Service Manual

3CX, 4CX, 214, 215, 217 & VARIANTS

Backhoe Loader

From M/c No. 930000 Onwards
From M/c No. 903000 Onwards (USA)

PUBLISHED BY THE
TECHNICAL PUBLICATIONS DEPARTMENT
OF JCB SERVICE; © WORLD PARTS CENTRE,
WATERLOO PARK, UTTOXETER, ST14 5PA
ENGLAND
Tel. ROCESTER (01889) 590312
PRINTED IN ENGLAND

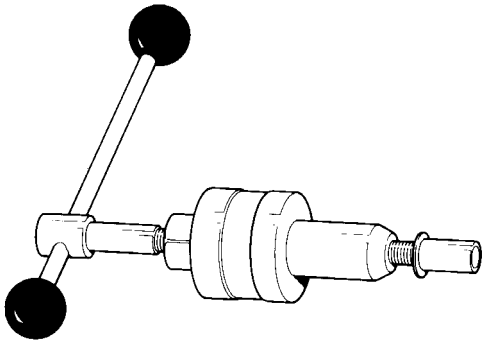
Publication No. 9803/3280

Service Tools (cont'd)

Section B - Body & Framework

826/01099 M6 x 16mm Rivet Nut
826/01101 M6 x 19mm Rivet Nut
826/01103 M8 x 18mm Rivet Nut
826/01102 M8 x 21mm Rivet Nut
826/01104 M10 x 23mm Rivet Nut
826/01105 M10 x 26mm Rivet Nut

Installation Tool Available from:
Bollhoff Fastenings Ltd.
Midacre
The Willenhall Estate
Rose Hill
Willenhall
West Midlands, WV13 2JW



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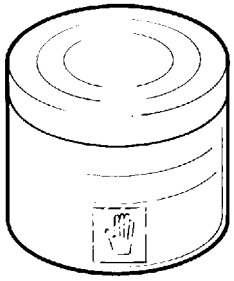


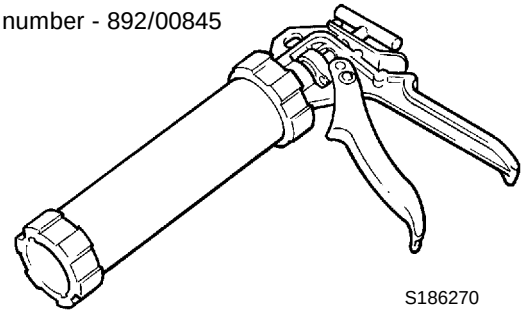
Hand Cleaner - special blend for the removal of polyurethane adhesives.

JCB part number - 4104/1310
(454g; 1 lb tub)

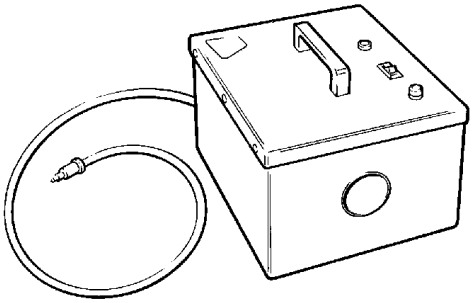
S186240

Cartridge Gun - hand operated - essential for the application of sealants, polyurethane materials etc.

JCB part number - 892/00845



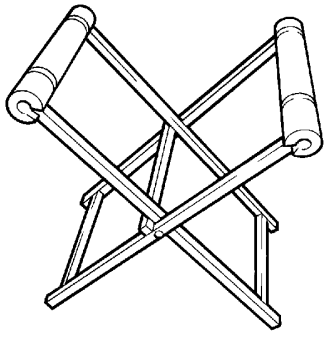
S186270



12V Mobile Oven - 1 cartridge capacity - required to pre-heat adhesive prior to use. It is fitted with a male plug (703/23201) which fits into a female socket (715/04300).

JCB part number - 992/12300

S186250



Folding Stand for Holding Glass - essential for preparing new glass prior to installation.

JCB part number - 892/00843

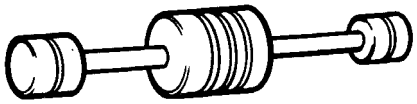
S186280

Service Tools (cont'd)

Section F - Transmission

892/00224

Impulse Extractor Set for Hub Bearing Seals



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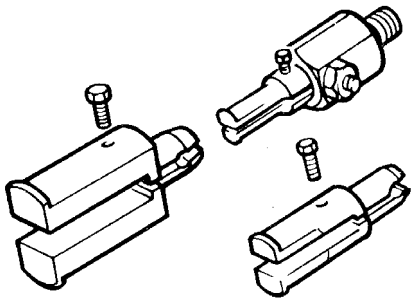
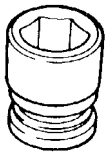


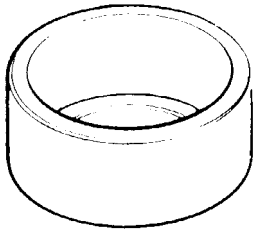
892/00225	Adapter - Impulse Extractor Small 17mm to 25mm Medium 25mm to 45mm Large 45mm to 80mm
993/59500	Adapter - Impulse Extractor (syncro shuttle and powershift transmission)



S216290

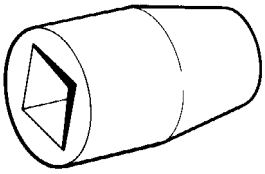
892/00817	17 mm A/F x 3/4in. square drive
892/00818	22 mm A/F x 3/4in. square drive
892/00819	15 mm A/F x 1/2in. square drive
892/00333	19 mm A/F x 3/4in. square drive

892/00174



Measuring Cup - Pinion Head Bearing

S190770



892/00822

Splined Bolt Socket for driveshafts

S197060

Contents	Page No.

It is most important that you read and understand this information and the publications referred to. Make sure all your colleagues who are concerned with lubricants read it too.

Hygiene

JCB lubricants are not a health risk when used properly for their intended purposes.

However, excessive or prolonged skin contact can remove the natural fats from your skin, causing dryness and irritation.

Low viscosity oils are more likely to do this, so take special care when handling used oils, which might be diluted with fuel contamination.

Whenever you are handling oil products you should maintain good standards of care and personal and plant hygiene. For details of these precautions we advise you to read the relevant publications issued by your local health authority, plus the following.

Storage

Always keep lubricants out of the reach of children.

Never store lubricants in open or unlabelled containers.

Waste Disposal

All waste products should be disposed of in accordance with all the relevant regulations.

The collection and disposal of used oil should be in accordance with any local regulations. Never pour used engine oil into sewers, drains or on the ground.

Handling

New Oil.

There are no special precautions needed for the handling or use of new oil, beside the normal care and hygiene practices.

Used Oil.

Used engine crankcase lubricants contain harmful contaminants.

Here are precautions to protect your health when handling used engine oil:

1 Avoid prolonged, excessive or repeated skin contact with used oil.

2 Apply a barrier cream to the skin before handling used oil.

3 Note the following when removing engine oil from skin:

a Wash your skin thoroughly with soap and water.

b Using a nail brush will help.

c Use special hand cleansers to help clean dirty hands.

d Never use petrol, diesel fuel, or paraffin for washing.

4 Avoid skin contact with oil soaked clothing.

5 Don't keep oily rags in pockets.

6 Wash dirty clothing before re-use.

7 Throw away oil-soaked shoes.

First Aid - Oil

Eyes.
In the case of eye contact, flush with water for 15 minutes. If irritation persists, get medical attention.

Swallowing.
If oil is swallowed do not induce vomiting. Get medical advice.

Skin.
In the case of excessive skin contact, wash with soap and water.

Spillage

Absorb on sand or a locally approved brand of absorbent granules. Scrape up and remove to a chemical disposal area.

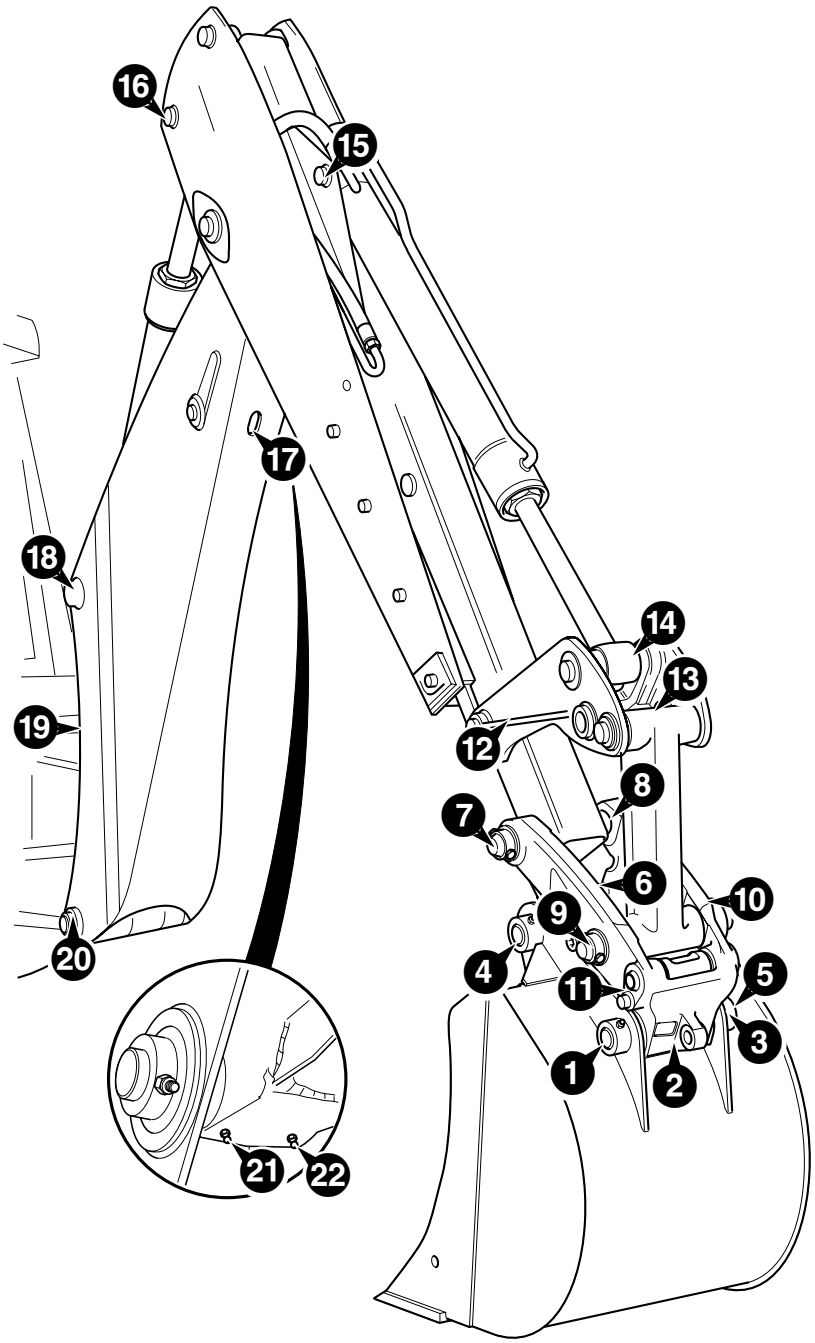
Fires

Extinguish with carbon dioxide, dry chemical or foam. Fire-fighters should use self-contained breathing apparatus.

Backhoe & Quickhitch

22 Grease Points

Note: Figure shows a typical boom and dipper arrangement.



A340900

Checking the Oil Level

1 Make sure the park brake is engaged and the transmission set to neutral. Lower the loader arms and backhoe to the ground, switch OFF the engine and remove the starter key.

2 Open the bonnet, **see Engine Panels, Opening and Closing the Bonnet.**

3 Check that the oil level is between the two marks on the dipstick **A**.

4 If necessary, remove the side panel and add oil through filler **B**. Make sure that the dipstick and filler cap are fully inserted and tightened.

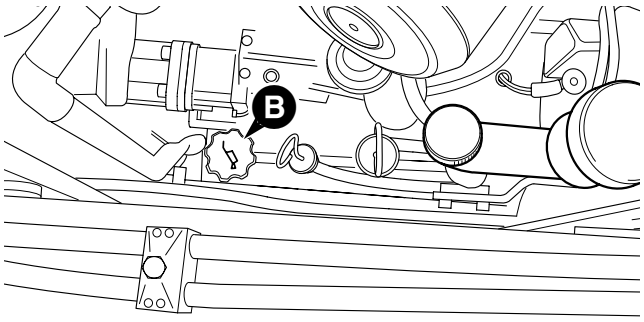
Changing the Oil and Filter

1 Drain the oil when the engine is warm as contaminants held in suspension will then be drained with the oil. Park the machine on firm ground.

⚠ WARNING

Make the machine safe before getting beneath it. Lower the attachments to the ground; engage the parking brake; remove the starter key, disconnect the battery.

2-3-2-2



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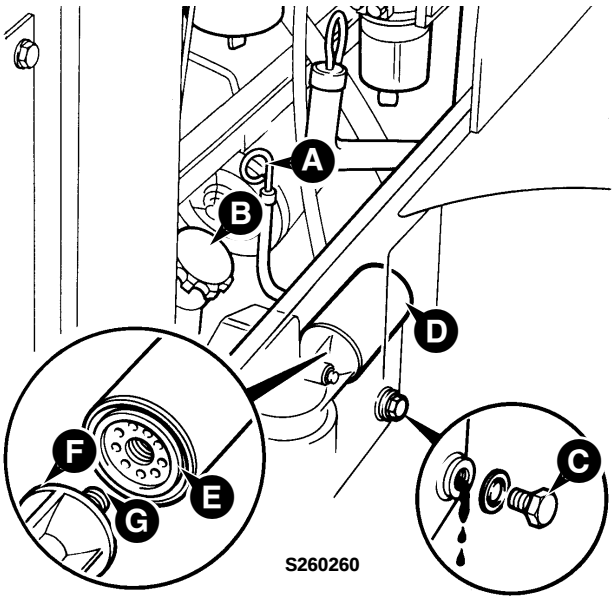


S260260

2 Make sure the park brake is engaged and the transmission set to neutral. Lower the loader arms and backhoe to the ground, switch OFF the engine and remove the starter key.

3 Open the bonnet, **see Engine Panels, Opening and Closing the Bonnet.**

4 Drain the oil**:**

⚠ CAUTION

Oil will gush from the hole when the drain plug is removed. Hot oil and engine components can burn you. Keep to one side when you remove the plug.

13-3-1-15

- **a** Place a container of suitable size beneath the drain plug.
- **b** Remove drain plug **C** and its 'O' ring. Let the oil drain out, then clean and refit the drain plug with a new 'O' ring. Tighten to 34 Nm (25 lbf ft).

5 Change the filter**:**

- **a** Unscrew the filter canister **D**. Remember that it will be full of oil.
- **b** Check that adapter **G** is secure.
- **c** Clean the filter head **F**.
- **d** Add clean engine lubricating oil to the new filter canister. Allow enough time for the oil to pass through the filter element.
- **e** Smear the seal **E** on the new filter with oil. Screw in the new filter canister - hand tight only.

6 Fill the engine to the max mark on the dipstick with new oil through the filler. See **Service Capacities and Lubricants** for recommended oil grades. Wipe off any spilt oil. Check for leaks. Make sure the filler cap is correctly refitted.

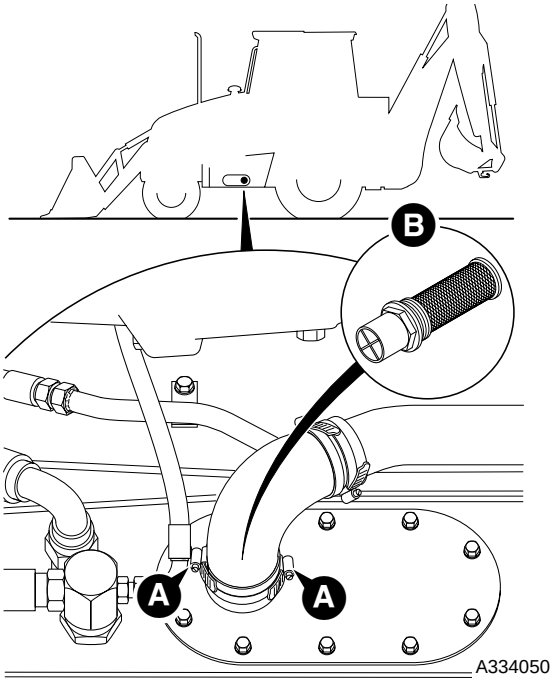
7 Make sure the engine will not start and turn the starter switch to operate the starter motor until the oil pressure light is extinguished. (To make sure the engine will not start, remove the engine shut-off solenoid fuse, housed in the fuse box).

8 Insert the engine shut-off solenoid fuse and operate the engine. Check for leaks. When the engine has cooled, check the oil level.

Changing the Suction Strainer

⚠ WARNING

Make the machine safe before getting beneath it. Lower the attachments to the ground; engage the parking brake; remove the starter key, disconnect the battery.
2-3-2-2



1 Position the machine on level ground. Roll the loader shovel forward and rest it on the ground. Retract the extending dipper if fitted. Close the backhoe bucket. Swing in the dipper. Lower the boom until the bucket rests on the ground. Lower the stabilisers to the ground. Stop the engine. Remove the starter key and disconnect the battery.

2 Remove hydraulic tank filler cap.

3 Place a container beneath the hydraulic tank to catch the oil, remove drain plug and drain the hydraulic tank. Make sure the container is large enough to hold the tank contents, see **Service Capacities and Lubricants**.

4 Undo clips **A** and disconnect the hydraulic return pipe.

5 Using a 65mm A/F spanner unscrew suction strainer **B** and discard.

6 Fit a new filter assembly **B**, torque tighten to 15-20 Nm (11-15 lbf ft).

7 Reconnect suction hose. Make sure the clips **A** are positioned 180° apart.

8 Refit drain plug, torque tighten to 100 Nm (74 lbf ft).

9 Refill hydraulic tank, fit and tighten the filler cap, see **Hydraulic Tank Cap**.

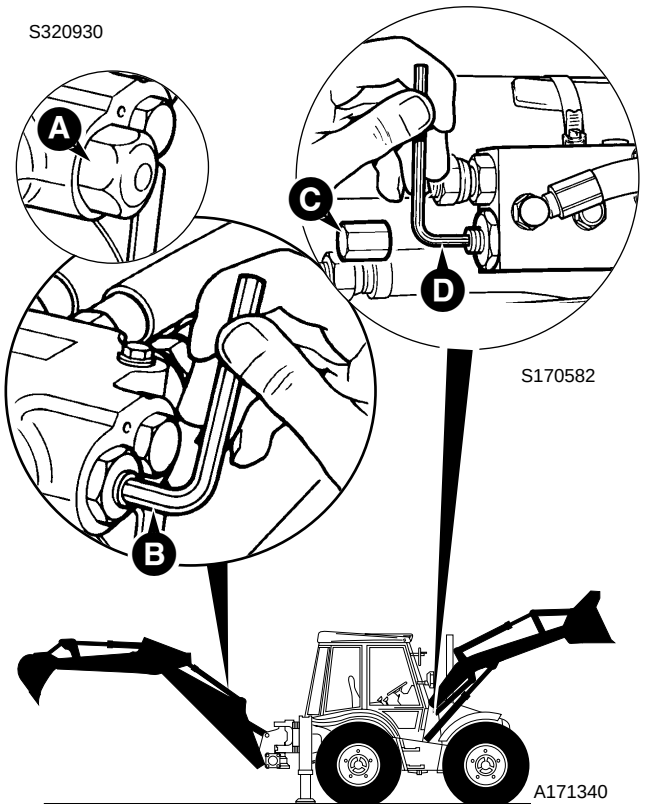
The hose burst protection valves (if fitted) prevent the loader or backhoe falling in the event of a hose burst. These valves may be fitted on rams which raise or lower the loader arms, the boom or the dipper.

Checking Hose Burst Protection Valve

1 Raise the loader arms fully. Raise the boom to about 45°. Raise the dipper to the horizontal.

2 Stop the engine.

3 Using the control levers, try to lower the loader, boom and dipper. Push the levers fully to the 'lower' position. If there is any movement, get the hydraulic system checked by your JCB distributor.



Lowering a Load

During normal operation, the engine must be running before a load can be lowered. The following paragraphs describe how to safely and correctly lower a load in the event of engine failure or a hose burst; we recommend that only a competent maintenance engineer perform the procedures.

After lowering a load do not use the machine until the manual over-ride screw has been reset (Loader HBPV) or a new end cap and valve assembly fitted (Boom HBPV) by a qualified engineer, otherwise the valve will not operate as intended.

⚠ DANGER

Do not stand underneath the raised load during the lowering procedure. Stand clear and to one side until the load has been safely lowered. Make sure that the area is clear of other people before lowering the load. If you do not follow these precautions you or others could be killed or seriously injured.

2-3-5-3

Boom and Dipper Hose Burst Protection Valve (HBPV)

1 Remove cap **A** and pierce the warning label.
2 If a hose has burst, position a suitable container to catch the oil.
3 Insert a 6mm allen key into the socket head of screw **B.** Slowly turn the allen key in a clockwise direction until the load just begins move.
Burst hose **-** Lower the boom using screw **B**, turn the screw counter-clockwise to slow or stop the load from lowering.
Dead engine **-** Operate the control lever in the cab to lower the load.

Loader Hose Burst Protection Valve (HBPV)

1 Remove cap **C** from both HBPV check valves on the loader lift arms.
2 If a hose has burst, position a suitable container to catch the oil.
3 On the burst hose HBPV, insert a 5mm allen key into the socket head of screw **D.** Turn the allen key in a clockwise direction so that the screw winds fully in. Repeat slowly for the opposite side as the load is now supported on this HBPV.

Note: Count the number of full turns on each screw for resetting purposes.

4 Operate the control lever in the cab to lower the load.

Rivet Nut Tool Procedure

A 'Rivet Nut' is a one piece fastener installed 'blind' from one side of the machine body/framework. The rivet nut is compressed so that a section of its shank forms an 'upset' against the machine body/framework, leaving a durable thread (see illustrations).

Rivet nuts are fitted to various parts of the machine body and framework. They are used in a number of applications, for instance, hose clamp and hydraulic valve retention etc.

Various sized rivet nuts are available, see the table below to determine the size of rivet nut to be used for particular applications.

If for any reason a new rivet nut requires fitting, then the correct installation procedure must be followed:

1 Drill a hole in the machine body/framework where the rivet nut is to be fitted. De-burr hole edges.

2 Screw the rivet nut onto the mandrel of the installation tool. The bottom of the mandrel should be in line with the bottom of the rivet nut, shown at **A**.

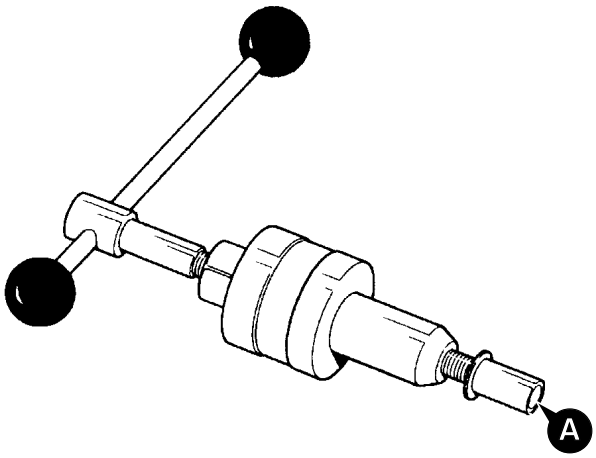
3 Wind the body of the installation tool down the threaded mandrel until it touches the head of the rivet nut, shown at **B**.

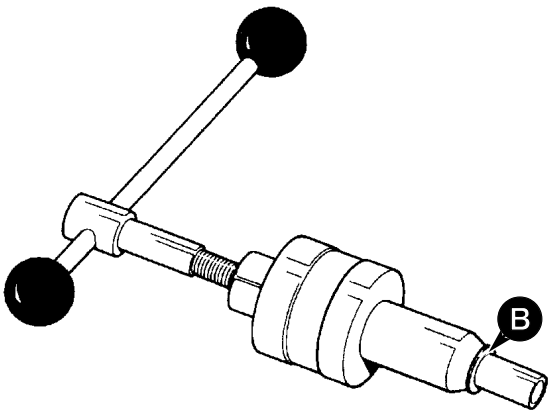
4 Insert the rivet nut (assembled to the tool) into the hole drilled in step **1**.

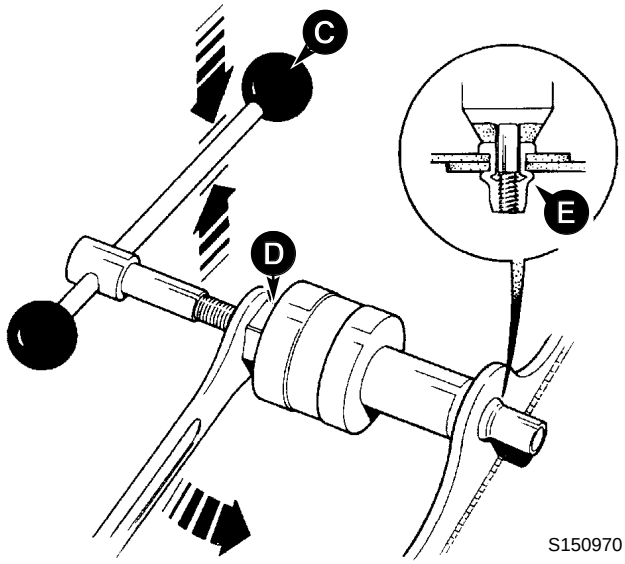
5 Hold handle **C** and at the same time draw the mandrel into the installation tool by turning nut **D**. The rivet nut will contract in length and form an 'upset' (smooth bulge) seating itself against the body/framework (see inset **E**).

Note: The thread of the rivet nut must not be stripped, take care when 'upsetting' the rivet nut.

6 Remove the installation tool.







Specifications (all dimensions in mm)

Rivet Nut Thread Diameter	Rivet Nut Outside Diameter	Material Thickness	Rivet Length (Total)	Drill Hole Dia.
M5	7	0.25 - 3.00 3.00 - 5.50	14.00 17.00	7.10
M6	9	0.50 - 3.00 3.00 - 5.50	16.00 19.00	9.10
M8	11	0.50 - 3.00 3.00 - 5.50	18.00 21.00	11.10
M10	13	1.00 - 3.50 3.50 - 6.00	23.00 26.00	13.10

Note: In an emergency, and if no installation tool is available, it is possible to fit a rivet nut by using a nut and bolt the same thread diameter as the rivet nut being installed. However, this is not the recommended method.

Air Conditioning
- System Diagnosis (cont'd)

No Refrigerant Circulation

Gauge Readings:

Low Side Gauge - Zero to negative.
High Side Gauge - Low.

Other symptoms:

Receiver-Drier - Frost or moisture on tubes before and after receiver-drier.

Diagnosis:

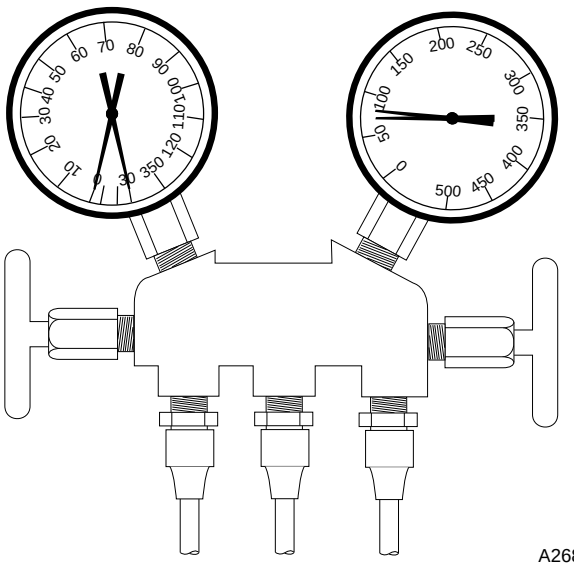
Refrigerant flow obstructed by dirt, moisture or gas leakage from expansion valve heat sensing tube.

Correction:

1. Evacuate A/C system.
2. Check heat sensing tube at expansion valve. Replace expansion valve if necessary.
3. Remove expansion valve and attempt removal of dirt. If dirt cannot be removed, replace expansion valve.
4. Replace receiver-drier.
5. Charge system with R-134a.
6. Operate system and check performance.

LOW SIDE (Blue)
Zero to negative

HIGH SIDE (Red)
Low



LOW SIDE - -1.0 bar (-1.1 kgf/cm^2)(-15 lbf/in^2)
HIGH SIDE - 5.4 bar (5.5 kgf/cm^2)(78 lbf/in^2)

Insufficient Cooling of Condenser or Refrigerant Overcharge

Gauge Readings:

Low Side Gauge - High.
High Side Gauge - High.

Other symptoms:

Sight Glass - No bubbles visible even at lower engine RPM.

Diagnosis:

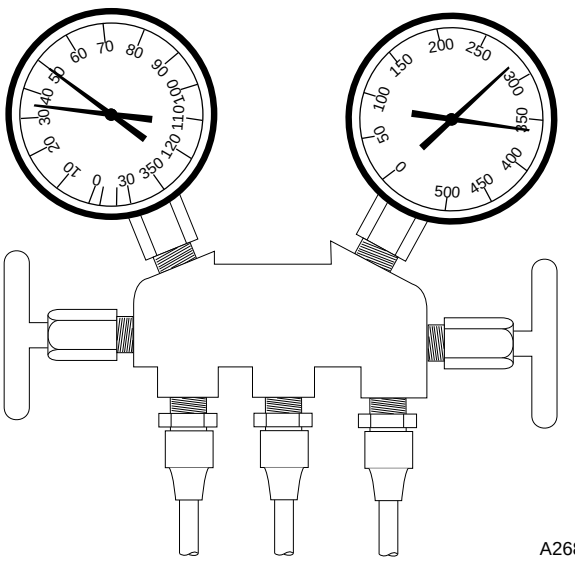
Refrigerant overcharge, condenser cooling fins clogged with dirt or cooling fans malfunctioning.

