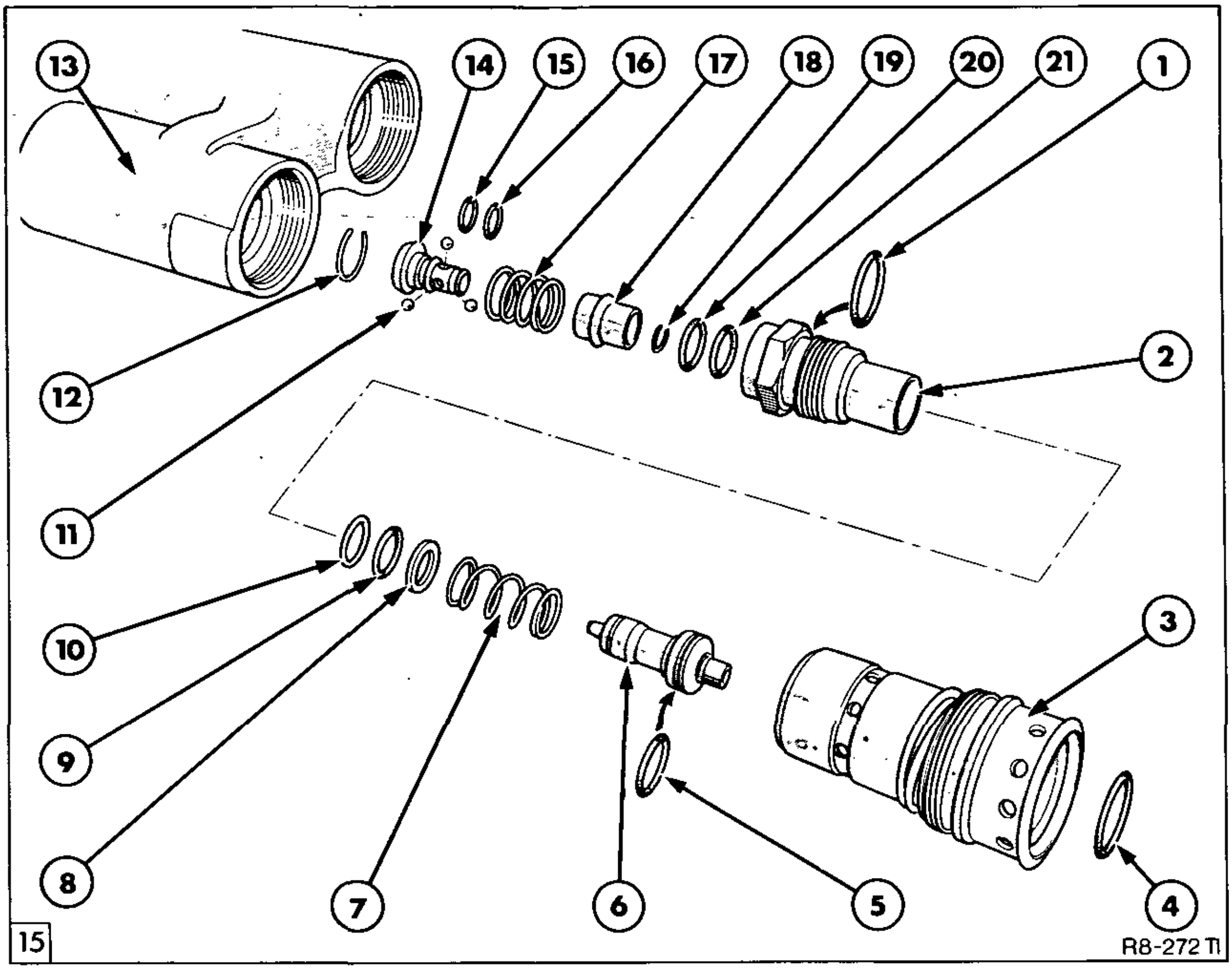
   When using the tool shown in Figure 14, engage the reduced diameter of the locking screws into three of the round holes on the outer diameter of the coupler and using a standard wrench unscrew the coupler.

2. Disassemble the coupling as shown in Figure 15.



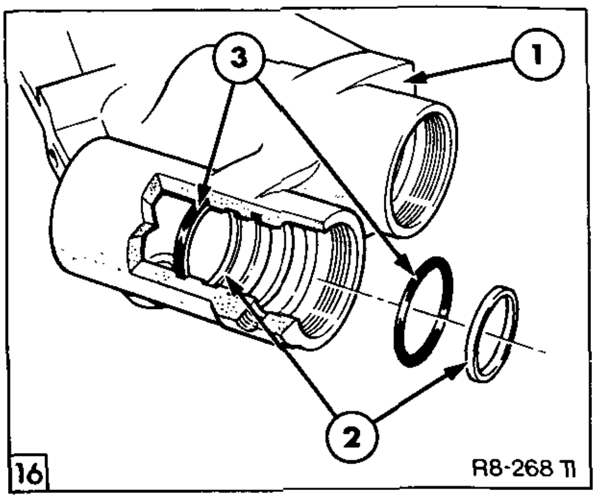
Tool for Removing Coupler

1. 30 mm Socket (welded inside item 2
2. Sleeve
3. Hardened Locking Screw (3 off) made from 6 mm Bolts



Remote Valve Coupler

1. ‘O’ Ring
2. Adaptor
3. Sleeve Assembly
4. Front Sealing Ring
5. ‘O’ Ring
6. Probe Assembly
7. Spring
8. Washer
9. ‘O’ Ring
10. Back–up Ring
11. Locking Balls
12. Retaining Ring
13. Coupler Housing
14. Locking Body
15. Back–up Ring
16. ‘O’ Ring
17. Spring
18. Locking Sleeve
19. Retaining Ring
20. Back–up Ring
21. ‘O’ Ring



Slipper Seals

1. Coupler Housing
2. Slipper Seals
3. 'O' Rings

3. Remove the two 'O' ring and slipper seals from the coupler housing, Figure 16.

RE–ASSEMBLY

Inspect components for wear or damage and replace all seals which are serviced.

1. Re–assemble the coupler using the disassembly procedure in reverse.

2. Lightly oil two new 'O' ring seals and install into the coupler housing grooves.

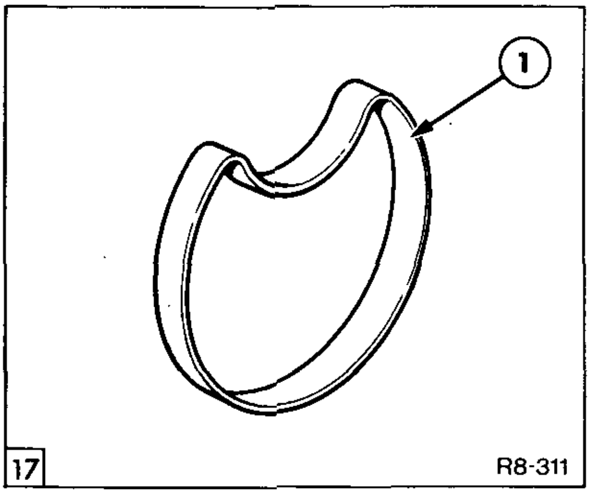
3. Shape the new slipper seals as shown in Figure 17 and locate inside 'O' ring seals. Use a clean finger to smooth the seals into position.

4. Where available insert slipper seal tool No FT 8611, into the housing and rotate back and forth. This operation slightly stretches and seats the seals in order that the coupling can be installed.

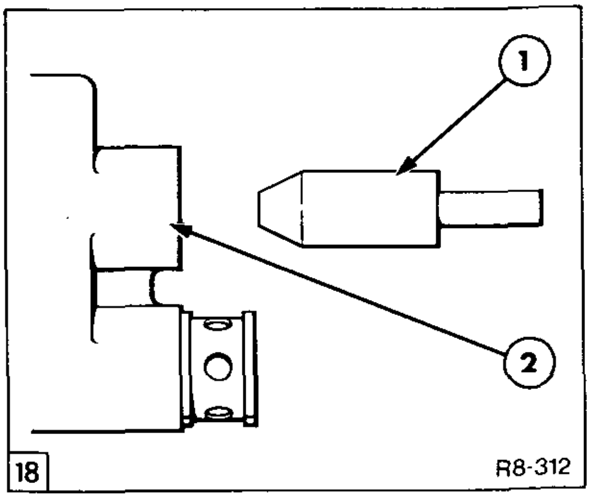
5. Lightly oil coupler and carefully install into the housing.

NOTE: *Extreme care must be exercised as the coupler engages and slightly expands the slipper seal. This is particularly important if the slipper seal tool is not available.*

6. Tighten the sleeve to a torque of 60 lbf ft (82 Nm).



Shaping Slipper Seal



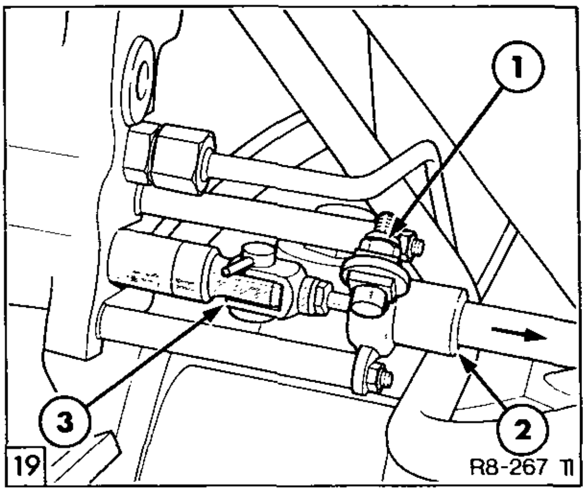
Seating Slipper Seals

1. Slipper Seal Tool No FT 8611
2. Coupler Housing

CABLE ADJUSTMENT

Adjust cable as follows:–

1. Move control lever to 'Raise' position and check that control valve spool is fully extended from housing.
2. Loosen cable clamp, Figure 19 and slide cable outer sleeve away from valve until all slack in the cable has been removed.
3. Tighten clamp and check for correct operation of the valve in 'Raise' Neutral' 'Lower' and 'Float' positions.



Control Cable Adjustment

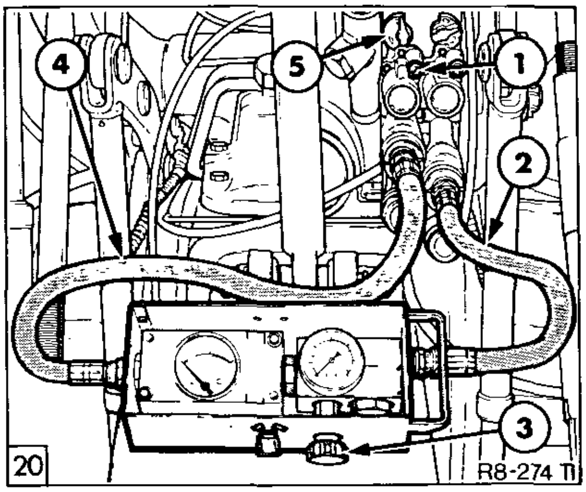
1. Clamp
2. Cable Sleeve
3. Spool (extended)

C. PRESSURE TESTING AND SPECIFICATIONS

PRESSURE TESTING

After servicing the detent regulating valve or if the control levers and spool are returning to neutral prematurely, the detent regulating valve should be tested as follows:–

1. Install inlet hose of a flowmeter into lift coupler of valve to be tested and set flow control knob to maximum flow, Figure 20.
2. Install return hose from flow meter into lift coupler of another remote valve on tractor.
3. Ensure load valve on flow meter is fully open.
4. Start tractor and set engine speed to 1700 rev/min.
5. Push remote control valve operating lever of remote valve connected to flowmeter 'Return' hose, to 'Float' position, fully forward.



Pressure Testing Detent Regulating Valve

1. Detent Regulating Valve
2. Return Hose from Flowmeter
3. Flowmeter Load Valve
4. Flowmeter Inlet Hose from Remote Valve Being Tested
5. Flow Control Knob

6. Pull lever of remote control valve to be tested, fully rearwards, to the extend position.

7. Adjust load valve on flow meter until pressure is at 2000 lbf/in^2 (140 bar) and run engine until hydraulic oil is at an operating temperature of 170°F (75°C).

8. With lever of remote control valve to be tested in the cylinder extend position slowly close the flowmeter load valve while observing the flowmeter pressure gauge.

   The pressure should steadily rise until the detent regulating valve opens, at which point the needle will fluctuate and the handle return to the neutral position. Note the gauge reading immediately prior to the needle fluctuation. The reading should be within the specified value 2150–2350 lbf/in^2 (148–162 bar).

9. If the reading is not to specification, adjust the 'return to neutral' pressure as follows:–

   Loosen locknut on detent regulating valve.

   Turn detent regulating valve adjusting screw to change pressure setting. Half a turn of screw is equivalent to approximately 450 lbf/in^2 (32 bar).

D. SPECIFICATIONS

Detent Regulating Valve Pressure	2150–2350 lbf/in^2 (148–162 bar)	
TORQUES		
Flow Control Valve Plug	20 lbf ft	27 Nm
Detent Shaft Pivot Coupling	5 lbf ft	7 Nm
Detent Housing Retaining Screws	5 lbf ft	7 Nm
Priority Check Valve	5 lbf ft	7 Nm
Valve to Coupler Housing Bolts	11–15 lbf ft	15–20 Nm
Valve to Mounting Bracket Bolts	20–26 lbf ft	27–35 Nm
Remote Valve Coupler to Housing	60 lbf ft	82 Nm

THREAD SEALANT

Loctite TL 242

SPECIAL TOOLS

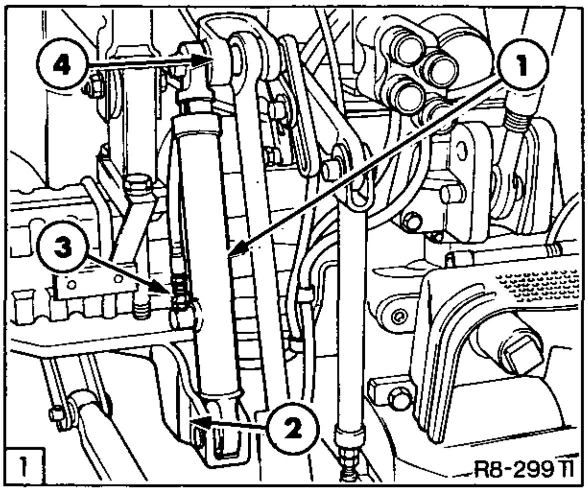
Flowmeter	VL Churchill MS820A, FNH 02755, FNH 02760 or suitable equivalent
Flowmeter Hoses	Procure locally to suit Flowmeter used
Coupler Remover	North America FNH 00095
Slipper Seal Installation Tool	VL Churchill FT 8611

PART 8

HYDRAULIC SYSTEMS

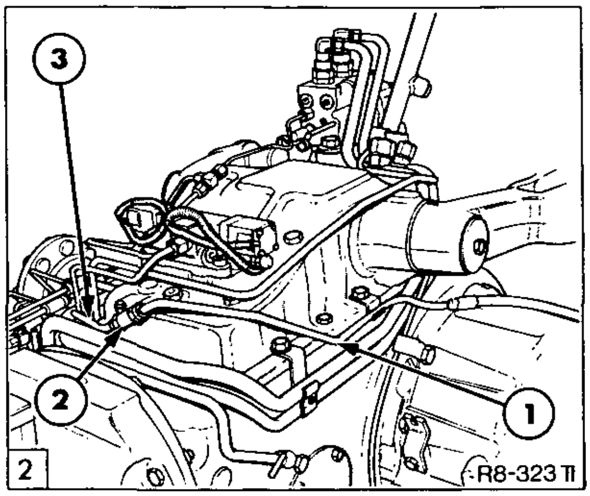
Chapter 8
ASSIST RAMS

A. DESCRIPTION AND OPERATION



Hydraulic Assist Ram Installation

1. Assist Ram
2. Bracket
3. Hose Connection
4. Lift Arm



Assist Ram Feed Tubes
(Tractor with Electronic Draft Control shown)

1. Assist Ram Feed Tube (Left Hand)
2. Supply Port to Assist Rams
3. Assist Ram Feed Tube (Right Hand)

In order to increase the hydraulic lift capacity, all series 40 tractors may be installed with either one or two assist rams.

Assist rams, which can be either factory or dealer installed, attach to a bracket beneath the rear axle and the end of the lift arm, Figure 1.

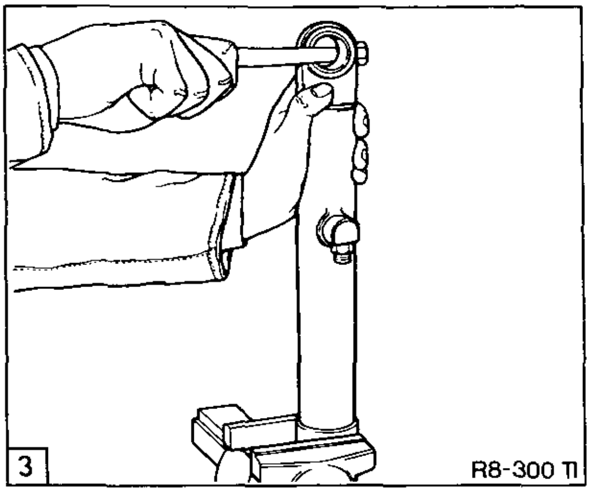
The hydraulic supply to each ram is taken from a port at the front of the hydraulic lift cover, Figure 2, which connects directly with the supply gallery to the lift cylinder.

B. OVERHAUL

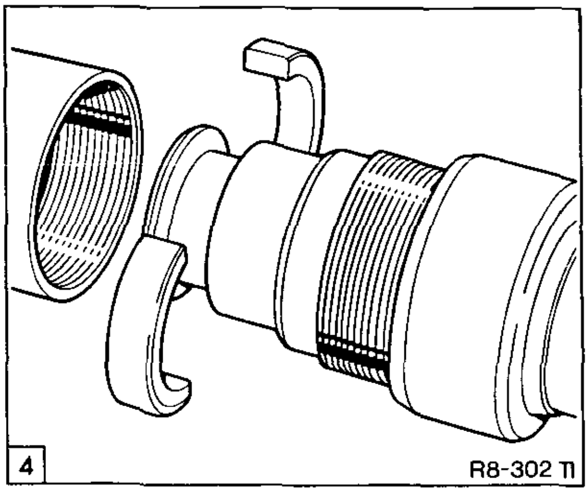
REMOVAL

1. Fully lower lift arms.
2. Disconnect hydraulic connection to assist ram.
3. Remove pin attaching assist ram to bracket.
4. Remove collar on pin attaching assist ram to lift arm and withdraw ram from tractor.

DISASSEMBLY



Unscrewing Assist Ram Cylinder



Cylinder Rod Guides

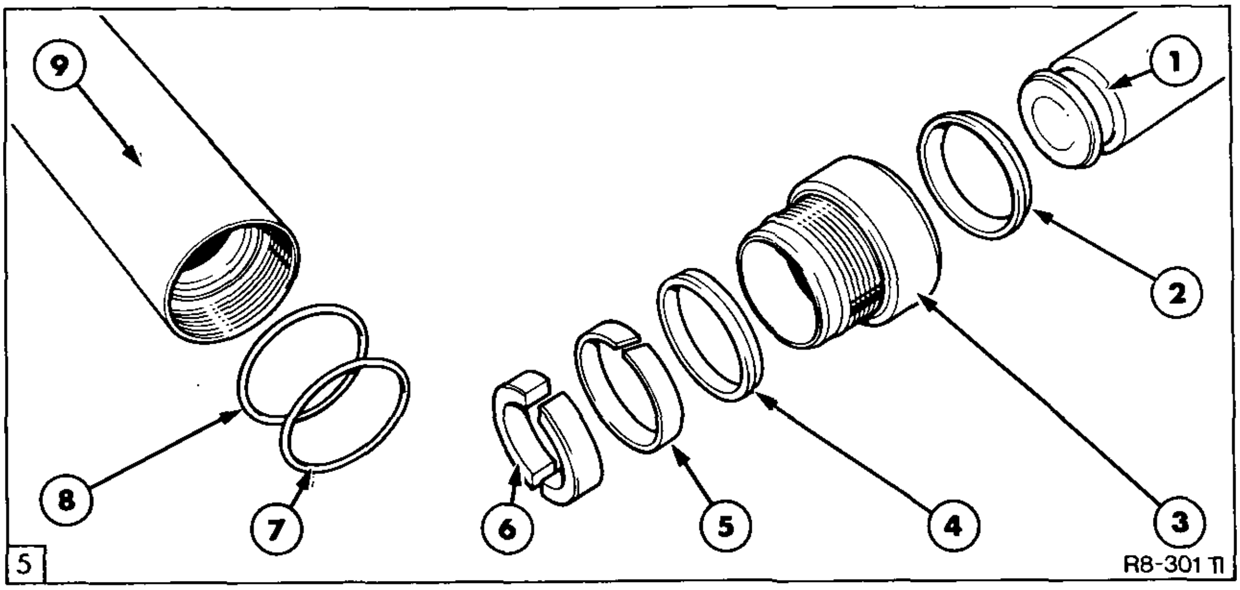
1. Grip assist ram end cap in vice and using suitable lever unscrew cylinder, Figure 3.
2. Remove guides from end of cylinder rod, Figure 4.
3. Slide end cap from rod and remove seal components, Figure 5.

INSPECTION AND REPAIR

1. Replace all seals
2. Examine cylinder rod for burs, scratches and distortion.
3. Examine the bearing in the eye at each end of the assist ram and replace if worn. To remove bearings relieve the staking around the edge of the eye and press out using a hydraulic press.
4. When installing new bearings ensure they are fully seated and securely staked in three positions.

RE–ASSEMBLY

Re–assembly follows the disassembly procedure in reverse.



Assist Ram Assembly

1. Piston Rod
2. Wiper Seal
3. End Cap
4. Seal
5. Bushing
6. Guides
7. Support Ring
8. 'O' Ring Seal
9. Cylinder Barrel

C. SPECIFICATIONS

MAXIMUM LIFT CAPACITY

Tractors with Fixed Displacement Gear Type Hydraulic Pump @ 2650 lbf/in^2 (183 bar)

Test results to OECD criteria–links horizontal

		5640	**6640**	**7740**	**7840**	**8240**	**8340**
Without Assist Rams							
at link ends	lb	6350	6350	n/a	n/a	n/a	n/a
	kg	2880	2880	n/a	n/a	n/a	n/a
24 in. to rear of link ends	lb	4910	4910	n/a	n/a	n/a	n/a
	kg	2227	2227	n/a	n/a	n/a	n/a
With One Assist Ram							
at link ends	lb	9370	9370	9370	9370	9370	9370
	kg	4250	4250	4250	4250	4250	4250
24 in. to rear of link ends	lb	7080	7080	7080	7080	7080	7080
	kg	3211	3211	3211	3211	3211	3211
With Two Assist Rams							
at link ends	lb	n/a	n/a	12300	12300	12300	12300
	kg	n/a	n/a	5579	5579	5579	5579
24 in. to rear of link ends	lb	n/a	n/a	9420	9420	9420	9420
	kg	n/a	n/a	4273	4273	4273	4273

Tractors with Fixed Displacement Gear Type Hydraulic Pump @ 2385 lbf/in^2 (164 bar)

Test results to SAE criteria–links horizontal

		5640	**6640**	**7740**	**7840**	**8240**	**8340**
Without Assist Rams							
24 in. to rear of link ends	lb	4200	4200	n/a	n/a	n/a	n/a
	kg	1905	1905	n/a	n/a	n/a	n/a
With One Assist Ram							
24 in. to rear of link ends	lb	6210	6210	6210	6210	6210	6210
	kg	2817	2817	2817	2817	2817	2817
With Two Assist Rams							
24 in. to rear of link ends	lb	n/a	n/a	8240	8240	8240	8240
	kg	n/a	n/a	3728	3728	3728	3728

MAXIMUM LIFT CAPACITY

Tractors with Variable Displacement Closed Centre Load Sensing (CCLS) Hydraulic Pump @ 2800 lbf/in² (193 bar)

Test results to OECD criteria–links horizontal

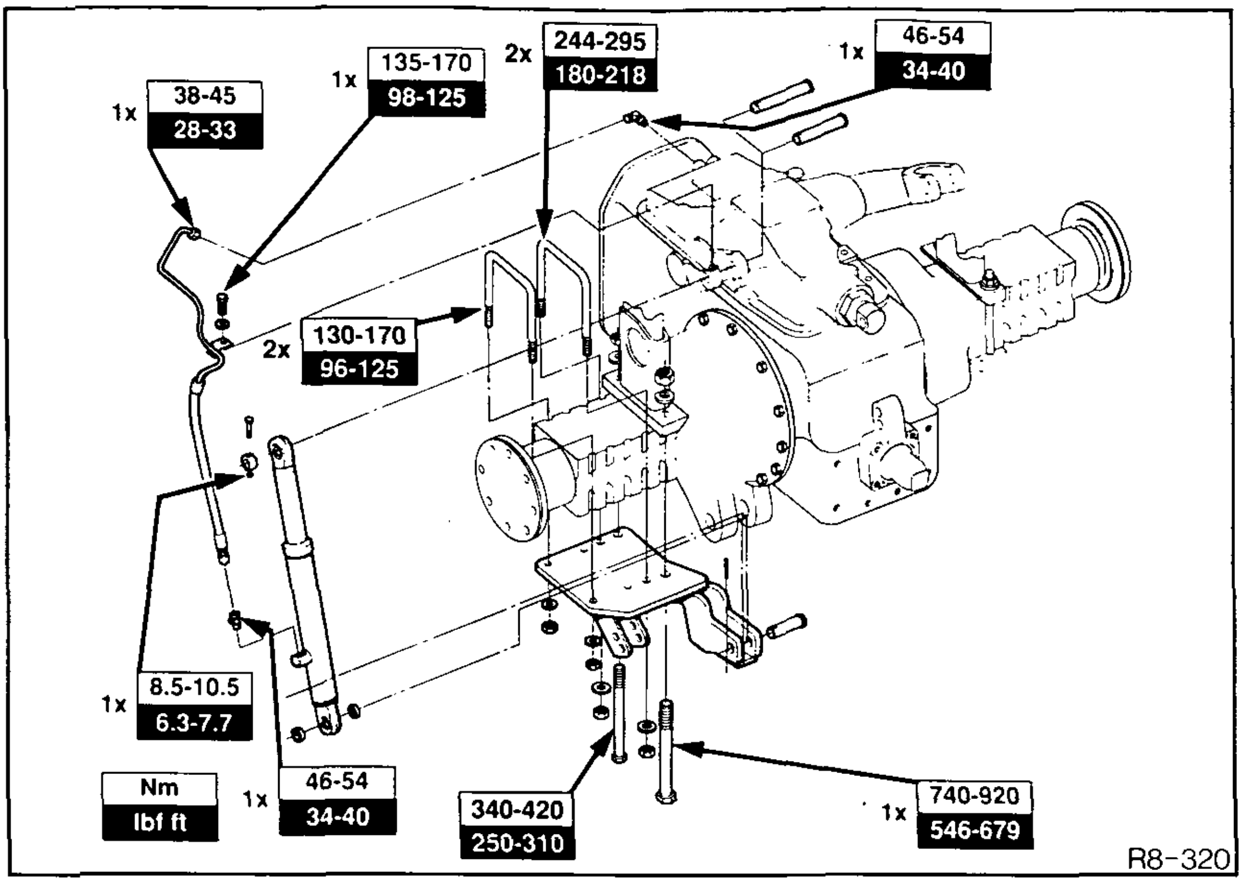
		5640	6640	7740	7840	8240	8340
Without Assist Rams							
at link ends	lb	6712	6712	n/a	n/a	n/a	n/a
	kg	3045	3045	n/a	n/a	n/a	n/a
24 in. to rear of link ends	lb	5190	5190	n/a	n/a	n/a	n/a
	kg	2354	2354	n/a	n/a	n/a	n/a
With One Assist Ram							
at link ends	lb	9904	9904	9904	9904	9904	9904
	kg	4492	4492	4492	4492	4492	4492
24 in. to rear of link ends	lb	7484	7484	7484	7484	7484	7484
	kg	3395	3395	3395	3395	3395	3395
With Two Assist Rams							
at link ends	lb	n/a	n/a	13001	13001	13001	13001
	kg	n/a	n/a	5897	5897	5897	5897
24 in. to rear of link ends	lb	n/a	n/a	9957	9957	9957	9957
	kg	n/a	n/a	4516	4516	4516	4516

Tractors with Variable Displacement Closed Centre Load Sensing (CCLS) Hydraulic Pump @ 2800 lbf/in² (193 bar)

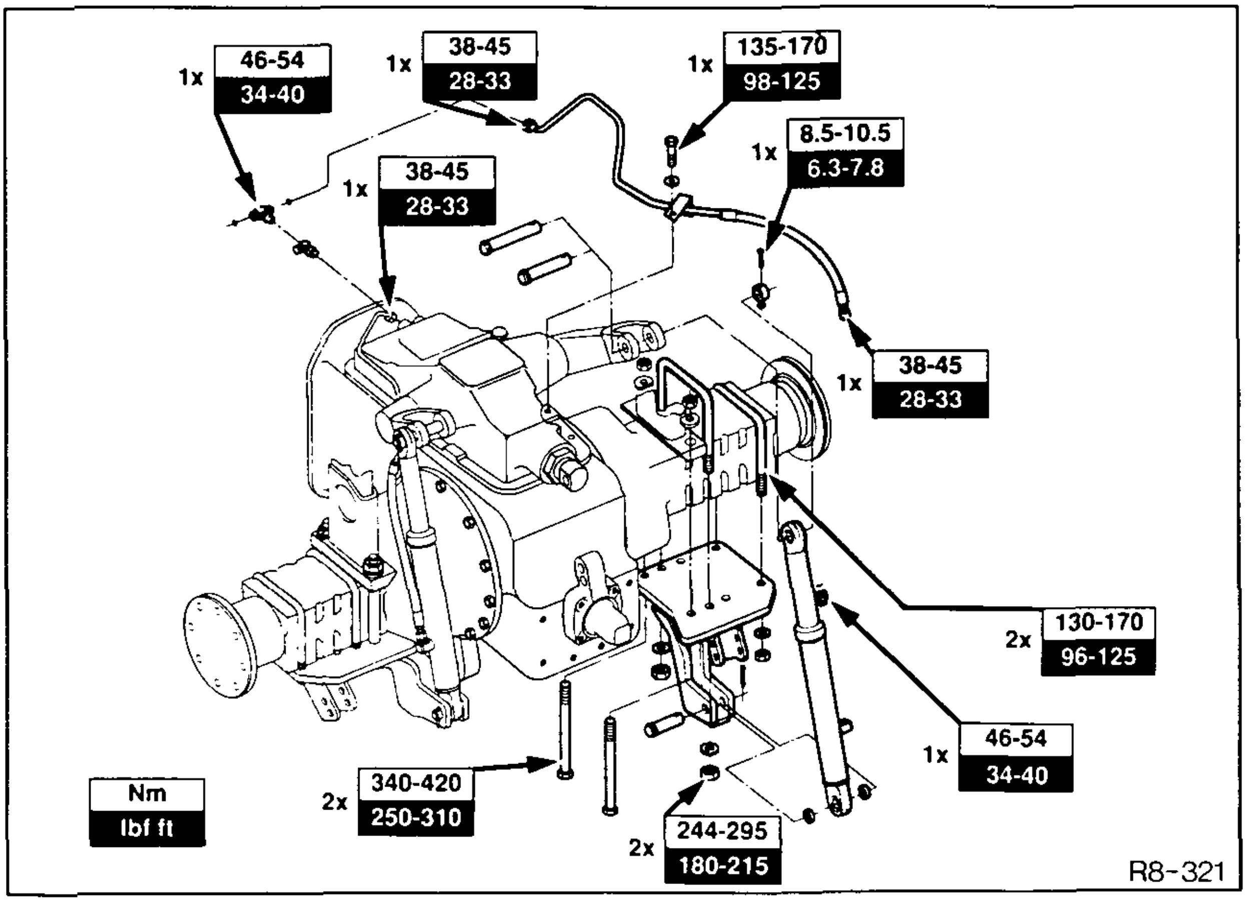
Test results to SAE criteria–links horizontal

		5640	6640	7740	7840	8240	8340
Without Assist Rams							
24 in. to rear of link ends	lb	4439	4439	n/a	n/a	n/a	n/a
	kg	2014	2014	n/a	n/a	n/a	n/a
With One Assist Ram							
24 in. to rear of link ends	lb	6564	6564	6564	6564	6564	6564
	kg	2978	2978	2978	2978	2978	2978
With Two Assist Rams							
24 in. to rear of link ends	lb	n/a	n/a	8710	8710	8710	8710
	kg	n/a	n/a	3950	3950	3950	3950

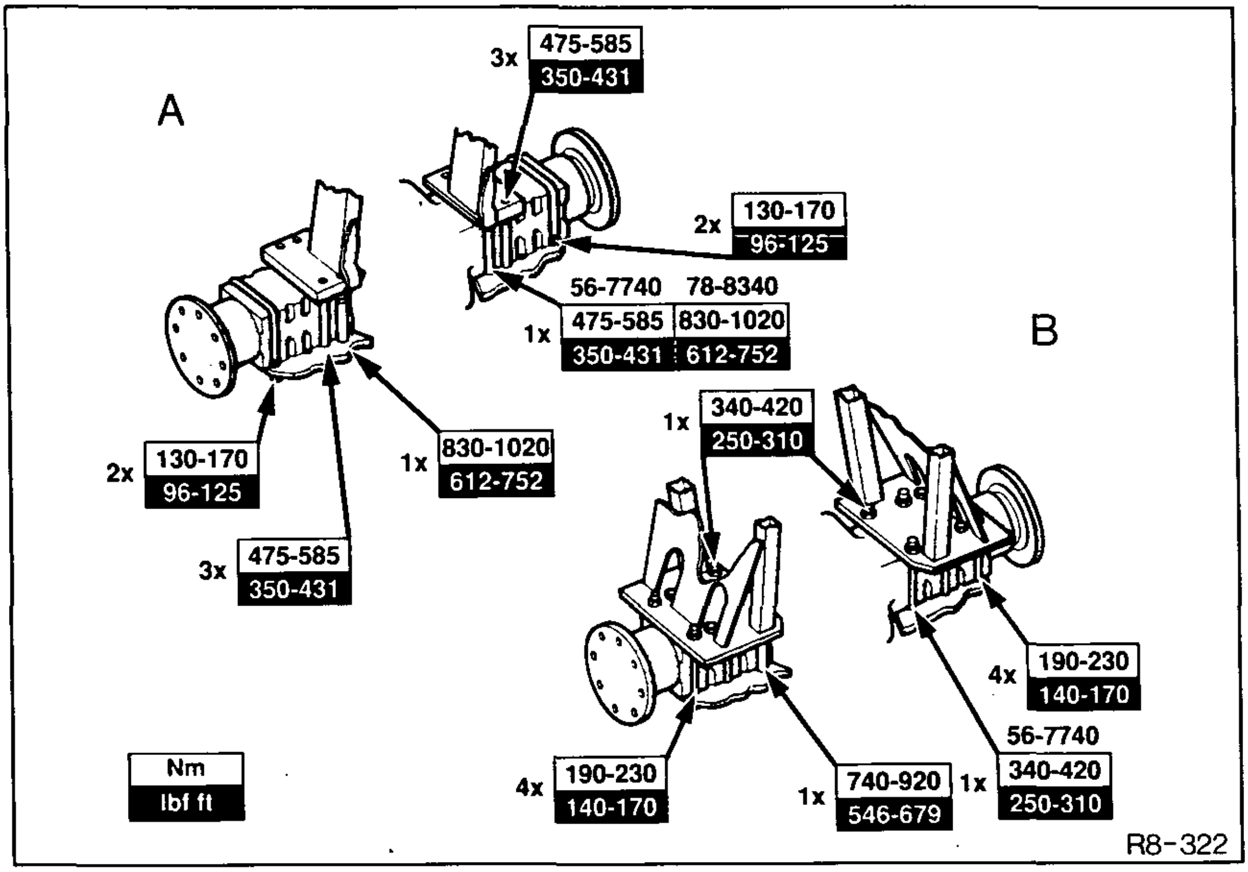
TORQUES



Single Hydraulic Assist Ram and Bracket Installation (With and Less Cab)



Double Hydraulic Assist Ram and Bracket Installation (With and Less Cab)



Assist Ram Mounting Bracket
(Two and Four Post Roll Over Protection Frame)

A. Two Post Roll Over Protection Frame B. Four Post Roll Over Protection Frame

PART 8

HYDRAULIC SYSTEMS

Chapter 9

HYDRAULIC LIFT ASSEMBLY WITH ELECTROLINK™ (ELECTRONIC DRAFT CONTROL) FOR TRACTORS WITH FIXED DISPLACEMENT HYDRAULIC PUMP

⚠ **CAUTION:** *Observe the following precautions when arc welding on tractors installed with electronic draft control*

- Where possible, disconnect the part or implement to be arc welded from the tractor.
- Disconnect both battery cables from the battery. Isolate the cable ends to avoid contact with each other and the tractor.
- Position the welder earth (ground) clamp as close to the welding area as possible.
- If welding is to be carried out in close proximity to the electronic draft control microprocessor then the microprocessor should be removed from the tractor.
- Never allow welding cables to lay on, near or across any electrical wiring or electronic component while welding is in progress.

A. DESCRIPTION AND OPERATION

INTRODUCTION

The closed centre load sensing hydraulic draft control system described in this chapter relates to those tractors installed with electronic draft control and the fixed displacement hydraulic pump.

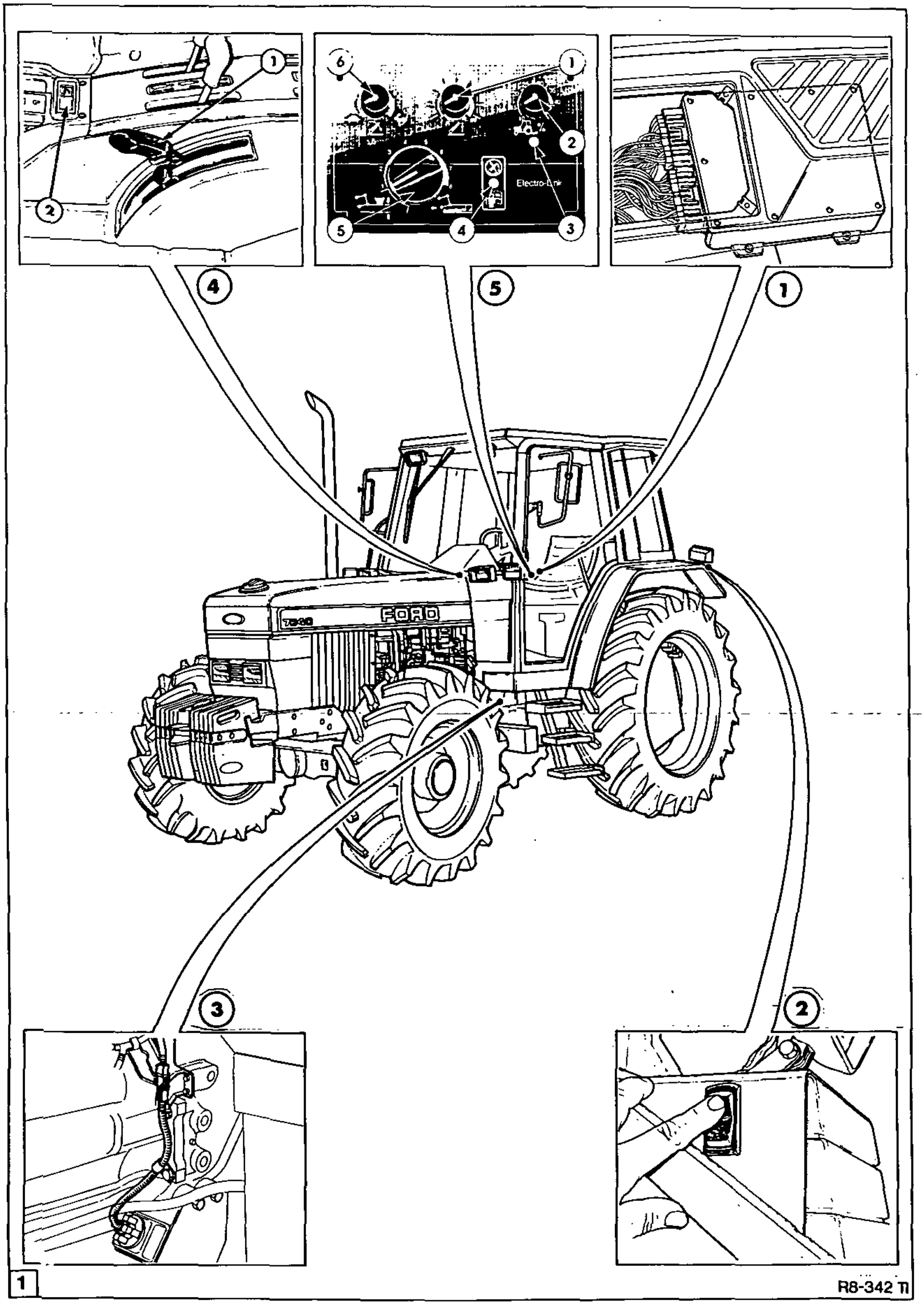
The location of all the components in this electronic draft control hydraulic system are shown in Figure 1 and Figure 2.

The principle of electronic draft control is to sense variations in implement draft using a load sensing pin in each lower link. A microprocessor then translates these variations into electronic signals which operate a control valve to raise and lower the hydraulic links and maintain a constant draft loading.

In addition to maintaining a constant draft loading the system also provides a fully electro–hydraulic method of raising and lowering the hydraulic lift, eliminating the necessity for mechanical linkage between the operator controls, hydraulic control valve and hydraulic lift assembly.

The principal differences between this system and the electronic draft control system released for tractors equipped with the variable displacement closed centre load sensing hydraulic pump are as follows:–

- The fixed displacement Hydraulic Pump
- The priority/unload valve assembly, necessary to interface between the fixed displacement hydraulic pump, hydraulic lift assembly and auxiliary engine mounted pump and hydraulic control valves where fitted.
- The location of the Hydraulic control valve on the tractor.
- The design of microprocessor which is now connected to the system using two multi pin connectors and also controls the functions of the dual power on the 12 x12 transmission.



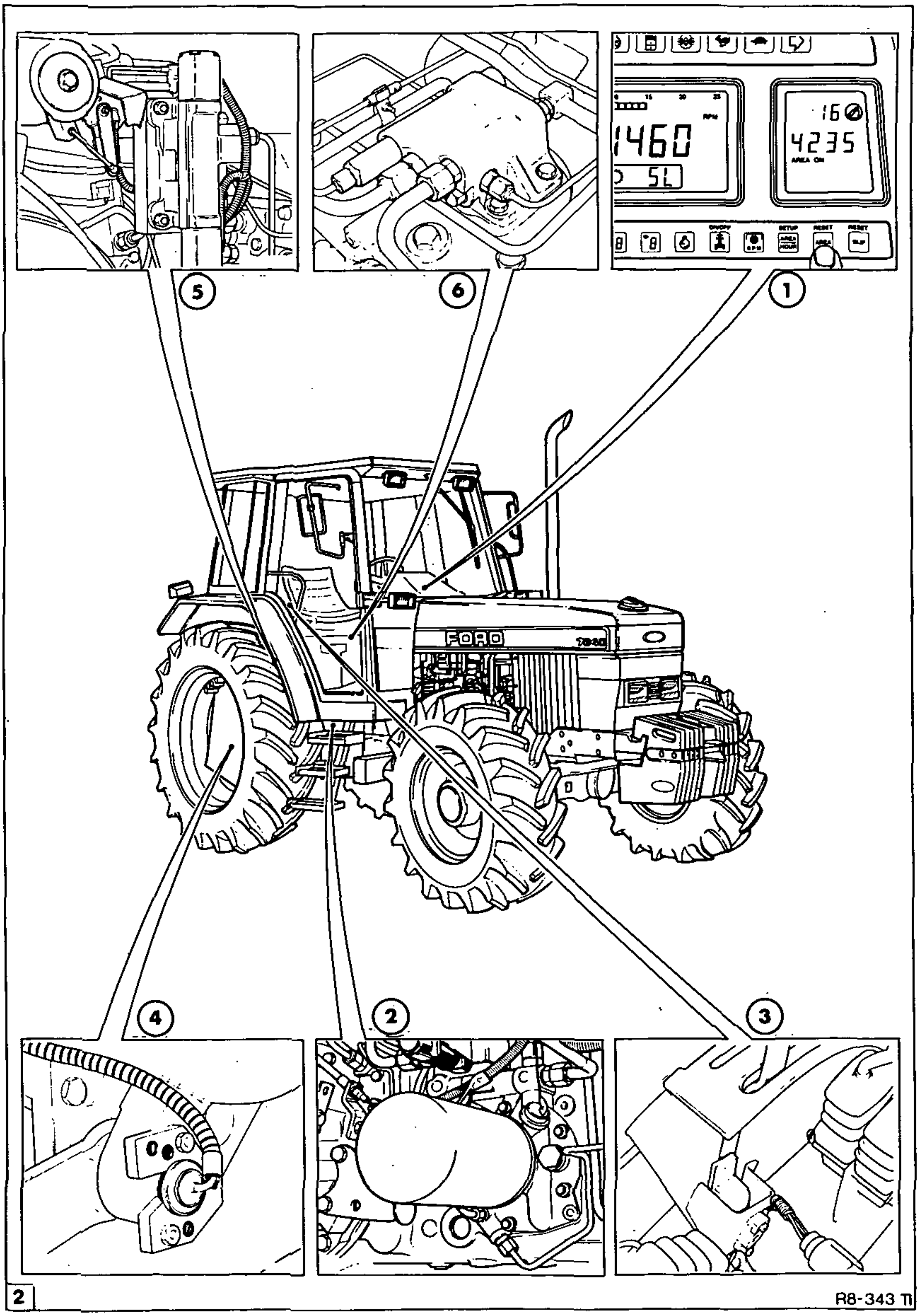
1

R8-342 TI

Electronic Draft Control Hydraulic Layout

1. Microprocessor*
2. Rear Fender External Lift/Lower Switches
3. Performance Monitor Radar
4. Lift Control Levers
5. Operator Control Console

*On Less Cab tractors the microprocessor is located behind the instrument console

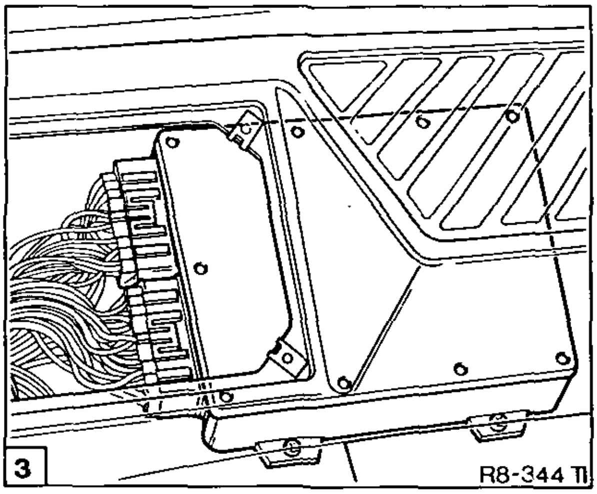


Electronic Draft Control Component Layout 2

1. Instrument Panel
2. Lift Lever Potentiometer
3. *Fixed Displacement Hydraulic Pump*
4. Load Sensing Pin
5. Lift Arm Position Sensing Potentiometer and Electronic Draft Control Valve
6. *Priority/Unload Valve Assembly*

COMPONENT DESCRIPTION

Microprocessor

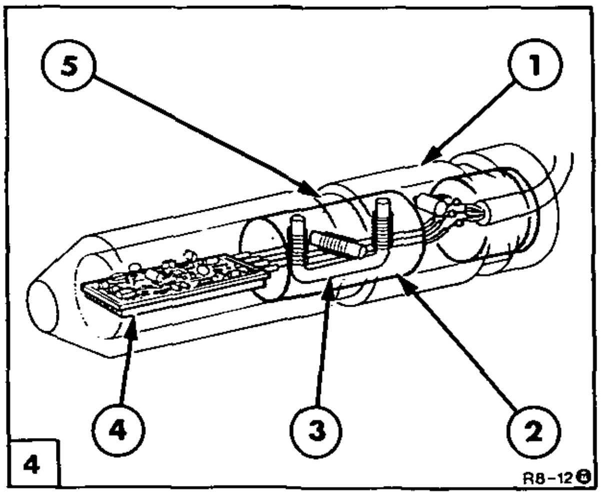


Microprocessor

The microprocessor, Figure 3, controls the electronic draft control system and also controls the 12 x 12 transmission dual power assembly, simultaneously but separately.

Control is maintained by sending, receiving and interpreting signals the other components in the system.

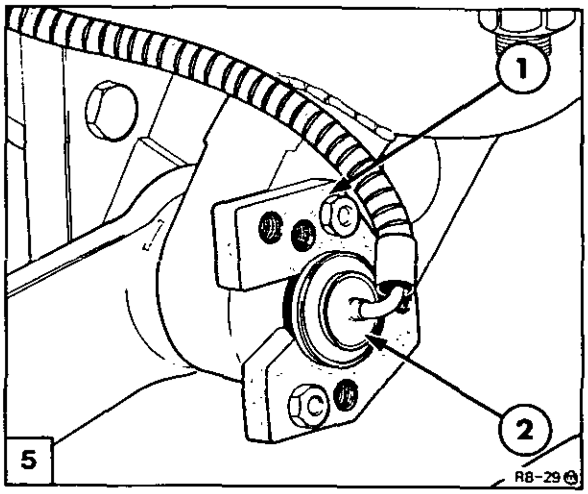
Load Sensing Pins



Load Sensing Pin

1. Metal Tube
2. Load Sensing Core
3. *Wire Coil (3 off)*
4. Circuit Board
5. Waisted Section

The load sensing pins, Figure 4, sense draft variations applied by an implement on the lower links and transmit a signal to the microprocessor.



Load Sensing Pin Installation

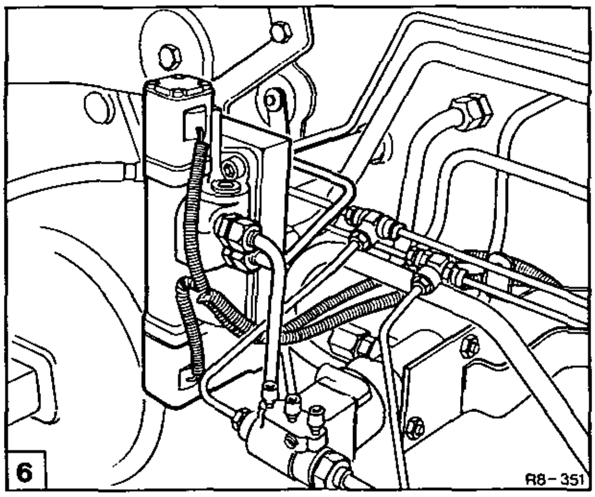
1. Clamp
2. Load Sensing Pin

The operating principal of the pin is to recognise sheer forces in a horizontal plane, applied to the waisted section of the pin by an implements draft. The pin does not react to vertical sheer forces applied by the weight of the implement.

When the pin is subjected to implement draft forces the magnetic field within the pin changes and the signal to the microprocessor is changed.

To ensure the pins are correctly installed and only sense sheer forces in the horizontal plane, a special clamp guarantees correct installation, Figure 5.

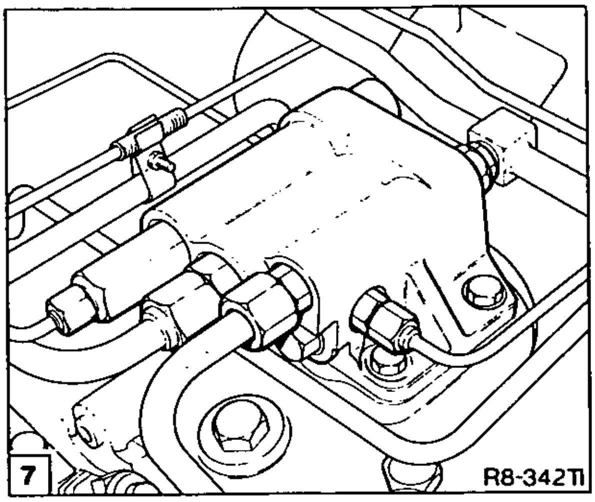
Hydraulic Control Valve



Hydraulic Control Valve Installation

The hydraulic control valve, Figure 6, is a proportional solenoid operated valve which responds to pulse width modulation signals from the microprocessor to direct pump pressure oil to and from the hydraulic lift cylinder.

Priority/Unload Valve Assembly

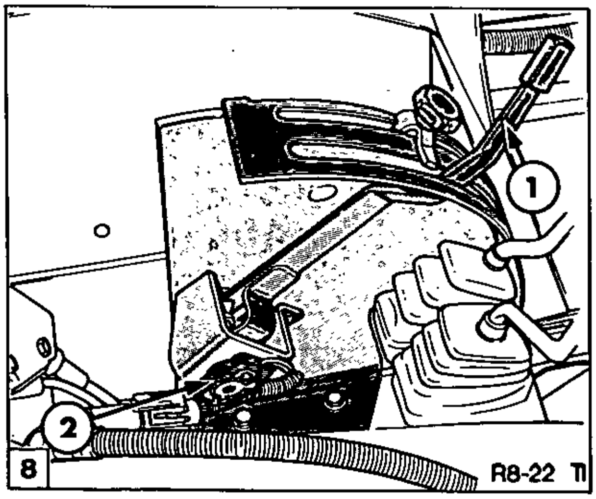


Priority/Unload Valve Assembly

The priority/unload valve assembly, Figure 7, contains both priority/unload and combining/unload (sequencing) valves which directs pump system pressure oil to either the hydraulic control valve, remote control vales or to sump as required.

The combining valve also directs the flow of oil from the engine mounted auxiliary pump to the remote valves or sump as required.

Lift Control Lever Potentiometer

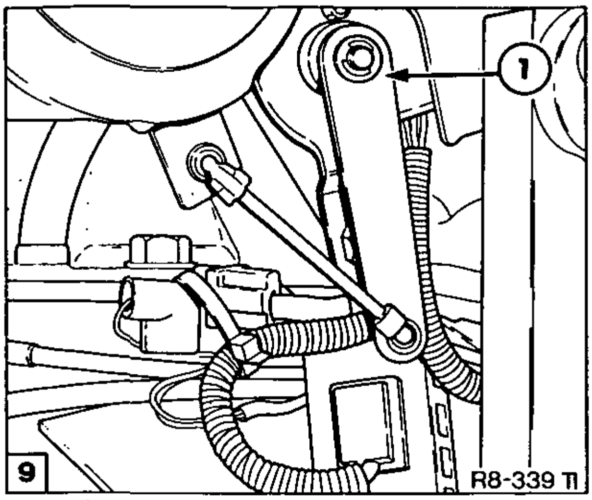


Lift Control Lever Potentiometer

1. Lift Control Lever
2. Potentiometer

The potentiometer on the lift control lever, Figure 8, is used to send a signal to the microprocessor to indicate the position to which the lift arms are to be raised.

Lift Arm Position Sensing Potentiometer



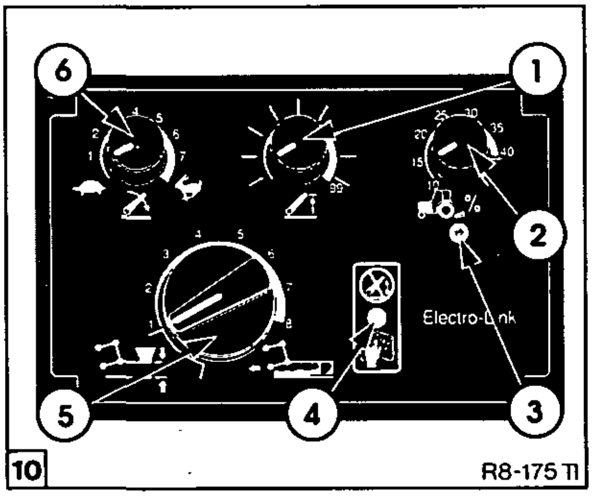
Lift Arm Position Sensing Potentiometer

1. Potentiometer

The potentiometer on the lift arm, Figure 9, is used to send a signal to the microprocessor to indicate when the arms have reached the required height.

NOTE: *If either the lift lever or lift arm potentiometer fails, control of the system is transferred to the external fender switches.*

Hydraulic Control Panel



Hydraulic Control Panel

1. Height Limit Control
2. Slip Limit Control (option)
3. Slip Limit 'On' Indicator
4. Status Indicator
5. Position/Draft Sensitivity Knob
6. Drop Rate Control Knob

The electronic draft and position control system is operated from a console to the right of the operator's seat, Figure 10. Each of the variably adjustable controls is directly attached to a potentiometer. When the control is rotated the potentiometer resistance is varied, changing the input signal to the microprocessor.

The function of each of the controls is as follows:–

The position/draft sensitivity knob selects full position control, maximum draft control or a mixture of the two allowing sensitivity in draft control according to operating needs.

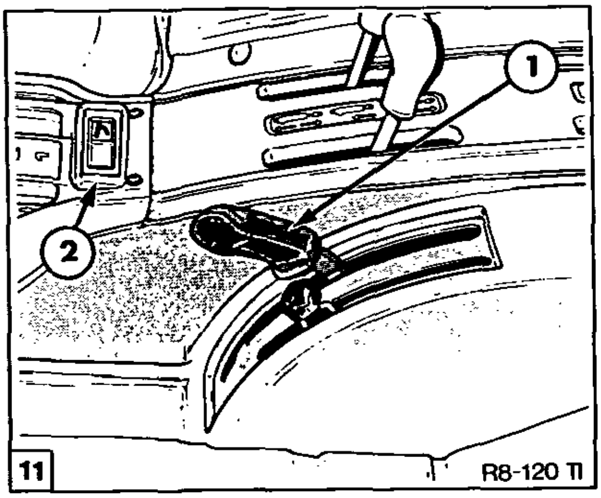
The drop rate control is provided to limit the rate of drop of the hitch and functions whenever the implement is raised out of the ground.

The height limit control restricts the maximum height the lift arms can be raised, to prevent large implements from striking the rear of the cab or platform. This control restricts the lift height when either the lift control lever, in cab fast raise/lower switch or external lift/lower switches are used.

The slip limit control (where fitted) limits the amount of wheel slip. The indicator light is illuminated when the lift arms are responding to an excessive slip condition.

The status indicator is flashed when a malfunction identified by the microprocessor occurs in the system. The status indicator is continuously illuminated when the hitch is disabled.

Hydraulic Lift Controls



Hydraulic Lift Controls

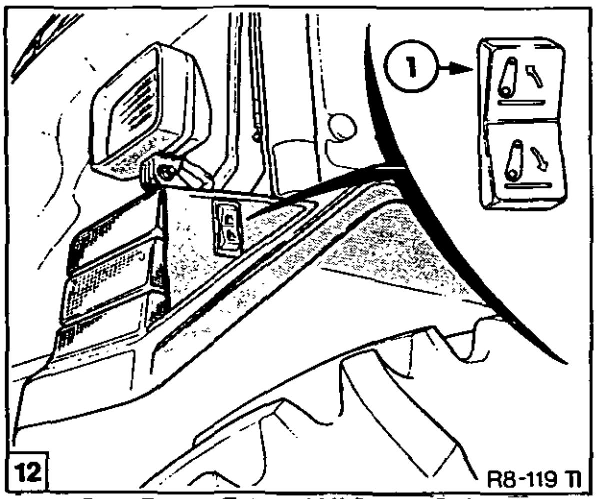
1. *Lift Control Lever*
2. In Cab Fast Raise/Lower Switch

Raising and lowering of the lift arms is controlled by a low effort lever in the right hand console, Figure 11.

A rocker switch is also provided for rapid raising and lowering of the lift arms.

NOTE: *The raise/lower switch will not lower the implement if the tractor speed is greater than 15 MPH (24 km/h).*

Rear Fender External Lift Lower Switches

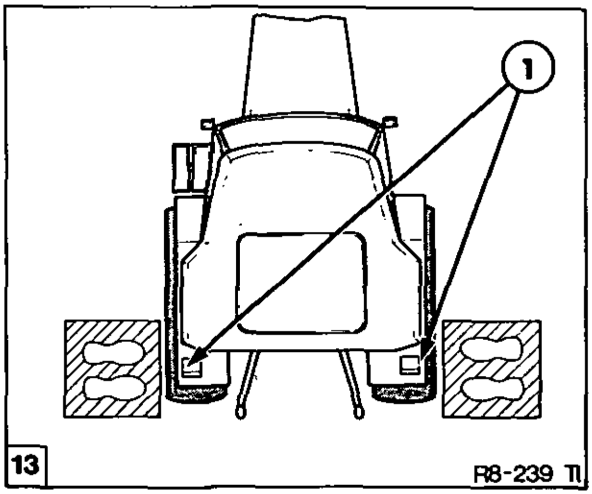


Rear Fender External Lift/Lower Switch

1. Three Position Fender Switch

These externally operated switches allow the hydraulic linkage to be raised or lowered by the operator while standing beside the tractor, so aiding attachment and detachment of implements.

Pushing the lift lever fully forward past the fixed stop, transfers control of the lift linkage to the rear fender mounted switches.



Fender Switch Operating Positions

1. Fender Switch Location

When using the external switches to operate the hydraulic lift the following precautions must be observed.

Never operate the external switches while standing:

- *Directly behind the tractor or tyres*
- *Between the lower links*
- *On or near the implement*

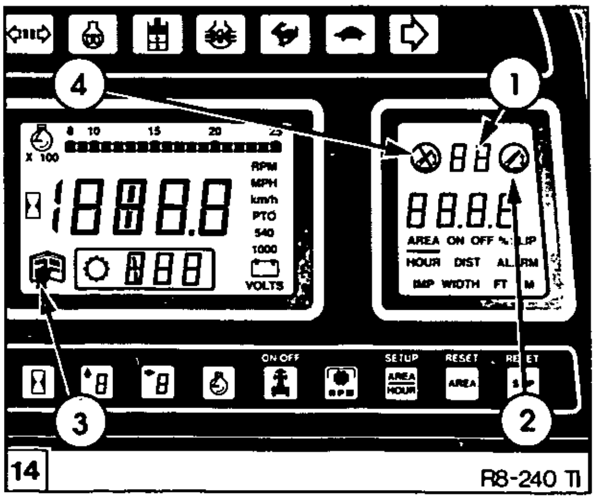
Never extend arms, legs, any other part of the body or any object into the area near the 3–point linkage or implement while operating the external switch.

*Never have an assistant working the opposite set of controls. When moving to the opposite set of controls, move around the tractor or implement. Do **not** cross between the implement and tractor.*

Instrument Panel

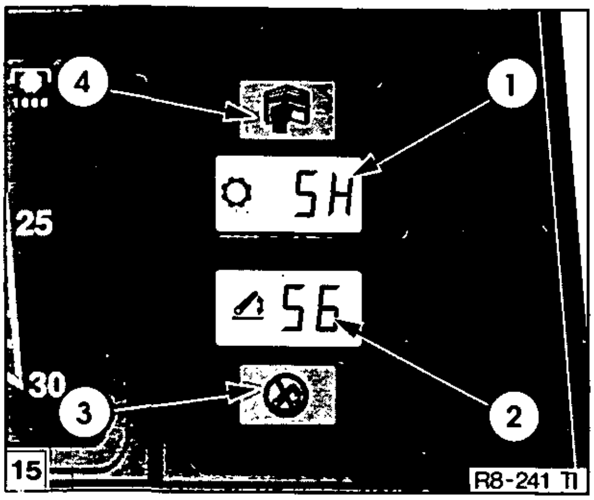
Either an electronic or analogue electronic instrument panel may be fitted to the tractor and incorporate the following functions to advise on the status of the hydraulic lift assembly. Refer to Figure 14 and Figure 15.

- Implement Position Display
- Hitch enabled Symbol (Electronic instrument panel only)
- Hitch Disabled Symbol
- Read Your Manual Symbol
- Diagnostic Error Code



Electronic Instrument Panel

1. Implement Position/Diagnostic Repair Code (LCD)
2. Hitch Enabled Symbol (LCD)
3. 'Read Your Manual' Symbol (LCD)
4. Hitch Disabled Symbol (LCD)



Analogue Electronic Instrument Panel

1. Malfunction Warning Light
2. Implement Position/Diagnostic Repair Code (LCD)
3. Hitch Disabled Warning Light
4. 'Read Your Manual' Light

Implement Position Display

The digital display indicates the position of the lift arms on the scale of 0 (fully lowered) to 99 (fully raised).

Hitch enabled Symbol

The hitch enabled symbol on the electronic instrument panel, illuminates when the position of the lift arms is in phase to the position of the lift control lever.

Hitch Disabled Symbol

The hitch disabled symbol is illuminated if the lift arms and lift control lever are out of phase.

This will occur if:–

(i) The lift control lever has been inadvertently moved whilst the engine is stopped.

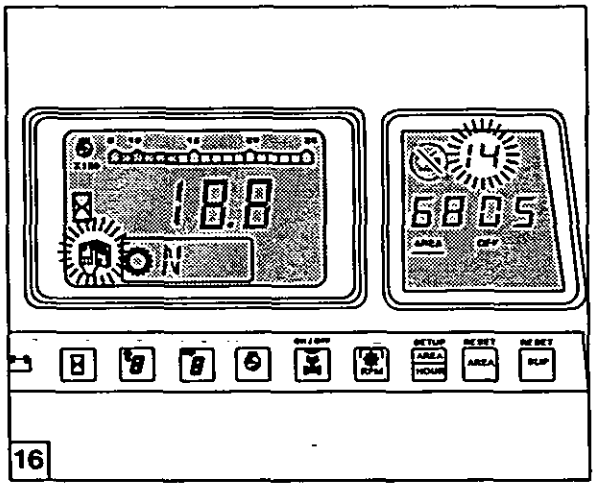
(ii) The lift control lever has been pushed fully forward in order to transfer control of the hydraulic lift to the external switches.

To realign the lift arms and lift lever, pull the lever fully forward and then slowly rearward until the hitch disabled symbol disappears. This operation is termed 'capturing the lift'.

Diagnostic Repair Code

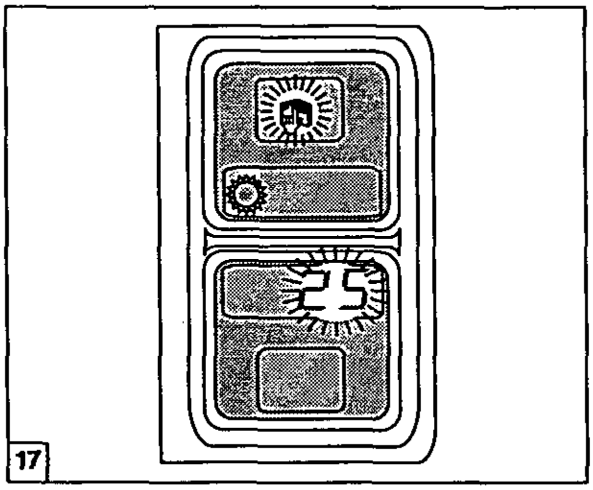
Tractors installed with electronic draft control also have a self diagnostic fault finding capability. If a malfunction occurs in the system, a 'flashing' two–digit diagnostic repair code, together with the flashing 'Read your Manual' symbol will be displayed on the instrument panel, Figure 16 and Figure 17.

Refer to Section B, Fault Finding, for further details on error code display and a detailed list of error codes.



16

Electronic Draft Control Error Code Display (Electronic Instrument Panel Shown)



17

Electronic Draft Control Error Code Display Analogue Electronic Instrument Panel Shown)

HYDRAULIC OPERATION AND CIRCUITS

Figure 18, illustrates in a block schematic form the flow of electronic signals to and from the hydraulic system, to raise and lower the hydraulic lift in accordance with operator position and draft control requirements.

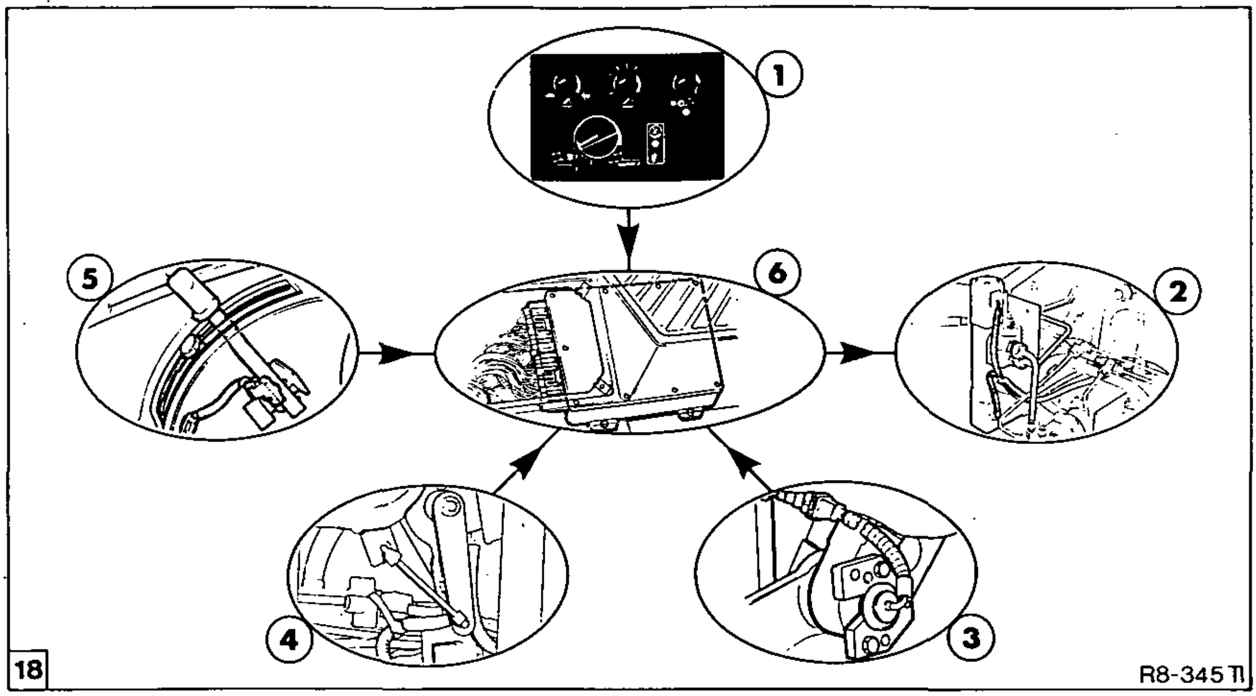
Electronic signals to the microprocessor for raising and lowering the hydraulic lift assembly in accordance with position and draft control requirements, are received from four main sources. These are the lift control lever and the lift arm position sensing potentiometer, the two load sensing draft control pins in the lower links and the draft/position sensitivity controls on the hydraulic control panel.

Additional signals from the drop rate and maximum lift height controls and wheel slip control (where fitted) also contribute towards the computation of the input signal.

When the lift control lever is moved to raise or lower the lift arms, the resistance of the potentiometer at the base of the lever changes and is sensed by the microprocessor. The processor transmits a revised signal to the hydraulic lift control valve, which raises or lowers the hydraulic lift accordingly.

As the position of the lift arms changes a feedback signal is received by the microprocessor from the lift arm position sensing potentiometer

When the lift arms have moved to the required position the control signal from the microprocessor to the control valve is turned 'Off' and the lift arms are held in position.



Position/Draft Control Schematic

1. Position/Draft Sensitivity Mix Control on Operator Control Panel
2. Solenoid Operated Hydraulic Control Valve
3. Implement Draft Feedback Signal from Load Sensing Pins
4. Hydraulic Lift Arm Position Feedback Signal from Lift Arm Position Sensing Potentiometer
5. Lift Control Lever
6. Microprocessor (Computes Input Signal to Solenoid Operated Hydraulic Control Valve)

When draft control is selected, draft forces imposed by the implement through the lower links are sensed by the two special load sensing pins.

The average of these draft load signals from each pin is calculated by the microprocessor and compared with the draft control setting selected using the operator control panel.

If the implement draft begins to increase beyond the range selected by the operator, the microprocessor transmits a revised pulse width modulated signal to the control valve which adjusts the implement depth and maintains the specified draft loading.

When a tractor is operated in draft control and under poor traction conditions, the situation can arise where as the tyres slip, the ground speed and draft forces on the load sensing pins reduce. In this situation the reduction in draft forces would signal the microprocessor to continue increasing implement depth to such an extent that it may ultimately stop the tractor from moving forward.

The 'limited slip' option prevents this situation from occurring and uses the microprocessor to calculate the percentage of wheel slip by comparing the tractor ground speed and axle speed.

When wheel slip exceeds the value set by the operator the control valve raises the lift arms, irrespective of draft loading, until the maximum accepted wheel slip is restored.

HYDRAULIC SYSTEM SCHEMATIC

The hydraulic system schematic for tractors with fixed displacement hydraulic pump and electronic draft control is shown in Figure 19.

Main hydraulic pump pressure oil flows to the priority/unload valve assembly through internal oil galleries in the centre housing and hydraulic top cover. A feed tube which intersects the gallery in the top cover, also permits pump pressure oil flow to the hydraulic control valve on the side of the tractor.

The pilot pressure line supplies low pressure circuit oil at 220–240 lbf/in^2 (15.2–16.8 bar) from the tractor low pressure circuit for operation of the main spool in the hydraulic control valve.

The priority/unload valve directs main pump system pressure oil flow to either the hydraulic lift system or remote control valves and return to sump circuits as required.

The load sensing line from the control valve signals the priority/unload valve to increase pump flow to the control valve whenever the hydraulic lift is operated.

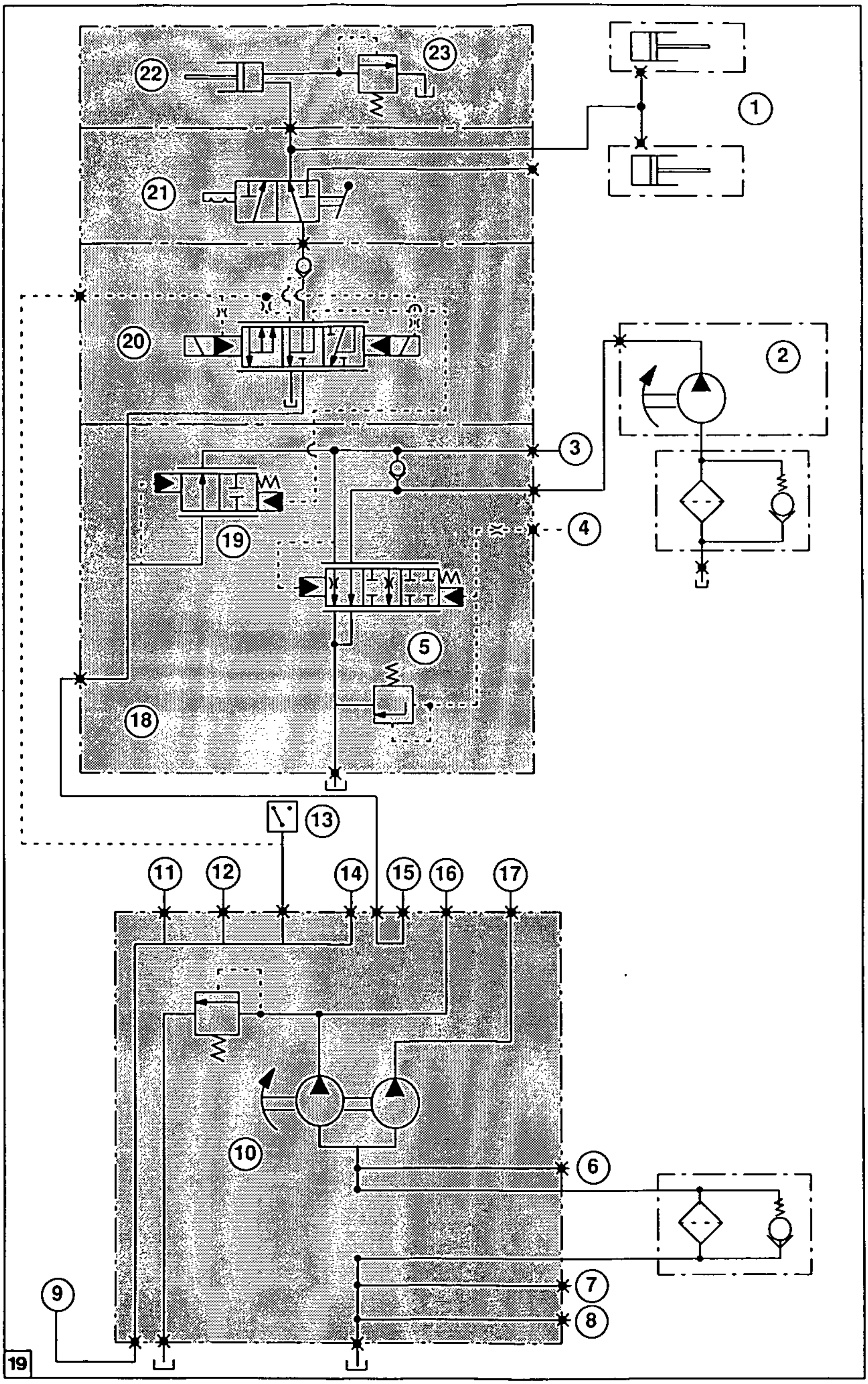
The combining valve combines the flow of main pump oil passing through the priority/unload valve with the output from the engine mounted auxiliary pump. This combined oil flow is used to supply the remote valve circuits and any excess flow is returned to sump through the combining valve.

NOTE: *The hydraulic lift always has priority over simultaneous operation of the remote valves.*

Figure 19

Hydraulic Circuit – Electronic Draft Control with Fixed Displacement Hydraulic Pump

1. Auxiliary Assist Rams (Where Fitted)
2. Auxiliary Engine Mounted Pump (Where Fitted)
3. Feed to Remote Valve Assembly
4. Load Sensing Line from Remote Valve Assembly
5. Combining/Unload (Sequencing) Valve
6. Blocked Filter Vacuum switch
7. Low Oil Temperature Switch
8. High Oil Temperature Switch
9. Feed to P.T.O. Valve
10. Fixed Displacement Hydraulic Pump Assembly
11. Feed to Four Wheel Drive Valve
12. Feed to Differential Lock Valve
13. Transmission Oil Pressure Switch
14. Return from Steering Motor
15. Return from Trailer Brake Valve
16. Feed to Trailer Brake Valve
17. Feed to Steering Motor
18. Priority/Unload Valve Assembly
19. Priority/Unload Valve
20. Electronic Draft Control Valve
21. Auxiliary Services Control Valve
22. Hydraulic Lift Assembly
23. Lift Cylinder Relief Valve



Hydraulic Circuit – Electronic Draft Control with Fixed Displacement Hydraulic Pump

Hydraulic Lift in Neutral

With reference to Figure 20

When the hydraulic lift arms are held in a stationary position, the hydraulic lift control valve is in 'Neutral' and the microprocessor is not sending raise or lower signals to the control valve solenoids.

In the neutral condition the spring force applied to each end of the main spool holds the spool in a central position, preventing oil flow from the main pump through the control valve to the hydraulic lift.

When the main spool is in neutral, the right hand end of the load sensing valve and hence the load sensing line are open to sump. In this condition the hydraulic lift load check valve remains seated and oil in the hydraulic lift cylinder is trapped maintaining the lift arms in a stationary position.

Because the hydraulic control valve load sensing line is open to sump the flow of oil from the main hydraulic pump acts on the right hand end of the priority/unload valve, causing the valve to move to the left.

All main pump oil now flows past the priority/unload valve to the remote valve circuits which are also supplemented with the output from the auxiliary engine mounted hydraulic pump.

Pump flow in excess of any remote valve demand, acts on the left hand end of the combining valve, causing the valve to move towards the right. Excess oil flow from both the main and auxiliary pumps then flows through the combining valve to sump through the exhaust port in the base of the housing.

Figure 20

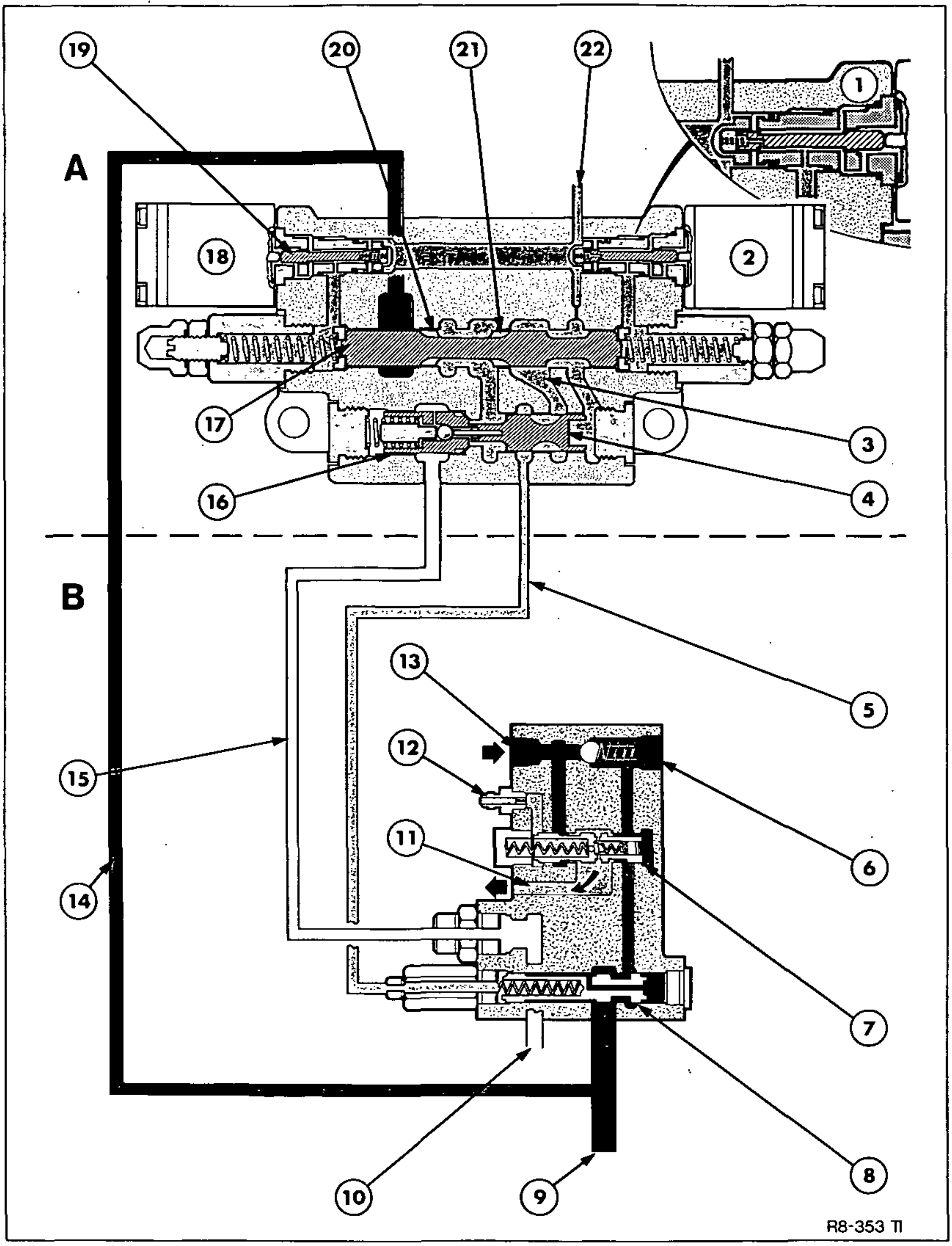
Electronic Draft Control Operation–Neutral

A. Hydraulic Control Valve

1. Pilot Spool
2. Solenoid (Raise)
3. Return to Sump Port
4. Load Sensing Valve
5. Load Sensing Line From Hydraulic Control Valve
6. To Remote Valves
7. Combining/Unload (Sequencing) Valve
8. Priority/Unload Valve
9. Pump System Pressure Inlet
10. To Hydraulic Lift
11. Return to Sump
12. Load Sensing Line from Remote Valves

B. Priority/Unload Valve Assembly

13. From Auxiliary Pump
14. System Pressure From Main Pump
15. To Hydraulic Lift via Gallery in Priority/Unload Valve Housing
16. Load Check Valve.
17. Main Spool
18. Solenoid (Lower)
19. Pilot Spool
20. Main Spool Inlet Metering Land
21. Main Spool Return To Sump Metering Land
22. Pilot Pressure Inlet



ELECTRONIC DRAFT CONTROL OPERATION – NEUTRAL

A Hydraulic Control Valve

B Priority/Unload Valve Assembly

■ Main Pump Pressure Oil

■ Auxiliary Pump Oil

□ Trapped Oil

▨ Pilot Pressure Oil 220 – 240 lbf/in² (15.2 – 16.8 bar)

▒ Exhaust Oil

Raising

With reference to Figure 21.

When the lift control lever is moved to the raise position the lift control lever potentiometer sends a signal to the microprocessor and then to the raise solenoid of the control valve.

The armature in the solenoid reacts to the signal and the pilot spool is moved to the left, allowing pilot pressure to be applied to the right hand end of the main spool.

The main spool moves to the left allowing pump system pressure oil to flow past the main spool inlet metering land to the load check and load sensing valves.

The flow of oil to the load sensing valve moves the valve to the right, blocking the return to sump gallery and allowing a sensing pressure to be applied to the right hand end of the priority/unload valve.

The pressure in the load sensing line, together with the spring pressure applied to the left hand end of the priority/unload valve moves the valve towards the right directing increased pump flow and system pressure to the hydraulic control valve.

The increase in pressure opens the load check valve and oil passes through to the lift cylinder.

The rate of lift is controlled by the modulated signal to the raise solenoid which by opening and closing the pilot valve allows the main spool to oscillate and continually adjust the volume of metered oil to the lift cylinder.

When the hydraulic lift is being operated in draft control the microprocessor similarly sends a signal to the raise solenoid whenever the implement draft exceeds that set by the operator using the draft/position control. The hydraulic lift will then raise until the required implement draft forces are restored.

Figure 21

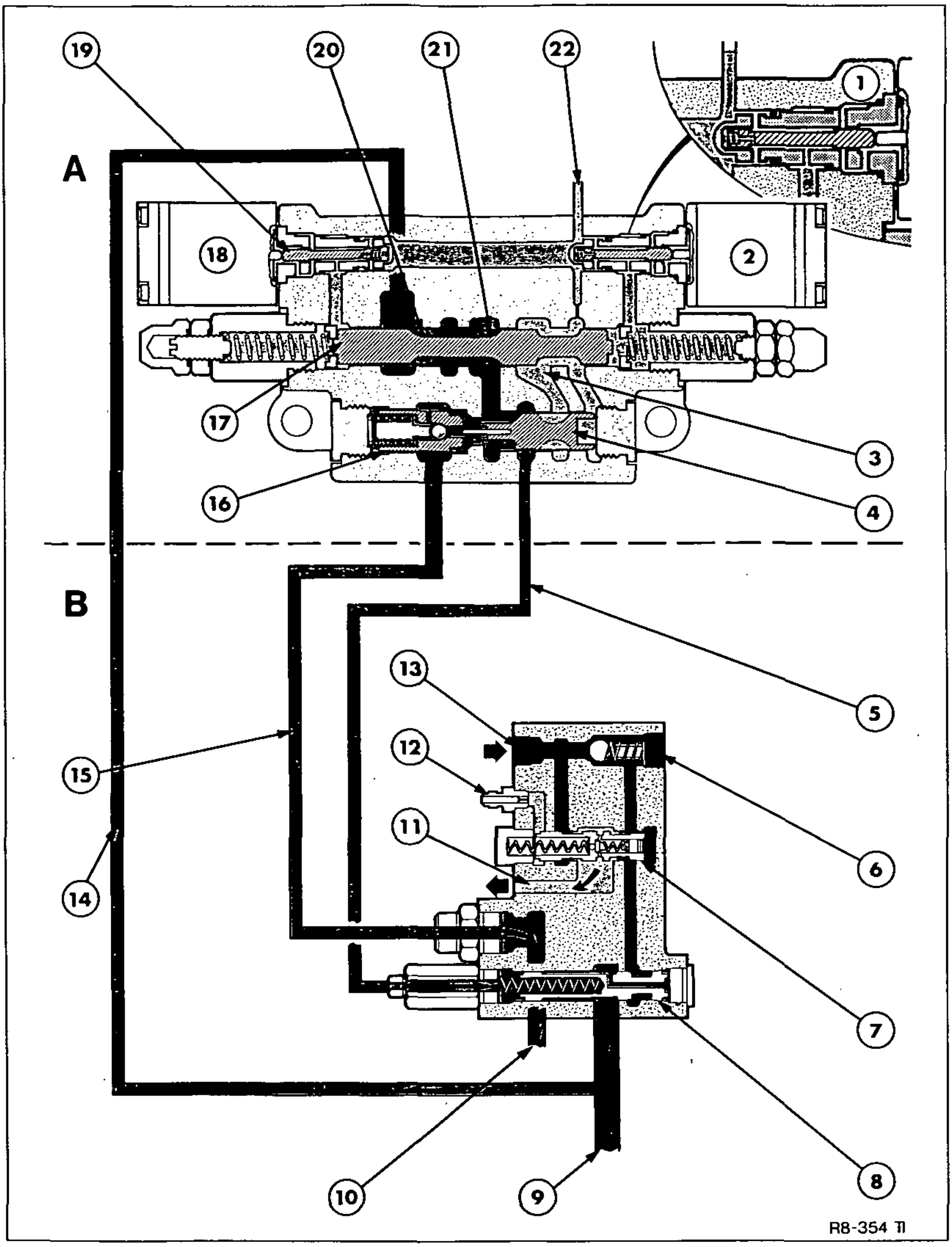
Electronic Draft Control Operation–Raising

A. Hydraulic Control Valve

1. Pilot Spool
2. Solenoid (Raise)
3. Return to Sump Port
4. Load Sensing Valve
5. Load Sensing Line From Hydraulic Control Valve
6. To Remote Valves
7. Combining/Unload (Sequencing) Valve
8. Priority/Unload Valve
9. Pump System Pressure Inlet
10. To Hydraulic Lift
11. Return to Sump
12. Load Sensing Line from Remote Valves

B. Priority/Unload Valve Assembly

13. From Auxiliary Pump
14. System Pressure From Main Pump
15. To Hydraulic Lift via Gallery in PriorityUnload Valve Housing
16. Load Check Valve
17. Main Spool
18. Solenoid (Lower)
19. Pilot Spool
20. Main Spool Inlet Metering Land
21. Main Spool Return To Sump Metering Land
22. Pilot Pressure Inlet



ELECTRONIC DRAFT CONTROL OPERATION – RAISING

A Hydraulic Control Valve

B Priority/Unload Valve Assembly

■ Main Pump Pressure Oil

■ Auxiliary Pump Oil

▩ Pilot Pressure Oil 220 – 240 lbf/in^2 (15.2 – 16.8 bar)

▨ Exhaust Oil

LOWERING

With reference to Figure 22.

When the lift control lever is moved to the lower position, the lift control lever potentiometer sends a signal to the microprocessor and then to the lower solenoid of the control valve.

The armature in the solenoid reacts to the signal and the pilot spool is moved to the right, allowing pilot pressure oil to be applied to the left hand end of the main spool.

The main spool now moves to the right allowing pilot pressure oil to flow to the right hand face of the load sensing valve.

The load sensing valve now moves to the left, venting the load sensing line to sump, while at the same time the pin on the end of the valve unseats the ball in the end of the load check valve.

With the ball unseated, oil behind the load check valve vents to sump enabling the load sensing valve to continue moving to the left and unseat the load check valve poppet.

The pressurised oil in the lift cylinder can now return to sump across the return to sump metering land of the main spool allowing the arms to lower at a controlled speed.

The rate of lowering is once again controlled by the modulated signal to the lower solenoid which by opening and closing the pilot valve allows the main spool to oscillate and continually adjust the volume of metered oil returning to sump from the lift cylinder.

During the lowering cycle, the load sensing line to the priority/unload valve is vented to sump enabling main pump system pressure to move the valve to the left.

Main pump pressure oil now flows past the priority/unload valve and returns to sump through the combining/unload valve.

Figure 22

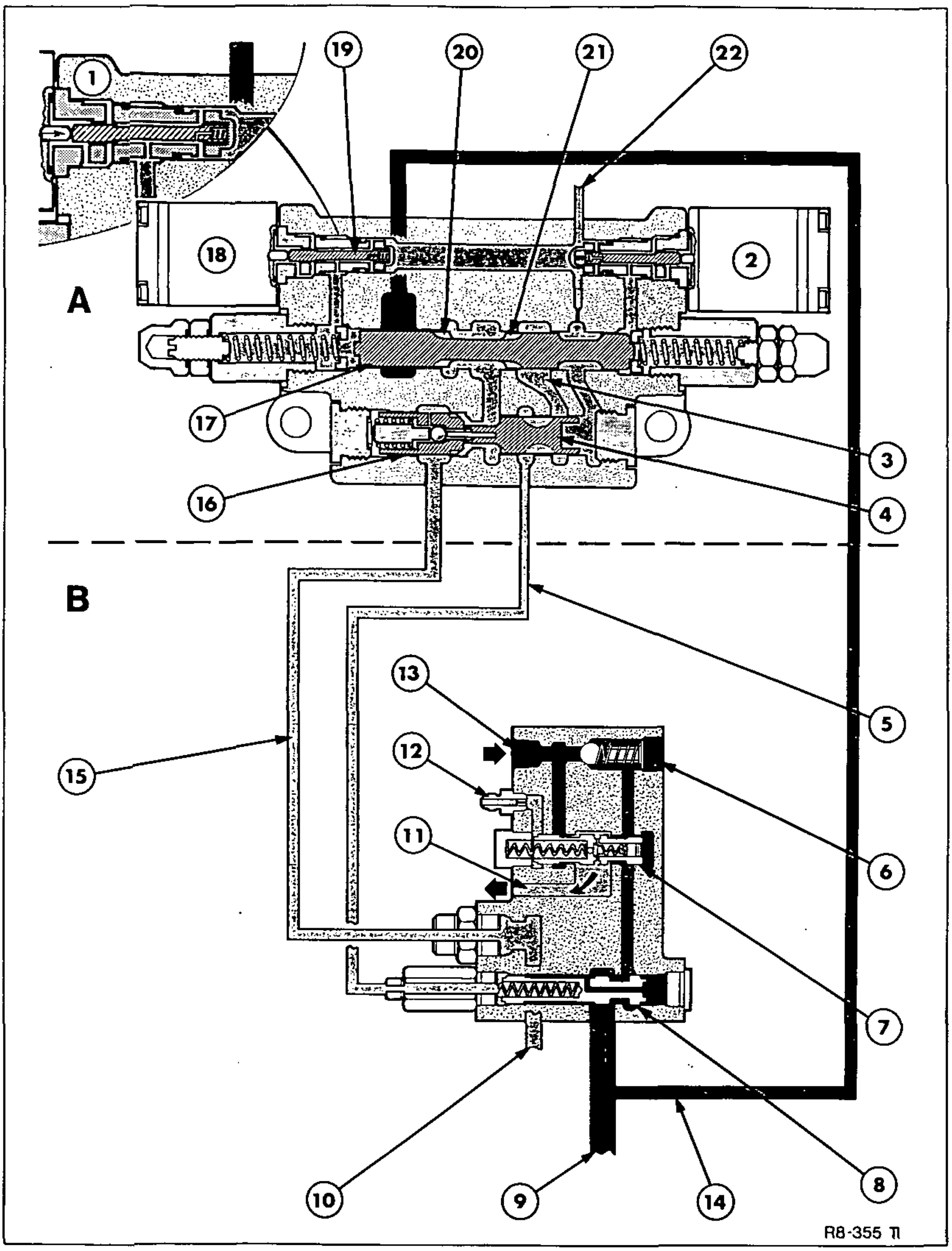
Electronic Draft Control Operation–Lowering

A. Hydraulic Control Valve

1. Pilot Spool
2. Solenoid (Raise)
3. Return to Sump Port
4. Load Sensing Valve
5. Load Sensing Line From Hydraulic Control Valve
6. To Remote Valves
7. Combining/Unload (Sequencing) Valve
8. Priority/Unload Valve
9. Pump System Pressure Inlet
10. To Hydraulic Lift
11. Return to Sump
12. Load Sensing Line from Remote Valves

B. Priority/Unload Valve Assembly

13. From Auxiliary Pump
14. System Pressure From Main Pump
15. To Hydraulic Lift via Gallery in Priority/Unload Valve Housing
16. Load Check Valve
17. Main Spool
18. Solenoid (Lower)
19. Pilot Spool
20. Main Spool Inlet Metering Land
21. Main Spool Return To Sump Metering Land
22. Pilot Pressure Inlet



ELECTRONIC DRAFT CONTROL OPERATION – LOWERING

A Hydraulic Control Valve

▨ Main Pump Pressure Oil

■ Auxiliary Pump Oil

B Priority/Unload Valve Assembly

▨ Pilot Pressure Oil 220 – 240 lbf/in² (15.2 – 16.8 bar)

▨ Exhaust Oil

B. FAULT FINDING AND REPAIR

Tractors installed with electronic draft Control are equipped with two separate systems to assist in the detection and correction of faults in the system.

These are:–

- Self Diagnostic Error Code Display
- Service Diagnostic Test Routines

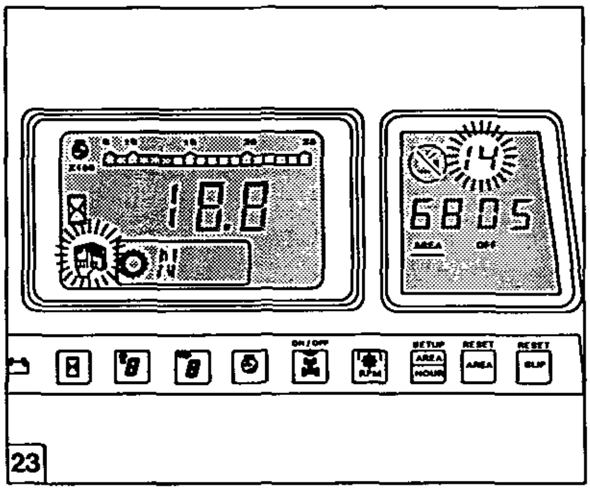
Fault finding should be carried out in a logical and methodical fashion. A few minutes spent understanding the system and analysing the complaint can save considerable time.

Prior to performing checks for continuity or short circuit, a visual inspection of the wiring to identify any obvious damage is recommended.

An essential piece of equipment for checking electronic systems is a good quality multi–meter with an input impedance of at least 20,000 ohms which can measure voltage, current and resistance.

SELF DIAGNOSTIC ERROR CODE DISPLAY

Electrical failures in the electronic draft control system are detected by the microprocessor and displayed as a flashing two digit error code on the right hand display of the instrument panel instrument panel along with the 'Read Your Manual' symbol. Refer to Figure 23 and Figure 24.



Electronic Draft Control Error Code Display
(Electronic Instrument Panel)

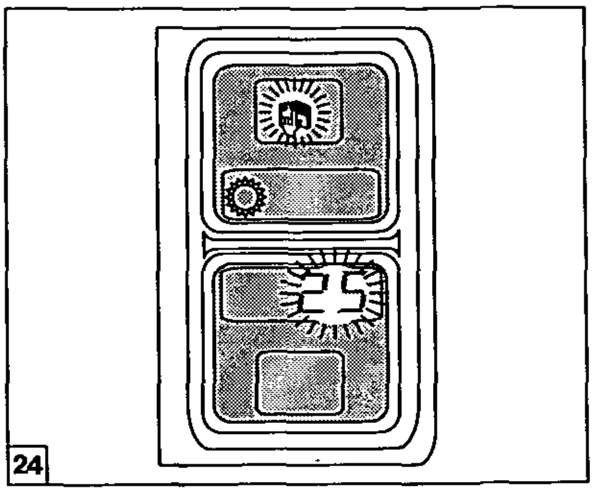
When an error code is displayed refer to the error code listing on Page 25. This gives a brief description of the fault and identifies the Page in this Section where a comprehensive fault finding chart for the error can be found.

Should more than one error occur simultaneously on the tractor, the most important error is displayed until repaired. Outstanding faults will then be displayed in an order of priority until all faults are cleared.

NOTE: *Upon completion of each repair it is necessary to turn the key–start switch 'On' and 'Off' to clear the code from the digital display and confirm that the repair was successful.*

To assist in fault finding, the location of each connector in the Electronic Draft Control system are illustration at the end of this Chapter.

In instances where an error code has not been displayed, it is possible that the cause is related to a hydraulic or mechanical failure which the microprocessor may not be able to detect. Reference should, therefore, be made to the fault finding chart at the rear of this section for malfunctions not detected by the microprocessor.



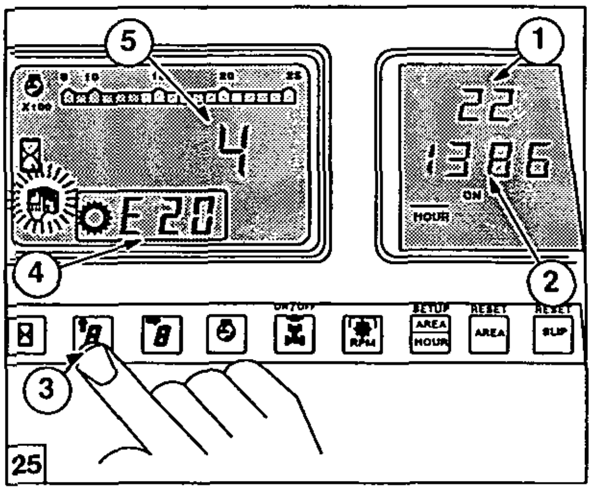
Electronic Draft Control Error Code Display
(Analogue Electronic Instrument Panel)

Error Code Recovery

Tractors with electronic instrument panel only:

The electronic instrument panel has a feature which stores and recalls the last ten error codes and the operating hours at which they occurred. This feature is useful in establishing a record of the last time that a particular error occurred on the tractor.

To enter the Error Code Recovery System proceed as follows:–



25

Error Code Recovery

1. Electronic Draft Control (EDC) Error Code
2. Hours of Error Occurrence
3. Digit Set Button
4. 12 x 12 Transmission Error Code
5. Electronic Instrument Cluster (EIC) Error Code

1. Hold down the DIGIT SET button on the electronic instrument panel and turn the key–start switch 'ON', Figure 25. **Do Not** start the engine. The Read Your Manual symbol will flash and the most recent error to have occurred on the tractor will be displayed on the appropriate instrument panel display together with the hours at which the error last occurred.

2. Press the DIGIT SET button and the next most recent error code will occur. This procedure can be repeated until a maximum of the last 10 error codes have been displayed.

SERVICE DIAGNOSTIC TEST ROUTINES

The service diagnostic test routines supplement the automatic diagnostic error codes previously described. Access to these test modes is via the service diagnostic connector Figure 26, located adjacent to the fuse box and enables the following menu system to be displayed on the instrument panel in order to perform specific tests on the tractor.

'H9' allows access to a further very comprehensive menu as shown on the following page and enables diagnostic test routines to be performed on potentiometers and voltage supplies.

Select Switch	Display	Hydraulic Lift Status	Electronic Draft Control Test Routine and Typical Value where applicable
Power Up	HH	Disabled	–
Press	H1	Enabled	EDC Calibration Counter– Manufacturing Use Only
Press	H2	Disabled	EDC Valve Calibration Values (37 Raise, 42 Lower)
Press	H3	Disabled	Not Used
Press	H4	Disabled	Software Revision Display
Press	H5	Disabled	Switch Diagnostic Mode
Press	H6	Enabled	Right Hand Load Sensing Pin Signal (42)
Press	H7	Enabled	Left Hand Load Sensing Pin Signal (42)
Press	H8	Disabled	Microprocessor Non–volatile Memory Reset
Press	H9	Enabled	Vehicle Sensor Operation and Voltage Tests
Press	HA	Enabled	Not Used
Press	HB	Enabled	Not Used

H9 Diagnostic Test Routine Menu

Channel Number	Description	Typical Approximate Values
3	Fuse 12 Sense	96
4	Not Applicable to Service	–
8	12 Volt Vh input to Microprocessor for EDC	43
9	8 Volt reference to EDC Load Sensing Pins	79
10	Not Used	–
11	Not Applicable to Service	–
12	Not Applicable to Service	–
13	Not Applicable to Service	–
14	Not Used	–
18	EDC Valve Raise Solenoid Current	0–66
19	EDC Valve Lower Solenoid Current	0–66
20	Ground Speed Signal	64
21	Not Used	–
22	Not Used	–
23	Not Used	–
24	Not Used	–
25	Implement Status Lamp Sense	7 when illuminated
26	Wheel Slip Lamp Sense	7 When Illuminated
27	Not Used	–
28	Lift Arm Position Sensing Potentiometer	33 lift Lowered 83 Lift raised
29	Lift Control Lever Potentiometer	27 Fully Lowered 83 Fully Raised
30	Drop Rate Control Potentiometer	84 turned Fully Clockwise 14 Turned Fully Counter Clockwise
31	Height Limit Control Potentiometer	84 turned Fully Clockwise 14 Turned Fully Counter Clockwise
32	Position/Draft SensitivityPotentiometer	84 turned Fully Clockwise 14 Turned Fully Counter Clockwise
33	Slip Limit Control Potentiometer	84 turned Fully Clockwise 14 Turned Fully Counter Clockwise
34	Right Hand Load Sensing Pin	48 When Implement Not Being Used
35	Left Hand Load Sensing Pin	48 When Implement Not Being Used

The H9 Diagnostic test routine menu has 35 channels. The channel numbers listed in the table above are only applicable to the Electronic draft control circuits and components. The channel numbers omitted from the table relate to circuits and components on the 12 x 12 transmission with dual power and are described in Part 5 Chapter 6 of this Repair Manual

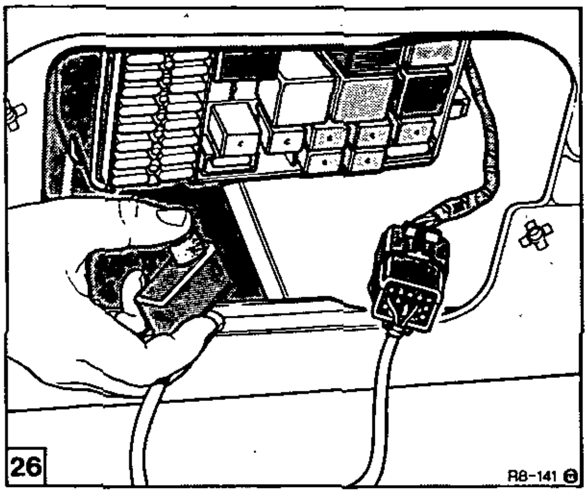
The test routines, which are operated through the menu, should be used in conjunction with the fault finding procedures described later in this section.

When a test routine is performed for a particular channel the data is displayed on the instrument panel and must be compared with the typical approximate values shown in the table above.

Where the data displayed differs by more than 5% from those typical values shown it is an indication that the component/circuit being tested is the cause of the malfunction.

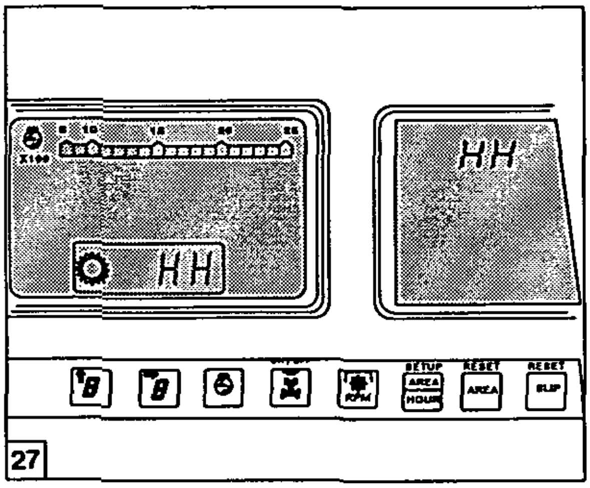
Examples on the procedure to enter and use the diagnostic test routines are described on the following pages.

Entering Diagnostic Test Routine



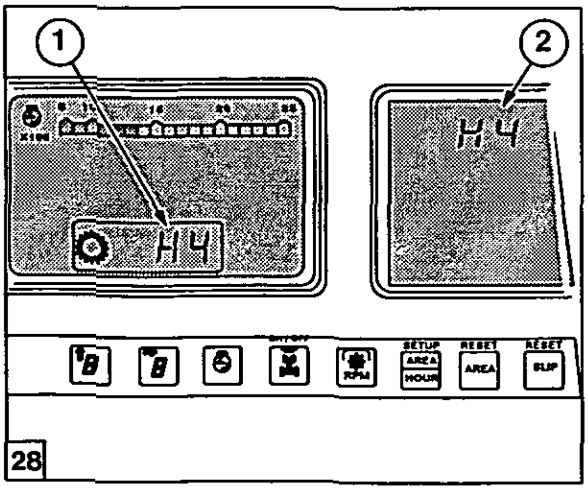
Diagnostic Switch Connected into Diagnostic Connector

1. Connect diagnostic switch special tool 4FT.950 into diagnostic socket.



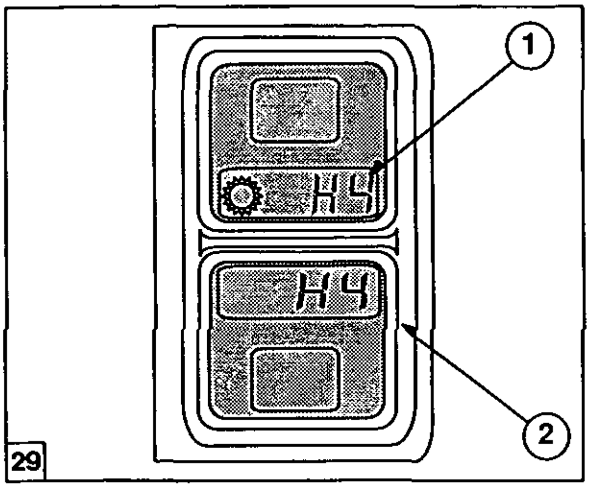
Instrument Panel Display 'HH'
(Electronic Instrument Panel)

2. Turn key–start switch 'On', the display on instrument panel will show 'HH'.



Menu H4 Selected
(Electronic Instrument Panel)

1. Electronic Draft Control Menu Display Window
2. 12 x 12 Transmission with Dual Power Menu Display Window

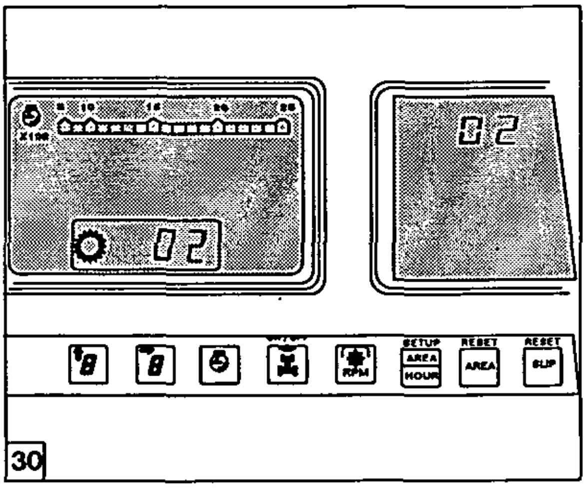


Menu H4 Selected
(Analogue Electronic Instrument Panel)

1. *Electronic Draft Control Menu Display Window*
2. 12 x 12 Transmission with Dual Power Menu Display Window

3. Repeatedly depress the button on the diagnostic switch until the display on the instrument panel changes to the required menu, Figure 28 and Figure 29.

NOTE: *The location on the instrument panel for the menu related to the electronic draft control system differs from that for the 12 x 12 transmission with dual power*



Example of Instrument Panel Displaying Software Design Level 2

4. After approximately 4 seconds the display will change and show the appropriate data for the menu selected. In our example the H4 has changed to show a software level of 2, Figure 30.

5. Turn key–start switch 'Off'.

6. Disconnect diagnostic switch and replace connector cover.

Examples On Using Diagnostic Menus

H5–Switch Diagnostic Mode

The switch diagnostic mode allows a simple method of checking the continuity of switches on both the electronic draft control hydraulic system and 12 x 12 transmission gear selector switches.

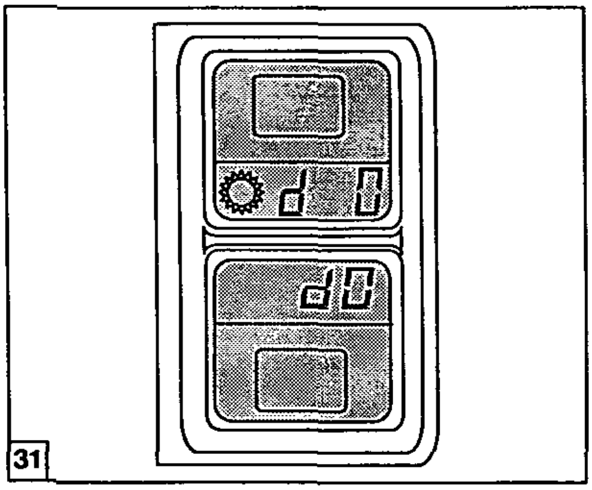
The switches on the EDC hydraulic system which can be checked using this switch are:–

In cab fast raise/lower switch

External lift/lower fender switches

To use diagnostic routine H5 proceed as follows:–

1. Enter the diagnostic routine and depress the button on the diagnostic switch 'five times' until the display on the instrument panel changes to 'H5.



31

Instrument Panel Display 'd0'
(Analogue Electronic Instrument Panel Shown)

2. After a maximum period of 4 seconds the display will again change to 'd0', Figure 31. This is the switch diagnostic mode.
3. Depressing either the in cab fast raise/lower switch or external fender switches will cause the numbers on the display to change as follows indicating that the switch being tested is operating correctly.

Switch Code	Switch Description
d1	Fender switch operating correctly in lower position.
d2	Fender switch operating correctly in raise position.
d3	In cab fast raise/lower switch operating correctly from raise to lower.
d4	In cab fast raise/lower switch operating correctly from lower to raise.

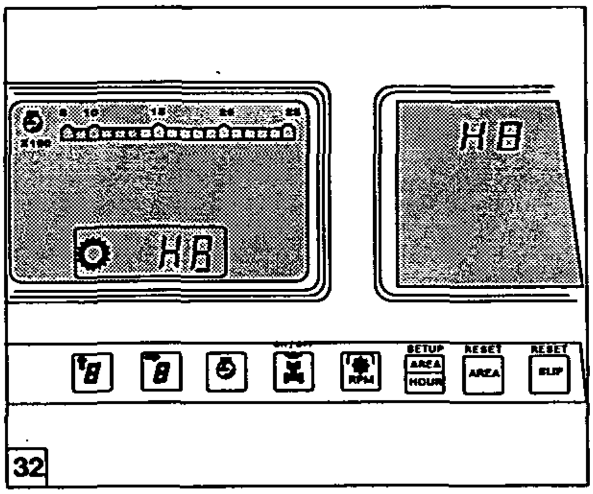
The switch diagnostic mode also enables the diagnosis of the switches related to the shift control levers on the 12 x 12 transmission with dual power. Refer to the 12 x 12 transmission with dual power section of this Repair Manual for further details.

H8–Microprocessor Memory Reset Procedure

Whenever the fault finding procedure specifies that it is necessary to replace or reset the microprocessor, the following 'Memory reset' procedure must be followed.

If the 'Memory Reset' procedure is not performed the operator may experience that the hydraulic lift arms will not raise or lower to the maximum limits of travel, or engage the mechanical stop at the top of its travel, before the lift control lever has been moved to the fully raised position.

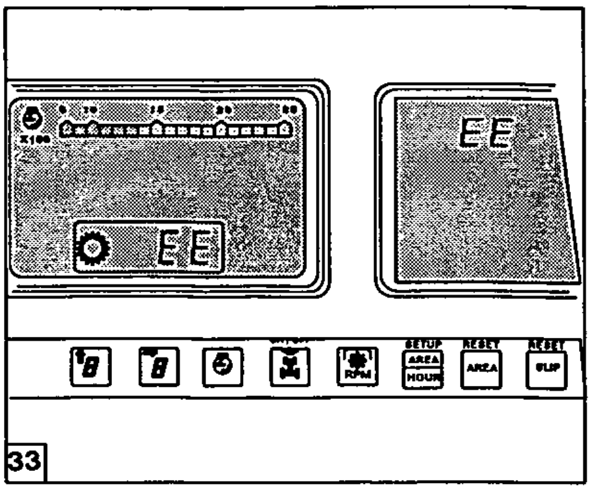
To reset the memory proceed as follows:–



32

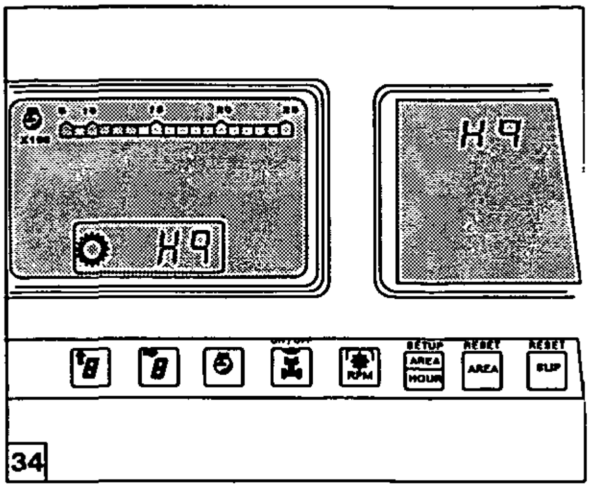
Instrument Panel Display 'H8'

1. Enter the diagnostic routine and depress the button on the diagnostic switch 'eight' times until the instrument panel changes to H8.



33

Instrument Panel Display 'EE'



34

Instrument Panel Display 'H9'

2. Wait for approximately 4 seconds for the microprocessor to select the memory erase routine. The instrument panel display will change from 'H8' to 'EE', Figure 33 and then return back to 'HH'.

3. Turn key–start switch 'Off'.

4. Disconnect diagnostic switch and replace connector cover.

5. Start tractor and perform auto–calibration procedure as detailed in Error Code 24.

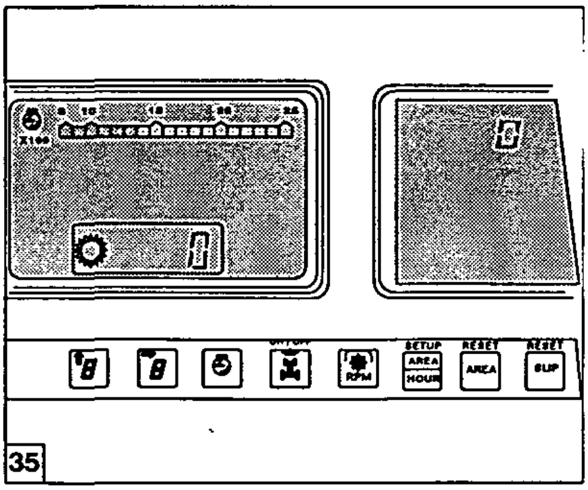
H9–Vehicle Sensor and Voltage Tests

This mode allows service personnel to verify the operation of various potentiometers and voltage supplies on the electronic draft control and 12 x 12 transmission with dual power systems. In this mode both the transmission display and EDC display initially shows a channel number followed by a number in the range 0–99 which is an indication of the voltage sensed in the circuit for the component circuit being checked.

For details on using the menu and channels for 12 x 12 transmission with dual power systems refer to Part 5 Chapter 3 of this Repair Manual.

To use diagnostic routine H9 proceed as follows:–

1. Enter the diagnostic routine and depress the button on the diagnostic switch 'nine times' until the display on the instrument panel changes to 'H9.

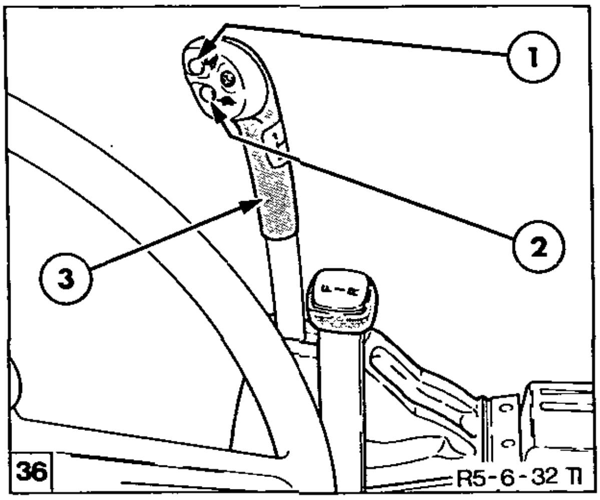


35

Instrument Panel Display Showing Channel 0

2. After approximately 4 seconds the display will change to '0'. This represents channel '0', a channel used exclusively for the 12 x 12 transmission with dual power and tests the clutch pedal potentiometer.

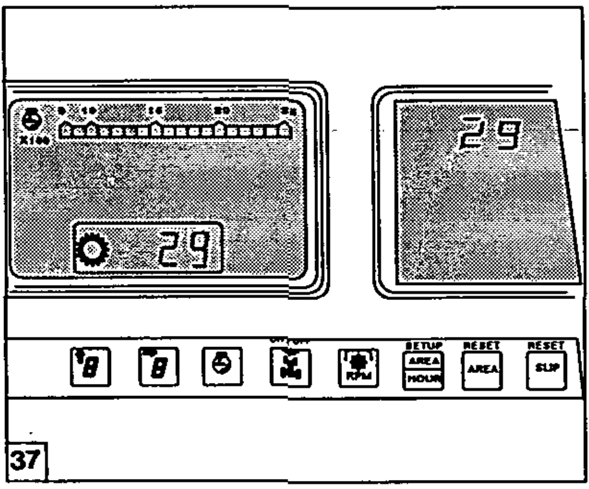
   This number will then change automatically to approximately 91 which represents the value for correct operation of the clutch pedal potentiometer when the pedal is released.



Transmission Gearshift Lever

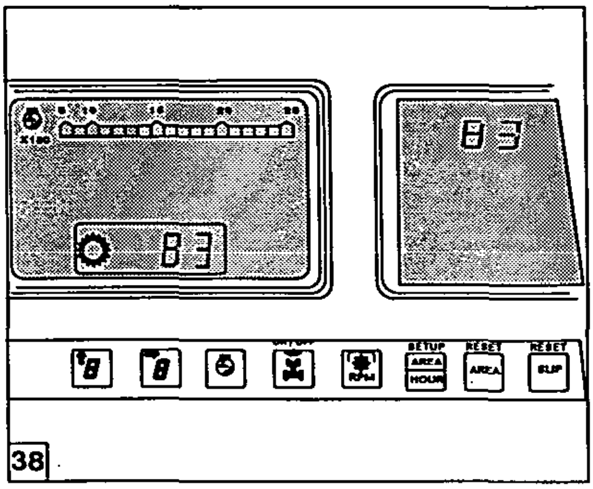
1. Upshift Button
2. Downshift Button
3. Gearshift Lever

3. By repeatedly depressing the transmission upshift and downshift switches, Figure 36, or the in cab fast raise lower switch the channel number can be increased or decreased until the desired channel has been selected.



Instrument Panel Display Channel 29 Shown

4. In Figure 37, Channel 29 has been selected which checks operation of the lift control lever potentiometer.



Instrument Panel Display Showing Value 83

5. The channel number selected will then change and indicate a value in the range 0–99, Figure 38. In our example the value 83 is shown.

6. This number must then be compared with the typical value in the H9 Channel chart on Page 20 and if different by greater than 5% indicates that there is a concern in either the component or section of the circuit being tested.

In our example the lift control lever has been moved to the fully raised position and the number 83 indicates that the potentiometer at the base of the lever is working correctly when in the raised condition. Moving the lever to the lowered position should change the reading to 27.

If the values are away from specification it is likely that the potentiometer is defective. Checks on the harnesses should however be made before replacing the potentiometer.

ELECTRONIC DRAFT CONTROL ERROR CODES

The following listing details the Electronic Draft Control error codes that can be displayed on the instrument panel whenever a fault is detected in the system.

Should an error occur, reference should be made to the appropriate page of the fault finding procedure. Where the procedure specifies a wiring check refer to the wiring diagram at the end of the fault finding Section.

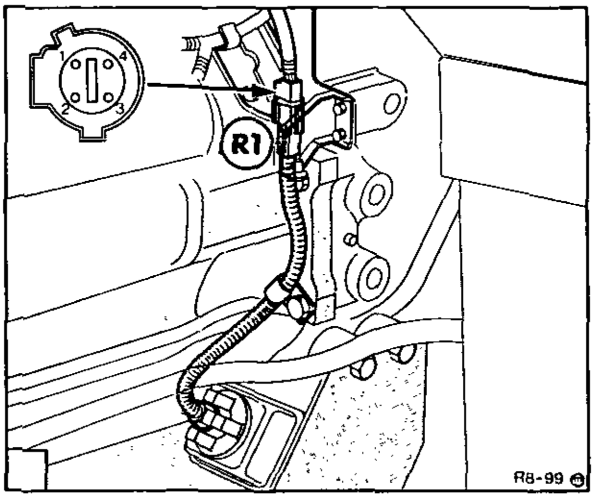
When using the wiring diagram, each connector and pin is identified using an alpha numeric code.

For example the wiring from the microprocessor to the transmission output speed sensor is identified as CN2–6 to R2–1. This indicates the wiring runs from the microprocessor connector CN2, pin number 6 to the speed sensor connector R2, pin number 1.

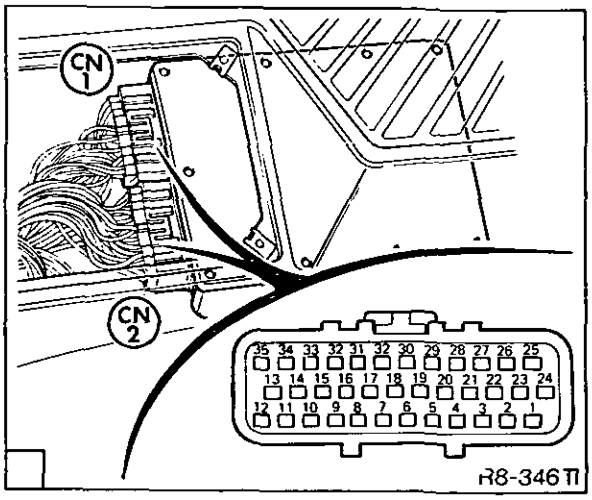
Refer to component identification chart at rear of this section and illustrations in fault finding procedures for connector reference numbers and pin layout,

Error Code 2 Poor or No Signal From Tractor Performance Monitor Radar

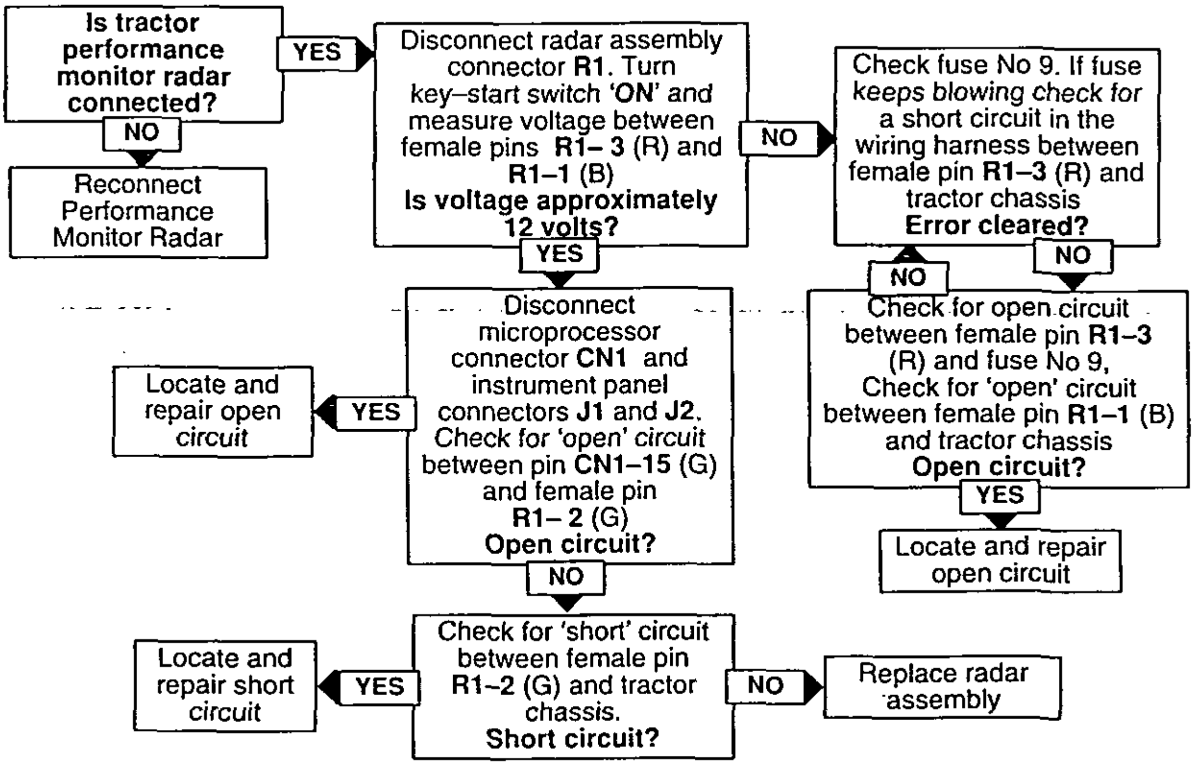
For EDC wiring diagram and connector location refer to end of this Section



Performance Monitor Radar Connector



Microprocessor Connectors



Is tractor performance monitor radar connected?

YES → Disconnect radar assembly connector **R1**. Turn *key–start switch* **'ON'** *and* measure voltage between female pins **R1– 3** (R) and **R1–1** (B) **Is voltage approximately 12 volts?**

NO → Reconnect Performance Monitor Radar

Disconnect radar assembly connector — NO → Check fuse No 9. If fuse *keeps blowing check for* a short circuit in the wiring harness between female pin **R1–3** (R) and tractor chassis **Error cleared?**

Error cleared? — NO → Check for open circuit between female pin **R1–3** (R) and fuse No 9, Check for 'open' circuit between female pin **R1–1** (B) and tractor chassis **Open circuit?**

Open circuit? — YES → Locate and repair open circuit

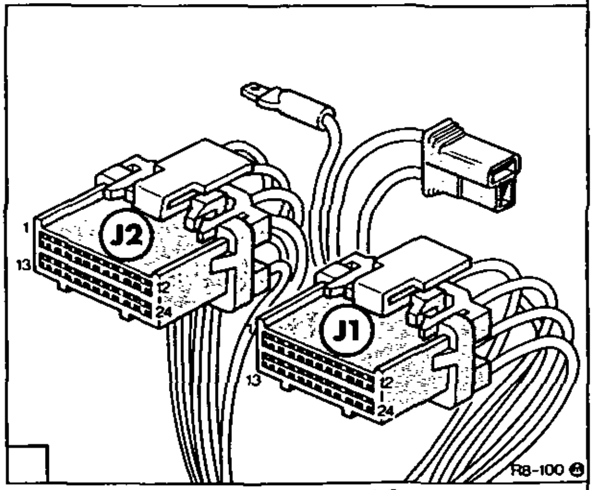
Disconnect radar assembly connector — YES → Disconnect microprocessor connector **CN1** and instrument panel connectors **J1** and **J2**. *Check for 'open' circuit* between pin **CN1–15** (G) and female pin **R1– 2** (G) **Open circuit?**

YES → Locate and repair open *circuit*

NO → Check for 'short' circuit between female pin R1–2 (G) and tractor chassis. **Short circuit?**

YES → Locate and repair short *circuit*

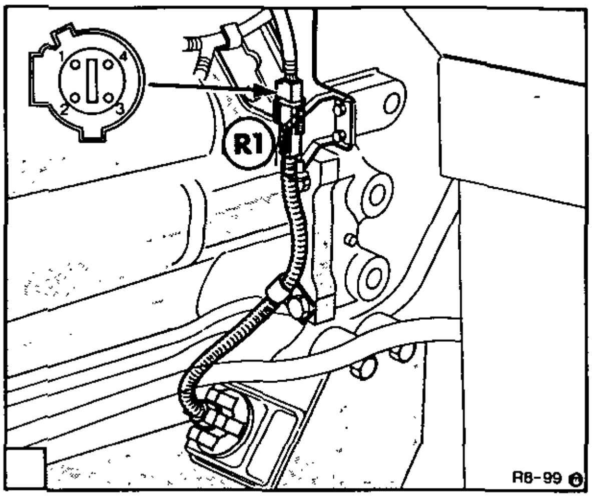
NO → Replace radar assembly



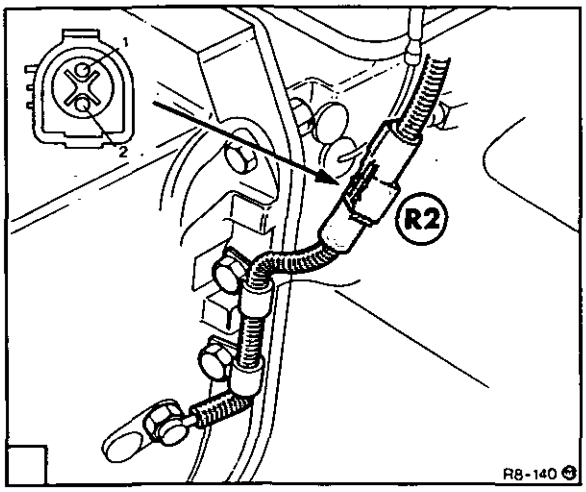
Electronic Instrument Panel Connectors

Error Codes 3, 4 and 5 Speed Sensor Errors

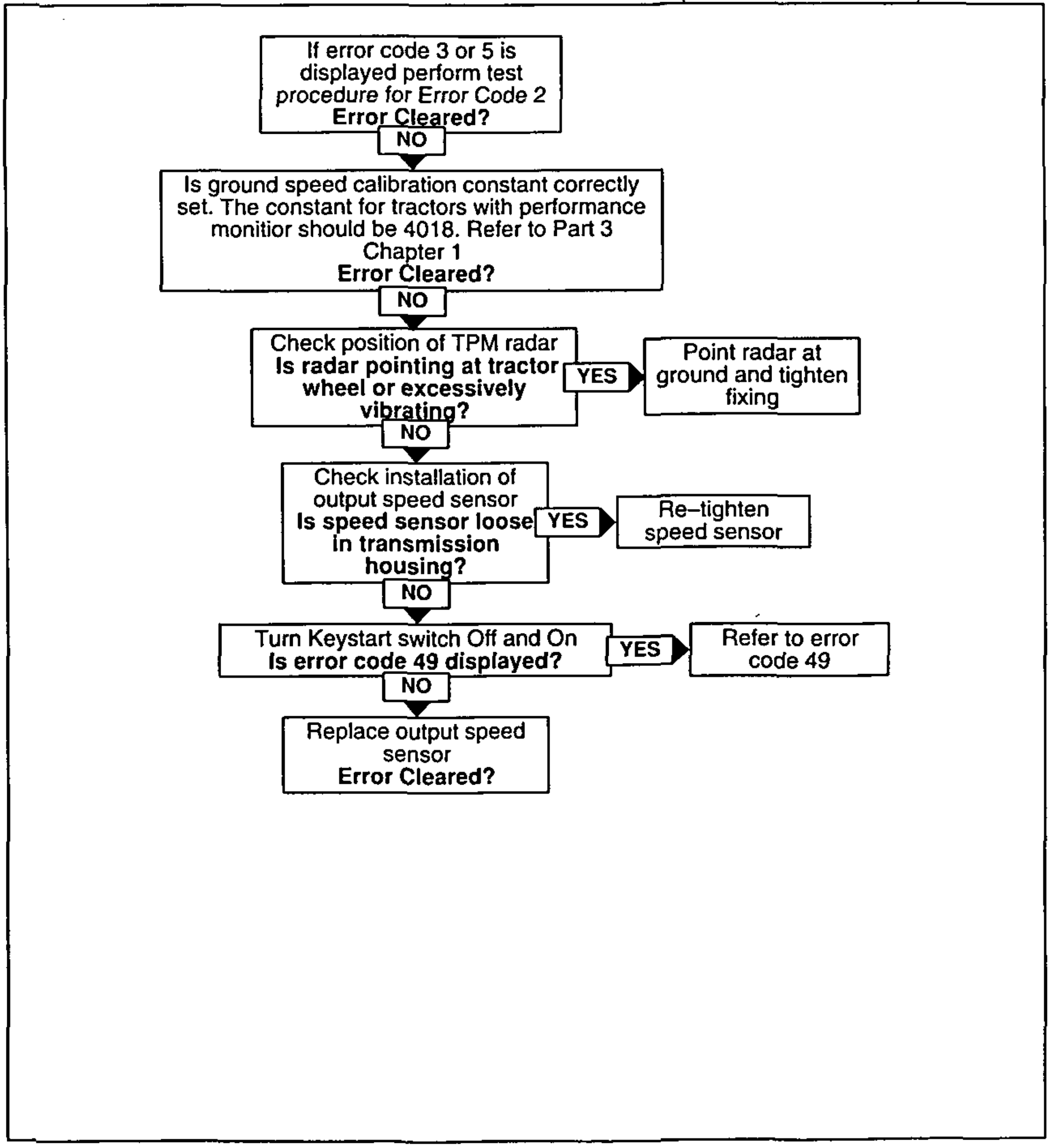
For EDC wiring diagram and connector location refer to the end of this Section



Performance Monitor Radar

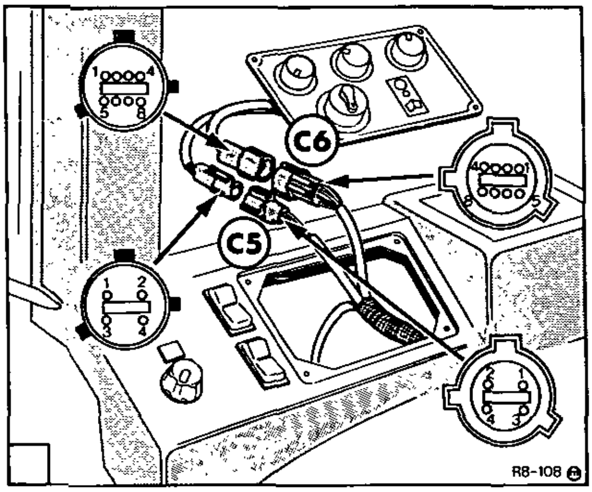


Transmission Output Speed Sensor
(Left Hand Side of Tractor)

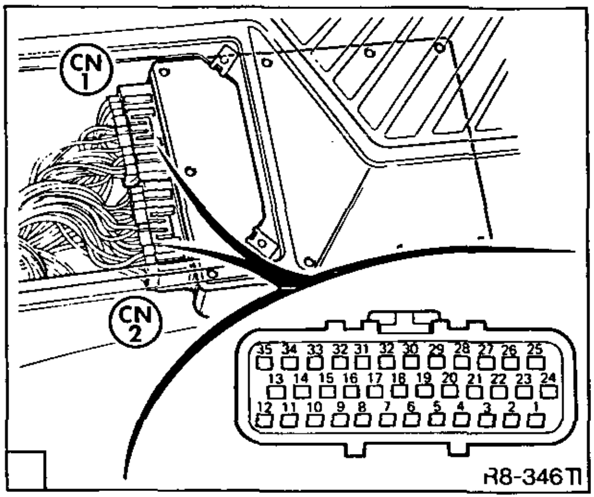


Error Codes 6 and 7 Slip Control Potentiometer or Circuit Failed

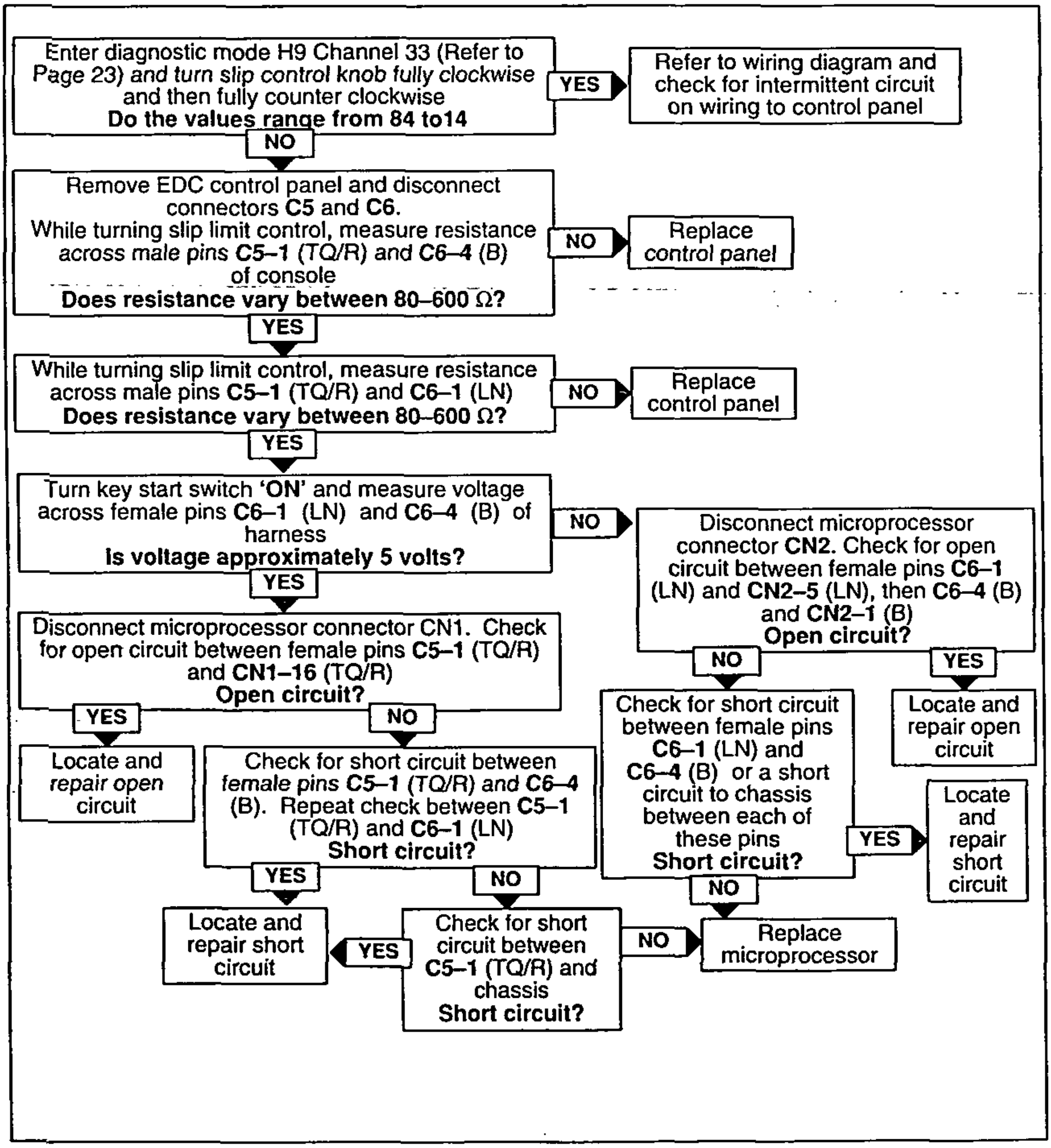
For EDC wiring diagram and connector location refer to the end of this Section



EDC Control Panel Connectors



Microprocessor Connectors



Enter diagnostic mode H9 Channel 33 (Refer to Page 23) and turn slip control knob fully clockwise and then fully counter clockwise **Do the values range from 84 to14**

YES → Refer to wiring diagram and check for intermittent circuit on wiring to control panel

NO ↓

Remove EDC control panel and disconnect connectors **C5** and **C6**. While turning slip limit control, measure resistance across male pins **C5–1** (TQ/R) and **C6–4** (B) of console **Does resistance vary between 80–600 Ω?**

NO → Replace control panel

YES ↓

While turning slip limit control, measure resistance across male pins **C5–1** (TQ/R) and **C6–1** (LN) **Does resistance vary between 80–600 Ω?**

NO → Replace control panel

YES ↓

Turn key start switch **'ON'** and measure voltage across female pins **C6–1** (LN) and **C6–4** (B) of harness **Is voltage approximately 5 volts?**

NO → Disconnect microprocessor connector **CN2**. Check for open circuit between female pins **C6–1** (LN) and **CN2–5** (LN), then **C6–4** (B) and **CN2–1** (B) **Open circuit?**

- YES → Locate and repair open circuit
- NO → Check for short circuit between female pins **C6–1** (LN) and **C6–4** (B) or a short circuit to chassis between each of these pins **Short circuit?**
  - YES → Locate and repair short circuit
  - NO → Replace microprocessor

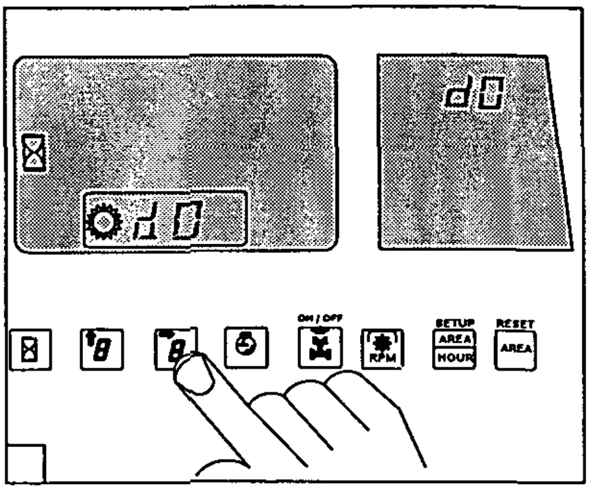
YES ↓

Disconnect microprocessor connector CN1. Check for open circuit between female pins **C5–1** (TQ/R) and **CN1–16** (TQ/R) **Open circuit?**

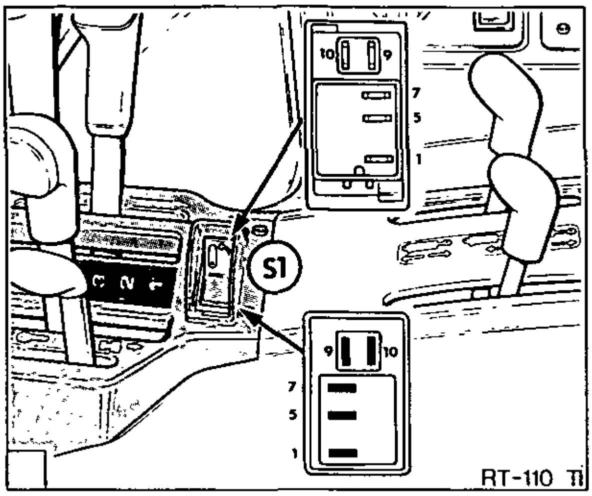
- YES → Locate and repair open circuit
- NO → Check for short circuit between female pins **C5–1** (TQ/R) and **C6–4** (B). Repeat check between **C5–1** (TQ/R) and **C6–1** (LN) **Short circuit?**
  - YES → Locate and repair short circuit
  - NO → Check for short circuit between **C5–1** (TQ/R) and chassis **Short circuit?**
    - YES → Locate and repair short circuit
    - NO → Replace microprocessor

Error Code 8 Raise/Work Switch Failure

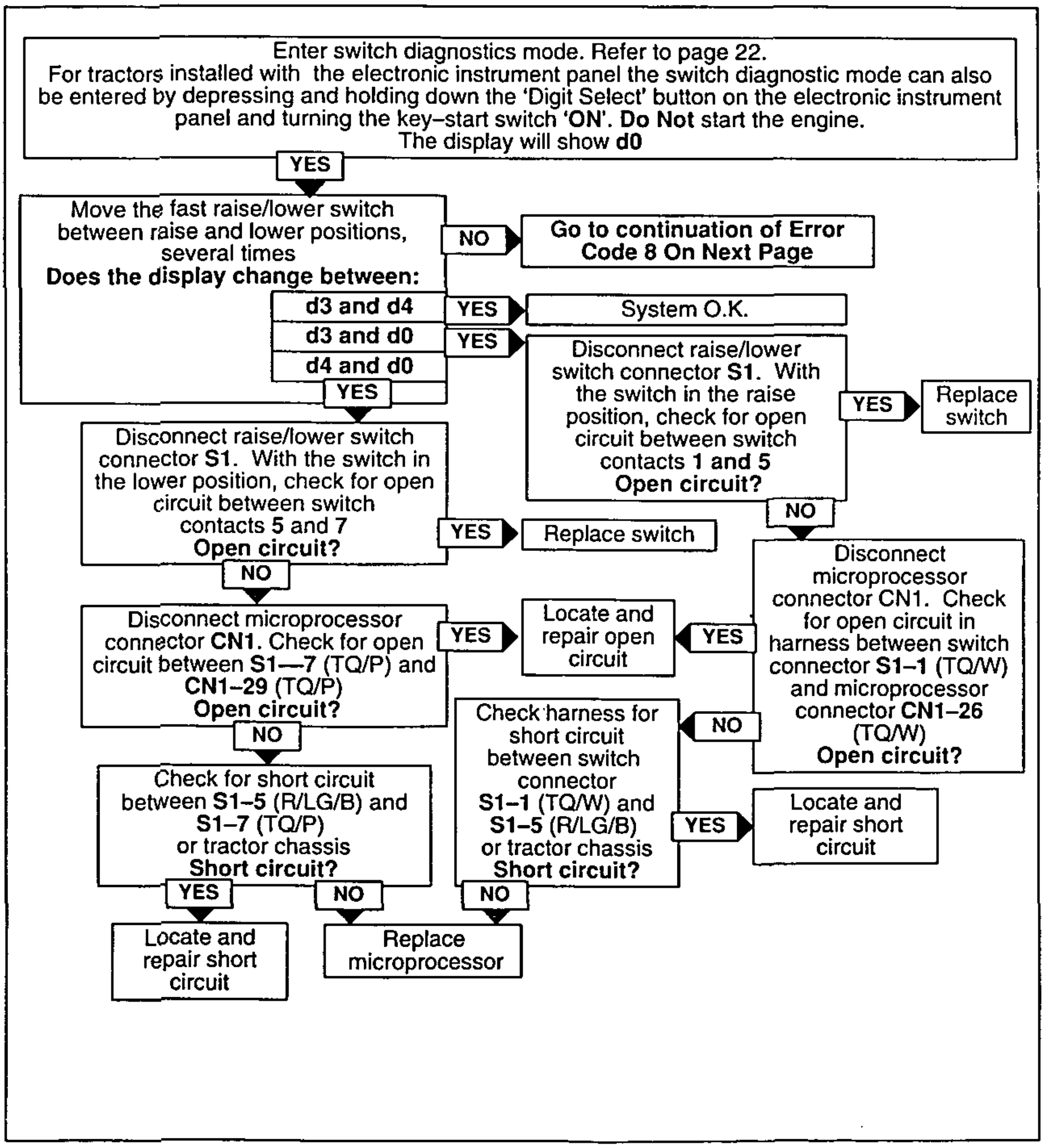
For EDC wiring diagram and connector location refer to the end of this Section



Entering Switch Diagnostic Mode on Electronic Instrument Panel



Fast Raise/Lower Switch



Enter switch diagnostics mode. Refer to page 22. For tractors installed with the electronic instrument panel the switch diagnostic mode can also be entered by depressing and holding down the 'Digit Select' button on the electronic instrument panel and turning the key–start switch **'ON'**. **Do Not** start the engine. The display will show **d0**

YES

Move the fast raise/lower switch between raise and lower positions, several times **Does the display change between:**

- **d3 and d4** — YES → System O.K.
- **d3 and d0** — YES → Disconnect raise/lower switch connector **S1**. With the switch in the raise position, check for open circuit between switch contacts **1 and 5** **Open circuit?**
- **d4 and d0** — YES → Disconnect raise/lower switch connector **S1**. With the switch in the lower position, check for open circuit between switch contacts **5** and **7** **Open circuit?**

NO → **Go to continuation of Error Code 8 On Next Page**

Disconnect raise/lower switch connector **S1**. With the switch in the raise position, check for open circuit between switch contacts **1 and 5** **Open circuit?**

YES → Replace switch

NO → Disconnect microprocessor connector CN1. Check for open circuit in harness between switch connector **S1–1** (TQ/W) and microprocessor connector **CN1–26** (TQ/W) **Open circuit?**

YES → Locate and repair open circuit

NO → Check harness for short circuit between switch connector **S1–1** (TQ/W) and **S1–5** (R/LG/B) or tractor chassis **Short circuit?**

YES → Locate and repair short circuit

NO → Replace microprocessor

Disconnect raise/lower switch connector **S1**. With the switch in the lower position, check for open circuit between switch contacts **5** and **7** **Open circuit?**

YES → Replace switch

NO → Disconnect microprocessor connector **CN1**. Check for open circuit between **S1—7** (TQ/P) and **CN1–29** (TQ/P) **Open circuit?**

YES → Locate and repair open circuit

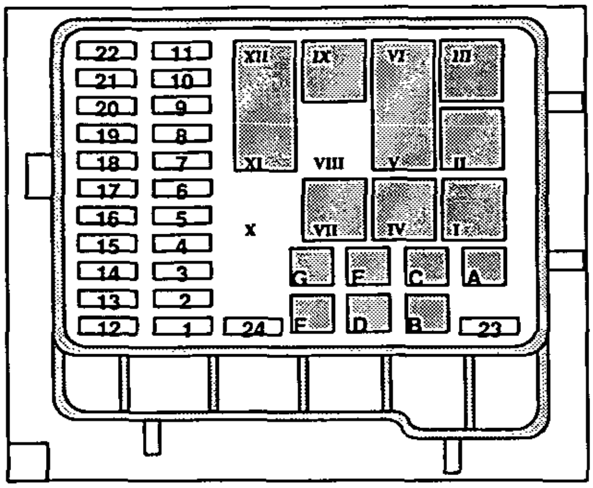
NO → Check for short circuit between **S1–5** (R/LG/B) and **S1–7** (TQ/P) or tractor chassis **Short circuit?**

YES → Locate and repair short circuit

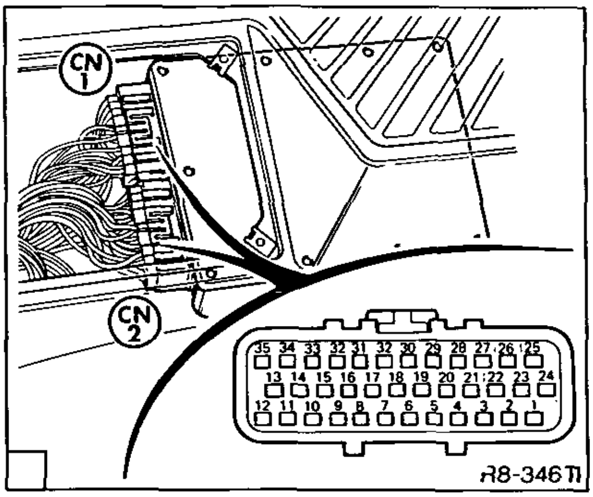
NO → Replace microprocessor

Error Code 8 Raise/Work Switch Failure

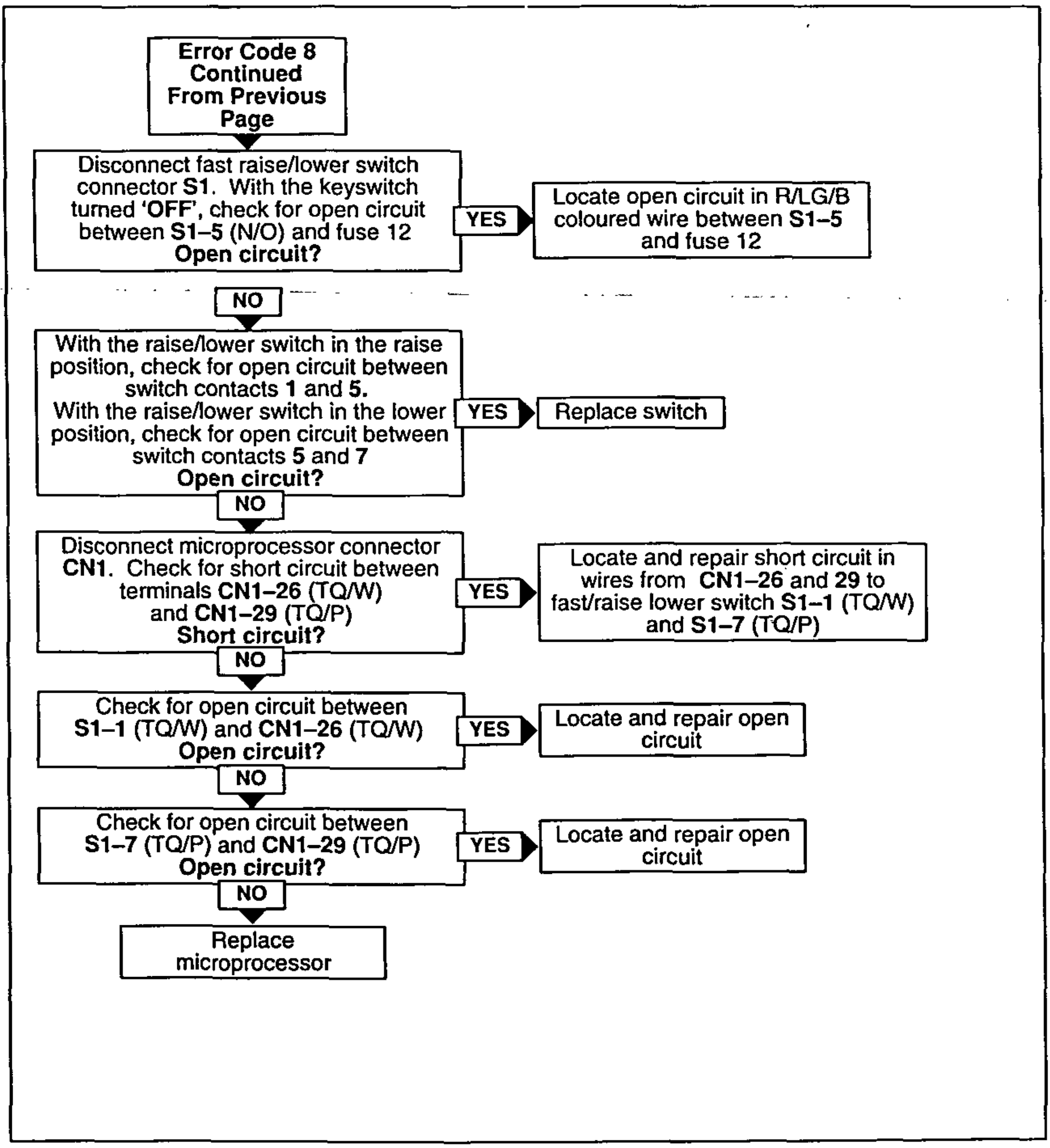
For EDC wiring diagram and connector location refer to the end of this Section



Fuse Panel



Microprocessor Connectors



Error Code 8 Continued From Previous Page

Disconnect fast raise/lower switch connector **S1**. With the keyswitch turned **'OFF'**, check for open circuit between **S1–5** (N/O) and fuse 12 **Open circuit?**

YES → Locate open circuit in R/LG/B coloured wire between **S1–5** and fuse 12

NO

With the raise/lower switch in the raise position, check for open circuit between switch contacts **1** and **5.** With the raise/lower switch in the lower position, check for open circuit between switch contacts **5** and **7** **Open circuit?**

YES → Replace switch

NO

Disconnect microprocessor connector **CN1**. Check for short circuit between terminals **CN1–26** (TQ/W) and **CN1–29** (TQ/P) **Short circuit?**

YES → Locate and repair short circuit in wires from **CN1–26** and **29** to fast/raise lower switch **S1–1** (TQ/W) and **S1–7** (TQ/P)

NO

Check for open circuit between **S1–1** (TQ/W) and **CN1–26** (TQ/W) **Open circuit?**

YES → Locate and repair open circuit

NO

Check for open circuit between **S1–7** (TQ/P) and **CN1–29** (TQ/P) **Open circuit?**

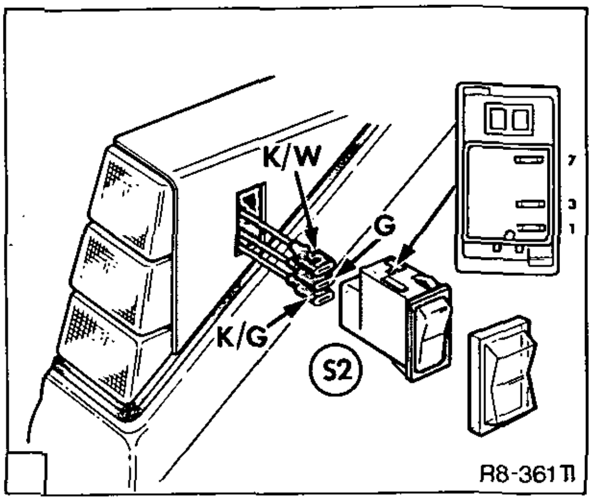
YES → Locate and repair open circuit

NO

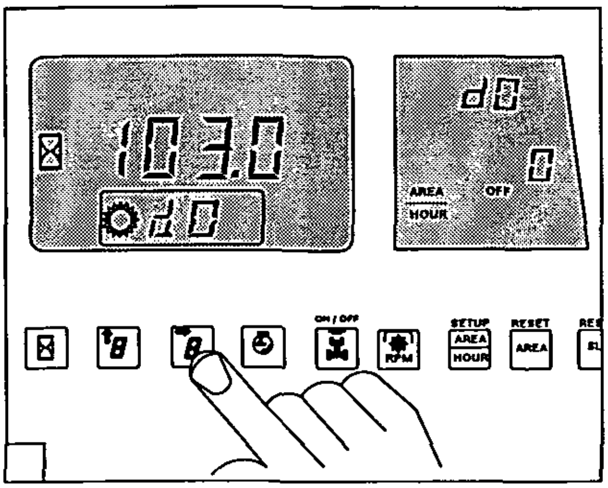
Replace microprocessor

Error Code 9 Both External Lift/Lower Fender Switches Are Being Operated Simultaneously

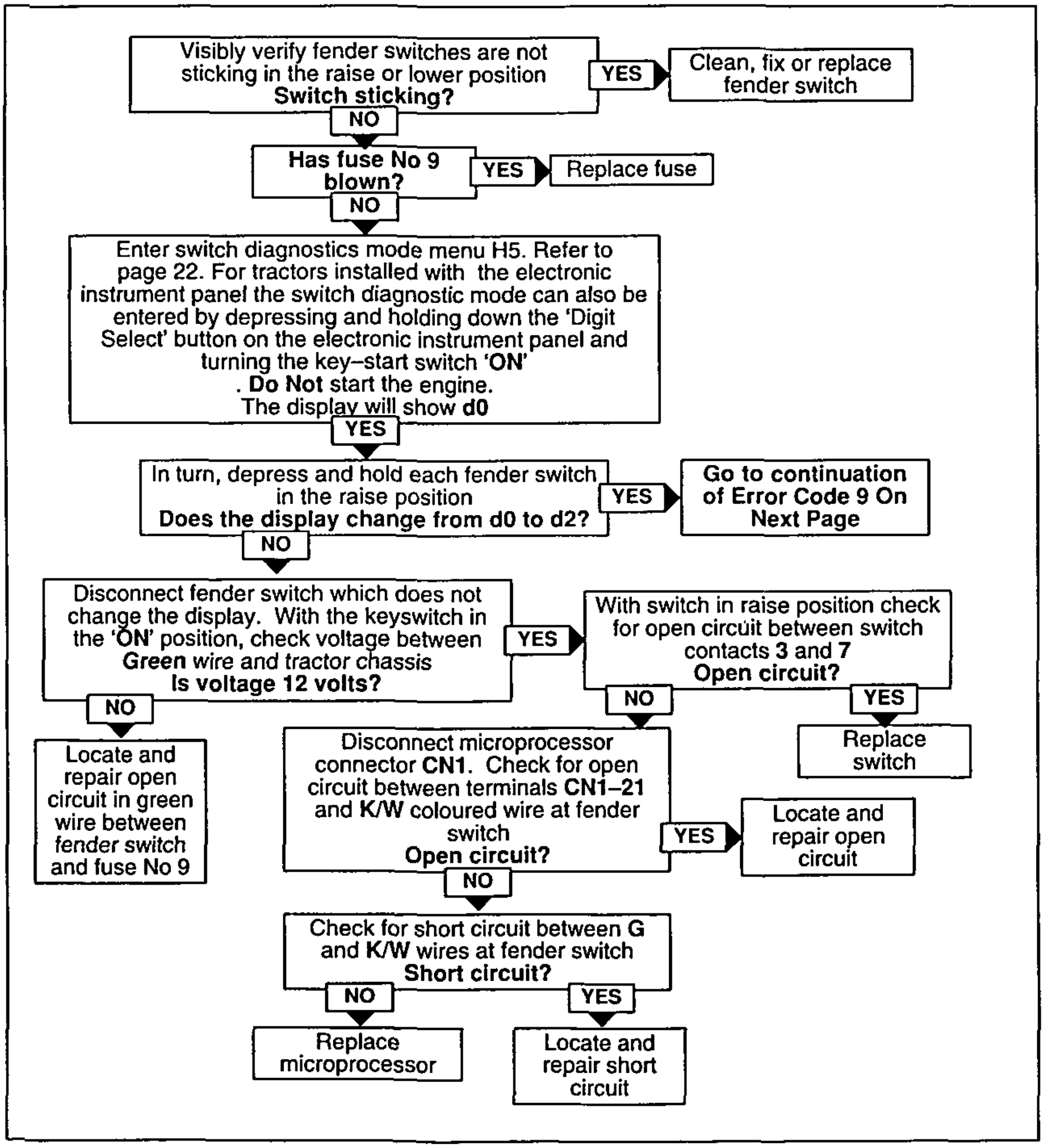
For EDC wiring diagram and connector location refer to the end of this Section



Fender Switch



Entering Switch Diagnostic Mode



Visibly verify fender switches are not sticking in the raise or lower position **Switch sticking?**

YES → Clean, fix or replace fender switch

NO ↓

Has fuse No 9 blown?

YES → Replace fuse

NO ↓

Enter switch diagnostics mode menu H5. Refer to page 22. For tractors installed with the electronic instrument panel the switch diagnostic mode can also be entered by depressing and holding down the 'Digit Select' button on the electronic instrument panel and turning the key–start switch **'ON'** . **Do Not** start the engine. The display will show **d0**

YES ↓

In turn, depress and hold each fender switch in the raise position **Does the display change from d0 to d2?**

YES → **Go to continuation of Error Code 9 On Next Page**

NO ↓

Disconnect fender switch which does not change the display. With the keyswitch in the **'ON'** position, check voltage between ***Green*** *wire and tractor chassis* **Is voltage 12 volts?**

NO ↓ Locate and repair open circuit in green wire between fender switch and fuse No 9

YES → With switch in raise position check for open circuit between switch contacts **3** and **7** **Open circuit?**

YES ↓ Replace switch

NO ↓

Disconnect microprocessor connector **CN1**. Check for open circuit between terminals **CN1–21** and **K/W** coloured wire at fender switch **Open circuit?**

YES → Locate and repair open circuit

NO ↓

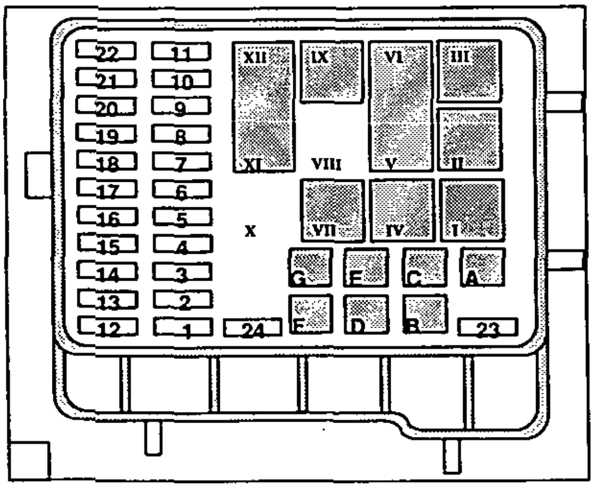
Check for short circuit between G and **K/W** wires at fender switch **Short circuit?**

NO ↓ Replace microprocessor

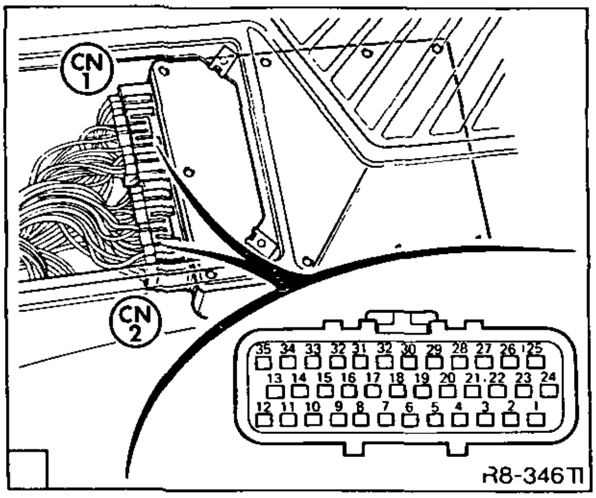
YES ↓ Locate and repair short circuit

Error Code 9 Both External Lift/Lower Fender Switches Are Being Operated Simultaneously

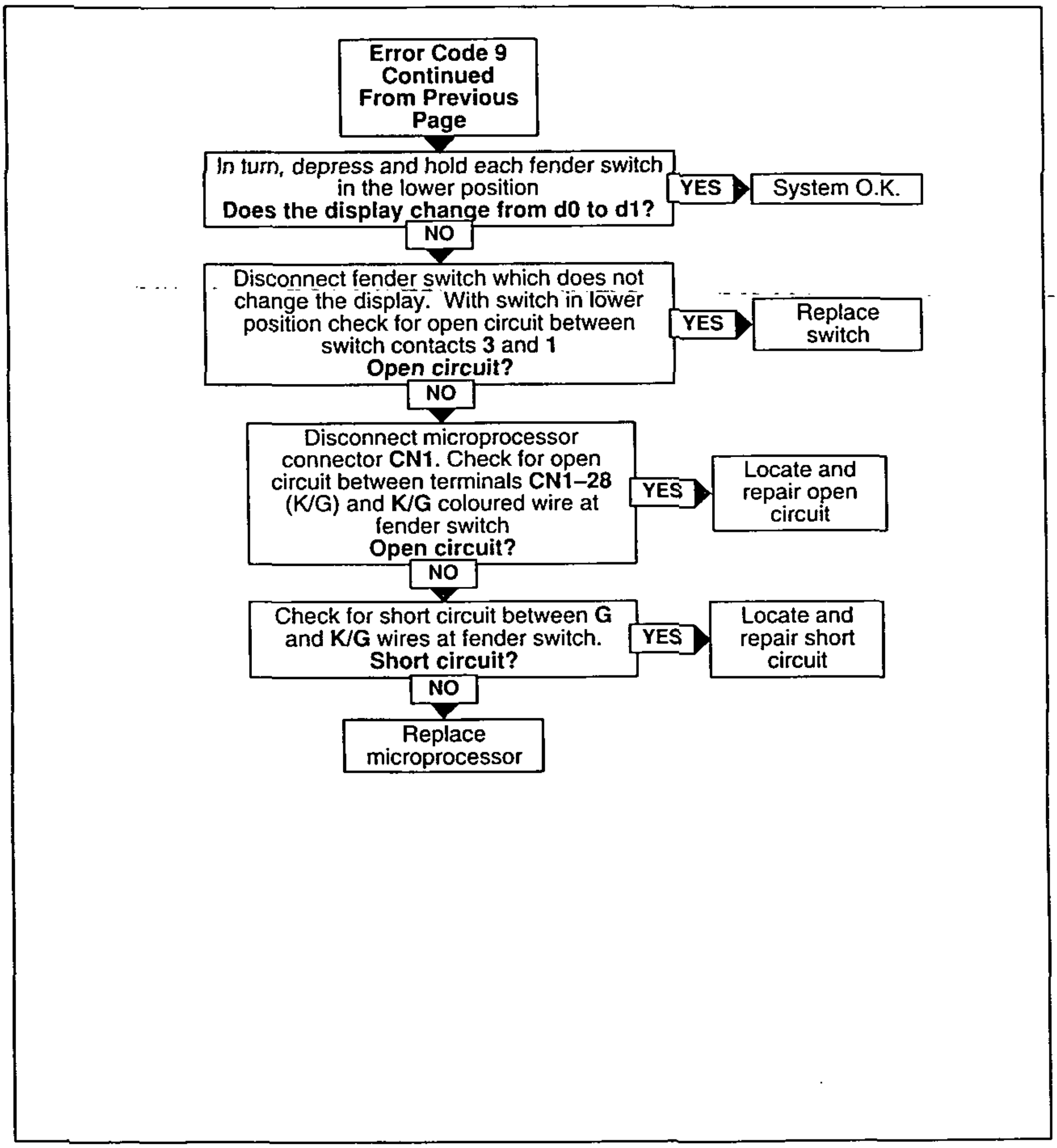
For EDC wiring diagram and connector location refer to the end of this Section



Fuse Panel



Microprocessor Connectors



Error Code 9 Continued From Previous Page

In turn, depress and hold each fender switch in the lower position
Does the display change from d0 to d1?
YES → System O.K.
NO ↓

Disconnect fender switch which does not change the display. With switch in lower position check for open circuit between switch contacts **3** and **1**
Open circuit?
YES → Replace switch
NO ↓

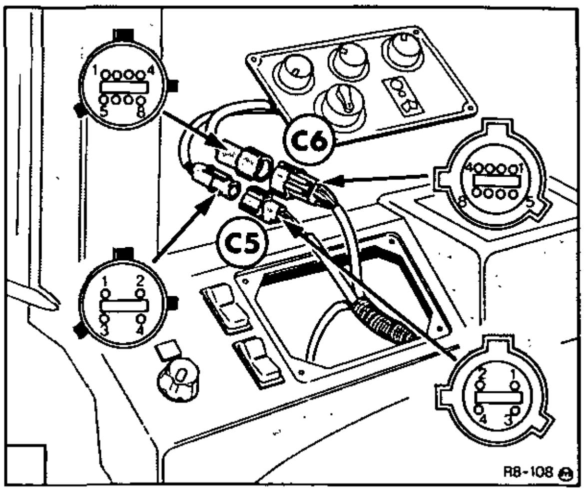
Disconnect microprocessor connector **CN1**. Check for open circuit between terminals **CN1–28** (K/G) and **K/G** coloured wire at fender switch
Open circuit?
YES → Locate and repair open circuit
NO ↓

Check for short circuit between **G** and **K/G** wires at fender switch.
Short circuit?
YES → Locate and repair short circuit
NO ↓

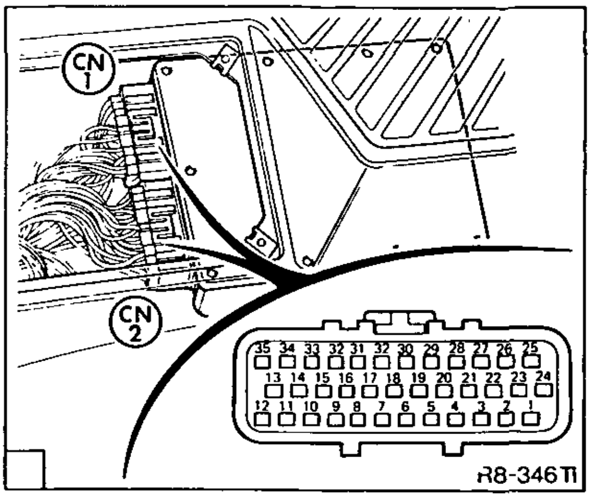
Replace microprocessor

Error Codes 10 and 11 Height Limit Control Potentiometer Failed

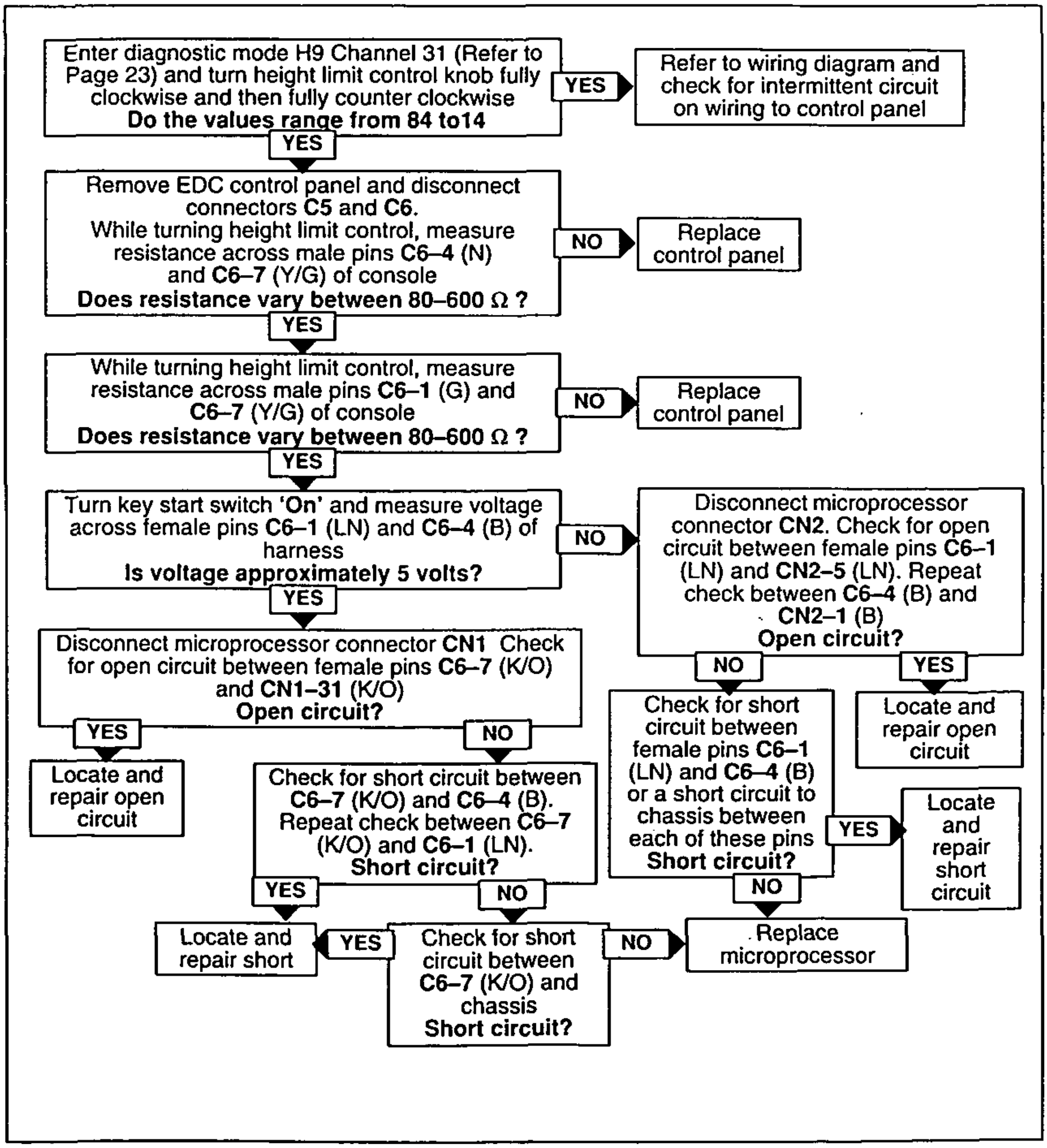
For EDC wiring diagram and connector location refer to the end of this Section



EDC Control Panel Connectors



Microprocessor Connectors



Enter diagnostic mode H9 Channel 31 (Refer to Page 23) and turn height limit control knob fully clockwise and then fully counter clockwise **Do the values range from 84 to14**

Refer to wiring diagram and check for intermittent circuit on wiring to control panel

Remove EDC control panel and disconnect connectors **C5** and **C6**. While turning height limit control, measure resistance across male pins **C6–4** (N) and **C6–7** (Y/G) of console **Does resistance vary between 80–600 Ω ?**

Replace control panel

While turning height limit control, measure resistance across male pins **C6–1** (G) and **C6–7** (Y/G) of console **Does resistance vary between 80–600 Ω ?**

Replace control panel

Turn key start switch **'On'** and measure voltage across female pins **C6–1** (LN) and **C6–4** (B) of harness **Is voltage approximately 5 volts?**

Disconnect microprocessor connector **CN2**. Check for open circuit between female pins **C6–1** (LN) and **CN2–5** (LN). Repeat check between **C6–4** (B) and **CN2–1** (B) **Open circuit?**

Disconnect microprocessor connector **CN1** Check for open circuit between female pins **C6–7** (K/O) and **CN1–31** (K/O) **Open circuit?**

Check for short circuit between female pins **C6–1** (LN) and **C6–4** (B) or a short circuit to chassis between each of these pins **Short circuit?**

Locate and repair open circuit

Locate and repair open circuit

Check for short circuit between **C6–7** (K/O) and **C6–4** (B). Repeat check between **C6–7** (K/O) and **C6–1** (LN). **Short circuit?**

Locate and repair short circuit

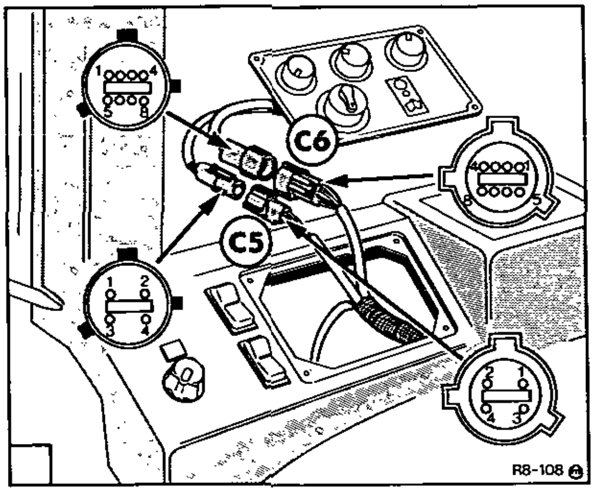
Locate and repair short

Check for short circuit between **C6–7** (K/O) and chassis **Short circuit?**

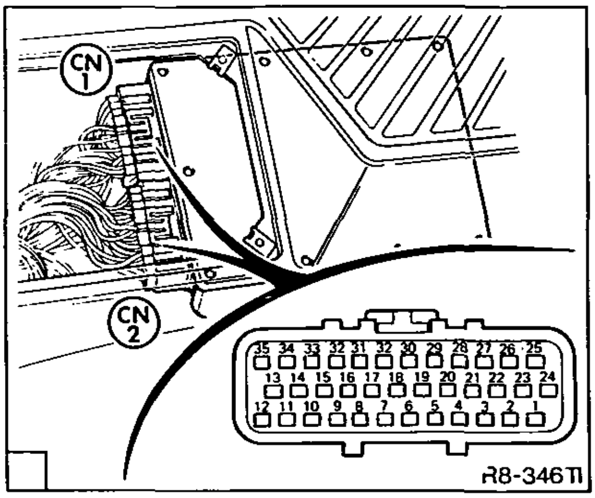
Replace microprocessor

Error Codes 12 and 13 Drop Rate Control Potentiometer Failed

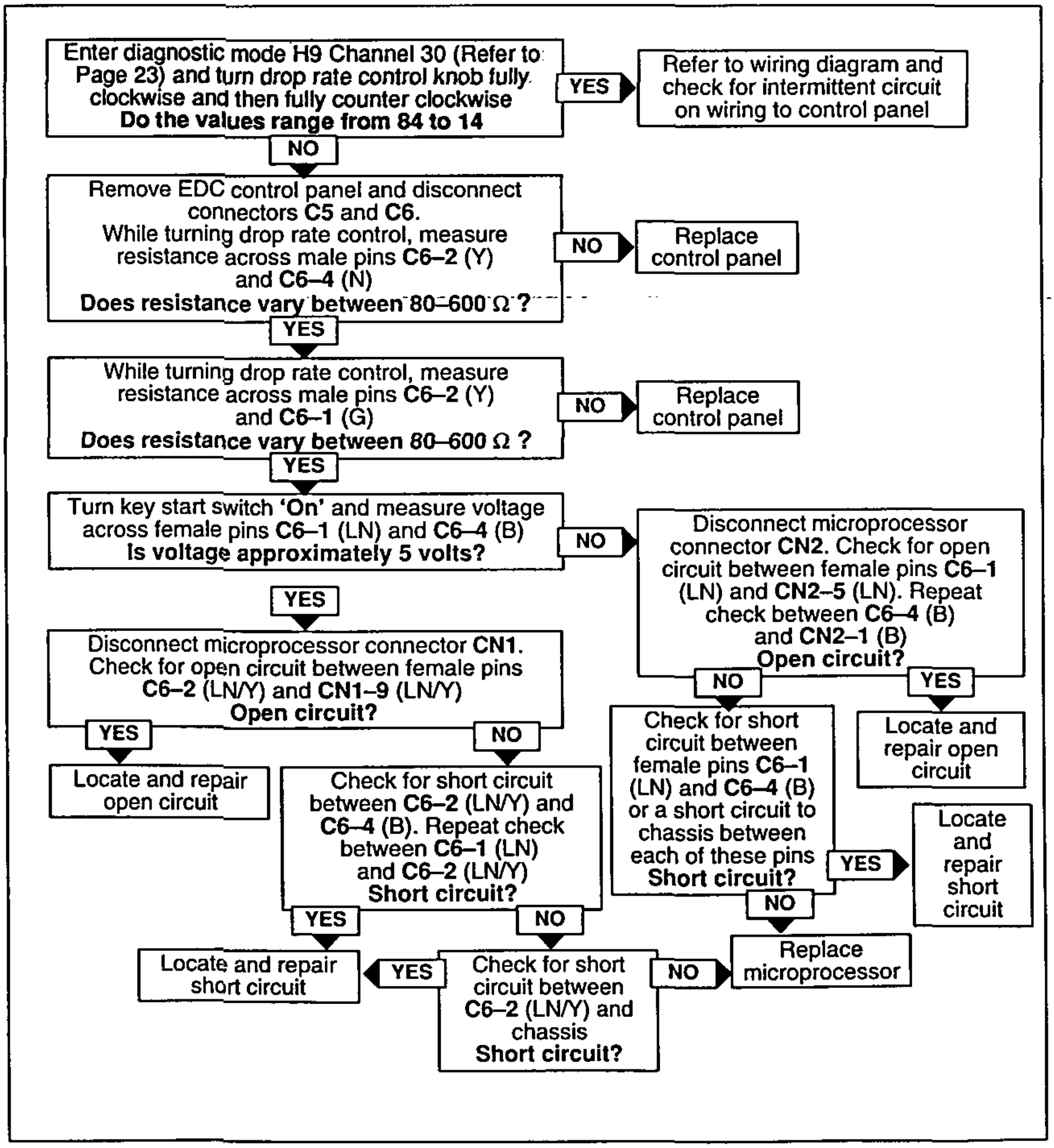
For EDC wiring diagram and connector location refer to the end of this Section



EDC Control Panel Connectors



Microprocessor Connectors



Enter diagnostic mode H9 Channel 30 (Refer to Page 23) and turn drop rate control knob fully clockwise and then fully counter clockwise **Do the values range from 84 to 14**

Refer to wiring diagram and check for intermittent circuit on wiring to control panel

Remove EDC control panel and disconnect connectors **C5** and **C6**. While turning drop rate control, measure resistance across male pins **C6–2** (Y) and **C6–4** (N) **Does resistance vary between 80–600 Ω ?**

Replace control panel

While turning drop rate control, measure resistance across male pins **C6–2** (Y) and **C6–1** (G) **Does resistance vary between 80–600 Ω ?**

Replace control panel

Turn key start switch **'On'** and measure voltage across female pins **C6–1** (LN) and **C6–4** (B) **Is voltage approximately 5 volts?**

Disconnect microprocessor connector **CN2**. Check for open circuit between female pins **C6–1** (LN) and **CN2–5** (LN). Repeat check between **C6–4** (B) and **CN2–1** (B) **Open circuit?**

Locate and repair open circuit

Check for short circuit between female pins **C6–1** (LN) and **C6–4** (B) or a short circuit to chassis between each of these pins **Short circuit?**

Locate and repair short circuit

Replace microprocessor

Disconnect microprocessor connector **CN1**. Check for open circuit between female pins **C6–2** (LN/Y) and **CN1–9** (LN/Y) **Open circuit?**

Locate and repair open circuit

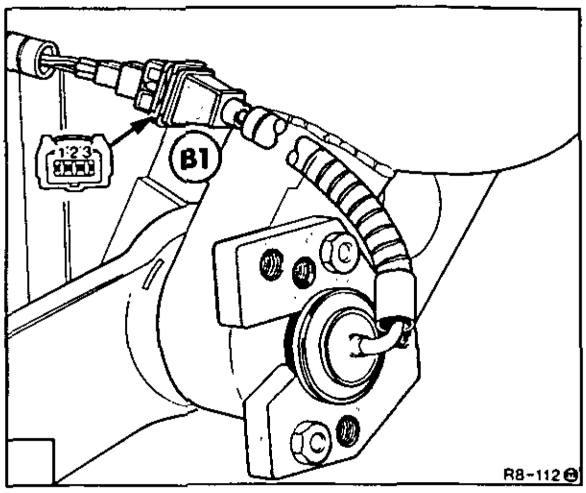
Check for short circuit between **C6–2** (LN/Y) and **C6–4** (B). Repeat check between **C6–1** (LN) and **C6–2** (LN/Y) **Short circuit?**

Locate and repair short circuit

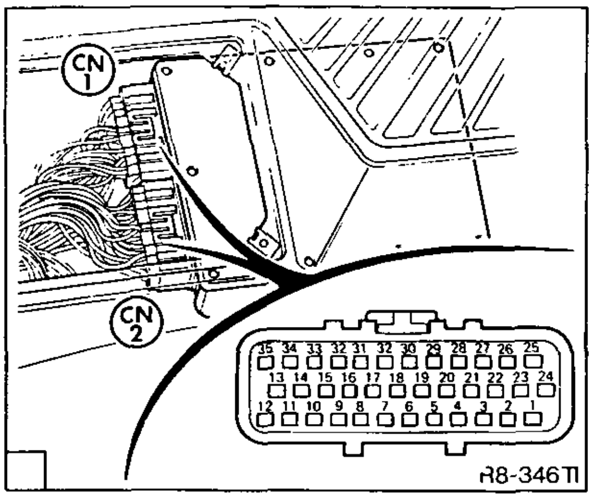
Check for short circuit between **C6–2** (LN/Y) and chassis **Short circuit?**

Error Codes 14 and 15 Right Hand Load Sensing Pin or Circuit Failed

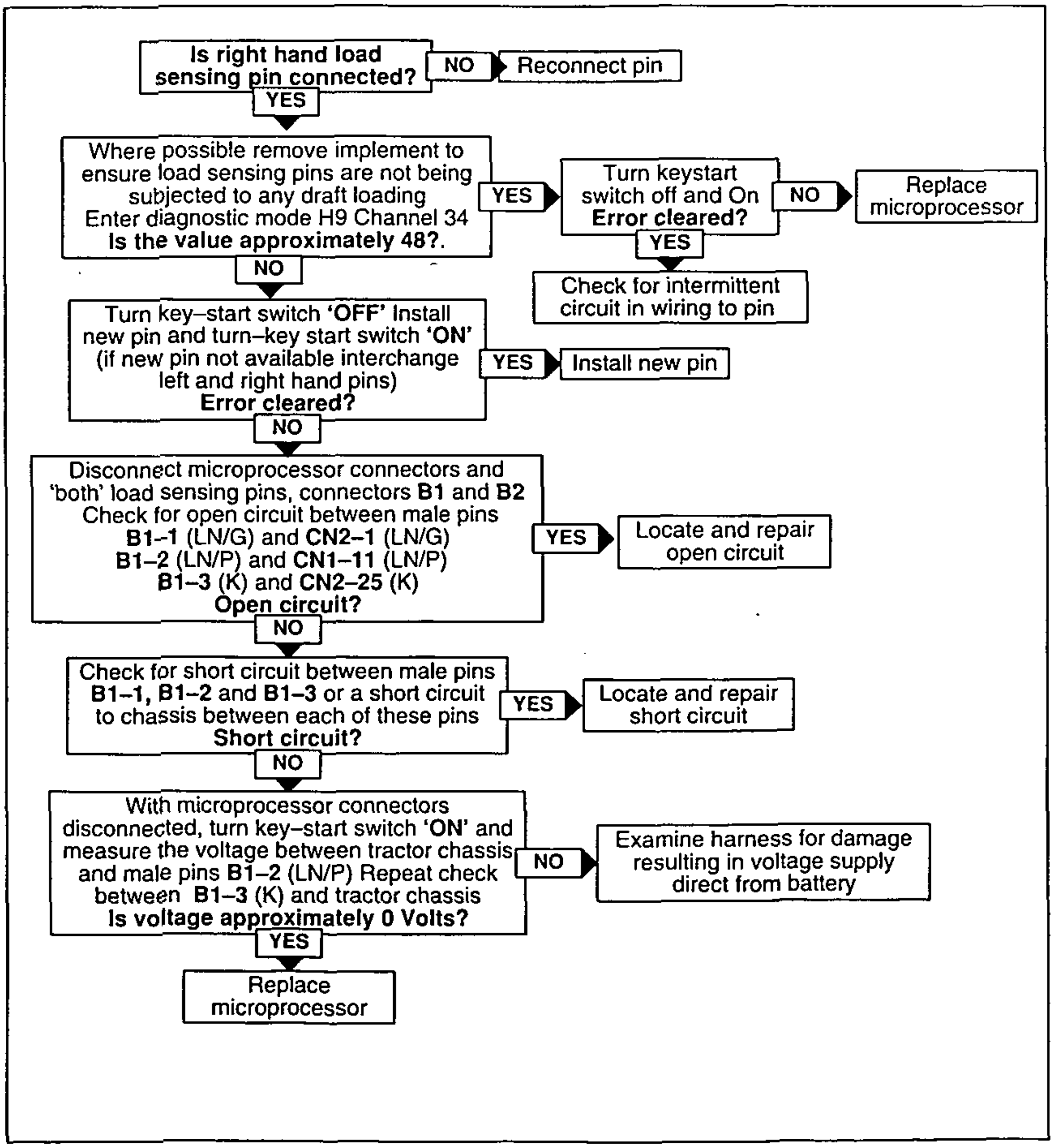
For EDC wiring diagram and connector location refer to the end of this Section



Right Hand Load Sensing Pin



Microprocessor Connector



Is right hand load sensing pin connected?

