

# Service Manual

3CX, 4CX, 214e, 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 Issue 4

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## Introduction

This publication is designed for the benefit of JCB Distributor Service Engineers who are receiving, or have received, training by JCB Technical Training Department.

These personnel should have a sound knowledge of workshop practice, safety procedures, and general techniques associated with the maintenance and repair of hydraulic earthmoving equipment.

Renewal of oil seals, gaskets, etc., and any component showing obvious signs of wear or damage is expected as a matter of course. It is expected that components will be cleaned and lubricated where appropriate, and that any opened hose or pipe connections will be blanked to prevent excessive loss of hydraulic fluid and ingress of dirt. Finally, please remember above all else **SAFETY MUST COME FIRST!**

The manual is compiled in sections, the first three are numbered and contain information as follows:

**1** = **General Information** - includes torque settings and service tools.  
**2** = **Care & Safety** - includes warnings and cautions pertinent to aspects of workshop procedures etc.  
**3** = **Routine Maintenance** - includes service schedules and recommended lubricants for all the machine.

The remaining sections are alphabetically coded and deal with Dismantling, Overhaul etc. of specific components, for example:

**A** = **Attachments**  
**B** = **Body & Framework** ...etc.

The page numbering in each alphabetically coded section is not continuous. This allows for the insertion of new items in later issues of the manual.

Section contents, technical data, circuit descriptions, operation descriptions etc are inserted at the beginning of each alphabetically coded section.

All sections are listed on the front cover; tabbed divider cards align directly with individual sections on the front cover for rapid reference.

Where a torque setting is given as a single figure it may be varied by plus or minus 3%. Torque figures indicated are for dry threads, hence for lubricated threads may be reduced by one third.

With the exception of slewing operations 'Left Hand' and 'Right Hand' are as viewed from the rear of the machine facing forwards.








## Machine Nomenclature

In this Service Manual, reference is made to machine models, e.g. 3CX, 4CX, these are European machine model names. North American machine models have different names, the table below shows the European and the equivalent North American nomenclature.

European		North American
3CX	=	214
4CX	=	214S, 215S, 217S

## Colour Coding

The following colour coding, used on illustrations to denote various conditions of oil pressure and flow, is standardised throughout JCB Service publications.

-  **Red** — **Full Pressure**  
Pressure generated from operation of a service. Depending on application this may be anything between neutral circuit pressure and M.R.V. operating pressure.
-  **Pink** — **Pressure**  
Pressure that is above neutral circuit pressure but lower than that denoted by red.
-  **Orange** — **Servo**  
Oil pressure used in controlling a device (servo).
-  **Blue** — **Neutral**  
Neutral circuit pressure.
-  **Green** — **Exhaust**
-  **Light Green** — **Cavitation**  
Oil subjected to a partial vacuum due to a drop in pressure (cavitation).
-  **Yellow** — **Lock Up**  
Oil trapped within a chamber or line, preventing movement of components (lock up).

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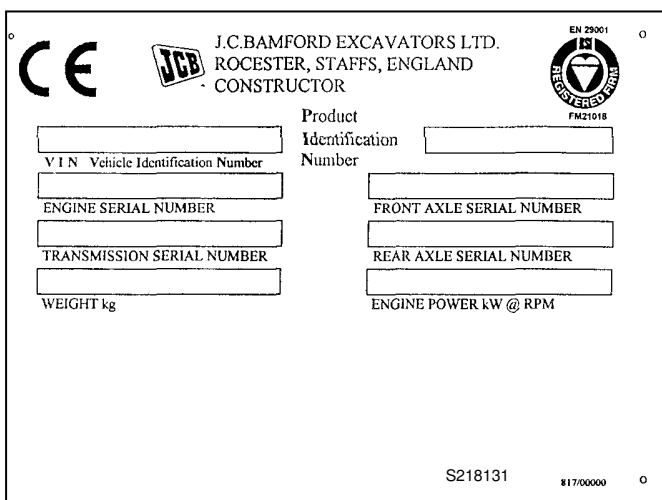
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### Machine Identification Plate

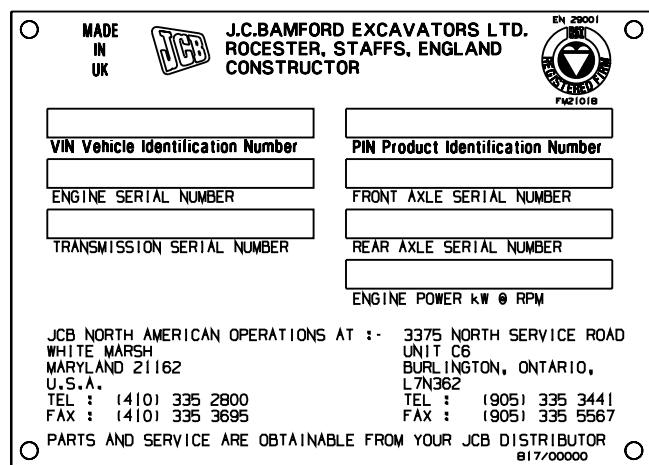
Your machine has an identification plate mounted on the loader tower. The serial numbers of the machine and its major units are stamped on the plate.

The serial number of each major unit is also stamped on the unit itself. If a major unit is replaced by a new one, the serial number on the identification plate will be wrong. Either stamp the new number of the unit on the identification plate, or simply stamp out the old number. This will prevent the wrong unit number being quoted when replacement parts are ordered.

The machine and engine serial numbers can help identify exactly the type of equipment you have.



U.K. and R.O.W.



North America

A246740

### Typical Vehicle Identification Number (VIN)

SLP 3CX T S V E 930000  
 A B C D E F G

- A World Manufacturer Identification
- B Machine Model
- C Steer Type (T= 2WS, F=4WS)
- D Build Type (S=Sideshift, C=Centremount, L=Loader)
- E Year of Manufacture:  
 2 = 2002  
 3 = 2003  
 4 = 2004  
 5 = 2005  
 6 = 2006  
 7 = 2007  
 8 = 2008
- F Manufacturer Location (E = England)
- G Product Identification Number (PIN)

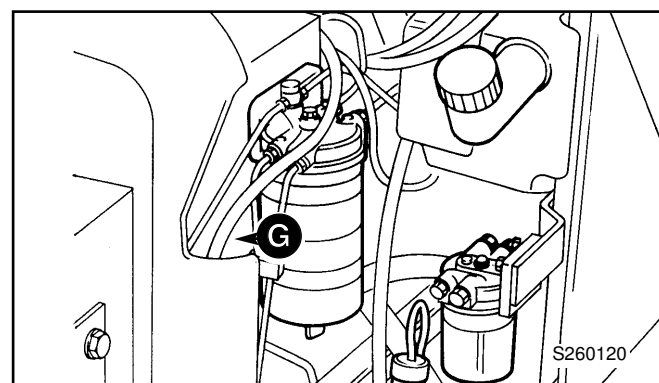
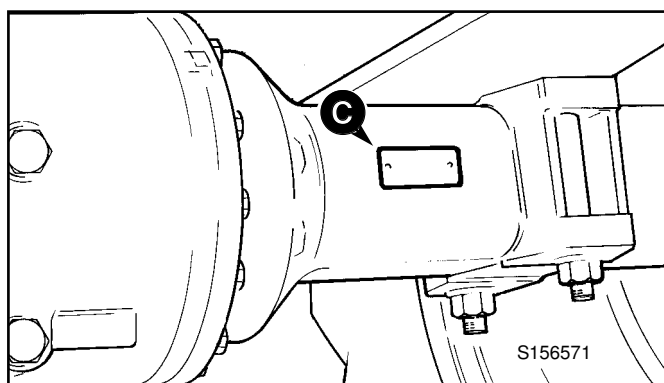
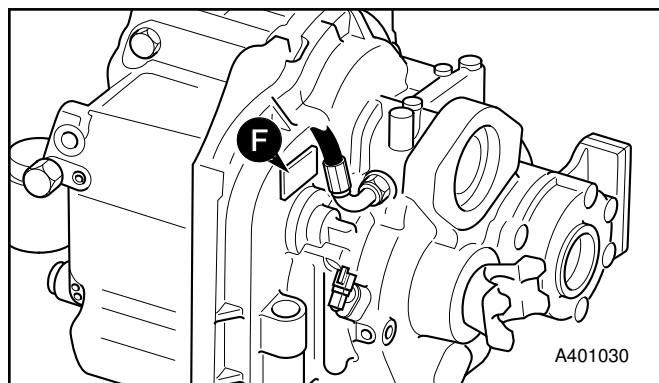
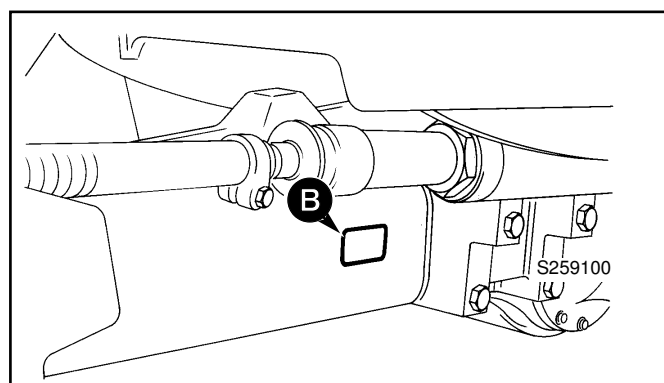
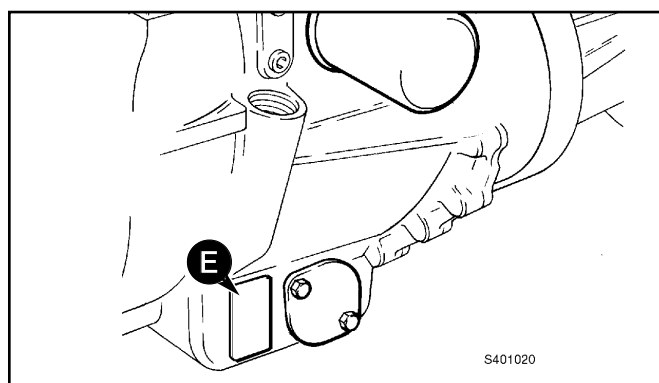
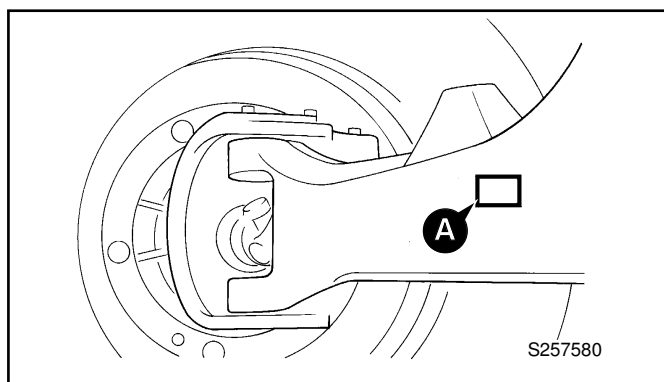
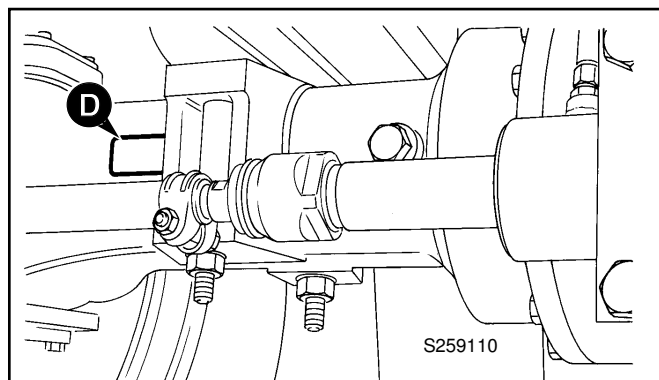
### Typical Engine Identification Number

AB 50262 U 500405 P  
 A B C D E

- A Engine Type  
 AB = 4 cylinder turbo
- B Build Number
- C Country of Origin
- D Engine Sequence Number
- E Year of Manufacture

### Serial Plates

- A** Front Axle (2WS machine)
- B** Front Axle (4WS machine)
- C** Rear Axle (2WS machine)
- D** Rear Axle (4WS machine)
- E** Synchro Shuttle Transmission
- F** Powershift Transmission
- G** Engine



## Torque Settings

Use only where no torque setting is specified in the text. Values are for dry threads and may be within three per cent of the figures stated. For lubricated threads the values should be REDUCED by one third.

### UNF Grade 'S' Bolts

Bolt Size in	(mm)	Hexagon (A/F) in	Torque Settings		
			Nm	kgf m	lbf ft
1/4	(6.3)	7/16	14	1.4	10
5/16	(7.9)	1/2	28	2.8	20
3/8	(9.5)	9/16	49	5.0	36
7/16	(11.1)	5/8	78	8.0	58
1/2	(12.7)	3/4	117	12.0	87
9/16	(14.3)	13/16	170	17.3	125
5/8	(15.9)	15/16	238	24.3	175
3/4	(19.0)	11/8	407	41.5	300
7/8	(22.2)	15/16	650	66.3	480
1	(25.4)	11/2	970	99.0	715
1 1/4	(31.7)	17/8	1940	198.0	1430
1 1/2	(38.1)	2 1/4	3390	345.0	2500

### Metric Grade 8.8 Bolts

Bolt Size	(mm)	Hexagon (A/F) mm	Torque Settings		
			Nm	kgf m	lbf ft
M5	(5)	8	7	0.7	5
M6	(6)	10	12	1.2	9
M8	(8)	13	28	3.0	21
M10	(10)	17	56	5.7	42
M12	(12)	19	98	10	72
M16	(16)	24	244	25	180
M20	(20)	30	476	48	352
M24	(24)	36	822	84	607
M30	(30)	46	1633	166	1205
M36	(36)	55	2854	291	2105

### Rivet Nut Bolts/Screws

Bolt Size	(mm)	Torque Settings (for steel rivet nuts)		
		Nm	kgf m	lbf ft
M3	(3)	1.2	0.12	0.9
M4	(4)	3.0	0.3	2.0
M5	(5)	6.0	0.6	4.5
M6	(6)	10.0	1.0	7.5
M8	(8)	24.0	2.5	18.0
M10	(10)	48.0	4.9	35.5
M12	(12)	82.0	8.4	60.5

**Note:** All bolts used on JCB machines are high tensile and must not be replaced by bolts of a lesser tensile specification.

## Service Tools Numerical List

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2403/0110	O-ring	4 - 13	892/00071 Male Adapter
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4101/0250	Threadlocker and Sealer (10 ml)	5 - 1	892/00076 Female Connector
4101/0251	Threadlocker and Sealer (50 ml)	5 - 1	892/00077 Female Connector
4101/0451	Threadlocker	5 - 1	892/00078 Connector
4102/0502	High Strength Gasketing	5 - 1	892/00137 Micro-Bore Hose 1/4in. BSP, 3 Metres
4102/0551	High Strength Threadlocker	5 - 1	892/00167 Ram Seal Protection Sleeve 90 mm
4102/0933	Clear Silicone Sealant	5 - 1	892/00174 Measuring Cup
4102/1212	Multi-Gasket	5 - 1	892/00179 Bearing Press
4102/1951	Threadseal	5 - 1	892/00180 Seal Fitting Tool
4102/2309	Black Polyurethane Sealant	5 - 1	892/00181 Replacement Plastic Boss
4103/2109	Ultra Fast Adhesive (310ml)	5 - 1	892/00182 Bearing Pad Driver
4104/0251	Activator (Aersol)	5 - 1	892/00223 Hand Pump
4104/0253	Activator (Bottle)	5 - 1	892/00224 Impulse Extractor
4104/1203	Active Wipe 205 (250g)	5 - 1	892/00225 Adapter for Extractor
4104/1206	Active Wipe 205 (30 ml)	5 - 1	892/00253 Pressure Test Kit
4104/1310	Hand Cleaner	4 - 1	892/00255 Pressure Test Adapter
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4104/1557	Cleaner/Degreaser (400 ml)	5 - 1	892/00257 Pressure Test Adapter
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The following parts are replacement items for kits and would normally be included in the kit numbers quoted on pages 1/3-1 and 1/3-2.

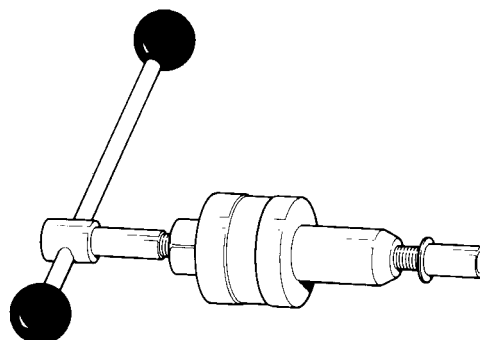
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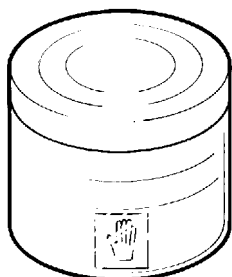
**Section B - Body & Framework**

- 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



S261210



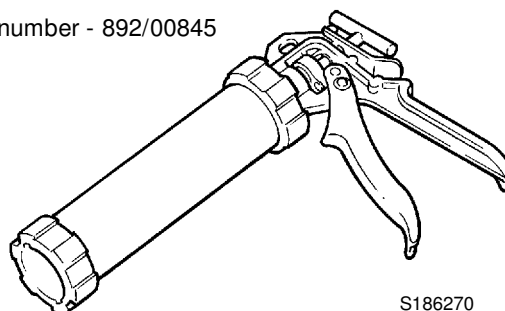
**Hand Cleaner** - special blend for the removal of polyurethane adhesives.

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

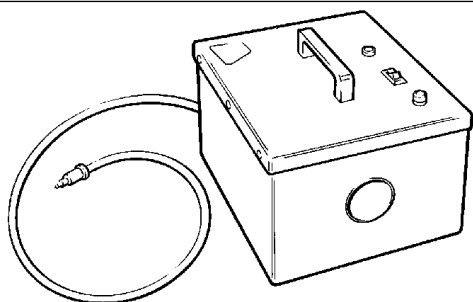
S186240

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

JCB part number - 892/00845



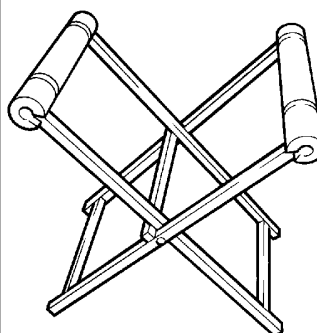
S186270



**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

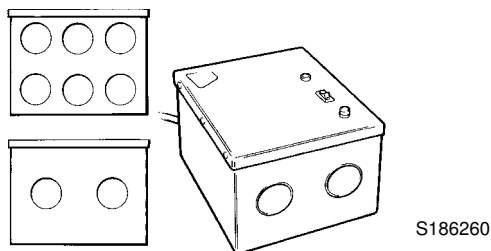
S186280

**Service Tools (cont'd)**

**Section B - Body & Framework**

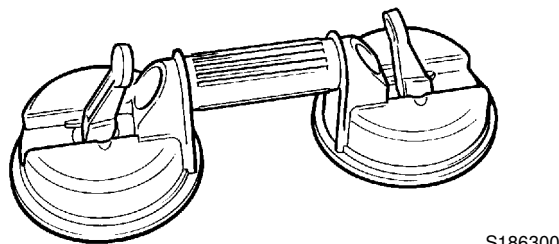
**240V Static Oven** - available with 2 or 6 cartridge capacity - required to pre-heat adhesive prior to use. No plug supplied. Note: 110V models available upon request - contact JCB Technical Service.

JCB part number:  
992/12400 - 2 Cartridge x 240V  
992/12600 - 6 Cartridge x 240V

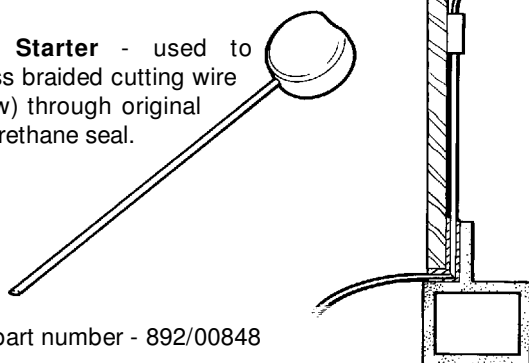


**Glass Lifter** - minimum 2 off - essential for glass installation, 2 required to handle large panes of glass. Ensure suction cups are protected from damage during storage.

JCB part number - 892/00842

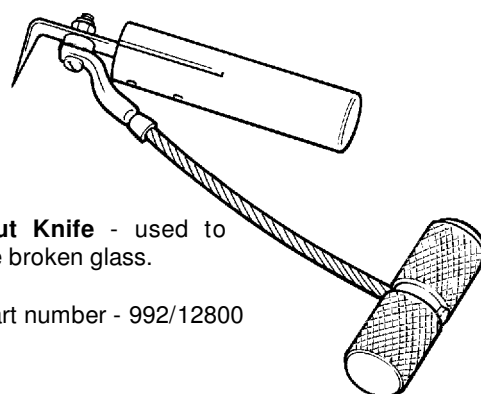


**Wire Starter** - used to access braided cutting wire (below) through original polyurethane seal.



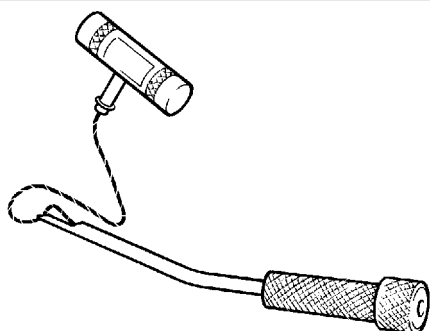
**Cut-Out Knife** - used to remove broken glass.

JCB part number - 992/12800



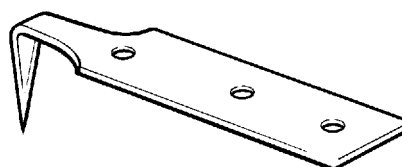
**Glass Extractor (Handles)** - used with braided cutting wire (below) to cut out broken glass.

JCB part number - 892/00846



**'L' Blades** - 25 mm (1 in) cut - replacement blades for cut-out knife (above).

JCB part number - 992/12801 (unit quantity = 5 off)

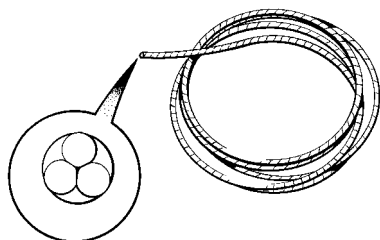


**Service Tools (cont'd)**

**Section B - Body & Framework**

**Braided Cutting Wire** - consumable heavy duty cut-out wire used with the glass extraction tool (above).

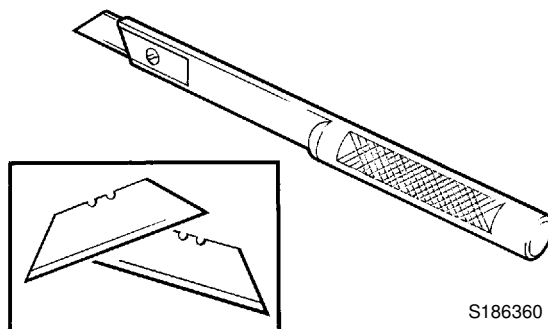
JCB part number - 892/00849  
(approx 25 m length)



S186330

**Long Knife** - used to give extended reach for normally inaccessible areas.

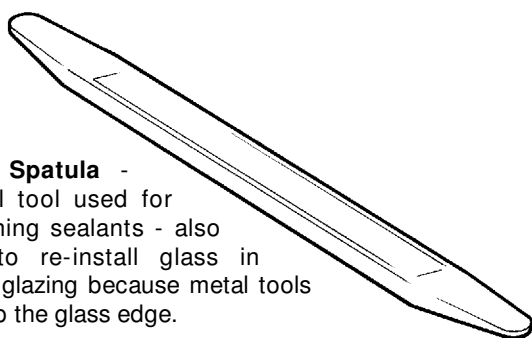
JCB part number - 892/00844



S186360

**Nylon Spatula** - general tool used for smoothing sealants - also used to re-install glass in rubber glazing because metal tools will chip the glass edge.

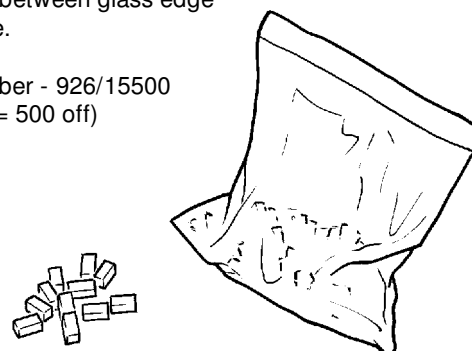
JCB part number - 892/00847



S186470

**Rubber Spacer Blocks** - used to provide the correct set clearance between glass edge and cab frame.

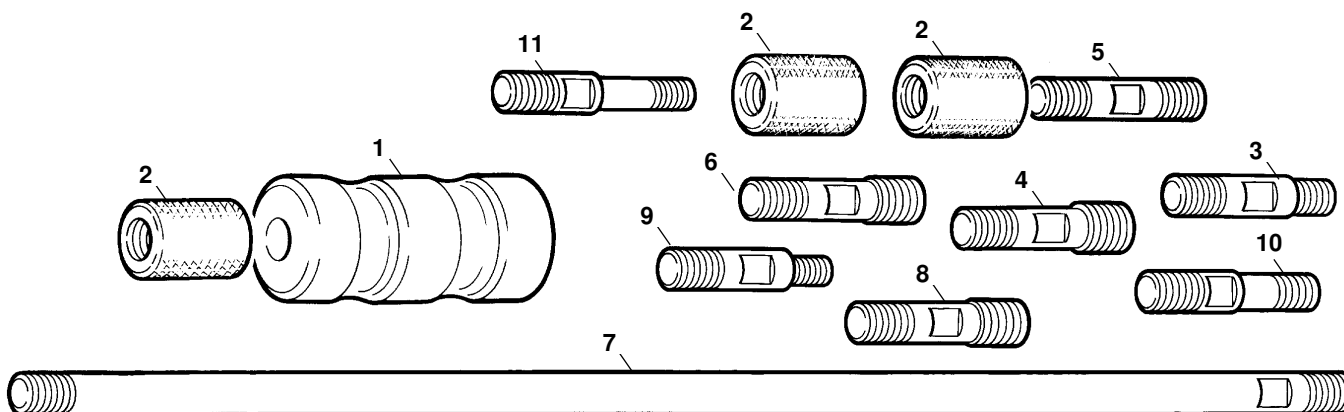
JCB part number - 926/15500  
(unit quantity = 500 off)



S186550

**Slide Hammer Kit - 993/68100**

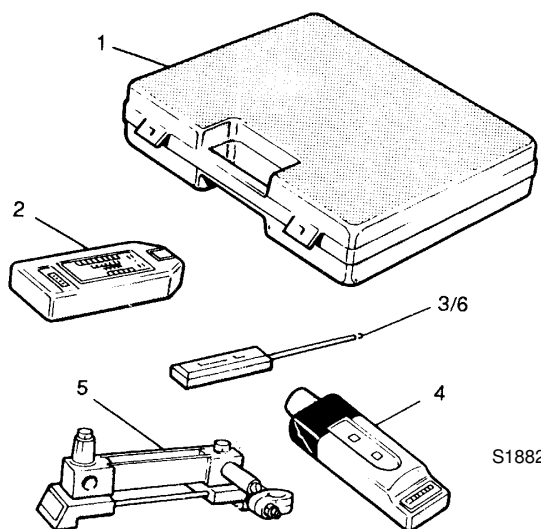
- |              |                          |               |                                     |
|--------------|--------------------------|---------------|-------------------------------------|
| 1 :993/68101 | Slide Hammer             | 6 :993/68106  | Adaptor - M20 x M24                 |
| 2 :993/68102 | End Stops                | 7 :993/68107  | Bar - M20 x M20 X 800MM             |
| 3 :993/68103 | Adaptor - M20 x 5/8" UNF | 8 :993/68108  | Adaptor - M20 x 7/8" UNF            |
| 4 :993/68104 | Adaptor - M20 x 1" UNF   | 9 :993/68109  | Adaptor - M20 x M12                 |
| 5 :993/68105 | Adaptor - M20 x M20      | 10 :993/68110 | Adaptor - M20 x 5/8" UNF (Shoulder) |
|              |                          | 11 :993/68111 | Adaptor - M20 x 1/2" UNF            |



S196910

**Service Tools (cont'd)**

**Section C - Electrics**

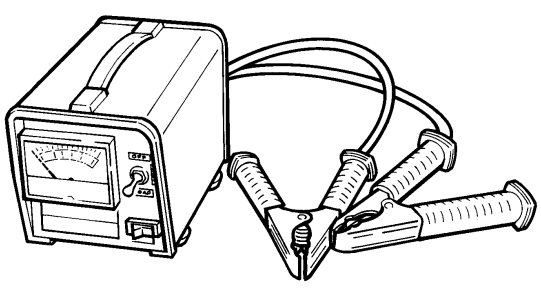


AVO Test Kit

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

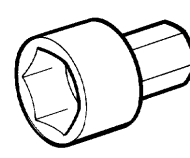
S188231

993/85700      Battery Tester



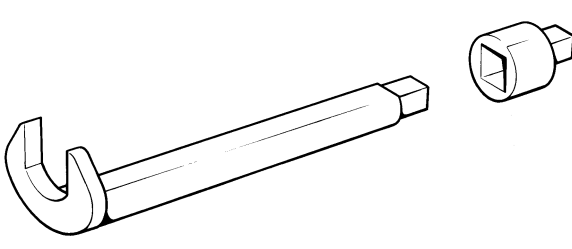
S239510

892/00882      Socket for Alternator Pulley Nut



S216770

825/00410      15 mm Crowfoot Wrench  
825/99833      Adapter

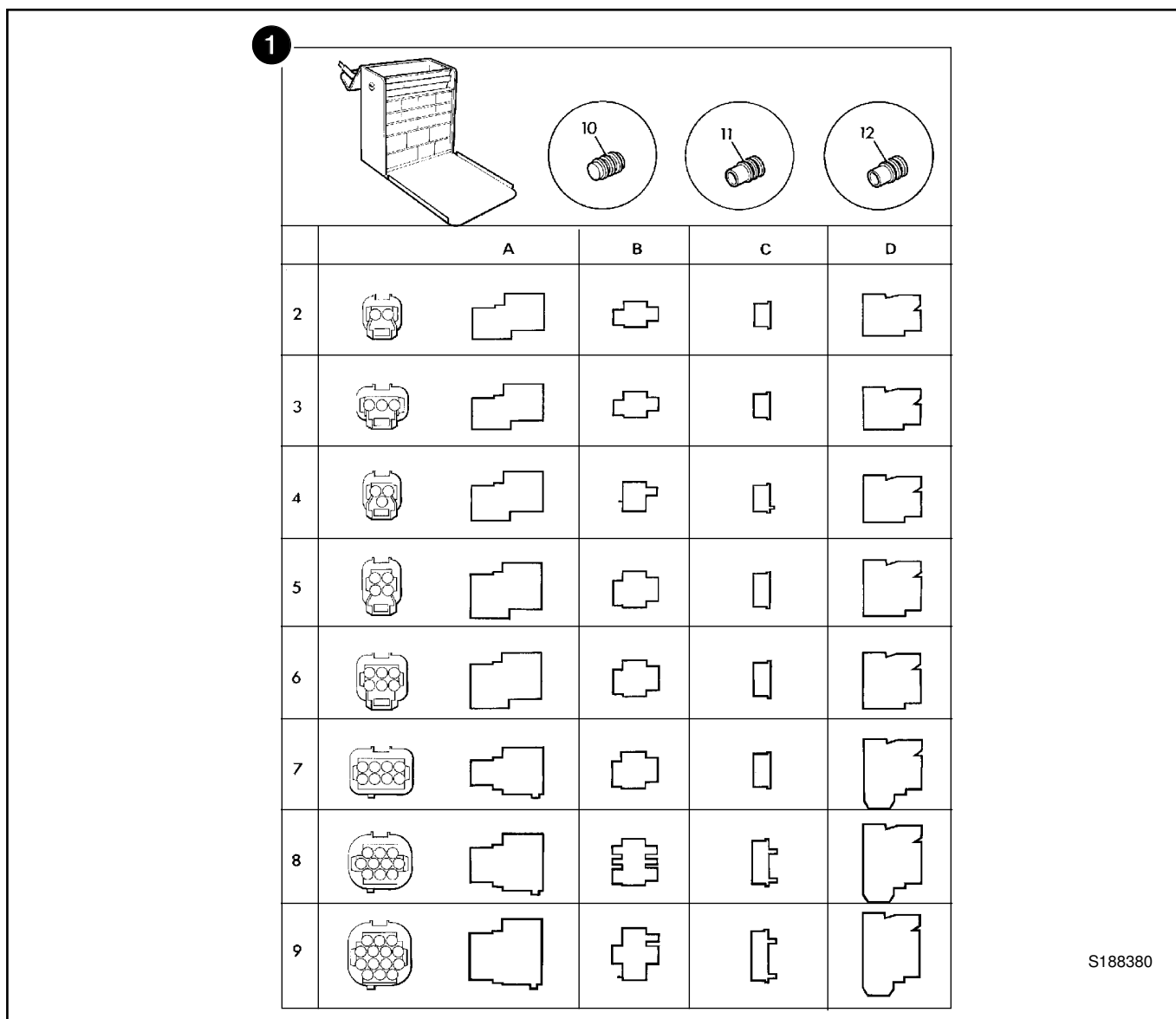


S216200

**Service Tools (cont'd)**

**Section C - Electrics**

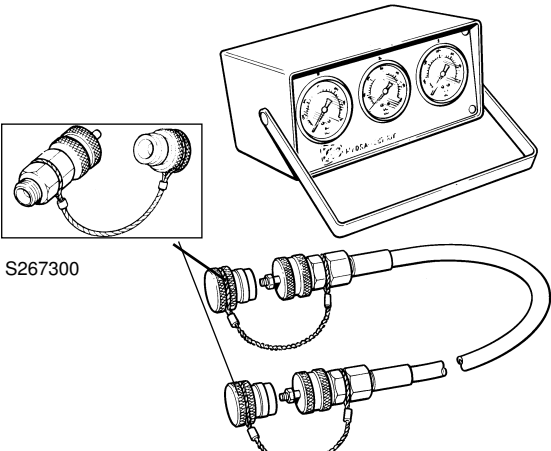
1	Electrical Repair Kit	6A :7216/0002	6 Way Pin Housing
2A :7212/0002	2 Way Pin Housing	6B :7216/0004	6 Way Pin Retainer
2B :7212/0004	2 Way Pin Retainer	6C :7216/0003	6 Way Socket Retainer
2C :7212/0003	2 Way Socket Retainer	6D :7216/0001	6 Way Socket Connector
2D :7212/0001	2 Way Socket Connector	7A :7218/0002	8 Way Pin Housing
3A :7213/0002	3 Way Pin Housing	7B :7218/0004	8 Way Pin Retainer
3B :7213/0004	3 Way Pin Retainer	7C :7218/0003	8 Way Socket Retainer
3C :7213/0003	3 Way Socket Retainer	7D :7218/0001	8 Way Socket Connector
3D :7213/0001	3 Way Socket Connector	8A :7219/0002	10 Way Pin Housing
4A :7213/0006	3 Way Pin Housing (DT)	8B :7219/0004	10 Way Pin Retainer
4B :7213/0008	3 Way Pin Retainer (DT)	8C :7219/0003	10 Way Socket Retainer
4C :7213/0007	3 Way Socket Retainer (DT)	8D :7219/0001	10 Way Socket Connector
4D :7213/0005	3 Way Socket Connector (DT)	9A :7219/0006	14 Way Pin Housing
5A :7214/0002	4 Way Pin Housing	9B :7219/0008	14 Way Pin Retainer
5B :7214/0004	4 Way Pin Retainer	9C :7219/0007	14 Way Socket Retainer
5C :7214/0003	4 Way Socket Retainer	9D :7219/0005	14 Way Socket Connector
5D :7214/0001	4 Way Socket Connector	10 :7210/0001	Dummy Plug
		11 :7210/0002	Wire Seal (1.4 - 2.2 mm dia.)
		12 :7210/0003	Wire Seal (2.2 - 2.9 mm dia.)



S188380

Service Tools (cont'd)

Section E - Hydraulics

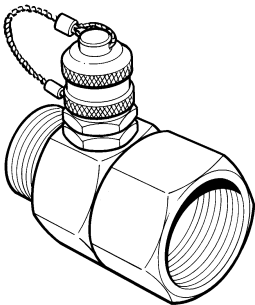


**Hydraulic Circuit Pressure Test Kit**

892/00253	Pressure Test Kit
:892/00201	Replacement Gauge 0-20 bar (0-300 lbf/in <sup>2</sup> )
:892/00202	Replacement Gauge 0-40 bar (0-600 lbf/in <sup>2</sup> )
:892/00203	Replacement Gauge 0-400 bar (0-6000 lbf/in <sup>2</sup> )
:892/00254	Replacement Hose
993/69800	Seal Kit for 892/00254 (can also be used with probe 892/00706)
892/00706	Test Probe

S267300

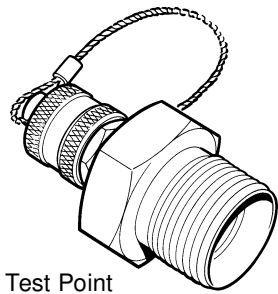
S188121



S188131

**Pressure Test 'T' Adapters**

892/00262	1/4 in M BSP x 1/4 in F BSP x Test Point
816/55038	3/8 in M BSP x 3/8 in F BSP x Test Point
816/55040	1/2 in M BSP x 1/2 in F BSP x Test Point
892/00263	5/8 in M BSP x 5/8 in F BSP x Test Point
892/00264	3/4 in M BSP x 3/4 in F BSP x Test Point
892/00265	1 in M BSP x 1 in F BSP x Test Point



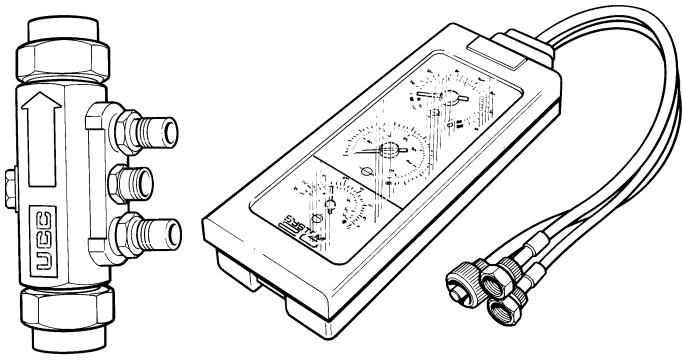
S200141

**Pressure Test Adapters**

892/00255	1/4 in BSP x Test Point
892/00256	3/8 in BSP x Test Point
892/00257	1/2 in BSP x Test Point
892/00258	5/8 in BSP x Test Point
816/15118	3/4 in BSP x Test Point
892/00259	1 in BSP x Test Point
892/00260	1.1/4 in BSP x Test Point
892/00261	5/8 in UNF x Test Point

**Flow Test Equipment**

892/00268	Flow Monitoring Unit
892/00269	Sensor Head 0 - 100 l/min (0 - 22 UK gal/min)
892/00293	Connector Pipe
892/00270	Load Valve
1406/0021	Bonded Washer
1604/0006	Adapter 3/4 in M x 3/4 in M BSP
1612/0006	Adapter 3/4 in F x 3/4 in M BSP
892/00271	Adapter 3/4 in F x 5/8 in M BSP
892/00272	Adapter 5/8 in F x 3/4 in M BSP
816/20008	Adapter 3/4 in F x 1/2 in M BSP
892/00275	Adapter 1/2 in F x 3/4 in M BSP
892/00276	Adapter 3/4 in F x 3/8 in M BSP
892/00277	Adapter 3/8 in F x 3/4 in M BSP
892/00273	Sensor Head 0 - 380 l/min
892/00294	Connector Pipe
1606/0015	Adapter 1.1/4 in M BSP x 1 in M BSP
892/00078	Connector 1 in F x 1 in F BSP
1604/0008	Adapter 1 in M x 1 in M BSP
1606/0012	Adapter 1 in M x 3/4 in M BSP
816/20013	Adapter 3/4 in F x 1 in M BSP



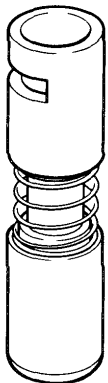
S188151



Service Tools (cont'd)

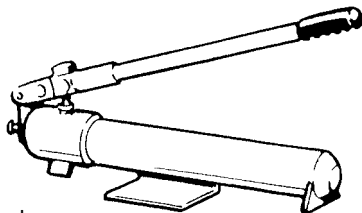
Section E - Hydraulics

892/00881 Valve Spool Seal Fitting Tool



S261220

Hand Pump Equipment



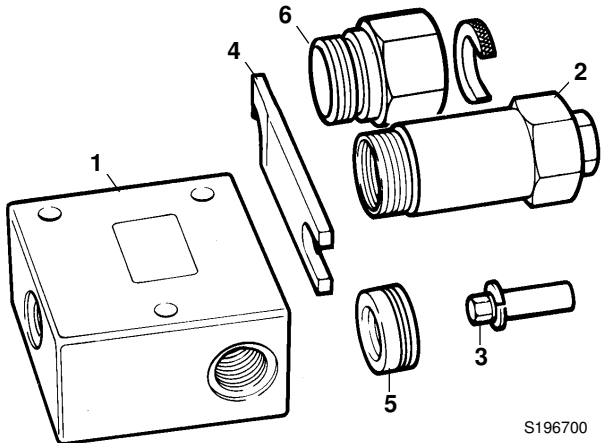
892/00223 Hand Pump  
 892/00137 Micro-bore Hose 1/4 in BSP x 3 metres  
 892/00274 Adapter 1/4 in M BSP x 3/8 in M BSP Taper  
 892/00262 1/4 in M BSP x 1/4 in F BSP x Test Point  
 892/00706 Test Probe  
 892/00278 Gauge 0 - 40 bar (0 - 600 lbf/in<sup>2</sup>)  
 892/00279 Gauge 0 - 400 bar (0 - 6000 lbf/in<sup>2</sup>)

S193850

Components for Valve Block A.R.V. Testing

For 4CX Variable Flow machines use 25/201103


892/00309	A.R.V. Pressure Test Kit
1 : 892/00340	Test Block Body
2 : 892/00341	Setting Body
3 : 993/68300	Adjusting Pin
4 : 892/00343	Spanner
5 : 892/00345	Anti-cavitation Lock Out Bung
6 : 892/00335	A.R.V. Cartridge Removal Tool



S196700

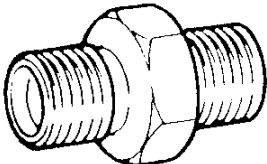
Bonded Washers

1406/0011	1/4 in. BSP
1406/0018	1/2 in. BSP
1406/0014	5/8 in. BSP
1406/0021	3/4 in. BSP
1406/0029	1.1/4 in. BSP



S188140

<p>Male Adapters - BSP x NPT (USA only)</p> <p>816/00439 3/8 in. x 1/4 in.              816/00440 1/2 in. x 1/4 in.              816/15007 3/8 in. x 3/8 in.              816/15008 1/2 in. x 3/8 in.</p>	<p>Male Adapters - BSP x BSP</p> <p>1606/0003 3/8 in. x 1/4 in.              1604/0003 3/8 in. x 3/8 in.              892/00071 3/8 in. x 3/8 in. taper              1606/0004 1/2 in. x 1/4 in.              1606/0007 1/2 in. x 3/8 in.              1604/0004 1/2 in. x 1/2 in.              1606/0017 5/8 in. x 1/2 in.              1606/0008 3/4 in. x 3/8 in.              1606/0009 3/4 in. x 1/2 in.              1604/0006 3/4 in. x 3/4 in.              1606/0012 3/4 in. x 1 in.              1606/0014 3/4 in. x 1.1/4 in.              1606/0015 1 in. x 1.1/4 in.</p>
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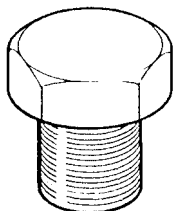
S193860

**Service Tools (cont'd)**

**Section E - Hydraulics**

**Female Cone Blanking Plug**

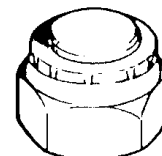
- 892/00055 1/4 in. BSP
- 892/00056 3/8 in. BSP
- 892/00057 1/2 in. BSP
- 892/00058 5/8 in. BSP
- 892/00059 3/4 in. BSP
- 892/00060 1 in. BSP



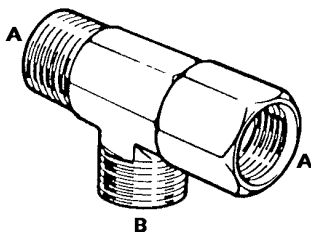
S193870

**Male Cone Blanking Cap**

- 816/00294 1/4 in. BSP
- 816/00189 3/8 in. BSP
- 816/00190 1/2 in. BSP
- 816/00197 5/8 in. BSP
- 816/00196 3/4 in. BSP
- 816/00193 1 in. BSP

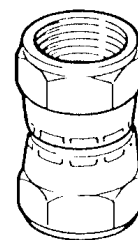


S193880



S193890

- 892/00047 3/8 in. BSP (A) x 1/4 in. BSP (B)
- 892/00048 1/2 in. BSP (A) x 1/4 in. BSP (B)
- 892/00049 5/8 in. BSP (A) x 1/4 in. BSP (B)
- 816/50043 3/4 in. BSP (A) x 1/4 in. BSP (B)
- 892/00051 1 in. BSP (A) x 1/4 in. BSP (B)
- 816/50005 1/2 in. BSP (A) x 1/2 in. BSP (B)
- 816/60096 3/4 in. BSP (A) x 3/4 in. BSP (B)
- 816/00017 1 in. BSP (A) x 1 in. BSP (B)

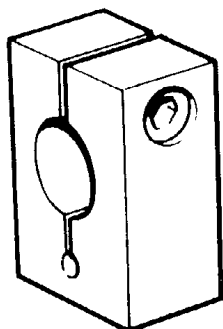


S193900

**Female Connectors**

- 892/00074 3/8 in. BSP x 3/8 in. BSP
- 892/00075 1/2 in. BSP x 1/2 in. BSP
- 892/00076 5/8 in. BSP x 5/8 in. BSP
- 892/00077 3/4 in. BSP x 3/4 in. BSP

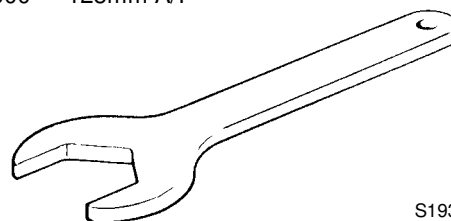
- 992/09100 Excavator Spool Clamp
- 892/00011 Spool Clamp



S216210

**Hexagon Spanners for Ram Pistons and End Caps**

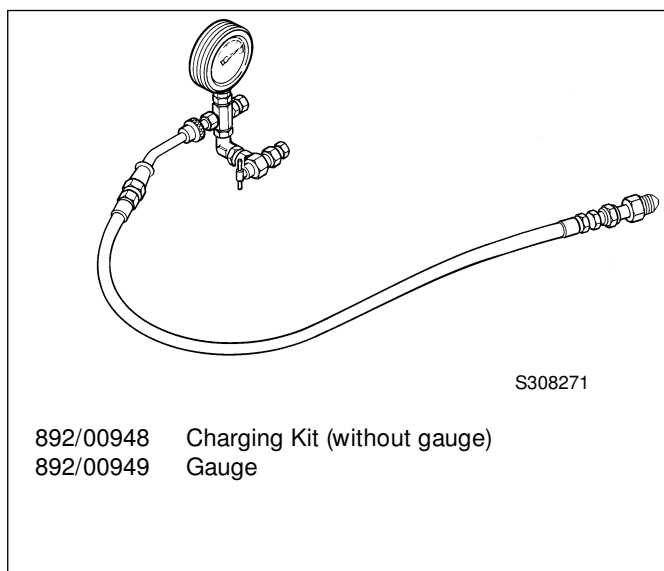
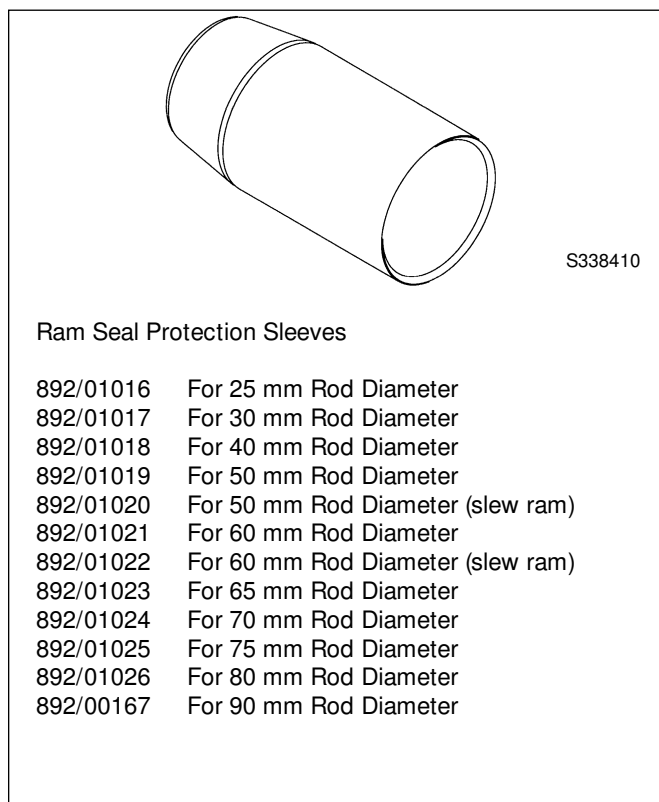
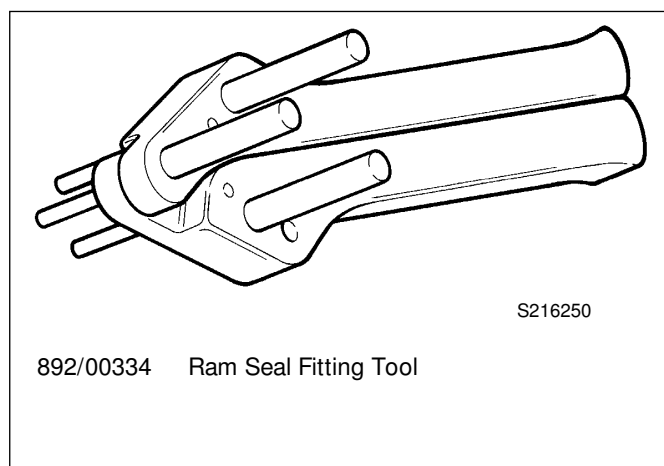
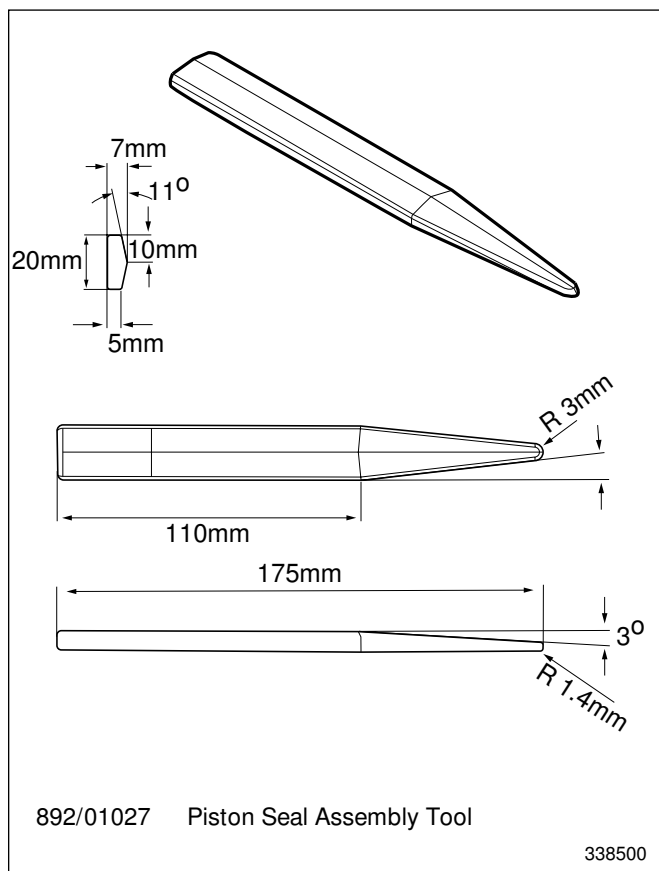
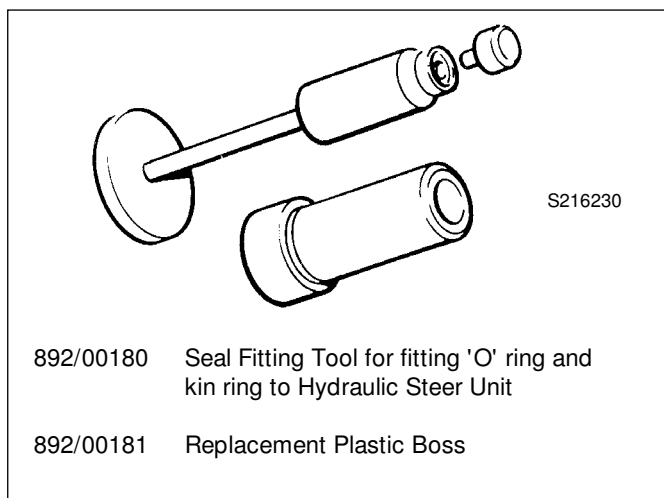
- 992/09300 55mm A/F
- 992/09400 65mm A/F
- 992/09500 75mm A/F
- 992/09600 85mm A/F
- 992/09700 95mm A/F
- 992/09900 115mm A/F
- 992/10000 125mm A/F



S193930

Service Tools (cont'd)

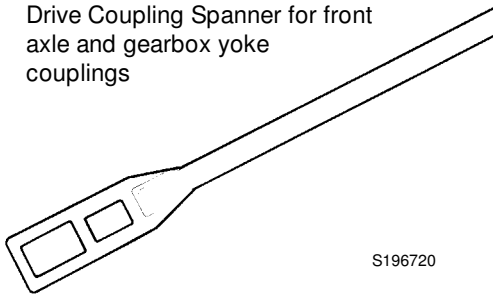
Section E - Hydraulics



**Service Tools (cont'd)**

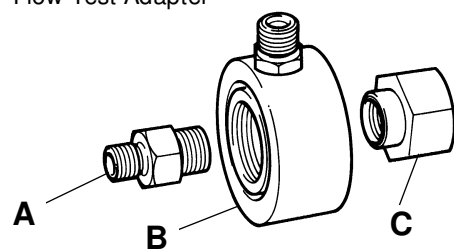
**Section F - Transmission**

892/00812 Drive Coupling Spanner for front axle and gearbox yoke couplings



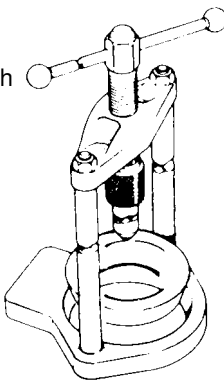
S196720

**A** 892/00920 Flow Test Adapter  
**B** 892/00301 Flow Test Adapter  
**C** 892/00302 Flow Test Adapter



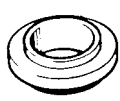
S266880

892/00179 Bearing Press (use with appropriate adapters)



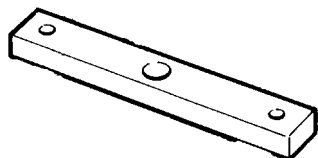
S188200

992/07608 Bearing Adapter  
 992/07609 Bearing Adapter  
 992/07610 Bearing Adapter  
 992/07611 Bearing Adapter  
 992/07612 Bearing Adapter  
 992/07613 Bearing Adapter

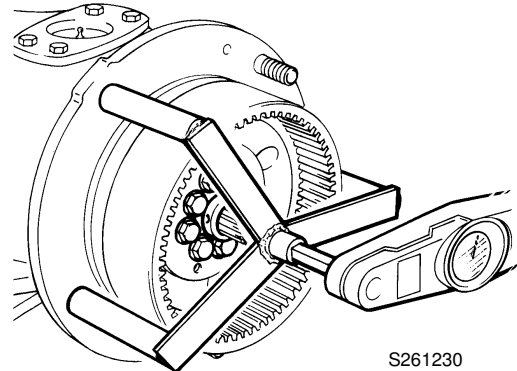


S188160

892/00922 12.2" Torque Converter Alignment Tool



S267260

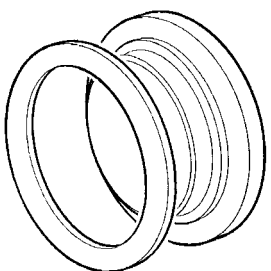


S261230

**Torque Measuring Tool for Wheel Hub Seals**

Manufacture locally, procedures in this manual show checking the wheel hub seal using a rolling force. However, the torque can be measured using above locally manufactured tool.

Bearing rolling torque is 12 to 22 Nm (9 to 16 lbf ft) excluding seal drag. Maximum permissible including seal drag is 40 Nm (29.5 lbf ft).



892/00891 Fitting Tool Assembly for Wheel Hub Seals

S227760

**Service Tools (cont'd)**

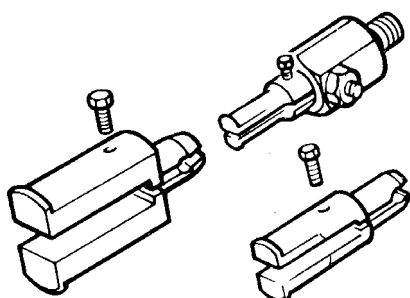
**Section F - Transmission**

892/00224

Impulse Extractor Set for Hub Bearing Seals



S197070



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)

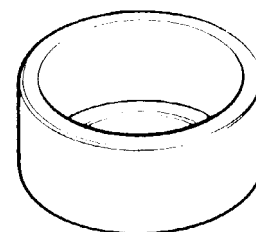


S216290

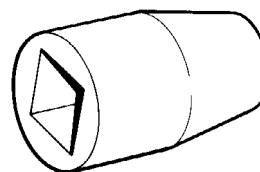
- 892/00817 17 mm A/F x 3/4in. square drive
- 892/00818 22 mm A/F x 3/4in. square drive
- 892/00819 15 mm A/F x 1/2in. square drive
- 892/00333 19 mm A/F x 3/4in. square drive

892/00174

Measuring Cup - Pinion Head Bearing



S190770



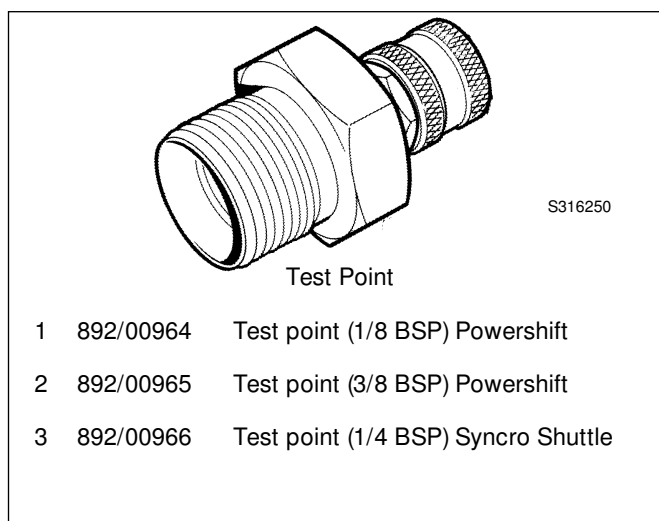
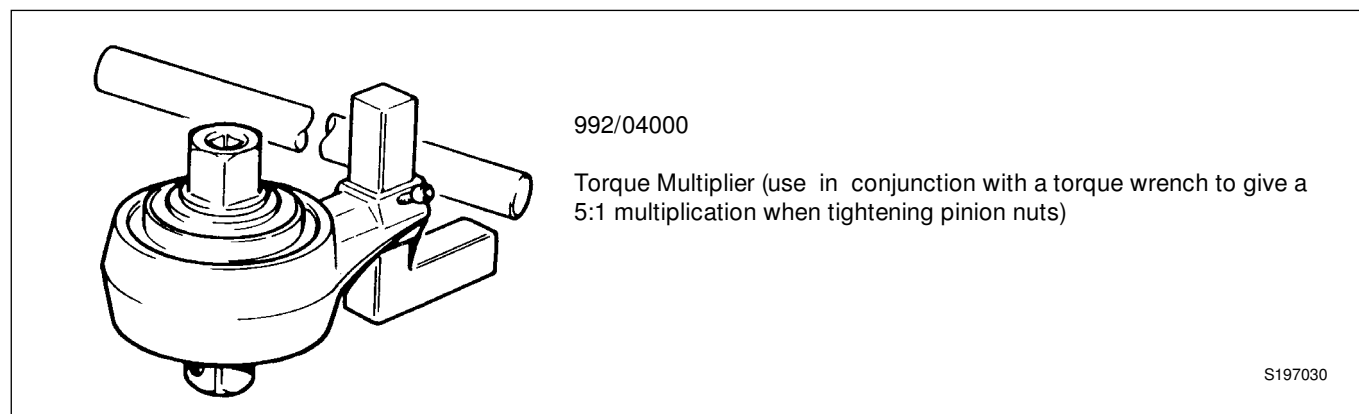
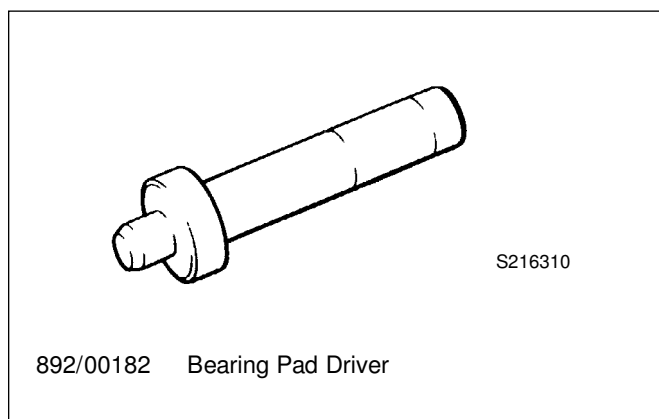
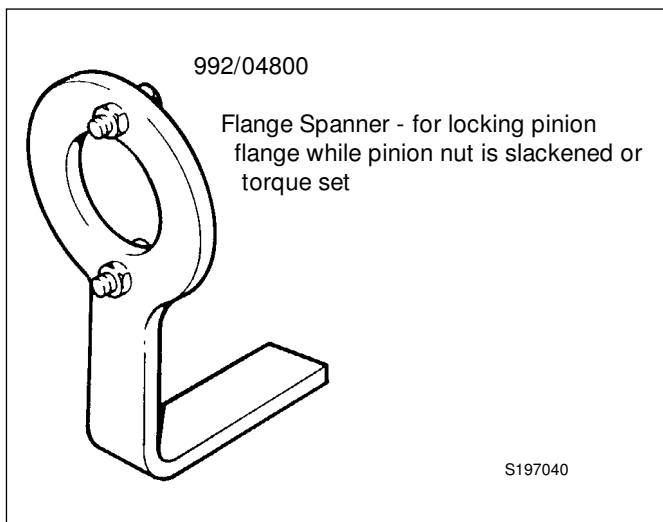
892/00822

Splined Bolt Socket for driveshafts

S197060

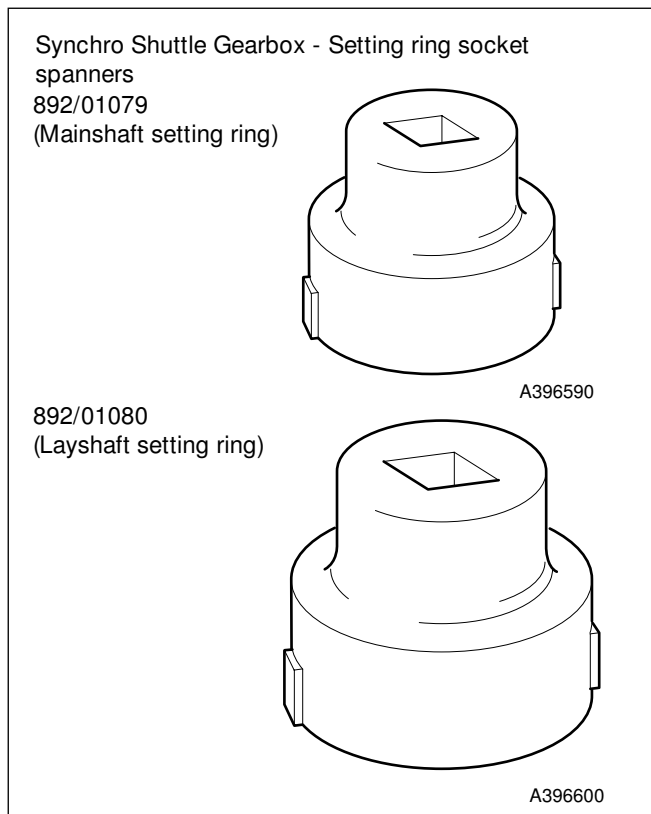
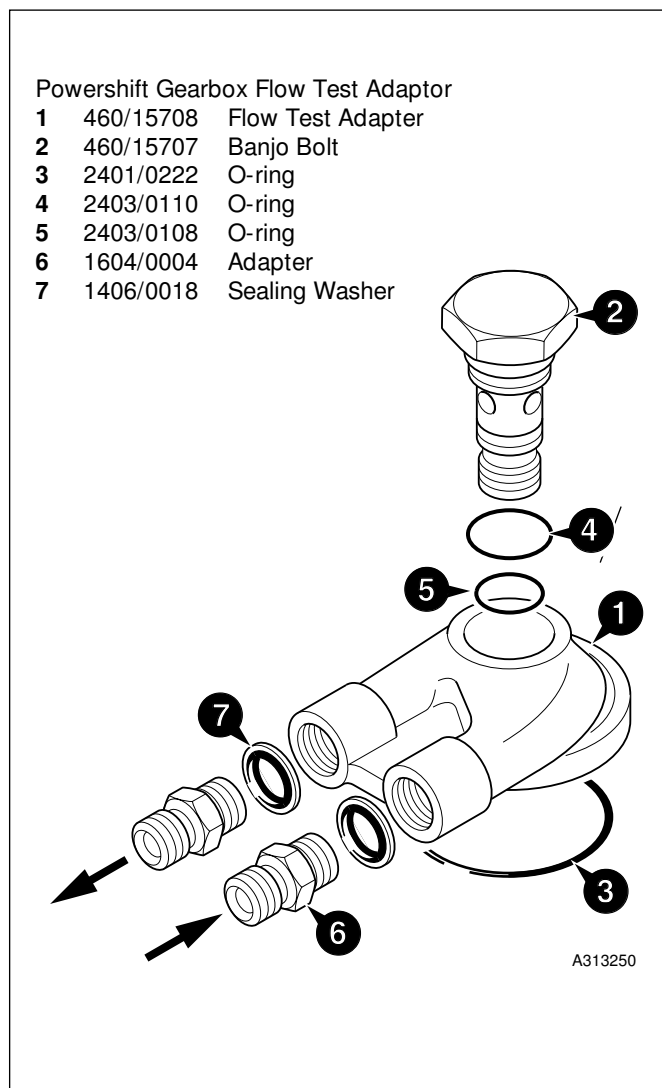
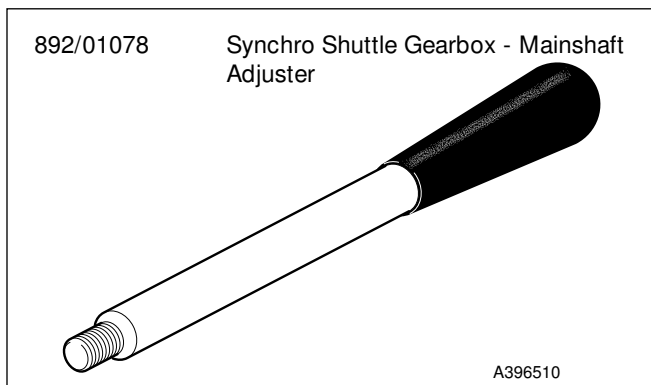
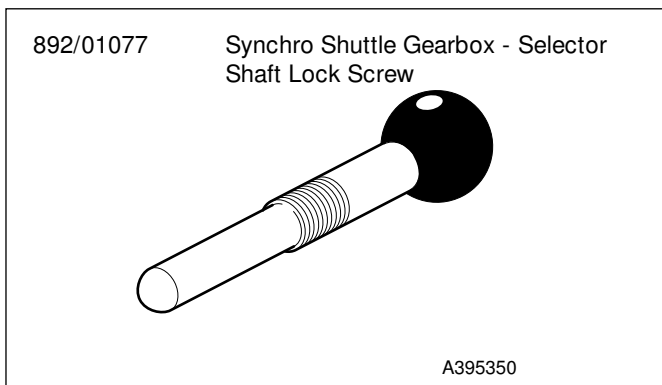
**Service Tools (cont'd)**

**Section F - Transmission**



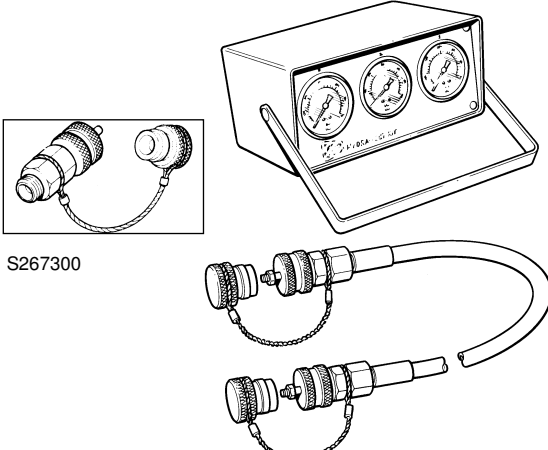
**Service Tools (cont'd)**

**Section F - Transmission**



**Service Tools (cont'd)**

**Section F - Transmission**



Hydraulic Circuit Pressure Test Kit (also used for main hydraulic system tests)

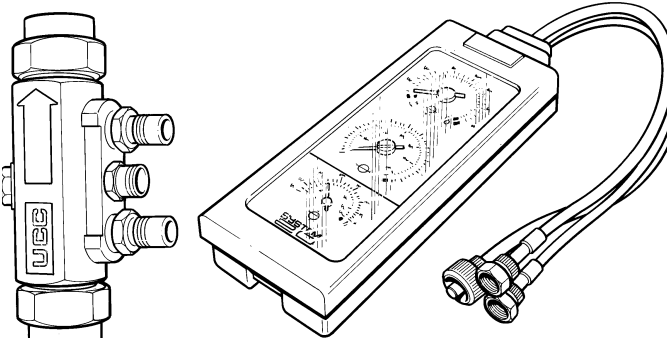
892/00253	Pressure Test Kit
:892/00201	Replacement Gauge 0-20 bar (0-300 lbf/in <sup>2</sup> )
:892/00202	Replacement Gauge 0-40 bar (0-600 lbf/in <sup>2</sup> )
:892/00203	Replacement Gauge 0-400 bar (0-6000 lbf/in <sup>2</sup> )
:892/00254	Replacement Hose
993/69800	Seal Kit for 892/00254 (can also be used with probe 892/00706)
892/00706	Test Probe

S267300

S188121

Flow Test Equipment (also used for main hydraulic system tests)

892/00268	Flow Monitoring Unit
892/00269	Sensor Head 0 - 100 l/min (0 - 22 UK gal/min)
892/00293	Connector Pipe
892/00270	Load Valve
1406/0021	Bonded Washer
1604/0006	Adapter 3/4 in M x 3/4 in M BSP
1612/0006	Adapter 3/4 in F x 3/4 in M BSP
892/00271	Adapter 3/4 in F x 5/8 in M BSP
892/00272	Adapter 5/8 in F x 3/4 in M BSP
816/20008	Adapter 3/4 in F x 1/2 in M BSP
892/00275	Adapter 1/2 in F x 3/4 in M BSP
892/00276	Adapter 3/4 in F x 3/8 in M BSP
892/00277	Adapter 3/8 in F x 3/4 in M BSP
892/00273	Sensor Head 0 - 380 l/min
892/00294	Connector Pipe
1606/0015	Adapter 1.1/4 in M BSP x 1 in M BSP
892/00078	Connector 1 in F x 1 in F BSP
1604/0008	Adapter 1 in M x 1 in M BSP
1606/0012	Adapter 1 in M x 3/4 in M BSP
816/20013	Adapter 3/4 in F x 1 in M BSP

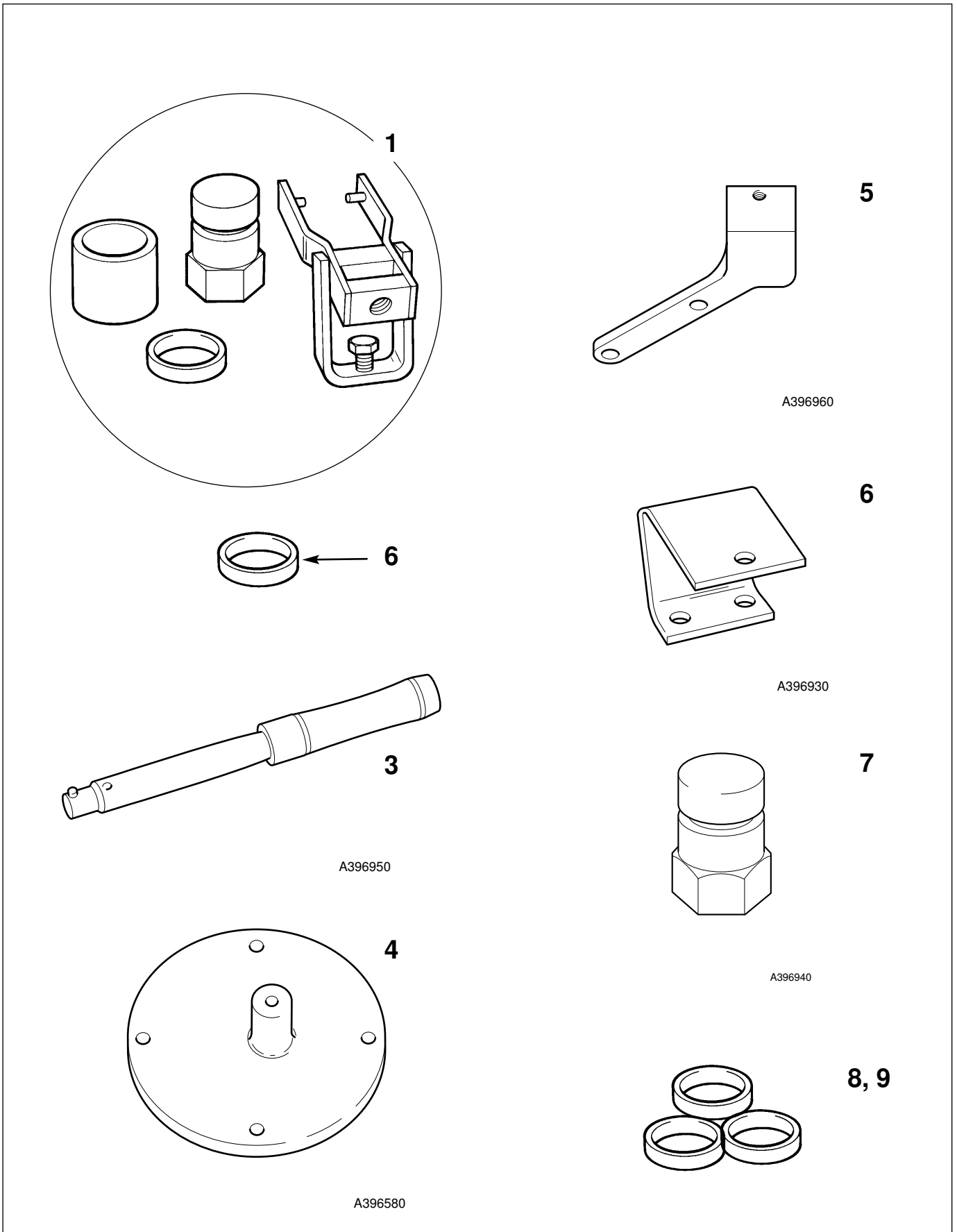


S188151



Service Tools (cont'd)

Section F - Transmission



**Service Tools (cont'd)**

**Section F - Transmission**

**Solid Spacer Setting Kit**

**Synchro Shuttle Gearbox, SD70, SD80 Axles**

**9** 921/53400 Spacer Kit - Sychro Shuttle Gearbox, SD70, SD80 Axles

Comprises of:

- 1 892/00918 Setting Tool Kit
- 2 921/52627 Spacer 14.20 Service use
- 3 993/70111 Breakback Torque Wrench
- 4 892/01076 Support Bracket -  
Synchro Shuttle Gearbox
- 5 892/01075 Support Bracket  
PD70, SD80 Rear Axles
- 6 997/11000 Support Bracket  
SD55, SD70 Front Axles
- 7 998/10567 SD80 Pinion Shaft Adaptor

Spacer thickness mm

**8** 921/53300 Spacer Kit - SD55 Axles

Comprises of:

- |           |                     |
|-----------|---------------------|
|           | Spacer thickness mm |
| 921/53322 | 13.550              |
| 921/53323 | 13.575              |
| 921/53324 | 13.600              |
| 921/53325 | 13.625              |
| 921/53301 | 13.650              |
| 921/53302 | 13.675              |
| 921/53303 | 13.700              |
| 921/53304 | 13.725              |
| 921/53305 | 13.750              |
| 921/53306 | 13.775              |
| 921/53307 | 13.800              |
| 921/53308 | 13.825              |
| 921/53309 | 13.850              |
| 921/53310 | 13.875              |
| 921/53311 | 13.900              |
| 921/53312 | 13.925              |
| 921/53313 | 13.950              |
| 921/53314 | 13.975              |
| 921/53315 | 14.000              |
| 921/53316 | 14.025              |
| 921/53317 | 14.050              |
| 921/53318 | 14.075              |
| 921/53319 | 14.100              |
| 921/53320 | 14.125              |
| 921/53321 | 14.150              |

- |           |        |
|-----------|--------|
| 921/52628 | 12.600 |
| 829/30405 | 12.625 |
| 921/52629 | 12.650 |
| 829/30406 | 12.675 |
| 921/52630 | 12.700 |
| 829/30407 | 12.725 |
| 921/52601 | 12.750 |
| 829/30408 | 12.775 |
| 921/52602 | 12.800 |
| 829/30409 | 12.825 |
| 921/52603 | 12.850 |
| 829/30410 | 12.875 |
| 921/52604 | 12.900 |
| 829/30411 | 12.925 |
| 921/52605 | 12.950 |
| 829/30412 | 12.975 |
| 921/52606 | 13.000 |
| 829/30413 | 13.025 |
| 921/52607 | 13.050 |
| 829/30414 | 13.075 |
| 921/52608 | 13.100 |
| 829/30415 | 13.125 |
| 921/52609 | 13.150 |
| 829/30416 | 13.175 |
| 921/52610 | 13.200 |
| 829/30417 | 13.225 |
| 921/52611 | 13.250 |
| 921/53424 | 13.275 |
| 921/53425 | 13.300 |
| 921/53426 | 13.325 |
| 921/53427 | 13.350 |
| 921/53428 | 13.375 |
| 921/53401 | 13.400 |
| 921/53402 | 13.425 |
| 921/53403 | 13.450 |
| 921/53404 | 13.475 |
| 921/53405 | 13.500 |
| 921/53406 | 13.525 |
| 921/53407 | 13.550 |
| 921/53408 | 13.575 |
| 921/53409 | 13.600 |
| 921/53410 | 13.625 |
| 921/53411 | 13.650 |
| 921/53412 | 13.675 |
| 921/53413 | 13.700 |
| 921/53414 | 13.725 |
| 921/53415 | 13.750 |
| 921/53416 | 13.775 |
| 921/53417 | 13.800 |
| 921/53418 | 13.825 |
| 921/53419 | 13.850 |
| 921/53420 | 13.875 |
| 921/53421 | 13.900 |
| 921/53422 | 13.925 |
| 921/53423 | 13.950 |
| 921/52626 | 14.000 |

**Note:** After using a spacer, obtain a replacement to keep the set complete.

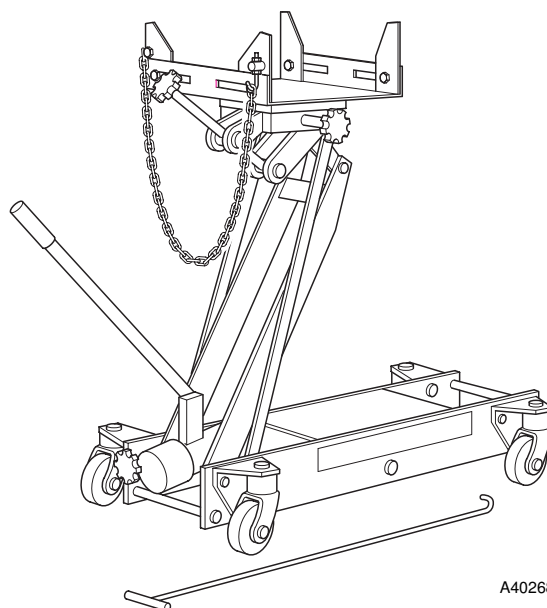
**Service Tools (cont'd)**

**Section F - Transmission**

- 892/01083 Powershift - Assembly tool, transfer gear.
- 892/01084 Powershift - Transfer gear, bearing assembly.
- 892/01085 Powershift - Seal fitting tool

**892/01094 Transmission Jack**

When removing the Powershift gearbox use of a special transmission jack is strongly recommended. This jack can also be used when removing Synchro Shuttle gearboxes.  
 Note that the jack must be used with special support plates, see below.



\* Powershift - Support plates, for use with transmission jack, Manufacture locally, for details see **Section F, Service Tools.**

892/01082 - Powershift - Assembly Cradle, for details see **Section F, Service Tools.**

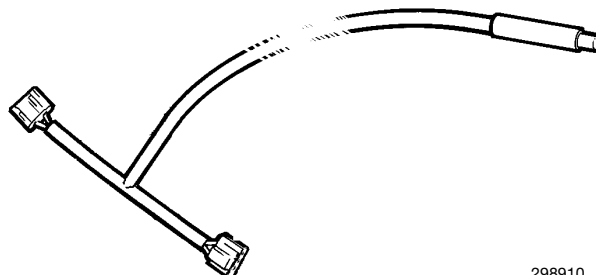
\* Powershift - Gearbox hydraulic pump removal tools, allow pump to be removed with torque converter housing fitted to gearbox. Manufacture locally, for details see **Section F, Service Tools.**

**823/10420 Thrust Washer Kit - Powershift gearbox - Layshaft clutch**

Comprises of:

	Washer thickness mm
823/10421	4.3
823/10422	4.4
823/10423	4.5
823/10424	4.6
823/10425	4.7
823/10426	4.8

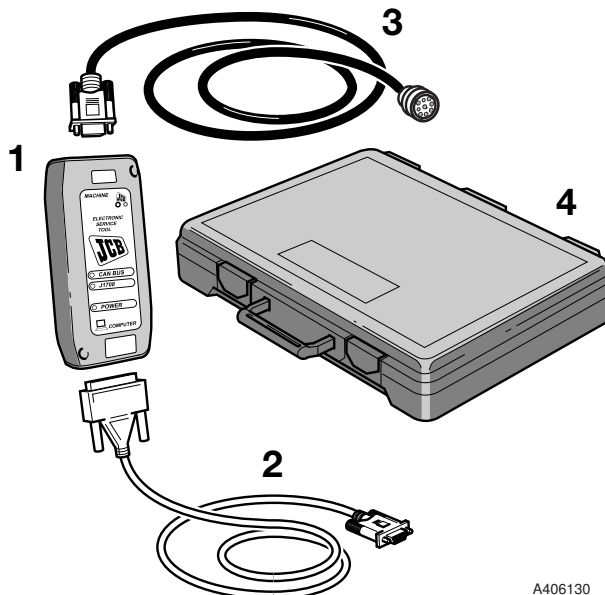
**892/01096 Speed Sensor Test Harness - Powershift Gearbox**



**Service Tools (cont'd)****Section F - Transmission****Powershift Gearbox - 6 Speed (ShiftMaster)  
Electronic Service Tool Kit**

892/01033 Kit comprises:

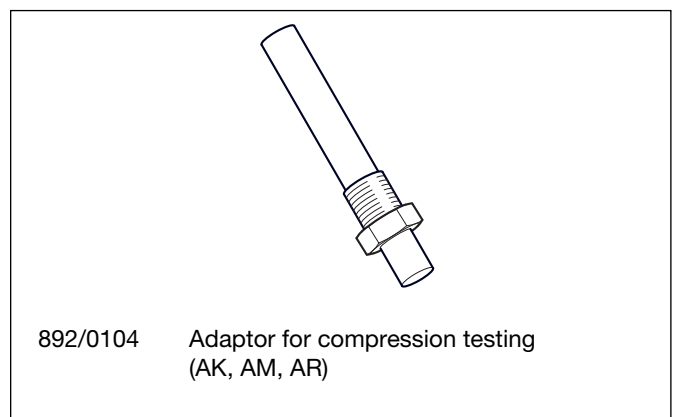
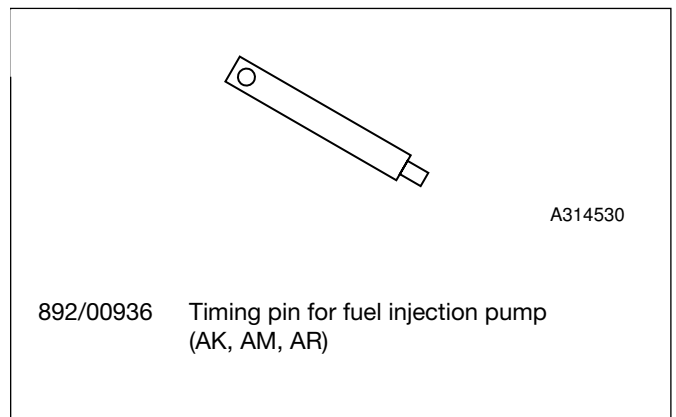
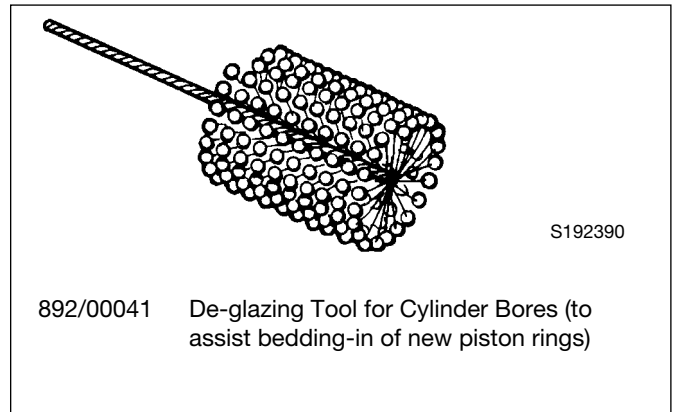
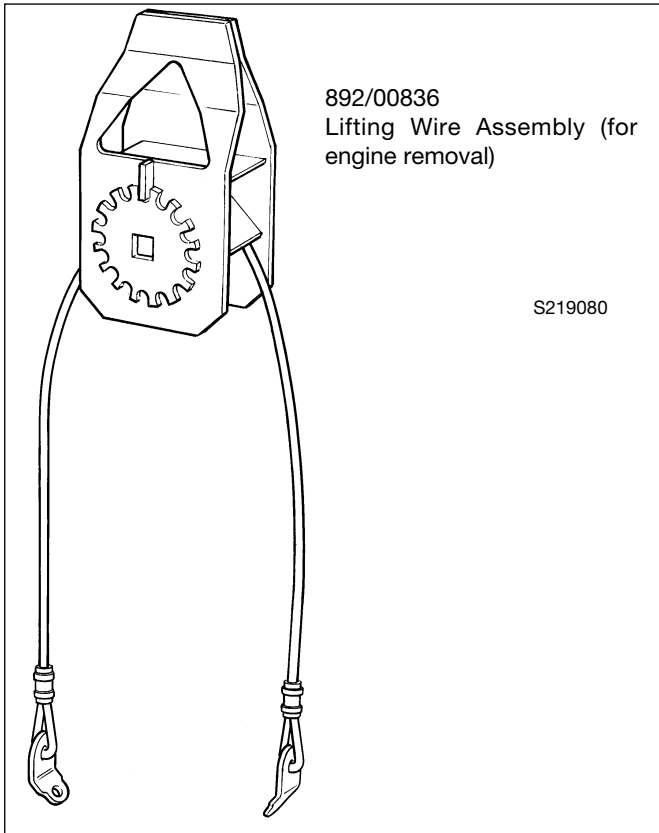
- 1 Data Link Adaptor (DLA), enables data exchange between the machine ECU (Electronic Control Unit) and a laptop PC loaded with the applicable ShiftMaster diagnostics software.
- 2 Interconnecting cable, DLA to laptop PC. Several cables are included to enable compatibility with different PC port types.
- 3 Interconnecting cable, DLA to machine ECU diagnostics socket.
- 4 Kit carrying case.



A406130

**Service Tools (cont'd)**

**Section K - Engine**



For details of other engine service tools refer to Engine Service Manual, Publication No. 9806/0100 or 9806/2140 for low emission engines.

## Sealing and Retaining Compounds

<b>JCB Multi-Gasket</b>	A medium strength sealant suitable for all sizes of gasket flanges, and for hydraulic fittings of 25-65mm diameter.	4102/1212	50ml
<b>JCB High Strength Threadlocker</b>	A high strength locking fluid for use with threaded components. Gasketing for all sizes of flange where the strength of the joint is important.	4102/0551	50ml
<b>JCB Retainer (High Strength)</b>	For all retaining parts which are unlikely to be dismantled.	4101/0651	50ml
<b>JCB Threadlocker and Sealer</b>	A high strength locking fluid for sealing and retaining nuts, bolts, and screws up to 50mm diameter, and for hydraulic fittings up to 25mm diameter.	4101/0250 4101/0251	10ml 50ml
<b>Threadseal</b>	A medium strength thread sealing compound.	4102/1951	50ml
<b>Threadlocker</b>	A locking fluid for use on threads larger than 50mm dia.	4101/0451	50ml
<b>Activator</b>	A cleaning primer which speeds the curing rate of anaerobic products.	4104/0251 4104/0253	(1ltr) Bottle (200ml)
<b>Cleaner / Degreaser</b>	For degreasing components prior to use of anaerobic adhesives and sealants.	4104/1557	400ml
<b>Direct Glazing Kit</b>	For one pane of glass, comprises items marked †below plus applicator nozzle etc.	993/55700	
† <b>Ultra Fast Adhesive</b>	For direct glazing	4103/2109	310 ml
† <b>Active Wipe 205</b>	For direct glazing	4104/1206 4104/1203	30 ml 250 g
† <b>Black Primer 206J</b>	For direct glazing	4201/4906	30 ml
<b>Clear Silicone Sealant</b>	To seal butt jointed glass	4102/0933	
<b>Black Polyurethane Sealant</b>	To finish exposed edges of laminated glass	4102/2309	310 ml
<b>JCB Cleaner &amp; Degreaser</b>	For degreasing components prior to use of anaerobic adhesives and sealants.	4104/1538	Aerosol

<b>Contents</b>	<b>Page No.</b>
Safety Notices	1 - 1
General Safety	2 - 1
Operating Safety	3 - 1
Maintenance Safety	4 - 1

## Safety Notices

In this publication and on the machine, there are safety notices. Each notice starts with a signal word. The signal word meanings are given below.

### DANGER

Denotes an extreme hazard exists. If proper precautions are not taken, it is highly probable that the operator (or others) could be killed or seriously injured.

INT-1-2-1

### WARNING

Denotes a hazard exists. If proper precautions are not taken, the operator (or others) could be killed or seriously injured.

INT-1-2-2

### CAUTION

Denotes a reminder of safety practices. Failure to follow these safety practices could result in injury to the operator (or others) and possible damage to the machine.

INT-1-2-3



All construction and agricultural equipment can be hazardous. When a JCB machine is correctly operated and properly maintained, it is a safe machine to work with. But when it is carelessly operated or poorly maintained it can become a danger to you (the operator) and others.

Do not work with the machine until you are sure that you can control it.

Do not start any job until you are sure that you and those around you will be safe.

If you are unsure of anything, about the machine or the job, ask someone who knows. Do not assume anything.

#### Remember

**BE CAREFUL  
BE ALERT  
BE SAFE**

GEN-1-6

## General Safety

### **WARNING**

#### Decals

You can be injured if you do not obey the decal safety instructions. Keep decals clean. Replace unreadable or missing decals with new ones before operating the machine. Make sure replacement parts include warning decals where necessary.

INT-1-3-4

### **WARNING**

#### Lifting Equipment

You can be injured if you use faulty lifting equipment. Make sure that lifting equipment is in good condition. Make sure that lifting tackle complies with all local regulations and is suitable for the job. Make sure that lifting equipment is strong enough for the job.

INT-1-3-7

### **WARNING**

#### Care and Alertness

All the time you are working with or on the machine, take care and stay alert. Always be careful. Always be alert for hazards.

INT-1-3-5

### **WARNING**

#### Raised Attachments

Raised attachments can fall and injure you. Do not walk or work under raised attachments unless they are safely blocked.

INT-1-3-8

### **WARNING**

#### Clothing

You can be injured if you do not wear the proper clothing. Loose clothing can get caught in the machinery. Wear protective clothing to suit the job. Examples of protective clothing are: a hard hat, safety shoes, safety glasses, a well fitting overall, ear-protectors and industrial gloves. Keep cuffs fastened. Do not wear a necktie or scarf. Keep long hair restrained.

INT-1-3-6

## Operating Safety

### **WARNING**

#### **Machine Condition**

A defective machine can injure you or others. Do not operate a machine which is defective or has missing parts. Make sure the maintenance procedures in this handbook are completed before using the machine.

INT-2-1-2

### **WARNING**

#### **Controls**

You or others can be killed or seriously injured if you operate the control levers from outside the cab. Operate the control levers only when you are correctly seated inside the cab.

INT-2-1-3

### **WARNING**

#### **Machine Limits**

Operating the machine beyond its design limits can damage the machine, it can also be dangerous. Do not operate the machine outside its limits. Do not try to upgrade the machine performance with unapproved modifications.

INT-2-1-4

### **WARNING**

#### **Engine/Steering Failure**

If the engine or steering fails, stop the machine as quickly as possible. Do not operate the machine until the fault has been corrected.

INT-2-1-5

### **WARNING**

#### **Engine**

The engine has exposed rotating parts. Do not open the engine cover while the engine is running. Do not use the machine with the cover open.

INT-2-1-6/1

### **WARNING**

#### **Entering/Leaving**

Always face the machine when entering and leaving the cab. Use the step(s) and handrails. Make sure the step(s), handrails and your boot soles are clean and dry. Do not jump from the machine. Do not use the machine controls as handholds, use the handrails.

INT-2-1-7

### **WARNING**

#### **Exhaust Gases**

Breathing the machine exhaust gases can harm and possibly kill you. Do not operate the machine in closed spaces without making sure there is good ventilation. If possible, fit an exhaust extension. If you begin to feel drowsy, stop the machine at once. Get out of the cab into fresh air.

INT-2-1-10

### **WARNING**

#### **ROPS/FOPS Structure**

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

### **WARNING**

#### **Communications**

Bad communications can cause accidents. Keep people around you informed of what you will be doing. If you will be working with other people, make sure any hand signals that may be used are understood by everybody. Work sites can be noisy, do not rely on spoken commands.

INT-2-2-3

### **WARNING**

#### **Ramps and Trailers**

Water, mud, ice, grease and oil on ramps or trailers can cause serious accidents. Make sure ramps and trailers are clean before driving onto them. Use extreme caution when driving onto ramps and trailers.

INT-2-2-6

### **DANGER**

#### **Sparks**

Explosions and fire can be caused by sparks from the exhaust or the electrical system. Do not use the machine in closed areas where there is flammable material, vapour or dust.

INT-2-2-10

### **WARNING**

#### **Powershift Transmission**

Do not change from a high gear to a low gear (for instance, 4th to 1st) in one sudden movement whilst the machine is moving. Otherwise the machine will rapidly decelerate, you or others could be killed or seriously injured. When selecting lower gears, allow the engine speed to drop before each gear change.

2-1-1-9/1

## Maintenance Safety

### **WARNING**

#### Repairs

Do not try to do repairs or any other type of maintenance work you do not understand. To avoid injury and/or damage get the work done by a specialist engineer.

GEN-1-5

### **WARNING**

#### Modifications and Welding

Non-approved modifications can cause injury and damage. Parts of the machine are made from cast iron; welds on cast iron can weaken the structure and break. Do not weld cast iron. Contact your JCB distributor for advice before modifying the machine.

INT-3-1-2/1

### **WARNING**

#### Metal Splinters

You can be injured by flying metal splinters when driving metal pins in or out. Use a soft faced hammer or drift to remove and fit metal pins. Always wear safety glasses.

INT-3-1-3

### **WARNING**

#### Electrical Circuits

Understand the electrical circuit before connecting or disconnecting an electrical component. A wrong connection can cause injury and/or damage.

INT-3-1-4

### **WARNING**

#### Communications

Bad communications can cause accidents. If two or more people are working on the machine, make sure each is aware of what the others are doing. Before starting the engine make sure the others are clear of the danger areas; examples of danger areas are: the rotating blades and belt on the engine, the attachments and linkages, and anywhere beneath or behind the machine. People can be killed or injured if these precautions are not taken.

INT-3-1-5

### **WARNING**

#### Petrol

Do not use petrol in this machine. Do not mix petrol with the diesel fuel; in storage tanks the petrol will rise to the top and form flammable vapours.

INT-3-1-6

### **WARNING**

#### Battery

A battery with frozen electrolyte can explode if it is used or charged. Do not use a machine with a frozen battery. To help prevent the battery from freezing, keep the battery fully charged.

INT-3-1-7

### **WARNING**

#### Battery Gases

Batteries give off explosive gases. Keep flames and sparks away from the battery. Do not smoke close to the battery. Make sure there is good ventilation in closed areas where batteries are being used or charged. Do not check the battery charge by shorting the terminals with metal; use a hydrometer or voltmeter.

INT-3-1-8

### **WARNING**

#### Battery Terminals

The machine is negatively earthed. Always connect the negative pole of the battery to earth.

When connecting the battery, connect the earth (-) lead last.

When disconnecting the battery, disconnect the earth (-) lead first.

INT-3-1-9

### **WARNING**

#### Hydraulic Fluid

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

### **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

**Maintenance Safety (cont'd)****⚠ WARNING****Diesel Fuel**

Diesel fuel is flammable; keep naked flames away from the machine. Do not smoke while refuelling the machine or working on the engine. Do not refuel with the engine running. There could be a fire and injury if you do not follow these precautions.

INT-3-2-2

**⚠ WARNING****Oil**

Oil is toxic. If you swallow any oil, do not induce vomiting, seek medical advice. Used engine oil contains harmful contaminants which can cause skin cancer. Do not handle used engine oil more than necessary. Always use barrier cream or wear gloves to prevent skin contact. Wash skin contaminated with oil thoroughly in warm soapy water. Do not use petrol, diesel fuel or paraffin to clean your skin.

INT-3-2-3

**⚠ WARNING****Soft Ground**

A machine can sink into soft ground. Never work under a machine on soft ground.

INT-3-2-4

**⚠ WARNING****Tyres and Rims**

Over-inflated or over-heated tyres can explode. Follow the instructions in this handbook for inflating the tyres. Do not weld or cut rims. Get a tyre/wheel specialist to do any repair work.

INT-3-2-6

**⚠ WARNING****Hot Coolant**

The cooling system is pressurised when the engine is hot. Hot coolant can spray out when you remove the radiator cap. Let the system cool before removing the radiator cap. To remove the cap; turn it to the first notch and let the system pressure escape, then remove the cap.

INT-3-2-9

**⚠ WARNING**

Always wear safety glasses when dismantling assemblies containing components under pressure from springs. This will protect against eye injury from components accidentally flying out.

GEN 6-2

**⚠ CAUTION****Rams**

The efficiency of the rams will be affected if they are not kept free of solidified dirt. Clean dirt from around the rams regularly. When leaving or parking the machine, close all rams if possible to reduce the risk of weather corrosion.

INT-3-2-10

**⚠ CAUTION****Cleaning**

Cleaning metal parts with incorrect solvents can cause corrosion. Use only recommended cleaning agents and solvents.

INT-3-2-11

**⚠ CAUTION****'O' rings, Seals and Gaskets**

Badly fitted, damaged or rotted 'O' rings, seals and gaskets can cause leakages and possible accidents. Renew whenever disturbed unless otherwise instructed. Do not use Trichloroethane or paint thinners near 'O' rings and seals.

INT-3-2-12

**⚠ WARNING****Fires**

If your machine is equipped with a fire extinguisher, make sure it is checked regularly. Keep it in the operator's cab until you need to use it.

Do not use water to put out a machine fire, you could spread an oil fire or get a shock from an electrical fire. Use carbon dioxide, dry chemical or foam extinguishers. Contact your nearest fire department as quickly as possible. Firefighters should use self-contained breathing apparatus.

INT-3-2-7/1

**⚠ WARNING****Jacking**

A machine can roll off jacks and crush you unless the wheels have been chocked. Always chock the wheels at the opposite end of the machine that is to be jacked. Do not work underneath a machine supported only by jacks. Always support a jacked-up machine on axle stands before working underneath it.

INT-3-2-8

**Maintenance Safety (cont'd)****⚠ WARNING****Hydraulic Hoses**

Damaged hoses can cause fatal accidents. Inspect the hoses regularly for:

- Damaged end fittings
- Chafed outer covers
- Ballooned outer covers
- Kinked or crushed hoses
- Embedded armouring in outer covers
- Displaced end fittings.

INT-3-3-2

**⚠ WARNING****Safety Strut**

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

2-1-1-6

**⚠ WARNING**

A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN-1-1

**⚠ WARNING**

Waxoyl contains turpentine substitute, which is flammable. Keep flames away when applying Waxoyl. Waxoyl can take a few weeks to dry completely. Keep flames away during the drying period.

Do not weld near the affected area during the drying period. Take the same precautions as for oil to keep Waxoyl off your skin. Do not breathe the fumes. Apply in a well-ventilated area.

5-3-1-9

**⚠ 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

**⚠ WARNING**

To avoid burning, wear protective gloves when handling hot components. To protect your eyes, wear goggles when using a wire brush to clean components.

HYD 1-3

**⚠ WARNING****JCB Extradig Dipper Lubricant**

JCB Extradig dipper lubricant contains 1.53% lead. The repeated swallowing of very small quantities can cause chronic lead poisoning. Do not smoke or touch food while handling this lubricant. Dispose of waste (rags etc.) in accordance with local regulations.

2-1-1-8

**⚠ WARNING****Fluoroelastomeric Materials**

Certain seals and gaskets (e.g. crankshaft oil seal) on JCB machines contain fluoroelastomeric materials such as Viton, Fluorel and Technoflon. Fluoroelastomeric materials subjected to high temperatures can produce highly corrosive hydrofluoric acid. THIS ACID CAN SEVERELY BURN.

New fluoroelastomeric components at ambient temperature require no special safety precautions.

Used fluoroelastomeric components whose temperatures have not exceeded 300°C require no special safety precautions. If evidence of decomposition (e.g. charring) is found, refer to the next paragraph for safety instructions DO NOT TOUCH COMPONENT OR SURROUNDING AREA.

Used fluoroelastomeric components subjected to temperatures greater than 300°C (e.g. engine fire) must be treated using the following safety procedure. Make sure that heavy duty gloves and special safety glasses are worn:

- 1 Ensure that components have cooled then remove and place material into plastic bags.
- 2 Thoroughly wash contaminated area with 10% calcium hydroxide or other suitable alkali solution, if necessary use wire wool to remove burnt remains.
- 3 Thoroughly wash contaminated area with detergent and water.
- 4 Contain all removed material, gloves etc. used in this operation in sealed plastic bags and dispose of in accordance with Local Authority Regulations.

DO NOT BURN FLUOROELASTOMERIC MATERIALS.

If contamination of skin or eyes occurs, wash the affected area with a continuous supply of clean water or with calcium hydroxide solution for 15-60 minutes. Get medical attention immediately.

INT-3-3-5/1

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**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.

A badly maintained machine is a danger to the operator and the people working around him. Make sure that the regular maintenance and lubrication jobs listed in the service schedules are done to keep the machine in a safe and efficient working condition.

Apart from the daily jobs, the schedules are based on machine running hours. Keep a regular check on the hourmeter readings to correctly gauge service intervals. Do not use a machine which is due for a service. Make sure any defects found during the regular maintenance checks are rectified immediately.

**⚠ WARNING**

**Maintenance**

**Maintenance must be done by suitably qualified personnel. Before attempting any maintenance work, make sure the machine is safe. Park on level ground. If it is necessary to work with the loader arms raised, then the loader arm safety strut must be fitted as shown in Loader Arm Safety Strut in MAINTENANCE section.**

2-3-1-1

**Calendar equivalents:**

- 10 Hours = Daily
- 50 Hours = Weekly
- 500 Hours = Six Months
- 1000 Hours = Yearly
- 2000 Hours = 2 Years

Pre-start Cold Checks	Operation	10 Hr	50 Hr	100 Hr	500 Hr	1000 Hr	2000 Hr
<b>Service Points and Fluid Levels</b>							
<b>ENGINE</b>							
Oil level	- Check	•	•				
Oil and Filter ④	- Change			•	•	•	•
Air Cleaner Outer Element ⑥	- Change					•	•
Air Cleaner Inner Element	- Change						•
Fuel Filter	- Change			•	•	•	•
Fuel Filter	- Drain		•				
Coolant Quality/Level	- Check	•	•	•	•	•	•
Fuel Sedimenter	- Drain and Clean		•	•	•	•	•
Fan Belt Tension/Condition	- Check		•	•	•	•	•
Valve Clearances and Clean Breather Gauze (if fitted) ③	- Check and Adjust						•
Engine Mounting Bolts for Tightness ③	- Check			•	•	•	•
Radiator	- Clean				•	•	•
All Hoses - Condition	- Check			•	•	•	•
<b>TRANSMISSION, AXLES AND STEERING</b>							
Transmission Oil Level	- Check	•	•	•	•		
Transmission Oil ⑧	- Change					•	•
Transmission Filter	- Change			•	•	•	•
Axle Oil Level (incl. Hubs when applicable) ①	- Check			•	•		
Axle Oil (incl. Hubs when applicable) ②	- Change					•	•
Axle Oil - Limited Slip Differential	- Change				•	•	•
Tyre Pressures/Condition	- Check	•	•	•	•	•	•
Front Hub Bearings ③	- Check			•	•	•	•
Transmission Strainer	- Clean					•	•
Drive Shafts	- Security/Grease			•	•	•	•
Steer Axle Movement/Shimming ③	- Check			•	•	•	•
Steer Axle Pivots and Linkages ⑦	- Grease			•	•	•	•
Front Axle Main Pivot	- Grease	•	•	•	•	•	•
<b>HYDRAULICS</b>							
Oil Level ②	- Check	•	•	•	•	•	
Oil ③	- Sample/Change						•
Oil Filter	- Change			•	•	•	•
Rams - Chrome Condition	- Check			•	•	•	•

<b>Pre-start Cold Checks</b>	<b>Operation</b>	<b>10 Hr</b>	<b>50 Hr</b>	<b>100 Hr</b>	<b>500 Hr</b>	<b>1000 Hr</b>	<b>2000 Hr</b>
<b>Service Points and Fluid Levels</b>							
Hydraulic Oil Cooler	- Clean				•	•	•
Hydraulic Oil Strainer	- Clean						•
Hydraulic Tank Filler Cap (with integral filter)	- Change						•
Hydraulic Pump Drive Shaft	- Examine/Grease			•	•	•	•
<b>BRAKES</b>							
Brake System Fluid Level	- Check	•	•	•	•	•	•
Brake System Fluid ③	- Change						•
Parking Brake	- Check and Adjust			•	•	•	•
<b>ELECTRICS</b>							
Battery Electrolyte Level (if applicable)	- Check				•	•	•
Wiring for Chaffing/Routing	- Check		•	•	•	•	•
Battery Terminals for Condition and Tightness	- Check			•	•	•	•
<b>BODYWORK AND CAB</b>							
All Pins and Bushes	- Check and Grease	•	•	•	•	•	•
Door/Window Hinges	- Lubricate				•	•	•
All Cables	- Lubricate				•	•	•
Cab Heater Filter ⑥	- Clean/Change				•	•	•
Extending Dipper	- Adjust/Grease		•	•	•	•	•
Hydraclamp ③	- Check and Adjust			•	•	•	•
Door - Fit and Catches	- Check			•	•	•	•
Cab Seat - Operation	- Check			•	•	•	•
Front Mudguards - Security (if fitted)	- Check			•	•		
Windscreen Washer Fluid Level	- Check	•	•	•	•	•	•
Boom Lock Engagement	- Check	•	•	•	•	•	•
Condition of Paintwork	- Check			•	•	•	•
Stabiliser Legs (Sideshift)	- Check/Adjust		•	•	•	•	•
Machine Generally ③	- Check and Clean	•	•	•	•	•	•
Power Sideshift Wear Pads	- Grease	•	•	•	•	•	•
Power Sideshift Wear Pads	- Check					•	•
Power Sideshift Chain	- Lubricate		•	•	•	•	•
Power Sideshift Chain Tension	- Check/Adjust			•	•	•	•
<b>ATTACHMENTS</b>							
6-in-1 Clam Shovel	- Grease	•	•	•	•	•	•
Backhoe & Loader Quick Hitch	- Grease	•	•	•	•	•	•
<b>Functional Test and Final Inspection</b>							
<b>ENGINE</b>	<b>Operation</b>	<b>10 Hr</b>	<b>50 Hr</b>	<b>100 Hr</b>	<b>500 Hr</b>	<b>1000 Hr</b>	<b>2000 Hr</b>
Idle Speed ③	- Check and Adjust			•	•	•	•
Stall Speed ③	- Check			•	•	•	•
Maximum No-Load Speed ③	- Check and Adjust			•	•	•	•
Exhaust Smoke (excessive)	- Check		•	•	•	•	•
Exhaust System Security ③	- Check			•	•	•	•
Air Inlet System Security	- Check			•	•	•	•
Throttle System and Control Cable ③	- Check			•	•	•	•
<b>TRANSMISSION, AXLES AND STEERING</b>							
Steer Modes - Operation/Phasing	- Check	•	•	•	•	•	•
2WD/4WD Selection	- Check			•	•	•	•
Wheel Nuts Torque	- Check	•	•	•	•	•	•
Forward/Reverse and Gear Change - Operation	- Check			•	•	•	•

Functional Test and Final Inspection	Operation	10 Hr	50 Hr	†100 Hr	500 Hr	1000 Hr	2000 Hr
Hydraulic Speed Control - Operation (if fitted)	- Check			•	•	•	•
Steer Circuit Pressure ③	- Check			•	•	•	•
Transmission Main Line Pressure ③	- Check				•	•	•
Transmission Dump Operation	- Check			•	•	•	•
Neutral Start Operation	- Check		•	•	•	•	•
Clutch Pack Pressures ③	- Check			•	•	•	•
<b>HYDRAULICS</b>							
MRV Pressure ③	- Check and Adjust			•	•	•	•
Operation All Services	- Check		•	•	•	•	•
Hose Burst Protection Valves (if fitted)	- Check			•	•	•	•
Offloader Valve Pressure ③	- Check and Adjust			•	•	•	•
Auxiliary Circuit & Pressures ③	- Check and Adjust			•	•	•	•
<b>BRAKES</b>							
Foot Brake - Operation	- Check	•	•	•	•	•	•
Parking Brake - Operation	- Check	•	•	•	•	•	•
Servo Operation (if fitted)	- Check			•	•	•	•
<b>ELECTRICS</b>							
Starter Motor	- Check			•	•	•	•
Alternator - Output	- Check			•	•	•	•
All Electrical Equipment Operation, (e.g. warning lights, beacon, alarms, horn, wipers etc)	- Check	•	•	•	•	•	•
Operation of Stop Control/E.S.O.S.	- Check	•	•	•	•	•	•
<b>BODYWORK AND CAB</b>							
Teeth and Side Cutters	- Check			•	•	•	•
Doors and Windows - Fitment/Leaks	- Check			•	•	•	•
Seat/Seat Belts	- Check			•	•	•	•

†Note: First 100 Hours Service only, to be completed by your JCB Distributor.

- ① **Note:** Check for leaks every 50 hours, check level if leaking.
- ② **Note:** Check the hydraulic fluid level with the loader and backhoe in the travel position.
- ③ **Note:** Jobs which should only be done by a specialist are indicated by a †.
- ④ **Note:** If operating under arduous conditions, change the engine oil and filter every 250 hours.
- ⑤ **Note:** Check generally for leaks on ALL systems, for example, hydraulic, engine (coolant, fuel and oil), transmission, brakes, axles etc. If a leak is evident find the source and repair as required. Make sure that the system is topped up with the recommended fluid after repair. Examples of machine general damage are paintwork, toe plate, glazing rubbers etc., repair any damage as required. If any of the repair or top up procedures are not detailed in this handbook, then contact your local JCB Distributor for advice.
- ⑥ **Note:** If operating in dusty working environments, change more frequently.
- ⑦ **Note:** The axles and driveshafts are factory greased with a high performance grease, if during service a standard grease is used, then the interval must be reduced to every 50 hours, contact your JCB Distributor for advice.
- ⑧ **Note:** After a major transmission repair, the new oil should be run to operating temperature and changed again to remove any contamination which entered during the repair. Change the oil and filter after a further 100 hours if the oil was heavily contaminated because of, or from the failure (eg. water contamination).
- ⑨ **Note:** After a hub repair, the new oil should be run to operating temperature and changed again to remove any contamination which entered during the repair. Change the oil again after a further 100 hours to remove any bedding-in wear. This is particularly important if new brake plates have been fitted.

## Installing

Install the loader arm safety strut as detailed below before working underneath raised loader arms.

### **⚠ WARNING**

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

2-1-1-6

**1 Empty the Shovel and Raise the Loader Arms fully.**

**2 Stop the Engine**

Remove the starter key.

### **⚠ WARNING**

**You could be killed or injured if the loader control is accidentally operated. Make sure no-one comes near the machine while you release the safety strut.**

2-3-1-2

**3 Release the Strut**

- a Release fastener **A**.
- b Remove strut **C** from its stowage bracket.

**4 Install the Strut**

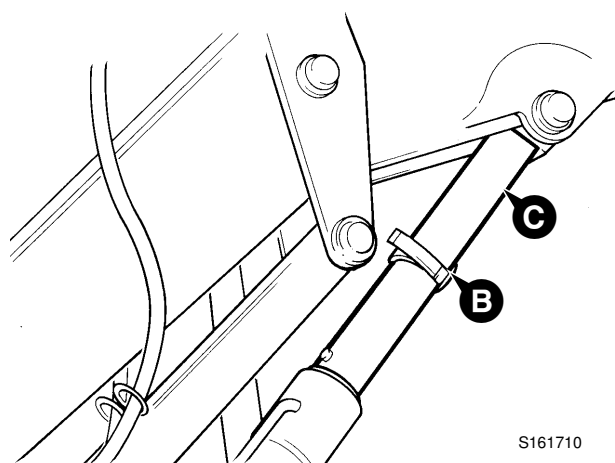
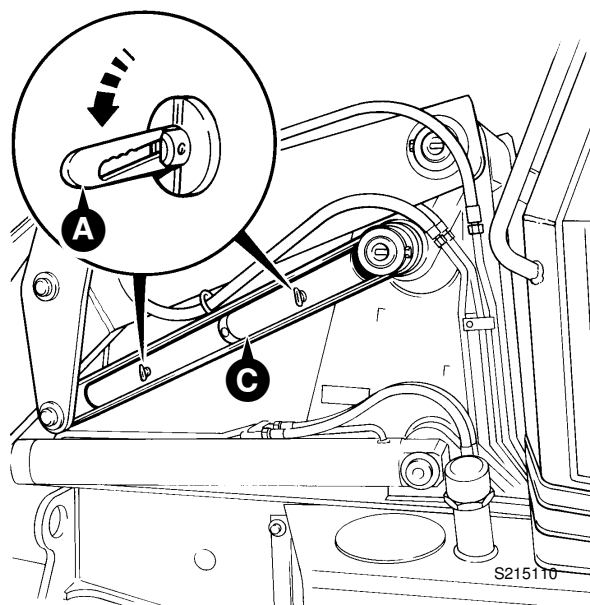
- a Push strut **C** over the ram piston rod.
- b Secure the strut in position with strap **B**.

**5 Lower the Strut Onto the Cylinder**

To prevent any chance of the loader arms creeping down and trapping your fingers, the loader arms should be carefully lowered onto the safety strut as shown.

Start the engine and slowly lower the loader arms onto the safety strut, stop the movement immediately the weight of the loader arms is supported by the safety strut.

**Note:** When lowering the loader, operate the control lever carefully. 'Feather' the lever to lower the loader very slowly.



## Removing

**1 Fully Raise the Loader Arms**

To take the weight off the safety strut.

**2 Stop the Engine**

Remove the starter key.

### **⚠ WARNING**

**You could be killed or injured if the loader control is accidentally operated. Make sure no one comes near the machine while you remove the safety strut.**

2-3-1-3

**3 Remove the Strut**

- a Undo the strap **B**.
- b Remove the strut **C** from the ram piston rod.

**4 Stow the Strut**

Secure the strut in its stowage position with fastener **A**.

Inspect steelwork for damage. Note damaged paintwork for future repair.

Make sure all pivot pins are correctly in place and secured by their locking devices.

Ensure that the steps and handrails are undamaged and secure.

Check for broken or cracked window glass. Replace damaged items.

Check all bucket teeth for damage and security.

Check all lamp lenses for damage.

Inspect the tyres for damage and penetration by sharp objects.

Check that all safety decals are in place and undamaged. Fit new decals where necessary.

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

Clean the machine using water and/or steam. Do not allow mud, debris etc to build upon the machine, pay particular attention to the following areas:

- 1 Backhoe hoses passing through mainframe.
- 2 Around twin slew rams.
- 3 Twin ram slew recess in chassis (centremount).
- 4 Kingpost slide rails (sideshift).
- 5 Kingpost hose tray and bottom 'shelf' (sideshift).
- 6 Recess between slew ram and kingpost casting (sideshift).

Stabiliser cavities can become clogged when operating in soft/wet ground conditions. Remove and clean away all debris that may have built up.

Do not allow mud to build up on the engine and transmission. Make sure the radiator grille is not clogged up.

### WARNING

**Airborne particles of light combustible material such as straw, grass, wood shavings, etc. must not be allowed to accumulate within the engine compartment or in the propshaft guards (when fitted). Please inspect these areas frequently and clean at the beginning of each work shift or more often if required. Before opening the engine cover, ensure that the top is clear of debris.**

5-3-1-12/2

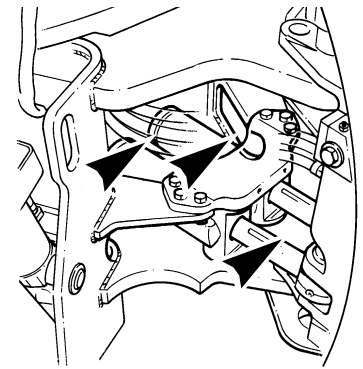
Avoid using neat detergent - always dilute detergents as per the manufacturer's recommendations, otherwise damage to the paint finish may occur.

It is important to note that excessive power washing can cause damage to the seals or bearings. Take care during routine machine washing not to direct high power water jets directly at oil seals or universal joints.

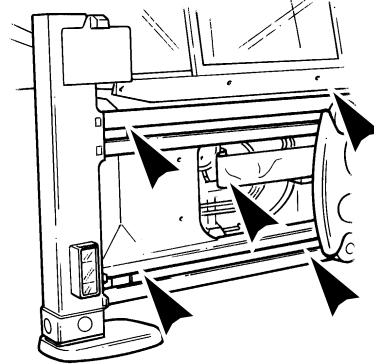
**Note:** The machine must always be greased after pressure washing or steam cleaning.

Always adhere to local regulations regarding the disposal of debris created from machine cleaning.

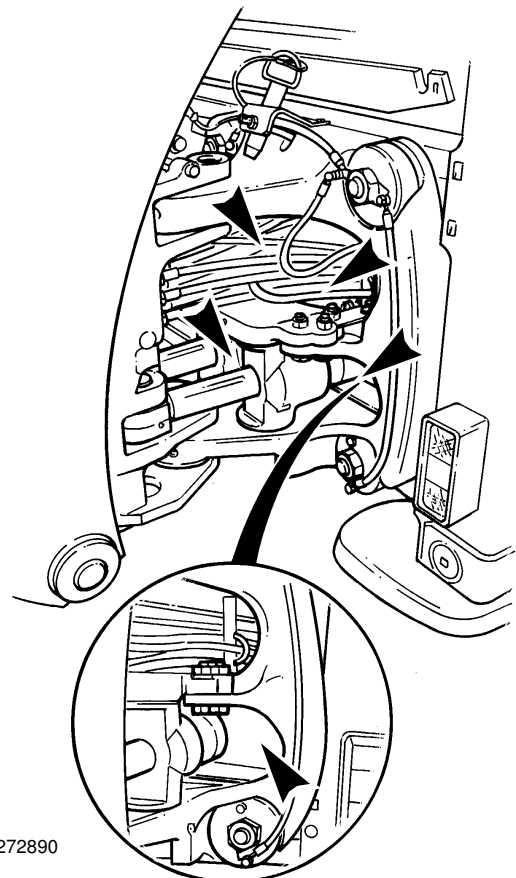
The illustrations show some of the areas that must be thoroughly cleaned as required.



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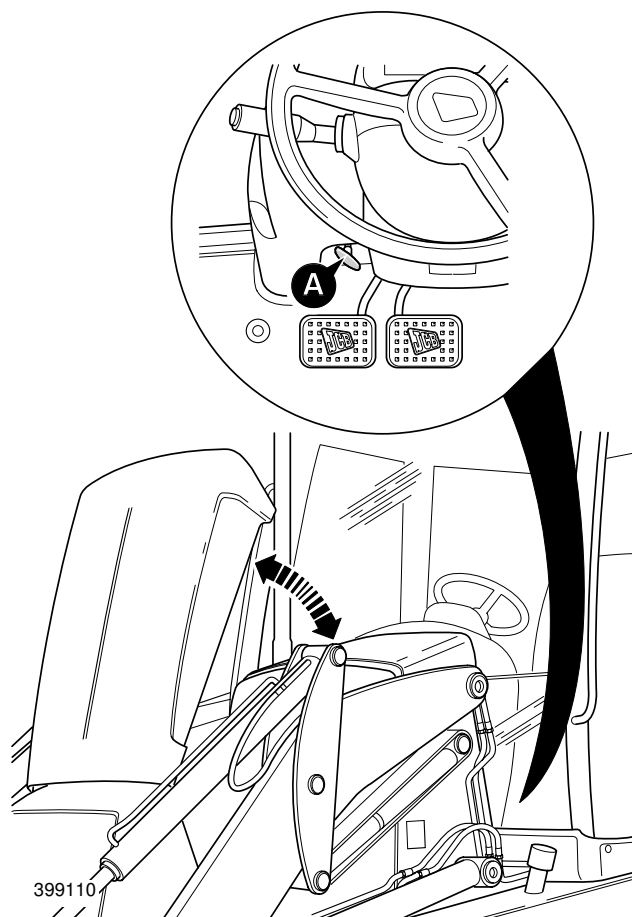


S272890

## Opening and Closing the Bonnet

To release the bonnet, pull handle **A**, the bonnet will automatically open and be supported on gas struts.

To close the bonnet, push the bonnet down, make sure it is locked in place and the side panels are located correctly.



## Removing and Fitting a Side Panel

### ⚠ WARNING

The loader arms must be raised and locked before you remove an engine side panel. Keep the arms locked up until the side panel is put back. If you do not lock the loader arms, the shovel can fall and you could be crushed. See Loader Arm Safety Strut in MAINTENANCE section.

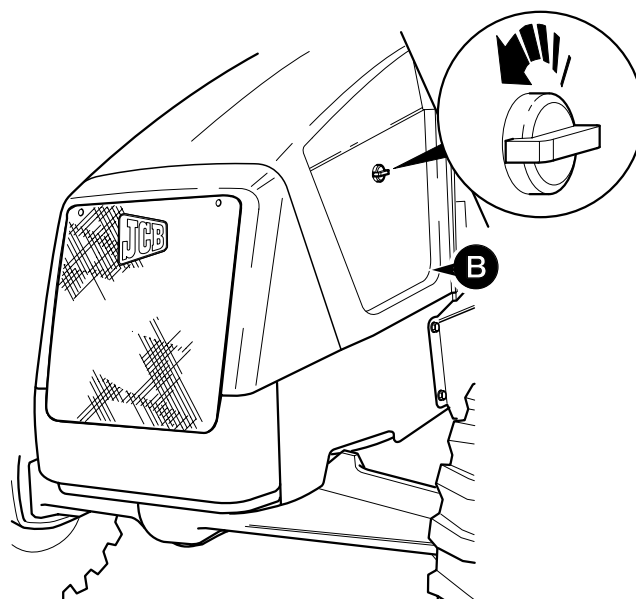
2-3-1-4/1

### ⚠ WARNING

Do not remove the engine side panel while the engine is running.

2-3-1-5

- 1 Raise the loader arms and fit the safety strut, see **Loader Arms Safety Strut**.
- 2 Stop the engine, and remove the starter key.
- 3 Open the bonnet.
- 4 Remove the side panel **B**, lift the side upwards and outwards.
- 5 Fit the side panel, carefully slot the side panel into position. Lower and lock the bonnet.





## Checking the Seat Belt Condition and Security

### WARNING

**When a seat belt is fitted to your machine replace it with a new one if it is damaged, if the fabric is worn, or if the machine has been in an accident. Fit a new seat belt every three years.**

2-3-1-7/1

Inspect the seat belt for signs of fraying and stretching. Check that the stitching is not loose or damaged. Check that the buckle assembly is undamaged and works correctly.

Check that the belt mounting bolts are undamaged, correctly fitted and tightened.

You must grease the machine regularly to keep it working efficiently. Regular greasing will also lengthen the machine's working life.

The machine must always be greased after pressure washing or steam cleaning.

**⚠ WARNING**

You will be working close into the machine for these jobs. Lower the attachments if possible. Remove the starter key and disconnect the battery. This will prevent the engine being started. Make sure the parking brake is engaged.

Check all four wheels before getting under the machine.

2-3-2-1

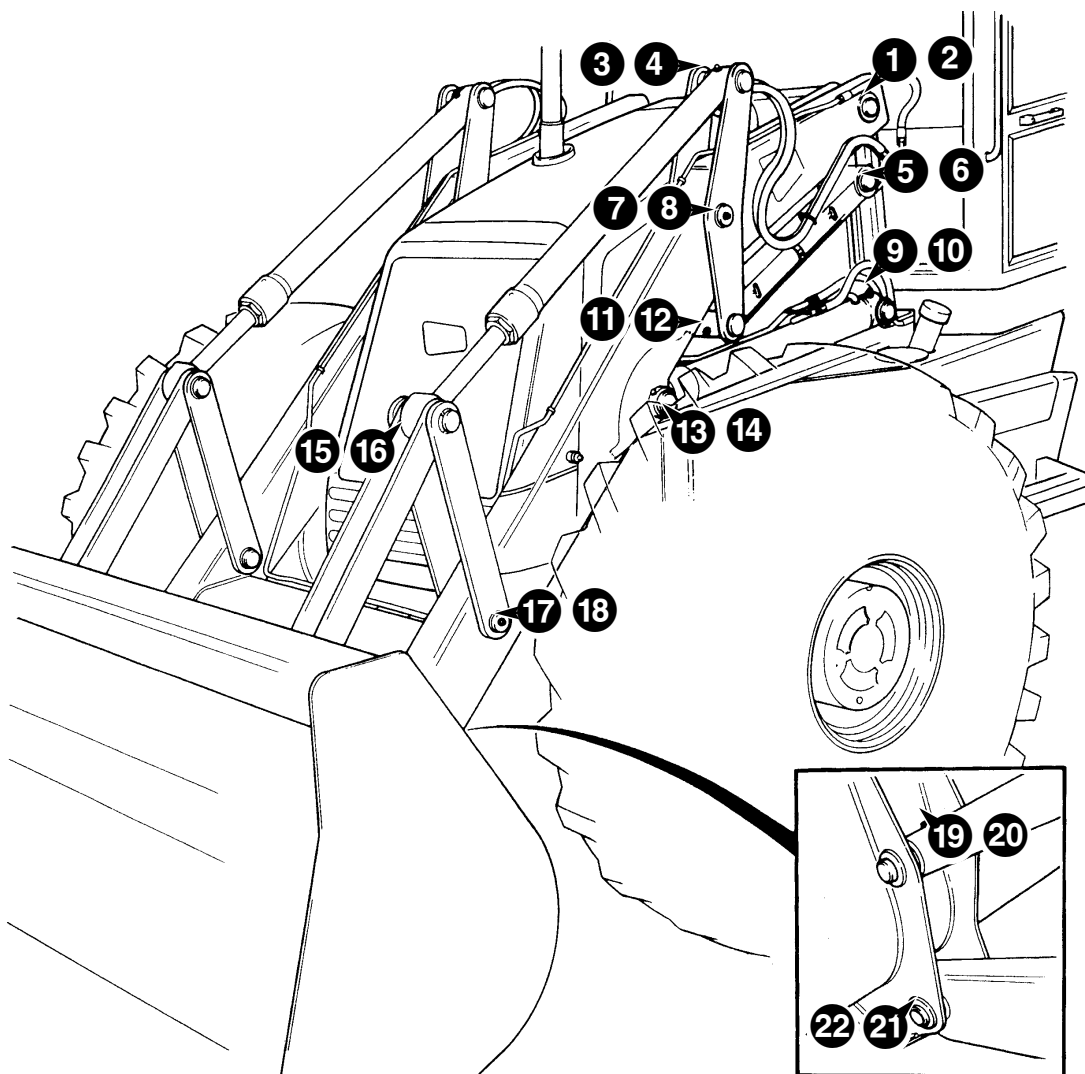
Greasing should be done with a grease gun. Normally, two strokes of the gun should be sufficient. Stop greasing when fresh grease appears at the joint.

In the following illustrations, the grease points are numbered. Count off the grease points as you grease each one. Refit the dust caps after greasing.

**Loader Arms**

For each grease point shown, there is another on the other side of the machine.

Total 22 grease points.

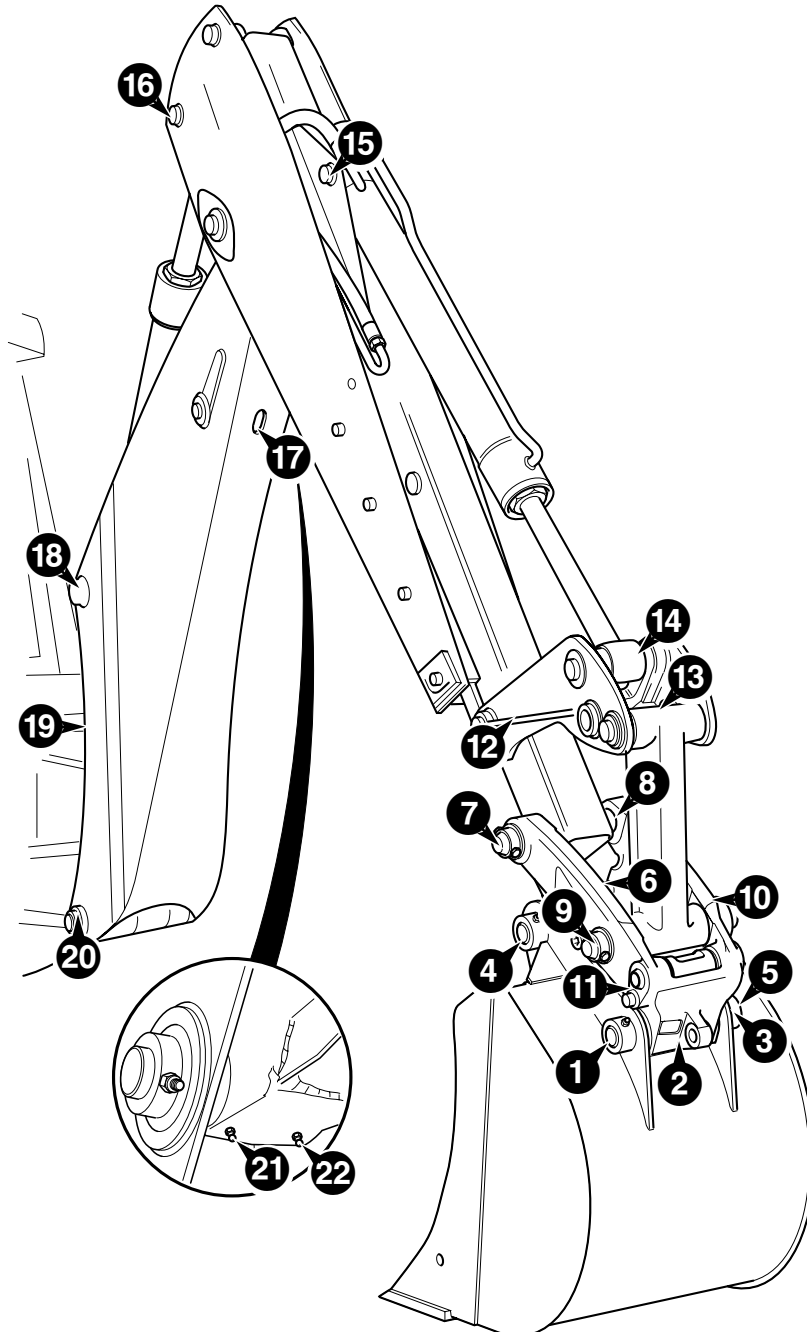


S260190

### Backhoe & Quickhitch

#### 22 Grease Points

**Note:** Figure shows a typical boom and dipper arrangement.

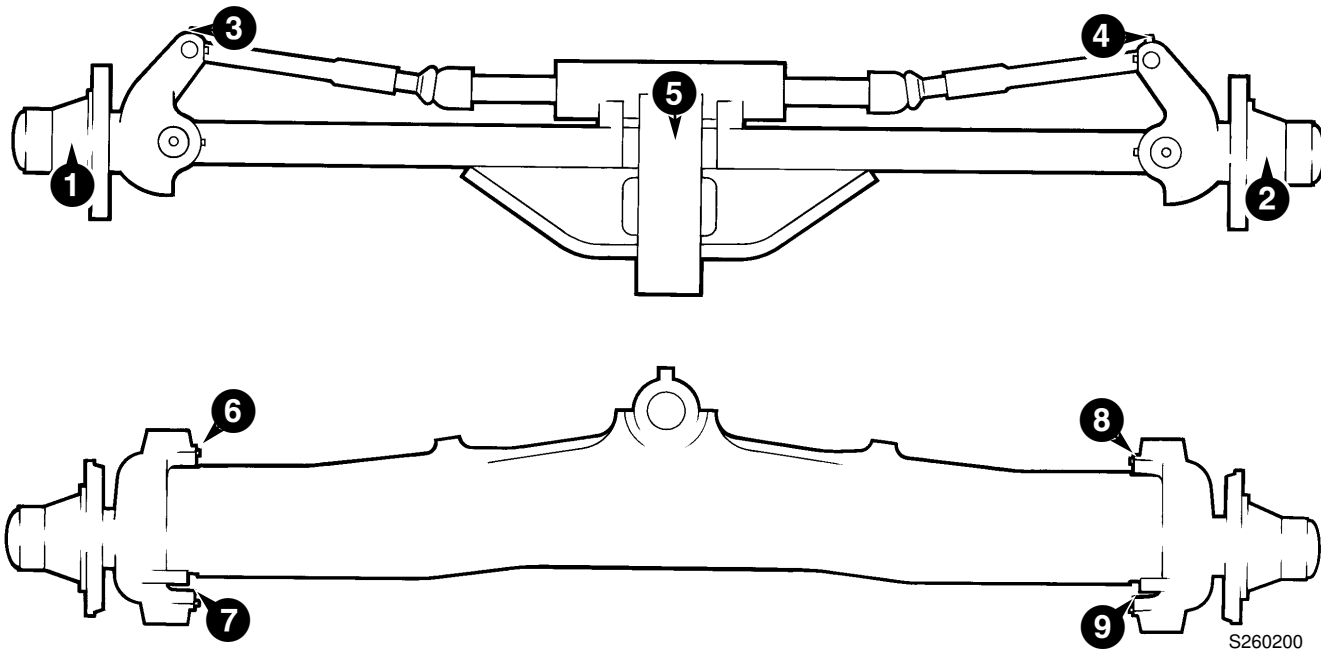


A340900

### Front Axle (2 Wheel Drive Machines)

9 Grease Points

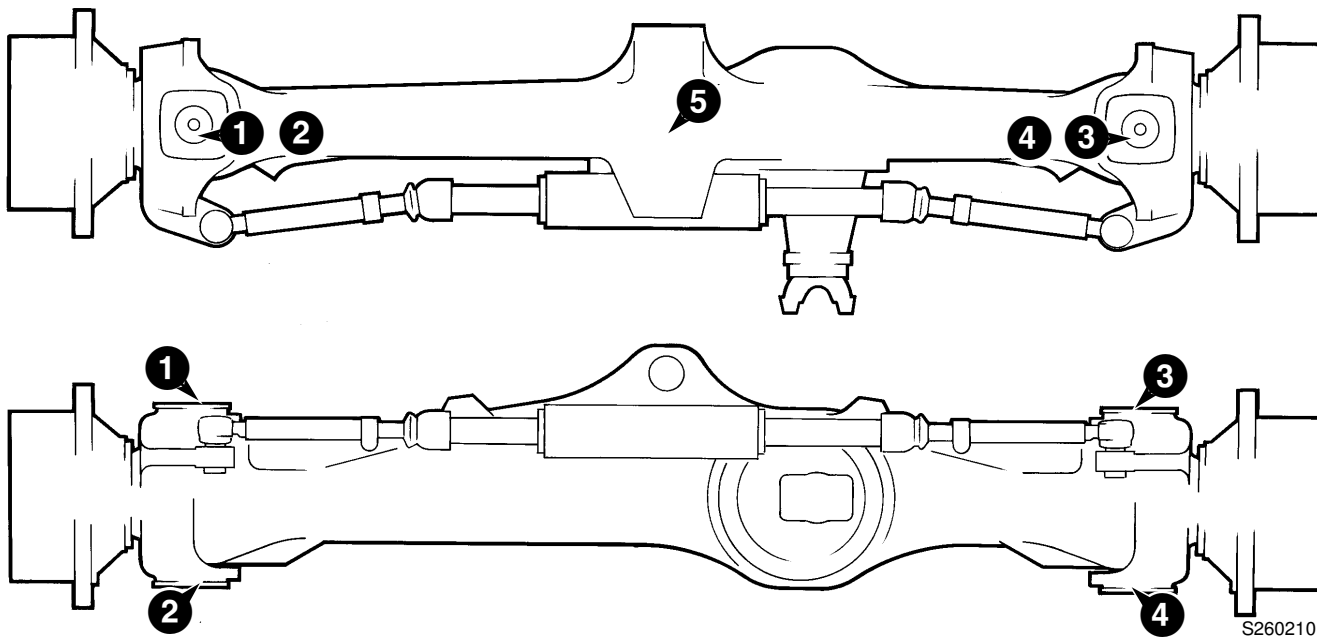
**Note:** Grease point 5 is a remote grease point mounted on the side of the mainframe chassis (near the left front wheel).



### Front Axle (4 Wheel Drive Machines)

5 Grease Points

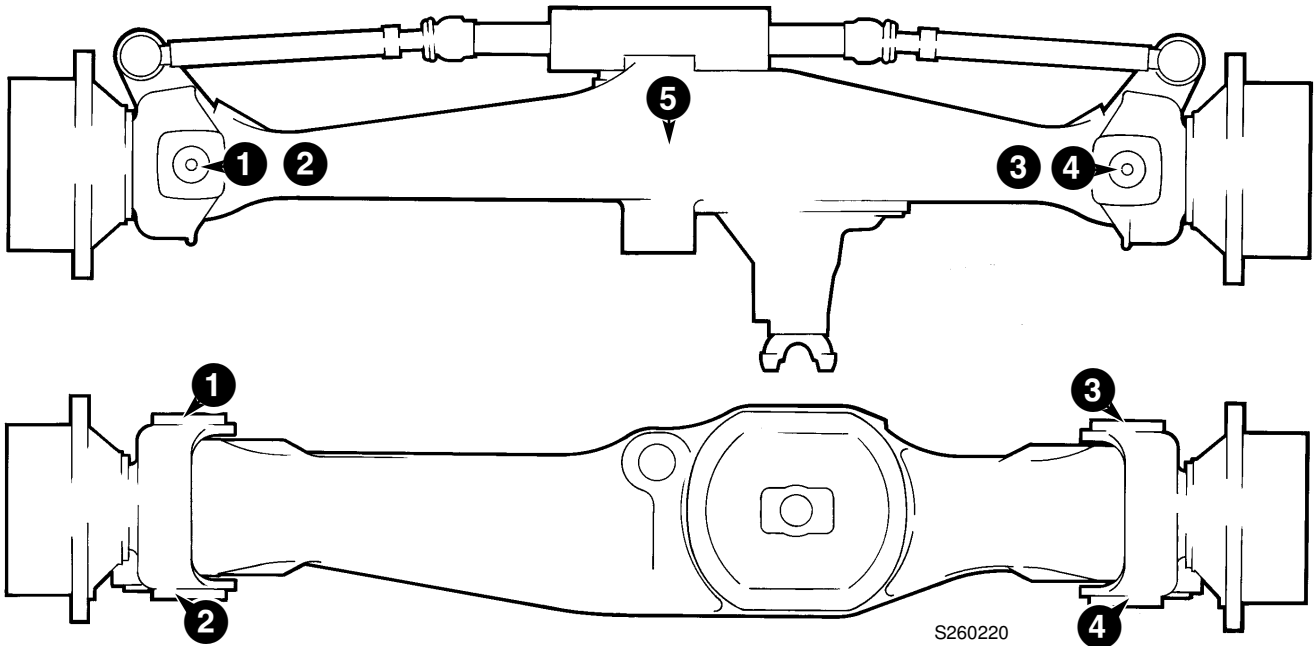
**Note:** Grease point 5 is a remote grease point mounted on the side of the mainframe chassis (near the left front wheel).



### Front Axle (All Wheel Steer Machines)

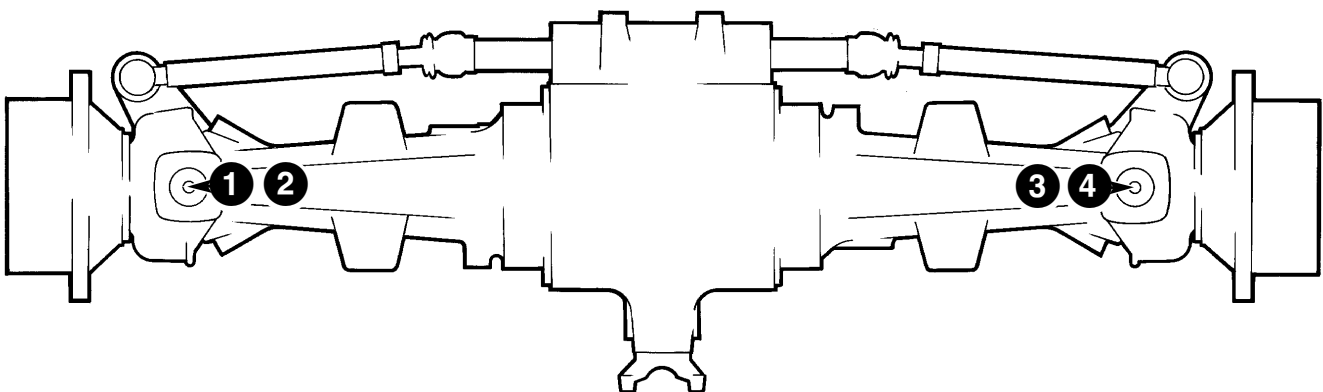
5 Grease Points

**Note:** Grease point 5 is a remote grease point mounted on the side of the front nose (near the left front wheel).



### Rear Axle (All Wheel Steer Machines)

4 Grease Points



### Extending Dipper

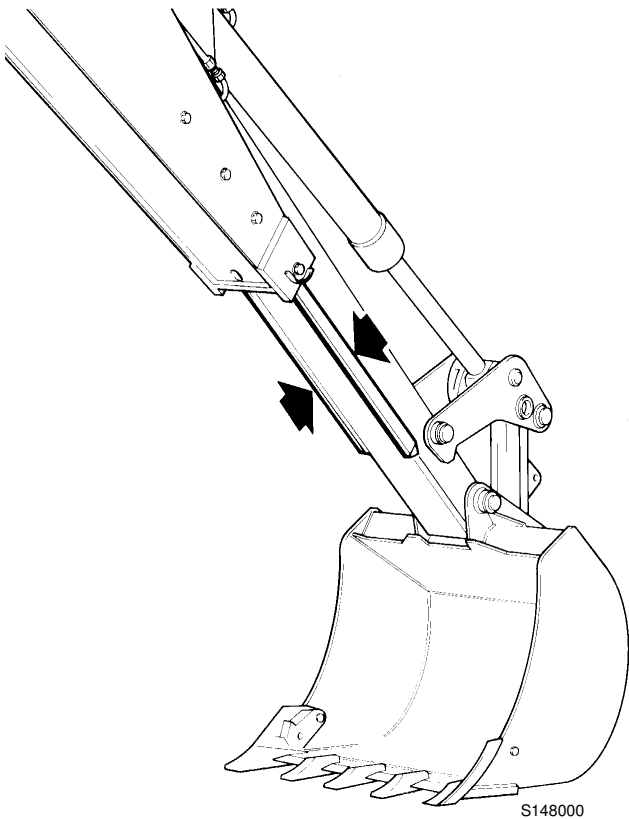
#### **⚠ CAUTION**

Waxoyl contains turpentine substitute, which is inflammable. Keep flames away when applying Waxoyl. Waxoyl can take a few weeks to dry completely. Keep flames away during the drying period.

Do not weld near the affected area during the drying period. Take the same precautions as for oil to keep Waxoyl off your skin. Do not breathe the fumes. Apply in a well-ventilated area.

5-3-1-9

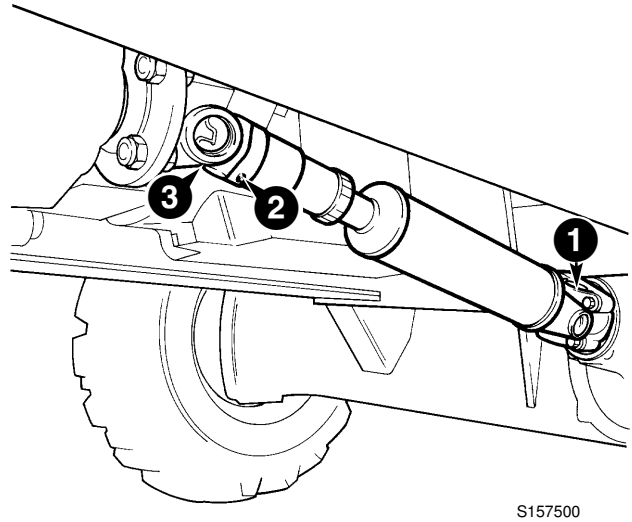
Extend the dipper. Coat the runners with **Waxoyl** as shown.



### Driveshafts

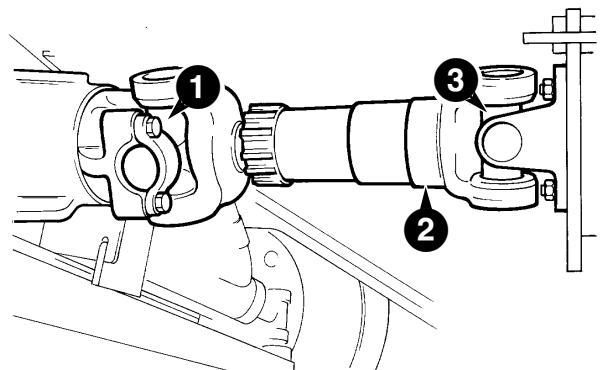
#### Front Driveshaft

#### 3 Grease Points



#### Rear Driveshaft

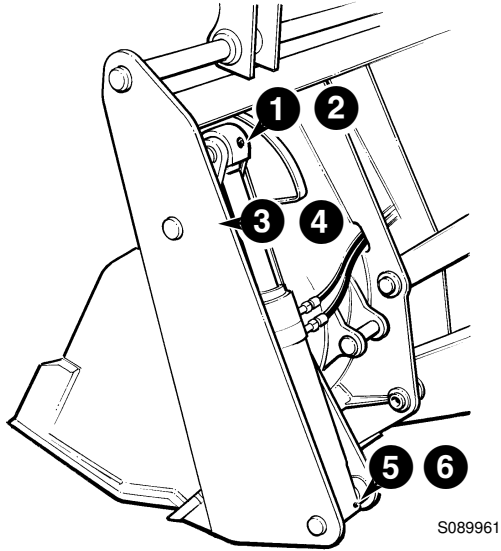
#### 3 Grease Points



**6 - In - 1 Clamshovel**

3 grease points each end -

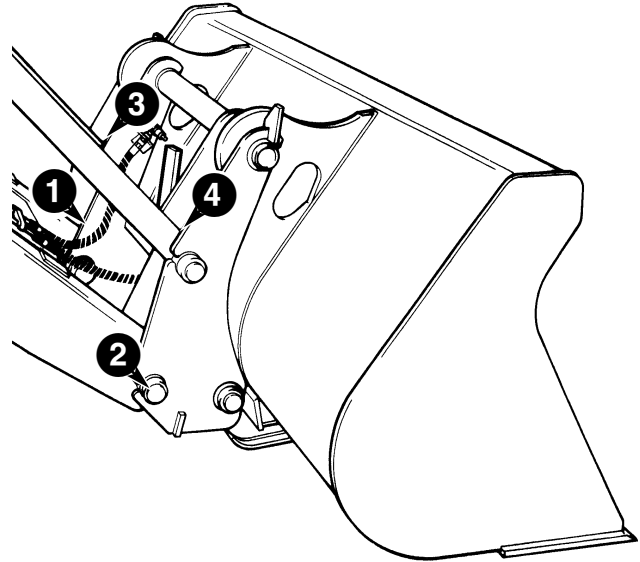
**Total 6 Grease Points**



**Loader Quickhitch**

2 grease points each end -

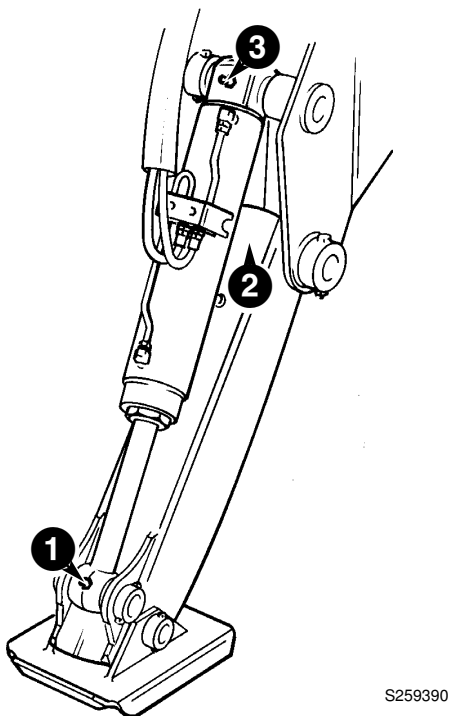
**Total 4 Grease Points**



**Stabilisers (Centremount Machines)**

3 grease points on each stabiliser -

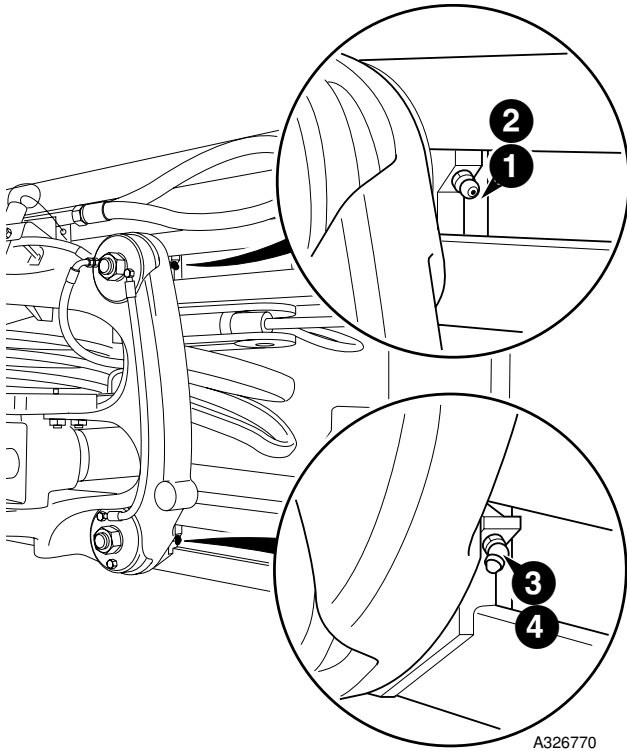
**Total 6 Grease Points**



### Power Sideshift

#### Total 4 Grease Points

**Note:** Release the kingpost clamps and lower the excavator to the ground before greasing.

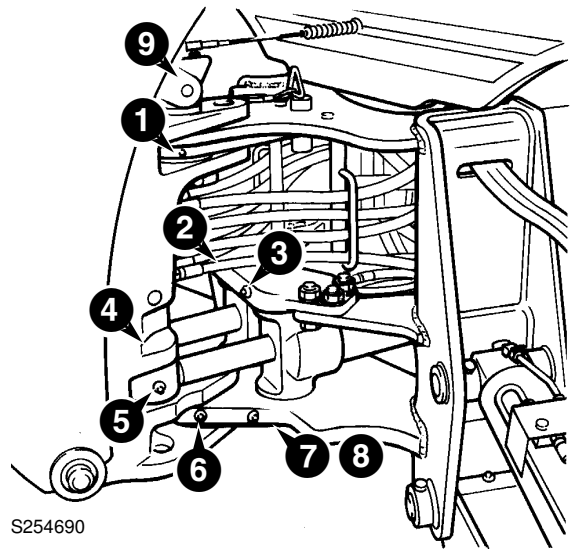


### Kingpost

#### 9 Grease Points

**Note:** Figure shows a centremount kingpost, greasing is same for sideshift kingpost.

**Note:** It is recommended that grease points 2 and 3 are lubricated using a hand grease gun. The use of a power grease gun may result in the mounting plate being distorted.

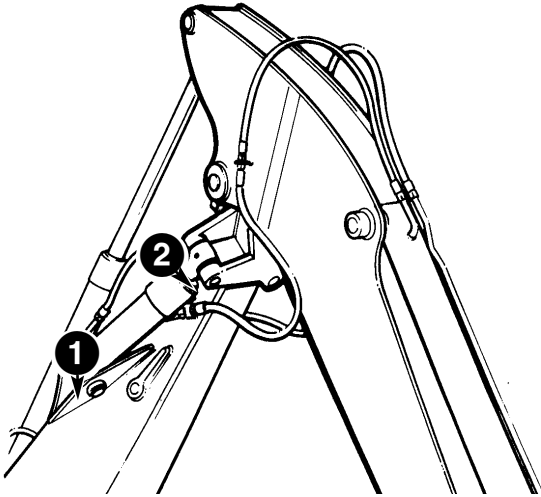




### Knuckle (if fitted)

Refer to Backhoe greasing for the boom and dipper grease points.

**Total 2 Grease Points.**



S256440

### Backhoe Quickhitch (Hydraulic)

#### **⚠ CAUTION**

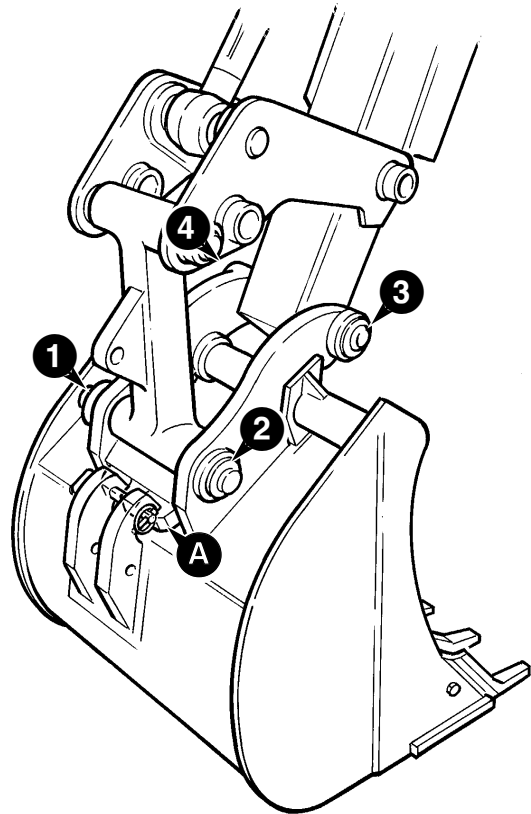
Waxoyl contains turpentine substitute, which is inflammable. Keep flames away when applying Waxoyl. Waxoyl can take a few weeks to dry completely. Keep flames away during the drying period.

Do not weld near the affected area during the drying period. Take the same precautions as for oil to keep Waxoyl off your skin. Do not breathe the fumes. Apply in a well-ventilated area.

5-3-1-9

Coat the slide **A** with Waxoyl.

**4 Grease Points**



S211750

## Tyre Inflation

These instructions are for adding air to a tyre which is already inflated. If the tyre has lost all its air pressure, call in a qualified tyre mechanic. The tyre mechanic should use a tyre inflation cage and the correct equipment to do the job.

### WARNING

**An exploding tyre can kill, inflated tyres can explode if overheated. Do not cut or weld the rims. Use a tyre/wheel specialist for all repair work.**

2-3-2-7

#### 1 Prepare the Wheel

Before you add air to the tyre, make sure it is correctly fitted on the machine or installed in a tyre inflation cage.

#### 2 Prepare the Equipment

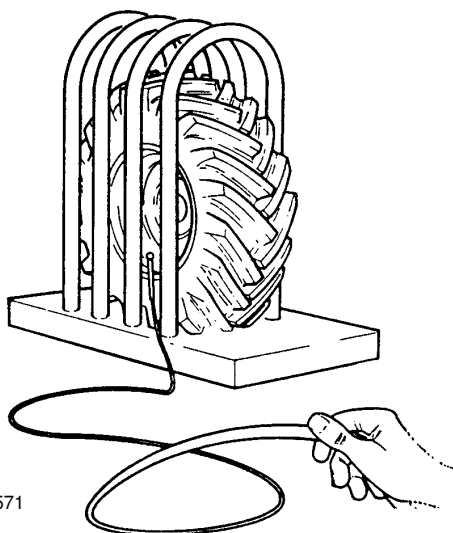
Use only an air supply system which includes a pressure regulator. Set the regulator no higher than 1.38 bar (20 psi) above the recommended tyre pressure. See Section F, **Technical Data** for recommended tyres and pressures for your machine.

Use an air hose fitted with a self-locking air chuck and remote shut-off valve.

#### 3 Add the Air

Make sure that the air hose is correctly connected to the tyre valve. Clear other people from the area. Stand behind the tread of the tyre while adding the air.

Inflate the tyre to the recommended pressure. Do not over-inflate.



S089571

## Checking the Wheel Nut Torques

On new machines, and whenever a wheel has been removed, check the wheel nut torques every two hours until they stay correct.

Every day, before starting work, check that the wheel nuts are tight.

The correct torques are shown in the table below.

Front - Nm	lbf ft
680	500

Rear - Nm	lbf ft
680	500

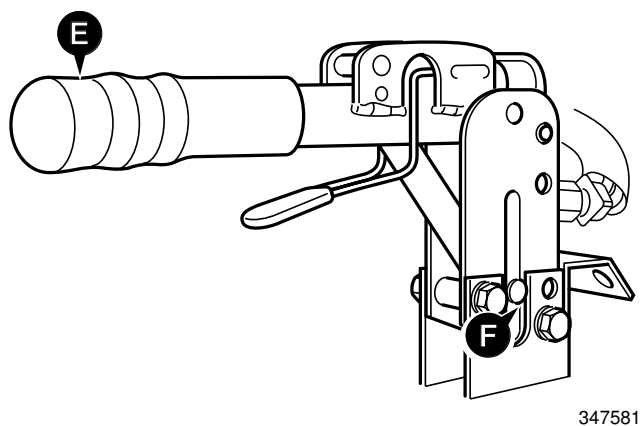
### WARNING

**If, for whatever reason, a wheel stud is renewed, all the studs for that wheel must be changed as a set, since the remaining studs may have been damaged.**

2-3-2-8

## Parking Brake Adjustment

- 1 Disengage the parking brake (lever horizontal).
- 2 Turn handle grip **E** clockwise, half a turn.
- 3 Test the parking brake, see Section G, **Service Procedures**.
- 4 If the brake fails the test, repeat steps 1, 2 and 3. If there is no more adjustment and pin **F** is at the end of its travel get the brake checked by your JCB Dealer.



## Checking the Foot Brake Fluid Level

### ⚠ WARNING

Faulty brakes can kill. If you have to add oil to the brake reservoir regularly get the brake system checked by your JCB Dealer. Do not use the machine until the fault has been put right.

2-3-2-5

- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Raise and block the loader arms. Lower the backhoe to the ground and stop the engine.
- 2 Remove the reservoir cap **A** and check the level. The MAX and MIN marks are marked on the side of the reservoir **B**. If necessary, add fluid as in Step 3.

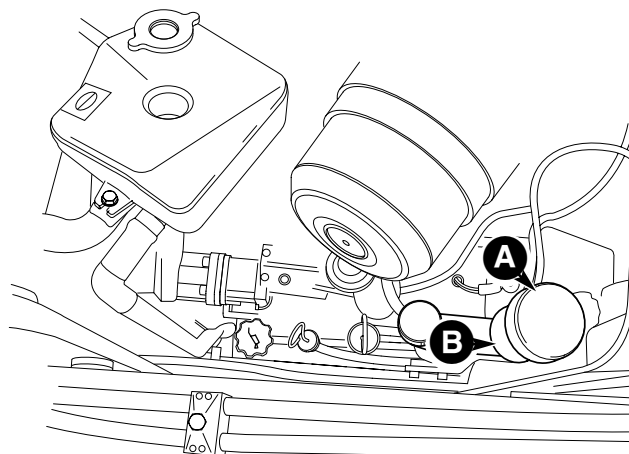
If the level has fallen below the MIN mark, get the system checked by your JCB Dealer.

### ⚠ WARNING

Using incorrect brake fluid could damage the system. See Service Capacities and Lubricants in MAINTENANCE Section. The fluid can harm your skin. Wear rubber gloves. Cover cuts and grazes.

4-3-2-3

- 3 If required, carefully pour the recommended fluid (DO NOT USE ORDINARY BRAKE FLUID) until it reaches the correct level.
- 4 Refit the reservoir cap. Wipe up any spillage.



## Changing the Elements

### ⚠ CAUTION

The outer element must be renewed immediately if the warning light on the instrument panel illuminates.

2-3-3-1

**Note:** Do not attempt to wash or clean the elements - they must only be renewed.

**Note:** Do not run the engine with the dust valve **J** removed.

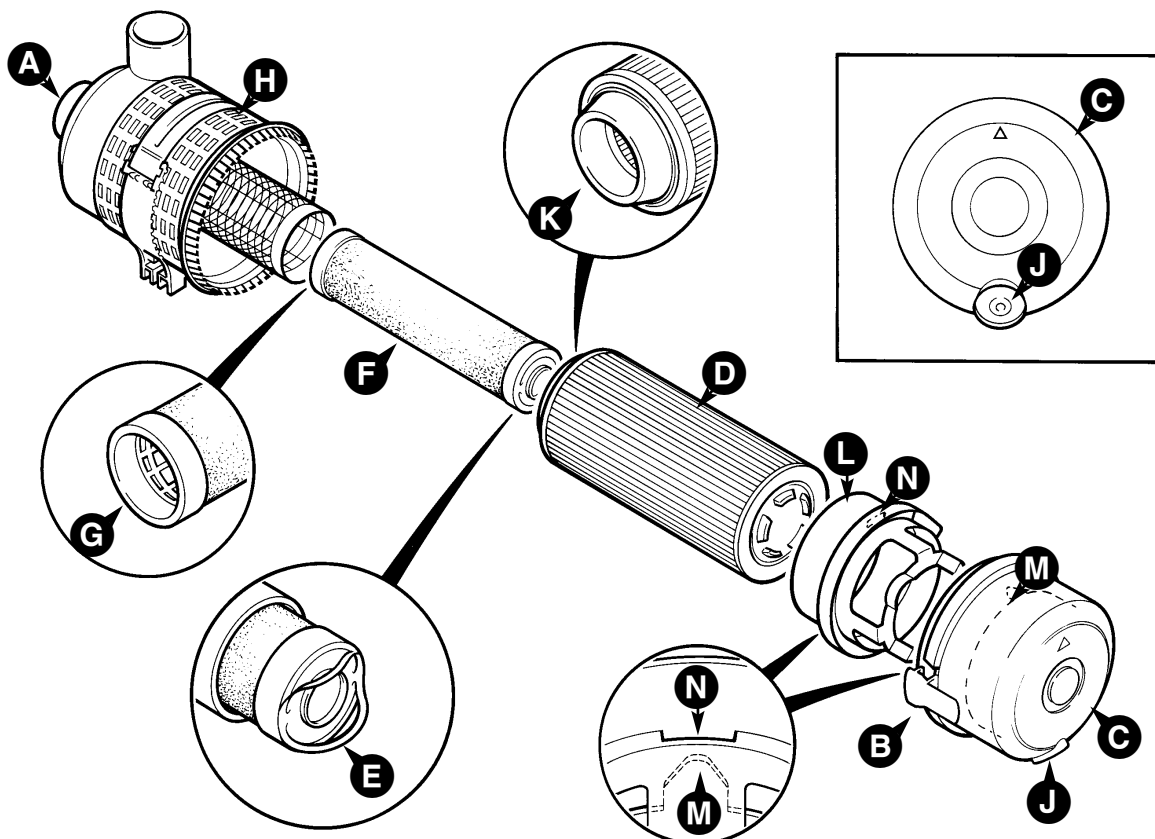
**Note:** A new inner element must be fitted at least every third time the outer element is changed. As a reminder, mark the inner element with a felt tipped pen each time the outer element is changed.

- 1 Stop the engine.
- 2 Remove the engine side panel (left hand side).
- 3 If changing the inner element, cover the end of the hose to prevent rain and dirt from getting into the engine.

- 4 Depress clips **B** and lift off cover **C**. Remove outer element **D**. Take care not to tap or knock the element. If the inner element is to be changed, lift up pulls **E** and remove inner element **F**. On turbocharged engines, remove pulsation ring **L**.
- 5 Clean inside the canister **H**, pulsation ring **L**, cover **C** and dust valve **J**.
- 6 Insert the new elements into the canister, pushing them firmly in so that seals **G** and **K** are fully seated. On turbocharged engines, assemble the pulsation ring **L** into the cover, making sure that tongue **M** fits into slot **N**. Fit cover **C** with dust valve **J** at the bottom. Push the cover firmly into position and make sure it is secured by clips **B**.

**Note:** Pulsation ring **L** is not fitted in this application.

- 7 Refit the induction hose to stub pipe **A**. Make sure that the wire is connected to the **Air Filter Blocked** switch.



S257910

## 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.

- 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

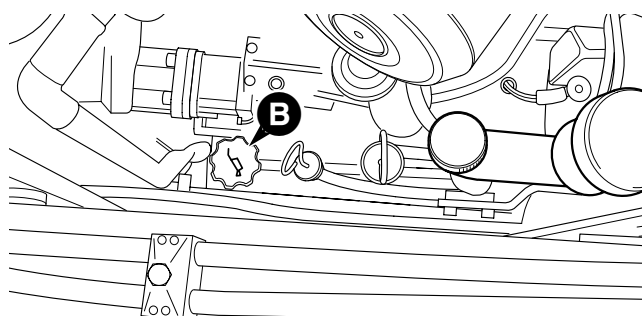
## Changing the Oil and Filter

- 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.

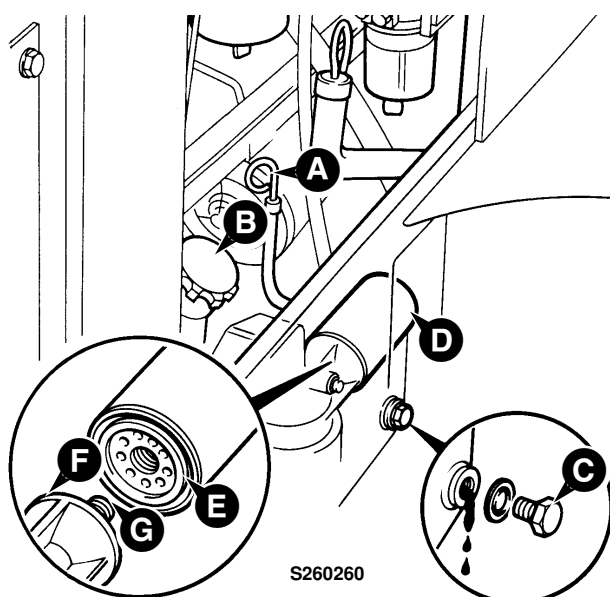
### ⚠ WARNING

**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



399290



S260260

- 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 spilled 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.

## Checking the Coolant

### ⚠ WARNING

The cooling system is pressurised when the coolant is hot. Hot coolant will burn you. Make sure the engine is cool before checking the coolant level or draining the system.

2-3-3-3

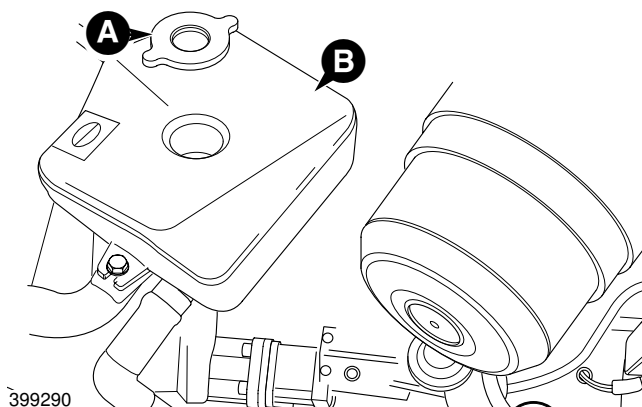
- 1 Make sure the park brake is engaged and the transmission set to neutral. Lower the loader arms and backhoe to the ground, switch OFF the engine and remove the starter key.
- 2 Open the bonnet, see **Engine Panels, Opening and Closing the Bonnet**.
- 3 The coolant level should be between the COLD/MIN and the HOT/MAX marks on coolant reservoir **B**. Fill with pre-mixed water/antifreeze if necessary.

## Changing the Coolant

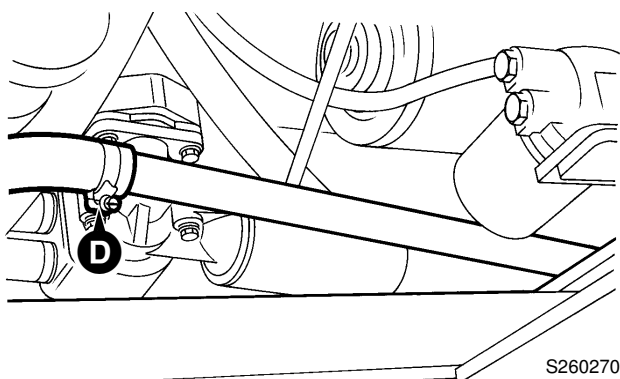
### ⚠ WARNING

The cooling system is pressurised when the coolant is hot. Hot coolant will burn you. Make sure the engine is cool before checking the coolant level or draining the system.

2-3-3-3



399290



S260270

- 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 Carefully loosen cap **A**. Let any pressure escape. Remove the cap.

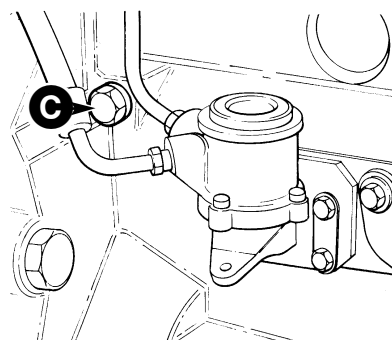
### ⚠ CAUTION

Keep your face away from the drain hole when removing the drain plug.

2-3-3-4

- 4 Remove drain plug **C** and let the coolant drain out. Make sure the drain hole is not blocked.
- 5 Disconnect the radiator hose at **D** and allow the coolant to drain. Flush the system using clean water.
- 6 Clean and refit plug **C**. Make sure it is secure. Reconnect the radiator hose
- 7 Use the necessary mix of clean, soft water and antifreeze, see **Coolant Mixtures**. Fill to the COLD/MIN level on coolant reservoir **B**.
- 8 Start the engine and run at idle to circulate the coolant, top up with coolant as necessary.
- 9 Refit the filler cap. Make sure it is tight.
- 10 Run the engine for a while, to raise the coolant to working temperature and pressure. Stop the engine. Check for leaks.

**Note:** Make sure the cab heater control is in the hot position. This will ensure the coolant mixture circulates through the entire cooling system.



S148060

## Adjusting the Fan Belt

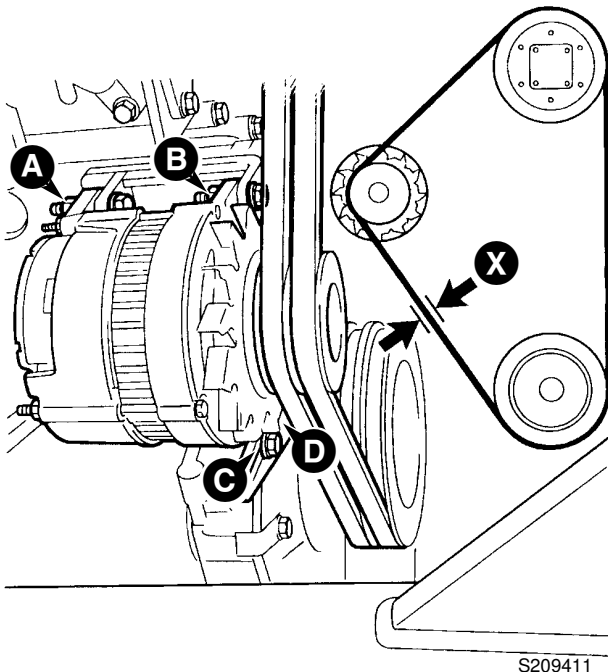
### **⚠ WARNING**

**Make sure the engine cannot be started. Disconnect the battery before doing this job.**

2-3-3-5

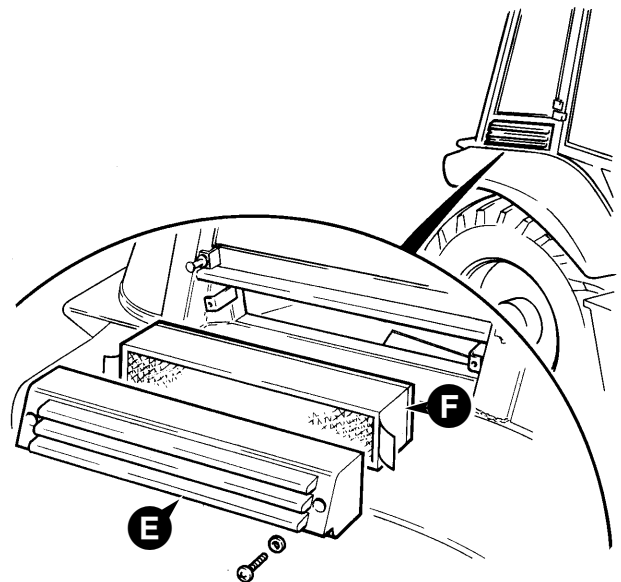
- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Raise and block the loader arms. Lower the backhoe to the ground and stop the engine.
- 2 Loosen pivot fastening bolts **A** and **B**. Loosen adjustment link fastening bolts **C** and **D**.
- 3 Position the alternator so that there is 10 mm (3/8 in) slack at point **X**.
- 4 Tighten bolts **C** and **D**, then bolts **A** and **B**.

**Note:** If a new belt is fitted, the belt tension must be checked again after the first 20 hours of operation.



## Cleaning the Cab Heater Filter

- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the attachments to the ground and stop the engine.
  - 2 Remove the cover retaining screws (2 off) and then remove the cover, item **E**.
  - 3 Knock loose dust off the filter **F**. Carefully blow compressed air through all the folds of the filter, blow in the opposite direction to the arrows marked on the filter.
- Note:** The compressed air must be set at a pressure no greater than 7 bar (100 lb/in<sup>2</sup>).
- 4 Refit the cover **E** and secure with the retaining screws (2 off).



S254720

## Types of Fuel

Use good quality diesel fuel to get the correct power and performance from your engine. The recommended fuel specification for engines is given below.

**Cetane Number:** 45(minimum)

**Viscosity:** 2.5/4.5 centistokes at 40 °C (104 °F)

**Density:** 0.835/0.855 kg/litre  
(0.872/0.904 lb/pint)

**Sulphur:** 0.5% of mass (maximum)

**Distillation:** 85% at 350 °C (662 °F)

### Cetane Number

Indicates ignition performance. Fuel with a low cetane number can cause cold start problems and affect combustion.

### Viscosity

Is the resistance to flow. If this is outside limits, the engine performance can be affected.

### Density

Lower density will reduce engine power. Higher density will increase both engine power and exhaust smoke.

### Sulphur

High sulphur content can cause engine wear. (High sulphur fuel is not normally found in North America, Europe or Australia.) If you have to use high sulphur fuel you must also use a highly alkaline engine lubricating oil; or change the normal oil more frequently.

Low sulphur fuels are commonly used throughout the world. These fuels contain fewer lubrication additives. The fuel injection pumps fitted to the engine (with exception of 160TW, Euro 1 engine) are lubricated by the fuel; therefore using low sulphur fuel may, in the long term, affect the pump.

If you have to use low sulphur fuel you are advised to use a lubrication additive as recommended by your fuel supplier.

### Distillation

This indicates the mixture of different hydrocarbons in the fuel. A high ratio of lightweight hydrocarbons can affect the combustion characteristics.

## Fuel Standards

Consult your fuel supplier, JCB distributor about the suitability of any fuel you are unsure of.

## Low Temperature Fuels

Special winter fuels may be available for engine operation at temperatures below 0°C (32°F). These fuels have a lower viscosity. They also limit wax formation in the fuel at low temperatures. (Wax forming in the fuel can stop the fuel flowing through the filter.)

Flow improvers may also be available. These can be added to the fuel to reduce wax formation.

### Fatty Acid Methyl Ester Fuels as a replacement for Diesel Fuels

Fuel resources such as Rape Methyl Ester and Soybean Methyl Ester, collectively known as Fatty Acid Methyl Esters are being used as alternatives and extenders for mineral oil.

Fatty Acid Methyl Esters must conform to certain standards to be of acceptable quality, just as mineral oils do at present.

Consult your JCB distributor for advice about the use of Fatty Acid Methyl Ester fuels, as improper application may impair engine performance.

### Petrol

#### WARNING

**Do not use petrol in this machine. Do not mix petrol with the diesel fuel; in storage tanks the petrol will rise to the top and form flammable vapours.**

INT-3-1-6

### Advice

If you have to use non-standard fuels, contact your JCB distributor for advice on engine adjustments and oil change periods.

#### WARNING

**Diesel fuel is flammable; keep naked flames away from the machine. Do not smoke while refuelling the machine or working on the engine. Do not refuel with the engine running. There could be a fire and injury if you do not follow these precautions.**

INT-3-2-2



## Filling the Tank

### WARNING

Lower the loader arms and switch off the engine before refuelling. Do not permit operation of the machine controls while refuelling.

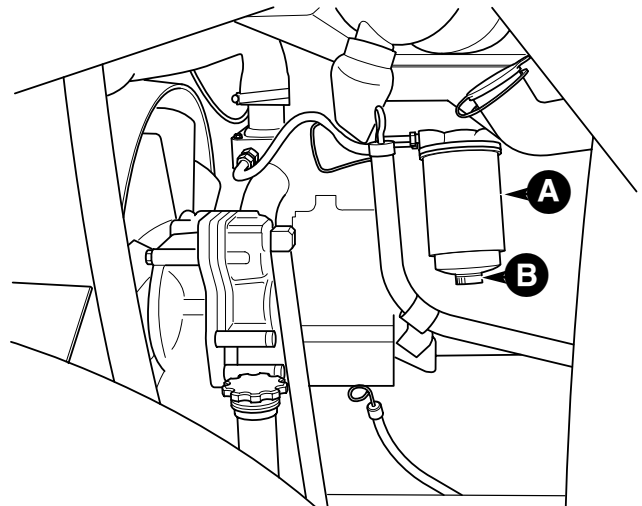
2-3-3-9

At the end of every working day, fill the tank with the correct type of fuel. This will prevent overnight condensation from developing in the fuel.

The cap incorporates a side mounted barrel lock that is operated by the ignition/door key.

#### Fit the Cap

Once the key has been removed, the cap will simply rotate on the filler neck. To remove the cap from the filler neck, the key must be reinserted and the cap unlocked.



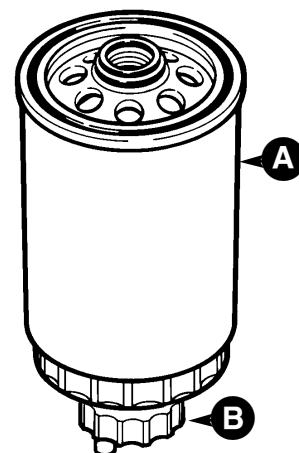
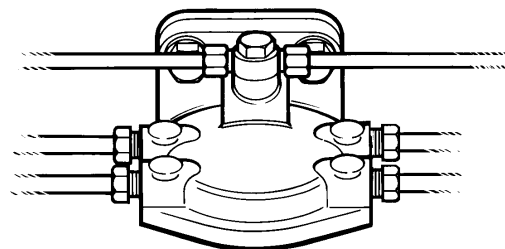
399470

## Draining the Filter

- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Raise and block the loader arms. Lower the backhoe to the ground and stop the engine.
- 2 Drain off any water in the element **A** by turning tap **B**

## Changing the Filter Element

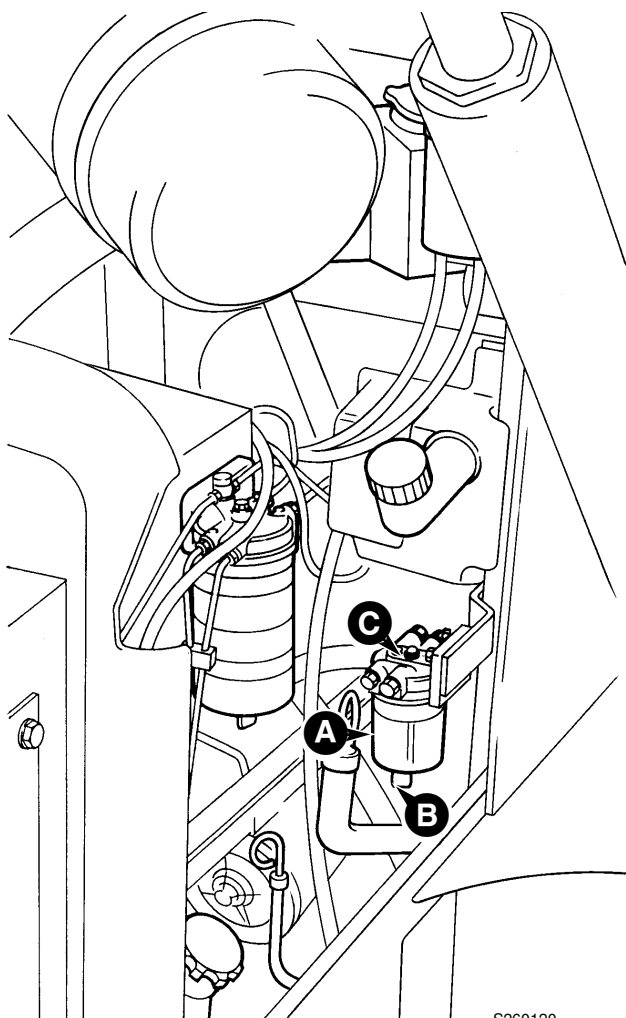
- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the loader arms and backhoe to the ground, stop the engine.
- 2 Unscrew the filter element **A**. The element is hand tight but may require a strap wrench to remove. The filter will be full of fuel.
- 3 To assist with bleeding, fill the new filter element with fuel before fitting. Install new element **A** hand tight only. Check for leaks.
- 4 Bleed the System.



S233870

## Draining the Sediment Bowl

- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the loader arms and backhoe to the ground, stop the engine.
- 2 Look in bowl **A**. If it contains sediment, do Steps 3 to 6. If there is water but no sediment, drain off the water by opening tap **B**. Make sure tap **B** is turned off and secure.
- 3 Support bowl **A**; unscrew nut **C**. Remove the bowl.
- 4 Wash the bowl. Use clean fuel.
- 5 Refit the bowl, make sure gasket is seated correctly.
- 6 Bleed the System.



## Bleed the System

### ⚠ CAUTION

Running the engine with air in the system could damage the fuel injection pump. After maintenance, remove air from the system as detailed below.

2-3-3-7

- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the loader arms and backhoe to the ground and stop the engine.
- 2 Set the starter key to the IGN position.

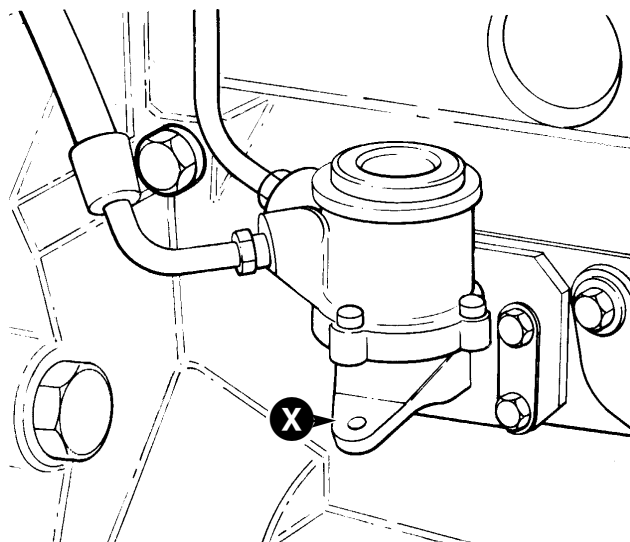
### ⚠ WARNING

Hot oil and engine components can burn you. Make sure the engine is cool before doing this job.

2-3-3-2

- 3 Operate the fuel lift pump priming lever **X** slowly, for approximately two minutes. The engine is now ready to start. If the engine runs smoothly for a short time, and then begins to run roughly or stops, check again for air in the fuel system. Check all seals and connections, especially in the low pressure side of the system.

**Note:** If no fuel is moved when the fuel lift pump priming lever **X** is operated, then the pump diaphragm may have rested in a 'maximum lift' position. To move the diaphragm, use the starter key to turn the engine, then try the priming lever again.



## 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 Switch OFF the engine and remove the starter key, fill the transmission to maximum mark on dipstick/filler **A**. Use only the recommended oil.
- 4 Start and run the engine slowly for a period not exceeding five minutes. This allows the oil to fill filter, pump, torque converter, oil cooler and hoses.
- 5 Switch OFF the engine and remove the starter key, wait approximately 20 seconds. Check the oil level and if required, fill to dipstick level.

## Changing the Oil and Filter

The transmission oil should be drained through the suction strainer aperture to flush out any particles which fall off the strainer during its removal.

### **⚠ 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 Park the machine on level ground. Engage the parking brake. Lower the attachments to the ground. Stop the engine. Remove the starter key. Disconnect the battery.

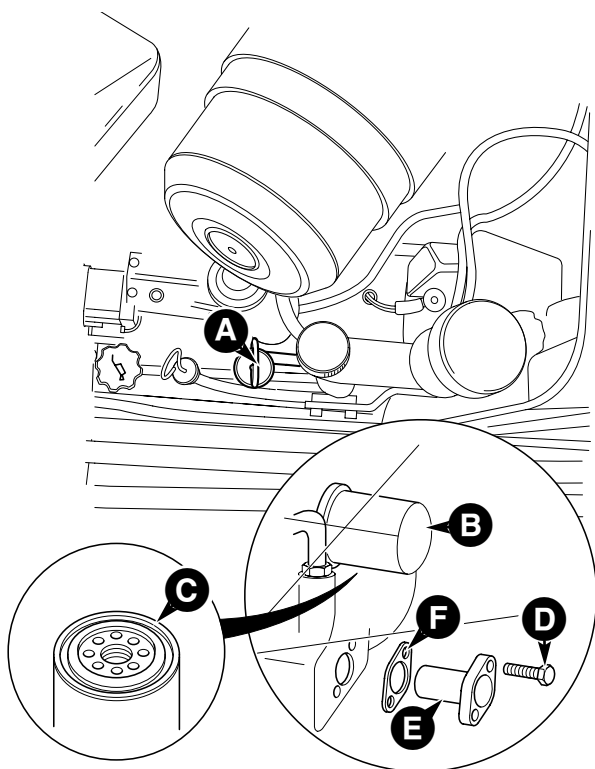
### **⚠ CAUTION**

**When the strainer is removed, oil will gush out. Keep to one side when you remove the strainer.**

2-3-4-1

- 2 Place a container, of suitable size beneath the drain plug. Remove bolts **D**. Pull out the strainer **E** and its gasket **F**. Allow the oil to drain into the container.
- 3 Clean the strainer with a suitable solvent. Follow the solvent manufacturer's instructions on safety.
- 4 Fit the strainer **E** and a new gasket **F**. Apply JCB Threadlocker and Sealer to bolts **D** before fitting and tightening them. Torque tighten the bolts to 10 Nm (7 lbf ft).
- 5 Unscrew and remove the filter **B**. Fit the new filter:
  - 5.1 Smear seal **C** with transmission oil.
  - 5.2 Screw the filter on until it just contacts the filter head.
  - 5.3 Turn the filter at least another 3/4 of a turn.
- 6 Fill the system with new oil through the dipstick/filler **A**. Do not fill past the top mark on the dipstick.

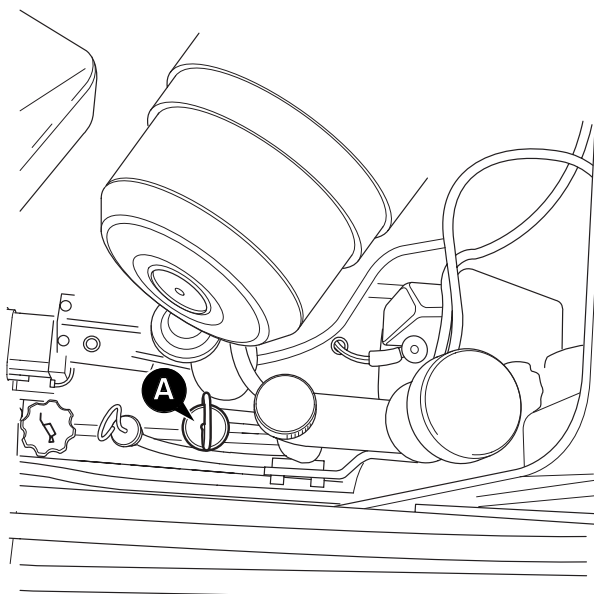
**Note:** Fit only a genuine supplied JCB filter, otherwise damage to the system may be incurred through contamination.



399310

### 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 Switch OFF the engine and remove the starter key, fill the gearbox to maximum mark on dipstick/filler **A**. Use only the recommended oil.
- 4 Start and run the engine slowly for a period not exceeding five minutes. This allows the oil to fill filter, pump, torque converter, oil cooler and hoses.
- 5 Switch OFF the engine and remove the starter key, wait approximately 20 seconds. Check the oil level and if required, fill to dipstick level.



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## Changing the Oil and Filter

When draining JCB 760 Series Powershift gearboxes it is recommended that the oil is drained through the cover plate **A** to make sure that the debris collected in the transmission sump is flushed out. Draining oil through the sump plug will filter oil through the strainer and not flush out the debris.

### **⚠ 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.**

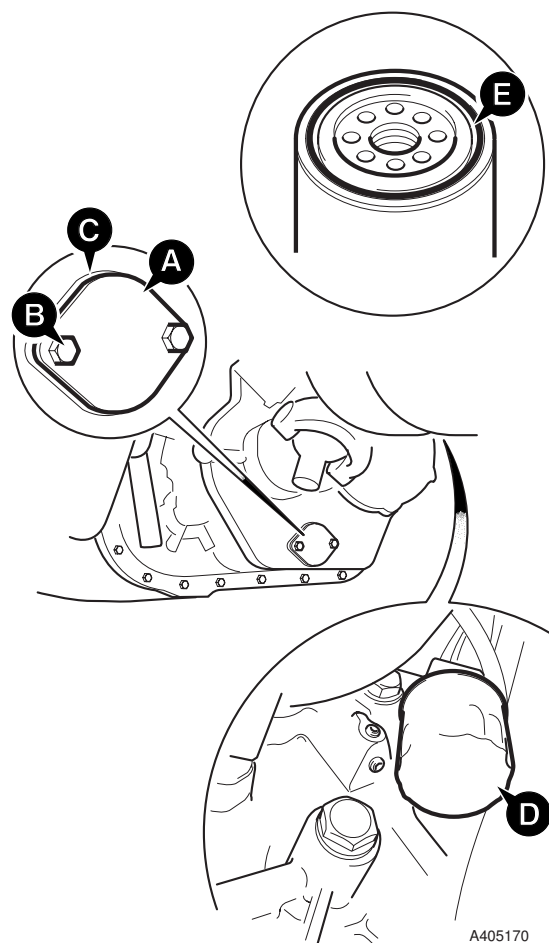
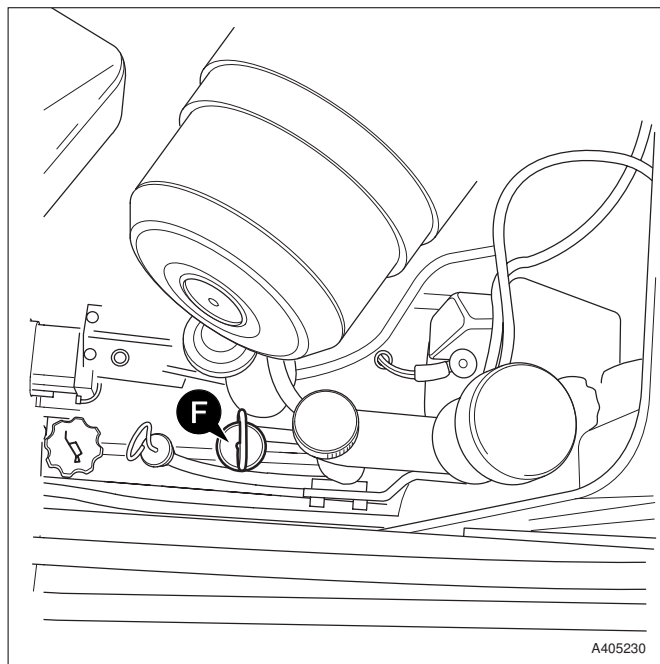
2-3-2-2

- 1 Park the machine on firm level ground, apply the park brake. Lower the loader arms, open the engine bonnet, raise the loader arms and fit the safety strut. Lower the excavator to the ground, switch OFF the engine and remove the starter key.
- 2 Apply the parking brake and disconnect the battery, remove the engine side panels.
- 3 Place a container of suitable size beneath the transmission to catch the oil.
- 4 Remove bolts **B**. Pull off cover plate **A** and gasket **C**, allow the oil to drain into the container. Be aware that the oil may be hot.

**Note:** When the cover is removed oil will gush out. Keep to one side when you remove the cover plate.

- 5 Fit cover plate **A** and a new gasket **C**. Apply JCB Threadlocker and Sealer to bolts **B** before fitting them. Torque tighten the bolts to 28 Nm (20.5 lbf ft.).
- 6 Unscrew and remove the filter **D**. Fit the new filter:
  - 6.1 Smear seal **E** with transmission oil.
  - 6.2 Screw the filter on until it just contacts the filter head.
  - 6.3 Turn the filter at least another 3/4 of a turn.
- 7 Fill the system with new oil through the dipstick/filler **F**. Do not fill past the top mark on the dipstick.
- 8 On completion check for oil leaks.

**Note:** Fit only a genuine supplied JCB filter, otherwise damage to the system may be incurred through contamination.



## Checking the Fluid Level

### ⚠ 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

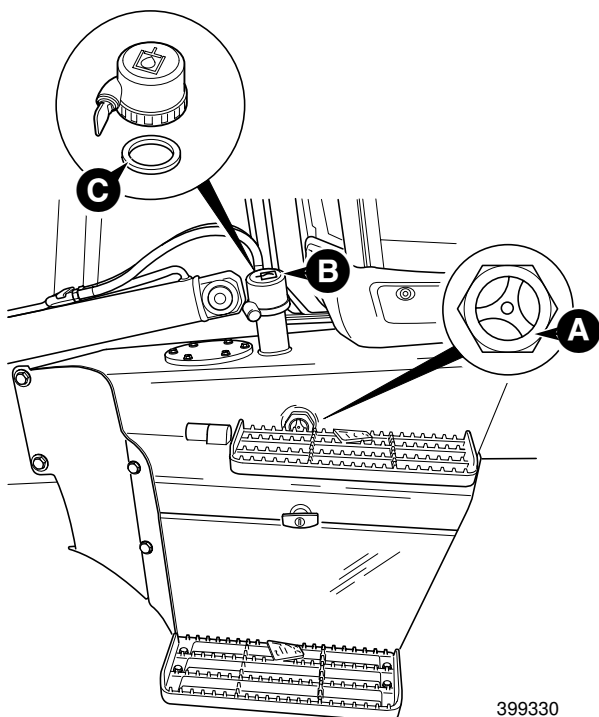
- 1 Position the machine on level ground. Set the loader shovel on the ground. Retract the extending dipper if fitted. Raise the boom, swing in the dipper and close the bucket. Stop the engine. Remove the starter key.
- 2 Look at the fluid level in the sight glass **A**. The level should be at the red mark (or above).

### ⚠ CAUTION

If the fluid in the tube appears cloudy, then water or air has entered the system. The hydraulic pump could be severely damaged if the machine is operated. Contact your JCB distributor immediately.

2-3-4-3

- 3 If the oil level is low, remove filler cap **B** and replenish with recommended hydraulic oil as required.



## Hydraulic Tank Cap

The hydraulic tank breather (and filter) forms an integral part of the hydraulic tank cap **B**. Replace the cap (and breather filter) with a new one at the recommended interval, see Service Schedules.

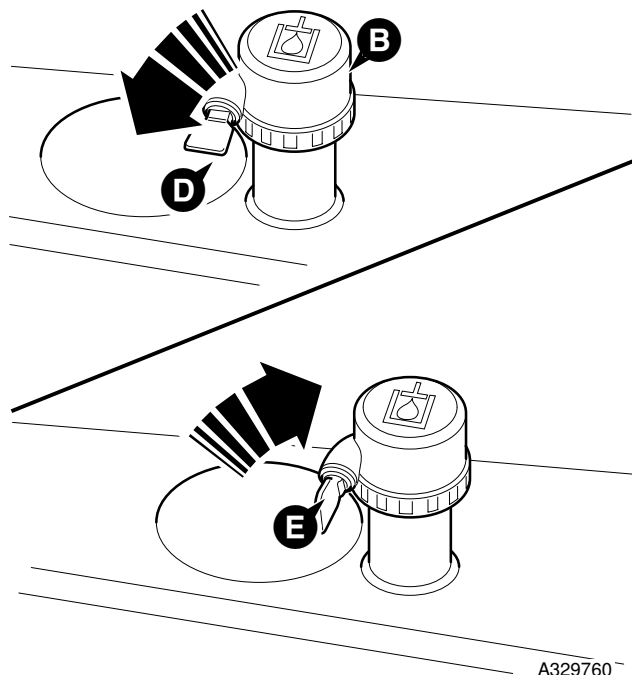
The cap incorporates a side mounted barrel lock that is operated by the ignition/door key. It is important to note that seal **C** must be in good condition and correctly installed in the cap.

### Fit the Cap

Insert the key and turn anticlockwise **D**, screw the cap on until resistance is felt then turn a further quarter of a turn, turn the key clockwise **E** and remove the key. With the key removed the cap will rotate and can not be undone.

### Remove the Cap

Insert the key and turn anticlockwise **D**, unscrew the cap.



## Changing the Filter Element

### 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.

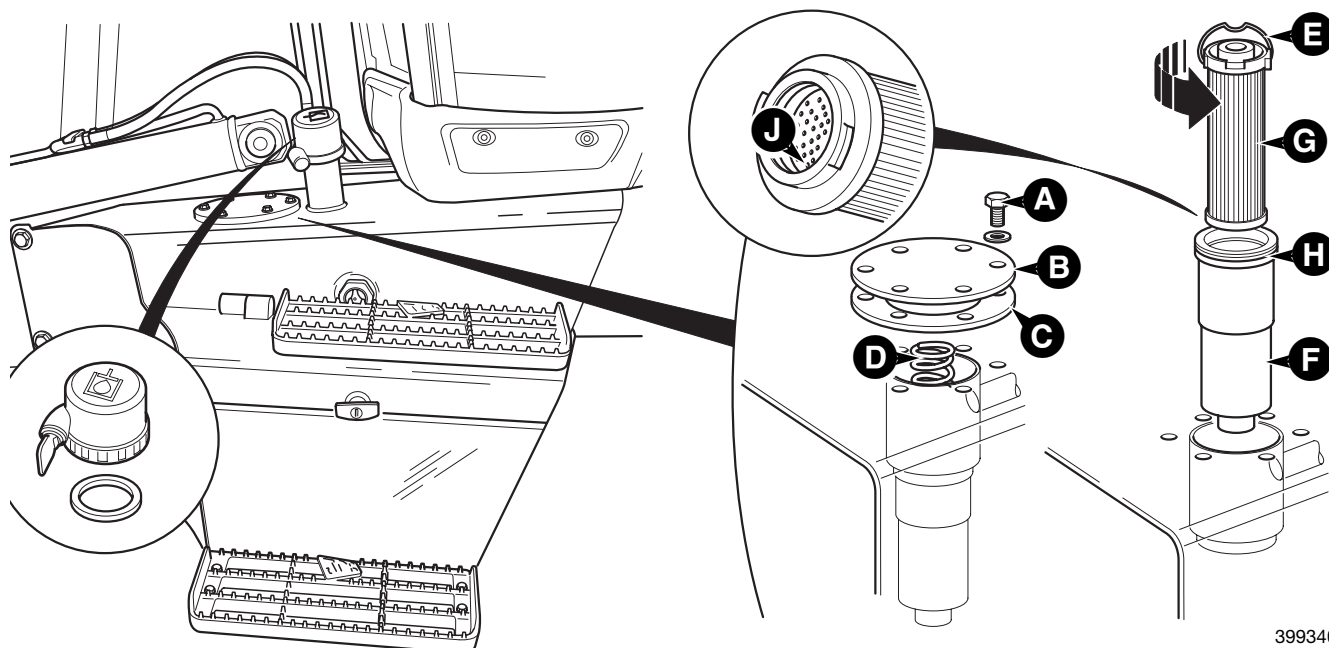
INT-3-1-10/1

- 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.
  - 2 Remove the element assembly
    - a Remove screws **A**. Remove the cover plate **B** and gasket **C**
- \* **Note:** If gasket **C** is a rubber type it can be reused provided it is undamaged. If the gasket is a cork type it must be discarded and a new gasket fitted on assembly.
- b Remove spring **D**.
  - c Hold handle **E** and pull the element assembly from the hydraulic tank.

- 3 Remove the element from its canister.
  - a Hold canister **F**.
  - b Hold handle **E** and rotate the element **G** 90° anti-clockwise.
  - c Pull on handle **E**, the element **G** should separate from its canister **F**. Discard the old element.
  - d Remove and discard seal **H**.
  - e Clean the inside of canister **F**.

New machines are fitted with a 5 micron filter element which must be replaced at the first 100 hour service with a 10 micron filter element.

- 4 Fit the new element.
    - a Fit a new seal **H**.
    - b Make sure that seal **J** is fitted in the new element.
    - c Push the element **G** into its canister **F** and rotate the element 90° to lock it into position. Check that the element has locked into position by pulling on handle **E**.
    - d Install the element assembly in the hydraulic tank.
- \* e Fit spring **D** and gasket **C**, (see 'Note' at step 2).
- f Fit cover plate **B** and tighten screws **A** to 21 Nm (15.5 lbf ft).
  - g Check oil level and replenish as required through filler. Fit and tighten the filler cap as described on previous page.



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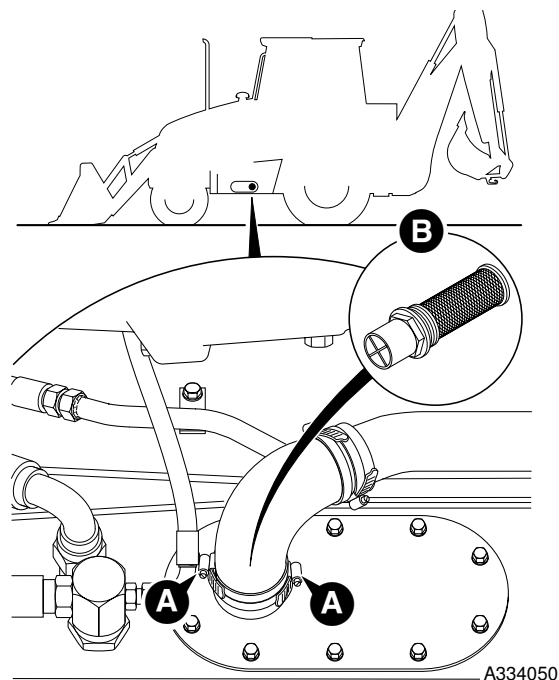
## Changing the Suction Strainer

### **⚠ 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**.





## Checking the Differential Oil Level

### ⚠ 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

### ⚠ CAUTION

The axle oil level must be checked with the machine level, otherwise a false indication of the amount of oil in the axle will be given.

16-3-5-3

- 1 Park the machine on level ground. Engage the parking brake. Set the transmission to neutral. Lower the attachments to the ground. Stop the engine and remove the starter key.
- 2 Clean the area around fill/level plug **A**, then remove the plug and its sealing washer. Oil should be level with the bottom of the hole. Add recommended oil if necessary.
- 3 Clean and refit the plug and its washer.

## Changing the Differential Oil

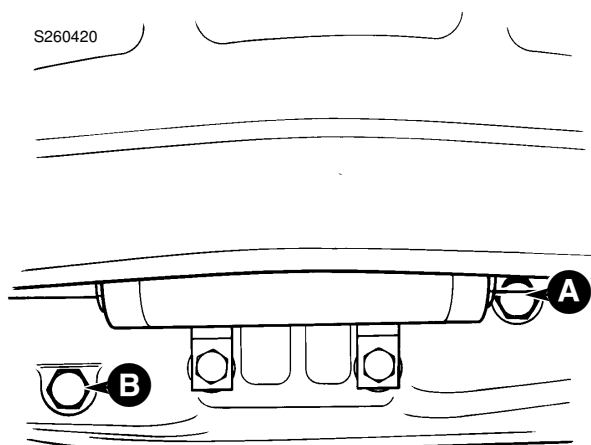
### ⚠ WARNING

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.

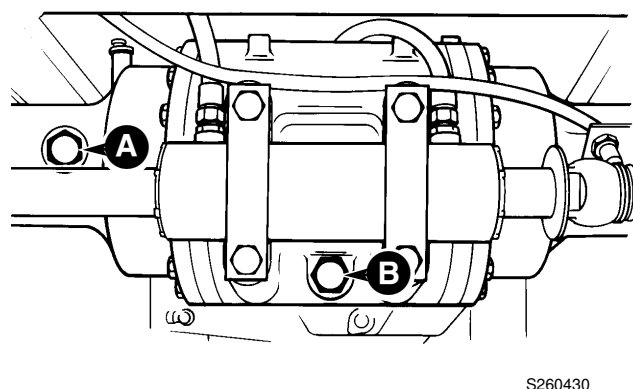
2-3-2-2

- 1 Park the machine on level ground. Engage the parking brake. Set the transmission to neutral. Lower the attachments to the ground. Stop the engine and remove the starter key.
- 2 Place a container of suitable size beneath plug **B** to catch the oil. Remove the drain plug **B** and its seal. Allow oil to drain out. The drain plug is magnetic. Wipe it clean. (Metallic particles should be carefully removed). Fit drain plug **B** and its washer. Tighten to 79 Nm (60 lbf ft).
- 3 Fill with recommended oil through fill/level hole **A**. Clean and refit plug **A** and its seal. Tighten to 79 Nm (60 lbf ft).

### FRONT



### REAR



## Checking the Hub Oil Levels

Check each hub separately.

- 1 Park the machine on level ground with the OIL LEVEL mark horizontal. There is a tolerance of 5 mm (0.2 in) above or below the horizontal.
- 2 Engage the parking brake. Set the transmission to neutral. Lower the attachments to the ground. Stop the engine and remove the starter key.
- 3 Clean the area around the fill/level plug **C**. Remove the plug. Oil should be level with the bottom of the hole. If necessary, add the recommended oil. Clean the plug before refitting it.

## Changing the Hub Oil

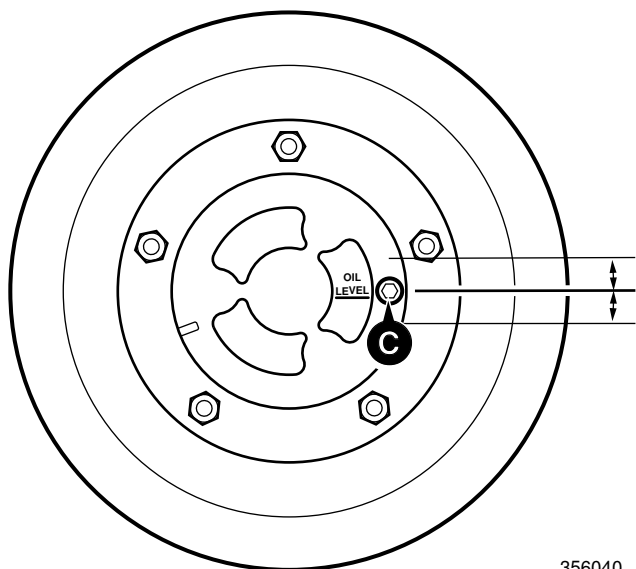
The axle oil is used to lubricate the brake components and cool the brake plates.

It is important that the oil is changed regularly as specified in the service schedule - the lubricating properties of the oil will reduce as a result of brake wear.

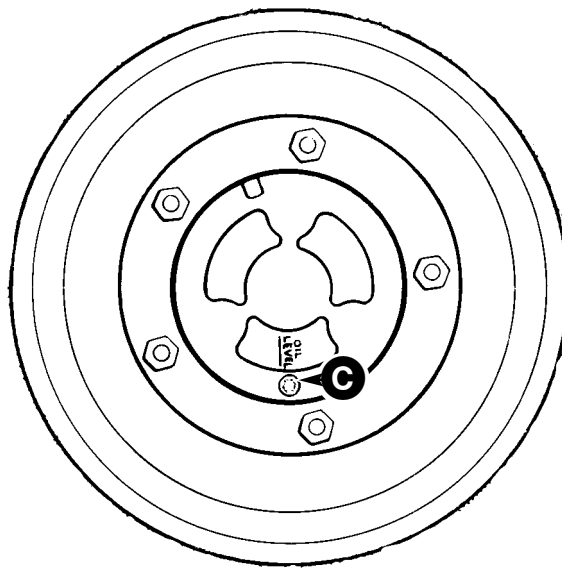
Consult your JCB distributor for advice if necessary.

Change the oil in each hub separately

- 1 Set the machine level, with the tyres just clear of the ground. Manually rotate the wheels to bring the OIL LEVEL mark on the hubs to the vertical position, with the fill/level plugs **C** at the bottom.
- 2
  - a Place a container of suitable size beneath plug **C** to catch the oil.
  - b Remove fill/level plugs **C**. Allow time for the oil to drain out.
- 3
  - a Set OIL LEVEL marks to the horizontal.
  - b Fill the hubs with recommended axle oil, through the fill/level holes **C**. Oil should be level with the bottom of the fill/level hole.
  - c Clean and refit fill/level plugs **C**.



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The front axle procedures are the same as described on the previous pages (all wheel steer machines). Refer to the following procedures for checking and changing the oil on the rear axle.

## Checking the Oil Level

### **⚠ CAUTION**

The axle oil level must be checked with the machine level, otherwise a false indication of the amount of oil in the axle will be given.

16-3-5-3

- 1 Park the machine on level ground. Engage the parking brake. Set the transmission to neutral. Lower the attachments to the ground. Stop the engine and remove the starter key.
- 2 Clean the area around fill/level plug **A**, then remove the plug and its sealing washer. Oil should be level with the bottom of the hole. Add recommended oil if necessary.
- 3 Clean and refit the plug and its washer.

## Changing the Oil

The axle oil is used to lubricate the brake components and cool the brake plates.

It is important that the oil is changed regularly as specified in the service schedule - the lubricating properties of the oil will reduce as a result of brake wear.

Consult your JCB distributor for advice if necessary.

- 1 Park the machine on level ground so that the 'OIL LEVEL' mark on one hub is at the bottom, as shown in fig. 1. Engage the parking brake. Set the transmission to neutral. Lower the attachments to the ground. Stop the engine and remove the starter key.
- 2 Place a container of suitable size beneath fill/level plug **C** to catch the oil. Remove the fill/level plug **C** from the hub. Allow the oil to drain out. The drain plug is magnetic. Wipe it clean. (Metallic particles should be carefully removed). Clean and refit the hub fill/level plug **C**.
- 3 Position the other wheel of the rear axle so that the 'OIL LEVEL' mark on its hub is at the bottom. Repeat step 2.
- 4 Place a container of suitable size beneath the drain plug **B** to catch the oil.

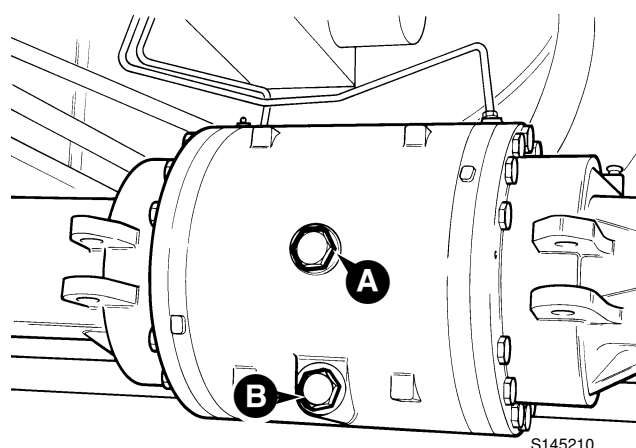
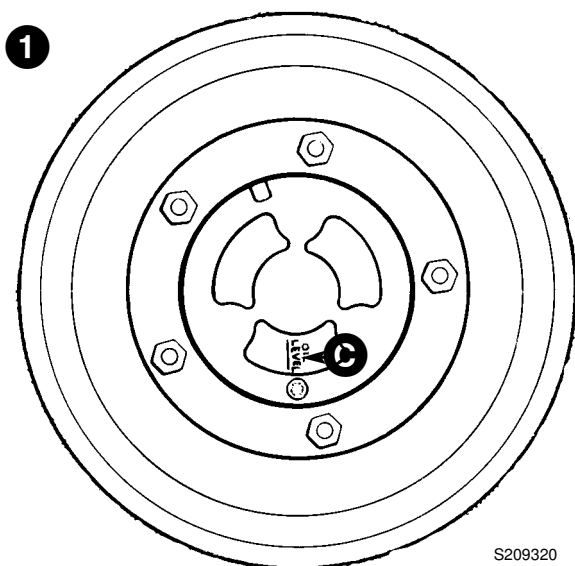
### **⚠ CAUTION**

Oil will gush from the hole when the drain plug is removed. Keep to one side when you remove the plug.

2-3-4-2

Remove the drain plug **B**. Allow the oil to drain out. The drain plug is magnetic. Wipe it clean. (Metallic particles should be carefully removed). Clean and refit the drain plug **B**.

- 5 Remove fill/level plug **A**. Fill the axle with the specified quantity and recommended type of oil. Clean and refit fill/level plug **A**.



**Warning Symbols**

The following warning symbols may be found on the battery.

**Symbol**

**Meaning**



A289230

Keep away from children.



A289260

Shield eyes.



A289280

No smoking, no naked flames, no sparks.



A289250

Explosive Gas.



A289240

Battery acid.



A289270

Note operating instructions.

**⚠ CAUTION**

Do not disconnect the battery while the engine is running, otherwise the electrical circuits may be damaged.

INT- 3- 1-14

**⚠ WARNING**

Understand the electrical circuit before connecting or disconnecting an electrical component. A wrong connection can cause injury and/or damage.

INT-3-1-4

**⚠ DANGER**

Battery electrolyte is toxic and corrosive. Do not breathe the gases given off by the battery. Keep the electrolyte away from your clothes, skin, mouth and eyes. Wear safety glasses.

INT-3-2-1/3

**⚠ CAUTION**

Damaged or spent batteries and any residue from fires or spillage should be put in a closed acid proof receptacle and must be disposed of in accordance with local environmental waste regulations.

INT-3-1-12

**⚠ WARNING**

Batteries give off explosive gases. Keep flames and sparks away from the battery. Do not smoke close to the battery. Make sure there is good ventilation in closed areas where batteries are being used or charged. Do not check the battery charge by shorting the terminals with metal; use a hydrometer or voltmeter.

INT-3-1-8

**⚠ WARNING**

Batteries give off an explosive gas. Do not smoke when handling or working on the battery. Keep the battery away from sparks and flames.

Battery electrolyte contains sulphuric acid. It can burn you if it touches your skin or eyes. Wear goggles. Handle the battery carefully to prevent spillage. Keep metallic items (watches, rings, zips etc) away from the battery terminals. Such items could short the terminals and burn you.

Set all switches in the cab to OFF before disconnecting and connecting the battery. When disconnecting the battery, take off the earth (-) lead first.

When reconnecting, fit the positive (+) lead first.

Re-charge the battery away from the machine, in a well ventilated area. Switch the charging circuit off before connecting or disconnecting the battery. When you have installed the battery in the machine, wait five minutes before connecting it up.

**First Aid - Electrolyte**

Do the following if electrolyte:

**GETS INTO YOUR EYES**

Immediately flush with water for 15 minutes, always get medical help.

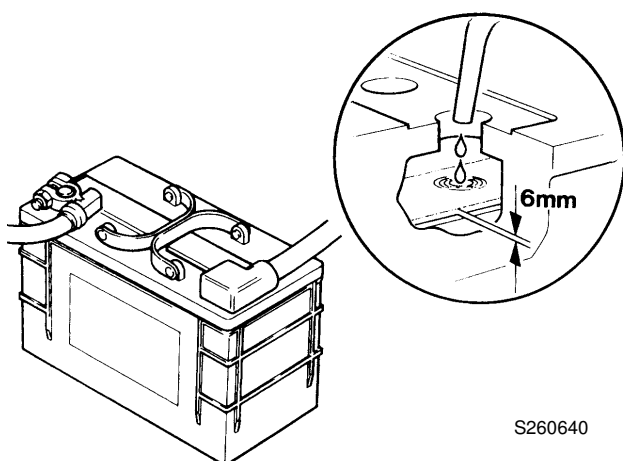
**IS SWALLOWED**

Do not induce vomiting. Drink large quantities of water or milk. Then drink milk of magnesia, beaten egg or vegetable oil. Get medical help.

**GETS ONTO YOUR SKIN**

Flush with water, remove affected clothing. Cover burns with a sterile dressing then get medical help.

5-3-4-3/1



S260640

**Checking the Electrolyte Level**

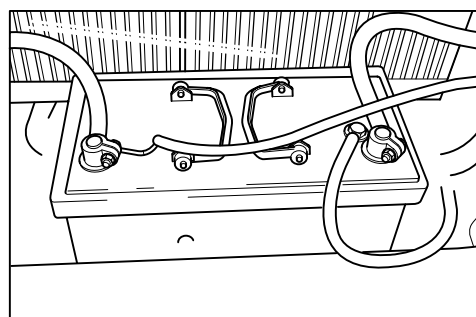
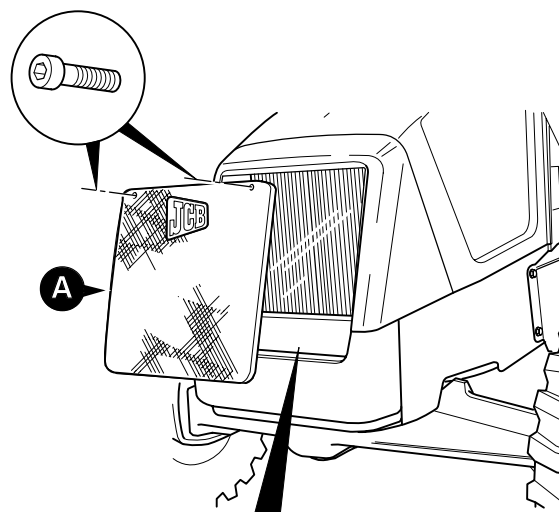
Maintenance free batteries used in normal temperate climate applications should not need topping up. However, in certain conditions (such as prolonged operation at tropical temperatures or if the alternator overcharges) the electrolyte level should be checked as described below.

**⚠ WARNING**

**Do not top the battery up with acid. The electrolyte could boil out and burn you.**

2-3-4-6

- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the backhoe to the ground, raise the loader arms and fit the safety strut, see Loader Arm Safety Strut. Switch OFF the engine and remove the starter key.
- 2 Remove the front grille **A**.
- 3 Remove battery cell covers. Look at the level in each cell. The electrolyte should be 6 mm (1/4 in) above the plates. Top up if necessary with distilled water or de-ionised water.



399350

## Battery Isolator

To disconnect the battery from the machine electrics a battery isolator has been fitted.

### **⚠ CAUTION**

**Except in an emergency, do not use the battery isolator to switch OFF the engine. Failure to comply may result in damage to the electrical circuits.**

INT-3-2-13

At the end of a working cycle or if the machine is being left unattended, provided the lights are not required, the battery must be isolated. Before attempting to start the engine or use the machine electrics the battery isolator key must be fitted and switched on.

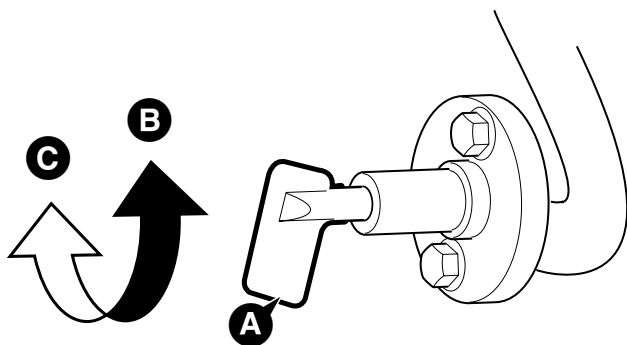
- 1 To isolate the battery turn the battery isolator key **A** in an anti-clockwise direction **B** and remove. Keep the key in a safe place and available for when the machine is next required.
- 2 To connect the battery insert the key **A** and turn in a clockwise direction **C**.

### **⚠ CAUTION**

**Before carrying out arc welding on the machine disconnect the battery and alternator to protect the circuits and components.**

**The battery must still be disconnected even if the battery isolator is fitted.**

INT-3-1-13

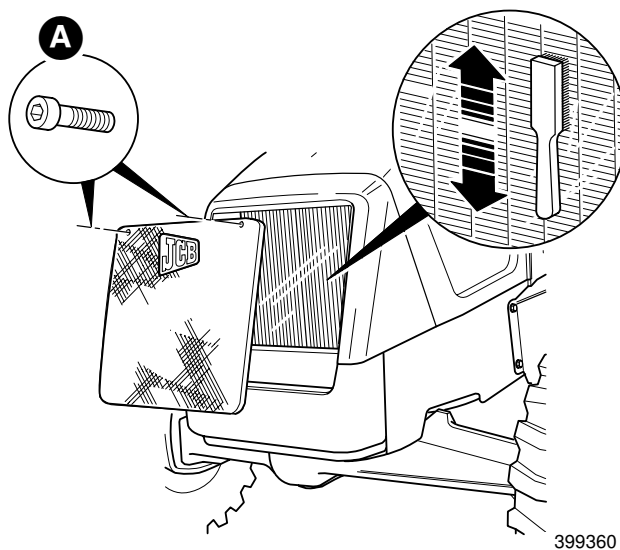


A323611

## Cleaning the Tubes/Fins

The hydraulic oil cooler is in front of the engine radiator. If the hydraulic oil cooler tubes/fins get clogged (by dirt and flies etc) the radiator and cooler will be less efficient.

- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Raise and block the loader arms. Lower the backhoe to the ground and stop the engine.
- 2 Unscrew bolts **A**. Lift off the radiator grille.
- 3 Brush off all debris from the cooler tubes and fins. Make sure the loosened material is brushed out of the cooler enclosure.
- 4 Refit the radiator grille. Tighten bolts **A** evenly.



## Wear Pads

The wear pads support and guide the inner leg section. They ensure that during extension and retraction the inner leg is kept central and has a minimum amount of 'float'.

Upper wear pads **A** (4 off) are fitted to the top of the inner leg as shown. The upper pads are available in 3 sizes and are colour coded; 5mm (green); 6mm (red) and 7mm (blue). Lower wear pads comprise adjustable pads **B** (2 off) and fixed pads **C** (2 off).

When pads **A** and **C** have worn to a minimum thickness of 0.5 mm (0.020 in.) they must be replaced with new ones. To replace the pads, the stabiliser inner leg must be removed (contact your JCB Distributor).

It is important to note that lower pads **C** are designed to take most of the 'loading' during stabiliser leg operation, as a consequence these pads must be checked regularly for wear.

When replacing pads, it is recommended that the complete lower set of pads are replaced (items **B** and **C**). The top pads should be inspected and replaced as required.

## Wear Pad Adjustment

**Note: It is very important that the wear pads are adjusted at the correct service intervals, as the inner leg could contact the outer leg and scoring could occur. Scoring will dramatically reduce wear pad life.**

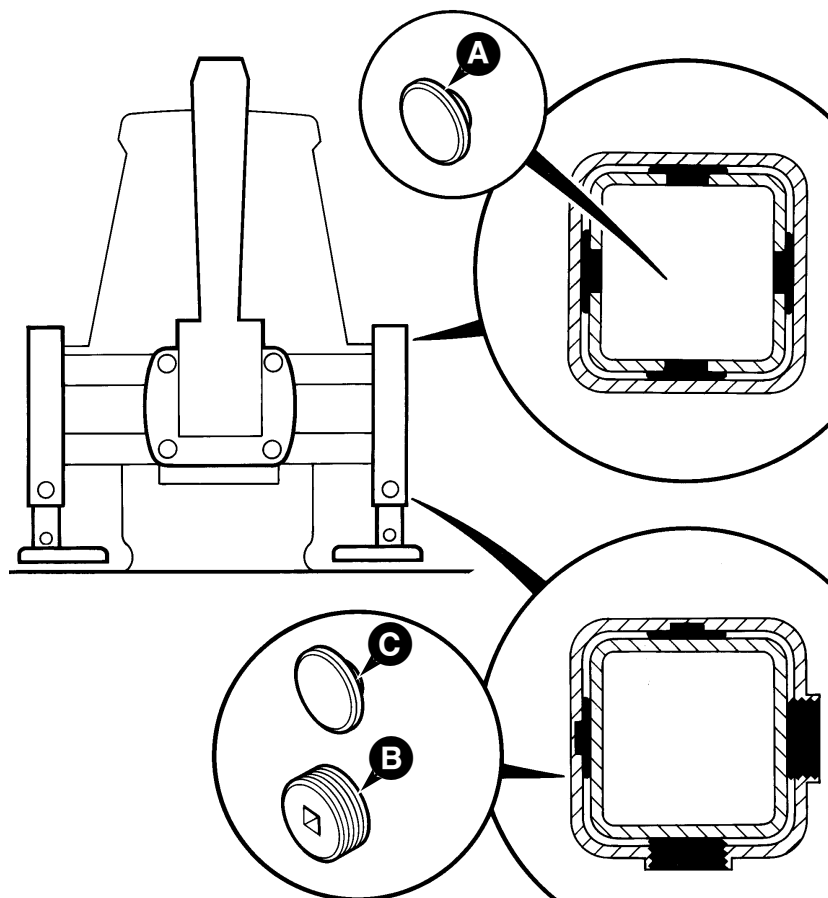
Remove and clean away all debris that may have built up in stabiliser cavities.

As a guide, there should be approximately 1mm (0.039 in.) float between the stabiliser inner and outer leg.

Before adjusting the clearance make sure that the leg is raised clear of the ground but not fully retracted.

To adjust the clearance, screw pad **B** fully in until it just touches the inner leg and then back the pad off by one quarter of a turn.

**Note: Over-tightening the adjustable pad **B** will lock the pad in position, it will not be possible to back the pad off. If this should happen, operate the stabiliser leg as normal but be aware that pads **B** and **C** will wear more rapidly.**



S273120



**⚠ WARNING**

The air conditioning system is a closed loop system and contains pressurised refrigerant. No part of the system should be disconnected until the system has been discharged by a refrigeration engineer or a suitably trained person. You can be severely frostbitten or injured by escaping refrigerant.

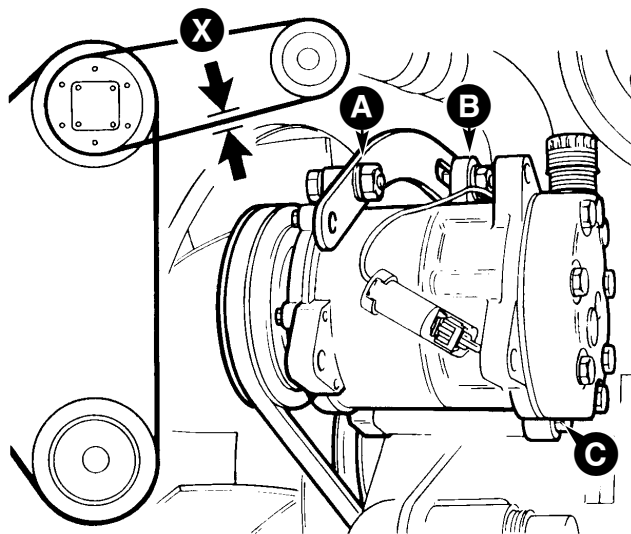
4-3-4-1/2

**Adjusting the Compressor Drive Belt****⚠ WARNING**

Make sure the engine cannot be started. Disconnect the battery before doing this job.

2-3-3-5

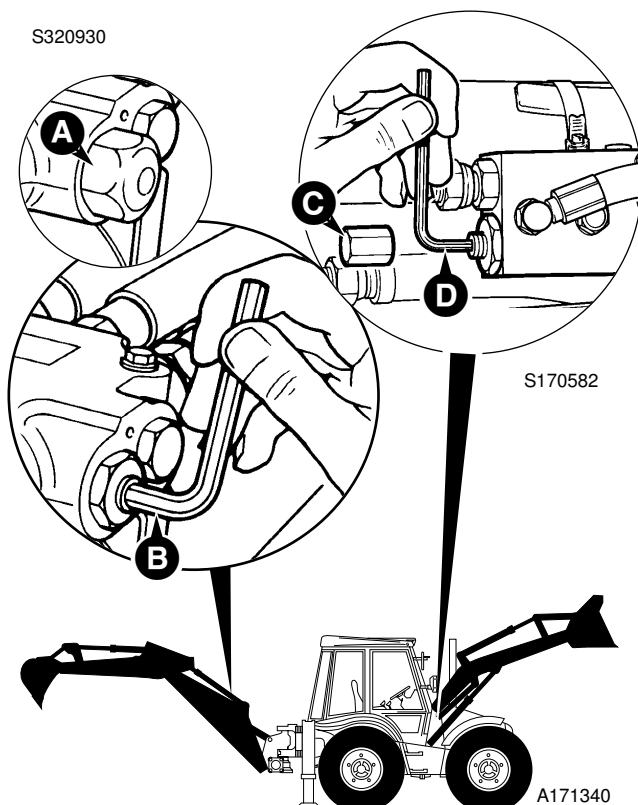
- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Raise and block the loader arms. Lower the backhoe to the ground and stop the engine.
- 2 Loosen bolts **A**, **B** and **C**. Position the compressor so that there is 10 mm (3/8 in) slack at point **X**.
- 3 Tighten bolt **A**, then bolts **B** and **C**.



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.

ITEM	CAPACITY		FLUID/LUBRICANT	INTERNATIONAL SPECIFICATION
	Litres	UK Gal		
Fuel Tank	150	33	Diesel Oil	ASTM D975-66T Nos. 1D, 2D
Engine (Oil) ①				
2 Wheel Steer Machines				
- Build AR	11.0	2.4	<b>JCB Super Multigrade 15W/40</b> -10°C to +50°C (14°F to 122°F)	SAE15W/40 CF-4/SG
- Build AK	10	2.2		
4 Wheel Steer Machines				
- Build AK	10.0	2.2	<b>JCB Super Multigrade 10W/30</b> -15°C to +40°C (5°F to 104°F)	SAE10W/30 CF-4/SG
Engine (Coolant)	23.0	5.1	<b>JCB Four Seasons Antifreeze &amp; Summer Coolant/Water</b> (see <b>Coolant Mixtures</b> )	ASTM D3306, BS6580
Syncro Shuttle (2WD) ②	14.4	3.2	<b>JCB Extreme Performance</b> (Below 40 °C, 104 °F)	SAE10W
Syncro Shuttle (4WD) ②	15.4	3.4	<b>JCB Extreme Performance</b> (Below 40 °C, 104 °F)	SAE10W
Powershift 6 speed ②	16	3.5	<b>JCB Extreme Performance</b> (Below 40 °C, 104 °F)	SAE10W
Powershift 4 speed ②	15.5	3.4	<b>JCB Extreme Performance</b> (Below 40 °C, 104 °F)	SAE10W
Front Axle (4WD)				
Housing (2WS)	13	2.86	<b>JCB HD90 Gear Oil</b> (without LSD)	API-GL-5
Housing (4WS) ⑥	18	3.96	<b>JCB Special Gear Oil Plus</b> (with LSD)	API-GL-4
Hubs (x2)	2.0	0.44	Must be suitable for use with limited slip differentials (LSD).	
Rear Axle (4WS)				
Housing	18	3.96	<b>JCB Special Gear Oil Plus</b> Must be suitable for use with oil immersed brakes and limited slip differentials (LSD).	API-GL-4
Hubs (x2)	2.0	0.44		
Rear Axle (2WS)	23	5.0		
Brake System	1.4	0.3	<b>JCB Light Hydraulic Fluid</b> <b>⚠ CAUTION: DO NOT USE ORDINARY BRAKE FLUID</b>	ISO VG15
Hydraulic System ③	130	28.6	<b>JCB High Performance Hydraulic Oil</b> (Above 38 °C, 100 °F)	ISO VG46
			<b>JCB Hydraulic Fluid HP32</b> (Below 38 °C, 100 °F)	ISO VG32

ITEM	CAPACITY		FLUID/LUBRICANT	INTERNATIONAL SPECIFICATION
	Litres	UK Gal		
Grease Points	---		<b>JCB HP Grease</b> or <b>JCB Special MPL-EP Grease</b> ④	Lithium complex NLGI No.2 consistency including extreme pressure additives Lithium based NLGI No.2 consistency including extreme pressure additives
Extending Dipper	---		<b>Waxoyl</b> ⑤	
Electrical connections	---		As a corrosion and moisture inhibitor all exposed connections should be coated liberally with petroleum jelly.	
Power Sideshift Chains	---		<b>JCB Chain Lubricant</b>	

- ① **Note:** New engines DO NOT require a running-in period. The engine/machine should be used in a normal work cycle immediately, glazing of the piston cylinder bores, resulting in excessive oil consumption, could occur if the engine is gently run-in. Under no circumstances should the engine be allowed to idle for extended periods; (e.g. warming up without load). Engines of new machines are filled at the factory with JCB 10W/30 Multigrade oil. This oil should be drained after the first 100 hours operation and the engine filled with the appropriate recommended grade as shown in the lubrication chart. JCB 10W/30 Multigrade should also be used for the first 100 hours operation whenever a new or reconditioned engine is fitted to the machine. After the first 100 hours operation, it is essential that the 10W/30 oil is replaced by the lubricant recommended. The figure quoted is TOTAL system capacity. Use the MIN and MAX marks on the dipstick when filling the system. Figures quoted within  $\pm 0.5$  litre (0.11 U.K. gal).
- ② **Note:** The figure quoted is TOTAL system capacity. Use the MIN and MAX marks on the dipstick when filling the system. Figures quoted within  $\pm 1.0$  litre (0.22 U.K. gal).
- ③ **Note:** The total hydraulic system capacity depends on the equipment being used. Fill with all rams closed. Watch level indicator on hydraulic tank.
- ④ **Note:** JCB HP Grease is the recommended specification grease, if using JCB Special MPL-EP then the greasing must be carried out more frequently.
- ⑤ **⚠ WARNING:** Waxoyl contains turpentine substitute, which is inflammable. Keep flames away when applying Waxoyl. Waxoyl can take a few weeks to dry completely. Keep flames away during the drying period. Do not weld near the affected area during the drying period. Take the same precautions as for oil to keep Waxoyl off your skin. Do not breathe the fumes. Apply in a well-ventilated area.
- GEN-1-3
- ⑥ **Note:** 4WS axles with limited slip differential must use **JCB Special Gear Oil Plus**.

## Coolant Mixtures

### WARNING

**Antifreeze can be harmful. Obey the manufacturers instructions when handling neat or diluted antifreeze.**

7-3-4-4

The protection provided by JCB Four Seasons Antifreeze and Summer Coolant is shown below. If any other anti-freeze is used, refer to the manufacturer's instructions and ensure that a corrosion inhibitor is included. DO NOT use solutions of more than 60% or less than 50% or damage to the cooling system will occur.

**55% Solution** - Maintains circulation down to -36 deg C (-33 degF), protects against damage down to -41 deg C (-42 degF)

The strength of the anti-freeze solution must be checked at least once a year, preferably at the beginning of the cold period. It is an advantage to leave the anti-freeze in all the year round as it gives continued protection against corrosion. Always renew the anti-freeze every two years. A 50% anti-freeze mixture must be used even if frost protection is not needed. This gives protection against corrosion and raises the coolants boiling point.

It should be noted that serious damage to the cooling system can occur if corrosion inhibitors are not used.

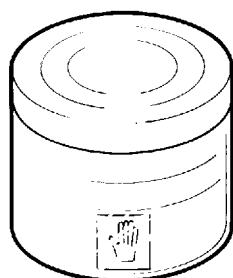
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\*HVAC = Heating, Ventilation and Air Conditioning

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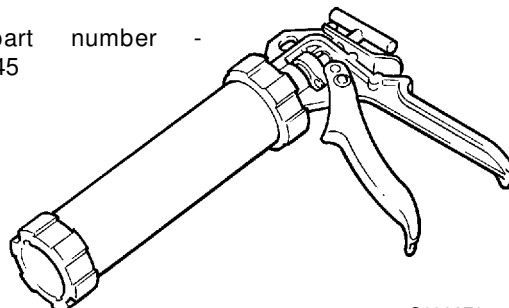
**Hand Cleaner** - special blend for the removal of polyurethane adhesives.

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

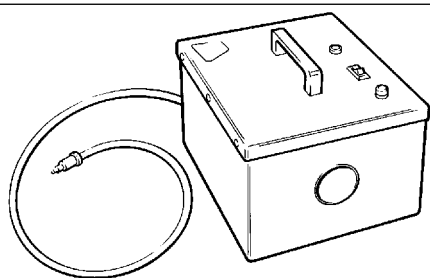
S186240

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

JCB part number - 892/00845



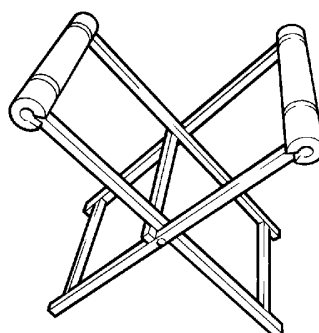
S186270



**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



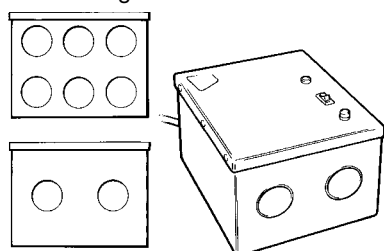
**Folding Stand for Holding Glass** - essential for preparing new glass prior to installation.

JCB part number - 892/00843

S186280

**240V Static Oven** - available with 2 or 6 cartridge capacity - required to pre-heat adhesive prior to use. No plug supplied. Note: 110V models available upon request - contact JCB Technical Service.

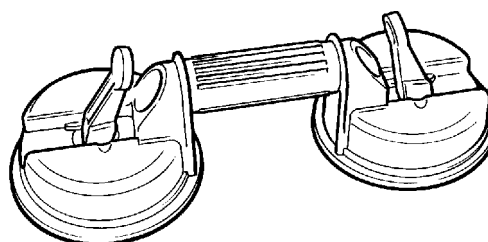
JCB part number:  
992/12400 - 2 Cartridge x 240V  
992/12600 - 6 Cartridge x 240V



S186260

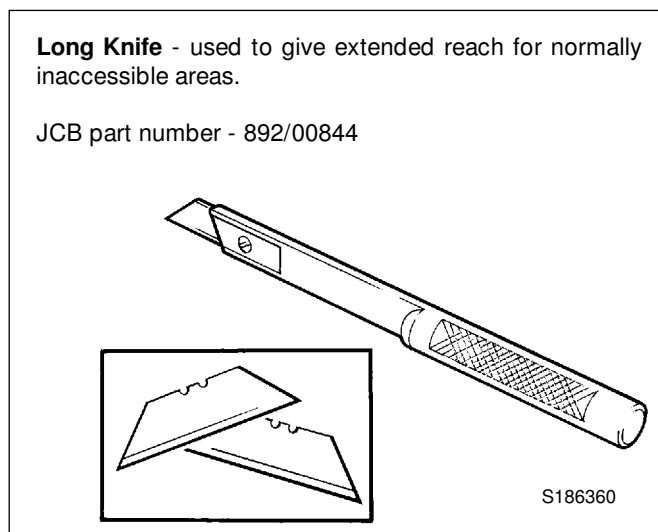
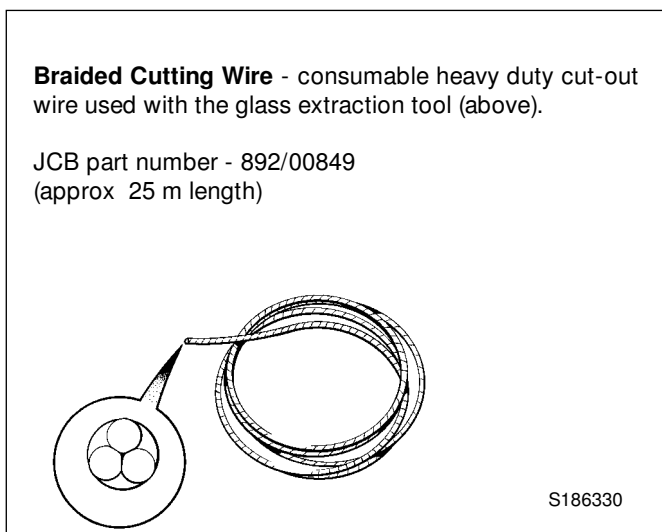
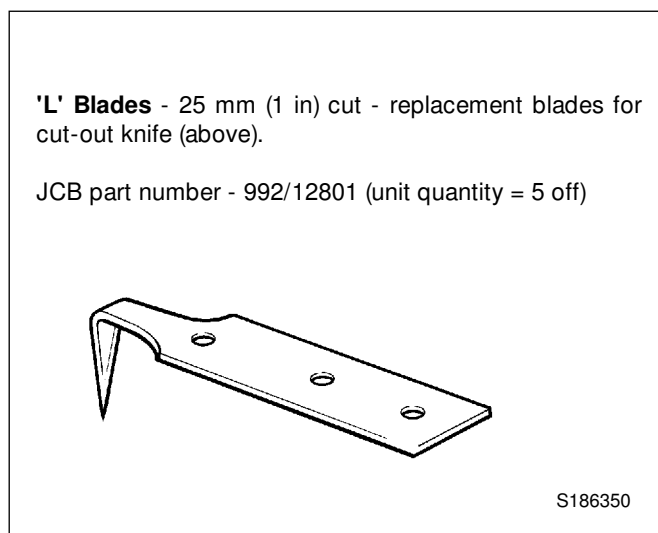
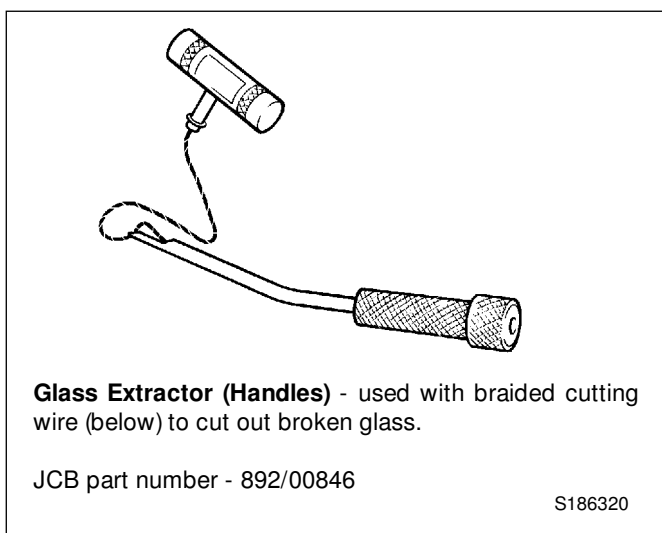
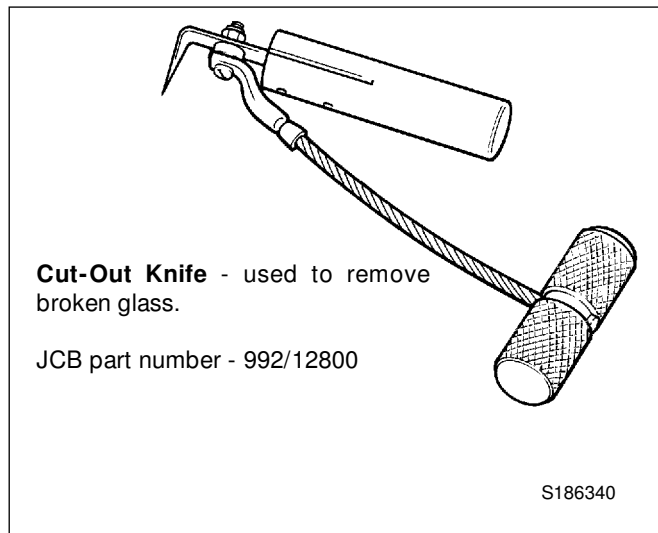
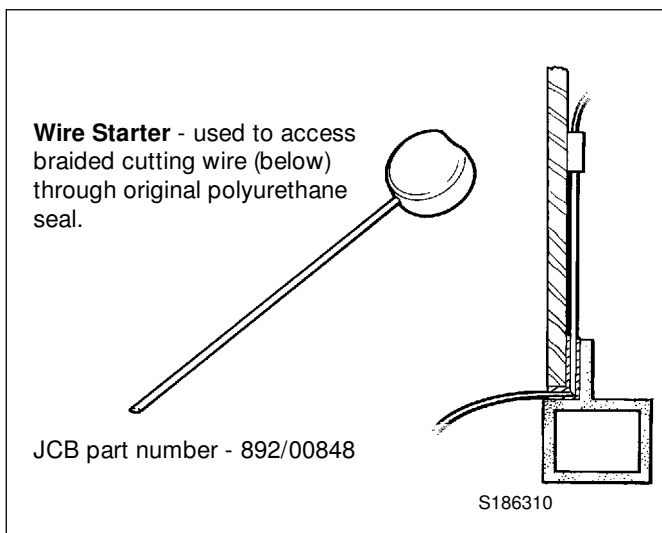
**Glass Lifter** - minimum 2 off - essential for glass installation, 2 required to handle large panes of glass. Ensure suction cups are protected from damage during storage.