Correction:

1. Clean condenser cooling fins.
2. Check cooling fan operation.
3. Evacuate A/C system.
4. Charge system with R-134a.
5. Operate system and check performance.

LOW SIDE (Blue)
High

HIGH SIDE (Red)
High



LOW SIDE - 3.0 bar (3.0 kgf/cm^2)(43 lbf/in^2)
HIGH SIDE - 22.1 bar (22.5 kgf/cm^2)(320 lbf/in^2)

Air Conditioning

Binary Pressure Switch Testing

The binary pressure switch assembly comprises a low pressure switch designed to open at 1.96 bar (28.4 lbf/in^2) and a high pressure switch designed to open at 27.5 bar (400 lbf/in^2)

When the refrigerant pressure is within the 1.96 and 27.5 bar limits the switches will be closed and providing the freeze protection thermostat and ON/OFF switches are closed, a current will be supplied to the field coil of the clutch. Through electro- magnetic action the field coil clutch will be pulled towards the compressor's clutch and the refrigeration cycle will commence.

If the fault finding table indicates that the pressure switch assembly is defective the fault may be electrical or due to incorrect system pressure.

Refer to **Checking Refrigerant Charge Level**. If the refrigerant charge level is OK use the following electrical test procedures.

1 Switch the engine off so that the air conditioning system cannot operate.

2 Disconnect the binary pressure switch harness from the side console harness and connect an external 12V power supply between the pressure switch harness connector and chassis. If both pressure switches are working correctly, and the system is at the correct charge level, the compressor clutch will operate.

If the compressor clutch does not operate with the external power supply, one of the pressure switches in the assembly is faulty or the level of refrigerant charge is insufficient to close the low pressure switch.

3 Replace the pressure switch assembly. Refer to **Binary Pressure Switch - Removal and Replacement**. If the clutch still fails to operate check all electrical connections.

Cab ROPS/FOPS Structure - Checks

⚠ WARNING

The machine is fitted with a Roll Over Protection Structure (ROPS) and a Falling Objects Protection Structure (FOPS). You could be killed or seriously injured if you operate the machine with a damaged or missing ROPS/FOPS. If the ROPS/FOPS has been in an accident, do not use the machine until the structure has been renewed. Modifications and repairs that are not approved by the manufacturer may be dangerous and will invalidate the ROPS/FOPS certification.

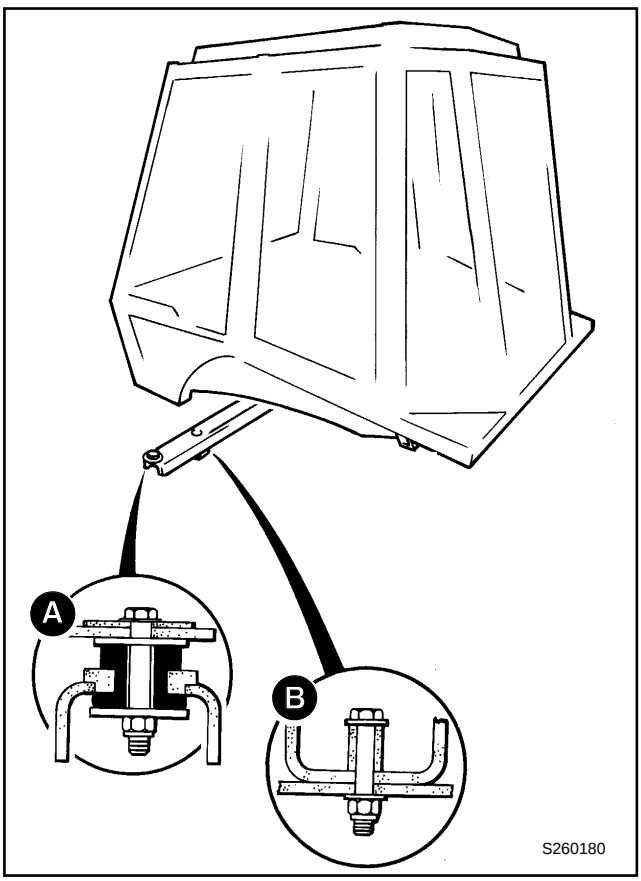
INT-2-1-9/3

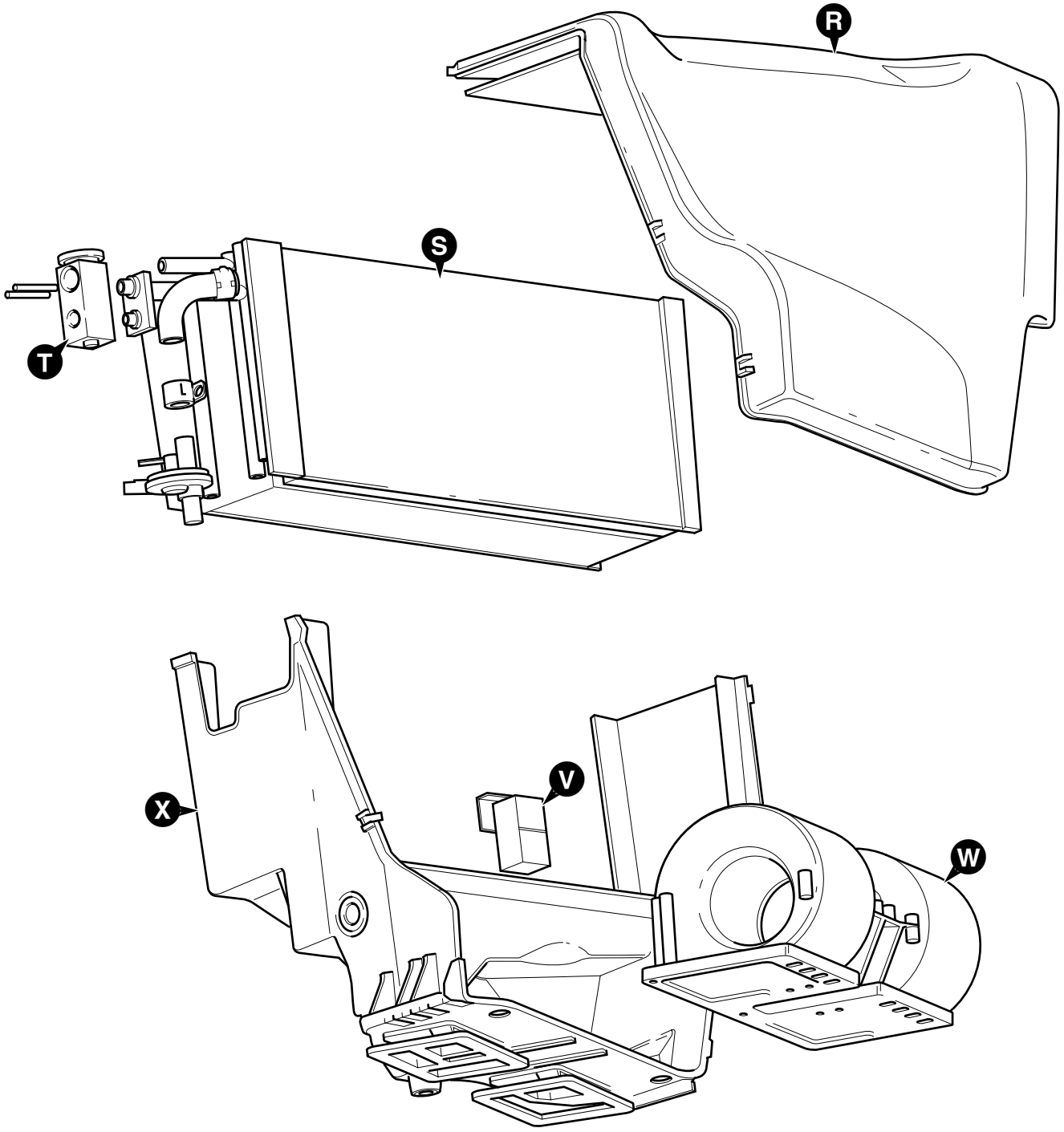
Failure to take these precautions could result in death or injury to the operator.

Check the structure for damage. Check that the mounting bolts are installed and undamaged. Check the bolt torques. Tighten them to the correct torque if necessary.

Torque Settings

Bolts **A** 205 Nm (150 lbf ft)
Bolts **B** 476 Nm (352 lbf ft)

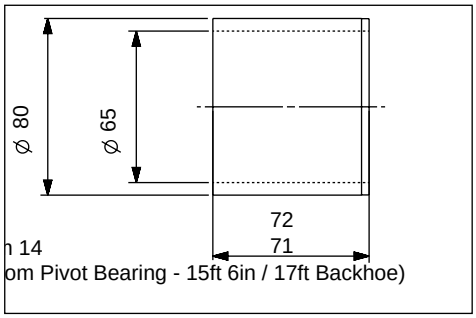




Component Key:

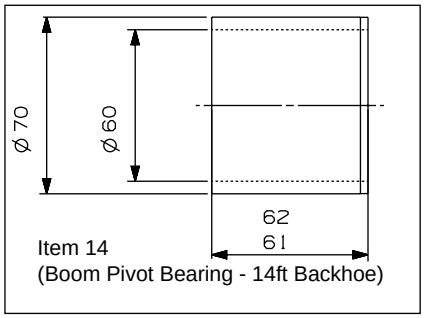
R HVAC Unit Top Cover
S Heat Exchanger (Heater and Evaporator)
T Expansion Valve
V Freeze Protection Thermostat
W Blower Unit
X HVAC Unit Housing

Removal and Replacement



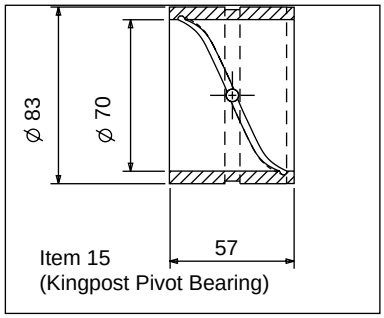
h 14
om Pivot Bearing - 15ft 6in / 17ft Backhoe)

A261800



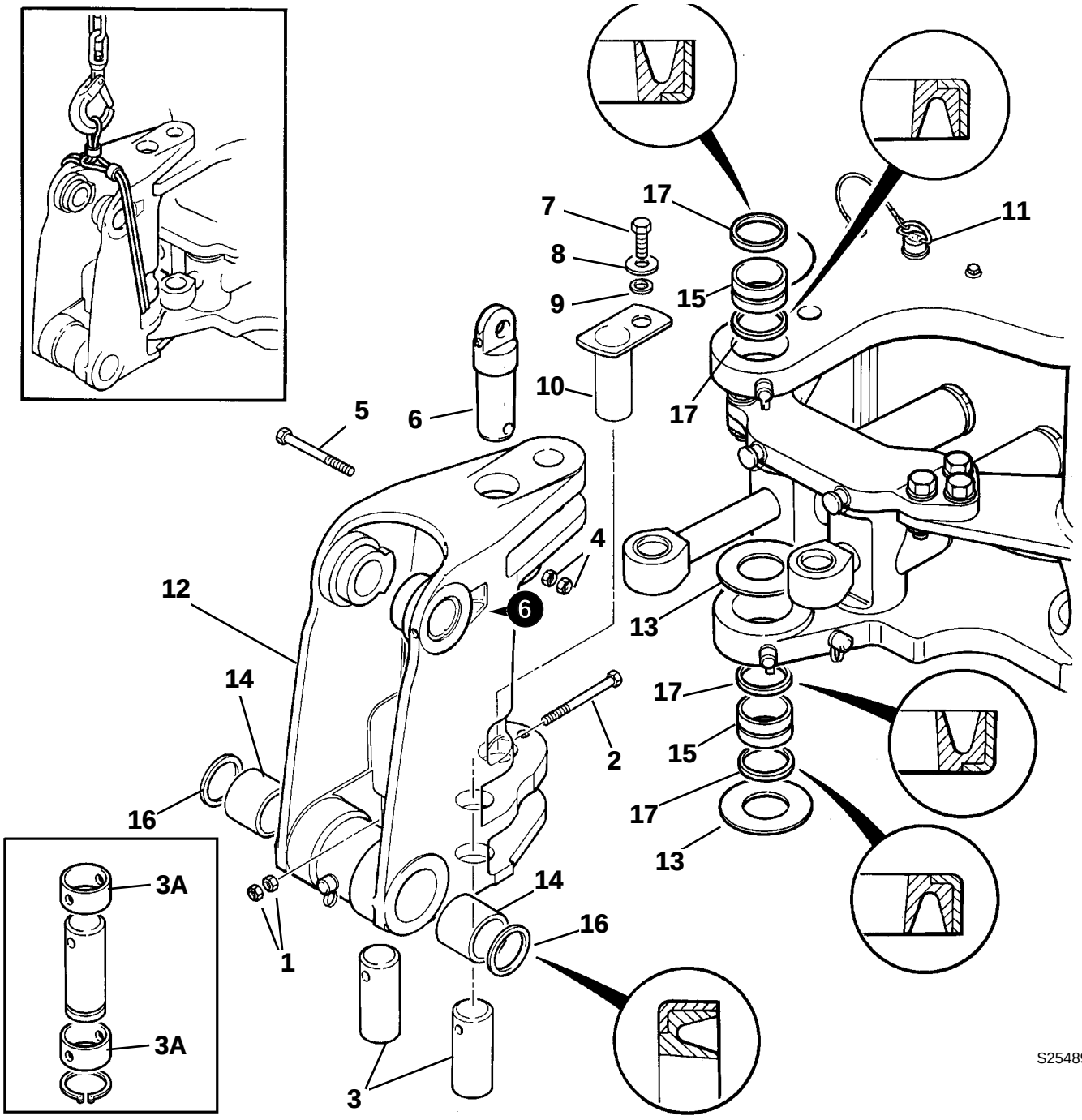
Item 14
(Boom Pivot Bearing - 14ft Backhoe)

A252870

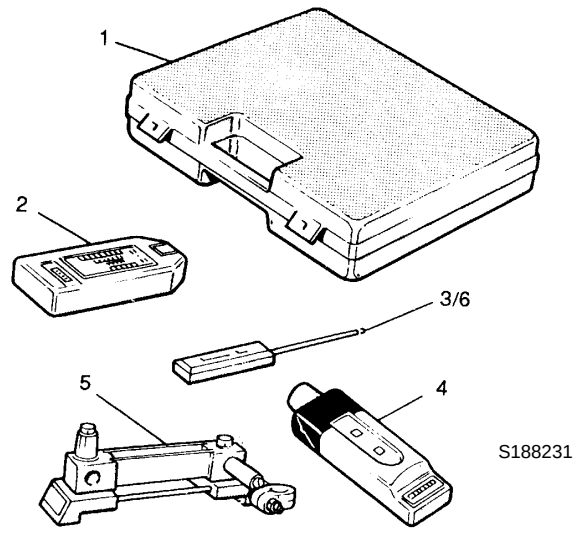


Item 15
(Kingpost Pivot Bearing)

A252880



S254893

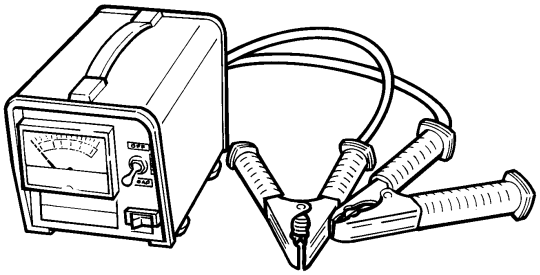


S188231

AVO Test Kit

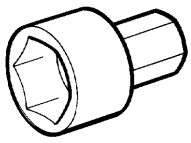
1	892/00283	Tool Kit Case
2	892/00298	Fluke Meter 85
3	892/00286	Surface Temperature Probe
4	892/00284	Venture Microtach Digital Tachometer
5	892/00282	100 amp Shunt - open type
6	892/00285	Hydraulic Temperature Probe

993/85700 Battery Tester



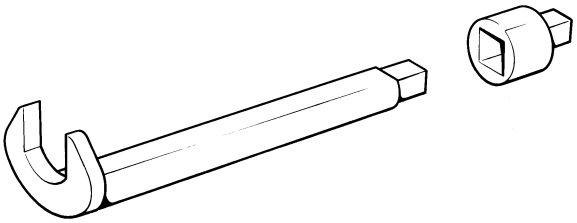
S239510

892/00882 Socket for Alternator Pulley Nut



S216770

825/00410 15 mm Crowfoot Wrench
825/99833 Adapter



S216200

Circuit Schematic - Synchro Shuttle and 4 Speed Powershift

Synchro Shuttle Transmission

1 To wire 401 on page C/4-1
2 Parking Brake Relay
3 Parking Brake Switch
4 Transmission Dump Relay
5 Dump Switch on Loader Lever
6 Dump switch on Gear lever
7 Forward/Reverse Selector Lever
8 Forward Relay
9 To Neutral Start Relay on page C/4-1
10 Forward Solenoid
11 Reverse Relay
12 Reverse Solenoid
13 To Fuse A5 on page C/4-1
14 Reverse Alarm

Powershift Transmission

1 To wire 401 on page C/4-1
2 Parking Brake Relay
3 Parking Brake Switch
4 Transmission Dump Relay
5 Dump Switch on Loader Lever
6 Gear Selector Switch
7 Forward/Reverse Selector Lever
8 Forward Relay
9 To Neutral Start Relay on page C/4-1
10 Interlock Relay
11 Drive Relay
12 Reverse Relay
13 Mainshaft Solenoid
14 To Fuse A5 on page C/4-1
15 Layshaft Solenoid
16 Reverse Alarm
17 Reverse High/Low Relay
18 Reverse Low Solenoid
19 Reverse High Solenoid
20 Forward High/Low Relay
21 Forward Low Solenoid
22 Forward High Solenoid

Servo Command

Fault	Probable Cause	Action
Left hand rocker switch fails to operate (stabiliser, aux)	Blown fuse left hand amplifier	Check fuse 3 As right hand rocker switch fails to operate
Stabilisers fail to operate		As, right hand rocker switch fails to operate
Stabiliser changeover logic fails to operate	Faulty relay	Check relays R16 to R23

Starter Motor (cont'd)

Starting Circuit Test (cont'd)

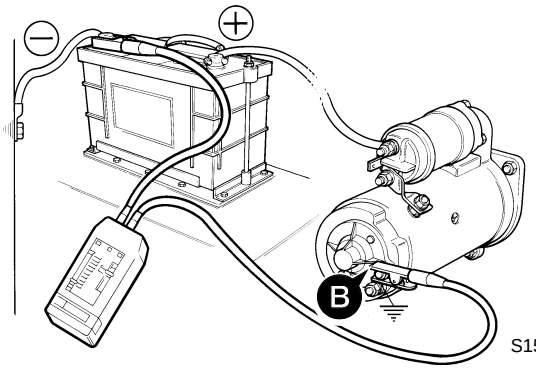
Test 3b

If the reading between terminal **D** and earth is below 8.0V, connect the voltmeter between terminal **E** and earth. An increase in the reading to 8.0V indicates either a faulty start relay or a fault in the feed from the transmission selector switch to the relay solenoid. Check also the solenoid earth connection.

If the reading between **E** and earth is less than 8.0V, the fault must be in either the starter switch or in the wiring between the solenoid, starter switch, and the start relay.

Test 4

Connect the voltmeter between battery negative and starter earth connection **B**. The reading in the 'start' position should be practically zero, maximum permissible reading 0.25V.

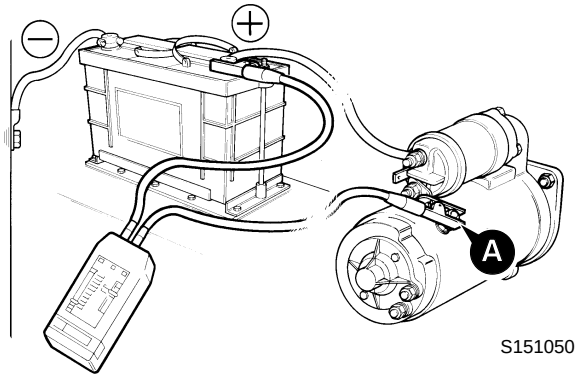


S151040

If the reading is above 0.25V, a high resistance in the earth lead or connections is indicated.

Test 5

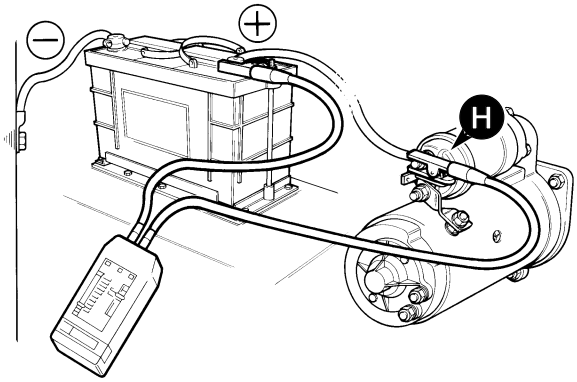
Connect the voltmeter between battery positive and the starter main terminal **A**. With the starter switch 'off', the voltmeter should indicate battery voltage, but it should fall to practically zero when the switch is turned to the 'on' position, maximum permissible reading 0.25V.



S151050

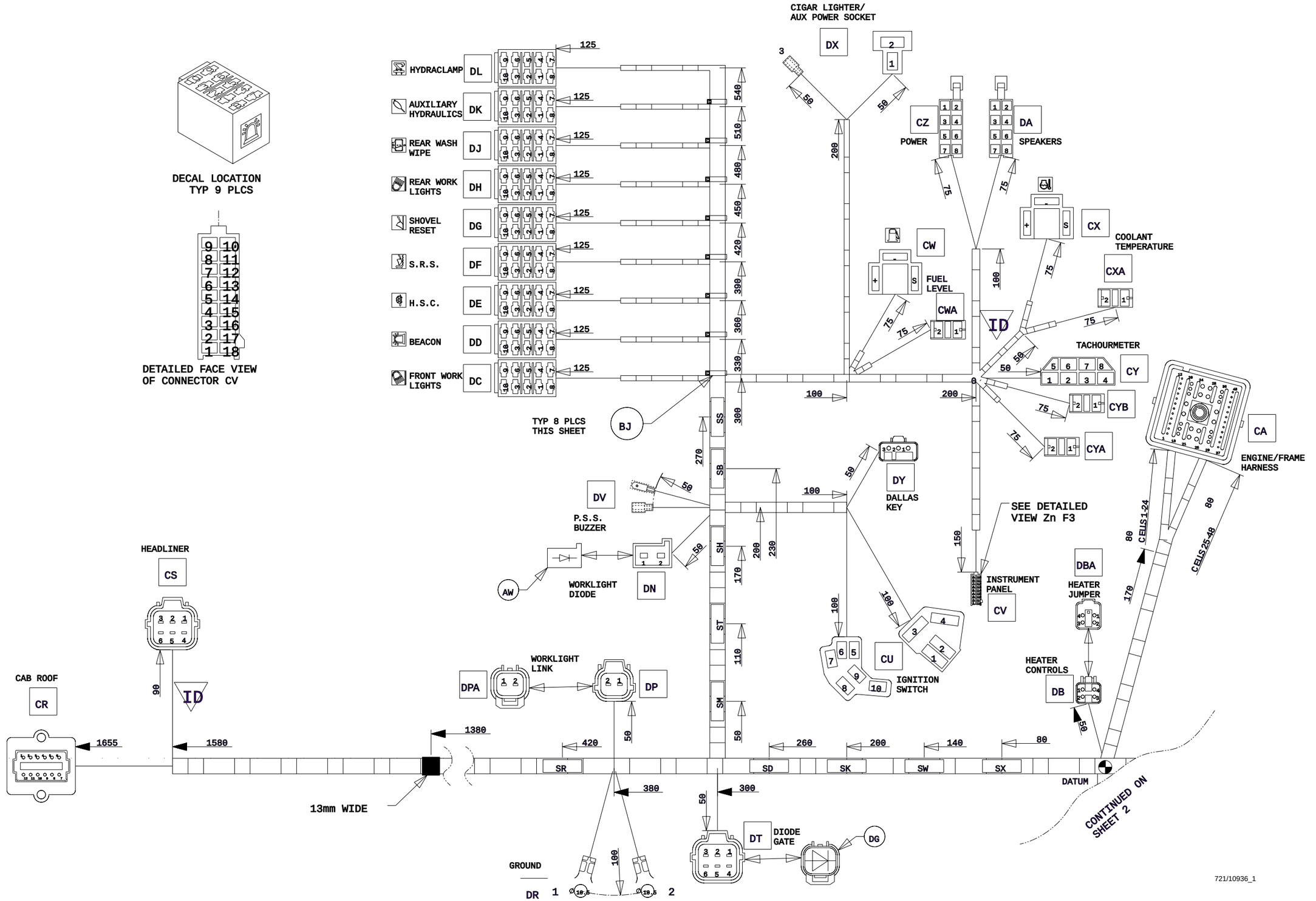
Test 5a

If the reading is above 0.25V, a high resistance is present in the insulated lead or in the solenoid. Connect the voltmeter between the battery positive and solenoid connection **H**. If the voltmeter now reads zero with the switch closed, the fault is in the solenoid.



Finally refit the engine stop fuse.

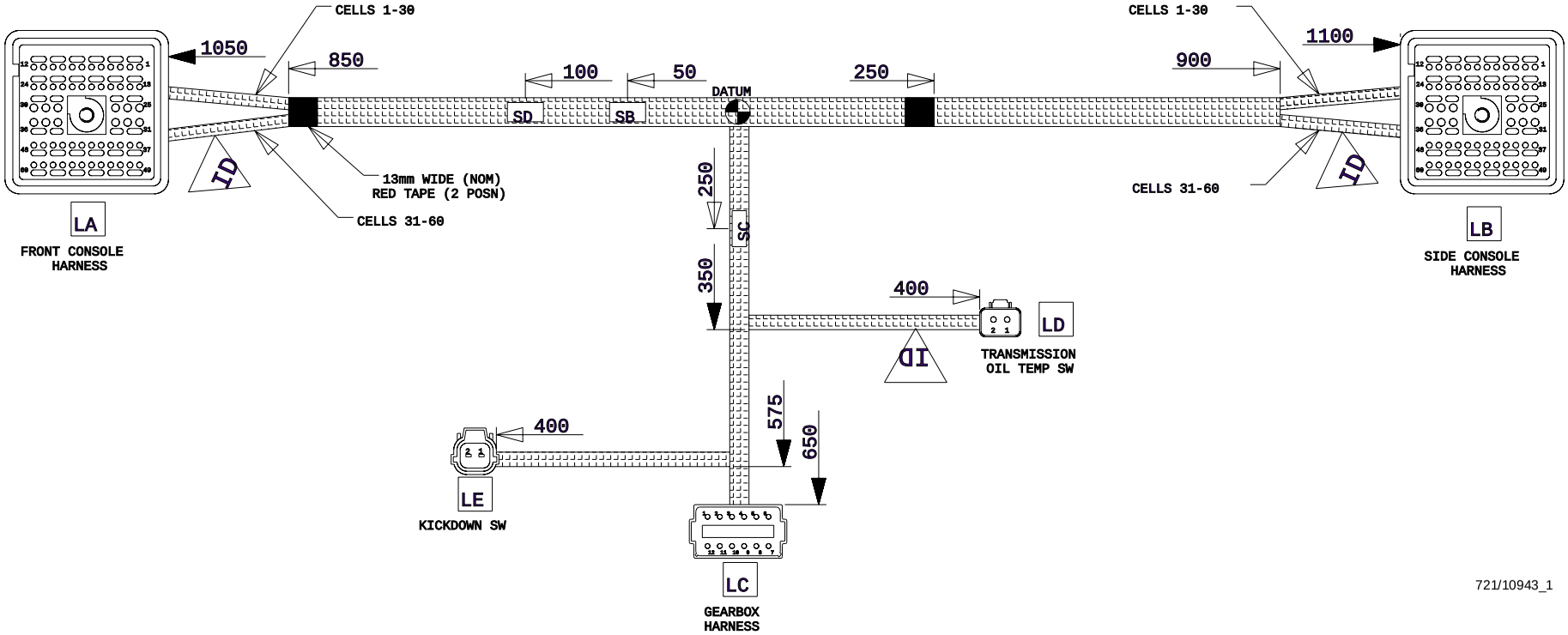
Harness Drawing - Side Console, page 1 of 2 - CAD 721/10936 Issue 1



Harness Drawing - Transmission, page 1 of 2 - CAD 721/10943 Issue 1

Key to Connectors:

LA	Front Console Harness
LB	Side Console Harness
LC	Gearbox
LD	Transmission Oil Temperature Switch
LE	Kickdown Switch
SB	Transmission Fused Splice
SC	Earth Splice
SD	Transmission Oil P Splice



Contents Page No.

Contents Page No.