NO → Reconnect pin

YES ↓

Where possible remove implement to ensure load sensing pins are not being subjected to any draft loading
Enter diagnostic mode H9 Channel 34
Is the value approximately 48?.

YES → Turn keystart switch off and On **Error cleared?**

- NO → Replace microprocessor
- YES → Check for intermittent circuit in wiring to pin

NO ↓

Turn key–start switch **'OFF'** Install new pin and turn–key start switch **'ON'** (if new pin not available interchange left and right hand pins)
Error cleared?

YES → Install new pin

NO ↓

Disconnect microprocessor connectors and 'both' load sensing pins, connectors **B1** and **B2**
Check for open circuit between male pins
B1–1 (LN/G) and **CN2–1** (LN/G)
B1–2 (LN/P) and **CN1–11** (LN/P)
B1–3 (K) and **CN2–25** (K)
Open circuit?

YES → Locate and repair open circuit

NO ↓

Check for short circuit between male pins **B1–1**, **B1–2** and **B1–3** or a short circuit to chassis between each of these pins
Short circuit?

YES → Locate and repair short circuit

NO ↓

With microprocessor connectors disconnected, turn key–start switch **'ON'** and measure the voltage between tractor chassis and male pins **B1**–2 (LN/P) Repeat check between **B1–3** (K) and tractor chassis
Is voltage approximately 0 Volts?

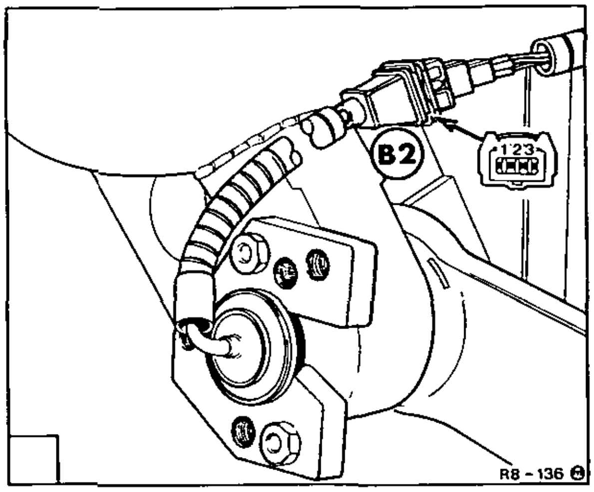
NO → Examine harness for damage resulting in voltage supply direct from battery

YES ↓

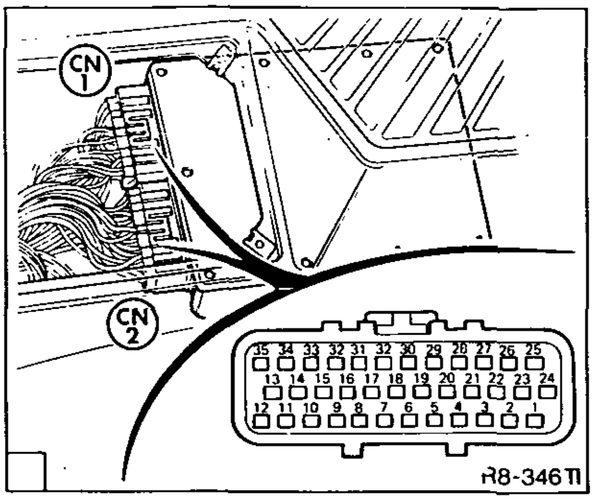
Replace microprocessor

Error Codes 16 and 17 Left Hand Load Sensing Pin or Circuit Failed

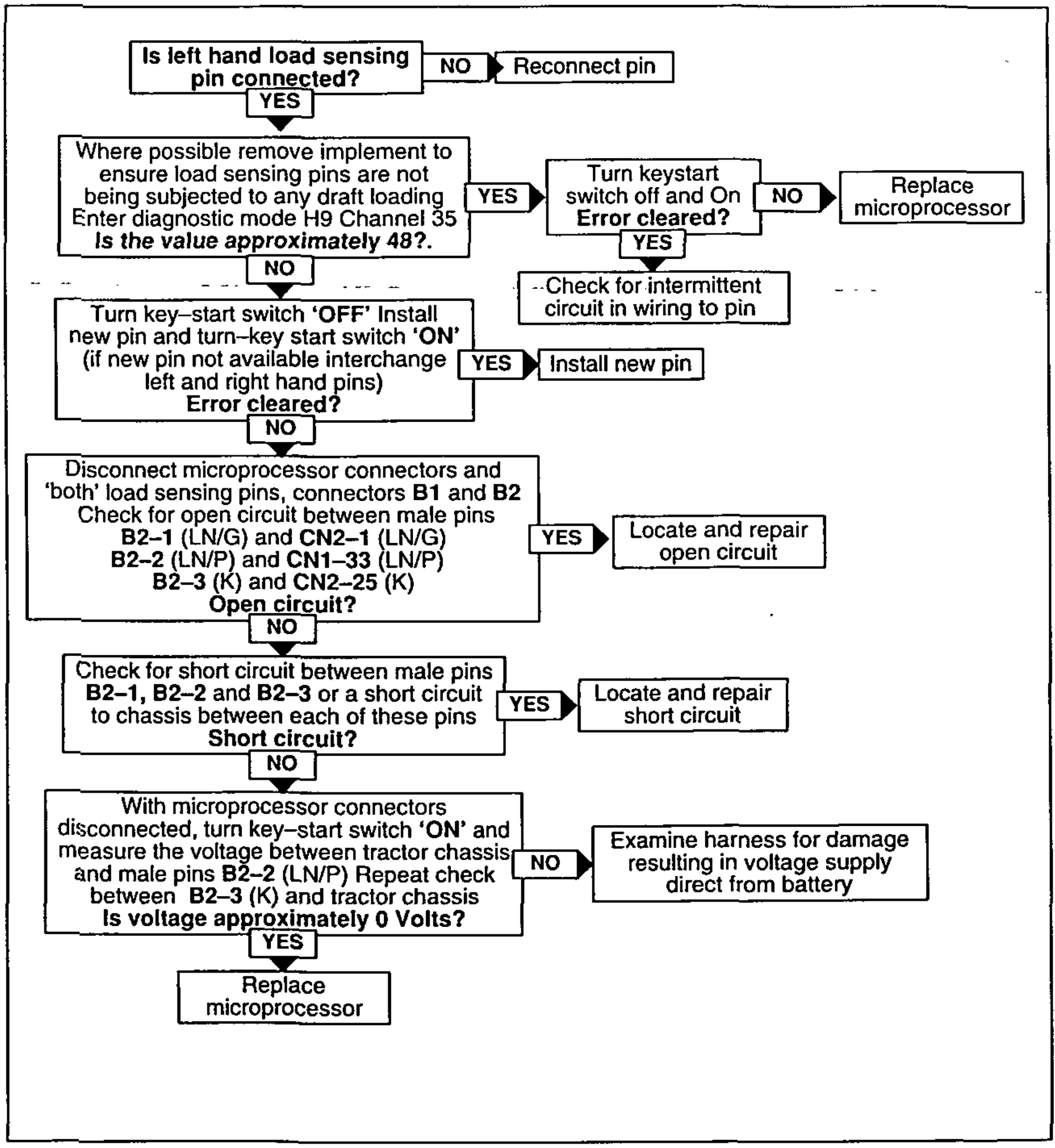
For EDC wiring diagram and connector location refer to the end of this Section



Left Hand Load Sensing Pin

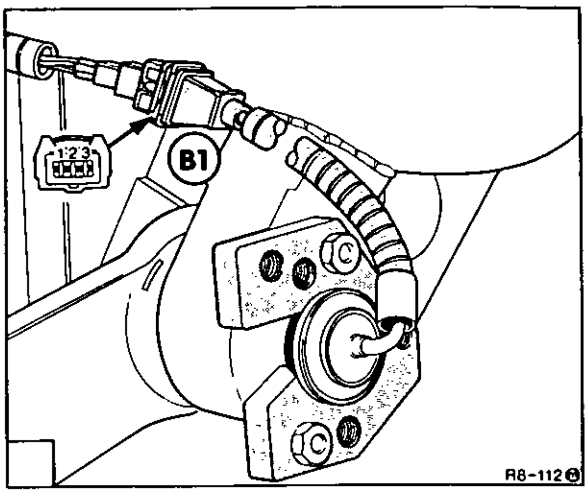


Microprocessor Connectors

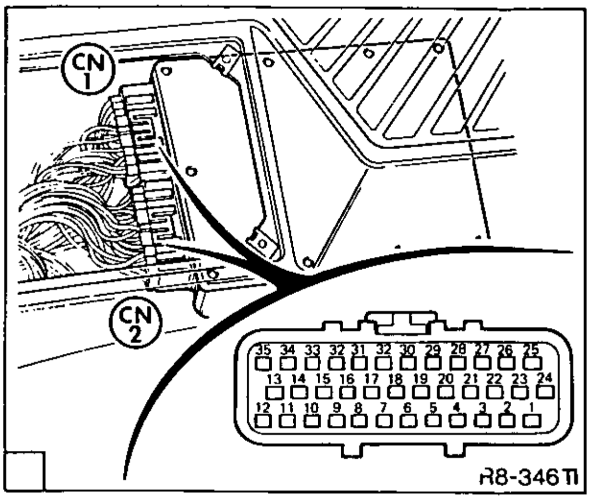


Error Code 18 Both Load Sensing Pins Disconnected

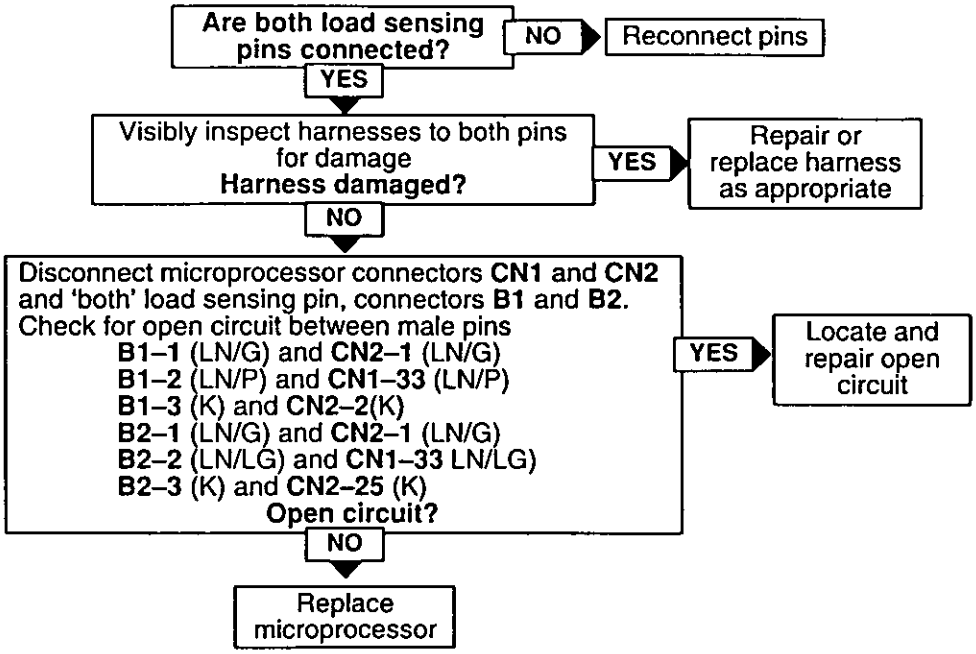
For EDC wiring diagram and connector location refer to the end of this Section



Load Sensing Pins (Right Hand Pin Shown)



Microprocessor Connectors



Are both load sensing pins connected?

NO → Reconnect pins

YES ↓

Visibly inspect harnesses to both pins for damage
Harness damaged?

YES → Repair or replace harness as appropriate

NO ↓

Disconnect microprocessor connectors **CN1** and **CN2** and 'both' load sensing pin, connectors **B1** and **B2**.
Check for open circuit between male pins
B1–1 (LN/G) and **CN2–1** (LN/G)
B1–2 (LN/P) and **CN1–33** (LN/P)
B1–3 (K) and **CN2–2**(K)
B2–1 (LN/G) and **CN2–1** (LN/G)
B2–2 (LN/LG) and **CN1–33** LN/LG)
B2–3 (K) and **CN2–25** (K)
Open circuit?

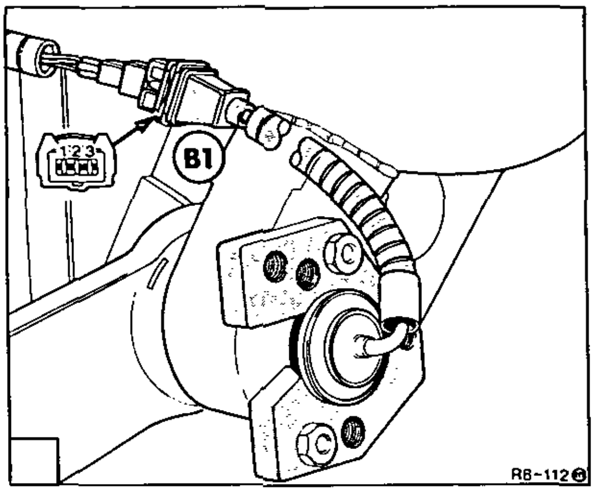
YES → Locate and repair open circuit

NO ↓

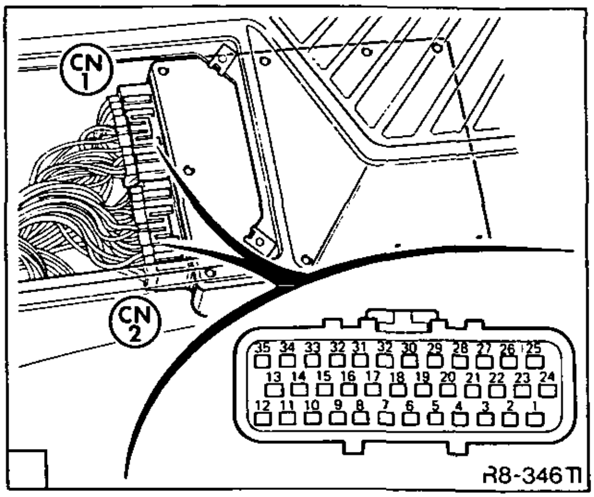
Replace microprocessor

Error Codes 19 and 20 Incorrect Load Sensing Pin Reference Voltage

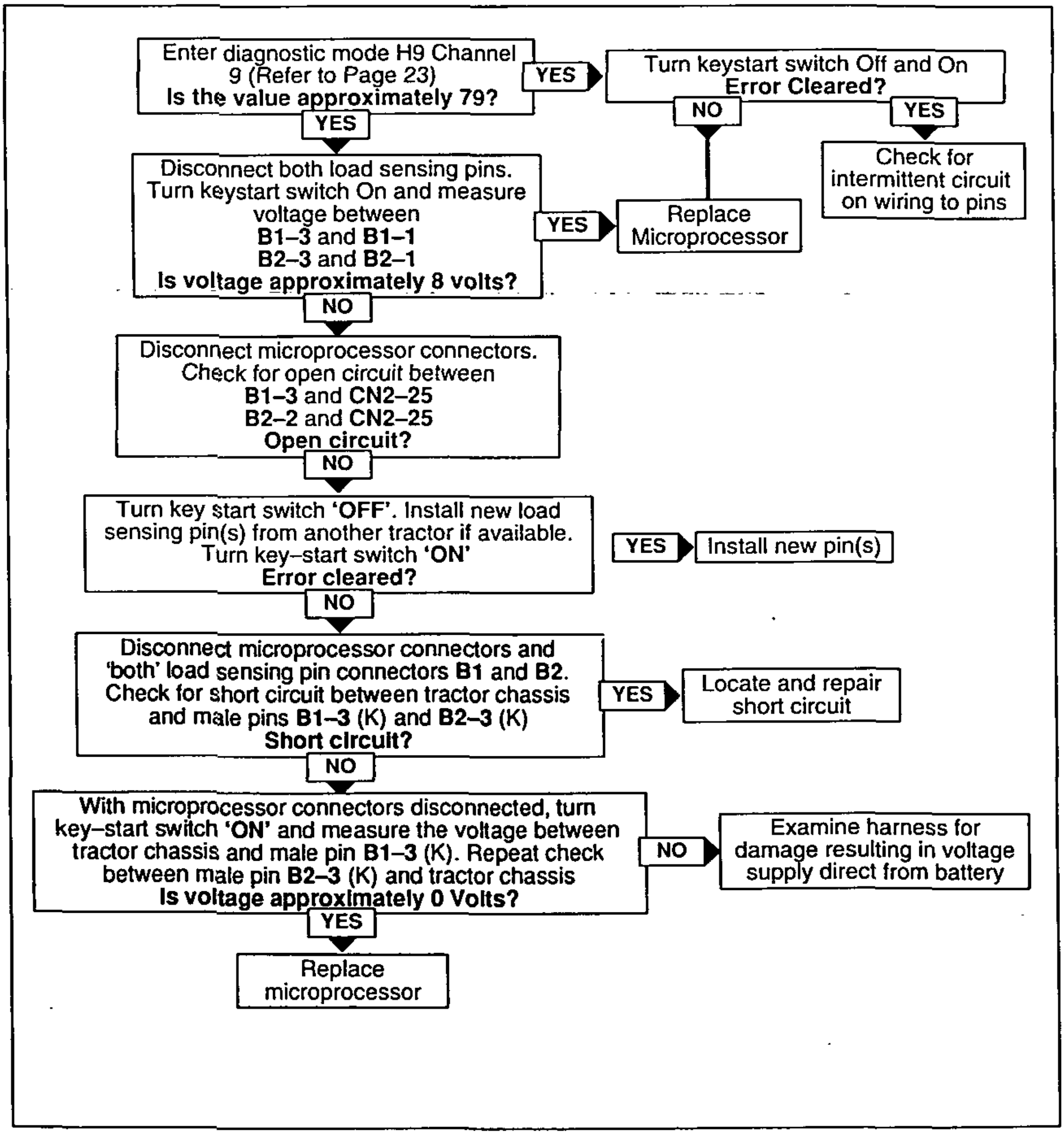
For EDC wiring diagram and connector location refer to the end of this Section



Load Sensing Pin (Right Hand Pin Shown)

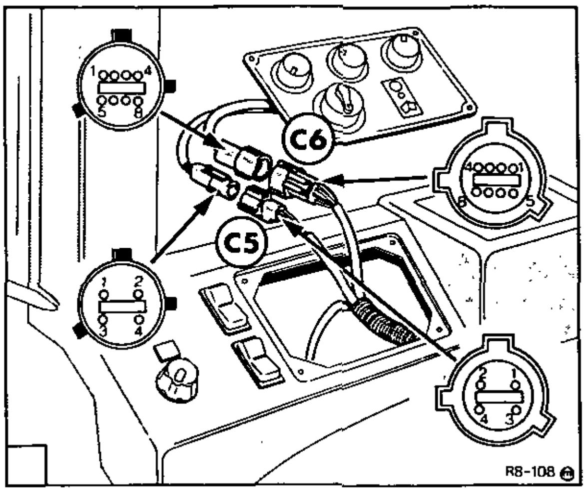


Microprocessor Connectors

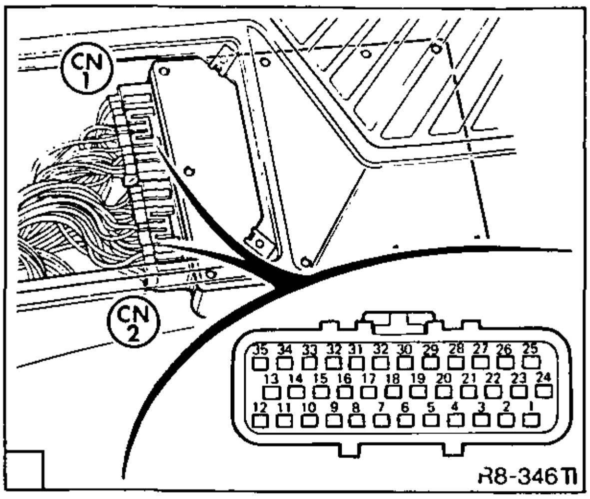


Error Codes 21 and 22 Position/Draft Sensitivity Control Potentiometer or Circuit Failed

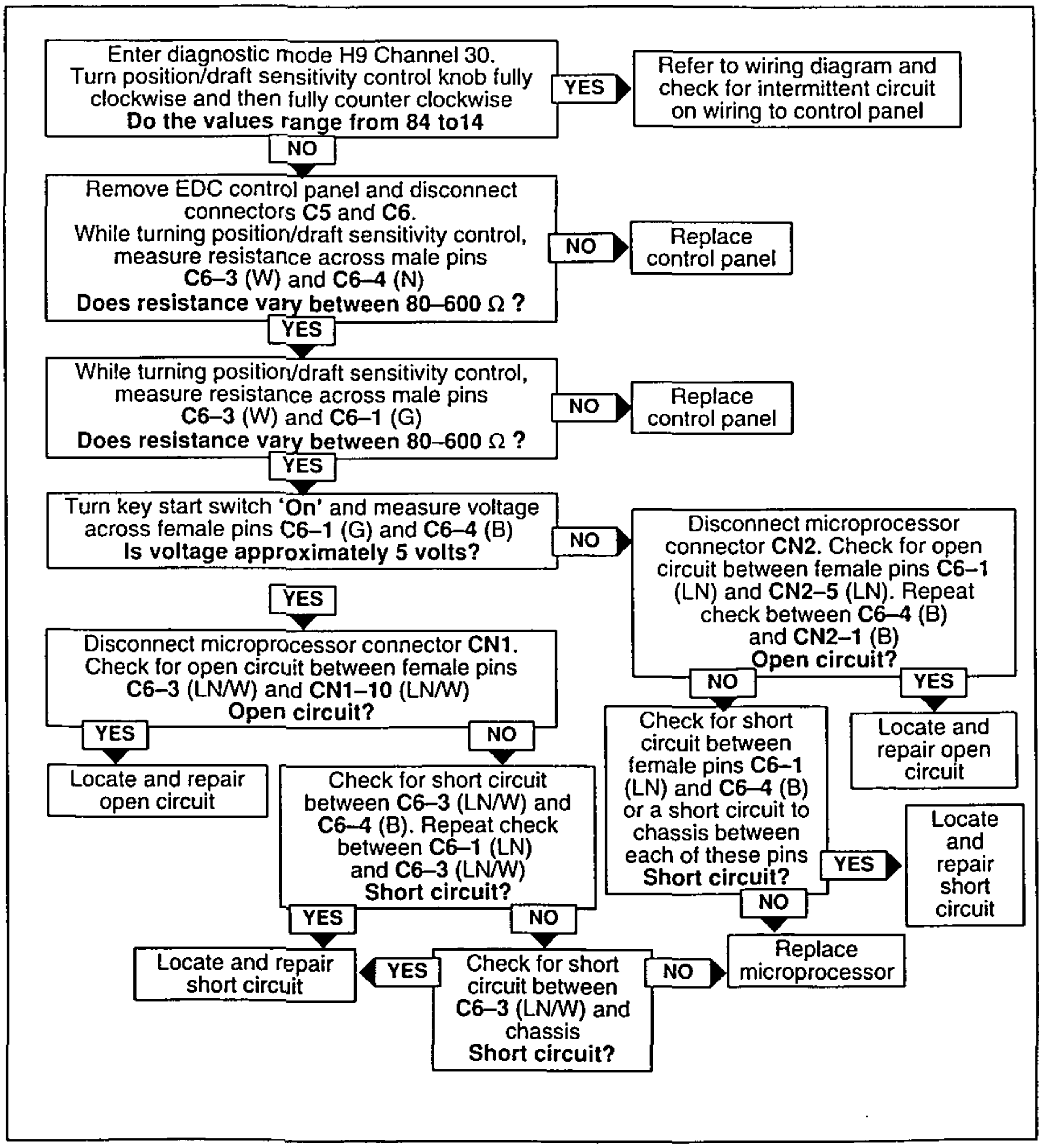
For EDC wiring diagram and connector location refer to the end of this Section



EDC Control Panel Connectors

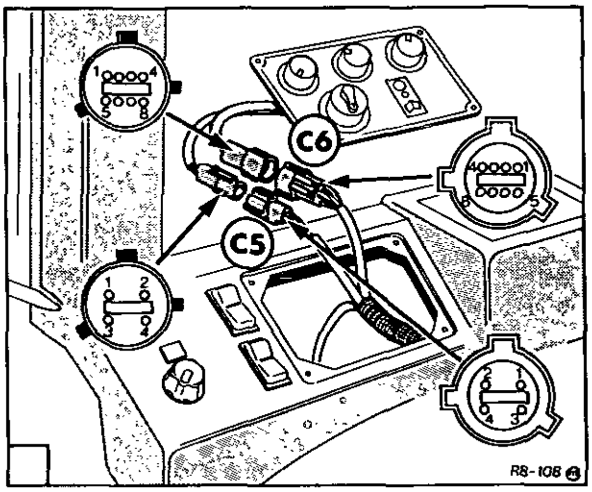


Microprocessor Connectors

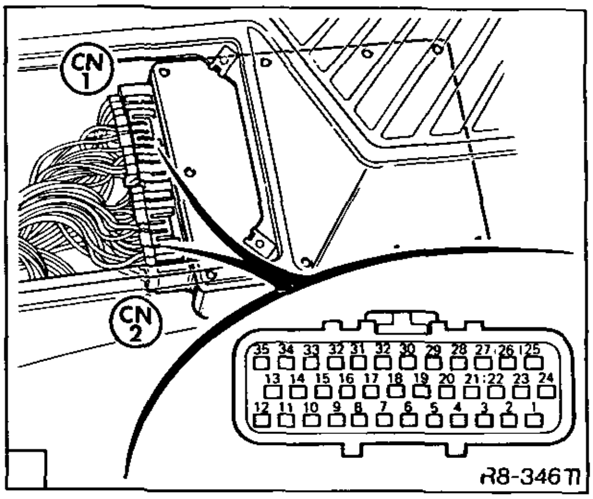


Error Code 23 Control Panel Disconnected

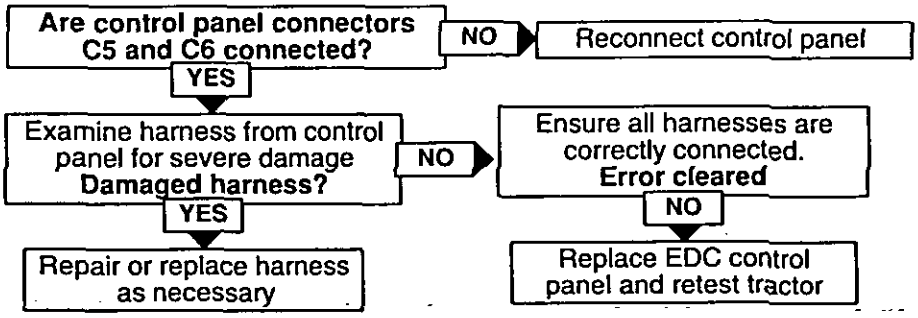
For EDC wiring diagram and connector location refer to the end of this Section



EDC Control Panel Connectors



Microprocessor Connectors



Are control panel connectors C5 and C6 connected?

NO → Reconnect control panel

YES ↓

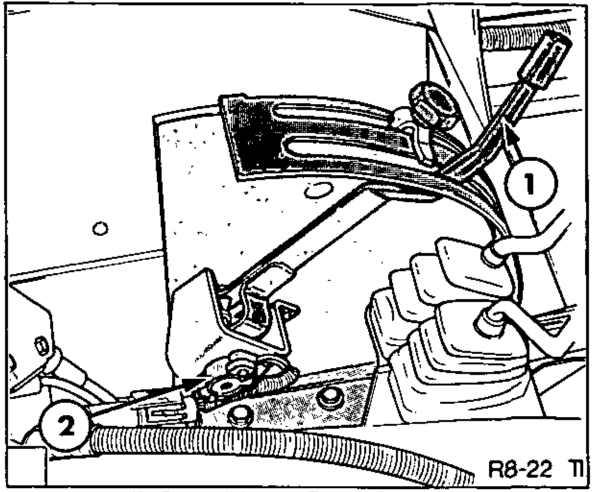
Examine harness from control panel for severe damage **Damaged harness?**

YES ↓ Repair or replace harness as necessary

NO → Ensure all harnesses are correctly connected. **Error cleared**

NO ↓ Replace EDC control panel and retest tractor

Error Code 24 Perform Hydraulic Lift Autocalibration

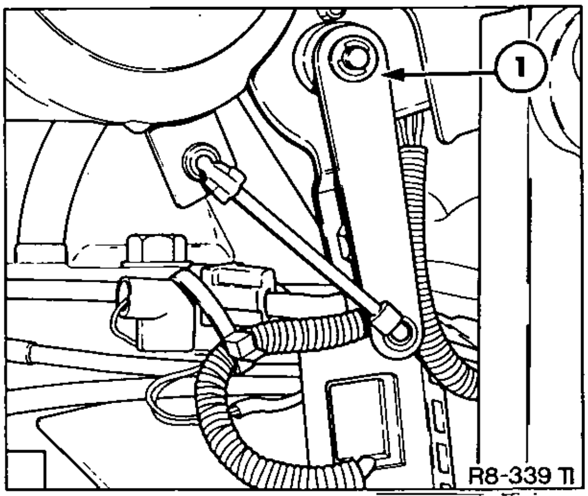


Lift Control Lever Potentiometer

1. Lift Control Lever
2. Potentiometer

This procedure is required whenever any of the following situations have occurred while the key–start switch was turned **'ON'**:–

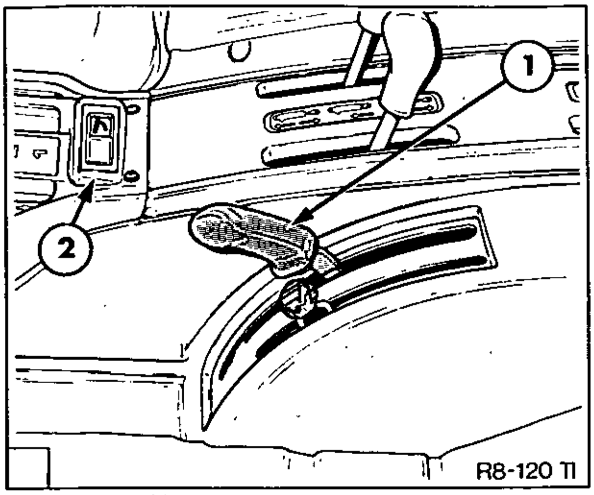
- The position sensing potentiometer on the right hand lift arm has been replaced.
- The microprocessor has been replaced or its memory has been reset as detailed on Page 22 of this Chapter.
- The potentiometer on the lift control lever has been replaced.



Lift Arm Position Sensing Potentiometer

1. Potentiometer
2. Connector

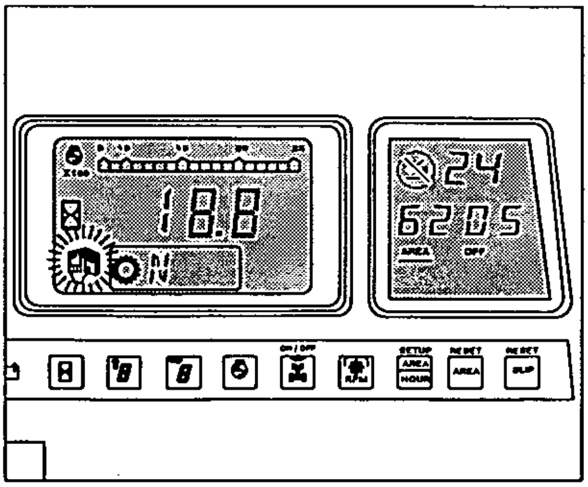
If Error Code 24 does not automatically appear after replacement of these potentiometers, or the operator is aware that the system is not operating correctly, the hydraulic lift system must be artificially put into the the Error Code 24 situation as follows:–



Hydraulic Lift Control Lever

1. Lift Control Lever
2. In Cab Raise/Lower Switch

1. Press the bottom of the in cab raise/lower switch to select the lowering position.
2. Turn the key–start switch 'ON' but **Do Not** start the engine.
3. Disconnect and then reconnect the connector to either the lift control lever or position sensing potentiometers. Error code 25 or 27 will be displayed.

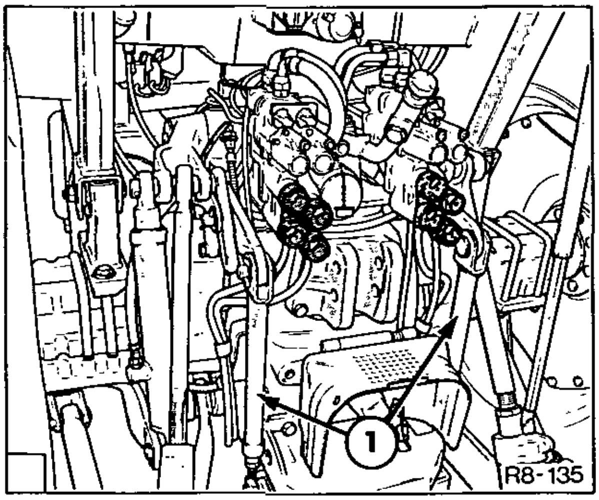


Error Code 24 Display
(Electronic Instrument Panel Shown)

4. Turn key–start switch 'OFF' and then 'ON'. Error code 24 will now be displayed and the 'Read your Owners Manual' and 'Lift Disabled Symbols' will flash. The system must now be autocalibrated as described in the following autocalibration procedure.

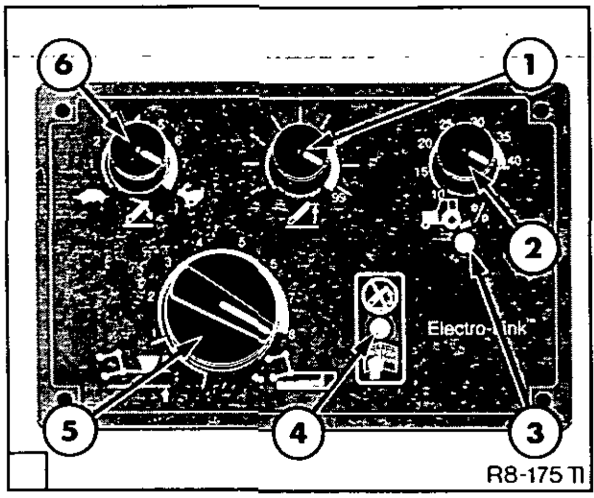
AUTOCALIBRATION PROCEDURE

Error Code 24 and Error Code HL



Automatic Pick–Up Hitch Lift Rods

1. Disconnect vertical rods from hanger on automatic pick–up hitch (where fitted). This will allow the lift arms to raise to their maximum position.

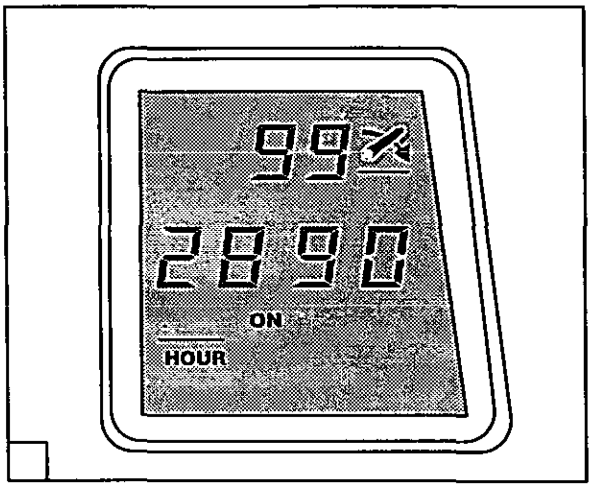


Hydraulic Control Panel

1. Height Limit Control
2. Slip Limit Control
3. Slip Limit 'On' Indicator
4. Status Indicator
5. Position/Draft Sensitivity Knob
6. Drop Rate Control Knob

2. Turn all the EDC operator controls fully clockwise and set in cab raise/lower switch to lowering.

NOTE: *If the height limit control has not been turned fully clockwise to the maximum height position, the* ***Error Code HL*** *will be displayed during the calibration procedure. Should this occur, set the height limit control to maximum height and restart the calibration procedure.*



Lift Height Position '99'

3. Start engine and set the engine speed to 1100 rpm.

4. Slowly move the lift control lever back and forth through its entire range until the "Hitch Disabled" symbol disappears.

5. Pull the lift control lever back to the fully raised position and allow the lift to fully raise, at which point the relief valve in the hydraulic pump will momentarily operate. When the lift is at the top of its travel the digital display(s) will indicate a lift position of "99". This procedure calibrates the position sensing potentiometer on the right hand lift control arm and the potentiometer at the base of the lift control lever, for the 'Full Raise' condition of the hydraulic lift.

6. Move the lift control lever fully forward and past the mechanical detent. The "Lift Disabled" symbol will be displayed.

7. Slowly move the lift control lever rearwards until the "Lift Disabled" symbol disappears.

8. Move the lift control lever forward until it is against the mechanical detent.

9. Allow the lift arms to lower, the digital display will now indicate a lift position of "0".

The position sensing potentiometers are now calibrated for the hydraulic lift in the fully lowered condition. If the hydraulic valve has not been calibrated the lift arms may not be able to achieve position 0 or 99. Should this occur, repeat steps 8 and 9.

10. Using the lift control lever, slowly raise the hydraulic lift until the display shows a value between **70–90**. Leave the lift control lever in this position while the system carries out three automatic calibrations. This will start after a few seconds and will be observed as a slight raising followed by a slight lowering of the lift arms. This will be repeated automatically two more times over a period of approximately one minute.

11. Once the cycle has been completed, pull the lift control lever rearwards to raise the arms completely and ensure that "99" is shown on the display.

12. Reconnect and adjust the rod on the automatic pick–up hitch as follows:–

    Move the lift control lever forward to allow the lift arms to fall slowly, then quickly move the lift control lever fully forward to activate the external switches on the rear fenders.

    Reconnect the pick–up hitch lift rods.

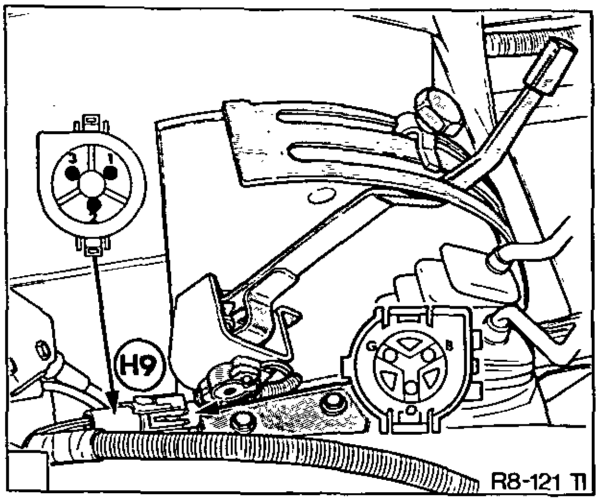
    Adjust the length of the lift rods so that when the hydraulic lift is fully raised using the external fender switches, the lift rods are slightly loose.

    Check that the automatic pick–up hitch operates correctly.

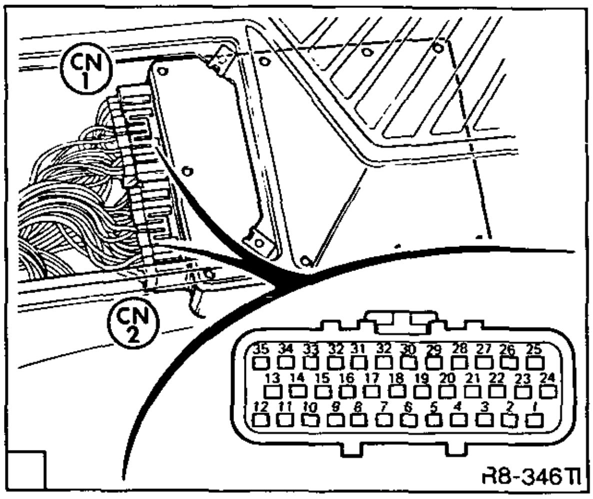
13. Capture the hydraulic lift with the lift control lever.

Error Codes 25 and 26 Lift Control Lever Potentiometer Disconnected or Circuit Failed

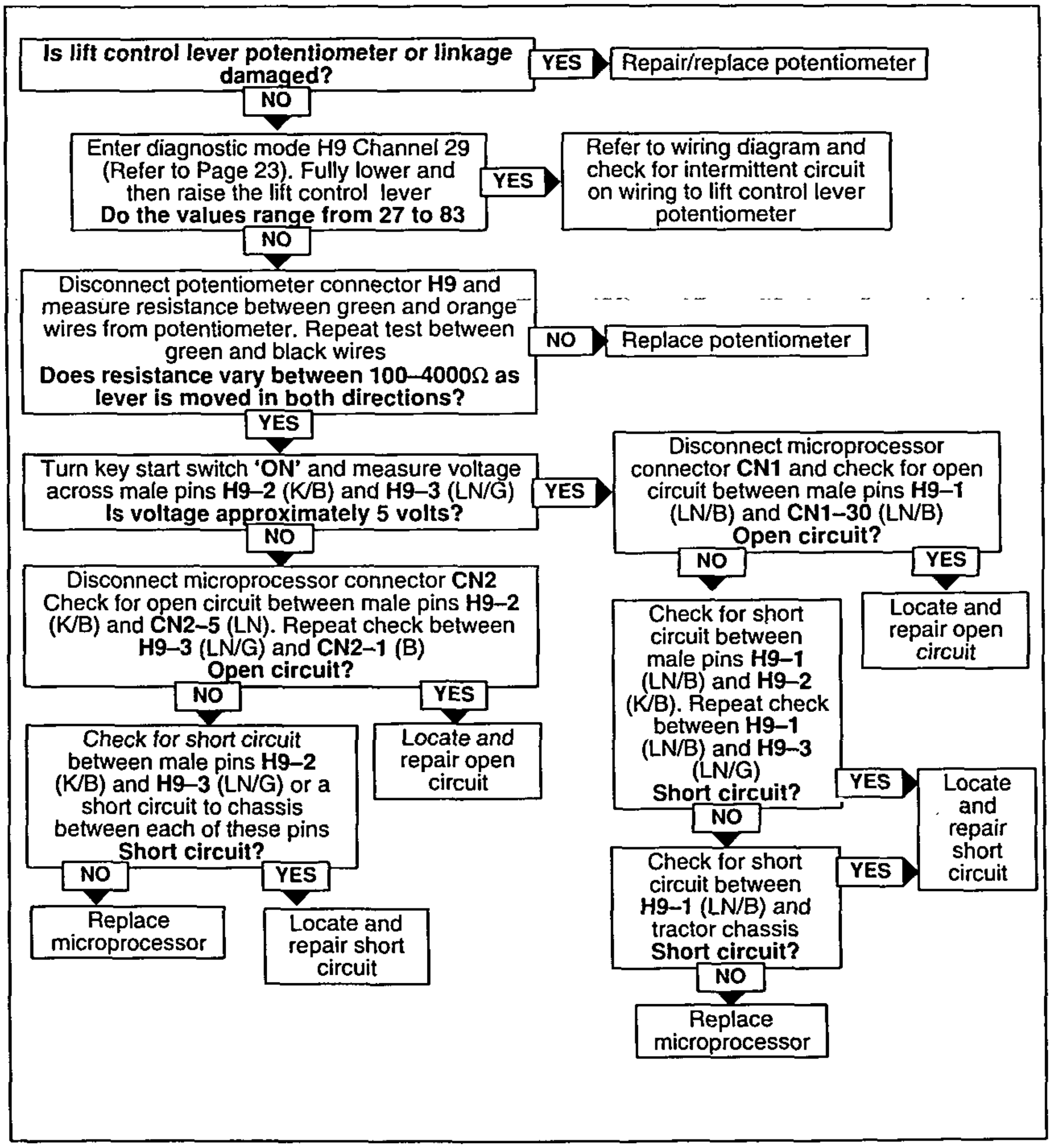
For EDC wiring diagram and connector location refer to end of this Section



Lift Control Lever Potentiometer

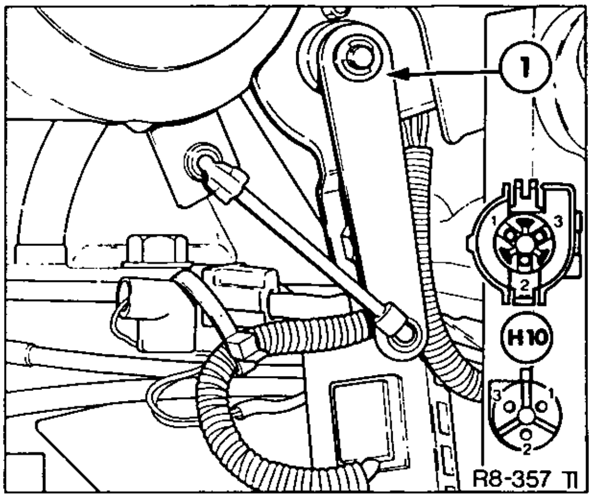


Microprocessor Connectors

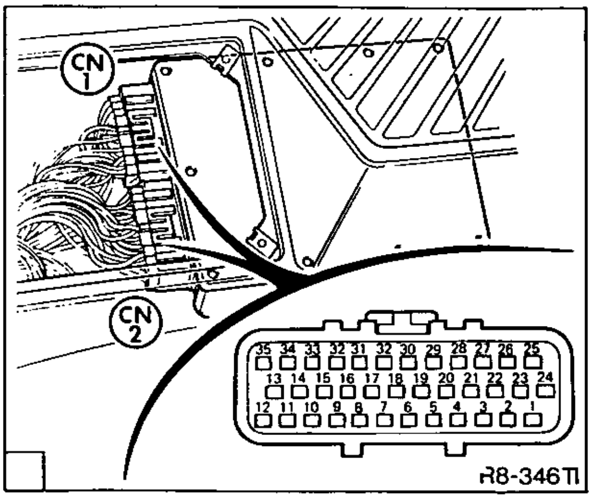


Error Codes 27 and 28 Lift Arm Position Sensing Potentiometer Disconnected or Circuit Failed

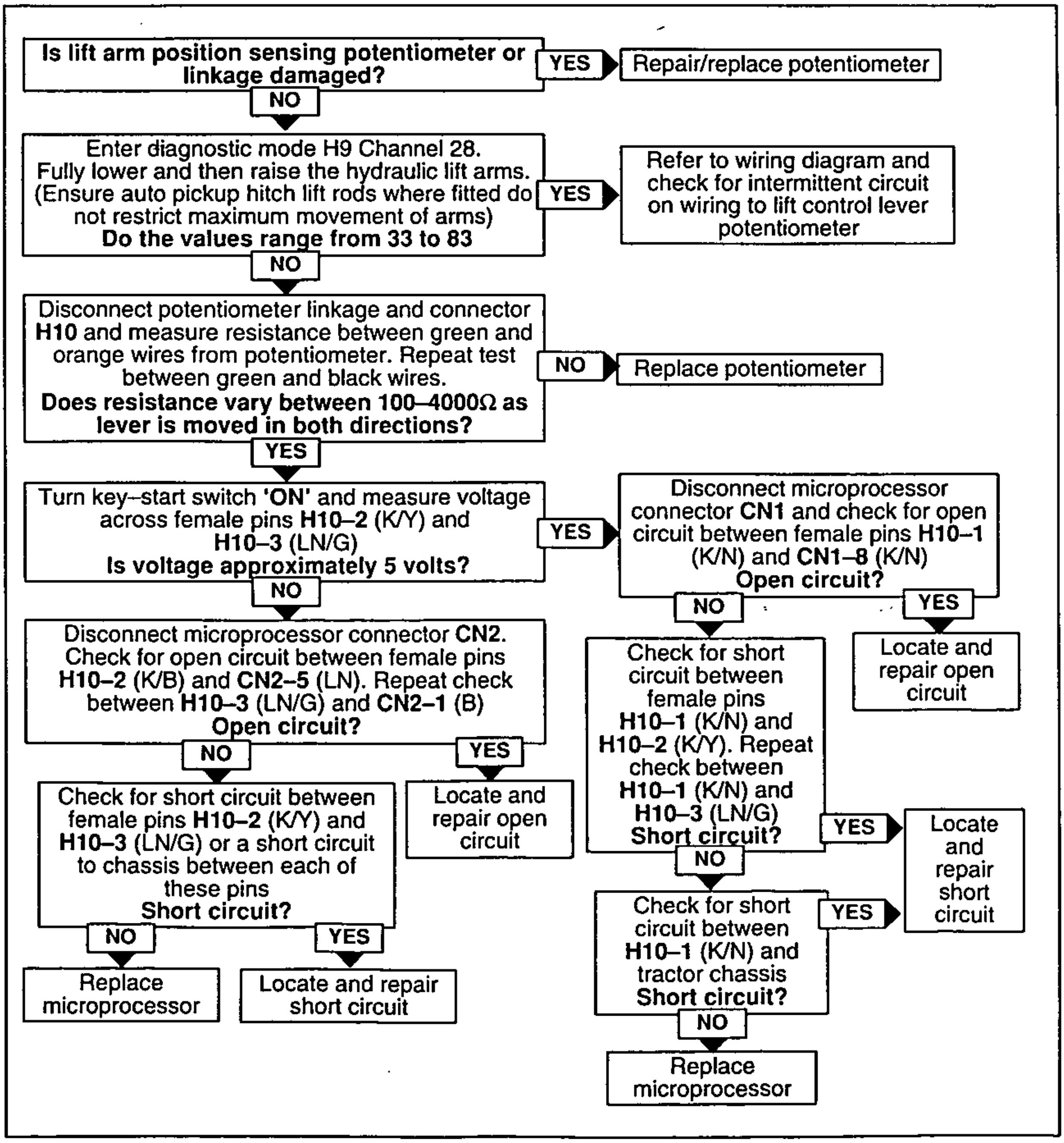
For EDC wiring diagram and connector location refer to end of this Section



Lift Arm Position Sensing Potentiometer



Microprocessor Connectors



Is lift arm position sensing potentiometer or linkage damaged?
YES → Repair/replace potentiometer
NO ↓

Enter diagnostic mode H9 Channel 28. Fully lower and then raise the hydraulic lift arms. (Ensure auto pickup hitch lift rods where fitted do not restrict maximum movement of arms)
Do the values range from 33 to 83
YES → Refer to wiring diagram and check for intermittent circuit on wiring to lift control lever potentiometer
NO ↓

Disconnect potentiometer linkage and connector **H10** and measure resistance between green and orange wires from potentiometer. Repeat test between green and black wires.
Does resistance vary between 100–4000Ω as lever is moved in both directions?
NO → Replace potentiometer
YES ↓

Turn key–start switch **'ON'** and measure voltage across female pins **H10–2** (K/Y) and **H10–3** (LN/G)
Is voltage approximately 5 volts?
YES → Disconnect microprocessor connector **CN1** and check for open circuit between female pins **H10–1** (K/N) and **CN1–8** (K/N) **Open circuit?**
- YES → Locate and repair open circuit
- NO → Check for short circuit between female pins **H10–1** (K/N) and **H10–2** (K/Y). Repeat check between **H10–1** (K/N) and **H10–3** (LN/G) **Short circuit?**
  - YES → Locate and repair short circuit
  - NO → Check for short circuit between **H10–1** (K/N) and tractor chassis **Short circuit?**
    - YES → Locate and repair short circuit
    - NO → Replace microprocessor

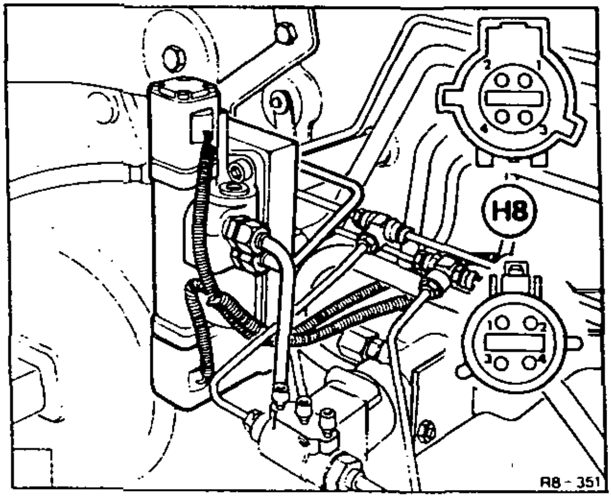
NO ↓

Disconnect microprocessor connector **CN2**. Check for open circuit between female pins **H10–2** (K/B) and **CN2–5** (LN). Repeat check between **H10–3** (LN/G) and **CN2–1** (B)
Open circuit?
YES → Locate and repair open circuit
NO ↓

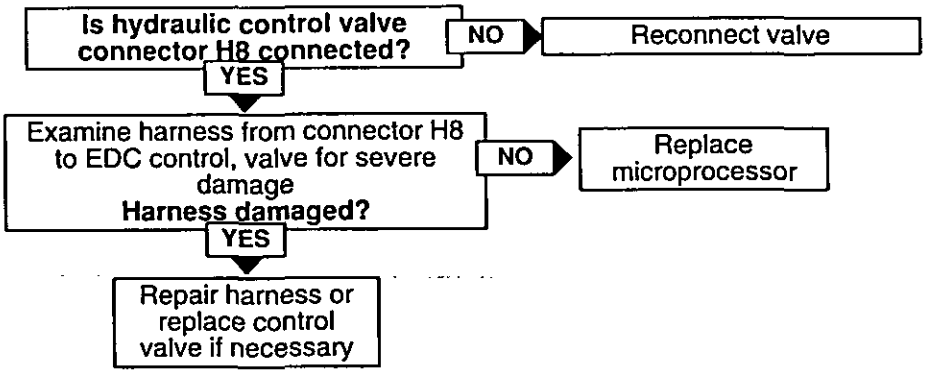
Check for short circuit between female pins **H10–2** (K/Y) and **H10–3** (LN/G) or a short circuit to chassis between each of these pins
Short circuit?
NO → Replace microprocessor
YES → Locate and repair short circuit

Error Code 29 Hydraulic Control Valve Disconnected

For EDC wiring diagram and connector location refer to end of this Section

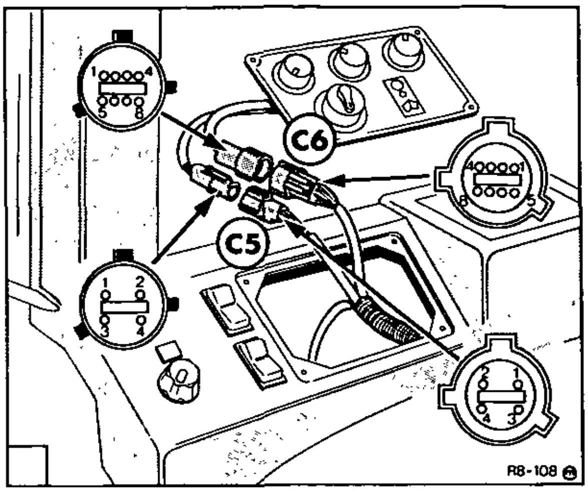


Hydraulic Control Valve

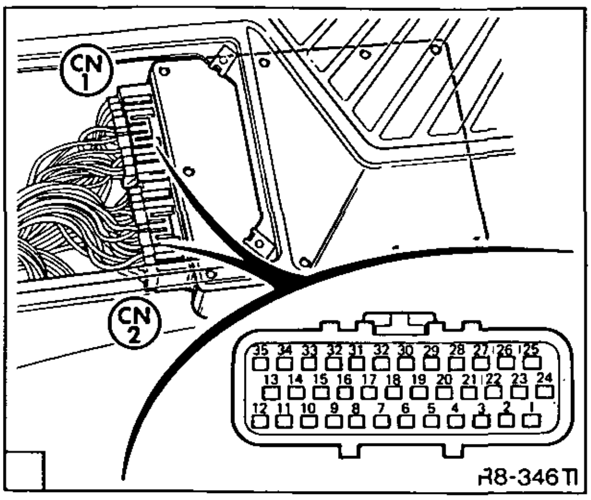


Error Code 30 Signal Ground Open Circuit

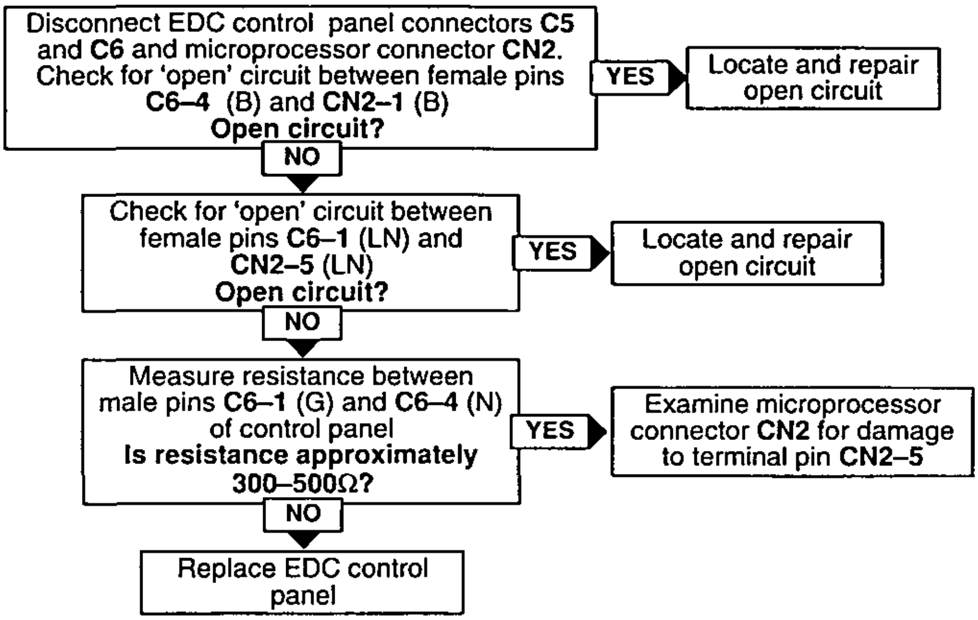
For EDC wiring diagram and connector location refer to end of this Section



EDC Control Panel Connectors



Microprocessor Connectors



Disconnect EDC control panel connectors **C5** and **C6** and microprocessor connector **CN2**. Check for 'open' circuit between female pins **C6–4** (B) and **CN2–1** (B) **Open circuit?**

YES → Locate and repair open circuit

NO ↓

Check for 'open' circuit between female pins **C6–1** (LN) and **CN2–5** (LN) **Open circuit?**

YES → Locate and repair open circuit

NO ↓

Measure resistance between male pins **C6–1** (G) and **C6–4** (N) of control panel **Is resistance approximately 300–500Ω?**

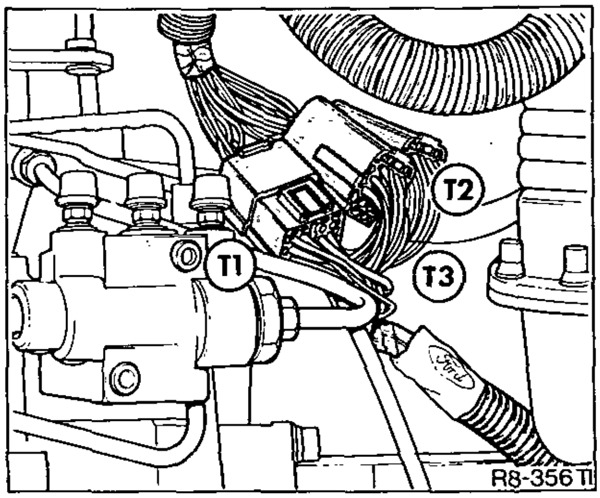
YES → Examine microprocessor connector **CN2** for damage to terminal pin **CN2–5**

NO ↓

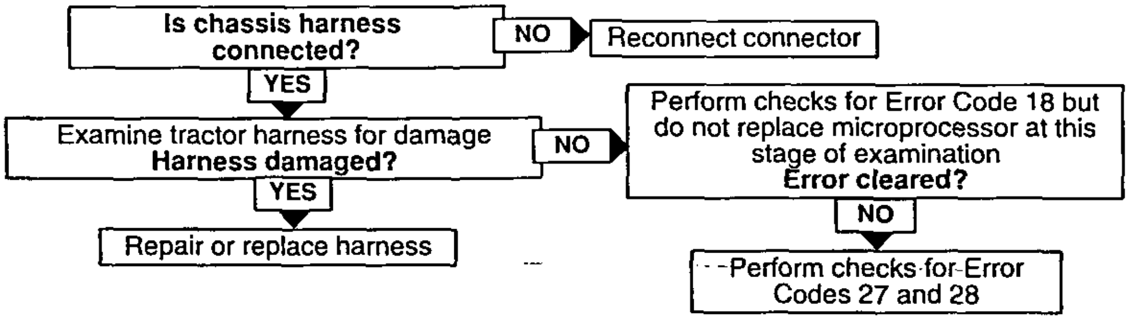
Replace EDC control panel

Error Code 31 Chassis Harness Disconnected

For EDC wiring diagram and connector location refer to end of this Section

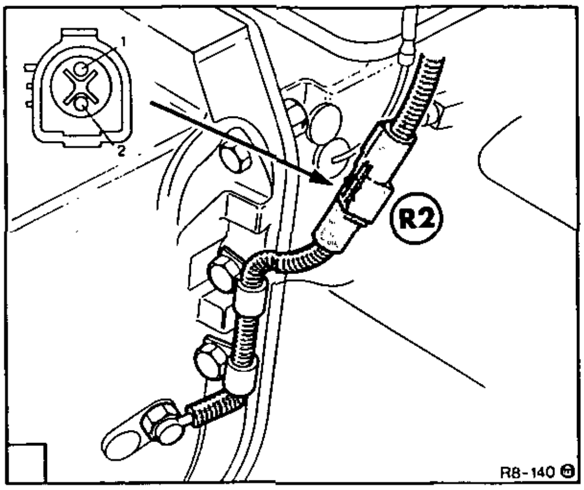


Chassis Harness Connectors

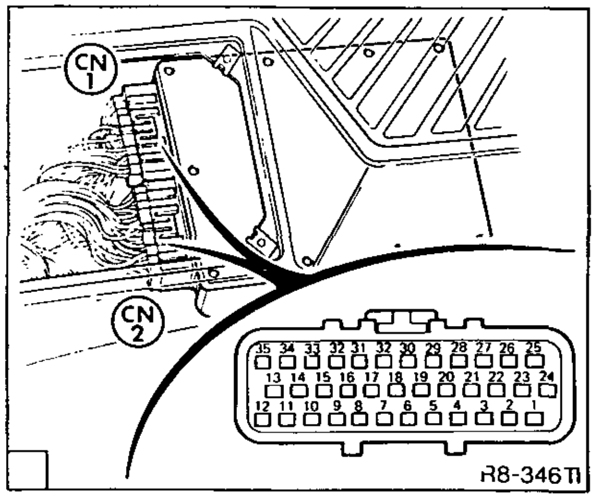


Error Code 49 Wheel Speed Sensor Open or Short Circuit

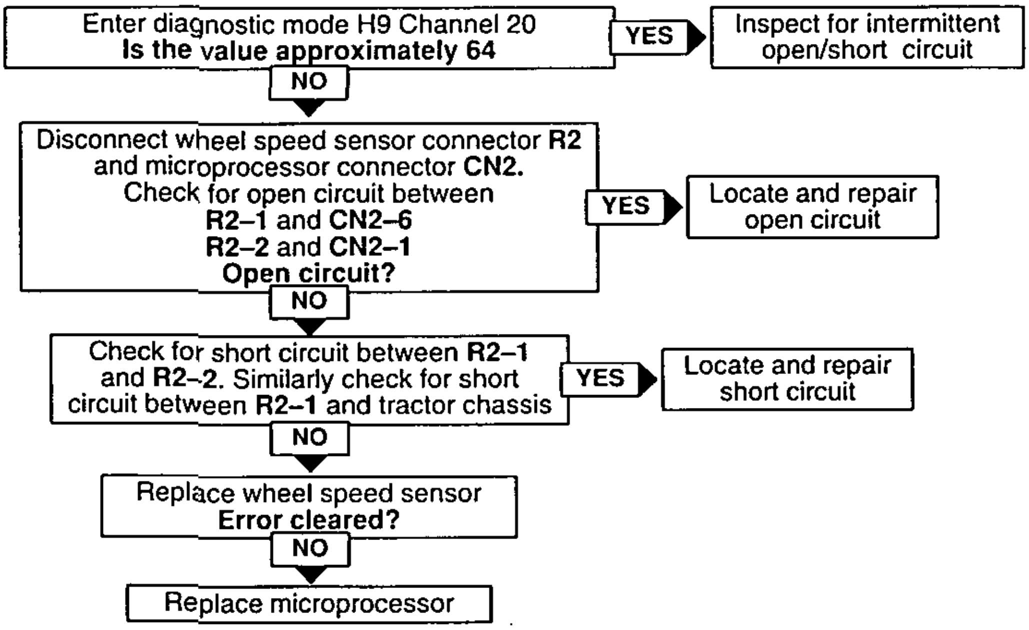
For EDC wiring diagram and connector location refer to end of this Section



Wheel Speed Sensor



Microprocessor Connectors



Enter diagnostic mode H9 Channel 20
Is the value approximately 64
YES → Inspect for intermittent open/short circuit
NO ↓

Disconnect wheel speed sensor connector **R2** and microprocessor connector **CN2.**
Check for open circuit between
R2–1 and **CN2–6**
R2–2 and **CN2–1**
Open circuit?
YES → Locate and repair open circuit
NO ↓

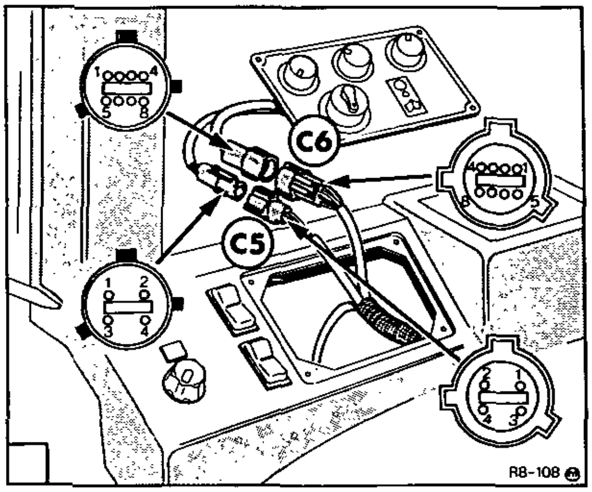
Check for short circuit between **R2–1** and **R2–2**. Similarly check for short circuit between **R2–1** and tractor chassis
YES → Locate and repair short circuit
NO ↓

Replace wheel speed sensor
Error cleared?
NO ↓

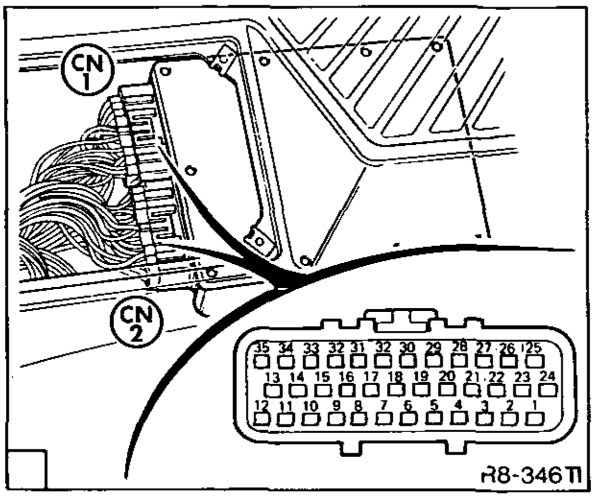
Replace microprocessor

Error Code 53 Microprocessor 5 volt reference Shorted to 12 volts

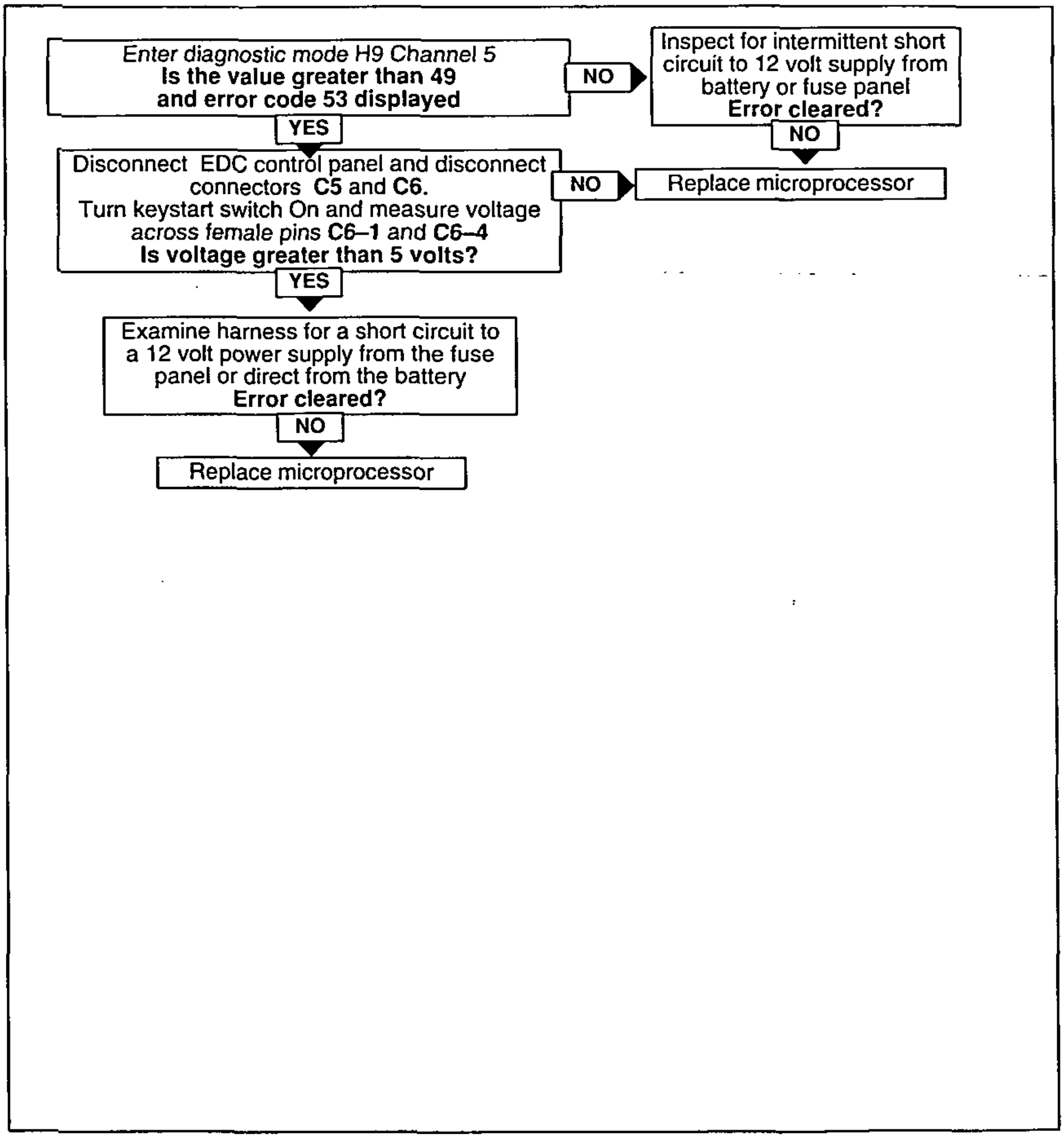
For EDC wiring diagram and connector location refer to end of this Section



EDC Control Panel Connectors



Microprocessor Connectors



Enter diagnostic mode H9 Channel 5
Is the value greater than 49
and error code 53 displayed

NO → Inspect for intermittent short circuit to 12 volt supply from battery or fuse panel
Error cleared?

NO → Replace microprocessor

YES → Disconnect EDC control panel and disconnect connectors **C5** and **C6**.
Turn keystart switch On and measure voltage *across female pins* **C6–1** and **C6–4**
Is voltage greater than 5 volts?

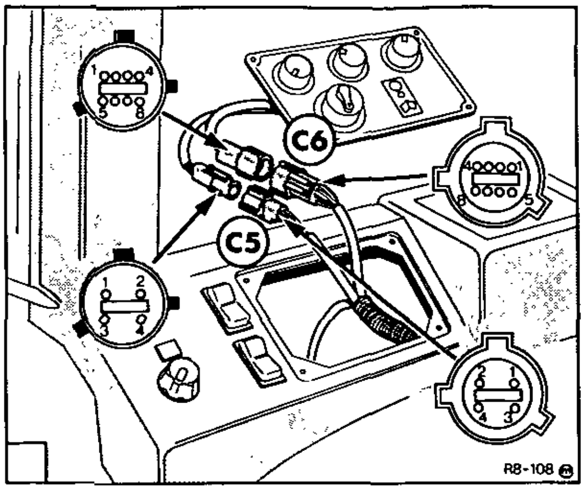
NO → Replace microprocessor

YES → Examine harness for a short circuit to a 12 volt power supply from the fuse panel or direct from the battery
Error cleared?

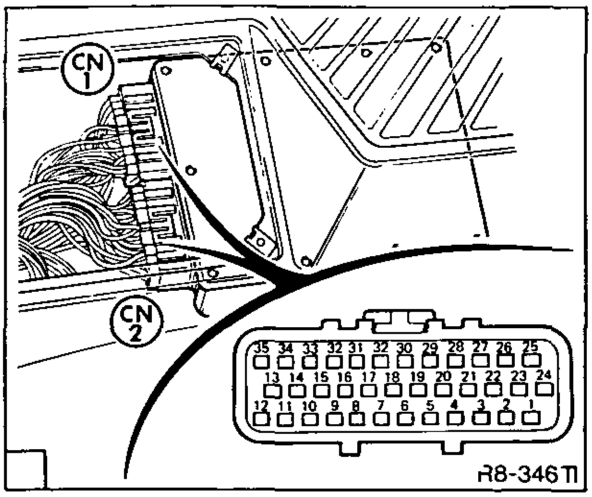
NO → Replace microprocessor

Error Code 54 Microprocessor 5 volt reference Shorted to Ground

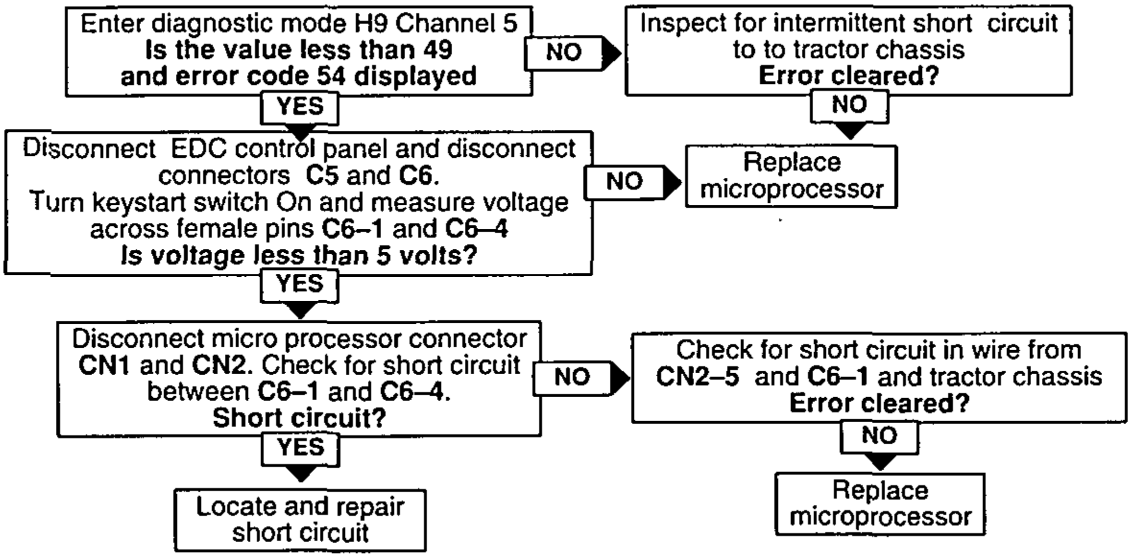
For EDC wiring diagram and connector location refer to end of this Section



EDC Control Panel Connectors



Microprocessor Connectors



Enter diagnostic mode H9 Channel 5
Is the value less than 49
and error code 54 displayed

NO → Inspect for intermittent short circuit to to tractor chassis **Error cleared?** NO → Replace microprocessor

YES ↓

Disconnect EDC control panel and disconnect connectors **C5** and **C6**.
Turn keystart switch On and measure voltage across female pins **C6–1** and **C6–4**
Is voltage less than 5 volts?

NO → Replace microprocessor

YES ↓

Disconnect micro processor connector **CN1** and **CN2**. Check for short circuit between **C6–1** and **C6–4**.
Short circuit?

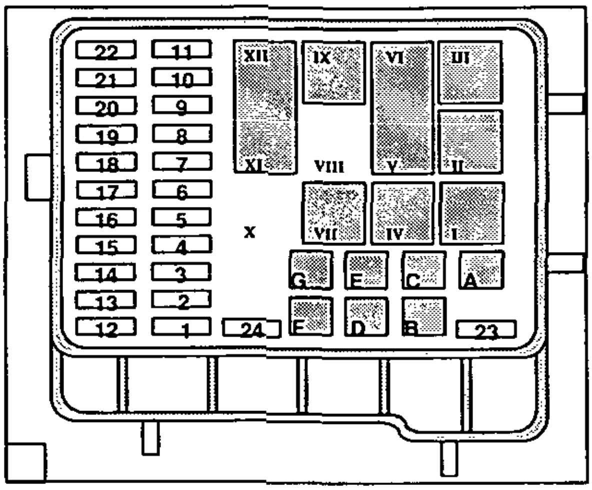
NO → Check for short circuit in wire from **CN2–5** and **C6–1** and tractor chassis **Error cleared?** NO → Replace microprocessor

YES ↓

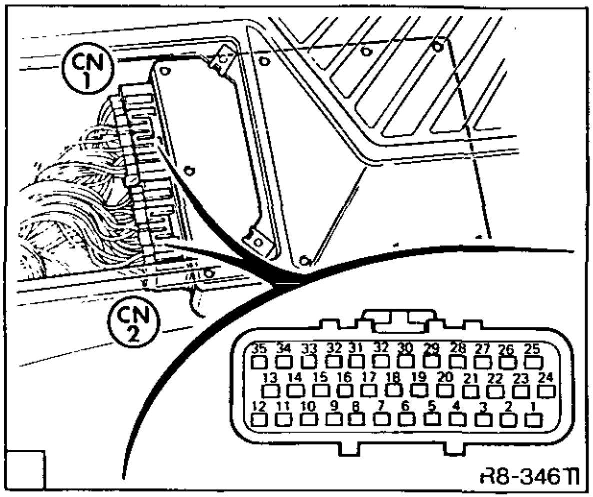
Locate and repair short circuit

Error Code 57 EDC Microprocessor Failure

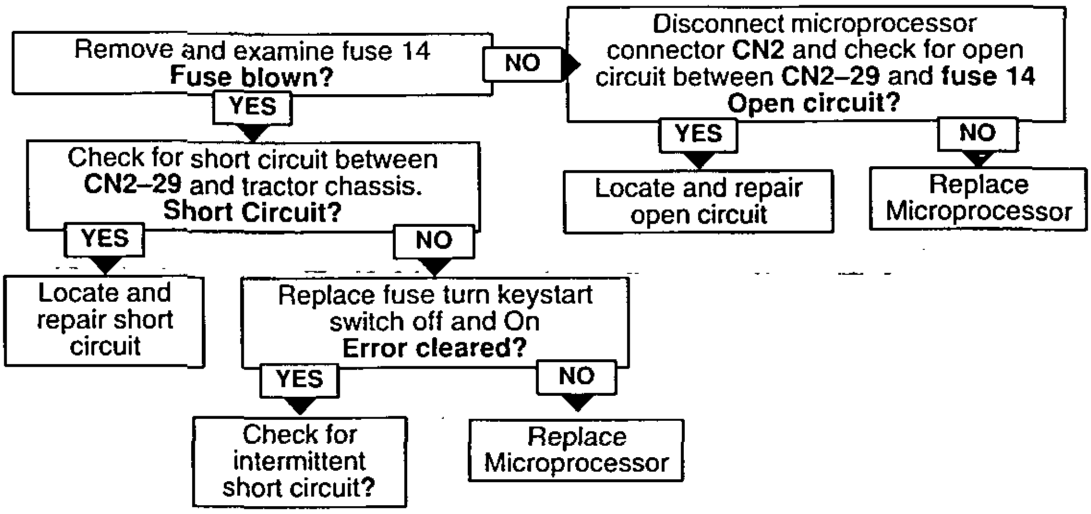
For EDC wiring diagram and connector location refer to end of this Section



Fuse Panel

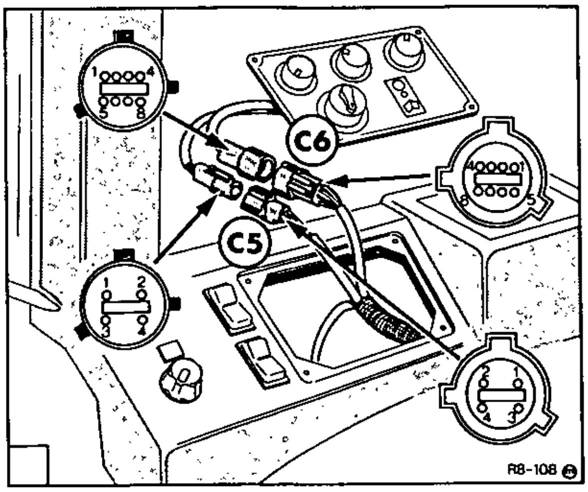


Microprocessor

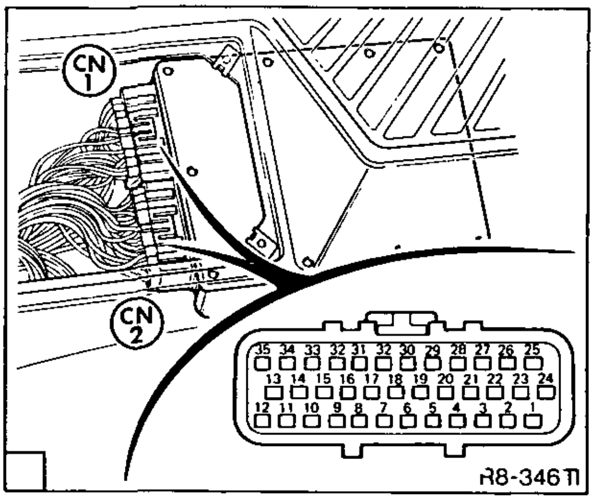


Error Code 59 Micro–computer Reference Voltage Open Circuit

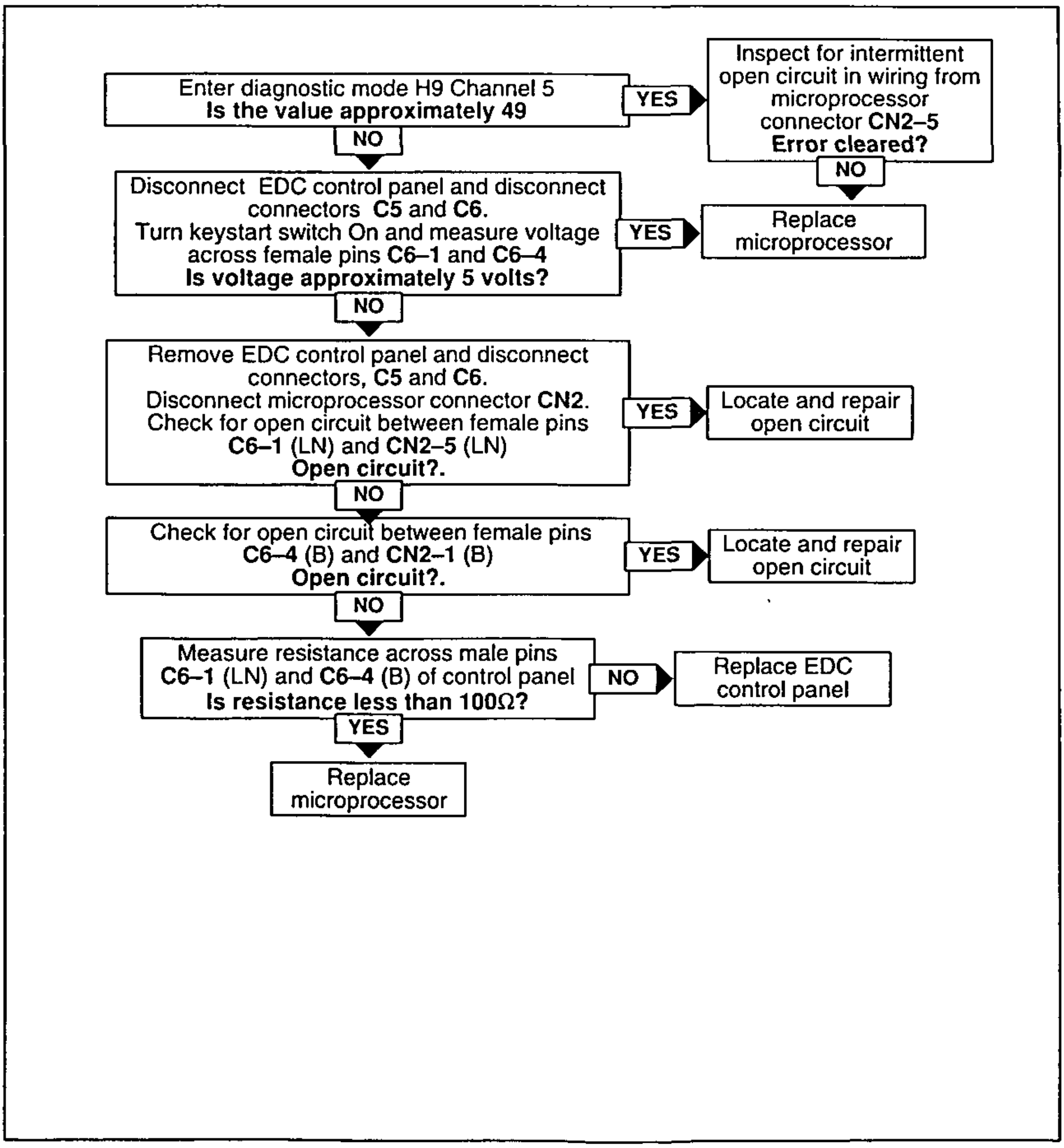
For EDC wiring diagram and connector location refer to end of this Section



EDC Control Panel Connectors



Microprocessor Connectors



Enter diagnostic mode H9 Channel 5
Is the value approximately 49

YES → Inspect for intermittent open circuit in wiring from microprocessor connector **CN2–5** **Error cleared?**
NO → Replace microprocessor

NO ↓

Disconnect EDC control panel and disconnect connectors **C5** and **C6**.
Turn keystart switch On and measure voltage across female pins **C6–1** and **C6–4**
Is voltage approximately 5 volts?

YES → Replace microprocessor

NO ↓

Remove EDC control panel and disconnect connectors, **C5** and **C6**.
Disconnect microprocessor connector **CN2**.
Check for open circuit between female pins **C6–1** (LN) and **CN2–5** (LN)
Open circuit?.

YES → Locate and repair open circuit

NO ↓

Check for open circuit between female pins **C6–4** (B) and **CN2–1** (B)
Open circuit?.

YES → Locate and repair open circuit

NO ↓

Measure resistance across male pins **C6–1** (LN) and **C6–4** (B) of control panel
Is resistance less than 100Ω?

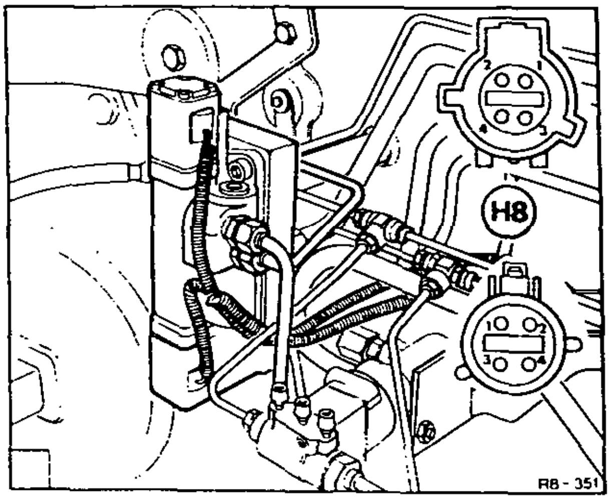
NO → Replace EDC control panel

YES ↓

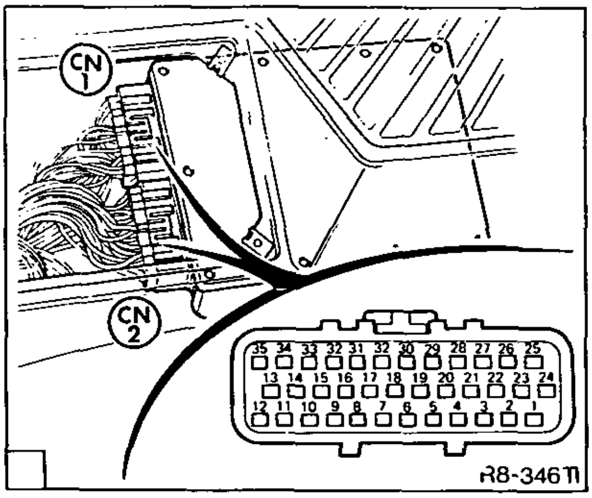
Replace microprocessor

Error Code 63 EDC Hydraulic Valve Lower Solenoid Open Circuit
Error Code 65 EDC Hydraulic Valve Lower Solenoid Short Circuit

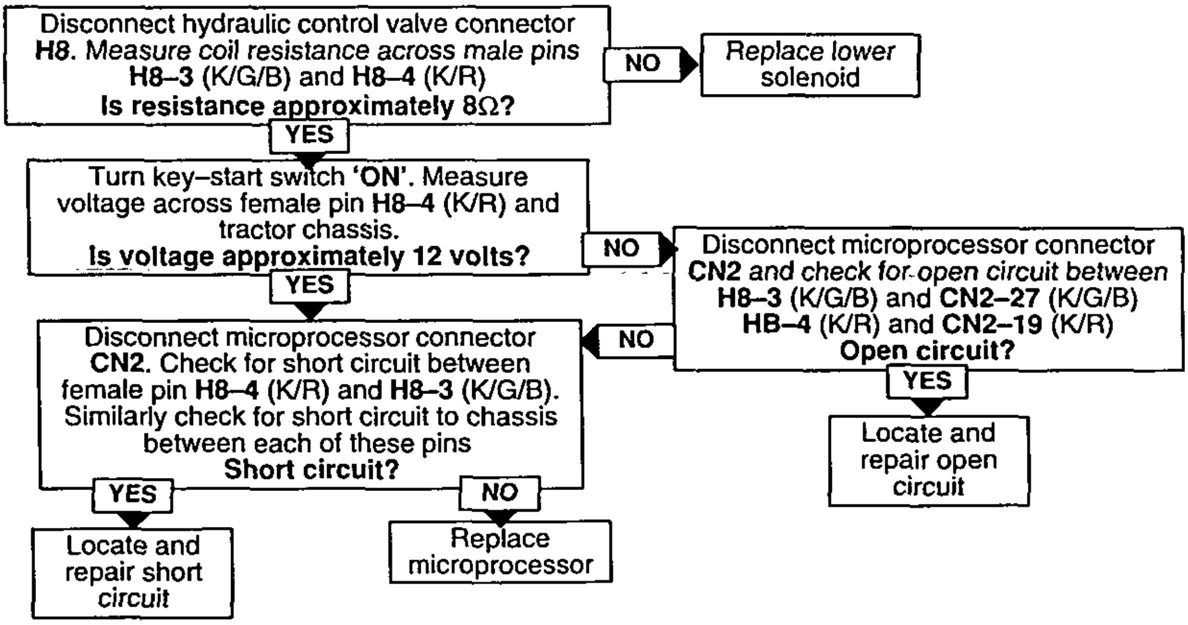
For EDC wiring diagram and connector location refer to end of this Section



Hydraulic Control Valve



Microprocessor Connectors



Disconnect hydraulic control valve connector **H8**. *Measure coil resistance across male pins* **H8–3** (K/G/B) and **H8–4** (K/R)
Is resistance approximately 8Ω?

NO → *Replace lower* solenoid

YES ↓

Turn key–start switch **'ON'**. Measure voltage across female pin **H8–4** (K/R) and tractor chassis.
Is voltage approximately 12 volts?

NO → Disconnect microprocessor connector **CN2** *and check for open circuit between* **H8–3** (K/G/B) and **CN2–27** (K/G/B) **HB–4** (K/R) and **CN2–19** (K/R)
Open circuit?

YES ↓ Locate and repair open circuit

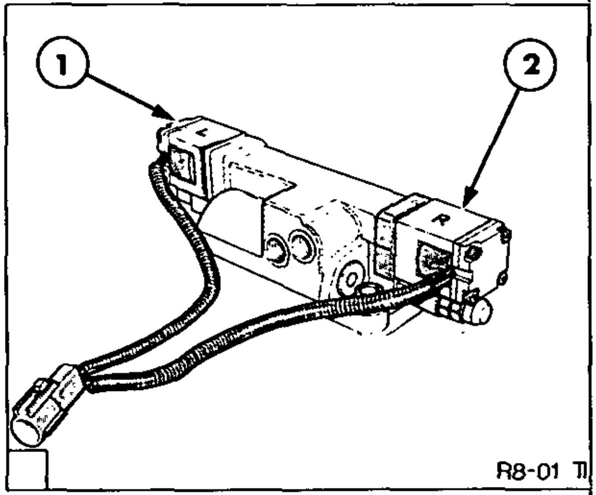
NO ←

YES ↓

Disconnect microprocessor connector **CN2**. Check for short circuit between female pin **H8–4** (K/R) and **H8–3** (K/G/B). Similarly check for short circuit to chassis between each of these pins
Short circuit?

YES ↓ Locate and repair short *circuit*

NO ↓ Replace microprocessor

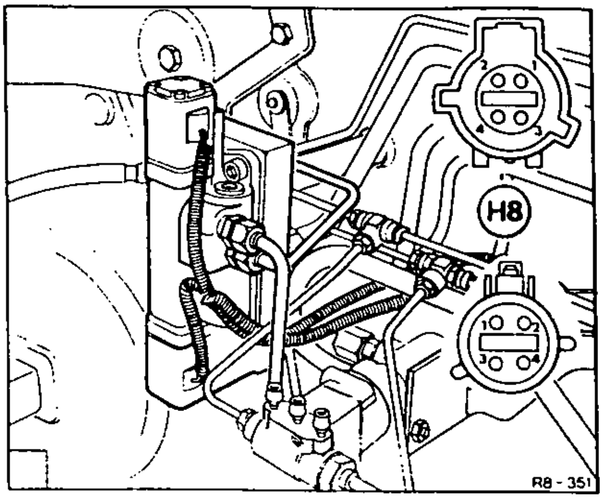


Hydraulic Control Valve Solenoids

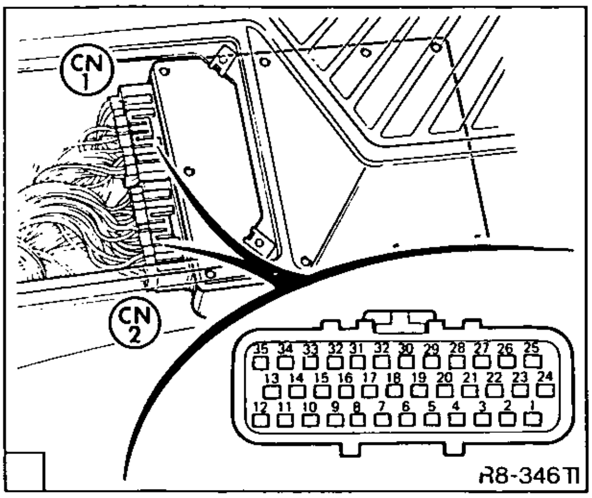
1. Lower Solenoid
2. Raise Solenoid

Error Code 64 EDC Hydraulic Valve Raise Solenoid Failed Open Circuit
Error Code 66 EDC Hydraulic Valve Raise Solenoid Failed Short Circuit

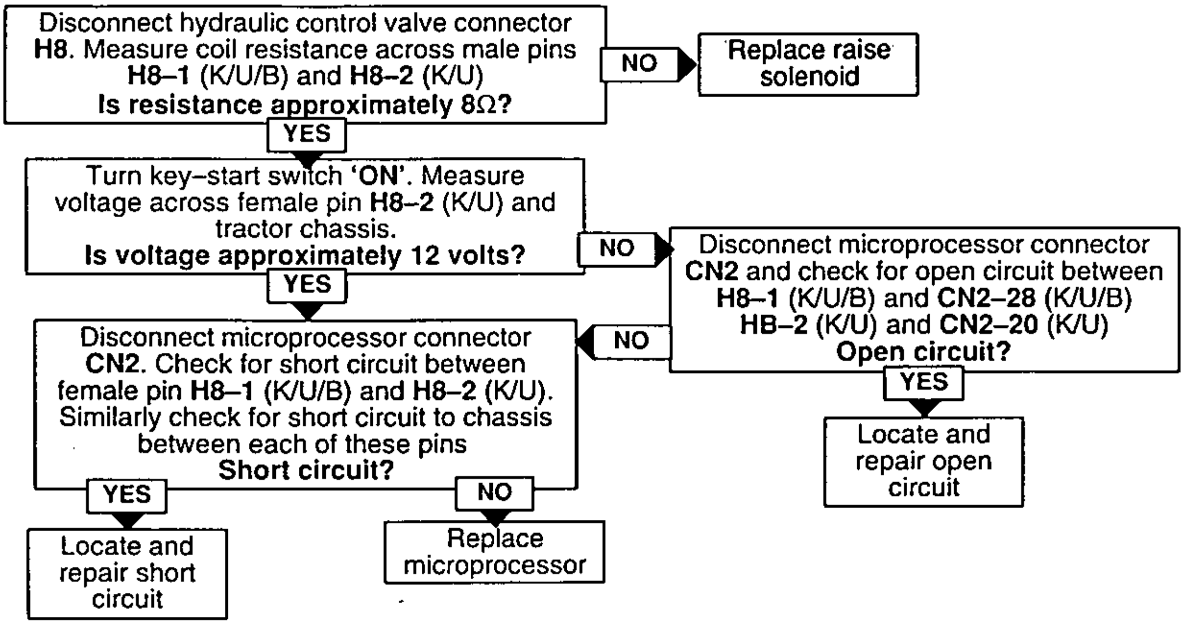
For EDC wiring diagram and connector location refer to end of this Section



Hydraulic Control Valve



Microprocessor Connectors



Disconnect hydraulic control valve connector **H8**. Measure coil resistance across male pins **H8–1** (K/U/B) and **H8–2** (K/U)
Is resistance approximately 8Ω?

NO → Replace raise solenoid

YES ↓

Turn key–start switch **'ON'**. Measure voltage across female pin **H8–2** (K/U) and tractor chassis.
Is voltage approximately 12 volts?

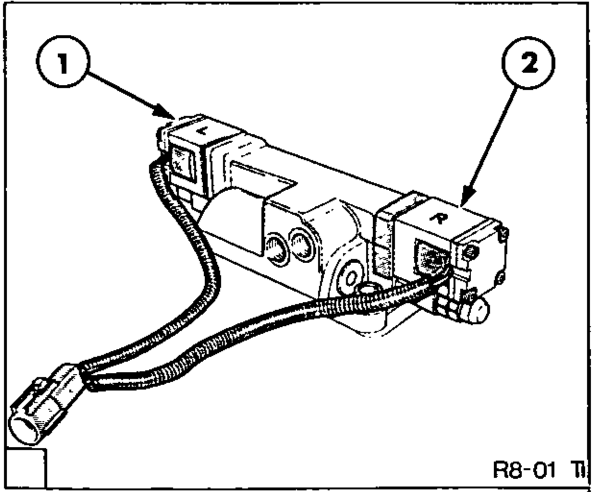
NO → Disconnect microprocessor connector **CN2** and check for open circuit between **H8–1** (K/U/B) and **CN2–28** (K/U/B) **HB–2** (K/U) and **CN2–20** (K/U)
Open circuit?

- YES → Locate and repair open circuit
- NO → Disconnect microprocessor connector **CN2**. Check for short circuit…

YES ↓

Disconnect microprocessor connector **CN2**. Check for short circuit between female pin **H8–1** (K/U/B) and **H8–2** (K/U). Similarly check for short circuit to chassis between each of these pins
Short circuit?

- YES → Locate and repair short circuit
- NO → Replace microprocessor

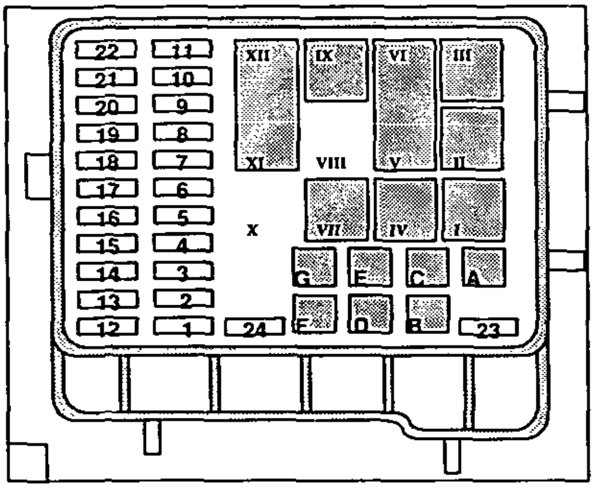


Hydraulic Control Valve Solenoids

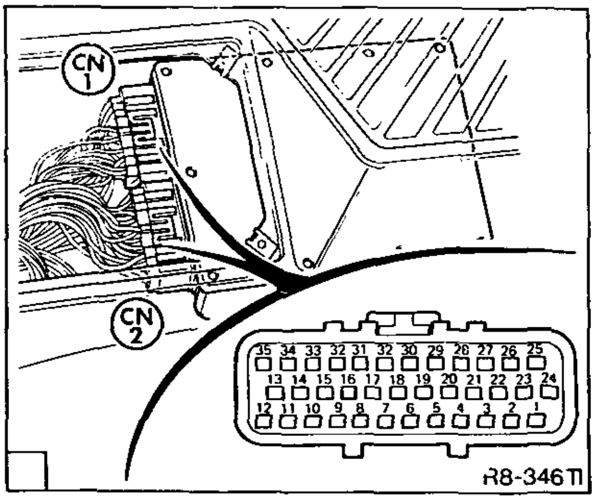
1. Lower Solenoid
2. Raise Solenoid

Error Code 67 EDC Hydraulic Valve Supply Voltage to Low

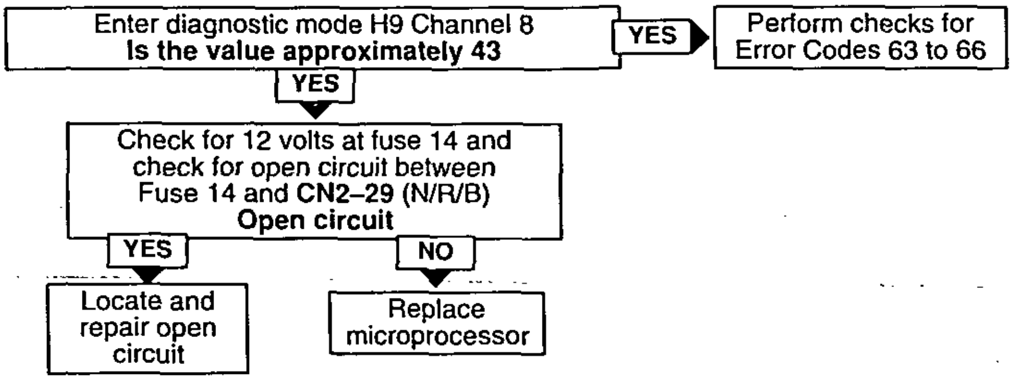
For EDC wiring diagram and connector location refer to end of this Section



Fuse Panel



Microprocessor Connectors



Enter diagnostic mode H9 Channel 8
Is the value approximately 43

YES → Perform checks for Error Codes 63 to 66

YES ↓

Check for 12 volts at fuse 14 and check for open circuit between Fuse 14 and **CN2–29** (N/R/B)
Open circuit

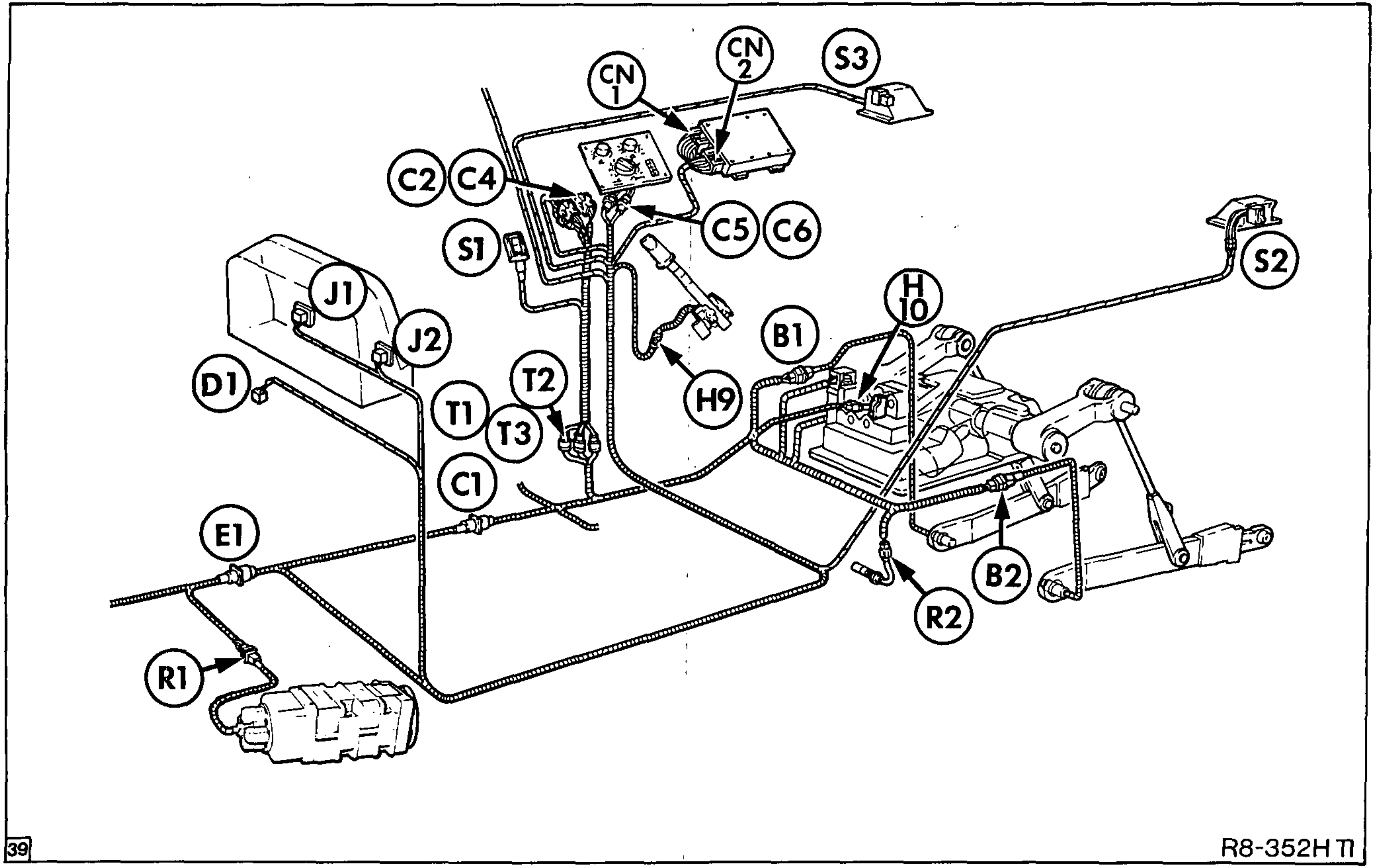
YES → Locate and repair open circuit

NO → Replace microprocessor

Fault Diagnostic Chart For Miscellaneous Hydraulic Lift Concerns

The following fault diagnostic chart relates to hydraulic or mechanical failures which are not detected by the microprocessor and for which there is no error code displayed.

SYMPTON	POSSIBLE CAUSE	DIAGNOSTIC PROCEDURE
Hydraulic lift will not operate.	**Auxiliary services (ASC) selected.**	**Ensure ASC selector lever is in disengaged position.**
	No pilot pressure to EDC hydraulic control valve.	**Perform hydraulic pump low pressure circuit tests. Refer to Chapter 5 Section E "pressure testing of fixed displacement Hydraulic Pump".** **Disconnect EDC valve pilot pressure line and check for blockage.**
	EDC load check valve sticking,	**Examine load check valve.**
Hydraulic lift will not lower.	**Load check valve piston sticking.**	**Examine load check piston.**
	Control valve spool sticking.	**Examine spool.**
	Lowering solenoid spool sticking.	**Examine solenoid spool and torque of solenoid retaining screws.**
	EDC Valve out of adjustment.	**Examine spool adjusters for signs of tampering. Check valve calibration values using diagnostic routine H2.**
	Dirt in control valve orifices.	**Wash valve.**
Lift arms eratic or move when not in operation.	**EDC valve receiving electronic signal.**	**Disconnect EDC valve connector and trace wiring fault if arms remain stationary.**
	Pilot or control valve spools sticking.	**Examine pilot and control valve spools for sticking or wear.**
	EDC valve out of adjustment.	**Examine spool adjusters for signs of tampering. Check valve calibration values using diagnostic routine H2.**
Lift arms slowly drop when held in raised position.	**Check valve leaking.**	**Examine check valve poppet ball seat for wear.**
Cannot lift heavy loads.	**Pump worn or lift cylinder seals leaking.**	**Perform hydraulic pump flow and pressure tests. Refer to Chapter 5 Section E "Pressure Testing of Fixed Displacement Hydraulic Pump".**
	Priority/unload valve sticking	**Examine priority/unload valve and orifice in connector.**
	No load sensing signal.	**Load sensing valve sticking.**
Hydraulic lift will not raise or lower to maximum limits of travel.	**Microprocessor incorrectly calibrated.**	**Perform memory reset and autocalibration procedure. See Error Code 24.**



Harness Layout Diagram for Tractors with Electronic Draft Control

Figure 39
Harness Layout Diagram for Tractors with Electronic Draft Control

The following illustration shows the approximate location of those connectors referenced in the fault finding procedure for tractors installed with Electronic Draft Control.

For clarity, those connectors on the harnesses which are not applicable to the electronic draft control fault finding procedure have been omitted from the illustration.

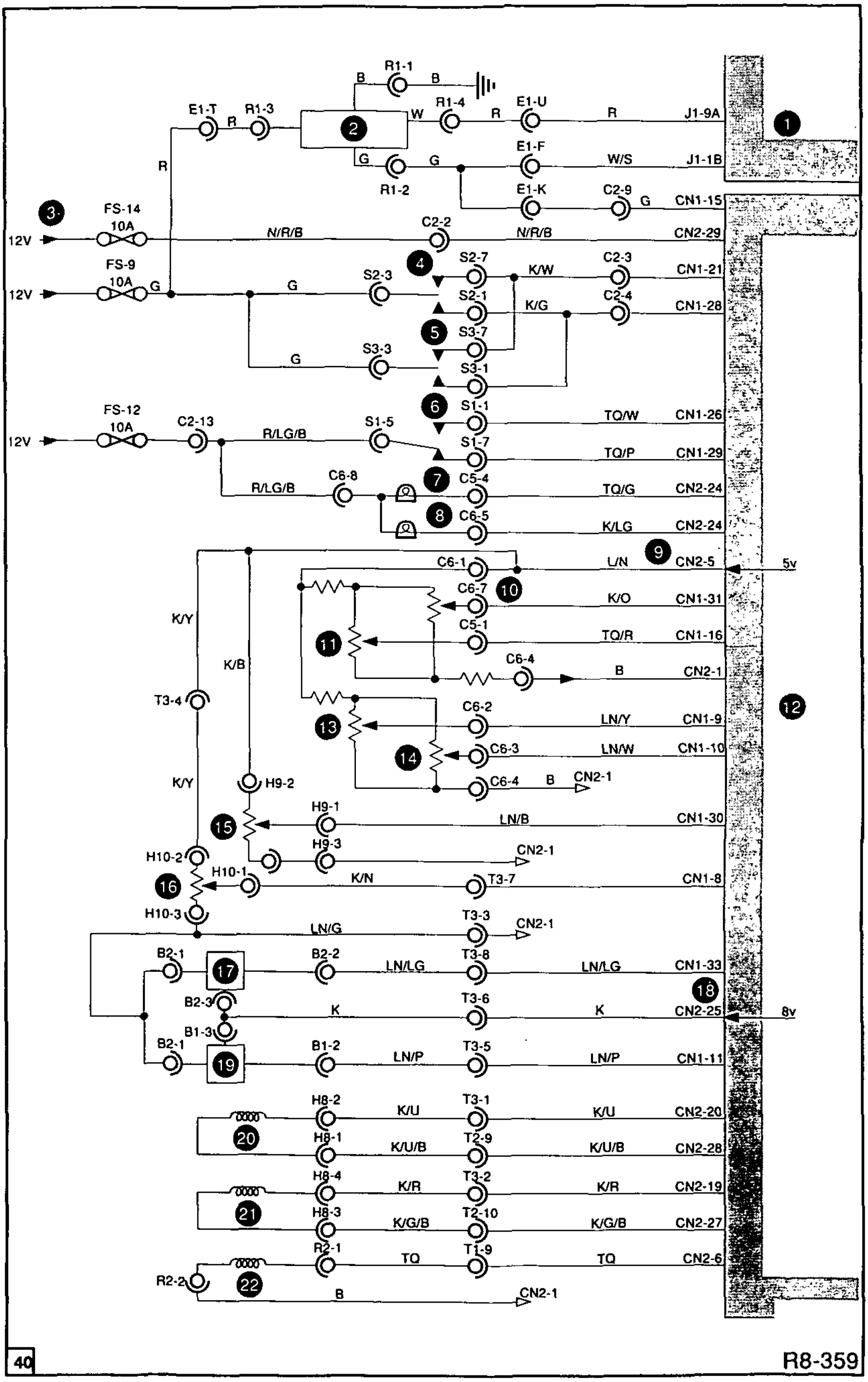
B1	Load Sensing Pin Connector (Right Hand)
B2	Load Sensing Pin Connector (Left Hand)
CN1	Microprocessor Connector (Black)
CN2	Microprocessor Connector (Red)
C1	Pump Harness Connector
C2	Transmission/EDC Harness Connector
C4	Transmission/EDC Harness Connector
C5	EDC Control Panel Connector
C6	EDC Control Panel Connector
D1	Service Diagnostic Connector
E1	Engine Harness Connector
CN1	Microprocessor Connector
CN2	Microprocessor Connector
H9	Lift Control Lever Potentiometer
H10	Lift Arm Position Sensing Potentiometer
J1	Electronic Instrument Panel Connector
J2	Electronic Instrument Panel Connector
R1	Performance Monitor Radar
R2	Transmission Output Speed Sensor
S1	In Cab Fast Raise/Lower Switch
S2	Hydraulic Lift Fender Switch (Left Hand)
S3	Hydraulic Lift Fender Switch (Right Hand)
T1	EDC Chassis Harness Connector
T2	EDC Chassis Harness Connector
T3	EDC Chassis Harness Connector

Figure 40
'Electrolink' Electronic Draft Control System Wiring Diagram

1. Instrument Panel and Connector
2. Performance Monitor Radar
3. 12 Volt Supply to Microprocessor for Operation of Electronic Draft Control Systems
4. Hydraulic Lift Fender Switch (Left Hand)
5. Hydraulic Lift Fender Switch (Right Hand)
6. In Cab Fast Raise/Lower Switch
7. Slip Limit 'On' Indicator Light
8. Hydraulic Lift Status (Captured) Indicator Light
9. 5 Volt Reference Voltage from Microprocessor
10. Height Limit Control Potentiometer
11. Slip limit Control Potentiometer
12. *Microprocessor*
13. Drop Rate Control Potentiometer
14. Position/Draft Sensitivity Control Potentiometer
15. Lift Control Lever Potentiometer
16. Lift Arm Position Sensing Potentiometer
17. Left hand Load Sensing Pin
18. 8 Volt Reference Voltage from Microprocessor to Load Sensing Pins
19. Right Hand Load Sensing Pin
20. Hydraulic Control Valve Raise Solenoid
21. Hydraulic Control Valve Lower Solenoid
22. Transmission Output Speed Sensor

Wire Colour Codes

B	BLACK	G	GREEN
N	BROWN	LG	LIGHT GREEN
LN	TAN	U	BLUE
S	SLATE	TQ	TURQUOISE
R	RED	P	PURPLE
O	ORANGE	K	PINK
Y	YELLOW	W	WHITE



'Electrolink' Electronic Draft Control System Wiring Diagram

C. HYDRAULIC CONTROL VALVE – OVERHAUL

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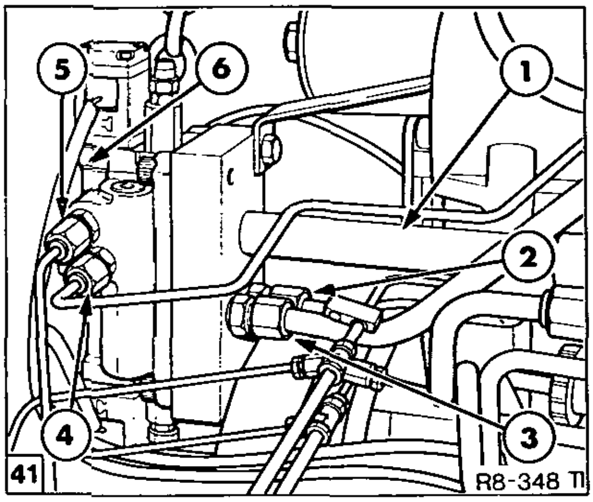

Hydraulic Control Valve Installation

1. Return to Reservoir Tube
2. System Pressure Inlet Tube
3. Feed Tube To Hydraulic Lift
4. Load Sense Line
5. Pilot Pressure Supply
6. Control Valve

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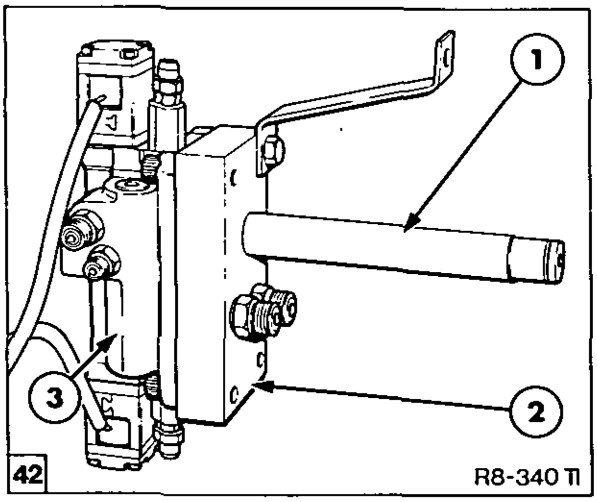

Hydraulic Control Valve and Manifold Removed from Tractor

1. Return to Reservoir Tube
2. Manifold
3. Control Valve

REMOVAL

NOTE: *The following procedure describes the removal of both the hydraulic control valve and manifold. It is not necessary to remove the manifold from the tractor if only the valve is being serviced.*

1. Fully lower hydraulic lift arms
2. Disconnect electrical connector to control valve.
3. Disconnect pilot, load sensing, system pressure inlet and hydraulic lift feed tubes at control valve, Figure 41.
4. Remove valve bracket retaining bolt and pull valve from tractor, Figure 42.
5. Separate control valve from manifold, Figure 43 and note the location of all 'O' ring seals.

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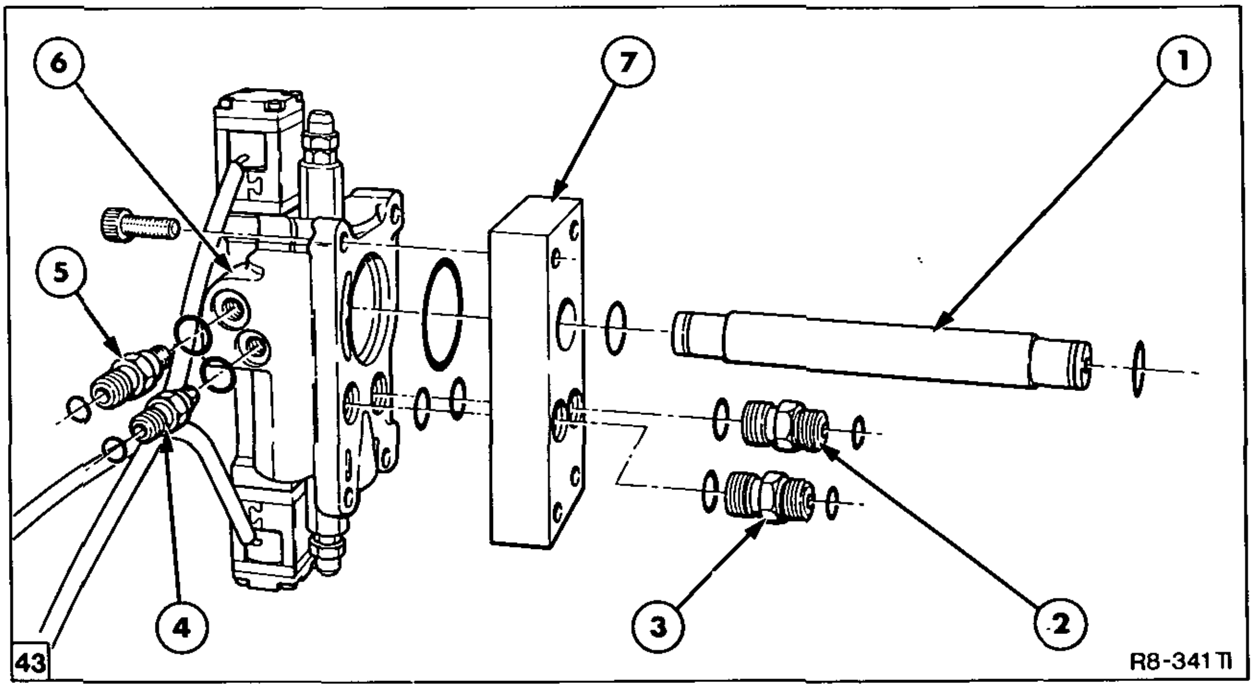
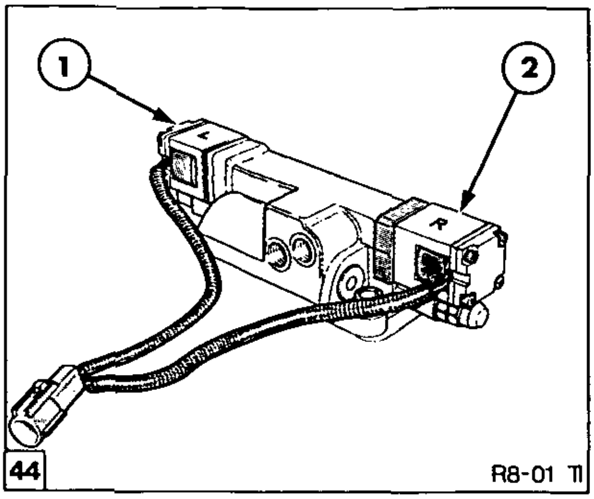


Hydraulic Control Valve and Manifold

1. Return to Reservoir Tube
2. Connector
3. Connector
4. Connector
5. Connector
6. Control Valve
7. Manifold



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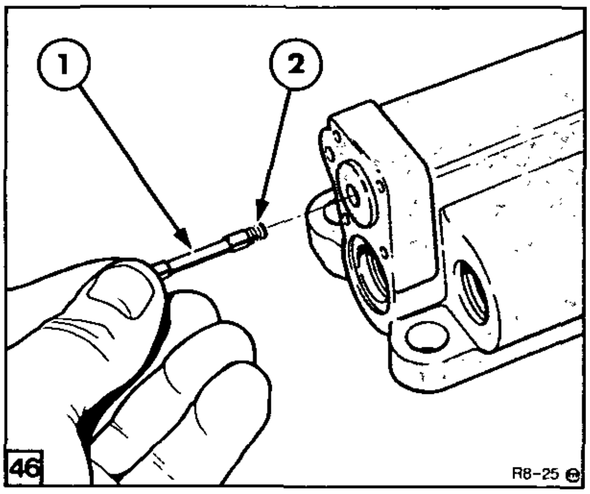
Hydraulic Control Valve Solenoids

1. Lower Solenoid
2. Raise Solenoid



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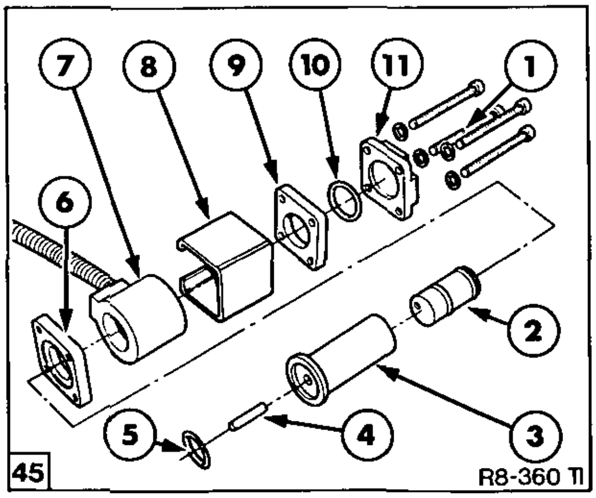
Pilot Spool Removal

1. Pilot Spool
2. Spring

DISASSEMBLY

Solenoids and Pilot Spools

1. Identify lower and raise solenoids, to aid re–assembly, Figure 44.
2. Remove solenoids from valve.
3. Separate solenoid components, Figure 45.
4. Remove pilot spool and spring from pilot operated valves, Figure 46.
5. Insert a $^{5}/_{16}$ in UNF bolt into end of pilot spool. Pull pilot spool from housing, Figure 47.



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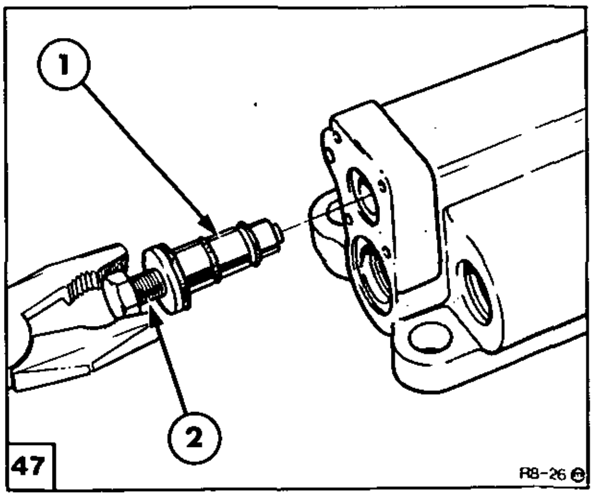
Solenoid Components–Exploded View

1. Allen Screws
2. Piston
3. Core
4. Plunger
5. 'O' Ring
6. Plate
7. Field Coil
8. Body
9. Plate
10. 'O' Ring
11. End Cap



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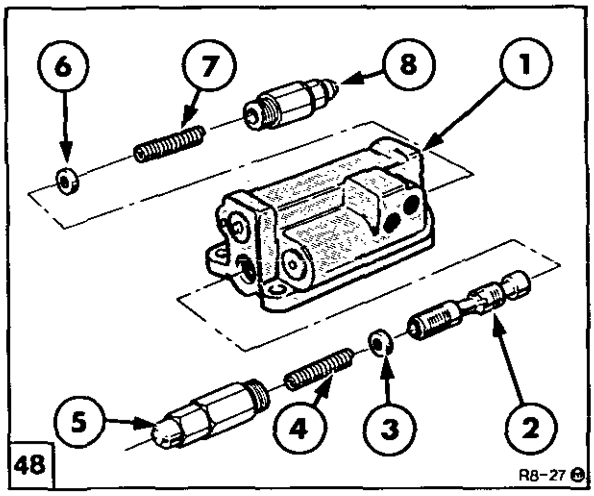
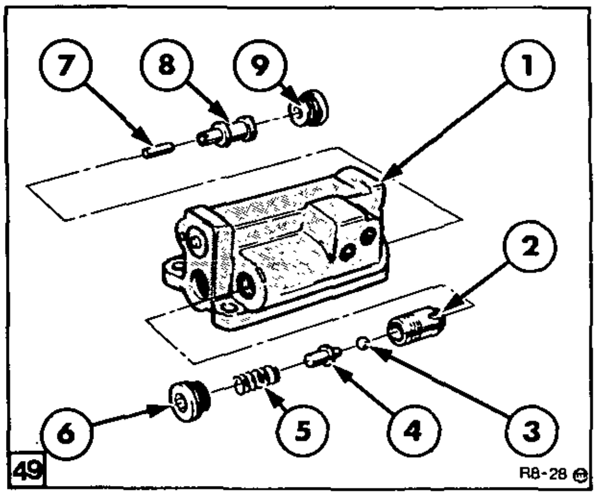
Removing Pilot Spool

1. Pilot Spool
2. $^{5}/_{16}$ in Bolt



Main Spool

1. Valve Housing
2. Spool
3. Seat
4. Spring
5. Adjuster Assembly
6. Seat
7. Spring
8. Adjuster Assembly



Load Check Valve

1. Valve Housing
2. Poppet
3. Ball
4. Guide
5. Spring
6. Plug and 'O' Ring
7. Pin
8. Piston
9. Plug and 'O' Ring

Main Spool

1. Using a suitable marker identify the right and left hand adjusters in relation to the valve housing body.

IMPORTANT: *Do not disassemble or reset the adjuster assemblies. The hydraulic control valve adjustment is pre–set at the factory and ensures that the spool is correctly set for the neutral position.*

2. Remove adjuster assemblies and withdraw spool centering springs and seats, Figure 48. Ensure that springs and seats remain matched with each adjuster.

Load Check Valve

1. Remove the load check valve plugs and withdraw the load check valve components, Figure 49.

NOTE: *The pin, item 7, is rounded on one end. When re–assembling the valve ensure the rounded end of the pin is inserted into the poppet, item 2.*

INSPECTION

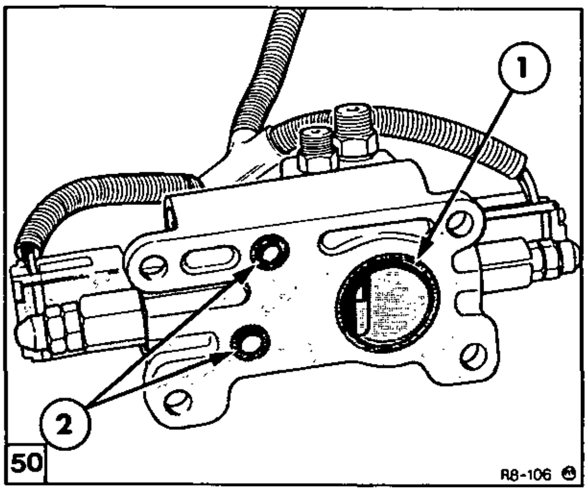
The majority of valve failures occur because of dirt and other foreign matter entering the valve causing scoring and distortion. Minor imperfections can be corrected by using fine abrasive emery cloth or fine lapping compound. Exercise extreme care when abrasive materials are used to ensure that all particles are removed from the valve housing.

1. Wash all parts, except solenoids, in a suitable solvent and dry with compressed air.
2. Inspect the valve housing, bores and spools for evidence of scoring or damage, paying particular attention to the condition of the highly finished surfaces in the spool and sleeve bores. If deep scores or serious pitting is observed discard the valve. Remove minor blemishes from the spools or sleeves with fine abrasive.
3. Ensure the spools move freely in their bores.
4. Discard all 'O' ring seals.

RE–ASSEMBLY and INSTALLATION

Re–assembly follows the disassembly procedure in reverse. During re–assembly observe the following:–

- Lubricate the spools with hydraulic oil.
- install new 'O' ring seals.
- Tighten all plugs and locknuts to the correct torque. See Specifications, Section E.
- When installing the solenoids, tighten the retaining screws gradually in a cross corner sequence to a torque of 15 lbf.in (1.7 Nm). **Do Not** over torque the screws.



Control Valve Mounting Face 'O' Ring Installation

1. 'O' Ring
2. 'O' Rings

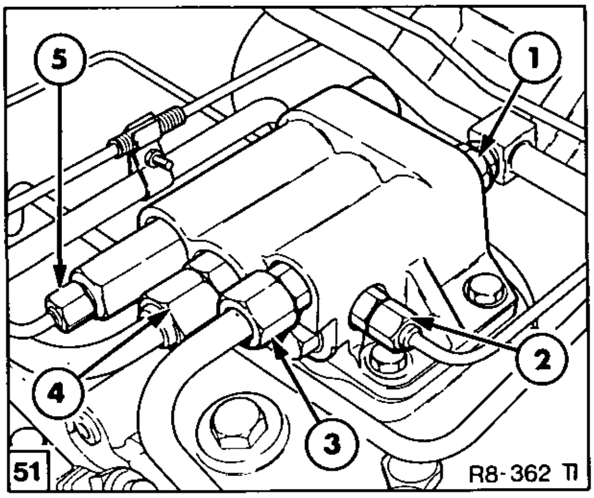
- Ensure 'O' ring seals are correctly located around oil galleries on mounting face of hydraulic control valve before installing the valve onto the hydraulic lift cover, Figure 50.

D. PRIORITY/UNLOAD VALVE ASSEMBLY–OVERHAUL

REMOVAL

1. Fully lower hydraulic lift arms
2. Less Cab Tractors:
   Remove seat to gain access to unload valve.
3. Remove panel in cab/platform floor to gain access to priority/unload valve assembly, Figure 51.
4. Thoroughly clean area around valve prior to proceeding with removal procedure.
5. Disconnect hydraulic connections to valve.

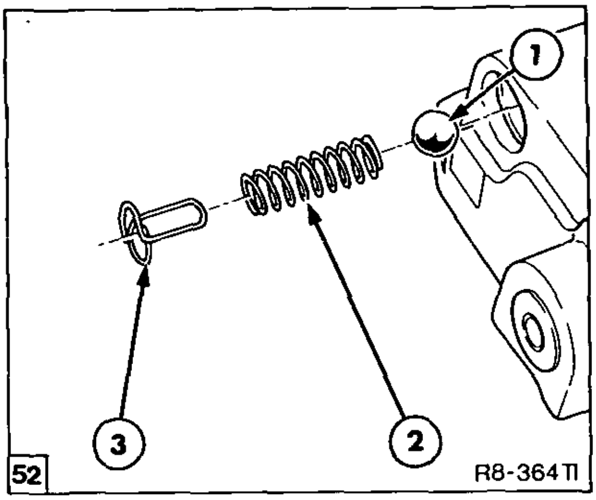
NOTE: *Be careful that check valve spring and ball is not ejected when disconnecting the remote valve supply tube.*



Priority/Unload Valve Assembly

1. Remote Valve Feed Tube
2. Remote Valve Pilot Line
3. Supply from Auxiliary Pump
4. Supply from Hydraulic Control Valve to Hydraulic Lift
5. Load Sense Line from Hydraulic Control Valve

6. Remove retaining bolts and lift valve assembly from lift cover.



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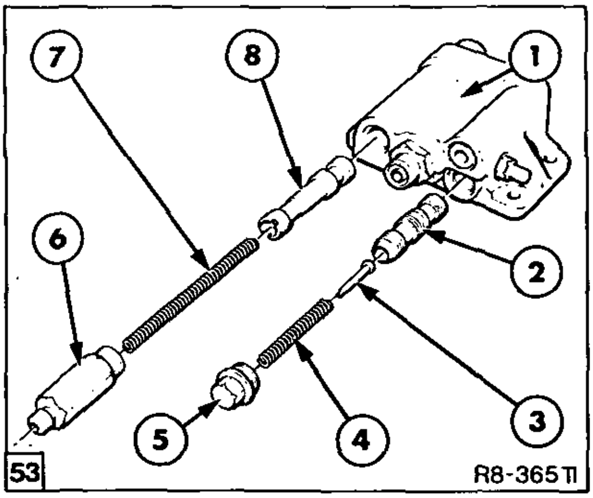
Auxiliary Pump Check Valve

1. Ball
2. Spring
3. Check Valve Stop

DISASSEMBLY

NOTE: *The connectors are installed against spring pressure and must be removed with care.*

Disassemble with reference to Figure 52 and Figure 53



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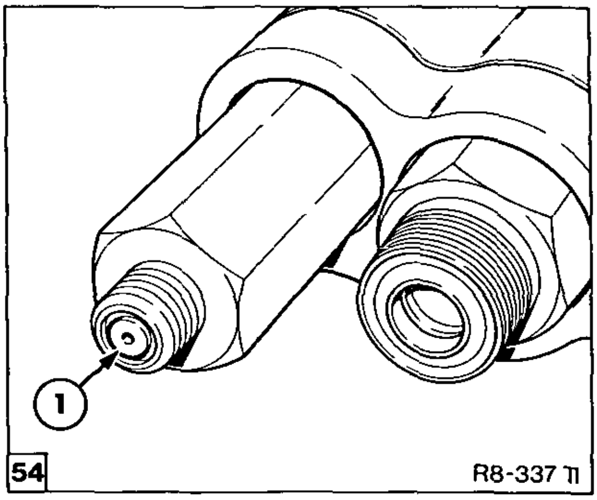
Priority/Unload Valve Assembly

1. Housing
2. Combining/Unload Valve
3. Filter
4. Spring – Unloaded Length 73.4 mm (2.89 in)
5. Plug
6. Connector
7. Spring – Unloaded Length 137 mm (5.39 in)
8. Priority/unload Valve



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Load Sense Line Orifice

1. Orifice

INSPECTION AND REPAIR

1. Wash all components in a suitable cleaning agent such as paraffin (kerosene), mineral spirits or a commercial cleaning agent.
2. Examine all valves and bores for burrs and scratches. Any minor burrs or scratches may be removed with a fine abrasive.
3. Ensure valves move freely in their bores. Heavy scoring or bores will necessitate installation of a new priority/unload valve assembly.
4. Inspect the orifice in the end of the priority/unload valve connector, Figure 54.

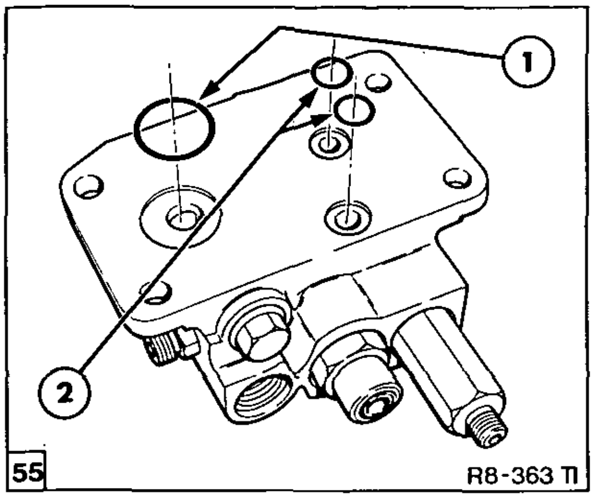
   This connector receives the signal from the electronic draft control valve load sensing line and if blocked will prevent operation of the valve resulting in a no/slow hydraulic lift.
5. Ensure the valve springs are not broken or damaged.
6. Renew all 'O' ring seal.s

RE–ASSEMBLY

1. Lubricate all components with hydraulic oil.

2. Replace all 'O' ring seals

3. Ensure the seals in the priority/unload valve housing are not dislodged during installation onto the tractor, Figure 55.



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Priority/Unload Valve Housing Seals
1. 'O' Ring
2. 'O' Ring

4. *Tighten the valve to top cover mounting bolts to a torque of 42–56 lbf ft (74–46 Nm).*

5. Securely tighten all connections.

E. HYDRAULIC LIFT COVER ASSEMBLY – OVERHAUL

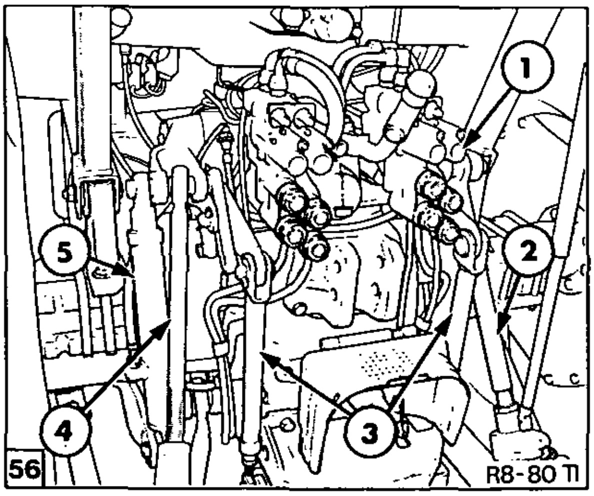
REMOVAL

1. Lower lift arms.

2. Less Cab Tractors Only:
   Remove platform to gain access to hydraulic cover

3. Where fitted turn auxiliary services control knob to engaged position and disconnect linkage at lift cover.

4. Disconnect hydraulic connections to assist rams (where fitted) and disconnect rams from lift arms, Figure 56.



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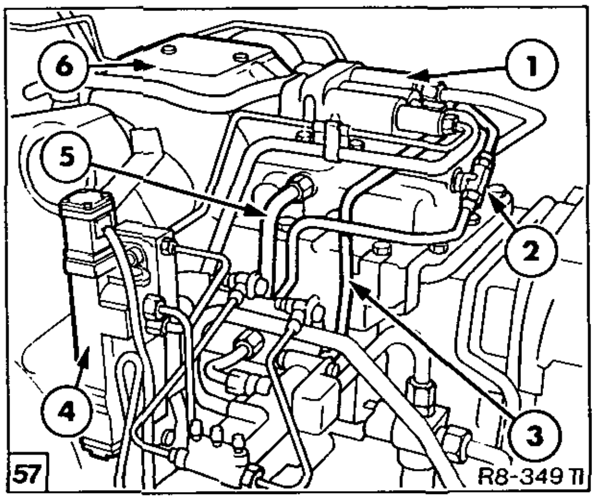
Hydraulic Lift Linkage and Remote Control Valves
1. Remote Control Valve
2. Lift Rod
3. Pick–up Hitch Lift Rods
4. Lift Rod
5. Assist Ram

5. Disconnect lift rods from lift arms

6. *Remove remote control valves.*

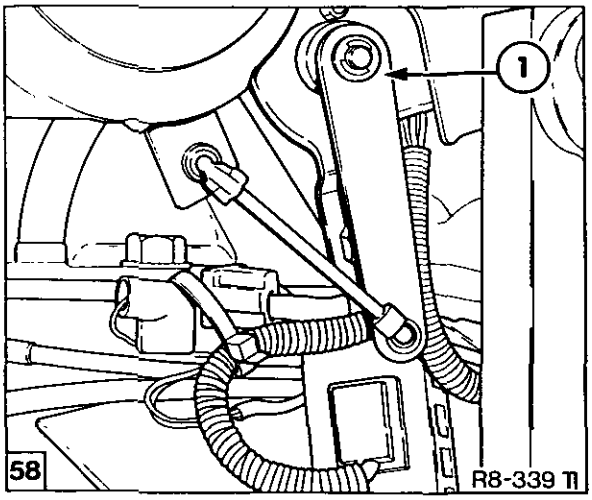


57 Hydraulic Lift Cover Installation

1. Priority/Unload Valve Assembly
2. Assist Ram Feed Tube
3. Trailer Brake Feed Tube
4. Hydraulic Control Valve
5. Feed Tube to Hydraulic Control Valve
6. Hydraulic Lift Cover

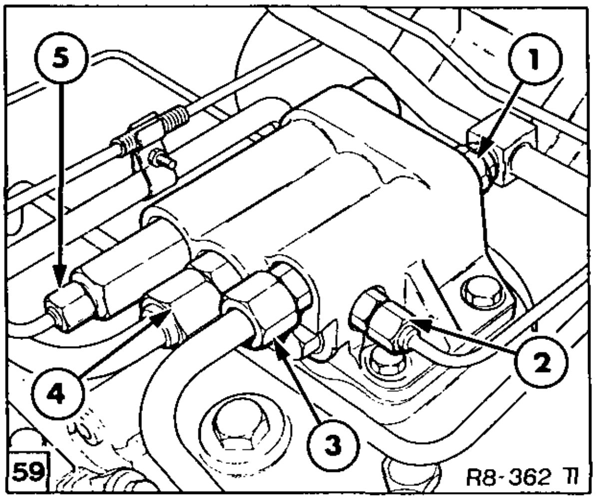
7. Remove hydraulic control valve, Figure 57, as described in Section C.

8. Remove feed tube from hydraulic top cover to control valve.



58 Lift Arm Position Sensing Potentiometer

9. Disconnect and remove lift arm position sensing potentiometer, Figure 58.



59 Priority/Unload Valve Assembly Installation

1. Remote Valve Feed Tube
2. Remote Valve Pilot Line
3. Supply from Auxiliary Pump
4. Supply from Hydraulic Control Valve to Hydraulic Lift
5. Load Sense Line from Hydraulic Control Valve

10. Disconnect tube connections at priority/unload valve assembly and remove tubes from tractor, Refer to Figure 59.

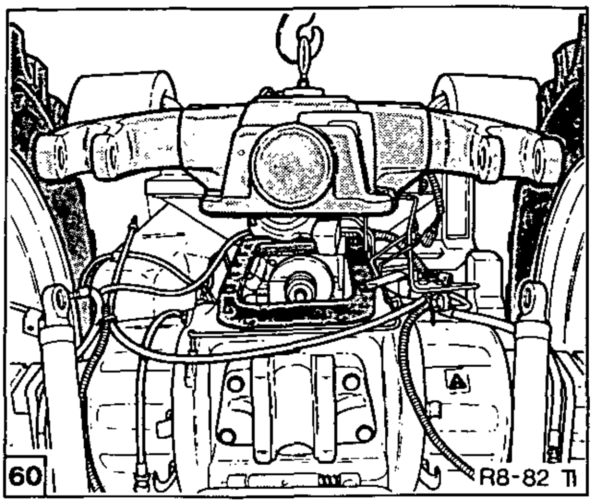
NOTE: *Be careful that check valve spring and ball is not ejected when disconnecting the remote valve supply tube.*

11. Remove trailer brake coupler and feed tube.

12. Remove assist ram feed tube.

13. Remove priority/unload valve assembly. Refer to Section C.

14. If the hydraulic lift assembly is being removed in order to overhaul the lift cylinder, it is recommended that the cylinder retaining bolts are **loosened** before removing the lift assembly from the tractor. **Do Not** remove these bolts.



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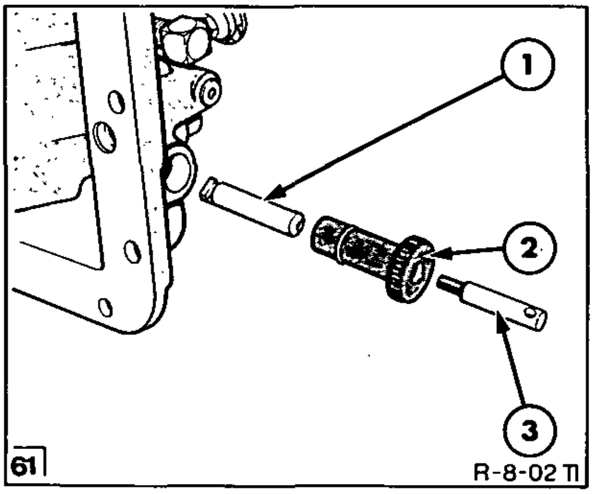
Removing Hydraulic Lift Cover

15. Using suitable lifting gear remove lift cover, Figure 60.

NOTE: *For clarity Illustration shows lift cover removal with platform removed. The cover can however be removed with the cab in situ. When removing the cover, with cab in situ, the lifting gear should be positioned beneath the lift arms taking care not to damage the small bracket on the right hand arm.*

DISASSEMBLY



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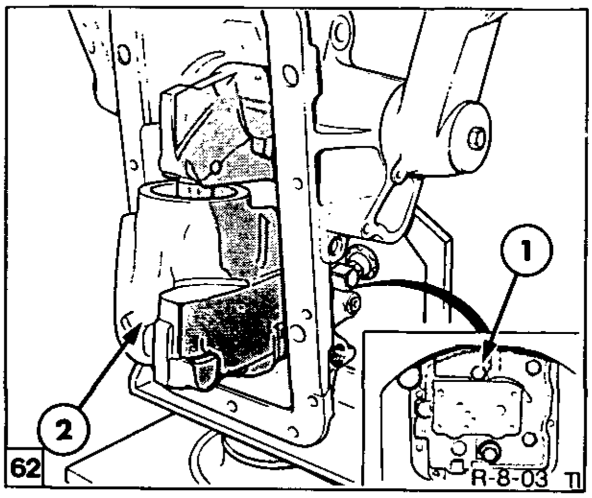
ASC Valve Selector Linkage

1. Selector Valve Stem
2. Knob
3. Control Linkage Connector

1. Where fitted pull ASC valve to engaged position. Unscrew control linkage connector, pull knob from lift cover and remove selector valve stem, Figure 61.



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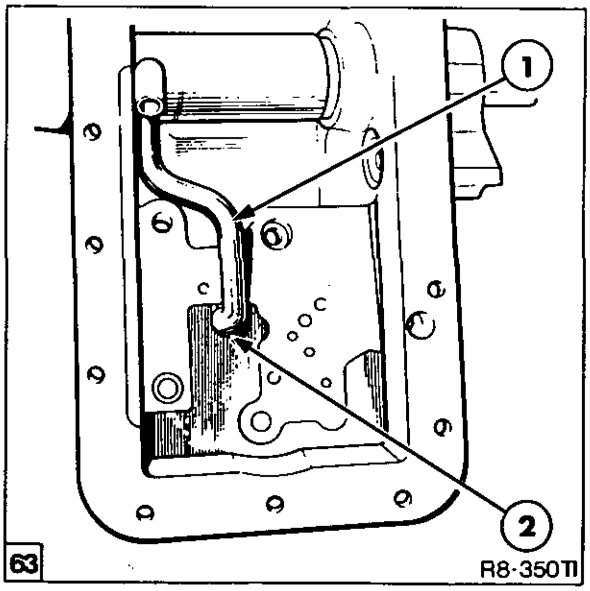
Lift Cylinder Removal

1. Lift Cylinder Retaining Bolts
2. Lift Cylinder

2. Remove four bolts securing lift cylinder to cover, Figure 62.

3. Move lift arms to raised position and carefully remove lift cylinder from locating dowels taking care not to damage the ASC valve spool.

4. Remove priority/unload valve assembly return tube, Figure 63.



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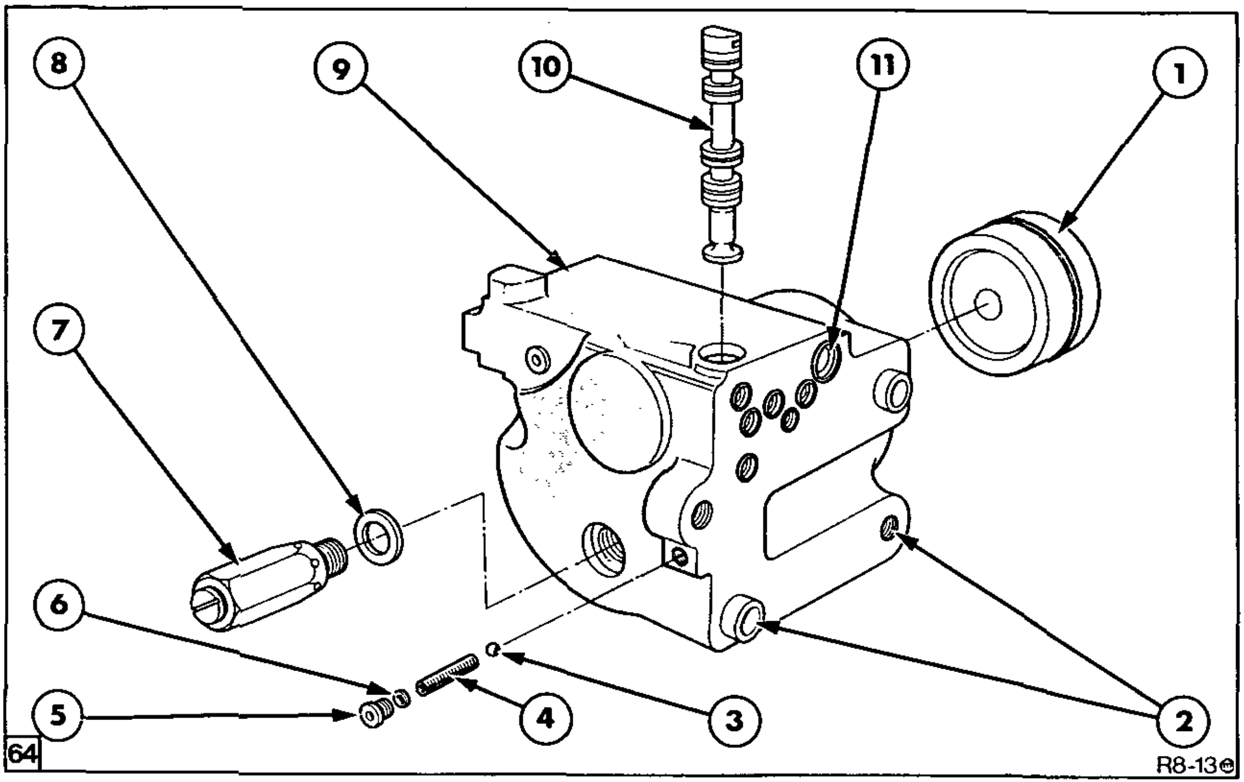
Priority/Unload Valve Assembly Return Tube

1. Return Tube
2. Return Port in Top Cover

5. Remove lift cylinder safety valve and discard seal. Refer to Figure 64.

NOTE: *The lift cylinder safety valve is not serviceable.*



Hydraulic Lift Cylinder–Exploded View

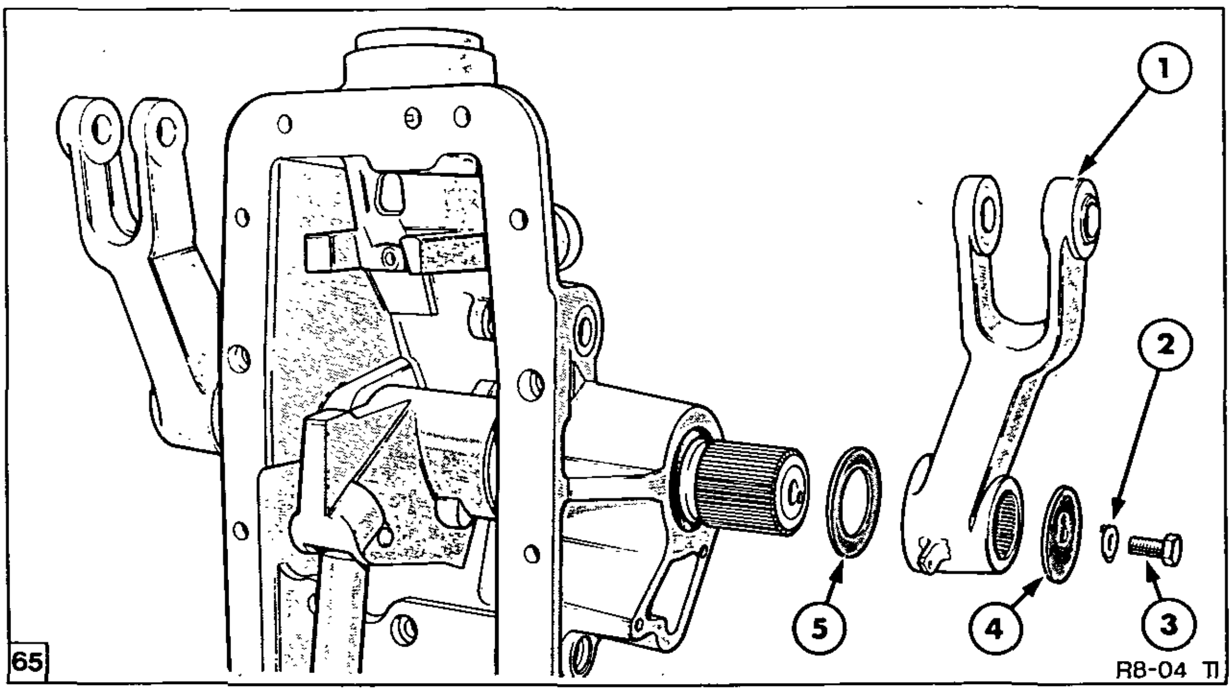
1. Piston
2. Ring Dowels
3. Ball
4. Spring
5. Plug
6. 'O' Ring
7. Safety Valve
8. Seal
9. Lift Cylinder
10. ASC Valve Spool
11. 'O' Rings (7 off)

6. Remove ASC valve detent plug ball and spring and withdraw valve spool.

7. Push a soft metal rod through safety valve bore and eject lift cylinder piston. Discard piston 'O' ring seal and back up ring.

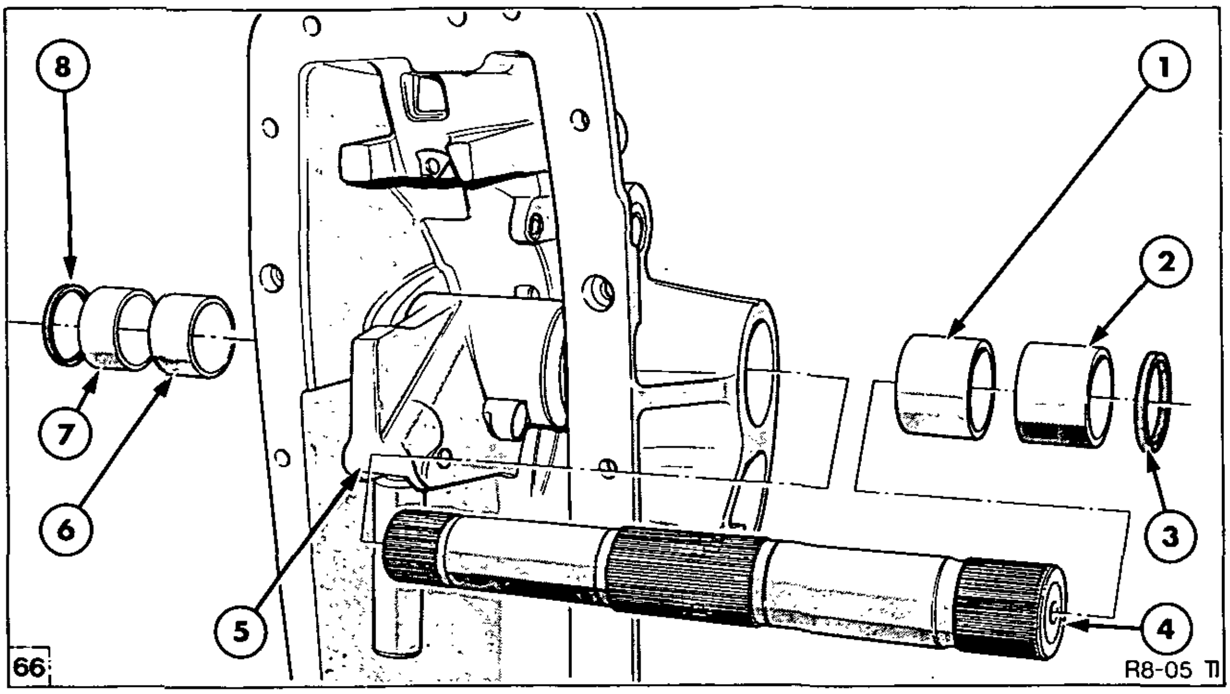
8. Remove lift arms. Refer to Figure 65.

9. Remove ASC valve detent plug ball and spring.



Lift Arm Assembly–Exploded View

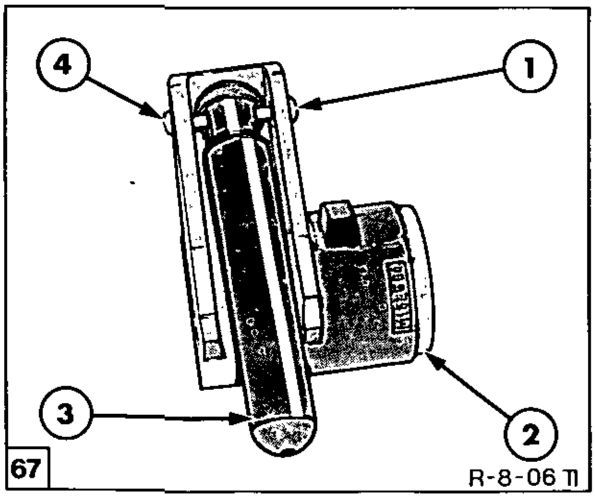
1. Lift Arm
2. Locking Washer
3. Bolt
4. Washer
5. Washer



Cross Shaft and Arm Assembly–Exploded View

1. Bush	4. Cross Shaft	7. Bush
2. Bush	5. Piston Rod and Arm Assembly	8. Seal
3. Seal	6. Bush	

10. Withdraw cross shaft assembly components. Refer to Figure 66.



Piston Rod and Arm Assembly–Exploded View

1. Pin	3. Rod
2. Arm	4. Pin

11. If arm, piston rod or retaining pins are worn, separate rod and arm assembly, Refer to Figure 67. The pins are an interference fit into the arm. To remove pins use a suitable lever between rod and end face of pin.

12. Where necessary, remove remaining plugs from lift cover. Under normal circumstances the removal of these plugs is not necessary.

INSPECTION AND REPAIR

1. Wash all parts in suitable solvent and replace all 'O' ring seals.

2. Examine ASC valve and mating bore for wear, burrs or scratches. Minor damage to valve may be removed with fine abrasive. Ensure valve is thoroughly washed before re–assembly. Ensure valve moves freely in bore. Heavy scoring of bore necessitates replacement of lift cylinder.

3. Check oil passages are free from obstruction.

4. Where a new lift cylinder is required select largest ASC valve spool which when lightly lubricated, will operate in bore without binding when turned through 360° and operated over full length of stroke.

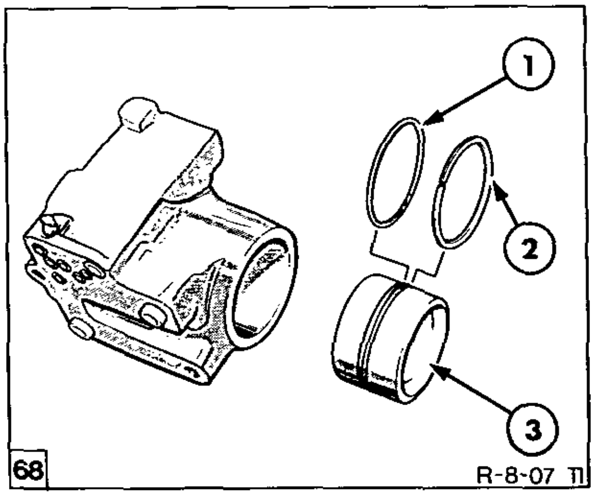
NOTE: *The ASC valve is colour coded only as a guide for matching the valve to the bore. To obtain an optimum fit a proprietary brand of metal polish may be used to lap a slightly oversize valve into the bore. Ensure all traces of polish are washed away and the components are dried prior to re–assembly. For control valve sizes refer to Specifications, Section E.*

RE–ASSEMBLY AND INSTALLATION

A master spline machined on the cross shaft ensures correct alignment of the both the lift arms and piston arm during re–assembly.

Re–assembly and installation follows the disassembly procedure in reverse while observing the following requirements.

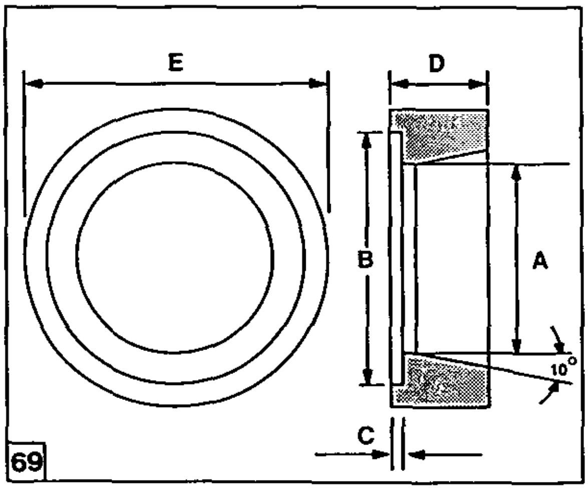
- Renew all 'O' rings and seals.



Lift Cylinder Piston Seals

1. 'O' Ring Seal
2. Back–Up Seal
3. Piston

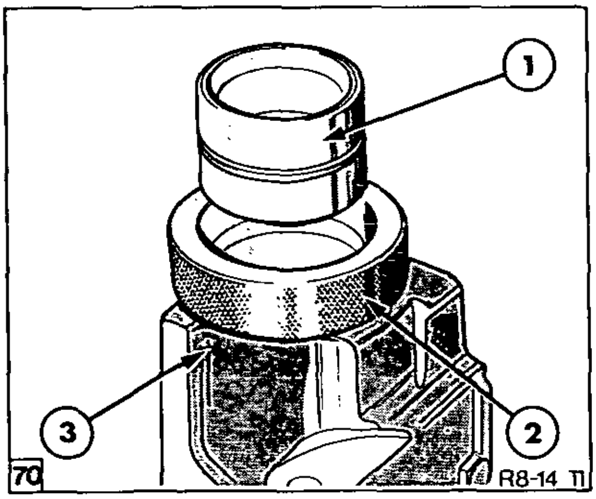
- Install piston 'O' ring seal (1) closest to closed end of piston and back-up seal (2) nearest open end of piston (3), Figure 68.



Piston Installation Guide

A.	4.126 inch (105 mm)	C.	0.12 inch (3 mm)
B.	5.25 inch (134 mm)	D.	1.62 inch (40 mm)
		E.	6.0 inch (155 mm)

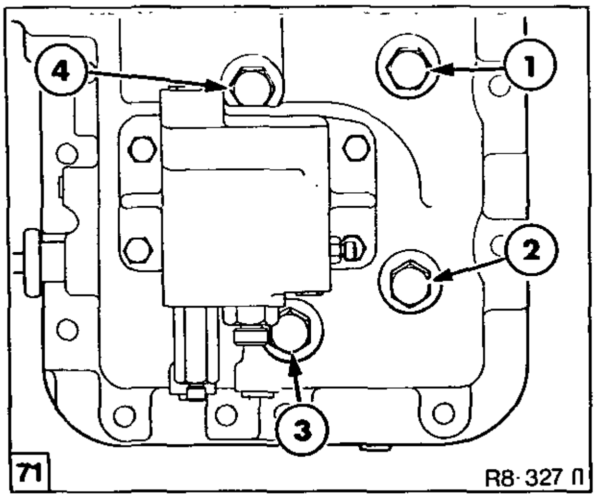
- To aid installation of piston into lift cylinder and prevent damage to the piston seals, a guide can be manufactured to the dimensions shown in Figure 69.



Installing Piston Into Lift Cylinder

1. Piston
2. Guide
3. Lift Cylinder

- Install piston into cylinder using guide as shown in Figure 70. If a guide is not available and installation is difficult a piston ring compressor may be used to compress the seals.



Lift Cylinder Retaining Bolt Locations (Viewed from Top of Hydraulic Lift Cover)

1. 3 in (76 mm) Bolt
2. 2.5 in (64 mm) Bolt
3. 2.25 in (57 mm) Bolt
4. 3 in (76 mm) Bolt with Thin Bolt Head

- Ensure the lift cylinder retaining bolts are installed in the correct locations and torque to 165–200 lbf ft (224–271 Nm), Figure 71.

- Prior to installation of the cross shaft coat the shaft and lip seals with grease.

- The following torque procedure must be observed when tightening the lift arm retaining bolts.

- Install the lift arms and tighten the left hand arm retaining bolt to a torque of 20–30 lbf ft (27–40 Nm). Lock the bolt in position with the tab washer. Refer to Figure 65.

- Raise both lift arms and tighten the right hand arm retaining bolt sufficiently to allow the arms to lower under their own weight. Lock the bolt in position with the tab washer. **Do Not** over tighten bolts as damage to the cross shaft seals and washers will occur.

- Prior to installation of the hydraulic top cover, apply a thin bead of Ford gasket sealer FP119 (Loctite 515), specification ESE–M4G234–A1 to **BOTH** sides of the hydraulic top cover gasket. The bead should be continuous around the entire face of the gasket and to a thickness of approximately 1/32 in (1mm).

- Install lift cover onto the rear axle centre housing and tighten retaining bolts to a torque of 100–125 lbf ft (135–170 Nm).

- Manually raise lift arms (engine not running) and check that lift arms fall slowly under their own weight. If the arms do not fall recheck the torque applied to the lift arm retaining bolts.

- Continue to install the lift cover, linkage and cab/platform using the removal procedure in reverse.

- Tighten all retaining bolts to the correct torque and apply sealant to threads where specified. See Specifications, Section F.

F. SPECIFICATIONS

VALVE SETTINGS

Lift Cylinder Relief Valve	2850–3050 lbf/in^2 (197–210 bar)

GASKET SEALER

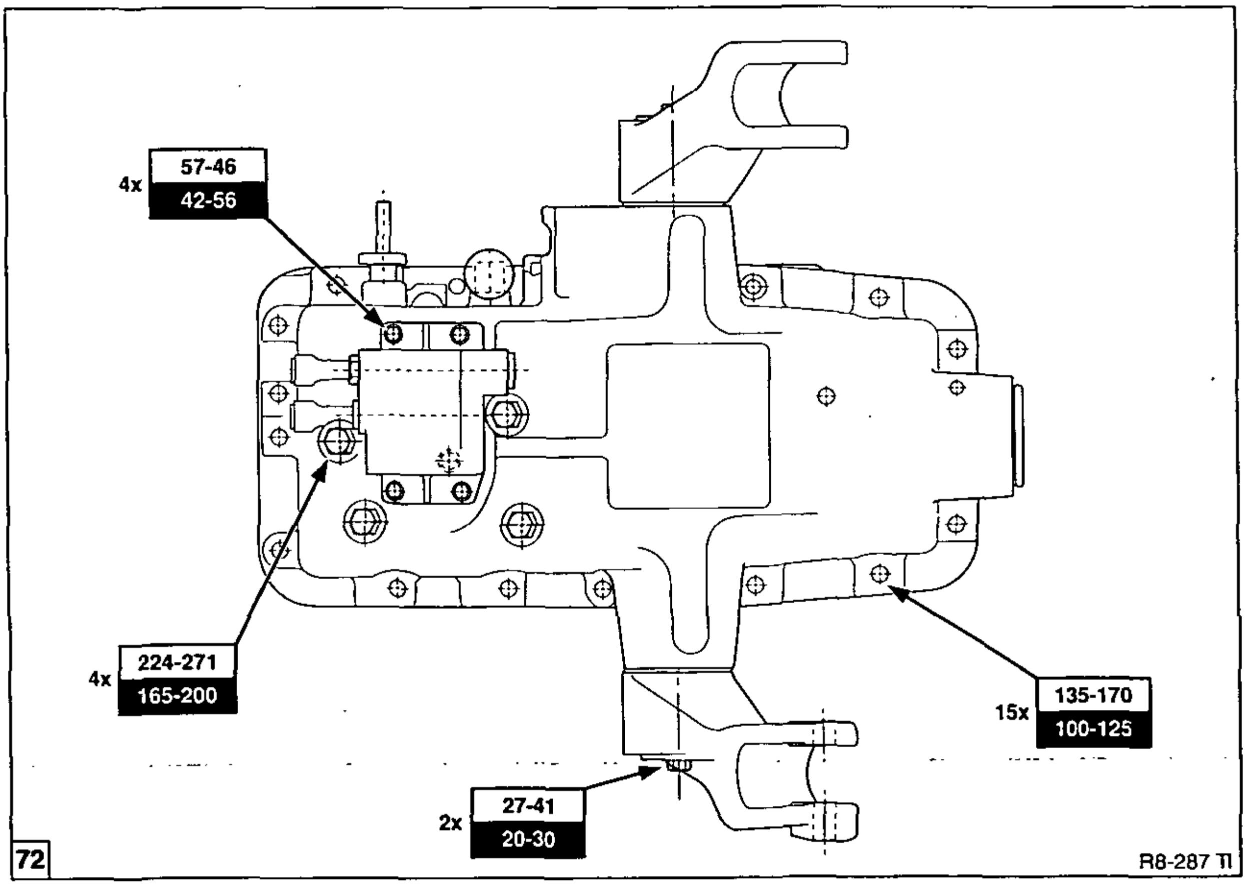
Ford Gasket Sealer FP119 (Loctite 515) to Ford Specification ESE–M4G234–A1

ASC CONTROL VALVE SIZES

Colour	Inches	mm
Green	.6247–.6244	15.8674–15.8598
Yellow	.6244–.6241	15.8598–15.8521
Blue	.6241–.6238	15.8521–15.8445
White	.6238–.6235	15.8445–15.8369
Blue/White	.6235–.6232	15.8369–15.8293

TORQUES

☐ = Nm
■ = lbf ft



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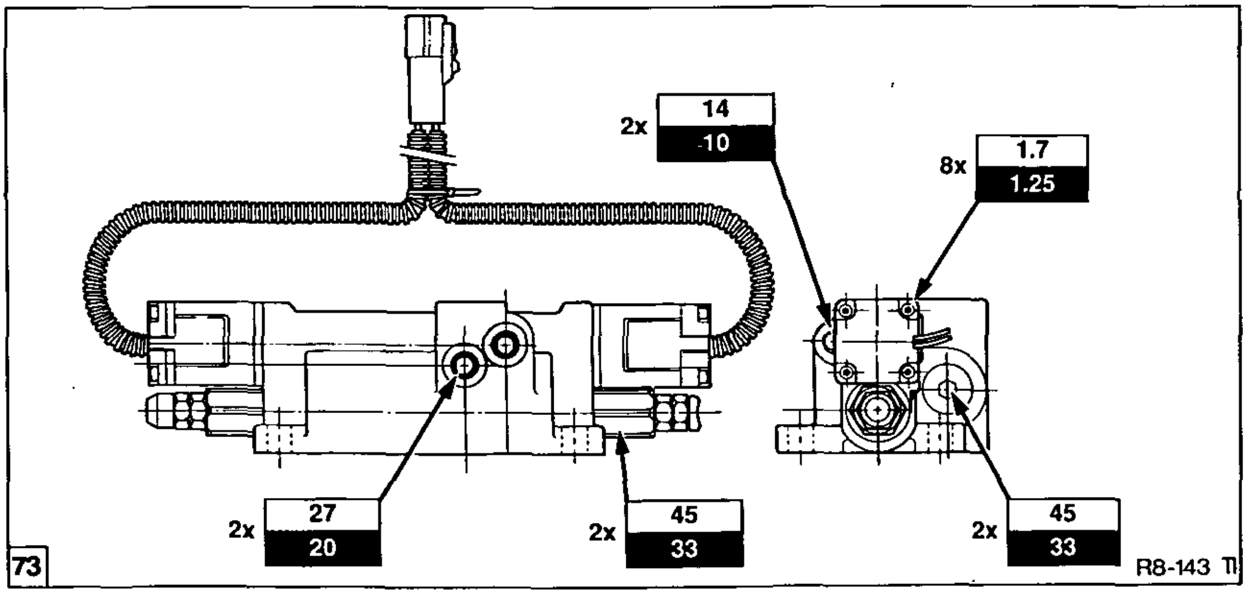
Lift Cylinder Relief Valve Torque 75–90 lbf ft (102–122Nm)



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PART 8
HYDRAULIC SYSTEM

Chapter 10
Electrolink – Fault Finding And Calibrations
(Post November 1995)
Software levels: 07 for 16x16 and 09 for 12x12 Dual Power

CONTENTS

A. INTRODUCTION

With the introduction of new wiring harnesses, which incorporate new connectors and revised wiring details, the fault finding charts for the Electrolink system have been updated to reflect the wiring level of tractors from Unit Date Code 5L01 (November 1st 1995).