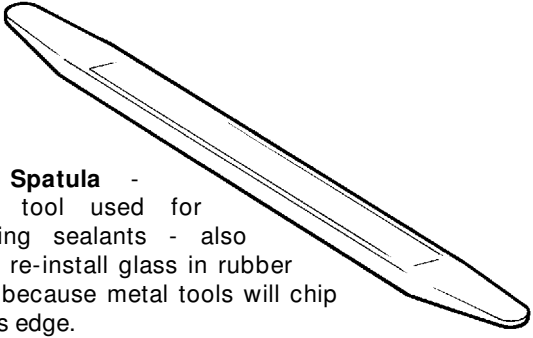
JCB part number - 892/00842



S186300







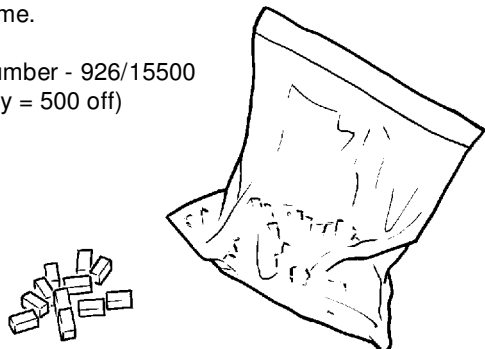
**Nylon Spatula** - general tool used for smoothing sealants - also used to re-install glass in rubber glazing because metal tools will chip the glass edge.

JCB part number - 892/00847

S186470

**Rubber Spacer Blocks** - used to provide the correct set clearance between glass edge and cab frame.

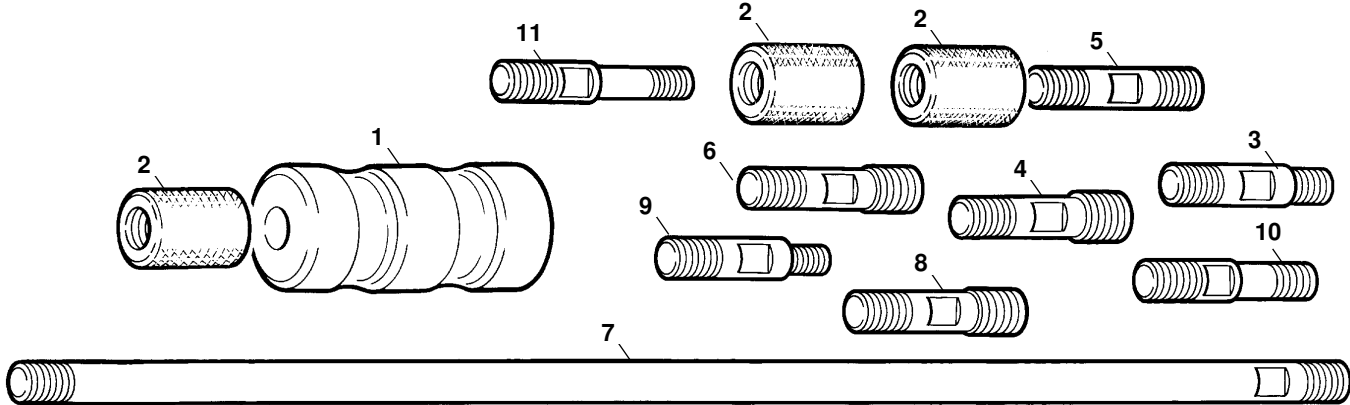
JCB part number - 926/15500 (unit quantity = 500 off)



S186550

**Slide Hammer Kit - 993/68100**

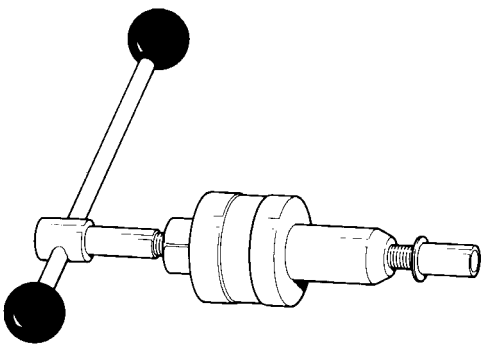
1 :993/68101	Slide Hammer	6 :993/68106	Adaptor - M20 x M24
2 :993/68102	End Stops	7 :993/68107	Bar - M20 x M20 X 800MM
3 :993/68103	Adaptor - M20 x 5/8" UNF	8 :993/68108	Adaptor - M20 x 7/8" UNF
4 :993/68104	Adaptor - M20 x 1" UNF	9 :993/68109	Adaptor - M20 x M12
5 :993/68105	Adaptor - M20 x M20	10 :993/68110	Adaptor - M20 x 5/8" UNF (Shoulder)
		11 :993/68111	Adaptor - M20 x 1/2" UNF



S196910

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



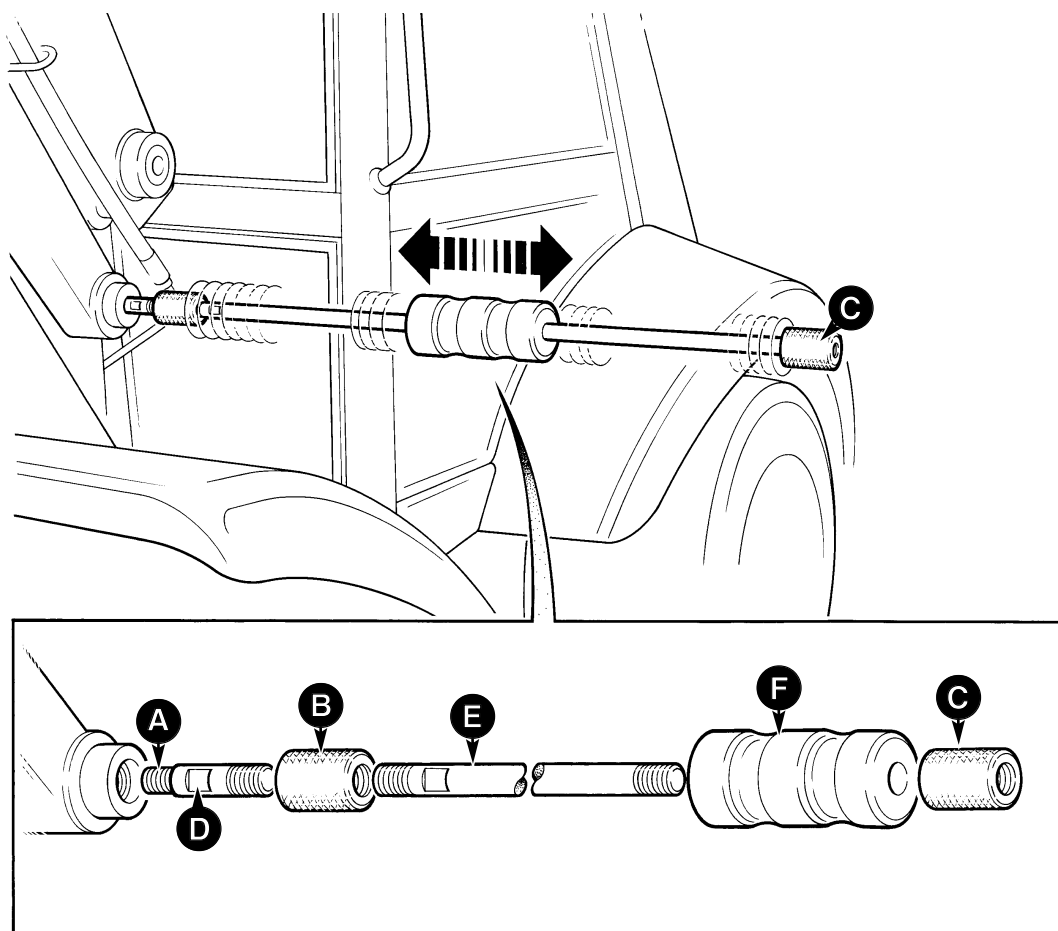
S261210

## Slide Hammer Kit Procedure

The slide hammer kit is used to remove pivot pins that must be extracted, i.e. cannot be 'knocked through'. The purpose of this description is to explain how the kit and the various components are used to remove the pivot pins.

The adaptors **A** that form part of the kit have a screwed thread at each end. One of the threads will always be M20 size, this is to accommodate the end stops, items **B** and **C**. The other end of the adaptor will have varying thread sizes to suit the different size of threads in the pivot pins.

- 1 Prepare the pivot pin, for instance, if fitted, remove the pivot pin retaining bolt.
- 2 Determine the thread size of the pivot pin and then fit the appropriate adaptor **A** as shown. Use the spanner flats **D** to securely fit the adaptor.
- 3 Fit an end stop **B** onto the other end of the adaptor (M20 thread size), make sure that the adaptor threads are fully engaged.
- 4 Fit the 'slide bar' **E** into the end stop. Again make sure that the threads are fully engaged.
- 5 Fit the 'slide hammer', item **F**, onto the slide bar as shown.
- 6 Finally, fit another end stop, item **C**, at the end of the slide bar, as shown. The slide hammer kit is now ready to use.
- 7 To extract the pivot pin, slide the hammer along the bar until it contacts end stop **C**. Repeat this step until the pivot pin is released.
- 8 To remove the slide hammer kit, reverse the steps described above.



S196900

### 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:

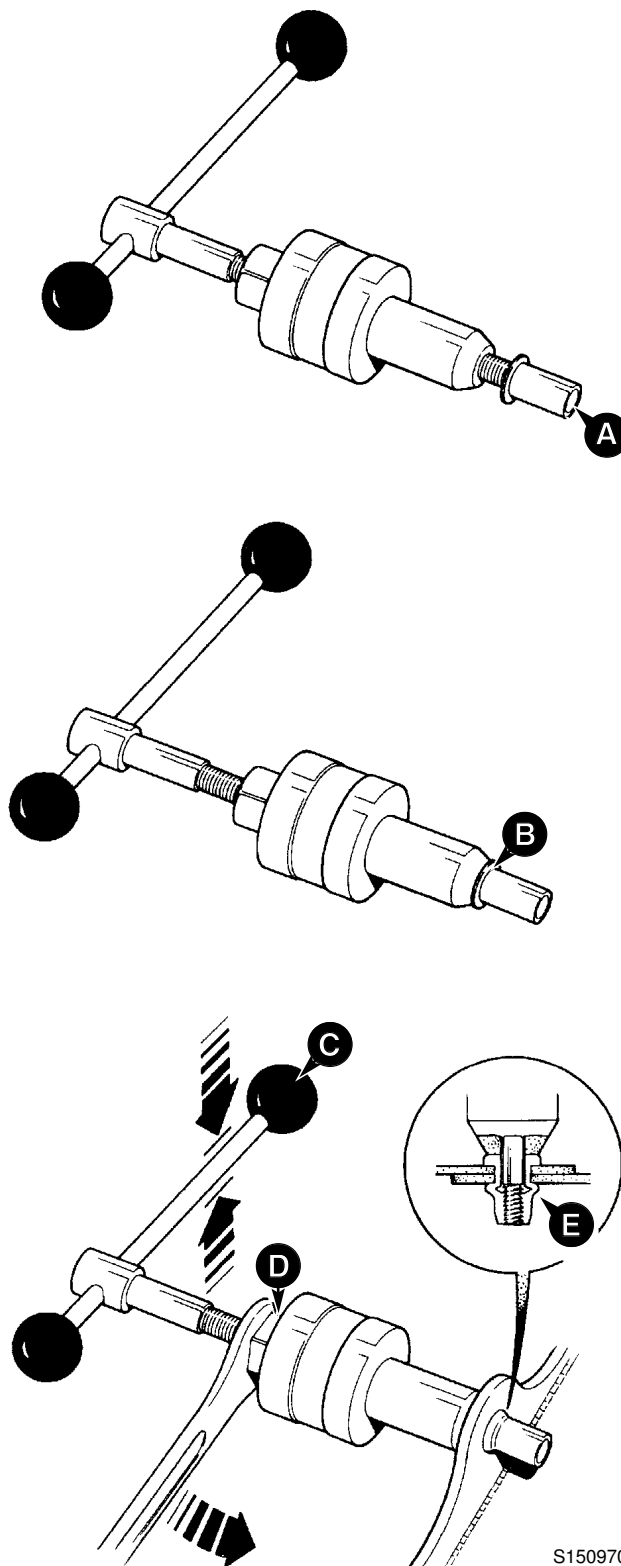
- 1 Drill a hole in the machine body/framework where the rivet nut is to be fitted. De-burr hole edges.
- 2 Screw the rivet nut onto the mandrel of the installation tool. The bottom of the mandrel should be in line with the bottom of the rivet nut, shown at **A**.
- 3 Wind the body of the installation 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	14.00	7.10
		3.00 - 5.50	17.00	
M6	9	0.50 - 3.00	16.00	9.10
		3.00 - 5.50	19.00	
M8	11	0.50 - 3.00	18.00	11.10
		3.00 - 5.50	21.00	
M10	13	1.00 - 3.50	23.00	13.10
		3.50 - 6.00	26.00	



S150970

**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 (Option)

### Binary Pressure Switch Settings

Low Pressure	1.96 bar	(2.0 kgf/cm <sup>2</sup> )	28.4 lbf/in <sup>2</sup> )
High Pressure	27.5 bar	(28 kgf/cm <sup>2</sup> )	400 lbf/in <sup>2</sup> )

### Thermostatic Switch Settings

Cut out	-0.6 °C	(33.0 °F)
Cut in	4.2 °C	(39.5 °F)

### Refrigerant

R-134a	1.4 Kg Maximum charge
--------	-----------------------

### Oil

PAG Oil

Quantities:

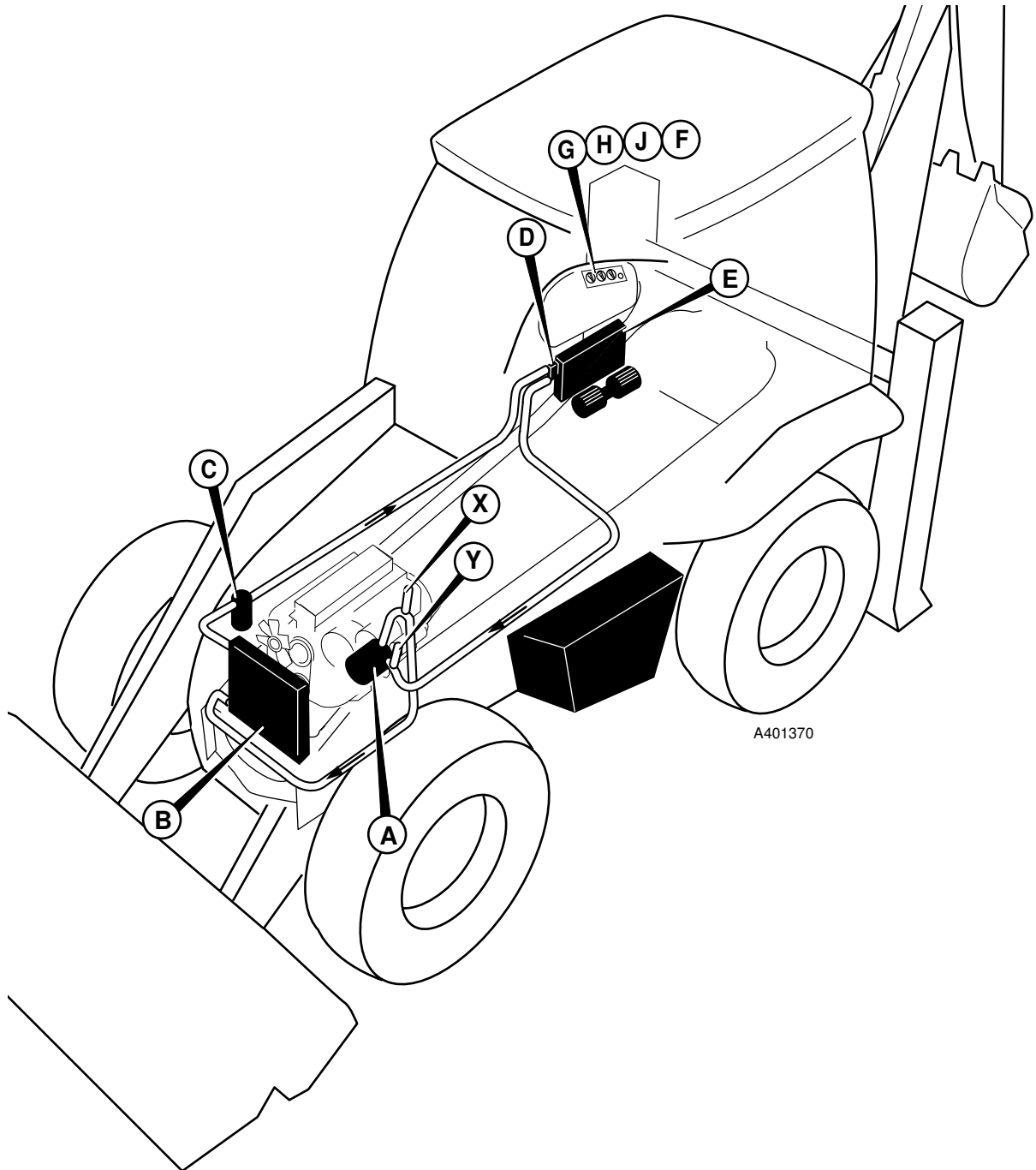
Condenser 1.5 fluid oz. (42.6 ml)

Evaporator 3.0 fluid oz. (85.2 ml)

Receiver Drier 0.3 fluid oz. (8.5 ml)

Compressor None - pre charged

Hoses If more than 4 metres of hose is replaced,  
then add 0.5 fluid oz. (15 ml) for every metre over 4 metres.



A401370

## Air Conditioning

### R-134a Refrigerant

Due to environmental concerns, the use of ozone depleting chlorofluorocarbons (CFCs) in air conditioning systems is being gradually phased out.

The R-12 refrigerant used in some systems contains CFCs and is now being replaced by a hydrofluorocarbon (HFC) refrigerant R-134a, which does not cause ozone depletion. **The refrigerant used in the 3CX air conditioning system is R-134a.**

Air conditioning systems using R-134a refrigerant are not compatible with systems using R-12 refrigerant. No attempt should be made to charge R-134a systems with R-12 refrigerant.

### System Operation

To maintain optimum operator comfort in warm climates or during seasons of high ambient temperature, the air conditioning system delivers cool, dehumidified air into the cab. Cooling is provided by passing the warm ambient air, together with recirculated air, over an evaporator matrix in the air conditioning unit.

The air conditioning system is a closed circuit through which the refrigerant is circulated, its state changing from gas to liquid and back to gas again, as it is forced through the system.

The major components of the system are the compressor **A**, condenser matrix **B**, receiver drier **C**, expansion valve **D** and evaporator matrix **E**.

To operate the air conditioning, press switch **F** to switch the system on. Press switch **G** to operate the 3-speed heater fan. Rotate **H** to select the desired temperature. Control **J** enables the operator to select either recirculating air or fresh air from outside the machine. A combination of both is also obtainable.

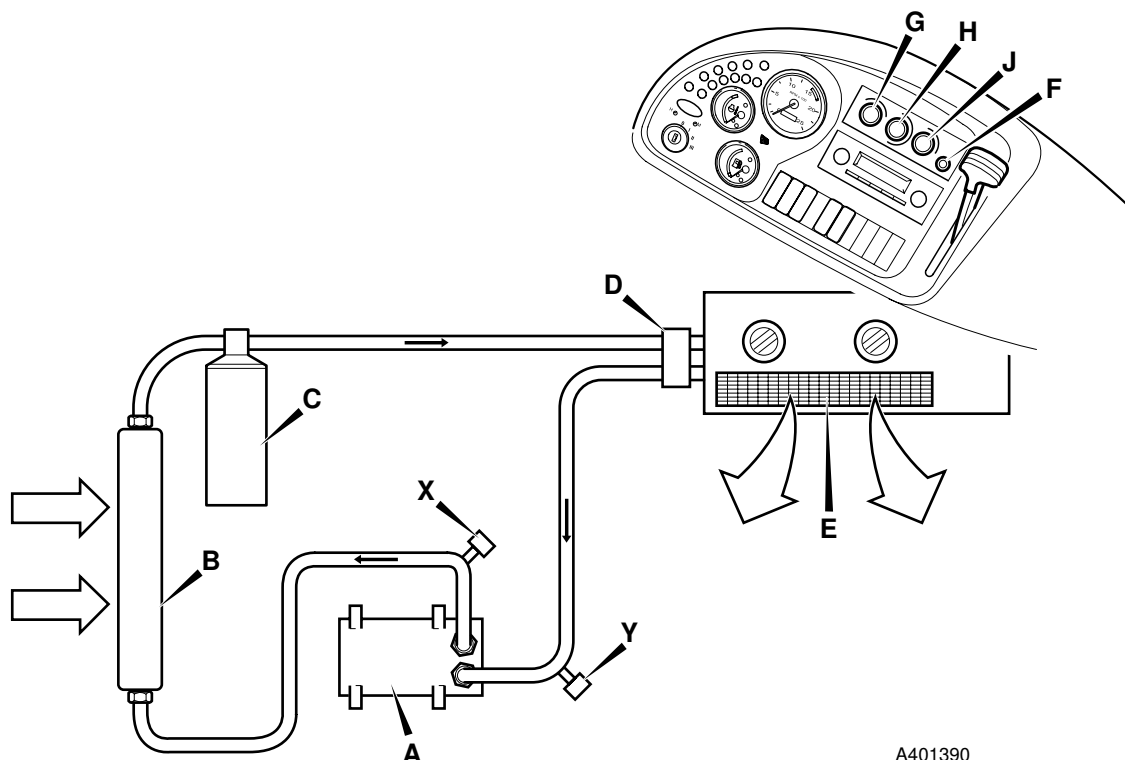
Air conditioning system power is generated from the engine, via an electromagnetic clutch to the compressor. Three switches, connected in series, are included in the clutch supply line, all must be closed for the clutch and therefore the air conditioning system to operate.

The compressor **A** draws in low pressure refrigerant gas from the suction line (evaporator to compressor) and increases refrigerant pressure through compression. This process also increases the refrigerant temperature.

High pressure refrigerant is forced from the compressor to the condenser **B**, which is mounted at the front of the engine. Ambient air is drawn across the condenser by the engine-driven cooling fan. In the condenser, the refrigerant changes state to a high pressure, high temperature liquid but with a lower heat content.

The refrigerant passes through the receiver drier **C**, which contains a desiccant to remove moisture from the system. The receiver drier serves as a reservoir for refrigerant and also includes a filter to remove foreign particles from the system.

The high temperature, high pressure refrigerant is forced by compressor action into the expansion valve **D**, which meters the amount of refrigerant entering the evaporator. In the expansion valve the refrigerant instantaneously expands to become a low pressure, low temperature liquid.



A401390

## Air Conditioning

### System Operation (cont'd)

The refrigerant is drawn through the evaporator matrix **E** by the suction of the compressor. The temperature of refrigerant is now considerably below that of the air being drawn across the evaporator matrix by the blowers. Heat is transferred from the ambient and recirculated air to the refrigerant, causing the low pressure liquid to vaporise and become a low pressure gas. Moisture in the air condenses on the evaporator matrix and is drained away via condensate.

Cool de-humidified air is emitted through air vents into the cab.

The low temperature, low pressure, high heat content refrigerant gas, is now drawn by suction back to the compressor, where the cycle is completed.

Service connection points **X** and **Y** adjacent to the compressor are provided for connecting the pressure gauge manifold, when charging/testing the refrigerant. Connection **X** high pressure (red) and connection **Y** low pressure (blue).

### System Control

Control of the system is achieved by the cyclic action of the compressor's electromagnetic clutch. When current is fed to the field coil of the compressor's clutch, a magnetic field develops between the field coil and the armature which pulls the field coil, complete with clutch assembly, onto the compressor's rotor. Since the clutch assembly is turned constantly by the crankshaft pulley drive belt, the compressor armature turns, starting the refrigeration cycle.

Current is fed to the field coil through three series switches whose contacts are controlled by the following:

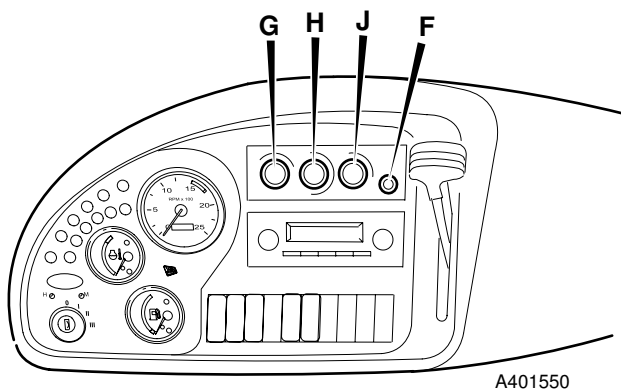
- a The manual A/C ON/OFF switch **F** in the control console.
- b The freeze protection thermostat switch monitoring the evaporator temperature.
- c The high and low level binary pressure switch.

The ON/OFF switch **F** will start the refrigeration cycle provided that the ambient temperature in the cab is greater than 0°C and the refrigerant pressure remains within the specified limits.

The thermostat has its sensor inserted in the evaporator matrix. It controls the refrigeration cycle by switching the compressor clutch on and off to prevent freezing of the condensate on the evaporator matrix.

The high and low level binary pressure switch assembly is located adjacent to the expansion valve on the HVAC unit. If the refrigerant pressure exceeds the upper pressure limit specified or falls below the lower limit, the contacts will open and the clutch will disengage, closing down the refrigeration cycle.

**Note:** Switch settings are given in the technical data, refer to **Technical Data - Air Conditioning (Option)**.



- F** A/C ON/OFF Switch
- G** Turn to switch on the 3-speed heater fan. Turn further clockwise for faster speeds. It functions only with the starter switch ON.
- H** Temperature - Turn anti-clockwise to increase the heat.
- J** Air Recirculation - Turn clockwise to recirculate air in the cab. Turn anti-clockwise for fresh air from outside. The control can be adjusted to give a combination of recirculated air and fresh air.



## Safety Procedures

The air conditioning system includes a pressurised closed circuit containing a non-CFC, environmentally friendly refrigerant, Type R-134a. Any service procedure which breaks into the closed circuit and therefore requires discharging of the system, must only be carried out by service personnel with specialist knowledge of air conditioning systems. The following guidelines should be adhered to by all personnel servicing the air conditioning system.

### WARNING

**The air conditioning system is a closed loop system and contains pressurised refrigerant. No part of the system should be disconnected until the system has been discharged by a refrigeration engineer, or a suitable trained person. You can be severely frostbitten or injured by escaping refrigerant**

4-3-4-1/2

### CAUTION

**Do not operate the air conditioning system when there is no refrigerant in the system, otherwise the compressor will be damaged.**

4-3-4-4

- 1 It is critical that the correct refrigerant (R-134a) is used and that charging is done only by qualified personnel. It is illegal to discharge the refrigerant into the atmosphere but as a precaution in case of accidental leakage, discharging and charging of the vehicle refrigerant system must be conducted in a well ventilated area.
- 2 Containers of refrigerant should be stored in a cool environment away from direct sunlight.

### WARNING

**Do not carry out welding operations close to the air conditioning refrigerant circuit. A poisonous gas is produced when refrigerant comes into contact with naked flames. Do not smoke or allow naked flames close to the refrigerant circuit.**

BF 1- 9

- 3 **Do Not** perform welding operations close to refrigerant hoses (maintain a distance of at least 0.5m from hoses).
- 4 **Do Not** steam clean refrigerant system components.
- 5 When charging or discharging the refrigerant system, no smoking or naked flames should be allowed in the immediate vicinity. The refrigerant does not give off a poisonous odour, however, when it comes into contact with a naked flame, a poisonous gas is produced.
- 6 When handling refrigerant, rubber gloves and goggles should be worn. Operators should ensure no refrigerant comes into contact with the skin. Particular care should be taken when connecting or disconnecting charging hoses or pressure switches. When these components are connected to the system, a short release of refrigerant occurs. This results in a high velocity, very cold gas being emitted from the connection point.

- 7 When checking the state of the refrigerant at the receiver drier sight glass, it is necessary to run the engine with the side panel removed and the bonnet raised. Extreme care must be taken to avoid moving engine parts such as fans, pulleys and belts.
- 8 Use caution when working near exposed evaporator fins. Painful cuts can be inflicted by the edges of the fins. Also, damage to the fins will reduce the efficiency of the system.
- 9 Make sure pressure cylinders are not over filled, particularly when recovering refrigerant.
- 10 Disconnect battery before doing any work.

## Air Conditioning

The system will not function in very low ambient temperatures, therefore tests should be carried out in a warm environment.

It is recommended that, to locate faults on the system accurately and quickly, an electronic leak detector and a refrigerant pressure gauge should be used. However, leaks can be detected on the system by using soapy water applied to the suspected leak area and system pressure can be assessed by the state of refrigerant passing through the receiver drier sight glass. Following sections of the manual deal with the major components of the air conditioning systems and give further fault finding and maintenance information.

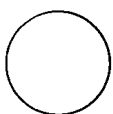
### General Fault Indications

There are several indications that may help to determine the fault area on a system not working efficiently:

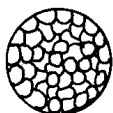
- |   |  |  |
|---|--|--|
| a) Poor performance.  | Low system pressure -<br>Condenser matrix air flow restricted -<br><br>Air filter blocked -<br>Compressor drive belt too slack - | Evacuate and recharge system.<br>Remove debris from around matrix using compressed air or low pressure water.<br>Remove and replace.<br>Adjust to correct tension. |
| b) Warm or slightly cool air emitted from unit.                     | Expansion valve stuck open or closed -   | Renew expansion valve.   |
| c) Blower operates on fan speed 3 only.<br>Blower does not operate. | Blower resistor failed -<br>Blower motor failed -<br>Fuse blown -  | Renew resistor.<br>Renew complete blower unit.<br>Replace fuse and retest.   |
| d) Compressor clutch continually cuts out.                          | Condenser matrix blockage -<br><br>Overcharging of refrigerant system -<br>Blocked expansion valve/condenser -                   | Remove debris from around matrix/renew condenser.<br>Evacuate and recharge system.<br>Clear blocked component .  |

### Sight Glass Indications

An approximate indication of the condition of the refrigerant can be seen through the receiver/drier sight glass when the compressor is running. Refer also to **Service Procedures - Checking Refrigerant Charge Level**.



Clear - No fault indicated unless the system is unable to provide cool air. The indication then is that the system is completely discharged of refrigerant.



Foam or bubbles - Refrigerant low and in need of charging.



Clouded - Dessicant breakdown in the receiver-drier.

S201520

**Note:** Sight glass indications cannot always give a positive identification of a problem. Further diagnosis, preferably by a refrigeration engineer using pressure gauges, is advisable before reaching a definite conclusion.

**Air Conditioning (cont'd)****No Air Conditioning**

<b>CHECK</b>	<b>ACTION</b>
1 Are the controls set correctly, i.e. air conditioning selected, thermostat switch set to coldest position and blower switched on?	YES: Check 2 NO: Reset controls and retest.
2 Is the air conditioning (evaporator) blower working?	YES: Check 3. NO: Check 4.
3 Is the compressor running (visual check of pulley/clutch)?	YES: Check 9. NO: Check 5.
4 Is the air conditioning fuse(s) blown?	YES: Renew fuse(s) and retest. NO: Check 8.
5 Is there a 12V supply to the pressure switch harness? Refer to <b>Service Procedures - Pressure Switch Testing</b>	YES: Check 6. NO: Check 7.
6 Does the compressor clutch engage with pressure switch assembly bypassed? Refer to <b>Service Procedures - Pressure Switch Testing</b>	YES: Replace pressure switch assembly. NO: Renew the compressor clutch and retest.
7 Does the clutch engage with thermostat switch bypassed?	YES: Renew thermostat switch and retest. NO: Check all electrical connections.
8 Are blower switch and wiring OK?	YES: Renew blower unit complete. NO: Renew switch or wiring.
9 Is sight glass indication OK?	YES: Check 10. NO: Charge check required by refrigeration engineer or suitably trained person.
10 Is condensor air flow blocked?	YES: Clean condensor and radiator. NO: Check 11.
11 Is evaporator air flow blocked?	YES: Clean filter and, if necessary the evaporator. NO: Call in refrigeration engineer or suitably trained person.

### Air Conditioning - System Diagnosis

This section gives an overview of the following conditions:

- Normally Functioning A/C System
- Low R-134a Charge
- Poor Refrigerant Circulation
- No Refrigerant Circulation
- Insufficient Cooling of Condenser
- Air in System
- Expansion Valve Improperly Mounted
- Compressor Malfunction
- Moisture in the System

**Note:** Normal gauge readings will depend on system components and ambient conditions, make sure that the valves are closed and the readings are stable and that the system has a full charge.

The pressures on the manifold at 25 °C with the engine at 1500 RPM, the blower on maximum and the thermostat set to maximum, should be approximately:

Typically, the high pressure is 6 - 8 times the low pressure.

#### Normally Functioning A/C System

**Gauge Readings:**

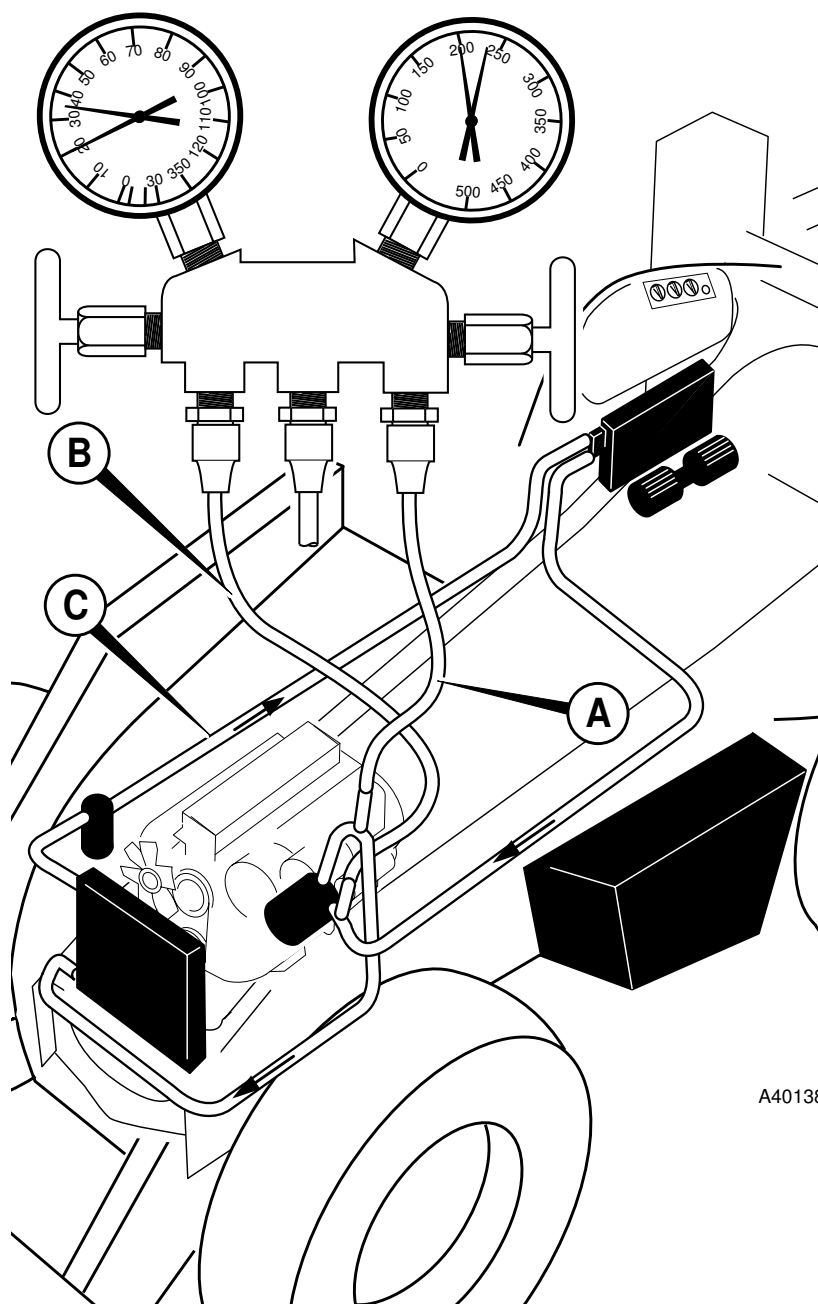
- Low Side Gauge - Normal.
- High Side Gauge - Normal.

**Other Indications:**

- Sight Glass - Clear.
- Discharge Air - Cold.

**LOW SIDE (Blue)**  
Normal  
LOW SIDE - 2.0 bar (2.0 kgf/cm<sup>2</sup>)(29 lbf/in<sup>2</sup>)

**HIGH SIDE (Red)**  
Normal  
HIGH SIDE - 14.8 bar (15.1 kgf/cm<sup>2</sup>)(215 lbf/in<sup>2</sup>)



**Component Key:**

- A High Pressure/Temperature Gas.
- B Low Pressure/Temperature Gas.
- C High Pressure Liquid.

A401380

**Air Conditioning**  
**- System Diagnosis (cont'd)**

**Low R-134a Charge**

**Gauge Readings:**

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

**Other symptoms:**

**Sight Glass** - Bubbles continuously visible.

**Diagnosis:**

**System slightly low on R-134a, due to leak or incorrect charge.**

**Correction:**

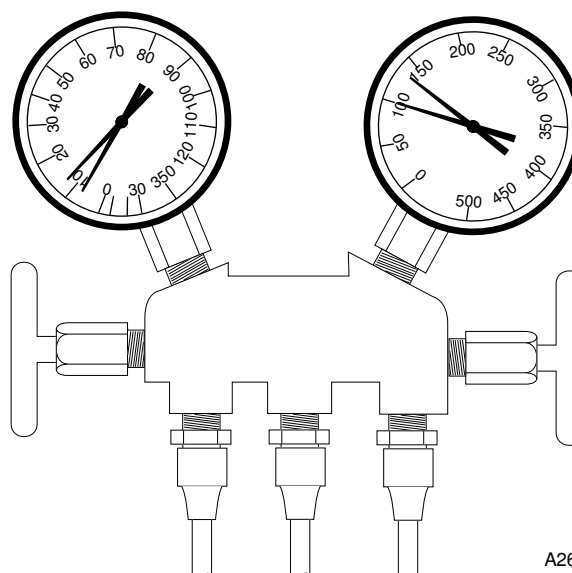
1. Leak test system.
2. Evacuate A/C system.
3. Repair system leaks.
4. Charge system with R-134a.
5. Operate system and check performance.

**LOW SIDE (Blue)**

Low

**HIGH SIDE (Red)**

Low



A268030

LOW SIDE - 0.76 bar (0.77 kgf/cm<sup>2</sup>)(11 lbf/in<sup>2</sup>)  
 HIGH SIDE - 8.3 bar (8.5 kgf/cm<sup>2</sup>)(121 lbf/in<sup>2</sup>)

**Poor Refrigerant Circulation**

**Gauge Readings:**

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

**Other symptoms:**

**Receiver-Drier** - Frost on tubes from receiver-drier to evaporator unit.

**Diagnosis:**

**Refrigerant flow obstructed by dirt, receiver-drier clogged.**

**Correction:**

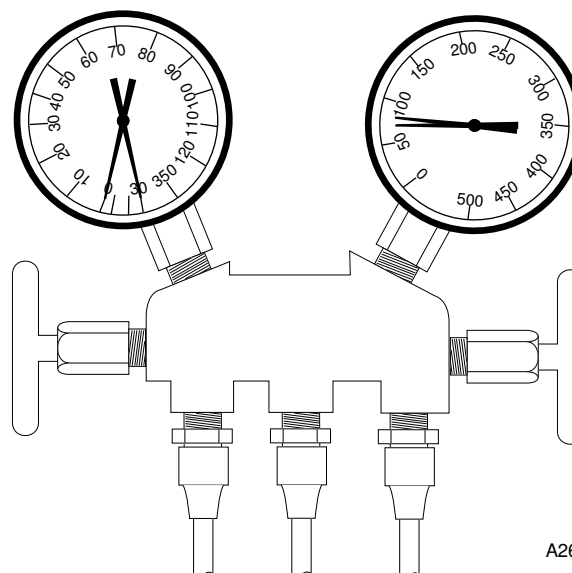
1. Evacuate A/C system.
2. Replace receiver-drier.
3. Charge system with R-134a.
4. Operate system and check performance.

**LOW SIDE (Blue)**

Zero to negative

**HIGH SIDE (Red)**

Low



A268040

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

**Air Conditioning**  
**- System Diagnosis (cont'd)**

**No Refrigerant Circulation**

**Gauge Readings:**

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

**Other symptoms:**

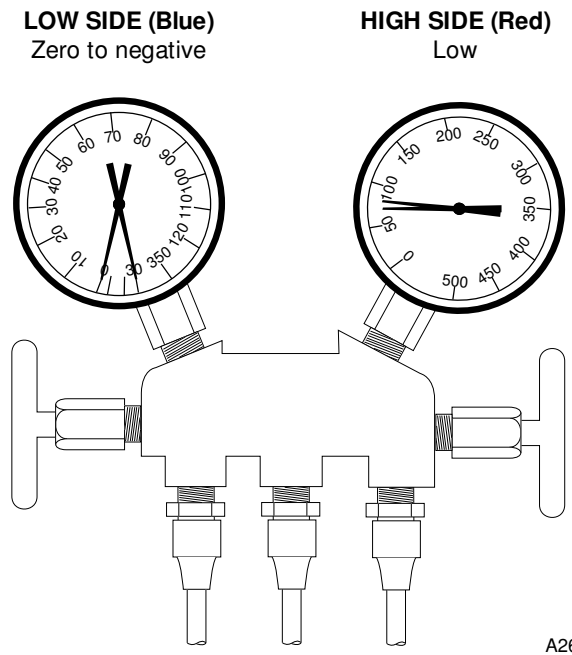
**Receiver-Drier** - Frost or moisture on tubes before and after receiver-drier.

**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 - -1.0 bar (-1.1 kgf/cm<sup>2</sup>)(-15 lbf/in<sup>2</sup>)  
 HIGH SIDE - 5.4 bar (5.5 kgf/cm<sup>2</sup>)(78 lbf/in<sup>2</sup>)

**Insufficient Cooling of Condenser or Refrigerant Overcharge**

**Gauge Readings:**

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

**Other symptoms:**

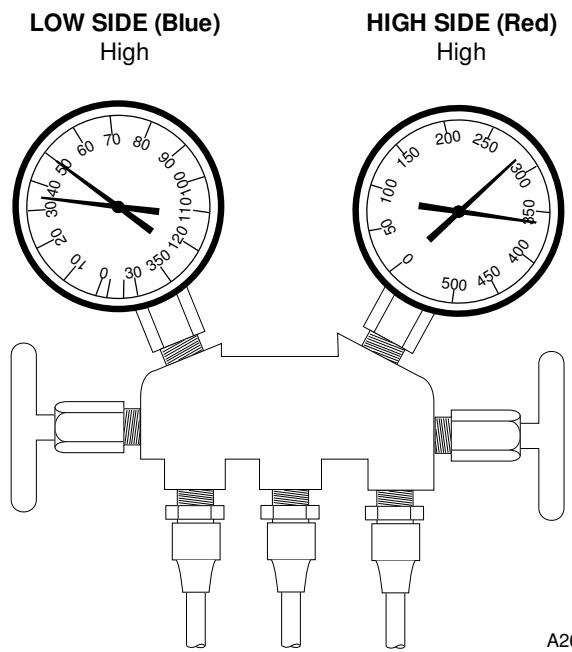
**Sight Glass** - No bubbles visible even at lower engine RPM.

**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 - 3.0 bar (3.0 kgf/cm<sup>2</sup>)(43 lbf/in<sup>2</sup>)  
 HIGH SIDE - 22.1 bar (22.5 kgf/cm<sup>2</sup>)(320 lbf/in<sup>2</sup>)

**Air Conditioning**  
**- System Diagnosis (cont'd)**

**Air in System**

**Gauge Readings:**

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

**Other symptoms:**

**Sight Glass** - Bubbles visible during system operation.

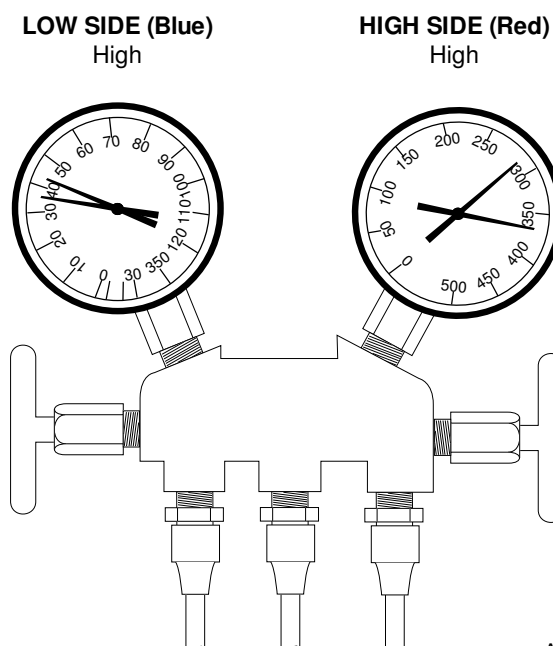
**Pipes** - Low pressure pipes are hot to the touch.

**Diagnosis:**

**Air is present in the system, possibly from inadequate evacuation procedure.**

**Correction:**

1. Evacuate A/C system.
2. Check compressor oil for contamination. Check compressor for proper oil amount. Correct if necessary.
3. Charge system with R-134a.
4. Operate system and check performance.



A268070

LOW SIDE - 2.8 bar (2.8 kgf/cm<sup>2</sup>)(40 lbf/in<sup>2</sup>)  
 HIGH SIDE - 22.1 bar (22.5 kgf/cm<sup>2</sup>)(320 lbf/in<sup>2</sup>)

**Expansion Valve Improperly Mounted or Heat Sensing Tube Defective (Opening Too Wide)**

**Gauge Readings:**

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

**Other symptoms:**

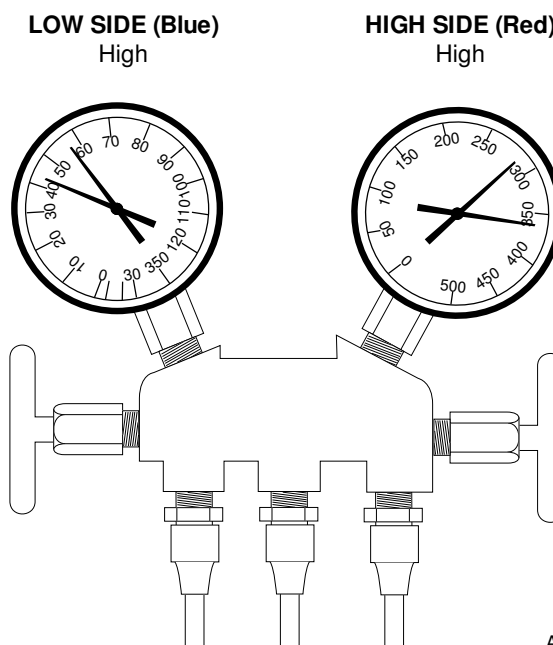
**Pipes** - Large amount of frost or moisture on low side pipes.

**Diagnosis:**

**Excessive refrigerant in low side pipes possibly from expansion valve being opened too wide.**

**Correction:**

1. Leak test system.
2. Evacuate A/C system.
3. Repair system leaks.
4. Charge system with R-134a.
5. Operate system and check performance.



A268080

LOW SIDE - 3.5 bar (3.5 kgf/cm<sup>2</sup>)(50 lbf/in<sup>2</sup>)  
 HIGH SIDE - 22.1 bar (22.5 kgf/cm<sup>2</sup>)(320 lbf/in<sup>2</sup>)

**Air Conditioning**  
**- System Diagnosis (cont'd)**

**Compressor Malfunction**

**Gauge Readings:**

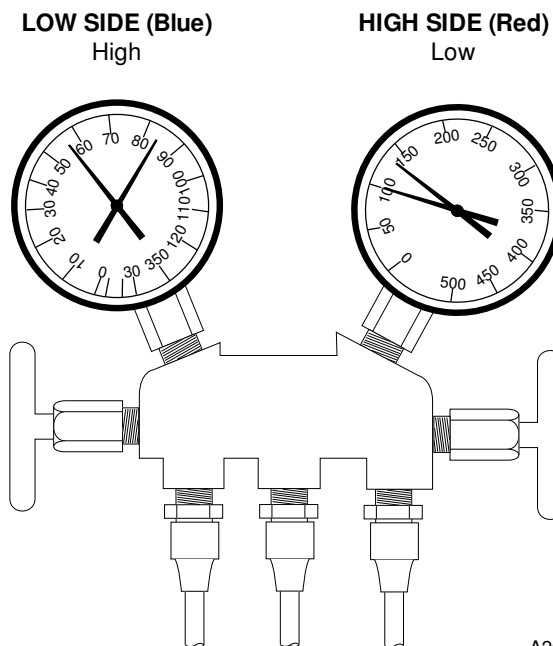
**Low Side Gauge** - High.  
**High Side Gauge** - Low.

**Diagnosis:**

**Internal compressor leak or compressor mechanically broken.**

**Correction:**

1. Evacuate A/C system.
2. Repair or replace compressor.
3. Charge system with R-134a.
4. Operate system and check performance.



A268090

LOW SIDE - 4.9 bar (5.0 kgf/cm<sup>2</sup>)(71 lbf/in<sup>2</sup>)  
 HIGH SIDE - 8.3 bar (8.5 kgf/cm<sup>2</sup>)(121 lbf/in<sup>2</sup>)

**Some Moisture in the System**

**Gauge Readings:**

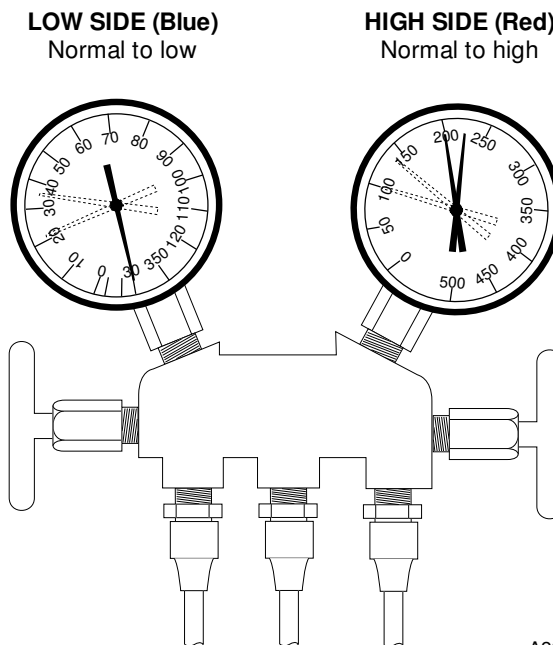
**Low Side Gauge** - Normal, then sometimes drops to below zero.  
**High Side Gauge** - Normal, then sometimes goes high.

**Diagnosis:**

**Moisture in system freezes, temporarily stopping cycle, normal system operation returns when ice melts.**

**Correction:**

1. Evacuate A/C system.
2. Replace receiver-drier.
3. Remove moisture by repeatedly evacuating system.
4. Charge system with R-134a.
5. Operate system and check performance.



A268020

LOW SIDE - -2.1 bar (-2.1 kgf/cm<sup>2</sup>)(-30 lbf/in<sup>2</sup>)  
 HIGH SIDE - 14.8 bar (15.0 kgf/cm<sup>2</sup>)(214 lbf/in<sup>2</sup>)



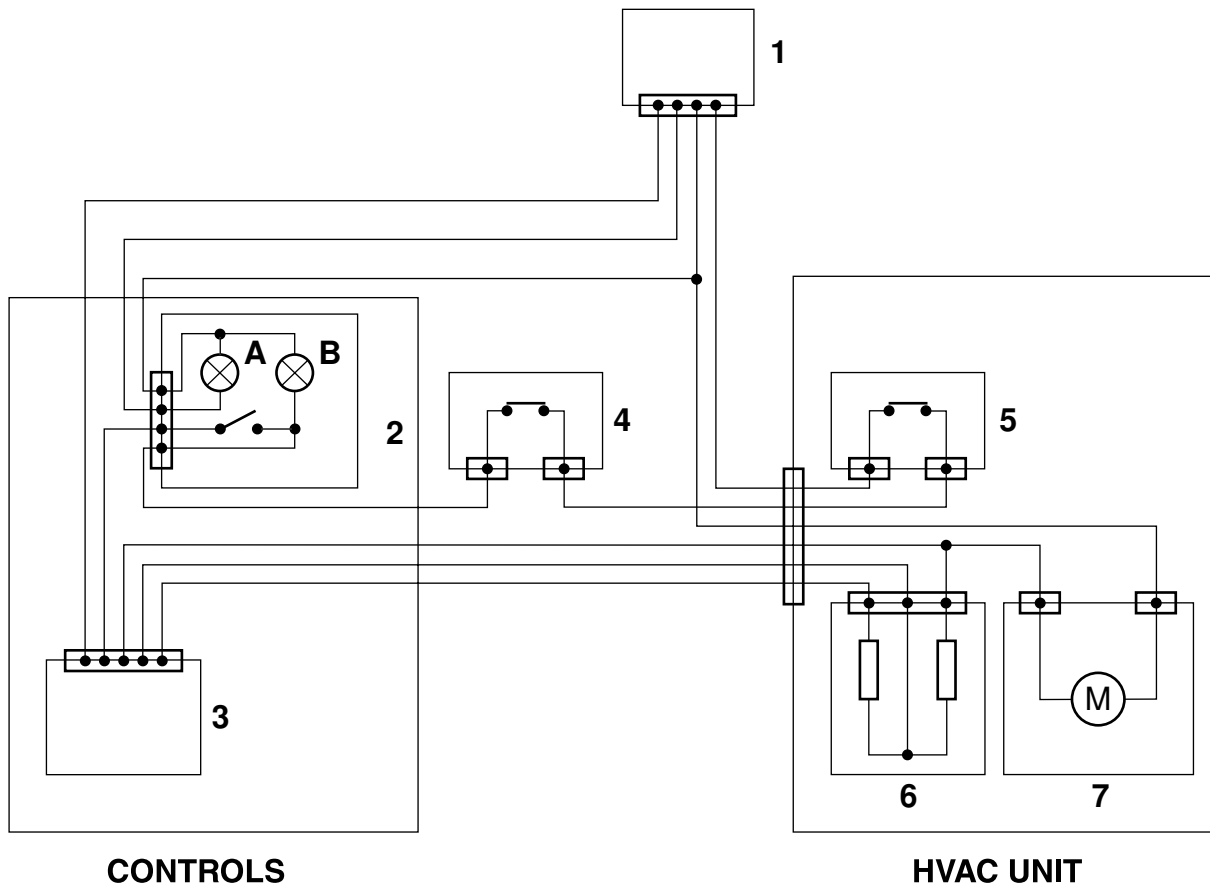
## Air Conditioning (cont'd)

### Wiring Continuity Checks

Use the illustration below to complete continuity checks on the HVAC/air conditioning system and heater harness wires. The harness connects to the main machine harness via connector 1. Refer also to the main machine circuit diagram in Section C Electrics.

#### Component Key:

- 1 Main Machine Harness Connector
- 2 Air Conditioning ON/Off Switch
- 2A Panel Illumination Bulb
- 2B Switch Illumination Bulb
- 3 Blower Switch
- 4 Binary Pressure Switch
- 5 Freeze Protection Thermostat
- 6 Blower Speed Resistor
- 7 Blower Unit Motor



A401410

## Air Conditioning

### Leak Testing

**Note:** The refrigerant is heavier than air and will leak downwards from the defective component. Check in still conditions but in a well ventilated area.

Hose or pipe connections are likely leakage points of any refrigerant circuit.

To test for leaks in the high pressure side of the system i.e. from the compressor output to the expansion valve, run the air conditioning for a few minutes then switch off the engine and test for leakage using an electronic leak detector.

To test for leakage in the low pressure side of the system, switch off the air conditioning and leave for a few minutes before testing.

#### WARNING

**Leak testing in Air Conditioning systems should be carried out only in a well ventilated area.**

BF 1-2

### Tightening Leaking Hoses

#### WARNING

**The air conditioning system is a closed loop system and contains pressurised refrigerant. No part of the system must be disconnected except by a qualified refrigeration engineer.**

4-3-4-1

The refrigerant hoses have crimped ferrule end fittings. The hose connectors have an 'O' ring seal which compresses when the connection is tight, creating an air tight seal.

Hoses are used to connect the inlets and outlets of the compressor, condenser, receiver drier and expansion valve (the evaporator coil is connected to the expansion valve within the air conditioning unit using rigid pipes).

If leakage is detected from a hose connector, either by means of an electronic leak detector or soapy water, tighten the connector up and repeat the leakage test. If leakage is still evident, it will be necessary to de-gas the system and renew the connector 'O' ring seal.

The 'O' rings used on an R-134a refrigerant system are of an HNBR compound and are colour coded green. These 'O' rings must be used as some 'O' ring materials can become porous to R-134a systems, resulting in leakage.

## Checking Refrigerant Charge Level

The pressure in the system, i.e. the refrigerant charge level can be determined by checking the state of refrigerant at the receiver drier sight glass.

If the level of charge is correct the sight glass will be clear. If the charge is low bubbles will be seen. Bubbles may also be an indication of inadequate cooling, due to a restriction of air flow around the condenser coil. Recharging of the system should be carried out by an air conditioning engineer. Check refrigerant charge level as follows:

- 1 Park the machine on firm, level ground. Lower the backhoe and loader to the ground.
- 2 Remove the starter key.
- 3 Remove the front grille.

#### WARNING

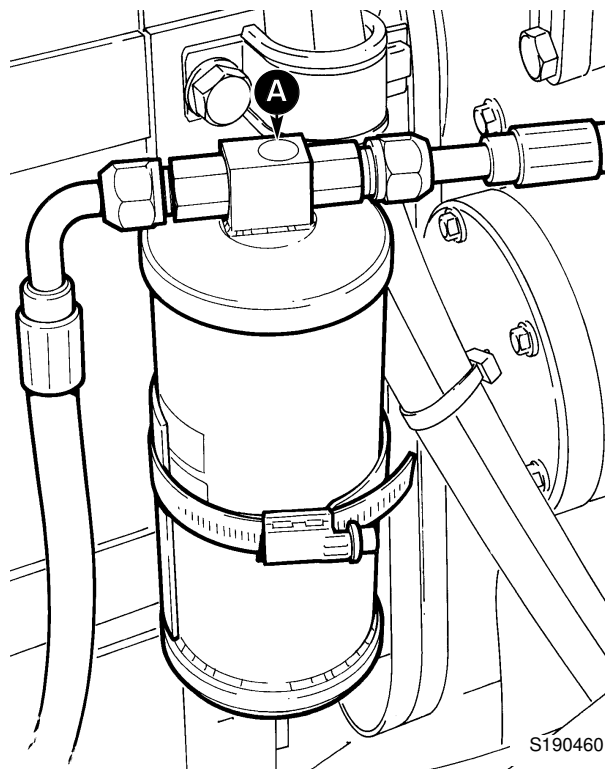
**When the engine is turning, there are parts rotating in the engine compartment.**

**Before starting this job make sure that you have no loose clothing (cuffs, ties etc) which could get caught in rotating parts.**

**When the engine is turning, keep clear of rotating parts.**

2-3-3-10

- 4 Start the engine and run at idle. Switch air conditioning ON to circulate refrigerant.
- 5 Check refrigerant charge level at sight glass A.



S190460

## Air Conditioning

### - Refrigerant Charging and Discharging

**Note:** The procedures for refrigerant charging and discharging must only be carried out by qualified service personnel who have received specialist training on the air conditioning system.

### **⚠ WARNING**

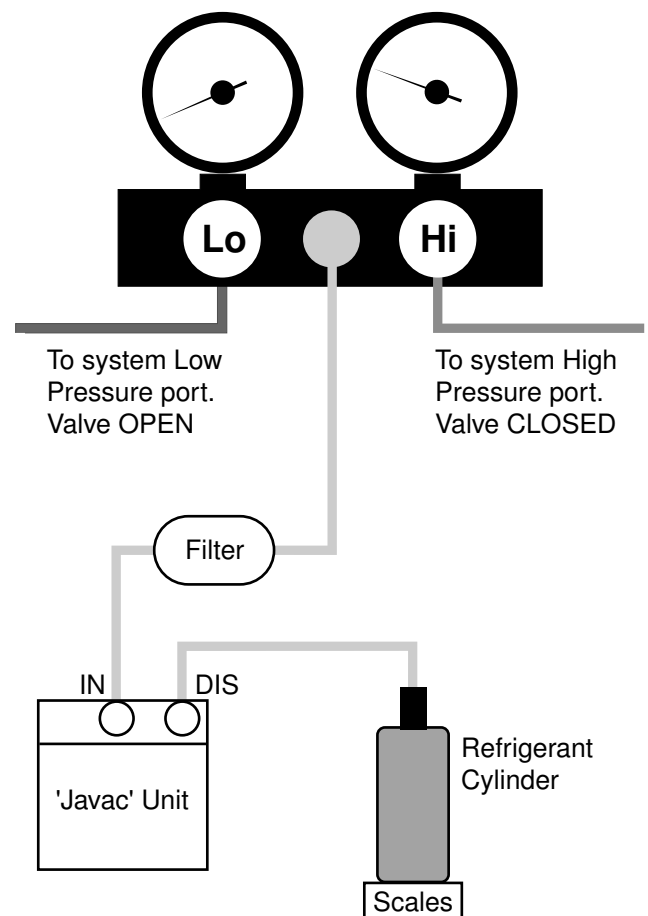
The air conditioning system is a closed loop system and contains pressurised refrigerant. No part of the system should be disconnected until the system has been discharged by a refrigeration engineer or a suitable trained person. You can be severely frostbitten or injured by escaping refrigerant.

4-3-4-1/2

### Refrigerant Recovery

The recovery process clears the system refrigerant prior to servicing or for refrigerant renewal.

- 1 Ensure that the engine is OFF and the starter key removed.
- 2 Connect the manifold to the system as shown, with the blue hose connected to the system low pressure port. DO NOT connect the red hose. Make sure that both valves are closed.
- 3 Connect the yellow hose to the 'Javac' unit filter.
- 4 Connect the filter to the 'Javac' unit.
- 5 Connect the 'Javac' unit to an empty receiver bottle. Weigh the bottle before and after filling to assess system capacity.
- 6 Switch on 'Javac' unit and open the low pressure manifold valve.
- 7 The 'Javac' unit will automatically switch off when a pressure balance exists between the system and the receiver bottle. Switch off 'Javac' at main switch, but leave the system connected. Switch on after 10 minutes, the 'Javac' will restart if residual pressure remains.
- 8 Close valves and remove equipment.



A396820

### Notes:

DO NOT fill the receiver bottle to more than 80% by weight.

DO NOT re-use refrigerant unless you are aware of its purity.

If the high pressure warning light on the 'Javac' unit comes on, throttle back the manifold low pressure valve to provide a restriction.

The JCB recommended 'Javac' unit only recovers refrigerant as a gas. Other units can recover refrigerant as a liquid and/or gas. ALWAYS check manufacturers instructions before using.

## Air Conditioning

### - Refrigerant Charging and Discharging

**Note:** The procedures for refrigerant charging and discharging must only be carried out by qualified service personnel who have received specialist training on the air conditioning system.

### **⚠ WARNING**

The air conditioning system is a closed loop system and contains pressurised refrigerant. No part of the system should be disconnected until the system has been discharged by a refrigeration engineer or a suitable trained person. You can be severely frostbitten or injured by escaping refrigerant.

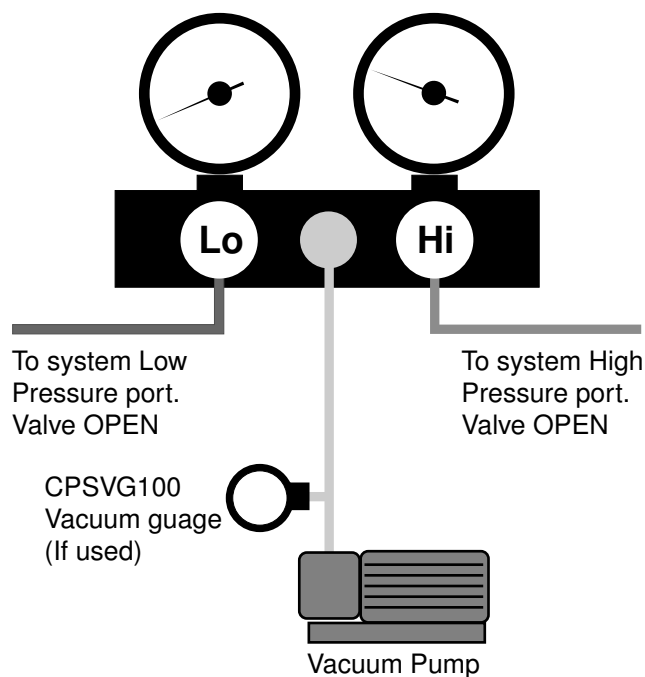
4-3-4-1/2

### Evacuating (Vacuuming)

This procedure follows on from the 'Recovery' process and is necessary to ensure proper refilling of the system with refrigerant.

To avoid leakage in the vacuum system itself, DO NOT use extensions to the yellow hose (use standard 2 metre length).

- 1 Recover all refrigerant from the system as described in **Refrigerant Recovery**.
- 2 Close all valves and connect the manifold as shown. Connect the blue hose to the system low pressure port and the red hose to the high pressure port.
- 3 Connect the yellow hose to the vacuum pump.
- 4 Open manifold valves.
- 5 Switch on the vacuum pump until 740mm (29 in) mercury vacuum reads on both gauges.
- 6 Maintain suction for approximately 30 minutes.
- 7 Close valves and remove equipment.

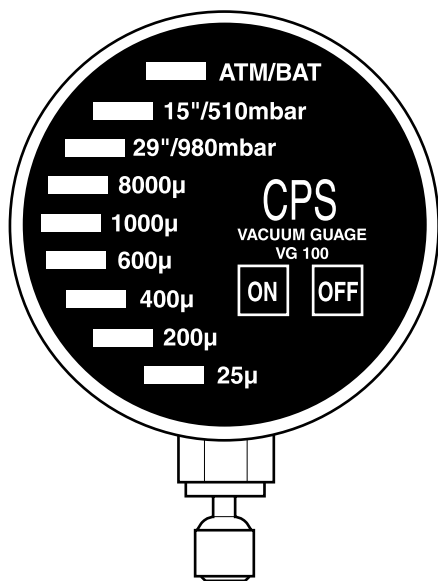


A396780

### Notes:

If the vacuum falls rapidly the system is leaking. Check all connections and reseal. If the point of leakage is not obvious, recharge the system and test again. Refer to **Service Procedures, Air Conditioning - Leak Testing**.

Achievable vacuum will vary with altitude. Maximum gauge reading will be 25mm (1 in) less for every 305 metres (1000 feet) above sea level.



A396790

### Electronic Vacuum Gauge

The CPS VG100 vacuum gauge is an electronic type using LED's to indicate various states of vacuum. It is used in place of or to supplement the gauge on the vacuum pump.

Before connecting into the system switch on to check that the first LED lights to show that the battery is in good condition.

**Note:** The indicator lights show pressure in inches of mercury (Hg) and vacuum in microns (0.001mm Hg).

ATM/BAT	Normal atmospheric pressure reading. Battery condition.
15''/510mbar	381mm (15 in)Hg. Partial vacuum - Vacuum system is operating.
29''/980mbar	736mm (29 in)Hg. No vacuum drawn - Possible system leakage.
8000µ	8.0mm (0.31 in)Hg. Partial vacuum - If the reading does not progress the system may have a slow leak.
1000µ	1.0mm (0.039 in)Hg. Deeper vacuum.
600µ	0.6mm (0.023 in)Hg. Deep vacuum.
400µ	0.4mm (0.015 in)Hg. Deep vacuum.
200µ	0.2mm (0.0078 in)Hg. Deep vacuum.
25µ	0.025mm (0.00098 in)Hg. Pump Test. Maximum sustainable vacuum.

## Air Conditioning

### - Refrigerant Charging and Discharging

**Note:** The procedures for refrigerant charging and discharging must only be carried out by qualified service personnel who have received specialist training on the air conditioning system.

### ⚠ WARNING

The air conditioning system is a closed loop system and contains pressurised refrigerant. No part of the system should be disconnected until the system has been discharged by a refrigeration engineer or a suitable trained person. You can be severely frostbitten or injured by escaping refrigerant.

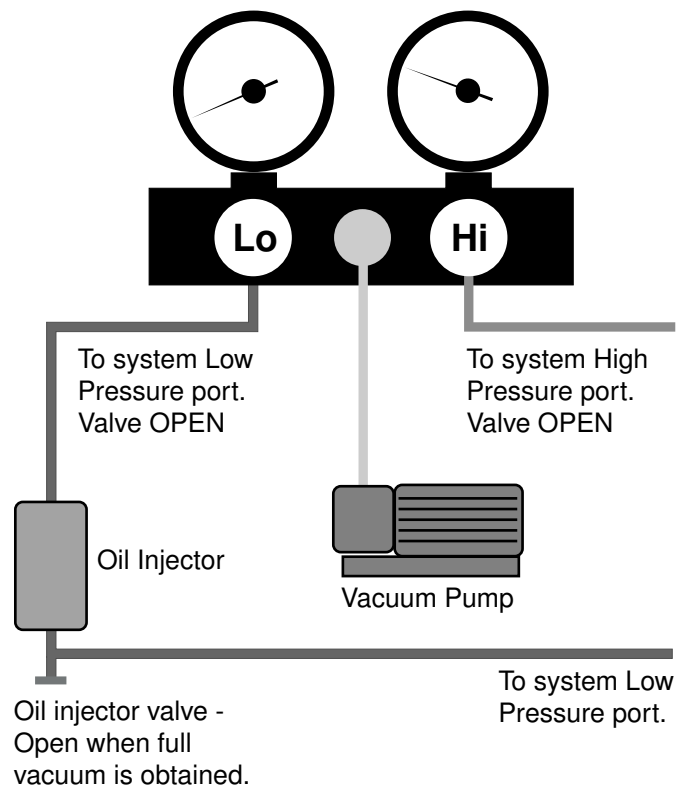
4-3-4-1/2

### Relubricating

Pre-lubrication is essential after recovering system refrigerant, vacuuming and component flushing.

The system should be evacuated to a vacuum of 740mm (29 in) of mercury before re-lubricating.

- 1 Ensure that the engine is OFF and the starter key is removed.
- 2 Close all valves and connect the manifold as shown, with the blue hose connected to the oil injector and the red hose to the system high pressure port.
- 3 Connect the yellow hose to the vacuum pump.
- 4 Connect the other end of the oil injector to the system low pressure point.
- 5 Switch on the vacuum pump and open the high pressure side valve.
- 6 Unscrew the oil injector cap and add the specified quantity of refrigerant oil.
- 7 When 740mm (29 in) mercury shows on the vacuum gauge, open the oil injector valve to allow the oil into the system.
- 8 If more oil is needed repeat the above procedure. The quantity of oil should be the same as that taken out during the **'Recovery'** procedure.



A396800

### Notes:

Use only PAG oil in R-134a systems.

## Air Conditioning

### - Refrigerant Charging and Discharging

**Note:** The procedures for refrigerant charging and discharging must only be carried out by qualified service personnel who have received specialist training on the air conditioning system.

#### WARNING

The air conditioning system is a closed loop system and contains pressurised refrigerant. No part of the system should be disconnected until the system has been discharged by a refrigeration engineer or a suitable trained person. You can be severely frostbitten or injured by escaping refrigerant.

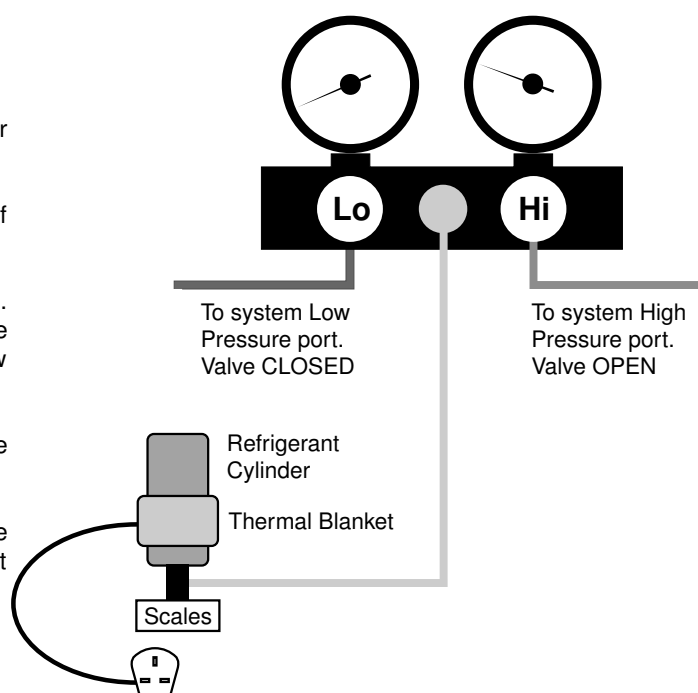
4-3-4-1/2

### Charging

This procedure is industry recommended practice for refilling air conditioning systems with refrigerant.

Evacuate the system beforehand to 740mm (29 in) of mercury.

- 1 Close all valves and connect the manifold as shown. Connect the blue hose to system low pressure and the red hose to system high pressure. Connect the yellow hose to the refrigerant cylinder.
- 2 Invert single valve cylinder on the scales and zero the scale reading (see **Notes:** for twin valve cylinders).
- 3 Slowly open the high pressure valve and allow the vacuum to draw-in refrigerant to the specified weight for the system. Refer to **Technical Data**.
- 4 Close all valves and remove the equipment.



A396810

#### Notes:

Add refrigerant as a LIQUID, not as a gas. Some refrigerant cylinders have separate valves for gas and liquid. Be sure to connect to the liquid port when following the above procedure.

Refrigerant can be used either in gas or liquid form. If recharging with gas follow the manufacturers instructions and recharge only via the low pressure port. DO NOT use liquid refrigerant at the low pressure port.

Add refrigerant until the scales indicate the specified weight for the system or the weight obtained when the system refrigerant was previously recovered.

To speed up the process a thermostatically controlled thermal blanket can be used around the replenishing cylinder.

## 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<sup>2</sup>) and a high pressure switch designed to open at 27.5 bar (400 lbf/in<sup>2</sup>)

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.



## Air Conditioning

### Condenser Matrix

It is likely that over a period of time, because of the machine's working environment, the airflow around the condenser matrix will become restricted due to a build up of airborne particles.

If the build up of particles is severe, heat dissipation from the refrigerant to the air will be significantly reduced, resulting in poor air conditioning performance.

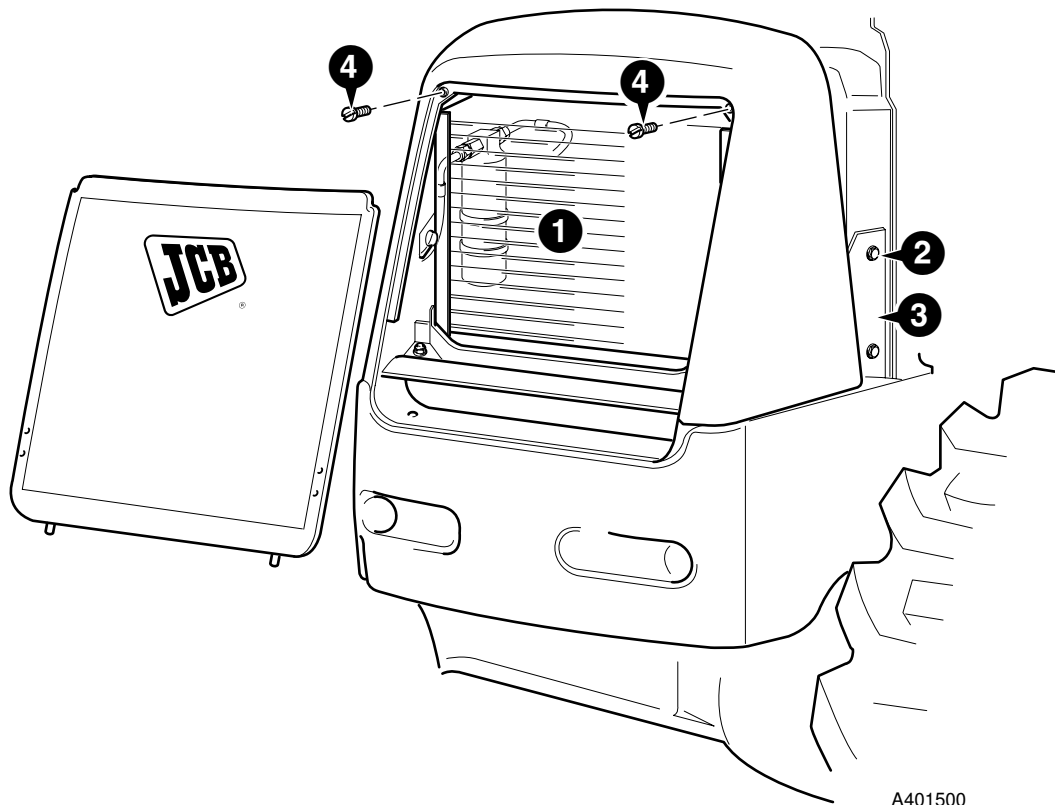
In extreme cases, over pressurisation of the system occurs, causing the high pressure cut out switch to operate and switch off the system.

High pressure cut out can also be caused by an internal blockage of the condenser matrix.

### Condenser Matrix Cleaning

Take care not to damage the condenser fins or tubes. Damaged fins must be straightened out to ensure a good airflow through the matrix.

- 1 Park the machine on firm level ground. Raise and block the loader arms. Lower the backhoe to the ground and stop the engine.
- 2 Remove the starter key.
- 3 Remove the front grille.
- 4 Remove both side panels.
- 5 Support the condenser 1.
- 6 Undo the nuts and bolts 2 at the three mounting brackets 3.
- 7 Remove the screws 4 fixing the condenser to the mounting brackets. Remove the brackets 3 to enable the condenser to be moved away from the radiator. This can be done without removing the hoses i.e. with the system fully charged.
- 8 With the condenser fully supported, use compressed air or low pressure water to backflow through the matrix fins. Take care not to damage the fins.
- 9 Refit the condenser matrix by reversing the removal procedure. Refit both side panels and bonnet.
- 10 Run the air conditioning and check cooling performance.



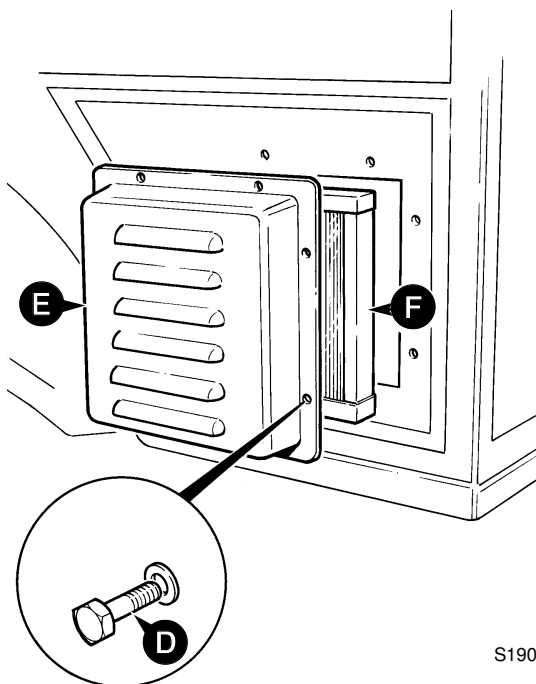
## Air Conditioning

### Filters - Changing and Cleaning

#### Air Intake Filter

- 1 Stop the engine and remove the starter key.
- 2 Remove Screws **D**, air intake cover **E** and filter **F**.

Clean filter element using compressed air. Refit filter into the cover and refit.



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## Air Conditioning

### Compressor Drive Belt - Adjusting

- 1 Park the machine on firm level ground. Raise and block the loader arms. Lower the backhoe to the ground and stop the engine.
- 2 Remove the starter key.

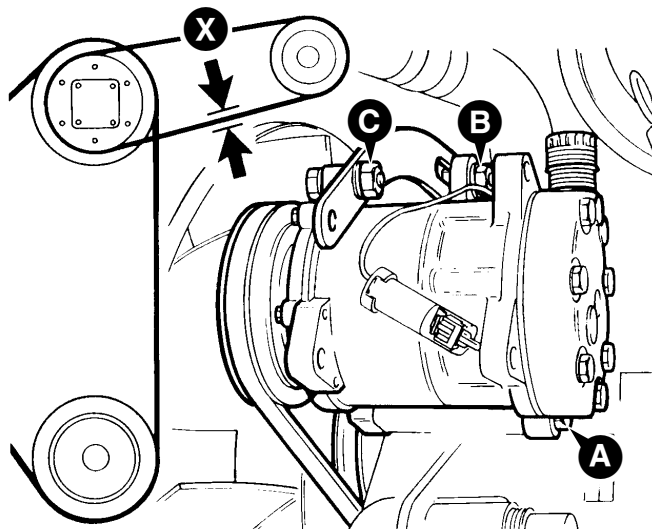
#### **⚠ WARNING**

**Make sure the engine cannot be started. Disconnect the battery before doing this job.**

2-3-3-5

- 3 Raise the Bonnet
- 4 Remove both Side Panels
- 5 Loosen pivot fastening bolt **A**. Loosen adjustment link fastening bolts **B** and **C**.
- 6 Position the compressor so that there is approximately 10 mm (3/8 in) slack at point **X** midway along the belt.
- 7 Tighten bolts **A**, **B** and **C**. Make sure that bolt **A** is the last to be tightened.

**Note:** If a new belt is fitted, check the belt tension after the first 20 hours of operation.



S209393

## Glazing

The glass panes on the cab are all direct glazed.

### Direct Glazing

The following procedures explain how to correctly remove and install panes of glass that are directly bonded to the cab frame apertures. When carrying out the procedures, relevant safety precautions must be taken:

- 1 Always wear safety glasses during both removal and replacement.
- 2 Use protective gloves - heavy duty leather gauntlet type gloves when cutting out the broken glass; 'non-slip' type gloves when handling/moving panes of glass; surgical type gloves when using the polyurethane adhesives.
- 3 Wear protective overalls.
- 4 DO NOT smoke - the activators and primers used in the procedures are highly flammable.
- 5 Do not attempt to handle or move panes of glass unless you are using glass lifters (see **Service Tools**).

### Removing the Broken Glass and Old Sealant

Several special tools are required to successfully complete the removal and replacement procedures. Reference is made to the tools in the text. The majority of these tools can be obtained locally and the remainder from JCB Service (see **Service Tools**).

The work must only be carried out in a dry, frost free environment. A protective canopy may be required or the machine/frame must be moved to a sheltered area. In damp or wet conditions, hinged doors and window frames can be removed from the machine and taken to a more suitable (dry) environment.

Glass should not be replaced at temperatures below 5°C (41°F).

**Note:** The front screen glass is laminated, the other glass is toughened. If a laminated pane breaks it will stay in one piece even though the glass is cracked. A toughened pane will shatter and fall apart. The method of removal of the glass depends upon which type it is. See WARNING below.

### WARNING

**Always wear safety glasses when removing or installing screen glass. Never use a power operated knife when removing the sealant around a toughened glass screen. The action of the knife could cause particles of glass to be thrown with sufficient force to cause serious injury, even when safety glasses are being worn. Use only hand operated tools when working with toughened glass.**

BF 2-3/1

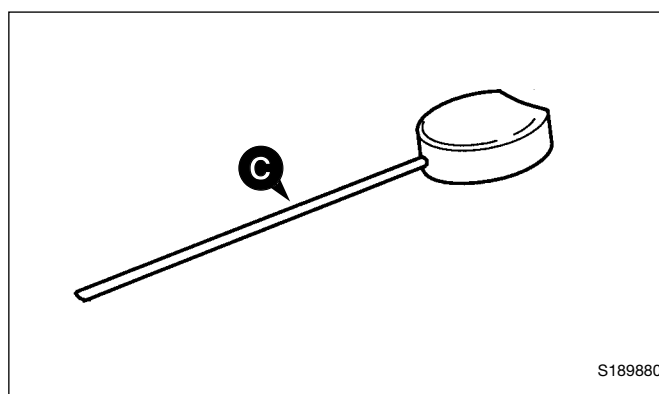
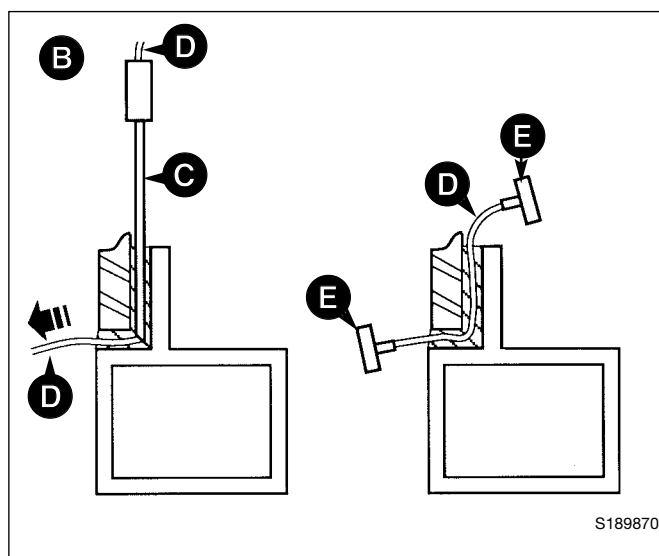
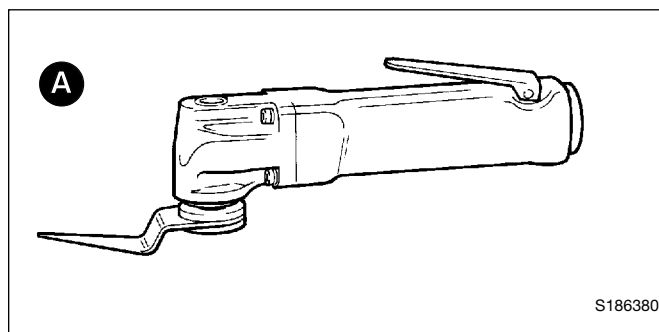
## Direct Glazing (cont'd)

### Removing the Broken Glass and Old Sealant (cont'd)

- 1 Position the machine on level ground and apply the parking brake. Stop the engine. Put protective covers over the cab seat and control pedestals.
- 2
  - a Laminated glass - leave installed until the old sealant has been cut away, after which it will be possible to lift the broken screen away from its frame housing in one piece.
  - b Toughened glass - remove as much of the shattered glass as possible prior to cutting out the old sealant.
- 3 Cut out the old sealant, leaving approximately 1 to 2 mm on the cab frame. There are several tools and techniques for doing this:
  - a Pneumatic Knife **A** provides one of the easiest methods of removing the sealant around laminated glass. The tool, powered by compressed air, should be sourced locally.

**Note:** This tool must not be used on toughened glass (see WARNING on previous page).

- (i) Press the handle to start the knife blade oscillating.
  - (ii) Insert the knife blade into the sealant.
  - (iii) Slowly move the knife along the sealant with the blade positioned as close to the glass as possible. Do not allow the knife blade to overheat or the sealant will melt.
- b Braided Cutting Wire and Handles **B**. This method uses a 3-core wire, a wire starter tube and two handles (see **Service Tools**).
    - (i) Insert the steel tube **C** into the old sealant on the inside of the glass.
    - (ii) Insert the braided cutting wire **D** down the centre of the steel tube. If necessary, from the outside, cut out local sealant at the point of the tube to gain access to the wire.
    - (iii) Using suitable pliers, pull the cutting wire through the sealant to the outer side of the glass.
    - (iv) Secure each end of the braided cutting wire in the special handles **E**.
    - (v) Move the cutting wire backwards and forwards in a sawing motion and at the same time gently push or pull the wire to cut through the old sealant.



## Direct Glazing (cont'd)

### Removing the Broken Glass and Old Sealant (cont'd)

**c** Cut-out Knife **F**. The cut-out knife can be used as a left handed or right handed tool. For the knife and its replaceable blades, refer to **Service Tools**.

- (i) Insert the knife blade into the sealant.
- (ii) Make sure that the blade of the knife is against the glass as shown at **G**.
- (iii) Use the 'pull-handle' to pull the knife along and cut out the old sealant.

**d** Craft Knife **H**. The blades are replaceable.

- (i) Insert the knife blade into the sealant.
- (ii) Pull the knife along and cut out the old sealant.

**Note:** There are other tools available to cut out the old sealant. For example, there is a long handle type craft knife to give extended reach. Refer to **Service Tools**, for details of this and any other tools.

**4 a** Laminated glass - lift out the broken pane using glass lifters (see **Service Tools**).

**b** Toughened glass - remove the cut off sealant and all remaining particles of shattered glass.

**5** If necessary, trim off the remaining old sealant to leave approximately 1 to 2 mm on the upright face of the cab frame aperture, as shown at **J**.

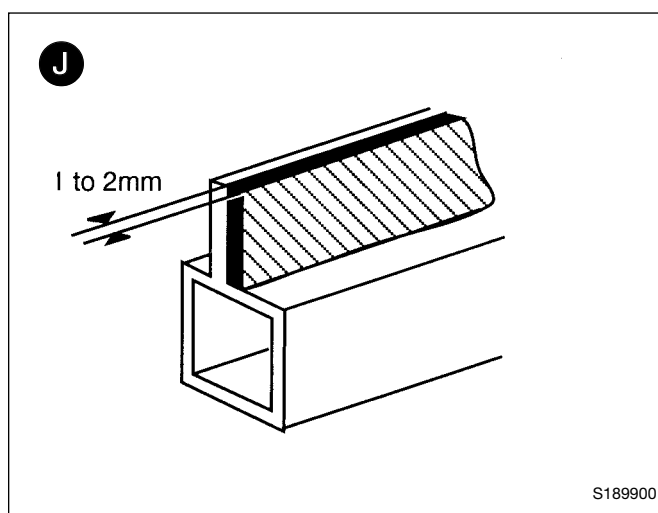
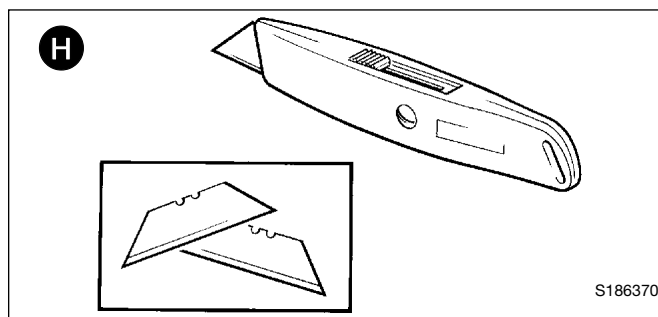
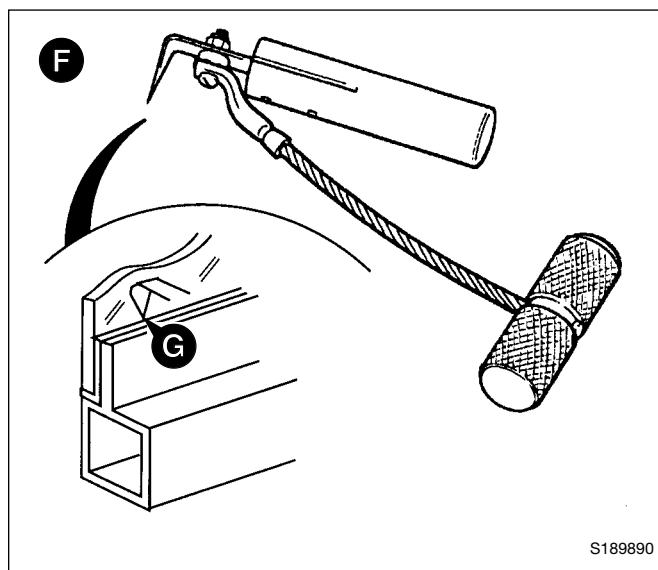
**6** Apply a coat of 'Black Primer 206J' to the paintwork if:

- a** Paintwork was damaged or scratched during the glass/sealant removal procedures.
- b** The old sealant was inadvertently cut back to the cab frame during the glass/sealant removal procedures.

### Preparing the Cab Frame Aperture

- 1** If damp or wet, dry the aperture area using a hot air gun (sourced locally).
- 2** Use 'Active Wipe 205' to thoroughly clean and 'prime' the trimmed sealant. Use a lint free cloth to apply the 'Active Wipe 205', allow 5 minutes flash off (drying) time.

**Note:** Do not use any other type of cleaning fluids, otherwise they may be absorbed into the old sealant and ultimately prevent the new glass from bonding.



## Direct Glazing (cont'd)

### Preparing the New Glass

#### **⚠ CAUTION**

The laminated front screen must be handled with extra care to prevent breakage. Wherever possible, store and handle it in a vertical attitude. When placing or lifting the screen in a horizontal attitude it must be supported over its whole area, not just at the edges.

BF 1-8

- 1 Make sure that the new glass correctly fits the frame aperture **K**.
  - a Put two spacer blocks **L** onto the bottom part of the frame aperture.
  - b Install the new glass on the spacer blocks - ALWAYS USE GLASS LIFTERS **M** (see **Service Tools**). Check that there is an equal sized gap all round the edge of the glass.

**Note:** The spacer blocks are rectangular in section to give two common gap widths. If necessary they can be trimmed to a smaller size to give an equal sized gap around the glass.

**IMPORTANT:** The glass edges MUST NOT touch the frame, otherwise movement of the frame will chip and eventually break the newly installed glass.

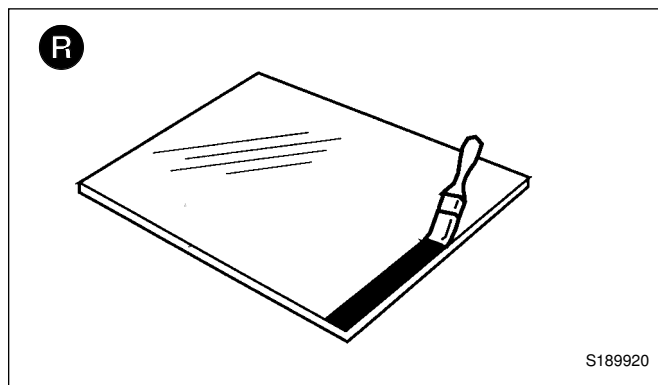
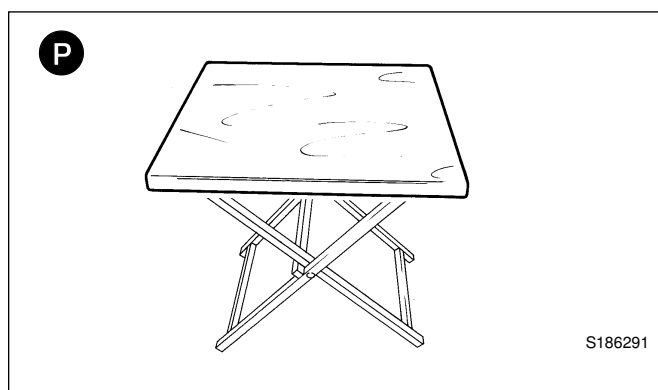
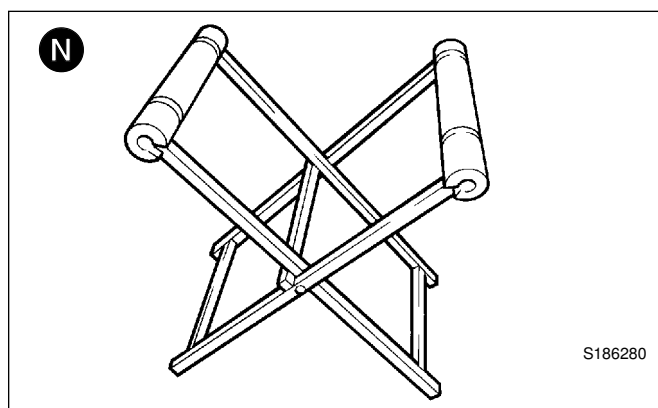
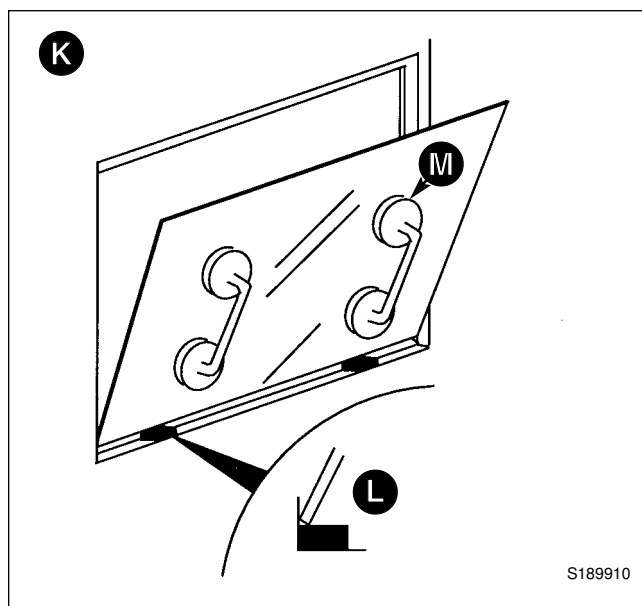
- 2 After checking for size, remove the new glass and place it on a purpose made glass stand **N** (see **Service Tools**).

Small panes of glass will need locating on a 600 x 700 mm x 15 to 19 mm thick plywood board **P** (sourced locally to fit the glass stand **N**). It is recommended that an access hole is cut in the board to accommodate the glass lifter, making it easier and safer to handle small panes of glass. The board should be covered with felt or carpet to give an anti-scratch surface. Resting the glass on four spacer blocks will ensure clearance of the cartridge nozzle tip during application of the polyurethane sealant.

- 3 Make sure the glass is positioned on the stand the correct way up (i.e. with the black ceramic ink band upwards) ready for application of primer etc.
- 4
  - a Use 'Active Wipe 205' to thoroughly clean and 'prime' the black ceramic ink band printed on the glass (see Note 1). Use a lint free cloth to apply the 'Active Wipe 205', allow 5 minutes flash off (drying) time.

**Note 1:** Do not touch the glass after cleaning with the 'Active Wipe 205'.

- b If the glass does not have a black ceramic ink band, paint a band on the glass using 'Black Primer 206J'. The band should be approximately 25mm (1in) wide, and the edge should be a neat straight line as shown at **R**.



## Direct Glazing (cont'd)

### Preparing the New Glass (cont'd)

- 5 Install the Ultra Fast Adhesive cartridge (see **Sealing and Retaining Compounds** and Note 2 below) into a suitable applicator gun:
  - a Remove the aluminium disc cover from the base of the cartridge and discard the 'desiccant capsule'.
  - b Make sure that the rolled edge of the cartridge is not damaged - if necessary, the edges should be pressed flat, otherwise it will be difficult to remove the cartridge from the applicator gun.
  - c Pierce the front 'nozzle' end of the cartridge to its maximum diameter.
  - d Fit the pre-cut nozzle shown at **S**.
  - e Install the cartridge in the applicator gun.

**Note 2:** Cold material will be very difficult to extrude. The cartridges must be pre-heated in a special oven (see **Service Tools**) for 1 hour to a temperature of 80°C (176°F). Pre-heating the cartridges makes the adhesive more workable and also brings the 'curing' time down to 30 minutes.

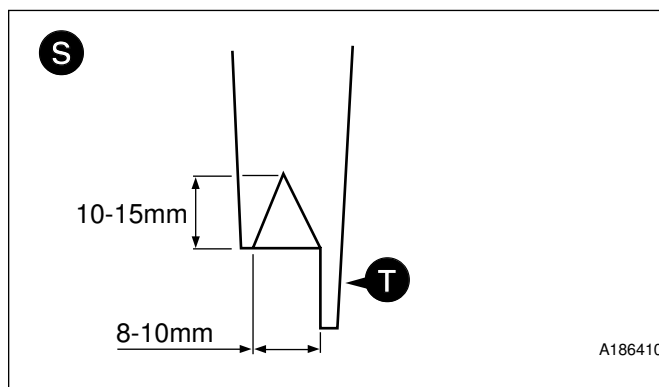
- 6 Apply the pre-heated adhesive to the glass (do not start in a corner). Keep the nozzle guide **T** against the edge of the glass and make sure that the adhesive forms a continuous 'pyramid' shape.

**Note 3:** Once the pre-heated adhesive has been applied to the glass, install the glass in the aperture as soon as possible. After approximately 10 minutes the sealant will form a 'skin', this will prevent the glass from bonding.

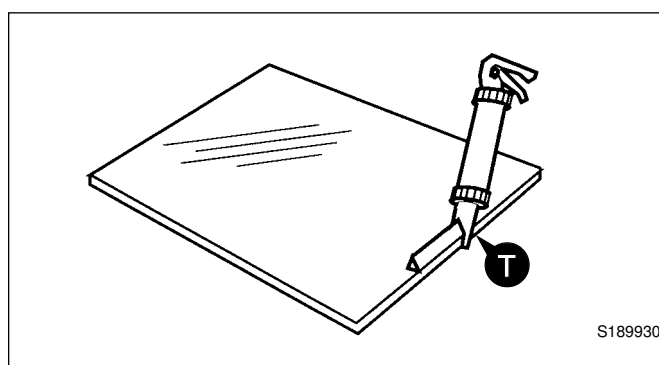
- 7 After applying the adhesive, leave a small amount of sealant protruding from the nozzle. This will prevent any adhesive left in the cartridge from 'curing'.

### Installing the New Glass

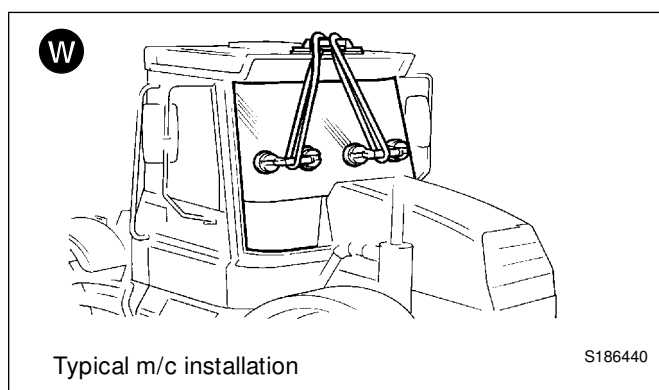
- 1 Make sure the two spacer blocks are in position (see step 1 of **Preparing the New Glass**).
- 2 Install the glass in the frame aperture:
  - a ALWAYS use the special lifting tools when moving the glass. Use a lifting strap to hold large panes of glass in position as shown **W**.
  - b Sit the bottom edge of the glass on the spacer blocks as shown **X**.
  - c Make sure that the glass is correctly positioned, then gently press around the edges of the glass and ensure full adhesive contact is achieved. Do not press too hard or too much adhesive will squeeze out.



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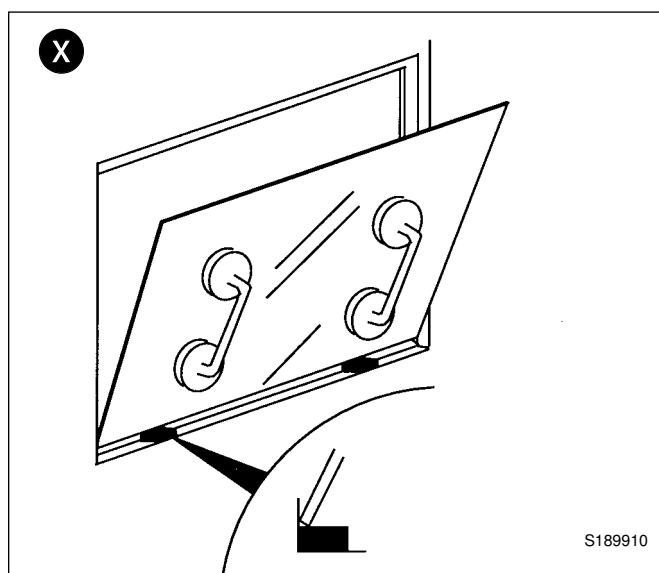


S189930



Typical m/c installation

S186440



S189910



## Direct Glazing (cont'd)

### Installing the New Glass (cont'd)

- 3 Make the inside seal smooth:
  - a Wearing surgical gloves, dip your finger in a soapy water solution.
  - b Use your finger to make the inside seal smooth.
- 4 All exposed edges must be sealed using Black Polyurethane Sealant (see **Sealing and Retaining Compounds**).
- 5 Clean the glass after installation:

**IMPORTANT:** Use extreme caution when wiping the inside of the new glass - pushing too hard on the inside of the glass will affect the integrity of the bonded seal.

- a Small amounts of sealant can be cleaned from the glass using the 'Active Wipe 205'.
- b Large amounts of excess sealant should be left to 'cure' (see Note 4) and then cut off with a sharp knife.

**Note 4:** On completion of the glass replacement procedures, the sealant 'curing' time is 30 minutes. This means that the machine can be driven and used after 30 minutes, but it **MUST NOT** be used during the curing period of 30 minutes.

- c Clean the glass using a purpose made glass cleaner.
- 6 On completion of the glass installation procedures tidy the work area:
    - a Remove ALL broken glass from the cab area.
    - b Remove the protective covers from the cab seat and control pedestals.
    - c Renew all 'warning' and 'information' decals so that the new installation conforms with the original cab installation.

## 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

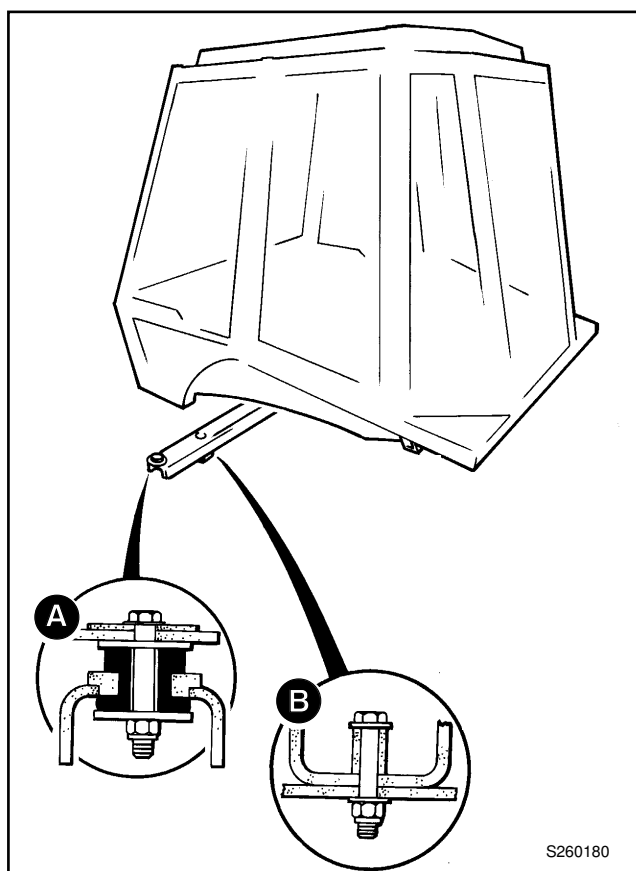
Failure to take these precautions could result in death or injury to the operator.

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)



## **Engine Panels**

### **- Removing and Fitting**

Instructions for removing and fitting the engine panels are described in the routine maintenance section, refer to Section 3 **Routine Maintenance - Engine Panels**.

## Stabiliser Leg

### Wear Pad Adjustment

Instructions for adjusting the wear pads are described in the maintenance section, refer to Section 3 **Stabiliser Legs - Wear Pad Adjustment**.

## Extending Dipper - Wear Pad Adjustment

The Extradig dipper wear pads are bolt-on replaceable items. They support and guide the inner dipper section during extension and retraction. The following procedures explain how to inspect, and where applicable, adjust the pads.

There is a front and rear set of pads, each set comprises top wear pads **A** and bottom wear pads **B**.

The top wear pads **A** are not adjustable and must be replaced with new pads once they have worn to their limit. See **Inspecting the Top Wear Pads**.

The bottom wear pads **B** are adjustable and take up the wear on both the top and bottom pads. They must also be replaced with new pads once they have worn to their limit. See **Adjusting the Bottom Wear Pads**.

New wear pads **A** and **B** must be replaced as a set and fitted by a qualified service engineer.

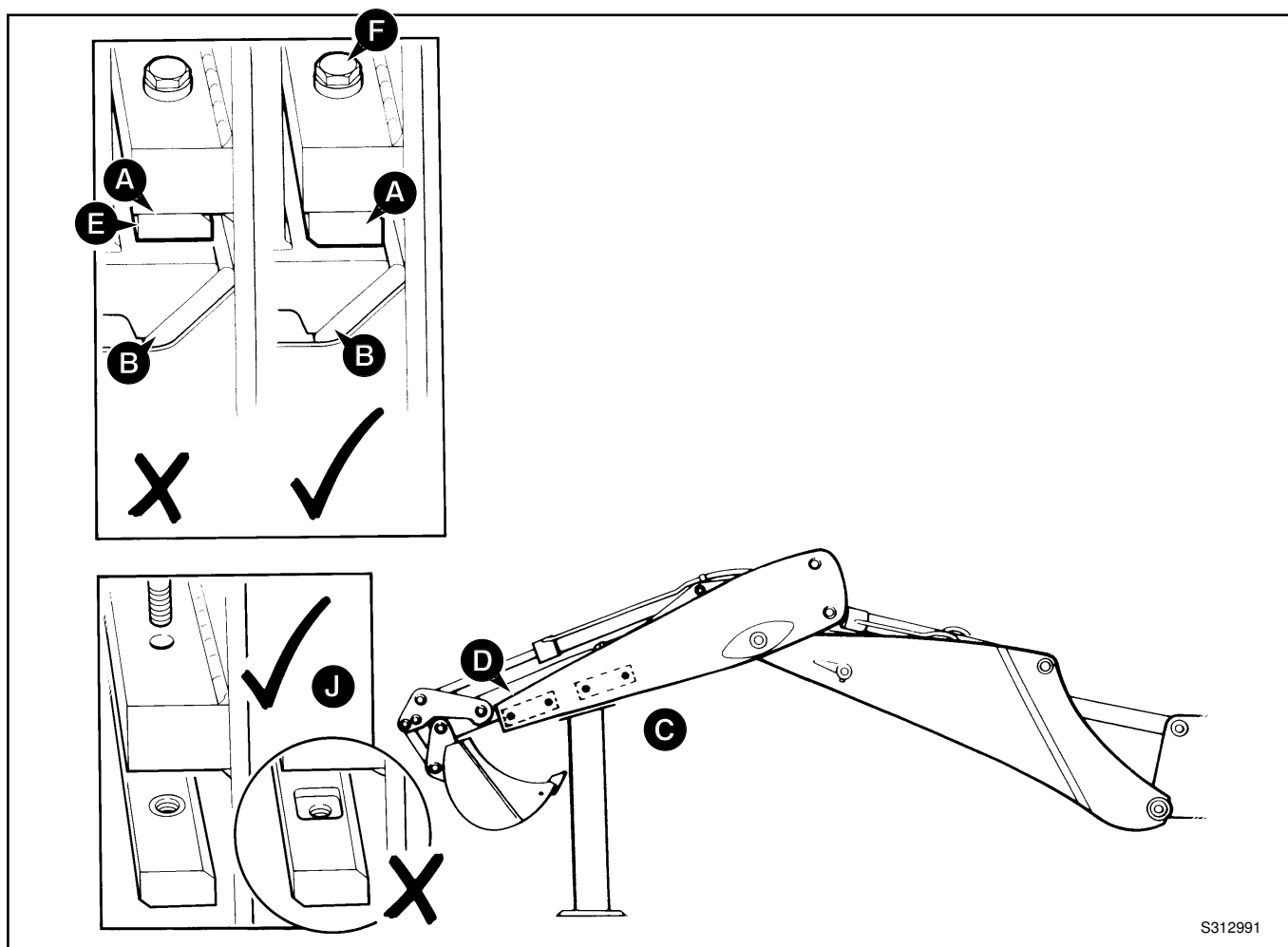
## Inspecting the Top Wear Pads

- 1 Park the machine on level ground. Engage the parking brake and put the transmission in neutral.
- 2 Position the boom and dipper as shown at **C**. Retract the Extradig dipper **D**. Make sure that the bucket is clear of the ground and the dipper is supported.
- 3 Stop the engine and remove the starter key.

Renew the pads when, or before they are worn down to the depth of the recess/chamfer as shown at **E**. If the pads are worn near to their limit then inspect them more frequently than recommended in the Service Schedules. To avoid damage to the dipper or wear pad make sure the pads are fitted the correct way round as shown at **J**.

## Torque Settings

Item	Nm	kgf m	lbf ft
<b>F</b>	56	5.7	4



S312991

## Extending Dipper - Wear Pad Adjustment (Cont'd)

### Adjusting the Bottom Wear Pads

- 1 Park the machine on level ground. Engage the parking brake and put the transmission in neutral.
- 2 Support the boom and dipper as shown at **C**.
- 3 Stop the engine.
- 4 Clean the sliding faces of the inner dipper with a suitable solvent.
- 5 Start the engine. Retract the Extradig dipper **D**. Make sure that the bucket is clear of the ground and the dipper is supported.
- 6 Stop the engine.
- 7 With grease, mud etc. removed from the sliding faces visually check the gap between inner dipper and top wear pad **A**, as shown at **G**. The gap should be no greater than 1.5 mm ( $1/16$  in).

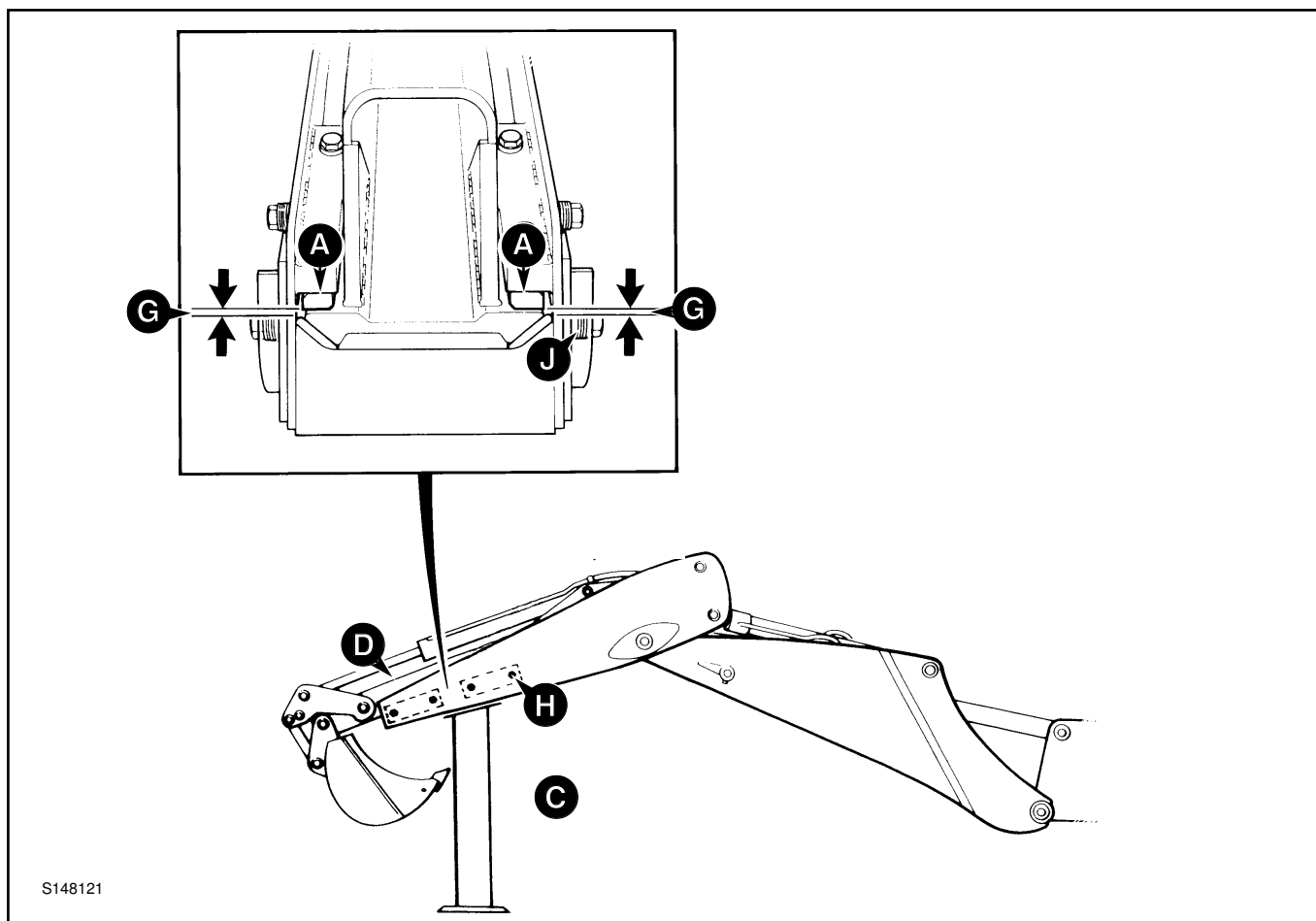
If the gap is greater than  $1/16$  in (1.5 mm) then adjust as follows:

- a Remove one adjusting bolt **H** and discard one washer **J**.
- b Refit and tighten bolt **H**.
- c Repeat the procedure for the remaining 3 adjusting bolts **H** on the same side of the dipper.
- d Visually re-check the gap is no greater than 1.5 mm ( $1/16$  in) as shown at **G**, if necessary repeat steps a to c for the other 4 bolts **H** on the opposite side of the dipper.
- e Make sure that the inner dipper seats central to the sides of the outer dipper.

**Note:** Remember to alternate sides each time an adjustment is made.

**Note:** When all the adjusting washers **J** have been removed and the clearance is greater than 1.5 mm ( $1/16$  in), then wear pads **A** and **B** must be replaced as a set and fitted by a qualified service engineer.

When the adjustments have been completed, apply Waxoyl to the runners of the inner dipper.

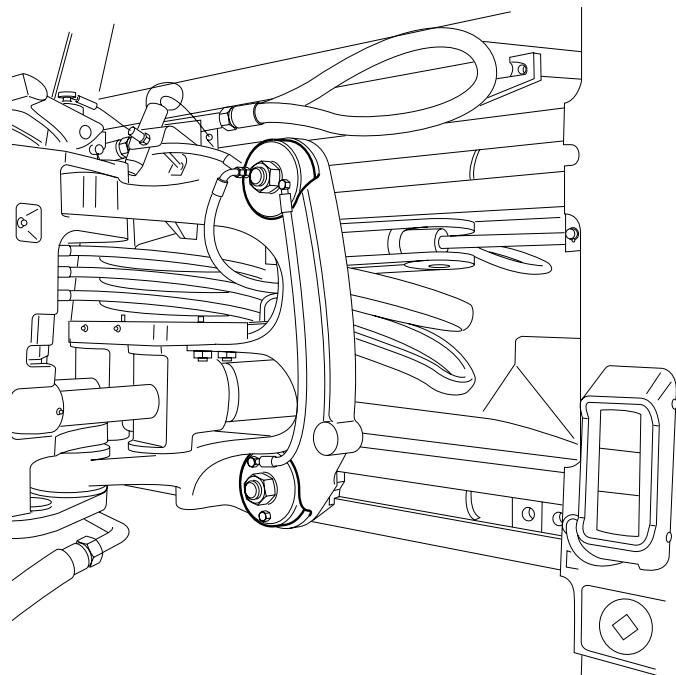
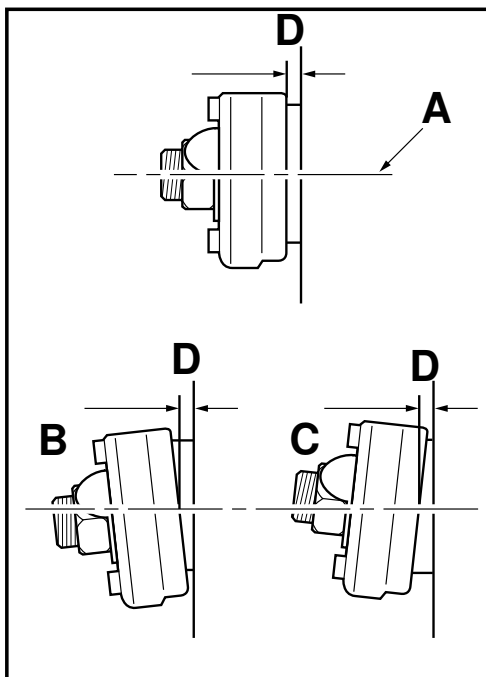


## Sideshift - Hydraclamp Clearance Setting

If the kingpost clearance **D** is not set correctly leaks may occur or the seal could become dislodged, use the procedure below to set the clearance.

- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the loader arms to the ground.
- 2 Select the carriage clamps to lock.
- 3 Measure all four clamps clearance, all measurements should be taken on the centre line **A** to allow for twisting of the clamp pot as shown at **B** and **C**:  

Manual	3 - 5 mm (0.11 - 0.19 in)
Power Sideshift	3 - 5 mm (0.11 - 0.19 in)
- 4 Release the clamps and tighten/loosen nut **1** as required, recheck measurement. When correct bend tab to lock nut.



338630

## Power Sideshift - Wear Pad Renewal

### Inspection (1000 hours)

When the wear pads are worn to 6 mm (0.23 in) or below they should be replaced.

It is permissible to rotate the top wear pads 180° to prolong service life, provided the contact surface is more than 6 mm (0.23 in) thick.

**Note:** If rotating the wear pad the grease nipples will have to be swapped over.

### Dismantling

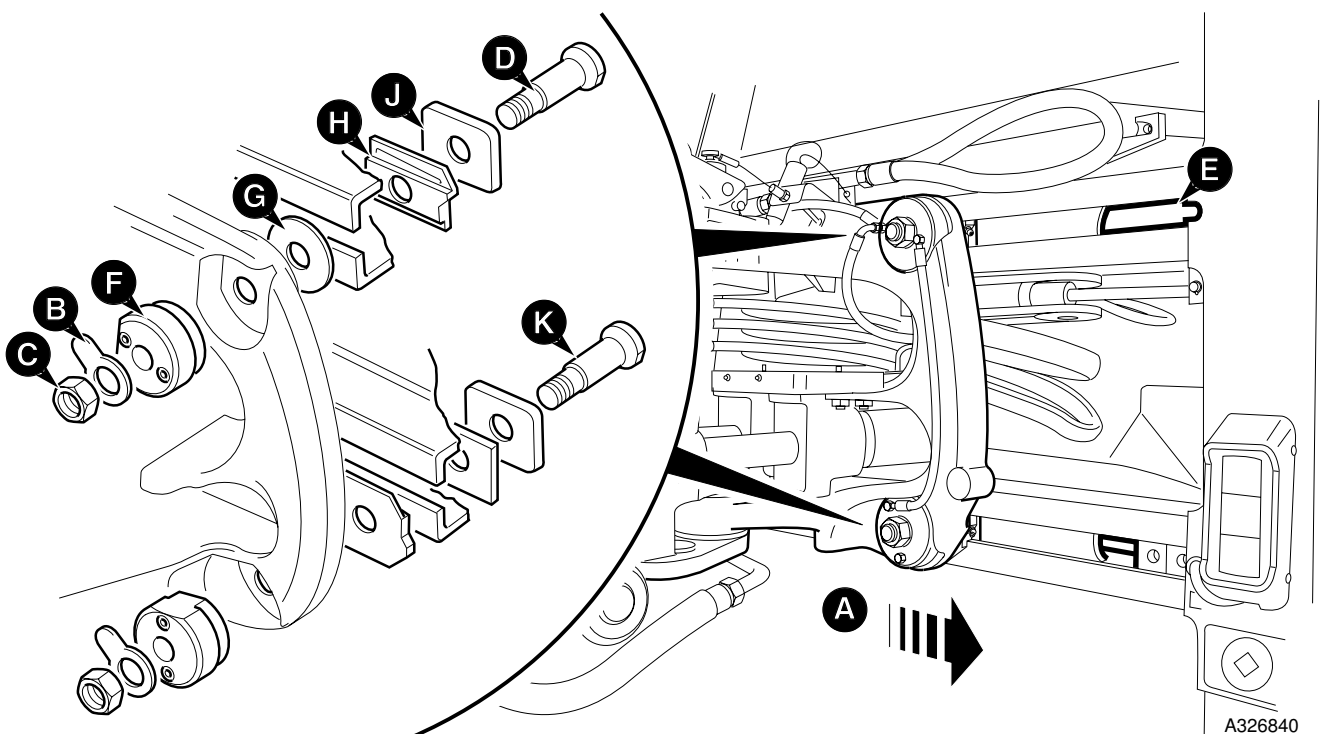
- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the loader arms to the ground.
- 2 Set the carriage fully to end of travel **A**, shown in centre position for clarity.
- 3 Lower the bucket to take the weight off the kingpost.
- 4 Switch OFF the engine and remove the starter key, operate the control levers to vent residual hydraulic pressure.
- 5 Unlock top lock tab **B** and unscrew nut **C**.
- 6 Remove bolt **D** through the slot in the rail **E**.
- 7 Hydraulic clamp **F** and washer **G** should remain in position.
- 8 Remove plate **J** and wear pad **H**.

### Assembly

- 9 Fit wear pad **H**, plate **J** and bolt **D**.
- 10 Fit new lock tab **B** and fit nut **C**.
- 11 Set the hydraclamp clearance as described in **Sideshift - Hydraclamp Clearance Setting**.
- 12 Repeat procedure steps 5 to 11 for the bottom clamp. The only difference on the bottom clamps is the wear pad is on the opposite side of the rail from the top clamp so bolt **K** need not be completely removed.

**Note:** If the wear pad is trapped between the rail and carriage, lower the bucket to relieve the load on the wear pad.

- 13 Lift the bucket and set the carriage to the opposite end of the travel, repeat the procedure for opposite side.
- 14 When all clamps have been assembled recheck the hydraclamp clearance of all clamps.





## Power Sideshift - Chain Adjustment

The chain tension should be checked at the initial 100 hours service and every 500 hours.

### Check and Adjust

- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the loader arms to the ground.
- 2 Position the carriage centrally and rest the bucket on the ground, remove the starter key.
- 3 Check the chain tension which should be 5 to 10mm (0.19 to 0.39in) deflection **A** at the mid point. The tension should be equal for all chains.
- 4 If adjustment is required, slacken locknuts **C** and adjust on nuts **B** as required, tighten locknuts **C** on completion.
- 5 Repeat steps 3 and 4 for the opposite pair of chains.

**Note:** When there is no thread left for adjustment fit new chains.

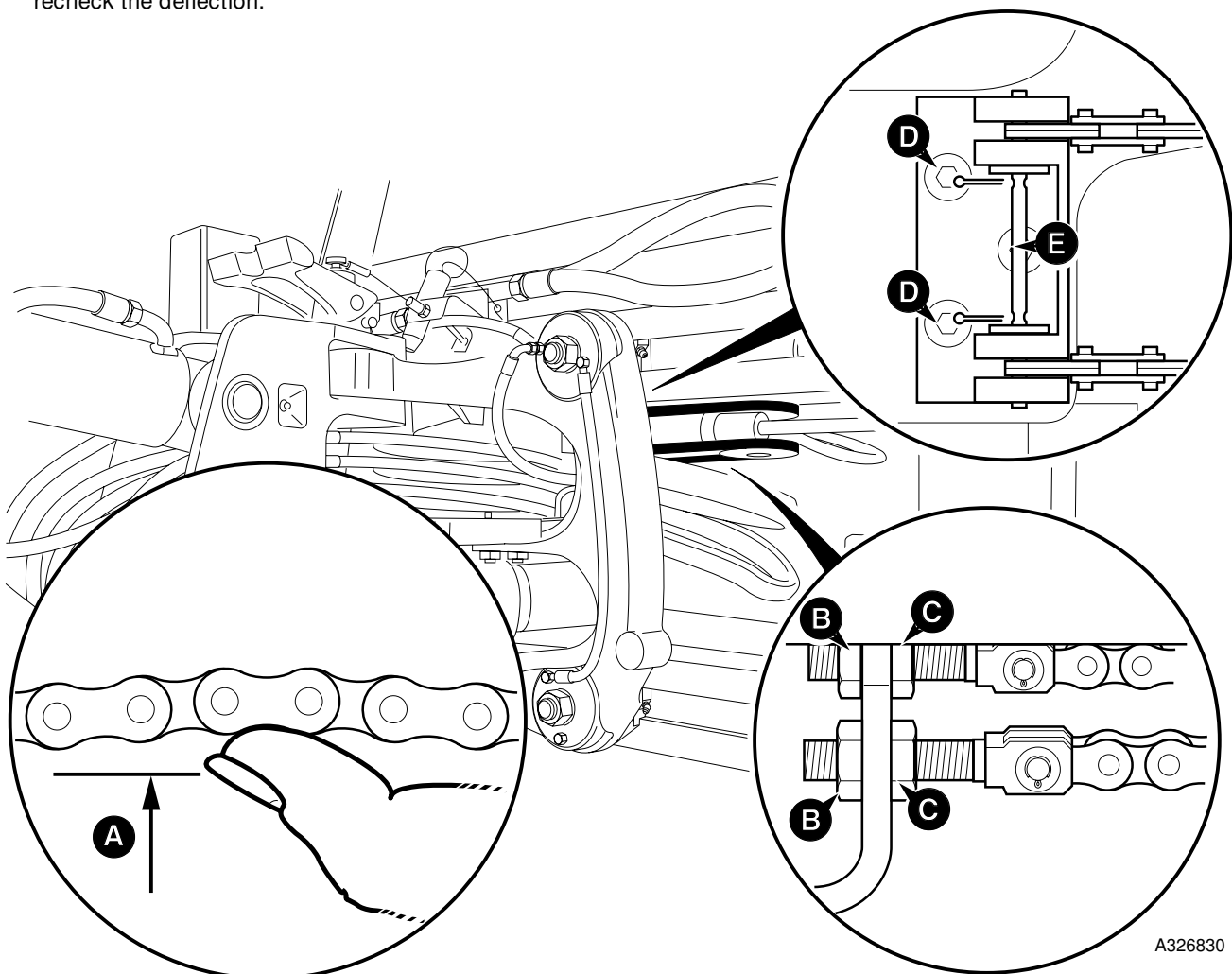
- 6 Operate the carriage side to side several times and recheck the deflection.

### Removal

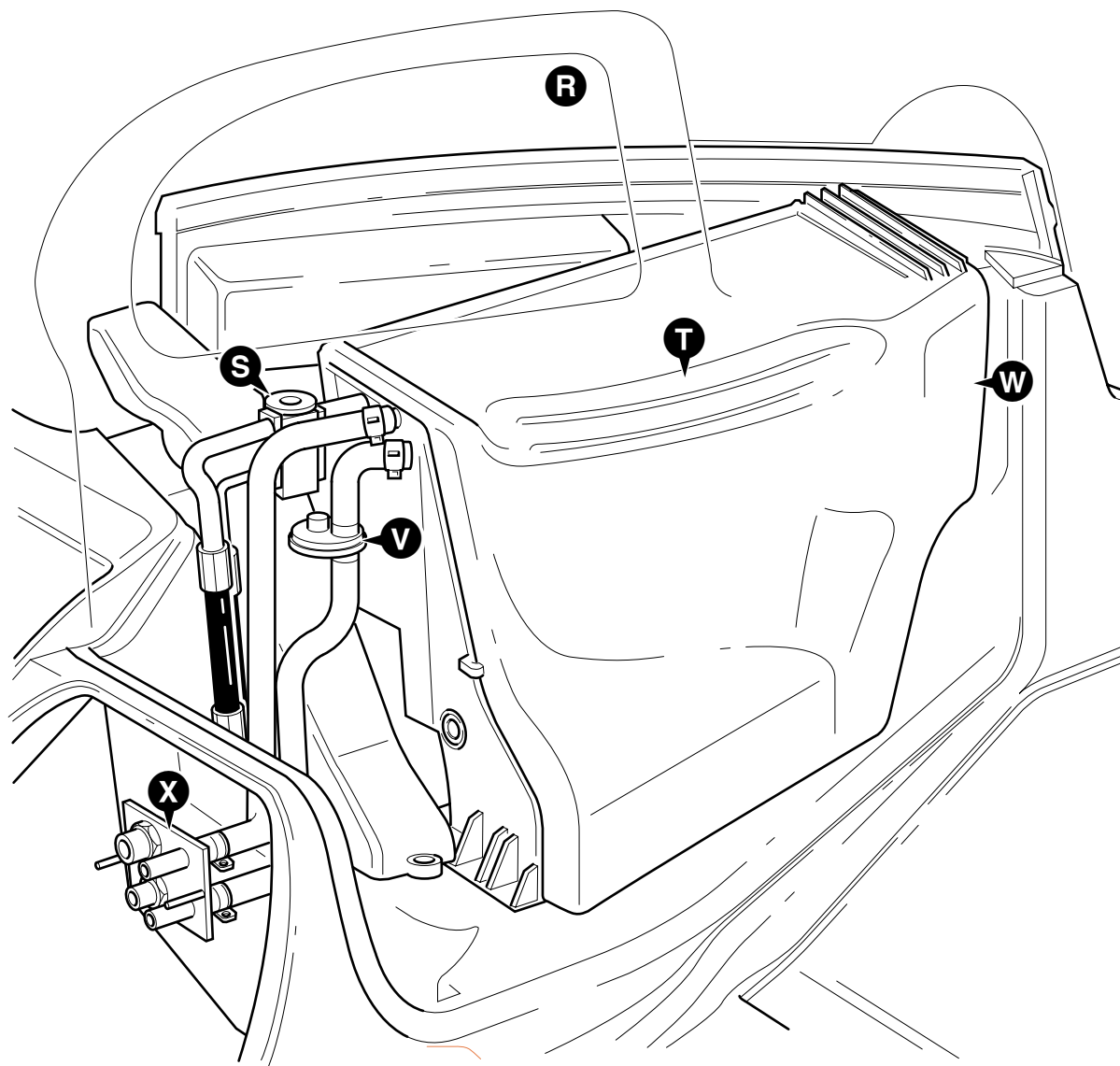
- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the loader arms to the ground.
- 2 Position the carriage centrally and rest the bucket on the ground, remove the starter key.
- 3 Undo and remove nuts **B**.
- 4 Remove split pins **D** and pin **E**.
- 5 Withdraw chains from the machine.

### Assembly

- 1 Thread the chains around the pulley and secure to the carriage with pin **E**, fit new split pins **D**.
- 2 Connect chain adjusters, tension chains as required, see **Check and Adjust**.



A326830



A401280

**Component Key:**

- R** A/C Controls
- S** Expansion Valve
- T** Re-circ Air Inlet
- V** Water Valve
- W** HVAC Unit
- X** Bulkhead Plate

## HVAC/Air Conditioning Unit - Removal and Replacement

**Note: Before removing the HVAC/Air Conditioning Unit, discharge the system. Refer to Service Procedures, Air Conditioning - Refrigerant Charging and Discharging.**

The HVAC/air conditioning unit is located in the cab beneath the right hand side console. To access the unit the side console must first be removed. With the right hand side console removed as shown it is possible to gain access to the following:

- HVAC Unit Top Cover
- Binary Pressure Switch
- Water Valve

The HVAC unit top cover must also be removed to access the following components:

- Freeze Protection Thermostat
- Blower Unit
- Resistor
- Heat Exchangers (Heater and Evaporator)

**Note:** When removing components or hoses, retain any lubricant within the component/hose and replenish the system with the same amount of clean lubricant (PAG Oil).

### Removal

Removal of the HVAC unit will require the assistance of a refrigeration engineer or suitably trained person since the refrigerant needs to be drained from the system.

- 1 Disconnect the battery.
- 2 Loosen and remove the side console screws and remove the side console.
- 3 Remove the spring clips (8 off) securing the HVAC unit top cover and carefully remove the HVAC top cover.

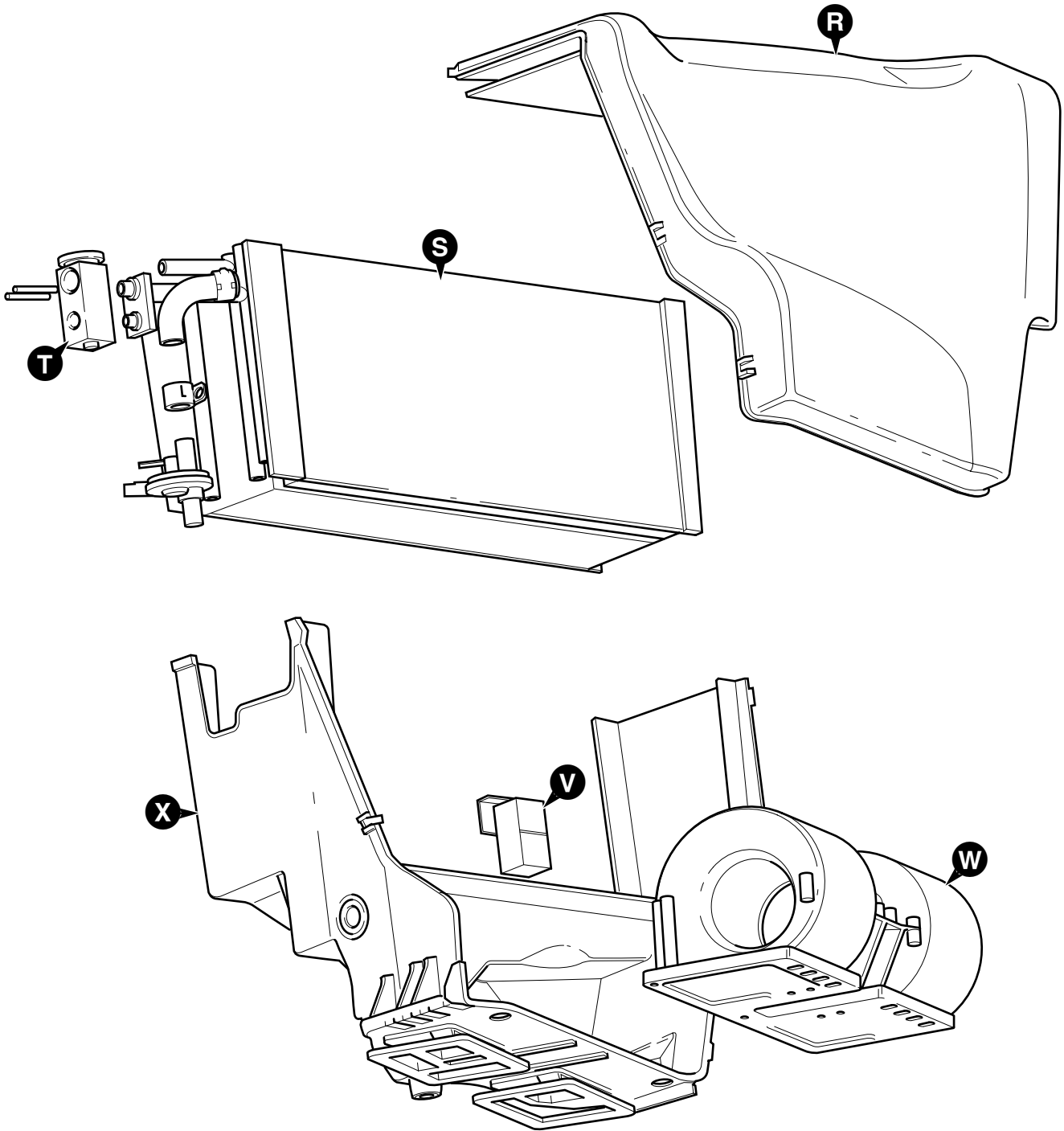
### WARNING

**The air conditioning system is a closed loop system and contains pressurised refrigerant. No part of the system must be disconnected except by a refrigeration engineer or suitably trained person. You can be severely frostbitten or injured by escaping refrigerant**

4-3-4-1/2

- 4 Drain the refrigerant from the unit and remove all pipe work (refrigerant and air) which will prevent the unit from being withdrawn from the machine. Check around the top of unit, rear, bottom and right side.
- 5 Disconnect the pipe and electrical connections adjacent to the bulkhead plate **X**.
- 6 Remove the screws securing the HVAC unit housing to the cab and carefully withdraw the HVAC unit.

Replacement is the reverse of the removal procedure.



A401270

**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

## Blower Unit - Removal and Replacement

The blower **W** is located inside the HVAC/air conditioning unit and can be removed without having to remove the HVAC unit from the machine.

The only user-serviceable part is the resistor which determines the blower motor speed. Other faults, excluding wiring faults, necessitate the replacement of the blower unit complete.

Resistor replacement requires the removal of the blower unit as follows:

### Removal

- 1 Disconnect the battery.
- 2 Gain access to the HVAC unit by removing the right hand side console and remove the HVAC unit top cover, refer to **HVAC/Air Conditioning Unit - Removal and Replacement** Steps 2 and 3.
- 3 Disconnect the electrical connections to the blower.
- 4 Remove the screws securing the blower unit to the HVAC unit housing.
- 5 Carefully withdraw the blower from the HVAC unit.
- 6 To remove the resistor, disconnect the electrical connections and unscrew the resistor.

Replacement is the reverse of the removal procedure.

## Freeze Protection Thermostat - Removal and Replacement

The Thermostat **V** monitors the external temperature of the evaporator and is located inside the HVAC/air conditioning unit.

### Removal

- 1 Disconnect the battery.
- 2 Gain access to the HVAC unit by removing the right hand side console and remove the HVAC unit top cover, refer to **HVAC/Air Conditioning Unit - Removal and Replacement** Steps 2 and 3.
- 3 Unclip the sensor wire from the evaporator and gently remove the wire from between the fins.
- 4 Disconnect the electrical connections to the thermostat.
- 5 Remove the screws securing the thermostat to the HVAC unit housing.

Replacement is the reverse of the removal procedure.

## Evaporator Matrix - Removal and Replacement

**Note: Before removing the Evaporator Matrix, discharge the system. Refer to Service Procedures, Air Conditioning - Refrigerant Charging and Discharging.**

The evaporator matrix **S** is located inside the HVAC/air conditioning unit and can be removed without having to remove the HVAC unit from the machine.

### Removal

Removal of the evaporator matrix will require the assistance of a refrigeration engineer or suitably trained person since the refrigerant needs to be drained from the system.

- 1 Disconnect the battery.
- 2 Gain access to the HVAC unit by removing the right hand side console and remove the HVAC unit top cover, refer to **HVAC/Air Conditioning Unit - Removal and Replacement** Steps 2 and 3.
- 3 Unclip the thermostat sensor wire from the evaporator and gently remove the wire from between the fins.

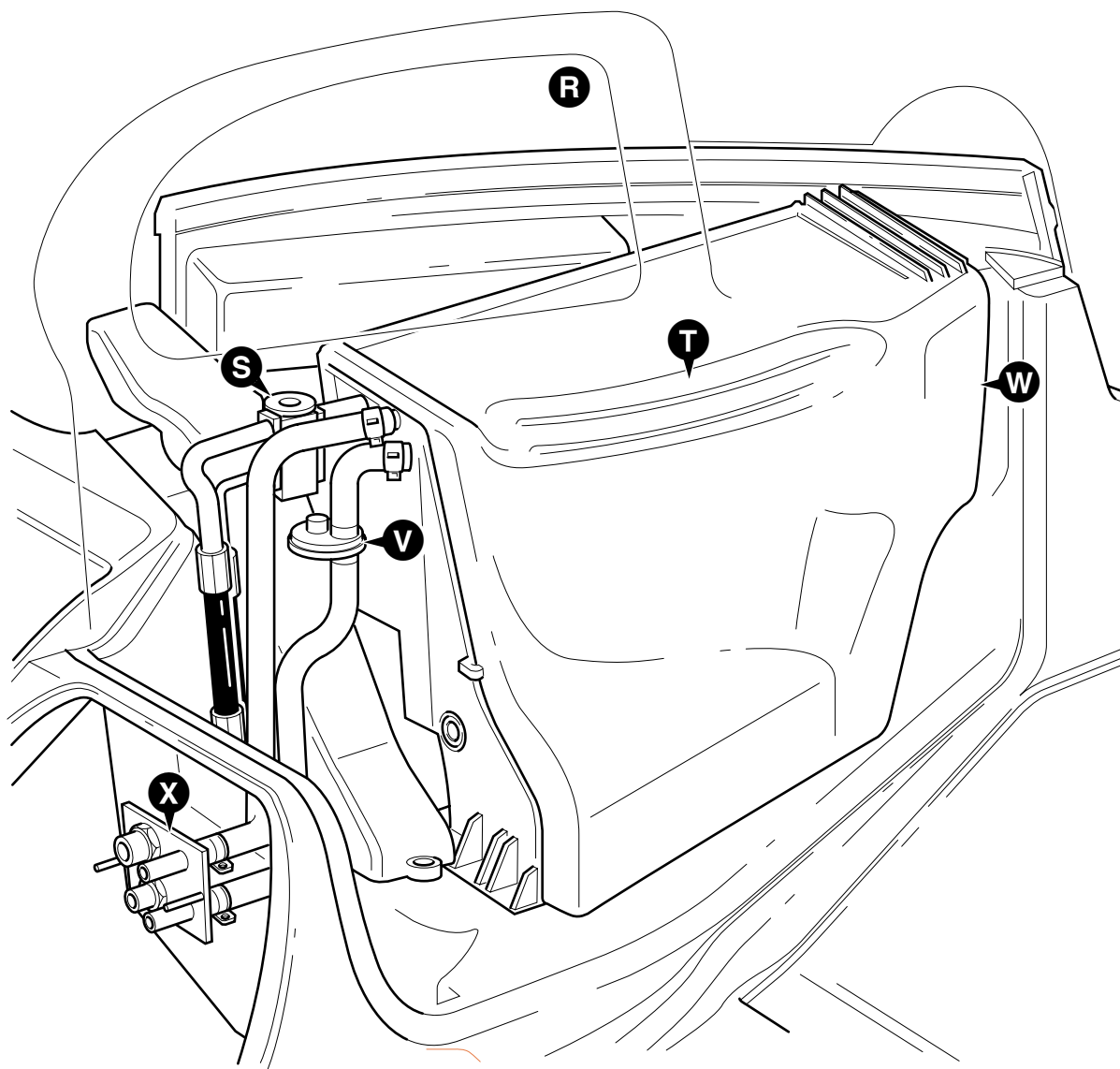
### WARNING

**The air conditioning system is a closed loop system and contains pressurised refrigerant. No part of the system must be disconnected except by a refrigeration engineer or suitably trained person. You can be severely frostbitten or injured by escaping refrigerant**

4-3-4-1/2

- 4 Drain the refrigerant from the unit and remove all pipe work (refrigerant and air) which will prevent the unit from being withdrawn from the machine. Check around the top of unit, rear, bottom and right side.
- 5 Carefully lift the evaporator matrix complete with expansion valve **T** from the housing, bearing in mind that a certain amount of resistance will be met due to the stiction from the sealing putty.

Replacement is the reverse of the removal procedure.



A401280

**Component Key:**

- R** A/C Controls
- S** Expansion Valve
- T** Re-circ Air Inlet
- V** Water Valve
- W** HVAC Unit
- X** Bulkhead Plate

## Binary Pressure Switch - Removal and Replacement

The pressure switch is located adjacent to the expansion valve **S** on the HVAC/air conditioning unit, beneath the right hand side console.

### **WARNING**

**Goggles and rubber gloves must be worn when pressure switches are removed or fitted. A small amount of refrigerant is released which can be harmful to the skin and eyes.**

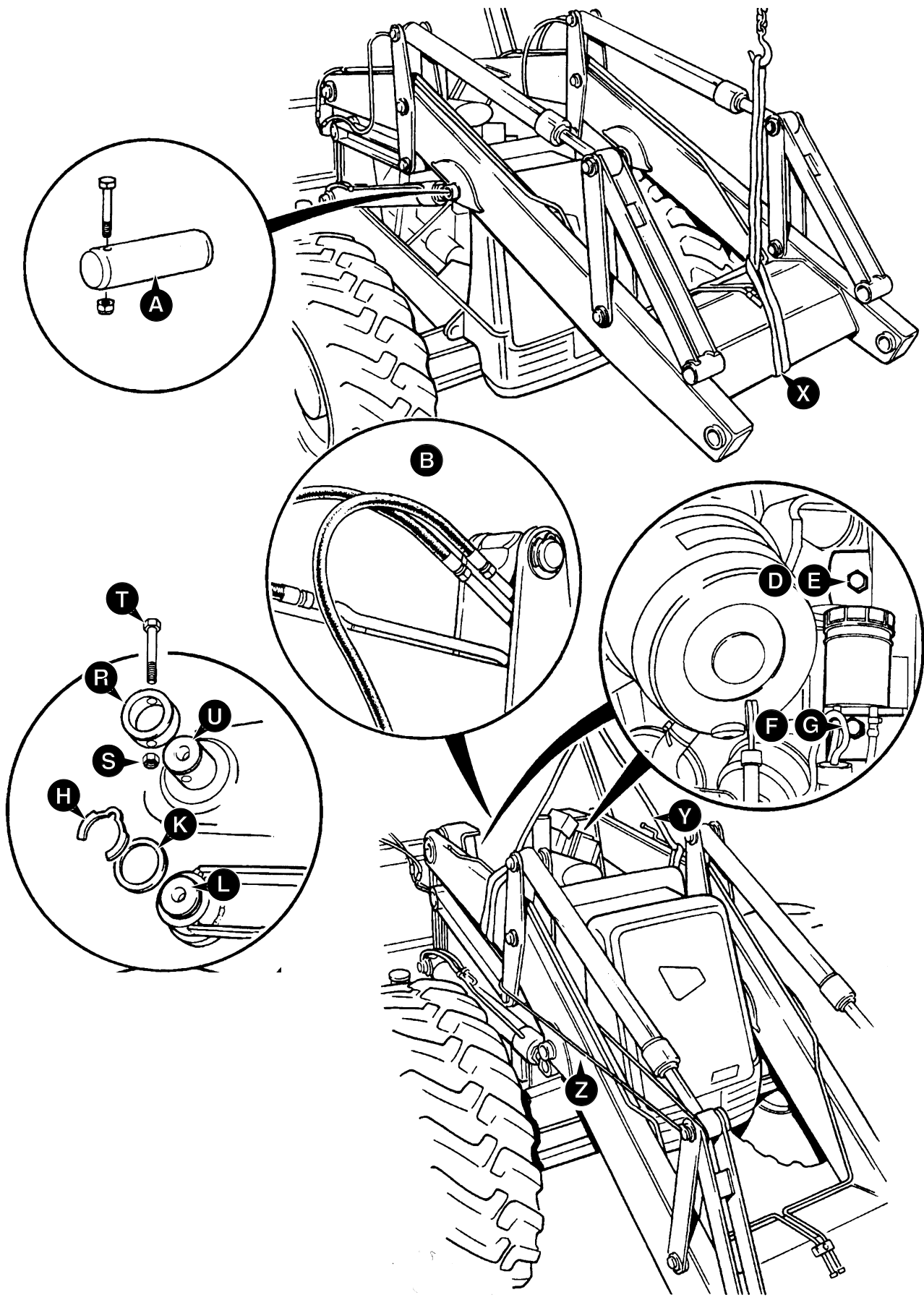
BF 1-10

#### Removal

- 1 Disconnect the battery.
- 2 Gain access to the HVAC unit by removing the right hand side console, refer to **HVAC/Air Conditioning Unit - Removal and Replacement** Step 2.
- 3 Disconnect the electrical connections and unscrew the pressure switch.

#### Replacement

- 1 Screw the pressure switch into the pressure switch port and torque tighten sufficiently to form a gas-tight seal.
- 2 Run the air conditioning and check the pressure switches for leaks. If any leaks are found, tighten the pressure switch further until the leaking stops.



S265931



## Removal and Replacement

### Removal

- 1 Park the machine on firm level ground. Engage the parking brake and set the transmission to neutral.
- 2 Remove loader end attachment (such as a shovel) if fitted. If the attachment is hydraulically operated, disconnect attachment hoses and plug/cap immediately. Vent residual hydraulic pressure prior to removing hoses by operating the control levers with the engine switched off.

### WARNING

**DO NOT work under raised loader arms unless they are adequately supported by stands and/or slings.**

BF 3-1

- 3 Remove the engine panels, refer to Section 3 **Routine Maintenance - Engine Panels**.
- 4 Raise the loader arms to give access to the lift ram pivot pins **A**.
- 5 Sling the loader arms as shown at **X**. Make sure that the slings are taut and therefore holding the weight of the loader arms.
- 6 Switch off the engine and vent residual hydraulic pressure from the loader end by operating the loader controls back and forth several times.
- 7 Remove the lift ram pivot pins **A**.

**Note:** Care must be taken when removing the lift ram pivot pin, once the pin is removed the ram will drop. Either hold the ram using a sling or have a second person hold the ram before removing the pin.

- 8 Lower the loader arms to the ground using the slings, it may be necessary to retract the lift rams to enable the loader arms to rest fully on the ground. Make sure the lift rams do not foul when retracted.
- 9 Make sure residual hydraulic pressure has been vented. Disconnect the shovel ram and auxiliary (if fitted) hoses, shown at **B**. Plug and cap the hoses immediately.
- 10 Disconnect the electrical connections (not shown) to the loader shovel reset switch (if fitted).
- 11 Remove pivot pin retaining bolts **D**, **E**, **F** and **G**.
- 12 Sling the loader arms as shown at **Y**. Make sure that the sling is wrapped around the loader arms only and not the level links.
- 13 Remove klipring **H** and shim **K**.

### WARNING

**The loader arm interlevers are potentially dangerous, when pivoting about their centre they form a 'scissor' point with the loader arm. Make sure the interlevers are securely blocked when working in the loader arm area.**

BF 2-1

- 14 Secure the interlever lever linkage as shown at **Z**, otherwise with level link pivot pin **L** removed, the interlever linkage could pivot about its centre and cause injury and/or damage.
- 15 Remove pivot pin **L** (use slide hammer kit, service tool 993/68100).
- 16 Repeat steps **13** to **15** for the opposite level link pivot pin.
- 17 Remove bolt **T** and retaining ring **R**.
- 18 Remove pivot pin **U** (use slide hammer kit, service tool 993/68100)
- 19 Repeat steps **17** and **18** for the opposite loader arm pivot pin.
- 20 When all four pivot pins have been removed, carefully reverse the machine clear of the loader arms

### Replacement

Replacement is a reversal of the removal sequence.

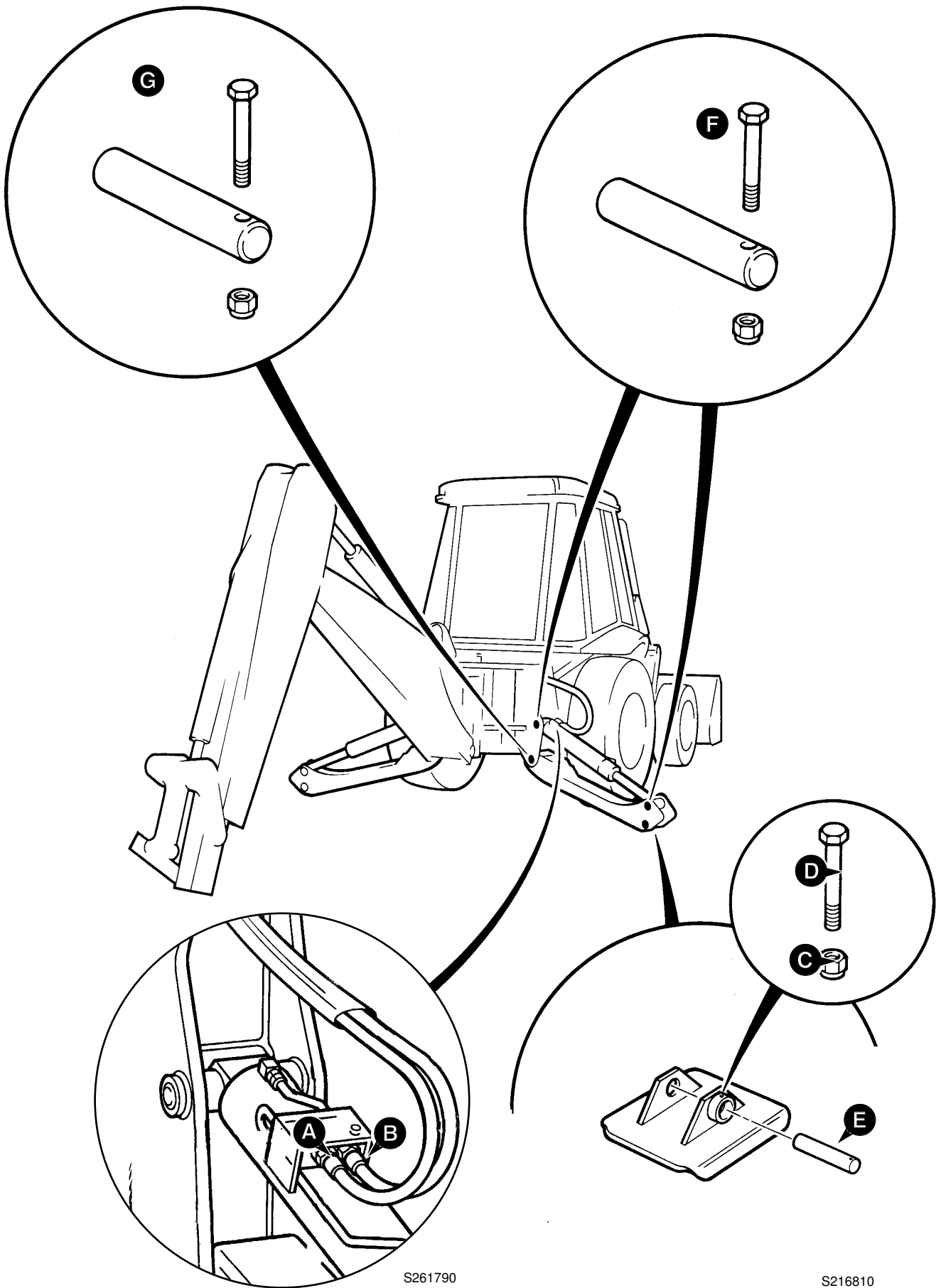
Fit pivot pins with the extraction hole on the outside of the machine.

Check operation of loader shovel reset switch (if fitted).

Apply grease to all mainframe bores.

Apply rust inhibiting oil to all pivot pins.

If fitting new liner bearings, assemble with a close fitting shouldered mandrel to ensure minimum ovality.



## Removal and Replacement - (Centremount Machines)

### 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 Lower the stabiliser legs to the ground.

### **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 Remove the stabiliser ram:
  - a 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.
  - b If a stabiliser foot is fitted, remove nut **C** and retaining bolt **D**. Drive out the foot retaining pin **E**.

### **CAUTION**

**The ram is heavy. It is recommended that the ram is removed with the assistance of a sling and suitable lifting appliance.**

BF 2-4

- c Wrap a suitable sling around the stabiliser ram, make sure that the weight of the ram is supported by the sling.
- d Remove the ram pivot pin retaining nut and bolt, drive out the ram pivot pin as shown at **F**.
- e Remove the stabiliser ram.

- 5 Remove the stabiliser leg:

### **CAUTION**

**The stabiliser leg is heavy. It is recommended that the stabiliser leg is removed with the assistance of a sling and suitable lifting appliance.**

BF 2-6

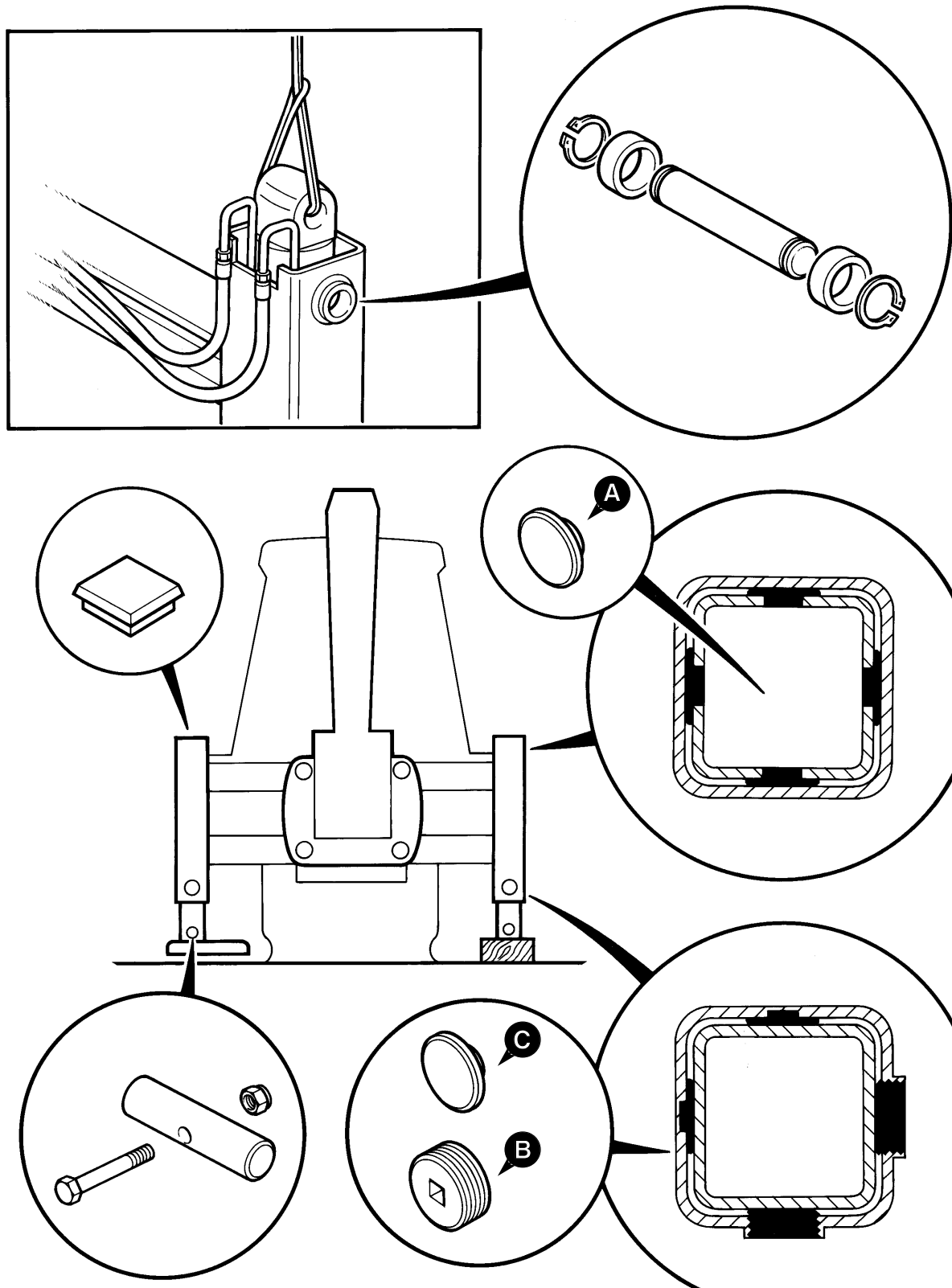
- a Wrap a suitable sling around the stabiliser leg, make sure that the weight of the leg is supported by the sling.
- b Remove the stabiliser leg pivot pin retaining nut and bolt, drive out the stabiliser leg pivot pin, as shown at **G**.
- c Remove the stabiliser leg.

### Replacement

Replacement is a reversal of the removal sequence.

Use suitable lifting appliances to locate the stabiliser ram and the stabiliser leg.

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



S271850

## Removal and Replacement - (Sideshift Machines)

### Removal

- 1 Park the machine on firm level ground. Engage the parking brake and set the transmission to neutral.
- 2 Lower the loader shovel to the ground.
- 3 Make sure that the backhoe assembly is set central to the mainframe as shown. If necessary 'sideshift' the backhoe into a central position.
- 4 Remove the stabiliser foot and ram, refer to Section E **Hydraulic Rams, Removal and Replacement - Stabiliser Ram**.
- 5 Remove the inner leg:
  - a Locate a suitable jack underneath the inner leg.
  - b Use the jack to lift the inner leg until the top wear pads **A** protrude from the top of the outer leg section.
  - c Remove the wear pads and attach suitable lifting gear through the wear pad locating holes.
  - d Use suitable lifting equipment, lift the inner leg clear.

### Replacement

Replacement is a reversal of the removal sequence.

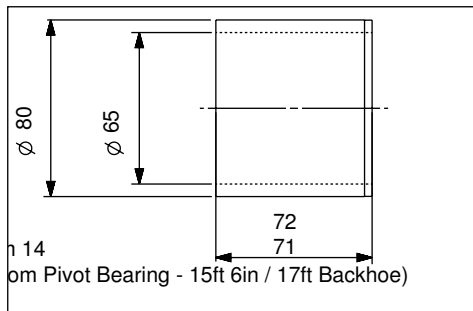
Select suitable size upper pads **A** to achieve a maximum permissible float of 1mm (0.039 in.).

Make sure that the bottom pads **C** are held in position before guiding the inner leg into position. If the lower pads are not secured then the inner leg could dislodge the pads during assembly.

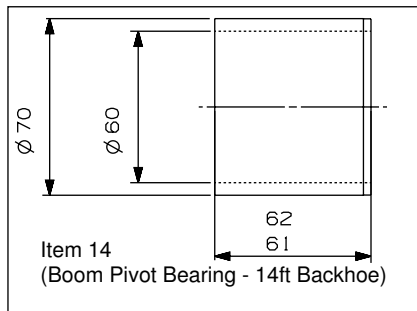
When the inner leg is in position adjust the bottom pads, refer to Section 3 **Stabiliser Legs - Wear Pad Adjustment**.

Apply a grease such as JCB slew grease (part number 4003/1601) to the threads of pad **B**.

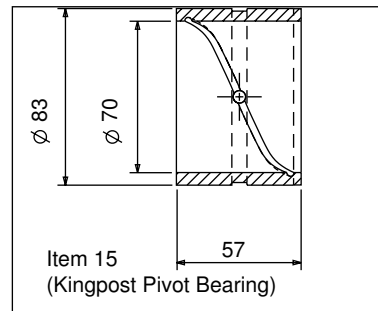
Removal and Replacement



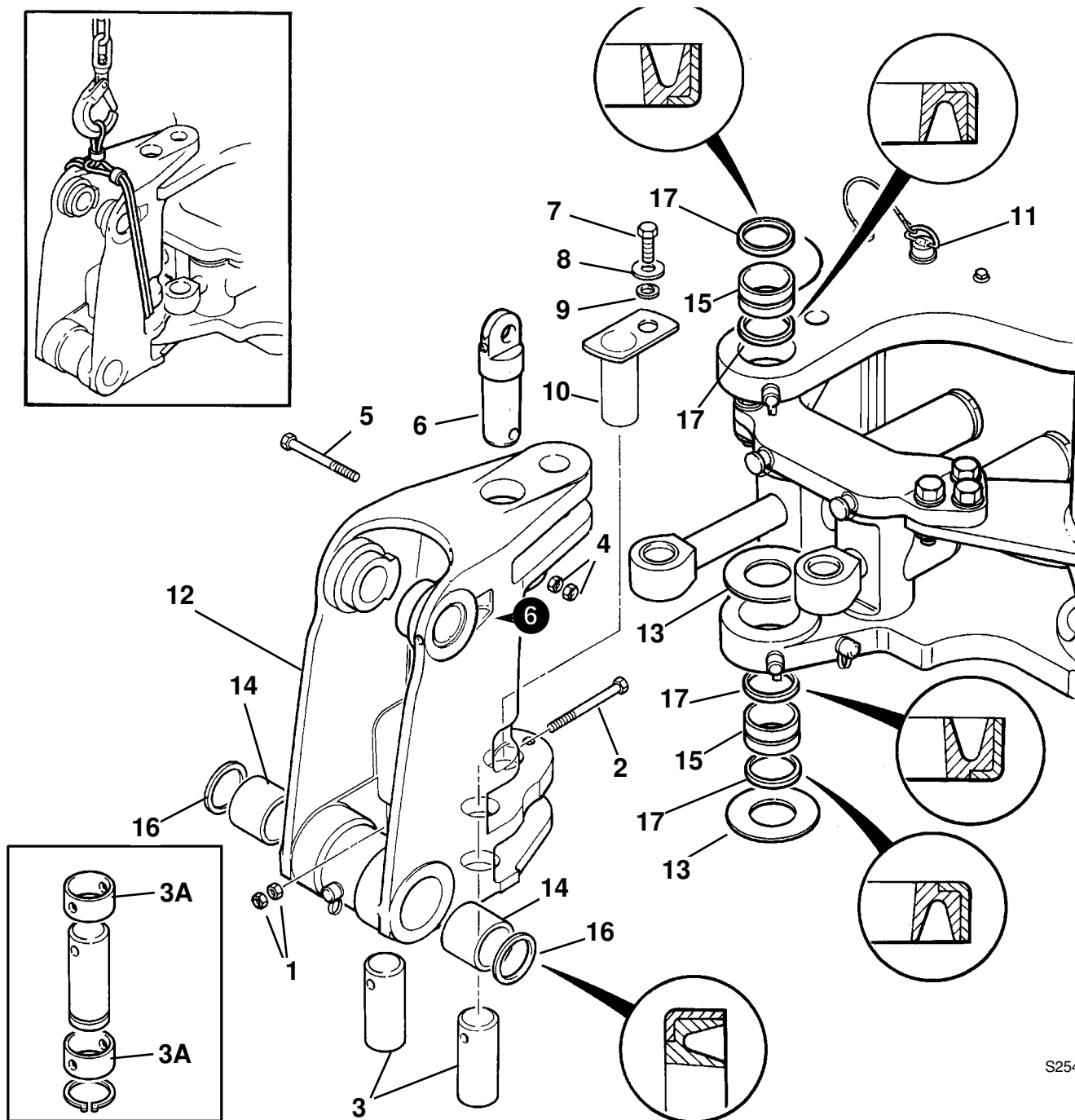
A261800



A252870



A252880



S254893

## Removal and Replacement

### Removal

- 1 Slew the kingpost to the centre and remove the boom and dipper.

### 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

- 2 Make sure that the slew lock pivot pin **11** is in its stowage position (i.e. not fitted in the 'slew lock' position).
- 3 Working from the base up, disconnect the backhoe hydraulic hoses, before disconnecting the hoses make sure that they are labelled (to assist with reassembly).
- 4 Plug and cap all open hydraulic connections to prevent ingress of dirt and loss of hydraulic fluid.
- 5 Remove thin nuts **1** (2 off per pivot pin) and remove pivot pin retaining bolt **2** (2 off).
- 6 Remove the slew ram (eye end) pivot pins **3** (2 off) and bearing liners **3A**.
- 7 Attach suitable lifting straps to the kingpost assembly. Note that the weight of the kingpost casting is approximately 130 kg (287 lbs).
- 8 Remove the boom lock assembly (see Boom Lock Removal and Replacement in Controls, section D).
- 9 Remove thin nuts **4** (2 off) and remove retaining bolt **5**.
- 10 Remove the kingpost top pivot pin **6**.
- 11 Remove bolt **7**, washer **8**, and spacer **9**.
- 12 Remove the kingpost bottom pivot pin **10**.
- 13 Remove the kingpost casting **12** from the rear frame and thrust washers **13**.

### Inspection

Inspect the nickel bronze liner bearings **14** and **15** for signs of damage, wear, scores or nicks etc. Use a suitable mandrel (manufactured locally) to facilitate removal of the liner bearings.

To ensure the drift is manufactured to the correct size, the liner bearing dimensions are shown on the illustration. Note that the dimensions are NOMINAL figures only and must not be used to manufacture the liner bearings.

### Replacement

Replacement is generally a reversal of the removal procedures, however note the following:

To assist with the identification of 15ft 6in and 17ft centremount kingposts the number **6** is stamped on the kingpost to identify 60mm diameter bores.

Check for and remove any burrs and sharp edges on both housing bore, bearing and pivot pin to minimise assembly damage.

If necessary, use oil or suitable lubricant to facilitate pressing-in bearing - to minimise scoring of mating face.

Bearings **14** and **15** have 'lead-in' diameters (noticeable with a slight step), always install the smaller diameter first into the pivot bore.

Thrust washers **13** come in different sizes to allow for variations of castings.

Make sure that the boom base liner bearings **14** are fully engaged in the boom base pivot bores. There must be a recess of 5mm (3/16 inch) to allow for installation of the seals **16**.

If fitting new liner bearings, assemble with a close fitting shouldered mandrel. Refer to liner bearing sizes on the illustration (nominal figures given).

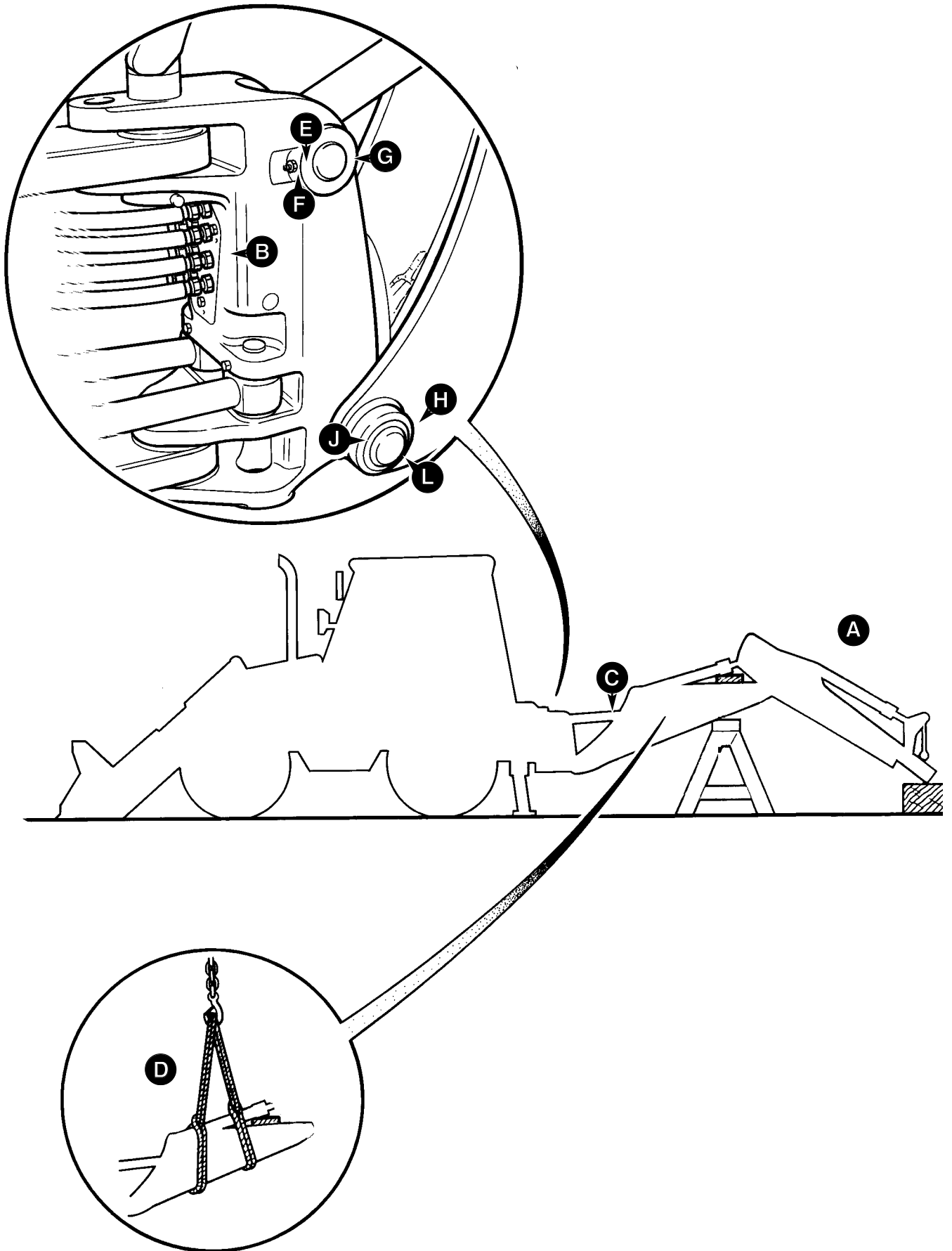
Make sure that the liner bearings **15** are fully engaged in the kingpost pivot bores. There must be a recess of 6mm (1/4 inch) to allow for installation of the seals **17**.

If a new kingpost casting has been installed, the boom lock may need resetting, refer to the boom lock removal and replacement procedures.

Seals **16** and **17** are lip seals, on reassembly make sure that the seal lips face outward (shown in insets on the kingpost pivot).

Make sure that thin lock nuts, items **1** and **4** are 'just' free when locked into position.

Make sure that all pivot bores and pivot pins are clean and greased when assembling. When fully assembled, apply grease at each grease nipple before operating the machine.





## Boom - Removal and Replacement

### Removal

The procedures describe the removal of the boom with the boom and dipper rams still installed. If required, these items can be removed separately before removing the boom, refer to the appropriate removal and replacement procedure.

- 1 Remove the backhoe bucket and place the backhoe in the position shown at **A**.
- 2 Lower the stabilisers.
- 3 Stop the engine and disconnect the battery (to prevent the engine being started).
- 4 Operate the backhoe control levers back and forth several times to release pressure trapped in the hydraulic hoses.

### 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

- 5 Disconnect the hydraulic hoses from the bulkhead plate **B**. Always label hydraulic hoses before disconnecting them, this will ensure that they are correctly reconnected. Plug and cap all hose open ends to prevent ingress of dirt and loss of hydraulic fluid.
- 6 Remove the dipper, see **Dipper - Removal and Replacement**.
- 7 Wrap a sling around the boom as shown at **D**. Make sure the weight of the boom is held by the sling before removing pivot pins etc.
- 8 Place a suitable support underneath the boom ram **C**.
- 9 Remove two thin nuts **E**, bolt **F** and pivot pin **G**.
- 10 Remove heavy duty circlip **H**, spacers **J** (one fitted each side) and pivot pin **L**. Mark the spacers so that they can be replaced in the same positions.
- 11 Hoist the boom clear of the kingpost assembly.

### Replacement

### WARNING

#### Hydraulic Fluid

**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.**

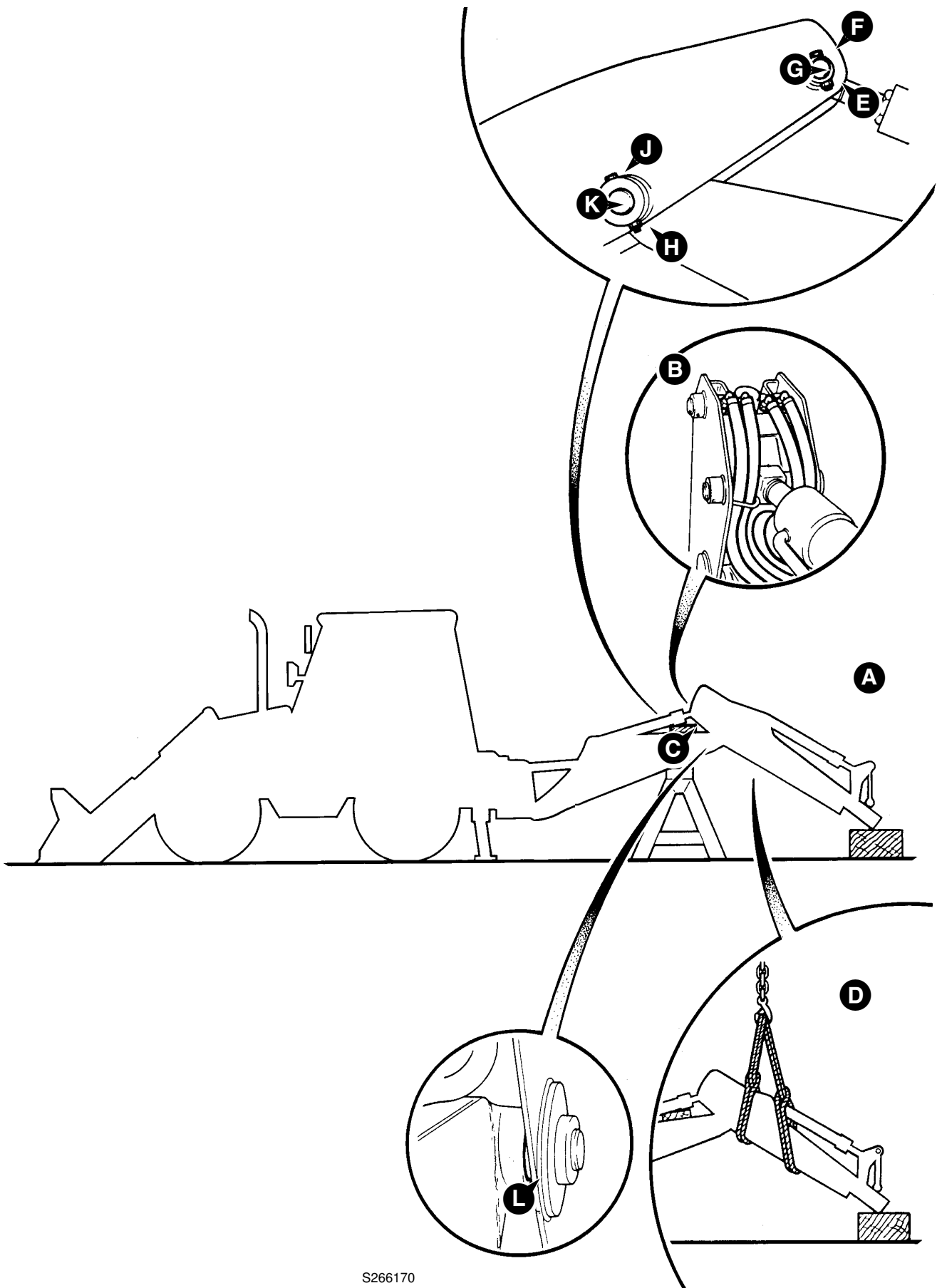
INT-3-1-10/1

Replacement is generally a reversal of the installation procedure.

The boom pivot pin **G** must be retained using two M12 thin nuts. Fit the first thin nut with zero torque, fit the second thin nut and torque to 98Nm (72 lbf ft).

When fitting the boom to the kingpost assembly, make sure that spacers **J** are refitted in their original positions.

Replace all pivot pin seals as required.



S266170

## Dipper - Removal and Replacement

### Removal

The procedures describe the removal of the dipper with the extradig (if fitted) and the bucket ram still installed. If required, these items can be removed separately before removing the dipper, refer to the appropriate removal and replacement procedure.

- 1 Remove the backhoe bucket and place the backhoe in the position shown at **A**.
- 2 Lower the stabilisers.
- 3 Stop the engine and disconnect the battery (to prevent the engine being started).
- 4 Operate the backhoe control levers back and forth several times to release pressure trapped in the hydraulic hoses.

### 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

- 5 Disconnect the hydraulic hoses, as shown at **B**. Always label hydraulic hoses before disconnecting them, this will ensure that they are correctly reconnected. Plug and cap all hose open ends to prevent ingress of dirt and loss of hydraulic fluid.
- 6 Place a suitable support underneath the dipper ram as shown at **C**.
- 7 Wrap a sling around the dipper as shown at **D**. Make sure the weight of the dipper is held by the sling before removing pivot pins etc.
- 8 Remove nut **E**, bolt **F** and pivot pin **G**.
- 9 Remove two thin nuts **H**, bolt **J** and pivot pin **K**.

**Note:** It is important to use two thin nuts, this arrangement allows the pivot pin retaining bolt to be secured without inducing a lateral tension.

- 10 Hoist the dipper clear of the boom.

### Replacement

### WARNING

#### Hydraulic Fluid

**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 generally a reversal of the installation procedure.

The boom to dipper pivot pin **K** must be retained using two M12 thin nuts. Fit the first thin nut with zero torque, fit the second thin nut and torque to 98Nm (72 lbf ft).

When fitting the dipper to the boom, make sure that shim, item **L** is installed as shown.

Replace all pivot pin seals as required.

## Removal and Replacement

### Removal

#### 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

- 1 Operate the control levers to vent residual pressure.
- 2 Remove the filler cap and unscrew plug **B** to drain the tank.
- 3 Disconnect and plug the hydraulic hoses **D** from the rear of the tank.

\* **Note:** Some machine variants may have different return hose configurations at the tank to those illustrated. Be sure to disconnect all hoses.

- \* 4 Loosen the 2 clips **F** on the suction hose **G**. Pull off the hose at the tank.
- 5 Support the tank, then unscrew mounting bolts **E** and lift tank away from the machine.

### Replacement

Replace the tank by reversing the removal procedure.

If a new tank is being fitted, remove the tool box from the old tank and fit to the new tank.

Apply JCB Threadlocker and Sealer to drain plug **B**.

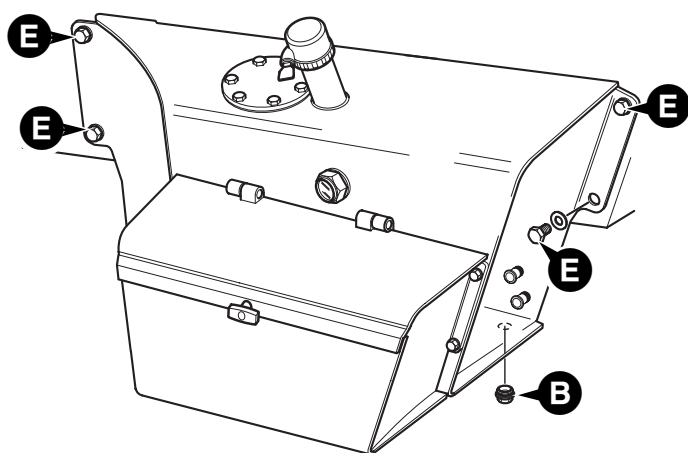
- \* When refitting the suction hose **G** make sure it is correctly fitted and phased on the tank spigot. There must be at least 12 mm (0.5 in) clearance between the hose and the gearbox casing. Phase the 2 clips **F** 180° apart.

Refill with clean hydraulic oil as specified, refer to Section 3 **Fluids, Lubricants, Capacities and Specifications**.

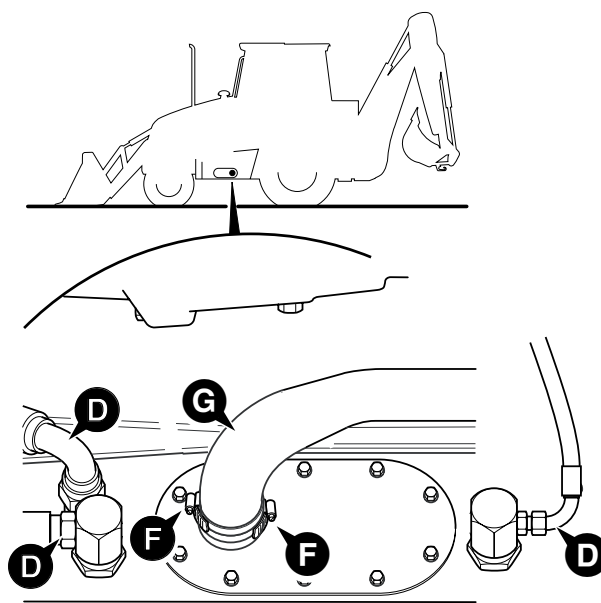
- \* Operate the machine until the hydraulic oil reaches operating temperature (50 °C, 122 °F). Stop the engine and check for leaks.

### Torque Setting

Item	Nm	lbf ft	kgf m
<b>B</b>	100	73.76	10.20
* <b>F</b>	5	4	0.5



A401540



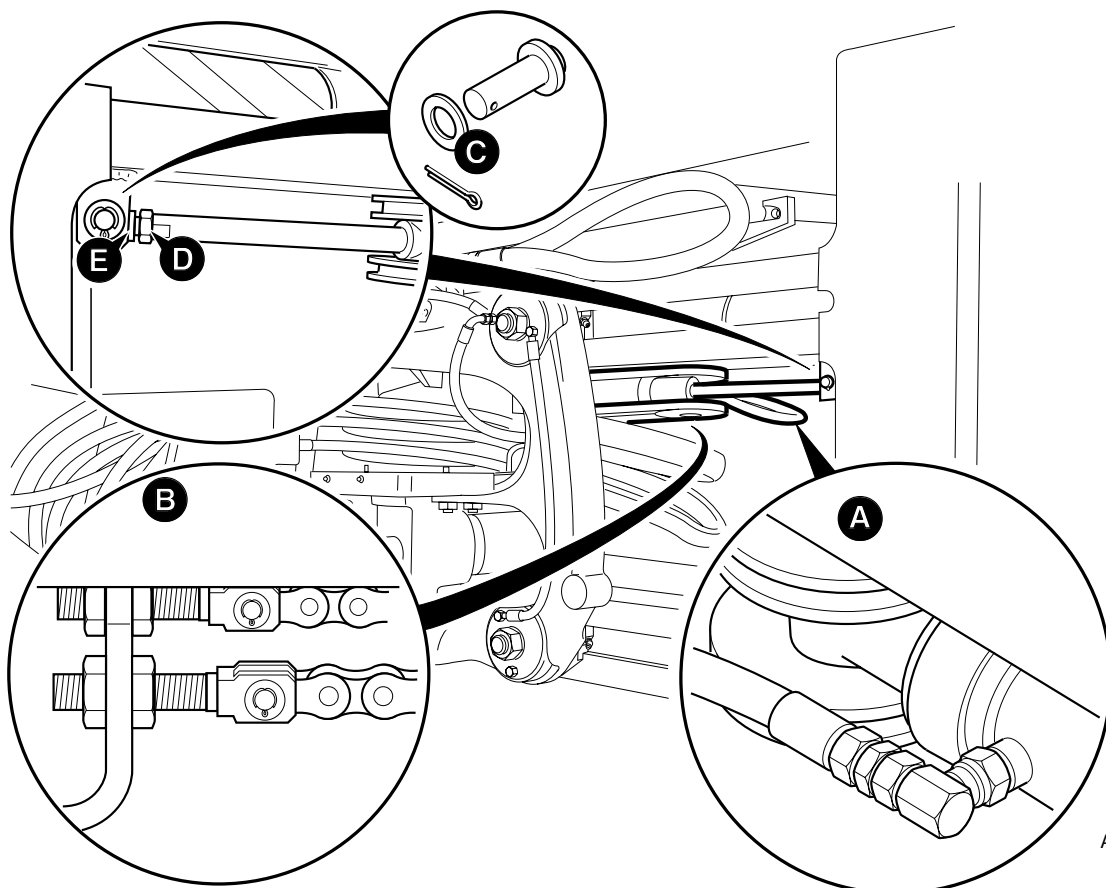
## Removal and Replacement

### Removal

- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the loader arms to the ground.
- 2 Position the carriage in the central protruding travel position at 150 mm (6 in) from end of the rail, rest the bucket on the ground and remove the starter key.
- 3 Operate control levers to vent hydraulic pressure.
- 4 Disconnect hydraulic hoses **A** and plug.
- 5 Disconnect all four chains at adjusters **B** and disengage chains from ram pulleys.
- 6 Remove pin **C** from one end and support the ram.
- 7 Remove pin **C** from opposite end, withdraw ram.

### Replacement

- 1 Locate the ram at one end with pin **C**. Adjust the ram eye end so the the opposite end of the ram aligns with mounting bracket.
- 2 Secure the opposite end of the ram in position with pin **C**.
- 3 With a spanner on the rod end flats **D** adjust the rod so that the ram eye end engagement is equal at each end of the ram. Lock eye ends in position with nut **E**.
- 4 Reconnect the hydraulic hoses.
- 5 Locate the chains around the applicable ram pulleys. Reconnect chains and adjust as required, refer to **Service Procedures, Power Sideshift - Chain Adjustment**.



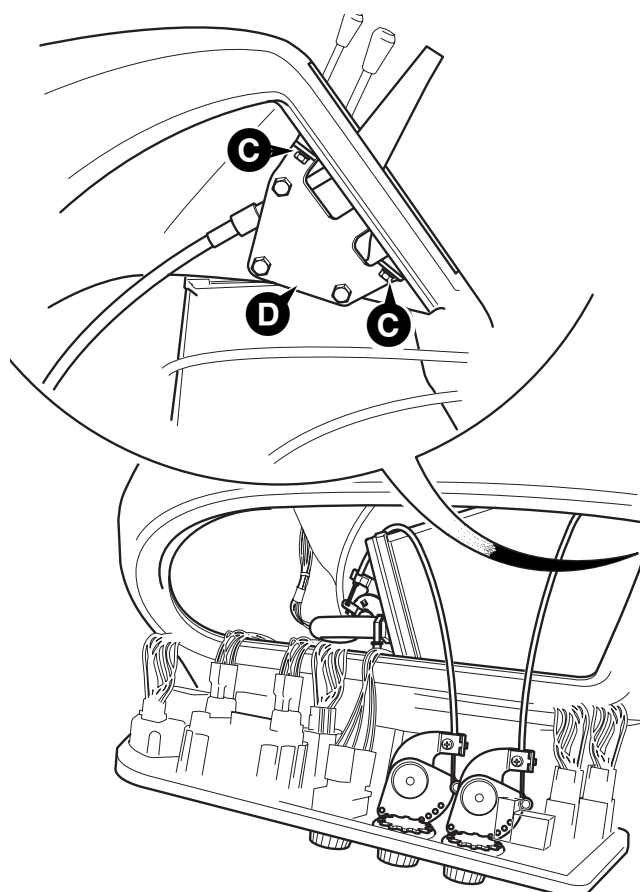
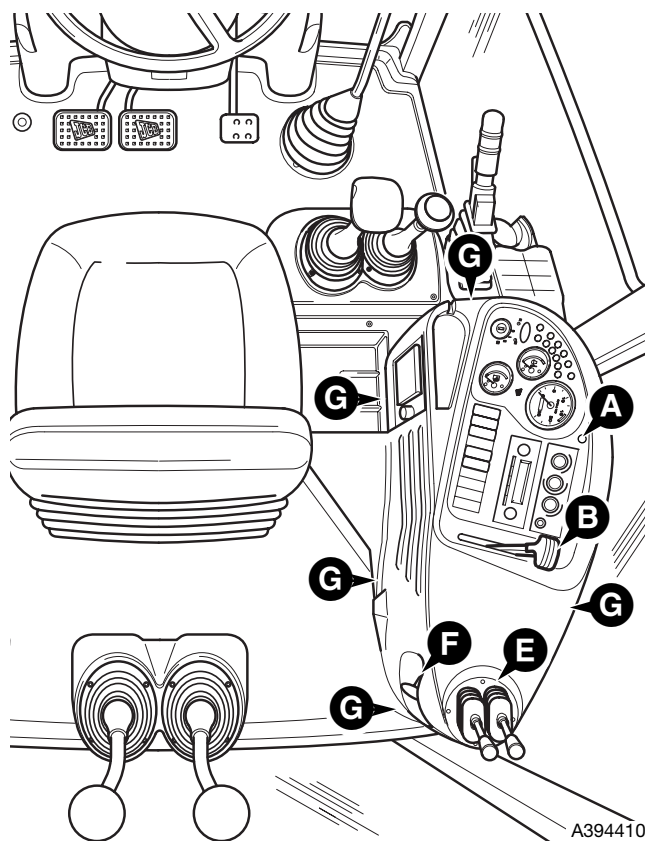
A326850

## Removal and Replacement

### Side Console

#### Removal

- 1 Park the machine on firm level ground, apply the parking brake. Lower the loader arms and excavator to the ground, switch OFF the engine and remove the starter key.
- 2 Disconnect the battery.
- 3 Working in the cab, remove the fixing **A** at the top of the instrument panel and carefully lift the panel forward to reveal the connections at the back as shown.
- 4 Disconnect the electrical connectors and heater controls cables at the rear of the instrument panel, then remove the instrument panel assembly clear of the side console. Label the connectors and controls cables before disconnecting to ensure correct replacement.
- 5 Remove the hand throttle lever knob **B**, remove the screws **C** from the hand throttle lever and mounting bracket assembly **D** inside the side console as shown. Withdraw the handle through the slot in the panel.
- 6 Remove the screws from around the base of the stabiliser control levers **E**, carefully withdraw the lever assembly from the side console and disconnect the control cables from the underside. Label each control cable before disconnecting to ensure correct replacement.
- 7 Unscrew the knob and lock nut from the boom lock control **F**.
- 8 Remove the fixings **G** (5 off) securing the side console panel at positions shown. Carefully lift up the rear corner of the side panel over the boom lock control outer sleeve, and then lift the side panel clear.



#### Replacement

Replacement is the reverse of the removal sequence.

Take care when removing/replacing the console panel to ensure that harnesses do not become snagged and that no other connections have been disturbed.

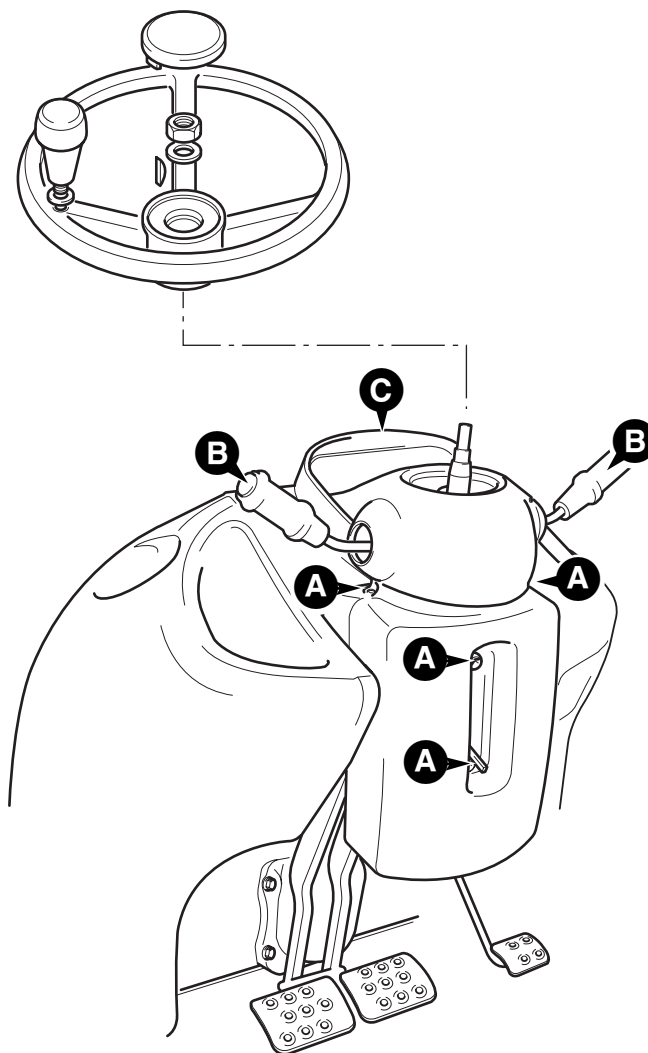
After re-fitting, operate the side console controls and check they all function correctly.

## Removal and Replacement

### Front/Steering Console

#### Removal

- 1 Park the machine on firm level ground, apply the parking brake. Lower the loader arms and excavator to the ground, switch OFF the engine and remove the starter key.
- 2 Disconnect the battery.
- 3 Working in the cab, remove the steering wheel as shown.
- 4 Remove the fixings **A** (4 off) at positions shown and take off the steering column pedestal cover.
- 5 Remove the column switches **B**.
- 6 Remove the instrument panel **C**.
- 7 Remove the fixings **D** (4 off) securing the front console panel at positions shown and then carefully lift up the front console clear of the steering column assembly.

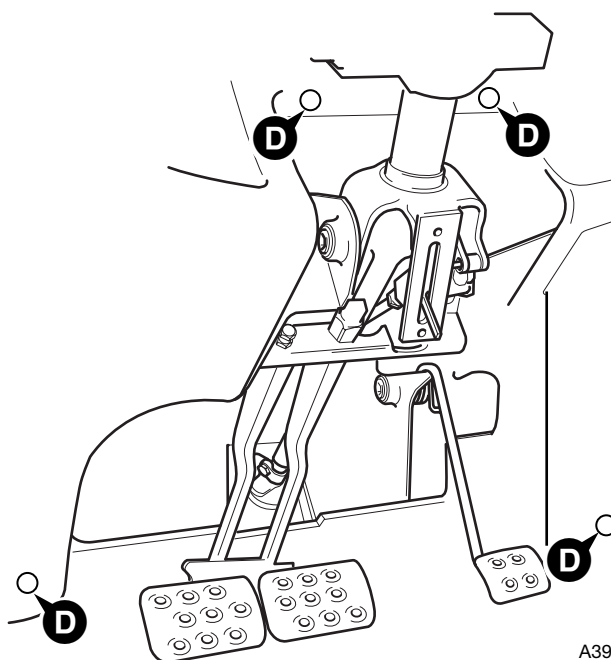


#### Replacement

Replacement is the reverse of the removal sequence.

Take care when removing/replacing the console panel to ensure that harnesses do not become snagged and that no other connections have been disturbed.

After re-fitting, operate the front/steering console controls and check they all function correctly.

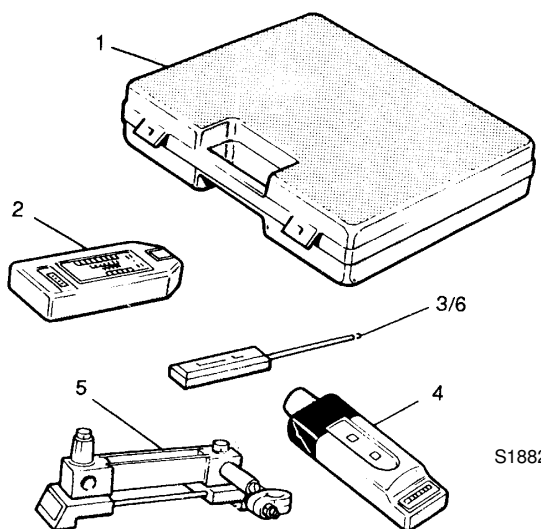


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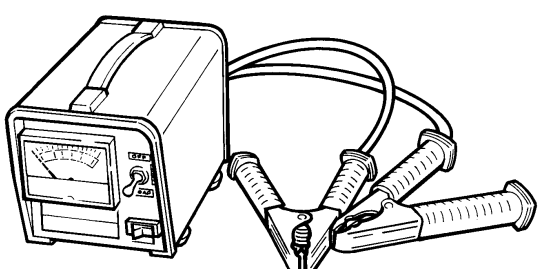


AVO Test Kit

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

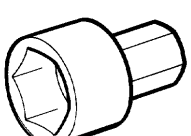
S188231

993/85700 Battery Tester



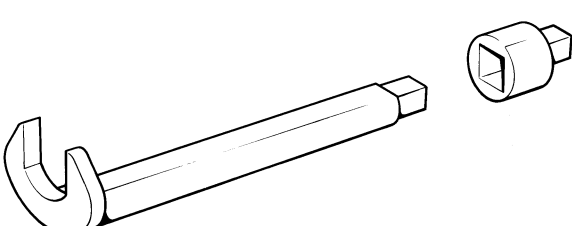
S239510

892/00882 Socket for Alternator Pulley Nut



S216770

825/00410 15 mm Crowfoot Wrench Adapter  
825/99833



S216200

**General Electrical Data**

System Type 12 Volt, negative earth

**Battery (Heavy Duty)**

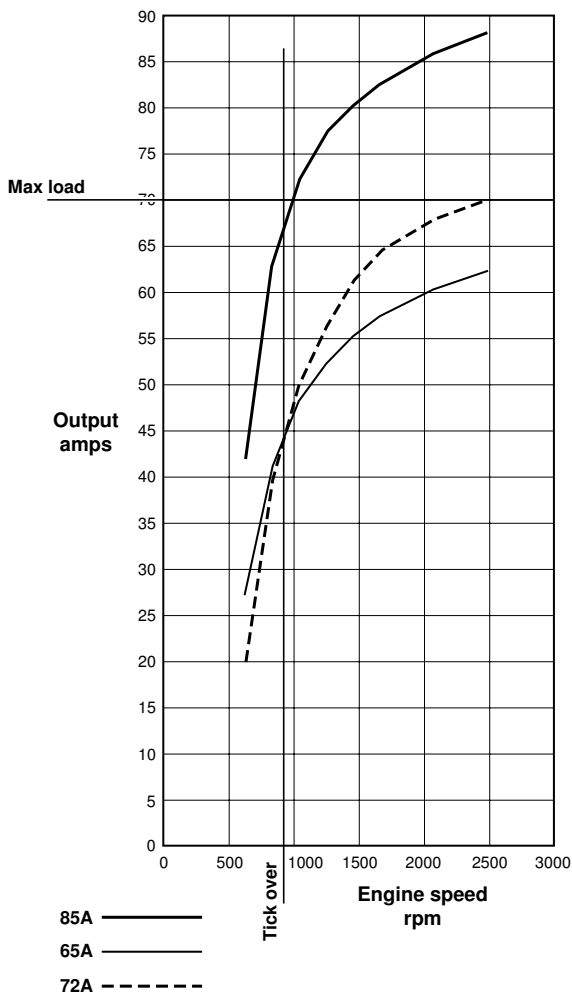
- Cold crank amps for 1 minute to 1.4 volts per cell at -18 deg C (0 deg F) 550
- Reserve capacity (minutes) for 25 amp load 220

**Battery (Temperate)**

- Cold crank amps for 1 minute to 1.4 volts per cell at -18 deg C (0 deg F) 410
- Reserve capacity (minutes) for 25 amp load 170

**Alternator**

- 2WS 65 Amp nominal output
- 4WS 72 Amp nominal output
- 4WS (air conditioning or ServoPlus builds) 85 Amp nominal output



A323770

## Fuses and Relays

### Fuses

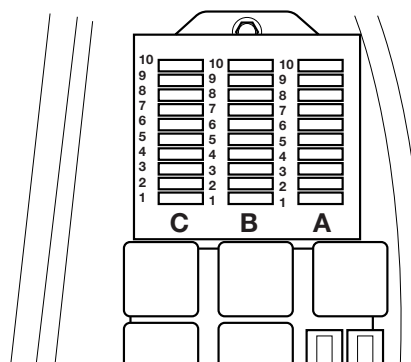


Always replace fuses with ones of correct ampere rating to avoid electrical system damage.

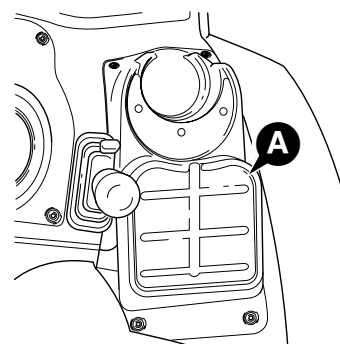
8-3-3-5

The relays and fuses are located in the side console underneath cover **A**.

If a fuse melts, find out why and rectify the fault before fitting a new one. The fuses are identified using column letters (A, B and C) and row numbers (1 to 10). Note that all the fuses are shown (including optional equipment fuses). Your machine may not be equipped with all the fuses shown.



396500



396490

### Machines up to serial no. 933756

COLUMN 'A'	Fuse Rating
1 Hydraulic auxiliary	10 Amp
2 Fuel pump solenoid (engine stop)	5 amp
3 Direction indicators	7.5 amp
4 Steer mode proximity switch	7.5 Amp
5 Gearbox control, Transmission	10 Amp
6 Spare	
7 Brake lights	5 Amp
8 4 wheel drive (automatic brakes)	3 Amp
9 Left hand side lights	5 Amp
10 Right hand side lights	5 Amp

COLUMN 'B'	Fuse Rating
1 Instruments, Buzzer	5 Amp
2 Front horn, Front washer/wiper	15 Amp
3 Rear horn	7.5 Amp
4 Heated seat, Cigar lighter, Face level fan	15 Amp
5 Rear wiper/wash	10 Amp
6 Brake switch	10 Amp
7 Return to dig enable	5 Amp
8 Rear working lights	25 Amp
9 Headlights	20 Amp
10 Front working lights	25 Amp

COLUMN 'C'	Fuse Rating
1 Lights	7.5 Amp
2 Hazard light	15 Amp
3 Beacon, Interior light	10 Amp
4 Radio	5 Amp
5 Thermostart	20 Amp
6 Heater	30 Amp
7 Ignition relay coils	3 Amp
8 Main beam	15 Amp
9 Fog light	3 Amp
10 Dip beam	15 Amp

### \* Machines from serial no. 933757

COLUMN 'A'	Fuse Rating
1 Hydraulic auxiliary	10 Amp
2 Fuel pump solenoid (engine stop)	5 amp
3 Direction indicators	7.5 amp
4 Steer mode proximity switch	7.5 Amp
5 Transmission	10 Amp
6 Gear select / Forward Reverse	3 Amp
7 Transmission	10 Amp
8 Brake lights	7.5 Amp
9 Left hand side lights	5 Amp
10 Right hand side lights	5 Amp

COLUMN 'B'	Fuse Rating
1 Instruments, Buzzer	5 Amp
2 Front horn, Front washer/wiper	15 Amp
3 Rear horn	7.5 Amp
4 Heated seat, Cigar lighter, Face level fan	15 Amp
5 Rear wiper/wash	10 Amp
6 Brake switch	10 Amp
7 Return to dig enable	5 Amp
8 Rear working lights	25 Amp
9 Headlights	20 Amp
10 Front working lights	25 Amp

COLUMN 'C'	Fuse Rating
1 Lights	7.5 Amp
2 Hazard light	15 Amp
3 Beacon, Interior light	10 Amp
4 Radio	5 Amp
5 Thermostart	20 Amp
6 Heater	30 Amp
7 Ignition relay coils	3 Amp
8 Main beam	15 Amp
9 Fog light	3 Amp
10 Dip beam	15 Amp

## Fuses and Relays

### Fuses

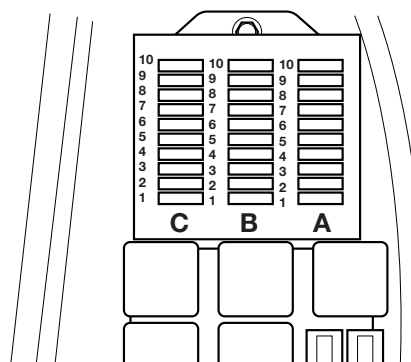


Always replace fuses with ones of correct ampere rating to avoid electrical system damage.

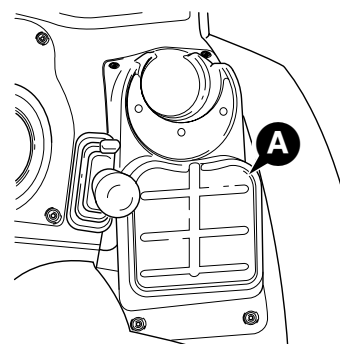
8-3-3-5

The relays and fuses are located in the side console underneath cover **A**.

If a fuse melts, find out why and rectify the fault before fitting a new one. The fuses are identified using column letters (A, B and C) and row numbers (1 to 10). Note that all the fuses are shown (including optional equipment fuses). Your machine may not be equipped with all the fuses shown.



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#### Machines up to serial no. 933756

COLUMN 'A'		Fuse Rating
1	Hydraulic auxiliary	10 Amp
2	Fuel pump solenoid (engine stop)	5 amp
3	Direction indicators	7.5 amp
4	Steer mode proximity switch	7.5 Amp
5	Gearbox control, Transmission	10 Amp
6	Spare	
7	Brake lights	5 Amp
8	4 wheel drive (automatic brakes)	3 Amp
9	Left hand side lights	5 Amp
10	Right hand side lights	5 Amp

COLUMN 'B'		Fuse Rating
1	Instruments, Buzzer	5 Amp
2	Front horn, Front washer/wiper	15 Amp
3	Rear horn	7.5 Amp
4	Heated seat, Cigar lighter, Face level fan	15 Amp
5	Rear wiper/wash	10 Amp
6	Brake switch	10 Amp
7	Return to dig enable	5 Amp
8	Rear working lights	25 Amp
9	Headlights	20 Amp
10	Front working lights	25 Amp

COLUMN 'C'		Fuse Rating
1	Lights	7.5 Amp
2	Hazard light	15 Amp
3	Beacon, Interior light	10 Amp
4	Radio	5 Amp
5	Thermostart	20 Amp
6	Heater	30 Amp
7	Ignition relay coils	3 Amp
8	Main beam	15 Amp
9	Fog light	3 Amp
10	Dip beam	15 Amp

#### \* Machines from serial no. 933757

COLUMN 'A'		Fuse Rating
1	Hydraulic auxiliary	10 Amp
2	Fuel pump solenoid (engine stop)	5 amp
3	Direction indicators	7.5 amp
4	Steer mode proximity switch	7.5 Amp
5	Transmission ECU 1	10 Amp
6	Gear select / Forward Reverse	3 Amp
7	Transmission ECU 2	10 Amp
8	Brake lights	7.5 Amp
9	Left hand side lights	5 Amp
10	Right hand side lights	5 Amp

COLUMN 'B'		Fuse Rating
1	Instruments, Buzzer	5 Amp
2	Front horn, Front washer/wiper	15 Amp
3	Rear horn	7.5 Amp
4	Heated seat, Cigar lighter, Face level fan	15 Amp
5	Rear wiper/wash	10 Amp
6	Brake switch	10 Amp
7	Return to dig enable	5 Amp
8	Rear working lights	25 Amp
9	Headlights	20 Amp
10	Front working lights	25 Amp

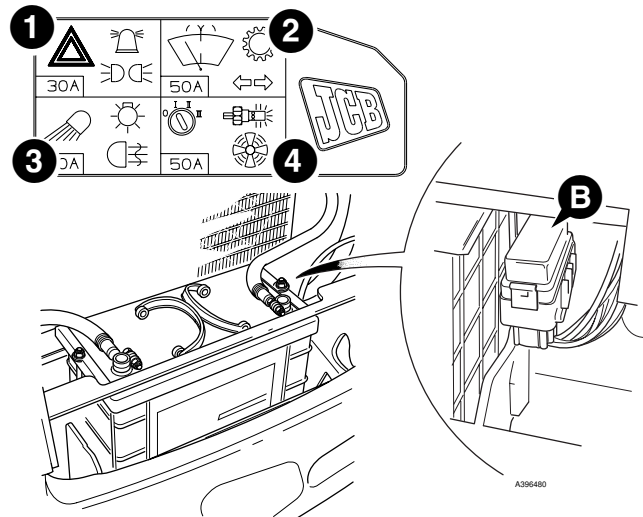
COLUMN 'C'		Fuse Rating
1	Lights	7.5 Amp
2	Hazard light	15 Amp
3	Beacon, Interior light	10 Amp
4	Radio	5 Amp
5	Thermostart	20 Amp
6	Heater	30 Amp
7	Ignition relay coils	3 Amp
8	Main beam	15 Amp
9	Fog light	3 Amp
10	Dip beam	15 Amp

## Fuses and Relays (continued)

## Link Box Fuses

To further protect the machine wiring harnesses and electrical circuits, a fuse link box is fitted to the battery, as shown at **B**. Remember to check the main circuit fuses as well as the link box fuses shown on this page.

- |   |                                       |        |
|---|---------------------------------------|--------|
| 1 | Hazard warning lights, Beacon, Lights | 30 Amp |
| 2 | Wash/Wipe, Transmission, Indicators   | 50 Amp |
| 3 | Work lights, Fog Lights, Brake lights | 50 Amp |
| 4 | Ignition, Heater, Thermostat          | 50 Amp |



## Relays

## 4 speed Powershift / Synchro Shuttle

The relays listed below are located in the side console underneath cover **A**.

- 1 Ignition 1
- 2 Hammer
- 3 Auxiliary (jaw bucket)
- 4 Main lights
- 5 Engine run
- 6 Hydraulic speed control (HSC)
- \* 7 Buzzer (from serial no. 933757 only)
- 8 Buzzer
- 9 Ignition 2
- 10 Front working lights
- 11 Rear working lights
- 12 Direction indicator
- 13 Neutral start
- \* 14 Rear horn
- \* 15 Parking brake warning light
- 16 Air conditioning compressor
- \* 17 Parking brake (from serial no. 933757 only)

## 6 speed Powershift (Shiftmaster)

The relays listed below are located in the side console underneath cover **A**.

- 1 Ignition 1
- 2 Hammer
- 3 Auxiliary (jaw bucket)
- 4 Main lights
- 5 Engine run
- 6 Hydraulic speed control (HSC)
- \* 7 Buzzer
- 8 Buzzer
- 9 Ignition 2
- 10 Front working lights
- 11 Rear working lights
- 12 Direction indicator
- 13 Neutral start
- \* 14 Rear horn
- \* 15 Parking brake warning light
- 16 Air conditioning compressor
- \* 17 Parking brake

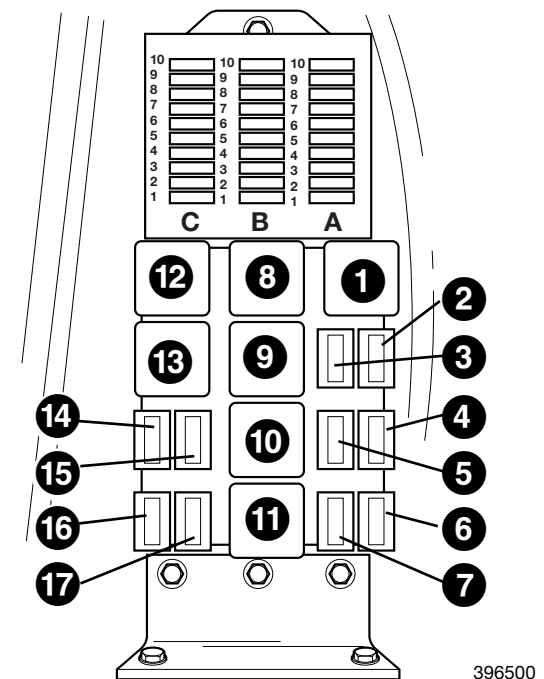
The relays listed below are located in the front console as shown at **C**.

- FD1 Forward HI/LO  
 FD2 Forward  
 FE1 Reverse HI/LO  
 FE2 Reverse  
 FF1 Interlock  
 FF2 Drive  
 FG1 Blank  
 FG2 Transmission dump  
 FH1 Auto 2WD  
 FH2 4WB

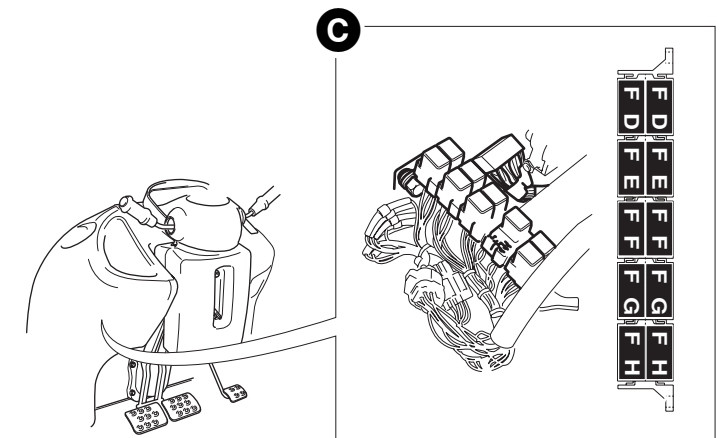
The relays listed below are located in the front console as shown at **D**.

- FG1 Reverse Alarm  
 FG2 Transmission dump  
 FH1 2WB  
 FH2 Brake lights

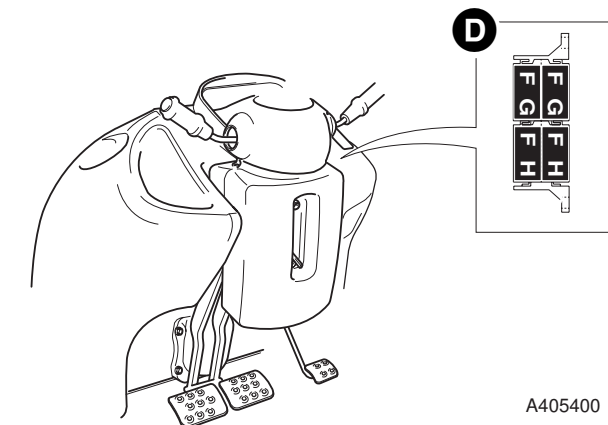
**Note:** Relay base positions may vary from those shown at **D**. Compare wire numbers on the relevant front console harness drawing to confirm relay identification



396500

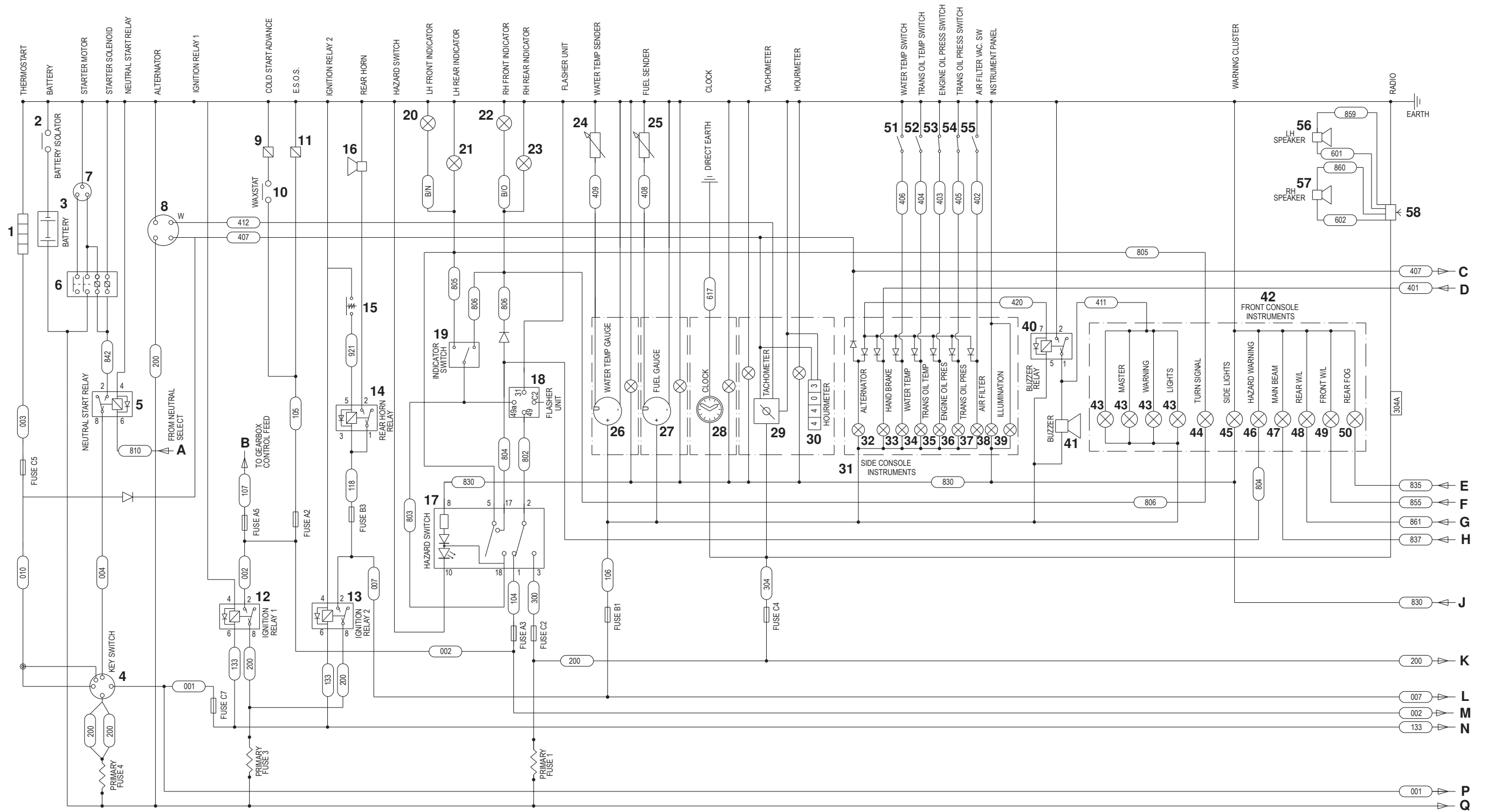


A405390



A405400

**Circuit Schematic - Basic Machine**



A409180

852/30241sht1 Iss1

## Circuit Schematic - Basic Machine

Refer to pages C/4-1 and C/4-4.

The basic circuit shows a standard machine. The remaining pages in section C/4 show machine circuits that differ from the 'basic'. Note that ONLY the differences are shown.

### \* Main Components:

- 1 Thermostart
- 2 Battery Isolator
- 3 Battery
- 4 Starter Switch
- 5 Neutral Start Relay
- 6 Starter Solenoid
- 7 Starter Motor
- 8 Alternator
- 9 Cold Start Advance Solenoid
- 10 Cold Start Advance Switch
- 11 Engine Shut-Off Solenoid (ESOS)
- 12 Ignition Relay '1'
- 13 Ignition Relay '2'
- 14 Rear Horn Relay
- 15 Rear Horn Switch
- 16 Rear Horn
- 17 Hazard Warning Switch
- 18 Indicator Flasher Unit
- 19 Direction Indicator Switch
- 20 LH Front Indicator
- 21 LH Rear Indicator
- 22 RH Front Indicator
- 23 RH Rear Indicator
- 24 Engine Coolant Temperature Sender
- 25 Fuel Gauge Sender
- 26 Engine Coolant Temperature Gauge
- 27 Fuel Gauge
- 28 Clock
- 29 Tachometer
- 30 Hourmeter
- 31 Side Instrument Console
- 32 Alternator Warning Indicator Light
- 33 Parking Brake Indicator Light
- 34 Engine Coolant Temperature Indicator Light
- 35 Transmission Oil Temperature Indicator Light
- 36 Engine Oil Pressure Indicator Light
- 37 Transmission Oil Pressure Indicator Light
- 38 Air Filter Blocked Indicator Light
- 39 Panel Illumination
- 40 Warning Buzzer Relay
- 41 Warning Buzzer
- 42 Front Instrument Console
- 43 Master Warning Lights
- 44 Turn Signal Indicator
- 45 Side Lights Indicator
- 46 Hazard Warning Indicator
- 47 Main Beam Warning Indicator Light
- 48 Rear Working Light Indicator
- 49 Front Working Light Indicator
- 50 Rear Fog Light Indicator

- 51 Engine Coolant Temperature Switch
- 52 Transmission Oil Temperature Switch
- 53 Engine Oil Pressure Switch
- 54 Transmission Oil Pressure Switch
- 55 Air Filter Restriction Switch
- 56 LH Speaker
- 57 RH Speaker
- 58 Radio (if fitted)

### \* Connections:

- A From **A** on page C/4-5 and C/4-13 as applicable
- B To **B** on page C/4-5
- C To **C** on page C/4-4
- D From **D** on page C/4-5 and C/4-13 as applicable
- E From **E** on page C/4-4
- F From **F** on page C/4-4
- G From **G** on page C/4-4
- H From **H** on page C/4-4
- J From **J** on page C/4-4
- K To **K** on page C/4-4
- L To **L** on page C/4-4 and C/4-8, and C/4-13 as applicable
- M To **M** on page C/4-8 and C/4-13 as applicable
- N To **N** on page C/4-4
- P To **P** on page C/4-4
- Q To **Q** on page C/4-4



**Circuit Schematic - Basic Machine (cont'd)****\* Main Components:**

- 59 Cigar Lighter
- 60 Face Level Fan
- 61 Face Level Fan Switch
- 62 Heated Seat
- 63 Heated Seat Switch
- 64 Rear Washer/Wiper Switch
- 65 Rear Wiper Motor
- 66 Rear Washer Motor
- 67 Front Washer/Wiper Switch
- 68 Front Washer Motor
- 69 Front Wiper Intermittent Electronic Control Unit
- 70 Front Wiper Motor
- 71 Head Light Flasher Switch
- 72 Front Horn Switch
- 73 Front Horn
- 74 Rear Fog Light Switch
- 75 Rear Fog Light
- 76 Removed For Territories - Italy, Germany
- 77 Fitted For Territories - Italy, Germany
- 78 Road Lights Relay
- 79 Road Lights Switch
- 80 Head Light Dip Switch
- 81 LH Main Beam Light
- 82 RH Main Beam Light
- 83 LH Dip Beam Light
- 84 RH Dip Beam Light
- 85 LH Tail Light
- 86 LH Side Light
- 87 Socket (Dipper Light)
- 88 Number Plate Light
- 89 RH Tail Light
- 90 RH Side Light
- 91 Engine Running Relay
- 92 Front Working Lights Relay
- 93 Rear Working Lights Relay
- 94 Front Working Lights Switch
- 95 Rear Working Lights Switch
- 96 Front Working Lights
- 97 Rear Working Lights
- 98 Cab Interior Light/Switch
- 99 Beacon Switch
- 100 Beacon
- 101 Heater Switch
- 102 Heater Motor
- 103 Heater Resistor
- 104 Air Conditioning Pressure Switches
- 105 Air Conditioning Compressor Solenoid

**\* Connections:**

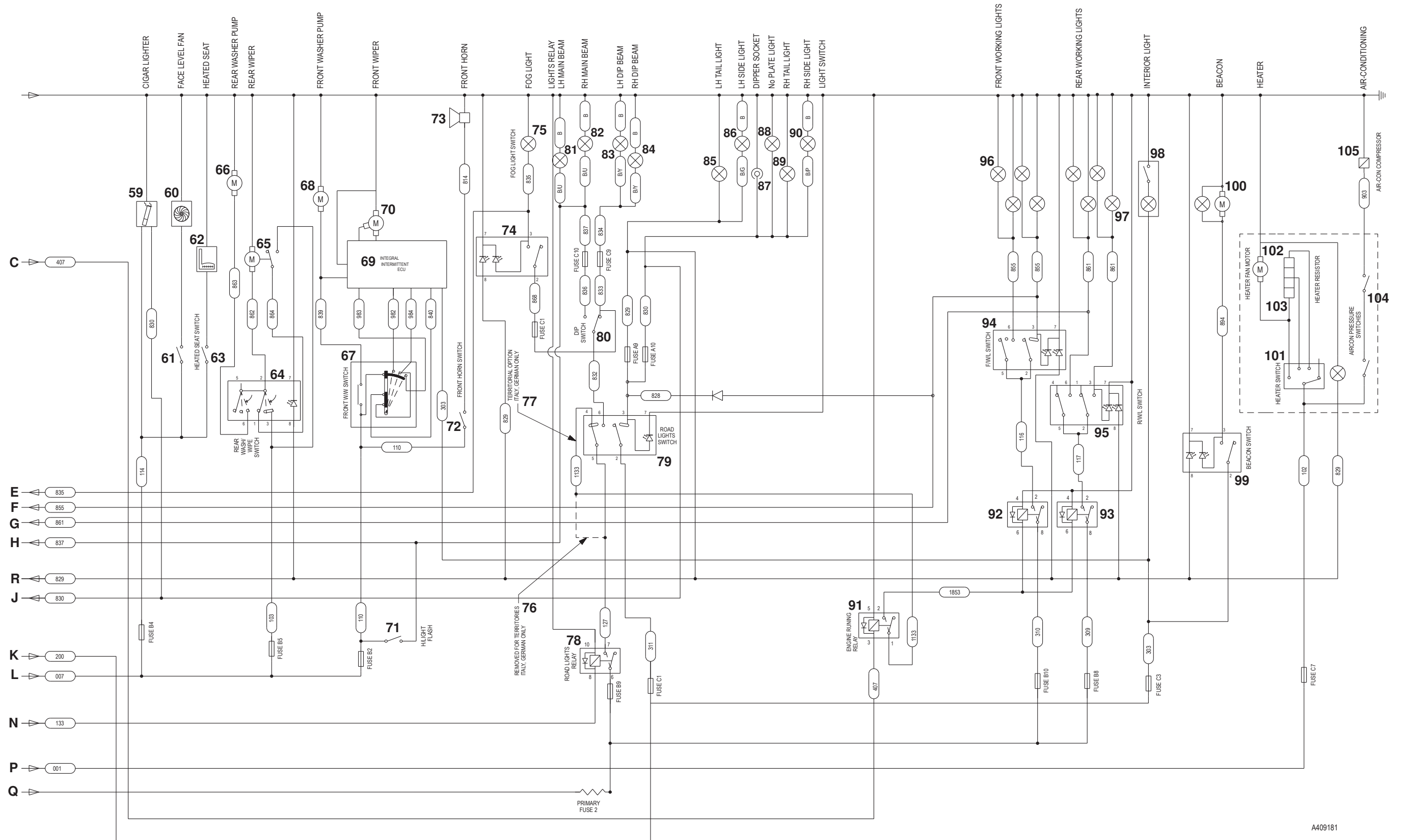
- C From **C** on page C/4-1
- E To **E** on page C/4-1
- F To **F** on page C/4-1
- G To **G** on page C/4-1
- H To **H** on page C/4-1
- J To **J** on page C/4-1 and C/4-9
- K From **K** on page C/4-1
- L From **L** on page C/4-1
- N From **N** on page C/4-1
- P From **P** on page C/4-1
- Q From **Q** on page C/4-1
- R To **R** on page C/4-9

**Fuses:**

- A1 - A10
- B1 - B10
- C1 - C10

Refer to Technical Data pages at the beginning of Section C for further fuse details and ratings.

**Circuit Schematic - Basic Machine (cont'd)**



A409181  
852/30241sht2 Iss1

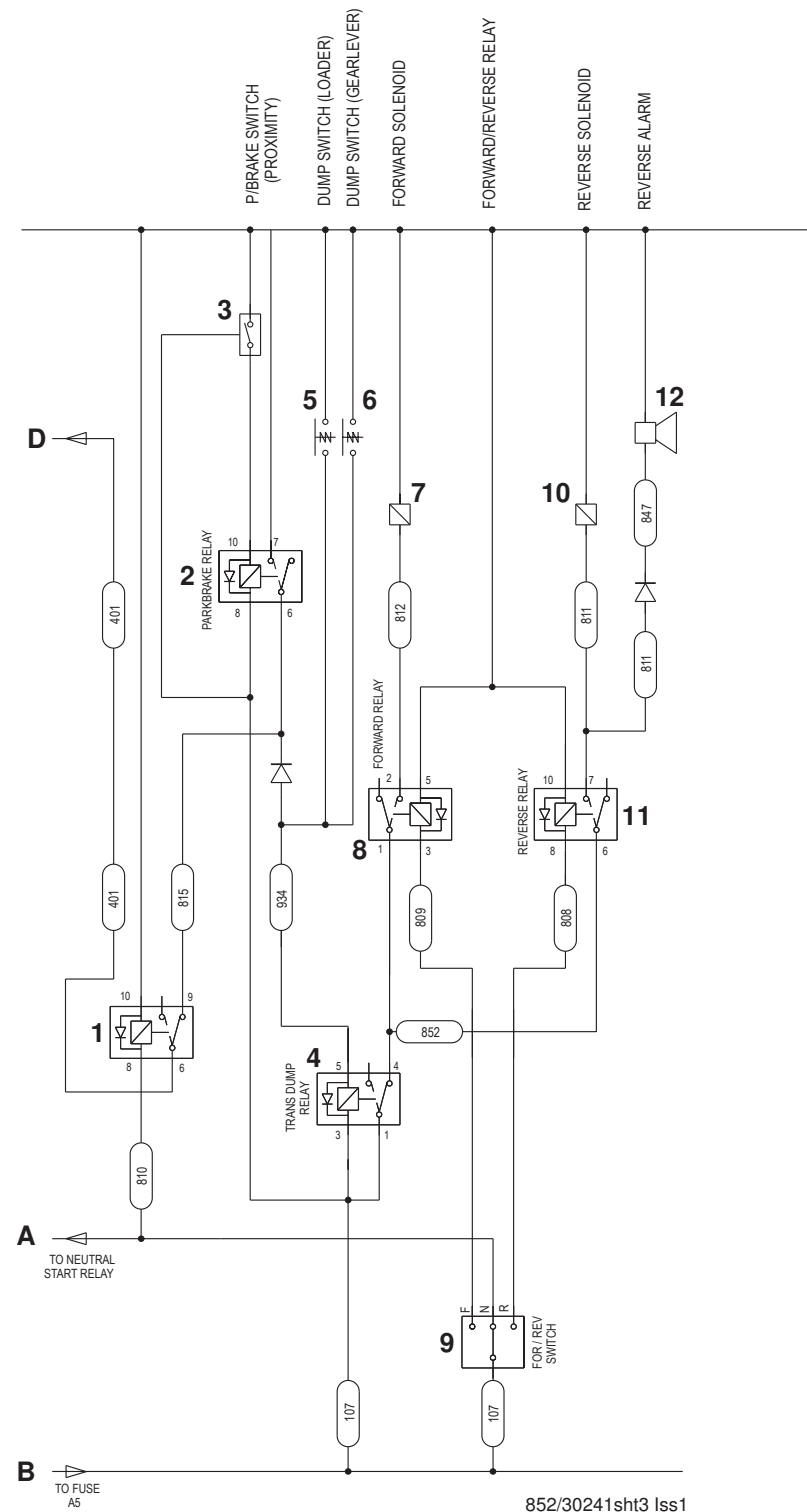
**Circuit Schematic - Synchro Shuttle**

**Circuit Schematic - Powershift**

**Note:** For further details on Powershift gearbox electrical circuits and connections, refer to **Section F - Electrical Connections**.