Relief Valve Pressures

Loader Valve - Variable Flow

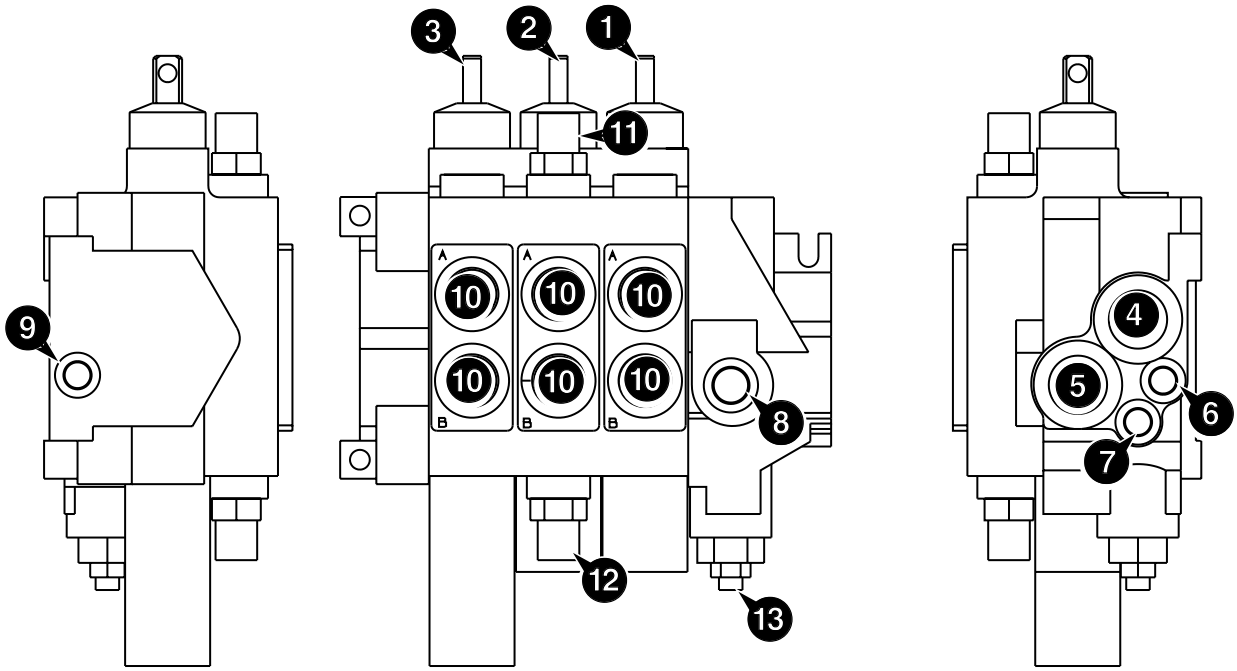
	bar	kgf/cm²	lbf/in²
Priority Relief Valve†	170 - 176	173 - 179	2450 - 2550
Auxiliary Relief Valves (A.R.V.) @ 0.5gal/min (1.9 litres/min)			
Shovel Ram Head Side	170 - 174	173 - 177	2465 - 2520
Shovel Ram Rod side	306 - 314	312 - 320	4450 - 4550

† **Note:** Steer circuit pressure is controlled by a relief valve housed in the hydraulic steer unit (Refer to Section H **Steering**). The priority relief valve housed in the loader valve must be set at 2500 lb/in^2, this will ensure it does not interfere with the operation of the relief valve housed in the hydraulic steer unit.

Weight:
2 Spool - TBA kg (TBA lbs)
3 Spool - TBA kg (TBA lbs)

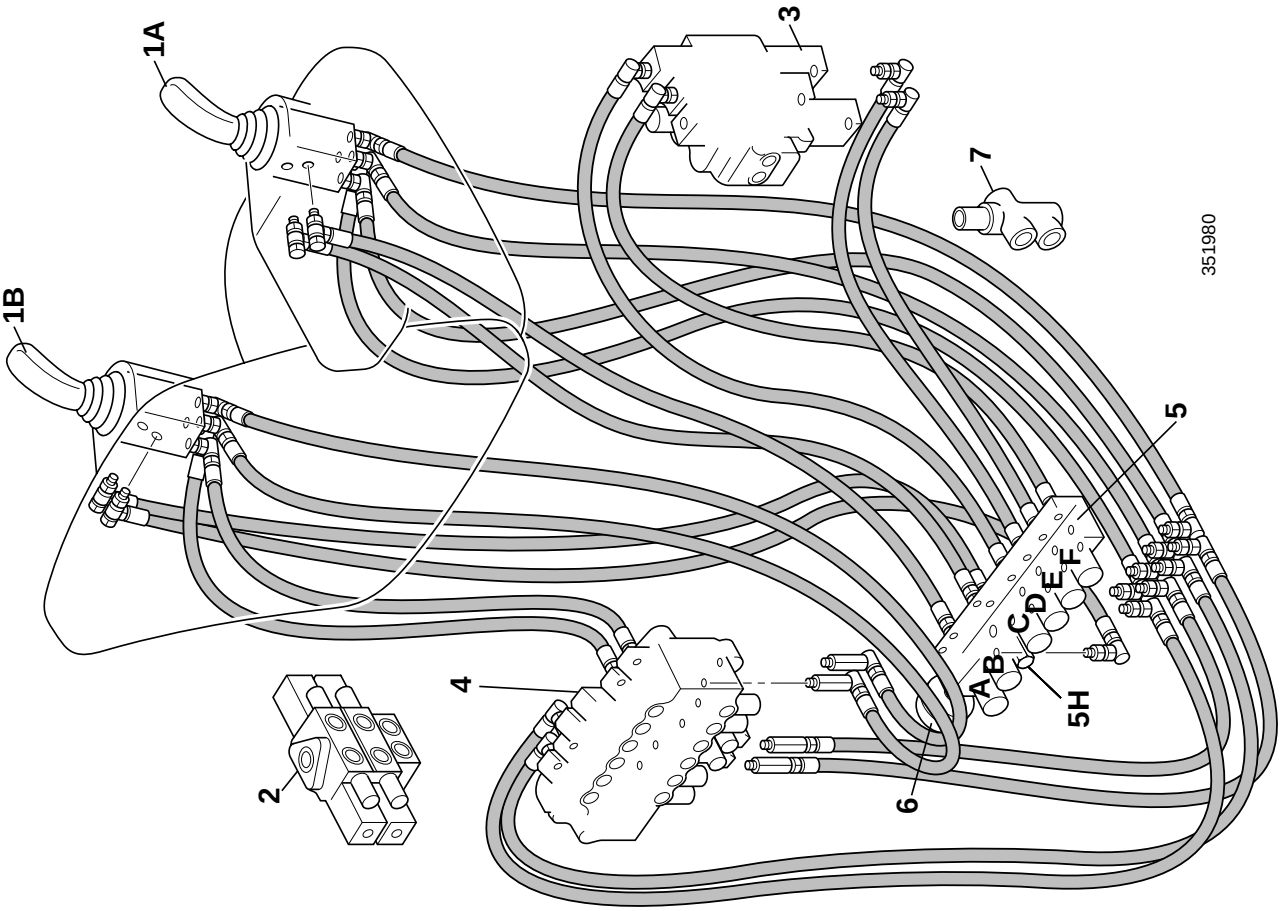
Component Key:

1	Auxiliary (optional) service
2	Shovel service
3	Arms lift service
4	Pump inlet
5	Tank port
6	Load sense port (to pump)
7	Priority load sense port (from steer unit)
8	Priority work port (to steer unit)
9	Load sense carry over port (to backhoe valve)
10	Service ports
11	Auxiliary relief valve (rod side)
12	Auxiliary relief valve (head side)
13	Priority relief valve †



A273670

Component Location



3CX, 4CX, 214, 215, 217 & 'S' Series Machines

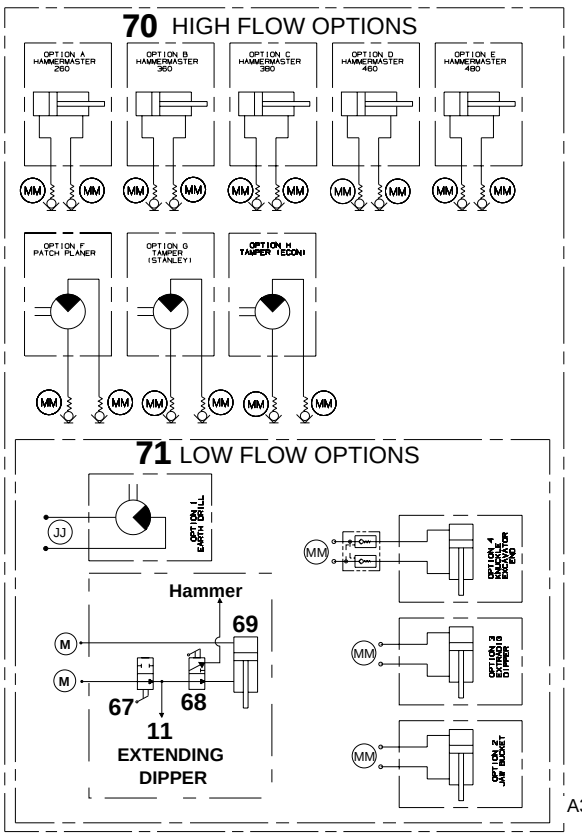
The policy of JCB is one of continuous improvement, therefore as products develop, there may be variations to the circuits.

Component Key

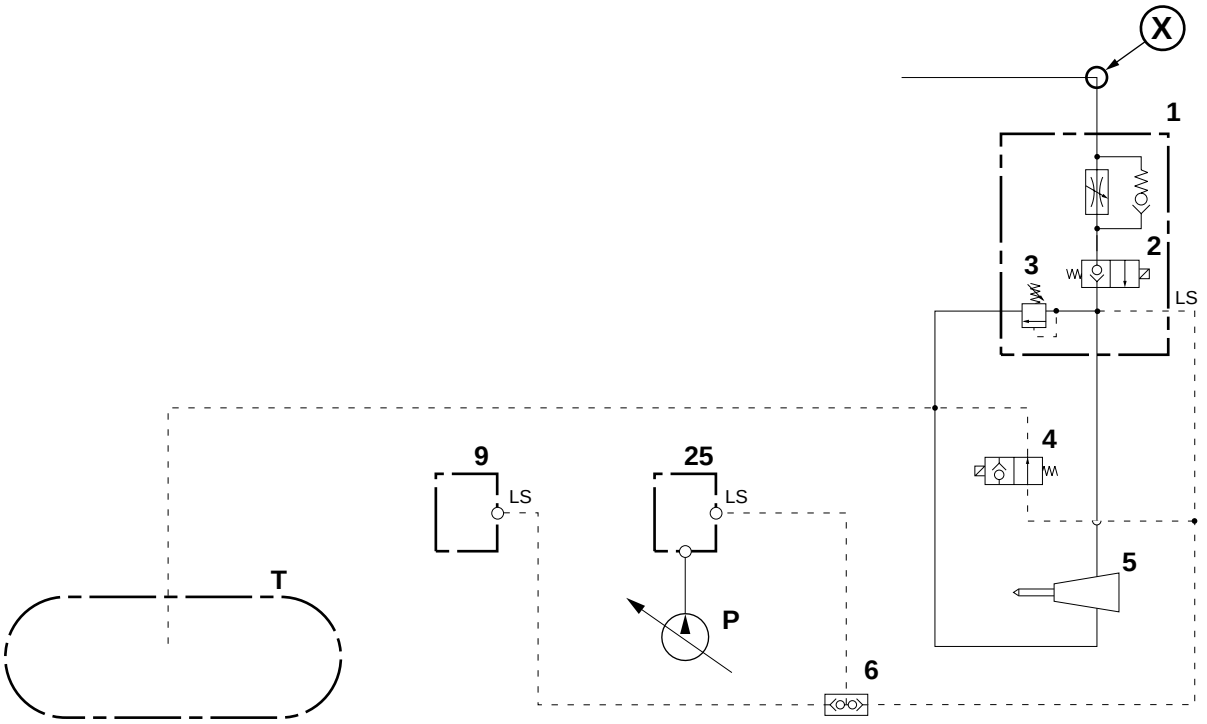
C Tank Cap
JJ Connections (as applicable)
P1 Pump, Main Section
P2 Pump, Secondary Section
P2A Pressure Test Point (auxiliary & unloader)
S Suction Line
T Tank
M Connections (as applicable)
MM Quick Release Couplings
1A Neutral Circuit Line
1B Neutral Circuit Line
2A Neutral Circuit Line
3 Loader Valve Block
3A Pressure Test Point (M.R.V.)
3B Unloader Pilot Valve
3C Loader Lift Ram Spool
3D Loader Shovel Ram Spool
3E Clamshovel Spool
3F Shovel Ram Head Side A.R.V.
3G Shovel Ram Rod Side A.R.V.
3J Load Hold Check Valve
3L Unloader Valve Spool
3M Main Relief Valve
3N Unloader Check Valve
3Q Hydraulic Speed Control Solenoid
4 Excavator Valve Block

Excavator services shown here are to the JCB control pattern. If ISO, Case or Ford control pattern is used, the excavator spools and relief valves will apply to different services.

4A Slew Spool
4B Boom Spool
4C Stabiliser Spool
4D Stabiliser Spool
4E Dipper Spool
4F Bucket Spool
4G Hydraclamp Valve (Sideshift Machines Only)
4H Slew A.R.V.
4J Slew A.R.V.
4K Boom Ram Rod Side A.R.V.
4L Boom Ram Head Side A.R.V.
4M Dipper Ram Head Side A.R.V.
4N Dipper Ram Rod Side A.R.V.
4P Bucket Ram Head Side A.R.V.
5 Auxiliary Valve Block (foot operated)
5A Auxiliary Spool
5B A.R.V.
5C A.R.V.
6 In-tank Filter
6A Filter By-pass Valve
6B Suction Strainer
7 Priority Valve
8 Filter
9 Filter
10 Diverter Valve (hammer only)
11 Sequence Valve (hammer only)
12 Flow Regulator Valve
13 Anti-cavitation Check Valve
14 Check Valve (optional)
15 Smooth Ride System Selector Valve Assembly
16 Smooth Ride System Accumulator
26 Hydraulic Oil Cooler
31 Shovel Ram R.H.
32 Shovel Ram L.H.
33 Lift Ram R.H.
34 Lift Ram L.H.
35 Clam Shovel Ram R.H.
36 Clam Shovel Ram L.H.
38 2 Wheel Steer Power Track Rod
39 AWS Rear Axle Power Track Rod
40 AWS Front Axle Power Track Rod
41 AWS Valve Assembly
42 Steer Control Valve
43 Shock Valves
44 Steer Control Valve Relief Valve
51 Bucket Ram
52 Boom Ram
53 Stabiliser Ram
54 Stabiliser Ram
55 Dipper Ram
56 Left Hand Slew Ram
57 Right Hand Slew Ram
59 Stabiliser Check Valve
62 Hydraclamps (Sideshift Machines Only)
65 Restrictor
66 Dipper Restrictor with By-Pass
67 Manual Isolation Valve
68 Manual Change Over Valve
69 Extending Dipper Ram
70 High Flow Options
71 Low Flow options



4CX, 4CX Super Machines
Hand Held Tools Option



A322650

Component Key

P	Pump Variable Flow
T	Hydraulic Tank
X	Main Circuit Connection
1	Pressure Flow Regulator
2	High Pressure Flow Spool
3	Relief Valve (2000 lb/in^2 - 138 bar - 146 kgf/cm^2)
4	Load Sense Solenoid
5	Hand Held Tool
6	Shuttle Valve
9	Excavator Valve Block
25	Loader Valve Block

Component Key:

B Parallel gallery
C Gallery
D Drilling
T Tank Port
1A Pump Inlet (section P1)
1B High Pressure Carry Over
1C Pump Inlet (section P2)
3B Main Relief Valve
3C LIft Ram Spool
3D Shovel Ram Spool
3E Auxiliary Spool
3L Unloader Valve Spool
3M Unloader Pilot Valve
3N Check Valve
3P Spring Cavity
3Q Solenoid Valve

Loader Valve - Neutral Circuit

The loader valve is mounted on the chassis frame, right hand side (when viewed from the rear).

It includes the lift ram spool **3C**, shovel ram spool **3D** and auxiliary spool **3E**. Linkage rods connect the spool ends to the control levers.

In neutral circuit hydraulic oil from the pump section **P2** enters the loader valve at **1C** via the steering priority valve**.** On entering the valve block, oil flows around the waisted section of the unloader valve **3L**, past check valve **3N** and joins the flow from pump section **P1**.

Oil from pump section **P1** enters the loader valve at **1A**.

Combined oil flow from **P1** and **P2** passes the main relief valve (MRV) **3B** and fills the parallel gallery **B**. From the parallel gallery the oil flows around the waisted central portions of spools **3C**, **3D** and **3E** (all in neutral position) and flows on to feed the excavator valve via high pressure carry over line **1B**.

Pressure in inlet gallery **C** is sensed by pilot valve **3M** via the bore of spool **3L**. At pressures below the setting of the unloader valve, both pilot valve **3M** and spool **3L** remain closed.

Loader Valve - Unloader Operation

Unloader spool operation protects the engine from being overloaded if a service is being worked particularly hard, for example when using the excavator to tear out. It does this by dumping the oil from the pump section **P2** to tank, allowing engine power to be applied fully to the main pump section **P1**.

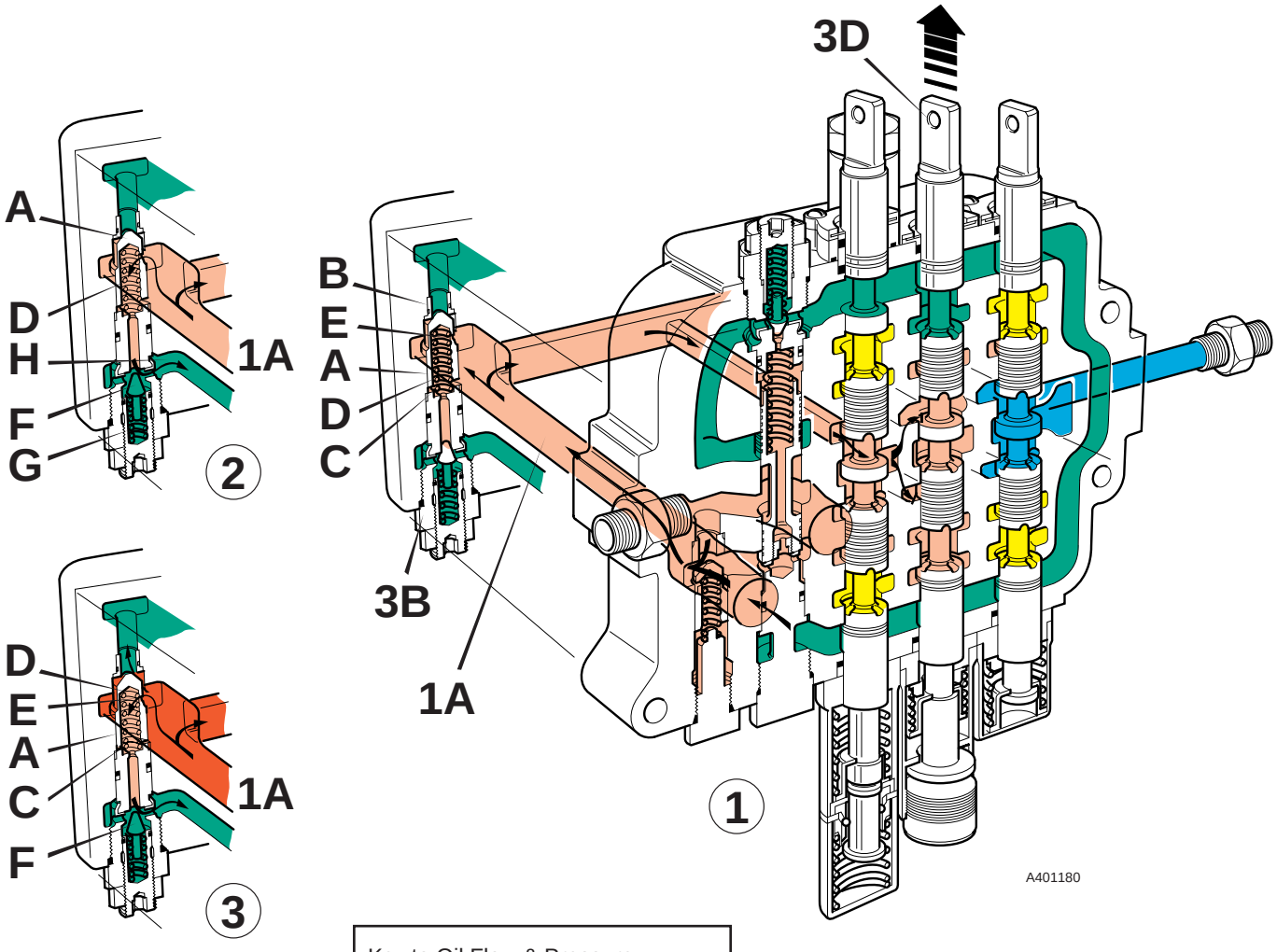
If the pressure in the inlet gallery **C** rises to the setting of the pilot valve **3M**, this valve will open, allowing oil in spring cavity **3P** to escape more quickly than it can be replaced by oil entering through the small drilling **D**.

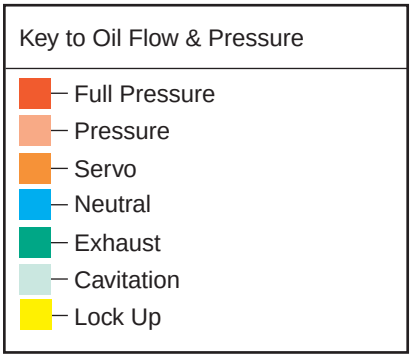
This creates a pressure differential between the spring cavity **3P** and gallery **C**. Higher pressure in gallery **C** acts on the face of spool **3L** causing the spool to be moved off its seat.

Oil entering the valve block from pump section **P2** now flow directly to tank **T**.

High pressure in gallery **C** also holds check valve **3N** firmly closed, preventing oil from pump section **P1** from also being dumped.

When pressure in inlet gallery **C** falls, for example if the excavator has stopped tearing out, pilot valve **3M** will close. This means oil in spring cavity **3P** will be at the same pressure as oil in gallery **C**, spring pressure will move spool **3L** back onto its seat, closing pump section **P2** connection to tank.


3D
A
D
H
F
G
1A
2
B
E
A
D
C
3B
1A
1
D
E
A
C
F
1A
3
A401180


Key to Oil Flow & Pressure
Full Pressure
Pressure
Servo
Neutral
Exhaust
Cavitation
Lock Up

A390630

Excavator Valve

Manual Control - Neutral Circuit

Component Key: (JCB 'X' Control Pattern)

A Inlet
B Parallel Gallery
C Load Hold Check Valves
4A Slew Spool
4B Boom Spool
4C Stabiliser Spool
4D Stabiliser Spool
4E Dipper Spool
4F Bucket Spool

Note: Machines with ISO control pattern have the boom and dipper spools interchanged.

Oil from the loader valve enters the excavator valve at **A** and flows through the neutral gallery and around the waists of the solid spools. It also fills the parallel gallery **B** but is not at a high enough pressure to open the load hold check valves **C**.

Excavator Valve

Hydraclamp Valve Operation (Sideshift Machines)

When the backhoe is being used for excavating duties, the kingpost assembly must be 'clamped' to the sideshift rearframe.

The hydraclamp control valve assembly (items **G**, **D** and **C**) is positioned in the inlet end of the excavator valve block and is connected directly to the parallel gallery **B**. The valve operates in conjunction with solenoid valve **E** housed in the side of the excavator valve block.

1 - Clamps Pressurised
When the hydraclamp switch **A** is in the OFF position (not pressed), the solenoid valve **E** is de-energised. The solenoid valve in this de-energised state blocks the exhaust path from the parallel gallery **B** to the drain port (tank).

When an excavator service is operated, pressure is generated in parallel gallery **B**, this pressurised oil enters the clamp valve **C** and lifts poppet **D** off its seat against the force of spring **G**. The oil flows past the poppet and out to the hydra-clamps **62**.

2 - Clamps Released
When the hydraclamp switch **A** is in the ON position (pressed down), the solenoid valve **E** is energised. The solenoid valve in this energised state now allows a connection to be made from the parallel gallery **B** to the drain port (tank) via gallery **F**.

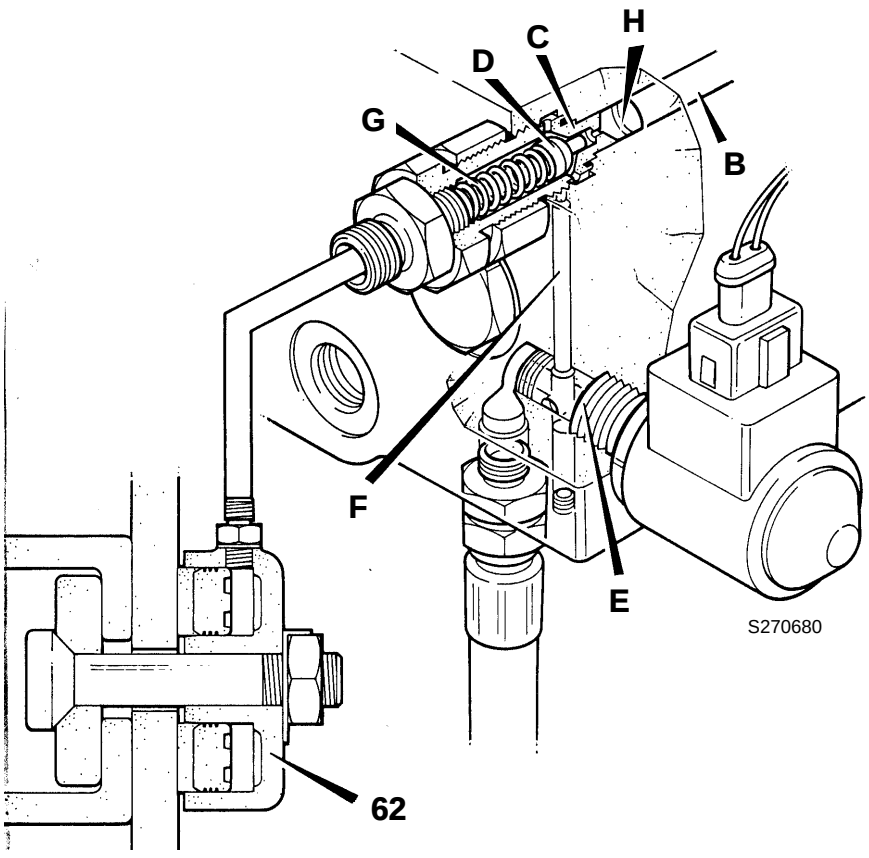
Oil from the hydra-clamps is vented through the clamp valve and gallery **F** to the drain port (tank).

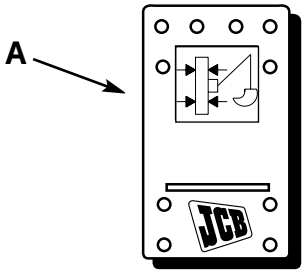
Also, pressure resulting from the operation of an excavator service passes by poppet **D** as before but the oil takes the path of least resistance and is vented via gallery **F** to the drain port (tank).

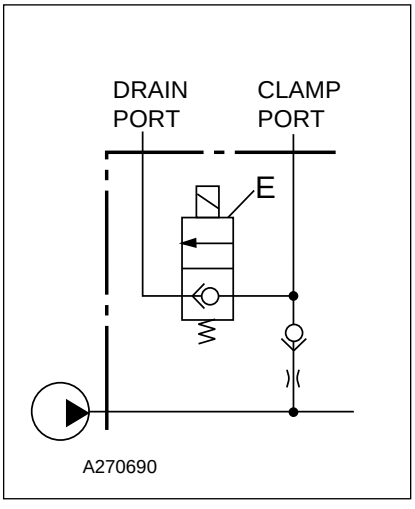
Restrictor **H** ensures that not all oil in gallery **B** is dumped back to tank.

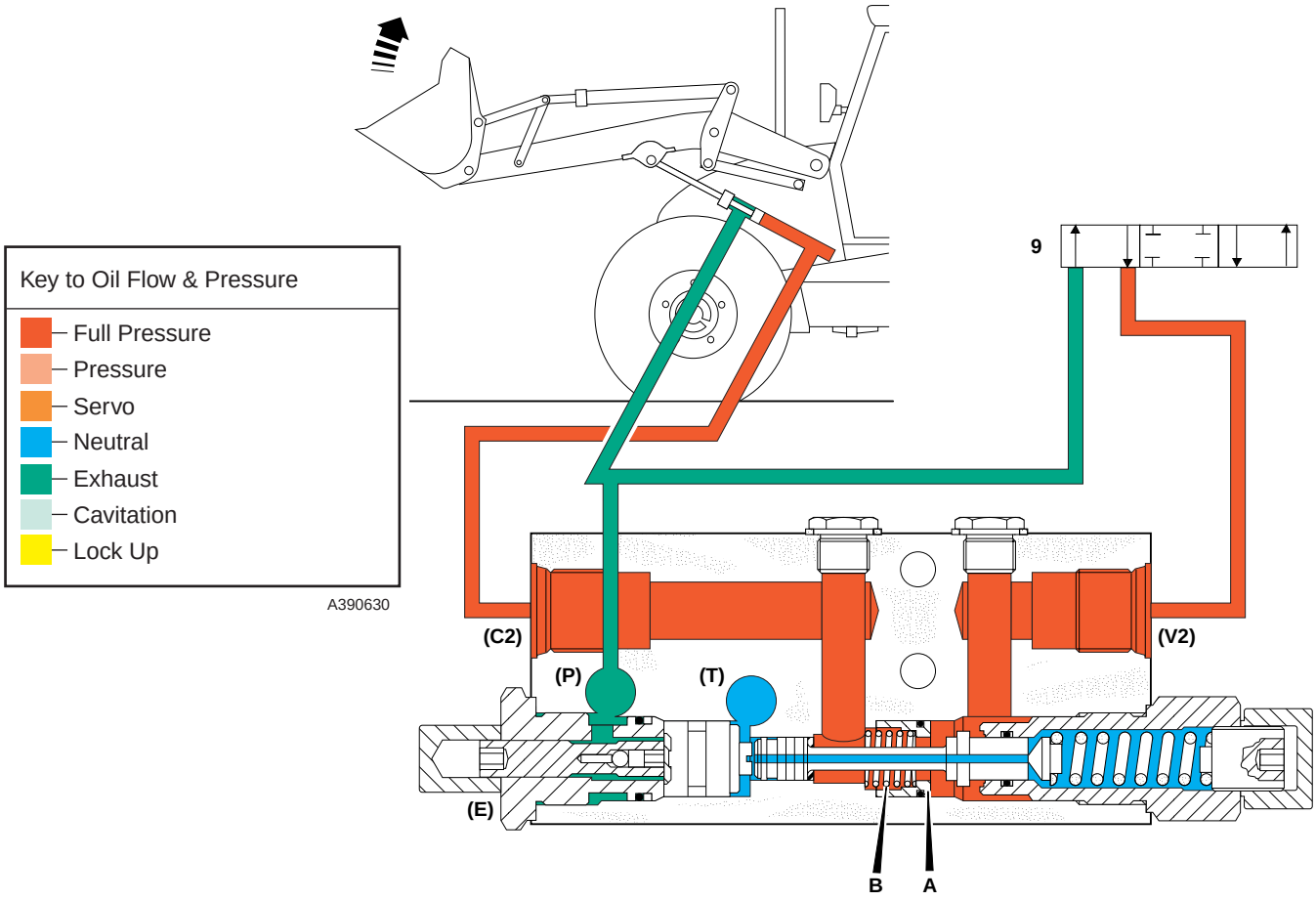
3 - Clamps Locked Up
If no service is being operated, pressure in the parallel gallery falls to that of the neutral circuit and the force of spring **G** is sufficient to keep the poppet seated.