The new software levels which introduced Dynamic Ride Control also provide an improved method of *calibration. The calibration procedure is described under Error Code 24 (EDC not calibrated).*

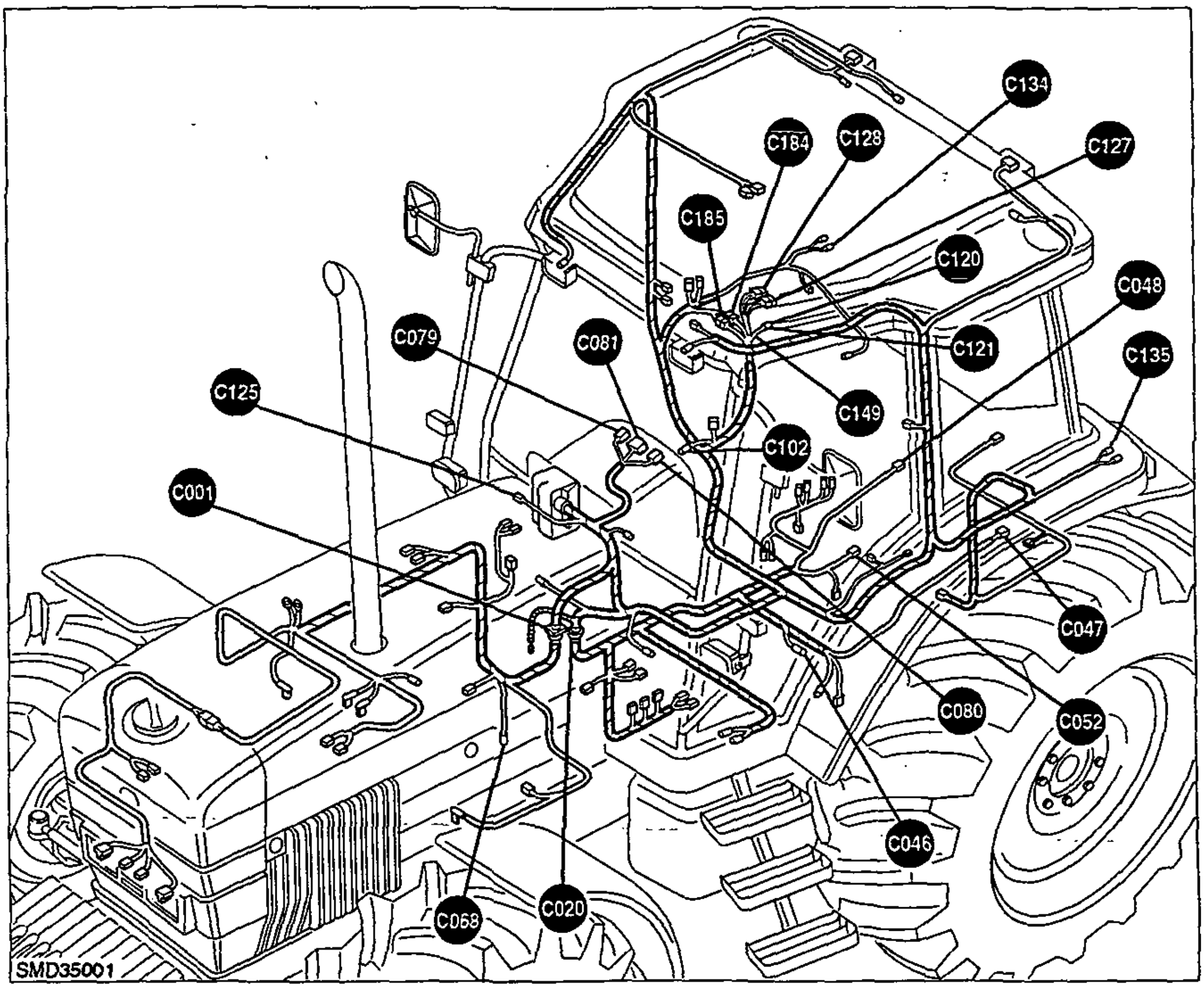
Where a specific item is not mentioned in the Contents table above this indicates that the procedure is unchanged from prior level models and reference should be made to the original Chapters.

Electronic Draft Control Error Codes

Error Code	Error Description
2	Poor on no signal from tractor performance monitor radar.
3	Transmission output speed sensor or tractor performance monitor radar circuit intermittent failure.
4	Transmission output speed sensor circuit intermittent failure.
5	Transmission output speed sensor shorted to chassis.
6	Slip control potentiometer failure, open circuit or shorted to chassis.
7	Slip control potentiometer failure or circuit shorted to supply voltage.
8	In cab hydraulic lift fast raise/lower work switch circuit failure.
9	Both external lift/lower fender switch circuits operating simultaneously.
10	Height limit control potentiometer/circuit - open circuit or shorted to chassis.
11	Height limit control potentiometer/circuit shorted to supply voltage.
12	Drop rate control potentiometer/circuit - open circuit or shorted to chassis.
13	Drop rate control potentiometer/circuit shorted to supply voltage.
14	Right hand load sensing pin failure/circuit open or shorted to chassis.
15	Right hand load sensing pin failure/circuit shorted to chassis.
16	Left hand load sensing pin failure/circuit open or shorted to chassis.
17	Left hand load sensing pin failure/circuit shorted to chassis.
18	Both load sensing pins disconnected or open load sensing pin circuit.
19	Load sensing pin supply voltage shorted to ground.
20	Load sensing pin supply voltage shorted to battery.
21	Position/draft control sensitivity control potentiometer/circuit - open circuit or shorted to chassis.
22	Position/draft control sensitivity control potentiometer/circuit shorted to supply voltage.

Electronic Draft Control Error Codes

Error Code	Error Description
23	Electronic draft control panel disconnected.
24	Perform hydraulic lift auto calibration.
25	Lift control lever potentiometer disconnected or circuit open or shorted to chassis.
26	Lift control lever potentiometer failure or circuit shorted to supply voltage.
27	Lift arm position sensing potentiometer failure, disconnected, open circuit or circuit shorted to chassis.
28	Lift arm position sensing potentiometer failure, or circuit shorted to supply voltage.
29	Hydraulic control valve/circuit short or open circuit.
30	Circuit failure to EDC control panel.
31	Chassis harness disconnected.
49	Wheel speed sensor open/short circuit.
53	5 volt reference shorted to 12 volts.
54	5 volt reference shorted to ground.
56	Lift arms lowering unintentionally.
57	Micro-computer failure.
59	Micro-computer reference voltage failed.
63	EDC hydraulic control valve lower solenoid/circuit failed.
64	EDC hydraulic control valve raise solenoid/circuit failed.
65	EDC hydraulic control valve lower solenoid/circuit failed.
66	EDC hydraulic control valve raise solenoid/circuit failed.
67	EDC hydraulic control valve supply voltage too low.
HL	Height limit control not set fully clockwise during calibration (Error code 24).



Harness Layout Diagram for Tractors with Electronic Draft Control

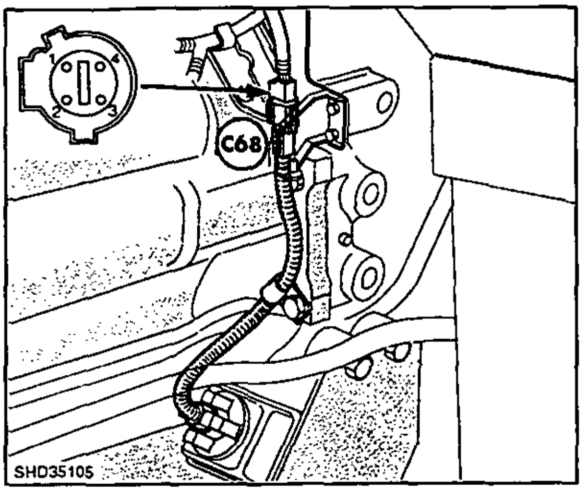
The above illustration shows the approximate location of those connectors referenced in the fault finding procedure for tractors installed with Electronic Draft Control.

For clarity, those connectors on the harnesses which are not applicable to the electronic draft control fault finding procedure have been omitted from the illustration.

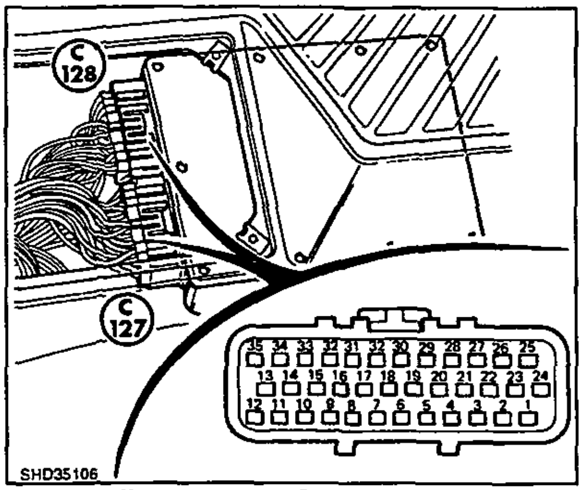
C48	Load Sensing Pin Connector (Right Hand)
C47	Load Sensing Pin Connector (Left Hand)
C128	Microprocessor Connector (Black)
C127	Microprocessor Connector (Red)
C184	Transmission/EDC Harness Connector
C185	Transmission/EDC Harness Connector
C121	EDC Control Panel Connector
C120	EDC Control Panel Connector
C125	Service Diagnostic Connector
C1	Engine Harness Connector
C149	Lift Control Lever Potentiometer
C52	Lift Arm Position Sensing Potentiometer
C79	Electronic Instrument Panel Connector
C80	Electronic Instrument Panel Connector
C81	Electronic Instrument Panel Connector
C46	Transmission Output Speed Sensor
C68	Performance Monitor Radar
C102	In Cab Fast Raise/Lower Switch
C135	Hydraulic Lift Fender Switch (Left Hand)
C134	Hydraulic Lift Fender Switch (Right Hand)
C20	EDC/Chassis Harness Connector

Error Code 2 - Poor or no signal from tractor performance monitor radar

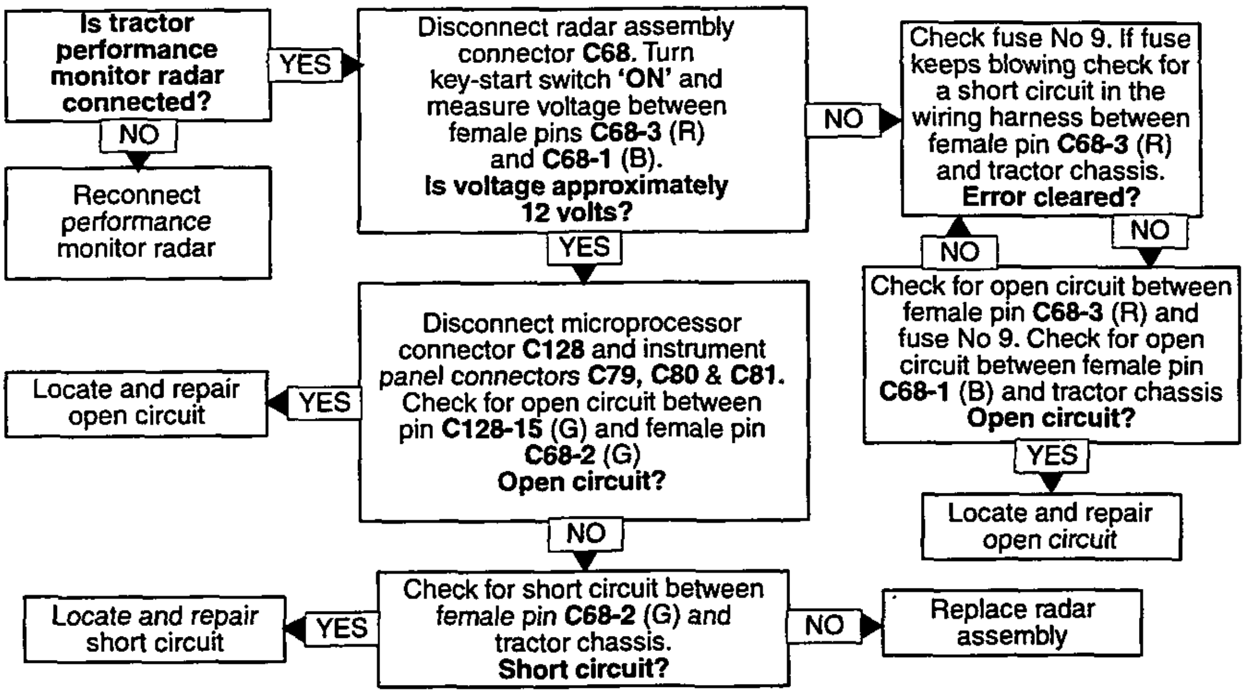
For EDC wiring diagram and connector location refer to end of this section



Performance Monitor Radar Connection



Microprocessor Connectors and
AEIC Ground Speed Wire



Is tractor performance monitor radar connected?

YES → Disconnect radar assembly connector **C68**. Turn key-start switch **'ON'** and measure voltage between female pins **C68-3** (R) and **C68-1** (B). **Is voltage approximately 12 volts?**

NO → Reconnect performance monitor radar

Disconnect radar assembly connector C68 … **Is voltage approximately 12 volts?**

NO → Check fuse No 9. If fuse keeps blowing check for a short circuit in the wiring harness between female pin **C68-3** (R) and tractor chassis. **Error cleared?**

YES → Disconnect microprocessor connector **C128** and instrument *panel connectors* **C79, C80 & C81.** Check for open circuit between pin **C128-15** (G) and female pin **C68-2** (G) **Open circuit?**

Check fuse No 9 … **Error cleared?**

NO → Check for open circuit between female pin **C68-3** (R) and fuse No 9. Check for open circuit between female pin **C68-1** (B) and tractor chassis **Open circuit?**

Check for open circuit between female pin C68-3 (R) and fuse No 9 … **Open circuit?**

NO → (back to Check fuse No 9)

YES → Locate and repair open circuit

Disconnect microprocessor connector C128 … **Open circuit?**

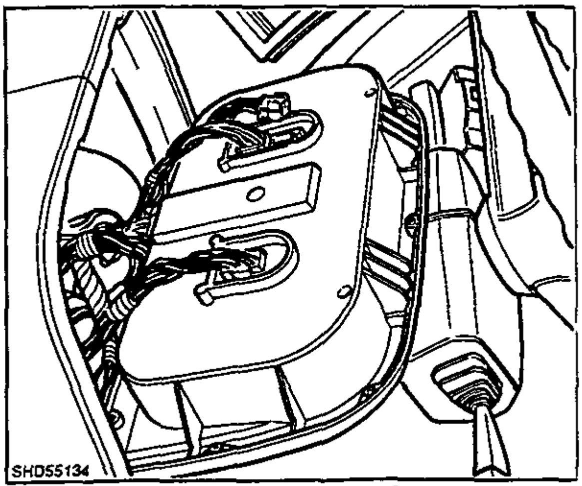
YES → Locate and repair open circuit

NO → Check for short circuit between *female pin* **C68-2** (G) and tractor chassis. **Short circuit?**

Check for short circuit between female pin C68-2 (G) and tractor chassis. **Short circuit?**

YES → Locate and repair short circuit

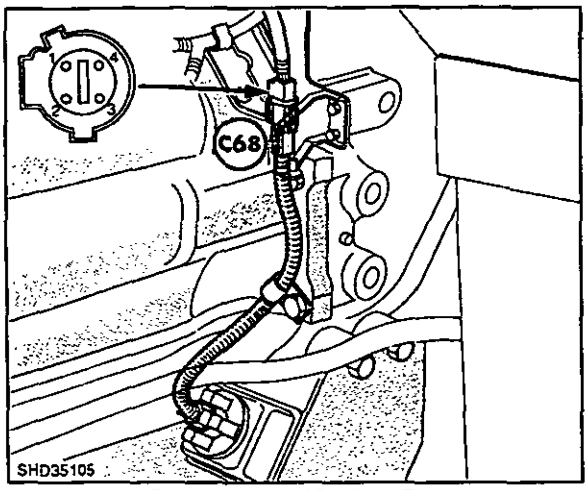
NO → Replace radar assembly



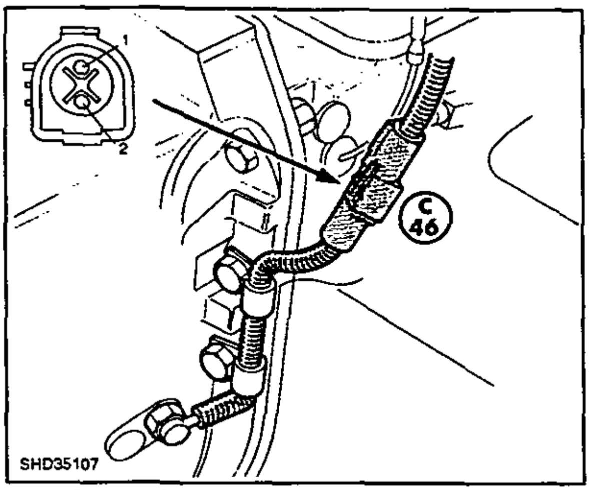
Electronic Instrument Panel Connectors

Error Codes 3, 4 and 5 - Speed sensor errors

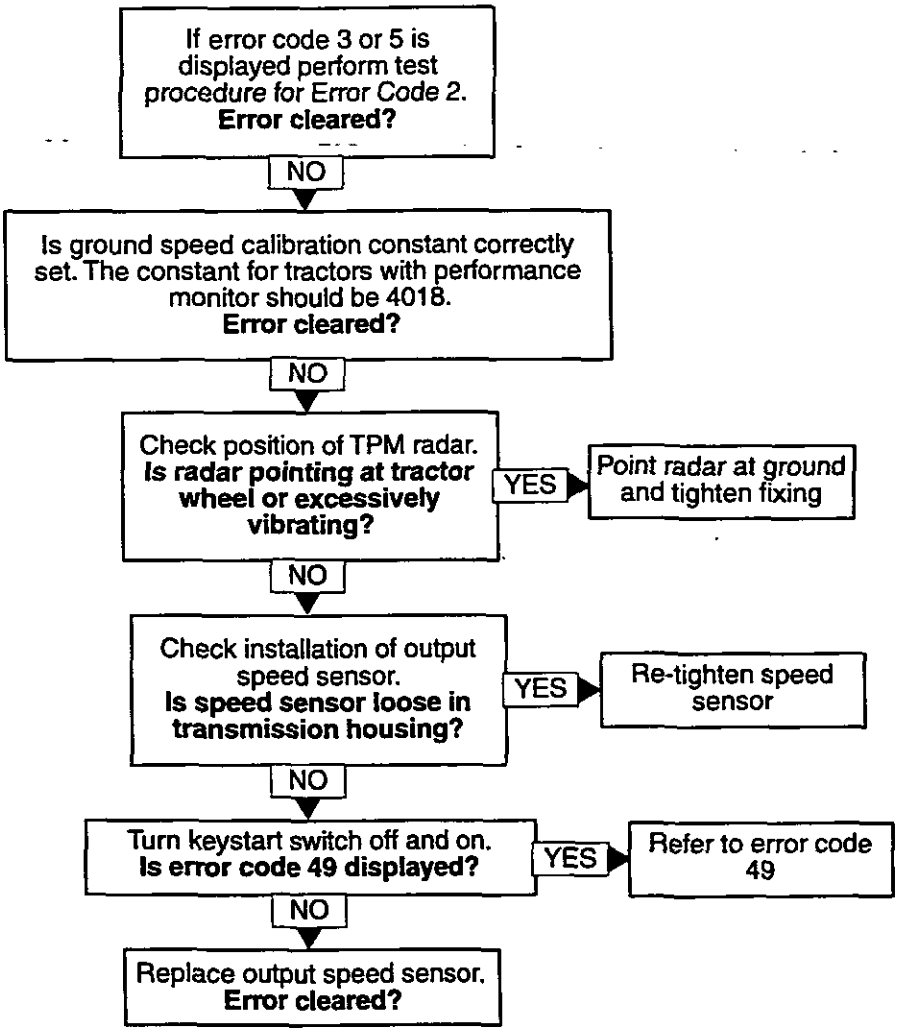
For EDC wiring diagram and connector location refer to end of this section



Performance Monitor Radar



Transmission Output Speed Sensor (Left Hand Side of Tractor)



If error code 3 or 5 is displayed perform test procedure for Error Code 2. **Error cleared?**

Is ground speed calibration constant correctly set. The constant for tractors with performance monitor should be 4018. **Error cleared?**

Check position of TPM radar. **Is radar pointing at tractor wheel or excessively vibrating?**

Point radar at ground and tighten fixing

Check installation of output speed sensor. **Is speed sensor loose in transmission housing?**

Re-tighten speed sensor

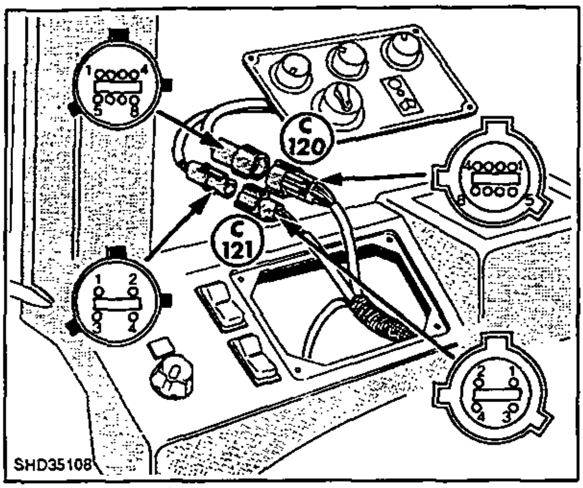
Turn keystart switch off and on. **Is error code 49 displayed?**

Refer to error code 49

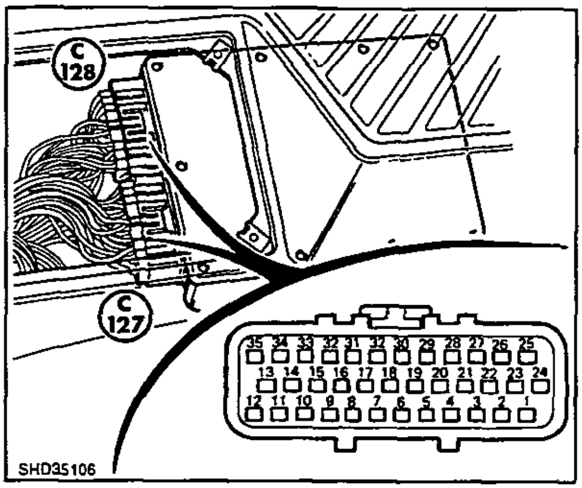
Replace output speed sensor. **Error cleared?**

Error Codes 6 and 7 - Slip control potentiometer or circuit failed

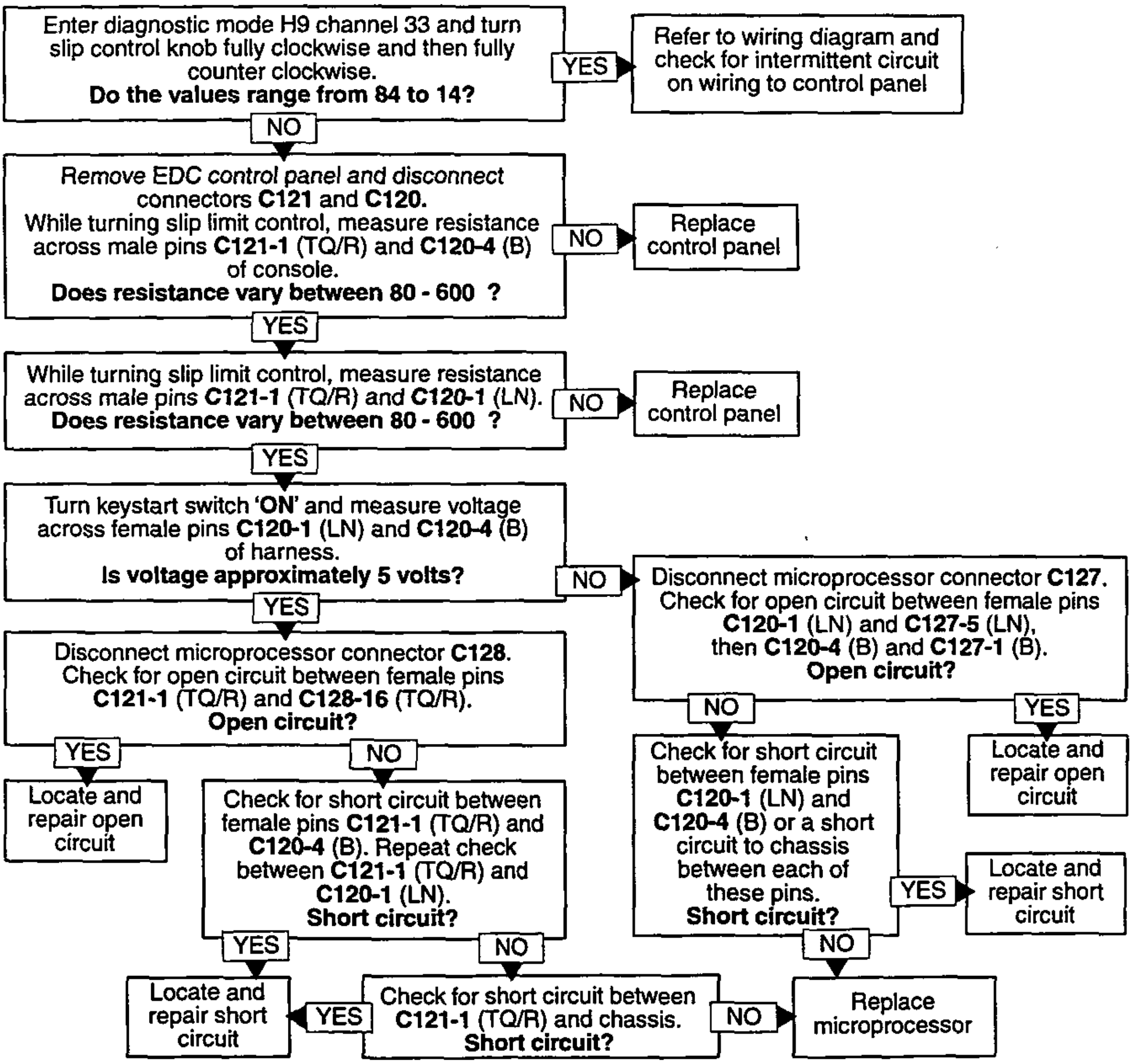
For EDC wiring diagram and connector location refer to end of this section



EDC Control Panel Connectors



Microprocessor Connectors



Enter diagnostic mode H9 channel 33 and turn slip control knob fully clockwise and then fully counter clockwise.
Do the values range from 84 to 14?

YES → Refer to wiring diagram and check for intermittent circuit on wiring to control panel

NO ↓

Remove EDC control panel and disconnect connectors **C121** and **C120.**
While turning slip limit control, measure resistance across male pins **C121-1** (TQ/R) and **C120-4** (B) of console.
Does resistance vary between 80 - 600 ?

NO → Replace control panel

YES ↓

While turning slip limit control, measure resistance across male pins **C121-1** (TQ/R) and **C120-1** (LN).
Does resistance vary between 80 - 600 ?

NO → Replace control panel

YES ↓

Turn keystart switch **'ON'** and measure voltage across female pins **C120-1** (LN) and **C120-4** (B) of harness.
Is voltage approximately 5 volts?

NO → Disconnect microprocessor connector **C127.** Check for open circuit between female pins **C120-1** (LN) and **C127-5** (LN), then **C120-4** (B) and **C127-1** (B).
Open circuit?

- YES ↓ Locate and repair open circuit
- NO ↓ Check for short circuit between female pins **C120-1** (LN) and **C120-4** (B) or a short circuit to chassis between each of these pins.
Short circuit?
  - YES → Locate and repair short circuit
  - NO ↓ Replace microprocessor

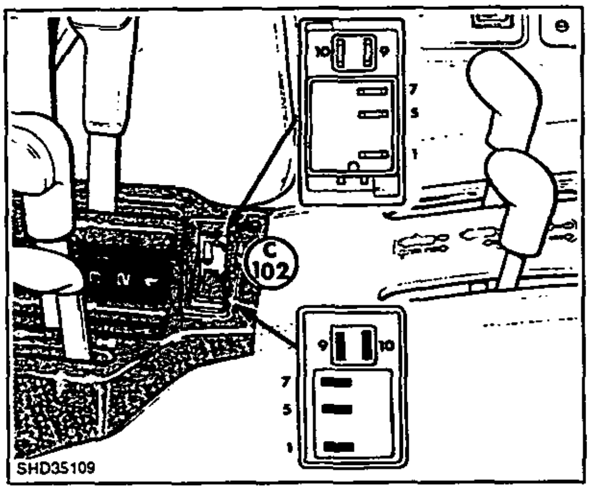
YES ↓

Disconnect microprocessor connector **C128.** Check for open circuit between female pins **C121-1** (TQ/R) and **C128-16** (TQ/R).
Open circuit?

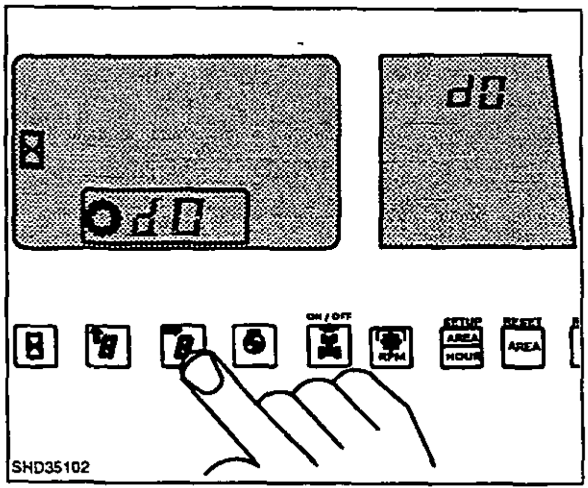
- YES ↓ Locate and repair open circuit
- NO ↓ Check for short circuit between female pins **C121-1** (TQ/R) and **C120-4** (B). Repeat check between **C121-1** (TQ/R) and **C120-1** (LN).
Short circuit?
  - YES ↓ Locate and repair short circuit
  - NO ↓ Check for short circuit between **C121-1** (TQ/R) and chassis.
Short circuit?
    - YES → Locate and repair short circuit
    - NO → Replace microprocessor

Error Code 8 - Raise/Work switch failure

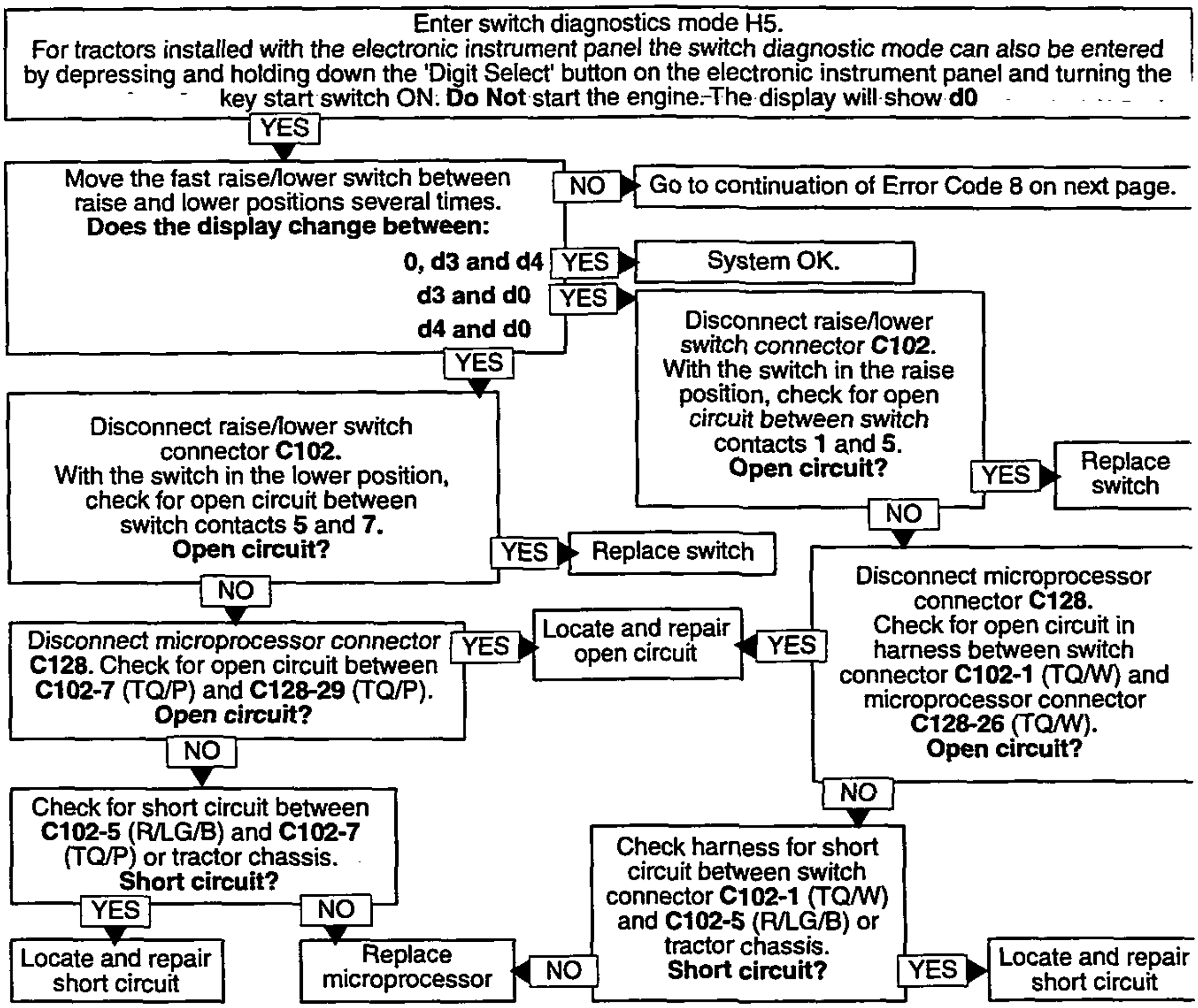
For EDC wiring diagram and connector location refer to end of this section



Fast Raise/Lower Switch



Entering Switch Diagnostic Mode on Electronic Instrument Panel



Enter switch diagnostics mode H5.
For tractors installed with the electronic instrument panel the switch diagnostic mode can also be entered by depressing and holding down the 'Digit Select' button on the electronic instrument panel and turning the key start switch ON. **Do Not** start the engine. The display will show **d0**

YES

Move the fast raise/lower switch between raise and lower positions several times.
Does the display change between:
0, d3 and d4 YES → System OK.
d3 and d0 YES → Disconnect raise/lower switch connector **C102.** With the switch in the raise position, check for open *circuit between switch* contacts **1** and **5.** **Open circuit?**
d4 and d0 YES → Disconnect raise/lower switch connector **C102.** With the switch in the lower position, check for open circuit between switch contacts **5** and **7.** **Open circuit?**
NO → Go to continuation of Error Code 8 on next page.

Disconnect raise/lower switch connector **C102.** With the switch in the raise position, check for open *circuit between switch* contacts **1** and **5.** **Open circuit?**
YES → Replace switch
NO → Disconnect microprocessor connector **C128.** Check for open circuit in harness between switch connector **C102-1** (TQ/W) and microprocessor connector **C128-26** (TQ/W). **Open circuit?**

Disconnect raise/lower switch connector **C102.** With the switch in the lower position, check for open circuit between switch contacts **5** and **7.** **Open circuit?**
YES → Replace switch
NO → *Disconnect microprocessor connector* **C128.** Check for open circuit between **C102-7** (TQ/P) and **C128-29** (TQ/P). **Open circuit?**

Disconnect microprocessor connector **C128.** Check for open circuit between **C102-7** (TQ/P) and **C128-29** (TQ/P). **Open circuit?**
YES → Locate and repair open circuit
NO → Check for short circuit between **C102-5** (R/LG/B) and **C102-7** (TQ/P) or tractor chassis. **Short circuit?**

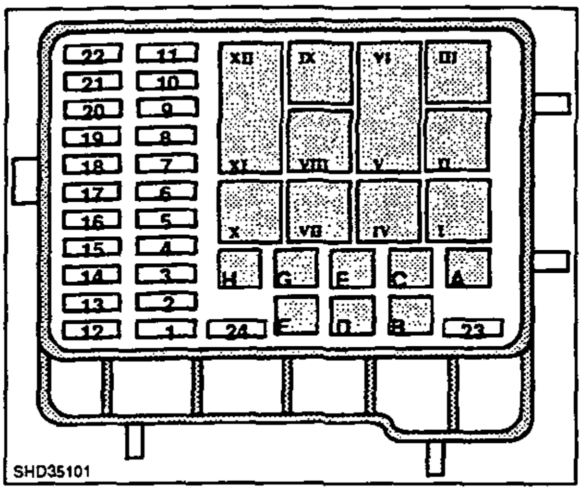
Check for short circuit between **C102-5** (R/LG/B) and **C102-7** (TQ/P) or tractor chassis. **Short circuit?**
YES → Locate and repair short circuit
NO → Replace microprocessor

Disconnect microprocessor connector **C128.** Check for open circuit in harness between switch connector **C102-1** (TQ/W) and microprocessor connector **C128-26** (TQ/W). **Open circuit?**
YES → Locate and repair open circuit
NO → Check harness for short circuit between switch connector **C102-1** (TQ/W) and **C102-5** (R/LG/B) or tractor chassis. **Short circuit?**

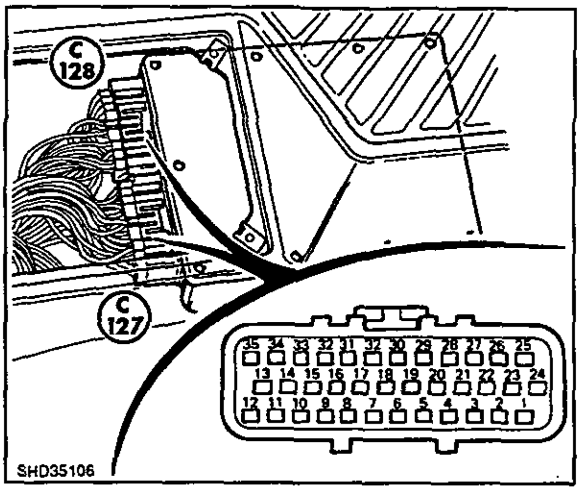
Check harness for short circuit between switch connector **C102-1** (TQ/W) and **C102-5** (R/LG/B) or tractor chassis. **Short circuit?**
YES → Locate and repair short circuit
NO → Replace microprocessor

Error Code 8 - Raise/Work switch failure

For EDC wiring diagram and connector location refer to end of this section



Fuse Panel



Microprocessor Connectors

Error Code 8 continued from previous page

Disconnect fast raise/lower switch connector **C102**. With the keyswitch turned **'OFF'**, check for open circuit between **C102-5** (N/O) and fuse 12. **Open circuit?**

- YES → Locate open circuit in R/LG/B coloured wire between **C102-5** and fuse 12.
- NO ↓

With the raise/lower switch in the raise position, check for open circuit between switch contacts **1** and **5**. With the raise/lower switch in the lower position, check for open circuit between switch contacts **5** and **7**. **Open circuit?**

- YES → Replace switch
- NO ↓

Disconnect microprocessor connector **C128.** Check for short circuit between terminals **C128-26** (TQ/W) and **C128-29** (TQ/P). **Short circuit?**

- YES → Locate and repair short circuit in wires from **C128-26** (TQ/W) and **C128-29** (TQ/P) to fast raise/lower switch **C102-5** (TQ/W) and **C102-7** (TQ/P)
- NO ↓

Check for open circuit between **C102-1** (TQ/W) and **C128-26** (TQ/W). **Open circuit?**

- YES → Locate and repair open circuit
- NO ↓

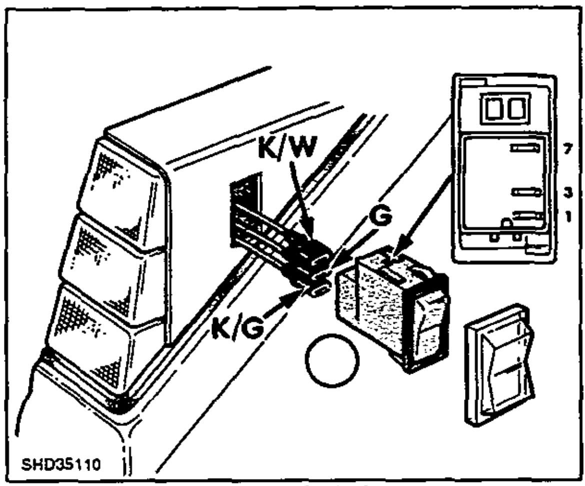
Check for open circuit between **C102-7** (TQ/P) and **C128-29** (TQ/P). **Open circuit?**

- YES → Locate and repair open circuit
- NO ↓

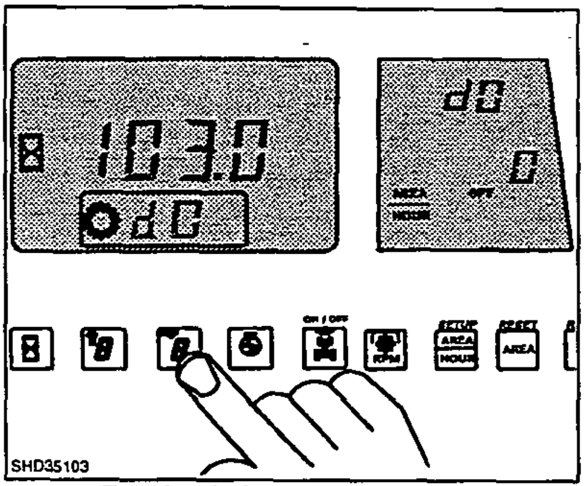
Replace microprocessor

Error Code 9 - Both external raise/lower fender switches being operated simultaneously

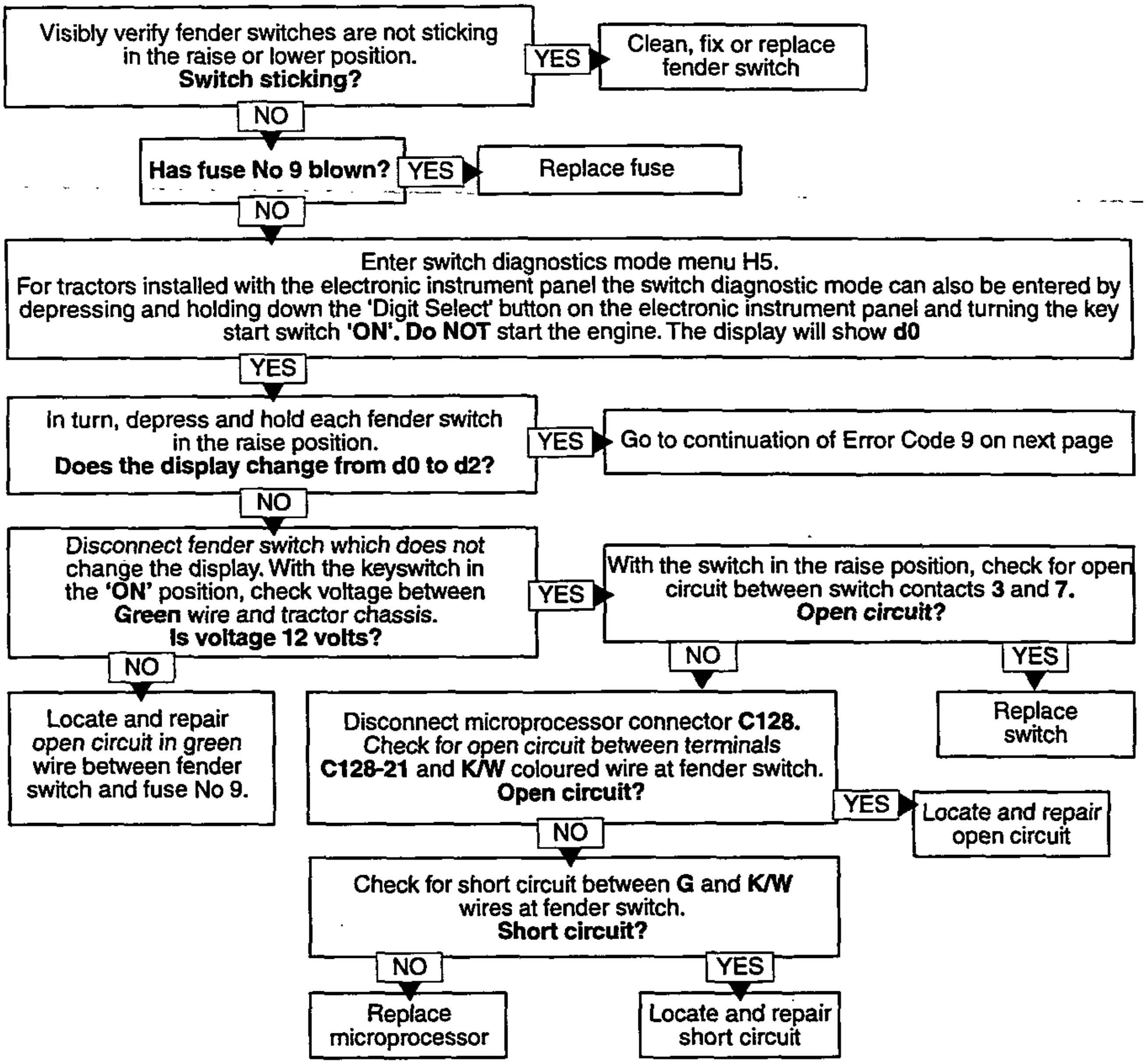
For EDC wiring diagram and connector location refer to end of this section



Fender Switch



Entering Switch Diagnostic Mode



Visibly verify fender switches are not sticking in the raise or lower position. **Switch sticking?**

YES → Clean, fix or replace fender switch

NO ↓

Has fuse No 9 blown?

YES → Replace fuse

NO ↓

Enter switch diagnostics mode menu H5. For tractors installed with the electronic instrument panel the switch diagnostic mode can also be entered by depressing and holding down the 'Digit Select' button on the electronic instrument panel and turning the key start switch **'ON'. Do NOT** start the engine. The display will show **d0**

YES ↓

In turn, depress and hold each fender switch in the raise position. **Does the display change from d0 to d2?**

YES → Go to continuation of Error Code 9 on next page

NO ↓

Disconnect fender switch which does not change the display. With the keyswitch in the **'ON'** position, check voltage between **Green** wire and tractor chassis. **Is voltage 12 volts?**

NO ↓ Locate and repair *open circuit in green* wire between fender switch and fuse No 9.

YES → With the switch in the raise position, check for open circuit between switch contacts **3** and **7**. ***Open circuit?***

YES ↓ Replace switch

NO ↓ Disconnect microprocessor connector **C128.** Check for *open circuit* between terminals **C128-21** and **K/W** coloured wire at fender switch. **Open circuit?**

YES → Locate and repair open circuit

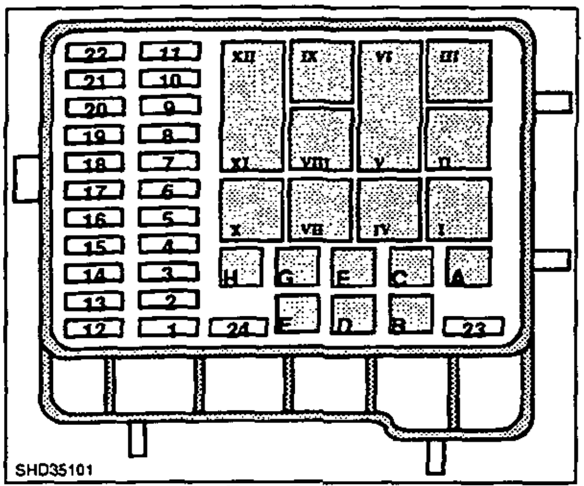
NO ↓ Check for short circuit between **G** and **K/W** wires at fender switch. **Short circuit?**

NO ↓ Replace microprocessor

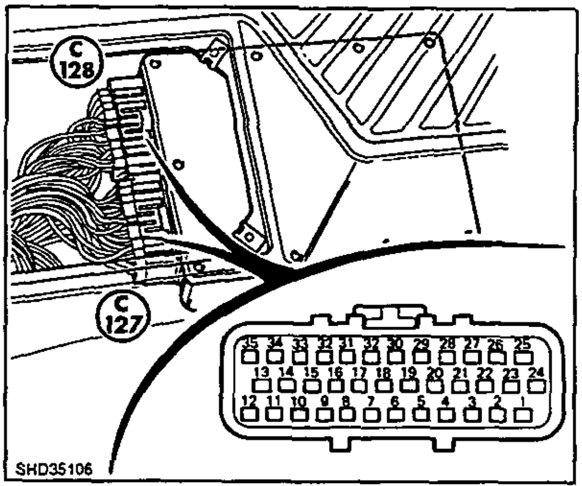
YES ↓ Locate and repair short circuit

Error Code 9 - Both external raise/lower fender switches being operated simultaneously

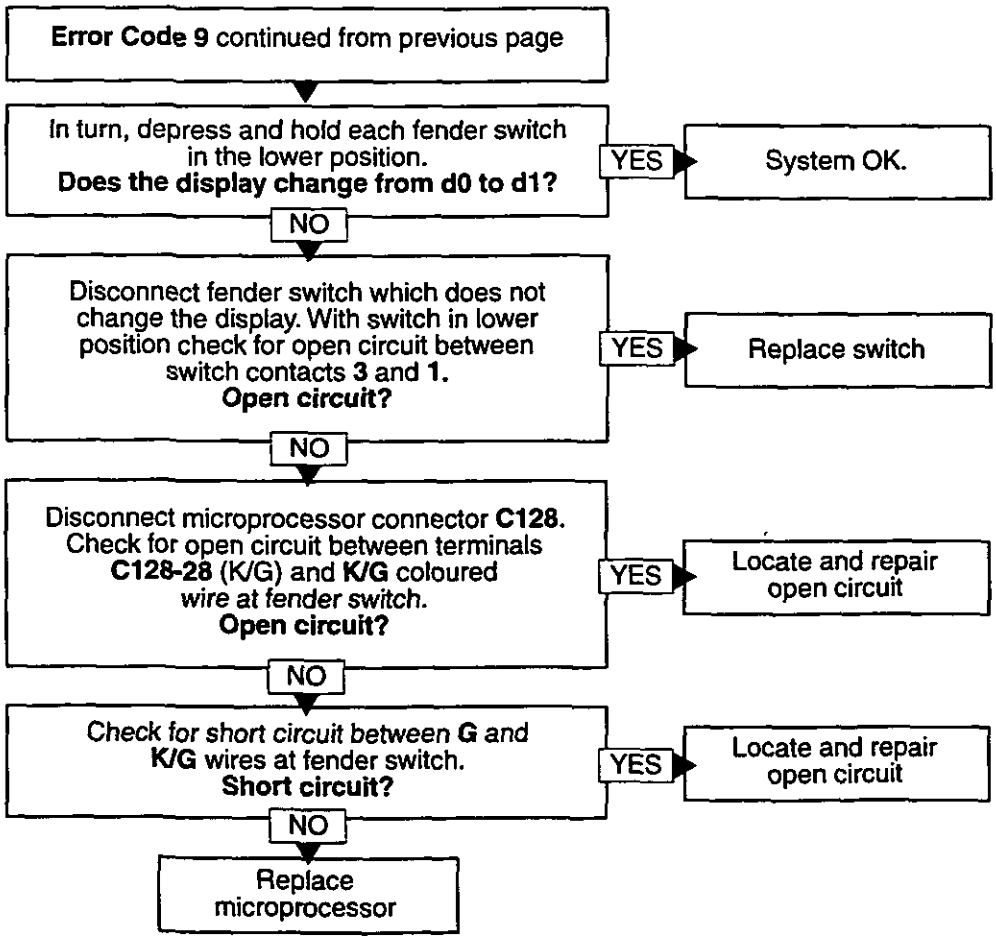
For EDC wiring diagram and connector location refer to end of this section



Fuse Panel



Microprocessor Connectors



Error Code 9 continued from previous page

In turn, depress and hold each fender switch in the lower position. **Does the display change from d0 to d1?**

YES → System OK.

NO ↓

Disconnect fender switch which does not change the display. With switch in lower position check for open circuit between switch contacts **3** and **1.** **Open circuit?**

YES → Replace switch

NO ↓

Disconnect microprocessor connector **C128.** Check for open circuit between terminals **C128-28** (K/G) and **K/G** coloured wire at fender switch. **Open circuit?**

YES → Locate and repair open circuit

NO ↓

Check for short circuit between **G** and **K/G** wires at fender switch. **Short circuit?**

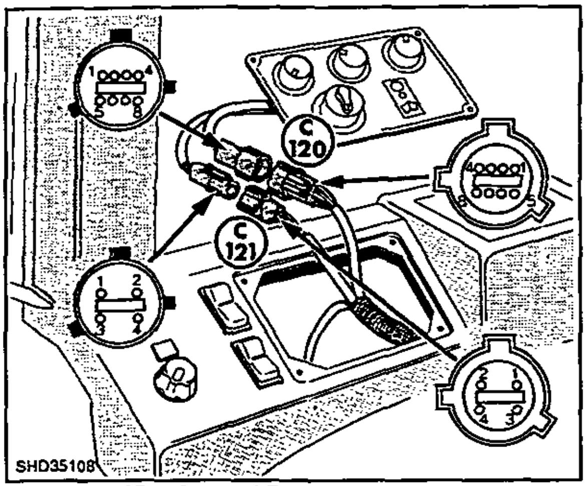
YES → Locate and repair open circuit

NO ↓

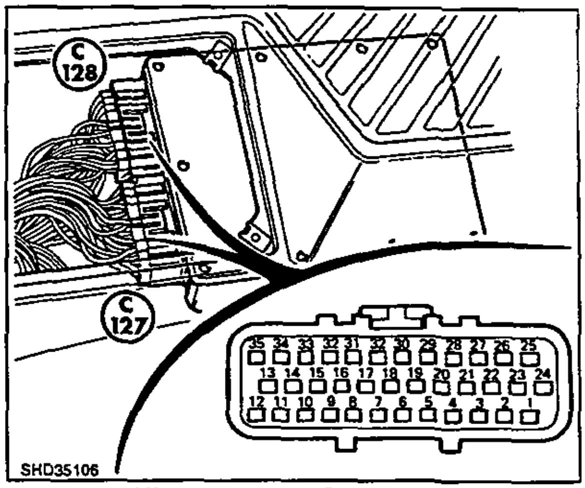
Replace microprocessor

Error Codes 10 and 11 - Height limit control potentiometer failed

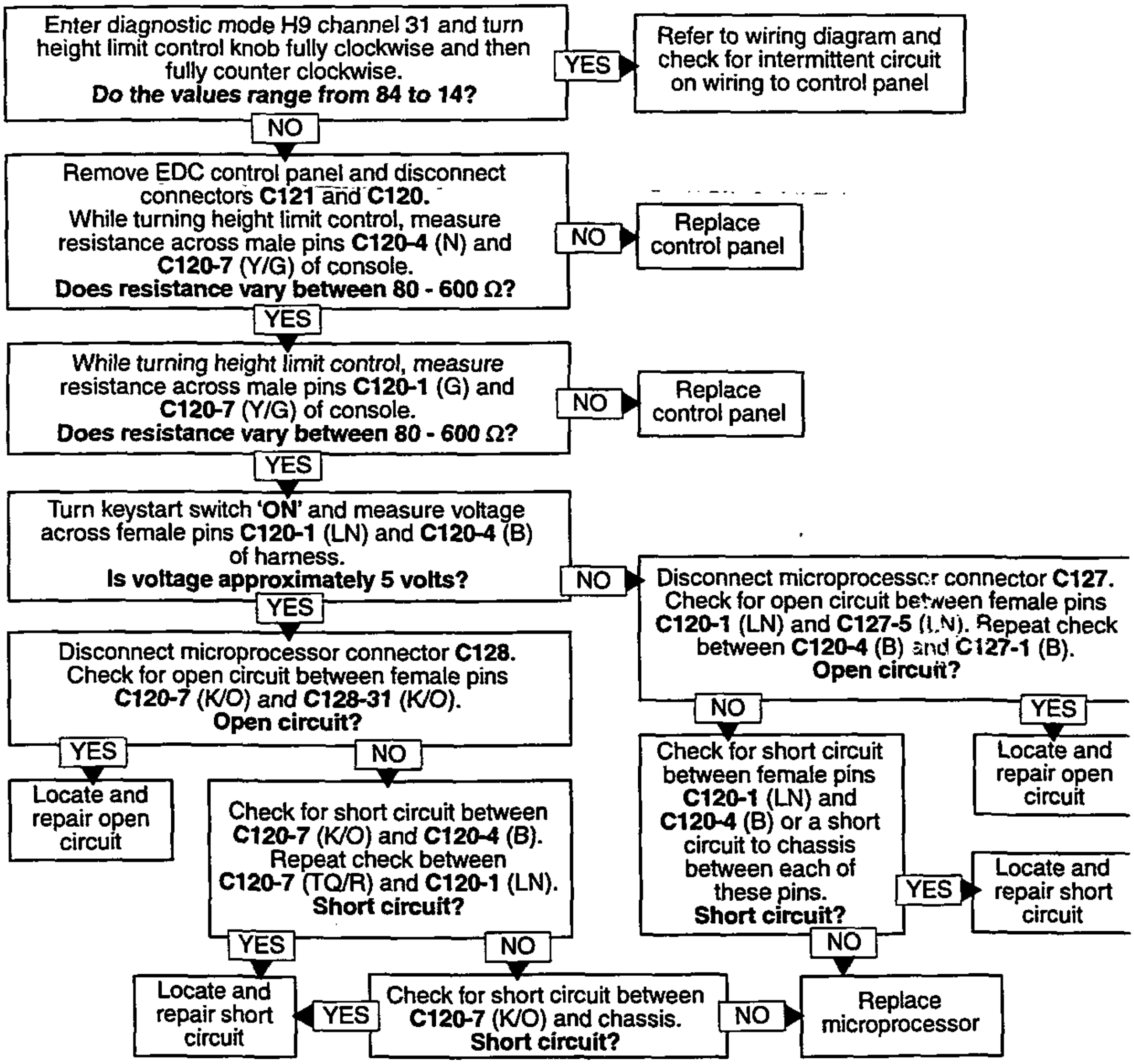
For EDC wiring diagram and connector location refer to end of this section



EDC Control Panel Connectors



Microprocessor Connectors



Enter diagnostic mode H9 channel 31 and turn height limit control knob fully clockwise and then fully counter clockwise.
Do the values range from 84 to 14?

YES → Refer to wiring diagram and check for intermittent circuit on wiring to control panel

NO ↓

Remove EDC control panel and disconnect connectors **C121** and **C120.**
While turning height limit control, measure resistance across male pins **C120-4** (N) and **C120-7** (Y/G) of console.
Does resistance vary between 80 - 600 Ω?

NO → Replace control panel

YES ↓

While turning height limit control, measure resistance across male pins **C120-1** (G) and **C120-7** (Y/G) of console.
Does resistance vary between 80 - 600 Ω?

NO → Replace control panel

YES ↓

Turn keystart switch **'ON'** and measure voltage across female pins **C120-1** (LN) and **C120-4** (B) of harness.
Is voltage approximately 5 volts?

NO → Disconnect microprocessor connector **C127.** Check for open circuit between female pins **C120-1** (LN) and **C127-5** (LN). Repeat check between **C120-4** (B) and **C127-1** (B).
Open circuit?

- YES → Locate and repair open circuit
- NO → Check for short circuit between female pins **C120-1** (LN) and **C120-4** (B) or a short circuit to chassis between each of these pins.
Short circuit?
  - YES → Locate and repair short circuit
  - NO → Replace microprocessor

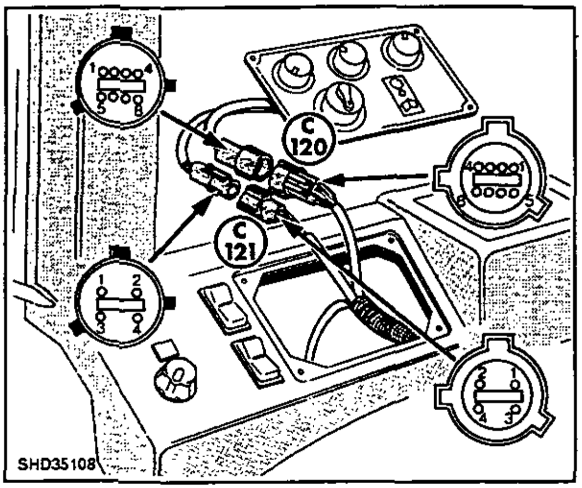
YES ↓

Disconnect microprocessor connector **C128.** Check for open circuit between female pins **C120-7** (K/O) and **C128-31** (K/O).
Open circuit?

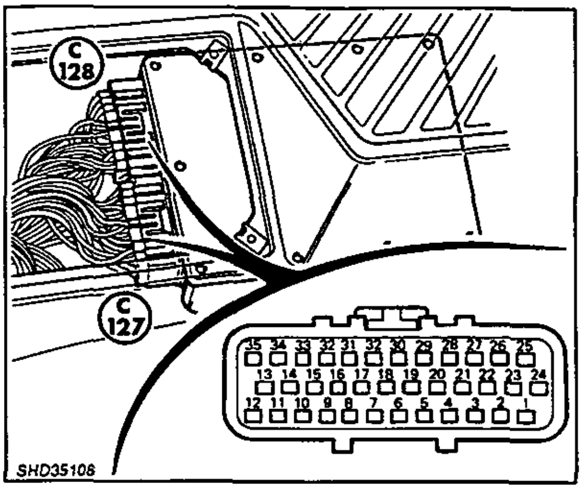
- YES → Locate and repair open circuit
- NO → Check for short circuit between **C120-7** (K/O) and **C120-4** (B). Repeat check between **C120-7** (TQ/R) and **C120-1** (LN).
Short circuit?
  - YES → Locate and repair short circuit
  - NO → Check for short circuit between **C120-7** (K/O) and chassis.
Short circuit?
    - YES → Locate and repair short circuit
    - NO → Replace microprocessor

Error Codes 12 and 13 - Drop rate control potentiometer failed

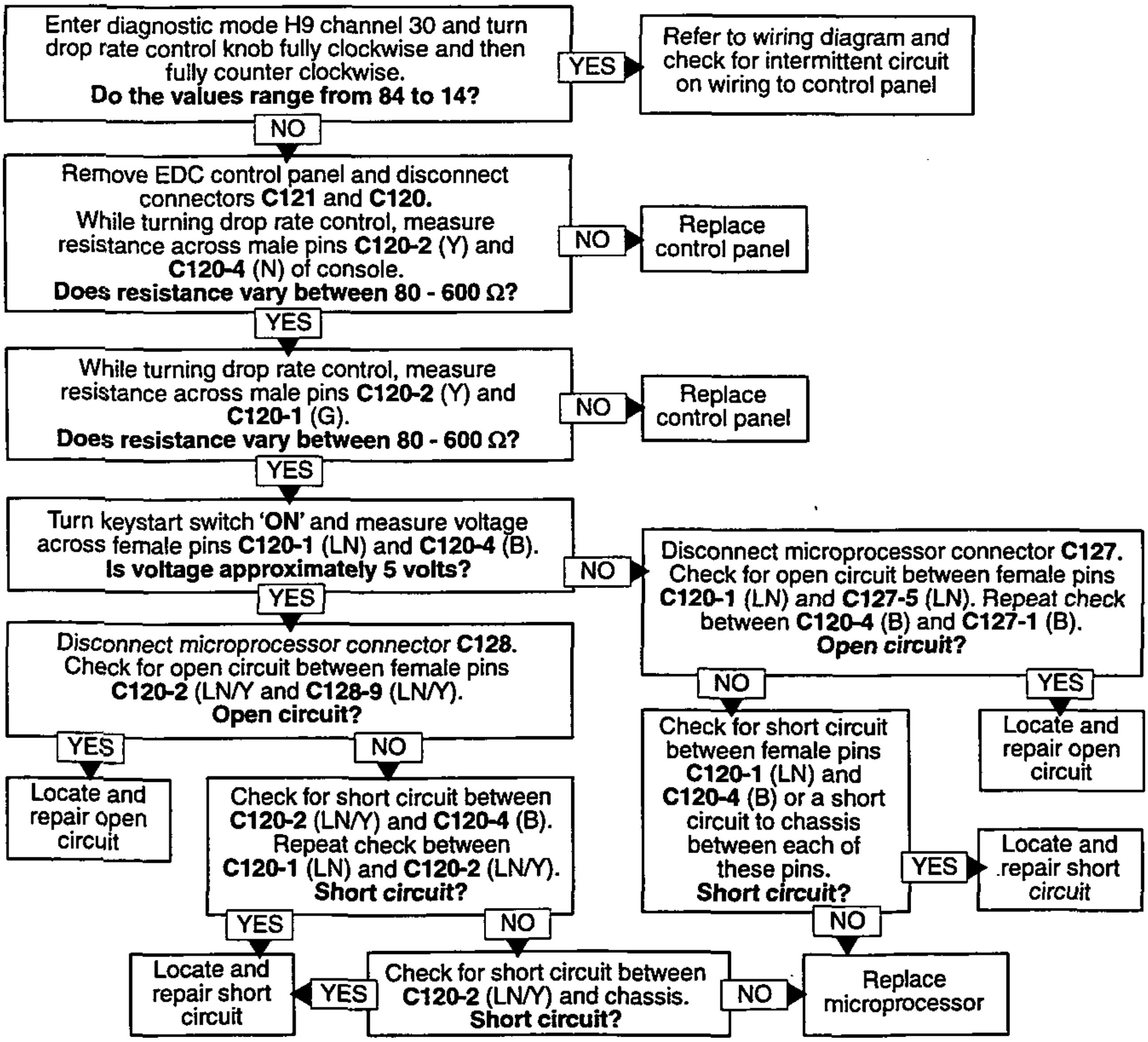
For EDC wiring diagram and connector location refer to end of this section



EDC Control Panel Connectors



Microprocessor Connectors



Enter diagnostic mode H9 channel 30 and turn drop rate control knob fully clockwise and then fully counter clockwise.
Do the values range from 84 to 14?

YES → Refer to wiring diagram and check for intermittent circuit on wiring to control panel

NO ↓

Remove EDC control panel and disconnect connectors **C121** and **C120.** While turning drop rate control, measure resistance across male pins **C120-2** (Y) and **C120-4** (N) of console.
Does resistance vary between 80 - 600 Ω?

NO → Replace control panel

YES ↓

While turning drop rate control, measure resistance across male pins **C120-2** (Y) and **C120-1** (G).
Does resistance vary between 80 - 600 Ω?

NO → Replace control panel

YES ↓

Turn keystart switch **'ON'** and measure voltage across female pins **C120-1** (LN) and **C120-4** (B).
Is voltage approximately 5 volts?

NO → Disconnect microprocessor connector **C127.** Check for open circuit between female pins **C120-1** (LN) and **C127-5** (LN). Repeat check between **C120-4** (B) and **C127-1** (B).
Open circuit?

- YES → Locate and repair open circuit
- NO → Check for short circuit between female pins **C120-1** (LN) and **C120-4** (B) or a short circuit to chassis between each of these pins.
Short circuit?
  - YES → Locate and repair short *circuit*
  - NO → Replace microprocessor

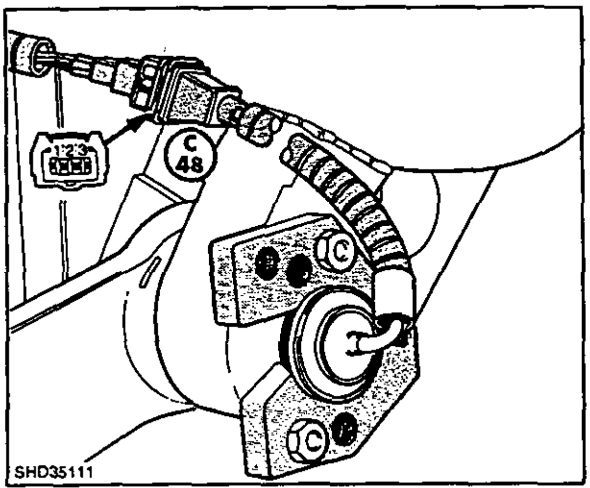
YES ↓

Disconnect microprocessor connector **C128.** Check for open circuit between female pins **C120-2** (LN/Y and **C128-9** (LN/Y).
Open circuit?

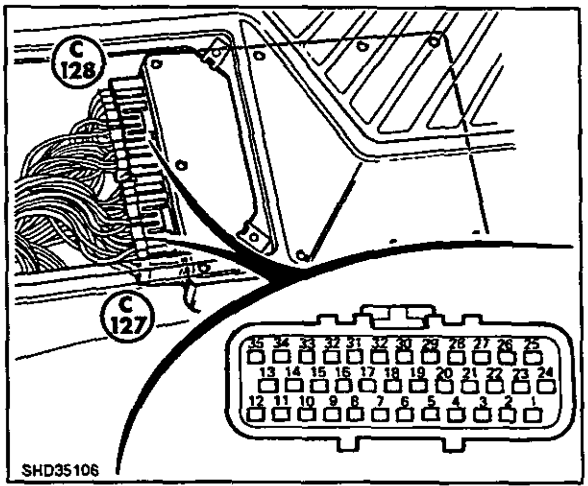
- YES → Locate and repair open circuit
- NO → Check for short circuit between **C120-2** (LN/Y) and **C120-4** (B). Repeat check between **C120-1** (LN) and **C120-2** (LN/Y).
Short circuit?
  - YES → Locate and repair short circuit
  - NO → Check for short circuit between **C120-2** (LN/Y) and chassis.
Short circuit?
    - YES → Locate and repair short circuit
    - NO → Replace microprocessor

Error Codes 14 and 15 - Right hand load sensing pin or circuit failed

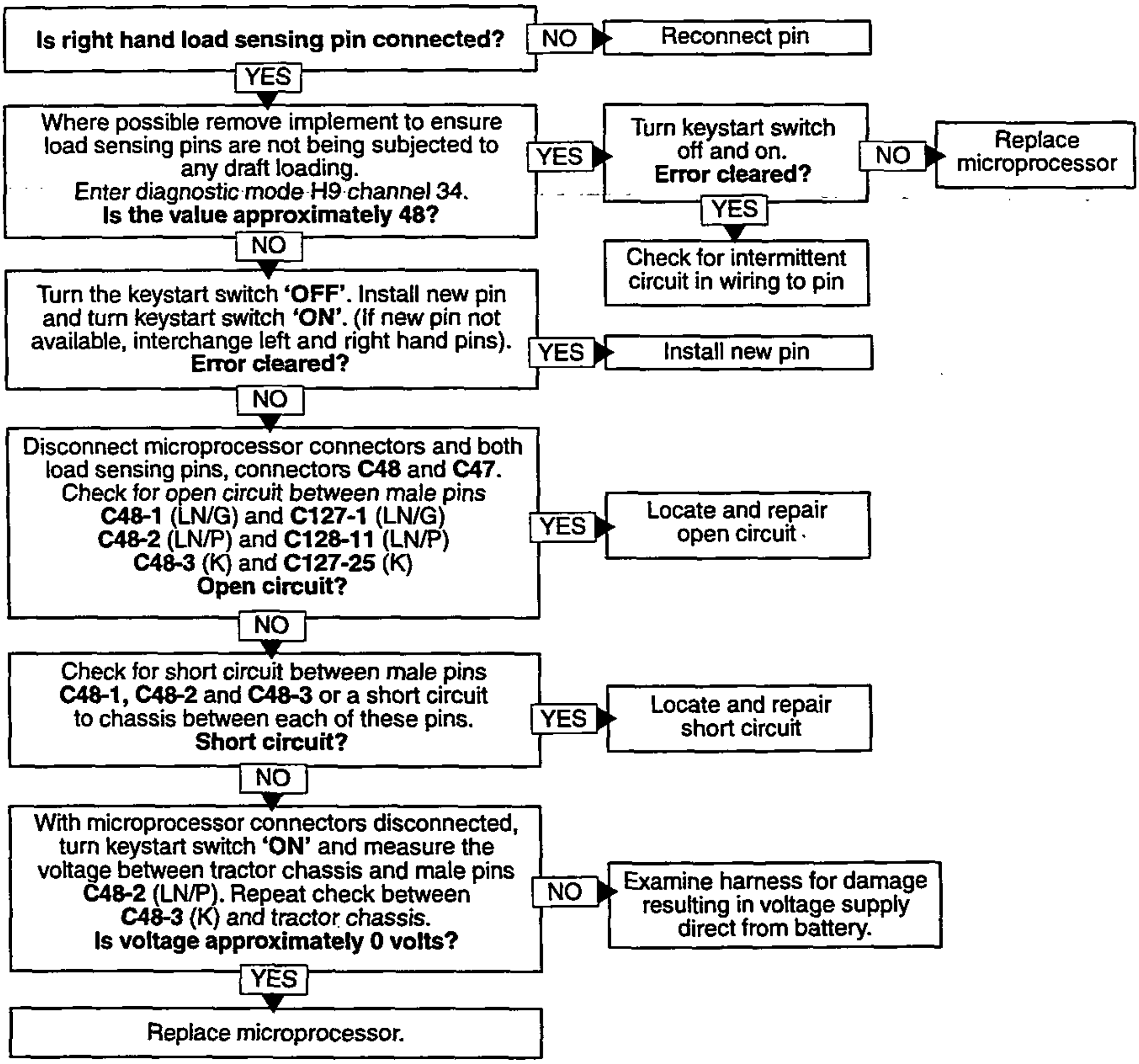
For EDC wiring diagram and connector location refer to end of this section



Right Hand Load Sensing Pin



Microprocessor Connectors



Is right hand load sensing pin connected?
NO → Reconnect pin
YES ↓

Where possible remove implement to ensure load sensing pins are not being subjected to any draft loading.
Enter diagnostic mode H9 channel 34.
Is the value approximately 48?
YES → Turn keystart switch off and on. **Error cleared?**
- NO → Replace microprocessor
- YES → Check for intermittent circuit in wiring to pin

NO ↓

Turn the keystart switch **'OFF'**. Install new pin and turn keystart switch **'ON'**. (If new pin not available, interchange left and right hand pins).
Error cleared?
YES → Install new pin
NO ↓

Disconnect microprocessor connectors and both load sensing pins, connectors **C48** and **C47**.
Check for open circuit between male pins
C48-1 (LN/G) and **C127-1** (LN/G)
C48-2 (LN/P) and **C128-11** (LN/P)
C48-3 (K) and **C127-25** (K)
Open circuit?
YES → Locate and repair open circuit.
NO ↓

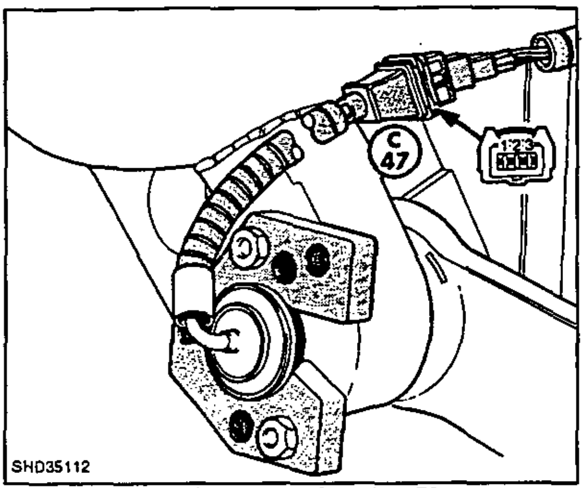
Check for short circuit between male pins **C48-1, C48-2** and **C48-3** or a short circuit to chassis between each of these pins.
Short circuit?
YES → Locate and repair short circuit
NO ↓

With microprocessor connectors disconnected, turn keystart switch **'ON'** and measure the voltage between tractor chassis and male pins **C48-2** (LN/P). Repeat check between **C48-3** (K) and tractor chassis.
Is voltage approximately 0 volts?
NO → Examine harness for damage resulting in voltage supply direct from battery.
YES ↓

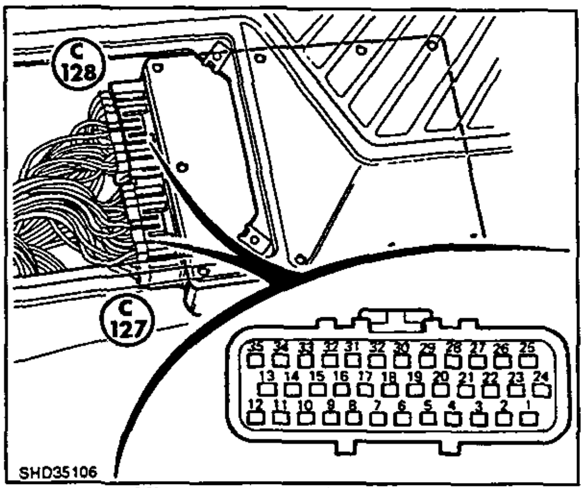
Replace microprocessor.

Error Codes 16 and 17 - Right hand load sensing pin or circuit failed

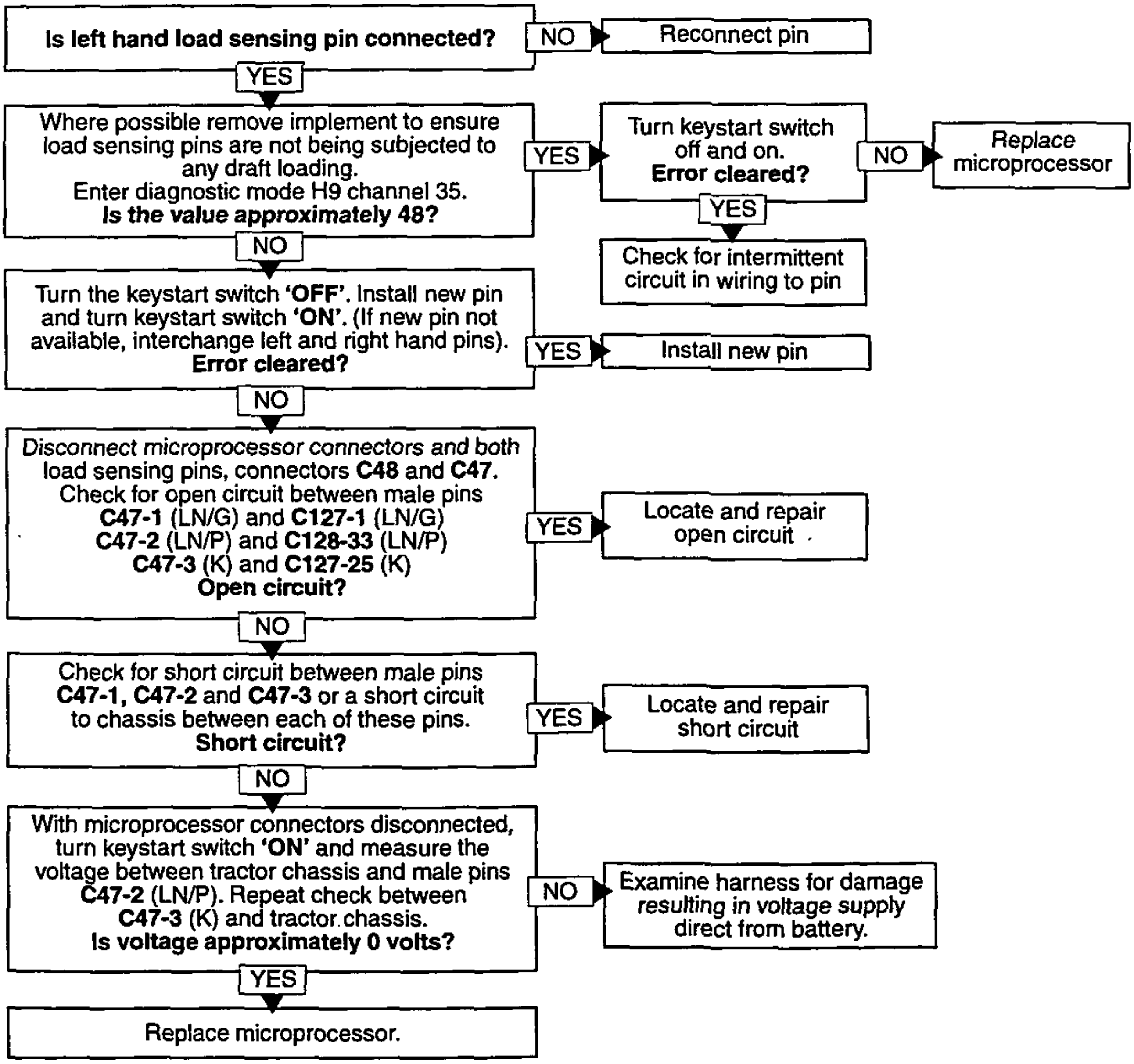
For EDC wiring diagram and connector location refer to end of this section



Left Hand Load Sensing Pin



Microprocessor Connectors



Is left hand load sensing pin connected?
NO → Reconnect pin
YES ↓

Where possible remove implement to ensure load sensing pins are not being subjected to any draft loading.
Enter diagnostic mode H9 channel 35.
Is the value approximately 48?
YES → Turn keystart switch off and on. **Error cleared?**
- NO → Replace microprocessor
- YES → Check for intermittent circuit in wiring to pin

NO ↓

Turn the keystart switch **'OFF'**. Install new pin and turn keystart switch **'ON'**. (If new pin not available, interchange left and right hand pins).
Error cleared?
YES → Install new pin
NO ↓

Disconnect microprocessor connectors and both load sensing pins, connectors **C48** and **C47**.
Check for open circuit between male pins
C47-1 (LN/G) and **C127-1** (LN/G)
C47-2 (LN/P) and **C128-33** (LN/P)
C47-3 (K) and **C127-25** (K)
Open circuit?
YES → Locate and repair open circuit
NO ↓

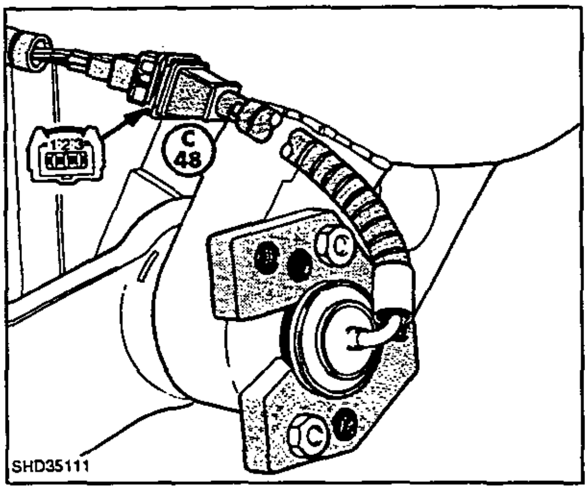
Check for short circuit between male pins **C47-1, C47-2** and **C47-3** or a short circuit to chassis between each of these pins.
Short circuit?
YES → Locate and repair short circuit
NO ↓

With microprocessor connectors disconnected, turn keystart switch **'ON'** and measure the voltage between tractor chassis and male pins **C47-2** (LN/P). Repeat check between **C47-3** (K) and tractor chassis.
Is voltage approximately 0 volts?
NO → Examine harness for damage *resulting in voltage supply* direct from battery.
YES ↓

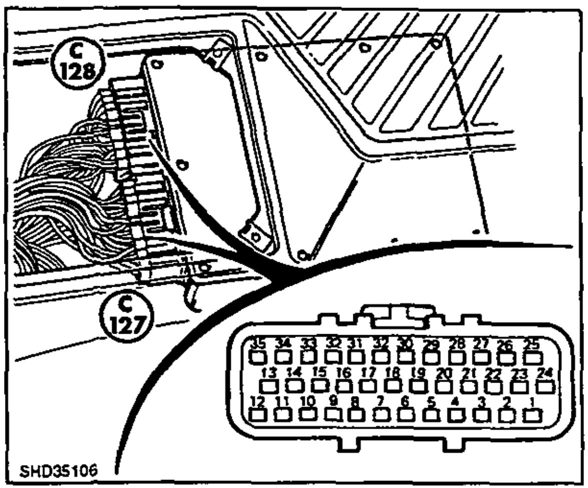
Replace microprocessor.

Error Code 18 - Both load sensing pins disconnected

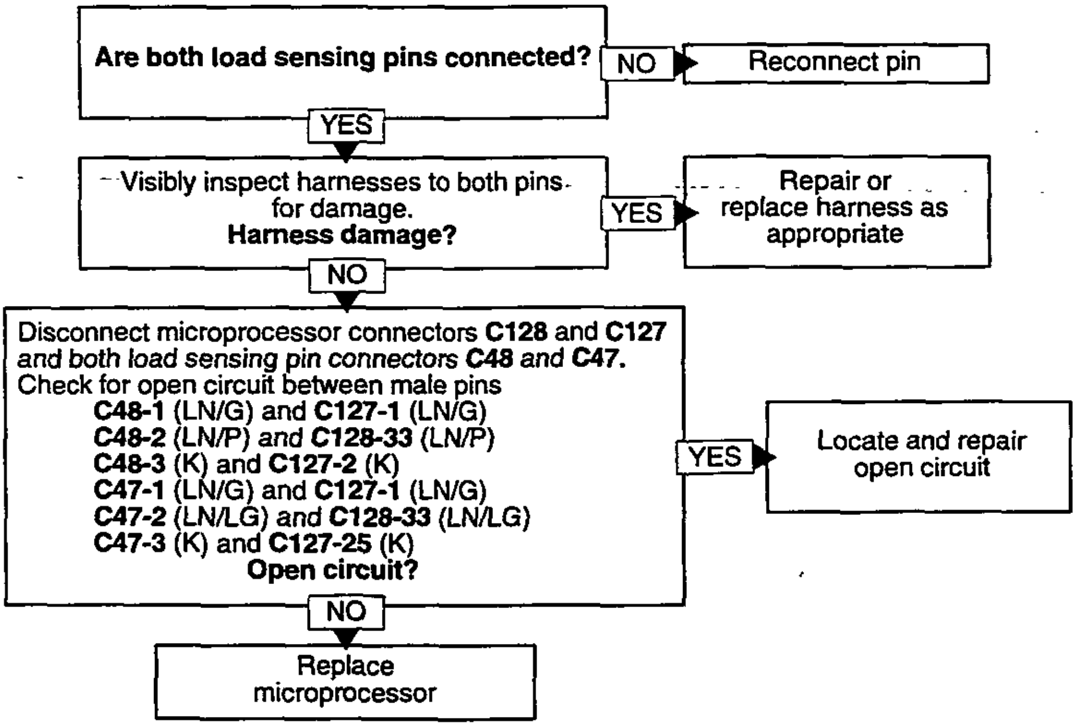
For EDC wiring diagram and connector location refer to end of this section



Load Sensing Pin (Right hand pin shown)



Microprocessor Connectors



Are both load sensing pins connected?

NO → Reconnect pin

YES ↓

Visibly inspect harnesses to both pins for damage.
Harness damage?

YES → Repair or replace harness as appropriate

NO ↓

Disconnect microprocessor connectors **C128** and **C127** *and both load sensing pin connectors* **C48** *and* **C47.**
Check for open circuit between male pins
C48-1 (LN/G) and **C127-1** (LN/G)
C48-2 (LN/P) and **C128-33** (LN/P)
C48-3 (K) and **C127-2** (K)
C47-1 (LN/G) and **C127-1** (LN/G)
C47-2 (LN/LG) and **C128-33** (LN/LG)
C47-3 (K) and **C127-25** (K)
Open circuit?

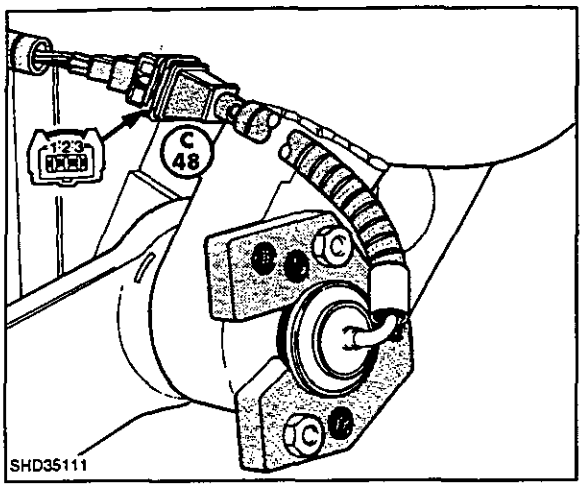
YES → Locate and repair open circuit

NO ↓

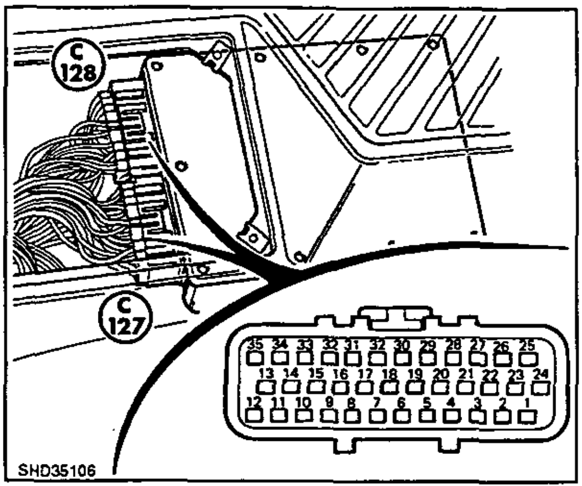
Replace microprocessor

Error Codes 19 and 20 - Incorrect load sensing pin reference voltage

For EDC wiring diagram and connector location refer to end of this section



Load Sensing Pin (Right hand pin shown)



Microprocessor Connectors

Enter diagnostic mode H9 channel 9
Is the value approximately 79?

YES ▶ Turn keystart switch Off and On
Error cleared?

- NO ▶ Replace microprocessor
- YES ▶ Check for intermittent circuit on wiring to pins

NO ▼

Disconnect both load sensing pins.
Turn keystart switch **ON** and measure voltage between
C48-3 and **C48-1**
C47-3 and **C47-1**
Is voltage approximately 8 volts?

YES ▶ Replace microprocessor

NO ▼

Disconnect microprocessor connectors.
Check for open circuit between
C48-3 and **C127-25**
C47-3 and **C127-25**
Open circuit?

NO ▼

Turn keystart switch **OFF**. Install new load sensing pin(s) from another tractor (if available).
Turn keystart switch **ON**
Error cleared?

YES ▶ Install new pin(s)

NO ▼

Disconnect microprocessor connectors and both load sensing pin connectors **C48** and **C47**.
Check for short circuit between tractor chassis and male pins **C48-3** (K) and **C47-3** (K)
Short circuit?

YES ▶ Locate and repair short circuit

NO ▼

With microprocessor connectors **C127** & **C128** disconnected, turn keystart switch **ON** and measure the voltage between tractor chassis and male pin **C48-3** (K). Repeat check between male pin **C47-3** (K) and tractor chassis
Is voltage approximately 0 volts?

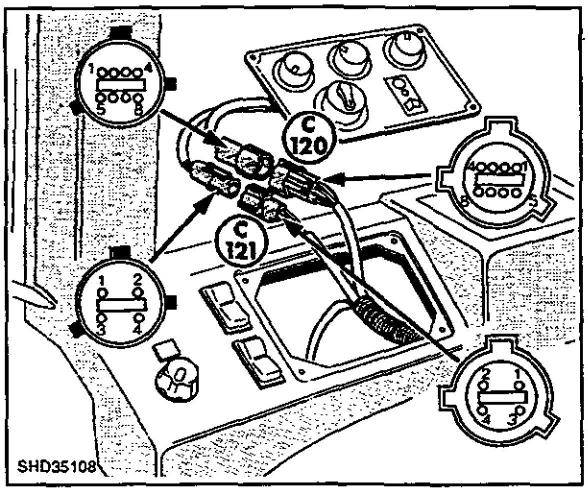
NO ▶ Examine harness for damage resulting in voltage supply direct from battery

YES ▼

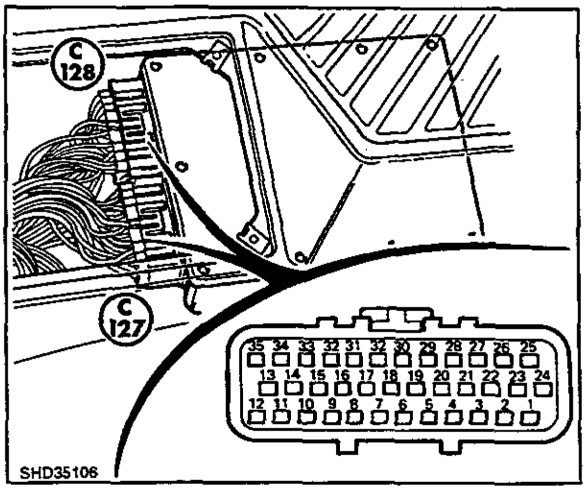
Replace microprocessor

Error Codes 21 and 22 - Position/Draft sensitivity control potentiometer or circuit failed

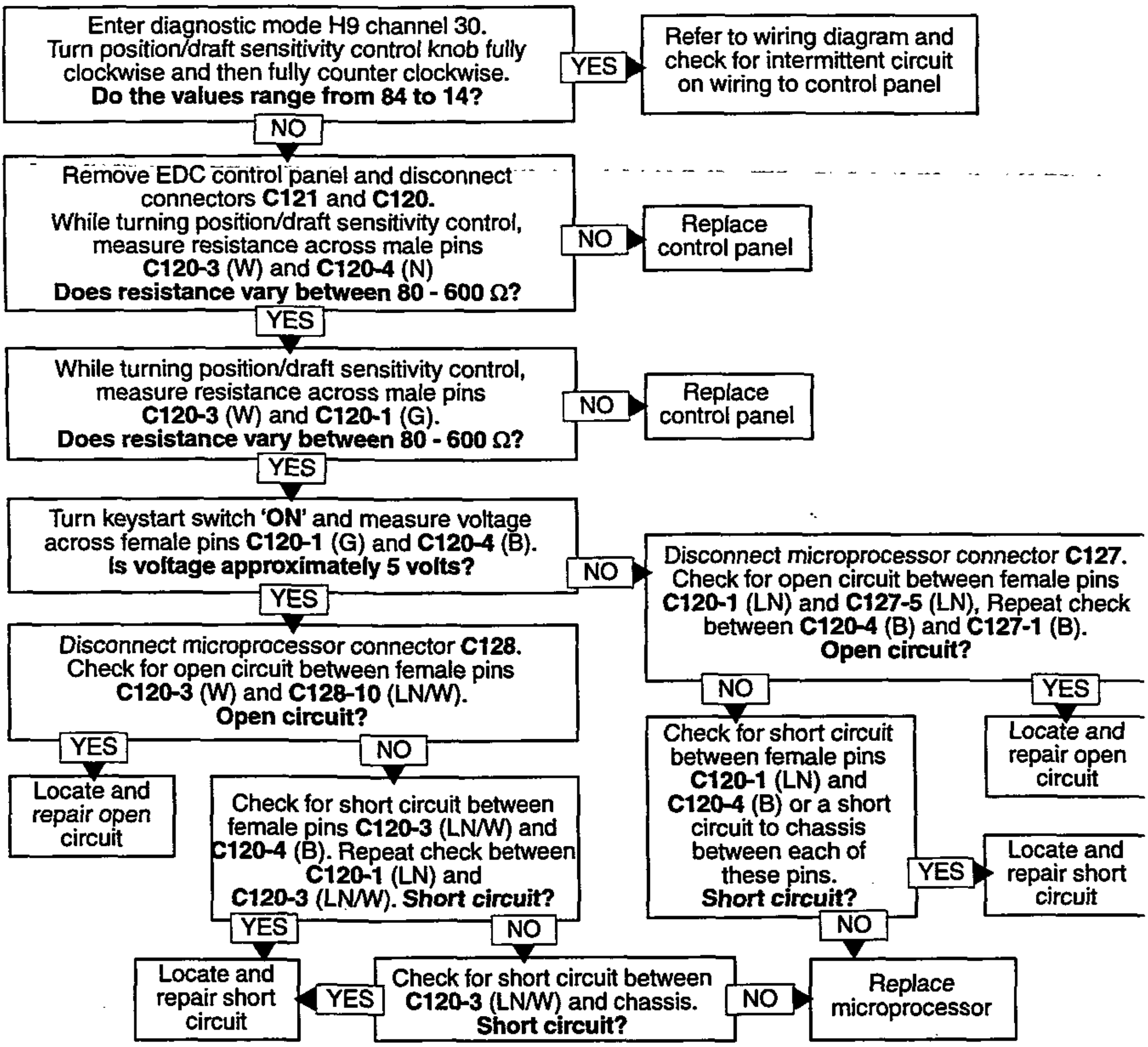
For EDC wiring diagram and connector location refer to end of this section



EDC Control Panel Connectors



Microprocessor Connectors



Enter diagnostic mode H9 channel 30. Turn position/draft sensitivity control knob fully clockwise and then fully counter clockwise. **Do the values range from 84 to 14?**

YES → Refer to wiring diagram and check for intermittent circuit on wiring to control panel

NO ↓

Remove EDC control panel and disconnect connectors **C121** and **C120**. While turning position/draft sensitivity control, measure resistance across male pins **C120-3** (W) and **C120-4** (N) **Does resistance vary between 80 - 600 Ω?**

NO → Replace control panel

YES ↓

While turning position/draft sensitivity control, measure resistance across male pins **C120-3** (W) and **C120-1** (G). **Does resistance vary between 80 - 600 Ω?**

NO → Replace control panel

YES ↓

Turn keystart switch **'ON'** and measure voltage across female pins **C120-1** (G) and **C120-4** (B). **Is voltage approximately 5 volts?**

NO → *Disconnect microprocessor connector* **C127**. Check for open circuit between female pins **C120-1** (LN) and **C127-5** (LN), Repeat check between **C120-4** (B) and **C127-1** (B). **Open circuit?**

- YES → Locate and repair open circuit
- NO → Check for short circuit between female pins **C120-1** (LN) and **C120-4** (B) or a short circuit to chassis between each of these pins. **Short circuit?**
  - YES → Locate and repair short circuit
  - NO → Replace microprocessor

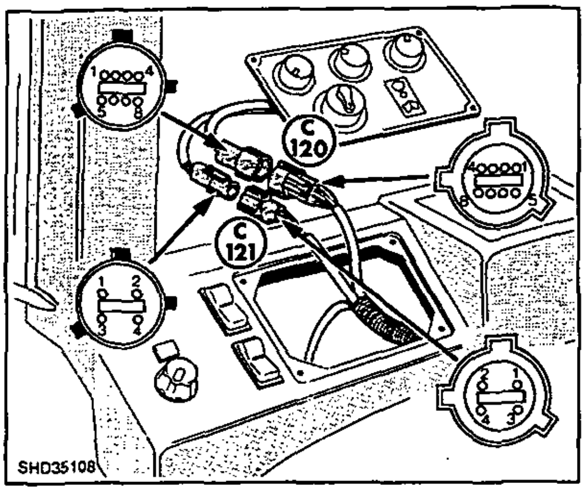
YES ↓

Disconnect microprocessor connector **C128**. Check for open circuit between female pins **C120-3** (W) and **C128-10** (LN/W). **Open circuit?**

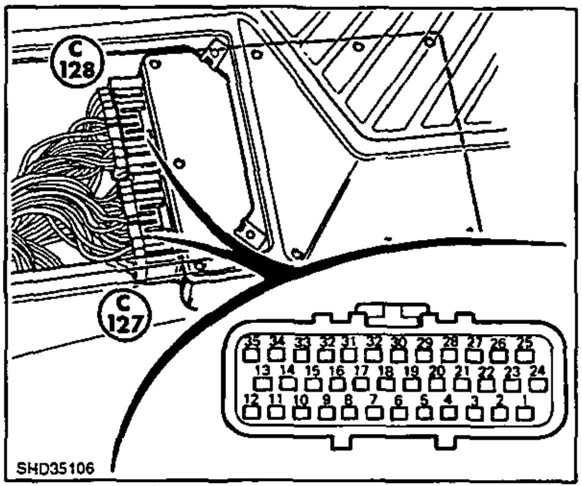
- YES → Locate and *repair open* circuit
- NO → Check for short circuit between female pins **C120-3** (LN/W) and **C120-4** (B). Repeat check between **C120-1** (LN) and **C120-3** (LN/W). ***Short circuit?***
  - YES → Locate and repair short circuit
  - NO → Check for short circuit between **C120-3** (LN/W) and chassis. **Short circuit?**
    - YES → Locate and repair short circuit
    - NO → Replace microprocessor

Error Code 23 - Control panel disconnected

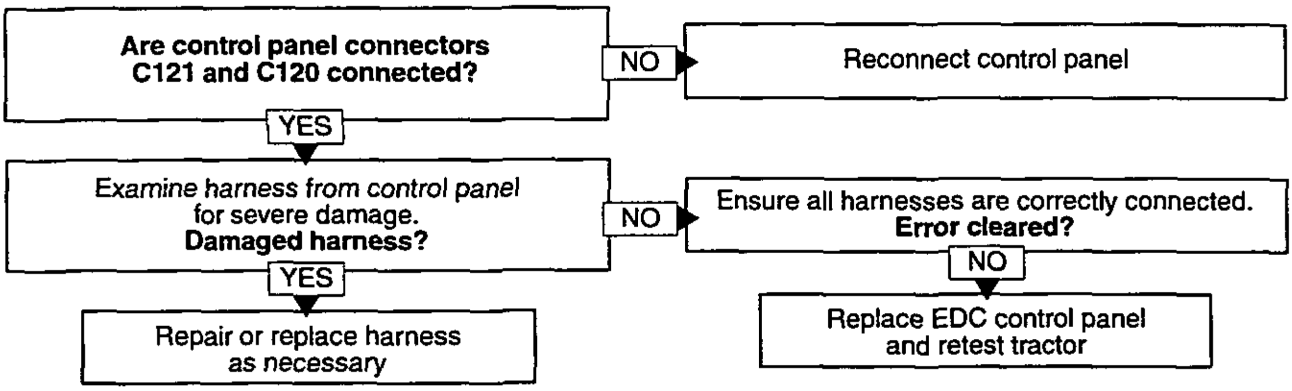
For EDC wiring diagram and connector location refer to end of this section



EDC Control Panel Connectors



Microprocessor Connectors



Are control panel connectors C121 and C120 connected?

NO → Reconnect control panel

YES ↓

Examine harness from control panel for severe damage. **Damaged harness?**

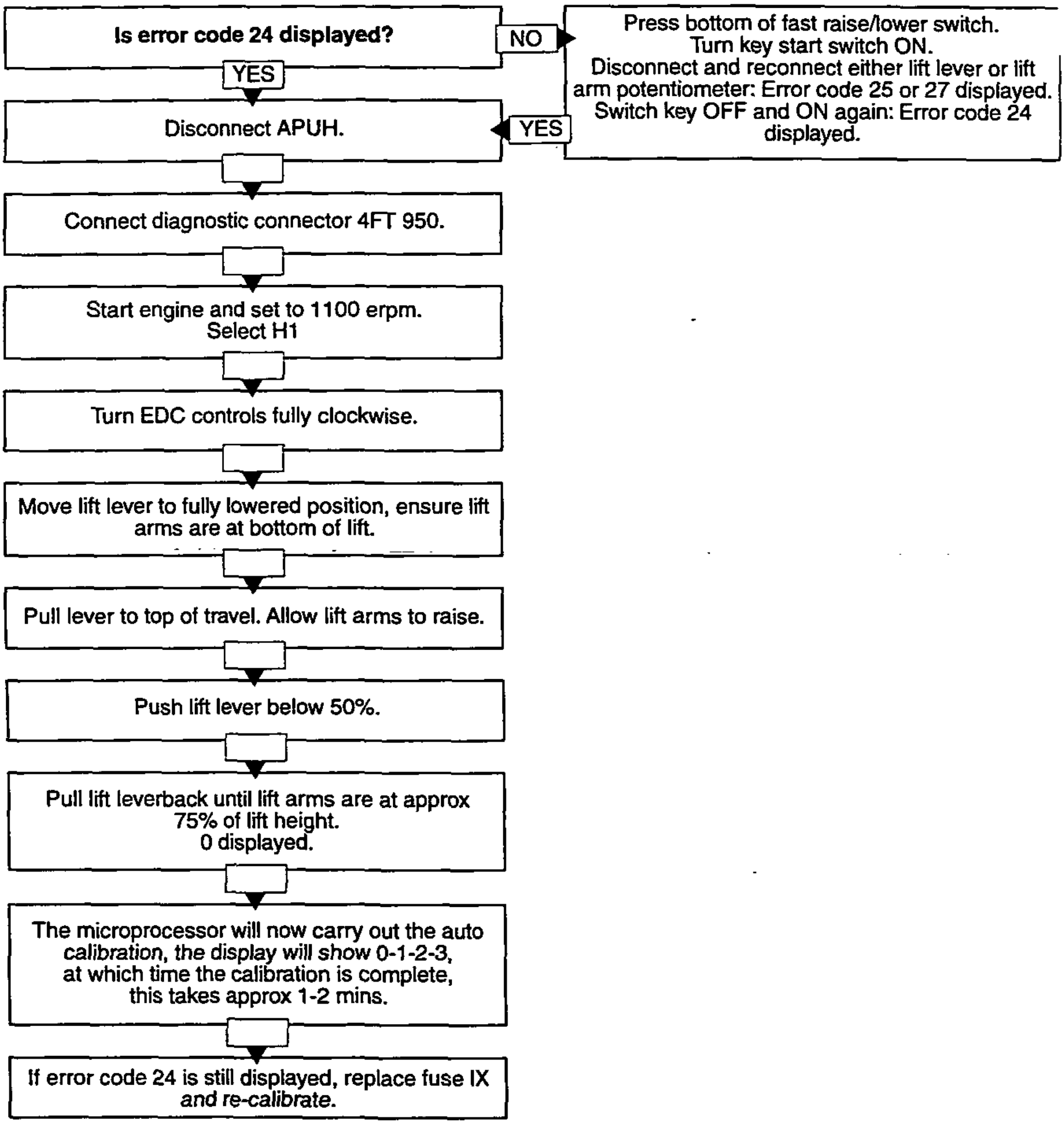
YES ↓ Repair or replace harness as necessary

NO → Ensure all harnesses are correctly connected. **Error cleared?**

NO ↓ Replace EDC control panel and retest tractor

Error Code 24 - Perform hydraulic lift calibration after replacement of lift arm potentiometer, microprocessor, lift lever potentiometer

For EDC wiring diagram and connector location refer to end of this section



Is error code 24 displayed?

Press bottom of fast raise/lower switch.
Turn key start switch ON.
Disconnect and reconnect either lift lever or lift arm potentiometer: Error code 25 or 27 displayed.
Switch key OFF and ON again: Error code 24 displayed.

Disconnect APUH.

Connect diagnostic connector 4FT 950.

Start engine and set to 1100 erpm.
Select H1

Turn EDC controls fully clockwise.

Move lift lever to fully lowered position, ensure lift arms are at bottom of lift.

Pull lever to top of travel. Allow lift arms to raise.

Push lift lever below 50%.

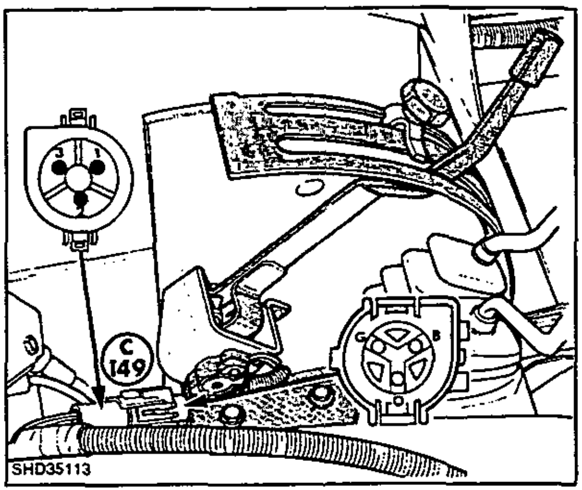
Pull lift leverback until lift arms are at approx 75% of lift height.
0 displayed.

The microprocessor will now carry out the auto calibration, the display will show 0-1-2-3, at which time the calibration is complete, this takes approx 1-2 mins.

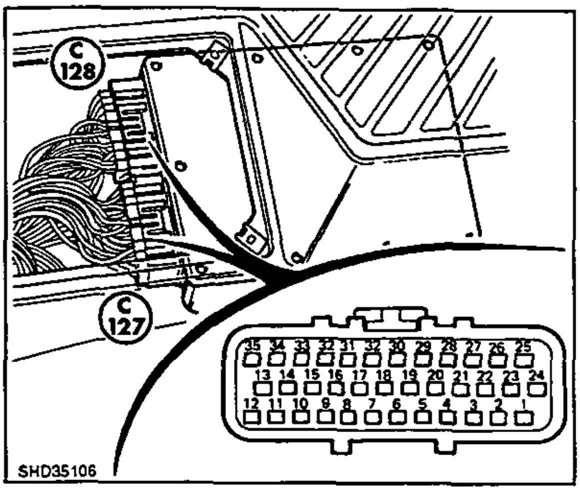
If error code 24 is still displayed, replace fuse IX and re-calibrate.

Error Codes 25 and 26 - Lift control lever potentiometer disconnected or circuit failed

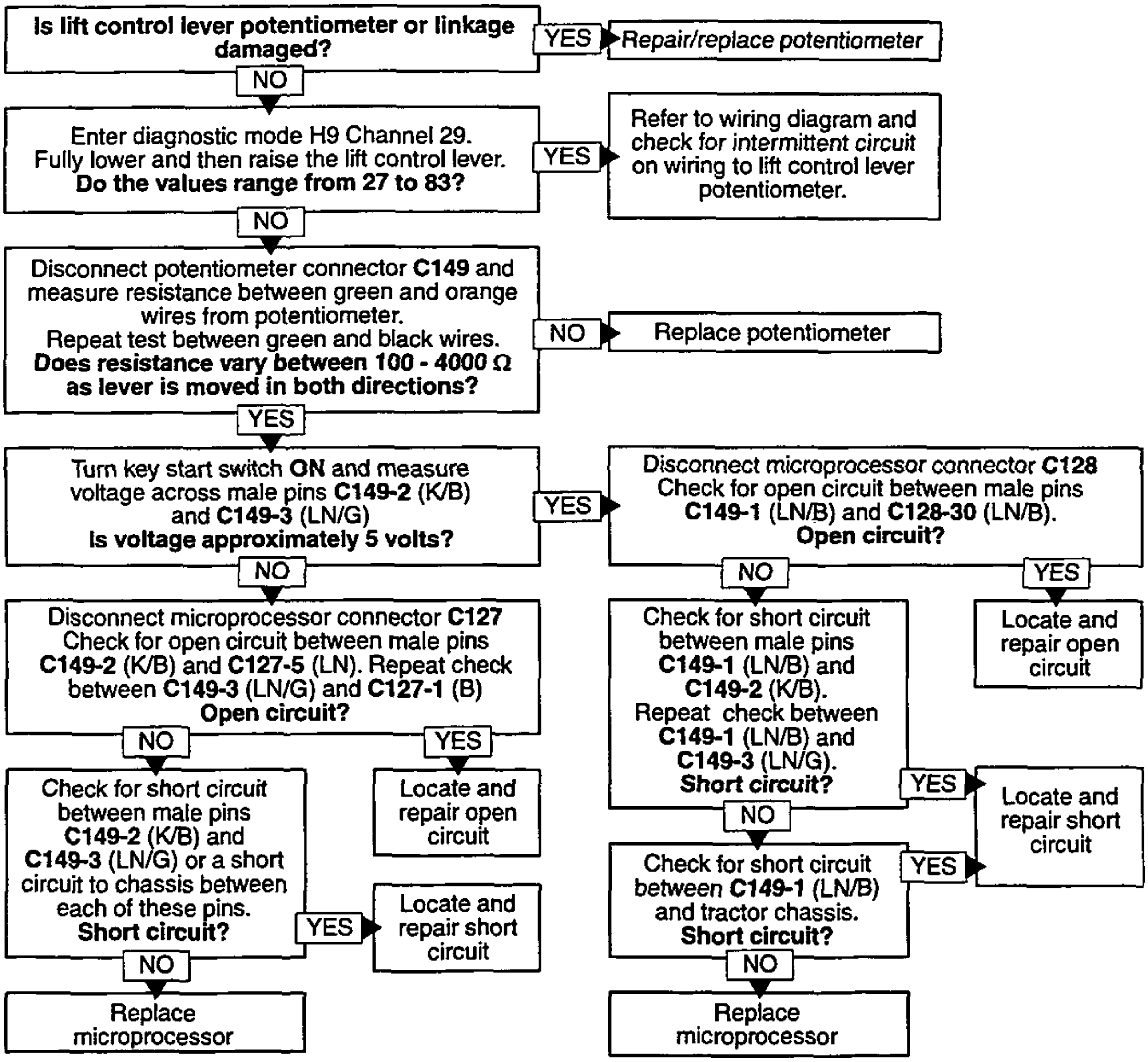
For EDC wiring diagram and connector location refer to end of this section



EDC Control Panel Connectors



Microprocessor Connectors



Is lift control lever potentiometer or linkage damaged?
YES → *Repair/replace potentiometer*
NO ↓

Enter diagnostic mode H9 Channel 29.
Fully lower and then raise the lift control lever.
Do the values range from 27 to 83?
YES → Refer to wiring diagram and check for *intermittent circuit* on wiring to lift control lever potentiometer.
NO ↓

Disconnect potentiometer connector **C149** and measure resistance between green and orange wires from potentiometer.
Repeat test between green and black wires.
Does resistance vary between 100 - 4000 Ω as lever is moved in both directions?
NO → Replace potentiometer
YES ↓

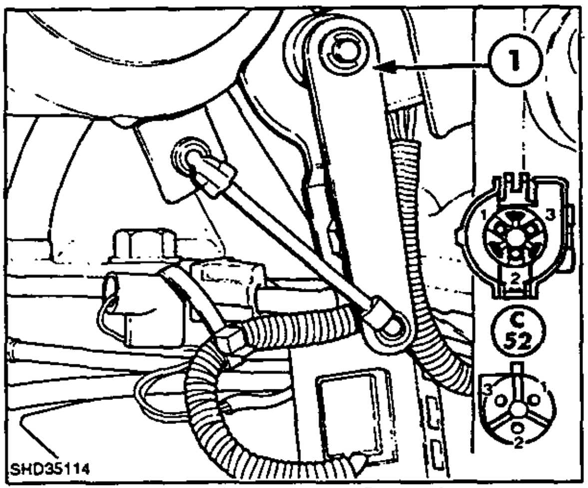
Turn key start switch **ON** and measure voltage across male pins **C149-2** (K/B) and **C149-3** (LN/G)
Is voltage approximately 5 volts?

YES → Disconnect microprocessor connector **C128**
Check for open circuit between male pins **C149-1** (LN/B) and **C128-30** (LN/B).
Open circuit?
- YES → Locate and repair open circuit
- NO → Check for short circuit between male pins **C149-1** (LN/B) and **C149-2** (K/B). Repeat check between **C149-1** (LN/B) and **C149-3** (LN/G). **Short circuit?**
  - YES → Locate and repair short circuit
  - NO → Check for short circuit between **C149-1** (LN/B) and tractor chassis. **Short circuit?**
    - YES → Locate and repair short circuit
    - NO → Replace microprocessor

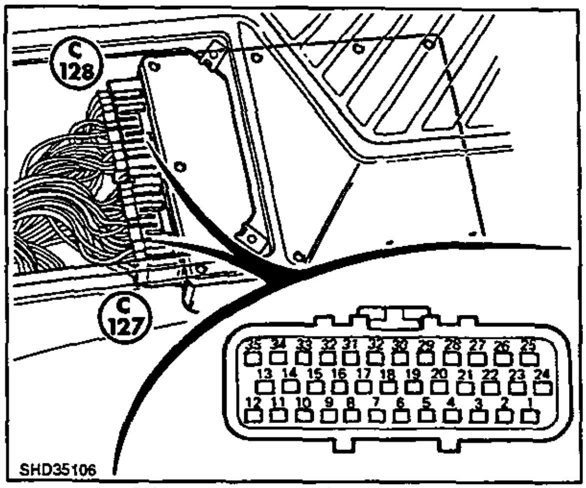
NO → Disconnect microprocessor connector **C127**
Check for open circuit between male pins **C149-2** (K/B) and **C127-5** (LN). Repeat check between **C149-3** (LN/G) and **C127-1** (B)
Open circuit?
- YES → Locate and repair open circuit
- NO → Check for short circuit between male pins **C149-2** (K/B) and **C149-3** (LN/G) or a short circuit to chassis between each of these pins. **Short circuit?**
  - YES → Locate and repair short circuit
  - NO → Replace microprocessor

Error Codes 27 and 28 - Lift arm position sensing potentiometer disconnected or circuit failed

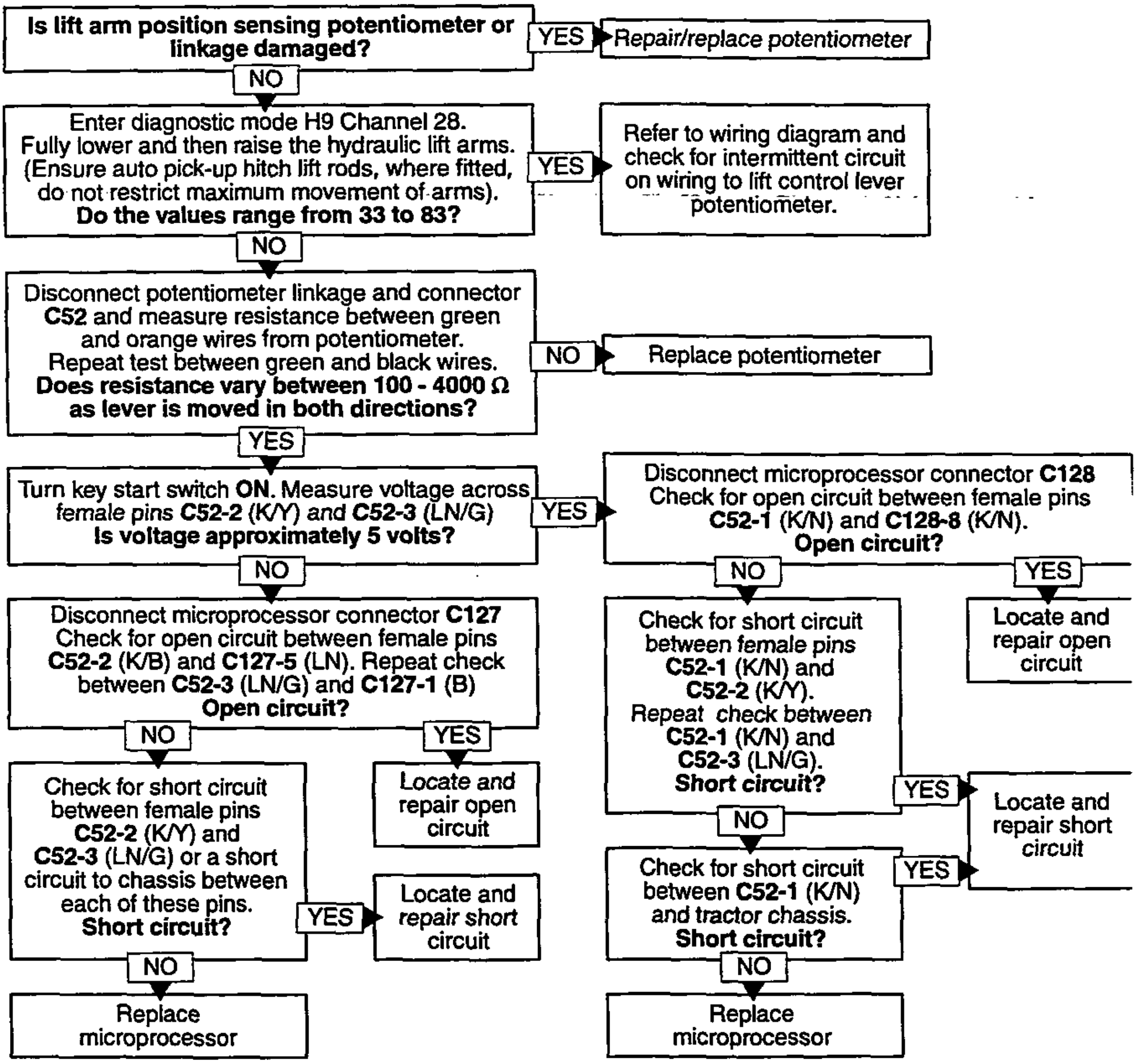
For EDC wiring diagram and connector location refer to end of this section



Lift Arm Position Sensing Potentiometer



Microprocessor Connectors



Is lift arm position sensing potentiometer or linkage damaged?

YES → *Repair/replace potentiometer*

NO ↓

Enter diagnostic mode H9 Channel 28. Fully lower and then raise the hydraulic lift arms. (Ensure auto pick-up hitch lift rods, where fitted, do not restrict maximum movement of arms). **Do the values range from 33 to 83?**

YES → Refer to wiring diagram and check for intermittent circuit on wiring to lift control lever potentiometer.

NO ↓

Disconnect potentiometer linkage and connector **C52** and measure resistance between green and orange wires from potentiometer. Repeat test between green and black wires. **Does resistance vary between 100 - 4000 Ω as lever is moved in both directions?**

NO → Replace potentiometer

YES ↓

Turn key start switch **ON**. Measure voltage across *female pins* **C52-2** *(K/Y) and* **C52-3** *(LN/G)* **Is voltage approximately 5 volts?**

YES → Disconnect microprocessor connector **C128** Check for open circuit between female pins **C52-1** (K/N) and **C128-8** (K/N). **Open circuit?**

- YES ↓ Locate and repair open circuit
- NO ↓ Check for short circuit *between female pins* **C52-1** (K/N) and **C52-2** (K/Y). *Repeat check between* **C52-1** (K/N) and **C52-3** (LN/G). ***Short circuit?***
  - YES → Locate and repair short *circuit*
  - NO ↓ Check for short circuit between **C52-1** (K/N) and tractor chassis. **Short circuit?**
    - YES → Locate and repair short *circuit*
    - NO ↓ Replace microprocessor

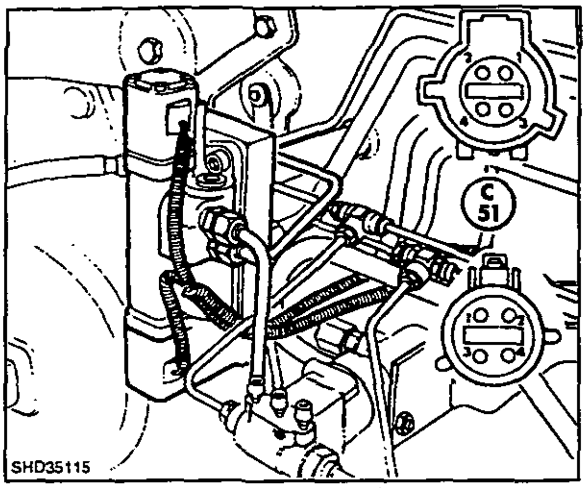
NO ↓

Disconnect microprocessor connector **C127** Check for open circuit between female pins **C52-2** (K/B) and **C127-5** (LN). Repeat check between **C52-3** (LN/G) and **C127-1** (B) **Open circuit?**

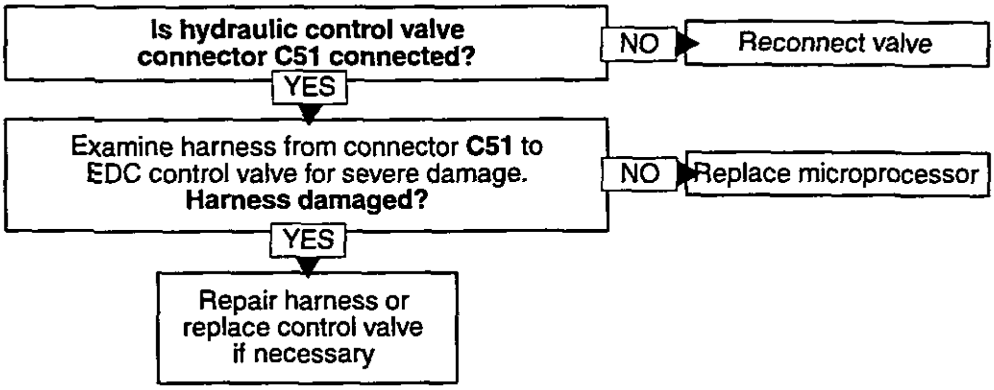
- YES ↓ *Locate and* repair open circuit
- NO ↓ Check for short circuit between female pins **C52-2** (K/Y) and **C52-3** (LN/G) or a short circuit to chassis between each of these pins. **Short circuit?**
  - YES → Locate and *repair short* circuit
  - NO ↓ Replace microprocessor

Error Code 29 - Hydraulic control valve Disconnected

For EDC wiring diagram and connector location refer to end of this section



Hydraulic Control Valve



Is hydraulic control valve connector C51 connected?

NO → Reconnect valve

YES ↓

Examine harness from connector **C51** to EDC control valve for severe damage. **Harness damaged?**

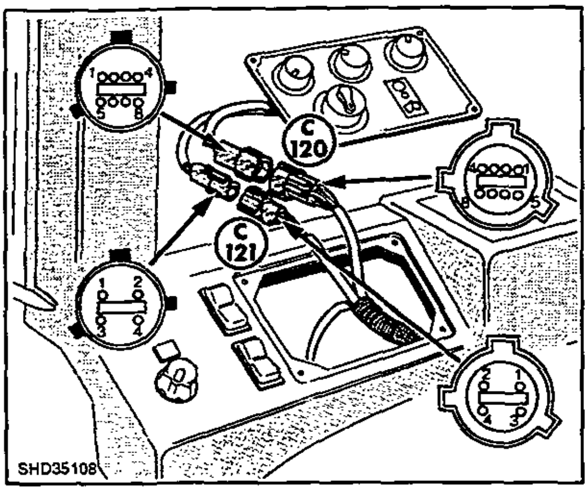
NO → Replace microprocessor

YES ↓

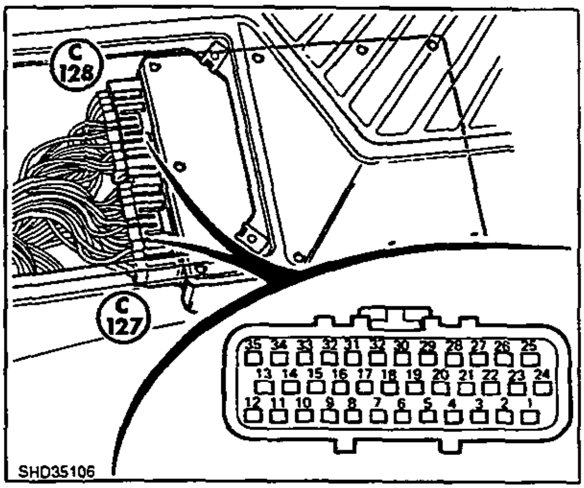
Repair harness or replace control valve if necessary

Error Code 30 - Signal ground open circuit

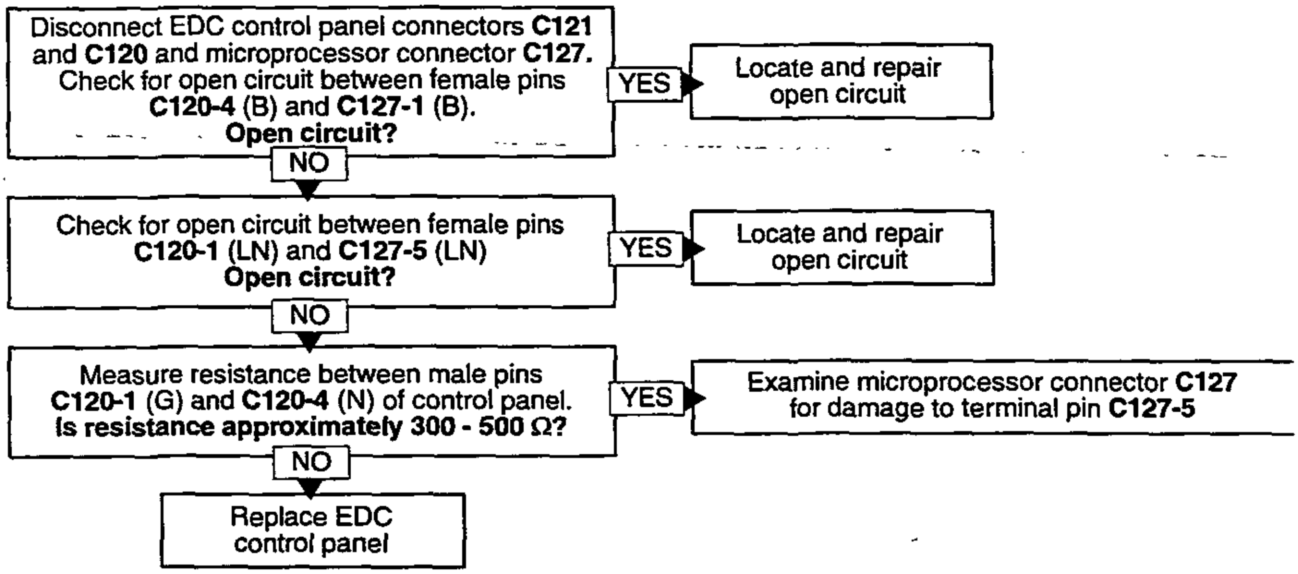
For EDC wiring diagram and connector location refer to end of this section



EDC Control Panel Connectors



Microprocessor Connectors



Disconnect EDC control panel connectors **C121** and **C120** and microprocessor connector **C127.** Check for open circuit between female pins **C120-4** (B) and **C127-1** (B). **Open circuit?**

YES → Locate and repair open circuit

NO ↓

Check for open circuit between female pins **C120-1** (LN) and **C127-5** (LN) **Open circuit?**

YES → Locate and repair open circuit

NO ↓

Measure resistance between male pins **C120-1** (G) and **C120-4** (N) of control panel. **Is resistance approximately 300 - 500 Ω?**

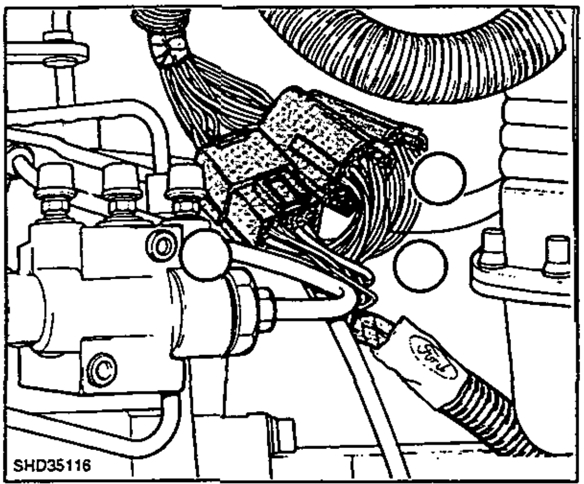
YES → Examine microprocessor connector **C127** for damage to terminal pin **C127-5**

NO ↓

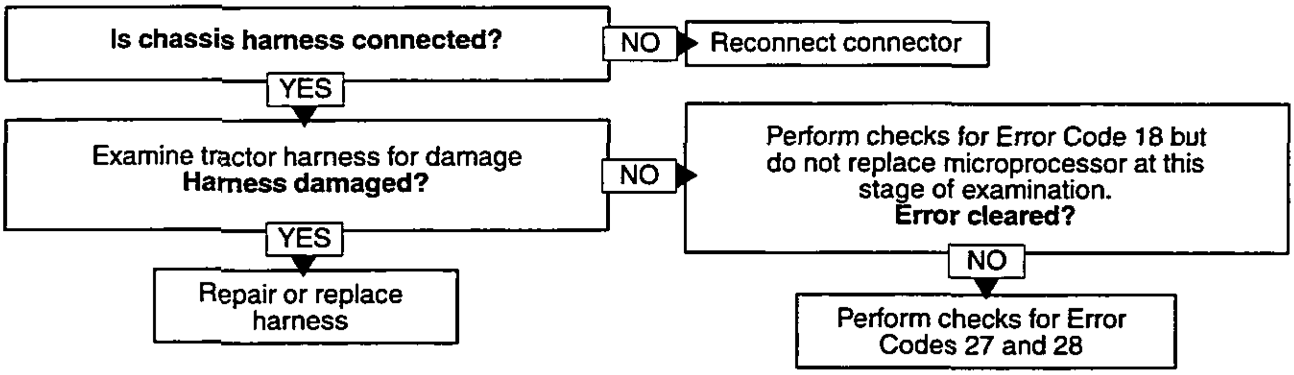
Replace EDC control panel

Error Code 31 - Chassis harness disconnected

For EDC wiring diagram and connector location refer to end of this section

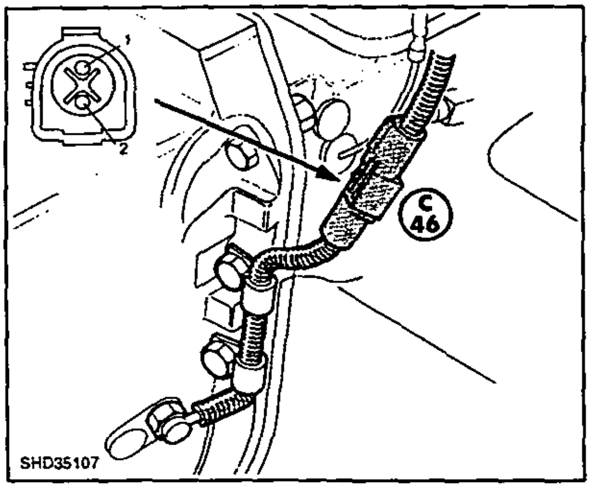


Chassis Harness Connectors

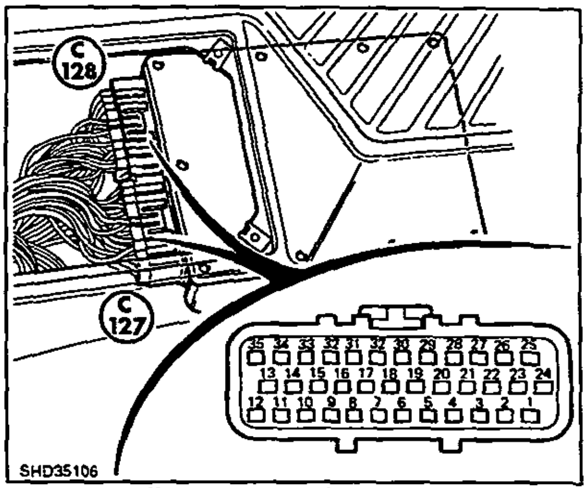


Error Code 49 - Wheel speed sensor open or short circuit

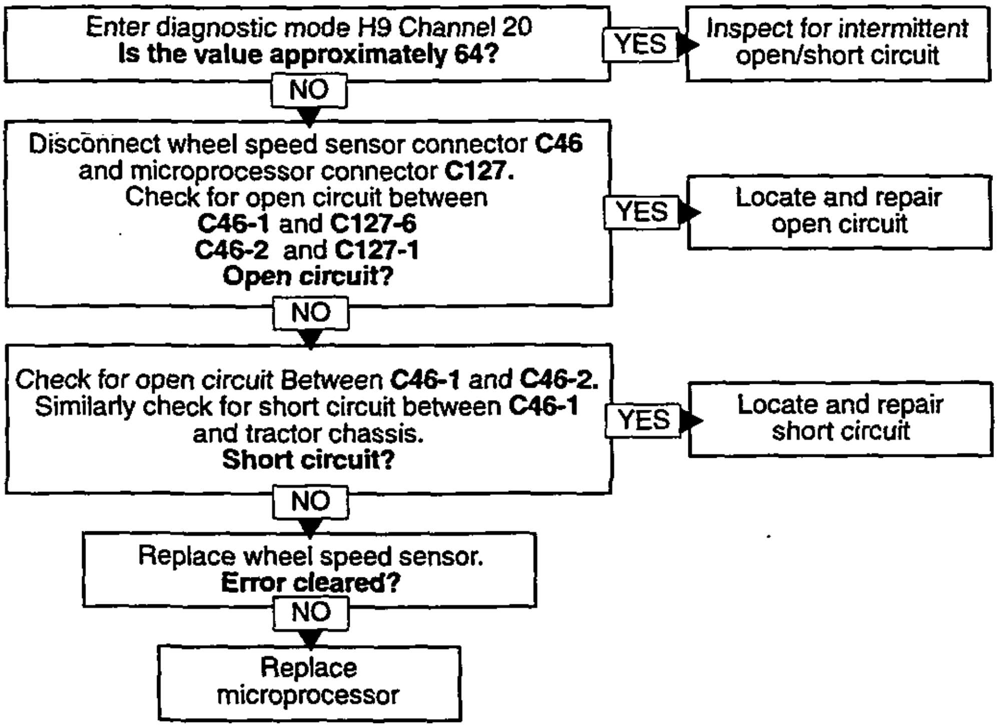
For EDC wiring diagram and connector location refer to end of this section



Wheel Speed Sensor



Microprocessor Connectors



Enter diagnostic mode H9 Channel 20
Is the value approximately 64?

YES → Inspect for intermittent open/short circuit

NO ↓

Disconnect wheel speed sensor connector **C46** and microprocessor connector **C127.**
Check for open circuit between
C46-1 and **C127-6**
C46-2 and **C127-1**
Open circuit?

YES → Locate and repair open circuit

NO ↓

Check for open circuit Between **C46-1** and **C46-2.**
Similarly check for short circuit between **C46-1** and tractor chassis.
Short circuit?

YES → Locate and repair short circuit

NO ↓

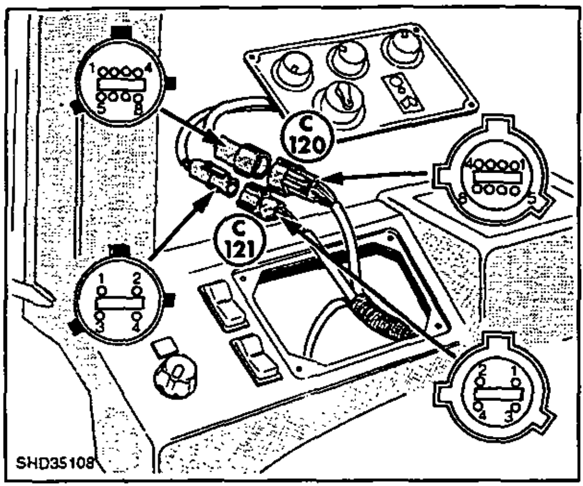
Replace wheel speed sensor.
Error cleared?

NO ↓

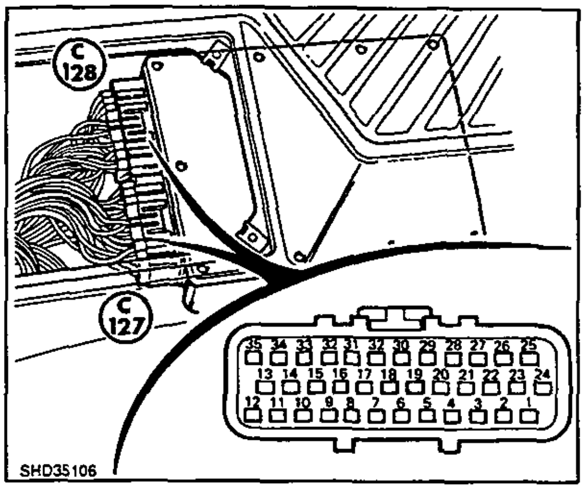
Replace microprocessor

Error Code 53 - Microprocessor 5 volt reference shorted to 12 volts

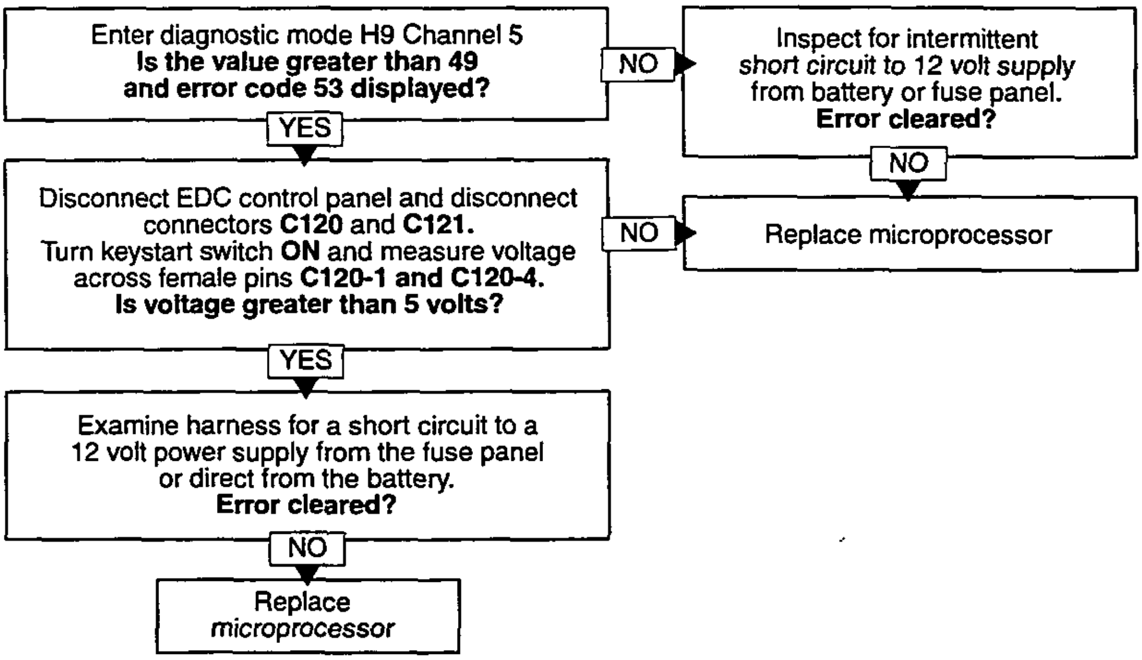
For EDC wiring diagram and connector location refer to end of this section



EDC Control Panel Connectors



Microprocessor Connectors



Enter diagnostic mode H9 Channel 5
Is the value greater than 49
and error code 53 displayed?

NO → Inspect for intermittent *short circuit to 12 volt supply* from battery or fuse panel. **Error cleared?**

NO → Replace microprocessor

YES

Disconnect EDC control panel and disconnect connectors **C120** and **C121**.
Turn keystart switch **ON** and measure voltage across female pins **C120-1 and C120-4.**
Is voltage greater than 5 volts?

NO → Replace microprocessor

YES

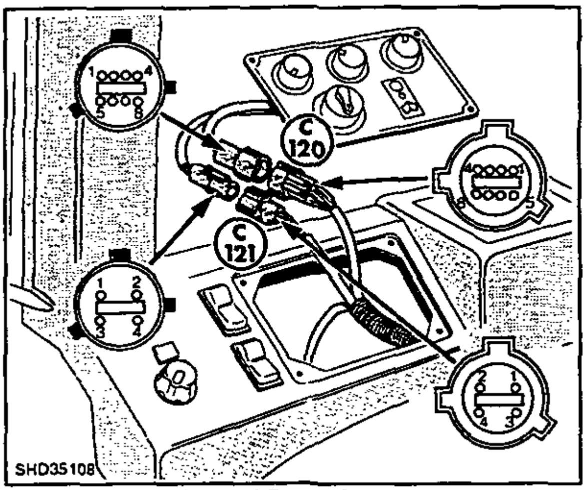
Examine harness for a short circuit to a 12 volt power supply from the fuse panel or direct from the battery.
Error cleared?

NO

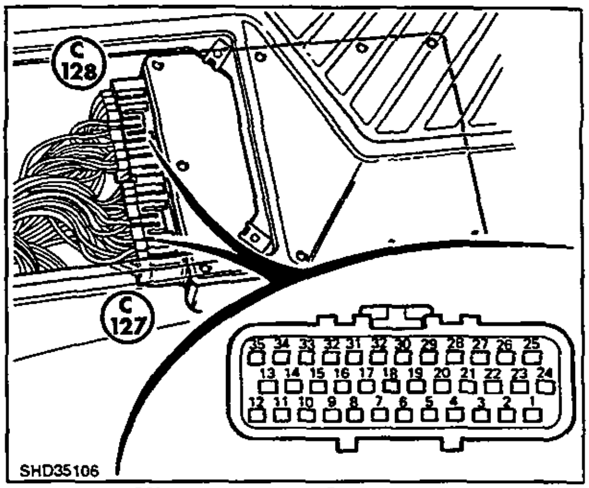
Replace *microprocessor*

Error Code 54 - Microprocessor 5 volt reference shorted to ground

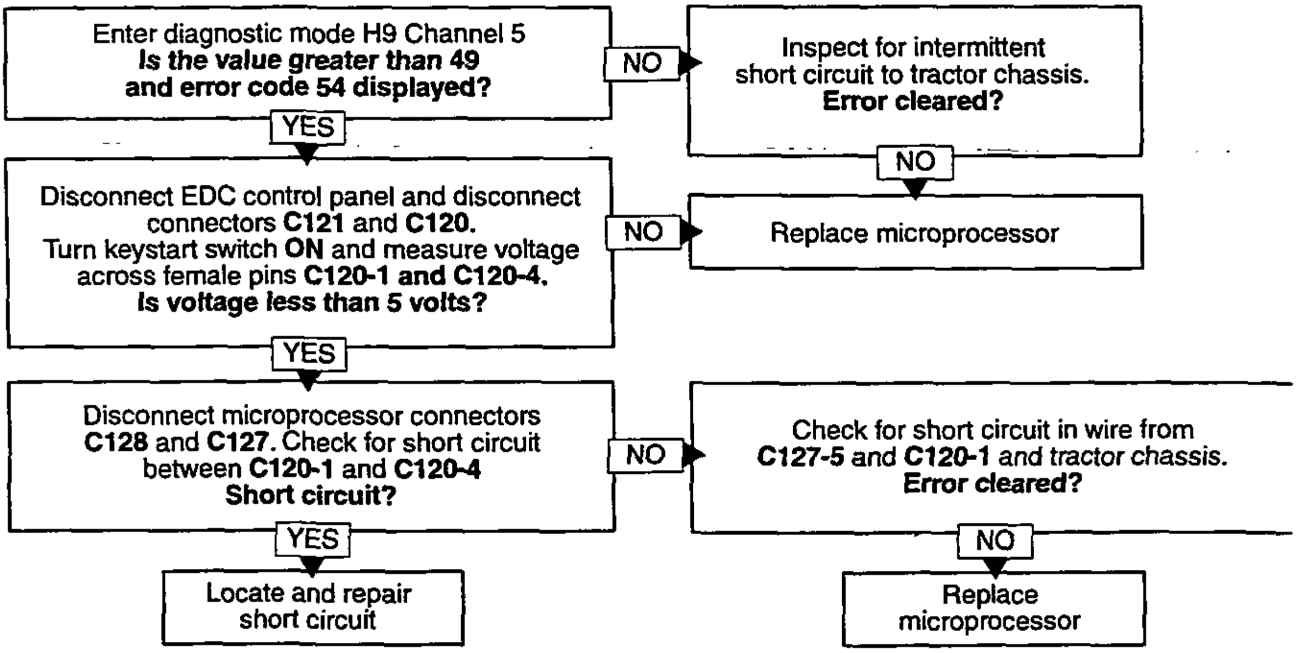
For EDC wiring diagram and connector location refer to end of this section



EDC Control Panel Connectors



Microprocessor Connectors



Enter diagnostic mode H9 Channel 5
**Is the value greater than 49
and error code 54 displayed?**

Inspect for intermittent
short circuit to tractor chassis.
Error cleared?

Disconnect EDC control panel and disconnect
connectors **C121** and **C120.**
Turn keystart switch **ON** and measure voltage
across female pins **C120-1 and C120-4.**
Is voltage less than 5 volts?

Replace microprocessor

Disconnect microprocessor connectors
C128 and **C127**. Check for short circuit
between **C120-1** and **C120-4**
Short circuit?

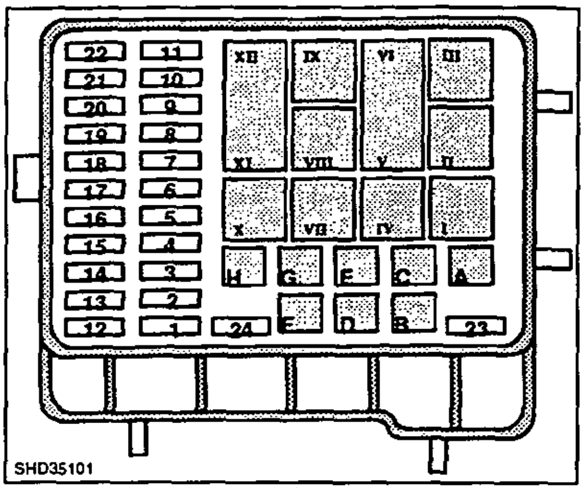
Check for short circuit in wire from
C127-5 and **C120-1** and tractor chassis.
Error cleared?

Locate and repair
short circuit

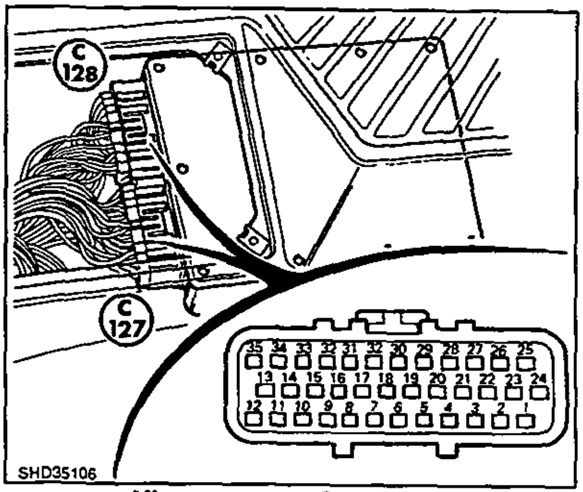
Replace
microprocessor

Error Code 57 - EDC microprocessor failure

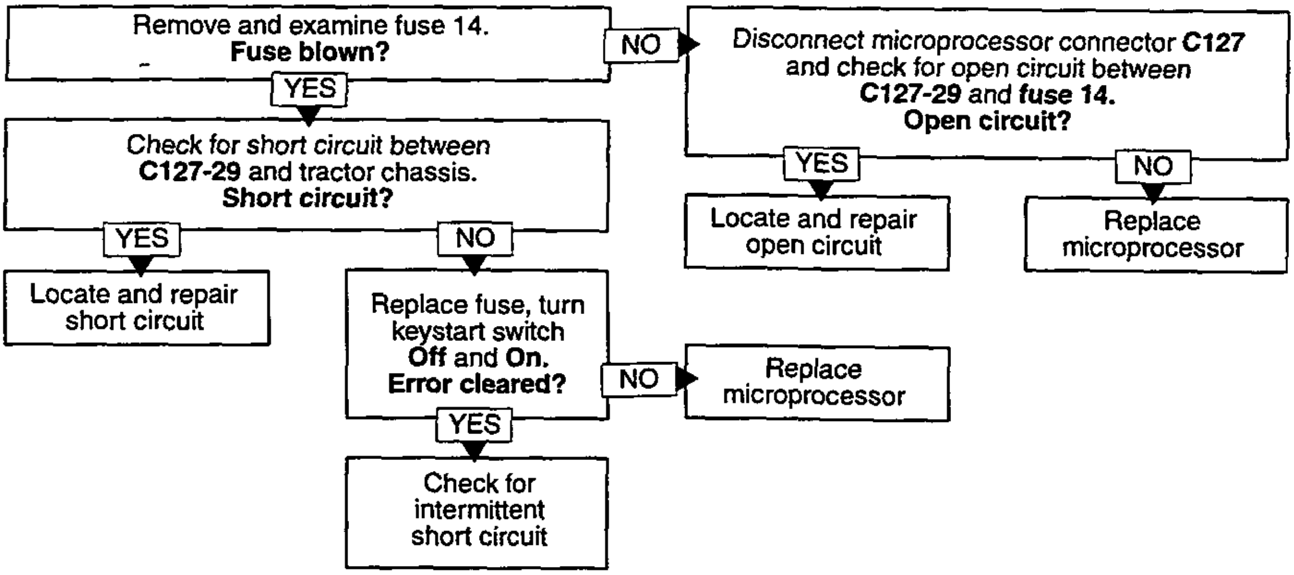
For EDC wiring diagram and connector location refer to end of this section



Fuse Panel



Microprocessor Connectors



Remove and examine fuse 14.
Fuse blown?

NO → *Disconnect microprocessor connector* **C127** and check for open circuit between **C127-29** and **fuse 14.** **Open circuit?**

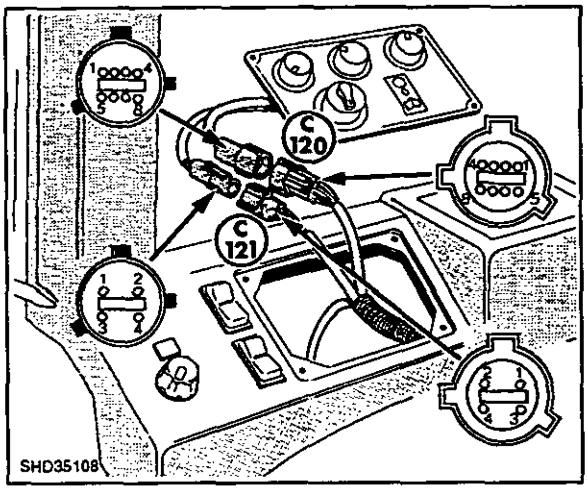
- YES → Locate and repair open circuit
- NO → Replace microprocessor

YES → Check for *short circuit* between **C127-29** and tractor chassis. **Short circuit?**

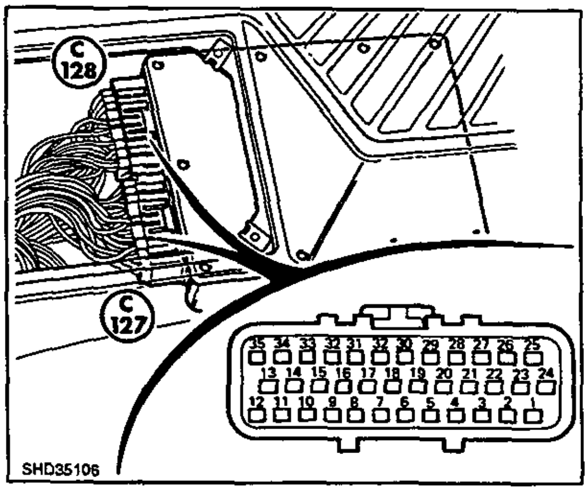
- YES → Locate and repair short circuit
- NO → Replace fuse, turn keystart switch **Off** and **On.** **Error cleared?**
  - NO → Replace microprocessor
  - YES → Check for intermittent short circuit

Error Code 59 - Microprocessor reference voltage open circuit

For EDC wiring diagram and connector location refer to end of this section



EDC Control Panel Connectors



Microprocessor Connectors

Enter diagnostic mode H9 Channel 5
Is the value approximately 49?

YES → Inspect for intermittent open circuit in wiring from microprocessor connector **C127-5.** **Error cleared?**

NO → Replace microprocessor

NO ↓

Disconnect EDC control panel and disconnect connectors **C121** and **C120.**
Turn keystart switch **ON** and measure voltage across female pins **C120-1** and **C120-4.**
Is voltage approximately 5 volts?

YES → Replace microprocessor

NO ↓

Remove EDC control panel and disconnect connectors **C121** and **C120.**
Disconnect microprocessor connector **C127.**
Check for open circuit between female pins **C120-1** (LN) and **C127-5** (LN).
Open circuit?

YES → Locate and repair open circuit

NO ↓

Check for open circuit between female pins **C120-4** (B) and **C127-1** (B).
Open circuit?

YES → Locate and repair open circuit

NO ↓

Measure resistance across male pins **C120-1** (LN) and **C120-4** (B) of control panel.
Is resistance less than 100 Ω?

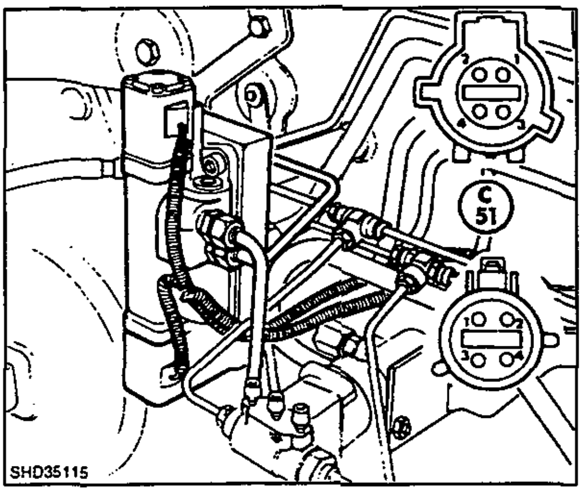
NO → Replace EDC control panel

YES ↓

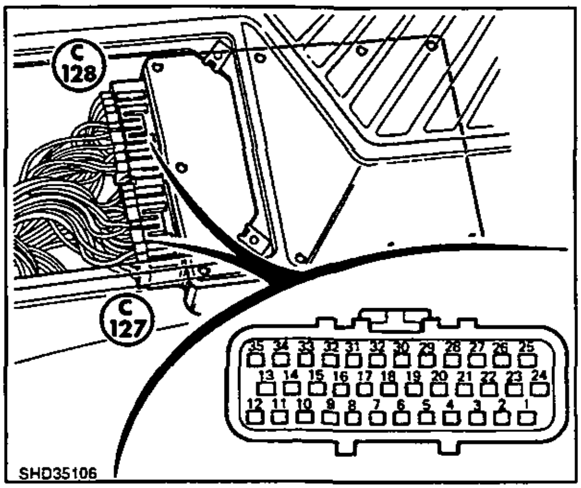
Replace microprocessor

Error Code 63 - EDC hydraulic valve lower solenoid open circuit
Error Code 65 - EDC hydraulic valve lower solenoid short circuit

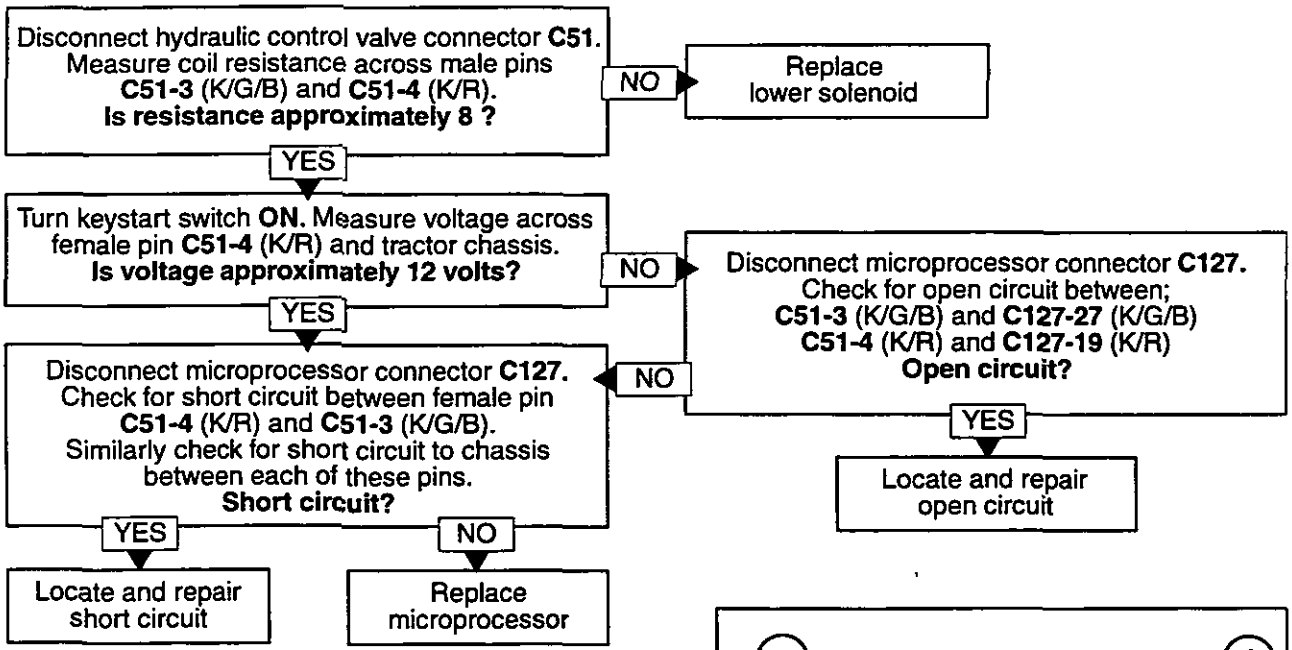
For EDC wiring diagram and connector location refer to end of this section



Hydraulic Control Valve



Microprocessor Connectors



Disconnect hydraulic control valve connector **C51**. Measure coil resistance across male pins **C51-3** (K/G/B) and **C51-4** (K/R). **Is resistance approximately 8 ?**

NO → Replace lower solenoid

YES ↓

Turn keystart switch **ON.** Measure voltage across female pin **C51-4** (K/R) and tractor chassis. **Is voltage approximately 12 volts?**

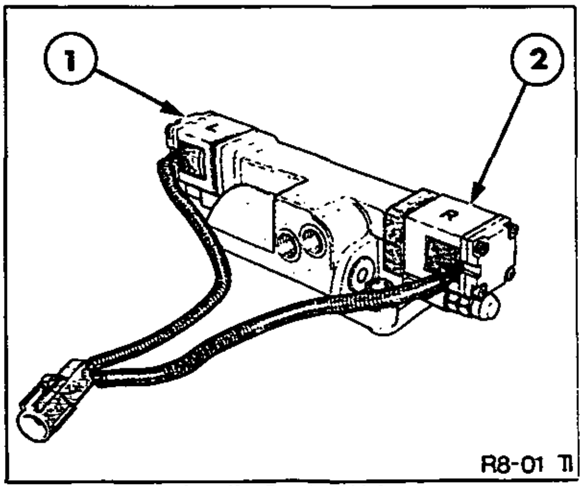
NO → Disconnect microprocessor connector **C127.** Check for open circuit between; **C51-3** (K/G/B) and **C127-27** (K/G/B) **C51-4** (K/R) and **C127-19** (K/R) **Open circuit?**

- YES → Locate and repair open circuit
- NO → (to next box)

YES ↓

Disconnect microprocessor connector **C127.** Check for short circuit between female pin **C51-4** (K/R) and **C51-3** (K/G/B). Similarly check for short circuit to chassis between each of these pins. **Short circuit?**

- YES → Locate and repair short circuit
- NO → Replace microprocessor

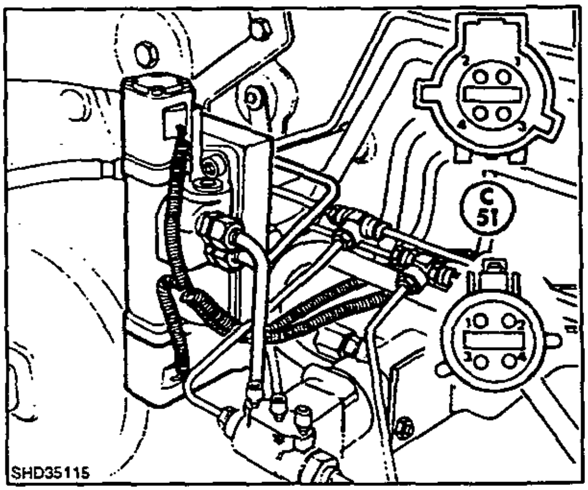


Hydraulic Control Valve

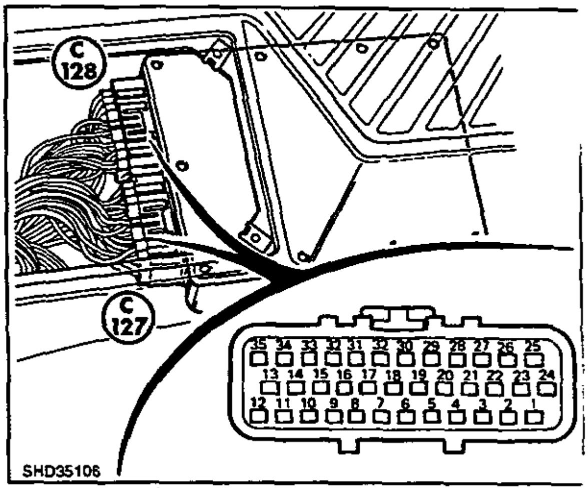
1 Lower Solenoid
2 Raise Solenoid

Error Code 64 - EDC hydraulic valve raise solenoid open circuit
Error Code 66 - EDC hydraulic valve raise solenoid short circuit

For EDC wiring diagram and connector location refer to end of this section



Hydraulic Control Valve



Microprocessor Connectors

Disconnect hydraulic control valve connector **C51**.
Measure coil resistance across male pins
C51-1 (K/U/B) and **C51-2** (K/U).
Is resistance approximately 8 Ω?

NO → Replace lower solenoid

YES ↓

Turn keystart switch **ON**. Measure voltage across
female pin **C51-2** (K/U) and tractor chassis.
Is voltage approximately 12 volts?

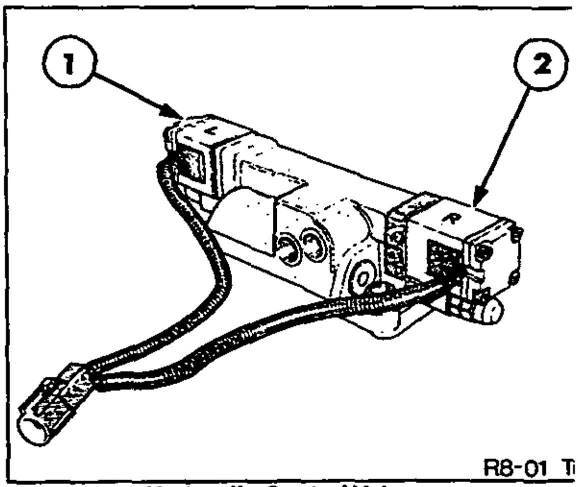
NO → Disconnect microprocessor connector **C127**.
Check for open circuit between;
C51-1 (K/U/B) and **C127-28** (K/U/B)
C51-2 (K/U) and **C127-20** (K/U)
Open circuit?

- YES ↓ Locate and repair open circuit
- NO → (to next box)

YES ↓

Disconnect microprocessor connector **C127**.
Check for short circuit between female pin
C51-1 (K/U/B) and **C51-2** (K/U).
Similarly check for short circuit to chassis
between each of these pins.
Short circuit?

- YES ↓ Locate and repair short circuit
- NO ↓ Replace microprocessor

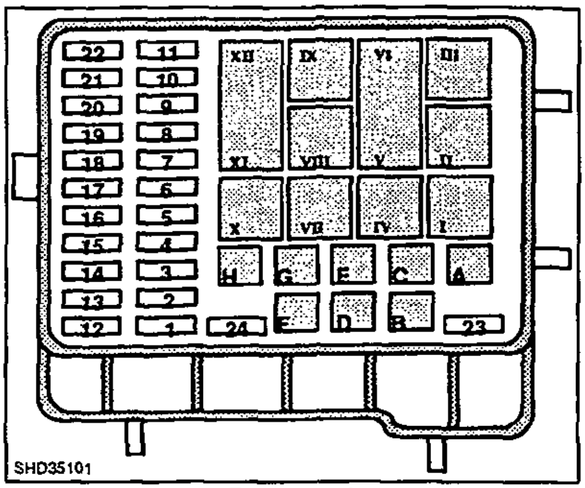


Hydraulic Control Valve

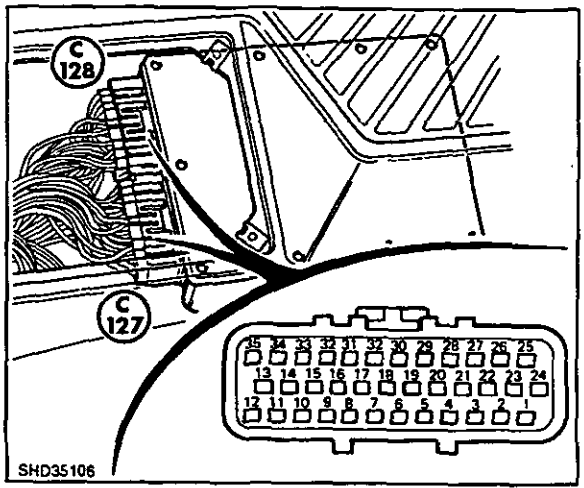
1 Lower Solenoid
2 Raise Solenoid

Error Code 67 - EDC hydraulic valve supply voltage too low

For EDC wiring diagram and connector location refer to end of this section



Fuse Panel



Microprocessor Connectors

Enter diagnostic mode H9 Channel 8
Is the value approximately 3?

YES → Perform checks for Error Codes 63 to 66

NO ↓

Check for 12 volts at fuse 14 and check for open *circuit between fuse 14 and* **C127-29** *(N/R/B).*
Open circuit?

YES → *Locate and repair* open circuit

NO → Replace microprocessor

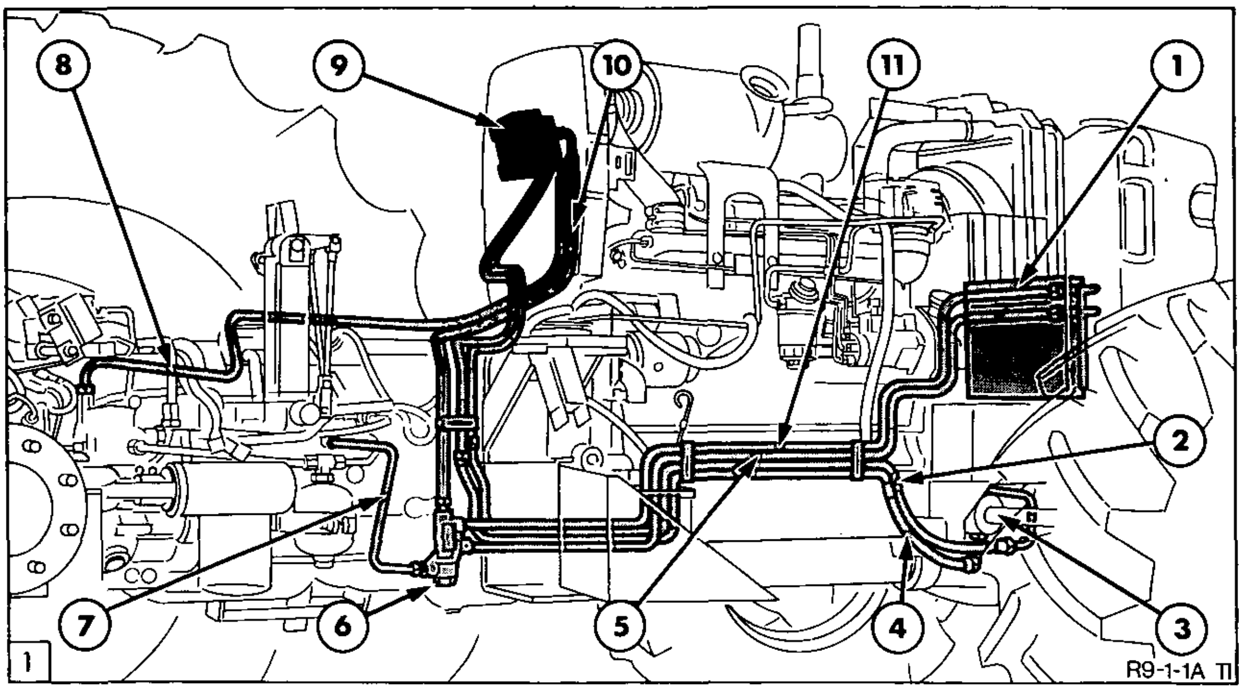
Fault Diagnostic Chart for Miscellaneous Hydraulic Lift Concerns

The following fault diagnostic chart relates to hydraulic or mechanical failures which are not detected by the microprocessor and for which there is no error code displayed.

Symptom	Possible Cause	Diagnostic Procedure
Hydraulic lift will not operate.	Auxiliary services (ASC) selected.	Ensure ASC selector lever is in disengaged position.
	No pilot pressure to EDC hydraulic control valve	Perform hydraulic pump low pressure circuit tests. Refer to chapter 5 section E 'Pressure testing of fixed displacement hydraulic pump'. Disconnect EDC valve pilot pressure line and check for blockage.
	EDC load check valve sticking.	Examine load check valve.
Hydraulic lift will not lower.	Load check valve piston sticking.	Examine load check valve.
	Control valve spool sticking.	Examine spool.
	Lowering solenoid spool sticking.	Examine solenoid spool and torque of solenoid retaining screws.
	EDC valve out of adjustment.	Examine spool adjusters for signs of tampering. Check valve calibration values using diagnostic routine H2.
	Dirt in control valve orifices.	Wash valve.
Lift arms erratic or move when not in operation.	EDC valve receiving electronic signal.	Disconnect EDC valve connector and trace wiring fault if arms remain stationary.
	Pilot or control valve spools sticking.	Examine pilot and control valve spools for sticking or wear.
	EDC valve out of adjustment.	Examine spool adjusters for signs of tampering. Check valve calibration values using diagnostic routine H2.
Lift arms slowly drop when held in raised position.	Check valve leaking.	Examine check valve poppet ball seat for wear.
Cannot lift heavy loads.	Pump worn or lift cylinder seals leaking.	Perform hydraulic pump low pressure circuit tests. Refer to chapter 5 section E 'Pressure testing of fixed displacement hydraulic pump'.
	Priority/unload valve sticking.	Examine priority/unload valve and orifice in connector.
	No load sensing signal.	Load sensing valve sticking.
Hydraulic lift will not raise or lower to maximum limits of travel.	Microprocessor incorrectly calibrated.	Perform memory reset and autocalibration procedure. See error code 24.

PART 9
STEERING SYSTEMS
Chapter 1
HYDROSTATIC STEERING SYSTEM

A. DESCRIPTION AND OPERATION



Hydrostatic Steering System Component Layout – SLE Model

1. Transmission Oil Cooler
2. Left Hand Turn Hose
3. Steering Cylinder
4. Right Hand Turn Hose
5. Cooler Outlet Line
6. Cooler Bypass Valve
7. Transmission / Rear Axle Lubrication Line
8. Steering Pump Output Line
9. Steering Motor
10. Steering Return / Lubrication Line
11. Oil Cooler Outlet Line

The new Series 40 tractor range have fitted as standard hydrostatic steering systems, that are powered when the engine is running by hydraulic pumps mounted in the rear axle.

The design of pumps vary upon the type of transmission installed in the vehicle:–

SLE models – feature a CCLS pump assembly, incorporating the steering pump, with a unique suction filter.

S & SL models – feature a Tandem gear pump with a single combined function filter.

These pumps driven by the PTO idler gear, pressurise the steering column operated steering motor. The pressurised oil from the steering motor drives the axle mounted double acting steering cylinder.

The steering motor is similar across the vehicle range and is bolted to a bracket within the steering console and connected to the steering column by a splined shaft.

The steering column, dependent upon models is adjustable for varying angles of tilt and height.

On two wheel drive units the steering cylinder is bolted at one end to the front axle beam and at the other to an eye on the track rod.

On four wheel drive units the steering cylinder is bolted to the rear of the axle casing and both ends of the piston rod are connected to the steering arms by a short track rod.

On both cylinders the piston is mounted centrally on the piston rod, so presenting an equal area of the piston to pressured oil during left or right turns.

The pressure relief valve for the system is contained within the steering motor itself.

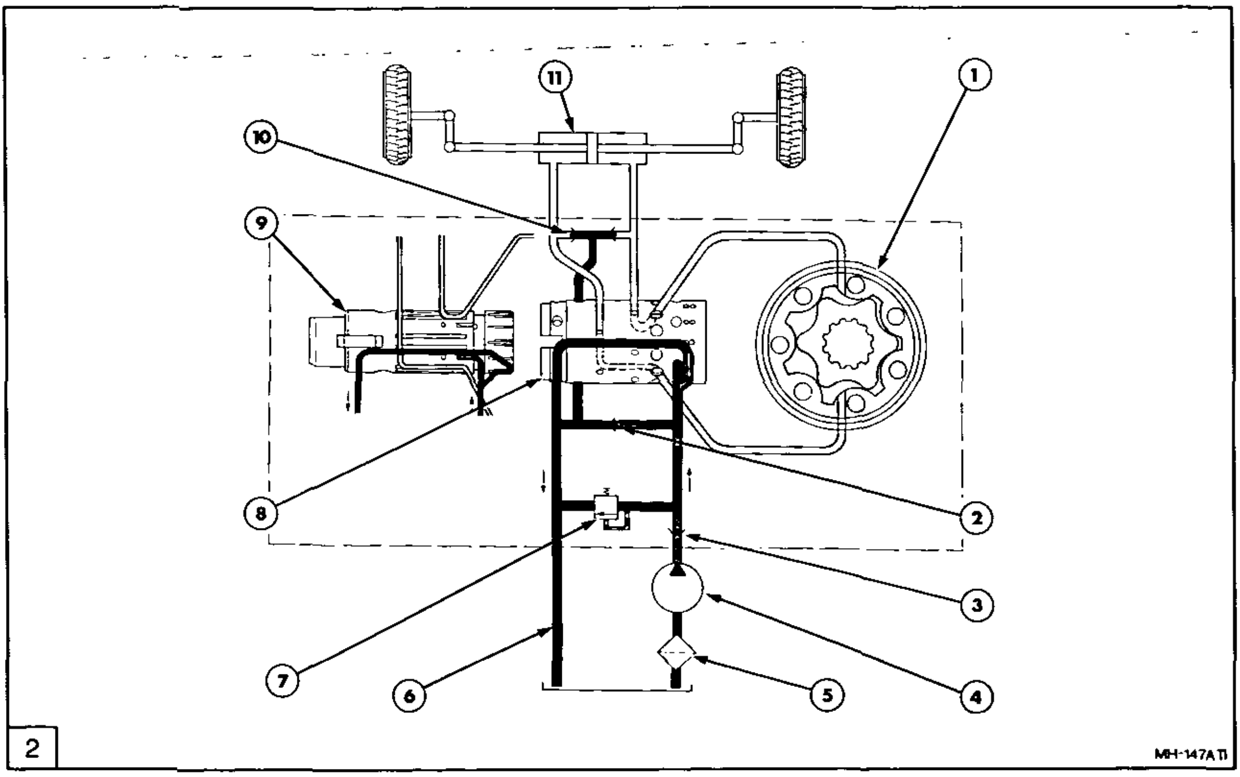
OPERATION

Oil is drawn from the rear axle and into the pump through a filter, pressurised by the rotation of the gears, and expelled through the pump outlet port to the steering motor. The pressurised oil when received at the steering motor is directed to the steering actuating cylinder when the steering wheel is turned.

The steering motor incorporates a metering unit which regulates the volume of oil supplied to the cylinder so that it is proportional to the angular movement of the steering wheel. The metering unit in combination with suction valves also allows the steering to be operated **MANUALLY** without pressurised oil being supplied from the pump.

The system is fully hydrostatic and as such there is no mechanical connection between the steering column and the steering wheels.

Neutral Position



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Steering Operation Schematic – Neutral Position

1. Metering Unit
2. Check Valve
3. Non Return Valve
4. Pump
5. Filter
6. Return via Cooling and Lubrication
7. Pressure Relief Valve
8. Control Valve Sleeve
9. Control Valve Spool
10. Suction Valves
11. Steering Cylinder

■ Suction Oil

■ Return Oil (Restricted by cooling and Lubrication)

□ Trapped Oil

▨ Pump Oil

With the steering wheel held still, the leaf springs in the steering motor return and hold the spool and sleeve in the neutral position. This ensures no more oil is supplied to the steering cylinder. The sleeve also traps the oil in the steering cylinder, holding the wheels in a set position, Figure 2.

Right Hand Turn

When the steering wheel is turned the movement of the control valve spool in its sleeve forms a series of passages. During right turns the oil flows through the sleeve along a groove in the valve spool and into a passage in the steering motor housing which leads to the metering unit, Figure 3.

The metering unit is turned by the drive shaft and directs oil along another set of passages in the spool and sleeve and into the steering cylinder. Return oil from the other side of the cylinder is directed through the valve spool and sleeve to a return passage in the housing.

Left Hand Turn

When turning the wheel to the left oil flows along the sleeve and operates in a similar manner as described in right hand turn, Figure 3.

Manual Right Turn

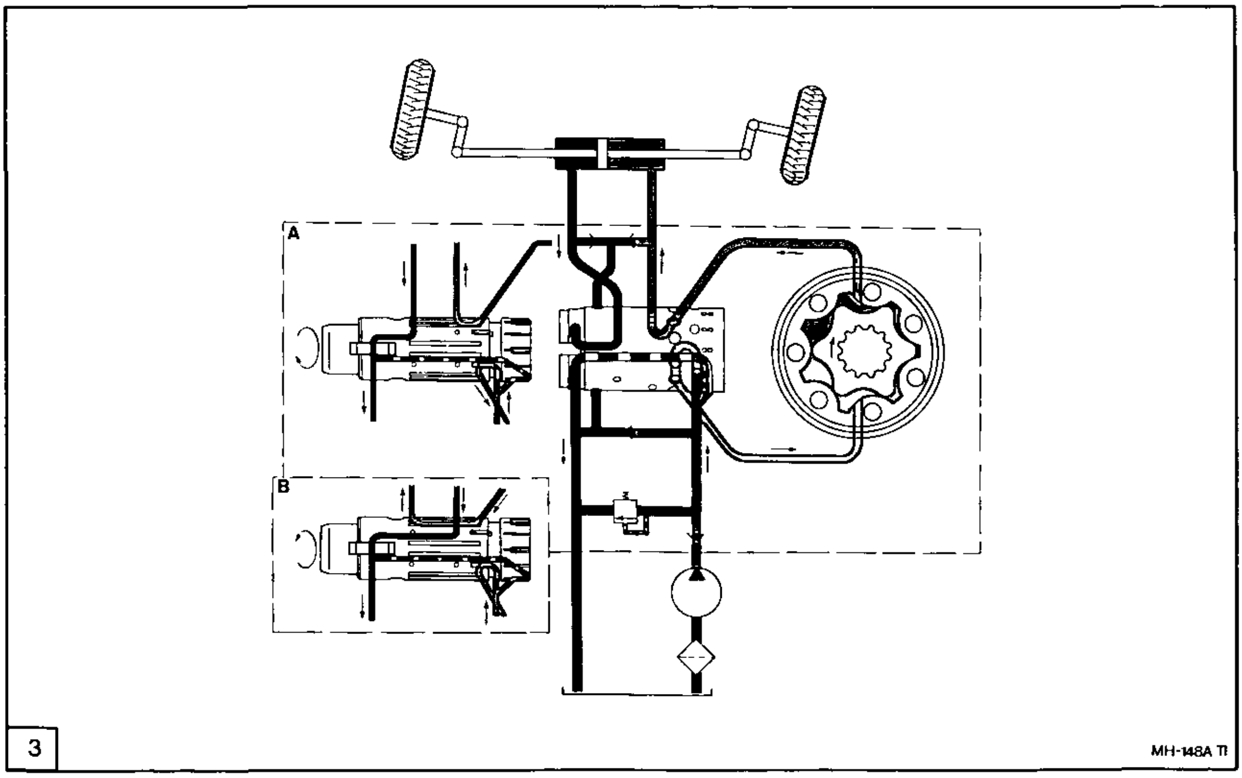
In the event of a power steering pump failure or loss of oil pressure, the power steering system can be operated manually. Turning the steering wheel rotates the metering unit rotor and forces oil into the rod side of the power steering cylinder.

On the suction side of the metering unit, return oil flows from the cylinder and is drawn through the suction valve to feed the metering unit.

Manual Left Turn

Turning the steering wheel rotates the metering unit rotor which forces oil into the piston side of the power steering cylinder.

When additional oil supply is required, as in making a left turn, additional oil is drawn from the power steering reservoir through the suction valve to the metering unit.



3

Oil Flow Schematic
A– Right Hand Turn B– Left Hand Turn

■ Suction Oil

□ Metering Unit Supply

■ Return Oil (Restricted by cooling and Lubrication)

■ Pressure Supply

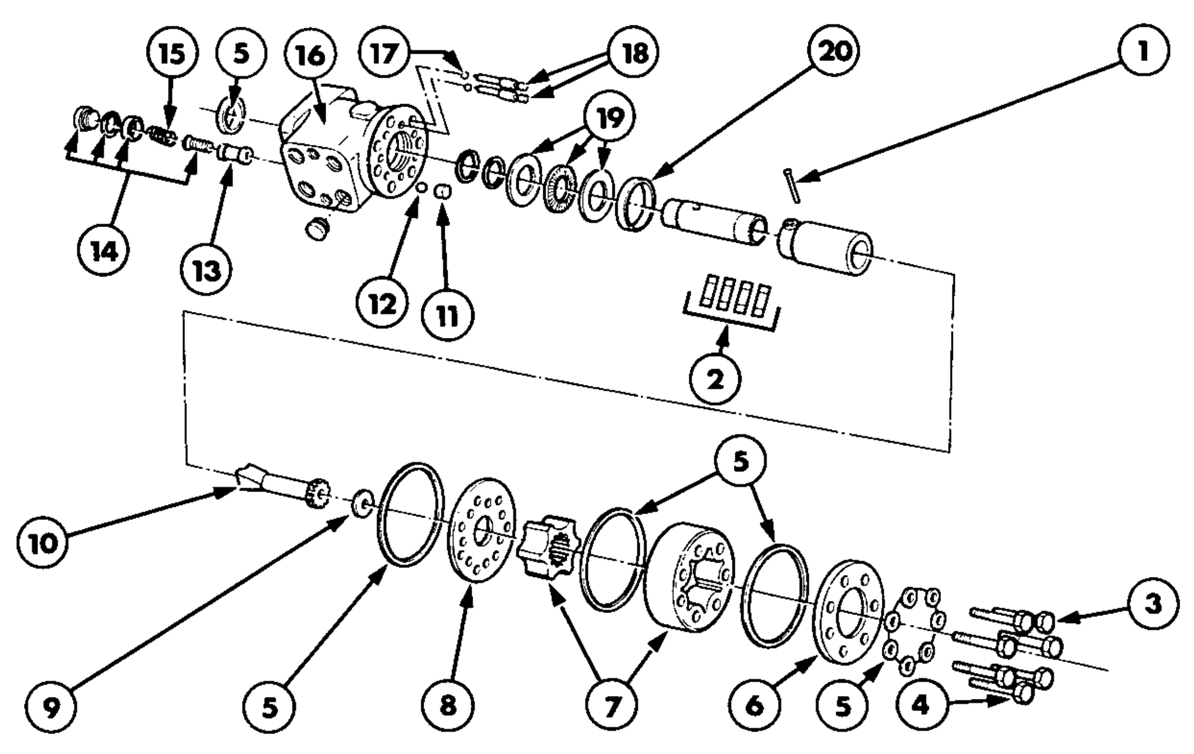
▣ Metered Oil To Steering Cylinder

B. FAULT FINDING

IMPORTANT: *When effecting a repair the cause must be corrected to avoid a repeat failure.*

PROBLEM	POSSIBLE CAUSE	REMEDY
No steering or excessive effort to steer	1. Air in system	1. Check for loose connections or damaged tubing. Purge system of air.
	2. Steering system relief valve sticking/faulty	2. Check system pressure.
	3. Worn pump	3. Inspect and repair.
	4. Leaking steering cylinder	4. Inspect and repair.
	5. Broken or damaged steering column coupling	5. Inspect and replace as required.
	6. Damaged or worn metering unit	6. Inspect and replace as required.
Steering wanders	1. Excessive play in steering linkage joints	1. Inspect and replace as required.
	2. Leaking steering cylinder	2. Inspect and repair.
	3. Damaged or worn metering unit	3. Inspect and replace as required.
Front wheels surge when steering	1. Leaking steering cylinder	1. Inspect and repair.
	2. Damaged or worn metering unit	2. Inspect and replace as required

C. STEERING MOTOR - OVERHAUL



4

R9-1-4 TI

Steering Motor

1. Pin
2. Centering Springs
3. Retaining Bolts
4. Dowel Pin Bolt
5. 'O' Ring Seal (Kit)
6. End Plate
7. Rotor and Stator Assembly
8. Manifold Plate
9. Spacer
10. Drive Shaft
11. Retainer
12. Ball
13. Relief Valve Seat
14. Relief Valve (Kit items)
15. Spring
16. Complete Assembly
17. Ball
18. Pin
19. Thrust Bearing and Washers
20. Spacer

NOTE: *Parts/Motors are common between the two steering pumps, with the exception of items 7,11,13 and 14, Figure 4.*

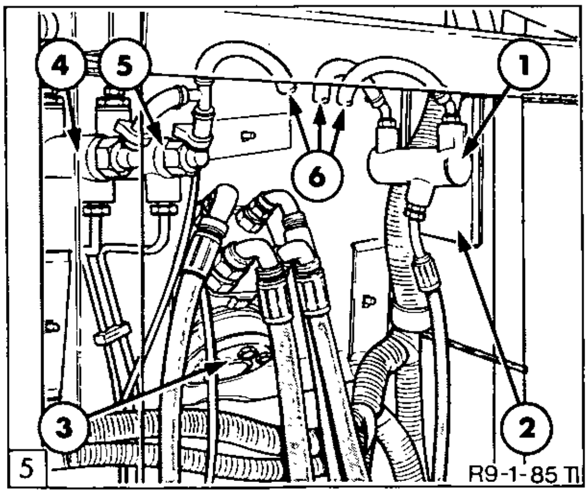
Removal

1. Position the tractor on a hard level surface and apply the parking brake.

2. To gain access to the steering motor remove the following:–

   - Exhaust Pipe
   - Top Bonnet / Hood
   - Brake and Clutch Reservoir
   - Starter Relay Bolted to Firewall
   - Earth Cable Bolted to Firewall

3. Remove the three bolts holding the fire wall to the cylinder head, through the side of the steering console inside the cab.