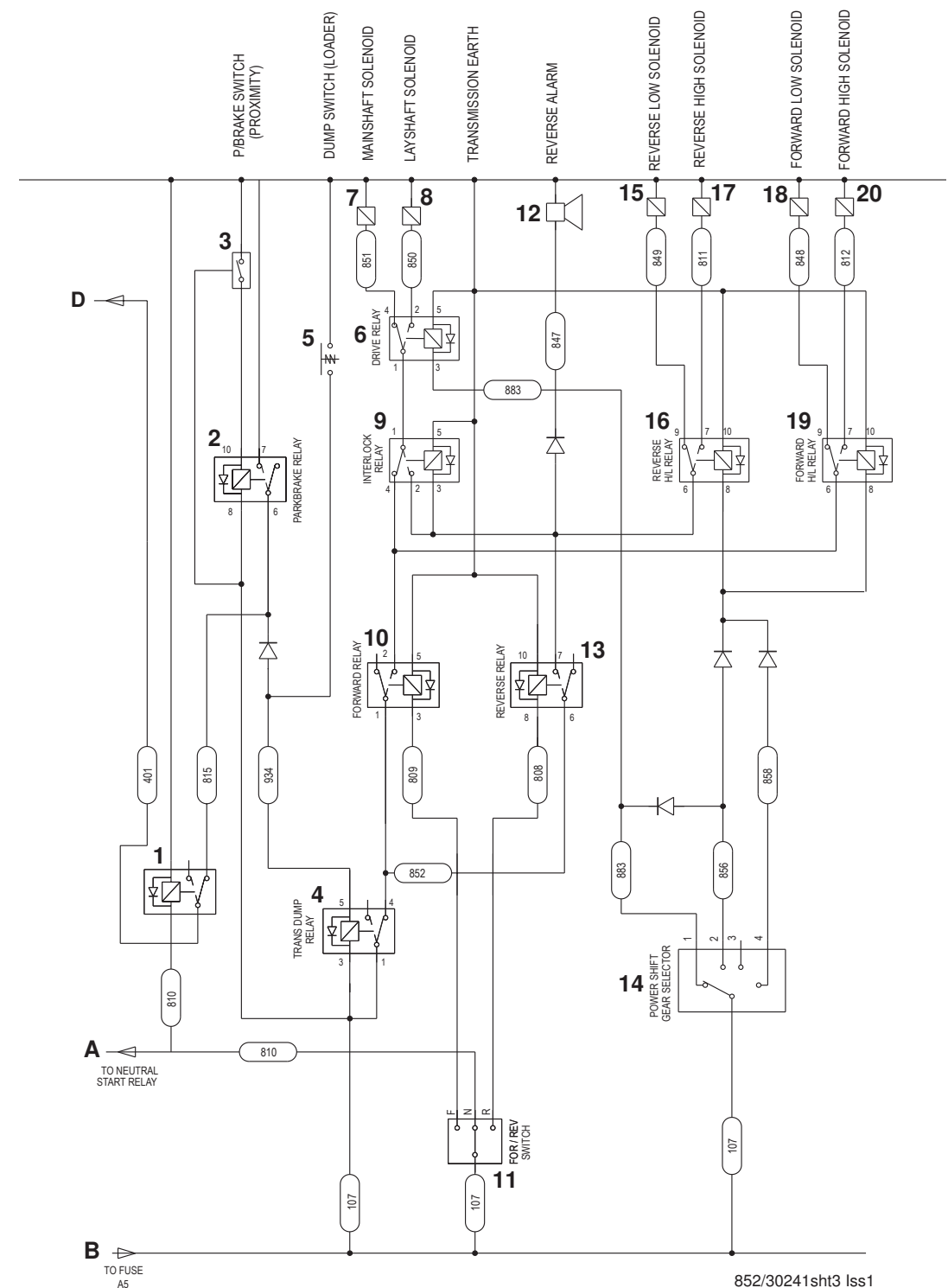
Synchro Shuttle Transmission

4 Speed Powershift Transmission



852/30241sht3 Iss1

A409182



852/30241sht3 Iss1

A409182

## Circuit Schematic - Synchro Shuttle and Powershift

### \* Synchro Shuttle Transmission

- 1 Parking Brake Warning Light Relay
- 2 Parking Brake Relay
- 3 Parking Brake Switch
- 4 Transmission Dump Relay
- 5 Transmission Dump Switch on Loader Lever
- 6 Transmission Dump Switch on Gear Lever
- 7 Forward Solenoid
- 8 Forward Relay
- 9 Forward/Reverse Selector Lever
- 10 Reverse Solenoid
- 11 Reverse Relay
- 12 Reverse Alarm

#### Connections:

- A To **A** on page C/4-1
- B From **B** on page C/4-1
- D To **D** on page C/4-1

### \* 4 Speed Powershift Transmission

- 1 Parking Brake Warning Light Relay
- 2 Parking Brake Relay
- 3 Parking Brake Switch
- 4 Transmission Dump Relay
- 5 Transmission Dump Switch on Loader Lever
- 6 Drive Relay
- 7 Mainshaft Solenoid
- 8 Layshaft Solenoid
- 9 Interlock Relay
- 10 Forward Relay
- 11 Forward/Reverse Selector Lever
- 12 Reverse Alarm
- 13 Reverse Relay
- 14 Gear Selector Switch
- 15 Reverse Low Solenoid
- 16 Reverse High/Low Relay
- 17 Reverse High Solenoid
- 18 Forward Low Solenoid
- 19 Forward High/Low Relay
- 20 Forward High Solenoid

#### Connections:

- A To **A** on page C/4-1
- B From **B** on page C/4-1
- D To **D** on page C/4-1

## Circuit Schematics - Options

### Steer Mode - 4CX and 3CX Super (4x4x4)

- 1 Front Axle Proximity Switch
- 2 Rear Axle Proximity Switch
- 3 Steer Mode Selector Switch
- 4 Steer Mode Printed Circuit Board
- 5 Crab Relay
- 6 Crab/4 Wheel Steer Relay
- 7 2 Wheel Steer Relay
- 8 4 Wheel Steer Relay
- 9 4 Wheel Steer/Crab Mode Selector (part of 4)
- 10 2 Wheel Steer/4 Wheel Steer Mode Selector (part of 4)
- 11 Crab/4 Wheel Steer Solenoid
- 12 4 Wheel Steer Solenoid
- 13 4 Wheel Steer Indicator Light
- 14 Crab Solenoid
- 15 Crab Indicator Light
- 16 2 Wheel Steer Solenoid
- 17 2 Wheel Steer Indicator Light (Side Console)
- 18 2 Wheel Steer Indicator Light (Front Console)

#### \* Connections:

- L From **L** on page C/4-1
- M From **M** on page C/4-1

#### \* 2 Wheel Steer/Brake Mode

- 1 LH Brake Light
- 2 RH Brake Light
- 3 Brake Light Switch
- 4 4 Wheel Braking Relay
- 5 Brake Mode Selector Switch
- 6 4 Wheel Drive/4 Wheel Braking Solenoid
- 7 Auto 2 Wheel Drive Relay

#### Connections:

- S From **14** on page C/4-5 and **9** on C/4-13 as applicable

#### \* 2 Wheel Steer/Brake Mode (Germany)

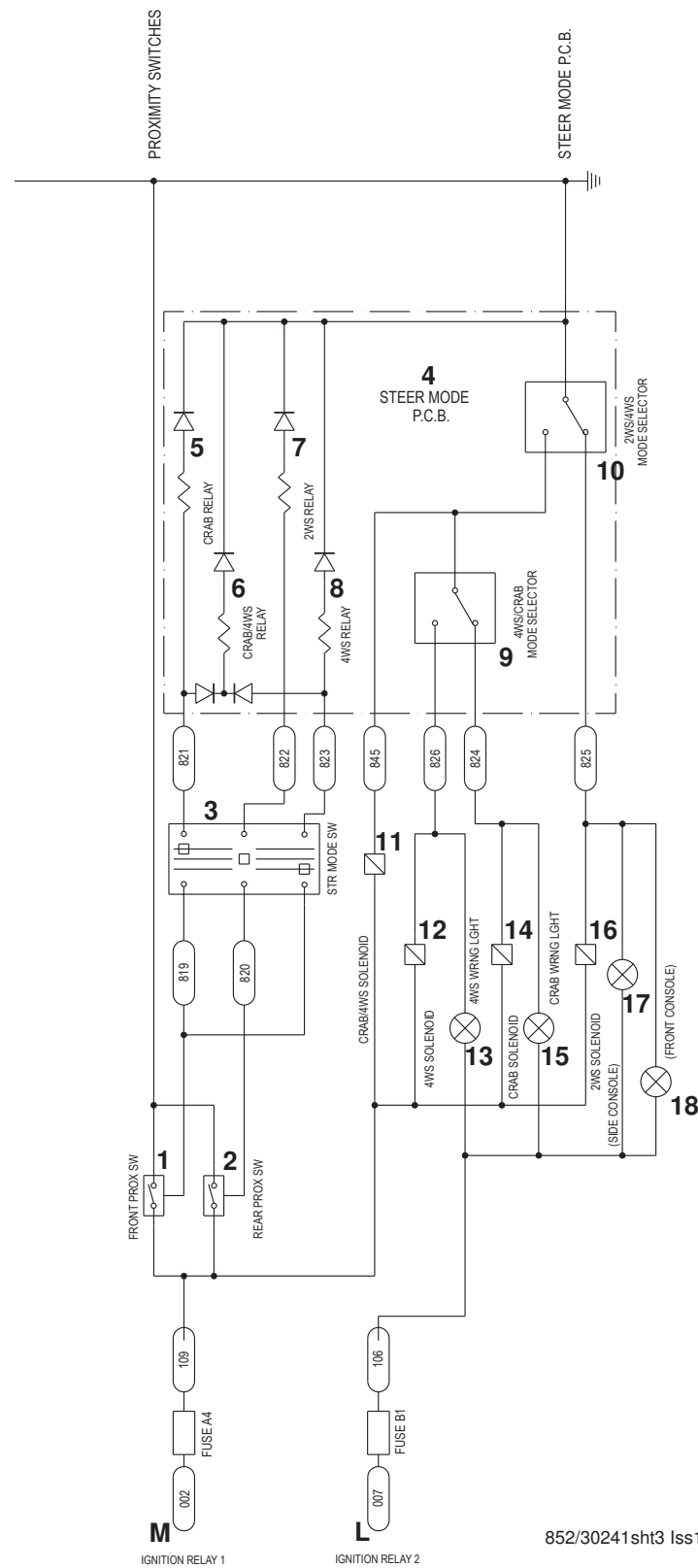
- 1 LH Brake Light
- 2 RH Brake Light
- 3 Brake Light Switch
- 4 4 Wheel Braking Relay
- 5 2 Wheel Drive Solenoid
- 6 Brake Mode Selector Switch
- 7 Auto 2 Wheel Drive Relay

#### Connections:

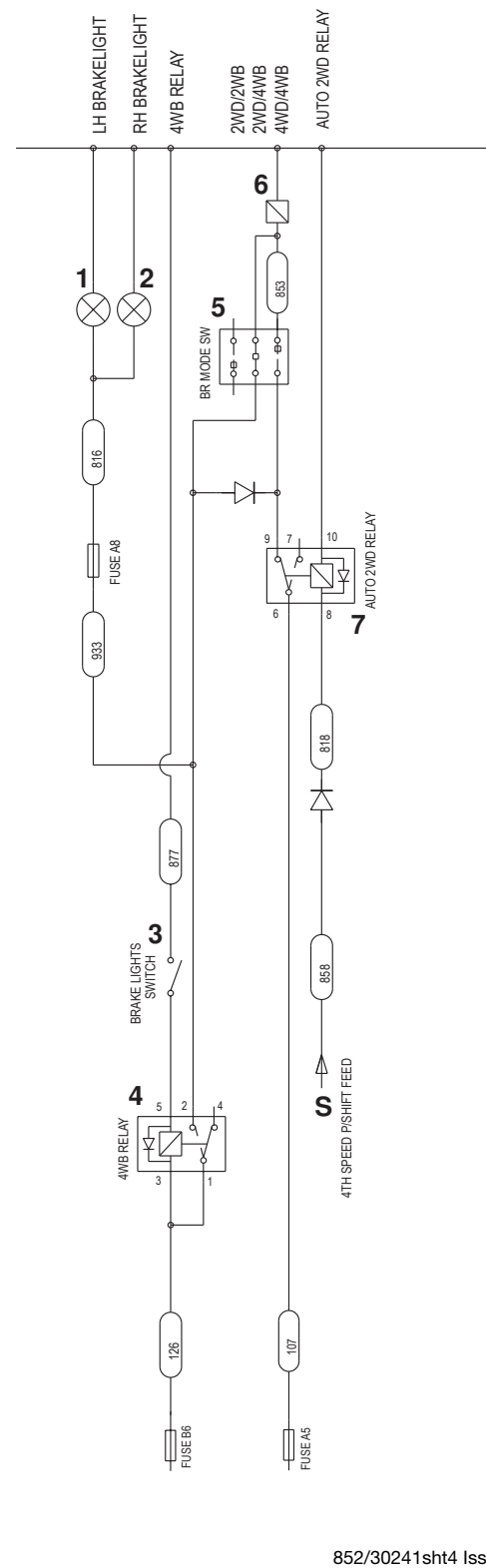
- S From **14** on page C/4-5 and **9** on C/4-13 as applicable

**Circuit Schematics - Options**

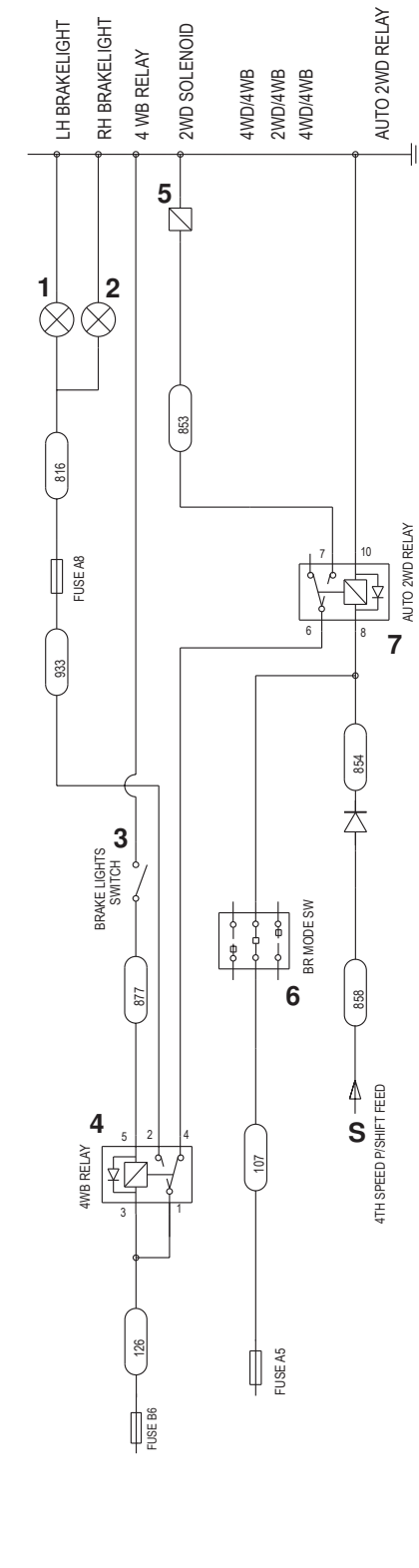
Steer Mode - 4CX and 3CX Super (4x4x4)



2 Wheel Steer/Brake Mode



2 Wheel Steer/Brake Mode (Germany)

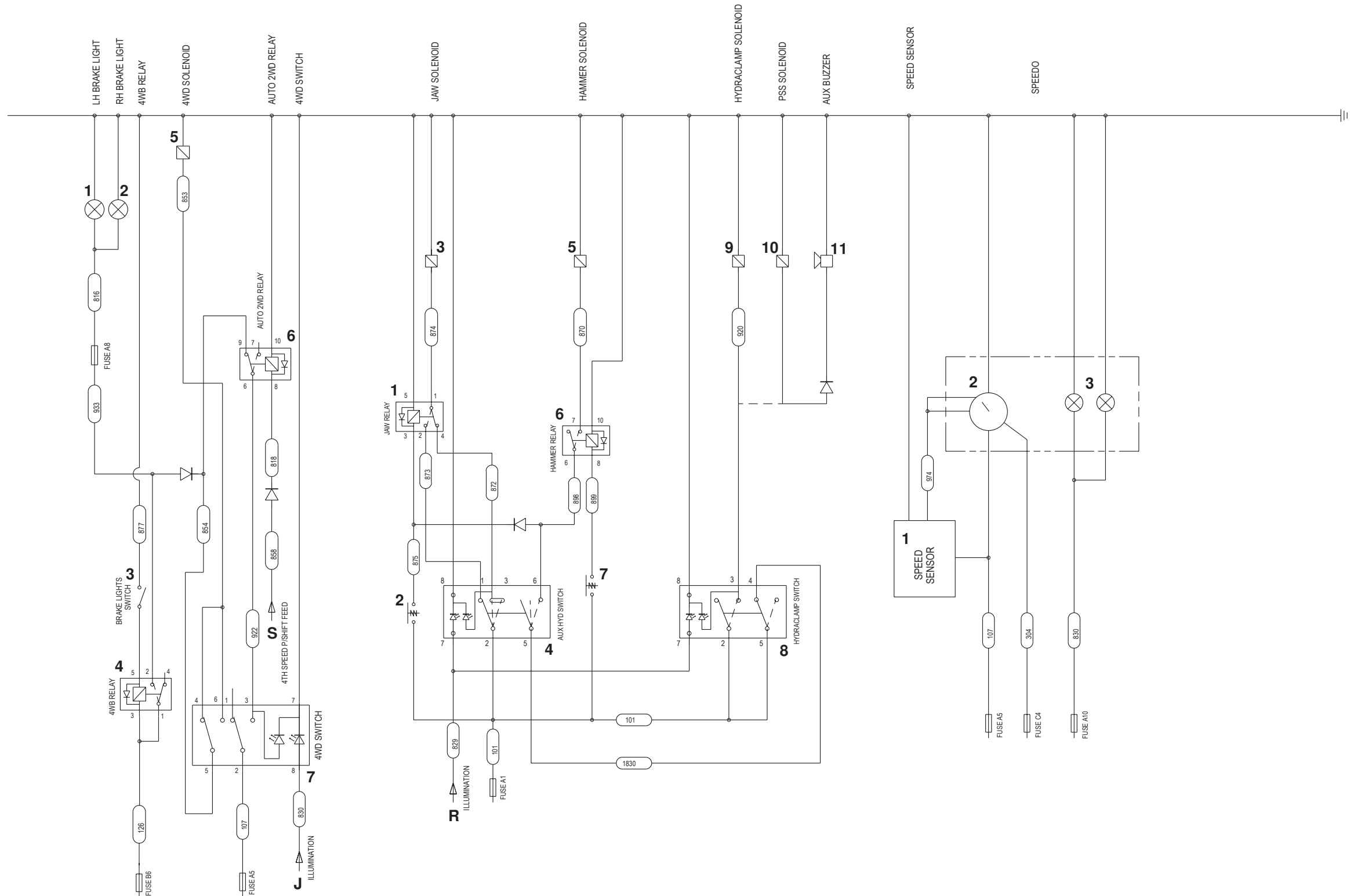


Circuit Schematics - Options

All Wheel Steer/Brake Mode

Auxiliary and Hydraclamp Hydraulics

Speedometer



A409183  
852/30241sht4 Iss1

## Circuit Schematics - Options

### \* All Wheel Steer/Brake Mode

- 1 LH Brake Light
- 2 RH Brake Light
- 3 Brake Light Switch
- 4 4 Wheel Braking Relay
- 5 4 Wheel Drive Solenoid
- 6 Auto 2 Wheel Drive Relay
- 7 4 Wheel Drive Selector Switch

#### Connections:

- J From **J** on page C/4-4  
S From **14** on page C/4-5 and **9** on C/4-13 as applicable

### Auxiliary and Hydraclamp Hydraulics

- 1 Jaw Relay
- 2 Push-Button Switch on Excavator Lever
- 3 Jaw Solenoid
- 4 Auxiliary Hydraulics Selector Switch
- 5 Hammer Solenoid
- 6 Hammer Relay
- 7 Footpedal Switch
- 8 Hydra-clamp Selector Switch
- 9 Hydra-clamp Solenoid
- 10 Power Sideshift Solenoid (if fitted)
- 11 Warning Buzzer

#### Connections:

- R From **R** on page C/4-4

### Speedometer Option

- 1 Speed Sensor
- 2 Speedometer
- 3 Illumination



### Circuit Schematics - Options

**\* Hand Held Tools**

- 1 Selector Switch
- 2 Indicator Lamp
- 3 Roadbreaker Solenoid

**\* Dedicated Quickhitch**

- 1 Hitch Enable Switch
- 2 Quick-Hitch Relay
- 3 Warning Buzzer
- 4 Lever 'hold-in' Button
- 5 Lever 'hold-in' Button
- 6 Quick-Hitch Solenoid

**\* Pole Planter**

- 1 Selector Switch
- 2 Grab Solenoid
- 3 Rotation Solenoid

**\* Smooth Ride System (SRS)**

- 1 Accumulator Solenoids
- 2 Hose Burst Control Valve Relay (if fitted)
- 3 Selector Switch
- 4 Hose Burst Control Valve Solenoids (if fitted)

**\* Return to Dig (Shovel Reset)**

- 5 Lever 'hold-in' Solenoid
- 6 Ram Proximity Switch
- 7 Selector Switch

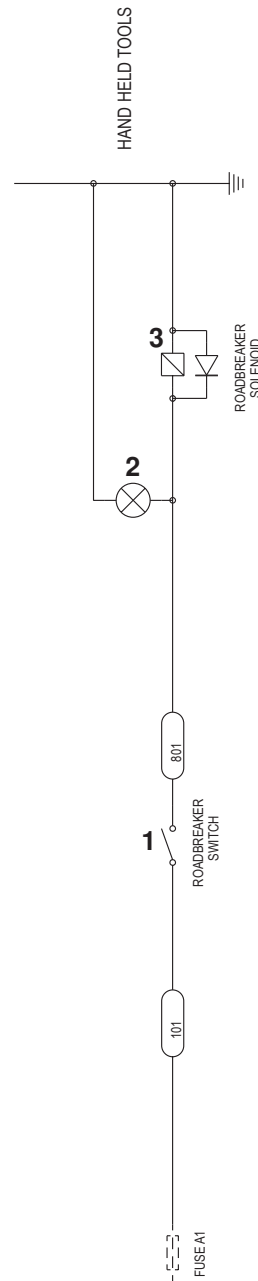
**\* Hydraulic Speed Control (HSC)**

- 1 Selector Switch
- 2 HSC Solenoid
- 3 HSC Relay
- 4 Control Lever Push-Button

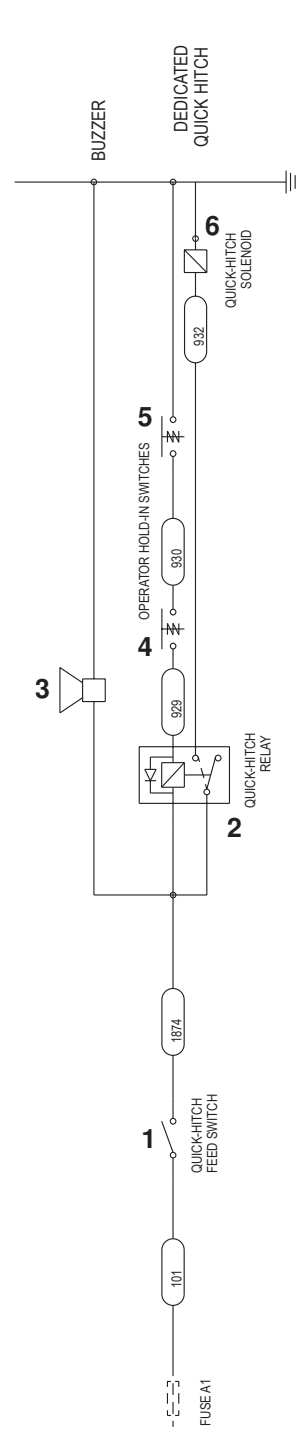
**Connections:**

- S From **14** on page C/4-5 and **9** on C/4-13 as applicable

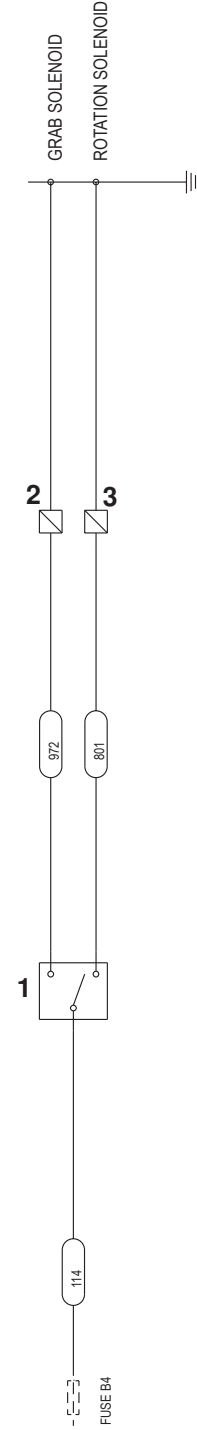
**Circuit Schematics - Options**



**Hand Held Tools**

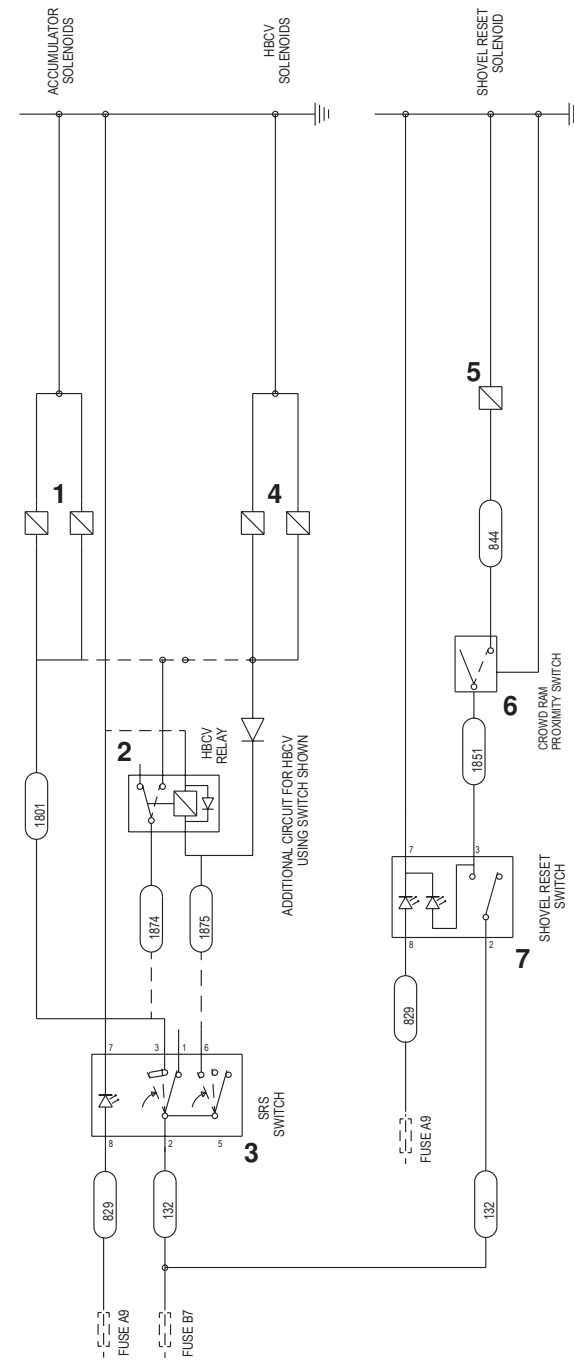


**Dedicated Quick-Hitch**



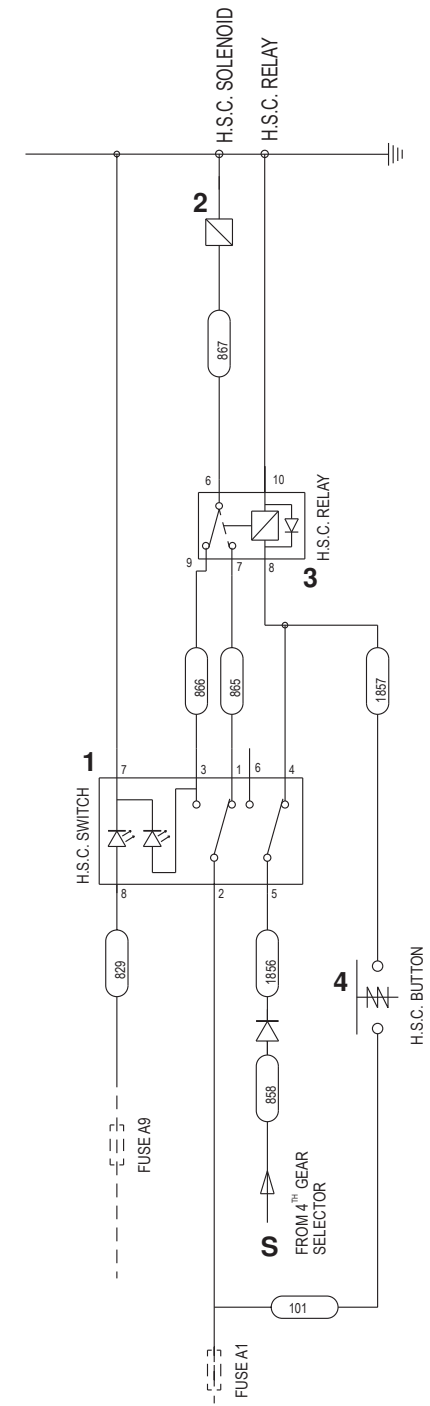
**Pole Planter**

A409185  
852/30241sht6 Iss1



**Smooth Ride System (SRS)**

**Return To Dig (Shovel Reset)**

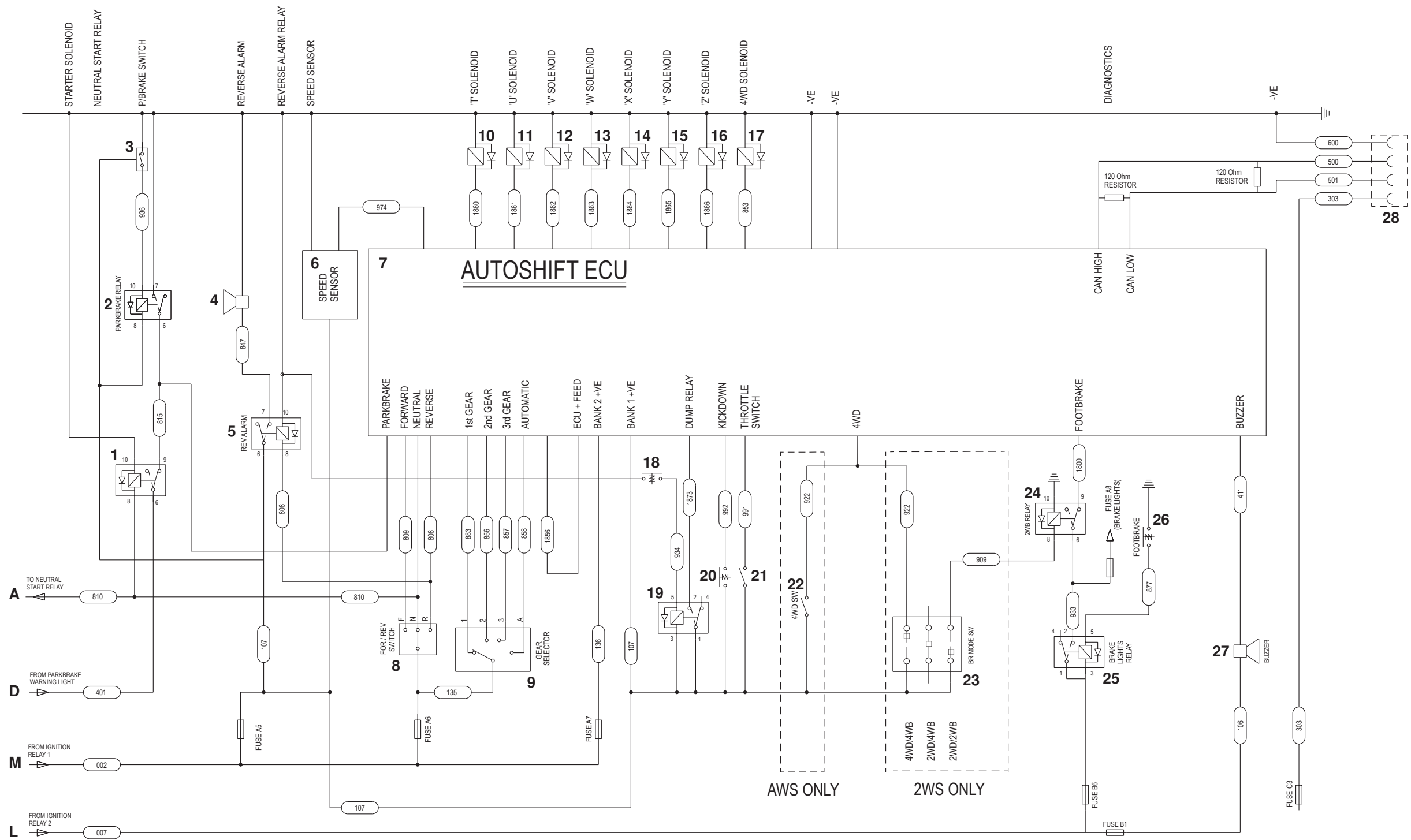


**Hydraulic Speed Control (HSC)**

A409185  
852/30241sht6 Iss1

**Circuit Schematics - 6 Speed Powershift (Shiftmaster)**

**Note:** For further details on Powershift gearbox electrical circuits and connections, refer to **Section F - Electrical Connections**.



A409184  
852/30241sht5 Iss1

\* **Circuit Schematic**  
**- 6 Speed Powershift (Shiftmaster)**

**6 Speed Powershift Transmission**

- 1 Parking Brake Warning Light Relay
- 2 Parking Brake Relay
- 3 Parking Brake Switch
- 4 Reverse Alarm
- 5 Reverse Alarm Relay
- 6 Speed Sensor
- 7 Electronic Control Unit
- 8 Forward/Reverse Selector Lever
- 9 Gear Selector Switch
- 10 Solenoid 'T'
- 11 Solenoid 'U'
- 12 Solenoid 'V'
- 13 Solenoid 'W'
- 14 Solenoid 'X'
- 15 Solenoid 'Y'
- 16 Solenoid 'Z'
- 17 4 Wheel Drive Solenoid
- 18 Transmission Dump Switch
- 19 Transmission Dump Relay
- 20 Kick-down Switch
- 21 Throttle Switch
- 22 4 Wheel Drive Switch
- 23 Brake Mode Selector Switch
- 24 2 Wheel Braking Relay
- 25 Brake Lights Relay
- 26 Footbrake Switch
- 27 Warning Buzzer
- 28 Diagnostics Connector

**Connections:**

- A To **A** on page C/4-1
- D To **D** on page C/4-1
- M From **M** on page C/4-1
- L From **L** on page C/4-1

**Circuit Schematic - 214e Machines**

Refer to pages C/4-16 and C/4-17.

**Main Components:**

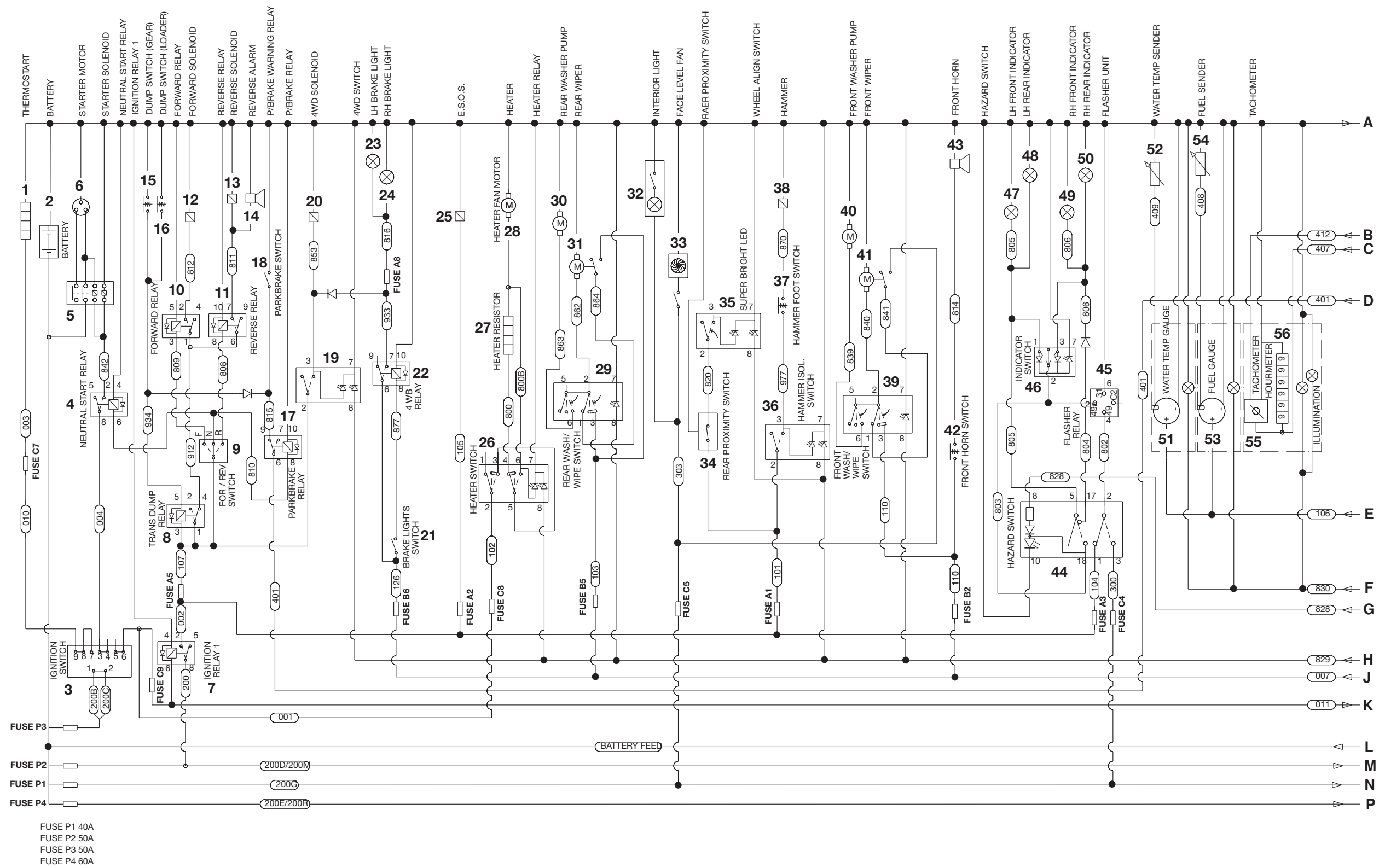
- 1 Thermostart
- 2 Battery
- 3 Starter Switch
- 4 Neutral Start Relay
- 5 Starter Solenoid
- 6 Starter Motor
- 7 Ignition Relay '1'
- 8 Transmission Dump Relay
- 9 Forward/Reverse Selector Lever
- 10 Forward Relay
- 11 Reverse Relay
- 12 Forward Solenoid
- 13 Reverse Solenoid
- 14 Reverse Alarm
- 15 Transmission Dump Switch on Gear Lever
- 16 Transmission Dump Switch on Loader Lever
- 17 Parking Brake Relay
- 18 Parking Brake Switch
- 19 4 Wheel Drive Selector Switch
- 20 4 Wheel Drive Solenoid
- 21 Brake Light Switch
- 22 4 Wheel Braking Relay
- 23 LH Brake Light
- 24 RH Brake Light
- 25 Engine Shut-Off Solenoid (ESOS)
- 26 Heater Switch
- 27 Heater Resistor
- 28 Heater Fan Motor
- 29 Rear Washer/Wiper Switch
- 30 Rear Washer Motor
- 31 Rear Wiper Motor
- 32 Cab Interior Light/Switch
- 33 Face Level Fan/Switch
- 34 Rear Proximity Switch
- 35 Wheel Align Switch
- 36 Hammer Isolaton Switch
- 37 Hammer Foot Switch
- 38 Hammer Solenoid
- 39 Front Washer/Wiper Switch
- 40 Front Washer Motor
- 41 Front Wiper Motor
- 42 Front Horn Switch
- 43 Front Horn
- 44 Hazard Warning Switch
- 45 Indicator Flasher Unit
- 46 Direction Indicator Switch
- 47 LH Front Indicator
- 48 LH Rear Indicator
- 49 RH Front Indicator
- 50 RH Rear Indicator

- 51 Engine Coolant Temperature Gauge
- 52 Engine Coolant Temperature Sender
- 53 Fuel Gauge
- 54 Fuel Gauge Sender
- 55 Tachometer
- 56 Hourmeter

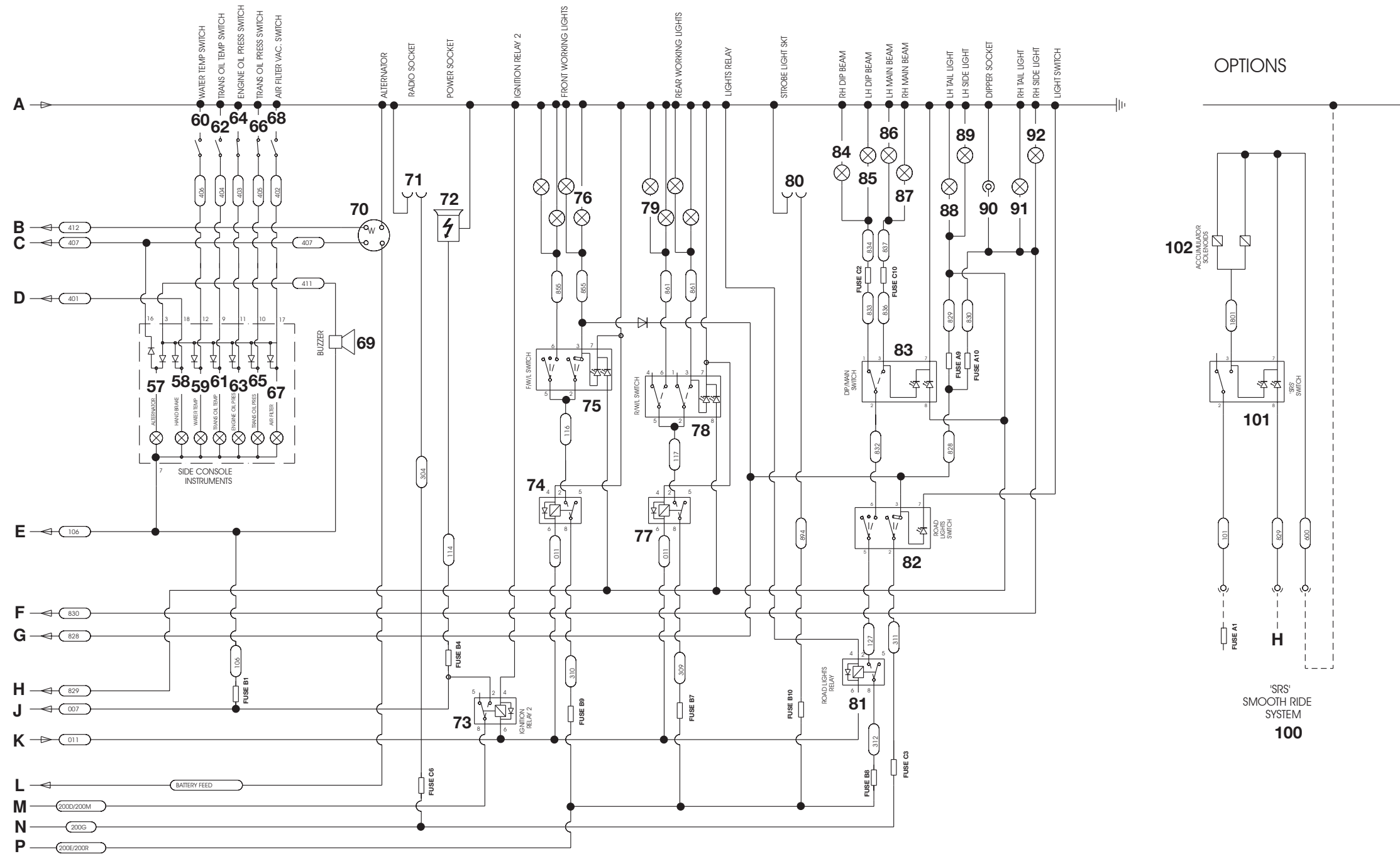
**Connections:**

- A To **A** on page C/4-17
- B From **B** on page C/4-17
- C From **C** on page C/4-17
- D From **D** on page C/4-17
- E From **E** on page C/4-17
- F From **F** on page C/4-17
- G From **G** on page C/4-17
- H From **H** on page C/4-17
- J From **J** on page C/4-17
- K To **K** on page C/4-17
- L From **L** on page C/4-17
- M To **M** on page C/4-17
- N To **N** on page C/4-17
- P To **P** on page C/4-17

**Circuit Schematic - 214e Machines**



**Circuit Schematic - 214e Machines (cont'd)**



**Circuit Schematic - 214e Machines (cont'd)****Main Components:**

- 57 Alternator Warning Indicator Light
- 58 Parking Brake Indicator Light
- 59 Engine Coolant Temperature Indicator Light
- 60 Engine Coolant Temperature Switch
- 61 Transmission Oil Temperature Indicator Light
- 62 Transmission Oil Temperature Switch
- 63 Engine Oil Pressure Indicator Light
- 64 Engine Oil Pressure Switch
- 65 Transmission Oil Pressure Indicator Light
- 66 Transmission Oil Pressure Switch
- 67 Air Filter Blocked Indicator Light
- 68 Air Filter Restriction Switch
- 69 Warning Buzzer
- 70 Alternator
- 71 Radio Socket
- 72 Cab Auxiliary Power Socket
- 73 Ignition Relay '2'
- 74 Front Working Lights Relay
- 75 Front Working Lights Switch
- 76 Front Working Lights
- 77 Rear Working Lights Relay
- 78 Rear Working Lights Switch
- 79 Rear Working Lights
- 80 Beacon/Strobe Light Socket
- 81 Road Lights Relay
- 82 Road Lights Switch
- 83 Head Light Dip Switch
- 84 RH Dip Beam Light
- 85 LH Dip Beam Light
- 86 LH Main Beam Light
- 87 RH Main Beam Light
- 88 LH Tail Light
- 89 LH Side Light
- 90 Socket (Dipper Light)
- 91 RH Tail Light
- 92 RH Side Light

**Options:**

- 100 SRS Smooth Ride System
- 101 Selector Switch
- 102 Accumulator Solenoids

**Connections:**

- A From **A** on page C/4-16
- B To **B** on page C/4-16
- C To **C** on page C/4-16
- D To **D** on page C/4-16
- E To **E** on page C/4-16
- F To **F** on page C/4-16
- G To **G** on page C/4-16
- H To **H** on page C/4-16
- J To **J** on page C/4-16
- K From **K** on page C/4-16
- L To **L** on page C/4-16
- M From **M** on page C/4-16
- N From **N** on page C/4-16
- P From **P** on page C/4-16

**Fuses:**

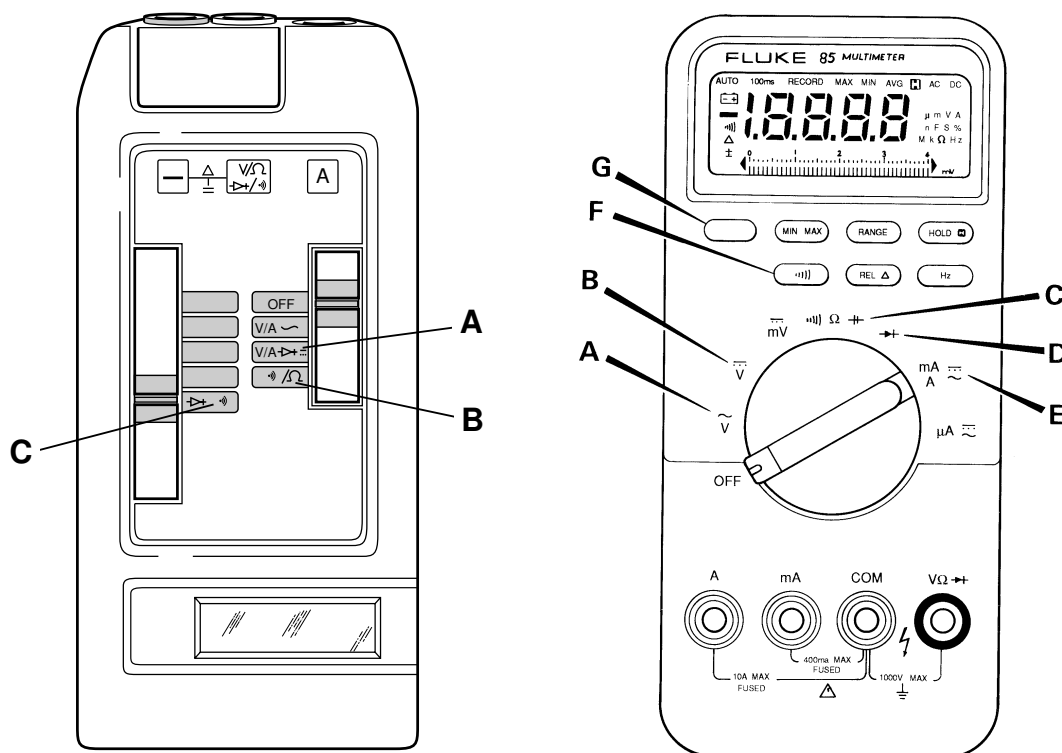
- A1 - A10
- B1 - B10
- C1 - C10

Refer to Technical Data pages at the beginning of Section C for further fuse details and ratings.



## Electrical Testing Methods - Using a Multimeter

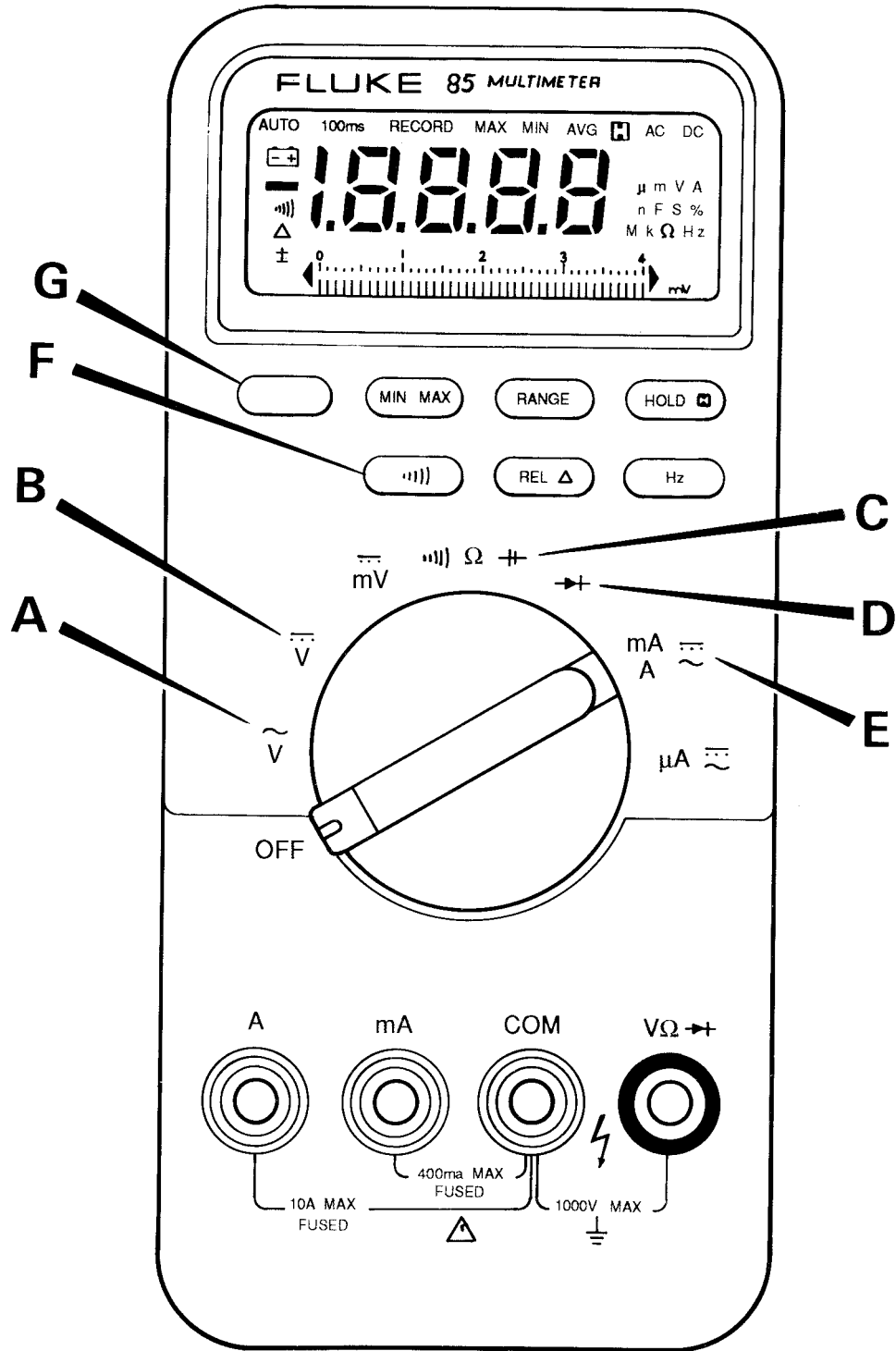
These instructions are intended to cover the use of the recommended multimeters.



A171900

S153070

- 1 Make sure that the test leads are plugged into the correct sockets. The black test lead should be plugged into the black socket (sometimes, this socket is also marked by a "-", or "E" or marked as "COMMON" or "COM"). The red test lead should be plugged into the red socket marked with "+", "V" or "Ω".
- 2 When making measurements ensure that the test probes have a good clean contact with bare metal, free from grease, dirt, and corrosion as these can cause a false reading.
- 3 When measuring voltage:  
Make sure that the correct range is selected, that is set the selector to a value equal to or greater than that you are about to measure.  
e.g. If asked to measure 12 Volts, set the selector to the 12V range. If there is no 12V range, set the selector to the next range higher, 20V for instance.  
If the meter is set to a range that is too low, it may be damaged.  
e.g. setting to the 2V range to measure 12V.



S153070

## Electrical Testing Methods - Using a Multimeter

### 1 Measuring DC Voltage

- a On the FLUKE 85  
Turn the switch to position **B**.
- b On the AV0 2003  
Move the right slider switch to position **A**, and the left hand slider switch to the appropriate range.
- c On an analogue meter  
Turn the dial to the appropriate DC Volts range.

Connect the black probe to the nearest available suitable earth point, usually this will be the starter motor earth, the battery negative, or the chassis. Connect the red probe to the wire or contact from which you are measuring the voltage.

### 2 Measuring Resistance

Make sure there is no power to the part of the circuit you are about to measure.

Connect one probe at one end of the component or wire to be checked and the other probe at the other end. It does not matter which way round the two probes are placed.

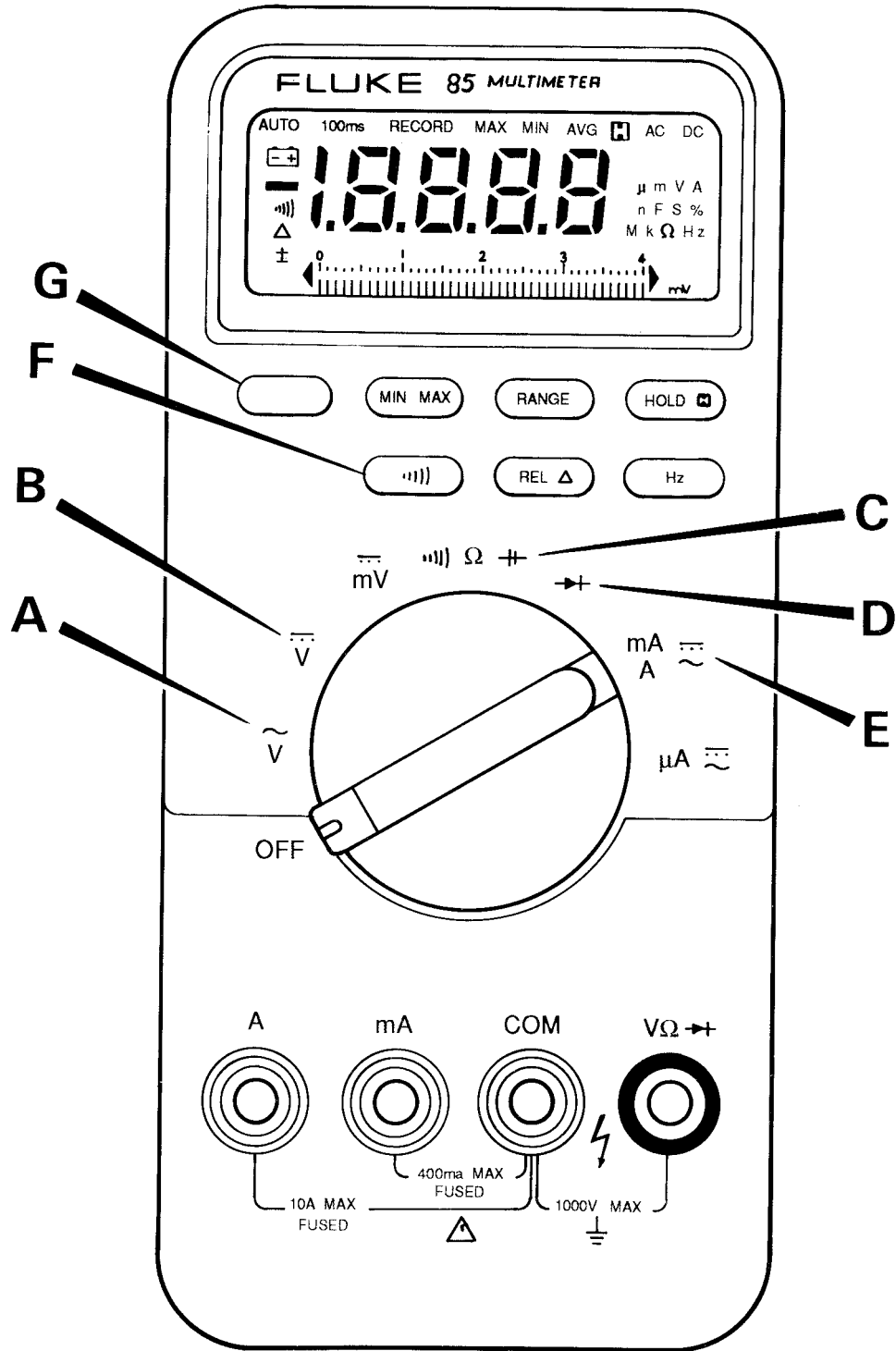
- a On the FLUKE 85  
Turn the switch to position **C** and check that the  $\Omega$  sign at the right hand side of the display window is on. If the **F** sign is on instead, press the blue button **G** to change the reading to  $\Omega$ .  
  
Touch the meter lead probes together and press the **REL** <sup>3</sup> key on the meter to eliminate the lead resistance from the meter reading.
- b On the AV0 2003  
Move the right hand slider switch to position **B**, and the left hand slider switch to the appropriate Ohms ( $\Omega$ ) range.
- c On an analogue meter  
Move the dial to the appropriate Ohms ( $\Omega$ ) range.

### 3 Measuring Continuity

Make sure there is no power to the part of the circuit you are checking for continuity.

Connect one probe to one end of the component or wire to be checked and the other probe to the other end. It does not matter which way round the two probes are placed.

- a On the FLUKE 85  
Turn the switch to position **C** and check that the beeper symbol appears at the left hand side of the display window. If the **F** sign is on instead, press the button labelled **F** in the meter drawing.  
  
If there is continuity in the circuit, the beeper will sound. If there is no continuity (open circuit), the beeper will not sound.
- b On the AV0 2003  
Move the right hand slider switch to position **B**, and the left hand slider switch to position **C**.  
  
If there is continuity (i.e. very low resistance) between two points the buzzer will sound.
- c On an analogue meter  
Turn the dial to the lowest Ohms ( $\Omega$ ) range.  
  
If there is continuity (i.e. very low resistance) between two points the needle will move across fully (or almost fully) to the right hand side of the scale.



## Electrical Testing Methods - Using a Multimeter

### 4 Testing a Diode or a Diode Wire

A diode wire is a diode with male connector fitted on one end and a female connector fitted on the other end. The diode is sealed in heatshrink sleeving.

- a** On the FLUKE 85  
Turn the switch to position **D**.

Press the **HOLD** button and check that the **H** sign appears at the top right hand side of the display window.

Connect the black probe to the end of the diode with a band or to the male connector of the diode wire. Connect the red probe to the other end of the diode or diode wire. If the beeper does not sound the diode or diode wire is faulty.

Connect the red probe to the end of the diode marked with a band, or to the male connector of the diode wire, the black probe should be connected to the other end of the diode or diode wire. If the beeper sounds or the meter does not read **O.L.**, the diode or diode wire is faulty.

Press the **HOLD** button and check that the **H** sign disappears from the right hand side of the display window.

- b** On the AV0 2003  
Move the right hand slider to position **A**, and the left hand slider switch to position **C**.

Connect the black probe to the end of the diode marked with a band, or to the male connector of the diode wire, the red probe should be connected to the other end of the diode or diode wire. If the Avometer does not buzz the diode is faulty.

Connect the red probe to the end of the diode marked with a band, or to the male connector of the diode wire, the black probe should be connected to the other end of the diode or diode wire. If the Avometer does not read "1" the diode is faulty.

- c** On an analogue meter  
Select the Ohms 1000s (1k) range.  
Connect the black probe to the end of the diode marked with a band, or to the male connector of the diode wire, the red probe should be connected to the other end of the diode or diode wire. The meter should read 20-400 K $\Omega$ , if it reads more than this the diode is faulty.

Select the Ohms 100s range.  
Connect the red probe to the end of the diode marked with a band, or to the male connector of the diode wire, the black probe should be connected to the other end of the diode or diode wire. The meter should read 300-400 $\Omega$ , if it reads less than this the diode is faulty.

## Battery

### Maintenance

To ensure that the battery provides optimum performance the following steps should be observed:

- 1 Make sure that the electrical connections are clean and tight. Smear petroleum jelly on connectors to prevent corrosion.
- 2 When applicable - never allow the electrolyte level to fall below the recommended level - 6 mm (1/4 in) above the plates. Use only distilled water for topping up.
- 3 Keep the battery at least three quarters charged, otherwise the plates may become sulphated (hardened) - this condition makes recharging the battery very difficult.

Extra precautions must be taken when bench charging maintenance free batteries, they are more prone to damage by overcharging than the standard type of battery:

- NEVER boost-charge a maintenance free battery.
- NEVER charge a maintenance free battery at a voltage in excess of 15.8 Volts.
- NEVER continue to charge a maintenance free battery after it begins to gas.

### Safety

#### WARNING

Batteries give off an explosive gas. Do not smoke when handling or working on the battery. Keep the battery away from sparks and flames.

Battery electrolyte contains sulphuric acid. It can burn you if it touches your skin or eyes. Wear goggles. Handle the battery carefully to prevent spillage. Keep metallic items (watches, rings, zips etc) away from the battery terminals. Such items could short the terminals and burn you.

Set all switches in the cab to OFF before disconnecting and connecting the battery. When disconnecting the battery, take off the earth (-) lead first.

When reconnecting, fit the positive (+) lead first.

Re-charge the battery away from the machine, in a well ventilated area. Switch the charging circuit off before connecting or disconnecting the battery. When you have installed the battery in the machine, wait five minutes before connecting it up.

### First Aid - Electrolyte

Do the following if electrolyte:

#### GETS INTO YOUR EYES

Immediately flush with water for 15 minutes, always get medical help.

#### IS SWALLOWED

Do not induce vomiting. Drink large quantities of water or milk. Then drink milk of magnesia, beaten egg or vegetable oil. Get medical help.

#### GETS ONTO YOUR SKIN

Flush with water, remove affected clothing. Cover burns with a sterile dressing then get medical help.

5-3-4-3/1

**Battery (cont'd)**

**Testing**

This test is to determine the electrical condition of the battery and to give an indication of the remaining useful 'life'.

Before testing ensure that the battery is at least 75% charged (SG of 1.23 to 1.25 for ambient temperature up to 27°C).

Ensure that the battery is completely disconnected from the vehicle.

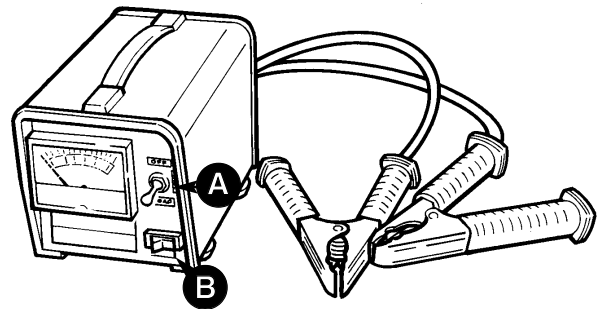
Connect up the battery tester (part no. 993/85700) as follows:

- 1 Set the CHECK/LOAD switch **A** to OFF.
- 2 Set rocker switch **B** to the battery voltage (12V).
- 3 Connect the red flying lead to the battery positive (+) terminal and the black flying lead to the battery negative (-) terminal.
- 4 Set the CHECK/LOAD switch **A** to CHECK to read the battery no-load voltage which should be at least 12.4 volts.

- 5 Set the CHECK/LOAD switch **A** to LOAD and hold down for 5 - 10 seconds until the meter reading stabilises. The reading should be at least 9 volts.

**Note:** Do not hold the switch in the LOAD position for more than 10 seconds.

- 6 If the foregoing tests are unsatisfactory, consult Fault Diagnosis below.



239510

**Fault Diagnosis**

Battery Tester Readings	Remedy
1 CHECK: 0 - 12.6 Volts LOAD: less than 6 Volts	Renew battery
2 CHECK: 6 - 12.4 Volts LOAD: less than 9 Volts and falls steadily but remains in yellow zone.	Recharge and re-test. If tests still unsatisfactory renew battery.
3 CHECK: less than 10 Volts LOAD: less than 3 Volts	Indicates battery has been over-discharged and unlikely to recover. Renew battery.
4 CHECK: more than 11 Volts LOAD: 6 - 10 Volts steady	Charge battery which will probably recover.

**Specific Gravity Testing**

The specific gravity of the electrolyte gives an idea of the state of charge of the battery. Readings should be taken using a hydrometer, when the electrolyte temperature is 15 °C (60 °F). If the battery has recently been on charge, wait approximately one hour (or slightly discharge the battery) to dissipate the surface charge before testing.

Readings should be as tabulated and should not vary between cells by more than 0.04. A greater variation indicates an internal fault on that particular cell.

If the electrolyte temperature is other than 15 °C (60 °F) a 'correction factor' must be applied to the reading obtained. Add 0.07 per 10 °C (18 °F) if the temperature is higher than 15 °C (60 °F) and subtract the same if the temperature is lower.

Specific Gravity at 15 °C (60 °F)	Fully Charged	Half Discharged	Fully Discharged
Ambient temperature up to 27 °C (80 °F)	1.270 - 1.290	1.190 - 1.210	1.110 - 1.130
Ambient temperature above 27 °C (80 °F)	1.240 - 1.260	1.170 - 1.190	1.090 - 1.110

## Alternator

### General Description

The alternator is a three phase generator having a rotating field winding and static power windings.

When the start switch is turned on, current from the battery flows by way of the 'No Charge' warning light to the field winding. This creates a magnetic field which supplements the residual magnetism in the rotor poles. As the engine is started, the fan belt drives the rotor and alternating current is generated in the power windings as they are cut by the rotating magnetic field. Output is controlled by a solid state regulator which varies the field current in accordance with electrical demand.

Servicing is restricted to periodic inspection of slip ring brushes. Bearings are 'sealed for life'.

### Service Precautions

- a Ensure that the battery negative terminal is connected to the earthing cable.
- b Never make or break connections to the battery or alternator, or any part of the charging circuit whilst the engine is running. Disregarding this instruction will result in damage to the regulator or rectifying diodes.
- c Main output cables are 'live' even when the engine is not running. Take care not to earth connectors in the moulded plug if it is removed from the alternator.
- d During arc welding on the machine, protect the alternator by removing the moulded plug (or if separate output cables fitted, remove the cables).
- e If slave starting is necessary, connect the second battery in parallel without disconnecting the vehicle battery from the charging circuit. The slave battery may then be safely removed after a start has been obtained. Take care to connect batteries positive to positive, negative to negative.

### Charging Test

Ensure that all battery and alternator connections are in place, secure and making good metal - to - metal contact, especially the 'earth' connections to chassis and engine.

Make sure that the alternator drive belt tension is correctly adjusted.

If the battery is in a fully charged condition, switch on the working lights for 3 minutes before commencing the test. Alternatively, operate the starter for a few moments with the engine shut off solenoid (ESOS) fuse removed (refer to fuse identification pages).

Install a 100 amp open - type shunt between the battery positive lead and the battery positive terminal.

Connect a multimeter positive lead to machine side of the shunt and negative lead to battery side of the shunt.

Connect the leads to the meter and set the meter to the relevant range as follows.

AVO 2002 Red lead to volts (middle) socket on meter.  
Black lead to negative on meter.  
RH slider to DC voltage.  
LH slider as shown in the illustration.

AVO 2003 Red lead to amps socket (marked **A**) on the meter.  
Black lead to negative on meter.  
RH slider to DC voltage  
LH slider to 200 Shunt

FLUKE 85 Red lead to volts socket (marked **V**) on meter.  
Black lead to COM socket on meter.  
Set dial to mV.

Start the engine and run at maximum speed (see **Technical Data**). Meter should show maximum alternator output in Amps (see **Technical Data**).

**Note:** The meter reading should be taken as soon as possible after starting the engine, as the charging current will fall rapidly.

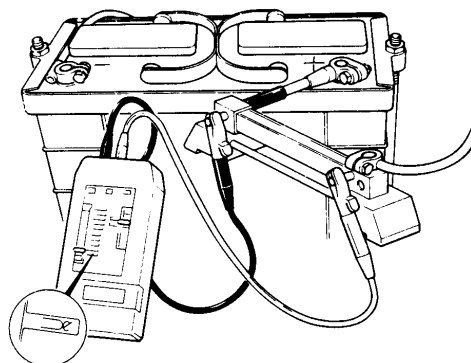
A zero reading indicates failure of the alternator and may be caused by one of the following conditions. These are listed in the order of probability.

- a Defective suppression capacitor.
- b Dirty slip rings or worn brushes.
- c Defective regulator.
- d Defective rectifier.
- e Open or short - circuited field (rotor) windings.
- f Open or short - circuited power (stator) windings.

To check for fault **a**, disconnect the capacitor and repeat the charging test. Renew the capacitor if necessary.

To check for faults **b** and **c**, remove the regulator and brush box assembly. Check the condition of the brushes and, if necessary, clean the slip rings using extra-fine glasspaper. The regulator may only be checked by substitution.

Faults **d**, **e**, and **f** may be checked only by removing and dismantling the alternator for further testing.



S08346



## Starter Motor

### Starting Circuit Test

Before carrying out the voltmeter tests, check the battery condition (see Battery Testing) and ensure that all connections are clean and tight.

To prevent the engine starting during the tests ensure that the engine stop fuse is removed, (refer to fuse identification page).

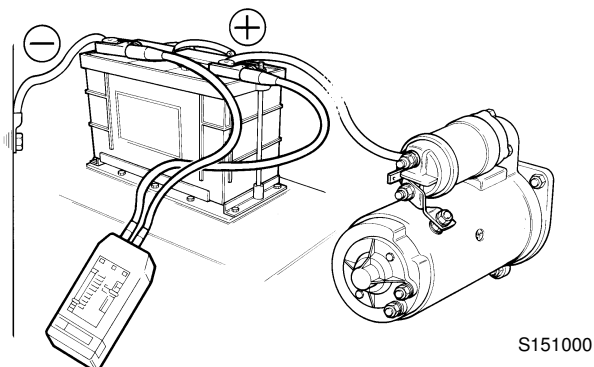
Check the readings in the following sequence using a voltmeter. Unless otherwise stated, the readings must be taken with the starter switch held in the 'start' position ('HS') and the transmission forward/reverse selector in neutral.

**Note:** Do not operate the starter motor for more than 20 seconds at one time. Let the starter motor cool for at least two minutes between starts.

#### Test 1

Connect the voltmeter across the battery terminals. Reading in 'start' position: 10.0V approximately. Minimum permissible reading in 'start' position 9.5V.

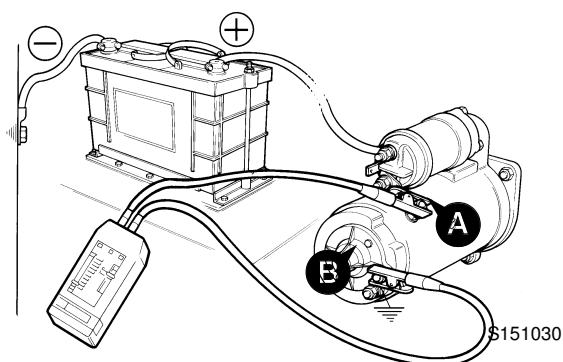
A low reading probably indicates a fault in the starter motor.



#### Test 2

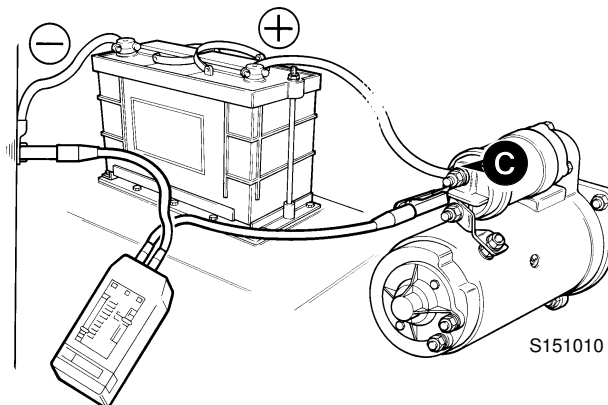
Connect the voltmeter between the starter main terminal **A** and the commutator end bracket **B**. In the 'start' position, the reading should not be more than 0.5V below the reading obtained in Test 1. Minimum permissible reading in 'start' position 9.0V.

If the reading is within this limit, continue to Test 3. If the reading is outside the limit, proceed to Tests 4 and 5.



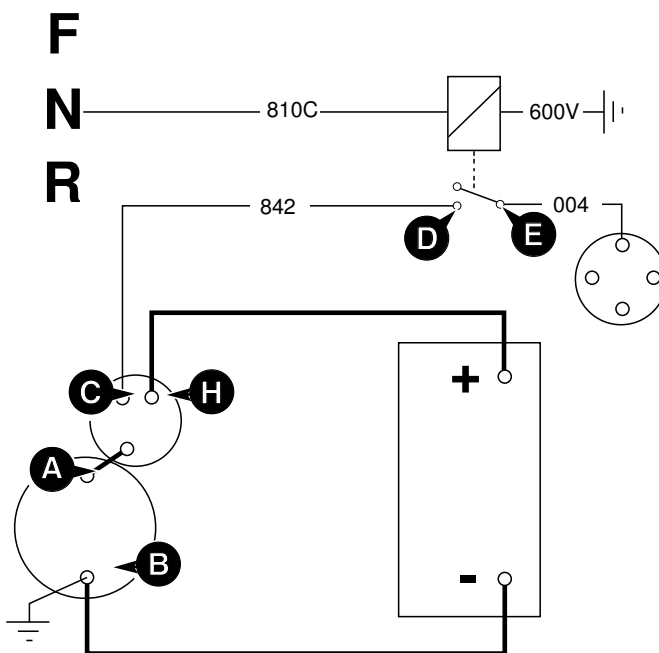
#### Test 3

Connect the voltmeter between the solenoid terminal **C** and a good earth. Minimum permissible reading in 'start' position: 8.0V.



#### Test 3a

If the reading is less than specified, connect the voltmeter between the neutral start relay terminal **D** and earth. An increase in reading to 8.0V indicates a fault in the wiring from the start relay to the solenoid.



## Starter Motor (cont'd)

### Starting Circuit Test (cont'd)

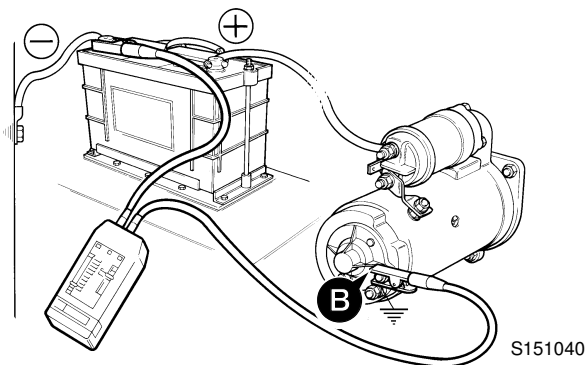
#### Test 3b

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.

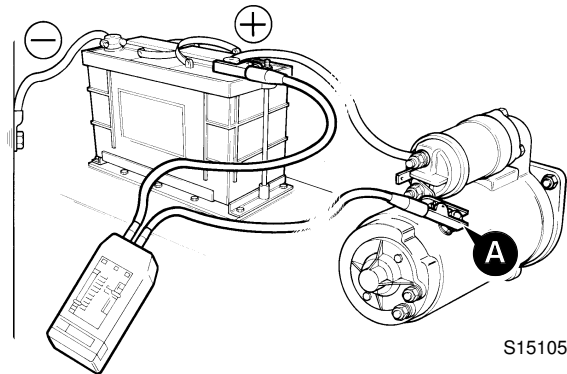


S151040

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

#### Test 5

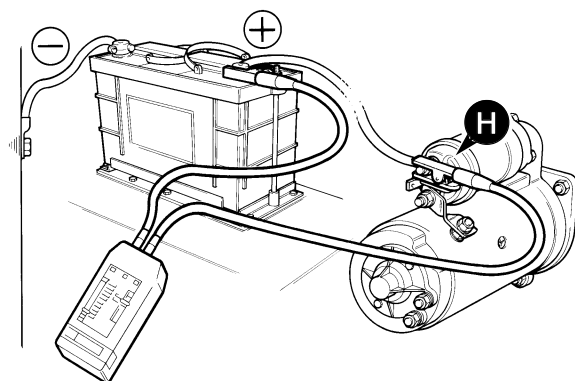
Connect the voltmeter between battery positive and the starter main terminal **A**. With the starter switch 'off', the voltmeter should indicate battery voltage, but it should fall to practically zero when the switch is turned to the 'on' position, maximum permissible reading 0.25V.



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.

## Wiring Harness

### Introduction

Instances do occur where it is necessary to incorporate auxiliary electrical components into existing electrical circuits and, although unlikely with present wiring harnesses, repair or replace specific individual wires within a harness. This will also apply to other machines in addition to those of JCB manufacture.

To ensure that either the inclusion of an auxiliary electrical component or a repair within a harness is completed to an acceptable standard it is strongly recommended that the following tools, equipment and procedures are always used. Note that JCB harnesses have an International Protection rating of 67 (I.P.67).

The sheath covering of the recommended splice is heat shrunk onto the original wire insulation. This results in a seal and corresponding joint to IP 67 specifications.

### ⚠ CAUTION

**When installing Auxiliary Electrical Components always ensure that the additional load rating is suitable for that particular circuit. It is unacceptable to simply increase the fuse rating as this can cause overloading and consequential failure of wiring, along with failure of integral circuit components, which the fuse is protecting.**

ELEC 2 - 1

### ⚠ WARNING

**In addition to the warnings incorporated into the procedure, extreme care should be taken when handling the gas heating tool to ensure that the flame does not damage or set fire to any items in the vicinity of the repair, i.e. other wires, floor panels, floor mats, sound proofing, paintwork. etc. This tool should not be used in any restricted location prohibiting the use of 'Naked Flames' or where risk of explosive gas or similar safety parameters apply. No other heat source should be used to attempt a sealed joint .**

ELEC 2 - 2

### ⚠ CAUTION

**When the heater is in use, the reflector and the air coming out are extremely hot. Keep away to avoid accidental burns. Do not touch the reflector until it has had time to cool down after switching off. If flame reappears at the reflector when the heater is in use, the catalytic element is damaged or used up. Stop work immediately and replace the heater.**

ELEC 2-3

### Tools Required

892/00350	Butane Heater assembly	1
892/00349	Crimp tool	1
892/00351	Splice 0.5-1.5 mm (Red)	50
892/00352	Splice 1.5-2.5 mm (Blue)	50
892/00353	Splice 3.0-6.0 mm (Yellow)	50

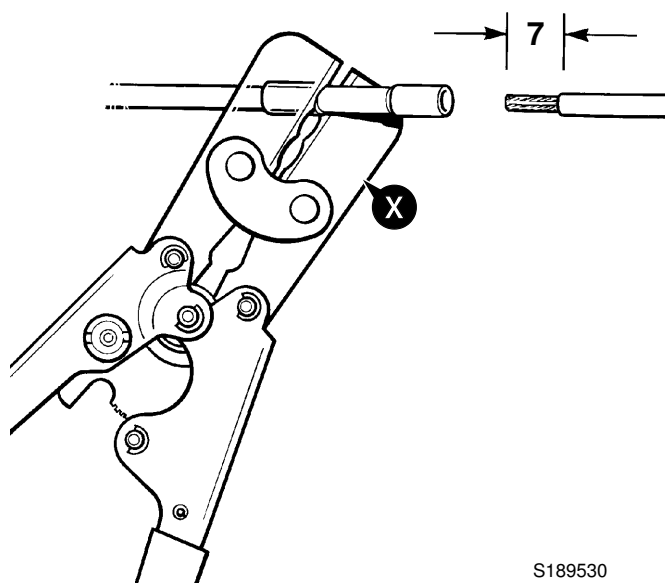
### Repair Procedure

- 1 Cut the wire and remove the protective insulation for a suitable distance dependent upon the size of wire and splice to be used. For the splices detailed above, the dimension is 7mm.
- 2 Using the correct sized splice, attach the new section of wire required or auxiliary flying lead to the existing harness and secure using the crimp tool **X**, part number 892/00349.

Note that each of the splices detailed is colour-coded to make size and range readily visible. They are secured using the corresponding size and matching colour-coded jaws of the crimp tool to ensure joint security. This tool also incorporates a ratchet closing mechanism which will not release until the splice is fully closed to the correct compression size.

- 3 With the Butane heater assembly, 892/00350, seal the connection using the procedure on the next page.

....continued

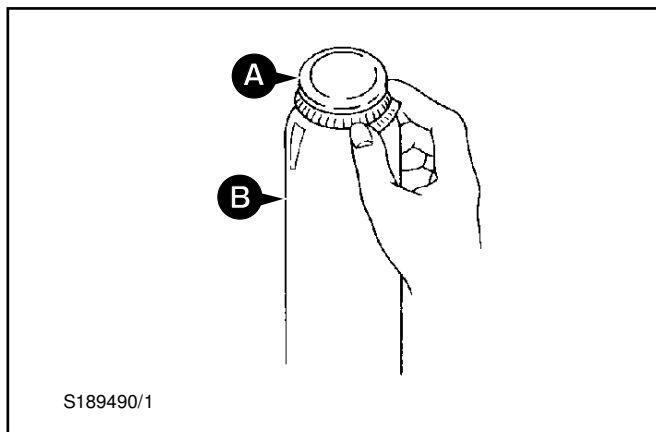


S189530

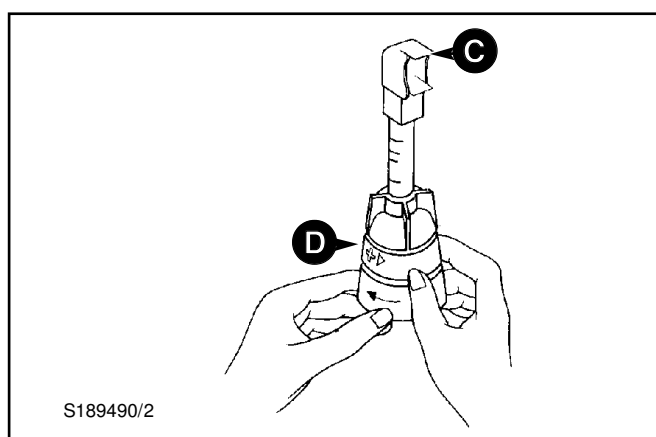
### Wiring Harness - Repair Procedure (cont'd)

With the Butane Heater assembly 892/00350, seal the connection using the following procedure.

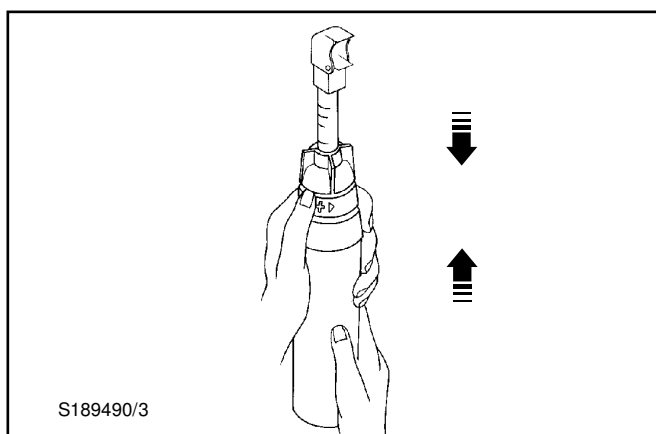
- a Remove the cap **A** from the end of the disposable gas cartridge **B**.



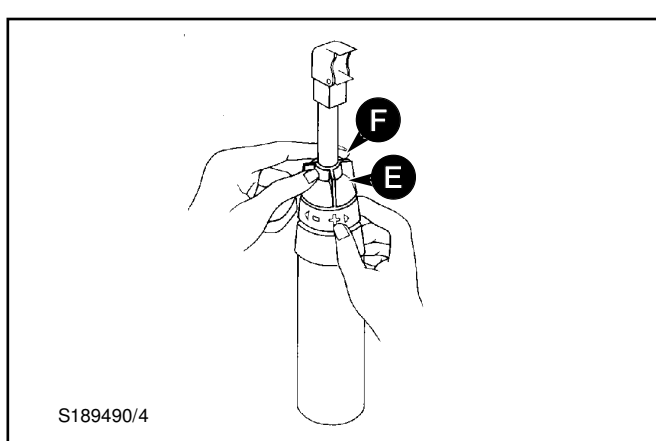
- b Before assembling the gas cartridge to the reflector element **C**, turn the red ring **D** to the left, (in the direction of the minus sign marked on the ring).



- c Position the tube hanging down from inside the reflector assembly into the hole at the top of the gas cartridge. Then press the gas cartridge up into the reflector assembly as far as possible until the two elements are clamped firmly together. A click will be heard.



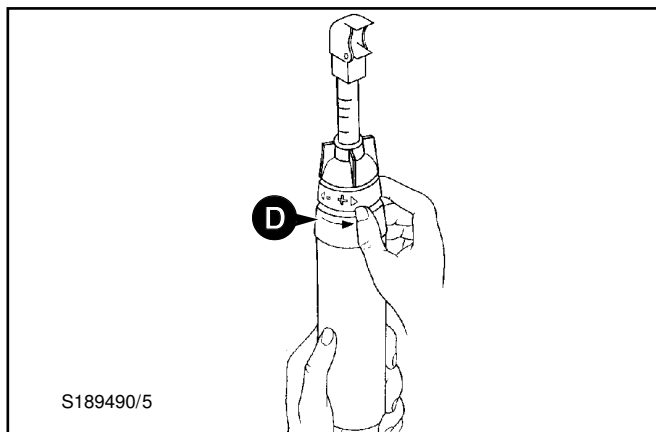
- d Turn the small ring **E** so that the air holes at **F** are completely closed.



## Wiring Harness - Repair Procedure (cont'd)

- e Turn the red ring **D** to the right (in the direction of the plus sign) in order to turn on the gas.

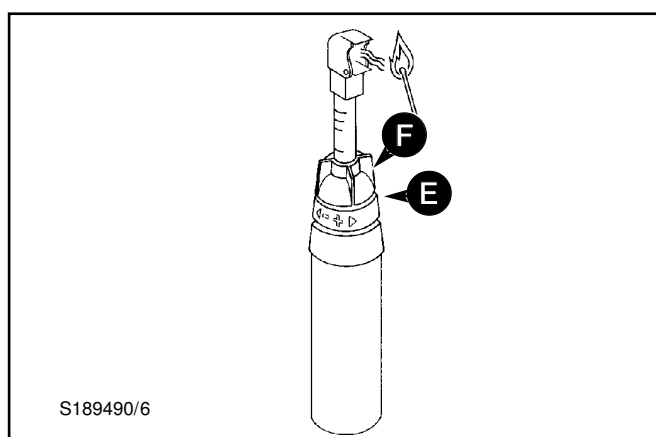
**IMPORTANT:** Before turning the heater on, make sure that the cartridge is not hotter than the reflector element. This may occur if the cartridge is held in the hand for a long time. The temperature difference between the cartridge and the reflector element may cause long yellow flames to appear on ignition.



- f Hold the heater vertically and, using a match or cigarette lighter, light the gas as shown.

**Note:** The fact that the sound of liquid cannot be heard when the cartridge is shaken does not mean it is empty. No sound will be heard even when the cartridge is full.

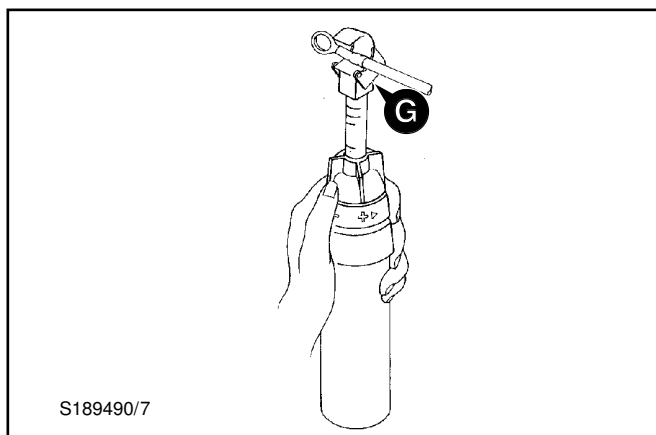
Hold the heater vertically for 1 to 2 minutes until the catalytic reaction occurs. This is indicated when the blue flame fades and the ceramic element glows red. Then turn the small ring **E** until the air holes at **F** are completely open. The tool is ready for use.



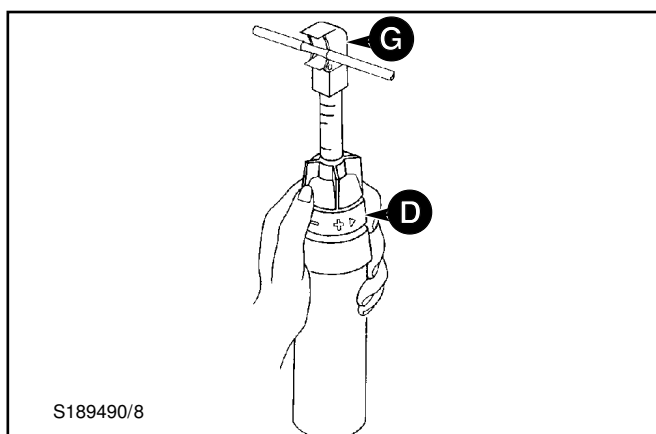
The heater can be used in two modes:

- g Side wings **G** down, reflector head completely open. In this mode the infra-red heat waves are dominant (recommended for the light coloured plastic splices).

Side wings **G** up (see fig at step **h**), reflector head opening reduced. In this mode the heating is done only by the hot gas (use for dark coloured plastic splices).



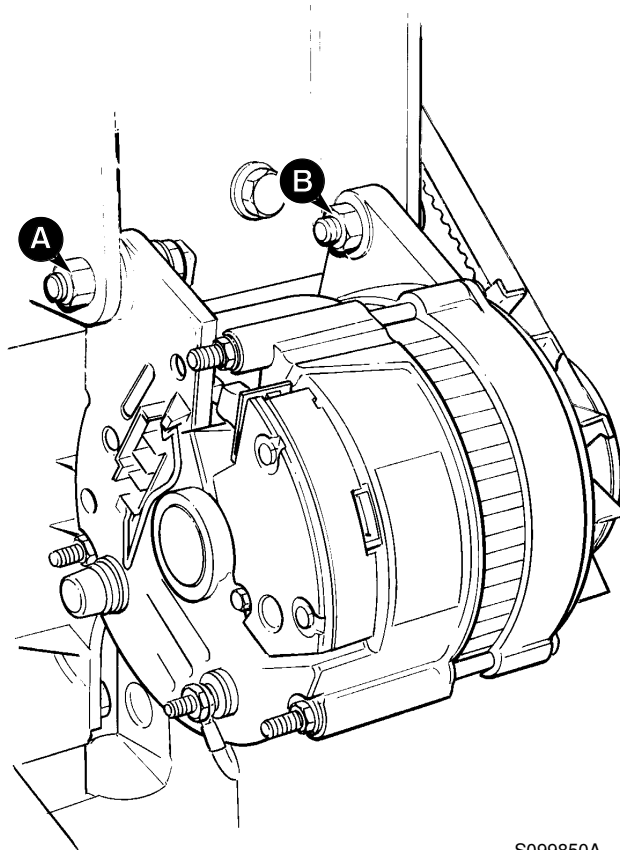
- h To switch off the heater, turn the red ring **D** to the left (in the direction of the minus sign).



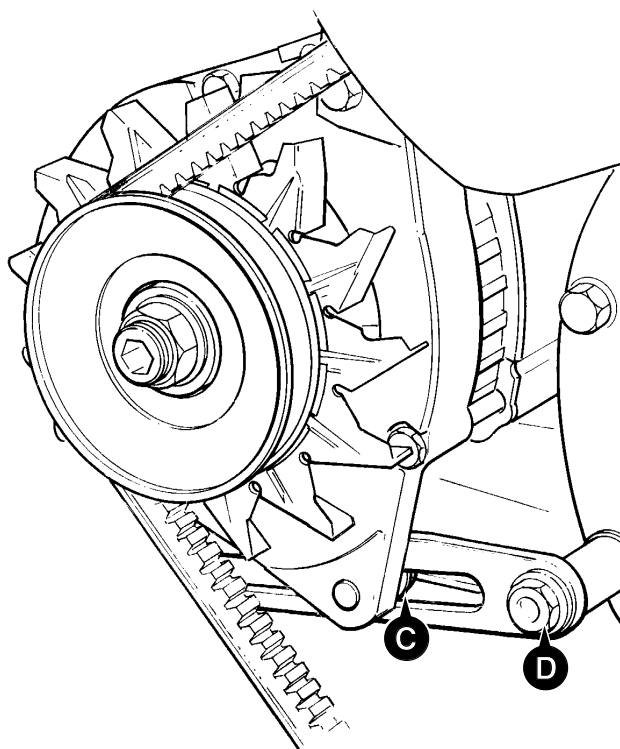
## Removal and Replacement

Disconnect cables from rear of alternator, remove bolts **A**, **B** and **C** and withdraw unit from machine.

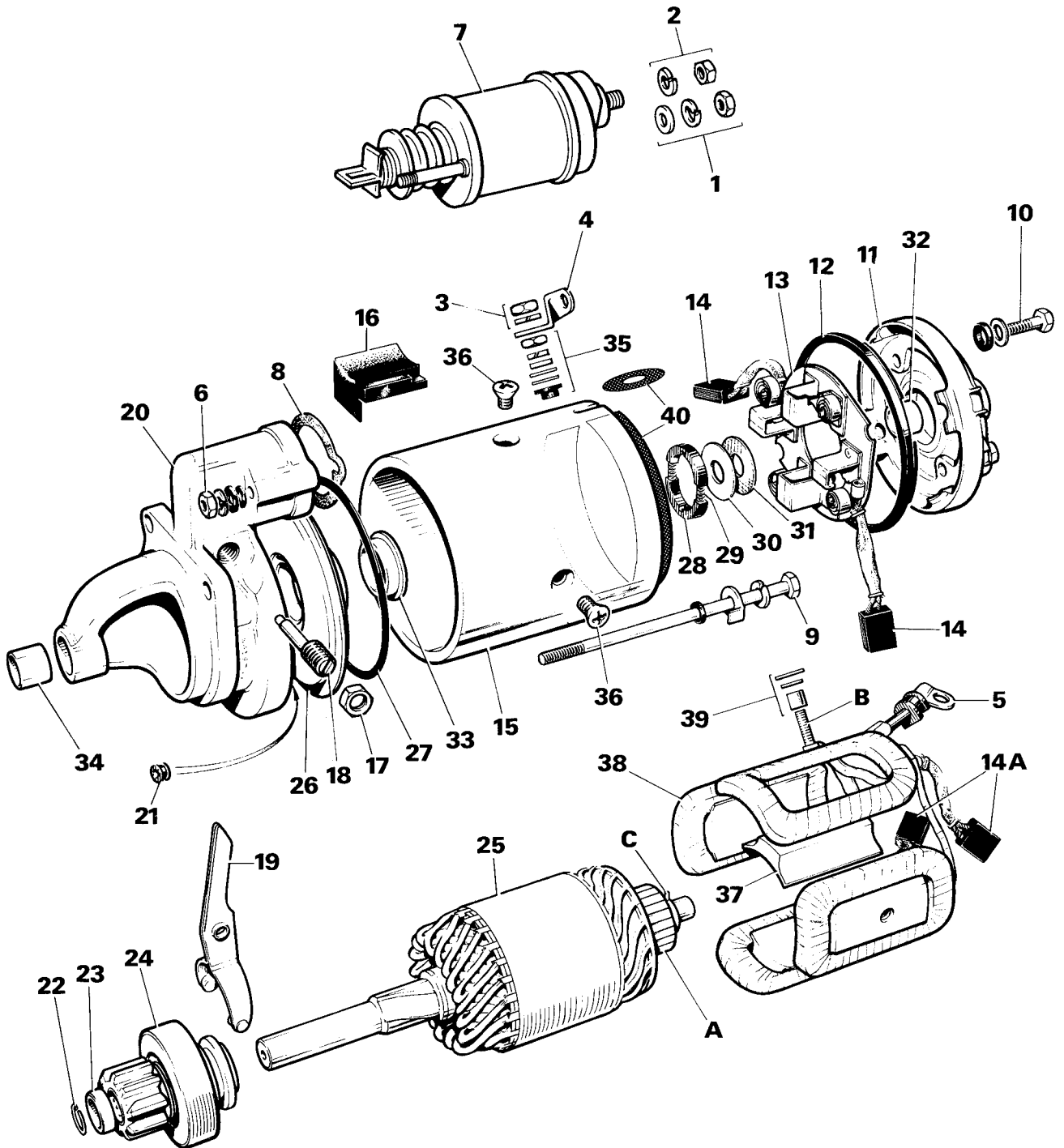
Replace by reversing the removal sequence. Position the alternator until belt deflection is approximately 10mm (3/8 in) before tightening bolts **B** and **C**. It may be necessary to slacken bolt **D** to allow full movement of alternator. Tighten bolt **A** last of all.



S099850A



S099850B



S02043C

## Removal and Replacement

Disconnect cables and remove battery. Remove cables from main starter terminal and solenoid terminal. Using special tool 825/00410 (and adapter 825/99833 if required) unscrew three securing nuts and remove starter motor.

Replace by reversing the removal sequence.

## Dismantling

**Note:** Dismantle only to item **34** unless the field windings are to be renewed. Test the windings electrically before removing them from the motor yoke **15**.

Using a slotted steel tube, displace ring **23** to permit withdrawal of ring **22**.

Allow brake shoes **28** to remain in the end plate **11** unless requiring renewal.

## Inspection

Renew brushes **14** and **14A** if their length is less than 8mm (0.3in.).

Clean the commutator **A**. If individual copper bars are burned or eroded the armature has broken windings and must be renewed. Otherwise polish with fine grade glass paper (not emery). Renew armature if commutator diameter is 38mm (1.5in.) or less.

Check the field windings for open circuits by connecting a multimeter set to measure resistance (see **Electrical Testing Methods**) between the stud terminal **B** and each positive brush **14A** in turn. A high or infinity reading indicates an open circuit. Similarly, connect the meter between brushes **14A** and the motor yoke **15**. Any reading other than infinity indicates a short circuit between the coils and the yoke. Renew the coils as necessary, removing screws **36** with a pole shoe screwdriver C50 (obtainable from Lucas dealers).

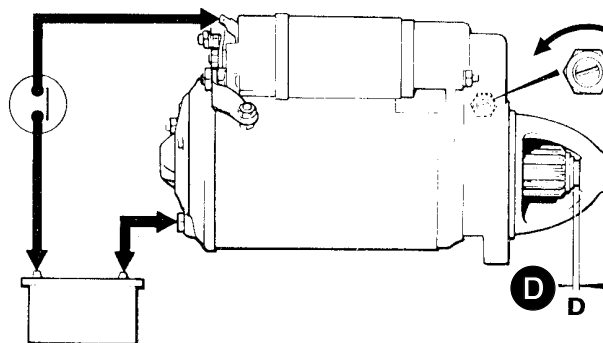
Check bronze bushes **32** and **34** for wear.

## Assembly

Align crosspin **C** with the notches in the brake shoes **28** before assembling brush carrier and back plate to motor yoke. Ensure that brushes **14A** are correctly located in the insulated brush boxes.

Smear drive shaft splines and operating collar bearing surface with JCB MPL Grease before assembly. Assemble operating fork **19** with curved face toward the armature.

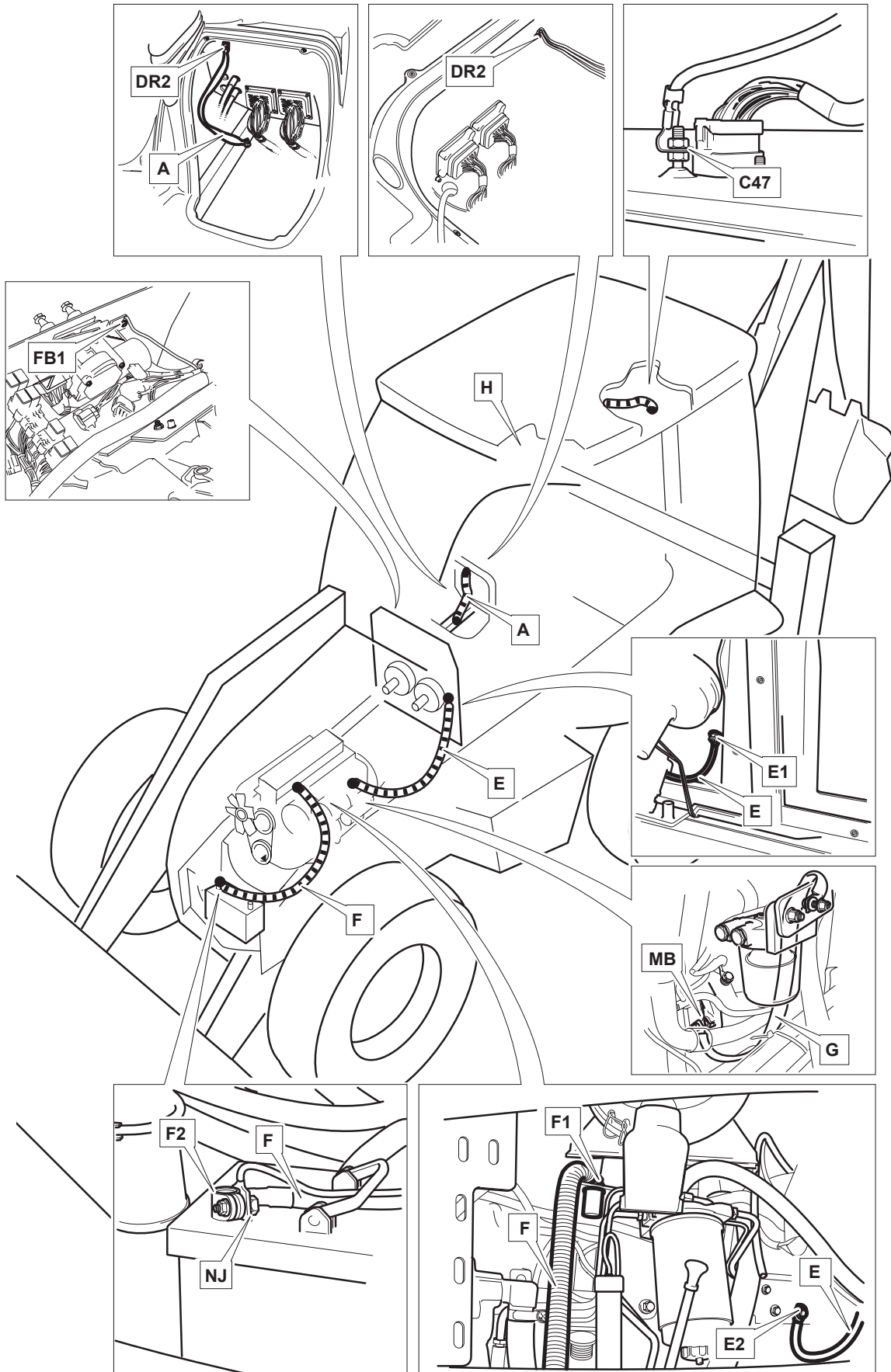
Set the movement of drive pinion **24** by connecting a 6v battery and switch as shown. Operate switch and check dimension **D**. Adjust to 0.13-1.14mm (0.005-0.045in.) by slackening locknut **17** and rotating eccentric pin **18** as necessary. Re-tighten locknut.



S02303A



Earth Points



A405010

## Earth Points

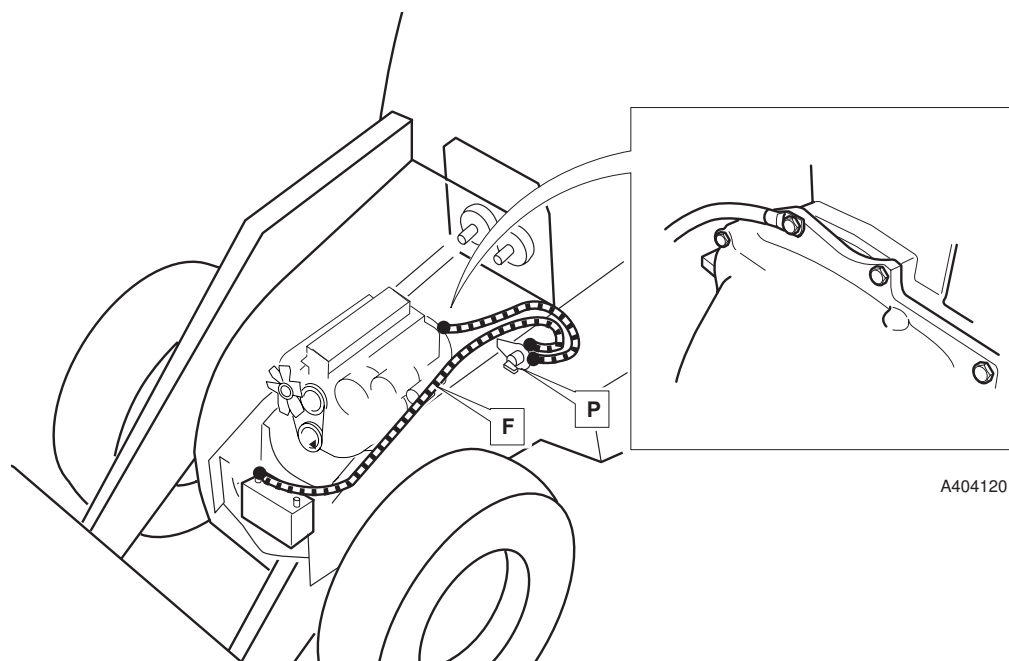
### Introduction

The illustration opposite shows the machine electrical earth point locations. This can be useful when tracing electrical faults, typically when several electrical devices are malfunctioning.

### Key

Description	Access
<b>A</b> Earth strap, cab. From DR2 to cab frame.	Remove loader control console.
<b>C47</b> Earth, cab roof harness.	Remove - inside cab: 'B' post covers, roof lining. Outside cab: lift moulded roof panel.
<b>DR2</b> Earth, side console harness.	Remove side console.
<b>E</b> Earth cable E, cab to engine.	
<b>E1</b> Earth cable E, cab end.	Undo one side on the flexible grey moulding at the front on the cab (outside).
<b>E2</b> Earth cable E, engine end.	Remove engine side panel.
<b>F</b> Earth cable F, engine to battery.†	
<b>F1</b> Earth cable F, engine end.	Remove engine side panel.
<b>F2</b> Earth cable F, battery end.	Remove front grille.
<b>FB1</b> Earth, front console harness.	Remove front console, see <b>Section B, Body and Framework</b> .
<b>G</b> Earth strap, starter motor.	Remove engine side panel.
<b>H</b> Earth, work lights harness.	Remove - inside cab: 'B' post covers, roof lining. Outside cab: lift moulded roof panel.
<b>MB</b> Earth at starter motor, engine/mainframe harness.	Remove engine side panel.
<b>NJ</b> Earth at battery, engine/mainframe harness.	Remove front grille.

†The illustration opposite shows the battery earth cable connection for machines not fitted with a battery isolator switch. Machines fitted with a battery isolator **P** have earth cable connections as shown below.



A404120

## Drawings

### Introduction

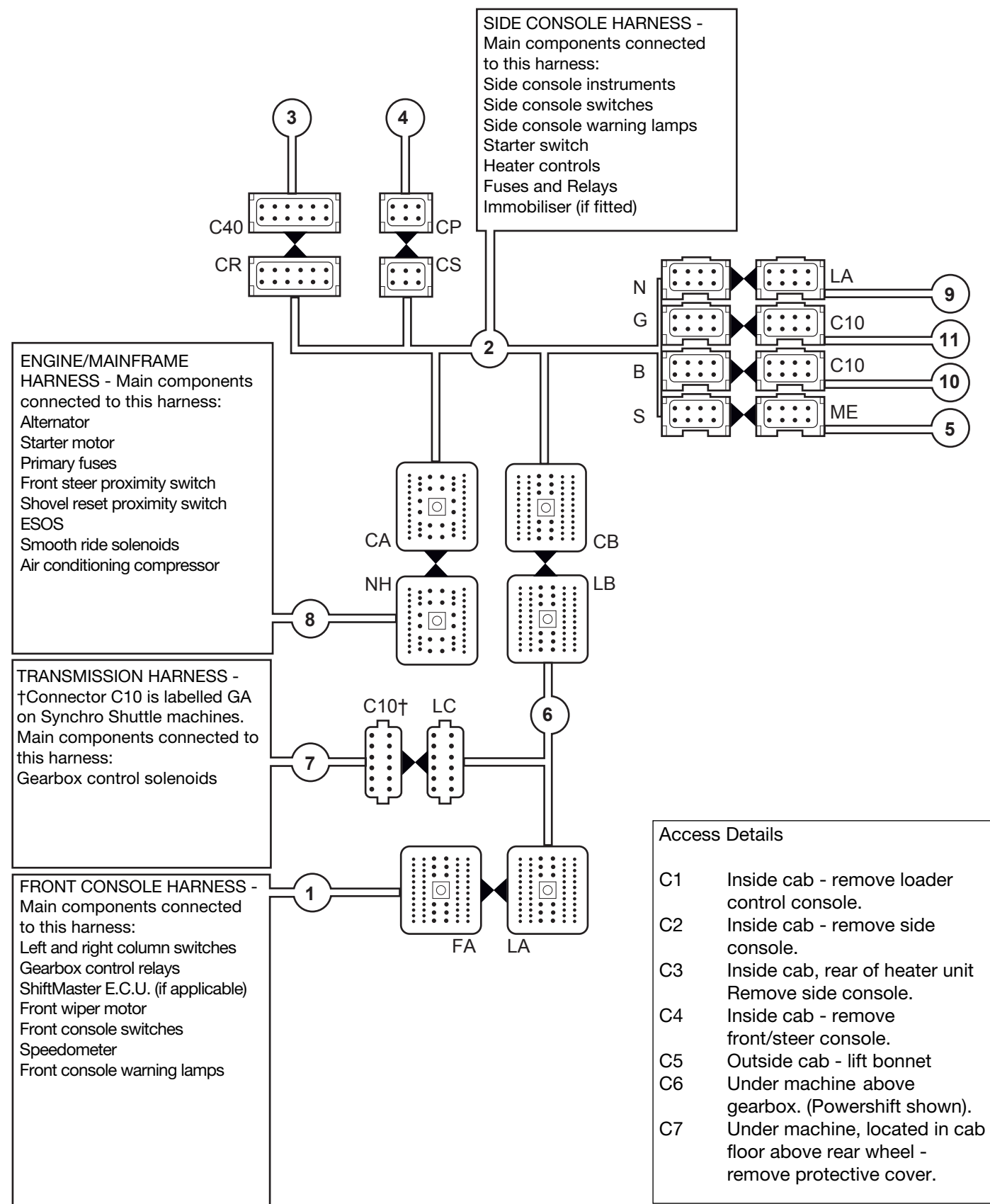
The following drawings are reproduced from production electrical harness drawings. Each harness drawing includes tables showing wire connections and destinations for all the connectors on the harness.

### \* Harness Interconnection

The harness number refers to and corresponds with the annotations in the schematic drawing on the adjacent page.

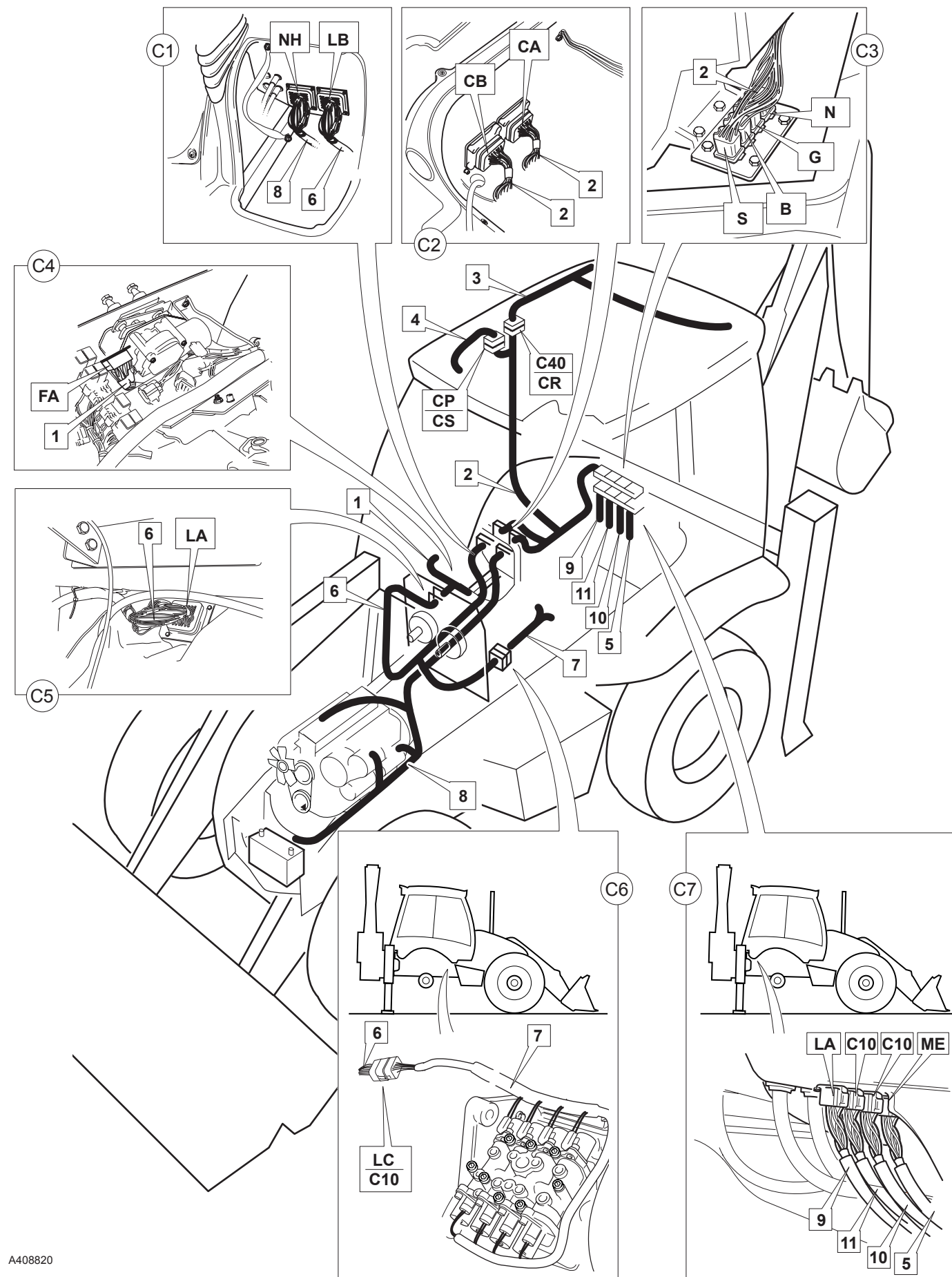
Harness No.	Issue	Remarks	Page
<b>1 Front Console</b>			
721/10940	1	4 speed Powershift / Synchro Shuttle	151 - 1
721/10937	3	6 speed Powershift (ShiftMaster)	151 - 3
<b>2 Side Console</b>			
721/10936	1	Machines up to S/No. 933756	153 - 1
721/10970	2	Machines from S/No. 933757	153 - 5
<b>3 Cab Roof</b>			
721/10966	1	USA only	155 - 1
721/10965	1	Not USA	155 - 3
<b>4 Interior Light, Radio Speakers</b>			
721/11050	1		155 - 5
<b>5 Steer Controls</b>			
721/10968	1	Not crab steer	157 - 1
721/10967	1		157 - 2
<b>6 Cab Link</b>			
721/10943	1	6 speed Powershift (ShiftMaster)	160 - 1
721/10942	1	4 speed Powershift / Synchro Shuttle	160 - 3
<b>7 Transmission</b>			
721/10941	1	6 speed Powershift	160 - 5
721/10938	2	Synchro Shuttle	160 - 7
721/10939	1	4 speed Powershift	160 - 8
<b>8 Engine/Mainframe</b>			
721/10935	2		165 - 1
<b>9 Rear Lights, Hydraclamp</b>			
721/10944	1	Sideshift	165 - 3
<b>10 Rear Horn, Alarm</b>			
721/10946	1	Sideshift	165 - 4
721/10947	1	Centre mount	165 - 5
<b>11 Auxiliary</b>			
721/10974	1	Excavator	165 - 6

Harness Interconnection (continued)



A408780

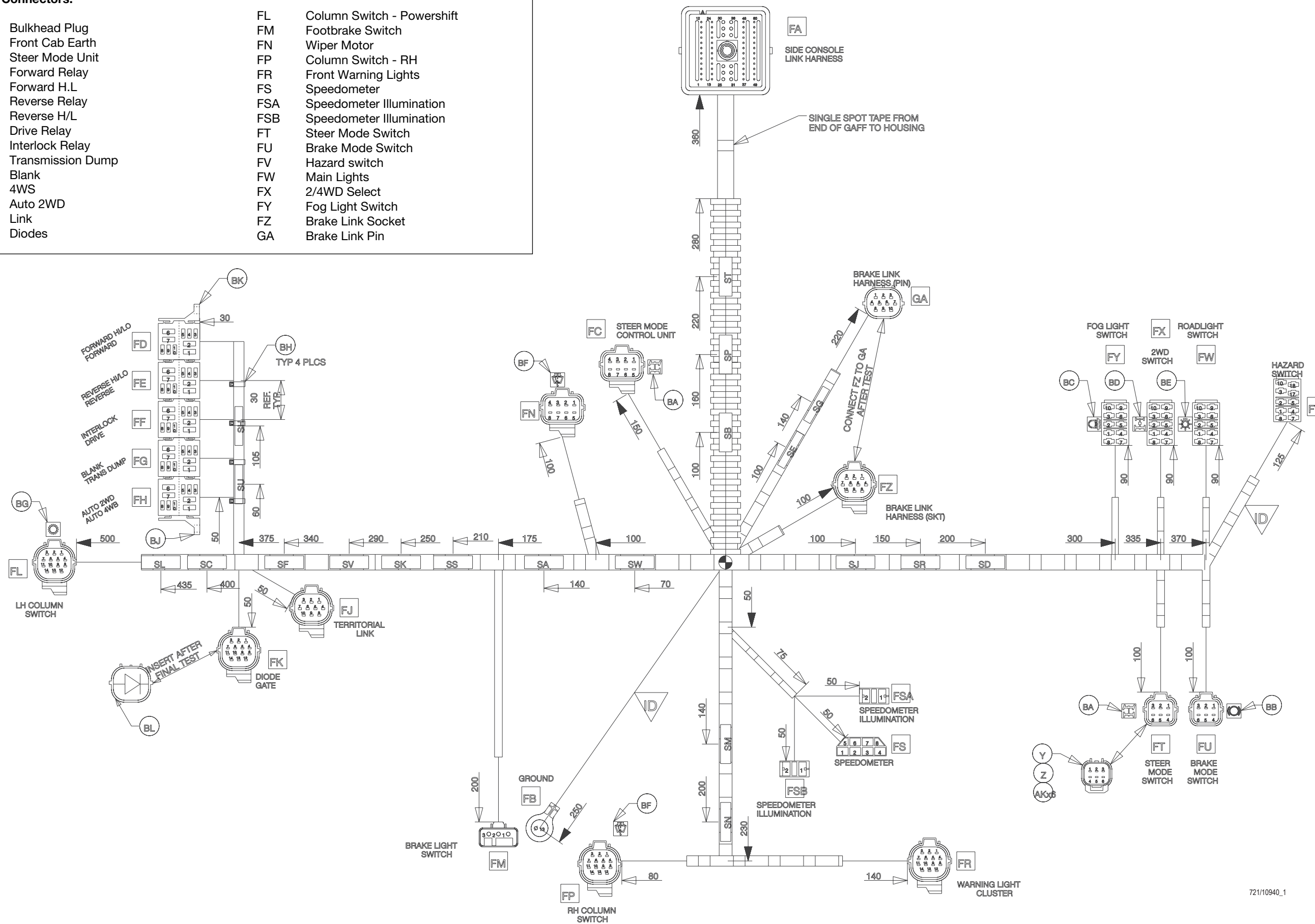
A408820



Harness Drawing - Front Console, 4 speed Powershift, Synchro Shuttle, page 1 of 2 - CAD 721/10940 Issue 1

Key to Connectors:

FA	Bulkhead Plug	FL	Column Switch - Powershift
FB	Front Cab Earth	FM	Footbrake Switch
FC	Steer Mode Unit	FN	Wiper Motor
FD	Forward Relay	FP	Column Switch - RH
FE	Forward H.L	FR	Front Warning Lights
FF	Reverse Relay	FS	Speedometer
FG	Reverse H/L	FSA	Speedometer Illumination
FH	Drive Relay	FSB	Speedometer Illumination
FI	Interlock Relay	FT	Steer Mode Switch
FJ	Transmission Dump	FU	Brake Mode Switch
FK	Blank	FV	Hazard switch
		FW	Main Lights
		FX	2/4WD Select
		FY	Fog Light Switch
		FZ	Brake Link Socket
		GA	Brake Link Pin



721/10940\_1

Harness Drawing - Front Console, 4 speed Powershift, Synchro Shuttle, page 2 of 2 - CAD 721/10940 Issue 1

Table with columns: FA, BULKHEADPLUG, A,B, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-60.

Table with columns: FB, FRONT CABEARTH, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-1.

Table with columns: FC, STEERMODEUNIT, D,E, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-8.

Table with columns: FD, FORWARDRELY, F, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-10.

Table with columns: FE, REVERSERELAY, F, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-10.

Table with columns: FF, DRIVERELAY, F, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-10.

Table with columns: FG, TRANSDUMP, F, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-5.

Table with columns: BLANK, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 6-10.

Table with columns: FH, 4WB, F, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-10.

Table with columns: FJ, LINK, G,H, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-10.

Table with columns: FK, DIODES, J,K, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-14.

Table with columns: FL, COLUMNSWITCH-P/SHIFT, J,K, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-14.

Table with columns: FM, FOOTBRAKESW, L,M, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-3.

Table with columns: FN, WIPERMOTOR, D,E, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-8.

Table with columns: FP, COLUMNSWITCH-RH, J,K, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-14.

Table with columns: FR, FRONT WARNINGLIGHTS, J,K, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-14.

Table with columns: FS, SPEEDO, R, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-8.

Table with columns: FSA, SPEEDOILLUM, S, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-2.

Table with columns: FSB, SPEEDOILLUM, S, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-2.

Table with columns: FT, STEERModesW, N,P, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-6.

Table with columns: FU, BRAKEModesW, N,P, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-6.

Table with columns: FV, HAZARDSWITCH, T, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-18.

Table with columns: FW, MAINLIGHTS, U, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-10.

Table with columns: FX, 2/4WDSELECT, U, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-10.

Table with columns: SB, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 825B, 825C, 825D.

Table with columns: FY, FOGLEIGHT SWITCH, U, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-10.

Table with columns: FZ, BRAKELINKSKT, G,H, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-10.

Table with columns: GA, BRAKELINKPIN, V,W, TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for terminals 1-10.

Table with columns: SA, AX,AZ, WIRE, SIZE, DEST. Contains wiring data for terminals 621, 600L, 600N, 600AB, 600AD, 600AE, 600AF, 600AG, 600AK, 600BR, 600DW, 600DX, 600FA, 600JA, 600JB, 600MA, 600DN, 600DP, 628, 600AC, 600LF.

Table with columns: SB, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 825B, 825C, 825D.

Table with columns: SC, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 856, 856A, 856B.

Table with columns: SD, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 819, 819A, 819B.

Table with columns: SE, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 933, 933B, 933C, 933D.

Table with columns: SF, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 818E, 818F, 818G, 818H.

Table with columns: SG, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 853, 853F, 853G, 853H, 853J, 853K.

Table with columns: SH, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 884, 884A, 884C, 884D.

Table with columns: SJ, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 854E, 854F, 854G, 854H.

Table with columns: SK, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 934B, 934C, 934D, 934.

Table with columns: SL, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 858, 858A, 858K.

Table with columns: SM, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 806, 806B, 806D, 806H.

Table with columns: SN, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 805, 805A, 805B, 805D.

Table with columns: SP, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 110, 110A, 110B, 110H, 110K.

Table with columns: SR, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 830C, 830AV, 830AU, 830AG, 830AH, 830AJ, 830AK, 830AL.

Table with columns: SS, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 107, 107D, 107L, 107R, 107AD, 107AE, 107AF, 107AL, 107A, 107P.

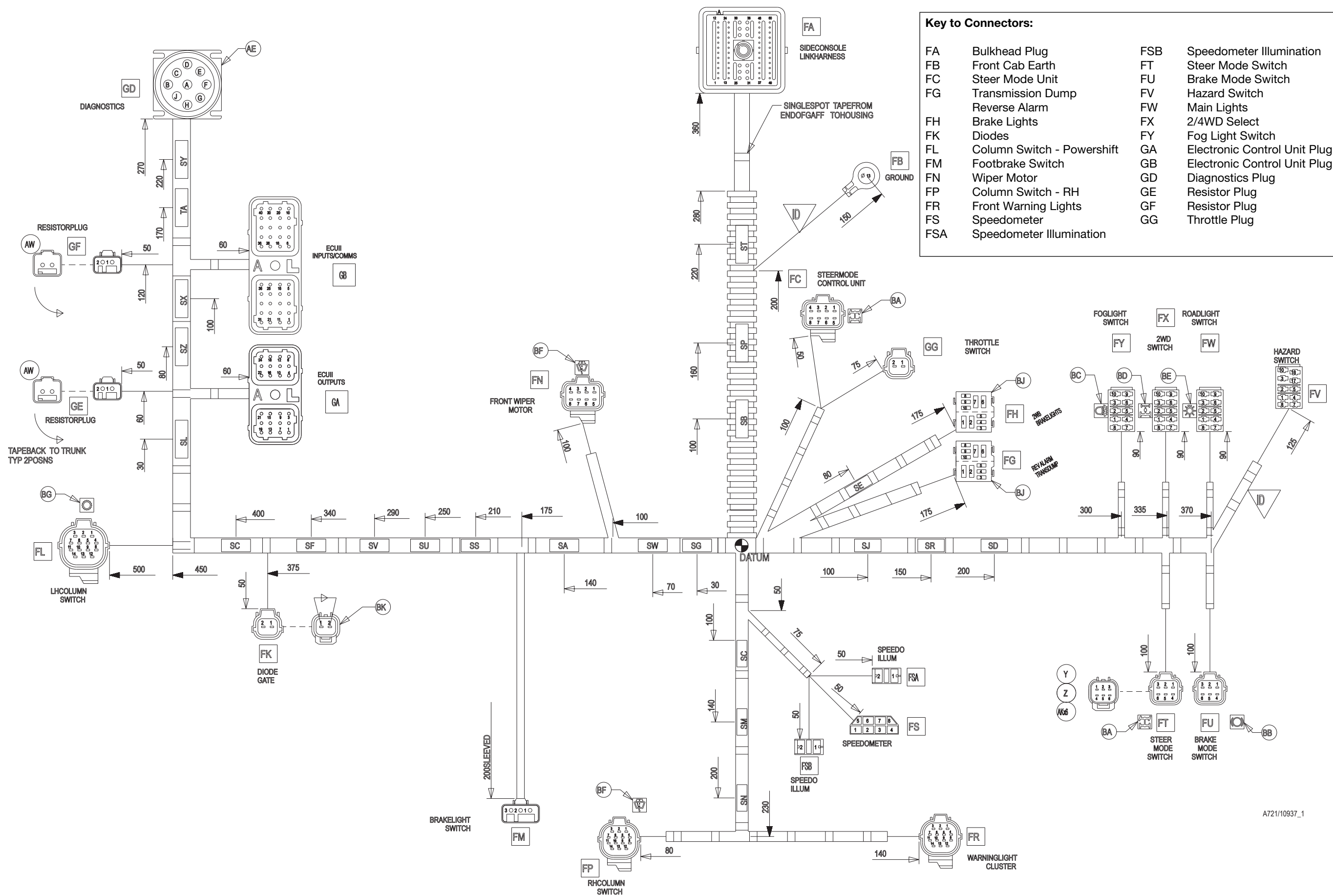
Table with columns: ST, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 1858, 1858A, 1858B, 1858C, 1858D.

Table with columns: SU, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 883, 883B, 883E.

Table with columns: SV, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 922D, 922E, 922A.

Table with columns: SW, AX,AY, WIRE, SIZE, DEST. Contains wiring data for terminals 839, 839A, 839B.

Harness Drawing - Front Console, 6 speed Powershift (ShiftMaster) page 1 of 2 - CAD 721/10937 Issue 1



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Harness Drawing - Front Console, 6 speed Powershift (ShiftMaster) page 2 of 2 - CAD 721/10937 Issue 1

Table with columns: FA, BULKHAEDPLUG, WIRE, SIZE, DEST, TYPE, A,B. Includes rows 1-30.

Table with columns: FB, FRONT CABEARTH, WIRE, SIZE, DEST, TYPE. Includes row 1.

Table with columns: FC, STEERMOTOREUNIT, WIRE, SIZE, DEST, TYPE, D,E. Includes rows 1-8.

Table with columns: FG, TRANSDUMP, WIRE, SIZE, DEST, TYPE, F. Includes rows 1-10.

Table with columns: FH, BRAKELIGHTS, WIRE, SIZE, DEST, TYPE, F. Includes rows 1-10.

Table with columns: TERM, WIRE, SIZE, DEST, TYPE. Includes rows 31-60.

Table with columns: FK, DIODES, WIRE, SIZE, DEST, TYPE, BN,BP. Includes rows 1-2.

Table with columns: FM, FOOTBRAKESW, WIRE, SIZE, DEST, TYPE, L,M. Includes rows 1-3.

Table with columns: FL, COLUMNSWITCH-P/SHIFT, WIRE, SIZE, DEST, TYPE, J,K. Includes rows 1-14.

Table with columns: FN, WIPERMOTOR, WIRE, SIZE, DEST, TYPE, D,E. Includes rows 1-8.

Table with columns: FP, COLUMNSWITCH-RH, WIRE, SIZE, DEST, TYPE, J,K. Includes rows 1-14.

Table with columns: FR, FRONT WARNINGLIGHTS, WIRE, SIZE, DEST, TYPE, J,K. Includes rows 1-14.

Table with columns: FS, SPEEDO, WIRE, SIZE, DEST, TYPE, R. Includes rows 1-6.

Table with columns: FSA, SPEEDOILLUM, WIRE, SIZE, DEST, TYPE, S. Includes rows 1-2.

Table with columns: FSB, SPEEDOILLUM, WIRE, SIZE, DEST, TYPE, S. Includes rows 1-4.

Table with columns: FT, STEERMOTODESW, WIRE, SIZE, DEST, TYPE, N,P. Includes rows 1-6.

Table with columns: FU, BRAKEMOTODESW, WIRE, SIZE, DEST, TYPE, N,P. Includes rows 1-6.

Table with columns: FV, HAZARDSWITCH, WIRE, SIZE, DEST, TYPE, T. Includes rows 1-18.

Table with columns: FW, MAINLIGHTS, WIRE, SIZE, DEST, TYPE, U. Includes rows 1-8.

Table with columns: FX, 2/4WDSELECT, WIRE, SIZE, DEST, TYPE, U. Includes rows 1-8.

Table with columns: FY, FOGLIGHT SWITCH, WIRE, SIZE, DEST, TYPE, U. Includes rows 1-8.

Table with columns: GA, ECU/I/B'PLUG, WIRE, SIZE, DEST, TYPE, G. Includes rows 1-10.

Table with columns: GB, ECU/I/A'PLUG, WIRE, SIZE, DEST, TYPE, H. Includes rows 1-24.

Table with columns: SA, AX,AZ, WIRE, SIZE, DEST. Includes rows 1-40.

Table with columns: SD, AX,AY, WIRE, SIZE, DEST. Includes rows 1-10.

Table with columns: SE, AX,AY, WIRE, SIZE, DEST. Includes rows 1-2.

Table with columns: SF, AX,AY, WIRE, SIZE, DEST. Includes rows 1-2.

Table with columns: SG, AX,AY, WIRE, SIZE, DEST. Includes rows 1-2.

Table with columns: SJ, AX,AY, WIRE, SIZE, DEST. Includes rows 1-8.

Table with columns: SK, AX,AY, WIRE, SIZE, DEST. Includes rows 1-8.

Table with columns: SL, AX,AY, WIRE, SIZE, DEST. Includes rows 1-8.

Table with columns: SM, AX,AY, WIRE, SIZE, DEST. Includes rows 1-8.

Table with columns: SN, AX,AY, WIRE, SIZE, DEST. Includes rows 1-8.

Table with columns: SP, AX,AY, WIRE, SIZE, DEST. Includes rows 1-8.

Table with columns: SQ, AX,AY, WIRE, SIZE, DEST. Includes rows 1-8.

Table with columns: ST, AX,AY, WIRE, SIZE, DEST. Includes rows 1-4.

Table with columns: SU, AX,AY, WIRE, SIZE, DEST. Includes rows 1-4.

Table with columns: SV, AX,AY, WIRE, SIZE, DEST. Includes rows 1-4.

Table with columns: SW, AX,AY, WIRE, SIZE, DEST. Includes rows 1-4.

Table with columns: SX, AX,AY, WIRE, SIZE, DEST. Includes rows 1-4.

Table with columns: SY, AX,AY, WIRE, SIZE, DEST. Includes rows 1-4.

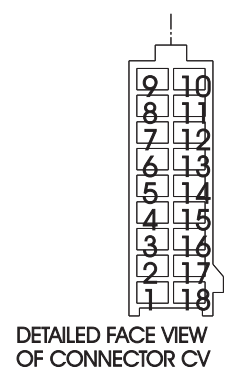
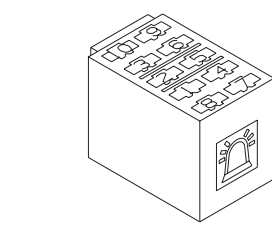
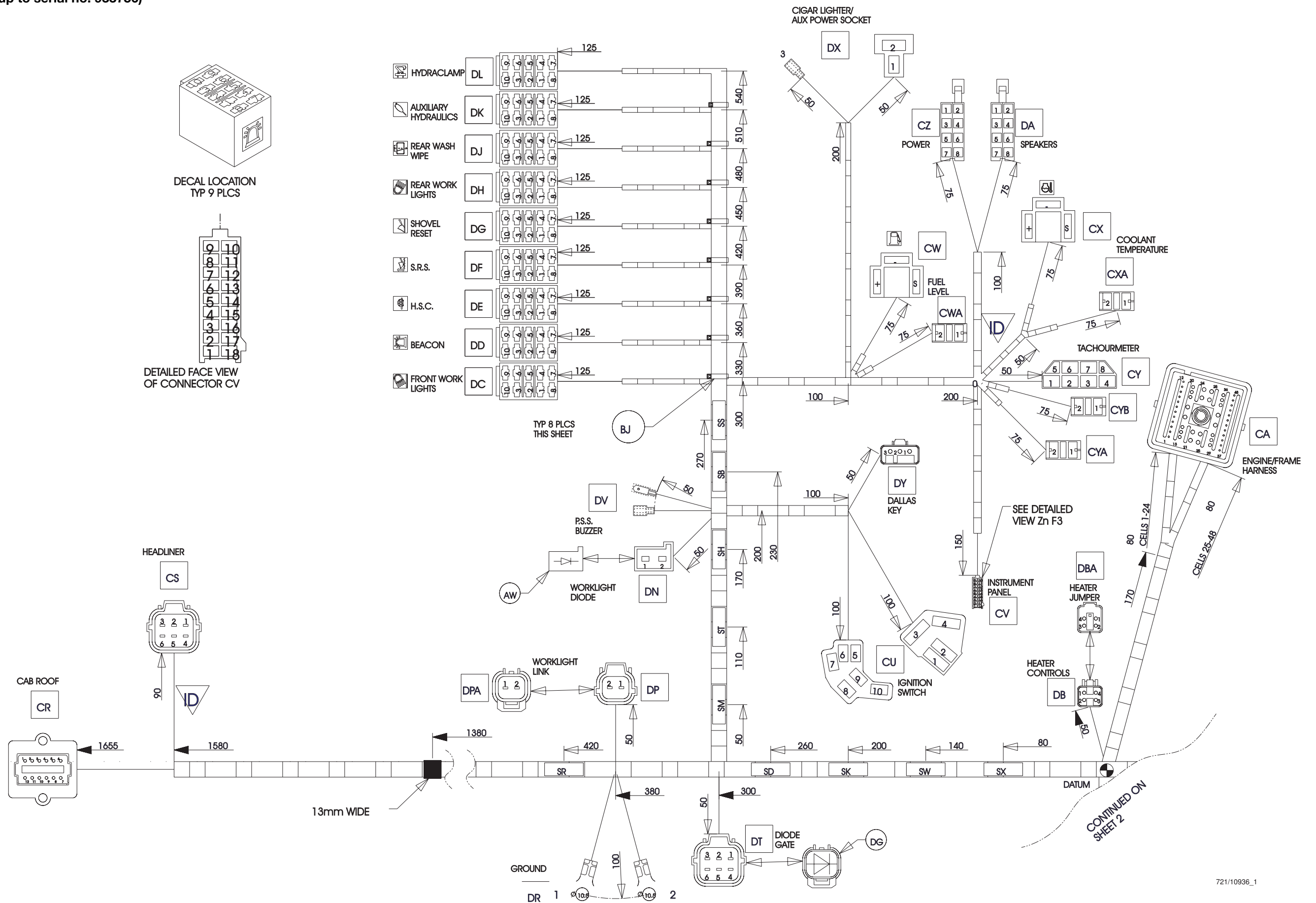
Table with columns: SZ, AX,AY, WIRE, SIZE, DEST. Includes rows 1-4.

Table with columns: TA, AX,AY, WIRE, SIZE, DEST. Includes rows 1-4.

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Harness Drawing - Side Console, page 1 of 4\* - CAD 721/10936 Issue 1 (Machines up to serial no. 933756)



TYP 8 PLCS THIS SHEET

SEE DETAILED VIEW Zn F3

CONTINUED ON SHEET 2

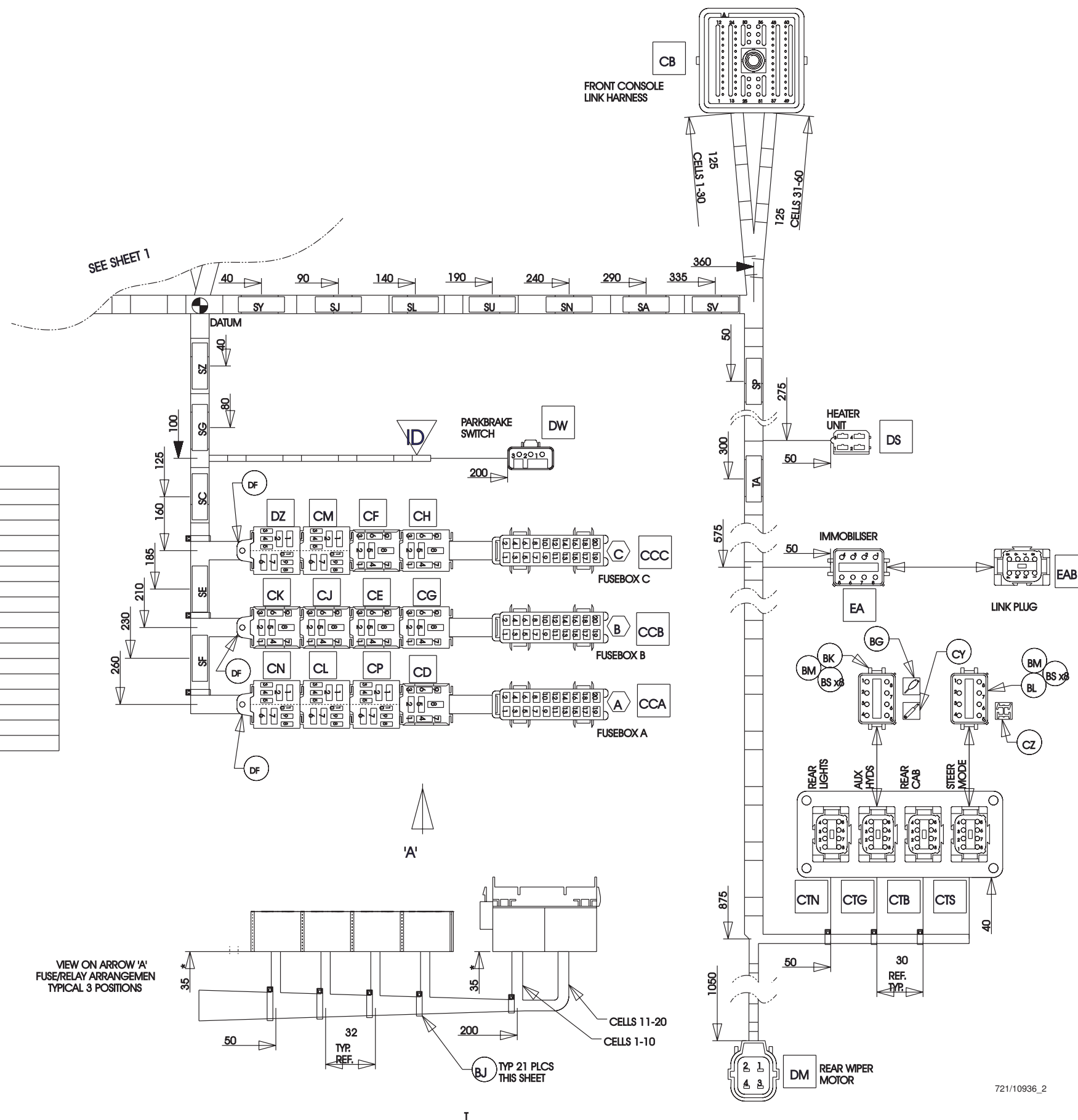
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**Harness Drawing - Side Console, page 2 of 4\* - CAD 721/10936 Issue 1**  
 (Machines up to serial no. 933756)

**Key to Connectors:**

- |     |                                |     |                            |
|-----|--------------------------------|-----|----------------------------|
| CA  | Mainframe Plug                 | DH  | Rear Worklight Switch      |
| CB  | Cab Link                       | DJ  | Rear Wash/Wipe Switch      |
| CCA | Fuse Box A                     | DK  | Auxiliary Hydraulic Switch |
| CCB | Fuse Box B                     | DL  | Hydraclamp Switch          |
| CCC | Fuse Box C                     | DM  | Rear Wiper                 |
| CD  | Ignition 1                     | DN  | Worklight Diode            |
| CE  | Ignition 2                     | DP  | Worklight Connector        |
| CF  | Start Inhibit                  | DPA | Worklight Connector        |
| CG  | Buzzer                         | DR  | Earth Ring                 |
| CH  | Direct Relay                   | DS  | Heater Unit                |
| CJ  | Front Worklight Relay          | DT  | Diode Gate                 |
| CK  | Rear Worklight Relay           | DV  | PSS Buzzer                 |
| CL  | Engine Run Relay               | DW  | Park Brake                 |
|     | Lights                         | DX  | Cigar Lighter              |
| CM  | Rear Horn                      | DY  | Dallas Key                 |
|     | Park Brake Relay               | DZ  | A/C Compressor Relay       |
| CN  | Blank                          |     | Blank                      |
|     | HSC Relay                      | EA  | Immobiliser                |
| CP  | Jaw Bucket Relay               | EAB | Link                       |
|     | Hammer                         |     |                            |
| CR  | Cab Roof                       |     |                            |
| CS  | Headliner                      |     |                            |
| CT  | Rear Cab Bulkhead              |     |                            |
| CU  | Ignition Switch                |     |                            |
| CV  | Instrument Panel               |     |                            |
| CW  | Fuel Gauge                     |     |                            |
| CWA | Fuel Gauge Illumination        |     |                            |
| CX  | Water Temperature Gauge        |     |                            |
| CXA | Water Temperature Illumination |     |                            |
| CY  | Tachometer                     |     |                            |
| CYA | Tachometer Illumination        |     |                            |
| CYB | Tachometer Illumination        |     |                            |
| CZ  | Radio Cassette                 |     |                            |
| DA  | Radio Speaker                  |     |                            |
| DB  | Heater Controls                |     |                            |
| DBA | Heater Jumper                  |     |                            |
| DC  | Front Worklight Switch         |     |                            |
| DD  | Beacon Switch                  |     |                            |
| DE  | HSE Switch                     |     |                            |
| DF  | SRS Switch                     |     |                            |
| DG  | Shovel Reset                   |     |                            |

HSG REF.	RELAY FUNCTION
CN 1-5	BLANK
CN 6-10	HSC RELAY
CL 1-5	ENGINE RUN RELAY
CL 6-10	LIGHTS RELAY
CP 1-5	JAW BUCKET RELAY
CP 6-10	HAMMER RELAY
CD	IGNITION RELAY 1
CK	REAR WORKLIGHT RELAY
CJ	FRONT WORKLIGHT RELAY
CE	IGNITION 2 RELAY
CG	BUZZER
DZ 1-5	A/C COMPRESSOR RELAY
DZ 6-10	BLANK
CM 1-5	REAR HORN RELAY
CM 6-10	PARKBRAKE RELAY
CF	START INHIBIT RELAY
CH	DIRECTION INDICATOR RELAY



VIEW ON ARROW 'A'  
 FUSE/RELAY ARRANGEMENT  
 TYPICAL 3 POSITIONS

Harness Drawing - Side Console, page 3 of 4 - CAD 721/10936 Issue 1 (Machines up to serial no. 933756)

Table with columns: CA, MAINFRAME PLUG, A,B. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for mainframe plug.

Table with columns: CB, CAB LINK, C,D. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for cab link.

Table with columns: CCA, FUSE BOX A, E,F. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for fuse box A.

Table with columns: CCB, FUSE BOX B, E,F. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for fuse box B.

Table with columns: CCC, FUSE BOX C, E,F. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for fuse box C.

Table with columns: CD, IGN 1, G. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for ignition 1.

Table with columns: CE, IGN 2, G. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for ignition 2.

Table with columns: CF, START INHIBIT, G. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for start inhibit.

Table with columns: CG, BUZZER, H. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for buzzer.

Table with columns: CH, DI RELAY, H. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for di relay.

Table with columns: CJ, FRONT WORKLIGHT RELAY, G. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for front worklight relay.

Table with columns: CK, REAR WORKLIGHT RELAY, G. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for rear worklight relay.

Table with columns: CL, ENG RUN RELAY, J. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for engine run relay.

Table with columns: CM, REAR HORN, J. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for rear horn.

Table with columns: CN, HSC RELAY, J. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for horn signal control relay.

Table with columns: CP, JAW BUCKET RELAY, J. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for jaw bucket relay.

Table with columns: CR, CAB ROOF, K,L. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for cab roof.

Table with columns: CS, HEADLINER, M,N. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for headliner.

Table with columns: CT, REAR CAB B/HEAD, AUJAVx4. Rows: TERM, WIRE, SIZE, DEST, TYPE. Contains wiring data for rear cab b/head.

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Harness Drawing - Side Console, page 4 of 4 - CAD 721/10936 Issue 1 (Machines up to serial no. 933756)

Table CU: IGNITION SWITCH, P. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-10.

Table CV: INSTRUMENT PANEL, S,T. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-18.

Table CW: FUEL GAUGE, U. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-5.

Table CWA: FUEL GAUGE ILLUM, V. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-2.

Table CX: WATER TEMP GAUGE, U. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-5.

Table CXA: WATER TEMP ILLUM, V. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-2.

Table CY: TACHOMETER, W. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-8.

Table CYA: TACHO ILLUM, V. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-2.

Table CYB: TACHO ILLUM, V. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-2.

Table CZ: RADIO CASSETTE, X. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-8.

Table DA: RADIO SPEAKER, Y. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-8.

Table DB: HEATER CONTROLS, ZAA. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-4.

Table DB A: HEATER JUMPER, AB,AC. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-4.

Table DC: FWL SWITCH, AD. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-10.

Table DD: BEACON SWITCH, AD. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-10.

Table DE: H.S.C. SWITCH, AD. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-10.

Table DF: SRS SWITCH, AD. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-10.

Table DG: SHOVEL RESET, AD. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-10.

Table DH: RWL SWITCH, AD. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-10.

Table DJ: R WASH/WIPE SW, AD. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-10.

Table DK: AUX HYD SWITCH, AD. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-10.

Table DL: HYDRACLAMP SW, AD. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-10.

Table DM: REAR WIPER, AE,AF. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-4.

Table DN: WORKLIGHT DIODE, AG. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-2.

Table DP: WORK LIGHT CONN., AH,AJ. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-2.

Table DPA: WORK LIGHT CONN., AK,AL. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-2.

Table DR: EARTH RING, -. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-2.

Table DS: HEATER UNIT, AN. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-4.

Table DT: DIODE GATE, M,N. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-6.

Table DV: PSS BUZZER. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-2.

Table DW: PARK BRAKE, AR,AS. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-3.

Table DX: CIGAR LIGHTER, AT. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-3.

Table DY: DALLAS KEY, AR,AS. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-3.

Table DZ: A/C COMPRESSOR RELAY, J. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-10.

Table EA: IMMOBILISER, APBM. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-8.

Table EAB: LINK, DH,DJ. Columns: TERM, WIRE, SIZE, DEST, TYPE. Rows 1-8.

Table SA: DA,DB. Columns: WIRE, SIZE, DEST. Rows 1-3.

Table SB: DA,DD. Columns: WIRE, SIZE, DEST. Rows 1-10.

Table SC: DA,DC. Columns: WIRE, SIZE, DEST. Rows 1-10.

Table SJ: DA,DB. Columns: WIRE, SIZE, DEST. Rows 1-3.

Table SK: DA,DC. Columns: WIRE, SIZE, DEST. Rows 1-10.

Table SL: DA,DB. Columns: WIRE, SIZE, DEST. Rows 1-10.

Table SM: DA,DC. Columns: WIRE, SIZE, DEST. Rows 1-10.

Table SN: DA,DB. Columns: WIRE, SIZE, DEST. Rows 1-5.

Table SF: DA,DC. Columns: WIRE, SIZE, DEST. Rows 1-4.

Table SG: DA,DC. Columns: WIRE, SIZE, DEST. Rows 1-4.

Table SH: DA,DC. Columns: WIRE, SIZE, DEST. Rows 1-4.

Table SU: DA,DB. Columns: WIRE, SIZE, DEST. Rows 1-3.

Table SV: DA,DB. Columns: WIRE, SIZE, DEST. Rows 1-3.

Table SW: DA,DC. Columns: WIRE, SIZE, DEST. Rows 1-4.

Table SX: DA,DC. Columns: WIRE, SIZE, DEST. Rows 1-4.

Table SY: DA,DC. Columns: WIRE, SIZE, DEST. Rows 1-4.

Table SZ: DA,DB. Columns: WIRE, SIZE, DEST. Rows 1-4.

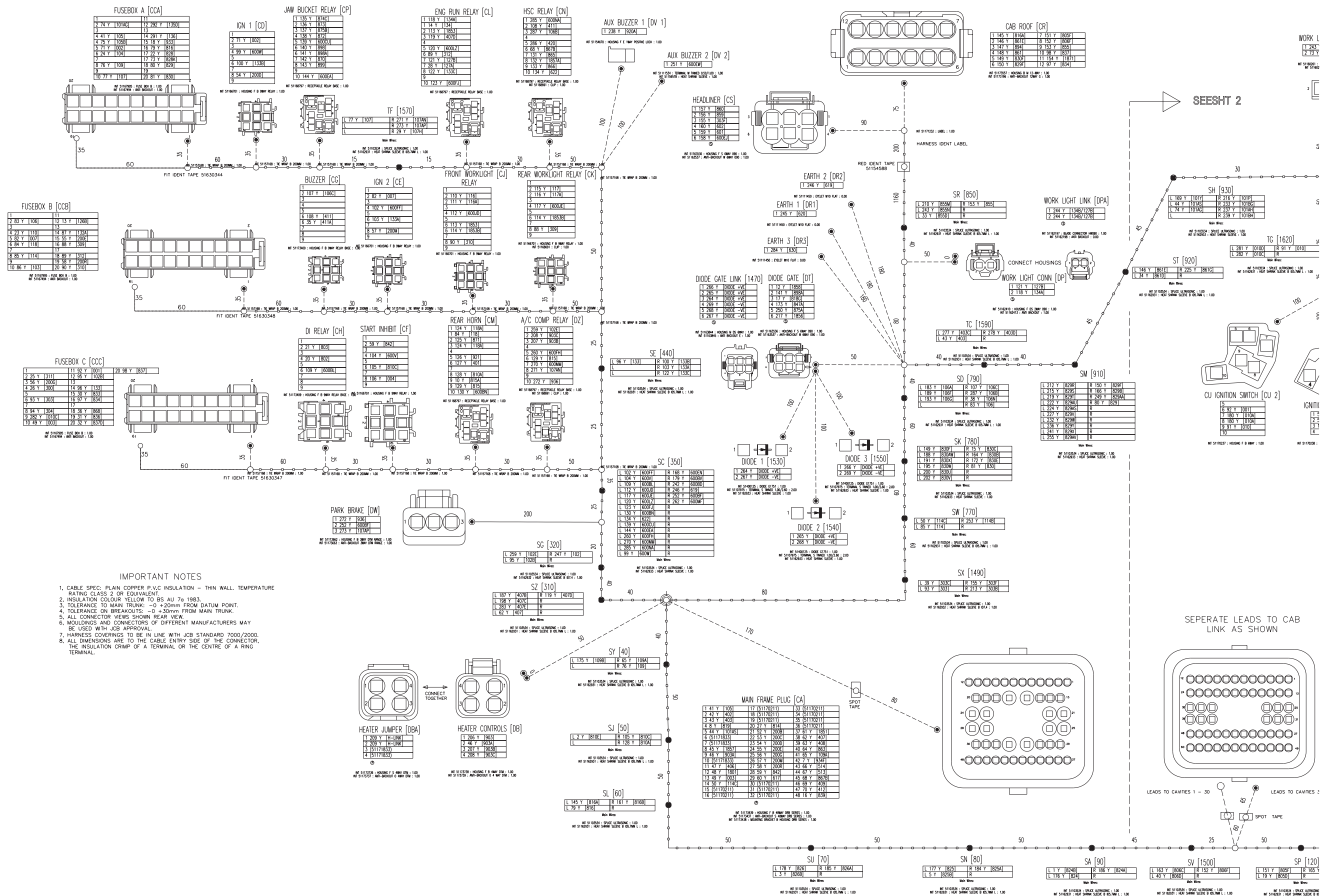
Table TA: DA,DB. Columns: WIRE, SIZE, DEST. Rows 1-3.

Table TB: DA,DB. Columns: WIRE, SIZE, DEST. Rows 1-4.

Table TC: DA,DB. Columns: WIRE, SIZE, DEST. Rows 1-3.

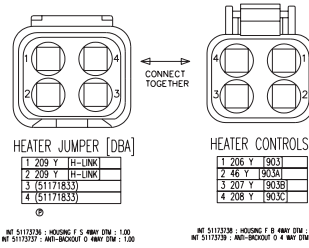
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Harness Drawing - Side Console, page 1 of 5 - CAD 721/10970 Issue 2 (Machines from serial no. 933757)

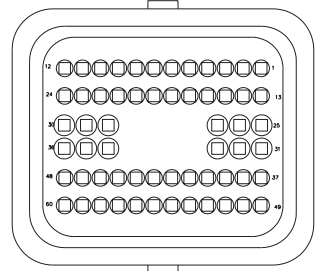


IMPORTANT NOTES

1. CABLE SPEC: PLAIN COPPER P.V.C INSULATION - THIN WALL. TEMPERATURE RATING CLASS 2 OR EQUIVALENT.
2. INSULATION COLOUR YELLOW TO BS Au 70 1983.
3. TOLERANCE TO MAIN TRUNK: -0 +20mm FROM DATUM POINT.
4. TOLERANCE ON BREAKOUTS: -0 +30mm FROM MAIN TRUNK.
5. ALL CONNECTOR VIEWS SHOWN REAR VIEW.
6. MOULDINGS AND CONNECTORS OF DIFFERENT MANUFACTURERS MAY BE USED WITH JCB APPROVAL.
7. HARNESS COVERS TO BE IN LINE WITH JCB STANDARD 7000/2000.
8. ALL DIMENSIONS ARE TO THE CABLE ENTRY SIDE OF THE CONNECTOR, THE INSULATION CRIMP OF A TERMINAL OR THE CENTRE OF A RING TERMINAL.



SEPARATE LEADS TO CAB LINK AS SHOWN



SEESHT 2

721/10970.1

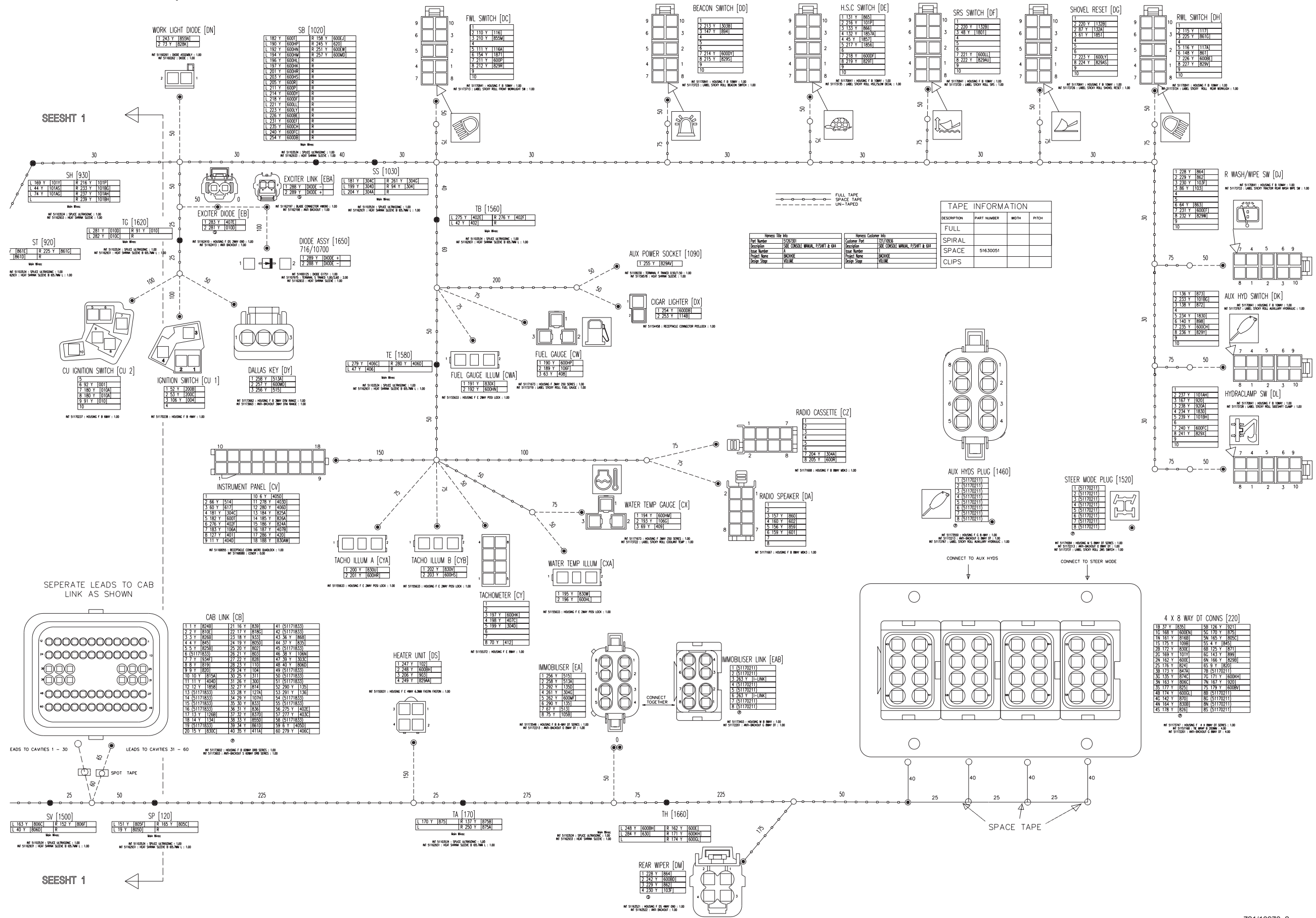
**Harness Drawing - Side Console, page 2 of 5 - CAD 721/10970 Issue 2  
(Machines from serial no. 933757)****Key to Connectors:**

CA	Main Frame Plug
CCA	Fusebox A
CCB	Fusebox B
CCC	Fusebox C
CD	Ignition 1
CE	Ignition 2
CF	Start Inhibit
CG	Buzzer
CH	Direction Indicator Relay
CJ	Front Work Light Relay
CK	Rear Work Light Relay
CL	Engine Run Relay
CM	Rear Horn
CN	Hydraulic Speed Control Relay
CP	Jaw Bucket Relay
CR	Cab Roof
CS	Headliner
CU	Ignition Switch (CU2)
DB	Heater Controls
DBA	Heater Jumper
DP	Work Light
DPA	Work Light link
DR1	Earth 1
DR2	Earth 2
DR3	Earth 3
DT	Diode Gate
DV1	Auxiliary Buzzer 1
DV2	Auxiliary Buzzer 2
DW	Park Brake
DZ	Air Conditioning Compressor Relay

**Harness Drawing - Side Console, page 3 of 5 - CAD 721/10970 Issue 2  
(Machines from serial no. 933757)****Key to Connectors:**

CB	Cab Link
CU	Ignition Switch (CU1)
CV	Instrument Panel
CW	Fuel Gauge
CWA	Fuel Gauge Illum
CX	Water Temperature Gauge
CXA	Water Temperature Illum
CY	Tachometer
CYA	Tachometer Illum A
CYB	Tachometer Illum B
CZ	Radio Cassette
DA	Radio Speaker
DC	Front Work Light Switch
DD	Beacon Switch
DE	Hydraulic Speed Control Switch
DF	Smooth Ride System Switch
DG	Shovel Reset
DH	Rear Work Light Switch
DJ	Rear Wash/Wipe Switch
DK	Auxiliary Hydraulic Switch
DL	Hydraclamp Switch
DM	Rear Wiper
DN	Work Light Diode
DS	Heater Unit
DX	Cigar Lighter
DY	Dallas Key
EA	Immobiliser
EAB	Immobiliser Link
EB	Exciter Diode
EBA	Exciter Link

Harness Drawing - Side Console, page 4 of 5 - CAD 721/10970 Issue 2 (Machines from serial no. 933757)

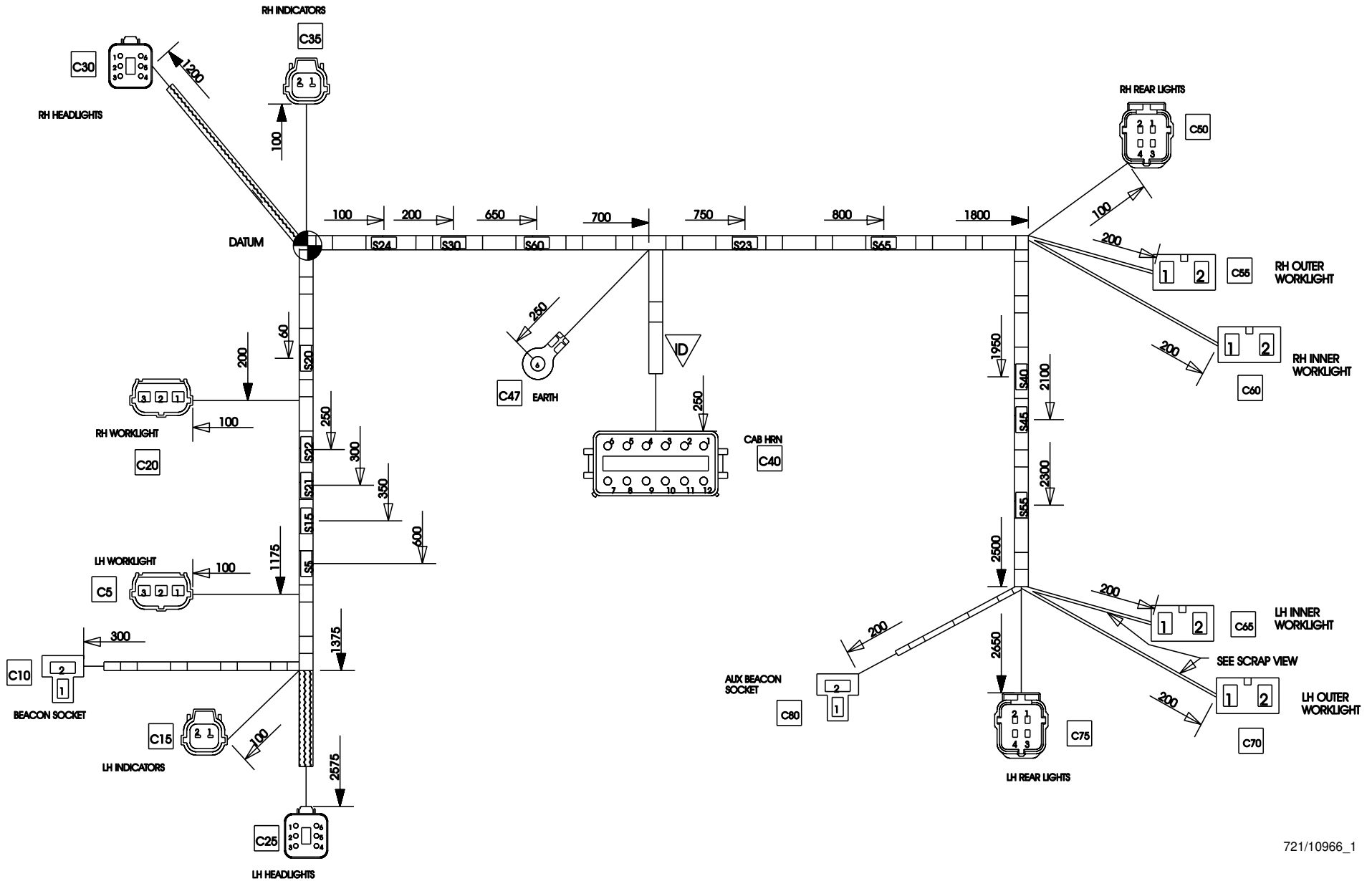




Harness Drawing - Side Console, page 5 of 5 - CAD 721/10970 Issue 2  
(Machines from serial no. 933757)

Wire	INT	Part	Tag Name	Color	From	To
235	51010050Y	600CH		Y	AUX HYD SWITCH	SB
236	51010050Y	829Y		Y	AUX HYD SWITCH	SM
237	51010100Y	101AH		Y	HYDRACLAMP SW	SH
238	51010050Y	920A		Y	HYDRACLAMP SW	AUX BUZZER 1
239	51010100Y	101BH		Y	HYDRACLAMP SW	SH
24	51010200Y	104		Y	CAB LINK	FUSEBOX A
240	51010050Y	600FC		Y	HYDRACLAMP SW	SB
241	51010050Y	829X		Y	HYDRACLAMP SW	SM
242	51010100Y	600BD		Y	REAR WIPER	SC
243	51010100Y	855N		Y	WORK LIGHT DIODE	SR
244	51010100Y	134B/127B		Y	WORK LIGHT LINK	WORK LIGHT LINK
245	51010800Y	620		Y	EARTH 1	SB
246	51010800Y	619		Y	EARTH 2	SC
247	51010300Y	102		Y	HEATER UNIT	SG
248	51010300Y	600BH		Y	HEATER UNIT	TH
249	51010050Y	829AA		Y	HEATER UNIT	SM
25	51010200Y	311		Y	CAB LINK	FUSEBOX C
250	51010050Y	875A		Y	DIODE GATE	TA
251	51010050Y	600EW		Y	AUX BUZZER 2	SB
252	51010050Y	600BF		Y	PARK BRAKE	SC
253	51010100Y	114B		Y	CICAR LIGHTER	SW
254	51010100Y	600DB		Y	CICAR LIGHTER	SB
255	51010050Y	829AW		Y	AUX POWER SOCKET	SM
256	51010050Y	515		Y	DALLAS KEY	IMMOBILISER
257	51010050Y	600MD		Y	DALLAS KEY	SB
258	51010050Y	513A		Y	DALLAS KEY	IMMOBILISER
259	51010100Y	102E		Y	A/C COMP RELAY	SG
26	51010200Y	300		Y	CAB LINK	FUSEBOX C
260	51010050Y	600FH		Y	A/C COMP RELAY	SC
261	51010050Y	304G		Y	IMMOBILISER	SS
262	51010050Y	600MF		Y	IMMOBILISER	SC
263	51010200Y	1-LINK		Y	IMMOBILISER LINK	IMMOBILISER LINK
264	51010100Y	DIODE +VE		Y	DIODE GATE LINK	DIODE 1
265	51010100Y	DIODE +VE		Y	DIODE GATE LINK	DIODE 2
266	51010100Y	DIODE +VE		Y	DIODE GATE LINK	DIODE 3
267	51010100Y	DIODE -VE		Y	DIODE GATE LINK	DIODE 1
268	51010100Y	DIODE -VE		Y	DIODE GATE LINK	DIODE 2
269	51010100Y	DIODE -VE		Y	DIODE GATE LINK	DIODE 3
27	51010200Y	814		Y	CAB LINK	MAIN FRAME PLUG
270	51010050Y	600MM		Y	A/C COMP RELAY	SC
271	51010050Y	107AN		Y	A/C COMP RELAY	TF
272	51010050Y	936		Y	A/C COMP RELAY	PARK BRAKE
273	51010050Y	107AP		Y	PARK BRAKE	TF
275	51010050Y	402E		Y	CAB LINK	TB
276	51010050Y	402F		Y	INSTRUMENT PANEL	TB
277	51010050Y	403C		Y	CAB LINK	TC
278	51010050Y	403D		Y	INSTRUMENT PANEL	TC
279	51010050Y	406C		Y	CAB LINK	TE
28	51010200Y	127A		Y	CAB LINK	ENG RUN RELAY
280	51010050Y	406D		Y	INSTRUMENT PANEL	TE
281	51010100Y	010D		Y	EXCITER DIODE	TC
282	51010300Y	010C		Y	IG	FUSEBOX C
283	51010100Y	407E		Y	EXCITER DIODE	SZ
284	51010800Y	630		Y	EARTH 3	TH
285	51010100Y	600NA		Y	HSC RELAY	SC
286	51010050Y	420		Y	HSC RELAY	INSTRUMENT PANEL
287	51010050Y	106B		Y	HSC RELAY	SD
288	51010050Y	DIODE -		Y	EXCITER LINK	DIODE ASSY
289	51010050Y	DIODE +		Y	EXCITER LINK	DIODE ASSY
29	51010200Y	107H		Y	CAB LINK	TF
290	51010100Y	135		Y	CAB LINK	IMMOBILISER
291	51010100Y	136		Y	CAB LINK	FUSEBOX A
292	51010100Y	135D		Y	FUSEBOX A	IMMOBILISER
3	51010050Y	826B		Y	CAB LINK	SJ
30	51010200Y	833		Y	CAB LINK	FUSEBOX C
31	51010200Y	836		Y	CAB LINK	FUSEBOX C
32	51010050Y	837D		Y	CAB LINK	FUSEBOX C
33	51010050Y	855D		Y	CAB LINK	SR
34	51010050Y	861D		Y	CAB LINK	ST
35	51010050Y	411A		Y	CAB LINK	BUZZER
36	51010100Y	868		Y	CAB LINK	FUSEBOX C
37	51010100Y	835		Y	CAB LINK	4 X 8 WAY DT CONNS
38	51010100Y	106N		Y	CAB LINK	SD
39	51010100Y	303C		Y	CAB LINK	SK
4	51010050Y	845		Y	CAB LINK	4 X 8 WAY DT CONNS
40	51010100Y	806D		Y	CAB LINK	SV
41	51010100Y	105		Y	MAIN FRAME PLUG	FUSEBOX A
42	51010050Y	402		Y	MAIN FRAME PLUG	TB
43	51010050Y	403		Y	MAIN FRAME PLUG	TC
44	51010100Y	101AS		Y	MAIN FRAME PLUG	SH
45	51010100Y	1857		Y	MAIN FRAME PLUG	H.S.C SWITCH
46	51010100Y	903A		Y	MAIN FRAME PLUG	HEATER CONTROLS
47	51010050Y	406		Y	MAIN FRAME PLUG	TE
48	51010100Y	1801		Y	MAIN FRAME PLUG	SRS SWITCH
49	51010200Y	003		Y	MAIN FRAME PLUG	FUSEBOX C
5	51010050Y	825B		Y	CAB LINK	SN
50	51010200Y	114C		Y	MAIN FRAME PLUG	SW
52	51010400Y	200B		Y	MAIN FRAME PLUG	IGNITION SWITCH
53	51010400Y	200C		Y	MAIN FRAME PLUG	IGNITION SWITCH
54	51010400Y	200D		Y	MAIN FRAME PLUG	IGN 1
55	51010400Y	200E		Y	MAIN FRAME PLUG	FUSEBOX B
56	51010400Y	200G		Y	MAIN FRAME PLUG	FUSEBOX C
57	51010400Y	200M		Y	MAIN FRAME PLUG	IGN 2
58	51010400Y	200R		Y	MAIN FRAME PLUG	FUSEBOX B
59	51010300Y	842		Y	MAIN FRAME PLUG	START INHIBIT
6	51010050Y	405D		Y	CAB LINK	INSTRUMENT PANEL
60	51010050Y	617		Y	MAIN FRAME PLUG	INSTRUMENT PANEL
61	51010100Y	1851		Y	MAIN FRAME PLUG	SHOVEL RESET
62	51010050Y	407		Y	MAIN FRAME PLUG	SZ
63	51010050Y	408		Y	MAIN FRAME PLUG	FUEL GAUGE
64	51010100Y	863		Y	MAIN FRAME PLUG	R WASH/WIPE SW
65	51010100Y	109A		Y	MAIN FRAME PLUG	SY
66	51010050Y	514		Y	MAIN FRAME PLUG	INSTRUMENT PANEL
67	51010050Y	513		Y	MAIN FRAME PLUG	IMMOBILISER
68	51010100Y	867B		Y	MAIN FRAME PLUG	HSC RELAY
69	51010050Y	409		Y	MAIN FRAME PLUG	WATER TEMP GAUGE
7	51010100Y	934F		Y	CAB LINK	MAIN FRAME PLUG
70	51010050Y	412		Y	MAIN FRAME PLUG	TACHOMETER
71	51010400Y	002		Y	FUSEBOX A	IGN 1
73	51010100Y	828K		Y	FUSEBOX A	WORK LIGHT DIODE
74	51010200Y	101AG		Y	FUSEBOX A	SH
20	51010050Y	105B		Y	FUSEBOX A	IMMOBILISER
76	51010200Y	109		Y	FUSEBOX A	SY
77	51010200Y	107		Y	FUSEBOX A	TF
79	51010100Y	816		Y	FUSEBOX A	SL
8	51010050Y	819		Y	CAB LINK	MAIN FRAME PLUG
80	51010100Y	829		Y	FUSEBOX A	SM
81	51010100Y	830		Y	FUSEBOX A	SK
82	51010400Y	007		Y	FUSEBOX B	IGN 2
83	51010100Y	106		Y	FUSEBOX B	SD
84	51010150Y	118		Y	FUSEBOX B	REAR HORN
85	51010200Y	114		Y	FUSEBOX B	SW
86	51010100Y	103		Y	FUSEBOX B	R WASH/WIPE SW
87	51010100Y	132A		Y	FUSEBOX B	SHOVEL RESET
88	51010300Y	309		Y	FUSEBOX B	REAR WORKLIGHT RELAY
89	51010200Y	312		Y	FUSEBOX B	ENG RUN RELAY
9	51010050Y	820		Y	CAB LINK	4 X 8 WAY DT CONNS
90	51010300Y	310		Y	FUSEBOX B	FRONT WORKLIGHT
91	51010300Y	010		Y	IG	CJ IGNITION SWITCH
92	51010300Y	001		Y	FUSEBOX C	CJ IGNITION SWITCH
93	51010300Y	303		Y	FUSEBOX C	SK
94	51010100Y	304		Y	FUSEBOX C	SS
95	51010300Y	102B		Y	FUSEBOX C	SG
96	51010150Y	133		Y	FUSEBOX C	SE
97	51010150Y	834		Y	FUSEBOX C	CAB ROOF
98	51010150Y	837		Y	FUSEBOX C	CAB ROOF
99	51010050Y	600W		Y	IGN 1	SC

Wire	INT	Part	Tag Name	Color	From	To
1	51010050Y	824B		Y	CAB LINK	SA
10	51010050Y	815A		Y	CAB LINK	REAR HORN
100	51010050Y	133B		Y	IGN 1	SE
102	51010050Y	600FF		Y	IGN 2	SC
103	51010050Y	133A		Y	IGN 2	SE
104	51010050Y	600V		Y	START INHIBIT	SC
105	51010050Y	810C		Y	START INHIBIT	SJ
106	51010300Y	004		Y	START INHIBIT	IGNITION SWITCH
107	51010050Y	106C		Y	BUZZER	SD
108	51010050Y	411		Y	BUZZER	HSC RELAY
109	51010050Y	600BL		Y	DI RELAY	SC
11	51010050Y	404D		Y	CAB LINK	INSTRUMENT PANEL
110	51010150Y	116		Y	FRONT WORKLIGHT	FWL SWITCH
111	51010150Y	116A		Y	FRONT WORKLIGHT	FWL SWITCH
112	51010050Y	600JD		Y	FRONT WORKLIGHT	SC
113	51010050Y	1853		Y	FRONT WORKLIGHT	ENG RUN RELAY
114	51010050Y	1853B		Y	FRONT WORKLIGHT	REAR WORKLIGHT RELAY
115	51010150Y	117		Y	REAR WORKLIGHT RELAY	RWL SWITCH
116	51010150Y	117A		Y	REAR WORKLIGHT RELAY	RWL SWITCH
117	51010050Y	600JE		Y	REAR WORKLIGHT RELAY	SC
118	51010100Y	134A		Y	ENG RUN RELAY	WORK LIGHT CONN
119	51010050Y	407D		Y	ENG RUN RELAY	SZ
12	51010100Y	1858		Y	CAB LINK	DIODE GATE
120	51010050Y	600LZ		Y	ENG RUN RELAY	SC
121	51010100Y	127B		Y	ENG RUN RELAY	WORK LIGHT CONN
122	51010050Y	133C		Y	ENG RUN RELAY	SE
123	51010050Y	600FJ		Y	ENG RUN RELAY	SC
124	51010050Y	118A		Y	REAR HORN	REAR HORN
125	51010150Y	871		Y	REAR HORN	4 X 8 WAY DT CONNS
126	51010050Y	921		Y	REAR HORN	4 X 8 WAY DT CONNS
127	51010050Y	401		Y	REAR HORN	INSTRUMENT PANEL
128	51010050Y	810A		Y	REAR HORN	SJ
129	51010050Y	815		Y	REAR HORN	A/C COMP RELAY
13	51010100Y	126B		Y	CAB LINK	FUSEBOX B
130	51010050Y	600BN		Y	REAR HORN	SC
131	51010100Y	865		Y	H.S.C SWITCH	H.S.C SWITCH
132	51010050Y	1857A		Y	H.S.C RELAY	H.S.C SWITCH
133	51010100Y	866		Y	H.S.C RELAY	H.S.C SWITCH
134	51010050Y	622		Y	HSC RELAY	SC
135	51010100Y	874C		Y	JAW BUCKET RELAY	4 X 8 WAY DT CONNS
136	51010100Y	873		Y	JAW BUCKET RELAY	AUX HYD SWITCH
137	51010050Y	875B		Y	JAW BUCKET RELAY	TA
138	51010100Y	872		Y	JAW BUCKET RELAY	AUX HYD SWITCH
139	51010050Y	600CU		Y	JAW BUCKET RELAY	SC
14	51010100Y	134		Y	CAB LINK	ENG RUN RELAY
140	51010100Y	898		Y	JAW BUCKET RELAY	AUX HYD SWITCH
141	51010100Y	898A		Y	JAW BUCKET RELAY	DIODE GATE
142	51010050Y	870		Y	JAW BUCKET RELAY	4 X 8 WAY DT CONNS
143	51010100Y	899		Y	JAW BUCKET RELAY	4 X 8 WAY DT CONNS
144	51010050Y	600EA		Y	JAW BUCKET RELAY	SC
145	51010100Y	816A		Y	CAB ROOF	SL
146	51010150Y	861E		Y	CAB ROOF	ST
147	51010150Y	894		Y	CAB ROOF	BEACON SWITCH
148	51010150Y	861		Y	CAB ROOF	RWL SWITCH
149	51010100Y	830F		Y	CAB ROOF	SK
15	510101					



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### Key to Connectors:

C5	LH Worklight
C10	Beacon Socket
C15	LH Front Indicators
C20	RH Worklight
C25	LH Headlights
C30	RH Headlights
C35	RH Front Indicators
C40	Cab Horn
C47	Earth
C50	RH Rear Lights
C55	RH RR/Out Worklight
C60	RH RR/In Worklight
C65	LH RR/In Worklight
C70	LH RR/Out Worklight
C75	LH Rear Lights
C80	Auxiliary Beacon Socket
S5	FWL O
S15	FWL 1
S20	Beacon
S21	Dip
S22	HD.L
S23	Earth
S24	RH Indicators
S30	LH Indicators
S40	RWL O
S45	Brake
S55	RWL 1
S60	LH SL
S65	RH SL

C5 LH WORKLIGHT					D,E
TERM	WIRE	SIZE	DEST	TYPE	
1	1860B	1.0	S5	FH	
2	600AS	1.4	S23	FH	
3	855B	1.0	S15	FH	

C10 BEACON SOCKET					A
TERM	WIRE	SIZE	DEST	TYPE	
1	894A	1.4	S20	B	
2	600AP	1.4	S23	B	

C15 LH F INDICATORS					J,K
TERM	WIRE	SIZE	DEST	TYPE	
1	805E	0.6	S30	LM	
2	600EM	0.6	S23	LM	

C20 RH WORKLIGHT					D,E
TERM	WIRE	SIZE	DEST	TYPE	
1	855A	1.0	S15	FH	
2	600AR	1.4	S23	FH	
3	1860A	1.0	S5	FH	

C25 LH HEADLIGHTS					W,X
TERM	WIRE	SIZE	DEST	TYPE	
1	806K	1.0	S24	U	
2	834B	1.4	S21	U	
3	837B	1.4	S22	U	
4	829E	1.0	S60	U	
5	805N	1.0	S30	U	
6	600BC	1.4	S23	U	

C30 RH HEADLIGHTS					W,X
TERM	WIRE	SIZE	DEST	TYPE	
1	-	-	-	C	
2	834A	1.0	S21	U	
3	837A	1.0	S22	U	
4	830D	1.0	S65	U	
5	806	1.0	S24	U	
6	600BD	1.0	S23	U	

C35 RH F INDICATORS					J,K
TERM	WIRE	SIZE	DEST	TYPE	
1	806E	0.6	S24	LM	
2	600AZ	0.6	S23	LM	

C40 CAB HRN					S,T
TERM	WIRE	SIZE	DEST	TYPE	
1	816A	1.0	S45	U	
2	861E	1.4	S55	U	
3	894	1.4	S20	U	
4	861	1.4	S40	U	
5	830F	1.0	S65	U	
6	829F	1.0	S60	U	
7	805F	1.0	S30	U	
8	806F	1.0	S24	U	
9	855	1.4	S15	U	
10	837	1.4	S22	U	
11	1871	1.4	S5	U	
12	834	1.4	S21	U	

C47 EARTH					-
TERM	WIRE	SIZE	DEST	TYPE	
1	600B	10.0	S23	AB	

C50 RH REAR LIGHTS					Z,AA
TERM	WIRE	SIZE	DEST	TYPE	
1	R-830H	1.0	S65	FH	
2	GP-816G	1.0	S45	FH	
3	G-806C	1.0	S24	FH	
4	600AW	1.0	S23	FH	

C55 RH RR/OUT W/LIGHT					N,R
TERM	WIRE	SIZE	DEST	TYPE	
1	861A	1.0	S40	P	
2	600AY	1.0	S23	P	

C60 RH RR/IN W/LIGHT					N,R
TERM	WIRE	SIZE	DEST	TYPE	
1	861C	1.0	S55	P	
2	600JL	1.0	S23	P	

C65 LH RR/IN W/LIGHT					N,R
TERM	WIRE	SIZE	DEST	TYPE	
1	861D	1.0	S55	P	
2	600JM	1.0	S23	P	

C70 LH RR/OUT W/LIGHT					N,R
TERM	WIRE	SIZE	DEST	TYPE	
1	861B	1.0	S40	P	
2	600AV	1.0	S23	P	

C75 LH REAR LIGHTS					Z,AA
TERM	WIRE	SIZE	DEST	TYPE	
1	R-829J	1.0	S60	FH	
2	GP-816F	1.0	S45	FH	
3	G-805C	1.0	S30	FH	
4	600AT	1.0	S23	FH	

C80 AUX BEACON SKT					A
TERM	WIRE	SIZE	DEST	TYPE	
1	894B	1.4	S20	B	
2	600AU	1.4	S23	B	

S5 FWL O			G
WIRE	SIZE	DEST	
1871A	1.0	C20	3
1871B	1.0	C5	1
1871	1.4	C40	11

S15 FWL 1			G
WIRE	SIZE	DEST	
855	1.4	C40	9
855A	1.0	C20	1
855B	1.0	C5	3

S20 BEACON			G
WIRE	SIZE	DEST	
894	1.4	C40	3
894A	1.4	C10	1
894B	1.4	C80	1

S21 DIP			G
WIRE	SIZE	DEST	
834	1.4	C40	12
834A	1.0	C30	2
834B	1.4	C25	2

S22 HD.L			G
WIRE	SIZE	DEST	
837	1.	C40	10
837A	1.0	C30	3
837B	1.4	C25	3

S23 EARTH			G
WIRE	SIZE	DEST	
600B	10.0	C47	1
600BC	1.4	C25	6
600BD	1.0	C30	6
600AZ	0.6	C35	2
600EM	0.6	C15	2
600AS	1.4	C5	2
600AR	1.4	C20	2
600AW	1.0	C50	4
600AP	1.4	C10	2
600AT	1.0	C75	4
600AU	1.4	C80	2
600AY	1.0	C55	2
600AV	1.0	C70	2
600JL	1.0	C60	2
600JM	1.0	C65	2

S24 RH IND			G
WIRE	SIZE	DEST	
806	1.0	C30	5
806E	0.6	C35	1
806K	1.0	C25	1
806F	1.0	C40	8
G-806C	1.0	C50	3

S30 LH IND			G
WIRE	SIZE	DEST	
G-805C	1.0	C75	3
805E	0.6	C15	1
805F	1.0	C40	7
805N	1.0	C25	5

S40 RWL O			G
WIRE	SIZE	DEST	
861	1.4	C40	4
861A	1.0	C55	1
861B	1.0	C70	1

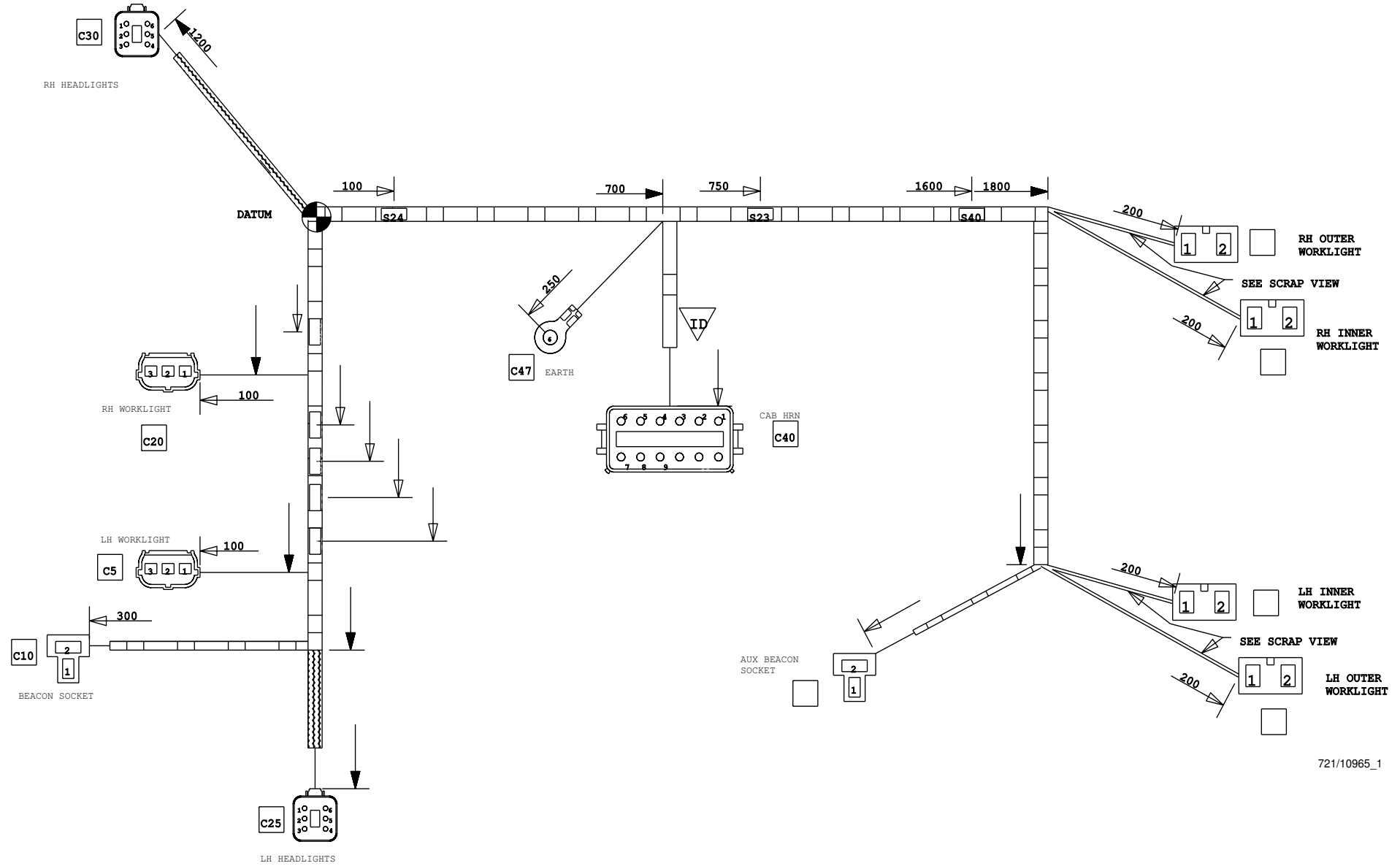
S45 BRAKE			G
WIRE	SIZE	DEST	
816A	1.0	C40	1
GP-816G	1.0	C50	2
GP-816F	1.0	C75	2

S55 RWL 1			G
WIRE	SIZE	DEST	
861C	1.0	C60	1
861E	1.4	C40	2
861D	1.0	C65	1

S60 LH SL			G
WIRE	SIZE	DEST	
829E	1.0	C25	4
R-829J	1.0	C75	1
829F	1.0	C40	6

S65 RH SL			G
WIRE	SIZE	DEST	
R-830H	1.0	C50	1
830D	1.0	C30	4
830F	1.0	C40	5

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**Key to Connectors:**

C5	LH Worklight
C10	Beacon Socket
C20	RH Worklight
C25	LH Headlights
C30	RH Headlights
C40	Cab Horn
C47	Earth
C55	RH RR/Out Worklight
C60	RH RR/In Worklight
C65	LH RR/In Worklight
C70	LH RR/Out Worklight
C80	Auxiliary Beacon Socket
S5	FWL O
S15	FWL 1
S20	Beacon
S21	Dip
S22	HD.L
S23	Earth
S24	RH Indicators
S40	RWL

C5		LH WORKLIGHT			D, E
TERM	WIRE	SIZE	DEST	TYPE	
1	1871B	1.0	S5	F, H	
2	600AS	1.4	S23	F, H	
3	855B	1.0	S15	F, H	

C10		BEACON SOCKET			A
TERM	WIRE	SIZE	DEST	TYPE	
1	894A	1.4	S20	B	
2	600AP	1.4	S23	B	

C20		RH WORKLIGHT			D, E
TERM	WIRE	SIZE	DEST	TYPE	
1	855A	1.0	S15	F, H	
2	600AR	1.4	S23	F, H	
3	1871A	1.0	S5	F, H	

C25		LH HEADLIGHTS			W, X
TERM	WIRE	SIZE	DEST	TYPE	
1	806K	1.0	S24	U	
2	834B	1.4	S21	U	
3	837B	1.4	S22	U	
4	829E	1.0	C40 6	U	
5	805N	1.0	C40 7	U	
6	600BC	1.4	S23	U	

C30		RH HEADLIGHTS			W, X
TERM	WIRE	SIZE	DEST	TYPE	
1	-	-	-	C	
2	834A	1.0	S21	U	
3	837A	1.0	S22	U	
4	830D	1.0	C40 5	U	
5	806	1.0	S24	U	
6	600BD	1.0	S23	U	

C40		CAB HRN			S, T
TERM	WIRE	SIZE	DEST	TYPE	
1	-	-	-	C	
2	861E	1.4	S40	U	
3	894	1.4	S20	U	
4	861	1.4	S40	U	
5	830D	1.0	C30 4	U	
6	829E	1.0	C25 4	U	
7	805N	1.0	C25 5	U	
8	806F	1.0	S24	U	
9	855	1.4	S15	U	
10	837	1.4	S22	U	
11	1871	1.4	S5	U	
12	834	1.4	S21	U	

C47		EARTH			-
TERM	WIRE	SIZE	DEST	TYPE	
1	600B	10.0	S23	AB	

C55		RH RR/OUT W/LIGHT			N, R
TERM	WIRE	SIZE	DEST	TYPE	
1	861A	1.0	S40	P	
2	600AY	1.0	S23	P	

C60		RH RR/IN W/LIGHT			N, R
TERM	WIRE	SIZE	DEST	TYPE	
1	861C	1.0	S40	P	
2	600JL	1.0	S23	P	

C65		LH RR/IN W/LIGHT			N, R
TERM	WIRE	SIZE	DEST	TYPE	
1	861D	1.0	S40	P	
2	600JM	1.0	S23	P	

C70		LH RR/OUT W/LIGHT			N, R
TERM	WIRE	SIZE	DEST	TYPE	
1	861B	1.0	S40	P	
2	600AV	1.0	S23	P	

C80		AUX BEACON SKT			A
TERM	WIRE	SIZE	DEST	TYPE	
1	894B	1.4	S20	B	
2	600AU	1.4	S23	B	

S5		FWL O	G, V
WIRE	SIZE	DEST	
1871A	1.0	C20 3	
1871B	1.0	C5 1	
1871	1.4	C40 11	

S15		FWL I	G, V
WIRE	SIZE	DEST	
855	1.4	C40 9	
855A	1.0	C20 1	
855B	1.0	C5 3	

S20		BEACON	G, V
WIRE	SIZE	DEST	
894	1.4	C40 3	
894A	1.4	C10 1	
894B	1.4	C80 1	

S21		DIP	G, V
WIRE	SIZE	DEST	
834	1.4	C40 12	
834A	1.0	C30 2	
834B	1.4	C25 2	

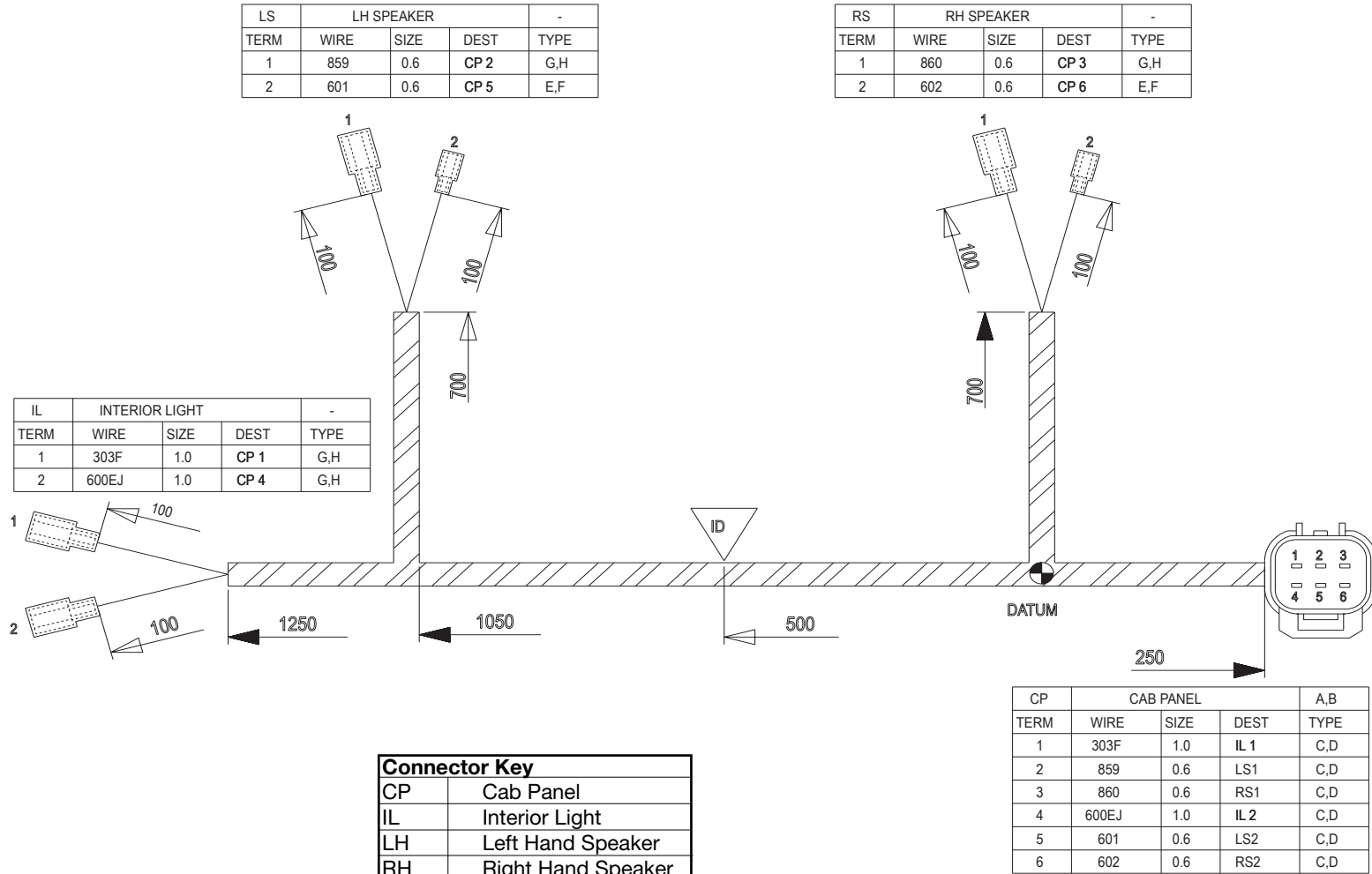
S22		HD.L.	G, V
WIRE	SIZE	DEST	
837	1.4	C40 10	
837A	1.0	C30 3	
837B	1.4	C25 3	

S23		EARTH	G, Y
WIRE	SIZE	DEST	
600B	10.0	C47 1	
600BC	1.4	C25 6	
600BD	1.0	C30 6	
600AS	1.4	C5 2	
600AR	1.4	C20 2	
600AP	1.4	C10 2	
600AU	1.4	C80 2	
600AY	1.0	C55 2	
600AV	1.0	C70 2	
600JL	1.0	C60 2	
600JM	1.0	C65 2	

S24		RH IND	G, V
WIRE	SIZE	DEST	
806	1.0	C30 5	
806K	1.0	C25 1	
806F	1.0	C40 8	

S40		RWL	G, Y
WIRE	SIZE	DEST	
861	1.4	C40 4	
861A	1.0	C55 1	
861B	1.0	C70 1	
861C	1.0	C60 1	
861E	1.4	C40 2	
861D	1.0	C65 1	

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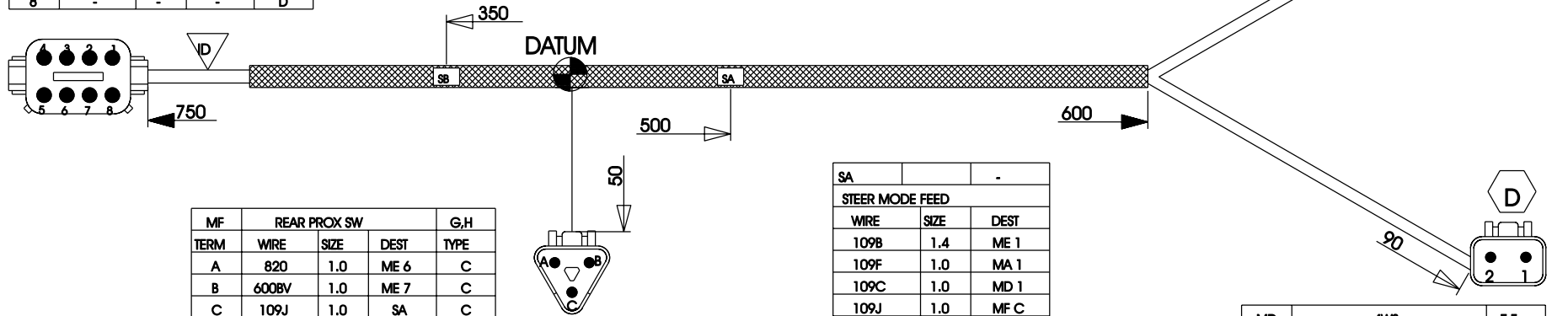
**Key to Connectors:**

- MA 2WS
- MD 4WS
- ME Cab Connector
- MF Rear Proximity Switch
- SA Steer Mode Feed
- SM Steer Mode Feed

ME	CAB CONNECTOR			A,B
TERM	WIRE	SIZE	DEST	TYPE
1	109B	1.4	SA	C
2	-	-	-	D
3	825	1.0	MA 2	C
4	826	1.0	SB	C
5	826/845	1.0	SB	C
6	820	1.0	MF A	C
7	600BV	1.0	MF B	C
8	-	-	-	D

SB	-	
STEER MODE FEED		
WIRE	SIZE	DEST
826	1.0	ME 4
826C	1.0	MD 2
826/845	1.0	ME 5

MA	2WS		E,F
TERM	WIRE	SIZE	DEST
1	109F	1.0	SA
2	825	1.0	ME 3



MF	REAR PROX SW			G,H
TERM	WIRE	SIZE	DEST	TYPE
A	820	1.0	ME 6	C
B	600BV	1.0	ME 7	C
C	109J	1.0	SA	C

SA	-	
STEER MODE FEED		
WIRE	SIZE	DEST
109B	1.4	ME 1
109F	1.0	MA 1
109C	1.0	MD 1
109J	1.0	MFC

MD	4WS		E,F
TERM	WIRE	SIZE	DEST
1	109C	1.0	SA
2	826C	1.0	SB

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Electrics

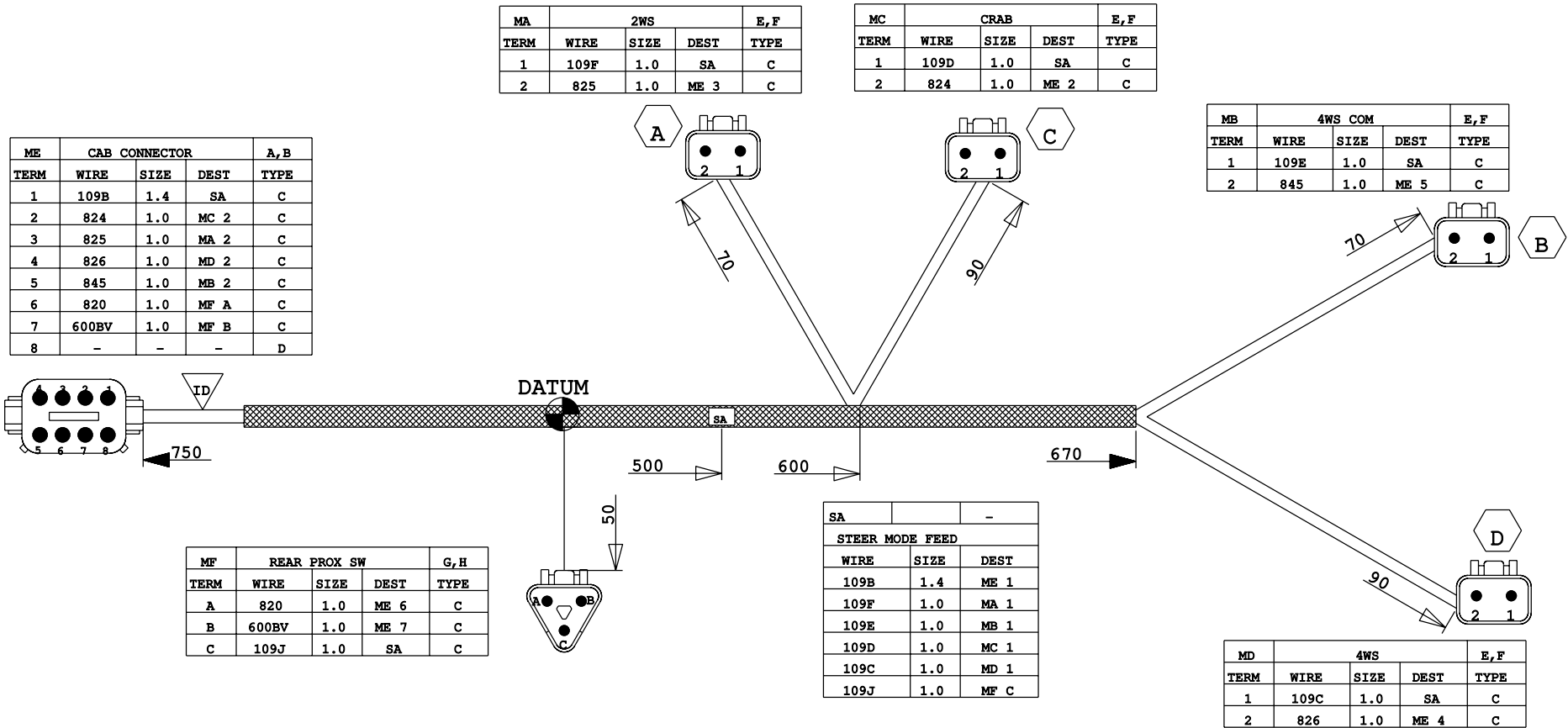
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**Key to Connectors:**

- MA 2WS
- MB 4WS com
- MC Crab
- MD 4WS
- ME Cab Connector
- MF Rear Proximity Switch
- SA Steer Mode Feed



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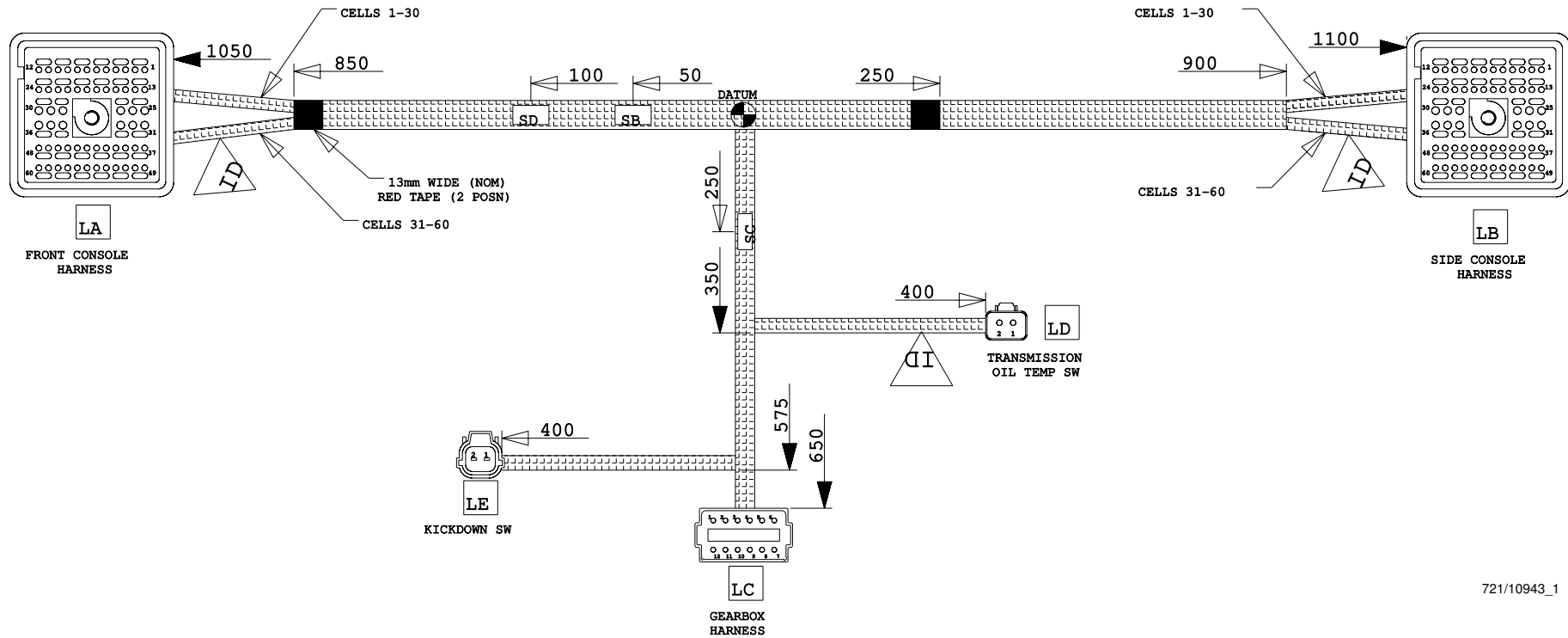


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**Key to Connectors:**

- 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



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LA	FRONT CONSOLE HARNESS			A, B
TERM	WIRE	SIZE	DEST	TYPE
1	824B	1.0	LB 1	C
2	810E	1.0	LB 2	C
3	826B	1.0	LB 3	C
4	845	1.0	LB 4	C
5	825B	1.0	LB 5	C
6	1861	1.0	LC 4	C
7	934	1.0	LB 7	C
8	819	1.0	LB 8	C
9	820	1.0	LB 9	C
10	815A	1.0	LB 10	C
11	1860	1.0	LC 8	C
12	1858	1.0	LB 12	C
13	1862	1.0	LC 3	C
14	853	1.0	LC 5	C
15	1863	1.0	LC 9	C
16	1866	1.0	LC 10	C
17	126A	1.0	LB 17	C
18	134	1.0	LB 18	C
19	1865	1.0	LC 11	C
20	830C	1.0	LB 20	C
21	839	1.0	LB 21	C
22	818G	1.0	LB 22	C
23	933	1.0	LB 23	C
24	805D	1.0	LB 24	C
25	802	2.0	LB 25	D
26	803	2.0	LB 26	D
27	828	2.0	LB 27	D
28	110	2.0	LB 28	D
29	104	2.0	LB 29	D
30	311	2.0	LB 30	D
31	300	2.0	LB 31	D
32	814	2.0	LB 32	D
33	127A	2.0	LB 33	D
34	107H	2.0	SB	D
35	833	2.0	LB 35	D
36	836	2.0	LB 36	D
37	837D	1.0	LB 37	C
38	855D	1.0	LB 38	C
39	861D	1.0	LB 39	C
40	411A	1.0	LB 40	C
41	405A	1.0	LC 2	C
42	974	1.0	LC 7	C
43	868	1.0	LB 43	C
44	835	1.0	LB 44	C
45	992	1.0	LE 2	C
46	106N	1.0	LB 46	C
47	303C	1.0	LB 47	C
48	806D	1.0	LB 48	C
49	600DF	1.0	SC	C
50	600DN	1.0	SC	C
51	1864	1.0	LC 12	C
52	-	-	-	E
53	-	-	-	E
54	-	-	-	E
55	-	-	-	E
56	402	1.0	LB 56	C
57	403	1.0	LB 57	C
58	404B	1.0	SD	C
59	405	1.0	LB 59	C
60	406	1.0	LB 60	C

LB	SIDE CONSOLE HARNESS			A, B
TERM	WIRE	SIZE	DEST	TYPE
1	824B	1.0	LA 1	C
2	810E	1.0	LA 2	C
3	826B	1.0	LA 3	C
4	845	1.0	LA 4	C
5	825B	1.0	LA 5	C
6	-	-	-	E
7	934	1.0	LA 7	C
8	819	1.0	LA 8	C
9	820	1.0	LA 9	C
10	815A	1.0	LA 10	C
11	404A	1.0	SD	C
12	1858	1.0	LA 12	C
13	-	-	-	E
14	-	-	-	E
15	-	-	-	E
16	-	-	-	E
17	126A	1.0	LA 17	C
18	134	1.0	LA 18	C
19	-	-	-	E
20	830C	1.0	LA 20	C
21	839	1.0	LA 21	C
22	818G	1.0	LA 22	C
23	933	1.0	LA 23	C
24	805D	1.0	LA 24	C
25	802	2.0	LA 25	D
26	803	2.0	LA 26	D
27	828	2.0	LA 27	D
28	110	2.0	LA 28	D
29	104	2.0	LA 29	D
30	311	2.0	LA 30	D
31	300	2.0	LA 31	D
32	814	2.0	LA 32	D
33	127A	2.0	LA 33	D
34	107	2.0	SB	D
35	833	2.0	LA 35	D
36	836	2.0	LA 36	D
37	837D	1.0	LA 37	C
38	855D	1.0	LA 38	C
39	861D	1.0	LA 39	C
40	411A	1.0	LA 40	C
41	-	-	-	E
42	-	-	-	E
43	868	1.0	LA 43	C
44	835	1.0	LA 44	C
45	-	-	-	E
46	106N	1.0	LA 46	C
47	303C	1.0	LA 47	C
48	806D	1.0	LA 48	C
49	-	-	-	E
50	-	-	-	E
51	-	-	-	E
52	-	-	-	E
53	-	-	-	E
54	-	-	-	E
55	-	-	-	E
56	402	1.0	LA 56	C
57	403	1.0	LA 57	C
58	-	-	-	E
59	405	1.0	LA 59	C
60	406	1.0	LA 60	C

LC	GEARBOX			F, G
TERM	WIRE	SIZE	DEST	TYPE
1	600Z	2.0	SC	K
2	405A	1.0	LA 41	L
3	1862	1.0	LA 13	L
4	1861	1.0	LA 6	L
5	853	1.0	LA 14	L
6	107AK	1.0	SB	L
7	974	1.0	LA 42	L
8	1860	1.0	LA 11	L
9	1863	1.0	LA 15	L
10	1866	1.0	LA 16	L
11	1865	1.0	LA 19	L
12	1864	1.0	LA 51	L

LD	TRANS OIL TEMP SW			H, J
TERM	WIRE	SIZE	DEST	TYPE
1	404	1.0	SD	R
2	600C	1.0	SC	R

LE	KICKDOWN SW			S, T
TERM	WIRE	SIZE	DEST	TYPE
1	107U	1.0	SB	U, V
2	992	1.0	LA 45	U, V

SB	M, P		
TRANS FUSED SPLICE			
WIRE	SIZE	DEST	
107AK	1.0	LC 6	
107	2.0	LB 34	
107H	2.0	LA 34	
107U	1.0	LE 1	

SC	M, P		
EARTH SPLICE			
WIRE	SIZE	DEST	
600DN	1.0	LA 50	
600DF	1.0	LA 49	
600C	1.0	LD 2	
600Z	2.0	LC 1	

SD	M, P		
TRANS OIL P SPLICE			
WIRE	SIZE	DEST	
404	1.0	LD 1	
404A	1.0	LB 11	
404B	1.0	LA 58	

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Section C

Electrics

Section C

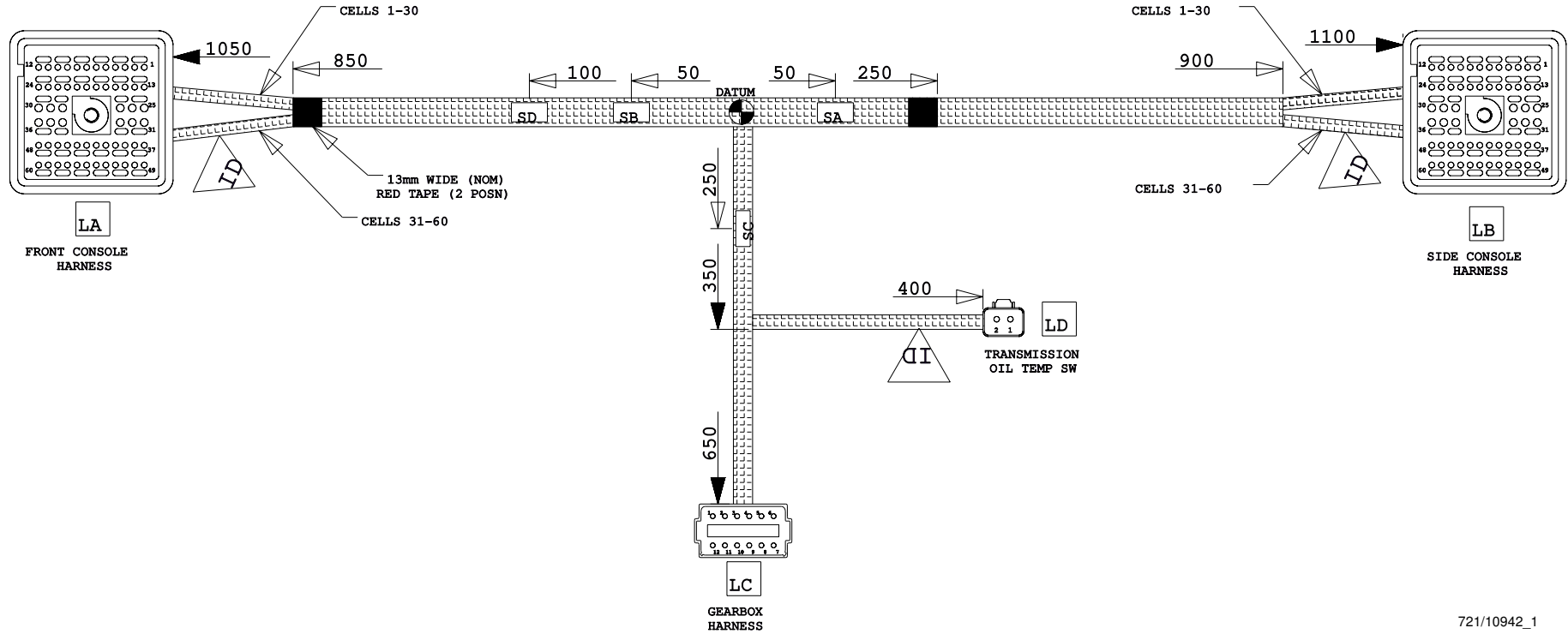
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Harness Data

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**Key to Connectors:**

LA	Front Console Harness
LB	Side Console Harness
LC	Gearbox
LD	Transmission Oil Temperature Switch
SA	Dump Splice
SB	Transmission Feed Splice
SC	Earth Splice
SD	Transmission Oil P Splice



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LA FRONT CONSOLE HARNESS A,B				
TERM	WIRE	SIZE	DEST	TYPE
1	824B	1.0	LB 1	C
2	810E	1.0	LB 2	C
3	826B	1.0	LB 3	C
4	845	1.0	LB 4	C
5	825B	1.0	LB 5	C
6	812	1.0	LC 4	C
7	934	1.0	SA	C
8	819	1.0	LB 8	C
9	820	1.0	LB 9	C
10	815A	1.0	LB 10	C
11	812/848	1.0	LC 8	C
12	1858	1.0	LB 12	C
13	811	1.0	LC 3	C
14	853	1.0	LC 5	C
15	811/849	1.0	LC 9	C
16	850	1.0	LC 10	C
17	126A	1.0	LB 17	C
18	134	1.0	LB 18	C
19	851	1.0	LC 11	C
20	830C	1.0	LB 20	C
21	839	1.0	LB 21	C
22	818G	1.0	LB 22	C
23	933	1.0	LB 23	C
24	805D	1.0	LB 24	C
25	802	2.0	LB 25	D
26	803	2.0	LB 26	D
27	828	2.0	LB 27	D
28	110	2.0	LB 28	D
29	104	2.0	LB 29	D
30	311	2.0	LB 30	D
31	300	2.0	LB 31	D
32	814	2.0	LB 32	D
33	127A	2.0	LB 33	D
34	107H	2.0	SB	D
35	833	2.0	LB 35	D
36	836	2.0	LB 36	D
37	837D	1.0	LB 37	C
38	855D	1.0	LB 38	C
39	861D	1.0	LB 39	C
40	411A	1.0	LB 40	C
41	405A	1.0	LC 2	C
42	974	1.0	LC 7	C
43	868	1.0	LB 43	C
44	835	1.0	LB 44	C
45	-	-	-	E
46	106N	1.0	LB 46	C
47	303C	1.0	LB 47	C
48	806D	1.0	LB 48	C
49	600DP	1.0	SC	C
50	600DN	1.0	SC	C
51	-	-	-	E
52	-	-	-	E
53	-	-	-	E
54	-	-	-	E
55	-	-	-	E
56	402	1.0	LB 56	C
57	403	1.0	LB 57	C
58	404B	1.0	SD	C
59	405	1.0	LB 59	C
60	406	1.0	LB 60	C

LB SIDE CONSOLE HARNESS A,B				
TERM	WIRE	SIZE	DEST	TYPE
1	824B	1.0	LA 1	C
2	810E	1.0	LA 2	C
3	826B	1.0	LA 3	C
4	845	1.0	LA 4	C
5	825B	1.0	LA 5	C
6	-	-	-	E
7	934F	1.0	SA	C
8	819	1.0	LA 8	C
9	820	1.0	LA 9	C
10	815A	1.0	LA 10	C
11	404A	1.0	SD	C
12	1858	1.0	LA 12	C
13	-	-	-	E
14	-	-	-	E
15	-	-	-	E
16	-	-	-	E
17	126A	1.0	LA 17	C
18	134	1.0	LA 18	C
19	-	-	-	E
20	830C	1.0	LA 20	C
21	839	1.0	LA 21	C
22	818G	1.0	LA 22	C
23	933	1.0	LA 23	C
24	805D	1.0	LA 24	C
25	802	2.0	LA 25	D
26	803	2.0	LA 26	D
27	828	2.0	LA 27	D
28	110	2.0	LA 28	D
29	104	2.0	LA 29	D
30	311	2.0	LA 30	D
31	300	2.0	LA 31	D
32	814	2.0	LA 32	D
33	127A	2.0	LA 33	D
34	107	2.0	SB	D
35	833	2.0	LA 35	D
36	836	2.0	LA 36	D
37	837D	1.0	LA 37	C
38	855D	1.0	LA 38	C
39	861D	1.0	LA 39	C
40	411A	1.0	LA 40	C
41	-	-	-	E
42	-	-	-	E
43	868	1.0	LA 43	C
44	835	1.0	LA 44	C
45	-	-	-	E
46	106N	1.0	LA 46	C
47	303C	1.0	LA 47	C
48	806D	1.0	LA 48	C
49	-	-	-	E
50	-	-	-	E
51	-	-	-	E
52	-	-	-	E
53	-	-	-	E
54	-	-	-	E
55	-	-	-	E
56	402	1.0	LA 56	C
57	403	1.0	LA 57	C
58	-	-	-	E
59	405	1.0	LA 59	C
60	406	1.0	LA 60	C

LC GEARBOX FG				
TERM	WIRE	SIZE	DEST	TYPE
1	600Z	2.0	SC	K
2	405A	1.0	LA 41	L
3	811	1.0	LA 13	L
4	812	1.0	LA 6	L
5	853	1.0	LA 14	L
6	107AK	1.0	SB	L
7	974	1.0	LA 42	L
8	812/848	1.0	LA 11	L
9	811/849	1.0	LA 15	L
10	850	1.0	LA 16	L
11	851	1.0	LA 19	L
12	934B	1.0	SA	L

LD TRANS OIL TEMP SW H,J				
TERM	WIRE	SIZE	DEST	TYPE
1	404	1.0	SD	R
2	600C	1.0	SC	R

SA M,P			
DUMP SPLICE			
WIRE	SIZE	DEST	
934	1.0	LA 7	
934F	1.0	LB 7	
934B	1.0	LC 12	

SB M,P			
TRANS FUSED SPLICE			
WIRE	SIZE	DEST	
107AK	1.0	LC 6	
107	2.0	LB 34	
107H	2.0	LA 34	

SC M,P			
EARTH SPLICE			
WIRE	SIZE	DEST	
600DN	1.0	LA 50	
600DP	1.0	LA 49	
800C	1.0	LD 2	
600Z	2.0	LC 1	

SD M,P			
TRANS OIL P SPLICE			
WIRE	SIZE	DEST	
404	1.0	LD 1	
404A	1.0	LB 11	
404B	1.0	LA 58	

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Harness Data

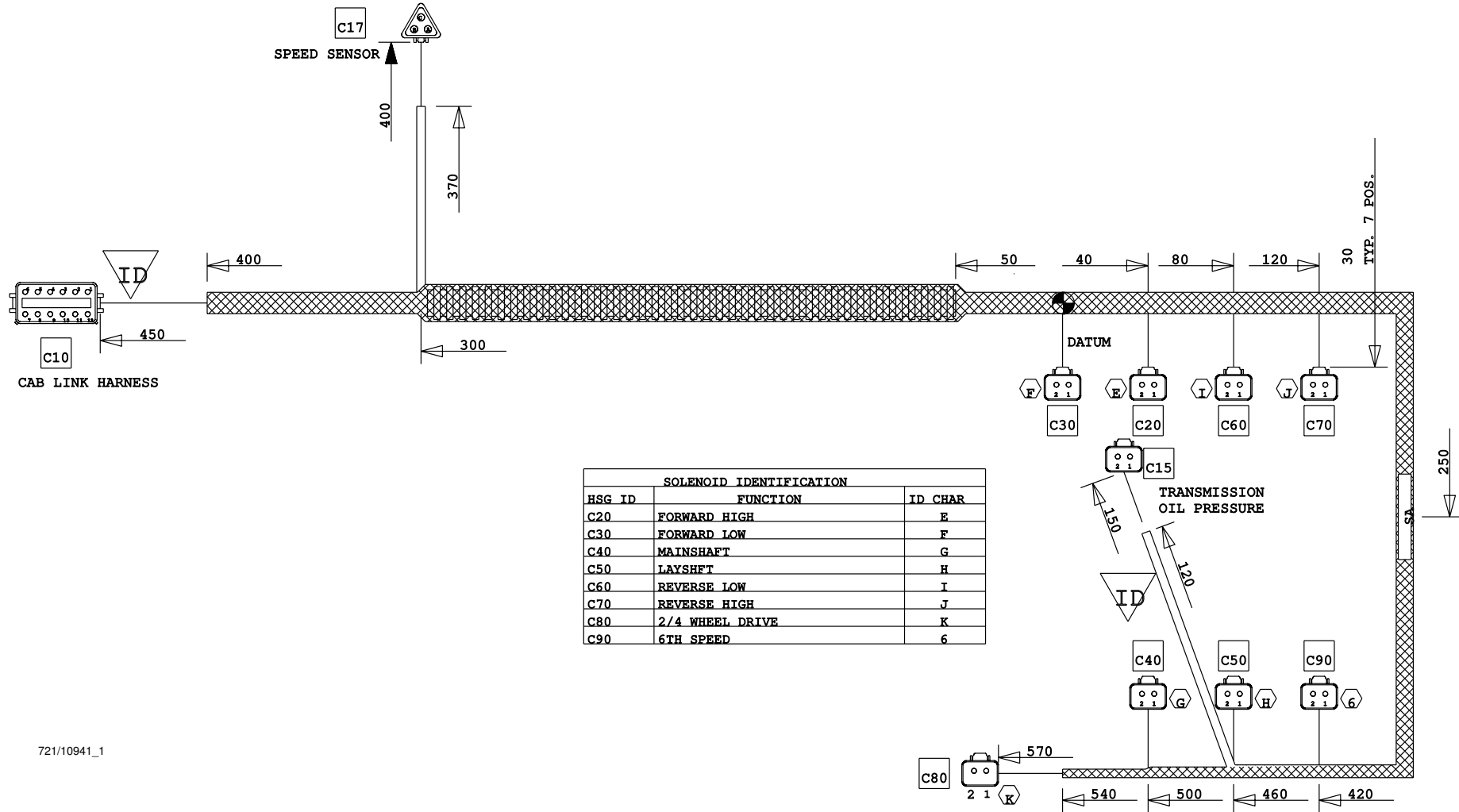
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Section C

Electrics

Section C

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**Key to Connectors:**

- C10 Cab Panel
- C15 XMSN Oil Press Switch
- C17 Speed Sensor
- C20 Forward High
- C30 Forward Low
- C40 Main Shaft
- C50 Lay Shaft
- C60 Reverse Low
- C70 Reverse High
- C80 4WD
- C90 6th Speed

C10	CAB PANEL			A,B
TERM	WIRE	SIZE	DEST	TYPE
1	600Z	2.0	SA	G
2	405	1.0	C15 1	H
3	1862	1.0	C70 1	H
4	1861	1.0	C20 1	H
5	853	1.0	C80 1	H
6	107AK	1.0	C17 3	H
7	974	1.0	C17 2	H
8	1860	1.0	C30 1	H
9	1863	1.0	C60 1	H
10	1866	1.0	C50 1	H
11	1865	1.0	C40 1	H
12	1864	1.0	C90 1	H

C15	XMSN OIL PRESS SW			C,D
TERM	WIRE	SIZE	DEST	TYPE
1	405	1.0	C10 2	H
2	600BU	1.0	SA	H

C17	SPEED SENSOR			E,F
TERM	WIRE	SIZE	DEST	TYPE
1	600HV	1.0	SA	H
2	974	1.0	C10 7	H
3	107AK	1.0	C10 6	H

C20	FORWARD HIGH			C,D
TERM	WIRE	SIZE	DEST	TYPE
1	1861	1.0	C10 4	H
2	600BS	1.0	SA	H

C30	FORWARD LOW			C,D
TERM	WIRE	SIZE	DEST	TYPE
1	1860	1.0	C10 8	H
2	600BX	1.0	SA	H

C40	MAIN SHAFT			C,D
TERM	WIRE	SIZE	DEST	TYPE
1	1865	1.0	C10 11	H
2	600BZ	1.0	SA	H

C50	LAY SHAFT			C,D
TERM	WIRE	SIZE	DEST	TYPE
1	1866	1.0	C10 10	H
2	600BY	1.0	SA	H

C60	REVERSE LOW			C,D
TERM	WIRE	SIZE	DEST	TYPE
1	1863	1.0	C10 9	H
2	600CA	1.0	SA	H

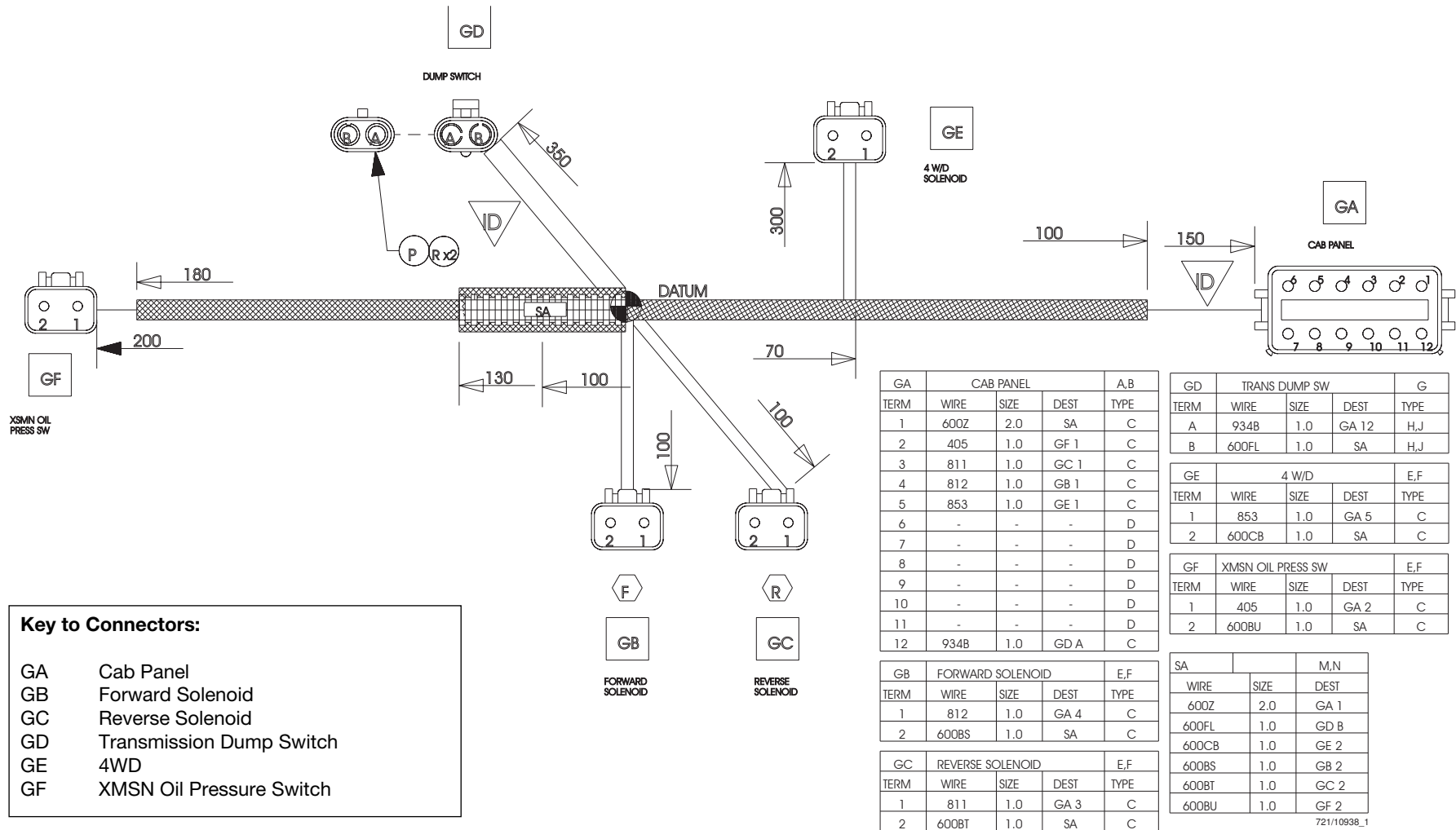
C70	REVERSE HIGH			C,D
TERM	WIRE	SIZE	DEST	TYPE
1	1862	1.0	C10 3	H
2	600BT	1.0	SA	H

C80	4 W/D			C,D
TERM	WIRE	SIZE	DEST	TYPE
1	853	1.0	C10 5	H
2	600CB	1.0	SA	H

C90	6TH SPEED			C,D
TERM	WIRE	SIZE	DEST	TYPE
1	1864	1.0	C10 12	H
2	600ME	1.0	SA	H

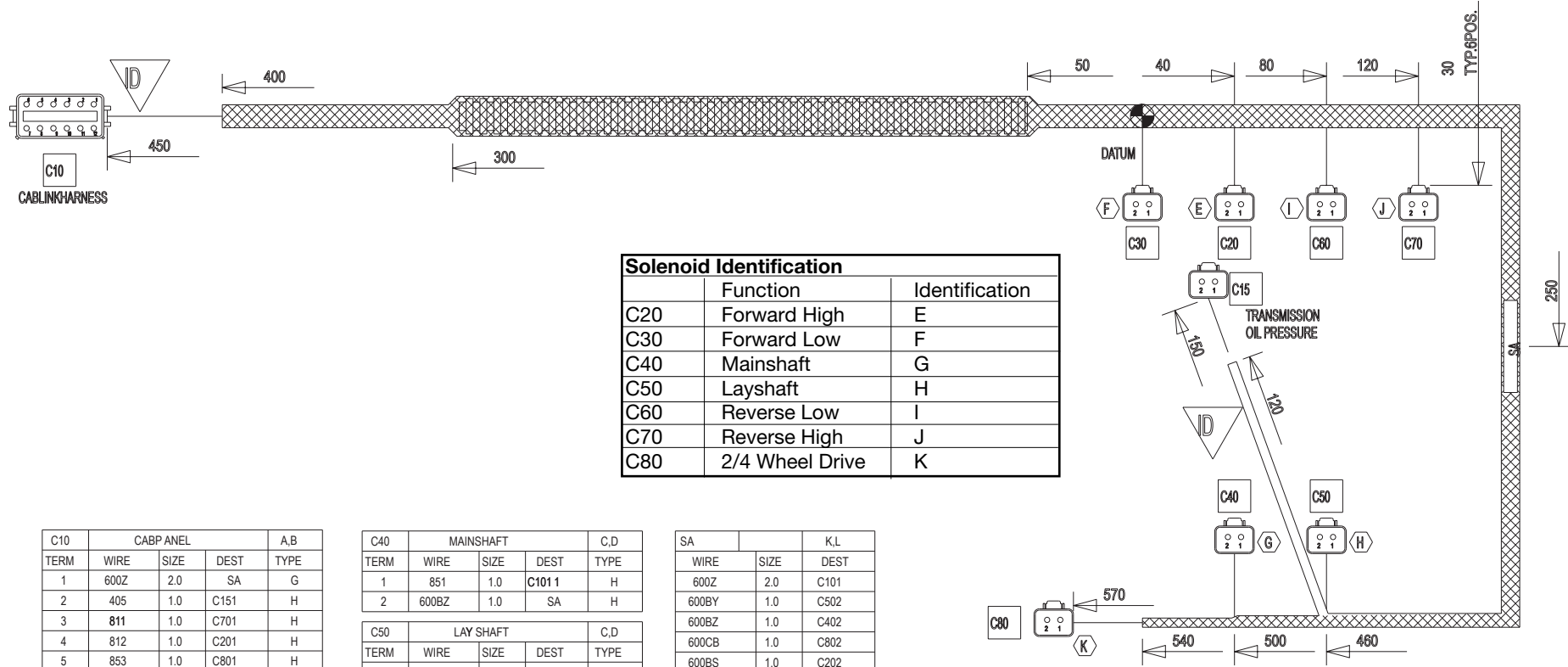
SA	K,L	
WIRE	SIZE	DEST
600Z	2.0	C10 1
600BY	1.0	C50 2
600BZ	1.0	C40 2
600CB	1.0	C80 2
600BS	1.0	C20 2
600BX	1.0	C30 2
600CA	1.0	C60 2
600BT	1.0	C70 2
600BU	1.0	C15 2
600HV	1.0	C17 1
600ME	1.0	C90 2

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Harness Drawing - Transmission - Powershift 4 speed, page 1 of 1 - CAD 721/10939 Issue 1

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C10 CAB PANEL				
TERM	WIRE	SIZE	DEST	TYPE
1	600Z	2.0	SA	G
2	405	1.0	C151	H
3	811	1.0	C701	H
4	812	1.0	C201	H
5	853	1.0	C801	H
6				J
7				J
8	848	1.0	C301	H
9	849	1.0	C601	H
10	850	1.0	C501	H
11	851	1.0	C401	H
12	-	-	-	J

C15 XMSNOIL PRESSSW				
TERM	WIRE	SIZE	DEST	TYPE
1	405	1.0	C102	H
2	600BU	1.0	SA	H

C20 FORWARDHIGH				
TERM	WIRE	SIZE	DEST	TYPE
1	812	1.0	C104	H
2	600BS	1.0	SA	H

C30 FORWARDLOW				
TERM	WIRE	SIZE	DEST	TYPE
1	848	1.0	C108	H
2	600BX	1.0	SA	H

C40 MAINSHAFT				
TERM	WIRE	SIZE	DEST	TYPE
1	851	1.0	C1011	H
2	600BZ	1.0	SA	H

C50 LAY SHAFT				
TERM	WIRE	SIZE	DEST	TYPE
1	850	1.0	C1010	H
2	600BY	1.0	SA	H

C60 REVERSELOW				
TERM	WIRE	SIZE	DEST	TYPE
1	849	1.0	C109	H
2	600CA	1.0	SA	H

C70 REVERSEHIGH				
TERM	WIRE	SIZE	DEST	TYPE
1	811	1.0	C103	H
2	600BT	1.0	SA	H

C80 4W/D				
TERM	WIRE	SIZE	DEST	TYPE
1	853	1.0	C105	H
2	600CB	1.0	SA	H

SA			K.L	
WIRE	SIZE	DEST		
600Z	2.0	C101		
600BY	1.0	C502		
600BZ	1.0	C402		
600CB	1.0	C802		
600BS	1.0	C202		
600BX	1.0	C302		
600CA	1.0	C602		
600BT	1.0	C702		
600BU	1.0	C152		

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Harness Data

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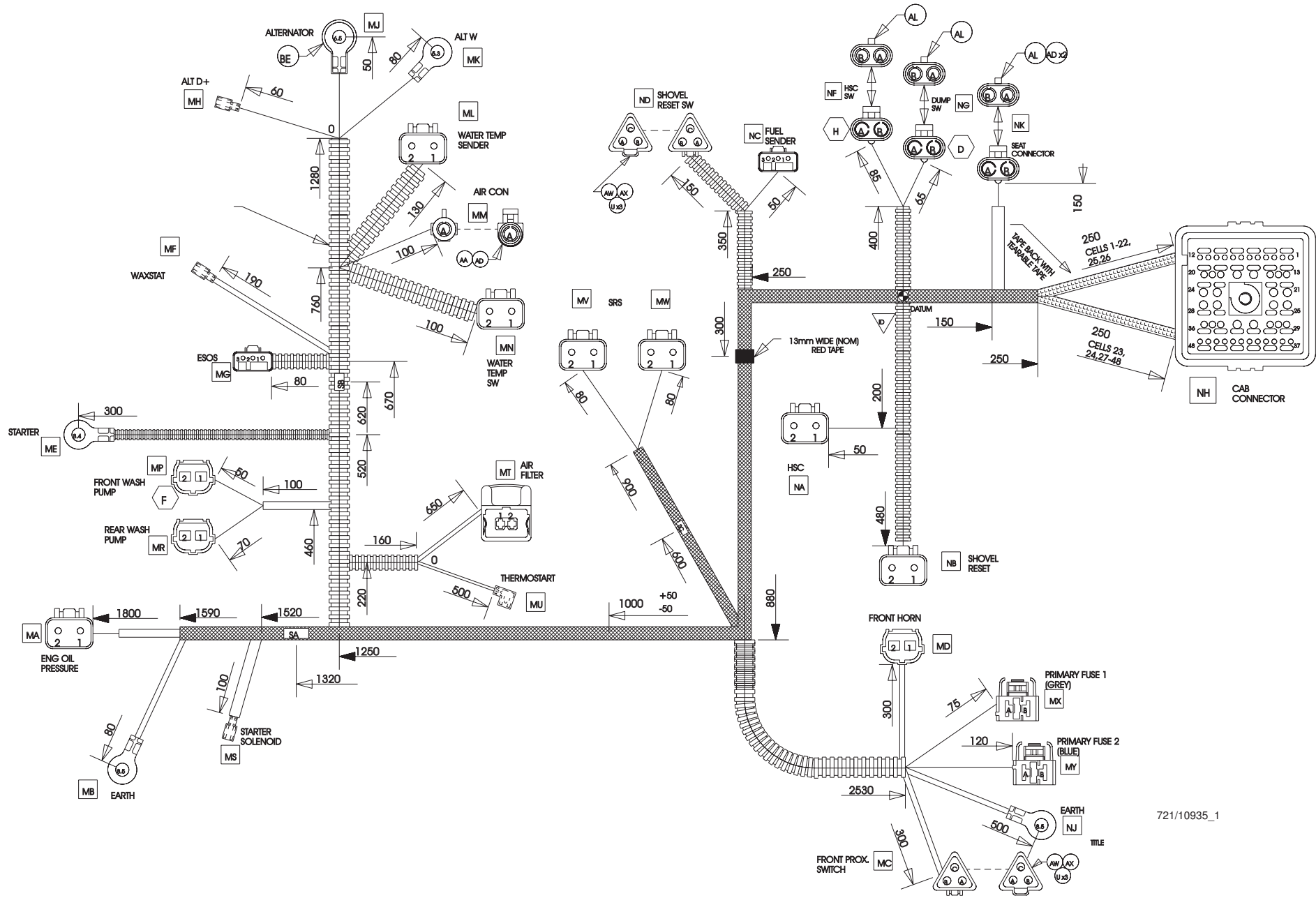
Section C

Electrics

Section C

Issue 1





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### Key to Connectors:

MA	Engine Oil Pressure
MB	Earth
MC	Front Proximity Switch
MD	Front Horn
ME	Starter
MF	Waxstat
MG	ESOS
MH	Alternator D+
MJ	Alternator PWR
MK	Alternator W
ML	Water Temperature Sender
MM	Air Conditioning
MN	Water Temperature Switch
MP	Front wash Pump
MR	Rear Wash Pump
MS	Start Solenoid
MT	Air Filter
MU	Thermostat
MV	SRS
MW	SRS
MX	Primary Fuse 1 (Grey)
MY	Primary Fuse 2 (Blue)
NA	HSE Solenoid
NB	Shovel Reset
NC	Fuel Sender
ND	Reset Switch
NF	HSC Switch
NG	Dump Switch
NH	Cab Panel - Bulk Head
NU	Earth
NK	Seat Connector

MA					ENG OIL PRESS					C.D	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	403	1.0	NH 3	BB							
2	600MC	1.0	SA	BB							

MB					EARTH					-	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	600A	4.0	SA	AAN							

MC					FRONT PROX SW					AU,AV	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
A	819	1.0	NH 4	BB							
B	600BW	1.0	SA	BB							
C	109	1.0	NH 41	BB							

MD					FRONT HORN					J.K	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	814	2.0	NH 20	M,N							
2	600B	2.0	SA	M,N							

ME					STARTER					-	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	200J	16.0	MJ 1	AM,B							

MF					WAXSTAT					-	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	105A	1.0	SB	V,W							

MG					ESOS					AR,AS	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	105B	1.0	SB	BF							
2	600	1.0	SA	BF							
3	513	1.0	NH 44	BF							

MH					ALTERNATOR D+					-	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	407	1.0	NH 38	V,W							

MJ					ALTERNATOR PWR					-	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	200J	16.0	ME 1	X,B							

MK					ALTERNATOR W					-	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	412	1.0	NH 47	Y,AN							

ML					WATER TEMP SENDER					C.D	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	409	1.0	NH 46	BB							
2	600JT	1.0	SA	BB							

MM					AIR CON					Z	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	903	1.0	NH 9	AB,AC							

MN					WATER TEMP SW					C.D	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	406	1.0	NH 11	BB							
2	600CK	1.0	SA	BB							

MP					FRONT WASH PUMP					J.K	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	839	1.0	NH 48	L,M							
2	600BG	1.0	SA	L,M							

MR					REAR WASH PUMP					J.K	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	863	1.0	NH 40	L,M							
2	600BK	1.0	SA	L,M							

MS					START SOLENOID					-	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	842	3.0	NH 28	AP,V							

MT					AIR FILTER					R	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	402	1.0	NH 2	S,T							
2	600CF	1.0	SA	S,T							

MU					THERMOSTART					-	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	003	2.0	NH 13	AF,AE							

MV					SRS					C.D	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	1801A	1.0	SC	BB							
2	600LH	1.0	SA	BB							

MW					SRS					C.D	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	1801B	1.0	SC	BB							
2	600LJ	1.0	SA	BB							

MX					PRIMARY FUSE 1 (GREY)					AH	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
A	200B	4.0	NH 21	AJ							
	200C	4.0	NH 22	AJ							
B	200E	4.0	NH 24	AJ							
	200R	4.0	NH 27	AJ							

MY					PRIMARY FUSE 2 (BLUE)					AG	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
A	200G	4.0	NH 25	AJ							
	200V	4.0	NH 16	AJ							
B	200D	4.0	NH 23	AJ							
	200M	4.0	NH 26	AJ							

NA					HSC SOLENOID					C.D	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	867B	1.0	NH 45	BB							
2	600DE	1.0	SA	BB							

NB					SHOVEL RESET					C.D	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	844	1.0	ND A	BB							
2	600D	1.0	SA	BB							

NC					FUEL SENDER					AR,AS	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	408	1.0	NH 39	BF							
2	600CE	1.0	SA	BF							
3	514	1.0	NH 43	BF							

ND					RESET SWITCH					AU,AV	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
A	844	1.0	NB 1	BB							
B	600LW	1.0	SA	BB							
C	1851	1.0	NH 37	BB							

NF					HSC SWITCH					AK	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
A	101AS	1.0	NH 5	G,AB							
B	1857	1.0	NH 8	G,AB							

NG					DUMP SWITCH					AK	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
A	934A	1.0	NH 42	G,AB							
B	600EZ	1.0	SA	G,AB							

NJ					EARTH					-	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	617	1.0	NH 29	Y,AN							

NK					SEAT CONNECTOR					AK	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
A	114C	2.0	NH 14	G,AB							
B	600DH	2.0	SA	G,AB							

NH					CAB PANEL BLK HD					E,F	
TERM	WIRE	SIZE	DEST	TYPE	TERM	WIRE	SIZE	DEST	TYPE		
1	105	1.0	SB	BF							
2	402	1.0	MT 1	BF							
3	403	1.0	MA 1	BF							
4	819	1.0	MC A	BF							
5	101AS	1.0	NF A	BF							
6	-	-	-	P							
7	-	-	-	P							
8	1857	1.0	NF B	BF							
9	903	1.0	MM 1	BF							
10	-	-	-	P							
11	406	1.0	MN 1	BF							
12	1801	1.0	SC	BF							
13	003	2.0	MU 1	BC							
14	114C	2.0	NK A	BC							
15	-	-	-	U							
16	200V	4.0	MY A	BA							
17	-	-	-	U							
18	-	-	-	U							
19	-	-	-	U							
20	814	2.0	MD 1	BB							
21	200B	4.0	MX A	BA							
22	200C	4.0	MX A	BA							
23	200D	4.0	MY B	BA							
24	200E	4.0	MX B	BA							
25	200G	4.0	MY A	BA							
26	200M	4.0	MY B	BA							
27	200R	4.0	MX B	BA							
28	842	3.0	MS 1	BA							
29	617	1.0	NJ 1	BB							
30	-	-	-	U							
31	-	-	-	U							
32	-	-	-	U							
33	-	-	-	U							
34	-	-	-	U							
35	-	-	-	U							
36	-	-	-	U							
37	1851	1.0	ND C	BF							
38	407	1.0	MH 1	BF							
39	408	1.0	NC 1	BF							
40											

\* Harness Drawing - Rear Lights / Hydraclamp - Sideshift, page 1 of 1 - CAD 721/10944 Issue 1

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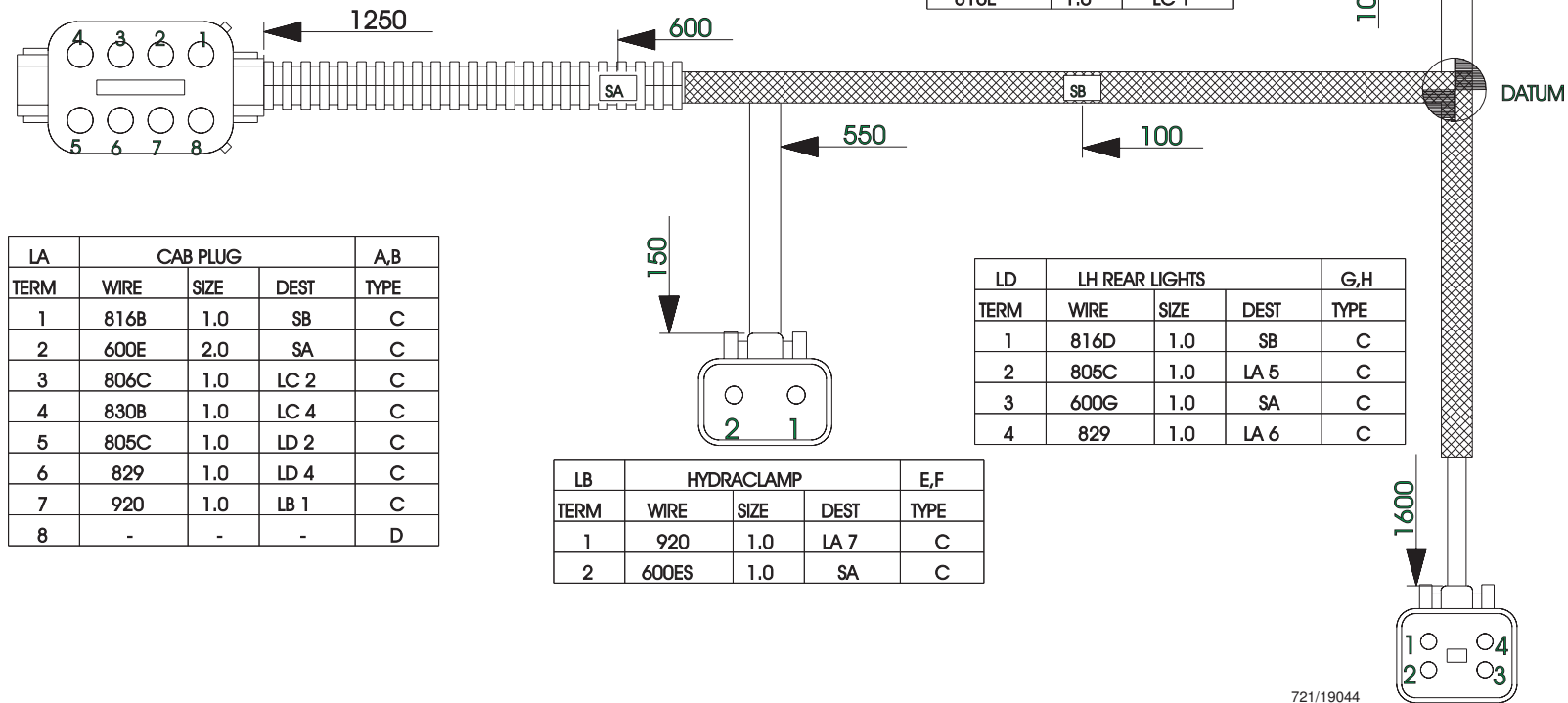
**Key to Connectors:**

- LA Cab Plug
- LB Hydraclamp
- LC RH Rear Lights
- LD LH Rear Lights
- SA Earth
- SB Brake Lights

LC	RH REAR LIGHTS			G,H
TERM	WIRE	SIZE	DEST	TYPE
1	816E	1.0	SB	C
2	806C	1.0	LA 3	C
3	600H	1.0	SA	C
4	830B	1.0	LA 4	C

SA	J,K	
EARTH		
WIRE	SIZE	DEST
600E	2.0	LA 2
600H	1.0	LC 3
600G	1.0	LD 3
600ES	1.0	LB 2

SB	J,K	
BRAKE LIGHTS		
WIRE	SIZE	DEST
816B	1.0	LA 1
816D	1.0	LD 1
816E	1.0	LC 1



LA	CAB PLUG			A,B
TERM	WIRE	SIZE	DEST	TYPE
1	816B	1.0	SB	C
2	600E	2.0	SA	C
3	806C	1.0	LC 2	C
4	830B	1.0	LC 4	C
5	805C	1.0	LD 2	C
6	829	1.0	LD 4	C
7	920	1.0	LB 1	C
8	-	-	-	D

LB	HYDRACLAMP			E,F
TERM	WIRE	SIZE	DEST	TYPE
1	920	1.0	LA 7	C
2	600ES	1.0	SA	C

LD	LH REAR LIGHTS			G,H
TERM	WIRE	SIZE	DEST	TYPE
1	816D	1.0	SB	C
2	805C	1.0	LA 5	C
3	600G	1.0	SA	C
4	829	1.0	LA 6	C

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Section C

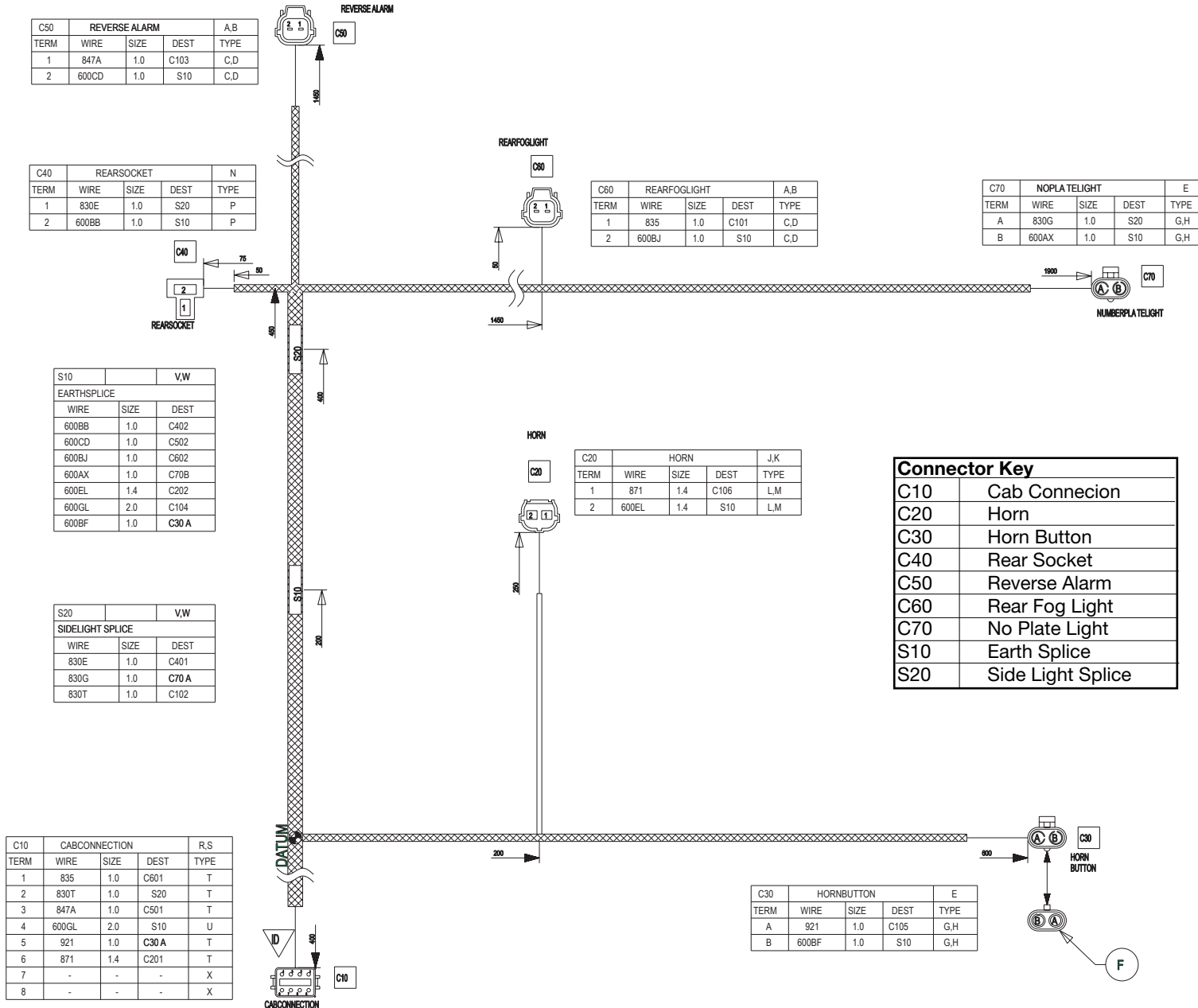
Harness Data

Electrics

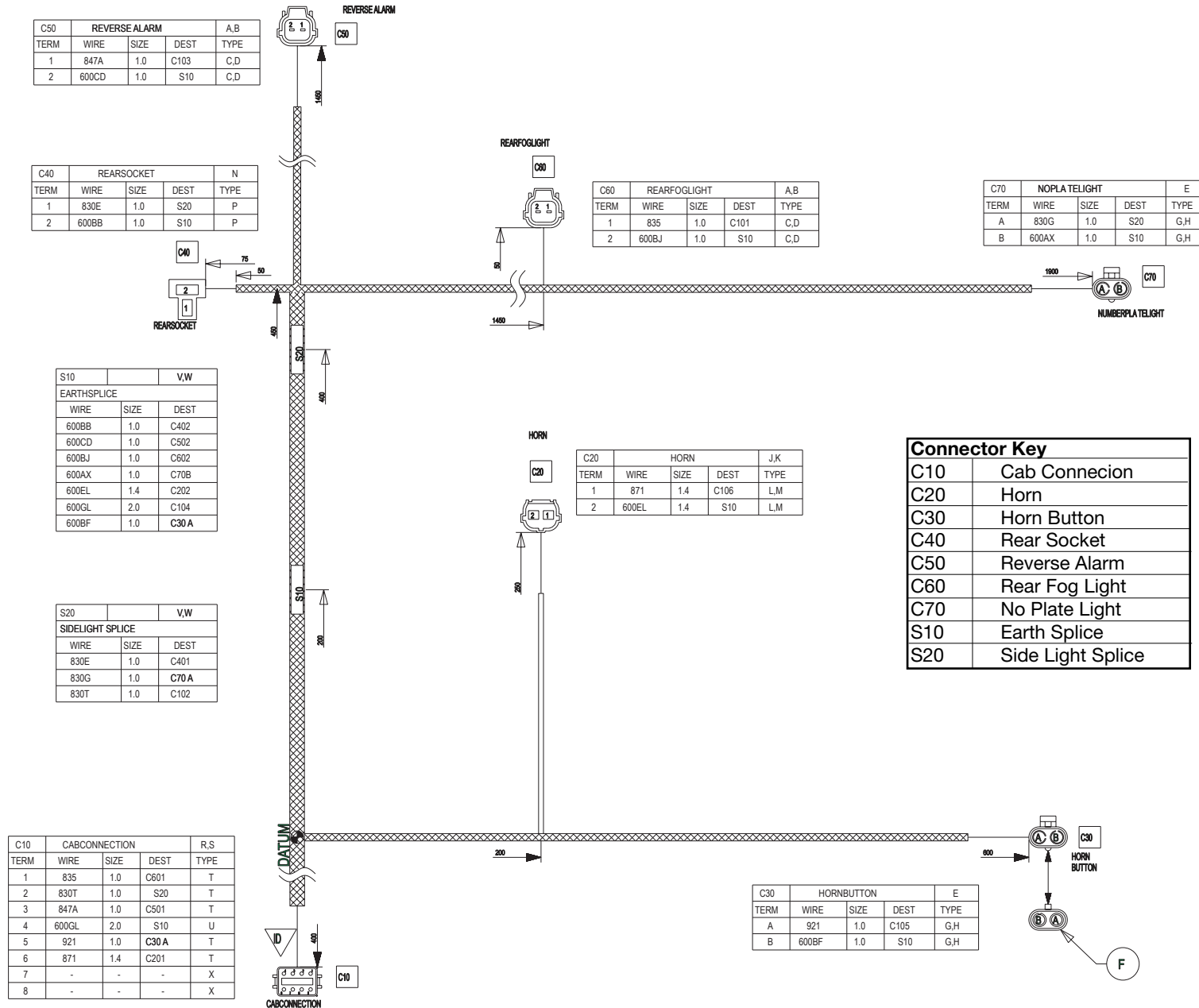
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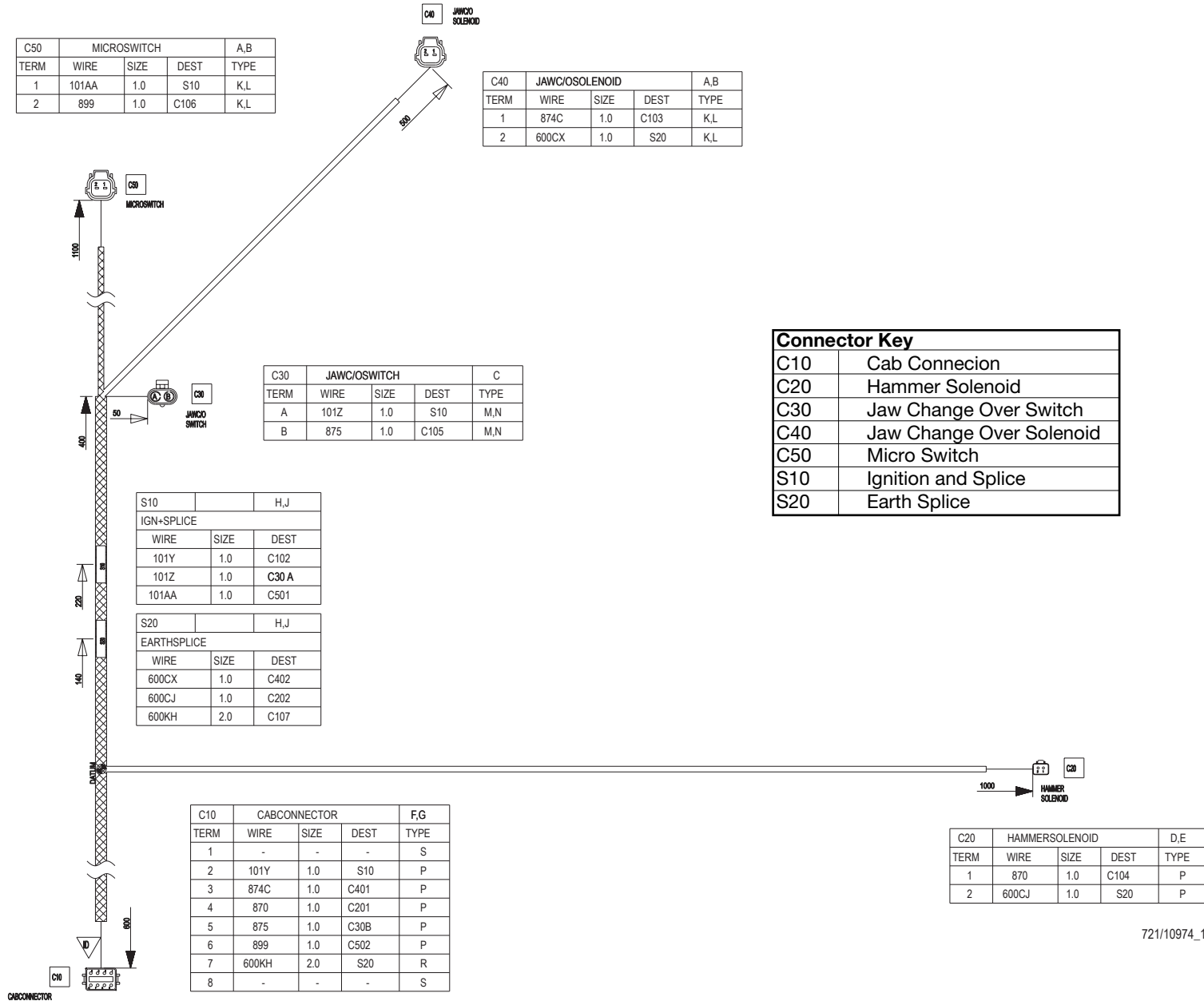
Issue 2\*



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721/10946\_1

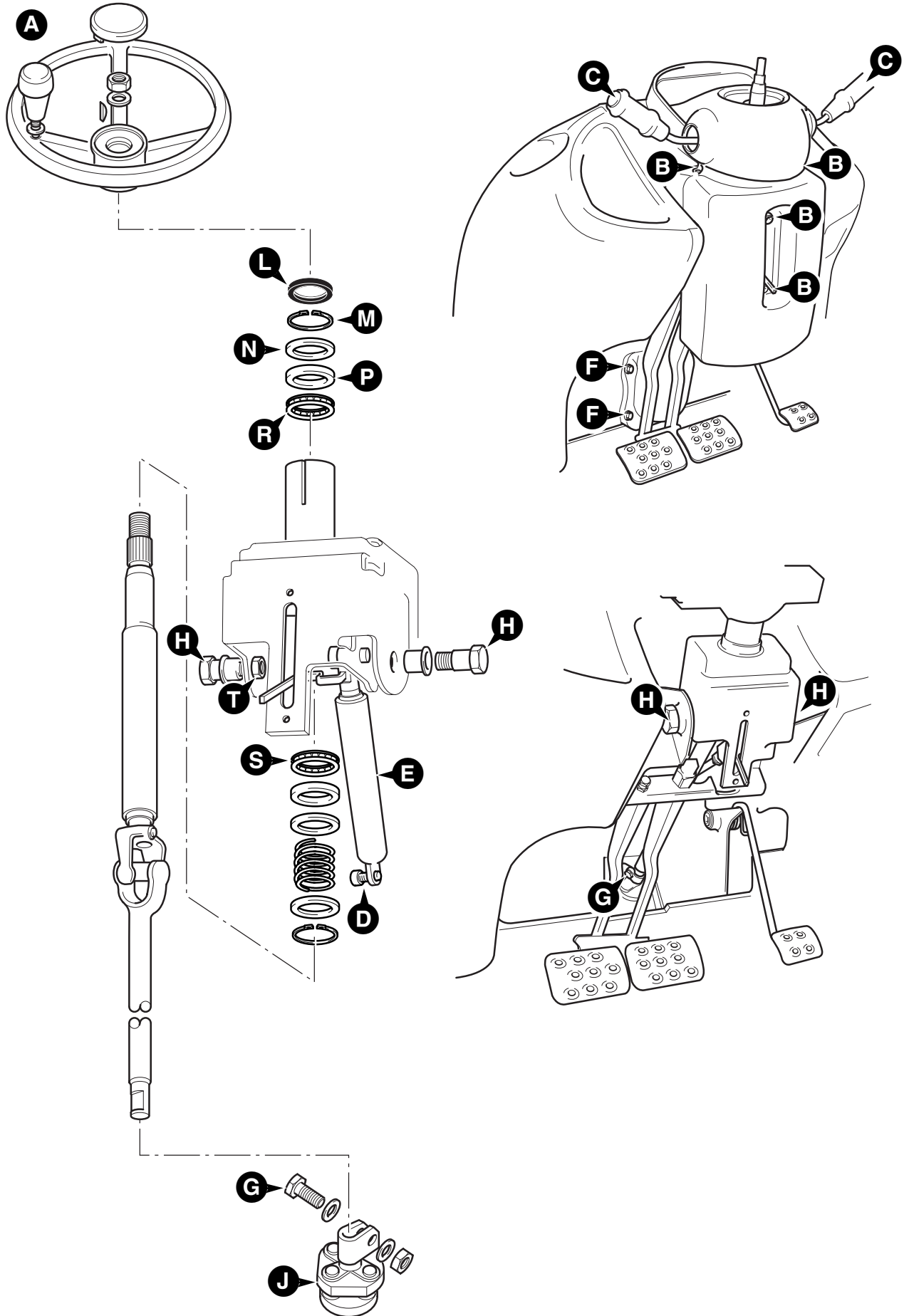


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A396921

## Removal and Replacement

The steering column can be tilted to improve operator reach and comfort levels. This type of assembly is referred to as a 'tilt column'.