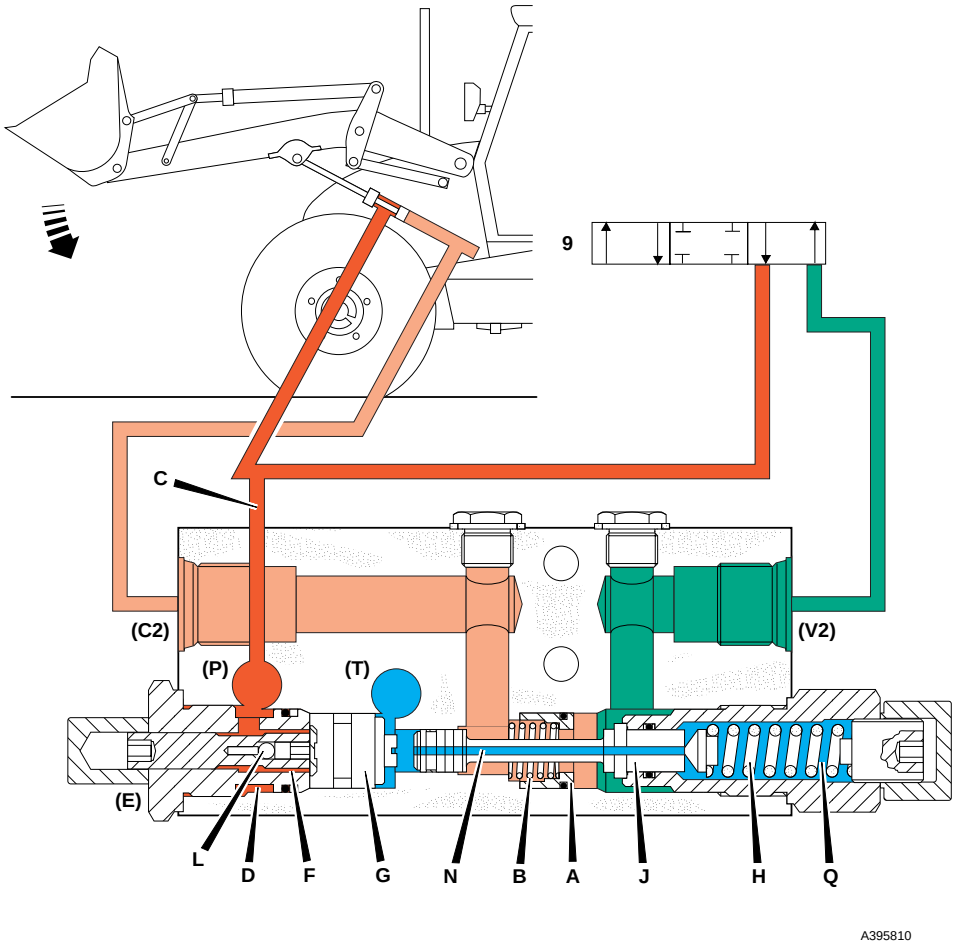
Pressure is therefore trapped in the line to the clamps, maintaining the excavator end in a securely clamped condition.








Key to Oil Flow & Pressure
Full Pressure
Pressure
Servo
Neutral
Exhaust
Cavitation
Lock Up
A390630
9
(C2)
(V2)
(P)
(T)
(E)
B
A
A395800


9
C
(C2)
(V2)
(P)
(T)
(E)
L
D
F
G
N
B
A
J
H
Q
A395810

Smooth Ride System

	Fault	Probable Cause	Action
1	Unable to power down loader arms with system switched OFF.	Rod side solenoid valve open.	Check if solenoid operating, replace solenoid or selector valve as required.
2	Restricted loader arm suspension movement when switched ON.	Rod side solenoid valve closed.	Check if solenoid operating, replace solenoid or selector valve as required.
3	Springy loader arm lift with system switched OFF.	Head side solenoid valve open.	Check if solenoid operating, replace solenoid or selector valve as required.
4	No suspension, unable to power down when switched ON.	Head side solenoid valve closed.	Check if solenoid operating, replace solenoid or selector valve as required.
5	Accumulator gas pressure decrease.	Leak across accumulator piston.	Recharge, if frequent replace seals in accumulator.
6	Oil in gas side of accumulator.	Leak across accumulator piston.	Discharge, drain and recharge, if frequent replace seals in accumulator.
7	Increase in charge pressure.	Oil to gas leak across accumulator piston.	Discharge, drain and recharge, if frequent replace seals in accumulator.

Note: It is normal for the loader arms to lift or lower slightly, when SRS is switched ON.

Check fuse A1 replace as required.

Variable Flow Pumps

Renewing Drive Shaft Seal

Note: The following procedure describes renewal of the shaft seal. However this is not the normal sequence, the sealing ring would normally be assembled with the taper roller bearing from inside the pump to ensure a secure sealing condition. If the shaft seal is to be renewed in this manner, it is extremely important not to scratch or damage the shaft, otherwise leakage will occur.

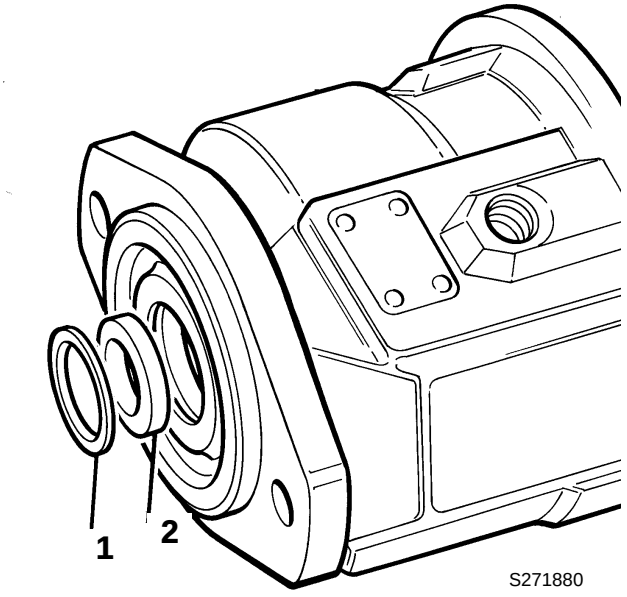
1 Remove retaining ring **1** and use a special rounded tool such as a ground screwdriver to remove the drive shaft sealing ring **2**.

2 Examine the seal running area (driveshaft and housing) for wear or damage. Damage in these areas will require the pump to be further dismantled.

3 Lubricate the new seal with JCB Special MPL Moly Grease.

4 Install the new seal, it is advisable to use a tube or similar located over the driveshaft to ensure the seal enters the housing evenly. DO NOT push the seal too far into the housing. If the shaft seal touches the bearing, the seal will be damaged.

5 Assemble the retaining ring **1**.



Ram Creep Tests - All Services

If ram creep is suspected the following procedures must be carried out to define if the leakage is within tolerance. Ram creep can be caused by a number of reasons: Cylinder/Piston Leakage, Spool Leakage, ARV Leakage.

The text and illustrations show a typical ram installation (in this instance the boom ram), the principle applies to all rams.

Note: The procedures are not applicable for rams fitted with hose burst protection valves.

⚠ WARNING

Hydraulic fluid at system pressure can injure you. Before disconnecting or connecting hydraulic hoses, stop the engine and operate the controls to release pressure trapped in the hoses. Make sure the engine cannot be started while the hoses are open.
INT-3-1-11/1

⚠ WARNING

Take care when disconnecting hydraulic hoses and fittings as the oil will be HOT.
TRANS 1-2

A Test for Ram Creep

1 Operate the machine to bring the hydraulic oil to a normal working temperature of 50°C (122°F) which can be measured using a hydraulic oil temperature probe (service tool 892/00285).

2 Fit an appropriate pressure gauge **A** to a tee-piece in the service hose which is pressurised when the ram in question is supported (Fig 1).

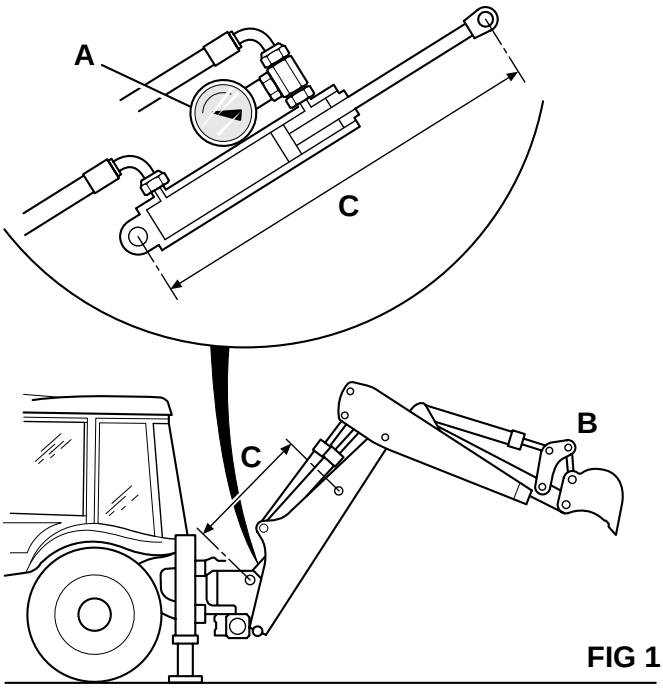


FIG 1
380190

3 Operate the rams to ensure they are full of hot oil.

4 Apply a load to the suspect ram for example the boom ram by raising the dipper to the horizontal as at **B**.

5 Measure the actual piston rod movement over 10 minutes. Measure the movement by checking the pivot pin to pivot pin dimensions as at **C**. Alternatively mark the rod with a felt tip pen 150mm (5.9 in) from the end cap and check the movement after 10 minutes, this is not possible on the majority of boom/extending dipper rams.

6 Using Table 1, check if the piston rod movement is within the recommended tolerance. If so, the ram creep is acceptable.

Note: The table indicates the MAXIMUM permitted ram movement.

7 If the rate of movement is unacceptable, identify if the fault is as a result of cylinder/piston leakage or spool leakage at the control valve, see procedure **B** and **C**.

Servo Pilot Controlled Valves

Lowering a Load - In a Failure Condition

During normal operation, the engine must be running before a load can be lowered. The following paragraphs describe how to safely and correctly lower a load in the event of engine/hydraulic failure or electrical failure; we recommend that only a competent maintenance engineer perform the procedures.

Machines with Hose Burst Protection Valve fitted, refer to **Hose Burst Protection Valves, Lowering a Load - In a Failure Condition**.

In the event of an engine, hydraulic or electrical failure an accumulator provides enough pilot pressure to put the machine into a safe condition, ie. lower the boom and loader arms.

⚠ DANGER

Do not stand underneath the raised load during the lowering procedure. Stand clear and to one side until the load has been safely lowered. Make sure that the area is clear of other people before lowering the load. If you do not follow these precautions you or others could be killed or seriously injured.
2-3-5-3

Engine or hydraulic failure

1 Turn the starter to the ON position.

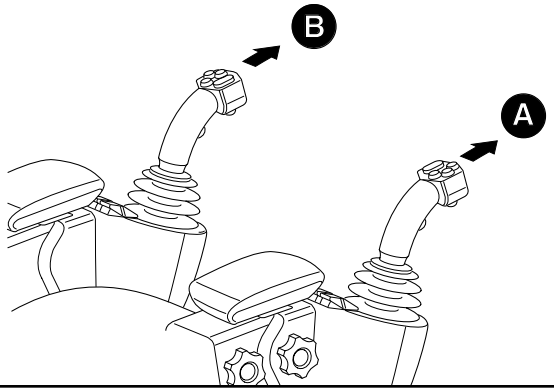
2 To lower the loader arms, with the seat facing forward push the right hand joystick forward **A**.

3 To lower the boom, with the seat facing the rear:

JCB Plus Pattern - push the left hand joystick towards the rear of the machine **B**.

ISO Plus Pattern - push the right hand joystick towards the rear of the machine **A**.

4 When the loader arms and/or boom have been lowered, switch OFF the starter switch.



Electrical failure

After lowering a load do not use the machine until the manual over-ride screw has been reset and the fault rectified, otherwise the machine will not operate as intended.

1 Remove the protective cover and screw the manual override **C** fully in.

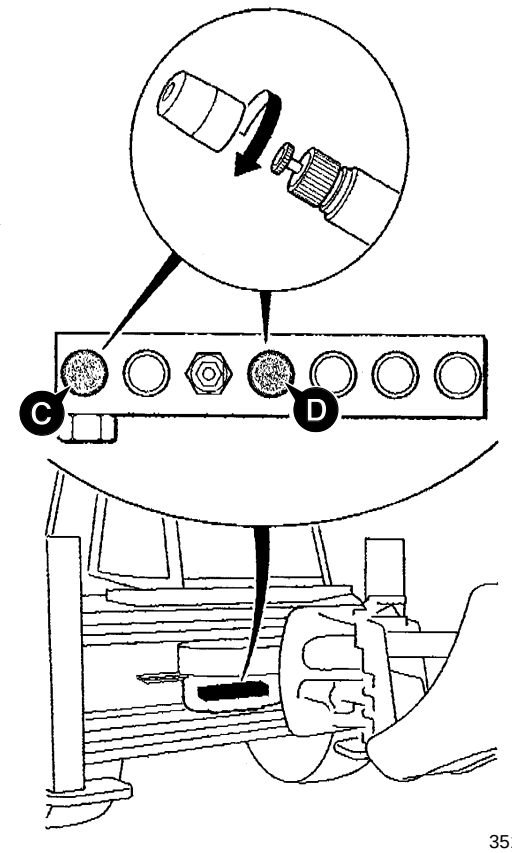
2 To lower the loader arms, with the seat facing forward push the right hand joystick forward **A**.

3 Remove the protective cover and screw the manual override **C** and **D** fully in.

4 To lower the boom, with the seat facing the rear:

JCB Plus Pattern - push the left hand joystick towards the rear of the machine **B**.

ISO Plus Pattern - push the right hand joystick towards the rear of the machine **A**.



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Removal and Replacement

Servo Pilot Controlled

⚠ WARNING

Make the machine safe before working underneath it. Park the machine on level ground, lower the arms. Apply the parking brake, put the transmission in neutral and stop the engine. Chock both sides of all four wheels.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.
GEN-1-2

⚠ DANGER

Hydraulic fluid at system pressure can injure you. Before disconnecting or connecting hydraulic hoses, stop the engine and operate the controls to release pressure trapped in the hoses. Make sure the engine cannot be started while the hoses are open.
INT-3-1-11/1

Removal

The illustration is viewed from the top when disconnecting pilot hoses and solenoid valves also disconnect the pilot hoses and solenoid on the bottom.

1 Operate the valve block joystick levers back and forth to vent accumulator pressure.

2 Disconnect all hydraulic pilot hoses **A** from the valve block and plug all orifices to prevent ingress of dirt. The hoses should be labelled, if not label each hose before disconnecting, this will ensure correct position when refitting.

3 Disconnect electrical connections **B** to auxiliary spool.

4 Disconnect hydraulic hoses to services **C**, inlet **D**, tank returns **E** and high pressure carry over **J** from the valve block, plug all orifices to prevent ingress of dirt. Label each hose before disconnecting, this will ensure correct position when refitting.

5 Steer hose **K** is clipped to the valve block and may need disconnecting for access.

6 Loosen and remove nuts **F,** remove the loader valve assembly and spacing washers **G**.

7 If the pilot hose adaptors **H** are going to be removed, label before removing as restrictors are fitted in most positions.

Replacement

Replacement is a reversal of the removal sequence.

⚠ WARNING

Fine jets of hydraulic fluid at high pressure can penetrate the skin. Do not use your fingers to check for hydraulic fluid leaks. Do not put your face close to suspected leaks. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of hydraulic fluid. If hydraulic fluid penetrates your skin, get medical help immediately.
INT-3-1-10/1

After replacement check the main relief valve (M.R.V.) and auxiliary relief valve (A.R.V.) pressure settings.

Note: All hydraulic adapters that are installed together with a bonded sealing washer must also have JCB Threadseal applied to the threads of the adapter.

Dismantling and Assembly

Standard Spool - Manual

The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

- CONTAMINATION
- DAMAGE TO SPOOL
- DAMAGE TO SEAL GROOVES

All or any of the above points may result in possible problems with the valve.

Dismantling

Remove the lever linkage from the tang (lever) end of the spool.

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the spool or seal grooves, for instance, item **3**, which is a wiper seal and is a press fit in the counterbore.

Care must be taken to ensure that the spool **8** is not damaged when removing it from the valve block.

Hold the spool in clamp 992/10100, unscrew bolt **9** and remove spring **12**, spacer **10** and cups **11** and **13**.

Check for surface contamination on the under side of the seal plates **2** and **14**. Clean if necessary. Check for the flatness of the seal plate. If found to be bent - replace with new (any work previously carried out on this valve may have resulted in the bending of the seal plate).

Assembly

1 Fit the boot **1A** to the seal plate **2**.

2 Fit a new lipseal **4** into the valve block, ensure square. Fit wiper **3** on top of lipseal.

3 Fit the seal plate and boot assembly to valve block section but do not torque tighten capscrews **1** at this stage. Ensure wiper locates into seal plate.

4 Use clean hydraulic oil as a lubricant. From the bottom, insert spool through the valve block, do not use excessive force when fitting, a turning motion should ease the spool through the valve block.

5 Check that the tang end of the spool passes through the boot without dislodging or damaging the boot. Ensure that the tang aligns with the control rod and that the boot is not distorted and is located in the spool land.

6 Torque tighten cap screws **1**.

7 When fitting bolt **9**, clean the threads thoroughly using JCB Cleaner/Degreaser, leave it for 10 minutes then apply a small quantity of JCB Threadlocker and Sealer to the threads of the spool.

8 Make sure that all the parts move freely, check that item **10** does not interfere with item **13**.

9 Renew 'O' ring**15**. Make sure the 'O' ring is not trapped or damaged.

10 Fit seal **15** and seal plate **14** to the valve block section. Torque tighten capscrew **5** on completion.

Re-connect the lever mechanism to the tang (lever) end of the spool.

Run the engine and inspect the valve for external leaks.

Torque Settings

Item	Nm	kgf m	lbf ft
1	9.5	0.96	7
5	9.5	0.96	7
9	9.5	0.96	7

Dismantling and Assembly

Electric Spool - Servo Pilot Controlled

It is possible to remove a spool without removing the valve block. The spring **5** is at the bottom so the spool must be removed from the bottom.

The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

- CONTAMINATION
- DAMAGE TO SPOOL
- DAMAGE TO SEAL GROOVES

All or any of the above points may result in possible problems with the valve.

Dismantling

Hold the spool in clamp 992/10100, unscrew bolt **3** and remove spring seat **4**, spring **5** and spring seat **6**.

Care must be taken to ensure that the spool **11** is not damaged when removing it from the valve block.

Check for surface contamination on the under side of the seal caps **2** and **9**.

Note: If removing a proportional pressure reducing valve from a valve block that is fitted on a machine the pilot circuit accumulator pressure must be vented first.

Switch on the starter switch, without the engine running. Switch the joystick isolator on and operate the joystick controls several times.

To remove a proportional pressure reducing valve, unscrew nut **12** and remove coil **13**.

Unscrew solenoid cartridge **14**.

Assembly

Renew 'O' ring seals **7** and **10**. Make sure the 'O' ring seals are not trapped or damaged.

Renew ‘O’ ring seals on the solenoid valve.

When fitting bolt **3**, clean the threads thoroughly using JCB Cleaner/Degreaser, leave it for 10 minutes then apply a small quantity of JCB Threadocker and Sealer to the threads of the spool.

The proportional pressure reducing valve must be replaced as a complete unit. Refit solenoid cartridge **14**, place coil **13** onto the cartridge and position the coil so that the electrical connection is at the correct angle.

Fit and tighten nut **12** holding coil **13** to prevent turning.

Run the engine and inspect the valve for external leaks.

Torque Settings

Item	Nm	kgf m	lbf ft
1	9.5	0.96	7
3	9.5	0.96	7
8	9.5	0.96	7
12	6.75	0.70	5
14	27.1	2.76	20

Dismantling and Assembly

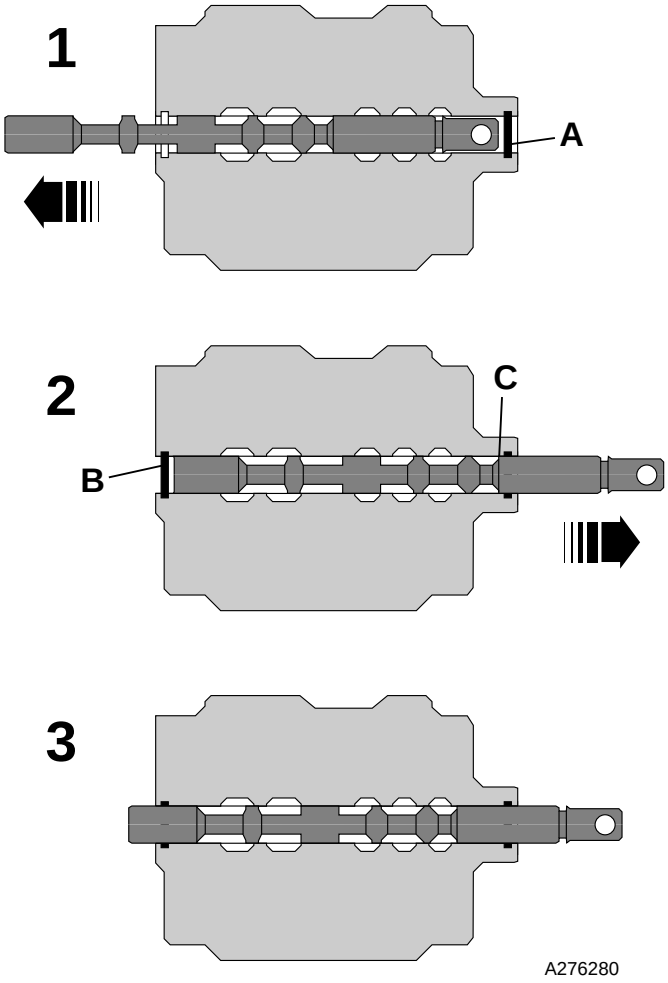
Fitting Spool Seal

Use the procedure described below to correctly install the valve spool seals:

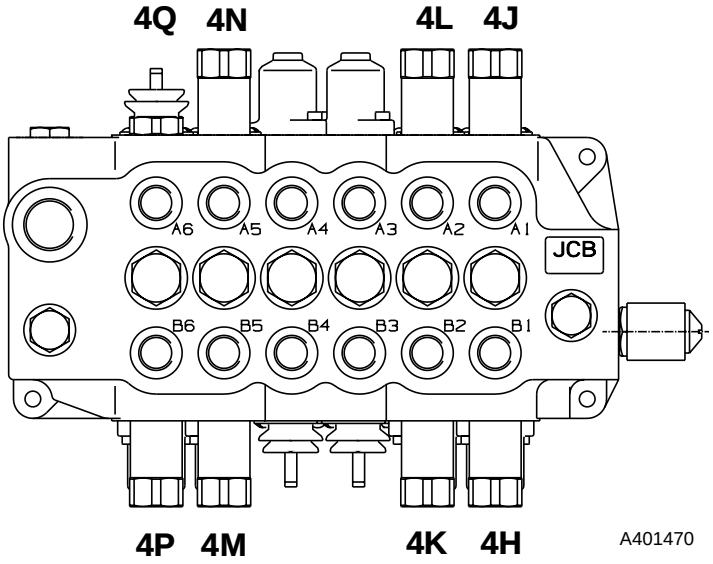
1 Lubricate the spool, bore and O-ring groove with JCB Hydraulic Fluid. Move the spool to the position shown and then install the O-ring **A** in its groove.

2 Move the spool to the position shown and then install the O-ring **B**. It is important to note that the spool must not be moved beyond the position shown, otherwise the edge of the spool (face **C**) may damage the first fitted O-ring (item **A**).

3 Position the spool in its central position as shown. Re-assembe the centering assembly, dust boot etc as detailed previously in this section.



Auxiliary Relief Valves



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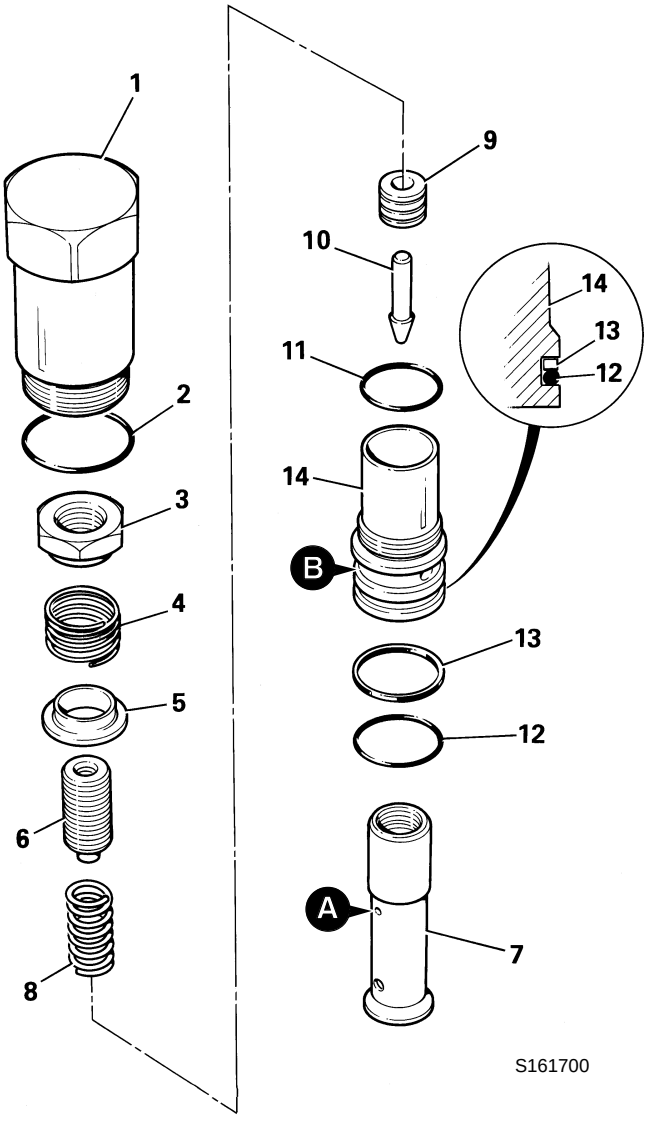


S161700

Dismantling and Assembly - Loader Lift Ram

This procedure applies to Hose Burst Protection Valves fitted to the loader arm rams ONLY.

The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

Dismantling

If possible, avoid disturbing pressure settings, remove cartridges by unscrewing hexagons **1** and **13** and do not remove capnuts **3** and **16**.

Spool **2** and check valve **11** each have a Teflon ring fitted (items **A** and **B** respectively). These Teflon rings should only be removed and replaced with new ones if they are damaged.

Do not try to dismantle items **20**, **21** and **22** (these items are shown for pictorial reference only). To clean, use a non-metallic probe to move the ball **21** against spring **22** whilst assembly **17** is submersed in cleaning fluid.

Check condition of all visible seating faces. If any are damaged, renew complete cartridge or valve assembly.

Check valve bores and spools for nicks, scratches or scoring, if necessary, renew complete cartridge or valve assembly.

Assembly

DO NOT apply JCB Threadlocker and Sealer or any other type of locking fluid to the threads of item **17**. The threads form an integral part of the valve operating sequences - applying locking fluid to the threads will seriously effect the operation of the valve.

Ensure that the small drilled holes **C** and **D** in items **2** and **17** respectively are not blocked.

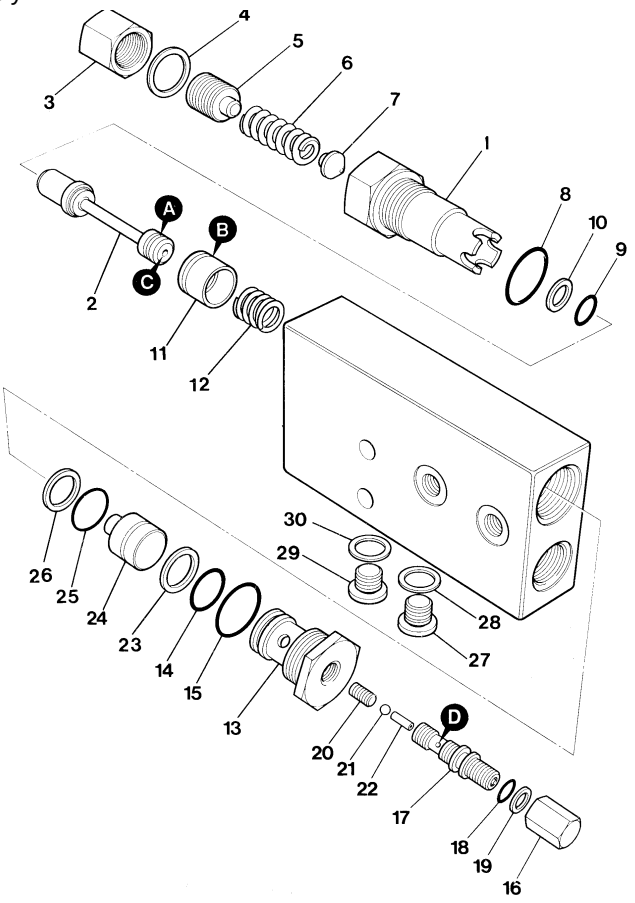
Renew all seals. If fitting new Teflon rings **A** & **B**, use a conical guide, such as item **E**, to expand the rings gradually. Complete the ring fitting procedure as quickly as possible, otherwise the ring will stretch. See below.