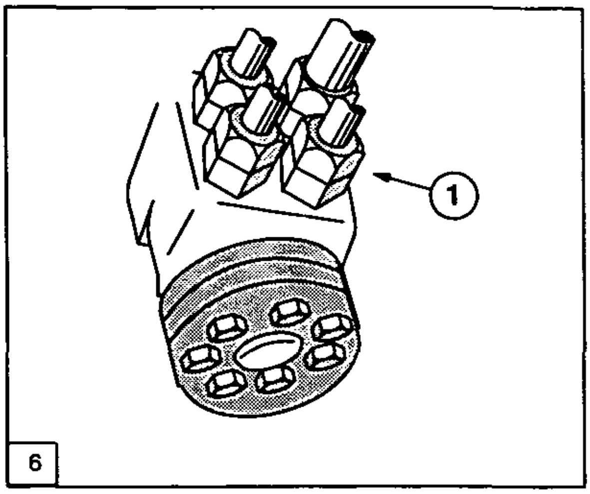
5

R9-1-85 TI

Steering Motor Removal

1. Clutch Master Cylinder
2. Access Panel
3. Steering Motor
4. Right Hand Brake Cylinder
5. Left Hand Brake Cylinder
6. To Master Cylinder

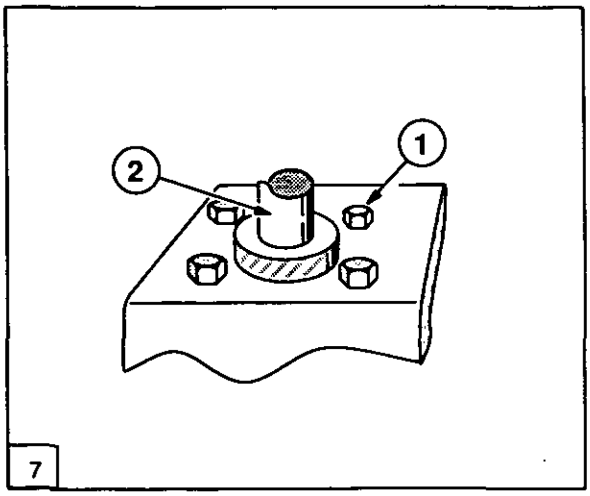
4. Disconnect the four supply/return tubes and 'O' ring seals from the steering motor and cap the ends of the tubes, Figure 6.



Steering Motor Connections
1. Motor Connections

5. Remove the roll pin from the drive collar to separate the steering shaft.

6. To gain access to the front mounting bolts remove the instrument panel.



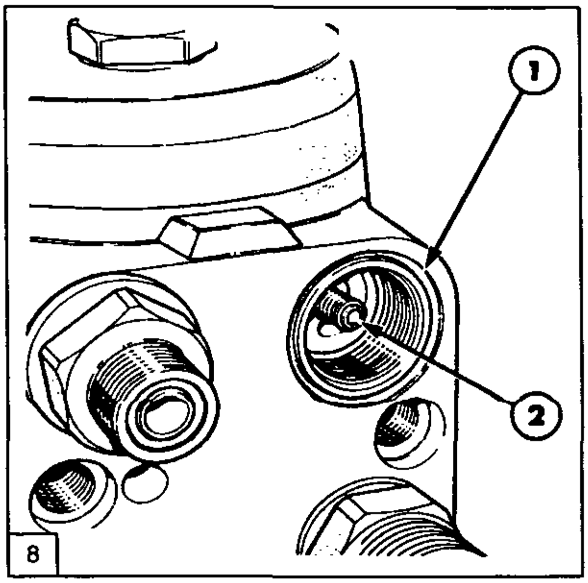
Steering Motor Support

1. Support Bolts
2. Steering Motor

7. Remove the four bolts at the base of the steering column and slide the steering motor from the upper section of the steering column, Figure 7.

8. Remove the steering motor from the front of the cab through the engine compartment.

Disassembly

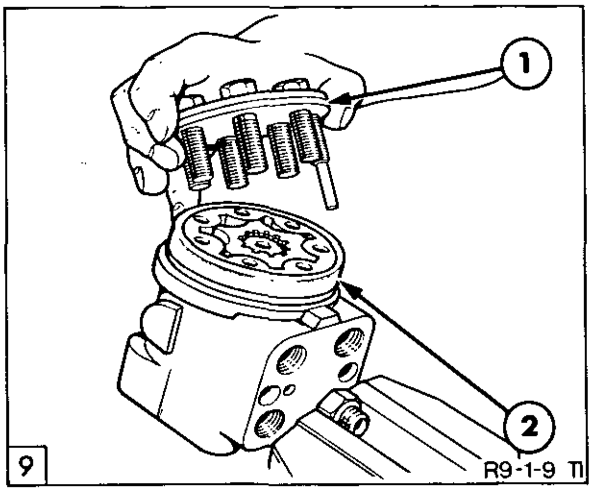


Supply Line Non Return Valve

1. Steering Motor Oil Supply Port
2. Non Return Valve

1. With the steering motor connectors removed note position of the non return valve.

2. Hold the steering motor securely in a vice using a tube connector as shown in, Figure 9.

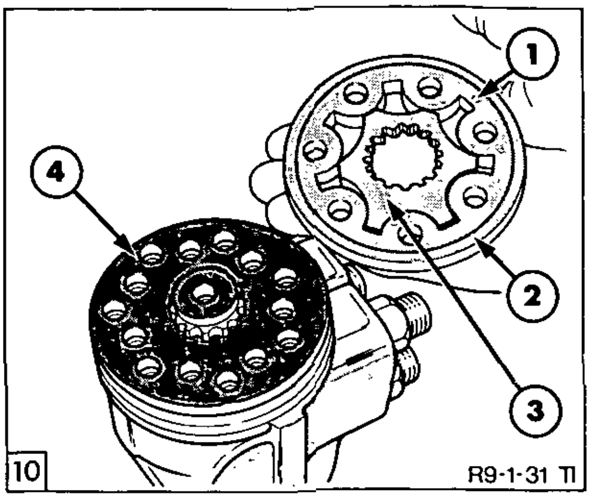


End Plate Removal

1. End Plate
2. Housing

NOTE: *The position of the pin bolt must remain the same on re–assembly.*

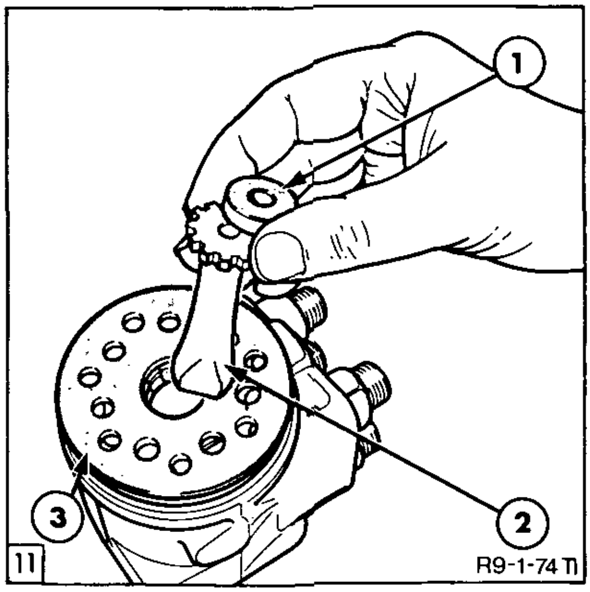
3. Remove the end plate bolts, end plate and 'O' ring, Figure 9.



Metering Unit Removal

1. End Plate	3. Rotor
2. 'O' Ring	4. Manifold Plate

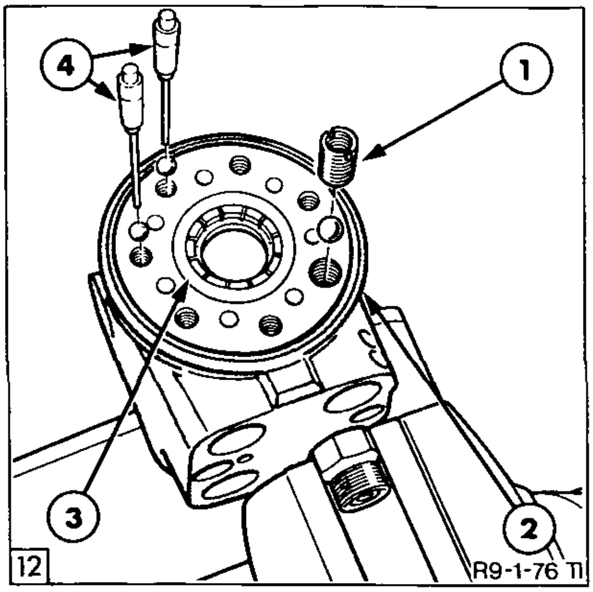
4. Remove metering unit, valve plate and 'O' ring seals, note mating surfaces for correct re–assembly, Figure 10.



Rotor Drive Removal

1. Spacer	3. Housing
2. Drive Link	

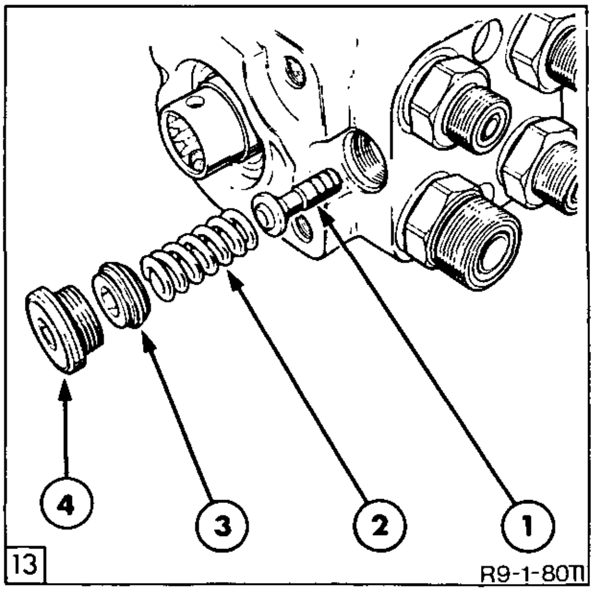
5. Lift out rotor drive-shaft, Figure 11.



Suction and Check Valve

1. Check Valve Retainer
2. Housing
3. Control Valve
4. Suction Valves

6. Unscrew the check valve retainer, Figure 12 and shake out the check and suction valves.



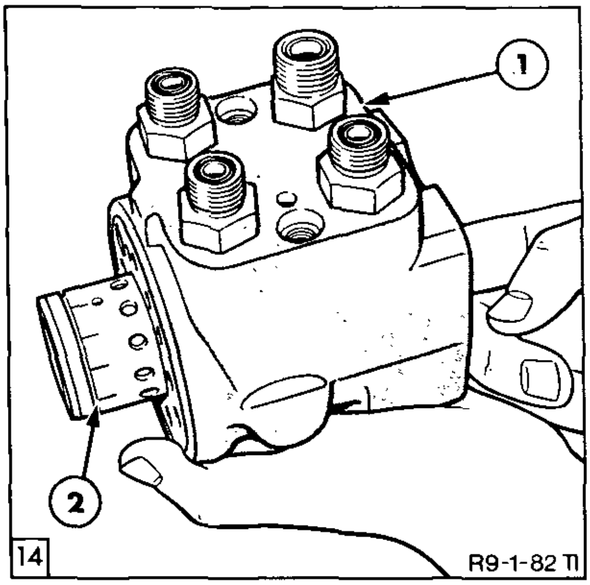
Relief Valve

1. Relief Valve	3. Adjuster
2. Spring	4. Plug

7. Remove the relief valve assembly, Figure 13.

IMPORTANT: *The relief valve must be set to the correct pressure setting on re–assembly.*

Follow the correct procedure as detailed under the heading 'Pressure relief valve setting', "SECTION G, PRESSURE TESTING."

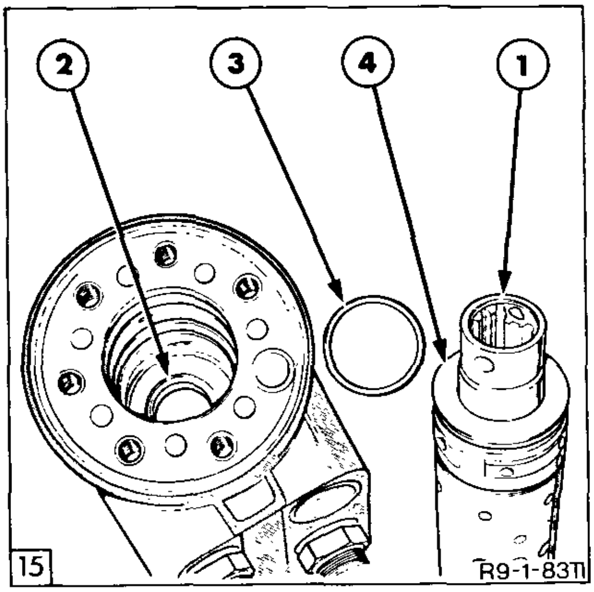


Control Valve Removal

1. Steering Motor Housing
2. Inner and Outer Valve Seals

8. Remove the inner and outer valve sleeves, bearings and thrust washer, Figure 14.

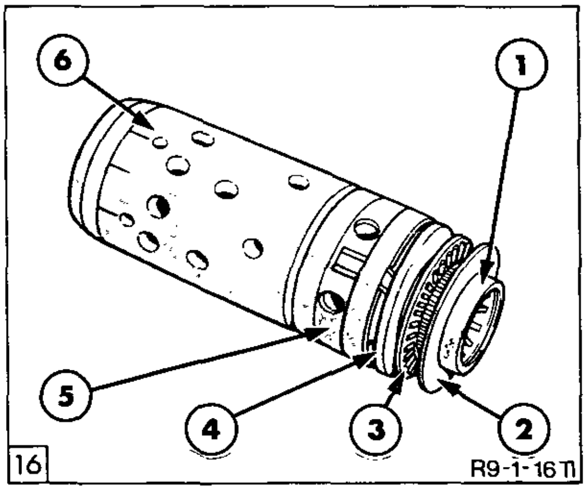
NOTE: *When removing spool and sleeve ensure drive pin is in a horizontal position so that it cannot fall into an internal gallery and make removal difficult.*



Oil Seal Location

1. Control Valve	3. 2 Piece Oil Seal
2. Oil Seal Seat	4. Thrust Washer

9. Once spool is disassembled from the body ensure oil seal is removed, Figure 15.

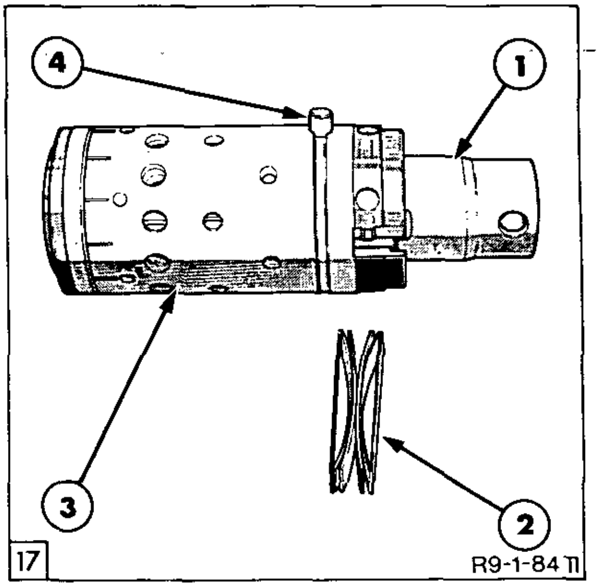


Control Valve

1. Valve pool
2. Thin Thrust Washer
3. Thrust Bearing
4. Thick Thrust Washer
5. Retaining Ring
6. Valve Sleeve

IMPORTANT: *Upon re–assembly ensure washer, item 4, Figure 16 is installed with chamfer towards the valve sleeve.*

10. Remove the control valve spool and sleeve, Figure 16.



Drive Pin and Centering Rings

1. Control Valve Spool	3. Control Valve Sleeve
2. Centering Springs	4. Drive Pin

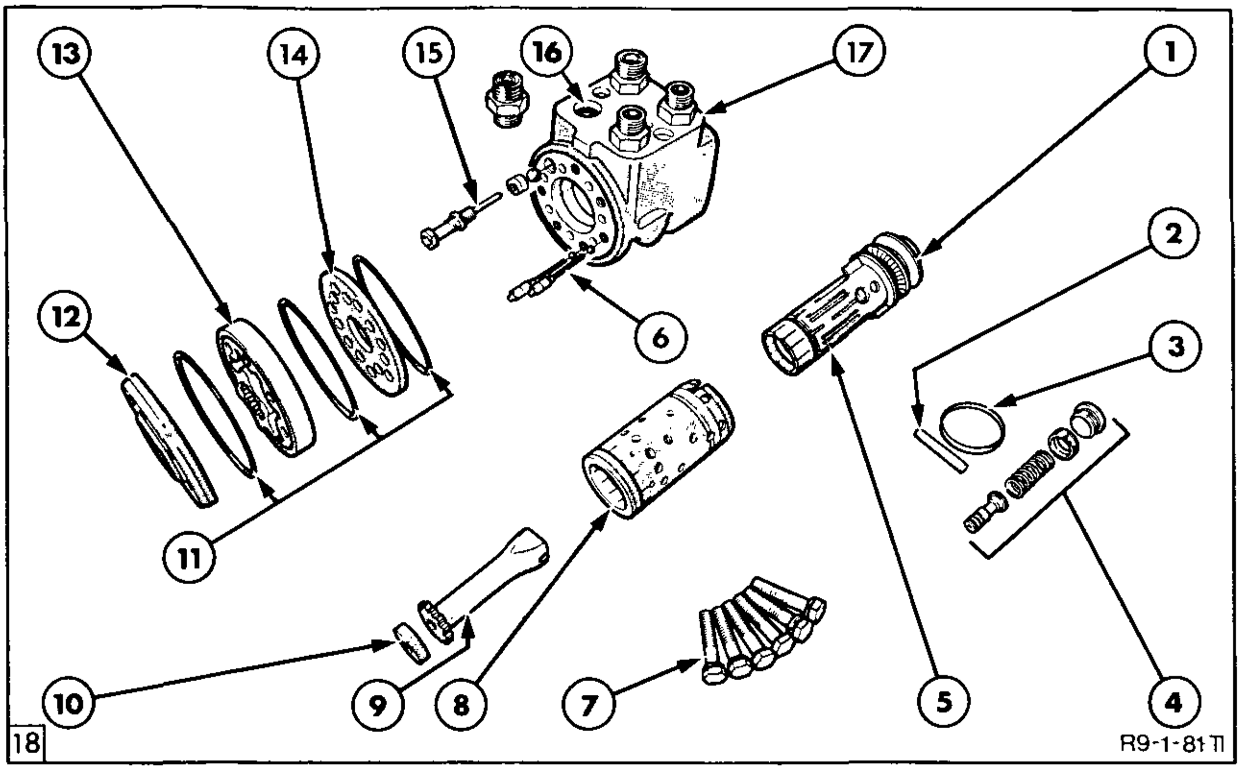
11. Remove centering springs, Figure 17.

NOTE: *Arrangement of the leaves must remain the same upon re–assembly.*

12. Remove drive pin, Figure 17.

13. Push inner sleeve from outer sleeve.

14. Remove 'O' ring and back-up ring.



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Hydrostatic Steering Components

1. Thrust Washers and Bearing
2. Drive Pin
3. Retaining Ring
4. Relief Valve
5. Control Valve Spool
6. Suction Valves
7. Bolts
8. Control Valve
9. Drive Link
10. Spacer
11. 'O' Ring
12. End Plate
13. Metering Unit
14. Distributor Plate
15. Check Valve Bolt
16. Non Return Valve
17. Housing

Inspection

1. Wash all parts in a suitable solvent to remove any foreign particles and dry with a clean lint free cloth or compressed air.

2. Inspect valve sleeves for, damage or wear. Minor burrs or scratches can be removed with a fine abrasive. Ensure all parts are thoroughly cleaned prior to re-assembly.

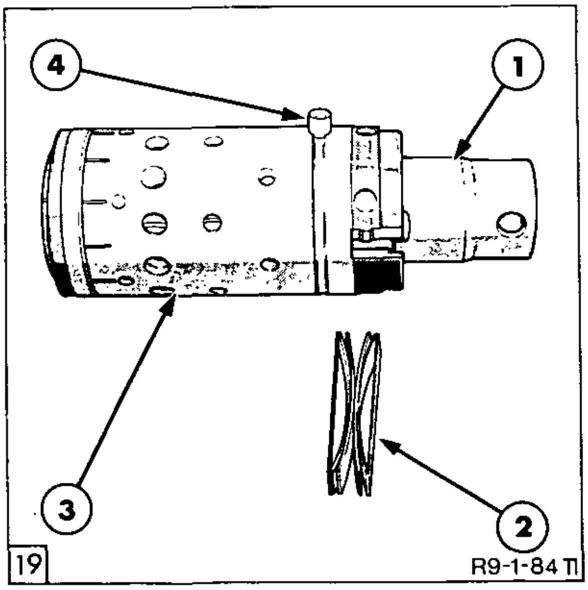
3. Check leaf springs for damage. Replace if necessary.

4. Discard all 'O' ring seals and replace with new seals on re-assembly.

Re-Assembly

1. Assemble inner and outer sleeves so that the leaf spring slots align.

2. Install the drive pin, Figure 19.



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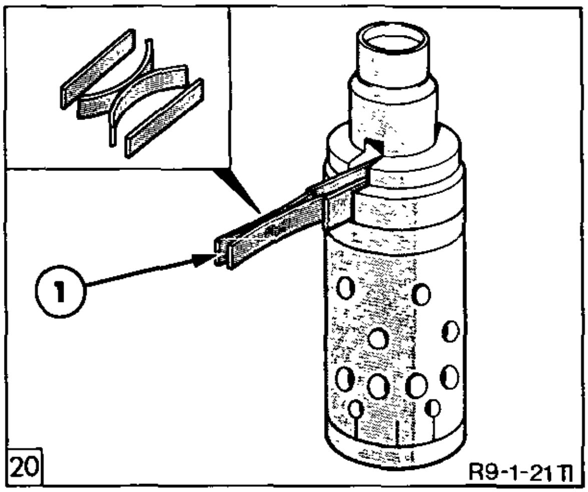
Drive Pin and Centering Rings

1. Control Valve Spool
2. Centering Springs
3. Control Valve Sleeve
4. Drive Pin

3. Install the leaf springs and push fully into position, Figure 20.

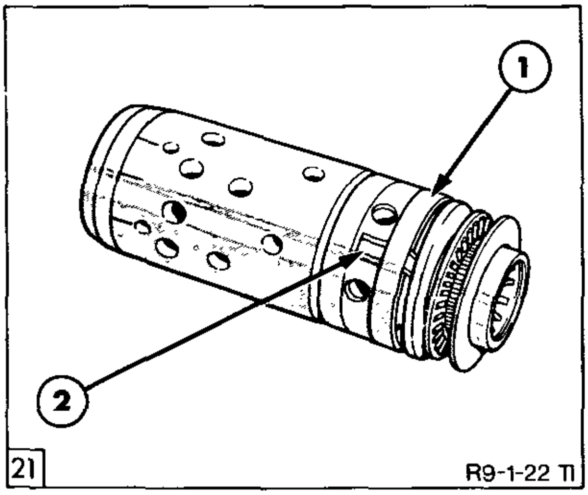


Leaf Spring Installation

1. Leaf Spring

4. Install leaf spring retainer, and bearing, Figure 21.

NOTE: *The inner bearing race must be positioned with the chamfer side facing the spool, Figure 16.*

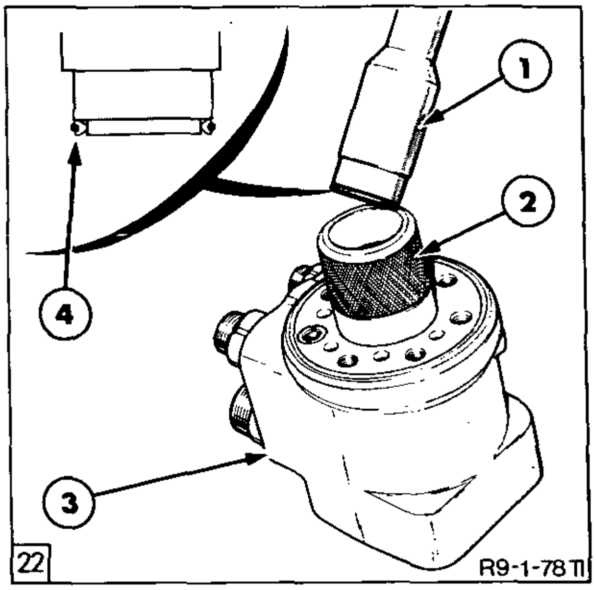


Leaf Spring Retainer

1. Retainer	2. Leaf Spring

5. Apply a light coating of hydraulic oil onto the sleeve item 2 and insert into the steering motor body, item 3, Figure 22.

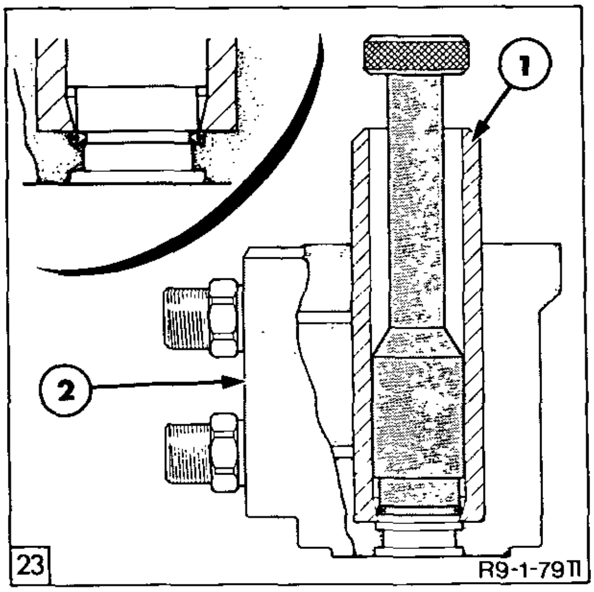
6. Coat the 'O' ring and back-up ring, item 4, Figure 22, with hydraulic fluid and position them onto the seal installer guide.



Seal Installer

1. Seal Locator
2. *Sleeve*
3. Steering Motor Body
4. Seal Placed on Inner Tool

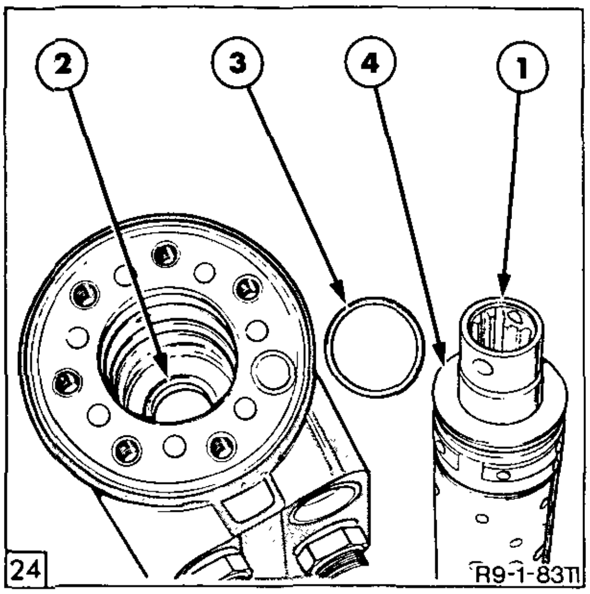
7. Position the seal guide tool into the sleeve and push down with a twisting action, Figure 23.



Installation Tool

1. Sleeve
2. Steering Motor Body

8. Remove tools once the seal has seated.

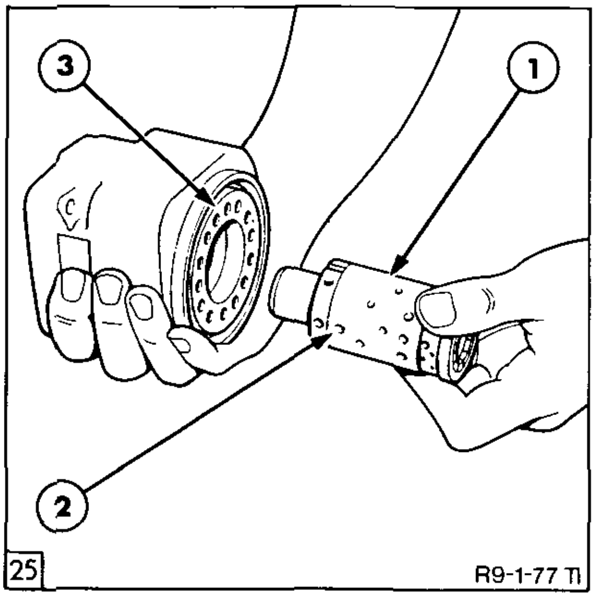


Oil Seal Installation

1. Control Valve
2. Oil Seal Seat
3. 2 Piece Oil Seal
4. Thrust Washer

9. With the seal installed in the motor body refit control valve, Figure 25.

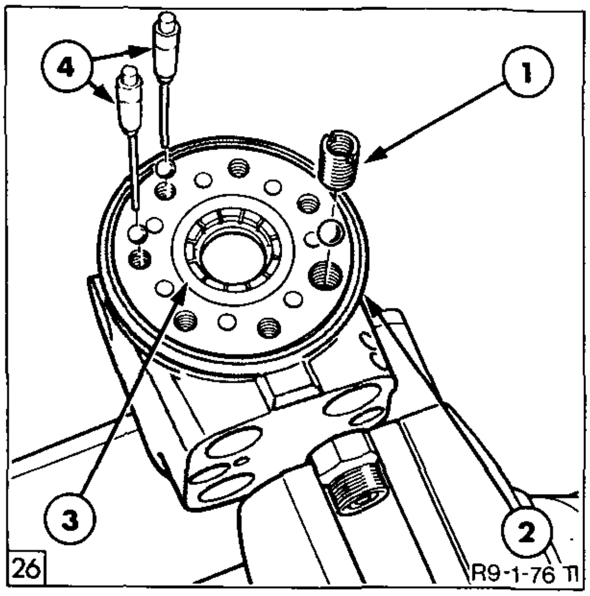
NOTE: *Ensure that the Drive is in a horizontal position to aid re–assembly.*



Reinstall Control Valve Housing

1. Control Valve
2. Drive Pin
3. Housing

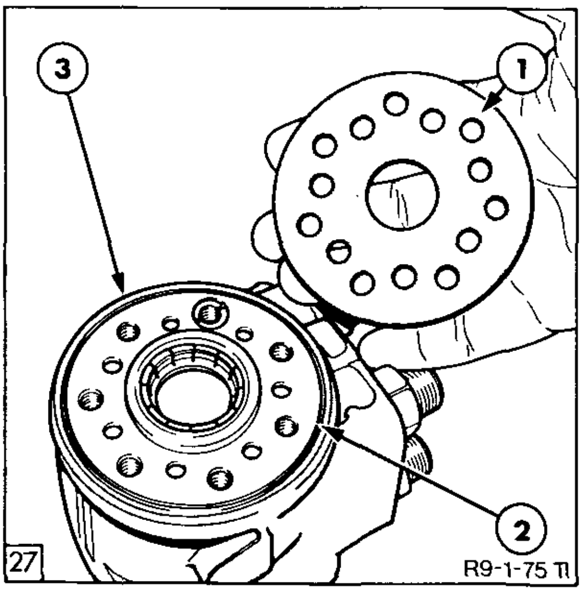
10. Once the control valve is seated correctly refit the check and suction valves, Figure 26.



Reinstall Check and Suction Valves

1. Check Valve and Retainer
2. Housing
3. Control Valve
4. Suction Valves

11. Screw the check valve down to just below the surface of the housing.



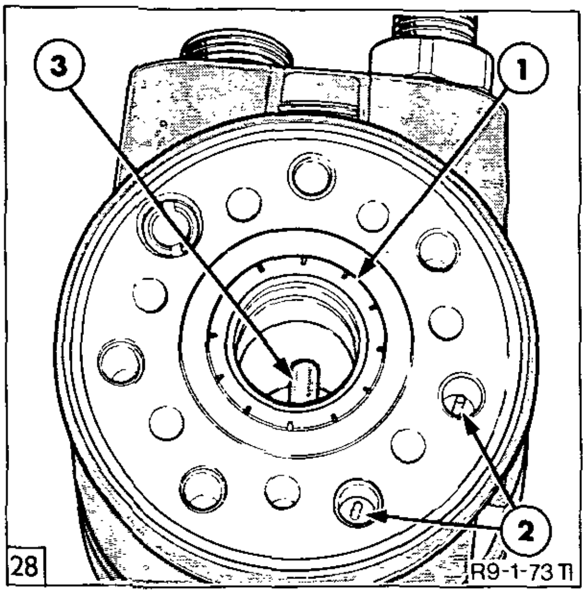
Valve Plate

1. Manifold Plate
2. 'O' Ring
3. Motor Housing

12. Refit the 'O' Ring and place the end plate in position.

METERING UNIT TIMING

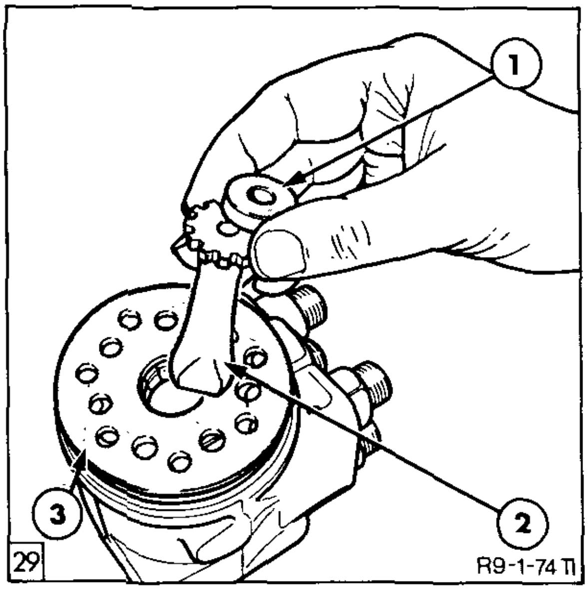
IMPORTANT: *The metering unit must be timed correctly, otherwise a 'Kick back' of the steering wheel will occur during turning.*



Drive Pin Position

1. Control Valve
2. Suction Valves
3. Drive pin

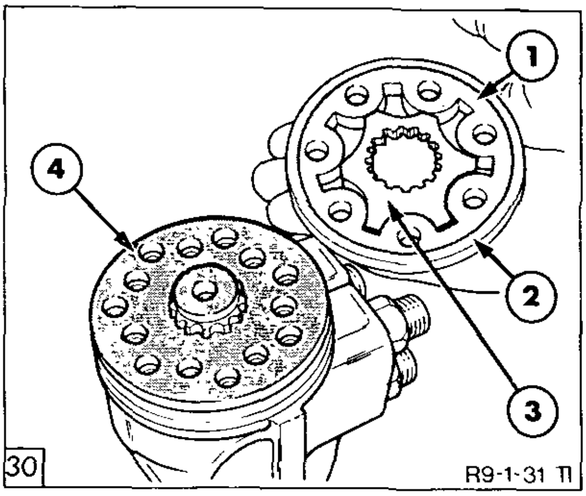
1. Assemble the control valve into the housing so that the drive pin is perpendicular to the front face of the housing, Figure 28.



Drive Link Installation

1. Spacer
2. Drive Link
3. Housing

2. Install drive link into the steering motor body. Install the spacer if fitted, Figure 29.

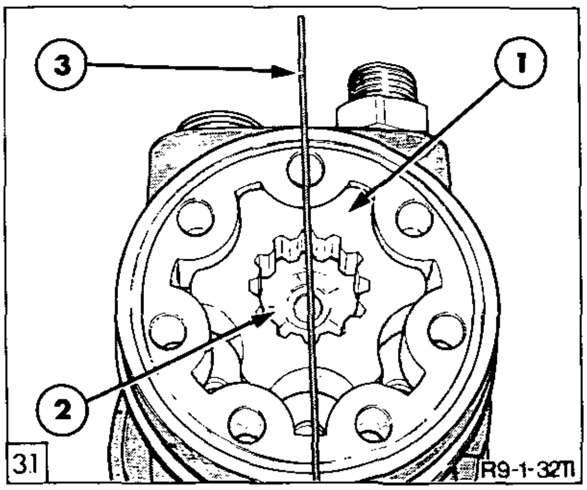


Metering unit

1. 'O' Ring
2. Stator
3. Rotor
4. Manifold Plate

3. Assemble the metering unit rotor and stator and install new lightly greased 'O' rings to either side of the stator, Figure 30.

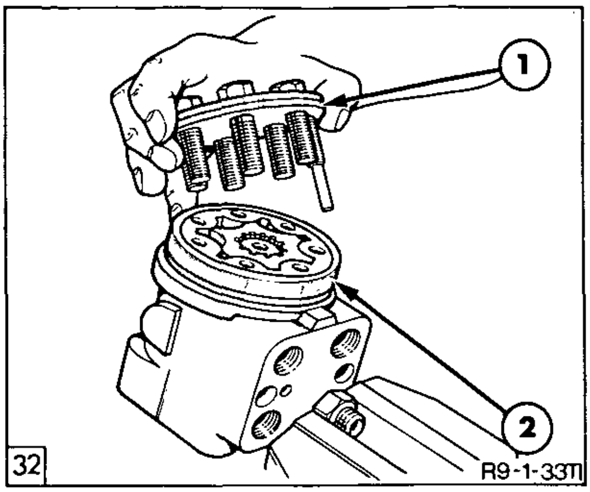
4. Assemble the rotor and stator onto the drive link so that two hollows in the rotor align with the drive pin.



Metering Unit Timing

1. Rotor
2. Drive Link
3. Position of Drive Link to Rotor

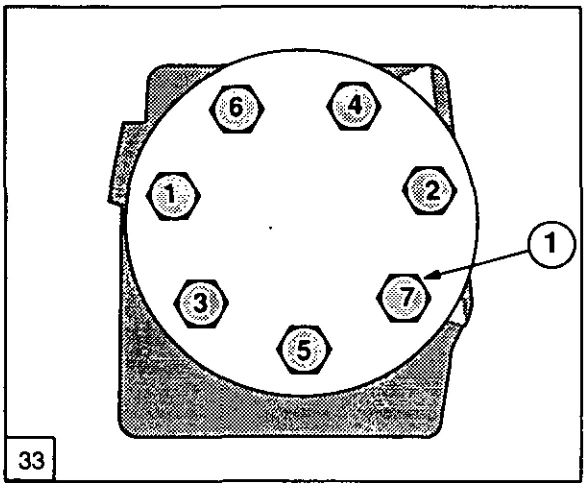
5. If the motor has been assembled correctly one of the rotor hollows should be over a lobe of the stator and in line with the pin, Figure 31.



End Plate Re–Assembly

1. End Plate 2. Motor Body

6. Install the end plate and bolts, ensure the pin bolt is fitted in position '7'. Tighten the bolts in two steps, first to 8 lbf.ft (10.8 Nm) and then to 21 lbf.ft (28.4 Nm) in sequence as shown, Figure 33.



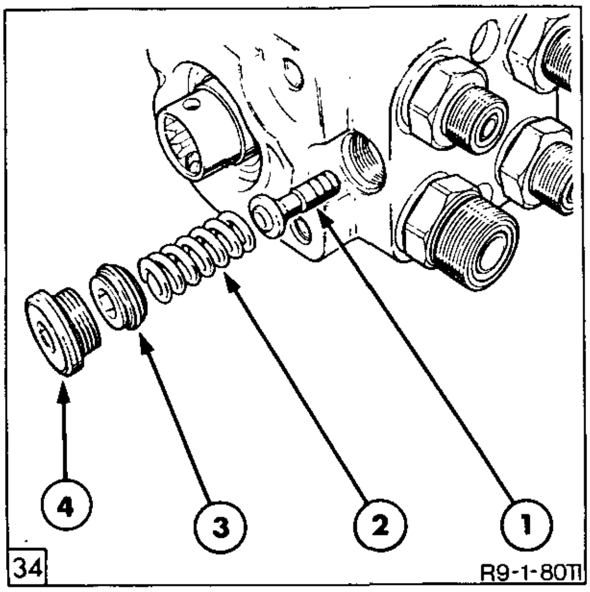
End Plate Installation

1. Pin Bolt

7. Install the relief valve assembly, items 1, 2 and 3 Figure 34, leaving the plug, item 4 out until after the relief valve has been adjusted.

8. Check to ensure the motor turns freely without binding.

IMPORTANT: *The relief valve must be set to the correct pressure setting after the motor has been re–assembled. Follow the correct procedure as detailed under 'Pressure relief valve setting', "SECTION G, PRESSURE TESTING."*



Relief Valve Installation

1. Relief Valve
2. Spring
3. Adjuster
4. Plug

9. After the relief valve has been correctly set re–install the steering motor onto the mounting bracket and tighten the securing bolts to a torque value of 10–15 lbf ft(13–20Nm).

10. Reconnect the steering hoses, tighten to a torque value of 10–15 lbf ft (13–20Nm).

11. Purge the air from the system by operating the steering system from lock to lock until the system functions correctly.

D. TWO WHEEL DRIVE STEERING CYLINDER - OVERHAUL

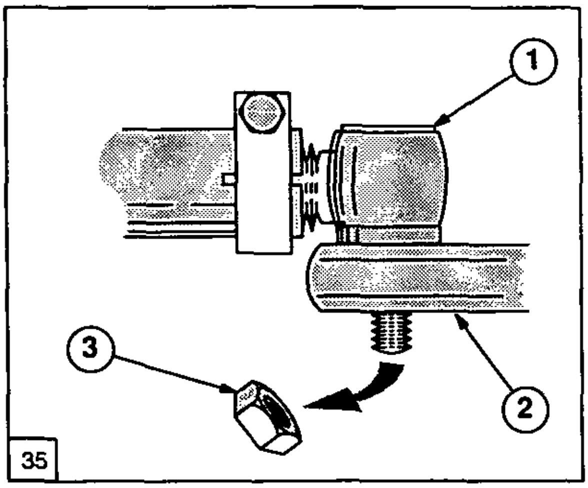
Removal

1. Stand the unit on a hard level surface and position the front wheel in the straight ahead position.

2. Disconnect flexible pipes, cap the open pipe ends

NOTE: *Position of flexible pipes and orientation of connectors must be the same upon re–assembly.*

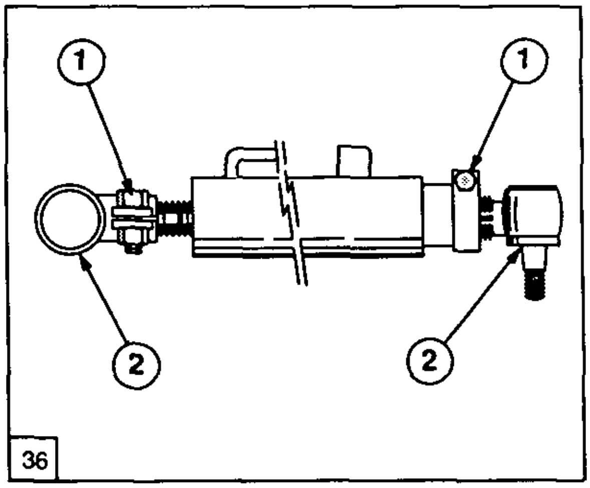
3. Remove retaining nuts and separate ball joints from track rod/axle, Figure 35.



Cylinder Rod Removal

1. Ball Joint
2. Axle Mount
3. Nut

Disassembly



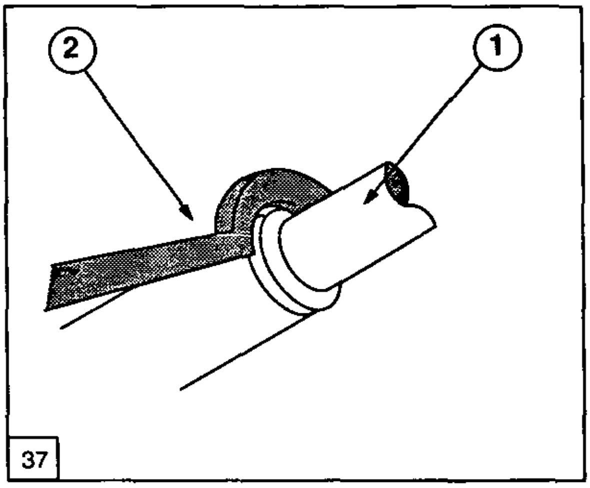
Cylinder Removal

1. Clamp Bolts
2. Ball Joint

1. Drain the cylinder of all oil. Cap the ports.
2. Loosen the clamp bolts and remove ball joint assemblies, Figure 36.
3. Install suitable fittings into the cylinder ports to enable the cylinder to be clamped in the jaws of a vice.

IMPORTANT: *Do not clamp directly around the cylinder barrel, as damage may occur.*

4. Using a 'C' spanner unscrew the extension tube and gland assembly, Figure 37.



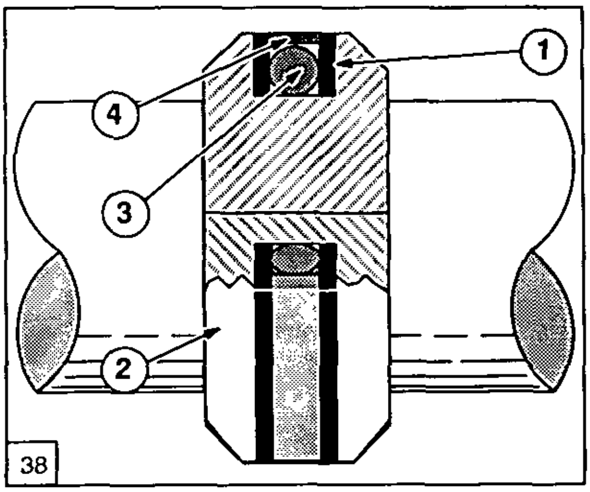
Extension Tube Removal

1. Extension Tube
2. 'C' Spanner

5. Withdraw gland and piston/rod assembly from the cylinder.
6. Remove all seals.

Inspection

1. Wash all components in a suitable solvent and air dry.
2. Inspect all parts for damage/wear. Minor nicks/ burrs can be removed with an abrasive stone.
3. Inspect ball-joints for fee play. Replace as necessary.



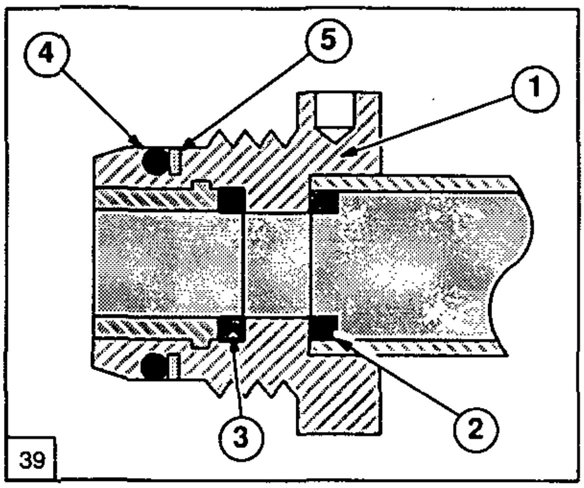
Piston Seal Assembly

1. Wear Rings
2. Piston
3. 'O' Ring
4. Piston Seal

Re-Assembly

1. Install a new 'O' ring, piston seal and wear rings onto the piston, Figure 38.

2. Install new rod seals in the glands, ensure sealing lip faces towards oil pressure. Install new back-up rings, 'O' rings and rod wipers, Figure 39.



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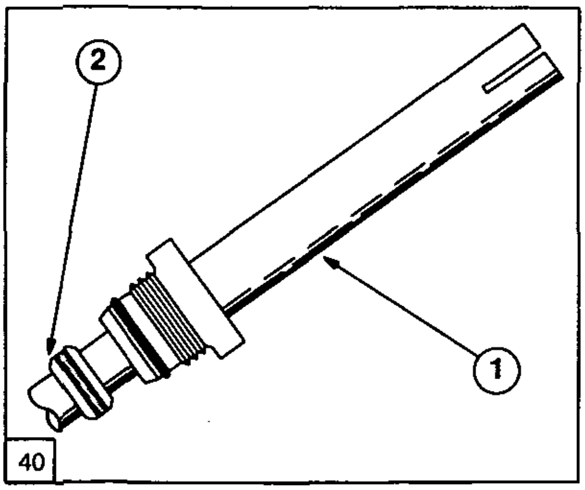
Rod Seals

1. Gland	4. Piston Seal
2. Rod Wiper	5. Back up Rings
3. Rod Seal	

3. Lubricate seals and slide the gland assembly onto the piston rod, Figure 40.



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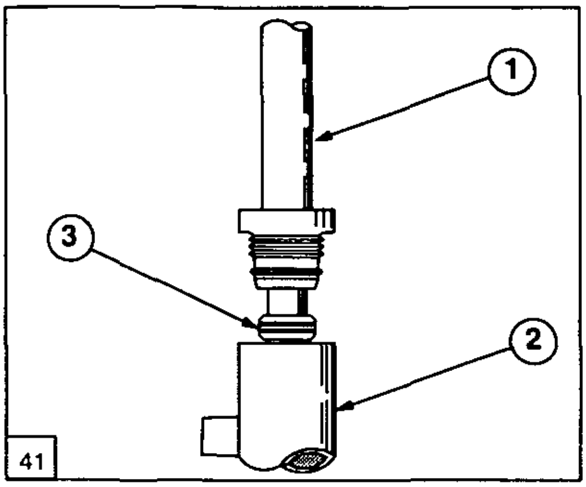
Piston Gland Assembly

1. Piston Rod	2. Gland Assembly

4. Place cylinder barrel in a vertical position and insert the piston/rod and gland assembly, Figure 41.



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Cylinder Barrel Assembly

1. Piston Rod	3. Gland
2. Cylinder Barrel	

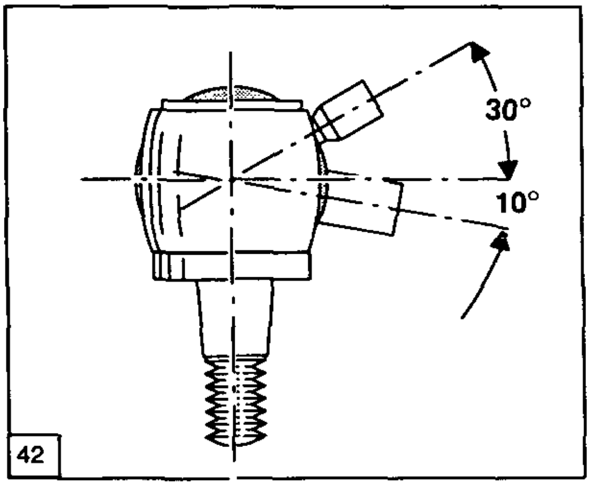
NOTE: *Installation of the piston seal on top of the 'O' ring requires special care. Allow the seal to contract naturally before installing the piston and rod assembly into the cylinder.*

5. Screw gland into barrel until fully seated.

Installation

1. Installation of steering cylinder and track control rods is the removal procedure in reverse.

2. Screw anchor end ball joint into extension tube. Unscrew ball joint a fraction of a turn and ensure the connectors are positioned as, Figure 42. Tighten the clamp to 32.0 lbf.ft (43.0Nm) 4.4 kgf m.

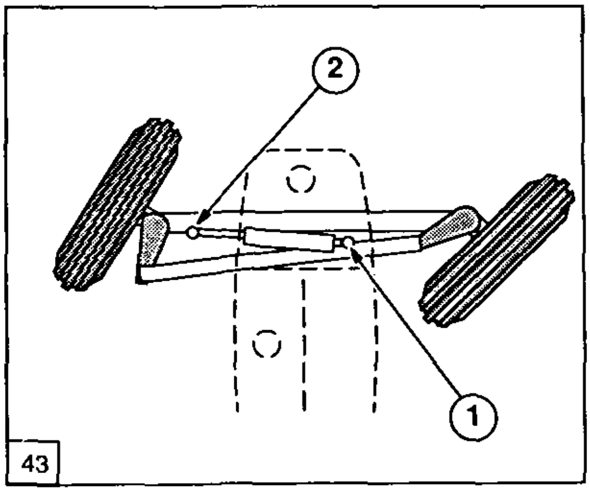


Ball Joint Adjustment

3. Compress the cylinder rod until the piston bottoms in the cylinder.

4. Assemble the anchor end ball joint to the track rod axle, Figure 43 and tighten to 130 lbf ft (176Nm) 18.0 kgf m.

5. Position right hand wheel in the full right hand lock position.



Cylinder Rod Re–Assembly

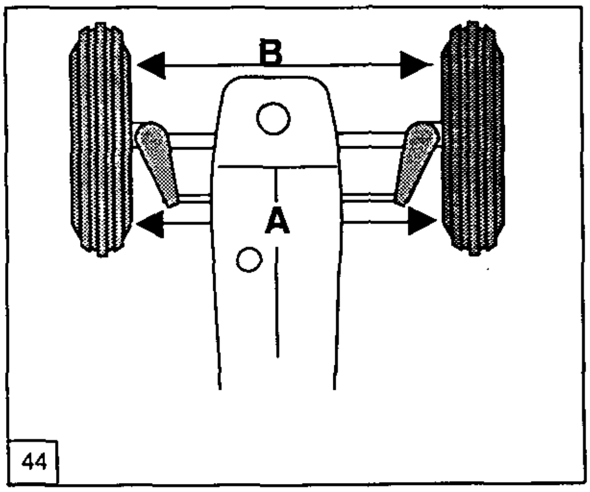
1. Track Rod Connection
2. Axle Connection

6. Extend cylinder rod from the fully compressed position by 0.15 – 0.4 in (4.0 – 10.0 mm).

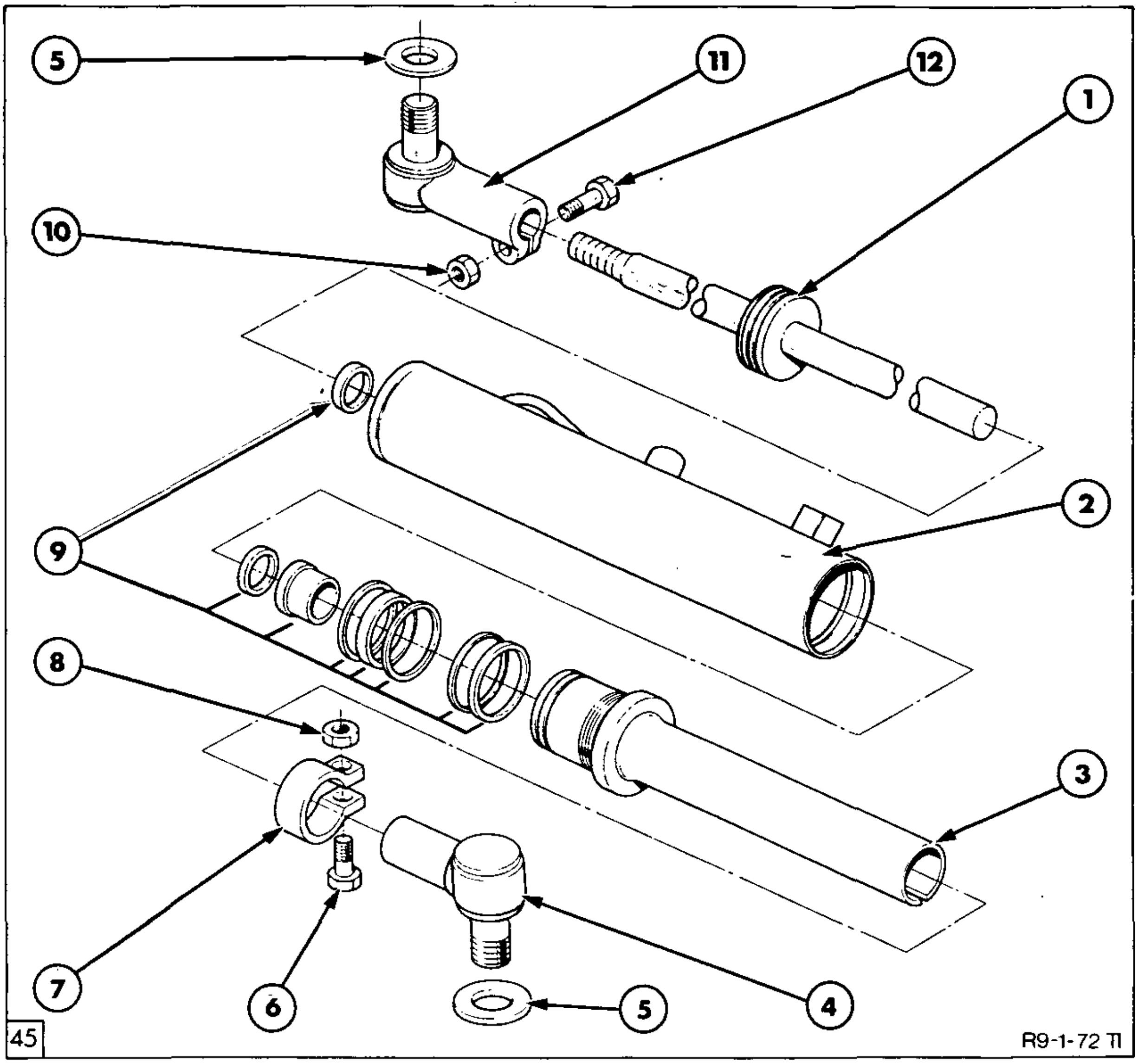
7. Adjust the piston rod ball joint to align with lug on track rod. Install joint and tighten to 130 lbf ft (176 Nm) 18.0 kgf m.

8. Position front wheels in the straight ahead position, adjust track rod to achieve a **toe-out** of 0 – 0.5 in (0 – 13.0 mm) measured on the wheel rim at hub height (A minus B), Figure 44.

9. Purge the air from the system by starting the engine and turning the wheels from lock to lock several times. Repeat until steering operates correctly.



Track Rod Adjustment



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Steering Cylinder Assembly

1. Piston and Rod Assembly
2. Cylinder
3. Extension Tube
4. Track Rod End
5. Dust Washer
6. Clamp Bolt
7. Clamp
8. Nut
9. Seal Kit items*
10. Nut
11. Track Rod End
12. Clamp Bolt

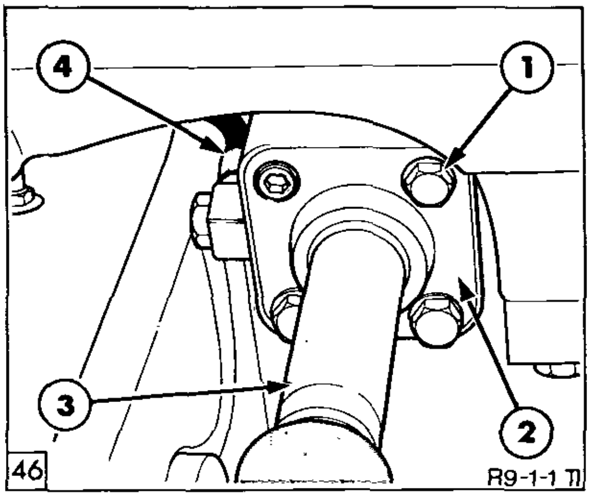
* Seal Kit Consists of:–

Rod Seals and Bushing
Piston Seals
Gland Seals

E. FOUR WHEEL DRIVE STEERING CYLINDER - OVERHAUL

Seal Replacement

1. Position the unit on a hard level surface.
2. Loosen attaching bolts two turns, Figure 46.
3. Unseat the cylinder from the differential casing by turning steering wheel to the left until the endplate is free.
4. Apply parking brake and block the rear wheels.



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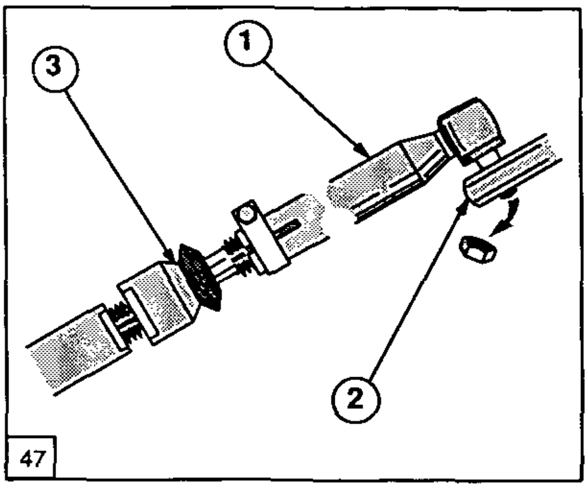
Seal Removal

1. Attaching Bolt
2. End Plate
3. Cylinder Rod
4. Hose

5. Raise and remove left front wheel.
6. Disconnect track rod ends from steering arms and cylinder ball joints; Figure 47.



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Steering Cylinder Removal

1. Track Rod	3. Cylinder Ball Joint
2. Steering Arm	

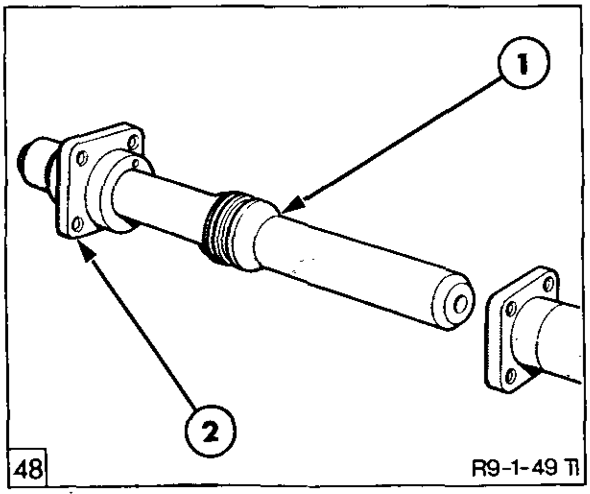
7. Unscrew ball joints from piston rod.

NOTE: *These connections are tightened to a high torque value and will require support and good quality tooling to loosen.*

8. Disconnect hydraulic hoses and remove the steering cylinder from the axle. Cap open pipe ends.

Disassembly

1. Remove rod and piston assembly. Remove cylinder end plate, Figure 48.



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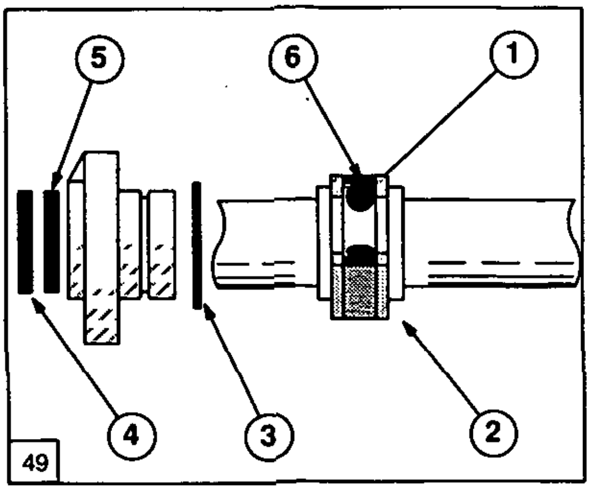
Cylinder Assembly

1. Cylinder Rod	2. End Plate

2. Remove wear rings, piston seal, 'O' ring , end plate seal, oil seal and wiper seal, Figure 49.



Rod Assembly

1. 'O' Ring
2. Wear Rings
3. End Plate Seal
4. Wiper Seal
5. Oil Seal
6. Piston Seal

Inspection

1. Wash the cylinder components in a suitable solvent and allow to air dry.
2. Inspect the cylinder rod for damage. Relieve minor nicks or burrs with an abrasive stone.
3. Inspect the inside of the cylinder barrel for damage.

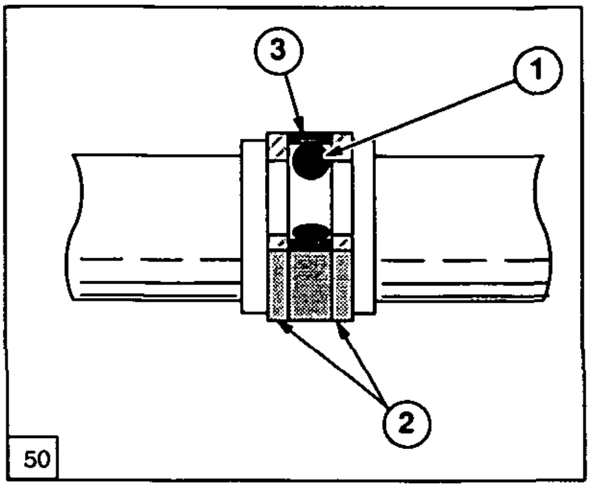
NOTE: *The cylinder rod and barrel are not serviced as individual components. If either of these parts is damaged, the complete cylinder assembly must be replaced.*

4. Inspect track rod ends and cylinder rod ball joint for free play. Replace as necessary.

Re–Assembly

1. Install new seals in the right hand cylinder end and new seals and 'O' ring in the cylinder end plate, Figure 48.
2. Install a new seal, 'O' ring and wear rings on the piston, Figure 50.
3. Lubricate all seals and the piston and re–assemble the piston and rod assembly into the cylinder barrel.

NOTE: *Installation of the piston seal on top of the 'O' ring requires special care. Allow the seal to contract before attempting to install the piston assembly into the cylinder.*

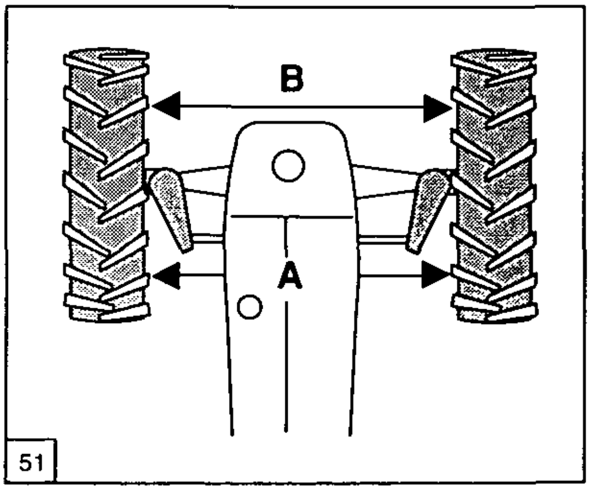


Cylinder Seals

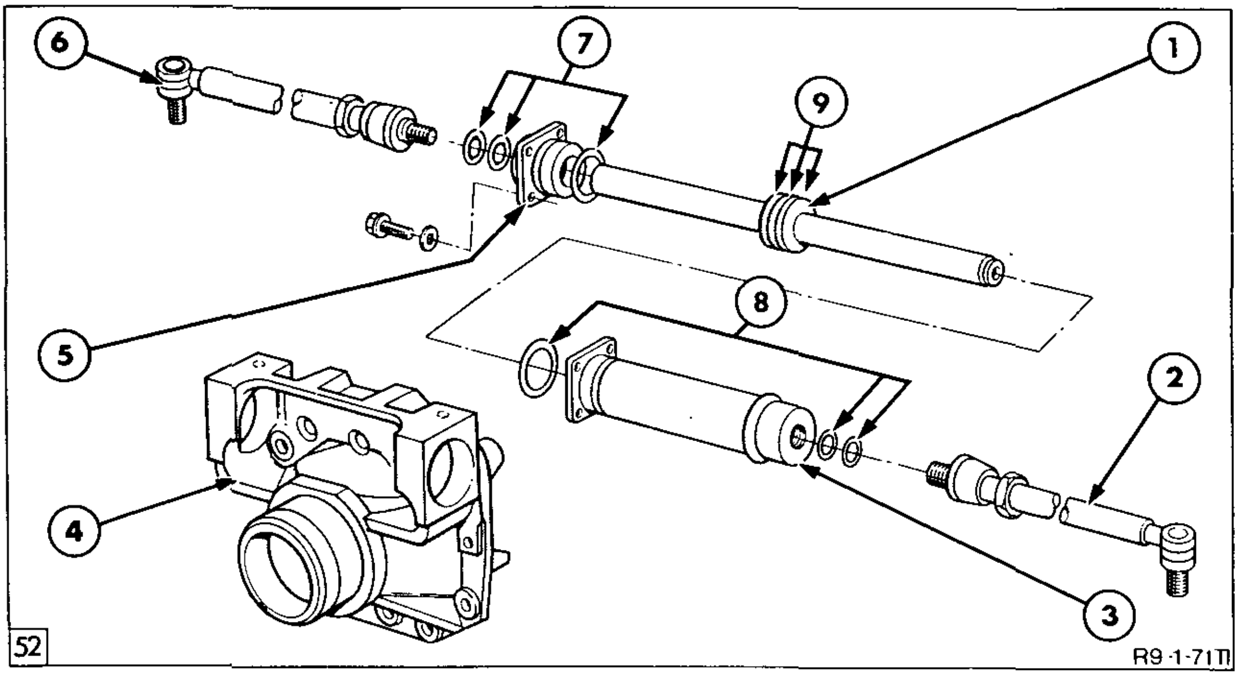
1. 'O' Ring
2. Wear Rings
3. Seal

Installation

1. Installation of the steering cylinder follows the removal procedure in reverse.
2. Ensure steering ball joint nuts to the axle are tightened to a torque of, 30 lbf ft (176Nm) 17.6 kgf m.
3. Ensure that the steering hydraulic hose connections are routed and positioned correctly to avoid any foul or touch condition through all degrees of front axle articulation.
4. Adjust and set the front wheel **toe–in** of 0.5 in (13.0 mm). Ensure this measurement is made at the inside of each wheel rim and at hub height, Figure 51.



Tracking Adjustment

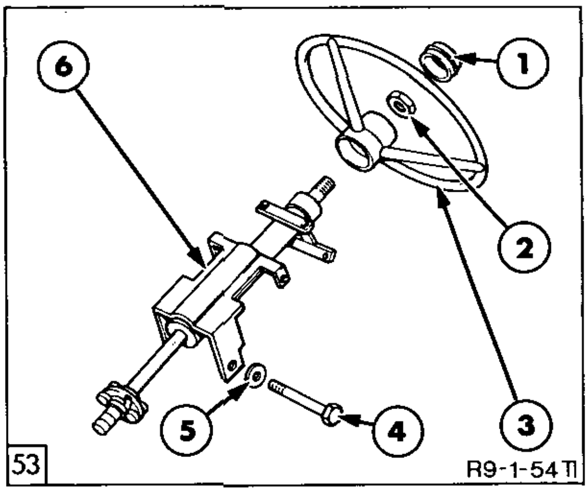


Cylinder Assembly

1. Wiper Seal
2. Track Rod
3. Cylinder Barrel
4. Housing
5. End Plate
6. Track Rod
7. Wear Ring
8. Seals
9. Seals

F. STEERING COLUMN – OVERHAUL

NOTE: *The component parts of the steering column as listed are serviced separately.*



Steering Column Less Tilt

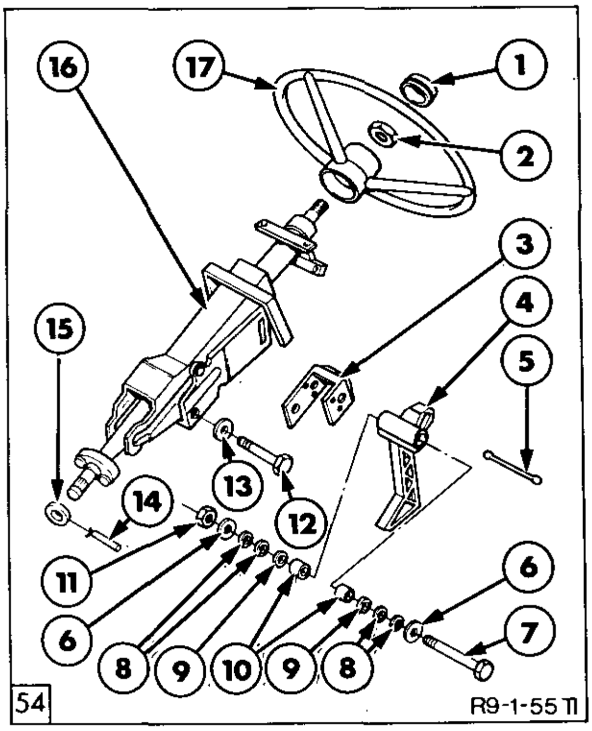
1. Cap
2. Retaining Nut
3. Wheel
4. Bolt
5. Washer
6. Column Assembly

Removal

1. Remove the steering wheel.

2. Remove the multi–function switch.

3. Remove the instrument console panels.



Steering Column With Tilt

1. Cap
2. Retaining Nut
3. Support
4. Lever
5. Pin
6. 0.5mm Washers
7. Bolt
8. Washers
9. Washers
10. Bushes
11. Nut
12. Bolts x4
13. Washers x4
14. Pin
15. Drive Collar
16. Column Assembly
17. Steering Wheel

4. Remove securing bolts from top of the column.

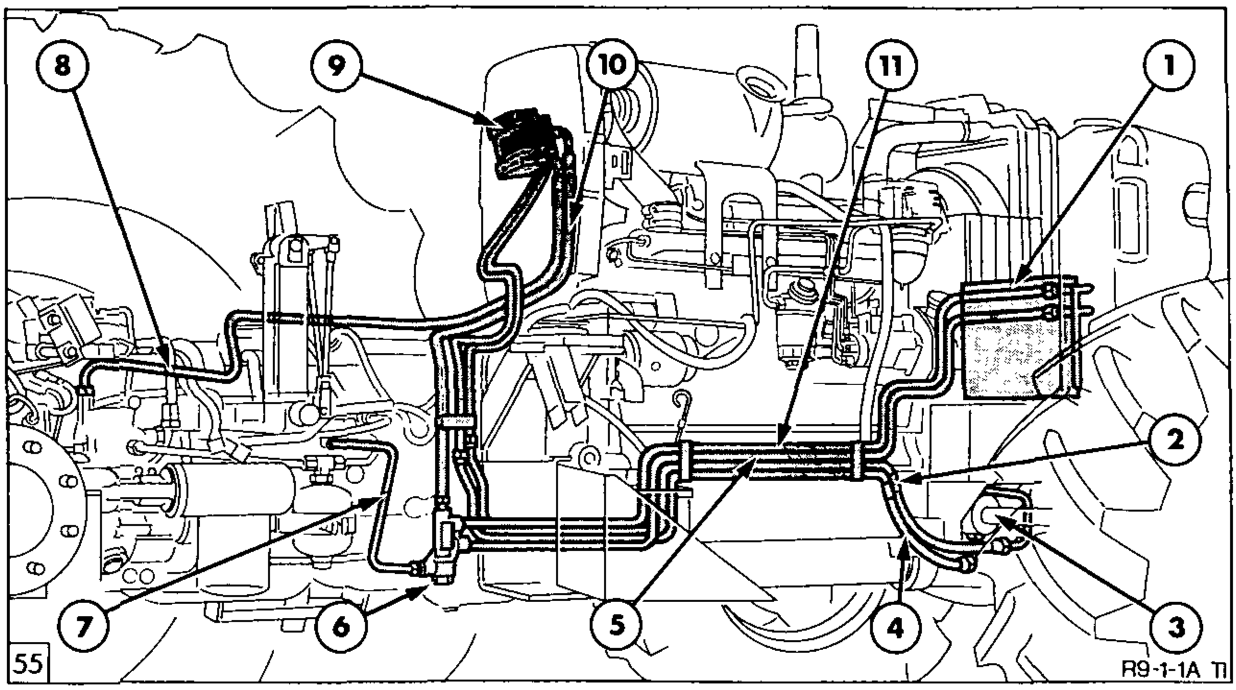
5. Lift the column clear of the steering motor and clear of the instrument console.
6. Remove the pin from the spacer at the bottom of the column and remove the spacer.

Installation

1. Place spacer on the bottom of the column and refit the pin.
2. Carefully place the steering column through the instrument console and into the steering motor.
3. Replace the securing bolts at the top of the column.
4. Ensure all loom connectors are reconnected in the console.
5. Refit the instrument console panels.
6. Refit the steering wheel.

G. PRESSURE TESTING

Tractors Installed with Variable Displacement CCLS Hydraulic Pump



Hydrostatic Steering System Component Layout – SLE Model

1. Transmission Oil Cooler
2. Left Hand Turn Hose
3. Steering Cylinder
4. Right Hand Turn Hose
5. Cooler Inlet Line
6. Cooler Bypass Valve
7. Transmission / Rear Axle Lubrication Line
8. Steering Pump Output Line
9. Steering Motor
10. Steering Return / Lubrication Line
11. Oil Cooler Outlet Line

When the hydrostatic steering system is in operation, the pressure of oil supplied by the steering pump to the steering motor, can rise towards the maximum setting of the steering motor relief valve, which is 2100–2500 lbf/in^2 (145–172 bar) depending on tractor model.

The pressure of oil, however, on leaving the steering motor and returning via the oil cooler to the 16 x 16 transmission and PTO clutch lubrication circuits, is limited to a maximum pressure of 100 lbf/in^2 (7 bar) by the lubrication circuit relief valve, located within the transmission control valve.

Should the oil cooler become restricted, which would cause oil starvation to the lubrication circuits, the cooler bypass valve will operate, diverting oil directly to the lubrication circuit and bypassing the cooler.

The operating pressure of the bypass valve should the cooler become restricted is 100 lbf/in² (7 bar).

The cooler bypass valve is also thermostatically controlled enabling a proportion of the cold oil during initial start up to bypass the cooler until the nominal operating temperature of 68°C (155°F) has been reached. This feature enables a faster warm up cycle of the hydraulic oil.

Steering Pump

There is no relief valve in the steering pump. The following practical test will determine if steering pump output is sufficient to allow satisfactory operation of the steering system.

Steering Test

1. Set engine speed to 1000 rev/min.
2. Turn steering quickly from lock to lock. If steering is operating correctly the reaction of the steering should be immediate with no time delay between turning the steering wheel and movement of the wheels. At full lock the relief valve in the steering motor should be heard to blow and the engine speed should drop to approximately 970 rev/min.

Steering Pump Flow Test

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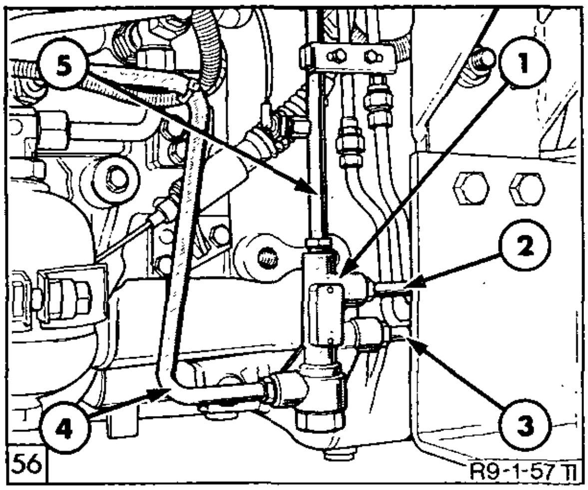

Oil Cooler Bypass Valve

1. Bypass Valve
2. Oil Cooler Feed Tube
3. Oil Cooler Return
4. To Transmission/Rear Axle Lubrication Circuits
5. *Feed Tube Steering Motor to Bypass Valve*

1. Disconnect and remove oil cooler bypass valve, Figure 56.

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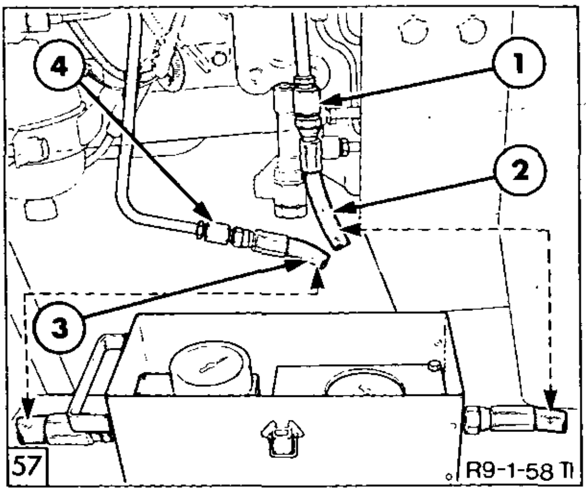


Flow Testing Steering Pump

1. Adaptor 4FT. 852
2. Supply Hose to Flow meter
3. Flowmeter Return Hose
4. Adaptor 4FT. 852

2. Plug feed and return tubes to oil cooler to *prevent contamination and loss of oil.*
3. Using Adaptors 4FT.852 install flowmeter between tube from steering motor and tube to transmission/rear axle lubrication circuits, Figure 57.

NOTE: *Adaptors 4FT.852 are suitable for installing ¾ in JIC hoses to flowmeter. If hoses of a different size are used with the flowmeter, suitable adaptors with a female thread size of ¾–18 UNC on one end will be required.*

4. It is important to ensure that the flowmeter load valve is fully open, Figure 57.

IMPORTANT: *If the flowmeter load valve remains closed damage will occur to the steering pump.*

5. Set engine speed to 2100 rev/min and turn steering onto full left hand lock. Hold steering on full lock so that steering motor relief valve can be heard to 'blow'.

6. Record pump flow.

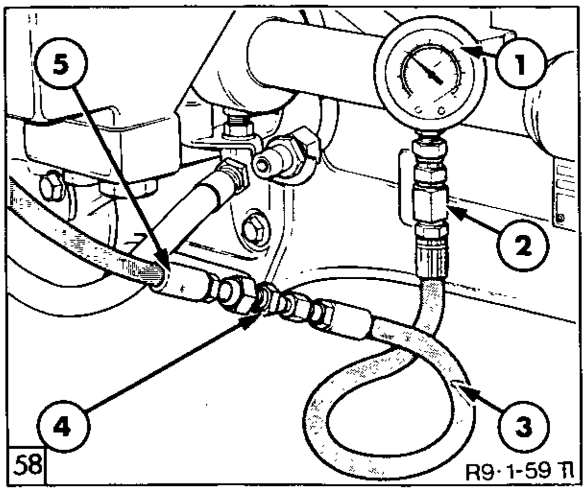
If pump flow is less than 8.2 U.S Galls/min (6.8 Imp Galls/min, 31 Ltrs/min) the steering pump requires overhaul.

Steering Relief Valve Pressure Test

IMPORTANT: *There is no relief valve in the steering pump and the following pressure tests must only be performed as specified below. Failure to observe this precaution may result in severe damage to the steering and lubrication circuit hydraulic pump.*

1. Turn steering onto full left hand lock.

2. Disconnect left hand turn feed hose at steering cylinder.



Power Steering Circuit Pressure Test

1. Pressure Gauge FT. 8503A
2. Adaptor FT. 8503–8 or FNH 00705
3. Test Hose E1NN F493 AA Finis Code 3936707
4. Adaptor 4FT.853 (11/16 x 16UN to $^{7}/_{16}$ JIC)
5. Left Hand Turn Steering Hose

3. Install 0–6000 lbf/in^2 pressure gauge FT. 8503A, Figure 58.

4. Start tractor and set engine speed to 1450 rev/min. Turn steering wheel to the left with a pull of approximately 5 lbf and observe the pressure reading.

The pressure reading for all 5640–7840 2WD tractors should be 2220–2370 lbf/in^2 (153–163 bar). The pressure reading for all other tractors should be 2620–2770 lbf/in^2 (180–191 bar).

If the steering test was satisfactory but the pressure readings are away from specification the relief valve in the steering motor must be adjusted.

TRACTORS INSTALLED WITH FIXED DISPLACEMENT TANDEM GEAR PUMPS

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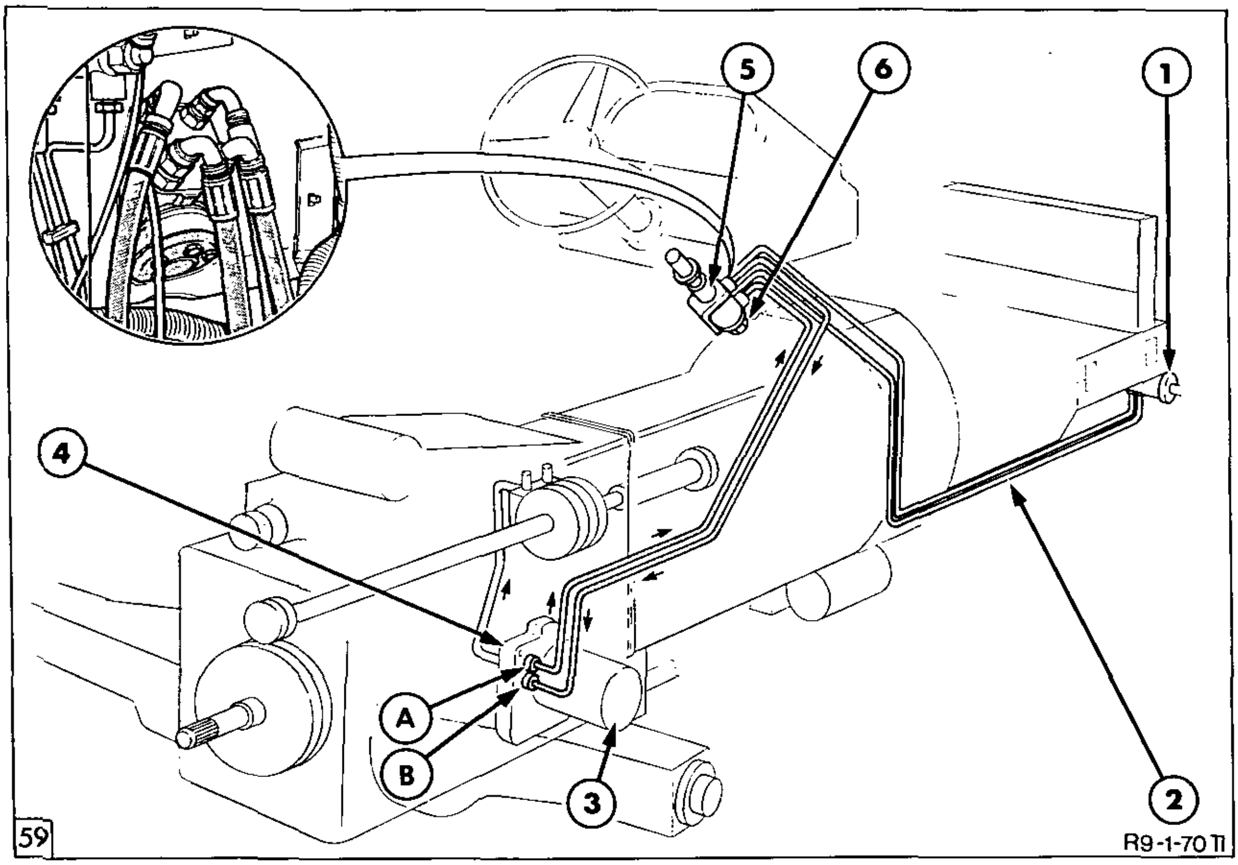


Hydrostatic Steering System Component Layout – Tandem Gear Pump Models

1. Steering Cylinder
2. Steering Pipes
3. Filter
4. Hydraulic Pump
5. Pressure Relief Valve
6. Hydrostatic Steering Motor

A. Pump Supply to Steering Motor
B. Steering Motor Return to Low Pressure System

On tractors installed with the fixed displacement tandem gear type pump the oil supply for the steering, low pressure and lubrication circuits is only supplied by the steering pump within the tandem pump assembly.

Figure 59, illustrates the flow of oil from the steering pump to the steering motor, low pressure and lubrication circuits on tractors installed with a tandem pump.

As with tractors installed with the variable displacement (CCLS) hydraulic pump, the maximum pressure of oil supplied by the pump to the hydrostatic steering circuit, during steering operations, is regulated by the steering motor relief valve. This valve *operates at 2100 lbf/in² (145 bar) maximum* differential pressure on 5640–7840 two wheel drive tractors and 2500 lbf/in² (172 bar) maximum differential pressure on all other models.

Differential Pressure

Differential pressure is the difference in pressure between the supply and sump ports on the steering motor. Measured (gauge) pressure is equal to the relief valve setting plus system back pressure.

System back pressure varies between 120 and 270 lbs in² (8.3 to18.6 bar) depending on hydraulic system.

The flow of oil on leaving the steering motor returns to the pump body for distribution to the low pressure and lubrication circuits. The pressure of oil returning from the steering motor is regulated at a pressure of 220–240 lbf/in² (15.2– 16.6 bar) by the low pressure regulating valve in the PTO clutch assembly at 2100 revs/min. As the pressure is regulated, excess oil in the low pressure *circuit flows through the regulating valve, into* an adjacent lubrication circuit relief valve which limits the pressure of oil in the lubrication circuit to 72–83 lbf/in² (5.0–5.7 bar) at 1.1 gpm (4.5 Ltrs/min).

Steering Pump

The following practical test will determine if the steering pump outlet is sufficient to allow satisfactory operation of the steering system.

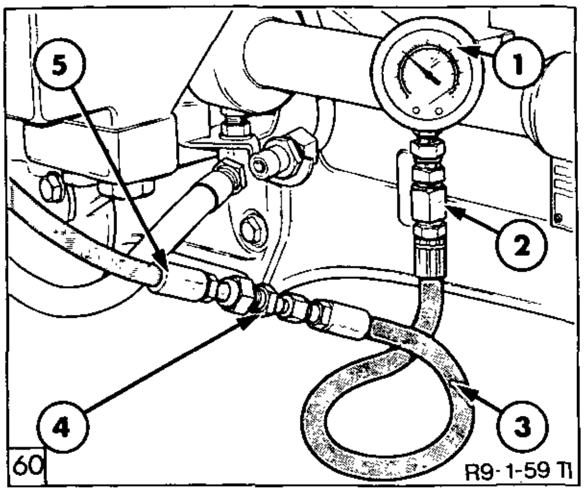
Steering Test

1. Set engine speed to 1000 rev/min.
2. Turn steering quickly from lock to lock. If steering is operating correctly the reaction of the steering should be immediate, with no time delay between turning the steering wheel and movement of the wheels. At full lock the relief valve in the steering motor should be heard to blow and the engine speed drop to approximately 970 rev/min.

Steering System Pressure Test

IMPORTANT: *The steering system pressure is controlled by a relief valve fitted in the steering motor body. Should the valve be disassembled it must be reset as described in Relief Valve Adjustment.*
To establish if the valve is operating correctly check the system pressure as detailed below.

1. Turn steering onto full left hand lock.
2. Disconnect the left hand turn feed hose at the steering cylinder.
3. Install 0–6000 lbf/in² (400 bar) pressure gauge FT.8503A, Figure 60.



Power Steering Circuit Pressure Test

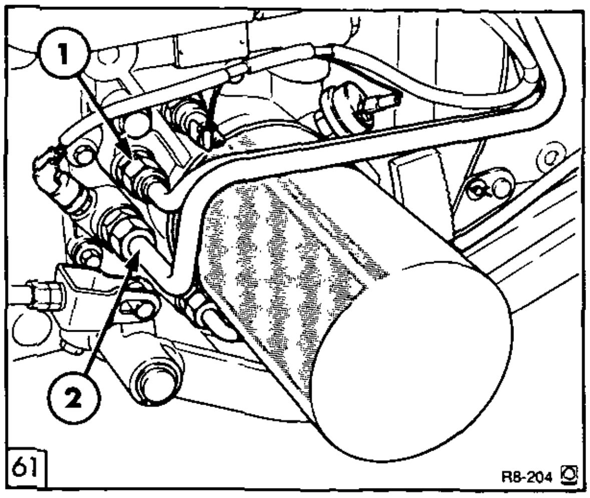
1. Pressure Gauge FT.8503–A
2. Adaptor FT.8503–8 or FNH 00705
3. Test Hose E1NN–F493–AA (Finis Code 3936707)
4. Adaptor 4FT.853
5. Left Hand Turn Steering Hose

4. Start tractor and set engine speed to 2100 rev/min.
5. Using a force of approximately 5 lbf. hold steering wheel on full left hand lock and observe the pressure reading. The use of a force greater than 5 lbf. at the rim of the steering wheel may lead to slightly inaccurate readings due to the pumping action of the hydrostatic steering motor.
6. Reduce the engine speed to 1450 rev/min and again observe the pressure reading.

The pressure readings should be:–
5640–7840 2WD Tractors
2220–2370 lbf/in² (153–163 bar).
All 4WD and 6 cyl 82/8340 2WD Tractors
2620–2770 lbf/in² (180–191 bar).

7. If the system pressure is not to specification proceed to Relief Valve Adjustment.

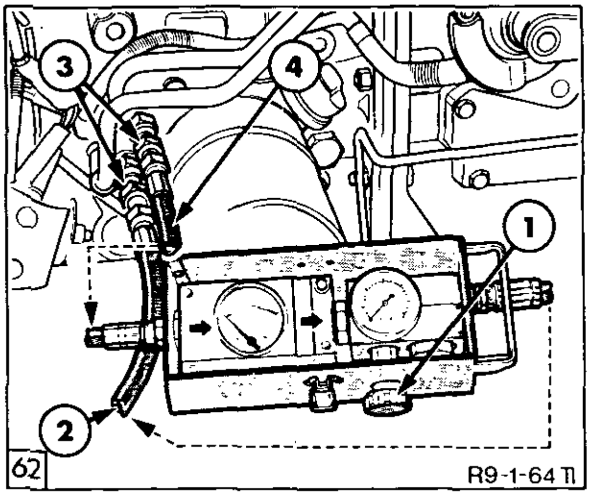
Steering Pump Flow Test



Steering Motor Feed and Return Tubes

1. Feed Tube to Steering Motor
2. Return Tube from Steering Motor

1. Disconnect feed and return tubes to steering motor, Figure 61.



Installation of Flowmeter for Steering Pump Flow Test

1. Flowmeter Load Valve
2. Return Hose from Flowmeter
3. Adaptors 4FT.859
4. Inlet Hose to Flowmeter

2. Install flowmeter, Figure 62.

NOTE: *The flowmeter used for this test must be capable of withstanding a back pressure off 300 lbf/in^2 (21 bar).*

If hoses of a different size are used with the flowmeter, suitable adaptors with a female thread size of $^{13}/_{16}$ in–*16 ORFS for installing onto the pump inlet and outlet ports will be required.*

3. It is important to Ensure that the flowmeter load valve is fully open.

IMPORTANT: *If the flowmeter load valve remains closed damage will occur to the steering pump.*

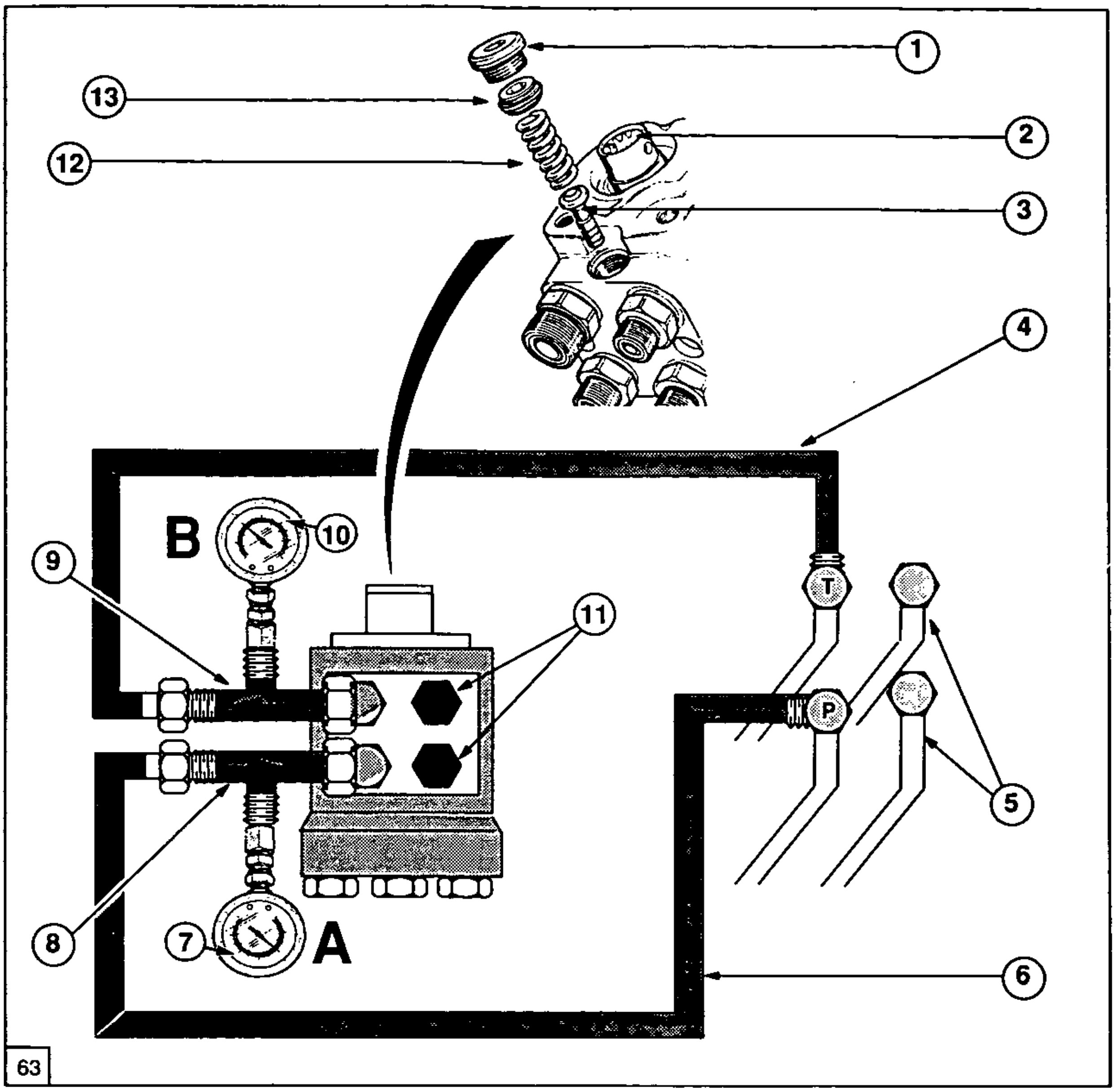
4. Set engine speed to 2100 rev/min and slowly close the load valve until a pressure of 2000 lbf/in^2 (138 bar) is recorded on the flowmeter pressure gauge. **DO NOT** increase the pump pressure beyond this value.

5. Record the pump flow.

If pump flow is less than 6.8 Imp gals/min (8.2 U.S. Gals/min 31 Ltrs/min) the steering pump requires overhaul.

IMPORTANT: *If the flowmeter load valve remains closed the low pressure lubrication supply to the transmission shafts will cease with possible damage to the transmission.*

Depending on engine speed, the pressure should be 73–123 lbf/in^2 (5.0–8.5 bar).
73 lbf/in^2 (5.0 bar) is the minimum operating pressure of the lubrication circuit relief valve, located in the PTO valve and clutch assembly.



Steering Motor Relief Valve Adjustment

1. Plug
2. Steering Shaft
3. Relief Valve
4. Fabricated Steering Motor Output Hose
5. Tractor Tubes to Steering Cylinder
6. Fabricated Hose for Pump Supply to Steering Motor
7. Pressure Gauge 0–5000lbf.in²
8. Size 8 ORS Swivel Running Tee
9. Size 10 ORS Swivel Running Tee
10. Pressure Gauge 0–500lbf.in²
11. Size 6 ORS Blanking Cap
12. Spring
13. Adjuster

Relief Valve Adjustment – All Models

With reference to Figure 63.

NOTE: *To adjust the steering system relief valve it is necessary to remove the steering motor from the steering bracket, to gain access to the hexagon headed adjusting screw.*

1. Disconnect the steering motor from the steering bracket, as detailed in Section C of this Chapter, and remove from the tractor.

2. Fabricate suitable test hoses to connect from the tractor pressure and return tubes. Connect the hoses into locally procured tee pieces and install pressure gauges. Start the engine and idle between 1450 and 1500 rev/min. Run the tractor until the transmission oil reaches normal working temperature of approximately 68°C (155°F).

3. With the engine running, turn the steering motor shaft to obtain full lock. The pressure gauge reading at point ‘A’ should read 2350 lbf.in² (162 bar) on 2wd models and 2750 lbf.in² (190 bar) on 4wd models. The gauge pressure at point ‘B’ should be in the region of 250 lbf.in² (17 bar).

4. To establish actual (differential) pressure subtract gauge ‘B’ reading from the gauge ‘A’ reading. The differential

pressure should be to the specification of:
Gauge 'A' 2350 lbf.in^2 (162 bar) minus Gauge 'B 250 lbf.in^2 (17 bar) =
2100 lbf.in^2 (145 bar) on 2WD models
Gauge 'A' 2750 lbf.in^2 (190 bar) minus Gauge 'B 250 lbf.in^2 (17 bar) =
2500 lbf.in^2 (172 bar) on all 4WD models and 82/8340 2WD models

5. If the pressure readings are not correct, reset the adjuster (item 13), Figure 63, using an 8mm hexagon key. Half a turn on the adjuster equates to approximately 200 lbf.in^2 (13.8 bar).

6. Once the relief valve is in the correct position apply a small amount of sealer to the adjuster to hold in the set position.

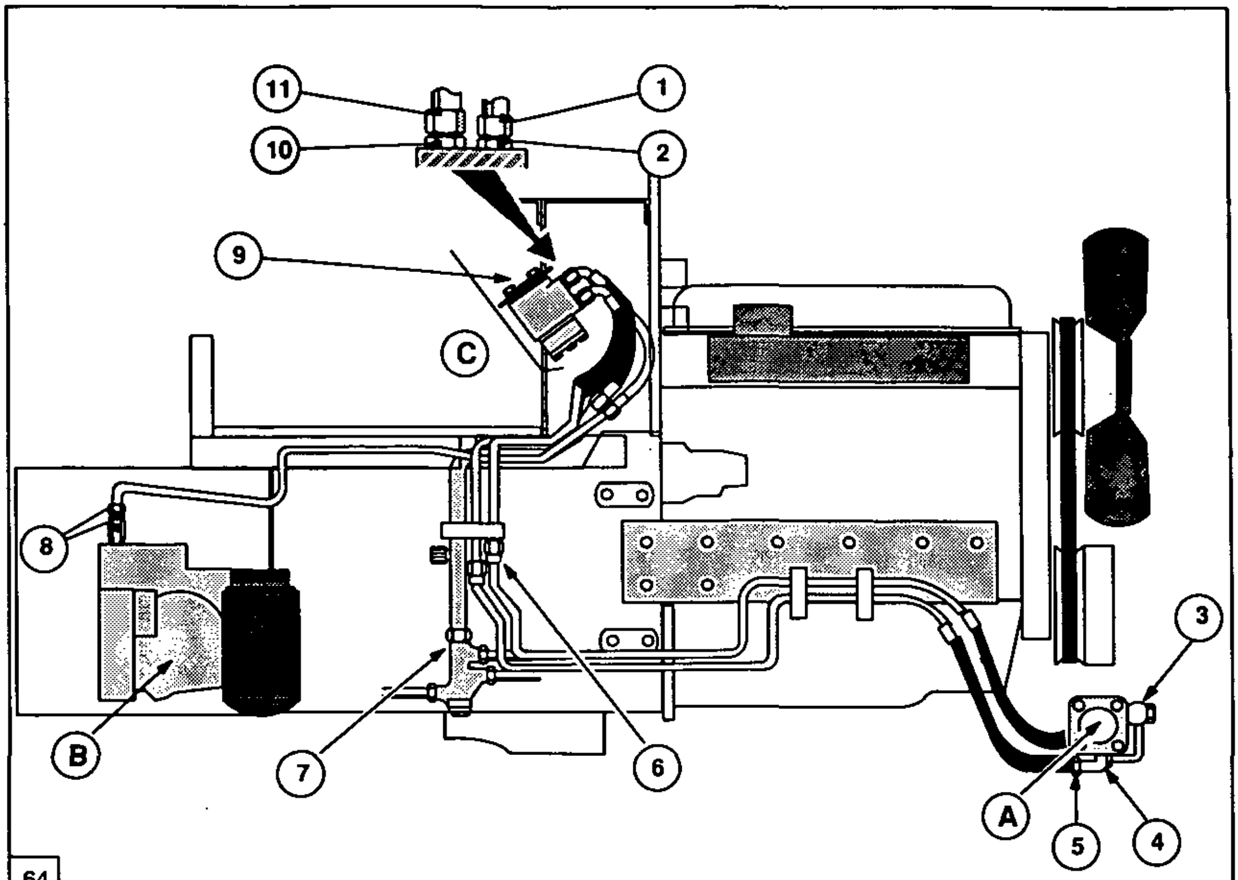
7. Replace the relief valve plug and torque to 8 lbf ft (11 Nm), disassemble the test rig and re–assemble the motor to the vehicle.

H. SPECIFICATIONS – TORQUES – SPECIAL TOOLS

Specifications

HYDROSTATIC SYSTEM		
Minimum Pump Output (all Models)	6.8 Imp.Galls/Min (31 Litres/Min) (8.2 US. Galls/Min)	
Pump specifications	**56–7840 2wd only**	**82–8340 2wd/all 4wd**
Steering Motor Displacement	125cc/revolution	150cc/revolution
Relief Valve Maximum Differential Pressure Setting	145 Bar 2100 lbf.in^2	172 Bar 2500 lbf.in^2
Absolute Gauge Pressure	153–163 Bar 2220–2370 lbf.in^2	180–190 Bar 2620–2770 lbf.in^2
	TWO WHEEL DRIVE AXLE	
	5640–7840	**8240–8340**
Maximum Steering angle	55°	55°
Steering Wheel Turns (Lock to Lock)	3.37 (56–7840)	3.46 (82–8340)
Cylinder	Double acting Balanced	
Turning Radius with Brakes	3.27m	3.88m
Turning Radius less Brakes	3.66m	4.32m
Toe–Out	0–13 mm (0.0–0.5 in)	
	FOUR WHEEL DRIVE AXLE	
	5640–7740 **(4 Cylinder)**	**7840–8340** **(6 Cylinder)**
Maximum Steering angle	55°	55°
Steering Wheel Turns (Lock to Lock)	4.74	
Cylinder	Double acting Balanced	
Turning Radius with Brakes (4WD disengaged)	3.27m	3.88m
Turning Radius less Brakes (4WD disengaged)	3.66m	4.32m
Toe–In	13 mm (0.5in)	

Tightening Torques



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A. Steering Cylinder
C. Steering Motor

B. Variable Displacement / Tandem Gear Pump

Steering System (Figure 64)	**lbf ft**	**Nm**	**kgf m**
1 Steering Hose Connections (Flow Out)	54.0	73.0	7.3
2 Steering Motor Connections	61.0	83.0	8.3
3 Cylinder Connections	24.0	33.0	3.4
4 Elbow to Cylinder	25.0	34.0	3.5
5 Tube to Cylinder Connections	25.0	34.0	3.5
6 Tube Connections	25.0	34.0	3.5
7 By Pass Valve Connections	27.0	36.0	4.0
8 Pump connections	37.0	50.0	5.0
9 Motor Attaching Bolts	21.0	28.0	2.8
10 Steering Motor Connections	61.0	83.0	8.3
11 Steering Hose Connections (Return)	54.0	73.0	7.3

Steering General

Steering Wheel Retaining Nut	17.0	23.0	2.3
Front Wheel Nut 2WD	98.0	133.0	13.3
Front Wheel Nut 4WD	350.0	475.0	47.5
Motor End Cover	17.0	23.0	2.3
Cylinder Ball–joint to Extension	32.0	43.0	4.3
Cylinder Ball–joint to Axle	130.0	176.0	17.6
Cylinder Ball-joint Clamps	32.0	43.0	4.4
Cylinder Ball-joint Nuts	130.0	176.0	18.0
Cylinder Extension Tube to Cylinder	200.0	271.0	27.5
Column Tilt Bolt	17.0	23.0	2.3

Special Tools

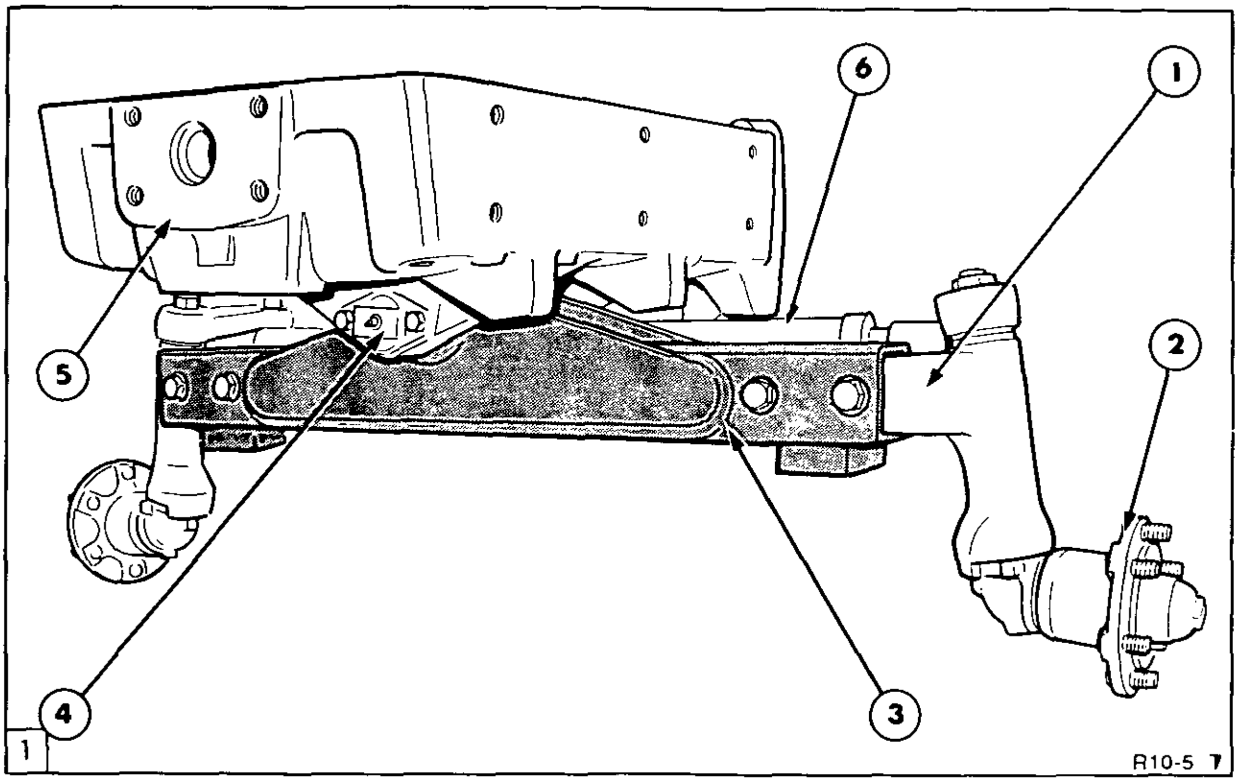
DESCRIPTION	V.L.CHURCHILL TOOL No.	NUDAY TOOL No.	DANFOSS TOOL No.
Pressure Gauge (0–6000 lb/in^2)	FT8503A	2028	–
Seal Installer	–	–	Danfoss No. SJ.150-9000-11
Adapter	4FT 852	–	–
Adapter	FT8503–8		FNH00705
Test Hose E1NN F493 AA (Finish Code 3936707)			
Adapter	4FT853		
Pressure Gauge (0–400 lbf.in^2)	FT8616		FNH 06653
Adapter	4FT 850		
Adapters	4FT 859		
Oil Seal Installation	New Holland 395892 Finis Number8395892		

10

PART 10
FRONT AXLE

Chapter 1
TWO WHEEL DRIVE AXLE

A. DESCRIPTION AND OPERATION



Two Wheel Drive Axle Assembly

1. Telescopic Axle Extension
2. Wheel Hub and Spindle
3. Centre Beam
4. Support Pin
5. Front Support
6. Track Control Rod Assembly

The two wheel drive front axle consists of a hollow centre beam with telescopic axle extensions and spindle assemblies at each end, Figure 1.

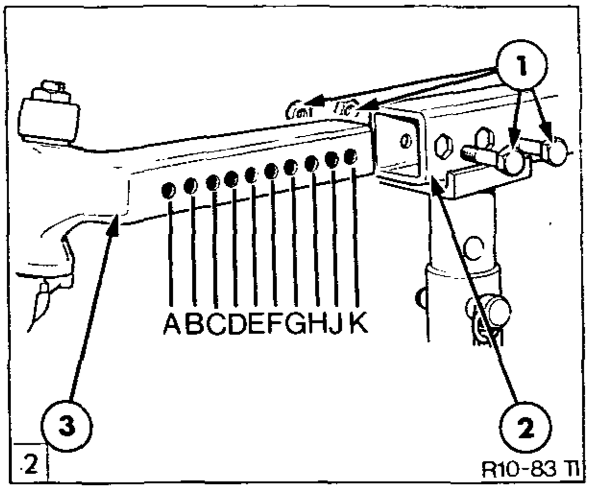
The centre beam is attached to the support using a single pin, allowing radial movement of the axle about the centre line of the tractor.

The axle is equipped with hydrostatic steering as standard using a cylinder connected between the axle beam and track control rod assembly.

The centre beam, telescopic extensions and track control rod are machined to provide a series of holes allowing the track of the axle to be varied in 4 in (102 mm) steps between 56 in (1422 mm) and 84 in (2134 mm) depending on the tractor model.

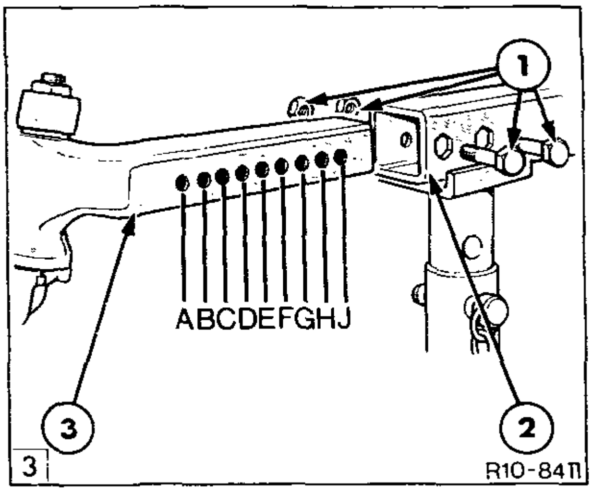
B. ADJUSTMENTS

TRACK WIDTH ADJUSTMENT



Front Axle Extension
56–7840 Tractors

1. Securing Bolts
2. Centre Beam
3. Telescopic Extension



Front Axle Extension
82–8340 Tractors

1. Securing Bolts
2. Centre Beam
3. Telescopic Extension

1. Apply the handbrake and place blocks at the front and rear wheels.

2. Jack up the front axle and place on axle stands.

3. Remove axle extension securing bolts, Figure 2 or Figure 3.

4. Remove locating bolts from both ends of track rod, Figure 4 and Figure 5.

5. Set the left and right hand axle extensions to the required track as indicated in the following tables.

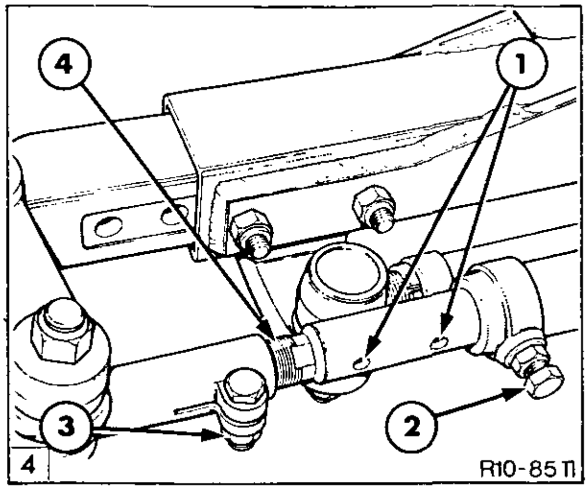
NOTE: *The track settings shown are approximate. The front wheel discs are off–set relative to the centre line of the rim. The track settings in the table are with the dished side of the wheel nearest the axle hub. If the front wheels are reversed on the hubs the track settings shown in the tables will be increased by approximately 4 in. (100 mm).*

5640 – 7840 Tractors

Track Setting		Securing Bolt Locations Refer to Figure 2	
in.	mm		
56	1422	A	C
60	1524	B	D
64	1626	C	E
68	1727	D	F
72	1829	E	G
76	1930	F	H
80	2032	G	J
84	2134	H	K

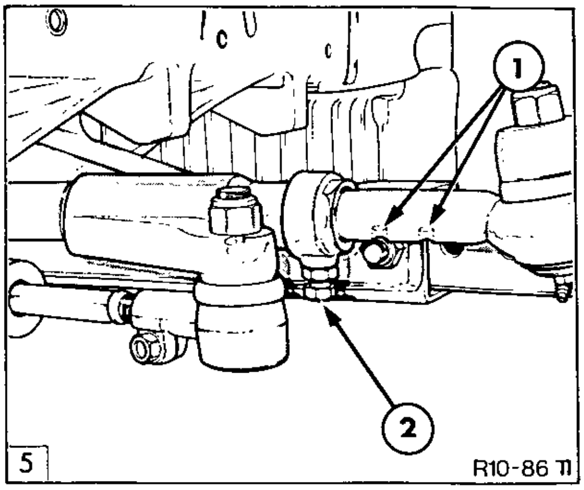
8240 and 8340 Tractors

Track Setting		Securing Bolt Locations Refer to Figure 3	
in.	mm		
60	1524	A	C
64	1626	B	D
68	1727	C	E
72	1829	D	F
76	1930	E	G
80	2032	F	H
84	2134	G	J



Track Control Rod – Left Hand End

1. Drillngs
2. Locating Bolt and Locknut
3. Clamp Bolt
4. Threaded Section



Track Control Rod – Right Hand End

1. Drillings
2. Locating Bolt and Locknut

6. Install the axle extension securing bolts and tighten to a torque of 300 lbf ft (407 Nm).

7. Position both wheels straight ahead and install the track control rod locating bolts. Tighten the bolts to a torque of 110 lbf ft (150 Nm) and their locknuts to 55 lbf ft (75 Nm). Re–check all torque settings after 50 hours of operation.

FRONT WHEEL TRACK ADJUSTMENT

After resetting the track width, the front wheel **'Toe–Out'** may require adjustment. For correct operation, the front wheel toe–out should be 0–0.5 in. (0–13 mm).

1. Position the front wheels in the straight ahead position and measure the distance between the wheel rims at hub height at the **front** of the wheels. Position B, Figure 6.

2. Rotate both wheels 180°, to eliminate wheel rim run out errors and check the measurements at the rear of the wheels in position A, Figure 6.

3. Calculate the toe–out measurement by subtracting dimension A from dimension B.

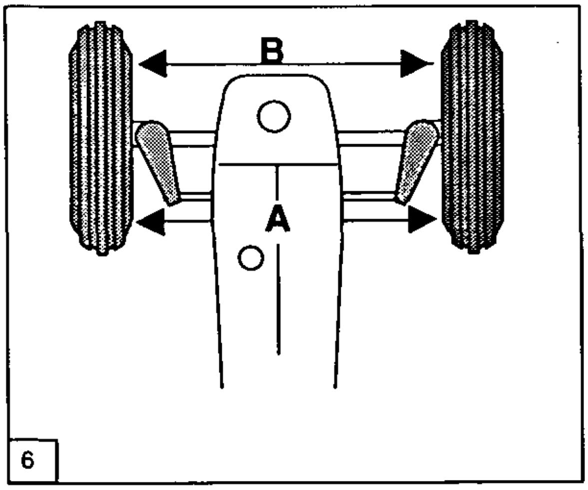
NOTE: *If the toe out is correctly adjusted, Dimension A should be up to 0.5 in (13 mm) greater than dimension B.*

Where necessary adjust tracking as follows:

4. Remove locating bolt from left hand end of track rod, Figure 4.

5. Slacken clamp bolt and turn threaded section of track rod in or out until toe–out is correct when the locating bolt is re–inserted.

6. Tighten the locating bolts to a torque of 110 lbf ft (150 Nm) and their locknuts to 55 lbf ft (75 Nm).



Track Rod Adjustment

C. FRONT AXLE–OVERHAUL

The wheel hubs spindles and extensions can be serviced without removing the axle from the tractor. It is only necessary to remove the axle in order to replace the bushes in the centre beam.

For overhaul of the steering cylinder refer to Part 9 Steering Systems.

HUB AND BEARING OVERHAUL

REMOVAL

1. Use a suitable jack or hoist to support the tractor and remove wheel.

2. Remove hub grease retaining cap and castellated nut, Figure 8 or Figure 9.

NOTE: *On 5640–7840 tractors the retaining cap unscrews from the hub and on 8240/8340 tractors the retaining cap is a push fit into the hub.*

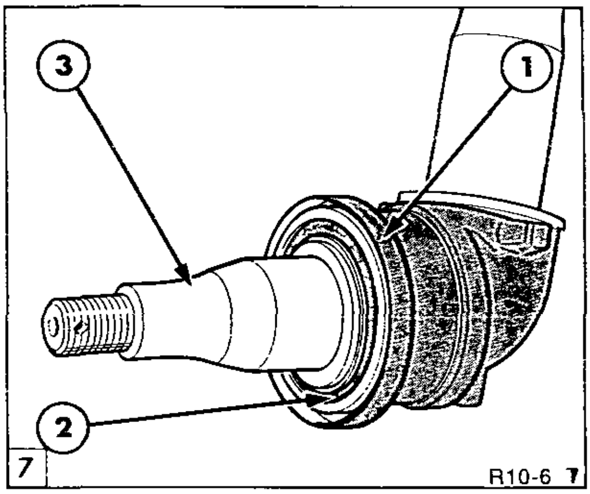
3. Pull hub assembly from spindle and separate components.

4. On 8240 and 8340 tractors remove mud shield from spindle.

INSPECTION AND REPAIR

1. Clean all components using a suitable cleaning agent such as paraffin (Kerosene).

2. Inspect hub inner and outer bearings and cups. If damaged they should be replaced as an assembly, ensuring that the new cups seat correctly against the shoulders in the wheel hub.



7

Mud Shield
8240 and 8340 Tractors

1. Mud Shield
2. Grease Retainer
3. Spindle

RE–ASSEMBLY

1. 8240 and 8340 tractors only:
   Press a new mud shield onto the spindle, Figure 7.

2. Position grease retainer and inner bearing on spindle.

3. Pack the hub and bearing with grease to Specification ESA–MIC 75–B or ESEN–M!C137–A.

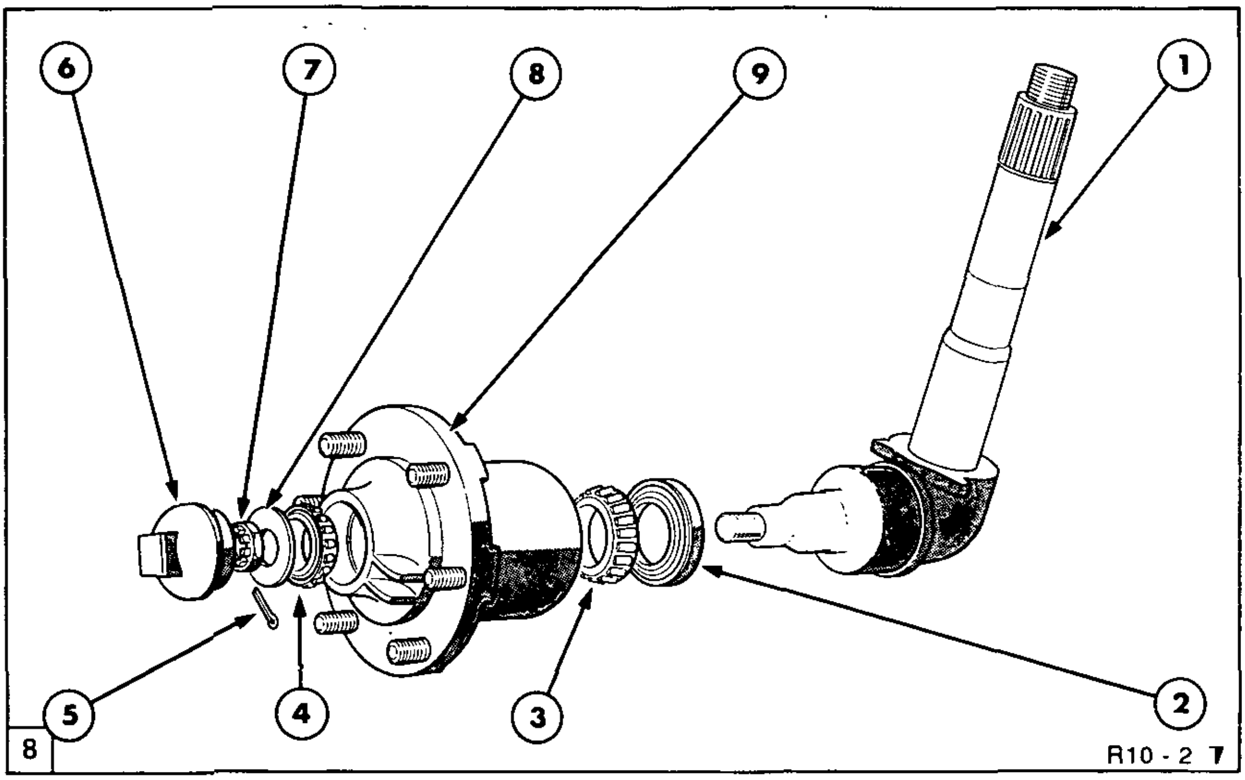
4. Install hub, outer bearing, washer and castellated nut.

5. Tighten castellated nut to a torque of 20–30 lbf ft (27–40 Nm)

6. Rotate hub clockwise 3–6 revolutions.

7. Further tighten the retaining nut to a torque of 45–55 lbf ft (61–74 Nm) and install a new split pin.

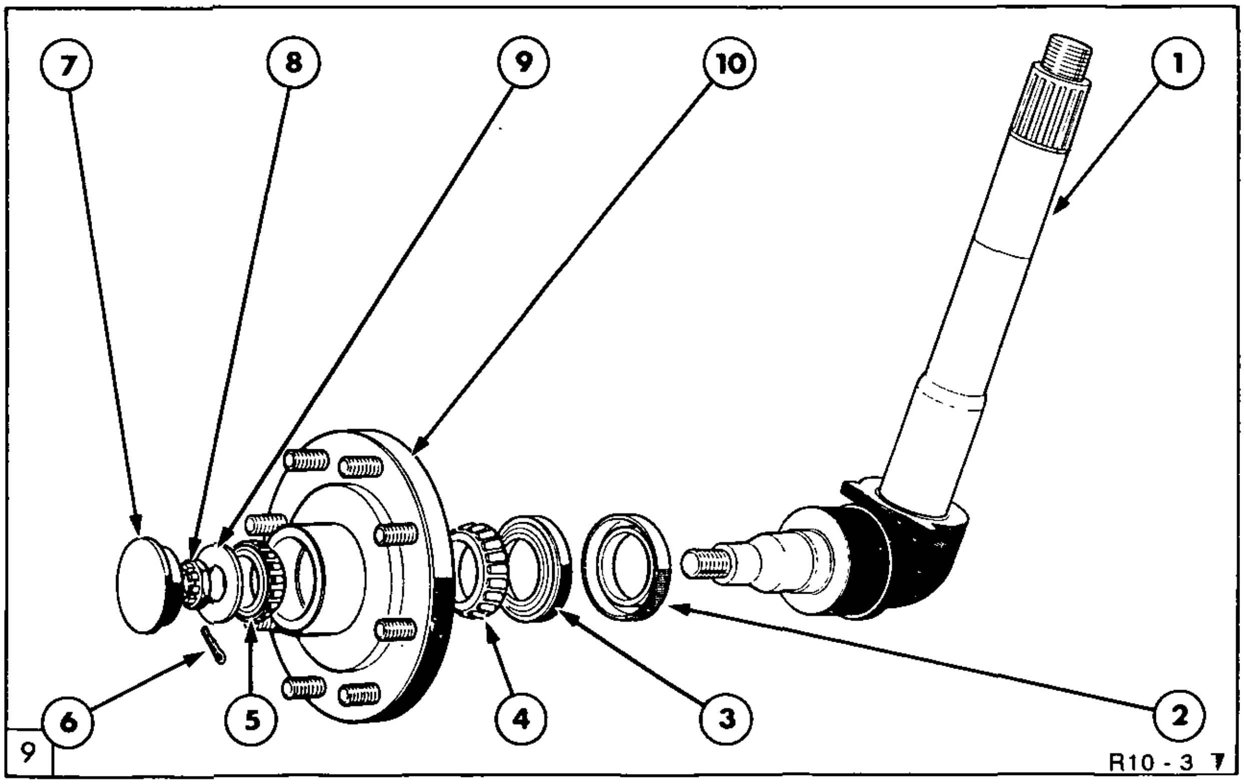
8. Pack the outer bearing with grease and install the cap.



8

Hub and Spindle Assembly
5640–7840 Tractors

1. Spindle
2. Grease Retainer
3. Inner Bearing
4. Outer Bearing
5. Split Pin
6. Grease Retaining Cap
7. Castellated Nut
8. Washer
9. Hub



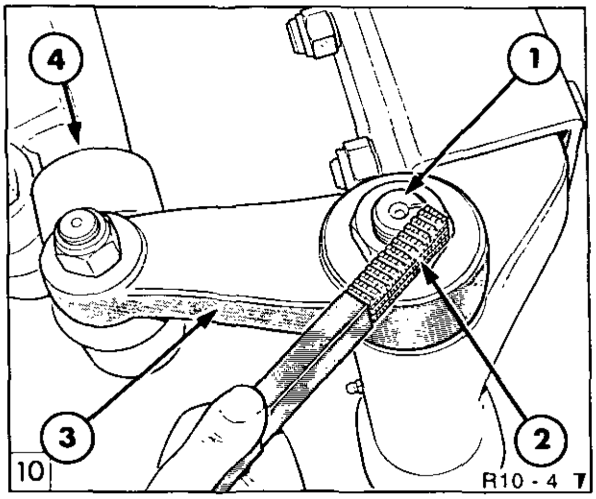
9

Hub and Spindle Assembly
8240 and 8340 Tractors

1. Spindle
2. Shield
3. Grease Retainer
4. Inner Bearing
5. Outer Bearing
6. Split Pin
7. Grease Retaining Cap
8. Castellated Nut
9. Washer
10. Hub

SPINDLE OVERHAUL

REMOVAL



Cleaning Spindle Arm Thread

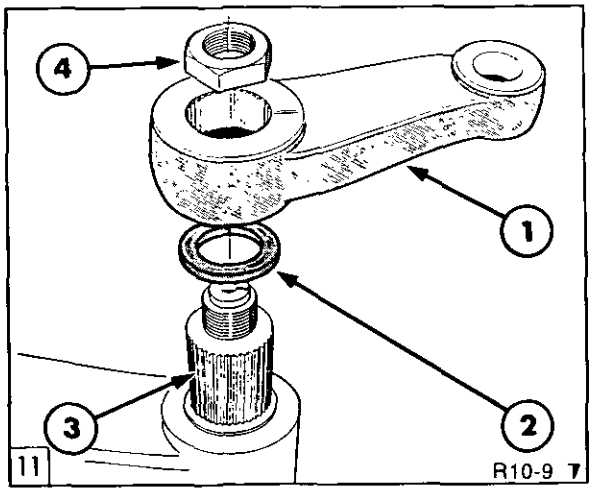
1. Spindle Thread
2. Thread File
3. Spindle Arm
4. Track Control Rod Assembly

1. Use a suitable jack or hoist support the tractor and remove wheel.

2. Using a thread file clean the threads at the top of the spindle, Figure 10.

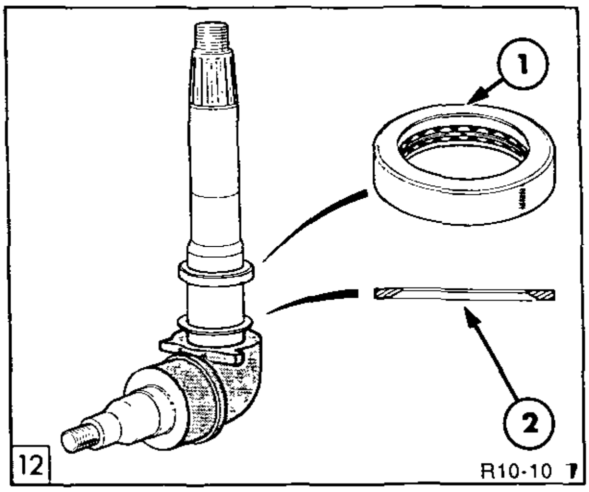
NOTE: *The threads are deformed during assembly to act as a locking device on the spindle arm retaining nut.*

3. Disconnect track control rod assembly from spindle arm.



Spindle Arm Installation

1. Spindle Arm
2. Felt Washer
3. Spindle
4. Nut



Wheel Spindle Removal

1. Thrust Bearing (Manufactures Name on Top)
2. Spacer (Chamfered Edge on Bottom)

4. Using a suitable puller remove spindle arm, Figure 11.

5. Remove spindle, thrust bearing and spacer, Figure 12.

INSPECTION AND REPAIR

1. Clean all components using a suitable cleaning agent such as paraffin (Kerosene).

2. Inspect the spindle bearing surfaces, thrust bearing and washer for wear or damage.

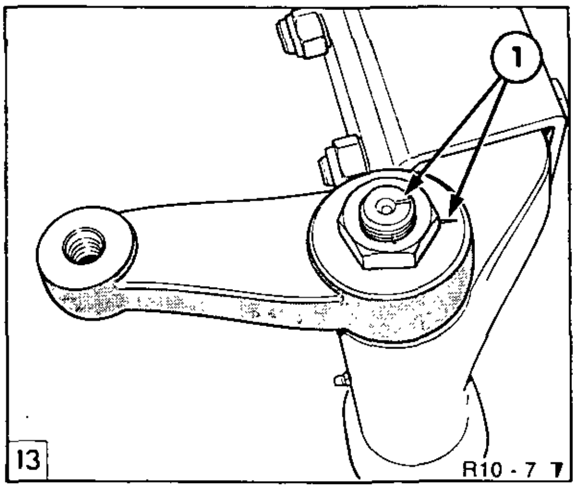
3. Inspect the spindle bushes in the top and bottom of the axle telescopic extensions.

   If worn remove extension from tractor and replace bushes.

4. Inspect track control rod ball joints.

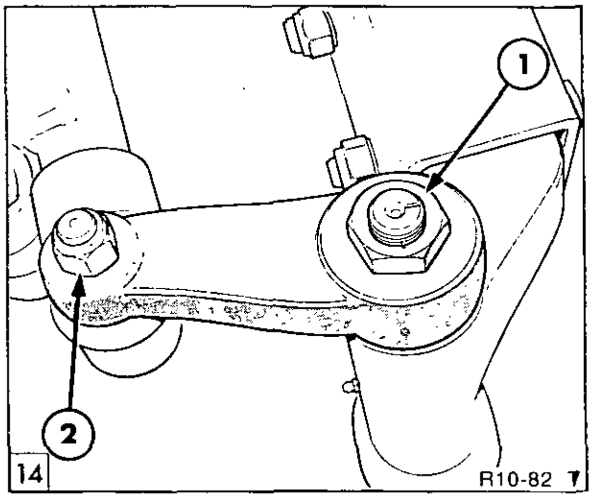
RE–ASSEMBLY

1. Position spacer on wheel spindle. Ensure chamfered edge of spacer faces down, Figure 12.
2. Position bearing on spindle with manufacturers name facing upwards.
3. Pack spindle thrust bearing with grease to specification ESA–M1C75–B or ESEN–M1C137–A and install on spindle.
4. Install spindle into axle extension. Ensure spindle rotates freely in the bushes.
5. Install a new felt dust seal



Spindle and Track Control Arm Alignment
1. Alignment Marks

6. Position arm onto the spindle ensuring the marks on both the arm and spindle are aligned, Figure 13.
7. Tighten the spindle nut to a torque of 360–440 lbf ft (488–597 Nm). To prevent the nut from loosening during normal operation deform the protruding thread adjacent to the nut.



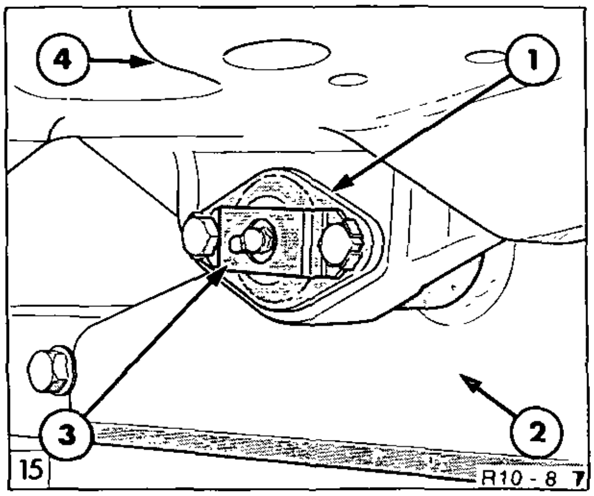
Track Control Rod Installation
1. Spindle Arm
2. Track Control Rod Ball Joint

8. Reconnect track control rod and tighten ball joint, Figure 14, to the correct torque as follows:–
   56\66\7840 Tractors
   133–170 lbf in (180–236 Nm)
   82\8340 Tractors
   200–240 lbf in (270–325 Nm)
9. After re–assembly check front wheel track adjustment. Refer to Page 3.

AXLE CENTRE BEAM AND FRONT SUPPORT OVERHAUL

REMOVAL

1. Position the front wheels straight ahead.
2. Disconnect and remove steering cylinder.
3. Raise the front of the tractor and position safety stands under the engine and remove front wheels.
4. Support axle centre beam assembly to remove weight from support pin.



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Axle Installation

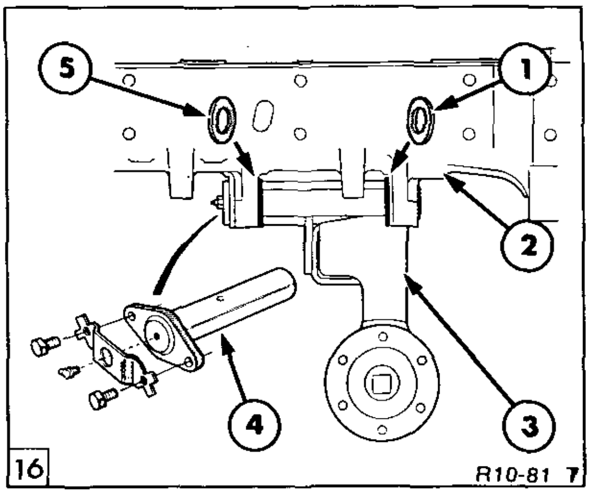
1. Support Pin
2. Axle Centre Beam
3. Locking Plate
4. Front Support

5. Remove locking plate, Figure 15.

6. Drive the pin from the support and carefully lower axle from front support.

INSPECTION AND REPAIR

1. Inspect bushes and pin, replacing if worn or damaged.



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Axle Pivot Pin Installation

1. Thrust washer
2. Front Support
3. Axle assembly
4. Pivot Pin
5. Thrust Washer

2. Replace thrust washers.

3. Replace support pin locking plate.

4. *Inspect front support for signs of cracks.*

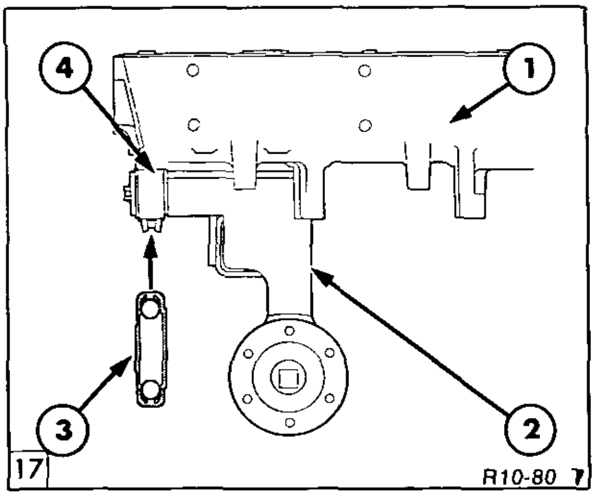
RE–ASSEMBLY

1. Install axle onto front support ensuring thrust washers are positioned at both ends of axle pivot pin bore, Figure 16.

2. Tighten support pin retaining bolts to a torque of 52–66 lbf ft (70–90 Nm) and bend locking plate tabs against bolt heads.

NOTE: *On tractors fitted with the long wheel base option, ensure the axle pivot pin trunnion to front support retaining bolts are tightened to a torque of 254–317 lbf ft (345–430 Nm) and locked in position with a locking plate. Figure 17.*

3. Reconnect steering cylinder and bleed steering system of air as described in Part 9 Steering Systems.



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Trunnion Retaining Bolts
(Tractors With Long Wheel Base Option)

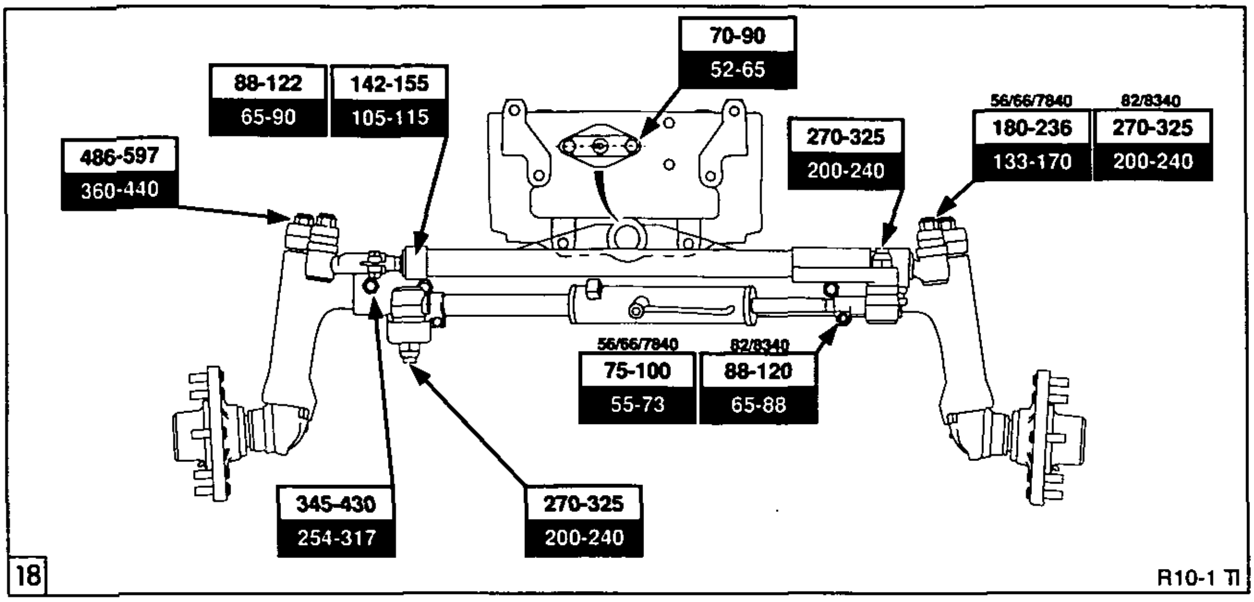
1. Front Support
2. Axle assembly
3. Retaining Bolt Locking Plate
4. Trunnion

D. SPECIFICATIONS

TORQUES

☐ Nm

■ lbf ft



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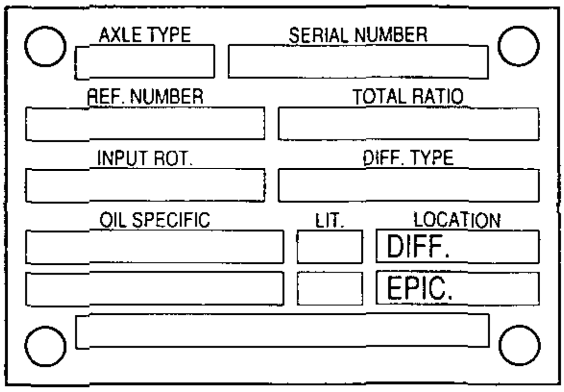
LUBRICANT

Hub bearing grease to Specification ESA–MIC 75–B or ESEN–M!C137–A.

PART 10
FRONT AXLE
Chapter 2

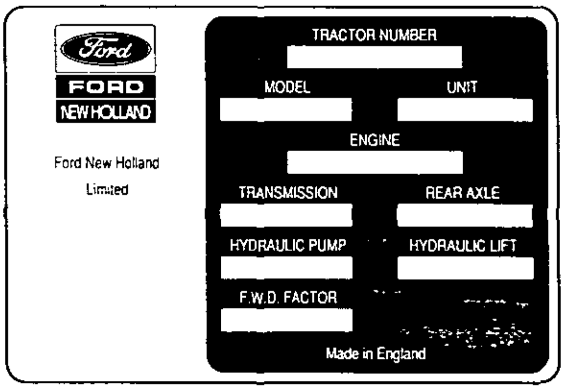
CARRARO 709 SERIES, STANDARD and HEAVY DUTY FOUR WHEEL DRIVE AXLES

A. DESCRIPTION AND OPERATION



1 R10-11 TI

Axle Identification Plate



2 R10-12 TI

Tractor Identification decal

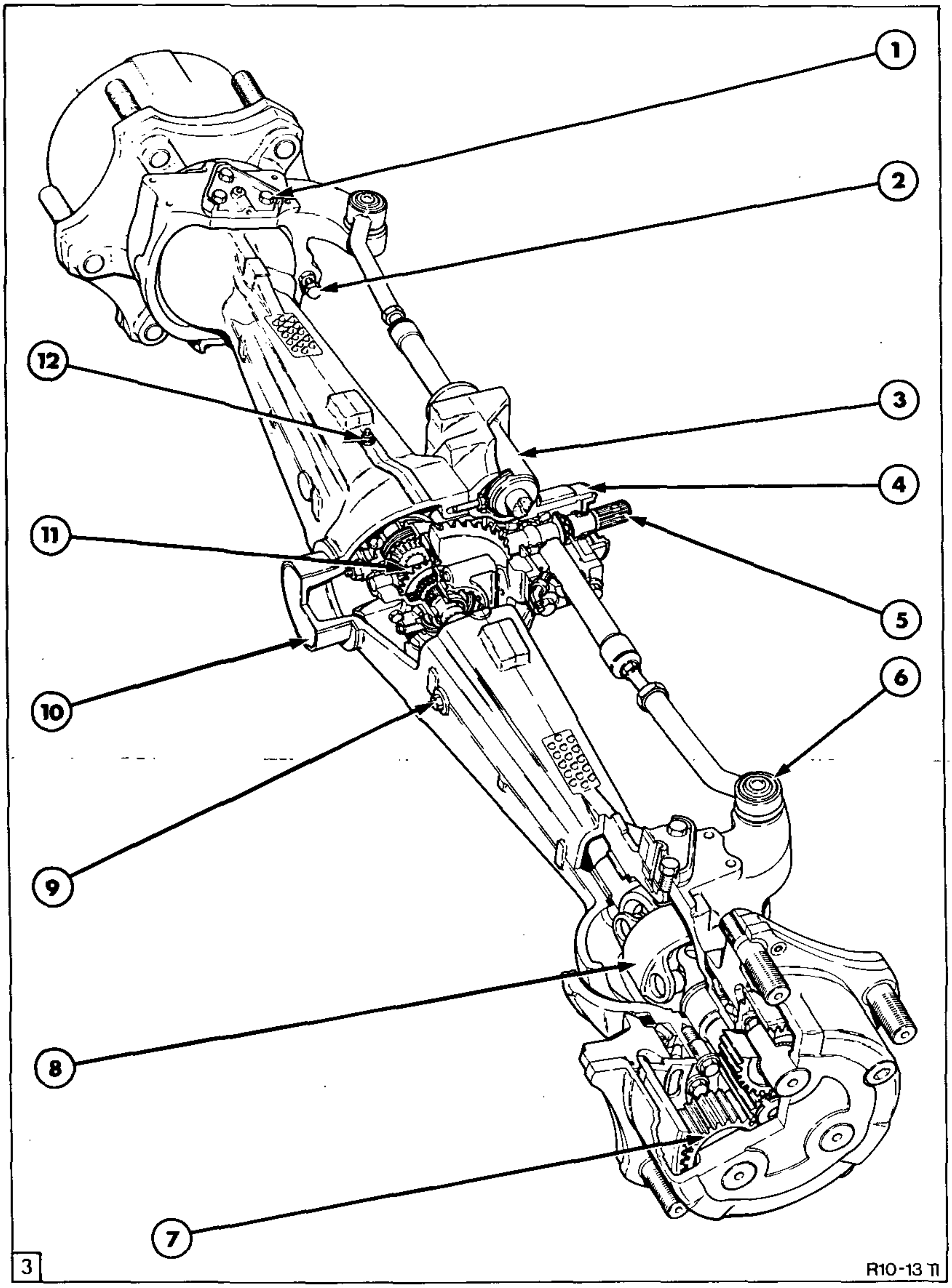
Series 40 tractors installed with four wheel drive incorporate the Carraro 709 series axle in either a standard (709–ST) or heavy duty (709–HD) 3 planetary reduction design. Refer to Figure 3 and Figure 4.

The type of axle installed can be readily identified by an identification plate on the right hand rear side of the axle, Figure 1.

A decal detailing the four wheel drive factor for the tractor is also positioned inside the right hand side engine hood, Figure 2.

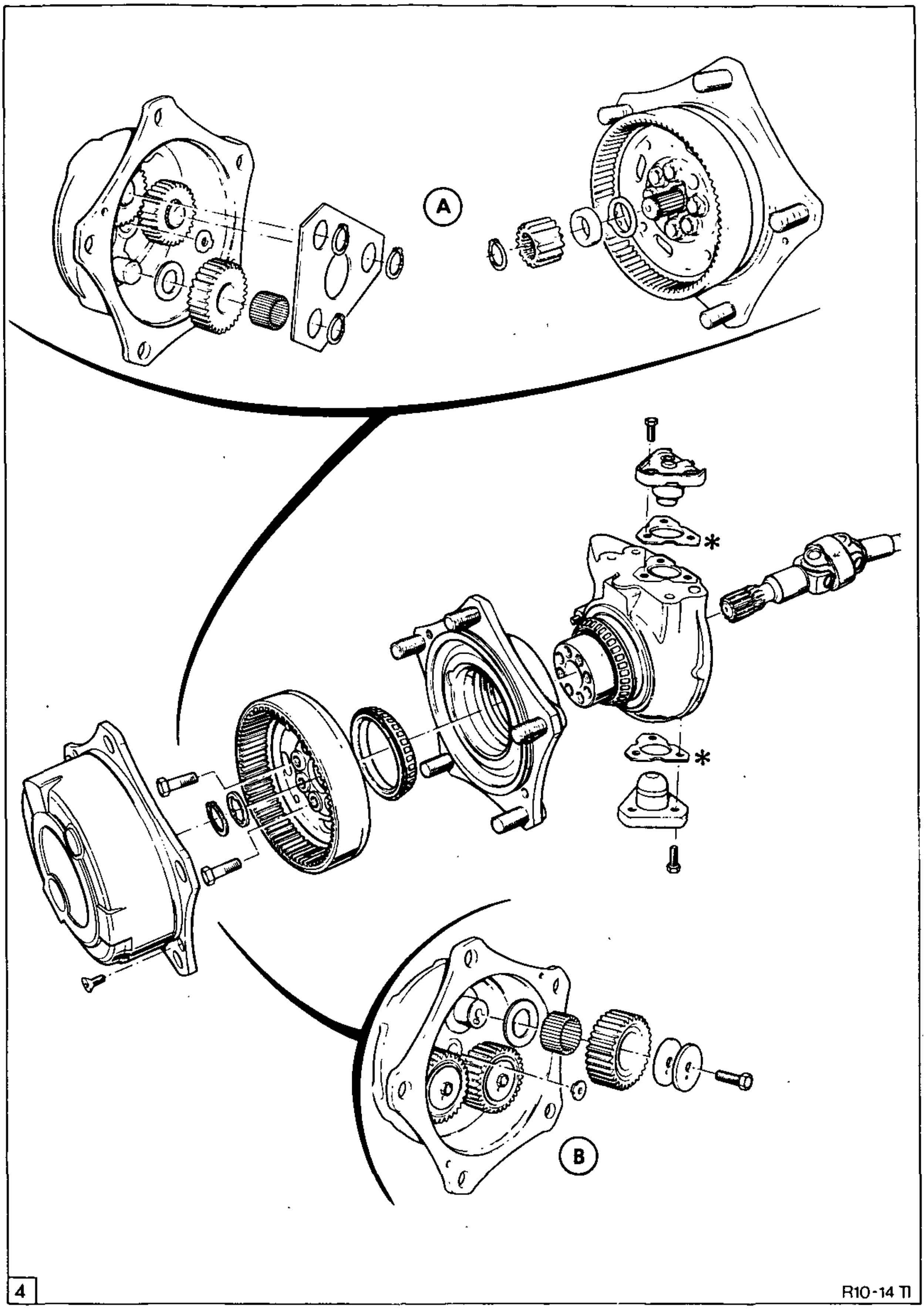
The four wheel drive axle features are summarised as follows:–

- Standard planetary reduction gear set axle on 5640 to 7840 tractors.
- Heavy duty planetary reduction gear set axle on 8240 and 8340 tractors.
- Centrally mounted differential assembly with automatic limited slip differential.
- Integral hydrostatic power steering.
- 30° – 55° infinitely variable steering angle.
- 8° – 12° axle articulation angle.
- Maintenance free universal joint axle shafts.
- Short length tractor drive shaft (without universal joints) on tractors with 16 x 16 and 12 x 12 transmissions.



Front Axle–Cutaway View

1. Swivel Pin	5. Pinion Shaft	9. Axle Oil Fill/Level Plug
2. Steering Stop	6. Track Rod End	10. Front Trunnion Mounting
3. Steering Cylinder	7. Reduction Gears	11. Limited Slip Differential
4. Rear Trunnion Mounting	8. Double Universal Joint	12. Axle Breather

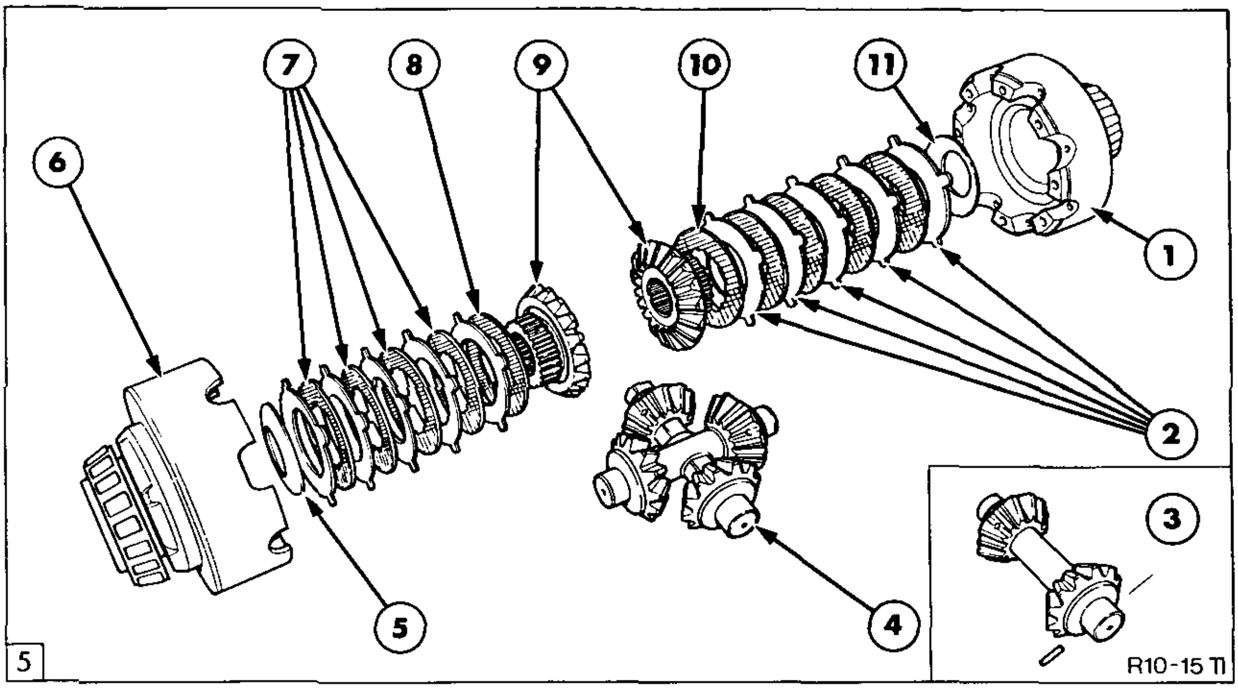


Reduction Hub Components

A – Axle Type 709–ST (5640, 6640, 7740, 7840)

B – Axle Type 709–HD (8240, 8340)

* Where Fitted



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Limited Slip Differential Components

1. Differential Housing
2. Steel Plate
3. Differential Gear Assembly (Standard Axle)
4. Differential Gear Assembly (Heavy Duty Axle)
5. Belleville Washer (Where fitted)
6. Differential Housing
7. Friction Plates
8. Thrust/Friction Plate
9. Side Gears
10. Thrust/Friction Plate
11. Belleville Washer (Where fitted)

LIMITED SLIP DIFFERENTIAL OPERATION

The limited slip action is achieved by utilising a multi–plate clutch pack on each side of the differential gears. When traction is lost on one or other front wheel, the torque reaction on the differential exerts and axial outward force through the side gears to pressurise the clutch plates. The steel plates are splined to the differential housing and the friction plates splined to the side gears, Figure 5.

As the force increases, relative movement between the friction surfaces becomes difficult and locks the side gears to the differential housing, effectively locking the differential, so as to turn as a complete unit. As soon as the torque being transmitted is reduced, the torque reaction collapses and the differential automatically unlocks.

Front axles built prior to Serial numbers PO/7373, standard axle and P2/2351, heavy duty axle, incorporate belleville washers at the ends of each clutch pack. The belleville washers pre–load the clutch plates to provide a small amount of torque transfer at all times.

FRONT AXLE SERVICEABILITY

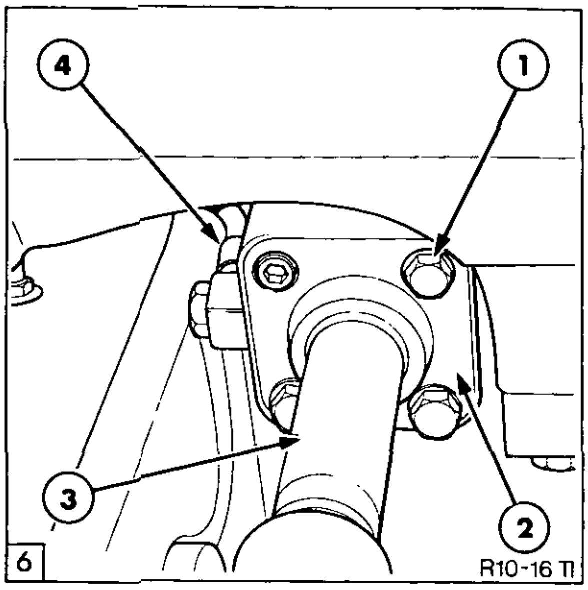
Components serviced with axle installed on tractor:

- Planetary Reduction Hub Assembly.
- Swivel Casing Assembly
- Swivel Pin Assemblies.
- Axle Drive Shaft Assemblies, Seals and Bushings.
- Steering Cylinder.

Components serviced with axle removed from tractor.

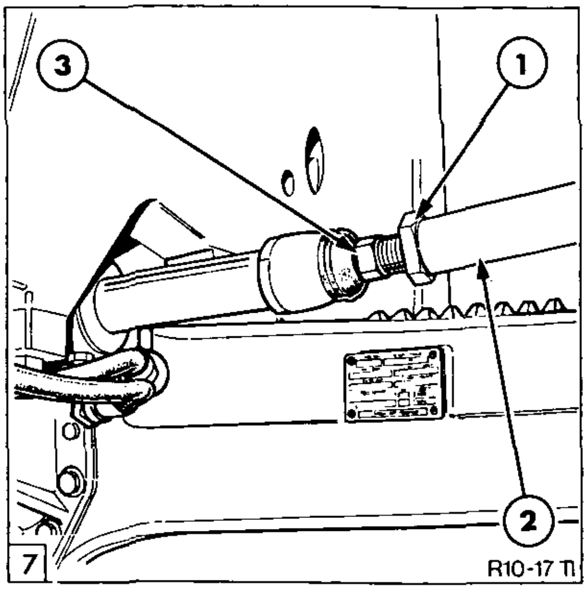
- Differential Assembly.

B. STEERING CYLINDER OVERHAUL



Steering Cylinder Left Hand Side

1. Retaining Bolts
2. End Plate
3. Cylinder Rod
4. Hydraulic Hose



Track Rod Installation

1. Locknut
2. Track Rod
3. Hexagon

The steering cylinder is located in lugs on the differential casing and is retained by four bolts, Figure 6.

The cylinder can be removed with the axle installed or with the axle removed. However, the cylinder must be removed for differential overhaul.

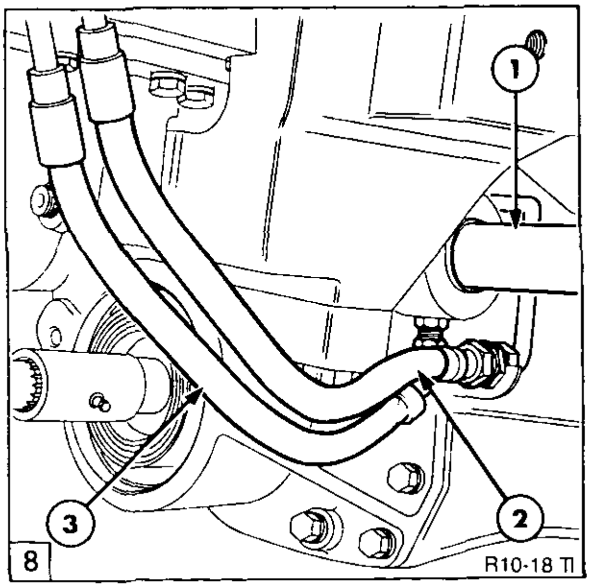
REMOVAL

Steering Cylinder Removal with Axle Installed

1. Loosen retaining bolts two turns and turn the steering wheel to the left to unseat cylinder assembly, Figure 6.
2. Jack up and support front axle and remove left hand front wheel.
3. Slacken track rod clamps, Figure 7.
4. Using spanners placed on the cylinder rod and ball joint flats, loosen the ball joints on each end of the cylinder.

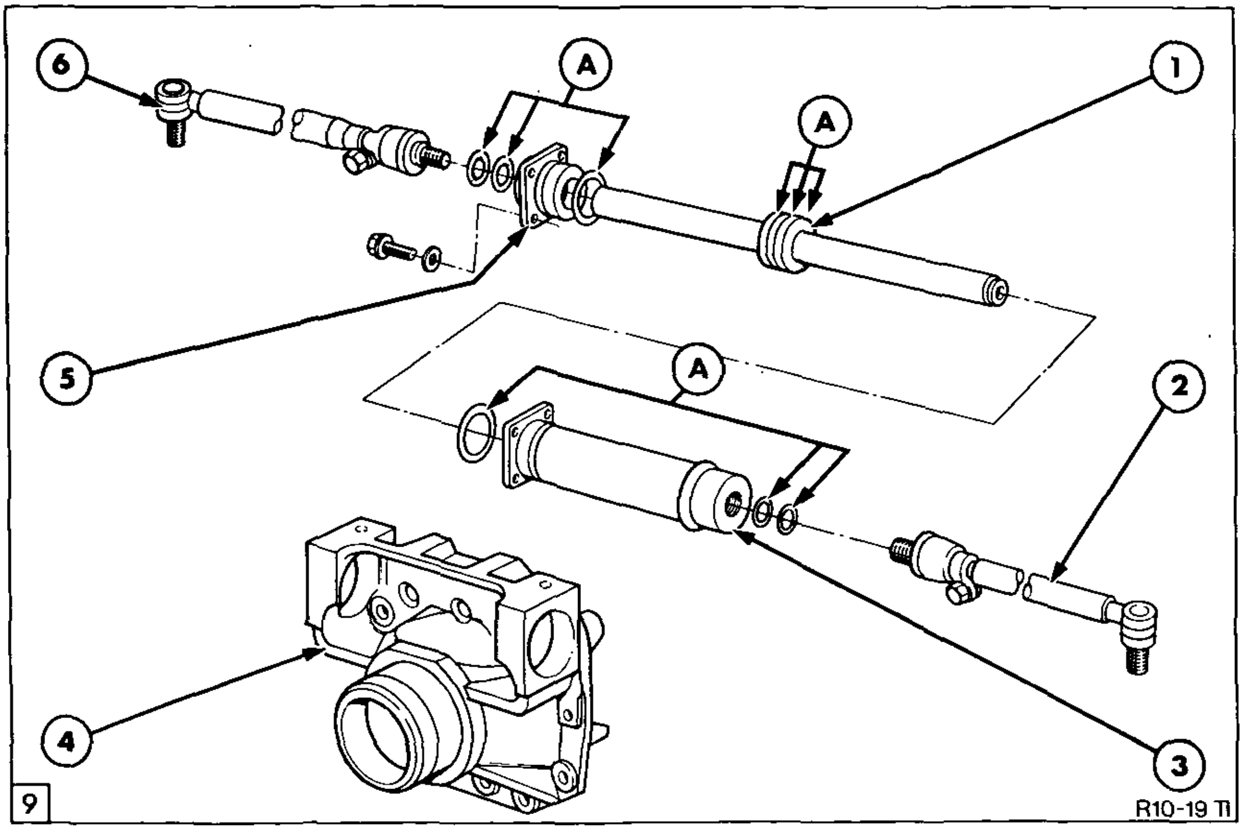
NOTE: *These joints are tightened in production to a torque of 220 lbf ft. (300 Nm).*

5. Disconnect track rods ball joints from steering arms.
6. Remove track rod end and ball joint assemblies from the steering cylinder rod.
7. Disconnect hydraulic hoses and remove hose fitting in right hand end of cylinder, Figure 6 and Figure 8.
8. Remove cylinder retaining bolts and pull out the complete assembly.



Steering Cylinder Right Hand Side

1. Steering Cylinder
2. Left Hand Turn Hydraulic Hose
3. Right Hand Turn Hydraulic Hose



Steering Cylinder – Service Parts

1. Rod & Piston Assembly
2. Track Rod Assembly
3. Cylinder
4. Differential Carrier
5. End Plate
6. Track Rod Assembly

A = Seal Kit Items

DISASSEMBLY

1. Withdraw rod and piston from cylinder and remove all seals, Figure 9.

INSPECTION AND REPAIR

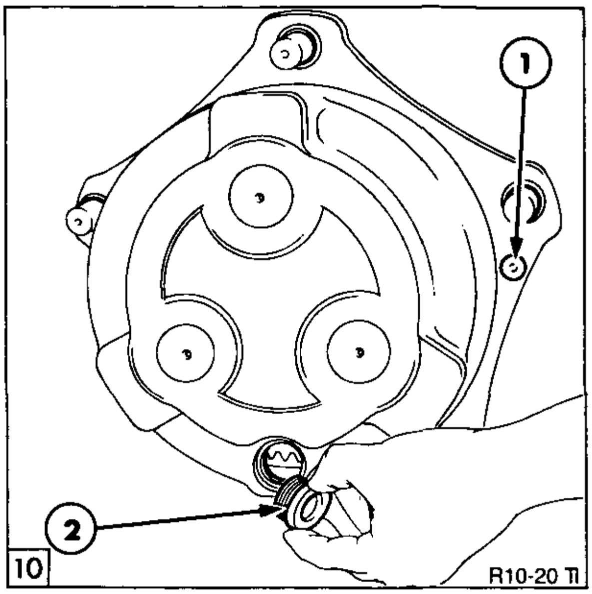
The cylinder rod and cylinder barrel are only serviced as a complete steering cylinder assembly. Inspect all components and replace where damaged

The seals and wear rings are only available as a complete seal kit and must be replaced following disassembly.

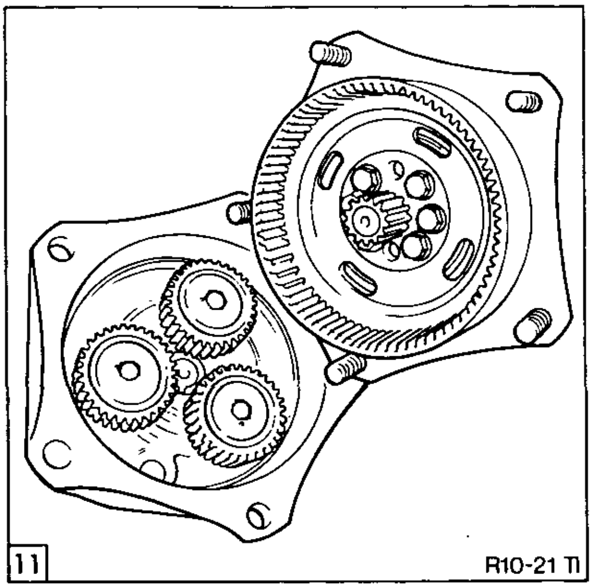
RE–ASSEMBLY

1. Replace all seals.
2. Allow the new piston seal, which is positioned on top of an 'O' ring, to contract before inserting the piston and rod into the cylinder barrel.
3. Replace end plate.
4. Relocate cylinder in axle housing and tighten the three hexagon headed bolts to a torque of 69 lbf ft (94 Nm).
5. Apply loctite 542 to the threads of Allen key bolt and tighten to a torque of 69 lbf ft (94 Nm).
6. Reconnect track control rods, tightening cylinder rod ball joints to 220 lbf ft. (300 Nm) and track control rod ball joints to 162 lbf ft (220 Nm).
7. Reconnect steering hoses.
8. Adjust and set the front wheel toe–in to 0 – 0.25 in (0 – 6 mm). Ensure this measurement is made at the inside of each wheel rim and at the hub height.
9. Start engine, observe for any leaks and turn steering repeatedly from lock to lock to purge all air from the system.

C. HUB ASSEMBLY, SWIVEL HOUSING AND AXLE SHAFT – OVERHAUL



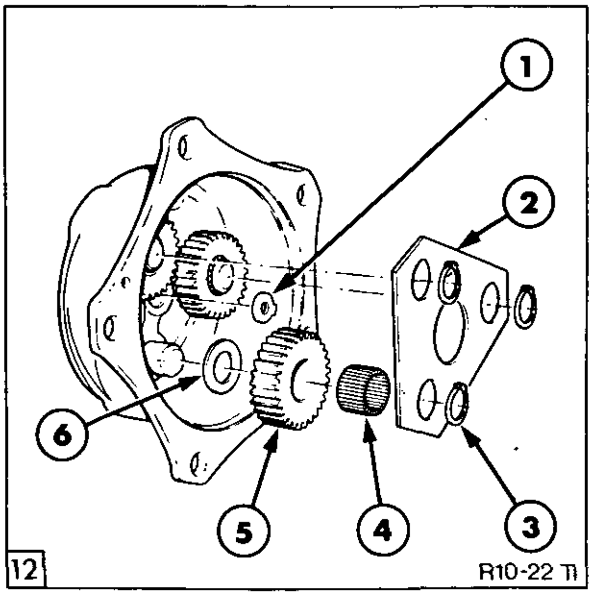
Preparation For Hub Removal
1. Retaining Screw (2)
2. Filler/Drain Plug



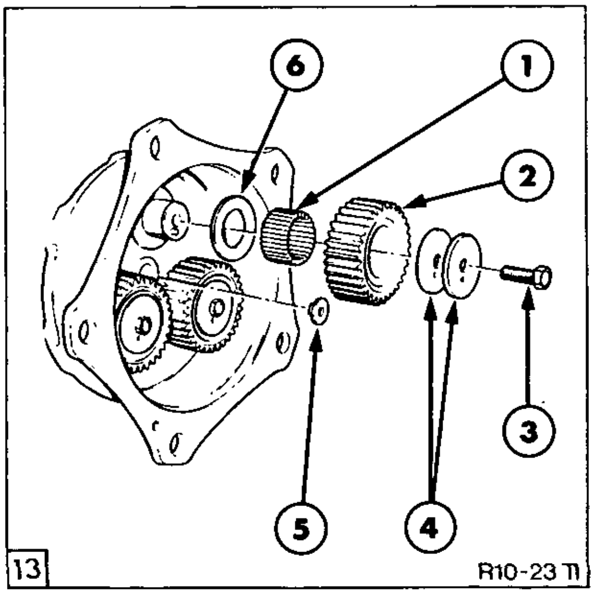
Planetary Carrier Removed
(Heavy Duty Axle)

REMOVAL

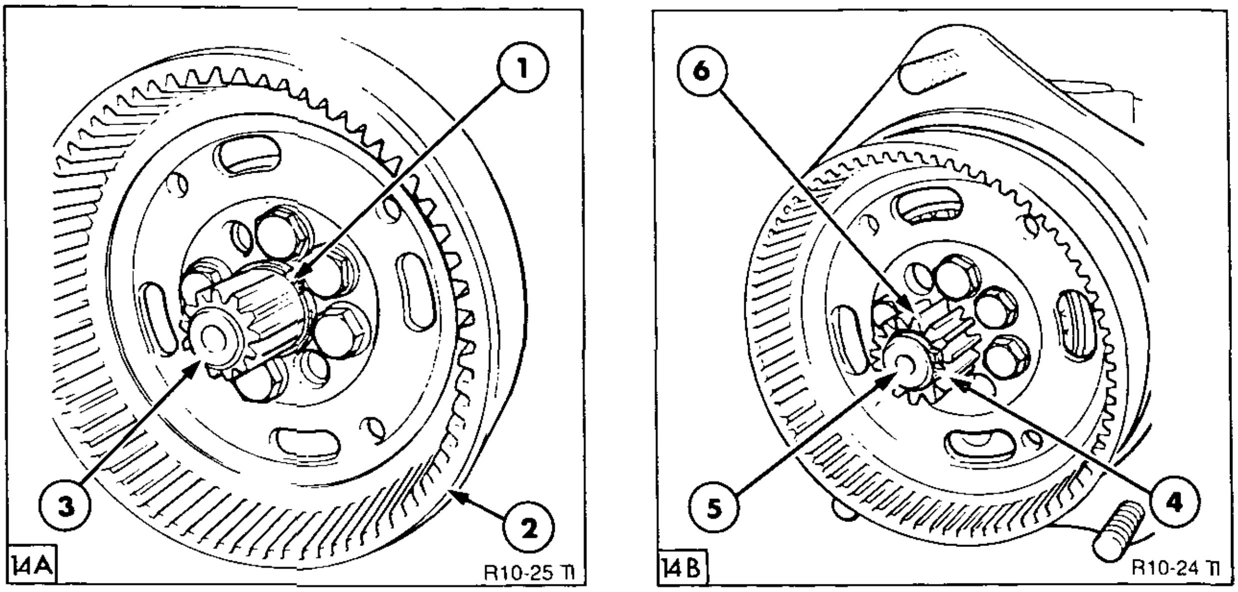
1. Jack up tractor, support front axle and remove road wheel.
2. Position hub filler/drain plug at its lowest point and drain oil, Figure 10.
3. Remove planetary carrier retaining screws and using soft mallet remove carrier from the hub, Figure 11.
4. Overhaul planetary reduction gear carrier with reference to Figure 12 and Figure 13. Use Loctite 638 to hold the tabbed thrust washer in position.



Planetary reduction Components
709–Standard Axle
1. Tabbed Thrust Washer
2. Retaining Plate
3. Snap Ring
4. Needle Roller Bearings
5. Planetary Gear
6. Drive Shaft Thrust Washer



Planetary Reduction Components
709–Heavy Duty Axle
1. Needle Roller Bearings
2. Planetary Gear
3. Retaining Bolt (Torque 58 lbf ft, 79 Nm)
4. Thrust Washers
5. Tabbed Thrust Washer
6. Drive Shaft Thrust Washer



Sun Gear and Drive Shaft Installation

Heavy Duty Axle

1. Circlip and Thrust Washer
2. Ring Gear
3. Drive Shaft and Sun Gear
4. Circlip

Standard Axle

5. Drive Shaft
6. Sun Gear

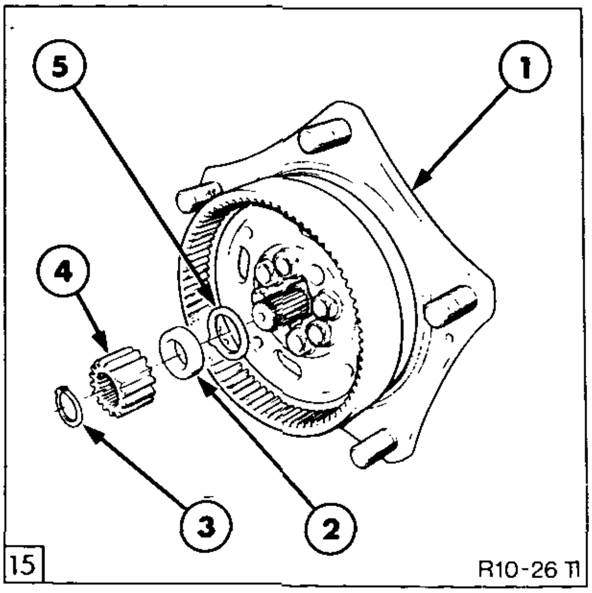
5. Standard Axle:
   Remove circlip on sun gear, Figure 14B. Remove sun gear, spacer and thrust washer, Figure 15.

6. Heavy Duty Axle:
   Remove circlip and thrust washer from driveshaft sun gear, Figure 14A.

NOTE: *The sun gear on the heavy duty axle is forged onto the end of the driveshaft and is not a separate gear.*

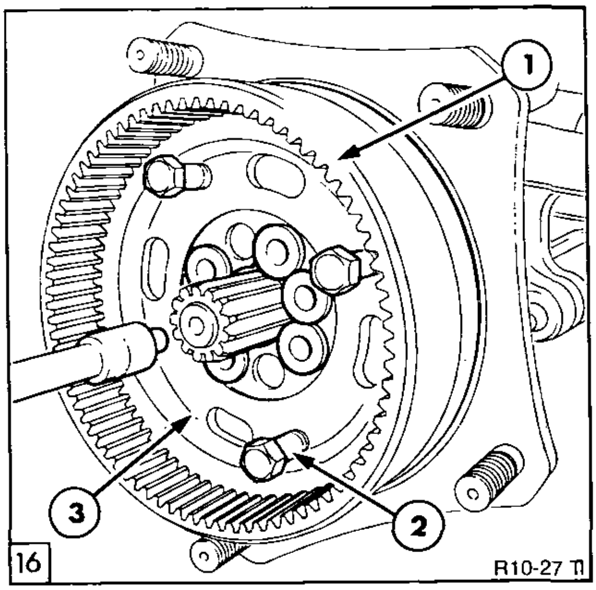
7. Remove ring gear retaining bolts.

8. Using 4 retaining bolts, jack the ring gear from the hub, Figure 16.



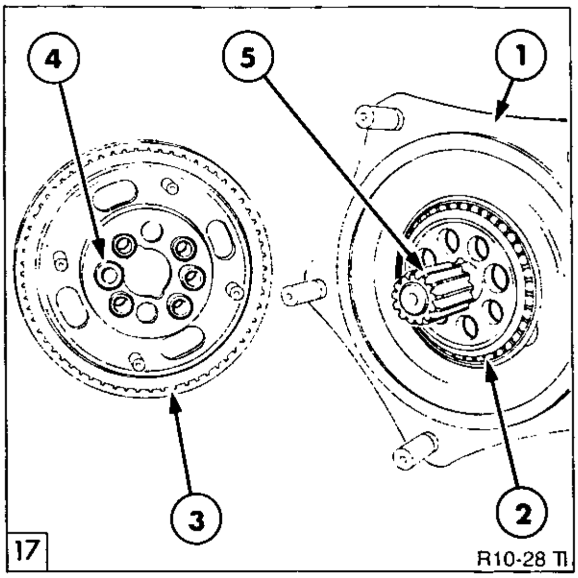
Sun Gear Assembly
(Standard Axle)

1. Hub Assembly
2. Spacer
3. Circlip
4. Sun Gear
5. Thrust washer



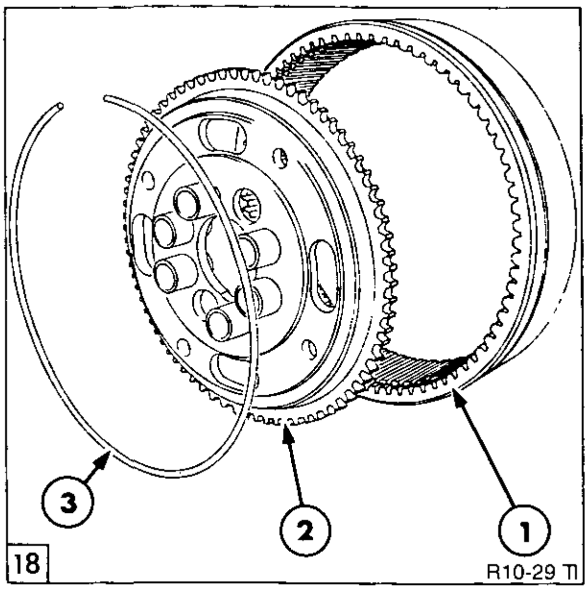
Ring Gear Removal

1. Ring Gear
2. Jacking Bolts
3. Adaptor Plate



Ring Gear Removal

1. Hub Assembly
2. Outer Bearing
3. Ring Gear and Adaptor Plate
4. Master Dowel
5. Sun Gear



Ring Gear and Adaptor Plate

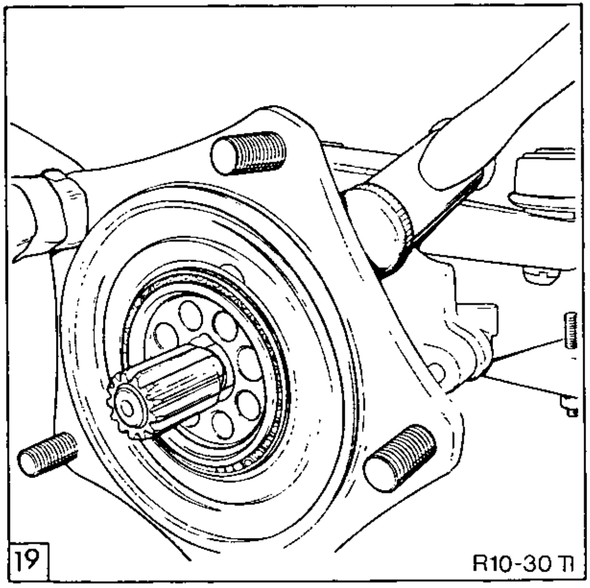
1. Ring Gear
2. Adaptor Plate
3. Snap Ring

9. Remove ring gear, Figure 17.

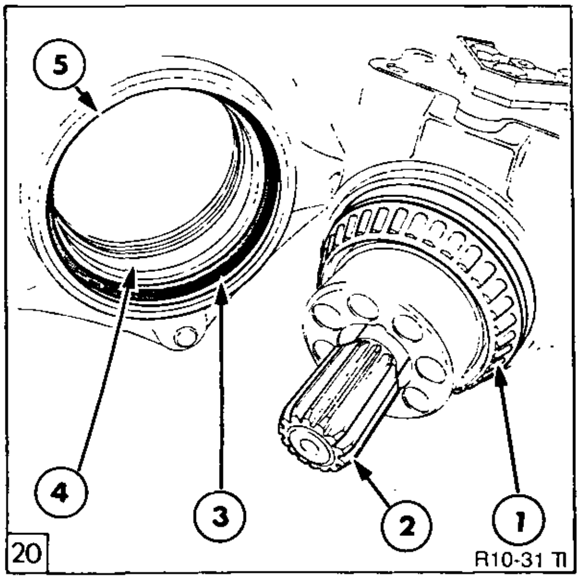
10. Separate ring gear and adaptor plate, Figure 18.