The illustration on the adjacent page is intended as a guide to removal and replacement.

### Removal

- \* 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the loader arms to the ground. Switch OFF the engine, remove the starter key and disconnect the battery.
- 2 Remove the steering wheel as shown at **A**.
- 3 Remove socket screws **B** and take off the steering column pedestal cover.
- 4 Remove the control column switches **C**.
- \* 5 Remove the socket screw **D** securing the gas damper strut **E**.
- 6 Remove socket screws **F** and lift up the rubber protective cover behind the brake pedals to gain access to the flexible coupling.
- \* 7 Remove the coupling bolt **G** and shoulder bolts **H**. Then carefully withdraw the steering column assembly (with the gas damper strut attached) from the flexible coupling **J**.

### Replacement

Replacement is the reverse of the removal sequence.

- \* Apply JCB Threadlocker and Sealer to threads of nuts **T**.

**Note:** The coupling bolt **G** must engage with the cut-out in the shaft.

- \* After re-fitting check that the steering tilt functions correctly, and that the direction indicators and lights operate correctly. Check that the wires from the brake pedal switch do not rub on the steering column.

### \* Torque Settings

Item	Nm	kgf m	lbf ft
<b>D</b>	14	1.4	10.3
<b>H</b>	40	4.1	29.5

## Dismantling and Assembly

The illustration on the adjacent page is intended as a guide to dismantling and assembly.

### Dismantling

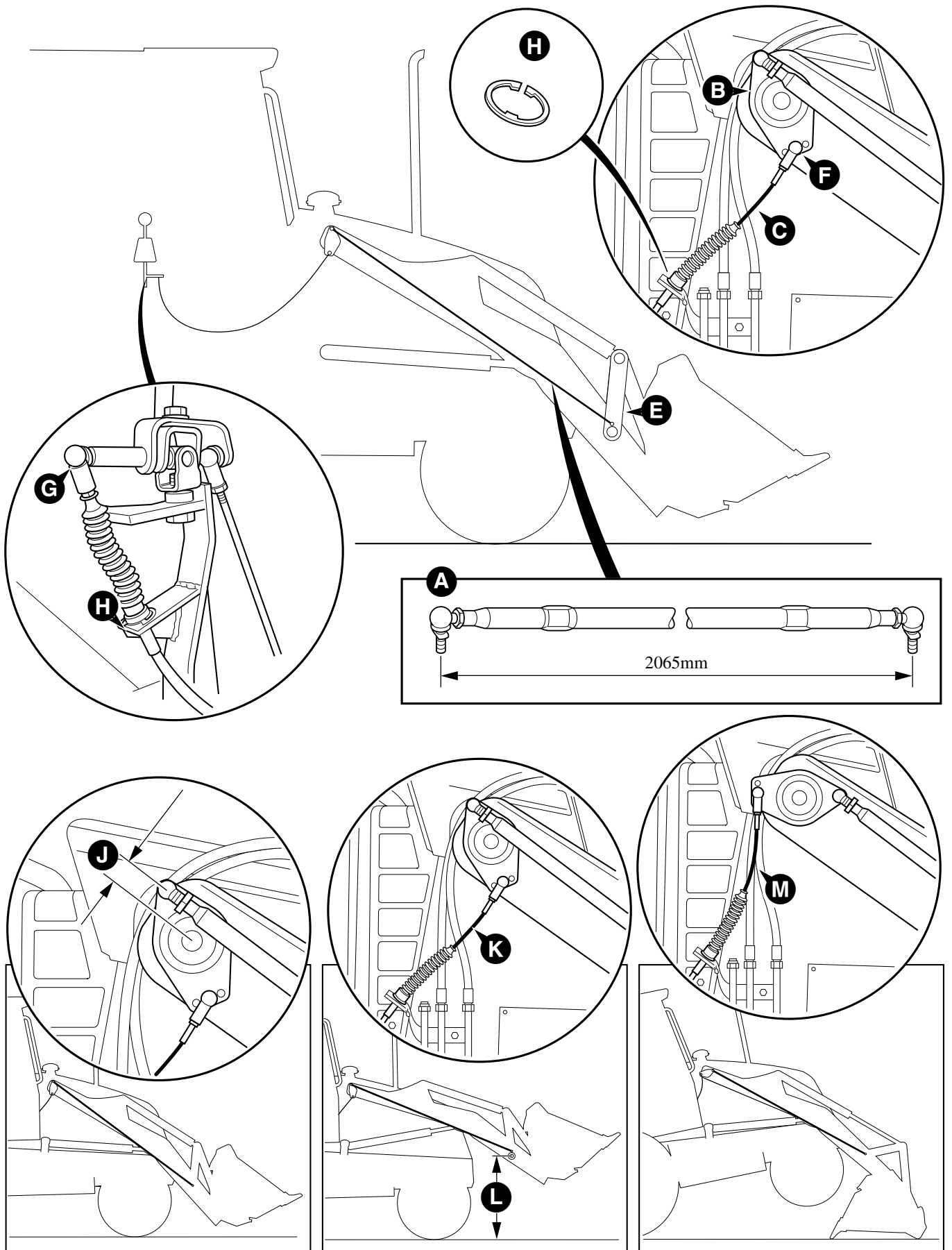
- 1 Using a screwdriver in the slot, carefully prise out the dust seal **L** from the outer column tube.
- 2 Remove external circlip **M**, washer **N**, tolerance ring **P** and withdraw the steering shaft from the outer column tube and pivot bracket.

**Note:** The top and bottom bearings **R** and **S** housed in the outer column tube are non serviceable parts. They may be removed for cleaning and inspection, but if the bearing(s) have failed a new outer column tube and pivot bracket assembly must be used.

**Note:** The gas damper strut **E** is a non serviceable part. If the damper is faulty it must be replaced with a new one.

### Assembly

Assembly is the reverse of the dismantling sequence.



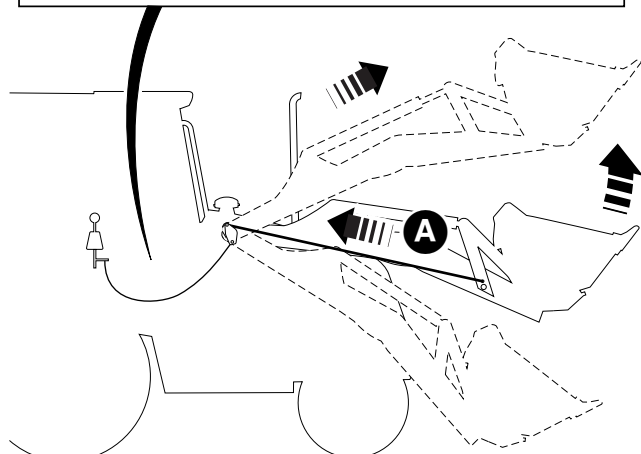
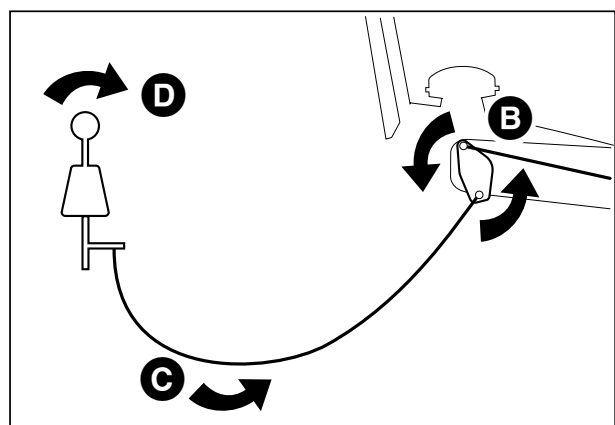
A320510

## 214e Machines Only

The shovel reset system is designed to automatically tilt the shovel forward when the loader arms are raised, this prevents a heaped shovel from depositing its contents over the back of the shovel onto the bonnet or cab when the loader arms are raised.

When the loader arms are raised the feed back link **A** causes the cam plate **B** to rotate anti-clockwise. The rotation of the cam plate pulls the cable **C** which selects the loader valve block shovel spool **D** to tip the shovel forwards.

When either a cable or feedback link is changed or if the shovel reset system is not operating correctly carry out functional adjustment check.



A320500

### Fitting

- 1 Adjust the feedback link **A** to 2065mm (81.3in). After adjusting tighten the lock nuts.
- 2 Fit cam plate **B** with the single threaded hole at the top.
- 3 Fit feed back link **A** to cam plate and shovel lever **E**.
- 4 Connect cable **C** to the bottom centre position **F** on the cam plate **B**, secure in position.

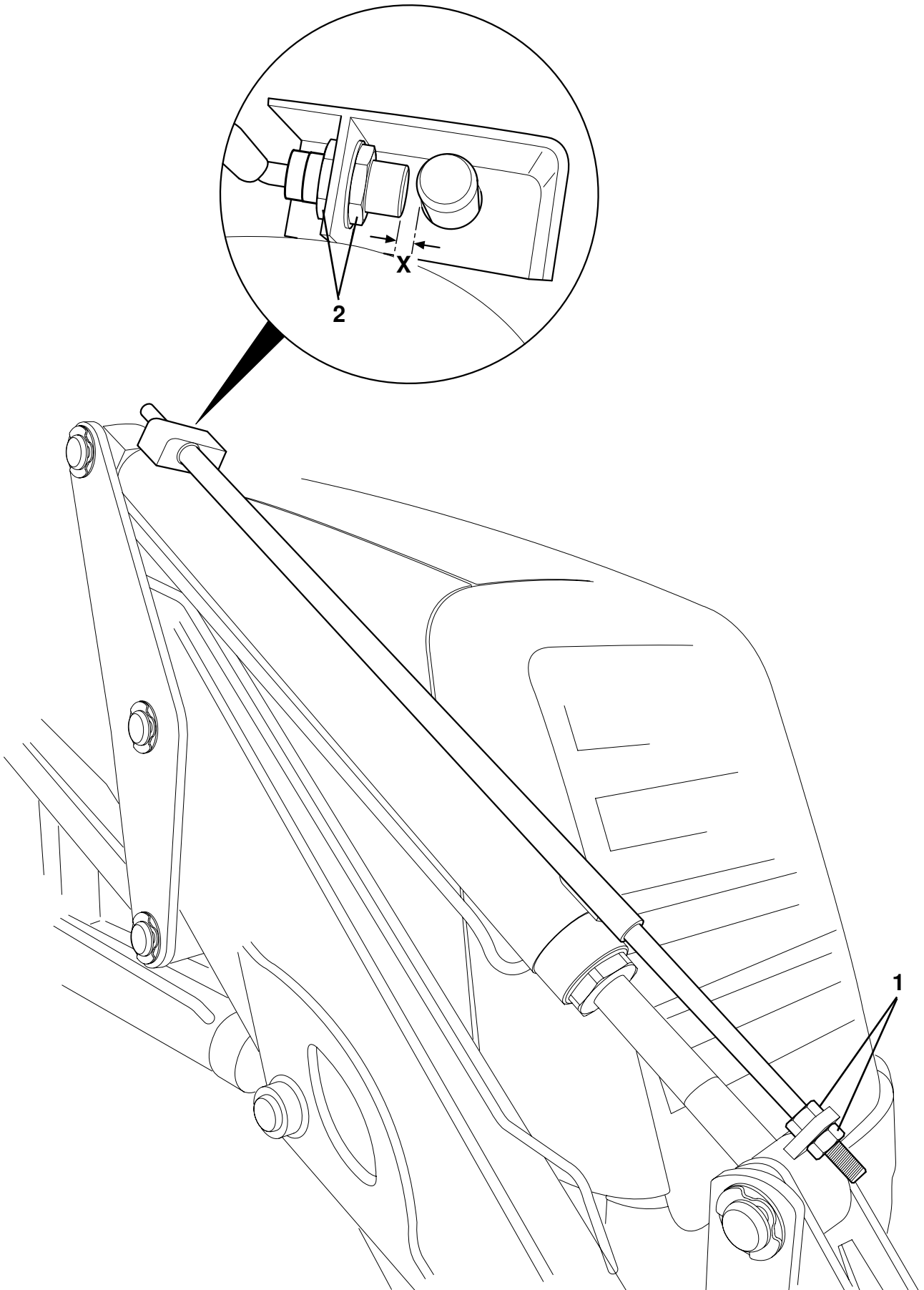
**Note:** The factory fit position for the cable end ball joint to cam plate is the centre position. Because of component variation it is permissible to fit the cable end ball joint in either the forward or rear position. The forward position will advance the levelling and the rear position will delay the levelling.

- 5 Connect cable **C** to the loader arm control lever **G**.
- 6 Secure cable ends with spring clips **H**.
- 7 Carry out the adjustment procedure.

### Adjustment

- 1 Roll the shovel fully back and lower to the ground.
- 2 The feedback link position in relation to the loader arm pivot pin measurement **J** should be 40mm (1.5in). Adjust feedback link as required.
- 3 When the loader arms are raised there should be no slack in the cable at **K** when the shovel arm pivot pin **L** is 1.0 to 1.5 meters (3.5 to 5.0 feet).
- 4 Roll the shovel fully forward and fully retract the lift arms, this will raise the front wheels off the ground.
- 5 In this position there should be slack in the cable at **M**, if not adjust the cable as required.

**Note:** Whenever any adjustment is made repeat steps 4/5 to make sure there is slack in the cable with the shovel rolled fully forward.



A374040

## Operation

This enables you to roll the shovel from the rolled forward position into the digging position quickly and easily.

When you select 'Return To Dig' a proximity switch on one of the loader arms cuts off the hydraulic pressure to the shovel rams immediately the shovel reaches the correct angle for digging.

To select 'Return To Dig':

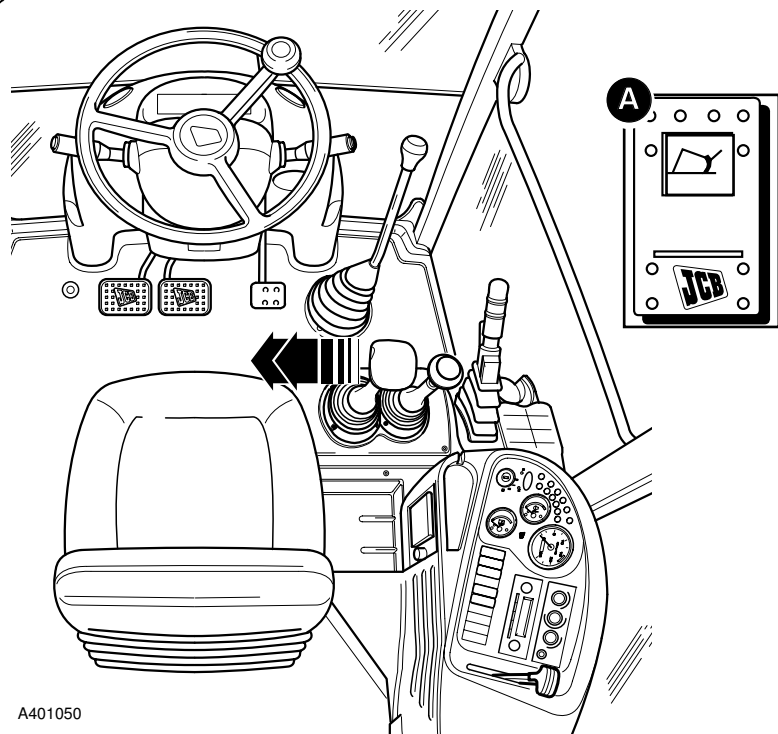
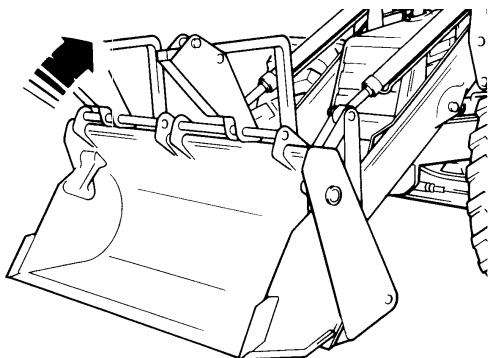
- 1 Press the 'Return To Dig Enable' switch **A** to the ON position, the switch will illuminate.
- 2 Pull the loader lever to the left as far as it will go. You will feel a slight pressure on the lever as it passes through the **Roll Back** position.

Release the lever, it will stay in the detent position until the shovel reaches the return to dig position when the lever will automatically return to the central hold position.

- 3 When return to dig is no longer required press the enable switch to the OFF position.

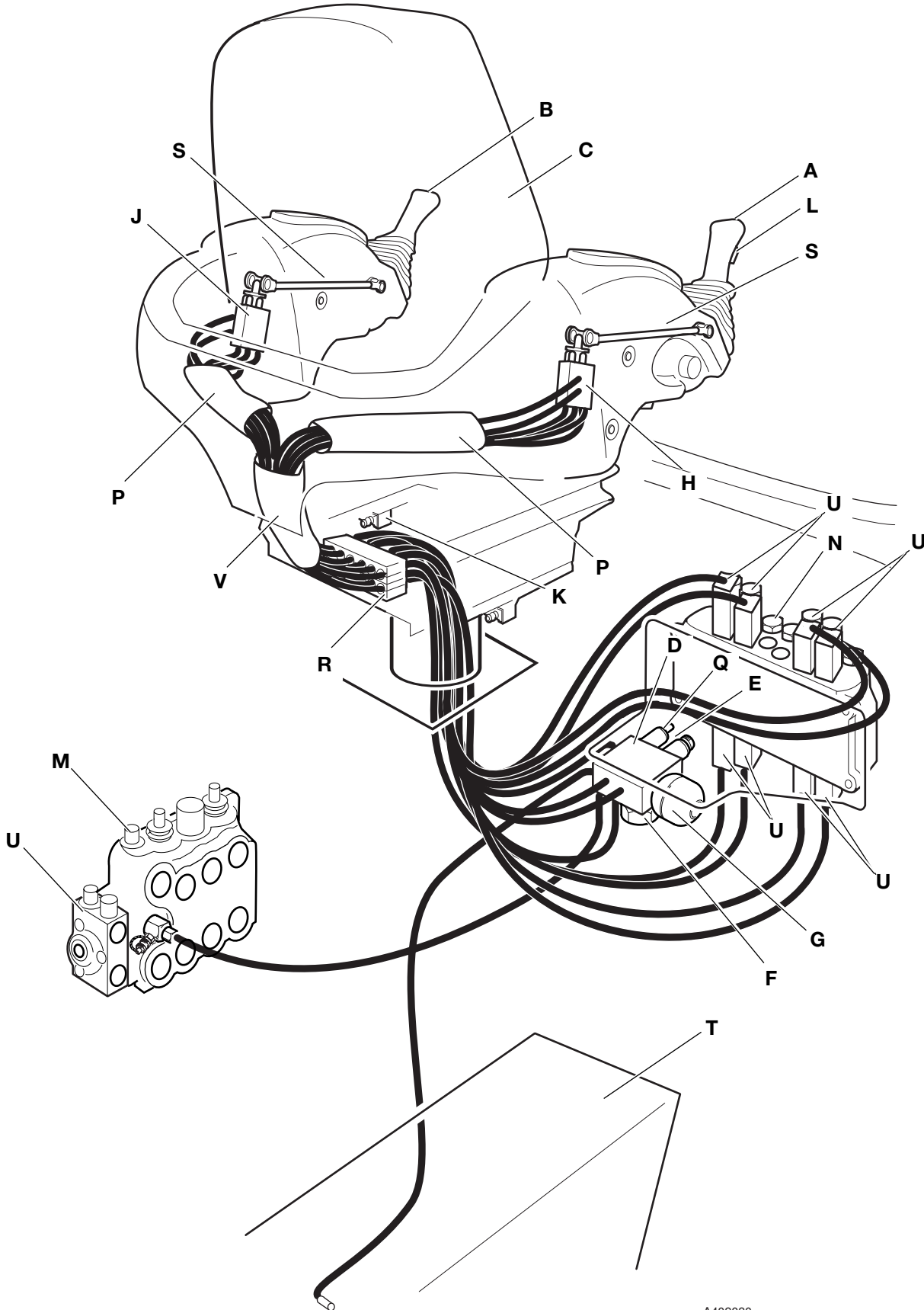
## Adjustment

- 1 Lower the loader arms and position the shovel in the required 'Return To Dig' position.
- 2 Switch OFF the engine but leave the ignition ON.
- 3 Press the 'Return To Dig Enable' switch to ON.
- 4 Adjust the rod with nuts **1** so that the LED on the proximity switches illuminates/extinguishes at this position.
- 5 Adjust the proximity switch with nuts **2** to give a clearance **X** of 2 mm (0.08 in).



A401050

**Basic System Operation**  
Component Location

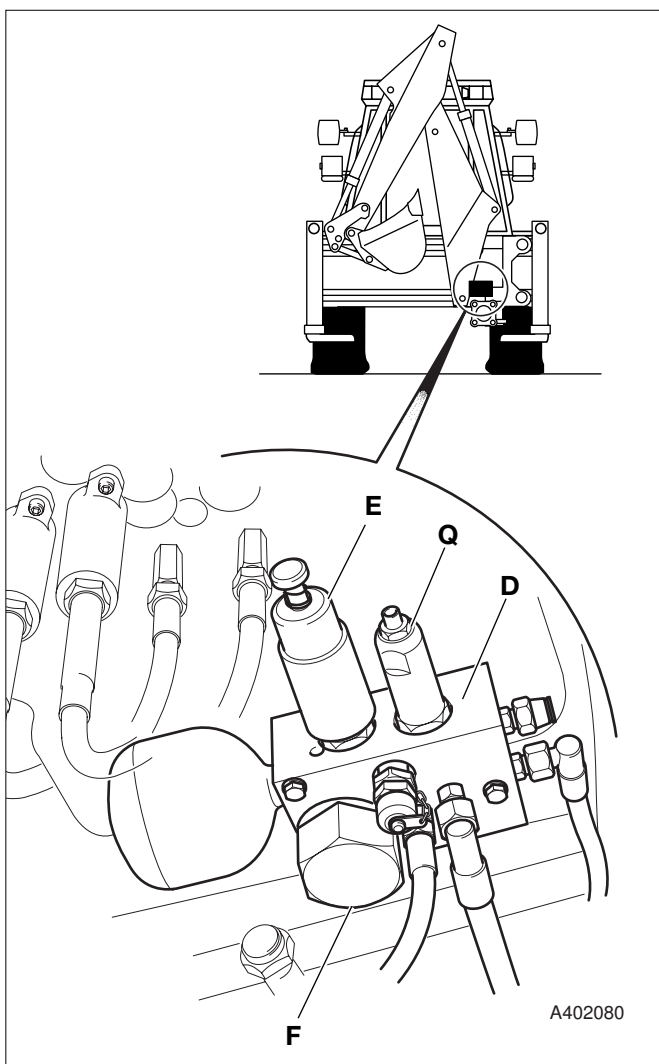


A402030

## Basic System Operation

### Component Identification

<b>A</b>	Right hand joystick
<b>B</b>	Left hand joystick
<b>C</b>	Operator seat
<b>D</b>	Pilot supply valve
<b>E</b>	Supply valve solenoid
<b>F</b>	Oil filter access plug
<b>G</b>	Accumulator
<b>H</b>	Right hand pilot control valve
<b>J</b>	Left hand pilot control valve
<b>K</b>	Seat mounted micro switch
<b>L</b>	Joystick mounted 'mode switch'
<b>M</b>	Loader valve block
<b>N</b>	Excavator valve block
<b>P</b>	Hose sleeves
<b>Q</b>	Pressure relief valve
<b>R</b>	Hose clamps (seat base mounted)
<b>S</b>	Mechanical linkages
<b>T</b>	Machine hydraulic tank
<b>U</b>	Bolt on spool section - extending dipper (if fitted)
<b>V</b>	Plastic cover panel



\* The following section describes the JCB Precision Control system fitted to machines up to serial number 931159. There is another JCB Precision Control system fitted to later machines, which is described in a separate section. Refer to **Precision Control (Servo) - Machines from January 2003**.

### Circuit Description

The JCB Precision Control system facilitates operation of the backhoe (excavator) via joysticks **A** and **B** mounted in the arms of the operator's seat. Unlike manual machines the excavator valve spools are moved by hydraulic pressure and not directly by a mechanical levers.

A pilot supply valve **D** maintains a constant supply of oil at servo pressure to the right and left hand pilot control valves **H** and **J**. The valves are mounted at the rear of the seat arm rests.

The joysticks each operate a hydraulic pilot control valve (**H** or **J** as applicable) via a mechanical linkage. These valves in turn operate the excavator valve spools via hydraulic pilot pressure. The interconnecting hoses are routed to and from the pilot control valves through the central seat support pillar and then through the cab floor.

The mechanical linkages **S** incorporate universal type couplings at both ends.

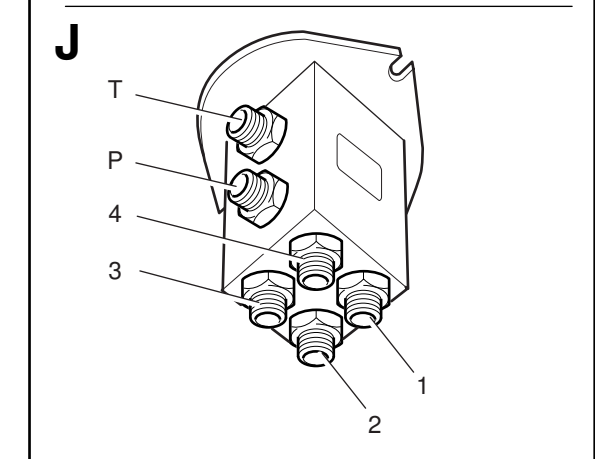
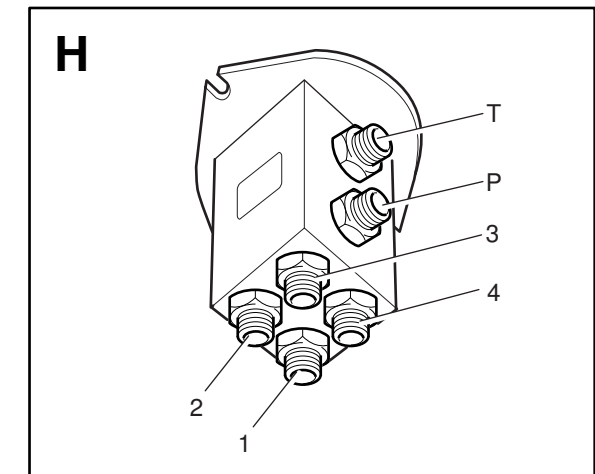
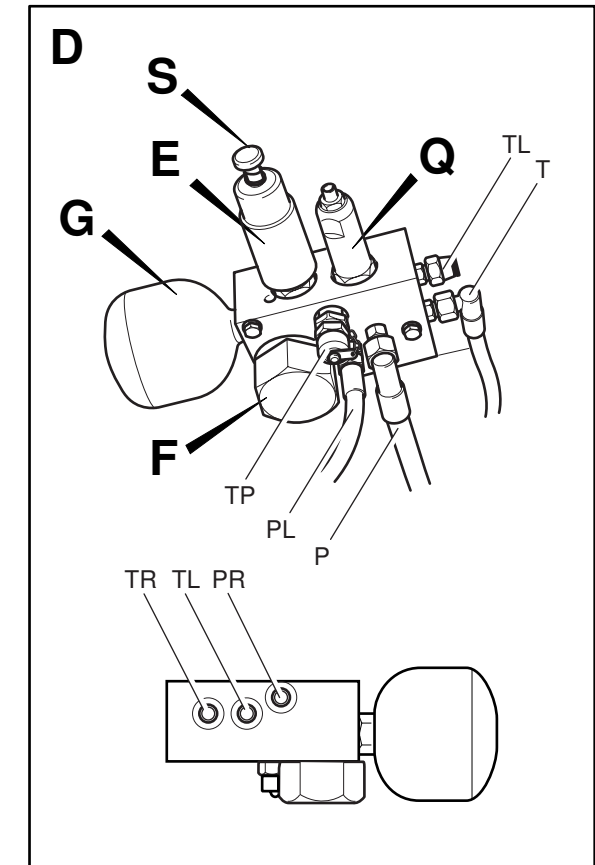
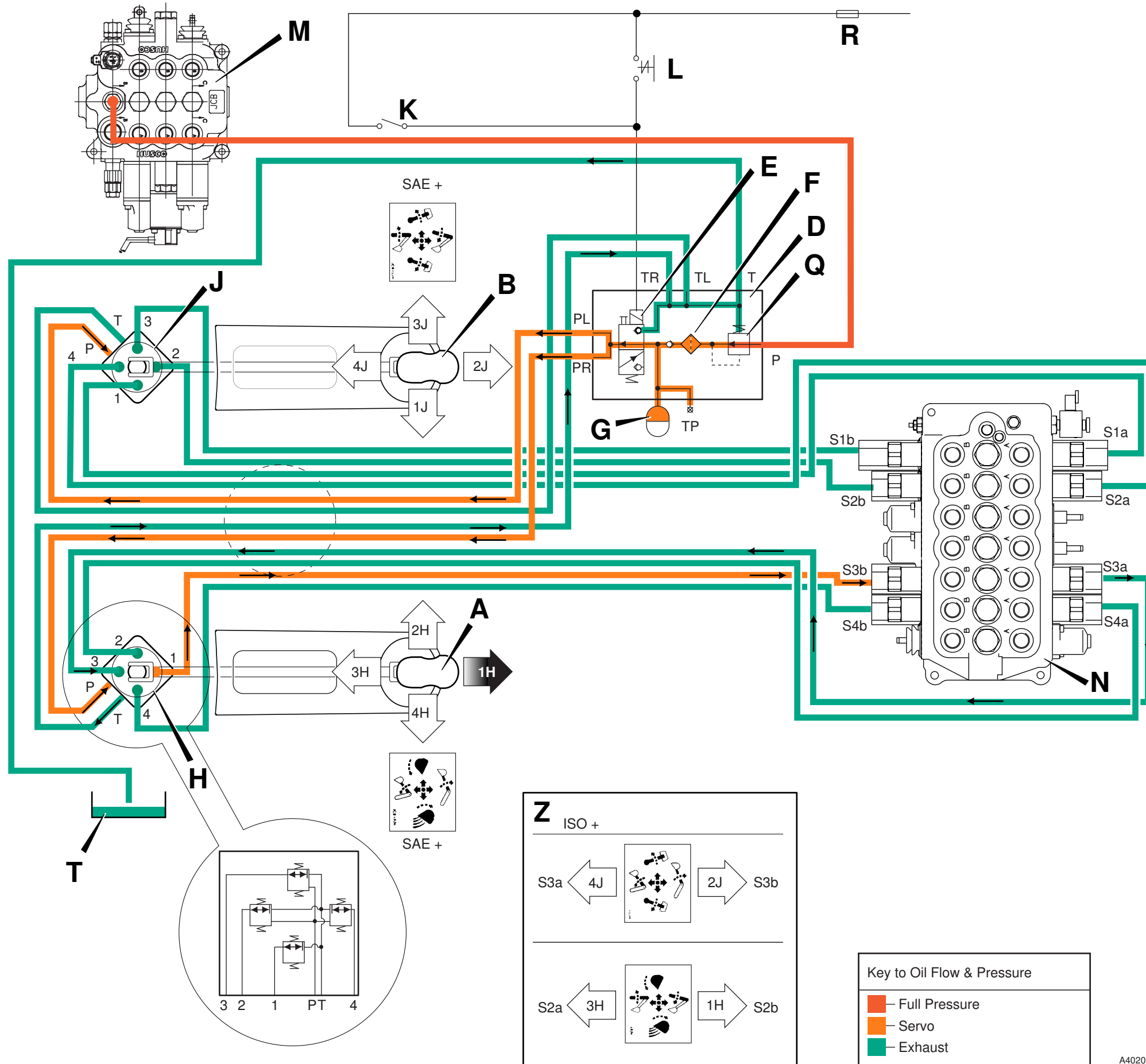
The joysticks control boom, dipper, bucket and slew functions. Unlike manual control machines, the foot pedal controlled auxiliary valve spool (typically used to operate the extending dipper ram) is located on the loader valve block. For details of this valve spool see Section E.

The seat arms incorporating the joysticks are adjustable for both height and length. A gas strut mounted in the left hand arm supports the weight of the assembly when adjusting the height.

#### Note: Precision control machines - extending dipper.

When fitted, the extending dipper ram is controlled by bolt on spool section **U** located on the loader valve. The spool is actuated by the normal foot pedal via a cable.





## Basic System Operation

### Component Key:

<b>A</b>	Right hand joystick
<b>B</b>	Left hand joystick
<b>D</b>	Pilot supply valve
<b>E</b>	Supply valve solenoid
<b>F</b>	Oil filter
<b>G</b>	Accumulator
<b>H</b>	Right hand pilot control valve
<b>J</b>	Left hand pilot control valve
<b>K</b>	Seat mounted micro switch
<b>L</b>	Joystick mounted 'mode switch'
<b>M</b>	Loader valve block
<b>N</b>	Excavator valve block
<b>P</b>	Machine hydraulic tank
<b>Q</b>	Pressure relief valve
<b>R</b>	Fuse
<b>S</b>	Solenoid manual override control knob
<b>S1a</b>	Excavator Pilot port - Slew ram spool
<b>S1b</b>	Excavator Pilot port - Slew ram spool
<b>S2a</b>	Excavator Pilot port - Boom ram spool
<b>S2b</b>	Excavator Pilot port - Boom ram spool
<b>S3a</b>	Excavator Pilot port - Dipper ram spool
<b>S3b</b>	Excavator Pilot port - Dipper ram spool
<b>S4a</b>	Excavator Pilot port - Bucket ram spool
<b>S4b</b>	Excavator Pilot port - Bucket ram spool
<b>T</b>	Tank

Note that the diagram opposite shows the servo hoses connected to give the SAE + (JCB +) control pattern. For ISO + control pattern some servo hoses are connected differently at the excavator valve, as shown at **Z**.

### Electrical Operation

A solenoid actuated valve is incorporated in the pilot supply valve block **D**. The solenoid is controlled either by micro switch **K** or 'mode switch' **L**.

When the operator seat is revolved to face the rear of the machine switch **K** is closed. This energises solenoid **E** and oil at pilot pressure is diverted to the 2 pilot control valves **H** and **J**, thus enabling the system. Solenoid **E** also incorporates a manual override facility (**S**). This enables the backhoe to be operated in an emergency situation, in the event of solenoid or electrical failure for example.

In some circumstances the operator may require actuation of the backhoe with the seat in the forward position (when un-sticking from boggy ground for example). This is achieved by means of joystick mounted mode switch **L**. The switch energises solenoid **E** and the system is enabled.

The left hand joystick houses a horn switch. On some machines the joysticks also incorporate switches for control of a hydraulic quickhitch and changeover from auxiliary (typically jaw bucket) to extending dipper operation.

### Hydraulic Operation

Oil at system pressure flows to the pilot supply valve **D** via a hose connected at the loader valve **M**. An integral pressure relief valve **Q** maintains the oil at 'pilot' pressure.

When the operator actuates the system by revolving the seat to face the rear, or by operating the mode switch, solenoid **E** is energised and moves the pilot supply valve spool. Oil flows to the pilot control valves **H** and **J**.

Each pilot control valve contains four spool valve 'capsules', numbered 1 to 4 on each valve. The valves are operated by moving the associated joystick. With the joystick in the neutral position all the valves vent oil from the excavator valve pilot ports S1-S4 to tank.

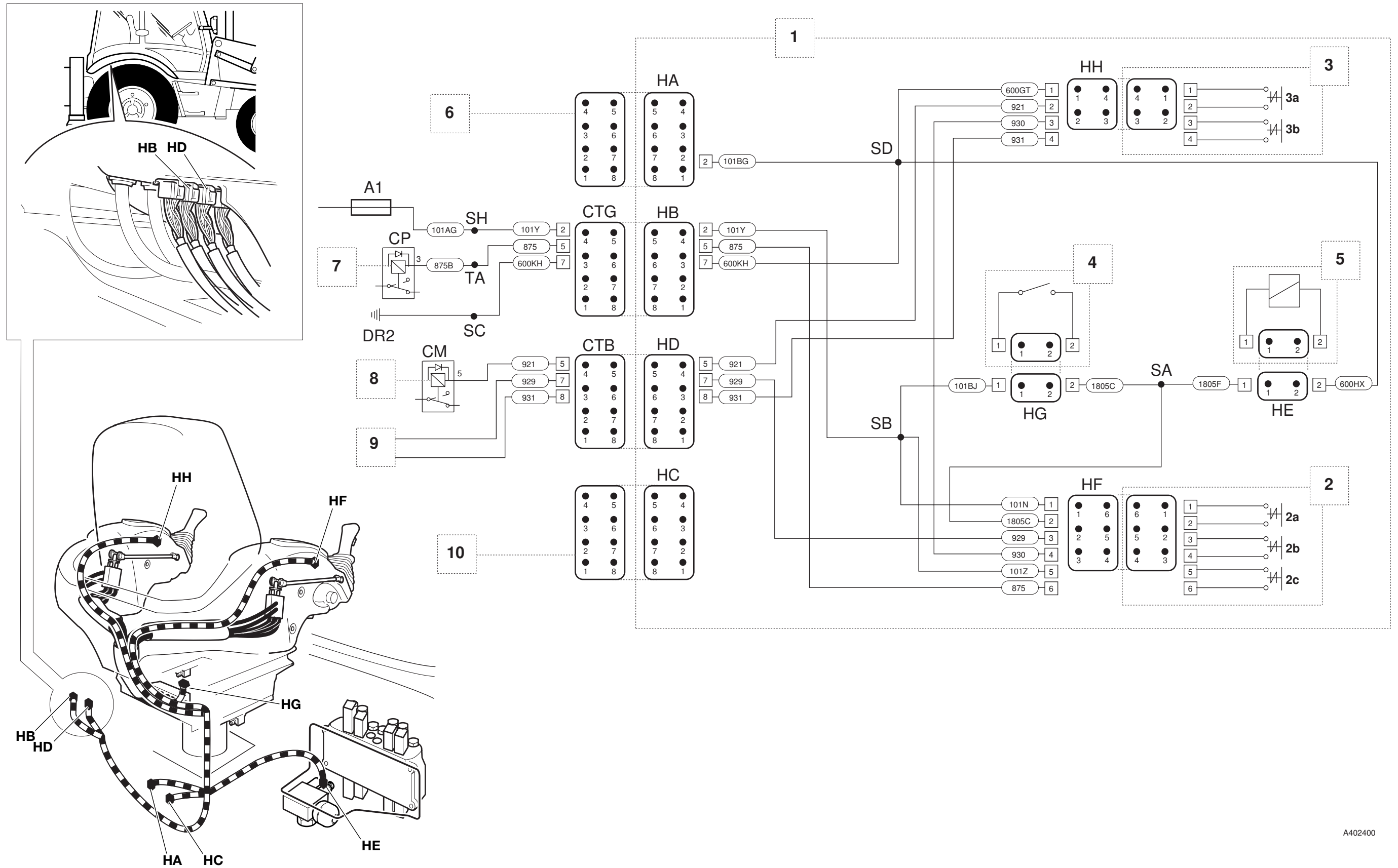
#### Example Operation:

When the operator moves the right hand joystick forward the mechanical linkage connected to pilot valve **H** pushes spool 1 down. Oil at pilot pressure is diverted to port S3b. in the excavator valve **N**. This causes the dipper spool to move and operate the dipper ram. As the dipper spool moves, oil is vented from port S3a via spool 3 and port T in control valve **H**.

The valve 'capsules' feature proportional control. This enables backhoe precision control. Each valve capsule modulates oil pressure supplied to the associated excavator valve pilot line in proportion to the joystick position. The further the joystick is moved the greater the pilot pressure and the further the associated excavator valve spool moves.

Accumulator **G** maintains hydraulic pressure for several operations of the excavator spools with the engine stopped. This allows venting of pressure from the backhoe hydraulic rams, or lowering of a load in the event of engine failure.

Electrical Connections



A402400

## Electrical Connections

On the electrical diagram opposite the electrical connectors (example, CTG to HB) are shown looking on the mating face of each connector when they are disconnected.

The wire numbers and colours, where appropriate, are shown as an aid to identification whilst fault finding.

Before fault finding make sure that you understand how the the electrical circuits work. Most potential faults can be traced using a multimeter to carry out continuity checks on wires, switches and solenoid coils. See **Service Procedures, Electrical Testing Methods** for more details.

### Component Key:

- 1 Servo harness
  - HA** Auxiliary hydraulics harness loop connector
  - HB** Auxiliary hydraulics connector
  - HC** Rear cab harness loop connector
  - HD** Rear cab harness connector
  - HE** Pilot control valve solenoid connector
  - HF** Right hand joystick connector
  - HG** Seat microswitch connector
  - HH** Left hand joystick connector
- 2 Right hand joystick
  - 2a** Microswitch - Mode
  - 2b** Microswitch - Excavator quickhitch latch control (if fitted)
  - 2c** Microswitch - Hydraulic changeover solenoid valve (if fitted)
- 3 Left hand joystick
  - 3a** Microswitch - Rear Horn
  - 3b** Microswitch - Excavator quick hitch latch control (if fitted)
- 4 Seat mounted microswitch
- 5 Pilot control valve solenoid
- 6 Auxiliary hydraulics wiring harness, see **Basic System Operation, Circuit Schematics**
- 7 Hydraulic change over circuit, see **Basic System Operation, Circuit Schematics, Auxiliary and Hydraclamp Hydraulics**
- 8 Rear horn circuit, see **Basic System Operation, Circuit Schematics**
- 9 Dedicated quick hitch circuit, see **Basic System Operation, Dedicated Quick Hitch**
- 10 Rear cab harness
- A1** Fuse - Hydraulic Auxiliary
- CP** Relay base - Auxiliary (jaw bucket)
- CM** Relay base - Rear horn

### Splices:

- SA**
- SB**
- SC**
- SD**
- SH**
- TA**

## Fault Finding

### Introduction

The fault finding procedures are given in the form of flow charts. There are a number of charts, each one dedicated to a particular fault. The charts are designed to identify possible causes by performing checks and where applicable, specific tests. Having identified a cause the suggested remedy is given. The charts are designed to identify causes through a process of elimination, starting with the simplest, most easily rectified faults.

Before proceeding:

- 1 Make sure that the hydraulic fluid is at the correct working temperature (50°C, 122°F).
- 2 Be sure to remove ALL contamination and if possible identify its origin. It may be part of a component from elsewhere in the circuit.
- 3 Replace any seals such as 'O' rings before assembling hydraulic components.

### Fault Finding Charts:

**Chart A** - No Servo Controls (system fails to operate)

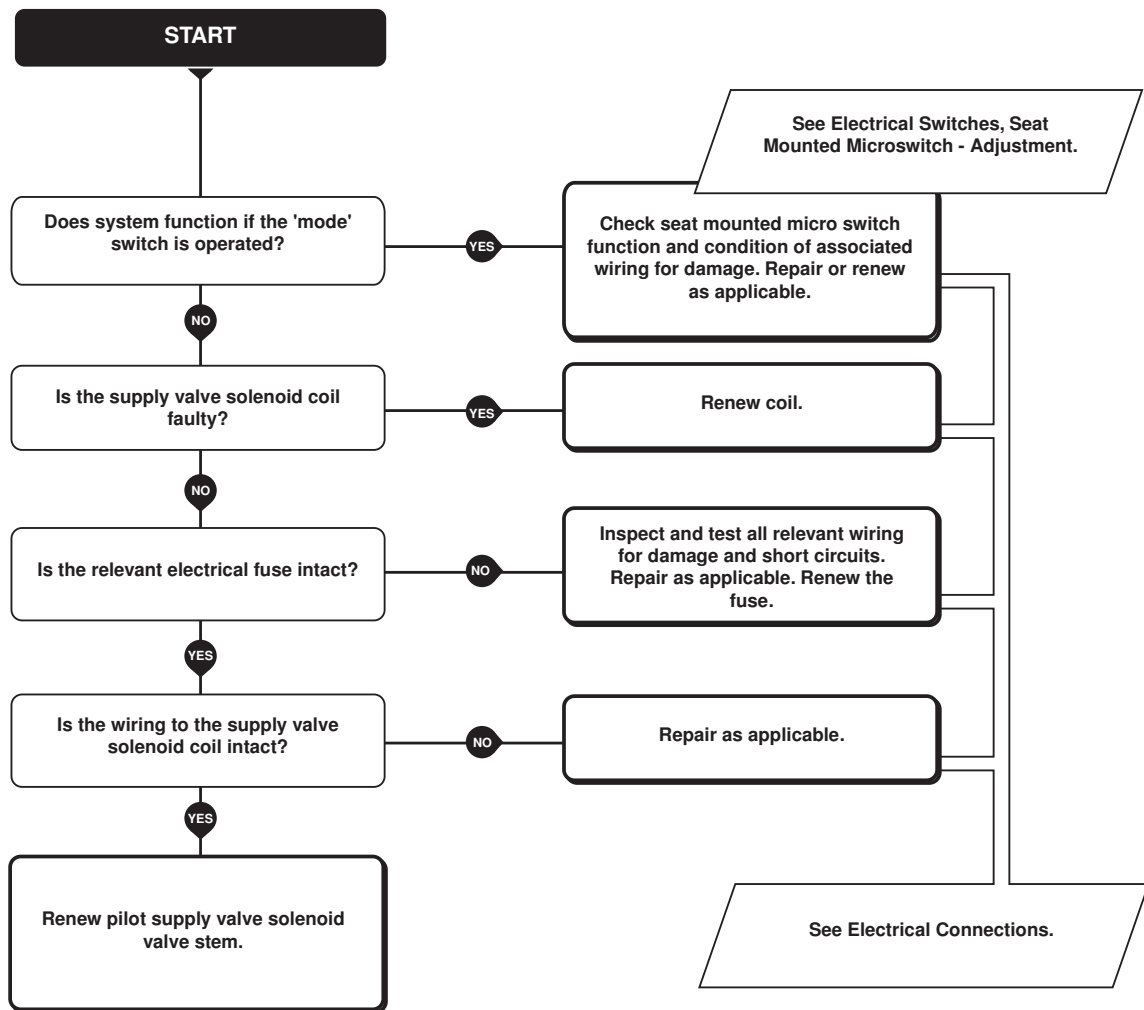
**Chart B** - All Backhoe Services Slow to Operate

**Chart C** - One Backhoe Service fails or is Slow to Operate

**Chart D** - System Fails to Operate when the 'Mode Switch' is Activated (operator seat facing forward)

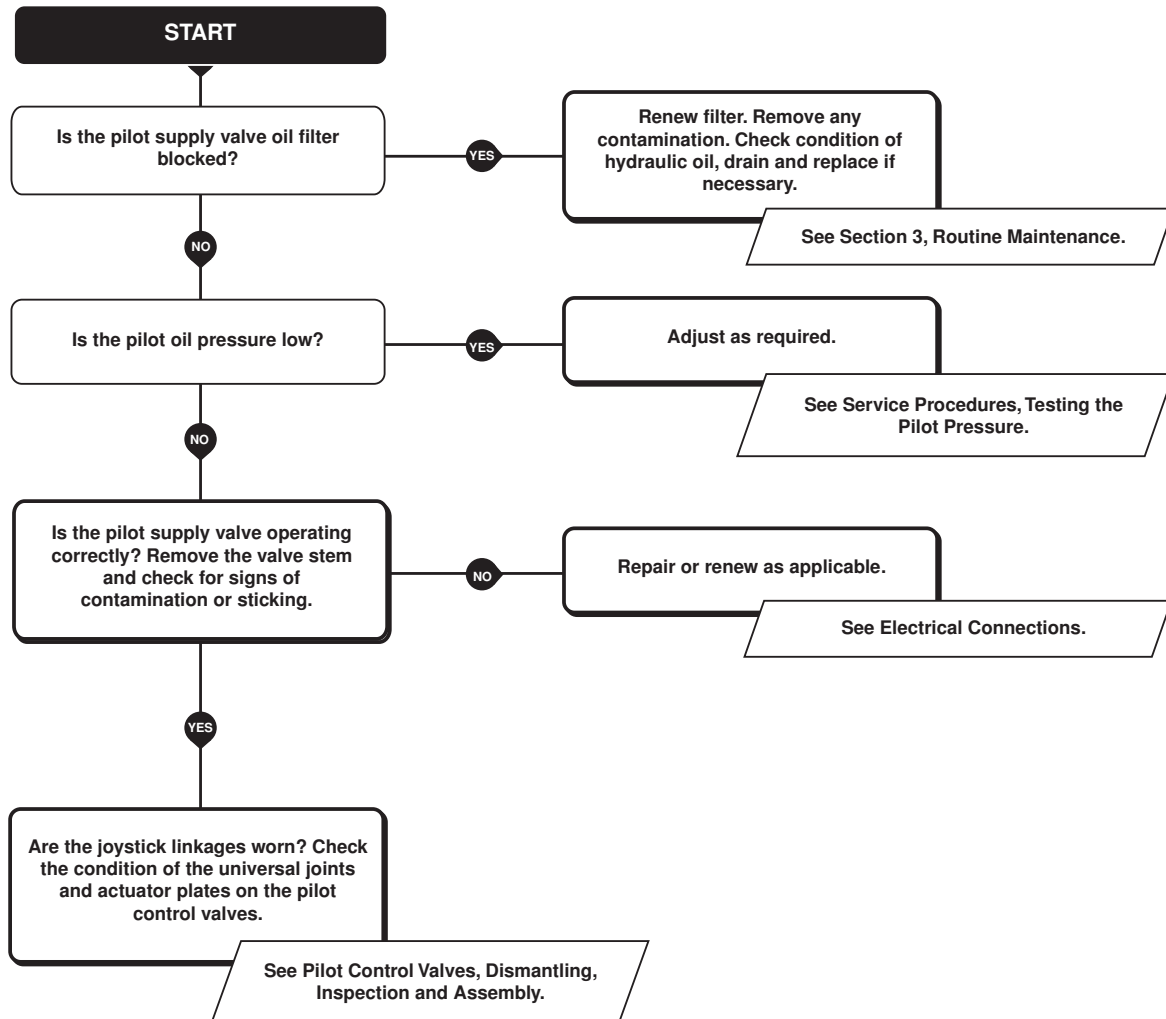
**Fault Finding**

**Chart A - No Servo Controls (system fails to operate)**



**Fault Finding**

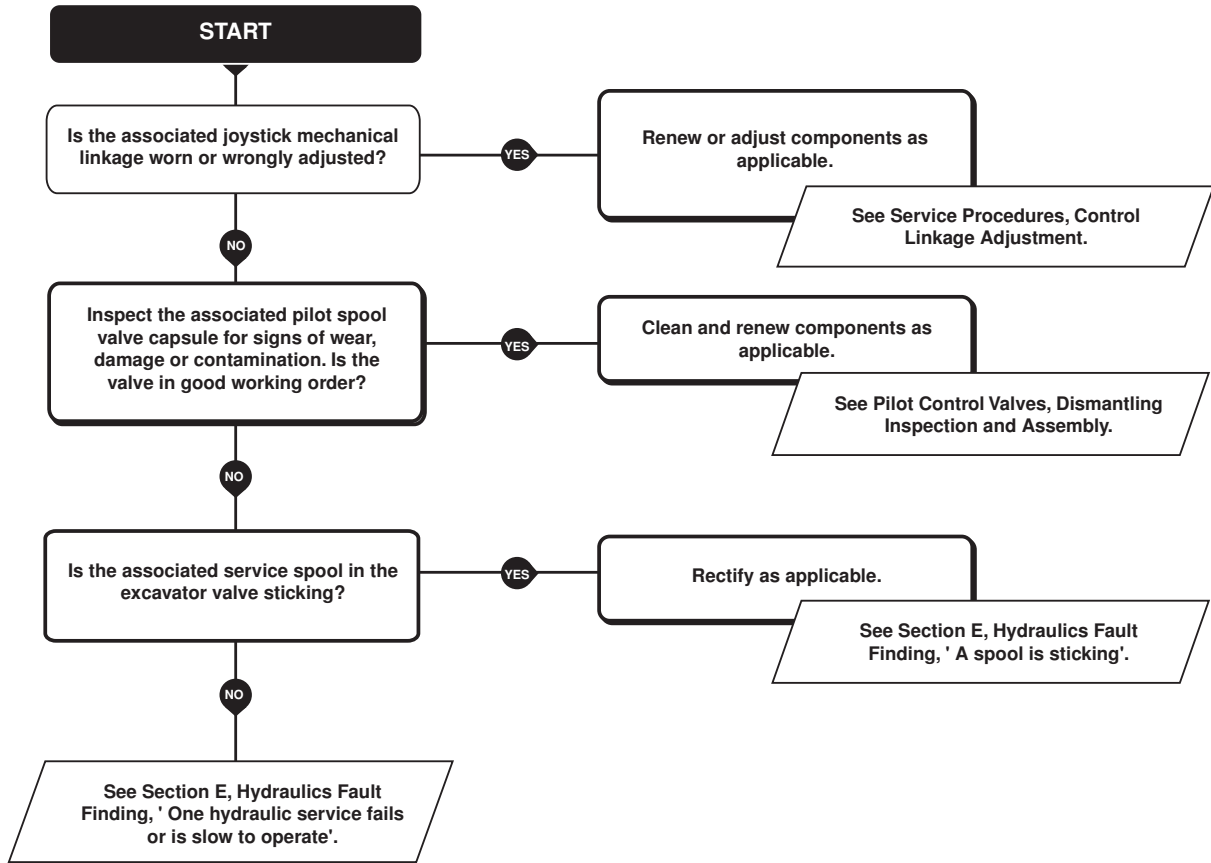
**Chart B - All Backhoe Services Slow to Operate**



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**Fault Finding**

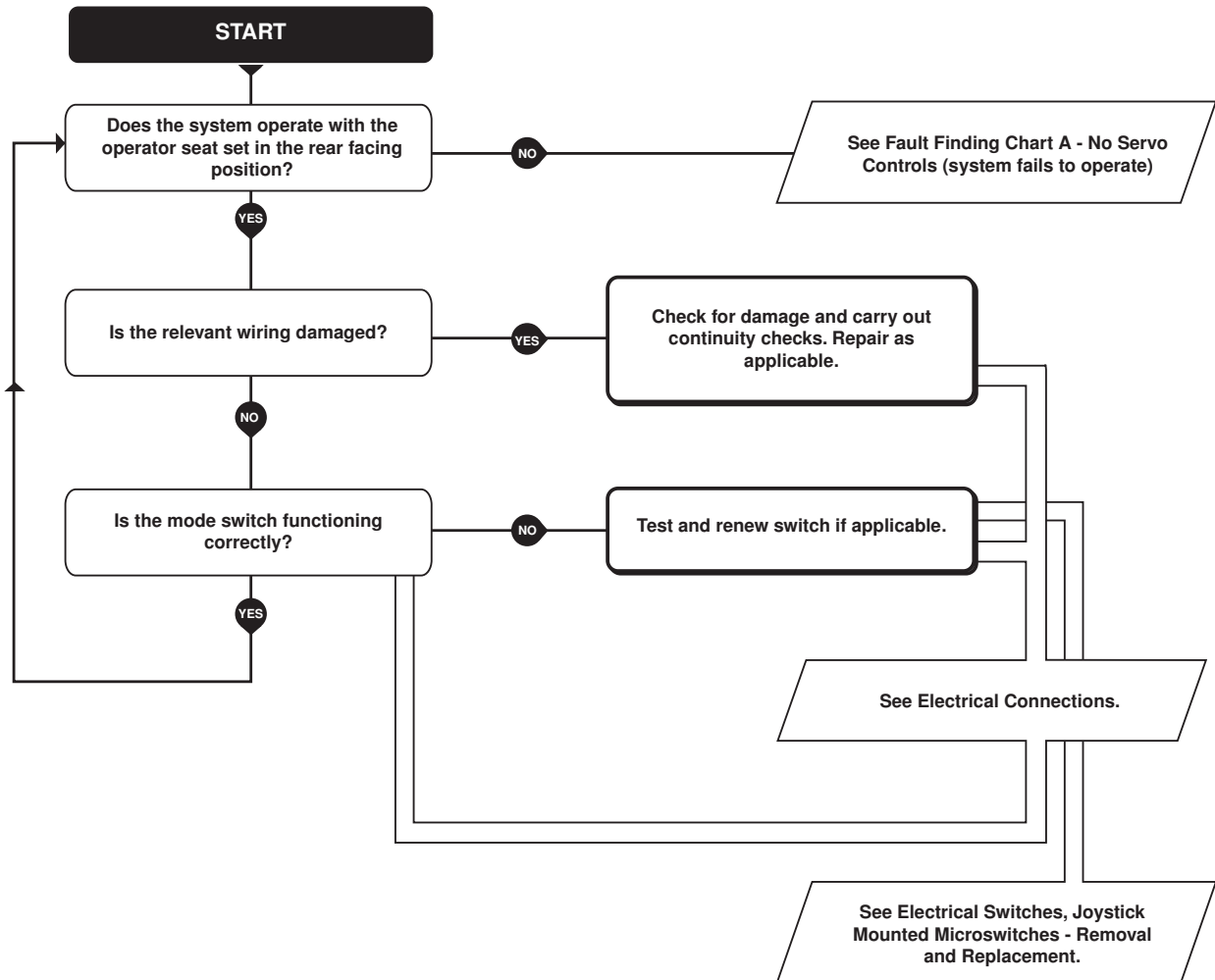
**Chart C - One Backhoe Service fails or is Slow to Operate**





**Fault Finding**

**Chart D - System Fails to Operate when the 'Mode Switch' is Activated (operator seat facing forward)**



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## Service Procedures

### Testing the Pilot Pressure

- 1 Position the backhoe to enable access to the pilot supply valve.

Before proceeding further the pilot circuit accumulator pressure must be vented.

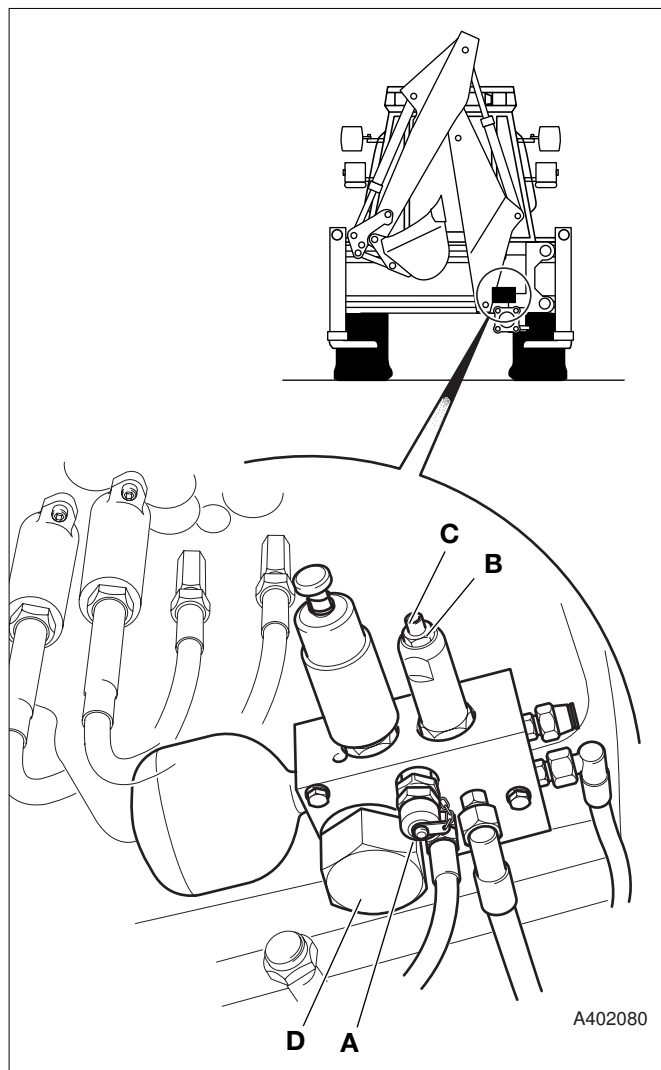
- 2 Stop the engine. With the operator seat set in the rear facing position (for backhoe operation), switch the starter to ON without starting the engine. Operate the joystick controls several times to vent the servo pressure from the accumulator. Switch the starter switch to the OFF position.
- 3 Connect a 0 - 50 bar pressure gauge to the test point **A**.
- 4 With the engine running at 1500 revs/min, operate a backhoe service fully. At the same time check the reading on the gauge. It should be 35 bar (36 kgf/cm<sup>2</sup> 507 lbf/in<sup>2</sup>).

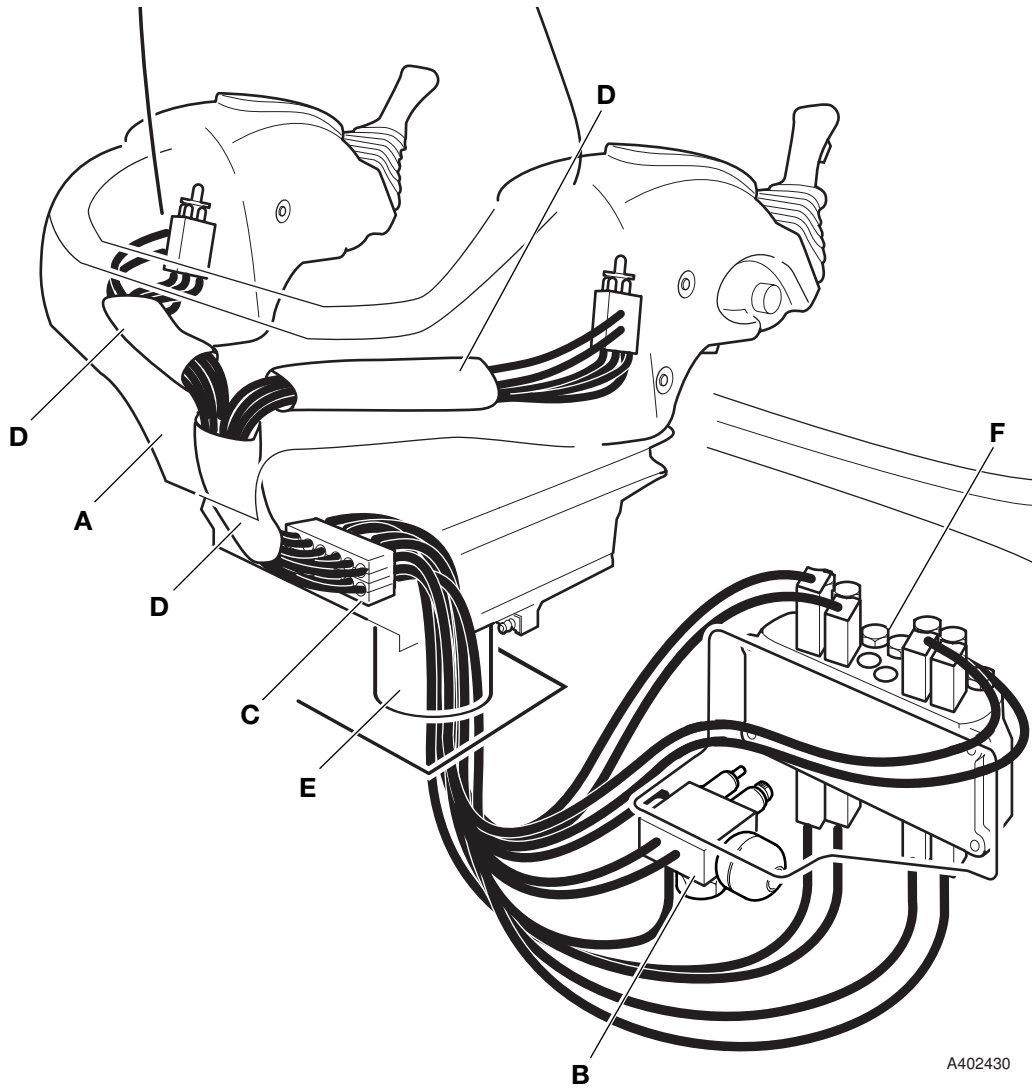
If necessary adjust the pressure as follows:

- 1 Stop the engine. Loosen lock nut **B** and adjust screw **C**. Turn screw **C** clockwise to increase pressure and anti-clockwise to decrease the pressure. When the pressure is correct, tighten the locknut and check the pressure again. Adjust as required.

### Renewing the Pilot Supply Valve Oil Filter

- 1 Position the backhoe to enable access to the pilot supply valve.
- 2 Stop the engine. Clean off all dirt on and around the filter cap **D**. Undo the cap. Remove and discard the filter element. The servo system is easily damaged by contaminated hydraulic oil. When installing a new filter element make sure that no dirt is allowed to enter the pilot supply valve.





A402430

## Service Procedures

### Pilot Hose Removal and Replacement

Before attempting to remove a servo hose the pilot circuit accumulator pressure must be vented.

- 1 Stop the engine. With the operator seat set in the rear facing position (for backhoe operation), switch the starter to ON without starting the engine. Operate the joystick controls several times to vent the servo pressure from the accumulator. Switch the starter switch to the OFF position.
- 2 Note the phasing and routing of the hose to be renewed. Working under the machine, disconnect the applicable hose. Note that the hoses have tags to identify their connections. Plug the open ports. Remove the hose from any ties under the machine.
- 3 Working in the cab remove the plastic shrouds **A** from the seat as required. Disconnect the hose at the pilot control valve **B**. Note that the hoses have tags to identify their connections. Attach some strong string or cord to the end of the disconnected hose.
- 4 Undo the hose clamp **C** at the base of the seat frame.
- 5 Draw the hose up into the cab through pedestal **E** and sleeves **D**. Undo the string from the end of the hose.
- 6 Make sure that the open ends of the new hose are plugged. Tie the correct end of the hose to the string. Draw the hose down through the sleeves **D** and pedestal **E**.
- 7 Remove the string and connect the hose as applicable, making sure to phase it correctly. Refit the hose clamp **C**.
- 8 Tag the new hose at both ends to identify its connections.

## Service Procedures

### Seat Arms Control Lever - Adjustment

In some instances it may be necessary to adjust the operation of the arms raise/lower control lever **1**.

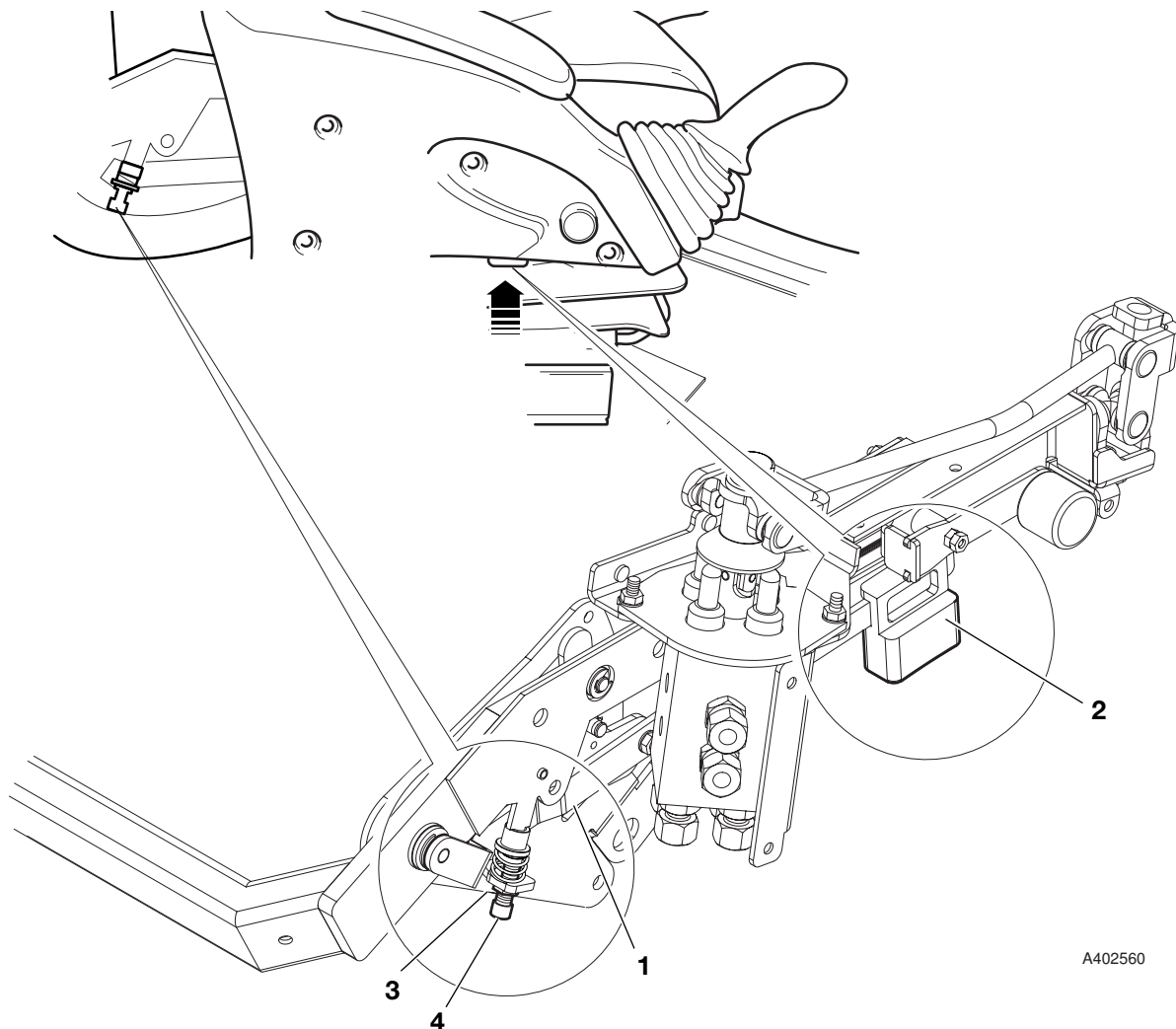
When the button **2** is depressed upwards fully, the arms are released for raise/lower. If the arms are not released, or release but re-lock when the button is fully depressed, adjust the control lever as follows:

#### If the arms do not release

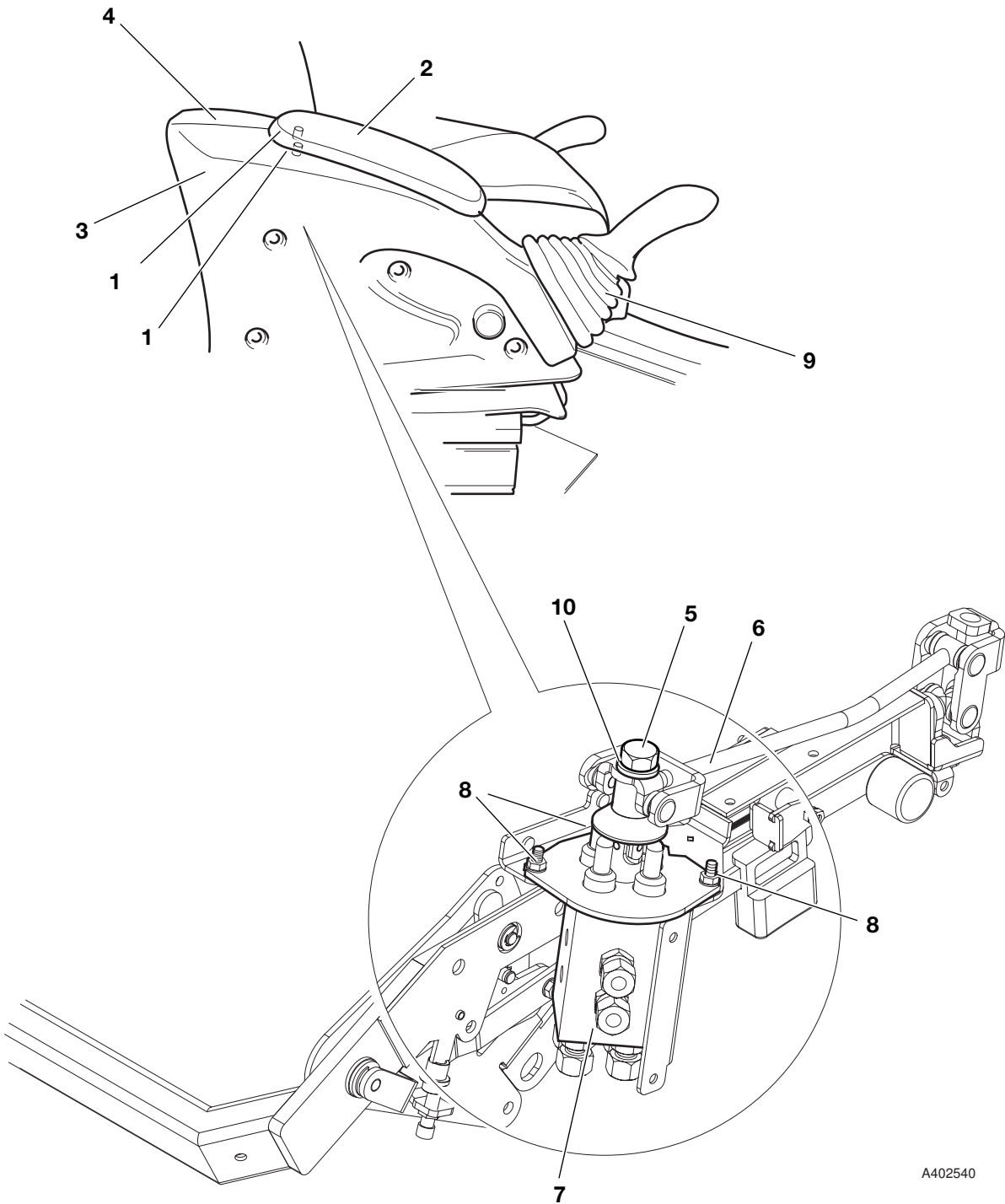
- 1 Slacken lock nut **3** and screw the stop bolt **4** out (anti-clockwise). Test the operation of the control lever and then tighten the lock nut **3**.

#### If the arms release but re-lock

- 1 Slacken lock nut **3** and screw the stop bolt **4** in (clockwise). Test the operation of the control lever and then tighten the lock nut **3**.



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## Pilot Control Valves

### Removal and Replacement

Note that the procedure shows the right hand control valve. The removal and replacement procedure for the left hand valve is identical.

Before attempting to remove a pilot control valve the pilot circuit accumulator pressure must be vented.

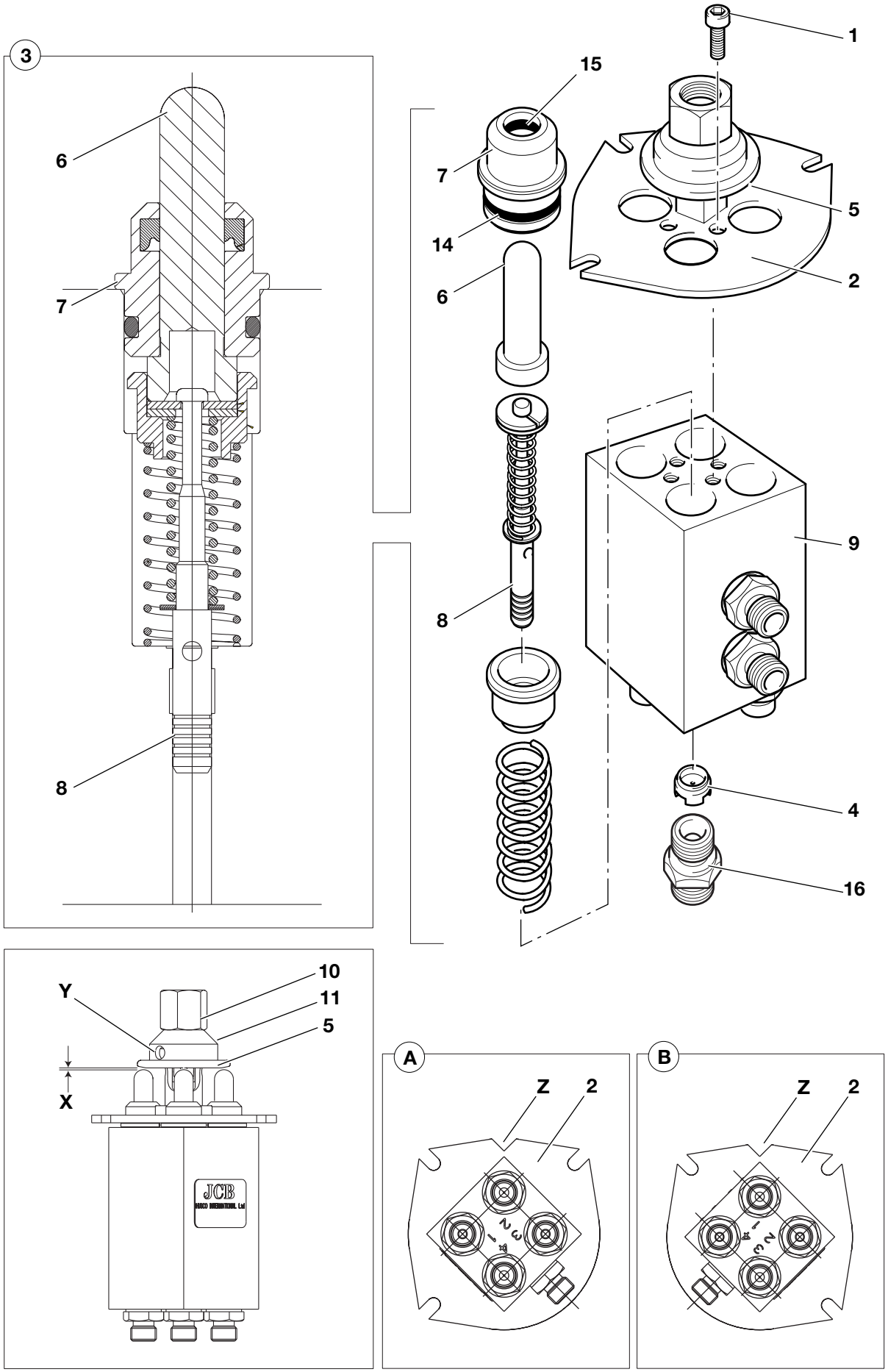
- 1 Stop the engine. With the operator seat set in the rear facing position (for backhoe operation), switch the starter to ON without starting the engine. Operate the joystick controls several times to vent the servo pressure from the accumulator. Switch the starter switch to the OFF position.

### Removal

- 1 Reach inside the arm assembly and undo the two arm rest fixing bolts **1**. Carefully lift the rear of the arm rest **2** and pull it to the rear to release.
- 2 Undo the retaining screws and remove the plastic covers **3** and **4**. Undo and remove bolt **5** together with lock washer **10**. Lift the link rod **6** to one side.
- 3 Note the phasing of the hoses connected at the valve **7**. If the hoses are not already tagged, tie on your own tags. Make sure you have recorded the connections correctly, enabling correct re-connection when replacing the valve. Disconnect the hoses at the valve. Cap all open hoses and ports.
- 4 Undo the three fixing bolts **8** and lift out the valve.

### Replacement

Replacement is the reverse of removal. Make sure that the joystick gaiter **9** is correctly located.



A402440



## Pilot Control Valves

### Dismantling, Inspection and Assembly

Note that the procedure shows the right hand control valve. The procedure for the left hand valve differs only in the location of one way restrictors **4** and orientation of joint mechanism assemblies **2**.

#### Dismantling

- 1** Undo the three cap screws **1**. Lift off the joint mechanism assembly **2**.
- 2** Pull out the four valve capsule assemblies **3**.
- 3** Remove the six adaptors **16** from the ports. Note that the adaptors incorporate seals. Note that one way restrictors **4** are fitted to some ports as follows:  
Right hand valve - ports 1 and 3.  
Left hand valve - ports 2 and 4.

#### Inspection

- 1** Inspect the underside of the wobble plate **5** for signs of excessive wear. If wear is evident the complete assembly **2** must be renewed.
- 2** Inspect the universal joint for signs of excessive play. If wear is evident the complete assembly **2** must be renewed.
- 3** Inspect the mating faces of plungers **6** and bushes **7** for signs of excessive wear. If wear is evident the valve capsule must be renewed as a complete assembly.
- 4** If the valve has been contaminated with debris be sure to remove it from all internal drillings. Carefully inspect the mating faces of spools **8** and body **9**. If scoring is evident the complete valve must be renewed.
- 5** Make sure that one way restrictors **4** are free from debris.

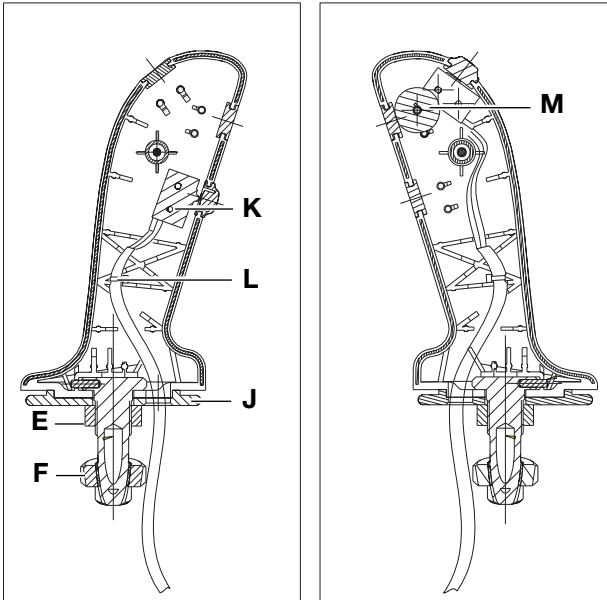
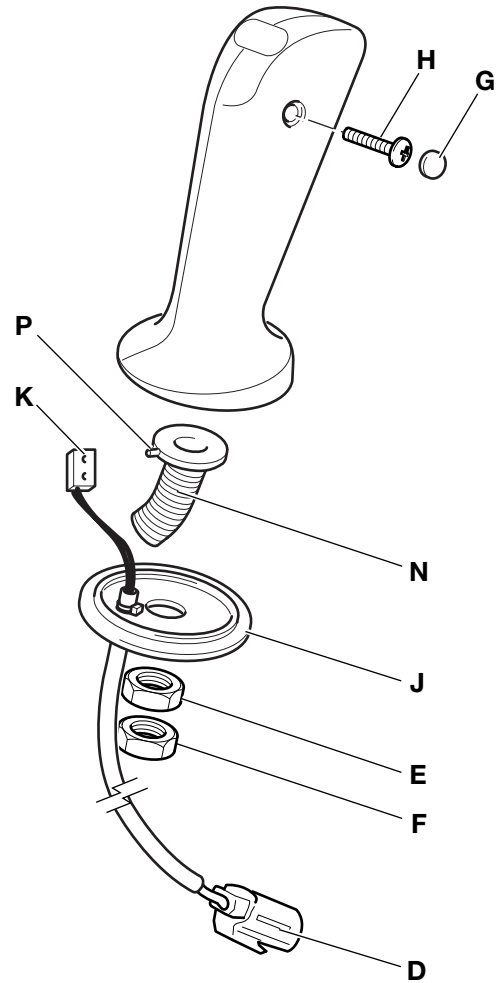
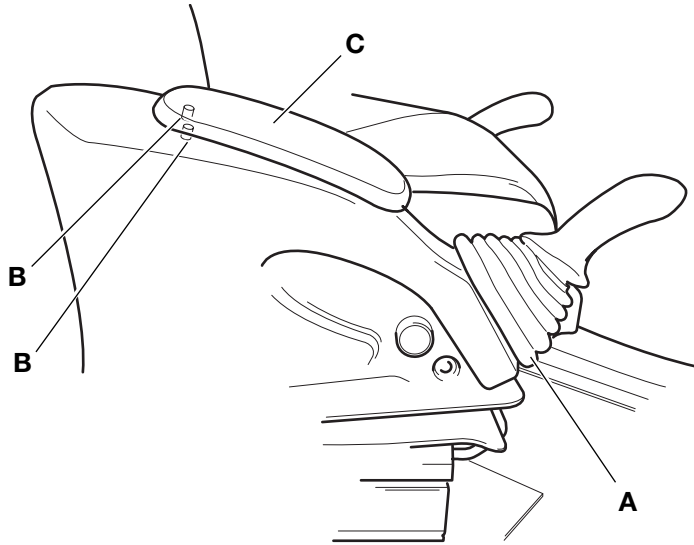
#### Assembly

Assembly is the reverse dismantling but note the following:

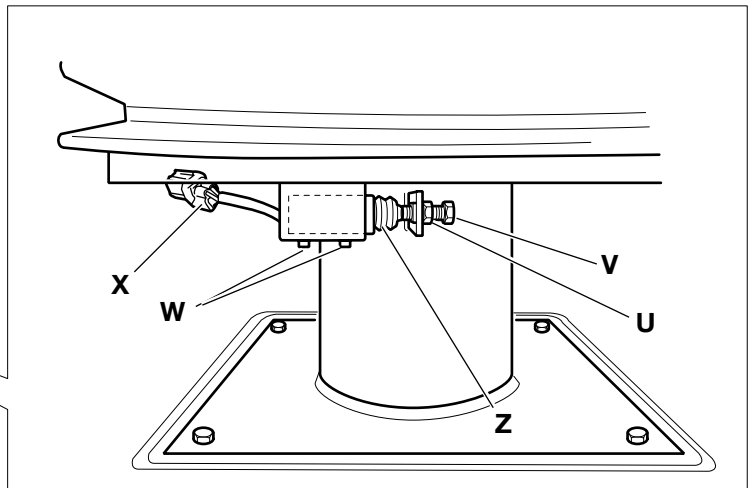
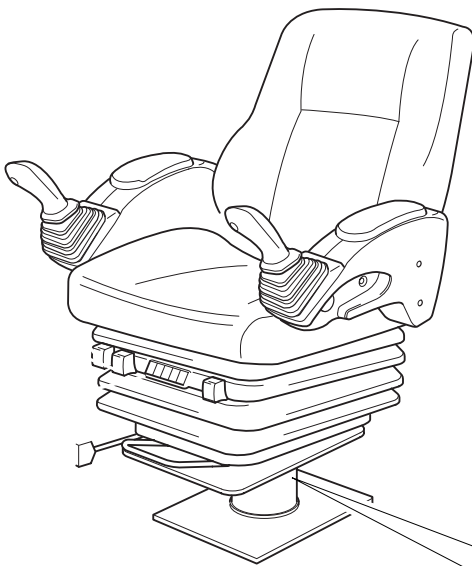
- 1** The valve assembly is susceptible to malfunction and damage if it is contaminated with debris or dirt. Make sure that all components are clean and free from debris.
- 2** Renew all 'O' rings **14** and seals **15**.
- 3** Be sure to fit the one way restrictors **4** the correct way up and in the correct ports. See Dismantling, Step 3.
- 4** Apply JCB HP Grease to the mating faces of wobble plate **5** and plungers **6**.
- 5** Be sure to orientate the joint mechanism assembly **2** correctly. On left hand valves note that the slot **Z** aligns with port **2** as shown at **A**. On right hand valves the slot **Z** aligns with port **1** as shown at **B**.
- 6** If the joint mechanism assembly **2** is to be renewed it must be adjusted correctly. With the assembly fixed in position, check the dimension **X**. The wobble plate **5** must be positioned so that it just makes contact with the top of the valve plungers. If there is a gap at **X**, or if the plate is depressing the plungers adjust as follows: Hold the collar **11** using a suitable rod located in hole **Y**. Slacken the lock nut **10** and then screw the collar **13** up or down as required. Tighten the lock nut **10**.

#### Torque Settings:

Item	Nm	Kgf m	lbf ft
<b>1</b>	<b>9</b>	<b>1</b>	<b>7</b>
<b>10</b>	<b>9</b>	<b>1</b>	<b>7</b>
<b>16</b>	<b>30</b>	<b>3</b>	<b>22</b>



A402410



A402590

## Electrical Switches

### Joystick Mounted Microswitches, Removal and Replacement

Note that the procedure shows the right hand joystick. the procedure is very similar for the left hand joystick. Note that where the joysticks incorporate more than one switch, all switches must be renewed as a complete harness and switch assembly.

#### Removal

- 1 With the operator seat set in the rear facing position (for backhoe operation), pull off the gaiter **A**.
- 2 Reach inside the arm assembly and undo the two arm rest fixing bolts **B**. Carefully lift the rear of the arm rest **C** and pull it to the rear to release.
- 3 Uncouple the joystick harness connector **D** from the servo harness. Note the orientation of the joystick. Slacken the lock nut **E** followed by lock nut **F**. Unscrew the joystick and remove it from the machine. Remove lock nuts **E** and **F**.
- 4 Drill a small hole in the centre of plastic cap **G**. Screw in a self tapping screw. Using pliers, grip the screw and draw out the cap **G**. Undo screw **H**. Lever off the aluminium base plate **J**.
- 5 Carefully part the two halves of the joystick making sure that components are not lost. Lift the switches **K** off their location pins. Note that replacement switches are supplied together with a new base plate **J**, wiring harness and connector already assembled.

#### Replacement

Replacement is the reverse of removal but note the following:

- 1 When assembling the joystick ensure that the wiring harness is located correctly. Cable tie **L** must be located to prevent strain on the wire connections at the switches. Make sure that bush **M** is fitted correctly (if applicable). If spigot **N** has been removed make sure it is fitted with its alignment pin **P** correctly located. Fit a new plastic cap **G**.
- 2 When screwing the joystick assembly to the control linkage be sure to orientate it correctly before tightening the lock nut **F**.

### Seat Mounted Microswitch, Removal, Replacement and Adjustment.

**Important Note:** Some machines may be fitted with two seat mounted microswitches, one on each side of the seat. On Precision Control machines only switch **Z** is used. Note that switch **Z** is located on the left side of the seat when set in the rear facing position. When renewing the switch make sure you re-connect the wiring harness to the correct switch. Under no circumstances attempt to connect to the switch on the right hand side of the seat.

#### Removal

- 1 With the operator seat set in the forward facing position (for loader operation), uncouple the electrical connector **X**. Undo the two retaining screws **W** and remove the switch.

#### Replacement

Replacement is the reverse of removal.

#### Adjustment

The switch must be adjusted to operate only when the operator seat is locked in the rear facing position. This is essential for safe operation of the machine, preventing backhoe operation until the operator is correctly seated.

- 1 With the operator seat set in the rear facing position (for backhoe operation), locate the adjustable bolt **V** on the seat pedestal. Loosen the lock nut **U** and screw the bolt in or out until the switch is heard to operate. Tighten lock nut **U**.
- 2 Start the machine and test the system.

**Basic System Operation**

**Component Location**

TBA

## Basic System Operation

### Component Identification

<b>A</b>	Right hand joystick controller
<b>B</b>	Left hand joystick controller
<b>C</b>	Operator seat
<b>D</b>	Servo pressure supply valve
<b>E</b>	Isolation valve solenoid
<b>F</b>	Accumulator
<b>G</b>	Servo pressure regulating valve
<b>H</b>	Servo pressure relief valve
<b>J</b>	Loader valve block
<b>K</b>	Excavator valve block
<b>L</b>	Hydraulic tank

The following section describes the JCB Precision Control system fitted to machines from January 2003. There is another JCB Precision Control system fitted to earlier machines, which is described in a separate section. Refer to **Precision Control (Servo) - Machines up to serial number 931159**.

### Circuit Description

The JCB Precision Control system facilitates operation of the backhoe (excavator) via joystick controllers **A** and **B** mounted in the arms of the operator's seat. Unlike manual machines the excavator valve spools are moved by hydraulic pressure and not directly by mechanical levers.

A servo pressure supply valve **D** maintains a constant supply of oil at servo pressure to the right and left hand joystick controllers.

The joysticks each directly operate pressure reducing valves. These valves in turn operate the excavator valve spools via hydraulic servo pressure. The interconnecting hoses are routed to and from the joystick controllers through the central seat support pillar and then through the cab floor.

The joysticks control the boom, dipper, bucket and slew functions.

## Basic System Operation

### Hydraulic Operation

Oil at system pressure flows to the servo pressure supply valve **C** via a hose connected at the excavator valve **J**. An integral pressure regulating valve **F** maintains the oil at 'servo' pressure.

When the operator actuates the system by locking the seat in the forward or reverse facing position and raising forward the arm rests, the isolation valve solenoids **D** are energised and oil is directed to the joystick controllers **A** and **B**.

Each joystick controller contains four spool valve 'capsules', numbered 1 to 4 on each valve. The valves are operated by moving the associated joystick. With the joystick in the neutral position the valves vent the oil from the excavator valve servo pilot ports to tank **K**.

#### Example Operation:

When the operator moves the right hand joystick **B** forward this pushes spool 3 down. Oil at servo pressure is directed to port **S5b** at the excavator valve **J**. This causes the boom spool to move and operate the boom ram. As the boom spool moves, oil is vented from port **S5a** via spool 1 and port T to tank.

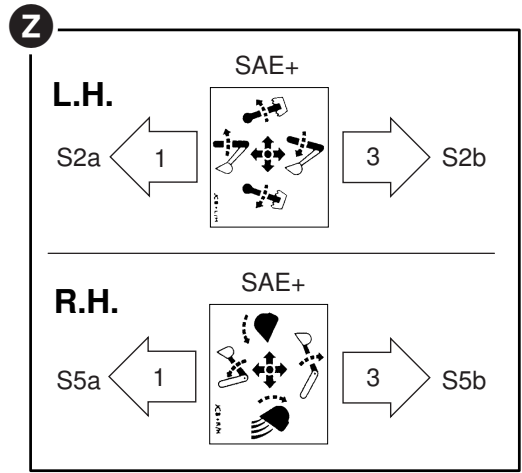
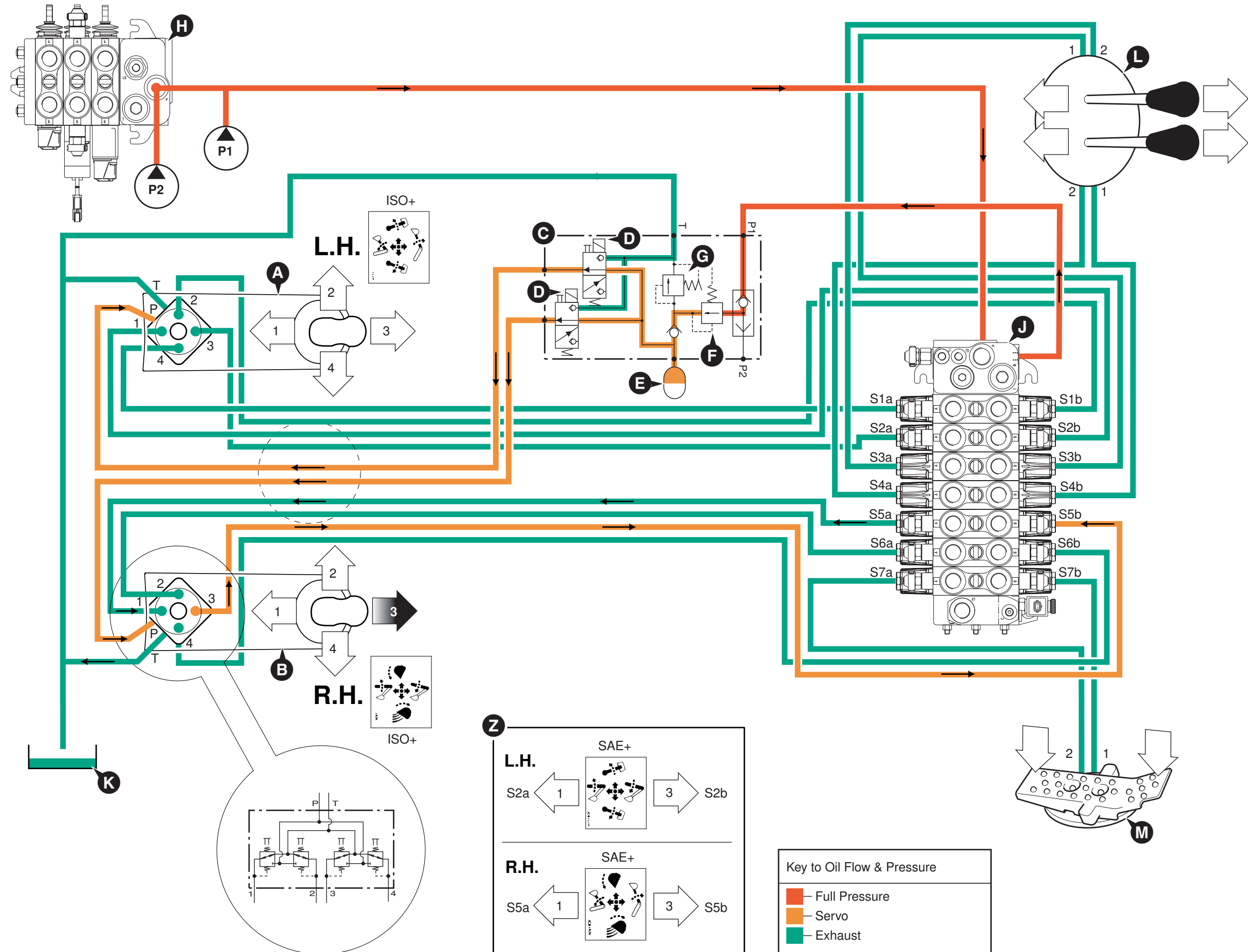
The valve 'capsules' feature proportional control. This enables backhoe precision control. Each valve capsule regulates the oil pressure supplied to the associated excavator valve pilot line in proportion to the joystick position. The further the joystick is moved the greater the servo pressure and the further the associated excavator valve spool moves.

Accumulator **E** maintains servo pressure for several operations of the excavator spools with the engine stopped. This allows venting of pressure from the backhoe hydraulic rams, or lowering of a load in the event of engine failure.

**Note:** The diagram opposite shows the servo pilot hoses connected to give the ISO + control pattern. For SAE + control pattern the servo pilot hoses are connected differently at the excavator valve as shown at **Z**.

#### Component Key:

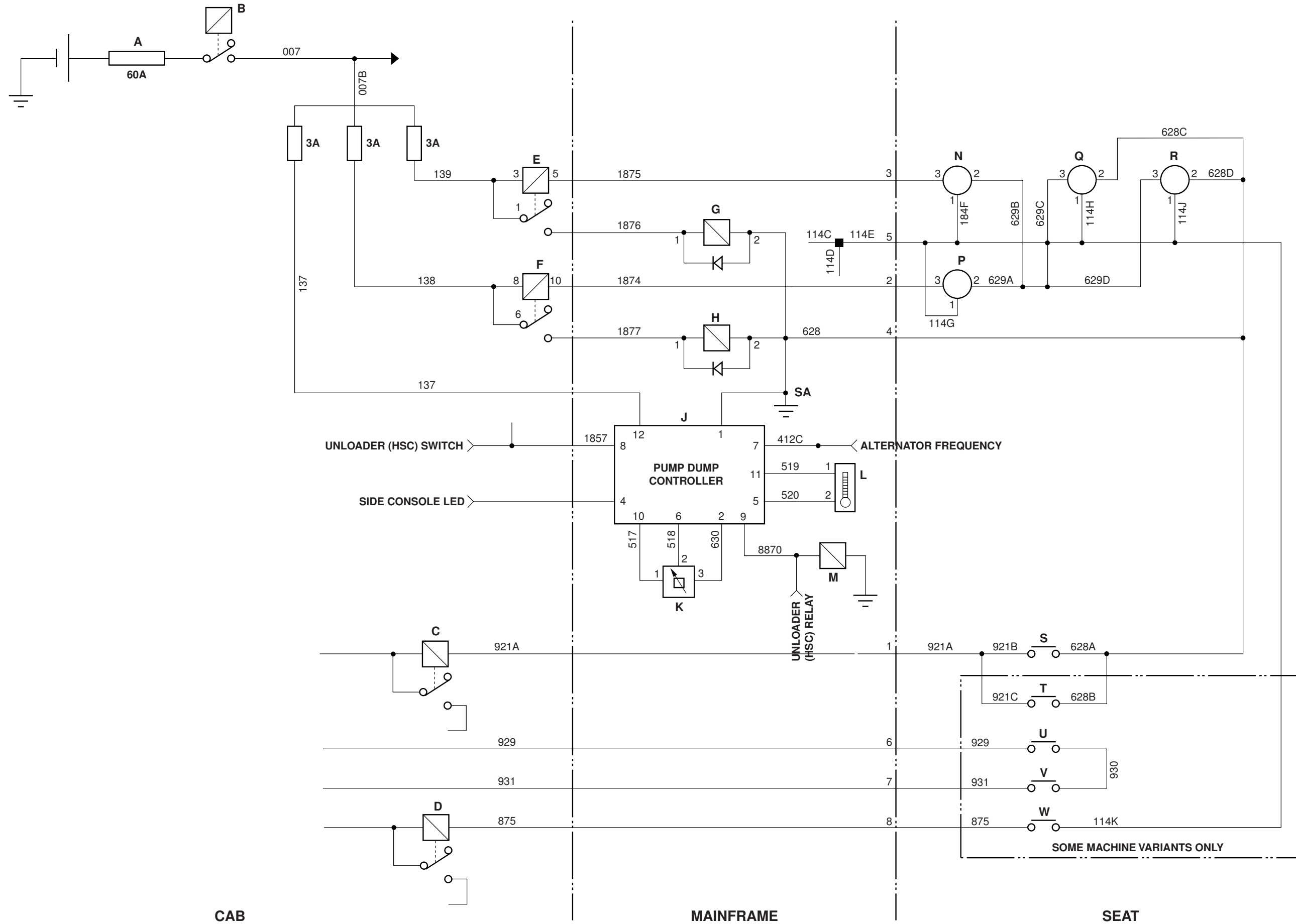
<b>A</b>	Left hand joystick controller
<b>B</b>	Right hand joystick controller
<b>C</b>	Servo pressure supply valve
<b>D</b>	Isolation valve solenoids
<b>E</b>	Accumulator
<b>F</b>	Servo pressure regulating valve
<b>G</b>	Servo pressure relief valve
<b>H</b>	Loader valve block
<b>J</b>	Excavator valve block
<b>K</b>	Hydraulic tank
<b>L</b>	Stabiliser controls
<b>M</b>	Auxiliary footpedal
<b>S1a</b>	Servo pilot port - Slew ram spool
<b>S1b</b>	Servo pilot port - Slew ram spool
<b>S2a</b>	Servo pilot port - Dipper ram spool
<b>S2b</b>	Servo pilot port - Dipper ram spool
<b>S3a</b>	Servo pilot port - R.H. stabiliser ram spool
<b>S3b</b>	Servo pilot port - R.H. stabiliser ram spool
<b>S4a</b>	Servo pilot port - L.H. stabiliser ram spool
<b>S4b</b>	Servo pilot port - L.H. stabiliser ram spool
<b>S5a</b>	Servo pilot port - Boom ram spool
<b>S5b</b>	Servo pilot port - Boom ram spool
<b>S6a</b>	Servo pilot port - Bucket ram spool
<b>S6b</b>	Servo pilot port - Bucket ram spool
<b>S7a</b>	Servo pilot port - Auxiliary spool (Extending Dipper)
<b>S7b</b>	Servo pilot port - Auxiliary spool (Extending Dipper)



**Key to Oil Flow & Pressure**

<span style="color: orange;">—</span>	Full Pressure
<span style="color: red;">—</span>	Servo
<span style="color: green;">—</span>	Exhaust

A404990



CAB

MAINFRAME

SEAT



## Basic System Operation

### Electrical Operation - Joystick Controller

There are two solenoid actuated isolation valves incorporated in the servo pressure supply valve block, which when energised direct servo pressure to enable the R.H. and L.H. joystick controllers. Each valve solenoid is controlled by proximity switches via a relay.

To make the joystick controllers active the seat must first be locked in the forward or rear facing position, thereby closing either the seat forward proximity switch **Q** or seat rear proximity switch **R**. The operator must then raise forward the arm rests. Raising the R.H. arm rest closes the R.H. arm proximity switch **P** energising relay **F** and the R.H. isolation valve solenoid **H**, making the R.H. joystick controller active. Similarly the L.H. joystick controller is made active when the L.H. arm rest is raised forward.

When an arm rest is pushed back by the operator, the proximity switch in that arm rest will open and de-energise the relay and solenoid, servo pressure will be isolated and the joystick controller in that arm rest will be disabled.

Should the operator move the seat from the forward or rear facing position, the appropriate proximity switch will open and servo pressure to both joystick controllers will be isolated, both joystick controllers will be disabled.

The L.H. joystick houses a horn switch **S**. On some machine variants the joysticks also incorporate switches **U** and **V** for control of a hydraulic quickhitch, and an auxiliary changeover switch **W**, typically to select between jaw bucket and extending dipper operation.

### Component Key:

<b>A</b>	Primary Fuse
<b>B</b>	Relay
<b>C</b>	Rear Horn Relay
<b>D</b>	Auxiliary Changeover Relay
<b>E</b>	Isolation Valve Relay - L.H. Joystick
<b>F</b>	Isolation Valve Relay - R.H. Joystick
<b>G</b>	Isolation Valve Solenoid - L.H. Joystick
<b>H</b>	Isolation Valve Solenoid - R.H. Joystick
<b>J</b>	Pump Dump Controller (Power Management ECU)
<b>K</b>	Throttle Position Sensor
<b>L</b>	Hydraulic Oil Temperature Sensor
<b>M</b>	Unloader Valve (HSC) Solenoid
<b>N</b>	Proximity Switch - L.H. Arm Rest
<b>P</b>	Proximity Switch - R.H. Arm Rest
<b>Q</b>	Proximity Switch - Seat Forward
<b>R</b>	Proximity Switch - Seat Rear
<b>S</b>	Rear Horn Switch
<b>T</b>	Rear Horn Switch
<b>U</b>	Quickhitch Switch
<b>V</b>	Quickhitch Switch
<b>W</b>	Auxiliary Change-over Switch
<b>SA</b>	Splice

### Pump Dump Controller (Power Management ECU)

The electronic control unit is mounted in the engine compartment and is used to control engine hydraulic power.

When operating under conditions of high engine load and/or conditions of high hydraulic oil temperature (when operating hammer attachments for example), the pump dump controller **J** automatically activates the unloader valve (HSC) circuit, dumping the hydraulic oil flow from the secondary pump section (P2) to tank.

#### 1 Engine Load Condition:

The pump dump controller **J** compares the 'actual' engine speed signal from the alternator stator with the engine speed 'demanded' signal from the throttle position sensor **K**.

If the engine speed should start to slow under conditions of high load, the pump dump controller **J** energises the unloader valve (HSC) solenoid **M** and illuminates an LED on the side console. The flow from the secondary pump section (P2) is dumped to tank reducing the flow available to the hydraulic system, thereby reducing the load on the engine. When the engine speed recovers the pump dump controller de-energises the unloader valve (HSC) solenoid (extinguishing the LED on the side console), enabling the hydraulic system to operate normally.

The operating parameters are as follows:

- At engine speeds below 1000 rpm, as determined by the throttle position sensor, the unloader valve (HSC) solenoid will always be energised.
- At 1000 rpm the unloader valve (HSC) solenoid will be energised if the engine rpm falls more than 150 rpm below the 'no load' engine speed as determined by the throttle position sensor. The unloader valve (HSC) solenoid will de-energise when the engine rpm recovers to less than 25 rpm below the 'no load' engine speed as determined by the throttle position sensor.
- At engine speeds greater than 1000 rpm, the unloader valve (HSC) solenoid energise and de-energise set points are increased by 10 rpm for every 100 rpm increase in engine speed.

#### 2 Hydraulic Oil Temperature Condition:

The pump dump controller **J** monitors the hydraulic oil temperature via a sensor **L** fitted at the rear of the hydraulic oil tank.

If the oil temperature should reach 90°C, the pump dump controller **J** energises the unloader valve (HSC) solenoid **M** and illuminates an LED on the side console. The flow from the secondary pump section (P2) is dumped to tank reducing the flow available to the hydraulic system. The pump continues to circulate the oil around the neutral circuit and through the oil cooler until the oil temperature has reduced sufficiently. When the oil temperature has fallen to less than 70°C, the pump dump controller de-energises the unloader valve (HSC) solenoid (extinguishing the LED on the side console), enabling the hydraulic system to operate normally.

### Basic System Operation

#### Joystick Controllers - Description

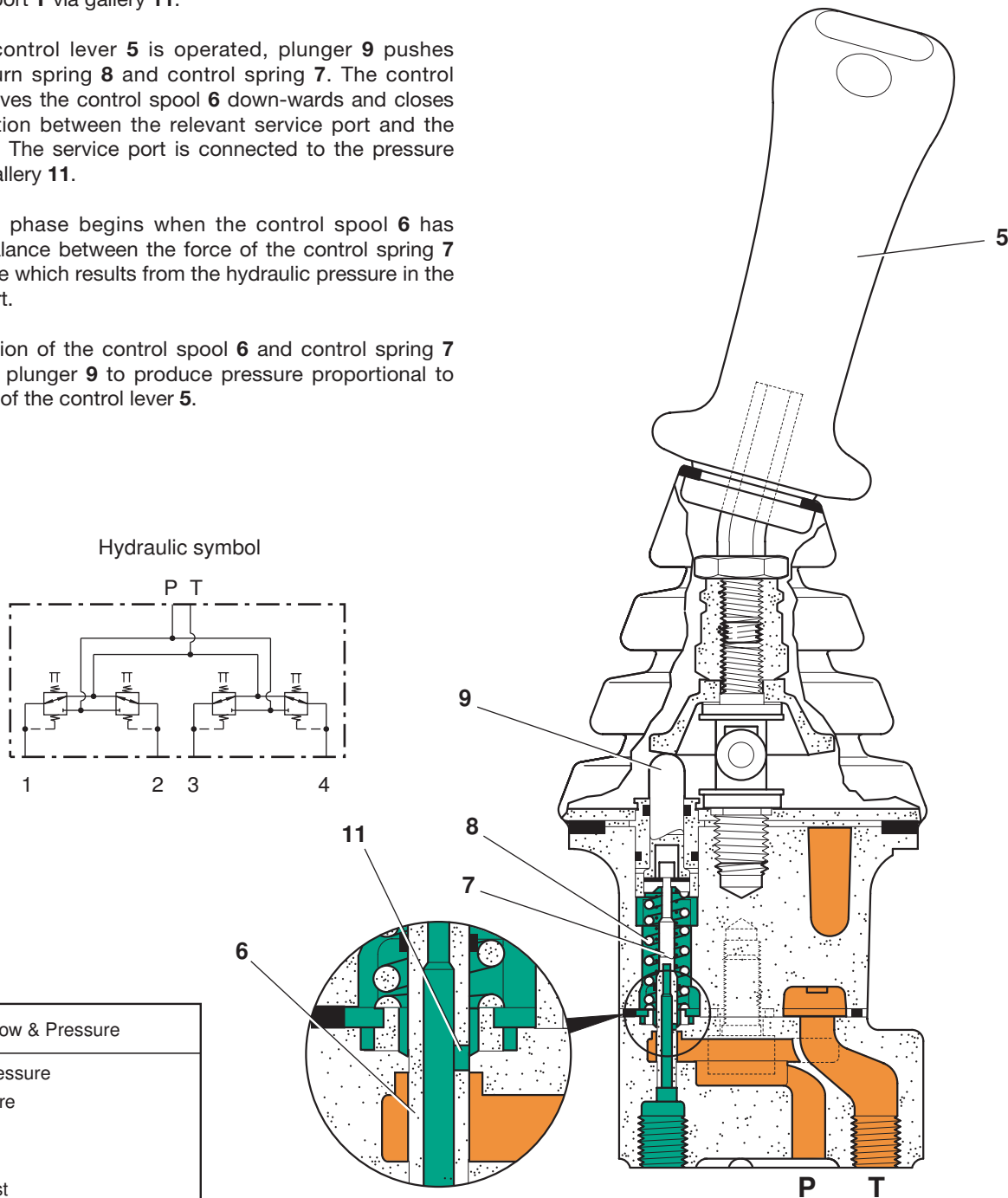
The joystick controllers operate as direct operated pressure reducing valves and consist of a hand control lever, four pressure reducing valves and the housing. Each pressure reducing valve consists of a control spool, control spring, return spring and a plunger.

In neutral the control lever **5** is kept in the central position by the return spring **8**. Service ports **1**, **2**, **3** and **4** are connected to the tank port **T** via gallery **11**.

When the control lever **5** is operated, plunger **9** pushes against return spring **8** and control spring **7**. The control spring **7** moves the control spool **6** down-wards and closes the connection between the relevant service port and the tank port **T**. The service port is connected to the pressure port **P** via gallery **11**.

The control phase begins when the control spool **6** has found its balance between the force of the control spring **7** and the force which results from the hydraulic pressure in the selected port.

The interaction of the control spool **6** and control spring **7** enables the plunger **9** to produce pressure proportional to the position of the control lever **5**.



Key to Oil Flow & Pressure	
<span style="color: red;">■</span>	Full Pressure
<span style="color: orange;">■</span>	Pressure
<span style="color: yellow;">■</span>	Servo
<span style="color: lightblue;">■</span>	Neutral
<span style="color: lightgreen;">■</span>	Exhaust
<span style="color: lightgrey;">■</span>	Cavitation
<span style="color: yellow;">■</span>	Lock Up

A390630

A403930

## Basic System Operation

### Servo Pressure Supply Valve - Description

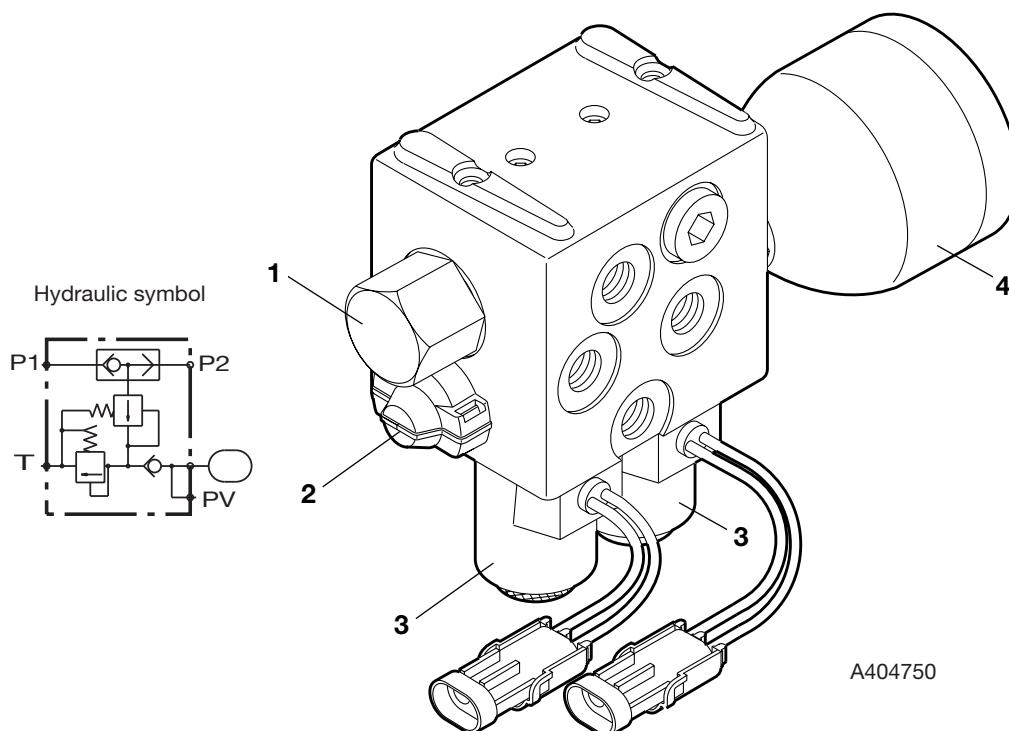
The servo pressure supply valve is fitted with a pressure regulating valve **1**, a pressure relief valve **2** and two solenoid valves **3** for servo pressure isolation.

The servo system is supplied from a single line tapped into the hydraulic pump feed at the excavator valve block. The pressure regulating valve **1** maintains servo pressure by regulating the incoming supply pressure. The valve is non-adjustable and is factory set with shims.

The pressure relief valve **2** is adjustable and limits the maximum pressure, protecting the valve block from over-pressurisation by opening and allowing excess pressure to vent to tank.

Down stream of the pressure regulating valve is located the servo accumulator **4** with its associated non return valve. The accumulator traps and stores servo pressure to enable the excavator spools to be operated for a limited period with a stopped engine. This allows the excavator end to be lowered safely to the ground should the engine stop.

The servo isolator solenoid valves **3** are energised by proximity switches on the drivers seat. When the seat arm rest is raised forward, the proximity switch closes and energises the relevant isolator solenoid, directing servo pressure to the particular joystick controller. When the arm rest is folded back the proximity switch opens and the isolation solenoid is de-energised, the isolation valve spool is spring returned to the closed position isolating the supply to the joystick controller.



## Fault Finding

### Introduction

The fault finding procedures are given in the form of flow charts. There are a number of charts, each one dedicated to a particular fault. The charts are designed to identify possible causes by performing checks and where applicable, specific tests. Having identified a cause the suggested remedy is given. The charts are designed to identify causes through a process of elimination, starting with the simplest, most easily rectified faults.

When fault finding note the following:

- 1 Make sure that the hydraulic fluid is at the correct working temperature (50°C, 122°F).
- 2 If hydraulic contamination is found be sure to remove ALL debris, and if possible identify its origin. It may be part of a component from elsewhere in the hydraulic circuit.
- 3 Renew any seals such as 'O' rings when re-assembling hydraulic components.

### Fault Finding Charts:

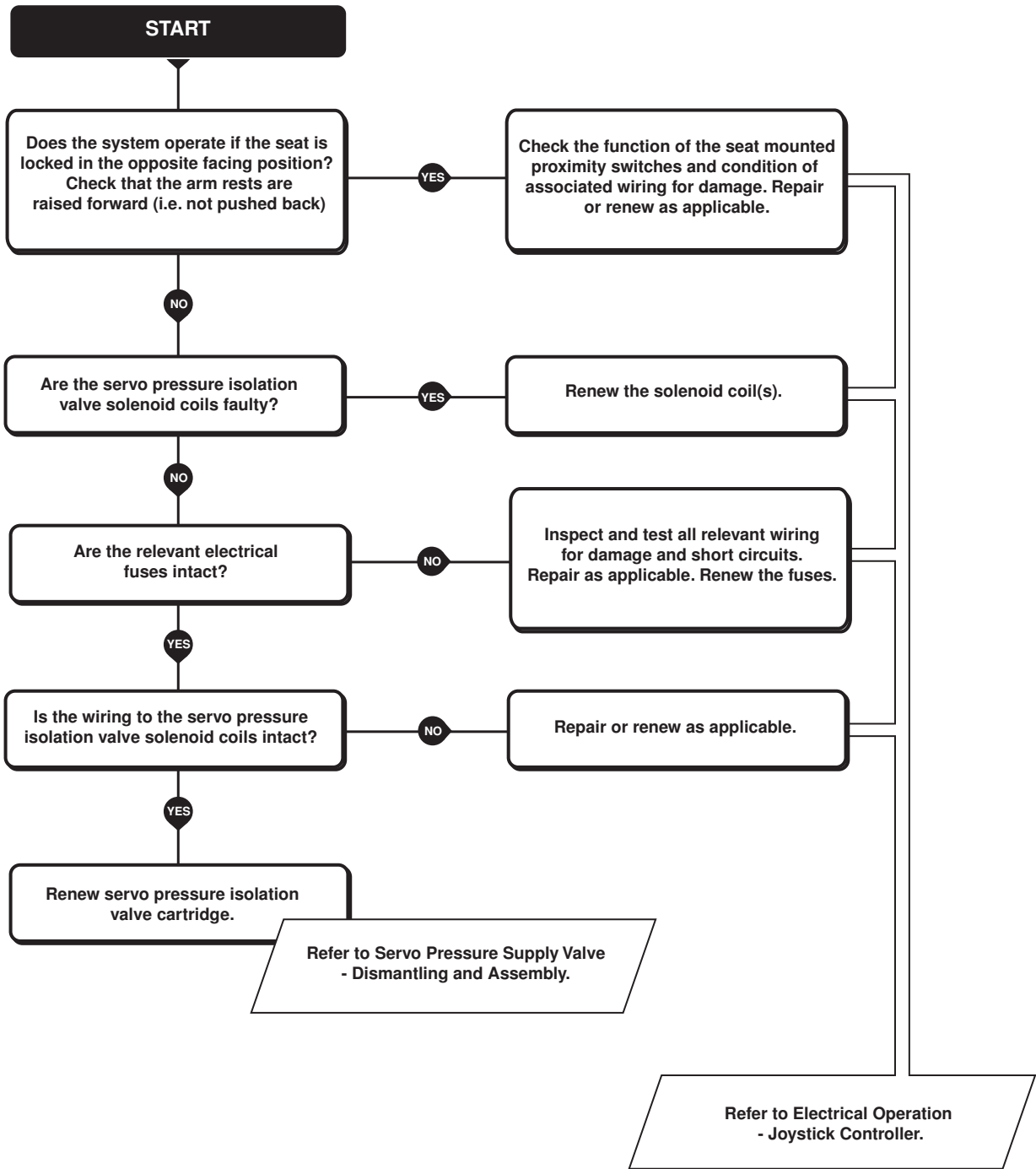
**Chart A** - No Servo Controls (system fails to operate)

**Chart B** - All Backhoe Services Slow to Operate

**Chart C** - One Backhoe Service fails or is Slow to Operate

**Fault Finding**

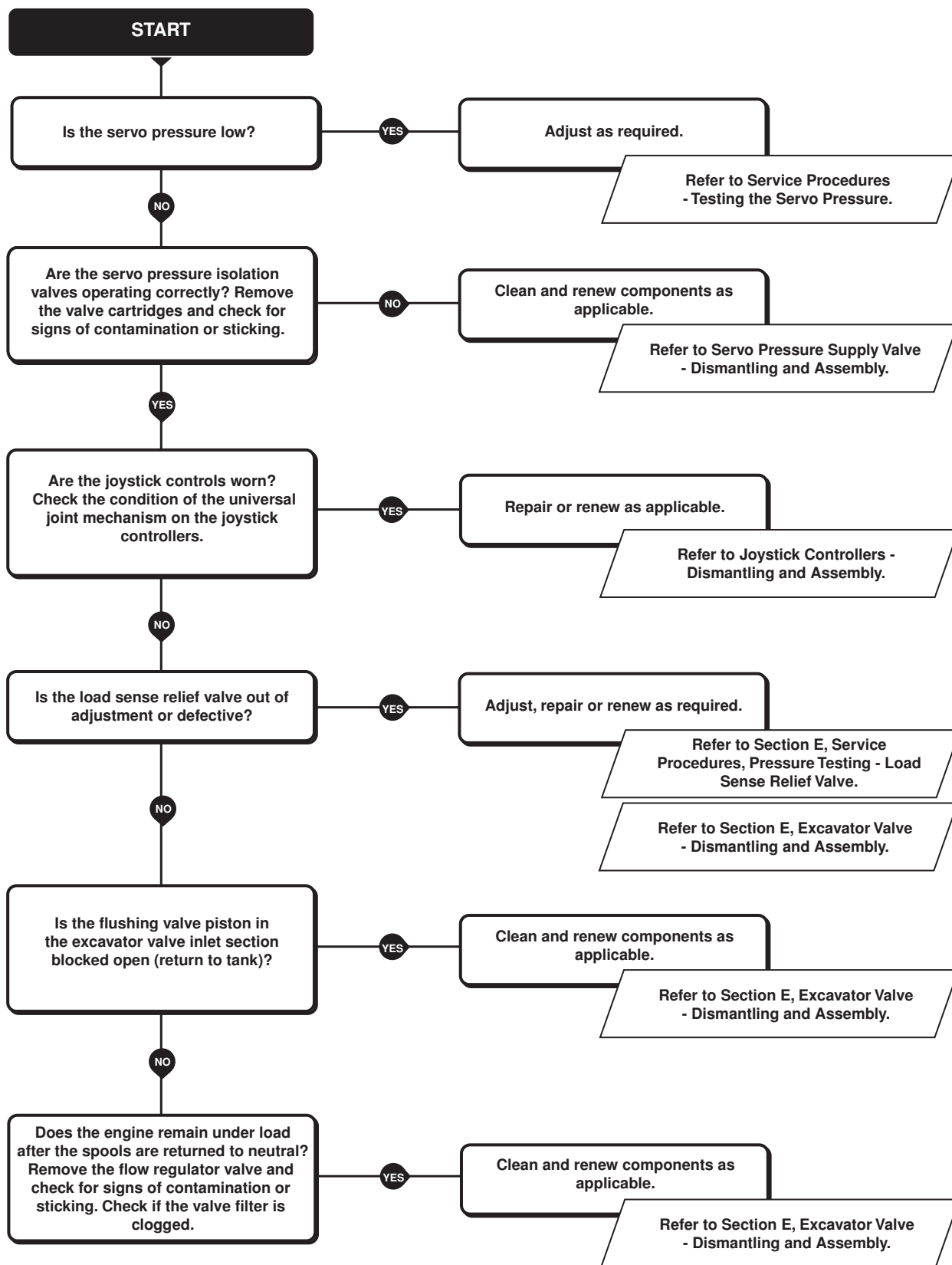
**Chart A - No Servo Controls (system fails to operate)**



A405600

**Fault Finding**

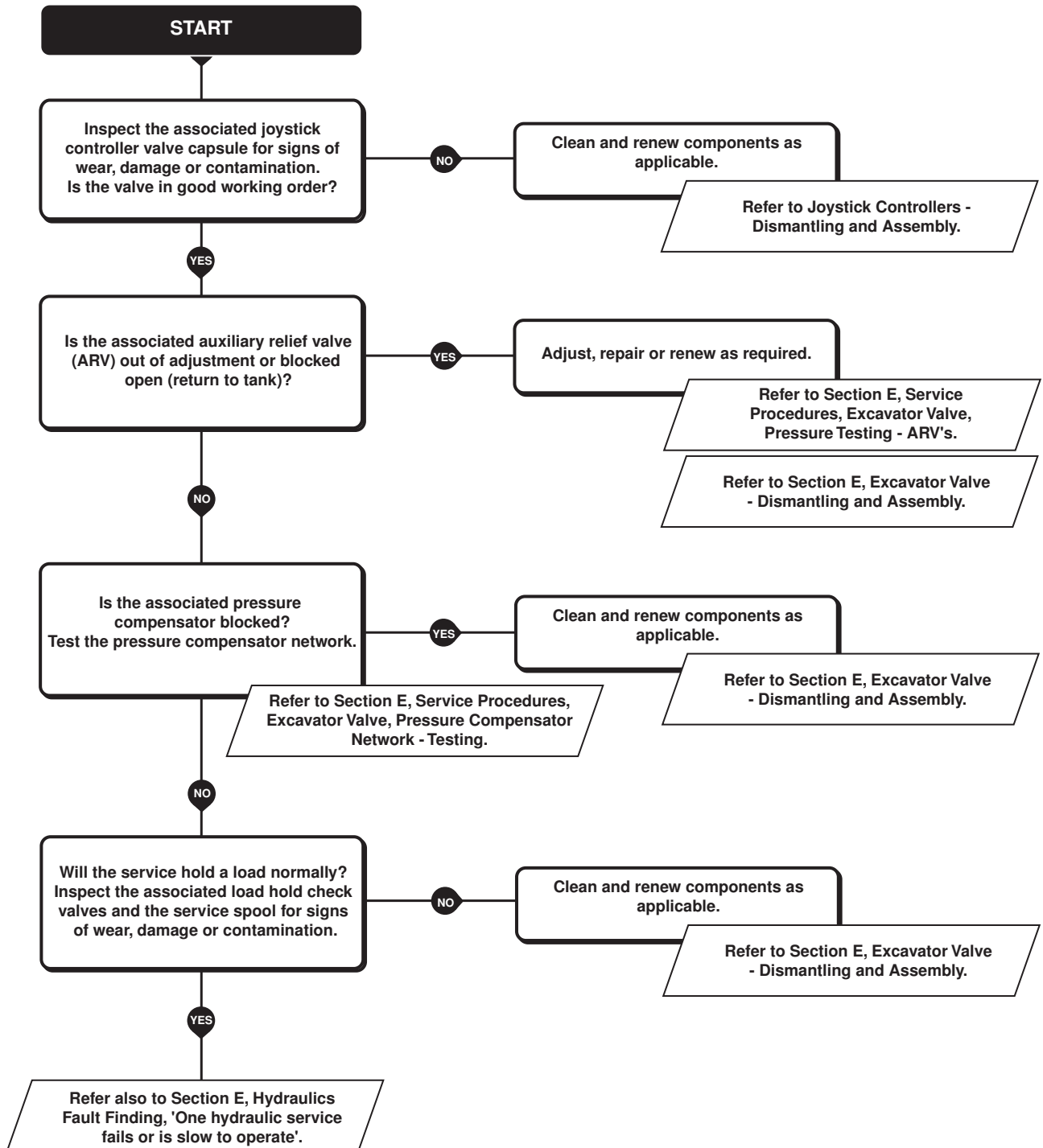
**Chart B - All Backhoe Services Slow to Operate**



A405670

**Fault Finding**

**Chart C - One Backhoe Service fails or is Slow to Operate**



A405690

**Service Procedures**

**Testing the Servo Pressure**

TBA



## Joystick Controllers

### Removal and Replacement

#### **⚠ 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

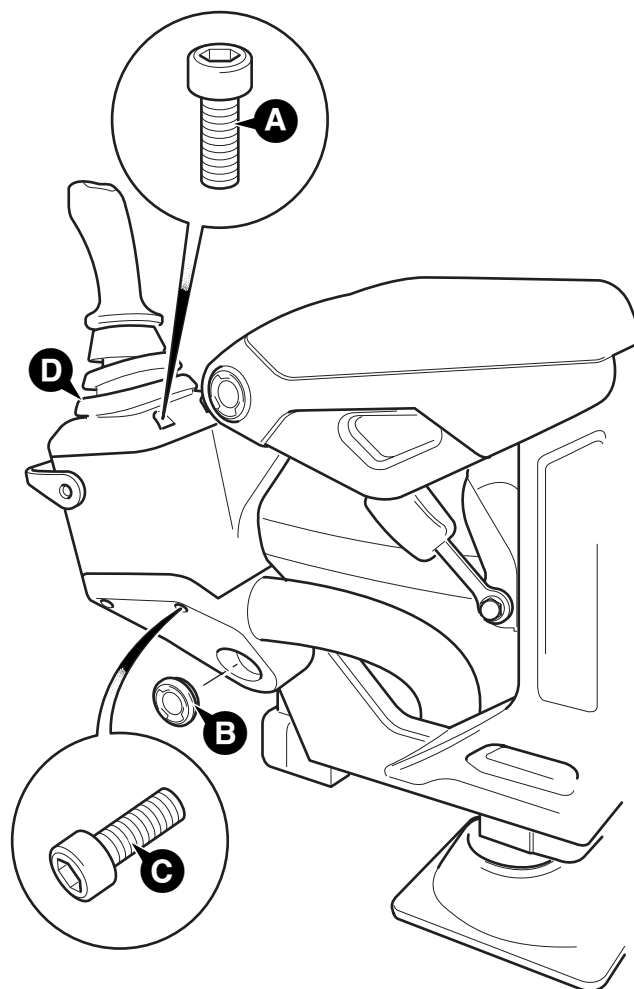
Note that the procedure shows the left hand joystick controller. The removal and replacement procedure for the right hand joystick controller is identical.

#### Removal

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

Before attempting to remove a joystick controller, vent the pilot circuit accumulator hydraulic pressure as follows:

- 2 With the operator seat locked in the rear facing position and with the arm rests raised forward (for backhoe operation), switch the starter to ON without starting the engine. Operate the joystick controls several times to vent the hydraulic pressure from the servo system and backhoe rams. Turn the starter switch to the OFF position and remove the key.
- 3 Remove the screws **A** (4 off) and lift off the top retaining plate as shown.
- 4 Using a screwdriver, carefully prise out the plastic cap **B**. Remove the screws **C** (2 off) and take off the lower cover to reveal the connections at the valve block.
- 5 Disconnect the electrical harness connector for the joystick handle switches.
- 6 Disconnect all hydraulic hoses from the valve block and plug the ports to prevent ingress of dirt. Label each hose before disconnecting to ensure correct replacement. Plug hose ends to prevent ingress of dirt.
- 7 Carefully prise back the rubber gaiter **D** to reveal the fixing bolts (4 off) securing the valve to the arm rest. Remove the fixing bolts and lift the valve assembly from the seat.



A405620

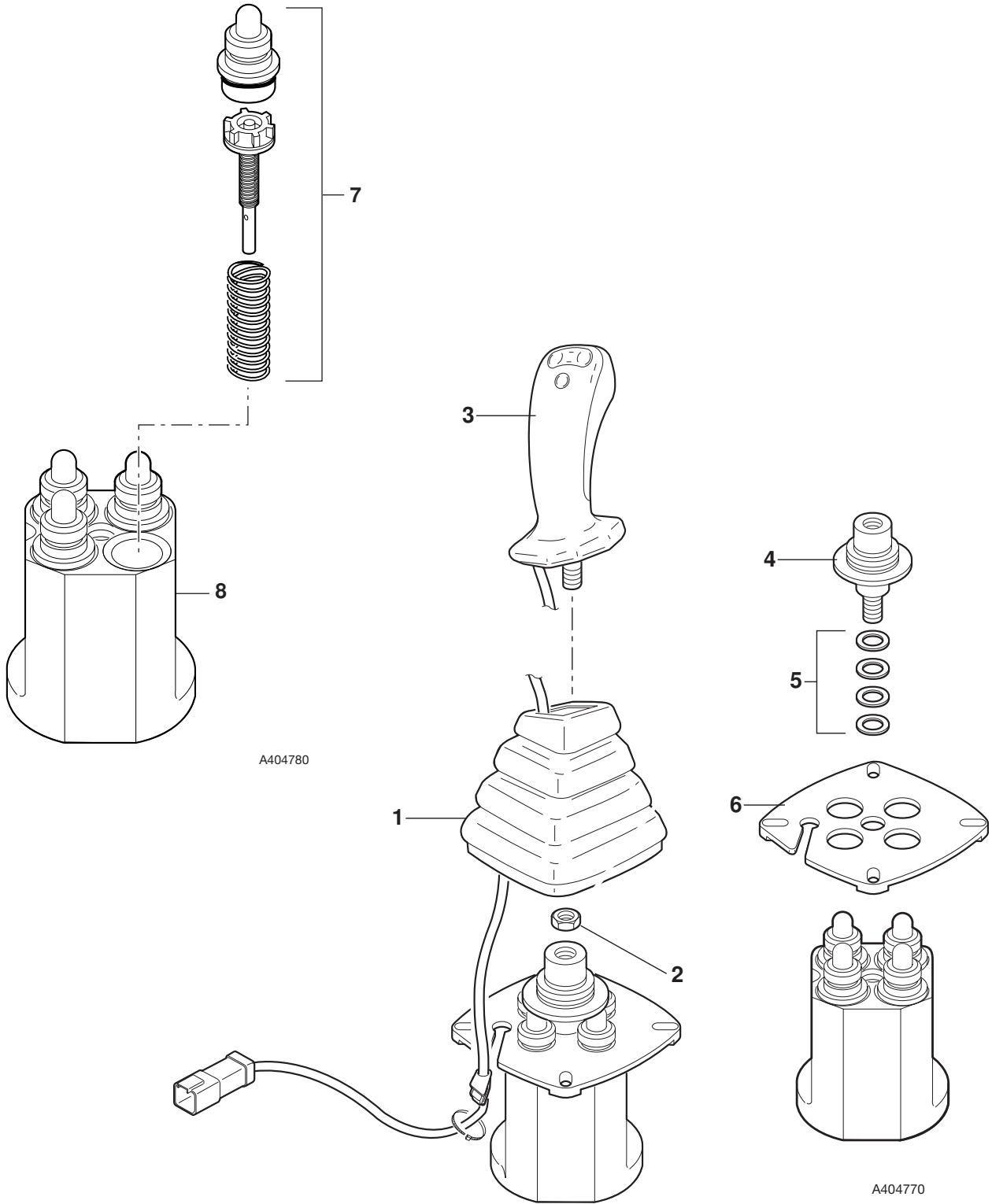
#### Replacement

Replacement is the reverse of the removal sequence.

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

### Joystick Controllers

### Dismantling and Assembly



## Joystick Controllers

### Dismantling and Assembly

#### Dismantling

The illustration shown on the opposite page is intended as a guide to dismantling. Be sure to note the location of all components when dismantling. Although some components may appear to be identical they are not interchangeable. Make sure that components are assembled in their original positions.

Great care should be taken when dismantling and assembling a valve to avoid the following:-

- Contamination
- Damage to spools
- Damage to seal grooves

Any of the above may result in possible problems with the operation of the valve.

- 1 Remove the joystick controller from the machine, refer to **Joystick Controller - Removal and Replacement**.
- 2 Carefully prise back the rubber gaiter **1**, loosen lock nut **2** and unscrew the handle **3**.
- 3 Unscrew the universal joint assembly **4**. Take care to keep all the shims **5** together.
- 4 Remove the retaining plate **6**. Carefully withdraw the regulating valve assemblies **7** from the valve body **8**.

#### Assembly

Assembly is the reverse of the dismantling sequence.

- 1 Clean the valve components in an appropriate solvent.
- 2 Renew all 'O' rings and back-up rings.
- 3 Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

#### Torque Settings

Item	Nm	kgf m	lbf ft
2	40	4.1	29.5
4	50	5.1	36.9

#### Regulating Valve Assemblies

Each of the regulating valve assemblies **7** can be removed as shown. Care must be taken to ensure that the spool is not damaged when removing it from the valve body. Note that all spools are similar in appearance but must not be interchanged as they are matched to their bores. All spools have the same centring and sealing components.

## Servo Pressure Supply Valve

### 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 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 attachments to the ground and stop the engine.

Before attempting to remove the valve, vent the pilot circuit accumulator hydraulic pressure as follows:

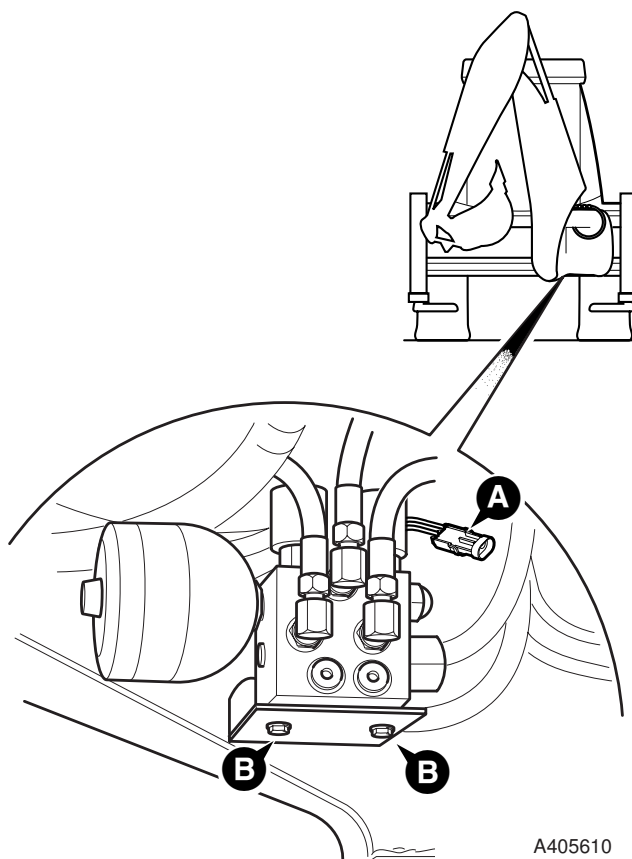
- 2 With the operator seat locked in the rear facing position and with the arm rests raised forward (for backhoe operation), switch the starter to ON without starting the engine. Operate the joystick controls several times to vent the hydraulic pressure from the servo system and backhoe rams. Turn the starter switch to the OFF position and remove the key.
- 3 Working underneath the rear of the machine as shown, disconnect the electrical harness connectors **A** at the solenoids. Label each connector before disconnecting to ensure correct replacement.
- 4 Disconnect all hydraulic hoses from the valve block and plug the ports to prevent ingress of dirt. Label each hose before disconnecting to ensure correct replacement. Plug hose ends to prevent ingress of dirt.
- 5 Take hold of the valve assembly, loosen and remove the fixing bolts **B** securing the valve to the chassis. Lift the valve assembly from the machine.

#### Replacement

Replacement is the reverse of the removal sequence.

After replacement check the valve pressure settings. Refer to **Service Procedures - Testing the Servo Pressure**.

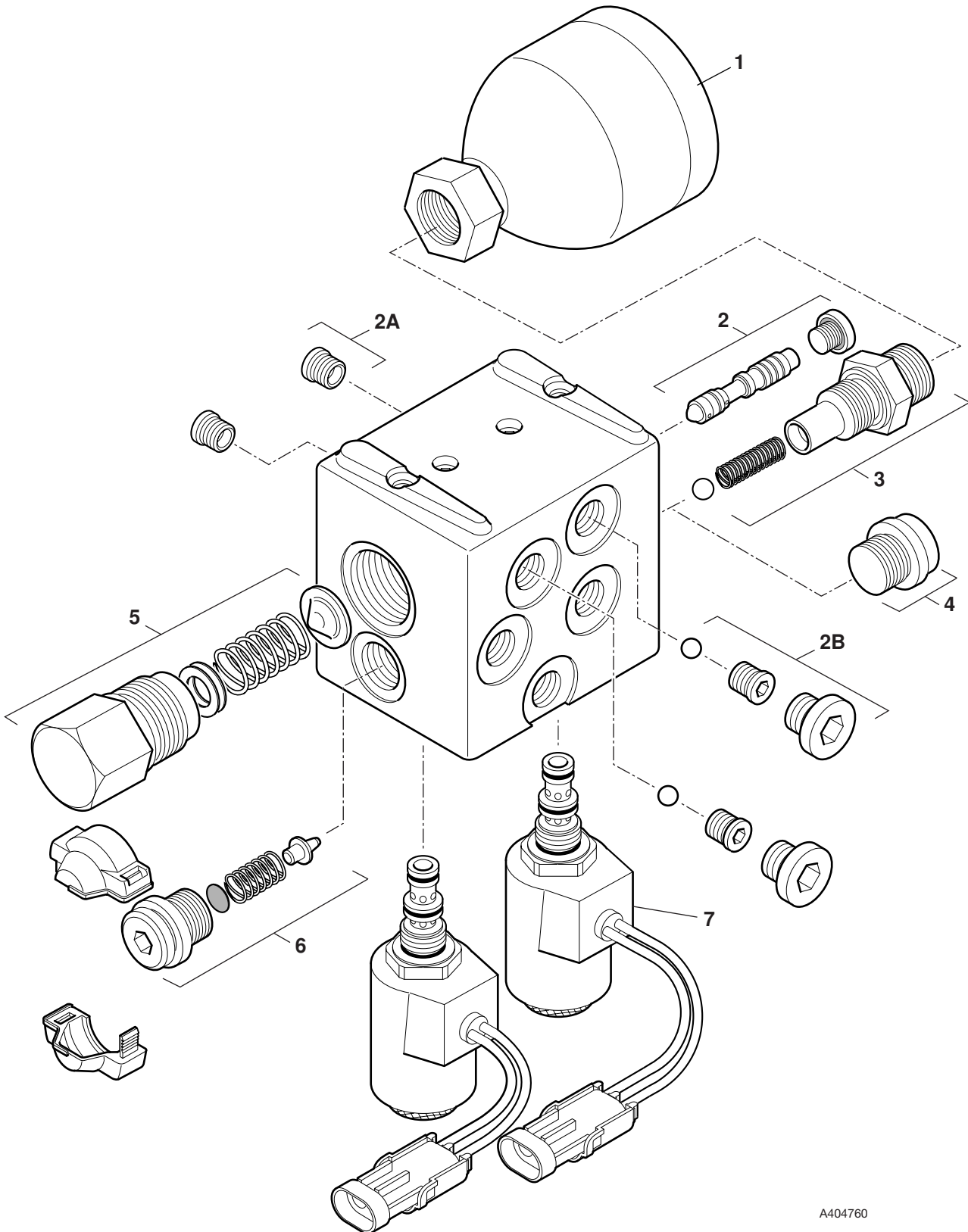
**Note:** All hydraulic adaptors that are installed together with a bonded sealing washer must also have JCB Threadseal applied to the threads of the adaptor.



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### Servo Pressure Supply Valve

### Dismantling and Assembly



A404760

## Servo Pressure Supply Valve

### Dismantling and Assembly

#### Dismantling

The illustration shown on the opposite page is intended as a guide to dismantling. Be sure to note the location of all components when dismantling. Although some components may appear to be identical they are not interchangeable. Make sure that components are assembled in their original positions.

Great care should be taken when dismantling and assembling a valve to avoid the following:-

- Contamination
- Damage to spools
- Damage to seal grooves

Any of the above may result in possible problems with the operation of the valve.

- 1 Remove the servo pressure supply valve from the machine, refer to **Servo Pressure Supply Valve - Removal and Replacement**.

**Note:** The illustration depicts a complete strip down, but to carry out specific servicing/repairs, e.g. renewal of one of the solenoids, it is only necessary to dismantle the relevant components.

#### Assembly

Assembly is the reverse of the dismantling sequence.

- 1 Clean the valve components in an appropriate solvent.
- 2 Renew all 'O' rings and back-up rings.
- 3 Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

#### Torque Settings

Item	Nm	kgf m	lbf ft
1	100	10.2	73.8
2	10	1	7.4
2A	10	1	7.4
2B	30	3	22.1
3	100	10.2	73.8
4	100	10.2	73.8
5	150	15.3	110.6
6	100	10.2	73.8
7	15-20	1.5-2	11-14.8

#### Accumulator

The accumulator **1** can be removed as shown. Take great care when handling the accumulator, the unit is pre-charged with nitrogen gas and further dismantling of the accumulator should not be attempted. The adaptor assembly **3** incorporates a non-return valve with a spring and ball as shown.

#### Regulating Valve Assembly

The regulating valve assembly **5** can be removed as shown. The valve is non-adjustable and is factory set with shims. Take care to keep all the shims together.

#### Pressure Relief Valve

The pressure relief valve **6** can be removed as shown.

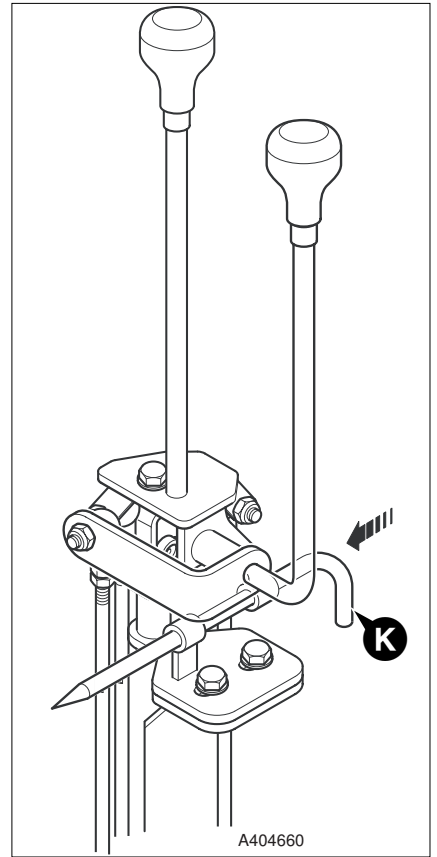
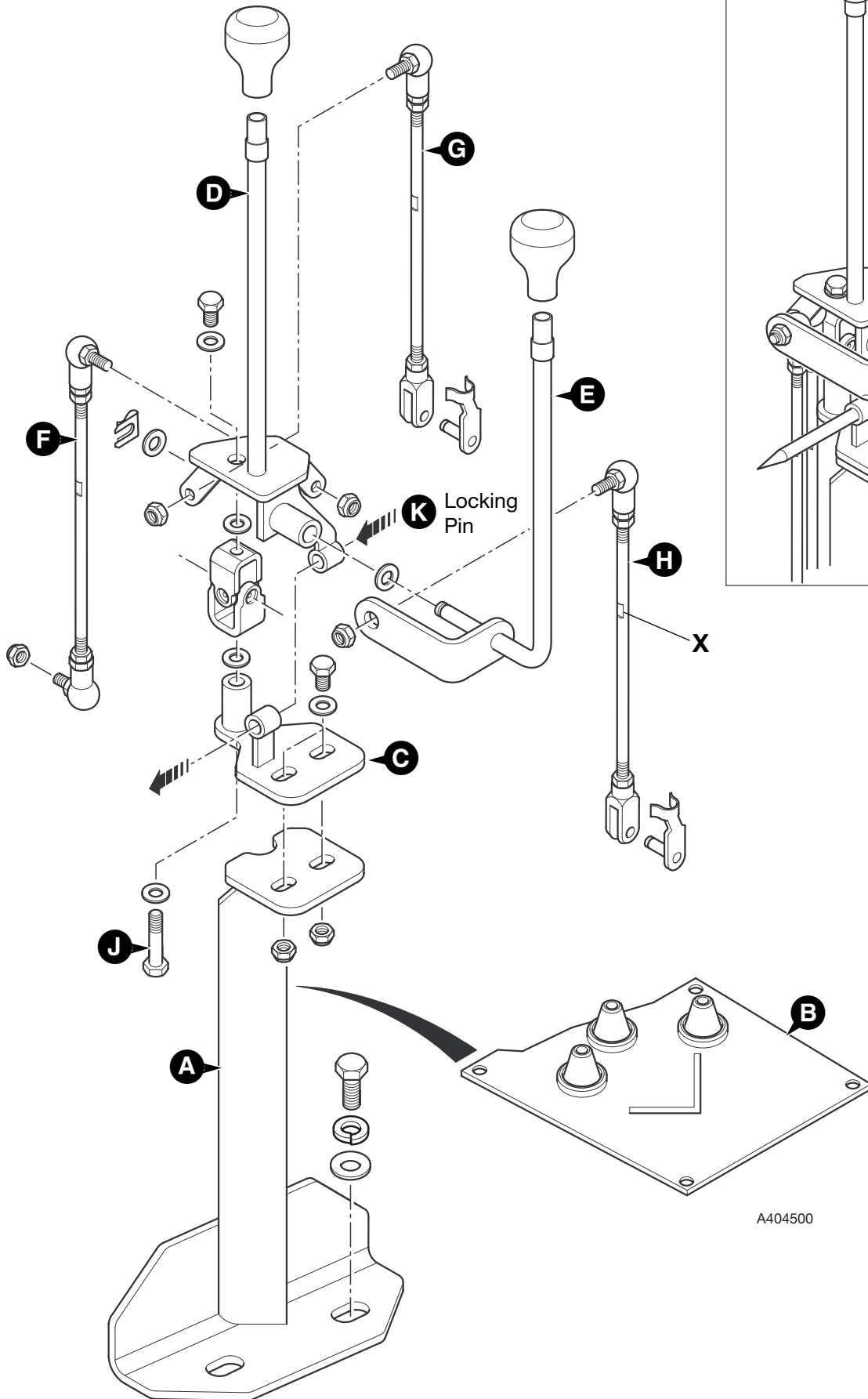
#### Solenoid Isolation Valves

The solenoid isolation valves **7** can be removed as shown. It is possible to remove the valve cartridges for cleaning or resealing without removing the complete valve from the machine. If there is evidence of damage to the valve or its seat caused by debris then the cartridge must be renewed.

**Note:** If removing components from a valve block that is fitted on a machine the pilot circuit accumulator pressure must be vented first. With the operator seat locked in the rear facing position and with the arm rests raised forward (for backhoe operation), switch the starter to ON without starting the engine. Operate the joystick controls several times to vent the hydraulic pressure from the servo system and backhoe rams. Turn the starter switch to the OFF position and remove the key.

Dismantling and Assembly

Loader Valve Controls



## Dismantling and Assembly

### Loader Valve Controls

The illustration on the adjacent page shows the control rods and linkages for the loader control valve and is intended as a guide to the dismantling and assembly.

#### Dismantling

- 1 Park the machine on firm level ground, apply the parking brake. Lower the loader arms and excavator to the ground, switch OFF the engine and remove the starter key. Disconnect the battery.
- 2 Working in the cab, remove the console panels surrounding the loader levers as shown at **Z**.
- 3 Uncouple the transmission dump switch electrical connector and remove the wires from the connector. Use a screwdriver to release the wires/pins from the connector, alternatively cut the wires and re-solder on assembly.
- 4 Remove the control lever knobs and gaiters.
- 5 Disconnect the control rods from the loader valve spools. Remove the bolts securing the complete lever assembly to the chassis and withdraw the control levers and mounting bracket through the floor aperture.

#### Assembly

Assembly is the reverse of the dismantling sequence.

- 1 Bolt the mounting bracket **A** to the chassis.
- 2 Fit the rubber cover **B** over the mounting bracket, make sure it is fitted the correct way round. Do not fix it to the floor at this stage.
- 3 Bolt the mounting plate **C** to mounting bracket as shown.
- 4 Assemble the loader lever **D** and auxiliary lever **E** together, with the washers and retaining clip as shown.
- 5 Fit the control rods **F**, **G** and **H** to the lever assembly. Ensure that the locking flats **X** are at the top.

**Note:** If necessary, loosen the lock nuts and rotate the end fittings to give equal amounts of adjustment (thread) at each end of the control rod.

- 6 Fit the lever assembly to the mounting plate **C** as shown, do not tighten the bolt **J** at this stage.
- 7 Thread the control rods through the rubber cover **B** and connect them to the loader valve spools.
- 8 Adjust the control rods as necessary, see **Adjustment**. After the control rods are adjusted fit the gaiters over the control levers.

- 9 Thread the transmission dump switch cable through the loader control lever and fit the wires/pins into the electrical connector. Couple the connector to the chassis harness and fit the control lever knobs.
- 10 Connect the battery, check that the controls and transmission dump switch operate correctly.
- 11 Refit the rubber cover **B** and the console panels around the loader levers.

#### Adjustment

- 1 Fit the control lever locking pin **K** as shown, tighten bolt **J** when aligned.

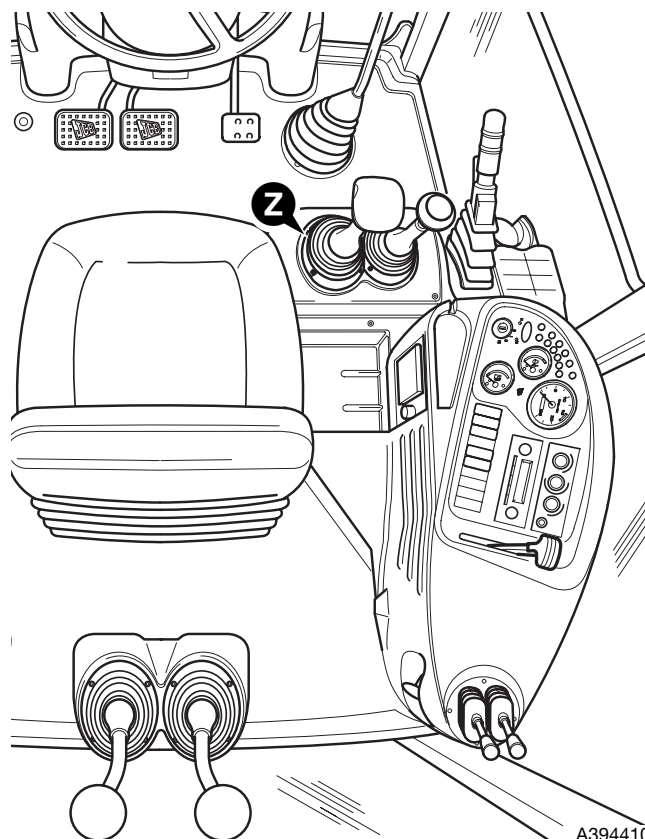
**Note:** If there is no lever locking pin with the machine use a suitable diameter metal bar.

- 2 Adjust the control rods **F** and **G** until the locking pin is a sliding fit, then tighten the control rods lock nuts.

**Note:** Make sure there is an equal amount of thread at each end of the control rod.

- 3 Adjust the auxiliary control rod **H** until the auxiliary lever **E** aligns with loader lever **D**, then tighten the control rod lock nuts.

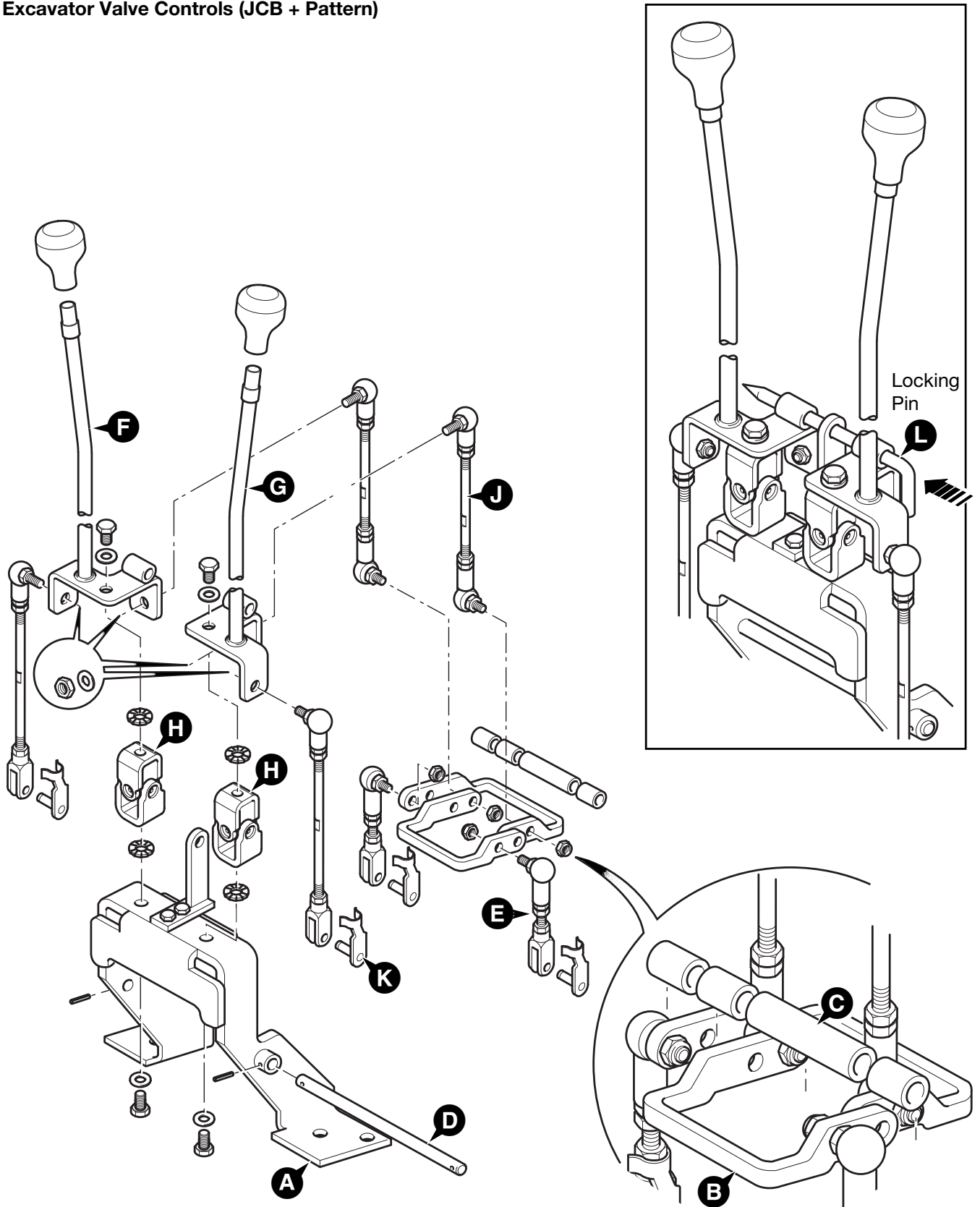
- 4 Remove the lever locking pin **K**.





Dismantling and Assembly

Excavator Valve Controls (JCB + Pattern)



A404810

## Dismantling and Assembly

### Excavator Valve Controls

The illustration on the adjacent page shows the control rods and linkages for the excavator control valve and is intended as a guide to the dismantling and assembly. Note JCB + pattern controls shown.

#### Dismantling

- 1 Park the machine on firm level ground, apply the parking brake. Lower the loader arms, move the excavator to the R.H. side of the machine and lower to the ground. Switch OFF the engine and remove the starter key. Disconnect the battery.
- 2 Working in the cab, remove the console panels surrounding the excavator levers as shown at **Z**.
- 3 Uncouple the rear horn switch electrical connector and remove the wires from the connector. Use a screwdriver to release the wires/pins from the connector, alternatively cut the wires and re-solder on assembly.
- 4 Remove the control lever knobs and gaiters.
- 5 Disconnect the control rods from the excavator valve spools. Remove the bolts securing the complete lever assembly to the excavator valve mounting plate and withdraw the control levers and mounting bracket through the floor aperture.

#### Assembly

Assembly is the reverse of the dismantling sequence.

- 1 Bolt the mounting bracket **A** to the excavator valve mounting plate.
- 2 Assemble the pivot levers **B** and spacers **C** to the mounting bracket and insert the pivot shaft **D**. Fit the short control rods **E** (2 off) to the pivot lever assembly as shown.
- 3 Assemble the excavator levers **F** and **G** to the mounting bracket together with the universal joints **H**. Fit the longer control rods **J** (4 off) to the lever assembly as shown.

**Note:** If necessary, loosen the lock nuts and rotate the end fittings to give equal amounts of adjustment (thread) at each end of the control rod.

- 4 Connect the control rods to the excavator valve spools with the clevis pins **K**.
- 5 Adjust the control rods as necessary, see **Adjustment**. After the control rods are adjusted fit the gaiters over the control levers.

- 6 Thread the rear horn switch cable through the control lever and fit the wires/pins into the electrical connector. Couple the connector to the chassis harness and fit the control lever knobs.
- 7 Connect the battery, check that the controls and rear horn switch operate correctly.
- 8 Refit the console panels around the excavator levers.

#### Adjustment

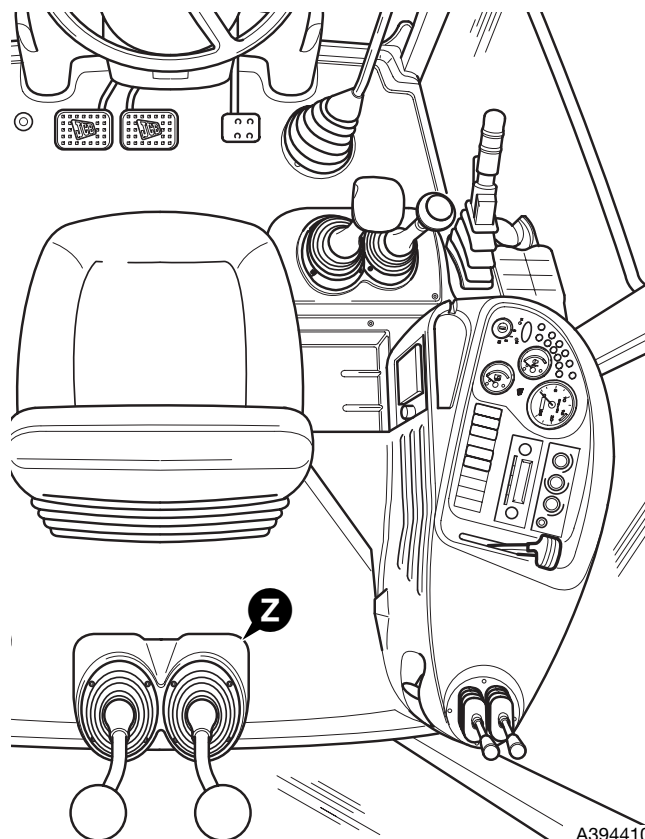
- 1 Fit the control lever locking pin **L** as shown.

**Note:** If there is no lever locking pin with the machine use a suitable diameter metal bar.

- 2 Adjust the control rods until the locking pin is a sliding fit, then tighten the control rods lock nuts.

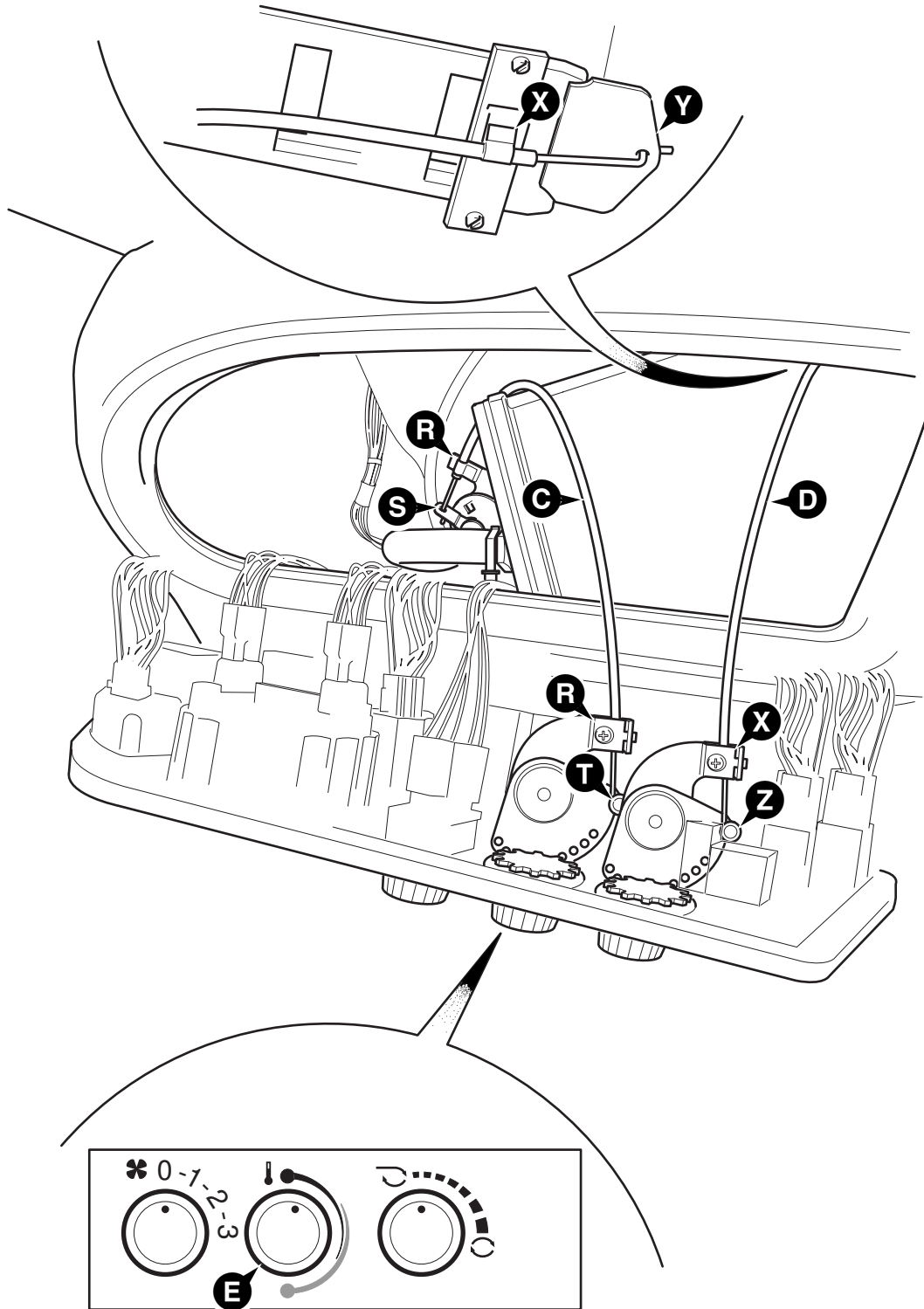
**Note:** Make sure there is an equal amount of thread at each end of the control rod.

- 3 Remove the lever locking pin **L**.



Removal and Replacement

Cab Heater Controls



A404491

## Removal and Replacement

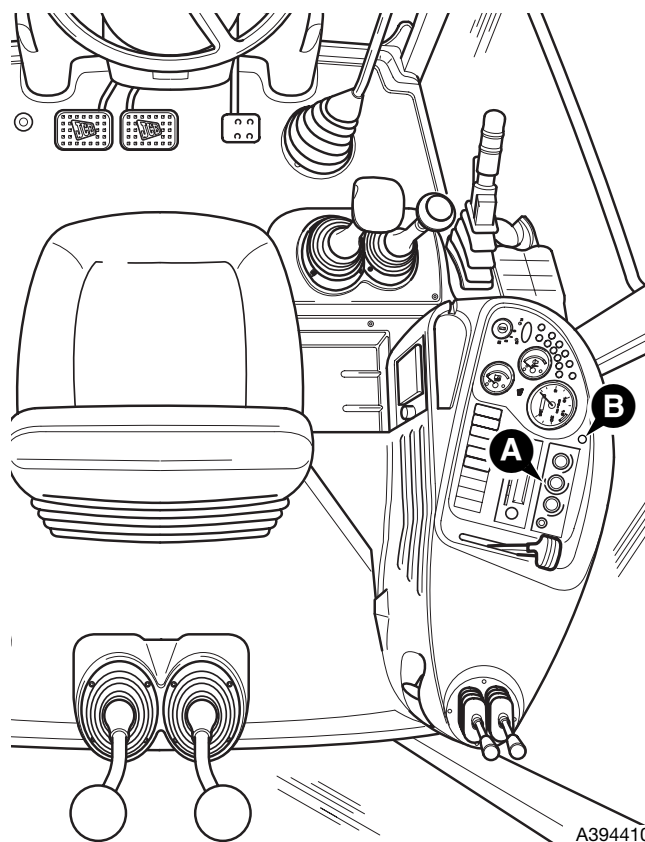
### Cab Heater Controls

The cab heater controls **A** and associated cables are housed in the R.H. side console as shown.

There are two control cables which operate the re-circulation vent and the hot water valve. Both the cables can be accessed by removing the side console instrument panel.

#### Removal

- 1 Park the machine on firm level ground, apply the parking brake. Lower the loader arms and excavator to the ground, switch OFF the engine and remove the starter key.
- 2 Remove the fixing **B** at the top of the instrument panel and carefully lift the panel forward to reveal the connections at the back.
- 3 Disconnect the temperature control cable **C** by releasing the cable outer sheath from the clips **R** at each end, and unhooking the cable from the water valve lever **S** and from the pin **T** at the control knob.
- 4 Disconnect the re-circulation vent cable **D** by releasing the cable outer sheath from the clips **X** at each end, and unhooking the cable from the vent **Y** and from the pin **Z** at the control knob.



#### Replacement

Replacement is the reverse of the removal sequence.

After fitting the cables, operate the heater controls and check that they function correctly.

#### Adjustment

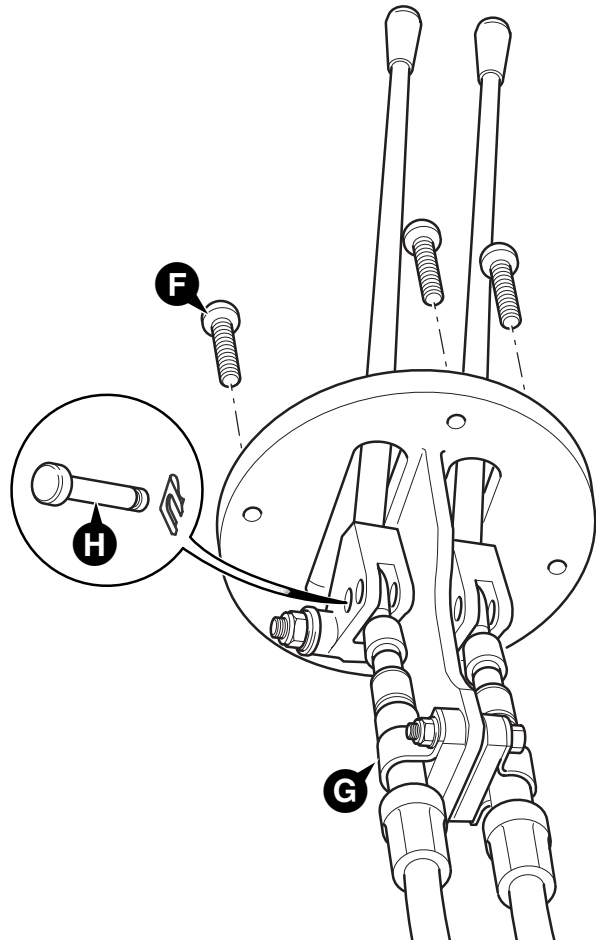
If the control cable **C** is not correctly assembled it is possible that the heater cannot be turned fully off.

To ensure that the heater can be turned fully OFF, the temperature control cable **C** should be adjusted so that the water valve will close FULLY within the range of movement of the control knob as follows:

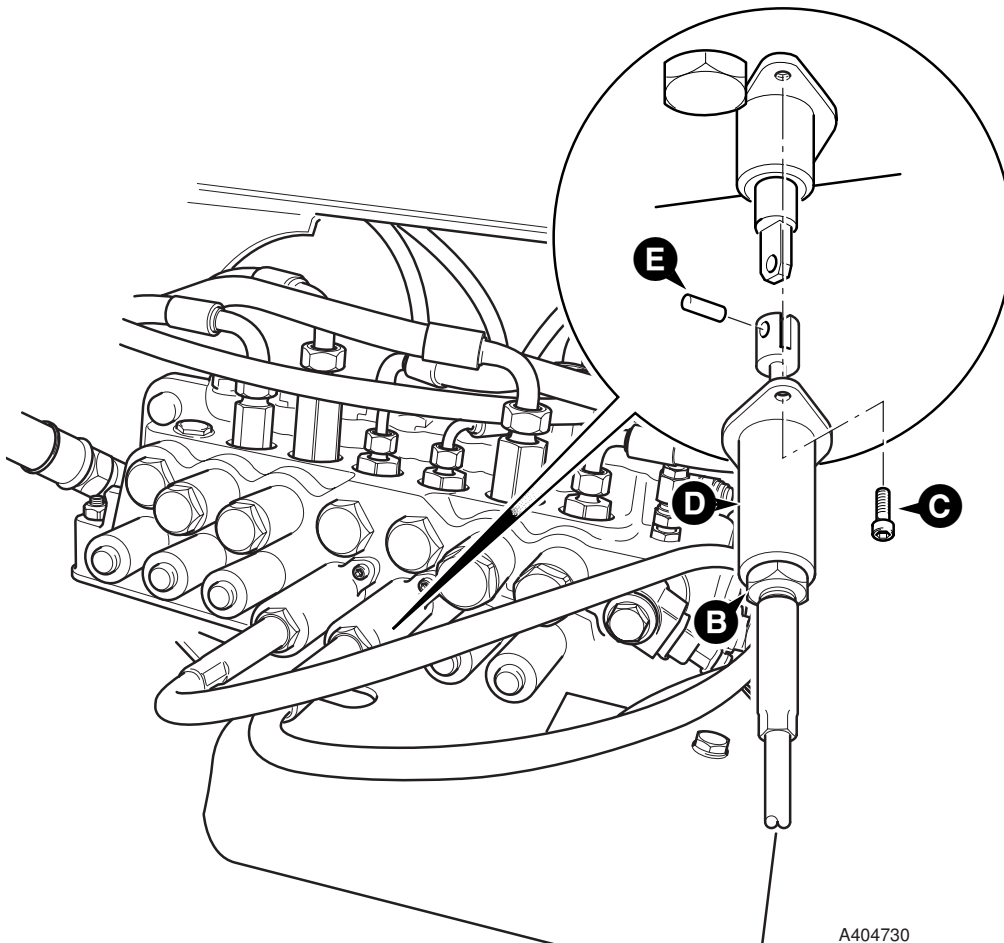
- 1 Set the water valve control lever **S** to the fully closed position.
- 2 Turn the heater control knob **E** a small amount clockwise from the closed position, i.e. a fraction before the cold position on the decal as shown.
- 3 Tighten the cable clips **R** to clamp the cable outer sheath.
- 4 Check the heater control range of movement and that the water valve can be fully closed by turning the knob.

### Removal and Replacement

#### Stabiliser Controls



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## Removal and Replacement

### Stabiliser Controls

The stabiliser controls **A** and associated cables are housed in the R.H. side console as shown.

There are two control cables which operate the R.H. and L.H. stabiliser control valves on the excavator valve block.

Note the routing of the existing cables and route the new cable(s) in the same way.

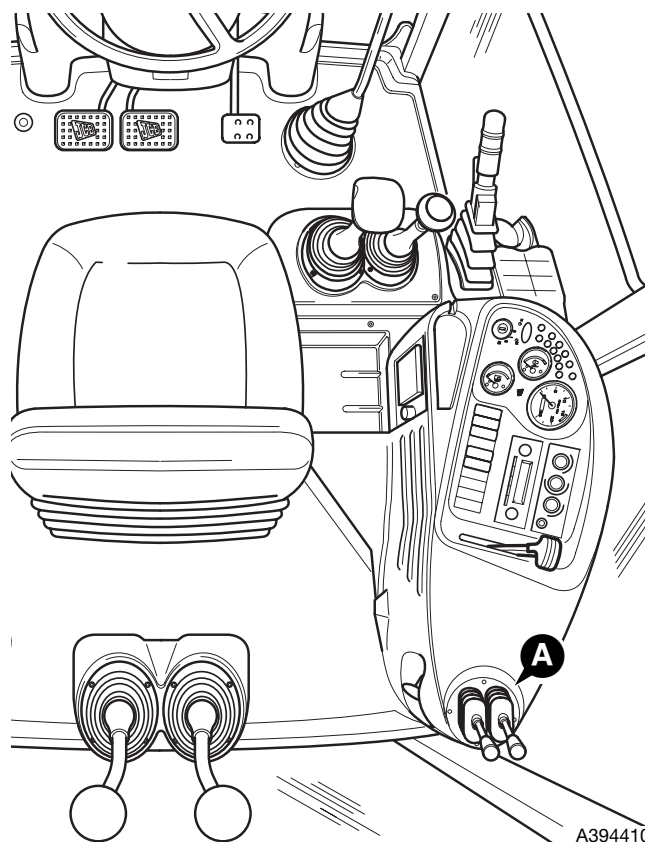
### Removal

- 1 Park the machine on firm level ground, apply the parking brake. Lower the loader arms and excavator to the ground, switch OFF the engine and remove the starter key.
- 2 Working under the machine at the excavator valve, undo the locknut **B**. Remove the screws **C** and slide back the housing **D** to reveal the clevis as shown. Remove the clevis pin **E** to release the cable from the spool.
- 3 Feed the end of the cable back underneath the cab to the rear wheel arch on the R.H. side of the machine and release the cable from the clamp assembly at position **X** as shown.
- 4 Working in the cab, remove the fixings **F** from around the base of the control levers and carefully withdraw the lever assembly from the side console to reveal the cables connected on the underside.
- 5 Remove the clamp **G** securing the cables to the bracket. Remove the spring clip and clevis pin **H** to release the cable.
- 6 From inside the side console, carefully pull the cable up into the cab through the aperture in the cab floor.

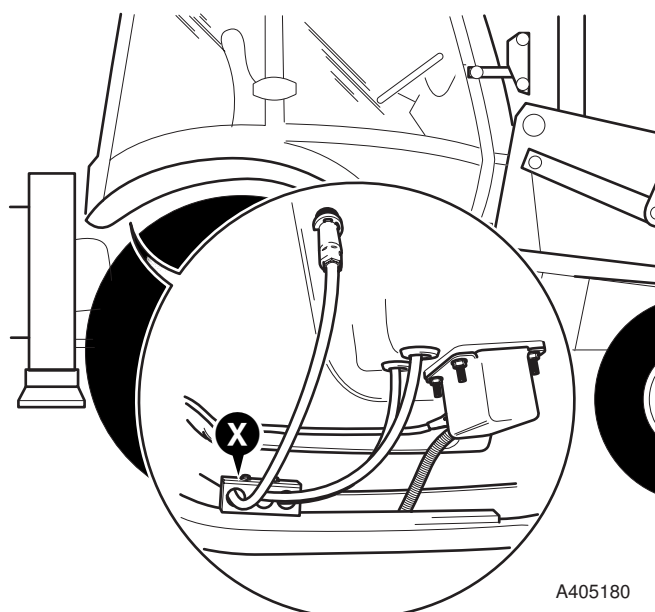
### Replacement

Replacement is the reverse of the removal sequence.

After fitting the cable(s), operate the controls and check that the stabilisers function correctly.



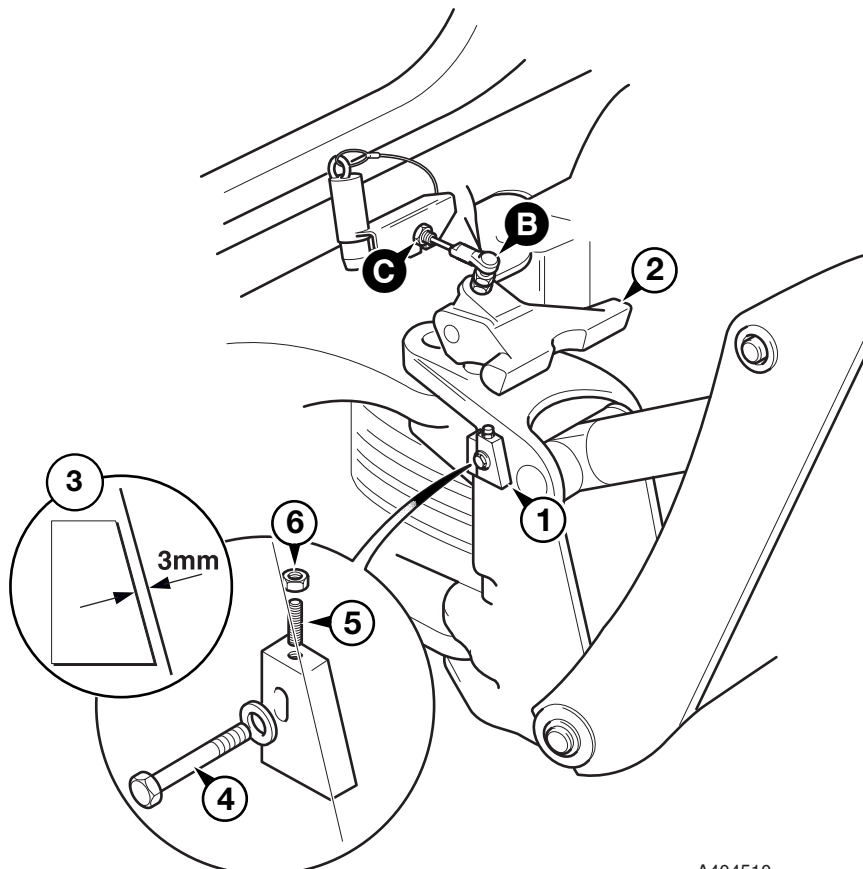
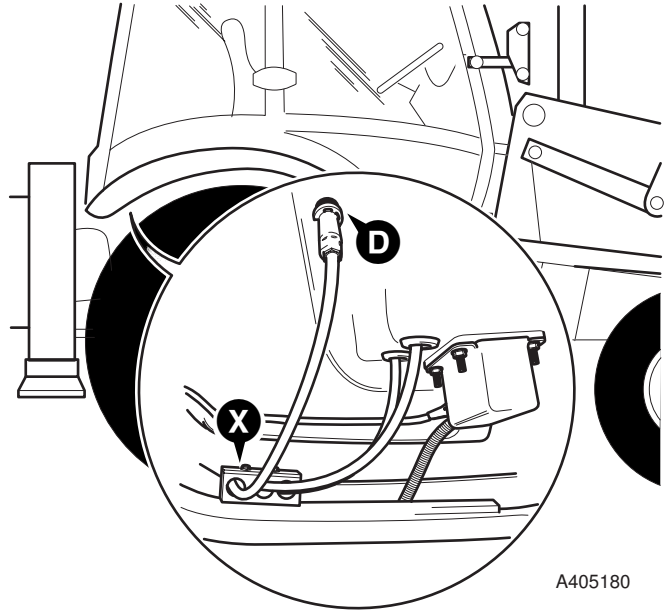
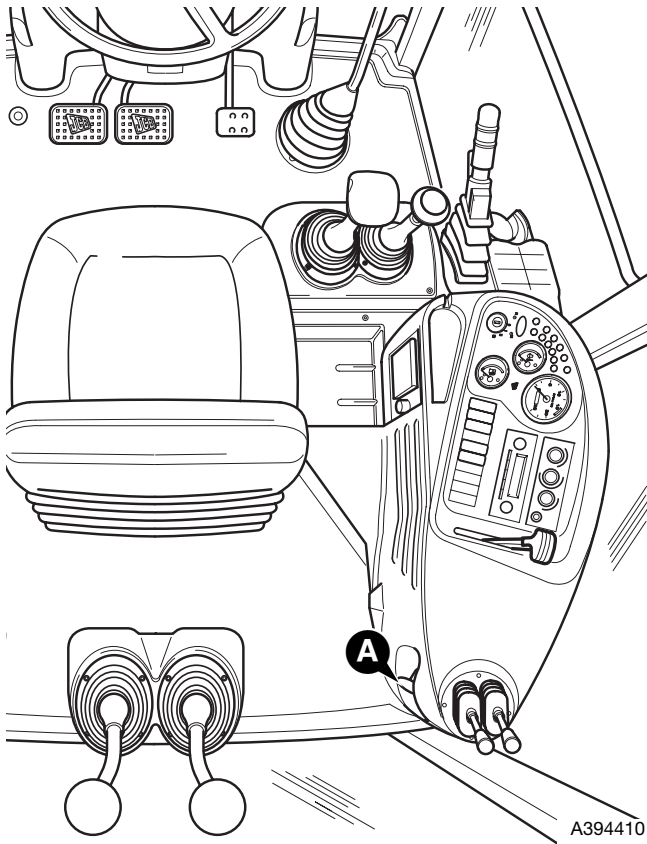
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### Removal and Replacement

#### Boom Lock Cable



## Removal and Replacement

### Boom Lock Cable

The boom lock control **A** and associated cable is housed in the R.H. side console as shown.

Note the routing of the existing cable and route the new cable in the same way.

#### Removal

- 1 Park the machine on firm level ground, apply the parking brake. Lower the loader arms and excavator to the ground, switch OFF the engine and remove the starter key.
- 2 Working at the boom, remove the cable ball stud **B** from the boom lock casting.
- 3 Loosen the lock nut and disconnect the bulkhead fitting **C** from the bracket. Feed the end of the cable back underneath the cab to the rear wheel arch on the R.H. side of the machine and release the cable from the clamp assembly at position **X** as shown. Remove the spring clip **D** from the outer sleeve.
- 4 Working in the cab, unscrew the knob and lock nut from the boom lock control **A**. Remove the fixings from the side console panel and carefully lift up the rear corner of the side console panel over the boom lock control outer sleeve.
- 5 With the rear corner of the side console panel lifted up, carefully pull the boom lock cable up into the cab through the aperture in the cab floor.

#### Replacement

Replacement is the reverse of the removal sequence.

- 1 After fitting the cable, with the control knob pressed down adjust the bulkhead fitting **C** to take up any slack in the cable. The cable should be tight but must not lift the boom lock from its fully down position.
- 2 Operate the boom and check that the boom lock will engage and disengage correctly using the control knob in the cab. Check the boom stop setting, see **Boom Stop Setting**.

### Boom Stop Setting

The boom stop block should be set as follows:

- 1 Lightly secure the boom stop block **1** in its lowest position.
- 2 Raise the boom lock **2** using the control knob in the cab.
- 3 Fully raise the boom (i.e. the boom ram fully retracted) and engage the boom lock using the control knob in the cab.
- 4 With the engine switched OFF, operate the excavator control levers several times to vent any residual pressure from the boom ram.
- 5 Adjust the boom stop block **1** until there is 3 mm (1/8 in.) gap between the stop and the boom profile as shown at **3**.
- 6 Tighten clamping bolt **4**. Tighten grubscrew **5** and lock nut **6**.
- 7 Switch ON the engine. Fully raise the boom (i.e. the boom ram fully retracted) and raise the boom lock using the control knob in the cab.
- 8 If the boom lock does not release readjust the stop block as follows:
  - a Loosen the lock nut **6** and slacken the grubscrew **5** a further half turn.
  - b Loosen clamping bolt **4** and reposition the stop block. Retighten bolt **4** and lock the grubscrew.
- 9 Operate the boom and check that the boom lock will engage and disengage correctly using the control knob in the cab.

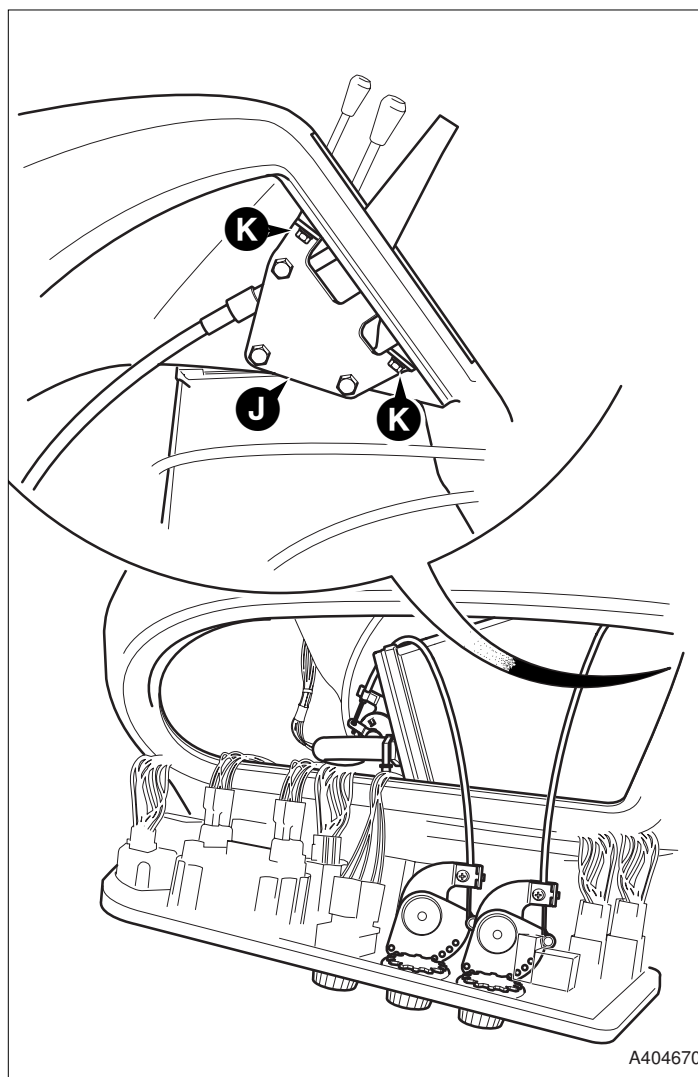
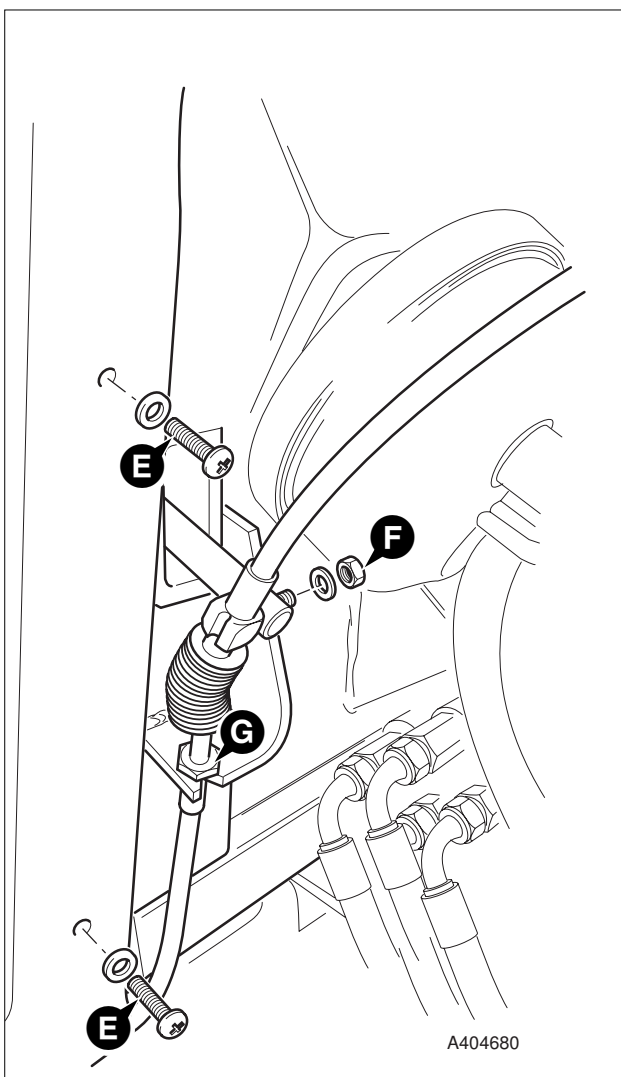
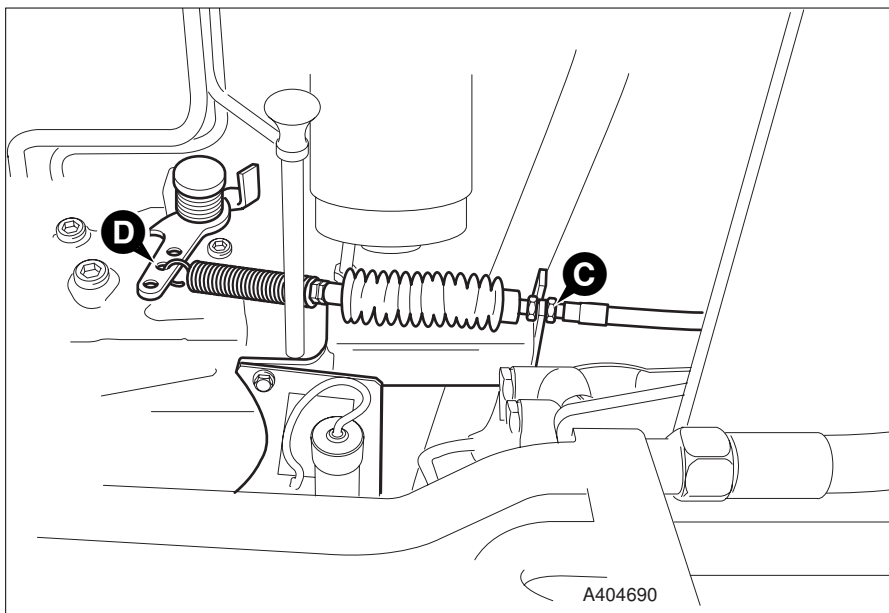
#### Torque Settings

Item	Nm	kgf m	lbf ft
E	476	48	352



### Removal and Replacement

#### Engine Throttle Cable



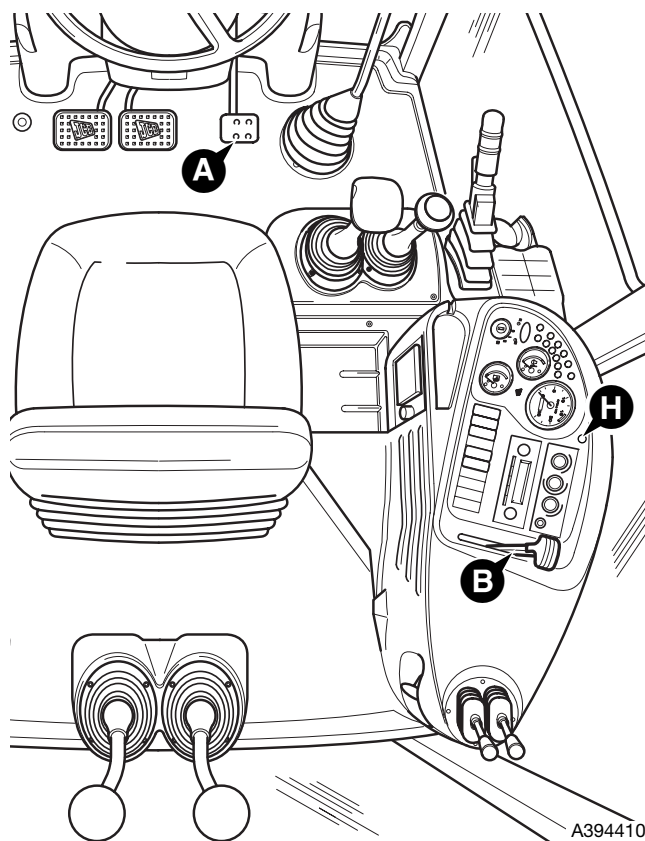
## Removal and Replacement

### Engine Throttle Cable

The engine throttle cable is routed from the L.H. side of the engine compartment to connect with the footpedal **A** at the engine compartment bulkhead, and to the hand throttle lever **B** housed in the R.H. side console as shown.

#### Removal

- 1 Park the machine on firm level ground, apply the parking brake. Lower the loader arms and excavator to the ground, switch OFF the engine and remove the starter key.
- 2 Open the bonnet and remove the engine side covers.
- 3 At the L.H. side of the engine compartment, disconnect the throttle cable by loosening the lock nut **C** and unhooking the cable from the fuel injector pump lever **D** as shown. Feed the end of the cable back across the engine compartment to the bulkhead on the R.H. side.
- 4 Working at the R.H. side of the engine compartment at the bulkhead, remove the screws **E** and ease back the rubber bulkhead cover to reveal the end of the footpedal lever as shown. Remove the nut **F** and disconnect the cable pivot block from the footpedal. Loosen the lock nut **G** and release the cable from the bracket. Feed the cable back underneath the cab to the rear wheel arch on the R.H. side of the machine.
- 5 Working in the cab, remove the fixing **H** at the top of the instrument panel and carefully lift the panel forward to reveal the hand throttle lever and mounting bracket assembly **J** inside the side console as shown.
- 6 Remove the hand throttle lever knob. Remove the screws **K**, taking hold of the hand throttle lever assembly withdraw the handle through the slot in the panel.
- 7 From inside the side console, carefully pull the cable up into the cab through the aperture in the cab floor.



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#### Replacement

Replacement is the reverse of the removal sequence.

After fitting the cable, operate the hand and foot throttle controls and check that they function correctly.

## Removal and Replacement

### Auxiliary Footpedal Cable

The auxiliary footpedal control **A** is mounted in the cab floor as shown. The cable operates the auxiliary control valve located adjacent to the excavator valve. The cable is accessible underneath the rear L.H. corner of the cab.

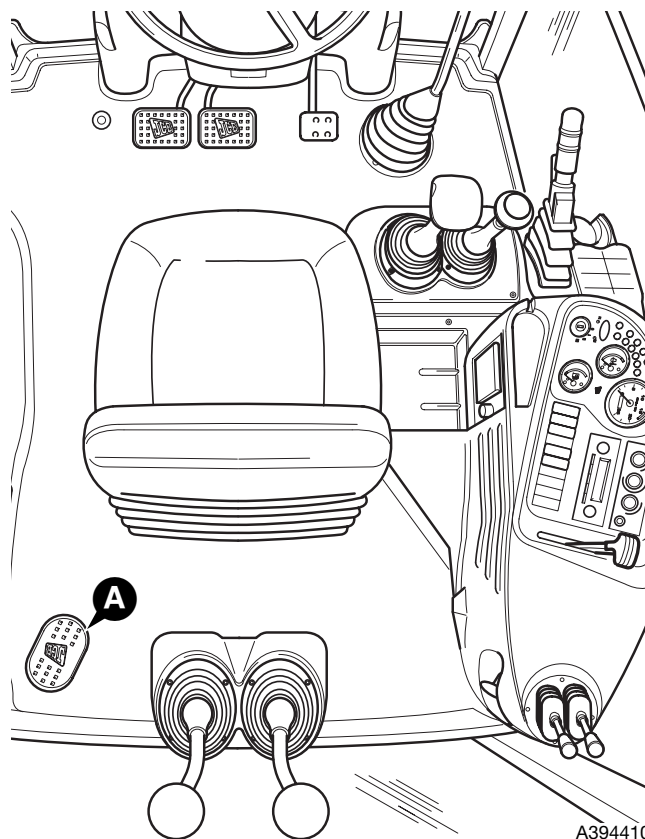
Note the routing of the existing cable and route the new cable in the same way.

#### Removal

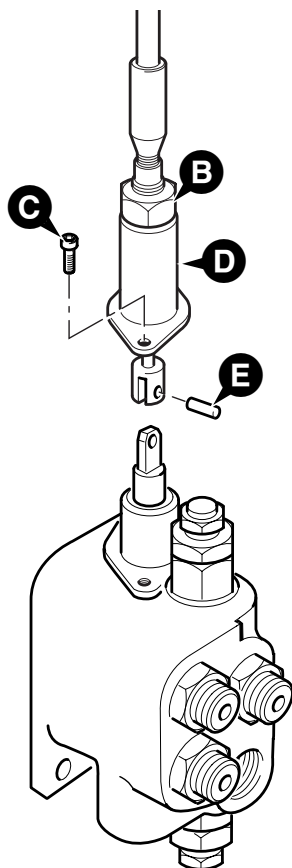
- 1 Park the machine on firm level ground, apply the parking brake. Lower the loader arms and excavator to the ground, switch OFF the engine and remove the starter key.
- 2 Working at the rear of the machine at the auxiliary valve, undo the locknut **B**. Remove the screws **C** and slide back the housing **D** to reveal the clevis as shown. Remove the clevis pin **E** to release the cable.
- 3 At the footpedal remove the U-clamp **F** securing the cable to the bracket. Remove the spring clip **G** to release the cable. If the cable is to be replaced, remove and retain the microswitch operating tab **H** from the old cable as shown.

#### Replacement

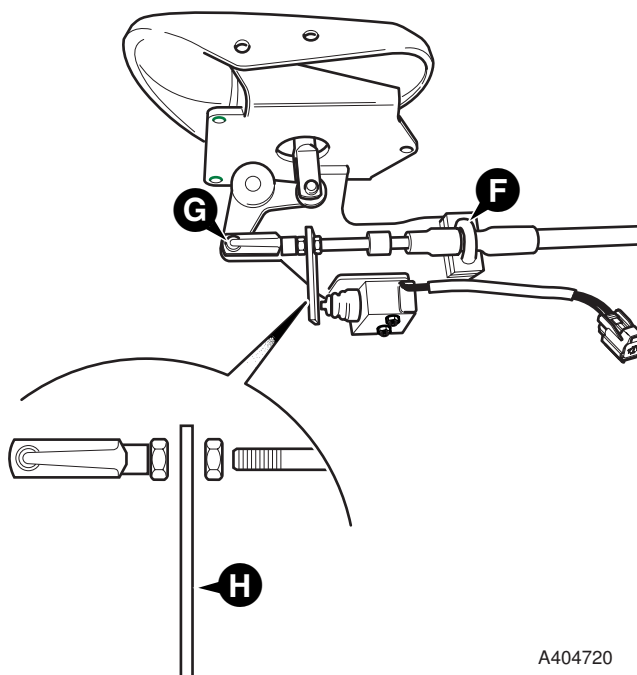
Replacement is the reverse of the removal sequence.



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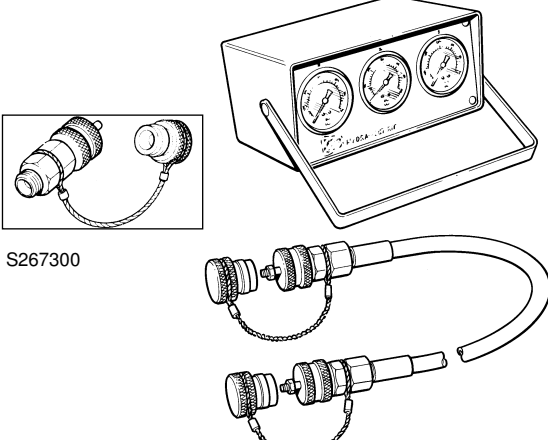
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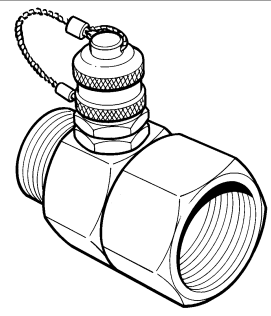


**Hydraulic Circuit Pressure Test Kit**

892/00253	Pressure Test Kit
:892/00201	Replacement Gauge 0-20 bar (0-300 lbf/in <sup>2</sup> )
:892/00202	Replacement Gauge 0-40 bar (0-600 lbf/in <sup>2</sup> )
:892/00203	Replacement Gauge 0-400 bar (0-6000 lbf/in <sup>2</sup> )
:892/00254	Replacement Hose
993/69800	Seal Kit for 892/00254 (can also be used with probe 892/00706)
892/00706	Test Probe

S267300

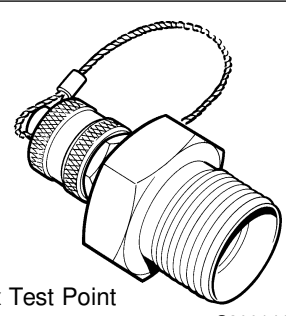
S188121



S188131

**Pressure Test 'T' Adapters**

892/00262	1/4 in M BSP x 1/4 in F BSP x Test Point
816/55038	3/8 in M BSP x 3/8 in F BSP x Test Point
816/55040	1/2 in M BSP x 1/2 in F BSP x Test Point
892/00263	5/8 in M BSP x 5/8 in F BSP x Test Point
892/00264	3/4 in M BSP x 3/4 in F BSP x Test Point
892/00265	1 in M BSP x 1 in F BSP x Test Point



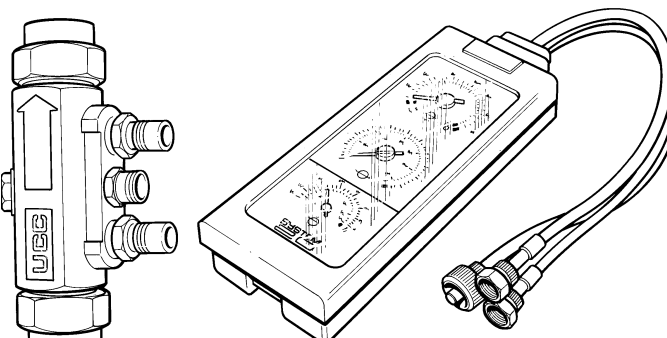
S200141

**Pressure Test Adapters**

892/00255	1/4 in BSP x Test Point
892/00256	3/8 in BSP x Test Point
892/00257	1/2 in BSP x Test Point
892/00258	5/8 in BSP x Test Point
816/15118	3/4 in BSP x Test Point
892/00259	1 in BSP x Test Point
892/00260	1.1/4 in BSP x Test Point
892/00261	5/8 in UNF x Test Point

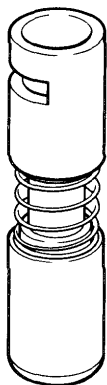
**Flow Test Equipment**

892/00268	Flow Monitoring Unit
892/00269	Sensor Head 0 - 100 l/min (0 - 22 UK gal/min)
892/00293	Connector Pipe
892/00270	Load Valve
1406/0021	Bonded Washer
1604/0006	Adapter 3/4 in M x 3/4 in M BSP
1612/0006	Adapter 3/4 in F x 3/4 in M BSP
892/00271	Adapter 3/4 in F x 5/8 in M BSP
892/00272	Adapter 5/8 in F x 3/4 in M BSP
816/20008	Adapter 3/4 in F x 1/2 in M BSP
892/00275	Adapter 1/2 in F x 3/4 in M BSP
892/00276	Adapter 3/4 in F x 3/8 in M BSP
892/00277	Adapter 3/8 in F x 3/4 in M BSP
892/00273	Sensor Head 0 - 380 l/min
892/00294	Connector Pipe
1606/0015	Adapter 1.1/4 in M BSP x 1 in M BSP
892/00078	Connector 1 in F x 1 in F BSP
1604/0008	Adapter 1 in M x 1 in M BSP
1606/0012	Adapter 1 in M x 3/4 in M BSP
816/20013	Adapter 3/4 in F x 1 in M BSP



S188151

892/00881 Valve Spool Seal Fitting Tool

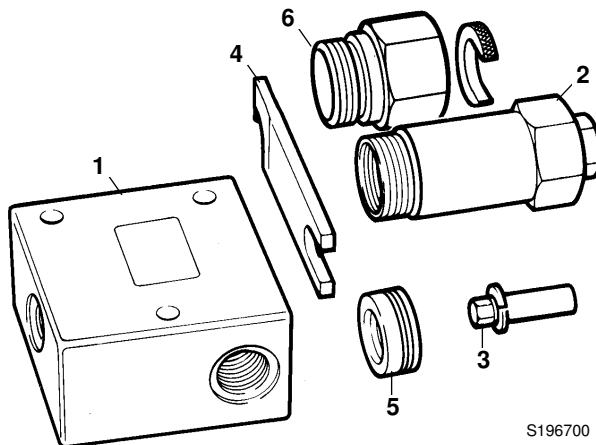


S261220

Components for Valve Block A.R.V. Testing

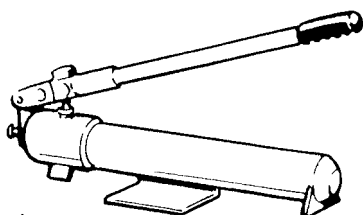
For 4CX Variable Flow machines use 25/201103

- 892/00309 A.R.V. Pressure Test Kit
- 1 : 892/00340 Test Block Body
- 2 : 892/00341 Setting Body
- 3 : 993/68300 Adjusting Pin
- 4 : 892/00343 Spanner
- 5 : 892/00345 Anti-cavitation Lock Out Bung
- 6 : 892/00335 A.R.V. Cartridge Removal Tool



S196700

Hand Pump Equipment



- 892/00223 Hand Pump
- 892/00137 Micro-bore Hose 1/4 in BSP x 3 metres
- 892/00274 Adapter 1/4 in M BSP x 3/8 in M BSP Taper
- 892/00262 1/4 in M BSP x 1/4 in F BSP x Test Point
- 892/00706 Test Probe
- 892/00278 Gauge 0 - 40 bar (0 - 600 lbf/in<sup>2</sup>)
- 892/00279 Gauge 0 - 400 bar (0 - 6000 lbf/in<sup>2</sup>)

S193850

Bonded Washers

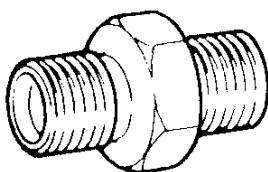
- 1406/0011 1/4 in. BSP
- 1406/0018 1/2 in. BSP
- 1406/0014 5/8 in. BSP
- 1406/0021 3/4 in. BSP
- 1406/0029 1.1/4 in. BSP



S188140

Male Adapters - BSP x NPT (USA only)

- 816/00439 3/8 in. x 1/4 in.
- 816/00440 1/2 in. x 1/4 in.
- 816/15007 3/8 in. x 3/8 in.
- 816/15008 1/2 in. x 3/8 in.



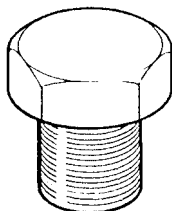
S193860

Male Adapters - BSP x BSP

- 1606/0003 3/8 in. x 1/4 in.
- 1604/0003 3/8 in. x 3/8 in.
- 892/00071 3/8 in. x 3/8 in. taper
- 1606/0004 1/2 in. x 1/4 in.
- 1606/0007 1/2 in. x 3/8 in.
- 1604/0004 1/2 in. x 1/2 in.
- 1606/0017 5/8 in. x 1/2 in.
- 1606/0008 3/4 in. x 3/8 in.
- 1606/0009 3/4 in. x 1/2 in.
- 1604/0006 3/4 in. x 3/4 in.
- 1606/0012 3/4 in. x 1 in.
- 1606/0014 3/4 in. x 1.1/4 in.
- 1606/0015 1 in. x 1.1/4 in.

Female Cone Blanking Plug

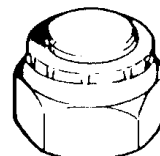
- 892/00055 1/4 in. BSP
- 892/00056 3/8 in. BSP
- 892/00057 1/2 in. BSP
- 892/00058 5/8 in. BSP
- 892/00059 3/4 in. BSP
- 892/00060 1 in. BSP



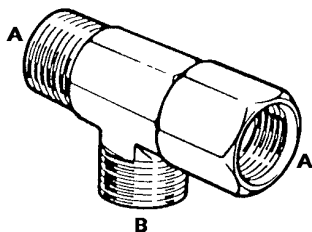
S193870

Male Cone Blanking Cap

- 816/00294 1/4 in. BSP
- 816/00189 3/8 in. BSP
- 816/00190 1/2 in. BSP
- 816/00197 5/8 in. BSP
- 816/00196 3/4 in. BSP
- 816/00193 1 in. BSP

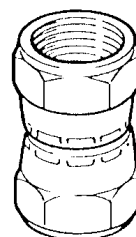


S193880



S193890

- 892/00047 3/8 in. BSP (A) x 1/4 in. BSP (B)
- 892/00048 1/2 in. BSP (A) x 1/4 in. BSP (B)
- 892/00049 5/8 in. BSP (A) x 1/4 in. BSP (B)
- 816/50043 3/4 in. BSP (A) x 1/4 in. BSP (B)
- 892/00051 1 in. BSP (A) x 1/4 in. BSP (B)
- 816/50005 1/2 in. BSP (A) x 1/2 in. BSP (B)
- 816/60096 3/4 in. BSP (A) x 3/4 in. BSP (B)
- 816/00017 1 in. BSP (A) x 1 in. BSP (B)

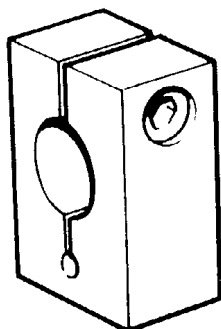


S193900

Female Connectors

- 892/00074 3/8 in. BSP x 3/8 in. BSP
- 892/00075 1/2 in. BSP x 1/2 in. BSP
- 892/00076 5/8 in. BSP x 5/8 in. BSP
- 892/00077 3/4 in. BSP x 3/4 in. BSP

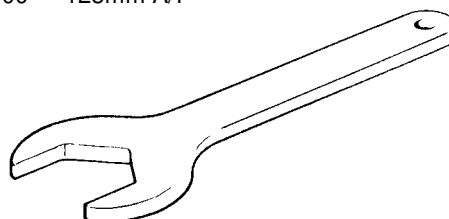
- 992/09100 Excavator Spool Clamp
- 892/00011 Spool Clamp

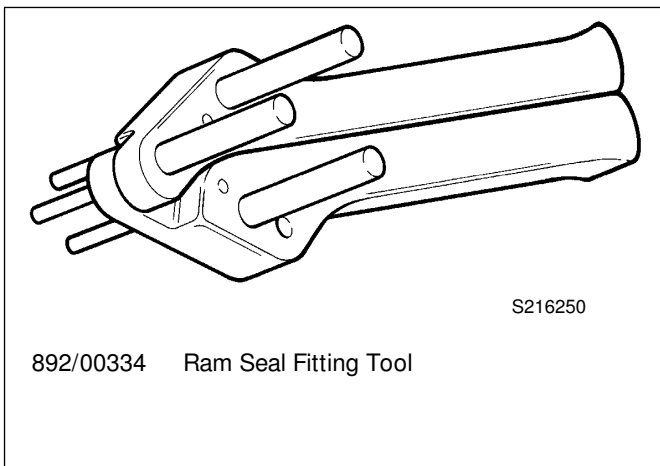


S216210

Hexagon Spanners for Ram Pistons and End Caps

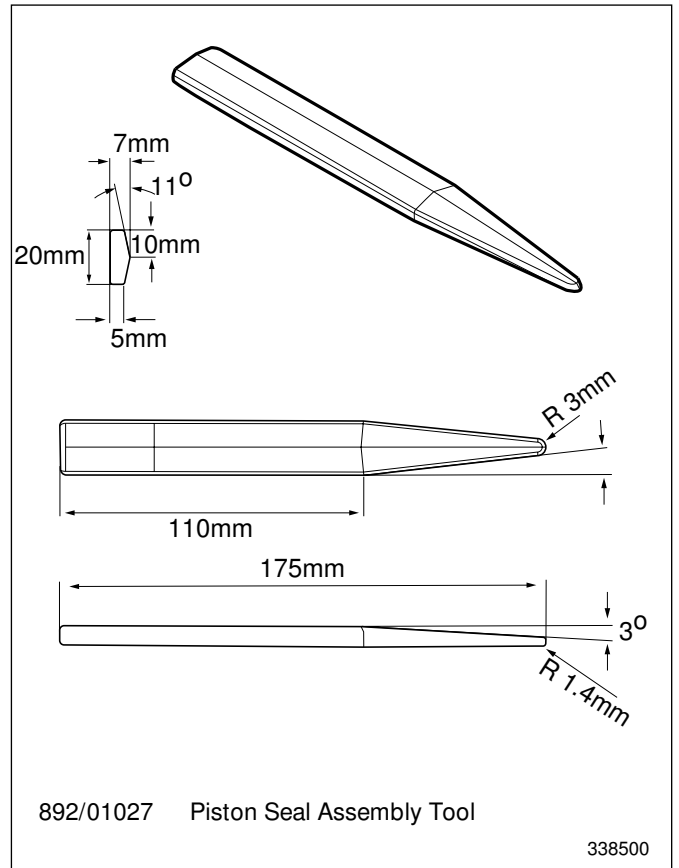
- 992/09300 55mm A/F
- 992/09400 65mm A/F
- 992/09500 75mm A/F
- 992/09600 85mm A/F
- 992/09700 95mm A/F
- 992/09900 115mm A/F
- 992/10000 125mm A/F





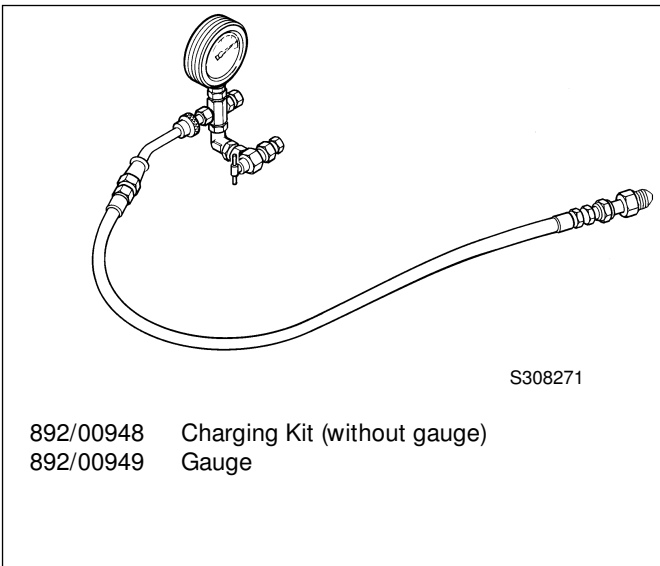
S216250

892/00334 Ram Seal Fitting Tool



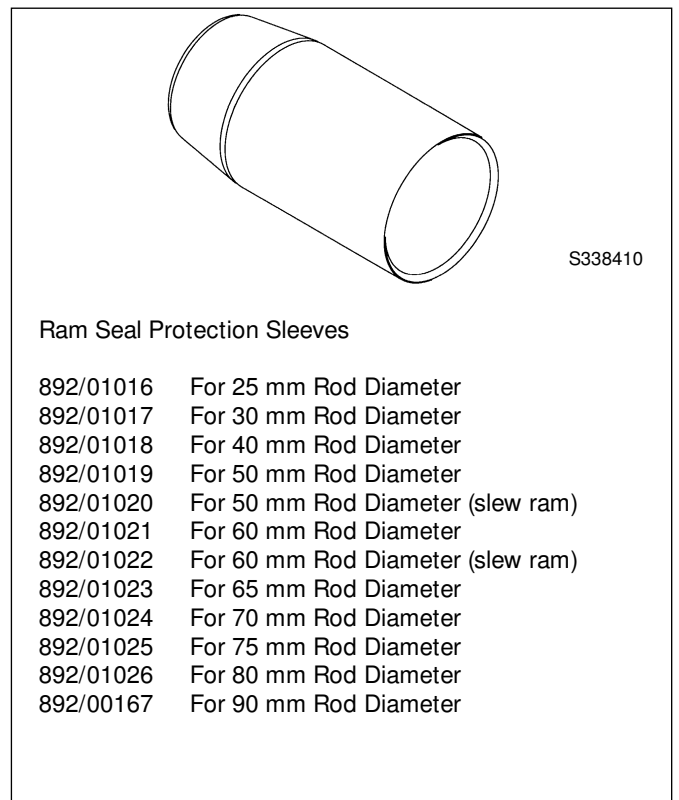
892/01027 Piston Seal Assembly Tool

338500



S308271

892/00948 Charging Kit (without gauge)  
892/00949 Gauge



S338410

Ram Seal Protection Sleeves

- 892/01016 For 25 mm Rod Diameter
- 892/01017 For 30 mm Rod Diameter
- 892/01018 For 40 mm Rod Diameter
- 892/01019 For 50 mm Rod Diameter
- 892/01020 For 50 mm Rod Diameter (slew ram)
- 892/01021 For 60 mm Rod Diameter
- 892/01022 For 60 mm Rod Diameter (slew ram)
- 892/01023 For 65 mm Rod Diameter
- 892/01024 For 70 mm Rod Diameter
- 892/01025 For 75 mm Rod Diameter
- 892/01026 For 80 mm Rod Diameter
- 892/00167 For 90 mm Rod Diameter

## Hydraulic Pumps

### Fixed Flow

	Model/Reference	Double pump/4070H		
*	Mounting	Gearbox		
	Theoretical displacement:	<b>cc/rev</b>	<b>cu in/rev</b>	
	Pump section 1 (mounting flange end)	33	2.01	
	Pump section 2	23	1.40	
	Flow at 2200 rev/min and system pressure (90% min displacement):	<b>litres/min</b>	<b>UK gal/min</b>	<b>US gal/min</b>
	Pump section 1 (mounting flange end)	65.3	14.4	17.2
	Pump section 2	45.5	10.0	12.0
	Maximum speed @ pressure P1	3000 rev/min		
	Minimum speed @ pressure P1	500 rev/min		
	Approximate Weight	24kg (53 lbs)		

	Model/Reference	Double pump/83103		
*	Mounting	Gearbox		
	Theoretical displacement:	<b>cc/rev</b>	<b>cu in/rev</b>	
	Pump section 1 (mounting flange end)	36	2.19	
	Pump section 2	26	1.59	
	Flow at 2200 rev/min and system pressure (90% min displacement):	<b>litres/min</b>	<b>UK gal/min</b>	<b>US gal/min</b>
	Pump section 1 (mounting flange end)	71.3	15.7	18.8
	Pump section 2	51.5	11.3	13.5
	Maximum speed @ pressure P1	3000 rev/min		
	Minimum speed @ pressure P1	500 rev/min		
	Approximate Weight	23.8kg (52 lbs)		

	Model/Reference	Double pump/7441N		
*	Mounting	Gearbox		
	Theoretical displacement:	<b>cc/rev</b>	<b>cu in/rev</b>	
	Pump section 1 (mounting flange end)	41	2.50	
	Pump section 2	26	1.59	
	Flow at 2200 rev/min and system pressure (90% min displacement):	<b>litres/min</b>	<b>UK gal/min</b>	<b>US gal/min</b>
	Pump section 1 (mounting flange end)	81.2	17.9	21.5
	Pump section 2	51.5	11.3	13.5
	Maximum speed @ pressure P1	3000 rev/min		
	Minimum speed @ pressure P1	500 rev/min		
	Approximate Weight	24.5kg (54 lbs)		

	Model/Reference	Double pump/4071F		
*	Mounting	Gearbox		
	Theoretical displacement:	<b>cc/rev</b>	<b>cu in/rev</b>	
	Pump section 1 (mounting flange end)	41	2.50	
	Pump section 2	29	1.77	
	Flow at 2200 rev/min and system pressure (90% min displacement):	<b>litres/min</b>	<b>UK gal/min</b>	<b>US gal/min</b>
	Pump section 1 (mounting flange end)	81.2	17.9	21.5
	Pump section 2	57.4	12.6	15.1
	Maximum speed @ pressure P1	3000 rev/min		
	Minimum speed @ pressure P1	500 rev/min		
	Approximate Weight	24.5kg (54 lbs)		

continued.....

**Hydraulic Pumps****Fixed Flow (continued)**

* Model/Reference	Double pump/PGP620/Common outlet		
Mounting	Gearbox		
Theoretical displacement:	<b>cc/rev</b>	<b>cu in/rev</b>	
Pump section 1 (mounting flange end)	29	1.77	
Pump section 2	23	1.40	
Flow at 2200 rev/min and system pressure (90% min displacement):	<b>litres/min</b>	<b>UK gal/min</b>	<b>US gal/min</b>
Pump section 1 (mounting flange end)	57.4	12.6	15.1
Pump section 2	45.5	10.0	12.0
Maximum speed @ pressure P1	3000 rev/min		
Minimum speed @ pressure P1	500 rev/min		
Approximate Weight	24kg (53 lbs)		

## Hydraulic Pumps

### Variable Flow

Type	Variable Displacement
Reference	A10VO - 978753
* Mounting	Gearbox
Load Sense Pressure (in neutral position)	Maximum permitted - 5 bar; 72.5 lbf/in <sup>2</sup>
Load sense pressure relief Valve (if fitted)	230 bar; 3335 lbf/in <sup>2</sup>
Stand-by Pressure	20 bar; 290 lbf/in <sup>2</sup>
Maximum Hydraulic Stall Pressure	
460001 to 472554 without relief valve	232 bar; 3364 lbf/in <sup>2</sup>
460001 to 472554 with relief valve and all from 472555	270 bar; 3915 lbf/in <sup>2</sup>
Maximum Displacement	74cc/rev; 4.5 in <sup>3</sup> /rev
Flow at 2200 rev/min and 2500 lb/in <sup>2</sup> pressure †	
- minimum acceptable flow rate (new or rebuilt pump)	75 -80 litres/min; 16.5 - 17.6 UK gal/min
- minimum acceptable flow rate (used pump)	70 - 75 litres/min; 15.4 - 16.5 UK gal/min
Flow in the Load Sense Line at 2200 rev/min (no pressure)	1 - 5 litres/min; 0.22 - 1.1 UK gal/min
Weight	TBAkg (TBA lbs)

† **Note:** It is not possible to test full pump flow at system pressure, figures quoted give a 'snapshot' indication of pump performance. For more detail refer to **Service Procedures, Variable Flow Pumps - Flow and Pressure Testing.**

**Relief Valve Pressures**

**Loader Valve - Fixed Flow**

	bar	kgf/cm <sup>2</sup>	lbf/in <sup>2</sup>
Main Relief Valve (M.R.V.)	236 - 241	240 - 245	3420 - 3500
Unloader Valve	207 - 214	207 - 211	3000 - 3100
Auxiliary Relief Valves (A.R.V.)			
Loader			
Shovel Ram Head Side	172 - 179	176 - 183	2500 - 2600
Shovel Ram Rod side	310 - 317	316 - 323	4500 - 4600

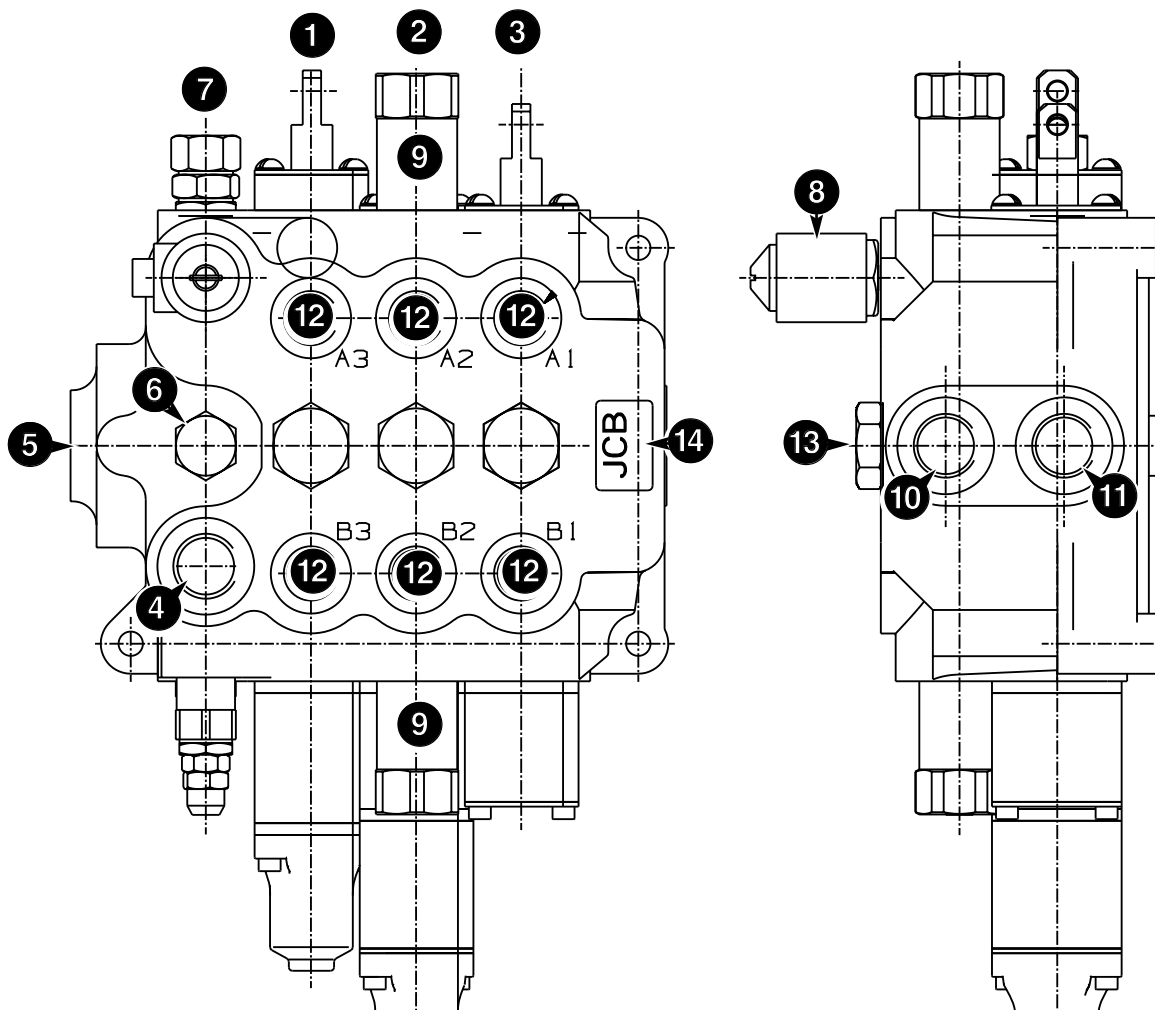
**Note:** Instructions for pressure testing and adjustment are described in **Service Procedures, Loader Valve - Pressure Testing.**

**Weight**

25kg (55lbs) (3 spool)  
TBA (2 spool)

**Component Key:**

- |   |                        |    |                                      |
|---|------------------------|----|--------------------------------------|
| 1 | Arms lift service      | 8  | Unloader solenoid                    |
| 2 | Shovel service         | 9  | Auxiliary relief valve               |
| 3 | Auxiliary (optional)   | 10 | Tank port                            |
| 4 | Pump section 1 - inlet | 11 | High pressure carry-over (HPCO) port |
| 5 | Pump section 2 - inlet | 12 | Service ports                        |
| 6 | Pressure test port     | 13 | Load hold check valve assemblies     |
| 7 | Unloader Assembly      | 14 | Data plate                           |



A262160



**Relief Valve Pressures**

**Loader Valve - Precision Control (Servo)**

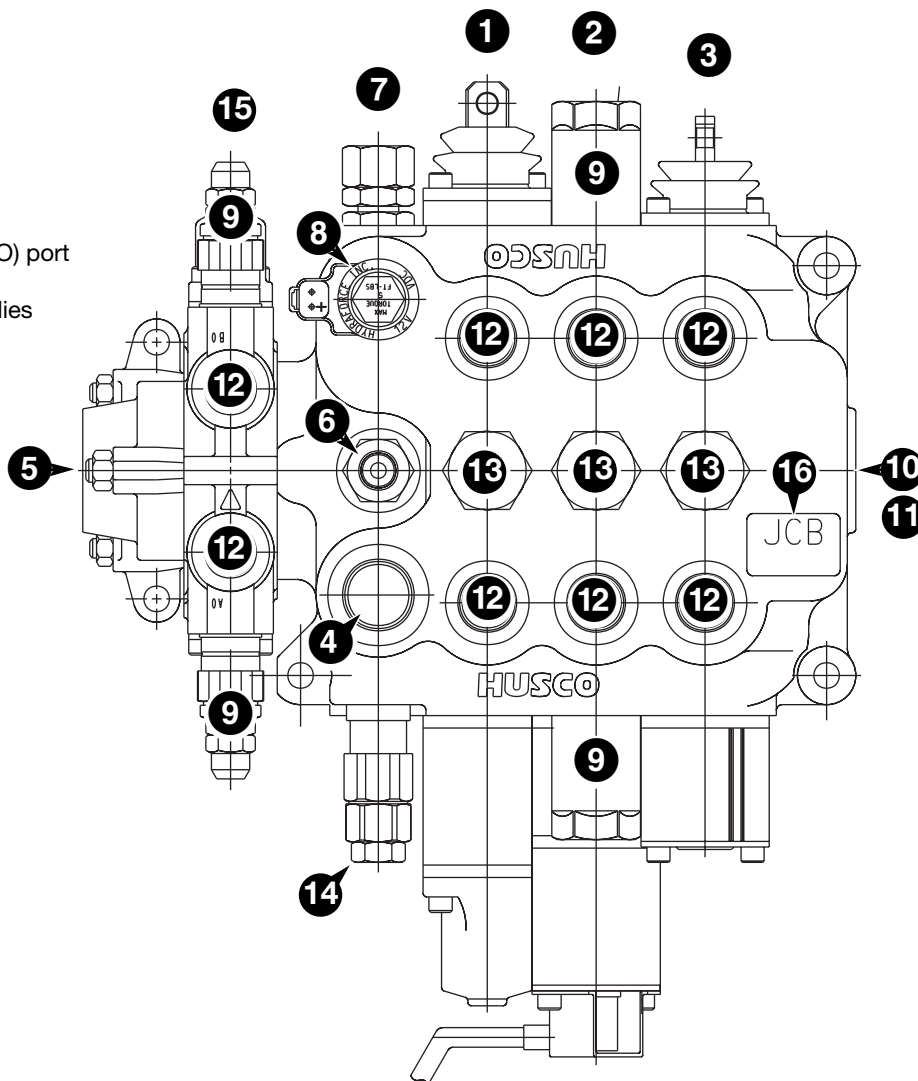
\* (Machines up to serial no. 931159)

	bar	kgf/cm <sup>2</sup>	lbf/in <sup>2</sup>
Main Relief Valve (M.R.V.)	227 - 231	232 - 235	3300 - 3350
Unloader Valve	203 - 207	207 - 211	2950 - 3000
Auxiliary Relief Valves (A.R.V.)			
Loader			
Shovel Ram Head Side	172 - 175	175 - 179	2500 - 2550
Shovel Ram Rod side	308 - 312	315 - 318	4475 - 4525
Bolt on Auxiliary Spool (extending dipper, if fitted)			
Top relief valve	136 - 140	139 - 142	1975 - 2025
Bottom relief valve	205 - 208	209 - 212	2975 - 3025

**Note:** Instructions for pressure testing and adjustment are described in **Service Procedures, Loader Valve - Pressure Testing.**

**Component Key:**

- 1 Arms lift service
- 2 Shovel service
- 3 Auxiliary (optional)
- 4 Pump section 1 - inlet
- 5 Pump section 2 - inlet
- 6 Pressure test port
- 7 Unloader Assembly
- 8 Unloader solenoid
- 9 Auxiliary relief valve
- 10 Tank port
- 11 High pressure carry-over (HPCO) port
- 12 Service ports
- 13 Load hold check valve assemblies
- 14 Main relief valve (MRV)
- 15 Bolt on auxiliary spool
- 16 Data plate



A402480

**Relief Valve Pressures**

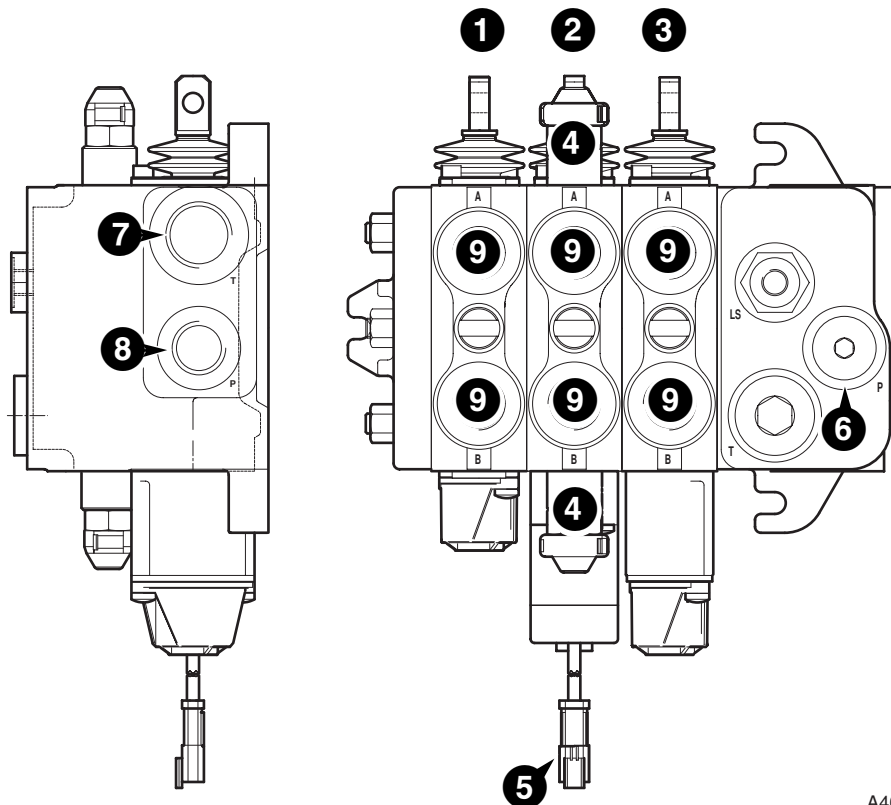
**Loader Valve - Precision Control (Servo)  
 (Machines from January 2003)**

	bar	kgf/cm <sup>2</sup>	lbf/in <sup>2</sup>
Auxiliary Relief Valves (A.R.V.)			
Shovel Ram Head Side	310	315	4500
Shovel Ram Rod Side	170	175	2500

**Note:** Instructions for pressure testing and adjustment are described in **Service Procedures, Loader Valve - Pressure Testing.**

**Component Key:**

- 1 Auxiliary (options)
- 2 Shovel service
- 3 Arms lift service
- 4 Auxiliary relief valves
- 5 Electric detent spool connector
- 6 Inlet port (secondary pump section P2)
- 7 Tank port
- 8 Inlet port (main pump section P1)
- 9 Service ports



A403690

## Relief Valve Pressures

### Loader Valve - Variable Flow

	bar	kgf/cm <sup>2</sup>	lbf/in <sup>2</sup>
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<sup>2</sup>, this will ensure it does not interfere with the operation of the relief valve housed in the hydraulic steer unit.