Note: There is an O-ring **F** fitted underneath each Teflon ring, if the Teflon rings are to be renewed, make sure that new O-rings are fitted first.

After assembly, make sure that the valve parts move freely, if they don't, check that all the seals are correctly fitted.

After refitting the valve to the machine, ensure that pressure settings are correct, see **Technical Data** page, and check that the valve operates correctly.

If the pressure settings were disturbed, then the valve must be re-set, refer to **Service Procedures, Hose Burst Protection Valves, Pressure Testing - Loader Lift Ram**.



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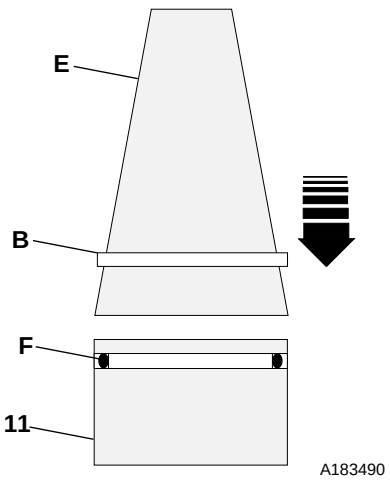


A183490

Removal and Replacement - Stabiliser Ram (Centremount)

Removal

1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the stabiliser legs to the ground.

2 Lower the backhoe and loader end to the ground and stop the engine.

DANGER

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before disconnecting or connecting hydraulic hoses, stop the engine and operate the controls to release pressure trapped in the hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11/1

3 Make sure the engine is switched off, vent residual hydraulic pressure by moving the backhoe and stabiliser control levers back and forth.

Note: If a check valve is fitted on the ram, the system will not vent. Extreme caution must be used when releasing hydraulic connections - release the connections one turn and allow the pressure to dissipate.

4 Carefully disconnect hydraulic hoses **A** and **B** from the stabiliser hydraulic ram, label the hoses before removing (as an aid to assembly). Release the connections slowly.

⚠ CAUTION

This component is heavy. Do not attempt to remove it unless its weight is held by a sling. Make sure that the sling is attached to a suitable lifting appliance.

HYD 2-3/1

5 Wrap a suitable sling around the stabiliser ram, make sure that the weight of the ram is supported by the sling.

6 Remove the ram pivot pin retaining nut and bolt, drive out the ram pivot pin as shown at **C**.

7 Remove the stabiliser ram.

Replacement

Replacement is a reversal of the removal sequence.

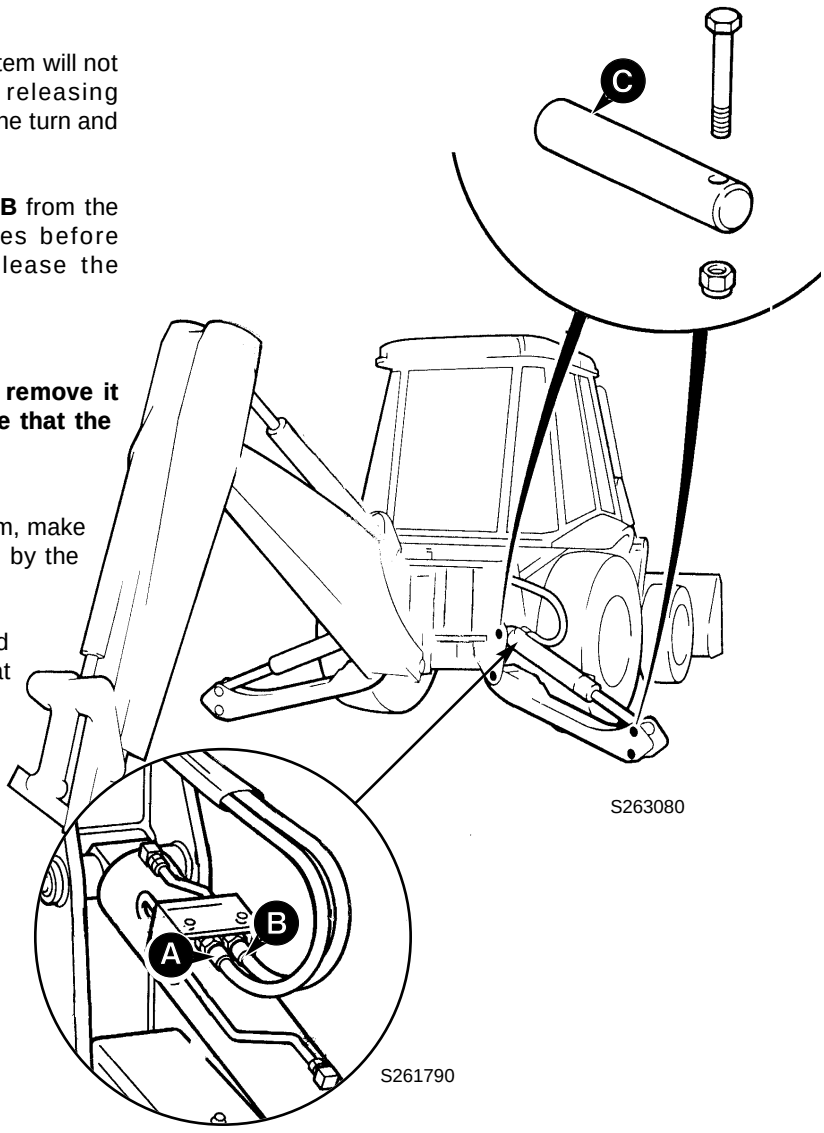
⚠ WARNING

Fine jets of hydraulic fluid at high pressure can penetrate the skin. Do not use your fingers to check for hydraulic fluid leaks. Do not put your face close to suspected leaks. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of hydraulic fluid. If hydraulic fluid penetrates your skin, get medical help immediately.

INT-3-1-10/1

Use suitable lifting appliances to locate the stabiliser ram.

After replacing or fitting the ram, connect the hydraulic pipes, make sure that the ram and leg operate freely and do not foul.



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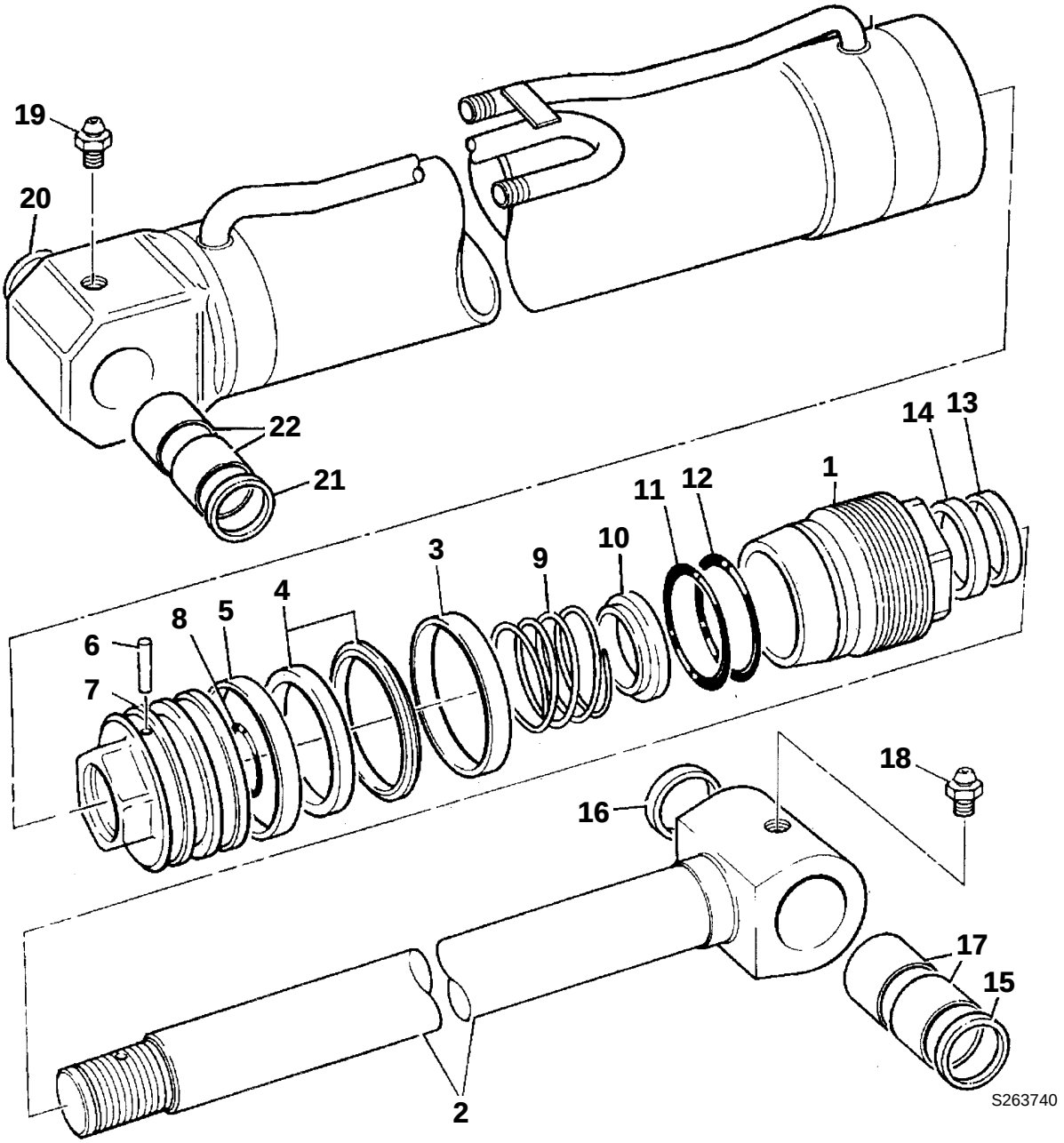
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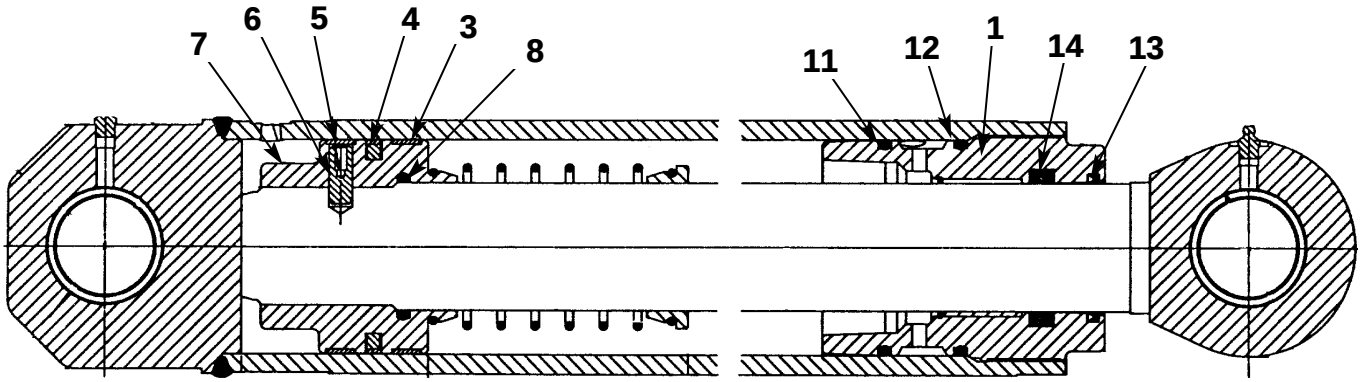
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S263730

Removal and Replacement

⚠ WARNING

Raised loader arms can drop suddenly and cause serious injury. Before working under raised loader arms, fit the loader arm safety strut.

GEN 3-2

⚠ DANGER

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before disconnecting or connecting hydraulic hoses, stop the engine and operate the controls to release pressure trapped in the hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11/1

Removal

1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the backhoe and loader end to the ground and stop the engine.

2 Vent residual hydraulic pressure by operating the controls back and forth several times.

3 Label and then remove hydraulic hoses **A** and **B** (see note). Plug and cap all open ports to prevent loss of fluid and ingress of dirt.

Note: When installing and removing hoses from the cooler, it is essential to note that adaptor **C** must be held with a spanner whilst installing or removing the hose. It may be easier to remove the top hose connection once the cooler has been removed from the machine (disconnect top hose at connection **D**).

4 Loosen and remove cooler mounting bolts **E** (4 off) and remove the cooler **F**.

Replacement

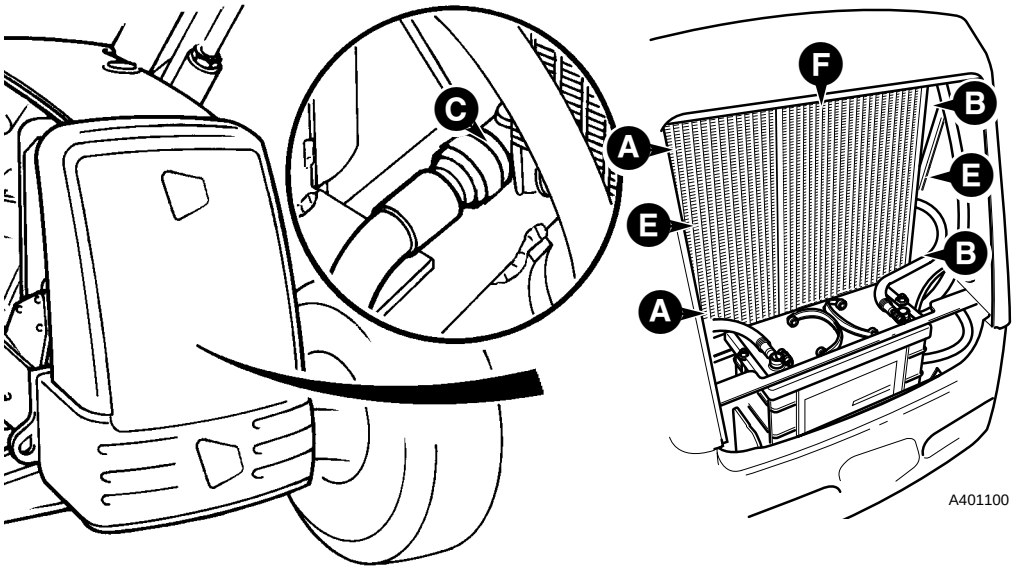
Replacement is a reversal of the removal sequence.

⚠ WARNING

Fine jets of hydraulic fluid at high pressure can penetrate the skin. Do not use your fingers to check for hydraulic fluid leaks. Do not put your face close to suspected leaks. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of hydraulic fluid. If hydraulic fluid penetrates your skin, get medical help immediately.

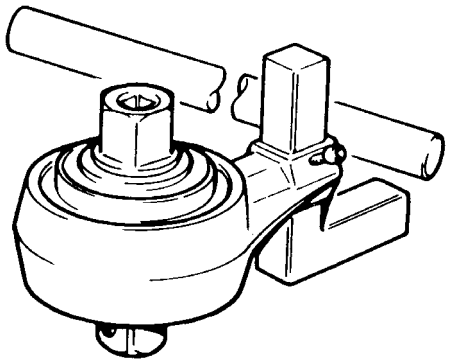
INT-3-1-10/1

When installing and removing hoses from the cooler, it is essential to note that adaptor **C** must be held with a spanner whilst installing or removing the hose. Tighten hose connections to a torque of 58 Nm (42 lbf ft).



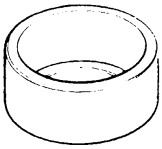
S401350

992/04000 Torque Multiplier (use in conjunction with a torque wrench to give a 5:1 multiplication when tightening pinion nuts)



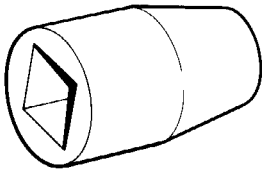
S197030

892/00174 Measuring Cup - Pinion Head Bearing



S190770

892/00822 Splined Bolt Socket for driveshafts



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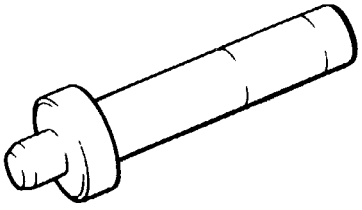
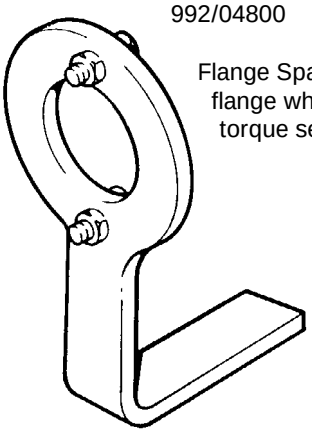


S216310

892/00182 Bearing Pad Driver

992/04800

Flange Spanner - for locking brake disc flange while pinion nut is slackened or torque set



S197040

Rear Axle

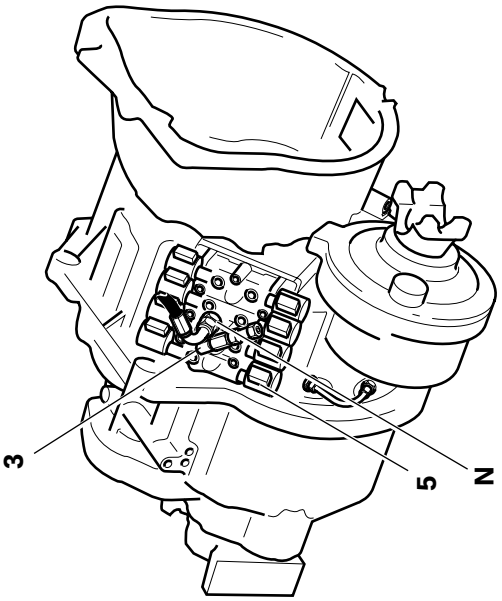
Note: It is essential that the correct ratio axle in relationship to the gearbox ratio is fitted to the machine. Do not fit a new axle with a different ratio to the axle being replaced.

ALL WHEEL STEER MACHINES

Type	3 piece, JCB spiral bevel input with epicyclic hub reduction and inboard braking. Pinion mounted park brake disc.		
Designation	SD80		
Installation	Rigid pad mount		
Number of steer rams	1 (Double rod)		
Weight (dry, with no steer rams and without wheels)	410 kg (904 lbs) approx.		
Half (Axle) Shaft Braking/Type	5 friction plate, 6 counter plate (each half shaft)		
Input Type	Yoke		
Oscillation	± 5°		
Toe - in	0 °		
Castor Angle	0 °		
Camber Angle	1 °		
King - pin inclination	0 °		
Hub Reduction	5.4:1		
Ratios	OPTION 1	OPTION 2	OPTION 3
Overall	15.78:1	18.16:1	13.7:1
Crownwheel and Pinion	2.923:1	3.363:1	2.538:1
Number of Teeth			
Crownwheel	38	37	33
Pinion	13	11	13

2 WHEEL STEER MACHINES

Type	3 piece, JCB spiral bevel input with epicyclic hub reduction and inboard braking. Pinion mounted park brake disc.		
Designation	PD70		
Installation	Rigid pad mount		
Weight (dry and without wheels)	386 kg (851 lbs) approx.		
Half (Axle) Shaft Braking/Type	5 friction plate, 6 counter plate (each half shaft)		
Input Type	Yoke		
Hub Reduction	5.4:1		
Ratios	OPTION 1	OPTION 2	OPTION 3
Overall	15.78:1	18.16:1	13.7:1
Crownwheel and Pinion	2.923:1	3.363:1	2.538:1
Number of Teeth			
Crownwheel	38	37	33
Pinion	13	11	13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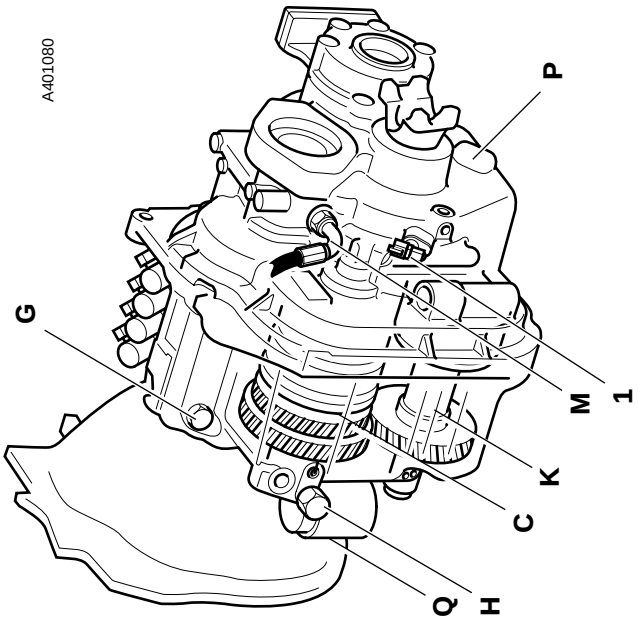
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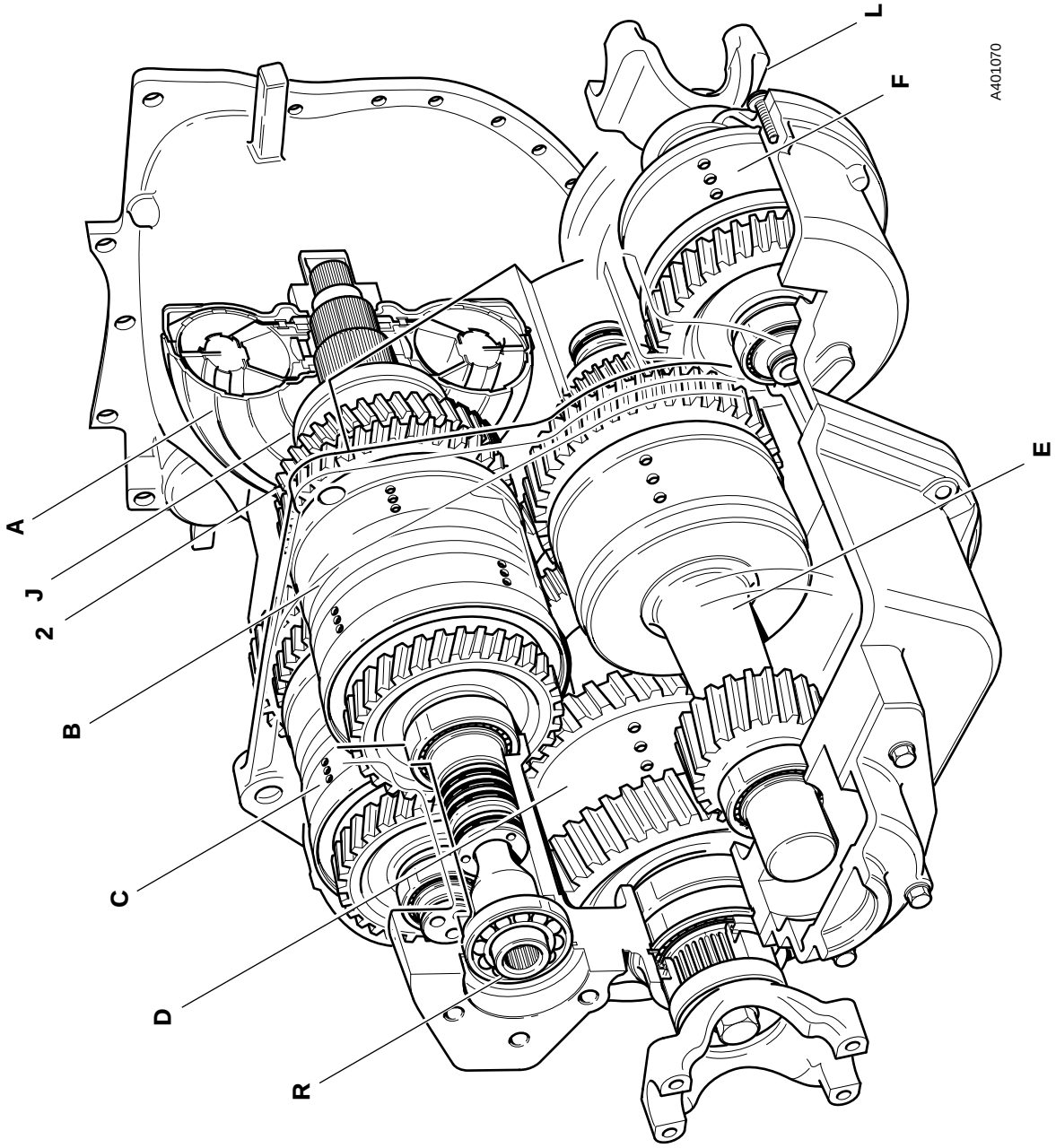
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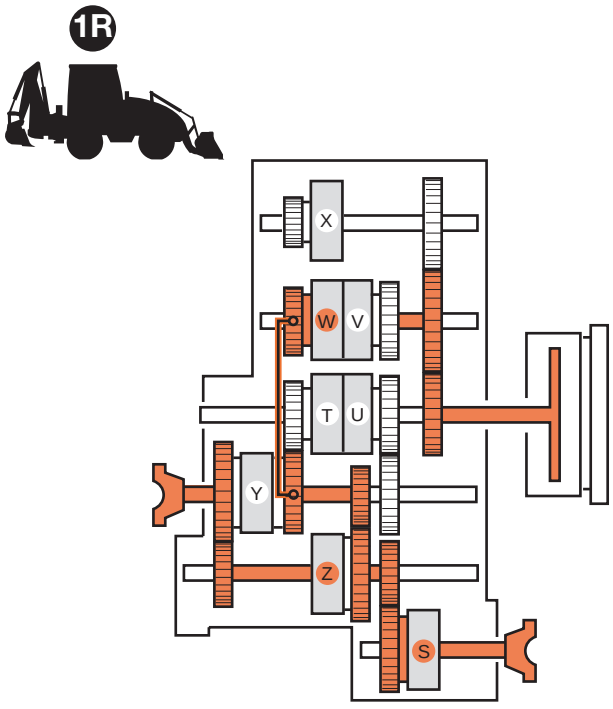

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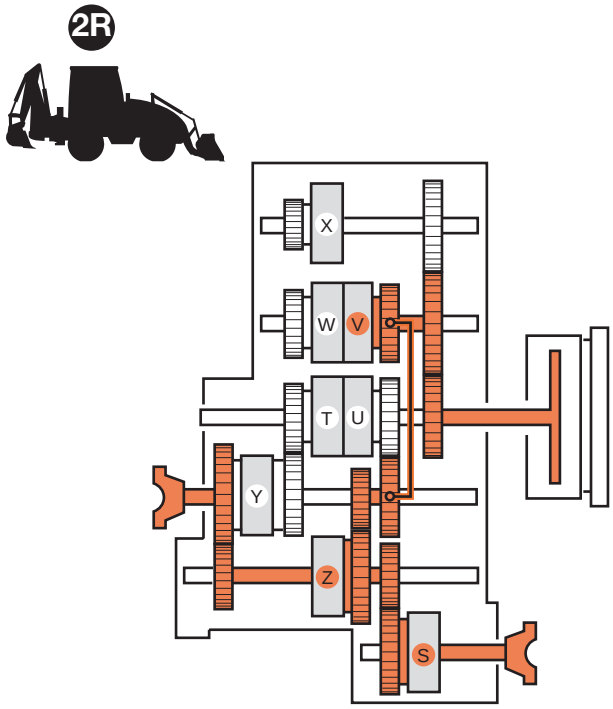

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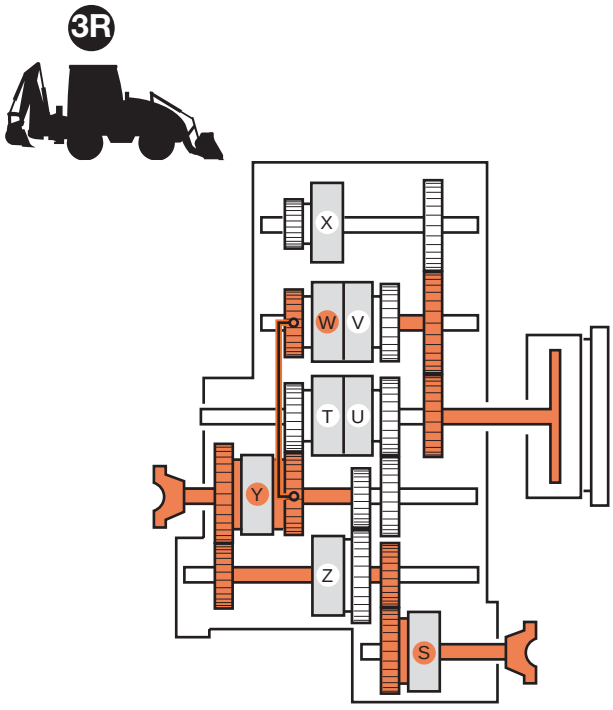