11. Using soft faced mallet loosen hub on swivel housing, Figure 19.

12. Remove hub from swivel housing, Figure 20.

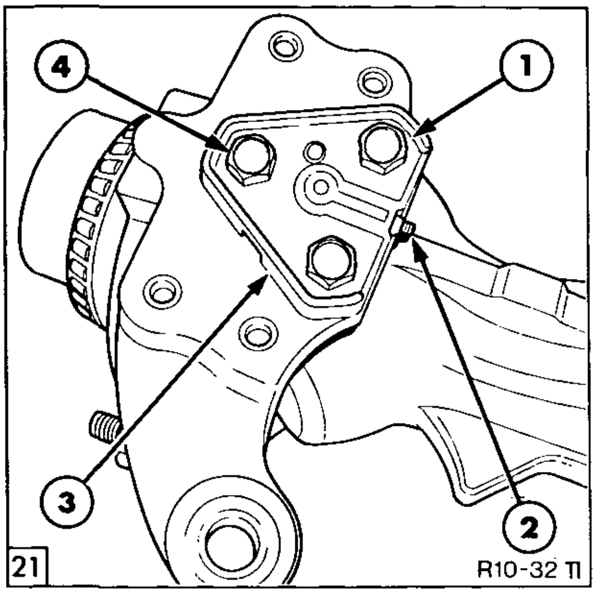


Removing Hub Assembly Using a Soft Mallet



Hub Removed From Swivel Housing

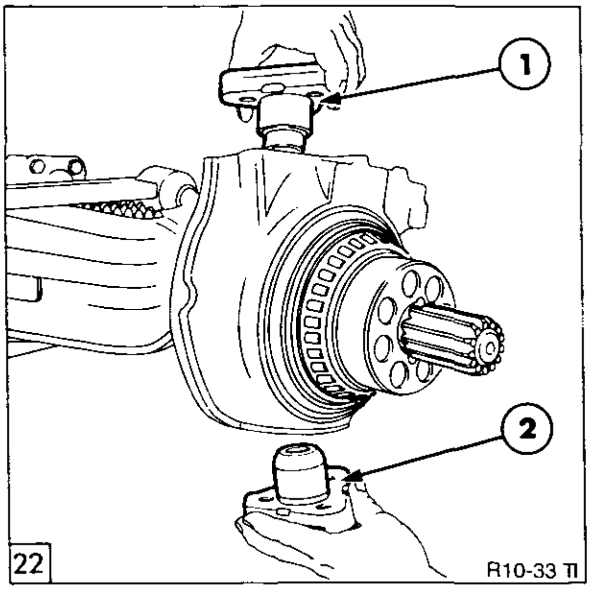
1. Inner Bearing
2. Sun Gear
3. Oil Seal
4. Inner Bearing Cup
5. Hub



21

Upper Swivel Pin and Retaining Bolts

1. Swivel Pin
2. Greaser
3. Lever Slot
4. Retaining Bolts (3 off)



22

Removing Swivel Pins

1. Shim Where Fitted
2. Shim Where Fitted

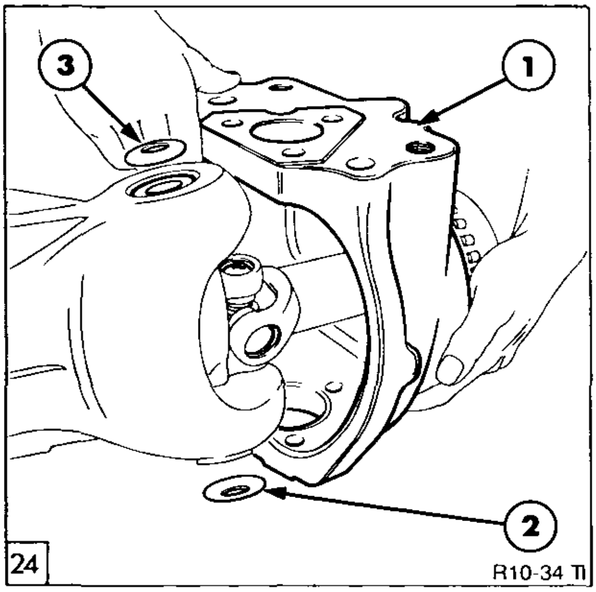
13. Disconnect track control rod from steering arm. Support the hub and remove upper and lower swivel pins retaining bolts, Figure 21.

14. Remove swivel pins and if fitted, note the position of any shims located under the pins, Figure 22.

15. Carefully remove swivel hub and belleville washers, if fitted, Figure 24.

NOTE: *Early axles use shims to provide adjustment of the swivel pins. Later axles incorporate belleville washers which provide automatic adjustment of the swivel pins.*

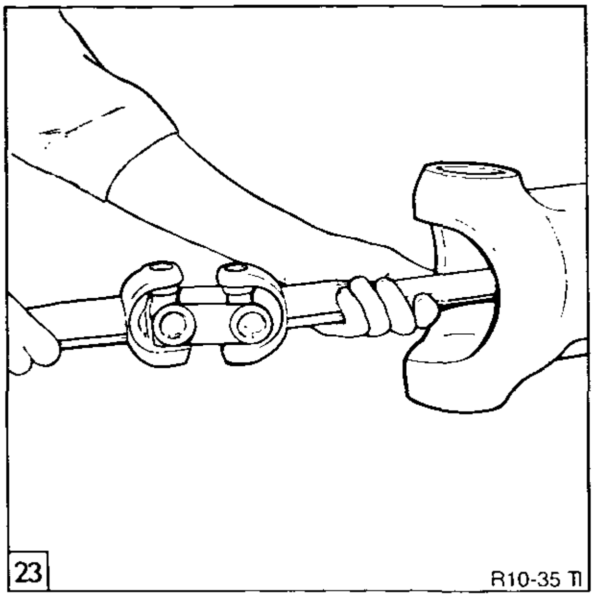
16. Pull drive shaft from axle casing, Figure 23.



24

Removing Swivel Hub

1. Swivel Hub
2. Belleville Washer, Thin, Where Fitted
3. Belleville Washer, Thick, Where Fitted



23

Withdrawing Axle Shaft from Axle Casing

INSPECTION AND REPAIR

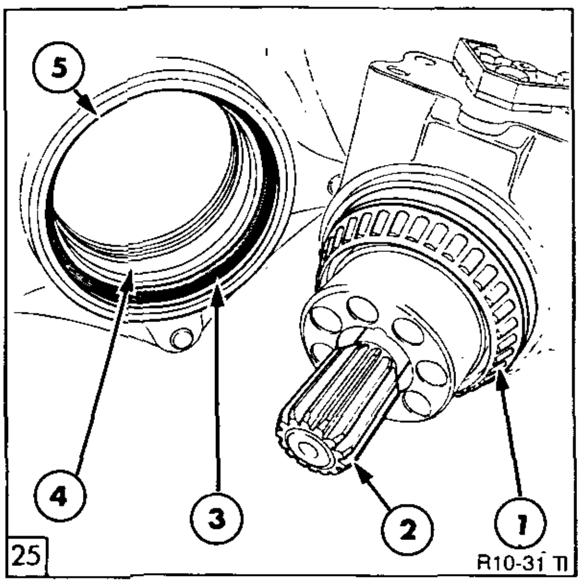
Check the following items for wear to determine if replacement is required.

- Reduction hub, gears, bearings and thrust washers.

Hub oil seals, bearings and cups.

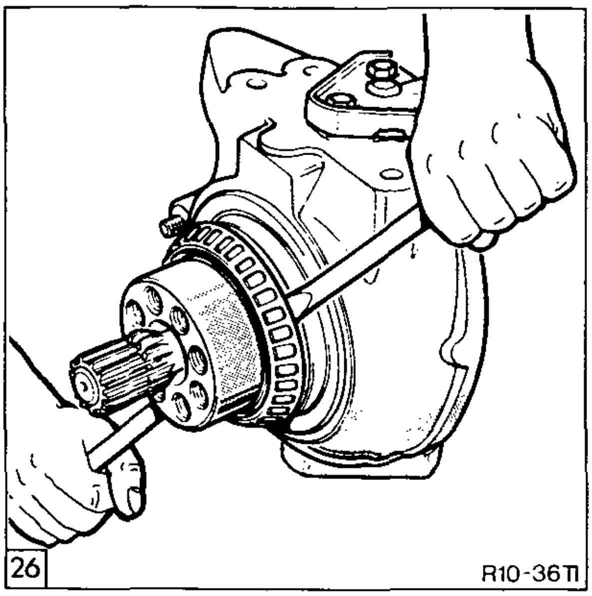
- Driveshaft and universal joint assembly.
- Swivel pin bearings and cones.
- Planetary gears and bearings.

Where necessary refer to Figure 25 to Figure 36 for replacement techniques.

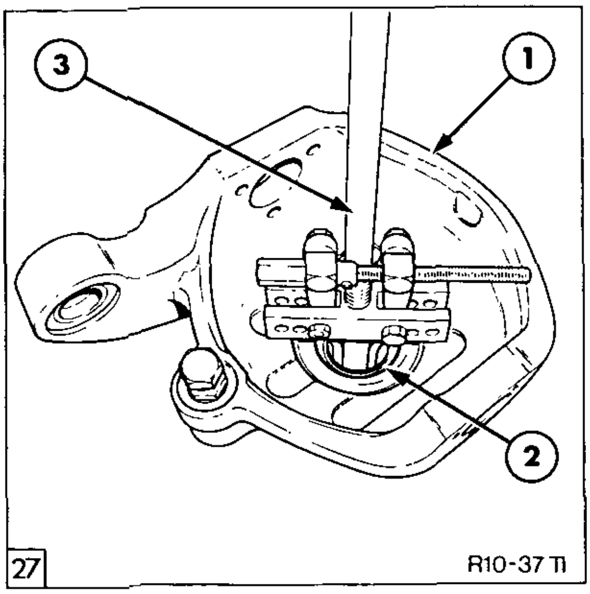


Hub Inner Oil Seal and Bearing

1. Inner Bearing
2. Sun Gear
3. Oil Seal
4. Inner Bearing Cup
5. Hub

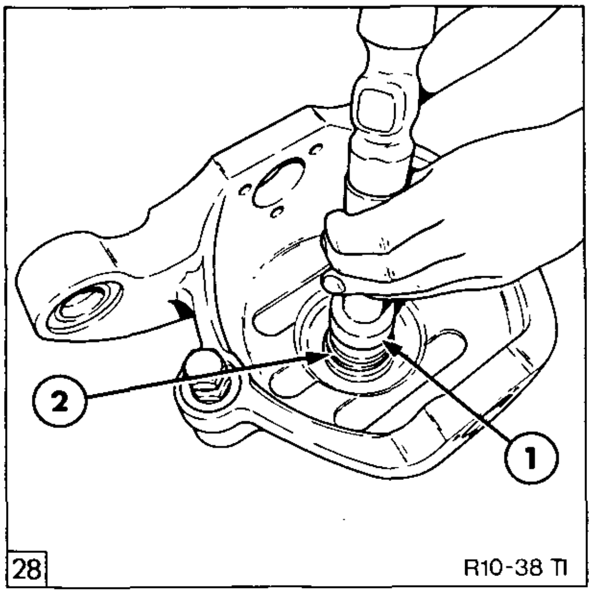


Removing Hub Inner Bearing



Removing Bushing from Swivel Casing

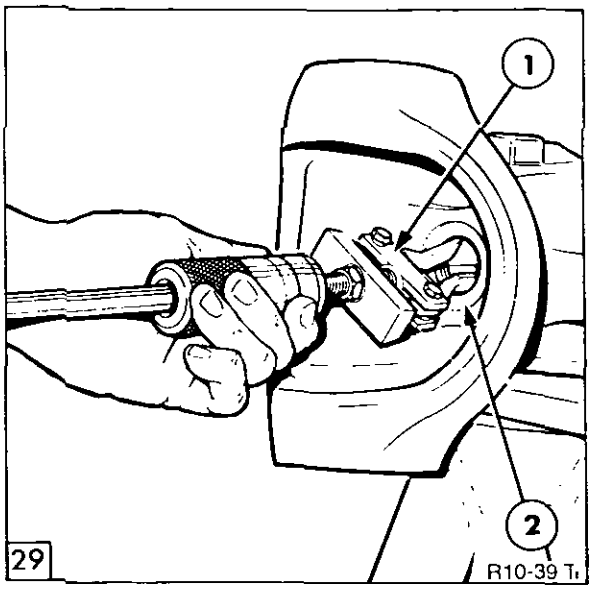
1. Swivel Casing
2. Bushing
3. Puller Tool No. 943 or FNH 09507 and Slide Hammer Tool No. 943S or FNH 09567



Installing Oil Seal in Swivel Casing

1. Driver Handle Tool No. 550
2. Oil Seal Installer Tool

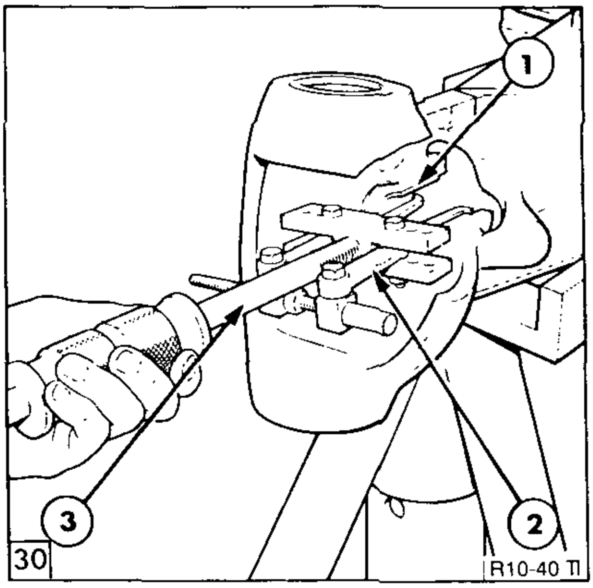
29



Removing Axle Shaft Seal from Axle Casing

1. Puller Tool No. 954C or FNH 09508
2. Oil Seal

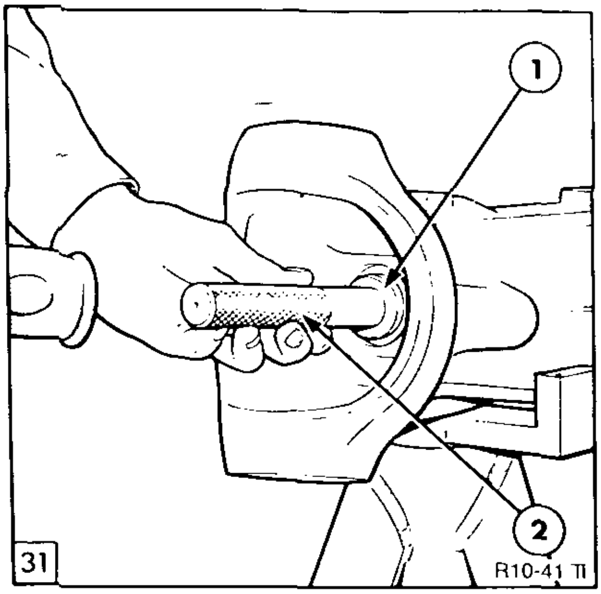
30



Removing Axle Shaft Bushing from Axle Casing

1. Bushing
2. Puller Tool No. 943 or 9507
3. Slide Hammer Tool No. 943S or FNH 09567

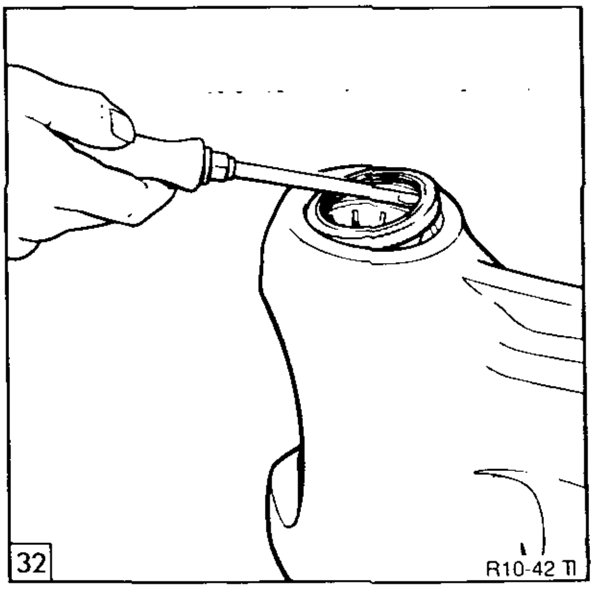
31



Axle Shaft Seal and Bushing Installation

1. Bushing/Seal Installer
2. Driver Handle Tool No 550

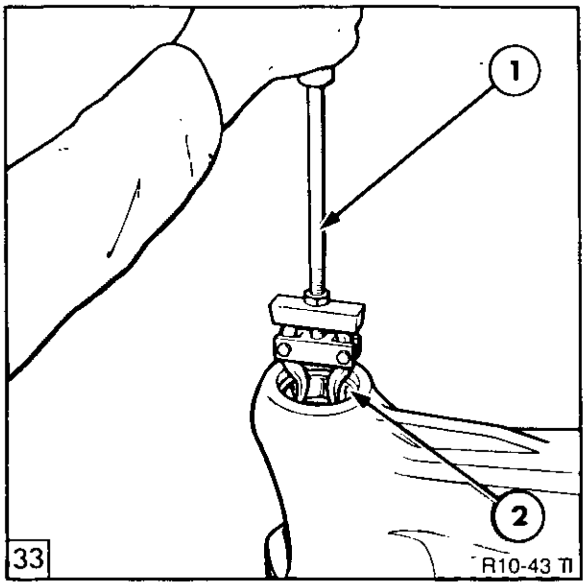
32



Removing Swivel Pin Grease Seal

NOTE: *Grease seals are only fitted to axles where shims are installed beneath the swivel pins.*

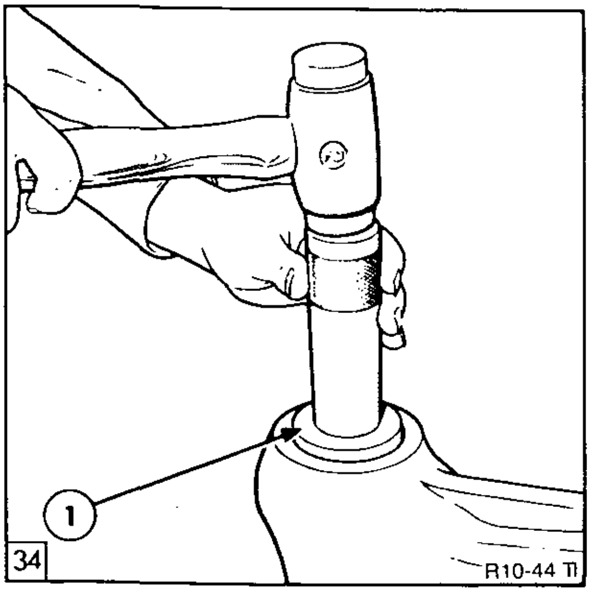
33



Removing Upper Swivel Pin Bearing Bush

1. Slide Hammer Tool No. 943S or 9567
2. Bearing Bush

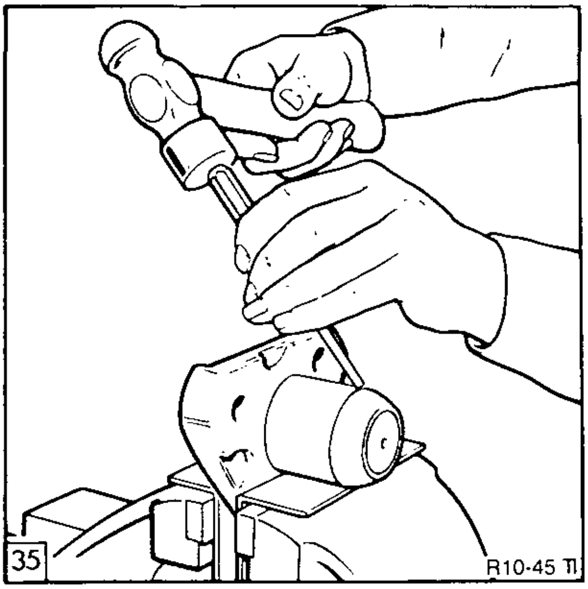
34



Installing Upper Swivel Pin Bearing Bush

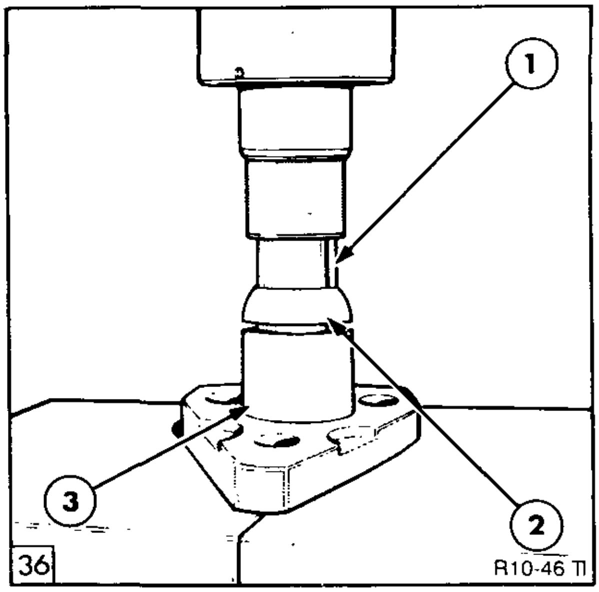
1. Suitable Driver Tool

35



Removing Lower Swivel Pin Bearing Cone

36



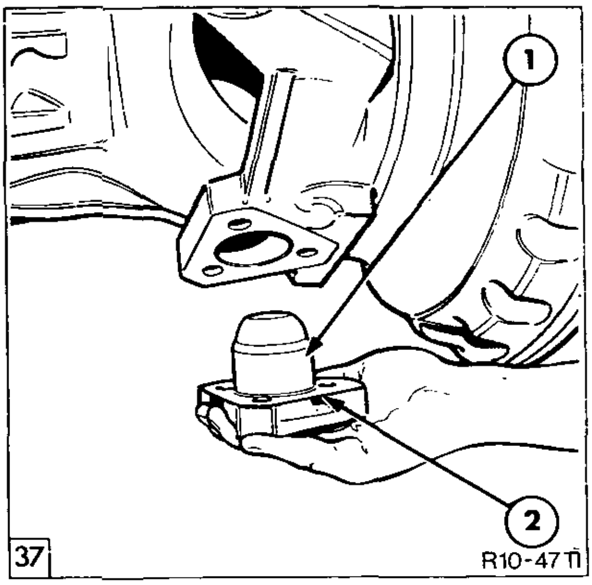
Pressing Lower Swivel Pin Bearing Cone onto Pin

1. Spacer Block
2. Bearing Cone
3. Swivel Pin

Refer to the table below for the appropriate tools necessary to insert seals and bushes.

SEAL/BUSHING SPECIAL TOOLS	709–ST	709–HD
SWIVEL CASING SHAFT SEAL	FT3162	A
SWIVEL CASING SHAFT BUSHING	FT3164	A
AXLE CASING SHAFT SEAL	FT3166	FT3166
AXLE CASING SHAFT BUSHING	FT3163	FT3163

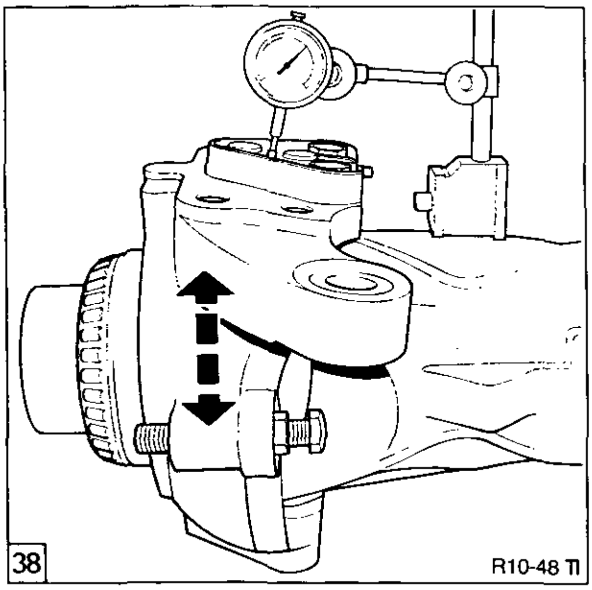
A = Use proprietary bushing/seal driver set



37 R10-47 Tl

Lower Swivel Pin and Shim Installation

1. Swivel Pin
2. Shim (1 mm)



38 R10-48 Tl

Dial Gauge Mounted To Record Swivel Pin Bearing Clearance

RE–ASSEMBLY

NOTE: *If the differential assembly requires overhaul* ***DO NOT*** *install the driveshafts and swivel housings until overhaul and installation of the differential is complete.*

1. Install the drive shafts ensuring that splines on end of the shaft engage with splines in the differential side gear.

2. Wrap protective tape around the outer drive shaft splines to prevent damage to the hub drive shaft oil seal.

3. Position the swivel hub onto the axle. Where Belleville washers are used, slide these between the axle housing and swivel hub.

4. Install the upper swivel pin, less shims if applicable.

5. Install the lower swivel pin and if applicable, with a 1.0 mm shim, Figure 37.

6. Tighten retaining bolts to a torque of 140 lbf ft (190 Nm).

7. Lubricate the Swivels of axles with belleville washers fitted with the specified Grease.

Axles with shimmed Swivel Pins

8. Measure the free play of the swivel hubs, Figure 38.

9. Calculate shim thickness required to obtain 0–0.10 mm free play using the following example:–

Example: Swivel Pin Shim Thickness Calculation

Specified Free play: 0–0.10 mm

Recorded movement, Figure 38 = 0.25 mm = A
Specified free play = 0.05 mm = B
Shim pack already positioned = 1.00 mm = C
Shim required = C – (A – B) = 1.00 mm – (0.25 mm – 0.05 mm)
= 1.00 mm – 0.20 mm
Total Shim Thickness required = 0.80 mm

Install half the calculated shim thickness beneath each swivel pin. Using this example you would install 0.40 mm of shims beneath each pin.

Note; *Shim thicknesses available are 0.10 mm : 0.19 mm : 0.35 mm.*

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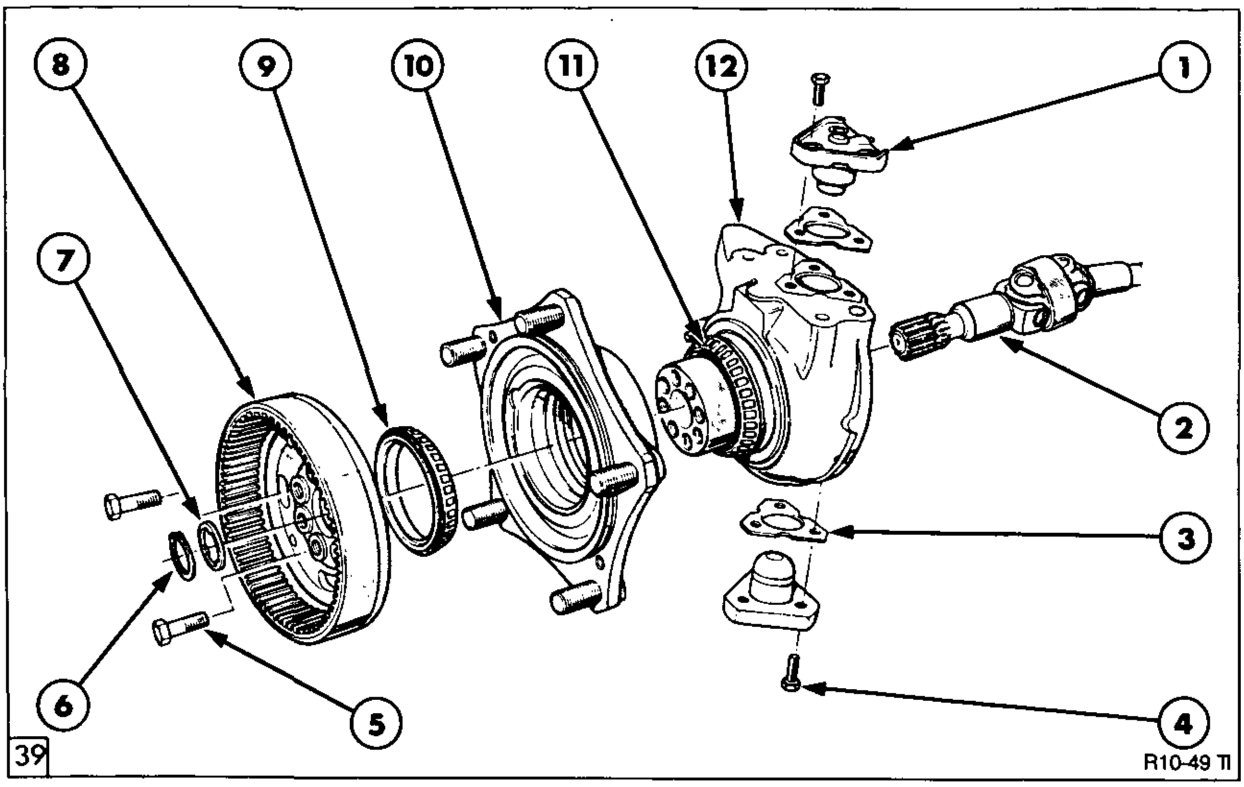


Hub and Swivel Housing Installation
(709–HD Heavy Duty Axle Shown)

1. King Pin
2. Drive Shaft
3. Shim (Where Fitted)
4. King Pin Bolt (6 off)
5. Ring Gear Retaining Bolt (6 off)
6. Drive Shaft Snap Ring
7. Thrust Washer
8. Ring Gear and Adaptor Plate
9. Outer Bearing
10. Hub Assembly
11. Inner Bearing
12. Swivel Housing Assembly

10. Apply grease to lower swivel pin and install hub and swivel housing, refer to Figure 39 and Figure 40.

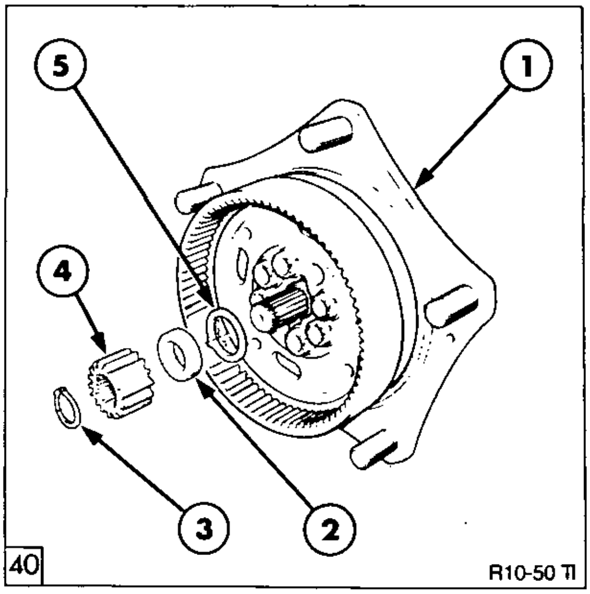
All Axles

11. Tighten ring gear retaining bolts to a torque of 162 lbf ft (220 Nm).

12. Install planetary carrier. Use Loctite 638 to hold axle shaft tabbed thrust washer in position when installing carrier. Refer to Page 7, Figure 12 and Figure 13.

13. Fill hub with 1.3 litres of oil to Specification, ESN M2C–134–D.

40



Sun Gear Assembly
(709–STD Standard Axle)

1. Hub Assembly
2. Spacer
3. Snap Ring
4. Sun Gear
5. Thrust Washer

D. AXLE REMOVAL

To overhaul the differential assembly it is necessary to remove the axle from the tractor.

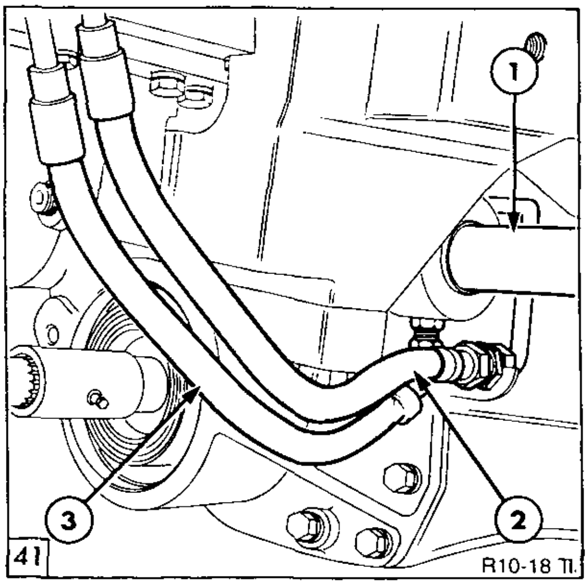
If the axle is being removed for differential overhaul, it is recommended that the axle oil is drained and the pinion nut is loosened prior to removal.

The pinion shaft oil seal can be replaced once the driveshaft has been removed and with the axle installed.

REMOVAL

1. Apply the handbrake and chock the rear wheels to prevent the tractor from moving.
2. Remove front end weights
3. Disconnect the steering hose connections, Figure 41.
4. Remove drive shaft cover, where fitted.

41

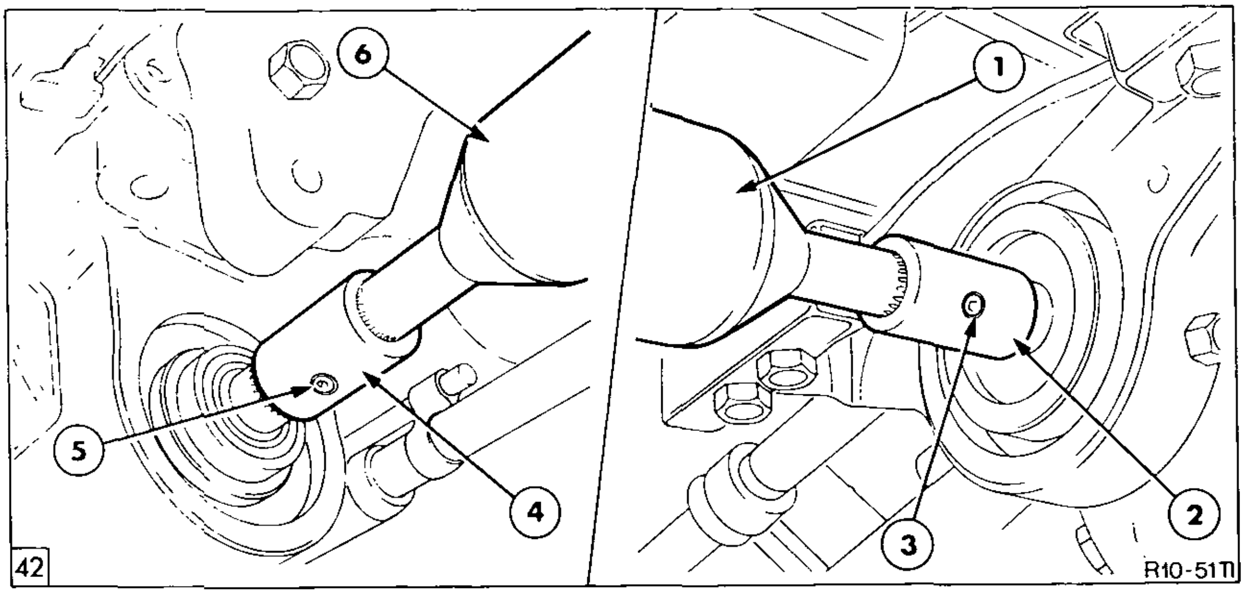


Steering Cylinder Right Hand Side

1. Steering Cylinder
2. Left Hand Turn Hydraulic Hose
3. Right Hand Turn Hydraulic Hose

5. Disconnect drive shaft couplings and remove shaft, Figure 42.

42



Drive Shaft Installation

1. Drive Shaft
2. Sliding Coupler (front)
3. Retaining Bolt
4. Sliding Coupler (Rear)
5. Retaining Bolt
6. Drive Shaft

6. If differential assembly is to be overhauled prise pinion shaft oil seal from differential housing, Figure 43.

7. If differential assembly is to be overhauled use pinion nut wrench FT3168 to loosen the pinion retaining nut.

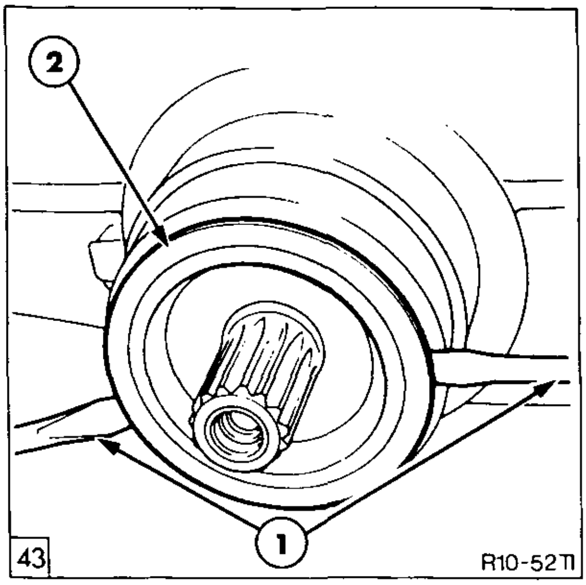
8. Jack up front of tractor and securely support tractor with stands positioned beneath the engine to transmission buckle up flange and also under the cast engine sump, as additional support.

NOTE: *Do not support the vehicle on the engine sump only. Always place a piece of wood across the stand to spread the load across the sump pan.*

9. Remove front wheels.

10. Support axle with trolley jack positioned under centre of axle or alternatively use other suitable lifting equipment.

11. Remove front and rear axle support bolts, Figure 44 and Figure 45.

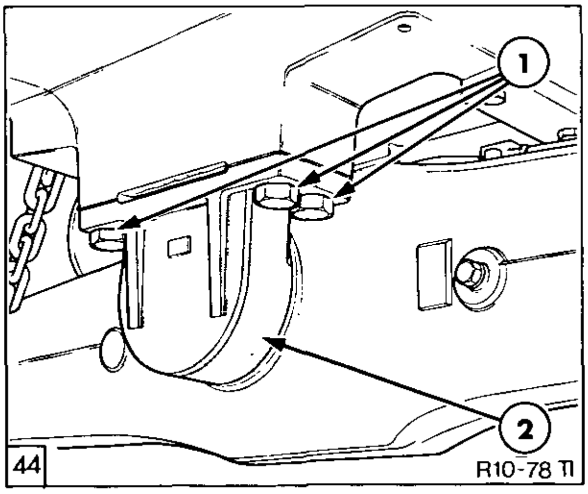


Pinion Shaft Oil Seal Removal

1. Screwdrivers
2. Oil Seal

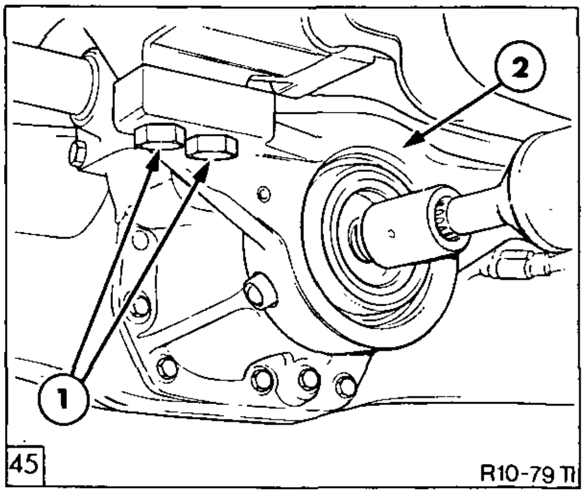
12. Carefully lower axle to ground.

13. Position axle in suitable stand in order to perform disassembly.



Front Support Pillar Retaining Bolts

1. Retaining Bolts
2. Support Pillar



Rear Support Retaining Bolts

1. Retaining Bolts
2. Support Pillar

INSPECTION

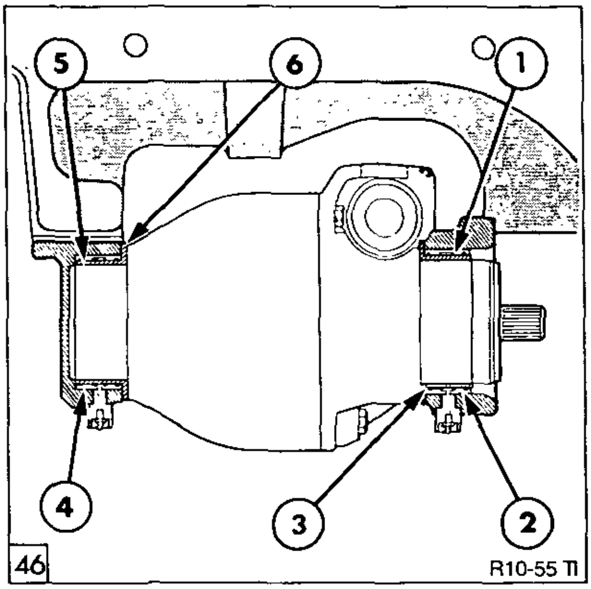
1. Inspect trunnion and support pillar bushes and thrust washers for wear, Figure 46. Assess degree of wear by rocking supports from side to side.

INSTALLATION

1. Installation of the axle follows the removal procedure in reverse.

2. Tighten support pillar retaining bolts to a torque of 234–286 lbf ft (317–388 Nm).

3. Tighten steering hose connections to a torque of 25 lbf ft (34 Nm).

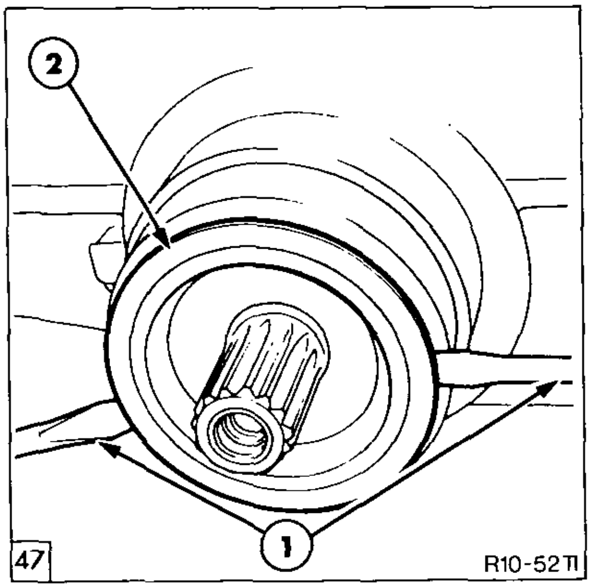


Front and Rear Support Pillar Bushings

1. Rear Support Bushing
2. 'O' Ring Seal
3. Rear Pillar Bearing
4. Front Support Bushing
5. *Front Trunnion Bushing*
6. Thrust Washer

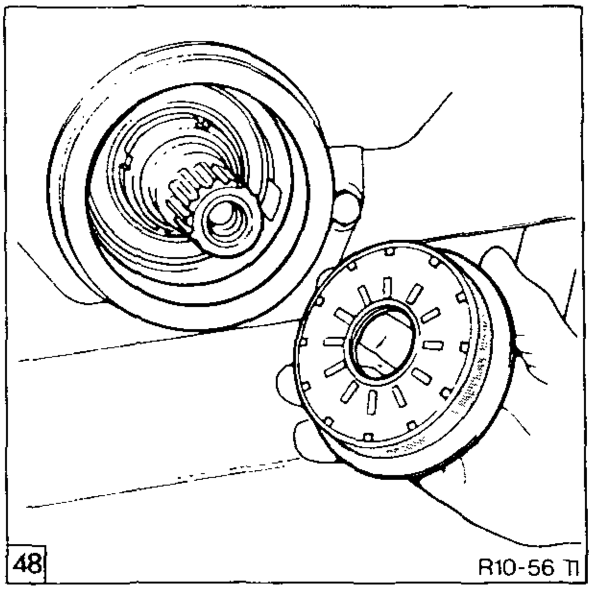
E. DIFFERENTIAL OVERHAUL

REMOVAL



Pinion Shaft Oil Seal Removal

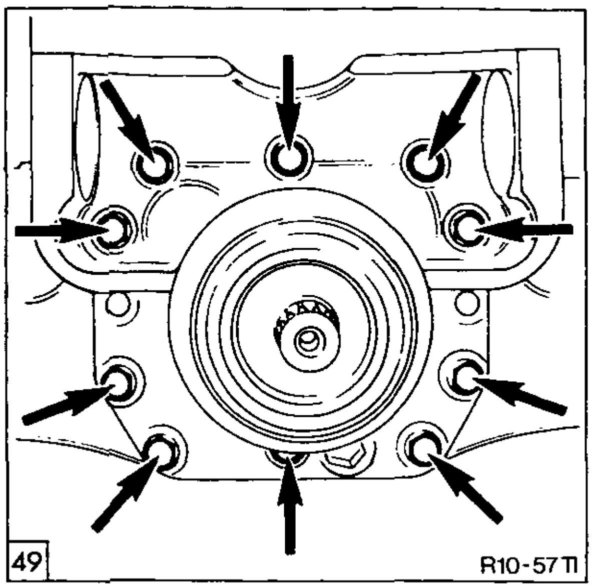
1. Screwdrivers
2. Oil Seal



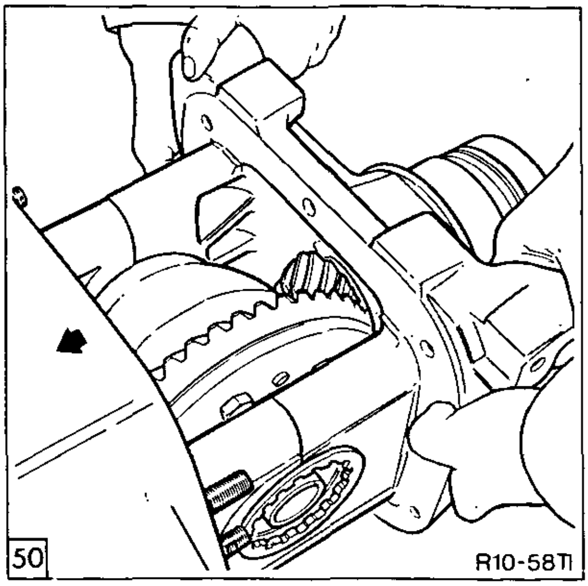
Pinion Shaft Oil Seal

1. Drain axle oil and prise out pinion shaft oil seal, Figure 47 and Figure 48.

NOTE: *It is recommended that this operation is conducted prior to axle removal.*



49 Differential Support Casing Retaining Bolts



50 Differential Removal

2. Remove differential retaining bolts, Figure 49 and carefully lift differential from axle housing, Figure 50.

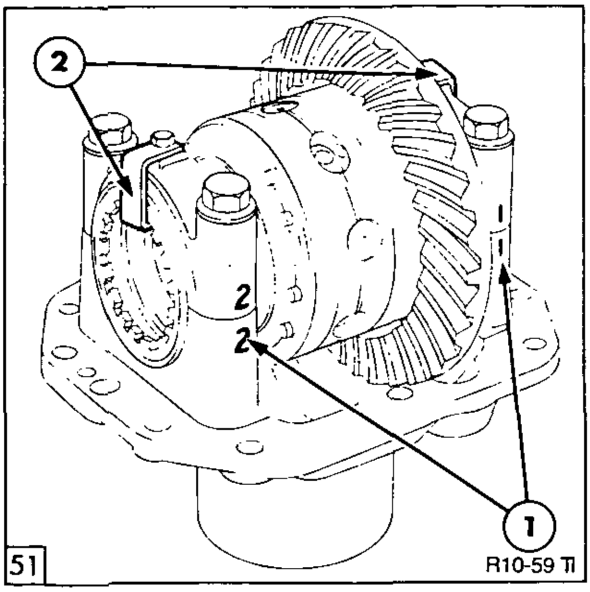
DISASSEMBLY

1. **Before disassembly mark each bearing cap to ensure they are not interchanged during reassembly, Figure 51.** Note the position of the crown wheel in relation to the differential housing.

2. If pinion nut was not loosened during axle removal place a bar through the steering cylinder lugs to support the assembly.

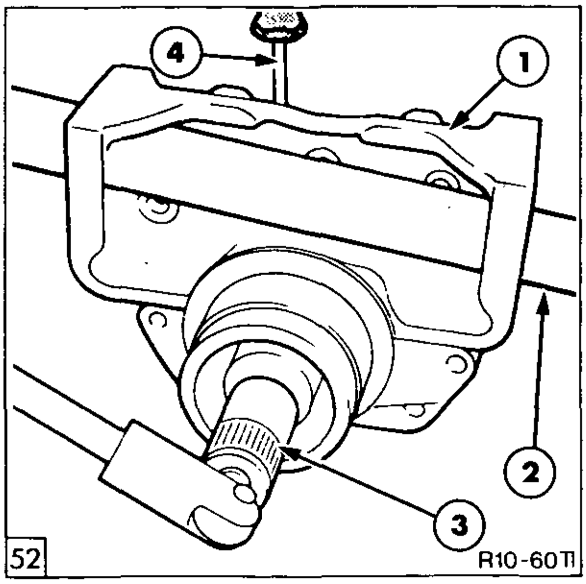
Put a screwdriver between the crown wheel and pinion teeth to hold the pinion still.

Loosen the pinion nut using special tool No. FT3168, Figure 52.



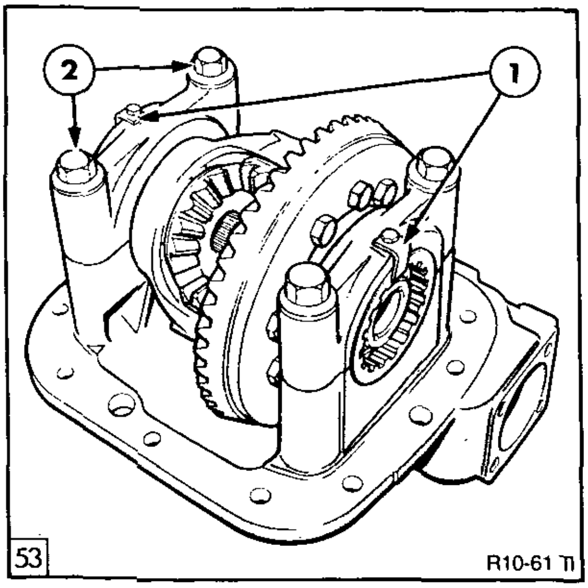
51 Differential Assembly

1. Identification Marks
2. Locking Tabs



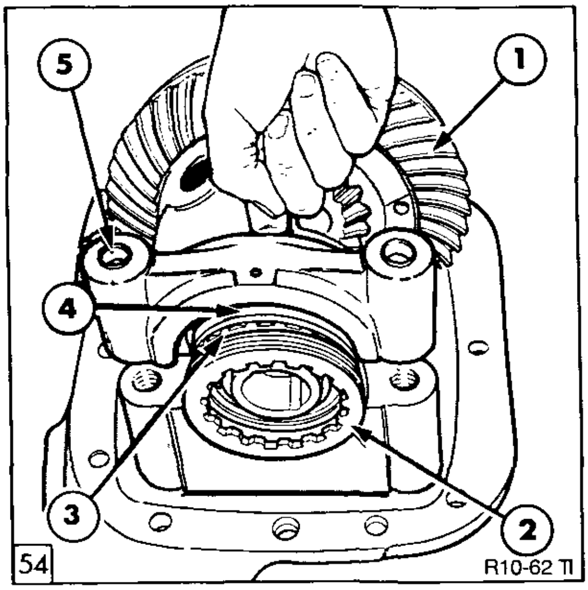
52 Slackening Pinion Nut

1. Differential Housing
2. Bar
3. Special Tool FT3168
4. Screw Driver



Differential Disassembly

1. Locking Tabs
2. Cap Retaining Bolts



Differential Assembly Removal

1. Crown Wheel
2. Adjuster Ring
3. Bearing
4. Bearing Cup
5. Bearing Cap

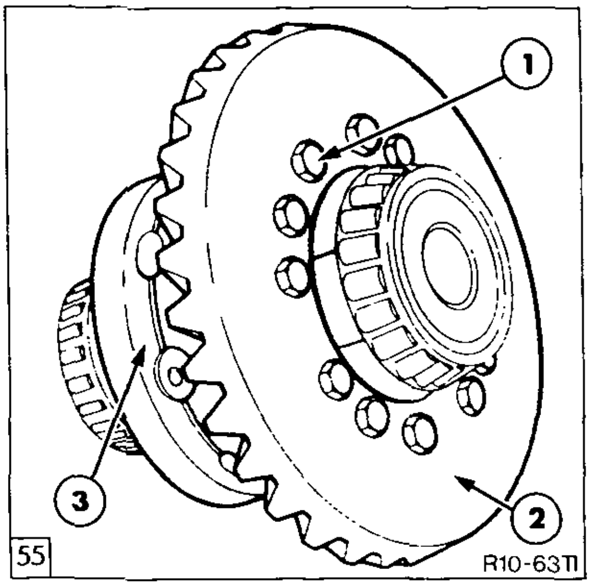
3. Remove locking tabs and bearing cap retaining bolts, Figure 53.

4. Loosen adjuster rings and remove bearing caps, Figure 54. Ensure locating bushes which align the cap to the differential housing are not lost.

5. Remove crown wheel retaining bolts, Figure 55.

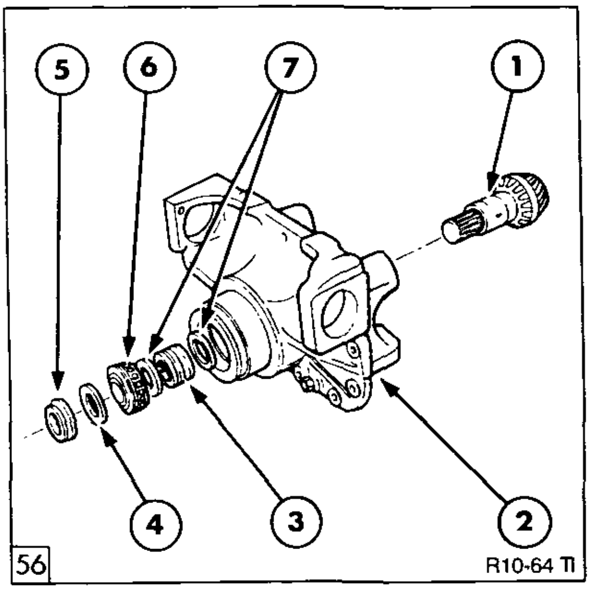
6. Disassemble differential with reference to Figure 57 to Figure 59.

7. *Remove pinion and discard collapsible* spacer and tab washer, Figure 56.



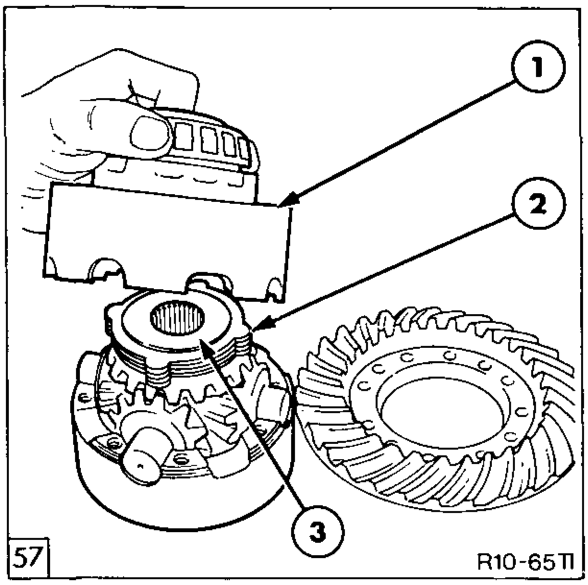
Differential and Crown Wheel Assembly

1. Crown Wheel Securing Bolts
2. Crown Wheel
3. Differential Housing



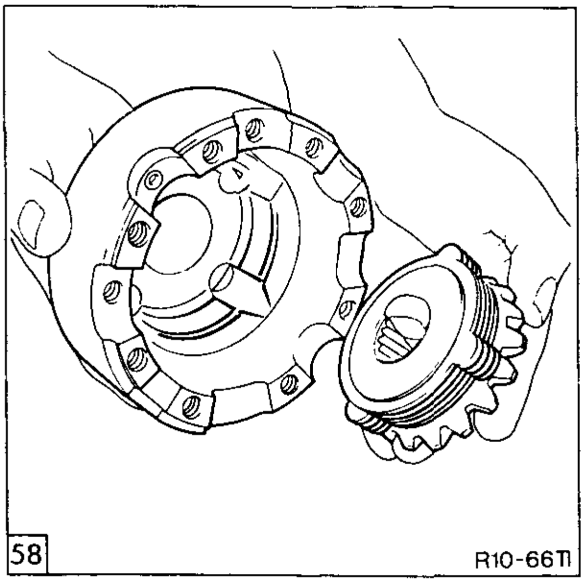
Drive Pinion Components

1. Pinion and Bearing
2. Support Housing
3. Collapsible Spacer
4. Tab Washer
5. Pinion Nut
6. Outer Bearing
7. Washers

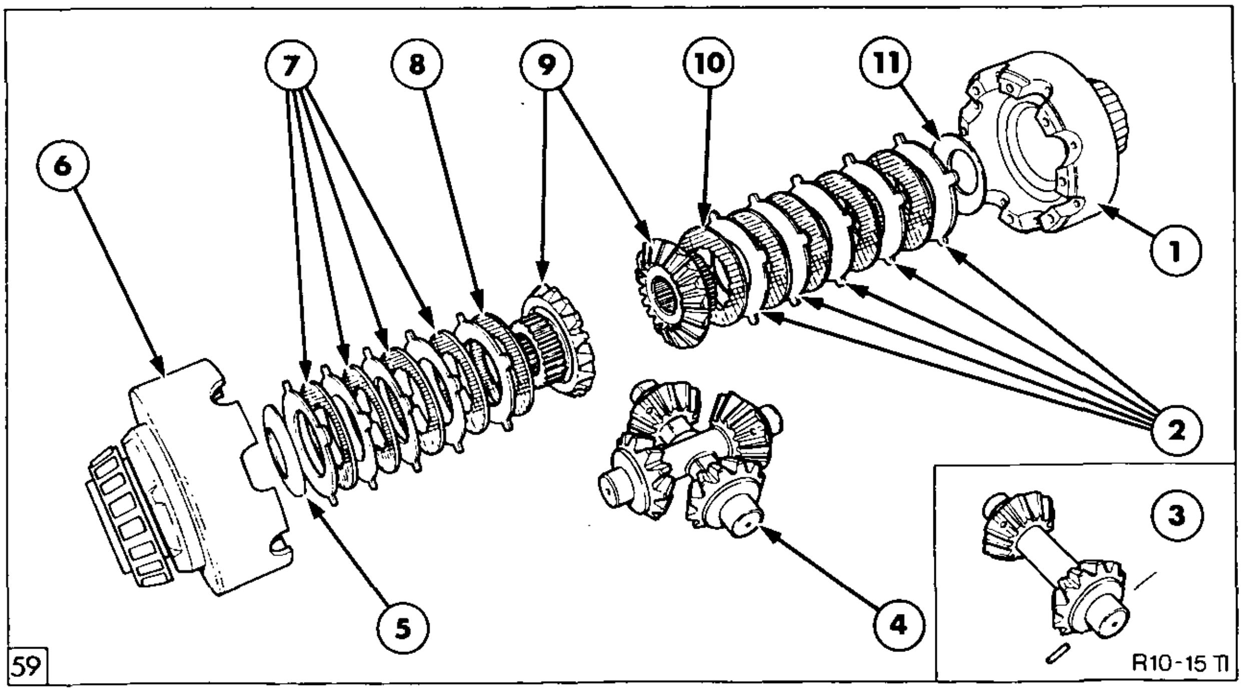


Differential Disassembly

1. Differential Housing
2. Differential Plates
3. Belleville Washer (Where fitted)



Differential Side Gear Removal



Limited Slip Differential Components

1. Differential Housing
2. Steel Plate
3. Differential Gear Assembly (Standard Axle)
4. Differential Gear Assembly (Heavy Duty Axle)
5. Belleville Washer (Where fitted)
6. Differential Housing
7. Friction Plates
8. Thrust/Friction Plate
9. Side Gears
10. Thrust/Friction Plate
11. Belleville Washer (Where fitted)

INSPECTION AND REPAIR

Inspect all components paying particular attention to the following:–

- Crown wheel and pinion
- Differential Support housing

  NOTE: *If the crown wheel and pinion or differential support housing require replacement the pinion shimming procedure* ***must*** *be carried out prior to final re–assembly.*

- Bearings
- Pinion nut
- Differential steel and friction plates.

  The friction plates and thrust plates should be replaced if less than minimum thickness indicated below.

  The 5 steel drive plates with external lugs.

  Thickness:
  NEW: 1.5 mm (0.06 ins.)
  MIN: 1.4 mm (0.055 ins.)

  The 4 internally splined friction plates.

  Thickness:
  NEW: 1.6 mm (0.063 ins.)
  MIN: 1.45 mm (0.057 ins.)

  The 1 internally splined thrust plate.

  Thickness:
  NEW: 2.8 mm (0.110 ins.)
  MIN: 2.7 mm (0.106 ins.)

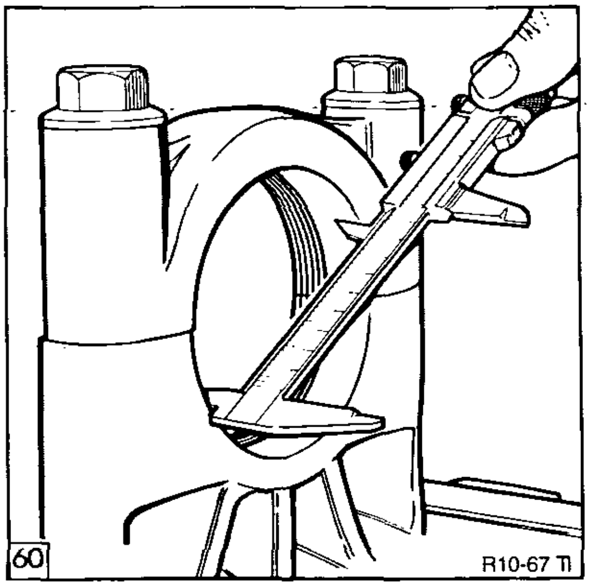
RE–ASSEMBLY

To ensure that the differential is correctly installed, perform the following adjustment and re–assembly procedures in the order shown.

Pinion Shimming Procedure

If the crown wheel and pinion or differential support housing have been replaced recalculate the thickness of shims placed behind the head of the drive pinion. These shims ensure the correct pinion to crown wheel tooth engagement is achieved and is calculated as follows:–

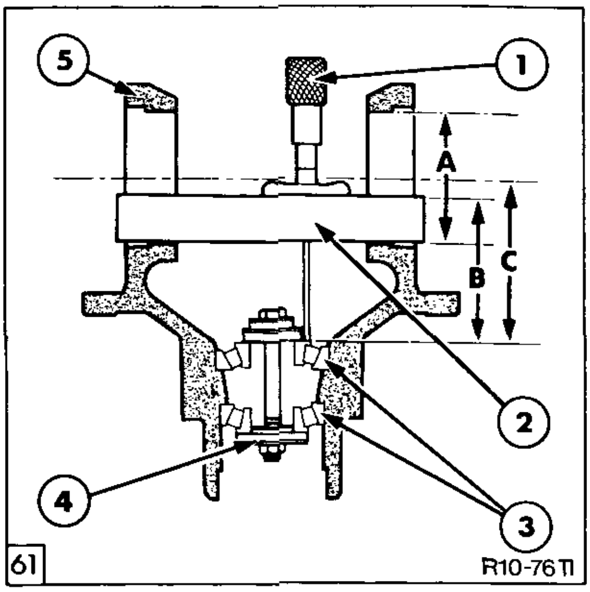
1. Install bearing caps (less bearing cup) and tighten to a torque of 196 lbf ft (266 Nm).



Measuring Dimension 'A'
Differential Housing Bearing Bore Diameter

2. Measure internal diameter of bearing bore, Figure 60 and call this dimension 'A'.
3. Install new pinion bearings in the differential support housing and clamp in position with special tool FT 3135, Figure 61.

   NOTE: *Tighten the clamp so that the bearing cones can just be turned by hand.*



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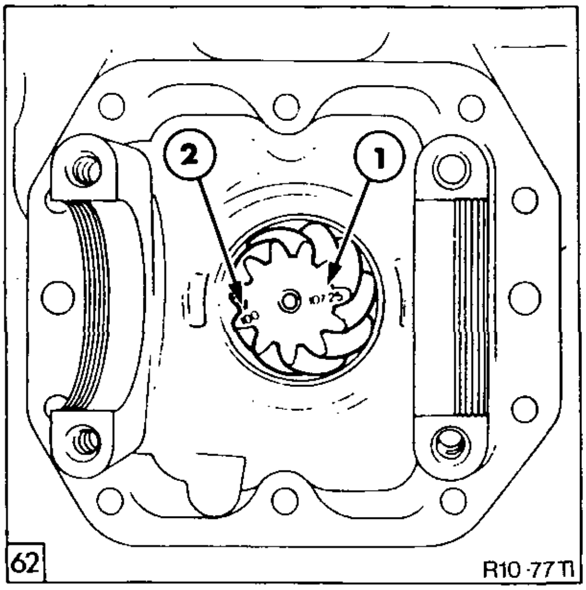
Measuring Dimension 'B'

1. Depth Gauge
2. Bar Gauge – Part of Tool No. 3135 or 4775
3. Pinion Shaft Bearings
4. Pinion Setting Gauge – Tool No. FT–3135 or 4775
5. Differential Support Casing



62

Drive Pinion Installation

1. Pinion Height Measurement
2. Pinion to Crown Wheel Serial Number

4. Locate bar gauge, part of Tool No FT3135, across bearing bore and measure dimension 'B', Figure 61.

5. Calculate Dimension '**C**' using Formula

$$\mathbf{C} = \mathbf{B} - 25\text{mm}^* + \left(\frac{\mathbf{A}}{2}\right)$$

NOTE: **FT–3135 Bar gauge is 25 mm diameter.*

6. Calculate shim thickness required.

Shim thickness = difference between value etched on head of pinion, Figure 62 and Dimension '**C**'.

Refer to the following example for a typical calculation of shim thickness.

EXAMPLE FOR CALCULATION OF PINION SHIM THICKNESS

A = 90.00 mm

B = 90.25 mm

$$\mathbf{C} = 90.25 - 25 + \left(\frac{90}{2}\right)$$

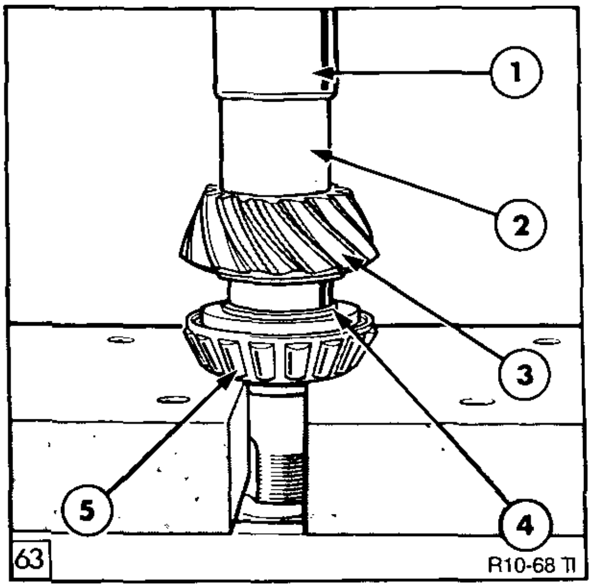
C = 110.25 mm

Value etched on head of pinion gear = 107.25

Shim Thickness Required = 110.25 – 107.25

= 3.00 mm

Shim sizes available 2.5–3.4 mm in 0.1 mm increments.



Pressing Inner Bearing onto Pinion

1. Press
2. Protector
3. Pinion
4. Shim
5. Inner Bearing

7. Install selected shim between pinion head and bearing, Figure 63. Ensure the chamfer on the shim abuts the pinion head.

NOTE: *If the crown wheel and pinion or differential support housing have not been replaced the original shim, removed during disassembly, may be installed.*

Pinion Bearing Preload

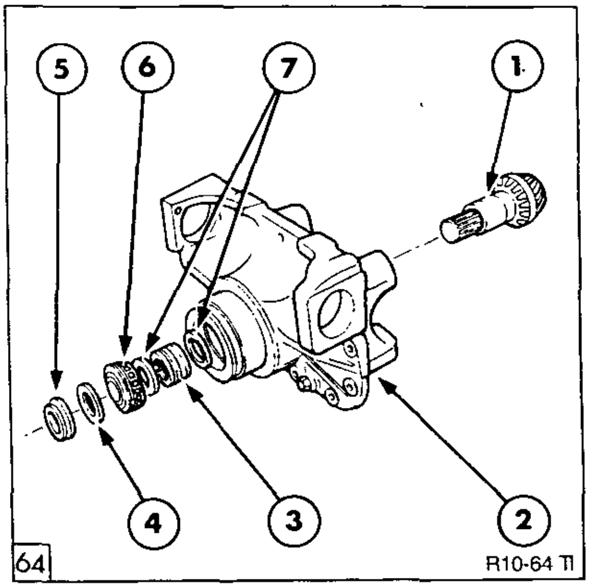
1. Locate pinion in support housing and install a new collapsible spacer, Figure 64.

2. Using special Tool FT 3168 sufficiently tighten pinion nut to eliminate free play.

3. Wrap a length of cord attached to a spring balance, evenly and without overlapping around the pinion gear spline.

4. Using a slow steady pull, measure the force required to rotate the pinion, Figure 65.

5. Progressively tighten the pinion nut until the pull force reaches 22–33 lbf (10.1–15.2 kgf).

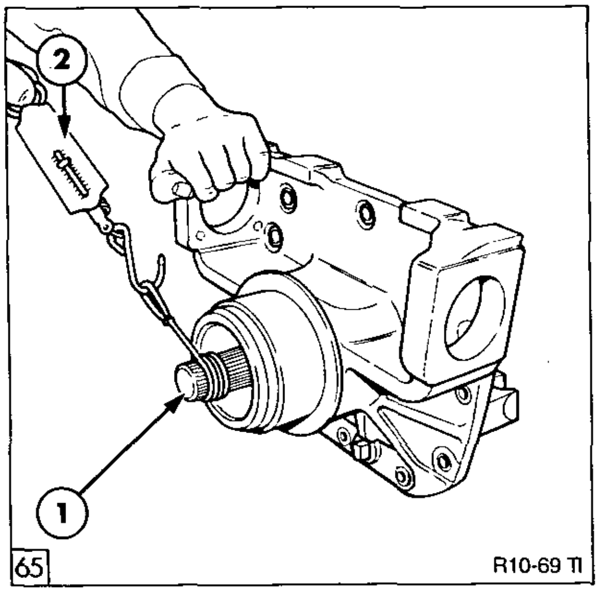


Drive Pinion Components

1. Pinion and Bearing
2. Support Housing
3. Collapsible Spacer
4. Tab Washer
5. Pinion Nut
6. Outer Bearing
7. Washers

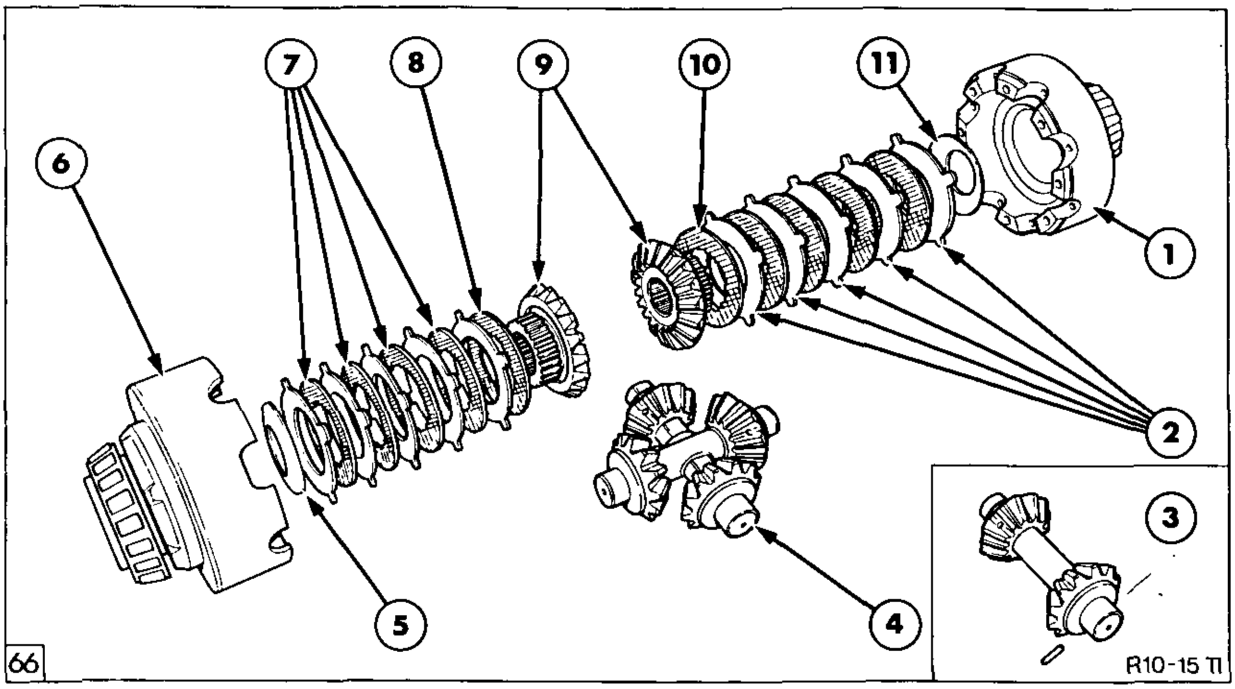
6. Record final pull force obtained in setting the pinion pre–load to specification. This value is required when adjusting the differential bearing preload as described on Page 26.

7. Lock the retaining nut to the pinion shaft by forming the locking sleeve on the nut into the slot in the pinion shaft.



Checking Pinion Shaft Bearing Rolling Resistance

1. Shaft
2. Spring Balance



Limited Slip Differential Components

1. Differential Housing
2. Steel Plate
3. Differential Gear Assembly (Standard Axle)
4. Differential gear assembly (Heavy Duty axle)
5. Belleville Washer
6. Differential Housing
7. Friction Plates
8. Thrust/Friction Plate
9. Side Gears
10. Thrust/Friction Plate
11. Belleville Washer

Differential Re–assembly

1. Re–assemble the differential with reference to Figure 66 and observe the following:–

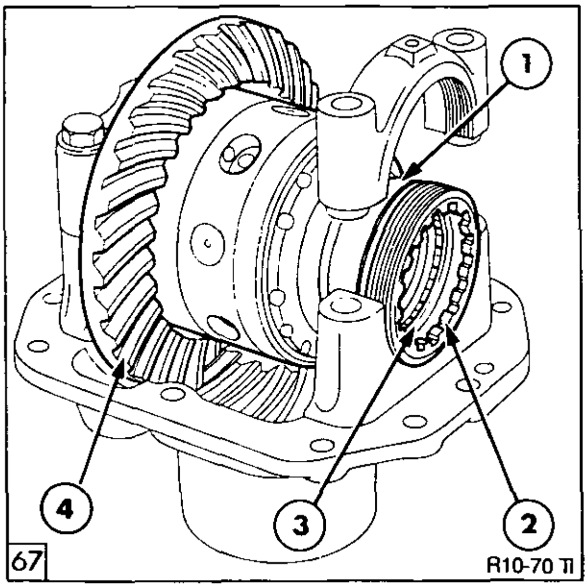
   Install the thick thrust plate item 8 and 10 with the friction face against the externally lugged steel plate.

   Apply loctite 270 to the threads of the crown wheel retaining bolts and tighten to a torque of 57 lbf ft (78 Nm).

Crown Wheel To Pinion Backlash

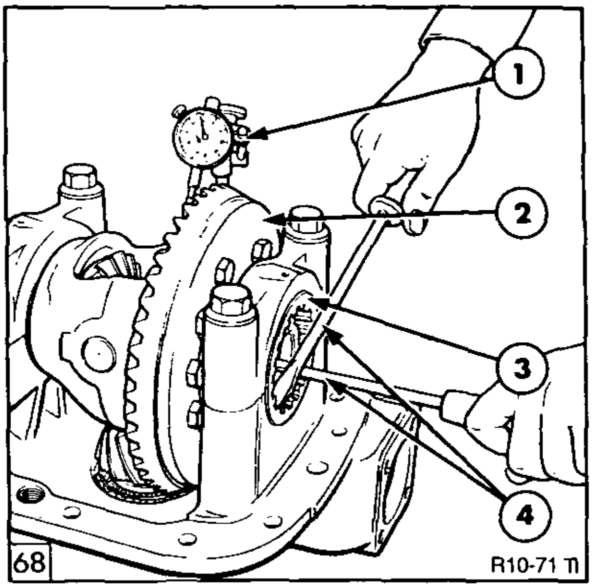
1. Locate the differential assembly into the support casing with the crown wheel to the right hand side of the pinion, when viewing the drive gear end of the pinion.

2. Tighten bearing cap bolts sufficiently to hold the caps in position and allow the adjuster rings, Figure 67, to be rotated. Do not fully torque the cap bolts.

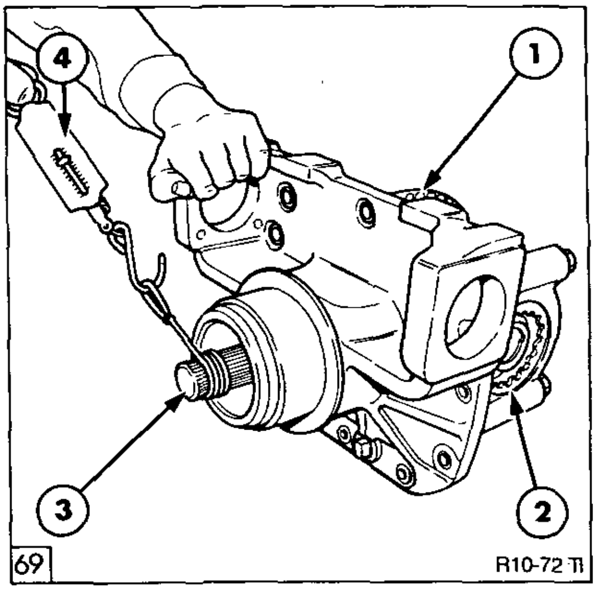


Differential and Support Housing

1. Bearing Track
2. Adjuster Ring
3. Bearing
4. Crown Wheel



Measuring Crown Wheel to Pinion Backlash
1. Dial Indicator
2. Crown Wheel
3. Adjuster Rings
4. Pry Bars



Checking Pinion and Differential Bearing Rolling Resistance
1. Installed Differential
2. Right Hand Adjusting Ring
3. Pinion
4. Spring Balance

3. Adjust the rings to remove all free play between the crown wheel and pinion.

4. Position a dial indicator with the stylus at 90° to the crown wheel teeth and adjust each ring nut by equal amounts until crown wheel to pinion backlash is 0.18 – 0.25 mm (0.007 – 0.010 in), Figure 68.

5. Perform the differential bearing preload adjustment as follows

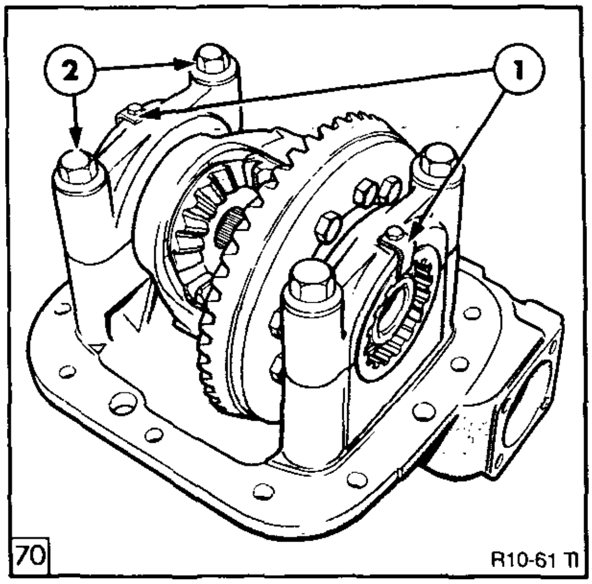
Differential Bearing Preload

1. Wrap a length of cord attached to a spring balance, evenly and without overlapping around the pinion gear spline.

2. Using a slow steady pull, measure the force required to rotate the pinion and crown wheel, Figure 69.

3. Subtract the pinion only reading obtained in step 6 of Page 24 from the combined pinion and differential reading obtained in the previous step 2.

4. Adjust the ring 'opposite' the crown wheel to increase or reduce differential bearing preload to the specified 7–10 lbf (3.2–4.7 kgf). Refer to following example.

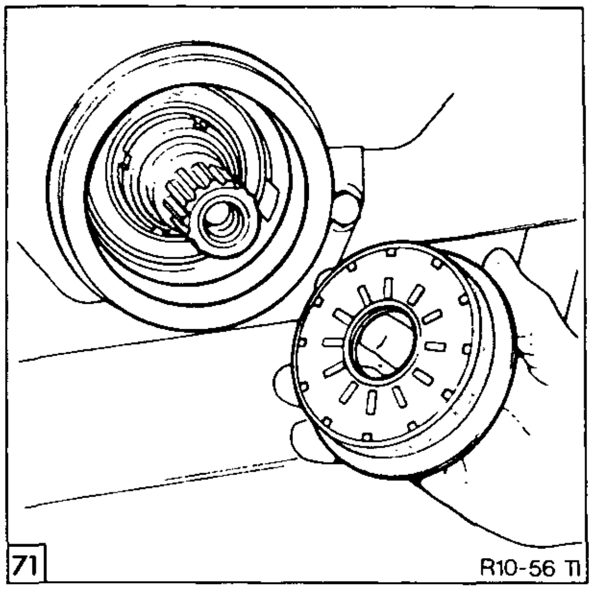


Differential Unit Bearing Adjuster Locking Plates
1. Locking Plates
2. Cap Retaining Bolts

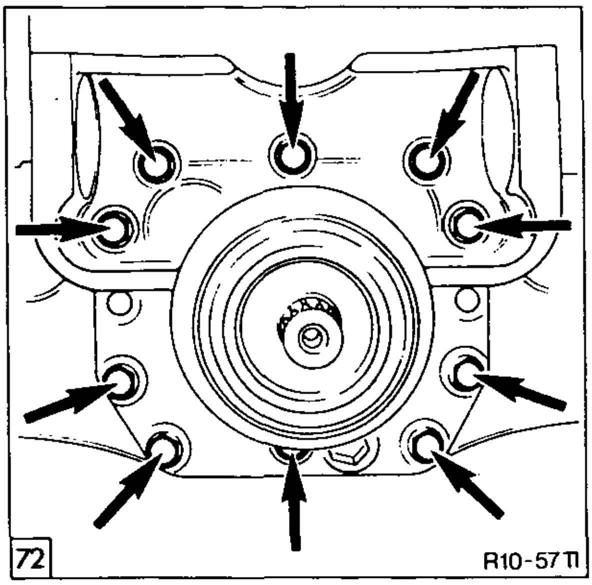
EXAMPLE

Pull required to turn slowly:

Pinion and Differential	16kgf
Pinion Only	–12 kgf
Differential Bearing Preload	= 4 kgf



Pinion Shaft Oil Seal



Differential Support Casing Retaining Bolts

5. Tighten bearing cap bolts to a torque of 196 lbf ft (266 Nm).
6. Recheck pinion backlash and install locking tabs, Figure 70. Tighten the tab retaining bolts to a torque value of 9 lbf.ft (12 Nm).
7. Install new pinion shaft oil seal, Figure 71.
8. Ensure the locating dowels in differential casing are correctly inserted. If removed install new dowels using loctite 638.
9. Apply loctite 510 liquid gasket to mounting face of housing and install onto axle. Tighten housing bolts to a torque of 125 lbf ft (169 Nm), Figure 72.
10. Install hubs, swivel housing and axle drive shaft as detailed in Section C.
11. Refill axle and hubs with oil to specification ESN–M2C134–D.
12. Install steering cylinder and axle onto tractor. Refer to Sections B and D.

F. FOUR WHEEL DRIVE SLIP FACTOR

To achieve the maximum tractor efficiency and tyre life, the four wheel drive system must have a slip factor of 1–6% (i.e. front wheels drive faster than rear).

The slip factor is calculated by a simple formula:

$$\% \text{ SLIP} = \frac{\text{FWD FACTOR X FRONT WHEEL ROLLING CIRCUMFERENCE}}{\text{* REAR WHEEL ROLLING CIRCUMFERENCE}} -1 \text{ X } 100$$

* Weighting and tyre pressures for field work.

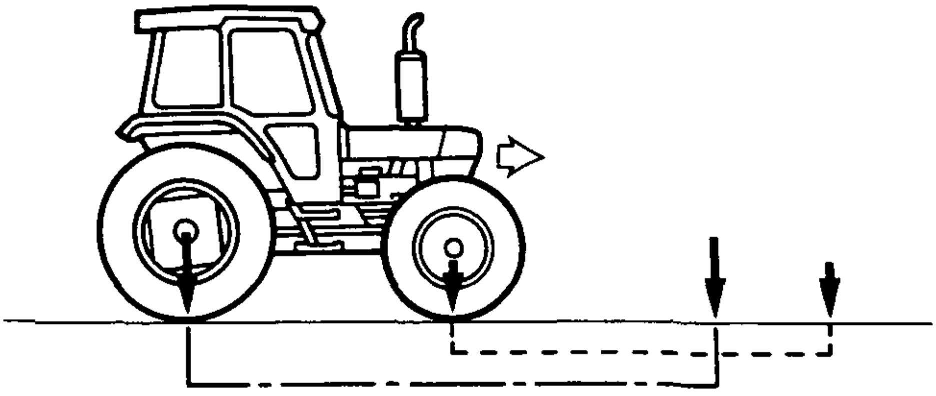
NOTE: *Where radial ply tyres are used, the rolling circumference must be multiplied by 1.015 to allow for expansion of the tyre.*

$$\text{F.W.D. FACTOR} = \frac{\text{REAR AXLE RATIO}}{\text{FRONT AXLE RATIO X TRANSFER RATIO}}$$

The F.W.D. factor can be found on the tractor identification decal or on the table on the following page.

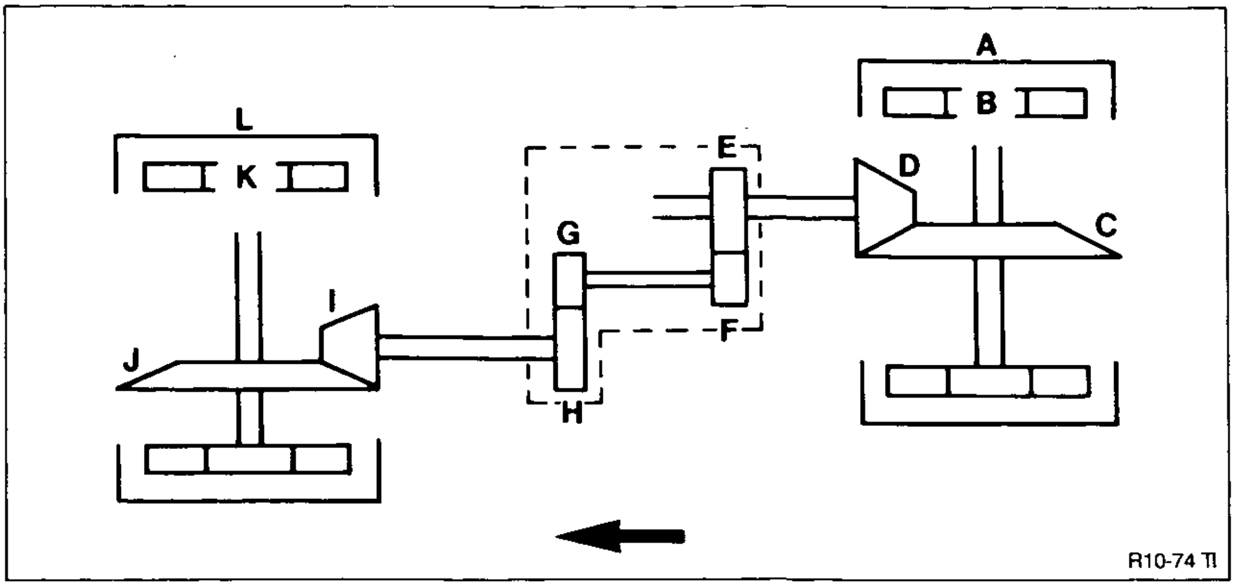
To ensure correct front and rear wheel compatibility, where manufacturer's rolling circumference figures are not available, establish front and rear loaded wheel rolling circumferences on hard level surface.

- Ensure tyre pressures are correct and tractor has normal ballast and weights.



R10-73TI

- Mark point where front and rear tyres contact the ground using a plumb line.
- Ensure F.W.D. is disengaged.
- Drive slowly in 1st gear until the front and then rear wheel marks contact the ground, marking the ground in both cases.
- Measure the distance between the respective front and rear wheel first and second marks, which are the respective loaded wheel rolling circumference.



DRIVE LINE SCHEMATIC

		56–7840 S	56–7840 SL	56–7840 SLE	82–8340 SL	82–8340 SLE
				No. of Gear Teeth		
REAR AXLE						
A	Ring Gear	56	80	80	80	80
B	Sun Gear	16	16	16	16	16
C	Crown Wheel	37	45	45	45	45
D	Pinion	7	.8	8	8	8
TRANSFER BOX						
E	Pinion Drive Gear	43	38	29	38	29
F	Idler Gear	44*	34	26	34	26
G	Driven Gear	*	26	26	26	26
H1	Transfer Box Output Gear	39	37	37	37	37
H2	Transfer Box Output Gear	40	38	38	38	38
FRONT AXLE		STD Axle			HD Axle	
I	Pinion	10	10	10	11	11
J	Crown Wheel	32	32	32	31	31
K	Sun Gear	15	15	15	13	13
L	Ring Gear	75	75	75	77	77
REAR AXLE RATIOS						
Reduction Ratio	A/B	4.5:1	6.0:1	6.0:1	6.0:1	6.0:1
Crown Wheel & Pinion	C/D	5.28:1	5.625:1	5.625:1	5.625:1	5.625:1
Rear Axle Ratio		23.76:1	33.75:1	33.75:1	33.75:1	33.75:1
FRONT AXLE RATIOS						
Reduction Ratio	K/L	6.0:1	6.0:1	6.01	6.92:1	6.92:1
Crown Wheel & Pinion	J/I	3.2:1	3.2:1	3.2:1	2.82:1	2.82:1
Front Axle Ratio		19.2:1	19.2:1	19.2:1	19.51:1	19.51:1
FWD Factor with Transfer Box Output Gear	H1	1.3659	1.3805	1.3777	1.3586	1.3558
	H2	1.3318	1.3442	1.3415	1.3228	1.3201

* **NOTE:** *For "S" model tractors with FWD. The drive is taken from the pinion shaft via an idler gear to the transfer case, mounted under the rear axle centre housing.*

G. SPECIFICATIONS

Type	Carraro centre driven, double reduction (crown wheel and pinion plus planetary hubs), limited slip differential and integral steering cylinder.	
Steering Turn Angle (dependent on track setting)	Standard – Adjustable between 30° and 55°.	
Axle Articulation Angle	12° maximum Can be restricted to 8°.	
Overall Width	709–ST 2032 mm	709–HD 2090 mm
Oil Capacities	709–ST Axle	709–HD Axle
Hubs (each)	1.5 litres	1.3 litres
Axle Differential	6.2 litres	8.0 litres
Oil Change Period	Every 1,200 hours or annually.	

Lubricants

Oil to Ford Specification – ESN–M2C–134D.
Grease to Ford Specification – ESE–M1C–75B.

Thread Sealant

To Ford Specification – ESE–M4G.140A (Loctite 542). Use on crown wheel retaining bolts and planetary shaft cover screw heads.

Dowel Fixative Adhesive

To Ford Specification – SPM–2G.9120A (Loctite 638) – Differential support casing to centre housing dowel.

Flange Sealant (Face to Face Sealant)

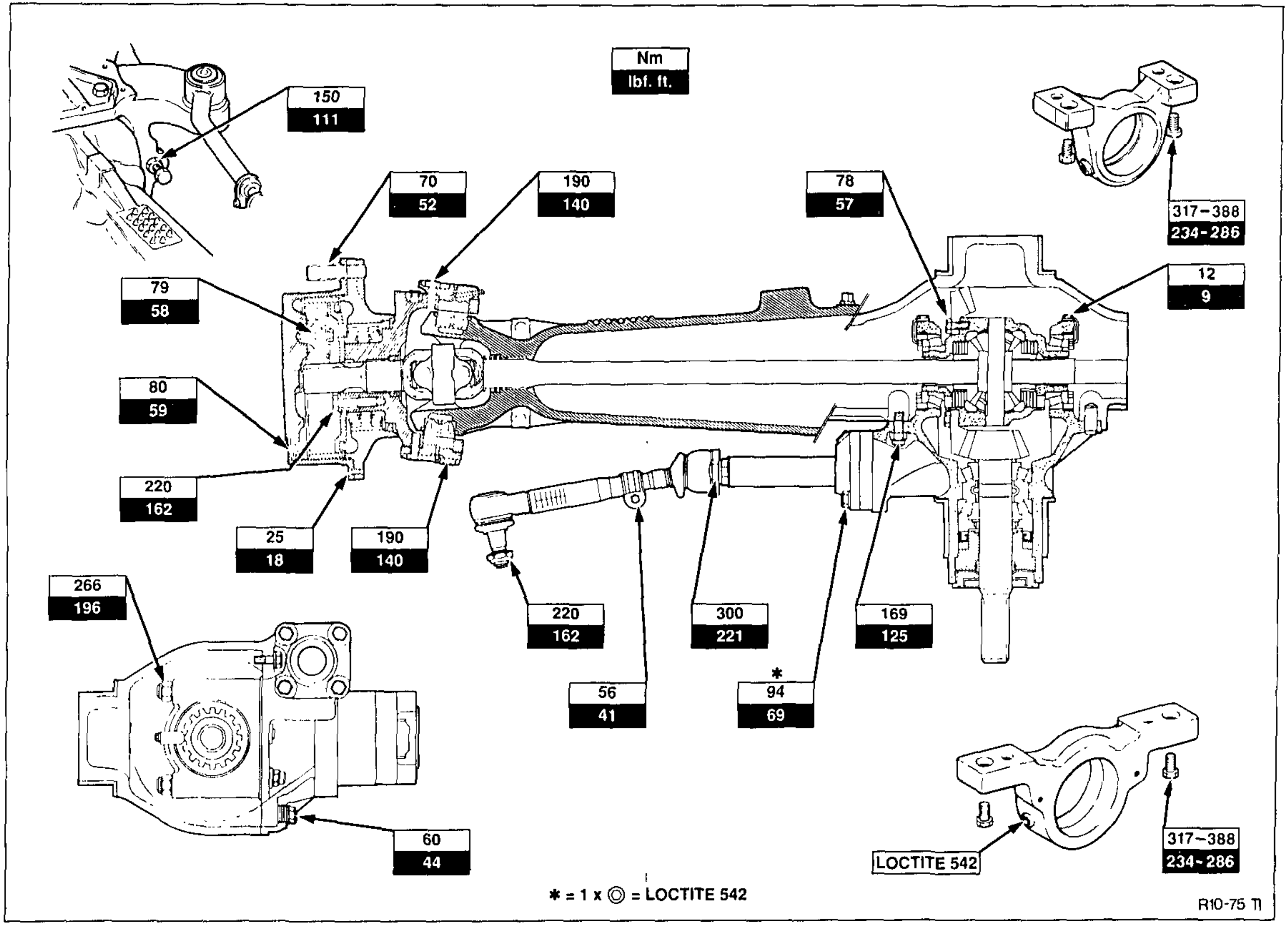
To Ford Specification ESE–M4G. 234–AS (Loctite Superflex Silicone, Loctite 510) – Planetary carrier to hub housing and differential support casing to axle housing.

Clearances and Adjustments

Front Wheel Toe–In	0–0.25 in. (0–6.0 mm)
Axle Hub Bearing Rolling Resistance	Non–Adjustable, Pre–Set
Swivel Bearing Free play	0.00 – 0.004 in (0.00 – 0.10 mm)
	Adjustable by shims of:– 0.004 in. (0.10 mm) 0.007 in. (0.19 mm) 0.014 in. (0.35 mm)
Drive Pinion Bearing Rolling Resistance (see text)	22 – 33 lbf (10.1 – 15.2 kgf)
Pinion to Crown Wheel Backlash	0.007 – 0.010 in. (0.19 – 0.25 mm)
Pinion to Crown Wheel Bevel Distance	Adjustable by Shims 2.5 – 3.4 mm in steps of 0.1 mm (0.10 – 0.136 in., in steps of 0.004 in.)
Differential Bearing Rolling Resistance (see text)	Drive Pinion Bearing Rolling Resistance plus 7 – 10 lbf. (3.2 – 4.7 kgf)
Limited Slip Differential Clutch Plate Wear Limits	
Internally Splined Friction Plates	
New	0.063 in. (1.6 mm)
Minimum Thickness	0.059 in. (1.5 mm)
External Lug Steel Drive Plates	
New	0.059 in. (1.5 mm)
Minimum Thickness	0.055 in. (1.4 mm)
Internally Splined Thrust Plate	
New	0.110 in. (2.8 mm)
Minimum Thickness	0.106 in. (2.7 mm)

SPECIAL TOOLS

DESCRIPTION	V.L. CHURCHILL TOOLS	NUDAY TOOLS
Puller	954C	FNH 09508
Puller	943	FNH 09507
Slide Hammer	943S	FNH 09567
Driver Handle	MS 550	–
Seal Installer	FT3162	–
Bushing Installer	FT3163	–
Bushing Installer	FT3164	–
Seal Installer	FT3166	–
Pinion Nut Wrench	FT3168	–
Pinion Setting Gauge	FT3135	FNH 04775


Nm
lbf. ft.
150
111
70
52
190
140
78
57
317–388
234–286
79
58
12
9
80
59
220
162
25
18
190
140
266
196
220
162
300
221
169
125
56
41
*
94
69
60
44
317–388
234–286
LOCTITE 542
* = 1 x ◎ = LOCTITE 542
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PART 10
FRONT AXLE

Chapter 3
FOUR WHEEL DRIVE AXLE TRANSFER BOX TRACTORS WITH 8 X 2 AND 16 X 4 TRANSMISSION

A. DESCRIPTION AND OPERATION

The transfer box assembly of four wheel drive tractors installed with either 8x2 or 16x4 transmissions is mounted under the rear axle centre housing and through a universally jointed drive shaft passing along the central axis of the tractor, connects the output from the transmission to the four wheel drive axle.

The transfer box features a simple dog type clutch to engage the drive to the front axle. Engagement/disengagement of the dog clutch is controlled by a combination of hydraulic pressure taken from the low pressure hydraulic circuit and return springs within the transfer box assembly.

A helical gear mounted on the rear axle pinion shaft transmits the drive through a mating helical idler gear, carried in two taper roller bearings in the transfer box to a driven gear on the lower shaft.

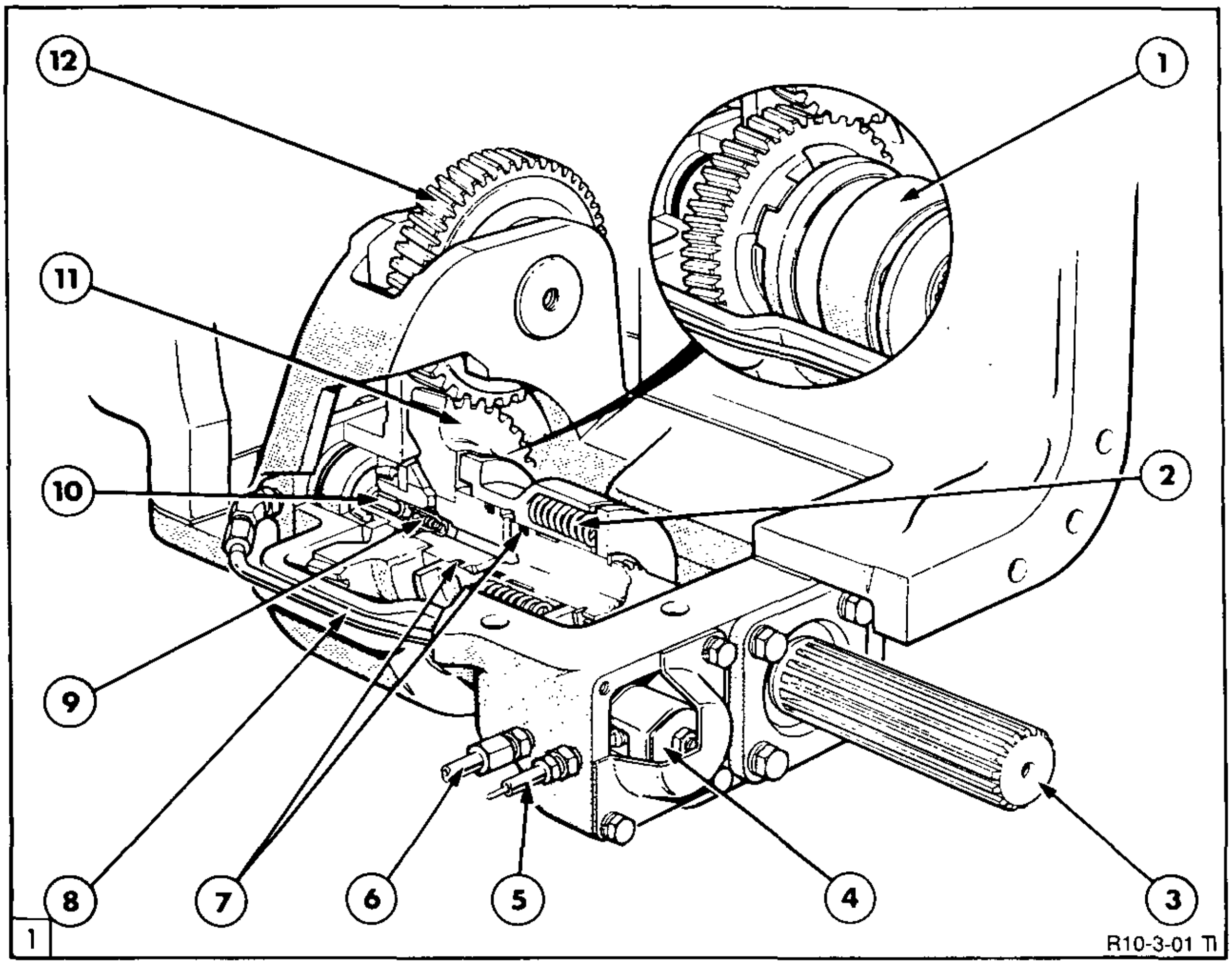
Two ratios of transfer box 0.93:1 (44/40) and 0.907:1 (44/39) are available to suit the various front and rear tyre sizes. The ratio is stamped on a plate located on the top left hand side of the transfer box case. The ratio is determined by the number of teeth on the driven, lower, gear. To change the ratio the driven gear is replaced with either a 39 or 40 tooth gear as appropriate.

The total ratio, front to rear, is 1.3659:1 with the 44/39 gears and 1.33175:1 with the 44/40 gear set. This ratio is stamped on the tractor identification decal, located under the hood.

The lower shaft is supported in two taper roller bearings and has a sliding dog clutch splined to its central portion. The driven gear carries a mating dog clutch and when not engaging with the sliding component is free to rotate on the shaft. The clutch is engaged by four radially positioned springs and released by hydraulic pressure signaled by an electrical switch on the control console.

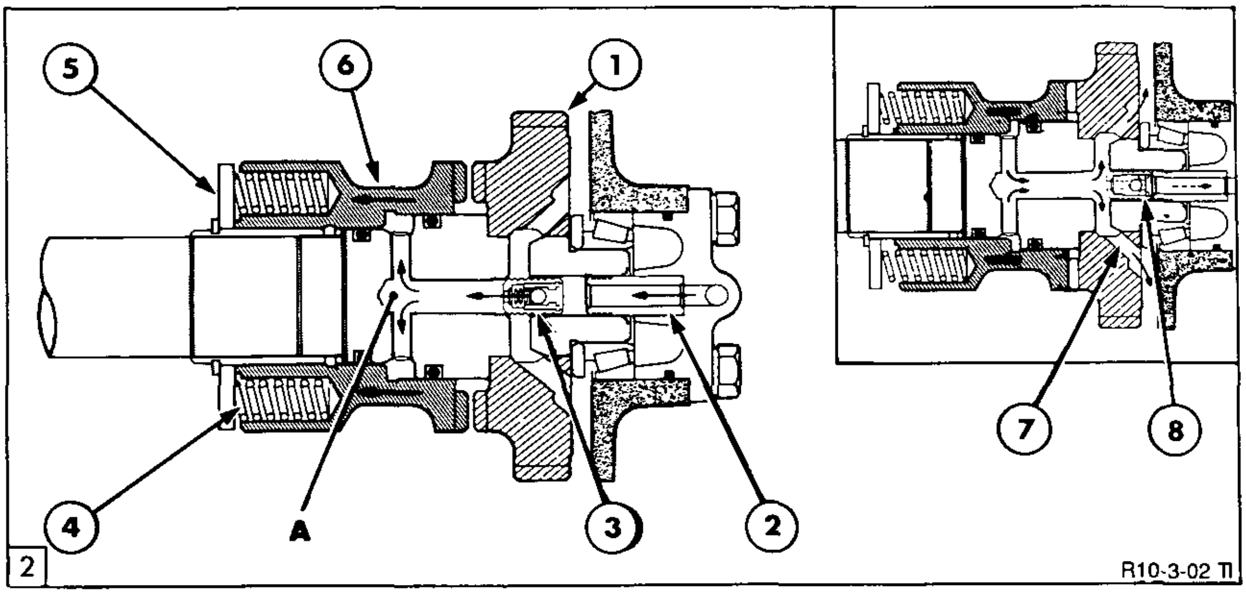
An electrically operated solenoid valve directs oil from the low pressure hydraulic circuit, via an external tube to the rear end plate of the transfer box. When four wheel drive is disengaged by the operator, the solenoid is actuated and oil flow is directed through the short transfer tube to the central bore of the lower shaft.

A moving double check valve positioned in this central bore moves forward and the pressurised oil flow passes through the centre of the valve by lifting the inner check valve off its seat, Figure 2. Pressurised oil on entering Gallery 'A' moves the sliding clutch against the radially positioned springs, disengaging the dog teeth on the driven gear. The driven gear is now free to rotate on the shaft and drive to the front axle is disconnected.



Transfer Box Assembly – Cutaway View

1. Sliding Clutch	5. Electrical Supply Connection	9. Double Check Valve
2. Coil Springs (4 off)	6. Hydraulic Oil Supply	10. Oil Transfer Tube
3. Output Shaft	7. Sealing Rings	11. Driven Gear
4. Solenoid Valve	8. External Oil Tube	12. Idler Gear



Clutch Operation – Schematic View
(Inset Showing Clutch Engagement)

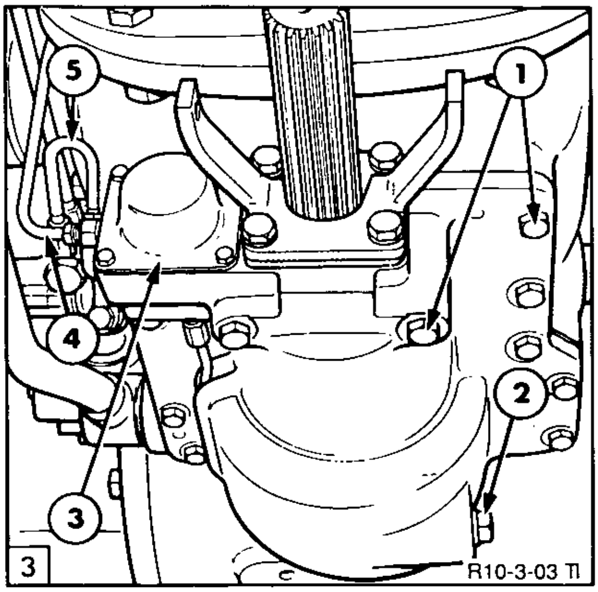
1. Driven Gear	4. Return Springs (4 off)	7. Oil Exhaust Route
2. Oil Transfer Tube (inlet)	5. Spring Keeper Plate	8. Check Valve (ball seated, valve moved rearwards)
3. Check Valve (ball unseated)	6. Sliding Clutch	

When the operator engages four wheel drive the electrical circuit to the solenoid is broken and the solenoid deactivated. Hydraulic pressure to the check valve now collapses and spring pressure forces the sliding clutch towards the driven gear. As the sliding clutch moves, discharging oil slides the whole check valve rearwards; the inner primary check ball will not allow oil to pass through the valve centre from gallery 'A', hence the whole valve slides rearwards. This movement exposes a large exhaust path, through radial drillings in both the shaft and the gear to the rear axle reservoir, permitting a rapid engagement of the clutch. A small amount of oil is also initially exhausted through the solenoid to allow the check valve to move.

B. TRANSFER BOX – OVERHAUL

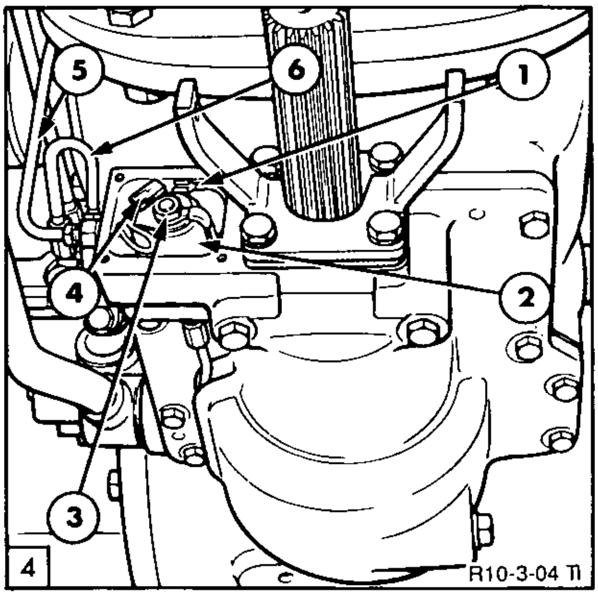
REMOVAL

1. Park the tractor on a hard level surface and block the wheels.
2. Remove the drive shaft guard and drive shaft.
3. Remove the rear axle/transmission drain plug and allow the oil to drain into a suitable container capable of holding 66 litres (14.5 Imp. Galls, 17.4 U.S. Galls).
4. Remove the solenoid cover plate and disconnect the wire from the solenoid, Figure 4.
5. Disconnect the wire protecting tube from the side of the transfer box casing.
6. Disconnect the hydraulic oil feed pipe from the casing.
7. Support the transfer box with a suitable jack, remove the retaining bolts and lower the transfer box assembly away from the tractor.



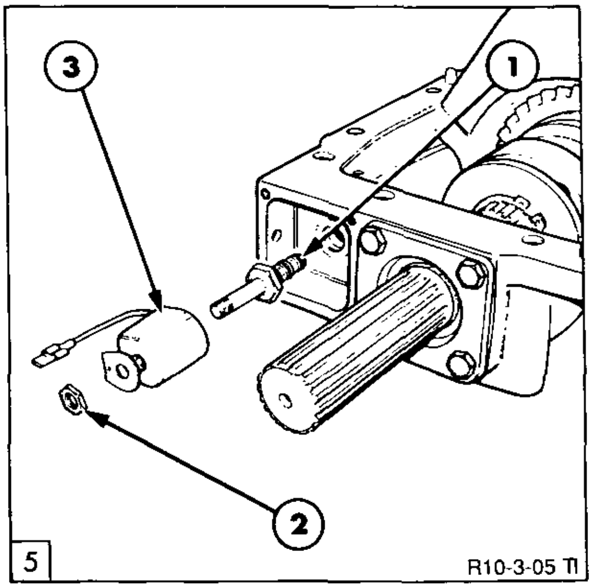
Transfer Box Installed

1. Retaining Bolts
2. Drain Plug
3. Solenoid Valve Cover
4. Feed Wire Protection Tube
5. Hydraulic Feed Pipe



Solenoid Cover Removed and Electrical Connections

1. Coil Supply
2. Solenoid Assembly
3. Earth Connection
4. Supply Wire
5. Electrical Protection Tube
6. Hydraulic Feed Tube



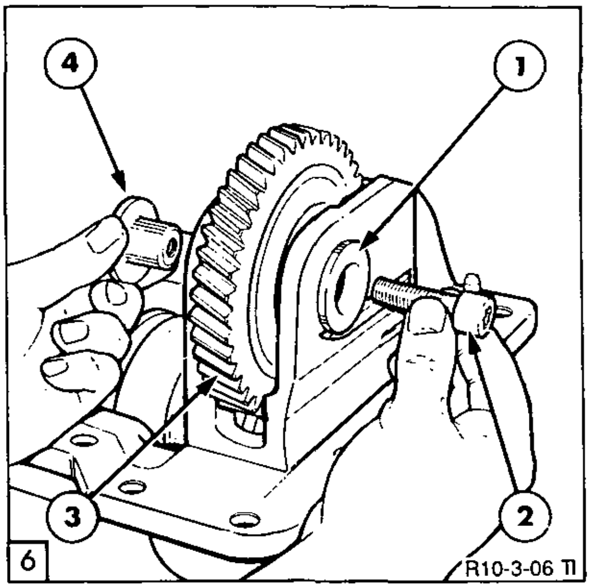
5

Solenoid Valve/Core Removed from Casing

1. Valve/Core
2. Coil Retaining Nut
3. Coil and Feed Wire

DISASSEMBLY

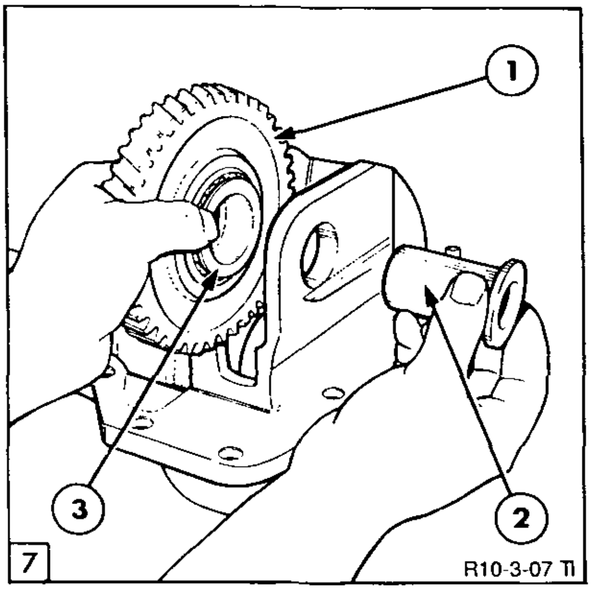
1. Remove the external oil tube linking the solenoid port to the transfer box rear end plate.
2. Remove the solenoid coil and unscrew the core and valve assembly, Figure 5.
3. Remove the socket head bolt securing the idler gear and bearing assembly, Figure 6. If necessary, carefully apply heat to the nut end to soften and release the thread locking compound applied during manufacture.



6

Idler Gear Shaft Retainer

1. Shaft
2. Socket Head Screw
3. Idler Gear
4. Shouldered Anchor Nut

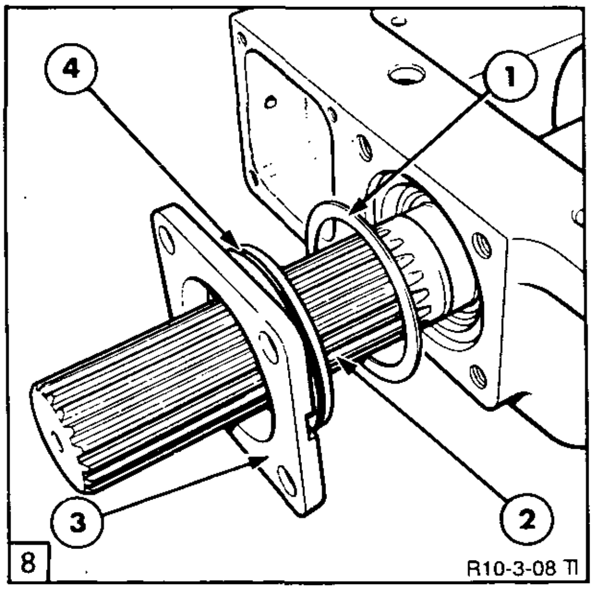


7

Removing Idler Gear

1. Idler Gear
2. Shaft
3. Bearing Assembly

4. Mark the front of the idler gear to aid reassembly. Drive out the central shaft and lift out the gear and bearing assemblies. Keep the bearings, spacers and shims together for possible re–use, Figure 7.

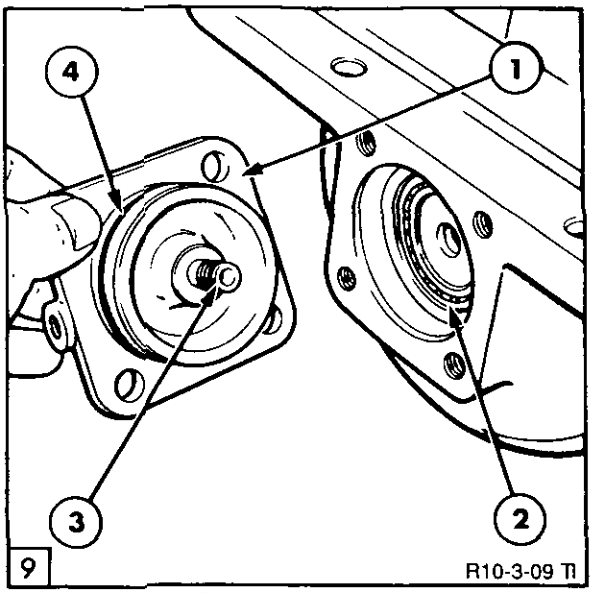


8

Removing Output Shaft End Plate/Seal Carrier and Shims

1. Shims
2. Output Shaft
3. End Plate/Seal Carrier
4. 'O' Ring Seal

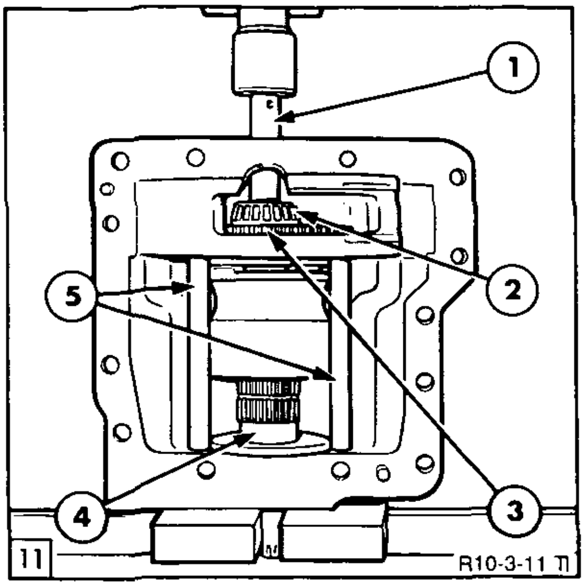
9



Removing Output Shaft Rear End Plate

1. End Plate
2. Bearing Assembly
3. Oil Transfer Tube
4. 'O' Ring Seal

11

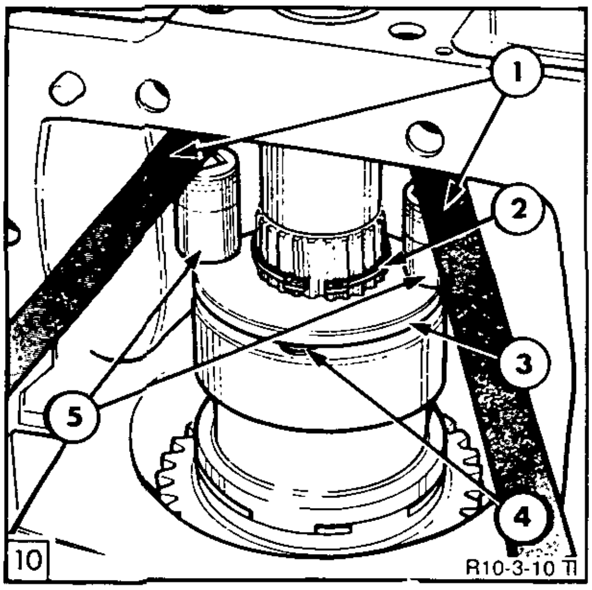


Removing Output Shaft Rear Bearing

1. Adaptor
2. Bearing
3. Driven Gear
4. Output Shaft
5. Support Rods

5. Remove the output shaft end plate. Collect and identify the shims positioned between the plate and the bearing outer track, Figure 8.

10



Levering Clutch Spring Keeper Plate Against Clutch Springs

1. Levers
2. Snap Ring
3. Keeper Plate
4. Clutch Spring (4 off)
5. Distance Pieces

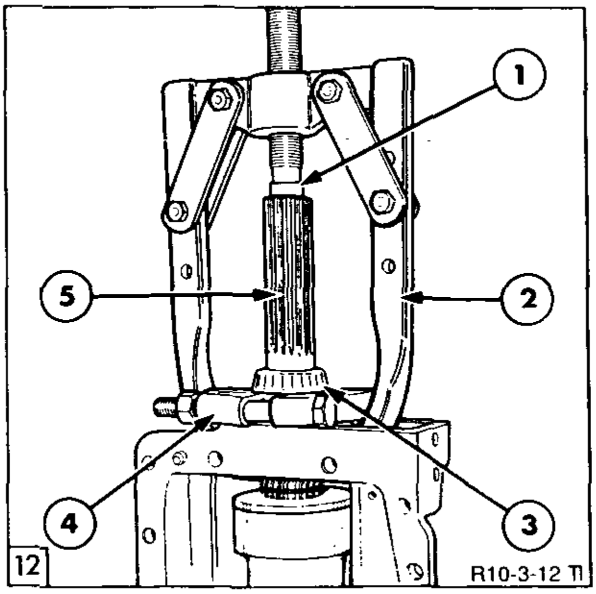
6. Remove the rear end plate, Figure 9. Remove the short oil transfer tube from the shaft, if this remained in the shaft.

7. Gently drive the output shaft forward and backward and remove the front and rear bearing outer tracks.

8. With the aid of an assistant, lever the clutch spring keeper against the clutch springs, Figure 10, to release the load on the snap ring, remove the snap ring.

9. Remove the four clutch springs.

10. Position two suitable lengths of steel rod or tube between the drive gear and the front of the casing so that the shaft may be pressed through the driven gear, Figure 11. Remove the bearing.



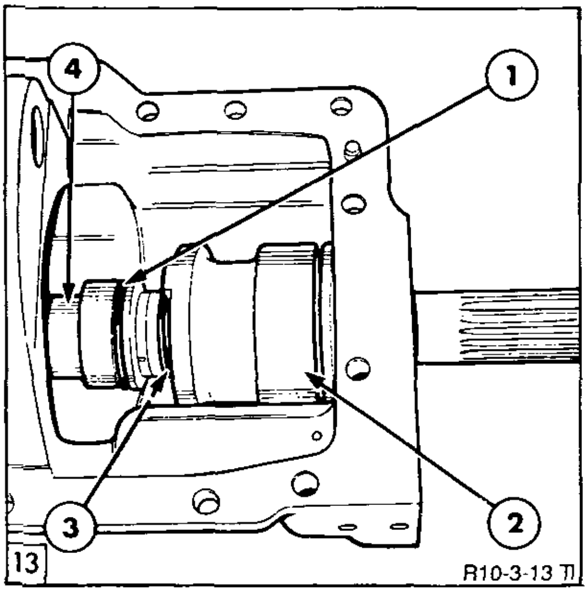
Removing Output Shaft Front Bearing

1. Shaft Protector
2. Tool No.1003 (9516)
3. Bearing
4. Tool No.951 (9190)
5. Output Shaft

11. Ease the shaft forward as far as the clutch will permit and lift out the drive gear and thrust washer.

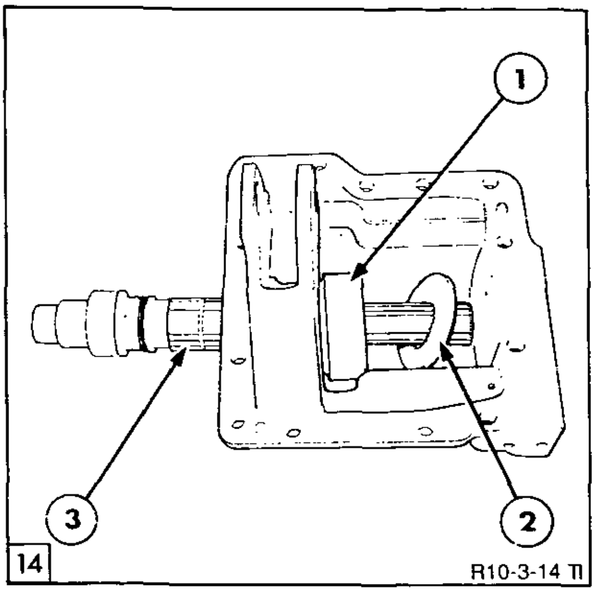
12. With the shaft still eased forward remove the front bearing.

13. Remove the clutch snap ring, passing it along the waisted section of the shaft and over the short splined area.



Clutch Sealing Rings on Output Shaft

1. Rear Sealing Ring
2. Clutch Body
3. Front Sealing Ring
4. Output Shaft



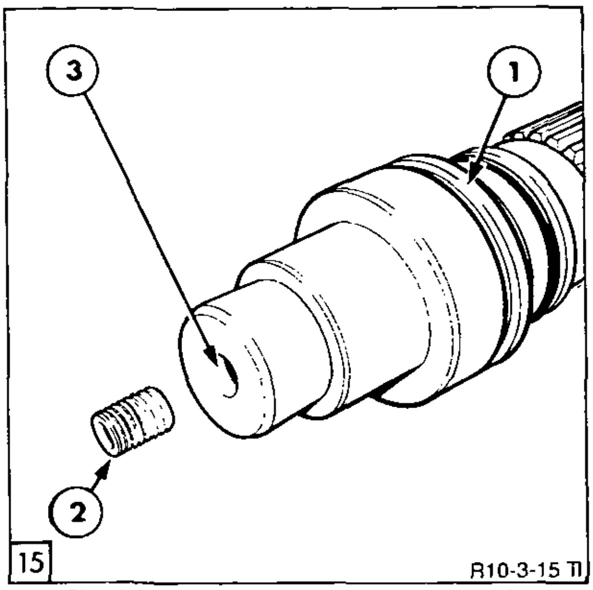
Output Shaft Moved Rearward from Transfer Box Case

1. Clutch Body
2. Spring Keeper
3. Output Shaft

14. Ease the shaft rearwards and draw the clutch forwards to expose the clutch rear sealing ring, Figure 13. Remove the sealing ring.

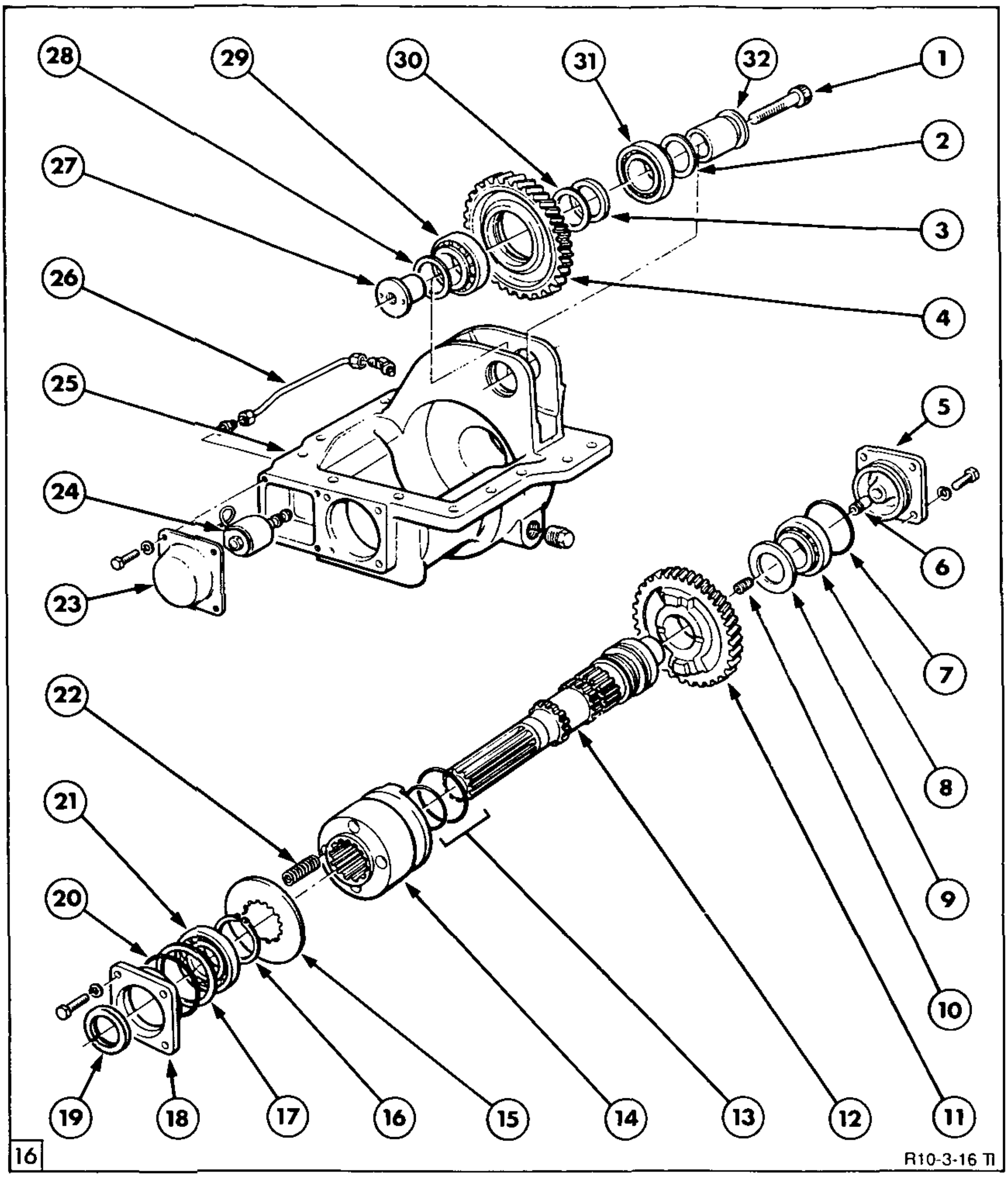
15. Carefully ease the shaft rearwards and lift out the clutch and spring keeper, Figure 14.

16. Remove the check valve from the central bore of the shaft, Figure 15. Applying an air line to the cross drilling between the clutch sealing rings will aid removal.



Check Valve Removed from inner Bore of Output Shaft

1. Output Shaft
2. Check Valve
3. Central Bore



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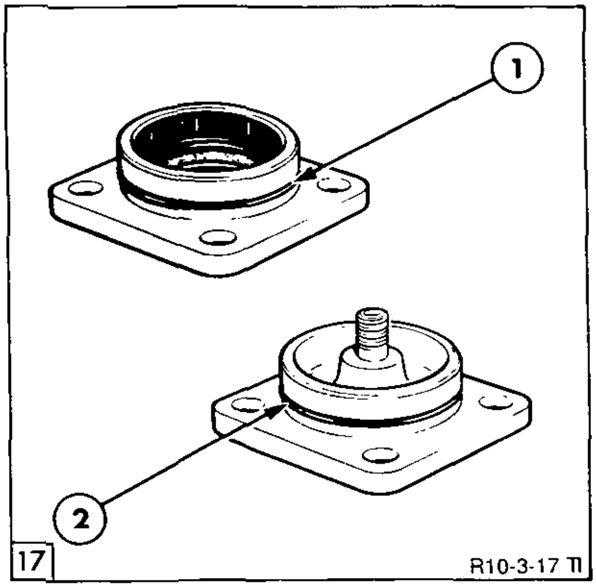
Transfer Box Assembly – Exploded View

1. Bolt
2. Shim
3. Spacer
4. Idler Gear
5. Rear End Plate
6. Oil Transfer Tube
7. 'O' Ring
8. Bearing
9. Thrust Washer
10. Check Valve
11. Driven Gear
12. Output Shaft
13. Sealing Rings
14. Sliding Clutch
15. Spring Keeper
16. Snap Ring
17. Shim
18. Front End Plate
19. Seal
20. 'O' Ring
21. Bearing
22. Spring – 4 off
23. Solenoid Cover
24. Solenoid/Valve
25. Casing
26. Oil Tube
27. Retainer
28. Shim
29. Bearing
30. Shim
31. Bearing
32. Shaft

INSPECTION AND REPAIR

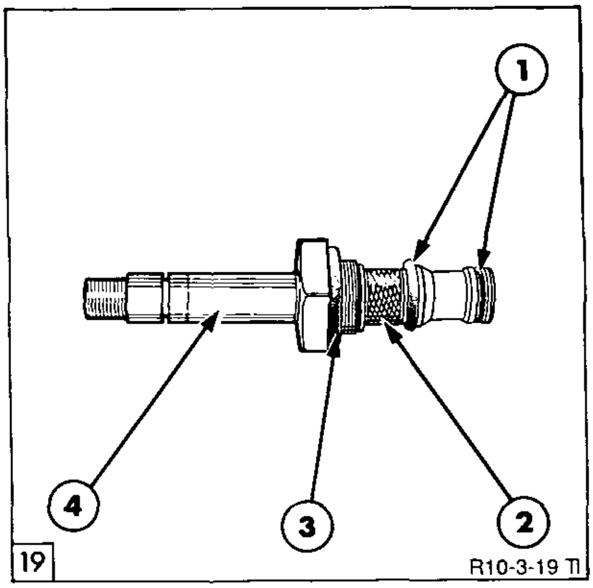


Output Shaft End Plates
1. 'O' Ring Seal – Front Plate
2. 'O' Ring Seal – Rear Plate

1. Remove the 'O' ring seals from the shaft end plates, Figure 17 and the remaining sealing ring on the central area of the shaft.

2. Remove and discard the felt/lip seal from the output end plate, Figure 18. Do not install a new seal at this stage.

3. Wash all components, including the actuating valve, the oil transfer tube and the check valve from the centre of the shaft, in a suitable solvent and allow to air dry.



Solenoid Valve Core

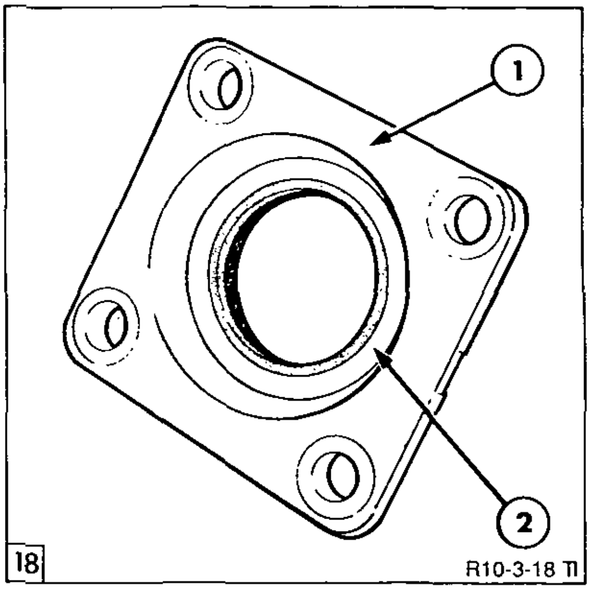
1. 'O' Rings	3. 'O' Ring
2. Screen Mesh	4. Valve Core

4. *From the tractor remove the transfer box* hydraulic feed pipe, Figure 3, and clean the small filter/screen positioned inside the now exposed adaptor.

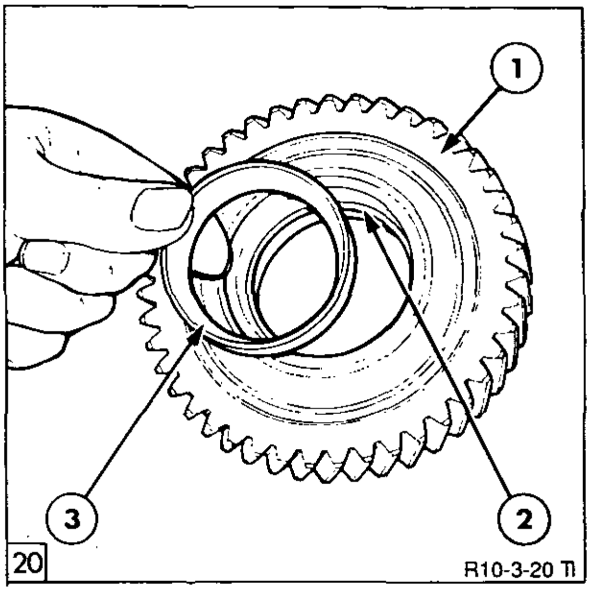
5. Inspect the valve core 'O' rings, renewing as required, Figure 19. Inspect the *screen mesh for damage or excessive* contamination.

6. Carefully inspect the idler gear bearings. If worn or damaged, renew both bearings. Slide the outer tracks from the gear, Figure 20.

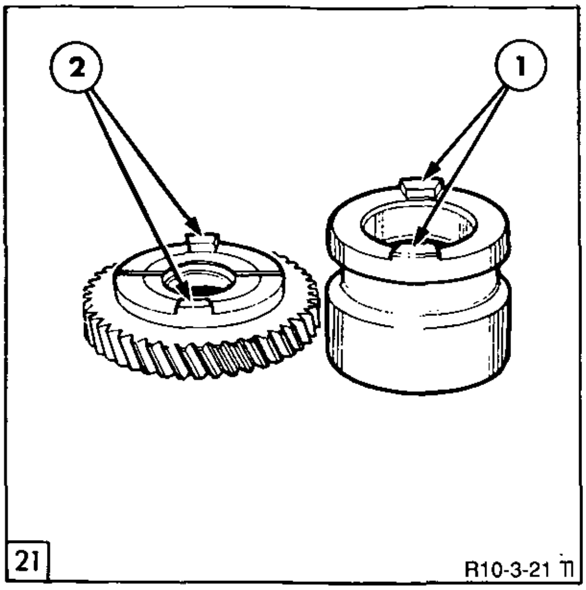
7. Inspect the idler gear and lower gear teeth for wear or damage. If wear or damage is found also inspect the driving gear on the rear axle pinion.



Output Shaft Front End Plate
1. End Plate
2. Felt/Lip Seal



Idler Gear Bearing Inner Tracks
1. Idler Gear
2. Separating Shoulder
3. Inner Track – 2 off



Clutch Dog Teeth

1. Clutch Dog Teeth
2. Driven Gear Dog Teeth

8. Inspect the clutch dog teeth on both the sliding clutch component and the gear. If the clutch dogs show wear, or are not square, then both parts should be renewed, Figure 21.

9. Inspect the clutch springs for deformity and cracks, check that the spring free length is 48 mm (1.889 in).

10. Inspect the clutch and shaft splines. Ensure the clutch slides smoothly on the splines.

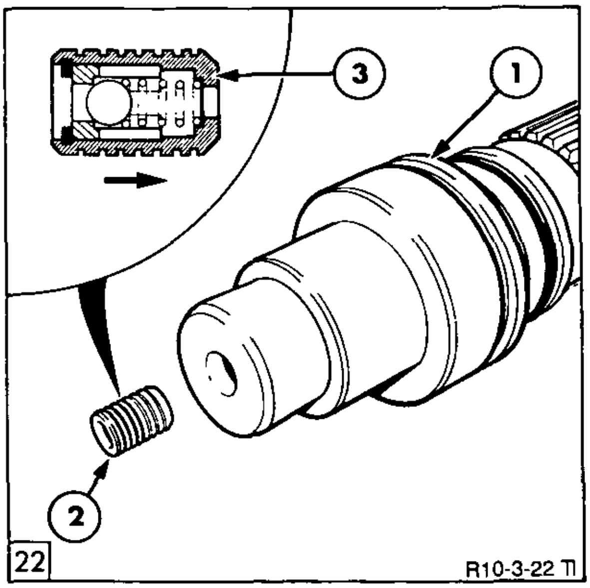
11. Inspect the lower shaft bearing assemblies. Renew where necessary.

12. Inspect the output shaft to driveshaft spline for damage and wear.

RE-ASSEMBLY

1. Install new 'O' ring seals on the two end plates and install a new clutch sealing ring on the smaller diameter of the shaft. Do not install the larger sealing ring until the shaft has been positioned inside the casing.

2. Coat the check valve with grease to retain in the shaft during assembly and install the valve in the shaft. Ensure the valve is entered with the spring facing forward and the ball to the rear, Figure 22.



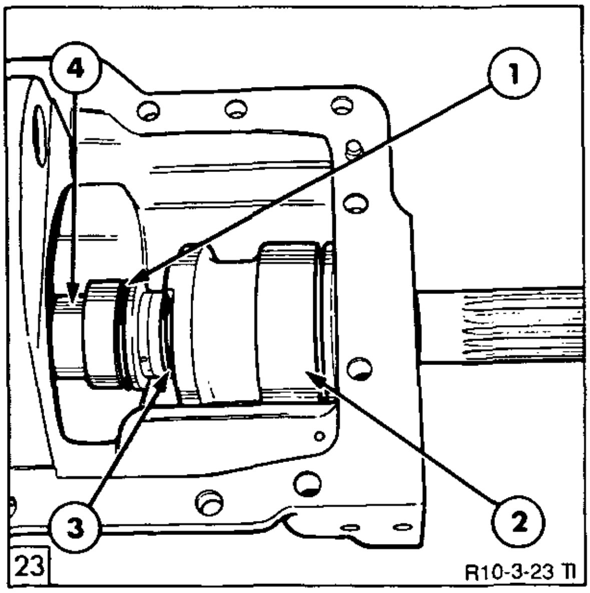
Check Valve Installation in Output Shaft

1. Output Shaft
2. Check Valve
3. Identification Section

3. Thoroughly lubricate the inside of the clutch and lay the clutch in the casing with the spring keeper plate.

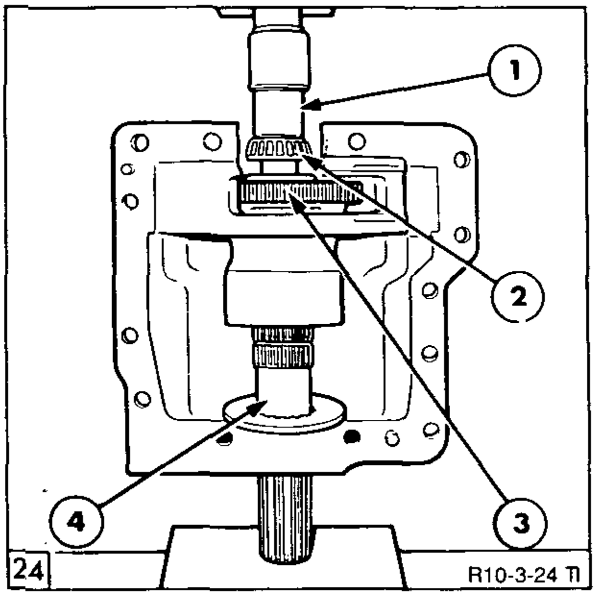
4. Pass the shaft through the rear bearing bore and through the clutch and keeper plate. Before fully assembling the clutch on the shaft, install the larger diameter sealing ring. Lubricate both sealing rings, Figure 23.

5. Fully assemble the clutch onto the shaft moving the clutch to the fully closed position.



Output Shaft Entered in Casing

1. Rear Sealing Ring
2. Clutch Body
3. Front Sealing Ring
4. Output Shaft



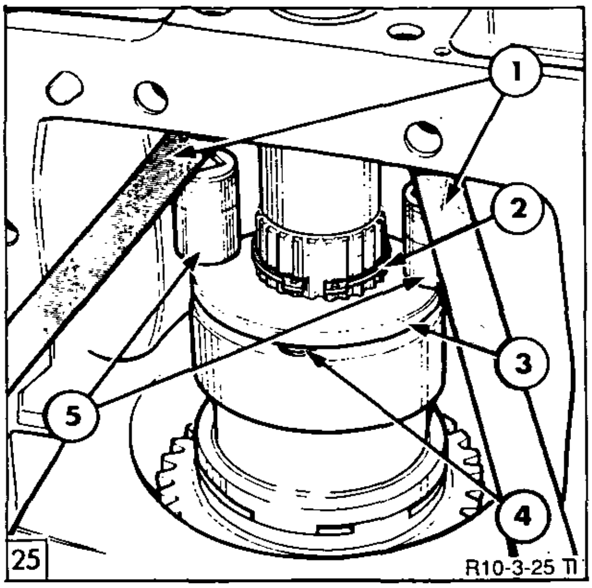
Pressing Rear Bearing onto Output Shaft

1. Adaptor
2. Bearing
3. Driven Gear
4. Output Shaft

6. With the shaft eased fully forward, assemble the driven gear and thrust washer onto the shaft.

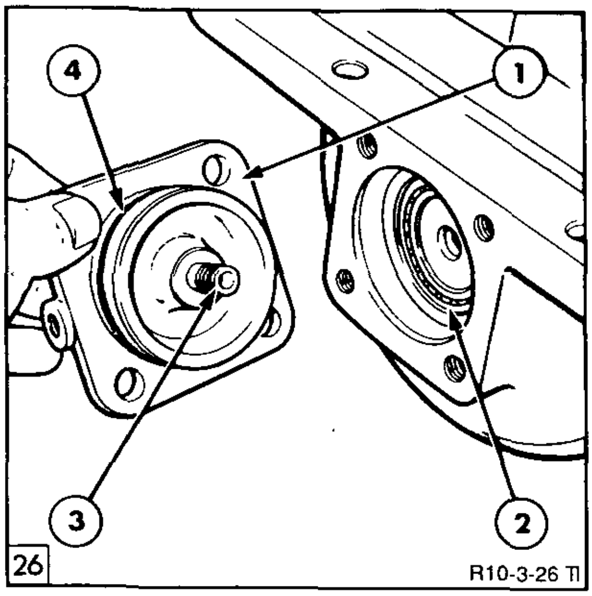
7. Using a suitable spacer, press the rear bearing onto the shaft whilst supporting the front of the shaft, Figure 24.

8. Position the snap ring on the shaft, adjacent to the keeper plate in the waisted section.



Levering Clutch Spring Keeper Against Clutch Springs

1. Levers
2. Snap Ring
3. Keeper Plate
4. Clutch Springs – 4 off
5. Distance Pieces



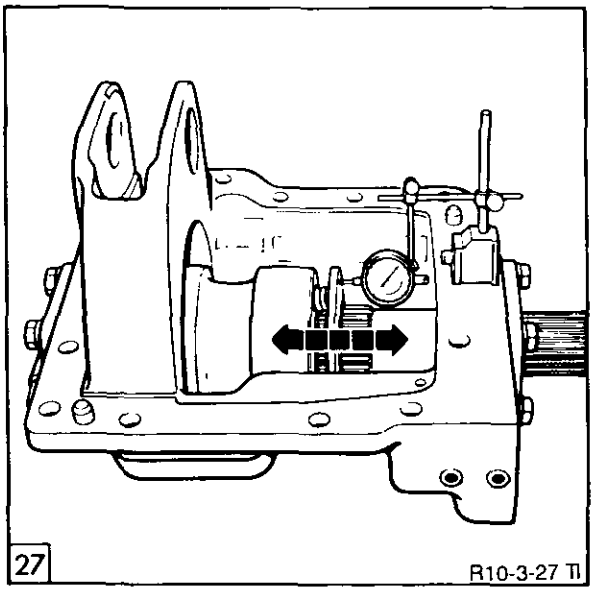
Installing Output Shaft Rear End Plate

1. End Plate
2. Bearing Assembly
3. Oil Transfer Tube
4. 'O' Ring Seal

9. Using a suitable sleeve drive on the front bearing, ensure the sleeve only bears on the inner track.

10. Install the four clutch springs and following the disassembly procedure in reverse, compress the keeper and springs to install the snap ring. Ensure the snap ring is fully seated in its groove, *Figure 25.*

11. Ensure the check valve is still in position inside the shaft, slide in the bearing outer track and install the rear end plate with the oil transfer tube, Figure 26. Tighten the bolts to a torque of 38 lbf.ft (51 Nm).



Assessing Output Shaft End Float

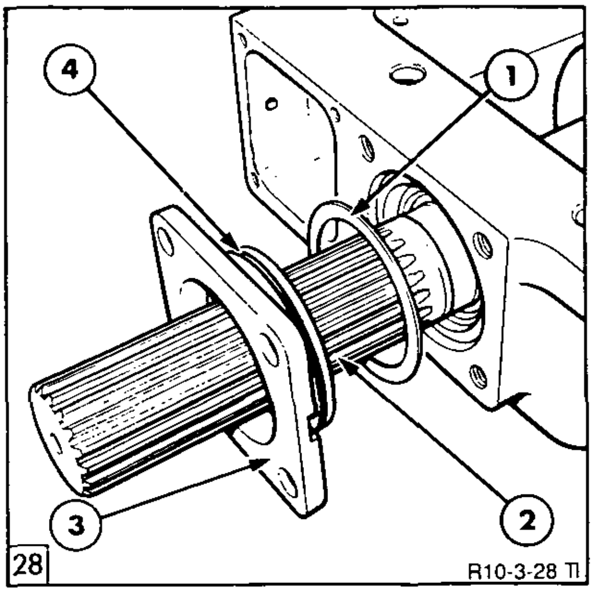
12. Slide in the front bearing outer track and install the front bearing retainer without its felt/lip seal and shims. Tighten the bolts to a torque of 38 lbf.ft (51 Nm).

13. Access the degree of end float by mounting a dial indicator against the clutch assembly and moving the shaft forward and backwards, Figure 27.

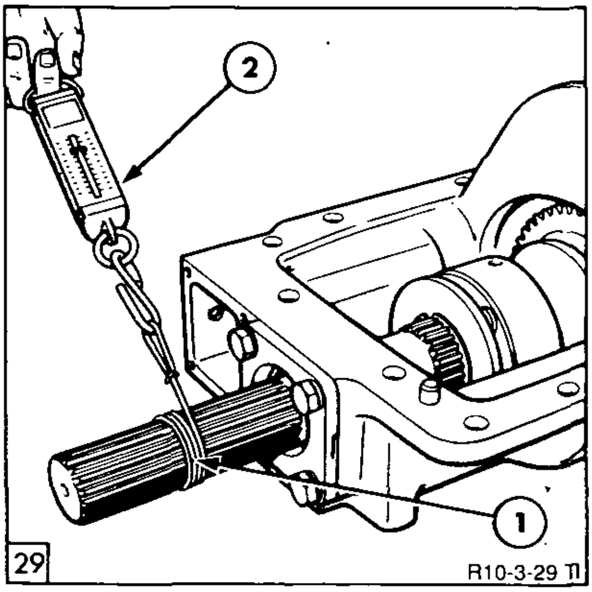
14. Select shims equivalent to this end float assessment and add a further 0.1 mm (0.004 in) shim to the result.

15. Remove the front bearing retainer, install the shim pack and plate and hand tighten the retaining bolts, Figure 28.

16. Measure the rolling resistance of the shaft within its bearing, using a length of string wrapped around the output shaft and a spring balance. Progressively tighten the bolts to a final torque of 38 lbf.ft (51 Nm) and ensure the rolling resistance is within 4.2– 9.9 lbf. (1.9–4.5 Kgf.). Only read the spring balance when the shaft is rotating and ensure that the string does not over wrap on the shaft, Figure 29.



Installing Output Shaft End Plate and Shims
1. Shims
2. Output Shaft
3. End Plate Without Seal
4. 'O' Ring Seal



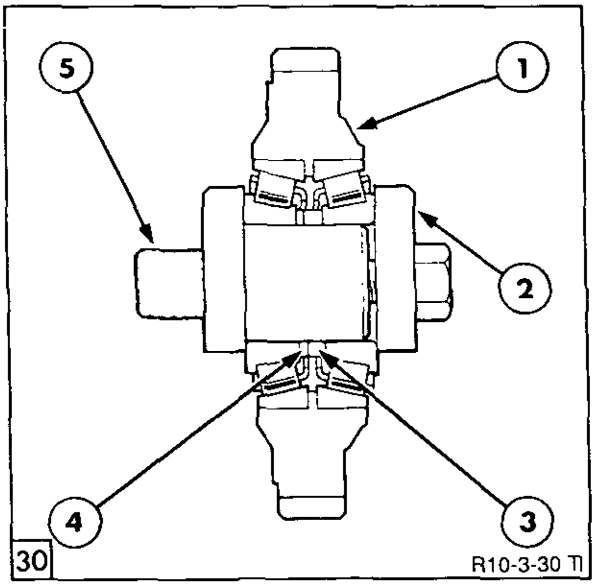
Measuring Rolling Resistance of Output Shaft Bearings
1. String
2. Spring Balance

17. If the rolling resistance is not within the specified limits adjust the shim pack accordingly. Add shims to increase the rolling resistance, subtract shims to decrease.

18. When the correct rolling resistance is obtained, remove the end plate and install a new felt/lip seal. Carefully replace the end plate, taking care not to damage the seal and tighten the end plate retaining bolts to a torque of 38 lbf.ft (38 Nm).

19. Install the solenoid valve and oil transfer tube.

20. The idler gear can now be re–assembled, but requires the pre–load on its taper roller bearings to be calculated by measuring the rolling resistance using special Tool No. FT3169, using the following procedure:



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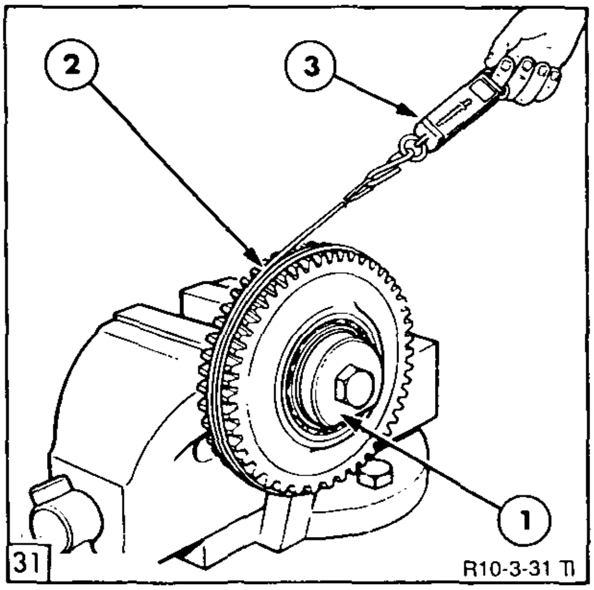
Idler Gear and Bearing Assembly Mounted on Special Tool

1. Idler Gear
2. Special Tool No. FT3169
3. Spacer
4. Shim
5. Vice Grip

(i) Slide the bearing outer tracks into the idler gear and assemble the inner bearings with the spacer and one 0.3 mm (0.012 in.) shim between them.

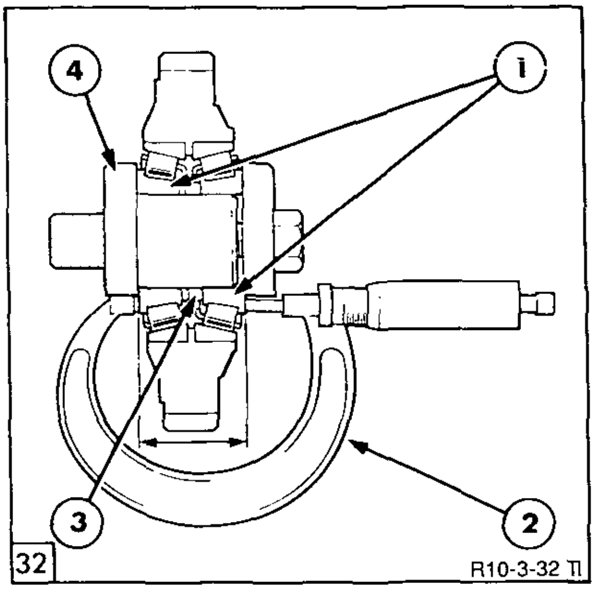
(ii) Mount this assembly on the special tool and tighten the tool bolt to a torque of 50 lbf.ft (68 Nm), Figure 30.



31

Measuring Rolling Resistance of idler Gear Bearings

1. Special Tool No. FT 3169
2. String
3. Spring Balance



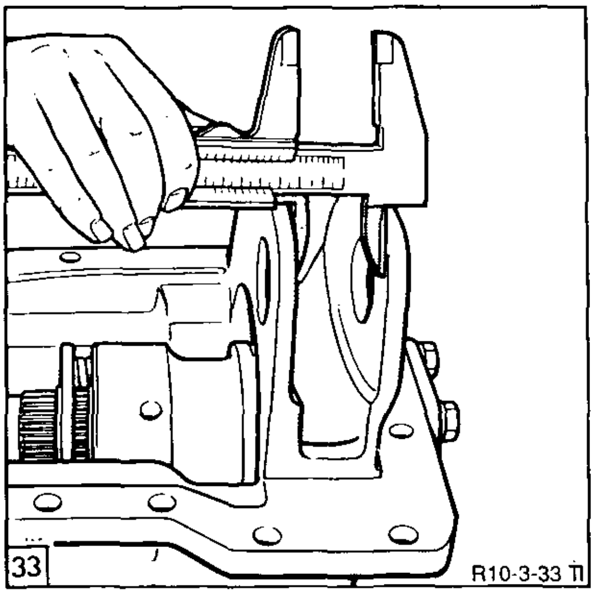
32

Measuring Distance Across Idler Gear Bearing Inner Races

1. Bearing Inner Races
2. Micrometer
3. Shim and Spacer
4. Tool No. FT3169

(iii) With the tool stock mounted in a vice, measure the rolling resistance of the bearings by wrapping a length of string around the gear and using a spring balance, Figure 31. Make the reading as the gear rotates, not at the point where rotation begins.

(iv) Increase the value of the shim placed between the bearings to reduce the rolling resistance or decrease the value to increase the rolling resistance. Adjust the shims until the resistance is between 1.0–2.2 lbf (0.45–1 Kgf).



33

Measuring Width of Idler Gear Mounting Lugs in Transfer Box Casing

(v) When the specified rolling resistance is achieved, measure the distance across the bearing inner races as shown in Figure 32.

(vi) Measure the distance across the casing idler gear mounting lugs, Figure 33.

(vii) Subtract the bearing width measurement from the casing lug measurement and make up a shim pack equal to this result. Divide the resultant value by two where possible and place half the value of shims on each side of the bearing assemblies. It is not essential that these shims be exactly equal as long as the sum total of the two sets of shims equals the required amount.

Example:
Width of bearing races, Figure 32,
= 3.75 mm

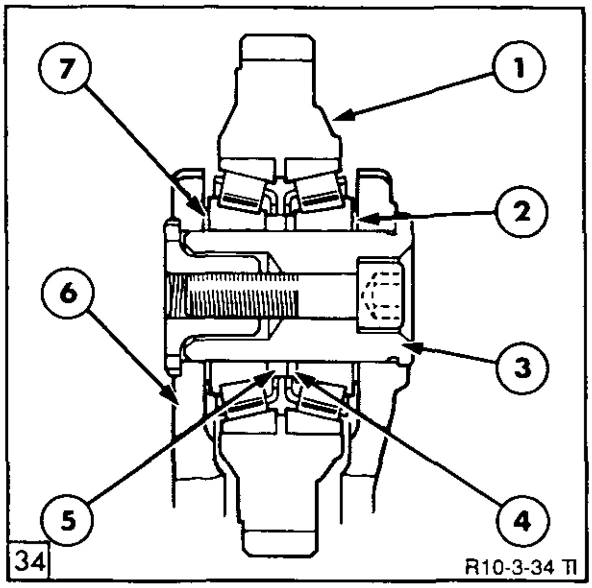
Width of transfer case lugs, Figure 33,
= 3.95 mm

3.95 – 3.75 = 0.2 mm

Therefore two shims are required, each of 0.1 mm. Add one shim to each side of the bearing.

21. Remove the idler gear from the special tool. Lightly lubricate and assemble the gear, bearings and predetermined shim values to the transfer casing as shown in Figure 34. Apply a suitable thread locking compound, meeting FNH Specification ESE–M4G–140–A, (Loctite 542 or 569) and tighten the idler gear retaining bolt to a torque value of 59 lbf.ft (80 Nm).

34



Idler Gear Installed in Transfer Box Casing

1. Idler Gear
2. Shim
3. Centre Shaft
4. Shim
5. Spacer
6. Casing
7. Shim

INSTALLATION

1. Installation of the transfer box assembly follows the removal procedure in reverse.

IMPORTANT: *Use only the approved gasket between the transfer box and rear axle housing. Any variation in thickness and material from that specified may result in excessive gear noise or premature gear wear.*

2. Tighten the transfer box retaining bolts to a torque of 49 lbf.ft (66 Nm). Tighten the driveshaft bolts to a torque of 42 lbf.ft (57 Nm). Apply a suitable thread locking compound, meeting FNH Specification ESE–M4G–140–A, (Loctite 542 or 569) to the drive shaft to axle drive flange coupling bolts.

3. Fill the rear axle with the correct quantity and grade of oil.

C. SPECIFICATIONS, TIGHTENING TORQUES AND SPECIAL TOOLS

SPECIFICATIONS:

Type	*Rear axle centralised mounting with* electro/hydraulic actuation of dog type non slip clutch. Mechanically engaged/electro–hydraulic release.
Transfer Box Ratio	0.930:1 and 0.907:1
Idler Gear Teeth	44
Driven Gear Teeth	40 and 39
Clearances And Adjustments	
Idler Gear Bearings rolling resistance	1 – 2.2 lbf (0.45 – 1 Kgf) Adjustable by shims
Idler Gear Bearing Shims Available	0.10, 0.25, 0.30, 0.50 mm
Output Shaft Bearings Rolling Resistance	4.2 – 9.9 lbf (1.9 – 4.5 Kgf) Adjustable by shims
Output shaft Bearings Shims Available	0.10, 0.25, 0.30, 0.50 mm
Clutch Spring Free Length	48.0 mm (1.889 in)
Oil Capacity	
Transfer Box Assembly	Lubricated by Rear Axle Oil
Increase in Rear Axle Oil Capacity With Transfer Box Installed	
Litres	1.3
Imp. Pints	2.2
U.S. Pints	2.6
Thread Sealant	*Ford New Holland Specification –* ESE–M4G–140–A or Loctite 542 or 569

TIGHTENING TORQUES:

COMPONENTS	lbf. ft	Nm
Transfer Box to Rear Axle Retaining Bolts	49	66
Driveshaft Bolts	42	57
Idler Gear Retaining Bolt	59	80
Oil Drain Plug	59	80
End Plate Bolts	38	51

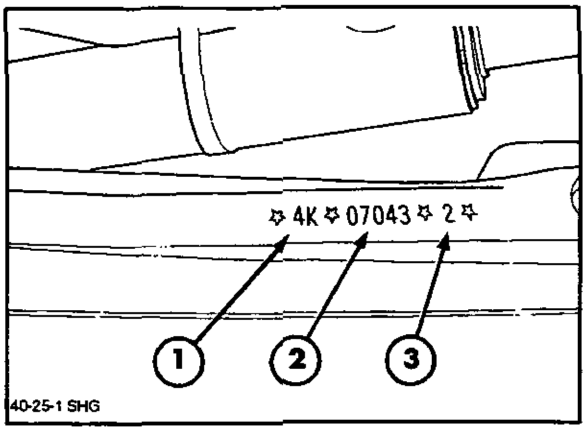
SPECIAL TOOLS:

DESCRIPTION	V.L. CHURCHILL LTD TOOLS	NUDAY TOOLS
Idler Gear Bearing Fixture	FT3169	–
Pulling Attachment: Small	951	9190
Puller: Large	1003	9516

PART 10
FRONT AXLE

Chapter 4
NEW HOLLAND CLASS 2 and 3 FOUR WHEEL DRIVE AXLES

A. DESCRIPTION AND OPERATION



Axle identification Code

1. Year/ Month of Production (4K = 1994/October)
2. Axle Serial Number
3. Axle Class

From November 1994 the New Holland class 2 and class 3 axles have been progressively introduced onto Series 40 tractors. These axles are not interchangeable with previous Carraro manufactured axles.

New Holland axles can be identified by the code stamped on the top left hand side of the axle. Always identify the type of axle installed on the tractor before proceeding with any overhaul.

Class 2 axles have an overall width between wheel flanges of 1722 mm and are used on 5640 to 7840 tractors.

Class 3 axles have an overall width between wheel flanges of 1922 mm and are used on 8240 and 8340 tractors.

The four wheel drive axle features are:–

- Centrally mounted differential assembly with automatic limited slip on all axles.
- 2 planetary (spider) gear differential on class 2 axles (5640 to 7840 tractors).
- 4 planetary (spider) gear differential on class 3 axles (8240 to 8340 tractors).
- 25°–55° infinitely variable steering angle
- 8°–12° axle articulation angle

FRONT AXLE SERVICEABILITY

Components serviced with axle installed on tractor:

- Planetary Reduction Hub Assembly
- Swivel Casing Assembly
- Swivel Pin Assemblies
- Axle Drive Shaft Assemblies, Seals and Bushes
- Steering Cylinders

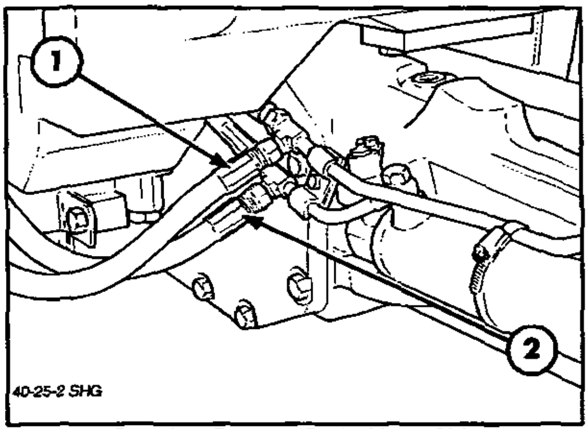
Components serviced with axle removed from tractor:

- Differential Assembly

B. AXLE REMOVAL

REMOVAL

1. Apply the handbrake and chock the rear wheels to prevent the tractor from moving.
2. Remove front end weights

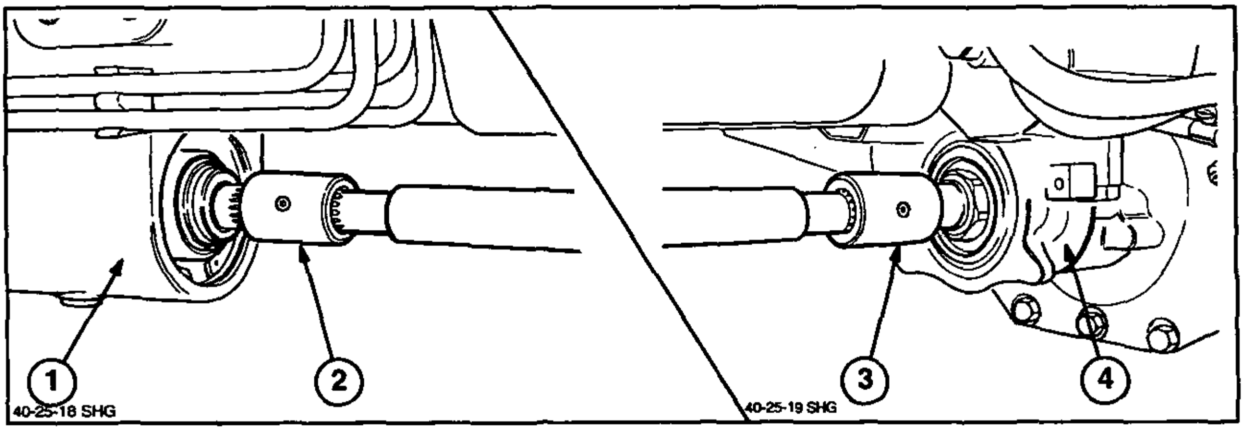


Steering Cylinder Right Hand Side

1. *Right Hand Turn Hydraulic Hose*
2. Left Hand Turn Hydraulic Hose

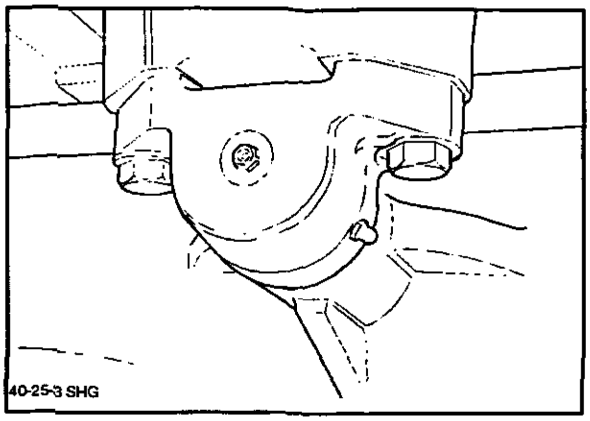
3. Disconnect the steering hose connections.
4. Remove drive shaft cover, where fitted.
5. Disconnect drive shaft couplings and remove shaft.
6. If differential assembly is to be overhauled use New Holland pinion nut wrench 293878 to loosen the pinion retaining nut. Refer to Section E.
7. Jack up front of tractor and securely support tractor with stands positioned beneath the engine to transmission buckle up flange and also under the cast engine sump, as additional support.

NOTE: *Do not support the vehicle on the engine sump only. Always place a piece of wood across the stand to spread the load across the sump pan.*

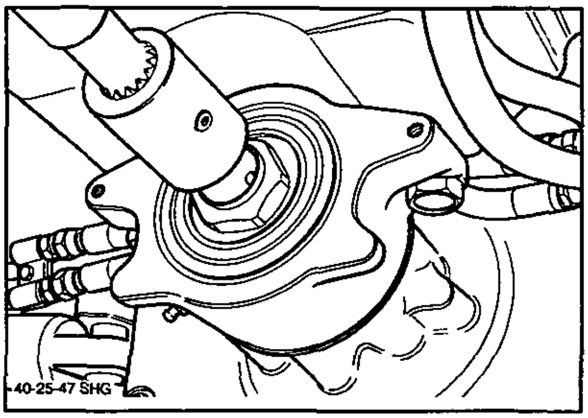


Drive Shaft Installation

1. *Transfer Box*
2. Sliding Coupler (Rear)
3. *Sliding Coupler* (front)
4. Front Axle

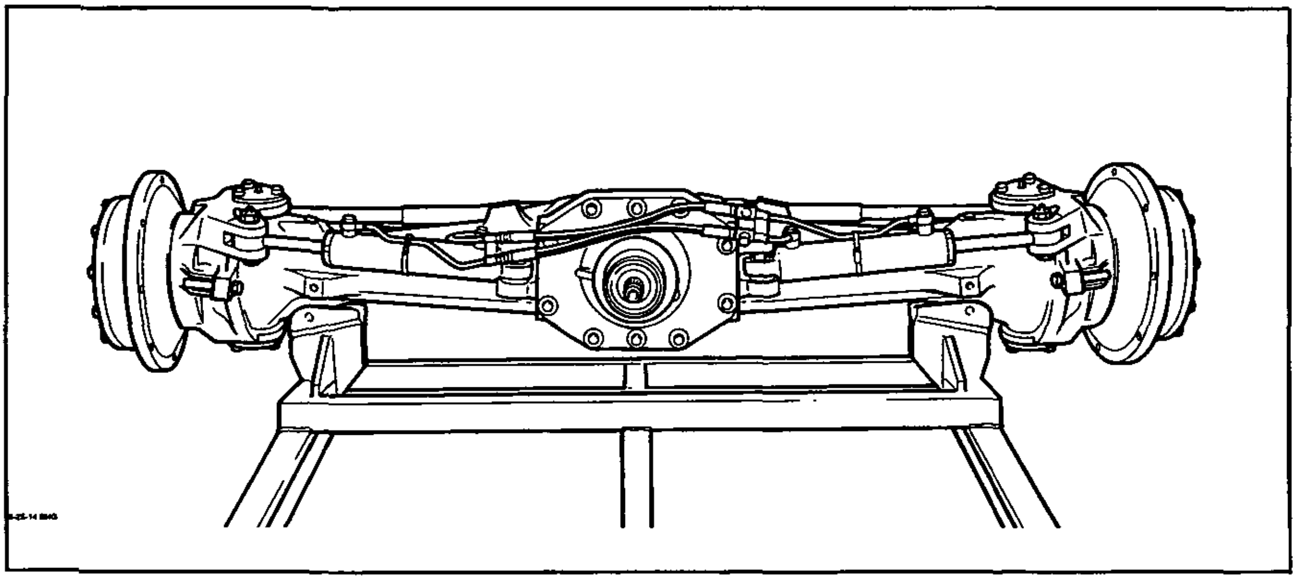


Front Support Pillar



Rear Support Pillar

8. Remove front wheels.
9. Support axle with trolley jack positioned under centre of axle or alternatively use other suitable lifting equipment.
10. Remove front and rear axle support bolts.
11. Carefully lower axle to ground and mount in a suitable axle stand.



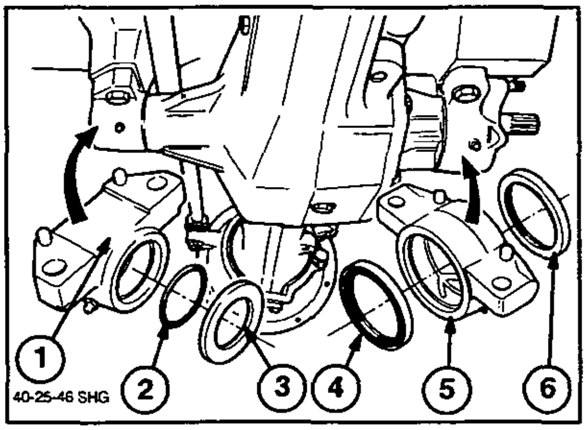
Axle Mounted in Stand

INSPECTION

1. Inspect trunnion and support pillar bushes and thrust washers for wear.

INSTALLATION

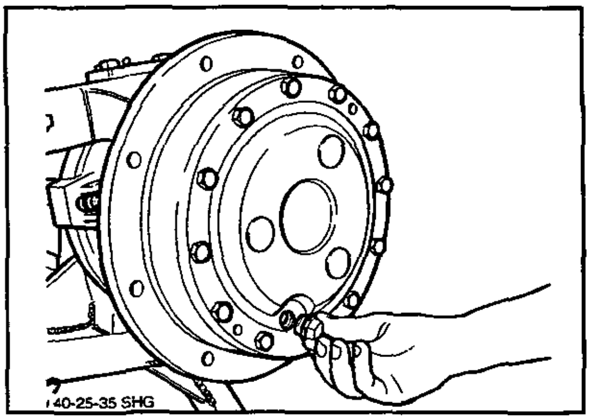
1. Installation of the axle follows the removal procedure in reverse.
2. Tighten support pillar retaining bolts to a torque of 234–286 lbf ft (320–400 Nm).
3. Tighten steering hose connections to a torque of 25 lbf ft (34 Nm).



Front and Rear Support Pillar

1. Front Support Pillar
2. 'O' Ring
3. Spacer
4. Seal
5. Rear Support Pillar
6. Seal

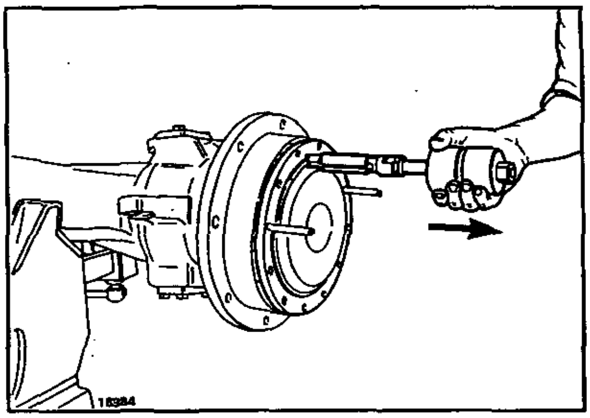
C. PLANETARY GEAR ASSEMBLY – OVERHAUL



Hub Oil Filler/Drain Plug

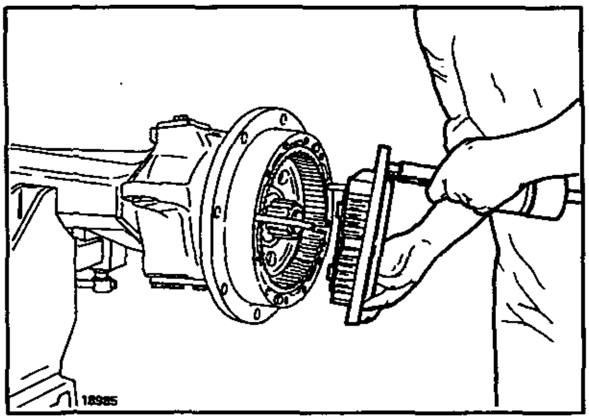
REMOVAL

1. Jack up tractor, support the front axle and remove road wheel.
2. Position hub filler/drain plug at lowest point and drain oil from hub.
3. Remove planetary carrier retaining bolts.



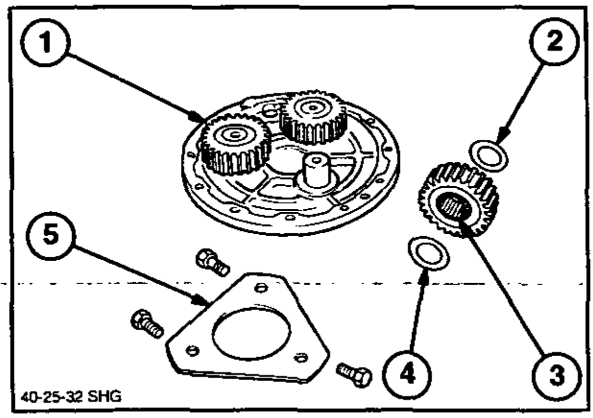
Breaking Seal on Planetary Carrier

4. Install slide hammer and extractor into filler/drain plug hole and break the seal between planetary cover and hub.



Removing Planetary Carrier

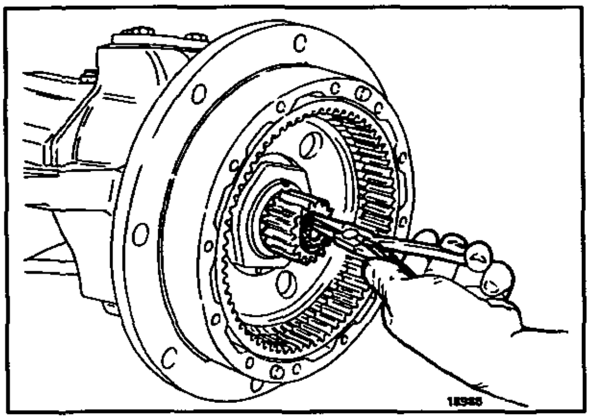
5. Remove planetary carrier from hub.



Planetary Carrier Components

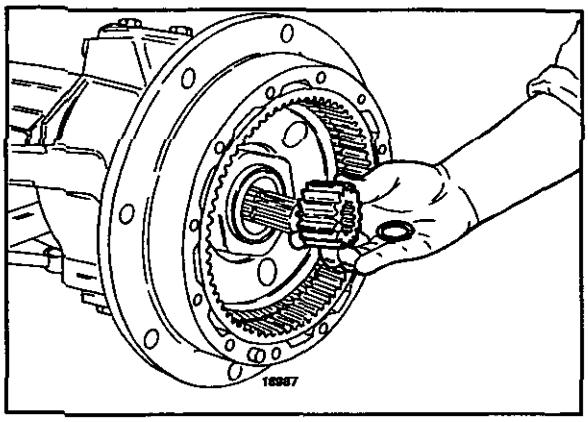
1. Planetary Gear
2. Thrust Washer
3. Needle Roller (22 off)
4. Thrust Washer
5. Retaining Plate

6. Disassemble and inspect planetary carrier.



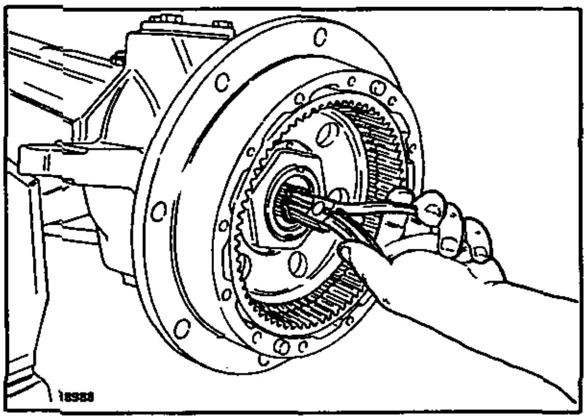
Sun Gear

7. Remove the sun gear retaining ring.



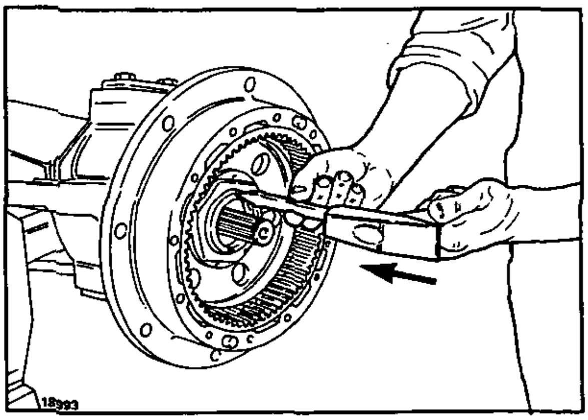
Sun Gear Removal

8. Remove sun gear.



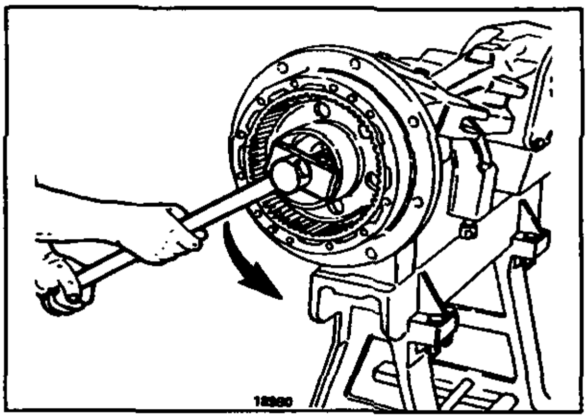
Removing Retaining Ring

9. Remove retaining ring from the axle shaft.



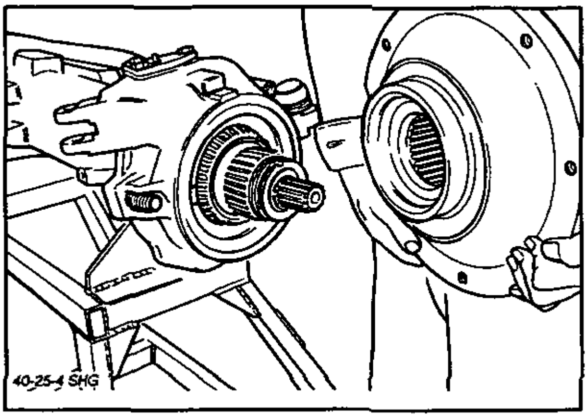
Relieving Ring Gear Nut Locking Tab

10. Relieve the locking tab on ring gear nut.



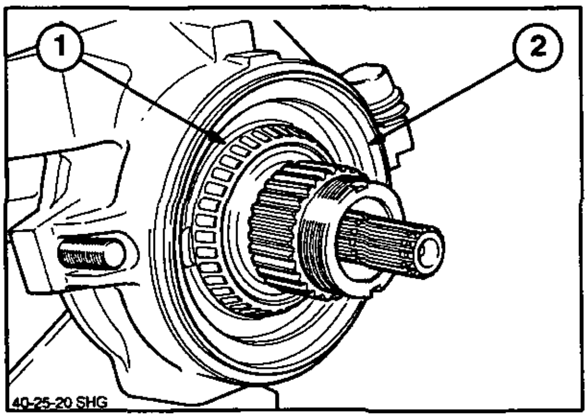
Removing Ring Gear Locking Nut

11. Remove the ring gear locking nut using New Holland Tool No.293880.



Ring Gear and Hub Removal

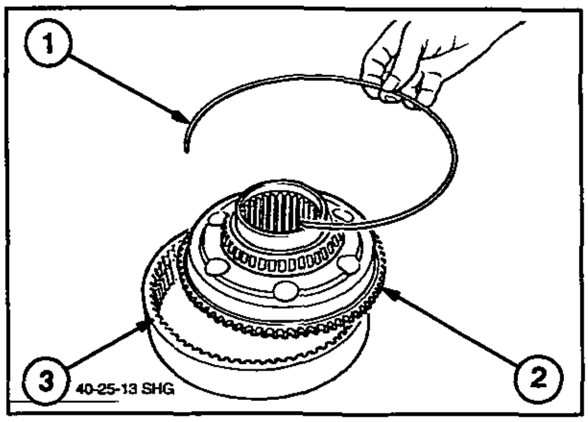
12. Remove ring gear and wheel hub.



Hub Inner Bearing and Cassette Seal

1. Bearing
2. Cassette Seal

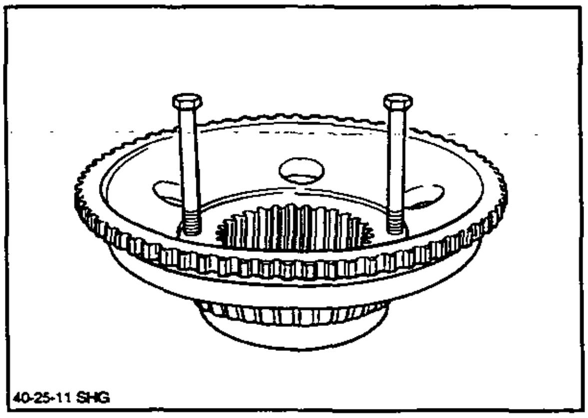
1. Inspect the hub inner bearing and cassette seal and replace if worn or damaged.