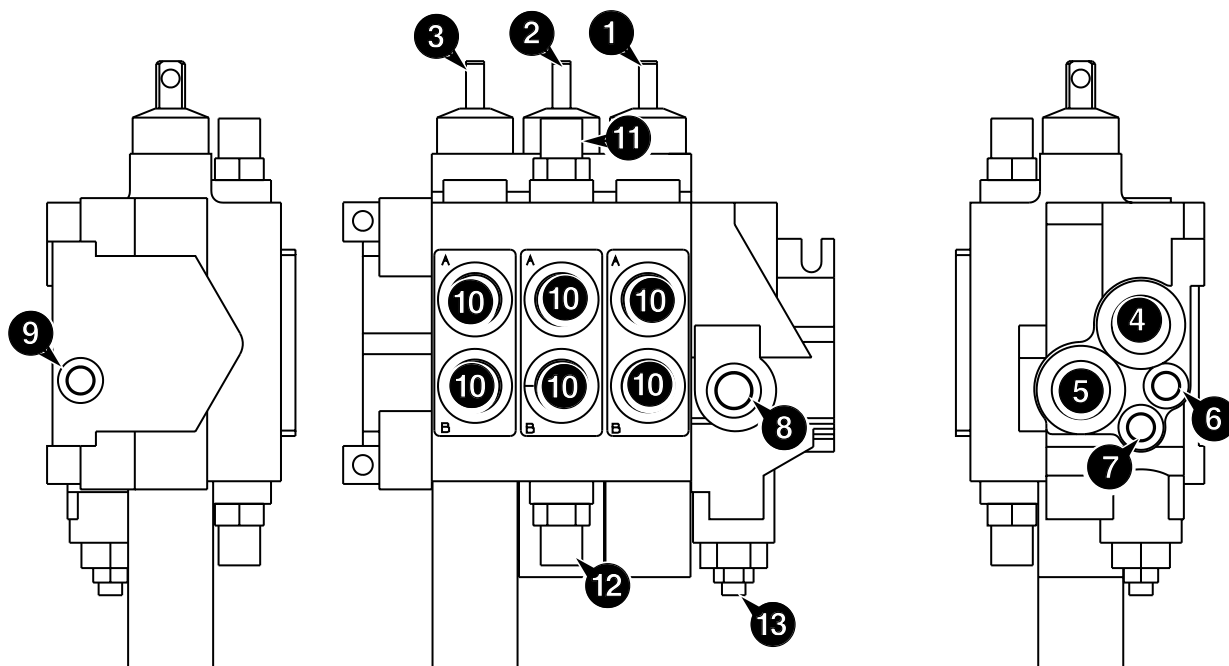
#### Weight:

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

**Relief Valve Pressures**

**Excavator Valve - Fixed Flow**

	bar	kgf/cm <sup>2</sup>	lbf/in <sup>2</sup>
Boom Ram Head Side	248 - 255	253 - 260	3600 - 3700
Boom Ram Rod Side	345 - 352	351 - 358	5000 - 5100
Bucket Ram Head Side			
Centremount (17' , 15' 6" backhoe - except knuckle)	310 - 317	316 - 323	4500 - 4600
Centremount (14' backhoe, 15' 6" backhoe with a knuckle fitted)	248 - 255	253 - 260	3600 - 3700
Sideshift	248 - 255	253 - 260	3600 - 3700
Bucket Ram Rod Side (Machines with Rockbreaker only)	248 - 255	253 - 260	3600 - 3700
Dipper Ram Head Side	248 - 255	253 - 260	3600 - 3700
Dipper Ram Rod Side	248 - 255	253 - 260	3600 - 3700
Slew Left and Right	262 - 269	267 - 274	3800 - 3900

**Weight:**

44 kg (97 lbs) - Centremount

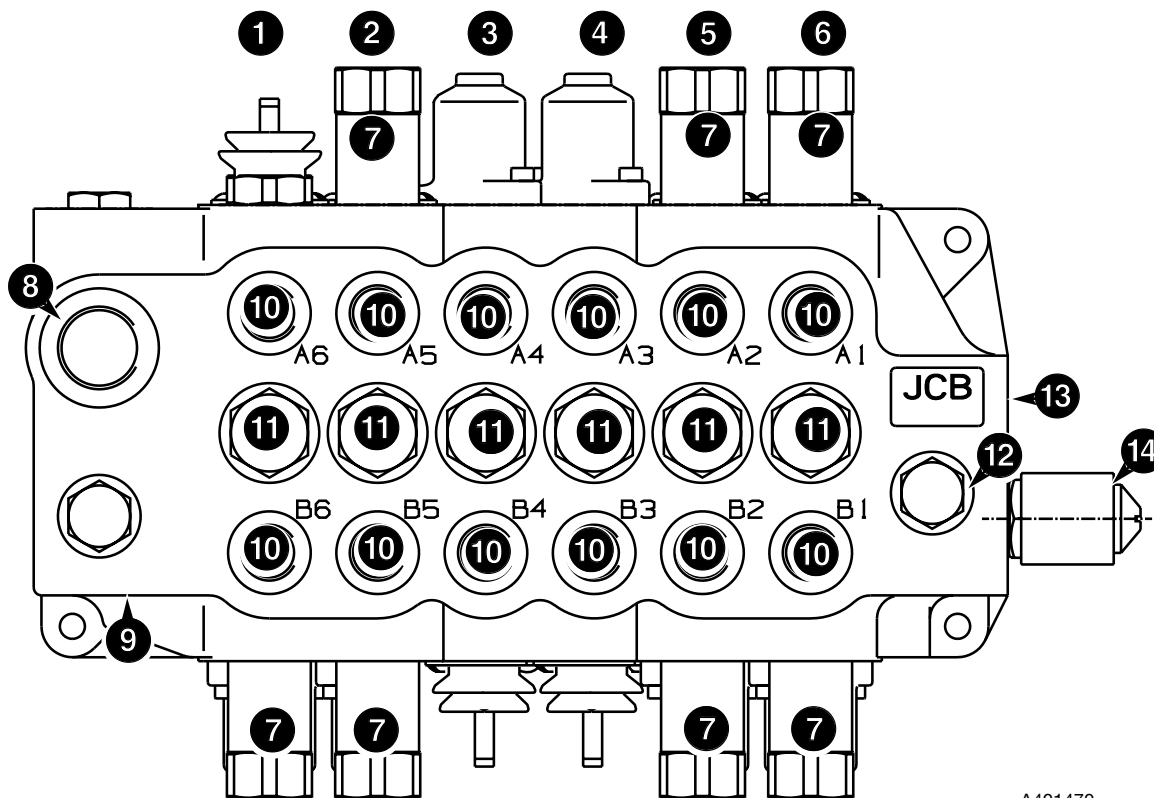
46 kg (101 lbs) - Sideshift

**Note:** Instructions for pressure testing and adjustment are described in **Service Procedures, Loader Valve - Pressure Testing.**

† System shown is for JCB plus pattern and JCB diagonal pattern. For ISO system, the boom and dipper spools change position, i.e. boom is position 2 and dipper is position 5. The bottom ARV from spool 5 will also be swapped with the bottom ARV from spool 2.

**Component Key:**

- |   |                        |    |                                      |
|---|------------------------|----|--------------------------------------|
| 1 | Bucket crowd           | 8  | Tank port                            |
| 2 | Dipper †               | 9  | High pressure carry-over (HPCO) port |
| 3 | Stabiliser             | 10 | Service ports                        |
| 4 | Stabiliser             | 11 | Load hold check valve assemblies     |
| 5 | Boom †                 | 12 | Make-up check valve assembly         |
| 6 | Slew                   | 13 | Inlet port                           |
| 7 | Auxiliary relief valve | 14 | Hydraclamp solenoid                  |



A401470

**Relief Valve Pressures**

**Excavator Valve - Precision Control (Servo)**

\* (Machines up to serial no. 931159)

	bar	kgf/cm <sup>2</sup>	lbf/in <sup>2</sup>
Boom Ram Head Side	248 - 255	253 - 260	3600 - 3700
Boom Ram Rod Side	345 - 352	351 - 358	5000 - 5100
Bucket Ram Head Side	248 - 255	253 - 260	3600 - 3700
Bucket Ram Rod Side	248 - 255	253 - 260	3600 - 3700
Dipper Ram Head Side	248 - 255	253 - 260	3600 - 3700
Dipper Ram Rod Side	248 - 255	253 - 260	3600 - 3700
Slew Left and Right	262 - 269	267 - 274	3800 - 3900
Load Sense Relief Valve †	208 - 212	213 - 216	3025 - 3075

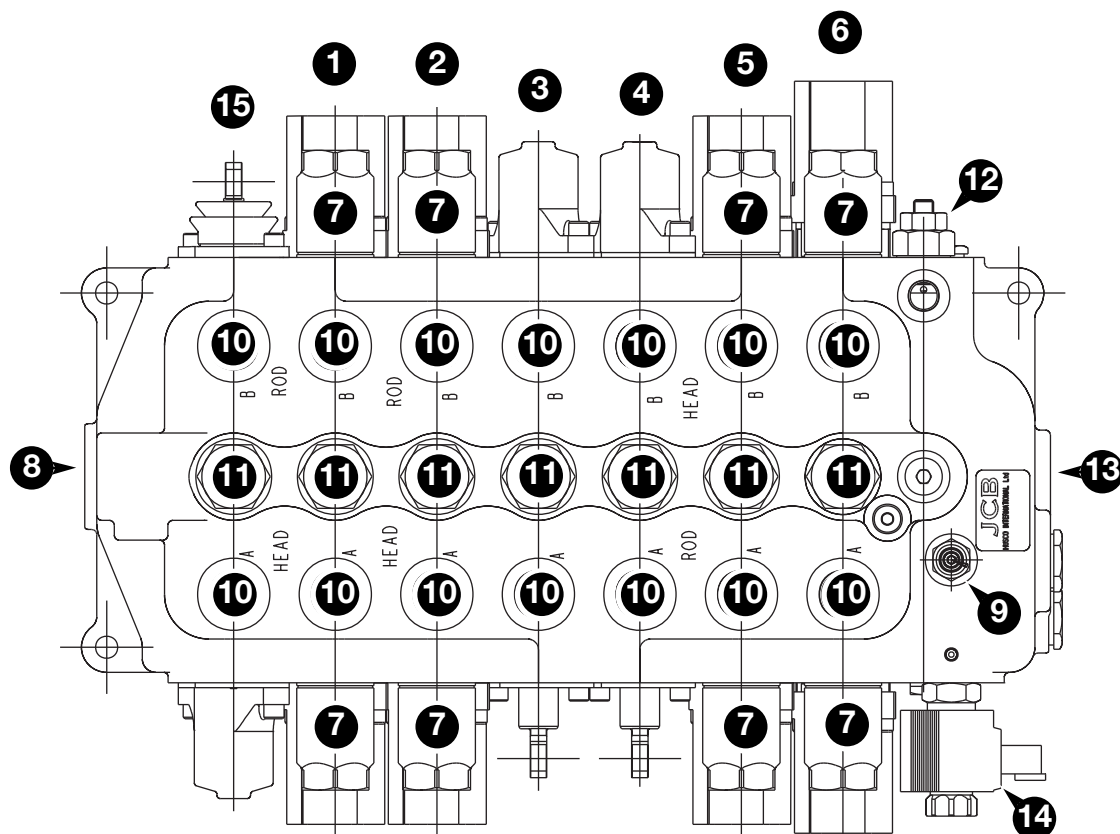
**Note:** Instructions for pressure testing and adjustment are described in **Service Procedures, Loader Valve - Pressure Testing.**

† **Note:** For pressure testing and adjustment of the load sense relief valve, see **Service Procedures, Pressure Testing, Load Sense Drain Regulator and Relief Valve.**

**Component Key:**

- 1 Bucket
- 2 Dipper
- 3 Stabiliser
- 4 Stabiliser
- 5 Boom
- 6 Slew
- 7 Auxiliary relief valve
- 8 Tank port

- 9 Pilot operated check valve (hydraclamp)
- 10 Service ports
- 11 Load sense valve
- 12 Load sense drain regulator and relief valve
- 13 Inlet port
- 14 Hydraclamp solenoid
- 15 Auxiliary spool



A402500

**Relief Valve Pressures**

**Excavator Valve - Precision Control (Servo)  
(Machines from January 2003)**

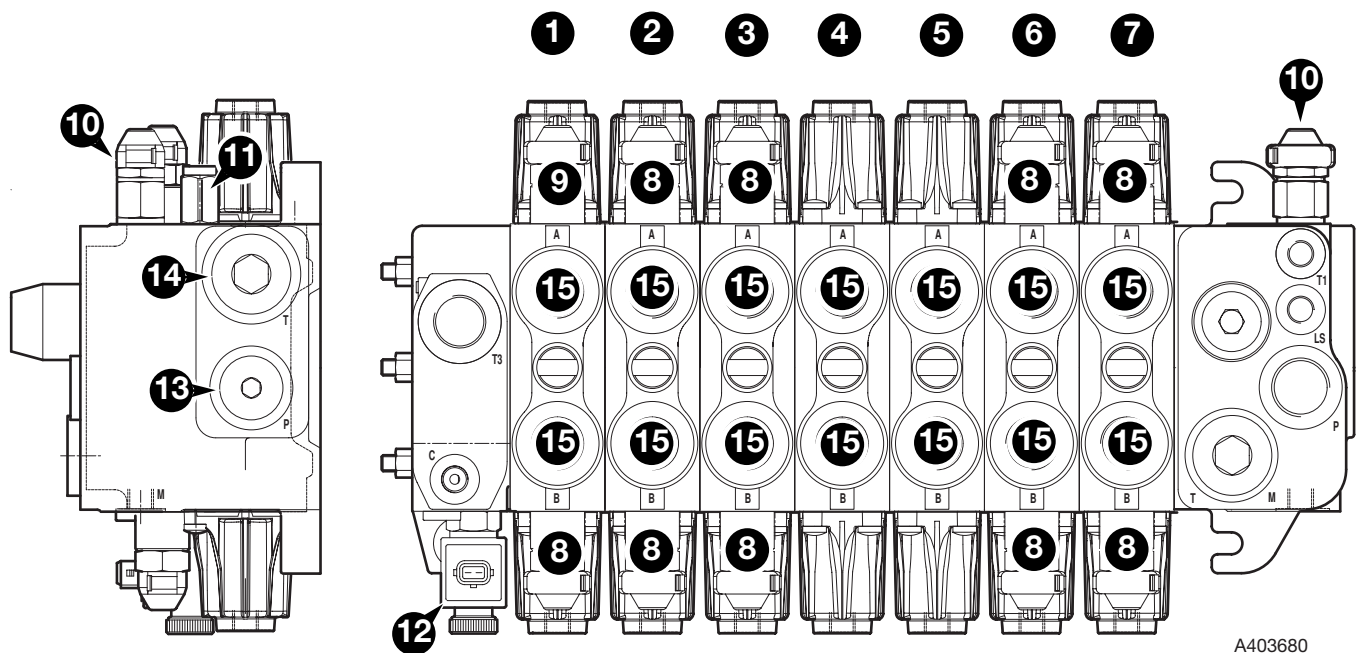
	bar	kgf/cm <sup>2</sup>	lbf/in <sup>2</sup>
Auxiliary Relief Valves (A.R.V.)			
Boom Ram Head Side	245	250	3550
Boom Ram Rod Side	350	355	5000
Bucket Ram Head Side	255	260	3700
Bucket Ram Rod Side	255	260	3700
Dipper Ram Head Side	255	260	3700
Dipper Ram Rod Side	255	260	3700
Slew Left and Right	265	270	3850
Load Sense Relief Valve †	250	255	3650

**Note:** Instructions for pressure testing and adjustment are described in **Service Procedures, Loader Valve - Pressure Testing.**

† **Note:** For pressure testing and adjustment of the load sense relief valve, see **Service Procedures, Pressure Testing, Load Sense Relief Valve.**

**Component Key:**

- |   |                         |    |                         |
|---|-------------------------|----|-------------------------|
| 1 | Auxiliary (options)     | 9  | Anti-cavitation valve   |
| 2 | Bucket                  | 10 | Load sense relief valve |
| 3 | Dipper                  | 11 | Flow regulator valve    |
| 4 | Stabiliser              | 12 | Hydraclamp solenoid     |
| 5 | Stabiliser              | 13 | Inlet port              |
| 6 | Boom                    | 14 | Tank port               |
| 7 | Slew                    | 15 | Service ports           |
| 8 | Auxiliary relief valves |    |                         |



**Relief Valve Pressures****Auxiliary Valve - Fixed Flow**

	<b>bar</b>	<b>kgf/cm<sup>2</sup></b>	<b>lbf/in<sup>2</sup></b>
Extradig Ram Head Side	138 - 145	141 - 148	2000 - 2100
Extradig Ram Rod Side	207 - 214	211 - 218	3000 - 3100
Jaw Bucket Ram Head Side	138 - 145	141 - 148	2000 - 2100
Jaw Bucket Ram Rod Side	207 - 214	211 - 218	3000 - 3100
Knuckle Ram Head Side	138 - 145	141 - 148	2000 - 2100
Knuckle Ram Rod Side	207 - 214	211 - 218	3000 - 3100
Hammermaster	207 - 214	211 - 218	3000 - 3100
Power Sideshift (both)	207 - 214	211 - 218	3000 - 3100
Hand Held Tools	138 - 150	141 - 153	2000 - 2200

**Component Key:**

- 1 Auxiliary Spool
- 2 Inlet port
- 2 Outlet port
- 3 Auxiliary relief valve
- 4 High pressure carry-over (HPCO) port
- 7 Service 'A' ports
- 8 Service 'B' ports

**Weight:**

TBA kg (TBA lbs)

## Smooth Ride System

### System Type

A piston type accumulator operates as a liquid spring absorbing displaced fluid from the lift rams. Selectable from a switch in the cab.

Charging Gas

Air Free Dry Nitrogen

Accumulator Capacity

1.0 litre (58 cu/in)

Accumulator Weight

4.4 kg (9.75 lb)

### Accumulator Charge Pressure

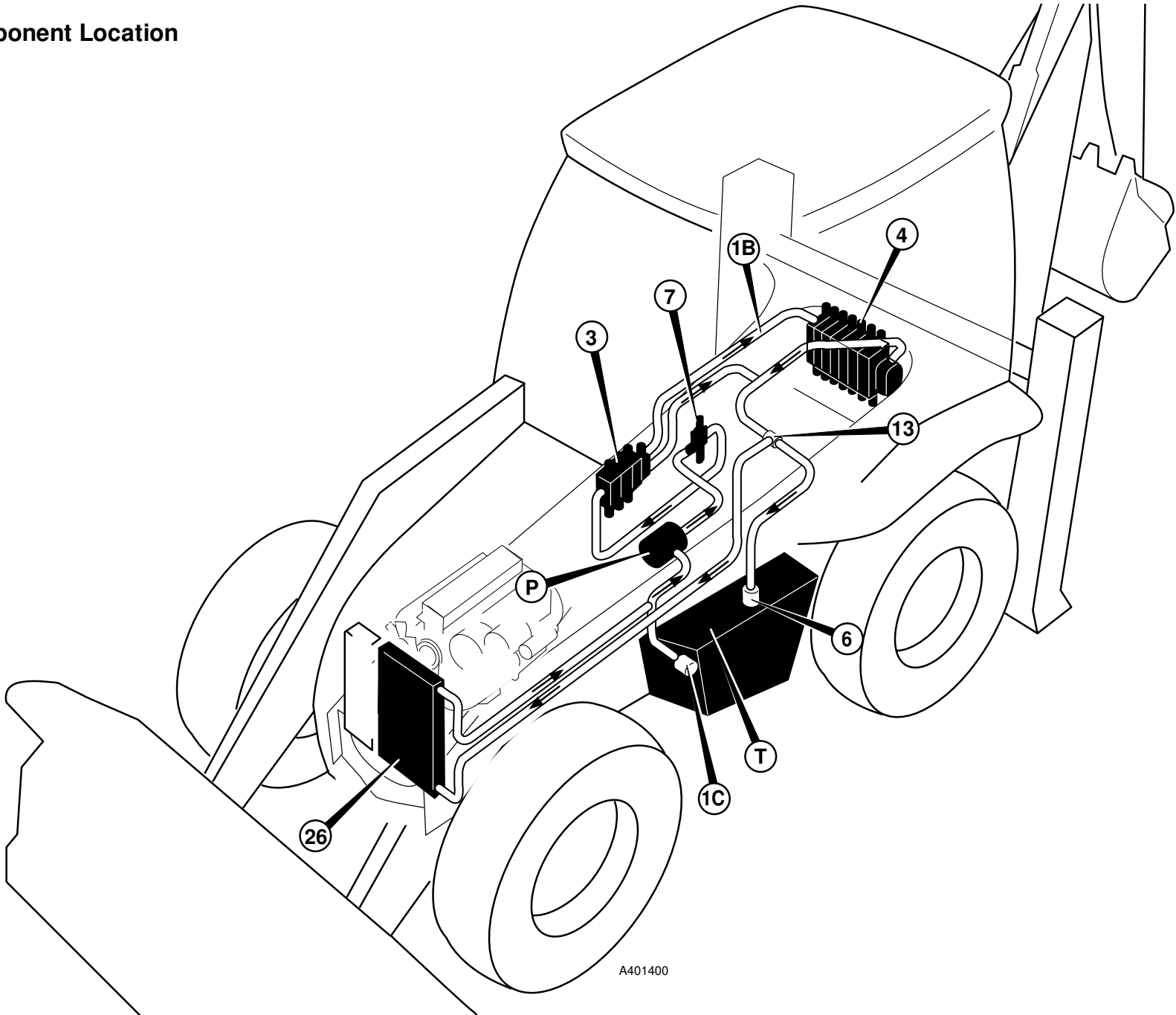
As a general guide for given shovel weights (loaded) see below:-

	<b>bar</b>	<b>kgf/cm<sup>2</sup></b>	<b>lbf/in<sup>2</sup></b>
Shovel weights up to 700 kg (1540 lb)	13.8	14	200
Shovel weights 700 kg to 950 kg (1540 - 2100 lb)	19	19.4	275
Shovel weights over 950 kg (2100 lb)	24	24.5	350

**Note:** Replacement accumulators will only be supplied in an uncharged, non pressureised condition to meet Health and Safety/Airfreight hazardous goods requirements.



Component Location



## Component Location

### Component Key:

- T** Hydraulic Tank
- P** Hydraulic Pump (engine driven)
- 1B** Hose - High Pressure Carry Over
- 3** Loader Valve Block
- 4** Excavator Valve
- 6** Return Line Filter (inside hydraulic tank)
- 7** Steer Circuit Priority Valve
- 13** Return Line Check Valve
- 26** Hydraulic Oil Cooler

## Neutral Circuit Description

### Fixed Flow - Single Pump

Oil is drawn from the hydraulic tank **T** by the single stage hydraulic pump **P**. The pump is mounted on the rear of the gearbox and is engine driven via a driveshaft.

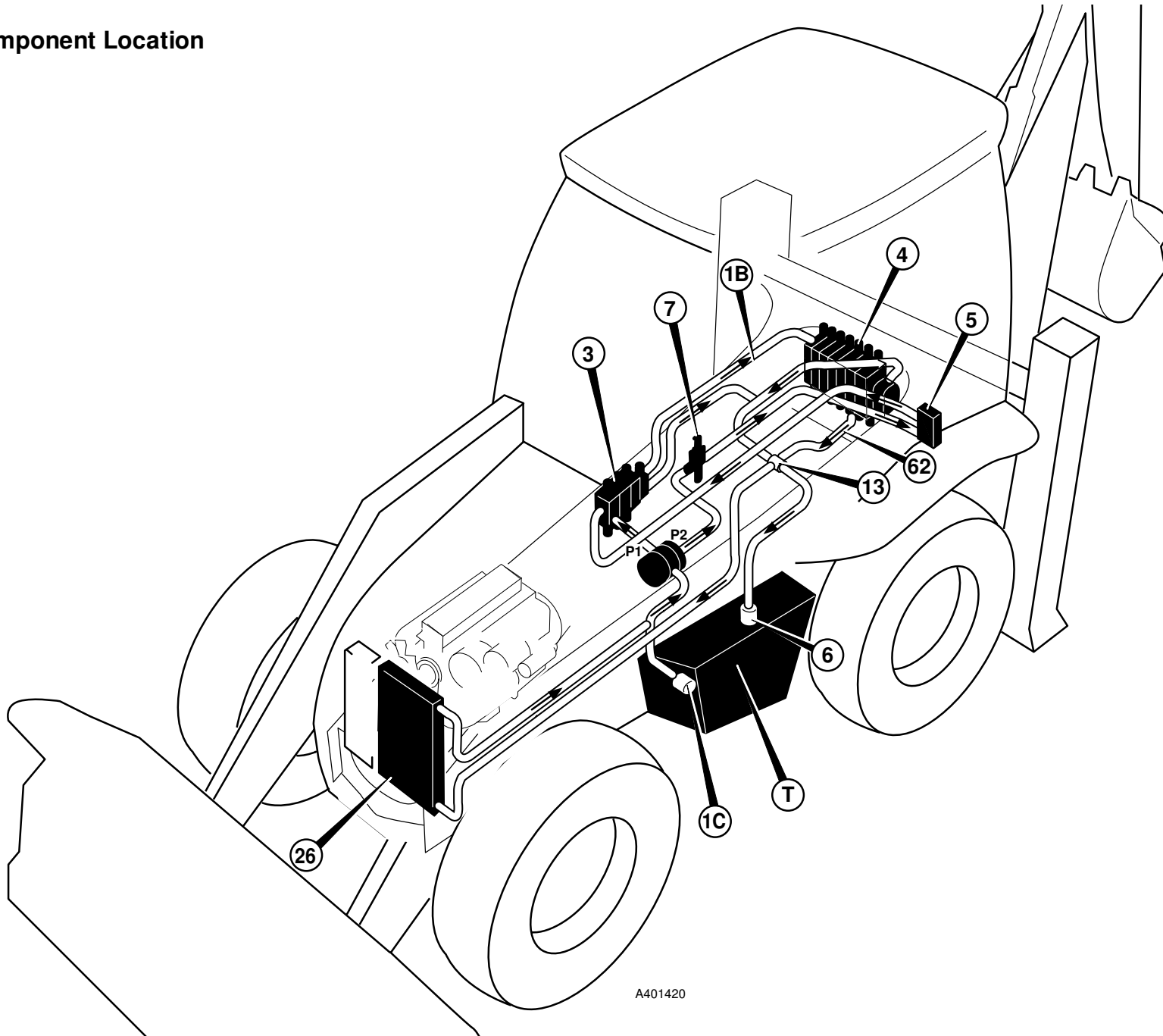
Pressurised oil from the pump flows to steering priority valve **7**, and in neutral circuit flows through the priority valve to the loader valve **3**.

From the loader valve neutral gallery, oil flows via a high pressure carry-over line **1B** to the excavator valve **4**.

Some of the exhaust oil flows directly back to the tank through an in-tank filter **6**, and some of the exhaust oil returns to tank via the hydraulic oil cooler **26**.

To help prevent excavator dipper ram and loader lift ram cavitation, there is a check valve **13** fitted to the return line. The check valve raises approximately 5 bar (75 lbf/in<sup>2</sup>) of pressure in the line, which improves the operation of the respective anti-cavitation valves.

Component Location



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## Component Location

### Component Key:

- T** Hydraulic Tank
- P1** Hydraulic Pump (main section)
- P2** Hydraulic Pump (secondary section)
- 1B** Hose - High Pressure Carry Over
- 3** Loader Valve Block
- 4** Excavator Valve
- 5** Auxiliary Valve
- 6** Return Line Filter (inside hydraulic tank)
- 7** Steer Circuit Priority Valve
- 13** Return Line Check Valve
- 26** Hydraulic Oil Cooler
- 62** Hydraclamp exhaust hose

## Neutral Circuit Description

### Fixed Flow - Double Pump

Oil is drawn from the hydraulic tank **T** by the hydraulic pump. The pump has two sections, **P1** and **P2**.

The hydraulic pump is mounted on the rear of the gearbox and is driven by the engine via a driveshaft.

Oil from the larger section **P1** flows direct to the loader valve **3**. Oil from pump section **P2**, flows to steering priority valve **7**, and in neutral circuit flows through the priority valve to the auxiliary valve **5** and then to join the flow from **P1** at the loader valve.

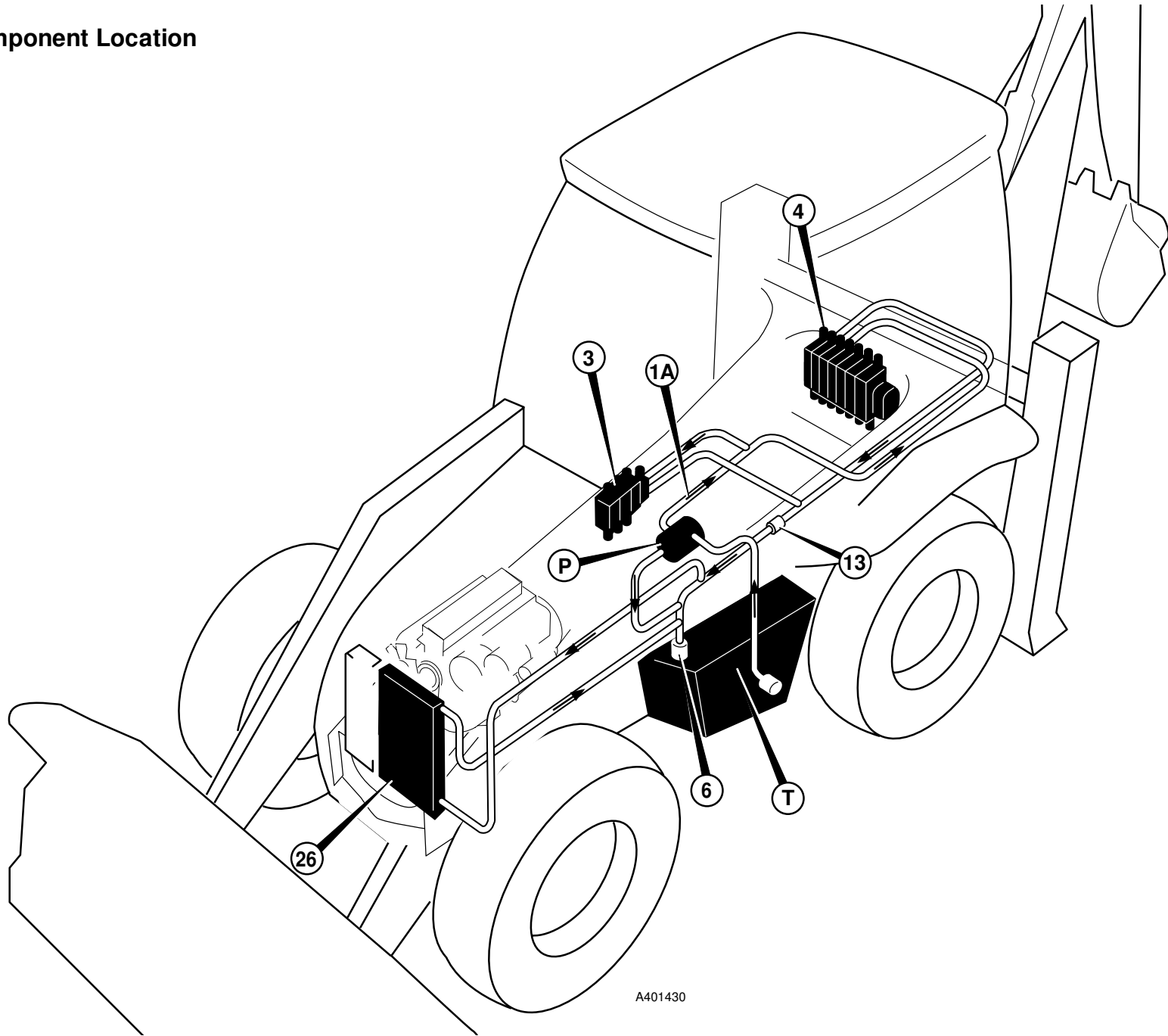
From the loader valve neutral gallery, oil flows via a high pressure carry-over line **1B** to the excavator valve **4**.

Some of the exhaust oil flows directly back to the tank through an in-tank filter **6**, and some of the exhaust oil returns to tank via the hydraulic oil cooler **26**.

To help prevent excavator dipper ram and loader lift ram cavitation, there is a check valve **13** fitted to the return line. The check valve raises approximately 5 bar (75 lbf/in<sup>2</sup>) of pressure in the line, which improves the operation of the respective anti-cavitation valves.

On sideshift machines only, hydraclamp exhaust hose **62** is fitted. The hose connects the hydraclamp spool directly into the exhaust circuit. This prevents the clamps from 'locking-up' when the sideshifting operation is required.

Component Location



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## Component Location

### Component Key:

- T Hydraulic Tank
- P Hydraulic Pump (engine driven)
- 1A Pump Outlet Pipe/Hose
- 3 Loader Valve Block
- 4 Excavator Valve
- 6 Return Line Filter (inside hydraulic tank)
- 13 Return Line Check Valve
- 26 Hydraulic Oil Cooler

## Neutral Circuit Description

### Variable Flow

The variable flow displacement pump **P** is mounted on the rear of the gearbox and is engine driven via a driveshaft.

With variable flow hydraulics, there is no 'neutral' circuit. This is because the pump **P** operates on a demand signal from the services (see **Circuit Descriptions, Hydraulic Pump - Variable Flow Operation**). If there is no demand, then the pump does not draw oil from the tank and no oil is delivered, there is no pump flow in the neutral position.

When a service is selected, the pump senses the demand and oil is drawn from the hydraulic tank **T**. Pressurised oil from the pump flows to the loader valve **3** and/or the excavator valve **4** via hose and pipe assembly **1A**.

The loader valve **3** is fitted with a priority inlet manifold, oil entering the loader valve is distributed to the (priority) steer circuit and/or the loader services as required (see **Circuit Descriptions, Loader Valve - Variable Flow Operation**).

Some of the exhaust oil flows directly back to the tank through an in-tank filter **6**, and some of the exhaust oil returns to tank via the hydraulic oil cooler **26**.

To help prevent excavator dipper ram and loader lift ram cavitation, there is a check valve **13** fitted to the return line. The check valve raises approximately 5 bar (75 lbf/in<sup>2</sup>) of pressure in the line, which improves the operation of the respective anti-cavitation valves.

**Introduction to Hydraulic Schematic Symbols**

Complex hydraulic components and circuits can be described to the engineer by using graphical symbols. The following pages illustrate and give a brief description for some of the more common symbols used.

There are many symbols in use and it would be impossible to include them all here. However it should be noted that most are only variations or refinements on the basic principles explained here. If more detailed information is required you are recommended to obtain a copy of BS2917 or ISO1219.

Once familiar with the symbols, the engineer can use hydraulic circuit diagrams as an aid to fault finding. It will be possible to see the complete hydraulic circuit and decipher the relationship between hydraulic components.

**General (Basic & Functional Symbols)**



Spring



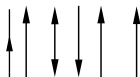
Flow restriction affected by viscosity



Direction of flow



Indication of rotation



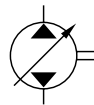
Indication of direction and paths of flow



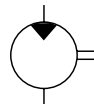
Variable control

A189660

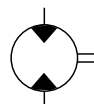
**Pumps & Motors**



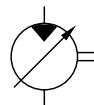
Variable capacity pump  
two directions of flow



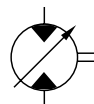
Fixed capacity motor  
one direction of flow



Fixed capacity motor  
two directions of flow

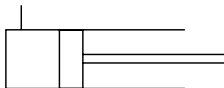


Variable capacity motor  
one direction of flow



Variable capacity motor  
two directions of flow

**Rams**



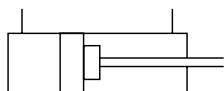
Single acting



Double acting



Double ended



Double acting with  
damping at rod area end

A189670

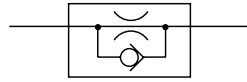
A189680

**Introduction to Hydraulic Schematic Symbols (cont'd)**

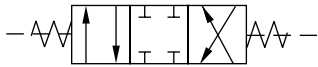
**Control Valves**



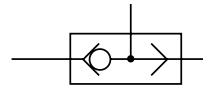
Used to enclose several valves indicating that they are supplied as one unit



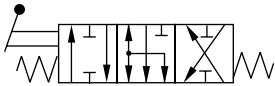
One way restrictor



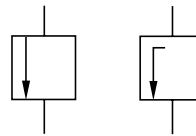
3-Position, 4-Port spring centred pilot operated valve



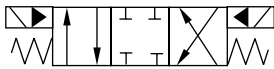
High pressure selector (shuttle valve)



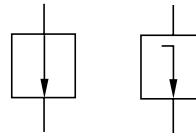
3-Position, 6-Port spring centred hand operated valve



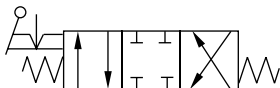
Throttling orifice - normally closed



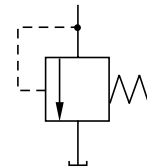
3-Position, 4-Port spring centred solenoid & pilot pressure operated valve



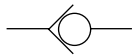
Throttling orifice - normally open



3-Position, 4-Port spring centred detent hand operated valve



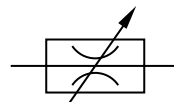
Relief valve



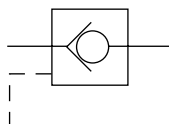
Non - return valve



Non - return valve with back pressure spring



Variable restrictor





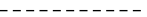
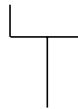


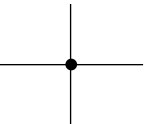
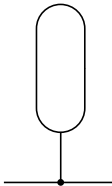

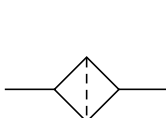
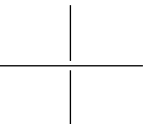
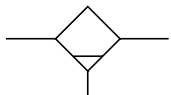
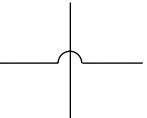
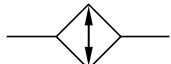
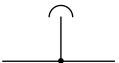
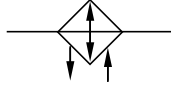
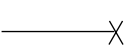

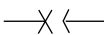
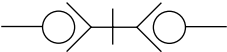
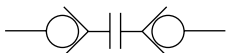


Pilot operated non - return valve



**Introduction to Hydraulic Schematic Symbols (cont'd)**

**Energy Transmissions and Conditioning**







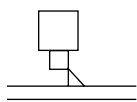

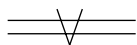


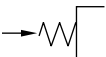







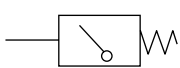


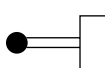
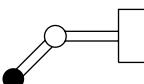
	Working line, return or feed		Reservoir - return line above fluid level
	Pilot control		Reservoir - return line below fluid level
	Drain lines		Header tank
	Flexible pipe		Pressure sealed tank
	Line junction		Accumulator
			Filter or strainer
	Crossing lines		Water trap
			Cooler - with no indication of coolant flow
	Air bleed		Cooler - indicating direction of coolant flow
	Line plugged, also pressure test point		Heater
	Line plugged with take off line		
	Quick release couplings - connected		
	Quick release couplings - disconnected		

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**Introduction to Hydraulic Schematic Symbols (cont'd)**

**Control Mechanisms**

	Rotating shaft-one direction		Solenoid one winding
	Rotating shaft-two directions		Solenoid two winding
	Detent		Electric motor operated
	Locking device		Internal pressure pilot operated
	Over centre device		External pressure pilot operated
	Simple linkage		Pressure operated spring release
	General control		Pilot operated by solenoid pilot valve
	Push button operated		Pilot operated by a solenoid or separate pilot valve
	Lever operated		Pressure gauge
	Pedal operated		Pressure switch
	Stem operated		
	Spring operated		
	Roller operated		
	Roller trip operated (one directional)		

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S189740

**Introduction to Hydraulic Schematic Symbols (cont'd)**

**Control Valves**

Control valves are usually represented by one or more square boxes.

Fig. 1 shows a control valve represented by three boxes. The number of boxes indicates the number of possible valve operating positions, (4 boxes - 4 positions etc).

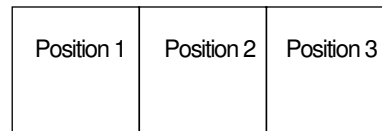


Fig. 2 - In circuit diagrams the pipework is usually shown connected to the box which represents the unoperated condition. (Hydraulic circuit diagrams are usually shown in the unoperated condition).

FIG 2

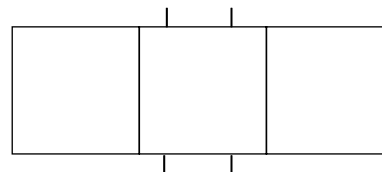
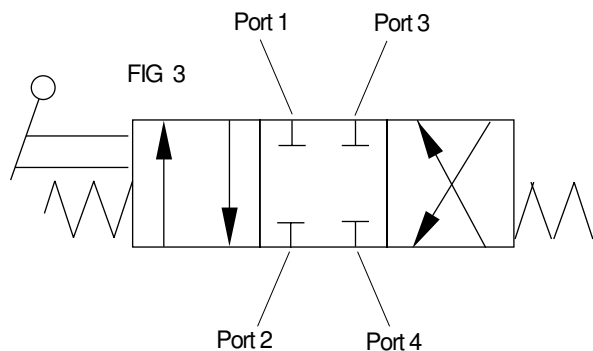


Fig. 3 shows a valve described as a 3- position, 4-port control valve. Port describes the openings to and from the valve by which the hydraulic fluid enters or leaves. In the fig shown, Position 2 indicates that in an unoperated condition all 4 ports are blocked.

If the valve spool was moved to Position 1, movement of the spool would connect Port 1 to Port 2, and Port 3 to Port 4.

If the valve spool was moved to Position 3, movement of the spool would connect Port 1 to Port 4, and Port 3 to Port 2.

It must be noted that not all spools are of the same type. Their operating designs can be seen by following the path the flow arrows take in their respective operating squares.



Three typical JCB style spools are known as 'D' spools, 'F' spools and 'N' spools.

The 'D' spools generally control rams because when in the neutral position the outlet ports are blocked, preventing ram movement. Fig 3 shows a 'D' type spool.

Fig 4 - 'F' spools are often shown as four position spools with the three normal positions for neutral and service control; and the fourth position, which has a detent, connects both sides of the ram together to allow the service to 'float'.

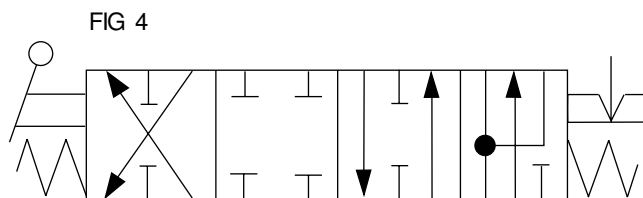
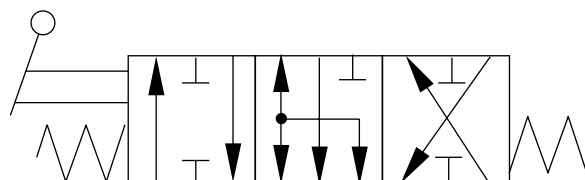


Fig 5 - 'N' spools are sometimes used to control hydraulic motors, and it can be seen from the flow arrows, that in neutral position both service ports are connected to the exhaust oil port

FIG 5



## Introduction to Hydraulic Schematic Symbols (cont'd)

### Example of Schematic Circuit

Some of the symbols described on the preceding pages have been arranged into a simple schematic circuit shown below.

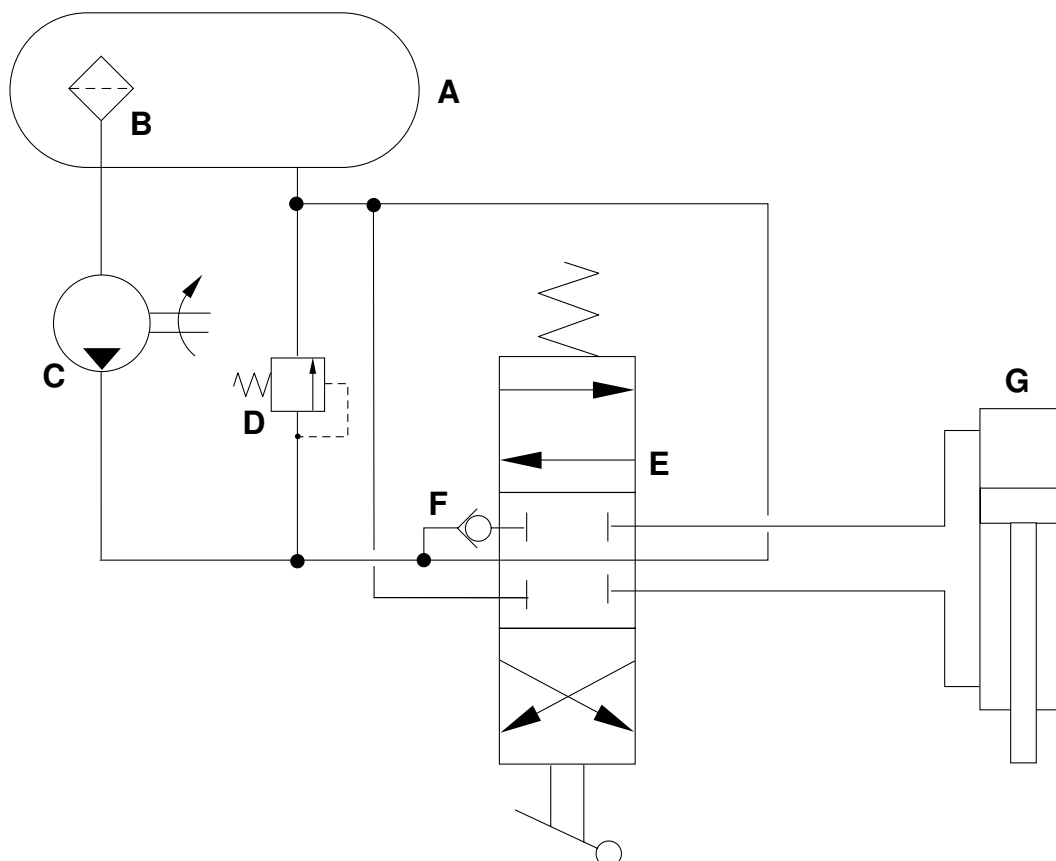
Hydraulic tank **A** is a pressurised tank with an internally mounted strainer **B** on the suction line to the fixed displacement pump **C**. System pressure is limited to the setting of relief valve **D**.

Valve spool **E** is an open-centre spool that is in neutral position; flow from the pump passes through the spool and returns to the hydraulic tank.

If the lever operated spool is moved away from neutral position hydraulic fluid is directed to either head side or rod side of hydraulic ram **G**. Notice that the fluid must first open one way valve **F** before flowing to the ram.

### Example Circuit Key

- A** Hydraulic Tank
- B** Strainer
- C** Fixed Displacement Pump
- D** Relief Valve
- E** Spool
- F** One Way Valve
- G** Double Acting Hydraulic Ram



A189770

**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.

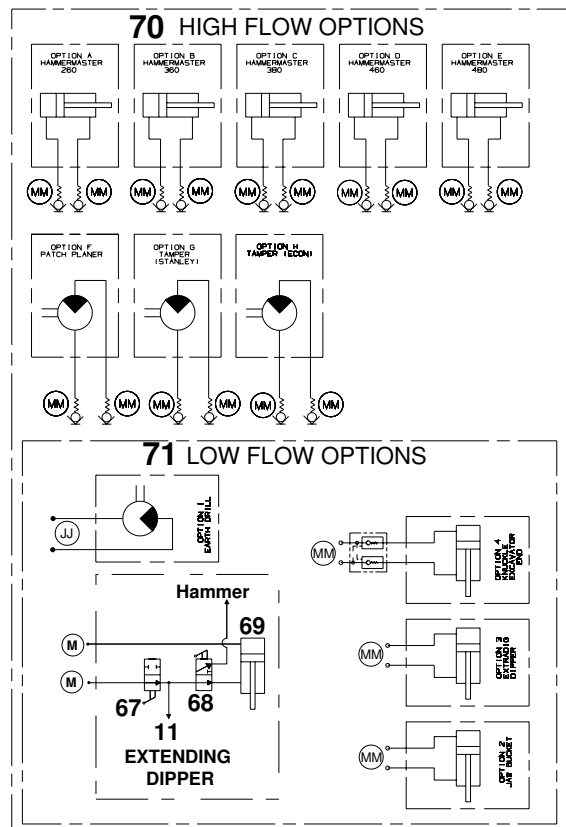
**Component Key**

- 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.

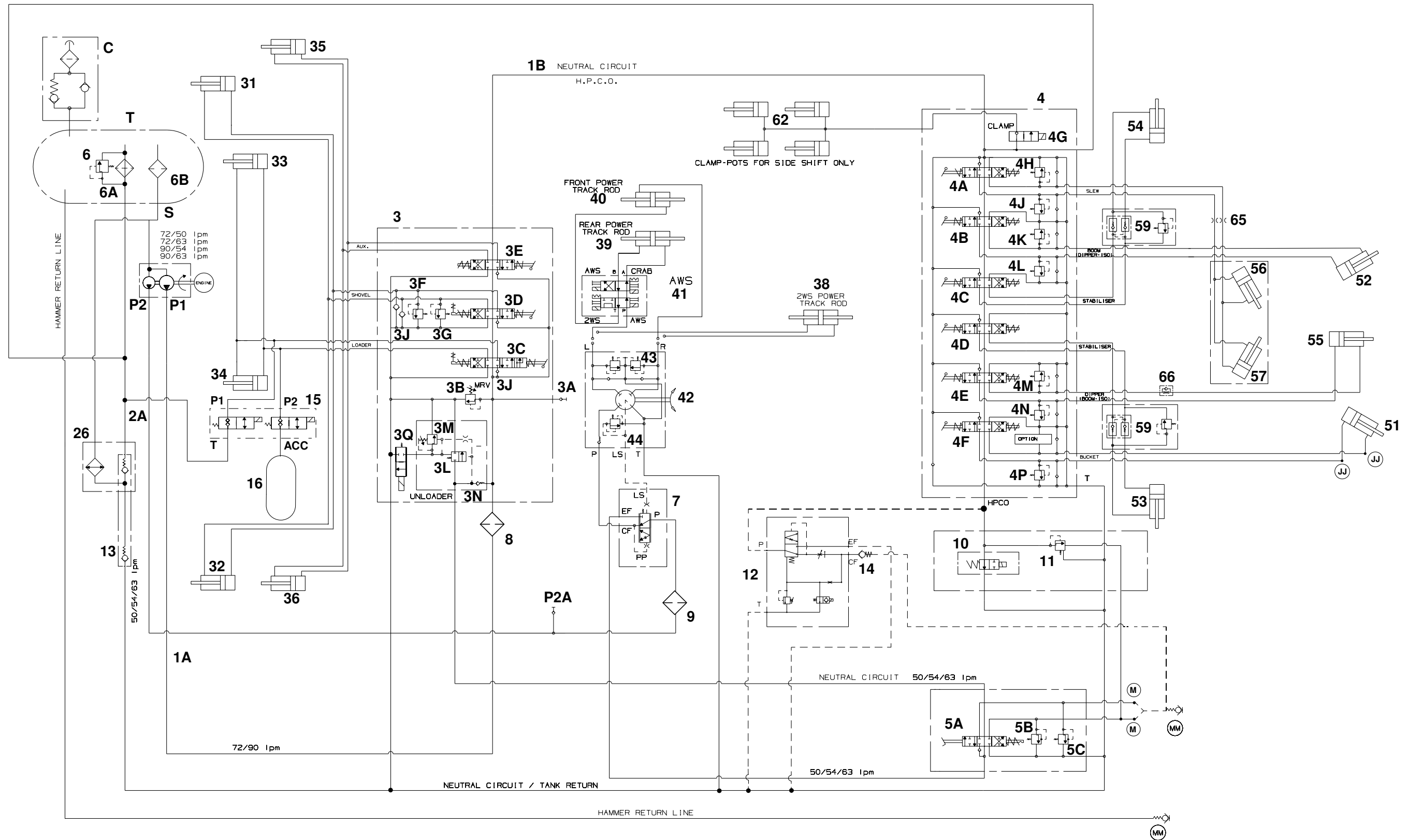
- 4A Slew Spool
- 4B Boom Spool
- 4C Stabiliser Spool
- 4D Stabiliser Spool
- 4E Dipper Spool
- 4F Bucket Spool
- 4G Hydraclamp Valve (Sideshift Machines Only)
- 4H Slew A.R.V.
- 4J Slew A.R.V.
- 4K Boom Ram Rod Side A.R.V.
- 4L Boom Ram Head Side A.R.V.
- 4M Dipper Ram Head Side A.R.V.
- 4N Dipper Ram 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



A325660

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



A262643

**3CX 'S' Series & 4CX Gear Pump Options**

This circuit shows the Extending Dipper and Power Sideshift, for the main hydraulic circuit see pages E/3-20 and E/3-21.

**Component Key**

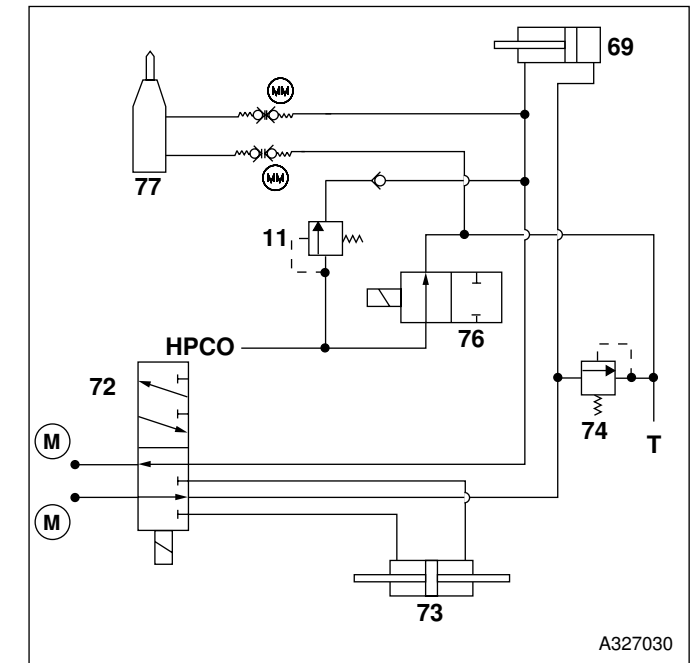
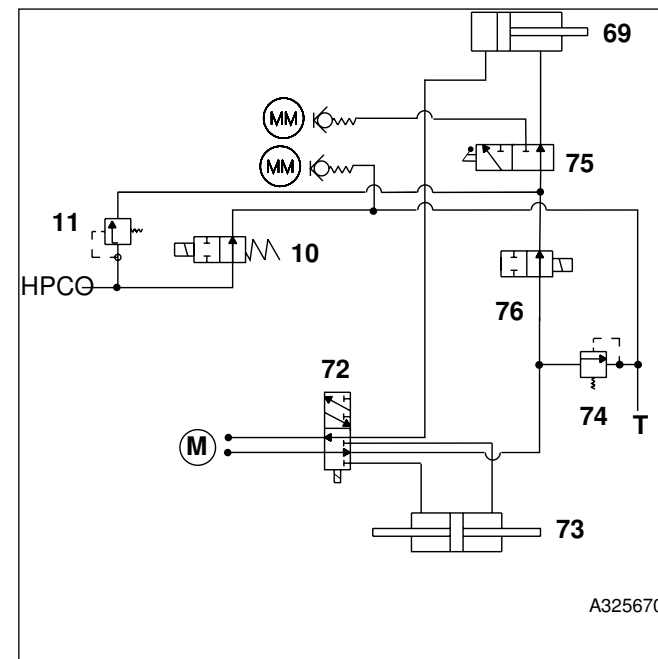
- HPCO High Pressure Carry Over (From Excavator Valve Block 4)
- M Hydraulic Connections
- MM Quick Release Couplings
- T Hydraulic Tank Return
- 10 Diverter valve
- 11 Sequence valve
- 69 Extending Dipper Ram
- 72 Change Over Valve
- 73 Power Sideshift Cylinder
- 74 Relief Valve
- 75 Manual Change Over Valve
- 76 Isolation Valve

**3CX 'S' Series Options**

This circuit shows the Low Flow Hammer, Extending Dipper and Power Sideshift, for the main hydraulic circuit see pages E/3-20 and E/3-21.

**Component Key**

- HPCO High Pressure Carry Over (From Excavator Valve Block 4)
- M Hydraulic Connections
- MM Quick Release Couplings
- T Hydraulic Tank Return
- 11 Sequence valve
- 69 Extending Dipper Ram
- 72 Change Over Valve
- 73 Power Sideshift Cylinder
- 74 Relief Valve
- 76 Isolation Valve
- 77 Hammer

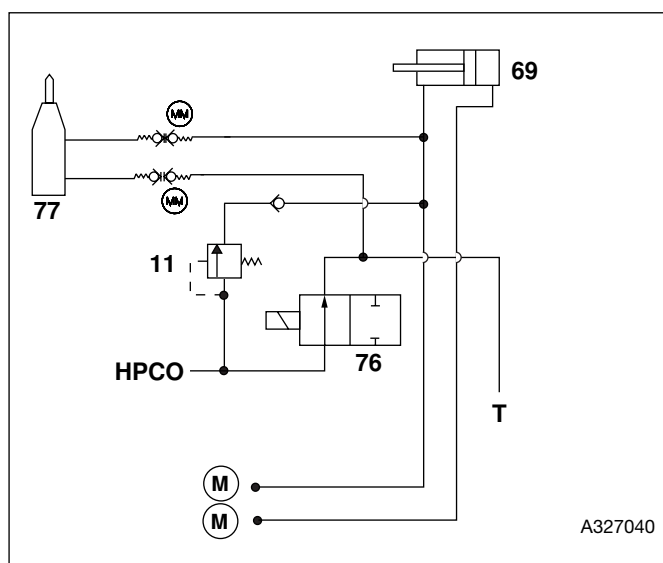


### 3CX 'S' Series Options

This circuit shows the Low Flow Hammer and Extending Dipper, for the main hydraulic circuit see pages E/3-20 and E/3-21.

#### Component Key

HPCO	High Pressure Carry Over (From Excavator Valve Block 4)
M	Hydraulic Connections
T	Hydraulic Tank Return
11	Sequence valve
69	Extending Dipper Ram
76	Isolation Valve
77	Hammer





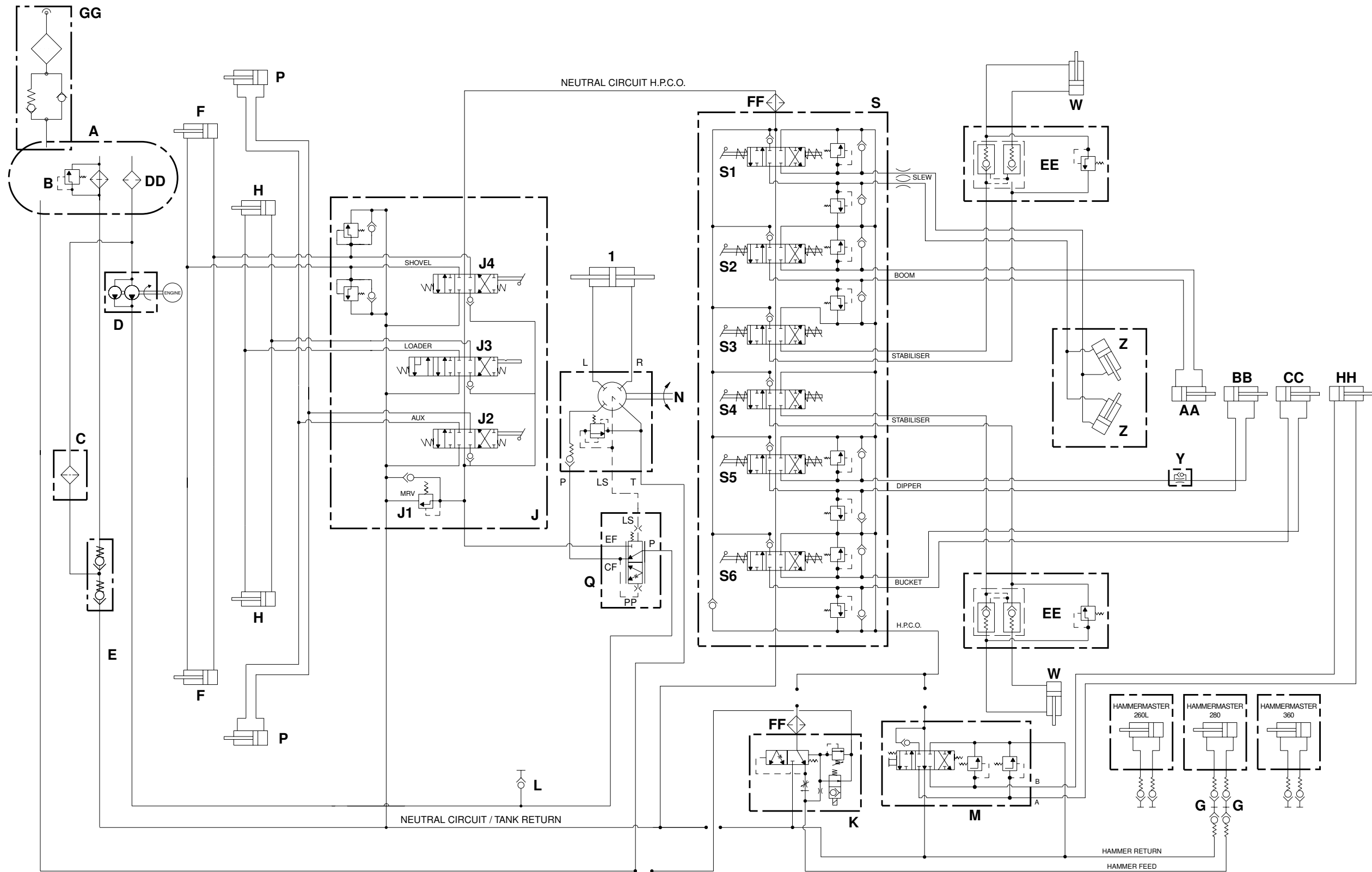
## 214e Machines

### Component Key:

A	Hydraulic Tank
B	Return filter
C	Hydraulic Oil Cooler
D	Hydraulic Pump
E	Twin Check Valve
F	Shovel Rams
G	Quick Release Couplings
H	Lift Rams
J	Loader Valve Block
J1	Main Relief Valve
J2	Auxiliary Spool
J3	Lift Spool
J4	Shovel Spool
K	Flow Regulator Valve (Option)
L	Pressure Test Point
M	Auxiliary Valve Block (Option)
	Either option K or M can be fitted but not both.
N	Steer Control Valve
P	Auxiliary Rams
Q	Priority Valve
S	Excavator Valve Block
S1	Slew Spool
S2	Boom Spool
S3	Stabiliser Spool
S4	Stabiliser Spool
S5	Dipper Spool
S6	Bucket Spool
W	Stabiliser Rams
Y	One Way Restrictor
Z	Slew Rams
AA	Boom Ram
BB	Dipper Ram
CC	Bucket Ram
DD	Suction Strainer
EE	Stabiliser Check Valve
FF	Last Chance Filter
GG	Tank Cap
HH	Extending Dipper
1	2WS Front Power Track Rod

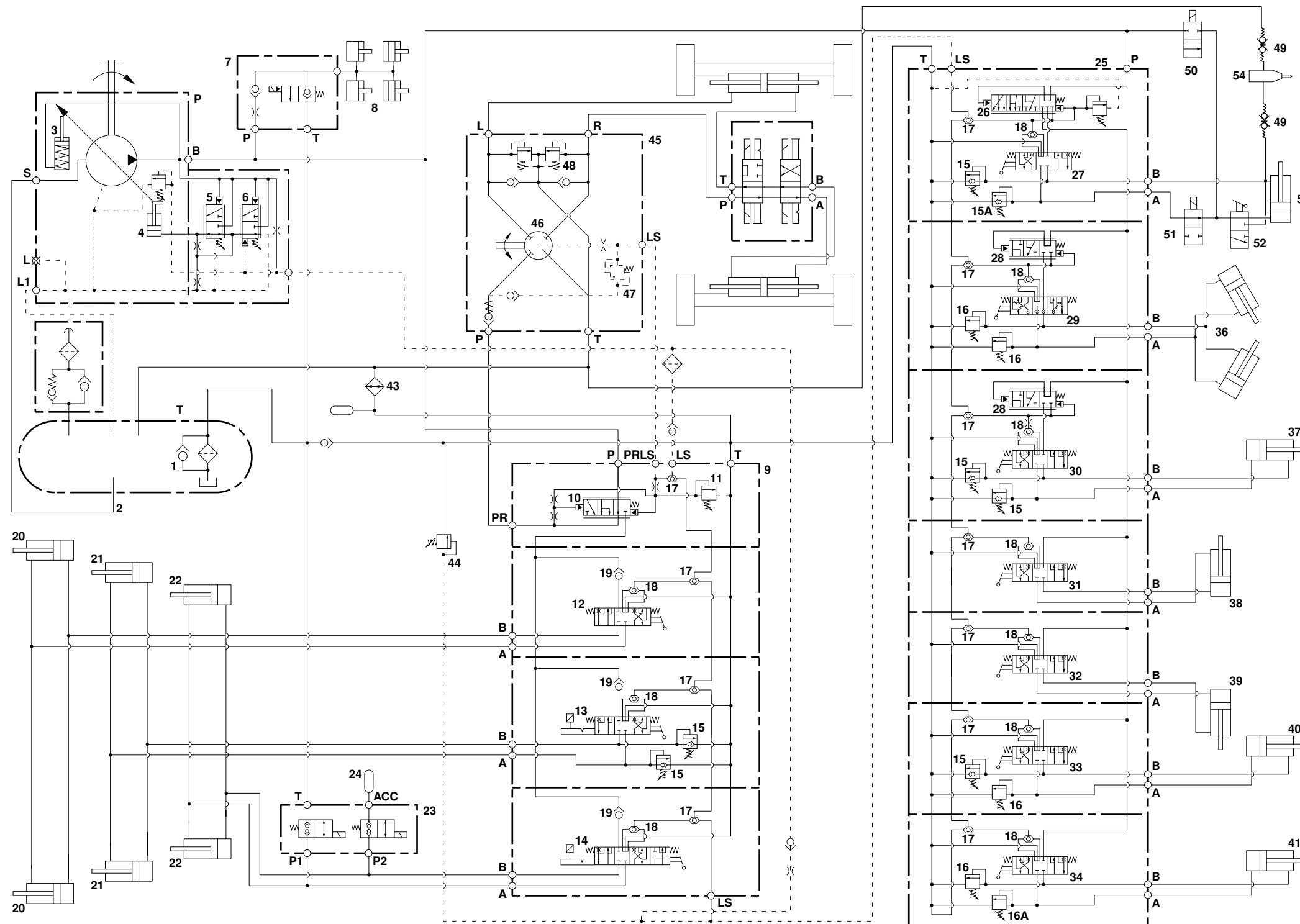
**Note:** For smooth ride system schematic, refer to **Circuit Descriptions - Smooth Ride System**.

214e Machines



A408750

4CXE, 4CX Super Machines  
(7 Spool With High Flow Options)



**4CX, 4CX Super Machines****(7 Spool With High Flow Options)****Component Key**

Small letters on the schematic indicate port markings. Refer to Technical Data pages at the beginning of this section for more information. Ports **A** and **B** are always identified as service ports (feed and return from respective ram).

T	Hydraulic Tank
1	By-pass Filter
2	Suction Line
P	Pump Variable Flow
3	Stroking Piston
4	Control Piston
5	System Pressure Spool
6	Stand-by Pressure Spool
7	Hydraclamp Valve
8	Hydraclamps
9	Loader Valve Block
10	Priority Inlet Section
11	Relief Valve †
12	Auxiliary Service Spool
13	Shovel Service Spool
14	Lift Service Spool
15	Auxiliary Relief Valves (anti-cavitation)
15A	ARV item 16 if Rockerbreaker Application
16	Auxiliary Relief Valves (direct acting)
16A	ARV Only Fitted For Rockbreaker Application
17	Secondary Shuttle Valve
18	Primary Shuttle Valve
19	Load Hold Check Valve
20	Auxiliary Rams
21	Shovel Rams
22	Lift Rams
23	Smooth Ride Selector Valve
24	Smooth Ride Accumulator
25	Backhoe Loader Valve Block
26	Extradig Priority Valve
27	Extradig Service Spool
28	Compensator Valves
29	Slew Service Spool
30	Boom Service Spool
31	Stabiliser Service Spool
32	Stabiliser Service Spool
33	Dipper Service Spool
34	Bucket Service Spool
35	Extradig Ram
36	Slew Rams
37	Boom Ram

38	Stabiliser Ram
39	Stabiliser Ram
40	Dipper Ram
41	Bucket Ram
42	Accumulator
43	Oil Cooler
44	Load Sense Relief Valve
45	Steer Unit Assembly
46	Steer Valve
47	Relief Valve
48	Shock Valves
49	Quick release Couplings
50	Isolation Valve
51	Extending Dipper Isolation Valve
52	Foot Valve
53	Extending Dipper Ram
54	Hammer

†**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<sup>2</sup> (173 bar, 176 kgf/cm<sup>2</sup>) this will ensure it does not interfere with the operation of the relief valve housed in the hydraulic steer unit.

## 4CX, 4CX Super Machines

### (6 Spool With High/Low Flow Options)

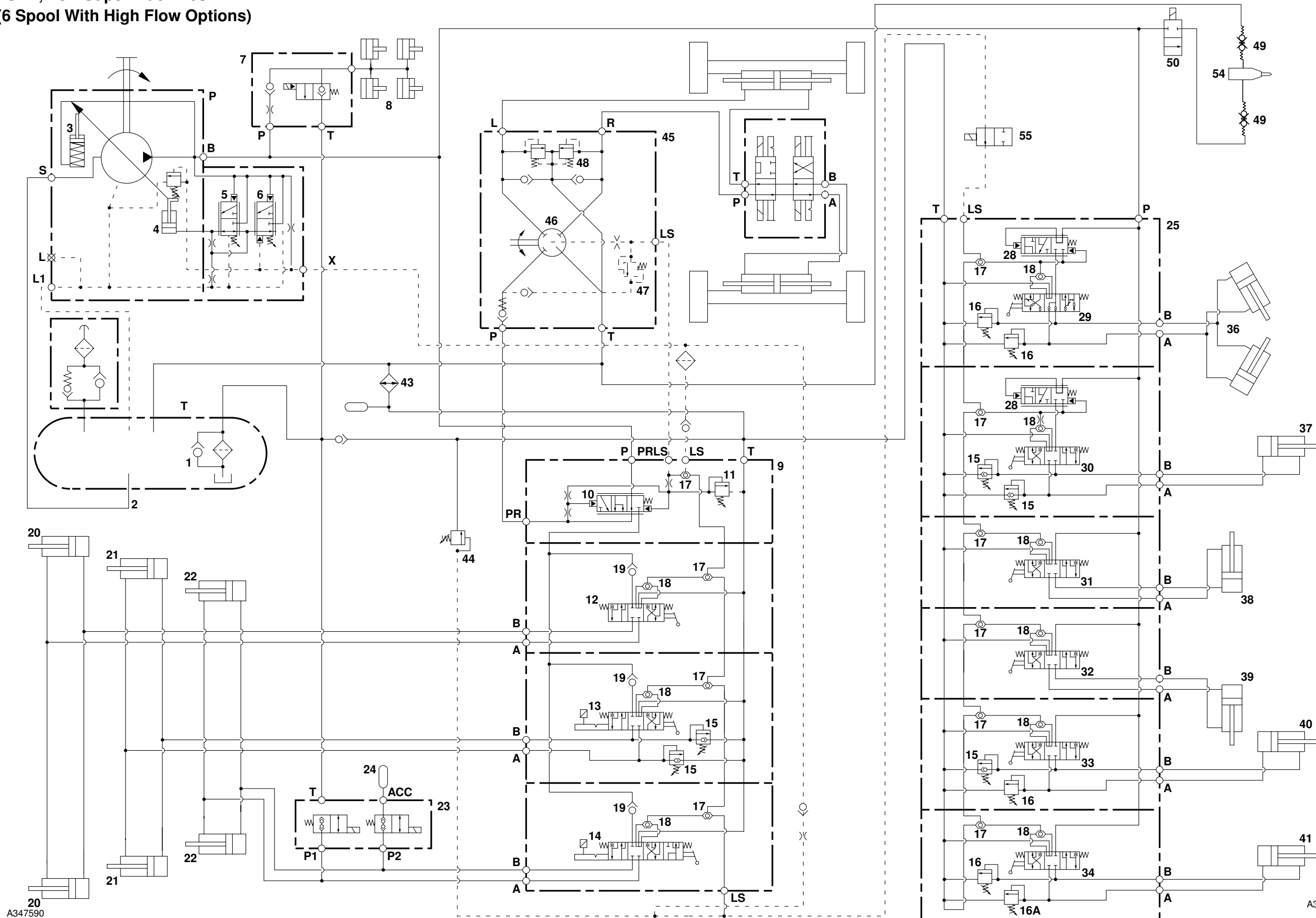
#### Component Key

Small letters on the schematic indicate port markings. Refer to Technical Data pages at the beginning of this section for more information. Ports **A** and **B** are always identified as service ports (feed and return from respective ram).

T	Hydraulic Tank
1	By-pass Filter
2	Suction Line
P	Pump Variable Flow
3	Stroking Piston
4	Control Piston
5	System Pressure Spool
6	Stand-by Pressure Spool
7	Hydraclamp Valve
8	Hydraclamps
9	Loader Valve Block
10	Priority Inlet Section
11	Relief Valve †
12	Auxiliary Service Spool
13	Shovel Service Spool
14	Lift Service Spool
15	Auxiliary Relief Valves (anti-cavitation)
16	Auxiliary Relief Valves (direct acting)
16A	ARV Only Fitted For Rockbreaker Application
17	Secondary Shuttle Valve
18	Primary Shuttle Valve
19	Load Hold Check Valve
20	Auxiliary Rams
21	Shovel Rams
22	Lift Rams
23	Smooth Ride Selector Valve
24	Smooth Ride Accumulator
25	Backhoe Loader Valve Block
28	Compensator Valves
29	Slew Service Spool
30	Boom Service Spool
31	Stabiliser Service Spool
32	Stabiliser Service Spool
33	Dipper Service Spool
34	Bucket Service Spool
36	Slew Rams
37	Boom Ram
38	Stabiliser Ram
39	Stabiliser Ram
40	Dipper Ram
41	Bucket Ram
42	Accumulator
43	Oil Cooler
44	Load Sense Relief Valve
45	Steer Unit Assembly
46	Steer Valve
47	Relief Valve
48	Shock Valves
49	Quick release Couplings
50	Isolation Valve
54	Hammer
55	Load Sense Isolation Valve

†**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<sup>2</sup> (173 bar, 176 kgf/cm<sup>2</sup>) this will ensure it does not interfere with the operation of the relief valve housed in the hydraulic steer unit.

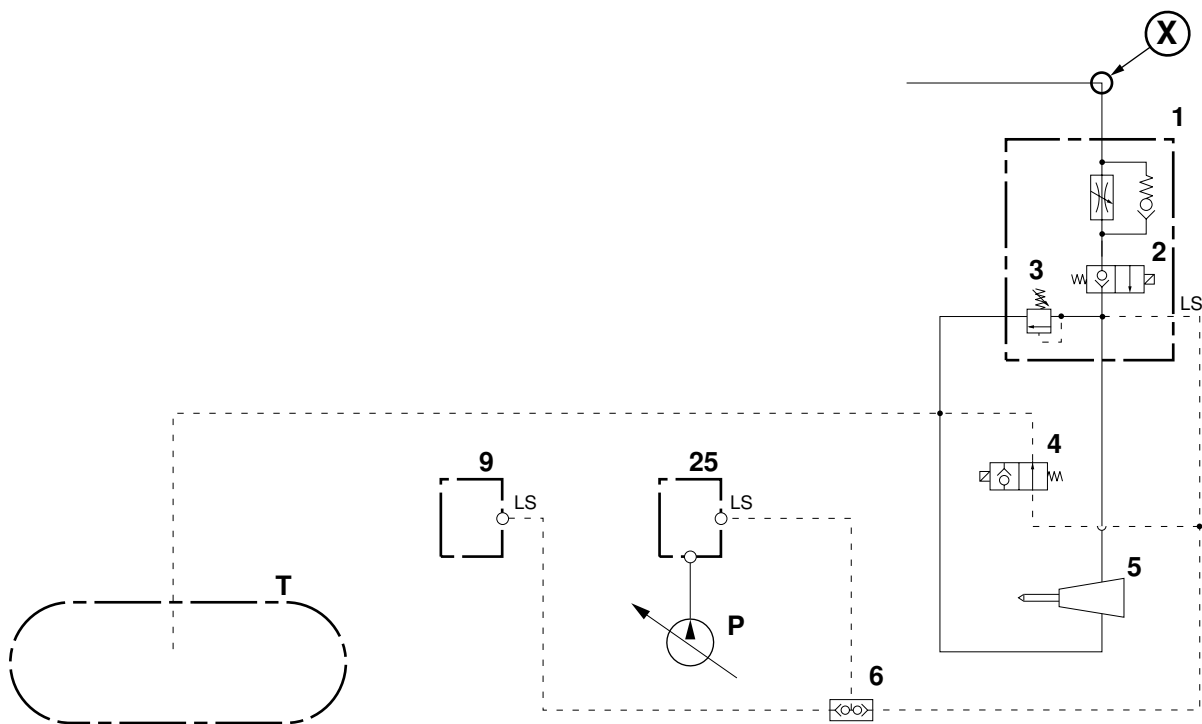
4CXE, 4CX Super Machines  
(6 Spool With High Flow Options)



A347590

A327070

### 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<sup>2</sup> - 138 bar - 146 kgf/cm<sup>2</sup>)
- 4 Load Sense Solenoid
- 5 Hand Held Tool
- 6 Shuttle Valve
- 9 Excavator Valve Block
- 25 Loader Valve Block

**Hydraulic Circuit Schematic****Precision Control (Servo)**

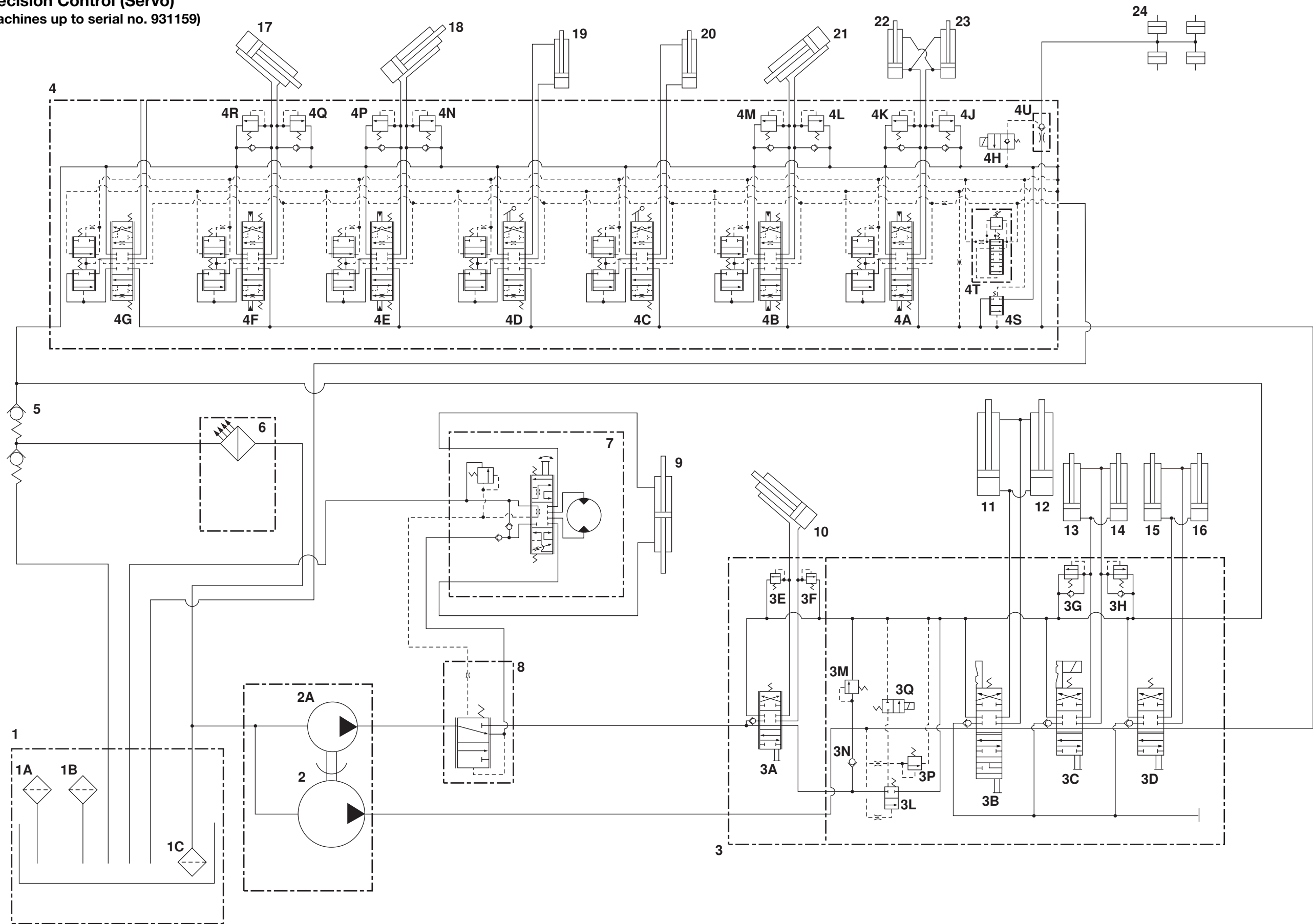
\* (Machines up to serial no. 931159)

**Component Key:**

1	Tank	5	Anti Cavitation Check Valve
1A	Breather	6	Hydraulic Oil Cooler
1B	Fill Screen	7	Steer Unit
1C	Suction Strainer	8	Priority Valve
2	Pump, Main Section	9	2WS Power Track Rod Ram
2A	Pump, Secondary Section	10	Extending Dipper Ram
3	Loader Valve Block	11	Lift Ram L.H.
3A	Extending Dipper Spool	12	Lift Ram R.H.
3B	Loader Lift Ram Spool	13	Shovel Ram L.H.
3C	Loader Shovel Ram Spool	14	Shovel Ram R.H.
3D	Clamshovel Spool	15	Clam Shovel Ram L.H.
3E	Extending Dipper Ram Rod Side A.R.V.	16	Clam Shovel Ram R.H.
3F	Extending Dipper Ram Head Side A.R.V.	17	Bucket Ram
3G	Shovel Ram Head Side A.R.V.	18	Dipper Ram
3H	Shovel Ram Rod Side A.R.V.	19	Stabiliser Ram
3L	Unloader Valve Spool	20	Stabiliser Ram
3M	Main Relief Valve (MRV)	21	Boom Ram
3N	Unloader Check Valve	22	Slew Ram L.H.
3P	Unloader Pilot Valve	23	Slew Ram R.H.
3Q	Hydraulic Speed Control Solenoid	24	Hydraclamps (Sideshift Only)
4	Excavator Valve Block		
4A	Slew Spool		
4B	Boom Spool		
4C	Right Stabiliser Spool		
4D	Left Stabiliser Spool		
4E	Dipper Spool		
4F	Bucket Spool		
4G	Auxiliary Spool		
4H	Hydraclamp Valve (Sideshift Only)		
4J	Slew A.R.V.		
4K	Slew A.R.V.		
4L	Dipper Ram Head Side A.R.V.		
4M	DipperRam Rod Side A.R.V.		
4N	Boom Ram Rod Side A.R.V.		
4P	Boom Ram Head Side A.R.V.		
4Q	Bucket Rod Side ARV (Hammer Only)		
4R	Bucket Ram Head Side A.R.V.		
4S	Bypass Compensator Valve		
4T	Load Sense Drain Regulator and Relief Valve		
4U	Pilot Operated Check Valve (Hydraclamp)		

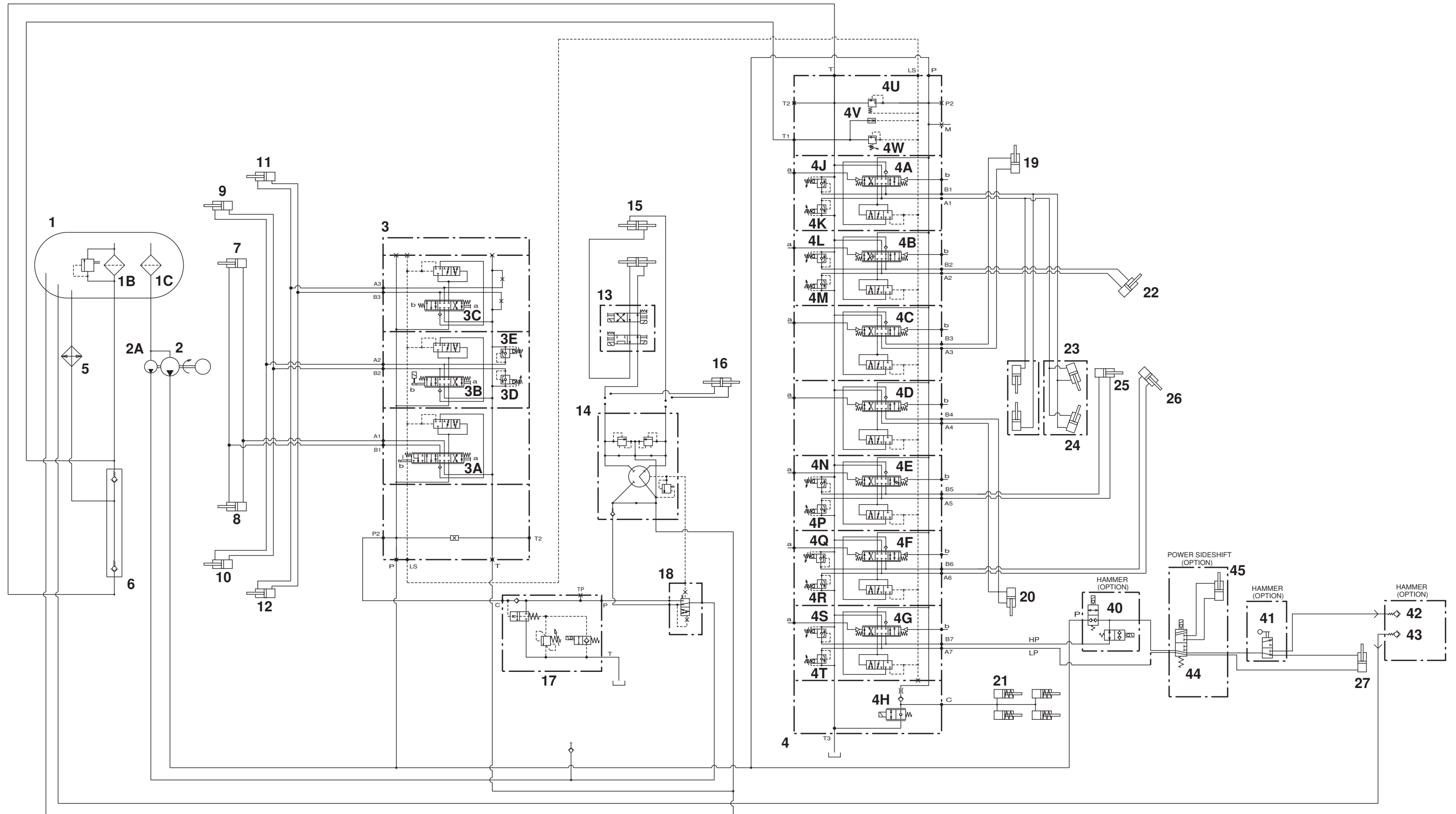


**Precision Control (Servo)**  
\* (Machines up to serial no. 931159)



A396210

Precision Control (Servo)  
(Machines from January 2003)



A403921

## Hydraulic Circuit Schematic

### Precision Control (Servo) (Machines from January 2003)

The schematic shows the main system hydraulics for Precision Control (Servo) machines. For the pilot circuit refer to relevant pages.

**Note:** The boom and dipper services are interchanged for the ISO control pattern.

#### Component Key:

Small letters on the schematic indicate port markings. Refer to **Technical Data** pages at the beginning of this section for more information. Ports **A** and **B** are always identified as service ports (feed and return from respective ram).

1 Tank	5 Hydraulic Oil Cooler	
1B Return Filter	6 Anti Cavitation Check Valve	
1C Suction Strainer	7 Lift Ram R.H.	
2 Pump, Main Section	8 Lift Ram L.H.	
2A Pump, Secondary Section	9 Shovel Ram R.H.	
3 Loader Valve Block	10 Shovel Ram L.H.	
3A Loader Lift Ram Spool	11 Clam Shovel Ram R.H.	
3B Loader Shovel Ram Spool	12 Clam Shovel Ram L.H.	
3C Clam Shovel Spool	13 Steer Mode Control Valve	
3D Shovel Ram Head Side A.R.V.	14 Steer Unit	
3E Shovel Ram Rod Side A.R.V.	15 AWS Power Track Rod Rams	
4 Excavator Valve Block	16 2WS Power Track Rod Ram	
4A Slew Spool	17 Unloader Valve	
4B Boom Spool (Dipper ISO)	18 Priority Valve	
4C Right Stabiliser Spool	19 Stabiliser Ram R.H.	
4D Left Stabiliser Spool	20 Stabiliser Ram L.H.	
4E Dipper Spool (Boom ISO)	21 Hydraclamps (Sideshift Only)	
4F Bucket Spool	22 Boom Ram (Dipper ISO)	
4G Extending Dipper Spool	23 Slew Ram R.H.	
4H Hydraclamp Valve (Sideshift Only)	24 Slew Ram L.H.	
4J Slew A.R.V.	25 Dipper Ram (Boom ISO)	
4K Slew A.R.V.	26 Bucket Ram	
4L Boom Ram Rod Side A.R.V.	27 Extending Dipper Ram	
4M Boom Ram Head Side A.R.V.		
4N Dipper Ram Head Side A.R.V.		
4P Boom Ram Rod Side A.R.V.		
4Q Bucket Ram Head Side A.R.V. (Hammer Only)	Hammer Option:	
4R Bucket Ram Rod Side A.R.V.	40 Hammer Flow Valve	
4S Extending Dipper Ram Rod Side A.R.V.	41 Hammer Selector Valve	
4T Extending Dipper Ram Head Side A.R.V.	42 Hammer Feed Coupling QR	
4U Flow Regulator Valve	43 Hammer Return Coupling QR	
4V Flushing Valve		
4W Load Sense Relief Valve	Power Sideshift Option:	
	44 Power Sideshift Selector Valve	
	45 Power Sideshift Ram	

## Hydraulic Circuit Schematic

### Precision Control (Servo) (Machines from January 2003)

The schematic shows the pilot circuit for Precision Control (Servo) machines. For the main system hydraulics refer to relevant pages.

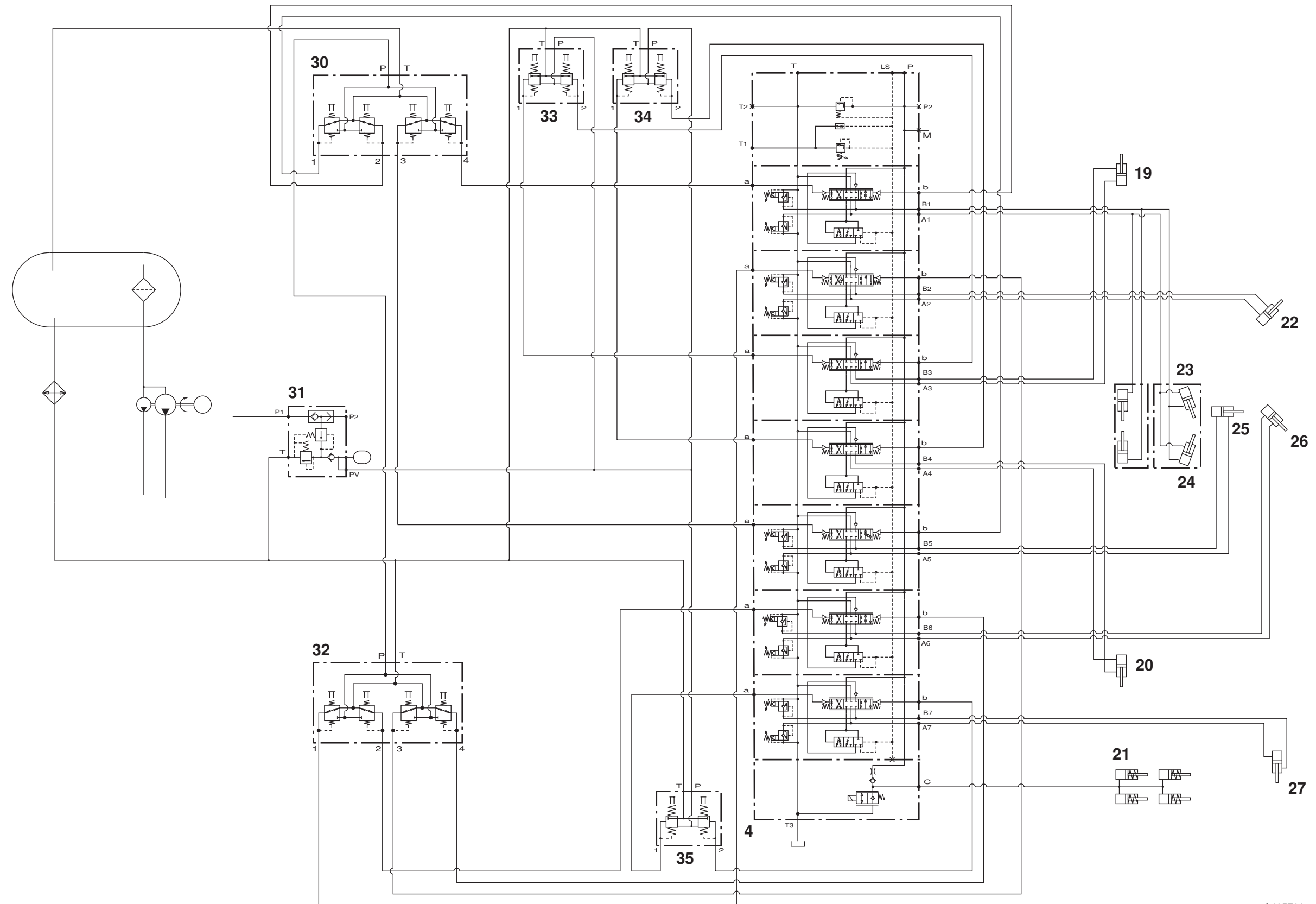
**Note:** The boom and dipper services are interchanged for the ISO control pattern.

#### Component Key:

Small letters on the schematic indicate port markings. Refer to **Technical Data** pages at the beginning of this section for more information. Ports **A** and **B** are always identified as service ports (feed and return from respective ram).

4	Excavator Valve Block
19	Stabiliser Ram R.H.
20	Stabiliser Ram L.H.
21	Hydraclamps (Sideshift Only)
22	Boom Ram (Dipper ISO)
23	Slew Ram R.H.
24	Slew Ram L.H.
25	Dipper Ram (Boom ISO)
26	Bucket Ram
27	Extending Dipper Ram
30	Joystick Controller L.H.
31	Servo Pressure Supply Valve
32	Joystick Controller R.H.
33	Stabiliser Control R.H.
34	Stabiliser Control L.H.
35	Footpedal Control (Extending Dipper)

Precision Control (Servo)  
(Machines from January 2003)



A405700

**Component Key:**

- A** Spur Gear - Idler
- B** Spur Gear - Driven
- C** Channel
- D** Recess
- P1** Main Section
- P2** Secondary Section

**Hydraulic Pump - Fixed Flow****Single Pump - Operation**

The hydraulic pump is a gear type. The basic principle of the pump depends on the meshing of the two spur gears **A** and **B**, one of which is engine-driven whilst the other is an idler. Oil is picked up on the inlet side of the pump by the gears and carried round between the gear teeth and the pump body. As the gears come into mesh the oil is forced through the pump outlet port.

Lubrication is provided by the hydraulic oil which is directed around the unit, via special oil ways, by the motion of the meshing gears.

**Double Pump - Operation**

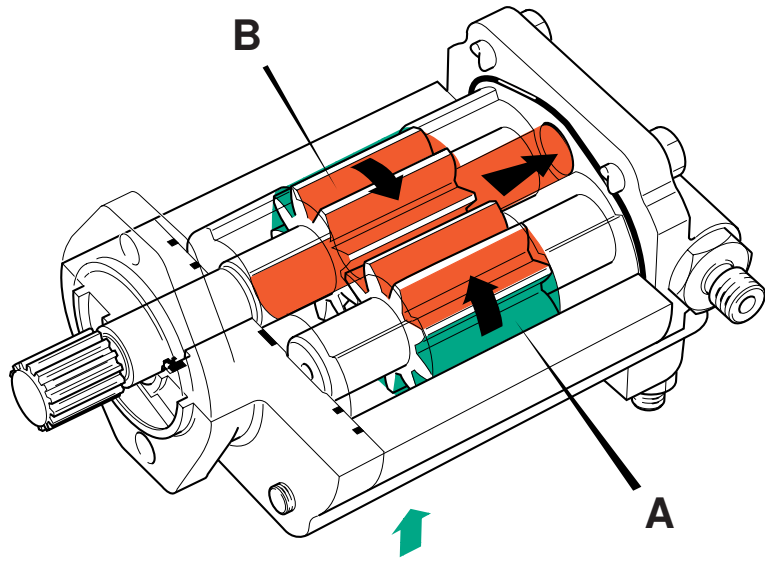
Both sections **P1** and **P2** operate as described below:

The basic principle of the gear pump depends on the meshing of two spur gears **A**, one of which is engine driven while the other is an idler.

Oil is picked up by the gear teeth on the inlet side of the pump and carried around between the teeth and the pump body. As the gears come into mesh, the space carrying the oil is filled by a gear tooth on the mating gear, forcing the oil out of the space and the through the pump outlet.

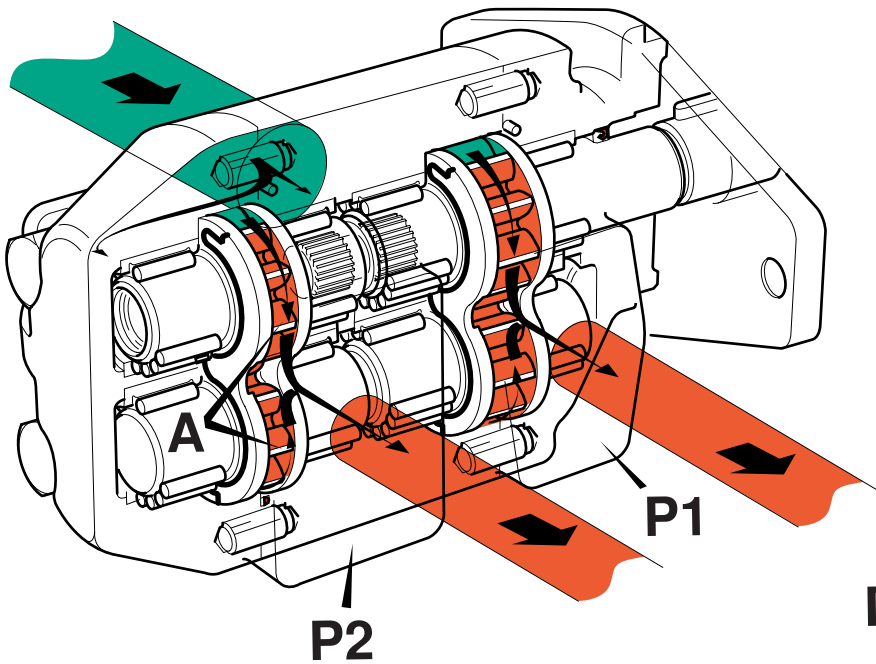
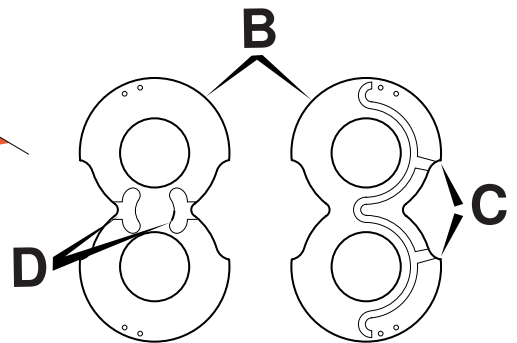
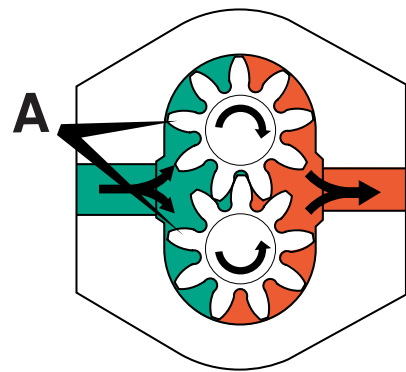
The wear plates **B** are loaded towards the gears by pressurised oil which is fed to the backs of the wear plates via channels **C**. This ensures that the clearance between the wear plates and gears is prevented from becoming excessive as outlet pressure rises.

The side of each wear plate that faces the gears has two recesses **D**. The recess on the inlet side of the pump assists the flow of oil into the gear spaces, thus raising the cavitation threshold of the pump. The recess on the outlet side vents oil trapped between meshing gear teeth to prevent compression loads on the bearings.



Key to Oil Flow & Pressure	
<span style="color: red;">■</span>	Full Pressure
<span style="color: orange;">■</span>	Pressure
<span style="color: blue;">■</span>	Servo
<span style="color: green;">■</span>	Neutral
<span style="color: cyan;">■</span>	Exhaust
<span style="color: lightblue;">■</span>	Cavitation
<span style="color: yellow;">■</span>	Lock Up

A390630



A396380

## Hydraulic Pump - Variable Flow

### Operation

The pump is a variable displacement axial piston type. Displacement of oil is achieved by the continuous operation of nine pistons. Pump fluid output is controlled by a tilting cam (swashplate), the angle of which is regulated to ensure that only the amount of fluid necessary to satisfy load conditions is delivered. If a load condition is such that no flow is required, only sufficient fluid for cooling and lubrication is provided.

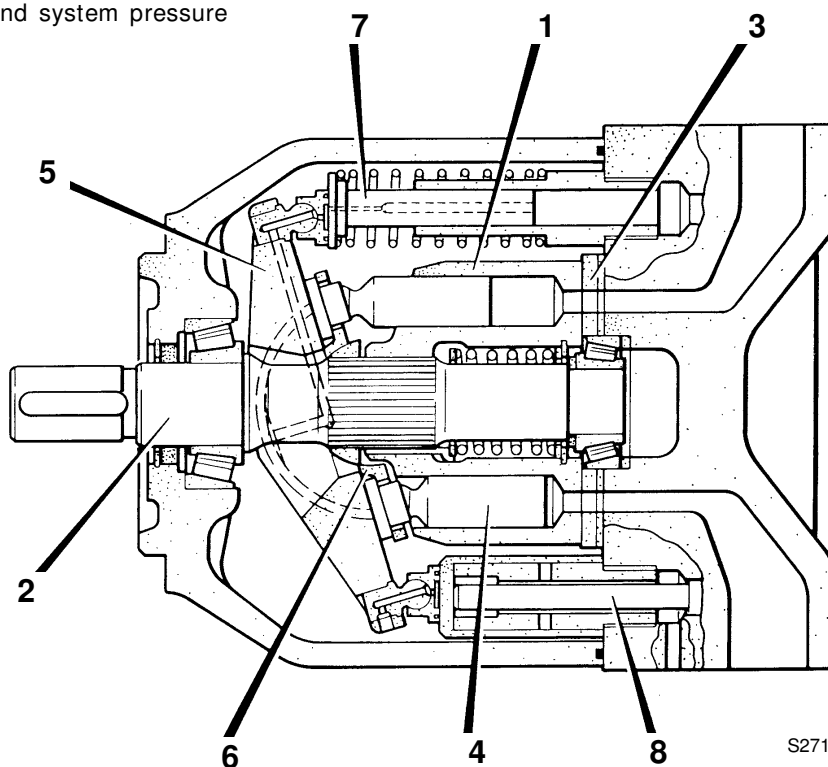
Main components of pump **P** are a cylinder barrel **1** splined to a drive shaft **2** which is held against a kidney plate **3**. Contained in the cylinder barrel are the axial pistons **4**, each having an articulated shoe that is in held contact with the swashplate **5** by an attachment plate **6**. The tilting action of the swashplate is exercised by a stroking piston **7** and a control piston **8**, the latter fed by servo pressure. Fitted to the pump exterior is the valve block **9** housing the pressure/flow regulators that provide servo control.

Rotation of the cylinder barrel causes linear movement of the axial pistons and fluid from the suction port is drawn into the pump through the kidney plate to fill a developing vacuum behind the piston. As the cylinder barrel rotates the fluid is carried from an elongated suction kidney to an elongated pressure kidney where linear movement starts to return the piston into the cylinder barrel. Fluid is forced from the pump through the pressure port.

The stroke length of the pistons and consequently the output of fluid is directly related to the swashplate angle. The swashplate is normally held in its maximum displacement angle by the stroking piston spring and system pressure inside the stroking piston.

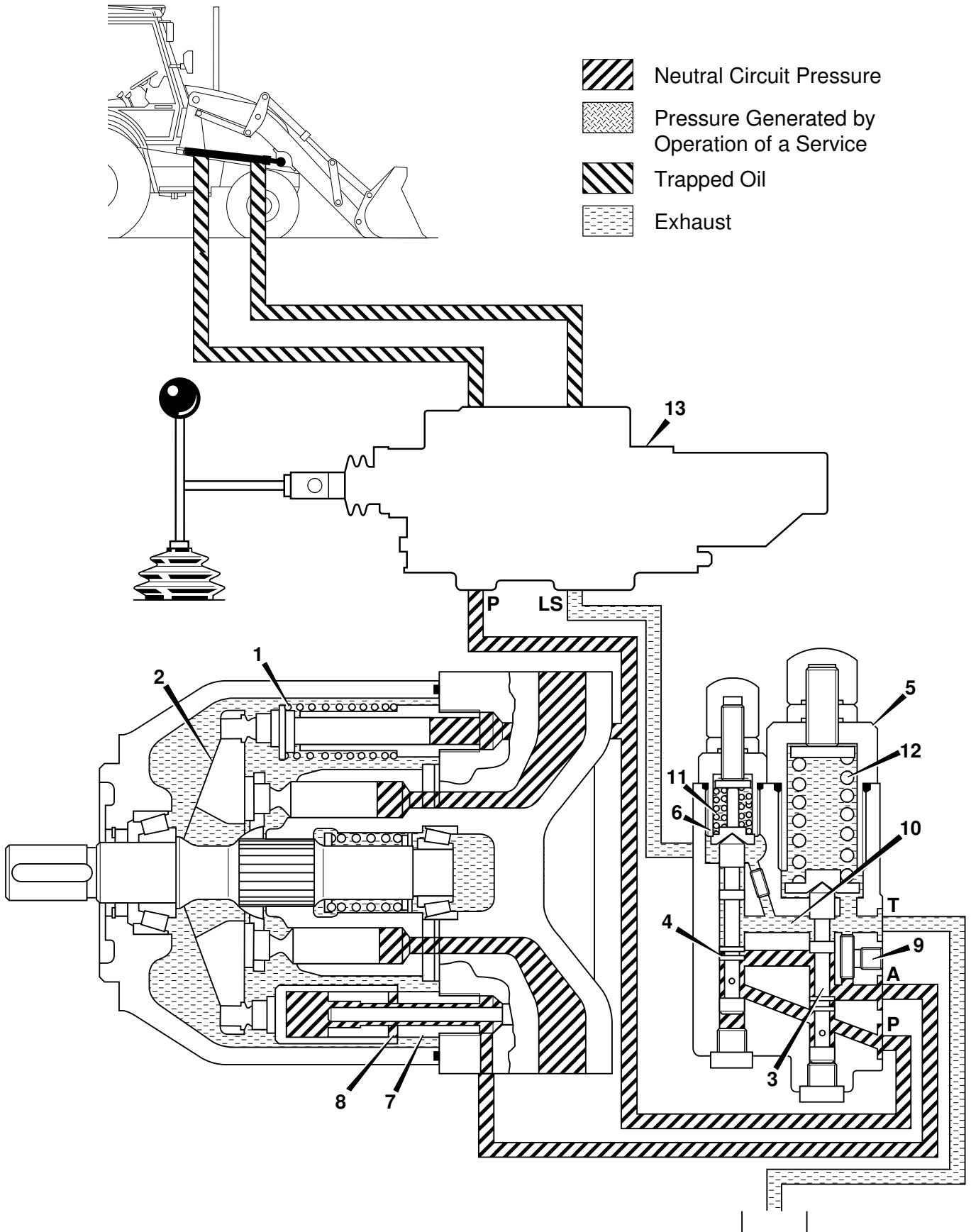
### Component Key:

P	Pump
1	Cylinder Barrel
2	Drive Shaft
3	Kidney Plate
4	Axial Piston
5	Swashplate
6	Shoe Plate
7	Stroking Piston
8	Control Piston
9	Pressure/Flow Compensator Valve



S271440





A275730

## Hydraulic Pump - Variable Flow

### Pressure/Flow Regulator Valve

The pressure and flow regulator valve assembly is mounted to the pump. The valve maintains the pump pressure and flow rate in accordance with demand at the service valve blocks.

#### Load Sensing - Stand-by Position

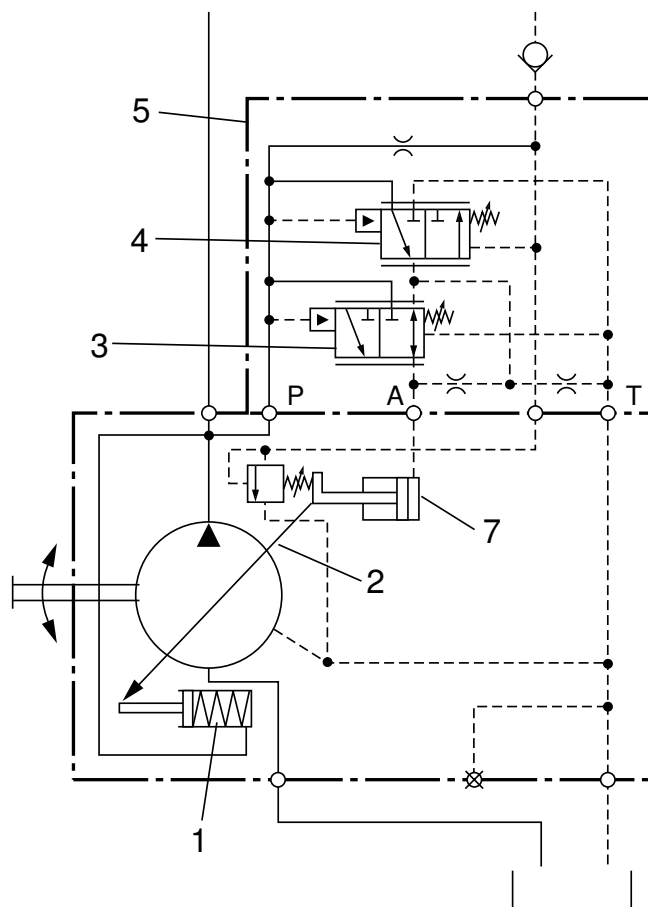
Stand-by is when the machine is running but the control levers are in neutral position, i.e. no implements are being used. There is no pressure or flow demands on the pump, therefore there will be no pressure signal .

With the engine switched off, spring 1 holds swashplate 2 at the maximum angle. When the engine is started and the pump begins to turn, oil begins to flow and pressure builds in the closed centre hydraulic system.

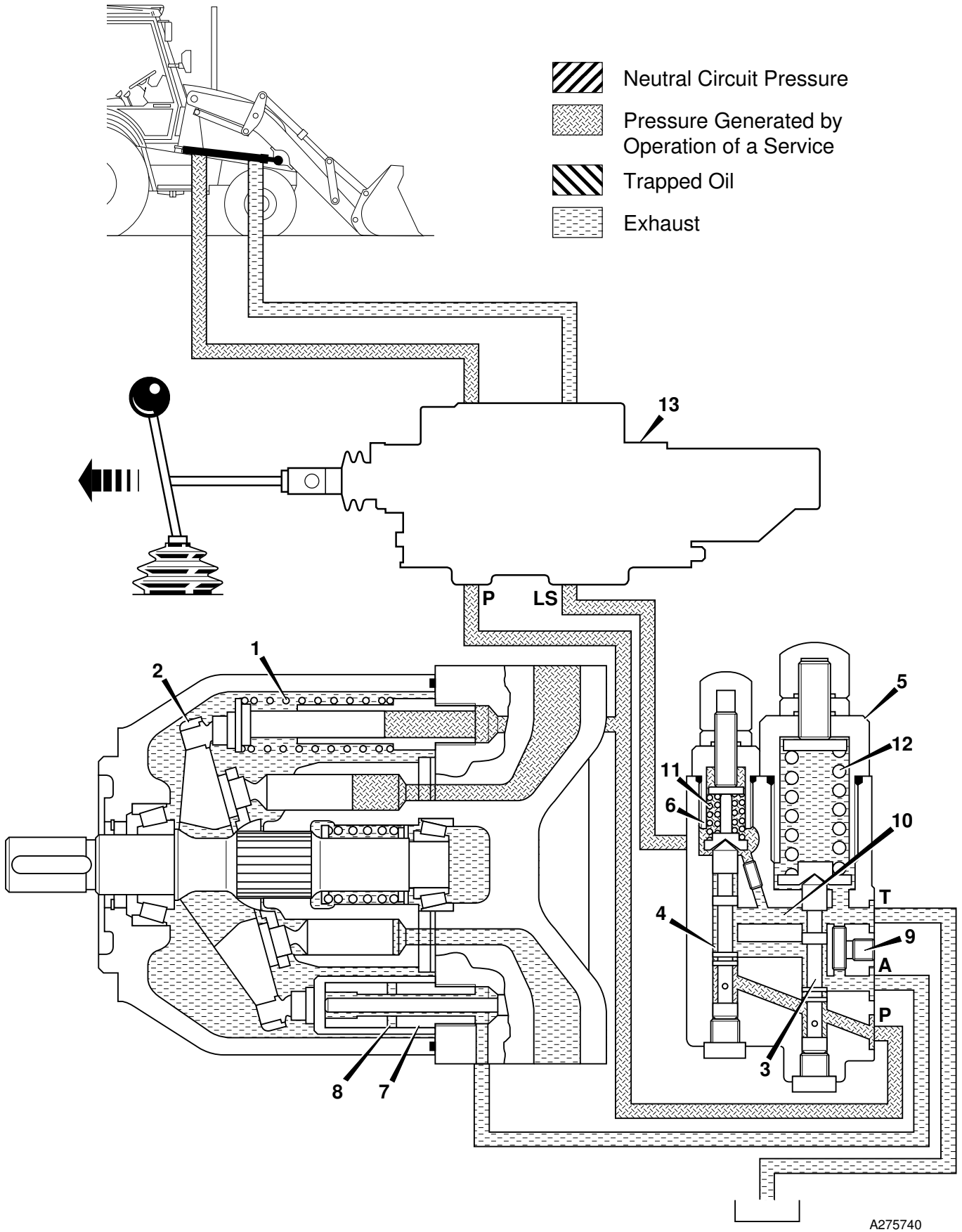
Valve 5 houses a flow regulator spool 4 and pressure regulator spool 3. Pressure which is building in the closed centre system is sensed at port P of the regulator valve. The increasing pressure pushes flow compensating spool 4 up against its spring 6. This movement creates a flow path from port P to port A. Oil now flows from the flow regulator valve (via port A) to swashplate control piston 7.

The control piston now moves the swashplate 2 towards its minimum angle. As the piston moves towards its full travel position, cross-drilled holes 8 are uncovered allowing oil to drain.

The cross-drilled holes limit the travel of the control piston - when the holes are exposed, pump flow is insufficient to make up for leakage through the holes and maintain the pressure behind the control piston. Therefore the piston moves back to partially cover the cross holes thus maintaining enough flow to cater for normal system leakage whilst establishing a system stand-by pressure (see **Technical Data** for pressure).



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A275740

## Hydraulic Pump - Variable Flow

### Pressure/Flow Regulator Valve

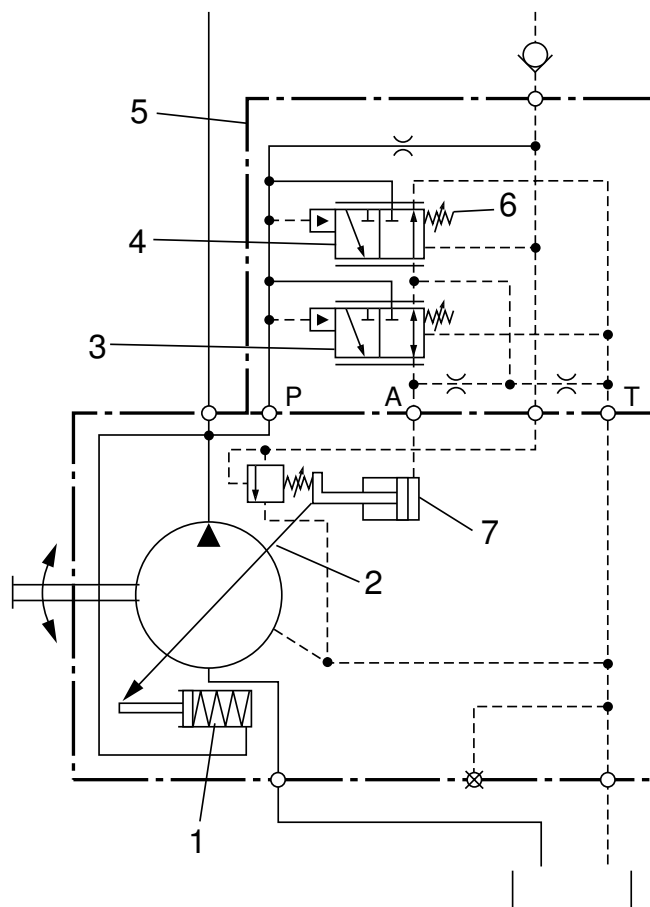
#### Load Sensing - Maximum Flow

When a service is operated, the signal pressure from the loader (or backhoe) valve **13** increases. The increase in signal pressure combined with the force of spring **6** moves spool **4** down. Oil in control piston **7** is allowed to drain back to the tank via restrictor **9** and passage **10**.

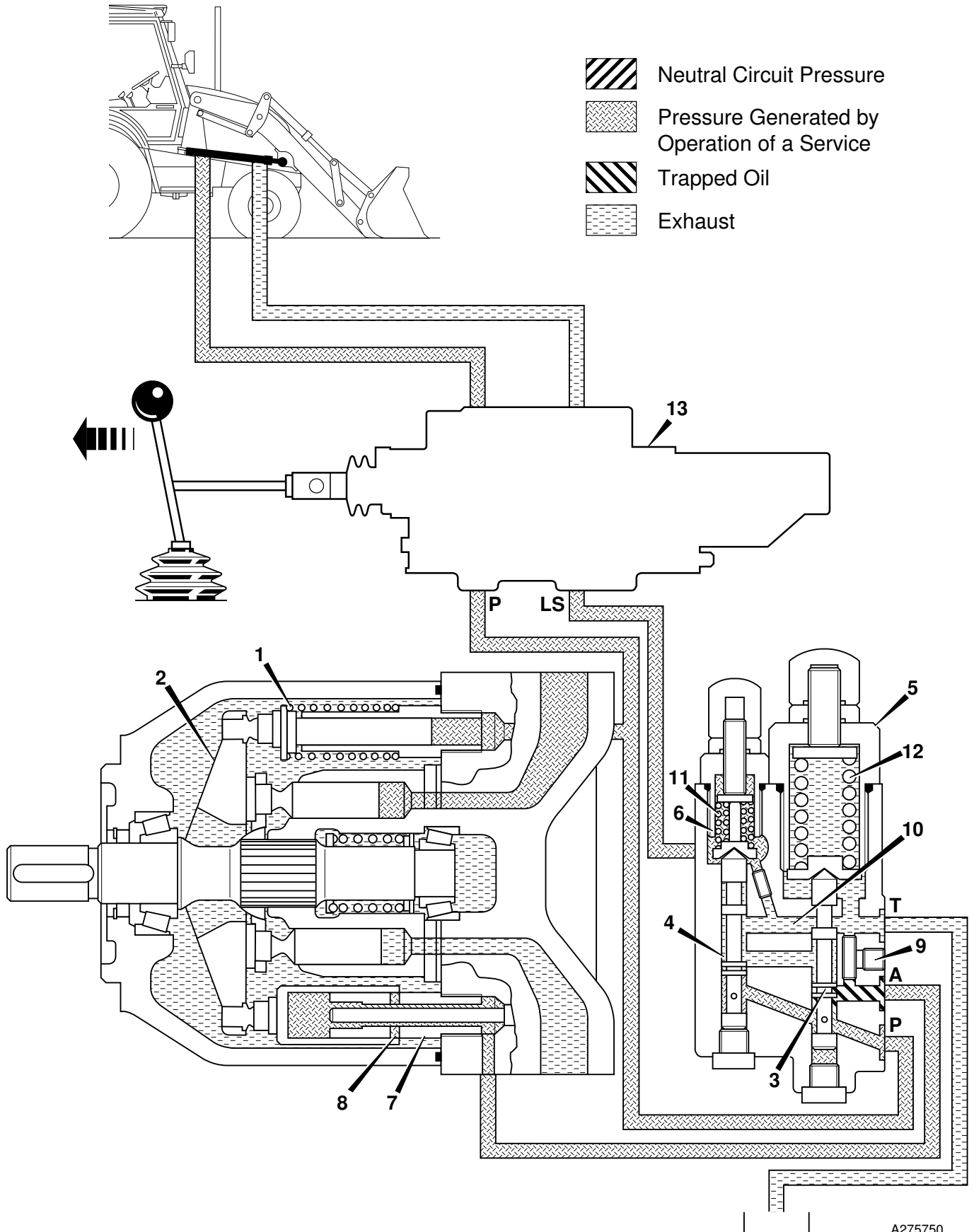
The force of spring **1** is now sufficient to increase the angle of swashplate **2**. The increased angle of the swashplate increase the output of the pump.

The pump output pressure will continue to increase, eventually the pressure will move flow regulating spool **4** against the force of spring **6** and the signal pressure in cavity **11**. Pump output pressure is now sent to control piston **7** via port **A**. Control piston **7** will overcome the force of spring **1**. The pump swashplate angle decreases and therefore the pump outlet decreases. Eventually the pressure in the load sense line and the force of spring **6** will move spool **4** down and the 'metering' cycle starts again.

The up and down movement of the spool **4** keeps the pressure on both ends of the spool equal. Spring **6** is equivalent to 20 bar (290 lbf/in<sup>2</sup>), therefore the pump pressure should be this amount greater than the signal pressure (except when at maximum pressure - see **Load Sensing - Maximum Pressure (no flow)**).



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A275750

## Hydraulic Pump - Variable Flow

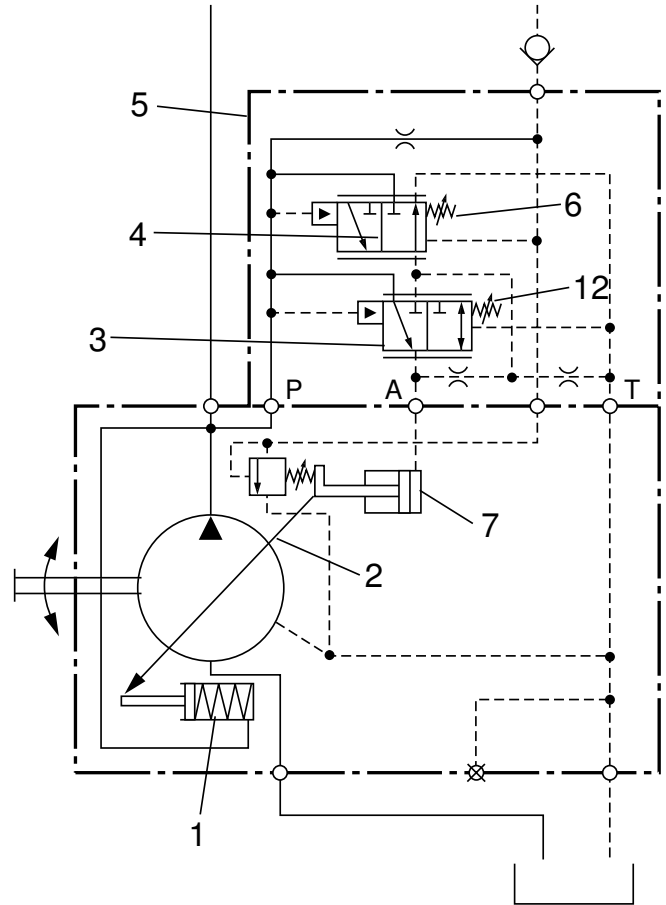
### Pressure/Flow Regulator Valve

#### Load Sensing - Maximum Pressure (no flow)

When a service ram reaches the end of its stroke or the service meets resistance (for instance tearing out), the signal pressure from the loader (or backhoe) valve **13** will increase to the same pressure as pump output pressure.

The force of spring **6** is sufficient to move spool **4** down. The pressure in the system is also sufficient to move spool **3** up against the force of spring **12**, this creates a connection from the pump outlet to control piston **7** via port **A**.

Control piston **7** moves thus decreasing the angle of swashplate **2**. Pump output flow now decreases whilst the system pressure is maintained at maximum setting. There is now no flow but maximum system pressure.



A275780

**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**.

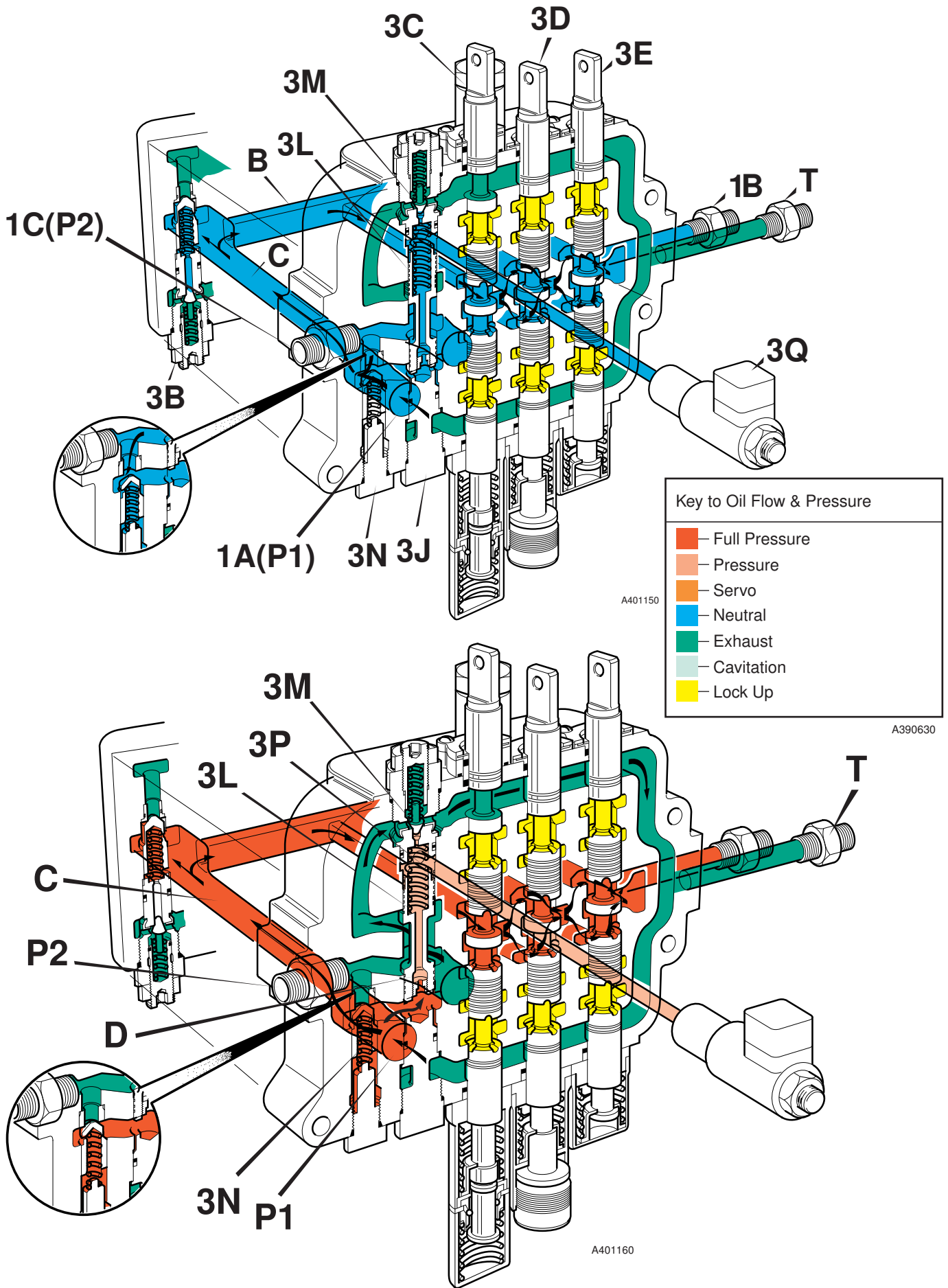
If the pressure in the inlet gallery **C** rises to the setting of the pilot valve **3M**, this valve will open, allowing oil in spring cavity **3P** to escape more quickly than it can be replaced by oil entering through the small drilling **D**.

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.

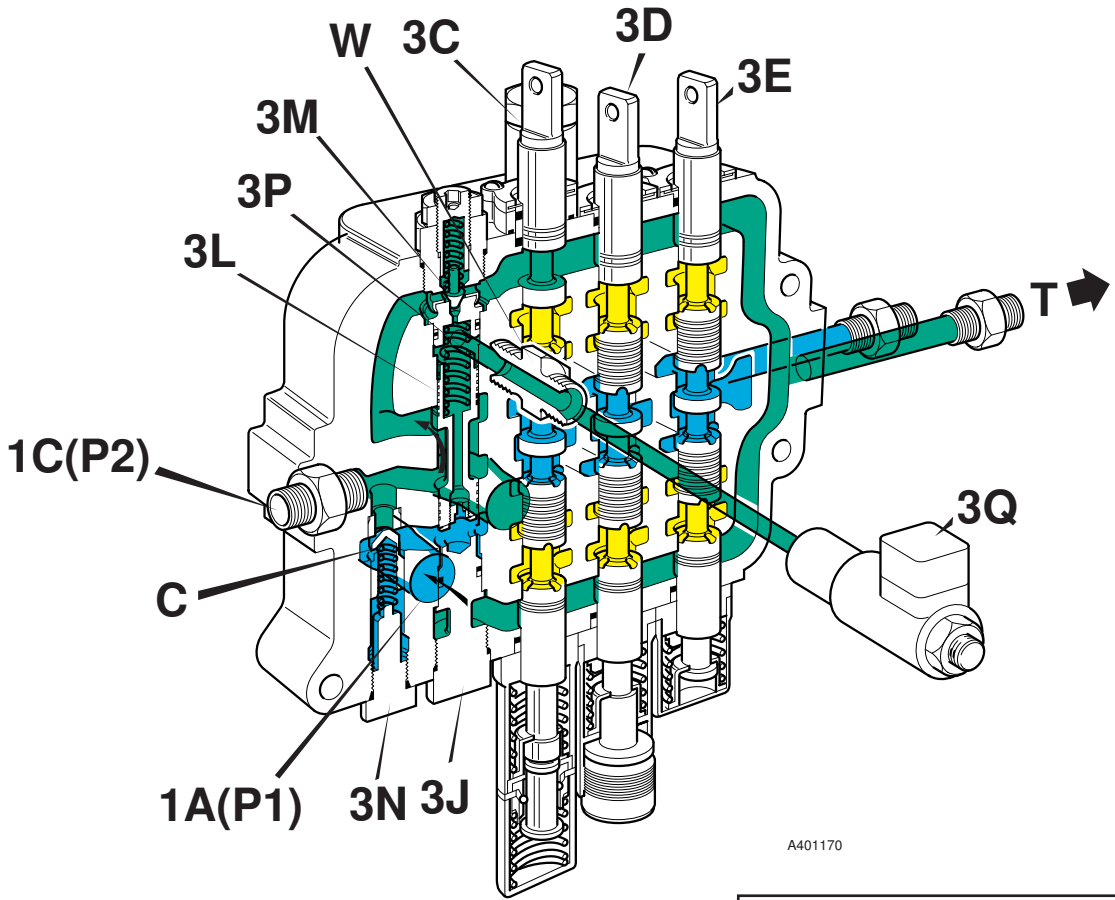
Oil entering the valve block from pump section **P2** now flow directly to tank **T**.

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.







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Key to Oil Flow & Pressure	
<span style="color: red;">■</span>	Full Pressure
<span style="color: orange;">■</span>	Pressure
<span style="color: blue;">■</span>	Servo
<span style="color: cyan;">■</span>	Neutral
<span style="color: green;">■</span>	Exhaust
<span style="color: lightblue;">■</span>	Cavitation
<span style="color: yellow;">■</span>	Lock Up

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## Loader Valve - Hydraulic Speed Control (HSC)

Solenoid valve **3Q** allows the operator to control the unloader spool movement (to dump flow from the hydraulic pump section **P2**) using a switch. There are two main applications for this operation:

- 1 More tractive force can be applied to the loader end when entering a stock pile. This is because more power is available from the engine as flow from pump section **P2** is being dumped directly to tank.
- 2 More power can be made available from the engine whilst the machine is travelling on the highway. Again, this is because flow from pump section **P2** is being dumped directly to tank.

When the solenoid valve **3Q** is de-energised its spool is moved by spring pressure. This spool movement makes a connection from the unloader spool chamber **3P** to tank.

Because the unloader chamber is now connected to tank, and so at exhaust pressure, pressure in gallery **C** (neutral shown) acts on the face of unloader spool **3L** causing the spool to be moved off its seat. Oil entering the valve block from pump section **P2** now flows directly to tank.

When solenoid valve **3Q** is energised its spool closes the connection from the unloader valve spool chamber to tank. Spool **3L** is once again controlled by system pressure.

### Component Key:

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

**Component Key:**

- 1A** Pump Inlet
- B** Parallel Gallery
- D** Service Line
- 3C** Lift Ram Spool
- 3J** Load Hold Check Valve
- 33** Lift Ram
- 34** Lift Ram

**Loader Valve - Load Hold Check Valves****Operation 1**

The illustration shows 'arms raise' being selected by the lift ram spool **3C**.

The weight of the loaded shovel, as indicated by the arrows, produces a higher pressure in service line **D** than in the parallel gallery **B**.

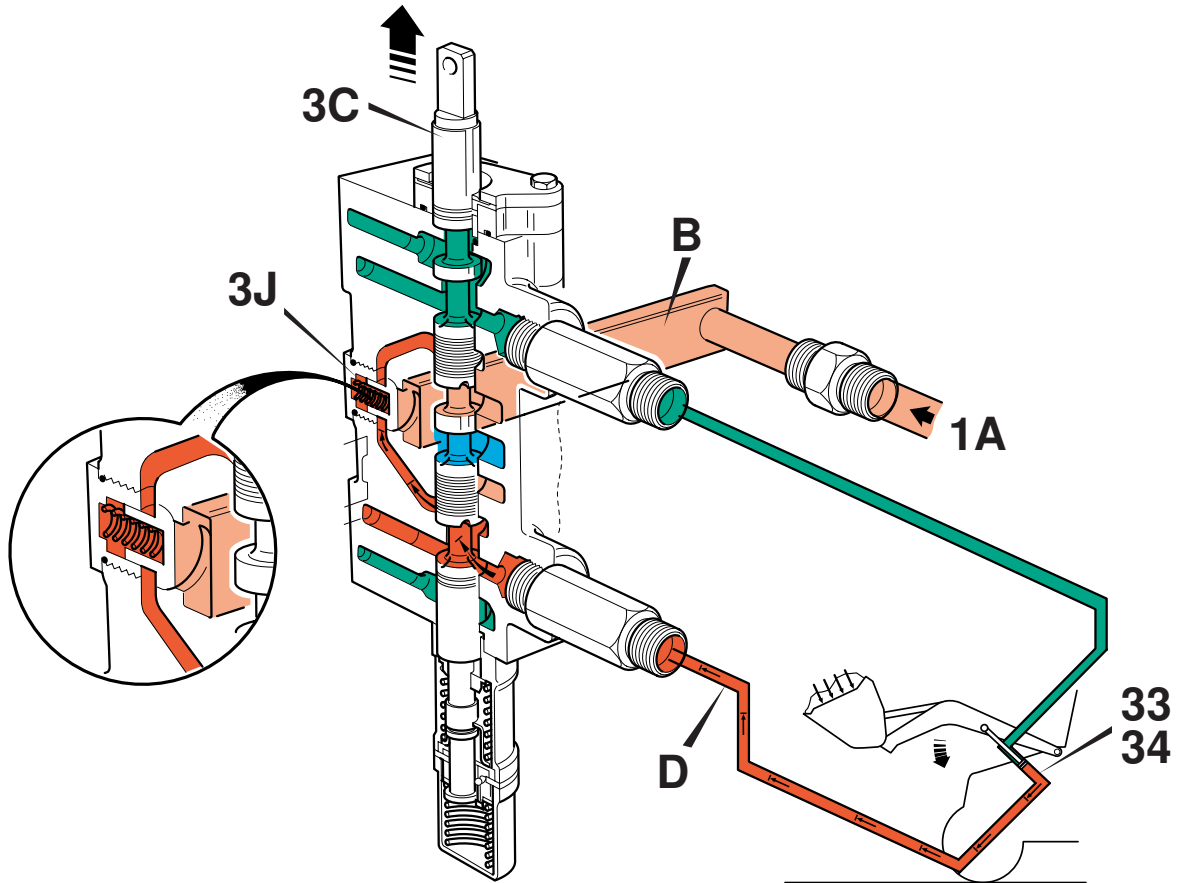
This pressure differential causes load hold check valve **3J** to close, thus preventing the load from dropping.

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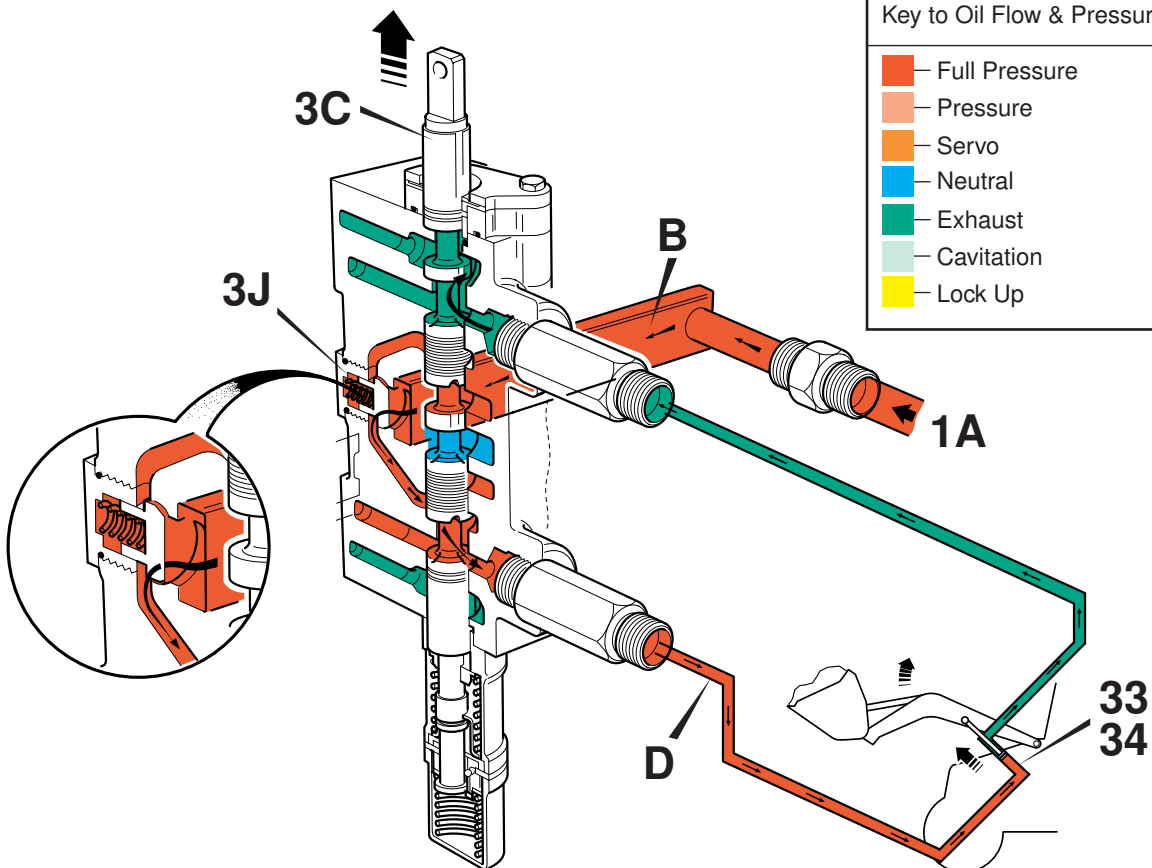
**Operation 2**

As the neutral circuit has been blocked by the central land of the selected spool **3C**, the pressure in parallel gallery **B** increases until it is greater than that in service line **D**.

At this point, load hold check valve **3J** opens, allowing oil to flow from the parallel gallery into the service line and operate the lift rams **33** and **34**.

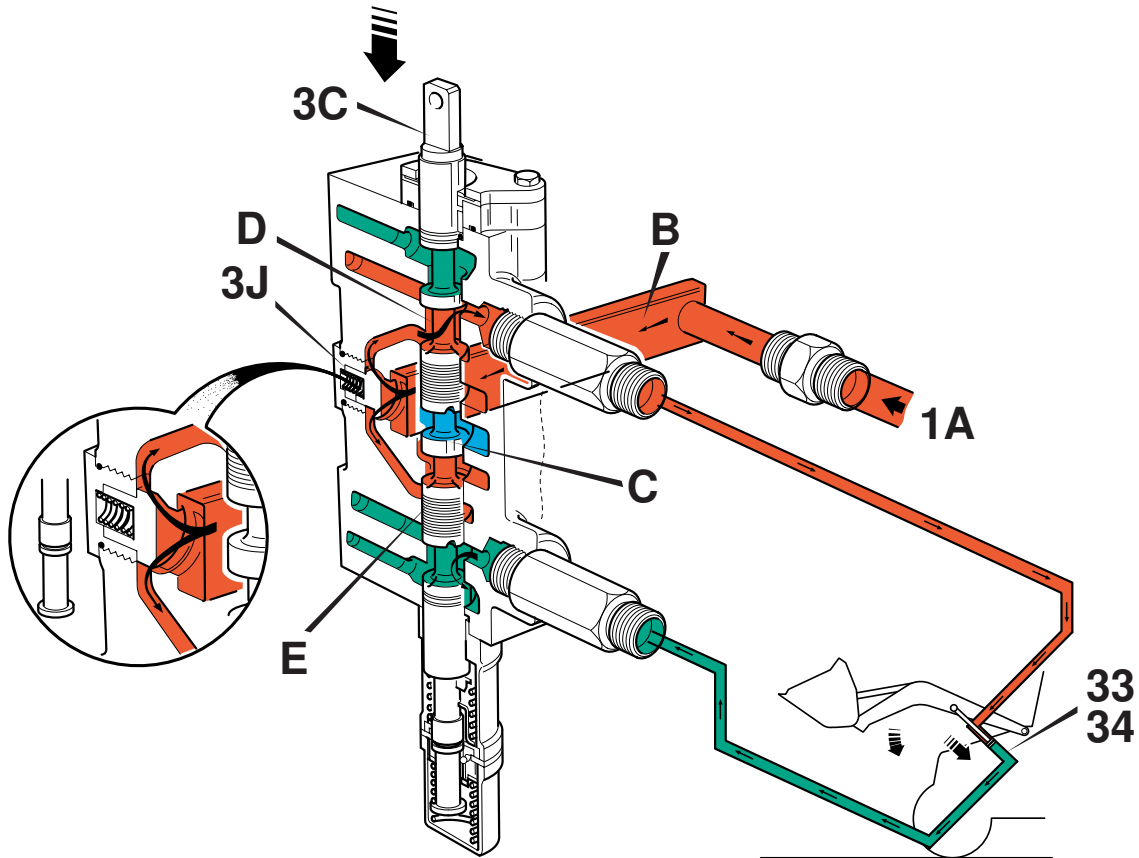


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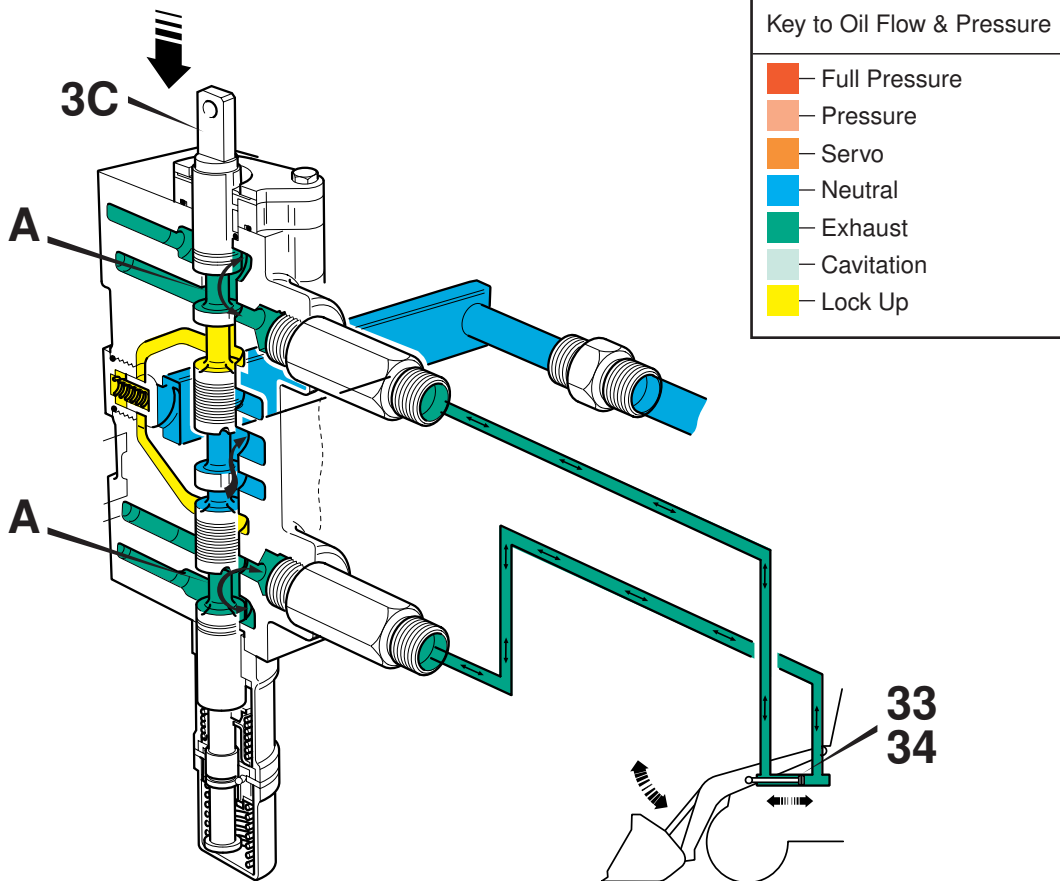


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## Loader Valve

### Arms Lower

When a spool is selected as shown at **3C**, the central land of the spool **C** blocks the neutral circuit. Oil from the pump, entering at **1A**, is diverted into the parallel gallery **B**, opens the load hold check valve **3J**, and flows around the waisted section of the spool **D** and out to the rod side of lift rams **33** and **34**.

The lower land of the selected spool **E** blocks the flow from the parallel gallery to the head side port and oil returning from the rams is diverted into the exhaust gallery.

### Component Key:

<b>A</b>	Spool Waists
<b>B</b>	Parallel Gallery
<b>C</b>	Central Land
<b>D</b>	Spool Waist
<b>E</b>	Lower Waist
<b>1A</b>	Pump Inlet
<b>3C</b>	Lift Ram Spool
<b>3J</b>	Load Hold Check Valve
<b>33</b>	Lift Ram
<b>34</b>	Lift Ram

---

## Float

The float facility is provided to allow the arms to move up and down so that the shovel can follow the surface contours as the machine is driven over uneven ground.

This is achieved by moving the lift spool **3C** down beyond 'arms lower' into the 'float' detent, when the feed from the parallel gallery to the service ports is blocked and the neutral circuit is re-opened. Both service ports are connected to exhaust via the spool waists **A**.

Oil can then be displaced from either end of the lift rams **33** and **34** into the exhaust gallery, allowing the rams to open and close as required.

### Loader Valve - A.R.V. Operation

**Component Key:**

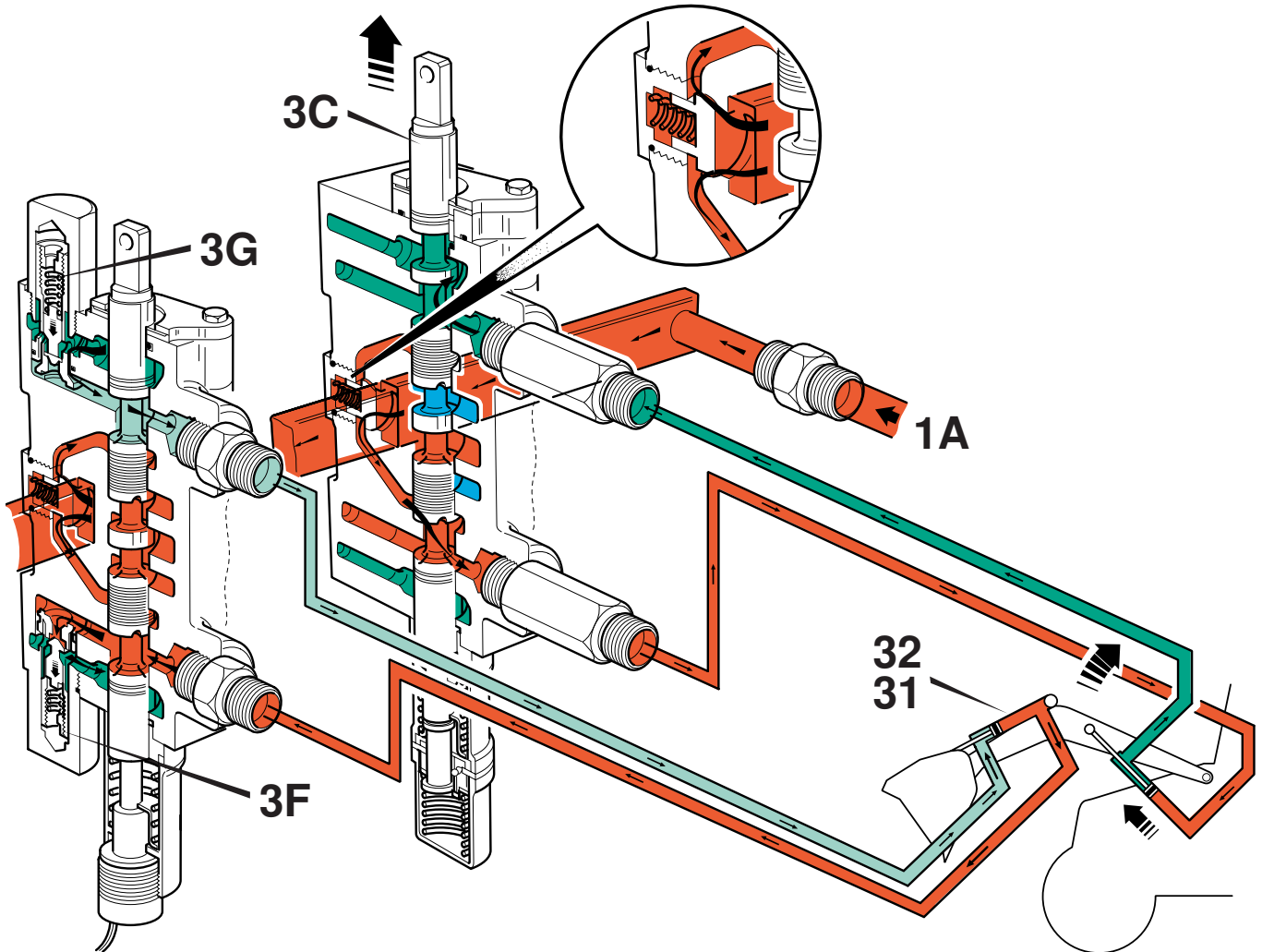
- 1A** Pump Inlet
- 3C** Lift Ram Spool
- 3D** Shovel Ram Spool
- 3F** ARV - Head Side
- 3G** ARV - Rod Side
- 31** Shovel Ram
- 32** Shovel Ram

Under normal operating conditions, with the shovel in the 'carry' position, the mechanical linkage keeps the shovel level as the arms are raised, to prevent spillage of the load.

If, as illustrated, the shovel is fully tipped when the arms are being raised, the shovel is unable to tip further, producing back pressure in the head side of the shovel rams **31** and **32** and cavitation in the rod side.

As the arms continue to rise, the back pressure increases until it reaches the setting of A.R.V. **3F**. This A.R.V. then opens, allowing the excess back pressure to be dumped to exhaust and prevent the rams and linkage from being damaged.

The rod side A.R.V. **3G** senses a higher pressure in the exhaust gallery than in the service port and therefore opens to allow exhaust oil to overcome the cavitation.

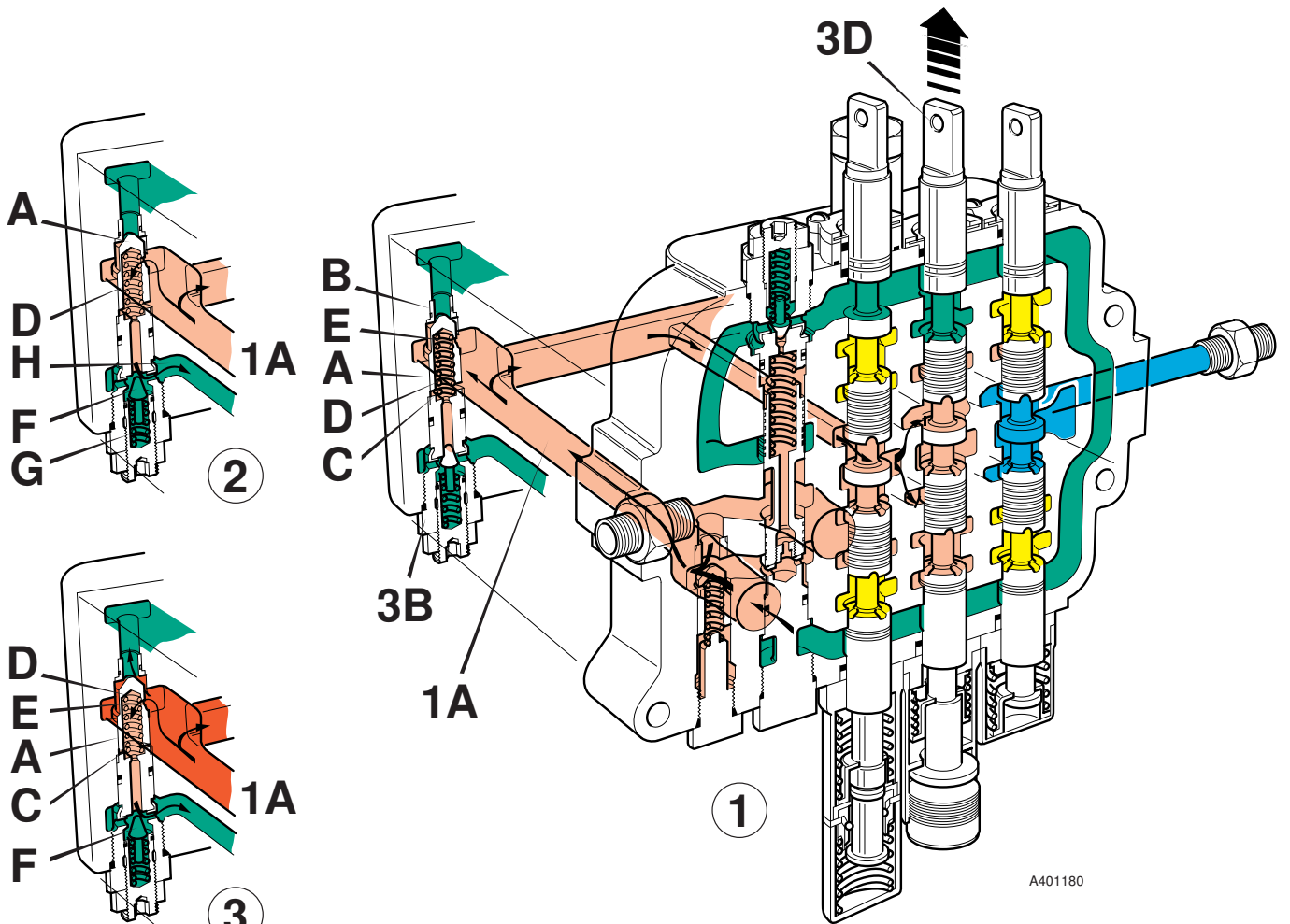


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Key to Oil Flow & Pressure	
<span style="color: red;">█</span>	Full Pressure
<span style="color: orange;">█</span>	Pressure
<span style="color: yellow;">█</span>	Servo
<span style="color: blue;">█</span>	Neutral
<span style="color: green;">█</span>	Exhaust
<span style="color: lightblue;">█</span>	Cavitation
<span style="color: yellow;">█</span>	Lock Up

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Key to Oil Flow & Pressure	
<span style="color: red;">■</span>	Full Pressure
<span style="color: orange;">■</span>	Pressure
<span style="color: lightorange;">■</span>	Servo
<span style="color: blue;">■</span>	Neutral
<span style="color: green;">■</span>	Exhaust
<span style="color: lightblue;">■</span>	Cavitation
<span style="color: yellow;">■</span>	Lock Up

A390630

## Main Relief Valve (MRV) - Operation

The main relief valve (M.R.V.) **3B**, situated in the loader valve block, provides control of both loader and excavator pressures.

### 1 Valve at Rest

The illustration **1** shows a loader service selected by spool **3D** causing pressure to rise in the service line and back through the loader valve to the pump via line **1A**. The service is operating under light load and the pressure is not sufficient to cause any response in the M.R.V.

The main plunger **A** is held on its seat **B** by the combined effect of spring **C** and the pump pressure which enters chamber **D** through the small drilling **E**. Pump pressure outside the chamber is not high enough to lift the plunger off its seat.

### 2 Pilot Valve Opens

If, as shown in view **2**, pump pressure rises high enough to force the pilot valve **F** from its seat (against spring **G**), the pressure in chamber **D** is vented into the exhaust gallery **H**.

Unless the pressure continues to rise, plunger **A** will remain on its seat.

### 3 Valve Moves off its seat

In view **3**, pump pressure at **1A** has risen to the setting of the main relief valve but pressure in chamber **D** has not risen because the seat orifice of pilot valve **F** is larger than small drilling **E** and oil is unable to fill the chamber as quickly as it is being exhausted.

Pressure acting on the upper faces of main plunger **A** is therefore greater than the combined force of spring **C** and the pressure in chamber **D**. The plunger then moves off its seat, allowing pressure to be released to the exhaust gallery.

As the pump pressure decreases, the pilot valve is able to reseat and pressure in chamber **D** assists spring **C** to force the main plunger **A** back onto its seat.

### Component Key:

<b>A</b>	Main Plunger
<b>B</b>	Valve Seat
<b>C</b>	Spring
<b>D</b>	Chamber
<b>E</b>	Drilling
<b>F</b>	Pilot Valve
<b>G</b>	Spring
<b>H</b>	Exhaust Gallery
<b>1A</b>	Pump Inlet
<b>3B</b>	Main Relief Valve
<b>3D</b>	Shovel Ram Spool

## Loader Valve - Variable Flow

### Operation

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

It is a stack type, directional control valve that is configured for closed centre operation. The valve block comprises two or three service valve sections and a priority steer inlet section.

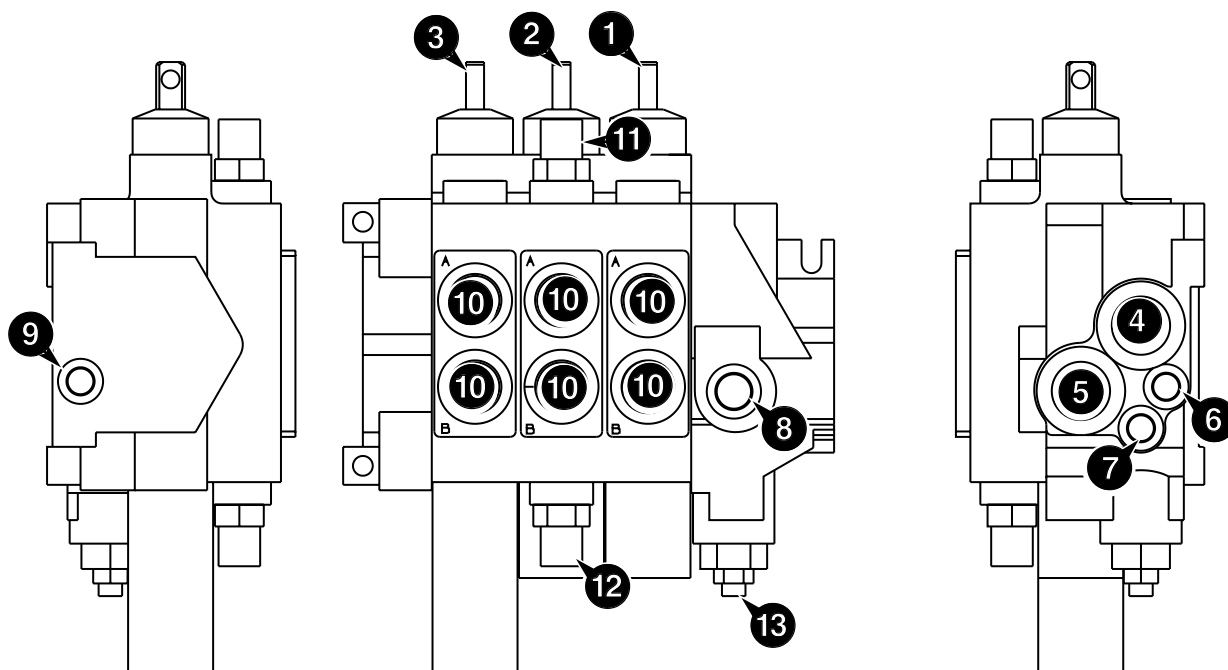
When operated, the designated valve section controls the volume and direction of oil by way of service ports **A** or **B**. A constant flow is maintained regardless of changing load pressures.

While the spools are in neutral position, the primary shuttles and secondary shuttles are vented to tank. When a spool is operated, the load pressure sensed at the work port is directed via the primary and secondary shuttles to the hydraulic pump, where the pump subsequently 'swashes' to meet this load sense demand.

### Component Key:

- 1 Auxiliary (optional) spool
- 2 Shovel spool
- 3 Arms lift spool
- 4 Pump inlet
- 5 Tank port
- 6 Load sense port (from valve blocks)
- 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 (rods side)
- 12 Auxiliary relief valve (head side)
- 13 Priority relief valve †

†**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<sup>2</sup>, this will ensure it does not interfere with the operation of the relief valve housed in the hydraulic steer unit.



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## Loader Valve - Variable Flow

### Priority Inlet Section Operation

The priority inlet section houses the steering priority valve and a relief valve assembly. Operation is as follows:

#### Steering

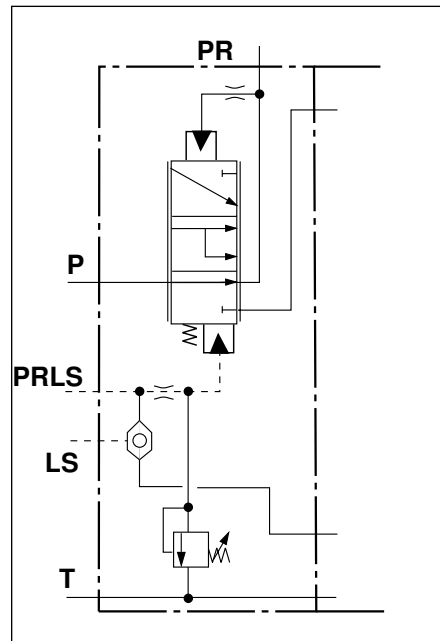
When the steering wheel is turned, a priority pressure demand signal is sent from the hydraulic steer unit and received at the priority inlet section (port **PRLS**). The signal oil flows through port **A** into chamber **C** via gallery **B**.

The combined force of spring **D** and signal oil pressure moves spool **E** up. The position of the spool now allows oil from the pump inlet port **P** to flow out to the hydraulic steer unit via priority work port **PR**.

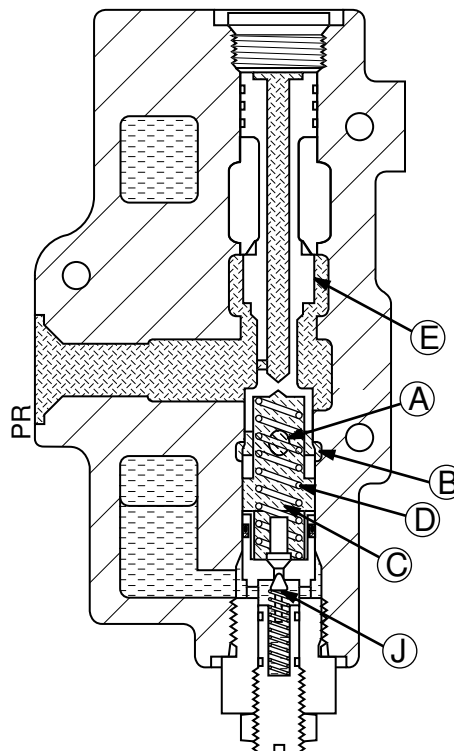
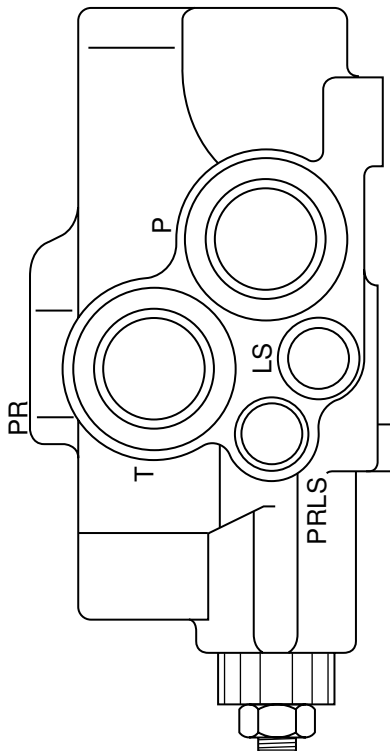
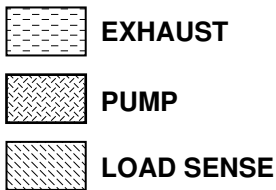
It must be noted that relief valve assembly **J** is redundant. This relief valve is part of the inlet section, however the hydraulic steer unit also houses a steer system relief valve. To ensure the relief valve in the hydraulic steer unit controls the steer system pressure, valve **J** is set abnormally high (172 bar; 2500 lb/in<sup>2</sup>).

#### Component Key:

<b>P</b>	Pump Inlet
<b>T</b>	Tank
<b>LS</b>	Load sense port (to pump)
<b>PRLS</b>	Priority Load Sense Port (from steer unit)
<b>PR</b>	Priority Work Port (to steer unit)



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**Loader Valve - Variable Flow**

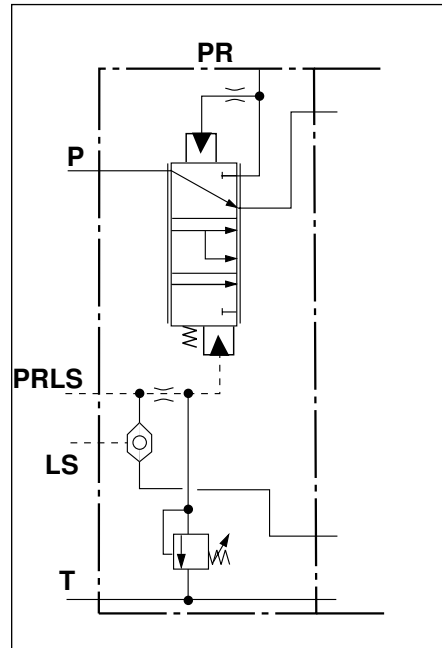
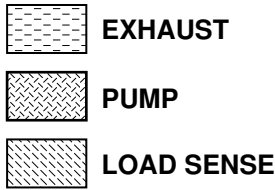
**Priority Inlet Section Operation**

**Service Selected (no steering demand)**

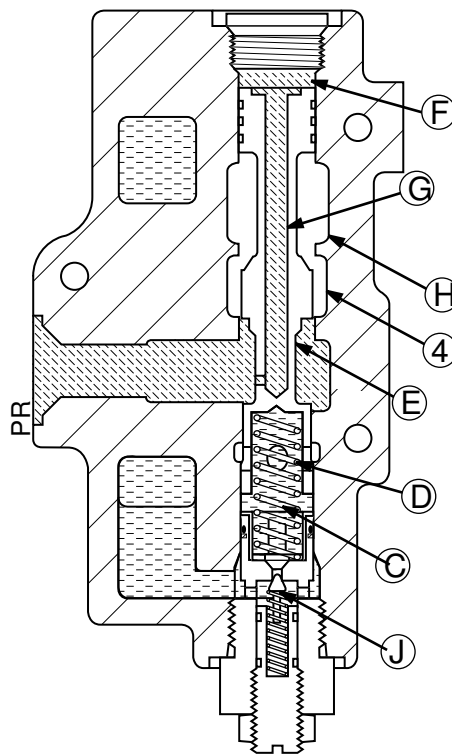
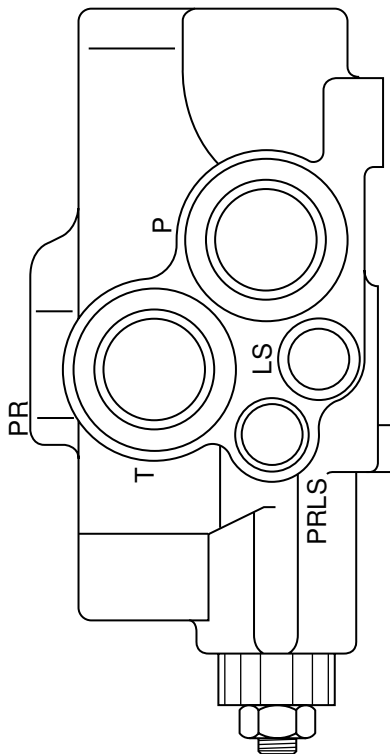
If the steering is not selected, there will be no pressure demand signal in chamber C. Pump pressure is 'dead ended' at the steer unit, this pressure is felt in chamber F via priority port PR and drilling G. The pressure is sufficient to force spool E down against the force of spring D. The position of the spool now allows oil from the pump inlet port P to flow into passage H and on to the selected service via the valve block service ports.

**Component Key:**

- P** Pump Inlet
- T** Tank
- LS** Load sense port (to pump)
- PRLS** Priority Load Sense Port (from steer unit)
- PR** Priority Work Port (to steer unit)



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### Loader Valve - Variable Flow

#### Auxiliary Spool

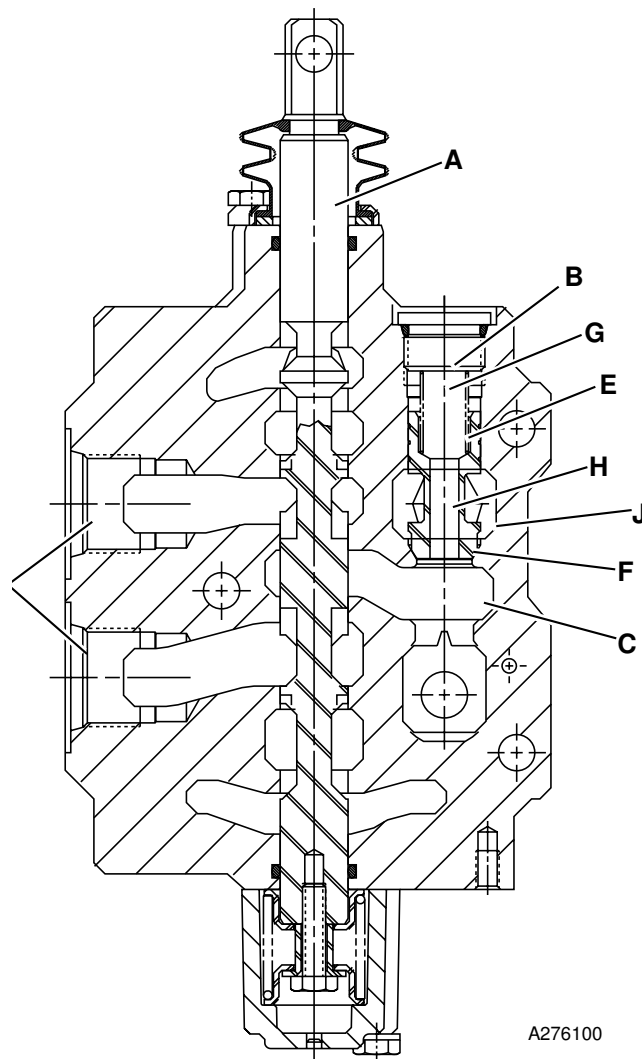
The auxiliary valve section comprises the spool assembly **A**, load hold check valve assembly **B**, primary and secondary shuttles, items **L** and **K** respectively.

While the spools are in neutral position, the primary shuttles and secondary shuttles are vented to tank. When a spool is operated, the load pressure sensed at the work port is directed via the primary and secondary shuttles to the hydraulic pump, where the pump subsequently 'swashes' and increases its output to meet this load sense demand.

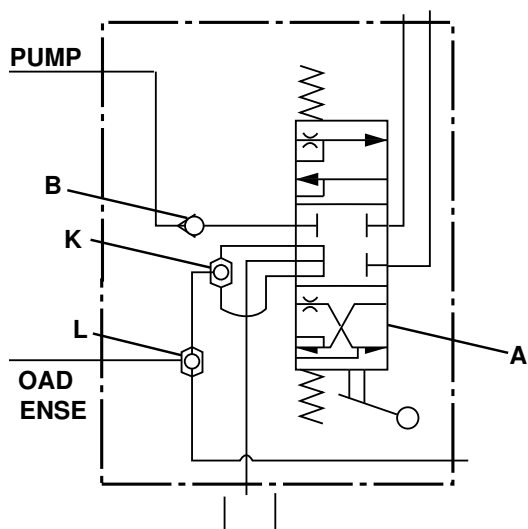
When a service is selected (the spool moved up or down), the waisted sections of the spool connect passage **C** to one of the service ports **D**. Oil from the pump must overcome the force of spring **E** to lift poppet **F** and make the connection from the pump passage **J** to the service ports **D** via passage **C**.

In some instances there is a back pressure in the service line (e.g. generated by the weight of a loaded shovel). This pressure is felt in chamber **G** via drilling **H** in poppet **F**. The back pressure combined with the force of spring **E** keeps the load hold check valve firmly closed, preventing the load from dropping.

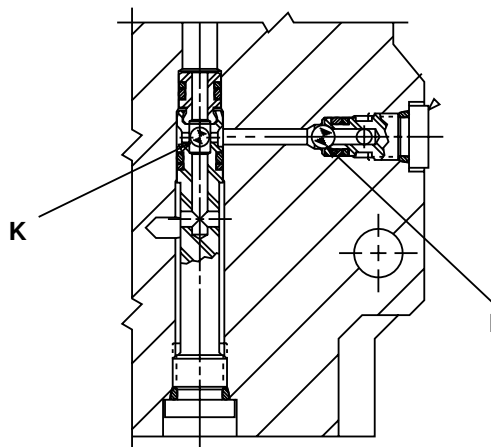
The pressure in pump passage **J** will increase until it is greater than that in the service line. At this point, the load hold check valve will open, as previously described.



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## Loader Valve - Variable Flow

### Loader Shovel Spool

The loader shovel spool operates in the same manner as the auxiliary spool, refer to **Auxiliary Spool**.

The shovel valve section also houses auxiliary relief valves (items **30** and **30A**).

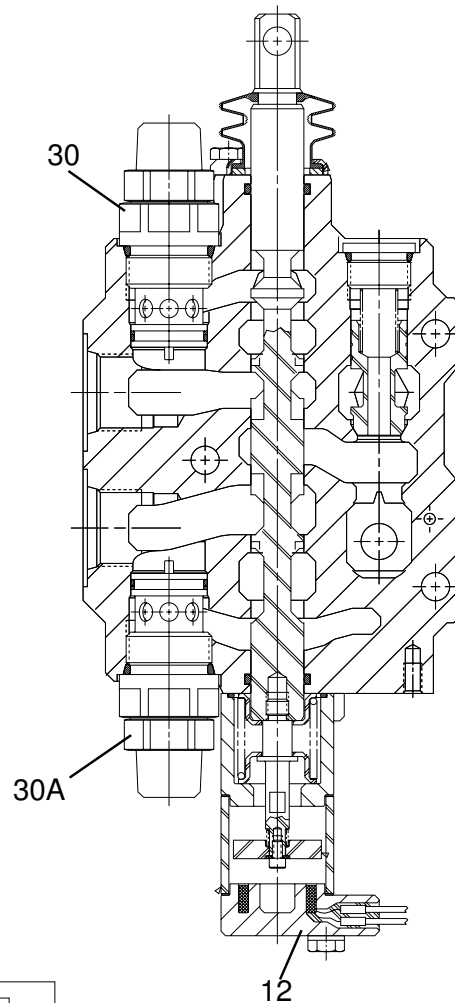
Under normal operating conditions, with the shovel in the 'carry' position, the mechanical linkage keeps the shovel level as the arms are raised, to prevent spillage of the load.

If, as illustrated, the shovel is fully tipped when the arms are being raised, the shovel is unable to tip further, producing back pressure in the head side of the shovel rams and cavitation in the rod side.

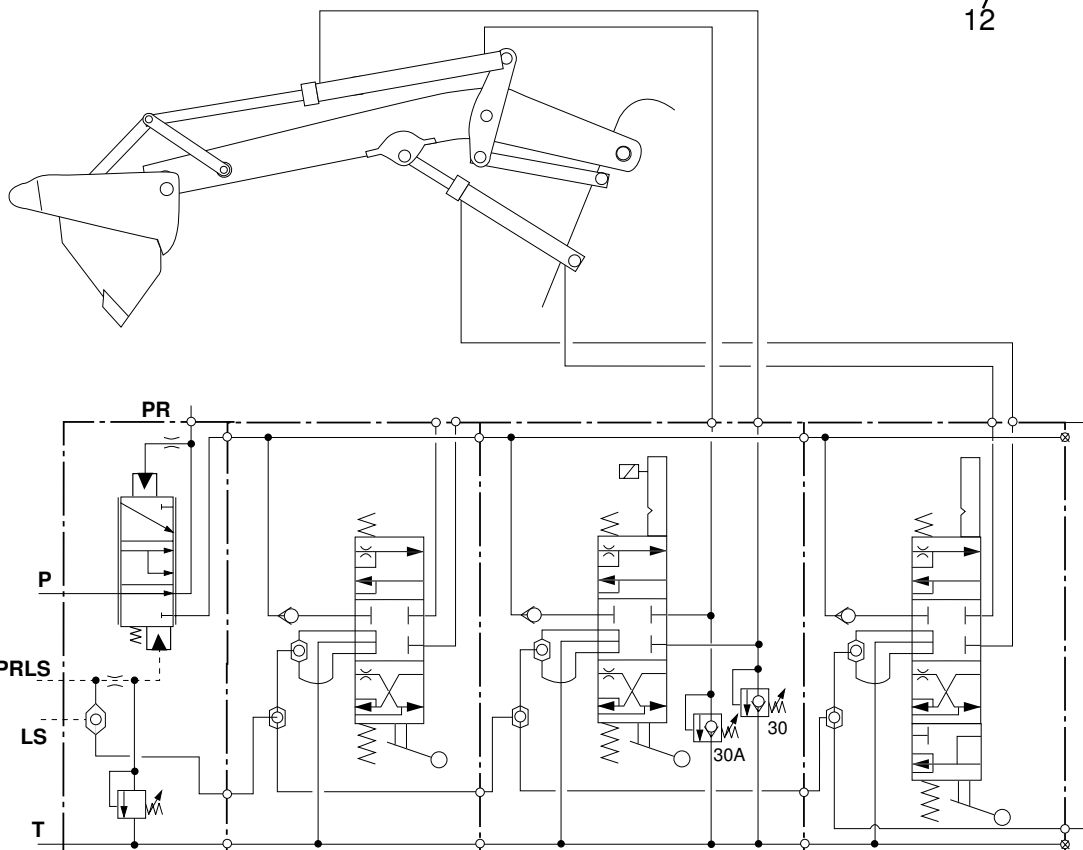
As the arms continue to rise, the back pressure increases until it reaches the setting of A.R.V. **30A**. This A.R.V. then opens, allowing the excess back pressure to be dumped to exhaust and prevent the rams and linkage from being damaged.

The rod side A.R.V. **30** senses a higher pressure in the exhaust gallery than in the service port and therefore opens to allow exhaust oil to overcome the cavitation.

The shovel service may also be fitted with a 'return to dig' detent solenoid **12**.



A278920



A279300

**Loader Valve - Variable Flow**

**Loader Lift Spool**

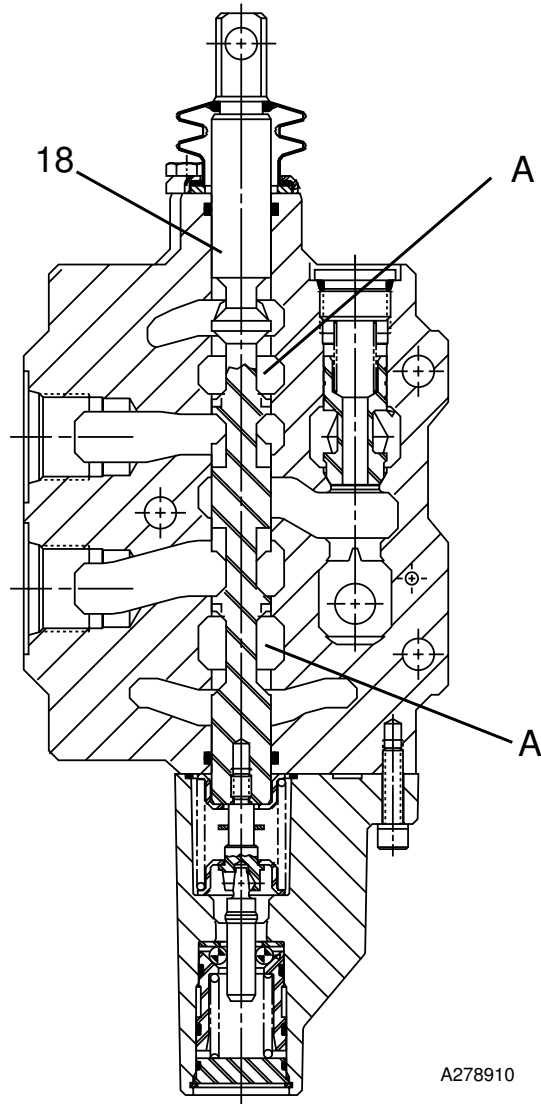
The loader lift spool operates in the same manner as the auxiliary spool, refer to **Auxiliary Spool**.

The lift service spool (item **18**) has a 'float' detent position.

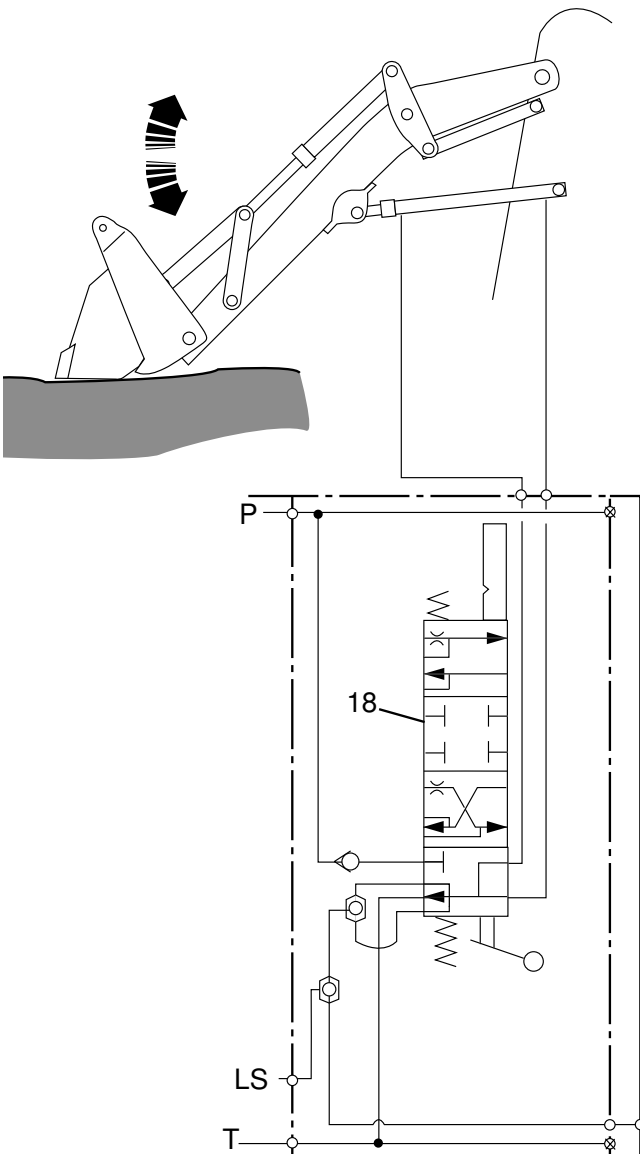
The float facility is provided to allow the arms to move up and down so that the shovel can follow the surface contours as the machine is driven over uneven ground.

This is achieved by moving the lift spool **18** down beyond 'arms lower' into the 'float' detent. Both service ports are connected to exhaust via the spool waists **A**.

Oil can then be displaced from either end of the lift rams and into the exhaust gallery, allowing the rams to open and close as required.



A278910



A279430



## Loader Valve - Variable Flow

### Shuttle Valve Signal Network

Each control valve section has two shuttle valves. Each valve compares two pressure signals. One of the shuttles is the primary **18** and the other is the secondary **17**.

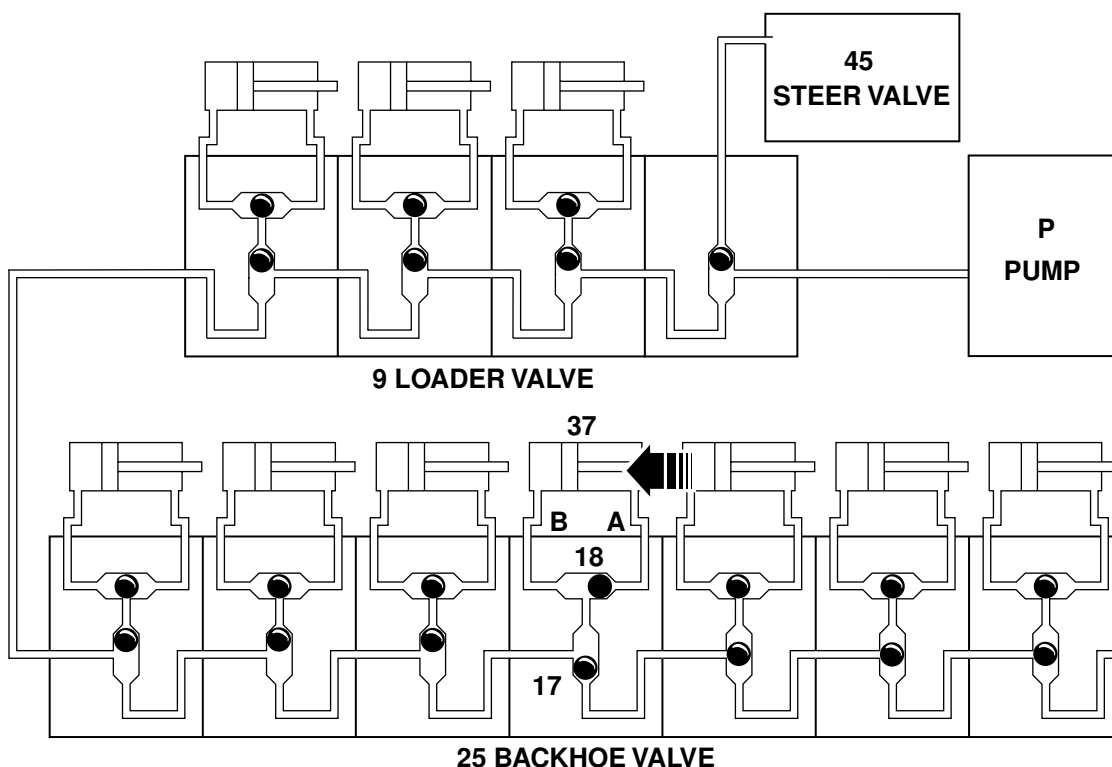
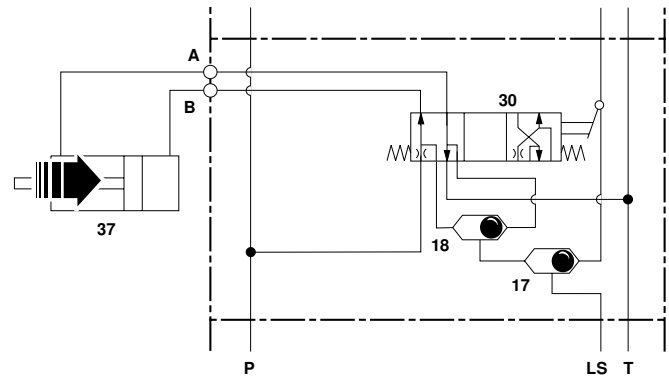
The primary shuttle **18** compares the pressure signal between the two service ports **A** and **B** in each valve section, the head and the rod pressure of the cylinder. In the example shown the boom service **37** port **B** pressure signal is greater than port **A**. Primary shuttle **18** moves across, the pressure signal is the highest shuttle pressure. This signal pressure passes to the next shuttle.

The secondary shuttle operates the same as the primary shuttle but compares pressure signals between valve sections.

The signal network is arranged in series. It starts at loader valve block **9** inlet section which is connected to the steer valve **45**. The last secondary shuttle in the loader valve block is connected to the first secondary shuttle in the backhoe valve block **25**. The highest shuttle signal pressure from the loader valve block goes to the backhoe valve block.

The highest shuttle signal pressure is felt at the hydraulic pump which instructs the pump to vary the output to meet the highest shuttle load requirement. The stand-by pressure spool in the pump adds margin pressure to the load requirement. The single highest shuttle signal pressure plus margin pressure governs pump output.

The pump will not change output until the shuttle network identifies a different shuttle signal.



A316510

## Excavator Valve

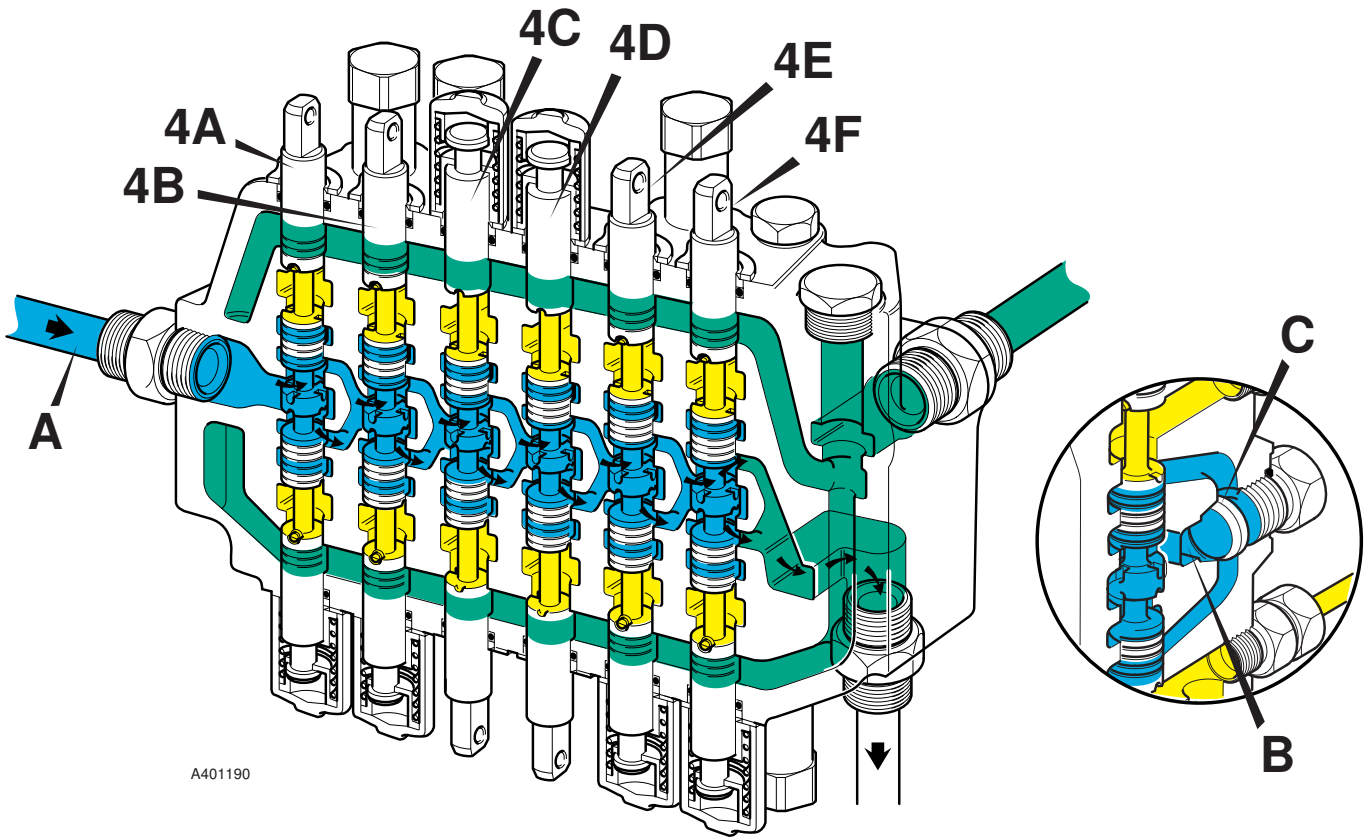
### Manual Control - Neutral Circuit

#### 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

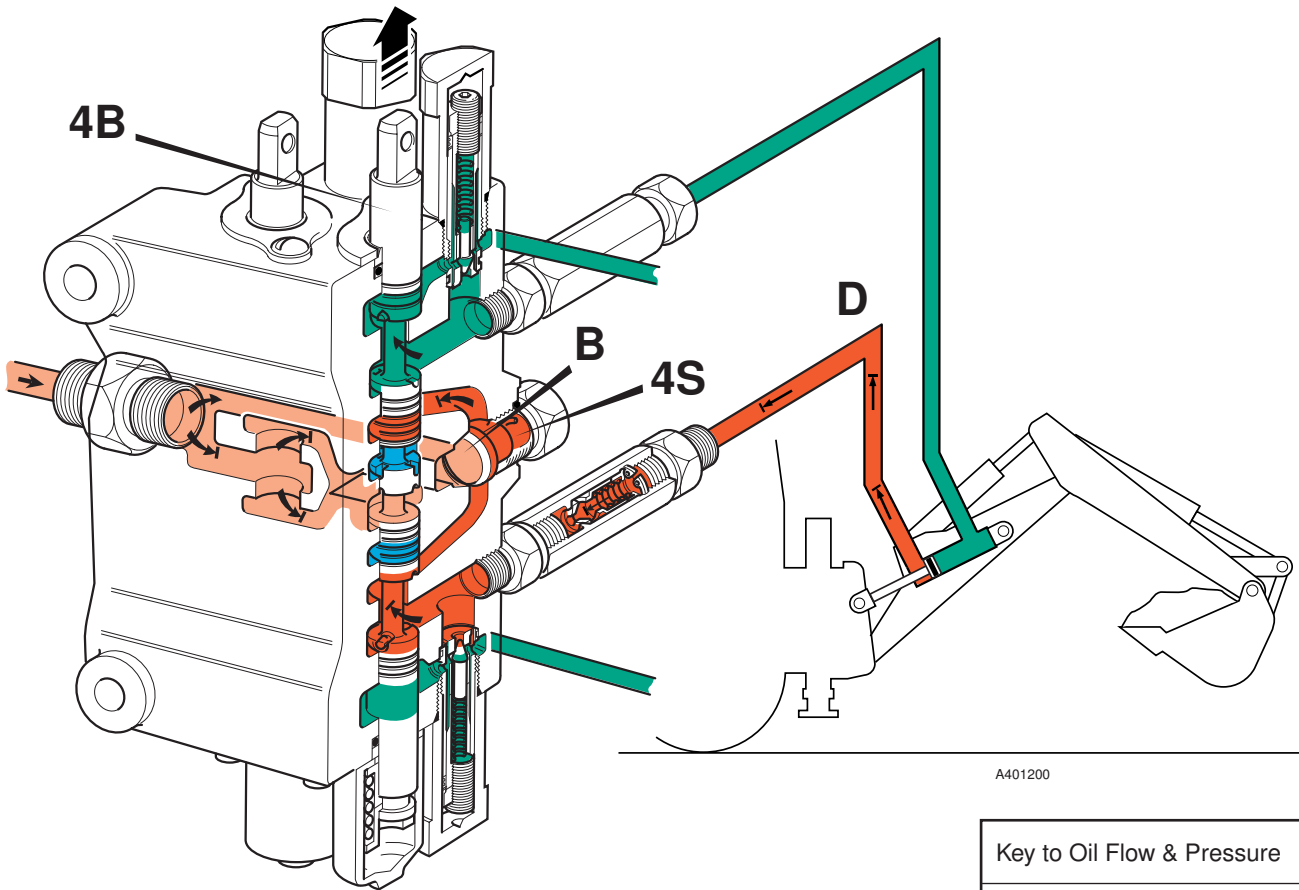
Oil from the loader valve enters the excavator valve at **A** and flows through the neutral gallery and around the waists of the solid spools. It also fills the parallel gallery **B** but is not at a high enough pressure to open the load hold check valves **C**.

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



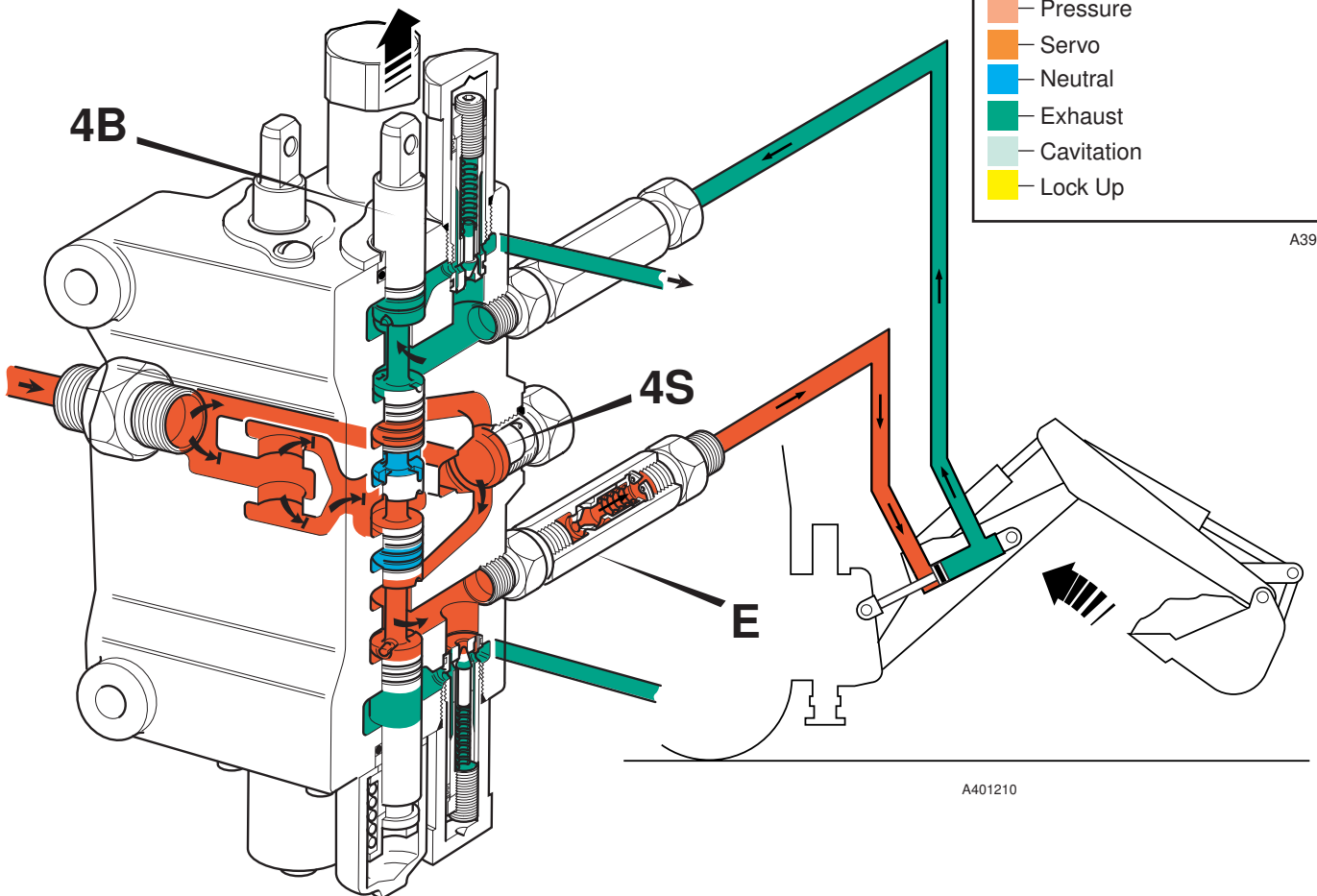
Key to Oil Flow & Pressure	
<span style="color: red;">■</span>	Full Pressure
<span style="color: orange;">■</span>	Pressure
<span style="color: yellow;">■</span>	Servo
<span style="color: blue;">■</span>	Neutral
<span style="color: green;">■</span>	Exhaust
<span style="color: lightgrey;">■</span>	Cavitation
<span style="color: yellow;">■</span>	Lock Up

A390630



Key to Oil Flow & Pressure	
<span style="color: red;">█</span>	Full Pressure
<span style="color: orange;">█</span>	Pressure
<span style="color: lightorange;">█</span>	Servo
<span style="color: blue;">█</span>	Neutral
<span style="color: green;">█</span>	Exhaust
<span style="color: lightblue;">█</span>	Cavitation
<span style="color: yellow;">█</span>	Lock Up

A390630



## Excavator Valve - Load Hold Check Valves

### Operation 1

Flow to the service via a typical solid spool **4B** is controlled by the load hold check valve **4S** which is a spring-loaded non-return valve operating across the pressure feed from the parallel gallery **B**. The valve prevents reverse flow from the rams into the pressure feed line, so maintaining ram pressure until exceeded by system pressure. The illustration shows a service selected but back pressure **D** exceeds system pressure which closes the load hold check valve **4S**.

### Component Key:

- B** Parallel Gallery
- D** Service Line
- 4B** Spool
- 4S** Load Hold Check Valve

---

### Operation 2

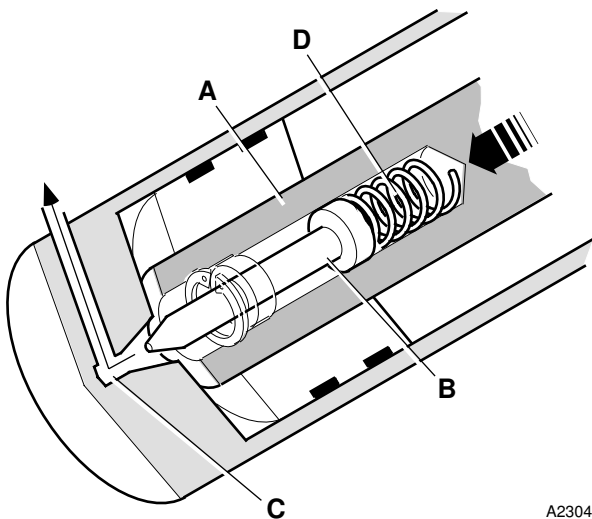
When pressure in the feed line exceeds back pressure, the load check valve **4S** opens and oil operates the ram. The remaining load hold check valves are also opened by system pressure but the galleries are dead-ended because the spools are in neutral.

**Componet Key:**

- C** Lower Service Port  
**D** Upper Service Port  
**E** One Way Restrictor  
**X** Parallel Gallery  
**4A** Slew Spool  
**4B** Boom Spool  
**4H** ARV  
**4J** ARV

**Slew Ram End Damping**

As ram **A** nears the closed position, damping rod **B** seats in cone **C**, where it is held by spring **D**. Tapered flutes on the end of the rod produce a restricting orifice, thus restricting the speed of the oil being exhausted from the ram. This provides a cushioning effect between the piston and the dump end of the ram, effectively damping out the shock loads which would otherwise occur when the boom reaches the end of its slewing arc.



A230420

- A** Ram  
**B** Damping Rod  
**C** Cone Seat  
**D** Spring

**Excavator Valve  
- One Way Restrictor Operation**

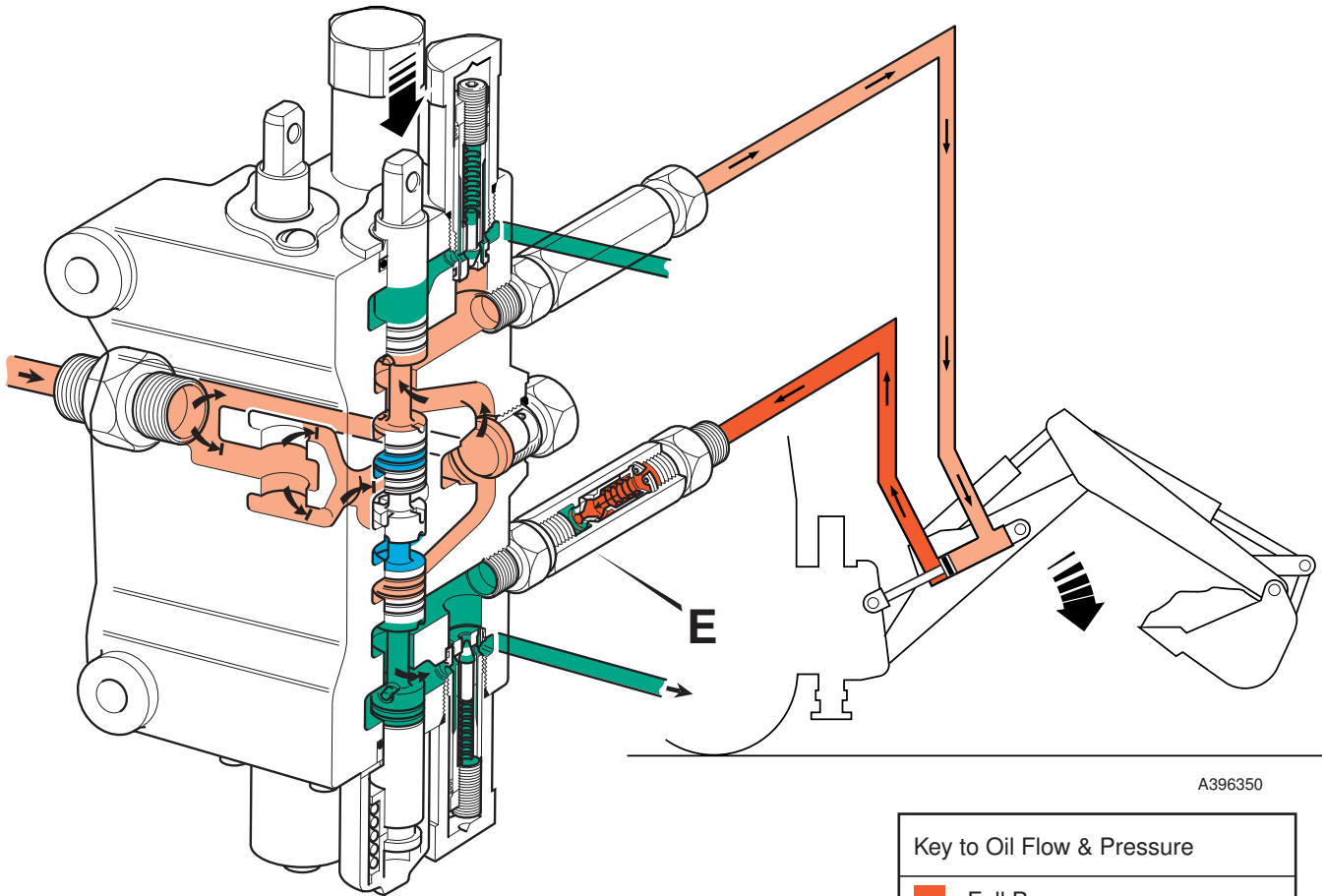
Because of its weight, the excavator end could take over control when boom lower was selected. The falling boom would tend to push oil out of the ram faster than the head side was being filled. Consequently, when the excavator had reached the ground, there would be a time lapse while the ram filled with oil before the service would operate again.

To prevent this from happening, the boom service is fitted with a one way restrictor. When the boom is being raised, the poppet in restrictor **E** is held off its seat by the pressurised oil flow, therefore oil delivery to the boom ram rod side is unrestricted.

When the boom is being lowered, the oil flow through the one way restrictor **E** re-seats the poppet, therefore the flow of oil is restricted through the small drilling in the base of the poppet. This slows the boom down to a controllable speed.

**Excavator Valve - Slew Operation**

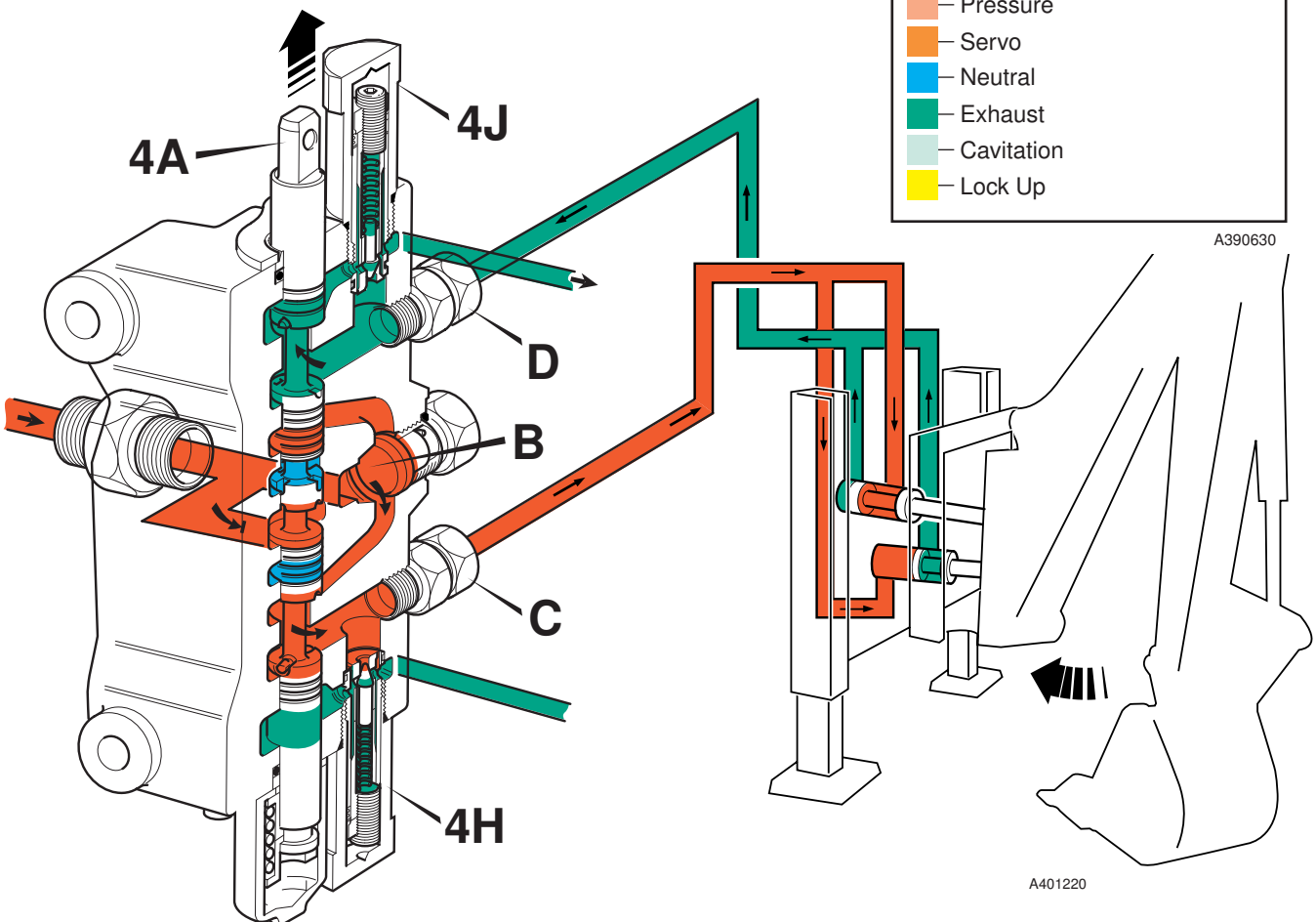
The illustration shows R.H. slew selected. The lower port **C** has been pressurised by the spool. Oil flows from the parallel gallery **B**, out past A.R.V. **4H** to both the head side of the L.H. slew ram and the rod side of the R.H. slew ram. The boom therefore slews to the right hand side of the machine. Displaced oil from the rod side of the L.H. slew ram and from the head side of the R.H. slew ram flows back through the upper service port **D** and back to tank.



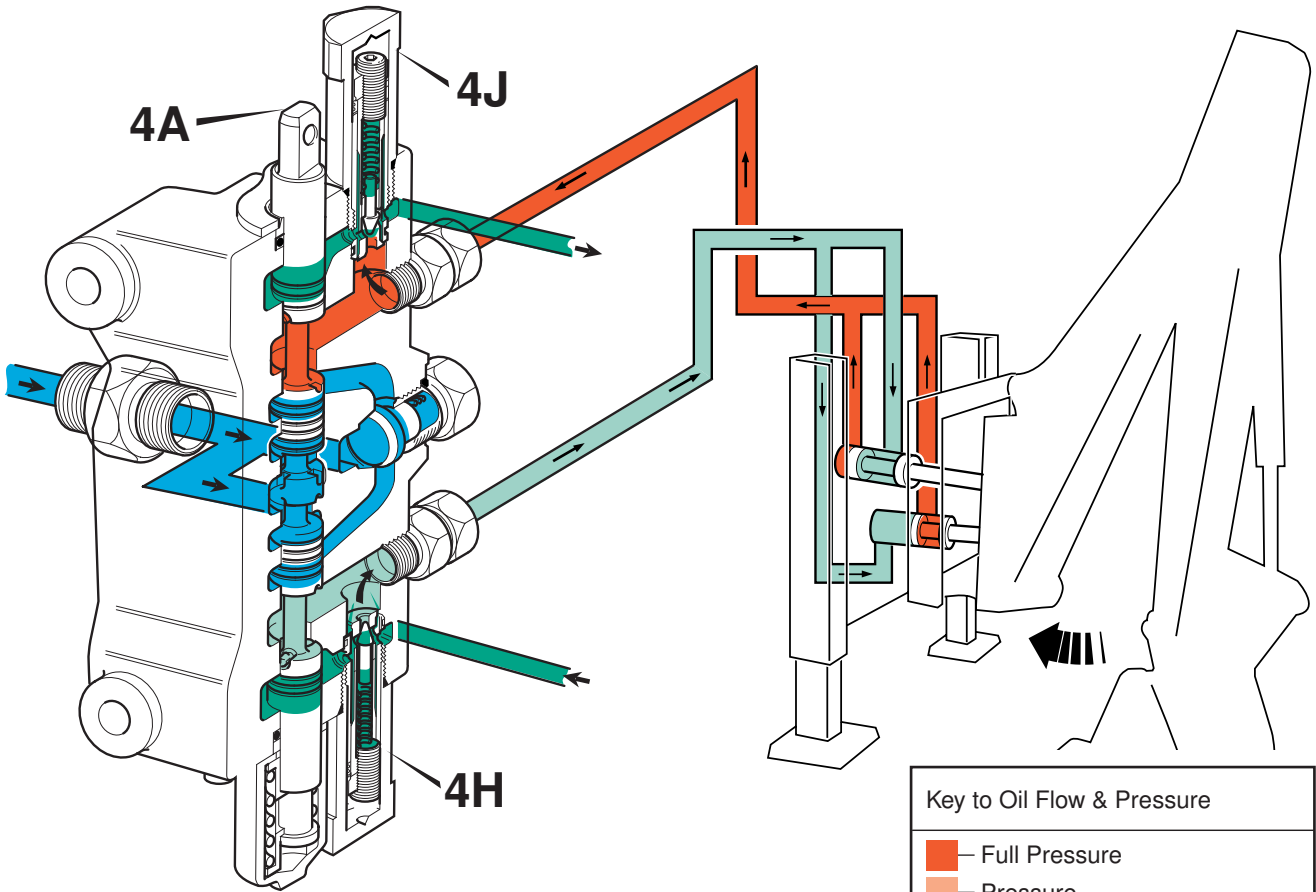
A396350

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

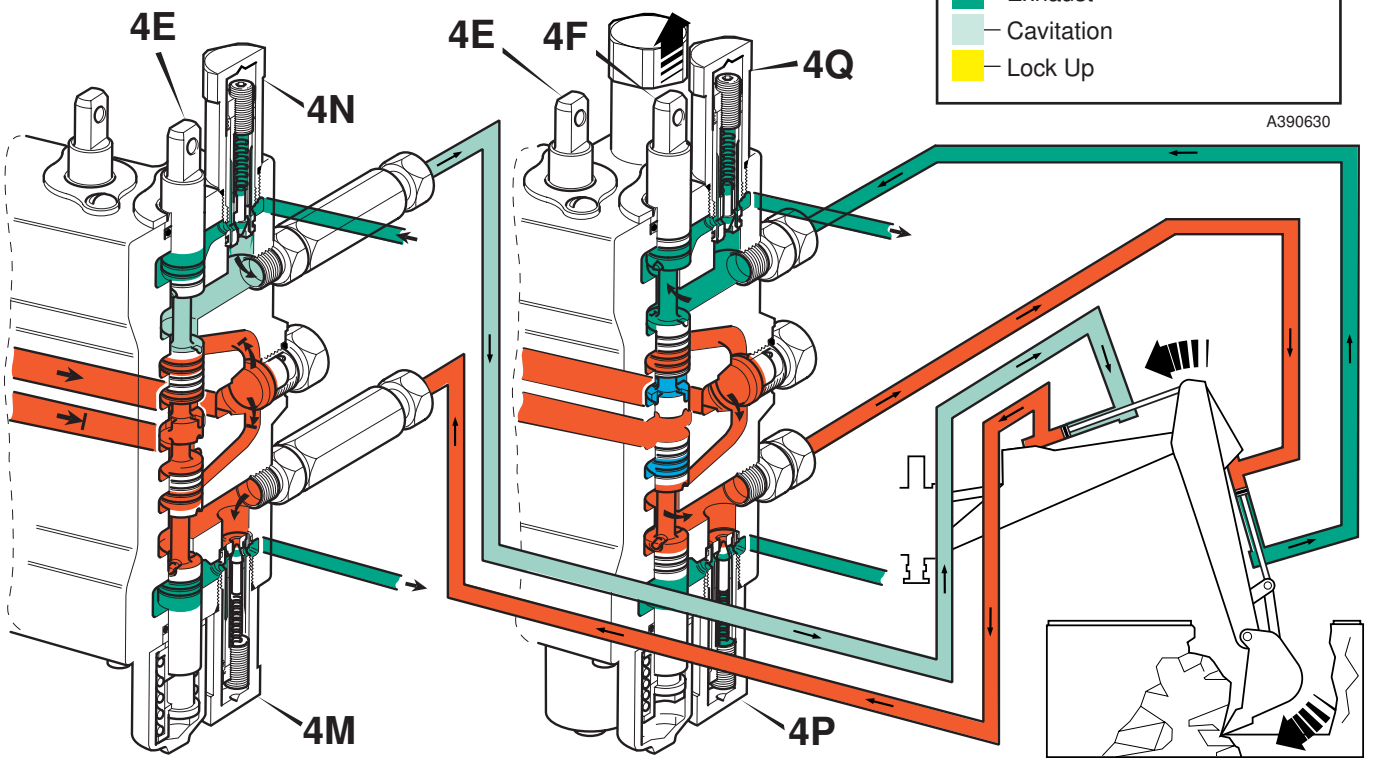
A390630



A401220



A390630



A396430



## Excavator Valve - Slew A.R.V. and Anti-Cavitation Operation

The spool **4A** is in neutral but the momentum of the slewing excavator end creates back pressure in the head side of the R.H. slew cylinder and in the rod side of the L.H. slew cylinder. This opens A.R.V. **4J** and dumps oil to exhaust. At this point the cylinders cavitate and exhaust oil pressure causes A.R.V. **4H** to open, allowing oil from the exhaust gallery to fill the L.H. cylinder.

### Component Key:

<b>4A</b>	Slew Spool
<b>4E</b>	Dipper Spool
<b>4F</b>	Bucket Spool
<b>4H</b>	ARV
<b>4J</b>	ARV
<b>4M</b>	ARV
<b>4N</b>	ARV
<b>4P</b>	ARV
<b>4Q</b>	ARV (option)

---

## Excavator Valve - A.R.V. Operation

The illustration shows the bucket spool **4F** selected to operate the service against an immovable object. This forces the dipper away from the obstruction and pressurises the head side of the dipper ram.

When this pressure reaches the setting of A.R.V. **4M**, this valve opens, relieving the pressure into the exhaust gallery.

Cavitation occurs in the rod side of the dipper service until A.R.V. **4N** opens, allowing the higher pressure in the exhaust gallery to supplement that in the service line.

Note: A.R.V. **4Q** is only fitted to machines with a Rockbreaker.

For a further detailed description, refer also to **Pilot - Operated Pressure Relief Valve Operation**.

## Pilot - Operated Pressure Relief Valve Operation

### Component Key:

- A Service Pressure
- B Poppet
- C Piston
- D Spring
- E Poppet
- F Spring
- G Locknut
- H Cavity
- J Sleeve
- K Exhaust Cavity
- L Cavity

### 1 Valve at Rest

A.R.V's are positioned in the excavator valve block in order to relieve excessive pressure in the services as described in **Excavator Valve - ARV Operation**.

When the service is in neutral and there are no excessive forces acting on the equipment, service pressure at **A** will be acting on the lower face of poppet **B** and will also be felt inside the valve via hollow piston **C**.

The force of springs **D** and **F**, combined with the service pressure acting on the upper faces of poppet **B** and piston **C**, keeps poppets **B** and **E** tightly seated.

The force of spring **F** is adjustable to suit the relevant service by means of adjuster screw and locknut **G**.

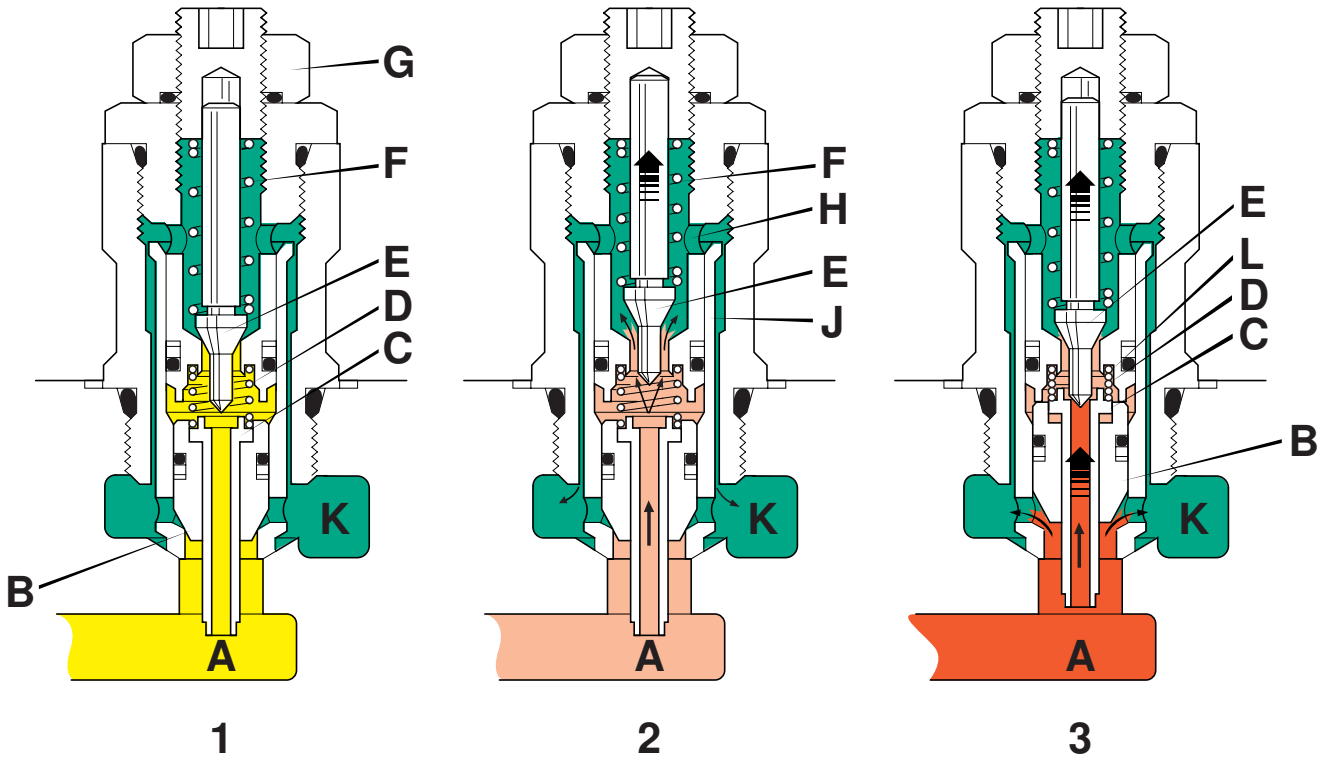
### 2 Pilot Valve Opens

As service pressure reaches the pilot setting of the valve, pilot poppet **E** lifts, allowing oil to escape into cavity **H** and pass down the sides of sleeve **J** into the exhaust gallery **K**.

### 3 Main Poppet Opens

As service pressure continues to rise and oil escapes from cavity **L**, the pressure differential between the upper and lower surfaces of piston **C** causes this piston to rise and seat on the point of pilot poppet **E**.

Oil continues to escape from cavity **L** but the incoming flow to the cavity has been cut off. This produces a pressure drop above poppet **B**, causing the poppet to lift and release service pressure into exhaust gallery **K**.



A390480

Key to Oil Flow & Pressure	
<span style="color: red;">■</span>	Full Pressure
<span style="color: lightorange;">■</span>	Pressure
<span style="color: orange;">■</span>	Servo
<span style="color: blue;">■</span>	Neutral
<span style="color: green;">■</span>	Exhaust
<span style="color: lightblue;">■</span>	Cavitation
<span style="color: yellow;">■</span>	Lock Up

A390630

\* Excavator Valve - Manual Control

**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 - Not Precision Control Machines**

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).

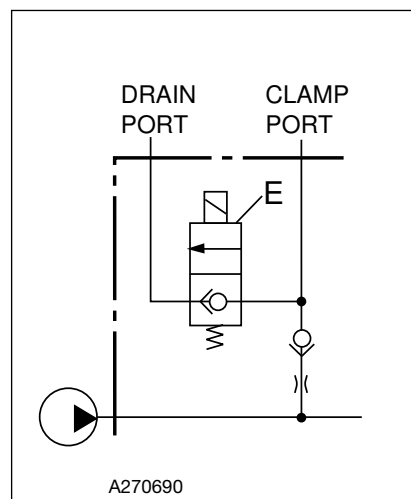
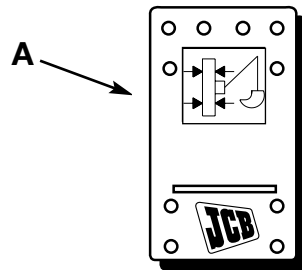
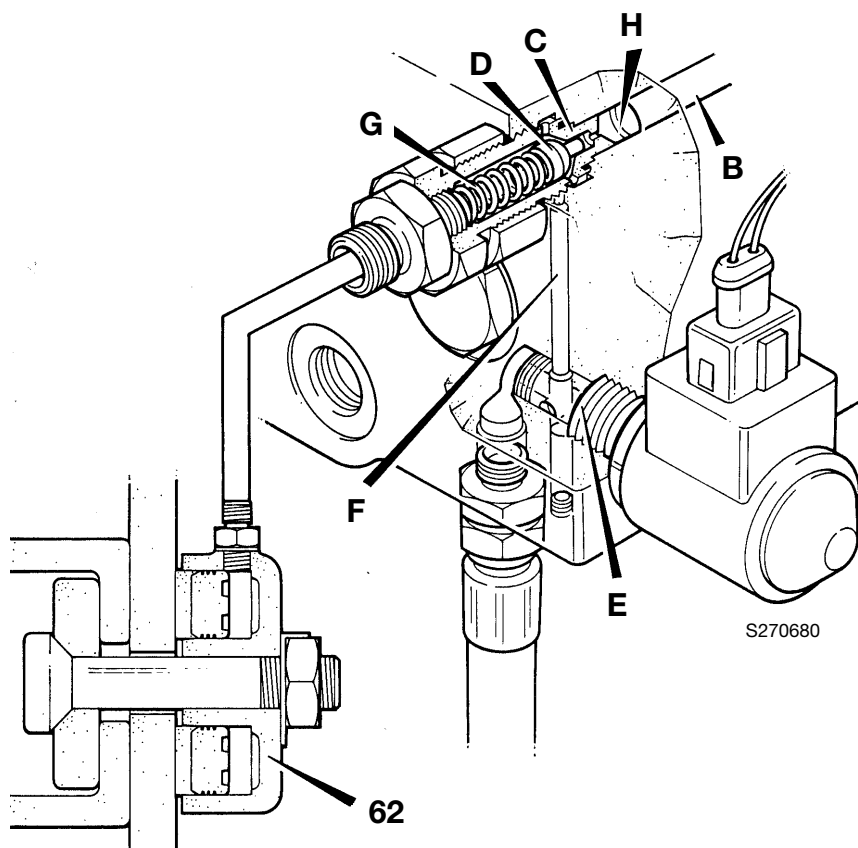
Also, pressure resulting from the operation of an excavator service passes by poppet **D** as before but the oil takes the path of least resistance and is vented via gallery **F** to the drain port (tank).

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.



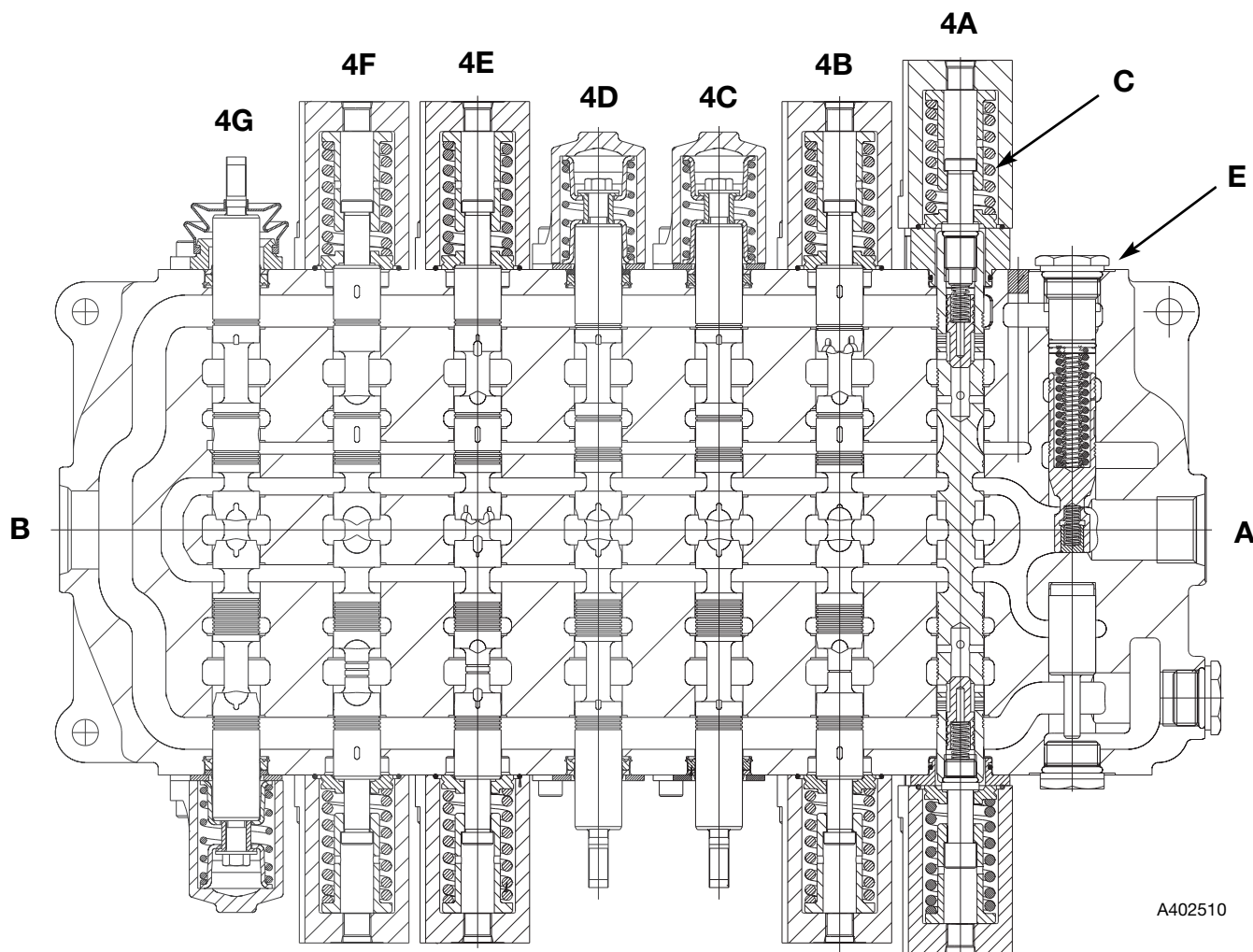
**Excavator Valve**

**Precision Control (Servo)**

\* (Machines up to serial no. 931159)

**Component Key:**

- A Inlet Port
- B Outlet Port
- C Centering Spring
- D Integral Load Sensing Valves (Isolator Compensator Spools)
- E Bypass Compensator Valve
- F Load Sense Drain Regulator and Relief Valve
- G Hydra-clamp Solenoid Valve
- H Pilot Operated Check Valve
- J Load Sense Drain Port
- 4A Slew Spool
- 4B Boom Spool
- 4C Stabiliser Spool
- 4D Stabiliser Spool
- 4E Dipper Spool
- 4F Bucket Spool
- 4G Aux. Spool (not used on some machine variants)



A402510

## Excavator Valve

### Precision Control (Servo) (continued)

\* (Machines up to serial no. 931159)

In the interest of machine efficiency and consistent backhoe operation the excavator valve is of a closed centre design and incorporates load sensing valves **D**, for each service. These features enable the valve to operate as follows:

#### No service is selected (all spools in neutral)

Oil from the loader valve high pressure carry over enters the excavator valve at the inlet port **A**. Oil flows across the bypass compensator spool assembly **E** and returns to tank from the outlet port **B**.

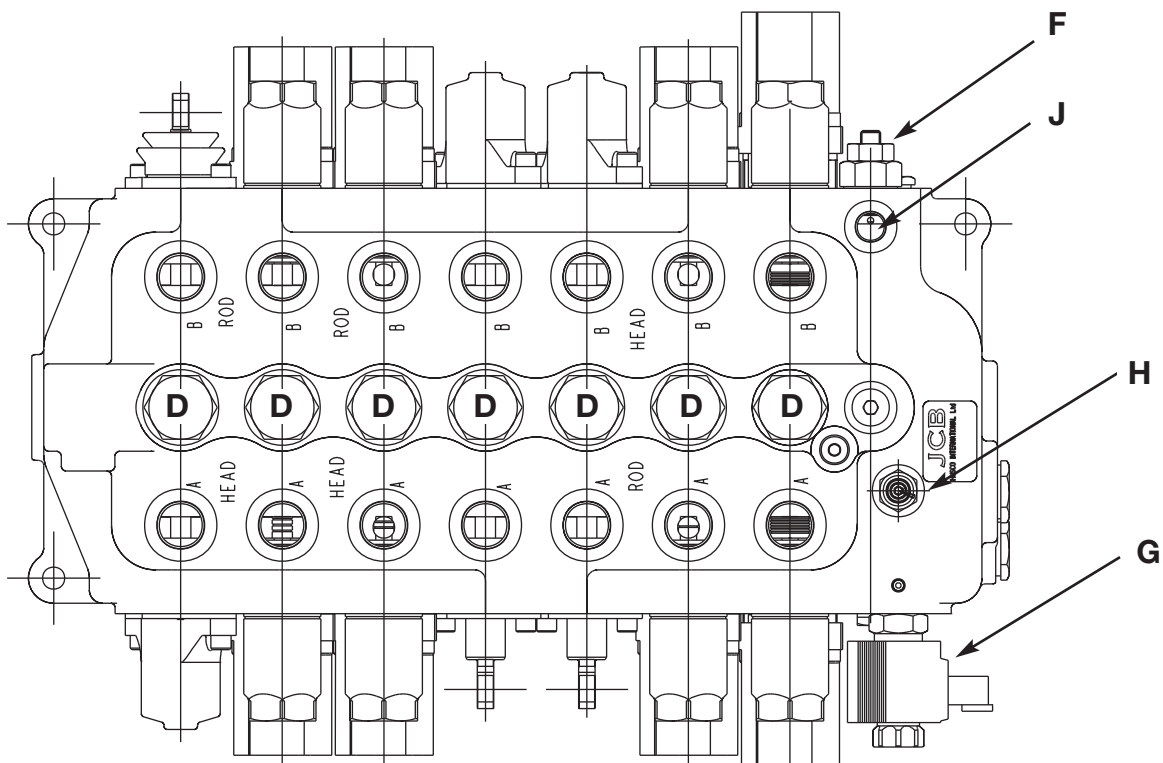
#### Servo Spool Actuation

When a service is operated servo pressure from the joystick control valve acts on the end of the relevant service spool eg. **4A** and displaces the spool proportionally against the force of the centering spring **C**, allowing the oil to flow to move the required service. When the servo pressure on the end of the service spool is reduced the force of the centering spring overcomes the servo pressure and the service spool will move back proportionally to the central neutral position. Note that spools **4G**, **4D** and **4C** are manually actuated.

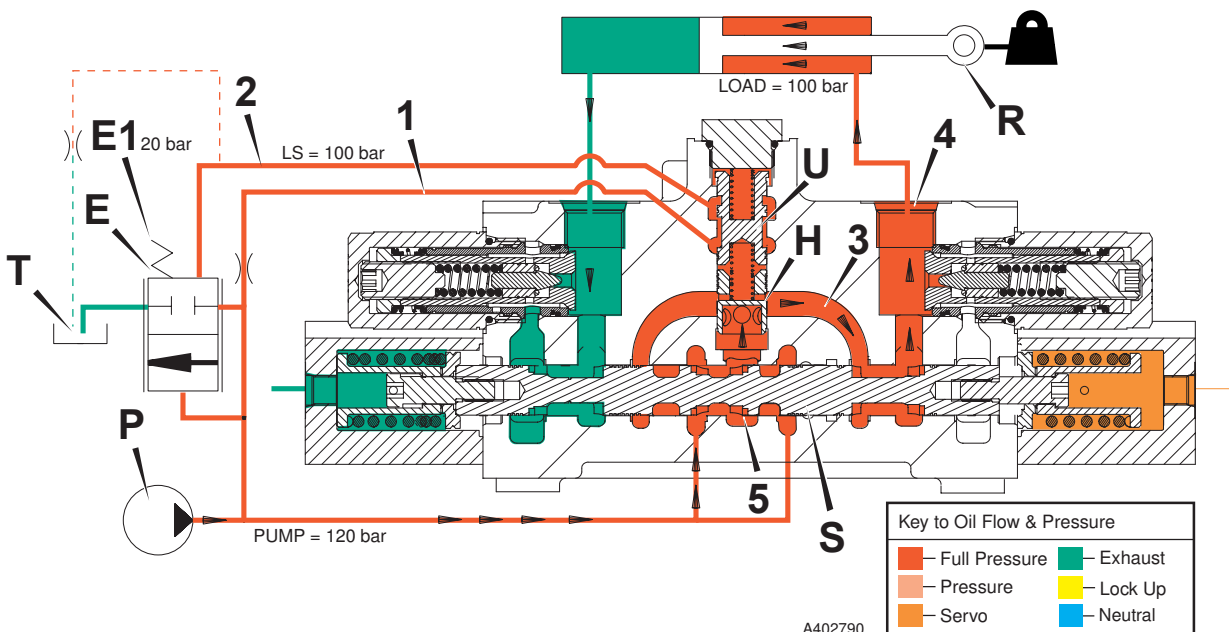
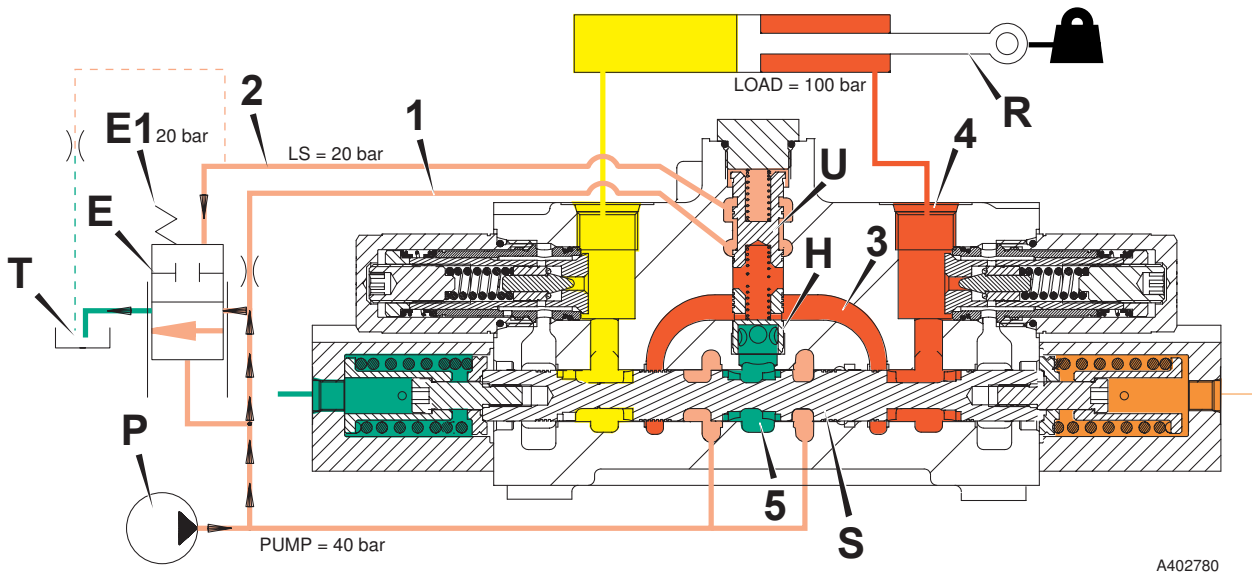
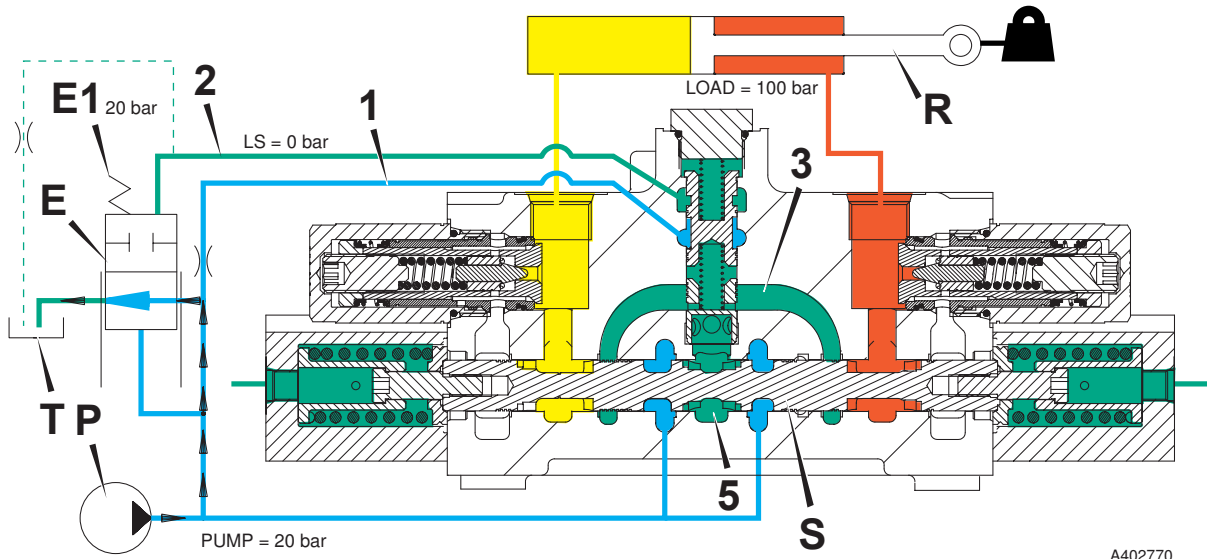
#### When a Service is Selected

When one or more services are selected the load sense valves detect the service generating the highest pressure. This causes the bypass compensator valve **E** to close and allow pump flow to the spools and service ports at sufficient pressure to move the load. The load sense valves **D** also incorporate check valves. These valves prevent the load falling back if the load pressure is greater than the pump pressure. The closed centre design ensures consistent service operation regardless of load.

For a full description of spool and load sense valve operation see **Load Sense (Isolator Compensator) Valve Operation** on the next page.



A402500



## Excavator Valve

### Precision Control (Servo) (continued)

\* (Machines up to serial no. 931159)

### Load Sense (Isolator Compensator) Valve Operation

#### No service is selected (all spools in neutral)

With the spools in the neutral position oil from the pump **P** flows to each spool and is dead ended. This generates sufficient pressure (about 20bar) to overcome the spring **E1** and oil flows across the bypass compensator spool assembly **E** to tank. Note that oil from the pump also flows into the 'auxiliary pump gallery' **1**. Oil from the 'bridge galleries' **3** is vented to tank via a groove in the main spool **S**.

Any load on the service ram **R** is held by the main spool **S**. Oil is also vented to tank from the load sense gallery **2** via the load sense drain regulator/relief valve **F** (see below).

#### Spool at point of operating a service

Pressure from the load on ram **R** enters the bridge gallery **3** via the service port **4**. Compensator check valve **H** is held down on its seat preventing the load moving. At the same time the isolator spool **U** lifts and allows oil from the auxiliary pump gallery **1** to flow into the load sense gallery **2**. Oil pressure builds in gallery **1** and the bypass compensator spool **E** begins to close under the action of the oil and spring (**E1**) pressure. This causes the pump pressure to rise to a new value as follows:

Pump pressure = Pressure in load sense gallery **2** + pressure from spring **E1**.