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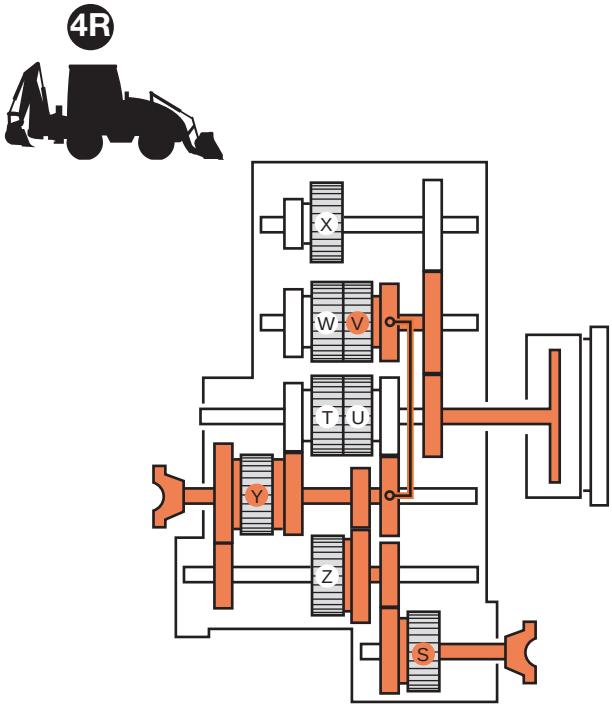

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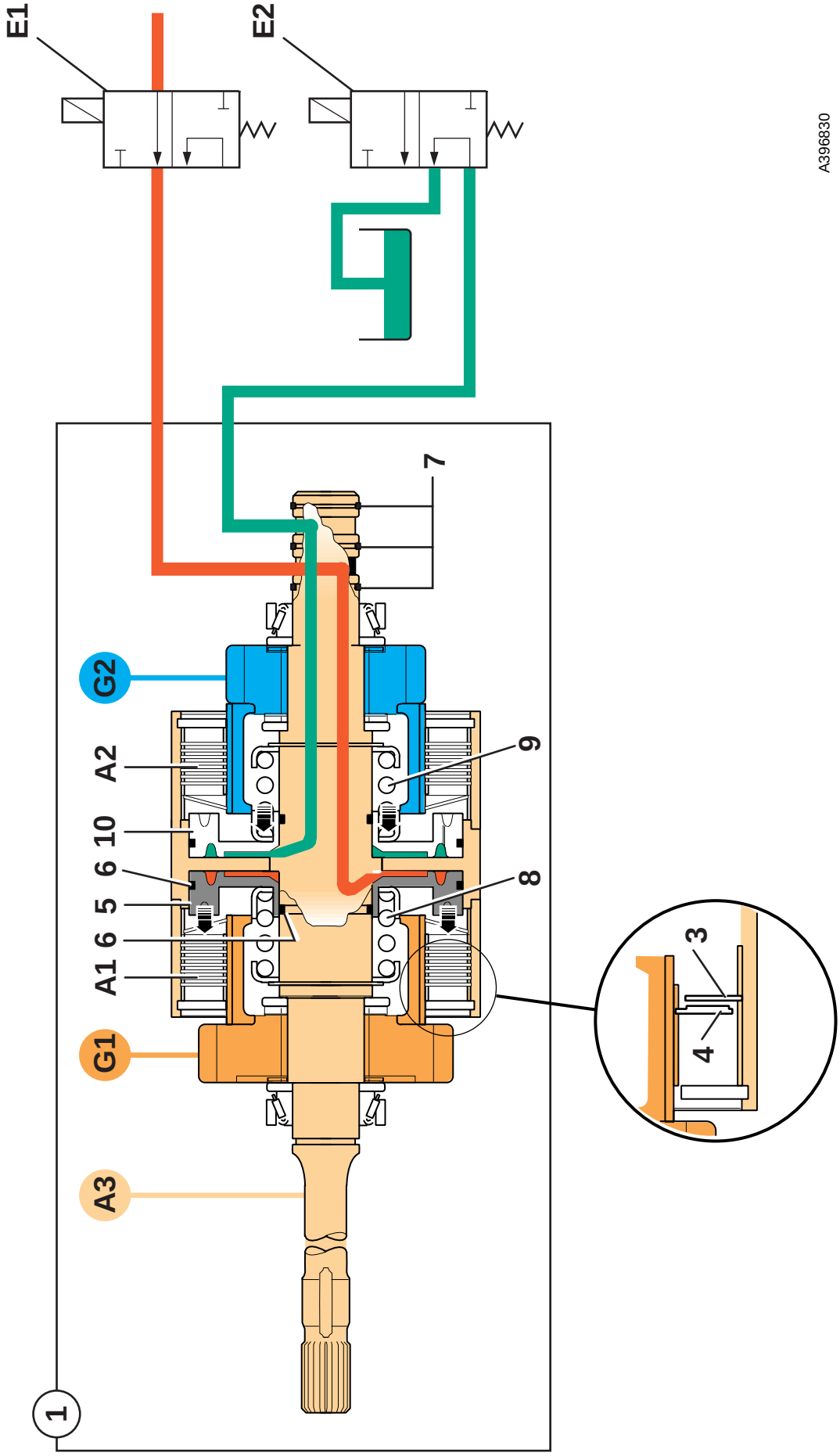
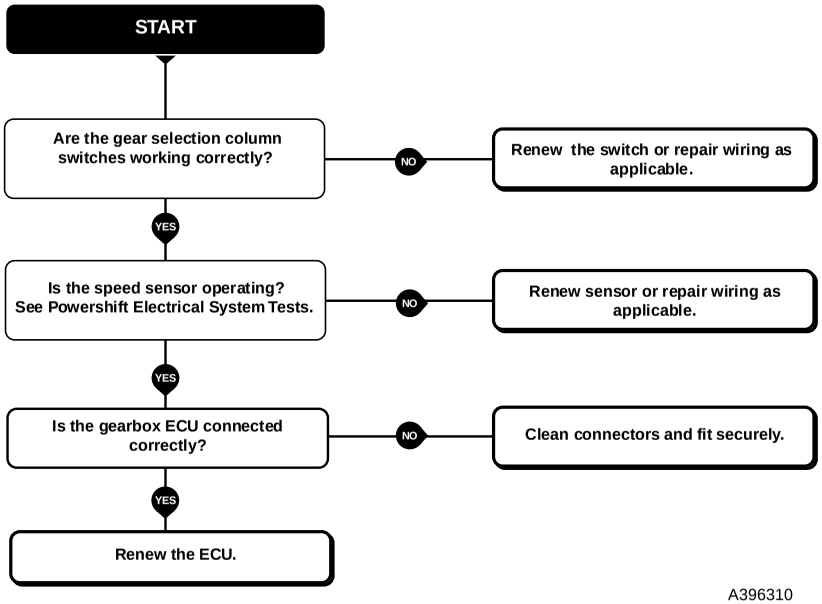


Powershift Gearbox
Clutch Operation - Forward, Reverse

Powershift Gearbox

Chart D - (6 speed gearbox only) Shiftmaster fails to function normally - fails to autoshift - shifts at incorrect road speed.



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Note: 4th, 5th and 6th gears utilise clutches used for 1st, 2nd and 3rd gears. If 4th, 5th or 6th gears fail to engage, check that the lower 3 gears function correctly before investigating a possible Shiftmaster fault. See **Fault Finding Chart C**.

Synchro Shuttle Gearbox

Forward/Reverse Solenoid Control Valve

Dismantling

Unscrew the knurled nut **2** and remove 'O' ring **3**, withdraw the solenoid **4** and 'O' ring **5**.

Hold the solenoid valve body **6** in a vice, using the spanner flats **A**, remove spindle **7** and 'O' ring **8**.

Pull out actuating pin **9**, spring **10**, spring retainer **11**, and spool **12**.

Inspect the spool and spool bore for signs of wear, nicks scratches etc.

Assembling

Assembly is reversal of the dismantle procedure.

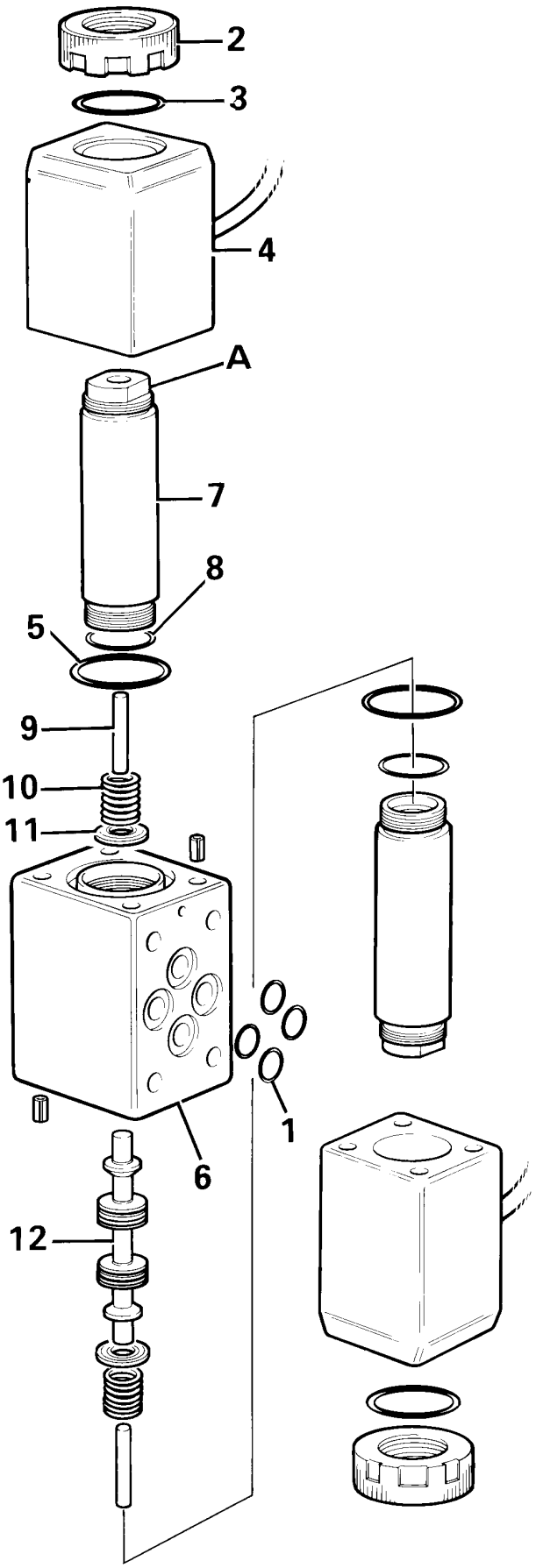
Renew all 'O' rings.

Lightly lubricate all parts with clean transmission fluid before assembling.

Check that the flying leads are secure and that the connectors are intact.

Torque Settings

Item	Nm	kgf m	lbf ft
2	10 to 15	1 to 1.5	8 to 10



Powershift Gearbox
Pressure Testing - Clutches

Isolating a Suspect Clutch

By performing the tests in the first 3 gears in forward and reverse all the clutches in the gearbox will be engaged, ensuring any clutch leakage will be easy to identify. Draw a table as shown so that you can record the results.

Clutch Pressure Test Results - 6 Speed Powershift						
Gear	**Clutches engaged**					
	Forward	bar	lbf/in^2	Reverse	bar	lbf/in^2
1st	X,Z			W,Z		
2nd	T,Z			V,Z		
3rd	U,Z			W,Y		

Clutch Pressure Test Results - 4 Speed Powershift						
Gear	**Clutches engaged**					
	Forward	bar	lbf/in^2	Reverse	bar	lbf/in^2
1st	T,Z			W,Z		
2nd	U,Z			V,Z		
3rd	T,Y			W,Y		

1 Stop engine, connect a 0-20 bar (0-300 lbf/in^2) pressure gauge to test connector **A** (mainline pressure test point).

2 Make sure that both sides of all four wheels are chocked. Apply the footbrake and parking brake.

Note: When fully engaged, the parking brake electrically disconnects the transmission drive; this prevents the machine from being driven with the parkbrake on. Therefore, so that we can complete the test, move the parkbrake lever fractionally forward until the warning light is just extinguished; hold the lever in this position for the duration of the test. DO NOT move the lever too far forward, otherwise the parkbrake will not be fully operational. Alternatively, disconnect the switch at the park brake.

3 Start engine and run at 1000 rev/min, engage 1st gear forward. Record the pressure reading. Repeat the test for 2nd and 3rd gears forward and 1st, 2nd and 3rd gears revers. Record the pressure readings as shown in the example below:

Clutch Pressure Test Results - 6 Speed Powershift						
Gear	**Clutches engaged**					
	Forward	bar	lbf/in^2	Reverse	bar	lbf/in^2
1st	X,Z	13.4	194	W,Z	13.4	194
2nd	**T,Z**	**12.0**	**175**	V,Z	13.6	197
3rd	U,Z	13.5	195	W,Y	13.5	195

Readings should not vary between clutches by more than 0.7 bar (10 lbf/in^2). In the example shown, we can see that pressure is low when 2nd gear forward is selected, indicating clutch leakage.

From the table we that the layshaft clutch **Z** is working normally (1st and 3rd gear forward and 1st and 2nd gears reverse all show normal operating pressure). We can assume that the forward low clutch **T** is leaking.

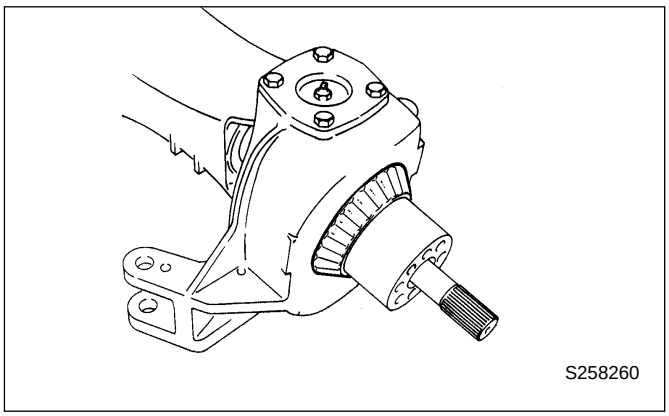
By carring out 'Individual Clutch Leakage Tests', (see next page) we can confirm that the forward low clutch **T** is leaking.

Hub and Driveshaft - Dismantling (cont'd)

14 Pull off the inner bearing - see Note at step 13.

15 Remove and discard the seal.

Note: The inner bearing and oil seal may withdraw with the bearing carrier.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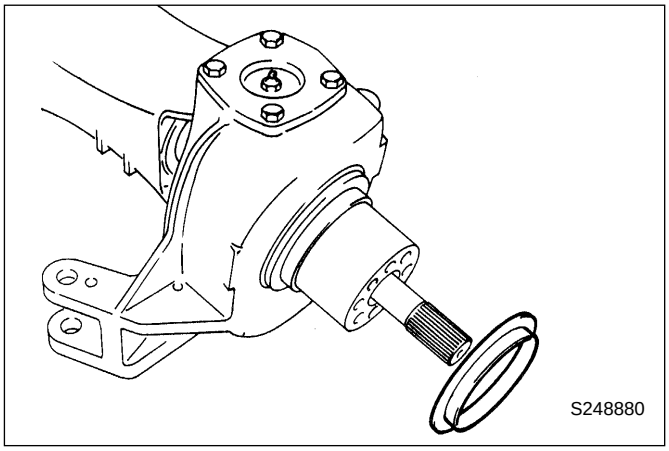
16 Remove and discard the combination seal. When assembling the axle, a new combination seal must be used.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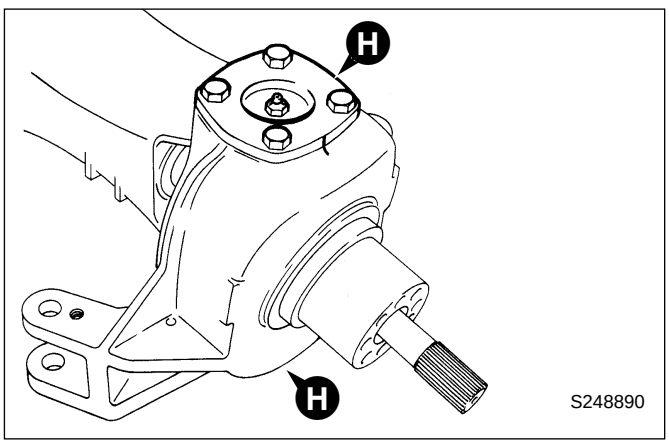
17 Mark position of top and bottom trunnions **H** and remove. Withdraw the hub carrier.

Note 1: Trunnions may be removed easily by pumping grease through the grease nipple.



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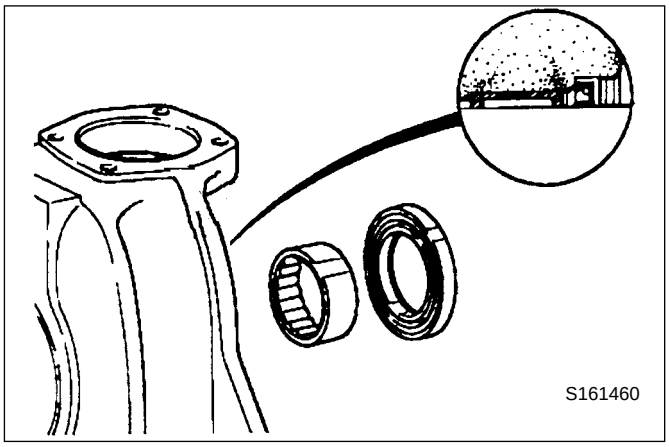
18 Use adaptor 993/59500 with slide hammer tool 892/00224 and remove driveshaft seal and needle roller bearing from the hub carrier.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Drive Head - Assembly

The outline procedure below refers also to the following aspects of the drivehead assembly, which are covered separately in detail as sub topics later in this section:

Pinion Depth Setting
Collapsible Spacer Assembly
Crown Wheel and Pinion Meshing

Note: Both the crownwheel **15** and pinion **20** and the bevel gears **9** and **10** are matched and should be renewed as sets if any of their components are damaged or excessively worn. The two differential housing halves **8A** and **8B** are also matched. Do not use unmatched halves.

Make sure all bearings are lightly oiled before fitting and setting. Make sure bearings are rotated whilst being set.

1 Determine the correct thickness required for the shims **23**, refer to **Pinion Depth Setting**.

2 Fit shims **23** behind new bearing cup **22**.

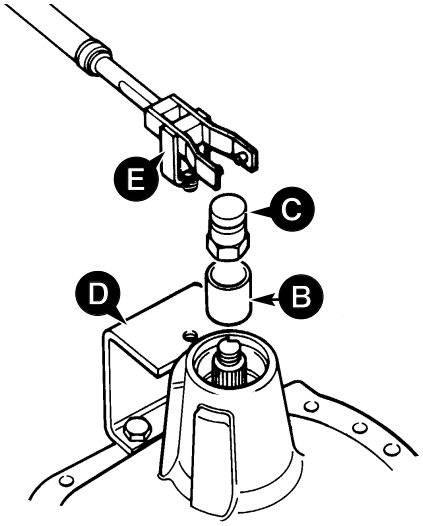
3 Fit new pinion head bearing cone **22** onto pinion **20**.

4 Install pinion and bearings into the drive head casing. Install largest available solid spacer **24** e.g (14.20 mm) and fit pinion tail bearing **21** (lightly oiled). Do not fit the oil seal **19** at this stage.

Note: It should be noted that the axle is assembled using a solid spacer. However, in the absence of the special tools required or the correct size solid spacer **24** it is acceptable to fit a collapsible spacer, refer to **Collapsible Spacer Assembly**.

5 Fit special tool sleeve **B** and special pinion shaft adapter **C**. Tighten adapter **C** to approximately 50 Nm, making sure the pinion is free to rotate and there is end float, this will prevent any damage to the bearing. If the pinion is not free to rotate or there is no end float at this stage check the bearing is fitted correctly. Also check the correct size spacer has been fitted.

6 Fit special bracket **D** to the drive-head housing using two M10 x 30 nuts and bolts. Fit special tool support pillar **E** to bracket **D** so that the fork end engages in adapter **C**. Ensure that fork **E** is centrally located on adapter **C**. If necessary, re-align bracket **D** to suit.



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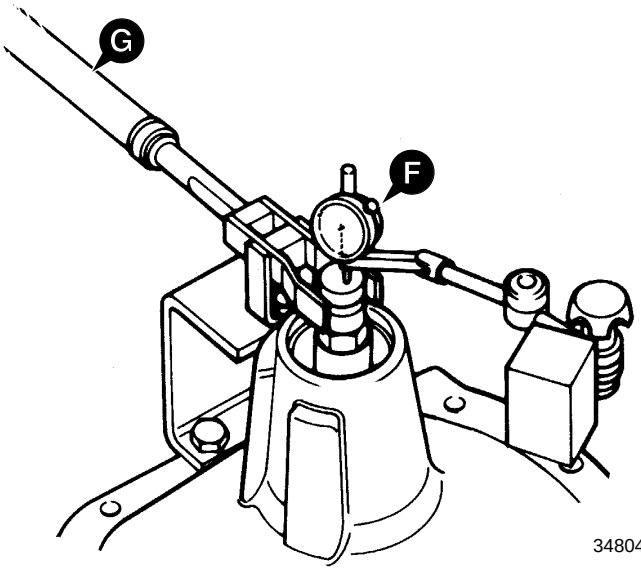
7 Fit dial test indicator (DTI) **F**. Ensure that the DTI is mounted on the drive head and not on bracket **D**.

8 Set torque wrench **G** to 35 Nm (25.8 lbf ft) and measure the end float while rotating the shaft.



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Drive Head - Assembly (cont'd)

9 To select the right size spacer **30**, subtract the end float obtained at step 7 from the solid spacer size (14.20 mm). Also subtract 0.04 mm to allow for theoretical bearing tolerance and pre load. The result is the size of spacer to be fitted from the solid spacer setting kit. If there is no spacer of this size, fit the next nearest size spacer, refer to **Service Tools - Axles**.

Example

Temporary spacer size	14.20
Subtract end-float	0.25
Total	13.95
Subtract tolerance & preload	0.04
Result	**13.91**

(No spacer available this size, use next nearest size spacer i.e 13.900)

10 Remove sleeve **B** and temporary spacer. fit correct size spacer from solid spacer setting kit, refer to **Service Tools - Axles**. During removal take care to avoid damaging the outer bearing.

11 Fit sleeve **B.** Tighten adapter **C** to no more than 50 Nm to protect against bearing damage while spacer selection is verified making sure the pinion is free to rotate. Check there is no end float and pinion is free to turn smoothly by hand. Remove adapter **C** and fit nut **16.** Then check that rolling torque is less than 2.0 Nm. If the rolling torque exceeds 2.0 Nm, check that the shaft has been assembled correctly.

Note: If the pinion is not free to rotate check the correct size spacer has been fitted.

12 If rolling torque measured at step 10 is too high, fit the next larger size spacer. If rolling torque is too low, fit the next smallest size spacer. If a correct spacer is not available from the range, check that drive head is assembled correctly.

13 Remove adapter **C** and sleeve **B**. Fit new oil seal **25**, grease between seal lips before fitting. Fit coupling yoke **23** and NEW stake nut **22**.

14 Progressively torque tighten stake nut **22**, occasionally rotating coupling yoke, up to 250 Nm. Providing the correct size spacer has been selected the rolling torque should be between 2.3 and 3.4 Nm including seal drag.

Note: The nut tightening torque can be increased to a maximum of 300 Nm provided that the pinion rolling torque does not exceed the maximum of 3.4 Nm.

15 Finally stake the nut **22** into the slot.

16 Assemble the trunnion pin **B**, bevel gears **14** and **16** and their thrust washers **15** and **17** into differential half case **13**.

17 Position differential half case **12** onto half case **13**, aligning the match-mark letters. Apply JCB Threadlocker and Sealer to the threads of bolts **7**, then fit and torque tighten to 56 Nm (42 lbf ft, 6 kgf m). Check the gears for free rotation.

18 Fit crownwheel **20** using new Verbus Ripp bolts **19** tightened to 166 Nm (122 lbf ft, 16.9 kgf m).

Note: Verbus Ripp bolts must not be reused.

19 Insall the differential assembly **10** onto the drive head carrier **2**.

20 Press taper roller bearing cone **9** onto the spigot of case half **13**.

21 Fit bearing outer races **7** and **8**, castellated nuts **5** and **6** to the drive head carrier **2**.

22 Adjust castellated nuts **5** and **6** to give an increase in input pinion rolling torque of between 1.36 - 2.5 Nm (12 - 22 lbf in) more than that recorded in Step 11.

23 Measure the backlash between crownwheel **20** and pinion **24**, which should be 0.17 - 0.28 mm (0.006 - 0.010 in). Adjust castellated nuts **5** and **6** by equal amounts when altering backlash. When backlash and preload are both correct, fit roll pins **3** and **4**.

24 Check tooth marking to verify crownwheel and pinion are set correctly, refer to **Crownwheel and Pinion Meshing**.

25 Apply JCB Multigasket to the mating faces of drive head carrier **2** and the axle casing. Fit the drive head carrier to the axle casing with the crownwheel towards the short drive shaft. Fit securing bolts **1** and tighten to 166 Nm (122 lbf ft, 16.9 kgf m).

26 Reassemble both driveshafts and hub assemblies, refer to **Axle Hub and Driveshaft - Dismantling and Assembly**.

27 Re-fill the hubs and differential with the correct grade of oil, refer to Section 3 **Lubricants and Capacities**.

28 Refit the propshaft, refer to **Propshafts - Removing and Replacing**.

Brakes (with controlled back off) continued

Assembly

1 Clean all sealant from the mating faces of the drive head and the brake piston housing.

2 Fit new seals **17** and **16**. Make sure they seat squarely in their grooves.

3 Carefully press the piston **15** all the way into its housing **7**. Make sure the brake back off holes in the piston and housing align.

4 Apply JCB Threadlocker and Sealer to threads of back off pins **12**. Screw the back off pins **12** into the brake piston and fit the springs **14** over the back off pins.

5 Place the tension bush **13** over the back off pin **12**. Using a suitable tool (steel tube) drive the tension bush onto the back off pin using a soft face hammer until the circlip **11** can just be fitted.

6 Apply JCB High Strength Gasketing to the drive head mating face, then fit the brake piston housing assembly. Ensure that the match marks made during dismantling are aligned.

7 Fit capscrews **9** and torque tighten to 56 Nm (42 lbf ft, 5.7 kgf m).

8 Remove the differential support.

9 Assemble the friction plates and counterplates **2** onto the brake carrier **3**. If the original brake pack is being re-used, return the plates to their original positions, see 'Dismantling'. Soak new friction plates in JCB Special Gear Oil before assembly. Fit circlip **4**.

On assembly of the brake packs, the oil flow holes **B** must be aligned with each other when being fitted to the brake plate carrier.

Note: Item **3A** is fitted to non steer axles.

Note: The illustration is typical only, refer to parts book or General Bulletin 061 (G20/N.Am) for exact number of friction and counter plates.

10 Locate the three reaction pins **5** into their grooves, securing them with grease. Push the pins fully into their location holes in the housing.

11 Install one counterplate **2** into the housing, then the brake pack, then the other counterplate. Return re-used counterplates to their original positions. Push the brake pack fully home.

12 Apply JCB High Strength Gasketing to the mating face of the drive head, and JCB Threadlocker and Sealer to the threads of bolts **1**. Locate the axle arm onto the drivehead, with the embossed word 'TOP' on the axle arm uppermost.

13 Fit bolts **1** and torque tighten.

Note: Check the grade of bolts fitted. Grade 8.8 should be tightened to 244 Nm (178lbf ft, 24.9 kgf m), grade 12.9 should be tightened to 400 Nm (295 lbf ft, 40.8 kgf m).

Drive Head-Assembly (cont'd)

13 Fit special tool sleeve **B** and special pinion shaft adapter **C**. Tighten adapter **C** to approximately 50 Nm, making sure the pinion is free to rotate and there is end float, this will prevent any damage to the bearing. If the pinion is not free to rotate or there is no end float at this stage check the bearing is fitted correctly. Also check the correct size spacer has been fitted.

14 Fit special bracket **D** to the drive-head housing using two M10 x 30 nuts and bolts. Fit special tool support pillar **E** to bracket **D** so that the fork end engages in adapter **C**. Ensure that fork **E** is centrally located on adapter **C**. If necessary, re-align bracket **D** to suit.
Fit dial test indicator (DTI) **F**. Ensure that the DTI is mounted on the drive head and not on bracket **D**.

15 Set torque wrench **G** to 35 Nm (25.8 lbf ft) and measure the end float while rotating the shaft.

16 To select the right size spacer, subtract the end float obtained at step 14 from the solid spacer size (14.20 mm). Also subtract 0.04 mm to allow for theoretical bearing tolerance and pre load. The result is the size of spacer to be fitted from the solid spacer setting kit. If there is no spacer of this size, fit the next nearest size spacer, refer to **Service Tools - Axles**.