Hub Support and Ring Gear

1. Wire Retaining Ring
2. Hub Support
3. Ring Gear

2. Inspect ring gear and if necessary separate ring gear from the bearing support by removing the wire retaining ring.



Removing Outer Support Bearing

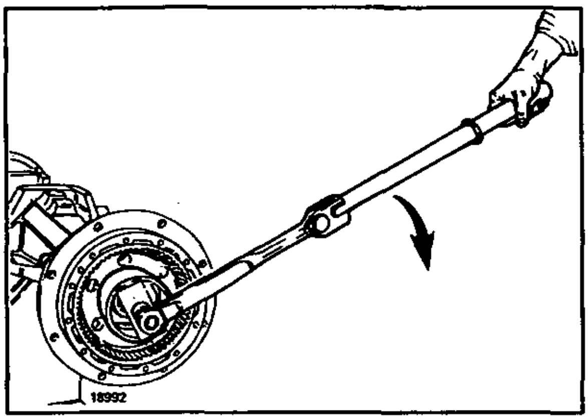
3. If the outer support bearing requires replacement install 2 M8 bolts into the jacking holes provided and remove the bearing.

RE–ASSEMBLY

Re–assembly of the planetary gears follows the removal procedure in reverse.

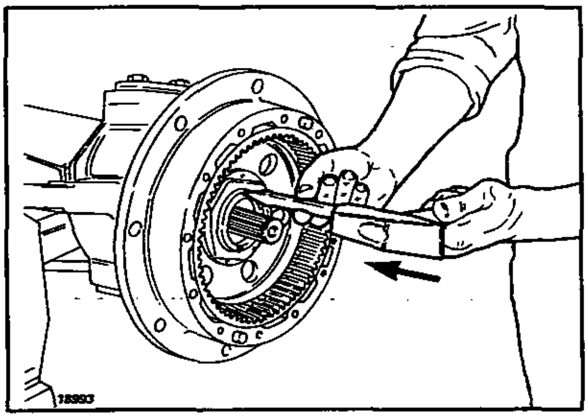
During re–assembly observe the following:

1. Using New Holland ring nut socket tool No 293880 gradually tighten the ring gear locking nut to a torque of 392 Nm (289 lbf ft).



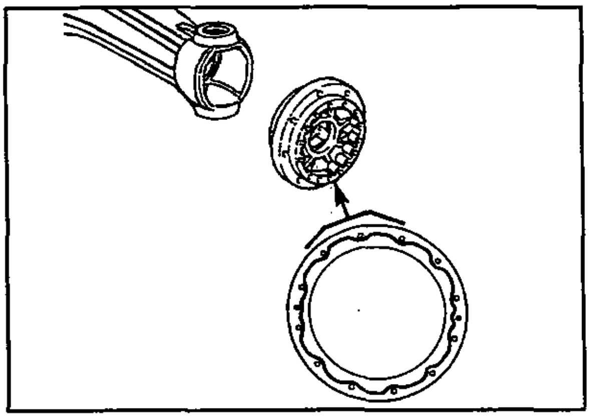
Tightening Ring Gear and Hub Retaining Nut

2. While tightening the nut continue turning the wheel hub to ensure the bearings are correctly seated.



Deforming Locking Tab

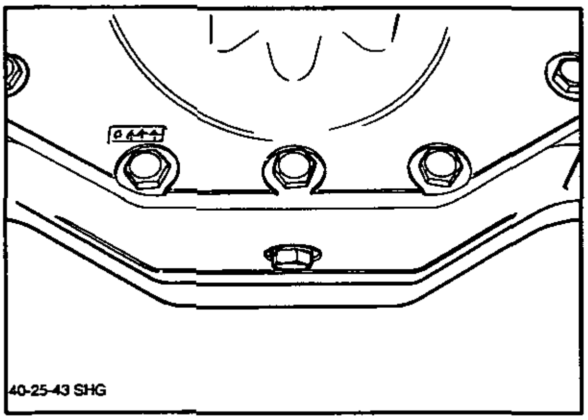
3. Deform the locking tab on the end of the nut and check that the hub turns without binding.



Sealant Application

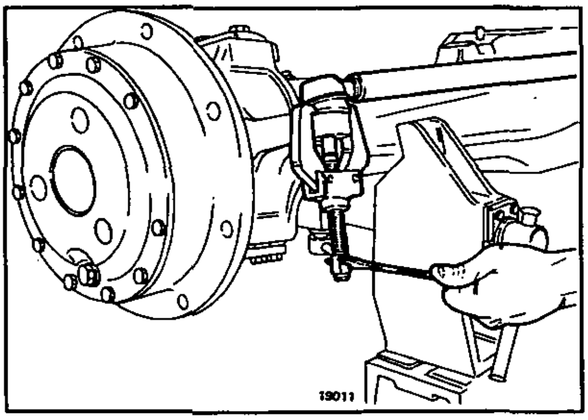
4. Prior to installation of the planetary cover thoroughly clean the mating surfaces and apply a 2mm bead of flexible sealing gasket New Holland Part No 8299571.

D. SWIVEL HOUSING AND AXLE SHAFT – OVERHAUL



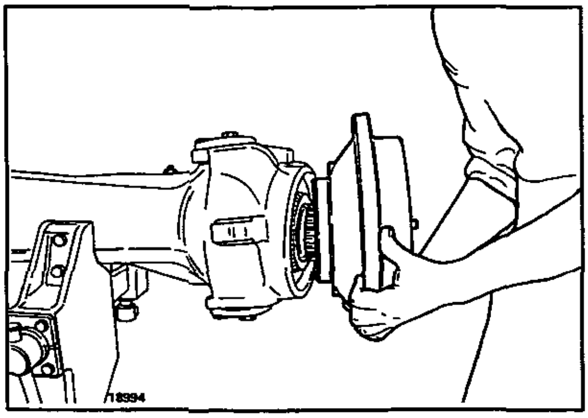
Axle Drain Plug

1. Drain the oil from the axle



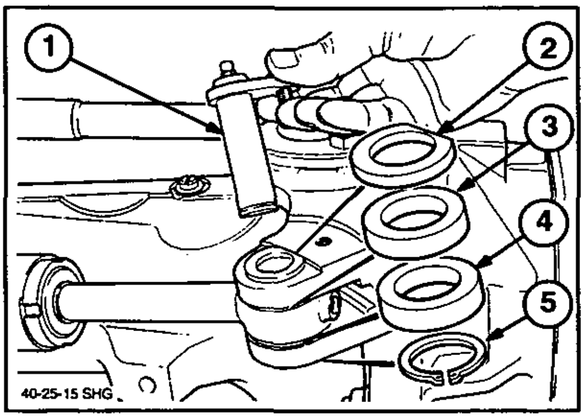
Disconnecting Tie Rod

2. Disconnect steering tie rod from swivel housing.



Removing Planetary Housing

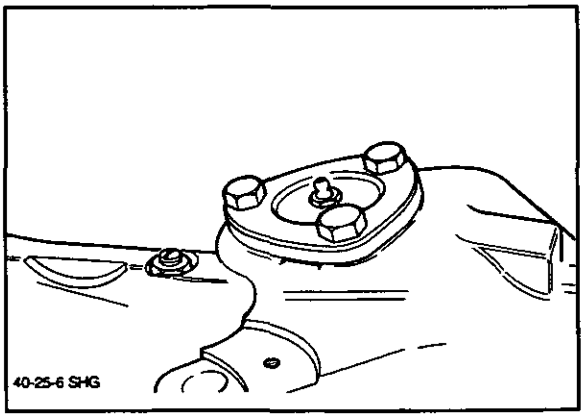
3. Remove the planetary housing and hub as described in Section C.



Steering Cylinder Installation

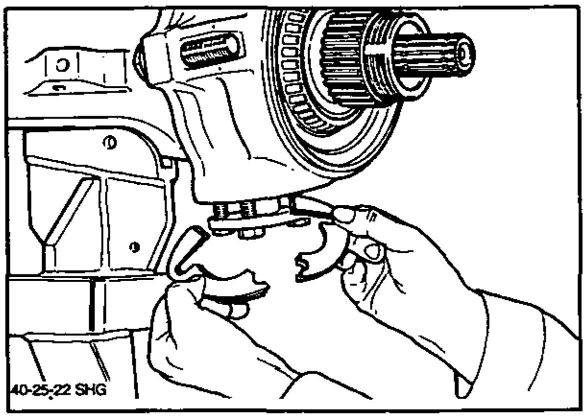
1. Pin
2. D Shaped Washer
3. Spacer
4. Spacer
5. Circlip

1. Disconnect steering cylinder from swivel housing and retrieve the D shaped washer and two spacers.



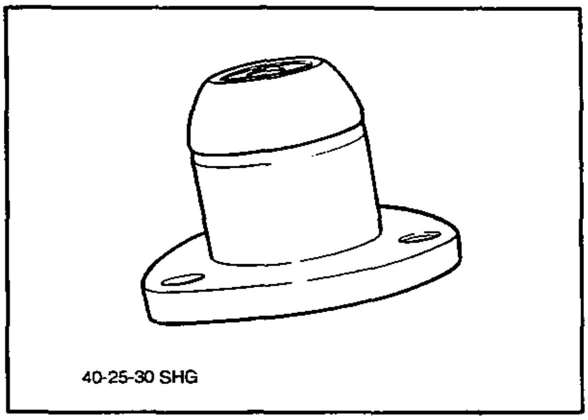
Upper Swivel Pin Installation

2. Remove swivel pin retaining bolts.
   Do Not remove pin.



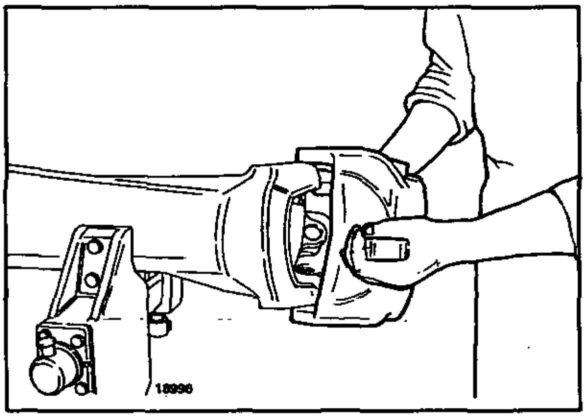
Lower Swivel Pin Installation

3. Remove lower swivel pin and retrieve shims located beneath the pin.



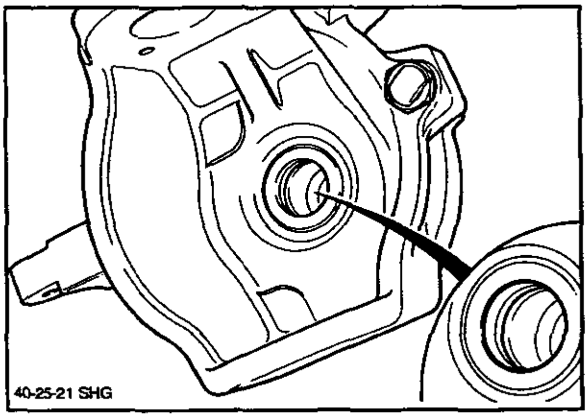
Swivel Pin

4. Remove the upper pin.
   NOTE: *Their are no shims located beneath the upper pin.*



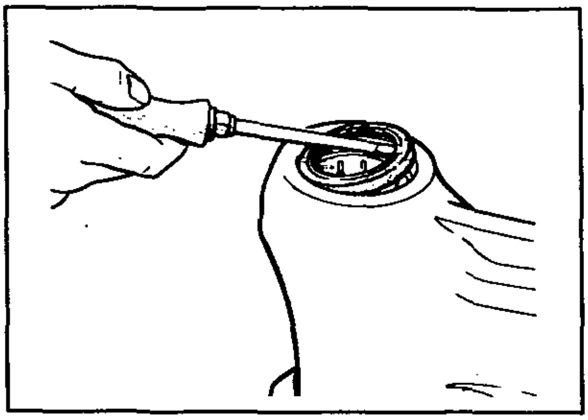
Swivel Housing Removal

5. Remove the swivel housing.



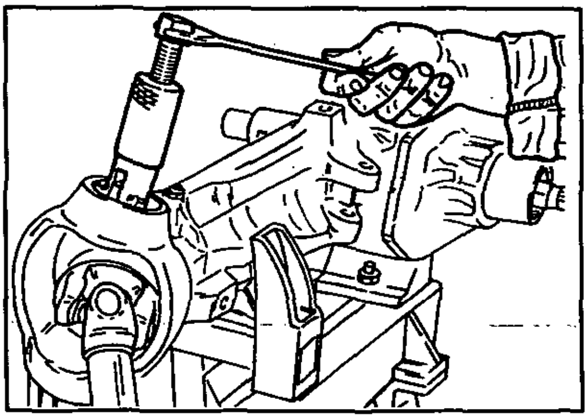
Swivel Housing Seal and Bush

6. Replace axle shaft oil/dust seal located in swivel housing and inspect the bush for damage .



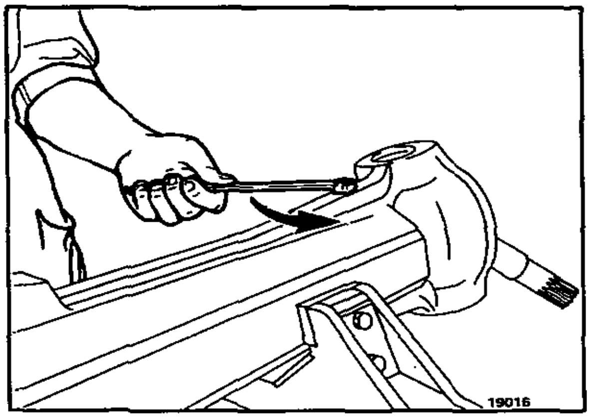
Removing Swivel Pin Grease Seal

7. Inspect/replace swivel pin grease seal.



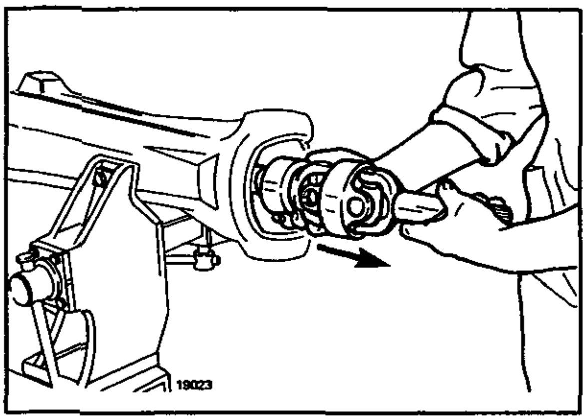
Removing swivel Pin Bearing Cup Using
New Holland Tool 292161

8. Inspect swivel pin bearing cone for damage and replace pin if damaged.
   If the New Holland Special Tool 292161 is not available use slide hammer and puller.



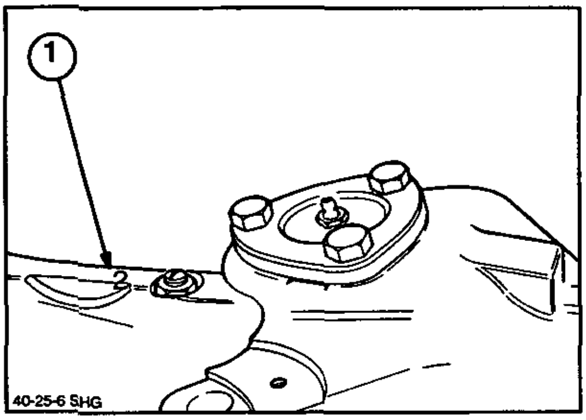
Axle Shaft Retaining Screw

9. Remove axle shaft retaining screw.



Axle Shaft Removal

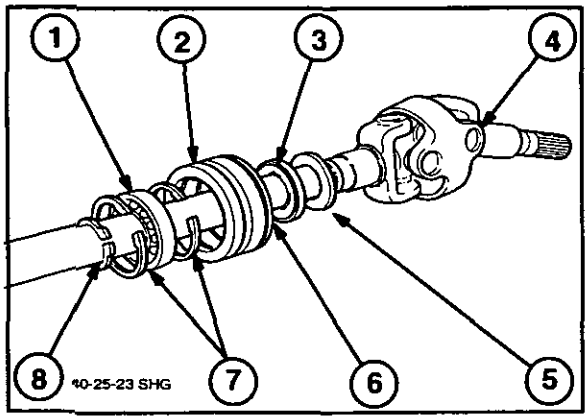
10. Remove axle shaft assembly.



Identification of Axle Shaft Manufacturer

1. Axle Shaft Identification Code.

11. Prior to overhaul of the axle shaft identify the shaft manufacturer using the code stamped on the top right hand side of the axle housing.
    1 = Birfield 2 = Universa Giunti
    3 = Gea 4 = Devon



Axle Shaft Bearing Housing

1. Bearing
2. Sleeve
3. Oil Seal
4. Axle Shaft
5. Dust Shield
6. O' Ring
7. Circlips
8. Circlip

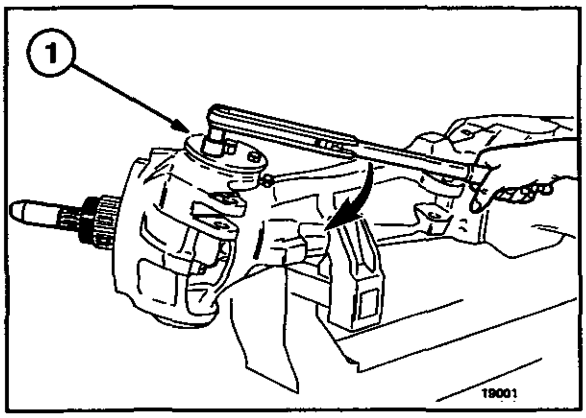
12. Disassemble axle shaft bearing housing. Inspect bearing for wear and replace oil seal, dust shield and 'O' ring.

RE–ASSEMBLY

NOTE: *If the differential assembly requires overhaul **DO NOT** install the driveshafts and swivel housings until overhaul and installation of the differential is complete.*

1. Install the axle shafts and swivel housing taking care not to damage the oil seal in the swivel housing.

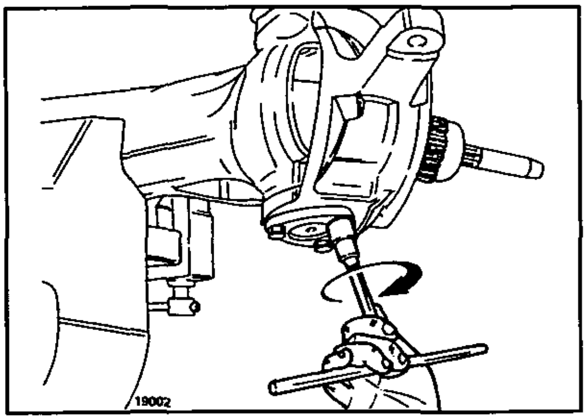
NOTE: *The left hand axle shaft is 60 mm longer than the right hand shaft.*



Swivel Pin Re–assembly

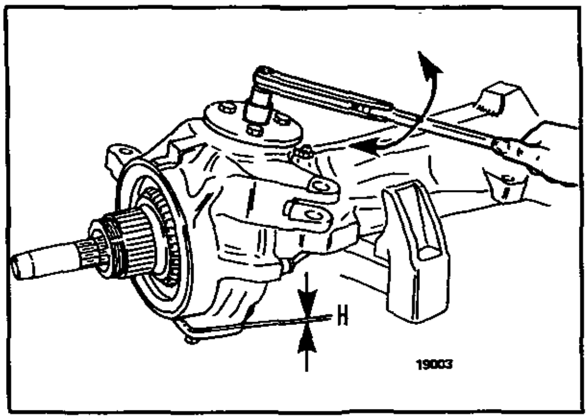
1. New Holland Tool No 29220/4

2. Lubricate the swivel pin bearing cups with grease to Specification ESE M1C 75B and install the upper pin and New Holland Tool No 292220/4. Tighten the retaining bolts to a torque of 113 Nm (83 lbf ft).

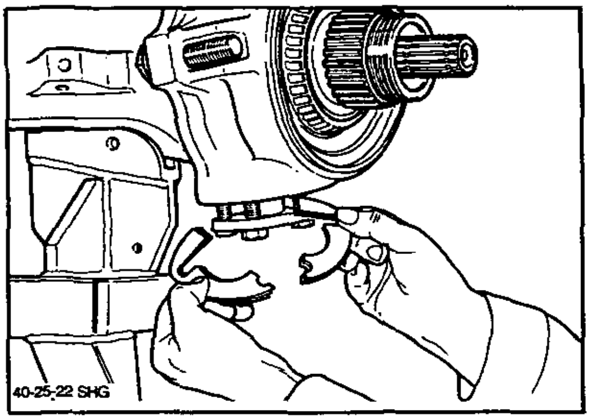


Lower Swivel Pin Installation– Less Shims

3. Install bottom swivel pin less shims. Lubricate swivel pin retaining bolts with engine oil and progressively tighten.



Measuring Swivel Housing Turning Torque



Installing Shims Under Lower Swivel Pin

4. Progressively tighten or loosen the lower swivel pin bolts until the torque required to swing the housing freely (excluding the break away torque) is 15 to 25 Nm. (1.5 to 2.5 kgm – 11 to 18 lbf ft).

5. Determine the thickness of shims to be installed under the lower swivel pin as follows:–

   Using a feeler gauge measure in 3 places the clearance between the lower swivel pin and swivel housing mating faces and calculate the arithmetic average of these three readings ('**H**').

   Shim Thickness= **H** – 0.20 mm (.008 in)

6. Slacken the bottom swivel pin retaining bolts and insert the calculated thickness of shims.

7. Tighten the retaining bolts to the following torque of 113 Nm (83 lbf ft).

8. Ensure that the swivel housing pins are fully seated by swinging the housing from side to side.

9. Check that the torque required to swing the housing from side to side after some initial rocking movement to settle the assembly is 118–147 Nm (87–108 lbf ft) excluding breakaway torque.

10. If required increase or decrease shim thickness to obtain correct torque value.

11. Remove tool from upper swivel pin, reinstall bolts and grease swivel pin.

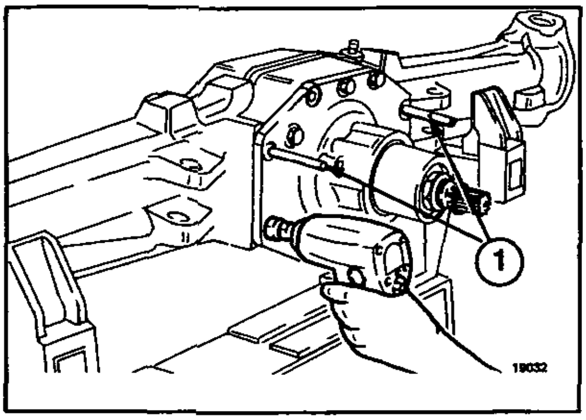
E. DIFFERENTIAL OVERHAUL

REMOVAL

1. Remove the axle from the tractor as described in Section B.

2. Remove the swivel housing and axle shaft assemblies as described in Section C.

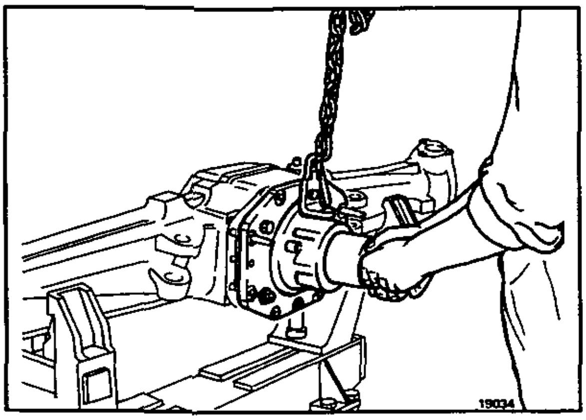
3. Remove the steering cylinders as described in Section F.



Differential Alignment Pins

1. Alignment Pins

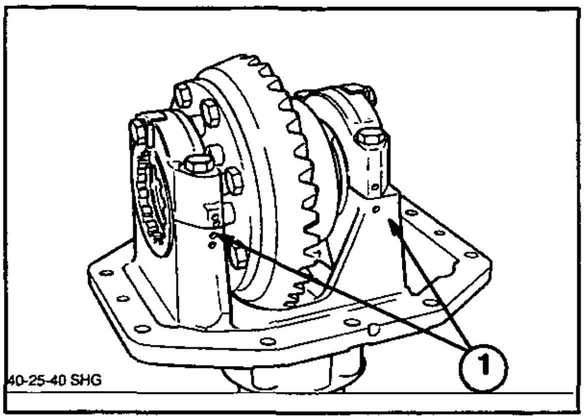
4. Remove two of the differential retaining bolts and replace with two locally manufactured alignment pins.



Removing Differential

5. Remove the remaining bolts ensuring the differential is securely supported on the alignment pins then withdraw the differential assembly.

DISASSEMBLY

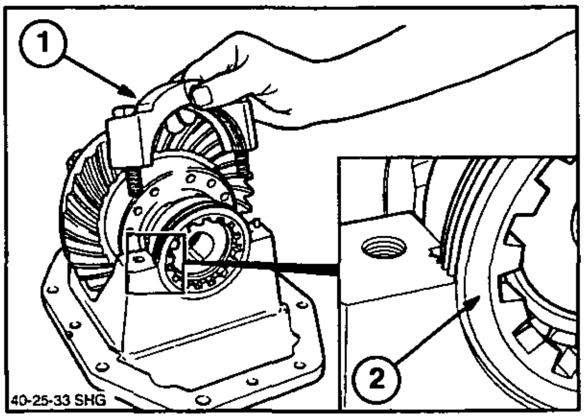


Differential Assembly

1. Cap Identification Marks

6. Prior to disassembly ensure each bearing cap has been marked to ensure they can not be interchanged during re–assembly.

7. Remove the locking tabs and bearing cap retaining bolts.

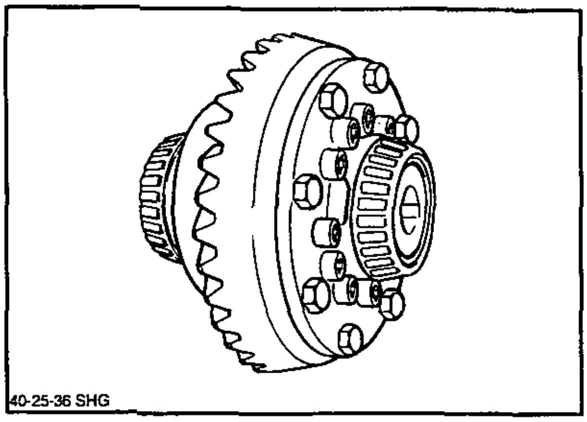


Differential Bearing Cap Removal

1. Bearing Cap
2. Adjuster ring

8. Loosen adjuster rings, remove bearing caps and withdraw differential assembly.

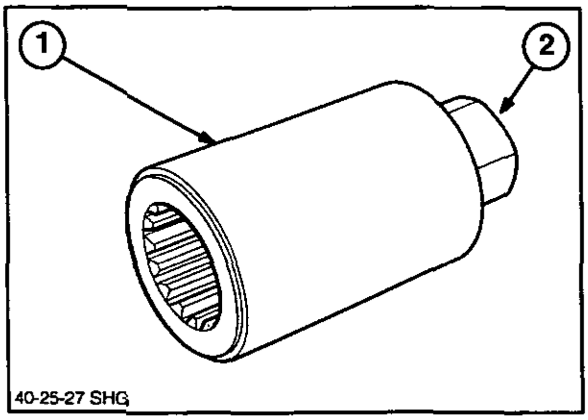
NOTE: *The stepped edge of the adjuster ring faces and touches the edge of the bearing.*



Differential and Crown Wheel Assembly

9. Remove differential housing retaining bolts and separate components.

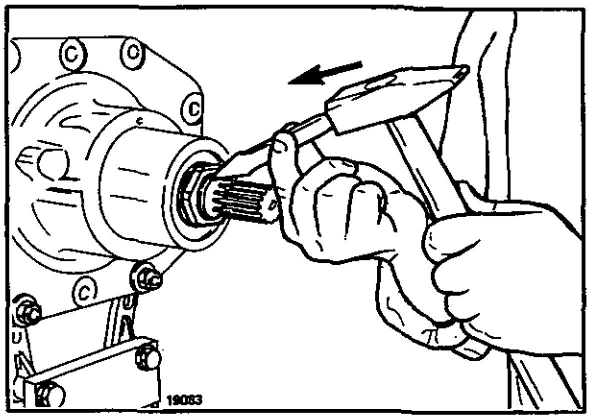
NOTE: it is not necessary to remove the crown wheel from the housing unless crown wheel and pinion replacement is necessary.



Locally Manufactured Pinion Shaft Tool

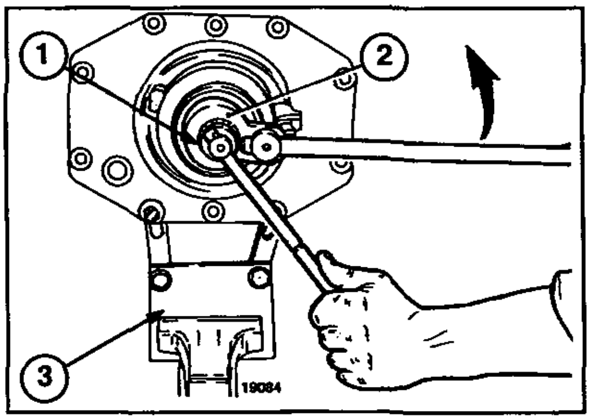
1. Coupler Part No F1NN 4684 AA
   Finis Code 1873108
2. 20 mm Nut

10. To loosen the pinion nut it is necessary to manufacture a tool to hold the pinion shaft. This can be manufactured by welding a suitable 20 mm nut to the end of a drive shaft coupling Part No F1NN 4684 AA Finis Code 1873108.



Pinion Nut Locking Tab

11. Remove the locking tab on the pinion nut

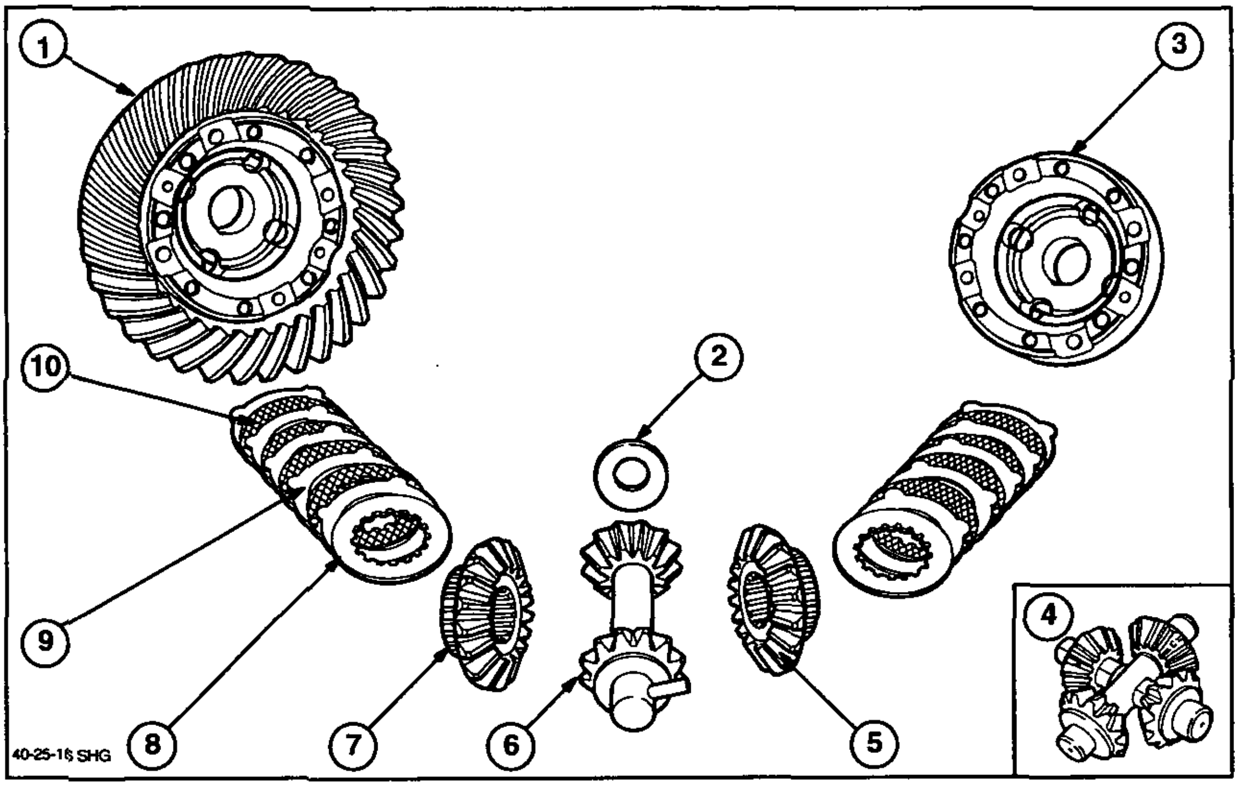


Loosening Pinion Nut

1. Pinion Shaft Retaining Tool
2. Pinion Nut Socket Tool No 293878
3. Differential Support Tool No 293743

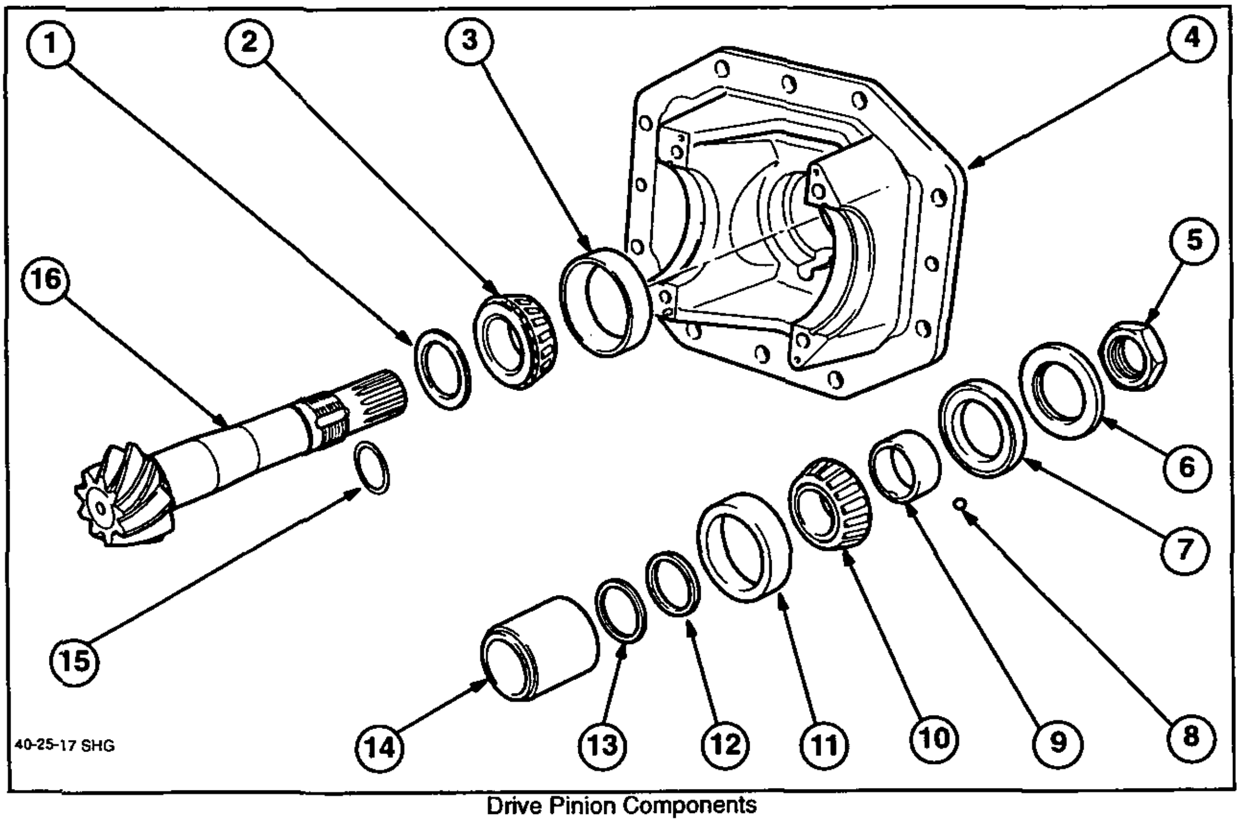
12. Using New Holland pinion nut socket Tool No 293878 and locally manufactured pinion tool, loosen the pinion nut.

13. Disassemble Pinion Assembly



Limited Slip Differential Components

1. Differential Housing and Crown Wheel
2. Thrust Washer
3. Differential Housing
4. Differential Gear Assembly (Category 3 Axles)
5. Side Gear
6. Differential Gear Assembly (Category 2 Axles)
7. Side Gear
8. Single Sided Friction Plate (1 Off Per Side)
9. Steel Separator Plates (5 off per side)
10. Double Sided Friction Plates (4 Off Per Side)



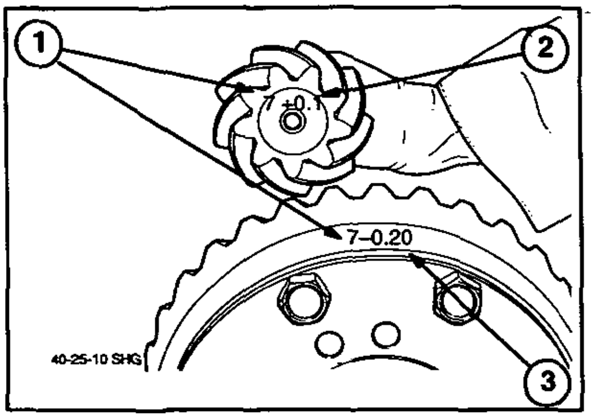
Drive Pinion Components

1. Shim
2. Bearing
3. Bearing Cup
4. Housing
5. Nut
6. Dust Cap
7. Seal
8. Ball
9. Sleeve
10. Bearing
11. Bearing Cup
12. Shim
13. Shim
14. Spacer
15. 'O' Ring
16. Pinion

INSPECTION AND REPAIR

Inspect all components paying particular attention to the following:–

- Crown wheel and pinion
- Differential support housing
- Bearings
- Differential steel and friction plates



Crown Wheel and Pinion Identification Number

1. Pinion Identification No
2. Pinion Correction Factor
3. Crown Wheel to Pinion Back lash

The crown wheel and pinion are supplied as a matched set identified by an identical number etched onto each component. Only replace these components as a matched pair.

The friction plates and steel separator plates should be replaced if less than the minimum thickness indicated as follows:–

Single Sided Friction Plate

New	2.8 mm	(0.110 in)
Minimum Thickness	2.7 mm	(0.106 in)

Double Sided Friction Plates

New	1.6 mm	(0.063 in)
Minimum Thickness	1.45 mm	(0.057 in)

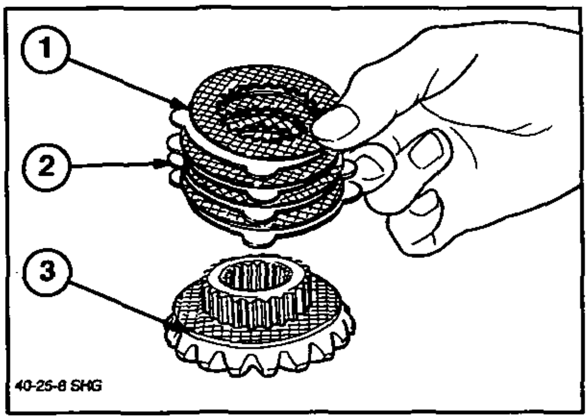
Steel Separator Plates

New	1.5 mm	(0.059 in)
Minimum Thickness	1.4 mm	(0.055 in)

RE–ASSEMBLY

Differential Re–Assembly

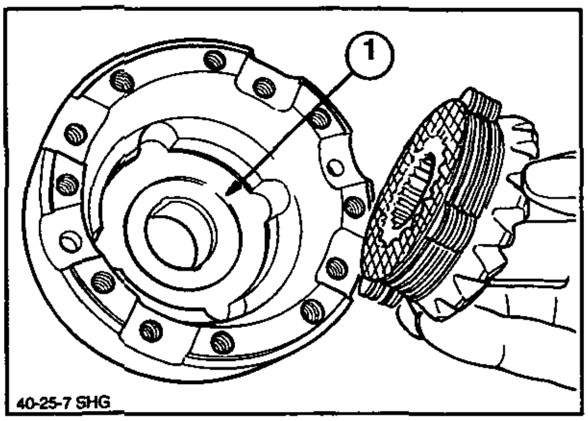
Re–assemble the limited slip differential unit using disassembly procedure in reverse. For correct re–assembly observe the following.



Differential Side Gear Assembly

1. Double Sided Friction Plate (4 off)
2. Steel Separator Plates (4 off)
3. Single Sided Friction Plate

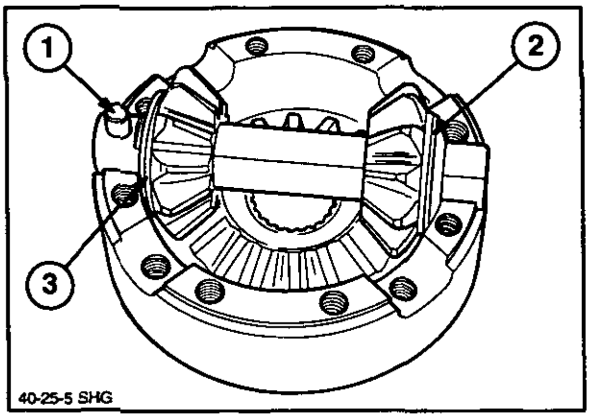
1. Install the single sided friction plate onto side gear, ensuring steel surface abuts gear face.
2. Install four steel separator plates and four double sided friction plates onto side gear.



Installing Side Gear into Differential Housing

1. Steel Separator Plate

3. Position a fifth steel separator plate into differential housing and locate side gear into housing.

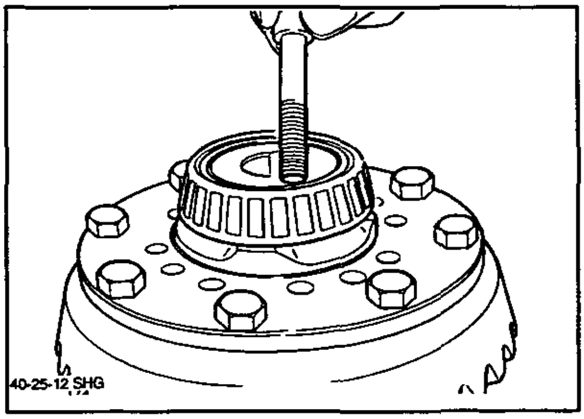


Differential Planetary Gear Installation
(Class 2 Axle Shown)

1. Locking Pin (Class 2 Axles Only)
2. Thrust Washer
3. Thrust Washer

4. Install planetary gears and thrust washers.

On class 2 axles ensure the locking pin is correctly installed.



Differential Casing Bolts

5. Apply thread locking sealant New Holland Part No 82995772 (Loctite 270) to the differential casing bolts and tighten bolts to a torque of 11.5 Nm (83 lbf ft).

Pinion and Differential assembly Adjustments

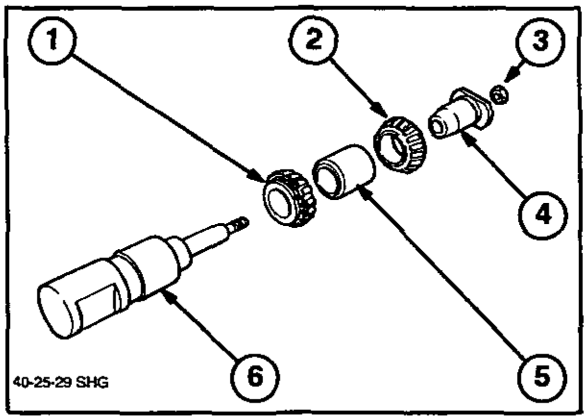
To ensure the pinion and differential housing are correctly installed the following adjustments must be performed in the order shown.

- Pinion bearing preload shimming procedure
- Pinion to crown wheel shimming procedure
- Differential bearing preload rolling torque
- Crown wheel to pinion backlash

Pinion Bearing Preload Shimming Procedure

The pinion bearing preload shimming procedure determines the thickness of shims, items 12 and 13 on Page 13, to be installed beneath the the spacer item 14. These shims ensure that when the pinion nut is tightened to the specified torque the pinion bearing preload will be correct.

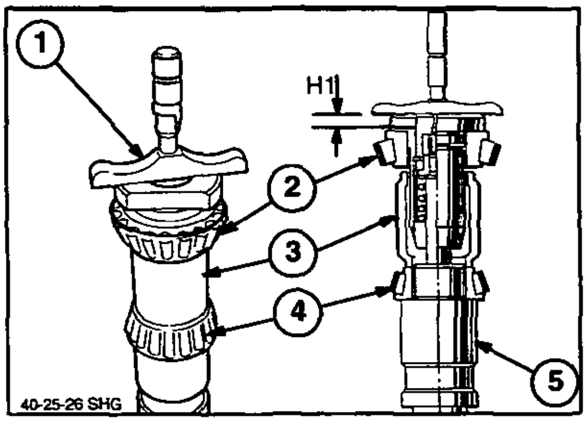
The adjustment procedure requires the use of New Holland Tool No 293391. If this tool is not available use the shims originally removed during disassembly to check the pinion rolling torque described on page 20.



Tool No 293391 and Pinion Bearings

1. Pinion Bearing
2. Pinion Bearing
3. Nut – Part of Tool 293391
4. Part of Tool 293391
5. Pinion Spacer
6. Part of Tool 293391

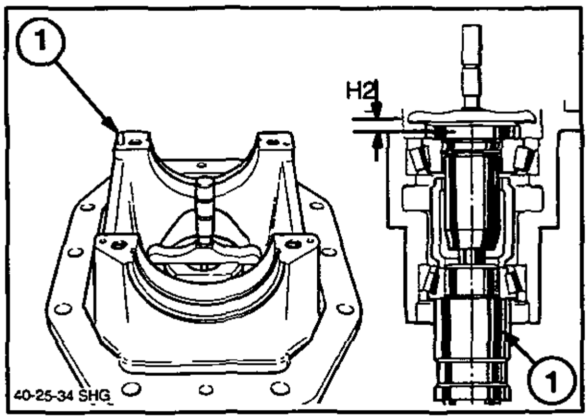
1. Install spacer and pinion bearings onto New Holland Tool Part No 293391 and fully tighten retaining nut.



Determining Pinion Bearing Preload Shim Dimension H1

1. Depth Gauge
2. Bearing
3. Spacer
4. Bearing
5. *New Holland Tool 293391*

2. Using depth gauge measure and record distance H1.
3. Remove bearings from tool. Lubricate bearings and now re–install bearings and *tool into differential housing.*
4. Fully tighten retaining nut (Part of Tool).
5. Rotate tool in differential housing to settle bearings.



Determining Pinion Bearing Preload Shim Dimension H2

1. Differential Housing
2. *New Holland Tool 293391*

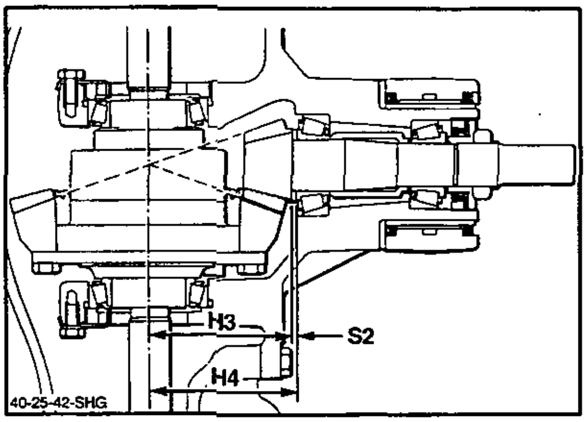
6. Using depth gauge once again measure distance between end faces of tool and record this as dimension H2.
7. Calculate the thickness of shims to be *installed between bearing and spacer as* follows:–

   Shim Thickness **S1**= H1–H2

   Select shims to within 0 – 0.05 mm (0 to 0.002 in) of thickness required and retain for installation during the pinion bearing preload check.

NOTE: *Do not remove tool from differential housing. The tool is used to clamp bearings while performing pinion to crown wheel shimming procedure.*

Pinion To Crown Wheel Shimming Procedure



Pinion Shimming Dimensions

H4	Dimension from Pinion Bearing to Centre line of Differential Casing
H3	115 mm Manufacturers Pinion Dimension ± C (Correction Factor)
S2	Shim Thickness

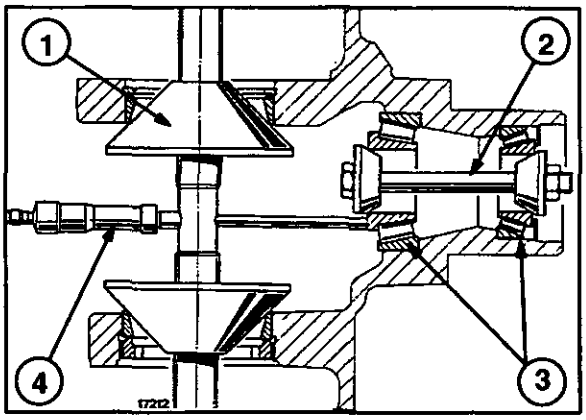
The pinion to crown wheel shimming procedure calculates the thickness of shims **S2**, item 1 Page 13, positioned beneath the shoulder of the pinion gear to ensure that the theoretical conical point of the pinion aligns with the centre of the differential crown wheel.

The dimension **H4** necessary in the calculation of the shim thickness can be determined using either New Holland pinion adjustment tool 293400 or VL Churchill tool FT3135.

Both procedures are explained as follows.

Pinion Shimming using New Holland Pinion Adjustment Tool 293400

1. Install pinion bearings in differential support housing and clamp in position using New Holland Tool No 293391 as used when determining thickness of shims for bearing preload.

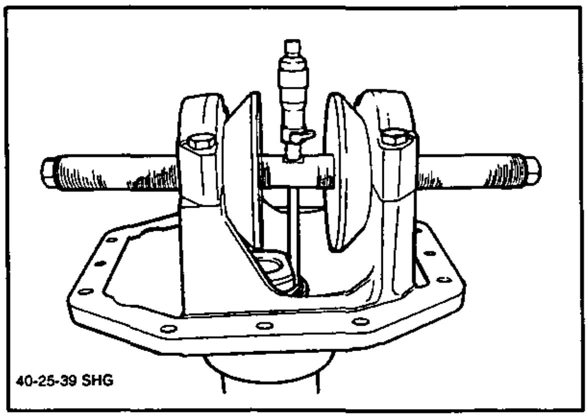


Calculating Pinion Shim Thickness
Using New Holland Tool 293400

1. Pinion Measuring Gauge Tool No 293400
2. Pinion Bearing Clamp. Use Tool No 293391 or alternative clamp 50048 as shown
3. Pinion Bearings
4. Micrometer (Part of Tool No 293400)

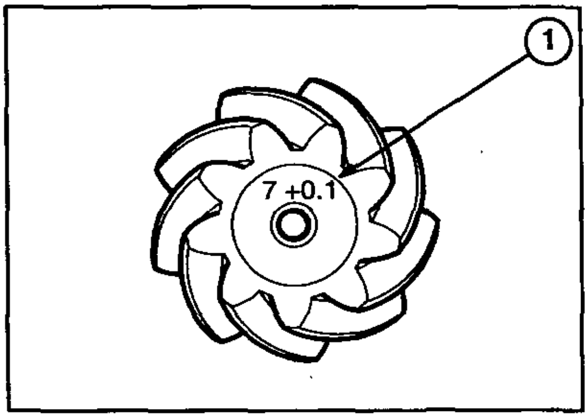
2. Install New Holland Pinion Setting Tool No 293400 complete with bearing cup and adjusting rings. Tighten bearing caps to 113 Nm (83 lbf).

   If New Holland Tool No 293391 as described in pinion bearing shimming procedure is not available the Bearing Clamp Tool No 50048 may be used to clamp the bearings as shown above.



Using Pinion Setting Gauge Tool No 293400
To Measure Dimension H4

3. Adjust the cones of the tool so that the micrometer tip touches the inner race of the bearing and measure the dimension (H4).



Pinion Manufacturing Correction Factor 'C'

4. Determine the thickness of shims to be installed beneath the pinion gear as follows:

Shim thickness **S2** = **H4–H3**

Where:–

H4 = Dimension measured using pinion micrometer tool

H3 = 115 mm±**C**

115 mm is the nominal manufacturing dimension from rear face of pinion gear to conical point of pinion. (Supplied by Manufacturer)

C= Manufacturing correction factor stamped on face of pinion.

Example **H4**=118.27

C=+0.1 mm

H3=115 + 0.1

=115.1 mm

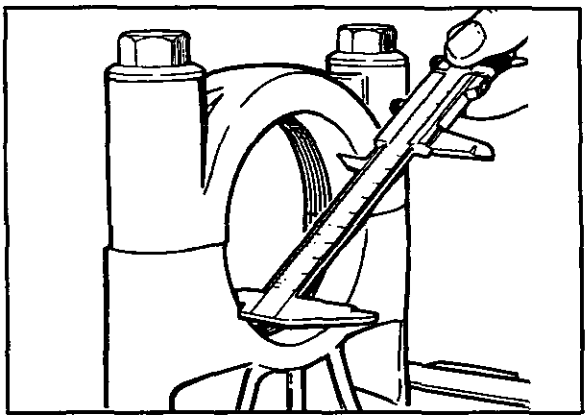
S2=**H4** –**H3**

=118.27 – 115.1

Shim Thickness **S2**=3.17 mm

Pinion Shimming using VL Churchill Tools FT. 3135

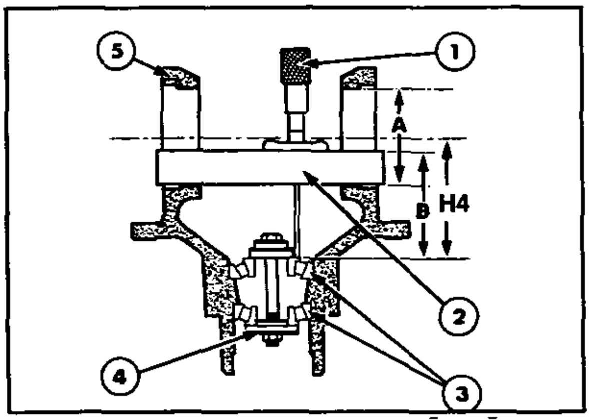
1. Install bearing caps (less bearing cup) and tighten to a torque of 113 Nm (83 lbf).



Measuring Differential Housing Bearing Bore Diameter 'A'

2. Measure internal dimension of bearing bore and call this dimension 'A'.
3. Install pinion bearings in the differential support housing and clamp in position with Tool No FT 3135.

NOTE: *Tighten the clamp so that the bearing cones can just be turned by hand.*



Determining Pinion Shim Thickness Using VL. Churchill Tool No 3135

1. Depth Gauge
2. Bar Gauge – Part Of Tool No FT.3135
3. Pinion Shaft Bearings
4. Pinion Setting Gauge – Tool No FT.3135
5. Differential; Support Casing

4. Locate the bar gauge, part of Tool No FT3135, across bearing bore and measure dimension 'B'.

5. Calculate Dimension '**H4**' using Formula

$$H4=B-25^{*}+\left(\frac{A}{2}\right)$$

NOTE: **FT 3135 Bar Gauge is 25 mm diameter.*

6. Determine the thickness of shims **S2** to be installed beneath the pinion gear as follows:

S2 = **H4** – **H3**

Where:–

H4 = Dimension Calculated in Step 5 above.

H3 = 115 mm±**C**

115 mm is the nominal manufacturing dimension from rear face of pinion gear to conical point of pinion. (Supplied by Manufacturer)

C= Manufacturing correction factor stamped on face of pinion.

Example **A** = 95 mm

B = 95.77 mm

$$H4=B-25^{*}+\left(\frac{A}{2}\right)$$

$$H4=95.77-25^{*}+\left(\frac{95}{2}\right)$$

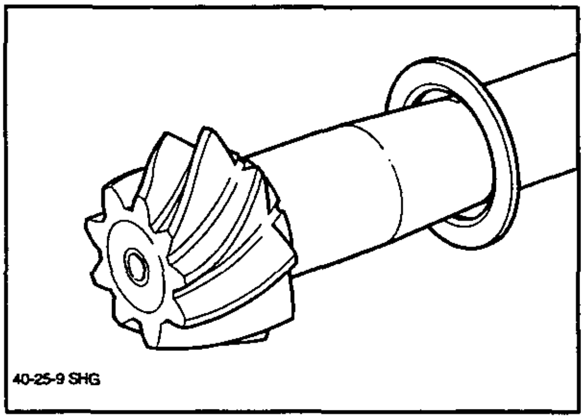
H4=118.27

C=0.1 mm

H3=15 + 0.1
= 115.1

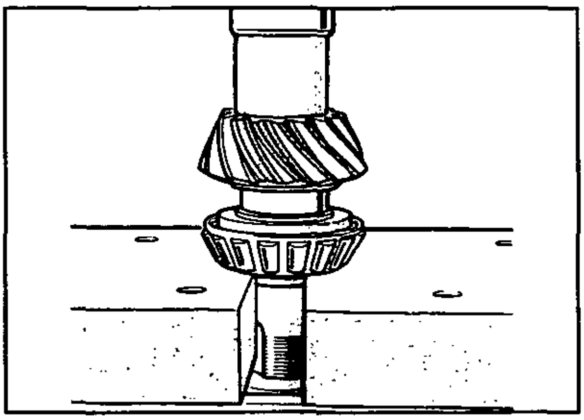
Shim Thickness **S2**=118.27 – 115.1
= 3.17 mm

Pinion Shim and Bearing Installation



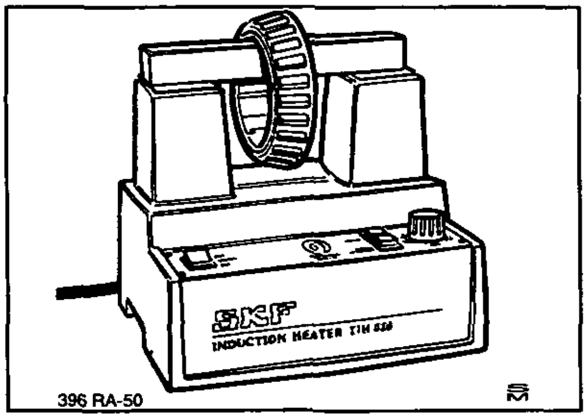
Pinion and Shim

7. Install shim selected in pinion to crown wheel shimming procedure between pinion head and bearing. Ensure the chamfer on the shim faces towards the pinion head.



Installing Pinion Outer Bearing

8. Install bearing onto pinion



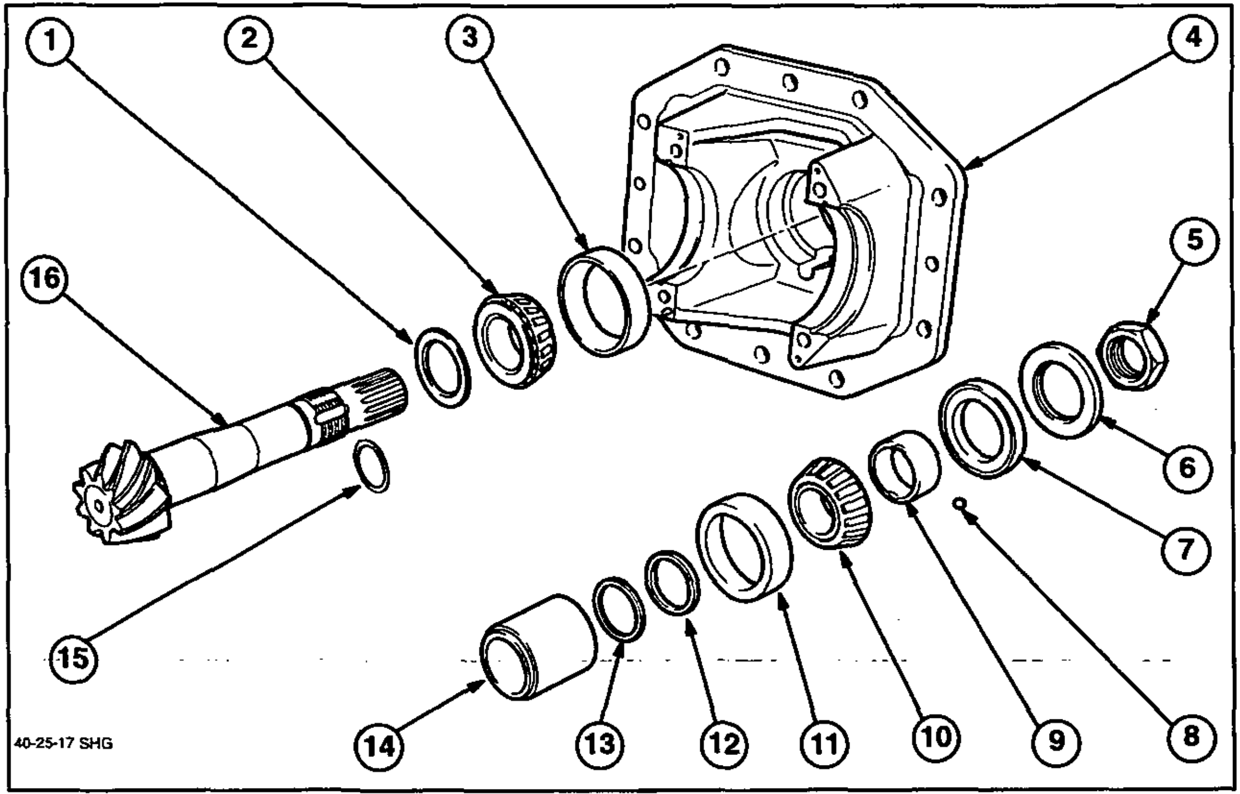
Bearing Induction Heater

NOTE: *The. use of a electronic induction heater will assist in the installation of the bearings without the need for a press.*

Pinion Bearing Preload Rolling Torque

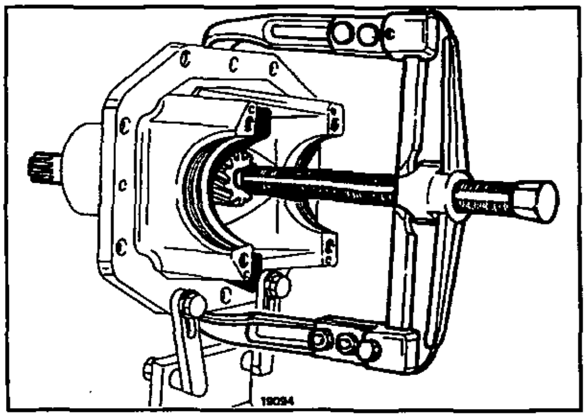
The pinion bearing preload is measured as the torque or force required to rotate the pinion. The shim selected in the Pinion Bearing preload shim adjustment procedure on Page 16 ensures that the correct preload is achieved when the pinion nut is tightened to a torque of 294 Nm (217 lbf ft).

NOTE: *If the special tool required to determine the thickness of preload shim is not available install the same shim as removed during disassembly.*

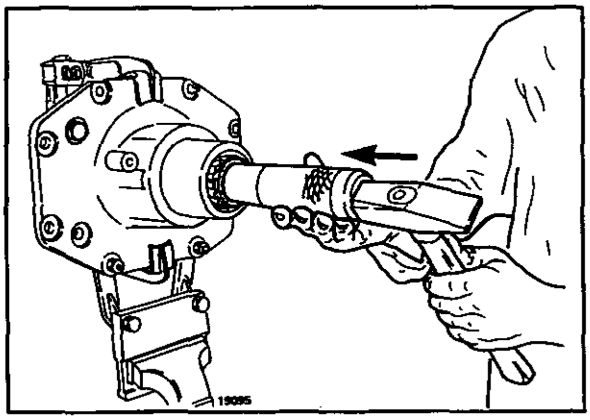


Drive Pinion Components

1. Shim
2. Bearing
3. Bearing Cup
4. Housing
5. Nut
6. Dust Cap
7. Seal
8. Ball
9. Sleeve
10. Bearing
11. Bearing Cup
12. Shim
13. Shim
14. Spacer
15. 'O' Ring
16. Pinion

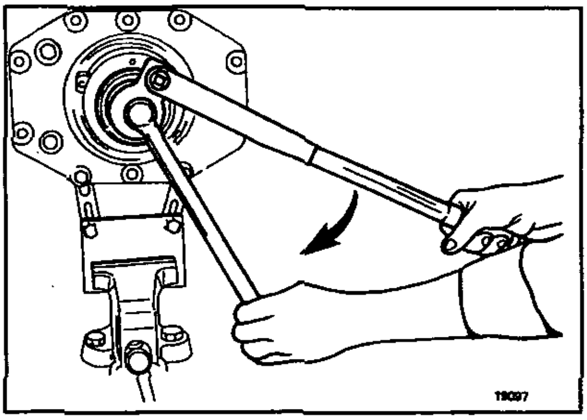


Locating Pinion In Carrier



Installing Pinion Outer Bearing

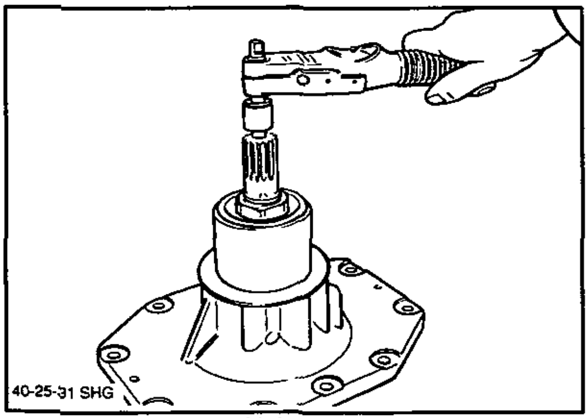
1. Install the inner pinion bearing onto the pinion and locate the pinion into the differential carrier. Hold the pinion in position with a universal puller.
2. Install the spacer and shims, items 12, 13 and 14 onto the pinion shaft. Lubricate and install the pinion outer bearing.



Tightening Pinion Nut

3. Install the sleeve. ball and pinion nut. Do Not install the pinion shaft 'O' ring at this stage.

4. Tighten the pinion nut to a torque of 294 Nm (217 lbf ft).



Measuring Pinion Rolling Torque

5. Screw an M12 bolt into end of the pinion shaft and use a suitable low value torque metre to measure the rolling torque of the pinion.

   The rolling torque should be 0.5–1.0 Nm (4.5–8.5 lbf in) excluding breakaway torque.

6. If the values recorded during the adjustment procedure are away from specification adjust the thickness of shim and recheck bearing preload.

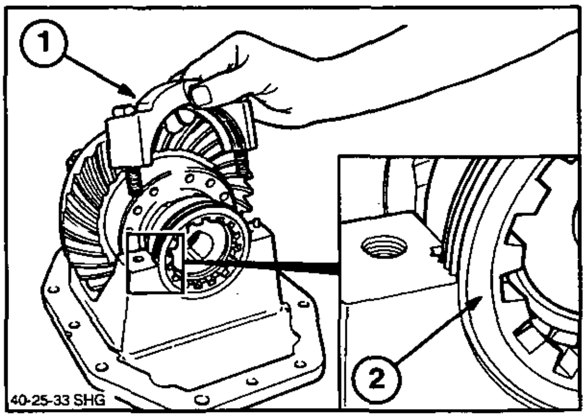
7. When the correct shim thickness has been established remove the pinion nut, sleeve and ball and install the 'O' ring and pinion oil seal.

8. Carefully reinstall the sleeve, ball and pinion nut.

NOTE: *Attempting to fit the oil seal with the sleeve installed may damage the oil seal lip.*

9. Tighten the pinion nut to a torque of 294 Nm (217 lbf ft) and deform the locking tab.

Crown Wheel to Pinion Backlash



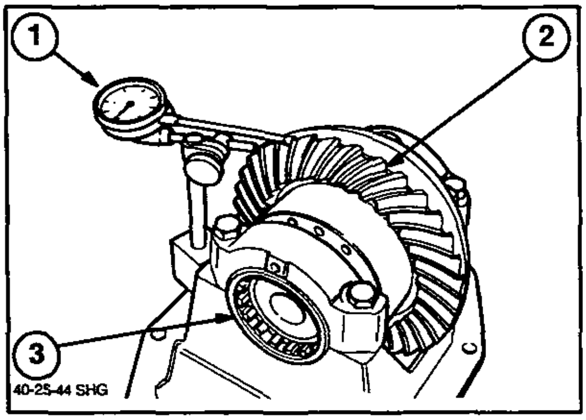
Differential Bearing Cap Removal

1. Bearing Cap
2. Adjuster Ring (Flat Edge Facing Outwards)

1. Locate the differential assembly into the support casing and tighten bearing cap bolts to a torque of 59 Nm (44 lbf ft).

NOTE: *Ensure the stepped edge of the adjuster ring faces and touches the edge of the bearing.*

2. Loosen bearing cap bolts and re–torque to 20 Nm (15 lbf ft)

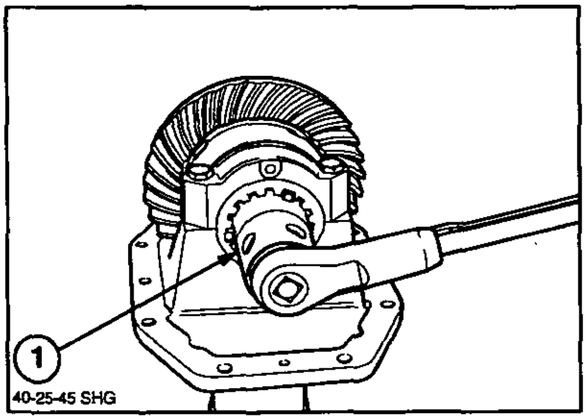


Measuring Crown Wheel to Pinion Backlash

1. Dial Indicator
2. Crown Wheel
3. Adjuster Ring

3. Adjust the ring gears to remove all free play between the crown wheel and pinion.

4. Position a dial indicator with the stylus at 90° to the crown wheel teeth and adjust each ring nut by equal amounts until crown wheel to pinion backlash is 0.18–0.23 mm (0.007–0.009 in)



Tightening Differential Ring Nuts

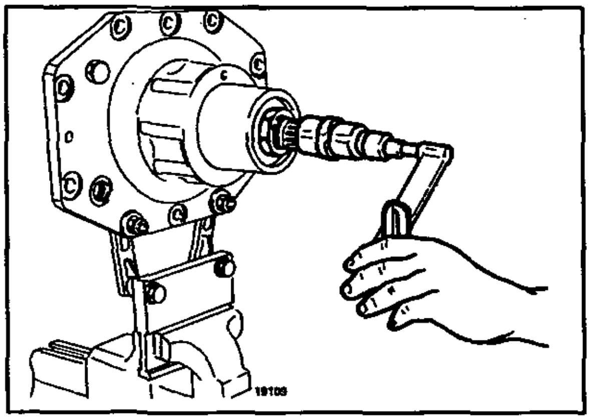
1. Ring Gear Tool No 293665

5. Tighten right hand ring nut (nut opposite crown wheel) to obtain a torque of 39–59 Nm (29–44 lbf ft) and recheck the crown wheel to pinion backlash.

6. Re–tighten the bearing cap bolts to a torque of 113 Nm (83 lbf. ft)

Differential Bearing Preload

The differential bearing preload is checked by measuring the combined rolling torque of the crown wheel and pinion assembly and comparing it to a known value.



Measuring Pinion Rolling Resistance

1. Attach a torque meter to the pinion shaft and measure the rolling torque to rotate the pinion and crown wheel.

2. Subtract from the rolling torque reading in step 1 described above, the pinion only rolling torque as described on Page 21.

   The difference between the two values should be 1 to 1.5 Nm, (9 – 13 lbf in).

3. If the rolling torque of the pinion and differential assembly is not to specification adjust the ring 'opposite' the crown wheel to increase or reduce differential bearing preload. Recheck the rolling torque as detailed above.

EXAMPLE

Rolling torque of Pinion and Differential

= 2.1 Nm (19 lbf in)

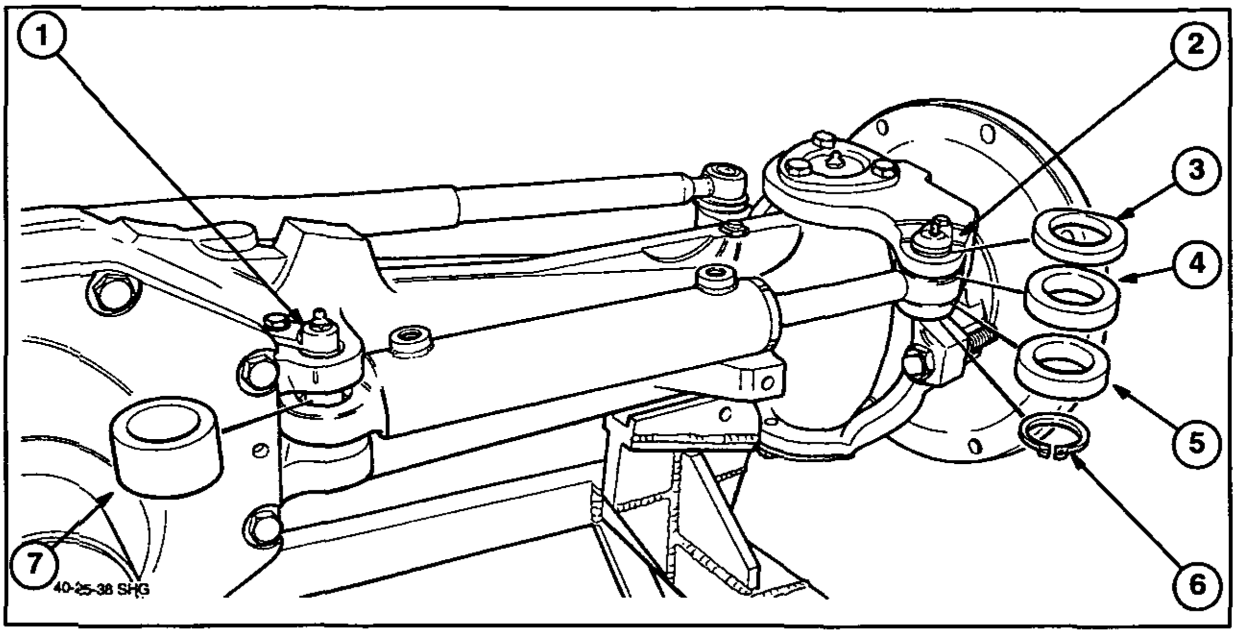
Rolling torque of Pinion

0.7 Nm (6 lbf in)

Calculated Rolling Torque of Differential
=2.1 – 0.7 Nm (19 – 6 lbf in)

=1.4 Nm (13 lbf in)

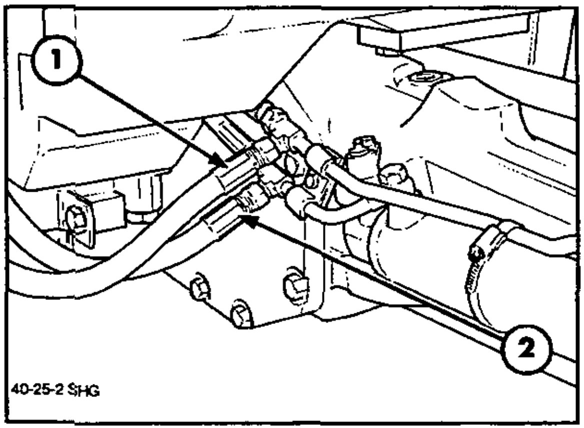
F. STEERING CYLINDER OVERHAUL



Steering Cylinder Installation

1. Locating Pin
2. Locating Pin
3. D Shaped Washer
4. Spacer
5. Spacer
6. Circlip

Detachable steering cylinders are located on lugs on either side of the axle casing

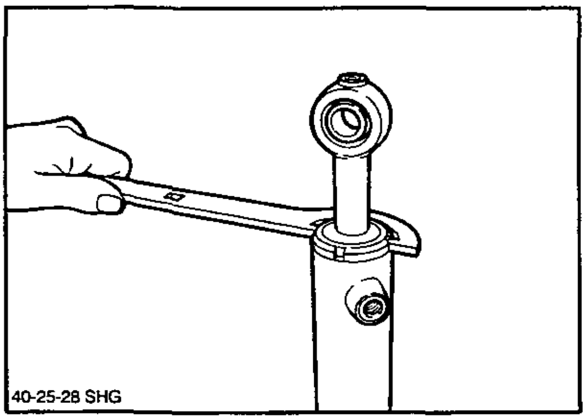


Steering Cylinder Right Hand Side

1. Right Hand Turn Hydraulic Hose
2. Left Hand Turn Hydraulic Hose

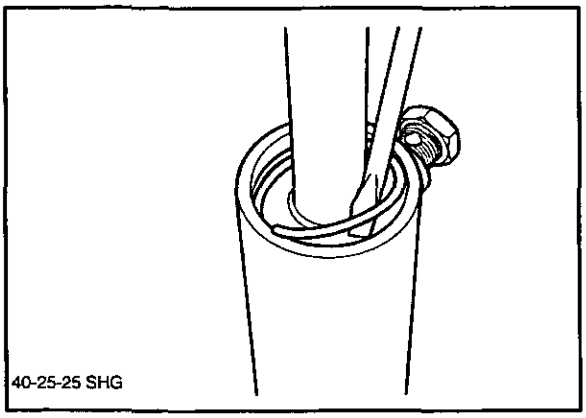
1. Disconnect the cylinder inlet and outlet connections and remove hose clamps.

2. Remove cylinder locating pins and withdraw cylinder from axle casing.



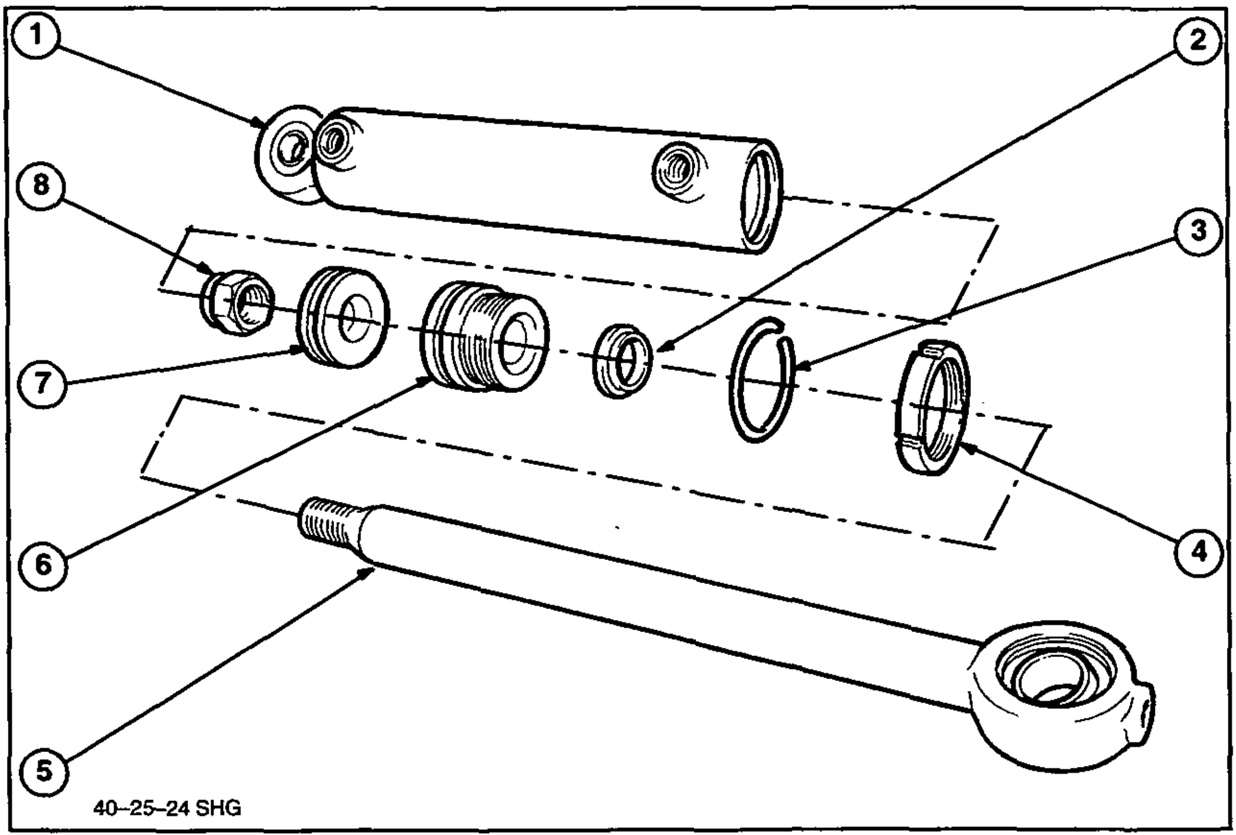
Unscrewing Gland Nut

3. *Using C spanner FT 3171 unscrew the* gland nut.



Removing Wire Locking Ring

4. Using a punch push the steering cylinder gland into the cylinder and remove wire locking ring.



Steering Cylinder Assembly

1. Cylinder
2. Wiper Seal
3. Retaining Ring
4. Gland Nut
5. Cylinder Rod
6. Gland and Seal Assembly
7. Piston
8. Nut

5. Pull the rod and gland assembly from the cylinder.

6. Disassemble and overhaul the cylinder. Inspect the bore of the cylinder and replace cylinder assembly if scored.

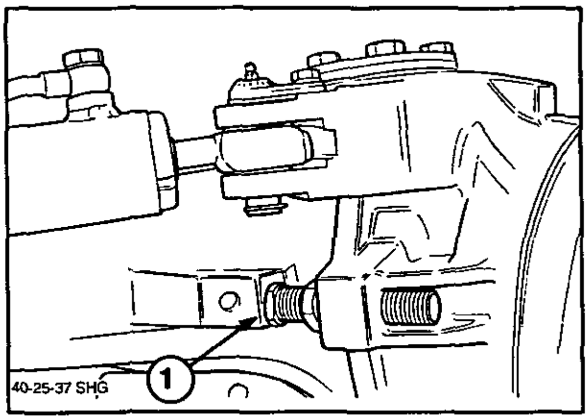
RE–ASSEMBLY

1. Suitably lubricate all components and replace all seals supplied in the seal kit.

NOTE: *The seal located in the centre of the gland is replaceable*

2. Re–assemble using the disassembly procedure in reverse.

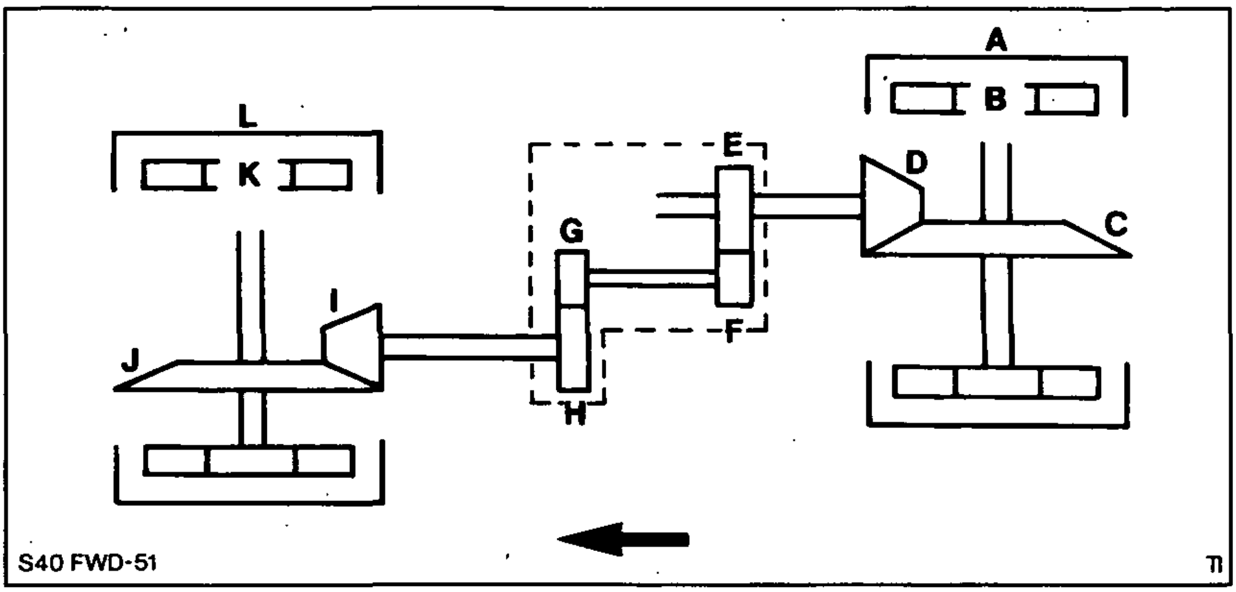
Steering Stop Adjustment



Steering Stop

3. Turn wheels on full lock and adjust steering stop to ensure tyres or fenders do not touch side of tractor and that steering cylinders have not reached end of travel.

G. DRIVE LINE SCHEMATIC



		56–7840 S	56–7840 SL	56–7840 SLE	82–8340 SL	82–8340 SLE
				No. of Gear Teeth		
REAR AXLE						
A	Ring Gear	56	80	80	80	80
B	Sun Gear	16	16	16	16	16
C	Crown Wheel	37	45	45	45	45
D	Pinion	7	8	8	8	8
TRANSFER BOX						
E	Pinion Drive Gear	43	38	29	38	29
F	Idler Gear	44*	34	26	34	26
G	Driven Gear	*	26	26	26	26
H1	Transfer Box Output Gear	39	37	37	37	37
H2	Transfer Box Output Gear	40	38	38	38	38
FRONT AXLE		Class 2 Axle			Class 3 Axle	
I	Pinion	9	9	9	11	11
J	Crown Wheel	33	33	33	41	41
K	Sun Gear	16	16	16	16	16
L	Ring Gear	68	68	68	68	68
REAR AXLE RATIOS						
Reduction Ratio	(A÷B)+1	4.5:1	6.0:1	6.0:1	6.0:1	6.0:1
Crown Wheel & Pinion	(C÷D)	5.28:1	5.625:1	5.625:1	5.625:1	5.625:1
Rear Axle Ratio		23.76:1	33.75:1	33.75:1	33.75:1	33.75:1
FRONT AXLE RATIOS						
Reduction Ratio	(K÷L)+1	5.25:1	5.25:1	5.25:1	5.25:1	5.25:1
Crown Wheel & Pinion	(J÷I)	3.67:1	3.67:1	3.67:1	3.73.:1	3.73:1
Front Axle Ratio		19.27:1	19.27:1	19.27:1	19.58:1	19.58:1
TRANSFER BOX RATIOS						
With Output Gear H1		0.907:1	1.273:1	1.276:1	1.273:1	1.276:1
With Output Gear H2		0.930:1	1.308:1	1.310:1	1.308:1	1.310:1
FWD FACTORS						
FWD Factor with Transfer Box Output Gear	H1	1.3659	1.3805	1.3777	1.3586	1.3558
	H2	1.3318	1.3442	1.3415	1.3228	1.3201

*** NOTE:** *For "S" model tractors with FWD. The drive is taken from the pinion shaft via an idler gear to the transfer case, mounted under the rear axle centre housing.*

H. SPECIFICATIONS

Type	Centre driven, double reduction (crown wheel and pinion plus planetary hubs), limited slip differential and two steering cylinders.	
Steering Turn Angle (dependent on track setting)	Adjustable between 25° and 55°.	
	Class 2 Axle	**Class 3 Axle**
Axle Ratio	19.25:1	19.568:1
Overall Width (Between Flanges)	1722 mm	1922 mm
Oil Capacities		
Hubs (each)	1.25 litres	1.7 litres
Axle Differential Housing	7.5 litres	9 litres
Oil Change Period	Every 1,200 hours or annually.	

Lubricants

Oil Specification	ESN–M2C–134D.
Grease Specification	ESE – M1C – 75B (TUTELA G9 or equivalent)

Thread Sealant

New Holland Thread Lock and Seal Part No 82995773 (Loctite 270)
Use on crown wheel retaining and differential housing bolts

Flange Sealant (Face to Face Sealant)

New Holland Flexible Sealing gasket Part No 82995771
Used on planetary carrier and differential support casing

CLEARANCES AND ADJUSTMENTS

Front Wheel Toe–In	0–6.0 mm (0–0.25 in.)	
Axle Hub Bearing Rolling Resistance	Non–Adjustable, Pre–Set	
Swivel Bearing Free play	**Class 2 Axle** 0.20 mm (0.008 in)	**Class 3 Axle** 0.40– mm (0.15 in)
	Adjustable by shims of:– 0.10 mm (0.004 in.)	
Pinion to Crown Wheel Shimming	Adjustable by Shims 2.5 – 3.7 mm in steps of 0.1 mm (0.098 – 0.146 in., in steps of 0.004 in.)	
Drive Pinion Bearing Preload		
Rolling Torque	0.5 – 1.0 Nm (4.5 – 8.5 lbf in)	
Adjusted Using Shims and Pinion Nut Torque		
Differential Bearing Preload	1 – 1.5 Nm + Pinion Bearing Rolling Torque (9 – 13 lbf in + Pinion Bearing Rolling Torque)	
Pinion to Crown Wheel Backlash	0.007 – 0.009 in. (0.18 – 0.23 mm)	

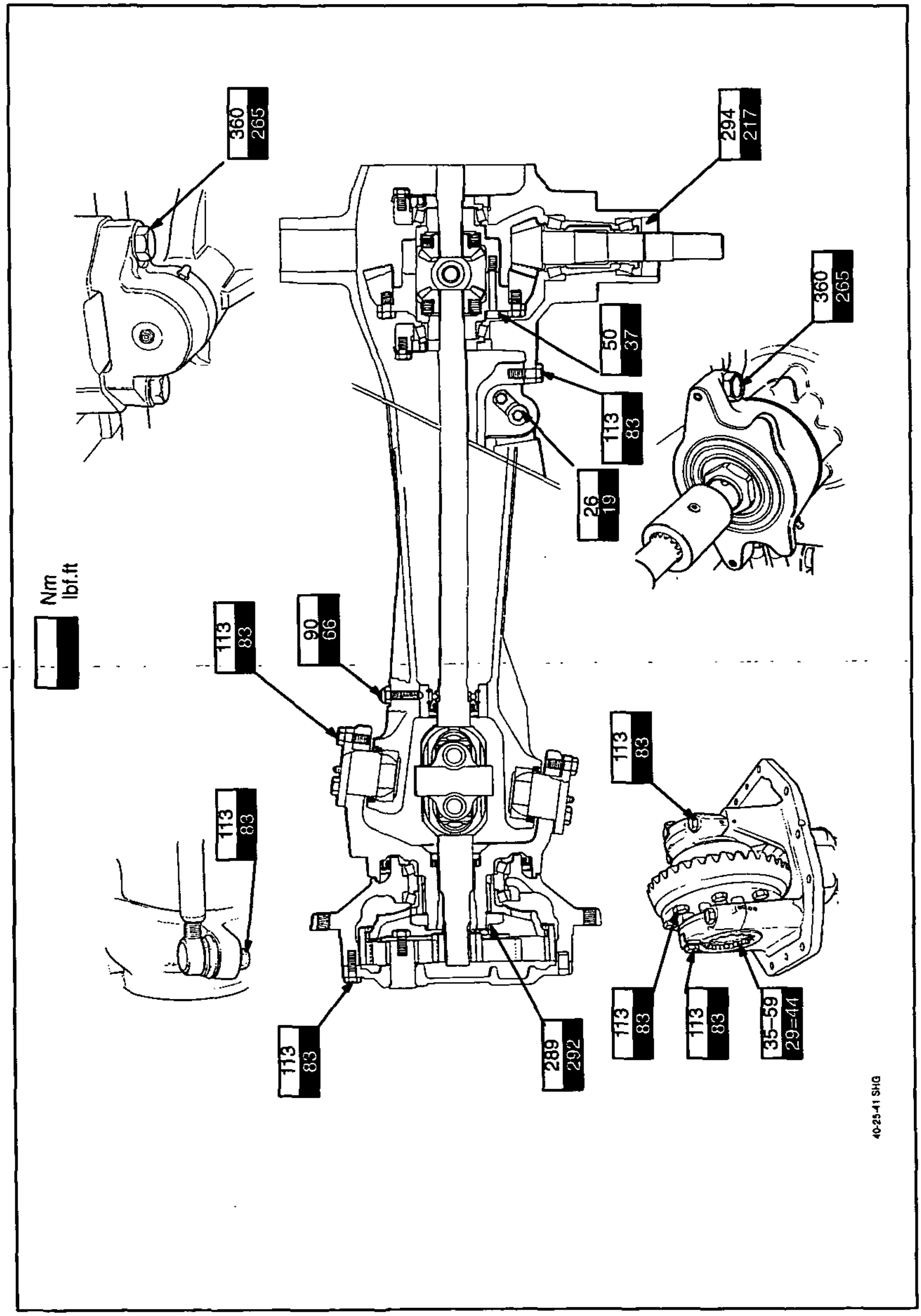
Limited Slip Differential Clutch Plate Wear Limits

Single Sided Friction Plate	
New	2.8 mm (0.110 in.)
Minimum Thickness	2.7 mm (0.106 in.)
Double Sided Friction Plates	
New	1.6 mm (0.063 in.)
Minimum Thickness	1.45 mm (0.057 in.)
Steel Seperator Plates	
New	1.5 mm (0.059 in.)
Minimum Thickness	1.4 mm (0.055 in.)

SPECIAL TOOLS

DESCRIPTION	V.L. CHURCHILL TOOLS	NEW HOLLAND TOOLS
C. Spanner	FT3171	
Pinion Nut Socket		293878
Pinion Setting Gauge	FT3135	293400
Pinion Bearing Clamp	Part of FT3135	293391 or 50048
Ring Gear Nut Socket		293880
Swivel Pin Bearing Cup Remover		292161
Swivel Pin Torque Wrench Adaptor		292220/4
Differential Adjustment Ring Adaptor		293665
Pinion Shaft Adaptor	Manufacture locally using drive shaft coupling F1NN 4684 AA (finis code 1873108)	

TORQUE SPECIFICATIONS



PART 11
CAB

Chapter 1
AIR CONDITIONING

A. SAFETY PRECAUTIONS

⚠ **WARNING:** *Before overhauling an air conditioning system read and observe the following Safety Precautions*

If a repair or replacement becomes necessary, ensure that only certified Air Conditioning technicians are employed, using approved equipment to effect repairs. Do ***not*** *attempt to disassemble the air conditioning system, It is possible to be* ***severely frostbitten or injured*** *by escaping refrigerant.*

IMPORTANT: *Do* ***not*** *allow refrigerant to escape into the atmosphere.*

Refrigerant must be handled with care in order to AVOID HAZARDS.

Undue direct contact with liquid refrigerant can produce freezing of skin and eyes.

Keep the refrigerant container and air conditioning system away from flame or heat sources, the resulting pressure increase can cause the container or system to explode.

If in direct contact with open flames or heated metal surfaces, the refrigerant will result in a toxic gas: **phosegene** and if inhaled will cause serious intoxication.

Make sure to comply with the following indications and simple precautions to avoid any risk of injury:

- Never discharge freon refrigerant into the atmosphere. When servicing air conditioning units a certified freon recovery unit operated by a certified technician must be used.
- When discharging the refrigerant in the system make sure you are operating in well–ventilated premises with good air circulation and far away from open flames.
- When charging and discharging the system always wear goggles and take suitable precautions to protect the face in general and the eyes in particular, from accidental spillage of the refrigerant fluid.
- The oil and refrigerant mixture inside the air conditioning system is pressurized. Consequently, never loosen fittings or tamper with lines unless the system has been properly discharged.

IMPORTANT: *Do not unscrew the oil level check plug on a charged system.*

- Before loosening any connection, cover the fitting in question with a cloth and wear gloves and goggles in order to prevent refrigerant from reaching the skin or eyes.
- In the event of an accident, proceed as follows:–

  If the refrigerant has reached the eyes, wash them immediately with copious amounts of sterilised water or mains pressure tap water and transfer to hospital for immediate medical help.

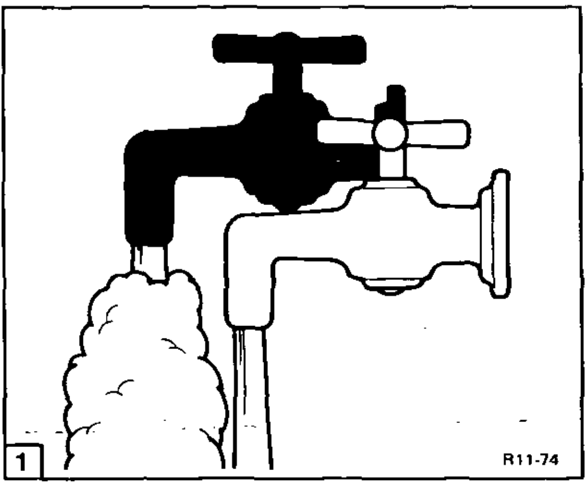
  If the refrigerant has touched the skin, wash with cold water and transfer to hospital for immediate medical help.

B. PRINCIPALS OF AIR CONDITIONING

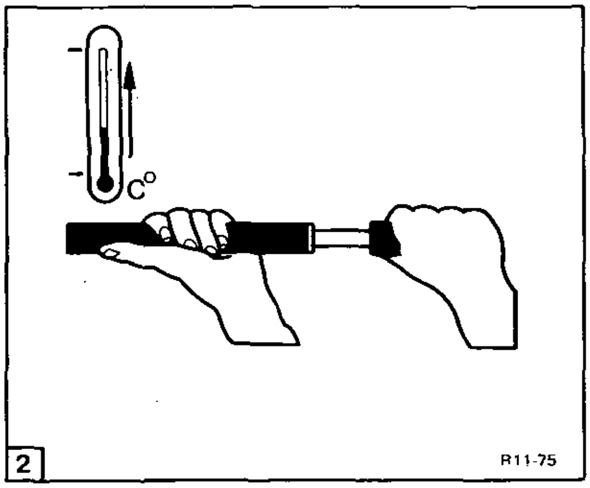
The function of the air conditioning system is to improve the operator's comfort by cooling the air temperature inside the cab and reducing the humidity level.

This temperature control is achieved by absorbing the heat within the cab into a refrigerant and then allowing the heat absorbed by the refrigerant to be transferred to the outside air

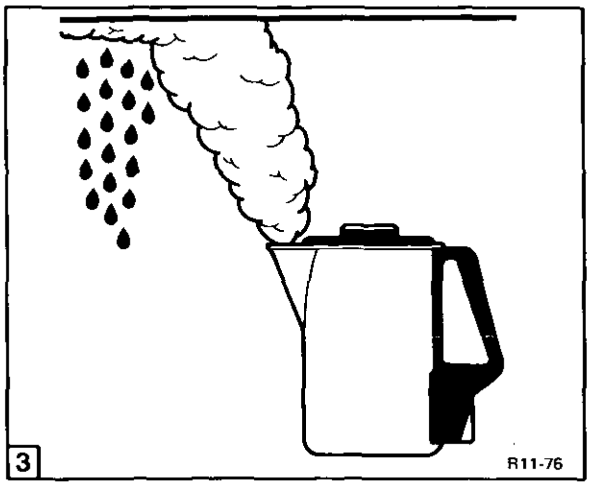
In order to achieve this heat transfer the following principals of heat generation and transfer are applied within the air conditioning system.



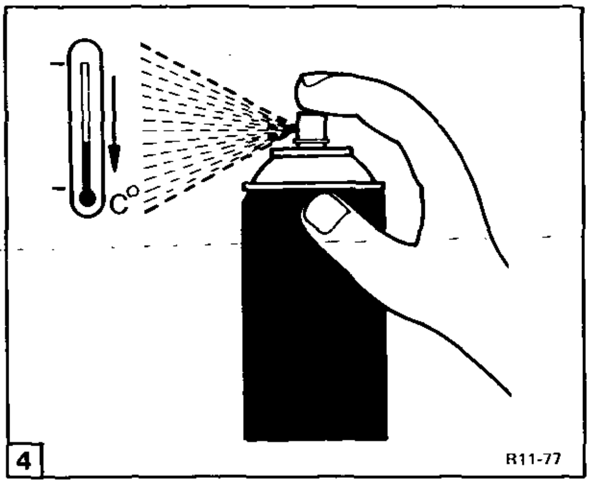
1. When two bodies of different temperature come together heat is transferred from one to another. On air conditioning systems an evaporator is used to hold the low temperature refrigerant which absorbs the heat from the air within the cab.



2. When a gas is pressurised the temperature of the gas will rise. In air conditioning systems the increase in pressure is achieved using a compressor.



3. When a gas is cooled it will condense into a liquid. In the air conditioning system a condenser is used to cool the gas and the resulting liquid is stored in a receiver dryer.

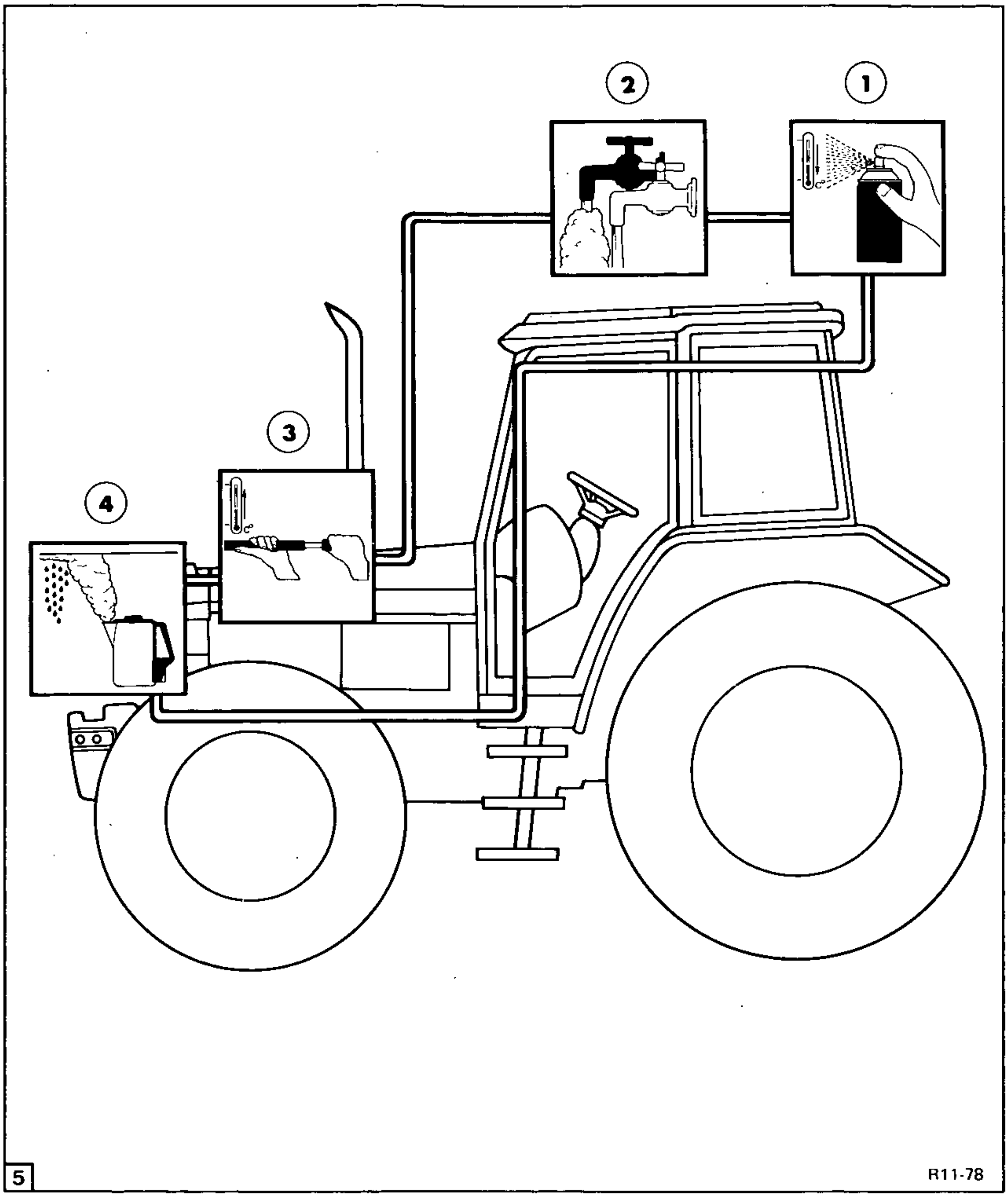


4. When a liquid is atomized through an orifice, the temperature of the resultant vapour will drop. The low temperature of the atomized liquid will then absorb heat from its surroundings. On air conditioning systems the refrigerant is atomized using an expansion valve.

It can now be seen that the principal components of an air conditioning system are:–

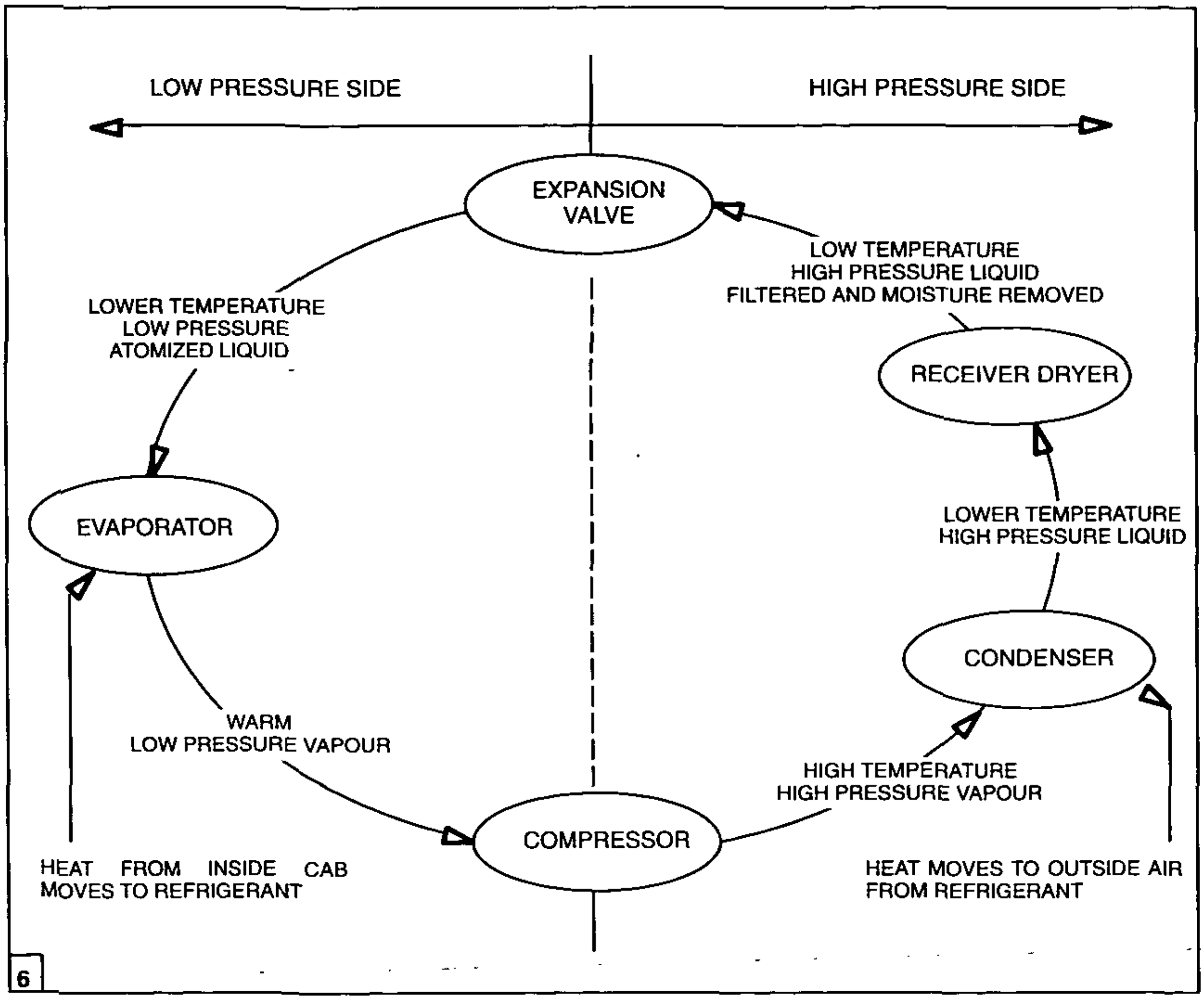
- Refrigerant
- Evaporator
- Compressor
- Condenser
- Receiver Dryer
- Expansion Valve

Figure 5, uses the examples above to illustrate the air conditioning cycle on Series 40 tractors.



Air Conditioning Principal of Operation

1. Expansion Valve – Atomizes Liquid Refrigerant Before Passing to Evaporator
2. Evaporator– Absorbs Heat From Air In Cab
3. Compressor – Compresses and Raises Temperature Of Refrigerant Gas
4. Condenser, Evaporator and Dryer – Converts Refrigerant from Gas to a Liquid



Air Conditioning Flow Diagram

Figure 6, shows in schematic form the flow of refrigerant through the five major components of an air conditioning system. Refer to, Figure 7, for the location of these components on the tractor.

Refrigerant is drawn into the compressor as a cool, low pressure vapor which is compressed and then pumped out as a hot, high pressure vapor to the condenser.

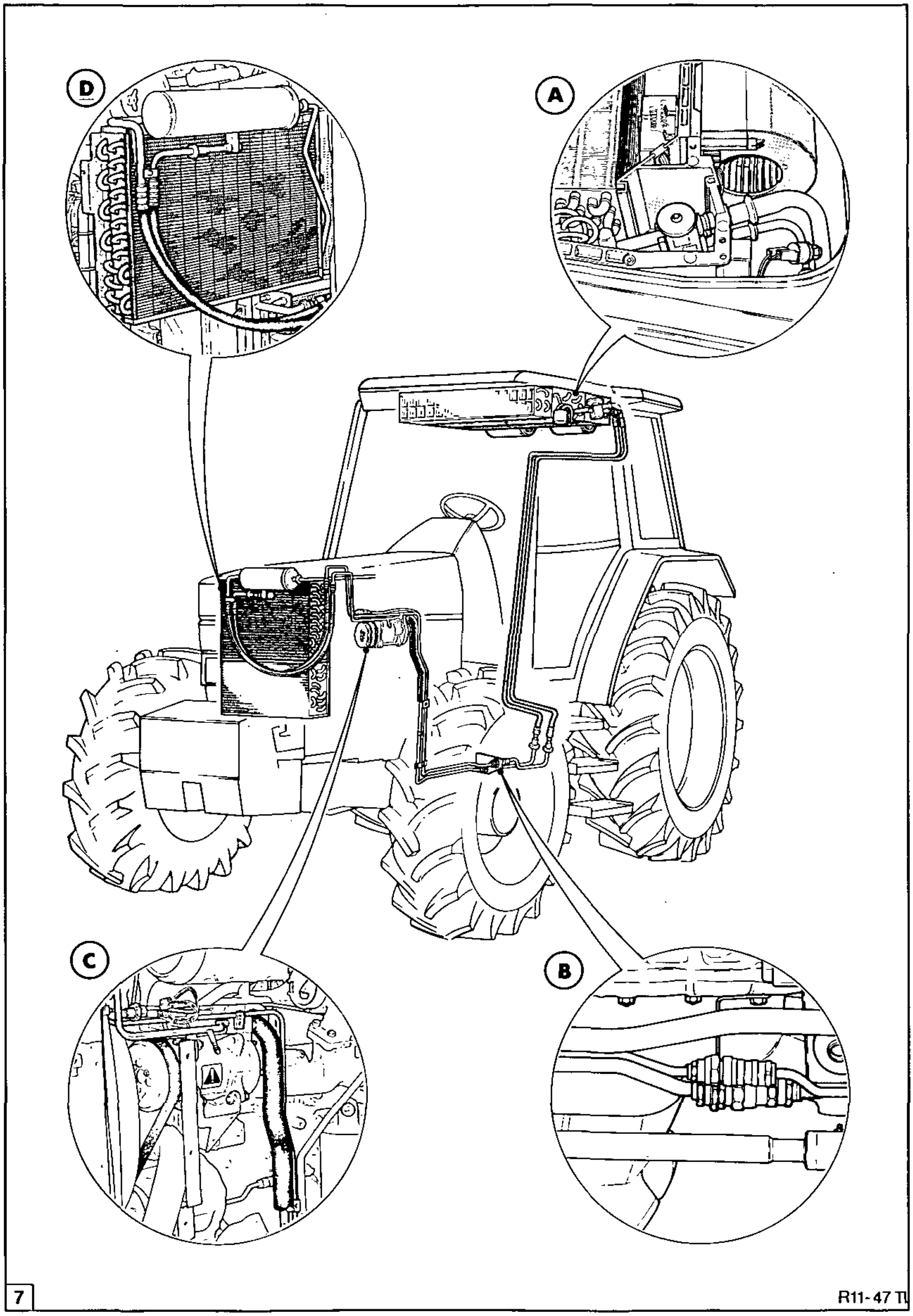
As the hot, high pressure vapor passes through the condenser core it gives off heat to the cooler outside air being drawn past the fins by the engine cooling fan.

By giving off heat to the outside air the vapor is condensed to a liquid which moves under high pressure to the receive dryer where it is stored until released to the evaporator by the temperature sensing expansion valve.

As liquid refrigerant passes through the metered orifice in the expansion valve the refrigerant changes from a high pressure liquid to a low pressure atomized liquid with a lower temperature.

This low pressure, low temperature, atomized liquid enters the evaporator coils and absorbs heat from the cab warm air blown across the coils and fins by the cab blower motor. The refrigerant now changes from a cold low pressure atomized liquid to a warm low pressure vapor and leaves the evaporator outlet, moving to the suction (low pressure) side of the compressor to repeat the cycle.

As this heat loss is taking place, moisture (humidity) in the cab air will condense on the outside of the evaporator and drain off as water through the drain hoses attached to the evaporator drain pan, thereby reducing the humidity level of the cab.



Air Conditioning Component Layout

A. Blower Motor, Expansion Valve and Evaporator
B. Quick Release Self Sealing Couplings
C. Compressor
D. Condenser and Receiver Dryer

C. SYSTEM COMPONENTS – DESCRIPTION AND OPERATION

REFRIGERANT

To achieve the absorption and the release of heat which is, in essence, the function of an air conditioning system, requires the use of a suitable "refrigerant" - a liquid that has a relatively low temperature boiling point, plus certain desirable safety and stability features.

The refrigerant currently used in the air conditioning systems of Series 40 Tractor is refrigerant R-12. (Trade name include Freon 12, Arcton 12, Genetron 12 and Freeze 12).

In the future Series 40 tractors will incorporate R–134A refrigerant and the Service technician should check the Decal on the compressor to determine the type of refrigerant used.

NOTE: *To help protect the environment legislation has been introduced in most territories banning the release into the atmosphere of CFC refrigerants,including R12. All service procedures contained in this manual can be carried out without the need to release refrigerant into the atmosphere.*

In order to prevent the incorrect type of refrigerant being charged to the system the schrader type service valves fitted to the tractor and necessary to connect up refrigerant recovery, evacuation and recycling/recharging equipment will be of two different sizes as recognised and specified by the air conditioning industry.

⚠ **WARNING:** *R–12 refrigerant is* ***not compatible*** *with R–134A refrigerant.* ***Do not*** *attempt to replace R12 refrigerant with R–134A refrigerant or test the system using gauges or equipment previously used with R134A as damage to the system will result.*

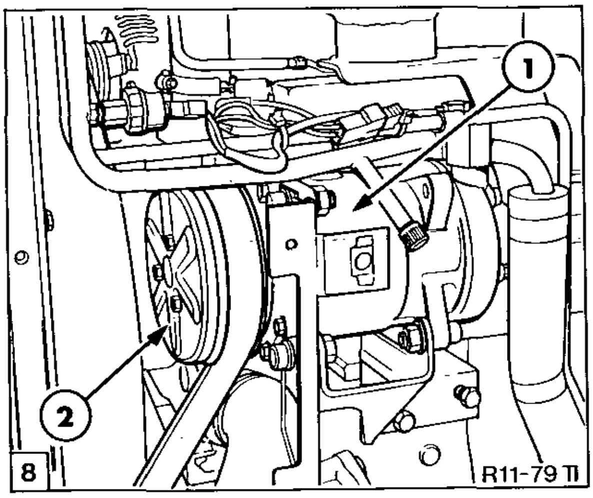
R-12 is refrigerant is stable at all operating temperatures and able to absorb great quantities of heat.

The boiling point of R-12 is - 21.7° F (-30.1° C) at atmospheric pressure.

If the pressure is increased, R-12 will readily vaporize to absorb heat at temperatures between 11° F (-11.7° C) at 15 lbf/in^2 (1.03 bar) and 32° F (0° C) at 30 lbf/in^2 (2.07 bar) in the evaporator.

At higher pressures, R-12 will condense and give off heat at temperatures between 130° F (54.4° C) at 180 lbf/in^2 (12.4 bar) and 150° F (66.6° C) at 230 lbf/in^2 (15.85 bar) in the condenser.

COMPRESSOR PUMP



Air Conditioning Compressor

1. Air Conditioning Compressor
2. Electromagnetic Clutch

The tractor air conditioning unit compressor pump is mounted on the left hand side of the engine and is belt driven by the crankshaft pulley, Figure 8.

The compressor separates the low and high pressure sides of the system and is basically a pump which has two functions:

(1) To raise the refrigerant temperature by compression to a higher degree of temperature than the ambient (outside air) temperature.

(2) To circulate the required volume of refrigerant through the system.

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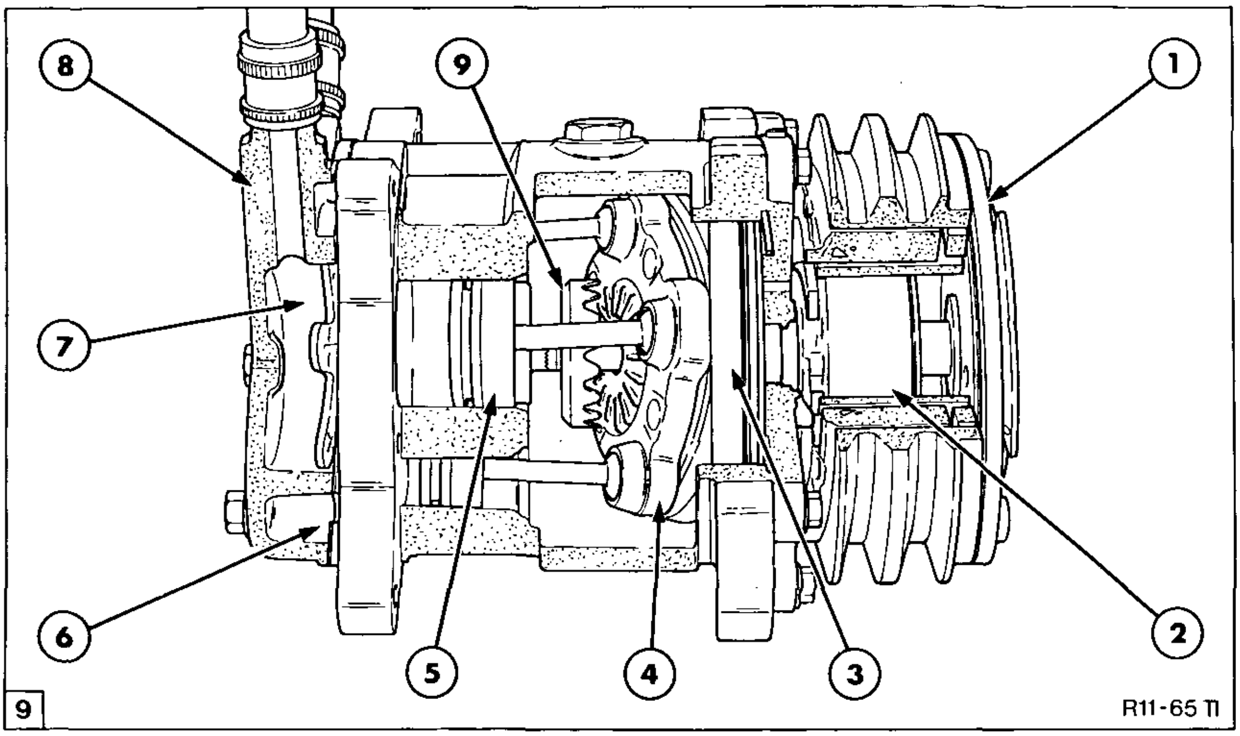


Air Conditioning Refrigerant Compressor

1. Electro–magnetic Clutch
2. Clutch Bearing
3. Cam Rotor
4. Wobble Plate
5. Piston
6. Suction Chamber
7. Discharge Chamber
8. Cylinder Head
9. Static Gear

The refrigerant compressor is a five (5) cylinder "wobble plate" unit housed in a die cast aluminum housing.

Drive to the "wobble plate" is from the pulley through the electro-magnetic clutch to the main driveshaft. Attached to the driveshaft is a cam rotor which oscillates the "wobble plate". The "wobble plate" is prevented from rotating by a static gear engaging with teeth formed in the face of the plate. The five pistons are connected to the "wobble plate" by rods located in ball sockets.

Refrigerant is drawn in on the downward stroke of a piston through a reed valve in the cylinder head. Refrigerant enters the cylinder head through a gallery in the outer circumference of the head.

The upwards stroke of the piston compresses the refrigerant and expels it through another reed valve into an inner gallery in the cylinder head and out into the refrigerant circuit.

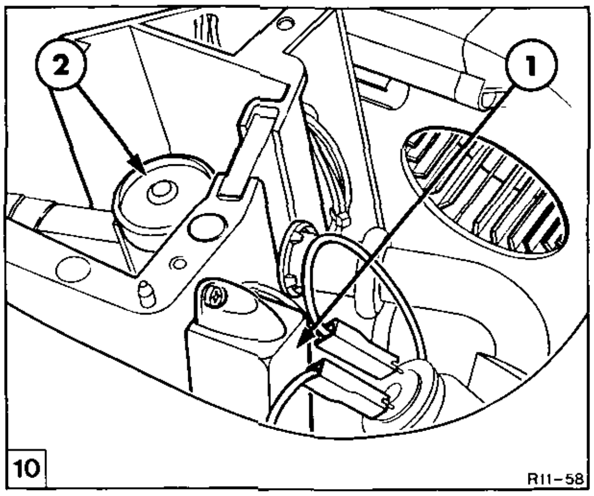
The compressor is internally lubricated and therefore a minimal amount of oil is passed into the refrigerant circuit.

The compressor is activated by an electro-magnetic clutch which functions to engage or disengage the compressor as required in the operation of the air conditioning system.

The clutch is primarily activated by the:–

- Temperature cycling control switch
- Combined high/low pressure cut–out switch
- Low pressure cut–out switch

AIR CONDITIONER TEMPERATURE CYCLING CONTROL SWITCH



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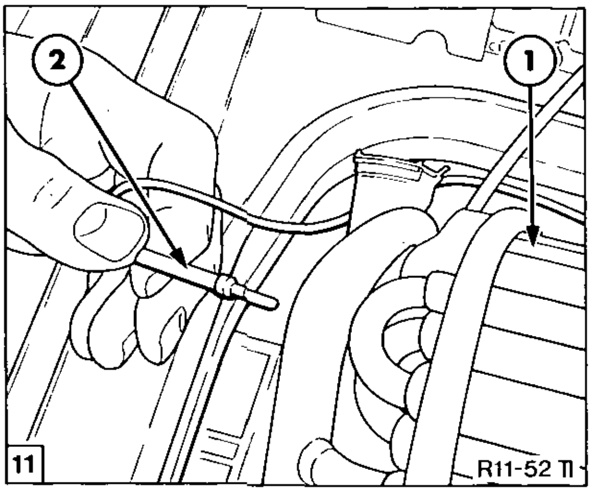
Air Conditioner Temperature Cycling Control Switch

1. Temperature Cycling Control Switch
2. Expansion Valve

The air conditioner temperature cycling control switch is mounted on the left hand side of the evaporator housing and close to the expansion valve, Figure 10.

The switch is a device which turns the compressor clutch on and off to maintain a constant average evaporator temperature and senses the evaporator temperature using a thermistor positioned within the evaporator fins, Figure 11.



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Thermistor Installation

1. Evaporator
2. Thermistor

The temperature cycling control switch compares the voltage of the thermistor, which is dependent on the temperature of the evaporator, with the voltage across the potentiometer of the 'in cab' temperature control switch.

The switch upon comparing the two voltages determines whether the compressor clutch should be switched 'on' or 'off' in order to maintain the desired in cab temperature control.

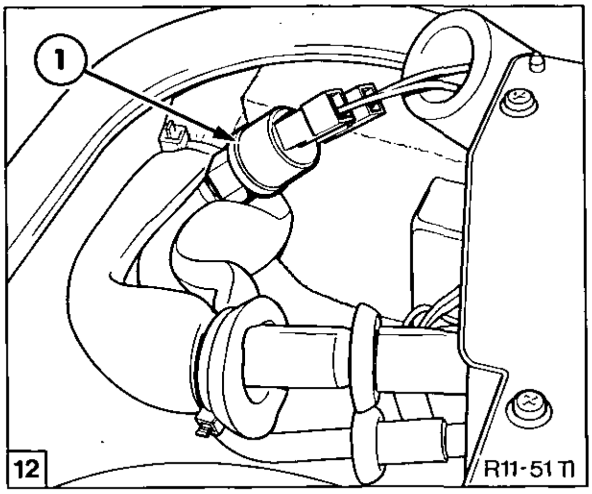
LOW PRESSURE CUT-OUT SWITCH

The low pressure switch, Figure 12, is in the evaporator outlet line and located in the cab roof next to the evaporator and temperature cycling control switch.

The purpose of the switch is to shut off the compressor pump in the event of low pressure in the refrigerant system.

Low refrigerant pressure may occur due to a faulty expansion valve, icing up of the expansion valve orifice or refrigerant loss. Low refrigerant pressure may result in damage to the compressor pump.

The low pressure switch is factory set and cannot be adjusted.



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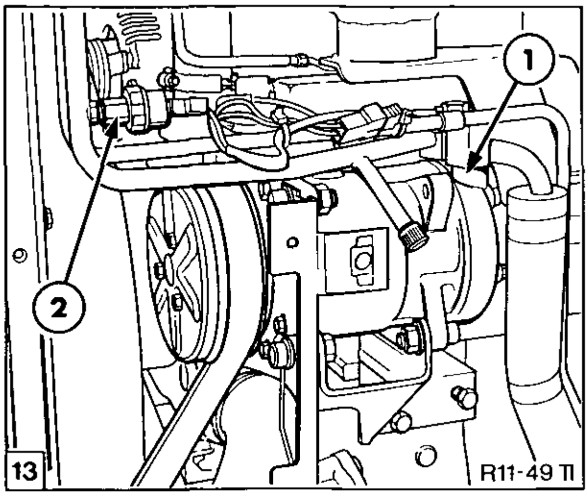
Low Pressure Cut–out Switch

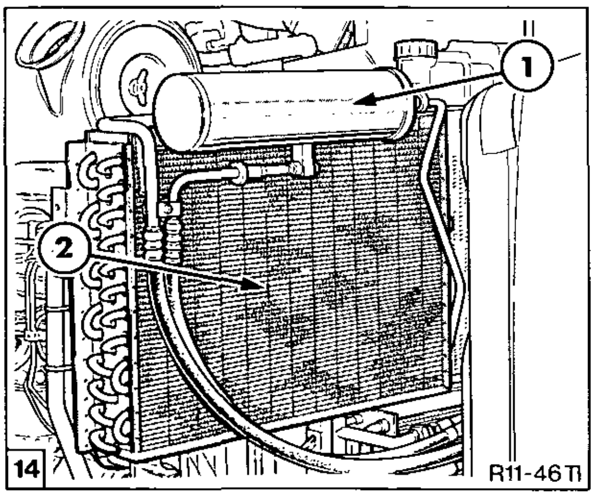
1. Low Pressure Cut–out Switch

COMBINED HIGH/LOW PRESSURE CUT–OUT SWITCH



Combined High/Low Pressure Switch

1. Compressor
2. Combined High Low Pressure Switch



Air Conditioning Condenser and Receiver/Dryer

1. Receiver/Dryer
2. Condenser Assembly

The combined high/low pressure switch, Figure 13, is located in the condenser inlet line from the compressor. The switch shuts off the compressor pump in the event of a restriction in the high pressure line or excessively low pressure due to lack of refrigerant in the system.

Loss of refrigerant in the system will result in insufficient cooling and lubrication and continuous operation will cause damage to the compressor pump.

CONDENSER and RECEIVER DRYER

The condenser located at the front of the tractor, Figure 14 consists of a number of turns of continuous coil mounted in a series of thin cooling fins to provide a maximum of heat transfer in a minimum amount of space.

The condenser receives the hot, high pressure refrigerant vapor from the compressor. The hot vapor passes through the condenser coils and outside air is pushed through the condenser by the engine cooling fan.

Heat moves from the hot refrigerant vapor into the cooler outside air flowing across the condenser coils and fins.

When the refrigerant vapor reaches the pressure and temperature that will induce a change of state, a large quantity of heat is transferred to the outside air and the refrigerant changes to a high pressure warm liquid.

The warm liquid refrigerant continues onto the receiver/drier where it is filtered and desiccated, to remove any moisture, before passing through an outlet line to the thermostatic expansion valve.

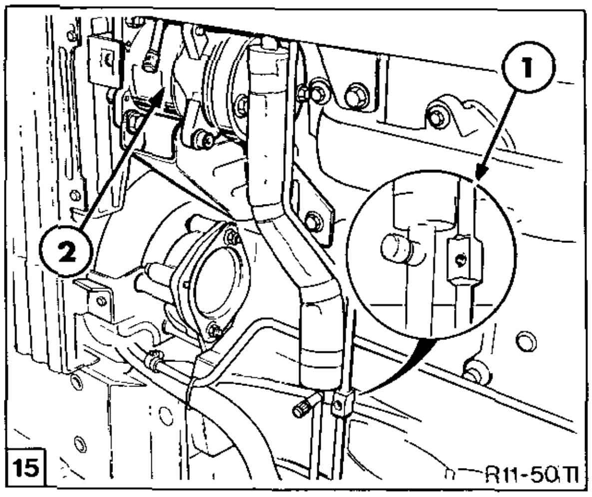
The receiver/dryer stores the liquid refrigerant to be sure a steady flow to the thermostatic expansion valve is maintained under widely different operating conditions.

The drier section contains a desiccant (Molecular sieve) to absorb any moisture within the system and a filter prevents the entry of foreign particles.

NOTE: *Any moisture in the air conditioning system is extremely harmful. Moisture not absorbed by the dehydrator will circulate with the refrigerant and droplets may collect and freeze in the thermostatic expansion valve orifice. This action will block the refrigerant flow and stop the cooling action. Moisture will also react with refrigerant R-12 to form a corrosive hydrochloric acid.*

The desiccant can only absorb a limited amount of moisture before reaching saturation point. Because of this, after any system component replacement or repairs requiring entry into the system, the receiver/dryer should be replaced.

SIGHT GLASS



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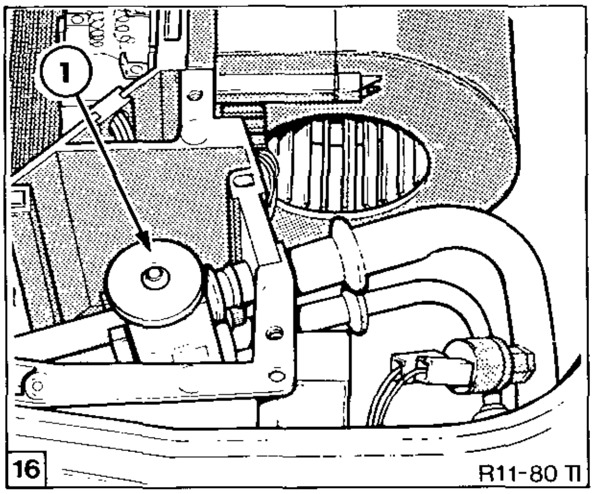
Air Conditioning Sight Glass
1. Sight Glass
2. Compressor

The sight glass, Figure 15, is located in the line between the receiver/drier and the expansion valve, through which liquid refrigerant flows.

The sight glass enables the condition of the refrigerant to be observed as follows:

- Clouded - Desiccant is escaping from the dehydrator and circulating through the system. The dehydrator and receiver must be replaced and the system purged (refrigerant replaced).
- Oil Streaks, Foam or Bubbles - Insufficient refrigerant in the system. (Occasional bubbles during initial operation is normal).
- Clear - A correct charge, an over-charge or a complete lack of refrigerant. (An over-charge is indicated when test gauge readings are above normal).

EXPANSION VALVE



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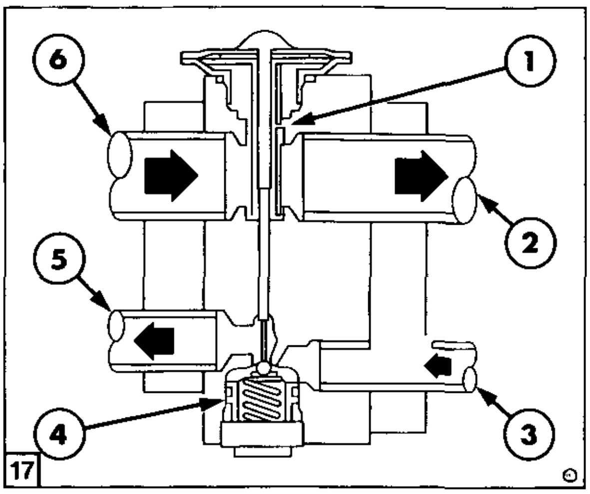
Air Conditioning Expansion Valve
1. Expansion Valve

The expansion valve, Figure 16, is located next to the evaporator, in the pressure line leading from the receiver/dryer and performs the following functions:

1. METERING ACTION -
   A metered orifice changes the liquid refrigerant from a high pressure low temperature liquid to a low pressure, lower temperature atomized liquid.
2. MODULATING ACTION -
   A thermostatically controlled valve within the expansion valve body controls the volume of liquid refrigerant passing through the orifice and makes sure the refrigerant is fully vaporized within the evaporator. Liquid refrigerant would damage the compressor reed valves or freeze the pistons.
3. CONTROLLING ACTION -
   The valve responds to changes in the cooling requirements. When increased cooling is required, the valve opens to increase the refrigerant flow and when less cooling is required the valve closes and decreases the refrigerant flow.

Expansion Valve - Operation



Expansion Valve

1. Temperature Sender
2. To Compressor
3. From Condensor
4. Ball and Spring
5. To Evaporator
6. From Evaporator

All of the needed temperature sensing and pressure sensing functions are consolidated into this basic unit and no external tubes are required for these purposes.

The refrigerant from the condenser and receiver dryer enters the thermostatic expansion valve as a high pressure warm liquid. Upon passing through the ball and spring controlled metering orifice, the pressure and temperature of the refrigerant is reduced and the refrigerant leaves the thermostatic expansion valve as a low pressure, lower temperature atomized liquid.

The atomized liquid now passes through the evaporator where it absorbs heat before returning via the expansion valve to the compressor as a warm Low pressure vapour.

There are two refrigerant passages in the valve. One passage is in the refrigerant line from the condenser to the evaporator and contains the ball and spring type orifice valve. The other passage is in the refrigerant line from the evaporator to the compressor and contains the valve's temperature sensing element.

Liquid refrigerant flow from the condenser and receiver dryer is controlled by a push-rod forcing the orifice valve ball off its seat and the spring exerting pressure on the ball to keep it on its seat.

During stabilized (vehicle shutdown) conditions, the pressure on the bottom of the expansion valve diaphragm rises above the pressure on the top of the diaphragm allowing the valve spring to close the orifice.

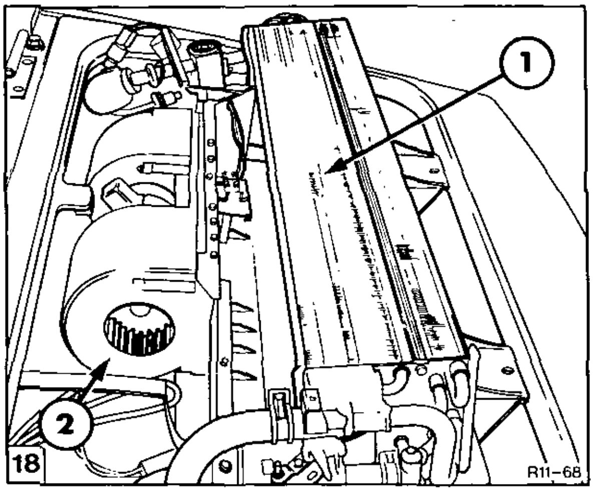
When the system is started, the pressure on the bottom of the diaphragm drops rapidly, allowing the orifice to open and meter atomized liquid refrigerant to the evaporator where it begins to vaporize.

Suction from the compressor draws the vaporized refrigerant out of the evaporator and back through a gallery in the top of the valve which passes the temperature sensor.

The temperature sensor reacts to variations in refrigerant gas pressure returning from the evaporator. When heat from the passenger compartment is absorbed by the refrigerant the pressure of the gas increases causing a differential pressure above and below the temperature sensor diaphragm. The diaphragm reacts to this pressure differential and a push rod forces the ball in the expansion valve orifice further off its seat. This reaction allows an increase in the atomized refrigerant to flow through the valve, to the evaporator, so that more heat can be absorbed by the air conditioning system.

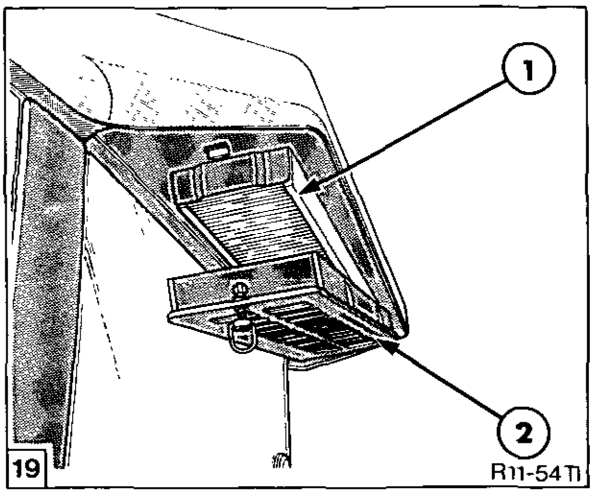
Similarly when the temperature of the gas returning from the evaporator decreases the pressure of the gas decreases. This causes the diaphragm to react accordingly and allow the ball in the orifice to move closer towards its seat thus reducing the flow of refrigerant through the valve to the evaporator.

EVAPORATOR



Evaporator Assembly

1. Evaporator
2. Blower Fan



Air Conditioning Filter
(One Each Side of Cab

1. Filter Element
2. Filter Cover

The evaporator, Figure 18, is located in the cab roof and consists of a number of turns of continuous coils mounted in a series of thin cooling fins to provide a maximum of heat transfer in a minimum amount of space.

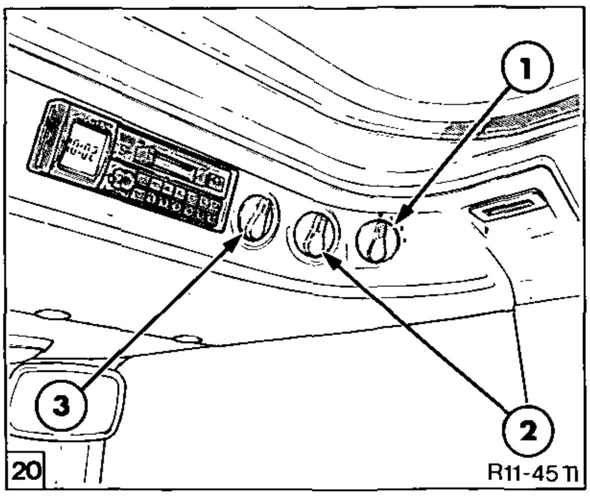
Low temperature refrigerant in the evaporator absorbs heat from the hotter air in the operator's compartment, thereby cooling the air.

BLOWER FAN

The blower fan, Figure 18 draws warm air from outside the cab through the intake filters, Figure 19 and forces it across the evaporator before entering the cab through louvered vents.

The blower motor is controlled by a three-speed switch, Figure 20. The switch uses a variable resistor to change the fan speed.

High blower speed provides the greatest volume of circulated air, however, a slower speed will allow the air to contact the cooling fins and coils of the evaporator for a longer *period resulting in the warm air giving up more* heat to the cooler refrigerant.Therefore, the coldest air temperature is obtained when the blower fan is operated at the lowest speed.



Roof Mounted Controls

1. Blower Control
2. Air Conditioner Temperature Control
3. Heater Temperature Control

D. FAULT FINDING AND TESTING THE AIR CONDITIONING SYSTEM

GENERAL

Overhaul of the air conditioning system should only be undertaken by a certified specialist refrigeration engineer using a comprehensive air conditioning test kit, including a gas leak detector, suitable for the type of refrigerant gas used in the system.

Before servicing the system it is important that you verify the type of refrigerant gas charged to the system. On early production tractors refrigerant gas R–12 was used and on later production tractors refrigerant gas R–134A. Where a tractor is charged with R–134A a different compressor is used and a decal on the compressor specifies the R–134A charge requirement.

⚠ **WARNING:** *R–12 refrigerant is **not compatible** with R–134A refrigerant. **Do not** attempt to replace the type of refrigerant gas charged to the system with that of a different type or service the system using gauges or equipment previously used for other refrigerant gasses as damage to the system will result.*

*Before dismantling an air condition system for repair the gas within the system must be discharged and recovered using a **certified recovery unit** designed for the type of refrigerant gas used in the system.*

NEVER release refrigerant gas into the atmosphere.

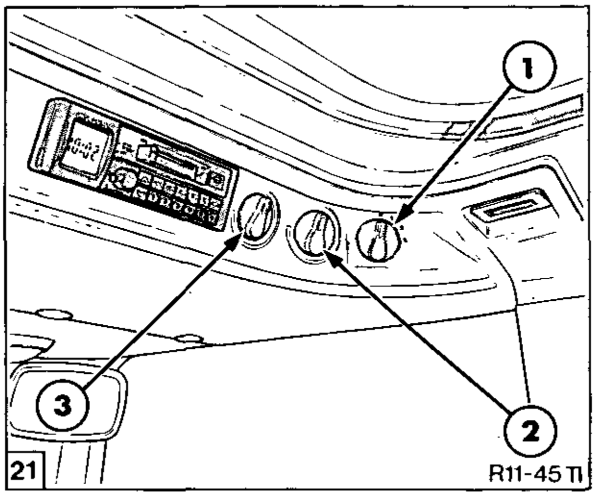
ALWAYS wear safety goggles and gloves when servicing any part of the air conditioning system.

To prevent the entry of any foreign material, observe the following points:

- Ensure all tools, gauges, hoses and replacement parts are kept clean and dry and are suitable for the type of refrigerant gas used in the system.
- Clean all hoses and fittings before disconnecting. cap or plug all openings when disconnected.
- When adding lubricating oil to the system always uncap and re-cap the oil container immediately before and after use. Always ensure the oil remains free of moisture.

PRELIMINARY FAULT FINDING

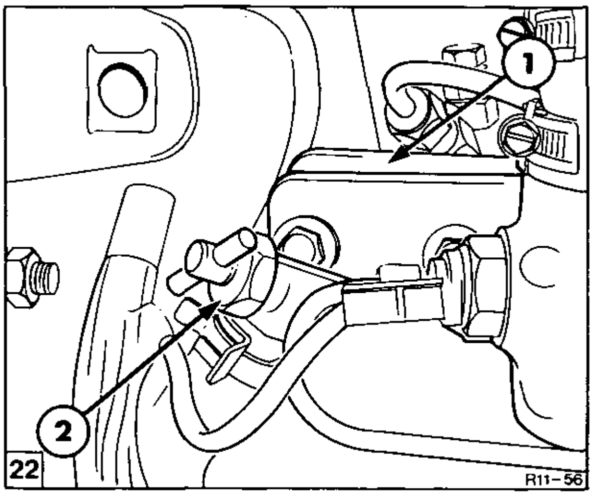
Always conduct the preliminary fault finding checks before performance testing the system.



Heater and Air Conditioning Controls

1. Blower Control
2. Air Conditioner Temperature Control
3. Heater Temperature Control

1. Run the engine at 1000-1200 rev/min for 10 minutes with the air conditioner set at maximum cooling and the blower on high speed.
2. Check that the heater temperature control is switched OFF.

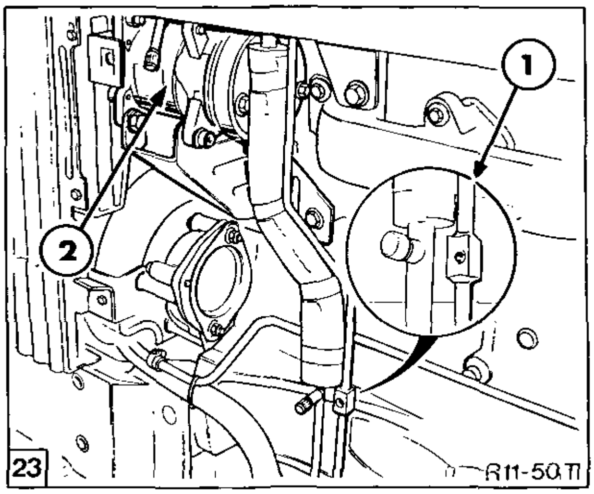


Heater Shut–off Valve

1. Inlet Manifold
2. Heater Shut Off Valve

3. Close the heater shut–off valve on the rear of the inlet manifold.
4. Check that the blower fan is operating at all speeds.

5. Check that the compressor clutch engages when the temperature control switch is turned from "OFF" to "ON" position. A clicking sound indicates the clutch is engaging. If the clutch fails to operate it may indicate an electrical problem in the high low pressure cut out switches or malfunction of the electric drive clutch on the compressor.
6. Check the engine cooling fan is drawing cool air through the condenser
7. Check the compressor drive belt tension.
8. Check the condenser core and grid is clean and free of obstruction.
9. Check the cab air filters are clean and free of obstruction.
10. Check the evaporator fins are not plugged or excessively dirty.



Air Conditioning Sight Glass

1. Sight glass
2. Compressor

11. Observe the refrigerant flow through the air conditioner tube sight glass, Figure 23. More than an occasional bubble indicates the system is low on refrigerant.

Sight glass interpretations can be made as follows;

- Oil streaks, foam or unusual amount of bubbles - a system that is partially discharged.
- Cloudy line - desiccant has escaped from the receiver/dryer.
- Clear sight glass - a system that is fully charged, completely discharged, or overcharged.

PERFORMANCE TESTING THE AIR CONDITIONING SYSTEM

The manifold gauge set is the most important tool used in testing and servicing the air conditioning system.

It should be noted however that for those dealers who posses the latest design level of refrigerant recovery, recycling and recharging station these gauges are an integral part of the machine.

The following instructions for performance testing the air conditioning system is based on the use of the gauge set shown in Figure 24. The principal of operation is however similar when testing the system using a recovery and recharging station with integral gauges.

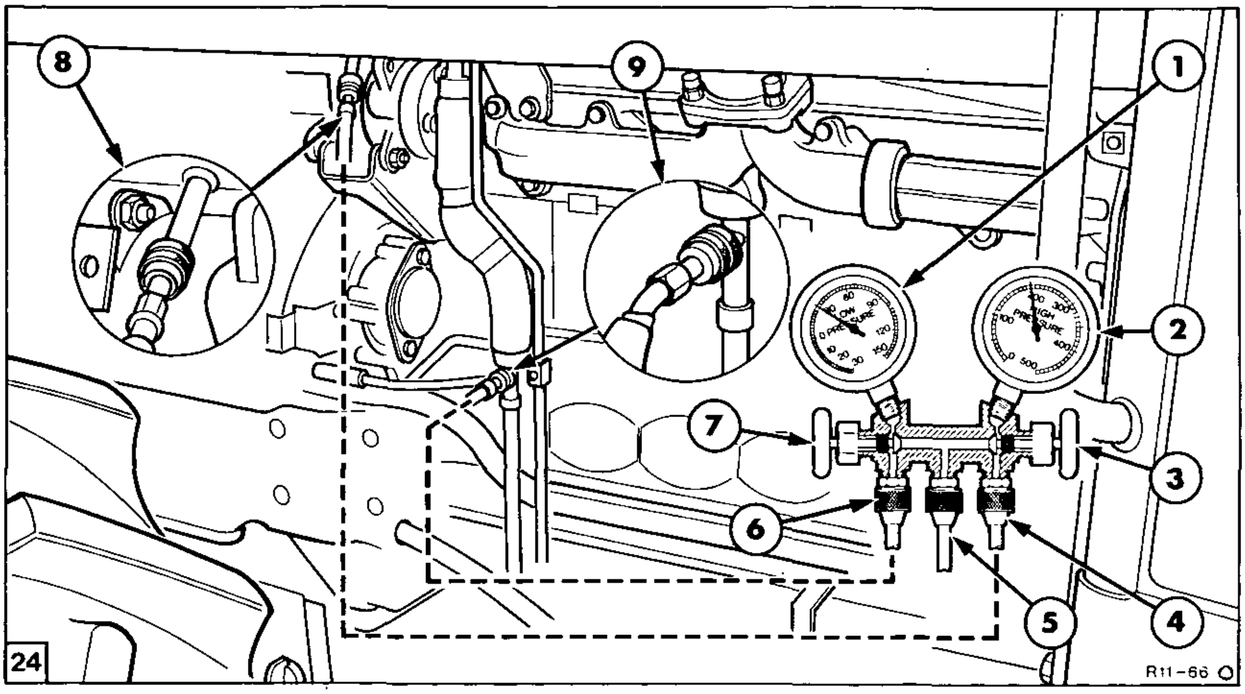
When using this type of equipment **always** consult the manufacturers operating instructions.

Operating Precautions

IMPORTANT: Always ensure the shut–off valves are **closed** (turn clockwise until seated) during all test operations.

In the closed position, refrigerant circulates around the valve stems to the gauges. Therefore, when the manifold gauge set is connected into a system, pressure is registered on both gauges.

- **NEVER** open the HIGH SIDE shut off valve when the system is operating.
- **ALWAYS** open the LOW SIDE shutoff valve when adding refrigerant.



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Attaching Manifold Gauge Set to the Tractor

1. Low Side Gauge
2. High Side Gauge
3. Shut-off Valve
4. Test Hose to High Side Service Connector
5. Center Hose (Not Used)
6. Test Hose to Low Side Service Connector
7. Shut-off Valve
8. High Pressure Side Service Valve
9. Low Pressure Side Service Valve

Attaching The Gauge Set To The Tractor

⚠ **WARNING:** *To avoid personal injury, stop the tractor engine during connection of the manifold gauge set.*

1. Check that the gauge set shut off valves are closed (turned fully clockwise).

2. Connect the high side gauge hose (normally red) to the high pressure side service valve and the low side gauge hose (normally blue) to the low pressure side service valve on the tractor, Figure 24. Ensure the hose connections are fully tightened.

IMPORTANT: *Prior to connection of the manifold gauge set, identify the suction (low pressure) and discharge (high pressure) service gauge ports. The high pressure service valve is always in the line from the compressor to the condenser.*

The high and low pressure service valves on the tractor are the Schrader type design and the spring loaded valve will be automatically opened when the test hose is connected.

NOTE: *The test hose must incorporate a valve depressor to actuate this type of valve.*

Schrader valves have a protective cap installed on the service port. This cap must be removed for test gauge connections and replaced when service operations are completed.

NOTE: *Some older style test hoses do not possess a self sealing feature at the schrader valve connector. These older hoses require purging which involves the release of a small quantity of refrigerant into the atmosphere. For this reason these older style hoses should be discarded and replaced with more modern test hoses incorporating the self sealing connector.*

TEST PROCEDURE

After the manifold gauge set has been connected and before pressure tests can be made, the system must be stabilized as follows:

1. Re–check that both the high and low side shut off valves on the manifold gauge set are fully **closed.**
2. Apply the parking brake, check the gear shift levers are in neutral and close the cab windows and doors.
3. Run the engine at 1000-1200 rev/min.
4. Turn the heater temperature control 'off'
5. Operate the system at maximum cooling, with the blower fan at high speed for 10 minutes to stabilize all components.
6. Check the system for full refrigerant charge by observing the sight glass.

If the refrigerant charge is determined to be insufficient, the system must be tested for leaks and recharged before accurate tests can be made for normal system operation.

NOTE: *Natural loss of some system refrigerant can be expected over a period of time.*

7. Check the manifold low pressure gauge reading is within the specified range of approximately 4-36 lbf/in^2 (0.28-2.48 bar) (0.28-2.53 kgf/cm^2).
8. Check the manifold high pressure gauge reading and compare the reading to the pressure indicated on the pressure temperature chart below.
9. Measure and compare the temperature of conditioned air entering the cab through the louvered air vents with the ambient air at the air intake filters on the outside of the cab.

   If the system is operating correctly the conditioned air entering the cab should be 6–9° C (*10*–15° F) cooler than the ambient temperature of the outside air.

10. If it is confirmed that the system is not operating correctly refer to the fault diagnostic charts and performance test gauge reading examples on the following pages for possible corrective action.

⚠ **WARNING:** *A significant amount of refrigerant vapor may have condensed to a liquid at the service fitting at the high side of the compressor. Use a cloth or other protective material when disconnecting the manifold hose from this fitting to prevent personal injury to hands and face.*

APPROXIMATE HIGH PRESSURE GAUGE READINGS

Ambient Air Temperature		High Pressure Gauge Reading		
Degrees F	Degrees C	lbf/in^2	bar	kgf/cm^2
80	27	140-160	9.6-11.0	9.8-11.2
85	29	155-175	10.7-12.1	10.9-12.3
90	32	170-190	11.7-13.1	11.9-13.3
95	35	185-210	12.7-14.5	13.0-14.8
100	38	200-230	13.8-15.9	14.1-16.2
105	41	220-252	15.2-17.4	15.5-17.7
110	43	240-275	16.5-19.0	16.9-19.3

PERFORMANCE TEST DIAGNOSIS

Gauge Readings:– **Low Pressure - Low**
High Pressure - Low

PROBLEM	POSSIBLE CAUSES	CORRECTION
Evaporator air not cold Bubbles in sight glass (Refer to Example 1 Page 21)	Low refrigerant charge.	Perform leak tests and repair Evacuate system Charge system, re–test system
Evaporator air warm No bubbles in sight glass	Extremely low refrigerant charge.	Perform leak tests and repair Evacuate system Charge system, re–test system
Evaporator air cool but not sufficiently cold . Low pressure switch cutting out Expansion valve to evaporator tube shows considerable condensation or frost. Too cold to touch	Expansion valve not permitting sufficient flow. Stuck valve	Check expansion valve as follows: Set a max. cooling Low pressure gauge should drop slowly If expansion valve is defective: Discharge system Replace expansion valve Evacuate system Charge system Re–test

PERFORMANCE TEST DIAGNOSIS CHART

Gauge Readings:– **Low Pressure - High**
High Pressure - High

PROBLEM	POSSIBLE CAUSES	CORRECTION
Evaporator air warm Liquid line hot (condenser outlet to expansion valve tube) Bubbles in sight glass High pressure switch cutting out	Improper operation of condenser Overcharged with refrigerant Air in system	Inspect for dirty condenser restricting air flow and cooling Check operation of condenser cooling fans. Repair or replace as needed. *Check for overcharge as follows:* Discharge system until bubbles appear in sight glass and both gauges drop below normal readings. Then add 4-6 oz. (100-200 grammes) refrigerant. Re–test system. If gauge readings are still to high, proceed as follows: Discharge system Remove condenser assembly, flush and clean thoroughly Replace receiver/drier Evacuate the system Charge the system Re–test.
Evaporator air not cold Occasional bubbles in sight glass	Expansion valve allowing too much refrigerant to flow through *the evaporator*	Check expansion valve as follows:- *Set for Maximum cooling.* Low pressure gauge should drop slowly If expansion valve is defective: Discharge System Replace Expansion Valve Evacuate System Charge System Re–test

PERFORMANCE TEST DIAGNOSIS CHART

Gauge Readings:– **Low Pressure - Low**
High Pressure - High

PROBLEM	POSSIBLE CAUSES	CORRECTION
Insufficient cooling	Restriction in liquid line	Discharge the system Replace the receiver/drier Inspect all lines and tubing from compressor outlet to expansion valve. Replace if needed. Evacuate the system Charge the system Re–test

PERFORMANCE TEST DIAGNOSIS CHART

Gauge Readings:– **Low Pressure - High**
High Pressure - Low

PROBLEM	POSSIBLE CAUSES	CORRECTION
Evaporator air not cold No bubbles in sight glass	Internal leak in compressor. (reed valves, gasket, worn or scored piston rings or cylinder)	Discharge the system Replace the compressor Evacuate the system Charge the system Re–test

PERFORMANCE TEST DIAGNOSIS CHART

Gauge Readings:– **Low Pressure - Normal**
High Pressure - Normal

PROBLEM	POSSIBLE CAUSES	CORRECTION
Insufficient cooling Low pressure reading does not fluctuate with changes in temperature control switch (pressure should drop until compressor cycles) Few or no bubbles in sight glass Evaporator air not cold.	System low on charge Air or moisture present in system	Perform leak test Discharge system Repair leaks Replace receiver/drier Check oil level Evacuate system Charge the system Re–test

PERFORMANCE TEST DIAGNOSIS CHART

Gauge Readings:– **Low Pressure - High**
High Pressure - Normal

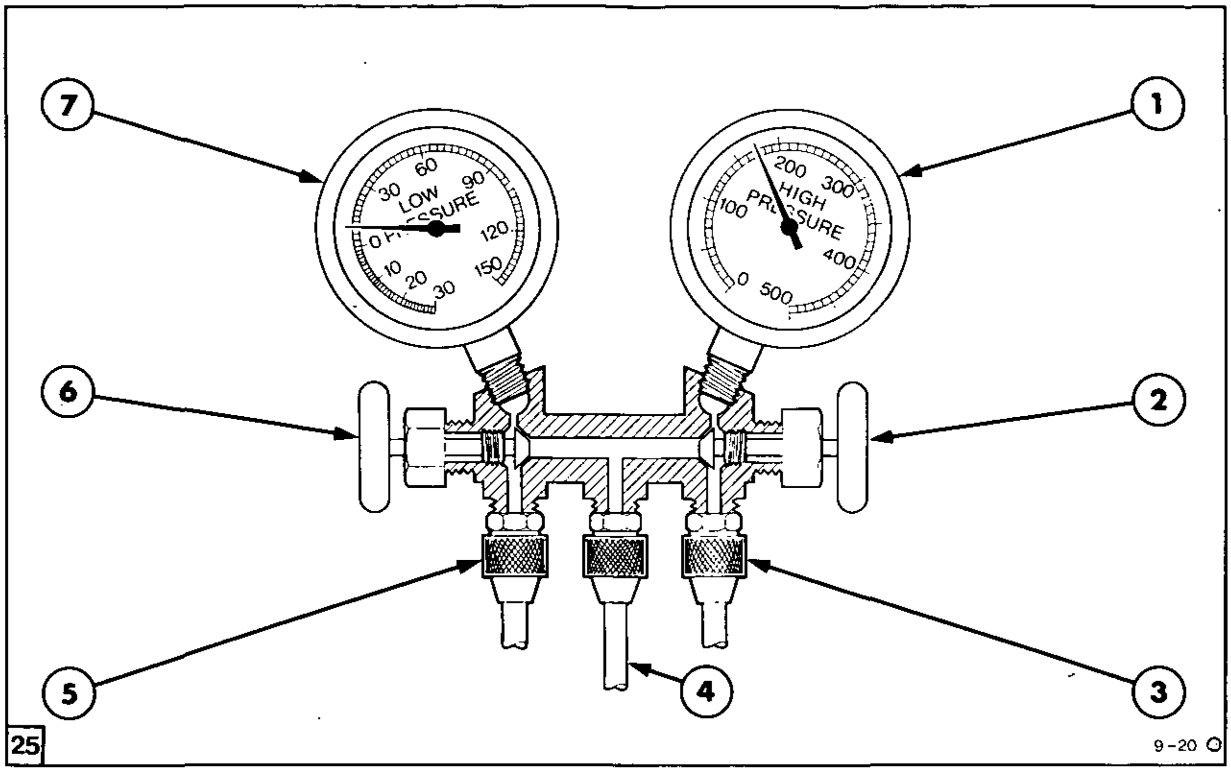
PROBLEM	POSSIBLE CAUSES	CORRECTION
Compressor cycles "on" and "off" too frequently	Defective temperature control, (thermostatic) switch	Stop engine and shut off A/C Replace temperature control switch Re–test system and check compressor cycling

EXAMPLES OF MANIFOLD GAUGE READINGS AND INTERPRETATIONS

The following examples show typical low and high pressure gauge readings obtained when performance testing the air conditioning system with an ambient temperature of 35° C (95° F).

The recommended corrective action is based on a similar fault as identified in the performance test diagnosis charts.

PERFORMANCE TEST EXAMPLE 1



Performance Test Example 1

1. High Side Low
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Low

PROBLEM:

Little or no cooling.

CAUSE:

Refrigerant slightly low.

CONDITIONS*

Low side pressure too low.
Gauge should read 15-30 lbf/in^2 (1–2 bar).

High side pressure too low.
Gauge should read 185-205 lbf/in^2 (12.7–14.1 bar).

Bubbles in sight glass.

Evaporator air not cold.

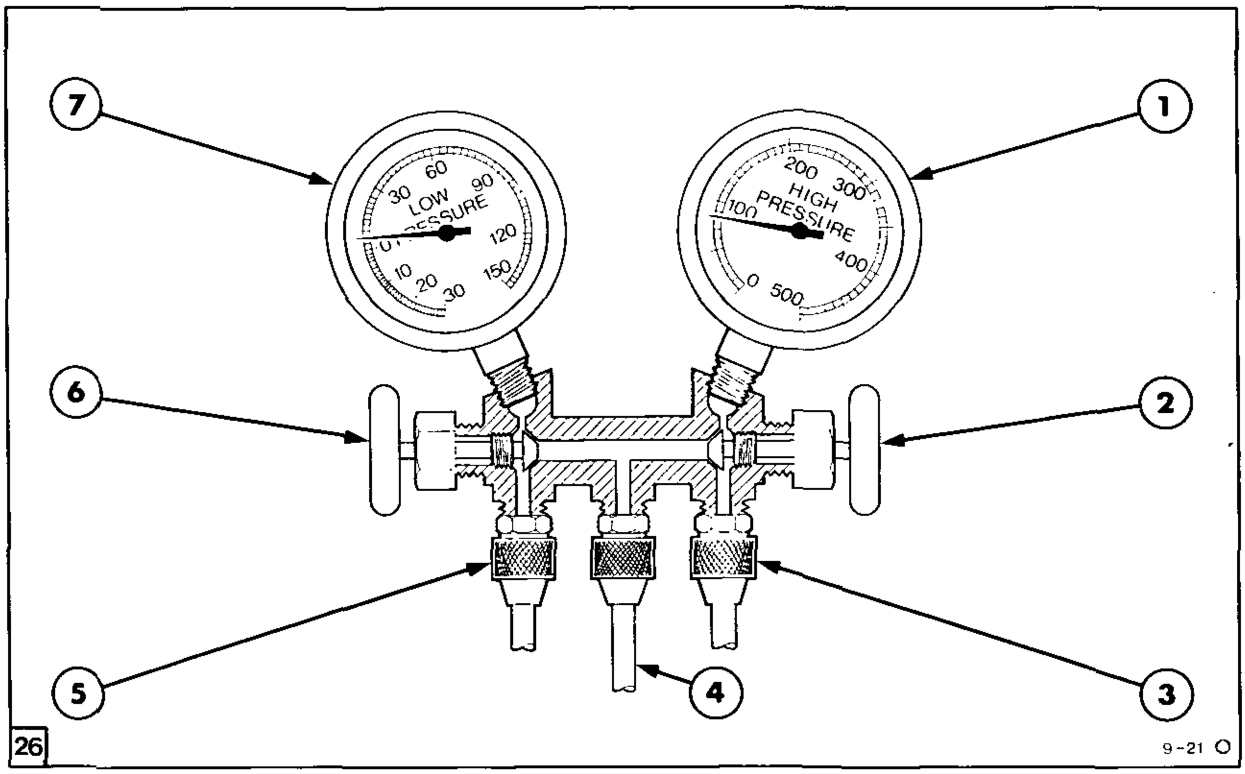
CORRECTIVE PROCEDURES

1. Leak test the system.
2. Repair leaks. (Discharge and recover the refrigerant from the system; replace lines or components).
3. Check compressor oil to ensure no loss.
4. Evacuate the system.
5. Charge the system.
6. Performance test the system.

DIAGNOSIS: *System refrigerant is low. May be caused by a small leak.*

***NOTE:** *Test procedure based upon ambient temperature of 95° F. For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 2



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Performance Test Example 2

1. High Side Low
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected t Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Low

PROBLEM:

Insufficient cooling.

CAUSE:

Refrigerant excessively low.

CONDITIONS*

Low side pressure very low.
Gauge should read 15-30 lbf/in^2 (1–2 bar)

High side pressure too low.
Gauge should read 185-205 lbf/in^2 (12.7–14.1 bar).

No liquid or bubbles in sight glass.

Evaporator air warm.

Low pressure switch cutting out

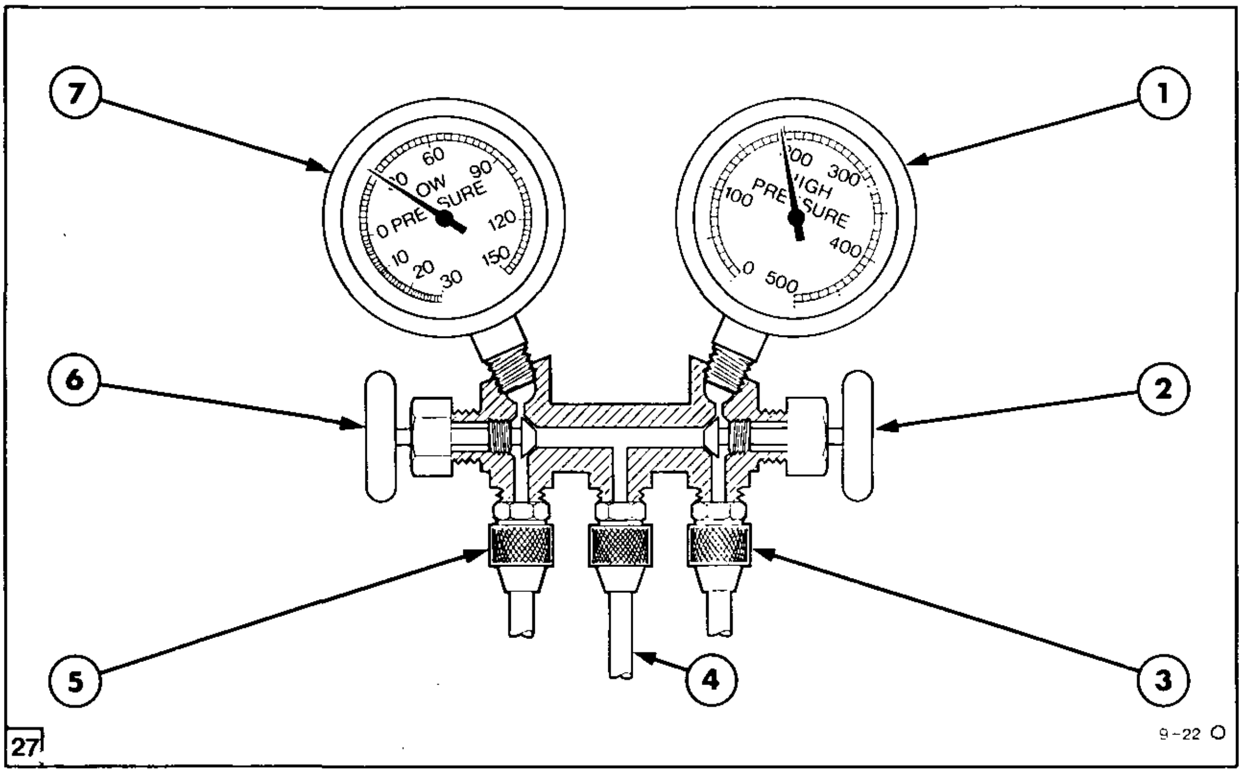
CORRECTIVE PROCEDURES

1. Leak test the system.
2. Discharge and recover the refrigerant from the system.
3. Repair leaks.
4. Check compressor oil to ensure no loss.
5. Evacuate the system.
6. Charge the system.
7. Performance test the system.

DIAGNOSIS: *System refrigerant is extremely low. A serious leak is indicated.*

***NOTE:** *Test procedure based upon ambient temperature of 95° F. For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 3



Performance Test Example 3

1. High Side Normal
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Low

PROBLEM:

Insufficient cooling.

CAUSE:

Air in system.

CONDITIONS*

Low side pressure reading does not change when compressor cycles "on" and "off".

High side pressure slightly high or slightly low. Gauge should read 185-205 lbf/in^2 (12.7–14.1 bar).

Few or no bubbles in sight glass.

Evaporator air not cold.

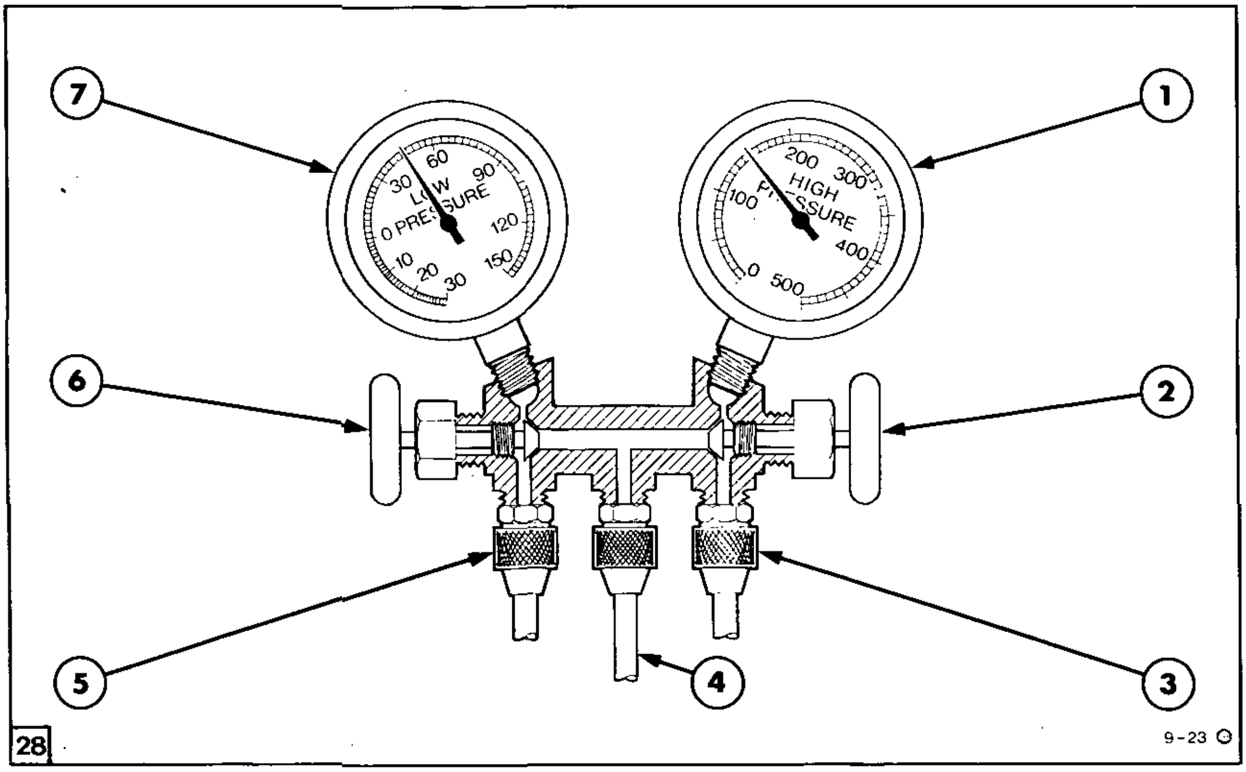
CORRECTIVE PROCEDURES

1. Leak test the system. Give special attention to the compressor seal area.
2. Discharge and recover the refrigerant from the system.
3. Repair leaks.
4. Replace the receiver/dryer.
5. Check compressor oil to ensure no loss.
6. Evacuate the system.
7. Charge the system.
8. Performance test the system.

DIAGNOSIS: *Air or moisture in system. System not fully charged.*

***NOTE:** *Test procedure based upon ambient temperature of 95° F. For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 4



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Performance Test Example 4

1. High Side Low
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side High

PROBLEM:

Insufficient cooling.

CAUSE:

Compressor malfunction.

CONDITIONS*

Low side pressure too high. Gauge should read 15-30 lbf/in^2 (1–2 bar).

High side pressure too low. Gauge should read 185-205 lbf/in^2 (12.7–14.1 bar).

No bubbles in sight glass (system fully charged).

Evaporator air not cold.

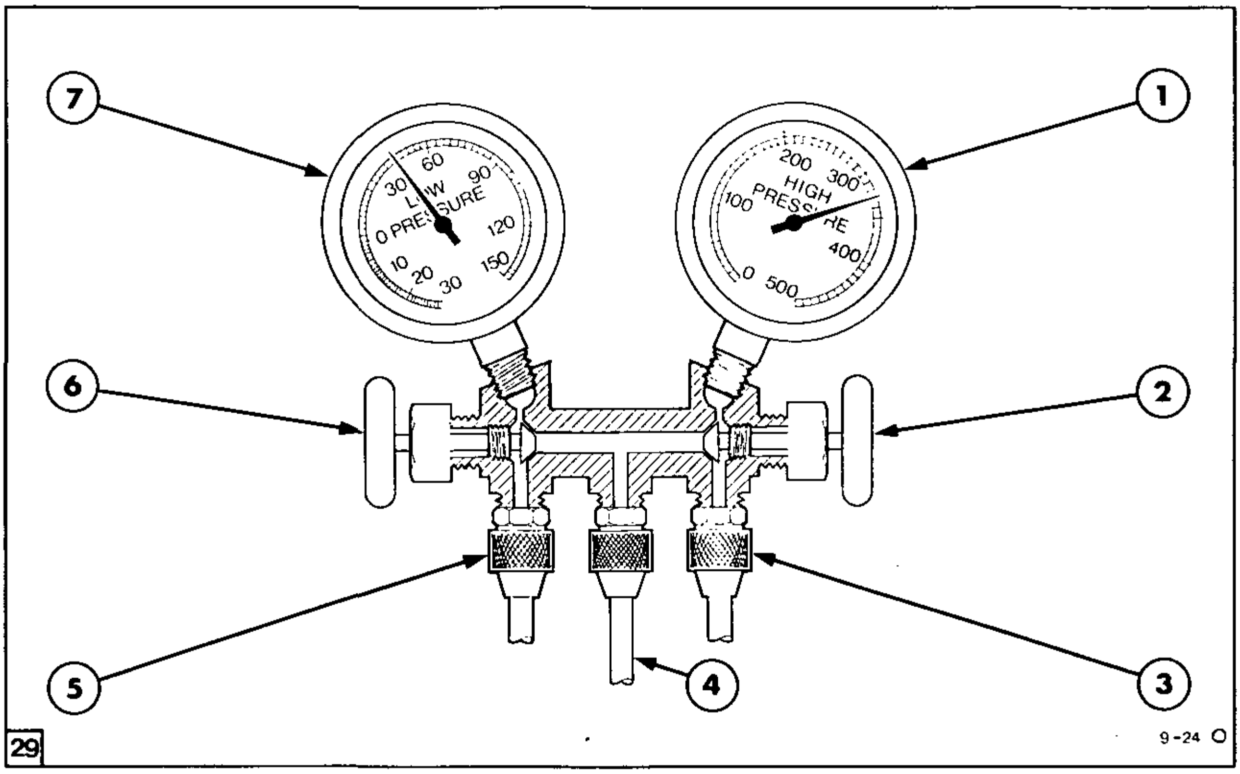
CORRECTIVE PROCEDURES

1. Replace the compressor.

DIAGNOSIS: *Internal leak in compressor caused by worn or scored pistons, rings, or cylinders.*

***NOTE:** *Test procedure based upon ambient temperature of 95° F. For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 5



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Performance Test Example 5

1. High Side High
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side High

PROBLEM:

Insufficient or no cooling. Engine overheats in some cases.

CAUSE:

Condenser not functioning properly.

CONDITIONS*

Low side pressure too high. Gauge should read 15-30 lbf/in^2 (1–2 bar).

High side pressure too high. Gauge should read 185-205 lbf/in^2 (12.7–14.1 bar).

Occasional bubbles in sight glass.

Liquid line hot.

Evaporator air warm.

High pressure switch cutting out.

CORRECTIVE PROCEDURES

1. Check belt. Loose or worn drive belts could cause excessive pressures in the compressor head.
2. Look for clogged passages between the condenser fins and coil, or other obstructions that could reduce condenser airflow.
3. If engine is overheating replace engine thermostat and radiator pressure cap.

At this point, operate the system and check its performance. If still unsatisfactory, proceed as follows:–

4. Check for overcharge of refrigerant, and correct as follows:–

   Discharge and recover the refrigerant until bubbles appear in sight glass and both gauge readings drop below normal.

   Add new refrigerant until bubbles disappear and gauge readings are normal. Then, add $^1/_4$-$^1/_2$ lb. of refrigerant.

Operate the system and recheck the performance. If the gauge readings are still too high, proceed as follows:–

5. Discharge and recover the refrigerant from the system.

6. Remove the condenser and clean and flush it to ensure a free flow of refrigerant. Or, if the condenser appears to be unduly dirty or plugged, replace it.

7. Replace the receiver/dryer.

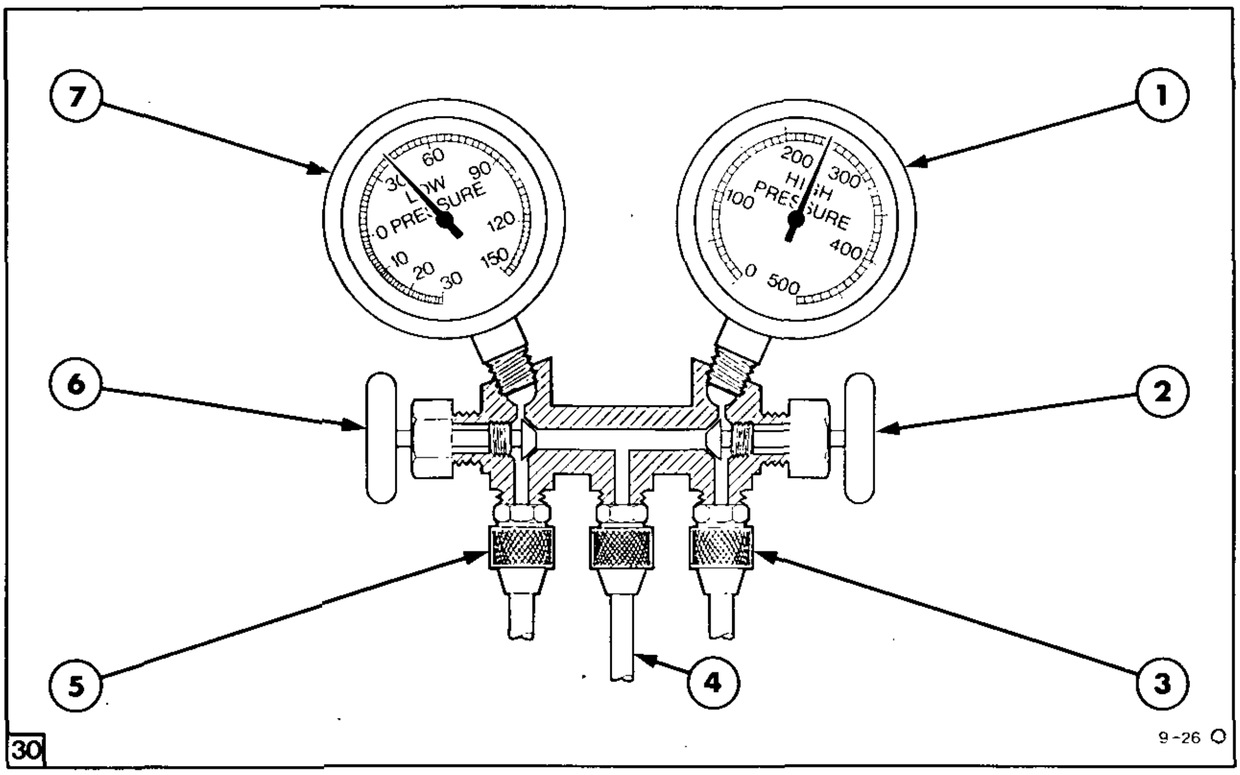
8. Evacuate the system, and recharge it.

9. Performance test the system.

DIAGNOSIS: *Lack of cooling caused by pressure that is too high on the high side, resulting from improper operation of condenser. (Refrigerant charge may be normal or excessive).*

***NOTE:** *Test procedure based upon ambient temperature of 95° F. For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 6



Performance Test Example 6

1. High Side Normal
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Normal

PROBLEM:

Insufficient or no cooling.

CAUSE:

Large amount of air in system.

CONDITIONS*

Low side pressure too high. Gauge should read 15-30 lbf/in^2 (1–2 bar).

High side pressure too high. Gauge should read 185-205 lbf/in^2 (12.7–14.1 bar).

Occasional bubbles in sight glass.

Evaporator air not cool.

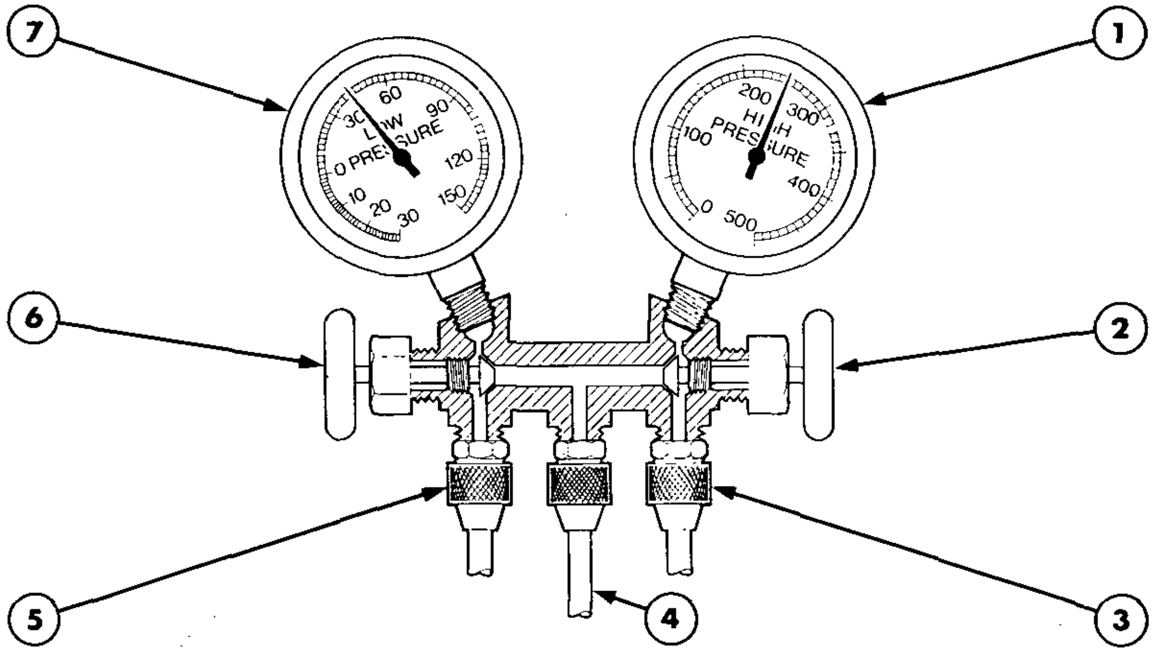
CORRECTIVE PROCEDURES

1. Discharge and recover the refrigerant from the system.
2. Replace the receiver/dryer.
3. Evacuate the system.
4. Charge the system.
5. Performance test the system.

DIAGNOSIS: *Air in system. This, and the moisture in the air, is contaminating the refrigerant, causing the system to operate improperly.*

***NOTE:** *Test procedure based upon ambient temperature of 95° F. For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 7



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Performance Test Example 7

1. High Side High
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Hide

PROBLEM:

Insufficient or no cooling.

CAUSE:

Improper operation of thermostatic expansion valve (stuck open)

CONDITIONS*

Low side pressure too high. gauge should read 15-30 lbf/in^2 (1–2 bar).

High side pressure too high. Gauge should read 185-205 lbf/in^2 (12.7–14.1 bar).

Evaporator air warm.

Evaporator and suction hose (to compressor) surfaces show considerable moisture.

CORRECTIVE PROCEDURES

1. Check for sticking expansion valve as follows:–

   Operate the system at maximum cooling.

   Check the low side gauge. The pressure should drop slowly.

2. If the test indicates that the expansion valve is defective, proceed as follows:

   Discharge and recover the refrigerant from the system.

   Replace the expansion valve.

   Evacuate the system.