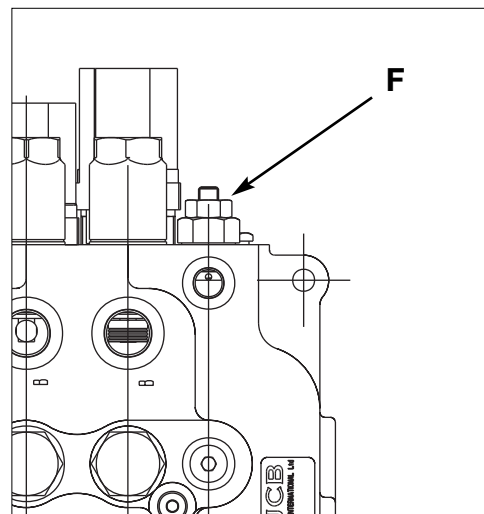
When the pressure in load sense gallery **2** reaches the load pressure, isolator spool **U** moves down and closes off the auxiliary pump gallery **1** from load sense gallery **2**. If the load pressure subsequently rises or falls, the isolator spool moves due to pressure imbalance and maintains the pressure in the load sense gallery **2** at the same pressure as the load pressure. The pressure in the load sense gallery **2** always

bleeds to tank, again causing pressure imbalance and the isolator spool to move, allowing the pressure in the gallery to be 'topped up'. This ensures that 'pressure balance' is always maintained.

It must be noted that the load sense gallery **2** is connected to all load sense valves (one for each service). The pressure in the gallery **2** will always be equal to the highest load from any of the backhoe services. The maximum load sense pressure is regulated by the load sense drain regulator/relief valve **F** (see below).

#### Spool fully operating a service

As the spool **S** is moved further oil from the pump is diverted into the central gallery **5**. If the pump pressure has risen sufficiently (to a pressure equal to the load + spring pressure **E1**) then check valve **H** moves up off its seat and allows oil to flow into bridge gallery **3**, and out to the ram **R** via service port **4**. Exhaust oil from the other side of ram **R** is diverted to tank.





## Excavator Valve

### Precision Control (Servo)

\* (Machines up to serial no. 931159)

#### Hydraclamp Valve Operation

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 front face of the excavator valve block and is connected directly to the parallel gallery **B**. The valve operates in conjunction with solenoid valve **E** located in the bottom 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 galleries **B** and **F** to the drain port **T** (tank).

When an excavator service is operated, pressure is generated in parallel gallery **B**, this pressurised oil moves piston **C** which pushes ball **D** off its seat against the force of spring **G**. The oil flows through restrictor **H**, past the ball and out to the hydra-clamps **62**.

#### 2 - Clamps Released - Precision Control Machines Only

To enable clamps release, the hydraclamp switch **A** must be in the ON position **and** an excavator service must be operated.

With the hydraclamp switch **A** in the ON position (pressed down), the solenoid valve **E** is energised. Pressure resulting from the operation of an excavator service moves piston **C** which pushes ball **D** off its seat.

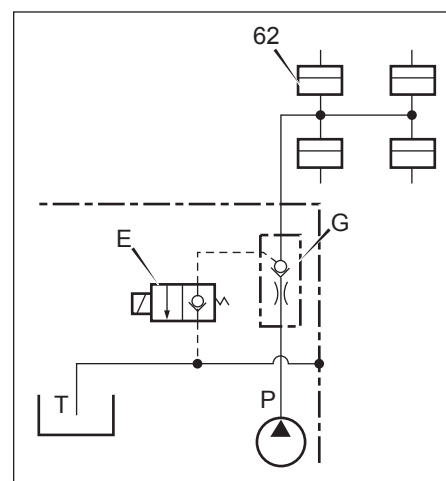
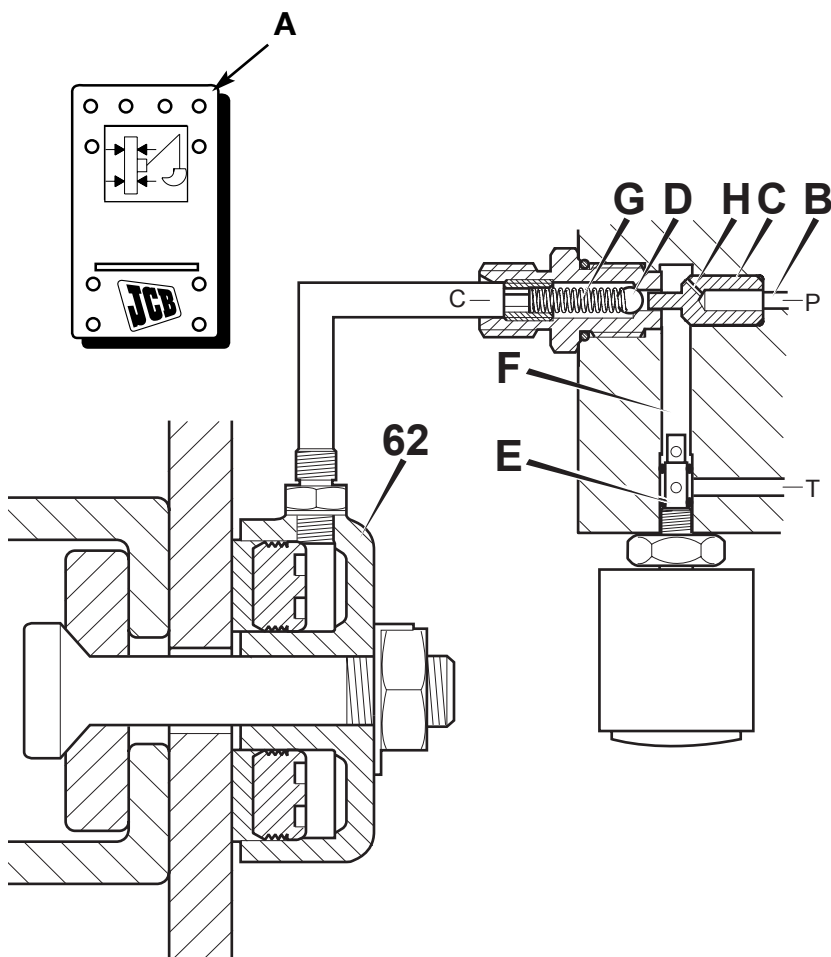
With ball **D** lifted and the solenoid valve in its energised state, oil from the hydra-clamps is vented through the clamp valve and gallery **F** to the drain port **T** (tank).

Also, pressure resulting from the operation of an excavator service passes through restrictor **H**. The oil takes the path of least resistance and is vented via gallery **F** to the drain port **T** (tank).

Restrictor **H** ensures that only a small amount of oil from 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 ball **D** seated. Pressure is therefore trapped in the line to the clamps, maintaining the excavator end in a securely clamped condition.



A402930

**Excavator Valve**

**Precision Control (Servo) (continued)**  
**(Machines from January 2003)**

In the interest of machine efficiency and consistent backhoe operation the excavator valve is of a closed centre design and incorporates pressure compensating valves **F**, for each service.

These features enable the valve to operate as follows:

**No service selected (all spools in neutral)**

Oil from the loader valve high pressure carry over enters the excavator valve at the inlet port **A**. Oil flows across the flushing valve spool assembly **B** and returns to tank from the outlet port **C**.

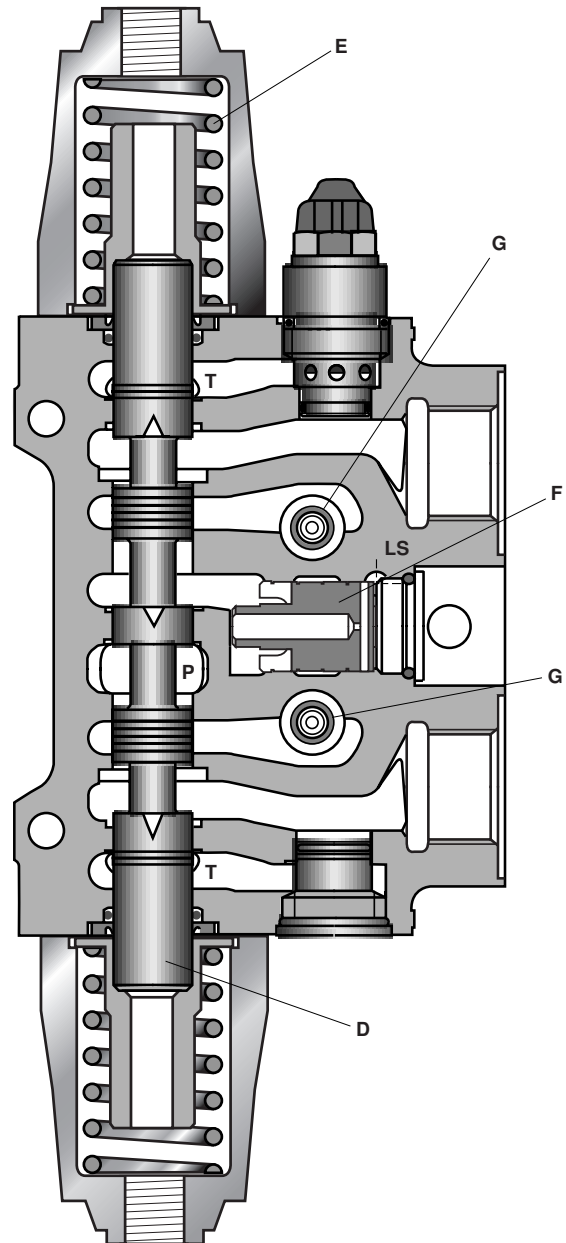
**Servo Spool Actuation**

When a service is operated servo pressure from the joystick control valve acts on the end of the relevant service spool **D** and displaces the spool proportionally against the force of the centering spring **E**, allowing the oil to flow to move the required service. When the servo pressure on the end of the service spool is reduced the force of the centering spring overcomes the servo pressure and the service spool will move back proportionally to the central neutral position.

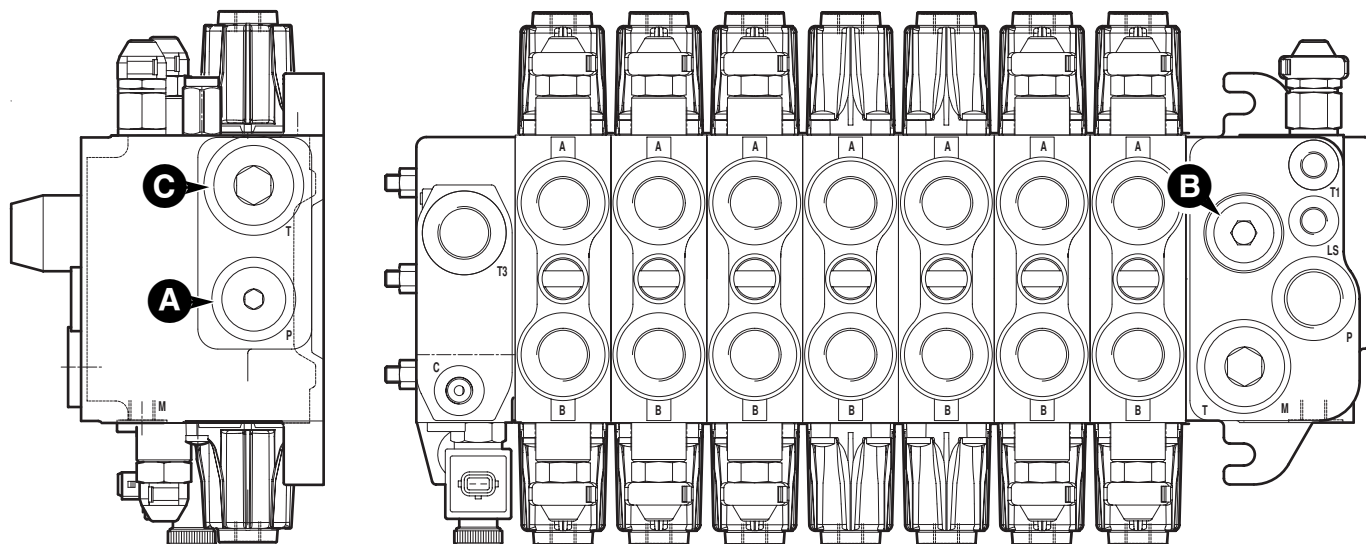
**When a Service is Selected**

When one or more services are selected the pressure compensator valves **F** detect the service generating the highest pressure. This causes the flushing valve spool **B** to close and allow pump flow to the spools and service ports at sufficient pressure to move the load. Load hold check valves **G** prevent the load falling back if the load pressure is greater than the pump pressure. The closed centre design ensures consistent service operation regardless of load.

For a full description of spool and pressure compensator valve operation see **Load Sense - Pressure Compensator Valve Operation**.



A405000



A403680

## Excavator Valve

### Precision Control (Servo) (continued) (Machines from January 2003)

#### Load Sense - Pressure Compensator Valves Operation

##### No service selected (all spools in neutral)

With the spools in the neutral position oil from the pump **P** flows to each service spool **S** and is dead ended. This generates sufficient pressure (about 15bar) to overcome the spring **E1** and oil flows across the flushing valve spool assembly **E** to tank **T**. Any load acting on the service ram **R** is held by the service spool **S**.

Oil in the load sense gallery **LS** is vented to tank across the flow regulator valve **F**.

The pressure compensator valve **PC** and load hold check valves **CV** are closed.

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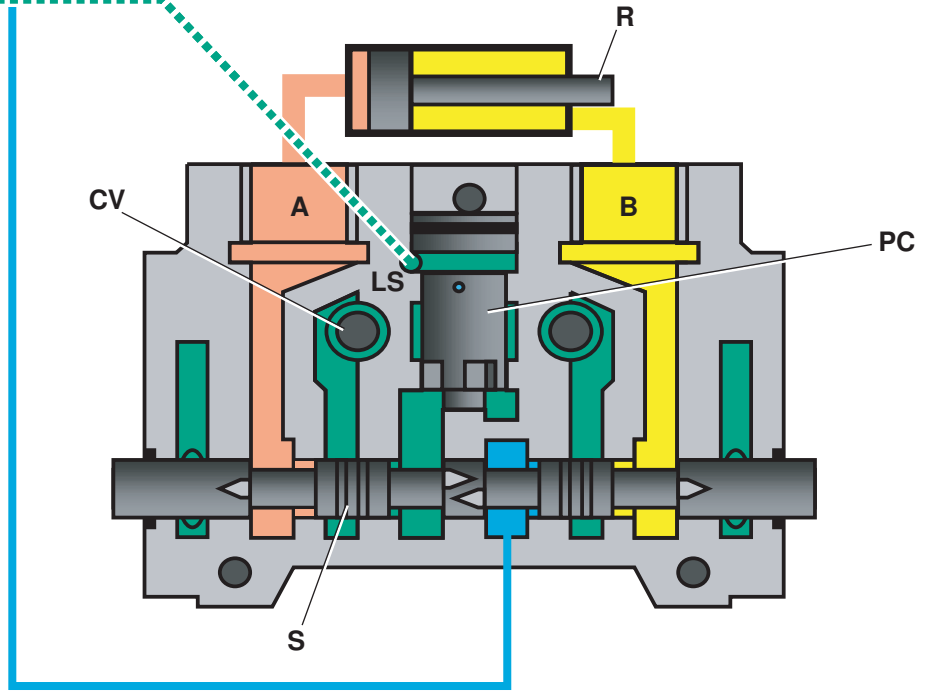
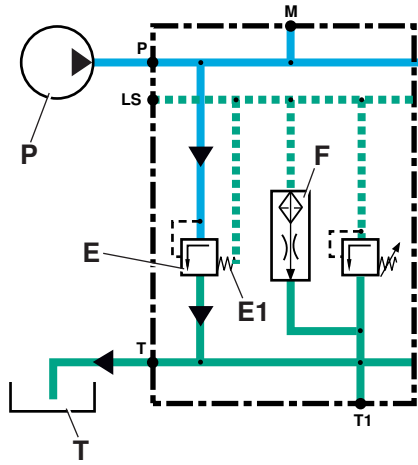
#### Operating a service

The service spool **S** is moved by servo pressure connecting the oil from the pump **P** to the gallery **P1**. The pressure in this chamber opens the pressure compensator valve **PC** allowing oil into the load sense gallery **LS**. Oil pressure builds in the gallery **LS** and the flushing valve spool **E** begins to close under the combined action of the oil pressure and spring force, causing the pump pressure to rise as follows:

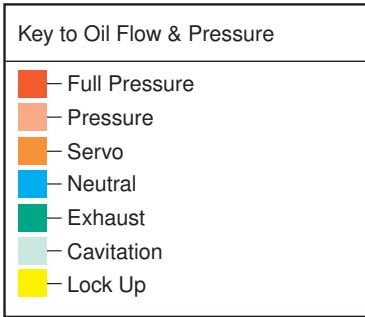
Pump pressure = Pressure in load sense gallery **LS** + pressure from spring **E1**.

When the pump pressure has risen sufficiently i.e. to a pressure equal to the load + spring pressure (15 bar) the load hold check valve **CV** moves off its seat and allows oil to flow into the service gallery **A**, initiating movement of the service ram **R**. Exhaust oil from the other side of the service ram is directed by the service spool **S** to tank.

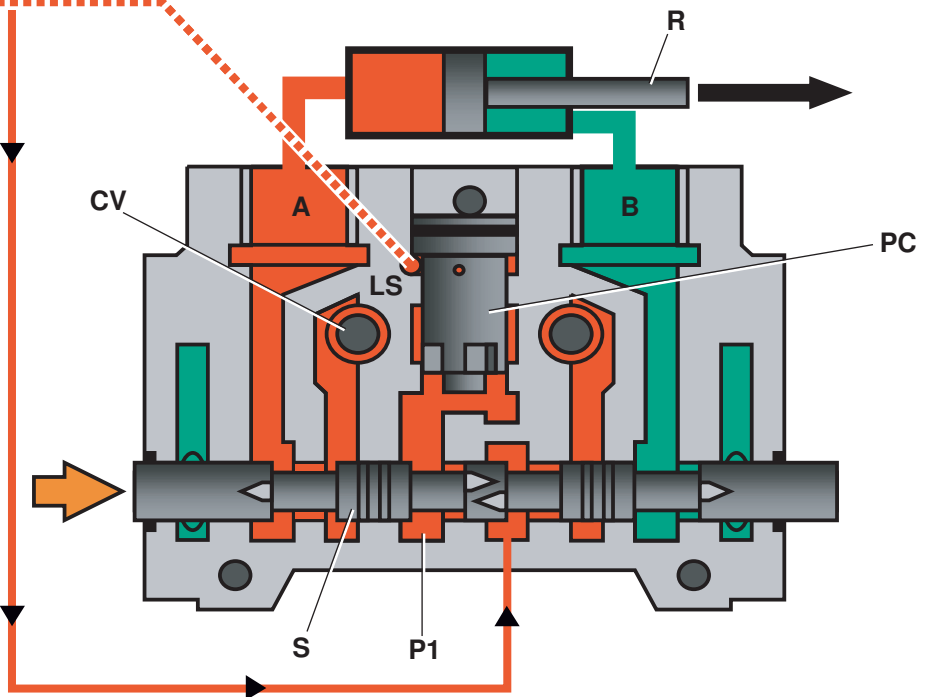
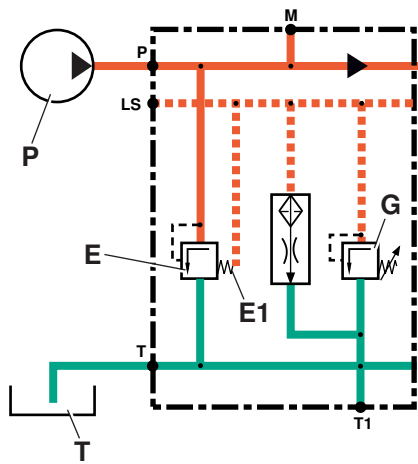
The maximum load sense pressure and hence pump pressure is set by the load sense relief valve **G**.



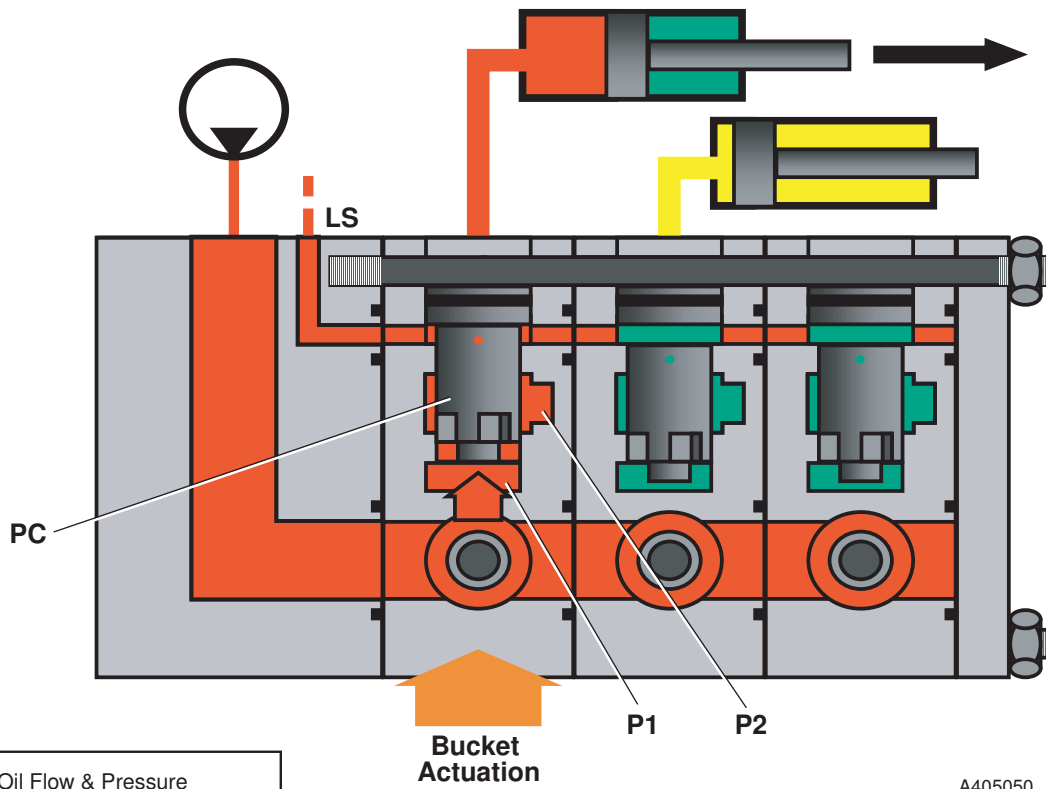
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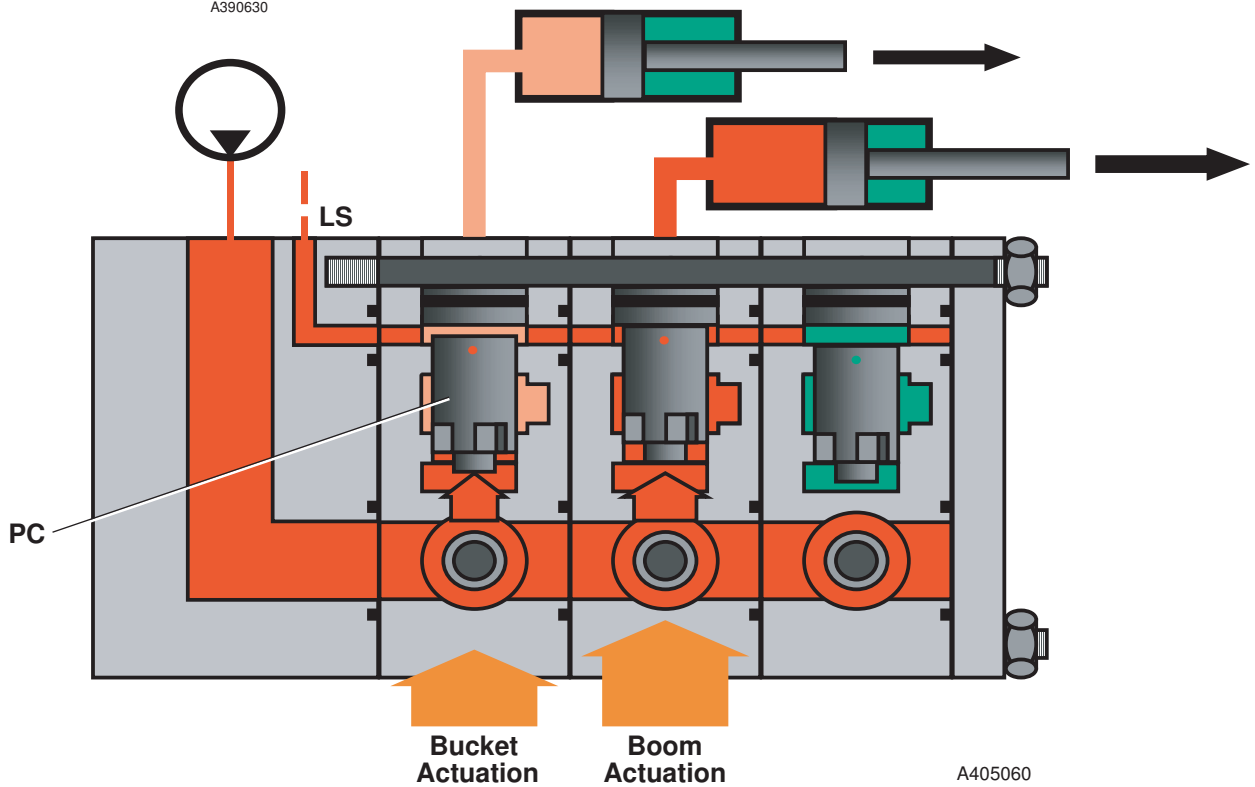


Key to Oil Flow & Pressure

<span style="color: red;">█</span>	Full Pressure
<span style="color: orange;">█</span>	Pressure
<span style="color: yellow;">█</span>	Servo
<span style="color: blue;">█</span>	Neutral
<span style="color: green;">█</span>	Exhaust
<span style="color: lightblue;">█</span>	Cavitation
<span style="color: yellow;">█</span>	Lock Up

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## Excavator Valve

### Precision Control (Servo) (continued) (Machines from January 2003)

#### Load Sense - Pressure Compensator Valves Operation

##### Operating an individual service

It must be noted that the load sense gallery **LS** is connected to all the pressure compensator valves **PC** (one for each service) as shown. The pressure in the load sense gallery **LS** will always be equal to the highest load from any of the backhoe services.

The pressure compensator valves are fitted between each service spool and service ram and sense the pressure acting on either side of the particular service spool. The pressure compensator valve will move in response to the pressure drop (pressure differential) created across the spool.

When one service only is operated the pressure compensator valve **PC** is FULLY opened as shown, connecting the gallery **P1** to gallery **P2** and to the ram service port without any pressure drop.

---

##### Operating multiple services

###### a) Normal Condition

When another service with a higher load is operated simultaneously, a typical example is the lifting of the boom and simultaneous operation of the bucket as shown.

The higher load pressure in the boom service causes the pressure compensator valve **PC** in the bucket service to partially close, reducing the size of the opening through which the oil must flow, and in this way maintains a pressure drop across the pressure compensator equal to the pressure drop across the bucket service spool.

In this example, because of the action of the pressure compensator valve the bucket service is always kept independent of the other services, the bucket ram speed remains constant (as controlled by the bucket service spool) and is not affected by the greater operating pressure in the boom service.

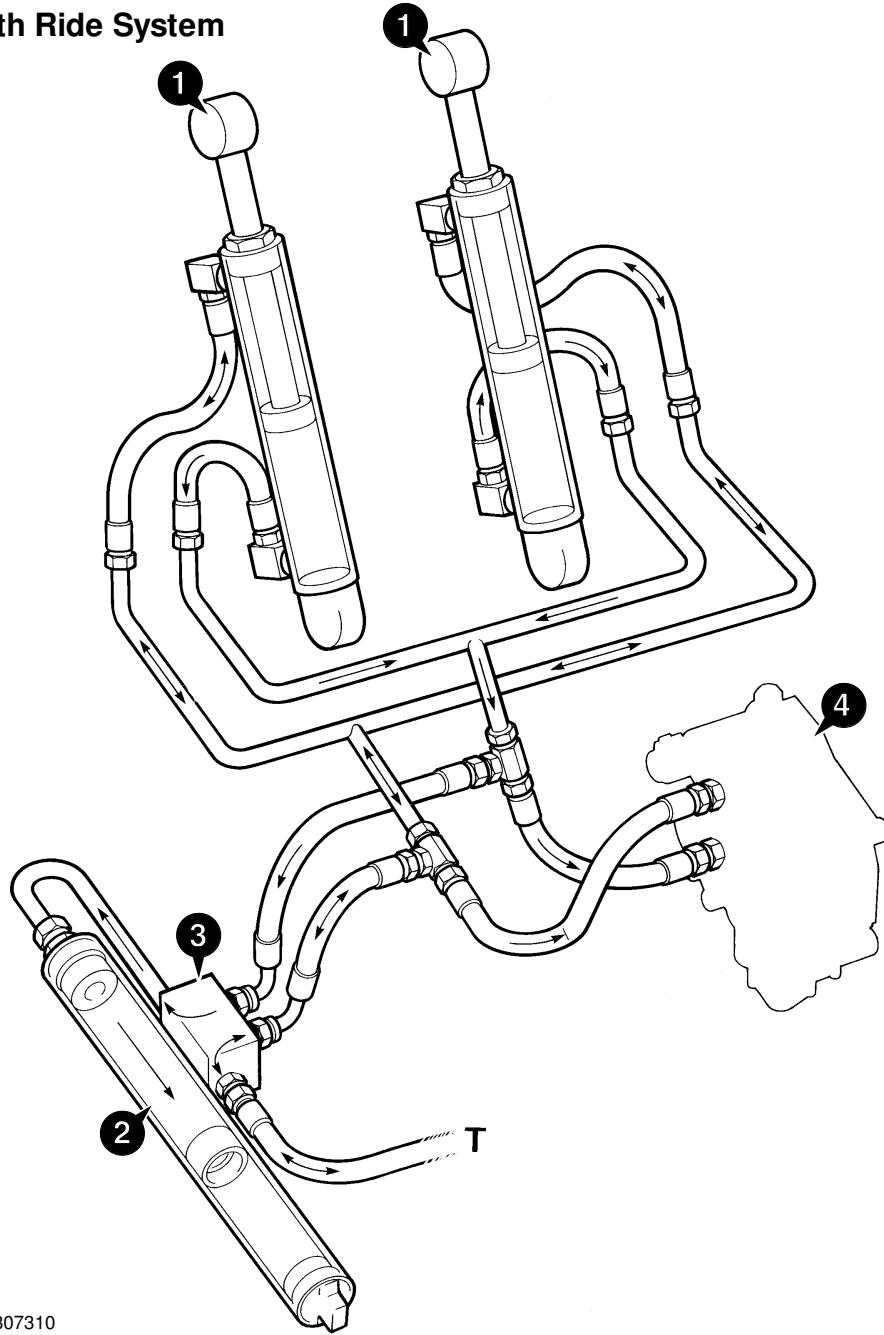
###### b) With insufficient flow from pump

Should the oil flow demanded by the sum of the combined services operating ever exceed that of the pump, all the pressure compensator valves will partially close accordingly, effectively dividing the available flow between all the services proportionally.

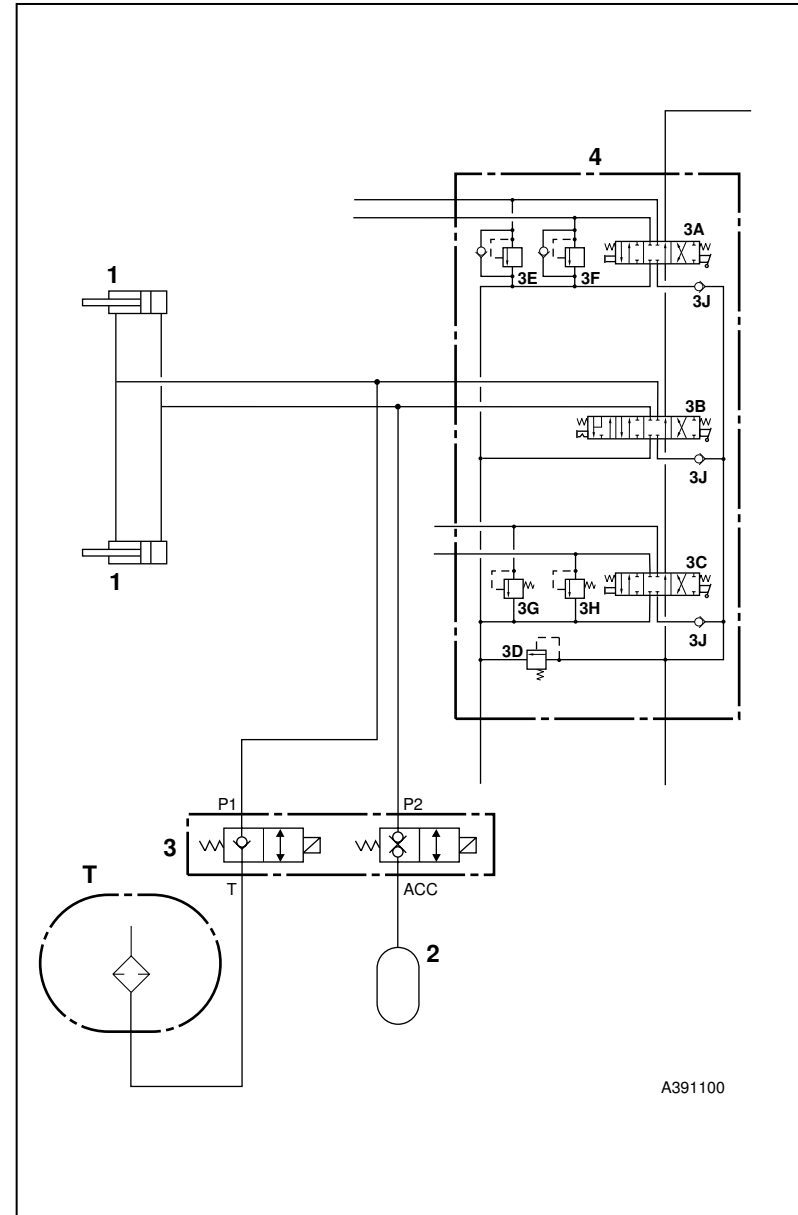
In this condition the service ram with the highest load will NOT stop, because the speed of the other service rams operating will have been reduced proportionally by the action of the pressure compensator valves to compensate.

When one of the service spools is returned to neutral, the speed of the other service rams still operating will all increase proportionally.

### Smooth Ride System



S307310



## Smooth Ride System

Smooth Ride System (SRS) will enhance the comfort of the ride by damping out the forces imposed on the machine by the movement of the loader arms as the machine travels over uneven surfaces.

This is achieved by connecting the head side of the loader arms **1** to a pressurised piston type accumulator **2**.

When a switch in the cab is operated, selector valve **3** is energised and opens. Hydraulic oil from the piston head side is dead ended at the loader valve block **4** but is connected to the accumulator. The rod side of the loader ram is connected to tank **T** via the selector valve to make up or dissipate oil as required.

**Note:** The smooth ride system will not function on machines fitted with hose burst check valves.

### Component Key:

- 1** Loader Lift Rams
- 2** Accumulator
- 3** Solenoid Valve Block
- 4** Loader Valve Block
- T** Tank



**Hose Burst Protection Valve**

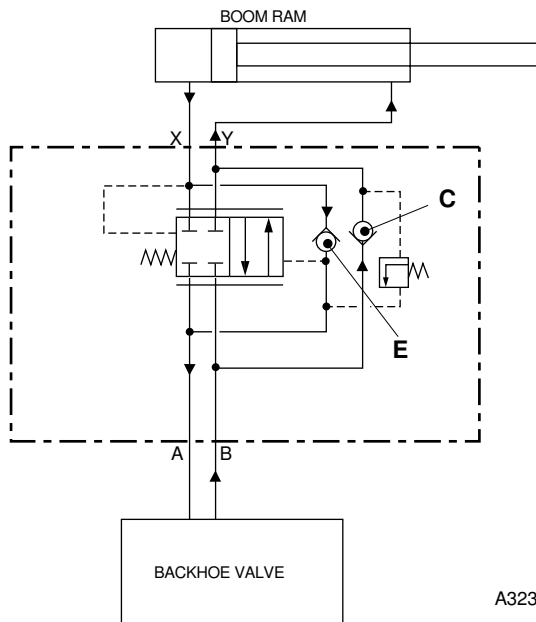
**Boom & Dipper Operation**

The small letter annotations **A**, **B**, **X**, and **Y** are stamped on the valve.

**Operation 1 - Load Raise**

When 'dipper out' is selected, oil from the excavator valve block is fed to port **B**, the oil opens check valve **C** against spring **D** and passes through internal galleries into the rod (raise) side of the ram via port **Y**.

Oil from the head side of the ram enters at port **X**, opens check valve assembly **E** and returns to tank via port **A** and the excavator valve block.



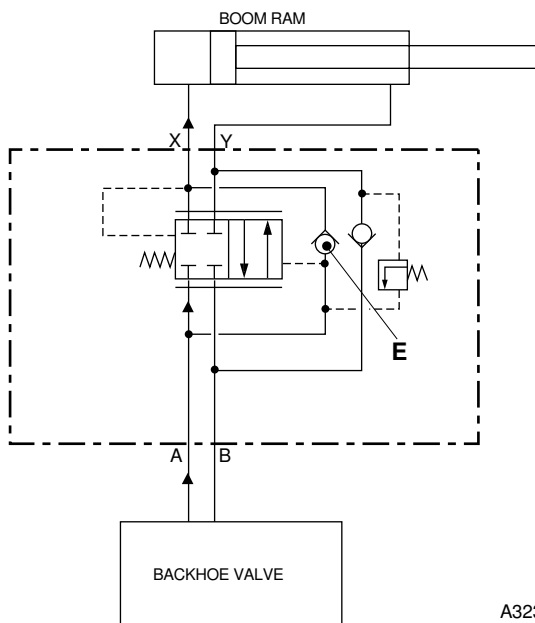
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**Operation 2 - Load Lower**

Oil from the excavator valve block is fed to port **A**. The connection to the head side of the ram is blocked by the check valve assembly **E** and the position of spool **F**.

A cross drilling **G** in the valve connects the **A** port gallery to cavity **J**. The pressure in cavity **J** increases to such a point that it moves spool **F** to the left against the force of spring **H**. The new position of the spool creates a connection between the **A** port gallery and the head side of the dipper ram (via port **X**).

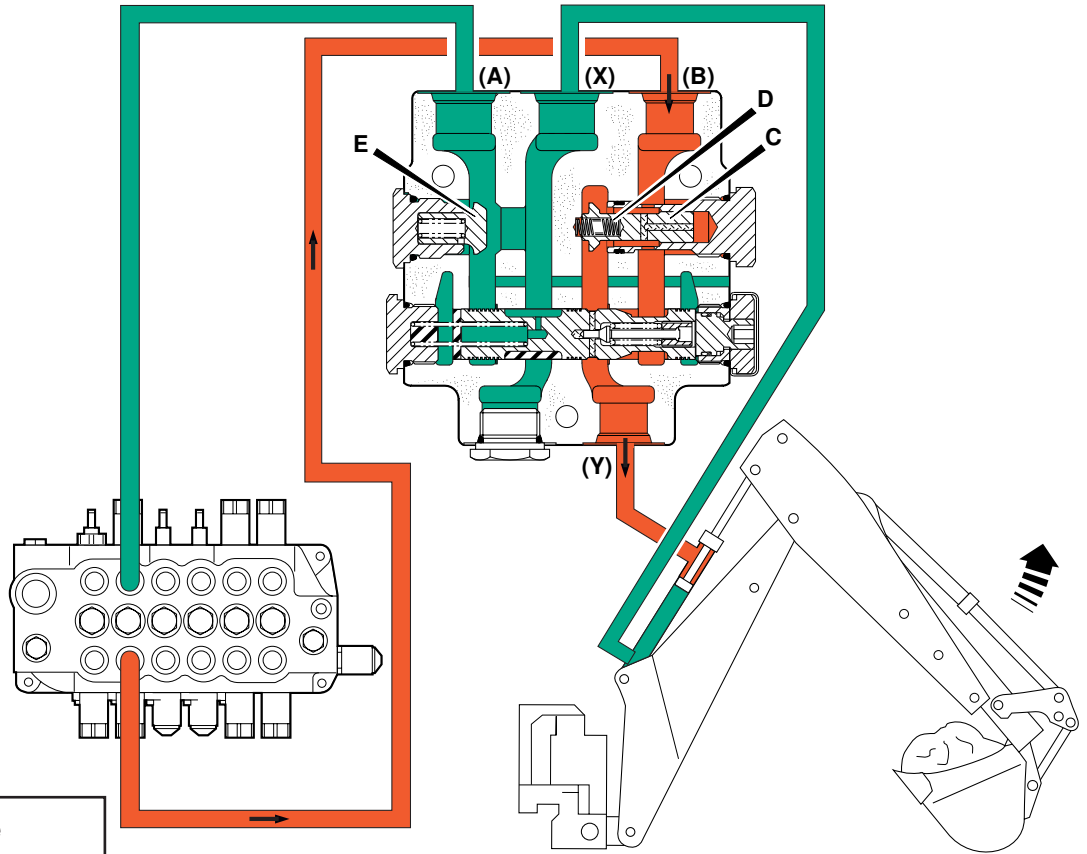
There is also a connection between the **Y** port gallery and the **B** port gallery. Oil from the rod side of the ram enters at port **Y** and returns to tank via port **B** and the excavator valve block.



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**Component Key:**

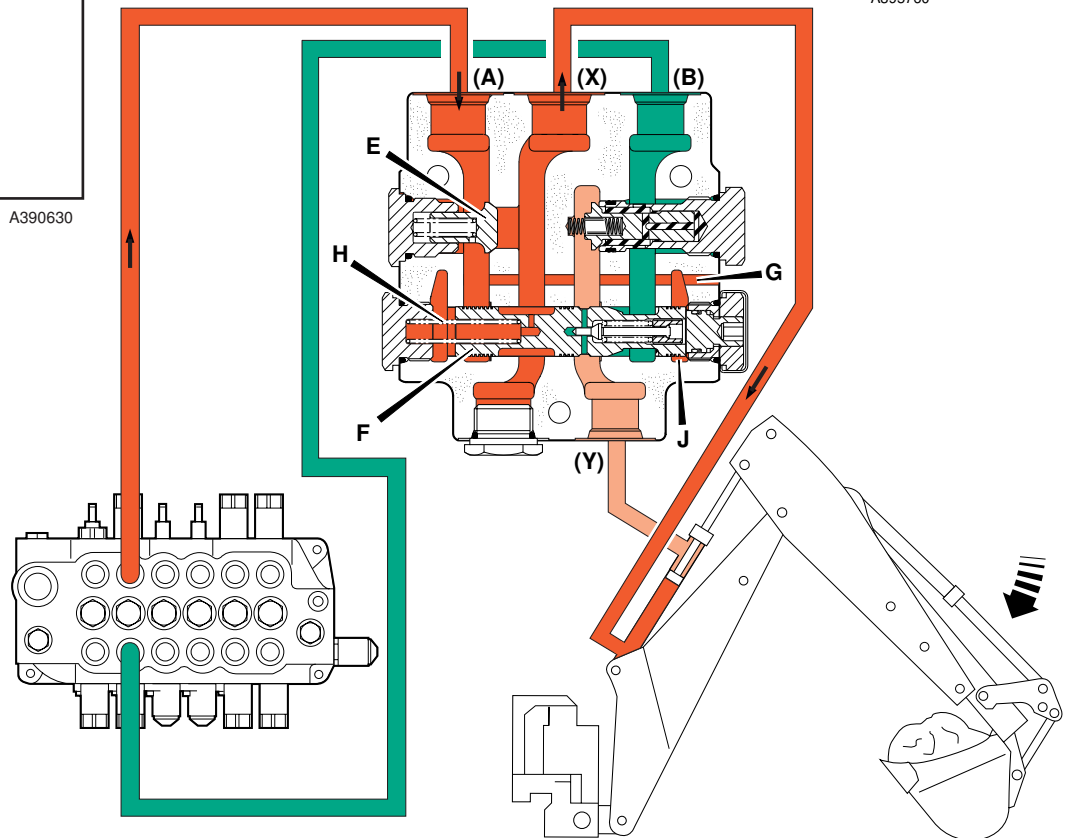
- C** Check Valve
- D** Spring
- E** Check Valve Assembly
- F** Spool
- G** Cross Drilling
- H** Spring
- J** Cavity



Key to Oil Flow & Pressure

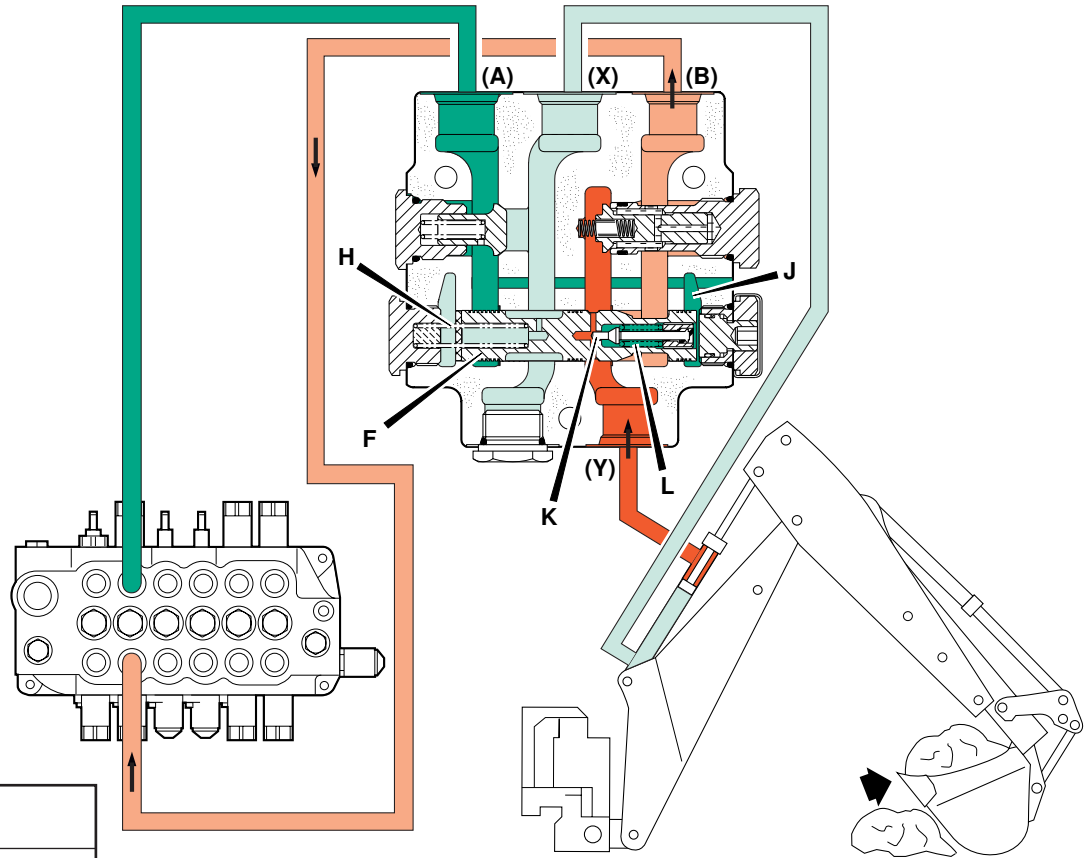
<span style="color: red;">█</span>	Full Pressure
<span style="color: orange;">█</span>	Pressure
<span style="color: blue;">█</span>	Servo
<span style="color: green;">█</span>	Neutral
<span style="color: lightblue;">█</span>	Exhaust
<span style="color: yellow;">█</span>	Cavitation
<span style="color: grey;">█</span>	Lock Up

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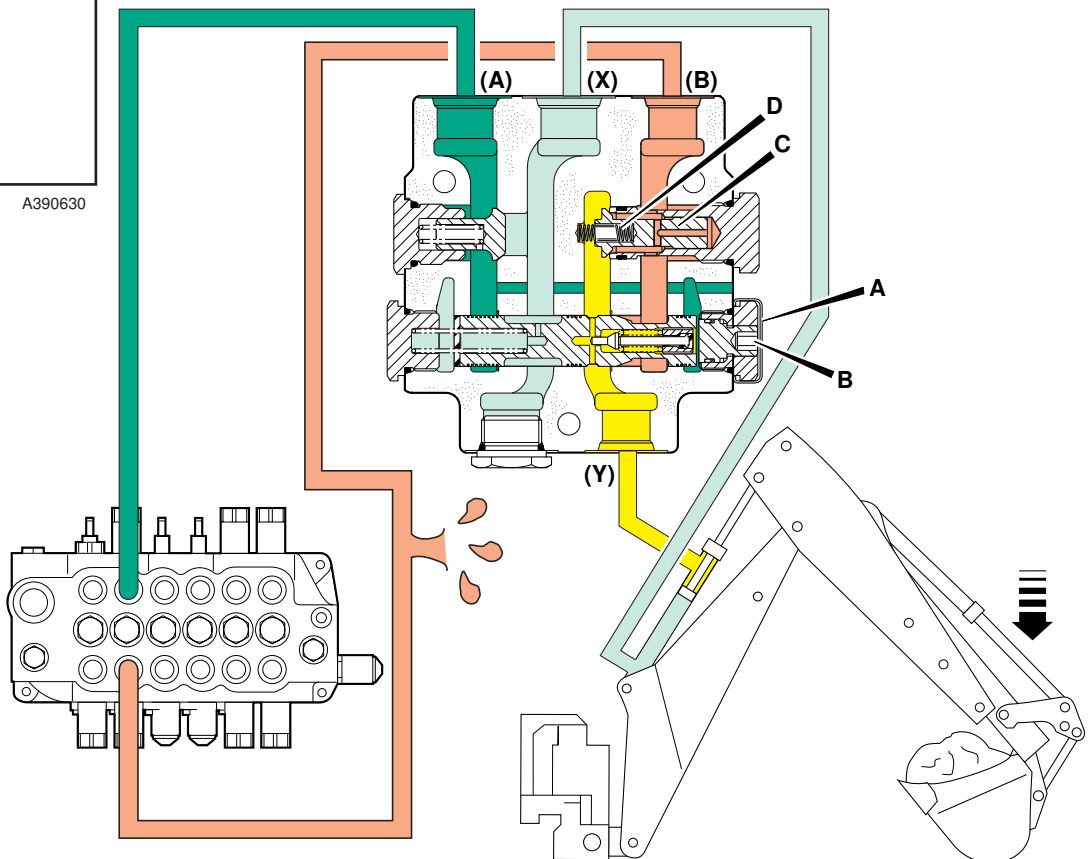


Key to Oil Flow & Pressure

<span style="color: orange;">█</span>	Full Pressure
<span style="color: lightorange;">█</span>	Pressure
<span style="color: yellow;">█</span>	Servo
<span style="color: blue;">█</span>	Neutral
<span style="color: green;">█</span>	Exhaust
<span style="color: lightblue;">█</span>	Cavitation
<span style="color: yellow;">█</span>	Lock Up

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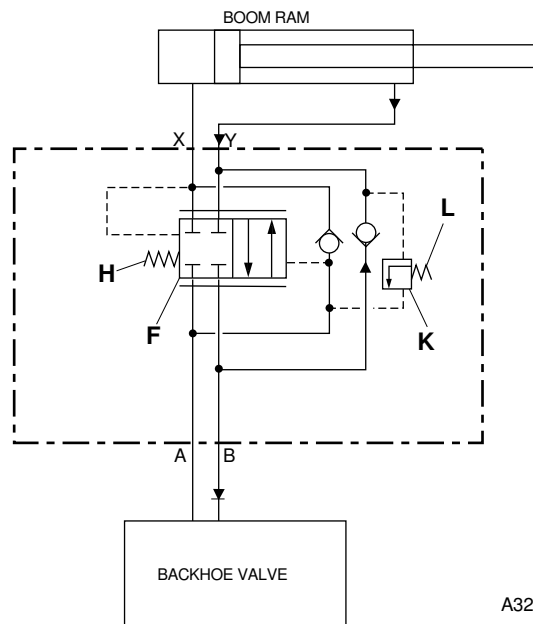
**Hose Burst Protection Valve**

**Boom & Dipper Operation (Cont'd)**

**Operation 3 - Relief Valve**

If during normal operation the pressure in the rod side of the dipper ram increases (for example, by the operation of the bucket against an obstacle), increasing pressure in the ram enters at port **Y**. The position of spool **F** prevents this increasing pressure from venting back to the tank. The pressure increases to such a point that it moves plunger **K** off its seat (to the right) against the force of spring **L**.

The new position of plunger **K** opens a connection to cavity **J**, the pressure is high enough to move spool **F** to the left against the force of spring **H**. The new position of the spool creates a connection from the rod side of the ram to port **B**. Note that oil exhausted via port **B** will not reduce to low pressure until the A.R.V. in the excavator valve block also opens.

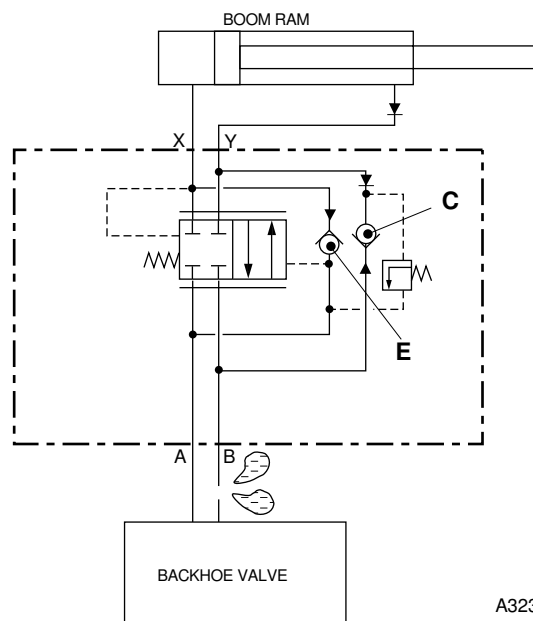


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**Operation 4 - Hose Burst Condition**

If a burst hose or other leakage occurs in the feed to the rod (raise) side of the ram, check valve **C** will be kept firmly held on its seat by the back pressure generated due to the weight of the load in the bucket and the force of spring **D**.

Oil trapped between the valve and the ram will prevent movement of the load. To lower the load, see Lowering The Load.



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**Component Key:**

- C** Check Valve
- D** Spring
- F** Spool
- H** Spring
- J** Cavity
- K** Plunger
- L** Spring

### Hose Burst Protection Valve

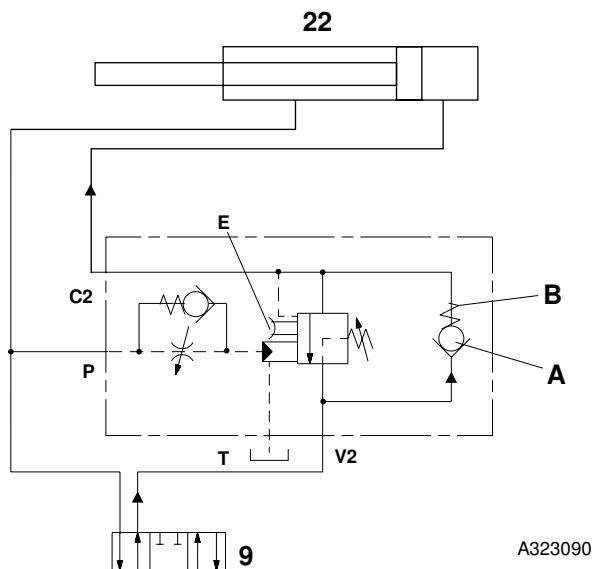
#### Loader Operation

The small letter annotations **V2**, **C2**, **P**, **T** and **E** are the same as the port markings found on the HBPV.

##### Operation 1 - Load Raise

When lift is selected, oil from the loader valve block **9** is fed to port **V2** on the HBPV, the oil opens check valve sleeve **A** against spring **B** and passes through internal galleries into the (raise) side of the ram via port **C2**.

Oil from the lower side of the ram returns to tank via port **P** and the loader valve block.



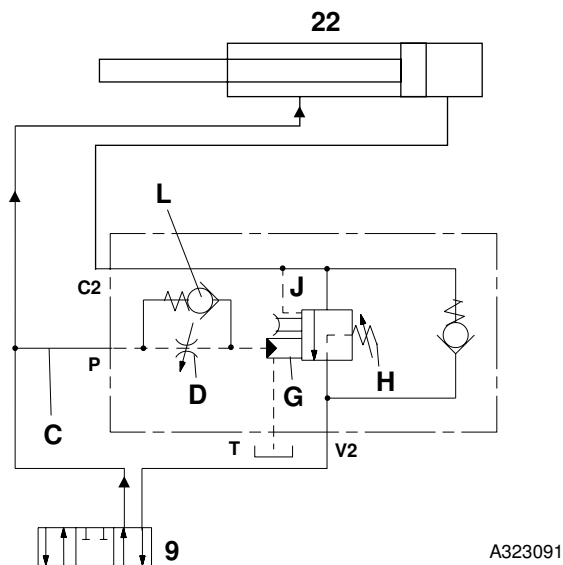
##### Operation 2 - Load Lower

Oil from the loader valve block **9** is fed directly to the (lower) side of the ram. A pilot line **C** from the service line is connected to the HBPV at port **P**.

Oil enters the HBPV at port **P** and passes through drilling **D**, down threads **F** and acts on the end face of piston **G**. The pressure is sufficient to move piston **G** to the right, thus moving plunger **J** off its seat against spring **H**. With the plunger off its seat, oil from the opposite side of the ram enters the HBPV at port **C2**, passes through the HBPV and returns to tank via port **V2** and the valve block.

A drilled hole **N** through the centre of plunger **J** connects chamber **Q** to atmosphere **T**, this prevents the pressure in chamber **Q** from rising to such a point that it would prevent any movement of plunger **J**.

Threads **F** and the one-way check valve ball **L** act as restrictors to 'dampen' any adverse effects of operating the control levers erratically.

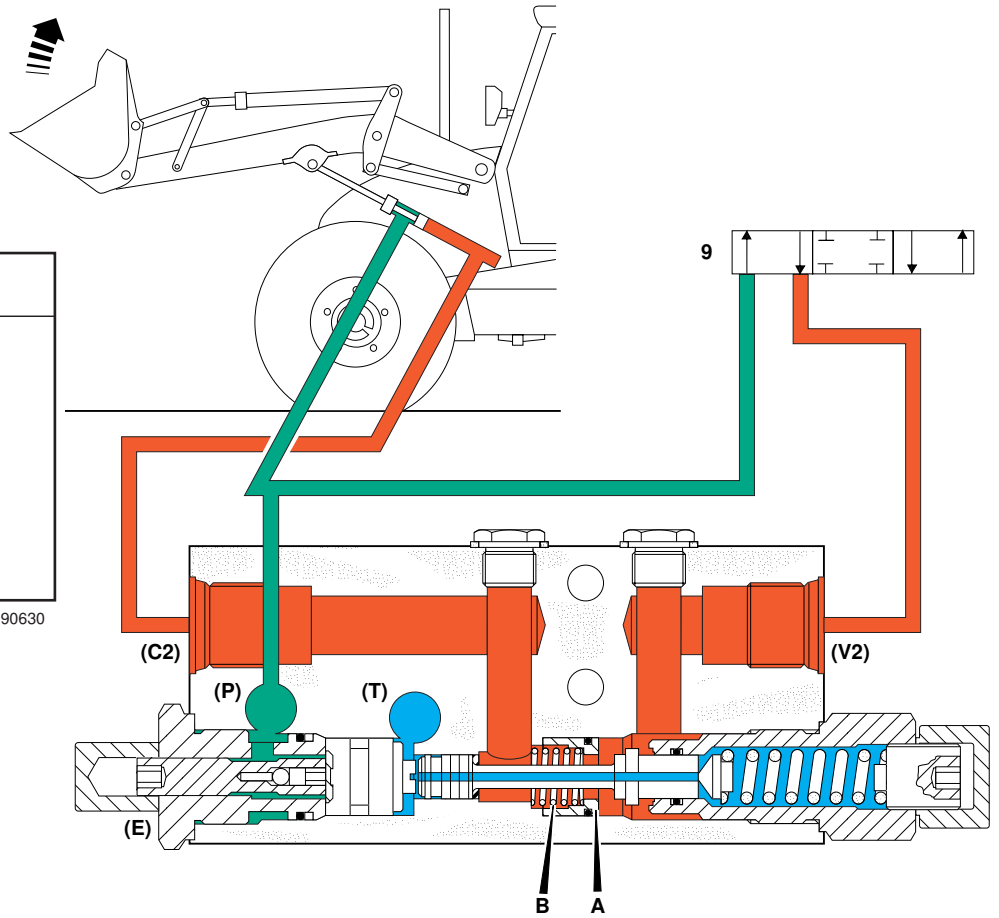


#### Component Key:

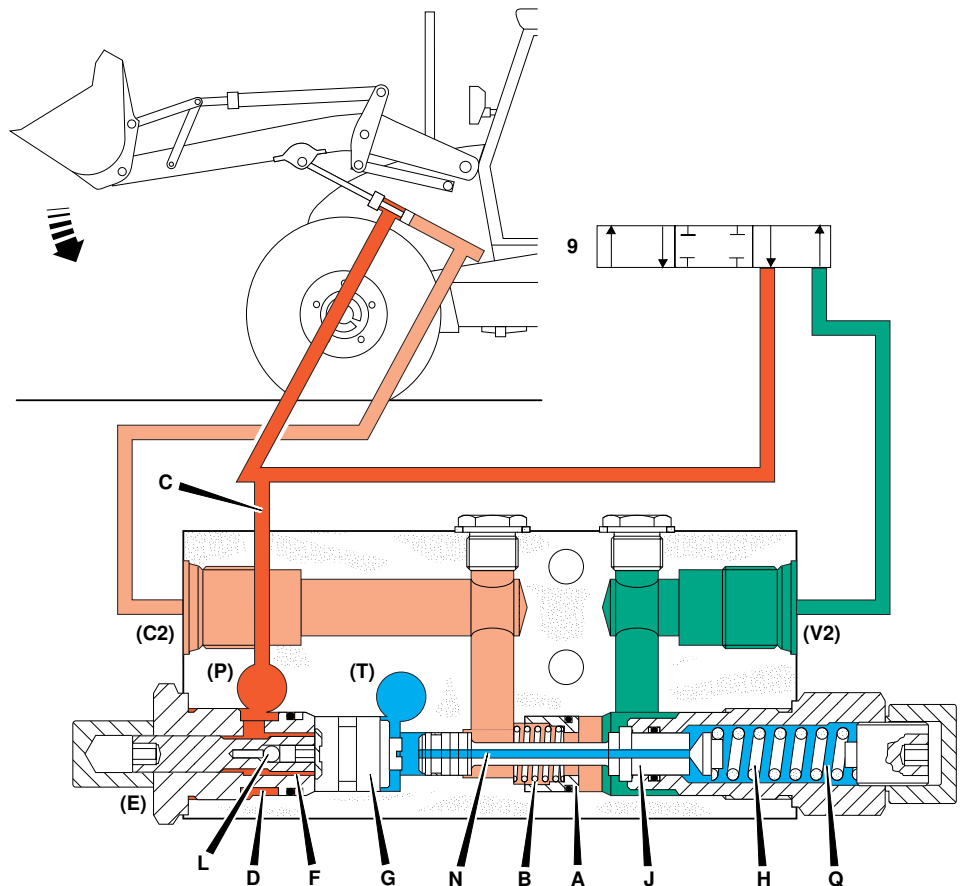
- A Check Valve Sleeve
- B Spring
- C Pilot Line
- D Drilling
- F Thread
- G Piston
- H Spring
- J Plunger
- L Ball
- N Orifice
- Q Chamber
- 9 Loader Valve Block

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

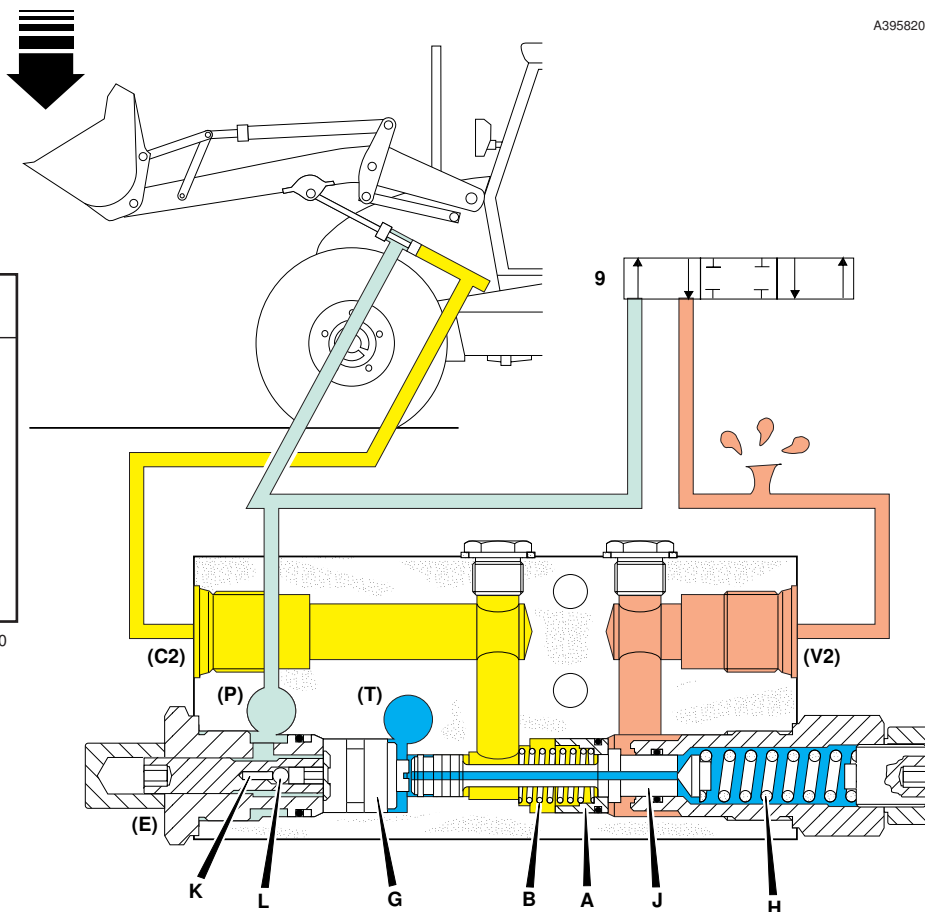
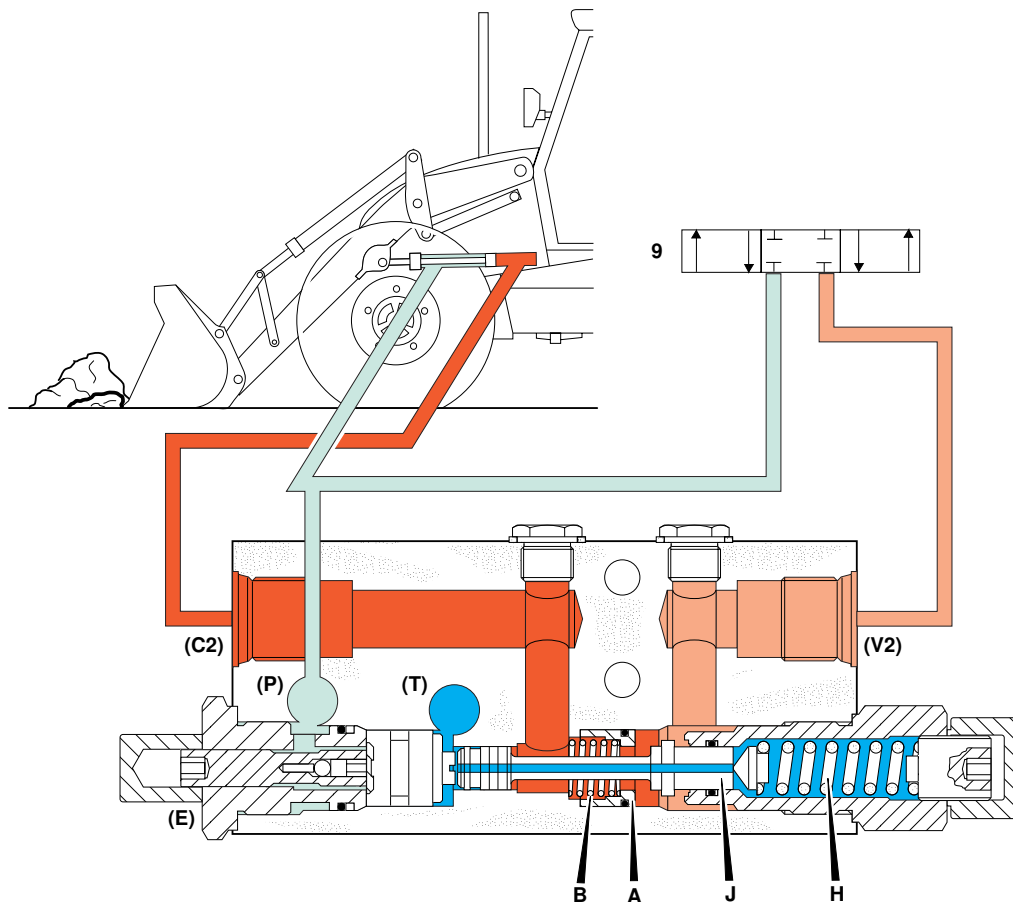
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Key to Oil Flow & Pressure	
<span style="color: red;">█</span>	Full Pressure
<span style="color: lightcoral;">█</span>	Pressure
<span style="color: orange;">█</span>	Servo
<span style="color: blue;">█</span>	Neutral
<span style="color: green;">█</span>	Exhaust
<span style="color: lightblue;">█</span>	Cavitation
<span style="color: yellow;">█</span>	Lock Up

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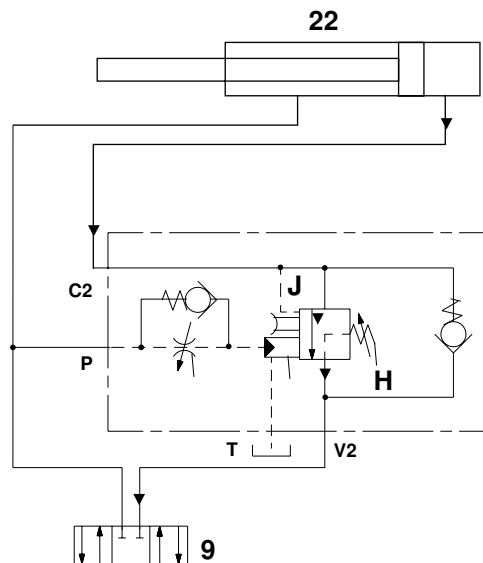
### Hose Burst Protection Valve

#### Loader Operation (Cont'd)

##### Operation 3 - Relief Valve

If during normal operation the pressure in the ram increases (for example, by the operation of the bucket against an obstacle), increasing pressure in the ram enters the HBPV at **C2** and will be sensed on the face of plunger **J**. When the force of spring **H** is exceeded, the plunger is made to move off its seat thus allowing oil to flow through the valve to port **V2**.

**Note:** Oil exhausted via port **V2** will not reduce to low pressure until the A.R.V. in the valve block **9** also opens.

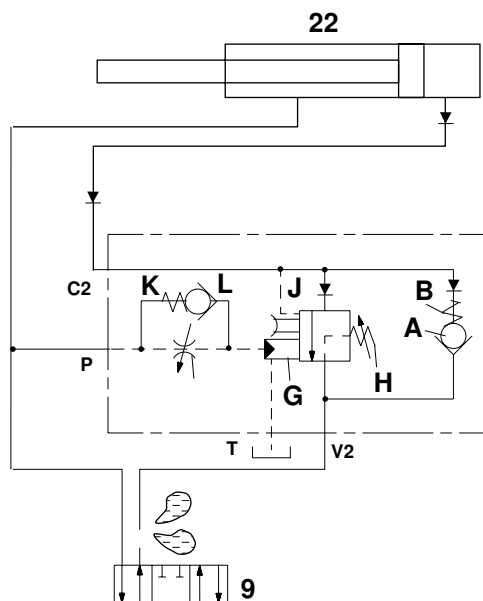


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##### Operation 4 - Hose Burst Condition

In the event of a hose burst or other leakage in the feed to the HBCV, plunger **J** will be held on its seat by the force of spring **H**. Also, back pressure and the force of spring **B** will hold check valve seat **A** firmly against the plunger, thus trapping a column of oil in the head side circuit which will prevent the load from dropping.

Note that before the plunger can move onto its seat, the pressure on the pilot side of the piston **G** must vent to atmosphere quickly, therefore ball **L** will open against the force of spring **K** which allows the oil to vent down the threads AND through the drilling previously plugged by ball **L**.



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#### Component Key:

- A** Check Valve Seat
- B** Spring
- G** Piston
- H** Spring
- J** Plunger
- K** Spring
- L** Ball
- 9** Loader Valve Block



## Hydraulic System - Fixed Flow

### Fault Finding Contents

	Page No.
Introduction	15 - 1
Lack of power in all hydraulic functions	15 - 1
All hydraulic rams slow to operate	15 - 2
One hydraulic service fails to operate or is slow to operate	15 - 2
The engine tends to stall when the hydraulics are under load	15 - 2
A spool is sticking	15 - 3
Leaking Oil Seal (Control Valves)	15 - 3
Ram creep	15 - 3
Hydraulic oil becomes too hot	15 - 4

### Introduction

The purpose of this section is to help you trace hydraulic faults to a faulty unit (valve, actuator, ram etc). Once you have traced the faulty unit, refer to the appropriate dismantling, inspecting and test instructions given elsewhere in the hydraulics section.

To help identify circuits, valves, rams etc mentioned in the fault finding procedures, refer to the hydraulic schematic diagrams (near the beginning of the Hydraulics Section).

**1** Before you begin fault finding, read the Safety information at the beginning of this manual.

**2** Make simple checks before say, stripping a major component.

**3** Make sure that the hydraulic fluid is at correct working temperature (50 °C, 122 °F).

**4** What ever the fault, check the condition of the hydraulic fluid. Drain and replace if necessary.

**5** Make any relevant electrical checks before moving on to the hydraulics.

**6** Be sure to remove ALL contamination and if possible identify its origin. It may be part of a component from elsewhere in the circuit.

**7** Replace any seals such as 'O' rings before re-assembling hydraulic components.

Fault	Probable Cause	Action
1 Lack of power in all hydraulic functions.	Insufficient hydraulic fluid.	Check for leaks and top up as required.
	Hydraulic leaks in system.	Check hoses, replace as required.
	Engine performance.	Check engine performance, see transmission section for stall speed test procedures.
	Main relief valve (MRV) setting incorrect.	Check and adjust as required.
	Low pump flow.	Check pump flow, if required service or replace pump.
	Hydraulic tank breather	Clean or replace the breather
	Tank filter by-pass valve	Check condition of hydraulic filter
	Unloader valve pressure setting too high	Check pressure setting of the unloader valve.
..... continued		

Fault	Probable Cause	Action
<p>2 All hydraulic rams slow to operate.</p>	<p>Neutral circuit or low pressure lines leaking, damaged, trapped or kinked.</p> <p>Low pump flow.</p> <p>Priority valve operating.</p> <p>Main relief valve (MRV) setting incorrect.</p> <p>Unloader valve</p> <p>Tank filter by-pass valve</p> <p>Hydraulic tank breather</p>	<p>Check pipe lines and replace as required.</p> <p>Check pump flow, if required service or replace pump.</p> <p>Check if the priority valve is sticking, rectify as required.</p> <p>Check and adjust as required.</p> <p>Check if unloader valve is sticking, i.e. dumping flow from pump section P2.</p> <p>Check condition of hydraulic filter</p> <p>Clean or replace the breather</p>
<p>3 One hydraulic service fails to operate or is slow to operate.</p>	<p>Associated service pipe lines , leaking damaged, trapped or kinked.</p> <p>Associated ram leaking.</p> <p>Auxiliary relief valve (ARV) setting incorrect.</p> <p>Associated valve block section leaking or not operating.</p> <p>Check valve malfunctioning (if fitted, e.g. stabiliser circuit)</p> <p>Hose burst protection valve (if fitted) malfunctioning.</p> <p>Piston rod is bent</p>	<p>Check hoses, replace as required.</p> <p>Complete ram leakage check, replace seals as required.</p> <p>Check and adjust as required.</p> <p>Check for leaks, rectify as required. Also, see fault 6 'Leaking Oil Seal (Control Valves)'.  Make sure that the associated load hold check valve is operating.  Check that the control lever and associated linkages is operating the spool, rectify as required. Also, see fault 5, 'A spool is Sticking'.  Test check valve, rectify as required.  Test HBPV, service as required.  Replace piston rod, check pressure settings of MRV and ARV.  Check that associated pivot pins are adequately greased</p>
<p>4 The engine tends to stall when hydraulics are under load.</p>	<p>M.R.V setting incorrect.</p> <p>Poor engine performance.</p> <p>Unloader valve pressure setting too high</p>	<p>Check and adjust as required.</p> <p>Check engine performance, see transmission section for stall speed test procedures.</p> <p>Check pressure setting of the unloader valve.</p>

Fault	Probable Cause	Action
<p>5 A spool is sticking.</p>	<p>Oil temperature abnormally high.</p> <p>The hydraulic fluid is dirty.</p> <p>The service pipe connection is over tightened.</p> <p>The valve housing was twisted during installation.</p> <p>Pressure too high.</p> <p>A control linkage is bent</p> <p>A spool is bent</p> <p>A return spring is broken.</p> <p>A return spring or cap is out of alignment.</p> <p>Temperature distribution within control valve not uniform.</p>	<p>Check for correct fluid, see Lubricants and Capacities. Check oil cooler and grille for blockage.</p> <p>Clean the tank strainer. If strainer badly clogged, drain and flush hydraulic system. Fill with clean hydraulic fluid.</p> <p>Check tightening torque.</p> <p>Loosen retaining bolts and tighten to correct torque figures.</p> <p>Check system pressure.</p> <p>Disconnect the linkage. Repair the linkage if possible, or fit a new one</p> <p>Dismantle the control valve. Renew spool as necessary.</p> <p>Renew as necessary.</p> <p>Remove the cap, check that the spring is in the correct position. Refit cap and torque tighten bolts</p> <p>Warm the entire system up before using service.</p>
<p>6 Leaking Oil Seal (Control Valves)</p>	<p>Paint or dirt on the seal face.</p> <p>The back pressure in the valve circuit is excessively high.</p> <p>Spool damaged.</p> <p>The seal is not secured.</p> <p>The seal is cut or damaged.</p>	<p>Remove the seal and clean.</p> <p>Check circuit pressures, adjust if possible. Otherwise investigate thoroughly.</p> <p>Dismantle. Inspect all parts. Renovate or renew as necessary.</p> <p>Clean the seal and tighten the retaining bolts to the correct torque.</p> <p>Fit a new seal.</p>
<p>7 Ram creep.</p>	<p>Associated ram or pipe lines from ram leaking.</p> <p>Check valve malfunctioning (if fitted, e.g. stabiliser circuit)</p> <p>Associated valve section spools leaking.</p> <p>Associated ARV leaking</p>	<p>Check and rectify as required.</p> <p>Test check valve, rectify as required.</p> <p>Rectify, check for contamination.</p> <p>Rectify, check for contamination</p>

**Note:** Refer also to **Service Procedures, Ram Creep Tests - All Services**

Fault	Probable Cause	Action
8 Hydraulic oil becomes too hot	Oil cooler obstructed  Restriction in neutral circuit lines  Hydraulic filter clogged and by-pass valve not working	Remove debris from cooler fins  Check hoses, replace as necessary  Change hydraulic filter

## Hydraulic System - Variable Flow

### Fault Finding Contents

	Page No.
Introduction	15 - 10
High or low system pressure	15 - 10
Pump stays at high pressure	15 - 10
Pressure or flow obtained at one port only	15 - 10
No pressure or flow at either port	15 - 10
High work port leakage	15 - 10
Leaks between sections	15 - 11
Sticking spool	15 - 11
Detent will not hold	15 - 11
Electrical detent will not hold	15 - 11
Poor performance, slow operating speed and/or low maximum stall speed	15 - 11

**PROBLEM:** High or Low system pressure.  
**POSSIBLE CAUSE:** 1) Wrong pressure and/or flow regulator valve settings. 2) Loss of pilot signal due to shuttle failure.  
**CORRECTIVE ACTION:** 1) Readjust regulator valves. 2) Operate individual services to determine which shuttle is at fault, refer to **Service Procedures, Variable Flow Pumps, Shuttle Valve Signal Network - Testing.**

**PROBLEM:** Pump stays at high pressure.  
**POSSIBLE CAUSE:** 1) Sticking main spool. 2) Sticking compensator spool.  
**CORRECTIVE ACTION:** 1) See 'Sticking Spool' guide. 2) Remove & clean compensator spool.

**PROBLEM:** Can only obtain pressure or flow at one port.  
**POSSIBLE CAUSE:** 1) Dirt in primary shuttle or damaged o-ring.  
**CORRECTIVE ACTION:** 1) Remove & clean shuttle, inspect o-ring and replace if required.

**PROBLEM:** No pressure or flow at either port.  
**POSSIBLE CAUSE:** 1) Dirt in secondary shuttle.  
**CORRECTIVE ACTION:** 1) Shift one spool at a time with blocked ports until faulty section found, remove shuttle and clean, inspect o-ring and replace if required.

**PROBLEM:** High work port leakage.  
**POSSIBLE CAUSE:** 1) Spool not centred. 2) Dirt in port relief valve.  
**CORRECTIVE ACTION:** 1) Check centring springs. 2) Remove & clean relief valve.

## Introduction

This section details the possible faults that may be found with the loader and backhoe valve blocks. The faults listed only appertain to valve blocks fitted on variable flow hydraulic machine systems (Rexroth valves).

- 1 Before you begin fault finding, read the Safety information at the beginning of this manual.
- 2 Make simple checks before say, stripping a major component.
- 3 Make sure that the hydraulic fluid is at correct working temperature (50 °C, 122 °F).
- 4 What ever the fault, check the condition of the hydraulic fluid. Drain and replace if necessary.
- 5 Make any relevant electrical checks before moving on to the hydraulics.
- 6 Be sure to remove ALL contamination and if possible identify its origin. It may be part of a component from elsewhere in the circuit.
- 7 Replace any seals such as 'O' rings before re-assembling hydraulic components.

---

**PROBLEM:** Leaks between sections.  
**POSSIBLE CAUSE:** 1) Missing or cut seals.  
**CORRECTIVE ACTION:** 1) Disassemble valve stack and check for missing or cut o-rings.

---

**PROBLEM:** Sticking spool.  
**POSSIBLE CAUSE:** 1) Linkage binding. 2) Damaged spool. 3) Uneven torque of tie-rod. 4) Incorrect number of shims on tie-rods.  
**CORRECTIVE ACTION:** 1) Check linkage. 2) Remove and inspect spool. 3) Loosen tie-rod bolts, check and re-torque. 4) Disassemble and check that each tie-rod has one shim.

---

**PROBLEM:** Mechanical detent will not hold.  
**POSSIBLE CAUSE:** 1) Broken detent shaft.  
**CORRECTIVE ACTION:** 1) Remove detent & inspect.

---

**PROBLEM:** Electrical detent will not hold.  
**POSSIBLE CAUSE:** 1) Current broken.  
**CORRECTIVE ACTION:** 1) Check current going into detent.

---

**PROBLEM:** Poor performance, slow operating speed and/or low maximum stall speed.  
**POSSIBLE CAUSE:** 1) Blocked flow regulator spool.  
**CORRECTIVE ACTION:** 1) Flow check, remove and clean flow regulator valve, refer to **Service Procedures, Variable Flow Pumps - Regulator Valve Adjustment**.

---

**Smooth Ride System**

<b>Fault</b>	<b>Probable Cause</b>	<b>Action</b>
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.

## Hydraulic Contamination

### Hydraulic Fluid Quality

Construction machinery uses a large volume of fluid in the hydraulic system for power transmission, equipment lubrication, rust prevention and sealing.

According to a survey conducted by a pump manufacturer, seventy per cent of the causes of problems in hydraulic equipment were attributable to inadequate maintenance of the quality of the hydraulic fluid.

Therefore, it is obvious that control of the quality of the hydraulic fluid helps prevent hydraulic equipment problems and greatly improves safety and reliability. Furthermore from an economic angle it extends the life of the hydraulic fluid if quality is maintained.

### Effects of Contamination

Once inside the system, hydraulic circuit contaminants greatly effect the performance and life of hydraulic equipment. For example, contaminants in a hydraulic pump develop internal wear to cause internal leakage and hence lower discharges. Wear particles generated will circulate with the hydraulic fluid to cause further deterioration in the performance of this and other equipment.

Contaminants also enter principal sliding sections of the equipment causing temporary malfunction, scuffing, sticking and leakage and can lead to major problems.

The main contaminants can be classified as follows:-

- 1 **Solid Particles** - sand, fibres, metallic particles, welding scale, sealing materials and wear particles etc.
- 2 **Liquid** - usually water and incompatible oils and greases.
- 3 **Gases** - Air, sulphur dioxide etc. which can create corrosive compounds if dissolved in the fluid.

These contaminants can appear during manufacture, assembly and operation.

### Cleaning Operation

The purpose of cleaning oil is to remove contaminants of all types and sludge by filtering hydraulic fluid through a cleaning unit, as illustrated or similar. General Bulletin 011 also refers.

#### Procedure

Connect the cleaning unit in place of the hydraulic filter and run the system for sufficient time to pump all the hydraulic fluid through the unit. Disconnect the cleaning unit and reconnect the filter. Top up the system with clean hydraulic fluid as required.

### Contaminant Standards

Dirt that damages your system is in many cases too small to be seen with the eye. The particle size is measured in microns.

1 micron= 0.001 mm (0.0000394 in)

Listed below are a few typical comparisons:-

Red Blood Cell	= 8 microns (0.008 mm, 0.000315 in)
Human Hair	= 70 microns (0.07 mm, 0.00275 in)
Grain of Salt	= 100 microns (0.1 mm, 0.00394 in)

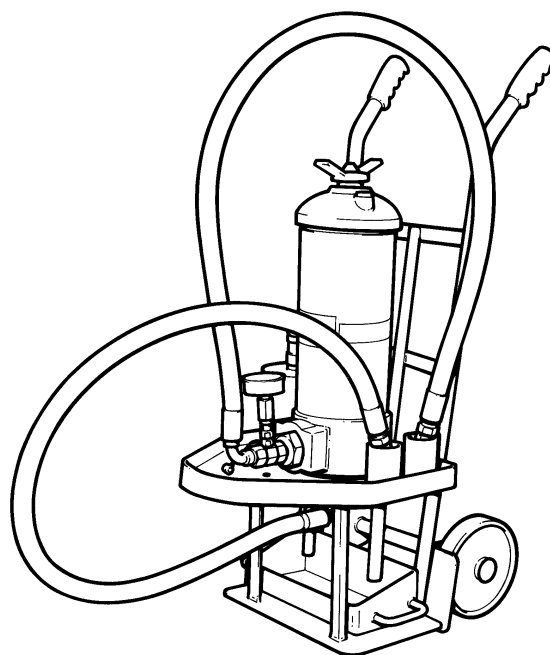
Smallest particle visible to the naked eye is 40 microns (0.00157) approximately.

Standards will often be quoted to ISO (International Standards Organisation) for which literature can be obtained.

### Filters

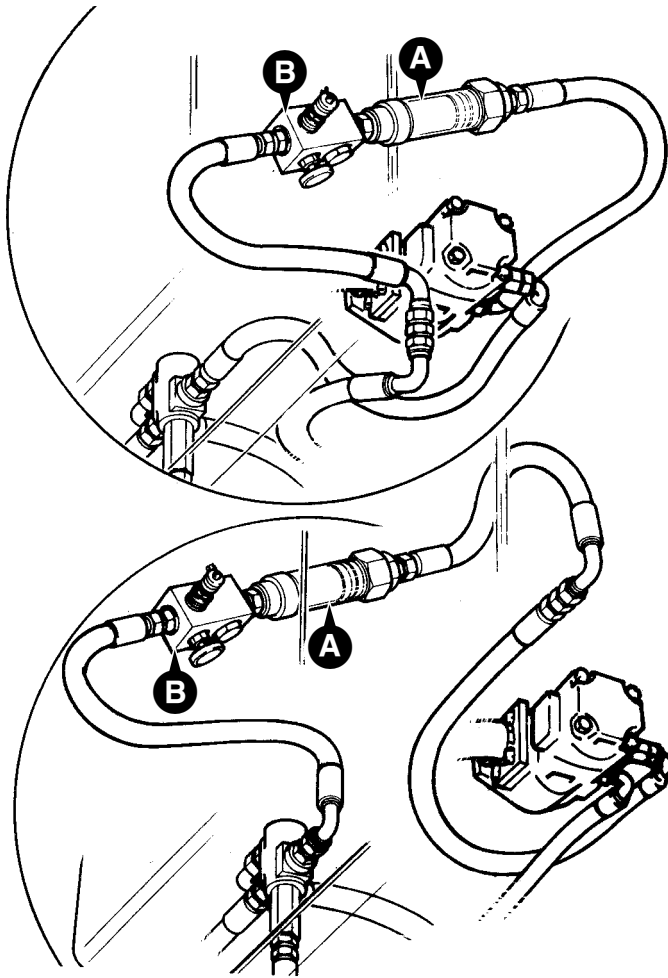
The filter assembly fitted to all product ranges is designed to filter all the contamination that is generated through use to the required level of cleanliness. The filter must be serviced to the requirements of the machine Service Schedules.

To ensure optimum performance and reliability it is important that the machines hydraulic system is serviced periodically in accordance with the manufacturers requirements. For service schedules refer to Section 3 **Routine Maintenance**.

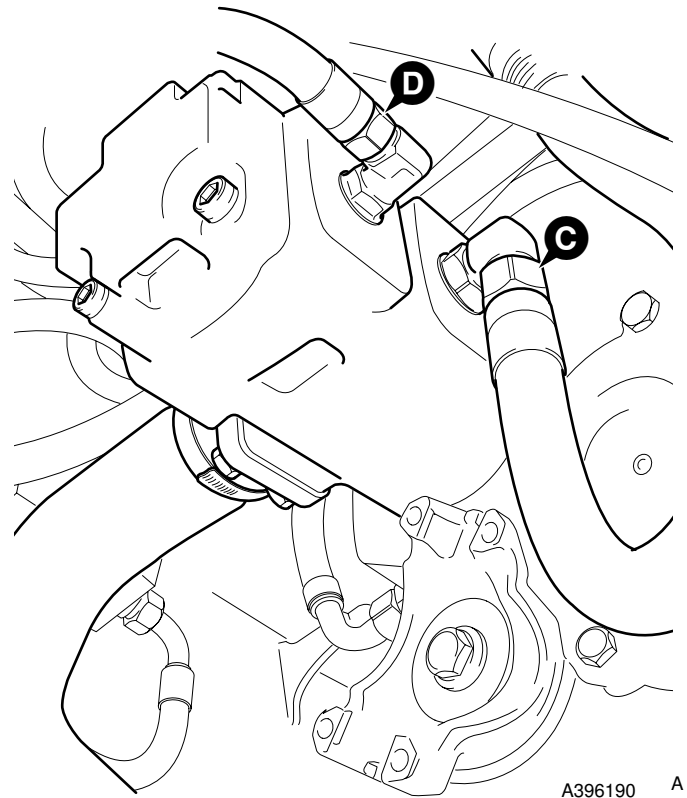


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## Fixed Flow Pumps

### Flow and Pressure Testing

Before removing the pump it is necessary to determine the source of any problem by measuring the output flow at system pressure from both of the pump outlet ports.

To check flow it is necessary to fit flow meter **A** into the output line of each pump section in turn. If available, load valve **B** (service tool 892/00270) should also be installed (see **Note 1**). Make sure the flow meter is installed with its arrow pointing away from the pump and, if applicable, located between the pump and the load valve.

**Note 1:** If no load valve is available, ignore the references to the load valve in **Fitting/Removing a Flow Meter and Load Valve** below. An alternative method of determining flow is included in the Checking Flow procedures following.

### Fitting/Removing a Flow Meter and Load Valve

Before fitting/removing a flow meter and load valve, switch off the machine and operate the loader/excavator controls a few times to vent system pressure.

#### 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.**

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#### WARNING

**Take care when disconnecting hydraulic hoses and fittings as the oil will be HOT.**

TRANS 1-2

#### Fitting

- 1 **a** Pump section 1 - disconnect hose **C** from the pump. Fit the flow meter and load valve (see **Note 2**) between hose **C** and the pump.
- b** Pump section 2 - disconnect hose **D** from the pump. Fit the flow meter and load valve (see **Note 2**) between hose **D** and the pump.

**Note 2:** Make sure the load valve is in the open position, i.e. with the adjusting knob screwed fully out, before carrying out the **Checking Flow** procedure.

#### Removing

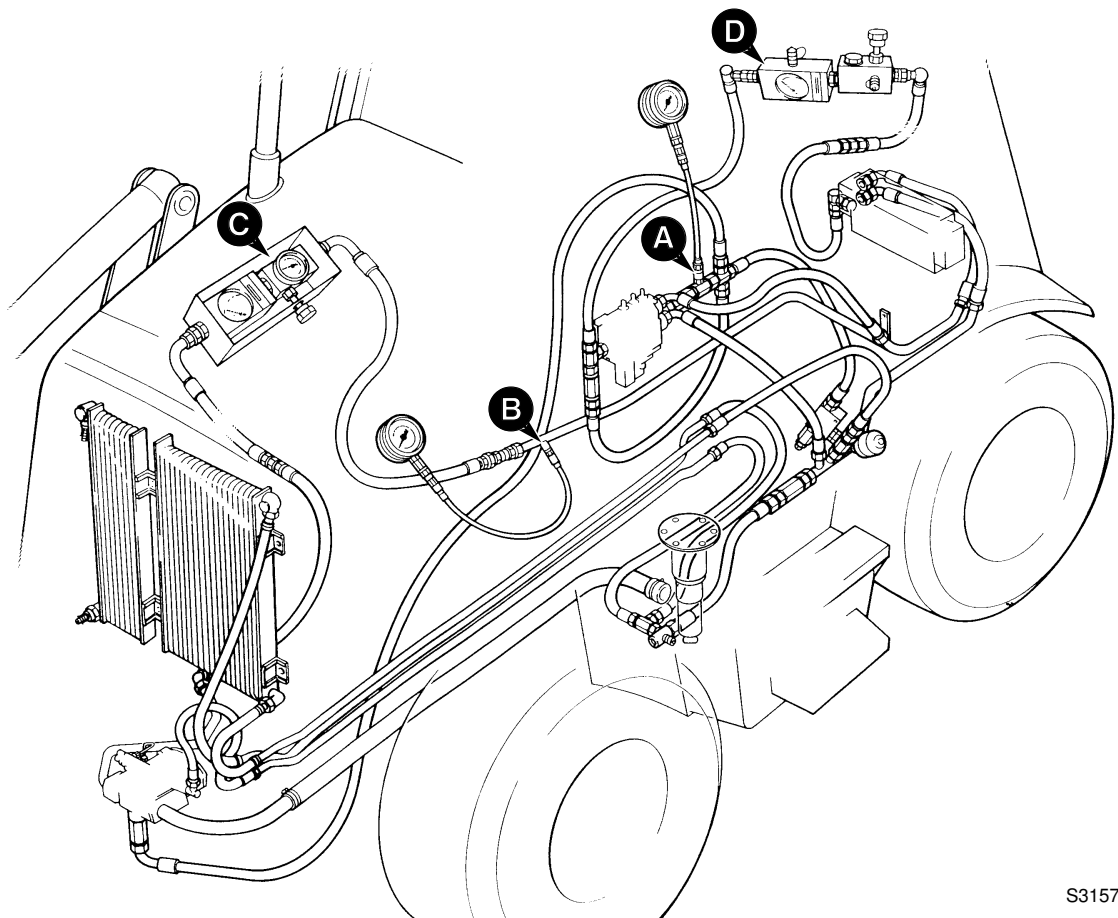
Removing is the reverse of fitting.

### Checking Flow

- 1 Check the setting of the Main Relief Valve (MRV) as described in **Loader Valve, Pressure Testing**. Adjust if necessary.
- 2 **a** *Using a load valve* - fit a flow meter and load valve, as described in Fitting, to each pump outlet in turn. Fit a 0-400 bar (0-6000 lbf/in<sup>2</sup>) pressure gauge to the load valve pressure test connector.
- b** *If no load valve is available* - fit a flow meter, as described in Fitting, to each pump output in turn.
- 3 Start the engine and bring the hydraulics up to working temperature 50°C (122°F). Set the engine speed to 2200 rpm.
- 4 **a** *Using a load valve* - adjust the load valve so that the pressure gauge reading is just below the MRV setting.
- b** *If no load valve is available* - raise or lower the loader arms until the rams are fully open or closed. Continue to operate the raise/lower control so that system pressure builds up. Watch the flow meter and note its reading at the moment the MRV operates.
- 5 The flow reading should be as listed in **Technical Data**.

**Variable Flow Pumps**

**Flow and Pressure Testing**



S315770

## Variable Flow Pumps

### Flow and Pressure Testing

#### Load Sensing Pressure

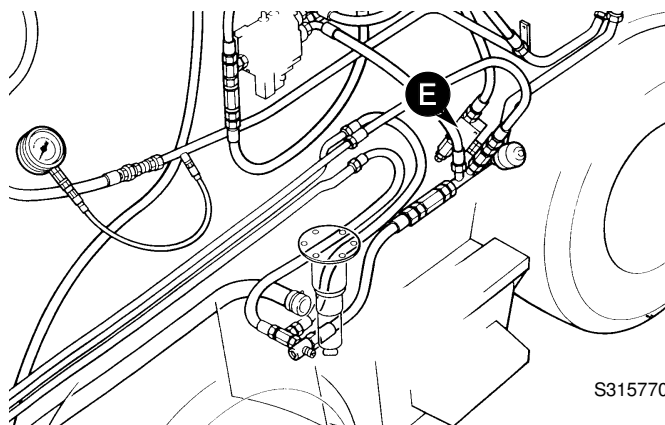
With no services operating, there should be no pressure in the load sense line, this is because hydraulic oil flows through the load sense circuit back to the hydraulic tank. If a shuttle valve is 'stuck', or a hose kinked, then a pressure could be induced in the load sense lines, this will have an effect on the hydraulic system. To check load sense pressure:

- 1 Warm the hydraulic oil to working temperature, i.e. 50°C (122°F):
  - a Set the engine speed to 2200 rev/min.
  - b Operate the loader shovel dump service to blow off the auxiliary relief valve.
- 2 Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.
- 3 Connect a 0 - 400 bar (0 - 6000 lbf/in<sup>2</sup>) pressure gauge to pressure test connector **A** located on the load sense line from the loader valve.
- 4 Start the engine and run at 2200 rev/min.
- 5 Do not move the steering wheel and make sure that all control levers remain in 'neutral' position.
- 6 Check the pressure gauge reading, which should be as specified in **Technical Data**.
- 7 If the pressure is higher than specified, first move the steering wheel and then any of the service levers. If this does not reduce the pressure, physically check the load sense lines for trapping or kinking. As a last resort, the service valves may have to be removed and checked for sticking shuttle valves. However, this should not be done until all other checks have been completed.
- 8 Machines with the load sense pressure relief valve adjust the load sense pressure relief valve **E**. Machines without a load sense pressure relief valve adjust the regulator valve.

#### Stand-by Pressure

With the engine switched off, the pump swashplate is spring loaded to the full flow position. On engine start up standby pressure moves the swash plate to minimum flow position (see descriptions). To check stand-by pressure:

- 1 Warm the hydraulic oil to working temperature, i.e. 50°C (122°F):
  - a Set the engine speed to 2200 rev/min.
  - b Operate the loader shovel dump service to blow off the auxiliary relief valve.
- 2 Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.
- 3 Connect a 0 - 400 bar (0 - 6000 lbf/in<sup>2</sup>) pressure gauge to pressure test connector **B** located on the pump pressure out line.
- 4 Start the engine and run at 2200 rev/min.
- 5 Do not move the steering wheel and make sure that all control levers remain in 'neutral' position.
- 6 Check the pressure gauge reading, which should be as specified in **Technical Data**.
- 7 If the pressure is not as specified, do not make any adjustments at this stage. Complete the other checks detailed in this section.
- 8 Refer to **Regulator Valve Adjustment**.



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## Variable Flow Pumps

### Flow and Pressure Testing (Cont'd)

#### Maximum Hydraulic Stall

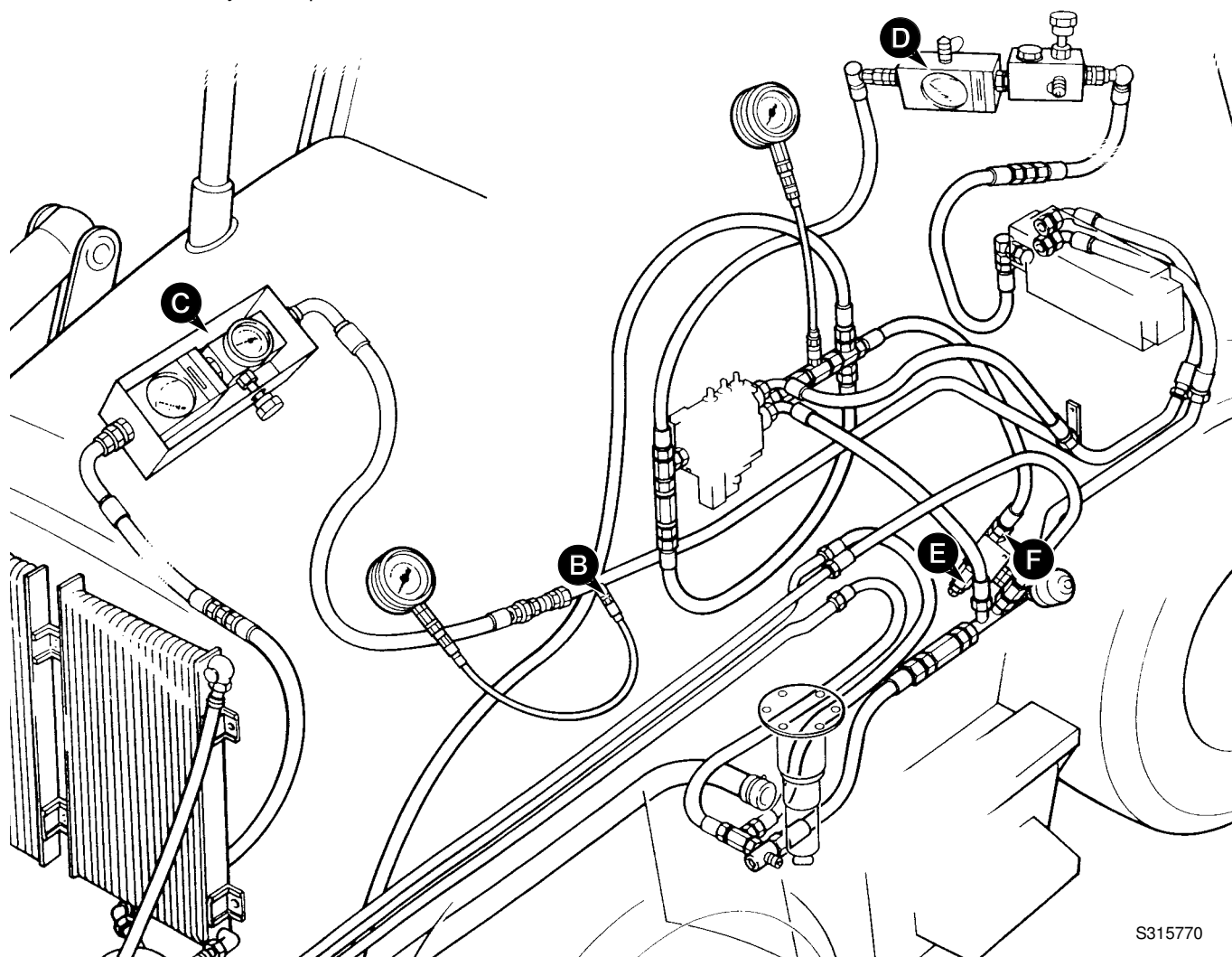
With variable flow hydraulics the pump swashplate angle will increase or decrease according to pressure demand. However in situations of maximum hydraulic stall, i.e. ram full travel, the pressure in the circuit will achieve the setting of the pressure regulator spool. To check the setting:

**Note:** Machines with a load sense relief valve, disconnect and blank the load sense relief valve **E** at **F**.

- 1 Warm the hydraulic oil to working temperature, i.e. 50°C (122°F):
  - a Set the engine speed to 2200 rev/min.
  - b Operate the loader shovel dump service to blow off the auxiliary relief valve.
- 2 Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.
- 3 Connect a 0 - 400 bar (0 - 6000 lbf/in<sup>2</sup>) pressure gauge to pressure test connector **B** located on the pump pressure out line.
- 4 Start the engine and run at 2200 rev/min.
- 5 Raise the loader arms to achieve full travel, hold the arms in this position and note the gauge reading, which should be as specified in **Technical Data**.
- 6 If the pressure is higher than specified, the pressure compensator spool may be set incorrectly or the swashplate may not be moving.
 

If the pump pressure is lower than specified, the flow spool may be set incorrectly, or there may be a leak in the load sense line.

Do not make any adjustments at this stage. Complete the other checks detailed in this section.
- 7 Refer to **Regulator Valve Adjustment**.



## Variable Flow Pumps

### Flow and Pressure Testing (Cont'd)

#### Pump Flow

It is not possible to test full pump flow at system pressure whilst the pump is installed on the machine. This is because the pump swashplate angle will return to minimum angle (zero flow) when the system reaches full pressure (see descriptions).

However, it is possible to test the pump flow whilst 'blowing off' an auxiliary relief valve which is set lower than system pressure. In the example below, the shovel head side A.R.V. is used. The readings taken in this test give a 'snapshot' of pump performance and can be used to establish if major pump maintenance is required.

- 1 Warm the hydraulic oil to working temperature, i.e. 50°C (122°F):
  - a Set the engine speed to 2200 rev/min.
  - b Operate the loader shovel dump service to blow off the auxiliary relief valve.
- 2 Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.
- 3 Connect a 0 - 400 bar (0 - 6000 lbf/in<sup>2</sup>) pressure gauge to pressure test connector **B** located on the pump pressure out line.
- 4 Connect a flowmeter to the pump pressure out line as shown at **C**.
- 5 Start the engine and run at 2200 rev/min.
- 6 Raise the loader arms and fully dump the loader shovel.
- 7 Hold the shovel in the dump position (to blow off the A.R.V.) and check the flow and pressure gauge readings, which should be as specified in **Technical Data**.
- 8 If the pump flow is not as indicated, do not make any adjustments at this stage. Complete the other checks detailed in this section.
- 9 Refer to **Regulator Valve Adjustment**.

#### Load Sense Line Flow

The load sense line communicates the load pressure required at a service to the pump. If there is a blockage or leak in the line, the hydraulic system will not operate effectively.

Load sensing is a 'dynamic flow' type. That is, there is a constant flow of oil from the pump to the shuttle valves. When a pressure signal is felt at the service port, the flow is interrupted and the pump immediately responds to the demand. (Unlike a 'static' system where the pressure signal must move from the valve block, back up the load sense line to the pump).

- 1 Warm the hydraulic oil to working temperature, i.e. 50°C (122°F):
  - a Set the engine speed to 2200 rev/min.
  - b Operate the loader shovel dump service to blow off the auxiliary relief valve.
- 2 Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.
- 3 Connect a flowmeter into the load sense line, a good access point is where the LS line enters the backhoe valve as shown at **D**.
- 5 Start the engine and run at 2200 rev/min. Check the flow which should be as specified in **Technical Data**.
- 6 If a service is selected, the flow should drop to zero (but the pressure will increase).
- 7 If there is no flow in the system, then check the load sense lines for being trapped or kinked, also move the service control levers and the steering wheel.

If there is still no flow, then there is the possibility of a shuttle valve being stuck. Do not dismantle valves at this stage but complete all other tests listed in this section.

## Variable Flow Pumps

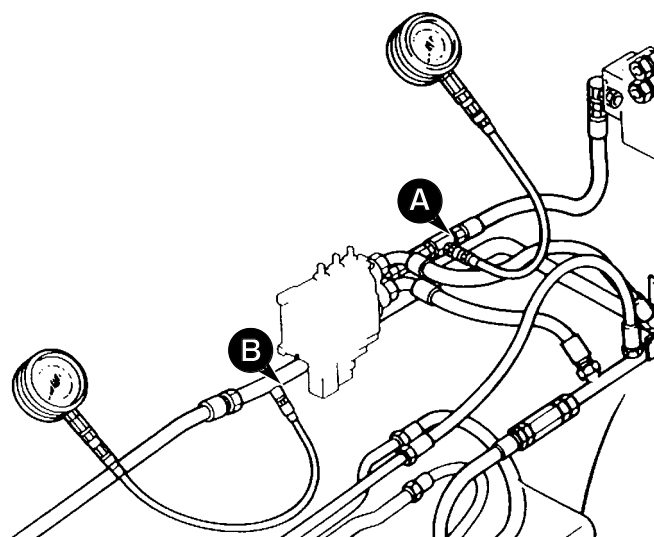
### Regulator Valve Adjustment

**Note:** If a new regulator valve is fitted, or a valve stripped, cleaned and rebuilt, then the pressure spool should be backed off to a low pressure. This will prevent inadvertent damage to the pump.

#### Flow Regulator Spool

The pressure in the pump out line (pressure test connector **B**) should be 20 bar (290 lbf/in<sup>2</sup>) greater than the pressure in the load sense line (pressure test connector **A**). If not adjust the regulator flow spool as described below:

- 1 Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.
- 2 Gain access to the regulator valve assembly (mounted on the pump).
- 3 Remove cap **C** and loosen locknut **D**.
- 4 Turn adjusting screw **E** clockwise to increase pressure setting and anti-clockwise to decrease setting.
- 5 Repeat pressure test as detailed previously and establish valve is set correctly.
- 6 Tighten locknut, refit cap.

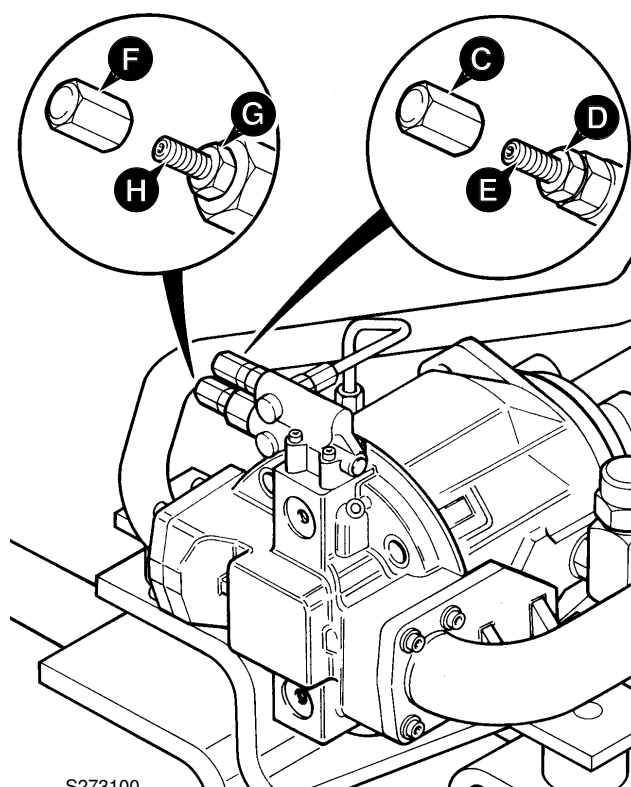


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#### Pressure Regulator Spool

As previously explained, there is no 'main relief valve' to control the system pressure (the pump swashplate angle will increase or decrease according to pressure demand). However in situations of maximum hydraulic stall, i.e. ram full travel, the pressure in the circuit will achieve the setting of the pressure regulator spool. To adjust the setting:

- 1 Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.
- 2 Gain access to the regulator valve assembly (mounted on the pump).
- 3 Remove cap **F** and loosen locknut **G**.
- 4 Turn adjusting screw **H** clockwise to increase pressure setting and anti-clockwise to decrease setting.
- 5 Repeat pressure test as detailed previously and establish valve is set correctly.
- 6 Tighten locknut, refit cap.



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## Variable Flow Pumps

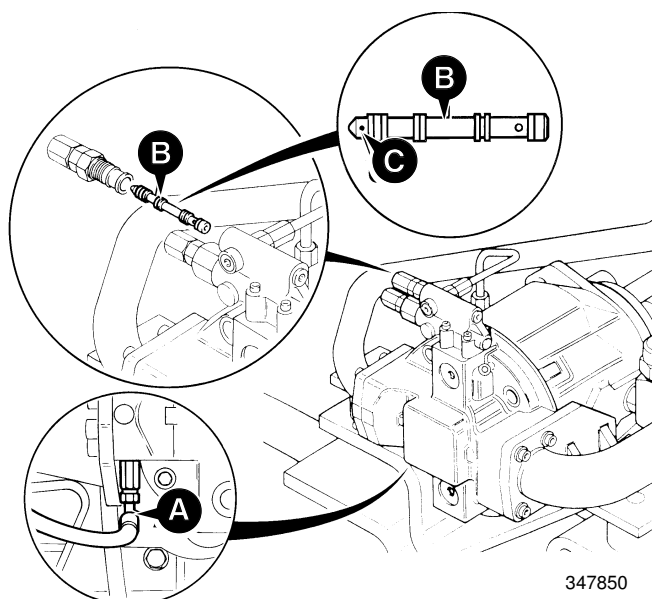
### Regulator Valve Adjustment (Cont'd)

The load sense system is a dynamic type, which means a small flow (0.22 to 1.1 gall/1 to 5 litre per minute) is circulated through the load sense line.

The flow is available due to a 0.02 in (0.6 mm) orifice in the flow regulator spool in the pump control housing. This orifice can be blocked or partially restricted which will give poor performance, slow operating speed and/or low maximum stall speed. If completely blocked, margin pressure and stand-by pressure can be difficult to adjust and the loader services may operate intermittently even though the excavator operates correctly.

If any of the above symptoms are experienced carry out the following:

- 1 Lower the backhoe bucket and loader shovel to rest on the ground. Stop the engine and remove the starter key.
- 2 Gain access to the regulator valve assembly.
- 3 Disconnect the load sense line at **A**. Attach a 0.25 inch (6.35 mm) hose to pump of suitable length to route to a measuring container.
- 4 Start the engine and measure the flow which should be at least 0.22 gall/1 litre per minute at 2200 RPM.
- 5 If the flow is below 0.22gall/1 litre per minute, remove spool **B** and clean/unblock orifice **C** as required.
- 6 Fit spool **B** and check the flow as described at step 3 and 4.
- 7 If the flow is within limits check the stand-by pressure. Refer to **Flow and Pressure Testing**.



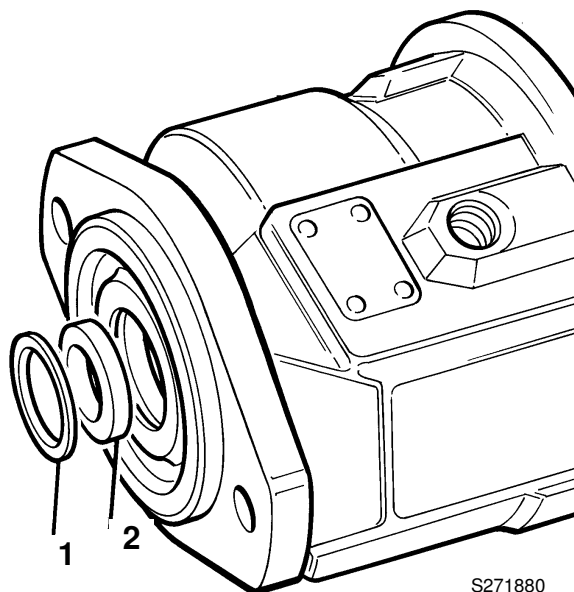


## Variable Flow Pumps

### 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**.



## Variable Flow Pumps

### Shuttle Valve Signal Network - Testing

The shuttle network can be easily checked. Start the engine and operate the hydraulic system until the oil is at working temperature.

With the engine at 1500 revs/min operate each service in the following order:

- 1 Bucket
- 2 Dipper
- 3 Right Stabiliser
- 4 Left Stabiliser
- 5 Boom
- 6 Slew
- 7 Extradig
- 8 Lift
- 9 Shovel
- 10 Auxiliary
- 11 Steering

**Note:** If your machine is not equipped with these valve sections, start with the furthest section from the pump and work back to the nearest section.

If one valve section function either fails to work or is slow to work in either one or both directions, the primary shuttle in that section may be at fault.

If two or more valve sections next to each other fail to operate correctly, check the secondary shuttles. To check the secondary shuttle operate each service in sequence, the last correctly functioning service nearest the pump may have a secondary shuttle in that section at fault.

When a shuttle is suspected of malfunctioning, do the following check:

Stall any control valve that is near the pump than the suspected control valve. This should stall the entire system. While at stall operate the malfunctioning valve section, if the section operates correctly the shuttle in question is at fault.

If section still malfunctions the shuttle is NOT at fault.

Shuttles may be removed, check the seals and the shuttle ball. Clean and refit or fit a new shuttle as required.

## Loader Valve - Pressure Testing

### Main Relief Valve (M.R.V.)

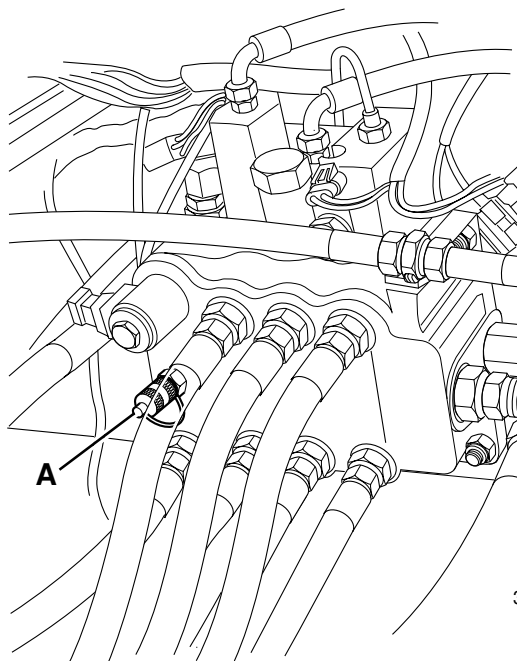
Make sure that the hydraulic oil is at working temperature, i.e. 50°C (122°F).

Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.

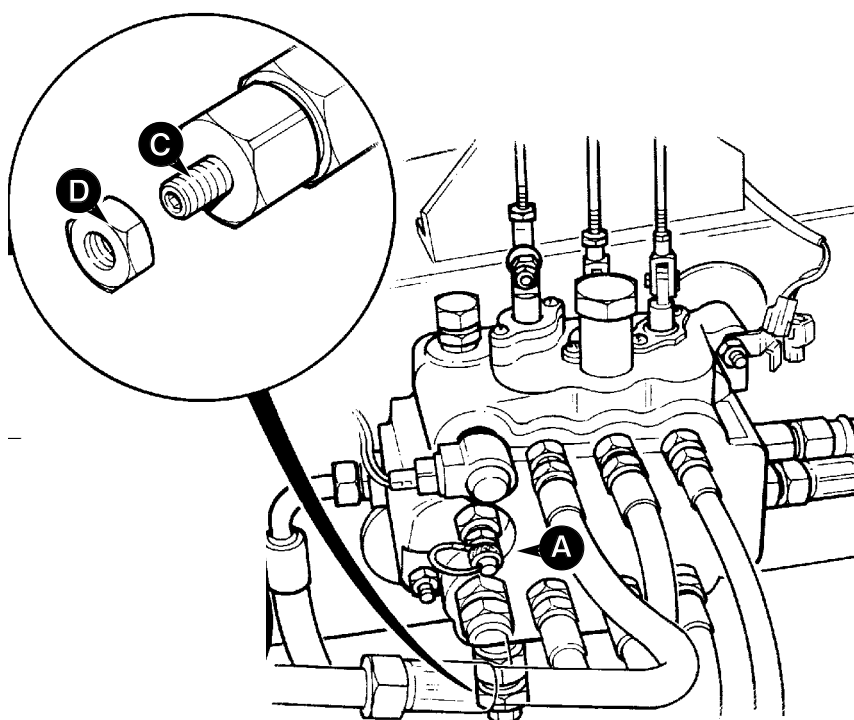
- 1 Connect a 0 - 400 bar (0 - 6000 lbf/in<sup>2</sup>) pressure gauge to pressure test connector **A** on the loader valve, (refer to **Service Tools**).
- 2 With the engine running at 1500 revs/min, check M.R.V. pressure by raising or lowering the loader arms until the rams are fully open or closed and noting the maximum gauge reading. **CAUTION:** Do not select 'float'. The maximum pressure should be as stated in Technical Data.

**Note:** The rams must be 'held' open or closed when reading gauge.

- 3 If the pressure is incorrect, loosen locknut **D** and adjust screw **C**. Turn it clockwise to increase pressure and anti-clockwise to decrease the pressure. When the pressure is correct, tighten the locknut and check the pressure again. Adjust as required.



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## Loader Valve - Pressure Testing

### Unloader Valve

Make sure that the hydraulic oil is at working temperature, i.e. 50°C (122°F).

Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.

Make sure that the 'hydraulic speed control' and 'smooth ride system' facilities are NOT switched on, otherwise the correct unloader valve pressure cannot be obtained.

If the machine has a front-mounted roadbreaker, ensure that the roadbreaker control valve lever is in the 'off' position (lever down), otherwise the roadbreaker relief valve will operate and prevent unloader valve pressure from being reached.

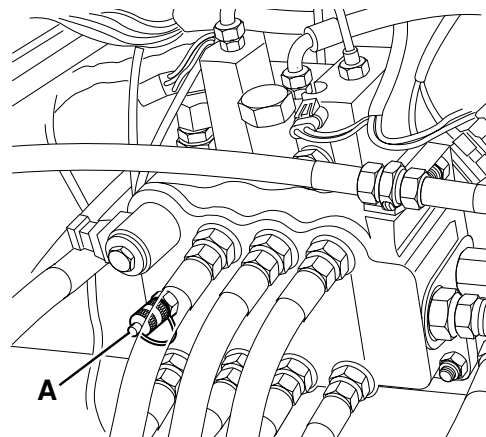
- 1 Connect a 0 - 400 bar (0 - 6000 lbf/in<sup>2</sup>) pressure gauge to pressure test connector **A**.
- 2 With the engine running at 1500 revs/min, slowly operate arms raise or lower.

**Note 1:** The arms raise or lower service is specified because it has no auxiliary relief valve (A.R.V.). Selecting this service ensures that the pressure vents through the M.R.V. and not an A.R.V.

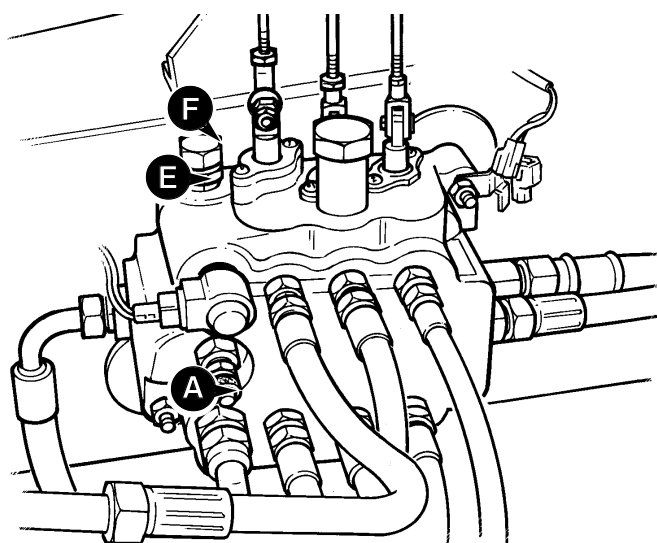
- 3 When the service reaches full travel, return the lever to the neutral position. Select the service again, very slowly, the pressure gauge will rise until a step/kick is seen in the rate of change in the pressure increase. This is the start of unloader operation. Keep selecting the service until a sudden sharp increase in pressure is observed with a change of engine sound, this point is the unloader setting and should be as specified in **Technical Data**.

- 4 If the pressure is incorrect, slacken locknut **E** and adjust cap **F**. Turn it clockwise to increase pressure and anti-clockwise to decrease the pressure. When the pressure is correct, tighten the locknut and check the pressure again. Adjust as required.

If the correct pressure cannot be achieved, add or subtract shims as required, refer to **Loader Valve - Fixed Flow, Dismantling and Assembly - Unloader Valve**.



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## Loader Valve - Pressure Testing

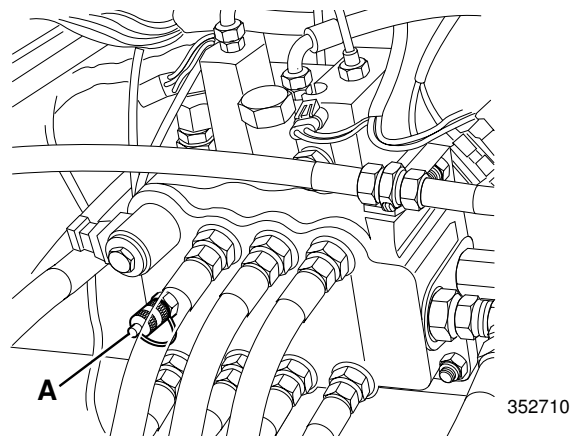
### Hydraulic Speed Control (HSC)

The following procedure can be used to establish if the hydraulic speed control facility is working correctly.

Make sure that the hydraulic oil is at working temperature, i.e. 50°C (122°F).

Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.

- 1 Connect a 0 - 400 bar (0 - 6000 lbf/in<sup>2</sup>) pressure gauge to pressure test connector **A**.
- 2 With the engine running at 1500 revs/min, slowly operate arms raise, the pressure should be approximately 138 bar (2000 lbf/in<sup>2</sup>).
- 3 Make sure that the HSC rocker switch (mounted on the console) is in the OFF position. Raise the arms slowly, select the rocker switch to ON, the arms should raise quicker.
- 4 Make sure that the HSC rocker switch (mounted on the console) is in the OFF position. Raise the arms slowly, press the button on the loader control knob, the arms should raise quicker.
- 5 If the loader arms fail to respond, then check the HSC hydraulic and electrical circuits for any faults.

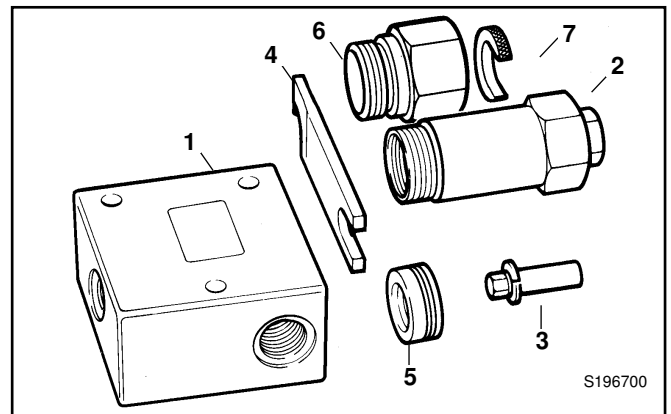


## Loader Valve - Pressure Testing

### Auxiliary Relief Valves - Using Hand Pump

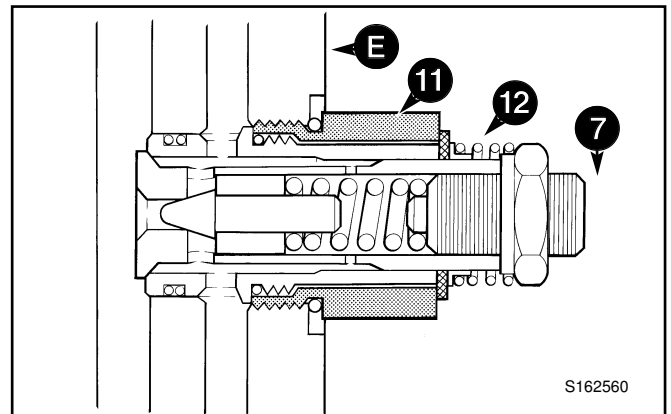
To pressure test and re-set the auxiliary relief valves (A.R.V.'s), service kit 892/00309 must be used.

The service kit comprises; a test block 1, a setting body 2 with adjusting pin 3, a special spanner 4, anti-cavitation lock out bung 5. A.R.V. cartridge removal tool 892/00335 comprises; an extractor cap 6 and a 'C' washer 7.

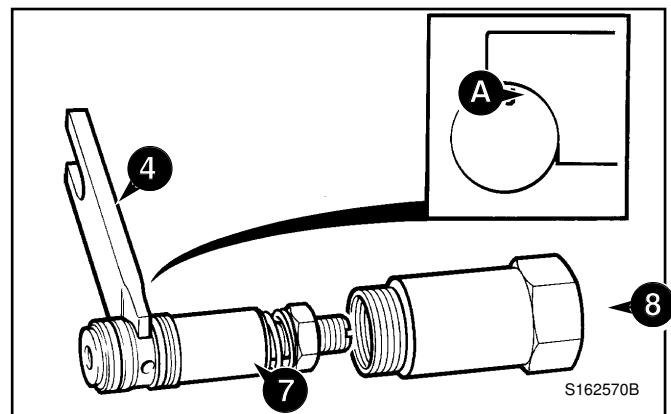


1 Remove the complete A.R.V. assembly from the valve block. If the A.R.V. sub-assembly 7 remains in the valve block, proceed as follows:

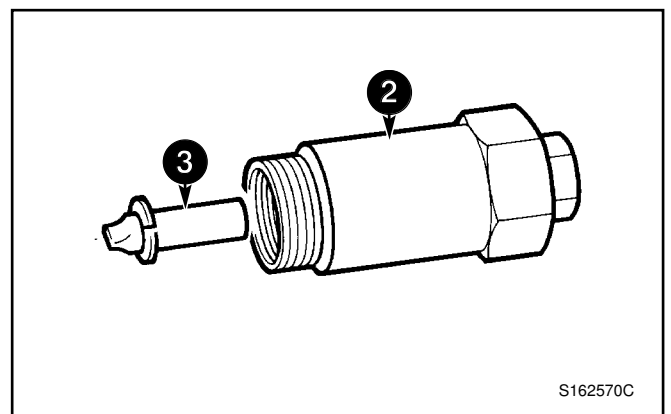
- a Fit extractor cap 11 over the A.R.V. sub-assembly 7, into the valve block E.
- b Fit 'C' washer 12 on top of the extractor cap, but under the anti-cavitation spring seat as shown.
- c Unscrew the extractor cap, - the A.R.V. sub-assembly will withdraw with the extractor cap.



2 Use special spanner 4 located in cross holes A and separate the A.R.V. sub-assembly 7 from its cap 8.



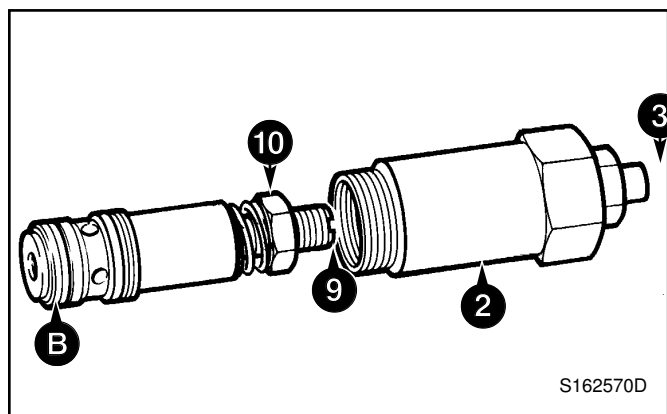
3 Install adjusting pin 3 into setting body 2.



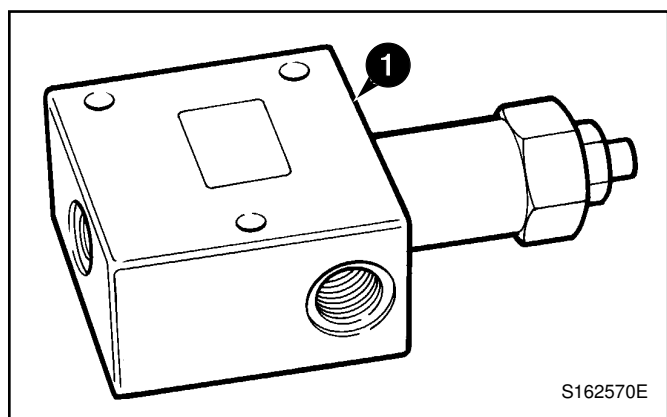
## Auxiliary Relief Valves - Using Hand Pump

- 4 Install the A.R.V. sub-assembly into setting body **2**. Make sure that the adjusting pin **3** correctly locates in adjusting screw **9**.

Make sure that the lock nut **10** correctly locates in the setting body socket - the anti-cavitation cone should still be closed, as shown at **B**.



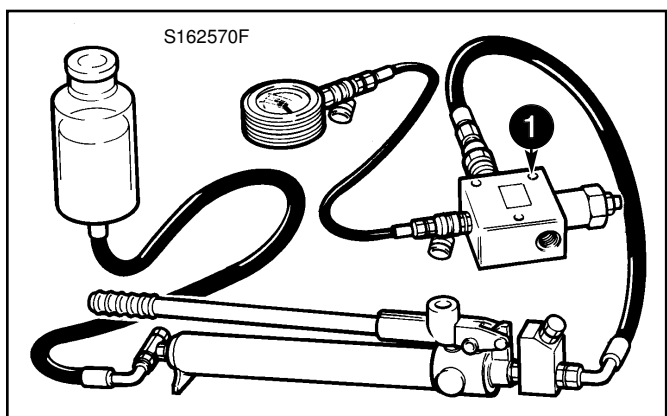
- 5 Install the A.R.V. sub-assembly and setting body into test block **1**. Make sure that the assembly is installed in the port marked 'RV' (relief valve).



- 6 Connect a hydraulic hand pump to port 'P' (pump) of the test block **1**. Make sure that the hand pump is filled with JCB Hydraulic fluid.

Connect a 0 to 400 bar (0 to 6000 lbf/in<sup>2</sup>) pressure test gauge to port 'G' (gauge) of the test block **1**.

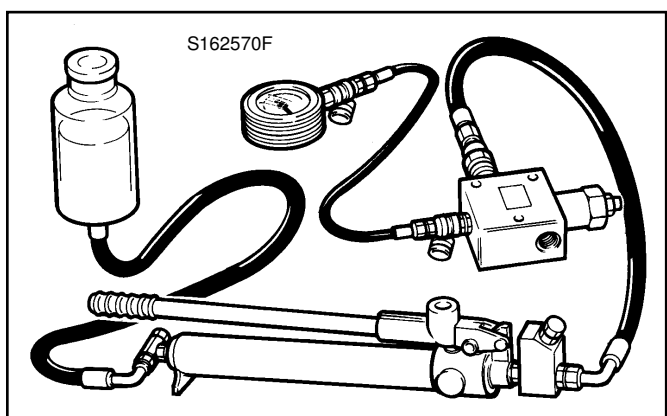
Port 'T' (tank) can be left open when using a hydraulic hand pump.



- 7 Raise the pressure at the valve inlet using the hydraulic hand pump, when the A.R.V. 'cracks' and oil escapes from the port marked 'T' the pressure gauge will indicate the A.R.V. setting.

If the A.R.V. setting is correct, move to step 12.

If the A.R.V. setting is not correct, move to step 8.



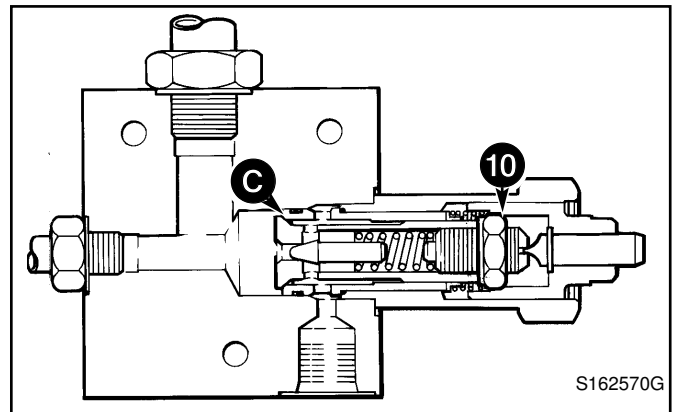
## Auxiliary Relief Valves - Using Hand Pump

- 8** Use the hand pump to raise approximately 172 bar (2500 lbf/in<sup>2</sup>) pressure at the valve inlet.

**Note:** Raising the pressure at the valve inlet locks the anti-cavitation cone **C** onto its seat, this allows the A.R.V. adjusting screw lock nut **10** to be loosened (step 10).

If the pressure is maintained move to step 10.

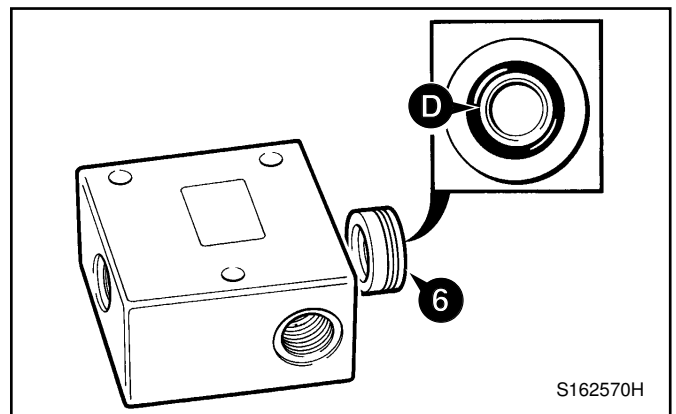
If the pressure falls off rapidly, or if no pressure can be obtained it is possible that the anti-cavitation cone is not seating effectively, in this instance move to step 9.



- 9** If no pressure can be raised (see step 8) at the valve inlet, remove the A.R.V. assembly and install anti-cavitation lock-out bung **6** in the port marked 'RV', make sure that the bung O-ring face seal **D** is facing out. Re-fit the A.R.V. assembly.

**Note:** The anti-cavitation lock-out bung seals and locks the A.R.V. anti-cavitation function. The bung is only suitable for the test block application and must NEVER be fitted to the valve block.

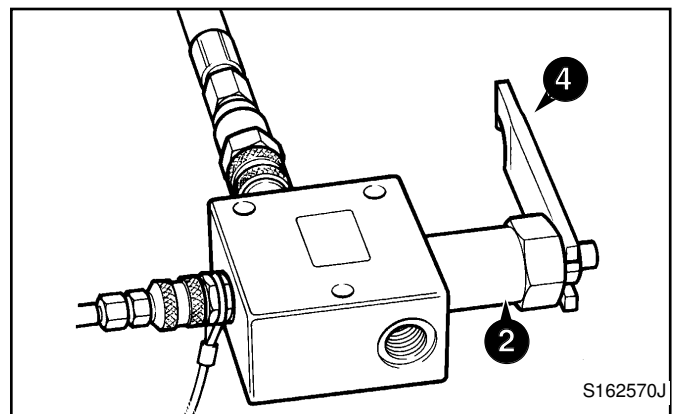
The bung can be extracted using a 3/8 - 16 UNC threaded bolt.



- 10** Release the A.R.V. adjusting screw lock nut (see note):

Engage the nut at the end of setting body **2** using the slot in special spanner **4**, turn the nut anti-clockwise to release the A.R.V. adjusting screw lock nut.

**Note:** Remember, it will not be possible to release the lock nut if there is not approximately 172 bar (2500 lbf/in<sup>2</sup>) pressure at the valve inlet.

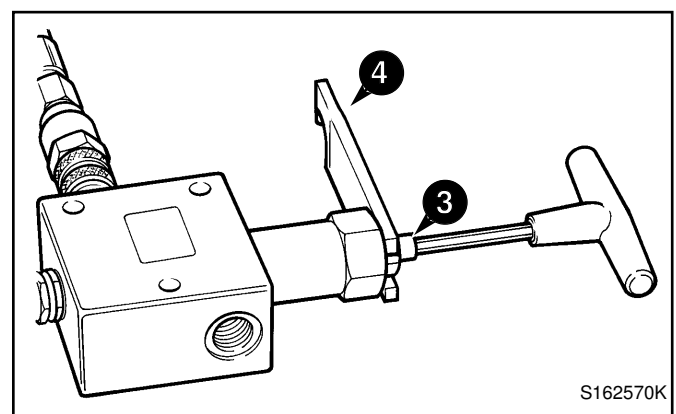


- 11** Insert an allen key into adjusting pin **3** (T-Bar type shown). Push the adjusting pin down and make sure it has engaged with the A.R.V. adjusting screw.

Rotate the T-bar clockwise to increase the pressure setting and anti-clockwise to decrease the pressure setting.

After adjustment, use the slot in spanner **4** to lock the A.R.V. adjusting screw lock nut (see note).

**Note:** Remember, pressure must be maintained at the valve inlet to ensure the lock nut is tightened.





### Auxiliary Relief Valves - Using Hand Pump

- 12 When the correct A.R.V. setting has been attained, release the pressure in the test block. Remove the A.R.V. sub-assembly and its setting body from the test block.

Separate the A.R.V. sub-assembly from its setting body.

Install the A.R.V. sub-assembly into its cap.

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## Excavator Valve - Pressure Testing

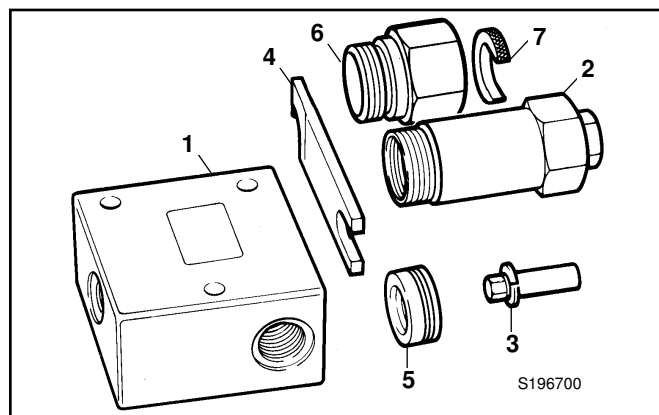
### Auxiliary Relief Valves - Using Hand Pump

The auxiliary relief valves found in the backhoe valve block are identical in design to those found in the loader valve block.

Therefore please refer to **Loader Valve - Pressure Testing, Auxiliary Relief Valves (ARV's)** for the correct pressure test procedures.

To pressure test and re-set the auxiliary relief valves (A.R.V.'s), service kit 892/00309 must be used.

The service kit comprises; a test block **1**, a setting body **2** with adjusting pin **3**, a special spanner **4**, anti-cavitation lock out bung **5**. A.R.V. cartridge removal tool 892/00335 comprises; an extractor cap **6** and a 'C' washer **7**.



**Excavator Valve - Precision Control (Servo)**

\* (Machines up to serial no. 931159)

**Pressure Testing**

**Load Sense Drain Regulator and Relief Valve**

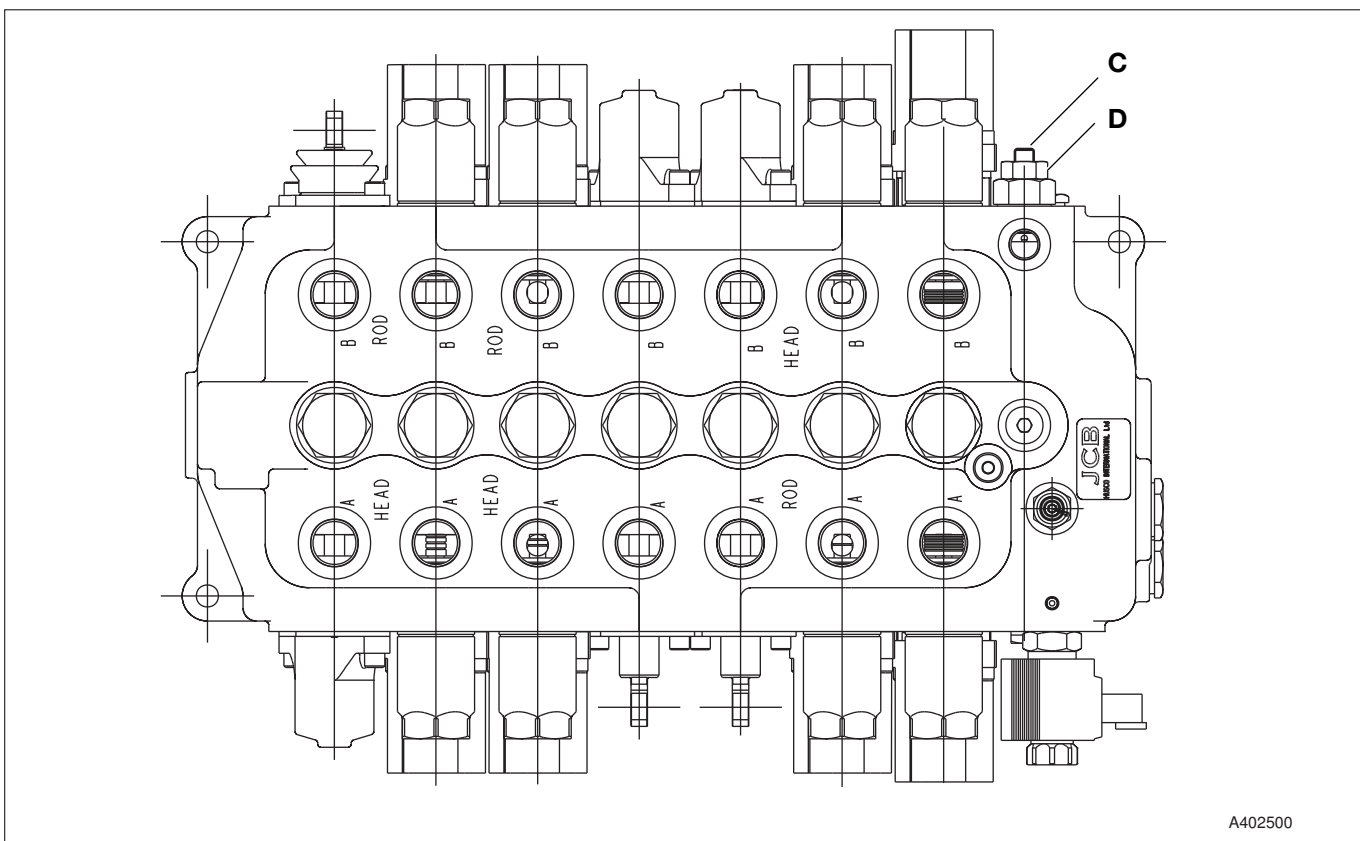
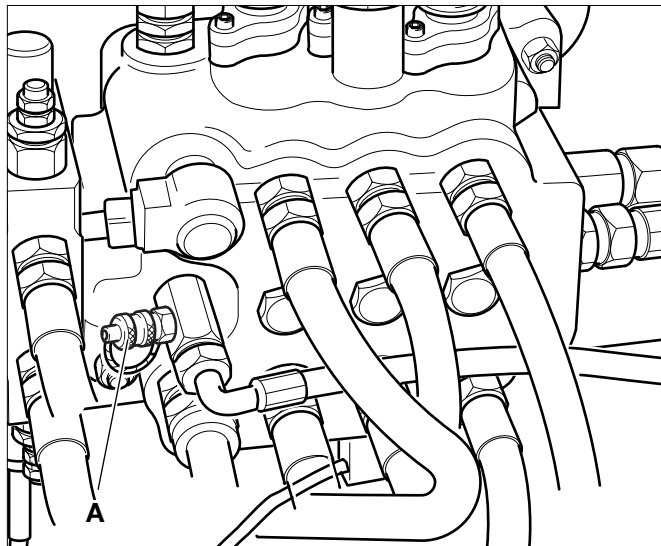
Make sure that the hydraulic oil is at working temperature, i.e. 50°C (122°F).

Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.

- 1 Connect a 0 - 400 bar (0 - 6000 lbf/in<sup>2</sup>) pressure gauge to pressure test connector **A** on the loader valve, (refer to **Service Tools**).
- 2 With the engine running at 1500 revs/min, check that the M.R.V. pressure is correct, see **Loader Valve - Pressure Testing, Main Relief Valve**.
- 3 With the engine running at 1500 revs/min, operate a stabiliser service fully and at the same time note the reading in the gauge which should be as stated in **Technical Data**.

**Note:** The ram must be 'held' open or closed when reading gauge.

- 4 If the pressure is incorrect, loosen locknut **D** and adjust screw **C**. Turn the screw **C** clockwise to increase pressure and anti-clockwise to decrease the pressure. When the pressure is correct, tighten the locknut and check the pressure again. Adjust as required.



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**Excavator Valve - Precision Control (Servo)**  
(Machines from January 2003)

**Pressure Testing**

**Load Sense Relief Valve**

TBA

## Excavator Valve - Precision Control (Servo)

### Pressure Compensator Network - Testing

The pressure compensator valve network can be easily checked as follows:

- 1 Start the engine and operate the hydraulic system until the oil is at working temperature.
- 2 With the engine at 1500 revs/min operate each service in turn starting with the service furthest from the pump inlet section.

If one control valve section function either fails to work or is slow to work in either one or both directions, the pressure compensator valve in that section may be at fault.

When a pressure compensator valve is suspected of malfunctioning, do the following check:

- 3 Stall any control valve that is nearer the pump inlet section than the suspected control valve section. This should stall the entire system. While at stall operate the malfunctioning valve section, if the section operates correctly the pressure compensator valve in question is at fault.

If the section still malfunctions the pressure compensator valve is NOT at fault.

**Note:** The pressure compensator valves may be removed for inspection, refer to **Excavator Valve - Dismantling and Assembly**. Clean and refit, or fit a new pressure compensator valve as required.

## 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.**

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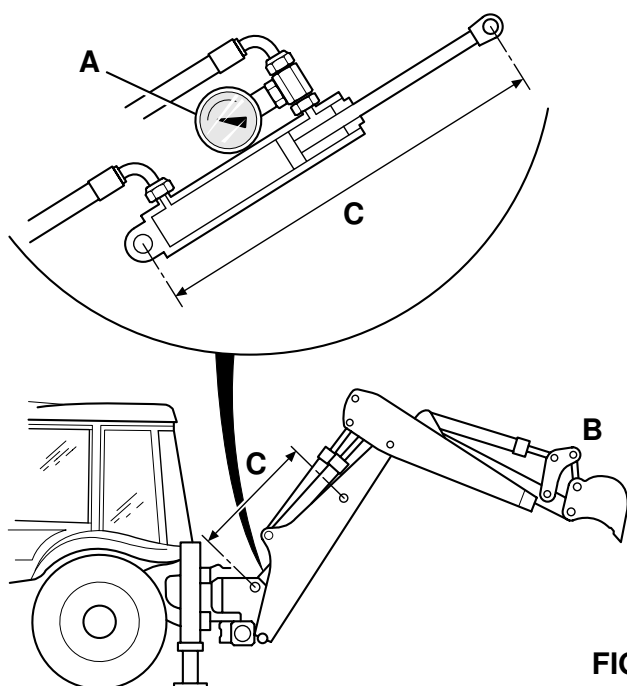
### **⚠ WARNING**

**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**

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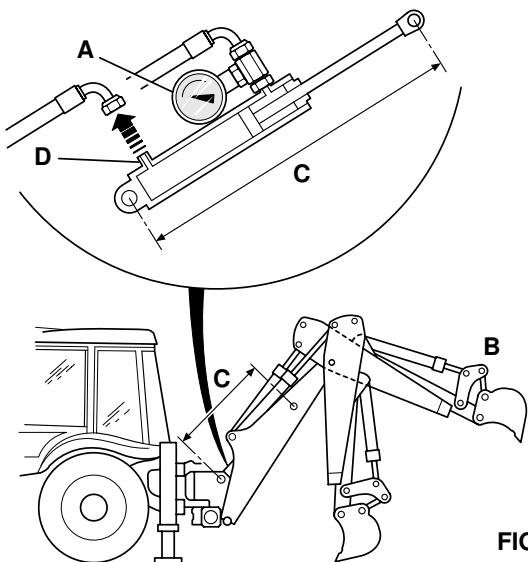
- 3 Operate the rams to ensure they are full of hot oil.
- 4 Apply a load to the suspect ram for example the boom ram by raising the dipper to the horizontal as at **B**.
- 5 Measure the actual piston rod movement over 10 minutes. Measure the movement by checking the pivot pin to pivot pin dimensions 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**.

**B Test Cylinder/Piston Leakage**

- 1 Ensure that the oil temperature is at 50°C (122°F) by using the hydraulic oil temperature probe detailed in A1.
- 2 Take the weight off the ram to be tested, in this example, by positioning the backhoe with dipper vertical and bucket on the ground.
- 3 Use a suitable pressure gauge **A** to blank off the supporting port of the ram.
- 4 Disconnect the hose from the opposite port **D** and leave the port open to atmosphere.
- 5 Apply a load to the suspect ram for example the boom ram by raising the dipper to the horizontal as at **B**.
- 6 After the initial movement measure the pin to pin movement as at **C** and note the rod movement over 10 minutes.
- 7 If rod movement is evident the ram is defective.



**FIG 2**  
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**C Test Spool Leakage**

**Note:** The following procedure applies only to services fitted with A.R.V.'s. Note A.R.V.'s are not fitted to loader lift, loader auxiliary, stabilisers or to the bucket rod side service except when a Rockbreaker is fitted.

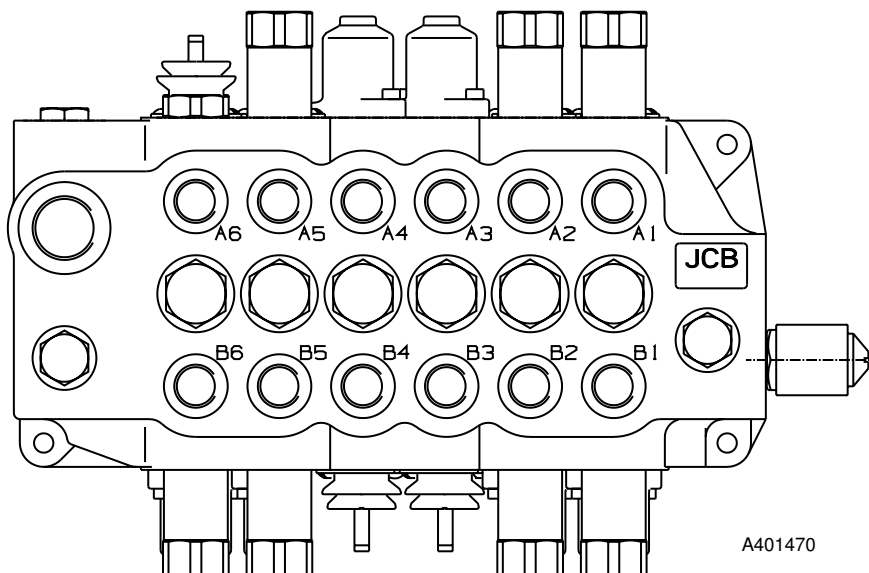
- 1 Render the A.R.V.'s inoperative in the suspect service. This is achieved by removing the A.R.V. and replacing with a blanking plug (part no. 25/609901) and seal kit (25/610301).
- 2 Re-check the piston rod movement as described steps A1 to A6.

**A.R.V. Control Layout**  
**JCB ISO**

<b>Slew</b>		
- Right	B1	B1
- Left	A1	A1
<b>Boom</b>		
- Rod	B2	B5
- Head	A2	A5
<b>Dipper</b>		
- Rod	A5	A2
- Head	B5	B2
<b>Bucket</b>		
- Rod	A6	A6
- Head	B6	B6

**Note:** Bucket ram rod side ARV only fitted to machines equipped with Rockbreakers.

- 3 If the rod movement is now acceptable the A.R.V. must be at fault. The A.R.V. may only require cleaning and then resealing. If dirt is evident, the hydraulic tank should be drained and cleaned. It is recommended that when re-filling the hydraulic tank that new oil and filter be used to prevent further contamination. If the A.R.V. is worn it should be replaced.



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**Table 1**

Ram	Cylinder Dia. (mm)	Rod Dia. (mm)	Total Displacement - mm/10 minutes @		
			69 bar (1000 lb/in <sup>2</sup> )	138 bar (2000 lb/in <sup>2</sup> )	207 bar (3000 lb/in <sup>2</sup> )
<b>HEAD SIDE</b>					
<b>Backhoe</b>					
S/shift Jack Leg	70	40	13	44	91
Knuckle	100	60	6	16	32
Ext Dip	70	40	13	32	65
<b>Loader</b>					
Clam	70	40	6	22	45
Lift	80	50	5	17	35
Lift	90	50	4	13	28
<b>ROD SIDE</b>					
<b>Backhoe</b>					
Boom	110	60	8	26	52
Boom	120	65	6	22	44
Boom	130	70	5	19	37
Boom	140	75	5	16	32
Bucket	90	50	11	45	114
Bucket	100	60	10	40	99
Dipper	100	60	10	34	70
Dipper	110	65	8	28	57
Ext Dip	70	40	19	66	96
<b>Loader</b>					
Shovel	70	40	10	33	68

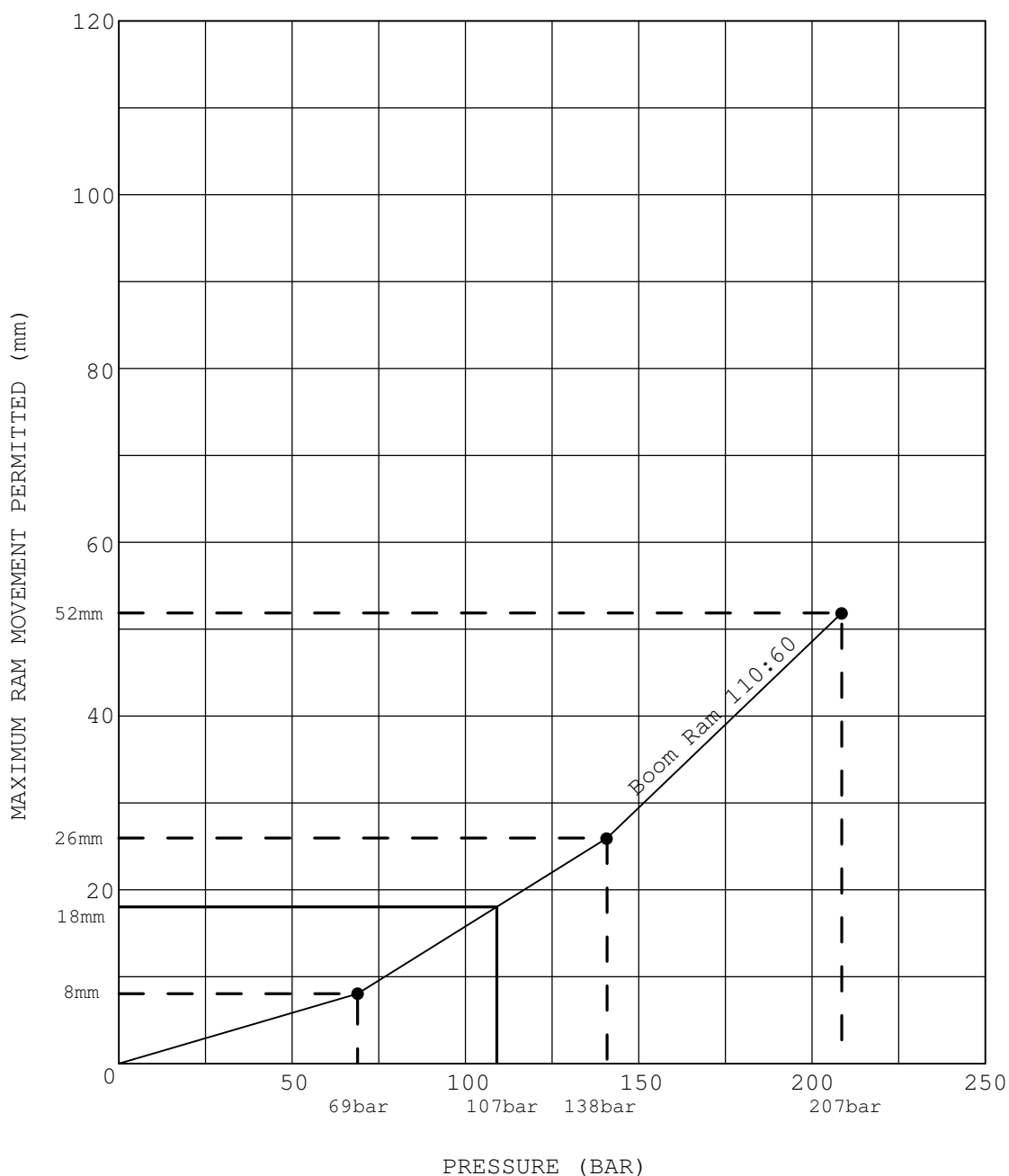
Using the figures above, a graph can be plotted and the maximum amount of movement determined. See the next page for a working example.



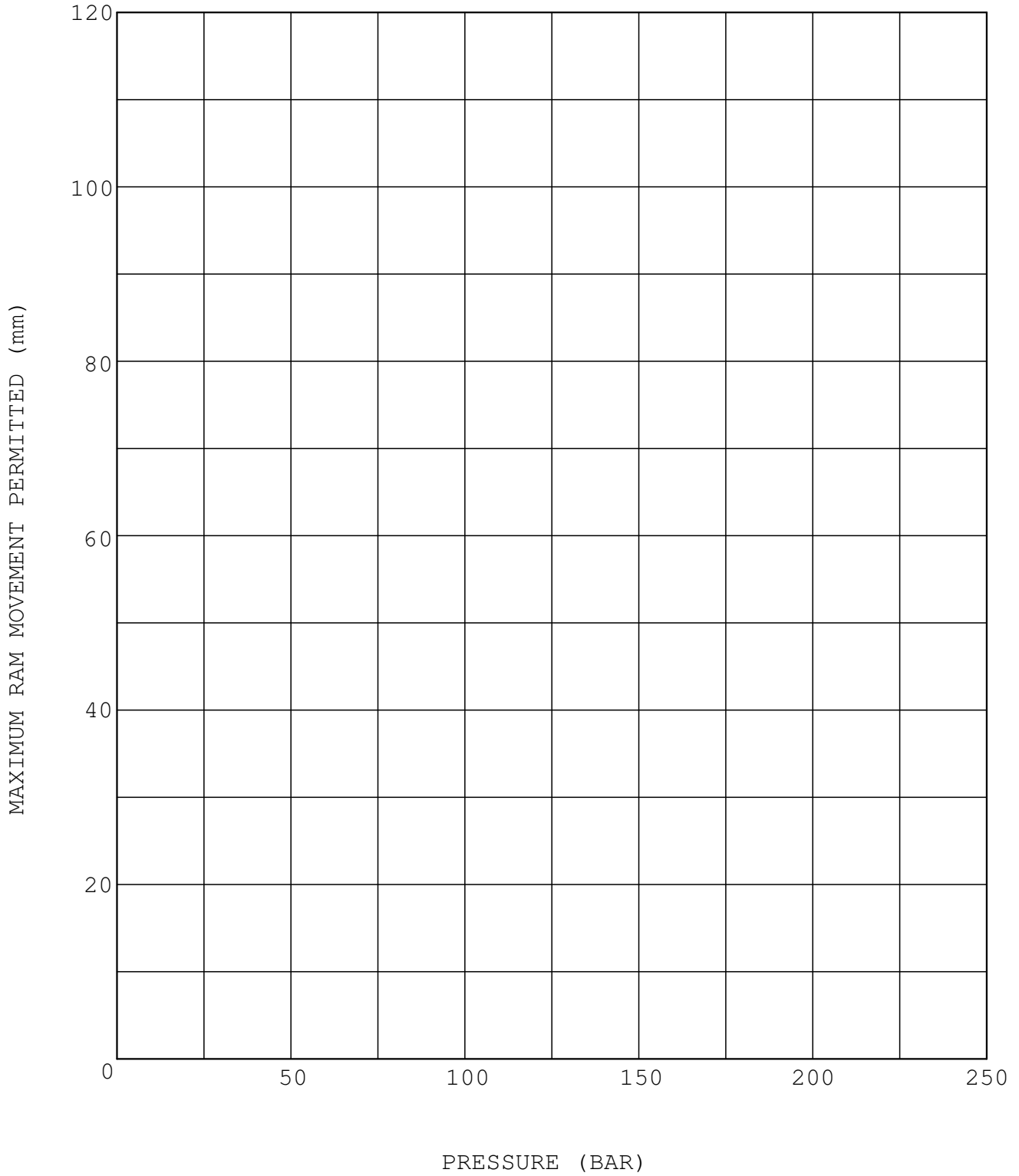
**EXAMPLE - Boom Ram 110 x 60**

- 1 Using the figures given in the table on page 3, plot a graph for the ram to be tested.
- 2 Check the pressure in the ram (induced by the applied load). In this example the pressure on the gauge reads 107 bar; 1500 lb/in<sup>2</sup>.
- 3 Draw a vertical line from the pressure reading to the plotted graph line. Where the vertical line intercepts the graph line, draw a horizontal line and read the permitted ram displacement. In this example the permitted maximum displacement is 18 mm.

**Note:** A blank graph is provided on the next page, photocopy and use as required.



380210



380220

## Quick Release Couplings - Connecting and Disconnecting

Flat face quick release couplings allow the operator to remove and install attachments swiftly and efficiently. Generally, your machine pipework will have female couplings **A** fitted, and the optional attachment hoses will have male couplings **B** fitted.

The quick release couplings should be trouble free and relatively easy to connect and disconnect, provided they are kept clean and used correctly. The recommendations listed below should always apply when using flat face quick release couplings.

Finally, please read the correct fitting and releasing procedures before installing or removing any optional attachment fitted with quick release couplings.

### Quick Release Couplings - Do's & Don'ts

**DO** wipe the two faces of the coupling and make sure they are clean before connecting.

**DO** make sure the outside sleeve (female coupling) is pulled back when disconnecting.

**DO** connect and disconnect a new coupling two or three times to 'work' the PTFE seals - sometimes a new coupling will stick if the seals have not been 'worked'.

**DO** use a spanner on the hexagon flats of the coupling when fitting adaptors.

**DO** use a rubber or hide hammer to disconnect a coupling if it sticks - sticking may occur if there is dirt present in the coupling.

**DON'T** attempt to re-connect a damaged half coupling - this will destroy the seals and necessitate replacing both half couplings.

**DON'T** leave the coupling where it may be run over by a machine or otherwise crushed - this will distort the coupling sleeve and prevent correct connection and disconnection.

**DON'T** clamp on the smooth diameter of the coupling when fitting adaptors - always use the hexagon.

**DON'T** try to turn the sleeve (female coupling) when the coupling has been disconnected - the locking ball will wedge underneath the sleeve and destroy the coupling.

**DON'T** damage the faces of the couplings - this can prevent connection and disconnection, or damage seals and cause leakage.

**DON'T** try to dismantle the couplings - they are non serviceable parts. If a coupling is damaged it should be replaced with a new one.

### ⚠ WARNING

**Hydraulic fluid at pressure can injure you. Make the machine safe before connecting or disconnecting quick release couplings; stop the engine and then operate the attachment control a few times to vent residual hydraulic pressure in the attachment hoses.**

2-4-1-11

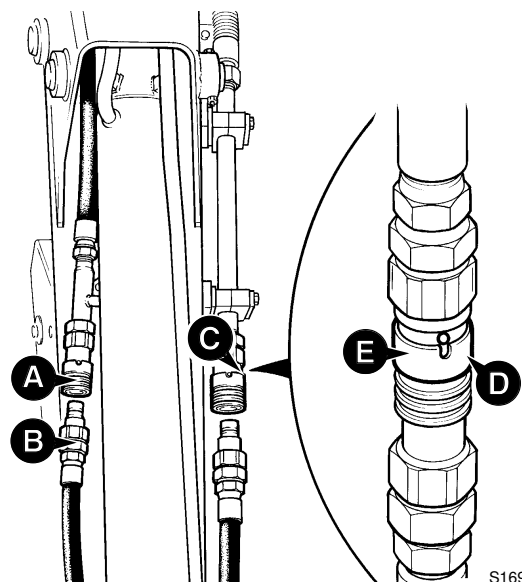
Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. This is usually achieved by switching off the engine and then operating the attachment control lever several times. Make sure the hose service line has been vented before connecting or removing hoses - refer to the appropriate attachment information in this section.

### Connecting Quick Release Couplings

- 1 Remove any residual hydraulic pressure trapped in the service line hose.
- 2 Wipe the two faces of the male and female couplings and make sure they are clean.
- 3 Make sure that ball **C** in the female coupling is located in one of its slots.
- 4 Fit the male coupling into the female coupling; To ensure that the coupling is not accidentally released, rotate sleeve **E** half a turn and make sure that the locking ball **C** does not align with the slot **D**.

### Disconnecting Quick Release Couplings

- 1 Remove any residual hydraulic pressure trapped in the service line hose.
- 2 Align the slot **D** with ball **C**.
- 3 Pull back sleeve **E** to release the coupling.



## Smooth Ride System

### Charging/Discharging the Accumulator

#### Charging

- 1 Park the machine on level ground, lower the loader arms, switch off the engine and chock all four wheels. Release all hydraulic pressure in the accumulator by selecting the starter key to the ON position without the engine running, SRS ON and operating the loader arm hydraulic lever.
- 2 Remove gas valve guard **A** and gas valve cap **B**.
- 3 Screw T handle **C** all the way out (counter clockwise) before attaching charging tool (service tool 892/00948) to accumulator gas valve.
- 4 Close bleed valve **D**.
- 5 Making sure not to loop or twist the hose, connect the charging tool to the gas valve. Tighten to 1.0 lbf ft (1.36 Nm, 0.14 kgf m).
- 6 Connect charging tool to a bottle of compressed nitrogen gas.
- 7 Screw T handle **C** all the way in (clockwise), this will depress the core in the gas valve. Check charge pressure which should be set to suit the loader and the attachment fitted to the machine. For recommended charge pressures refer to **Technical Data - Smooth Ride System**.
- 8 If charge pressure is low, carefully open hand valve **E** on the nitrogen bottle and SLOWLY fill the accumulator. Close valve **E** when the required charge pressure is reached on the gauge.
- 9 Let the pressure settle for 10 to 15 minutes. This will allow the gas temperature to stabilise. If the charge pressure is exceeded, with the gas bottle closed, open bleed valve **D**. Reduce pressure as required, then close bleed valve.

#### **CAUTION**

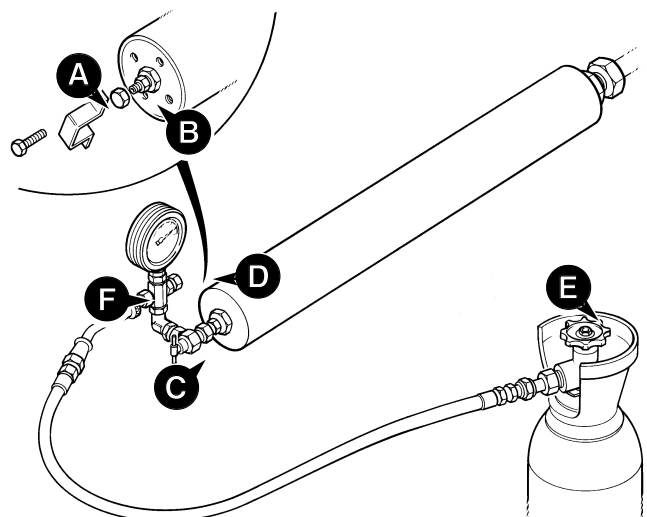
To reduce pressure use the recommended charging tool or the charge valve could be damaged which may result in rapid discharge of the accumulator.

HYD 2-4

- 10 When complete screw T handle **C** all the way out (counter clockwise) then open the bleed valve **D** to vent the hose.
- 11 Hold the gas valve to keep from turning, loosen nut and remove charging tool.
- 12 Refit gas valve cap and valve guard.

#### Discharging

- 1 Park the machine on level ground, lower the loader arms, switch off the engine and chock all four wheels. Release all hydraulic pressure in the accumulator by selecting the starter key to the ON position without the engine running, SRS ON and operating the loader arm hydraulic lever.
- 2 Remove gas valve guard **A** and gas valve cap **B**.
- 3 Screw T handle **C** all the way out (counter clockwise) before attaching charging tool (service tool 892/00948) to accumulator gas valve.
- 4 Close bleed valve **D**.
- 5 Either connect charging tool to a bottle of compressed nitrogen gas which is turned off or remove hose **F** and fit a suitable blank on charging tool.
- 6 Screw T handle **C** all the way in (clockwise), this will depress the core in the gas valve.
- 7 Open bleed valve **D** until all the gas charge is relieved from the accumulator. Remove the charging tool.



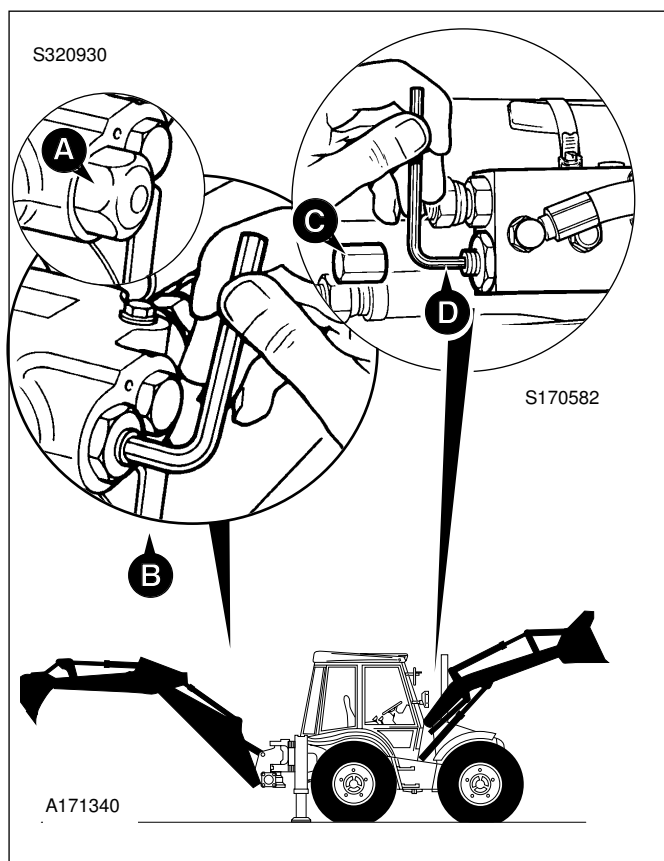
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## Hose Burst Protection Valves

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

- 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, adjust or replace the hose burst protection valve as applicable.



### 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 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, refer to **Pressure Testing - Loader Lift Ram**) or a new end cap and valve assembly fitted (Boom HBPV, refer to **Hose Burst Protection Valves - Dismantling and Assembly**), 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 an 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 HCPV 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 an 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.

## Hose Burst Protection Valves

### Pressure Testing - Loader Lift Ram

The following text describes the pilot valve setting procedures and pressure testing sequences for ONE HBPV only, repeat the procedures for BOTH loader arm lift rams.

#### Preparation

Before starting the pressure testing procedure vent hydraulic system pressure as follows:

- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral.
- 2 Lower the loader arms to the ground (not lifting the machine).
- 3 Select 'ARMS LOWER' to raise the front wheels approximately 25 - 50 mm (1 - 2 in) off the ground.
- 4 Switch off the engine.
- 5 Make sure all personnel are clear of the machine before completing step 6.
- 6 Select 'ARMS RAISE' - this will vent residual hydraulic pressure from the loader rams (head side).
- 7 Move all the backhoe control levers back and forth to vent any other residual hydraulic pressure from the backhoe service hoses.

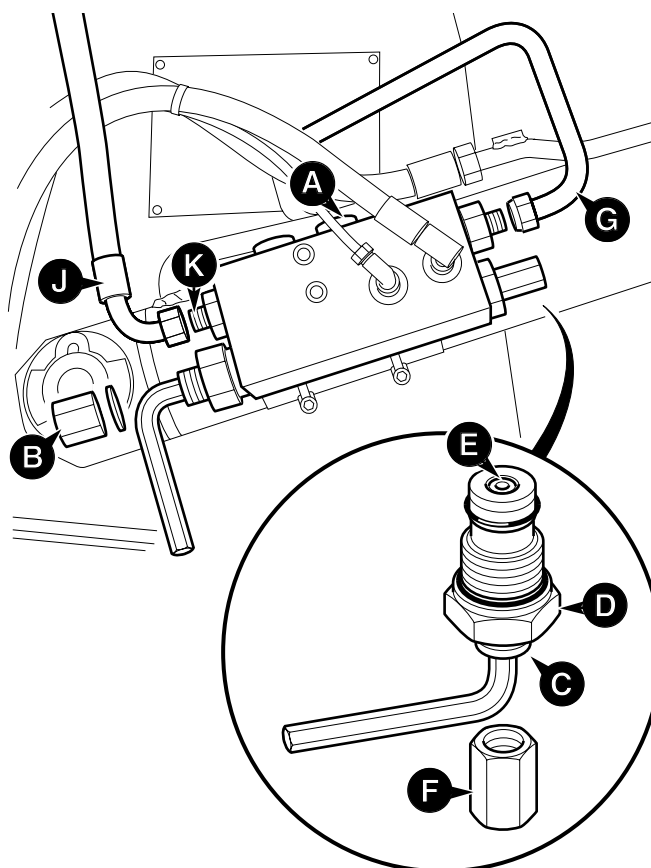
#### Pilot Valve Setting Procedure

The pilot valve assembly, shown at **C**, must be set correctly before doing the relief valve pressure test. If the pilot valve is screwed too far into the HBPV it will create a flow path connection from port C2 to port V2 (see descriptions of operation).

To set the pilot valve assembly:

- 1 Remove pilot housing, item **D**, from the HBPV.
- 2 Check that the end face of the pilot valve assembly, item **C**, is flush (level) with the end face of its housing **D**, as shown at **E**.
- 3 If necessary, remove end cap **F** and, using a suitable Allen key, adjust the pilot valve as required.
- 4 Refit the end cap.

Continued.....



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## Hose Burst Protection Valves

### Pressure Testing - Loader Lift Ram (continued)

#### Relief Valve Pressure Test

If the hose burst protection valve has been stripped and cleaned, then pre-set the valve as detailed in step 1. The pressure test procedure is described in steps 2 to 6.

- 1 Pre-set the relief valve:
  - a Remove cap **B** and its copper washer. Using an Allen key, turn the adjusting screw anti-clockwise to remove all tension.
  - b Using your fingers, turn the adjusting screw clockwise until a soft force (resistance) is felt.
  - c Using an Allen key, turn the adjusting screw a further  $2\frac{1}{4}$  turns to pre-set the relief valve. Refit the cap and washer.
- 2 Remove hose **G** from port C2. Cap and plug the hose and valve port adapter (the valve port adapter **MUST** be plugged, otherwise the test procedure will not work).
- 3 Remove hose **J** from port V2. Plug the hose but **DO NOT** cap the valve port adapter.
- 4 Remove plug **A** and in its place fit a 0-400 bar (0-6000 lbf/in<sup>2</sup>) pressure gauge connected to a hand pump.
- 5 Use the hand pump to increase the pressure. When the pressure reaches the setting of the relief valve, oil will escape from port V2, shown at **K**. Note the maximum gauge reading (the setting of the hose burst relief valve) which should be 250 bar (3625 lbf/in<sup>2</sup>).
- 6 If necessary, adjust the pressure setting as follows:
  - a Remove cap **B** and its copper washer.
  - b Using an Allen key, turn the adjusting screw clockwise to increase the pressure or anti-clockwise to decrease the pressure. For information; one full turn of the relief valve adjusting screw is equivalent to approximately 110 bar (1595 lbf/in<sup>2</sup>).
  - c Replace the cap and washer.
  - d Repeat pressure test, adjust as necessary.

**Fixed Flow****Removal and Replacement**

The following Procedure describes removal and replacement of a double section pump, follow the same procedure for single section pumps.

**Removal****⚠ WARNING**

**Make the machine safe before getting beneath it. Ensure that any fitments on the machine are secure; engage the parking brake, remove the starter key, disconnect the battery.**

INT-3-3-8

- 1 Remove the propshaft, refer to Section F **Propshafts - Removal and Replacement**.
- 2 Drain the hydraulic fluid from the hydraulic tank.
- 3 Remove flange bolts **B** (4 off) and disconnect the pump inlet hose flange from the pump body. Blank off all exposed connections to prevent ingress of dirt.
- 4 Disconnect the pump outlet hoses **C** and **D** from the elbow fittings. Blank off all exposed connections to prevent ingress of dirt.

**⚠ CAUTION**

**The hydraulic pump is heavy. Do not attempt to remove the pump unless its weight is held by a sling. Make sure that the sling is attached to a suitable lifting appliance.**

HYD 2-3

- 5 Secure the pump using a sling around the pump body, remove the pump mounting bolts **E** and carefully withdraw the pump clear of the gearbox.

**Torque Settings**

Item	Nm	kgf m	lbf ft
<b>B</b>	TBA		
<b>E</b>	TBA		

**Replacement**

Replacement is the reverse of the removal procedure.

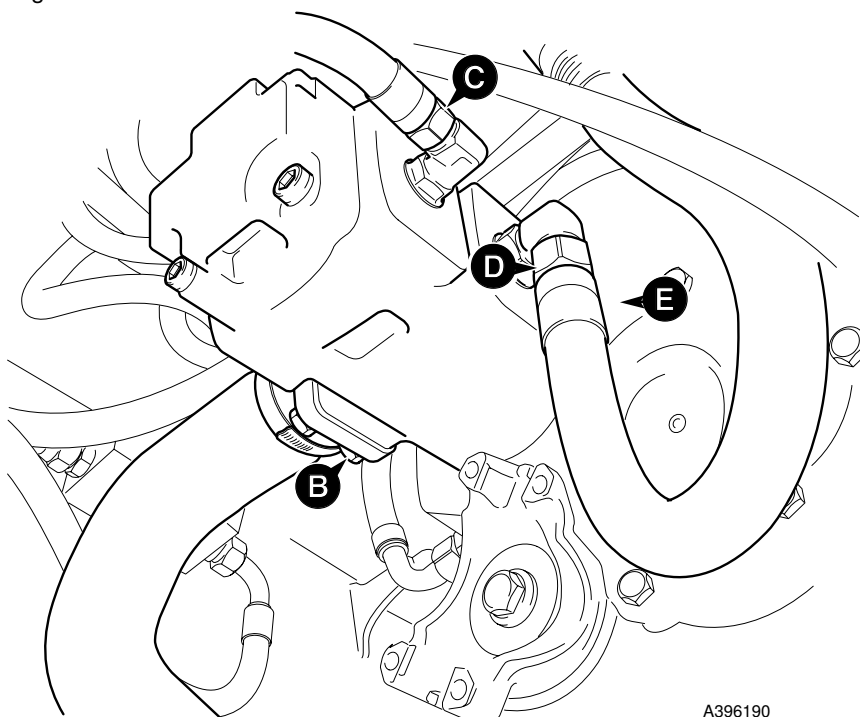
- 1 Clean off all traces of gasket compound from the pump and gearbox mounting faces. Apply a thin bead of JCB Multigasket to the gearbox mounting face.
- 2 Locate the splined shaft of the pump into the gearbox. Apply JCB Threadlocker and Sealer to bolts **E** and secure the pump flange to the gearbox mounting face.
- 3 Reconnect the pump outlet hoses **C** and **D** to the elbow fittings.

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

- 4 Reconnect the pump inlet hose flange to the pump body with bolts **B** (4 off).
- 5 Fit the propshaft, refer to Section F **Propshafts - Removal and Replacement**.
- 6 Fill the system to the correct level with recommended hydraulic fluid, refer to Section 3 **Fluids, Lubricants, Capacities and Specifications**.

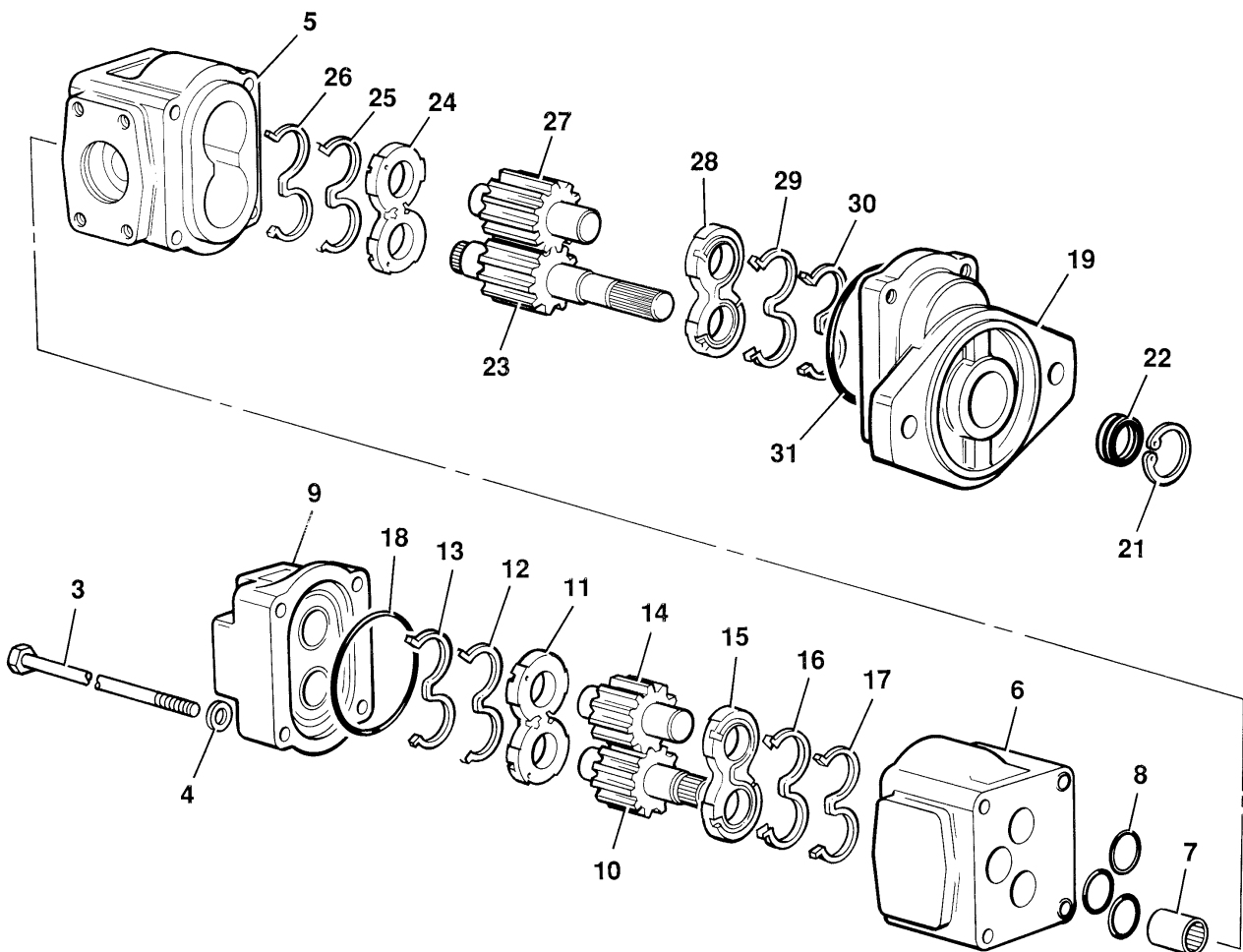
**Note:** Replace the suction strainer and return line filter after fitting a new or serviced pump.

- 7 After fitting a new or serviced pump and before starting the engine screw the main relief valve out. Run the engine and check for leaks, also check the main relief valve (M.R.V.) operating pressure. Refer to Section E **Service Procedures, Pressure Testing - MRV**.



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## Fixed Flow

### Dismantling and Assembly

Before removing and dismantling the pump, check flow and pressure. If either of these are low the pump must be changed. Renewal of components such as gears, bearings and housing will not effect a permanent cure. If the pump output is satisfactory but there is external leakage, the pump should be removed and dismantled for re-sealing only.

Before removing and dismantling the pump, make sure the exterior of the pump and working area is thoroughly cleaned and free of possible sources of contamination.

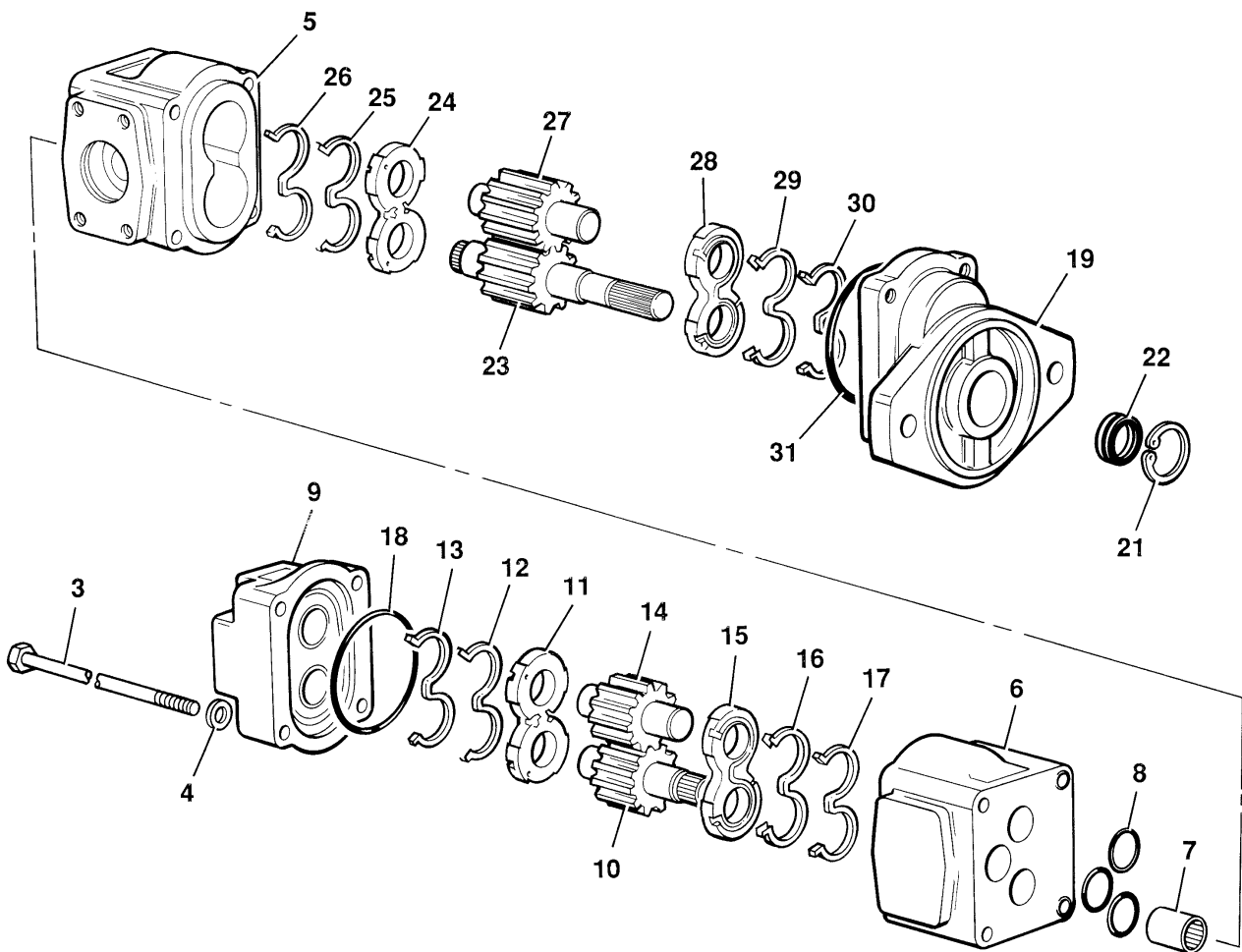
#### Dismantling

- 1 Remove the four bolts **3** and serrated washers **4** which clamp the units together.
- 2 Use a soft faced hammer to separate front body **5** and rear body **6** after first marking them to ensure correct re-assembly.
- 3 Remove splined coupling **7** and O-rings **8**. Discard the O-rings.
- 4 Use a soft faced hammer to separate end cover **9** from rear body **6**, after first marking them to ensure correct re-assembly.
- 5 Remove drive gear **10** from its bore. Pushing it out of the rear body will also remove balance plate **11** complete with seal **12** and seal energiser **13**. Discard the seal and seal energiser. Note the position of the driveshaft and the balance plate to ensure correct re-assembly.
- 6 Remove driven gear **14**, followed by balance plate **15** complete with seal **16** and seal energiser **17**. Discard the seal and seal energiser.
- 7 Discard O-ring **18**.
- 8 Use a soft hammer to separate mounting flange **19** from front body **5**, after first marking them to ensure correct re-assembly.
- 9 Remove circlip **21** and shaft seals **22**. Note which way round the seal lips are fitted to ensure correct fitting of new seals on re-assembly.
- 10 Remove driveshaft **23** from front body **5**. Removal will also remove balance plate **28** complete with seal **29** and seal energiser **30**. Discard the seal and seal energiser.
- 11 Remove driven gear **27** followed by balance plate **24**, seal **25** and seal energiser **26**. Discard the seal and seal energiser.

- 12 Discard O-ring **31**.
- 13 Remove all sealant from the contact faces of the mounting flange/front body and end cover/rear body interfaces.
- 14 Wash all components and immediately apply a coating of hydraulic oil to prevent corrosion.

#### Inspection

- 1 Generally check all pump parts for damage and/or wear. The O-ring grooves, the seal recess in the mounting flange and all sealing faces must be free of burrs and scores which could result in seal damage and hence hydraulic oil leakage.
- 2 Renew the pump if any of the following symptoms exist:
  - a The PTFE coated bearings in the pump bodies, the mounting flange and the end cover are worn through to reveal the bronze backing.
  - b The gear side faces are scored. Often contaminated fluid results in a distinct wear step coincident with the gear root diameter. This can normally be felt by drawing a sharp point across the gear side face from the journal towards the tip of the gear.
  - c There is a noticeable wear groove on driveshaft **23** where seals **22** run.
  - d The balance plate faces are scored, particularly in the area adjacent to the gear root diameter.
  - e The shaft splines are worn or severely fretted.
  - f The gear "cut-in" area in the low pressure side of the pump body is deeper than 0.15 mm (0.006 in) or has a torn or pitted appearance.



S401450

## Fixed Flow

### Dismantling and Assembly (continued)

#### Assembling

When carrying out the following procedure, renew all seals and O-rings. Lubricate using JCB Special Hydraulic Fluid.

- 1 Fit shaft seals **22** into mounting flange **19**, making sure the seal lips are the correct way round as noted in dismantling. Fit circlip **21** into its groove in the flange. Coat the seal lips with high melting point grease.

**Note:** If the seal recess is scored, it is permissible to seal outside diameter with JCB Multigasket to prevent leakage.

- 2 Stand front body **5** on its rear face. Fit seal **25** and seal energiser **26** into balance plate **24**.
- 3 Ensuring that the seals do not fall out, carefully feed the balance plate into the bores of the front body **5** with the two small holes through the balance plate to the low pressure side of the body (i.e. side with the large 4-bolt port pattern).
- 4 Insert driveshaft **23** and driven gear **27** into the original bores.
- 5 Fit balance plate **28** over the driveshaft and gear stub. Insert seal **29** and seal energiser **30** into the balance plate.
- 6 Fit O-ring **31** into the groove on mounting flange **19**.
- 7 Apply a small amount of JCB Multigasket to the face of front body **5** which seals with mounting flange **19** (i.e. the face containing the clamping bolt holes).
- 8 Carefully feed mounting flange **19** over driveshaft **23** in its original position, as marked earlier. Use a soft faced hammer to tap the flange onto its location spigot.
- 9 Support the front pump assembly on the mounting flange (but not the driveshaft). Fit O-rings **8** into the grooves on the rear face of the front body **5**. Install splined coupling **7**.
- 10 Fit rear body **6** onto front body **5** in its original position, as marked earlier, ensuring that it locates on the dowels and that the clamping bolt holes line up.
- 11 Fit seal **16** and seal energiser **17** into balance plate **15**. Ensuring that the seals do not fall out, carefully feed the balance plate into rear body **6** with the two small holes through the balance plate to the low pressure side (i.e. side without a port).
- 12 Fit drive gear **10** so that it locates with splined coupling **7**. Fit driven gear **14**.

- 13 Fit balance plate **11** in its original position (i.e. with the two small holes to the low pressure side). Fit seal **12** and seal energiser **13** into the balance plate.

- 14 Fit O-ring **18** into end cover **9**.

- 15 Apply a small amount of JCB Multigasket to the exposed face of rear body **6** (i.e. the face containing the clamping bolt holes).

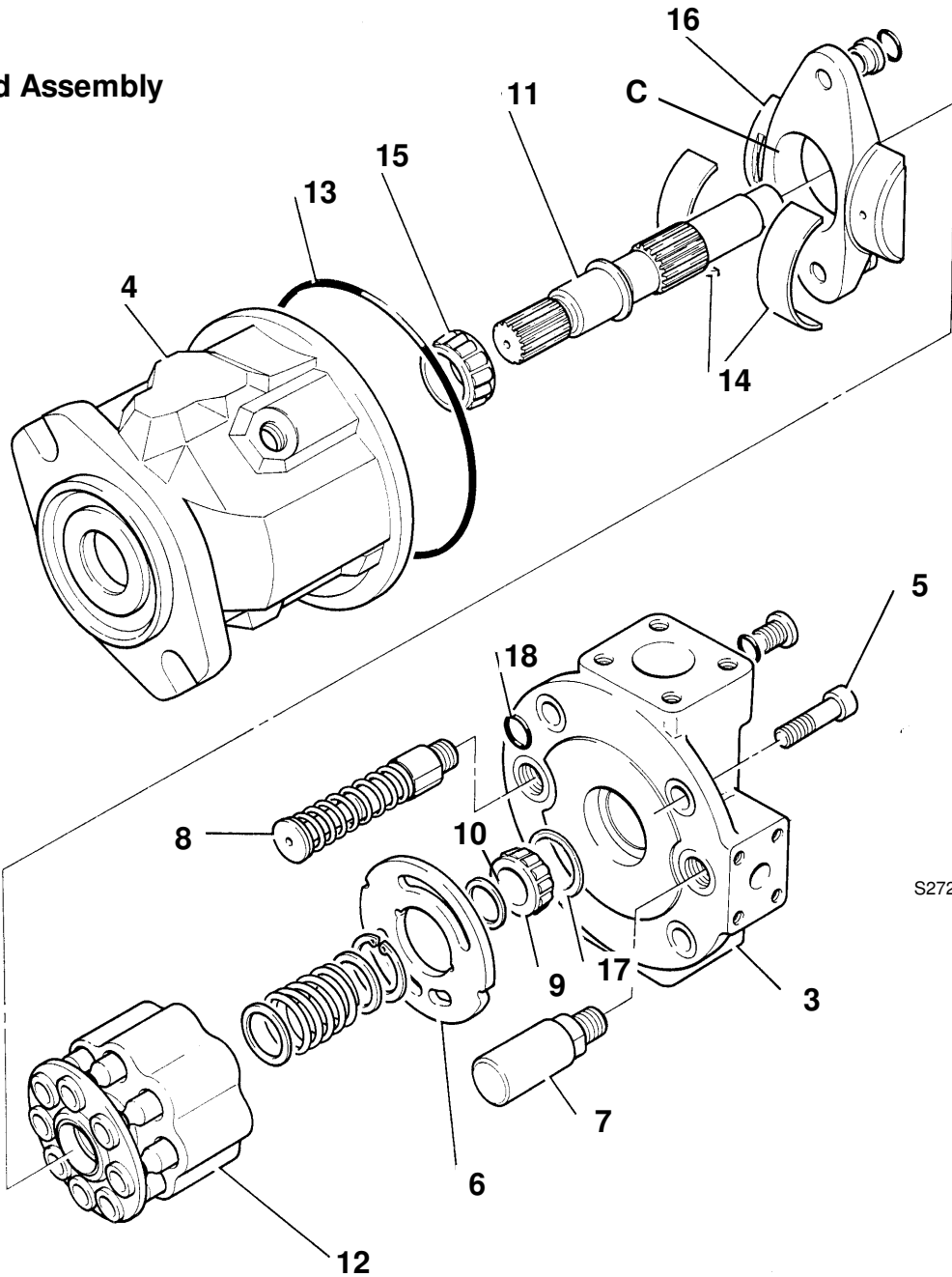
- 16 Fit end cover **9** in its original position, as marked earlier.

- 17 Install the four bolts **3**, each with a serrated washer **4**, and tighten evenly and progressively to a torque of 90 - 100 Nm (66 - 74 lbf ft).

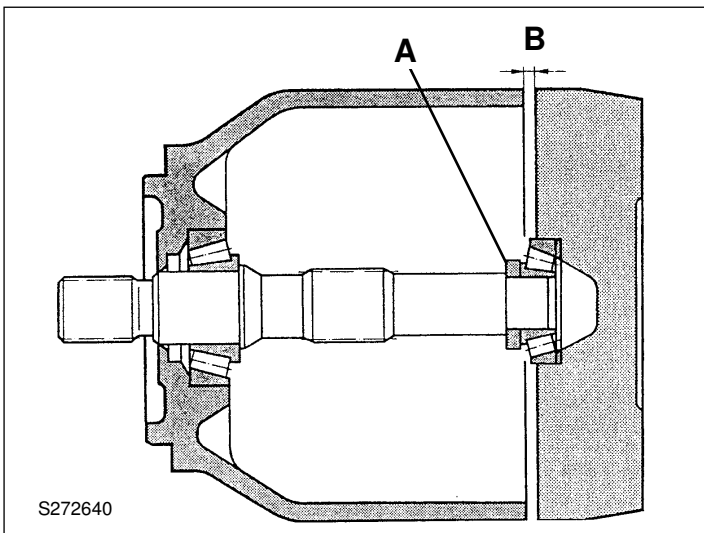
- 18 Pour a small amount of clean JCB Special Hydraulic Fluid into the ports. Check that driveshaft **23** rotates without undue force. If excessive force is required it is possible that one or more of the balance plate seals are trapped, in which case it will be necessary to dismantle and assemble the pump again.

Variable Flow

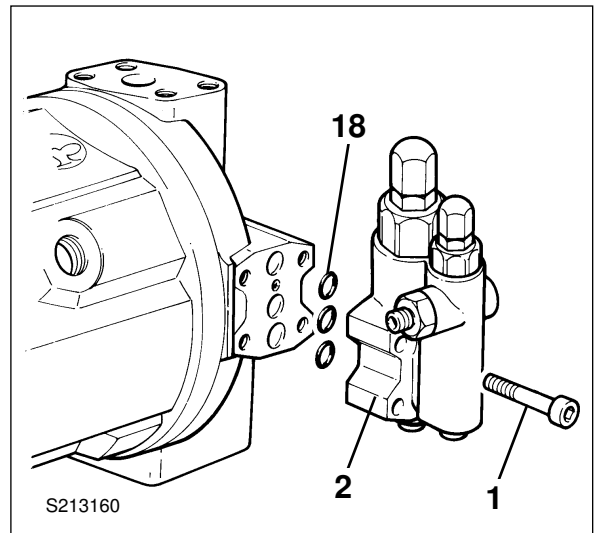
Dismantling and Assembly



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## Variable Flow

### Dismantling and Assembly

Before removing and dismantling the pump, make sure it is the pump that is at fault. Complete all the necessary checks as detailed in **Service Procedures, Variable Flow Pumps**. Make sure that the exterior of the pump and working area is thoroughly cleaned and free of possible sources of contamination. Following removal of the pump from the machine, transfer it to a clean dirt free environment ready for dismantling.

The variable displacement pump has matched-ground components. For this reason, some items will only be available as a sub-assembly, for instance the barrel and piston assembly.

All the 'O' rings, seals and bearings are available in a kit form from your JCB Distributor.

#### Dismantling

Refer also to **Service Procedures, Variable Flow Pumps - Renewing Drive Shaft Seal**.

- 1 Remove capscrews **1** (4 off) and detach the regulator assembly **2** from the pump housing.
- 2 Mark the position of the port plate **3** to pump housing **4**.
- 3 Remove socket screws **5**, and remove the port plate together with the valve plate **6**, control piston **7** and stroking piston **8**. Hold the plate in position during removal.
- 4 Remove taper roller bearing **9** and shim **10** from the drive shaft **11**.
- 5 Remove the rotary piston assembly **12** from the pump housing. Assembly includes shaft **11**, bearing **15**, and cradle **16**.
- 6 Remove and discard port plate to pump housing 'O' ring **13**.
- 7 Remove bearing shells **14** and disc **17**.
- 8 Remove the outer bearing races (not shown) from the pump housing and the port plate. Only remove the races if they are damaged and unserviceable.
- 9 Lift the valve plate **6** off the port plate, do not lose the dowel pins (not shown).
- 10 Remove and discard 'O' rings **18**.
- 11 Remove control piston **7**. Note that the control piston is mounted on the same side as the regulator valve.
- 12 Remove the stroking piston assembly **8**.

Further dismantling and assembly of the pump is not recommended.

#### Inspecting Parts

Generally check all pump parts for damage and/or wear. Any parts that are scored or damaged must be replaced with new ones.

The shaft 'O' ring grooves and all sealing faces must be free of burrs and scores. During assembly, make sure that the rotary piston group move freely. Renew all 'O' rings and seals.

#### Assembly

Assembly is generally a reversal of the dismantle procedure, but note the following:

The taper roller bearing must have a preload of 0.0 to 0.05mm (0.0 to 0.002in.). If the original bearing and shim is being fitted no preload adjustment is required. If a new bearing is installed a preload adjustment is required:

Preload Adjustment:

Install a setting shim of known thickness (as shown at **A**). The shim thickness must be manufactured to a tolerance of  $\pm 0.01\text{mm}$  (0.0004in.). In this example the shim thickness is 1.5mm.

Fit the port plate item **3** and finger tighten the socket screws. It is important that the socket screws are tightened evenly and the port plate sits square.

Using feeler gauges measure the gap **B** between the port plate and the pump housing **4**. Measure in more than one position to establish the port plate is fitted evenly. Obtain shim thickness (dimensions in mm):

Example measured gap	1.26
Subtract preload	- 0.05
<b>Total</b>	<b>1.21</b>
Known shim thickness	1.50
Subtract calculated preload	-1.21
<b>SHIM THICKNESS</b>	<b>0.29</b>

When the shim thickness has been calculated, remove the setting shim **A** and fit the required shim (in this instance the shim would be 0.29mm).

**Note:** Setting shim **A** is not currently available as a service tool. The shim (and the calculated shim) can be manufactured locally. Maintain a tolerance of  $\pm 0.01\text{mm}$  (0.0004in.).

The lubrication bore relief (item **C**) on the cradle must be fitted on the pressure side of the pump.

Check the control piston and the stroking piston move smoothly.

The regulator valve assembly is currently a non serviceable part.

## Removal and Replacement

### Manual Control

#### **⚠ 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.

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#### Removal

\* **Note:** The illustration shows a valve fitted with a bolt on auxiliary spool 1. This item is only fitted to some machines, typically Precision Control machines with extending dipper.

- \* 1 Operate the valve block levers back and forth to vent residual pressure. On Precision Control machines also operate the extending dipper foot pedal (if fitted).
- \* 2 Remove clevis pins **A** and nuts **B** to disconnect the control levers from the valve block spools. Disconnect the control cable **D** (if fitted). Undo the lock nut **E**. Undo the housing fixing screws and slide it down the cable. Remove the pin **F**.

- 3 Disconnect all hydraulic hoses from the valve block and plug all orifices to prevent ingress of dirt. Label each hose before disconnecting, this will ensure correct position when refitting.
- \* 4 Uncouple the dump solenoid electrical connector **G**. Uncouple the electric detent connector **H** (if fitted).
- \* 5 Loosen and remove the three fixing nuts **J**. Remove the loader valve and spacing washers **C**.

#### Replacement

Replacement is a reversal of the removal sequence.

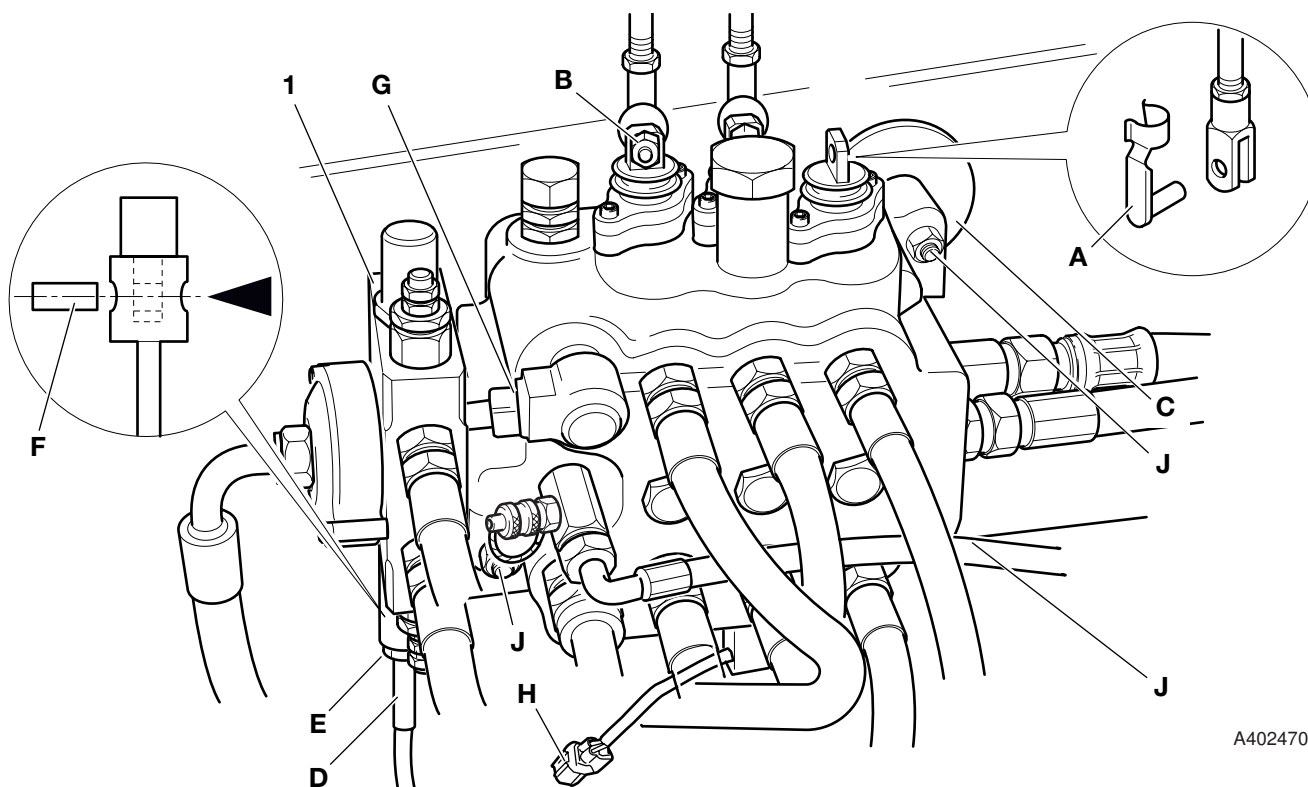
#### **⚠ WARNING**

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.

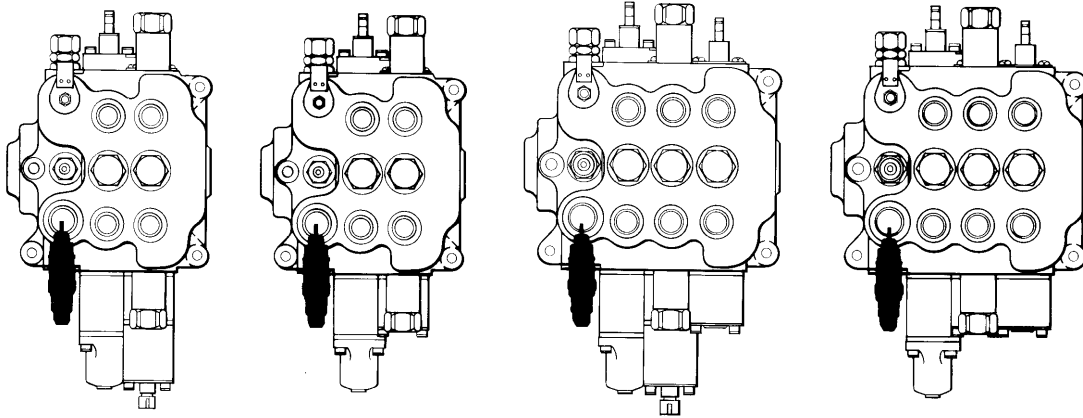
INT-3-1-10/1

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

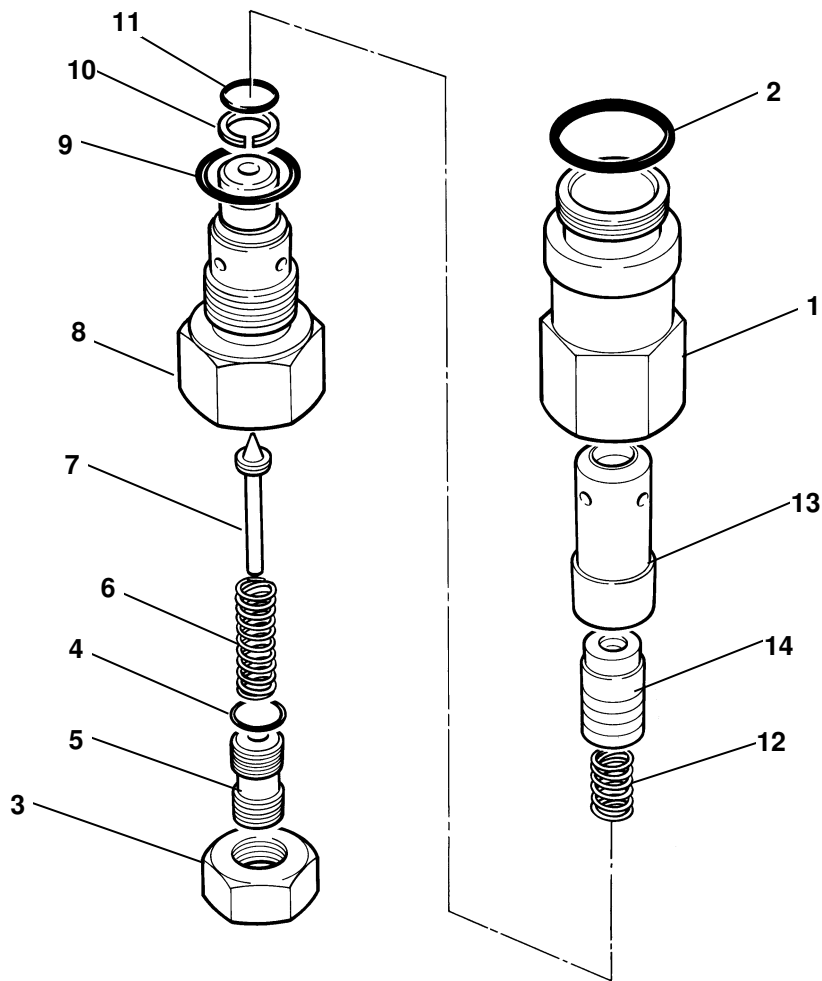
**Note:** All hydraulic adapters that are installed together with a bonded sealing washer must also have JCB Threadseal applied to the threads of the adapter.



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S262720



## Dismantling and Assembly

### Main Relief Valve (MRV)

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

When removing 'O' rings and seals, use an appropriately rounded tool that **WILL NOT** cause any damage to the seal grooves.

Discard **ALL** 'O' rings and back up rings. **DO NOT** use worn or damaged items.

Inspect the valve components for scratches, nicks or any other type of damage, replace with new if required.

#### Assembly

Renew all 'O' rings and back-up rings.

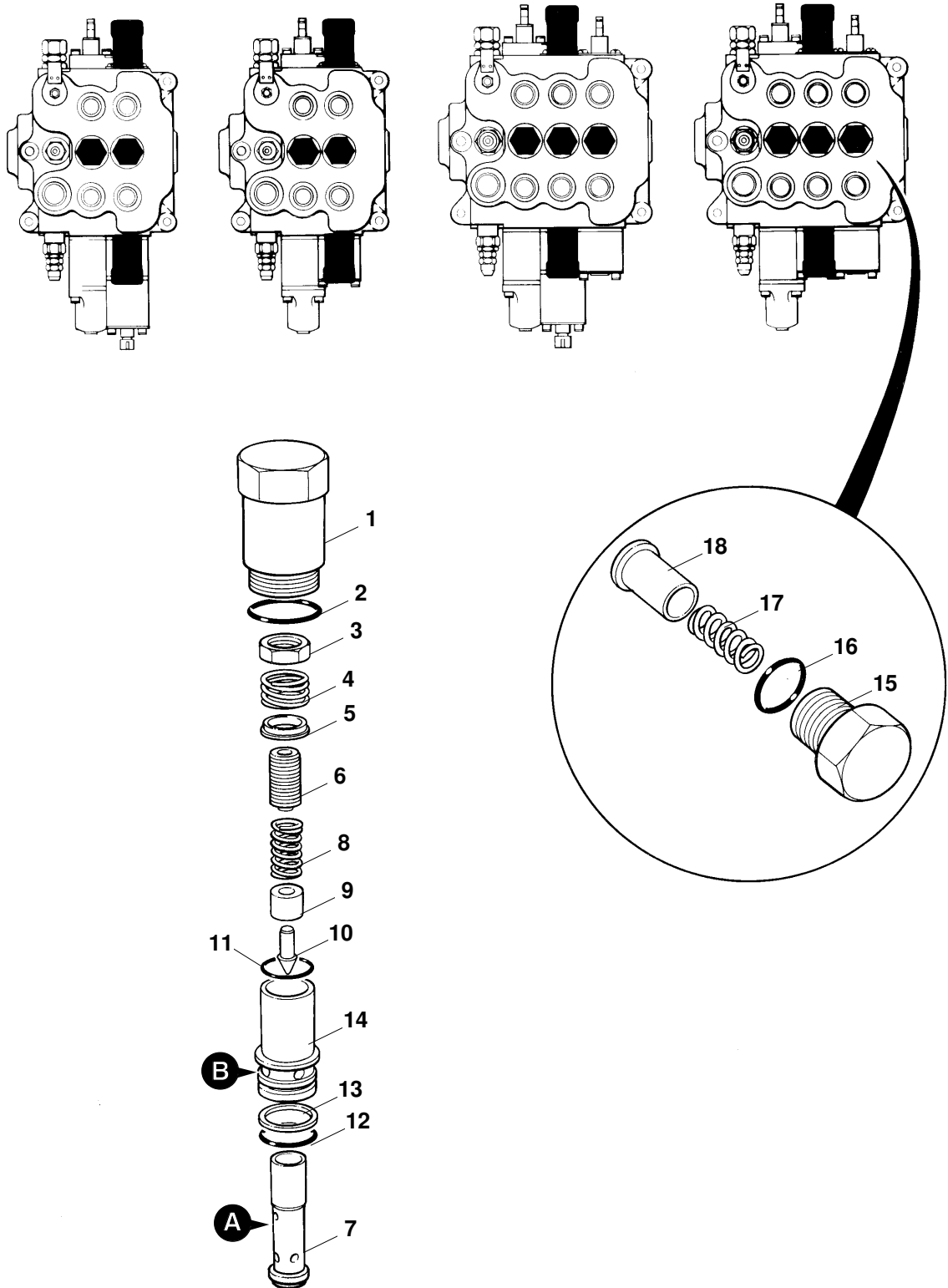
Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

Make sure that the 'O' rings and back-up rings are fitted the correct way, items **10** and **11**.

Adjust pressure setting as required, refer to **Service Procedures, Loader Valve - Pressure Testing**.

#### Torque Settings

Item	Nm	kgf m	lbf ft
<b>3</b>	5.4	0.6	4



S197420

## Dismantling and Assembly

### Auxiliary Relief Valves (ARV) and Load Hold Check Valves (LHCV)

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.

The ARV's are identical in design but have different pressure settings, refer to **Technical Data**.

The LHCV's are identical.

#### Dismantling

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves.

Discard ALL 'O' rings and back up rings. DO NOT use worn or damaged items.

Dismantle sub-assembly **14** from item **1** using a special tool (see **Service Tools**). The special spanner locates in cross holes **B**.

Make sure that small drilling **A** is not blocked.

Ensure good condition of seating faces on poppet **18** and on the mating face of the valve block.

Inspect the valve components for scratches, nicks or any other type of damage, replace with new if required.

#### Assembly

Renew all 'O' rings and back-up rings.

Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

Fit back-up ring **13** on the upper side of 'O' ring **12**.

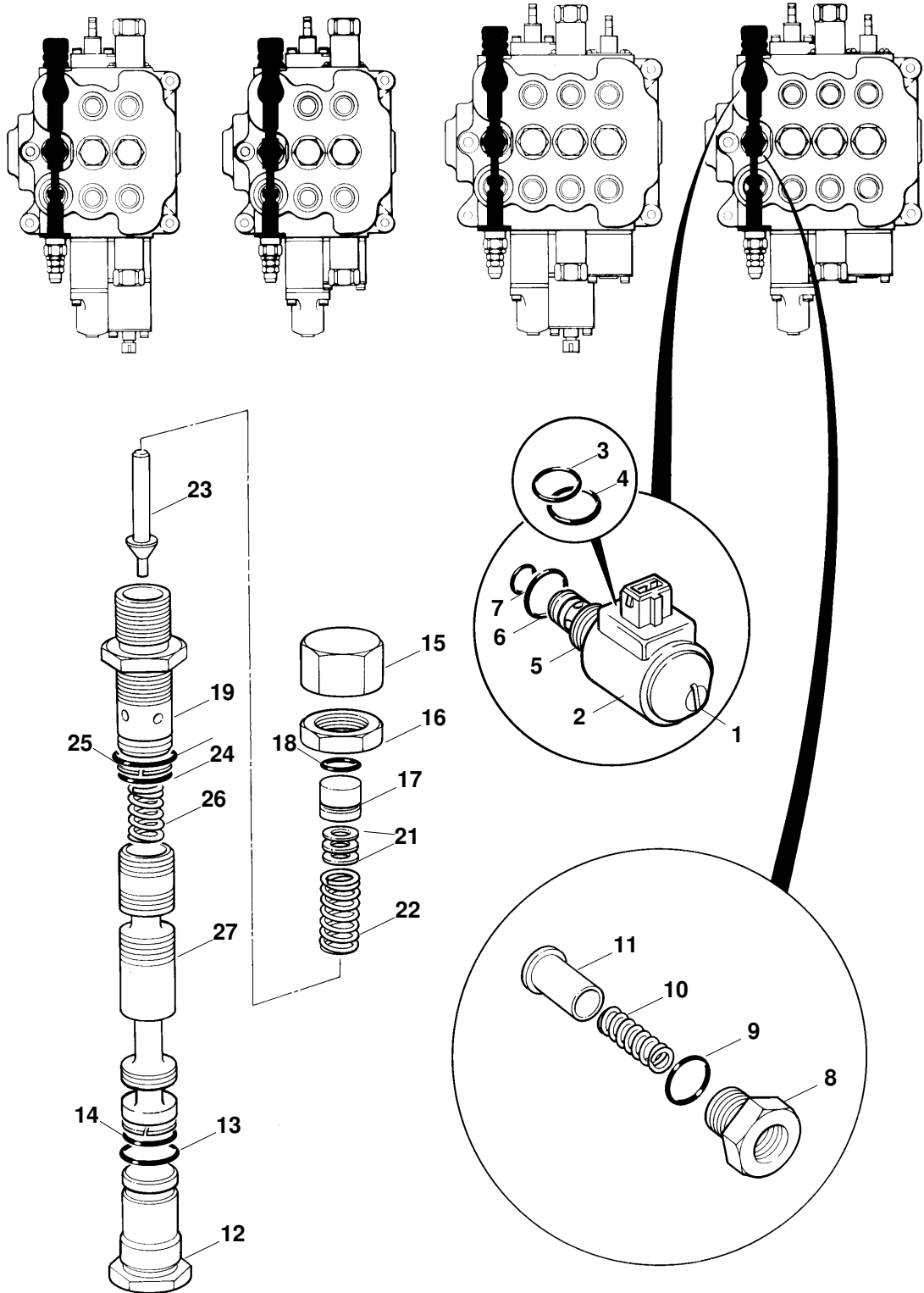
Fit flat face of sleeve **9** against shoulder of poppet **10**.

Torque tighten item **14** using the special tool (see **Service Tools**), until its shoulder seats firmly against item **1**.

Pressure test the relief valves, refer to **Service Procedures, Loader Valve - Pressure Testing**.

#### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	65	6.6	48
<b>3</b>	24	2.5	18
<b>15</b>	81	8.3	60



S197430

## Dismantling and Assembly

### Unloader Valve

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

When removing 'O' rings and seals, use an appropriately rounded tool that **WILL NOT** cause any damage to the seal grooves.

Discard ALL 'O' rings and back up rings. **DO NOT** use worn or damaged items.

Use a nylon rod to push out spool assembly item **23**, **DO NOT** damage spool bore.

Inspect the valve components for scratches, nicks or any other type of damage, replace with new if required.

#### Assembly

Renew all 'O' rings and back-up rings.

Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

Ensure that the small drilling through the centre of items **23**, is clear.

Shims **21** are intended to limit the maximum pressure setting, the specified pressure setting is achieved by adjusting capnut **15**. If the specified pressure cannot be achieved under test, it is permissible to add shims as required. There **MUST** be at least one hardened shim next to the spring item **22**.

Do not over-tighten the solenoid assembly, it may effect the operation of the solenoid, use the spanner flats and torque tighten to figure indicated in the table below (items **1** and **5**).

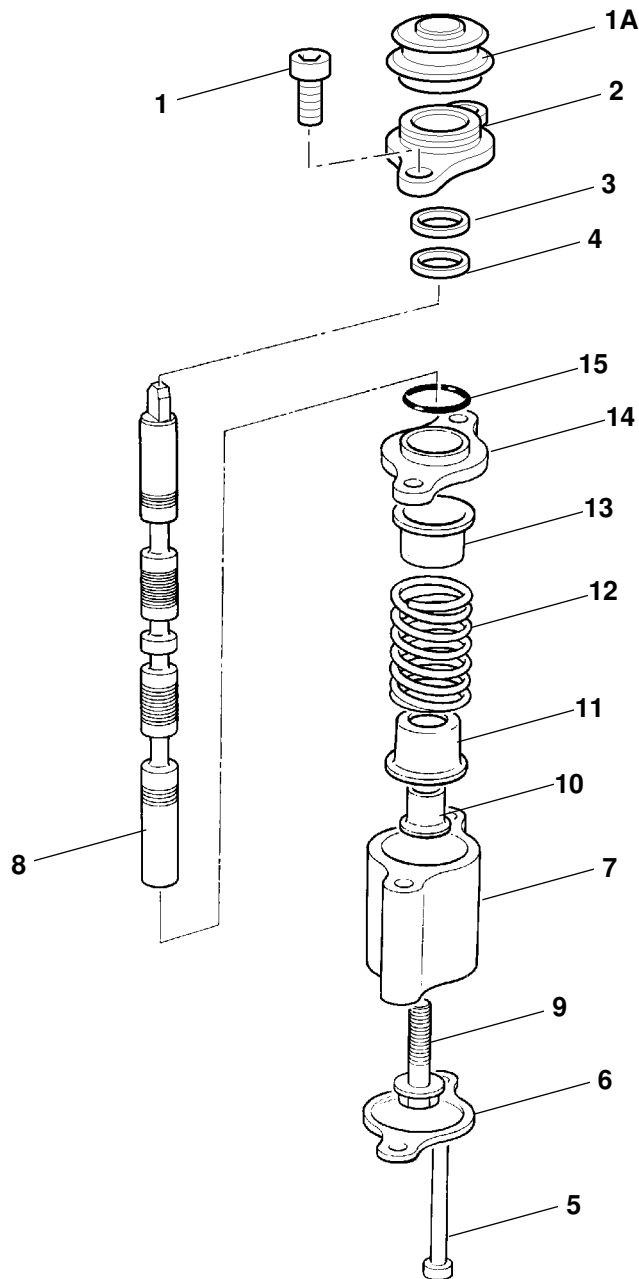
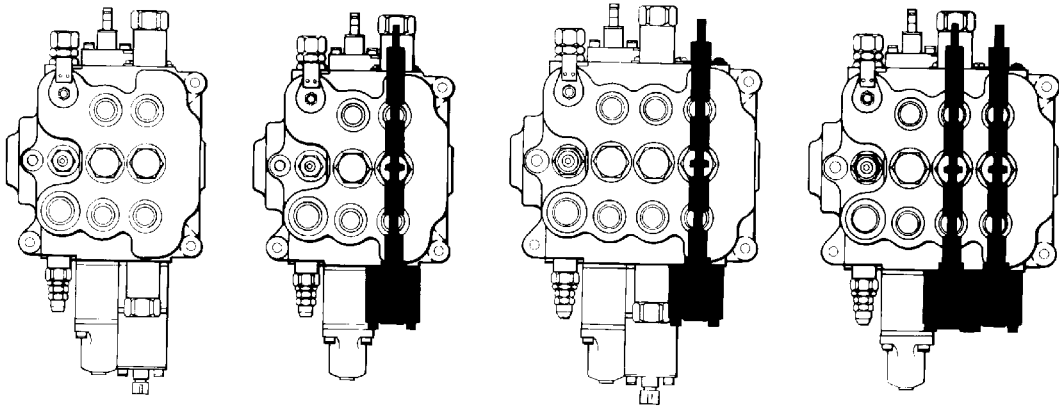
Fit chamfered end of spring **22** against head of pilot poppet item **23**.

Check pressure setting after refitting, refer to **Service Procedures, Loader Valve - Pressure Testing**.

Check the operation of the hydraulic speed control, refer to **Service Procedures, Loader Valve - Pressure Testing**.

#### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	6.7	0.7	5
<b>5</b>	27	2.8	20
<b>8</b>	81	8.3	60
<b>12</b>	81	8.3	60
<b>16</b>	45	4.6	33
<b>19</b>	34	3.5	25



S386380

## 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

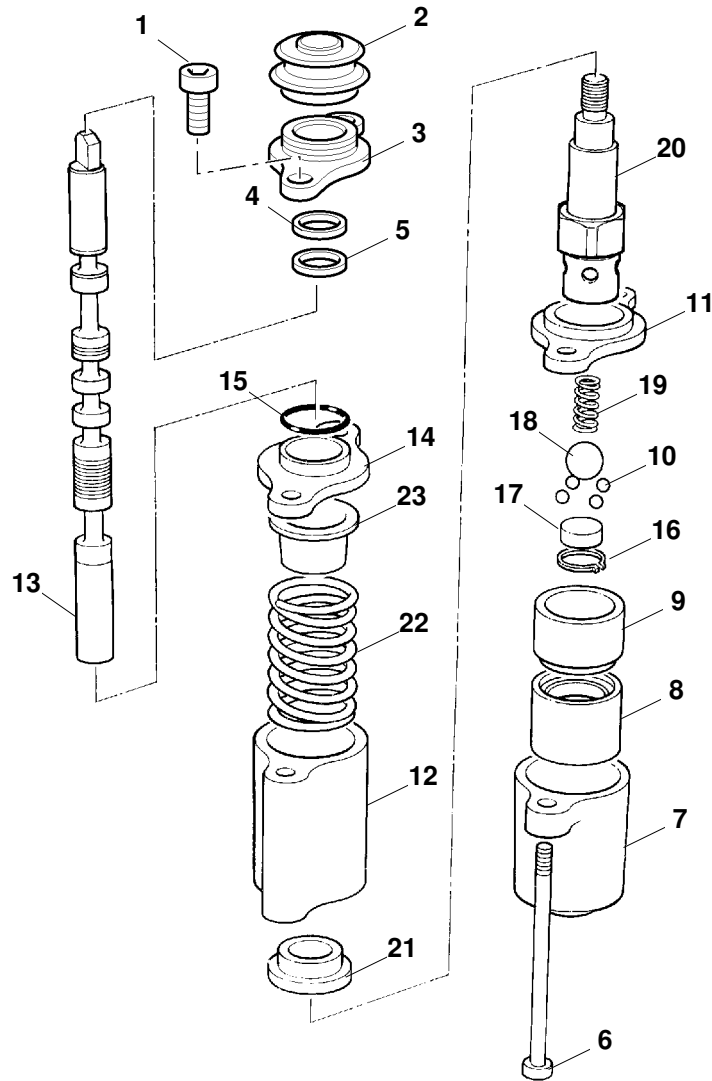
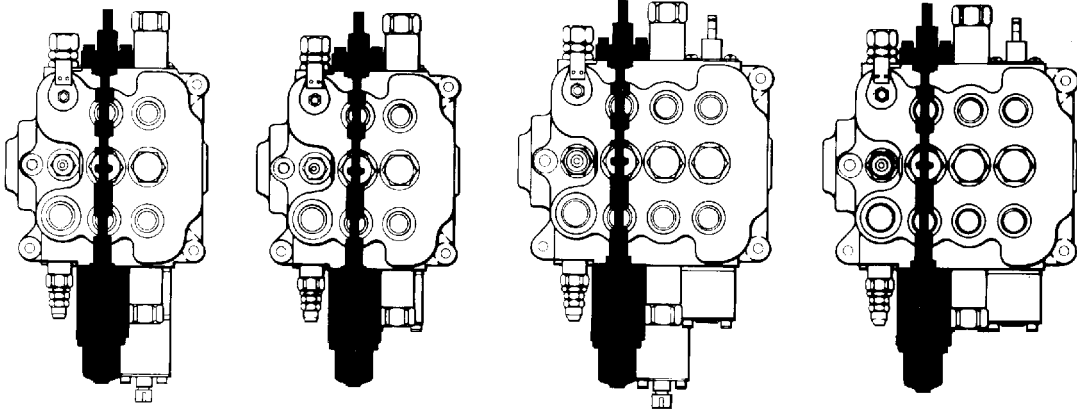
- 1** Fit the boot **1A** to the seal plate **2**.
- 2** Fit a new lipseal **4** into the valve block, ensure square. Fit wiper **3** on top of lipseal.
- 3** Fit the seal plate and boot assembly to valve block section but do not torque tighten capscrews **1** at this stage. Ensure wiper locates into 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
<b>1</b>	9.5	0.96	7
<b>5</b>	9.5	0.96	7
<b>9</b>	9.5	0.96	7



S386390



## Dismantling and Assembly

### Float 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 4, which is a wiper seal and is a press fit in the counterbore.

Care must be taken to ensure that the spool 13 is not damaged when removing it from the valve block.

Carefully remove collar 9 and collect detent balls 10.

Using tool 992/10100 to hold the spool, remove circlip 16, plug 17, ball 18 and spring 19. Unscrew detent pin 20 and remove spring 22 and cups 21 and 23.

Check for surface contamination on the under side of the seal plates 3 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

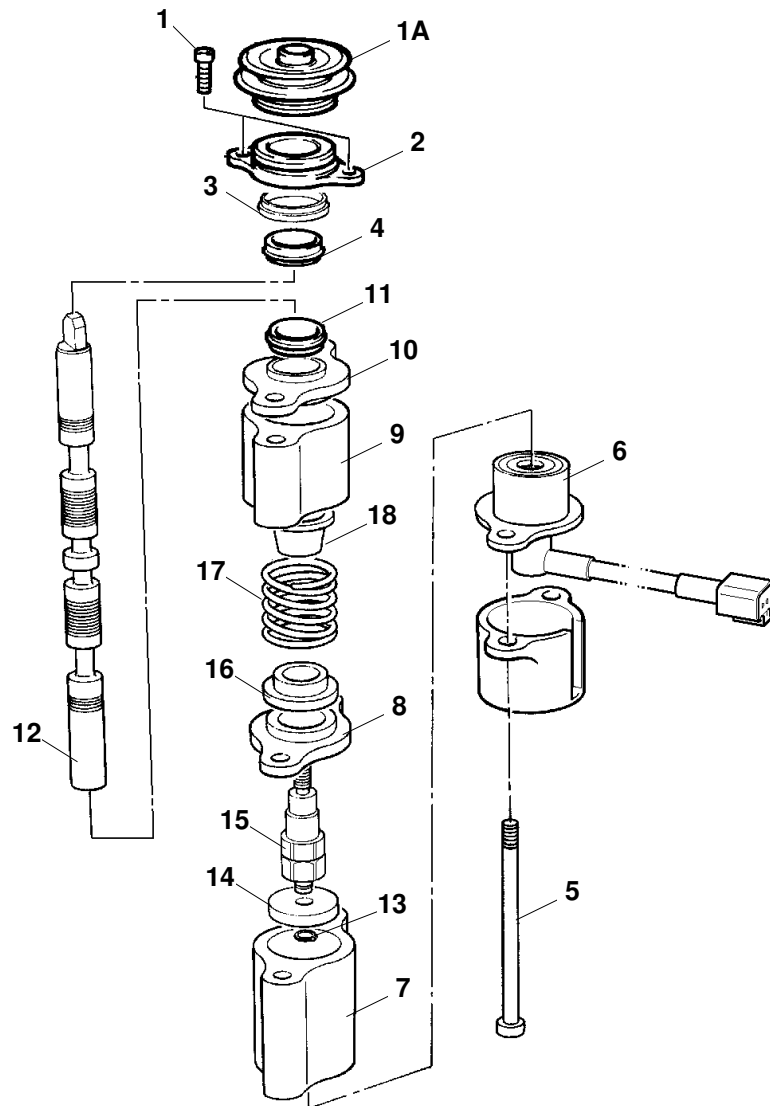
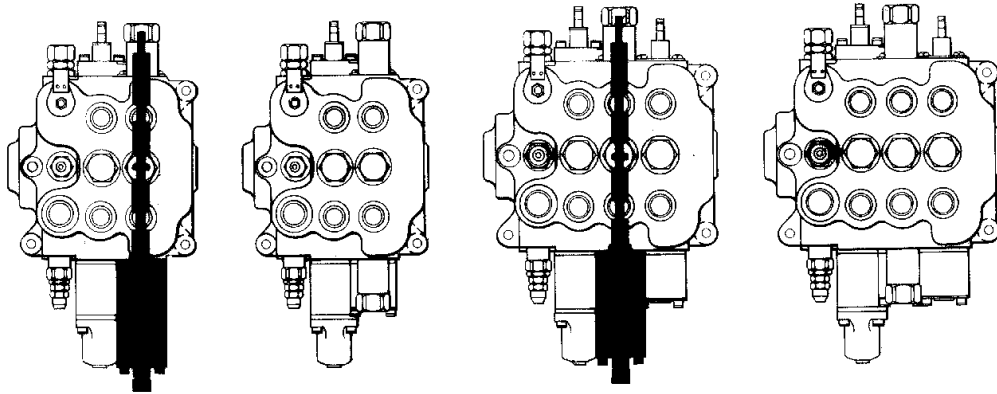
- 1 Fit the boot 2 to the seal plate 3.
- 2 Fit a new lipseal 5 into the valve block, ensure square. Fit wiper 4 on top of lipseal.
- 3 Fit the seal plate and boot assembly to valve block but do not torque tighten capscrews 1 at this stage. Ensure wiper locates into seal plate.
- 4 Use clean hydraulic 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 detent pin 20, 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 Apply grease liberally balls 10, this will help to hold the balls in position whilst assembling.
- 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 6 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
6	9.5	0.96	7
20	9.5	0.96	7



S401460

## Dismantling and Assembly

### Electric Detent 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

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 **12** is not damaged when removing it from the valve block.

Use tool 992/10100 to hold the spool, remove circlip **13** and 'clapper' **14**. Unscrew spool end **15** and remove spring **17** with cups **16** and **18**.

Check for surface contamination on the under side of the seal plates **2**, **8** and **10**. 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

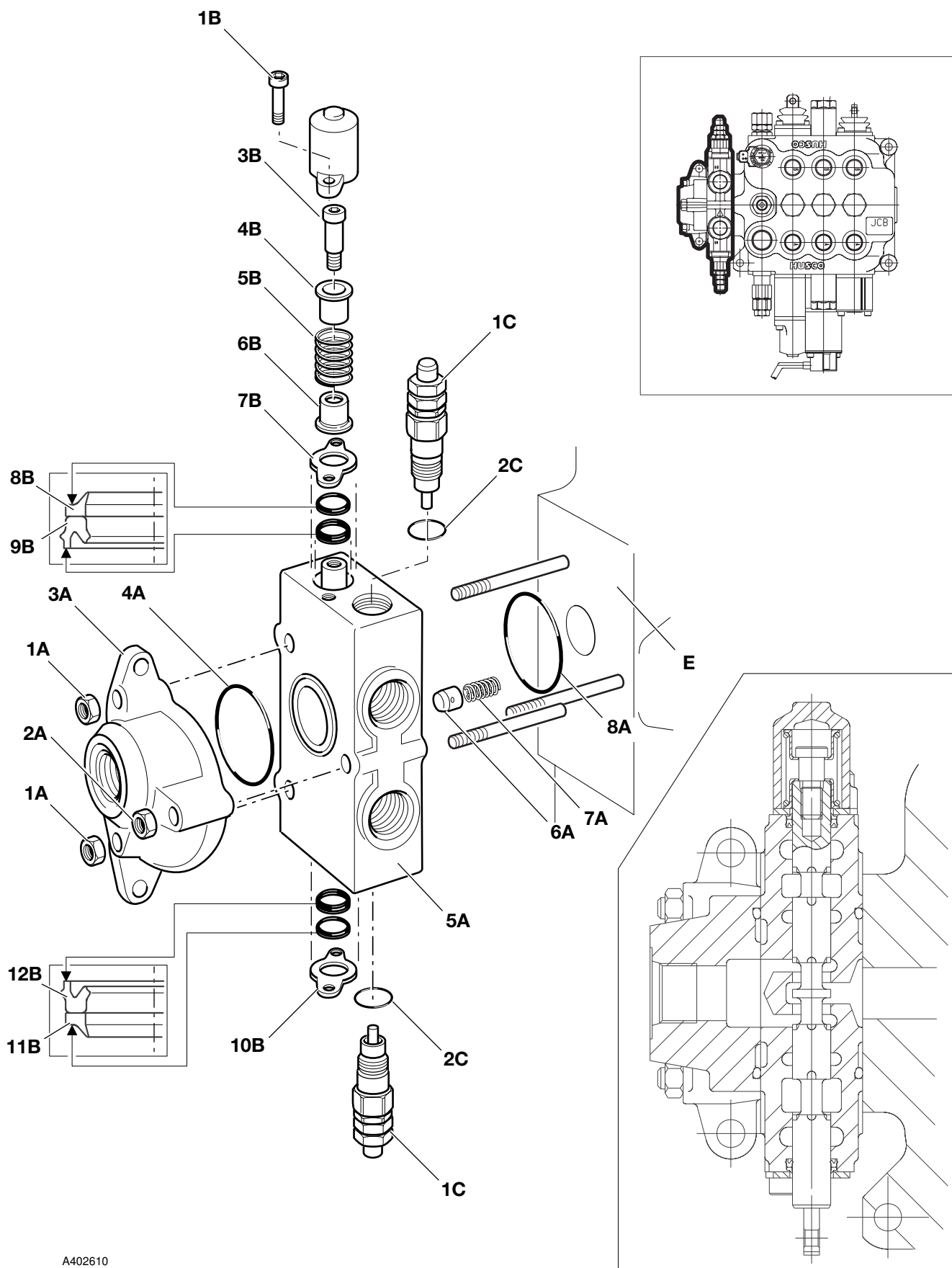
- 1** Fit the boot **1A** to the seal plate **2**.
- 2** Fit a new lipseal **4** into the valve block, ensure square. Fit wiper **3** on top of lipseal.
- 3** Fit the seal plate and boot assembly to valve block but do not torque tighten capscrews **1** at this stage. Ensure wiper locates into seal plate.
- 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 spool end **15**, 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 the chamfer on item **14** faces away from the solenoid, item **6**.
- 9** Renew lipseal **11**. Make sure the lipseal is not trapped or damaged.
- 10** Fit lipseal **11** and seal plate **10** to the valve block section. Torque tighten capscrew **5** on completion.

Check the operation of the solenoid **6** after assembly by connecting a 12V supply. The spool should be held when it is pushed into the detent position and returned when the supply is disconnected.

Run the engine and inspect the valve for external leaks.

#### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	9.5	0.96	7
<b>5</b>	9.5	0.96	7
<b>15</b>	9.5	0.96	7



A402610

## Dismantling and Assembly

### Bolt on Auxiliary Spool Section

#### Body and Spool

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

Two dismantling sequences are shown:

Components prefixed **A** - inlet section, valve body and non-return valve.

Components prefixed **B** - valve spool components.

The valve spool components can be dismantled and assembled with the valve body **5A** still assembled to the loader valve **E** if required.

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.

For dismantling and assembly of the auxiliary relief valves **1C**, see **Bolt on Auxiliary Spool Section - Auxiliary Relief Valves**.

#### When Dismantling

When removing 'O' rings and seals, use an appropriately rounded tool that **WILL NOT** cause any damage to the spool or seal grooves.

When dismantling the spool hold a rod through the eye end of the spool to prevent it rotating when undoing the screw at the opposite end.

#### Inspection

Inspect the valve components for signs of scratches, nicks or any other type of damage. Renew damaged components as required.

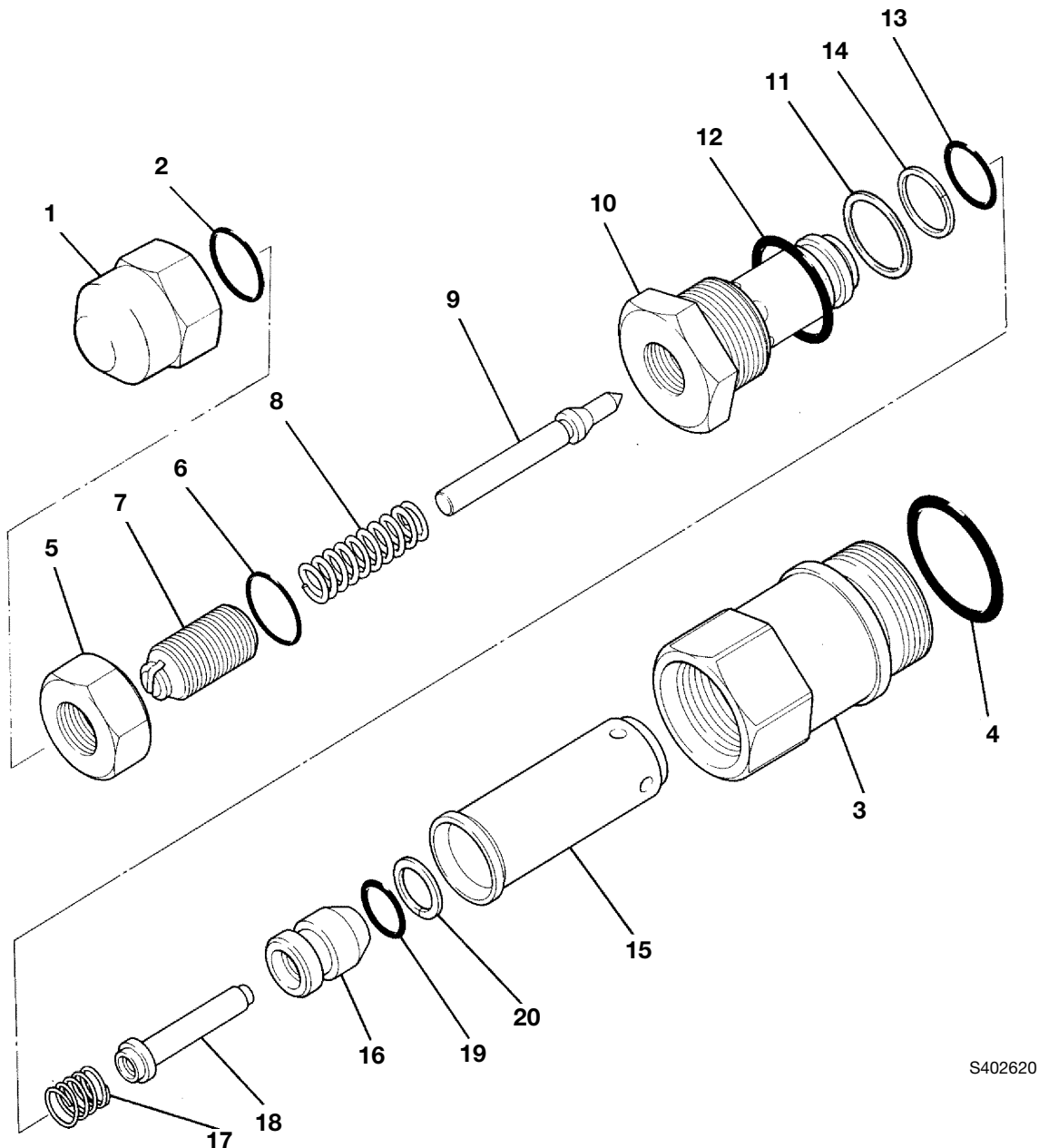
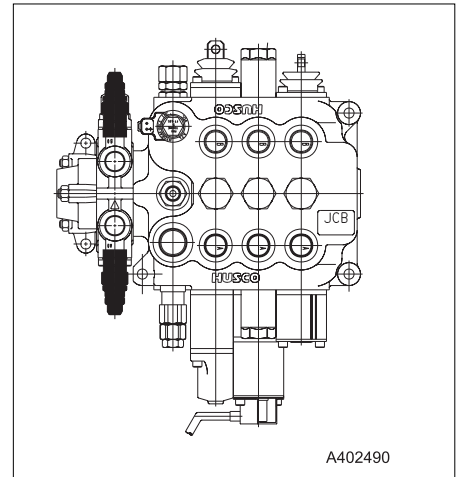
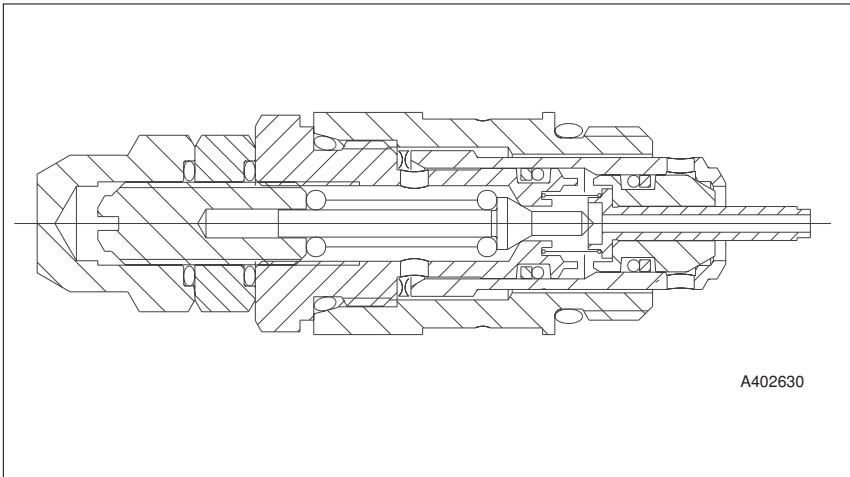
#### When Assembling

Renew 'O' ring seals **4A**, **8A**, and **2C**. Make sure the 'O' ring seals are not trapped or damaged.