Example

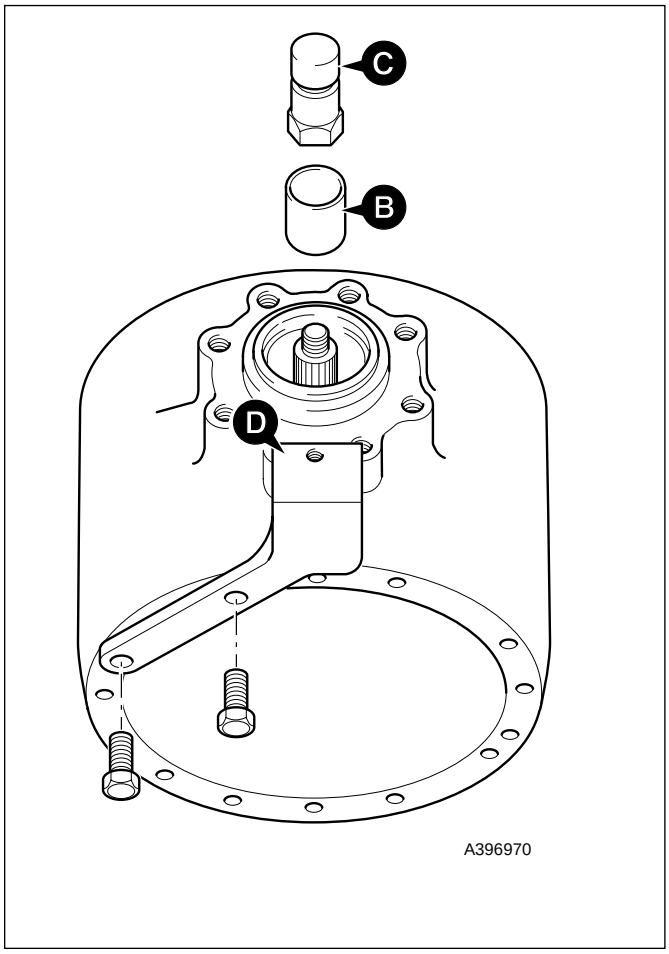
Temporary spacer size	14.20
Subtract end-float	0.25
Total	13.95
Subtract tolerance & preload	0.04
Result	**13.91**

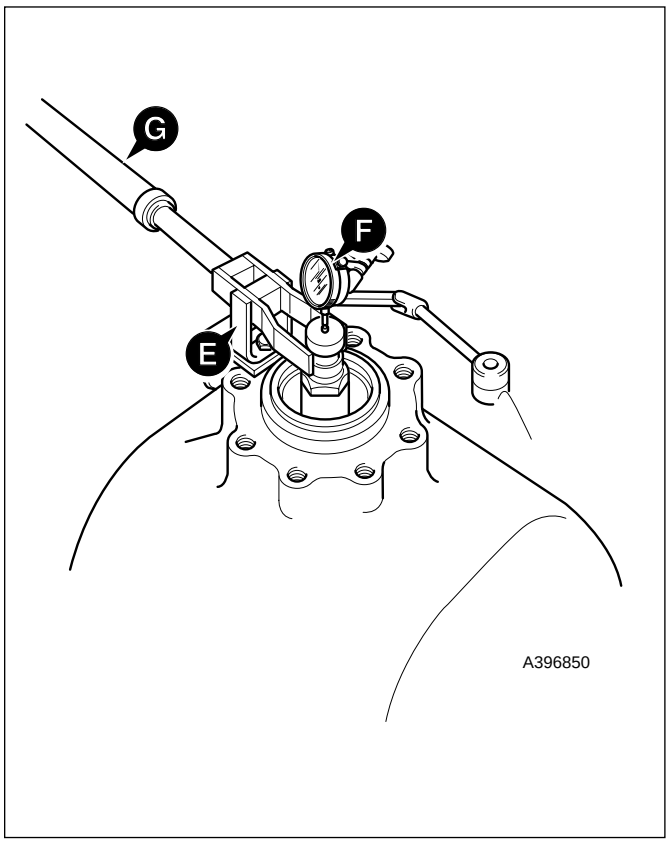
(No spacer available this size, use next nearest size spacer i.e 13.900)

17 Remove sleeve **B** and temporary spacer. fit correct size spacer from solid spacer setting kit, refer to **Service Tools - Axles**. During removal take care to avoid damaging the outer bearing.

18 Fit sleeve **B.** Tighten adapter **C** to no more than 50 Nm to protect against bearing damage while spacer selection is verified making sure the pinion is free to rotate. Check there is no end float and pinion is free to turn smoothly by hand. Remove adapter **C** and fit nut **16.** Then check that rolling torque is less than 2.0 Nm. If the rolling torque exceeds 2.0 Nm, check that the shaft has been assembled correctly.

Note: If the pinion is not free to rotate check the correct size spacer has been fitted.





Removal and Replacement (cont'd)

Replacement

Replacement is a reversal of the removal procedure but note the following:

1 Before replacing the gearbox remove circlip **5** and withdraw the pump driveshaft **6** together with its bearing **7** approximately 50 mm (2.0 in). The shaft can then be engaged after the gearbox has been fitted, making replacing the gearbox easier. Remember to engage the pump drive shaft, refit the bearing and circlip after the gearbox has been fitted.

2 Set the torque converter as described in **Torque Converter, Removal and Replacement**.

3 Align the Torque Converter

It is vitally important that the torque converter is fitted at the gearbox and engine flywheel correctly. Failure to locate the converter correctly will result in damage to the gearbox oil pump on engine start up. Proceed as follows:

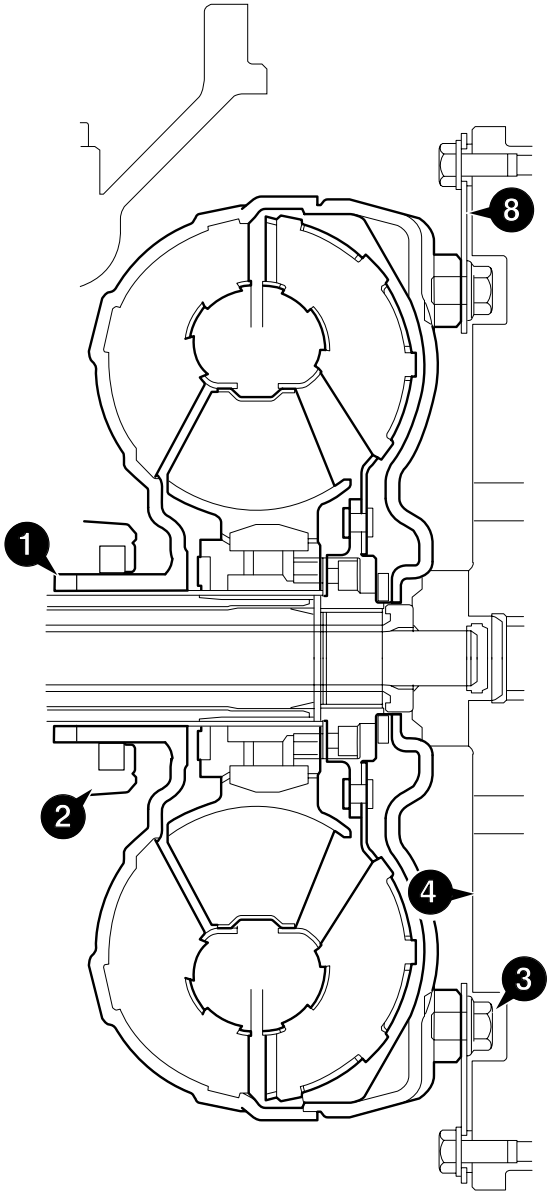
Make sure that the torque converter drive dogs **1** are correctly engaged with the pump **2** on the gearbox. Temporarily tie the converter onto the gearbox. Use wire tied at a drive plate bolt hole to a convenient point on the outside of the gearbox.

Take note of the flywheel and drive plate fixing hole phasing. The heads of the bolts **3** will foul the flywheel **4** if phasing is incorrect.

Before bolting the torque converter housing to the engine make sure the mating faces are fully together (DO NOT USE FORCE). The drive plate **8** should also be mated close to the flywheel. Do not force the components together with the fixing bolts.

Make sure that the torque converter is free to rotate slightly within the clearance of the location bolt holes. If you cannot rotate the converter it is trapped either by bolt heads **3** or by incorrectly located pump drive dogs. Make sure that all is well before tightening the bolts.

4 Fill the gearbox with the specified amount and type of oil (see **Section 3, Routine Maintenance**). Leave hose **N** off until the filling operation is complete. After filling refit hose **N**.



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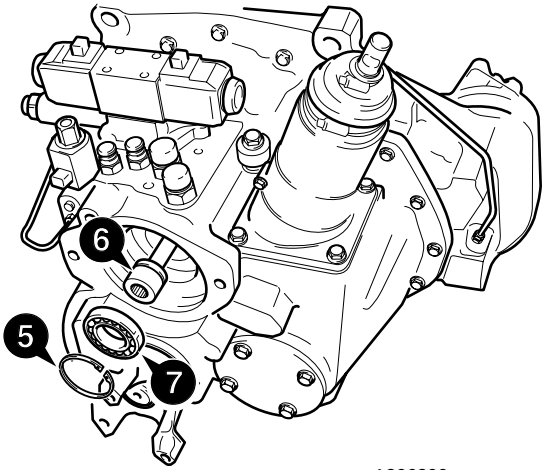

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Torque Settings

Item	Nm	kgf m	lbf ft
B	79	8	58
D	44	4.5	32
H	237	24	175
J,T	98	10	72

Inspection

Before assembling the gearbox make sure that a thorough inspection of all components is carried out. Remember that although a failed component may be easy to identify, the cause of that failure may be less easy to trace. It is also possible that a failed component may have caused damage to other areas of the gearbox.

1 Carefully remove all traces of gasket compound from components as follows:

a Front and rear casing mating faces.

b Front casing and torque converter housing mating faces.

2 Clean the inside of the casings using a suitable degreasing agent.

3 Carefully inspect all gears, bearing and shafts for signs of excessive wear or damage. If wear or damage is evident, components must be renewed.

4 Make sure that all oil way cross drillings in the casings, shafts and gears are clear and free from debris. Blocked oil ways are a common cause of bearing failure. Use an air line to blow through cross drillings.

Note: If failure of the forward/reverse or 4 wheel drive clutch is suspected see the relevant dismantling and assembly procedure in this section.

1st/2nd Gear Synchromesh Unit

The 1st/2nd gear synchro unit must be checked for wear before assembly as follows:

1 Before dismantling the unit be aware that on re-assembly, the components must be kept in their original relationships.

2 Dismantle the unit by removing the cones and rings **A1**, **A2** and **B1**, **B2**. Push off the sleeve **C** taking care to retrieve the sets of balls **D**, poppets **E** and springs **F**.

3 Inspect the mating faces of cones and rings. The wear indicator grooves **X** must still be visible. As a further check, locate the cones and rings together (as shown at **Y**) and measure the clearance between them using feeler gauges. The clearance should be between 0.5 and 1.9 mm for both **A** and **B** pairs. If either is out side these limits then the complete synchro unit must be renewed.

4 Inspect the teeth on all cones and rings for excessive wear or damage. If wear or damage is evident the unit must be renewed.

Assembly (cont'd)

35 End Float Setting - Layshaft

If the layshaft and/or its bearings have been renewed, the shaft end float must be reset.

a Fit the torque converter housing and stand the gearbox on the housing.

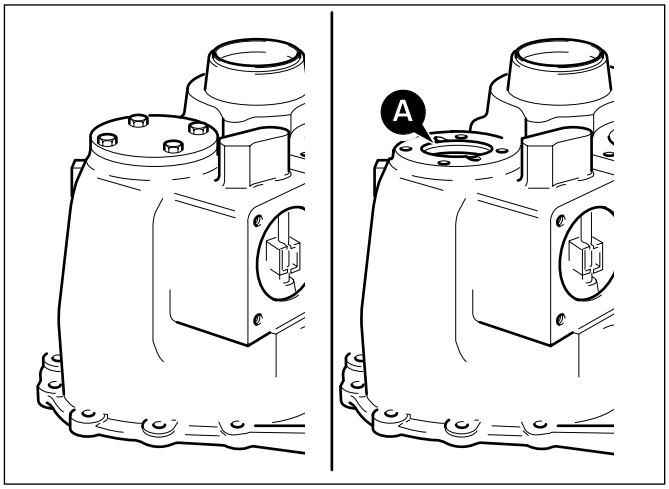
b Using service tool 892/01079 tighten the setting ring **A** to 25 Nm (18.4 lbf ft) whilst at the same time rotating the shaft via the output yoke (a gear must be engaged). Do not over tighten the ring. Overtightening will damage the bearings.

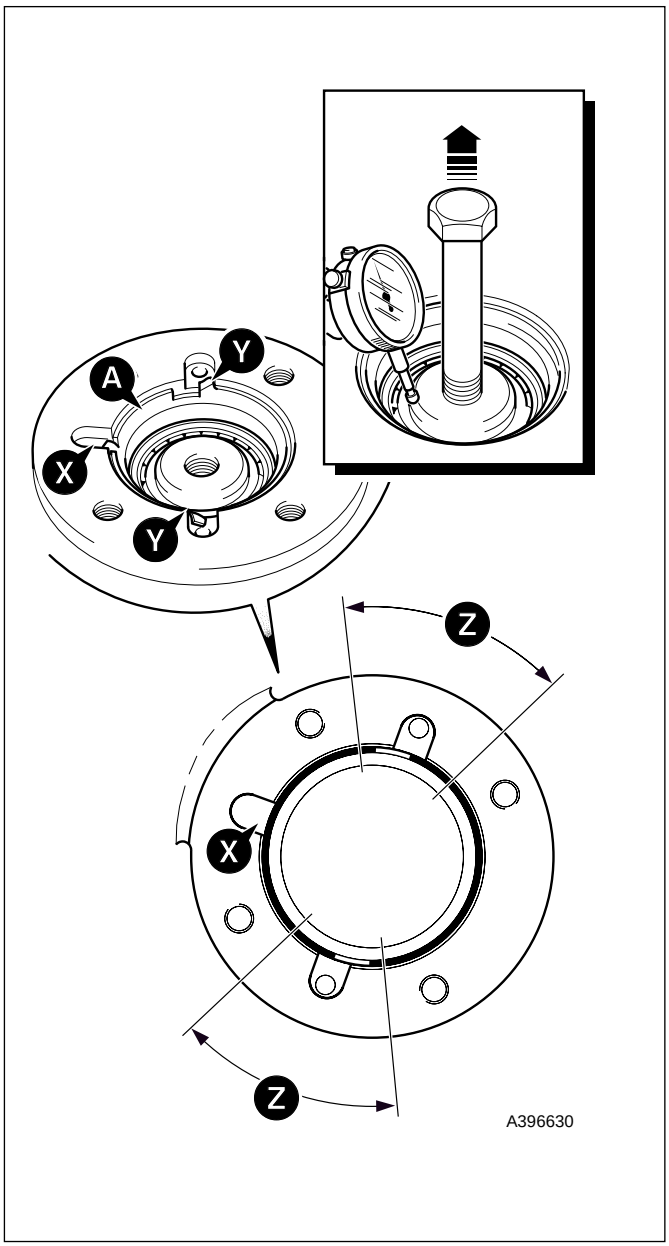
c Undo the ring a small amount to obtain a shaft end float of 0.03 to 0.08 mm (0.001 to 0.003 in). To measure the endfloat screw in a bolt (or service tool 892/01078) at the threaded hole in the end of the shaft. Set up a DTI with the probe on the chamfer of the shaft. Zero the DTI. Rotate the shaft and at the same time pull up on the bolt, noting the reading on the DTI. Screw the ring in or out until the end float is correct.

d When the correct setting has been obtained, stake the setting ring to the casing as shown at the two positions **Y** (see the note below). Note that once staked the setting ring can not be used again. If the ring is disturbed it must be discarded and a new one used to re-set the end float.

Note: If the slots in the setting ring fall close (within zone **Z**) to the staking positions **Y**, stake at position **X** instead. In this event the ring must also be folded on one side at the two positions **Y**, fold on the side furthest away from the slot in the ring. This is important as the ring will otherwise restrict the flow of lubrication oil.

e Using a new gasket, refit the layshaft bearing cover. Apply JCB Threadlocker and Sealer to the fixing bolts and tighten to 56 Nm (42 lbf ft).





Hydraulic 2/4 Wheel Drive Unit (4WD Pressure ON)

Dismantling

Note: To aid working on this item, use the output yoke as a stand.

Before dismantling the unit drain the gearbox oil.

1 Hold the yoke **E** using service tool 892/00812 and undo bolt **F**. Remove the yoke. Carefully remove and discard oil seal **M**. Be sure not to damage the seal housing.

2 Undo bolts **D**. Lift off the 4WD casing **P**. Lift out the 4WD unit from the gearbox.

3 Remove bearing **1**, only if to be renewed.

4 Remove seal ring **2**. Note, If the piston ring seal is damaged or excessively worn then check for burrs or damage on the shaft groove. If necessary remove burrs with a fine grade abrasion paper and oil.

5 Pull off the 4WD output gear **5**, together with its bearing **3**, needle roller bearings **6** and thrust washer **4**. Remove thrust washer **7**. (Note that thrust washers **4** and **7** are not interchangeable).

6 Remove circlip **8** and shim(s) **9** if fitted. Retain any shims as a set for assembly.

7 Remove pressure plate **10**, the clutch pack friction plates **11** and counter plates **12**.

Note: If only the clutch pack was to be removed, the job is now complete.

8 Using a suitable press and an adapter similar to **Y**, compress spring **15** and remove circlip **13**.

9 Remove spring retainer plate **14**, spring **15** and oil baffle **15A**.

10 Withdraw piston **16** then remove and discard 'O' rings **17** and **18**.

Note: The piston housing cannot be separated from the shaft, as on the other types of 2/4WD units.

Inspection

Carry out a visual inspection of the friction and counter plates.

Counter plates - light scoring/polishing is permissible, plates that are not flat, worn or heavily marked or scored must be replaced with a new set.

Friction plates - the cross hatching should be clearly visible, plates that are not flat, have friction material damage or scoring must be replaced with a new set.

Do not mix old, new and worn plates.

Two different suppliers of the thinner friction plates (1.6 to 1.7 mm, 0.062 to 0.067 in approx) have been used (identify as brown or green), do not mix the different plates in the same clutch pack.

Inspect the mating faces of the gearbox and 4WD casings for damage.

Assembly

If only the clutch pack has been removed, begin at step 4.

1 Grease the shaft, fit new 'O' rings **17** and **18** then locate piston **16** over the shaft and into the housing. It is recommended that that aluminium type piston **16** as shown is used and not the plastic type.

2 Locate oil baffle **15A**, spring **15** into the piston and position the retainer plate **14** over the spring.

3 Using a press and adapter **Y**, compress spring **15** and fit circlip **13**.

4 Build up the clutch pack, installing friction plates **11** and counter plates **12** alternately, starting with a counter plate and ending with a friction plate.

5 Install pressure plate **10**, shim(s) **9** and circlip **8**.

6 Measure the clutch pack end float using two screwdrivers as shown at **B**. End float should be between 1.0 mm and 2.2 mm. Adjust as necessary, by adding or removing shims **9**.

7 Fit thrust washer **7**, 4WD gear **5**, needle roller bearings **6** and thrust washer **4**.

8 Press bearing **3** squarely onto the shaft to seat on thrust washer **4**, taking care not to exert any force on the housing i.e. rest the unit on the opposite shaft end, not the housing.

9 Fit new seal **2**.

10 If required, press a new bearing **1** into position, taking care not to exert any force on the housing (see Step 8).

11 Fit the 2/4WD unit to the gearbox.

12 Apply a thin bead of JCB Multigasket to the 4WD mating face of the gearbox front case. Fit the case **P**, apply JCB Threadlocker and Sealer to bolts **C** and progressively torque tighten to 56 Nm, 46 lbf ft.

13 The 4WD clutch and its associated components are manufactured using a ‘setright’ system. Provided that components have been assembled correctly, the shaft end float will not exceed 0.03 mm (0.001 in).

Rotate the shaft by hand and ensure that it runs smoothly. Pull the shaft up and down to detect any excessive end float. If there is excessive end float or the shaft runts roughly, dismantle the unit and check for correct assembly.

14 Fit a new oil seal **M**, fit the output yoke **E**, and flanged bolt **F**. Torque tighten the bolt to 395 Nm; 291 lbf ft.

Removal and Replacement (cont'd)

Replacement

Replacement is a reversal of the removal procedure but note the following:

1 Before replacing the gearbox remove circlip **5** and withdraw the pump driveshaft **6** together with its bearing **7** approximately 50 mm (2.0 in). The shaft can then be engaged after the gearbox has been fitted, making replacing the gearbox easier. Remember to engage the pump drive shaft, refit the bearing and circlip after the gearbox has been fitted.

2 Set the torque converter as described in **Torque Converter, Removal and Replacement**.

3 Align the Torque Converter

It is vitally important that the torque converter is fitted at the gearbox and engine flywheel correctly. Failure to locate the converter correctly will result in damage to the gearbox oil pump on engine start up. Proceed as follows:

Make sure that the torque converter drive dogs **1** are correctly engaged with the pump **2** on the gearbox. Temporarily tie the converter onto the gearbox. Use wire tied at a drive plate bolt hole to a convenient point on the outside of the gearbox.

Take note of the flywheel and drive plate fixing hole phasing. The heads of the bolts **3** will foul the flywheel **4** if phasing is incorrect.

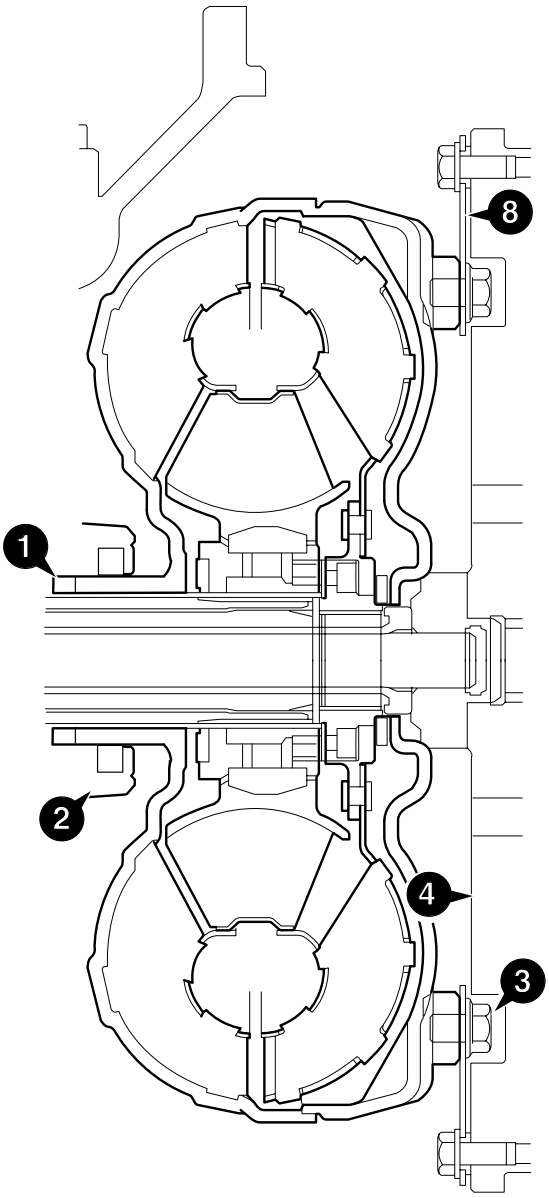
Before bolting the torque converter housing to the engine make sure the mating faces are fully together (DO NOT USE FORCE). The drive plate **8** should also be mated close to the flywheel. Do not force the components together with the fixing bolts.

Make sure that the torque converter is free to rotate slightly within the clearance of the location bolt holes. If you cannot rotate the converter it is trapped either by bolt heads **3** or by incorrectly located pump drive dogs.Make sure that all is well before tightening the bolts.

4 Fill the gearbox with the specified amount and type of oil (see **Section 3, Routine Maintenance**). Leave hose **N** off until the filling operation is complete. After filling refit hose **N**.

Torque Settings

Item	Nm	kgf m	lbf ft
B	79	8	58
D	44	4.5	32
H	237	24	175
J,T	98	10	72



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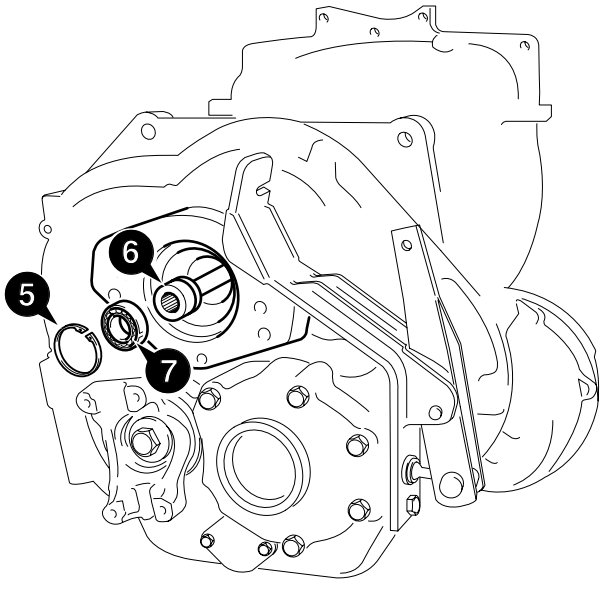

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Inspection

Before assembling the gearbox, make sure that a thorough inspection of all components is carried out. Remember that although a failed component may be easy to identify, the cause of that failure may be less easy to trace. It is also possible that a failed component may have caused damage to other areas of the gearbox.

1 Cleaning

a Carefully remove all traces of gasket or gasket compound from the following components:
Front and rear casing mating faces.
Front casing and torque converter housing mating faces.
Main hydraulic pump and rear casing mating faces.
Solenoid control valve manifold and casing mating faces.
4WD casing mating faces.
Layshaft cover and rear casing mating faces.

b Clean the inside of the casings using a suitable degreasing agent.

2 General Inspection

a Carefully inspect all gears, bearings and shafts for signs of excessive wear or damage. If wear or damage is evident, components must be renewed.

Note: The transfer gear shaft inner, outer bearing and spacer assembly is a matched set. If any of the components are damaged or worn the complete assembly must be renewed. Components are not interchangeable between bearing sets.

b Make sure that all oil way cross drillings are clear and free from debris. Blocked oil ways are a common cause of bearing failure. If necessary use an air line to blow through the oil ways.

3 Clutch Units

a If clutch failure is suspected see the relevant clutch dismantling and assembly procedure in this section.

4 Gearbox Hydraulic Pump

a If tests have shown the pump performance to be unacceptable, the pump must be renewed as a complete unit.

b If the existing pump is to be re-installed proceed as follows;
Undo the security screw **4a** and separate the pump body. Carefully inspect the gear teeth, white metal bearing and gear/body mating faces for signs of wear and damage, (If either is evident, the pump must be renewed).
Carefully remove and discard the oil seal **4b**. Take care not to damage the seal housing. Fit a new seal and then re-assemble the pump.

c Make sure that pump the mating face on the gearbox front cover is clean and free from surface damage.

5 Oil Transfer Pipes

The front case incorporates oil transfer pipes **5a**, **5b** and **5c**. If the pipes are damaged or if the gearbox has been contaminated, the pipes must be removed for cleaning or renewal.
4x4 Gearbox: pipe **5c** not fitted.

a Using a ‘crows foot’ type spanner and a ratchet wrench undo the pipes from the adaptors in the casing. Unless pipes are being transferred to a new casing it will not be necessary to remove the pipe adaptors.
6x4 Gearbox Only: If the adaptors are to be removed, adaptor **5e** must be removed last.

b If the adaptors have been removed make sure that the sealing rings are renewed and fitted correctly.
6x4 Gearbox Only: Position the lock nut **5f** on adaptor **5e** as shown and then fit the adaptor to the case. Screw in until the locking nut reaches the case. Do not tighten the locking nut down at this stage.
All Gearboxes: Fit the adaptors. Torque tighten to 70 Nm.

c Make sure the pipes are clear and free from debris before refitting. Loosly fit the pipes **5a** and **5b**. Make sure they are fitted at the correct adaptors as shown.
6x4 Gearbox Only: Loosly fit the pipe **5c,** rotate adaptor **5e** so that the pipe is not strained. Torque tighten down the lock nut **5f** to 70 Nm.
All Gearboxes: Torque tighten the pipes to 30 Nm.

6 Casings

If the gearbox casings are to be renewed, be sure to fit blanking plugs and adapters as required. Inspect the original casings and identify the blanking plug and adapter positions. Transfer the plugs and adapters to the new casings. Apply JCB Threadlocker and Sealer to the threads.

Note that new plugs may be supplied with a sealant ‘patch’, in which case sealant need not be applied.

Assembly (cont'd)

9 Fit the Gearbox Hydraulic Pump

a Make sure that the pump is fitted with a new oil seal **9a**, see **Powershift Gearbox, Inspection, step 4**.
Fit a new sealing ring **9b**. Locate the pump over the input shaft aligning the bolt holes. Apply JCB Threadlocker and Sealer to bolts **9c**. Fit the bolts together with new sealing washers **9d**. Progressively torque tighten the bolts to 28 Nm (20 lbf ft).

b Pour some clean, new, oil into the pump at position **X**.

10 Fit the Torque Converter Housing

a Make sure that the front case and torque converter housing (**10a**) mating faces are clean and undamaged. Apply a thin bead of JCB Multigasket to the front casing as shown at **B** (pump not shown for clarity). Make sure that gasket is applied between all the port channels as shown. Do not use an excessive amount of compound as it may cause oil ways to become blocked. Fit a new 'O' ring **10d** to the housing **10a**.

b Carefully locate the torque converter casing on the front case. Fit the 15 M10 bolts **10b**, and 3 M8 bolts **10c**. Progressively torque tighten the bolts **10b** to 56Nm (41 lbf ft) and bolts **10c** to 40 Nm (29 lbf ft).

11 Fit the Solenoid Control Valve Block

a Fit two guide studs at the valve interface on the front case. Locate a new valve block sealing gasket **11a** as shown at **C**. Care is needed as the gasket is thin. Gearboxes fitted with a sub-base plate have two gaskets, one each side of the plate.

b Fit the 8 socket head cap screws and washers **11b**. The screws must be progressively torque tightened. Gradually tighten all the screws to 35 Nm (26 lbf ft).