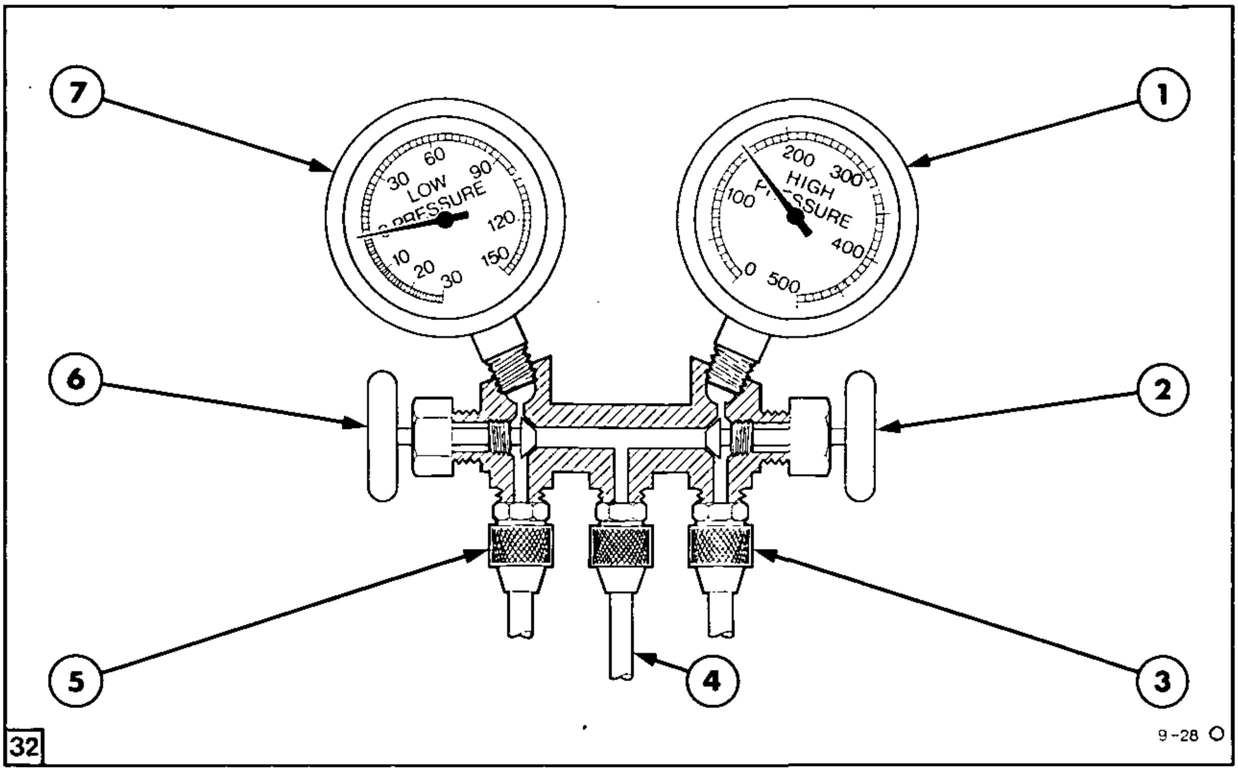
   Charge the system.

   Performance test the system.

DIAGNOSIS: *Thermostatic expansion valve is allowing too much refrigerant to flow through the evaporator coils. Valve may be stuck open.*

***NOTE:** *Test procedure based upon ambient temperature of 95° F. For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 8



Performance Test Example 8

1. High Side Low
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Low

PROBLEM: Insufficient cooling.

CAUSE: Improper operation of thermostatic expansion valve (stuck closed).

CONDITIONS*

Low side pressure too low (zero or vacuum). Gauge should read 15-30 lbf/in^2 (1–2 bar).

High side pressure low. Gauge should read 185-205 lbf/in^2 (12.7–14.1 bar).

Evaporator air cool, but not sufficiently cold.

Evaporator inlet pipe surface shows considerable moisture or frost.

Low pressure switch cutting out.

CORRECTIVE PROCEDURES

1. Place finger on expansion valve to evaporator tube. If too cold to touch, proceed as follows:

   Operate the system at maximum cooling. Check the low side gauge. The pressure should drop slowly.

2. If the procedure outlined in Step 1 shows that the expansion valve is defective, proceed as follows:

   Discharge system

   Replace expansion valve

   Evacuate the system.

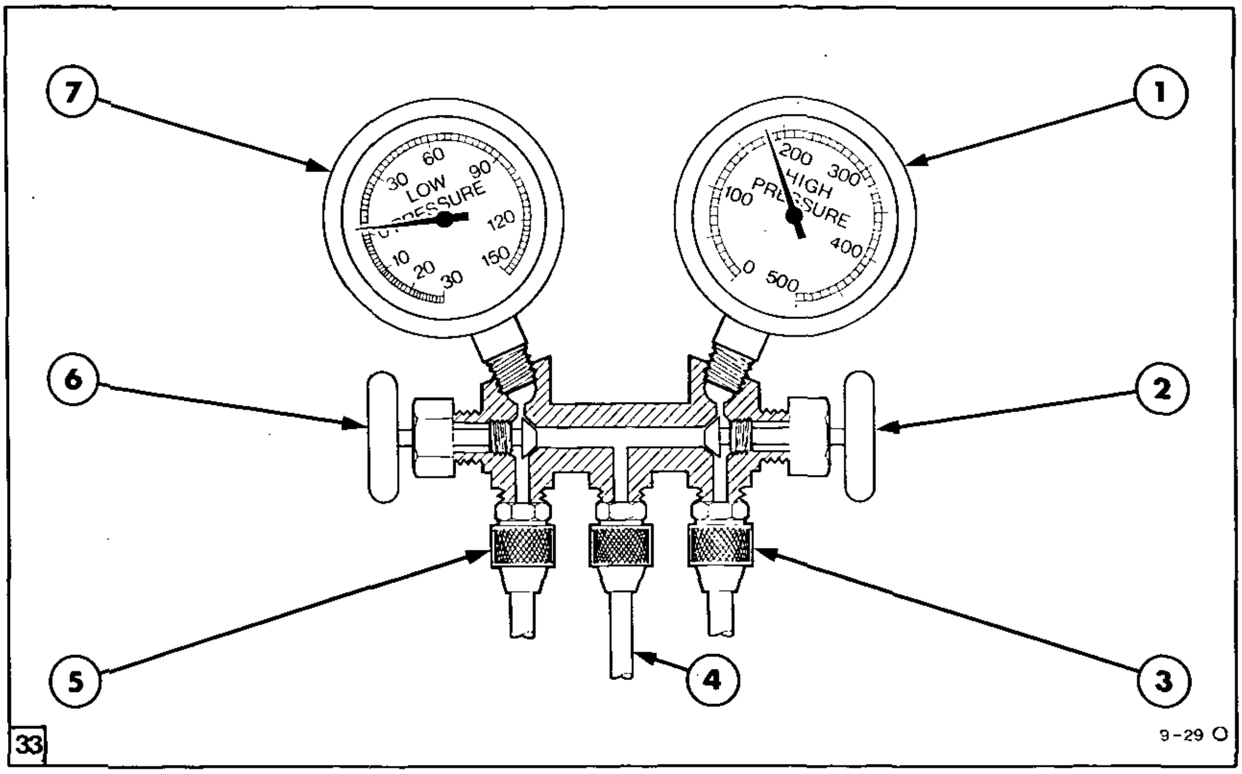
   Charge the system.

   Performance test the system.

DIAGNOSIS: *Expansion valve is not permitting a sufficient flow of refrigerant. May be caused by valve stuck in restricted or closed position.*

***NOTE:** *Test procedure based upon ambient temperature of 95° F. For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 9



Performance Test Example 9

1. High Side Low
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Low

PROBLEM:

Insufficient cooling.

CAUSE:

Restriction in high side of system.

CONDITIONS*

Low side pressure too low. Gauge should read 15-30 lbf/in^2 (1–2 bar).

High side pressure too low. Gauge should read 185-205 lbf/in^2 (12.7–14.1 bar).

NOTE: *A normal or high reading of the high side pressure gauge under these conditions indicates the system is overcharged or the condenser or receiver/dryer is too small.*

Evaporator only slightly cool.

Liquid line and receiver/dryer are cool to touch and show frost or considerable moisture.

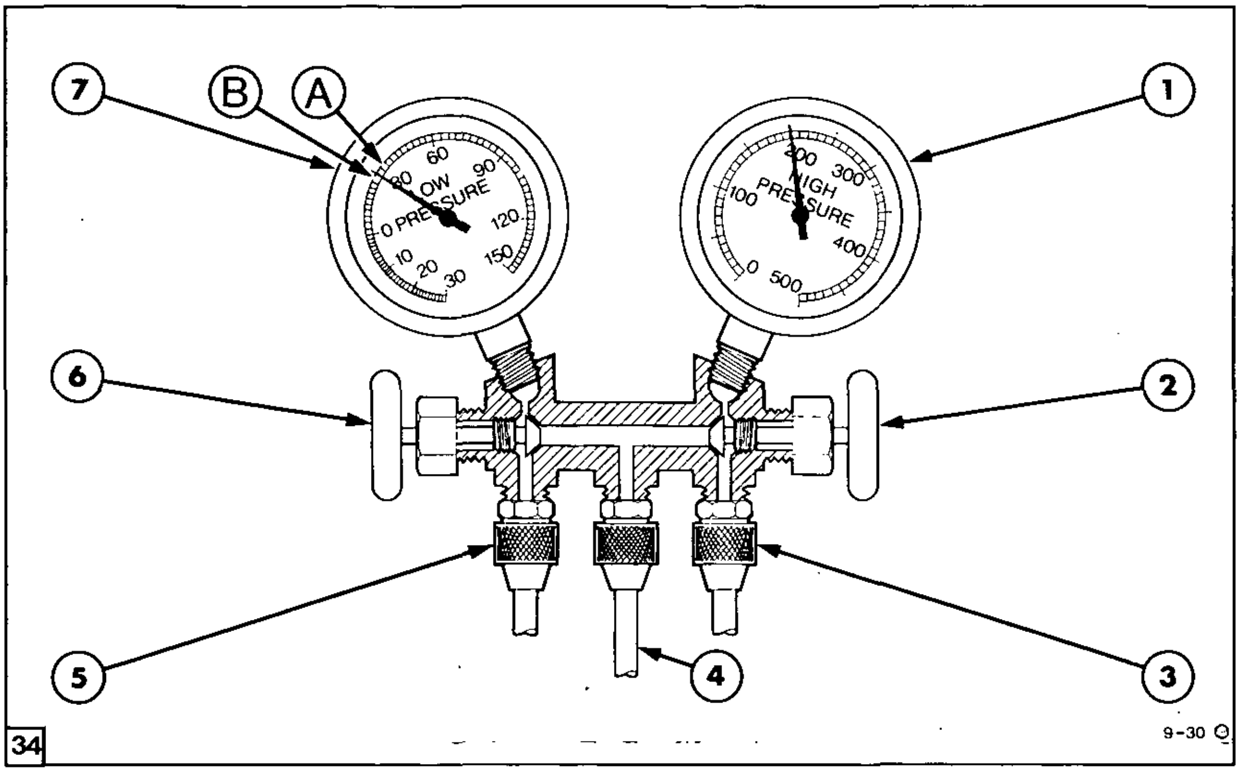
CORRECTIVE PROCEDURES

1. Discharge and recover the refrigerant from the system.
2. Replace the liquid lines, receiver/dryer, or other obstructed components.
3. Evacuate the system.
4. Charge the system.
5. Performance test the system.

DIAGNOSIS: *Restriction in the liquid line and/or receiver/dryer resulting in a "starved" evaporator (compressor moving refrigerant from the evaporator faster than it can enter).*

***NOTE:** *Test procedure based upon ambient temperature of 95° F. For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 10



Performance Test Example 10

1. High Side Normal
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Gauge
   Compressor Cycles on at 34 lbf/in^2 (2.3 bar)
   Compressor Cycles off at 28 lbf/in^2 (1.9 bar)

PROBLEM:

Compressor cycles (cuts in and out) too rapidly.

CAUSE:

Thermostatic switch defective.

CONDITIONS*

Low side pressure readings too high during both “on” and “off” compressor cycles and between cycles. Readings should be:

12-15 lbf/in^2 (0.8–1.0 bar) - cycle “off”

36-39 lbf/in^2 (2.5–2.7 bar) - cycle “on”

24-27 lbf/in^2 (1.7–1.9 bar) - between cycles

High side pressure normal. Gauge should read 185-205 lbf/in^2 (12.7–14.1 bar).

CORRECTIVE PROCEDURES

1. Stop the engine and shut off A/C system.
2. Replace thermostatic switch with switch of same type.
3. Make sure the switch’s temperature sensor is installed in the same position and depth (in evaporator core) as previous.
4. Performance test the system.

DIAGNOSIS: *Defective thermostatic switch.*

***NOTE:** *Test procedure based upon ambient temperature of 95° F. For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

E. LEAK TESTING, DISCHARGING and CHARGING THE AIR CONDITIONING SYSTEM

LEAK TESTING

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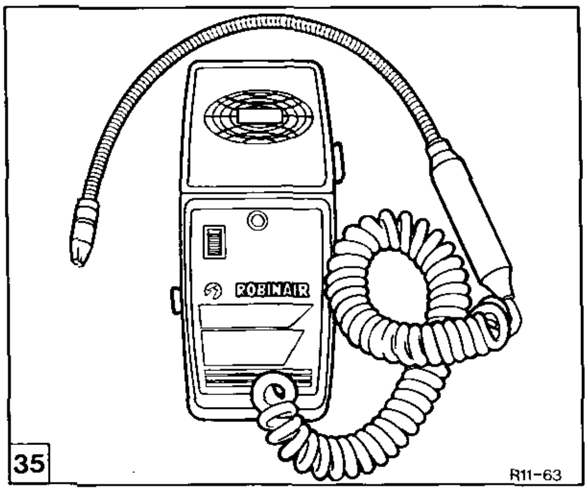


Electronic Leak Detector

To perform a leak test if refrigerant leakage is suspected, use an electronic leak detector, Figure 35 following manufacturer's instructions.

Electronic leak detectors use flashing lights or sound to alert the operator to a leak. If the leak detector's sensitivity is adjustable, be sure you calibrate the detector according to the manufacturer's instructions before use.

When using a leak detector, keep in mind that a very slight amount of leakage in the compressor pulley area is normal and does not necessarily indicate a repair is required.

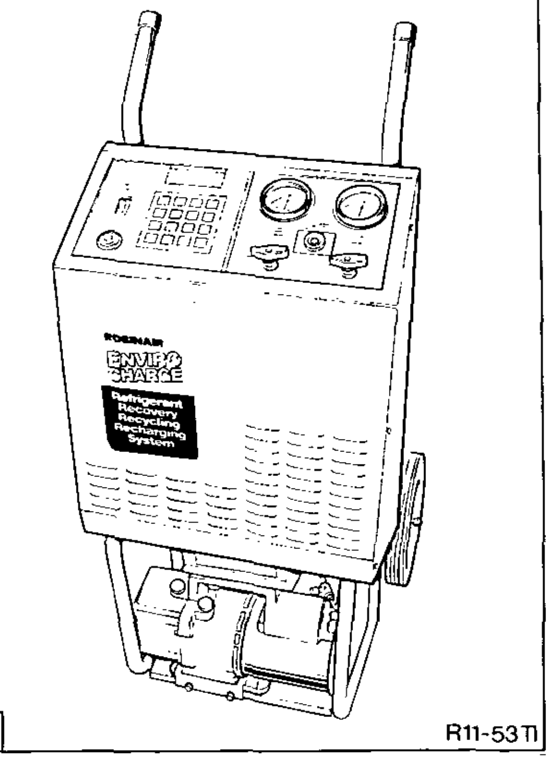
When a leak is located, follow these steps.

- Discharge the system using a certified freon recovery system.
- Repair the leak.
- Evacuate the system.
- Partially charge system with 400 grammes (14 ozs) of refrigerant.
- Check system for leaks.
- Fully charge the system.

Always check the system for leaks as a final test after evacuating and before recharging. Refer to Evacuating the system.

DISCHARGING THE SYSTEM

36



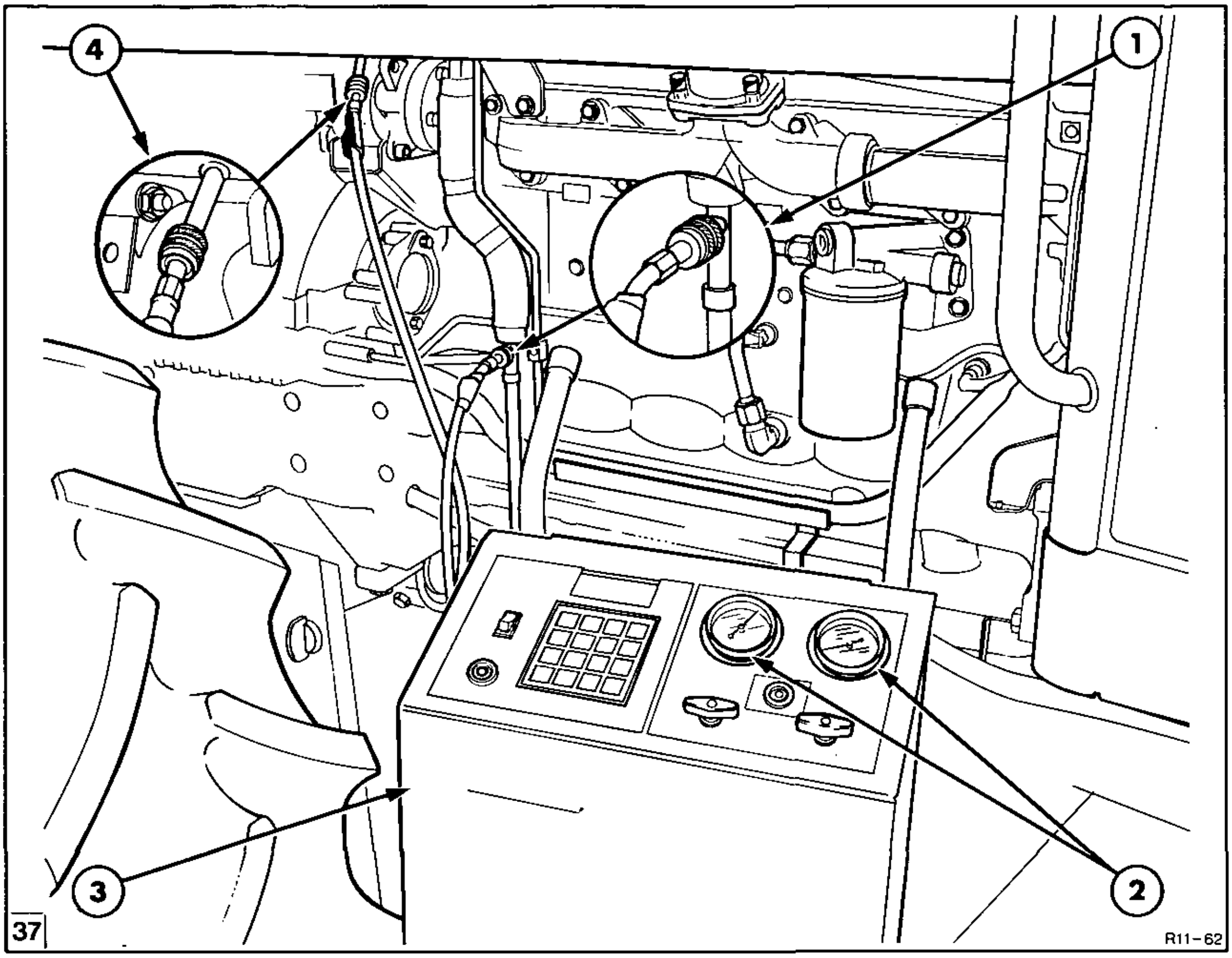
Recovery Recycling and Recharge Station

Legislation has been introduced banning the release of refrigerant into the atmosphere.

Whenever overhauling the air conditioning system or performing other tasks which require the air conditioning system to be dismantled it is necessary to discharge the refrigerant gas before commencing repair.

Before you can dismantle an air conditioning system for repairs, you must discharge and recover the refrigerant using a **certified** recovery unit in accordance with the manufacturers instructions.

Figure 36 shows a combined refrigerant recovery, evacuation and recycling/charging station. This equipment removes R–12 refrigerant from the air conditioning system, recycles and recharges all in one hook up. The unit is designed to be used with the manifold gauge set built into the control panel.



Connecting Recovery Evacuation and recycling/Charging Station to the Tractor

1. Low Side Service Valve (Blue Hose)
2. Built In Manifold Gauge Set
3. Recovery/Recharging Unit
4. High Side Service Valve (Red Hose)

If the air conditioning system has been designed and charged for use with R–134A refrigerant then an appropriate system for use with R–134A **must** be used. Refer to Section D Page 13.

Other recovery systems are available where the manifold gauges are not an integral part of the machine. When this type of equipment is used a separate manifold gauge set must be used.

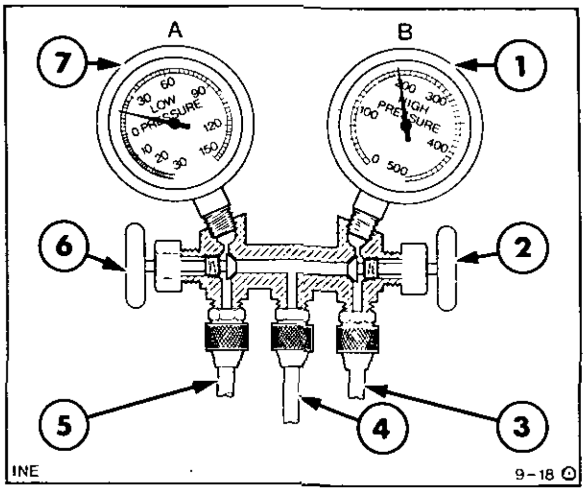
The following is a summary of the steps for discharging the system using a recovery/recycling unit

⚠ **WARNING:** ***Never*** *discharge refrigerant gas into the atmosphere. Always where safety goggles and gloves when working with refrigerant. Only use authorised refrigerant tanks.*

IMPORTANT: *Always follow the manufactures instructions when operating recovery equipment.*

1. Run the vehicle's air conditioning system for a few minutes.
2. Set up the recovery unit following manufacturer's instructions. Ensure that the units red (high side) hose is connected to the high side fitting and the blue (low side) hose to the low side fitting, Figure 37.

NOTE: *If a unit requiring the manifold gauge set is being used, the low and high sides of the manifold set are connected to the low and high sides of the tractor air conditioning system. The hose from the recovery unit is then connected to the manifold centre port. Refer to Figure 38.*



Manifold Gauge Set

1. High Side Gauge
2. High Side Shut - off Valve
3. High Side Hose
4. Center Service Hose
5. Low Side Hose
6. Low Side Shut - off Valve
7. Low Side Gauge

3. To recover refrigerant, open both high and low side valves on the control panel or the valves on the manifold gauge set if being used, Figure 38.

4. Open the valves labeled “gas” and “liquid” on the recovery unit refrigerant tank, Figure 39.

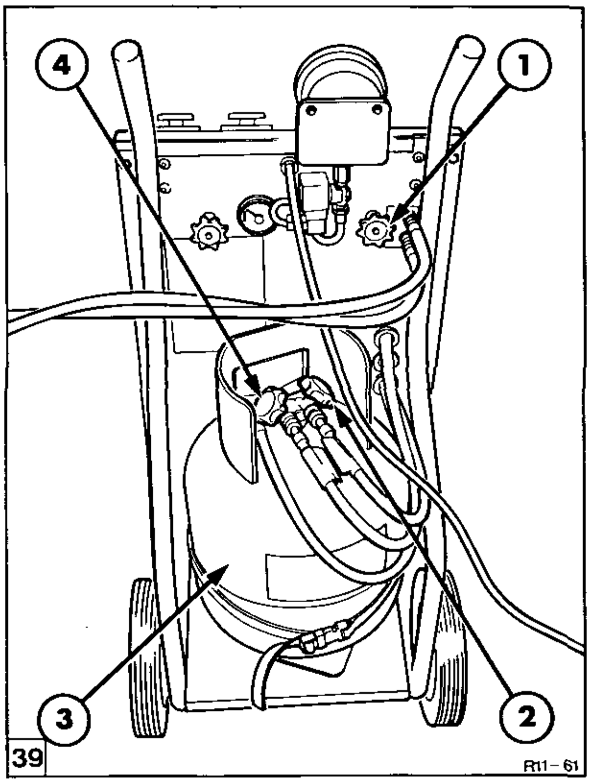
5. Plug in the units power cord

6. Operate the recovery system in accordance with the manufacturers instructions.

The compressor will shut off automatically when the recovery is complete.

FLUSHING THE SYSTEM

Air conditioning systems may occasionally become contaminated with solid particles. This contamination may be the result of allowing dirt to enter the system while it was open, from aluminum corrosion or sludge, or from disintegrated compressor reed plates. Contamination of this nature can result in plugged evaporators, condensers and expansion valves.



Refrigerant Bottle Valves

1. Oil Drain Valve
2. Gas Valve (Red)
3. Refrigerant Bottle
4. Liquid Valve (Blue)

Contaminated systems must be flushed with a special flushing solvent to remove the unwanted material. Prior to flushing, the system must be discharged as described in “Discharging the System”.

Each individual component must be flushed after disconnecting every hose fitting.

The compressor and expansion valve can not be flushed, therefore, the compressor should be disassembled and cleaned or replaced and the expansion valve should be replaced. When flushing the system always replace the receiver/drier.

NOTE: *Never use any solvent for flushing an air conditioning system other than a special flush solvent made specifically for air conditioning systems. Always follow the manufacturer's recommendations and directions for using the flushing equipment and solvent.*

Re–assemble and evacuate the system to remove air and moisture as described in “Evacuating the System”.

EVACUATING THE SYSTEM

IMPORTANT: *A system in which the refrigerant has been recovered to facilitate repairs, must be evacuated before new refrigerant is installed.*

Air and moisture are removed by evacuating the system using a vacuum pump.

The automatic recycling, recharge and evacuation stations or evacuating and charging stations available throughout the air conditioning industry incorporate a vacuum pump within the assembly. If this type of equipment is not available a separate vacuum pump and manifold gauge set must be used.

As the system is evacuated the boiling point of any moisture within the system is similarly lowered. As the vacuum increases the boiling reduces to below that of the ambient temperate and the moisture is subsequently boiled away.

The relationship of system vacuum to the boiling temperature at which the water vapor is removed from the system is as follows:

System Vacuum		Temperature	
In Mercury	Cm. of Mercury	° F	° C
28.0	71.0	100	38
28.9	73.4	80	27
29.4	74.6	60	16
29.7	75.4	40	5
29.8	75.7	20	-7
29.9	75.9	0	-18

NOTE: *For every 1000 feet (305 m) above sea level, the vacuum gauge reading must be corrected by adding 1" (2.54 cm) of mercury to compensate for the change in atmospheric pressure.*

IMPORTANT: *Be sure the system is completely discharged as refrigerant will damage the vacuum pump.*

1. If the manifold gauge set FNH00172 is being used connect the low and high sides of the manifold to the low and high sides of the tractor air conditioning system as described for discharging the system.

   Connect the manifold center hose to the vacuum pump suction port as per the manufactures instructions.

   Fully open both the low and high side gauge shutoff valves.

2. If a combined recovery/evacuation unit is to be used attach the unit to the air conditioning system in accordance with the manufactures instructions. Be sure to read all installation and operating instructions carefully before starting the unit.

3. After starting the evacuation cycle, note the low side gauge to be sure the system pulls down into a vacuum.

4. Time the evacuation for a minimum of 20 minutes from the point when lowest vacuum is attained.

5. When the low side gauge attains the lowest steady vacuum, stop the evacuation process.

NOTE: *The vacuum pump achieves ultimate vacuum with the vented exhaust valve closed.*

6. Check the system by closing the gauge shut–off valves, turning the vacuum pump off and noting the low side gauge reading. A loss of more than 2" (5 cm) of vacuum in 5 minutes indicates either a leak or moisture in the system.

7. If the gauge needle remains stationary and the vacuum is maintained for 3-5 minutes, close both the high and low side manifold hand valves, turn off and disconnect the center hose from the pump. The system is now ready for charging.

8. If a leak is detected, charge the system with approximately 14 ozs (400 g) of refrigerant, see charging the system and identify leak using a leak detector.

9. Once the leak is located discharge and recover the refrigerant in the system, repair the leak, then repeat the evacuation procedure.

CHARGING THE SYSTEM

***IMPORTANT:** Be sure there are no leaks in the system and the system has been fully evacuated.*
Observe all safety recommendations when handling refrigerant R-12, see "Precautions when Handling Refrigerant R-12" in this Section.

1. Ensure the charging unit is correctly connected to the tractor air conditioning system in accordance with the manufacturers instructions.

2. If a charging unit, in conjunction with the manifold gauge set is used, open the high and low side hand valves on the manifold.

3. Charge the system with 5.25 lbs. (2.4 Kg.) of refrigerant as per the manufacturers instructions.

4. If the charging rate becomes very slow close the high side valve, start the tractor and turn 'ON' the air conditioning so the that the compressor can pull the remainder of the refrigerant into the system.

5. If the refrigerant charge will not completely transfer to the air conditioning system, recover and recharge the system.

6. Close the high and low side valves on the units control panel, or manifold gauge set if being used and test the air conditioning as detailed in Performance Testing The Air Conditioning System on Page 14.

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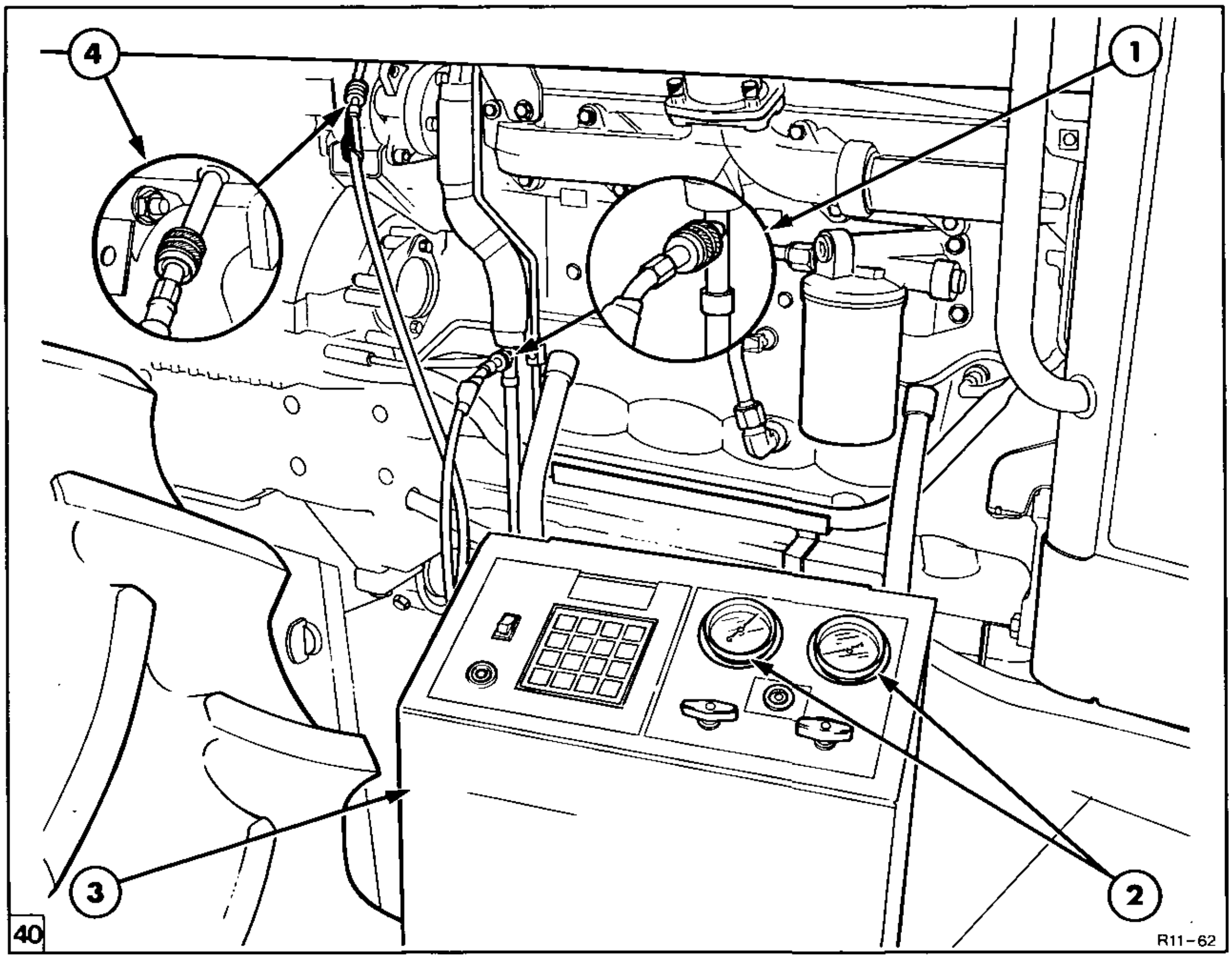


Connecting Recovery Evacuation and Recycling/Charging Station to the Tractor

1. Low Side Service Valve (Blue Hose)
2. Built In Manifold Gauge Set
3. Recovery / Recharging Unit
4. High Side Service Valve (Red Hose)

F. COMPONENT OVERHAUL (EXCLUDING COMPRESSOR)

GENERAL

IMPORTANT: *Before disconnecting components in the air conditioning system the refrigerant gas must be discharged and recovered using a certified recovery system. Refer to Discharging the system on Page* ***Do Not*** *discharge the gas into the atmosphere.*

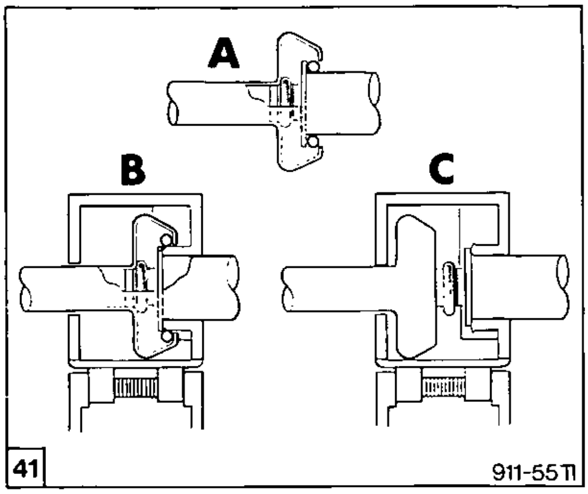
If an air conditioning component is to be replaced during a system overhaul it is necessary to drain any refrigerant oil that has collected in the component being replaced into a clean calibrated container.

A volume of clean refrigerant oil equivalent to that removed from the replaced component must then be added to the new item before being installed onto the tractor.

Upon completion of the repair evacuate, recharge, leak test and performance test the system to ensure correct operation.

Disconnection and Reconnection Of Air Conditioning Spring Lock Couplings

1. The spring lock couplings, Figure 41A, used on the Series 40 air conditioning system can be separated using Snap on Tools reference No ACT118, which are available for $^3/_8$, $^1/_2$, $^5/_8$, $^3/_4$ inch diameter air conditioning tubes.
2. To separate the connection position the tool around the connector and slide the tool into the coupling, Figure 41B, The sleeve on the tool will then release the retaining spring in the connector.



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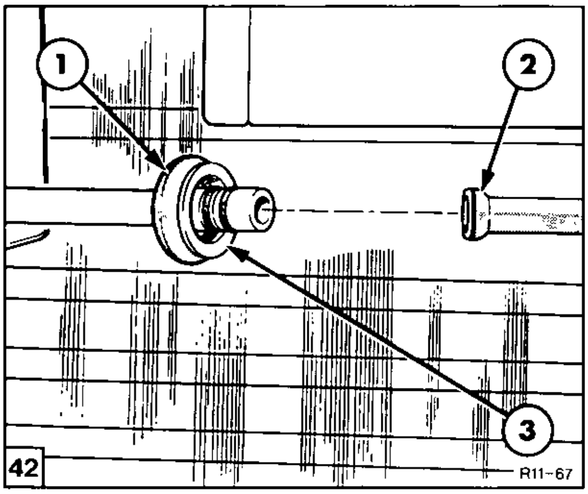
Disconnecting Spring Lock Couplings

A. Spring Lock Coupling
B. Installing Disconnection Tool
C. Separating Coupling

3. Pull the connector tubes to separate the coupling Figure 41C.
4. Prior to reconnecting the connections examine the 'O' ring seals for damage and replace as necessary.
5. Coat the 'O' rings with compressor oil.



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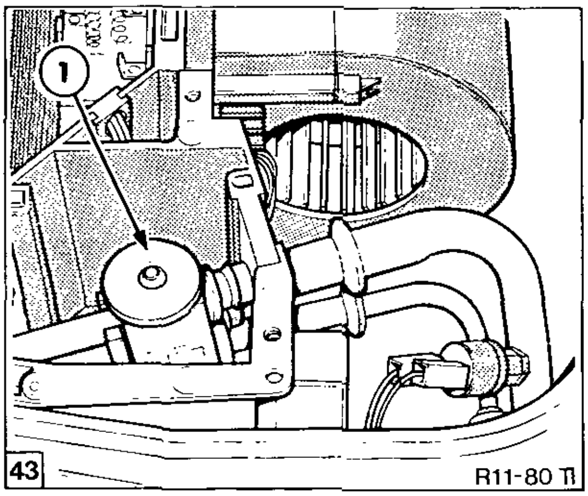
Reconnecting Spring Lock Couplings

1. Coupling (Bulbous Male Section)
2. Coupling (Female Section)
3. Plastic Ring

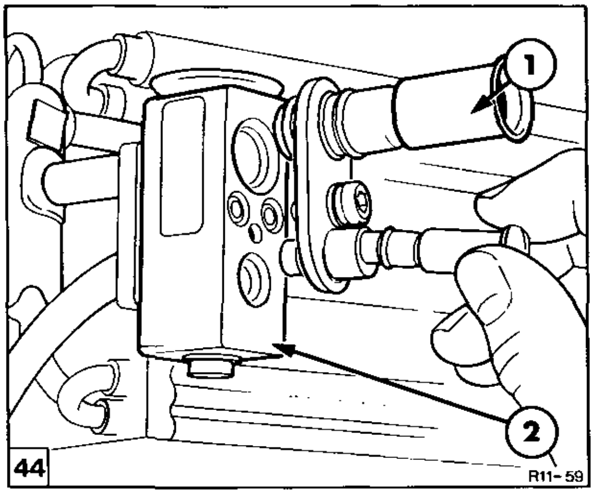
6. To reconnect the connector install the plastic ring (not part of the tool but supplied with the tractor) into the bulbous section of the coupling, Figure 42.
7. Push couplings firmly together until they 'lock' at which time the plastic ring will be ejected from the bulbous section of the tube.

EXPANSION VALVE



Expansion Valve

1. Expansion Valve



Expansion Valve Removal

1. Inlet and Outlet Connections
2. Expansion Valve

The *expansion valve is not a serviceable item* and must be replaced if defective.

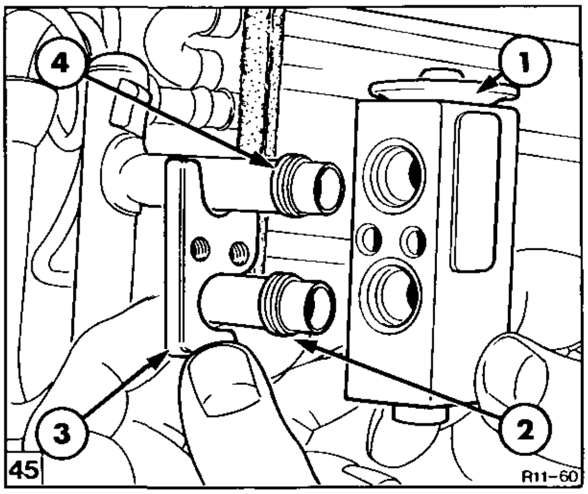
1. Fully discharge the air conditioning system.

2. Remove roof access hatch and evaporator cover plate to gain access to the valve, Figure 43.

3. To gain access to the expansion valve spring lock couplings partially lift the evaporator core from its position in the cab roof.

4. Disconnect the two spring lock couplings to the expansion valve.

5. Remove Allen screw securing the inlet and outlet connections to the valve, *Figure 44 and pull valve from tubing.*



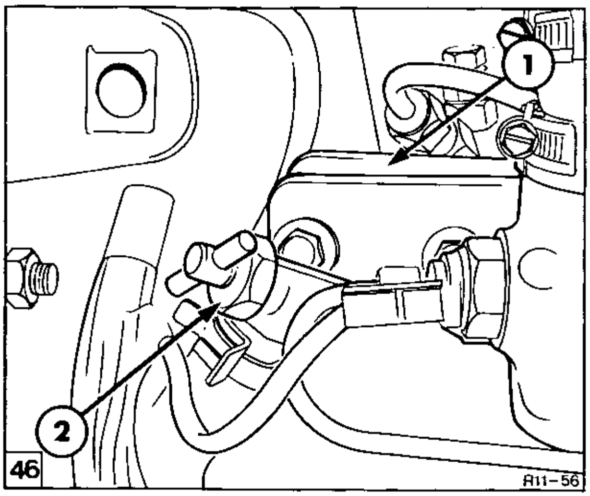
Installing Expansion Valve

1. Expansion Valve
2. 'O' Ring Seal
3. 'O' Ring Seal
4. Retaining Plate

6. Replace the 'O' ring seals and lubricate with refrigerant oil prior to installing the valve using disassembly procedure in reverse, Figure 45.

7. Evacuate, leak test and recharge the system.

EVAPORATOR

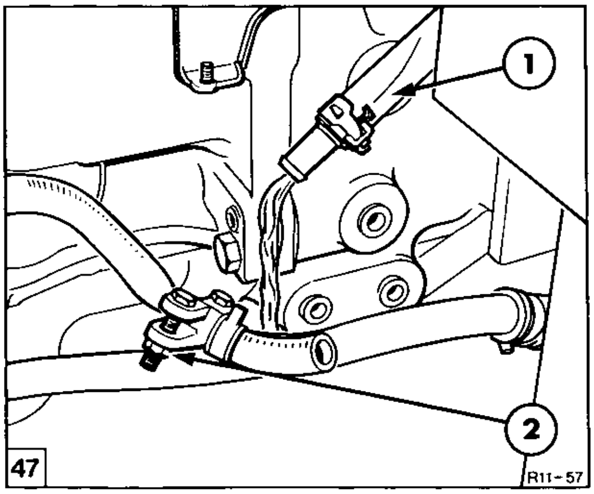


Heater Shut–off Valve

1. Shut–off Valve
2. Engine inlet manifold

1. Close the heater shut–off valve on the rear of the inlet manifold, Figure 46.

2. Turn the cab heater temperature control to maximum heat.



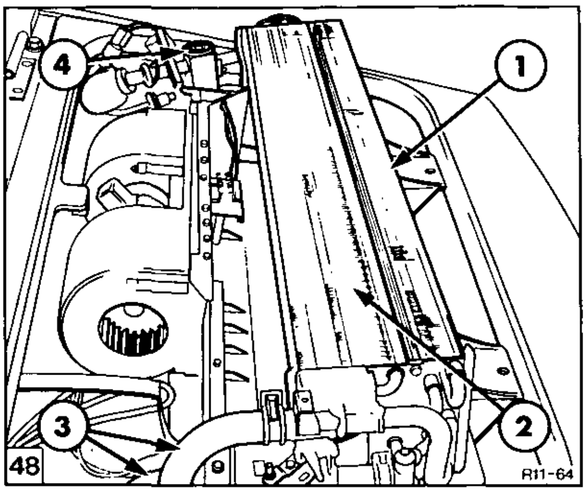
Draining Heater System

1. Heater Return Hose
2. Clamp

3. Apply a clamp to the heater return hose at the left side of the engine. Disconnect the hose and drain the heater system of coolant, Figure 47

4. Discharge and reclaim refrigerant gas using certified recovery systems.

5. Remove the black cover plate to reveal evaporator assembly.



Evaporator and Cab Heater Core Installation

1. Heater Core
2. Evaporator
3. Heater Hoses
4. Expansion Valve

6. Partially lift evaporator and heater core from plastic housing to improve access to hoses, Figure 48.

7. Remove temperature cycling control thermocouple, Refer to Figure 49.

8. Disconnect tubing to expansion valve.

9. Disconnect heater hoses and remove evaporator and heater core assembly.

10. Check the evaporator assembly fins for damage. Straighten fins if necessary.

11. Clean the evaporator core of all foreign material to be sure it is free of obstructions.

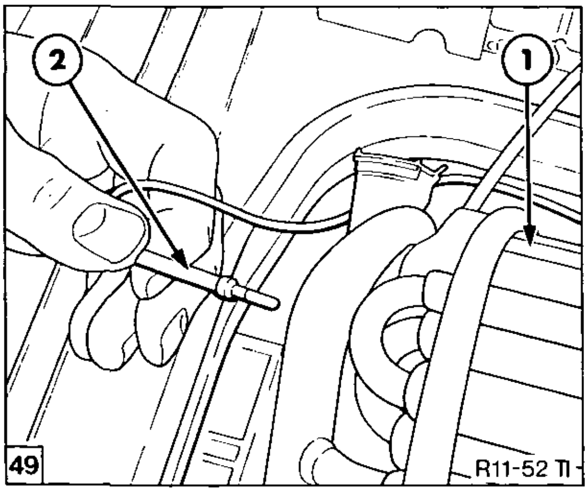
12. Check the evaporator assembly for indications of refrigerant leakage. If damage or leaks are evident, replace the evaporator core.

13. If a new evaporator is to be installed drain the refrigerant oil in the evaporator into a clean calibrated container. Measure the quantity of oil obtained and add the same quantity of new refrigerant oil directly into the replacement evaporator core.

14. Install evaporator using disassembly procedure in reverse.

15. Evacuate, leak test and recharge the system.

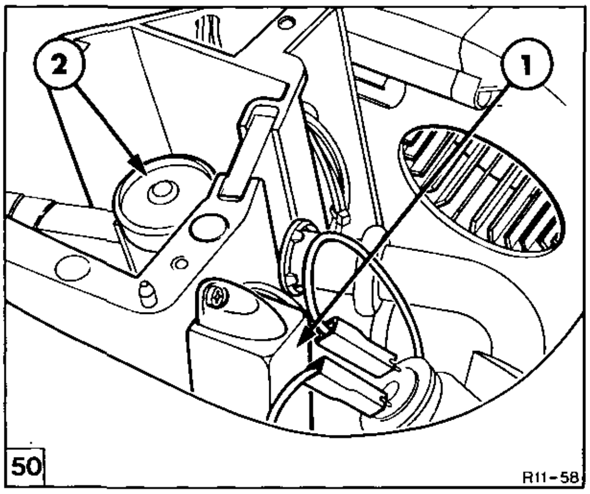
AIR CONDITIONER TEMPERATURE CYCLING CONTROL SWITCH



Temperature Cycling Control Switch Thermocouple

1. Evaporator
2. Thermistor

1. Remove the black evaporator cover plate.
2. Partially lift evaporator and heater core and remove temperature cycling control switch thermistor from left hand end of evaporator, Figure 49.
3. Carefully pull and disconnect the switch wiring connector from beneath the plastic housing which holds the evaporator and blower motor assembly. Refer to Figure 55.

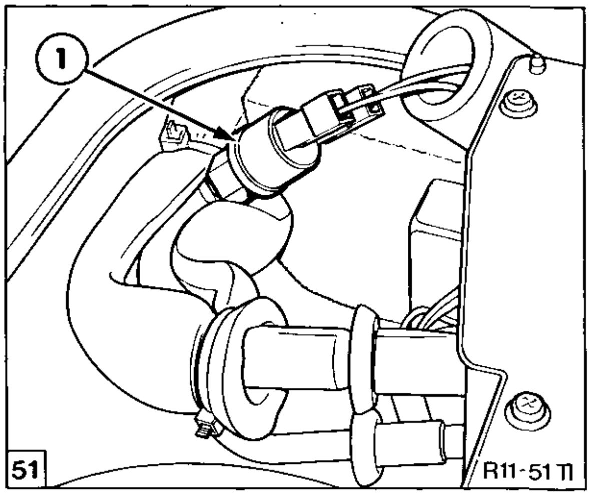


Temperature Cycling Control Switch and Expansion Valve

1. Temperature Cycling Control Switch
2. Expansion Valve

4. Remove temperature cycling control switch, Figure 50

LOW PRESSURE CUT–OUT SWITCH



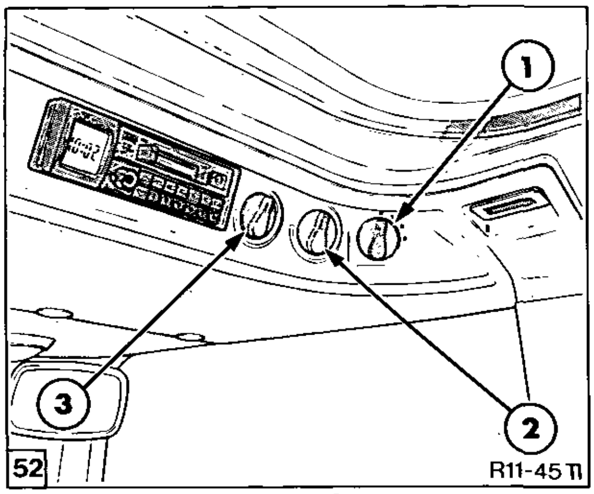
Low Pressure Cut–out Switch

1. With the engine 'Off' check continuity across the switch contacts, Figure 51. If the switch shows 'Open Circuit' replace as detailed below.

NOTE: *The switch can be replaced without discharging the system.*

2. Remove switch, Figure 51, by unscrewing from self sealing schrader valve.
3. Replace with new switch and connect to harness.

BLOWER MOTOR and FAN ASSEMBLY

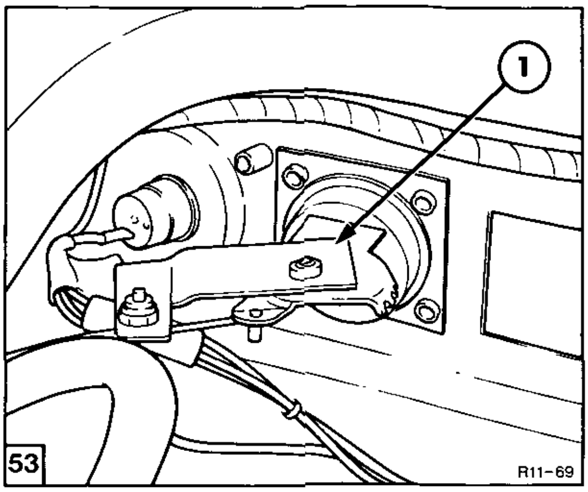


Roof Mounted Controls

1. Blower Control
2. Air Conditioner Temperature Control
3. Heater Temperature Control

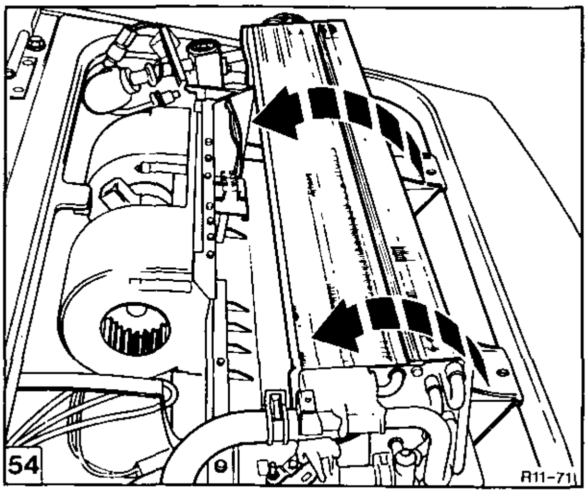
The blower motor can if required be removed without discharging the system as follows:–

1. Remove the cab heater temperature control knob, Figure 52 and then unscrew the control shaft retaining nut.



Temperature Control Mechanism
(viewed from cab roof)

1. Temperature Control Mechanism



Raising Evaporator Housing in preparation for
Blower Motor Removal

2. Remove the 3 head lining studs situated close to the air louvre vents inside the front of the cab.

3. Raise the cab roof and withdraw the heater control mechanism, Figure 53, from the control panel.

4. Remove the visible screws which attach the motor to the plastic air conditioning housing in the cab roof.

5. Remove the 2 retaining bolts from the plate which covers the evaporator and then remove the 2 bolts securing the plastic evaporator housing to the cab roof.

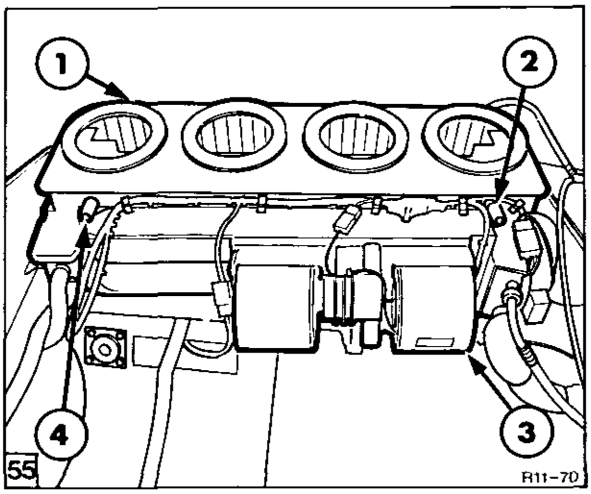
6. Carefully lift the front of the plastic evaporator housing and turn the complete assembly over towards the rear of the cab Refer to Figure 54 and Figure 55.

NOTE: *Take care not to damage hoses during this operation or spill any water onto the cab roof.*
If the cab heater hoses restrict movement of the housing drain the heater assembly and disconnect the hoses.

7. Disconnect the motor wiring connector block.

8. Remove the remaining motor securing screws and withdraw motor.

9. Re-assembly follows the disassembly procedure in reverse. During re-assembly ensure the 4 drain hoses are reconnected to the plastic air conditioning housing.



Blower Motor and Fan Wiring
(Evaporator Assembly Turned Fully Over)

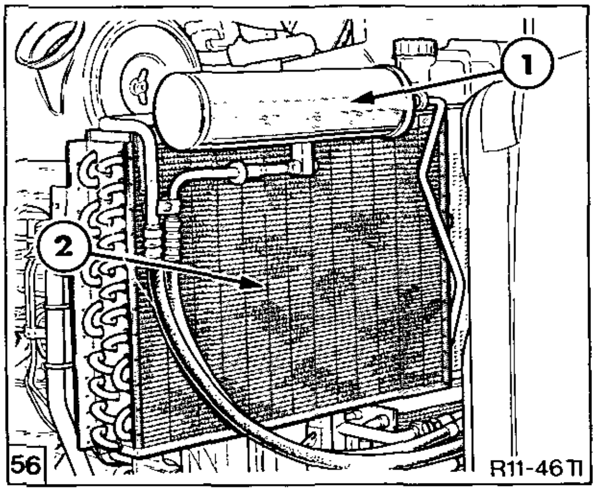
1. Plastic Housing
2. Drain Tube
3. Blower Motor
4. Drain Tube

RECEIVER DRYER and CONDENSER

The receiver/dryer cannot be overhauled and must be replaced, especially if the refrigerant when viewed through the sight glass was cloudy or moisture is believed to be in the system.

The receiver dryer must also be replaced if the system has been discharged and the air conditioning joints disconnected.

1. Discharge and reclaim refrigerant gas using certified recovery systems.

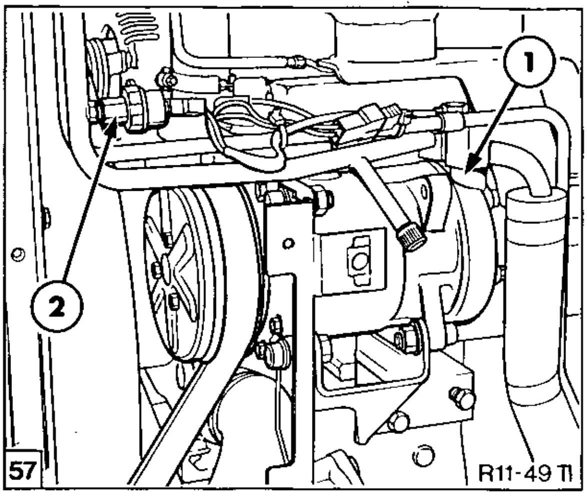


Air Conditioning Condenser and Receiver/Dryer

1. Receiver/Dryer
2. Condenser Assembly

2. Slide condenser and receiver dryer to side of tractor, Figure 56.
3. Separate the air conditioning tube spring lock couplings to the receiver dryer.
4. Remove the dryer from the tractor.
5. Disconnect the connections to the condenser.
6. Cap and plug all fittings to prevent any dirt entering the system.
7. Remove condenser from tractor.
8. Inspect the condenser assembly fins for damage and be sure they are not plugged.
9. Check the condenser for signs of leakage. If the condenser is damaged or leaking, install a new condenser assembly.
10. Drain the refrigerant oil from the receiver dryer into a clean calibrated container. Measure the quantity of oil obtained and add the same quantity of new refrigerant oil directly into the new item.
11. If the condenser is to be replaced, drain the refrigerant oil from the condenser into a clean calibrated container. Measure the quantity of oil obtained and add the same quantity of new refrigerant oil directly into the new condenser.
12. Soak new tubing connector 'O' rings in clean refrigerant lubrication oil and install onto tubing.
13. Install condenser and a new receiver dryer.
14. Evacuate, leak test and recharge the system.

COMPRESSOR HIGH LOW CUT-OUT SWITCH



High/Low Pressure Cut–Out Switch

1. Compressor
2. High Low Pressure Cut–out Switch

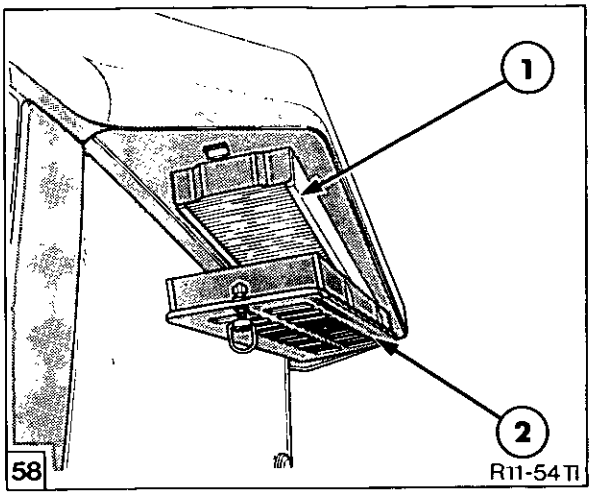
1. With the engine 'Off' check continuity across the switch contacts, Figure 57. If the switch shows 'Open Circuit' replace as detailed below.

NOTE: *The switch can be replaced without discharging the system.*

2. Remove switch by unscrewing from self sealing schrader valve.

3. Replace with new switch and connect the harness.

CAB AIR FILTERS



Filter Removal

1. Filter Element
2. Filter Cover

1. Before servicing the filters, switch off the blower and close the roof hatch, all windows and one door. Slam the final door closed and the resulting back pressure will dislodge most of the loose dirt from the underside of the filters.

2. Remove filter element(s), Figure 58 and clean by blowing with compressed air not exceeding 30 lbf/in^2 (2 bar).

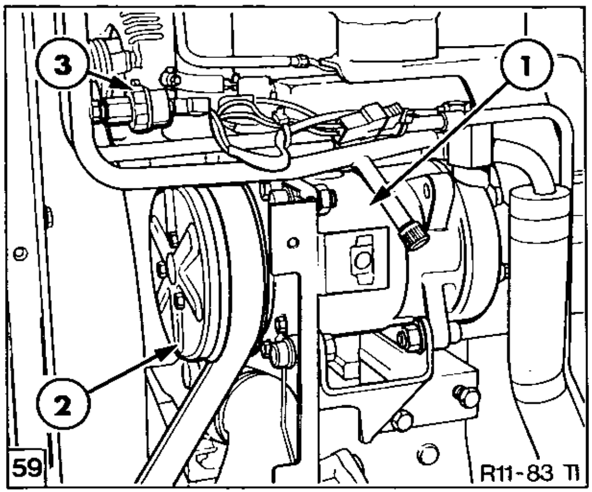
   Blow the dust from the upper surface through the element to the underside. Hold the nozzle at least 12 in (300 mm) from the element to prevent damage to the paper pleats.

3. Clean both filter chambers with a damp, lint free cloth.

4. Replace the filter elements with the rubber seal uppermost and re–install the covers.

G. COMPRESSOR – OVERHAUL

Compressor Removal



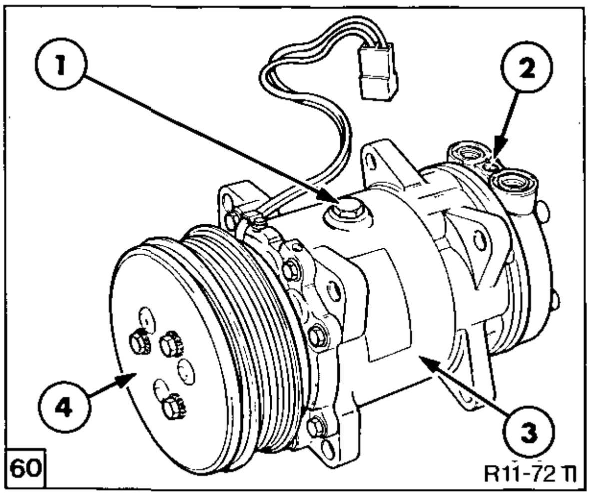
Compressor Installation

1. Compressor
2. Electromagnetic Clutch
3. High/Low Pressure Switch

1. Discharge and reclaim refrigerant gas using certified recovery systems.
2. Disconnect tubing to compressor.
3. Disconnect Connector to high/low pressure switch.
4. Disconnect drive belt and remove compressor from tractor.
5. Drain the refrigerant oil from the compressor into a clean calibrated container. Measure and record the quantity of oil obtained. This information is required during installation of the new or overhauled unit.

NOTE: *It is necessary to rotate the compressor drive shaft several times to completely expel all the oil.*

Preliminary Inspection



Compressor Assembly

1. Oil Fill/Drain Plug
2. Cylinder Head
3. Compressor
4. Clutch

1. Remove clutch cover plate.
2. Rotate compressor shaft using a 3/4″ AF socket wrench on the driveshaft nut.

   If severe roughness is felt while rotating the pulley, the compressor should be replaced.
3. Using a 12 volt battery check current drawn by field coil which could be between 3.6A to 4.2A.

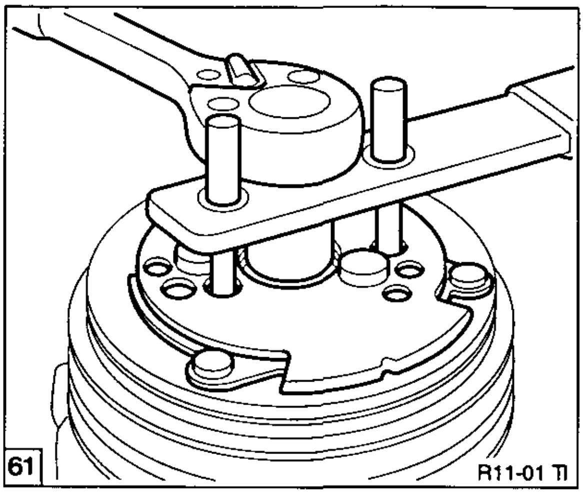
   Very high current readings indicate a short circuit in the field coil and no current reading indicate an open circuit. Replace coil with either fault.

   A poor earth (ground) connection of the field coil will result in a low voltage.
4. Ensure clutch is disengaged and rotate pulley by hand. If roughness in the bearing is felt, it will have to be replaced.

Clutch Overhaul

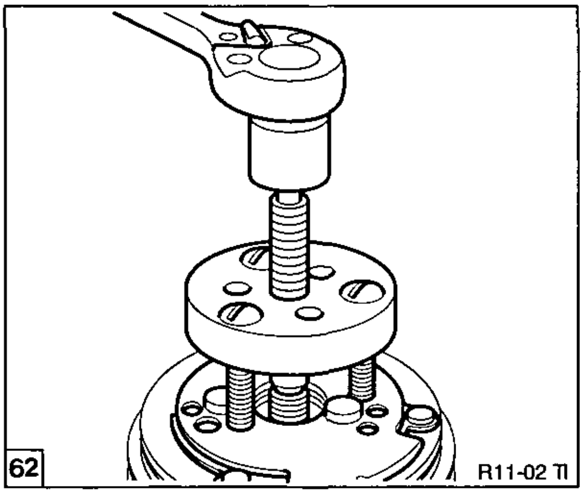
All clutch servicing should be done with the compressor removed from the vehicle:

1. Support the compressor. If using a vice, do not hold on to the housing.
2. Remove the cover on the front of the clutch plate.



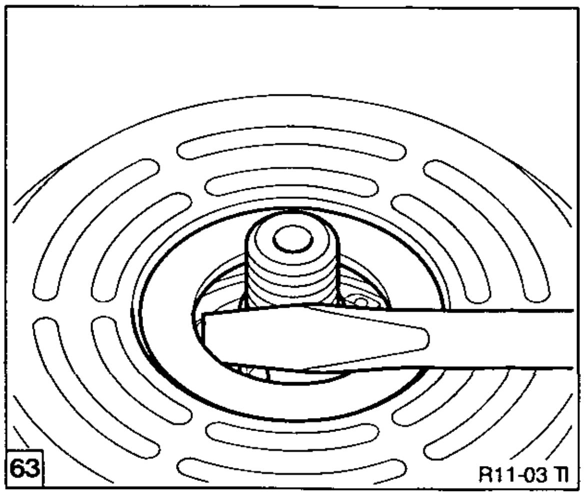
Driveshaft Nut Removal

3. Using the front plate spanner hold the clutch plate stationary and remove the retaining nut from the end of the shaft.



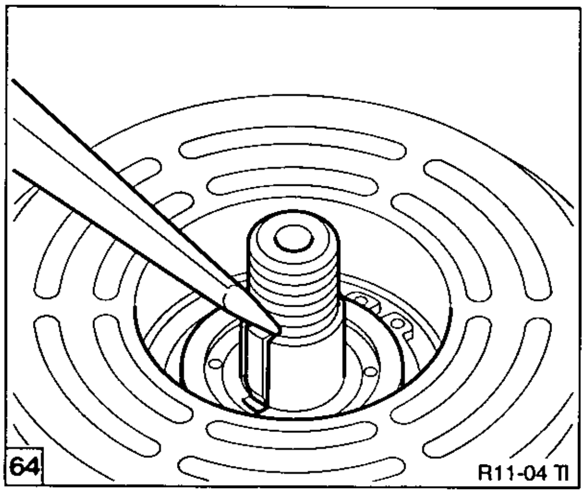
Clutch Hub Removal

4. Place a thread protector over the end of the driveshaft and using puller remove the clutch front plate.



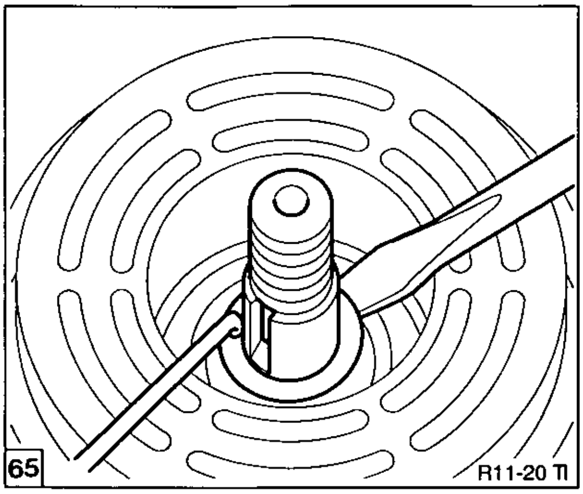
Bearing Dust Cover Removal

5. Carefully remove the bearing dust cover,



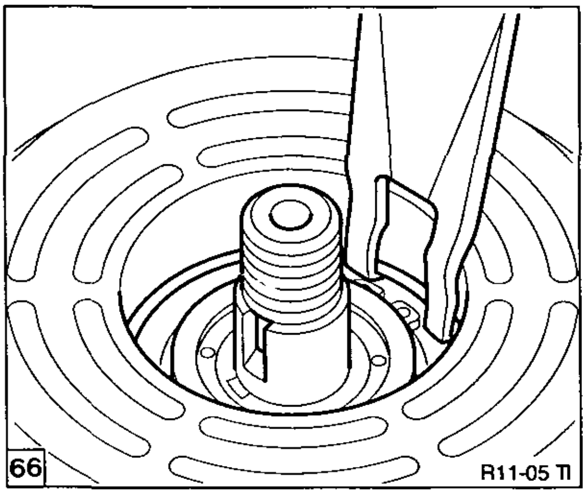
Removing Shaft Key Removal

6. Remove the shaft key



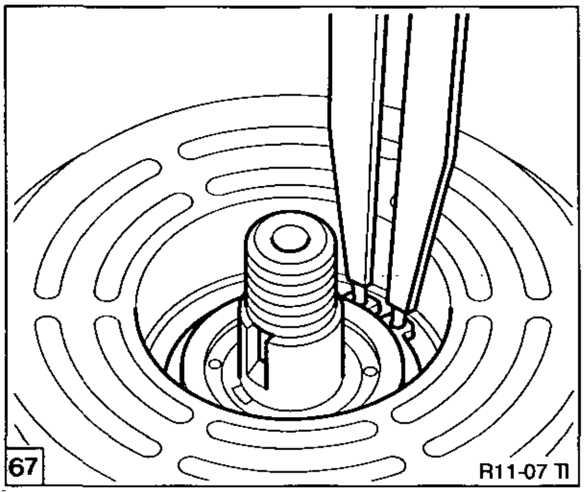
Removing Clutch Shims

7. Remove the clutch shims.



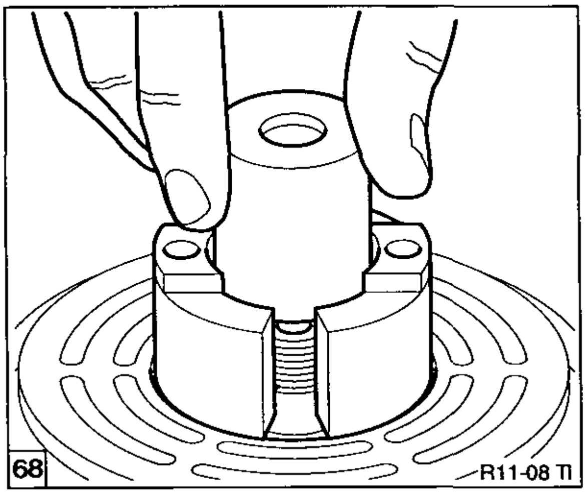
Removing Pulley Bearing Internal Snap Ring

8. Remove the pulley bearing internal snap ring.



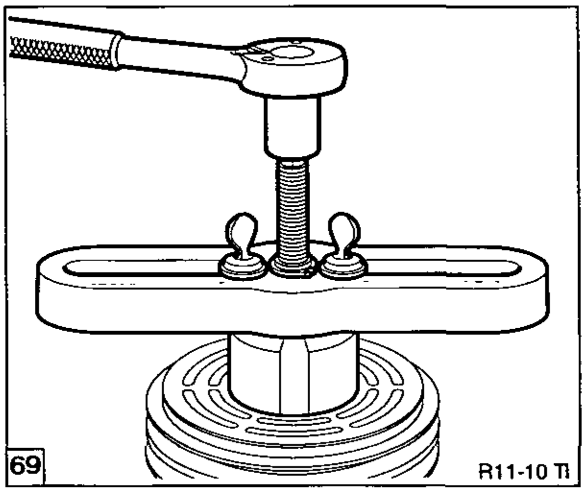
Removing Pulley Bearing External Snap Ring

9. Remove the pulley bearing external snap ring.



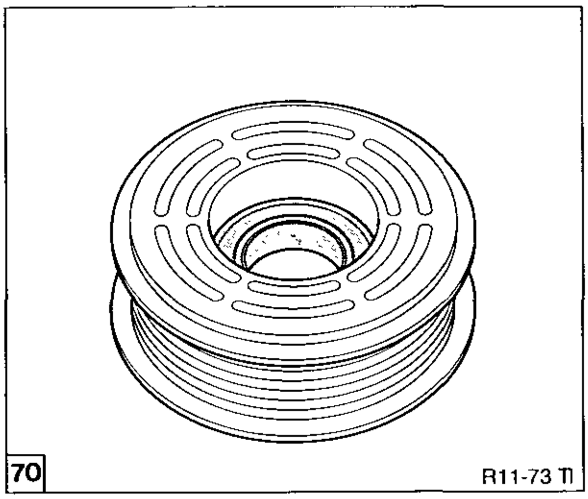
Installing Clutch Pulley Jaws

10. Insert the lip of the clutch pulley jaws , Tool No FNH.02343A–25, into the snap ring groove of the pulley and place a shaft protector over exposed shaft.



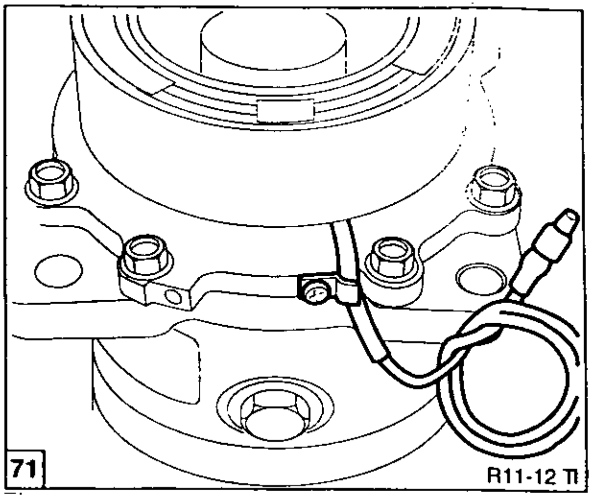
Installing Puller

11. assemble puller to pulley jaws and turn centre bolt to remove pulley.



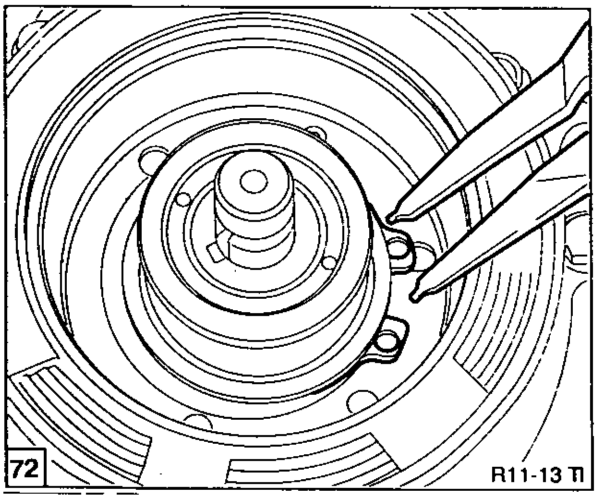
Pulley and Bearing

12. Inspect pulley bearing for wear and replace where necessary.



Field Coil Wire Retaining Clip

13. Remove field coil wirer retaining clip

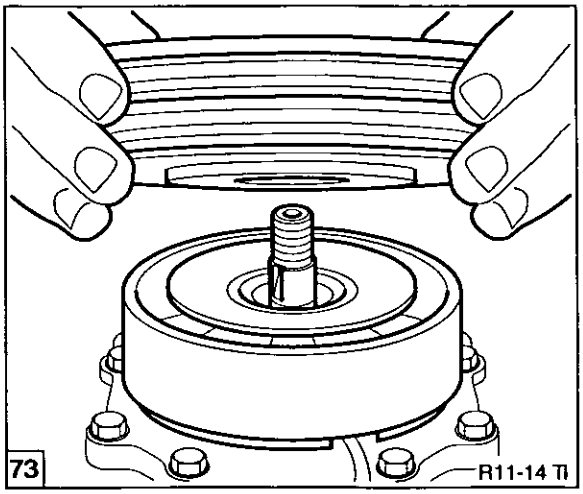


Field Coil Snap Ring

14. Remove field coil retaining snap ring and lift coil from housing.

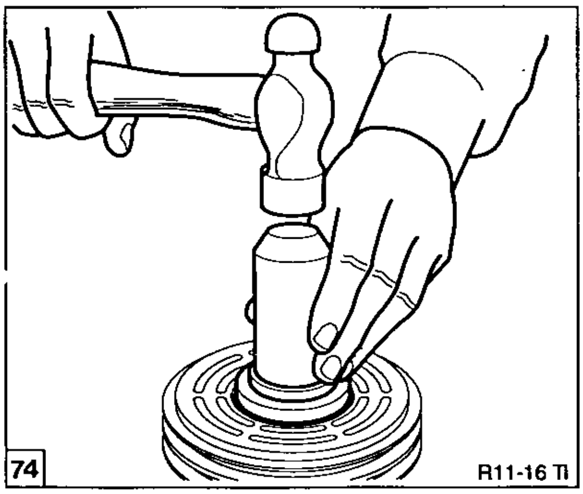
Clutch Re–Assembly

1. Install field coil ensuring that the lug on the compressor housing locates in the cut-out on the back of the coil housing, and secure with the snap ring.



Positioning Pulley on Housing Hub

2. Position the pulley on the housing hub.

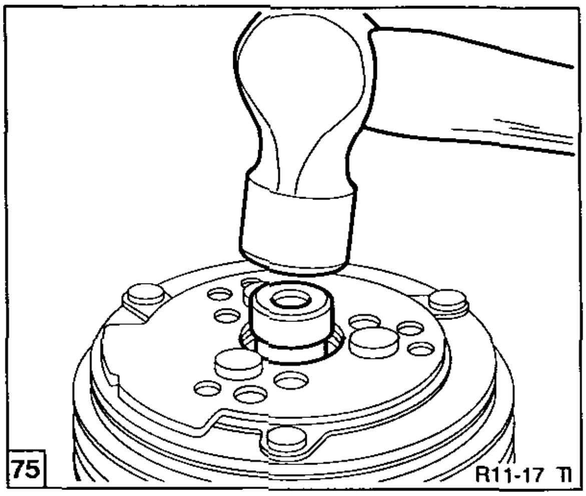


Installing Pulley

3. Using a suitable adaptor that rests firmly on the inner race of the pulley bearing, tap the pulley onto the front hub of the compressor.

4. Install bearing snap ring.

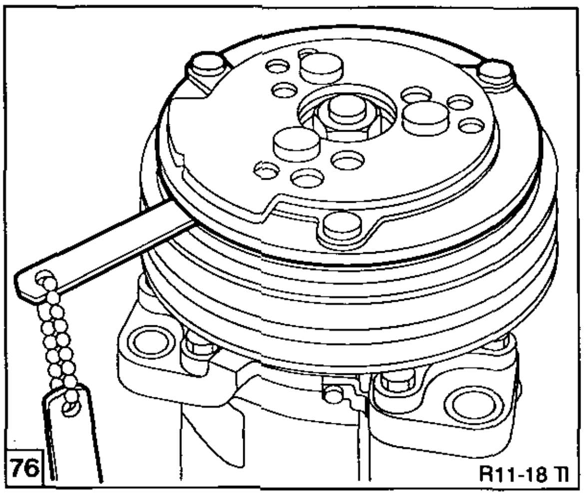
5. Replace the original shims, key and a new bearing dust cover.



Installing Clutch Front Plate

6. Install the clutch front plate and using a suitable adaptor to tap into position.

7. Replace the retaining nut and tighten to a torque of 28 lb/ft (38 N.m) (3.9 Kgf m).



Checking Air Gap Using Feeler Gauge

8. Check the clearance between the clutch front plate and pulley. This should be consistent around the circumference and be between 0.016 and 0.031" (0.4-0.8 mm).

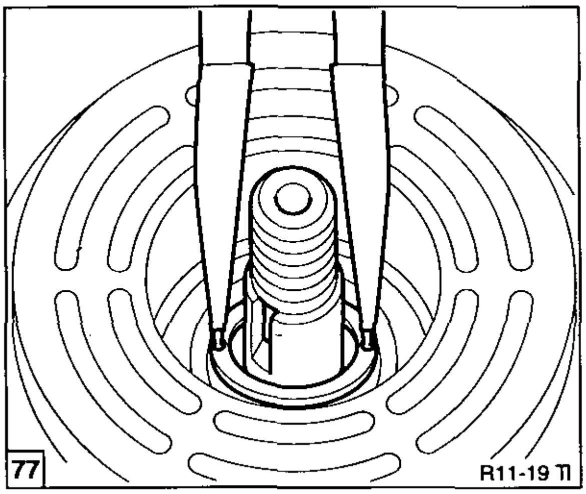
9. If the air gap is not consistent, lightly pry up on the counter–weighted front plate at the low spots. Lightly tap down at the high spots.

10. If the clearance is not within specification, the shims as shown in Figure 65, should be added or subtracted until correct clearance is obtained.

SHAFT SEAL REPLACEMENT

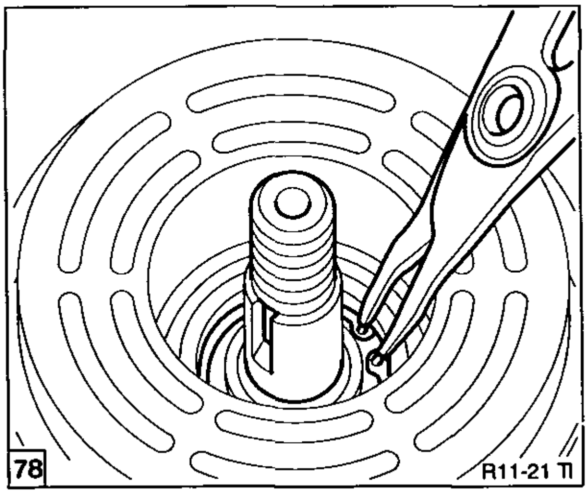
REMOVAL

1.Follow steps 1 to 7 of Clutch Disassembly.



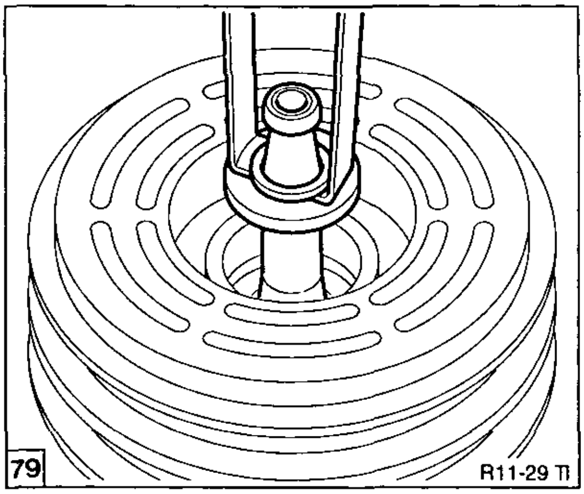
Removing Felt Ring

2.Using a pair of snap ring pliers remove the felt ring.



Removing Seal Seat Snap Ring

3. Remove shaft seal seat snap ring



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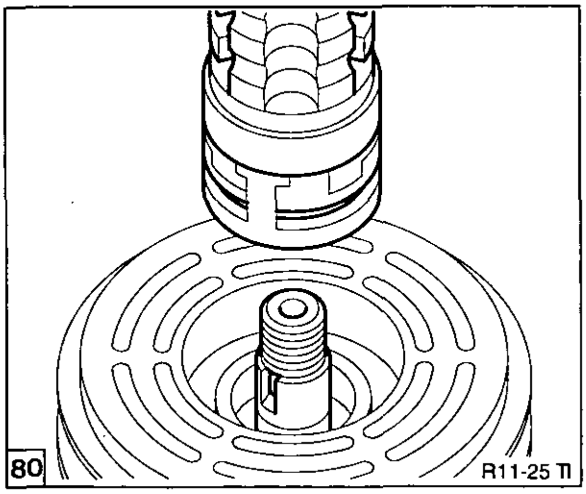
Removing Shaft Seal Seat

4. Remove the shaft seal seat using Tool No FNH.02343A–15.



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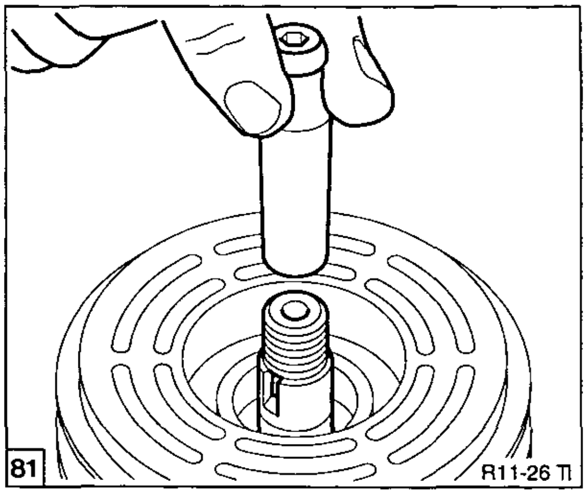
Removing Seal

5. Insert the seal remover/installation tool, Tool No FNH.02343A–12. Push down against the seal spring and twist the tool to engage the slots in the seal. Remove and discard the seal.

INSTALLATION

1. Thoroughly clean the seal cavity in the hub. Use "lint free" cloth only.



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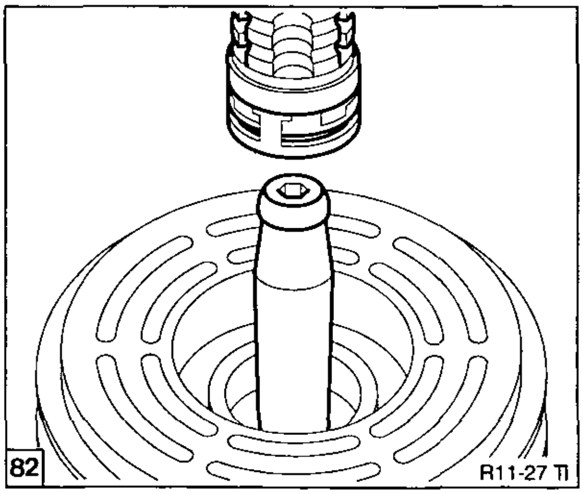
Installing Seal protector

2. Position the seal protector over the driveshaft.

3. Dip the new seal in clean refrigerant oil and attach to the seal remover/installer tool.



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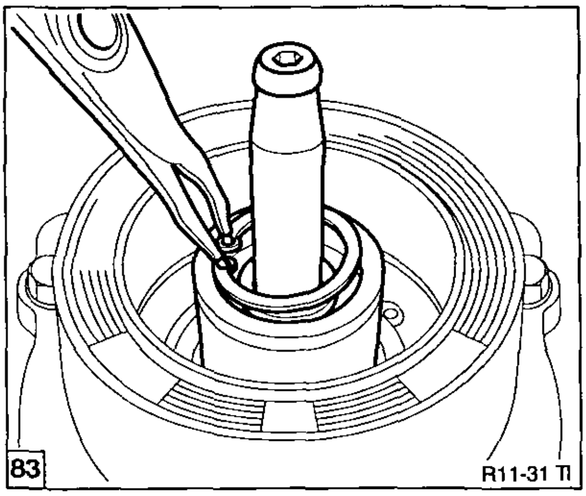
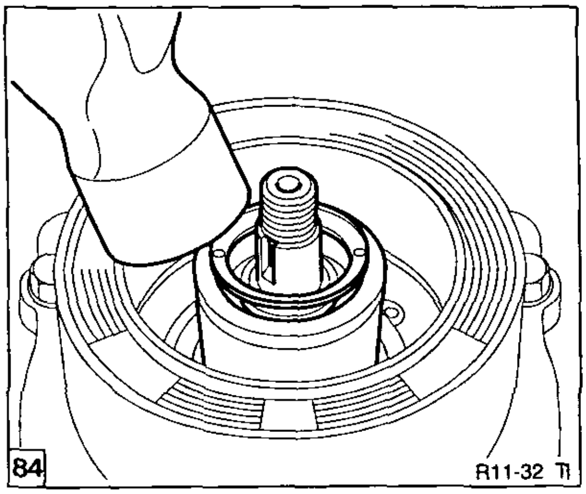
Installing Seal

4. Using seal installation tool, Tool No FNH.02343A–12, Insert the new seal fully into the hub.



Securing Seal Retainer with Snap Ring

5. Install the seal retainer and secure with snap ring. Install the seal snap ring with the beveled edge facing outward.



Installing Felt Seal

6. Install a new felt seal and gently tap into position.

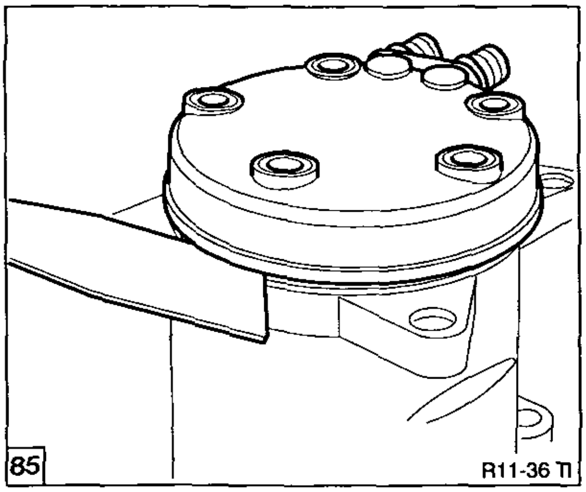
7. Position the shims over the shaft.

8. Reinstall the clutch front plate as described in clutch re–assembly

CYLINDER HEAD SERVICING

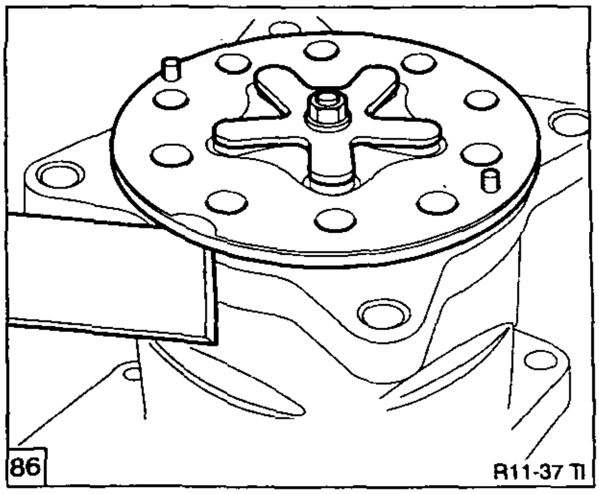
DISASSEMBLY

1. Drain the refrigerant oil from the compressor into a clean calibrated container. Measure and record the quantity of oil obtained. This information is required during installation of the new or overhauled unit



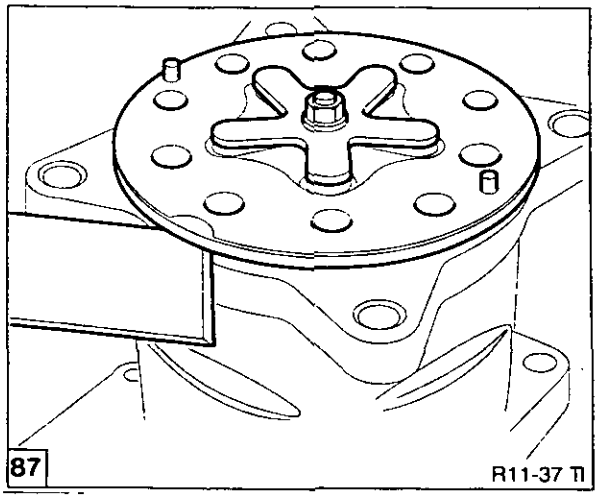
Removing Cylinder Head

2. Remove the five cylinder head bolts and using a "hide" mallet, gently tap the cylinder head free. The use of a gasket scraper may also be required to free cylinder head from compressor body

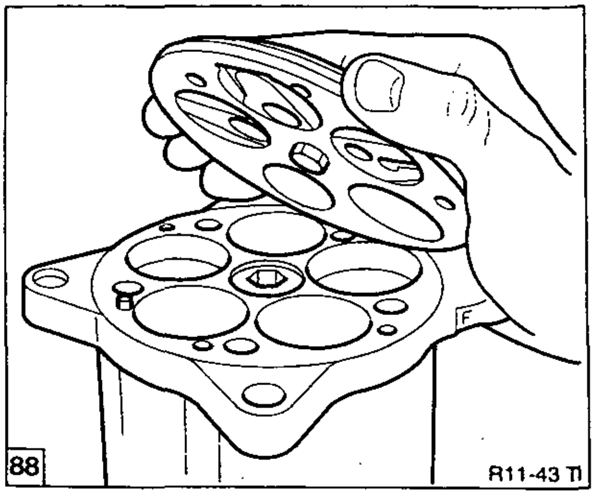


Removing Cylinder Head Gasket

3. If the valve plate and/or cylinder head are to be reused carefully remove gasket using a suitable scraper.



Removing Valve Plate



Installing Valve Plate

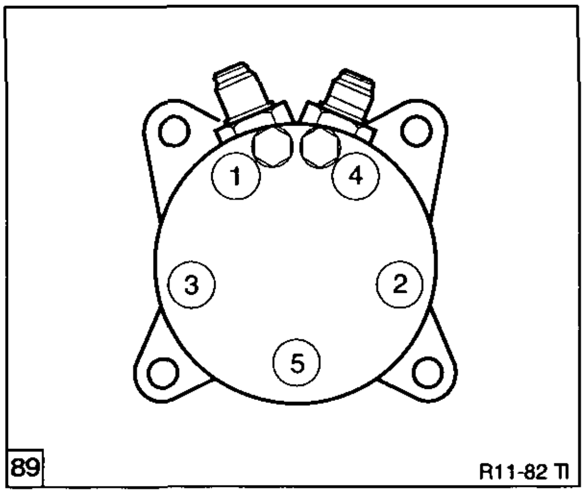
4. Gently pry the valve plate free from the cylinder block and remove the gasket.

5. Inspect valve plate for damage and removal of old gasket material.

REASSEMBLY

1. Coat the top of the valve plate with clean refrigerant oil and re–assemble the cylinder head using removal procedure in reverse.

2. When installing the gaskets and valve plate ensure they are correctly positioned over the locating pins in the cylinder block.



Cylinder Head Bolt Tightening Sequence

3. Tighten the cylinder head bolts to a torque of 24 lbf/ft (32.5 N.m, 3.3 kgf m) using the sequence shown above.

4. Upon completion of overhaul add to the compressor a volume of oil to that drained during assembly.

H. SPECIFICATIONS and SPECIAL TOOLS

SPECIFICATIONS

Refrigerant Specification	ESA-M17B2-A (R12)
Refrigerant Charge	5.25 lbs (2.4 kg)
Compressor Oil Specifications	ESA-M2C31-A (Suniso 5GS)
Refrigerant Oil Capacity (Compressor and system)	200 cc–250 cc

Cooling capacity @ 22° C – 49° C (75° F – 120°F) ambient. 4.5 kW Typical
(Actual capacity dependent on system control operator settings)

Combined High/Low Pressure Switch (Mounted Adjacent to Compressor)

Low Pressure Switch	
On	29.9 lbf/in^2 (2.06 bar)
Off	28.4 lbf/in^2 (1.96 bar)
High pressure switch	
On	299 lbf/in^2 (21 bar)
Off	384 lbf/in^2 (26 bar)

Low Pressure Cut Out Switch (Mounted in Cab Roof)

On	34 lbf/in^2 (2.3 bar)
Off	10 lbf/in^2 (0.7 bar)

Temperature Cycling Control Switch

Switch Setting	On	Off
Minimum Cooling	21° C	18° C
Maximum Cooling	5° C	2° C

COMPRESSOR

Compressor Clutch and Pulley Air Gap	0.016 and 0.031″ (0.4-0.8 mm)
Drive Belt Tension	Automatic Belt Tensioner

TORQUES

Compressor Cylinder Head Bolts		24 lbf/ft (32.5 N.m, 3.3 kgf m)
Compressor Clutch Front Plate retaining Bolt		28 lb/ft (38 N.m) (3.9 kgf m).
Self–sealing Couplings	small	29–40 lbf ft (40–54 Nm)
	large	40–50 lbf ft (54–68 Nm)
Compressor Mounting Bolts		29–37 lbf ft (40–51 Nm)

SPECIAL TOOLS

Certified Refrigerant Recover,Recycling and Recharge Equipment suitable for the type of refrigerant gas used on tractor (ie R12 or R134A as appropriate) are required when servicing air conditioning systems.

This special equipment is available through OTC/VL Churchill or Nationally recognised suppliers of air conditioning equipment. Refer to the Tool supplier for details on the latest equipment available for servicing the air conditioning system

Electronic Gas Leak Detector	
Sandon SD510 Compressor Tool Kit	OTC/V.L Churchill Part No FNH02343–A
Manifold Gauge Set (Where required)	OTC/V.L Churchill Part No FNH00172
Quick Release Coupling Tool	Snap On Reference No ACT 118

PART 11
CAB

Chapter 2
SANDEN SD7H15 AIR CONDITIONING COMPRESSOR

CONTENTS

A. SPECIFICATIONS

Refrigerant Specification	New Holland Specification 82000810 (R134a)
Refrigerant Charge	1.5 kg (3.31 lbs)
Compressor Oil Specifications	New Holland Specification 82008750 (PAG Type) (ISO 100 Viscosity) Sanden SP20
Refrigerant Oil Capacity (Compressor and system)	186 cc–228 cc

Cooling capacity @ 22° C – 49° C (75° F – 120°F) ambient. 4.5 kW Typical
(Actual capacity dependent on system control operator settings)

Combined High/Low Pressure Switch (Mounted Adjacent to Compressor)

Low Pressure Switch	
On	2.06 bar (29.9 lbf/in^2)
Off	1.96 bar (28.4 lbf/in^2)
High pressure switch	
On	21 bar (299 lbf/in^2)
Off	26 bar (384 lbf/in^2)

Low Pressure Cut Out Switch (Mounted in Cab Roof)

On	2.3 bar (34 lbf/in^2)
Off	0.7 bar (10 lbf/in^2)

Temperature Cycling Control Switch

Switch Setting	On	Off
Minimum Cooling	21° C	18° C
Maximum Cooling	5° C	2° C

COMPRESSOR

Manufacturer and Type	Sanden SD7H15 (model 7865)
Compressor Clutch and Pulley Air Gap	0.4–0.8 mm (0.016 and 0.031″)
Drive Belt Tension	Automatic Belt Tensioner

B. TIGHTENING TORQUES

Compressor Cylinder Head Bolts		24.5–26.5 Nm (18–19.5 lbf.ft)
Compressor Clutch Front Plate retaining Bolt		11.0–14.0 Nm (8–10 lbf.ft)
Self–sealing Couplings	small	40–54 Nm (29–40 lbf ft)
	large	54–68 Nm (40–50 lbf ft)
Compressor Mounting Bolts		20.5–25.5 Nm (15–19 lbf.ft)

C. SPECIAL TOOLS

Sanden SDH715 Tool Kit	OTC/V.L Churchill Ltd Part No. NH.50–100

D. SAFETY PRECAUTIONS

⚠ WARNING ⚠

Before overhauling an air conditioning system read and observe the following Safety PrecautionsIf a repair or replacement becomes necessary, ensure that only certified Air Conditioning technicians are employed, using approved equipment to effect repairs. Do ***not*** *attempt to disassemble the air conditioning system, It is possible to be* ***severely frost-bitten or injured*** *by escaping refrigerant.*

IMPORTANT: *Do* ***not*** *allow refrigerant to escape into the atmosphere.*

Refrigerant must be handled with care in order to AVOID HAZARDS.

Undue direct contact with liquid refrigerant can produce freezing of skin and eyes.

Keep the refrigerant container and air conditioning system away from flame or heat sources, the resulting pressure increase can cause the container or system to explode.

If in direct contact with open flames or heated metal surfaces, the refrigerant will decompose and produce products that are toxic and acidic.

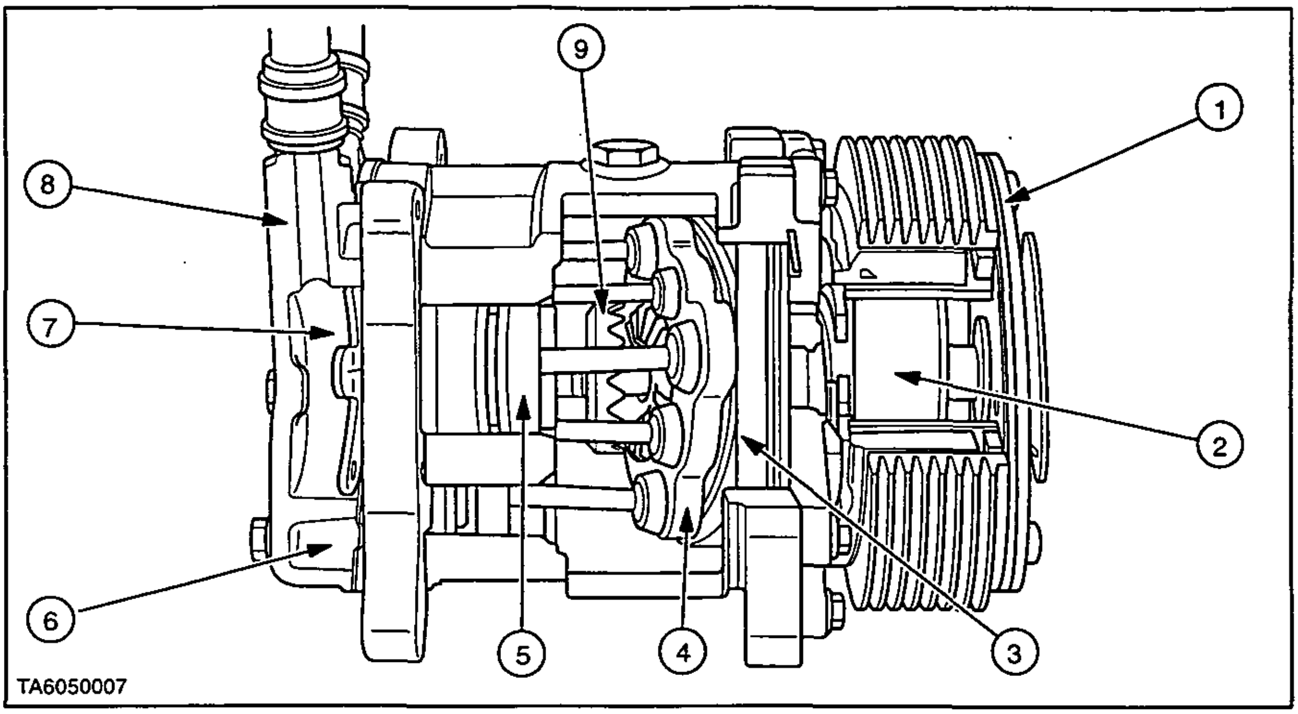
Make sure to comply with the following indications and simple precautions to avoid any risk of injury:

- Never discharge refrigerant into the atmosphere. When servicing air conditioning units a certified refrigerant recovery unit operated by a certified technician must be used.
- When discharging the refrigerant in the system make sure you are operating in well–ventilated premises with good air circulation and far away from open flames.
- When charging and discharging the system always wear goggles and take suitable precautions to protect the face in general and the eyes in particular, from accidental spillage of the refrigerant fluid.
- The oil and refrigerant mixture inside the air conditioning system is pressurized. Consequently, never loosen fittings or tamper with lines unless the system has been properly discharged.
- Before loosening any connection, cover the fitting in question with a cloth and wear gloves and goggles in order to prevent refrigerant from reaching the skin or eyes.
- In the event of an accident, proceed as follows:–

  If the refrigerant has reached the eyes, wash them immediately with copious amounts of sterilised water or mains pressure tap water and transfer to hospital for immediate medical help.

  If the refrigerant has touched the skin, wash with cold water and transfer to hospital for immediate medical help.

E. DESCRIPTION AND OPERATION



Air Conditioning Refrigerant Compressor 1

1. Electro–magnetic Clutch
2. Clutch Bearing
3. Cam Rotor
4. Wobble Plate
5. Piston
6. Suction Chamber
7. Discharge Chamber
8. Cylinder Head
9. Static Gear

Compressor Pump

The tractor air conditioning unit compressor pump is mounted on the left hand side of the engine and is belt driven by the crankshaft pulley, Figure 1.

The compressor separates the low and high pressure sides of the system and is basically a pump which has two functions:

(1) To raise the refrigerant temperature by compression to a higher degree of temperature than the ambient (outside air) temperature.

(2) To circulate the required volume of refrigerant through the system.

The refrigerant compressor is a seven cylinder wobble plate unit housed in a die cast aluminium housing.

Drive to the wobble plate is from the pulley, through the electro magnetic clutch to the main driveshaft. Attached to the driveshaft is a cam rotor which oscillates the wobble plate. The wobble plate is prevented from rotating by a static gear engaging with teeth formed in the face of the plate. The seven pistons are connected to the wobble plate by rods located in ball sockets.

Refrigerant is drawn in on the downward stroke of a piston through the reed valves located either end of the cylinder assembly. Refrigerant enters the cylinder assembly through a gallery in the outer circumference of the cylinder assembly.

The upwards stroke of the piston compresses the refrigerant and expels it through another reed valve into an inner gallery in the cylinder assembly and out into the refrigerant circuit.

The compressor is lubricated with a Polyalklene Glycol (PAG) oil. This oil is totally miscible with the refrigerant and is carried around the refrigerant circuit.

The compressor is activated by an electro-magnetic clutch which functions to engage or disengage the compressor as required in the operation of the air conditioning system.

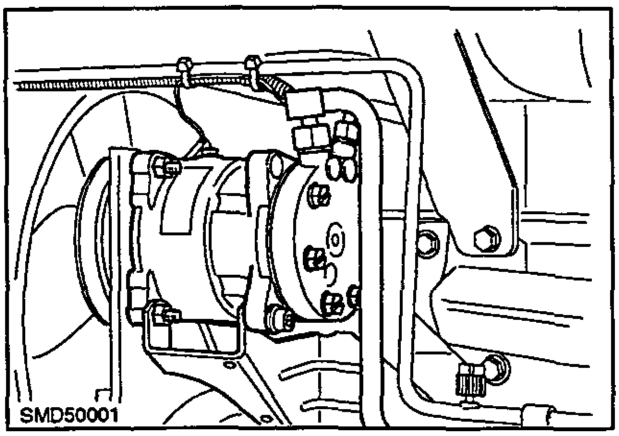
The clutch is primarily activated by the:–

- Temperature cycling control switch
- Combined high/low pressure cut–out switch
- Low pressure cut–out switch

F. COMPRESSOR OVERHAUL

Compressor Removal

1. Discharge and reclaim refrigerant gas using certified recovery systems. Record the amount of oil discharged as **(X)**.
2. Disconnect tubing to compressor.
3. Disconnect wiring connector to compressor clutch.
4. Disconnect drive belt, remove the four mounting bolts and remove compressor from tractor.



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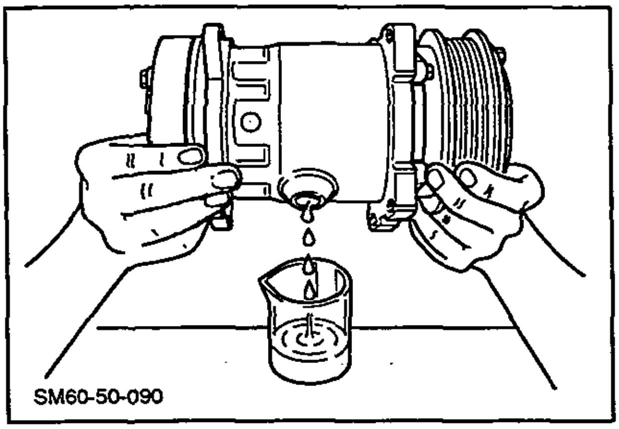
5. Drain the refrigerant oil from the old compressor into a clean calibrated container. Measure and record the quantity of oil as (Y). This information is required during installation of the new or overhauled unit.

NOTE: *It is necessary to rotate the compressor drive shaft several times to completely expel all the oil.*



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Compressor Installation

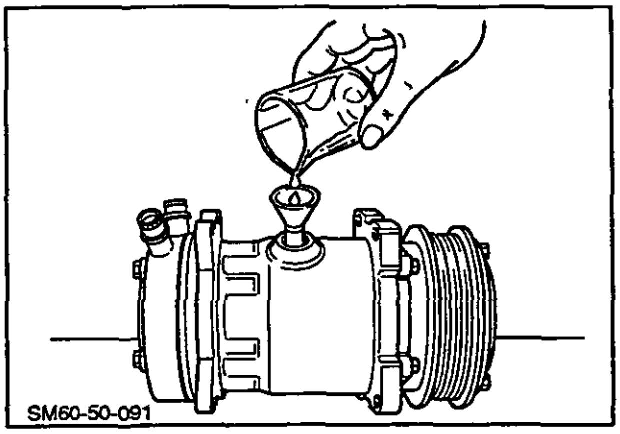
1. Installation is the reversal of the removal but the following points should be noted:–

- Torque the mounting bolts to 40–51Nm (29–38lbf.ft).

NOTE: It is recommended that a new receiver / drier assembly is installed after any system component replacement or any repair that requires entry into the system.

- Drain the oil from the new compressor to be fitted into a clean container, or if the old compressor is to be refitted, obtain a new can of refrigerant oil.
- Calculate the amount of oil to be installed as, **(x)+(y)**. Add this quantity of the new oil into the fill port on top of the compressor.

NOTE: *Refer to the following page regarding **Oil Level Measurement** to determine if the system oil quantity is correct.*



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After charging a system use the following start up procedure to ensure the lubricating oil is properly dispersed around the system:

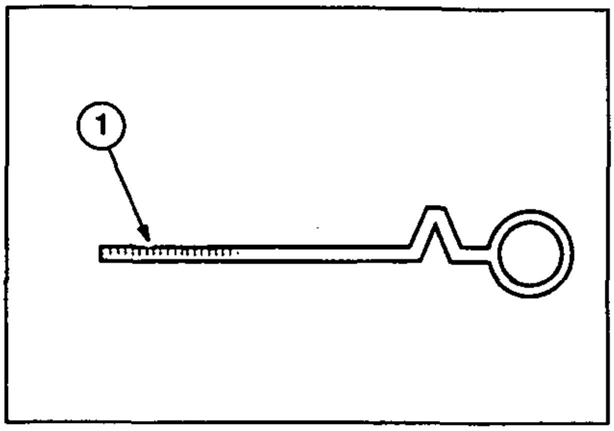
- Ensure air conditioning is switched OFF.
- Start the engine and bring speed down to idle.
- Turn the air conditioning ON and allow system to operate for at least five minutes before increasing engine speed.

Oil Level measurement (on vehicle)

Oil level in the compressor should be checked when a system component is removed or replaced or when an oil leak is suspected.

Use the following procedure to determine if the oil quantity is correct.

1. Start the engine and allow to idle. Switch on air conditioning and run the compressor for 10 minutes.
2. *Recover the refrigerant from the system, very* slowly so as not to lose any oil.
3. Carefully remove the oil filler plug. Turn the armature retaining nut to allow full insertion of the oil dipstick (1) Figure 5, supplied with kit NH.50–100.
4. Remove the dipstick and count the notches covered by the oil. An acceptable level of oil is when 5–7 notches are covered.
5. Add or subtract oil through the filler plug to obtain the correct level.
6. Ensure the filler hole seat and filler plug seal are clean and not damaged and Install the oil plug. Tighten to 15–25Nm (11–18lbf.ft).



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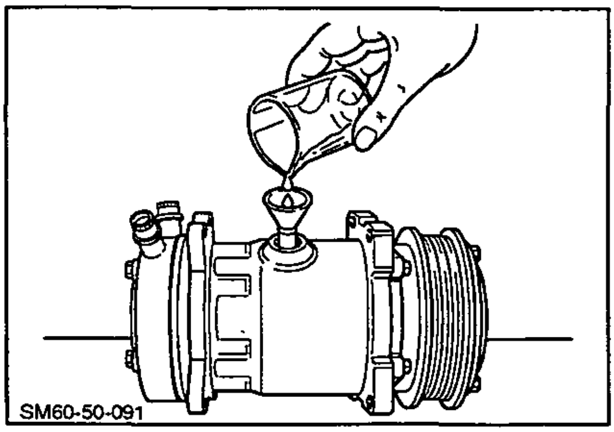

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Oil Retained in System Components

After replacement of individual system components it will be necessary to add some oil to the system to make up the amount lost in the removed component. The table, on the right, shows some typical volumes for the components. It is, however, still recommended that the on vehicle oil level measurement procedure, described above, is carried out after a new component has been installed to establish correct oil quantity.

Component	Typical oil amount	
	fl.oz.	cc
Evaporator	2.0	60
Condenser	1.0	30
Receiver / drier	0.5	15
Hoses	0.3	10

Preliminary Inspection

1. Rotate the compressor shaft. Use a suitable socket on the hub centre bolt or by hand using the rubber dampers.

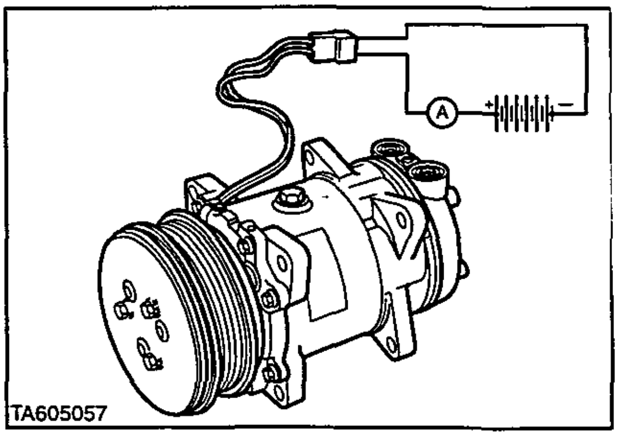
   If severe roughness is felt while rotating the hub, the compressor should be disassembled.

2. Using a 12 volt battery check current drawn by the field coil which should be between 3.6– 4.2 Amps.

   Very high current readings indicate a short circuit in the field coil and no current reading indicate an open circuit. Replace coil with either fault. Resistance of the coil using an ohmmeter should be approximately 3.0Ω at 20°C.

   A poor earth (ground) connection of the field coil will result in a low voltage.

3. Ensure clutch is disengaged and rotate pulley by hand. If roughness in the bearing is felt, it will be necessary to replace the pulley and bearing as an assembly.



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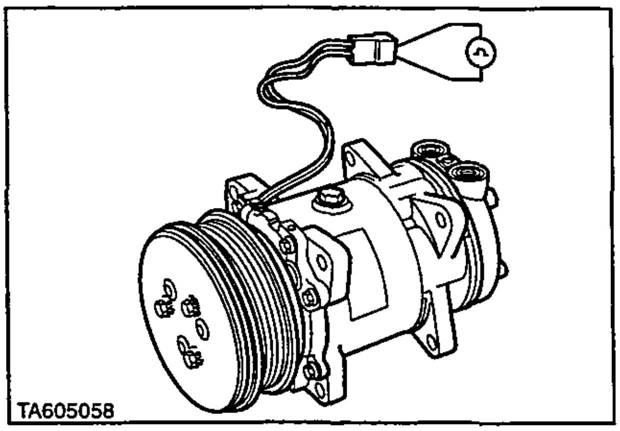

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Clutch Disassembly

Removal

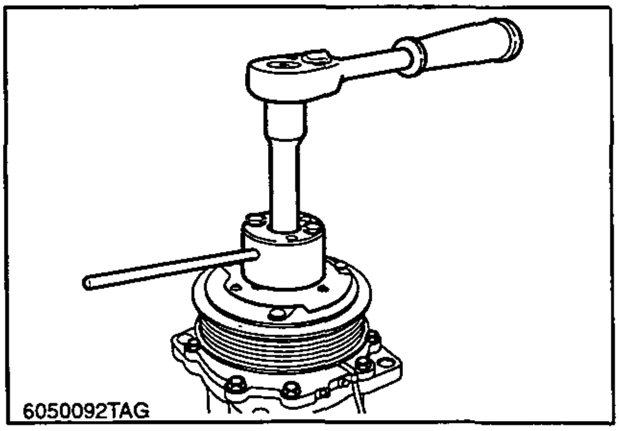
All clutch servicing should be done with the compressor removed from the vehicle:

1. Support the compressor. If using a vice, do not hold on to the housing.

2. Remove the cover on the front of the clutch plate.

3. Using the front plate tool hold the clutch plate stationary and remove the retaining nut from the end of the shaft. Figure 9.

4. Place a thread protector over the end of the driveshaft and using a puller remove the clutch front plate, Figure 10.



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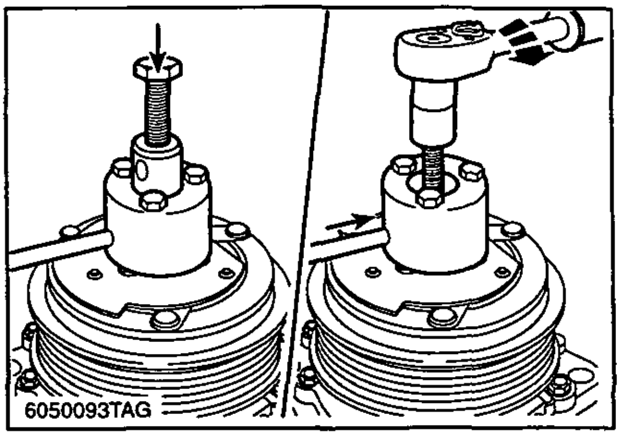

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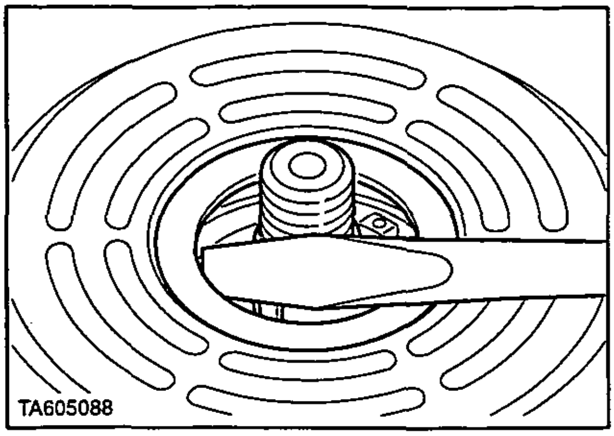
5. Carefully remove the bearing dust cover, if fitted.



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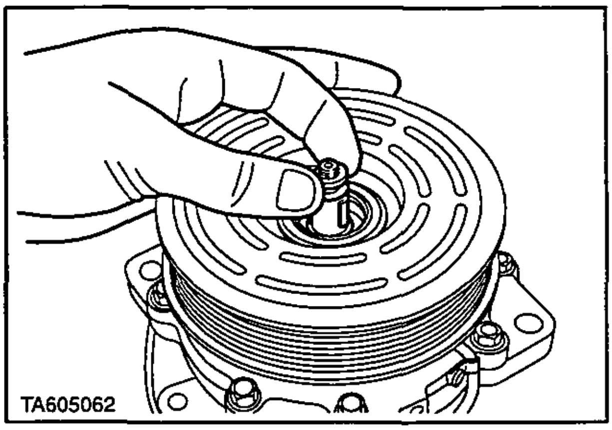
6. Remove the clutch shims



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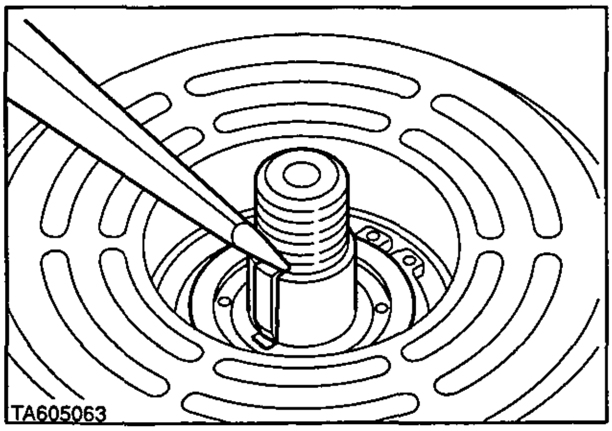
7. Remove the shaft key



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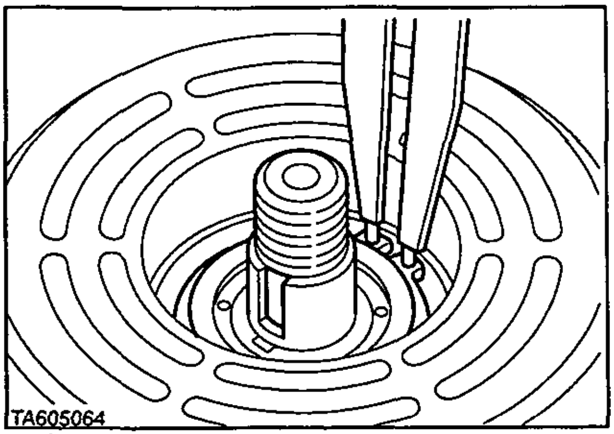
8. Remove the pulley bearing external snap ring



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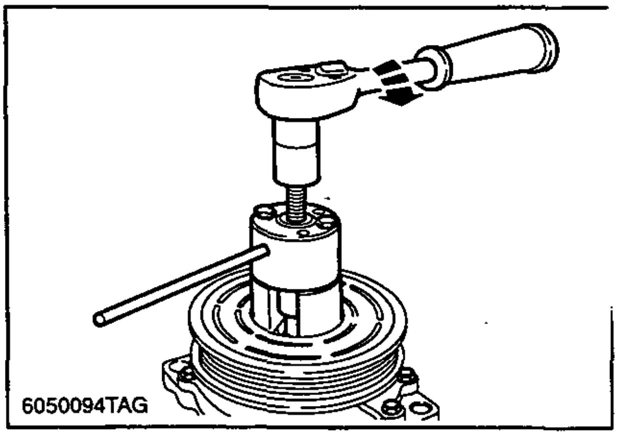
9. With a shaft protector over the exposed shaft, use a suitable puller to remove the clutch pulley.



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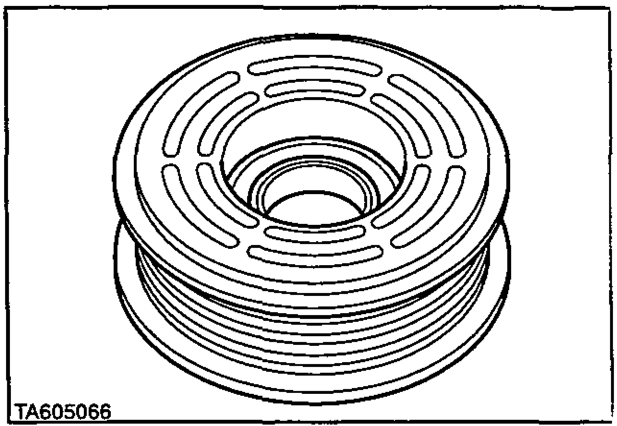
10. Inspect the pulley bearing for wear and replace where necessary.



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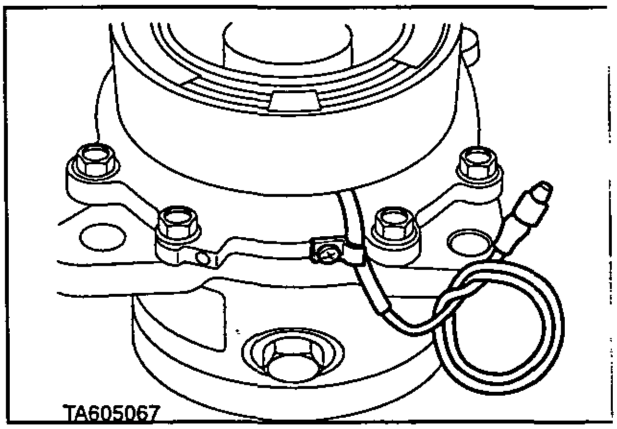
11.Remove the field coil wire retaining clip.



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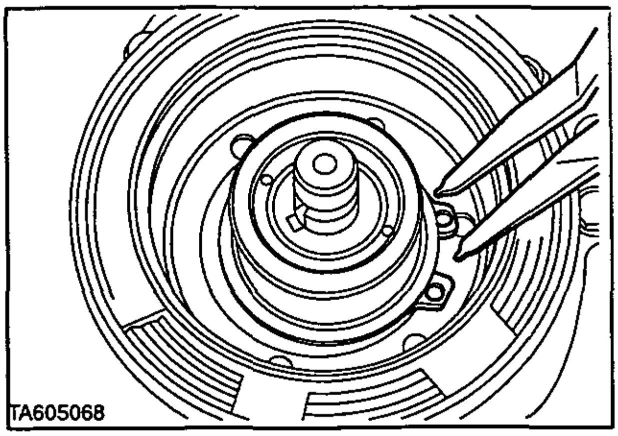
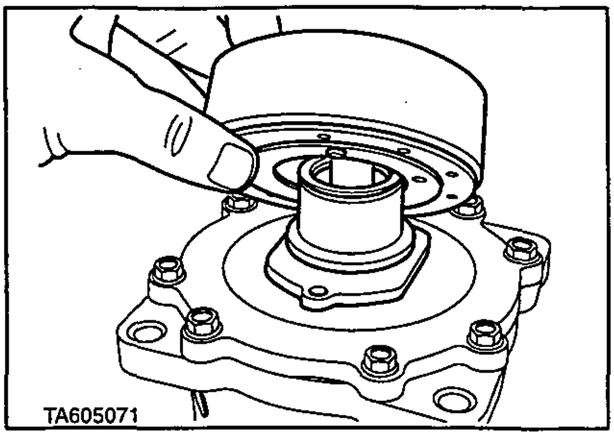
12. Remove the field coil retaining snap ring and lift the coil from the housing.



18

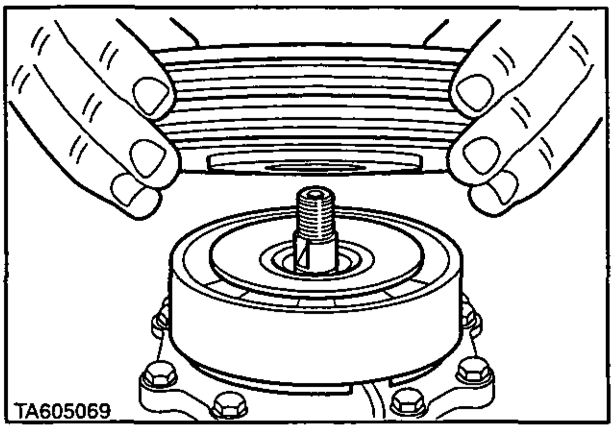
Clutch Reassembly

1. Install the field coil, ensuring that the lug on the compressor housing locates in the cut out on the back of the coil housing, secure with the snap ring.



19

2. Position the pulley on the housing hub.



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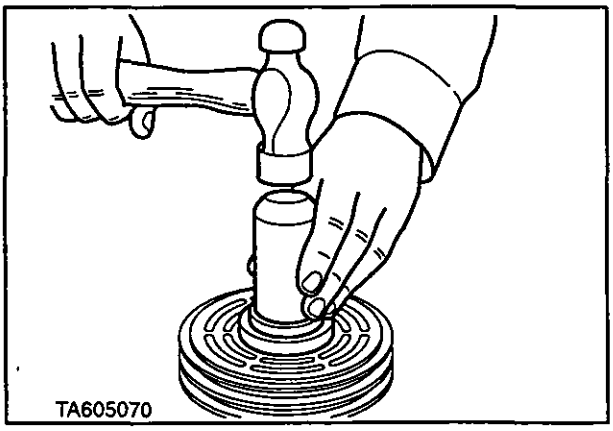
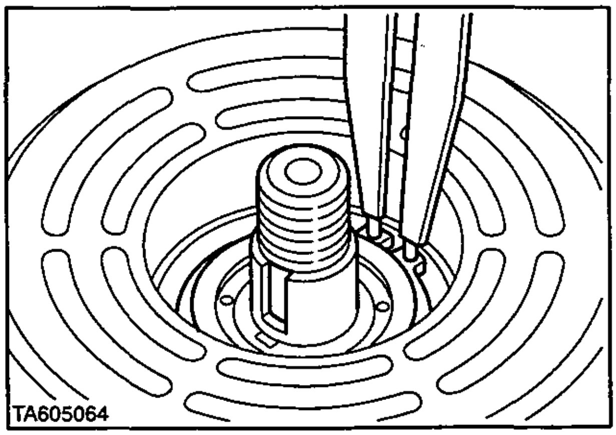
3. Using a suitable adaptor that rests firmly on the inner race of the pulley bearing, tap the pulley onto the front hub of the compressor.



21

4. Install the bearing snap ring.
5. Replace the original shims, key and a new bearing dust cover.



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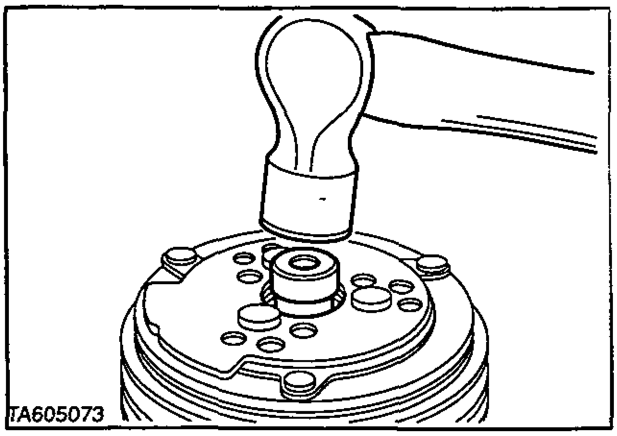
6. Install the clutch front plate and using a suitable adaptor, tap into position.



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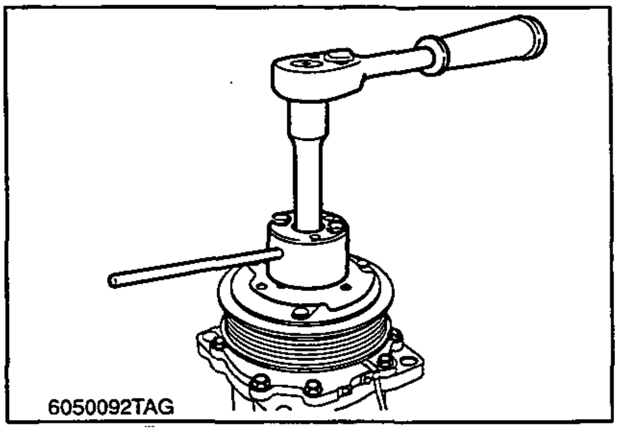
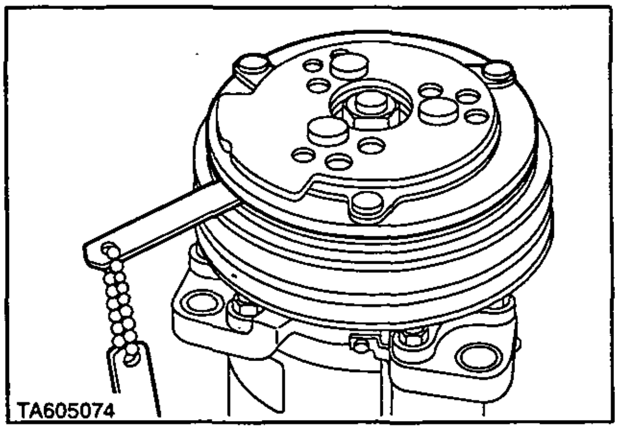
7. Replace the retaining nut and tighten to a torque of 18Nm (13lbf.ft).



24

8. Check the clearance between the clutch front plate and pulley. This should be consistent around the circumference and be between 0.4–0.8mm (0.016–0.031in.)
9. If the air gap is not consistent, lightly pry up on the counter weighted front plate at the low spots or lightly tap down at the high spots.



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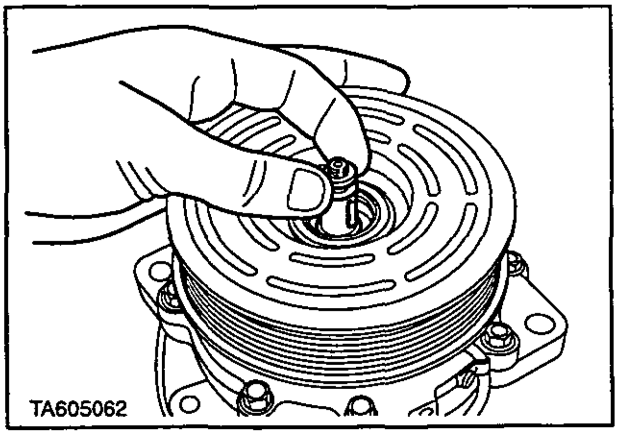
10. If the clearance is not within specification the shims under the front plate, Figure 26, should be added to or subtracted from until the correct clearance is obtained.

NOTE: *New shims are available in sizes 1.00, 0.50 and 0.13 mm, (0.040, 0.020 and 0.005 in.).*



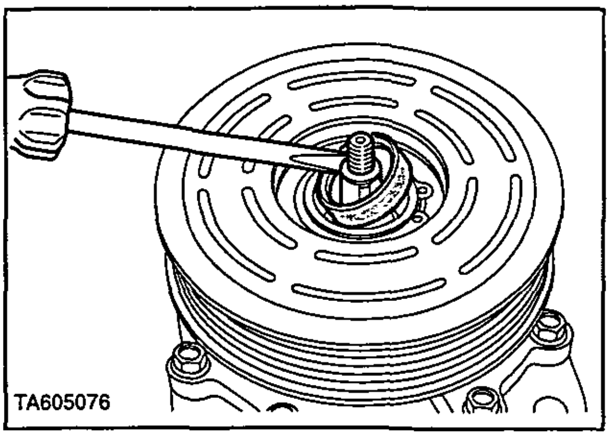
26

Shaft Seal Replacement

The refrigerant must be discharged from the system and the compressor removed from the vehicle prior to replacing the shaft seal.

Removal

1. Remove the clutch front plate, as detailed in steps 1 to 7 of clutch disassembly.
2. Using a suitable lever or pair of snap ring pliers, remove the felt ring.



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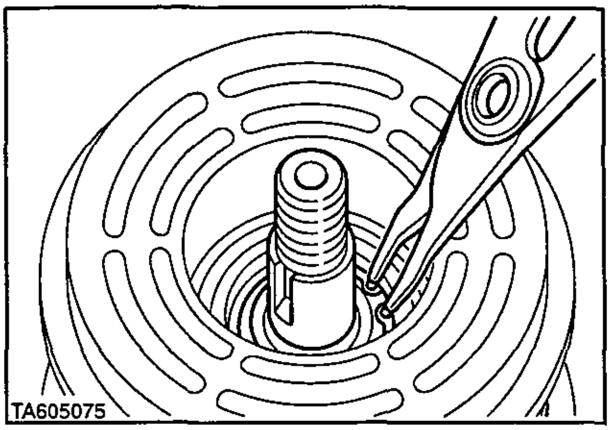
3. Remove the shaft seal retaining snap ring.



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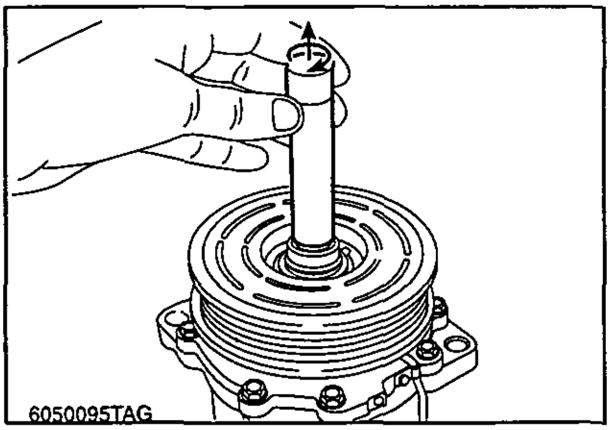
4. Insert the seal remover/installer tool. Twist the tool to engage the slots in the seal. Pull up to remove. Discard the seal.

NOTE: *If seal remover tool is not available, insert a suitable piece of hooked wire into the seal slot and pull out seal.*



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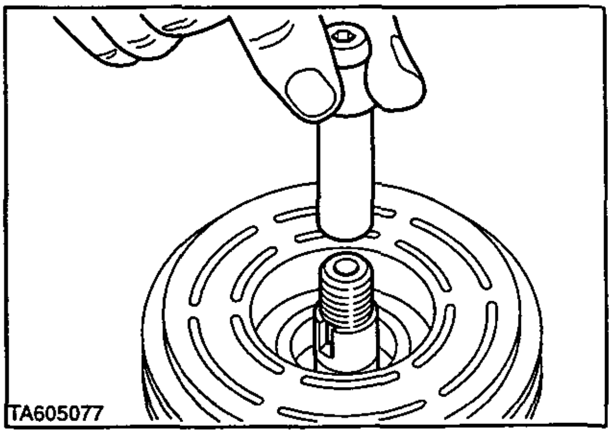
Installation

1. Thoroughly clean the seal cavity in the hub. Use 'lint free' cloth only.
2. Position the seal protector over the driveshaft.



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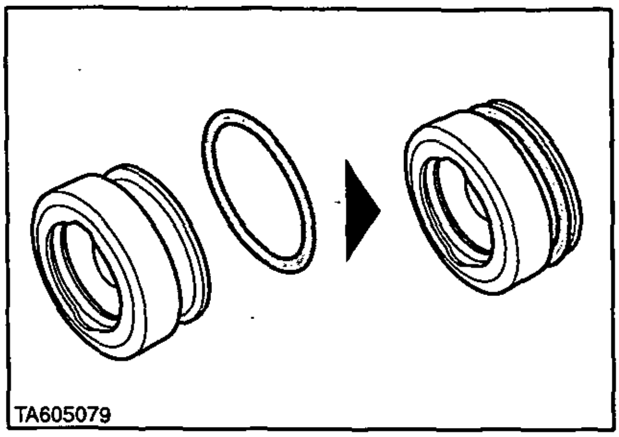
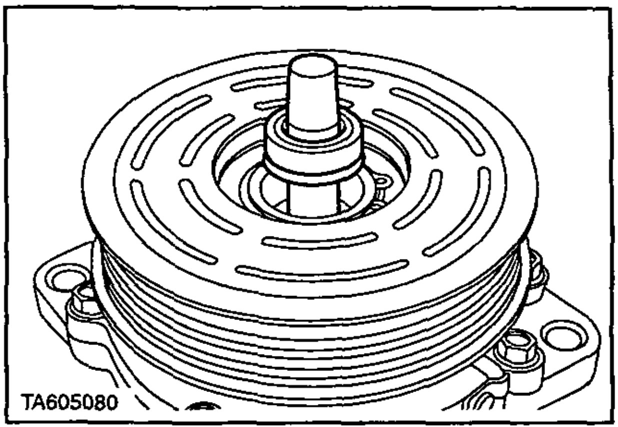
3. Ensure the shaft seal 'O' ring is installed onto the seal assembly.



31

4. Dip the new seal assembly in clean refrigerant oil and attach to the seal remover/installer tool.
5. Insert the new seal fully into the hub.

NOTE: *If remover/installer tool is not available, position the seal squarely in the hub and tap gently until fully seated.*



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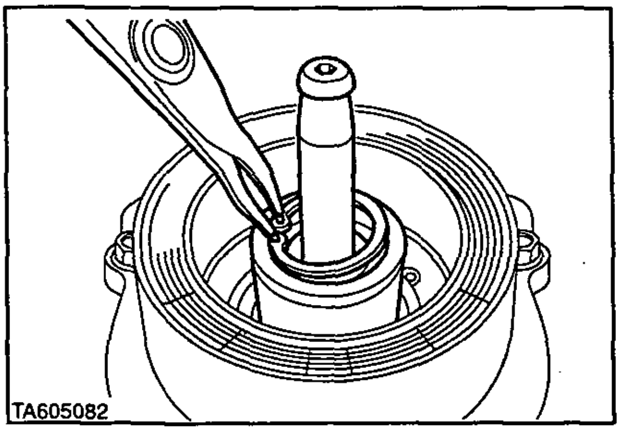
6. Install the seal snap ring. If the snap ring has a beveled edge this should face outwards.



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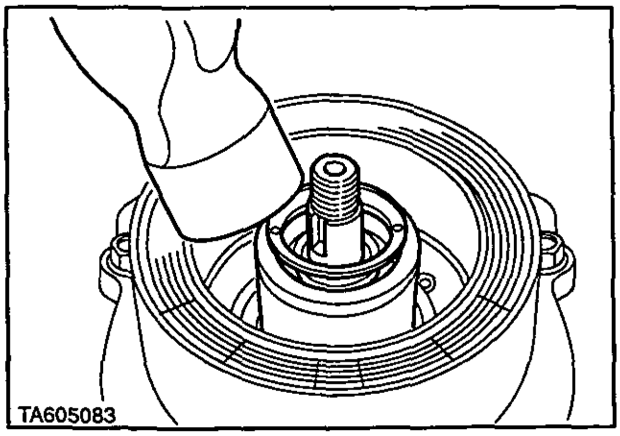
7. Install a new felt seal and gently tap into position.
8. Remove the shaft protector and position the shims over the shaft.
9. Reinstall the clutch front plate as described in clutch reassembly.



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CYLINDER HEAD SERVICING

Disassembly

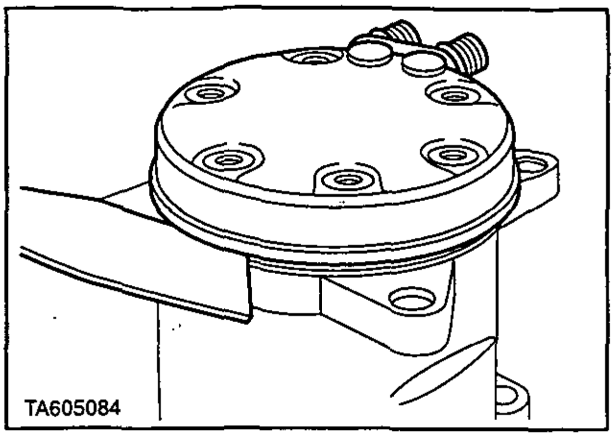
1. Drain the refrigerant oil from the compressor into a clean calibrated container. Measure and record the quantity of oil obtained. This information is required during installation of the new or overhauled unit.

2. Remove the six cylinder head bolts and using a hide mallet, gently tap the cylinder head free. The use of a gasket scraper may also be required to free cylinder the cylinder head from the compressor body.

3. If the valve plate and/or cylinder head are to be reused, carefully remove the gasket using a suitable scraper.

4. Gently pry the valve plate free from the cylinder block and remove the gasket.

5. Inspect the valve plate for damage.



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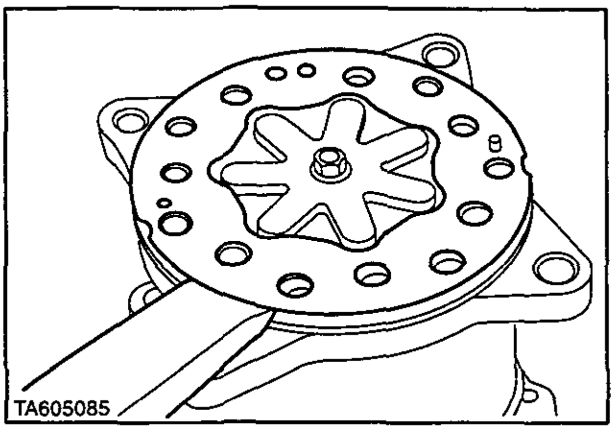

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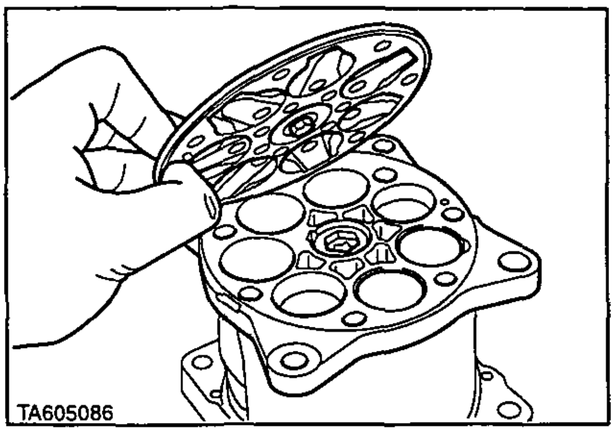

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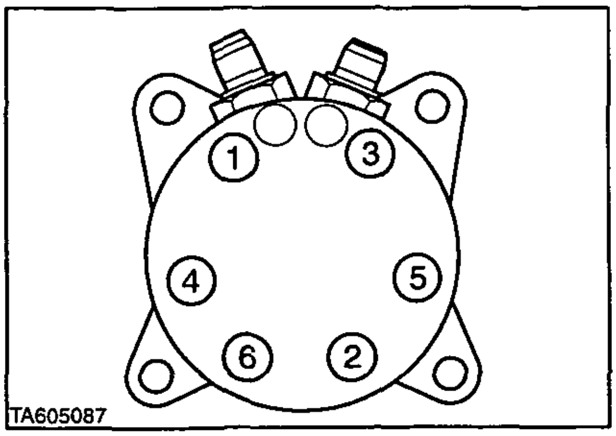
Reassembly

1. Coat the top of the valve plate with clean refrigerant oil and reassemble the cylinder head *using the reverse of the disassembly procedure.*

2. When installing the gaskets and valve plate ensure they are correctly positioned over the locating pins in the cylinder block.

3. Install the cylinder head bolts and tighten using the sequence shown in Figure 38. Torque initially to 20Nm (14lbf.ft) then finally to 32Nm (24 lbf.ft).

4. When the overhaul is complete add to the compressor a volume of oil equivalent to that drained prior to disassembly.



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12

PART 12
SEPARATING THE TRACTOR

Chapter 1
SAFETY CAB AND PLATFORM REMOVAL

A. SAFETY CAB AND PLATFORM DESCRIPTION

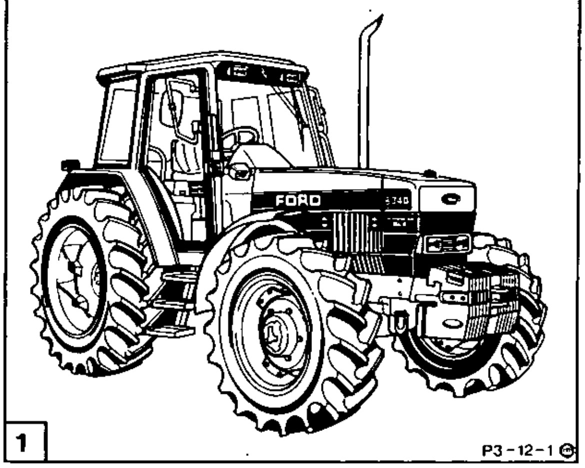
Safety Cabs, Figure 1, are of a steel monocoque construction, with an integral 6 post roll over protective structure.

The side and rear windows of the cab can be opened and locked in position to suit operator requirements. Low windows either side of the steering console and a large front screen allow excellent vision. Both Cab and Platform, Figure 2, offer a flat deck layout designed for operator ease of use.

The cabs are isolated from the tractor by rubber block bushes, mounted towards the front and rear of the cab, Figure 16 and Figure 17. The bushes are designed to absorb vibration and noise and improve the ride characteristics and operator comfort.

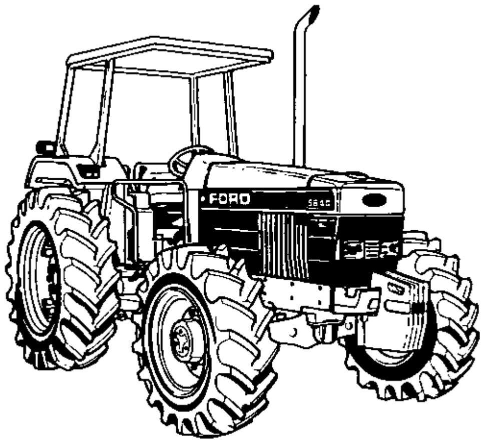
Various access panels are provided in the floor and steering console to allow servicing of the steering column, transmission and access below the floor pan.

Anti slip steps and hand grips are provided for ease of cab or platform entry and exit.



1

Safety Cab



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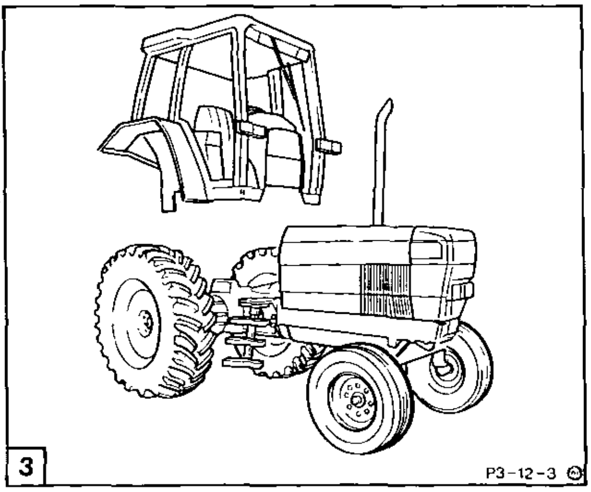
Platform (shown with 4 Post Roll Over Protection Support fitted)

SERVICING OF MAJOR COMPONENTS



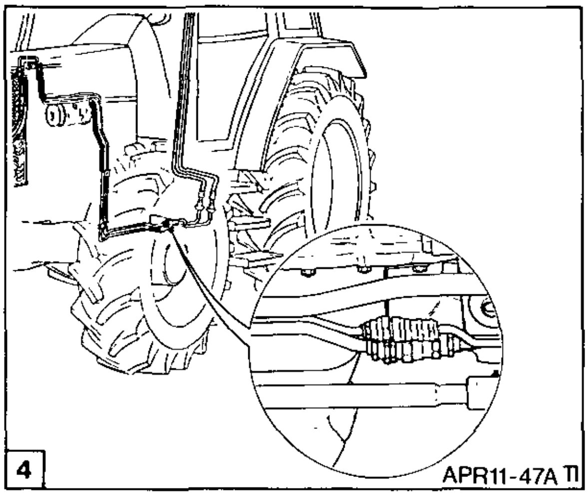
Lifting The Cab

IMPORTANT: *Description of the cab and platform disassembly is "general" for most models. Disassembly may vary slightly between vehicles dependent upon model and the options fitted.*

Listed below are the components that would require lifting or removal of the cab or platform to allow repairs, and facilitate repair of components difficult to access.

- **Hydraulic lift repairs and cover removal**
- **Brakes**
- **Front Transmission**
- **PTO Clutch**
- **Main Harness / Transmission Harness**
- **Rear Transmission**
- **Differential**
- **Separating between the front and rear transmission**
- **Hydraulic Pipework**
- **Underside of cab**

WARNING: *Do* ***not*** *attempt to disassemble the air conditioning system if fitted. It is possible to be* ***severely frostbitten or injured*** *by escaping refrigerant.*



Air Conditioning Quick Release Coupling

IMPORTANT: *To assist in cab removal, disconnect the Air conditioning hoses at the quick release couplings only, Figure 4, situated on the left hand side of the vehicle.*

WARNING: *The air-conditioning system contains R–12 refrigerant. This refrigerant is* ***not compatible*** *with R–134A refrigerant. Do* ***not*** *use gauges or test equipment previously used with R134A refrigerant as damage to the system will result.*

If disassembly of the Air Conditioning hoses is required at connections other than the quick release couplings, the refrigerant in the system must be evacuated into an Air Conditioning reclaim/recharge unit, refer to Air Conditioning, Chapter 11 Part 1.

IMPORTANT: *Do* ***not*** *allow refrigerant to escape into the atmosphere. If a repair or replacement becomes necessary, ensure that only certified Air Conditioning technicians are employed, using approved equipment to effect repairs.*

B. PREPARATION FOR REMOVING THE CAB FROM THE VEHICLE REFER TO, Figure 5.

IMPORTANT: *If the cab is to be lifted or removed, ensure the tractor is positioned on flat ground, with the wheels chocked and the battery disconnected.*

To minimise leakage of coolant or oil ensure all taps are turned off before disassembly. Plug all open pipes and ports to prevent dirt ingress.

Before disassembly ensure the hydraulic linkage is fully down. Point of lift position at the lever may require adjustment on re–assembly. Refer to hydraulic section, Part 8 Chapter 4 for correct setting procedure.

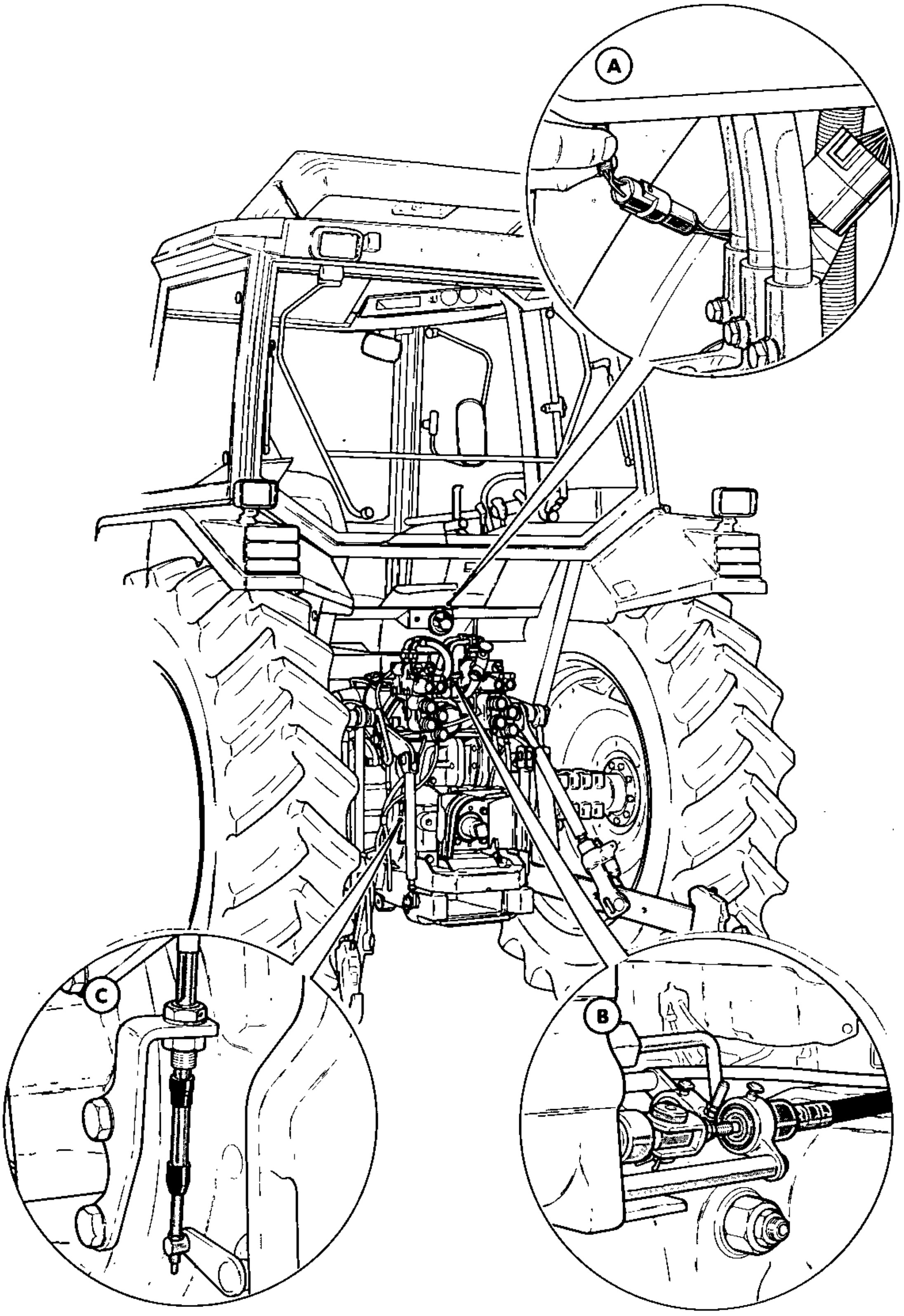
Cab Disassembly (Internal)

1. **Floor Mat** – Remove the kick plates and lift out the cab floor mat.
2. **Cab Floor Panels** – Remove the floor panels and access plates.
3. **Throttle Knob** – Remove attaching screw and remove knob from lever.
4. **Gear Shift Levers 16x16** – Remove gear lever knobs, the lower access panel and disconnect the harness connectors item A, figure 4. Remove the 4 screws on console and carefully lift off cover. Remove gear lever locking bolts and remove gear levers, item A.
5. **Gear Shift Levers (Not 16x16)** – Remove the gear knobs and the 4 screws on console and lift of the cover. Remove the lower access cover to gearshift and disconnect lever spring and hair clips remove the levers, item A.

Cab Disassembly (External)

1. **Cab Looms** – Disconnect at the harness connector, item A and tie back.
2. **Lift Actuator (Top Link Sensing Only)** – Disconnect and remove the right hand actuator and linkage from the hydraulic power lift. Disconnect the remainder of the linkage.
3. **Auxiliary Services Control Linkage** – Disconnect the linkage from the vehicle, where fitted.
4. **Remote Valves** – Disconnect the cable assembly at the rear of the remote valve block, item B. Re–adjustment of the lever position may be required upon re–assembly.
5. **Auto Pick Up Hitch (Where Fitted)** – Remove the clevis pin and disconnect the operating rod at the lever to the side of the auto hitch frame. Remove the cable from the fixing bracket.
6. **Two Speed Power Take Off (Where Fitted)** – Disconnect the cable at the lever to the left hand side of the rear axle, by removing the ‘C’ clip and removing the cable from the fixing bracket item C. Re–adjustment of the lever position may be required upon re–assembly.
7. **Cab Earth Strap** – Loosen and detach the strap from the hydraulic top cover.

CAB AND REAR OF THE VEHICLE



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APMH-129 TI

RIGHT HAND SIDE OF THE VEHICLE
REFER TO, Figure 7.

1. **Battery** – Disconnect the battery **'Earth'** lead first to prevent damage to the electrical components, and disconnect the fuel cut off loom. Remove power feed to solenoid from the battery clamp item F.

2. **Throttle Cable** – Disconnect the cable at the fuel pump and slacken and disassemble the cable attaching hardware on the support bracket, item A.

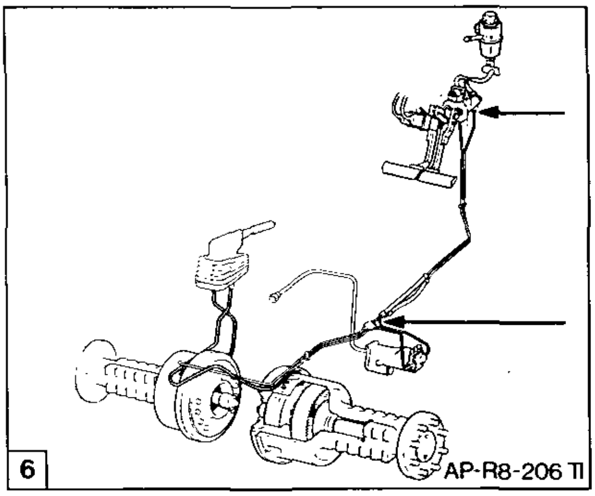
3. **Cab Step** – Right hand remove for access to the underside of the cab, item C.

4. **Radar** – (where fitted) disconnect and remove the radar and bracket from the vehicle.

5. **Main Harness** – Disconnect the main loom connector E1, positioned below and to the right hand side of the cab, item B, and tie back.

6. **Extension Harness** – Disconnect the harness connector C1, item D.

7. **Clutch Cable 16x16** – Disconnect the clutch cable at the clevis connector behind the battery box, item E, and detach from fixing bracket.



6

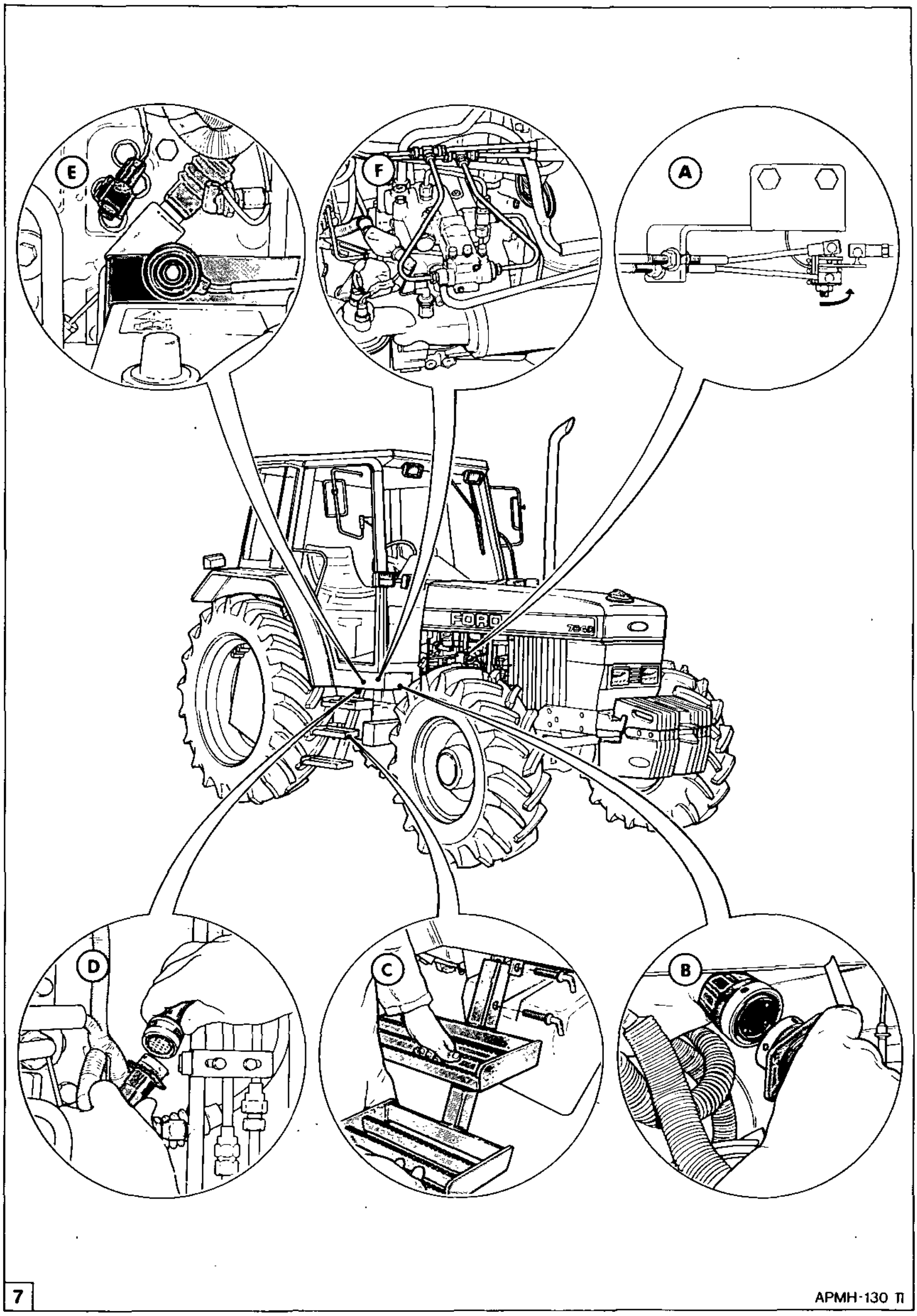
Tractor Brake Circuit

8. **Brake Fluid Reservoir** – Drain the oil and remove the reservoir and bracket from the cab bulkhead, tie back out of the way, Figure 6. Disconnect the brake pipes at the master cylinder.

9. **Power Assist Steering Pipes** – Disconnect and remove the pipe clamp from the right hand side of the transmission. Disconnect the supply pipes at the right hand side of transmission and disconnect the pressure feed pipe to the steering motor from the pump.

10. **Harnesses** – Disconnect all remaining looms and retaining straps and plugs at the hydraulic pump connections.

RIGHT HAND SIDE OF THE VEHICLE



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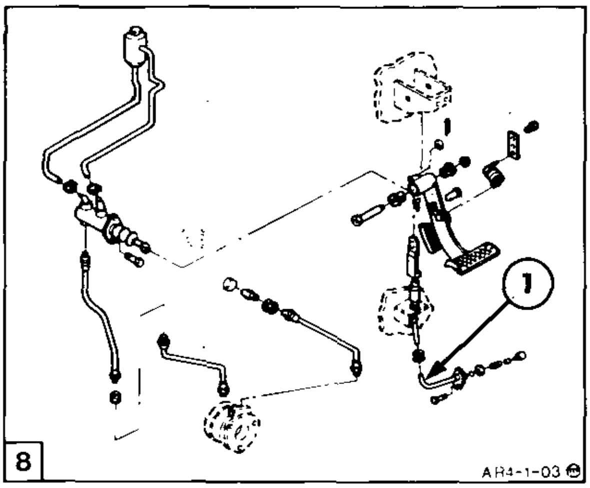
APMH-130 TI

LEFT HAND SIDE OF THE VEHICLE
REFER TO Figure 9

1. **Hand Brake Cables** – Disconnect the hand brake cables inside the cab, item A, and pull back through the cab floor.

2. **Cab Step Left Hand** – Remove the cab step to assist access to the underside of the cab.

3. **Clutch Interlock Cable 12x12** – Loosen and remove the attaching hardware, along with 'O' Ring, spring and ball from the front of the transmission, Figure 8.



8

Clutch Operating System

1. Clutch Interlock

4. **Clutch Reservoir** – Drain the oil and remove the reservoir from the bulkhead and tie back out of the way. Drain residual oil from the system and disconnect the oil pipes from the master cylinder.

5. **Radar** – (where fitted) disconnect and remove the radar and bracket from the vehicle.

⚠ **WARNING:** *Air Conditioning systems operate under pressure, when disconnecting the hoses, care should be taken to avoid personnel injury or leakage of the refrigerant into the atmosphere.*

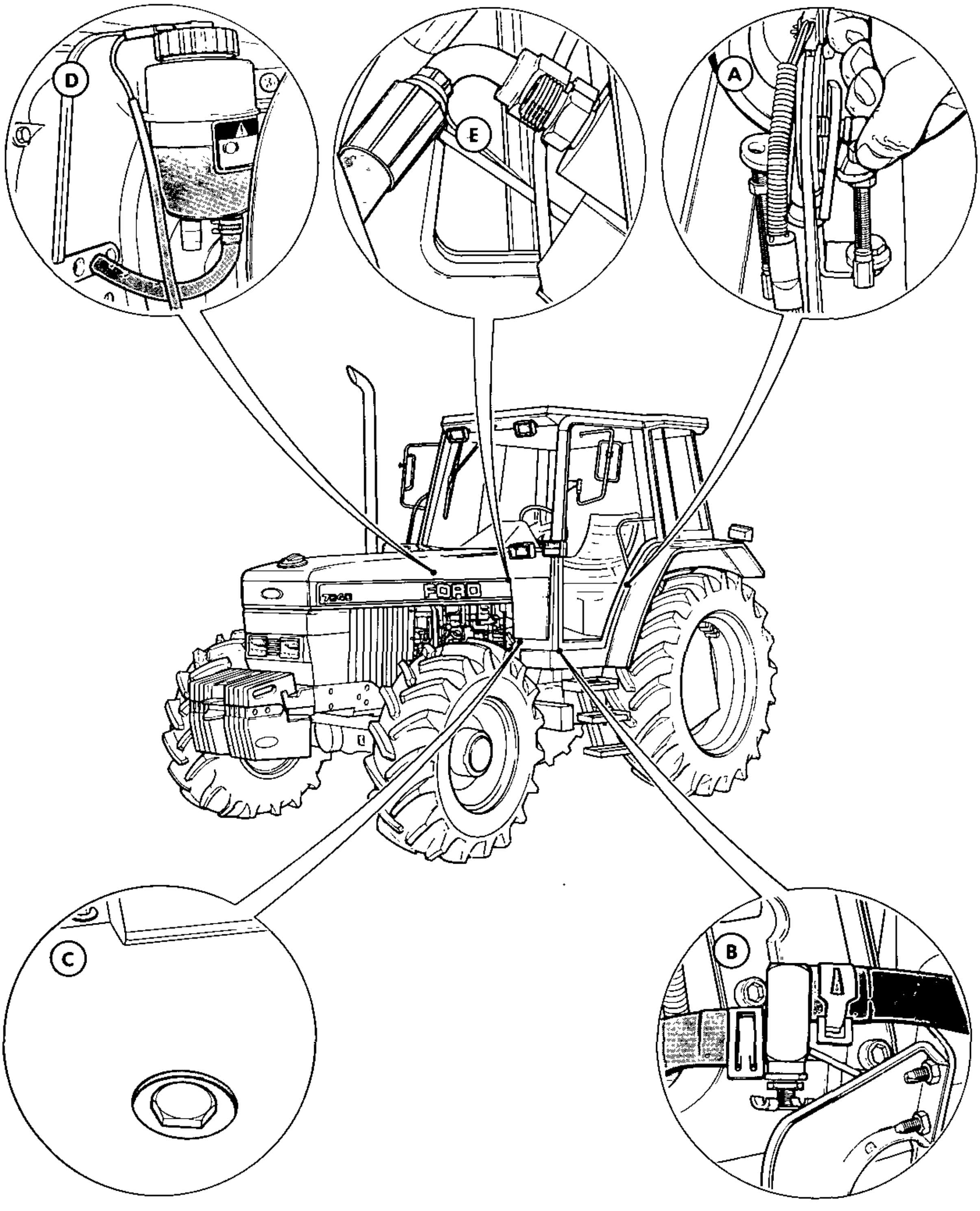
6. **Air Conditioning Hoses (Where Fitted)** – Disconnect the air conditioning hoses at the quick release couplings only, Figure 4, situated to the left hand side of the engine block.

7. **Heater Hoses** – Turn off the heater taps to prevent coolant loss from the system and disconnect the heater hoses, either side of the cab below the 'A' pillars.

Item A, Figure 7 – On right hand side
Item B, Figure 9 – On left hand side

Plug both hoses to prevent loss of coolant

LEFT HAND SIDE OF THE VEHICLE



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APMH-128 TI

LIFTING THE CAB
REFER TO, Figure 10

Lifting The Cab (Using FTC 213997 Spreader Bar and FTC 307943A Spacers) – Remove the centre two cab roof retaining bolts and transfer the sealing washers to the two lifting spacers. Thread the spacers into the cab roof until the washers are tight. Install the cab lifting fixture on the spacers and tighten the top nuts, item A.

Lifting The Cab (Using FT 10000 Lifting Kit) – Remove the centre two cab roof retaining bolts and replace the sealing washers in position where the roof bolts have been removed. Place the spreader bar "integral spacers" over the cab roof bolt holes and thread the bolts through the spreader bar and spacers into the roof. Tighten the bolts sufficiently to apply nominal pressure only on the cab roof.

NOTE: *Over tightening of the lifting bolts may damage the cab roof.*

Slowly raise the hoist sufficiently to take out any slack in the lifting chains and stop the hoist.

1. **Rear Mounting** – Loosen and remove the rear mounting bolts items B and C.

2. **Front Mounting Bolts** – With the nuts removed, the cab through bolts can remain in position as the cab is lifted, item E.

IMPORTANT: *It may be necessary with certain options fitted to slacken the cab support to rear axle mounting bolts. This allows the support an amount of float when the cab is lifted.*

Slowly raise the cab from the chassis ensuring that all cables, rods and hoses etc, are free to move.

With the cab clear of the chassis and safely seated on the ground on wooden sleepers, the vehicle can be repaired as required.

Re–assembly Of Cab To Chassis

After completion of repairs re–assemble cab to the vehicle in reverse order of disassembly.

When re–assembling, slowly lower the cab onto the chassis ensuring all looms, pipes and ancillary equipment is clear of the chassis.

With the cab decked re–attach pipes, hoses, looms and levers in the reverse order to disassembly.

Ensure all cab attaching hardware torque values are correct to specification, as detailed in 'Section D'.

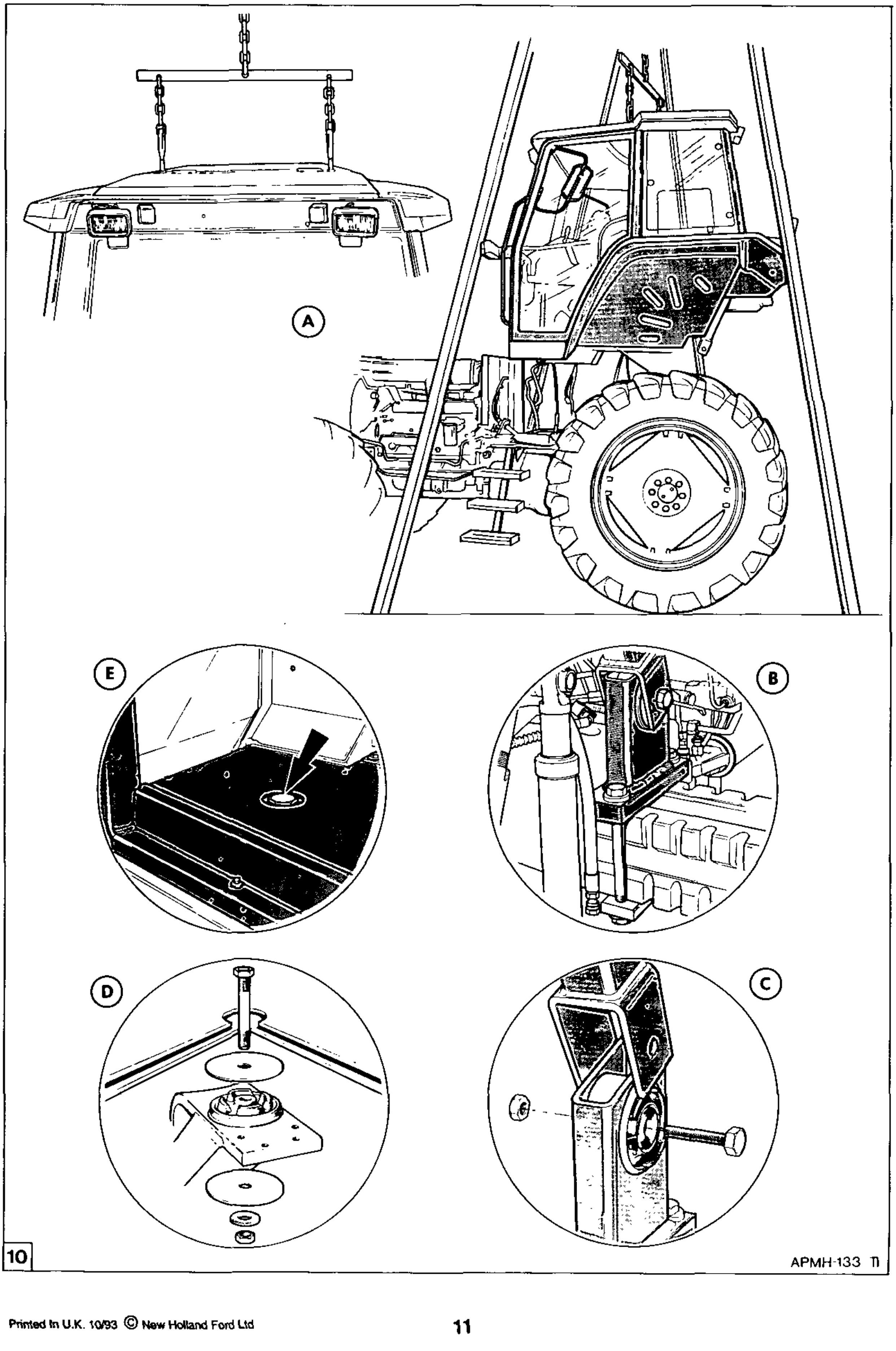
For torque values of ancillary components and hardware – refer to the appropriate repair manual chapters for individual component torque values, setting and adjustment procedures.

IMPORTANT: *When reconnecting the battery the electronic circuits may require resetting / re–calibration as the keep alive memory is limited when the battery is disconnected. Refer to the appropriate Repair Manual Chapter for full information.*

To reset the radio refer to the operators manual for tuning purposes.

Refill fluid levels and run vehicle to normal operating temperature too purge air out of the systems. Stop the engine and after sufficiently cooled, recheck and top up fluid levels as required.

LIFTING THE CAB



C. REMOVING THE PLATFORM FROM THE VEHICLE

IMPORTANT: *If the platform is to be lifted or removed, first ensure the tractor is positioned on flat ground with the wheels chocked and the battery disconnected as in paragraph 2.*

Before disassembly ensure the hydraulic linkage is fully down and locked to maintain point of lift position at the lever. Refer to hydraulic section, Part 8 Chapter 4 for correct setting procedure on re–assembly.

1. **Battery** – Disconnect the battery earth lead first to prevent damage to the electrical components, and disconnect the fuel cut off loom.

2. **Floor Mat** – Remove the kick plates and cab floor mat.

3. **Hand Brake Cable** – Loosen and remove and pull cable through platform

4. **Gear Lever Assembly** – Loosen and remove the gear knobs, remove the four console screws and remove with care. Remove lower access cover to gearshift and disconnect lever spring and hair clips, remove the levers. Undo and remove gear shift shroud.

5. **Throttle knob**, Hydraulic Knobs and Remote Lever Knobs, remove from levers.

6. **Throttle Cable** – Disconnect the cable at the fuel pump and slacken and disassemble the cable attaching hardware on the support bracket, item A, Figure 7.

7. **Hydraulic Console** – Remove the eight retaining screws. Remove 'E' clip from throttle, loom clip and push out Auxiliary Service Control rod where fitted.

8. **Seat** – Slide forward to expose platform attaching hardware and remove.

9. **4 Post Roll Over Protection Support** – The R.O.P.s (where fitted) should remain attached to the fenders. Remove as an assembly from the vehicle.

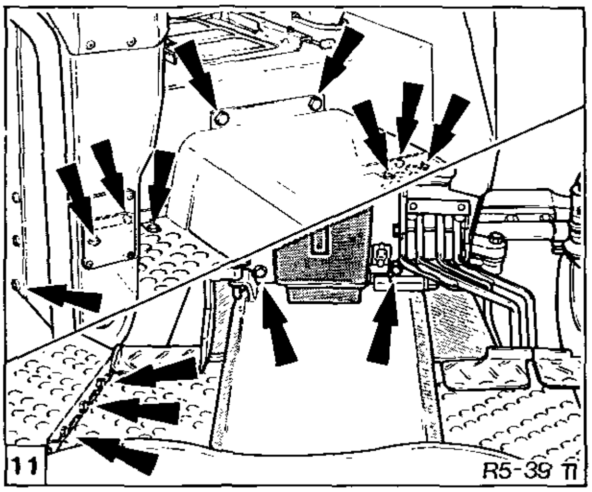
10. **2 Post Roll Over Protection Support** – Loosen and remove from the rear axle.

11. **Looms** – Remove loom / clips, trailer socket loom and unclip back to the transmission plate. Loosen and remove the bolts along lower edge of fender.

12. **Hydraulic lift levers** – Loosen and remove all the linkages, split pins and springs.

13. **Attaching bolts** – Remove all retaining hardware, Figure 11, including the pan and transmission plate.

IMPORTANT: *Prior to lifting the platform secure the leading edge of the instrument console (by attaching a strap from the console to a suitable fixed point on the platform) to prevent fracture of the lower steering console when unsupported, during lifting.*



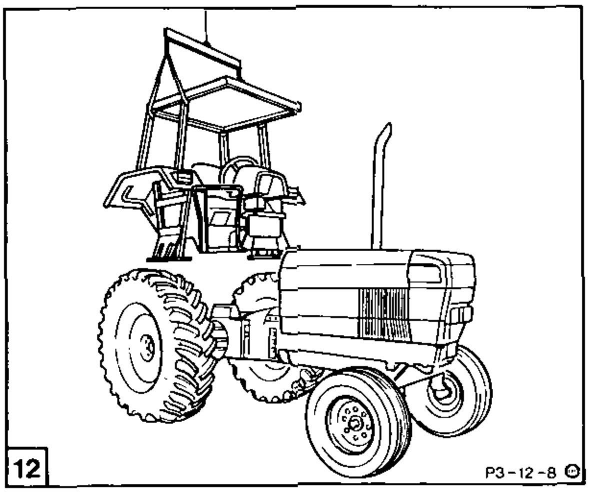
Platform Securing Bolts

Lifting the Platform

Using the correct lifting equipment, lift the platform slowly to expose the remotes (when fitted) and disconnect the PTO loom.

IMPORTANT: *When lifting the platform with a ROPS fitted, use the spreader bar with straps supporting the frame around the support posts.*

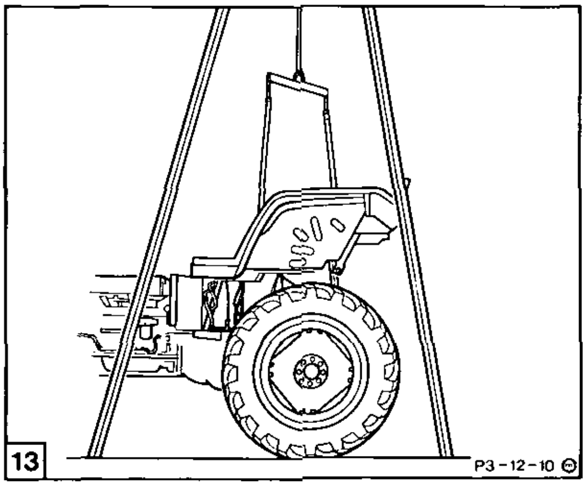
12



Lifting Platform and 4 Post Roll Over Protection Support (ROPS) Where fitted

IMPORTANT: *When lifting a platform less the ROPS place the strap around the fenders and lift the platform only sufficiently to move the platform away from the vehicle.*

13



Lifting the platform

Slowly raise the platform ensuring all looms, pipes, and hardware are detached between the platform and vehicle.

With the platform safely clear of the vehicle repairs can be performed on the vehicle.

Re–assembly Of Platform To Chassis

After completion of repairs re–assemble platform to the vehicle in reverse order of disassembly.

When re–assembling, slowly lower the platform onto the chassis ensuring all looms, pipes and ancillary equipment are clear of the chassis.

With the platform decked re–attach pipes, hoses, looms and levers in the reverse order to disassembly.

Ensure all platform attaching hardware, torque values,`are correct to specification, as detailed in 'Section D'.

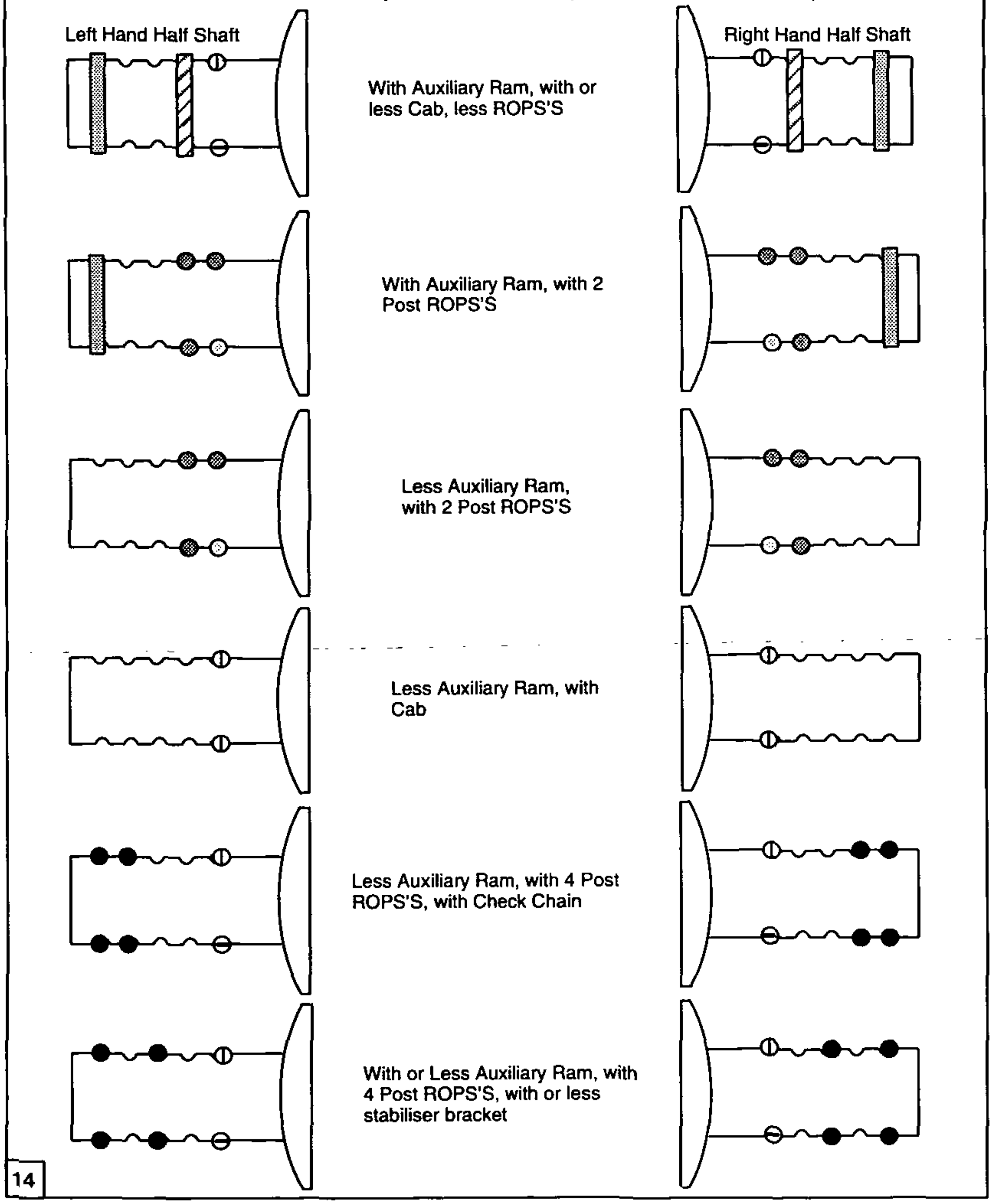
For torque values of ancillary components and hardware – refer to the appropriate repair manual chapters for individual component torque values, setting and adjustment procedures.