Renew wiper seals **8B** and **11B**, and spool seals **9B** and **12B**, note the correct seal orientation shown at **X**. When fitting seals **9B** and **12B** make sure they are square to the valve body.

#### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1A</b>	19	1.9	14
<b>2A</b>	45	4.6	33
<b>1B, 3B</b>	8 - 11	0.8 - 1.1	6 - 8
<b>1C</b>	40 - 49	4 - 5	30 - 36



S402620

## Dismantling and Assembly

### Bolt on Auxiliary Spool Section

#### Auxiliary Relief Valve (ARV)

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

For assembly the sequence should be reversed.

Great care should be taken when dismantling and assembling a valve to avoid the following:-

- Contamination**
- Damage to spools**
- Damage to seal grooves**

Any of the above may result in possible problems with the operation of the valve.

#### When Dismantling

When removing 'O' Rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves.

Discard ALL 'O' Rings and back-up rings. DO NOT use worn or damaged items.

#### Inspection

Inspect the valve components for scratches, nicks or any other type of damage, replace with new if required.

#### When Assembling

Renew all 'O' rings and back-up rings.

Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

Make sure that the 'O' rings and back-up rings are fitted the correct way, items **13, 14** and **19, 20**.

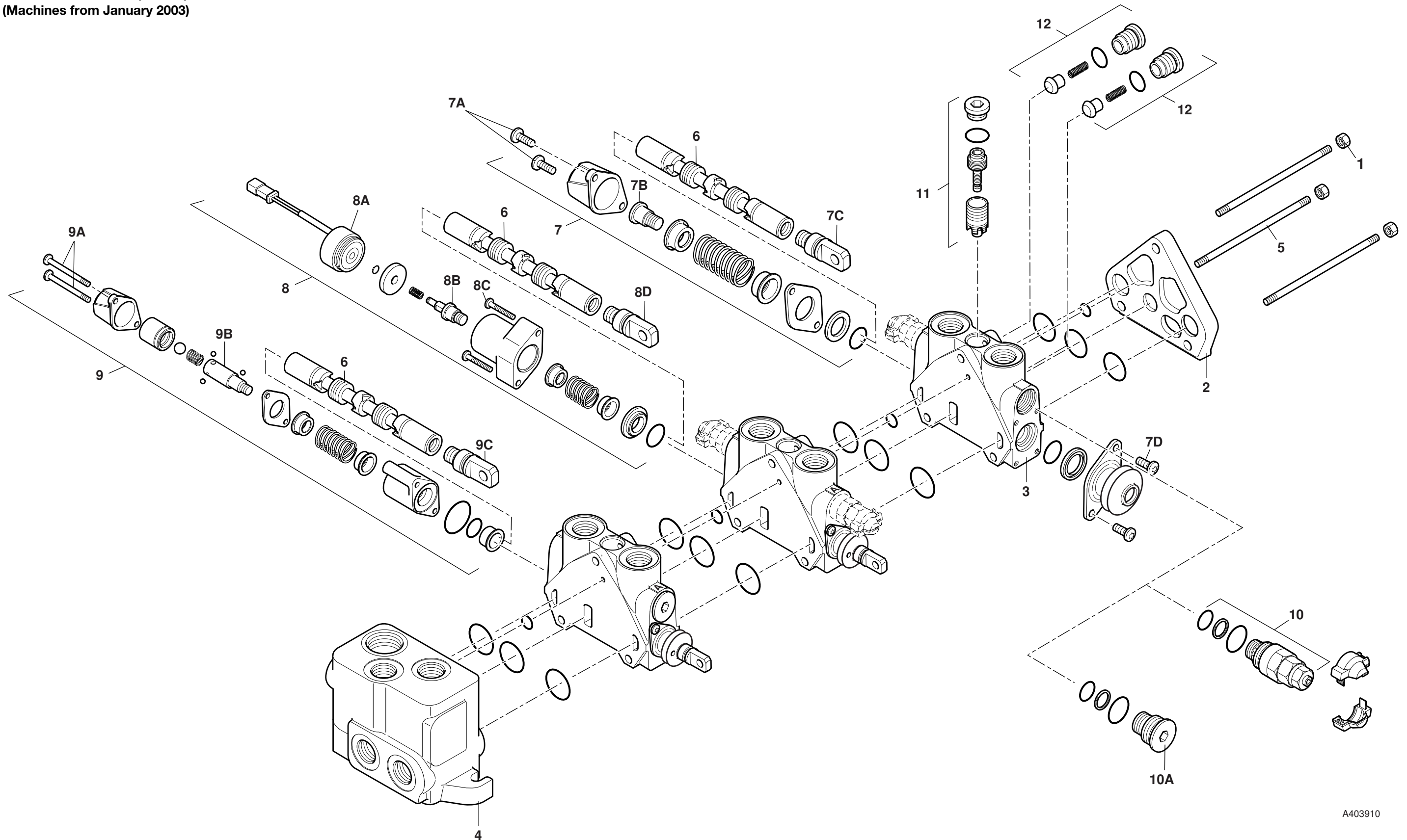
Adjust pressure setting as required, refer to **Service Procedures, Pressure Testing - MRV and ARV's**.

#### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	62	6.4	46
<b>5</b>	5.4 - 8.2	0.55 - 0.83	4 - 6
<b>10</b>	41 - 68	4.15 - 6.9	30 - 50

Dismantling and Assembly

Precision Control (Servo)  
(Machines from January 2003)



A403910



## Dismantling and Assembly

### Precision Control (Servo) (Machines from January 2003)

#### Dismantling

The loader valve block is a 'sandwich type', which is made up of a number of separate sections. The illustration shown on the opposite page is intended as a guide to dismantling. Be sure to note the location of all components when dismantling. Although some components may appear to be identical they are not interchangeable. Make sure that components are assembled in their original positions.

- 1 Remove the loader valve block from the machine.
- 2 Remove the three tie rod nuts **1**.
- 3 Carefully separate and remove the end plate **2** followed by the remaining service sections **3**. If the inlet section **4** is to be replaced, remove and retain the tie rods **5**.

#### Assembly

Assembly is the reverse of the dismantling sequence.

- 1 Clean the valve components in an appropriate solvent. Ensure that the mating faces of the valve sections are thoroughly clean before assembly.
- 2 Renew the 'O' rings located between the valve sections. Make sure the 'O' ring seals are not trapped or damaged.
- 3 Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

#### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	35	3.6	25.8
<b>7A</b>	10	1	7.4
<b>7B</b>	10	1	7.4
<b>7C</b>	10	1	7.4
<b>7D</b>	10	1	7.4
<b>8A</b>	20	2	14.8
<b>8B</b>	10	1	7.4
<b>8C</b>	10	1	7.4
<b>8D</b>	10	1	7.4
<b>9A</b>	10	1	7.4
<b>9B</b>	10	1	7.4
<b>9C</b>	10	1	7.4
<b>10</b>	70	7.1	51.6
<b>10A</b>	70	7.1	51.6
<b>11</b>	60	6.1	44.3
<b>12</b>	30	3	22.1

#### Service Spools

Care must be taken to ensure that the spools **6** are not damaged when removing them from the block. Note that all spools may be similar in appearance but must not be interchanged as they are matched to their bores.

#### Standard Spool

The dismantling and assembly procedures for the standard spool assembly **7** are detailed separately, refer to **Standard Spool**.

#### Electric Detent Spool

The dismantling and assembly procedures for the electric detent spool assembly **8** are detailed separately, refer to **Electric Detent Spool**.

#### Mechanical Detent Spool

The dismantling and assembly procedures for the mechanical detent spool assembly **9** are detailed separately, refer to **Mechanical Detent Spool**.

#### Auxiliary Relief Valves

The A.R.V's **10** appear identical but have various pressure settings, refer to **Technical Data**. Ensure that they are correctly adjusted and fitted in their specified positions. The dismantling and assembly procedures for the ARV's are detailed separately, refer to **Excavator Valve, Dismantling and Assembly - Auxiliary Relief Valves (ARV's)**.

#### Pressure Compensator Valves

Each of the pressure compensator valves **11** can be removed as shown. Note that all valves are identical in appearance. Note that components are not interchangeable.

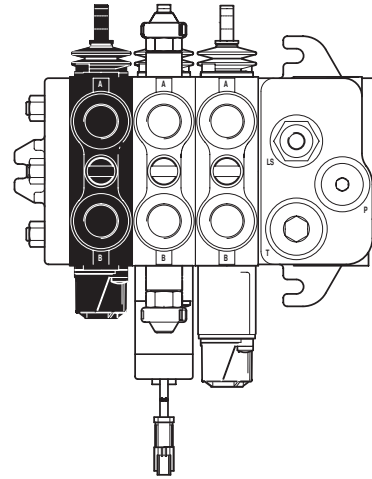
#### Load Hold Check Valves

Each of the load hold check valves **12** can be removed as shown. Note that all valves are identical in appearance. Ensure good condition of seating faces on poppets and on the mating faces in the valve block.

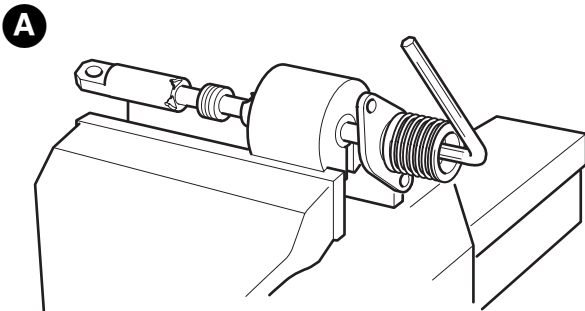
Dismantling and Assembly

Precision Control (Servo)  
(Machines from January 2003)

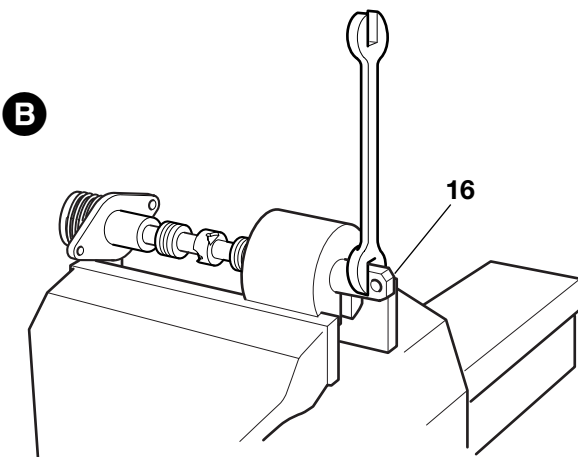
Standard Spool



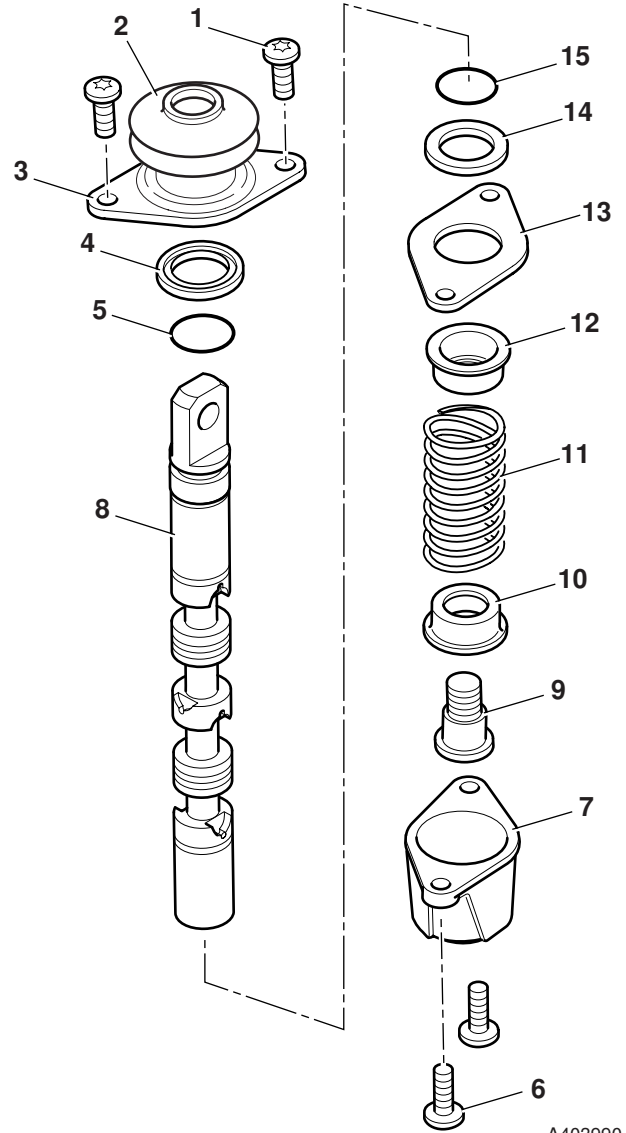
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A403950



A404060



A403990

## Dismantling and Assembly

### Precision Control (Servo) (Machines from January 2003)

#### Standard Spool

##### Removal

It is possible to remove a spool without removing the loader valve block from the machine. The centring spring **11** is at the bottom, so the spool must be removed from the bottom.

- 1 Gain access to the loader valve and disconnect and blank any hoses or pipes which may interfere with the removal of the spool.
- 2 Disconnect the control rod linkage from the spool tongue.
- 3 Remove the screws **1**, boot **2** and plate **3**.
- 4 Remove the screws **6**, cover **7** and carefully withdraw the spool assembly from the valve body.

##### Dismantling

Great care should be taken when dismantling and assembling a valve to avoid the following:-

- Contamination
- Damage to spools
- Damage to seal grooves

Any of the above may result in possible problems with the operation of the valve.

- 1 Hold the spool assembly in a vice using the spool clamp (service tool no. TBA, refer to **Service Tools**) as shown at **A**.
- 2 Unscrew the spool end **9** and remove the centring spring **11** with spring retainers **10** and **12**. It may be necessary to pre-heat the spool to 200° C in an oven or with a heat gun to remove the spool end.

**Note:** When removing 'O' Rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves.

Discard ALL 'O' Rings and back-up rings. DO NOT use worn or damaged items.

##### Inspection

- 1 Inspect the valve components for scratches, pitting, corrosion or any other type of damage.

##### Assembly

Assembly is the reverse of the dismantling sequence.

- 1 Clean the valve components in an appropriate solvent.
- 2 Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.
- 3 Renew lip seals **4** and **14**, and 'O' rings **5** and **15**.

**Note:** The lip seal MUST be fitted carefully onto the end of the spool to ensure that it is not damaged by the spool lands and that its tightness property does not deteriorate. The metal part of the seal should be on the outside.

##### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	10	1	7.4
<b>6</b>	10	1	7.4
<b>9</b>	10	1	7.4
<b>16</b>	10	1	7.4

##### Tongue Replacement (if necessary)

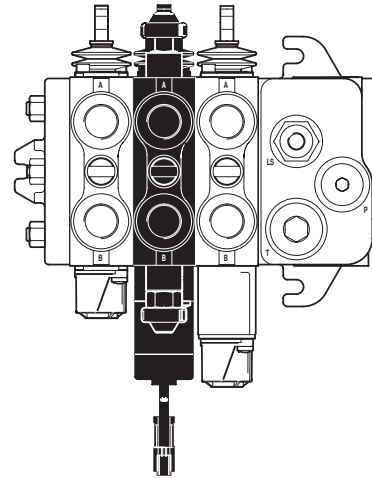
- 1 Hold the spool assembly in a vice using the spool clamp (service tool no. TBA, refer to **Service Tools**).
- 2 Loosen the tongue **16** with an open ended wrench as shown at **B**. It may be necessary to pre-heat the spool to 200° C in an oven or with a heat gun to dismantle the spool.

**Note:** DO NOT use a welding torch to heat the tongue as deformation of the spool may result.

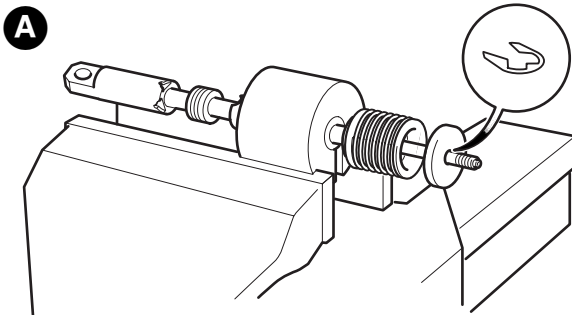
**Dismantling and Assembly**

**Precision Control (Servo)  
(Machines from January 2003)**

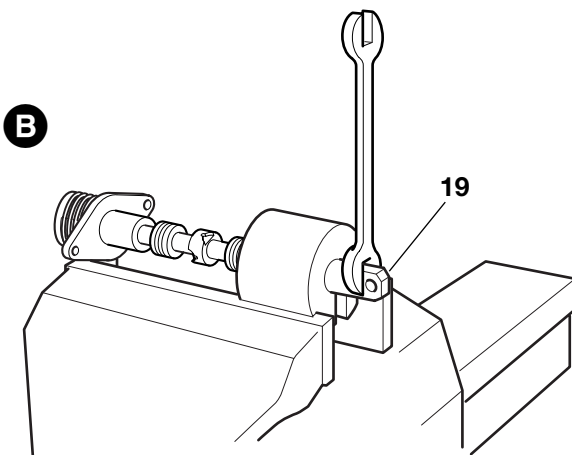
**Electric Detent Spool**



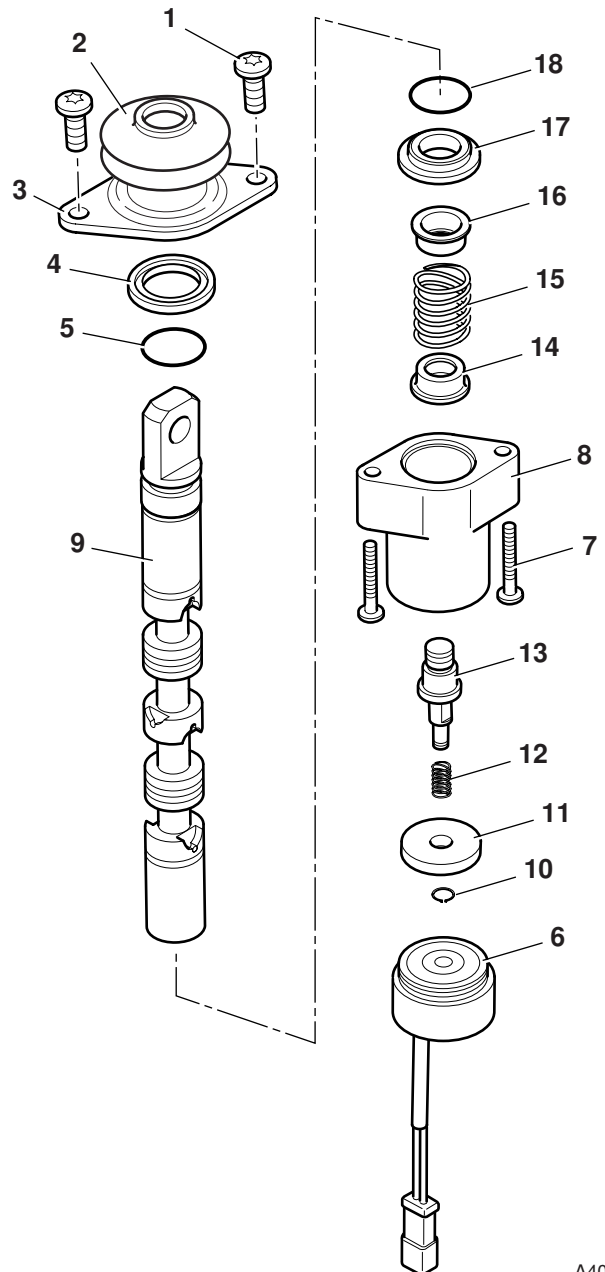
A403970



A404070



A404060



A404000

## Dismantling and Assembly

### Precision Control (Servo) (Machines from January 2003)

#### Electric Detent Spool

##### Removal

It is possible to remove a spool without removing the loader valve block from the machine. The centring spring **15** is at the bottom, so the spool must be removed from the bottom.

- 1 Gain access to the loader valve and disconnect and blank any hoses or pipes which may interfere with the removal of the spool.
- 2 Disconnect the control rod linkage from the spool tongue.
- 3 Remove the screws **1**, boot **2** and plate **3**.
- 4 Unscrew the solenoid **6** from the housing **8**. Remove the screws **7**, housing **8** and carefully withdraw the spool assembly from the valve body.

##### Dismantling

Great care should be taken when dismantling and assembling a valve to avoid the following:-

- Contamination
- Damage to spools
- Damage to seal grooves

Any of the above may result in possible problems with the operation of the valve.

- 1 Hold the spool assembly in a vice using the spool clamp (service tool no. TBA, refer to **Service Tools**) as shown at **A**.
- 2 Remove the circlip **10**, disc **11** and spring **12**.
- 3 Unscrew the spool end **13** and remove the centring spring **15** with spring retainers **14** and **16**. It may be necessary to pre-heat the spool to 200° C in an oven or with a heat gun to remove the spool end.

**Note:** When removing 'O' Rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves.

Discard ALL 'O' Rings and back-up rings. DO NOT use worn or damaged items.

##### Inspection

- 1 Inspect the valve components for scratches, pitting, corrosion or any other type of damage.

##### Assembly

Assembly is the reverse of the dismantling sequence.

- 1 Clean the valve components in an appropriate solvent.
- 2 Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.
- 3 Renew lip seal **4** and 'O' rings **5** and **18**.

**Note:** The lip seal MUST be fitted carefully onto the end of the spool to ensure that it is not damaged by the spool lands and that its tightness property does not deteriorate. The metal part of the seal should be on the outside.

##### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	10	1	7.4
<b>7</b>	10	1	7.4
<b>13</b>	10	1	7.4
<b>19</b>	10	1	7.4

##### Tongue Replacement (if necessary)

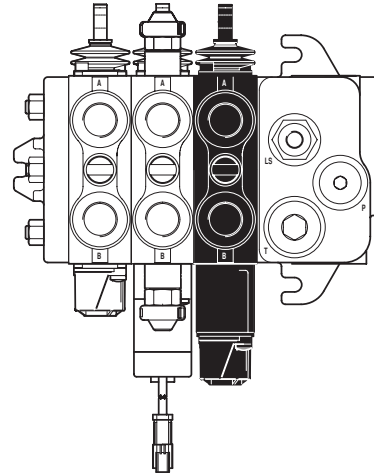
- 1 Hold the spool assembly in a vice using the spool clamp (service tool no. TBA, refer to **Service Tools**).
- 2 Loosen the tongue **19** with an open ended wrench as shown at **B**. It may be necessary to pre-heat the spool to 200° C in an oven or with a heat gun to dismantle the spool.

**Note:** DO NOT use a welding torch to heat the tongue as deformation of the spool may result.

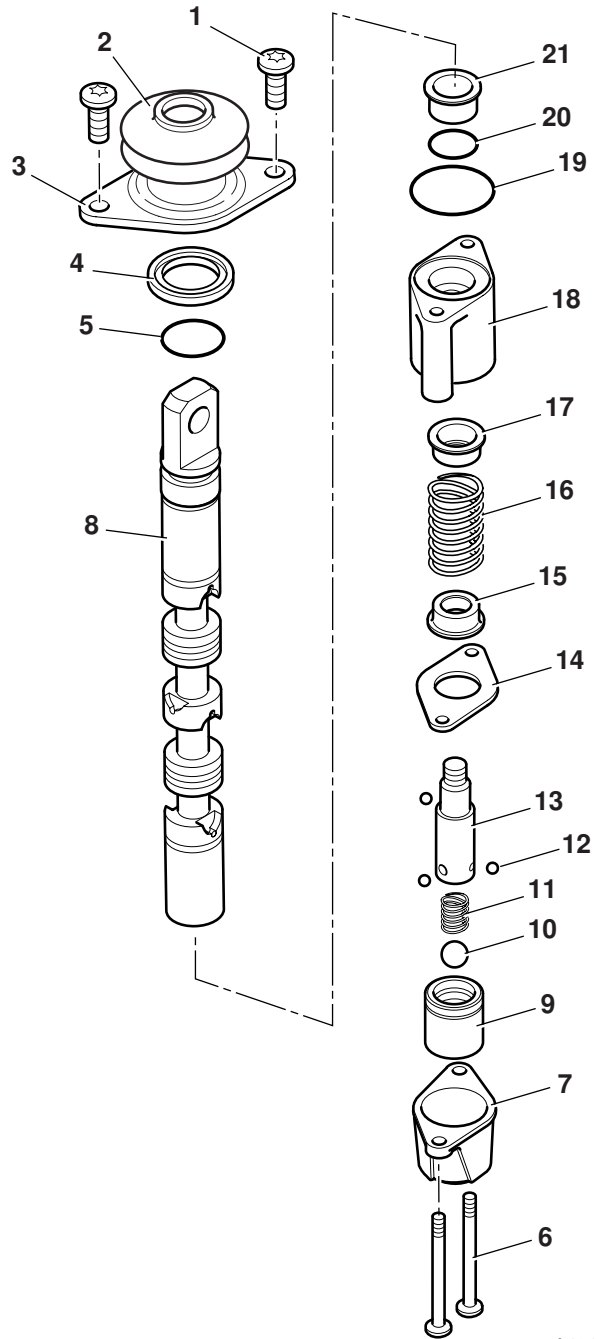
Dismantling and Assembly

Precision Control (Servo)  
(Machines from January 2003)

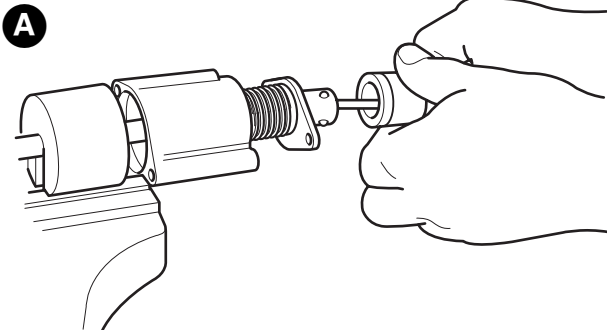
Mechanical Detent Spool



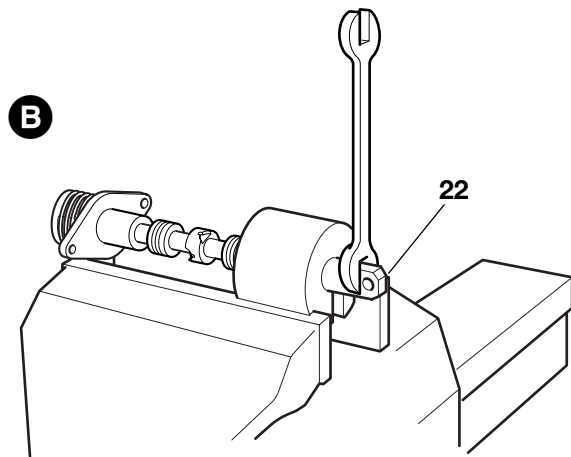
A403980



A404010



A404080



A404060

## Dismantling and Assembly

### Precision Control (Servo) (Machines from January 2003)

#### Mechanical Detent Spool

##### Removal

It is possible to remove a spool without removing the loader valve block from the machine. The centring spring **16** is at the bottom, so the spool must be removed from the bottom.

- 1 Gain access to the loader valve and disconnect and blank any hoses or pipes which may interfere with the removal of the spool.
- 2 Disconnect the control rod linkage from the spool tongue.
- 3 Remove the screws **1**, boot **2** and plate **3**.
- 4 Remove the screws **6**, cover **7** and carefully withdraw the spool assembly from the valve body.

##### Dismantling

Great care should be taken when dismantling and assembling a valve to avoid the following:-

- Contamination
- Damage to spools
- Damage to seal grooves

Any of the above may result in possible problems with the operation of the valve.

- 1 Hold the spool assembly in a vice using the spool clamp (service tool no. TBA, refer to **Service Tools**) as shown at **A**.
- 2 Use a metal rod (min. length 80 mm x 6 mm diameter) to push on the central ball **10** whilst extracting the detent bush **9** as shown. Mark the orientation of the bush to ensure that it is fitted the correct way round on re-assembly.
- 3 Carefully remove the balls **10** and **12**, and the spring **11**.
- 4 Unscrew the spool end **13** and remove the centring spring **16** with spring retainers **15** and **17**. It may be necessary to pre-heat the spool to 200° C in an oven or with a heat gun to remove the spool end.

**Note:** When removing 'O' Rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves.

Discard ALL 'O' Rings and back-up rings. DO NOT use worn or damaged items.

##### Inspection

- 1 Inspect the valve components for scratches, pitting, corrosion or any other type of damage.

##### Assembly

Assembly is the reverse of the dismantling sequence.

- 1 Clean the valve components in an appropriate solvent.
- 2 Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.
- 3 Renew lip seal **4** and 'O' rings **5**, **19** and **20**.

**Note:** The lip seal MUST be fitted carefully onto the end of the spool to ensure that it is not damaged by the spool lands and that its tightness property does not deteriorate. The metal part of the seal should be on the outside.

##### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	10	1	7.4
<b>6</b>	10	1	7.4
<b>13</b>	10	1	7.4
<b>22</b>	10	1	7.4

##### Tongue Replacement (if necessary)

- 1 Hold the spool assembly in a vice using the spool clamp (service tool no. TBA, refer to **Service Tools**).
- 2 Loosen the tongue **16** with an open ended wrench as shown at **B**. It may be necessary to pre-heat the spool to 200° C in an oven or with a heat gun to dismantle the spool.

**Note:** DO NOT use a welding torch to heat the tongue as deformation of the spool may result.

## 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 Operate the valve block levers back and forth to vent residual pressure.
- 2 Remove clevis pins **A** to disconnect the control levers from the valve block spools.
- 3 Disconnect all hydraulic hoses from the valve block and plug all orifices to prevent ingress of dirt. Label each hose before disconnecting, this will ensure correct position when refitting.
- 4 Loosen and remove nuts **B**, spacers **C**, the loader valve and resilient mounts **D**.

#### Inspection

Inspect the resilient mounts **D** for damage, cracking etc. If the mounts are suspect, then replace them with new ones.

#### Replacement

Replacement is a reversal of the removal sequence.

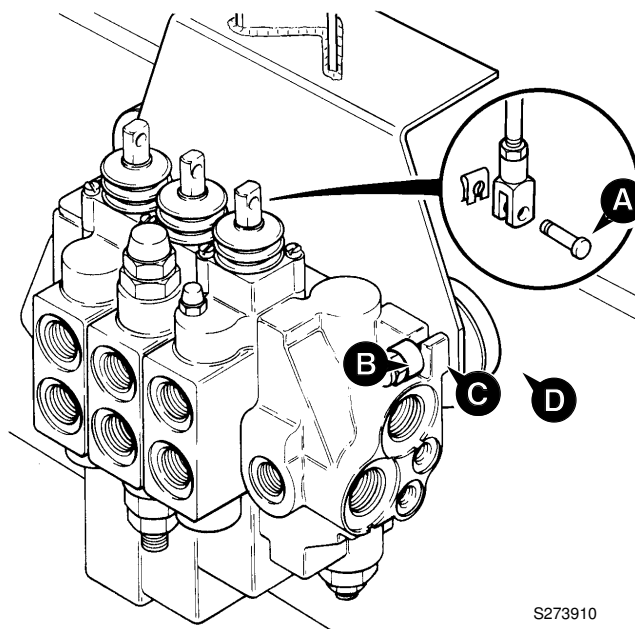
### **⚠ WARNING**

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 auxiliary relief valve (A.R.V.) pressure settings.

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

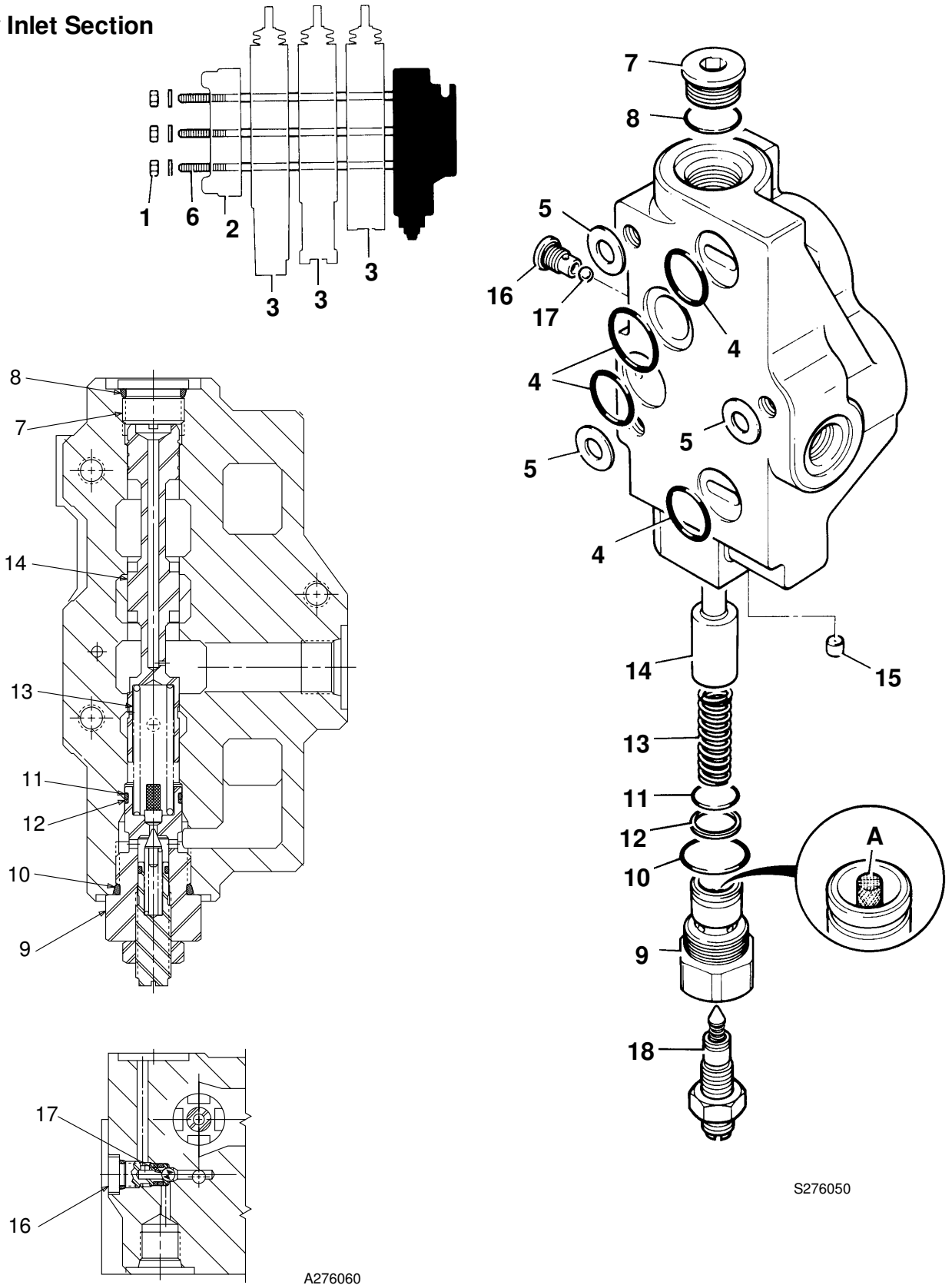


S273910



Dismantling and Assembly

Priority Inlet Section



## Dismantling and Assembly

### Priority Inlet Section

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 tie rod nuts **1** and end cover **2**. Separate the valve sections **3** take care not to lose shims **5**. Remove and discard 'O' rings **4**.

When removing 'O' rings and seals, use an appropriately rounded tool that **WILL NOT** cause any damage to the seal grooves.

Discard ALL 'O' rings and back up rings. **DO NOT** use worn or damaged items.

Inspect the valve components for scratches, nicks or any other type of damage, replace with new if required.

Inspect screen **A**, make sure the screen is clean and free of dirt.

Take care not to lose ball bearing **17**.

If required, the relief valve assembly **9** can be dismantled for cleaning. It is important to note that this relief valve is fitted as a standard part of the inlet section. However, in this application it does not perform any duties. This is because the steer system pressure is controlled by a relief valve in the orbitrol steer unit (see Steering section), **NOT** relief valve assembly **9**.

After assembling the relief valve, screw the adjusting screw **18** fully into the valve housing. This will ensure assembly **9** does not interfere with the steer system pressure.

### Assembly

Renew all 'O' rings and back-up rings.

Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

Make sure that the 'O' rings and back-up rings are fitted the correct way, items **11** and **12**

**ALWAYS** fit three shim (item **5**) in between each valve block section as shown.

After assembly, make sure the steering operates correctly. The steer circuit will always have priority (see descriptions).

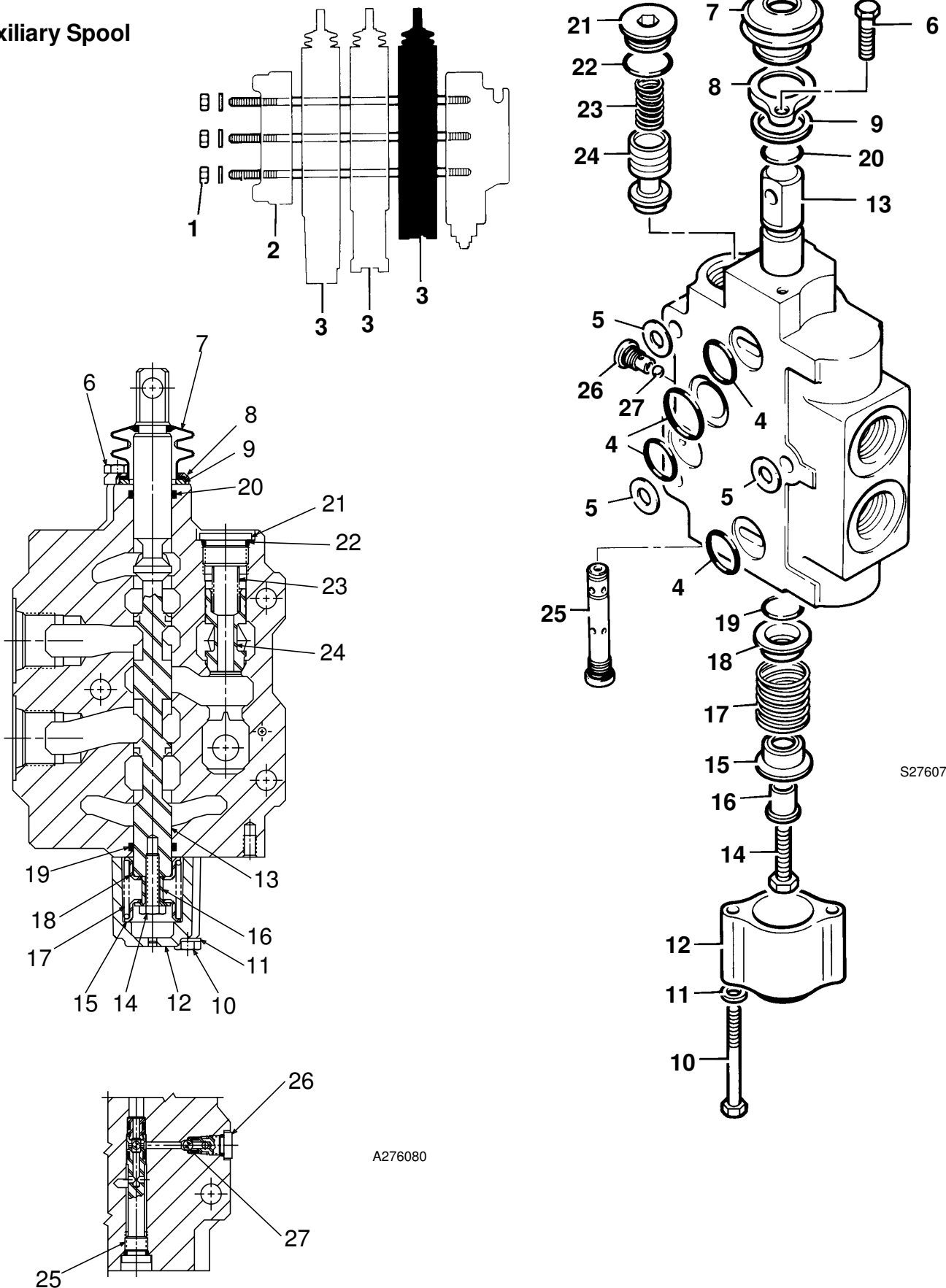
#### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	41	4.1	30
<b>7</b>	67	6.9	50
<b>9</b>	67	6.9	50
<b>16</b>	13.5	1.38	10

Item	Description
<b>1</b>	Tie rod nuts
<b>2</b>	End cover
<b>3</b>	Valve section
<b>4</b>	O-ring
<b>5</b>	Shim
<b>6</b>	Tie rod
<b>7</b>	Plug
<b>8</b>	O-ring
<b>9</b>	Relief valve assembly
<b>10</b>	O-ring
<b>11</b>	O-ring
<b>12</b>	Back-up ring
<b>13</b>	Spring
<b>14</b>	Spool
<b>15</b>	Expansion plug
<b>16</b>	Shuttle plug assembly
<b>17</b>	Ball bearing
<b>18</b>	Adjusting Screw

Dismantling and Assembly

Auxiliary Spool



S276070

A276080

## Dismantling and Assembly

### Auxiliary Spool

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 tie rod nuts **1** and end cover **2**. Separate the valve sections **3** take care not to lose shims **5**. Remove and discard 'O' rings **4**.

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the spool or seal grooves.

Care must be taken to ensure that the spool **13** is not damaged when removing it from the valve block.

Hold the spool in a suitable clamp, unscrew bolt **14** and remove spring **17**, spacer **16** and cups **15** and **18**.

### Assembly

Renew all 'O' rings and back-up rings.

When fitting bolt **14**, clean the threads then apply a small quantity of JCB Threadlocker & Sealer to the threads of the spool.

When fitting spool seals **19** and **20** refer to the procedure **Fitting Spool Seal**.

ALWAYS fit three shim (item **5**) in between each valve block section as shown.

Run the engine and inspect the valve for external leaks.

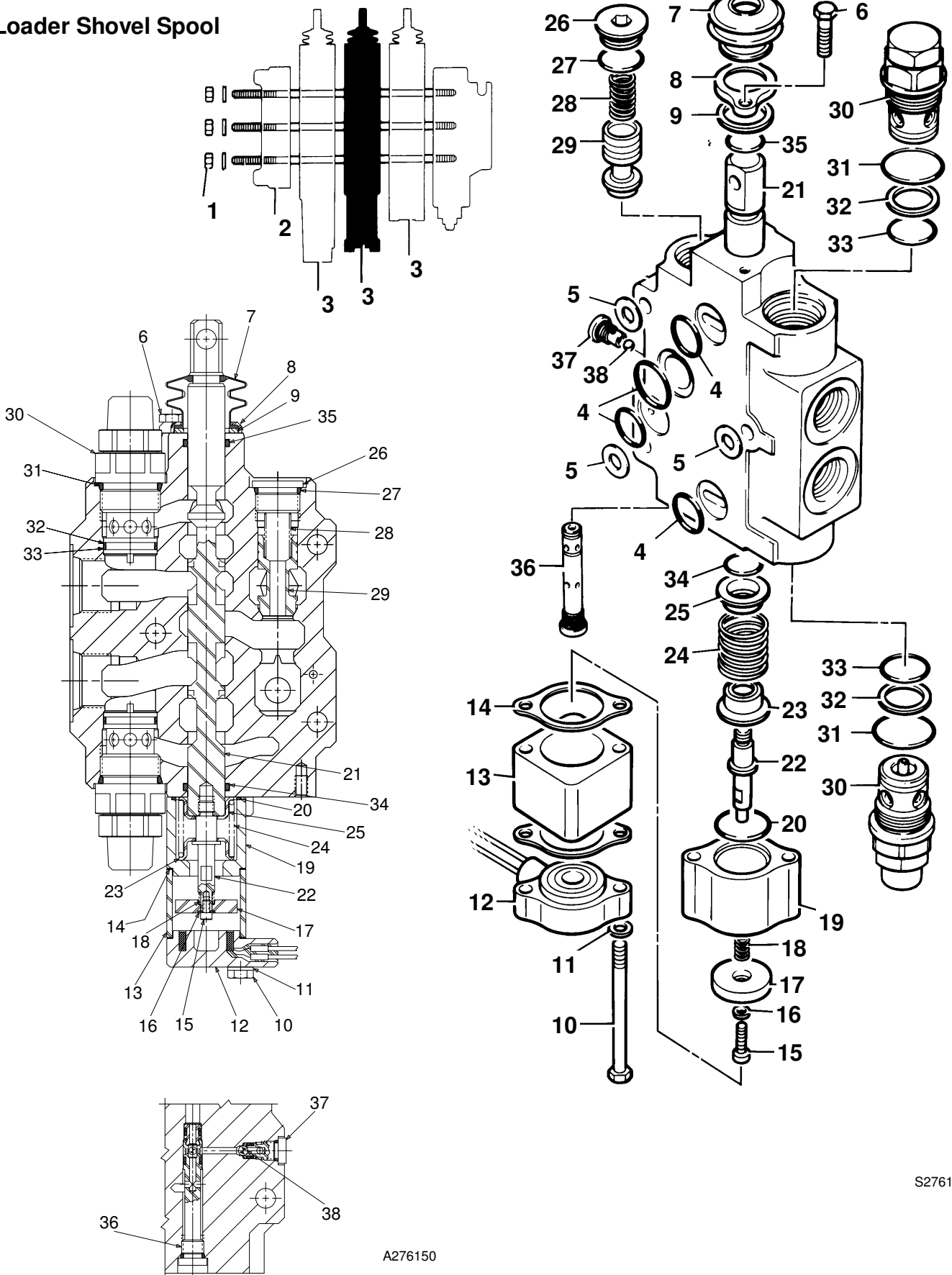
### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	41	4.1	30
<b>6</b>	6	0.55	4
<b>10</b>	8	0.8	6
<b>14</b>	8	0.8	6
<b>21</b>	67	6.9	50
<b>25</b>	13.5	1.38	10
<b>26</b>	13.5	1.38	10

Item	Description
<b>1</b>	Tie rod nuts
<b>2</b>	End cover
<b>3</b>	Valve section
<b>4</b>	O-ring
<b>5</b>	Shim
<b>6</b>	Bolt
<b>7</b>	Dust boot
<b>8</b>	Dust guard
<b>9</b>	Seal
<b>10</b>	Bolt
<b>11</b>	Washer
<b>12</b>	Centering spring housing
<b>13</b>	Spool assembly
<b>14</b>	Bolt
<b>15</b>	Spring cup
<b>16</b>	Spacer
<b>17</b>	Spring
<b>18</b>	Spring cup
<b>19</b>	O-ring
<b>20</b>	O-ring
<b>21</b>	Plug
<b>22</b>	O-ring
<b>23</b>	Spring
<b>24</b>	Poppet
<b>25</b>	Primary shuttle housing
<b>26</b>	Shuttle plug assembly
<b>27</b>	Ball bearing

Dismantling and Assembly

Loader Shovel Spool



S276140

A276150

## Dismantling and Assembly

### Loader Shovel Spool

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 tie rod nuts **1** and end cover **2**. Separate the valve sections **3** take care not to lose shims **5**. Remove and discard 'O' rings **4**.

When removing 'O' rings and seals, use an appropriately rounded tool that **WILL NOT** cause any damage to the spool or seal grooves.

Place a suitable rod through the eye end of spool **21**.

Care must be taken to ensure that the spool **21** is not damaged when removing it from the valve block.

Hold the spool in a suitable clamp, Unscrew coupling **22** and remove spring **24** and cups **23** and **25**.

Relief valve assembly **30** can be dismantled for cleaning purposes only. Individual parts for the relief valve are not available (except seal kits).

#### Assembly

Renew all 'O' rings and back-up rings.

Inspect gasket **14**, replace with a new one if required.

When fitting coupling **22**, clean the threads then apply a small quantity of JCB Threadlocker & Sealer to the threads of the spool.

Check the operation of the solenoid **12** after assembly by connecting a 12V supply . The spool should be held when it is pushed into the detent position and returned when the supply is disconnected.

When fitting spool seals **34** and **35** refer to the procedure **Fitting Spool Seal**.

ALWAYS fit three shim (item **5**) in between each valve block section as shown.

Run the engine and inspect the valve for external leaks.

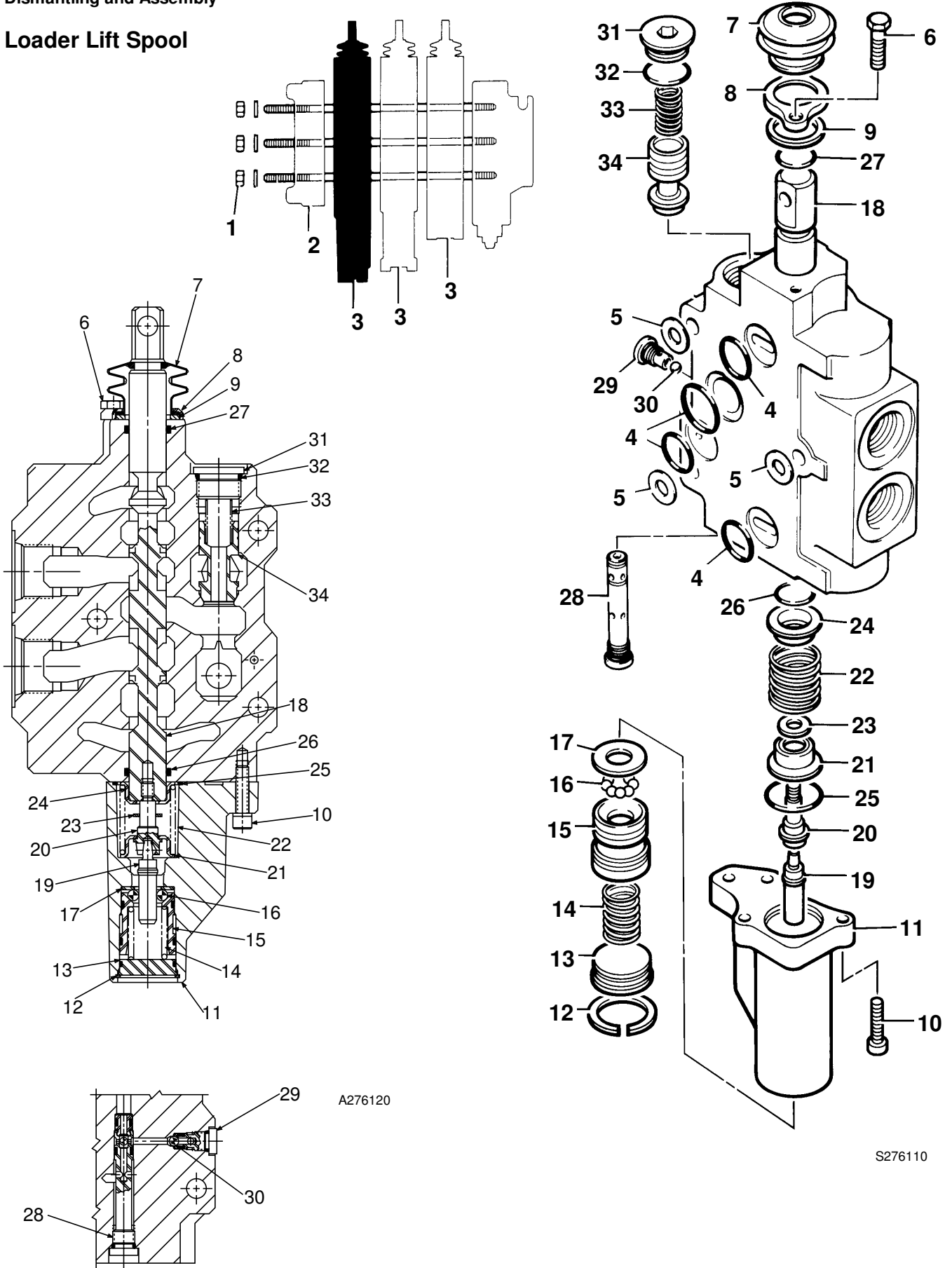
#### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	41	4.1	30
<b>6</b>	6	0.55	4
<b>10</b>	8	0.8	6
<b>15</b>	2.7	0.27	2
<b>22</b>	11	1.1	8
<b>26, 30</b>	67	6.9	50

Item	Description
<b>1</b>	Tie rod nuts
<b>2</b>	End cover
<b>3</b>	Valve section
<b>4</b>	O-ring
<b>5</b>	Shim
<b>6</b>	Bolt
<b>7</b>	Dust boot
<b>8</b>	Dust guard
<b>9</b>	Seal
<b>10</b>	Bolt
<b>11</b>	Washer
<b>12</b>	Detent Solenoid
<b>13</b>	Tube
<b>14</b>	Gasket
<b>15</b>	Cap screw
<b>16</b>	Washer
<b>17</b>	Armature Plate
<b>18</b>	Spring
<b>19</b>	Centering Spring Housing
<b>20</b>	O-ring
<b>21</b>	Spool
<b>22</b>	Coupling
<b>23</b>	Spring cup
<b>24</b>	Spring
<b>25</b>	Spring cup
<b>26</b>	Plug
<b>27</b>	O-ring
<b>28</b>	Spring
<b>29</b>	Poppet
<b>30</b>	Relief valve assembly
<b>31</b>	O ring
<b>32</b>	Back-up ring
<b>33</b>	O-ring
<b>34</b>	O-ring
<b>35</b>	O-ring
<b>36</b>	Primary shuttle housing
<b>37</b>	Shuttle plug assembly
<b>38</b>	Ball bearing

Dismantling and Assembly

Loader Lift Spool



A276120

S276110

## Dismantling and Assembly

### Loader Lift Spool

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 tie rod nuts **1** and end cover **2**. Separate the valve sections **3** take care not to lose shims **5**. Remove and discard 'O' rings **4**.

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the spool or seal grooves.

Care must be taken to ensure that the spool **18** is not damaged when removing it from the valve block.

Hold the spool in a suitable clamp, use a punch to separate detent shaft **19** from coupling **20**. Unscrew coupling **20** and remove spring **22**, spacer **23** and cups **21** and **24**.

Use a suitable press to compress spring **14** and remove retaining ring **12**. Take care not to lose detent balls **16**.

#### Assembly

Renew all 'O' rings and back-up rings.

When fitting coupling **20**, clean the threads then apply a small quantity of JCB Threadlocker & Sealer to the threads of the spool.

When fitting spool seals **26** and **27** refer to the procedure **Fitting Spool Seal**.

ALWAYS fit three shim (item **5**) in between each valve block section as shown.

Run the engine and inspect the valve for external leaks.

#### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	41	4.1	30
<b>6</b>	6	0.55	4
<b>10</b>	8	0.8	6
<b>20</b>	8	0.8	6
<b>28</b>	13.5	1.38	10
<b>29</b>	13.5	1.38	10
<b>31</b>	67	6.9	50

Item	Description
<b>1</b>	Tie rod nuts
<b>2</b>	End cover
<b>3</b>	Valve section
<b>4</b>	O-ring
<b>5</b>	Shim
<b>6</b>	Bolt
<b>7</b>	Dust boot
<b>8</b>	Dust guard
<b>9</b>	Seal
<b>10</b>	Capscrew
<b>11</b>	Detent housing
<b>12</b>	Retaining ring
<b>13</b>	Retainer
<b>14</b>	Spring
<b>15</b>	Piston
<b>16</b>	Detent balls
<b>17</b>	Washer
<b>18</b>	Spool assembly
<b>19</b>	Detent shaft
<b>20</b>	Pivot coupling
<b>21</b>	Spring cup
<b>22</b>	Spring
<b>23</b>	Spacer
<b>24</b>	Spring cup
<b>25</b>	O-ring
<b>26</b>	O-ring
<b>27</b>	O-ring
<b>28</b>	Primary shuttle housing
<b>29</b>	Shuttle plug assembly
<b>30</b>	Ball bearing
<b>31</b>	Plug
<b>32</b>	O-ring
<b>33</b>	Spring
<b>34</b>	Poppet

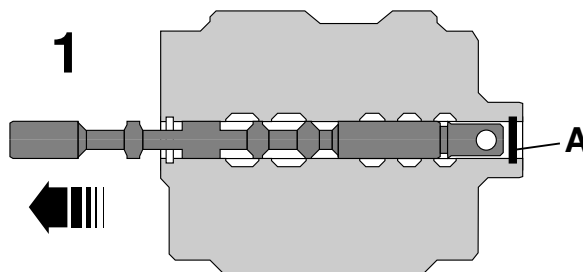


## Dismantling and Assembly

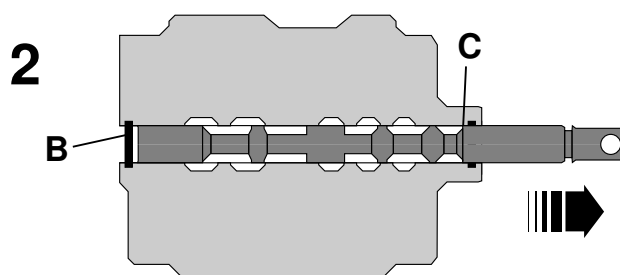
### Fitting Spool Seal

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

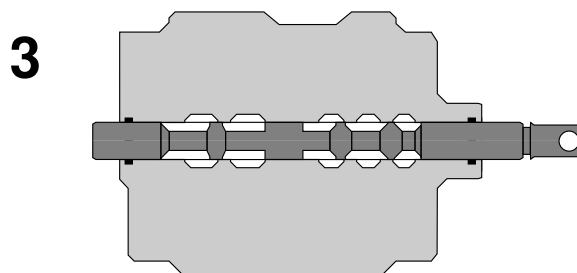
- 1 Lubricate the spool, bore and O-ring groove with JCB Hydraulic Fluid. Move the spool to the position shown and then install the O-ring **A** in its groove.



- 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-assemble the centering assembly, dust boot etc as detailed previously in this section.



A276280

## Removal and Replacement

### Manual Control

#### ⚠ 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

- 1 Operate the valve block levers back and forth to vent residual pressure.
- 2 Remove the rear valance.
- 3 Remove clevis pins **A** to disconnect the control levers from the valve block spools.
- 4 Disconnect all hydraulic hoses from the valve block and plug all orifices to prevent ingress of dirt. Label each hose before disconnecting, this will ensure correct position when refitting.
- 5 Loosen nuts **B** - do not completely remove the retaining nuts.

#### ⚠ 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

- 6 Wrap a suitable sling around the valve, make sure that the weight of the valve is supported by the sling.
- 7 Remove nuts **B** and lower the valve block to the ground.

### Replacement

Replacement is a reversal of the removal sequence.

Hoses and pipes (when applicable) must be re-connected and phased in same position as removal. Refer to **Dismantling and Assembly, Hoses and Pipes**.

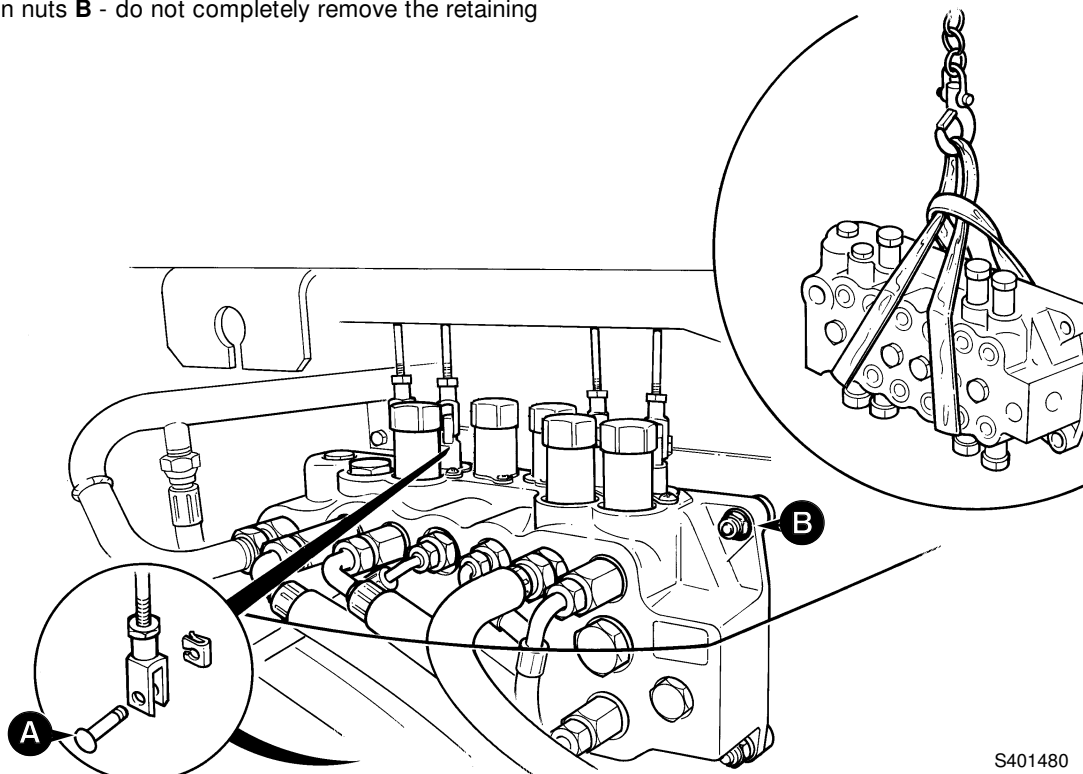
#### ⚠ WARNING

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 auxiliary relief valve (A.R.V.) pressure settings.

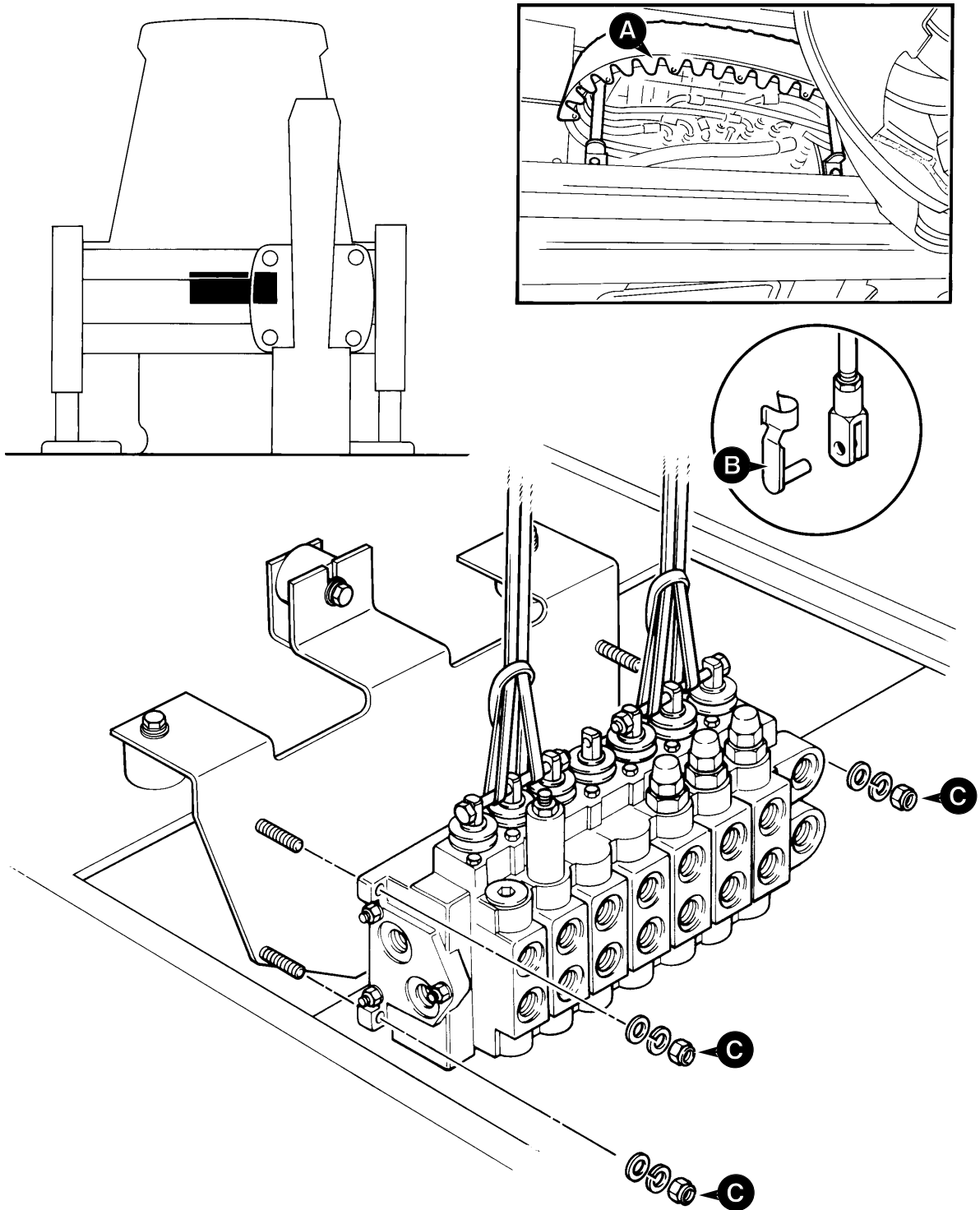
**Note:** All hydraulic adapters that are installed together with a bonded sealing washer must also have JCB Threadseal applied to the threads of the adapter.



S401480

Removal and Replacement

Variable Flow



S278930

## Removal and Replacement

### Variable Flow

#### 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 Sideshift the carriage to one side as shown (sideshift machines only). Lower the backhoe and loader end to the ground and stop the engine.
- 2 Operate the valve block levers back and forth to vent residual pressure.
- 3 Remove the hose guide **A** (this makes access to the valve block easier).
- 3 Remove clevis pins **B** to disconnect the control levers from the valve block spools.
- 4 Disconnect all hydraulic hoses from the valve block and plug all orifices to prevent ingress of dirt. Label each hose before disconnecting, this will ensure correct position when refitting.
- 5 Insert two M10 bolts through the eye end spools (three spools each end) as shown. Make sure the bolt has a retaining nut on each end. When the bolts are in place thread suitable slings around the bolts as shown.

#### 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

- 7 Remove nuts **C** and lower the valve block to the ground.

### Inspection

Inspect the resilient mounts for damage, cracking etc. If the mounts are suspect, then replace them with new ones.

### Replacement

Replacement is a reversal of the removal sequence.

Hoses and pipes (when applicable) must be re-connected and phased in same position as removal. Refer to **Dismantling and Assembly, Hoses and Pipes**.

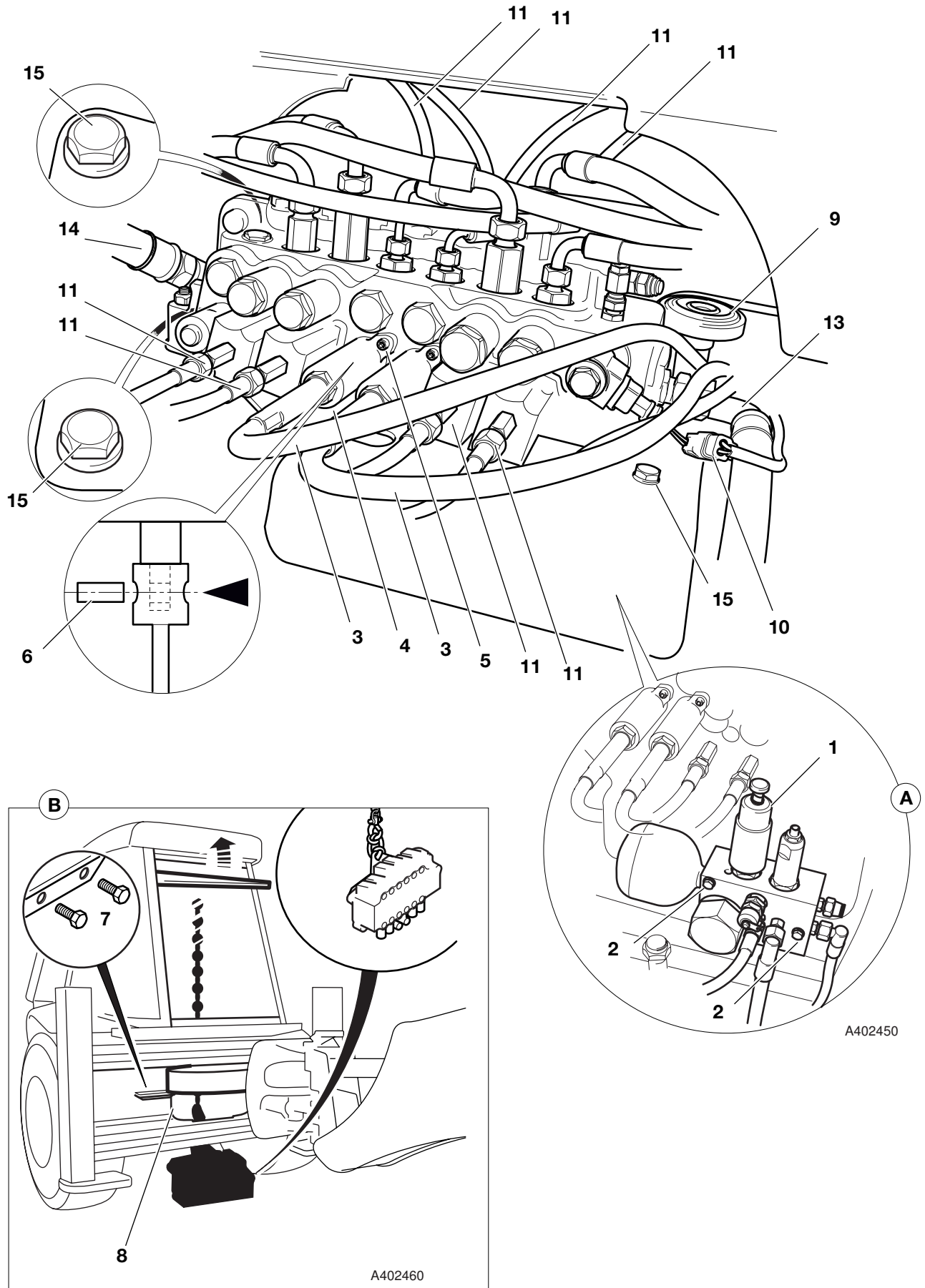
#### WARNING

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 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.



## Removal and Replacement

### Precision Control (Servo)

#### 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

It is recommended that the valve is removed complete with its mounting plate. The assembly is lowered down and then out from under the rear on the machine. Before commencing make sure that there is sufficient clearance between the machine and the ground. If necessary raise the rear of the machine using the stabilisers. Chock the machine securely, remembering to leave access for removal of the valve assembly.

The illustration is viewed from the bottom.

Before proceeding, vent the hydraulic pressure as follows:

- 1 Stop the engine. With the operator seat set in the rear facing position (for backhoe operation), switch the starter to ON without starting the engine. Operate the joystick controls several times to vent the hydraulic pressure from the servo system and backhoe rams.
- 2 Operate the stabiliser controls several times to vent pressure from the stabiliser rams.
- 3 Turn the starter switch to the OFF position and remove the key.

#### 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

To avoid damage to the pilot supply valve (shown at **A**), remove it as follows:

- 1 Carefully tag all the hoses connected at the valve. Record the phasing. Disconnect the hoses.
- 2 Uncouple the solenoid electrical connector **1**.
- 3 Undo the two fixing bolts **2** and remove the valve.

Disconnect the stabiliser spool control cables **3** as follows:

- 1 Undo the lock nut **4**.
- 2 Undo the housing retaining screws **5** and slide the housing down the cable.
- 3 Push out the cable connecting pin **6** and disconnect the cable at the spool. Tie the cables out of harms way.

Remove the excavator valve as follows:

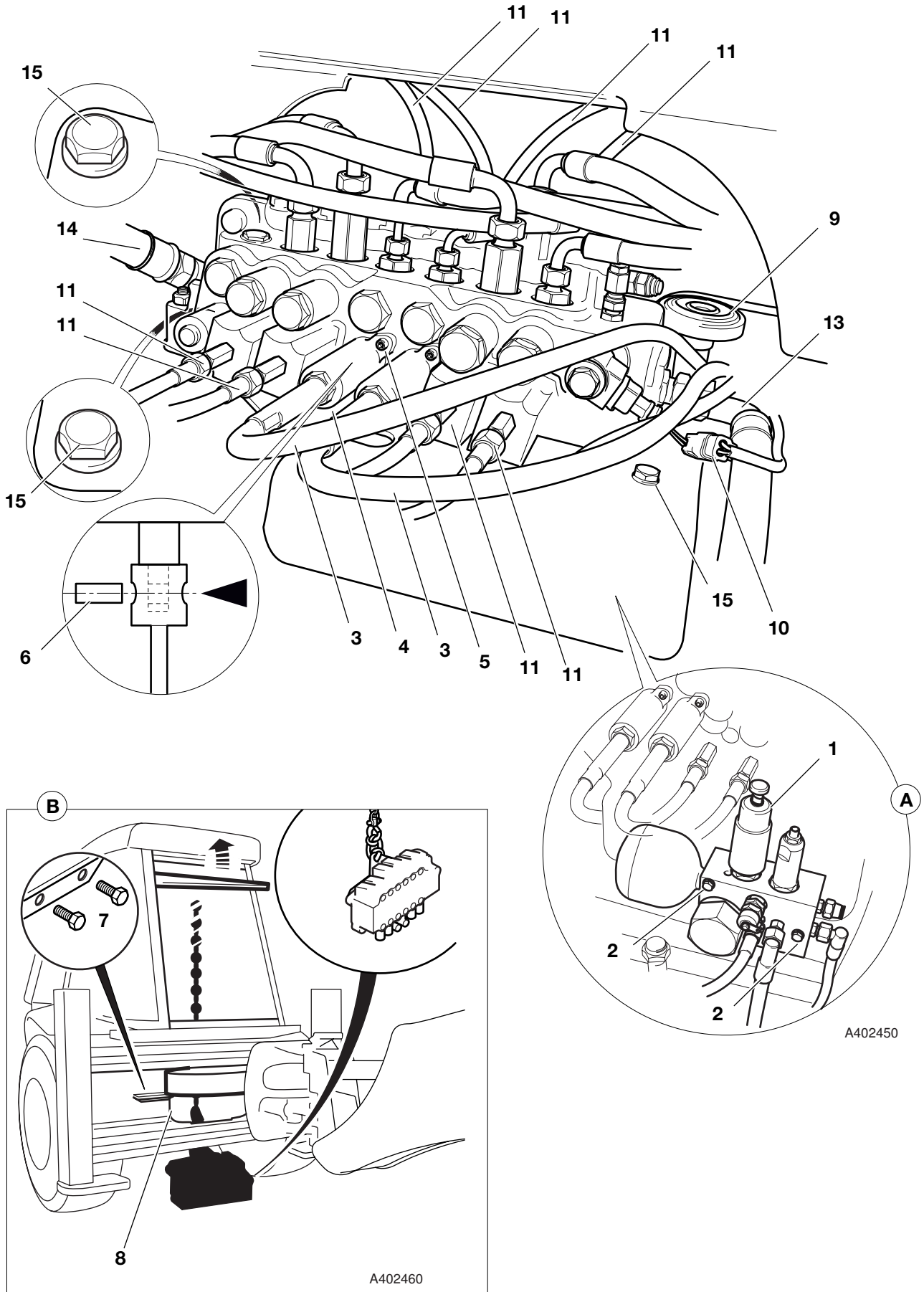
- 1 For access remove bolts **7** and tie hose guard **8** out of the way.
- 2 Uncouple electrical connection to the rear horn **9**.
- 3 Uncouple electrical connection **10** to the hydraclamp solenoid.
- 4 Record the phasing of the pilot hoses **11** connected at the top and bottom of the excavator valve. The hoses should be labelled, if not label each hose before disconnecting, this will ensure correct position when refitting. Disconnect all hydraulic pilot hoses from the valve block and plug all open ends and ports to prevent ingress of dirt.
- 5 Record the phasing of the service hoses connected at the front of the excavator valve. Label each hose before disconnecting, this will ensure correct position when refitting. Disconnect all the hoses from the valve block and plug all open ends and ports to prevent ingress of dirt.
- 6 Disconnect the inlet **13** and tank return **14** hoses from the valve block, plug all open ends and ports to prevent ingress of dirt.
- 7 Loosen the three mounting plate bolts **15** - DO NOT completely remove the retaining bolts.

#### 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

- 8 Open the rear window. Remove the access plate in the cab floor above the excavator valve. Attach a suitable sling to the mounting bracket slinging point, make sure that the weight of the valve is supported by the sling (shown at **B**).
- 9 Remove bolts **15** and lower the valve block to the ground.
- 10 If the hose adaptors are going to be removed from the valve block, label before removing to ensure replacement in the correct ports. Record the positions of any restrictors.



A402450

A402460

## Removal and Replacement (Cont'd)

### Precision Control (Servo)

#### Replacement

Replacement is a reversal of the removal sequence.

Hoses and pipes (when applicable) must be re-connected and phased in same position as removal.

#### **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.**

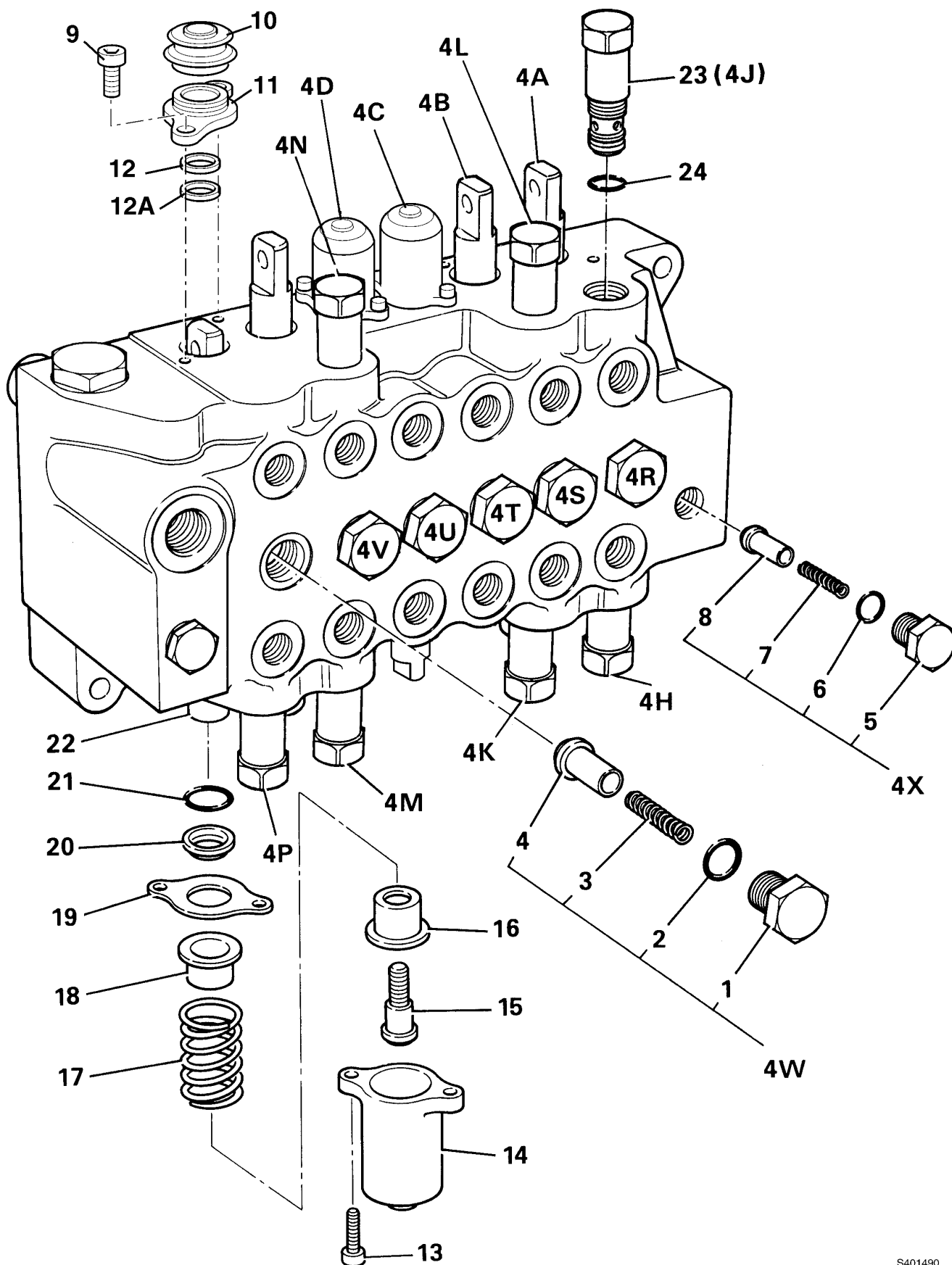
INT-3-1-10/1

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

#### Torque Settings

Item	Nm	kgf m	lbf ft
5	8 - 11	0.8 - 1.1	6 - 8





S401490

## Dismantling and Assembly

### Manual Control

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

For assembly the sequence should be reversed.

#### Check Valves

Each of the identical load hold check valves **4R** to **4W** can be removed as shown at **4W**. Make-up check valve **4X** is a smaller size but otherwise identical.

Ensure good condition of seating faces on poppets **4** and **8** and on the mating faces in the valve block.

#### Spools

Spools **4A**, **4B**, **4E** and **4F** are identical but must not be interchanged as they are matched to their bores. Stabiliser spools **4C** and **4D** are identical to each other but different from the excavator spools.

All spools have the same centring and sealing components items **9** to **21**.

To completely dismantle a spool, follow the sequence **9** to **21**. To prevent spool rotation when turning screw **15**, hold a rod through the eye end of the spool.

If only renewing the seals, dismantle as far as cap **14** then remove items **15** to **22** as an assembly.

Lubricate new seals with JCB Hydraulic Fluid and take care to prevent them from being damaged by the sharp edges of the spool.

Apply JCB Threadlocker and Sealer to threads of screw **15**.

#### Relief Valves

A.R.V's **4H** to **4P** appear identical but have various pressure settings, refer to **Technical Data**. Ensure that they are correctly adjusted and fitted in their specified positions.

Relief valve dismantling and assembly procedures are detailed separately.

**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.

### Assembly

- 1** Fit the boot **10** to the seal plate **11**.
- 2** Fit a new lipseal **12A** into the valve block, ensure square. Fit wiper **12** on top of lipseal.
- 3** Fit the seal plate and boot assembly to valve block but do not torque tighten capscrews **9** 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 **9**.
- 7** When fitting bolt **15**, 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 **16** does not interfere with item **18**.
- 9** Renew 'O' ring **21** and seal **20**. Make sure the 'O' ring and wiper seal are not trapped or damaged.
- 10** Fit seal **20** and seal plate **19** to the valve block section. Torque tighten capscrew **13** on completion.

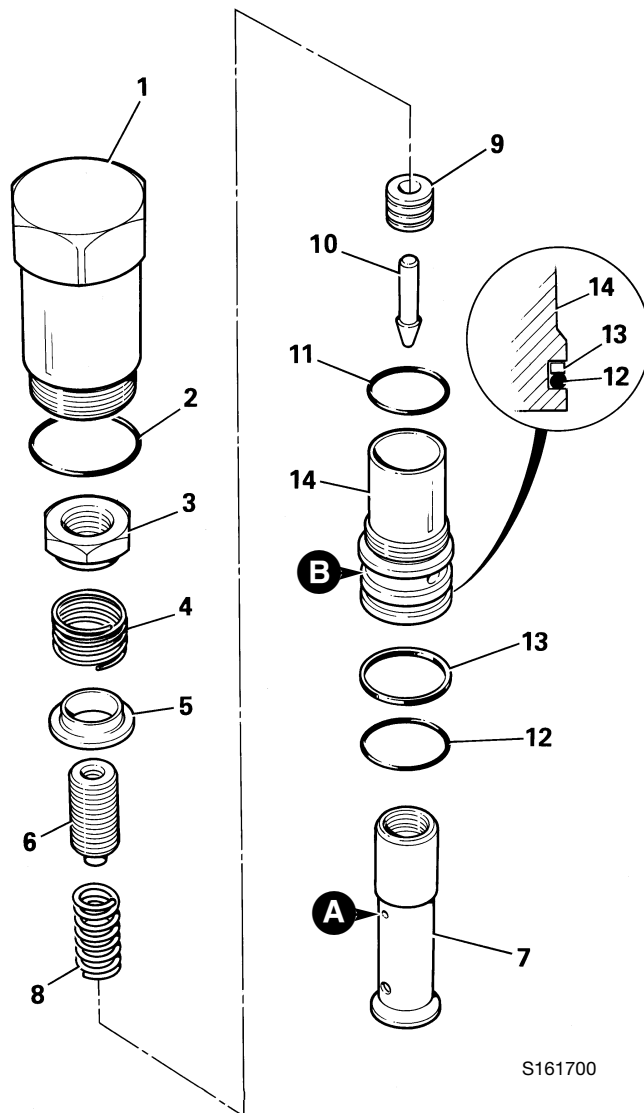
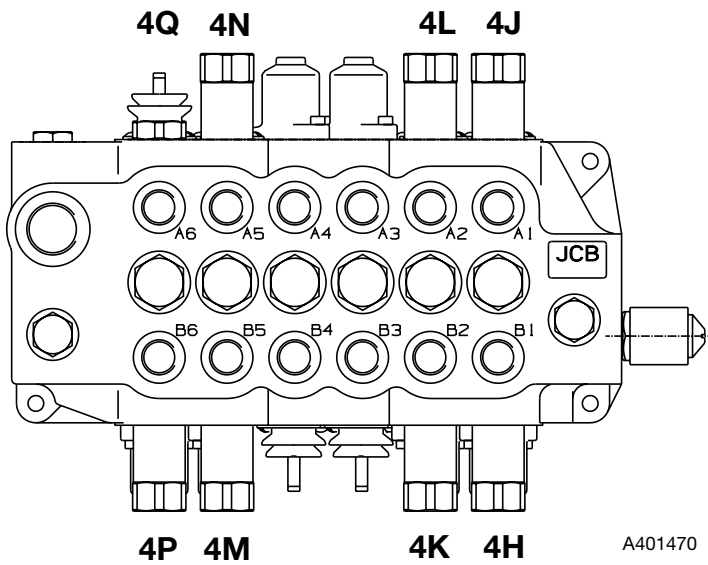
Re-connect the lever mechanism to the tang (lever) end of the spool.

Run the engine and inspect the valve for external leaks.

### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	122	12.4	90
<b>5</b>	80	8.3	60
<b>9</b>	9.5	0.96	7
<b>13</b>	7	0.7	5
<b>15</b>	11	1.1	8
<b>23</b>	95	10	70

Auxiliary Relief Valves



S161700

## Dismantling and Assembly

### Auxiliary Relief Valves

Eight A.R.V.'s are fitted at positions **4H** to **4Q**. These are identical in design but have various pressure settings, refer to **Technical Data**.

**Note:** Valve **4Q** is only fitted to machines equipped with a Powerbreaker.

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

For assembly the sequence should be reversed.

#### Dismantling

Dismantle sub-assembly **14** from item **1** using a special tool (see **Service Tools**). The special spanner locates in cross holes **B**.

Dismantle sub-assembly **14** into its component parts.

Make sure that small drilling **A** is not blocked.

Discard old and worn O-rings and back-up rings.

#### Assembly

Renew all O-rings and back-up rings.

Lubricate O-rings and back-up rings with JCB Hydraulic Fluid.

Fit back-up ring **13** on the upper side of 'O' ring **12** as shown in the inset.

Fit flat face of sleeve **9** against shoulder of poppet **10**.

Torque tighten item **14** using the special tool (see **Service Tools**), until its shoulder seats firmly against item **1**.

Pressure test the relief valves, refer to **Service Procedures, Excavator Valve - Pressure Testing**.

#### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	65	6.6	48
<b>3</b>	24	2.5	18

#### A.R.V. Position Key

	Control Layout			
	JCB	ISO	Case	Ford
Slew Right	4H	4H	4H	4H
Slew Left	4J	4J	4J	4J
Boom Rod	4K	4M	4M	4K
Boom Head	4L	4N	4N	4L
Dipper Rod	4N	4L	4K	4N
Dipper Head	4M	4K	4L	4M
Bucket Rod	4Q	4Q	4Q	4P
Bucket Head	4P	4P	4P	4Q

**Note:** The bucket rod side A.R.V. is only fitted to machines equipped with a Powerbreaker.

## Dismantling and Assembly

### Hydraclamp Valve - (Sideshift Machines) (Not Precision Control Machines)

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 POPPET AND SEAT
- DAMAGE TO SEAL GROOVES

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

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves. Discard ALL 'O' rings DO NOT use worn or damaged items.

Note that the hydraclamp comprises two separate valve assemblies; 1) the check valve assembly (items 1 to 8); 2) the solenoid assembly (items 11 to 14).

#### Dismantling

Loosen nut 1 (turn anti-clockwise) and then remove the check valve assembly from the valve block. If required, the check valve assembly can be dismantled into its component parts (items 1 to 8).

Inspect the valve components for scratches, nicks or any other type of damage, particularly on the poppet and seat faces. Replace with new if required.

#### Assembly

Renew all 'O' rings. The parts microfiche will identify the correct seal kit part numbers for items 2, 2A, 4, 6, 10 and 14.

Fit seal 2A with the recess towards 'O' ring 2, as shown at A.

Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

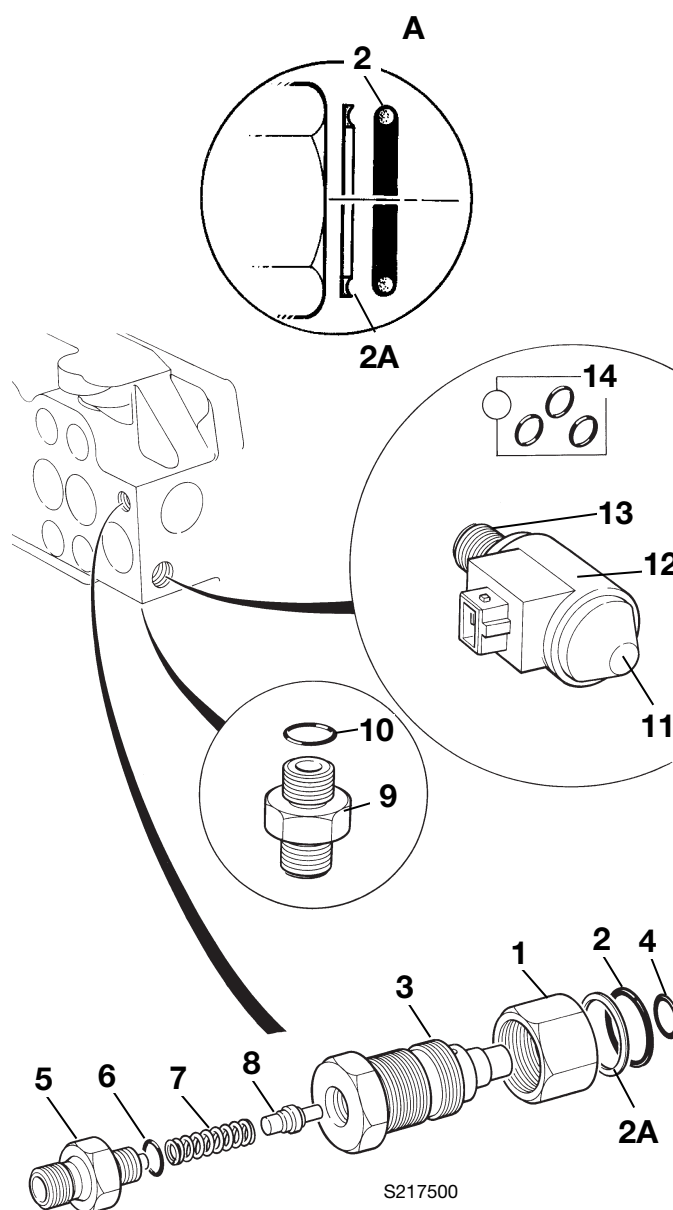
Ensure that the small drilling through the centre of item 3, is clear.

Do not over-tighten the solenoid assembly, it may affect the operation of the solenoid, use the spanner flats and torque tighten to figure indicated in the table below (items 11 and 13).

Check the operation of the electric hydraclamp, refer to **Circuit Descriptions, Excavator Valve - Manual Control - Hydraclamp Valve Operation.**

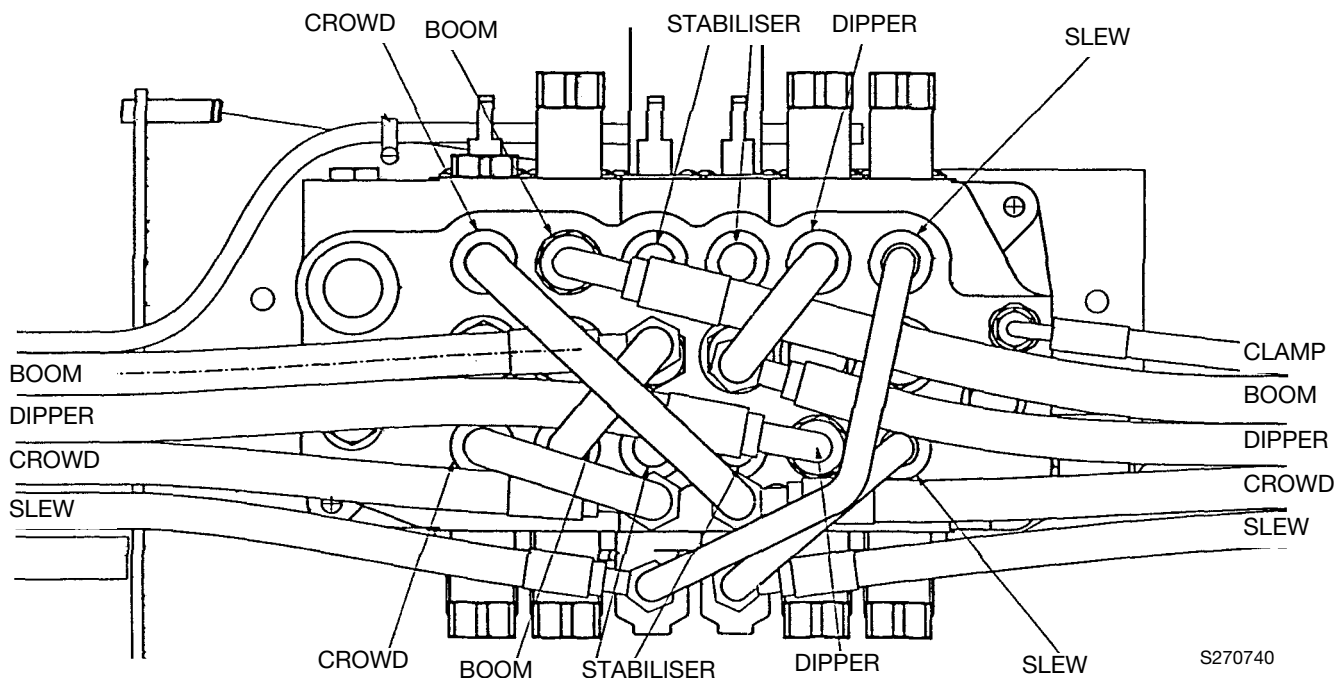
#### Torque Settings

Item	Nm	kgf m	lbf ft
1	13.5	1.4	10
3	24.5	2.5	18
5	13.5	1.4	10
11	5.5	0.5	4
13	24.5	2.5	18

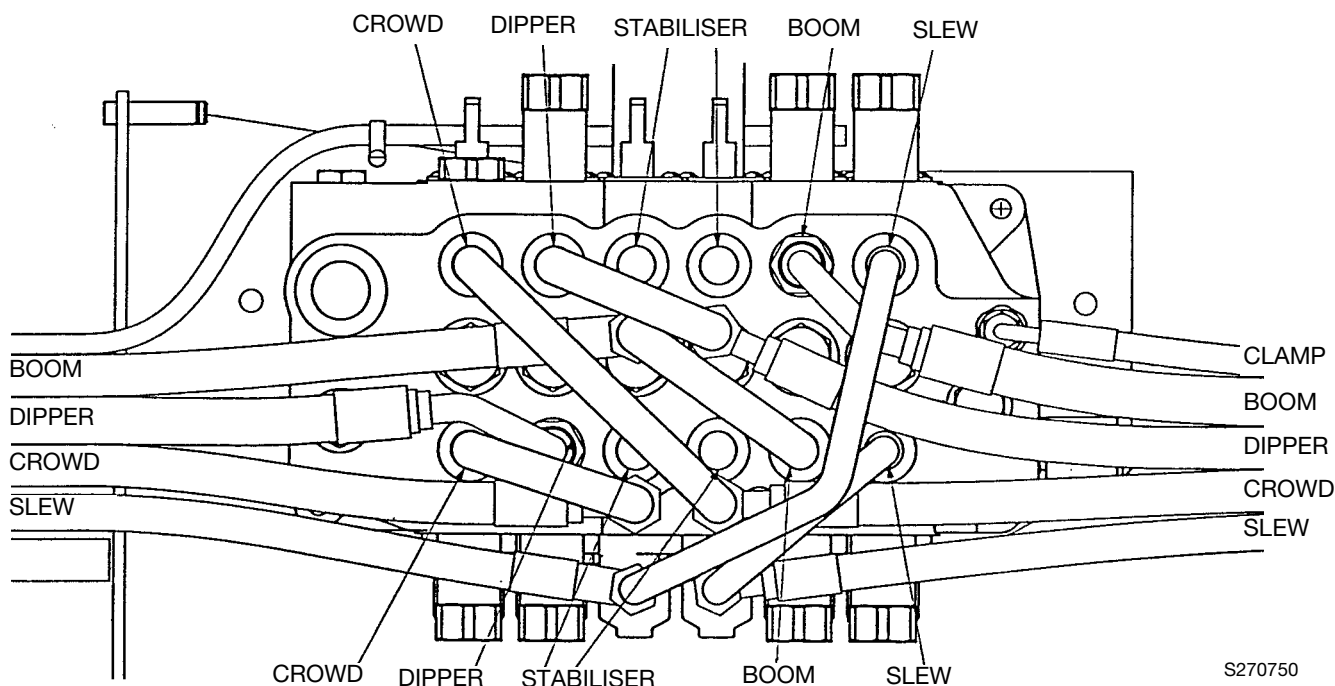


### Dismantling and Assembly - Hoses and Pipes (Sideshift Valve)

Refer to **Excavator Valve, Removal and Replacement** for valve block removal and replacement procedure. Hoses and pipes (when applicable) must be re-connected and phased in same position as removal.



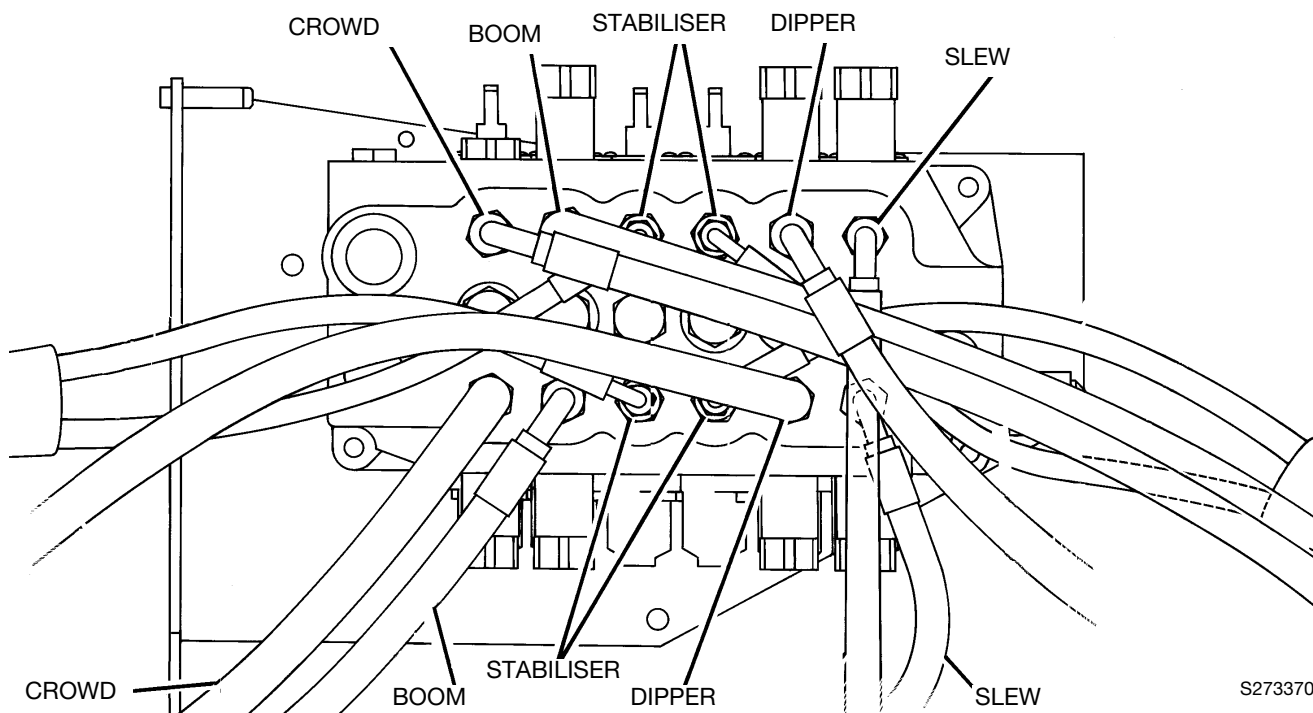
### ISO EXCAVATOR VALVE



### JCB EXCAVATOR VALVE

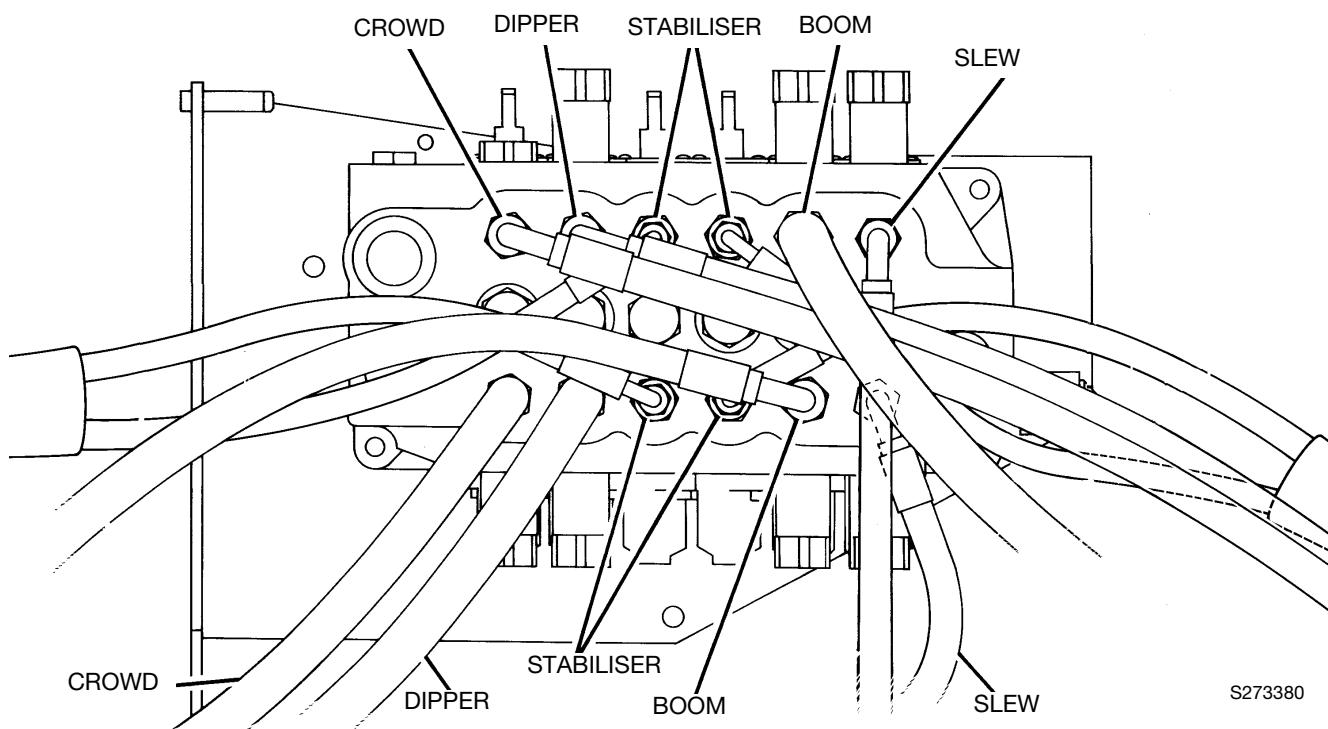
### Dismantling and Assembly - Hoses and Pipes (Centremount Valve)

Refer to **Excavator Valve, Removal and Replacement** for valve block removal and replacement procedure. Hoses and pipes (when applicable) must be re-connected and phased in same position as removal.



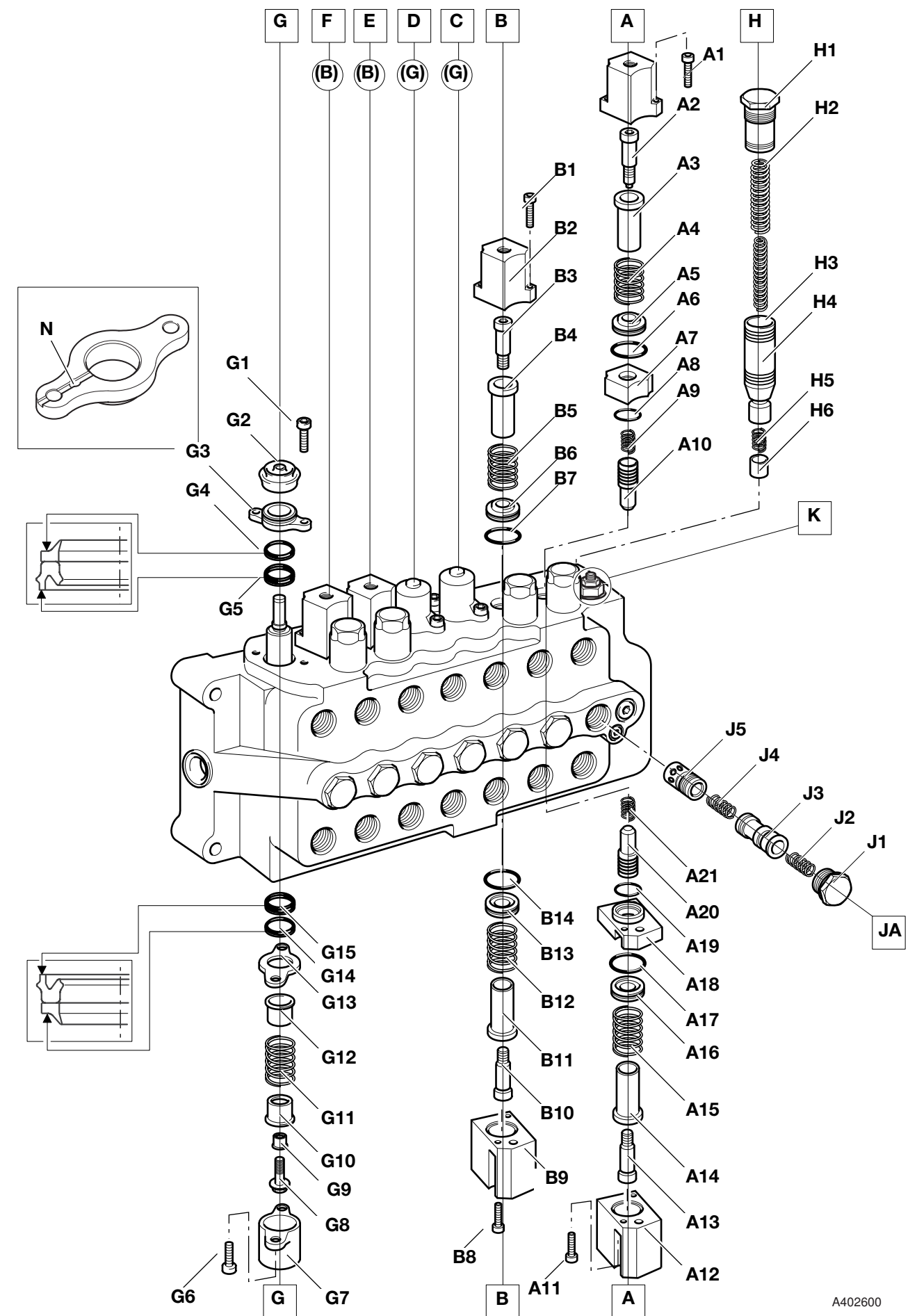
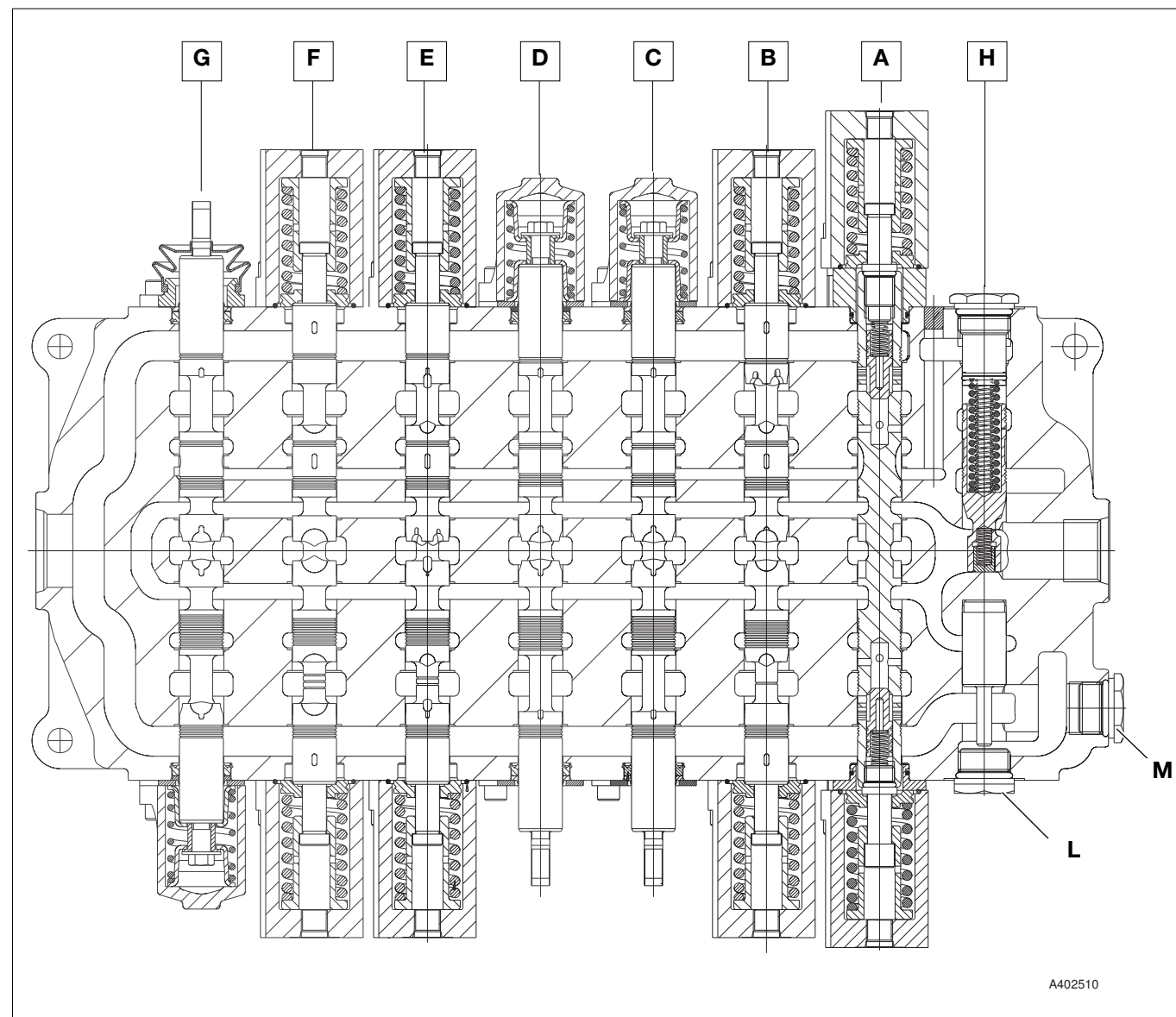
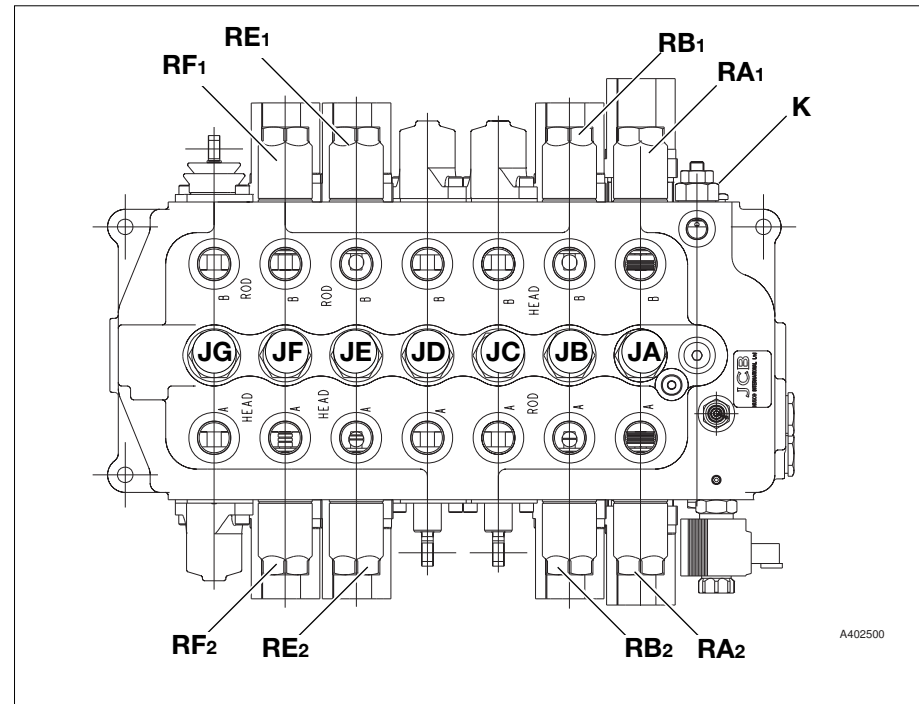
S273370

ISO EXCAVATOR VALVE



S273380

JCB EXCAVATOR VALVE





## Dismantling and Assembly

### Precision Control (Servo) (Machines up to serial no. 931159)

#### Introduction

The numerical sequence shown on the illustration is intended as a guide to dismantling. Be sure to note the location of all components when dismantling. Although some components may appear to be identical they are not interchangeable. Make sure that components are assembled in their original positions.

For assembly the sequence should be reversed.

#### Load Sense (Isolator/Compensator) Valves

Each of the load sense valves **JA** to **JG** can be removed as shown at **JA**. Note that all valves are identical in appearance except valve **JE**. This valve is of the same configuration but is dimensionally different. Note that components are not interchangeable, see the introduction above.

#### Spools

Note that not all the spools are shown with their components. This is because some spool assemblies are of the same configuration:

For spools **F** and **E** see spool **B**.

For spools **D** and **C** see spool **G**. Note that the spools are inverted relative to spool **G**.

Stabiliser spools **1D** and **4E** are identical to each other but different from the excavator spools. Spools must not be interchanged as they are matched to their bores

To dismantle spools **C**, **D** and **G** hold a rod through the eye end of the spool to prevent it rotating when undoing the screw at the opposite end. To dismantle spools **B**, **E** and **F** use allen keys in both screws, holding one whilst undoing the other. After removing one screw, hold the spool using service tool 992/10100 and then undo the remaining screw.

It is strongly recommended that that spool **A** is not dismantled. The spool has additional valve components in each end and can easily be damaged when dismantling. If the spool is damaged then the valve must be renewed. Only attempt to dismantle the spool in exceptional circumstances.

Lubricate new seals with JCB Hydraulic Fluid and take care to prevent them from being damaged by the sharp edges of the spool.

Note that the breather groove **N** in the seal retaining plates **G3** must be orientated facing the rear mounting face of the valve block

#### Relief Valves

A.R.V's **RA** to **RF** appear identical but have various pressure settings, refer to **Technical Data**. Ensure that they are correctly adjusted and fitted in their specified positions.

Relief valve dismantling and assembly procedures are detailed separately.

#### Bypass Compensator Valve

The bypass compensator valve is shown at **H**. Note that the assembly **L** is a blanking spool and would not normally need to be removed.

#### Load Sense Drain Regulator and Relief Valve

The dismantling and assembly procedure for the drain regulator and relief valve assembly **K** is detailed separately, see **Drain Regulator and Relief Valve**.

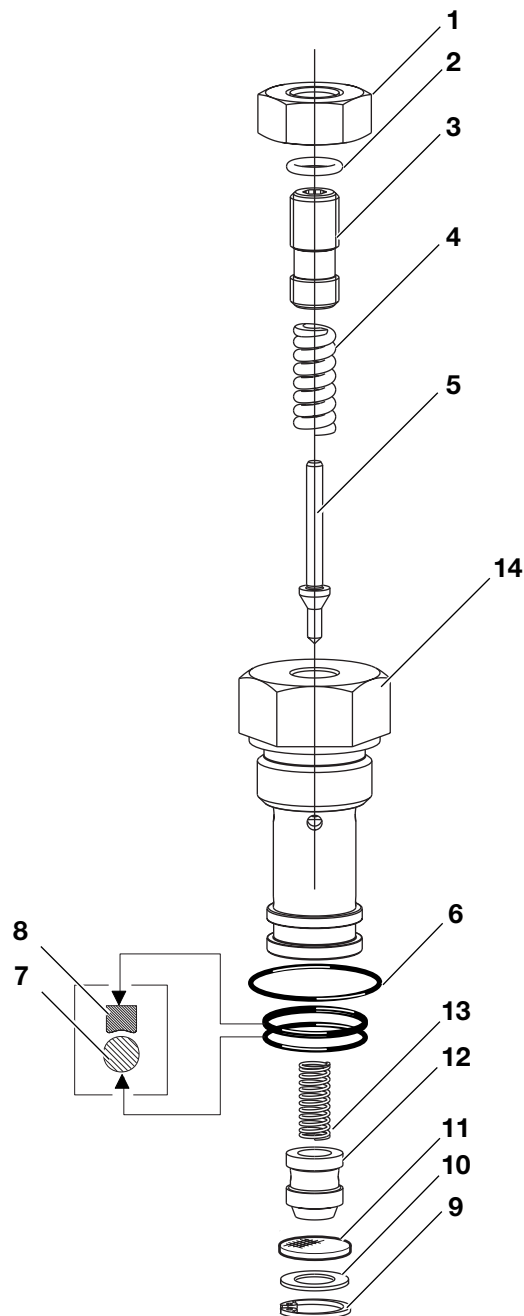
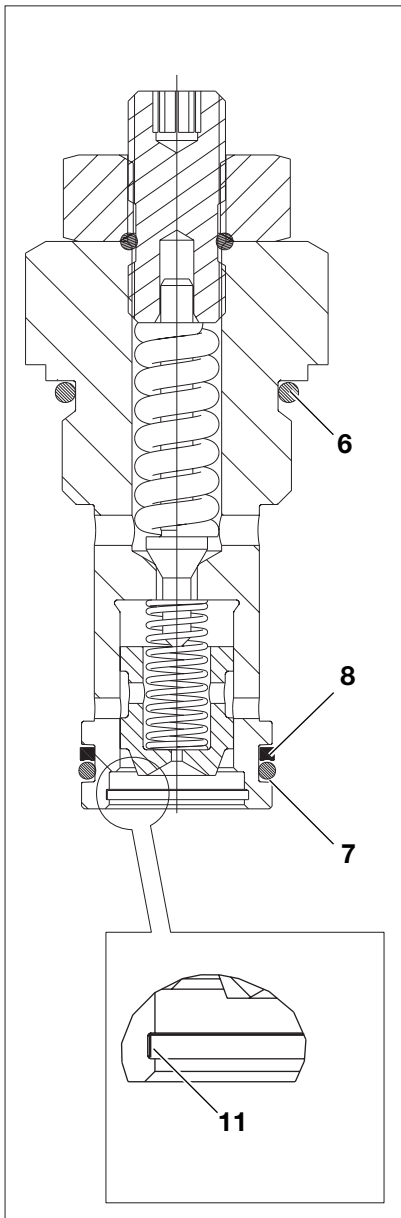
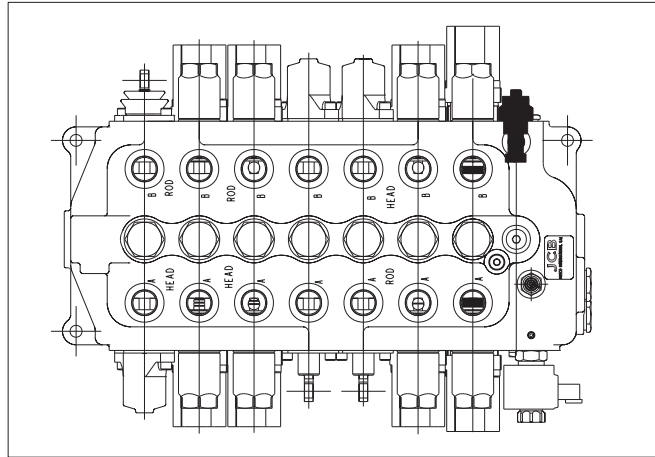
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**When assembling apply JCB Threadlocker to the following components:**

**A2**  
**A13**  
**G8**

#### Torque Settings

Item	Nm	kgf m	lbf ft
<b>A1</b>	8 - 11	0.8 - 1.1	6 - 8
<b>A2</b>	8 - 11	0.8 - 1.1	6 - 8
<b>A11</b>	8 - 11	0.8 - 1.1	6 - 8
<b>A13</b>	8 - 11	0.8 - 1.1	6 - 8
<b>B1</b>	8 - 11	0.8 - 1.1	6 - 8
<b>B3</b>	17 - 21	1.7 - 2.1	12.5 - 15.5
<b>B8</b>	8 - 11	0.8 - 1.1	6 - 8
<b>B10</b>	17 - 21	1.7 - 2.1	12.5 - 15.5
<b>G1</b>	8 - 11	0.8 - 1.1	6 - 8
<b>G6</b>	8 - 11	0.8 - 1.1	6 - 8
<b>G8</b>	8 - 11	0.8 - 1.1	6 - 8
<b>H1</b>	58 - 72	6 - 7.3	43 - 53
<b>JA</b>	58 - 72	6 - 7.3	43 - 53
<b>K</b>	58 - 72	6 - 7.3	43 - 53
<b>M</b>	58 - 72	6 - 7.3	43 - 53
<b>RA - RF</b>	58 - 72	6 - 7.3	43 - 53



A402640

## Dismantling and Assembly

### Precision Control (Servo)

(Machines up to serial no. 931159)

#### Load Sense Drain Regulator and Relief Valve

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

Note that components **6 - 13** can be dismantled and assembled without disturbing components **1 - 5**. If components **1 - 5** are dismantled, the valve must be reset to the correct operating pressure after assembly.

For assembly the sequence should be reversed.

Great care should be taken when dismantling and assembling a valve to avoid the following:-

- Contamination**
- Damage to spools**
- Damage to seal grooves**

Any of the above may result in possible problems with the operation of the valve.

#### When Dismantling

When removing 'O' Rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves.

Discard ALL 'O' Rings and back-up rings. DO NOT use worn or damaged items.

#### Inspection

Inspect the valve components for scratches, nicks or any other type of damage, replace with new if required.

#### When Assembling

Renew all 'O' rings and back-up rings.

Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

Make sure that the 'O' rings and back-up rings are fitted the correct way, items **7** and **8**.

Be sure to fit filter screen **11** the correct way round.

Adjust pressure setting as required.

#### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	8 - 11	0.8 - 1.1	6 - 8

## Dismantling and Assembly

### Precision Control (Servo) (Machines up to serial no. 931159)

#### Hydraclamp Valve

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 BALL SEAT AND PISTON
- DAMAGE TO SEAL GROOVES

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

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves. Discard ALL 'O' rings DO NOT use worn or damaged items.

Note that the hydraclamp comprises two separate valve assemblies; the clamp valve assembly shown at **A** and the solenoid assembly shown at **B**.

#### Dismantling

Unsecrew the clamp valve assembly **A** from the excavator valve block. Withdraw the piston **3** from the excavator valve block, if necessary use thin nose pliers.

Hold the body **1** and undo the spring retaining plug **4**. Withdraw the spring **5** and ball **6**.

Undo the nut **7** and remove solenoid coil **8**. Undo the valve stem **9**.

Make sure that all components and associated cross drillings are clean and free from debris.

Inspect the valve components for scratches, nicks or any other type of damage, particularly on the ball and seat faces. Carefully inspect the outside diameter of the piston **3** and its bore in the excavator valve block for damage or excessive wear. Renew components as required.

#### Assembly

Renew all 'O' rings.

Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

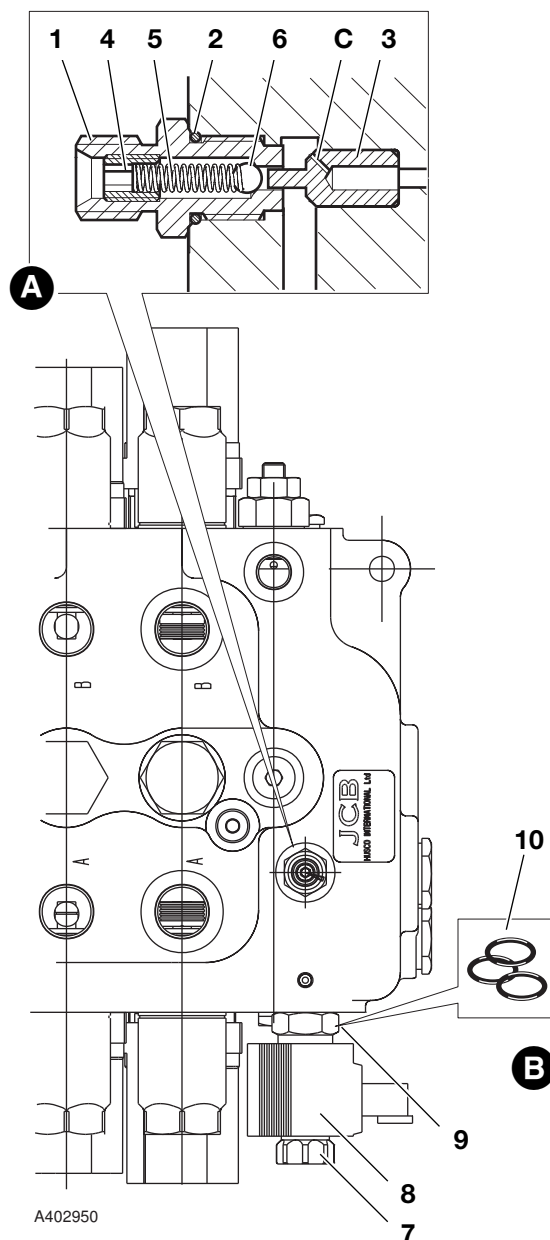
Ensure that the small drilling **C** in the piston **3** is clear.

Do not over-tighten the solenoid assembly, it may affect the operation of the solenoid, use the spanner flats and torque tighten to figure indicated in the table.

Check the operation of the electric hydraclamp, refer to **Circuit Descriptions, Excavator Valve - Precision Control - Hydraclamp Valve Operation**.

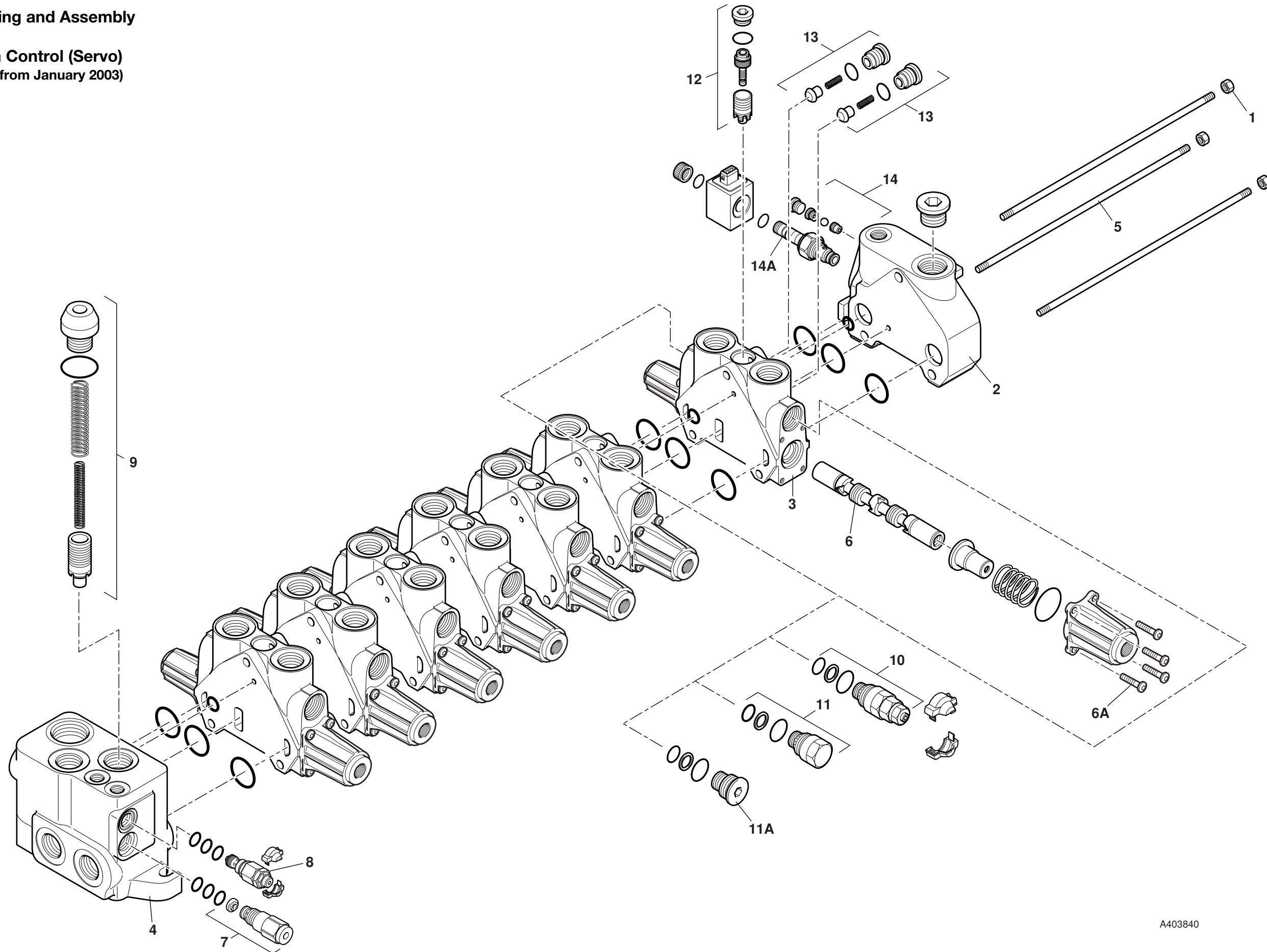
#### Torque Settings

Item	Nm	kgf m	lbf ft
4	8 - 11	0.8 - 1.1	6 - 8
7	4.7 - 6.1	0.5 - 0.6	3.5 - 4.5
9	41 - 48	4.1 - 5	30 - 36



Dismantling and Assembly

Precision Control (Servo)  
(Machines from January 2003)



A403840

## Dismantling and Assembly

### Precision Control (Servo) (Machines from January 2003)

#### Dismantling

The excavator valve block is a 'sandwich type', which is made up of a number of separate sections. The illustration shown on the opposite page is intended as a guide to dismantling. Be sure to note the location of all components when dismantling. Although some components may appear to be identical they are not interchangeable. Make sure that components are assembled in their original positions.

- 1 Remove the excavator valve block from the machine.
- 2 Remove the three tie rod nuts **1**.
- 3 Carefully separate and remove the outlet section **2** followed by the remaining service sections **3**. If the inlet section **4** is to be replaced, remove and retain the tie rods **5**.

#### Assembly

Assembly is the reverse of the dismantling sequence.

- 1 Clean the valve components in an appropriate solvent. Ensure that the mating faces of the valve sections are thoroughly clean before assembly.
- 2 Renew the 'O' rings located between the valve sections. Make sure the 'O' ring seals are not trapped or damaged.
- 3 Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

#### Torque Settings

Item	Nm	kgf m	lbf ft
<b>1</b>	35	3.6	25.8
<b>6A</b>	10	1	7.4
<b>7</b>	20	2	14.8
<b>8</b>	45	4.6	33.2
<b>9</b>	100	10.2	73.8
<b>10</b>	70	7.1	51.6
<b>11</b>	70	7.1	51.6
<b>11A</b>	70	7.1	51.6
<b>12</b>	60	6.1	44.3
<b>13</b>	30	3	22.1
<b>14</b>	20	2	14.8
<b>14A</b>	45	4.6	33.2

#### Service Spools

Each of the service spools **6** can be removed as shown. Care must be taken to ensure that the spool is not damaged when removing it from the block. Note that all spools are similar in appearance but must not be interchanged as they are matched to their bores. All spools have the same centring and sealing components.

#### Flow Regulator Valve

The dismantling and assembly procedures for the flow regulator valve **7** are detailed separately, refer to **Flow Regulator Valve**.

#### Load Sense Relief Valve

The dismantling and assembly procedures for the load sense relief valve **8** are detailed separately, refer to **Load Sense Relief Valve**.

#### Flushing Valve

The flushing valve **9** can be removed as shown.

#### Auxiliary Relief Valves

The A.R.V's **10** appear identical but have various pressure settings, refer to **Technical Data**. Ensure that they are correctly adjusted and fitted in their specified positions. The dismantling and assembly procedures for the ARV's are detailed separately, refer to **Auxiliary Relief Valves (ARV's)**.

#### Anti-cavitation Valve

The dismantling and assembly procedures for the anticavitation valve **11** are detailed separately, refer to **Anti-cavitation Valve**.

#### Pressure Compensator Valves

Each of the pressure compensator valves **12** can be removed as shown. Note that all valves are identical in appearance. Note that components are not interchangeable.

#### Load Hold Check Valves

Each of the load hold check valves **13** can be removed as shown. Note that all valves are identical in appearance. Ensure good condition of seating faces on poppets and on the mating faces in the valve block.

#### Hydra-clamp Solenoid Valve

The hydra-clamp solenoid valve **14** can be removed as shown.

## Dismantling and Assembly

### Precision Control (Servo) (Machines from January 2003)

#### Flow Regulator Valve

##### Removal

It is possible to remove a valve without removing the excavator valve block from the machine.

**Note:** If removing components from a valve block that is fitted on a machine the pilot circuit accumulator pressure must be vented first. With the operator seat locked in the rear facing position and with the arm rests raised forward (for backhoe operation), switch the starter to ON without starting the engine. Operate the joystick controls several times to vent the hydraulic pressure from the servo system and backhoe rams. Turn the starter switch to the OFF position and remove the key.

- 1 Gain access to the excavator valve and disconnect and blank any hoses or pipes which may interfere with the removal of the flow regulator valve.
- 2 Unscrew the flow regulator valve from the excavator valve block. Cover the ports to prevent the ingress of dirt and remove to a clean working area.

##### Dismantling

Great care should be taken when dismantling and assembling a valve to avoid the following:-

- Contamination
- Damage to spools
- Damage to seal grooves

Any of the above may result in possible problems with the operation of the valve.

- 1 Unscrew and remove top plug 1.
- 2 Carefully remove shims 2, spring 3 and piston 4.

**Note:** When removing 'O' Rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves.

Discard ALL 'O' Rings and back-up rings. DO NOT use worn or damaged items.

##### Inspection

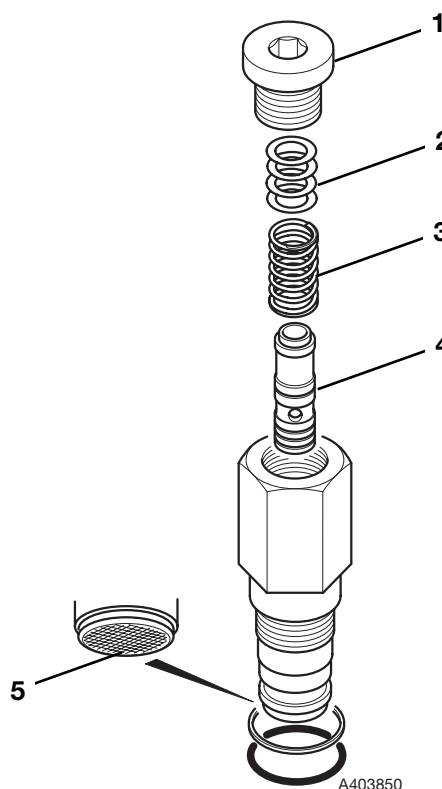
- 1 Inspect the valve components for scratches, pitting, corrosion or any other type of damage.
- 2 Clean the filter gauze 5 fitted in the end of the valve body.

**Note:** If any part other than 'O' rings are damaged the entire valve must be renewed.

##### Assembly

Assembly is the reverse of the dismantling sequence.

- 1 Clean the valve components in an appropriate solvent.
- 2 Renew all 'O' rings and back-up rings.
- 3 Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.
- 4 Be sure to fit filter gauze 5 the correct way round.



## Dismantling and Assembly

### Precision Control (Servo) (Machines from January 2003)

#### Load Sense Relief Valve

##### Removal

It is possible to remove a valve without removing the excavator valve block from the machine.

**Note:** If removing components from a valve block that is fitted on a machine the pilot circuit accumulator pressure must be vented first. With the operator seat locked in the rear facing position and with the arm rests raised forward (for backhoe operation), switch the starter to ON without starting the engine. Operate the joystick controls several times to vent the hydraulic pressure from the servo system and backhoe rams. Turn the starter switch to the OFF position and remove the key.

- 1 Gain access to the excavator valve and disconnect and blank any hoses or pipes which may interfere with the removal of the load sense relief valve.
- 2 Unscrew the load sense relief valve from the excavator valve block. Cover the ports to prevent the ingress of dirt and remove to a clean working area.

##### Dismantling

Great care should be taken when dismantling and assembling a valve to avoid the following:-

- Contamination
- Damage to spools
- Damage to seal grooves

Any of the above may result in possible problems with the operation of the valve.

- 1 Loosen locknut **1**, unscrew and remove adjuster nut **2** and adjuster screw **3**.
- 2 Carefully remove spring **4** and poppet **5** from valve body.

**Note:** When removing 'O' Rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves.

Discard ALL 'O' Rings and back-up rings. DO NOT use worn or damaged items.

##### Inspection

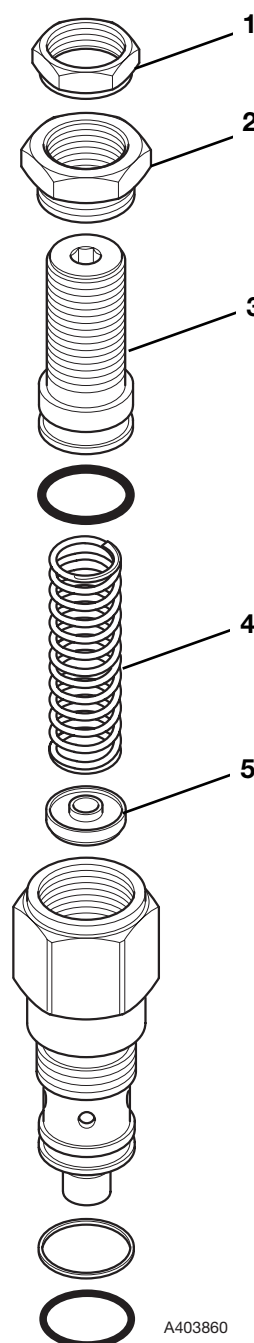
- 1 Inspect the valve components for scratches, pitting, corrosion or any other type of damage.

**Note:** If any part other than 'O' rings are damaged the entire valve must be renewed.

##### Assembly

Assembly is the reverse of the dismantling sequence.

- 1 Clean the valve components in an appropriate solvent.
- 2 Renew all 'O' rings and back-up rings.
- 3 Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.
- 4 Adjust the pressure setting as required. Refer to **Service Procedures, Pressure Testing, Load Sense Relief Valve**.





## Dismantling and Assembly

### Precision Control (Servo) (Machines from January 2003)

#### Auxiliary Relief Valves (ARV's)

##### Removal

It is possible to remove a valve without removing the excavator valve block from the machine.

**Note:** If removing components from a valve block that is fitted on a machine the pilot circuit accumulator pressure must be vented first. With the operator seat locked in the rear facing position and with the arm rests raised forward (for backhoe operation), switch the starter to ON without starting the engine. Operate the joystick controls several times to vent the hydraulic pressure from the servo system and backhoe rams. Turn the starter switch to the OFF position and remove the key.

- 1 Gain access to the excavator valve and disconnect and blank any hoses or pipes which may interfere with the removal of the auxiliary relief valve(s).
- 2 Unscrew the auxiliary relief valve(s) from the excavator valve block. Cover the ports to prevent the ingress of dirt and remove to a clean working area.

##### Dismantling

Great care should be taken when dismantling and assembling a valve to avoid the following:-

- Contamination
- Damage to spools
- Damage to seal grooves

Any of the above may result in possible problems with the operation of the valve.

- 1 Prise off plastic locking cap.
- 2 Loosen locknut 1 and remove adjuster screw 2.
- 3 Carefully remove spring 3 and poppet 4.
- 4 Unscrew upper valve body 5 and remove springs 6 and piston 7.

**Note:** When removing 'O' Rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves. Discard ALL 'O' Rings and back-up rings. DO NOT use worn or damaged items.

##### Inspection

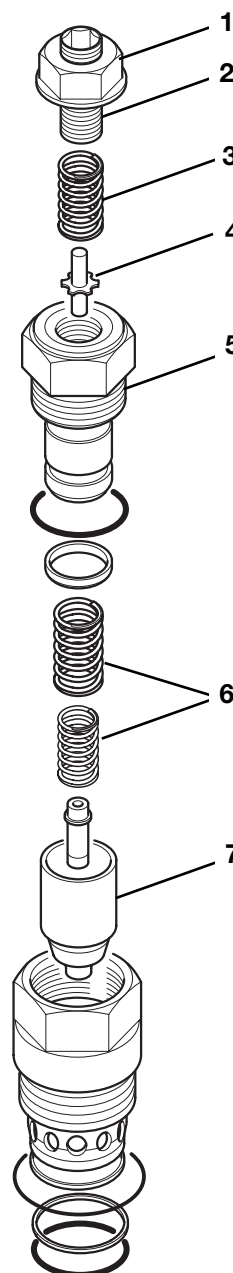
- 1 Inspect the valve components for scratches, pitting, corrosion or any other type of damage.

**Note:** If any part other than 'O' rings are damaged the entire valve must be renewed.

##### Assembly

Assembly is the reverse of the dismantling sequence.

- 1 Clean the valve components in an appropriate solvent.
- 2 Renew all 'O' rings and back-up rings.
- 3 Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.
- 4 Adjust the pressure setting as required. Refer to **Service Procedures, Auxiliary Relief Valve - Setting.**



A403870

## Dismantling and Assembly

### Precision Control (Servo) (Machines from January 2003)

#### Anti-cavitation Valve

##### Removal

It is possible to remove a valve without removing the excavator valve block from the machine.

**Note:** If removing components from a valve block that is fitted on a machine the pilot circuit accumulator pressure must be vented first. With the operator seat locked in the rear facing position and with the arm rests raised forward (for backhoe operation), switch the starter to ON without starting the engine. Operate the joystick controls several times to vent the hydraulic pressure from the servo system and backhoe rams. Turn the starter switch to the OFF position and remove the key.

- 1 Gain access to the excavator valve and disconnect and blank any hoses or pipes which may interfere with the removal of the anti-cavitation valve.
- 2 Unscrew the anti-cavitation valve from the excavator valve block. Cover the ports to prevent the ingress of dirt and remove to a clean working area.

##### Dismantling

Great care should be taken when dismantling and assembling a valve to avoid the following:-

- Contamination
- Damage to spools
- Damage to seal grooves

Any of the above may result in possible problems with the operation of the valve.

- 1 Unscrew and carefully remove the top nut **1** complete with piston **2** from the valve body.
- 2 Remove the piston **2** and spring **3** from the top nut spindle.

**Note:** When removing 'O' Rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves.

Discard ALL 'O' Rings and back-up rings. DO NOT use worn or damaged items.

##### Inspection

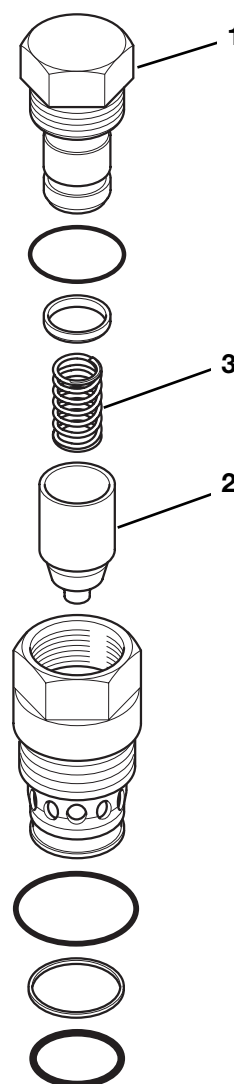
- 1 Inspect the valve components for scratches, pitting, corrosion or any other type of damage.

**Note:** If any part other than 'O' rings are damaged the entire valve must be renewed.

##### Assembly

Assembly is the reverse of the dismantling sequence.

- 1 Clean the valve components in an appropriate solvent.
- 2 Renew all 'O' rings and back-up rings.
- 3 Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.



A403880

## 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 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.

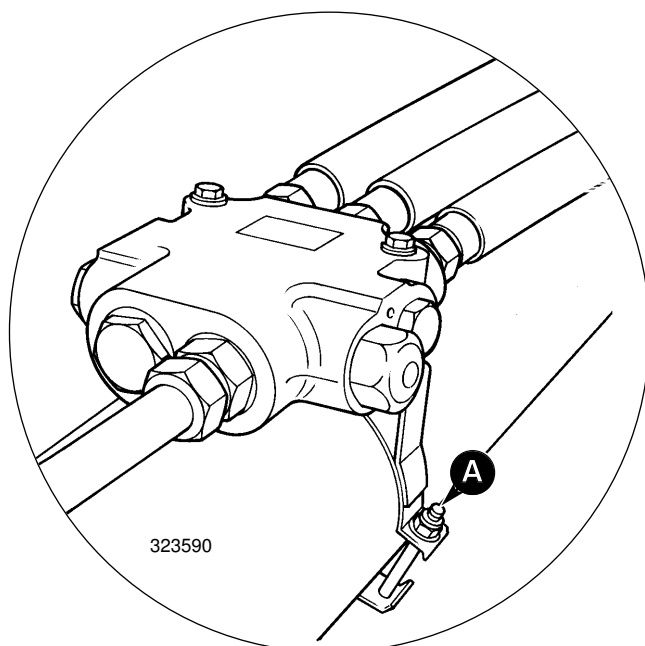
INT-3-1-11/1

#### 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.

**Note:** Refer to **Service Procedures, Hose Burst Protection Valves, Lowering a Load - In a Failure Condition** for lowering a load with engine failure or a burst hose.

- 2 Turn the manual over-ride screw fully clockwise.
- 3 Operate the main service control levers back and forth to vent residual pressure. For instance, if the HBPV is fitted on the boom or dipper then operate the backhoe control levers. If the HBPV is fitted on the loader arms then operate the loader control levers.



- 4 Disconnect all hydraulic hoses from the HBPV and plug all orifices to prevent ingress of dirt. Label each hose before disconnecting, this will ensure correct position when refitting.

- 5 Undo the retaining clips **A** and remove the HBPV.

#### Replacement

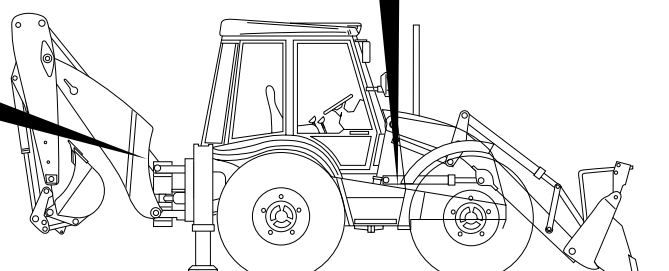
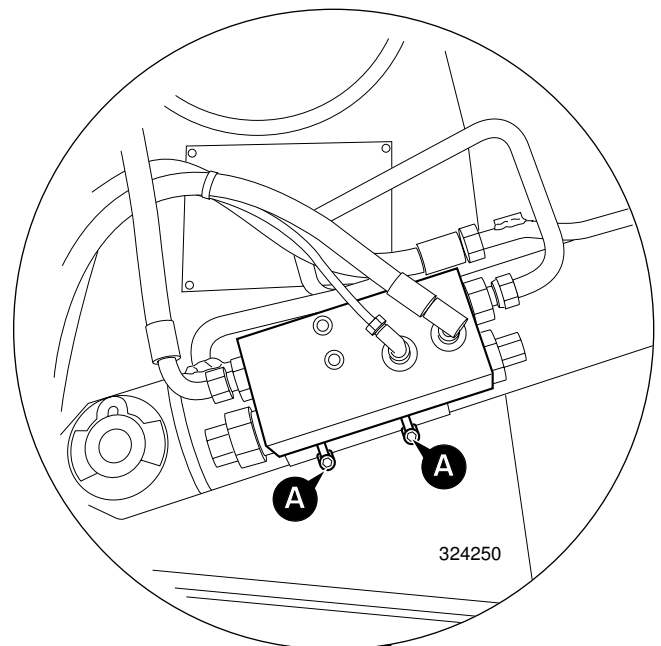
Replacement is a reversal of the removal sequence.

### **⚠ 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 refitting the valve to the machine, ensure that the valve operates correctly, refer to **Service Procedures, Hose Burst Protection Valves - Checking**.



A260734

## 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.

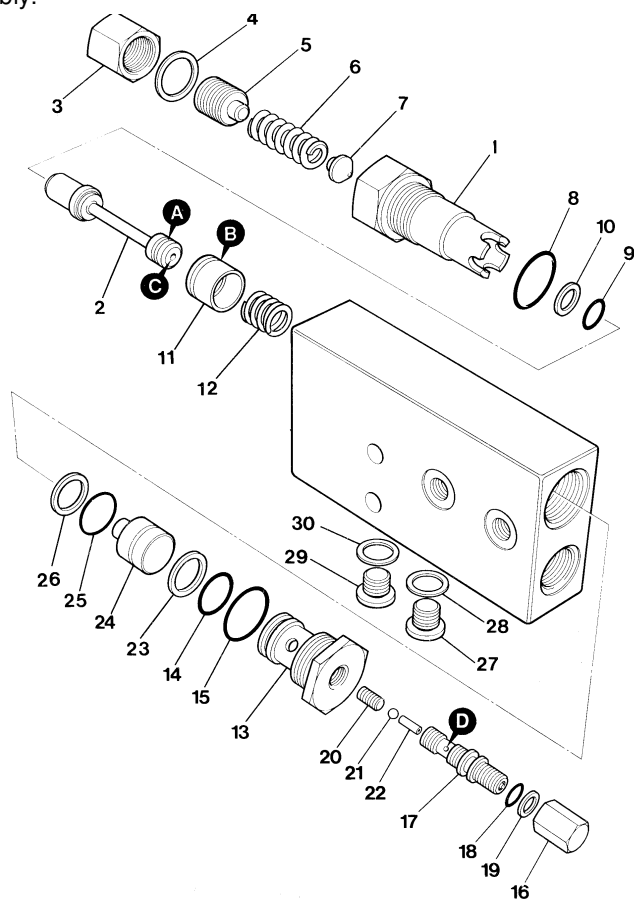
Renew all seals. If fitting new Teflon rings **A** & **B**, use a conical guide, such as item **E**, to expand the rings gradually. Complete the ring fitting procedure as quickly as possible, otherwise the ring will stretch. See below.

**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.

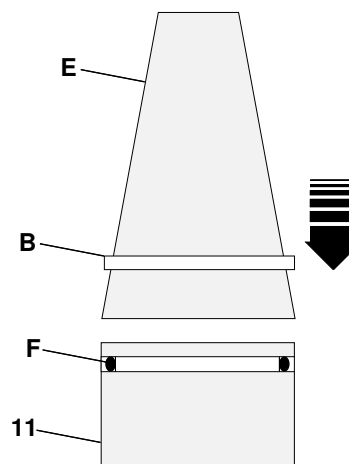
After assembly, make sure that the valve parts move freely, if they don't, check that all the seals are correctly fitted.

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**.



325780



A183490

## Dismantling and Assembly (Cont'd)

### - Boom and Dipper Rams

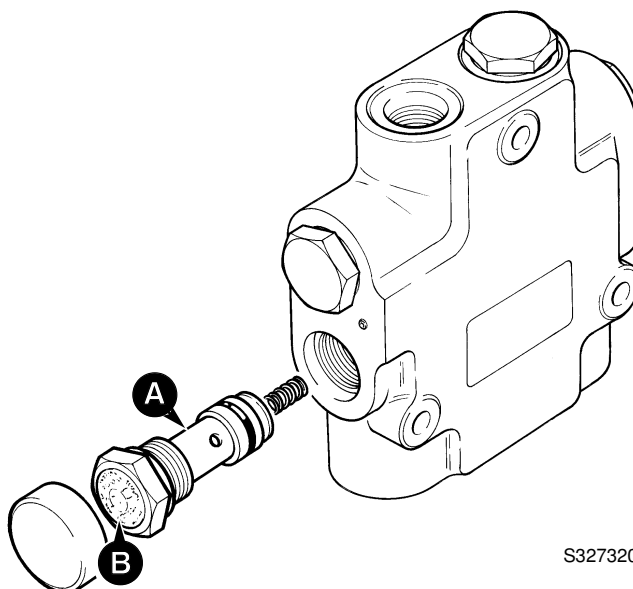
This procedure applies to Hose Burst Protection Valves fitted to the boom/dipper rams ONLY.

There is no servicing permitted on this valve apart from the removing and fitting a new check valve assembly **A** when the seal **B** has been broken.

DO NOT use the machine with a broken seal.

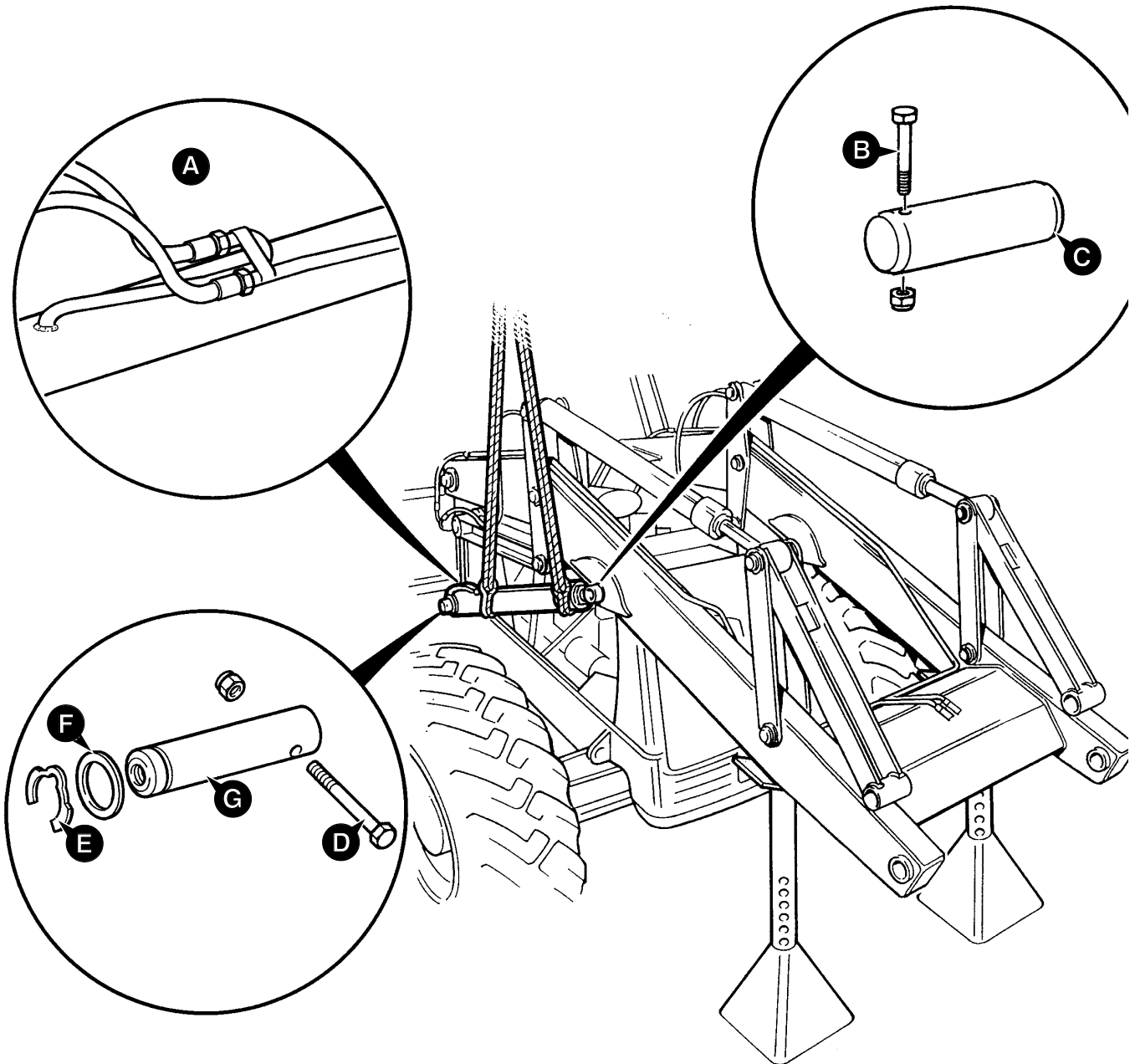
If the assembly is fitted to the machine, before removing the check valve **A**, operate the main service control levers back and forth to vent residual pressure.

After fitting a new check valve ensure that the valve assembly operates correctly, refer to **Service Procedures, Hose Burst Protection Valves - Checking**.



S327320

Removal and Replacement  
- Loader Lift Ram



S266330

## Removal and Replacement - Loader Lift Ram

### Removal

#### WARNING

The loader arm interlevers are potentially dangerous, when pivoting about their centre they form a 'scissor' point with the loader arm. Make sure the interlevers are securely blocked when working in the loader arm area.

BF 2-1

- 1 Park the machine on firm level ground. Engage the parking brake and set the transmission to neutral.
- 2 Raise the loader arms to give access to the lift ram pivot pins **C**. The loader arms must be supported, use a tool as shown.

#### 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 Switch off the engine and vent residual hydraulic pressure from the loader end by operating the loader controls back and forth several times.

**Note:** If a hose burst protection 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 Label and then remove the lift ram hoses **A**. Plug and cap all open orifices to prevent loss of fluid and ingress of dirt.

#### 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 Fasten lifting straps to the lift ram, make sure that the weight of the ram is supported by the sling.
- 6 Remove pivot pin retaining bolt **B** and then remove the pivot pin **C**.
- 7 Remove pivot pin retaining bolt **D**.
- 8 Remove klipring **E** and shim **F** from both sides of ram, use slide hammer kit (service tool 993/68100) to remove pivot pin **G**.
- 9 Remove the lift 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

Coat pivot pins with anti-rust lubricant.

Make sure that the head of item **D** is on the engine side.

Coat mainframe bores with grease.

Assembly sequence for shim **F** and klipring:

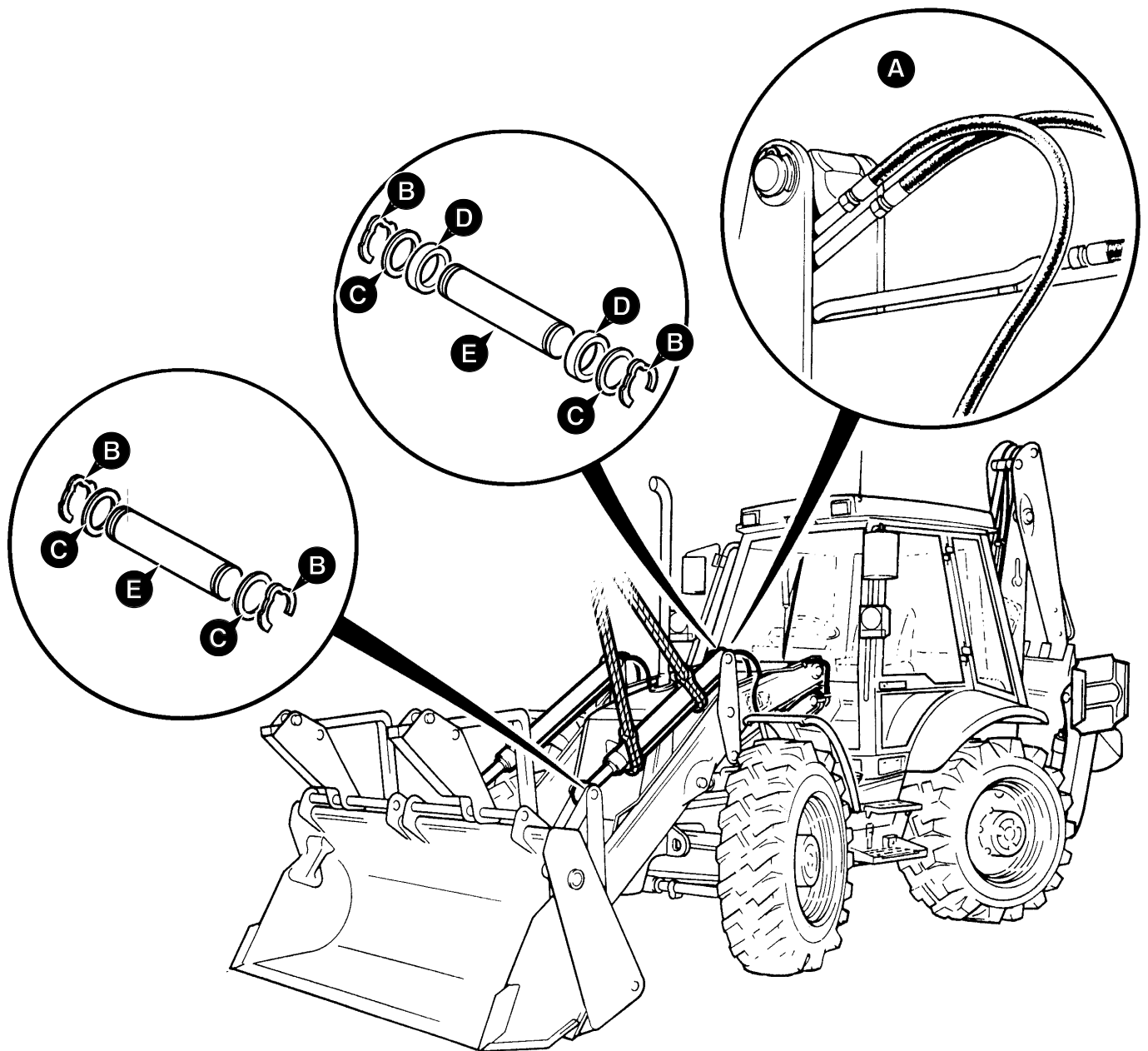
- 1st shim
- 2nd ram
- 3rd shim (as required)
- 4th klipring

Pivot pins with M24 pin extractor hole

- 1st spacer
- 2nd ram
- 3rd shim (as required)
- 4th klipring

All klipring installations to have a maximum end float of 2mm (0.080in.)

Removal and Replacement  
- Loader Shovel Ram



S266340



## Removal and Replacement - Loader Shovel Ram

### Removal

#### WARNING

The loader arm interlevers are potentially dangerous, when pivoting about their centre they form a 'scissor' point with the loader arm. Make sure the interlevers are securely blocked when working in the loader arm area.

BF 2-1

- 1 Park the machine on firm level ground. Engage the parking brake and set the transmission to neutral.
- 2 Rest the shovel flat on the ground.

#### 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 Switch off the engine and vent residual hydraulic pressure from the loader end by operating the loader controls back and forth several times.
- 4 Label and then remove the shovel ram hoses **A**. Plug and cap all open orifices to prevent loss of fluid and ingress of dirt.

#### 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 Fasten lifting straps to the shovel ram, make sure that the weight of the ram is supported by the sling.
- 6 Remove kliprings **B**, shims **C** and spacers **D**.
- 7 Remove pivot pins **E**.

### 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.

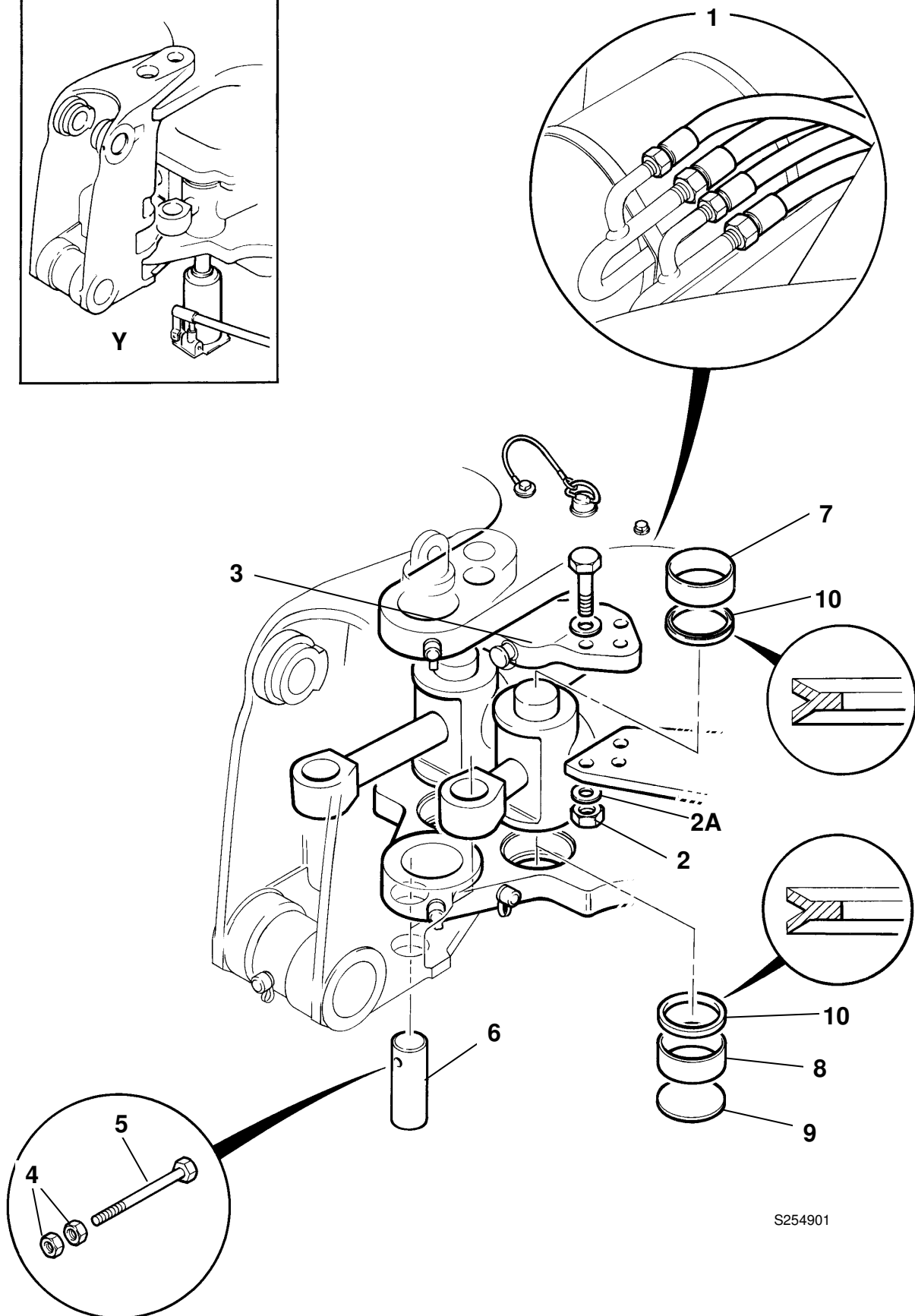
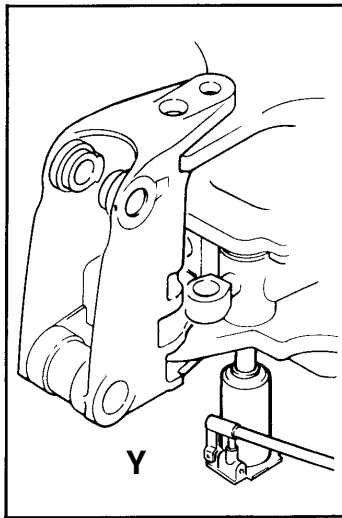
INT-3-1-10/1

Coat pivot pins with anti-rust lubricant.

All klipring intallations to have a maximum end float of 2mm (0.080in.)

Make sure that each klipring is installed with a shim.

Removal and Replacement  
- Slew Ram



S254901

## Removal and Replacement - Slew Ram

### Removal

- 1 Slew the backhoe to the left to remove the right hand slew ram and visa versa.
- 2 Lower the bucket to the ground and switch off the engine.

### 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

- 3 Vent any residual hydraulic pressure by operating the backhoe and slew control levers.
- 4 Disconnect the hydraulic hoses 1 to the slew rams - before disconnecting the hoses make sure that they are labelled (to assist with reassembly).
- 5 Plug and cap all open hydraulic connections to prevent ingress of dirt and loss of hydraulic fluid.
- 6 Loosen and remove trunnion bracket retaining nuts 2 and hardened washers 2A (see note).

**Note:** On assembly, the correct grade of nut (grade 12) and bolt (grade 10.9) must be used. Also, use hardened washers 2A - NOT ordinary washers. Using incorrect specification items could result in a reduction of clamping efficiency.

- 7 Remove the trunnion bracket 3.

### 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

- 8 Attach suitable lifting straps to the slew ram assembly. Note that the weight of the slew ram assembly is approximately 44 kg (97 lbs).
- 9 Remove thin nuts 4 ( 2 off per pivot pin) and remove the pivot pin retaining bolt 5. Use a 25 - 30 mm diameter bar to knock the pin out vertically.
- 10 Remove the slew ram (eye end) pivot pin 6 and swing the ram to clear the kingpost casting.
- 11 Lift the slew ram assembly clear of the machine.

### Inspection

Inspect the liner bearings 7 (located in the trunnion retaining bracket 3) and liner bearing 8 for signs of damage, wear, scores or nicks etc. Replace as required.

To remove the liner bearing 8 use a jack located against blanking plate 9. Shown in the inset at Y.

To remove the bearing liner 7 from the trunnion bracket use flat faced bearing pullers.

### 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 generally a reversal of the removal procedures, however note the following:

The liner bearings 7 and 8 have a 'lead-in' diameter (noticeable with a slight step), always install the smaller diameter first into the pivot bore. The bearings must be installed so that they sit flush.

The eye end pivot pins 6 should be secured first - i.e. BEFORE the trunnion bracket retaining nuts 2, this will help to maximise ram assembly alignment.

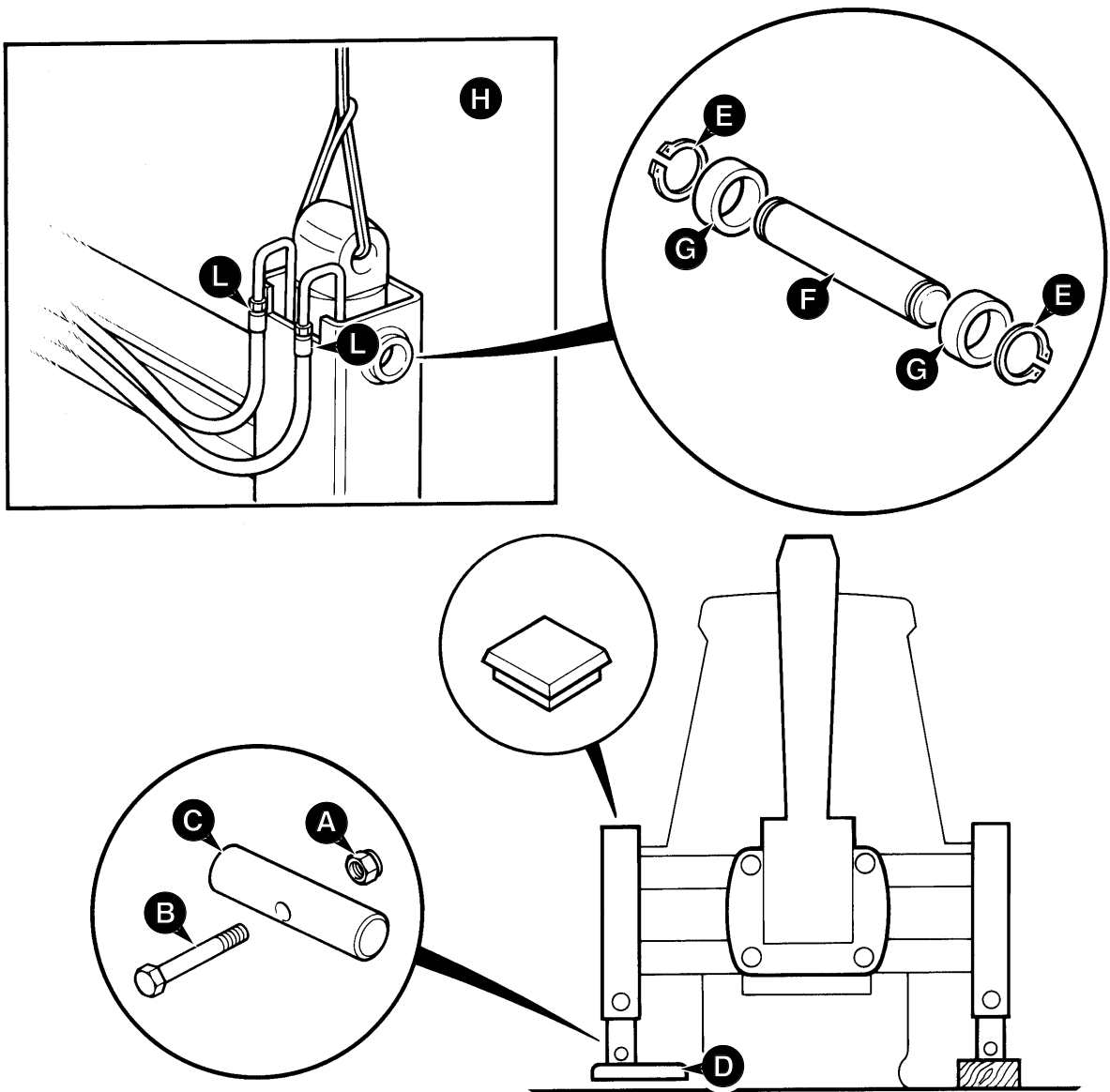
Make sure that the hydraulic hoses are correctly installed.

Make sure that any new or reused bearings are clean and smeared with grease prior to reassembly of pins and trunnion journals.

When fully assembled, apply grease at each grease nipple BEFORE operating the machine.

### Torque Setting

Item	Nm	lb ft	kgf m
2	650	480	66.3



S271860

## Removal and Replacement - Stabiliser Ram (Sideshift)

### 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.
- 2 Lower the stabiliser legs until the pads are approximately 4 in. (100mm) off the ground and stop the engine.
- 3 Remove the bottom locking nut **A** and bolt **B**. Drive out the bottom pivot pin **C** and allow the stabiliser foot **D** to fall clear. Lift the inner leg and temporarily refit the pivot pin **C** through inner leg and ram.
- 4 Place a block of wood underneath the stabiliser leg.
- 5 Remove circlips **E** and drive out top pivot pin **F** with spacing collars **G**.
- 6 Start the engine and slowly extend the stabiliser ram so that the dump end of the ram protrudes from the top of the outer leg section.
- 7 Attach suitable lifting gear to the ram as shown at **H**. Make sure that the weight of the ram is supported by the sling and remove the bottom pivot pin **C**.

## 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

- 8 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.

- 9 Loosen and remove the stabiliser hoses **L**, label the hoses before removing (as an aid to assembly). Plug all open orifices to prevent loss of fluid and ingress of dirt.

## 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

- 10 Using suitable lifting equipment, lift the ram clear.

### 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.

## 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.

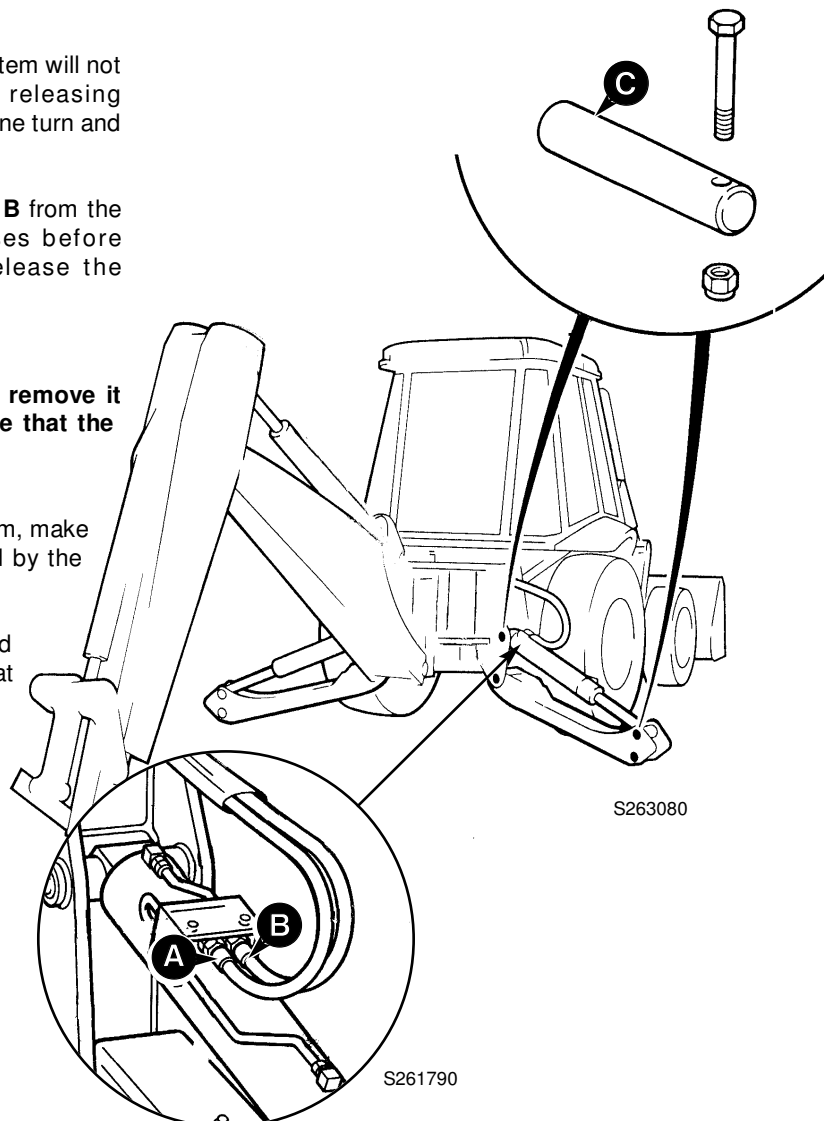
### WARNING

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.

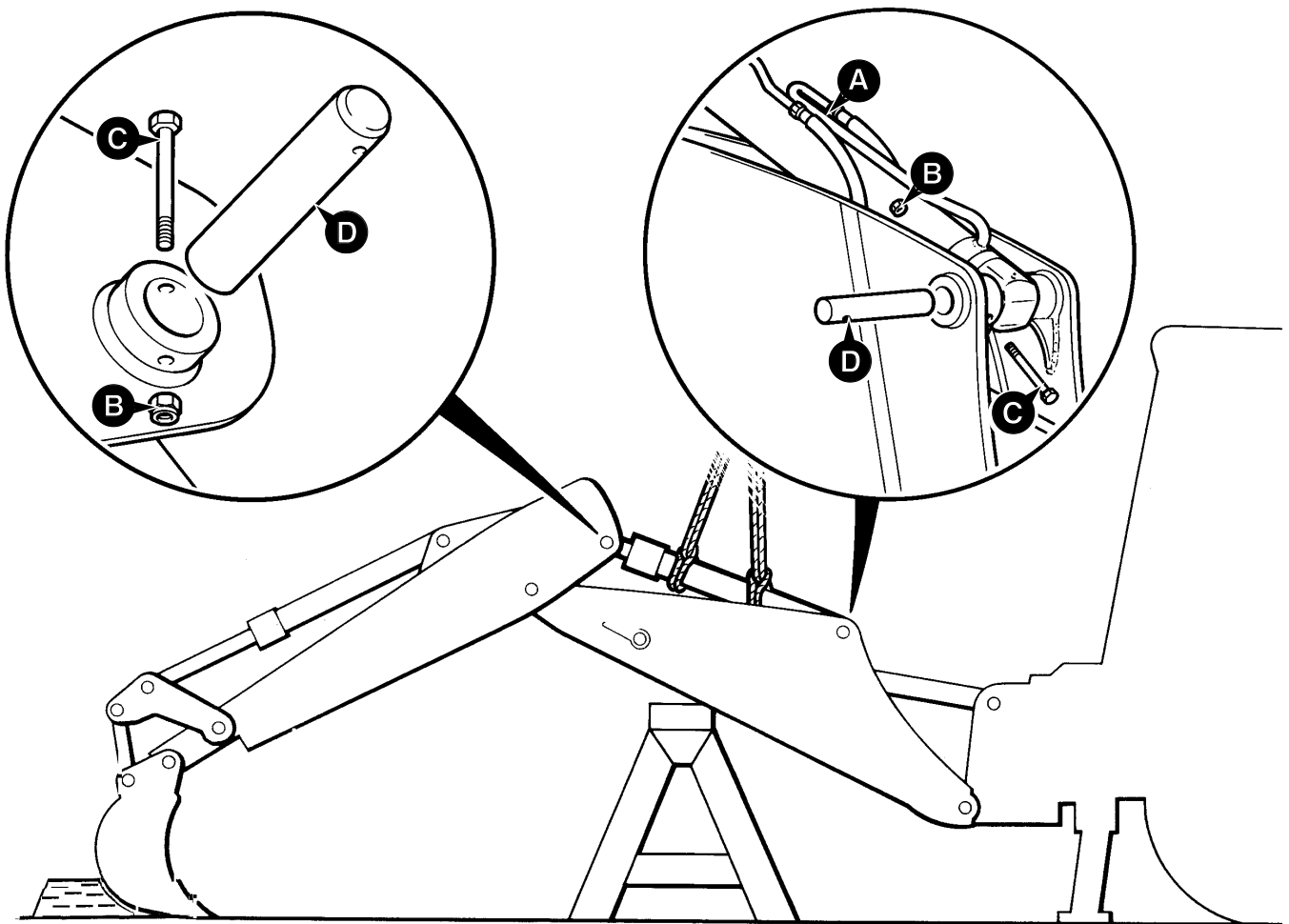
INT-3-1-10/1

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.



**Removal and Replacement  
- Dipper Ram**



S266350

## Removal and Replacement - Dipper Ram

### 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.

### **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

- 2 Vent residual hydraulic pressure from the backhoe hoses by operating the backhoe controls back and forth several times.

**Note:** If a hose burst protection 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.

- 3 Label and then remove the dipper ram hoses **A**. Plug and cap all open orifices to prevent loss of fluid and ingress of dirt.

### **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

- 4 Fasten lifting straps to the dipper ram, make sure that the weight of the ram is supported by the sling.
- 5 Remove the pivot pin retaining nut **B** and bolt **C**, remove the pivot pin **D**.
- 6 Remove dipper ram.

### Replacement

Replacement is a reversal of the removal sequence.

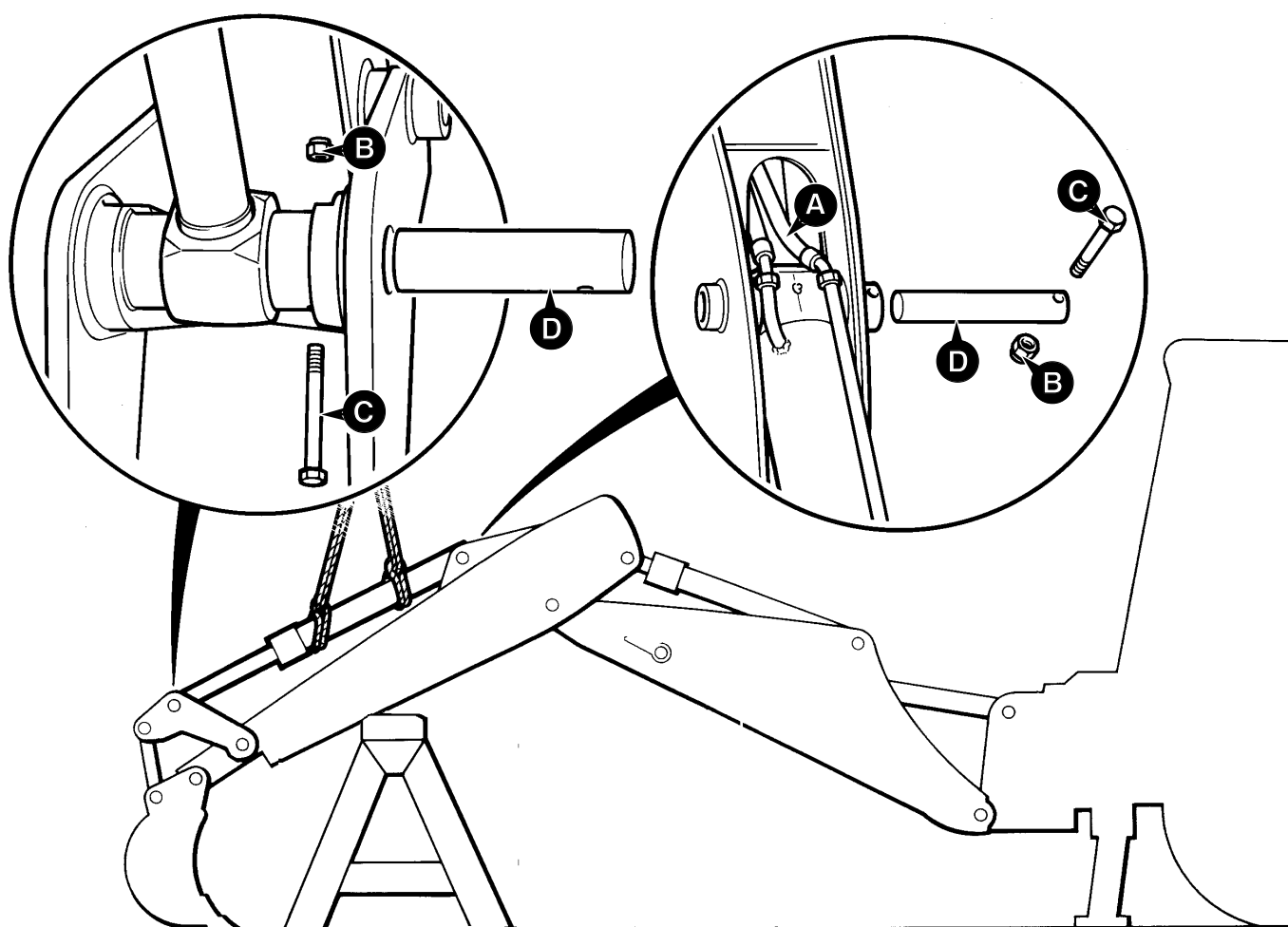
### **WARNING**

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



**Removal and Replacement  
- Bucket Crowd Ram**



S266360

## Removal and Replacement - Bucket Crowd Ram

### 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.

### **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

- 2 Vent residual hydraulic pressure from the backhoe hoses by operating the backhoe controls back and forth several times.

**Note:** If a hose burst protection 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.

- 3 Label and then remove the bucket crowd ram hoses **A**. Plug and cap all open orifices to prevent loss of fluid and ingress of dirt.

### **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

- 4 Fasten lifting straps to the bucket crowd ram, make sure that the weight of the ram is supported by the sling.
- 5 Remove the pivot pin retaining nut **B** and bolt **C**, remove the pivot pin **D**.
- 6 Remove the bucket crowd ram.

### Replacement

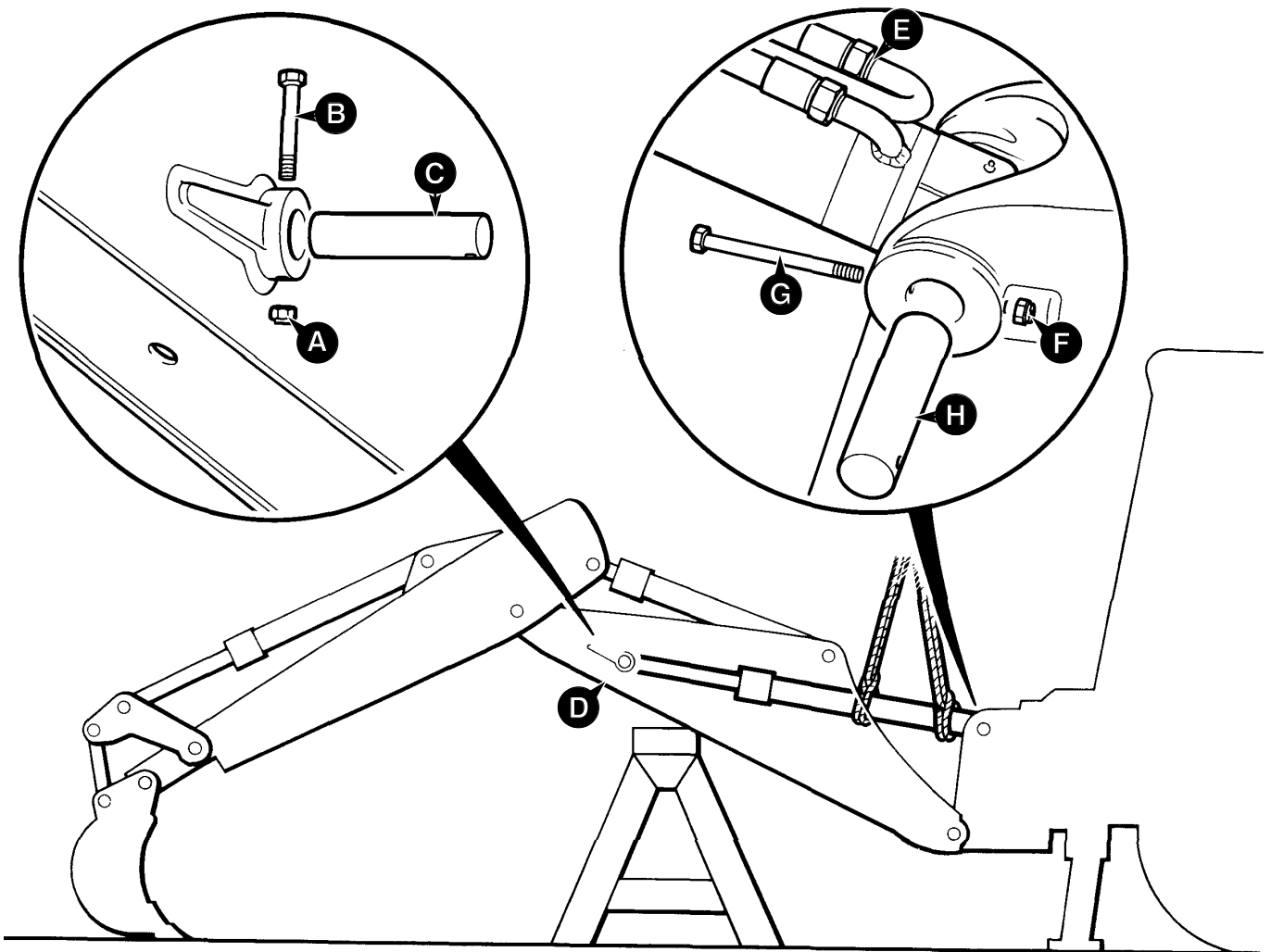
Replacement is a reversal of the removal sequence.

### **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

Removal and Replacement  
- Boom Ram



S266370

## Removal and Replacement - Boom Ram

### 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 Remove pivot pin retaining nut **A** and bolt **B**. Remove the pivot pin **C**.
- 3 Remove the grease nipple from the eye end of the ram (through access hole **D**).
- 4 Use the machine hydraulics to SLOWLY retract the ram.
- 5 Remove the hose clamp.

### 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

- 6 Vent residual hydraulic pressure from the backhoe hoses by operating the backhoe controls back and forth several times.

**Note:** If a hose burst protection 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.

- 7 Label and then remove the boom ram hoses **E**. Plug and cap all open orifices to prevent loss of fluid and ingress of dirt.

### 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

- 8 Fasten lifting straps to the boom ram, make sure that the weight of the ram is supported by the sling.
- 9 Remove the pivot pin retaining nut **F** and bolt **G** remove the kingpost pivot pin **H**.
- 10 Remove the boom ram.

### Replacement

Replacement is a reversal of the removal sequence.

### WARNING

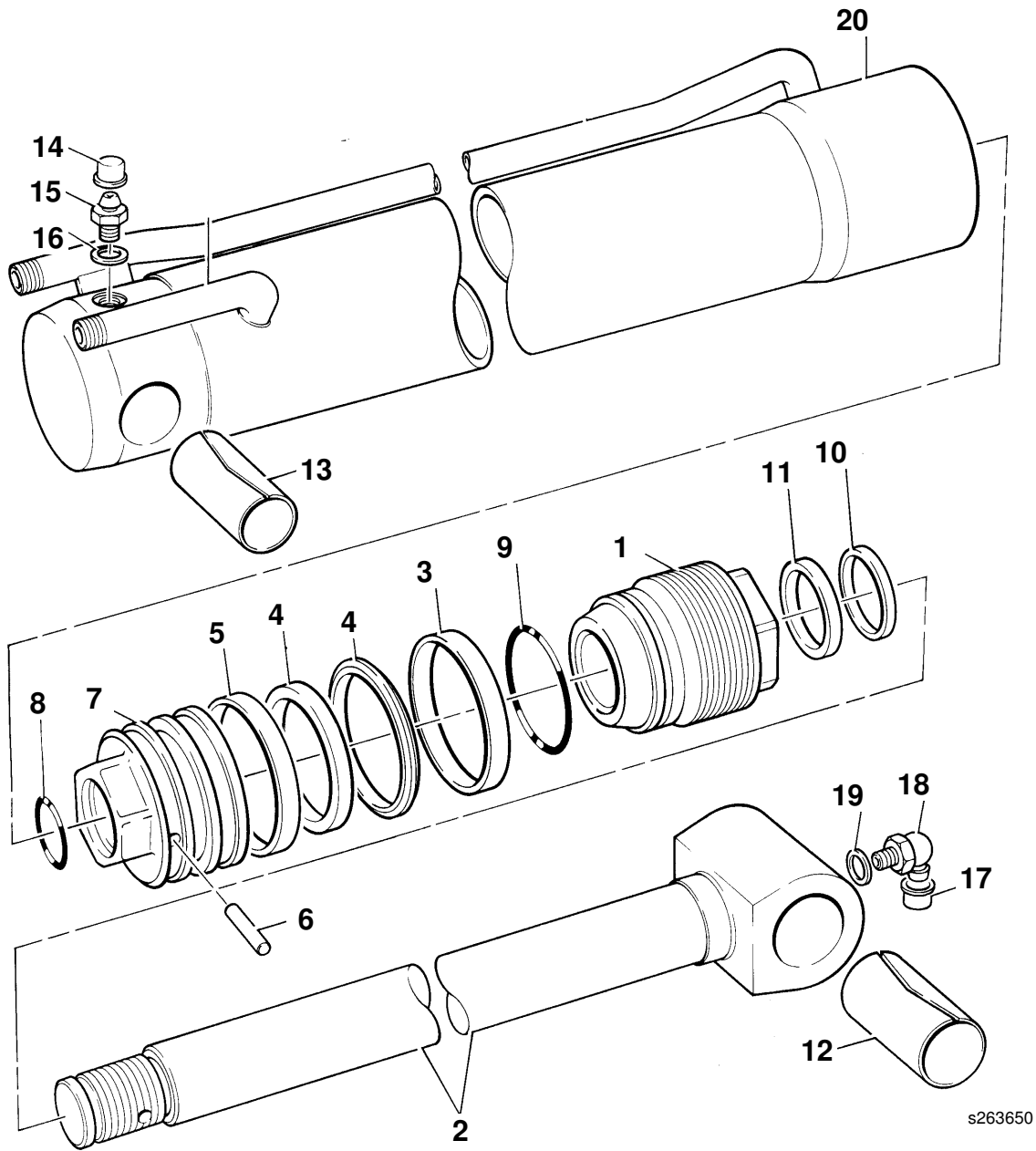
**Fine jets of hydraulic fluid at high pressure can penetrate the skin. Do not use your fingers to check for hydraulic fluid leaks. Do not put your face close to suspected leaks. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of hydraulic fluid. If hydraulic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

INT-3-1-10/1

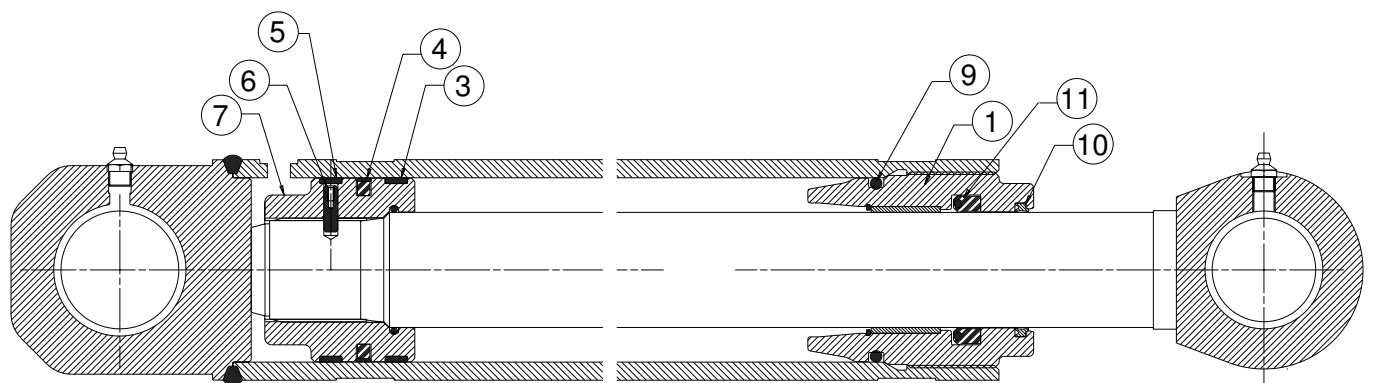
It will be necessary to extend the ram to align and engage the boom pivot pin **C**. As the ram extends, the ram will tend to turn.

For this reason it is recommended that a smaller diameter steel bar is used to locate the boom ram at the kingpost casting. The steel bar can be more readily removed to allow for re-alignment of the boom pivot pin **C**.

When the boom pivot pin has been correctly aligned and fitted, then fit the correct pivot pin **H** at the kingpost.



s263650



TYPICAL RAM ASSEMBLY

Note that on boom and bucket rams, pivot pin grease seals are fitted.

A263680

**Dismantling and Assembly**

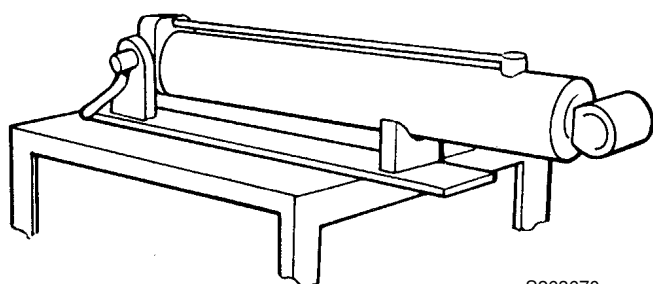
- Loader Lift Ram
- Loader Shovel Ram
- Boom Ram
- Bucket Ram
- Stabiliser Ram

**Dismantling**

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

For assembly the sequence should be reversed.

Place ram assembly on a locally manufactured strip/rebuild bench as shown.



S263670

Slacken end cap **1** using special spanner (see **Service Tools**), and remove the piston rod assembly **2** from the cylinder.

**⚠ WARNING**

**If air or hydraulic pressure is used to force out the piston assembly, ensure that the end cap is securely fitted. Severe injury can be caused by a suddenly released piston rod.**

HYD 1-2

Position piston rod assembly on bench in place of ram cylinder. Remove seal **4** and wear rings **3** and **5** from piston head.

Extract dowel **6** from the piston head using a metric screw (M3, M4, or M6 depending on ram size) threaded into the extractor hole.

Remove piston head from rod using special spanner (see **Service Tools**).

Remove gland bearing and end cap **1** from piston rod and remove the 'O' ring **9**, wiper seal **10** and rod seal **11**. Check the end cap bearing for damage, scores or nicks. If damaged, the bearing must be replaced as part of the end cap assembly.

Ensure that metal components are free from scoring, nicks and burrs. A damaged rod will impair the life of the seals.

Check the bore of the ram cylinder for damage.

**Assembly**

Clean threads of piston rod, piston head, end cap and cylinder using a wire brush. Use JCB Cleaner/Degreaser to ensure that all threads are free from grease, hydraulic oil and sealant. Allow 15 minutes for solvent to dry before applying JCB Threadlocker and Sealer (High Strength).

Ensure that lubricants used during assembly do not come into contact with the JCB Threadlocker and Sealer (High Strength).

Refer to **JCB Ram Sealing Procedure** for the correct method of fitting seals to the end cap and piston head.

Apply JCB Activator to threads of end cap and cylinder. Allow Activator to dry for 15 minutes before bringing into contact with the JCB Threadlocker and Sealer (High Strength).

**Note:** Neither the JCB Threadlocker and Sealer (High Strength) nor Activator must be allowed to contact seals, bearing rings, or 'O' rings.

Fit locking dowel **6** to piston head/rod as follows:

- 1** Fit 'O' ring **8** into piston head **7**.
- 2** Fit piston head to piston rod and torque tighten to 405 Nm (300 lbf ft).
- 3** New ram Shaft and piston head fitted.
  - If both are required, the following procedure should be followed:
    - a** Drill through piston head into piston rod. Use an undersized diameter drill first as a guide and then drill with the correct size diameter drill to suit; refer to the table for drill diameters and depths.
    - b** Remove all swarf and contamination. Insert dowel **6** into drilled hole, make sure tapped extractor hole is to outside.
- 4** New piston head fitted on a **pre-drilled piston rod**.
  - Re-drill and dowel **BOTH** the piston head and piston rod at 90° from the existing drilled dowel hole in the piston rod. Follow the procedures described in step 3.
- 5** New piston rod fitted to a **pre-drilled piston head**.
  - Use the pre-drilled hole in the piston head. Care must be taken not to elongate the existing hole in the piston head.
    - a** Use a drill the same diameter as the pre-drilled hole in the piston head to make a 'centre mark' in the piston rod. **DO NOT** drill the piston rod at this stage.

.....continued

**Dismantling and Assembly:**

- Loader Lift Ram
- Loader Shovel Ram
- Boom Ram
- Bucket Ram
- Stabiliser Ram

**Assembly (continued)**

- b** Use an undersized diameter drill as a guide and drill into the piston rod to the required depth (see table), make sure the drill has centred correctly on the 'centre mark' made at step 5a.
- c** Use the correct size diameter drill to suit the dowel and drill to the required depth (see table).
- d** Remove all swarf and contamination, insert the dowel.

Position cylinder on bench and install rod assembly into cylinder.

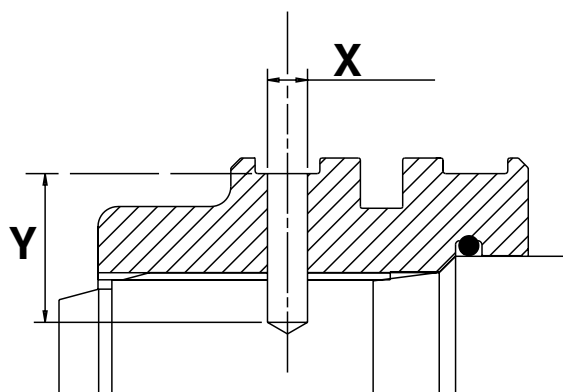
Apply JCB Threadlocker and Sealer (High Strength) to first three threads of cylinder, torque tighten the end cap to 678 Nm (500 lbf ft).

**Note:** If hydraulic oil contacts the uncured JCB Threadlocker and Sealer (High Strength) a weakening of the bond will result. Cure times vary according to the ambient temperature. Allow a minimum of 2 hours between assembly and filling the ram with oil.

**Note:** Cold weather operation. When operating in conditions which are consistently below freezing, it is recommended that the rams are operated slowly to their full extent before commencing normal working.

**Torque Settings**

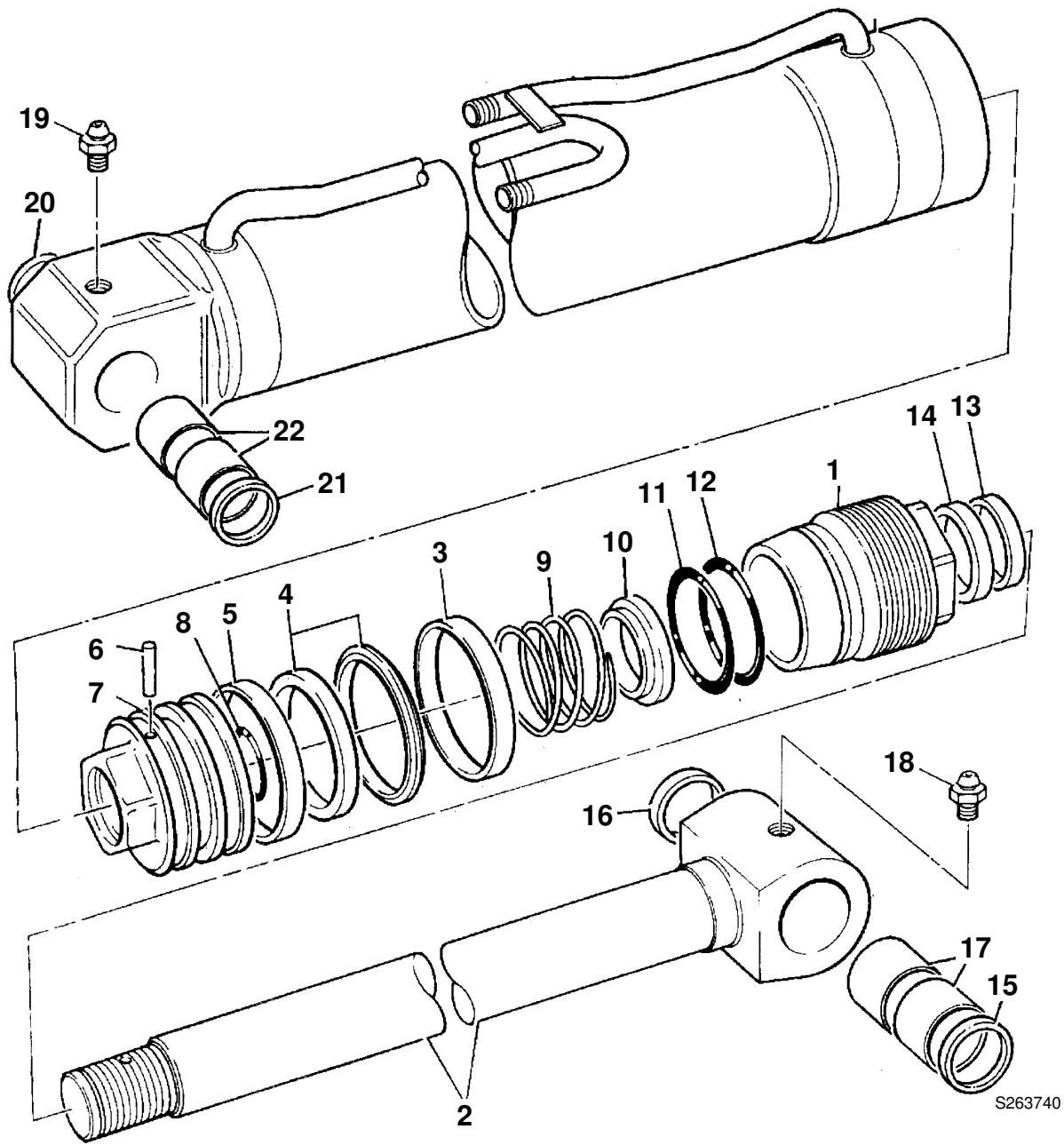
Item	Nm	kgf m	lbf ft
7	405	41.3	300
1	678	69.2	500

**DRILLING DETAILS FOR PISTON HEAD RETENTION**

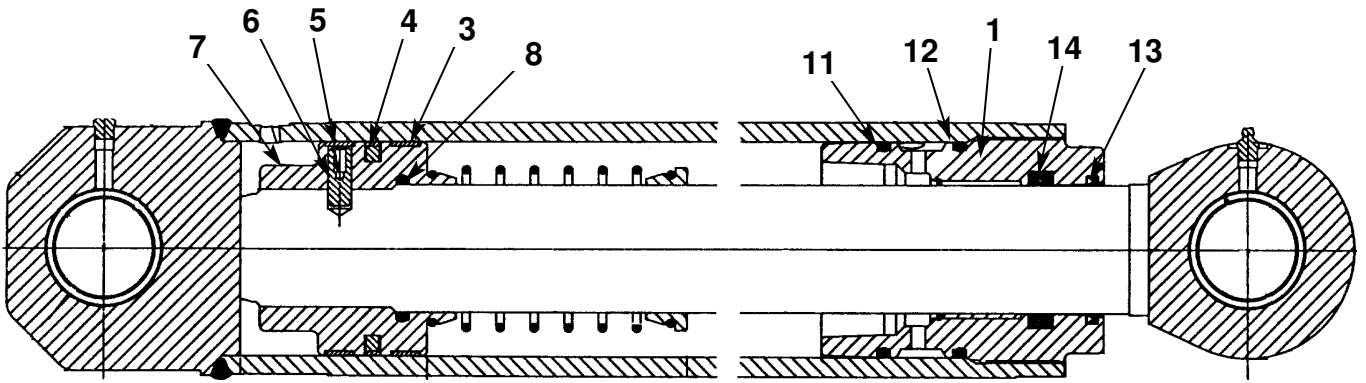
A263750

(all dimensions in mm)

Ram Size	Dowel Size	Guide Drill Ø	Guide Drill Depth	Dowel Drill Ø X	Dowel Drill Depth Y
80 x 50 70 x 40	6Ø x 20	4	21	6.02/6.10	22/23
90 x 50 100 x 60	8Ø x 25	5	24	8.02/8.10	27/28
110 x 60 110 x 65	12Ø x 30	8	28	12.02/12.10	32/33
120 x 65 130 x 75	12Ø x 35	8	33	12.02/12.10	37/38



S263740



S263730



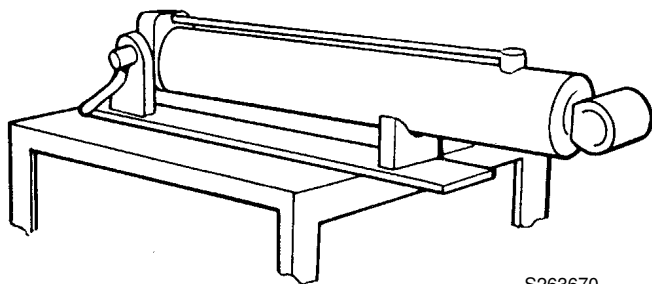
## Dismantling and Assembly - Dipper Ram

### Dismantling

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

For assembly the sequence should be reversed.

Place ram assembly on a locally manufactured strip/rebuild bench as shown.



S263670

Slacken end cap **1** using special spanner (see **Service Tools**), and remove the piston rod assembly **2** from the cylinder.

### **⚠ WARNING**

**If air or hydraulic pressure is used to force out the piston assembly, ensure that the end cap is securely fitted. Severe injury can be caused by a suddenly released piston rod.**

HYD 1-2

Position piston rod assembly on bench in place of ram cylinder. Remove seal **4** and wear rings **3** and **5** from piston head.

Extract dowel **6** from the piston head using a metric screw (M3, M4, or M6 depending on ram size) threaded into the extractor hole.

Remove piston head from rod using special spanner (see **Service Tools**).

Remove gland bearing and end cap **1** from piston rod and remove the 'O' rings **11** and **12**, wiper seal **13** and rod seal **14**. Check the end cap bearing for damage, scores or nicks. If damaged, the bearing must be replaced as part of the end cap assembly.

Ensure that metal components are free from scoring, nicks and burrs. A damaged rod will impair the life of the seals.

Check the bore of the ram cylinder for damage.

### Assembly

Clean threads of piston rod, piston head, end cap and cylinder using a wire brush. Use JCB Cleaner/Degreaser to ensure that all threads are free from grease, hydraulic oil and sealant. Allow 15 minutes for solvent to dry before applying JCB Threadlocker and Sealer (High Strength).

Ensure that lubricants used during assembly do not come into contact with the JCB Threadlocker and Sealer (High Strength).

Refer to **JCB Ram Sealing Procedure** for the correct method of fitting seals to the end cap and piston head.

Apply JCB Activator to threads of end cap and cylinder. Allow Activator to dry for 15 minutes before bringing into contact with the JCB Threadlocker and Sealer (High Strength).

**Note:** Neither the JCB Threadlocker and Sealer (High Strength) nor Activator must be allowed to contact seals, bearing rings, or 'O' rings.

Ensure that end damping spring **9** is engaged with collar **10** and piston head **7**.

Fit locking dowel **6** to piston head/rod as follows:

- 1** Fit 'O' ring **8** into piston head **7**.
- 2** Fit piston head to piston rod and torque tighten to 405 Nm (300 lbf ft).
- 3** New ram Shaft and piston head fitted.
  - If both are required, the following procedure should be followed:
    - a** Drill through piston head into piston rod. Use an undersized diameter drill first as a guide and then drill with the correct size diameter drill to suit; refer to the table for drill diameters and depths.
    - b** Remove all swarf and contamination. Insert dowel **6** into drilled hole, make sure tapped extractor hole is to outside.
- 4** New piston head fitted on a **pre-drilled piston rod**.
  - Re-drill and dowel **BOTH** the piston head and piston rod at 90° from the existing drilled dowel hole in the piston rod. Follow the procedures described in step 3.
- 5** New piston rod fitted to a **pre-drilled piston head**.
  - Use the pre-drilled hole in the piston head. Care must be taken not to elongate the existing hole in the piston head.

.....continued

## Dismantling and Assembly: - Dipper Ram

### Assembly (continued)

- a Use a drill the same diameter as the pre-drilled hole in the piston head to make a 'centre mark' in the piston rod. DO NOT drill the piston rod at this stage.
- b Use an undersized diameter drill as a guide and drill into the piston rod to the required depth (see table), make sure the drill has centred correctly on the 'centre mark' made at step 5a.
- c Use the correct size diameter drill to suit the dowel and drill to the required depth (see table).
- d Remove all swarf and contamination, insert the dowel.

Position cylinder on bench and install rod assembly into cylinder.

Apply JCB Threadlocker and Sealer (High Strength) to first three threads of cylinder, torque tighten the end cap to 678 Nm (500 lbf ft).

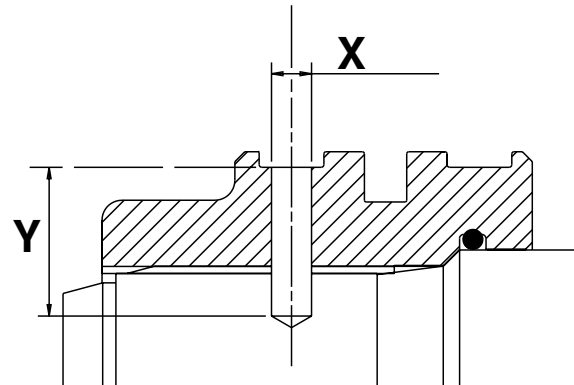
**Note:** If hydraulic oil contacts the uncured JCB Threadlocker and Sealer (High Strength) a weakening of the bond will result. Cure times vary according to the ambient temperature. Allow a minimum of 2 hours between assembly and filling the ram with oil.

**Note:** Cold weather operation. When operating in conditions which are consistently below freezing, it is recommended that the rams are operated slowly to their full extent before commencing normal working.

### Torque Settings

Item	Nm	kgf m	lbf ft
7	405	41.3	300
1	678	69.2	500

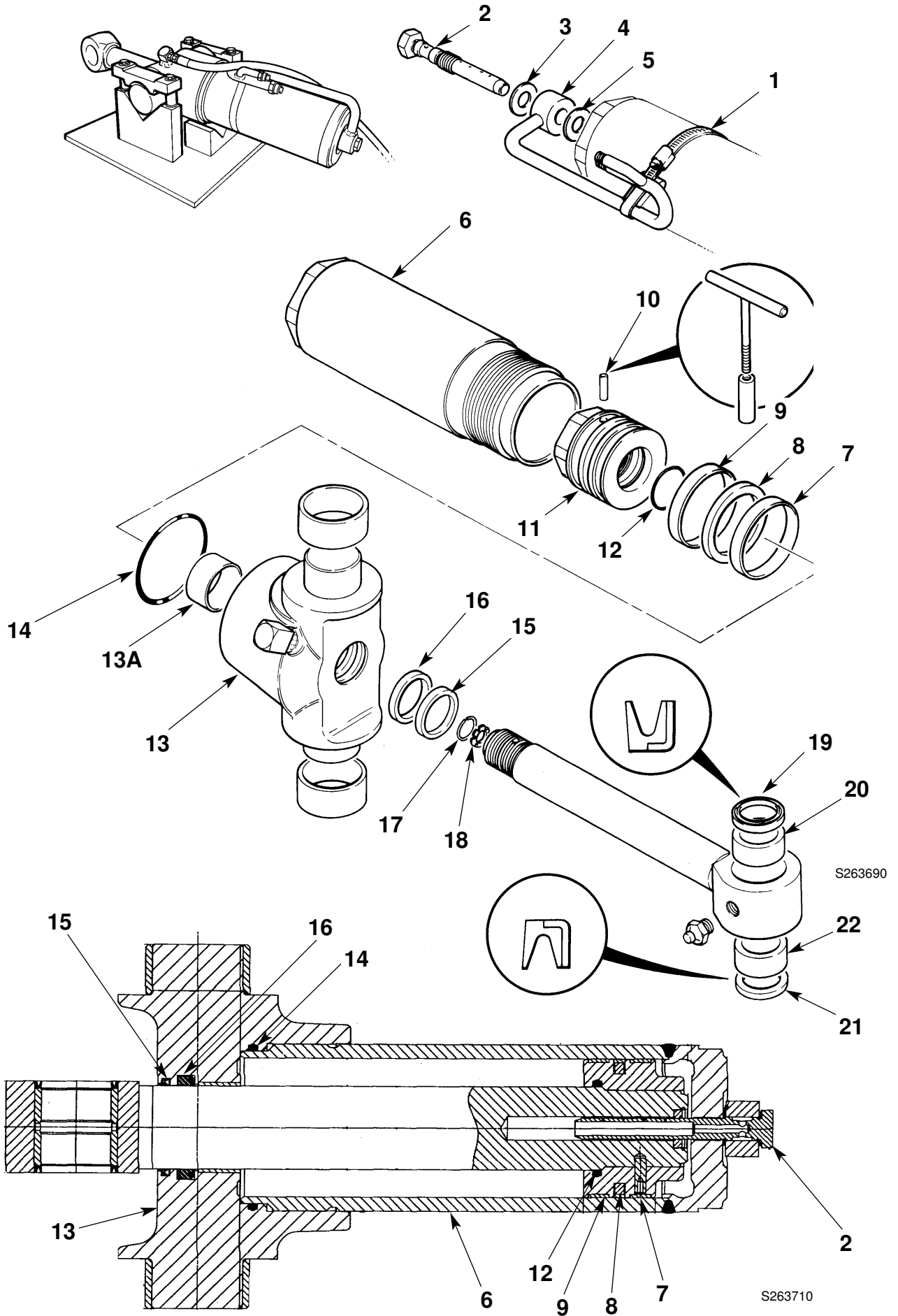
### DRILLING DETAILS FOR PISTON HEAD RETENTION



A263750

(all dimensions in mm)

Ram Size	Dowel Size	Guide Drill Ø	Guide Drill Depth	Dowel Drill Ø X	Dowel Drill Depth Y
80 x 50 70 x 40	6Ø x 20	4	21	6.02/6.10	22/23
90 x 50 100 x 60	8Ø x 25	5	24	8.02/8.10	27/28
110 x 60 110 x 65	12Ø x 30	8	28	12.02/12.10	32/33
120 x 65 130 x 75	12Ø x 35	8	33	12.02/12.10	37/38



## Dismantling and Assembly - Slew Ram

### Dismantling

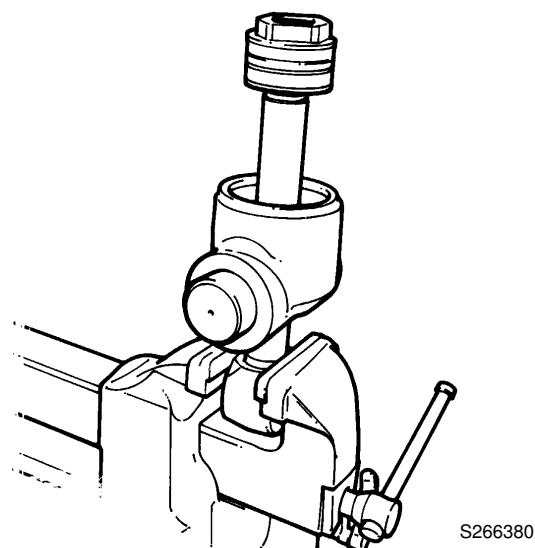
The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

Place ram assembly on a locally manufactured strip/rebuild bench as shown, or alternatively, hold the ram in a suitable vice taking care not to damage machined faces.

Remove cylinder **6** using special spanner (see **Service Tools**). Tap the cylinder off the piston head assembly using a suitable drift (e.g. nylon).

Position the piston rod assembly in a vice, use soft jaws and stand the assembly vertical whilst clamping on the eye end.



Remove seal **8** and wear rings **7** and **9** from piston head. Extract dowel **10** from the piston head using a metric screw threaded into the extractor hole.

Remove piston head from rod using special spanner (see **Service Tools**).

Remove 'O' ring **12**.

Lift the end cap assembly **13** off the piston rod. Remove 'O' ring **14**, rod wiper seal **15** and rod seal **16** from the end cap assembly. Check the end cap bearing **13A** for damage, scores or nicks.

Item **18** is the metering orifice plate and item **17** its retaining wire, do not remove these items unless problems with the metering are suspected.

Ensure that metal components are free from scoring, nicks and burrs. A damaged rod will impair the life of the seals.

Check the bore of the ram cylinder for damage.

### Assembly

Clean threads of piston rod, piston head, end cap and cylinder using a wire brush. Use JCB Cleaner/Degreaser to ensure that all threads are free from grease, hydraulic oil and sealant. Allow 15 minutes for solvent to dry before applying JCB Threadlocker and Sealer (High Strength).

Ensure that lubricants used during assembly do not come into contact with the JCB Threadlocker and Sealer (High Strength).

Refer to **JCB Ram Sealing Procedure** for the correct method of fitting seals to the end cap and piston head.

Apply JCB Activator to threads of end cap and cylinder. Allow Activator to dry for 15 minutes before bringing into contact with the JCB Threadlocker and Sealer (High Strength).

**Note:** Neither the JCB Threadlocker and Sealer (High Strength) nor Activator must be allowed to contact seals, bearing rings, or 'O' rings.

Fit locking dowel **10** to piston head/rod as follows:

- 1 Fit 'O' ring **12** into piston head **11**.
- 2 Fit piston head to piston rod and torque tighten to 405 Nm (300 lbf ft).
- 3 New ram Shaft and piston head fitted.
  - If both are required, the following procedure should be followed:
    - a Drill through piston head into piston rod. Use an undersized diameter drill first as a guide and then drill with the correct size diameter drill to suit; refer to the table for drill diameters and depths.
    - b Remove all swarf and contamination. Insert dowel **10** into drilled hole, make sure tapped extractor hole is to outside.
- 4 New piston head fitted on a **pre-drilled piston rod**.
  - Re-drill and dowel **BOTH** the piston head and piston rod at 90° from the existing drilled dowel hole in the piston rod. Follow the procedures described in step 3.
- 5 New piston rod fitted to a **pre-drilled piston head**.
  - Use the pre-drilled hole in the piston head. Care must be taken not to elongate the existing hole in the piston head.
    - a Use a drill the same diameter as the pre-drilled hole in the piston head to make a 'centre mark' in the piston rod. **DO NOT** drill the piston rod at this stage.

.....continued

## Dismantling and Assembly - Slew Ram

### Assembling (continued)

- b** Use an undersized diameter drill as a guide and drill into the piston rod to the required depth (see table), make sure the drill has centred correctly on the 'centre mark' made at step 5a.
- c** Use the correct size diameter drill to suit the dowel and drill to the required depth (see table).
- d** Remove all swarf and contamination, insert the dowel.

Install cylinder onto the rod assembly, make sure that the cylinder is fitted square to the rod assembly. Firmly push the cylinder over the piston head seals.

Apply JCB Threadlocker and Sealer (High Strength) to first three threads of cylinder, torque tighten the cylinder to 678 Nm (500 lbf ft).

**Note:** If hydraulic oil contacts the uncured JCB Threadlocker and Sealer (High Strength) a weakening of the bond will result. Cure times vary according to the ambient temperature. Allow a minimum of 2 hours between assembly and filling the ram with oil.

**Note:** Cold weather operation. When operating in conditions which are consistently below freezing, it is recommended that the rams are operated slowly to their full extent before commencing normal working.

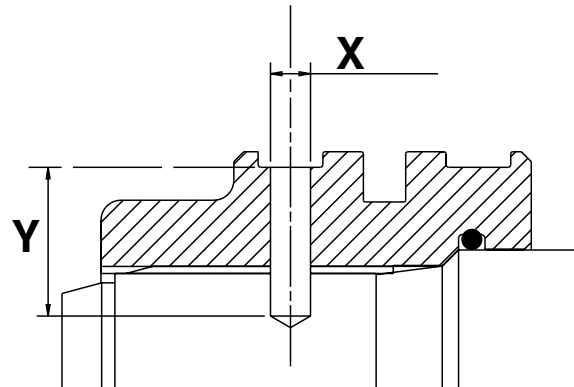
Position pipe assembly in correct position and torque tighten probe assembly **2** to 75Nm (55 lbf ft; 7.6 kgf m). DO NOT over-tighten the probe.

Make sure seals **19** and **21** are fitted the correct way as shown.

### Torque Settings

Item	Nm	kgf m	lbf ft
<b>11</b>	405	41.3	300
<b>6</b>	678	69.2	500

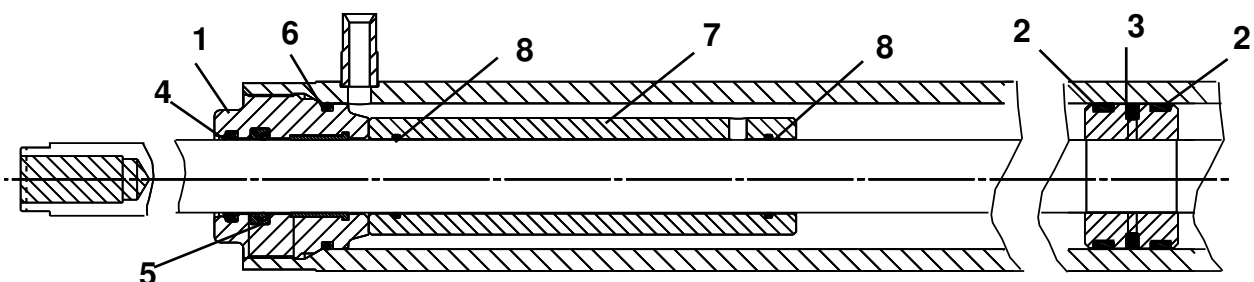
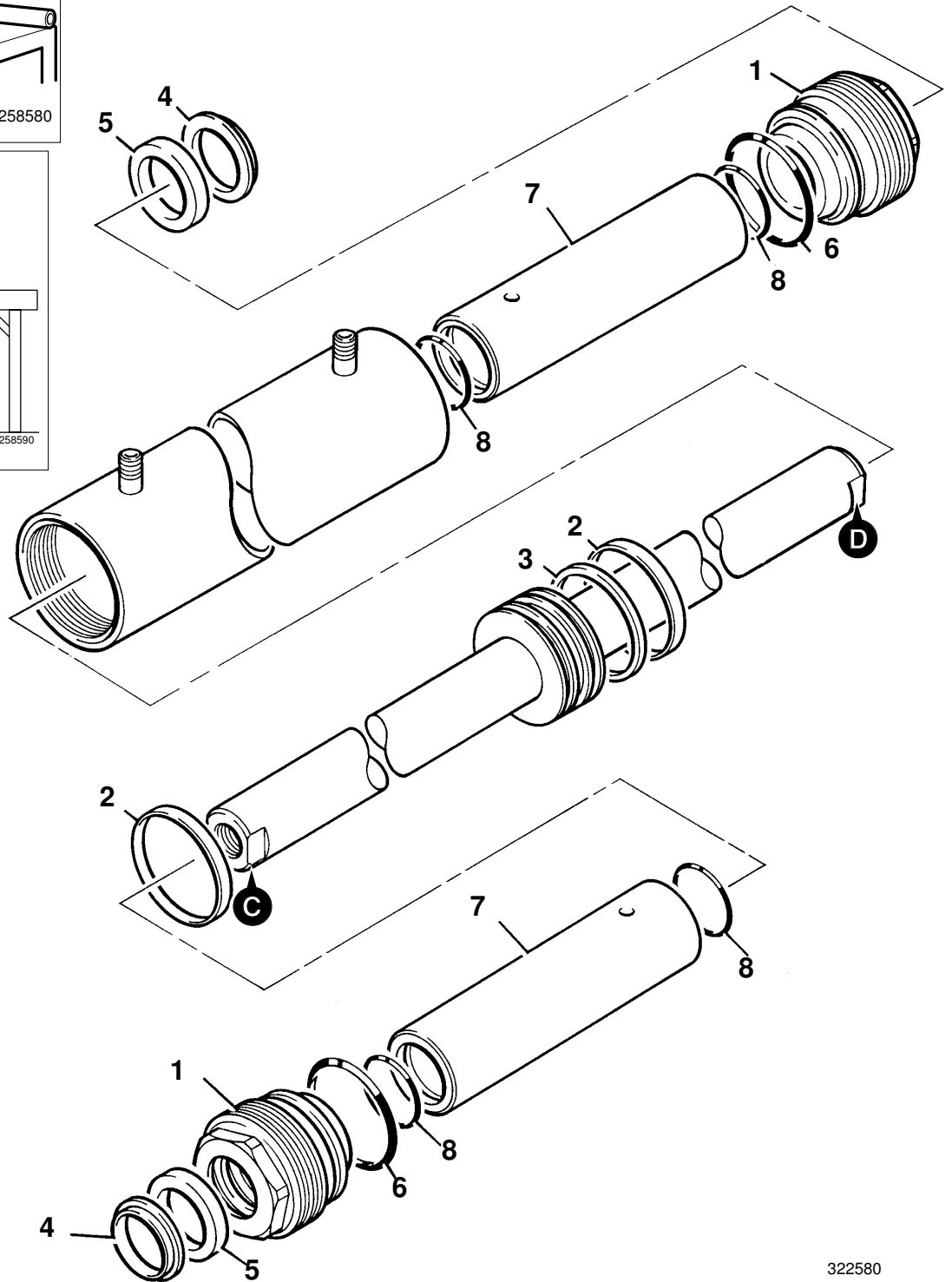
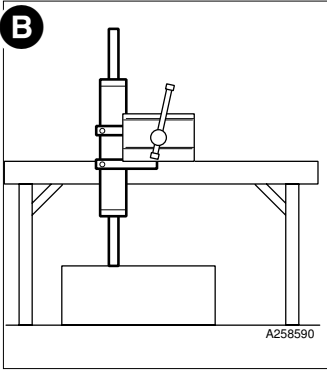
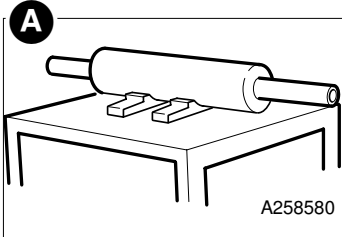
### DRILLING DETAILS FOR PISTON HEAD RETENTION



A263750

(all dimensions in mm)

Ram Size	Dowel Size	Guide Drill Ø	Guide Drill Depth	Dowel Drill Ø X	Dowel Drill Depth Y
80 x 50 70 x 40	6Ø x 20	4	21	6.02/6.10	22/23
90 x 50 100 x 60	8Ø x 25	5	24	8.02/8.10	27/28
110 x 60 110 x 65	12Ø x 30	8	28	12.02/12.10	32/33
120 x 65 130 x 75	12Ø x 35	8	33	12.02/12.10	37/38



## Dismantling and Assembly - Power Sideshift Ram

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

For assembly the sequence should be reversed.

### Dismantling

- 1 Fix the ram assembly on a locally manufactured strip/rebuild bench as shown at **A**.
- 2 Remove both end caps **1**, (46mm AF). Pull the piston rod assembly from the cylinder.

**Note 1:** DO NOT allow the piston rod to come into contact with the cylinder bore. The cylinder bore may be damaged by careless dismantling.

- 3 Position the piston rod assembly on a bench in place of the ram cylinder. Remove the wear rings **2** and seal **3** from the piston head.

**Note 2:** The piston head cannot be removed from the rod. If there is damage to the rod or piston head, replace the complete assembly.

- 4 Carefully inspect the bore of the cylinder and the piston rod outer diameter for scoring, nicks and burrs. If such damage is visible the components must be renewed.

**Note 3:** If burrs are evident on the ends of the piston rod at positions **C** or **D** remove by careful filing.

- 5 Remove the end cap seal **4**, wiper seal **5** and 'O' ring **6**, both end caps are the same
- 6 Remove spacers **7** and 'O' rings **8**.

### Assembly

- 1 Clean the threads of the end caps and cylinder using a wire brush.
- 2 Use JCB Cleaner/Degreaser to ensure that all threads are free from grease, hydraulic oil and sealant. Allow 15 minutes for solvent to dry before applying JCB Threadlocker and Sealer (High Strength).

Ensure that lubricants used during assembly do not come into contact with the JCB Threadlocker and Sealer (High Strength).

- 3 Refer to **JCB Ram Sealing Procedure** for the correct method of fitting seals to the end cap and piston head.
- 4 Clamp the cylinder vertically and lower the piston rod assembly in from the top, as shown at **B**. Take care not to allow the piston rod to come into contact with the cylinder bore. Be sure to engage the piston head new wear rings and seal carefully into the cylinder. If the piston head wear rings or seal are damaged during this stage, they must be renewed.

- 5 Fit new 'O' rings **8** to spacers **7**, slide onto the piston head and rod assembly.

- 6 Apply JCB Activator to threads of the end caps and cylinder. Allow Activator to dry for 15 minutes before bringing into contact with the JCB Threadlocker and Sealer (High Strength).

**Note 4:** Neither the JCB Threadlocker and Sealer (High Strength) nor Activator must be allowed to contact seals, bearing rings or 'O' rings.

- 7 Apply JCB Threadlocker and Sealer (High Strength) to threads of the ends caps, fit new 'O' rings **6**.
- 8 Ensure that there are no burrs at the ends of the piston rod, see **Dismantling - Note 3:**
- 9 Fit an end cap over the piston rod. Apply light hand pressure to the cap to engage the gland seal on the piston rod. DO NOT use excessive force. Screw on the first end cap and then fix the assembly on the strip/rebuild bench as shown at **A**. Fit the remaining cap and then torque tighten both caps.

**Note 5:** If hydraulic oil contacts the uncured JCB Threadlocker and Sealer (High Strength) a weakening of the bond will result. Cure times vary according to the ambient temperature. Allow a minimum of 2 hours between assembly and filling the ram with oil.

### Torque Settings

Item	Nm	kgf m	lbf ft
1	400	40.8	295

## JCB Ram Sealing Procedure

To fit new rod seal:

Use seal fitting tool (892/00334) to fit rod seals, the size (diameter) and position of pins **A** is determined by the diameter and radial width of the rod seal being fitted.

The pins are screwed into threaded holes in the tool body, the spacing of the holes is designed to suit small or large diameter rod seals.

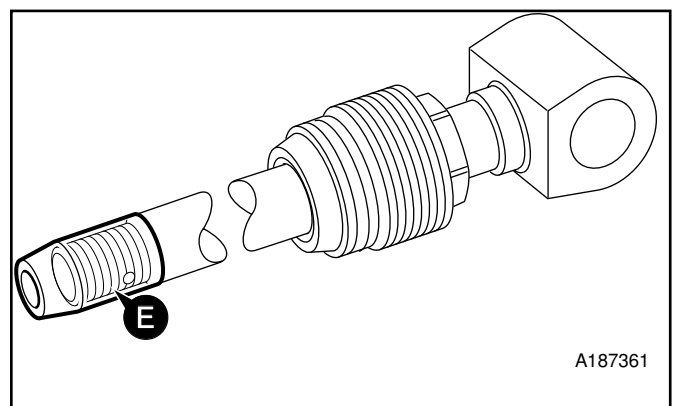
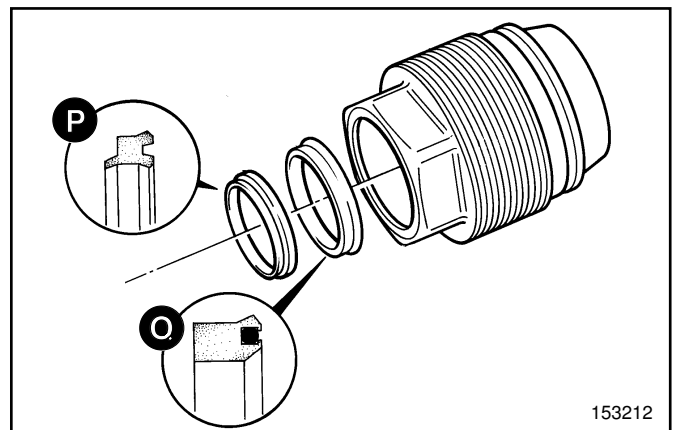
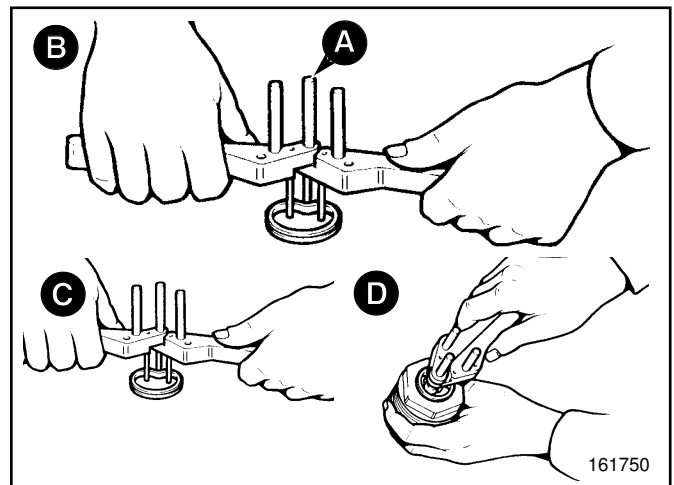
- 1 Open the tool as shown at **B** and insert the new rod seal, the seal must be fitted behind the two front pins but in front of the rear pin as shown.

**Note:** Make sure the seals are fitted the correct way round, as shown at **P** and **Q**.

- 2 Close the tool as shown at **C**. The seal must form a reniform (kidney shape).
- 3 Before fitting the rod seals check the seal grooves are free of contamination and sharp edges,
- 4 Locate the seal in the end cap groove, shown at **D**, when the seal is in position, open the tool to release the seal. Make sure the seal is correctly installed in its groove and remove the tool.
- 5 Fit rod wiper seal **P** into seal groove. Make sure the seal is correctly installed as shown.

**Note:** Some rod wipers, ie power track rod, may use a metal encased seal which is pressed into the housing. Care must be taken to ensure the seal is square before it is pressed in.

Sleeve **E** must be used to protect the rod seals from damage when fitting end cap onto the piston rod. There are various sizes of sleeve, see **Service Tools**. Make sure the hexagon on the end cap is towards the eye end of the rod.





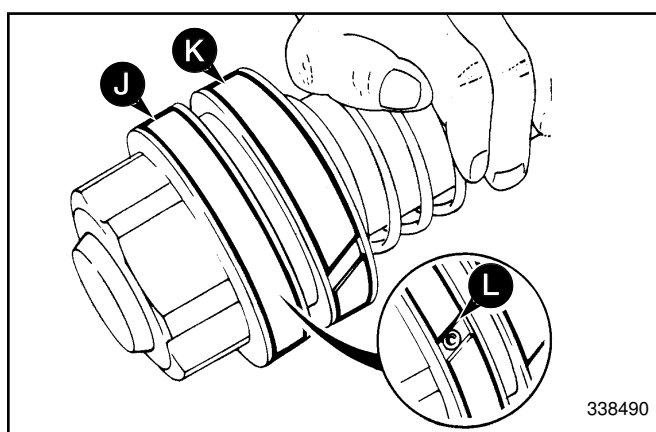
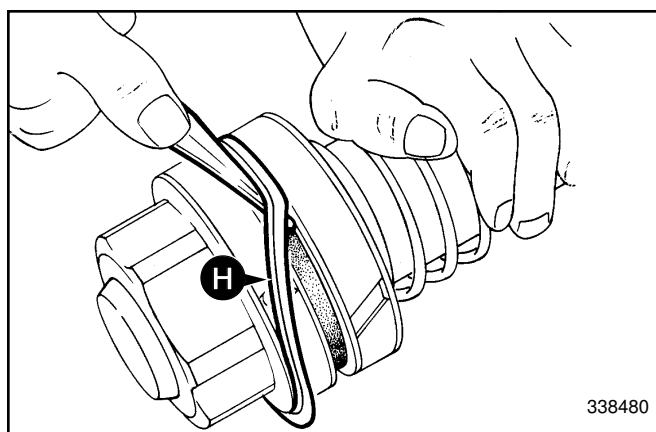
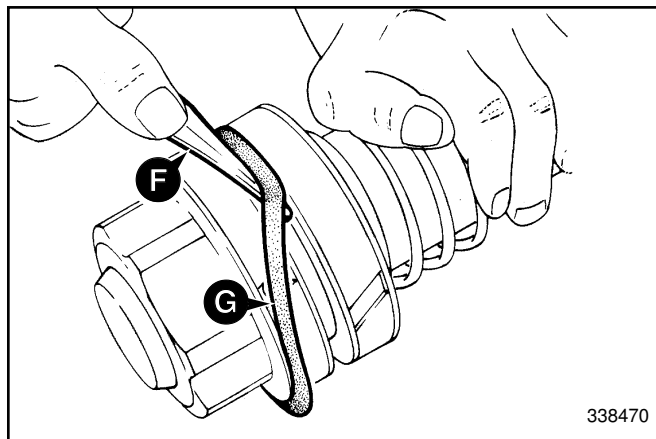
### JCB Ram Sealing Procedure (continued)

Fit new piston head seals:

- 6 Use a blunt instrument (892/01027) shown at **F**, lever the inner seal **G** into the piston head seal groove, do not let the seal twist. There are identification marks on the outer diameter of the seal, make sure the marks are visible and the seal is free to rotate, if not remove the seal and refit
- 7 Fit outer seal **H** using the same procedure as step 6. Check the external grooves are visible.
- 8 Ensure O ring is fitted into the internal seal groove on the piston head. Screw the piston head onto the thread of the piston rod, refer to the relevant section for torque figure and completion of ram assembly.
- 9 Fit the piston head retaining dowel, see ram dismantling and assembling relevant section
- 10 Fit wear rings **J** and **K**. Rotate the wear rings so that the piston retention dowel is covered by the wear ring, NOT as shown at **L**.

Fit the piston rod and head assembly into the cylinder:

- 11 Insert the piston/rod assembly into the cylinder. Align the rod and head assembly until parallel with the cylinder then push the assembly into the cylinder.
- 12 Fit the end cap, refer to the relevant section for torque figure and completion of ram assembly.



## 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

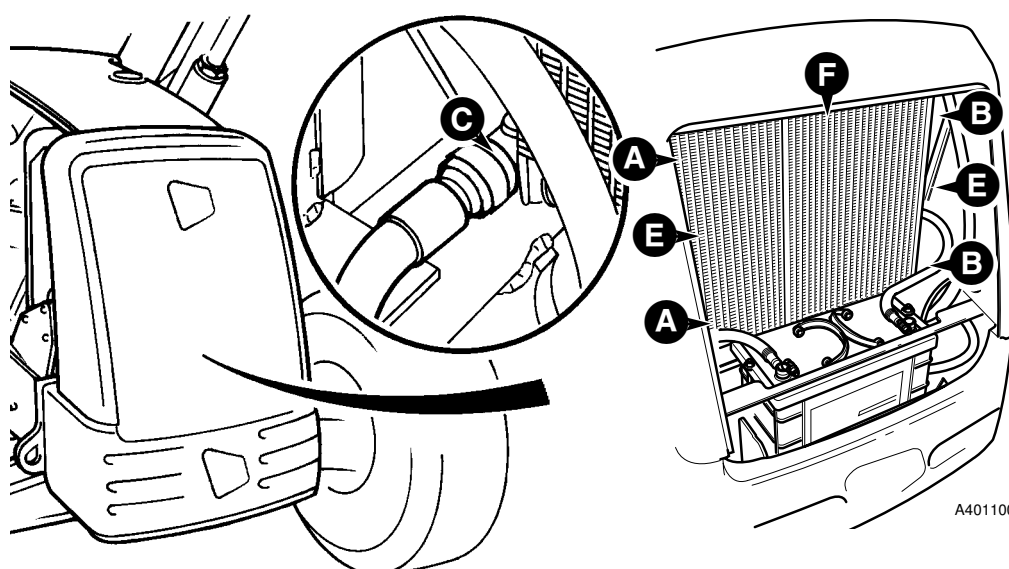
Replacement is a reversal of the removal sequence.

### ⚠ 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

A401100

## Accumulator

### Removal and Replacement

#### Removal

- 1 Park the machine on level ground, lower the loader arms, switch off the engine and chock all four wheels. Release all hydraulic pressure in the accumulator by selecting the SRS ON and operating the loader arm hydraulic lever.

#### **⚠ DANGER**

Before disconnecting or dismantling the accumulator discharge all gas pressure. Failure to comply can cause rapid discharge of gas and/or hydraulic fluid which can result in death, personal injury and damage to the machine.