12 Fit the Main Hydraulic Pump Driveshaft

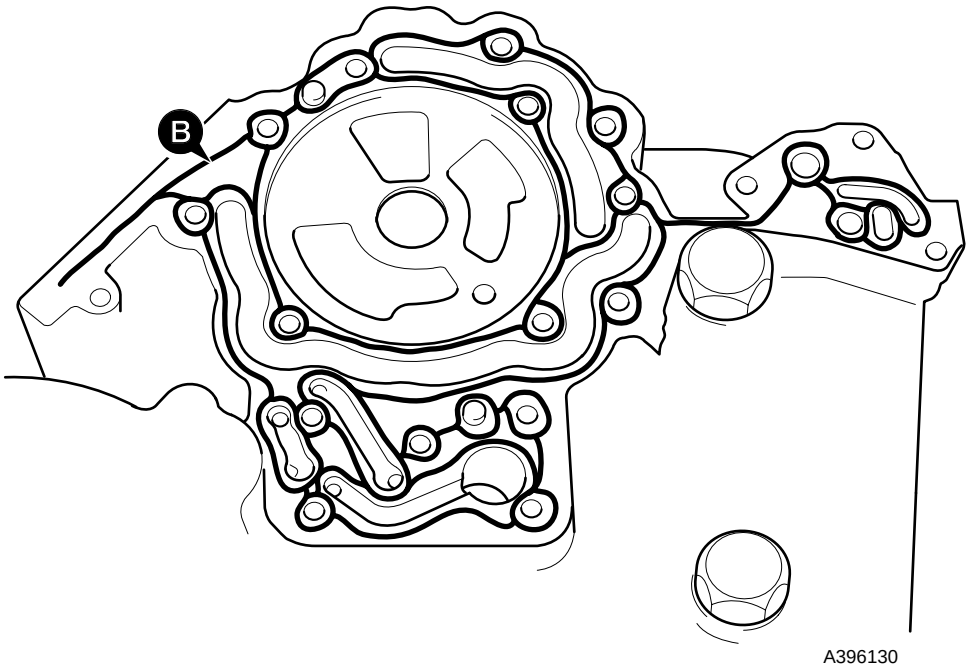
a Fit a new sealing ring **12a** to the shaft **12b**. Apply clean oil to the sealing ring and fit the shaft inside the gearbox.

b Apply clean oil to the ball bearing **12c**. Fit the bearing followed by circlip **12d**.

13 Fit the Layshaft Cover

a If applicable fit the layshaft cover **13a**. Make sure the casing mating faces a re clean and undamaged. Apply a thin bead of JCB Multigasket to the rear casing and fit the cover. Fit bolts **13b** and progressively torque tighten to 56Nm (41 lbf ft).

Note: The main machine hydraulic pump can be fitted at this stage. However, it is easier to fit the gearbox to the machine and then fit the pump. **See Section E, Main Hydraulic Pump, Replacement.**



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PS760 - Mainshaft Clutch - Dismantling

Note: The illustration shows a mainshaft assembly for a 6 - speed transmission. The mainshaft assembly for a 4 - speed transmission has some small differences. An explanation of the differences will be given as they occure in the procedure. The mainshaft assemblies for the 6 - speed and the 4 - speed transmission are the same basic construction, except the 4 - speed transmission have fewer friction/counter plates.

1 Carefully remove piston ring seals **1**.

Note: If the piston ring seals are excessively worn then check for burrs or damage on shaft grooves. If necessary remove burrs with a fine grade abrasion paper and oil.

2 Remove taper roller bearing **2** using a puller or press.

3 Withdraw the gears **3** and **4**. Make a note which way round the gears are fitted for assembly.

4 At the opposite end, use a suitable puller to remove the taper roller bearing **5**.

5 Remove the clutch friction/counter plates retaining circlip **6**.

6 Remove the pressure end plate **7** and shim **8**, if fitted.

7 Remove the clutch friction plates **9** and counter plates **10**. Keep them together in sets, DO NOT mix the plates with those from other clutches.

8 Position clutch assembly in a suitable press, with a cut away tube compress the piston spring as shown, then remove circlip **11**.

9 Lift off spring retaining plate **12**. The 4 - speed transmissions have a different shaped spring retaining plate fitted.

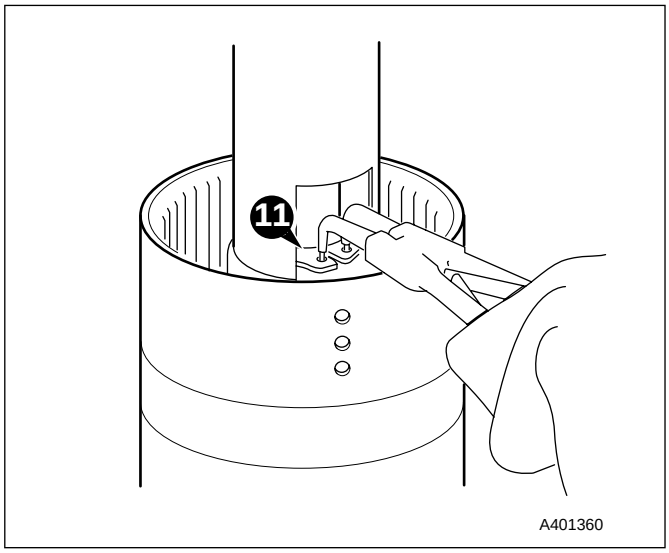
10 Remove the spring **13** and oil baffle **14**.

11 Turn the assembly over and knock the clutch shaft on a piece of aluminium (or wood) to loosen the piston **15**.

Note: If the piston does not loosen when the clutch shaft is knocked on aluminium, then hand pump air down the shaft oil inlet hole.

12 Remove the piston **15**. Remove and discard the piston 'O' ring **16** and shaft 'O' ring **17**.

13 Remove circlip **18** and withdraw the clutch housing **19** from the shaft. Remove and discard the 'O' ring **20**.



PS 760 - 2/4WD Clutch (Pressure ON) - Assembly

Visually inspect the friction and counter plates:

Counter plates - light scoring/polishing is permissible, plates that are not flat, worn or heavily marked or scored must be replaced with a new set.

Friction plates - the cross hatching should be clearly visible, plates that are not flat, have friction material damage or scoring must be replaced with a new set.

DO NOT mix old, new and worn plates, if a plate is damaged/worn fit a complete new set.

Needle roller bearings should slide into position freely, do not bend or distort the cage to fit. If the cage has been distorted fit new bearings.

Note: The piston incorporates a small check valve. Visually inspect the piston to ensure the ball is in place and that the seat is free from contamination. If necessary clean the valve by blowing through with an air line. DO NOT use a wire rod (or screwdriver) as damage to the valve seat could occure.

1 Fit new 'O' rings **17** and **18**. Lubricate the piston **16** with oil and press fully into bore of clutch housing.

2 Fit oil baffle **15A**, piston spring **15**, make sure the spring seats in the piston.

3 Fit the spring retaining plate **14**.

4 Compress the spring and secure with circlip **13**.

5 Fit one counter plate **12** followed by one friction plate **11**. Continue fitting alternate counter and friction plates, finishing with a friction plate.

6 Fit the pressure end plate **10**, do not fit shim **9** at this stage. Make sure the teeth are not aligned with the lubrication slots in the housing.

7 Fit the clutch friction/counter plates retaining circlip **8**.

8 Using a dial test indicator as shown, measure the end float of the pressure end plate **10**, which should be 1.9 to 2.5 mm (0.075 to 0.098 in).

If it is necessary to adjust the end float to bring it within tolerance, there is a choice of fitting a 6.0mm (0.23in) or 6.5mm (0.25in) thick pressure end plate **10**, with either a shim **9** or an extra counter plate **12** between the retaining circlip **8** and pressure end plate **10**.

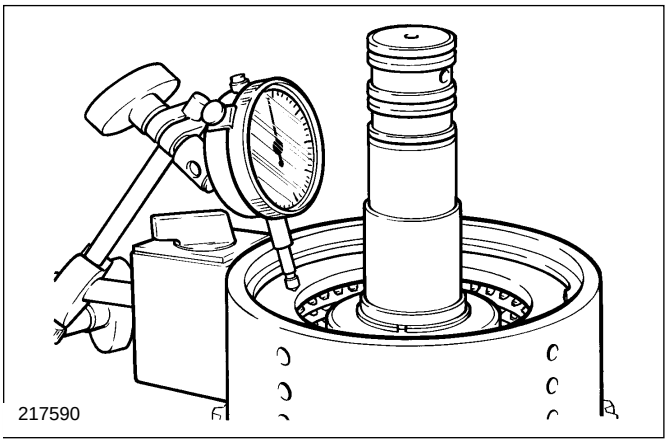
Use an airline to check the operation of the clutch.

9 Fit thrust washer **7**.

10 Carefully align the teeth of the clutch plates using a thin rod (or screwdriver) and fit the 4WD gear and splined hub **5**, needle roller bearings **6** and thrust washer **4**.

11 Smear the clutch end bearing **3** with gearbox oil and press the bearing onto the shaft to seat on thrust washer **4**.

12 Fit piston ring seal **2**, refer to **Piston Ring Seals - Fitting Procedure**.



Service Brakes

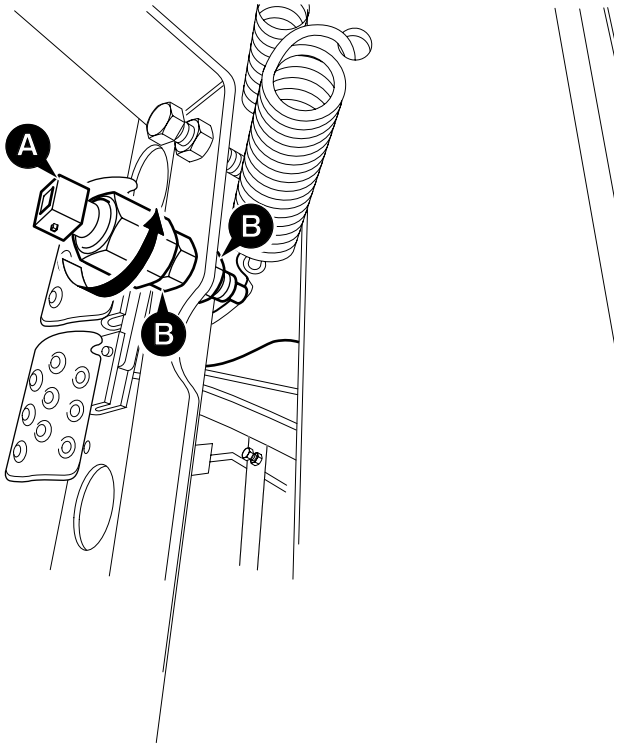
Brake Light Switch - Adjustment

1 Select the starter key switch to the ON position, do not start the engine.

2 With the brake pedal in the return position, adjust locknuts **B** and use feeler gauges to set the proximity switch **A** so that there is clearance of 2mm MIN - 3mm MAX between the end of the switch and the brake pedal lever. The light emitting diode (L.E.D.) on the switch should be illuminated.

3 Secure the switch in position by tightening locknuts **B**.

4 Depress the brake pedal and check the correct operation of the brake lights.



Torque Settings

Item	Nm	kgf m	lbf ft
B	29	2.95	21

Bleeding

⚠ WARNING

Before proceeding with the bleeding procedure it is important to ensure that the parking brake is engaged and that one pair of wheels is blocked on both sides.

BRAK 1-2

⚠ WARNING

Use of incorrect fluid will cause serious damage to the seals which could in turn cause brake failure.

BRAK 1-1

1 Fill the master cylinder reservoir with the correct fluid, refer to Section 3 **Fluids, Lubricants, Capacities and Specifications**, and ensure that throughout the bleeding process the level is not allowed to fall below the MINIMUM mark.

2 Unlatch the pedals, and bleed each brake separately as follows:

3 Right Hand Master Cylinder

a Attach a tube to the right hand brake bleed screw **A**, ensuring that the free end of the tube is immersed in fluid contained in a suitable container.

b Open the brake bleed screw and apply full pedal strokes of the right hand brake pedal until all air is expelled.

c Close the brake bleed screw with the pedal fully depressed.

4 Left Hand Master Cylinder

a Repeat procedure as for 'Right Hand Master Cylinder' but use left hand bleed screw and pedal.

5 Bridge Pipe

a Attach a tube to either the left or right hand brake bleed screw, ensuring that the free end of the tube is immersed in fluid contained in a suitable container.

b Make sure that the brake pedals are **locked** together.

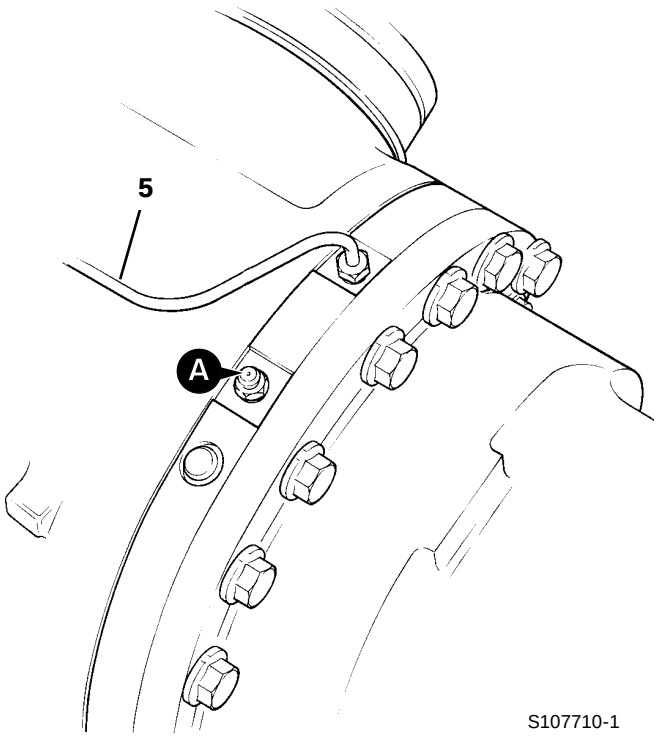
Note: 4WS machines do not have dual pedal braking. These machines are fitted with a single pedal that operates both master cylinders.

c Open the bleed screw and apply full pedal strokes of the brake pedals until all air is expelled.

d Close the bleed screw with the pedals fully depressed.

6 Repeat the procedures as necessary.

7 Top up the reservoir to the full mark.



S107710-1

System Type

Full power hydrostatic with selectable 2-wheel, 4-wheel and crab steer modes on 4 wheel steer machines.
Oil supply from Main Hydraulic Pump via Priority Valve to Steer Unit Valve complete with Load Sensing and Integral Relief Valve.
Double acting power track rod rams mounted on axles.

2 Wheel Steer Machines

STEER UNIT - FIG 1

Model	200 OSPC		
- Volumetric Displacement	200 cc/rev		
- Relief Valve	Fitted		
- Check Valve	Fitted		
- Shock Valve	Fitted		
- Relief Valve Operating Pressure (at 1500 revs/min)	120 ± 3 bar	122 ± 3.5 kgf/cm^2	1740 ± 50 lbf/in^2
-Shock Valve Operating Pressure	175 - 190bar	178 - 199 kgf/cm^2	2538 - 2756 lbf/in^2
Model	250 OSPC		
- Volumetric Displacement	250 cc/rev		
- Relief Valve	Fitted		
- Check Valve	Fitted		
- Shock Valve	Not Fitted		
- Relief Valve Operating Pressure (at 1500 revs/min)	120 ± 3 bar	122 ± 3.5 kgf/cm^2	1740 ± 50 lbf/in^2

PRIORITY VALVE - FIG 2

-Stand by Pressure	7 bar	7.1 kgf/cm^2	102 lbf/in^2

4 Wheel Steer Machines

STEER UNIT - FIG 1

Model	160 OSPC		
- Volumetric Displacement	160 cc/rev		
- Relief Valve	Fitted		
- Check Valve	Fitted		
- Shock Valve	Fitted		
- Relief Valve Operating Pressure (at 1500 revs/min)	120 ± 3 bar	122 ± 3.5 kgf/cm^2	1740 ± 50 lbf/in^2
- Shock Valve Operating Pressure	175 - 190bar	178 - 199 kgf/cm^2	2538 - 2756 lbf/in^2

PRIORITY VALVE - FIG 2

-Stand by Pressure	7 bar	7.1 kgf/cm^2	102 lbf/in^2

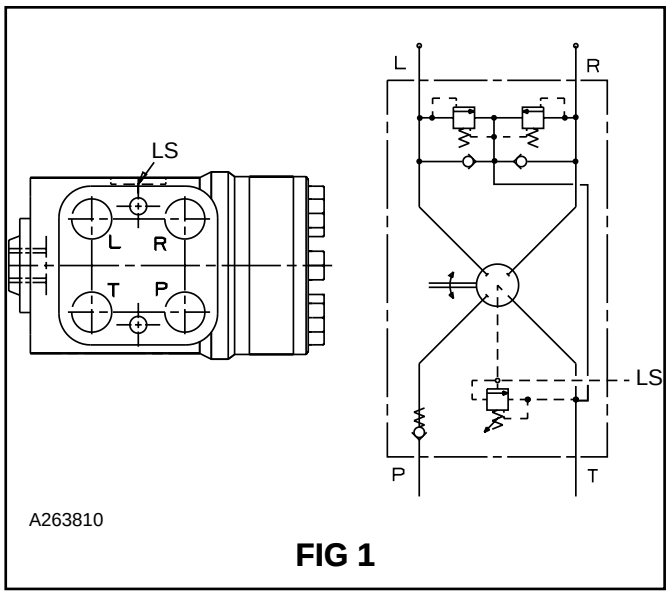


FIG 1

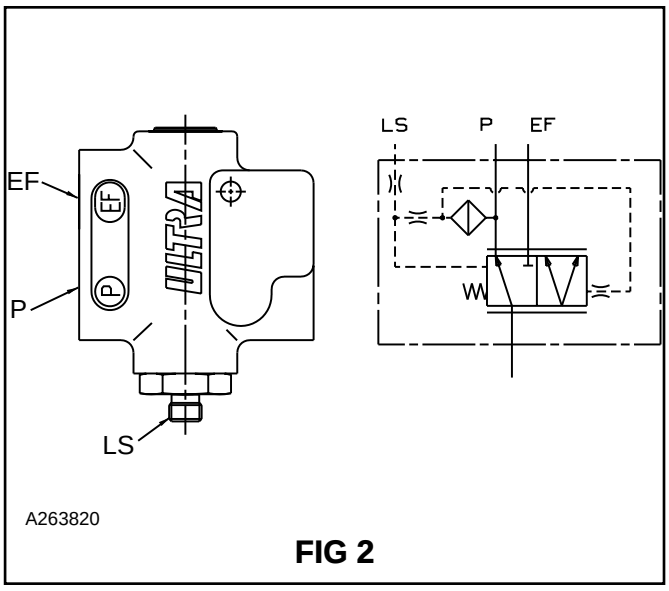


FIG 2

Steer Unit Operation
- 4 Wheel Steer Machines

4 Wheel Steer Mode
- Left Turn

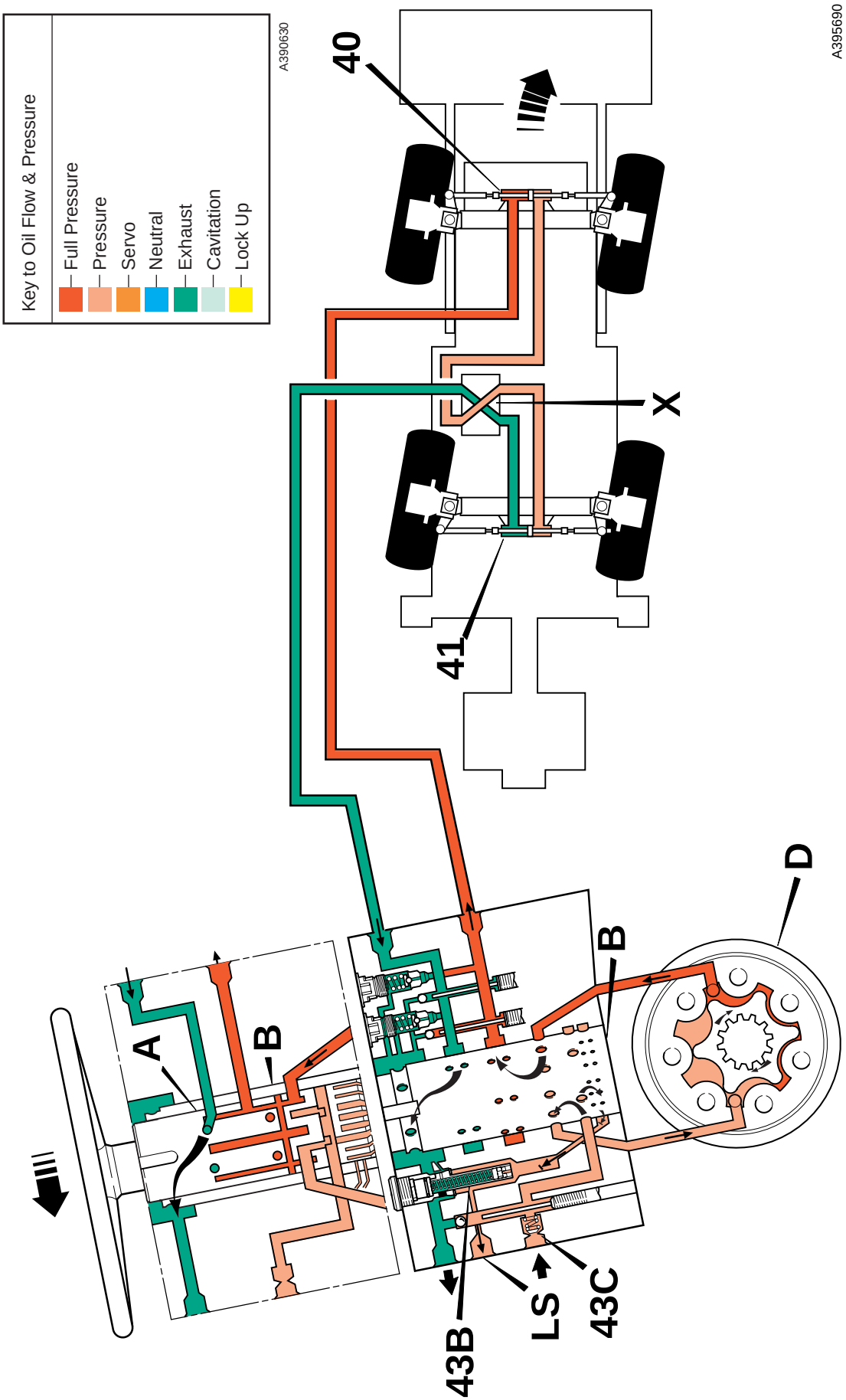
The illustration shows the flow through the steering unit in a left hand turn condition. Turning the steering wheel rotates the inner spool **A** a few degrees relative to the outer spool **B**, and sends a pressure signal to the relief valve **43B** and through the **LS** port back to the priority valve.

The relative movement between **A** and **B** directs pressure oil through 6 of the 12 holes in the bottom of sleeve **B**. The metering unit is linked to the spools by a cross pin. As the steering is operated the oil is diverted by inner spool **A** into the stator **D**.

The rotor lobes pump the oil out to one side of the rear power track rod ram **41** turning the rear wheels to the right. At the same time pressurised oil from the other side of the power track rod ram **41** is fed to the front power track rod ram **40**, hence turning the front wheels the required degree of left turn.

Component Key:

A Inner Spool
B Outer Spool
D Stator
LS Load Sensing Port
X Steer Mode Control Valve
40 Front Power Track Rod Ram
41 Rear Power Track Rod Ram
43B Relief Valve


Key to Oil Flow & Pressure
Full Pressure
Pressure
Servo
Neutral
Exhaust
Cavitation
Lock Up
A390630
A395690
40
X
41
A
B
B
D
43B
LS
43C

Proximity Switch - Setting

⚠ WARNING

Raised loader arms can drop suddenly and cause serious injury. Before working under raised loader arms, fit the loader arm safety strut.
GEN 3-2

Note: The proximity switch setting procedure is the same for both the front and rear axles. The illustration shows a typical rear axle.

1 Align the wheels in the straight ahead position. Check if straight ahead by measuring the steering ram position.

Set the steering so that dimension **X** is equal both sides.

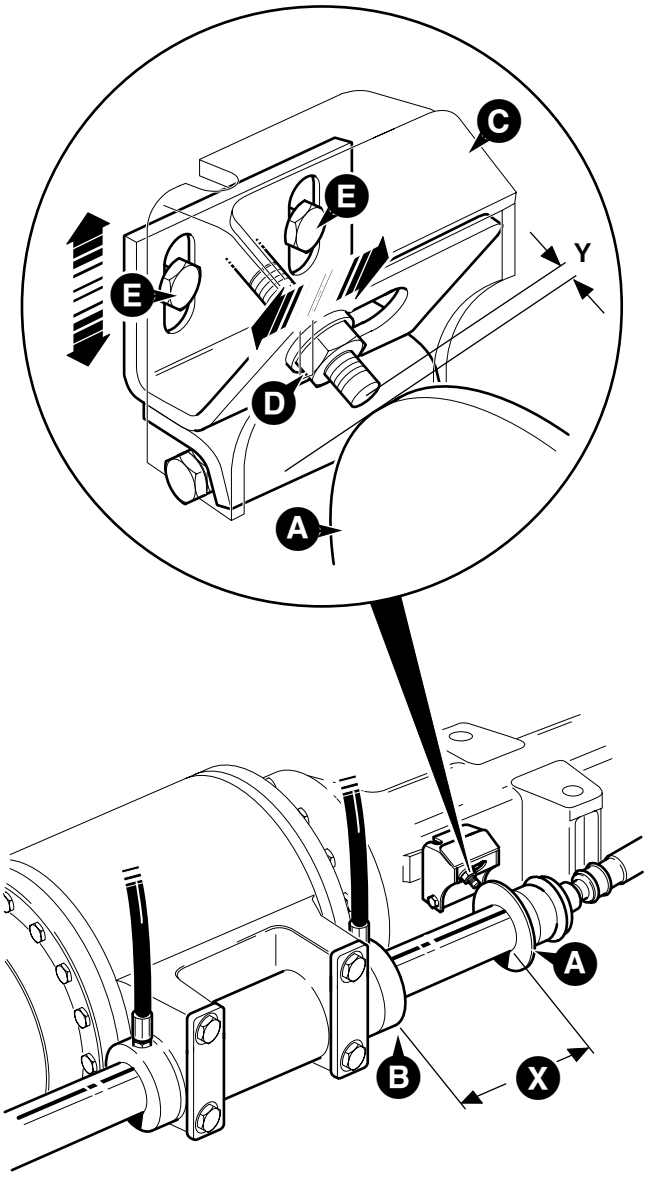
2 Remove the proximity switch cover **C**.

3 With the starter switch on, loosen the proximity switch lock nut **D** and slide the switch in line with the target disc **A**.

4 Loosen the bracket fixing bolts **E** and adjust the assembly up or down to bring the switch to the centre of the target disc. Tighten the fixing bolts **E**.

Make sure the light emitting diode (L.E.D.) is not illuminated (if it is then screw the switch out).

Now screw the proximity switch towards the target disc until the light emitting diode (L.E.D.) on the switch illuminates. Add a further 1 to 1.5 turns of the locknut. Tighten the locknut.



A258170

Removal and Replacement

⚠ WARNING

Make the machine safe before working underneath it. Park the machine on level ground, lower the arms. Apply the parking brake, put the transmission in neutral and stop the engine. Chock both sides of all four wheels.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.
GEN-1-2

⚠ DANGER

Hydraulic Pressure
Hydraulic fluid at system pressure can injure you. Before disconnecting or connecting hydraulic hoses, stop the engine and operate the controls to release pressure trapped in the hoses. Make sure the engine cannot be started while the hoses are open.
INT-3-1-11/1

Removal

1 Park the machine on level ground, engage the parking brake and set the transmission to neutral. Lower the attachments to the ground. Stop the engine and remove the starter key.

2 Turn the steering wheel to the left and to the right several times to vent system pressure.

Note 1: The steer mode valves assembly is fitted to a bracket which is mounted on the right hand side of the machine in front of the rear axle.

3 Disconnect the electrical solenoid connections. Label each connector before removal to ensure correct refitting. The wires should be identified **A**, **B**, **C** and **D** as shown.

4 Disconnect all hydraulic hoses from the steer mode valves assembly. Label the hoses to ensure correct refitting and cap the ends to prevent ingress of dirt.

5 Take hold of the steer mode valves assembly, loosen and remove bolts **E**. Lift the steer mode valves assembly and its retaining bracket from the machine.

Replacement

⚠ WARNING

Fine jets of hydraulic fluid at high pressure can penetrate the skin. Do not use your fingers to check for hydraulic fluid leaks. Do not put your face close to suspected leaks. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of hydraulic fluid. If hydraulic fluid penetrates your skin, get medical help immediately.
INT-3-1-10/1

Replacement is a reversal of the removal sequence.

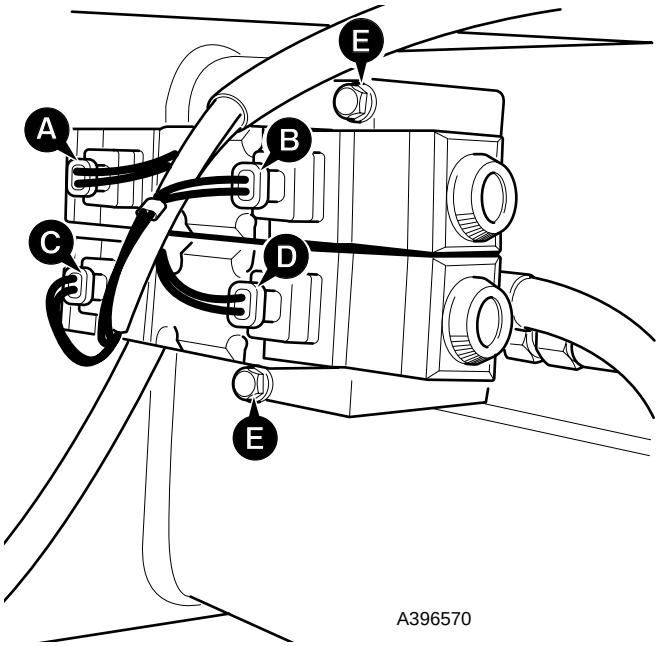
1 Make sure that the electrical solenoid connections are refitted in the correct position.

2 Make sure that the hoses are correctly installed. The hose connections from the steer mode valves assembly are as follows:

P - to hydraulic steer unit (L port)
B - to rear power track rod (left side)
A - to rear power track rod (right side)
T - to front power track rod (right side)

Note 2: The steer mode valves assembly ports should be stamped 'P', 'B', 'A' and 'T'. Left and right hand are as viewed from the rear of the machine.

3 Bleed the steering system, refer to **Service Procedures, Steering System - Bleeding**.



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