IMPORTANT: *When reconnecting the battery the electronic circuits may require resetting / re–calibration as the keep alive memory is limited when the battery is disconnected. Refer to the appropriate Repair Manual Chapter for full information.*

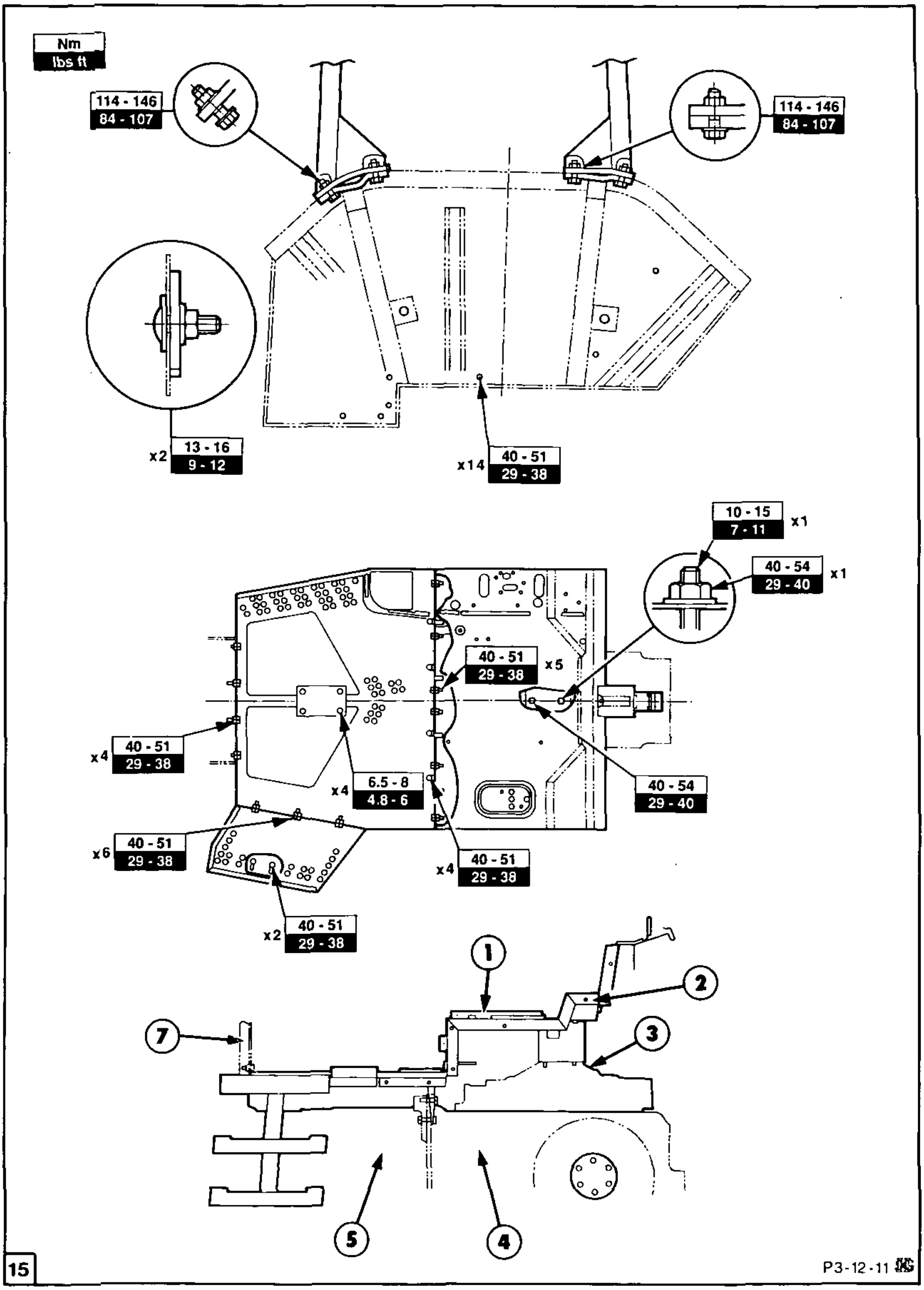
Refill fluid levels and run vehicle to normal operating temperature too purge air out of the systems. Stop the engine and after sufficiently cooled, recheck and top up fluid levels as required.

D. SPECIFICATIONS – TORQUES

Rear Axle Mounted Option Hardware Torques (As viewed from above)

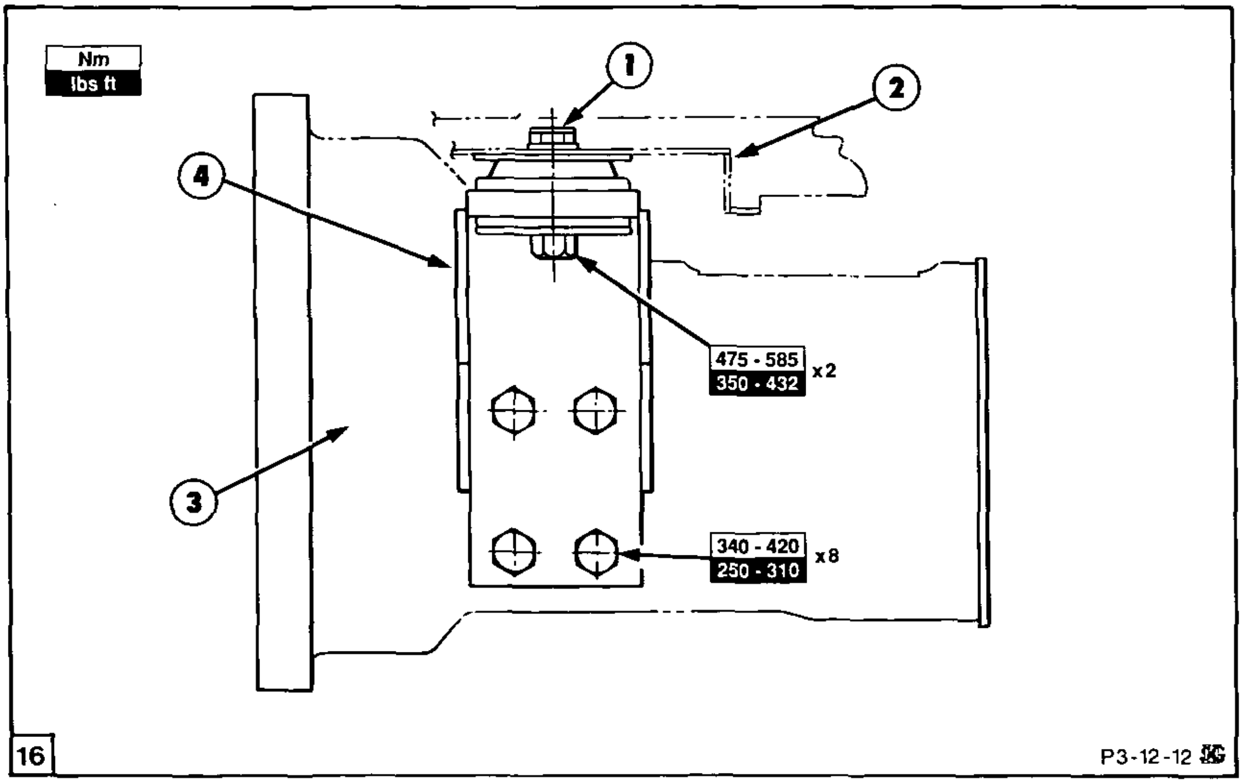


Legend	Description		lbf ft	Nm
▒	5/8in (16mm)	U / Bolt	110	150
▨	3/4in (19mm)	U / Bolt	200	270
⦶	3/4in (19mm)	Bolt (Grade 5)	280	380
⊖	1in (25mm)	Bolt (Grade 5)	610	830
◉	3/4in (19mm)	Bolt (Grade 8)	310	420
◎	1in (25mm)	Bolt (Grade 8)	678	920
●	5/8in (16mm)	Bolt	156	210



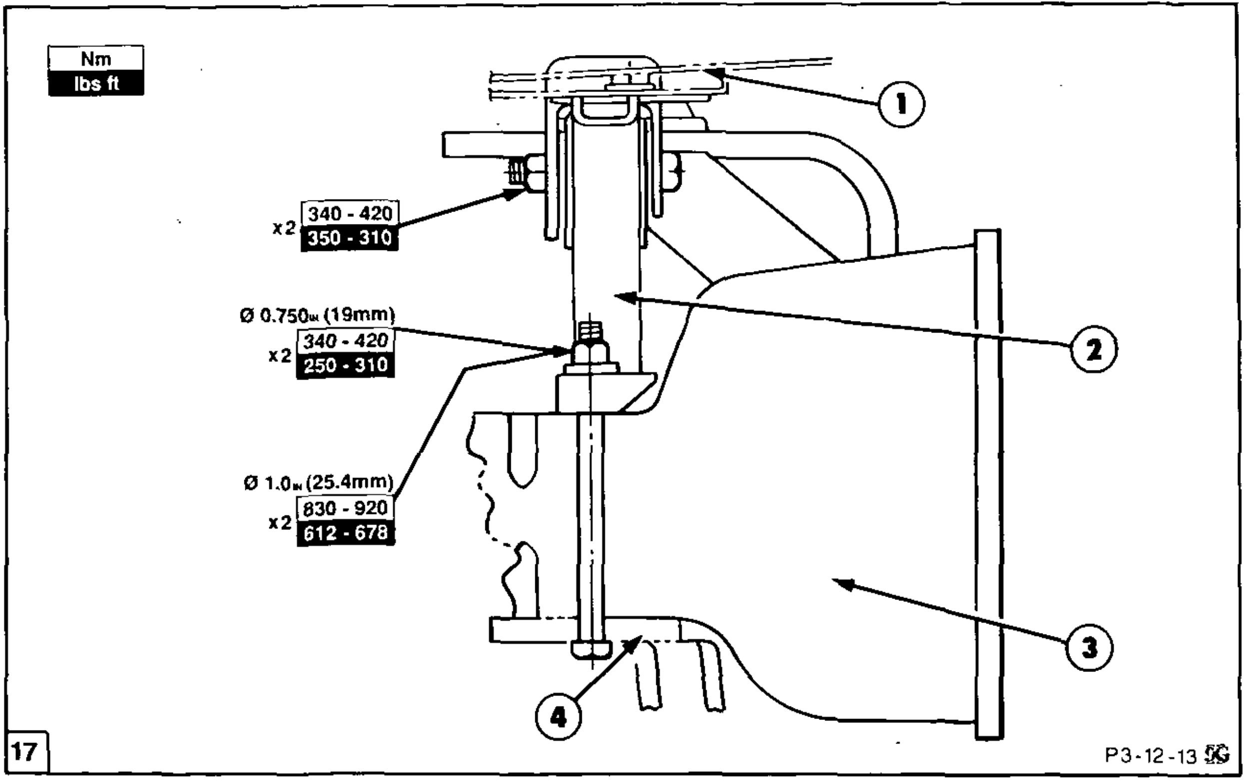
Platform to Vehicle Assembly

1. Platform
2. Platform to Fender
3. Hydraulic Top Cover
4. Rear Axle
5. Front Transmission
6. Step Left Hand
7. Steering Console



Front Cab Mount (Left Hand Shown)

1. Cab Bolt (Through Floor to Support Bracket)
2. Cab Floor
3. Front Transmission
4. Support Bracket



Rear Cab Mount (Left Hand Shown)

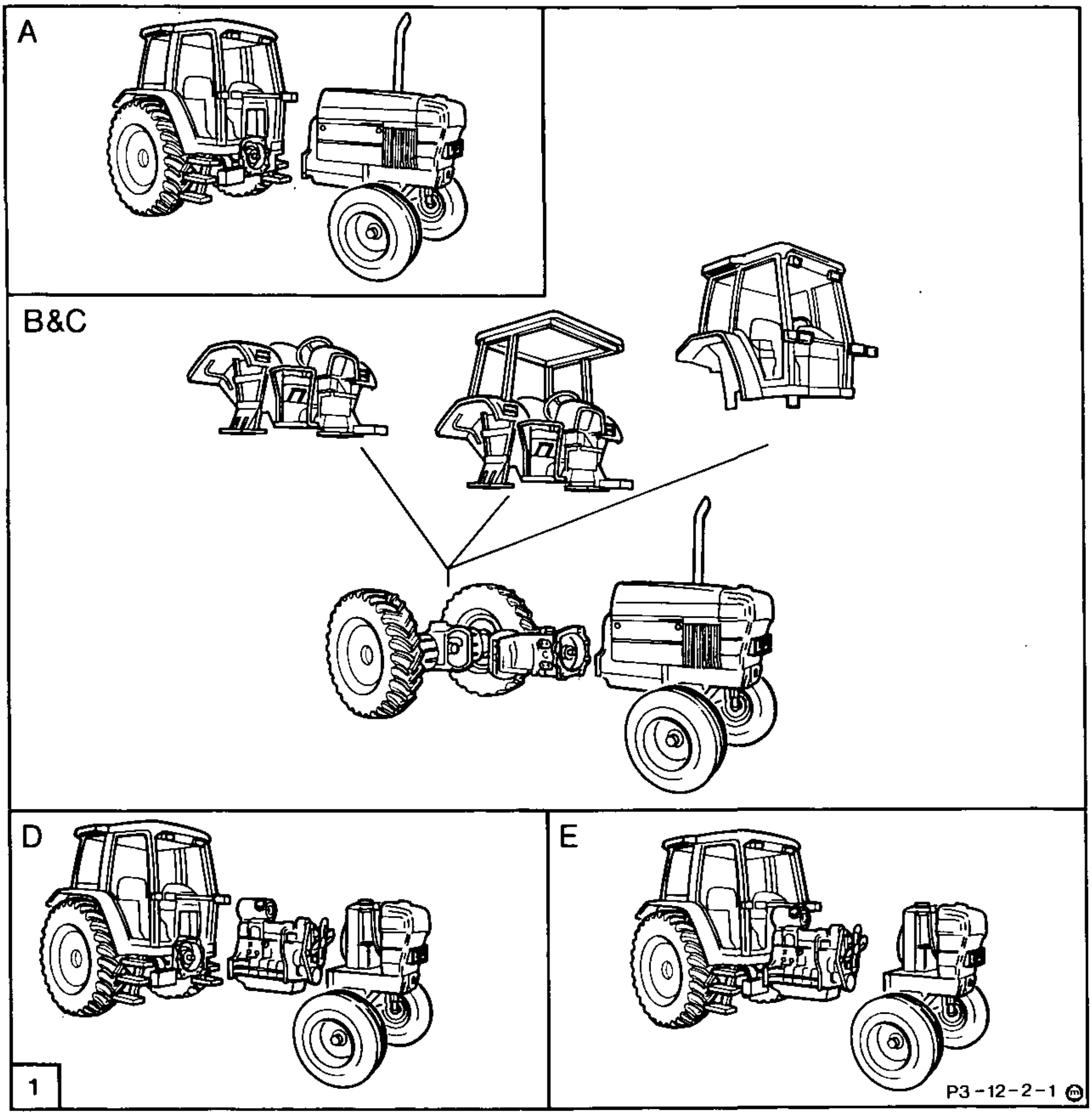
1. Cab Floor
2. Rear Cab Support
3. Half Shaft Housing
4. Lower Link Bracket

E. TOOLS

Description	V.L CHURCHILL	FNH (Finis No)	OTC
Cab Lifting Spreader Bar			FTC 46911
Cab Lifting Spreader Bar			FTC 213997
Cab Lifting Spacers			FTC 307943A
Cab Lifting Bar (Universal)	FT10000	T.B.A	FTC 213997B

PART 12
SEPARATING THE TRACTOR

Chapter 2
VEHICLE SEPARATION



A. SEPARATING ENGINE FROM THE FRONT TRANSMISSION

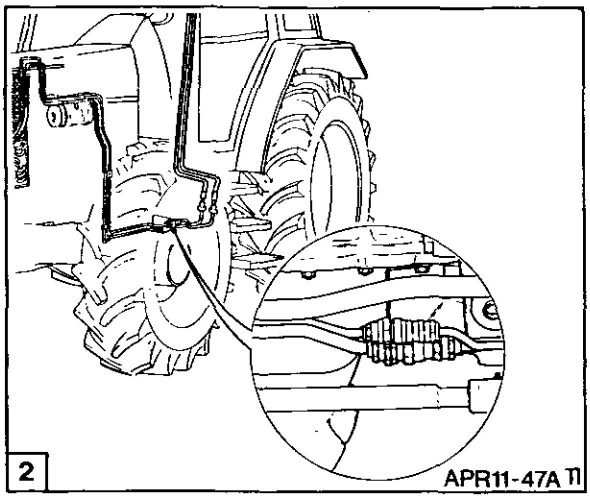
IMPORTANT: *In the interests of safety and efficient repair of the vehicle, read all of the following paragraphs, before commencing with the vehicle separation. Ensure all equipment to be used is correct for the repairs to be performed and is in good, safe working order.*

AIR CONDITIONING

⚠ **WARNING:** *Do **not** attempt to disassemble the air conditioning system where fitted. It is possible to be **severely frostbitten or injured** by escaping refrigerant.*

IMPORTANT: *Do **not** allow refrigerant to escape into the atmosphere. If a repair or replacement becomes necessary, ensure that only certified Air Conditioning technicians are employed, using approved equipment to effect repairs.*

IMPORTANT: *To assist with vehicle separation, disconnect the Air conditioning hoses at the quick release couplings only, situated on the lower left hand side to rear of the engine, Figure 2. If disassembly of the hoses is required at connections other than the quick release couplings, the refrigerant in the system must be evacuated into an Air Conditioning reclaim/recharge unit, refer to Chapter 11 Part 1.*



2

Air Conditioning Quick Release Couplings

⚠ **WARNING:** *The air-conditioning system contains R–12 refrigerant. This refrigerant is **not compatible** with R–134A refrigerant. Do **not** use gauges or test equipment previously used with R134A refrigerant as damage to the system will result.*

ELECTRICAL

IMPORTANT: *To minimize the possibility of damage to the electrical circuits disconnect the **Earth Lead First** from the battery.*

– *Never make or brake any of the charging circuit connections including the battery when the engine is running.*

– *Never short any of the charging components to earth.*

– *Do not use a slave battery of higher than 12 volt nominal voltage.*

– *Always observe correct polarity when installing a battery.*

– *Always disconnect the battery **Earth Cable First,** before carrying out arc welding on the tractor or any implement attached to the tractor. Locate the arc welder **Earth Clamp** close to the part under repair.*

GENERAL

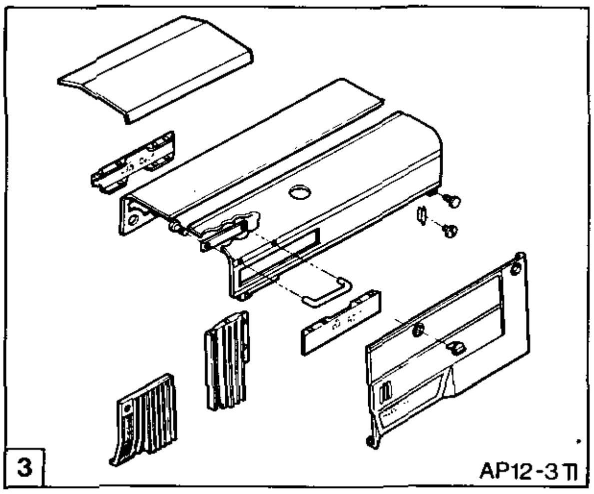
IMPORTANT: *Before separating the vehicle ensure the tractor is positioned on flat ground, in a safe working area, with the wheels chocked.*

NOTE: *To minimise leakage of fuel, coolant or oil, ensure all taps are turned off, with pipes and hoses plugged before disassembly.*

Disassembly

Battery Disconnect – To minimize the possibility of damage to the electrical circuits disconnect the **Earth Lead First** from the battery.

1. **Muffler Stack Pipe** – To remove, twist the stack pipe to loosen and lift remove from the vehicle.



Sheet Metal Removal

2. **Sheet Metal** – Loosen the retaining hardware, where appropriate and remove the following sheet metal from the vehicle, Figure 3.

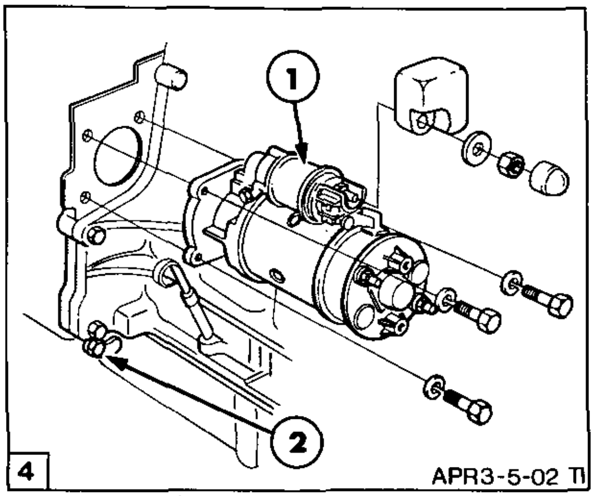
   - Hood Panel

   - Side Panels

   - Side Pulley guards

3. **Air Conditioning Hoses (Where fitted)** – Disconnect the air conditioning hoses at the quick release couplings only, situated to the left hand side of the engine block, Figure 2.

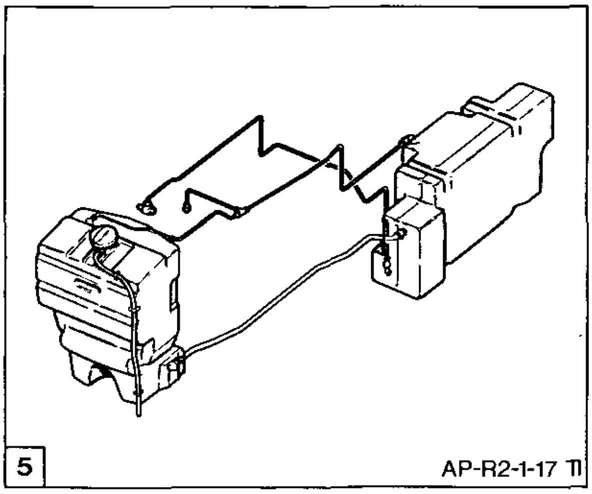
4. **Starter Motor** – Disconnect the starter motor harness and remove the attaching bolts, Remove the starter motor from engine, Figure 4.



Starter Motor

1. Starter Motor
2. Engine Timing Plate

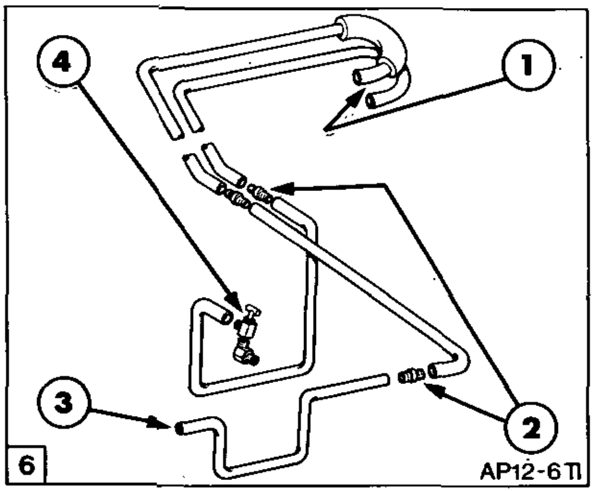
5. **Engine Flywheel Timing Plate** – Loosen and remove the bolt from the engine block, Figure 4.



Fuel Tank Feed Pipes

6. **Fuel Pipes** – Drain the contents of the fuel tanks where necessary, into a suitable clean container (refer to specifications Section 'H' for volume by model) and disconnect the pipes. Plug pipe ends to minimise contamination by dirt and prevent any residual leakage, Figure 5.

NOTE: *It may be necessary to partially drain the engine coolant system, prior to disconnecting the cab heater hoses.*



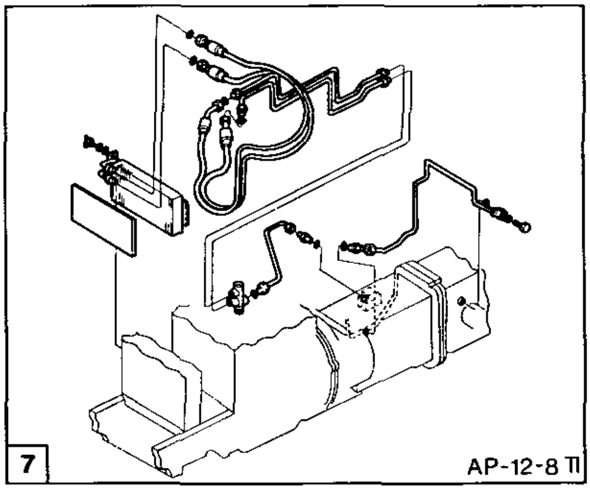
6

Heater Hoses

1. Hose To Cab Heater
2. Hose Connectors
3. Hose To Radiator
4. Hose To Engine Block

7. **Heater Hoses** – Disconnect at the hose connectors at the left and right hand side of the vehicle at the base of the cab 'A' pillars and plug the hoses to prevent residual leakage, Figure 6.

8. **Hydraulic Pump Pipework** – Disconnect the pipes in the area to be separated between the engine and front transmission, on the right hand side of the vehicle – refer to, Figure 15, Figure 16 and Figure 17. Drain the oil into a suitable clean container and plug the ends of the pipes to prevent dirt ingress / residual leakage.



7

Transmission Oil Cooler (16x16 Shown)

9. **Transmission Oil Cooler Pipes** – Disconnect at junctions only in the area to be separated between the engine and transmission on the right hand side of the vehicle, Figure 7. Drain the oil into a suitable clean container and plug the ends of the pipes to prevent dirt ingress / residual leakage.

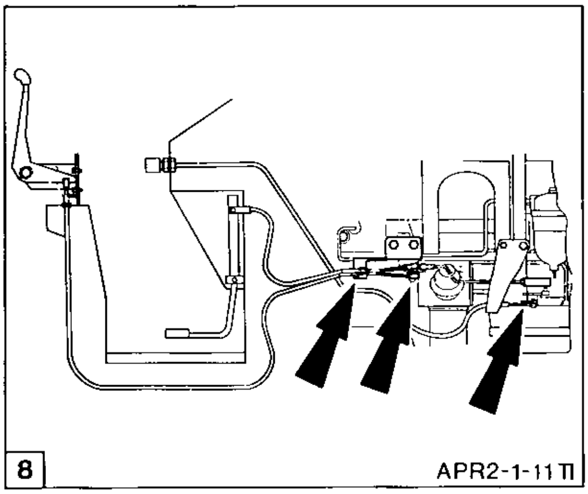
10. **Front Wheel Drive (where fitted)** – Remove prop shaft guard, disconnect propshaft and remove from the vehicle.

11. **Engine Harness** – Disconnect from engine system and all related components:

    - Alternator
    - Cold start
    - Fuel pump
    - Temperature Senders
    - Air Cleaner

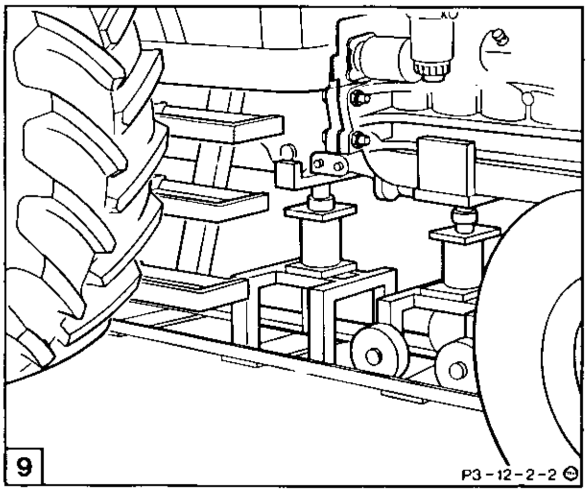
    Tie harness back clear of the engine.

12. **Power Steering Pipes** – Disconnect at the radiator cooler connections and drain the oil into a suitable clean container. Plug all ports to prevent dirt ingress and residual oil leakage.



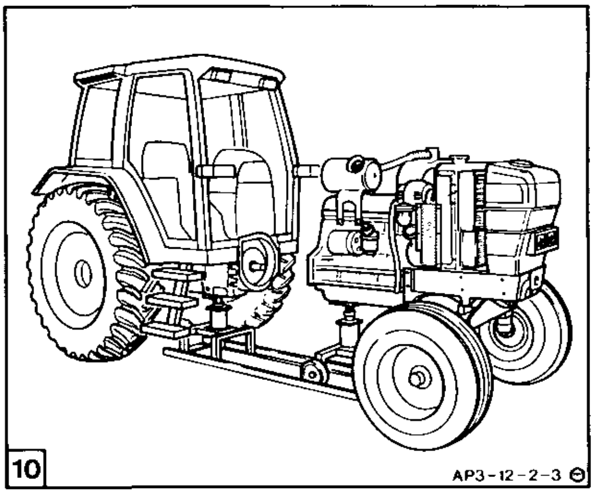
Throttle Linkage

13. **Throttle Cables** – Disconnect at the support bracket and fuel pump, Figure 8.



Positioning the Splitting Kit

With all connections separated between the front transmission and the front half of the vehicle, place in position the splitting tool no. MS.2700C, Figure 9.



Transmission Supported

14. **Buckle Up Bolts** – Loosen and remove the bolts between the engine and the front transmission.

Carefully prize the engine from the dowels on the transmission and wheel the engine/front axle assembly forward for repair.

Re–assembly

After completion of repairs re–assemble the engine to the front transmission in reverse order of disassembly, ensuring all looms, pipes and ancillary equipment are clear of the mating faces.

Ensure all attaching hardware torque values are correct to specification, as detailed in 'Section F'.

For torque values of ancillary components and hardware – refer to the appropriate repair manual chapters for individual component torque values, setting and adjustment procedures.

IMPORTANT: *When reconnecting the battery the electronic circuits may require resetting / re–calibration as the keep alive memory is limited when the battery is disconnected. Refer to the appropriate Repair Manual Chapter for full information.*

To reset the radio refer to the operators manual for tuning purposes.

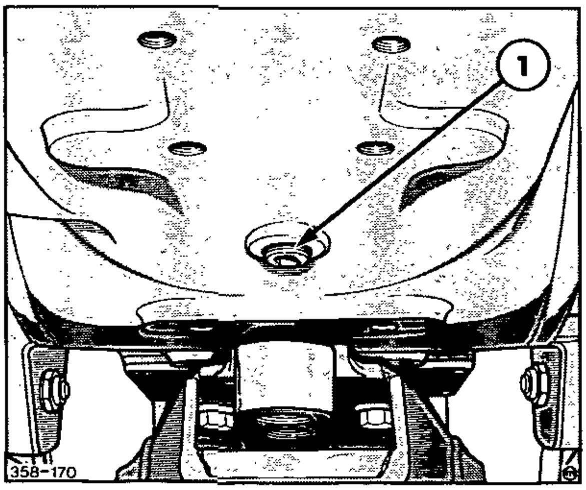
Refill fluid levels and run vehicle to normal operating temperature too purge air out of the systems. Stop the engine and after sufficiently cooled, recheck and top up fluid levels as required.

B. SEPARATING FRONT TRANSMISSION FROM REAR AXLE.

NOTE: *It will be necessary to remove the cab or platform prior to separating the tractor between transmission and rear axle, refer to Part 12 Chapter 1 lifting the cab.*

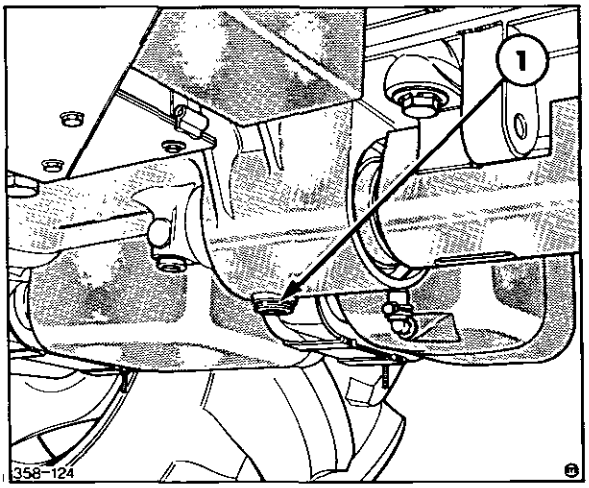
Battery Disconnect – To minimize the possibility of damage to the electrical circuits disconnect the **Earth Lead First** from the battery.

Rear Axle Oil – Drain the oil from the centre housing (2 Wheel Drive) or drop box (4 Wheel Drive) into a suitable clean container, capable of holding up to, 13.3 imp gallons (60.6 litres) 16 US gallons, Figure 11 and Figure 12.



Transmission/Hydraulic/Rear Axle Oil
(Two Wheel Drive)

1. Rear Axle Drain Plug

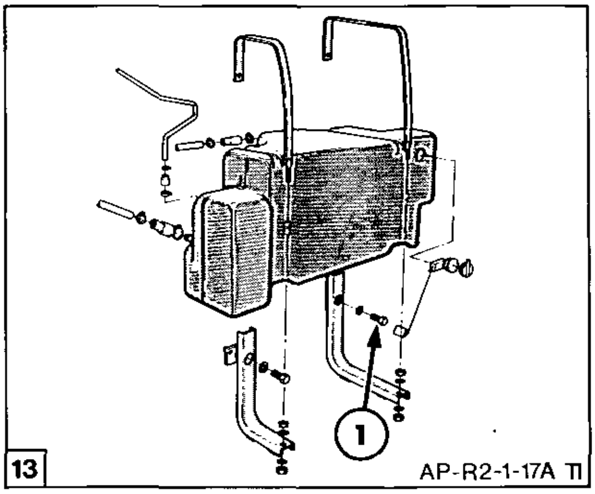


Transmission/Hydraulic/Rear Axle Oil
(Four Wheel Drive)

1. Rear Axle Drain Plug

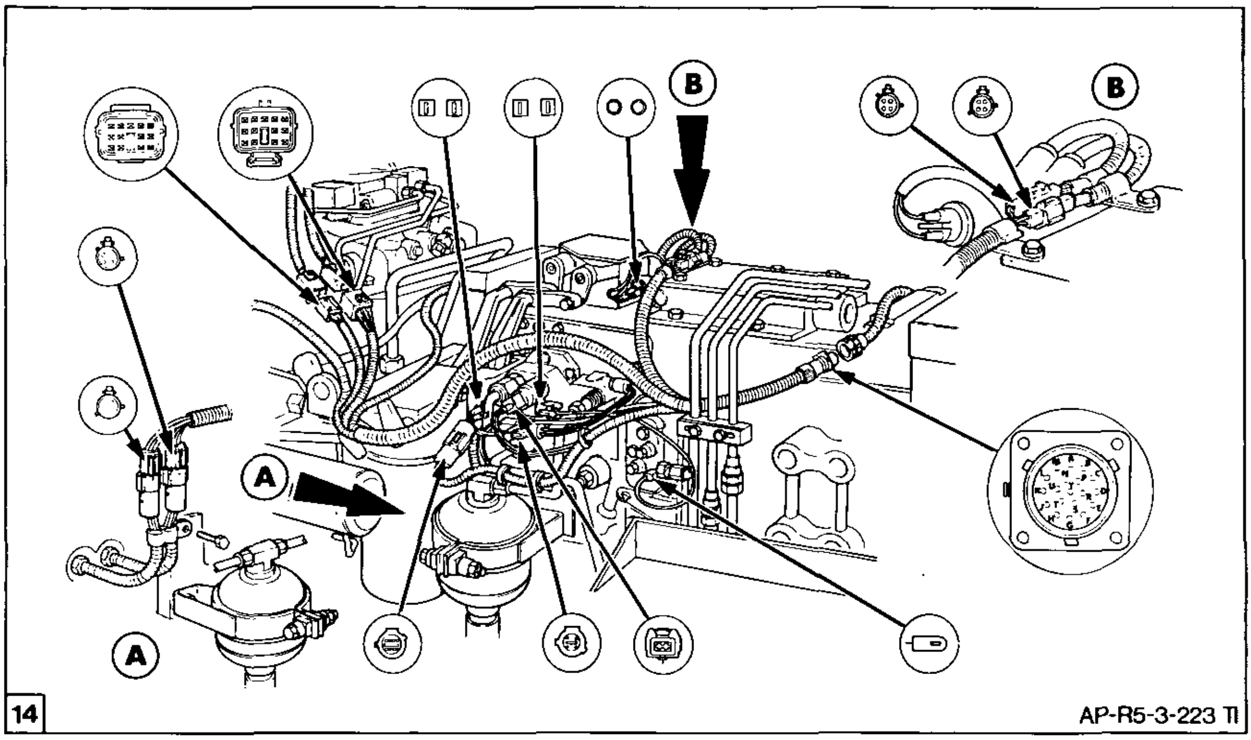
1. **Auxiliary Fuel Tank (Where Fitted)** – Drain the fuel into a suitable container and disconnect the fuel lines. Loosen the tank straps and remove the fuel tank from the support brackets.

NOTE: *The fuel tank support bracket rear lower bolt to rear axle is a "left handed" thread, and if removed should be loosened in a clockwise direction, Figure 13.*



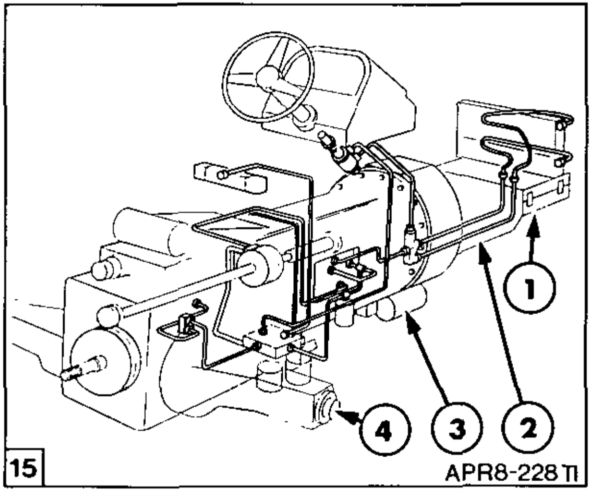
Fuel Tank Support Bracket

1. Support Bracket Bolt (left handed thread)



Transmission Electrical Connections (16x16 shown)

2. **Front Transmission Electrical Harness Connections** – Disconnect the harness connectors where appropriate and remove the harnesses where possible to prevent damage to harnesses or connectors during disassembly, Figure 14.



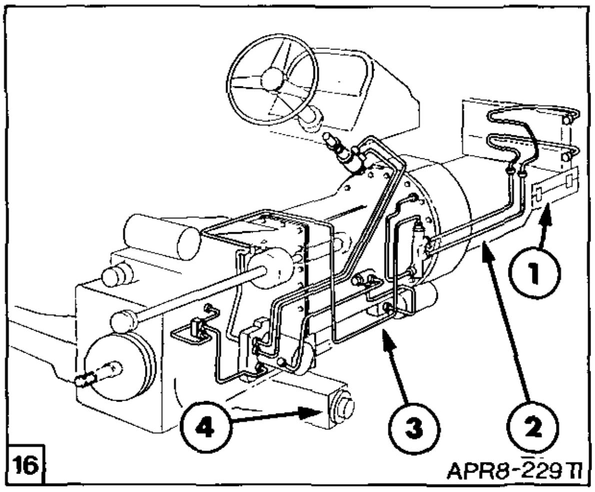
Closed Circuit Load Sensing Pump (16x16)

1. Front Support
2. Engine
3. Front Transmission
4. Rear Axle

3. **Closed Circuit Load Sensing Pump (16x16)** – mounted at the right hand side of the rear axle. Disconnect the following pipes as listed and illustrated in, Figure 15.

- Power Take Off output to control Valve
- Transmission supply tube to accumulator
- Electronic Draft Control Pilot Supply to EDC Control Valve
- Pump output to steering circuits

4. **Tandem Gear Pump (12x12)** – mounted at the right hand side of the rear axle. Disconnect the following pipes as listed and illustrated in, Figure 16.

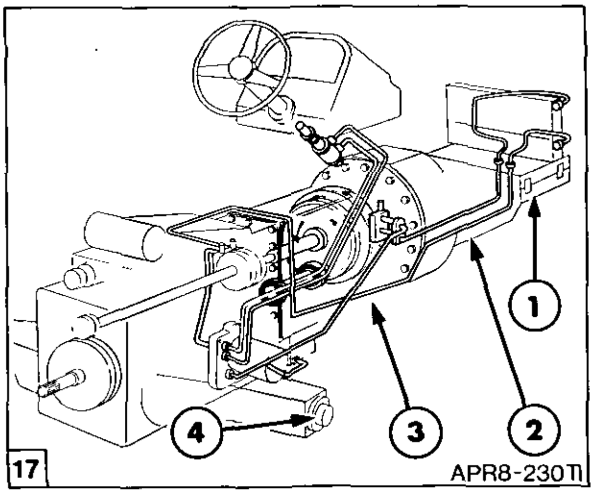


Tandem Gear Pump (12x12)

1. Front Support
2. Engine
3. Front Transmission
4. Rear Axle

- Power Take Off output to cooler bypass valve
- Front Wheel Drive oil feed to solenoid valve
- Steering output and return pipes to pump

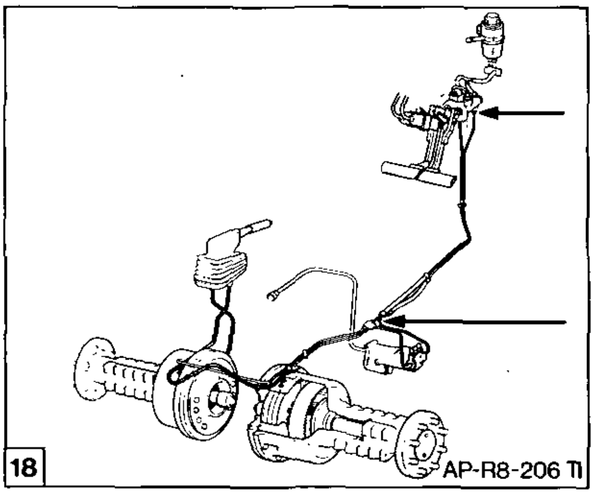
5. **Tandem Gear Pump (16x4)** – mounted at the right hand side of the rear axle. Disconnect the following pipes as listed and illustrated in Figure 17.



Tandem Gear Pump (16x4)

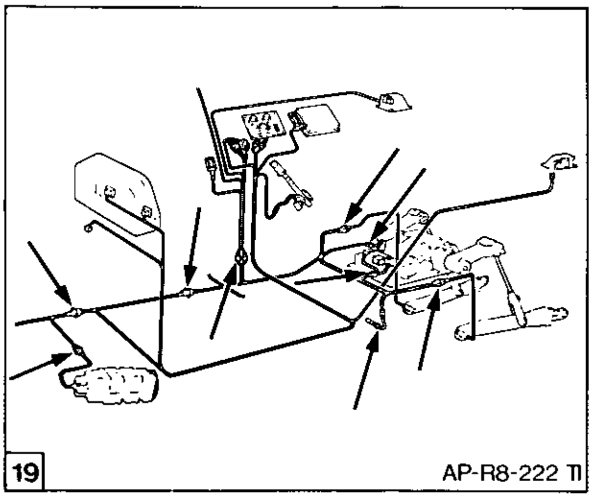
1. Front Support
2. Engine
3. Front Transmission
4. Rear Axle

- FWD supply tube
- Dual power tube to control valve
- Steering output and return pipes to pump
- PTO output tubes to cooler



Tractor Brake Circuit

6. **Tractor Brake Valve Pipes** – Drain the oil and disconnect the pipes at the 'T' junctions and plug pipes to prevent any dirt ingress, Figure 18.



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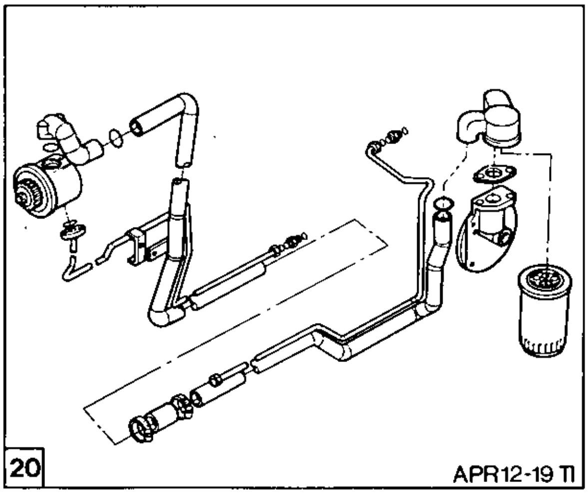
Rear Wiring Harness Connectors

7. **Lift Assembly Lower Link Arm Sensing (where fitted)** – Disconnect the looms at the connectors and tie back the looms to prevent damage, Figure 19.

8. **Performance Monitor Radar (Where Fitted)** – Disconnect the harness and from the monitor and remove monitor along with the support bracket from the vehicle.



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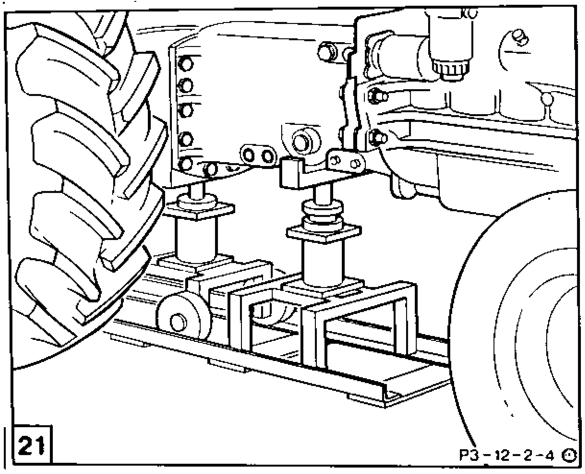
Auxiliary Engine Mounted Pump

9. **Auxiliary Supply Line From The Engine Mounted Pump (Where Fitted)** – Drain the pump oil into a suitable clean container and disconnect the pipe at the valve pack on the top of the rear axle, Figure 20.

10. **Transmission To Rear Axle** – Remove the oil lubrication tube from the from the transmission to the rear axle.

With all looms, pipes, cables and rods between the front transmission and rear axle disconnected, place the splitting stand MS. 2700 C in position, Figure 21.



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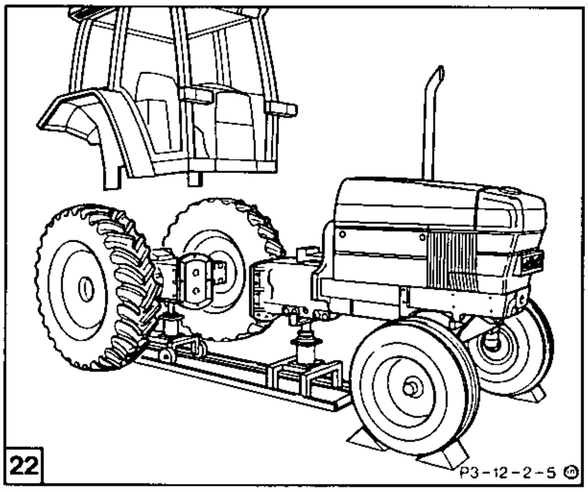
Positioning the Splitting Kit

Buckle up bolts can now be loosened and removed from the vehicle.



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Rear Axle Removal

Carefully prize the rear axle from the transmission and wheel the rear axle away from the vehicle for repair, Figure 22.

Re–assembly

After completion of repairs re–assemble the the front transmission to the rear axle in reverse order of disassembly, ensuring all looms, pipes and ancillary equipment are clear of the mating faces.

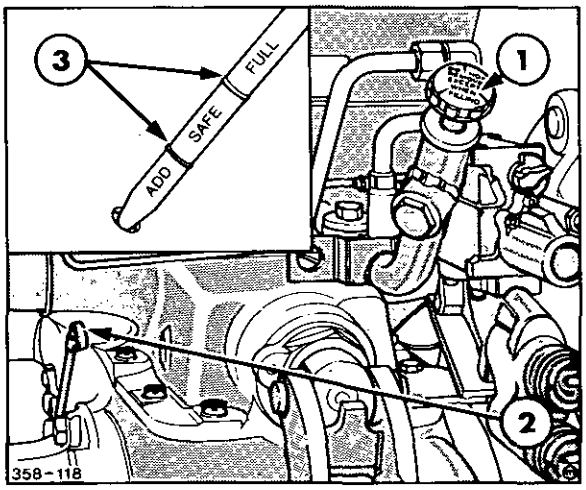
Ensure all attaching hardware torque values are correct to specification, as detailed in 'Section F'.

For torque values of ancillary components and hardware – refer to the appropriate repair manual chapters for individual component torque values, setting and adjustment procedures.

IMPORTANT: *When reconnecting the battery the electronic circuits may require resetting / re–calibration as the keep alive memory is limited when the battery is disconnected. Refer to the appropriate Repair Manual Chapter for full information.*

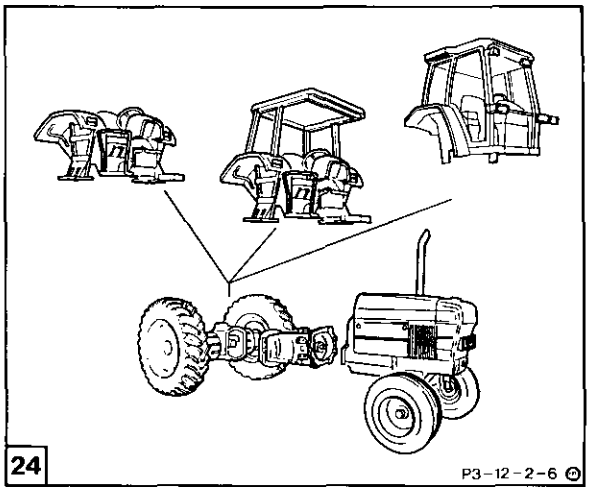
To reset the radio refer to the operators manual for tuning purposes.

Refill fluid levels and run vehicle to normal operating temperature too purge air out of the systems. Stop the engine and after sufficiently cooled, recheck and top up fluid levels as required.



Rear Axle Oil Refill

C. REMOVAL OF FRONT TRANSMISSION FROM THE VEHICLE



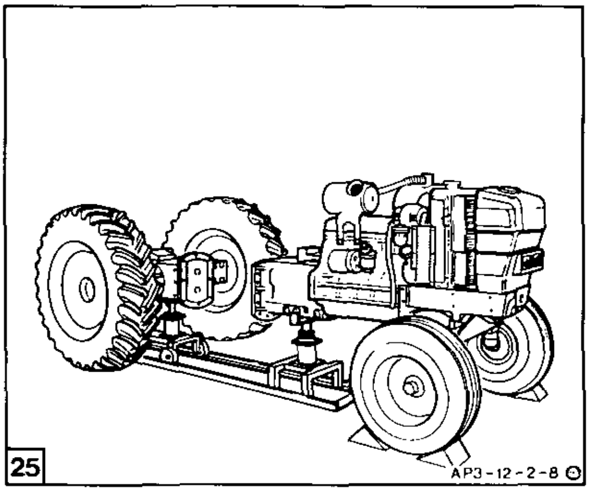
NOTE: *It will be necessary to remove the cab or platform prior to separating the tractor rear axle and engine refer to, Part 12 Chapter 1, lifting the cab.*

Battery Disconnect – To minimize the possibility of damage to the electrical circuits disconnect the **Earth Lead First** from the battery.

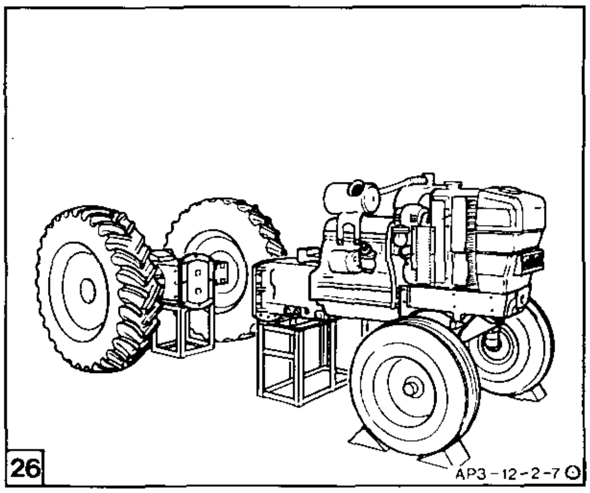
1. **Rear Axle** – Drain oil into a suitable clean container and disconnect all pipes, wiring looms, tubes and ancillary equipment, as described in section B.

Using splitting tool MS. 2700. C, remove the rear axle from the vehicle, Figure 25 .

Supporting the rear axle and front transmission assembly on suitable stands, relocate and position the splitting tool under the engine, Figure 26 and Figure 27.



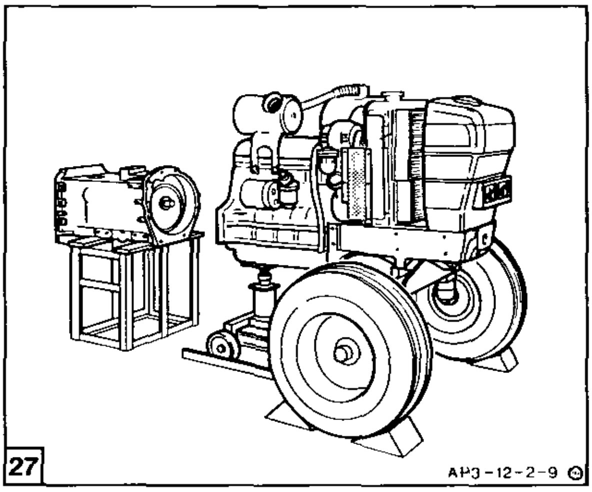
Rear Axle Assembly Removal



Rear Axle Assembly Removed

2. **Front Transmission** – Disconnect between front transmission and engine, refer to section A and remove all attaching equipment not previously removed:

- Battery and Battery Box
- Cab Steps
- Auxiliary Oil Pump Feed Pipe
- Fuel lines
- Cab Supports (where fitted)



Front Transmission Removal

With all equipment disconnected between the front transmission and engine move the engine forward clear of the front transmission. Using splitting tool as described in section A.

Re–assembly

After completion of repairs re–assemble the the front transmission in reverse order of disassembly, ensuring all looms, pipes and ancillary equipment are clear of the mating faces.

Ensure all attaching hardware torque values are correct to specification, as detailed in 'Section F'.

For torque values of ancillary components and hardware – refer to the appropriate repair manual chapters for individual component torque values, setting and adjustment procedures.

IMPORTANT: *When reconnecting the battery the electronic circuits may require resetting / re–calibration as the keep alive memory is limited when the battery is disconnected. Refer to the appropriate Repair Manual Chapter for full information.*

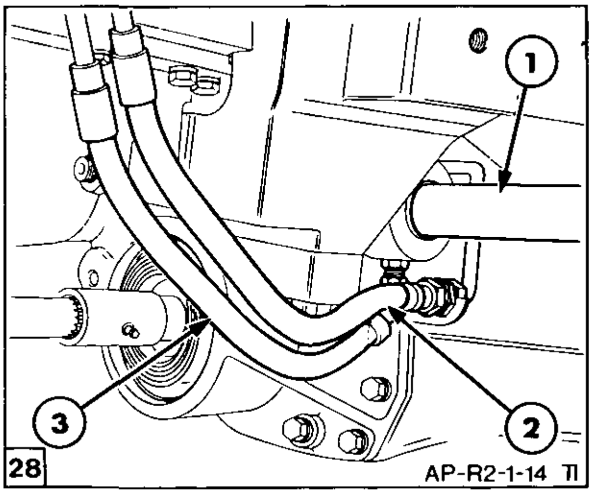
To reset the radio refer to the operators manual for tuning purposes.

Refill fluid levels and run vehicle to normal operating temperature too purge air out of the systems. Stop the engine and after sufficiently cooled, recheck and top up fluid levels as required.

D. SEPARATING FRONT AXLE TO ENGINE

Battery Disconnect – To minimize the possibility of damage to the electrical circuits disconnect the **Earth Lead First** from the battery.

1. **Power Steering Pipes** – Disconnect the pipes at the cooler mounted below the front radiator and at the steering cylinders on the front axle, Figure 28. Plug open ends to prevent leakage or dirt ingress.



28

Power Steering Cylinder (4WD Shown)

2. **Front Wheel Drive (where fitted)** – Disconnect and remove the propshaft guard (where fitted) and loosen and remove the propshaft from the vehicle.

3. **Hydraulic Pipes** – Drain oil into a suitable clean container, disconnect and plug tubes to prevent leakage or dirt ingress.

⚠ **WARNING:** *Air Conditioning systems operate under pressure, when disconnecting the hoses, care should be taken to avoid personnel injury or leakage of the refrigerant into the atmosphere.*

IMPORTANT: *If disassembly of the Air conditioning hoses is required, disconnect at the quick release couplings only, Figure 2.*
If disassembly of the hoses is required at other connections other than the quick release points the refrigerant in the system must be emptied into an Air Conditioning reclaim unit, refer to Chapter 11 Part 1.

4. **Air Conditioning Hoses (Where fitted)** – Disconnect the air conditioning hoses at the quick release couplings only, Figure 2.

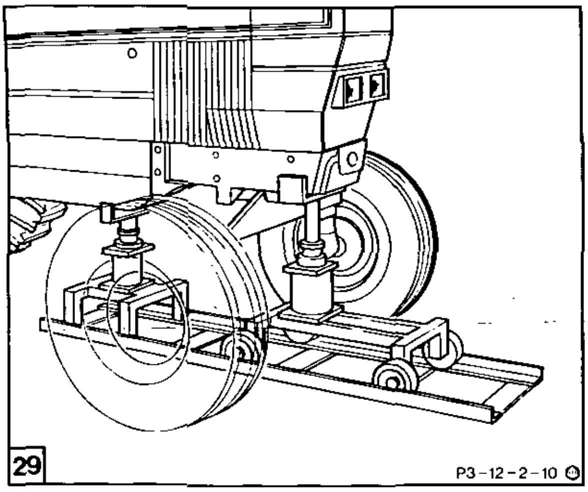
5. **Oil Cooler Pipes** – Drain the oil into a suitable clean container, disconnect the pipes and plug the ends to prevent leakage and dirt ingress.

6. **Fuel Pipes** – Drain fuel into a suitable clean container and disconnect and plug tubes to minimise contamination by dirt and prevent residual leakage.

7. **Harnesses** – Disconnect at the connector plugs and remove where possible or tie back to prevent damage any damage.

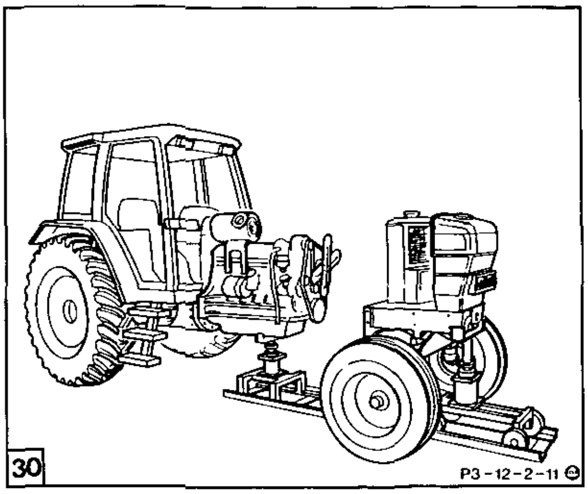
8. **Radiator Hoses** – Drain the cooling system into a suitable container clean and free of contaminates, and disconnect the hoses.

9. **Radiator Fan Shroud** – Remove attaching hardware and leave shroud in position.



Front Axle Supported

Axle Removal – Position splitting tool MS. 2700.C in position, Figure 29.



Removing Axle

Wheel front the front axle away from engine, Figure 30, for repair.

Re–assembly

After completion of repairs re–assemble the front axle to the engine in reverse order of disassembly, ensuring all looms, pipes and ancillary equipment are clear of the mating faces.

Ensure all attaching hardware torque values are correct to specification, as detailed in 'Section F'.

For torque values of ancillary components *and hardware – refer to the appropriate repair* manual chapters for individual component torque values, setting and adjustment procedures.

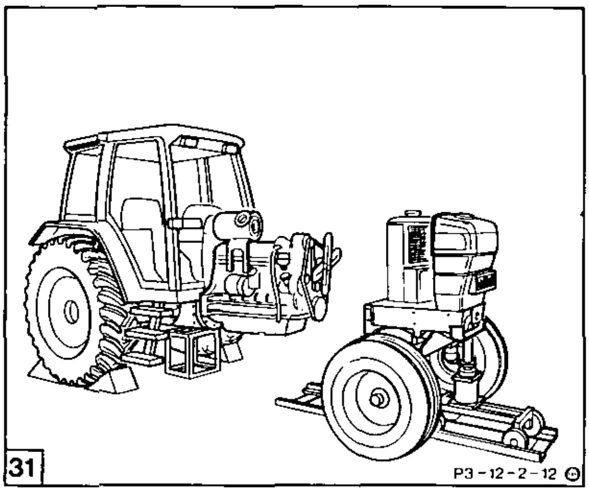
IMPORTANT: *When reconnecting the battery the electronic circuits may require resetting / re–calibration as the keep alive memory is limited when the battery is disconnected. Refer to the appropriate Repair Manual Chapter for full information.*

To reset the radio refer to the operators manual for tuning purposes.

Refill fluid levels and run vehicle to normal operating temperature too purge air out of the systems. Stop the engine and after sufficiently cooled, recheck and top up fluid levels as required.

E. REMOVAL OF THE ENGINE FROM THE VEHICLE

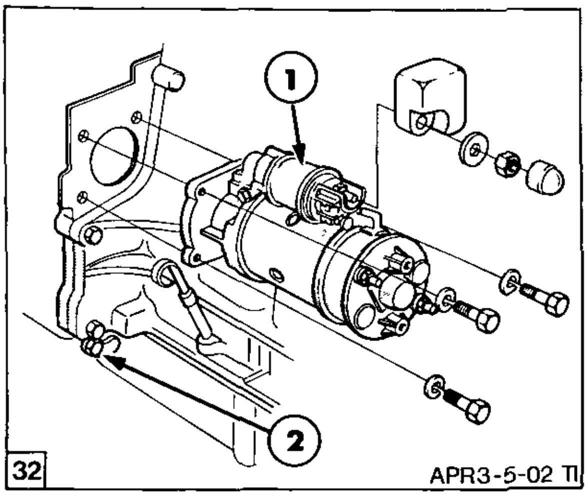
Place a suitable stand under the front transmission housing, Figure 31 and refer to 'Section A' for the disassembly procedure.



Front Transmission Supported

With the engine disconnected from the front axle as described in 'Section D' proceed with engine removal.

1. **Starter Motor** – Disconnect the starter motor harness and remove the attaching bolts. Remove the starter motor from engine, Figure 4.



Starter Motor

1. Starter Motor
2. Engine Timing Plate

2. **Engine Flywheel Timing Plate** – Loosen and remove the bolt from the engine block, Figure 4.

3. **Fuel Pipes** – With residual fuel drained from the system, disconnect the engine to tank fuel pipes and plug pipe ends to prevent dirt ingress

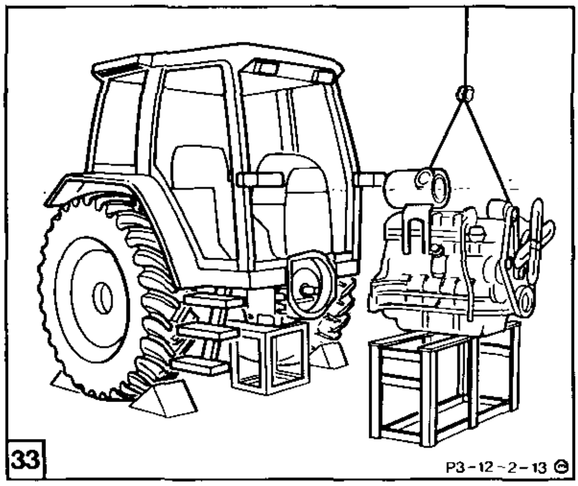
4. **Engine and Front Harness** – With all connections disconnected tie back the harnesses clear of the engine.

5. **Throttle Cables** – Disconnect at the support bracket and fuel pump, Figure 8.

6. **Buckle Up Bolts** – Loosen and remove the bolts between the engine and the front transmission.

With the engine supported by a hoist attached to the engine lifting brackets loosen and remove the buckle up bolts between the engine and front transmission, Figure 33.

Prize the engine carefully from the front transmission ensure all pipes and looms have been disconnected and place the engine on a suitable stand for repair.



Engine Removal

Re–assembly

After completion of repairs re–assemble the the engine in reverse order of disassembly, ensuring all looms, pipes and ancillary equipment are clear of the mating faces.

Ensure all attaching hardware torque values are correct to specification, as detailed in 'Section F'.

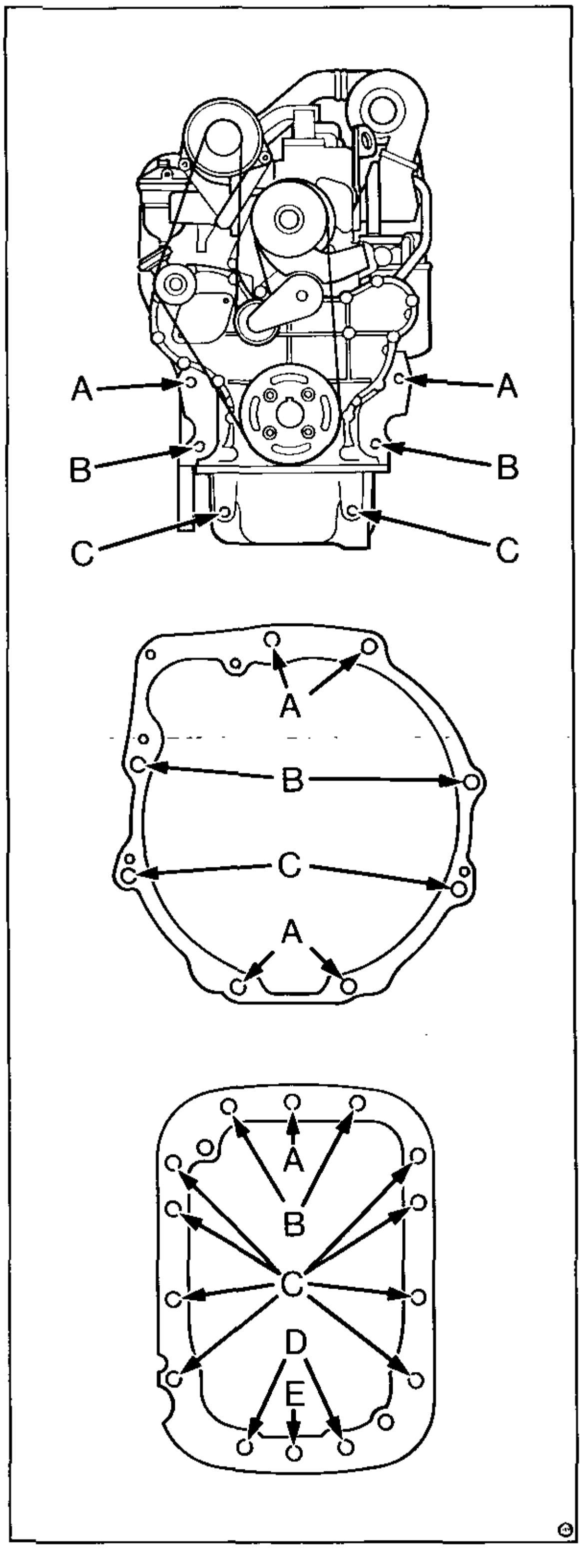
For torque values of ancillary components and hardware – refer to the appropriate repair manual chapters for individual component torque values, setting and adjustment procedures.

IMPORTANT: *When reconnecting the battery the electronic circuits may require resetting / re–calibration as the keep alive memory is limited when the battery is disconnected. Refer to the appropriate Repair Manual Chapter for full information.*

Refill fluid levels and run vehicle to normal operating temperature too purge air out of the systems. Stop the engine and after sufficiently cooled, recheck and top up fluid levels as required.

F. TORQUE SPECIFICATION – GENERAL

Cab Mounts Front – Through Bolts	350–432 lbs ft	475–585 Nm
Cab Mount Front Support Bracket to Transmission	250–310 lbs ft	340–420 Nm
Cab Mounts Rear – Cross Bolts	250–310 lbs ft	340–420 Nm
Cab Mount Rear Support Bracket To Axle	546–678 lbs ft	740–920 Nm
Platform to Support Brackets	30–38 lbs ft	40–51 Nm
Platform Support Bracket to Transmission	52–66 lbs ft	70–90 Nm
Starter Motor Retaining Bolts	20–25 lbs ft	27–34 Nm
Engine timing Tab Bolt	20–25 lbs ft	27–34 Nm



TORQUES – BUCKLE UP BOLTS

Front Support To Engine

A	180–220 lbs ft	240–298 Nm
B	180–220 lbs ft	240–298 Nm
C	180–220 lbs ft	240–298 Nm

Engine To Front Transmission

A	275–340 lbs ft	373–460 Nm
B	140–170 lbs ft	190–230 Nm
C	165–200 lbs ft	224–271 Nm

Front Transmission To Rear Axle
(Where **grade 5** bolts are fitted)

A	65–89 lbs ft	88–120 Nm
B	140–170 lbs ft	190–230 Nm
C	77–105 lbs ft	104–142 Nm
D	165–200 lbs ft	224–271 Nm
E	140–170 lbs ft	190–230Nm

Front Transmission To Rear Axle
(Where **grade 8** bolts are fitted)

A	100–125 lbs ft	136–170 Nm
B	214–258 lbs ft	290–350 Nm
C	115–140 lbs ft	156–190 Nm
D	224–276 lbs ft	305–375 Nm
E	214–258 lbs ft	290–350 Nm

G. FLUIDS AND LUBRICATION

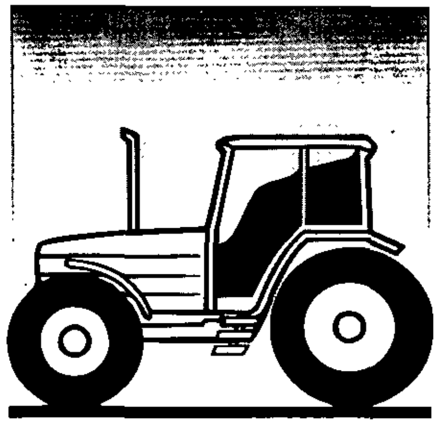
	5640	6640	7740	Capacities	7840	8240	8340
Fuel Tank Standard	—	20.8	—	Imp Gallons	—	47.9	—
	—	24.9	—	US Gallons	—	57.2	—
	—	94.6	—	Litres	—	217.7	—
Auxiliary Fuel Tank	—	23.0	—	Imp Gallons			
(With Cab)	—	27.6	—	US Gallons			
	—	104.8	—	Litres			
Auxiliary Fuel Tank	—	18.2	—	Imp Gallons			
(Less Cab)	—	21.8	—	US Gallons			
	—	82.9	—	Litres			
Cooling System (With Cab)	—	3.5	—	Imp Gallons	—	4.7	—
Antifreeze WSN–M97B18–D	—	4.2	—	US Gallons	—	5.6	—
	—	16.0	—	Litres	—	21.5	—
Cooling System (Less Cab)	—	3.2	—	Imp Gallons	—	4.4	—
Antifreeze WSN–M97B18–D	—	3.8	—	US Gallons	—	5.3	—
	—	16.0	—	Litres	—	21.5	—
Engine Oil Including Filter	—	2.5	—	Imp Pints	—	4.6	—
Ford ESN–M2C121–B, to E	—	3.0	—	US Gallons	—	5.5	—
	—	11.4	—	Litres	—	20.9	—
Rear Axle Oil 12X12	—	12.5	—	Imp Gallons	—	12.5	—
Ford ESN–M2C134–D	—	15.0	—	US Gallons	—	15.0	—
	—	56.8	—	Litres	—	56.8	—
Rear Axle Oil 16X16	—	13.3	—	Imp Gallons	—	13.3	—
Ford ESN–M2C134–D	—	16.0	—	US Gallons	—	16.0	—
	—	60.6	—	Litres	—	60.6	—
FWD Front Hubs (Per Hub)	—	5.3	—	Imp Pints	5.3	4.6	4.6
Ford ESN–M2C134–D	—	0.8	—	US Gallons	0.8	0.7	0.7
	—	3.0	—	Litres	3.0	2.6	2.6
FWD Front Axle	—	10.9	—	Imp Pints	10.9	14.1	14.1
Ford ESN–M2C134–D	—	1.6	—	US Gallons	1.6	2.1	2.1
	—	6.2	—	Litres	6.2	8.0	8.0
Brake and Clutch Reservoir							
Ford ESN–M6C59–A							

NOTE: When operating remote cylinders, the rear axle oil level will be affected. When topping up the rear axle to accommodate the oil requirement of remote cylinders, no more than 13 Imp Gallons (59 Litres) 15.5 US Gallons should be added to bring the oil level up to the upper mark on the dipstick when all rams are fully extended.

Alternatively, remote cylinders with an oil capacity of up to 4 Imp Gallons (18 Litres) 4.8 US Gallons may be connected to the hydraulic system without adding oil, provided the tractor is being operated on level ground.

13

NEW HOLLAND



NEW HOLLAND

Series 40

S90
S100

(Post Nov. 1995)

ELECTRICAL CONNECTOR IDENTIFICATION

NEW HOLLAND

SERVICE

Conn. No.	GB	DK	NL	F	D
C001	FRT Main E1-M/F	Forreste Hovednet E1-M/F	Voorste Hoofd E1-M/F	Principal Avant E1-M/F	Vorne Haupt E1-M/F
C003	Oil Press. Send	Olietryksindikator	Oliedrukzender	Sonde Pression Huile	Öldrucksender
C004	Oil Press. Switch	Olietrykskontakt	Oliedrukschakelaar	Inter. Pression Huile	Öldruckschalter
C005	Starter Relay	Startrelæ	Start Relais	Relais Demarreur	Anlasserrelais
C006	Start Solenoid	Startsolenoide	Startersolenoide	Solénoïde Demarreur	Anlasser-Elektromagnet
C007	Brake Fluid Res Switch	Kontakt for Bremsevæskestand	Remoliereservoir Schakelaar	Inter. Réservoir Fluide Frein	Schalter des Bremsaflüssigkeits-Vorratsbehälters
C009	Vacuum Switch	Vakuumkontakt	Vacuumschakelaar	Inter. Dépression	Vakuumschalter
C010	Air Con. Comp	Aircond. Kompressor	Airco. Compressor	Compresseur Air Cond.	Klimaanlagen-Kompr.
C011	De Icing Stat	Afisn. Temostat	Ontijsthermostaat	Thermostat Dégivrage	Enteisungs-Thermostat
C012	Cool Temp Send	Indikator for Kølevæsketemp.	Koelvl. Temp. Zender	Sonde Temp. Refroid.	Kühlmitteltemp.-Sender
C013	Alternator	Generator	Alternator	Alternateur	Lichtmaschine
C015	Fuel Shut Off	Brændstoflukkeventil	Brandstofafsluiter	Coupure Gazole	Kraftstoffabsperrung
C018	Thermostart	Termostart	Thermo Start	Thermostat	Thermostat
C019	Extension Con T1-F/M	Forlængerstik T1-F/M	Extensie Conn. T1/F/M	Connexion Ext. T1-F/M	Verlängerungs-Steckverbinder T1-F/M
C020	Extension Con C1-F/M	Forlængerstik C1-F/M	Extensie Conn. C1-F/M	Connexion Ext. C1-F/M	Verlängerungs-Steckverbinder C1-F/M
C022	Aux Fuel Tank Send	Indikator for Ekstra Brændstoftank	Hulpbrandstoftank Zender	Sonde Réservoir Aux. Gazole	Sender des Zusatz-Kraftstofftanks
C023	Trans Oil Temp Sender	Indikator for Transmissions Olietemperatur	Transm. Olietemp. Zender	Sonde Temp. Huile Trans.	Getriebe-Öltemperatursender
C025	Clutch C4	Kobling C4	Koppeling C4	Embrayage C4	Kupplung C4
C026	Clutch C3	Kobling C3	Koppeling C3	Embrayage C3	Kupplung C3
C027	Clutch C2	Kobling C2	Koppeling C2	Embrayage C2	Kupplung C2
C028	Clutch C1	Kobling C1	Koppeling C1	Embrayage C1	Kupplung C1
C034	FWD Solenoid	4WD Solenoide	4WD Solenoide	Solénoïde 4RM	VRA-Elektromagnetventil
C036	Oil Pressure Switch S1	Olietrykskontakt S1	Oliedruk Schakelaar S1	Inter. Pression Huile S1	Öldruckschalter S1
C041	PTO Solenoid	Solenoide F. Kraftudtag	PTO Solenoide	Solénoïde P.D.F.	Zapfwellen-Elektromag.V.
C042	Difflock Sol	Solenoide F. Diff. Spærre	Diff. Slot Solenoide	Solénoïde Bloc. Diff.	Diff.-Sperren-Elektromag.V.
C043	Difflock Switch	Kontakt F. Diff. Spærre	Diff. Slot Schakelaar	Inter. Bloc. Diff	Diff.-Sperren-Schalter
C046	Speed Sensor	Fartfler	Snelheid Sensor	Capteur Vitesse	Drehzahlsensor
C047	L/H Draft Pin	Venstre Træksensor	Trekpen Links	Axe-Capteur Gauche	Linker Kraftmessbolzen
C048	R/H Draft Pin	Højre Træksensor	Trekpen Rechts	Axe-Capteur Droit	Rechter Kraftmessbolzen
C051	EDC Valve Con	EDC Ventilstik	EDC Ventiel Conn.	Connexion Valve EDC	EDC-Ventil-Steckv.
C052	Rockshaft Pot	Vippearmsaksel Pot.	Hefarm Potetiometer	Potent. Arbre Relev.	Hubarm-Pot.
C053	Remote Valve Sol	Fjerncyl. Ventil Solenide	Sol. Van Ven. Voor Afstandbed	Solénoïde Distributor Aux.	Zusatz-Steuervent-Elektomag.V.
C054	PTO Speed Sensor	Kraftudtag Omdrejningsføler	PTO Snelh. Sensor	Sonde Régime P.D.F	Zapfwellen-Drehzahlsensor
C055	Trailer Socket	Anhængerstik	Aanhanger Contactdoos	Prise Remorque	Anhänger-Steckdose
C056	Headlamp Harness Con E2-M/F	Forlygte Ledningsnet Stik E2-M/F	Koplamp Draadbundelconn. E2-M/F	Connexion Faisceau Phare Avant E2-M/F	Scheinwerfer-Kabelstrang-Steckverb. E2/MF

I	FIN	N	P	ESP
Conn Parafango Sin F3	Vas. Lokasuojan Liitin F3	Kobling F3 Skjerm V/S	Lig. F3 do guarda-lamas esquer.	Conex. Guardabarros Izquierdo F3
Conn Parafango Sin F4	Vas. Lokasuojan Liitin F4	Kobling F4 Skjerm V/S	Lig. F4 do guarda-lamas esquer.	Conex. Guardabarros Izquierdo F4
Interr Dual Power Mod 8x2	8x2 Vaihteisto, Dual Powerin Kytkin	Dual Power Bryter 8x2 Transmisjon	Interruptor de corrente do Dual Power modelo 8x2	Int. Potencia Dual Modelo 8x2
Indicat Direz Ant Sin	Vasen Etumm. Suuntavalo	Retningslys Foran	Indicador de direcção diant. esq.	Indicador Intermitente Del. Izquierdo
Luce Parafango	Vasen Seisontavalo	Markeringslampe V/S	Luz repetidora esquerda	Luz Marcadora Izquierda
Indicatore Direz Post Sin	Vasen Takimm. Suuntavalo	Retningslys Bak V/S	Ind. de direcção traseiro esq.	Indicador Intermitente Tras. Izquierdo
Indicatore Direz Ant Des	Oikea Etumm. Suuntavalo	Retningslys Foran H/S	Ind. de direcção diant. direito	Indicador Intermitente Del. Derecho
Indicatore Direz Post Des	Oikea Takimm. Suuntavalo	Retningslys Bank H/S	Ind. de direcção tras. direito	Indicador Intermitente Tras. Derecho
Batteria	Akku	Batteri	Bateria	Batería
Conn H6	Liitin H6	Kobling H6	Ligação H6	Conexión H6
Elettrovalv Dual Power	Dual Powerin Solenoidi	Dual Power Solenoid	Solenoide do Dual Power	Solenoide Potencia Dual
Parafango Sinistro	Vasen Lokasuoja	Skjerm V/S	Guarda-lamas esquerdo	Guardabarros Izquierdo
Parafango Destro	Oikea Lokasuoja	Skjerm H/S	Guarda-lamas direito	Guardabarros Derecho
Interr Esclusione PDF	Voimanoton Turvakytkin	P.T.O. Innkoblings Bryter	Int. de sequrança da tomada de força	Interruptor Inhibidor T. De F.
Transmett Alto Livello Carbur	Korkean Polttoainetason Anturi	Drivstoffsender Høyt Novå	Unidade emissora de alto nível de combustível	Sensor Nivel Alto Combustible
Interr Temperatura	Lämpötilakytkin	Temperaturbryter	Interruptor de temperatura	Sensor Temperatura

Conn. No.	GB	DK	NL	F	D
C201	LH Fender Con F3	Venstre Skærmstik F3	Linker Spatbord Conn. F3	Connexion F3 Aile Gauche	Link. Kotflügel-Steckverb. F3
C202	LH Fender Con F4	Venstre Skærmstik F4	Linker Spatbord Conn. F4	Connexion F4 Aile Gauche	Link. Kotflügel-Steckverb. F4
C203	8x2 Model Dual Power Switch	Kontakt F. 8x2 Modul Dual Power	8x2 Model Dual Power Schakelaar	Inter. Dual Power Modèle 8x2	Dual Power-Schalter des 8x2 Modells
C204	LH FRT Turn Indicator	V. Forr. Blinklys	Richtingaanw. Links Voor	Clignot. Av Gauche	Linker vorderer Blinker
C205	LH Marker Lamp	V. Markeringslampe	Standlicht Links	Témoin Clignot. Gauche	Linke Markierungsleuchte
C206	LH RR Turn Indicator	V. Bag. Blinklys	Richtingaanw. Links Achter	Clignot. Ar Gauche	Linker hinterer Blinker
C207	RH FRT Turn Indicator	H. Forr. Blinklys	Richtinganw. Rechts Voor	Clignot. Av Droit	Rechter vorderer Blinker
C208	RH RR Turn Indicator	H. Bag. Blinklys	Richtingaanw. Rechts Achter	Clignot. Ar Droit	Rechter hinterer Blinker
C209	Battery	Batteri	Accu	Batterie	Batterie
C210	Conn H6	Stik H6	Connector H6	Connexion H6	Steckv. H6
C211	Dual Power Sol	Dual Power Solenoide	Dual Power Solenoide	Solénoïde Dual Power	Dual Power-Elek. Vent.
C212	LH Fender	Venstre Skærm	Spatbord Links	Aile Gauche	Linker Kotflügel
C213	RH Fender	Højre Skærm	Spatbord Rechts	Aile Droite	Rechter Kotflügel
C214	PTO Inhab Switch	Spærrekontakt F. Kraftudtag	PTO Beveiliging Schakelaar	Inter. Protect. P.D.F.	Zapfwellen-Sperrschalter
C215	High Level Fuel Sender	Sender for Høj Brændstofstand	Hoog Brandstofpeil Zender	Sonde Niveau élevé Gazole	Sender 'Kraftstoffüllstand Hoch'
C216	Temp Switch	Temperaturkontakt	Temperatuur Schakelaar	Sonde Temp.	Temperaturschalter

I	FIN	N	P	ESP
Princ Ant E1 M/F	Moot. Johtosarja E1 M/F	Fremre Hovednett E1-M/F	Principal dianteira E1-M/F	Delantero Principal E1-M/F
Transmett Press Olio	Öljynpaineanturi	Oljetrykkesender	Unid. emissora da pressão óleo	Sensor Presión Aceite
Interr Press Olio	Öljynpainekytkin	Oljetrykksbryter	Interruptor da pressão do óleo	Int. Presión Aceite
Rele' Avviamento	Käynnistimen Rele	Start Relé	Relé do motor de arranque	Relé Arranque
Elettrovalv Avviamento	Käynnistimen Solenoidi	Starter Solenoid	Solenoide do motor de arranque	Solenoide Arranque
Interr Serbatoio Fluido Freni	Jarrunestesailion Tasokytkin	Bremsevæskenivå Sender	Interruptor do reservatório do óleo dos travões	Int. Depósito Líquido Frenos
Interr Pneumatico	Alipainekytkin	Vakuum Bryter	Interruptor de vácuo	Interruptor De Vacío
Compress Aria Condiz	Ilmastoinnin Kompressori	Air Condition Kompressor	Compressor do ar condicionado	Compr. Aire Acond.
Termostato Sbrinatore	Lauht. Jääty. Estava Termo.	Avisings Termostat	Termostato do descongelador	Termostato Descongelador
Transmett Temp Refrig	Jäähdytinnesteen Lämpöanturi	Temperatur Sender	Unidade emissora da baixa temperatura	Sensor Temp. Refr.
Alternatore	Vaihtovirtalaturi	Alternator	Alternador	Alternador
Chiusura Carbur	Polttonesteen Syötön Katkaisu	Stopp Solenoid Dieselpumpe	Corte de combustivel	Corte Combustible
Termoavviatore	Kylmäkäynnistysllaite	Termostart	Termostart	Calentador Arranque
Conn Prolunga T1 F/M	Jatkojohtosarjan Liitin T1 F/M	Forlengelseskobling T1-F/M	Ligação da extensão T1-F/M	Conex. Extensión T1-F/M
Conn Prolunga C1 F/M	Jatkojohtosarjan Liitin C1 F/M	Forlengelseskobling C1-F/M	Ligação da extensão C1-F/M	Conex. Extensión C1-F/M
Trasmett Serb Carb Ausil	Lisäpolttonestesäiliön Anturi	Sender i Ekstra Drivstofftank	Unidade emissora do depósito auxiliar de combustivel	Sensor Dep. Aux. Combust.
Transmett Temp Olio Cambio	Väihteistoöljyn Lampöanturi	Transmisjonsoljetemp. Sender	Unidade emissora de temperatura do óleo da transmissão	Sensor Temp. Aceite Transm.
Frizione C4	Kytkin C4	Clutch C4	Embraiagem C4	Embrague C4
Frizione C3	Kytkin C3	Clutch C3	Embraiagem C3	Embrague C3
Frizione C2	Kytkin C2	Clutch C2	Embraiagem C2	Embrague C2
Frizione C1	Kytkin C1	Clutch C1	Embraiagem C1	Embrague C1
Elettrovalv DT	4-Vedon Solenoidi	Firehjulstrekk Solenoid	Solenoide de trans. dianteira	Solenoide DT
Interr Press Olio S1	Ölynpainekytkin S1	Oljetrykksbryter S1	Inter. S1 da pressão do óleo	Int. Presión Aceite SI
Elettrovalv PDF	Voimananoton Solenoidi	PTO Solenoid	Solenoide da tomado de força	Solenoide T. De F.
Elettrovalv Blocc Diff	Tas. Pyor. Lukon Solenoidi	Differensialsperre Solenoid	Sol. da blocagem do diferencial	Sol. Diferencial
Interr Blocc Diff	Tas. Pyor. Lukon Kytkin	Differensialsperre Bryter	Inter. da blocagem do diferencial	Int. Bloqueo Dif.
Sensore Velocita	Ajonopeusanturi	Hastighetssensor	Sensor de velocidade	Sensor Velocidad
Perno Di Sforzo Sin	Vetovarren Tunnustelu, Vas	Følebolt V/S	Pino esquerdo da tracção	Perno Izquierdo Tiro
Perno Di Sforzo Des	Vetovarren Tunnustelu, Oik	Følebolt H/S	Pino direito da tracção	Perno Direcho Tiro
Conn Valvola *Sollev Elettr*	Elektr. Nostol. Liitin	EDC Ventil Kobling	Ligação de válvula da tracção *constante electrónica*	Conex. Válvula *Cet*
Potenz Bracci Sollev	Nostoakselin Potentiometri	Potensiometer Løftearm	Potenciómetro do veio excent	Potenc. Eje Balancín
Elettrovalv Distrib Ausil	Ulkop. Ventt. Solenoidi	Solenoid Fjernkontrollventiler	Sol. das válvulas de con. rem	Solenoide Válvula Remota
Sensore Velocita' PDF	VO:n nopeusanturi	Hastinghetssensor PTO	Sensor de velocidade da tomado de força	Sensor Velocidad T. De F.
Presa Rimorchio	Peravaunun Pistoke	Tilhengerkontakt	Tomado para o atrelado	Enchufe Remolque
Conn Cablaggio Fari Ant E2 M/F	Ajovalojen Johtosarjan Liitin E2-M/F	Kontakt Hovedlys E2-M/F	Ligação da cablagem dos faróis E2-M/F	Conex. Cableado Faros Delant. E2-M/F

Conn. No.	GB	DK	NL	F	D
C057	Horn	Horn	Claxon	Avertisseur	Hupe
C059	RH Headlamp	Højre (H) forlygte	Rechter (R) koplamp	Phare droit (RH)	Rechter Scheinwerfer
C060	LH Headlamp	Venstre (V) forlygte	Linker (L) koplamp	Phare gauche (LH)	Linker Scheinwerfer
C062	Stop Lamp Right	Højre Stoplygte	Stoplicht Rechts	Feu Stop Droit	Bremslicht Rechts
C063	Stop Lamp Left	Venstre Stoplygte	Stoplicht Links	Feu Stop Gauche	Bremslicht Links
C064	Worklamp Lower R/H	Ned. Højre Arb. Lampe	Werklicht Onder Rechts	Phare Travail Inf. Droit	Arbeitsscheinw. Unt. Re.
C065	Worklamp Lower L/H	Ned. Venstre Arb. Lampe	Werklicht Onder Links	Phare Travail Inf. Gauche	Arbeitsscheinw. Unt. Li.
C066	Side Lamp R/H	H. Positionslys	Standlicht Rechts	Feu Latéral Droit	Begrenzungsleuchte Rechts
C067	Side Lamp L/H	V. Positionslys	Standlicht Links	Feu Latéral Gauche	Begrenzungsleuchte Links
C068	Radar Gun	Radar	Radar Sensor	Radar	Radarsensor
C072	Starter Switch	Startkontakt	Start Schakelaar	Inter. Démarreur	Anlasserschalter
C073	Windshield Wiper Switch	Kontakt F. Forrudevisker	Ruitewisser Schakelaar	Inter. Essuie-Glace	Schalter des Windschutzscheibenwischers
C074	Turn Switch	Blinklyskontakt	Richtingaanw. Schakelaar	Inter. Chang. Direction	Blinkschalter
C076	Clutch Switch	Koblingskontakt	Koppeling Schakelaar	Inter. Embrayage	Kupplungsschalter
C077	Clutch Pot	Koblingspotentiom.	Koppeling Potetiom.	Potent. Embrayage	Kupplungspot
C078	Switch Rear Wiper	Kontakt F. Bagrudevisker	Schak. Achter. Ruitewisser	Inter. Essuie-Glace Ar	Schalter Für Den Hinteren Wischer
C079	Inst Cluster A	Instrument Gruppe A	Instrum. Paneel A	Tableau Bord A	Instr. Tafel A
C080	Inst Cluster B	Instrumentruppe B	Instrum. Panel B	Tableau Bord B	Instr. Tafel B
C081	Inst Cluster C	Instrumentgruppe C	Instrum. Paneel C	Tableau Bord C	Instr. Tafel C
C082	Beacon Switch	Kontakt F. Rotorblink	Zwaailicht Schakelaar	Inter. Gyrophare	Drehwamleuchten-Schalter
C083	Hazard Switch	Kontakt F. Katastrofeblink	Noodknipperl. Schakelaar	Inter. Feux Détresse	Wamblinkanlagen-Schalter
C084	Worklamp Frt Upper L/H	Øv. V. Forr. Arb. Lampe	Werklicht Voor Boven Links	Phare Trav. Sup. Av Gauche	Arbeitsscheinw. Vo. Ob. Links
C085	Worklamp Front Upper R/H	Øv. H. Forr. Arb. Lampe	Werklicht Voor Boven Rechts	Phare Trav. Sup Av Droit	Arbeitsscheiuw. Ve. Ob. Rechts
C086	L/H Naso Front Flasher	V. Naso Forblink	Naso Knipperl. Links Voor	Clignotant Av Gauche-Naso	Li. Vorderer Naso Blinker
C087	R/H Naso Front Flasher	H. Naso Forblink	Naso Knipperl. Rechts Voor	Clignotant Av Droit-Naso	Re. Vorderer Naso Blinker
C088	Frt Wiper Motor	Forr. Viskermotor	Wisser Motor Voor	Moteur Essuie-Glace Av	Vorderer Wischermotor
C089	Trailer Brake Gauge Lamp	Anhængerbremse Kontrollampe	Aanhangerrem Kontr. Lamp	Témoin Jauge Frein Remorque	Leuchte der Anhängerbrem.
C090	L/H Door Switch	V. Dørkontakt	Deurschakelaar Links	Inter. Porte Gauche	Linker Türschalter
C091	R/H Door Switch	H. Dørkontakt	Deurschakelaar Rechts	Inter. Porte Droite	Rechter Türschalter
C092	Console Lamp	Konsollampe	Console Lamp	Lampe Console	Konsolenleuchte
C093	L/H Naso Rear Flasher	V. Naso Bagblink	Naso Knipperl Links Achter	Clignotant Ar Gauche-Naso	Li. hinterer Naso-Blinker
C094	R/H Naso Rear Flasher	H. Naso Bagblink	Naso Knipperl Rechts Achter	Clignotant Ar Droit-Naso	Re. hinterer Naso-Blinker
C095	L/H Rear Roof Licence/W Lamp	V. Bag. Tagnummerplade/ Arb. Lampe	Plaatverl./Werklicht Links Achter	Pavillon Ar Gauche-Plaque Avec Eclair.	Linke hintere Dach-Kennzeichen/Anzeigeleuchte
C096	R/H Rear Roof Licence/W Lamp	H. Bag. Tagnummerplade/ Arb. Lampe	Plaatverl./Werklicht Rechts Achter	Pavillon Ar Droit-Avec Eclair.	Rechte hintere Dach-Kennzeichen/Anzeigeleuchte
C097	L/H Beacon	V. Rotorblink	Zwaailicht Links	Gyrophare Gauche	Linke Drehwamleuchte

I	FIN	N	P	ESP
Valv Modulatrice Gamma Veloce	Jännitesyk. Jaksotusventt. Nopia	PWM Ventil Hi	Ligação dos contactos da válv. mod. da embraiagem de alta	PWM Hi
Elettrovalv Scarico	Vedonkatkaisusolenoidi	Dump Solenoid	Solenoide de corte	Solenoide De Corte
Interr Cambio 1a-4a	Vaiht. Asentokytkin 1-4	Transmisjonsbryter 1-4	Interruptor 1-4 da transmissão	Int. Transm. 1-4
Interr Cambio 5a-8a	Vaiht. Asentokytkin 5-8	Transmisjonsbryter 5-8	Interruptor 1-5 da transmissão	Int. Transm. 5-8
Interr Cambio Gamma Lenta	Vaiht. Hit. Alueen Asent.	Transmisjonsbryter Lav	Interruptor de baixa da trans.	Int. Subida Transm.
Interr Cambio Gamma Veloce	Vaiht. Nop. Alueen Asent.	Transmisjonsbryter Høy	Interruptor de alta da trans.	Int. Bajada Transm.
Interr Temp S4	Lämpötilakytkin S4	Temperatur Bryter S4	Interruptor da temperatura S4	Int. Temp. S4
Interr Temp S5	Lämpötilakytkin S5	Temperatur Bryter S5	Interruptor da temperatura S5	Int. Temp. S5
Interr Bassa Press Di Carica S2	Alhaisen Varauspaineen Painekytkin S2	Irykkbryter for Lavt Ladetrykk	Interruptor de baixa pressão de entrada S2	Int. Presión Baja Carja S2
Interr Press Pas	Ohjauksen Hydrau. Paine.	Trykkbryter For Servostyring	Inter. de press. da direc. assist.	Int. Presión Dirección
Interr DT/ Superridut	4-Vedon/Ryömintävaihteen Kytkin	Bryter For 4WD/Krypegear	Interruptor da tracção ás quatro rodas/extra-lenta	Int. DT/Super Reductora
Interr Esclusione Motore Avviam	Käynnistyspiirin Turvakytkin	Sikkerhetsstart Bryter	Int. de segurança do motor de arr	Int. Inhibidor Arranque
Interr Di Neutro Asta 3a/4a	Vapaa-Alueen Kytkin 3/4	Nøytral Bryter 3 Og 4 Gear	Int. de neutro do veio selector 3/4	Int. Neutral Rail 3/4
Interr Di Neutro Ast 1a/2a	Vapaa-Alueen Kytkin 1/2	Nøytral Bryter 1 Og 2 Gear	Int. de neutro do veio selector 1/2	Int. Neutral Rail 3/4
Interr Press Freni Pneumatici	Paineilmajarrujen Painekytkin	Bryter For Trykkluftbremser	Int. de pressão do travão de ar	Int. Presión Freno Aire
Presa Accessori	12V Pistoke	Kontakt til Ekstra Utstyr	Tomada para acessórios	Enchufe Accesorios
Interr PDF 540/1000	540/1000 Vo:n Kytkin	540/1000 P.T.O. Bryter	Interruptor de tomada de força 540/1000	Int. T. De F. 540/1000
Interr DT	4-Vedon Kytkin	4WD Bryter	Int. da tracção dianteira	Int. DT
Interr Blocc Diff	Tas. Pyör. Lukon Kytkin	Diff. Sperre Bryter	Int. da blocagem do diferencial	Int. Bloqueo Dif.
Cobb Cambio/ Sollev Allett C2	Vaiht./Elektr. Nost. Liitin C2	Transmisjons/EDC Kontakt C2	Ligação C2 da transmissão tracção constante electrónica	Conex. Trans/ CET C2
Cobb Cambio/ Sollev Allett C4	Vaiht./Elektr. Nost. Liitin C4	Transmisjons/EDC Kontakt C4	Ligação C4 da transmissão tracção constante electrónica	Conex. Trans/ (CET C4
Connecttore C5	Liitin C5	Kontakt C5	Ligação C5	Conexión C5
Interr Presa Attrezzo	Työvälineen Sähköpistokkeen Kytkin	Bryter For Redskapskontakt	Interruptor da tomada das alfaias	Int. Enchufe Implemento
Interr Luci Lavoro Ante Inf	Etumm. Alatyövalojen Kytkin	Bryter For Arbeidslys Nedre Foran	Interruptor dos faróis de trabalho inferiores dianteiros	Int. Faro Trabajo Frontal Inferior
Interr Luci Lavoro Ant Sup	Eutumm. Ylätyövalojen Kytkin	Bryter For Arbeidslys Øvre Foran	Interruptor dos faróis de trabalho superiores dianteiros	Int. Faro Trabajo Frontal Superior
Interr Luci Princip	Ajovalojen Kytkin	Hovedlysbryter	Interruptor dos faróis principais	Int. Principal Luces
Interr Luci Lavoro Post	Takatyövalojen Kytkin	Bryter for Arbeidslys Bak	Int. dos faróis de trab. traseiros	Int. Faros Trabajo Traseros
Interr Superridutt	Ryömintävaihteen Kytkin	Bryter For Krypegear	Interruptor da extra-lenta	Interruptor Super Reductora
Accendisigari	Tupakansytytin	Sigarettenner	Isqueiro	Encendedor Cigarrillos
Alimentazione DT	4-Vedon Syöttöjännite	Tilførselstrøm 4WD	Cor. para a trac. ás quatro rodas	Suministro DT
Trasmett Carbur Ausil/Princip	Polttoainesailiöiden Apü/Pää Valintakytkin	Drivstoff Sender Høyt nivå	Unidades emissoras de combustível auxiliar/principal	Sensor Combustilble Prince./Aux.
Interr Scarico Inversore	Suunnanvaihtovivun Vedonkatkaisukytkin	Vendegear Dump Bryter	Interruptor de corte da inversão de marcha	Interruptor corte Inversor
Interr Gamma Veloce/Media	Nopea/Hidas Kytkin	Høy/Medium Bryter	Interruptor de alta/média	Int. Largas/Medias
Conn Cablaggio Comandi Lato Des H5	Oik. Puol. Hallintapenelin Johtosarjan Liitin H5	Nettkobling H5 Høyre Konsoll	Ligação H5 da cablagem da consola direita	Conex. Cableado Consola Derecha H5
Conn Parafango Des F3	Oik. Lokasuojan Liitin F3	Kobling F3 Skjerm H/S	Lig. F3 do guarda-lamas direito	Conex. Guardabarros Derecho F3
Conn Parafango Des F4	Oik. Lokasuojan Liitinm F4	Kobling F4 Skjerm H/S	Lig. F4 do guarda-lamas direito	Conex. Guardabarros Derecho F4

Conn. No.	GB	DK	NL	F	D
C162	Hi PWM	Hi PWM	Hoog Pwm	Valve PWM Haute	ILM HI
C163	Dump Solenoid	Dumpesolenoide	Dumpsolenoide	Solénoïde Vidange	Auslass-Elektromag. Vent.
C164	Trans Switch 1-4	Transm. Kontakt 1-4	Transm. Schakelaar 1-4	Inter. Trans. 1-4	Getriebeschalter 1-4
C165	Trans Switch 5-8	Transm. Kontakt 5-8	Transm. Schakelaar 5-8	Inter. Trans. 5-8	Getriebeschalter 5-8
C166	Trans Switch Low	Transm. Kontakt Lav	Transm. Schakelaar Laag	Inter. Trans. Lente	Getriebeschalter Langsam
C167	Trans Switch High	Transm. Kontakt Høj	Transm. Schakelaar Hoog	Inter. Trans. Rapide	Getriebeschalter Schnell
C171	Temp Switch S4	Temp. Kontakt S4	Temp. Schakelaar S4	Inter. Temp. S4	Temp. Schalter S4
C172	Temp Switch S5	Temp. Kontakt S5	Temp. Schakelaar S5	Inter. Temp. S5	Temp. Schalter S5
C173	Low Charge Pressure *Switch S2*	Kontakt F. Lavt *Ladetryk S2*	Lage Laaddruk *Schakelaar S2*	Inter. Basse Pression *Charge S2*	Schalter 'Ladedruck *niedrig' S2*
C174	PAS Pressure Switch	Trykkontakt PAS	Sturingdruk Schakelaar	Inter. Pression Sce Aux.	Servolenkungs-Druckschalter
C175	4WD/Creeper Gear Switch	Kontakt F. 4WD/Krybegear	4WD/Kruipversn. Schakelaar	Inter. 4RM/Réducteur	VRA/Kriechgangschalter
C176	Start Inhibitor Switch	Startspærrekontakt	Schakelaar Start Beveiliging	Inter. Protect. Démarreur	Anlasser-Sperrschalter
C177	Neutral Sw. 3/4 Rail	Neutralkon. 3/4 Gearskinne	Neutraalschkelaar 3/4 Rail	Inter. Neutre Axe 3/4	Neutralschalter Schiene 3/4
C178	Neutral Sw. 1/2 Rail	Neutralkon. 1/2 Gearskinne	Neutraalschakelaar 1/2 Rail	Inter. Neutre Axe 1/2	Neutralschalter Schiene 1/2
C179	Air Brake Pressure Switch	Trykkontakt F. Luftbremse	Luchtrem Drukschakelaar	Inter. Pression Frein Pneum	Dr. Lu. Brem.-Dr. S.
C180	Accessory Socket	Tilbehørsstik	Accessoires Contactdoos	Prise Accessoires	Zusatzsteckdose
C181	540/1000 PTO Switch	Kontakt F. 540/1000 Kraftudtag	540/1000 DTP Schakelaar	Inter. P.D.F. 540/1000	Zapfwellenschalter 540/1000
C182	4WD Switch	Kontakt F. 4WD	4WD Schakelaar	Inter. 4RM	4RA-Schalter
C183	Diff Lock Switch	Kontakt F. Diff. Spærre	Diff. Slot Schakelaar	Inter. Bloc. Diff.	Diff. Sperrenschalter
C184	Trans/EDC Connector C2	Stik F. Transm./EDC C2	Transm./EDC Connector C2	Connexion C2 Trans/EDC	Getriebe/EDC-Steckverb. C2
C185	Trans/EDC Connector C4	Stik F. Transm./EDC C4	Transm./EDC Connector C4	Connexion C4 Trans/EDC	Getriebe/EDC-Steckverb. C4
C186	Connector C5	Stik C5	Connector C5	Connexion C5	Steckverbinder C5
C187	Switch Implement Socket	Kontakt F. Redskabsstik	Schakelaar Werktuig Contactdoos	Inter. Prise Outil	Schalter der Anbaugerätesteckdose
C188	Switch Worklamps FRT Lower	Kontakt F. Arb. Lamper Forr. Ned.	Schakelaar Werklampen Voor Onder	Inter. Phare Trav. Av Inf.	Schalter für die unt. vord. Arbeitsscheinwerfer
C189	Switch Worklamps FRT Upper	Kontakt F. Arb. Lamper Forr. Øv.	Schakelaar Werklampen Voor Boven	Inter. Phare Trav. Av Sup.	Schalter für die ob. vord. Arbeitsscheinwerfer
C190	Switch Main Lamps	Kontakt F. Kørelys	Lichtschakelaar	Inter. Lampes Princ.	Schalt. Haupt. sw.
C191	Switch Worklamps Rear	Kontakt F. Arb. Lamper Bag	Schakelaar Werklampen Achter	Inter. Phare Trav. Ar	Schalt Hin. Arb. sw.
C192	Creeper Gear Switch	Kontakt F. Krybegear	Kruipversn. Schakelaar	Inter. Réducteur	Kriechgangschalter
C193	Cigar Lighter	Cigarettænder	Aansteker	Allume-Cigare	Zigarettenanzünder
C194	4WD Supply	4WD Fødeledning	4WD Voeding	Aliment. 4RM	4RA-Zufuhr
C195	Fuel Sender Aux/Mian	Sender F. Ekstra/Hoved Brændstoftank	Brandst. Zender Hulp/Hoofd	Sonde Gazole Aux/Princ.	Kraftstoffsender Zusatz/Haupt
C196	Shuttle Dump Switch	Kon. F. Vendegear Dumper	Pendel Dump Schakelaar	Inter. Vidange Inverseur	Wendeschalt Unterbr. schalt.
C197	HI/MED Switch	Kontakt F. Hi/Med	Hoog/Med. Schakelaar	Inter. Haute/Moyenne	Schalter HI/Med
C198	RH Consol Harness Con H5	Stik F. H. Konsol Ledn. Net H5	Rechter Console Draadb. Conn. H5	Connexion H5 Faisceau Console Droit	Steckverb. H5 des rechten Konsolen-Kabelstrangs
C199	RH Fender Con F3	Højre Skærmstik F3	Rechter Spatbord Conn. F3	Connexion F3 Aile Droite	Rech. Kotflügel-Steckverb. F3
C200	RH Fender Con F4	Højre Skærmstik F4	Rechter Spatbord Conn. F4	Connexion F4 Aile Droite	Rech. Kotflügel-Steckverb. F4

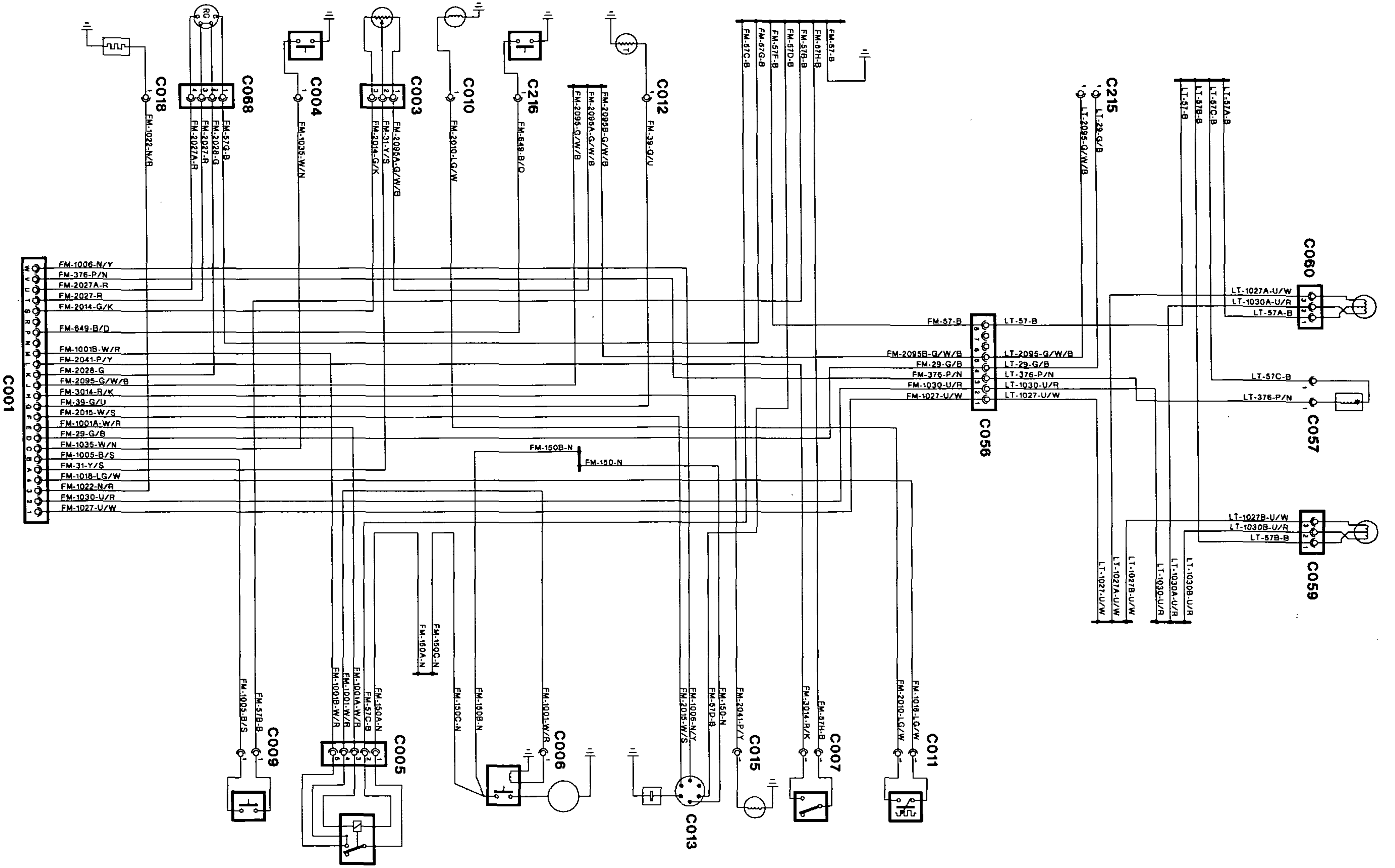
I	FIN	N	P	ESP
Avvistore Acustico	Äänimerkinantolaite	Horn	Buzina	Bocina
Faro Anteriore Destro	Ajovalo, aokea puoli	Hovedlys H/S	Farol dianteiro direito	Faro Delantero Derecho
Faro Anteriore Sinistro.	Ajovalo, vasen puoli	Hovedlys V/S	Farol dianteiro esquerdo	Faro Delantero Izquierdo
Luce Di Arresto Des	Jarruvalo, Oikea	Stopplys Høyre	Luz de par. do lado direito	Luz Pare Derecha
Luce Di Arresto Sin	Jarruvalo, Vasen	Stopplys Venstre	Luz de par. do lado esquerdo	Luz Pare Izquierda
Luce Lavoro Inf Des	*Alempi Työvalo, Oikea*	*Arbeidslys Nedre H/S*	*Far. de trabalho infer., lado dir.*	*Faro Trabajo Inferior Derecho*
Luce Lavoro Inf Sin	Alempi Työvalo, Vasen	Arbeidslys Nedre V/S	Far. de trabalho infer., lado esq.	Faro Trabajo Inferior Izquierdo
Luce Later Des	Sivuvalo, Oikea	Parklys H/S	Farolim, lado direito	Luz Posición Derecha
Luce Later Sin	Sivuvalo, Vasen	Parklys V/S	Farolim, lado esquerdo	Luz Posición Izquierda
Radar	*Ajonopeustutka*	*Radar*	*Emissor do radar*	*Cañón Radar*
Interr Avviamento	Käynnistyskytkin	Tenningslås	Inter. do motor de arranque	Interruptor Arranque
Interr Tergicrist	Tuulilasin Pyyhkimen Kytikin	Bryter Vinduspusser	Interruptor do limpa pára-brisas	Interruptor Limpia Parabrisas
Interr Indicat Direz*	Suuntavilkun Kytkin	Retningssignal Bryter	Inter. dos indic, de direcção	Interruptor Intermitentes
Inter Frizione	Kytkinpolkimen Kytkin	Clutch Bryter	Interruptor da embraiagem	Interruptor Embrague
Potenz Frizione	Kytkinpolkimen Potentiometri	Clutch Potensiometer	Potenciómetro da embraiagem	Potenc. Embrague
Interr Tergicrist Post	Takalasin Pyykimen Kytkin	Bryter Vinduspusser Bakrute	Interruptor do limpa vidros traseiro	Limpia Parabrisas Trasero
Strumentazione A	*Kojetaulu* A	*Instrumentbord* A	*Grupo do instrumentos* A	*Panel Instrumentos* A
Strumentazione B	Kojetaulu B	Instrumentbord B	Grupo de instrumentos B	Panel Instrumentos B
Strumentazione C	Kojetaulu C	Instrumentbord C	Grupo de instrumentos C	Panel Instrumentos C
Interr Lampeggiatore	Pyörivän Vilkun Kytkin	Rotorlampe Bryter	Interruptor do farol rotativo	Interruptor Faro Giratorio
Interr Luci Emergenza	Hätävilkun Kytkin	Bryter Varselbliniker	Inter. da sinalização de emerg	Interruptor Emergencia
Luce Lavoro Ant Sup Sin	Etumm. Ylätyövalo, Vasen	Arbeidslyts Foran V/S	Farol de trabalho dianteiro superior, esquerdo	Faro Trabajo Superior Frontal Izquierdo
Luce Lavoro Ant Sup Des	Etumm. Ylätyövalo, Oikea	Arbeidslys Foran H/S	Farol de trabalho dianteiro superior, direito	Faro Trabajo Superior Frontal Derecho
Lampegg Ant Sin "Naso"	Vasen Etuvilkku (USA)	Ikke For Norge	Indicador dianteiro esquerdo (mercado norte americano)	Intermit. Frontal Naso Izquierdo
Lampegg Ant Des "Naso"	Oikea Etuvilkku (USA)	Ikke For Norge	Indicador dianteiro direito (mercado norte americano)	Intermit. Frontal Naso Derecho
Motore Tergicrist Ant	Tuulilasin Pyyhkimen Moot.	Pussermotor Foran	Motor do limpa vidros dianteiro	Motor Limpia Frontal
Illuminaz Indicat Freno Rimorchio	Perävaunun Jarruvalo	Varsellys Tilhengerbrems (Luftbremser)	Luz do indicador dos travões do atrelado	Luz Freno Remolque
Interr Porta Sin	Ovikytkin, Vasen	Dørbryter V/S	Interruptor da porta esquerda	Int. Puerta Izquierdo
Interr Porta Des	Ovikytkin, Oikea	Dørbryter H/S	Interruptor da orta direita	Int. Puerta Derecha
Plafoniera	*Hallintapanenlin Valo*	*Konsoll Lys*	Luz da consola	*Luz Consola*
Lampegg Post Sin "Naso"	Vasen Takavilkku (USA)	Ikke For Norge	Indicador traseiro esquerdo (mercado norte americano)	Intermit. Trasero Naso Izquiredo
Lampegg Post Des "Naso"	Oikea Takavilkku (USA)	Ikke For Norge	Indicador traseiro direito (mercado norte americano)	Intermit. Trasero Naso Derecho
Luce Lav/Targa Tetto Post Sin	Katon Vasen Takatyövalo Ja Rekisterikilven Valo	Skiltlys Lampe H/S	Luz traseira esquer. da matrícula/farol de trabalho no tejadilho	Placa Matr. Superior Trasera Izquierda/Faro Trabajo
Luce Lav/Tetto Post Des	Katon Oikea Takatyövalo Ja Rekisterikilven Valo	Skiltlys Lampe H/S	Luz traseira direita da matrícula/farol de trabalho no tejadilho	Placa Matr. Superior Trasera Derecha/Faro Trabajo
Girofaro Sin	Pyörivä Vilkku, Vasen	Rotorlampe V/S	Farol rotativo do lado esquerdo	Faro Giratorio Izquierdo

Conn. No.	GB	DK	NL	F	D	I	FIN	N	P	ESP
C098	R/H Beacon	H. Rotorblink	Zwaailicht Rechts	Gyrophare Droit	Rechte Drehwarnleuchte	Girofara Des	Pyörivä Vilkku, Oikea	Rotorlampe H/S	Farol rotativo do lado direito	Faro Giratorio Derecho
C099	Interior Lamp	Interiørlampe	Binnen Verlichting	Eclair. Inter.	Innenlampe	Luce Interna	Ohjaamon Sisävalo	Ineriørlampe	Luz interior	Luz Interior
C102	Fast Raise/Lower Switch	Hæve/Sænkekontakt	Hef/Werk Snelschakelaar	Inter. Montée/ Desc. Rapide	Schalter Schnelles Heben/Arbeiten	Interr Alza/ Abbassa Rapido	Nopea Nosto/ Lasku Kytkin	Løft/Senk Bryter E.D.C.	Interruptor da subida/ descida rápida	Interruptor Subida Rápida/Bajada
C103	Gearshift T4-M/F	Gearskifte T4-M/F	Versn. Schakel. T4-M/F	Change. Vitesses T4-M/F	Gangschaltung T4-M/F	Leve Cambio T4 M/F	Vaihdevipu T4-M/F	Gearskiftkontakt T4-M/F	Mudanças de velocidade 4T/M/F	Cambio T4-M/F
C104	Gearshift Display T5-M/F	Gearskiftedisplay T5/M/F	Versn. Scherm T5-M/F	Afficheur Vitesses T5-M/F	Gangschaltungsdisplay T5-M/F	Visualizz Cambio Marce T5 M/F	Vaihteiston Näyttötaulu T5 M/F	Gearskift Display T5-M/F	Mostrador das mudanças de velocidade T5-M/F	Pantalla Cambio T5-M/F
C106	Radio A	Radio A	Radio A	Radio A	Radio A	Radio A	Radio A	Radio A	Rádio A	Radio A
C107	Radio B	Radio B	Radio B	Radio B	Radio B	Radio B	Radio B	Radio B	Rádio B	Radio B
C109	Wiper Motor Rear	Bag. Viskermotor	Wissermotor Achter	Moteur Essuie-Glace Ar	Wischermotor hinten	Motore Tergicrist Post	Takalasin Pyyhkimen Moot.	Pussermotor Bak	Motor do limpa vidros traseiro	Motor Limpia Trasero
C110	R/H Speaker	H. Højttaler	Luidspreker Rechts	Haut-Parleur Droit	Rechter Lautsprecher	Altoparlante Des	Kaiutin, Oikea	Høyttaler H/S	Altifalante direito	Altavoz Derecho
C111	L/H Speaker	V. Højttaler	Luidspreker Links	Haute-Parleur Gauche	Linker Lautsprecher	Altoparlante Sin	Kaiutin, Vasen	Høyttaler V/S	Altifalante equerdo	Altravoz Izquierdo
C116	PTO Switch	Kontakt F. Kraftudtag	PTO Schkelaar	Inter. P.D.F.	Zapfwellenschalter	Interr PDF	Voimanoton Kytkin	P.T.O. Bryter	Interruptor da tomada de força	Interruptor t. De f.
C117	PTO Engage Lamp	Kontrollampe F. Tilkobl. Kraftudtag	PTO "AAN" Lamp	Témoin Engag. P.D.F.	Leuchte 'Zapfwelle eingeschaltet'	Spia Innesto PDF	Voimanoton Merkkivalo	Varsellampe P.T.O.	Luz indicadora da ligação da tomada de força	Luz Conexión T. De F.
C119	Heater/Air Con. Connector T6-F/M	Varmeapp./Aircond. Stik T6-F/M	Verwarm./Airco Connector T6-F/M	Connexion Chauf./ Air Cond. T6-F/M	Heizungs-/Klimaanlagen-Steckverbinder T6-F/M	Conn Riscald/Aria Cond T6 F/M	Lämmitys/ Ilmastointilaitten Liitin T6 F/M	Varmeapparat/Air Condition Kontakt T6-F/M	Ligação do aquecimento/ar condicionado T6/F/M	Conex. Calefacción Aire Acond. T6-F/M
C120	EDC Control Panel 1	EDC Kontrolpanel 1	EDC Kontrole Paneel 1	Tableau CDE EDC 1	EDC-Bedienungsfeld 1	Pannello Com. Sellev Elettr 1	Elektr. Nostolaitteen Hallintapaneli 1	Kontrollpanel 1 EDC	Painel de comando da tracção constante electrónica 1	Panel Control CET 1
C121	EDC Control Panel 2	EDC Kontrolpanel 2	EDC Kontrole Paneel 2	Tableau CDE EDC 2	EDC-Bedienungsfeld 2	Pannello Com. Sellev Elettr 2	Elektr. Nostolaitteen Hallintapaneli 2	Kontrollpanel 2 EDC	Painel de comando da tracção constante electrónica 2	Panel control CET 2
C125	Diagnostic Con D1	Diagnosestik D1	Diagnose Connector D1	Connexion Diagnostic D1	Diagnosesteckverb. D1	Conn Diagnostico D1	Testilittimen Pistoke D1	Diagnosekontakt D1	Ligação D 1 de diagnostico	Conex. Diagnóstico D1
C127	Module Con CN2	Modulstik CN2	Modul Connector CN2	Connexion Module CN2	Modulsteckv. CN2	Conn Modulo CN2	Modulin Liitin CN2	Databoks Kontakt CN2	Ligação do módulo CN2	Conex. Módulo CN2
C128	Module Con CN1	Modulstik CN1	Modul Connector CN1	Connexion Module CN1	Modulsteckv. CN1	Conn Modulo CN1	Modulin Liitin CN1	Databoks Kontakt CN1	Ligação do módulo CN1	Conex. Módulo CN1
C129	Worklamp R/H Fender	Arb. Lampe H. Skærm	Werklicht Rechts Spatbord	Phare Trav. Aile Droite	Rech. Kotflügel-Artbeitsscheinw.	Luce Lav Parafango Des	Lokasuojan Oikea Työvalo	Arbeidslys Skjerm H/S	Farol de travalho no guarda-lamas do lado direito	Faro Trabajo Guardabarros Derecho
C130	Worklamp L/H Fender	Arb. Lampe V. Skærm	Werklicht Links Spatbord	Phare Trav. Aile Gauche	Linker Kotflügel-Arbeitsscheinw.	Luce Lav Parafango Sin	Lokasuojan Vasen Työvalo	Arbeidslys Skjerm V/S	Farol de travalho no guarda-lamas do lado esquerdo	Faro Trabajo Guardabarros Izquierdo
C131	Licence Plate Lamp L/H Fender	Nummerpladelampe V. Skærm	Plaatverl Lamp Links Spatbord	Eclair. Plaque Immat. Aile Gauche	Linke Kotflügel-Kennzeichenleuchte	Luce Targa Sin	Lokasuojan Vasen Rek. Kilven Valo	Skiltlys Skjerm V/S	Illuminação da matrícula no guarda-lamas esquerdo	Luz Matrícula Guardabarros Izquierdo
C132	RR Lamp R/H Fender	Bag. Lampe På H. Skærm	Achterlicht Rechts SpatB	Feu Ar Aile Droite	Hintere rechte Kotflügellampe	Luce Post Parafango Des	Lokasuojan Oikea Takavalo	Skiltlys Skjerm H/S	Luz tras. no guarda-lamas dir.	Luz Guardabarros Trasero Derecho
C133	RR Lamp L/H Fender	Bag. Lampe På V. Skærm	Achterlicht Links SpatB	Feu Ar Aile Gauche	Hintere linke Kotflügellampe	Luce Post Parafango Sin	Lokasuojan Vasen Takavalo	Baklampe Skjerm V/S	Luz tras. no guarda-lamas esq.	Luz Guardabarros Trasero Izquierdo
C134	HPL Raise/Lower Switch R/H	Lift Hæve/ Sænkekontakt H.	Hef/Daal Schakelaar Rechts	Inter. Montée/Desc. Ext. Droit	Rechter Schalter 'HPL Heben/Senken'	Interr Alza/ Abbassa Des	Nostol. Ulkop. Nosto/ Laskukytkin, Oikea	Utv. Bryter EDC H/S	Interruptor direito do levantador hidrâulico	Interruptor Subida/ Bajada Levante Derecho
C135	HPL Raise/Lower Switch L/H	Lift Hæve/ Sænkekontakt V.	Hef/Daal Schakelaar Links	Inter. Montée/Desc. Ext. Gauche	Linker Schalter 'HPL Heben/Senken'	Interr Alza/ Abbassa Sin	Nostol. Ulkop. Nosto/ Laskukytkin, Vasen	Utv. Bryter EDC V/S	Interruptor direito do levantador direito	Interruptor Subida/ Bajada Levante Izquierdo
C136	Handbrake	Parkeringsbremse	Handrem	Frein a Main	Feststellbremse	Freno Mano	Käsijarru	Håndbrems	Travão de mão	Freno De Mano
C138	Seat Pump	Sædekompressor	Pomp Van Stoel	Pompe Siège	Sitzpumpe	Pompa Sedile	Istuimen Ilmapumppu	Kompressor Luftsete	Bomba do banco do operador	Bomba Asiento
C139	FRT Washer Motor	Sprinklermotor For	Sproeier Motor Voor	Moteur Lave-Glace Av	Vorderer Waschermotor	Motore Lavavetro Ant	Tuulilasin Pesimen Moottori	Fremre Vindusspyler Motor	Motor do lava pāra-brisas	Motor Lava Frontal
C140	RR Washer Motor	Sprinklermotor Bag	Sproeier Motor Achter	Moteur Lave-Glace Ar	Hinterer Waschermotor	Motore Lavavetro Post	Takalasin Pesimen Moottori	Bakre Vindusspyler Motor	Motor do lava vidro traseiro	Motor Lava Trasero
C143	Implement Socket	Redskabsstik	Werktuig Contactdoos	Prise Outil	Anbaugeräte-Steckdose	Presa Attrezzo	Työvälineen Sähköpistoke	Redskapakontakt	Tomada para as alfaias	Enchufe Implemento
C147	Remote Valve Switch	Kontakt F. Fjerncyl. Ventil	Schakelaar Vent. Afstandbed	Inter. Distrib. Aux.	Zusatz-Steuerventil-Schalter	Interr Distrib Ausil	Ulkop. Hydr. Hallintaventt. Kytkin	Fjernkontroll Ventil Bryter	Int. das vālvulas de cont rem.	Interruptor Válvula Remota
C148	Diverter Valve	Fordelerventil	Wisselklep	Valve Dérivation	Verteilerventile	Valv Deviatrice	Jakoventtiili	Fordelingsventil	Vālvula de desvio	Válvula Divisora
C149	Quadrant Pot	Kvadrant Potentiometer	Kwadrant Potentiom	Potent. Secteur	Quadrant-Pot.	Potenz Quadrante	Nostol. Hallint. Potentiometri	Potensiometer Løftespak	Potenciómetro do quadrante	Potenc. Cuadrante
C154	HPL Vacuum Switch	Vakuumkontakt For Lift	Hefinr. Vacuumschakelaar	Inter. Dépression Relev.	HPL-Vakuumschalter	Interr Pneumatico Sollev	Nostol. Alipainekytkin	Vakuumbryter For Hydr. Løft	Int. de vāc do levantador hidr.	Interrup. Vació Levante
C161	Lo PWM	Lo PWM	Laag Pwm	Valve PWM Basse	ILM LO	Valv Modulatrice Gamma Lenta	Jānnitesyk. Jaksotusventt. Hidas	PWM Ventil Lo	Ligação dos contactos da válv. mod. da embraiagem de baixa	PWM Lo

GB	Front Main and Headlamp
D	Vorne Haupt und Scheinwerfer
DK	Forreste hovedledningsnet og forlygter
ESP	Delantero principal y faros de carretera
F	Principal avant et phares
FIN	Etummainen pääjohtosarja ja ajovalot
I	Principale anteriore e fari anteriori
N	Fremre hovednett inkl. frontlamper
NL	Vooraan hoofdbundel en koplicht
P	Dianteira principal e faróis

SERIES 40 (UP GRADE) WIRING DIAGRAM

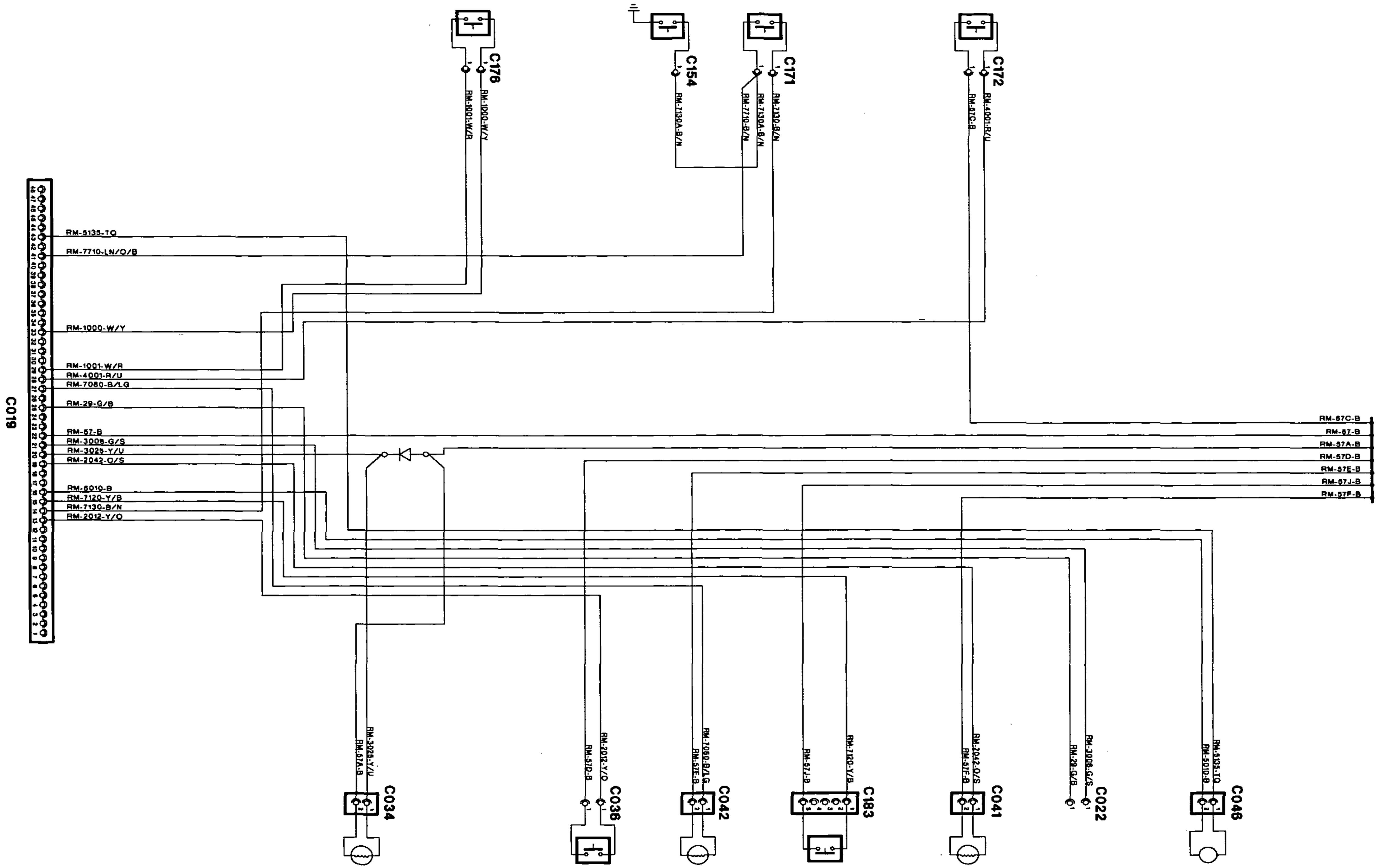
GB	D	DK	ESP	F	FIN	I	N	NL	P
FRONT MAIN AND HEADLAMP	VORNE HAUPT UND SCHEINWERFER	FORRESTE HOVEDLEDNINGSET OG FORLYGTER	DELANTERO PRINCIPAL Y FAROS DE CARRETERA	PRINCIPAL AVANT ET PHARES	ETUMMAINEN PÄÄJOHTOSARJA JA AJOVALOT	PRINCIPALE ANTERIORE E FARI ANTERIORI	FREMRE HOVEDNETT INKL FRONTLAMPER	VOORAAN HOOFBUNDEL EN KOPLICHT	DIANTEIRA PRINCIPAL E FARÓIS



GB	Chassis Main, 12 x 12, Less Dual Power, Less EDC
D	Fahrgestell Haupt, 12 x 12, ohne Dual Power, ohne EDC
DK	Chassis hovedledningsnet, 12 x 12, uden Dual Power, uden EDC
ESP	Principal de chasis, 12 x 12 sin Potencia Dual, sin CET
F	Châssis principal, 12 x 12 sans Dual Power, sans EDC
FIN	Jatkojohtosarja, 12 x 12 ilman Dual Poweria, ilman elektr. Nostolaitetta
I	Principale Telaio, 12 x 12, Senza Dual Power Senza Sollevatore Elettronico
N	Forlengelsesnett 12 x 12 uten DP, uten EDC
NL	Frameb. 12 x 12, Zonder Dual Power, Zonder EDC
P	Principal do chassis, 12 x 12, sem Dual Power, sem tracção constante electrónica

SERIES 40 (UP GRADE) WIRING DIAGRAM

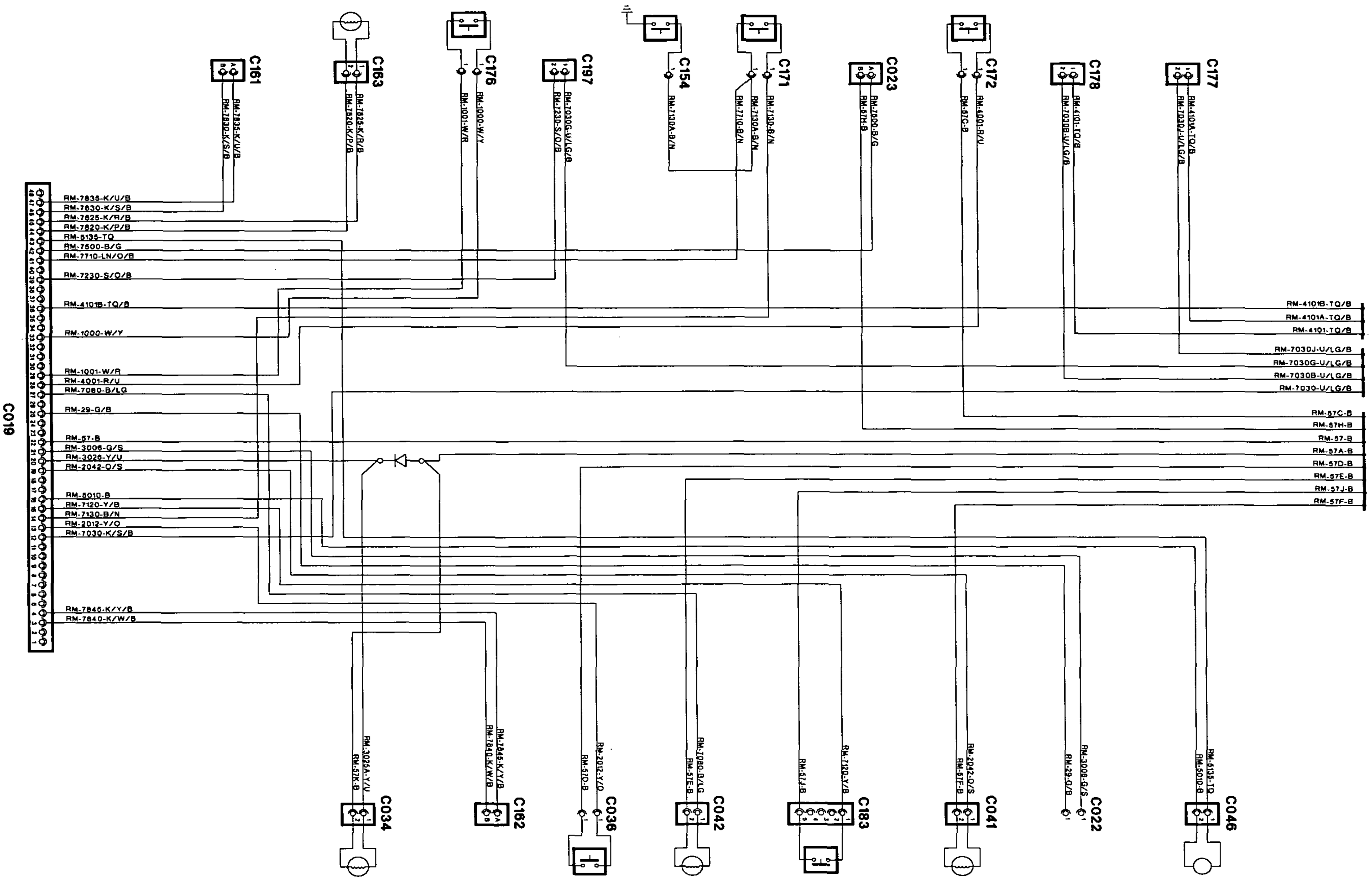
GB	D	DK	ESP	F	FIN	I	N	NL	P
CHASSIS MAIN 12X12 LESS DUAL POWER LESS EDC	FAHRGESTELL HAUPT 12X12 OHNE DUAL POWER OHNE EDC	CHASSIS HOVEDLED-NINGSNET 12X12 UDEN DUAL POWER UDEN EDC	PRINCIPAL DE CHASIS 12X12 SIN POTENCIA DUAL SIN CET	CHÂSSIS PRINCIPAL 12X12 SANS DUAL POWER SANS EDC	JATKOJOHTOSARJA 12X12 ILMAN DUAL POWERIA ILMAN ELEKTR NOSTOLAITETTA	PRINCIPALE TELAIO 12X12 SENZA DUAL POWER SENZA SOLLEVATORE ELETTRONICO	FORLENGELSESNETT 12X12 UTEN DP UTEN EDC	FRAMEB. 12X12 ZONDER DUAL POWER ZONDER EDC	PRINCIPAL DO CHASSIS 12X12 SEM DUAL POWER SEM TRACÇÃO CONSTANTE ELECTRÓNICA



GB	Chassis Main, 12 x 12, With Dual Power, Less EDC
D	Fahrgestell Haupt, 12 x 12, Mit Dual Power, ohne EDC
DK	Chassis hovedledningsnet, 12 x 12, med Dual Power, uden EDC
ESP	Principal de chasis, 12 x 12 con Potencia Dual, Sin CET
F	Châssis principal, 12 x 12 avec Dual Power, sans EDC
FIN	Jatkojohtosarja, 12 x 12 Dual Power ilman, elektr. Nostolaitetta
I	Principale telaio, 12 x 12, con Dual Power senza sollevatore elettronico
N	Forlengelsesnett 12 x 12 med DP, uten EDC
NL	Frameb. 12 x 12, met Dual Power, zonder EDC
P	Principal do chassis, 12 x 12, com Dual Power, sem Tracção constante electrónica

SERIES 40 (UP GRADE) WIRING DIAGRAM

GB	D	DK	ESP	F	FIN	I	N	NL	P
CHASSIS MAIN 12X12 WITH DUAL POWER LESS EDC	FAHRGESTELL HAUPT 12X12 MIT DUAL POWER OHNE EDC	CHASSIS HOVEDLEDNINGSNET 12X12 MED DUAL POWER UDEN EDC	PRINCIPAL DE CHASIS 12X12 CON POTENCIA DUAL SIN CET	CHÂSSIS PRINCIPAL 12X12 AVEC DUAL POWER SANS EDC	JATKOJOHTOSARJA 12X12 DUAL POWER ILMAN ELEKTR NOSTOLAITETTA	PRINCIPALE TELAIO 12X12 CON DUAL POWER SENZA SOLLEVATORE ELETTRONIC	FORLENGELSESNETT 12X12 MED DP UTEN EDC	FRAMEB. 12X12 MET DUAL POWER ZONDER EDC	PRINCIPAL DO CHASSIS 12X12 COM DUAL POWER SEM TRACÇÃO CONSTANTE ELECTRÓNICA

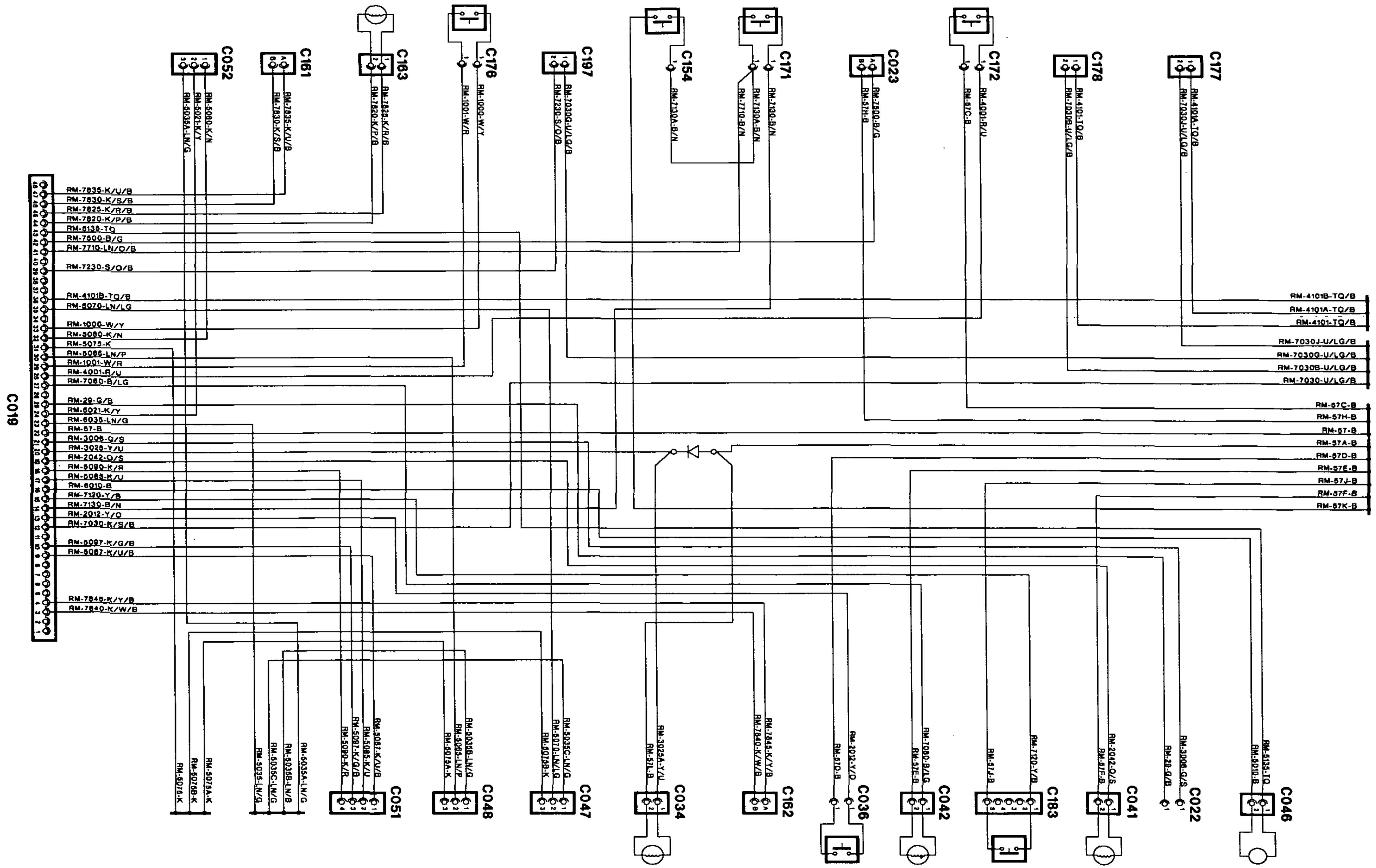


GB	Chassis Main, 12 x 12, With Dual Power, With EDC
D	Fahrgestell Haupt, 12 x 12, mit Dual Power, mit EDC
DK	Chassis hovedledningsnet, 12 x 12, med Dual Power, med EDC
ESP	Principal de chasis, 12 x 12 con Potencia Dual, con CET
F	Châssis principal, 12 x 12 avec Dual Power, avec EDC
FIN	Jatkojohtosarja, 12 x 12 Dual Power elektr. Nostolaitteella
I	Principale telaio, 12 x 12, con Dual Power con sollevatore Elettronico
N	Forlengelsesnett 12 x 12 med DP, med EDC
NL	Frameb. 12 x 12, met Dual Power, met EDC
P	Principal do chassis, 12 x 12, com Dual Power, com tracção constante electrónica

SERIES 40 (UP GRADE) WIRING DIAGRAM

NEW HOLLAND SERVICE

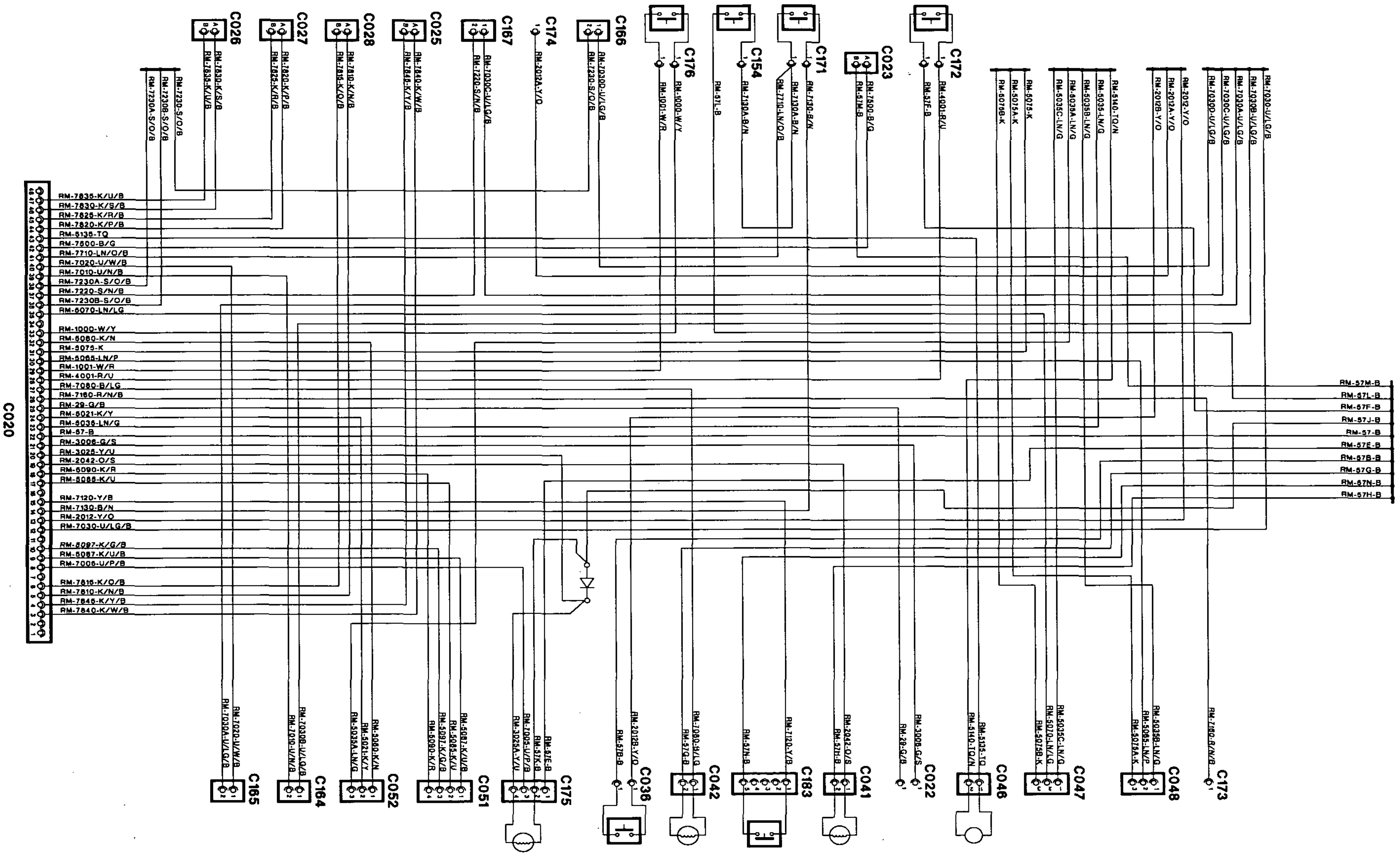
GB	D	DK	ESP	F	FIN	I	N	NL	P
CHASSIS MAIN 12X12 WITH DUAL POWER WITH EDC	FAHRGESTELL HAUPT 12X12 MIT DUAL POWER MIT EDC	CHASSIS HOVEDLEDNINGSNET 12X12 MED DUAL POWER MED EDC	PRINCIPAL DE CHASIS 12X12 CON POTENCIA DUAL CON CET	CHÂSSIS PRINCIPAL 12X12 AVEC DUAL POWER AVEC EDC	JATKOJOHTOSARJA 12X12 DUAL POWER ELEKTR NOSTOLAITTEELLA	PRINCIPALE TELAIO 12X12 CON DUAL POWER CON SOLLEVATORE ELETTRONICO	FORLENGELSESNETT 12X12 MED DP MED EDC	FRAMEB. 12X12 MET DUAL POWER MET EDC	PRINCIPAL DO CHASSIS 12X12 COM DUAL POWER COM TRACÇÃO CONSTANTE ELECTRÓNICA



GB	Chassis Main, 16 x 16, All Models
D	Fahrgestell Haupt, 16 x 16, alle modelle
DK	Chassis Hovedledningsnet, 16 x 16, alle modeller
ESP	Principal de chasis, 16 x 16 todos los modelos
F	Châssis principal, 16 x 16 tous modèles
FIN	Jatkojohtosarja, 16 x 16 vaihteisto, kaikki mallit
I	Principale Telaio, 16 x 16, tutti i modelli
N	Forlengelsesnett 16 x 16 alle modeller
NL	Framebundel. 16 x 16, alle modellen
P	Principal do chassis, 16 x 16, todos modelos

SERIES 40 (UP GRADE) WIRING DIAGRAM

GB	D	DK	ESP	F	FIN	I	N	NL	P
CHASSIS MAIN 16X16 ALL MODELS	FAHRGESTELL HAUPT 16X16 ALLE MODELLE	CHASSIS HOVEDLEDNINGSNET 16X16 ALLE MODELLER	PRINCIPAL DE CHASIS 16X16 TODOS LOS MODELOS	CHÂSSIS PRINCIPAL 16X16 TOUS MODÈLES	JATKOJOHTOSARJA 16X16 VAIHTEISTO KAIKKI MALLIT	PRINCIPALE TELAIO 16X16 TUTTI I MODELLI	FORLENGELSESNETT 16X16 ALLE MODELLER	FRAMEBUNDEL 16X16 ALLE MODELLEN	PRINCIPAL DO CHASSIS 16X16 TODOS OS MODELOS



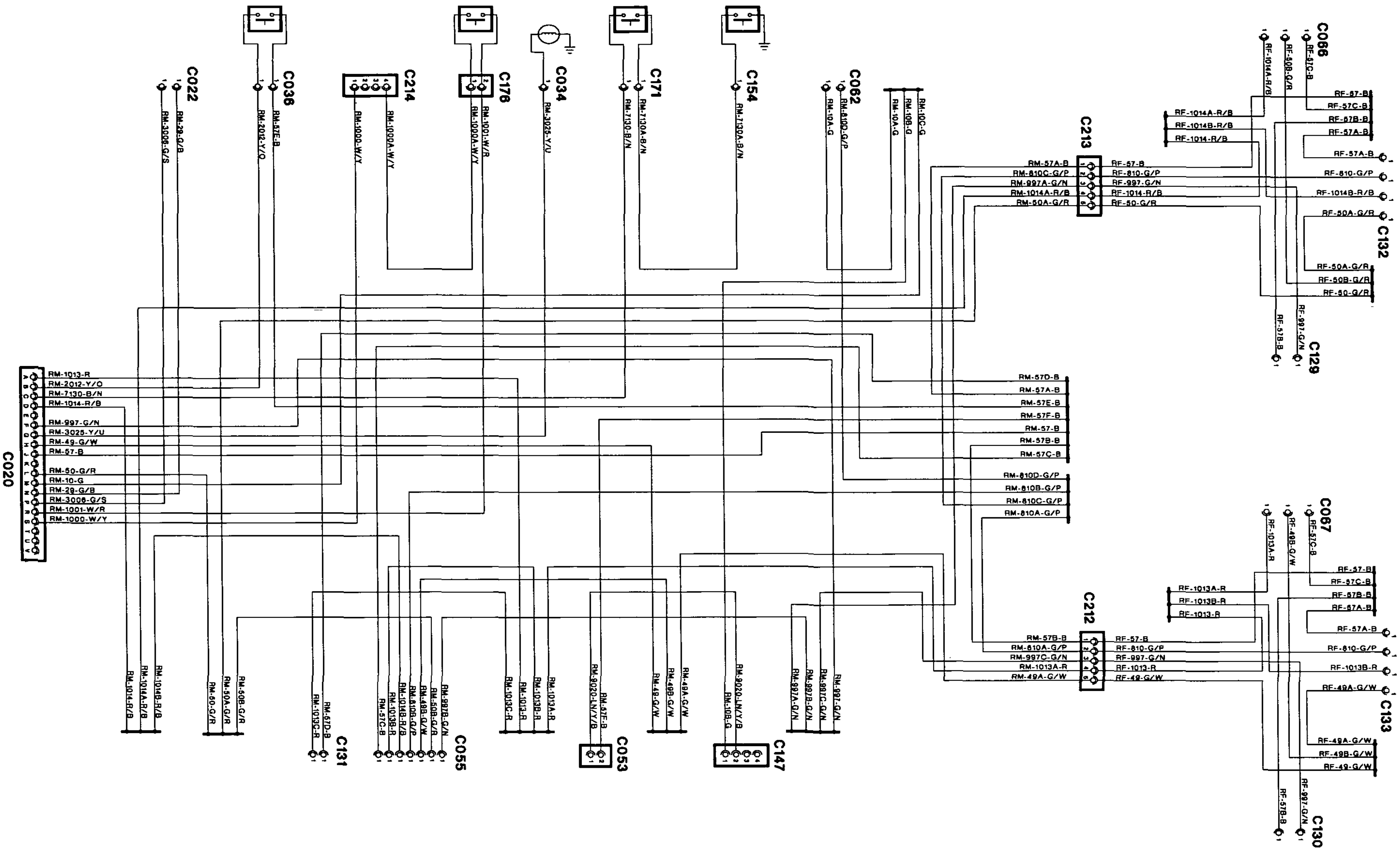
GB	Chassis Main, S Model
D	Fahrgestell Haupt, S - modell
DK	Chassis hovedledningsnet, S model
ESP	Principal de chasis, modelo S
F	Châssis principal, modèles S
FIN	Jatkojohtosarja, S - mallit
I	Principale telaio, modello S
N	Forlengelsesnett, S modeller
NL	Framebundel, S model
P	Principal do chassis, modelo S

NEW HOLLAND
SERVICE

SERIES 40 (UP GRADE) WIRING DIAGRAM

NEW HOLLAND
SERVICE

GB	CHASSIS MAIN S MODEL
D	FAHRGESTELL HAUPT S-MODELL
DK	CHASSIS HOVEDLEDNINGSNET S MODEL
ESP	PRINCIPAL DE CHASIS MODELO S
F	CHÂSSIS PRINCIPAL MODÈLES S
FIN	JATKOJOHTOSARJA S-MALLIT
I	PRINCIPALE TELAIO MODELLO S
N	FORLENGELSESNETT S MODELLER
NL	FRAMEBUNDEL S MODEL
P	PRINCIPAL DO CHASSIS MODELOS S



GB

NASO Fenders
1. L.H. Deluxe 2. R.H. Deluxe
3. L.H. Economy 4. R.H. Economy

D

NASO Kotflügel
1. Links Deluxe 2. Rechts Deluxe
3. Links Economy 4. Rechts Economy

DK

NASO Skærme
1. Venstre Deluxe 2. Højre Deluxe
3. Venstre økonomi 4. Højre økonomi

ESP

Guardabarros NASO
1. Izquierdo de lujo 2. Derecho de lujo
3. Izquierdo económico 4. Derecho económico

F

Ailes NASO
1. Deluxe Gauche 2. Deluxe Droite
3. Economy Gauche 4. Economy Droite

FIN

NASO Lokasuojat (USA)
1. Vasen Puoli, Deluxe-Ohjaamo 2. Oikea Puoli, Deluxe-Ohjaamo
3. Vasen Puoli, S-Malli 4. Oikea Puoli, S-Malli

I

Parafanghi NASO
1. Lato Sinistro Deluxe 2. Lato Destro Deluxe
3. Lato Sinistro Economy 4. Lato Destro Economy

N

NASO Skjermer
1. Venstre Side Deluxe 2. Høyre Side Deluxe
3. Venstre Side Economy 4. Høyre Side Economy

NL

NASO Spatborden
1. Linker De-luxe 2. Rechter De-luxe
3. Linker Economy 4. Rechter Economy

P

Guarda-lamas para os mercados norte-americanos
1. Lado esquerdo Deluxe 2. Lado Direito Deluxe
3. Lado esquerdo Economy 4. Lado Direito Economy

SERIES 40 (UP GRADE) WIRING DIAGRAM

GB

NASO
1. L.H. DELUXE
2. R.H. DELUXE
3. L.H. ECONOMY
4. R.H. ECONOMY

D

NASO-KOTFLÜGEL
1. LINKS DELUXE
2. RECHTS DELUXE
3. LINKS ECONOMY
4. RECHTS ECONOMY

DK

NSAO SKÆRME
1. VENSTRE DELUXE
2. HØJRE DELUXE
3. VENSTRE ØKONOMI
4. HØJRE OKONOMI

ESP

GUARDABARROS NASO
1. IZQUIERDO DE LUJO
2. DERECHO DE LUJO
3. IZQUIERDO ECONÓMICO
4. DERECHO ECONÓMICO

F

AILES NASO
1. DELUXE GAUCHE
2. DELUXE DROITE
3. ECONOMY GAUCHE
4. ECONOMY DROITE

FIN

NASO-LOKASUOJAT (USA)
1. VASEN PUOLI DELUXE-OHJAAMO
2. OIKEA PUOLI DELUXE-OHJAAMO
3. VASEN PUOLI S-MALLI
4. OIKEA PUOLI S-MALLI

I

PARAFANGHI NASO
1. LATO SINISTRO DELUXE
2. LATO DESTRO DELUXE
3. LATO SINISTRO ECONOMY
4. LATO DESTRO ECONOMY

N

NASO SKJERMER
1. VENSTRE SIDE DELUXE
2. HØYRE SIDE DELUXE
3. VENSTRE SIDE ECONOMY
4. HØYRE SIDE ECONOMY

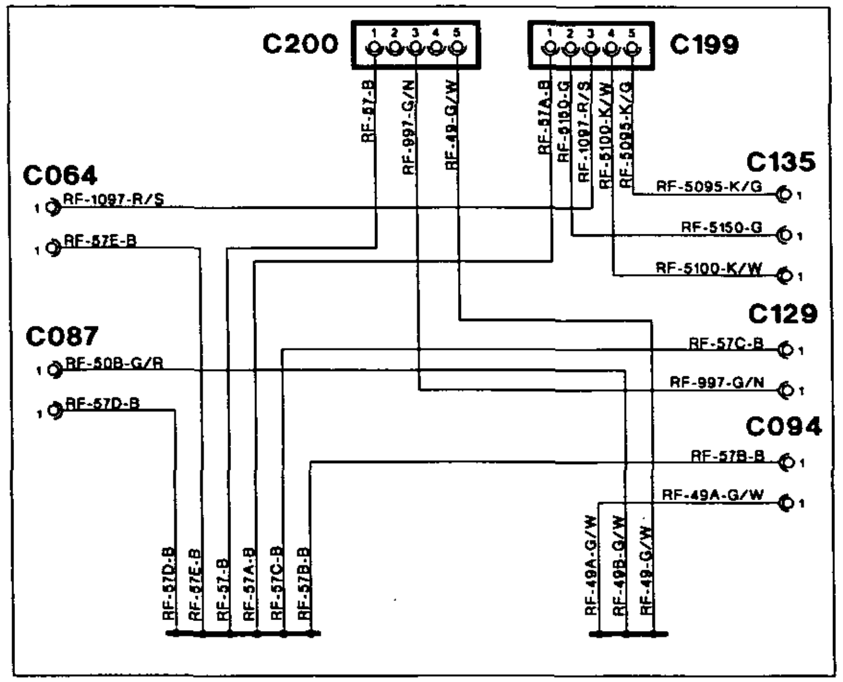
NL

NASO SPATBORDEN
1. LINKER DE-LUXE
2. RECHTER DE-LUXE
3. LINKER ECONOMY
4. RECHTER ECONOMY

P

GUARDA-LAMAS PARA OS MERCADOS NORTE-AMERICANOS
1. LADO ESQUERDO DELUXE
2. LADO DIREITO DELUXE
3. LADO ESQUERDO ECONOMY
4. LADO DIREITO ECONOMY

①



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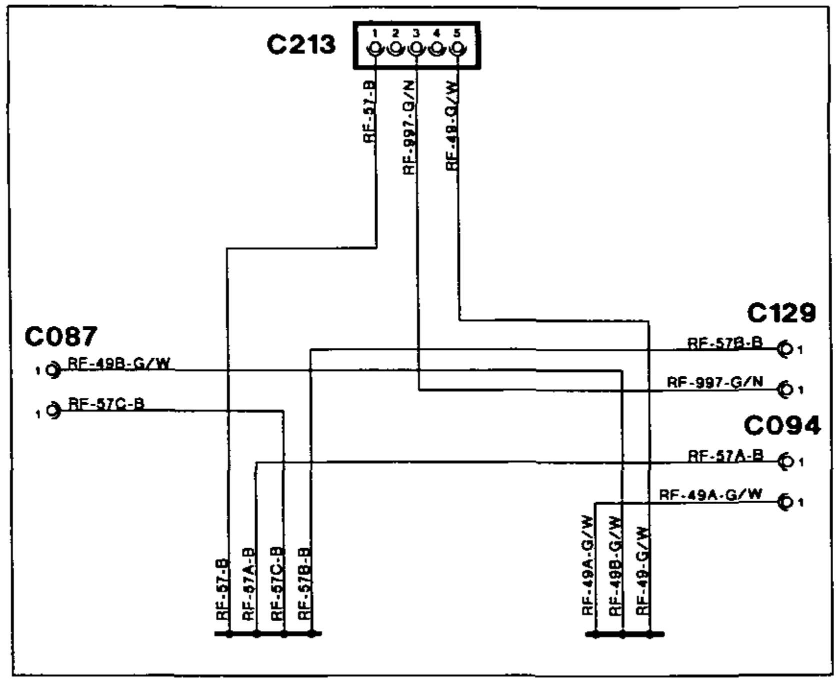

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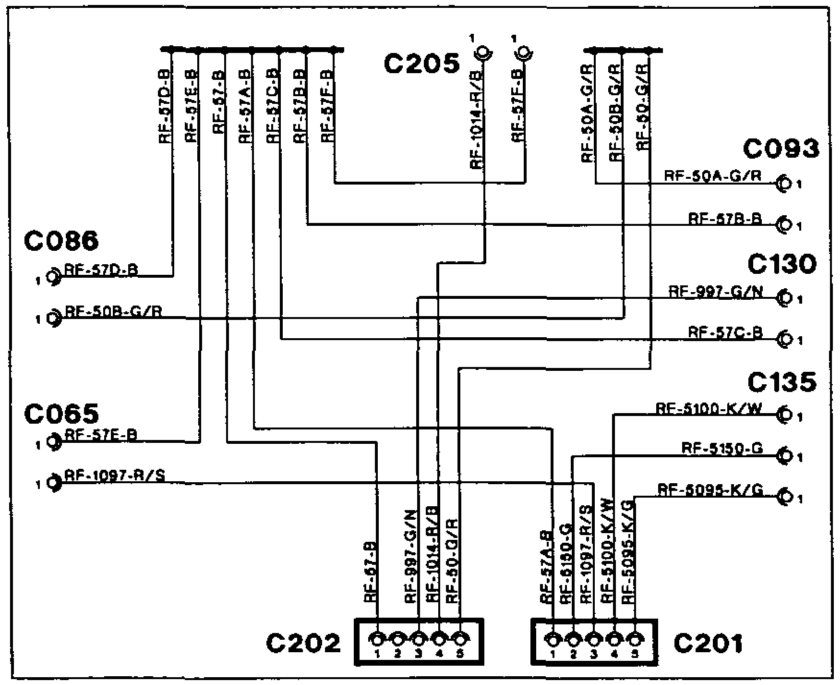

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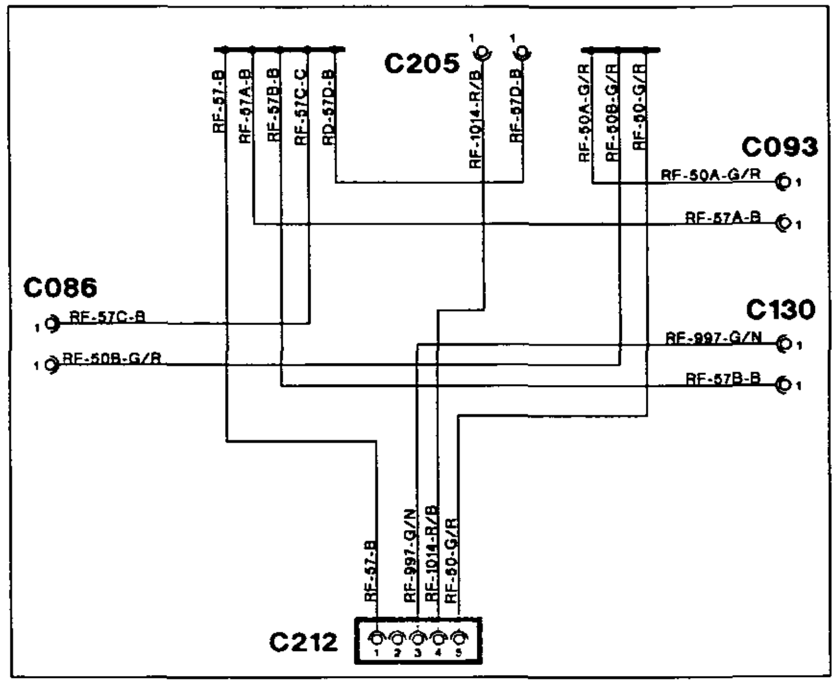


SERIES 40 (UP GRADE) WIRING DIAGRAM

GB

REAR MAIN,
WITH CAB,
LESS EDC

D

HINTEN HAUPT,
MIT KABINE
OHNE EDC

DK

BAGESTE
HOVEDLEDNINGSNET,
MED KABINE, UDEN
EDC

ESP

TRASERO
PRINCIPAL,
CON CABINA,
SIN CET

F

PRINCIPAL
ARRIÈRE,
AVEC CABINE,
SANS EDC

FIN

TAKIMM.
PÄÄJOHTOSARJA,
OHJAAMOLLA,
ILMAN ELEKTR.
NOSTOLAITETTA

I

PRINCIPALE
POSTERIORE,
CON CABINA,
SENZA SOLLEVATORE
ELETTRONICO

N

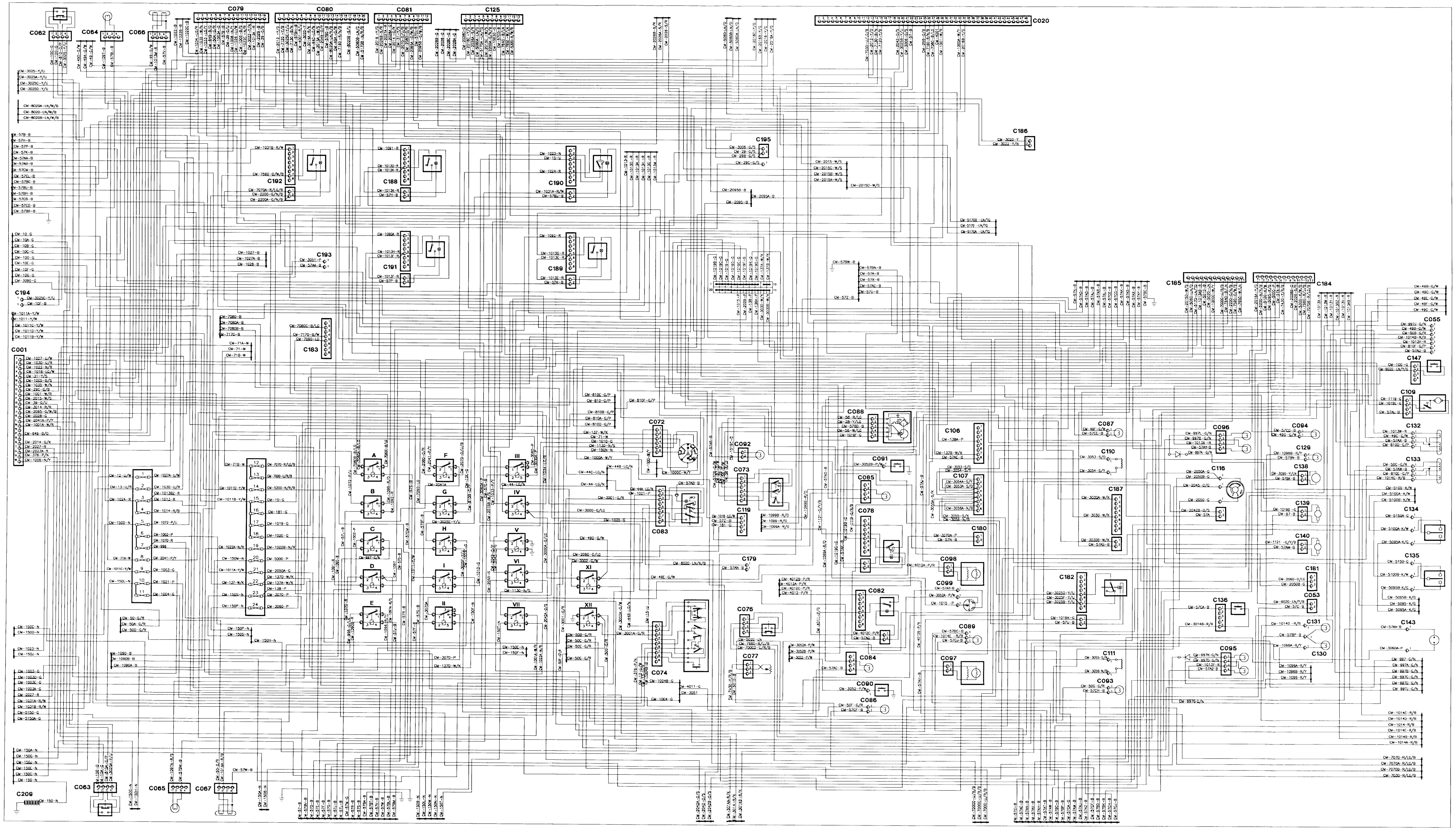
BAKRE HOVEDNETT
MODELLER MED
HYTTE, UTEN EDC

NL

HOOFDB.
ACHTERAAN,
MET CABINE,
ZONDER EDC

P

TRASEIRA PRINCIPAL,
COM CABINA, SEM
TRACÇÃO CONSTANTE
ELECTRÓNICA



SERIES 40 (UP GRADE) WIRING DIAGRAM

GB

REAR MAIN,
LESS CAB,
WITH EDC

D

HINTEN HAUPT,
OHNE KABINE
MIT EDC

DK

BAGESTE
HOVEDLEDNINGSNET,
UDEN KABINE,
MED EDC

ESP

TRASERO
PRINCIPAL,
SIN CABINA,
CON CET

F

PRINCIPAL
ARRIÈRE,
SANS CABINE,
AVEC EDC

FIN

TAKIMM.
PÄÄJOHTOSARJA,
ILMAN OHJAAMOA,
ELEKTR.
NOSTOLAITTEELLA

I

PRINCIPALE
POSTERIORE,
SENZA CABINA,
CON SOLLEVATORE
ELETTRONICO

N

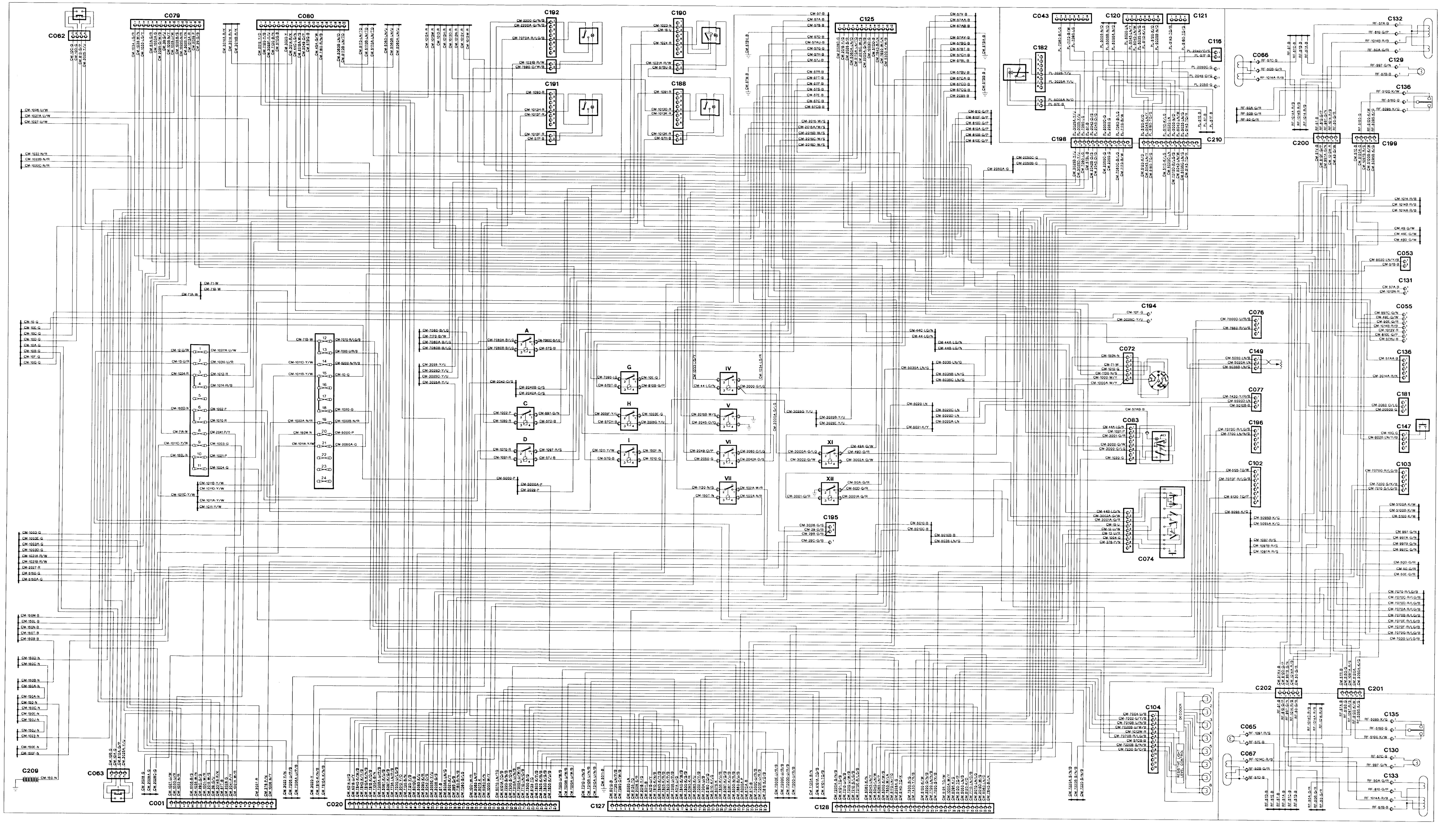
BAKRE HOVEDNETT
MODELLER UTEN
HYTTE, MED EDC

NL

HOOFDB.
ACHTERAAN,
ZONDER CABINE,
MET EDC

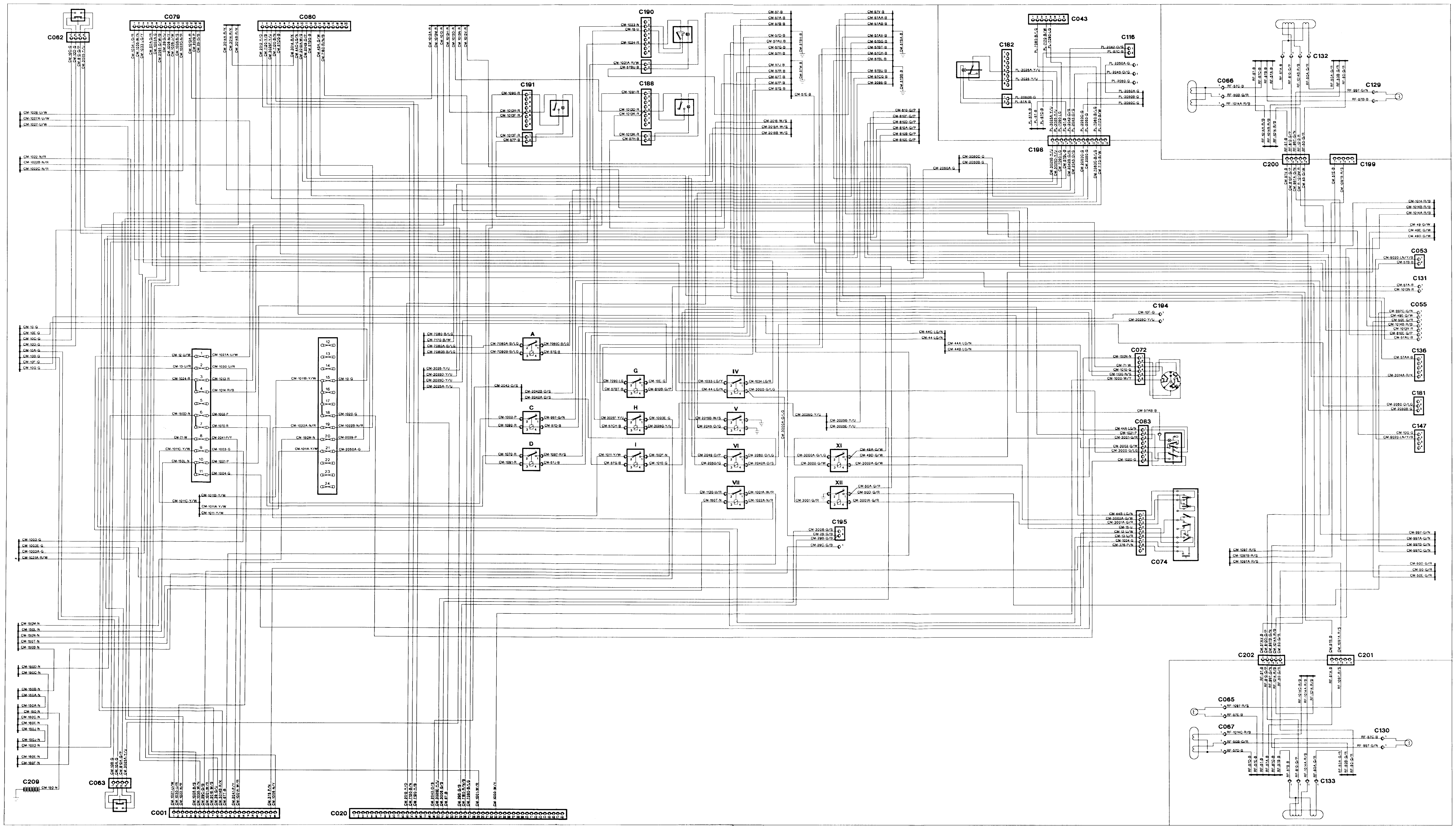
P

TRASEIRA PRINCIPAL,
SEM CABINA, COM
TRACÇÃO CONSTANTE
ELECTRÓNICA



SERIES 40 (UP GRADE) WIRING DIAGRAM

GB	D	DK	ESP	F	FIN	I	N	NL	P
REAR MAIN, LESS CAB, LESS EDC	HINTEN HAUPT, OHNE KABINE OHNE EDC	BAGESTE HOVEDLEDNINGSNET, UDEN KABINE, UDEN EDC	TRASERO PRINCIPAL, SIN CABINA, SIN CET	PRINCIPAL ARRIÈRE, SANS CABINE, SANS EDC	TAKIMM. PÄÄJOHTOSARJA, ILMAN OHJAAMOA, ILMAN ELEKTR. NOSTOLAITETTA	PRINCIPALE POSTERIORE, SENZA CABINA, SENZA SOLLEVATORE ELETTRONICO	BAKRE HOVEDNETT MODELLER UTEN HYTTE, UTEN EDC	HOOFDB. ACHTERAAN, ZONDER CABINE, ZONDER EDC	TRASEIRA PRINCIPAL, SEM CABINA, SEM TRACÇÃO CONSTANTE ELECTRÓNICA

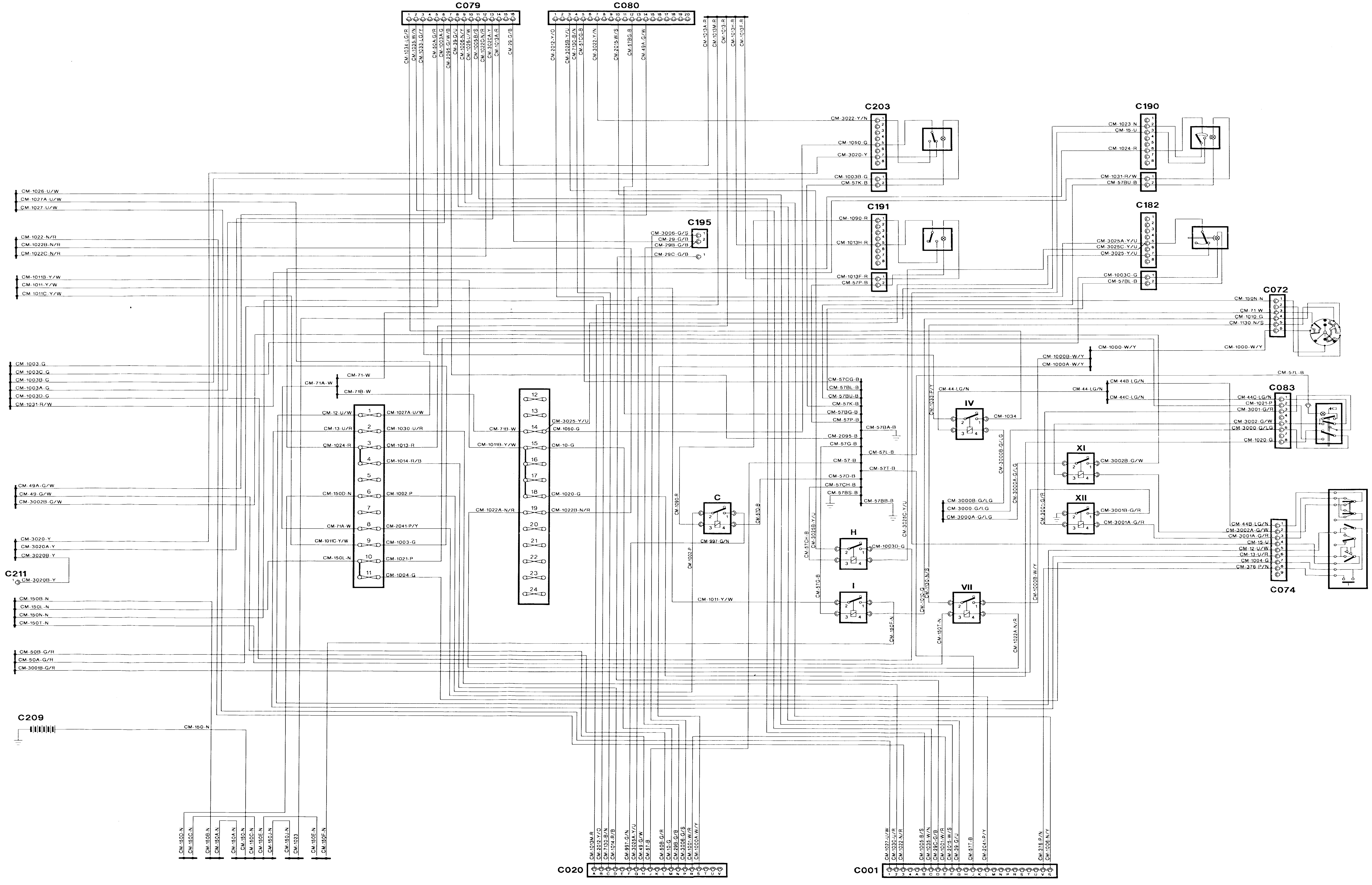


NEW HOLLAND
SERVICE

SERIES 40 (UP GRADE) WIRING DIAGRAM

NEW HOLLAND
SERVICE

GB	D	DK	ESP	F	FIN	I	N	NL	P
REAR MAIN, LESS CAB, ECONOMY	HINTEN HAUPT, OHNE KABINE ECONOMY	BAGESTE HOVEDLEDNINGSNET, UDEN KABINE, ØKONOMI	TRASERO PRINCIPAL, SIN CABINA, ECONÓMICO	PRINCIPAL ARRIÈRE, SANS CABINE, ECONOMY	TAKIMM. PÄÄJOHTOSARJA, ILMAN OHJAAMOA, S-MALLI	PRINCIPALE POSTERIORE, SENZA CABINA, ECONOMY	BAKRE HOVEDNETT MODELLER UTEN HYTTE, ECONOMY	HOOFDB. ACHTERAAN, ZONDER CABINE, ECONOMY	TRASEIRA PRINCIPAL, SEM CABINA, ECONÓMICA



NEW HOLLAND SERVICE

SERIES 40 (UP GRADE) WIRING DIAGRAM

NEW HOLLAND SERVICE

GB	D	DK	ESP	F	FIN	I	N	NL	P
REAR MAIN, WITH CAB, WITH EDC	HINTEN HAUPT, MIT KABINE MIT EDC	BAGESTE HOVEDLEDNINGSNET, MED KABINE, MED EDC	TRASERO PRINCIPAL, CON CABINA, CON CET	PRINCIPAL ARRIÈRE, AVEC CABINE, AVEC EDC	TAKIMM. PÄÄJOHTOSARJA, OHJAAMOLLA, ELEKTR. NOSTOLAITTEELLA	PRINCIPALE POSTERIORE, CON CABINA, CON SOLLEVATORE ELETTRONICO	BAKRE HOVEDNETT MODELLER MED HYTTE, MED EDC	HOOFDB. ACHTERAAN, MET CABINE, MET EDC	TRASEIRA PRINCIPAL, COM CABINA, COM TRACÇÃO CONSTANTE ELECTRÓNICA