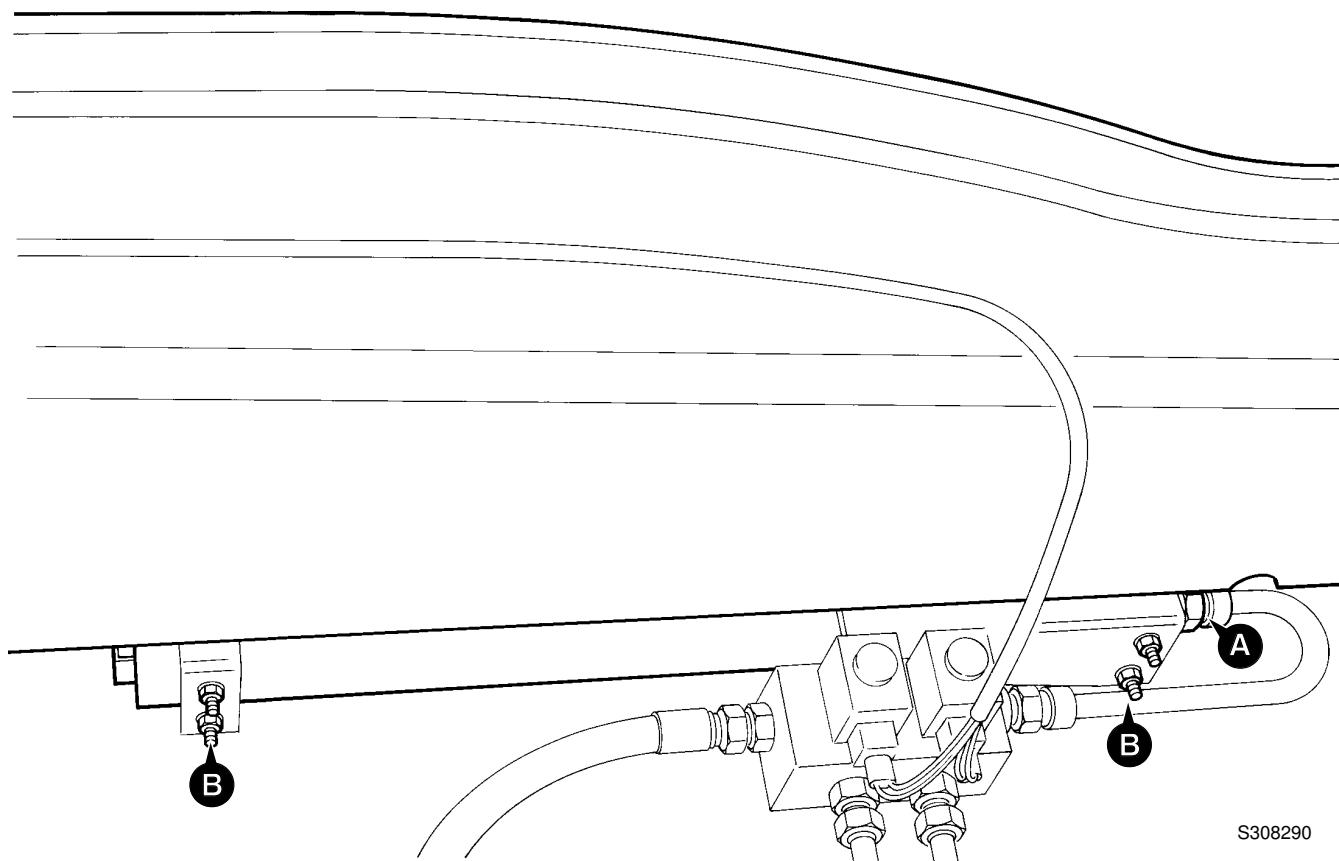
Hyd 2-5

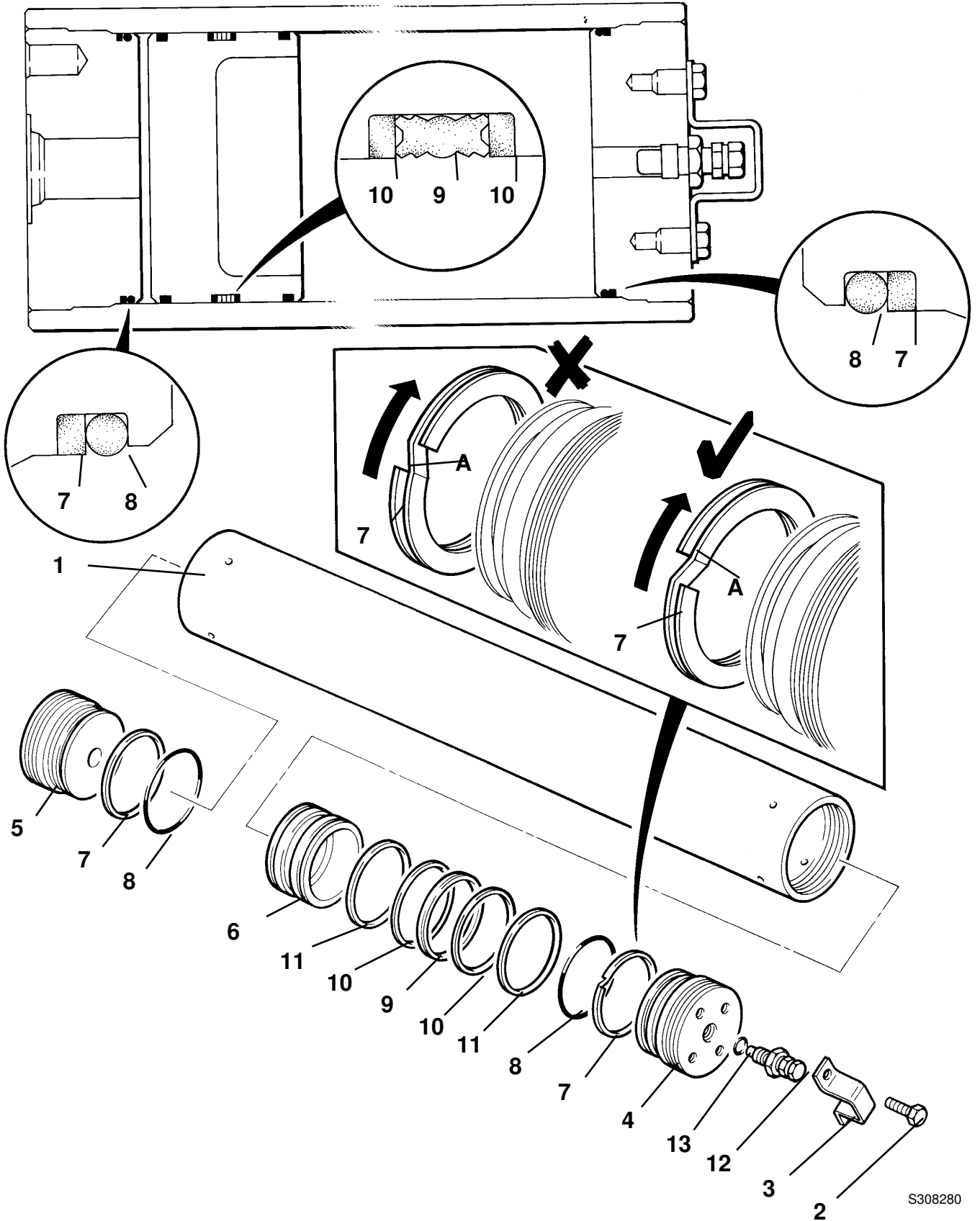
- 2 Discharge the accumulator, refer to **Service Procedures, Smooth Ride System - Charging/Discharging the Accumulator**.
- 3 Disconnect hydraulic hose **A** and plug.
- 4 Loosen both 'U' clamps **B** and slide the accumulator towards the front of the machine. When clear of the 'U' clamps carefully lower and withdraw accumulator.

#### Replacement

Replacement is a reverse of removal.

- 1 Charge the accumulator, refer to **Service Procedures, Smooth Ride System - Charging/Discharging the Accumulator**.
- 2 Operate the machines hydraulic system. Check for correct operation and leaks.
- 3 Replenish the hydraulic system with the recommended hydraulic fluid as required, refer to Section 3 **Fluids, Lubricants, Capacities and Specifications**.





S308280

## Accumulator

### Dismantling and Assembly

#### Dismantling

#### DANGER

Before disconnecting or dismantling the accumulator discharge all gas pressure. Failure to comply can cause rapid discharge of gas and/or hydraulic fluid which can result in death, personal injury and damage to the machine.

HYD 2-5

- 1 Check that the accumulator has been discharged, refer to **Service Procedures, Smooth Ride System - Charging/Discharging the Accumulator**.
- 2 Secure the accumulator in horizontal position.

#### CAUTION

The gas end cap (cap with gas valve) must be removed before the hydraulic end cap. This allows any residual pressure to escape through the safety vent holes. If the hydraulic end cap is removed first the piston will cover the safety vent holes, which could result in the piston being forced out under pressure which may result in personal injury.

HYD 2-6

- 3 Fit three pins into the holes in gas end cap 4, using a long bar working against the pins unscrew the end cap.
- 4 Fit three pins into the holes in hydraulic end cap 5, using a long bar working against the pins unscrew the end cap.
- 5 Remove and discard 'O' rings and back up rings from end caps.
- 6 Remove the piston 6 by pushing from the hydraulic end with a bar.

#### CAUTION

Do not remove the piston by applying compressed air at the opposite end.

HYD 2-7

- 7 Remove piston seal and 'O' rings.

#### Inspection

Inspect piston for cracks, burrs around the 'O' ring grooves, or damage. Examine the body bore 1, using a light, for scratches or scoring. Inspect end caps for damaged threads or burrs on 'O' ring grooves.

Minor nicks, scratches or light scoring of the body bore may be removed by using a very fine paper. Dress the bore until all apparent imperfections have been removed.

All seals and 'O' rings must be discarded and new ones fitted.

#### Assembly

- 1 Coat all internal components with clean hydraulic oil.
- 2 Fit piston seal 9, teflon back up rings 10 and seals 11.
- 3 Fit piston assembly into bore 1 with hollow side towards the gas end. Do not let piston seal drag on threads, the piston must go into the bore exactly square and very slowly. The piston is a tight fit, use a hammer and a block of wood to tap the piston until all of the piston is 2in. (50mm) below the beginning of honed bore.

**Note:** Keep pressure on the piston while tapping through the bore chamfer, otherwise the piston will bounce back, damaging the piston ring.

- 4 Fit end cap back up seal 7. Make sure the seal is fitted with leading edge A pointing in a counter clockwise direction otherwise the seal will bind when the end cap is fitted.
- 5 Fit end cap 'O' rings 8, it is important that seals 7 and 8 are fitted in the correct position in relation to each other to prevent leaks.
- 6 Fit end caps 4 and 5, use pins and a long bar. Make sure the gas end cap is fitted to the correct end, piston hollow end to gas side.

**Note:** The end caps will stop against the chamfer leading into the honed bore, 'O' ring sealing is not dependent upon cap tightness.

- 7 Use new 'O' ring 13 and fit the gas valve 12.

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**Continued...**

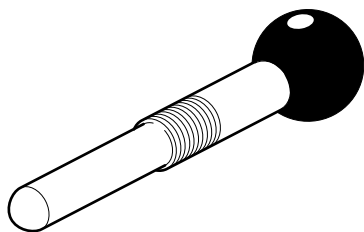
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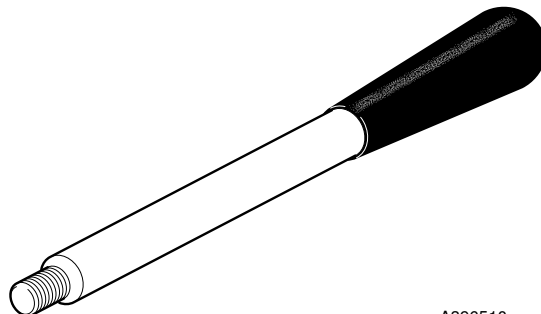


892/01077 Synchro Shuttle Gearbox - Selector Shaft Lock Screw



A395350

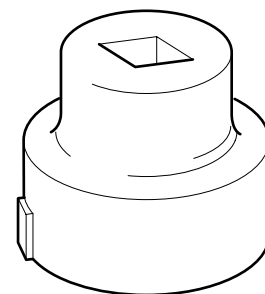
892/01078 Synchro Shuttle Gearbox - Mainshaft Adjuster



A396510

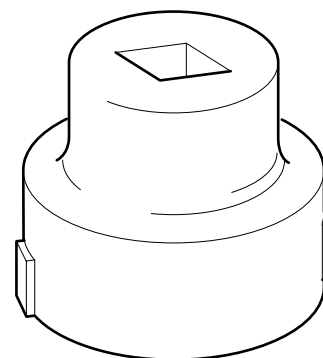
Synchro Shuttle Gearbox - Setting ring socket spanners

892/01079 (Mainshaft setting ring)



A396590

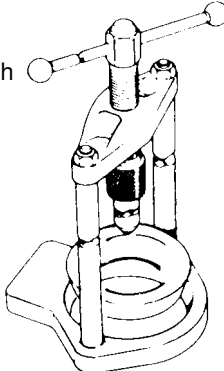
892/01080 (Layshaft setting ring)



A396600


Service Tools (cont'd)

892/00179 Bearing Press (use with appropriate adapters)



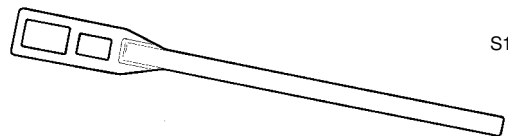
S188200

992/07608 Bearing Adapter  
 992/07609 Bearing Adapter  
 992/07610 Bearing Adapter  
 992/07611 Bearing Adapter  
 992/07612 Bearing Adapter  
 992/07613 Bearing Adapter



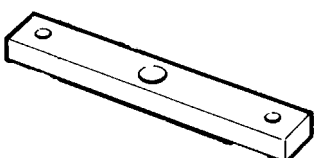
S188160

892/00812 Drive Coupling Spanner



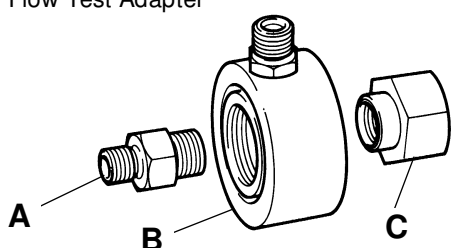
S107750

892/00922 12.2" Torque Converter Alignment Tool



S267260

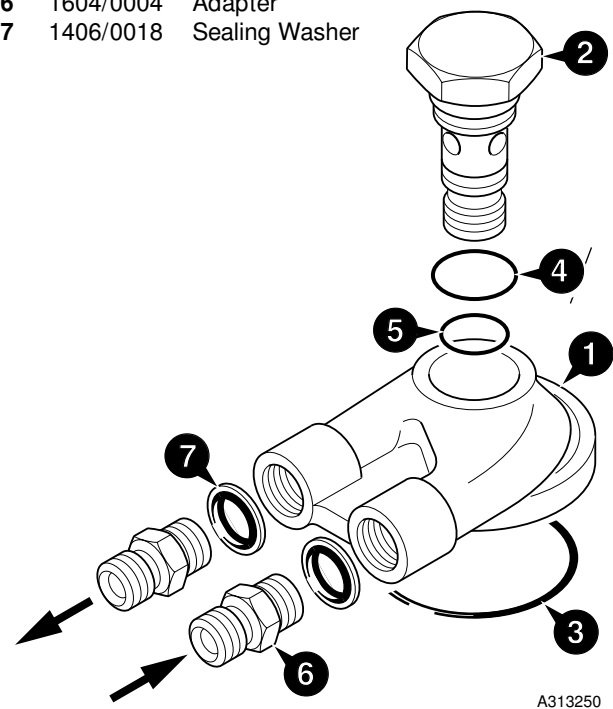
A 892/00920 Flow Test Adapter  
 B 892/00301 Flow Test Adapter  
 C 892/00302 Flow Test Adapter



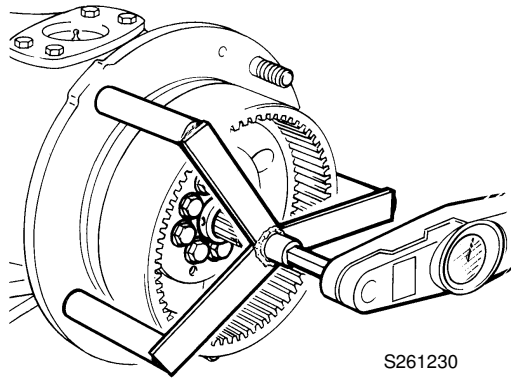
S188210

Powershift Gearbox Flow Test Adaptor

1 460/15708 Flow Test Adapter  
 2 460/15707 Banjo Bolt  
 3 2401/0222 O-ring  
 4 2403/0110 O-ring  
 5 2403/0108 O-ring  
 6 1604/0004 Adapter  
 7 1406/0018 Sealing Washer



A313250



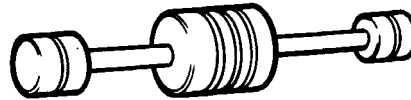
Torque Measuring Tool for Wheel Hub Seals

Manufacture locally, procedures in this manual show checking the wheel hub seal using a rolling force. However, the torque can be measured using above locally manufactured tool.

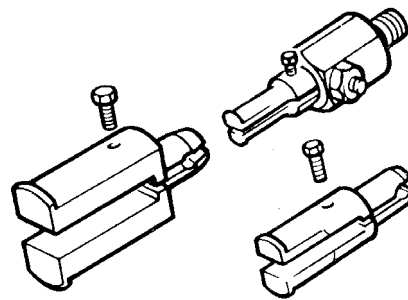
Bearing rolling torque is 12 to 22 Nm (9 to 16 lbf ft) excluding seal drag. Maximum permissible including seal drag is 40 Nm (29.5 lbf ft).

892/00224

Impulse Extractor Set for Hub Bearing Seals



S197070



892/00225

Adapter - Impulse Extractor

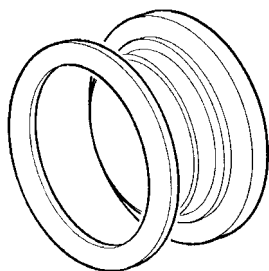
Small 17mm to 25mm

Medium 25mm to 45mm

Large 45mm to 80mm

993/59500

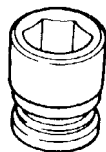
Adapter - Impulse Extractor (syncro shuttle and powershift transmission)



892/00891

Fitting Tool Assembly for Wheel Hub Seals

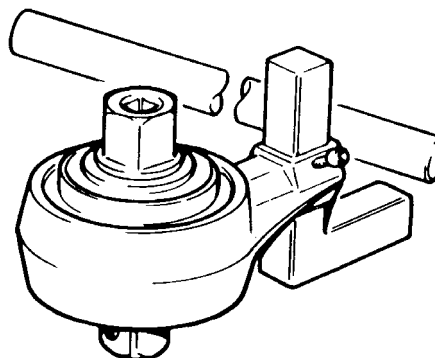
S227760



S216290

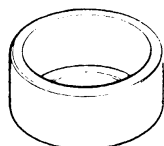
- 892/00817 17 mm A/F x 3/4in. square drive
- 892/00818 22 mm A/F x 3/4in. square drive
- 892/00819 15 mm A/F x 1/2in. square drive
- 892/00333 19 mm A/F x 3/4in. square drive

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



S197030

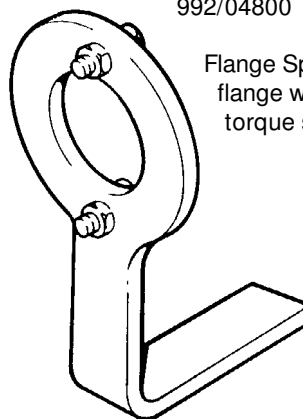
892/00174 Measuring Cup - Pinion Head Bearing



S190770

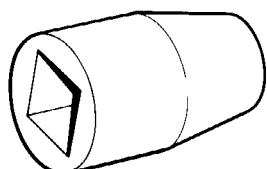
992/04800

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

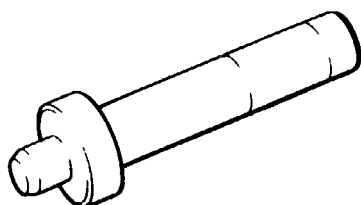


S197040

892/00822 Splined Bolt Socket for driveshafts

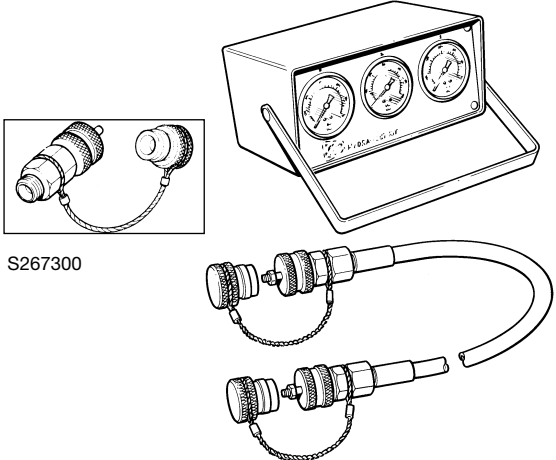


S197060



S216310

892/00182 Bearing Pad Driver



Hydraulic Circuit Pressure Test Kit (also used for main hydraulic system tests)

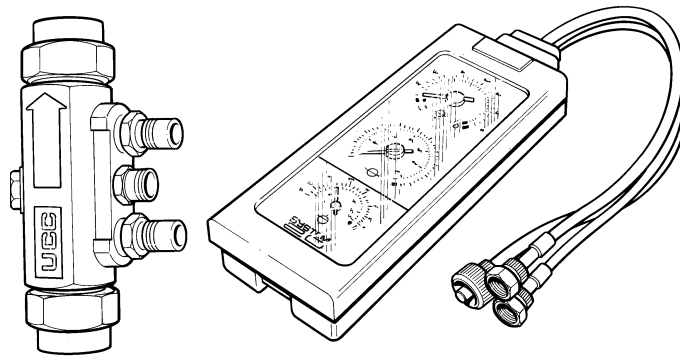
892/00253	Pressure Test Kit
:892/00201	Replacement Gauge 0-20 bar (0-300 lbf/in <sup>2</sup> )
:892/00202	Replacement Gauge 0-40 bar (0-600 lbf/in <sup>2</sup> )
:892/00203	Replacement Gauge 0-400 bar (0-6000 lbf/in <sup>2</sup> )
:892/00254	Replacement Hose
993/69800	Seal Kit for 892/00254 (can also be used with probe 892/00706)
892/00706	Test Probe

S267300

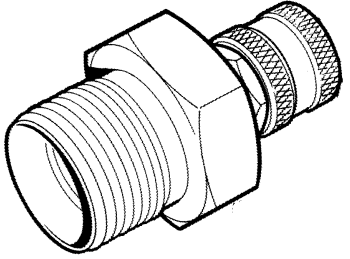
S188121

Flow Test Equipment (also used for main hydraulic system tests)

892/00268	Flow Monitoring Unit
892/00269	Sensor Head 0 - 100 l/min (0 - 22 UK gal/min)
892/00293	Connector Pipe
892/00270	Load Valve
1406/0021	Bonded Washer
1604/0006	Adapter 3/4 in M x 3/4 in M BSP
1612/0006	Adapter 3/4 in F x 3/4 in M BSP
892/00271	Adapter 3/4 in F x 5/8 in M BSP
892/00272	Adapter 5/8 in F x 3/4 in M BSP
816/20008	Adapter 3/4 in F x 1/2 in M BSP
892/00275	Adapter 1/2 in F x 3/4 in M BSP
892/00276	Adapter 3/4 in F x 3/8 in M BSP
892/00277	Adapter 3/8 in F x 3/4 in M BSP
892/00273	Sensor Head 0 - 380 l/min
892/00294	Connector Pipe
1606/0015	Adapter 1.1/4 in M BSP x 1 in M BSP
892/00078	Connector 1 in F x 1 in F BSP
1604/0008	Adapter 1 in M x 1 in M BSP
1606/0012	Adapter 1 in M x 3/4 in M BSP
816/20013	Adapter 3/4 in F x 1 in M BSP



S188151

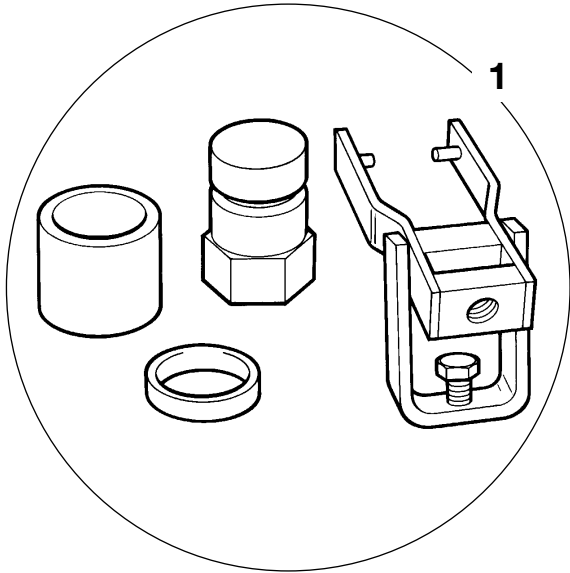


S316250

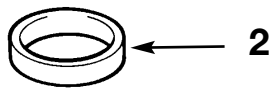
Test Point

1	892/00964	Test point (1/8 BSP) Powershift
2	892/00965	Test point (3/8 BSP) Powershift
3	892/00966	Test point (1/4 BSP) Synchro Shuttle

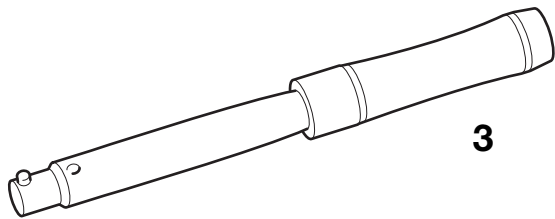
These test points can be left in position after testing.



1

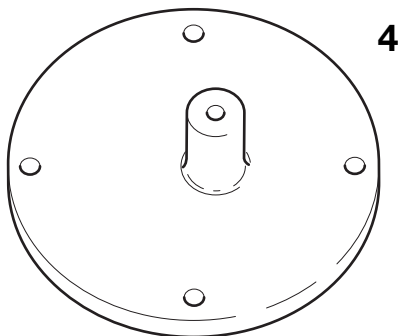


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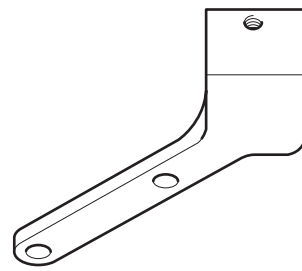
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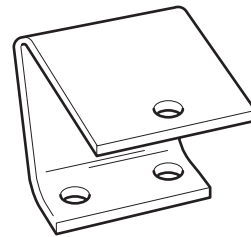
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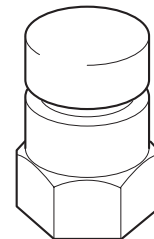
5

A396960



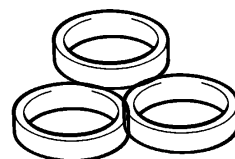
6

A396930



7

A396940



8, 9

**Service Tools (cont'd)****Solid Spacer Setting Kit  
Synchro Shuttle Gearbox, SD70, SD80  
Axles**

1	892/00918	Setting Tool Kit
2	921/52627	Spacer 14.20 Service use
3	993/70111	Breakback Torque Wrench
4	892/01076	Support Bracket - Synchro Shuttle Gearbox
5	892/01075	Support Bracket PD70, SD80 Rear Axles
6	997/11000	Support Bracket SD55, SD70 Front Axles
7	998/10567	SD80 Pinion Shaft Adaptor

**8 921/53300 Spacer Kit - SD55 Axles**

## Comprises of:

	Spacer thickness mm
921/53322	13.550
921/53323	13.575
921/53324	13.600
921/53325	13.625
921/53301	13.650
921/53302	13.675
921/53303	13.700
921/53304	13.725
921/53305	13.750
921/53306	13.775
921/53307	13.800
921/53308	13.825
921/53309	13.850
921/53310	13.875
921/53311	13.900
921/53312	13.925
921/53313	13.950
921/53314	13.975
921/53315	14.000
921/53316	14.025
921/53317	14.050
921/53318	14.075
921/53319	14.100
921/53320	14.125
921/53321	14.150

**9 921/53400 Spacer Kit - Sychro Shuttle Gearbox,  
SD70, SD80 Axles**

## Comprises of:

	Spacer thickness mm
921/52628	12.600
829/30405	12.625
921/52629	12.650
829/30406	12.675
921/52630	12.700
829/30407	12.725
921/52601	12.750
829/30408	12.775
921/52602	12.800
829/30409	12.825
921/52603	12.850
829/30410	12.875
921/52604	12.900
829/30411	12.925
921/52605	12.950
829/30412	12.975
921/52606	13.000
829/30413	13.025
921/52607	13.050
829/30414	13.075
921/52608	13.100
829/30415	13.125
921/52609	13.150
829/30416	13.175
921/52610	13.200
829/30417	13.225
921/52611	13.250
921/53424	13.275
921/53425	13.300
921/53426	13.325
921/53427	13.350
921/53428	13.375
921/53401	13.400
921/53402	13.425
921/53403	13.450
921/53404	13.475
921/53405	13.500
921/53406	13.525
921/53407	13.550
921/53408	13.575
921/53409	13.600
921/53410	13.625
921/53411	13.650
921/53412	13.675
921/53413	13.700
921/53414	13.725
921/53415	13.750
921/53416	13.775
921/53417	13.800
921/53418	13.825
921/53419	13.850
921/53420	13.875
921/53421	13.900
921/53422	13.925
921/53423	13.950
921/52626	14.000

**Note:** After using a spacer, obtain a replacement to keep the set complete

**Service Tools (cont'd)**

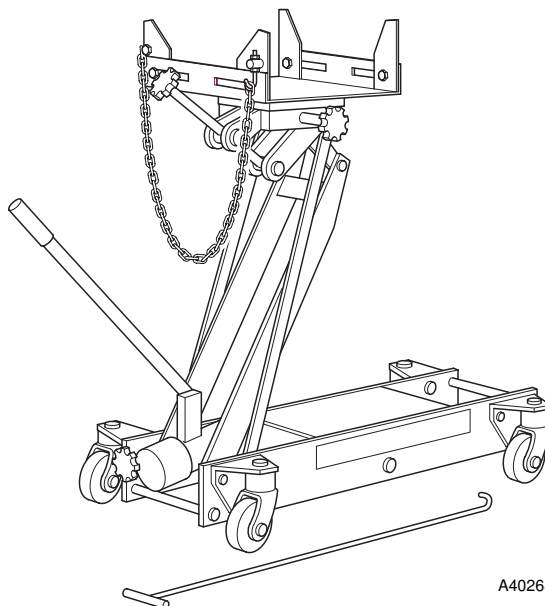
- 892/01083 Powershift - Assembly tool, transfer gear
- 892/01084 Powershift - Transfer gear, bearing assembly
- 892/01085 Powershift - Seal fitting tool

\*

892/01094 Transmission Jack

When removing the Powershift gearbox use of a special transmission jack is strongly recommended. This jack can also be used when removing Synchro Shuttle gearboxes.

Note that the jack must be used with special support plates, see the facing page for details.



\*

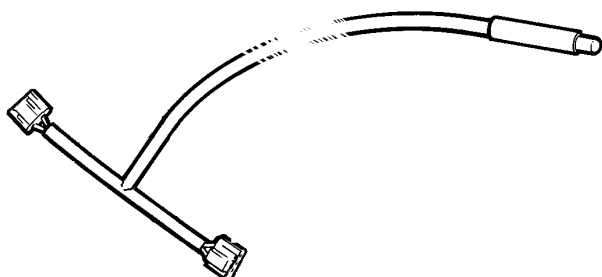
823/10420 Thrust Washer Kit - Powershift gearbox - Layshaft clutch

Comprises of:

	Washer thickness mm
823/10421	4.3
823/10422	4.4
823/10423	4.5
823/10424	4.6
823/10425	4.7
823/10426	4.8

\*

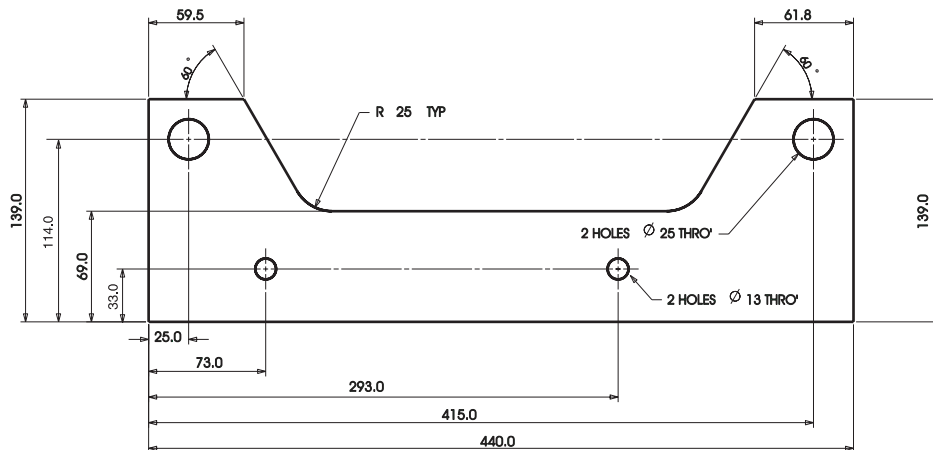
892/01096 Speed Sensor Test Harness - Powershift Gearbox



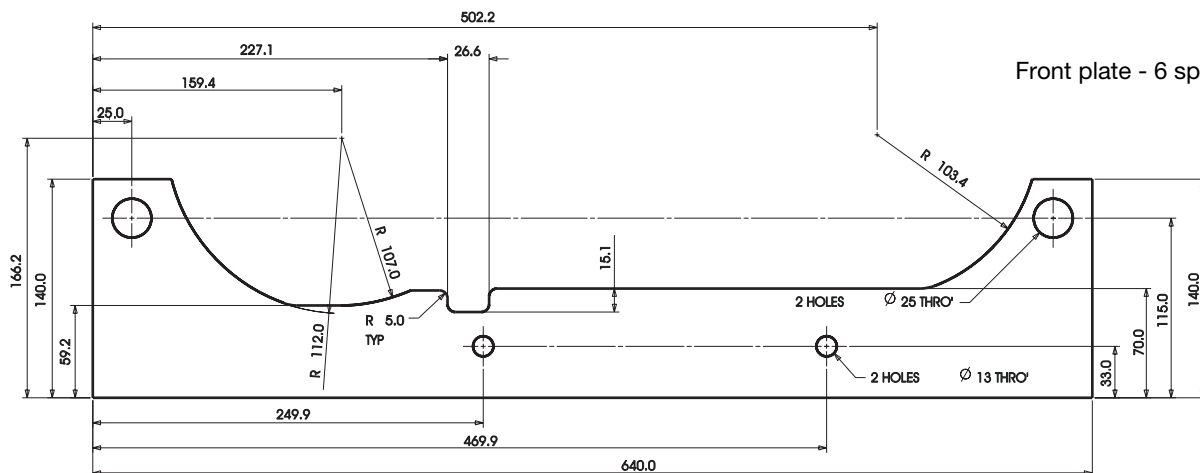


Service Tools (cont'd)

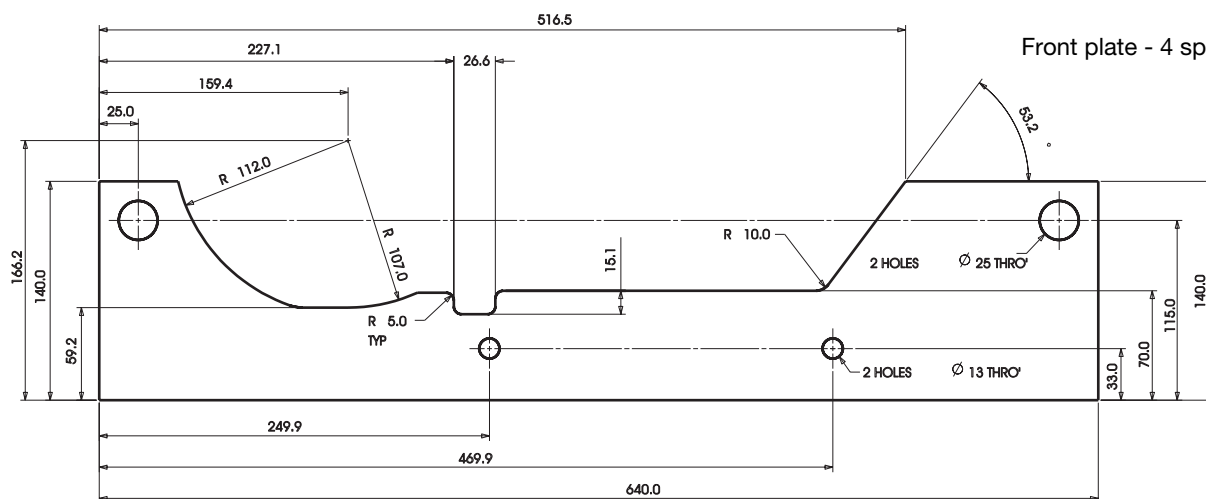
\* Powershift gearbox - support plates for use with hydraulic jack. Plates should be locally manufactured from 5 mm thick mild steel plate.



Rear plate - 4 speed and 6 speed.



Front plate - 6 speed.

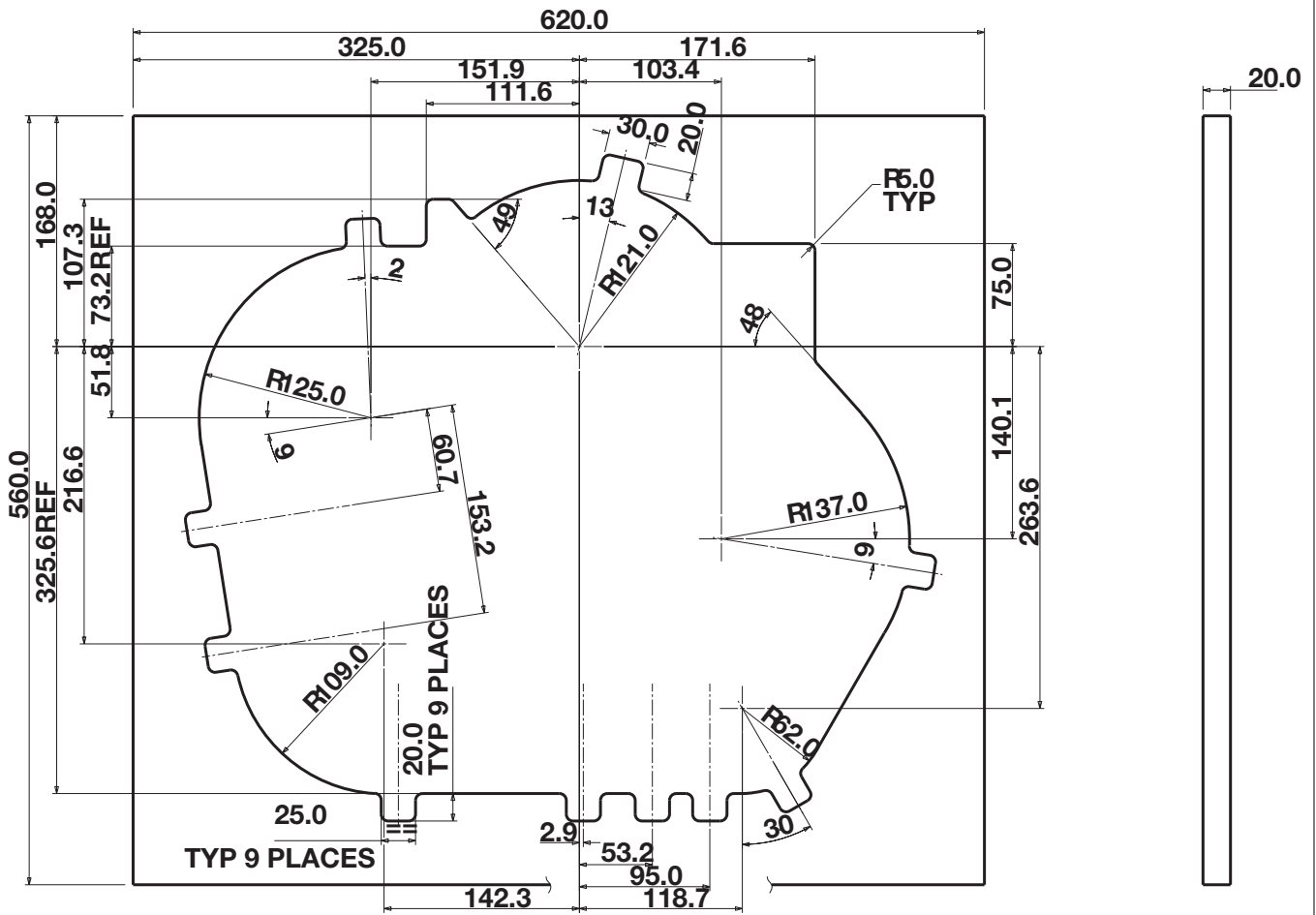


Front plate - 4 speed.

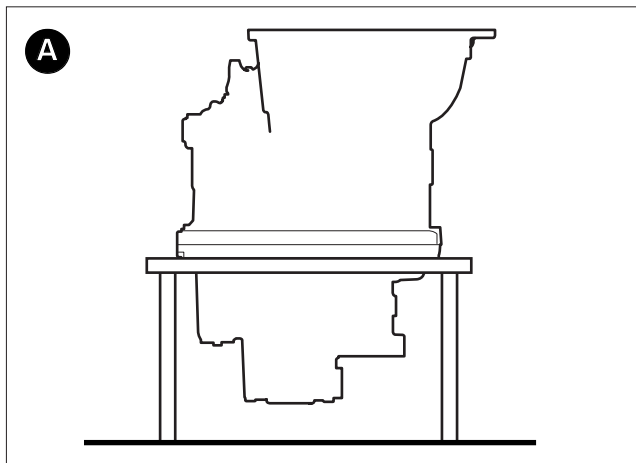
Service Tools (cont'd)

892/01082 Powershift - Assembly Cradle

**Note:** Support legs will also be required. These must be locally manufactured so that the gearbox can be supported as shown at A.



A402690

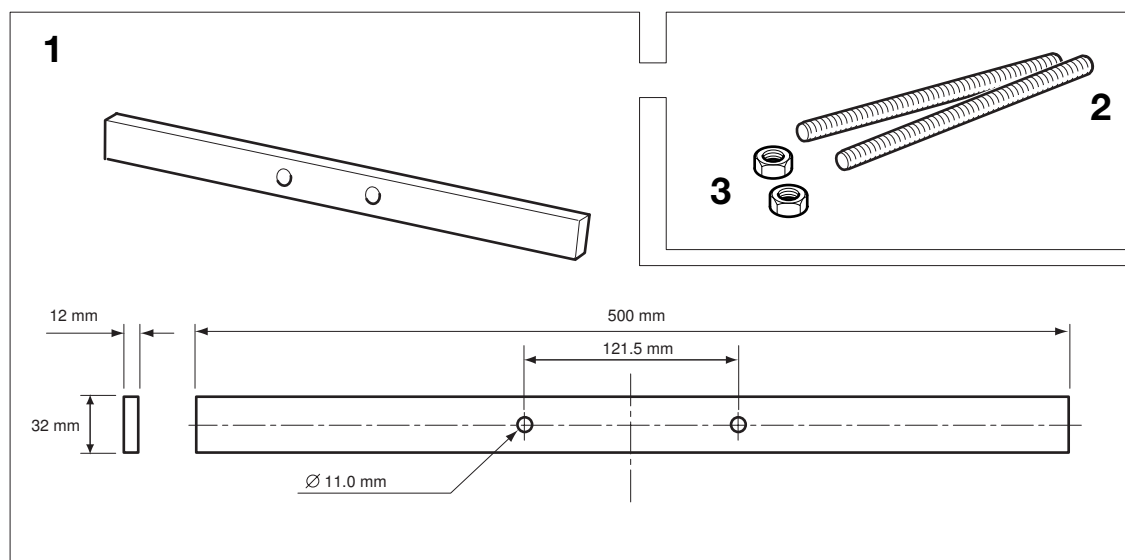


**Service Tools (cont'd)****Powershift Gearbox - hydraulic pump removal tools**

The tools detailed below enable the pump to be removed with the torque converter housing in place.

- 1 Reaction bar. Locally manufacture from mild steel bar. Drill the 2 holes through the bar as shown.
- 2 2 off lengths of M10 x 1.5 threaded rod 250 mm (10 in) long.
- 3 2 off M10 x 1.5 nuts.

A set of M10 x 1.5 taps will also be required.

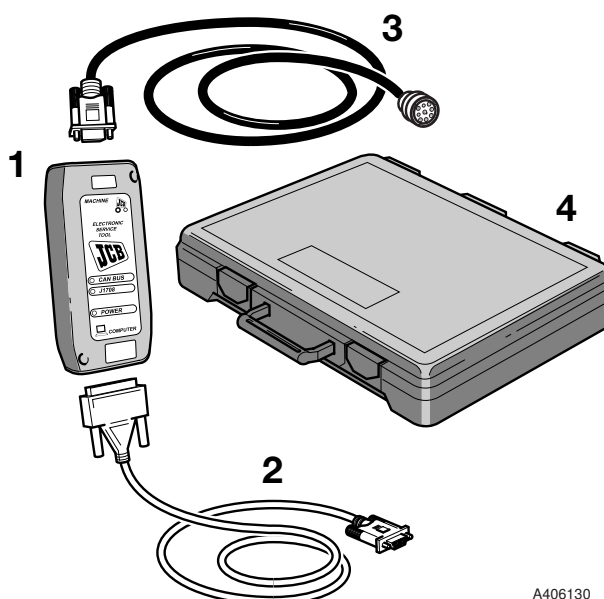


A406000

**Powershift Gearbox - 6 Speed (ShiftMaster) Electronic Service Tool Kit**

892/01033 Kit comprises:

- 1 Data Link Adaptor (DLA), enables data exchange between the machine ECU (Electronic Control Unit) and a laptop PC loaded with the applicable ShiftMaster diagnostics software.
- 2 Interconnecting cable, DLA to laptop PC. Several cables are included to enable compatibility with different PC port types.
- 3 Interconnecting cable, DLA to machine ECU diagnostics socket.
- 4 Kit carrying case.



A406130

## Tyre Pressures

**Note:** If the tyres fitted to your machine are not listed, then contact JCB for advice, DO NOT guess tyre pressures.

### Front Wheels

#### AWS/4WD MACHINES

Item	Size x Ply	Type	Make	Remarks	Pressure	
					bar	lbf/in <sup>2</sup>
1	16.9x24x12	IND	ARMSTRONG	TUBELESS	2.6	38
2	16.9x24x12	IND	GOODYEAR	TUBELESS	2.6	38
3	15.5x25	XTLA	MICHELIN	TUBELESS	2.5	36
4	16.9x28x12	IND	ARMSTRONG	TUBELESS	2.6	38
5	16.9x28x12	IND	GOODYEAR	TUBELESS	2.6	38
6	16.9x28x10	IND	GOODYEAR	TUBELESS	2.2	32
7	16.9x28	XM27	MICHELIN	TUBELESS	2.7	39
8	16.9x28x14	IND	NOKIA	TUBE	2.6	38
9	16.9x24x12	IND	GOODYEAR	TUBELESS	2.6	38
10	16.9x28x12	TRAC	OLYMPIC	TUBELESS	2.6	38
11	16.9x28x12	IND	OLYMPIC	TUBE	2.6	38
12	14.9x24x12	IND	GOODYEAR	TUBELESS	2.75	40
13	16.9x28	IND	GOODYEAR	TUBELESS	2.5	36

#### 2WS/2WD MACHINES

21	11.0x16x12	RIB	ARMSTRONG	TUBELESS	4.4	64
22	11.0x16x12	RIB	GOODYEAR	TUBELESS	4.2	61
23	11Lx16x12	IND	ARMSTRONG	TUBELESS	4.4	64
24	10.5x18x10	IND	FIRESTONE	TUBELESS	3.8	55
25	12.0x18x12	IND	FIRESTONE	TUBELESS	3.5	51

#### 2WS/4WD MACHINES

31	14x17.5x10	IND	ARMSTRONG	TUBELESS	3.8	55
32	14x17.5x10	IND	GOODYEAR	TUBELESS	3.8	55
34	12.0x18x12	IND	FIRESTONE	TUBELESS	3.5	51
35	12.0x18x12	IND	OLYMPIC	TUBELESS	4.25	62
36	335 x18	XM27	MICHELIN	TUBELESS	3.5	51
37	12.5x18x10	IND	GOODYEAR	TUBELESS	4.25	62
38	335 x20	XM27	MICHELIN	TUBE	3.0	43.5
39	340 x18	IND	GOODYEAR	TUBELESS	3.2	46

Items 4, 5, 6, 7,8, 9, 10, 11, 13, 38 must have steering lock restriction stops fitted.

## Tyre Pressures

**Note:** If the tyres fitted to your machine are not listed, then contact JCB for advice, DO NOT guess tyre pressures.

### Rear Wheels

#### AWS MACHINES

Item	Size x Ply	Type	Make	Remarks	Pressure	
					bar	lbf/in <sup>2</sup>
1	16.9x24x12	IND	ARMSTRONG	TUBELESS	2.6	38
2	16.9x24x12	IND	GOODYEAR	TUBELESS	2.6	38
3	15.5x25	XTLA	MICHELIN	TUBELESS	2.5	36
4	16.9x28x12	IND	ARMSTRONG	TUBELESS	2.6	38
5	16.9x28x12	IND	GOODYEAR	TUBELESS	2.6	38
6	16.9x28x10	IND	GOODYEAR	TUBELESS	2.2	32
7	16.9x28	XM27	MICHELIN	TUBELESS	2.7	39
8	16.9x28x14	IND	NOKIA	TUBE	2.6	38
9	16.9x24x12	IND	GOODYEAR	TUBELESS	2.6	38
10	16.9x28x12	TRAC	OLYMPIC	TUBELESS	2.6	38
11	16.9x28x12	IND	OLYMPIC	TUBE	2.6	38
12	14.9x24x12	IND	GOODYEAR	TUBELESS	2.75	40
13	16.9x28	IND	GOODYEAR	TUBELESS	2.5	36

#### 2WS MACHINES

21	16.9x24x10	IND	ARMSTRONG	TUBELESS	2.2	32
22	16.9x24x12	IND	GOODYEAR	TUBELESS	2.2	32
23	19.5x24x10	IND	ARMSTRONG	TUBELESS	1.9	28
24	19.5x24x12	IND	ARMSTRONG	TUBELESS	2.3	33
25	21L x24x12	IND	GOODYEAR	TUBELESS	2.2	32
26	18.4x26x12	TRAC	GOODYEAR	TUBELESS	2.5	36
27	18.4x26x12	TRAC	OLYMPIC	TUBELESS	2.4	35
28	18.4x26x12	IND	GOODYEAR	TUBELESS	2.0	29
29	16.9x28x12	TRAC	OLYMPIC	TUBELESS	2.2	32
30	16.9x28x12	TRAC	FIRESTONE	TUBE	2.2	32
31	16.9x28x12	IND	GOODYEAR	TUBELESS	2.2	32
32	16.9x28	XM27	MICHELIN	TUBELESS	2.5	36
33	18.4x30x14	IND	GOODYEAR	TUBE	2.0	29
34	16.9x28	IND	GOODYEAR	TUBELESS	2.5	36

**Note:** 12 ply tyres must be fitted on rear wheels when any backhoe attachment is used. For the correct pressure see the table above.

Items 4, 5, 6, 7, 8, 9, 10, 11, 13 must have steering lock restriction stops fitted.

## Front 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	JCB spiral bevel input with epicyclic hub reduction
Designation	SD70
Installation	Centre pivot
Weight	
(dry, with no steer rams and without wheels)	385 kg (850 lbs) approximately
Overall Gear Ratio	24.975:1
Crownwheel and Pinion Ratio	4.625:1
Number of Teeth	
Crownwheel	37
Pinion	8
Hub Reduction	5.4:1
Input Type	Yoke
Oscillation	± 5°
Toe - in	0°
Castor Angle	0°
Camber Angle	1°
King - pin inclination	0°

### 2 WHEEL STEER MACHINES (4 Wheel Drive)

Type	JCB spiral bevel input with epicyclic hub reduction
Designation	SD55
Installation	Centre pivot
Weight	
(dry, with no steer rams and without wheels)	330 kg (728 lbs) approximately
Hub Reduction	5.4:1
Input Type	Yoke
Oscillation	± 5°
Toe - in	0°
Castor Angle	0°
Camber Angle	1°
King - pin inclination	0°
Ratios	OPTION 1                      OPTION 2
Overall	16.2:1                      19.2:1
Crownwheel and Pinion	3:1                              3.556:1
Number of Teeth	
Crownwheel	33                              32
Pinion	11                              9

### 2 WHEEL STEER MACHINES (2 Wheel Drive)

Type	JCB centre oscillation, non-driven
Installation	Centre pivot
Weight	
(dry, with steer ram and without wheels)	239 kg (525 lbs) approximately
Oscillation	± 5°
Toe - in	0°
Castor Angle	0°
Camber Angle	3° positive

## 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

## Synchro Shuttle Gearbox

Description	Combined torque converter, reverser, and gearbox unit. Synchromesh manual gear selection. Electro hydraulic selection of forward and reverse.		
Designation	SS700 (4 wheel drive)		
Weight (dry)	* 170 kg (375 lb)		
2WD	* 200 kg (441 lb)		
4WD			
Gear Ratios	<b>Std Ratio</b>	<b>Low Ratio</b>	
1st	5.56:1	6.56:1	
2nd	3.45:1	4.06:1	
3rd	1.83:1	1.90:1	
4th	1.00:1	1.00:1	
Torque Converter			
Torque Converter Dia.	310 mm (12.2 in.)		
Torque Converter Identification	04/600580	04/600581	
Torque Multiplication at Stall	2.52:1	3.01:1	

<b>Converter Pressures (in neutral)</b>		<b>bar</b>	<b>kgf/cm<sup>2</sup></b>	<b>lbf/in<sup>2</sup></b>
Converter In at 50 deg.C	1000 rev/min	1.5 - 2.5	1.5 - 2.5	22 - 36
	2000 rev/min	5.3 - 6.7	5.4 - 6.8	77 - 97
Converter In at 100 deg.C	1000 rev/min	0.5 - 1.3	0.5 - 1.3	7 - 19
	2000 rev/min	4.1 - 4.9	4.2 - 5.0	59 - 71
Converter Out at 50 deg.C	1000 rev/min	0.8 - 1.6	0.8 - 1.6	12 - 23
	2000 rev/min	3.0 - 4.0	3.1 - 4.1	43 - 58
Converter Out at 100 deg.C	1000 rev/min	0.3 - 0.9	0.3 - 0.6	4 - 9
	2000 rev/min	2.1 - 2.9	2.1 - 3.0	30 - 42

<b>Lubrication Pressures (in neutral)</b>		<b>bar</b>	<b>kgf/cm<sup>2</sup></b>	<b>lbf/in<sup>2</sup></b>
At 50 deg.C	1000 rev/min	0.3 - 0.9	0.3 - 0.9	4 - 13
	2000 rev/min	1.8 - 2.4	1.8 - 2.4	26 - 35
At 100 deg.C	1000 rev/min	0.1 - 0.3	0.1 - 0.3	1 - 4
	2000 rev/min	1.3 - 2.1	1.3 - 2.1	19 - 30

<b>Main Line Pressure (in neutral) †</b>		<b>bar</b>	<b>kgf/cm<sup>2</sup></b>	<b>lbf/in<sup>2</sup></b>
At 50 deg. C	1000 rev/min	11.0 - 13.0	11.2 - 13.3	159 - 188
	2000 rev/min	13.0 - 15.6	13.3 - 16.0	188 - 226
At 100 deg.C	1000 rev/min	10.2 - 12.2	10.4 - 12.4	148 - 177
	2000 rev/min	11.4 - 14.0	11.8 - 14.3	165 - 203

**Clutch Pressures †** All clutch pressures should be the same as **Mainline Pressure** to within 0.7 bar (10 lbf/in<sup>2</sup>)

<b>Flow Rates (in neutral)</b>		<b>L/min</b>	<b>US gal/min</b>	<b>UK gal/min</b>
Cooler at 50 deg.C	1000 rev/min	7.7 - 11.0	2.0 - 2.9	1.7 - 2.4
	2000 rev/min	13.9 - 20.0	3.6 - 5.3	3.0 - 4.4
Cooler at 100 deg.C	1000 rev/min	5.2 - 8.2	1.1 - 2.2	1.1 - 1.8
	2000 rev/min	14.5 - 17.5	3.8 - 4.6	3.2 - 3.8
Pump at 50 deg.C	1000 rev/min	11.5 - 15.5	3.0 - 4.1	2.5 - 3.4
	2000 rev/min	24.0 - 33.0	6.7 - 8.8	5.3 - 7.3



**Powershift Gearbox - 6 Speed**

Description	Full electro-hydraulic transmission unit with input, reverse, layshaft, mainshaft, 6 speed and 4 wheel drive clutch packs giving 6 forward and 4 reverse speeds. Electronically controlled gear selection.			
Designation	PS766 (4 wheel drive)			
Weight (dry)	T.B.A.			
2WD	T.B.A.			
4WD	T.B.A.			
Gear Ratios	<b>Forward</b>	<b>Reverse</b>		
1st	8.17:1	6.45:1		
2nd	4.90:1	4.76:1		
3rd	3.62:1	1.78:1		
4th	2.25:1	1.31:1		
5th	1.35:1	-		
6th	1.00:1	-		
Torque Converter	310 mm (12.2 in.)			
Torque Converter Dia.	04/600580 04/600581			
Torque Converter Identification	2.52:1		3.01:1	
Torque Multiplication at Stall				
<b>Converter Pressures (in neutral)</b>	<b>bar</b>	<b>kgf/cm<sup>2</sup></b>	<b>lbf/in<sup>2</sup></b>	
Converter In at 50 °C	1000 rev/min	2.0 - 4.95	2.0 - 5.0	29 - 72
	2000 rev/min	4.0 - 6.8	4.1 - 6.9	58 - 99
Converter Out at 50 °C	1000 rev/min	0.6 - 2.25	0.6 - 2.3	8.7 - 33
	2000 rev/min	1.25 - 2.50	1.3 - 2.6	18 - 36
Converter Inlet Relief Valve Pressure (max.)		7.1	7.2	103
<b>Lubrication Pressures (in neutral)</b>				
At 50 °C	1000 rev/min	0.25 - 1.0	0.26 - 1.0	3.6 - 14.5
	2000 rev/min	0.50 - 1.0	0.51 - 1.0	7.3 - 14.5
<b>Main Line Pressure (in neutral)</b>				
At 50 °C	1000 rev/min	11.4 - 15.7	11.6 - 16.0	165 - 228
	2000 rev/min	12.4 - 17.0	12.6 - 17.3	180 - 246
<b>Flow Rates (in neutral)</b>		<b>L/min</b>	<b>US gal/min</b>	<b>UK gal/min</b>
Cooler at 50 °C	1000 rev/min	14.0 MIN	3.7 MIN	3.1 MIN
	2000 rev/min	17.0 MIN	4.5 MIN	3.7 MIN
Pump at 50 °C	1000 rev/min	16.0 MIN	4.2 MIN	3.5 MIN
	2000 rev/min	34.0 MIN	9.0 MIN	7.5 MIN
* <b>Control Solenoid Valves</b>	3 way, 2 position, normally closed, integral suppression diode.			
Coil Resistance	7.5 Ohm @ 20 °C			

**Powershift Gearbox - 4 Speed**

Description Full electro-hydraulic transmission unit with input, reverse, layshaft, mainshaft and 4 wheel drive clutch packs giving 4 forward and 4 reverse speeds.

Designation PS764 (4 wheel drive)

Weight (dry) 2WD **T.B.A.**  
4WD **T.B.A.**

Gear Ratios 1st 7.97:1  
2nd 4.29:1  
3rd 1.86:1  
4th 1.00:1

Torque Converter Torque Converter Dia. 310 mm (12.2 in.)  
Torque Converter Identification 04/600580 04/600581  
Torque Multiplication at Stall 2.52:1 3.01:1

<b>Converter Pressures (in neutral)</b>		<b>bar</b>	<b>kgf/cm<sup>2</sup></b>	<b>lbf/in<sup>2</sup></b>
Converter In at 50 °C	1000 rev/min	2.0 - 4.95	2.0 - 5.0	29 - 72
	2000 rev/min	4.0 - 6.8	4.1 - 6.9	58 - 99
Converter Out at 50 °C	1000 rev/min	0.6 - 2.25	0.6 - 2.3	8.7 - 33
	2000 rev/min	1.25 - 2.50	1.3 - 2.6	18 - 36
Converter Inlet Relief Valve Pressure (max.)		7.1	7.2	103

<b>Lubrication Pressures (in neutral)</b>				
At 50 °C	1000 rev/min	0.25 - 1.0	0.26 - 1.0	3.6 - 14.5
	2000 rev/min	0.50 - 1.0	0.51 - 1.0	7.3 - 14.5

<b>Main Line Pressure (in neutral)</b>				
At 50 °C	1000 rev/min	11.4 - 15.7	11.6 - 16.0	165 - 228
	2000 rev/min	12.4 - 17.0	12.6 - 17.3	180 - 246

<b>Flow Rates (in neutral)</b>		<b>L/min</b>	<b>US gal/min</b>	<b>UK gal/min</b>
Cooler at 50 °C	1000 rev/min	14.0 MIN	3.7 MIN	3.1 MIN
	2000 rev/min	17.0 MIN	4.5 MIN	3.7 MIN
Pump at 50 °C	1000 rev/min	16.0 MIN	4.2 MIN	3.5 MIN
	2000 rev/min	34.0 MIN	9.0 MIN	7.5 MIN

\* **Control Solenoid Valves** 3 way, 2 position, normally closed, integral suppression diode.  
Coil Resistance 7.5 Ohm @ 20 °C

### Engine Stall Speed Combinations

The stall speed figures on the following pages are intended as a guide to assist with machine fault diagnosis. The figures relate to tests conducted at an ambient of 25 deg. C and barometric pressure of 100 kPa (sea level). Note that changes in ambient temperature, pressure and humidity and fuel grade will affect engine power and hence the stall figures.

As an example, at 10,000 ft the power reduction of a naturally aspirated engine could be 29% and for a turbo engine 8%.

**Engine Stall Speed Combinations - Two wheel steer (2WS) machines, Low emission 1000 series engine**

**Note.** On all double pump options the test is to be carried out with single pump option selected.

	3CX	3CX	3CXT Std. Lft	3CXT Std. Lft	3CXT Hi. Lft	3CXT Hi Lft	3CX Contra	3CX Contra						
<b>Engine Speed @ Stall Combination</b>														
1.Convertor only.														
Max.r.p.m.	2160	2150	2150	2140	2140	2130	2190	2190						
Min.r.p.m.	2060	2040	2045	2035	2035	2025	2100	2090						
2.Convertor + M.R.V.														
Max.r.p.m.	1700	1690	1805	1800	1745	1735	1835	1825						
Min.r.p.m.	1550	1530	1665	1655	1590	1585	1700	1690						
<b>Build specification.</b>														
Engine size.														
N.A. (75hp) (56kw)	●	●												
T2 (92hp) (69kw)			●	●	●	●								
T3 (100hp) (75kw)							●	●						
Convertor type.														
W300 (3.01)	●	●												
W300 (2.52)			●	●	●	●	●	●						
Pump size.														
29 + 23cc														
33/23cc	●	●												
36/26cc			●	●										
41/26cc					●	●	●	●						
41/29cc														
74cc variable														
Fan Ratio.														
1 to 0.85	●													
1 to 1.06		●	●		●		●							
1 to 1.16				●		●		●						
Air Conditioning														
None	●		●		●		●							
Europe		●	●		●		●							
R.O.W.				●		●		●						

**Engine Stall Speed Combinations - All wheel steer (AWS) machines, Low emission 1000 series engine**

**Note.** On all double pump options the test is to be carried out with single pump option selected.

	3CX Super Std. Lft	3CX Super Std. Lft	3CX Super Hi. Lft	3CX Super Hi. Lft	4CX	4CX	4CX Super 4C	4CX Super 4C	4CX Super 4CX	4CX Super 4CX				
<b>Engine Speed @ Stall Combination</b>														
1.Convertor only.														
Max.r.p.m.	2150	2140	2140	2130	2190	2190	2200	2190	2235	2230				
Min.r.p.m.	2045	2035	2035	2025	2100	2090	2095	2090	2140	2130				
2.Convertor + M.R.V.														
Max.r.p.m.	1805	1800	1745	1735	1835	1825	1825	1820	N/A	N/A				
Min.r.p.m.	1665	1655	1590	1585	1700	1690	1685	1685	N/A	N/A				
<b>Build specification.</b>														
Engine size.														
N.A. (75hp) (56kw)														
T2 (92hp) (69kw)	●	●	●	●										
T3 (100hp) (75kw)					●	●	●	●	●	●				
Convertor type.														
W300 (3.01)														
W300 (2.52)	●	●	●	●	●	●	●	●	●	●				
Pump size.														
29 + 23cc														
33/23cc														
36/26cc	●	●												
41/26cc			●	●	●	●								
41/29cc							●	●						
74cc variable									●	●				
Fan Ratio.														
1 to 0.85														
1 to 1.06	●		●		●		●		●					
1 to 1.16		●		●		●		●		●				
Air Conditioning														
None	●		●		●		●		●					
Europe	●		●		●		●		●					
R.O.W.		●		●		●		●		●				

Engine Stall Speed Combinations - Two wheel steer (2WS) machines, Low emission 1000 series engine, (North America)

**Note.** On all double pump options the test is to be carried out with single pump option selected.

	214E	214e	214	214	215E 214T	215E 214T	214T	215 217						
<b>Engine Speed @ Stall Combination</b>														
1.Convertor only.														
Max.r.p.m.	2130	2130	2160	2140	2270	2270	2190	2190						
Min.r.p.m.	2020	2020	2060	2025	2170	2160	2090	2090						
2.Convertor + M.R.V.														
Max.r.p.m.	1330	1330	1700	1685	1870	1865	1825	1820						
Min.r.p.m.	970	970	1550	1520	1720	1715	1690	1685						
<b>Build specification.</b>														
Engine size.														
N.A. (75hp) (56kw)	●	●	●	●		●								
T2 (92hp) (69kw)					●	●								
T3 (100hp) (75kw)							●	●						
Convertor type.														
W300 (3.01)	●	●	●	●	●	●								
W300 (2.52)							●	●						
Pump size.														
29 + 23cc	●	●												
33/23cc			●	●										
36/26cc														
41/26cc					●	●	●							
41/29cc								●						
74cc variable														
Fan Ratio.														
1 to 0.85	●	●	●											
1 to 1.06					●									
1 to 1.16				●		●	●	●						
Air Conditioning														
None	●	●	●		●		●	●						
Air Con.				●		●	●	●						

## Engine Stall Speed Combinations - All wheel steer (AWS) machines, Low emission 1000 series engine, (North America)

**Note.** On all double pump options the test is to be carried out with single pump option selected.

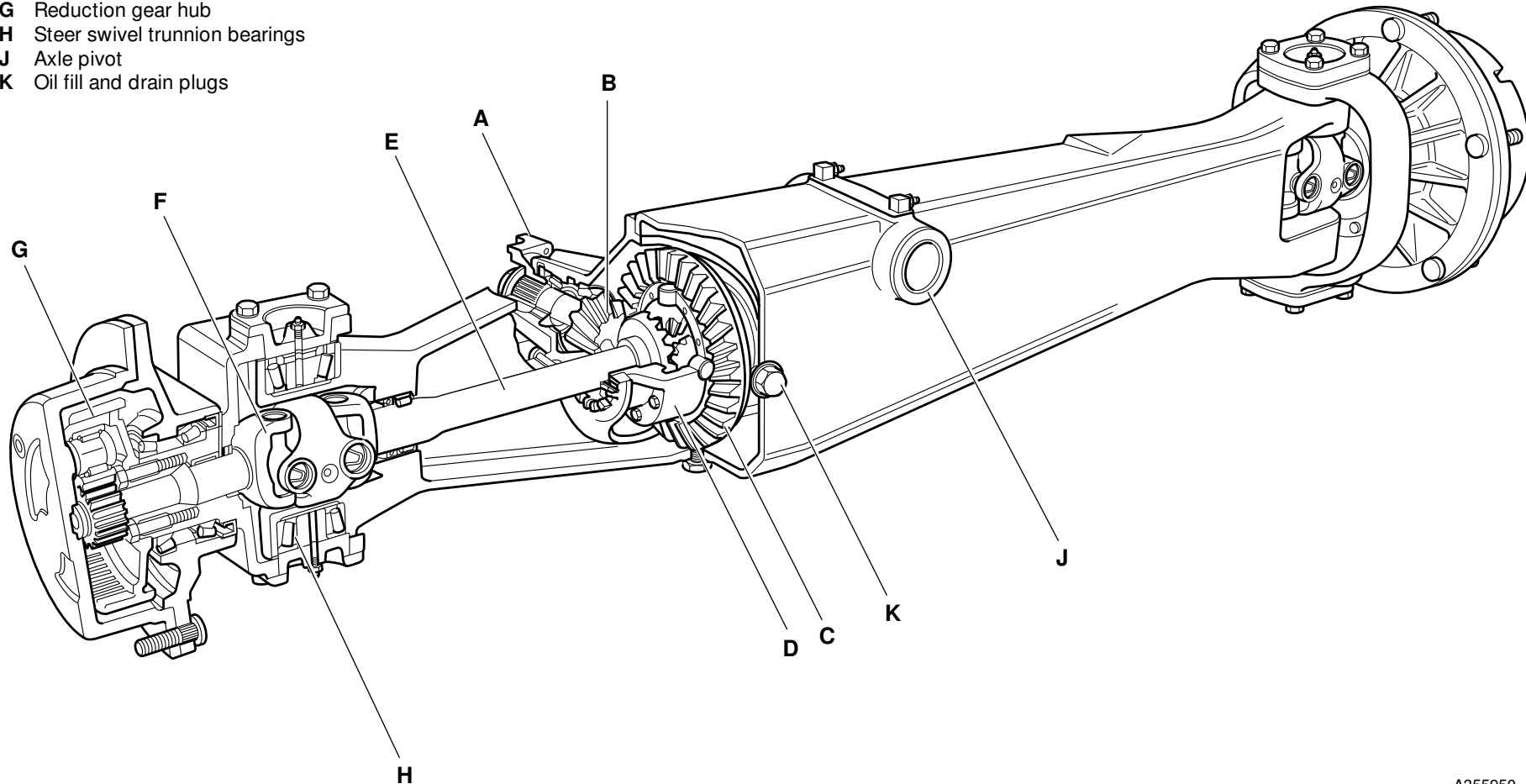
	214S	215S 217S										
<b>Engine Speed @ Stall Combination</b>												
1.Convertor only.												
Max.r.p.m.	2190	2190										
Min.r.p.m.	2090	2090										
2.Convertor + M.R.V.												
Max.r.p.m.	1825	1820										
Min.r.p.m.	1690	1685										
<b>Build specification.</b>												
Engine size.												
N.A. (75hp) (56kw)												
T2 (92hp) (69kw)												
T3 (100hp) (75kw)	●	●										
Convertor type.												
W300 (3.01)												
W300 (2.52)	●	●										
Pump size.												
29 + 23cc												
33/23cc												
36/26cc												
41/26cc	●											
41/29cc		●										
74cc variable												
Fan Ratio.												
1 to 0.85												
1 to 1.06												
1 to 1.16	●	●										
Air Conditioning												
None	●	●										
Air Con.	●	●										

## Front Axle - Steer Drive Type SD55, SD70

### Component Identification

The illustration shows a typical steer drive front axle.

- A Yoke connection to propshaft
- B Pinion
- C Crownwheel
- D Differential unit
- E Drive shaft
- F Universal coupling
- G Reduction gear hub
- H Steer swivel trunnion bearings
- J Axle pivot
- K Oil fill and drain plugs



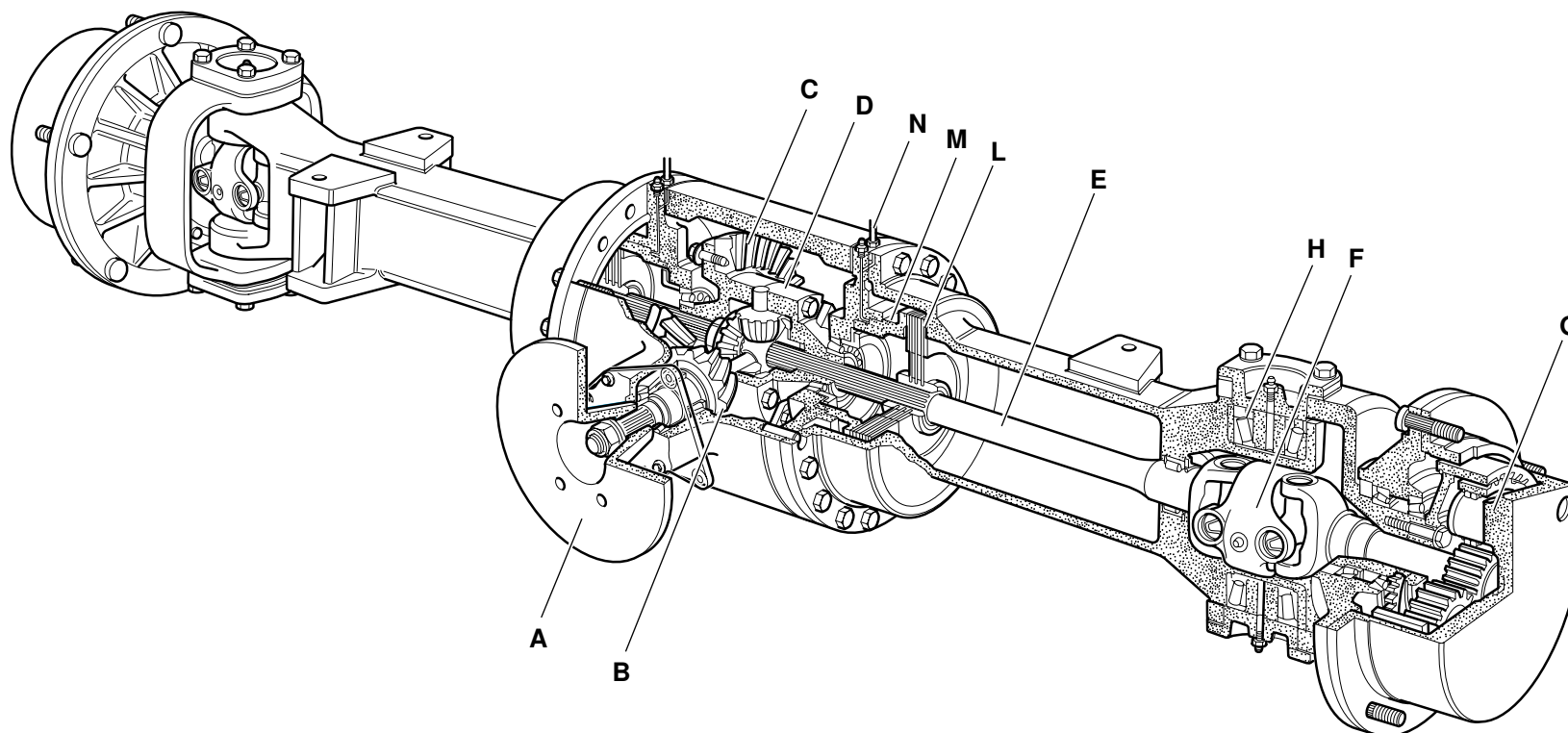


## Rear Axle - Steer Drive Type SD80

### Component Identification

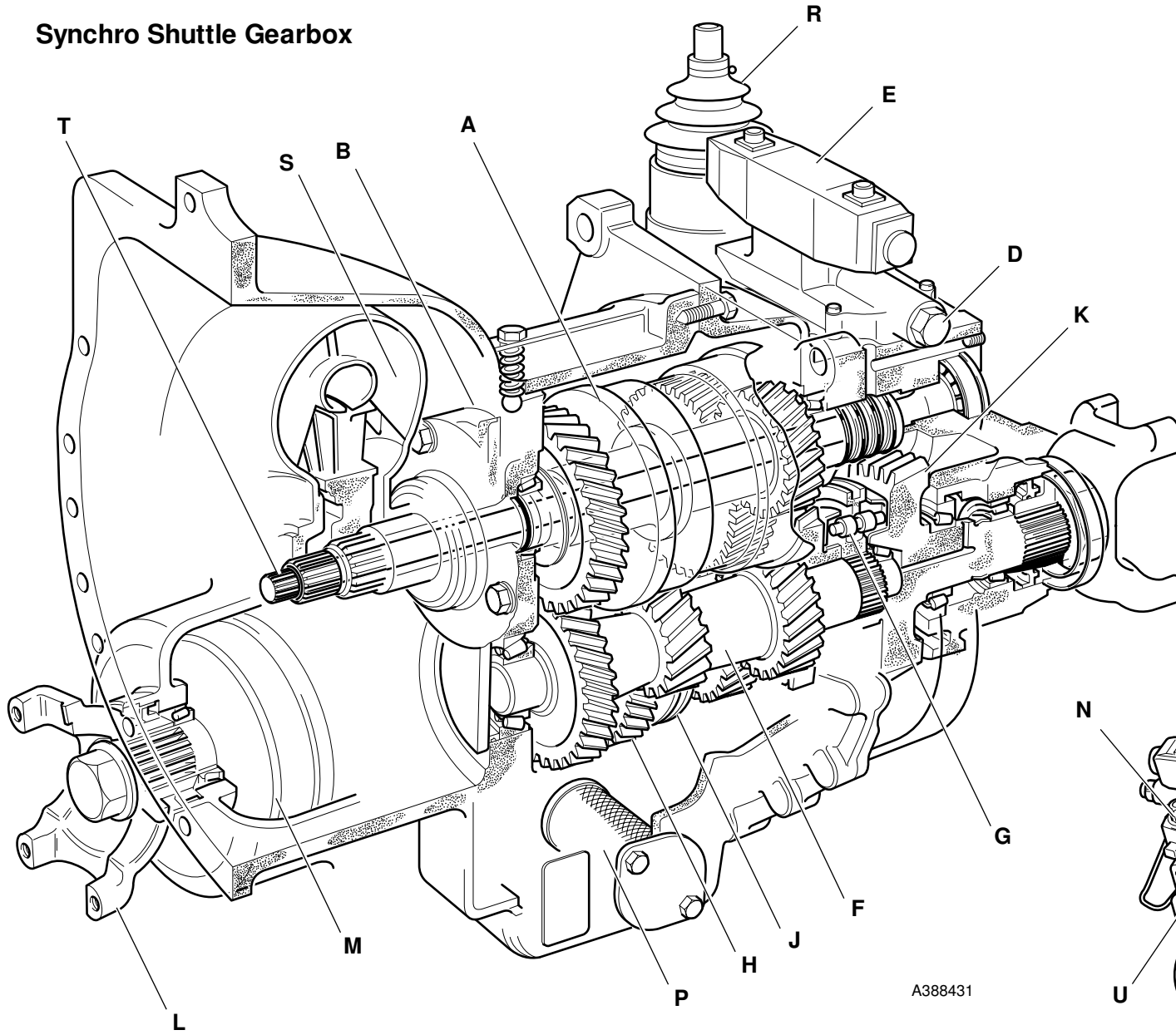
The illustration shows a typical steer drive rear axle. 2WS machines are fitted with non steer axles (PD70). These axles are similar to the axle shown but do not feature steer swivels or drive shaft universal joints.

- A** Park brake disc. The disc is fitted to the pinion instead of a yoke. The propshaft is bolted to the centre of the disc. The axle casing also carries a bracket for location of the park brake caliper.
- B** Pinion
- C** Crownwheel
- D** Differential unit
- Note:** Items A, B, C, and D form the 'drive head' part of the axle.
- E** Drive shaft
- F** Universal coupling
- G** Reduction gear hub
- H** Steer swivel trunnion bearings
- L** In-board oil immersed multi-plate disc brakes
- M** Brake actuating piston
- N** Hydraulic brake lines

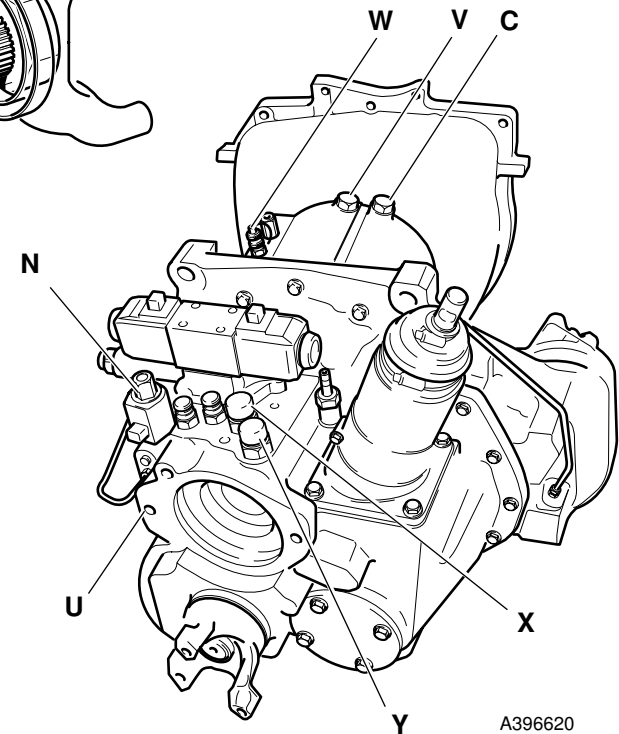
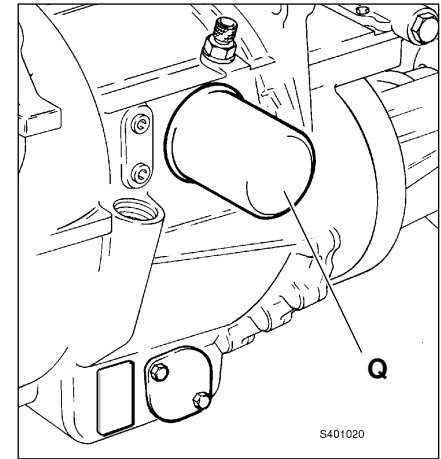


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### Synchro Shuttle Gearbox



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## Synchro Shuttle Gearbox

### Component Identification

- A** Forward/reverse clutch unit
- B** Transmission oil pump
- C** Torque converter pressure regulating valve
- D** Oil pressure maintenance valve
- E** Solenoid control valve
- F** Mainshaft
- G** Synchromesh unit - 3rd/4th gears
- H** Layshaft
- J** Synchromesh unit - 1st/2nd gears
- K** Transfer gear, output shaft and yoke
- L** 4WD output yoke (if fitted)
- M** 2/4WD clutch unit (if fitted)
- N** 4WD solenoid control valve (if fitted)
- P** Oil strainer
- Q** Oil filter
- R** Gear selection turret assembly
- S** Torque Converter
- T** Driveshaft (drives machine main hydraulic pump)
- U** Hydraulic pump mounting face
- V** Torque converter relief valve
- W** Oil pressure switch
- X** Hose connection - to cooler
- Y** Hose connection - from cooler
- Z** Gearbox oil cooler

### Principle of Operation

This illustration shows a typical JCB Synchro Shuttle which consists of a torque converter, hydraulic reverser unit, and integral manual 4-speed gearbox.

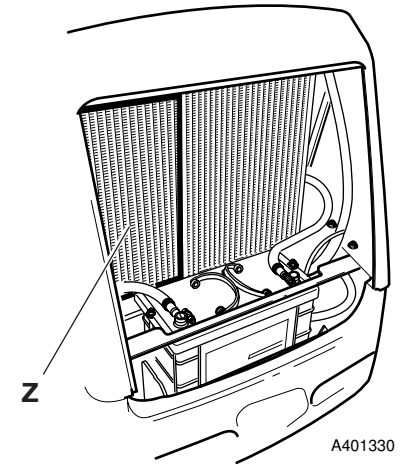
The reverser unit **A** has a pair of hydraulically operated clutches giving forward - neutral - reverse drive. Oil pressure is provided by a crescent type pump **B** driven at engine speed by the drive lugs of the torque converter. The oil pressure is controlled by maintenance valve **D**, and clutch selection is achieved by means of an electric solenoid valve **E**.

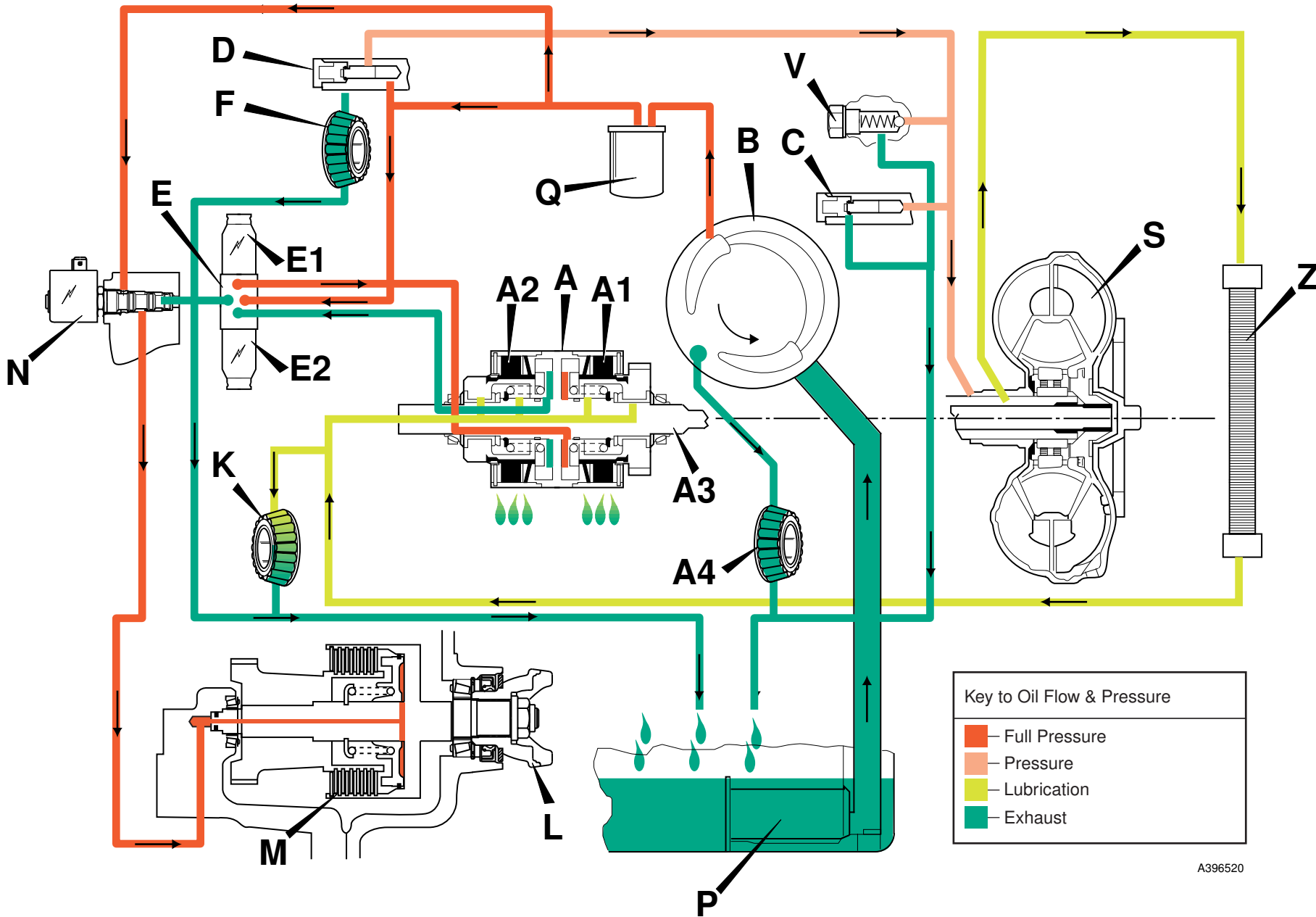
Drive is transferred from the reverser unit by helical gears to the mainshaft **F**, which carries the 3rd/4th synchromesh unit **G**, and to the layshaft **H**, which carries the 1st/2nd synchromesh unit **J**. Synchromesh unit **G** is of the 'Blocking Pin' type, a full description of which is given in this section. Synchromesh unit **J** features rings and cones with a sliding sleeve.

Drive is transmitted finally via the output shaft **K** to the rear axle. If 4 wheel drive is selected, the front wheels are also driven via 4 wheel drive output yoke **L**.

Driveshaft **T** is permanently driven by the engine and runs through the hollow forward/reverse unit shaft to the back of the gearbox. The shaft (**T**) drives the gearbox mounted machine main hydraulic pump.

Gearbox oil is cooled by an air blast cooler **Z**. The cooler is part of the front mounted machine 'cooling pack'.





Key to Oil Flow & Pressure	
Red	Full Pressure
Orange	Pressure
Yellow	Lubrication
Green	Exhaust

A396520

## Synchro Shuttle Gearbox

### Hydraulic and Electrical Operation

Oil from the pump **B** is fed through an internal passage via the filter to the pressure maintenance valve **D**, which maintains pressure to the solenoid valve **E** for clutch selection. Excess oil from the maintenance valve flows back through the casing to the torque converter **S**. Oil enters the converter between the converter hub and the stator support, and leaves between the stator and the input shaft. Pressure in the converter is controlled by a regulating valve **C** which dumps oil from the converter line back to the sump.

Torque converter relief valve **V** acts as a safety valve should the system pressure suddenly rise above normal, protecting the torque converter from being damaged.

Oil from the torque converter **S** flows out of the transmission to the external oil cooler **Z**, returning at the rear of the transmission unit to pass through the centre of the reverser shaft for clutch lubrication.

Lubrication oil is also provided via a pump drain line to the forward/reverse front shaft bearing **A4**. The drain from pressure maintenance valve **D** also provides lubrication for idler gear bearing **F**.

### Solenoid Valve (E) Operation

Pressurised oil at the solenoid valve **E** is used to control the forward/reverse clutches **A1** and **A2**.

#### Forward:

In the diagram, electrical solenoid **E1** is energised by the forward/reverse control lever in the cab. Pressurised oil is diverted to the forward clutch **A1** and forward is selected. A restrictor orifice in the feed to the solenoid valve modulates the pressure to the clutch to smooth engagement. At the same time oil from reverse clutch **A2** is diverted back to the sump via solenoid valve **E**.

#### Reverse:

When the reverse is selected electrical solenoid **E2** is energised and pressurised oil is diverted to the reverse clutch **A2**. At the same time oil from clutch **A1** is diverted back to the sump

#### Neutral:

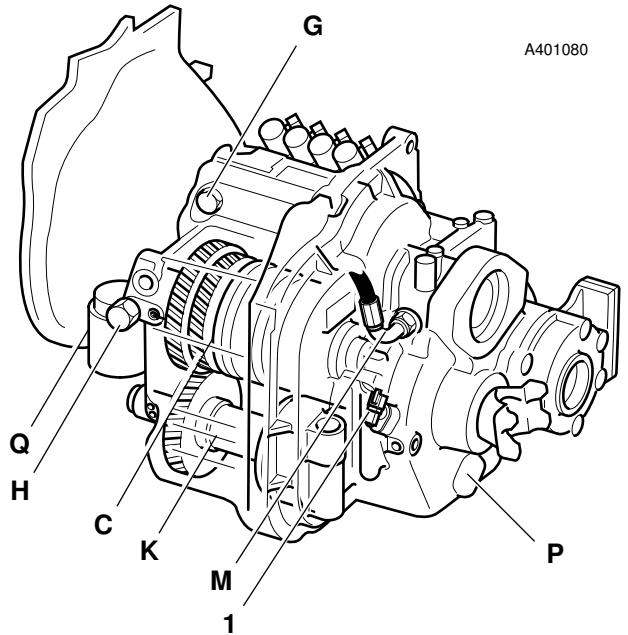
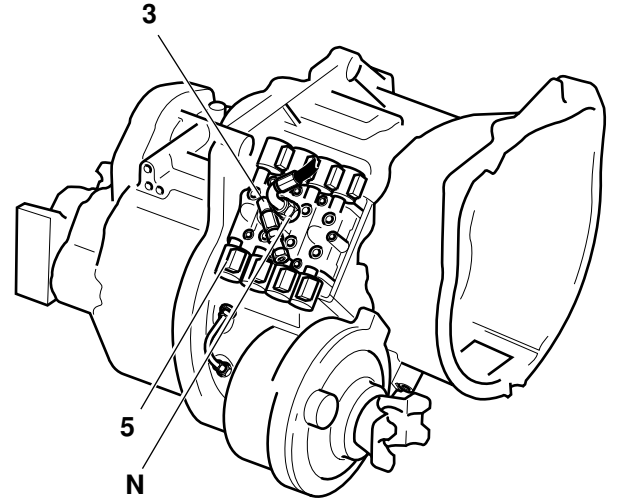
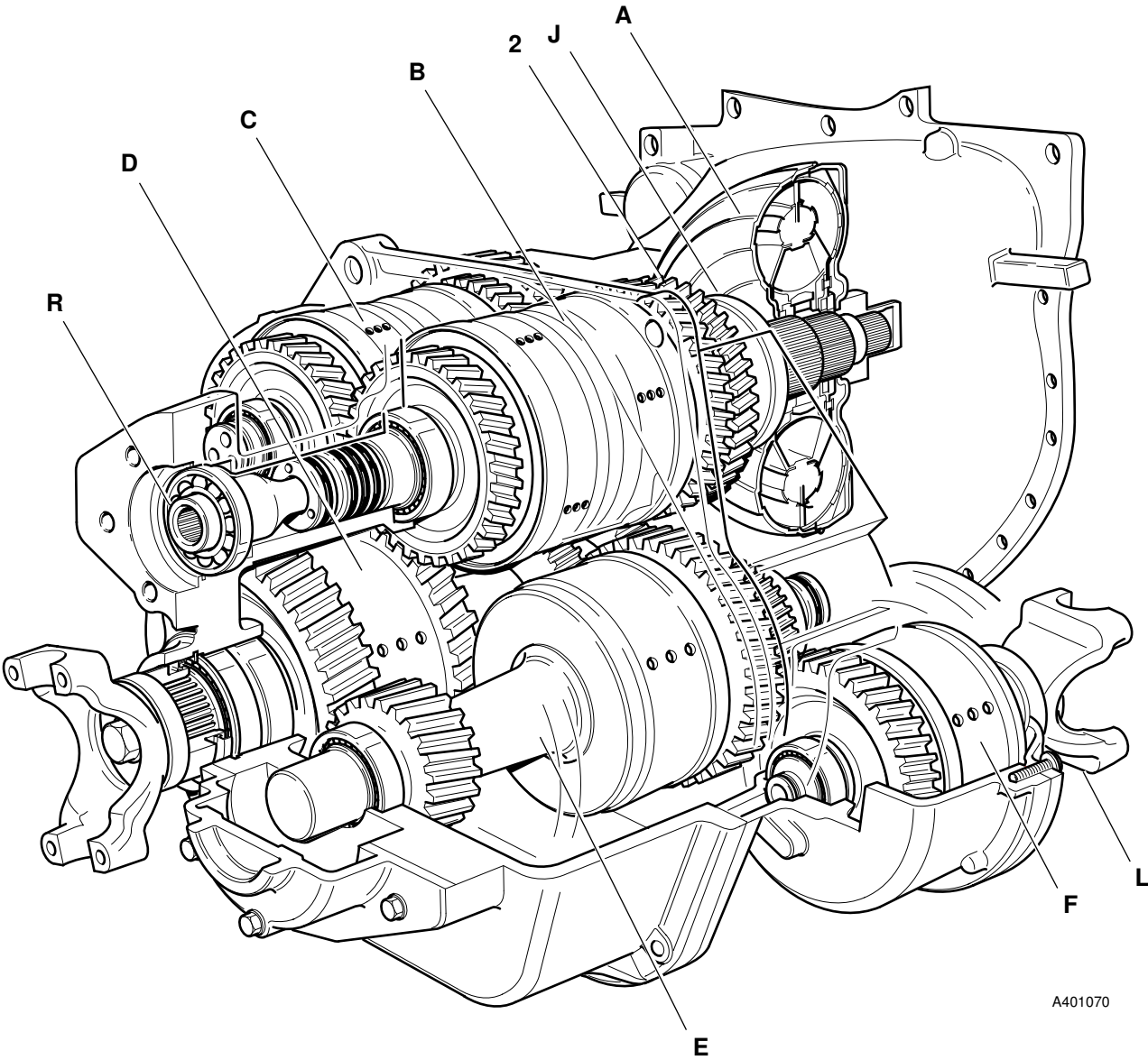
When neutral is selected (via the control lever or the transmission dump button), the flow of the pressurised oil is blocked at the solenoid valve. No solenoids are energised and no clutches engaged.

For a further detailed description refer to **Forward/Reverse Clutch - Operation**.

The 2/4WD unit **M** is controlled by solenoid valve **N**. For a full description of 2/4 wheel drive clutch operation refer to **2/4WD Clutch Operation**.

### Key

- A** Forward/reverse clutch unit
- A1** Forward clutch
- A2** Reverse clutch
- A3** Forward/reverse front shaft
- A4** Forward/reverse front shaft bearing
- B** Transmission oil pump
- C** Torque converter pressure regulating valve
- D** Oil pressure maintenance valve
- E** Solenoid control valve
- F** Idler gear bearing
- K** Output shaft bearing
- L** 4WD output yoke (if fitted)
- M** 2/4WD clutch unit (if fitted)
- N** 4WD solenoid control valve (if fitted)
- P** Oil strainer
- Q** Oil filter
- S** Torque Converter
- V** Torque converter relief valve
- Z** Oil Cooler



## Powershift Gearbox

### Component Identification

- A** Torque converter
- B** Forward/input clutch assembly
- C** Reverse clutch assembly
- D** Mainshaft assembly
- E** Layshaft assembly
- F** 2/4 wheel drive clutch assembly
- G** Torque converter relief valve
- H** Oil pressure maintenance valve
- J** Transmission oil pump
- K** 6 speed assembly (if fitted)
- L** 4WD output yoke
- M** Hose connection - to oil cooler
- N** Hose connection - from oil cooler
- P** Oil strainer
- Q** Oil filter
- R** Driveshaft (drives machine main hydraulic pump)

- 1** Speed sensor
- 2** Gear drive to reverse unit clutch assembly
- 3** Transmission oil pressure switch
- 4** Steering column mounted gear selection switch
- 5** Solenoid control valves
- 6** Gearbox oil cooler

### Principle of Operation

The JCB Powershift is an electro-hydraulic transmission unit. Gear shifting and direction selection are controlled using multi-disc clutch packs.

Electrically operated solenoid valves **5** divert pressurised oil (provided by pump **J**) to the selected clutch packs.

A combined lever/swivel switch **4** on the steering column actuates both gear ratio and direction solenoids.

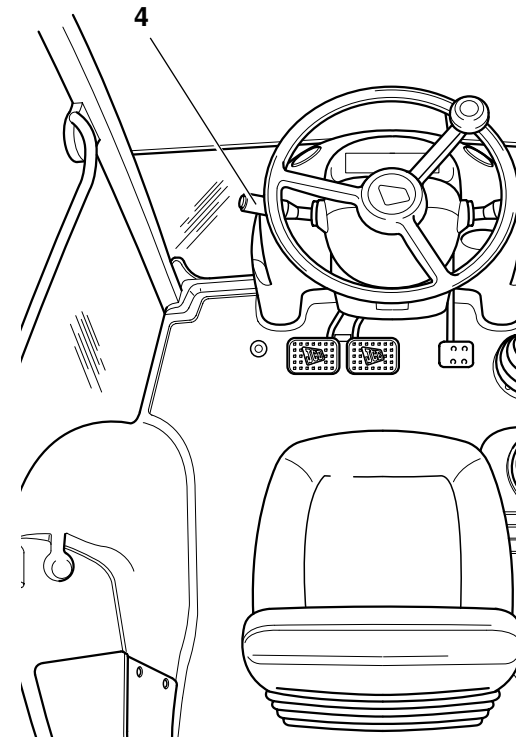
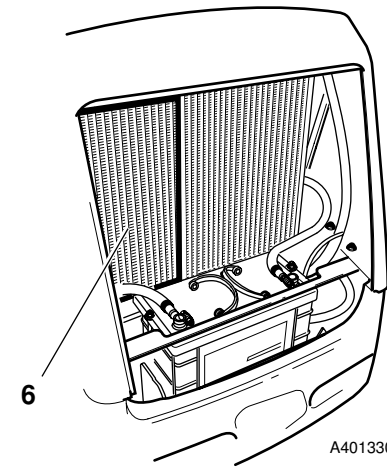
The Powershift unit consists of a torque converter **A**, forward clutch assembly **B**, reverse clutch assembly **C**, layshaft assembly **E**, mainshaft assembly **D**, 2/4 wheel drive clutch assembly **F**. 6 speed gearboxes incorporate a '6 speed' shaft and clutch assembly **K**.

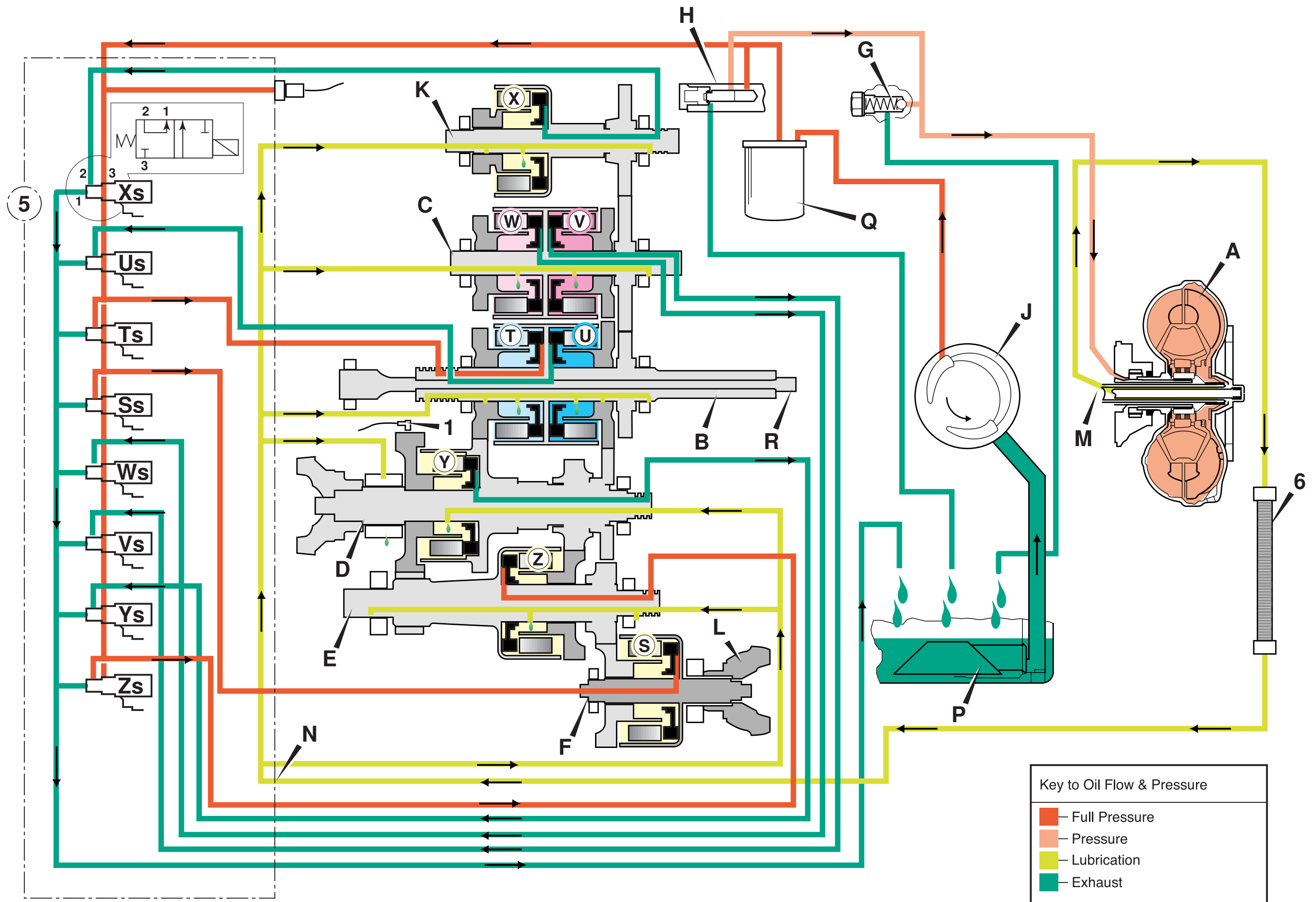
The forward clutch assembly **B** is driven by the torque converter **A**. The reverse clutch assembly **C** is permanently driven via constant meshing of spur gears **2**. On 6 speed gearboxes the 6 speed assembly is also driven via meshing gears **2**.

Driveshaft **R** is permanently driven by the engine and runs through the hollow forward/reverse unit shaft to the back of the gearbox. The shaft (**R**) drives the gearbox mounted machine main hydraulic pump.

Strainer **P** and filter **Q** are used to prevent potential system contamination by filtering dirt particles.

Gearbox oil is cooled by an air blast cooler **6**. The cooler is part of the front mounted machine 'cooling pack'.







## Powershift Gearbox

### Hydraulic and Electrical Operation

Oil pump **J** is directly driven by the engine via the torque converter.

Oil from the pump **J** is fed through an internal passage via the filter **Q** to the pressure maintenance valve **H**, which maintains pressure to the solenoid valve block for clutch selection. Excess oil from the maintenance valve flows back through the casing to the torque converter **A**. Pressure in the converter is controlled by a relief valve **G** which dumps oil from the converter line back to the sump.

Oil from the torque converter **A** flows out of the gearbox at position **M** to the external oil cooler **6**, returning to the solenoid valve manifold block **5** at position **N**. The oil then flows through internal oilways providing lubrication for clutches and bearings before returning to the gearbox sump.

The torque converter **A** is a fluid coupling bolted to a drive plate which in turn is bolted to the engine flywheel. As the engine starts to rotate, the converter gives smooth power take off gradually increasing the torque transmitted. This torque is transferred from the converter assembly to the clutch/gear assemblies via input shaft on the forward clutch assembly **B**.

Forward clutch assembly **B** contains two hydraulically operated clutches; one clutch (**T**) provides a forward low ratio drive and the other (**U**) a forward high ratio drive. Each clutch is controlled by a 2-position solenoid valve. When the applicable solenoid is energised, pressurised oil is directed to either the forward low (solenoid **Ts**) or forward high (solenoid **Us**) clutch.

The reverse clutch assembly **C** is similar to the forward clutch assembly. It contains two hydraulically operated clutches; one clutch (**W**) provides a reverse low ratio drive and the other (**V**) a reverse high ratio drive. 2-position solenoid valves when energised, direct pressurised oil to either the reverse low (solenoid **Ws**), or reverse high (solenoid **Vs**) clutch.

Both the mainshaft and the layshaft assemblies have a single clutch each. Solenoid valve **Zs**, when energised, directs pressurised oil to the layshaft clutch **Z**. Solenoid valve **Ys**, when energised, directs pressurised oil to the mainshaft clutch **Y**.

On 6 speed gearboxes, the 6 speed clutch **X** is controlled via solenoid valve **Xs**.

**Note:** The 6 speed clutch assembly is so called as it is fitted to 6 speed, and not 4 speed gearboxes. However, the clutch is NOT engaged when 6th gear is selected. See the adjacent table.

**Note:** All the clutches work on the same principle. For a full description of operation see **Systems Description**.

The 2/4 wheel drive unit **F** also has a single clutch **S**. When 4WD is selected, pressurised oil is directed via solenoid valve **Ss** to the 4WD clutch. When 2WD is selected a connection from the clutch to the transmission sump is made. For a full description of 2/4 wheel drive clutch operation see **Systems Description, 2/4WD Clutch Operation**

When a gear is selected via the control switch in the cab, 2 clutches are always engaged. By selecting different pairs of clutches different gear ratios are engaged. On 4 speed gearboxes the solenoids are electrically controlled using relays. On 6 speed gearboxes the solenoids are controlled by an electronic control unit (ECU) mounted in the cab. Speed sensor **1** is used to enable the gear selection to be managed automatically as required.

#### Example - 2nd gear forward 4WD (6 speed gearbox)

In the schematic, the gearbox is shown with 2nd gear forward engaged. 2nd gear forward requires the forward low clutch **T** and layshaft clutch **Z** to be engaged. When the gear selection switch is moved to 2nd gear forward, the electrical control system energises solenoid valves **Ts** and **Zs**. Pressurised oil is diverted to the back of pistons in both clutches to engage the drive. At the same time all other solenoids are de-energised, diverting oil from the back of the other clutch pistons to the gearbox sump. 4WD clutch **S** is also energised to give 4 wheel drive.

The tables show which clutches and solenoids are engaged for each gear selection.

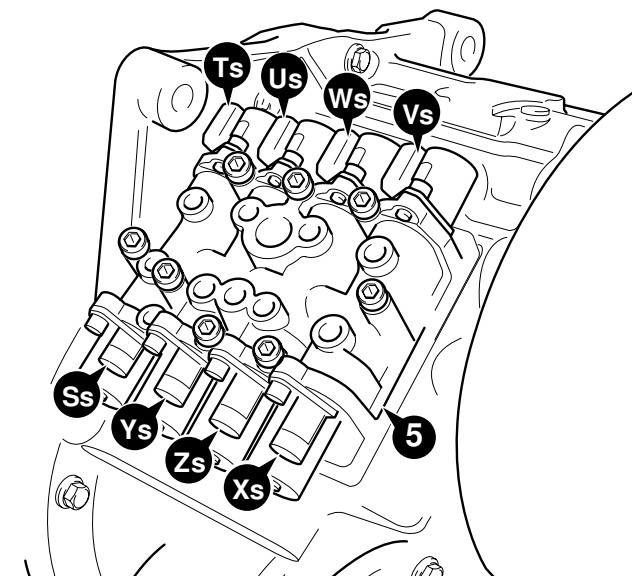
**Note:** Solenoid valve **Xs** controls clutch **X**, solenoid valve **Zs** controls clutch **Z** and so on.

4 Speed Powershift		
Gear	Clutches engaged	
	Forward	Reverse
1st	T,Z	W,Z
2nd	U,Z	V,Z
3rd	T,Y	W,Y
4th	U,Y	V,Y

6 Speed Powershift		
Gear	Clutches engaged	
	Forward	Reverse
1st	X,Z	W,Z
2nd	T,Z	V,Z
3rd	U,Z	W,Y
4th	X,Y	V,Y
5th	T,Y	-
6th	U,Y	-

### Key

- A** Torque converter
  - B** Forward clutch assembly
  - C** Reverse clutch assembly
  - D** Mainshaft assembly
  - E** Layshaft assembly
  - F** 2/4 wheel drive clutch assembly
  - G** Torque converter relief valve
  - H** Oil pressure maintenance valve
  - J** Transmission oil pump
  - K** 6 speed assembly (if fitted)
  - L** 4WD output yoke
  - M** Hose connection - to oil cooler
  - N** Hose connection - from oil cooler
  - P** Oil strainer
  - Q** Oil filter
  - R** Driveshaft (drives machine main hydraulic pump)
  - S** 2/4WD clutch
  - Ss** 2/4WD clutch solenoid
  - T** Forward low ratio clutch
  - Ts** Forward low ratio clutch solenoid
  - U** Forward high ratio clutch
  - Us** Forward high ratio clutch solenoid
  - V** Reverse high ratio clutch
  - Vs** Reverse high ratio clutch solenoid
  - W** Reverse low ratio clutch
  - Ws** Reverse low ratio clutch solenoid
  - X** 6 speed clutch (6 speed gearbox only)
  - Xs** 6 speed clutch solenoid (6 speed gearbox only)
  - Y** Mainshaft clutch
  - Ys** Mainshaft clutch solenoid
  - Z** Layshaft clutch
  - Zs** Layshaft clutch solenoid
- 
- 1** Speed sensor
  - 5** Solenoid valve manifold block
  - 6** Gearbox oil cooler



## Powershift Gearbox - 6 Speed

### ShiftMaster Operation Characteristics

Central to the system is the ShiftMaster ECU (Electronic Control Unit) **A**. The unit receives 'inputs' from electrical devices such as the gear select switch **B**. Depending on the input signals the ECU 'outputs' energise electrical devices such as gearbox solenoid control valves **C**. For a full description of how the ShiftMaster electrical system works see **Electrical Connections - Powershift Gearbox - 6 Speed**

#### Start up

When the starter switch is set to the ON position the ECU performs a series of self checks. If the checks are valid **three beeps** sound. After the checks the ECU selects neutral even if forward or reverse is selected on the column lever. To select forward or reverse the operator must cycle the lever through neutral.

If the checks fail, **1 or 2 beeps** will sound and the ECU will enter an appropriate limp mode (see **Limp modes**).

#### 'Manual' gear select

The operator can 'manually' select 1st, 2nd and 3rd gears using the column switch. When down shifting (say from 3rd to 2nd) the ECU checks to see if the machine road speed is suitable before down shifting the gearbox. If the road speed is too high a **repeating double beep** is sounded. When the road speed reduces to a pre-set value the ECU down shifts the gearbox and the beeps will stop.

#### Kick down operation

A floor mounted kickdown switch enables the operator to down shift to the next lowest gear. The ECU checks to see if the machine road speed is suitable before down shifting the gearbox. If the road speed is too high a **single double beep** is sounded.

Pressing the kick down switch a second time causes the ECU to select the previous gear.

#### 'Automatic' gear selection

When A (auto) and F (forward) are selected on the column switch, the ECU selects 4th, 5th or 6th gears, mainly according to road speed. The gearbox will automatically up shift and down shift. 2WD†† will also be selected.

To enable up shifts the accelerator pedal must be pressed, this prevents up shifting when coasting down hill for example, thus ensuring maximum machine control.

Note that the ECU does not automatically shift gears in response to engine load.

When A (auto) and R (reverse) are selected the ECU selects 4th gear and 2WD††. There is no automatic gear shifting in reverse.

†† On machines with 4WB (4 wheel brake), if the operator has selected 4WB the ECU will automatically select 4WD (4 wheel drive) when the brake pedal is pressed.

#### Park brake ON

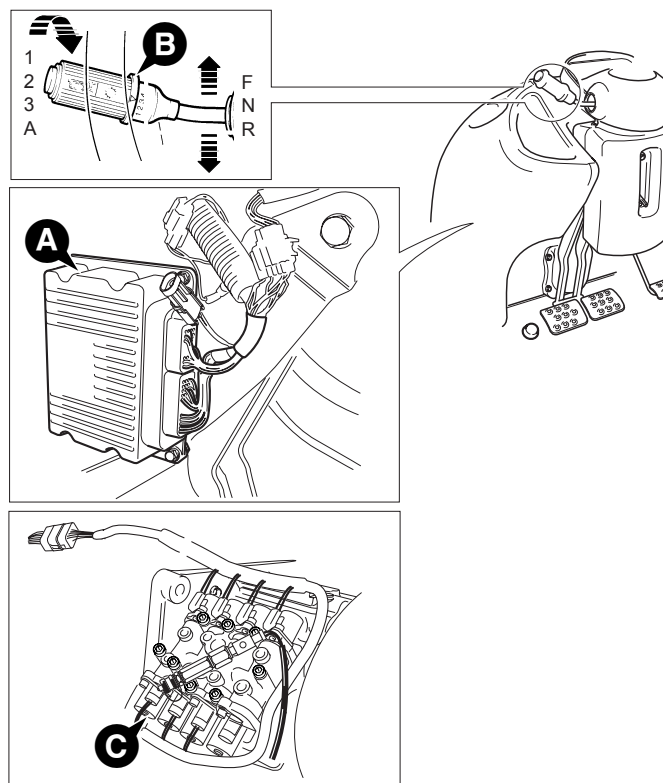
When the park brake is on, the ECU will hold the gearbox in neutral even if forward or reverse are selected. A **continuous tone** is sounded.

#### Transmission dump

When the operator presses the dump switch the ECU selects neutral by de-energising one clutch only. This enables smooth re-engagement of gears when the dump button is released.

#### Limp modes

When necessary the ECU will provide alternative gear selection should faults occur. This enables the machine to be moved ('limped') under its own power. For full details of the limp modes see **Fault Finding - Powershift Gearbox**.



**Powershift Gearbox**

**Drivepaths - 4 Speed**

**1F**

**1st GEAR FORWARD (4 wheel drive)**

Clutches Engaged		Solenoids Energised
T	Forward Low	Ts
Z	Layshaft	Zs
S	2/4 Wheel Drive	Ss

**2F**

**2nd GEAR FORWARD (4 wheel drive)**

Clutches Engaged		Solenoids Energised
U	Forward High	Us
Z	Layshaft	Zs
S	2/4 Wheel Drive	Ss

**3F**

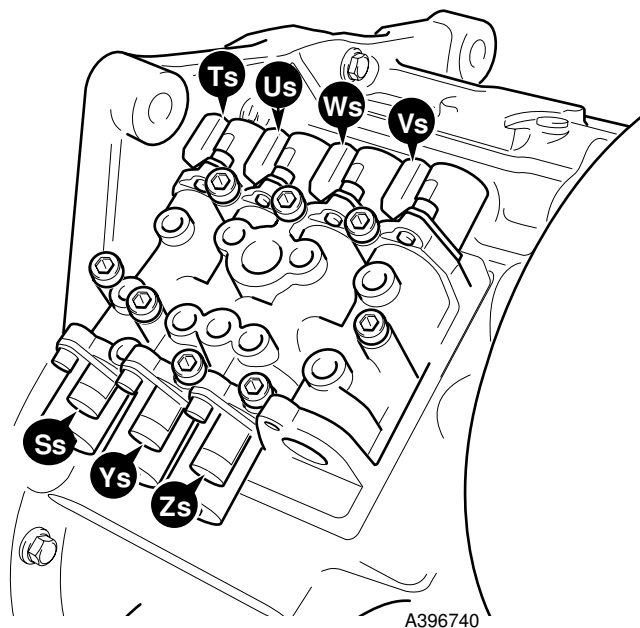
**3rd GEAR FORWARD (4 wheel drive)**

Clutches Engaged		Solenoids Energised
T	Forward Low	Ts
Y	Mainshaft	Ys
S	2/4 Wheel Drive	Ss

**4F**

**4th GEAR FORWARD (4 wheel drive)**

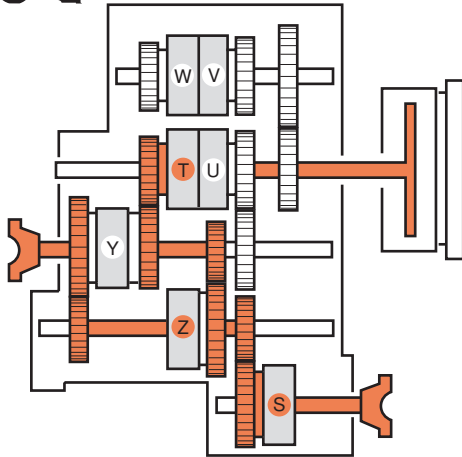
Clutches Engaged		Solenoids Energised
U	Forward High	Us
Y	Mainshaft	Ys
S	2/4 Wheel Drive	Ss



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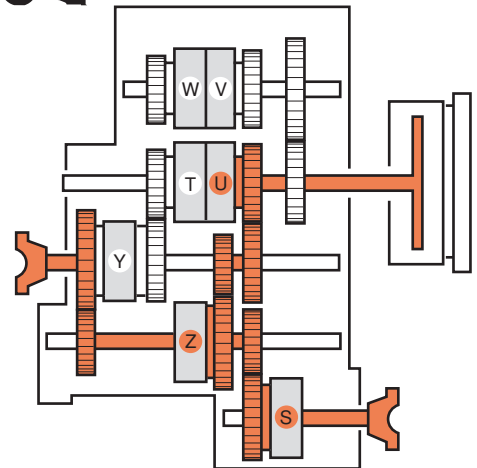
Powershift Gearbox

1F



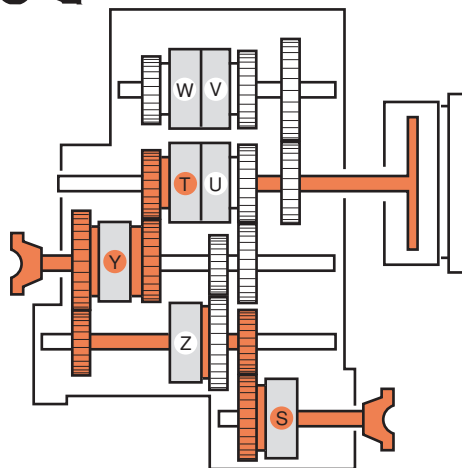
A396660

2F



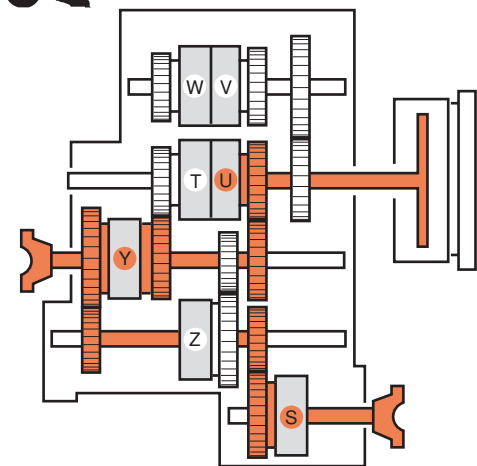
A396670

3F



A396680

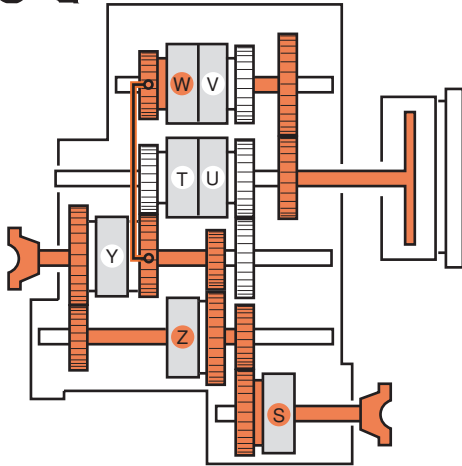
4F



A396690

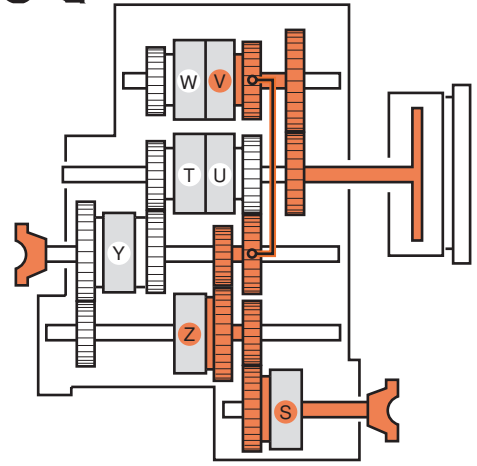
Powershift Gearbox

1R



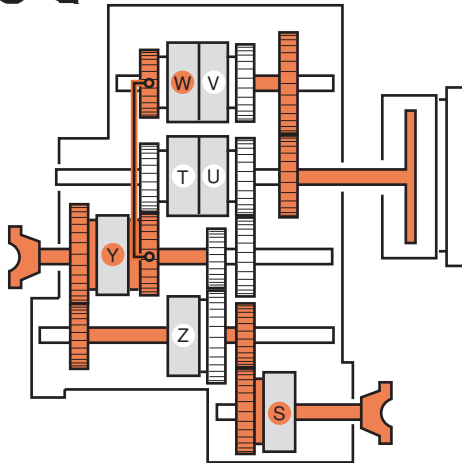
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2R



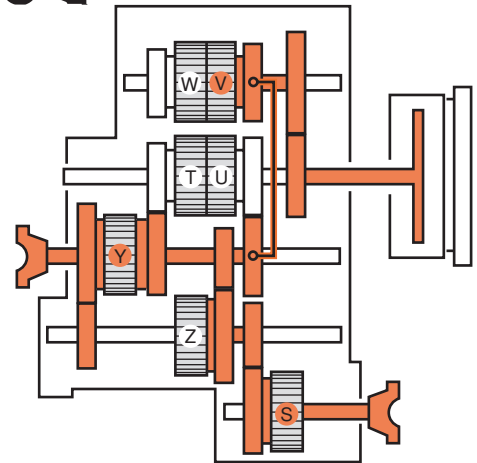
A396710

3R



A396720

4R



A396730

**Powershift Gearbox****Drivepaths - 4 Speed****1R****1st GEAR REVERSE (4 wheel drive)**

Clutches Engaged		Solenoids Energised
W	Reverse Low	Ws
Z	Layshaft	Zs
S	2/4 Wheel Drive	Ss

**2R****2nd GEAR REVERSE (4 wheel drive)**

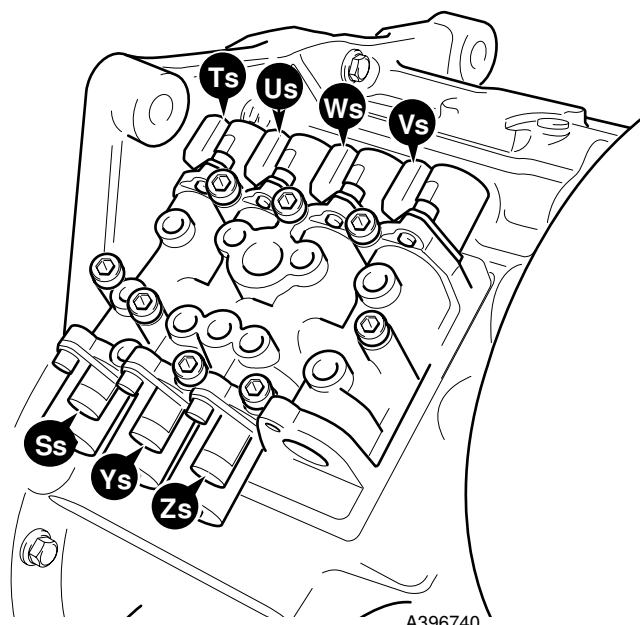
Clutches Engaged		Solenoids Energised
V	Reverse High	Vs
Z	Layshaft	Zs
S	2/4 Wheel Drive	Ss

**3R****3rd GEAR REVERSE (4 wheel drive)**

Clutches Engaged		Solenoids Energised
W	Reverse Low	Ws
Y	Mainshaft	Ys
S	2/4 Wheel Drive	Ss

**4R****4th GEAR REVERSE (4 wheel drive)**

Clutches Engaged		Solenoids Energised
V	Reverse High	Vs
Y	Mainshaft	Ys
S	2/4 Wheel Drive	Ss



**Powershift Gearbox**

**Drivepaths - 6 Speed**

**1F**

**1st GEAR FORWARD (4 wheel drive)**

Clutches Engaged		Solenoids Energised
X	'6 Speed'	Xs
Z	Layshaft	Zs
S	2/4 Wheel Drive	Ss

**2F**

**2nd GEAR FORWARD (4 wheel drive)**

Clutches Engaged		Solenoids Energised
T	Forward Low	Ts
Z	Layshaft	Zs
S	2/4 Wheel Drive	Ss

**3F**

**3rd GEAR FORWARD (4 wheel drive)**

Clutches Engaged		Solenoids Energised
U	Forward High	Us
Z	Layshaft	Zs
S	2/4 Wheel Drive	Ss

**4F**

**4th GEAR FORWARD (4 wheel drive)**

Clutches Engaged		Solenoids Energised
X	'6 Speed'	Xs
Y	Mainshaft	Ys
S	2/4 Wheel Drive	Ss

**5F**

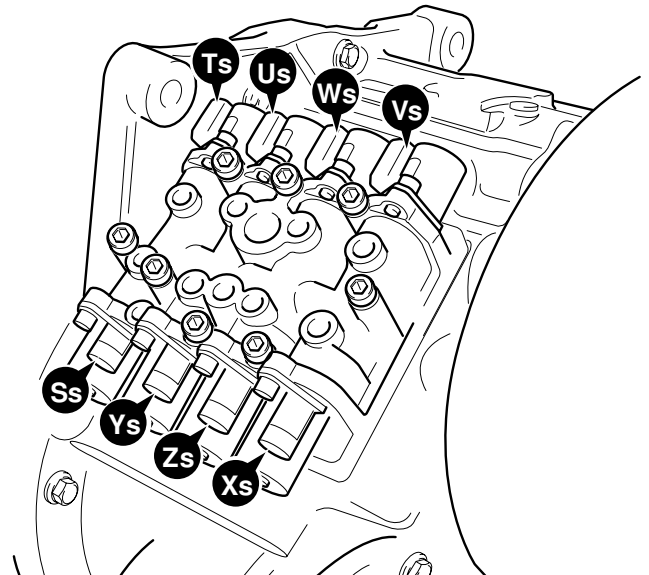
**5th GEAR FORWARD (4 wheel drive)**

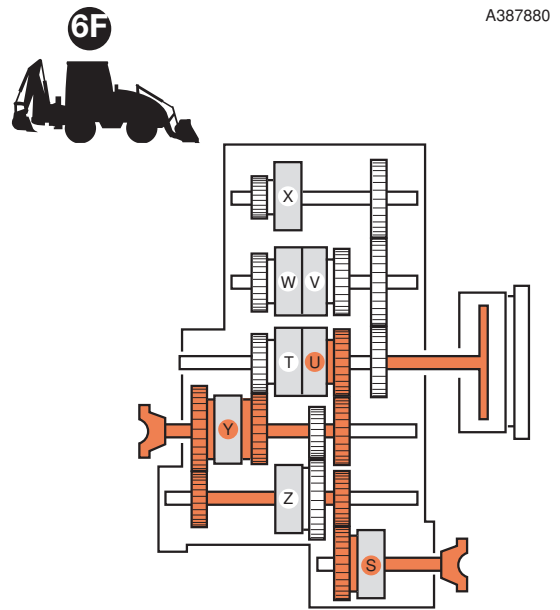
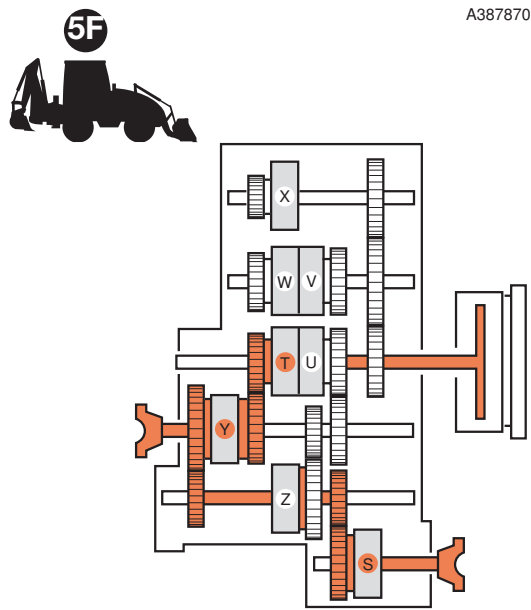
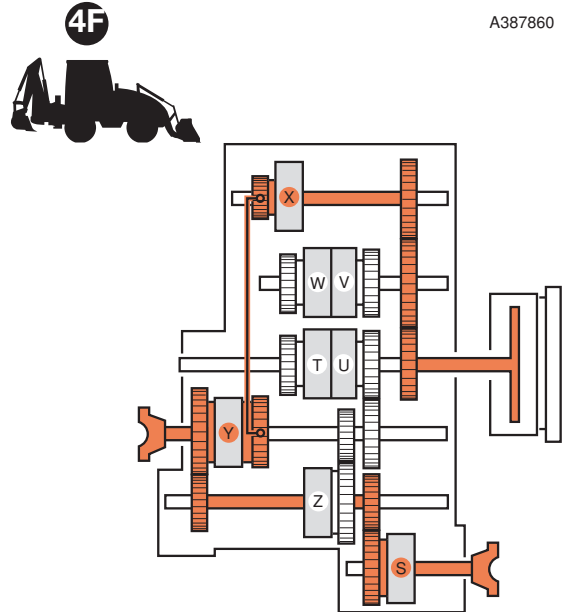
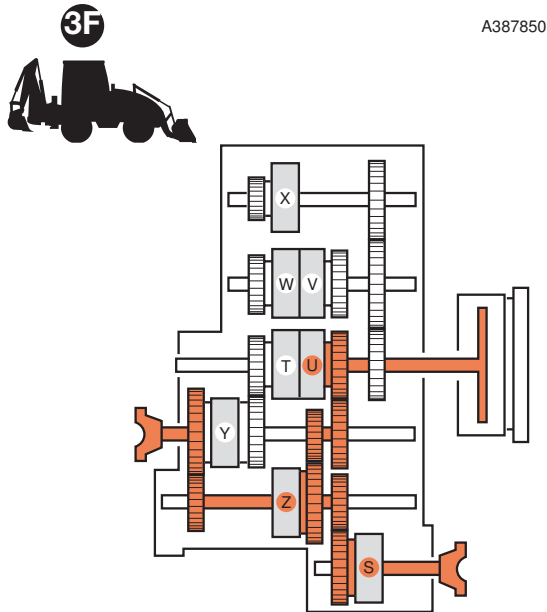
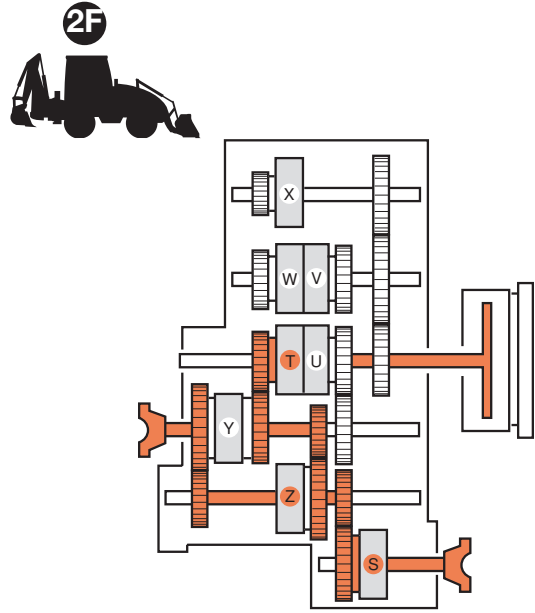
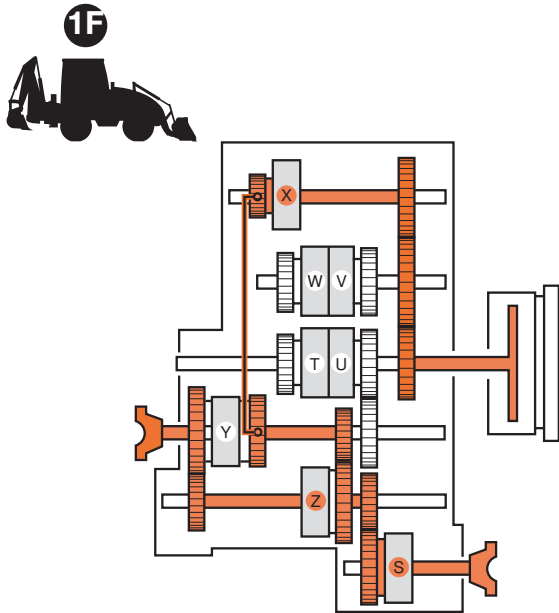
Clutches Engaged		Solenoids Energised
T	Forward Low	Ts
Y	Mainshaft	Ys
S	2/4 Wheel Drive	Ss

**6F**

**6th GEAR FORWARD (4 wheel drive)**

Clutches Engaged		Solenoids Energised
U	Forward High	Us
Y	Mainshaft	Ys
S	2/4 Wheel Drive	Ss





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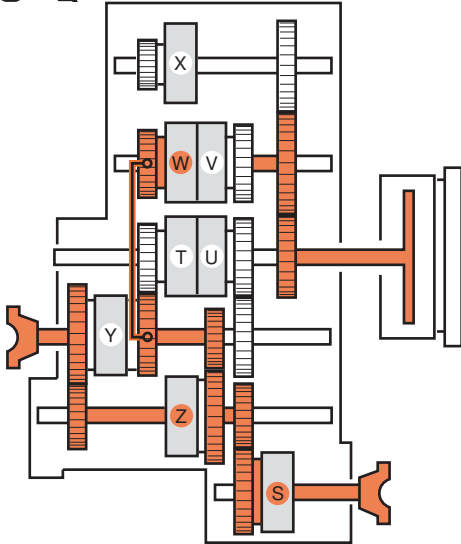
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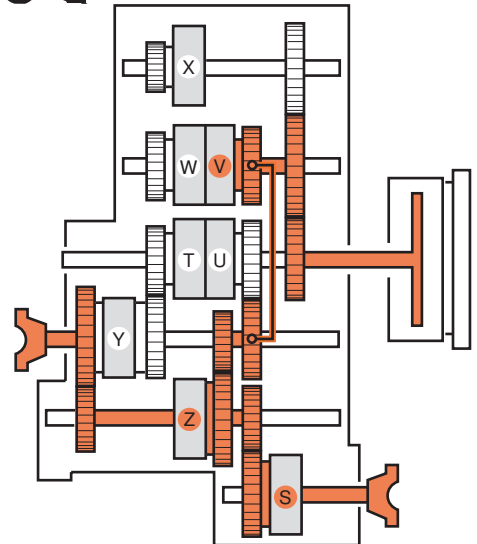
1R



A387910



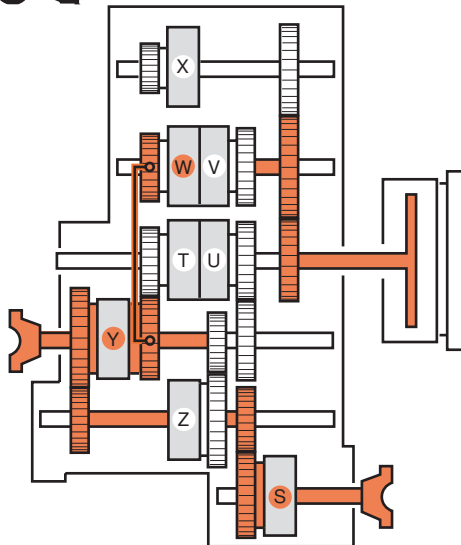
2R



A387920



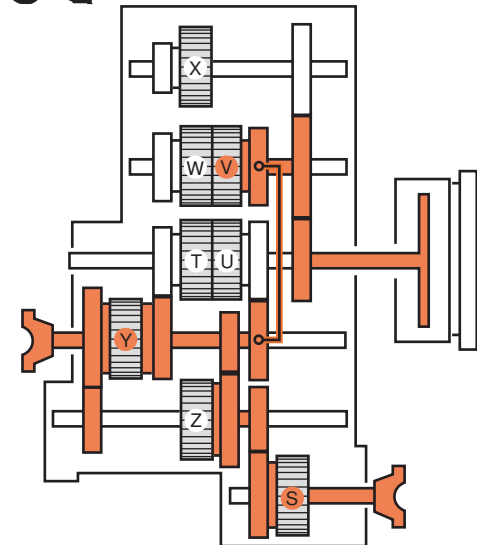
3R



A387930



4R



A387940

**Powershift Gearbox**

**Drivepaths - 6 Speed**

**1R**

**1st GEAR REVERSE (4 wheel drive)**

Clutches Engaged		Solenoids Energised
W	Reverse Low	Ws
Z	Layshaft	Zs
S	2/4 Wheel Drive	Ss

**2R**

**2nd GEAR REVERSE (4 wheel drive)**

Clutches Engaged		Solenoids Energised
V	Reverse High	Vs
Z	Layshaft	Zs
S	2/4 Wheel Drive	Ss

**3R**

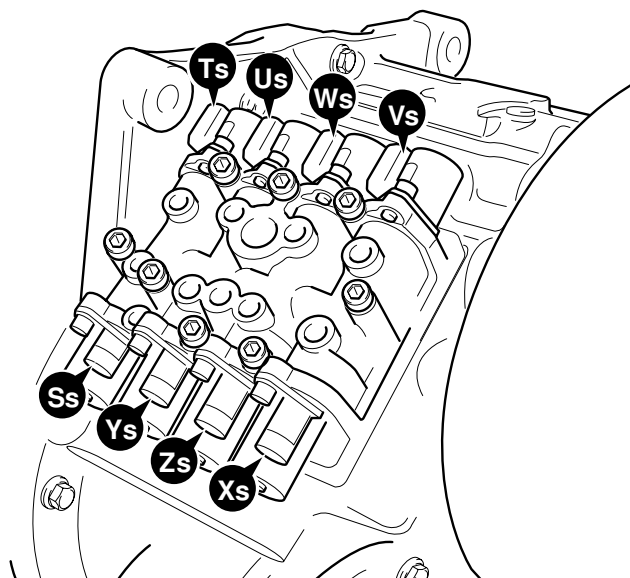
**3rd GEAR REVERSE (4 wheel drive)**

Clutches Engaged		Solenoids Energised
W	Reverse Low	Ws
Y	Mainshaft	Ys
S	2/4 Wheel Drive	Ss

**4R**

**4th GEAR REVERSE (4 wheel drive)**

Clutches Engaged		Solenoids Energised
V	Reverse High	Vs
Y	Mainshaft	Ys
S	2/4 Wheel Drive	Ss



## Torque Converter

### Component Identification

- A** Impeller
- B** Turbine
- C** Reaction member
- D** Drive plate
- E** Engine flywheel
- F** Drive to gearbox input shaft
- G** Spline location for reaction member
- H** Direct drive from the engine to the gearbox oil pump
- J** Direction of oil flow

### Principle of Operation

The torque converter is similar to a fluid coupling, which utilises the centrifugal force exerted in the transmission oil to transmit power from the engine to the gearbox. It multiplies the torque from the engine and functions as a combined clutch and infinitely variable reduction gearbox.

The torque converter is enclosed in a casing and consists of three basic parts, the impeller **A**, reaction member **C**, and turbine **B**.

Impeller **A** is driven by the engine.

Reaction member **C** does not rotate. Its hub engages with a splined tube on the gearbox oil pump and is held stationary.

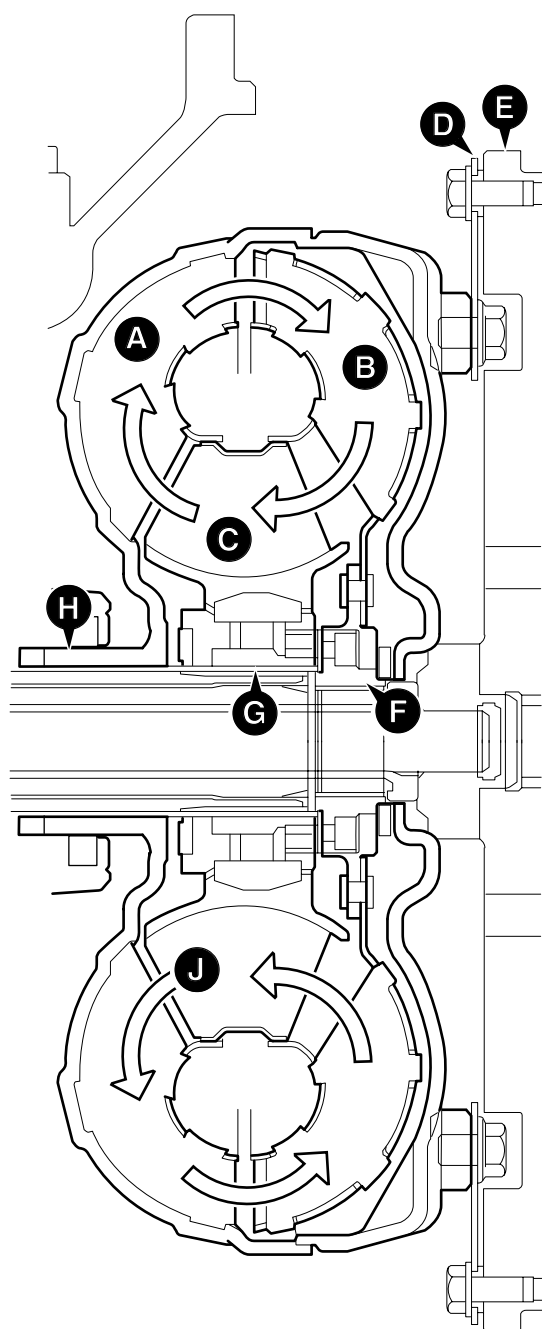
Turbine **B** is engaged with the splined end of the gearbox input shaft.

The impeller **A**, driven by the engine, forms one set of shaped blades, it can be likened to a centrifugal pump imparting energy to the transmission oil. This energy is transferred to another set of shaped blades, which form the turbine **B**. The turbine is connected to the gearbox and converts the energy back to a mechanical torque.

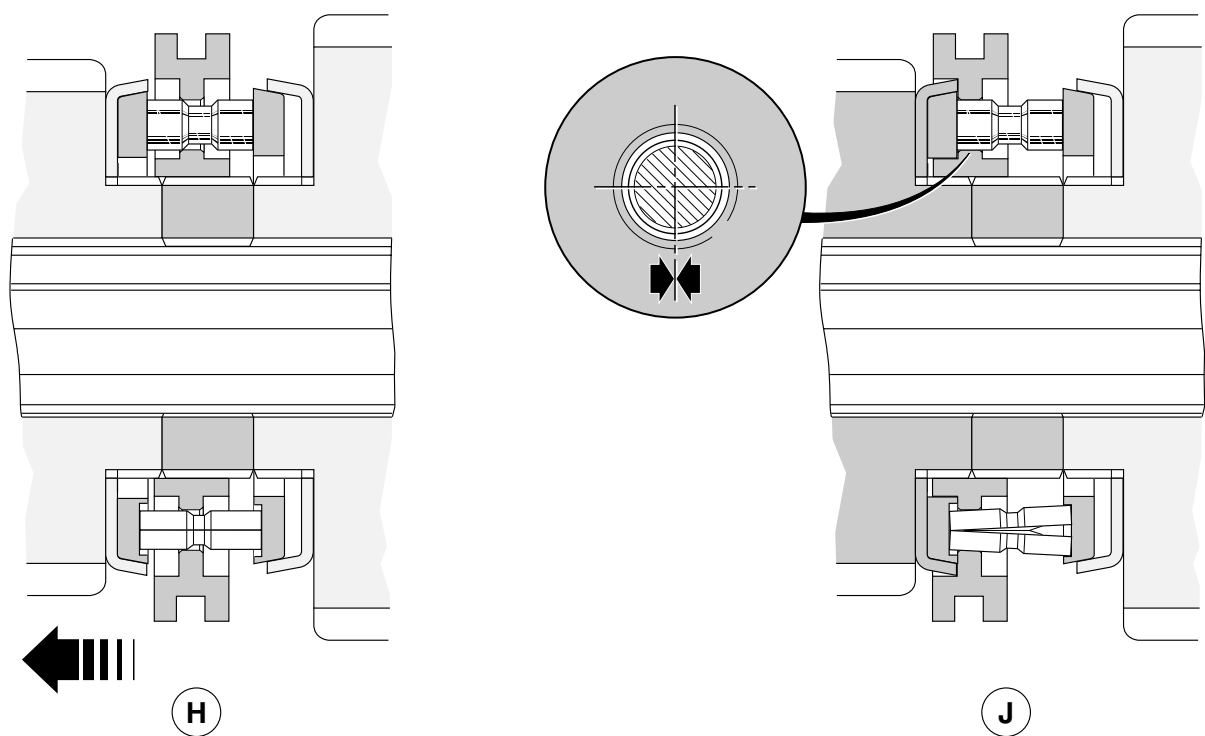
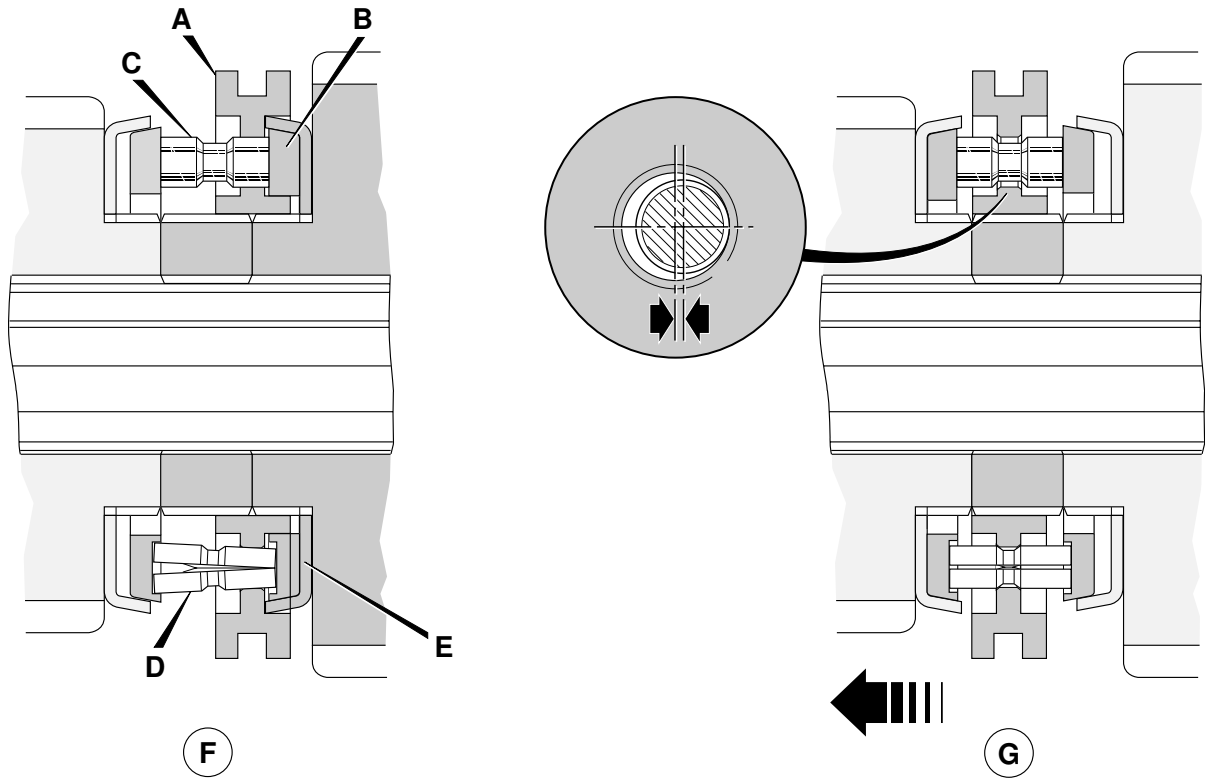
When the impeller **A** is rotating faster than the turbine **B**, the fixed reaction member **C** causes some of the energy in the oil to be transferred back to the impeller **A**. This has the effect of multiplying the torque available.

When the impeller **A** (input) is running much faster than the turbine **B** (output) there is a substantial circulation of transmission oil around the blades. The oil circulation is maximum when the turbine (output) is stalled, and is almost zero when the impeller and turbine speeds are equal i.e. the ratio is near 1:1. If the turbine (output) is stalled whilst the impeller (input) is revolving, all the power is dissipated as heat.

Because of the absence of a direct mechanical connection between the engine and the gearbox therefore, the flexibility of the torque converter drive greatly reduces wear on the transmission, absorbing shocks and torsional vibration from the engine. The engine cannot be stalled due to overload, as the fluid coupling slips.



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## Syncro Shuttle Gearbox

### Syncromesh (Blocking Pin Type)

The gearbox is fitted with 'Blocking Pin' syncromesh, comprising the following parts.

**SYNCRO HUB (A)** controls the operation of the syncromesh unit and gear selection, the selector fork fitting into the outer groove. Internal dog teeth link the selected gear to the drive shaft. Through the syncro hub centre are two sets of holes for the blocker pins (C) and the split energiser pins (D), spaced alternately.

**SYNCRO RINGS (B)** are rigidly joined by the blocker pins, with the split energiser pins held, in counterbores, between the two syncro rings.

**BLOCKER PINS (C)** have a narrow neck in the centre, against which the syncro hub transmits radial drive during gear changes. The edges of the blocker pin neck and their mating syncro hub holes are designed so that, as the radial loads are reduced, the syncro hub can slide over the shoulder of the blocker pin.

**SPLIT ENERGISER PINS (D)** take the initial axial load of the syncro hub on the shoulder of the split energiser pin neck. As the axial load reaches approximately 400 N (40.8 kg; 90 lb) the internal springs allow the split energiser pin to collapse and the syncro hub to move axially.

**SYNCRO CUPS (E)** take the frictional drive from the syncro ring on their inner faces. The syncro cups are splined to drive their respective gears whilst synchronisation is taking place.

### SYNCHROMESH - OPERATION

Diagram F shows the gearbox with first gear engaged. Syncro ring B is in contact with syncro cup E and the syncro hub dog teeth are linking first gear to the shaft gear. In this position the split energiser pins D are 'collapsed'.

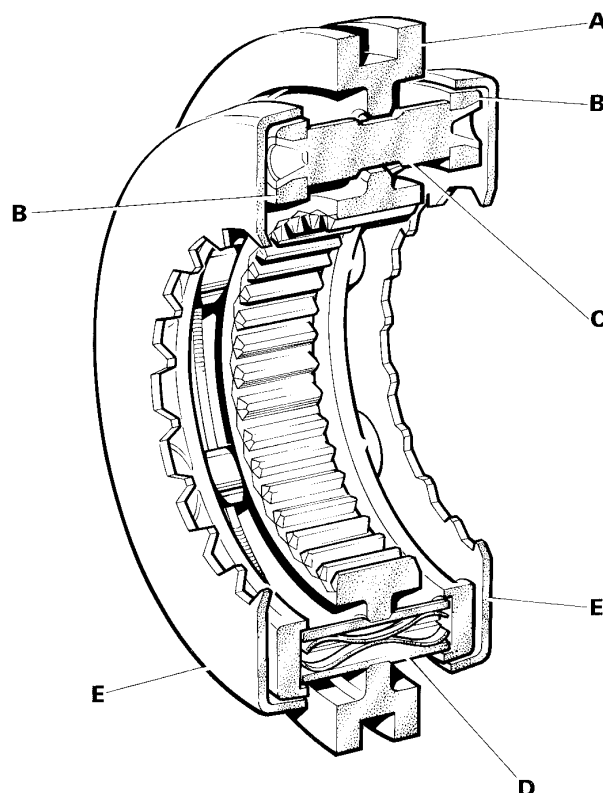
When selecting second gear the syncro hub A slides along the split energiser pins until the pin recess and the syncro hub flange are in line. At this point the split energiser pins open and the syncro rings are moved by the syncro hub pushing on the split energiser pin shoulder.

Initial contact between the syncro ring and the syncro cup starts to synchronise the speed of the shaft and second gear. The rotational force of the syncro ring is taken by the blocker pin against the edge of the syncro hub hole, as at G.

As the axial load on the syncro hub increases, the split energiser pin 'collapses' and the conical faces of the blocking pin and syncro hub hole come into contact, as at H.

Further increases in the axial loads increase the frictional grip of the syncro ring and the syncro cup, causing the shaft and gear speeds to synchronise.

As the speeds are synchronised the radial load on the blocker pin and the syncro hub is reduced. This allows the syncro hub to slide freely along the blocker pin and engage its dog teeth with second gear, see diagram J.



## Syncro Shuttle Gearbox

### Forward/Reverse Clutch Operation

The forward/reverse clutch unit **1** transfers drive from the input shaft **A3** to either gear **G1** or gear **G2** depending on which of the two clutches (**A1** or **A2**) is engaged, giving forward or reverse drive. When neither clutch is engaged, neutral is selected.

The clutches are of the wet, multi-plate type.

The clutch housings and input shaft are a one piece assembly **A3**. The assembly is permanently driven by the engine via the torque converter. Clutch counter plates **3** are also permanently driven via meshing teeth inside the clutch housings.

Clutch friction plates **4** are meshed with the gear/plate carriers (**G1** and **G2**).

In the diagram, clutch **A1** is engaged. The counter plates **3** and friction plates **4** are pressed together by hydraulically actuated piston **5**. Drive is then transmitted from the input shaft to the gear **G1**.

Clutch **A2** is disengaged and no drive is transmitted to gear/plate carrier **G2**. The gear is also free to rotate on the input shaft assembly.

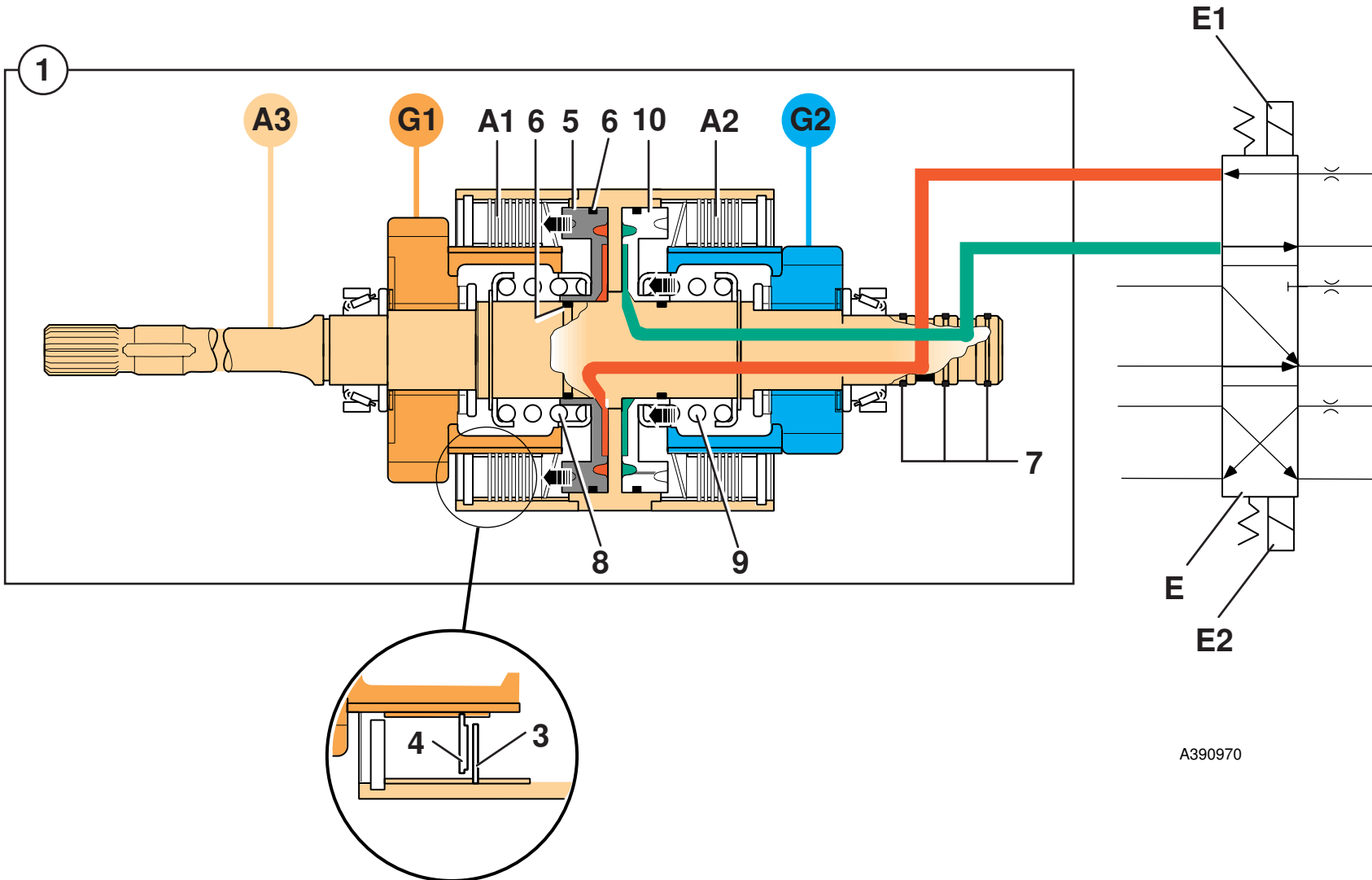
Actuation of the hydraulic pistons **10** and **5** is controlled via three position solenoid valve **E†**.

When neutral is selected, solenoids **E1** and **E2** are deactivated and the flow of pressurised oil to the clutches is blocked. Springs **8** and **9** move the pistons away from the clutch plates and oil from both pistons is vented to the sump.

When either forward or reverse is selected, the solenoid valve **E** diverts pressurised oil via cross drillings inside the input shaft **A3** to the appropriate clutch (piston **10** or **5**) in the unit. Pressure from the other clutch is vented to the sump via the solenoid valve spool. Oil is prevented from leaking by seals **6** on the pistons and ring seals **7** on the input shaft **A3**.

†The valve **E** is shown using symbols. For an explanation of how the symbols work, see **Section E, Introduction to Hydraulic Schematic Symbols**.

**Syncro Shuttle Gearbox**  
**Forward/Reverse Clutch Operation**



## Synchro Shuttle Gearbox

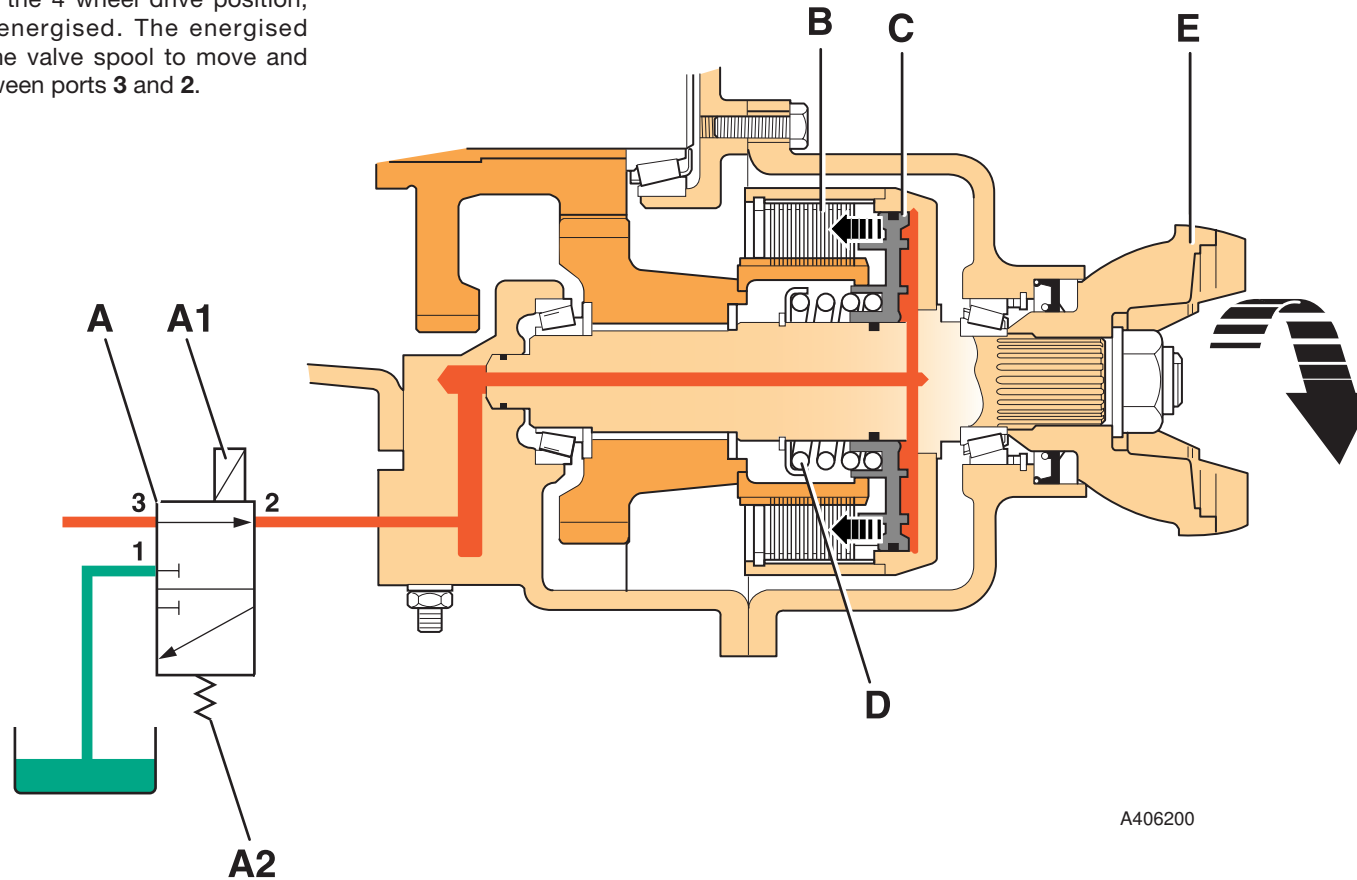
### 2/4 Wheel Drive Clutch Operation - Pressure ON/Spring OFF Type

#### 4 Wheel Drive Operation

This clutch is of the 'Pressure-ON (4WD)/Spring-OFF (2WD)' type. The clutch is engaged and disengaged by introducing or dumping pressurised oil behind piston **C** via a solenoid valve **A**. The solenoid valve is operated by a switch in the cab.

When the switch is in the 4 wheel drive position, solenoid valve **A** is energised. The energised solenoid **A1** causes the valve spool to move and form a connection between ports **3** and **2**.

Pressurised oil is directed to piston **C** via ports **3** and **2**. The piston moves, against spring **D**, to press the friction/counter plates of clutch pack **B** together, thus driving the output yoke **E**.



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## Synchro Shuttle Gearbox

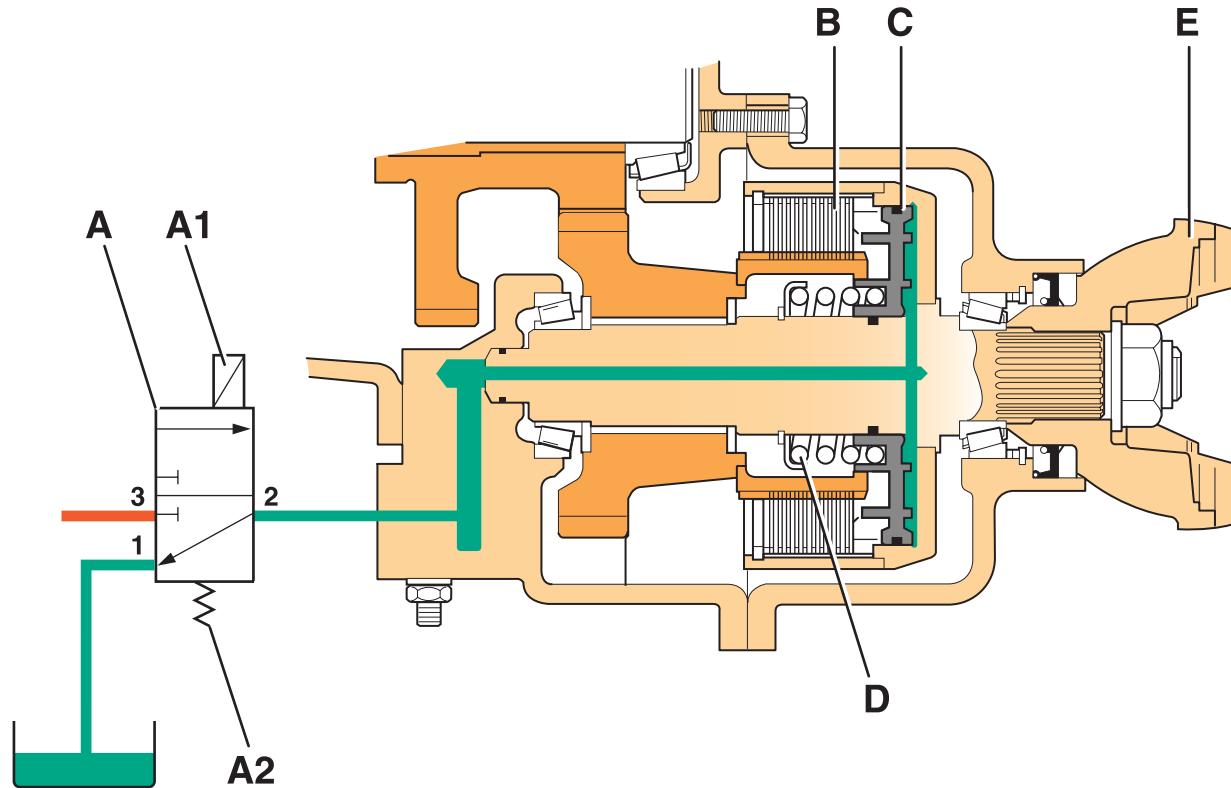
### 2/4 Wheel Drive Clutch Operation

- Pressure ON/Spring OFF Type (cont'd)

#### 2 Wheel Drive Operation

When the switch is in the 2 wheel drive position, solenoid valve **A** is de-energised. With the solenoid **A1** de-energised, the valve spool moves under the force of the spring **A2**. The oil supply to the piston **C** is blocked (shown at port **3**). At the same time oil vents from the back of piston **C** to the sump via ports **1** and **2**.

Because there is no pressure behind piston **C**, the friction/counter plates of clutch pack **B** now freely rotate on the output shaft, thus disengaging drive to the front axle.



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## Synchro Shuttle Gearbox

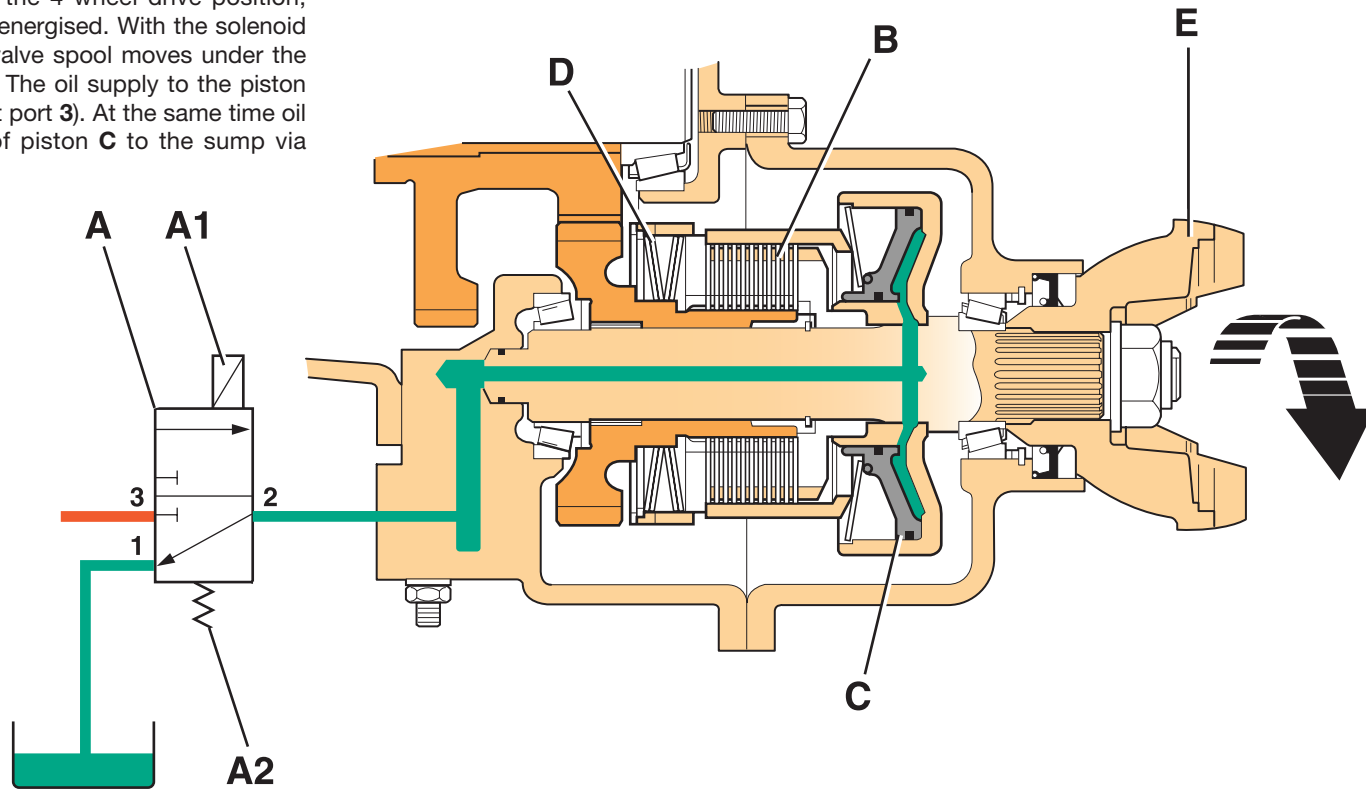
### 2/4 Wheel Drive Clutch Operation - Spring ON/Pressure OFF Type

#### 4 Wheel Drive Operation

This clutch is of the 'Spring-ON (4WD)/Pressure-OFF (2WD)' type. The clutch is engaged and disengaged by introducing or dumping pressurised oil behind piston **C** via a solenoid valve **A**. The solenoid valve is operated by a switch in the cab.

When the switch is in the 4 wheel drive position, solenoid valve **A** is de-energised. With the solenoid **A1** de-energised, the valve spool moves under the force of the spring **A2**. The oil supply to the piston **C** is blocked, (shown at port **3**). At the same time oil vents from the back of piston **C** to the sump via ports **1** and **2**.

Because there is no pressure behind piston **C**, the clutch friction/counter plates of clutch pack **B** are forced together by disc springs **D**, thus driving the output yoke **E**.



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## Synchro Shuttle Gearbox

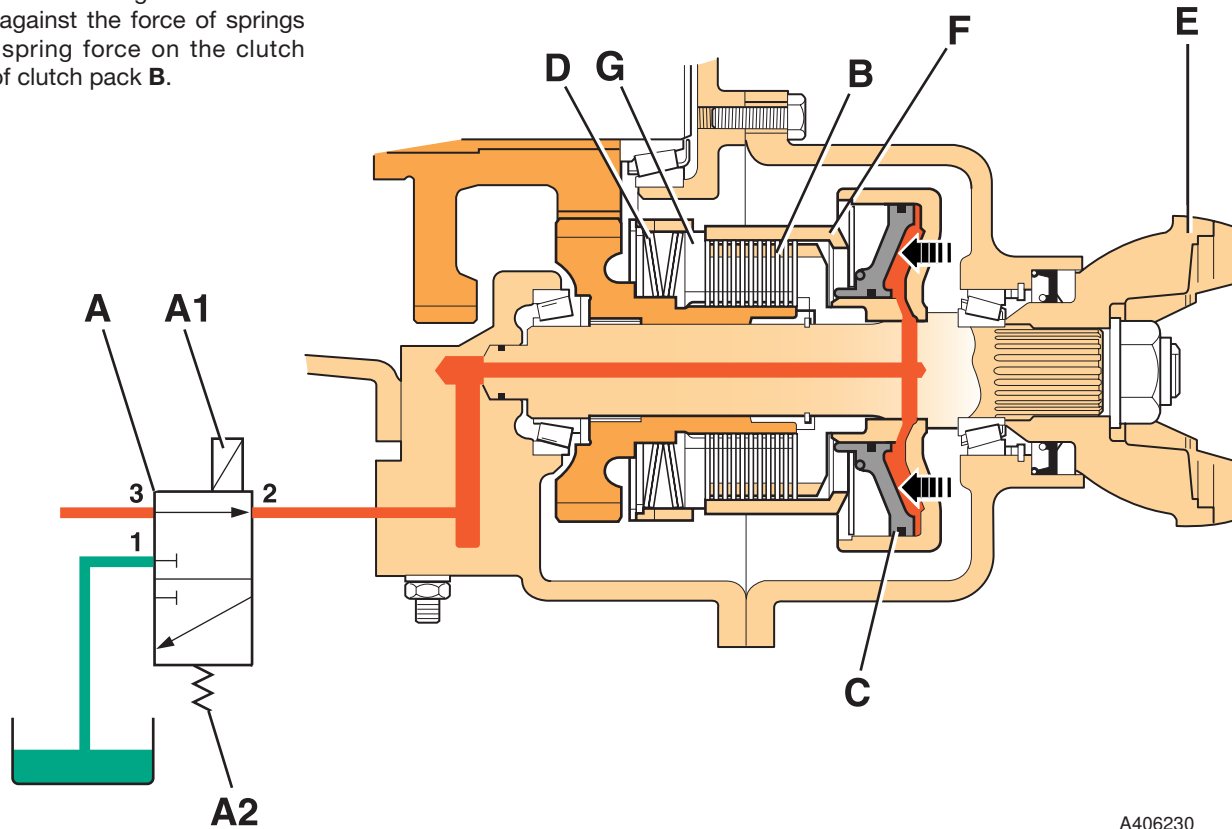
### 2/4 Wheel Drive Clutch Operation - Spring ON/Pressure OFF Type (cont'd)

#### 2 Wheel Drive Operation

When the switch is in the 2 wheel drive position, solenoid valve **A** is energised. The energised solenoid **A1** causes the valve spool to move and form a connection between ports **3** and **2**.

Pressurised oil is directed to piston **C** via ports **3** and **2**. The piston moves actuating sleeve **F** and then pressure plate **G** against the force of springs **D**, thus releasing the spring force on the clutch friction/counter plates of clutch pack **B**.

Because there is no spring force, the friction/counter plates of clutch pack **B** now freely rotate on the output shaft, thus disengaging drive to the front axle.



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## Powershift Gearbox

### Clutch Operation - Forward, Reverse

The forward and reverse clutch units are very similar in design and operate in the same way. The following description refers to one unit and can be applied to either the forward or reverse clutch units.

The clutch **1** transfers drive from the input shaft **A3** to either gear **G1** or gear **G2** depending on which of the two clutches (**A1** or **A2**) is engaged, transferring drive to the mainshaft. When neither clutch is engaged, neutral is selected.

The clutches are of the wet, multi-plate type.

The clutch housings and input shaft are a one piece assembly **A3**. The assembly is permanently driven by the engine via the torque converter. Clutch counter plates **3** are also permanently driven via meshing teeth inside the clutch housings.

Clutch friction plates **4** are meshed with the gear/plate carriers (**G1** and **G2**).

In the diagram, clutch **A1** is engaged. The counter plates **3** and friction plates **4** are pressed together by hydraulically actuated piston **5**. Drive is then transmitted from the input shaft to the gear **G1**.

Clutch **A2** is disengaged and no drive is transmitted to gear/plate carrier **G2**. The gear is also free to rotate on the input shaft assembly.

Actuation of the hydraulic pistons **10** and **5** is controlled via two position solenoid valves **E1** and **E2**†.

When neutral is selected, solenoids **E1** and **E2** are deactivated and the flow of pressurised oil to the clutches is blocked. Springs **8** and **9** move the pistons away from the clutch plates and oil from both pistons is vented to the sump.

When for example clutch **A1** is selected to be engaged, solenoid valve **E1** is energised and solenoid valve **E2** is de-energised. Pressurised oil is diverted via cross drillings inside the input shaft **A3** to the clutch piston **5**. Pressure from clutch **A2** is vented to the sump via the solenoid valve spool **E2**. Oil is prevented from leaking by seals **6** on the pistons and ring seals **7** on the input shaft **A3**.

†The valve **E** is shown using symbols. For an explanation of how the symbols work, see **Section E, Introduction to Hydraulic Schematic Symbols**.

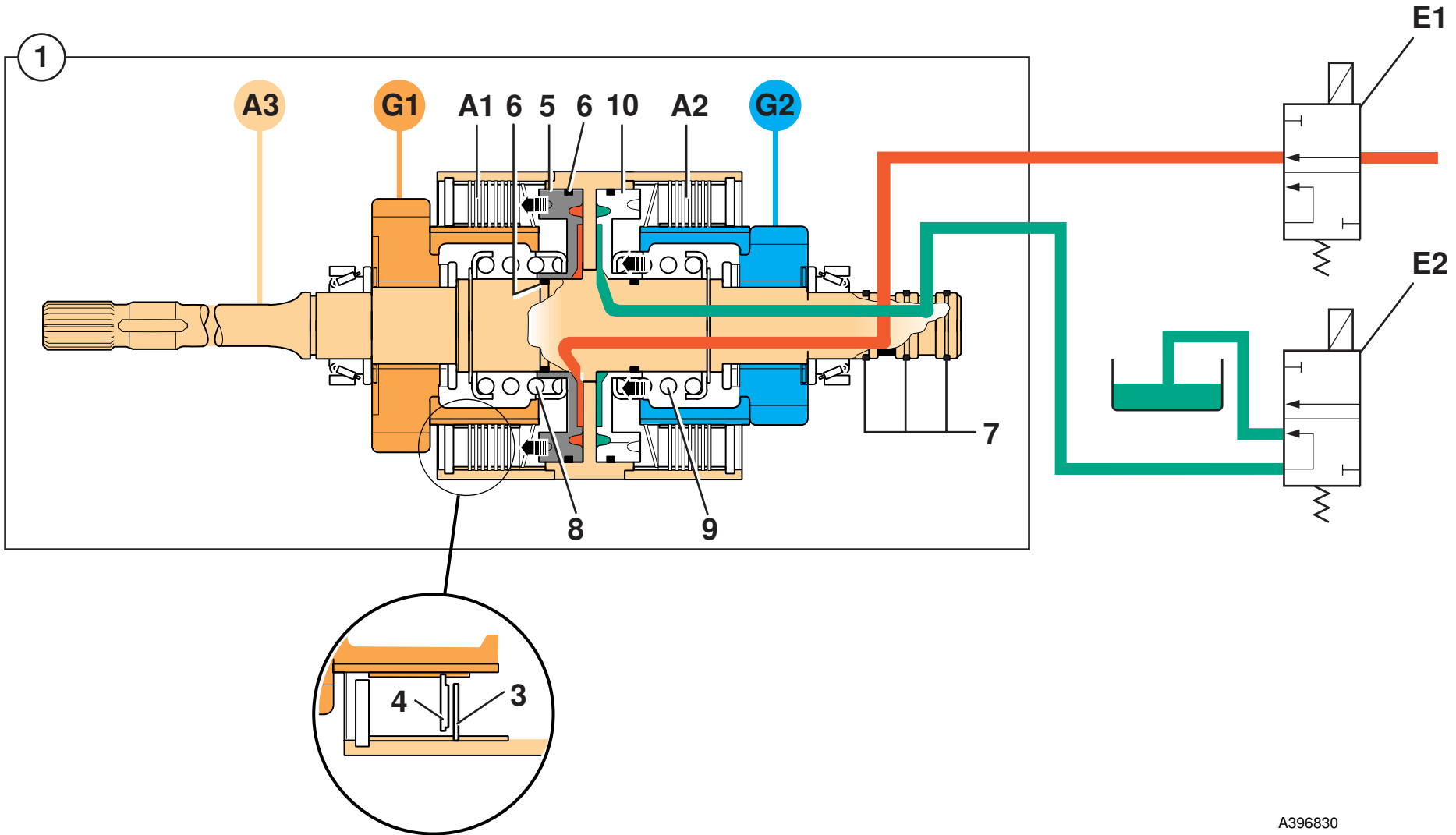
### Clutch Operation - Mainshaft, Layshaft, 6 Speed

The mainshaft, layshaft and 6 speed units all incorporate one clutch and not two, as in the forward and reverse units. The operation of the single clutches is the same as for one clutch in the forward or reverse units.

### Clutch Operation - 2/4 Wheel Drive Clutch

The 2/4 wheel drive clutch is similar to the Synchro Shuttle 2/4 wheel drive clutch. See **Synchro Shuttle Gearbox, 2/4 Wheel Drive Clutch Operation**.

**Powershift Gearbox**  
**Clutch Operation - Forward, Reverse**



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## Powershift Gearbox - 4 Speed

### Introduction

This section explains how the electrical system works when the following gearbox functions are operated:

**1st, 2nd, 3rd and 4th gears forward**

**Neutral**

**1st, 2nd, 3rd and 4th gears reverse**

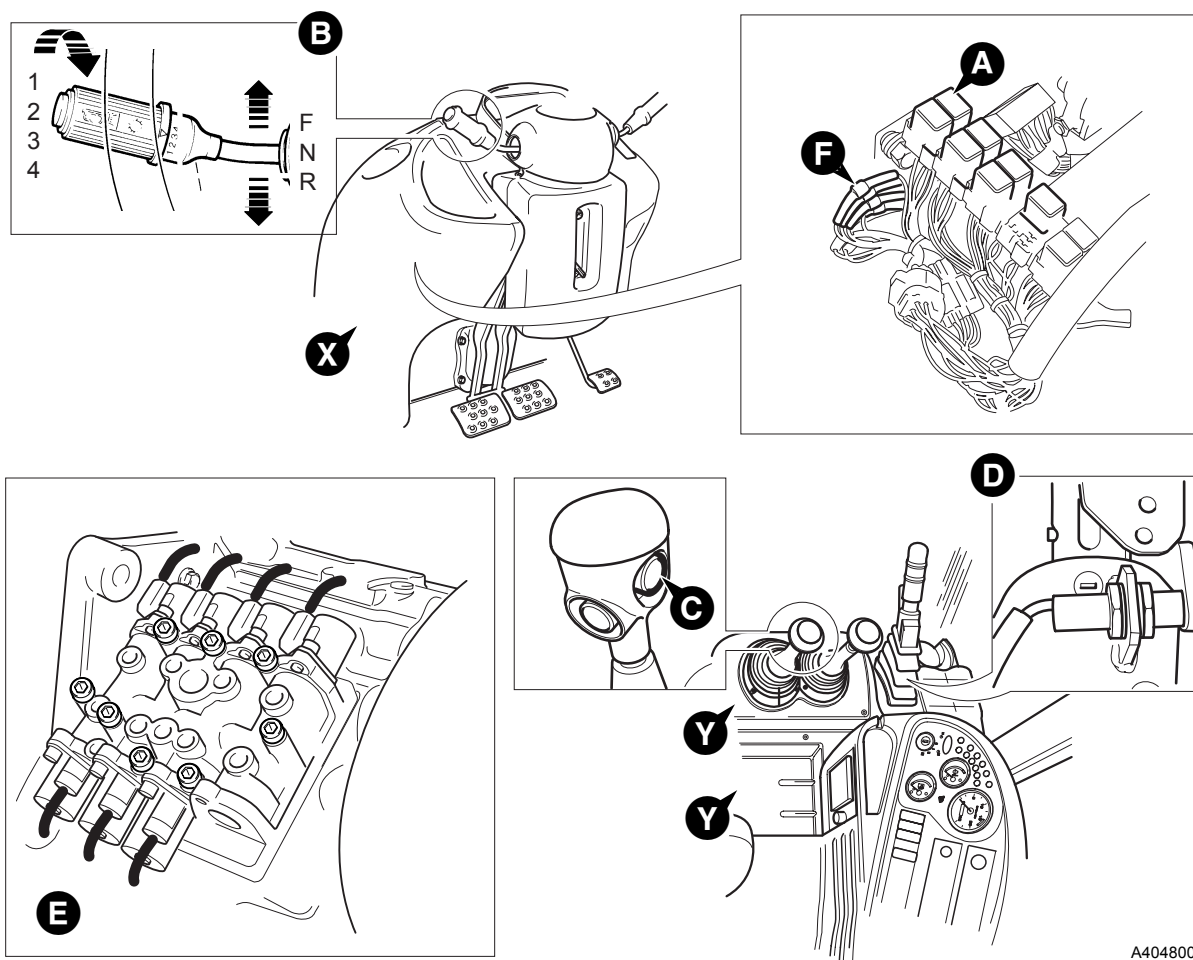
**Transmission dump**

**Park brake switch**

The 4-speed powershift gearbox is controlled using conventional relays. The relays at **A** are operated via the column mounted gear and forward/reverse lever **B**. The transmission dump switch **C** or park brake switch **D** also operate a relay at **A**. The contacts inside the relays energise the gearbox mounted solenoid control valves **E**.

Diode 'gates' **F** are also used as logic switches.

To access the relays and connectors it is necessary to remove the front/steering console panel **X** and side panels **Y**, refer to **Section B** for the correct procedure.



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**Powershift Gearbox - 4 Speed (cont'd)**

**Electrical Connections - Quick Reference**

The tables show switch positions together with energised relay and gearbox solenoids for each gearbox function (reverse gears are shown on the next page). The numbers show which contacts are 'live' and also relate to the actual connector pin numbers.

When fault finding it should be remembered that the system relies on the dump switch and park brake switches functioning correctly, failure of these switches will prevent forward or reverse gears being selected. From the tables it is possible to see common relay functions which can help trace faults. For example we can see that relay FF2 is energised to engage 1st or 2nd gear. Failure of these gears to select may indicate a fault with relay FF2.

Note that a non functioning relay or solenoid may not indicate a faulty component, the associated wires and connectors may have failed. For wire and connector details see the relevant schematic.

**Diagram X**

The diagram X (opposite) shows the electrical circuit for the gearbox control. It is shown with 3rd gear forward selected. 'Live feed' wires are coloured red and feed to earth are green.

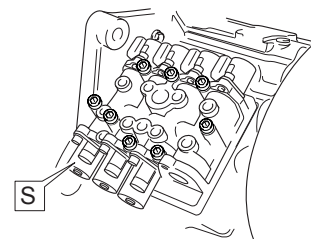
**Key**

- C50** Reverse alarm
- DW** Park brake switch
- FL** Column switch connector
- FK** Diode gate connector
- FG** Transmission dump relay
- FD2** Forward relay
- FE2** Reverse relay
- FF1** Interlock relay
- FD1** Forward Hi/Lo relay
- FE1** Reverse Hi/Lo relay
- FF2** Mainshaft/Layshaft relay
- NG** Dump switch

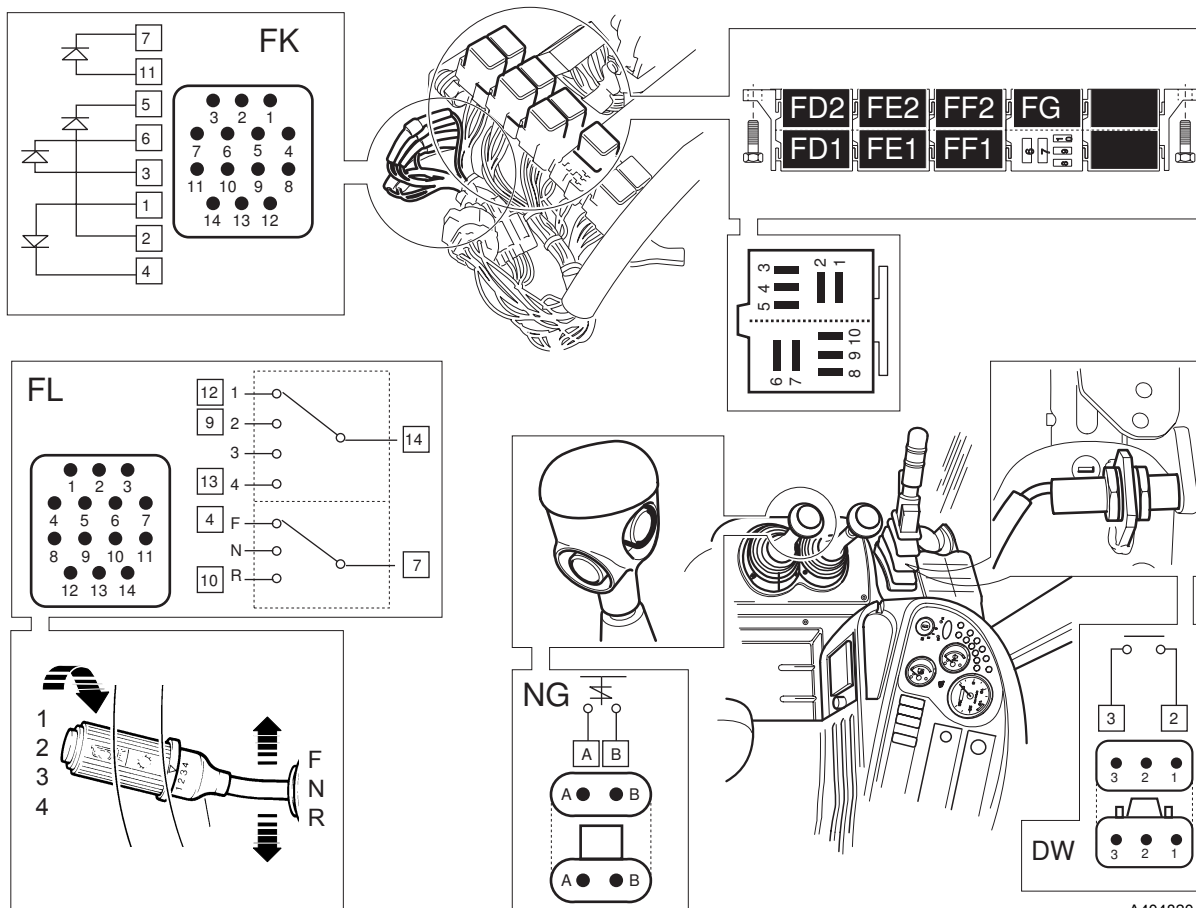
**Gearbox Solenoids**

- T** Forward low
- U** Forward high
- Y** Mainshaft
- Z** Layshaft

**Note:** Solenoid **S** is the 2/4WD solenoid. The 2/4WD select electrical system is not described in this section.



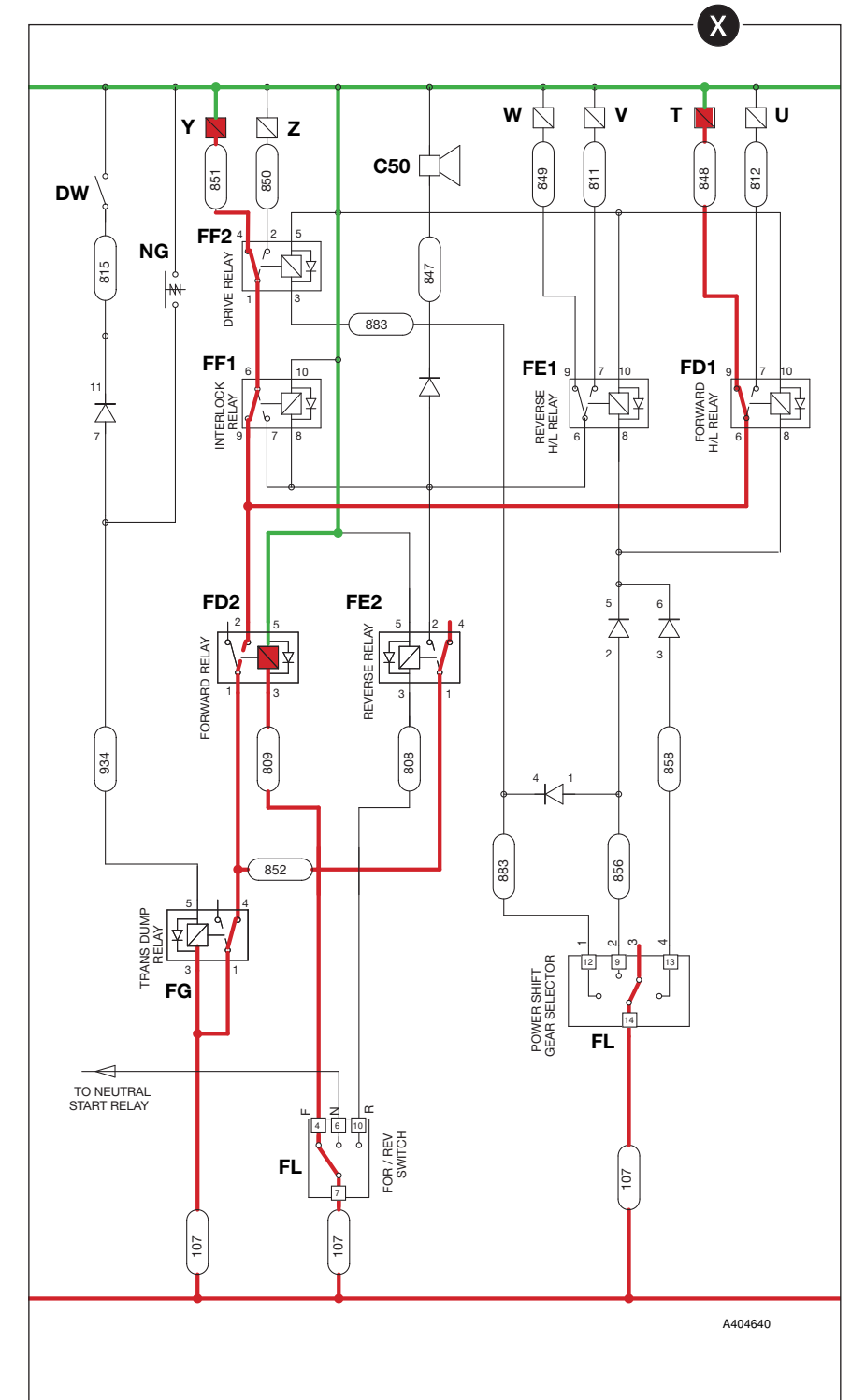
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Powershift Gearbox - 4 Speed

Gearbox function	Column Switch FL	Relay FG Dump	Relay FD2 Forward	Relay FE2 Reverse	Relay FF1 Interlock	Diode Gate FK	Relay FD1 Forward Hi Lo	Relay FE1 Reverse Hi Lo	Relay FF2 Mainshaft Layshaft	Gearbox Solenoid
1st GEAR FORWARD	14 - 12 7 - 4	1 - 4	3 - 5, 1 - 2	1 - 4	9 - 6	4	6 - 9		3 - 5, 1 - 2	
2nd GEAR FORWARD	14 - 9 7 - 4	1 - 4	3 - 5, 1 - 2	1 - 4	9 - 6	2 - 5, 1 - 4 1 - 4	8 - 10, 6 - 7		3 - 5, 1 - 2	
3rd GEAR FORWARD	14 - 13 7 - 4	1 - 4	3 - 5, 1 - 2	1 - 4	9 - 6		6 - 9		1 - 4	
4th GEAR FORWARD	14 - 13 7 - 4	1 - 4	3 - 5, 1 - 2	1 - 4	9 - 6	3 - 6 2 - 5	8 - 10, 6 - 7		1 - 4	
NEUTRAL			1 - 4	1 - 4						
TRANSMISSION DUMP / PARK BRAKE ON		5 - 3, 1 - 2								

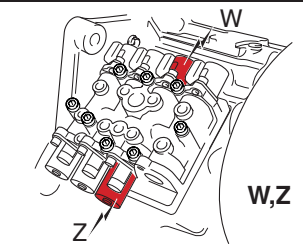
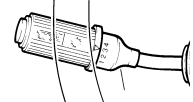
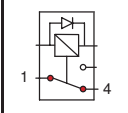
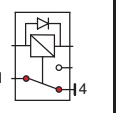
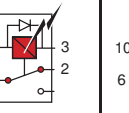
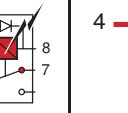
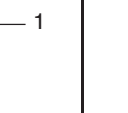
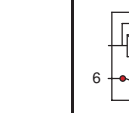
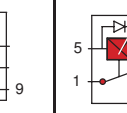
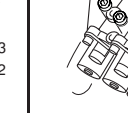
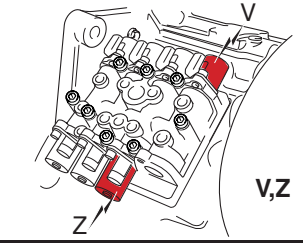
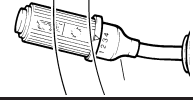
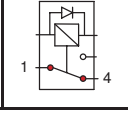
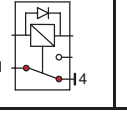
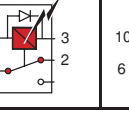
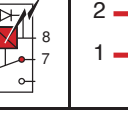
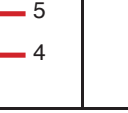
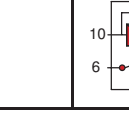
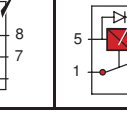

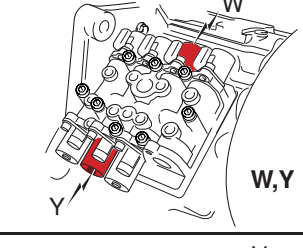
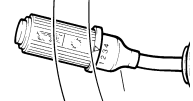
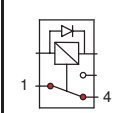
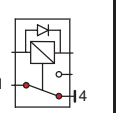
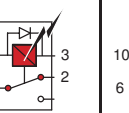
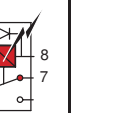
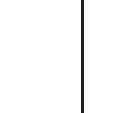
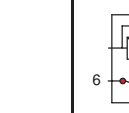
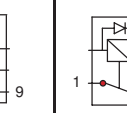
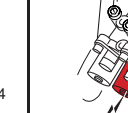
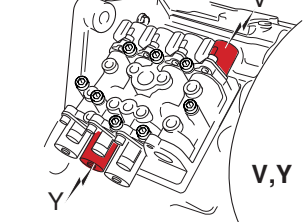
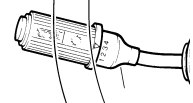
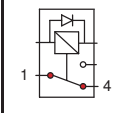
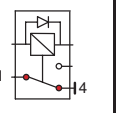
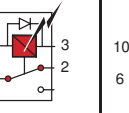
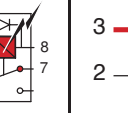

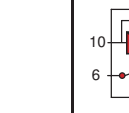
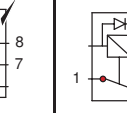
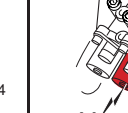


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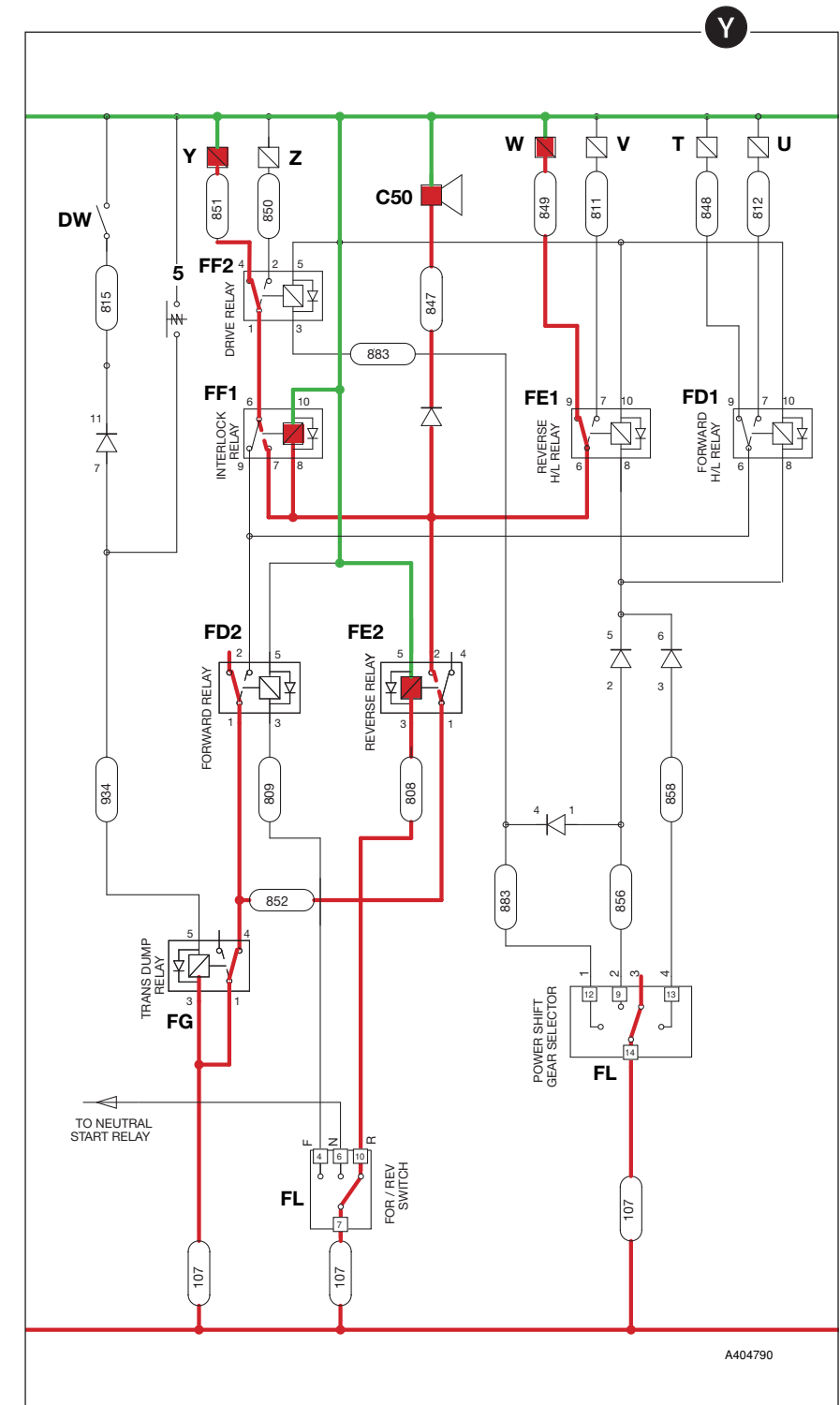
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Powershift Gearbox -4 Speed

Gearbox function	Column Switch FL	Relay FG Dump	Relay FD2 Forward	Relay FE2 Reverse	Relay FF1 Interlock	Diode Gate FK	Relay FD1 Forward Hi Lo	Relay FE1 Reverse Hi Lo	Relay FF2 Mainshaft Layshaft	Gearbox Solenoid
1st GEAR	14 - 12	1 - 4	1 - 4-1	3 - 5, 1 - 2	8 - 10, 7 - 6	4		6 - 9	3 - 5, 1 - 2	
REVERSE	7 - 10									
1R										
2nd GEAR	14 - 9	1 - 4	1 - 4-1	3 - 5, 1 - 2	8 - 10, 7 - 6	2 - 5, 1 - 4		8 - 10, 6 - 7	3 - 5, 1 - 2	
REVERSE	7 - 10									
2R										
3rd GEAR	14 - 13	1 - 4	1 - 4-1	3 - 5, 1 - 2	8 - 10, 7 - 6			8 - 10, 6 - 7	1 - 4	
REVERSE	7 - 10									
3R										
4th GEAR	14 - 13	1 - 4	1 - 4-1	3 - 5, 1 - 2	8 - 10, 7 - 6	3 - 6		8 - 10, 6 - 7	1 - 4	
REVERSE	7 - 10									
4R										

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**Powershift Gearbox - 4 Speed (cont'd)**

**Electrical Connections - Quick Reference (cont'd)**

The tables show switch positions together with energised relay and gearbox solenoids for each gearbox function. The numbers show which contacts are 'live' and also relate to the actual connector pin numbers.

When fault finding it should be remembered that the system relies on the dump switch and park brake switches functioning correctly, failure of these switches will prevent both forward and reverse being selected. From the tables it is possible to see common relay functions which can help trace faults. For example we can see that relay FF2 is energised to engage 1st or 2nd gear. Failure of these gears to select may indicate a fault with relay FF2.

Note that a non functioning relay or solenoid may not indicate a faulty component, the associated wires and connectors may have failed. For wire and connector details see the relevant schematic.

**Diagram Y**

The diagram **Y** opposite shows the electrical circuit for the gearbox control. It is shown with 3rd gear reverse selected. 'Live feed' wires are coloured red and feed to earth are green.

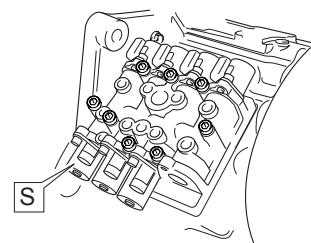
**Key**

- C50** Reverse alarm
- DW** Park brake switch
- FL** Column switch connector
- FK** Diode gate connector
- FG** Transmission dump relay
- FD2** Forward relay
- FE2** Reverse relay
- FF1** Interlock relay
- FD1** Forward Hi/Lo relay
- FE1** Reverse Hi/Lo relay
- FF2** Mainshaft/Layshaft relay
- NG** Dump switch

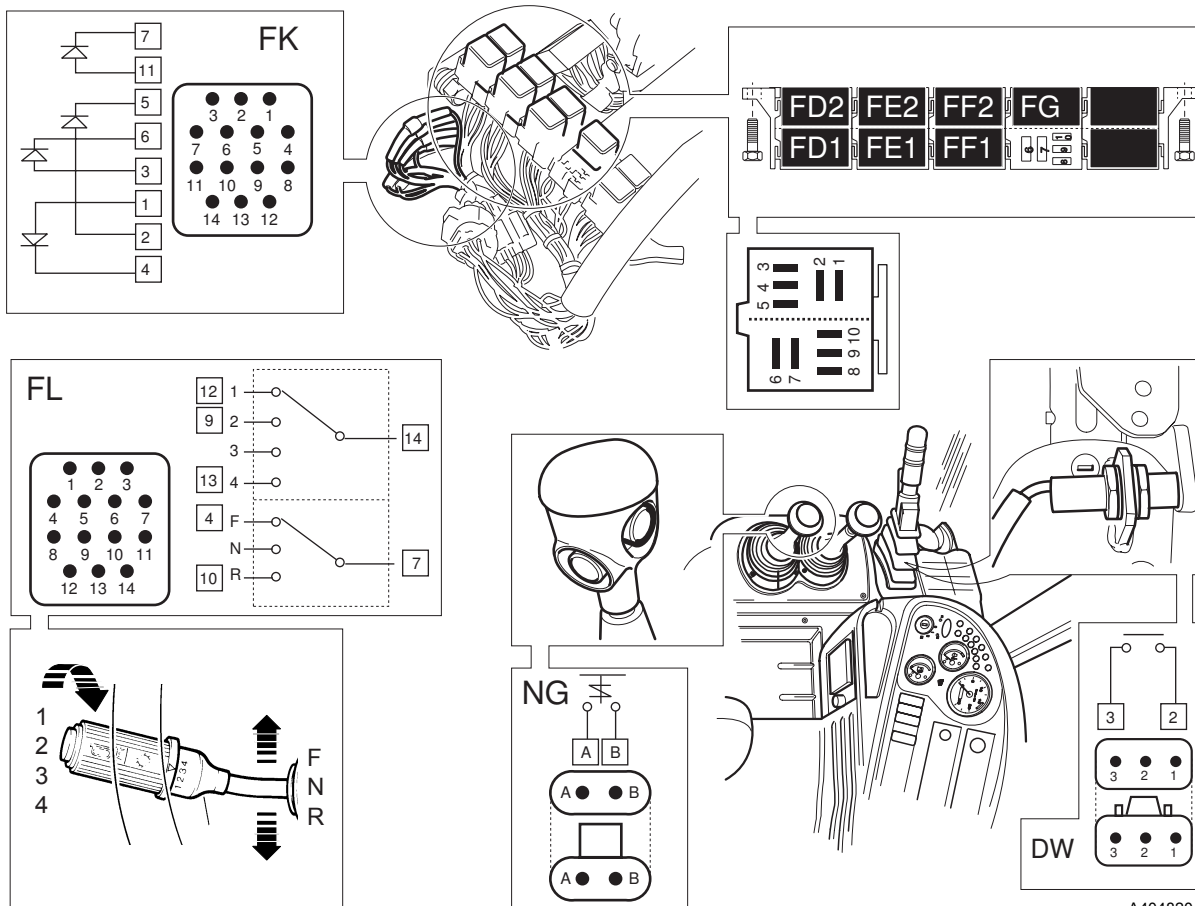
**Gearbox Solenoids**

- V** Reverse high
- W** Reverse low
- Y** Mainshaft
- Z** Layshaft

**Note:** Solenoid **S** is the 2/4WD solenoid. The 2/4WD select electrical system is not described in this section.



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A404820

### Powershift Gearbox - 4 Speed (Machines up to 933756)

#### Electrical Connections - Wires and Connectors

Although the system is straight forward in design it is never the less fairly complex in practice. For this reason schematics are divided into 2 parts: **Relay Actuation** and **Gearbox Solenoid Actuation**.

On the electrical diagram opposite the electrical connectors (example, FA to LA) are shown looking on the mating face of each connector when they are disconnected.

The wire numbers and colours, where appropriate, are shown as an aid to identification whilst fault finding.

Before fault finding make sure that you understand how the the electrical circuits work. Most potential faults can be traced using a multimeter to carry out continuity checks on wires, switches and solenoid coils. Gearbox solenoid coils can be checked for the correct resistance value as given in **Technical Data**. See **Service Procedures, Electrical Testing Methods** for more details.

#### Relay Actuation

For gearbox solenoid actuation see subsequent pages.

#### Component Key (Relay actuation):

The following key identifies the component connectors on the opposite diagrams. Note that the wires coloured red show the electrical 'live feed' to the column gear lever.

- h1** Harness - 721/10940 Front console
- h2** Harness - 721/10942 Link
- h3** Harness - 721/10936 Side console
- h4** Harness - 721/10935 Engine/mainframe

**Note:** For harness drawings see **Section C**.

#### Connectors (h1)

- FA** h1 → h2
- FB1** Earth point
- FD1** Forward high/low relay
- FD2** Forward relay
- FE1** Reverse high/low relay
- FE2** Reverse relay
- FF1** Interlock relay
- FF2** Mainshaft/layshaft relay
- FG** Transmission dump relay
- FK** Diode gate
- FL** Column gear lever

#### Connectors (h2)

- LA** h2 → h1
- LB** h2 → h3

#### Connectors (h3)

- CA** h3 → h4
- CB** h3 → h2
- CCA** Fuses
- CCB** Fuses
- CM** Park brake relay
- DW** Park brake switch
- EA** Immobiliser
- EAB** Link - immobiliser (if immobiliser is not fitted)

#### Connectors (h4)

- NH** h4 → h3
- NG** Transmission dump switch
- MB1** Earth point

#### Splices (h1)

- SL**
- SC**
- SG**
- SH**
- SK**
- SS**
- ST**

#### Splices h2

- SA**
- SB**

#### Splices h3

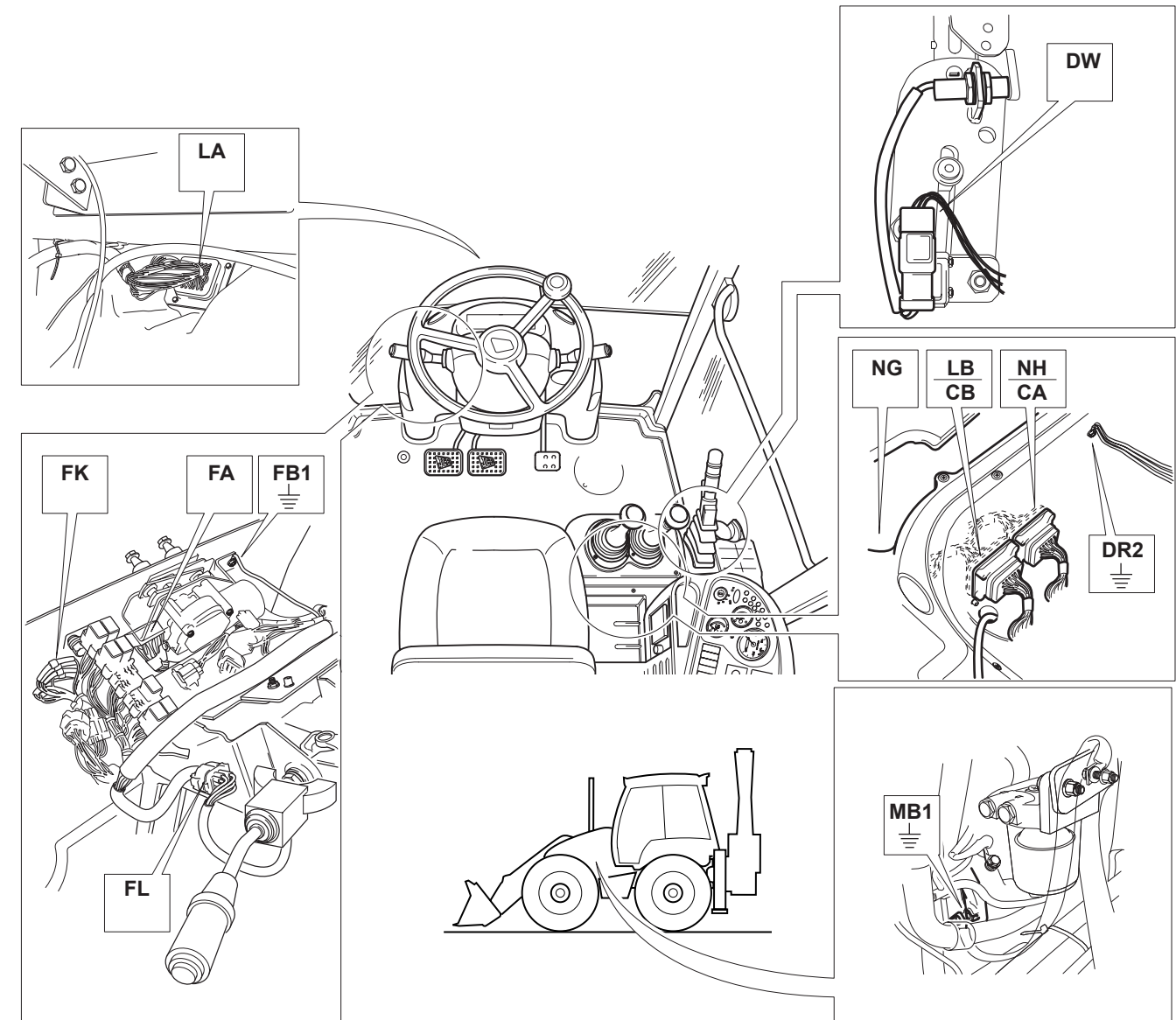
- SC**

#### Splices h4

- SA**

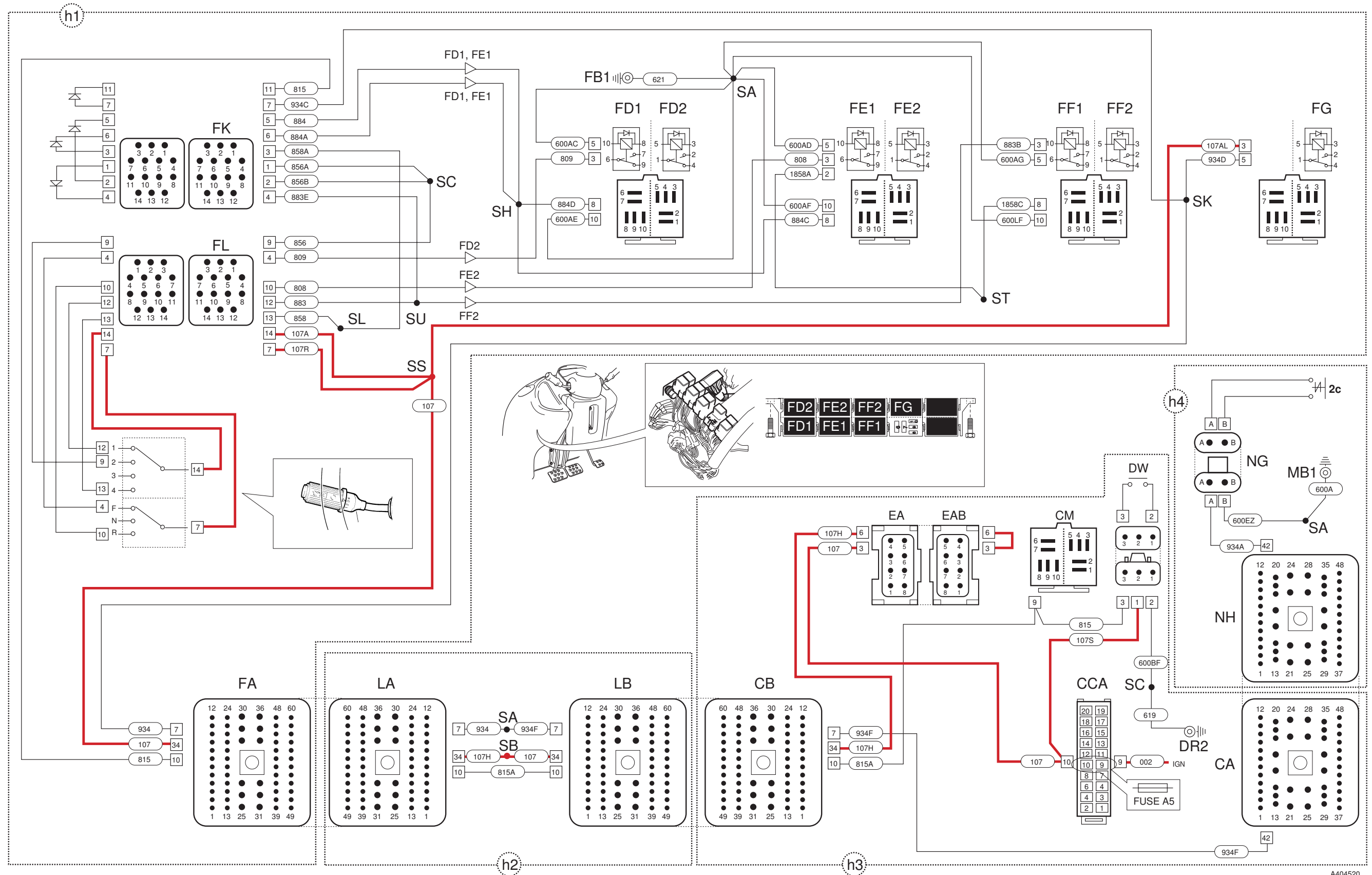
#### Earth Points

Faults may be caused by poor earth connections. Although earth connections are shown opposite, it must be remembered that the cab assembly is earthed via further earth strap and cable connections. For details of these connections see **Section C, Machine Earth Connections**.



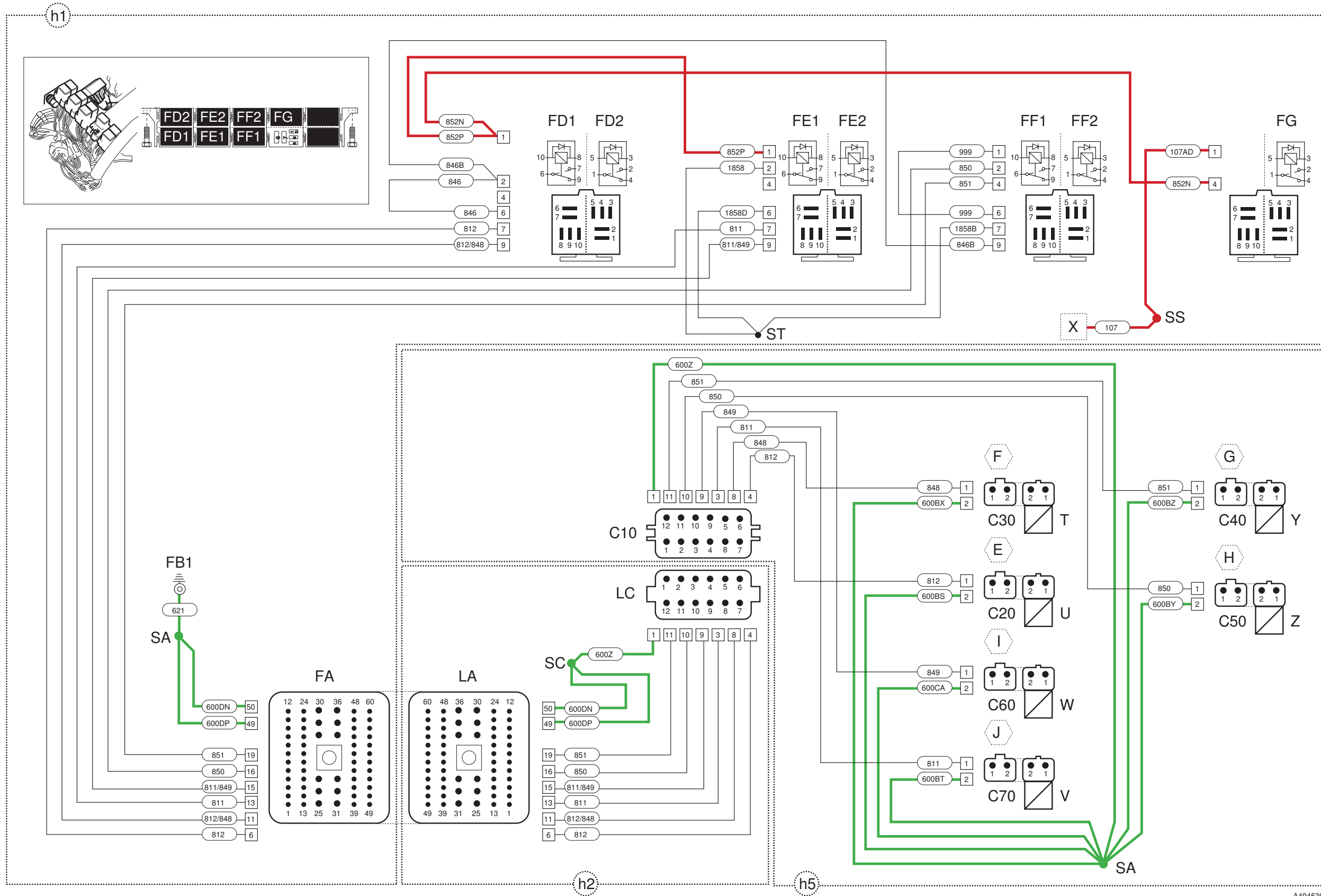
A405320

**Powershift Gearbox - 4 Speed  
Relay Actuation  
(Machines up to 933756)**



A404520

**Powershift Gearbox - 4 Speed  
Gearbox Solenoid Actuation  
(Machines up to 933756)**



A404530

### Powershift Gearbox - 4 Speed (cont'd) (Machines up to 933756)

#### Electrical Connections - Wires and Connectors Gearbox Solenoid Actuation

For relay activation see previous page.

#### Component Key (solenoid activation):

The following key identifies the component connectors on the diagrams opposite. Note that the wires coloured green show the electrical 'feed to earth' for the gearbox mounted solenoids. Live feed (wires coloured red) to the relay switches is supplied via the dump relay **FG**. Note that the destination for wire 107 from splice **SS** is shown on the relay actuation diagram (previous page).

- h1** Harness - 721/10940 Front console
- h2** Harness - 721/10942 Link
- h5** Harness - 721/10939 Gearbox

**Note:** For harness drawings see **Section C**.

#### Connectors (h1)

- FA** h1 → h2
- FB1** Earth point
- FD1** Forward high/low relay
- FD2** Forward relay
- FE1** Reverse high/low relay
- FE2** Reverse relay
- FF1** Interlock relay
- FF2** Mainshaft/layshaft relay
- FG** Transmission dump relay
- X** For wire 107 destination see **Relay Actuation** diagram

#### Connectors (h2)

- LA** h1 → h2
- LC** h2 → h5

#### Connectors (h5)

- C10** h5 - h2
- C20** Gearbox solenoid U (labelled **E**)
- C30** Gearbox solenoid T (labelled **F**)
- C40** Gearbox solenoid Y (labelled **G**)
- C50** Gearbox solenoid Z (labelled **H**)
- C60** Gearbox solenoid W (labelled **I**)
- C70** Gearbox solenoid V (labelled **J**)

#### Splices (h1)

- SS**
- ST**

#### Splices (h2)

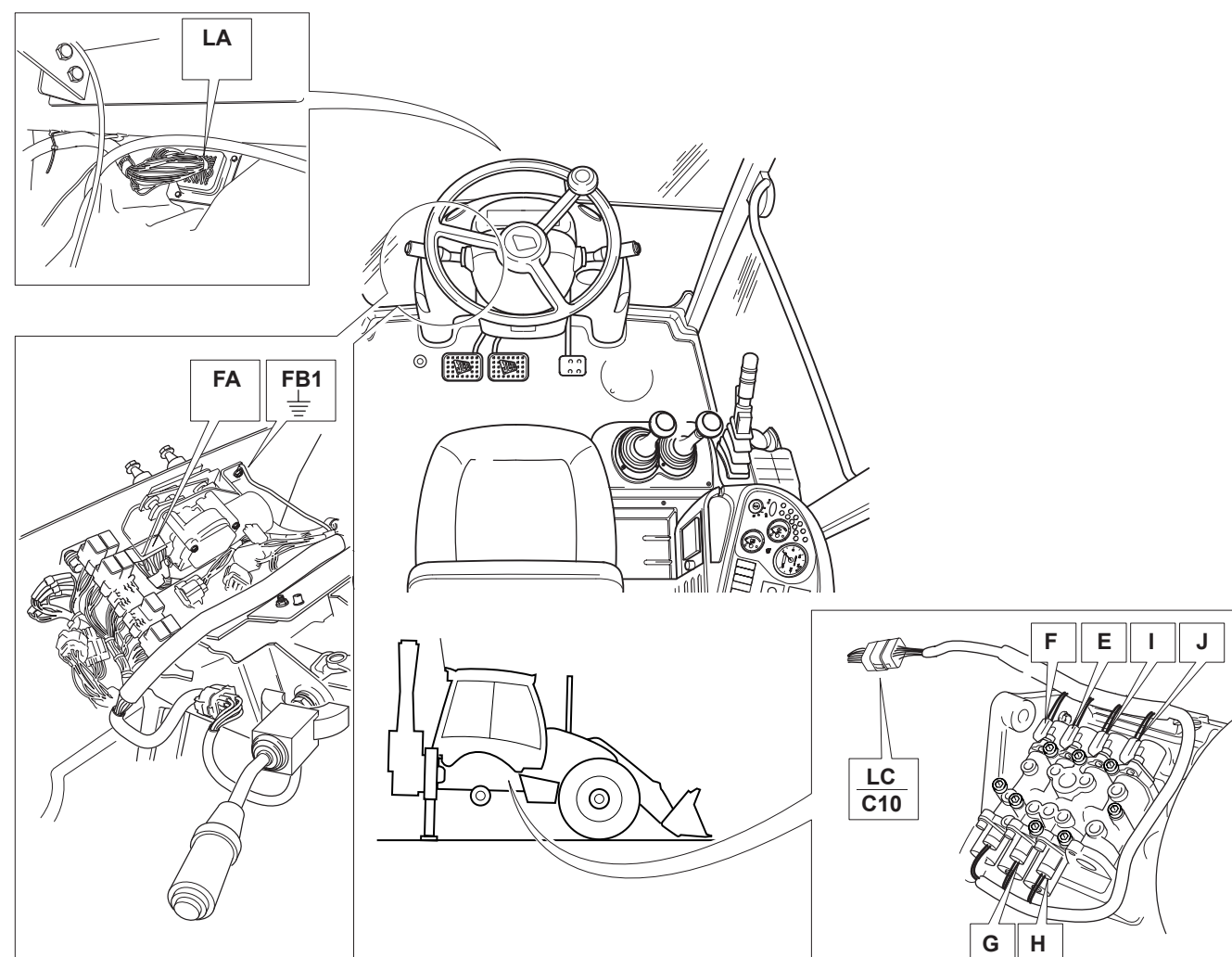
- SC**

#### Splices (h5)

- SA**

#### Earth Points

Faults may be caused by poor earth connections. Although earth connections are shown opposite, it must be remembered that the cab assembly is earthed via further earth strap and cable connections. For details of these connections see **Section C, Machine Earth Connections**.



A404900

## Powershift Gearbox - 6 Speed

### Introduction

This section explains how the Powershift 6 speed (ShiftMaster) electrical system works .

Central to the system is the ShiftMaster ECU (Electronic Control Unit) **1**. The unit receives 'inputs' from electrical devices such as the gear select switch **B**. Depending on the input signals the ECU 'outputs' energise electrical devices such as gearbox solenoid control valves **2**.

The ECU can be connected to diagnostics software loaded on a laptop PC. The communications link is facilitated via diagnostics socket **3**. See **Powershift Gearbox - 6 Speed, ShiftMaster Diagnostics - User Guide**.

**Note:** The ECU also controls 2/4WD selection by activating relay **S**. 2/4WD electrical system is not described in this section.

### Component Identification

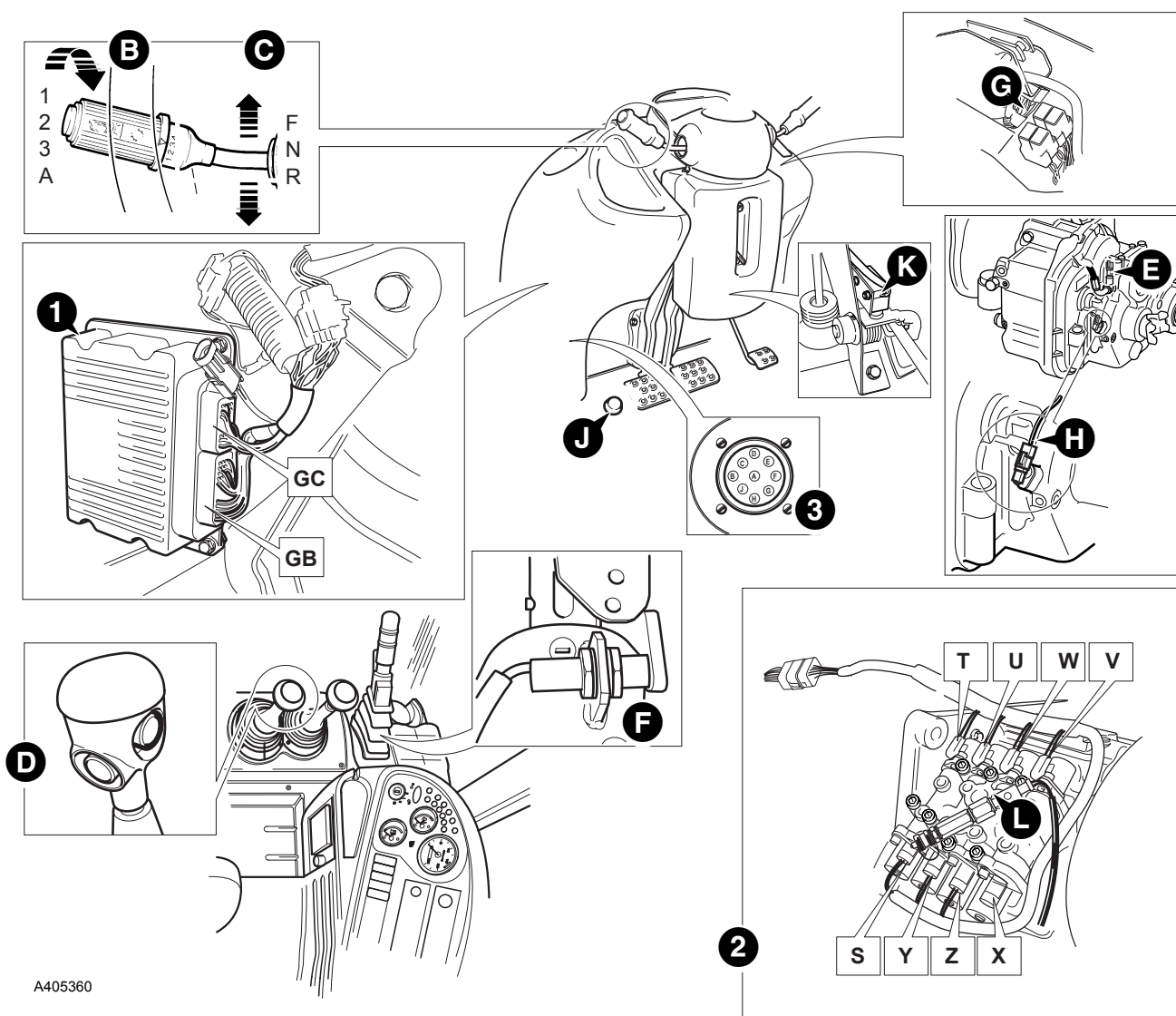
#### ECU input devices

- B** Gear select switch
- C** Forward/Neutral/Reverse select switch
- D** Transmission dump switch
- E** Gearbox oil temperature switch
- F** Park brake switch
- G** Transmission dump relay
- H** Speed sensor - gearbox mounted
- J** Kick down switch
- K** Throttle switch
- L** Gearbox oil pressure switch

#### ECU output - activated devices

- N** In-cab warning light - high gearbox oil temperature
- P** In-cab warning light - low gearbox oil pressure
- R** In-cab master warning light and buzzer
- S-Z** Gearbox solenoid control valves

**Note:** For identification of in-cab warning lights see the machine Operator Handbook.



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**Powershift Gearbox - 6 Speed**

**ECU Electrical Connections**

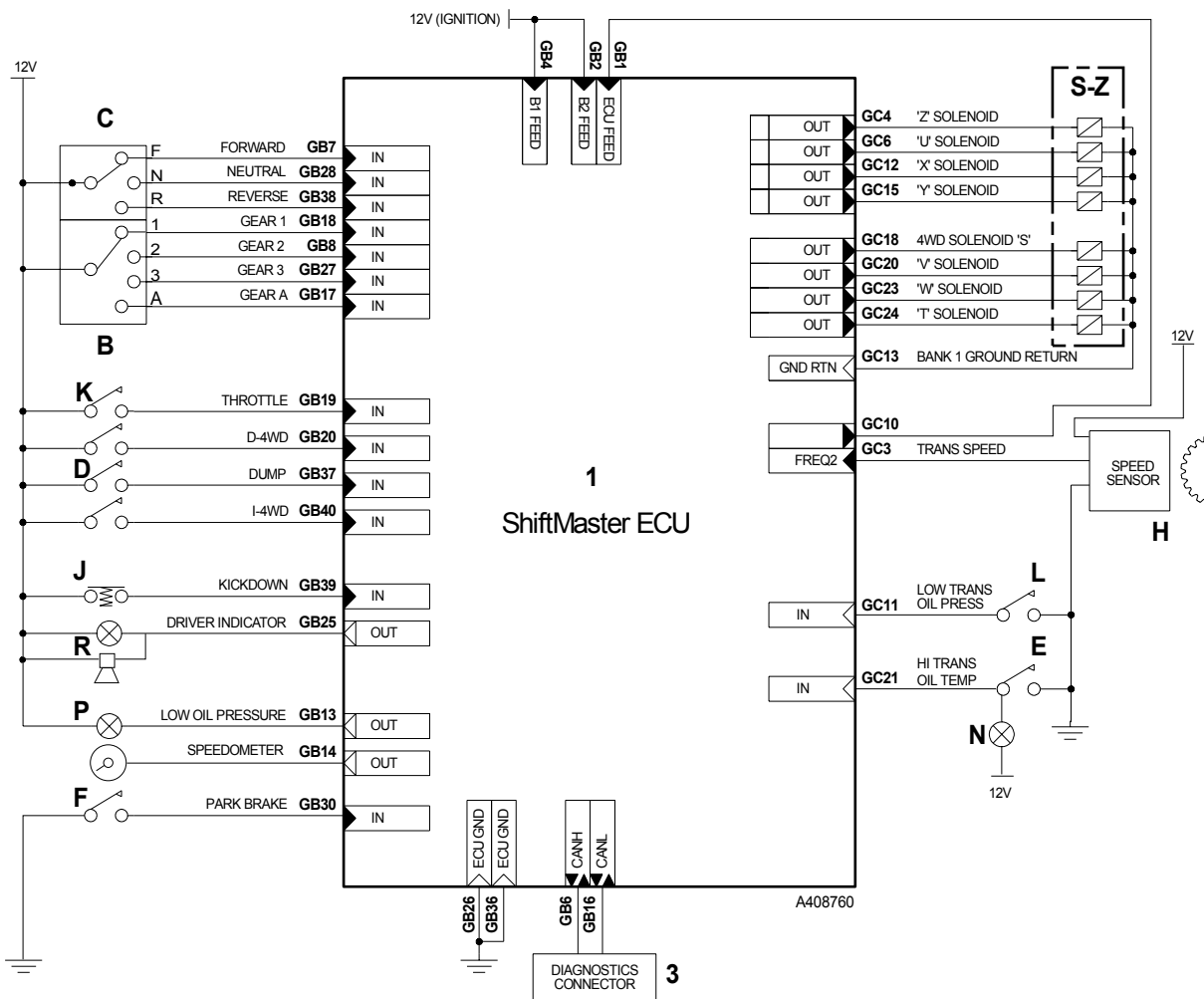
Electrical connections at the ECU are shown in the diagram below. Connections are divided into two groups;

- GB** Connections to components mounted on the gearbox
- GC** Connections to components mounted elsewhere on the machine.

For the key to the main components see **Component Identification** on the previous page. For more detailed explanations of the electrical connections for gearbox control see subsequent pages.

**Note:** When fault finding DO NOT use a multimeter on the ECU connector pins. Only test the associated wiring, uncouple connectors GB and GC and then use a multimeter at the pins inside these connectors as applicable. Use the ShiftMaster Diagnostics system to identify possible faults with the ECU See **Powershift Gearbox - 6 Speed, ShiftMaster Diagnostics - User Guide.**

- GB1** Feed from GC10
- GB2** 12v Feed
- GB4** 12v Feed
- GB6** Diagnostics connector
- GB7** Forward switch
- GB8** 2nd gear switch
- GB13** Warning lamp  
Low trans oil pressure
- GB14** Speedometer input
- GB17** Auto gear switch
- GB18** 1st gear switch
- GB19** Throttle switch
- GB20** Foot brake switch  
(4WD/4 wheel brake)
- GB24** Diagnostics connector
- GB25** Master warning lamp
- GB26** ECU Earth
- GB27** 3rd gear switch
- GB28** Neutral switch
- GB30** Parkbrake ON switch
- GB36** ECU Earth
- GB37** Trans dump switch
- GB38** Reverse switch
- GB39** Kickdown switch
- GB40** 4WD switch
- GC3** Speed sensor - input
- GC4** Output - 'Z' solenoid
- GC6** Output - 'U' solenoid
- GC10** Feed to GB1
- GC11** Switch  
Low trans oil pressure
- GC12** Output - 'X' solenoid
- GC13** ECU Earth
- GC15** Output - 'Y' solenoid
- GC18** Output - 'S' 4WD solenoid
- GC20** Output - 'V' solenoid
- GC21** Switch  
Trans oil temperature
- GC23** Output - 'W' solenoid
- GC24** Output - 'T' solenoid





**Powershift Gearbox - 6 Speed**

**Electrical Connections - Quick Reference**

The tables show live connector pins and also relevant earth destinations for given gearbox functions/systems as follows:

**E.C.U. feeds and earths**

**Transmission Dump**

**Park Brake ON (Transmission Dump)**

**1, 2, 3, 4(A), 5(A), 6(A) Forward** (see following pages)

**Neutral** (see following pages)

**1, 2, 3, 4 Reverse** (See following pages)

The information is intended as an aid when checking for faulty wires or connectors by means of continuity tests using a multimeter. DO NOT use a multimeter on the ECU connector pins (connectors A and B). Only test the associated wiring, uncouple connectors GB and GC and then use a multimeter at the pins inside these connectors as applicable. Use the ShiftMaster Diagnostics system to identify possible faults with the ECU See **Powershift Gearbox - 6 Speed, ShiftMaster Diagnostics - User Guide**.

Note that interconnecting harness connectors are not shown here. For full details see the relevant expanded harness schematic in this section.

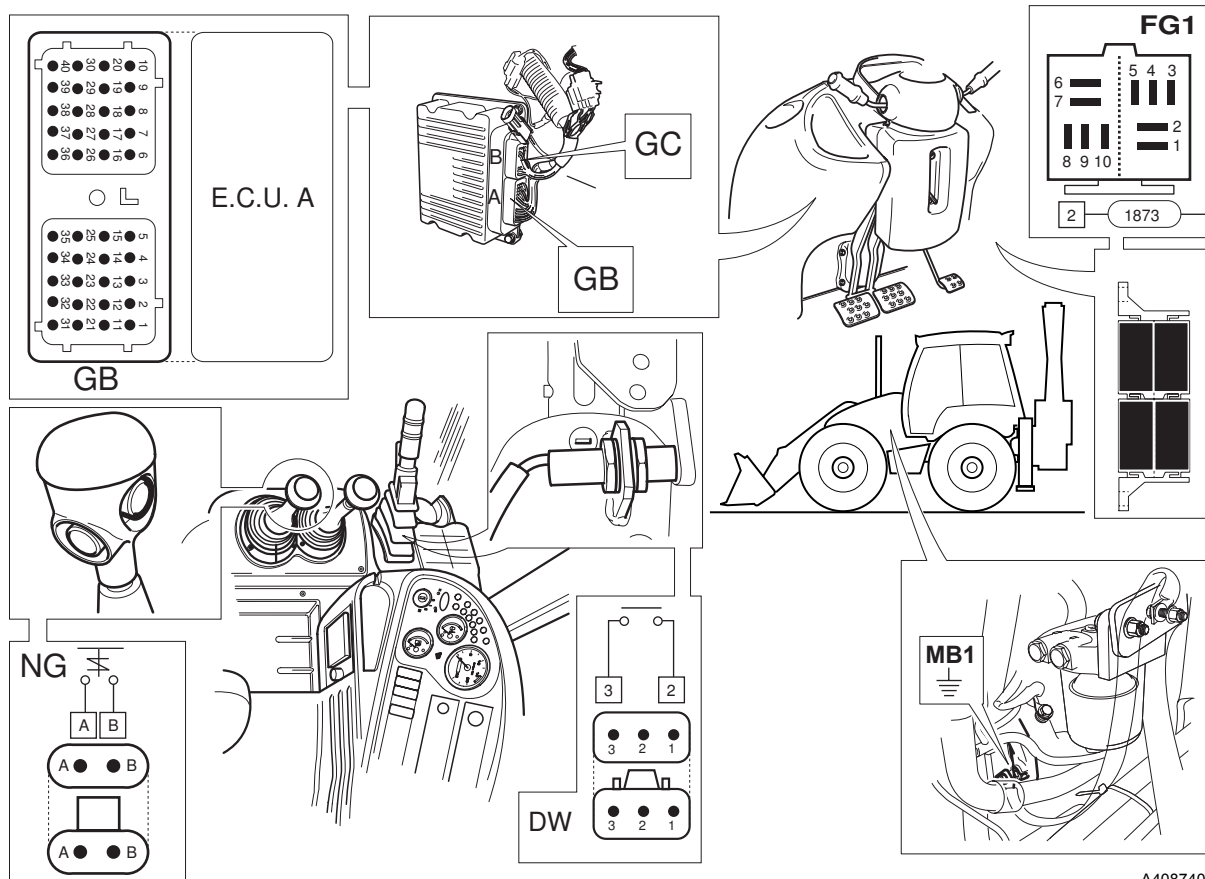
**Note:** Identify dump relay FG1 by locating wire 1873 at pin 2 of the corresponding relay base.

**Diagram X**

The diagram X (opposite) shows the electrical circuit for the gearbox control. It is shown with neutral selected and the park brake ON. 'Live feed' wires are coloured red and feed to earth are green.

**Key**

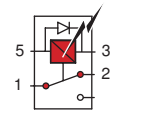
- A** Gearbox solenoids
- C50** Reverse alarm
- CM** Park brake warning light relay
- DW** Park brake switch
- DZ** Park brake relay
- FL** Column switch
- FG1** Transmission dump relay
- FG2** Reverse alarm relay
- GB** Harness connector - ECU 'A'
- GC** Harness connector - ECU 'B'
- GG** Throttle switch
- LE** Kick down switch
- NG** Transmission dump switch



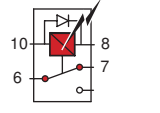
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**Powershift Gearbox - 6 Speed**

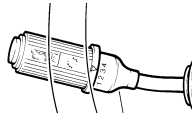
Gearbox function	Dump Switch NG	Relay FG1	E.C.U. GB
TRANSMISSION DUMP	A - B (MB1)	3 - 5, 1 - 2	37

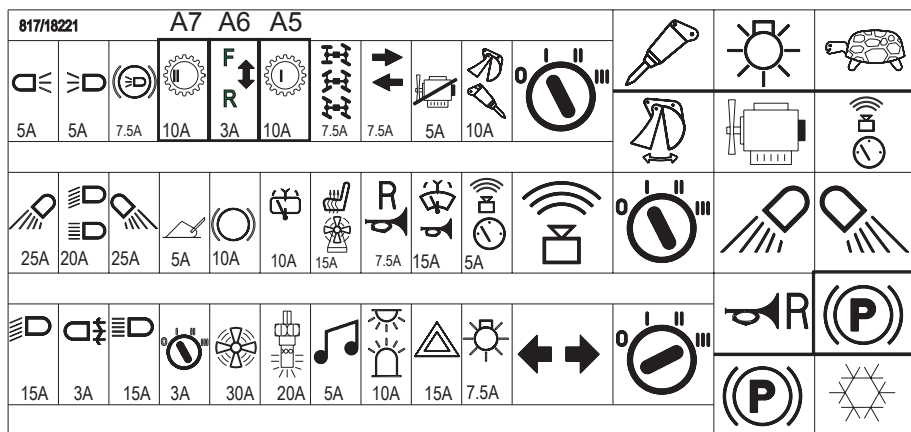
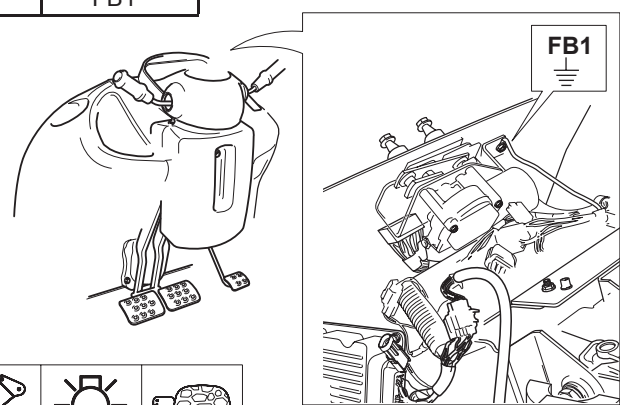


Gearbox function	Park Brake Switch DW	Relay DZ	E.C.U. GB
PARK BRAKE ON (TRANSMISSION DUMP)	1, 3, 2 (DR2)	8 - 10, 6 - 7 (DR2)	30

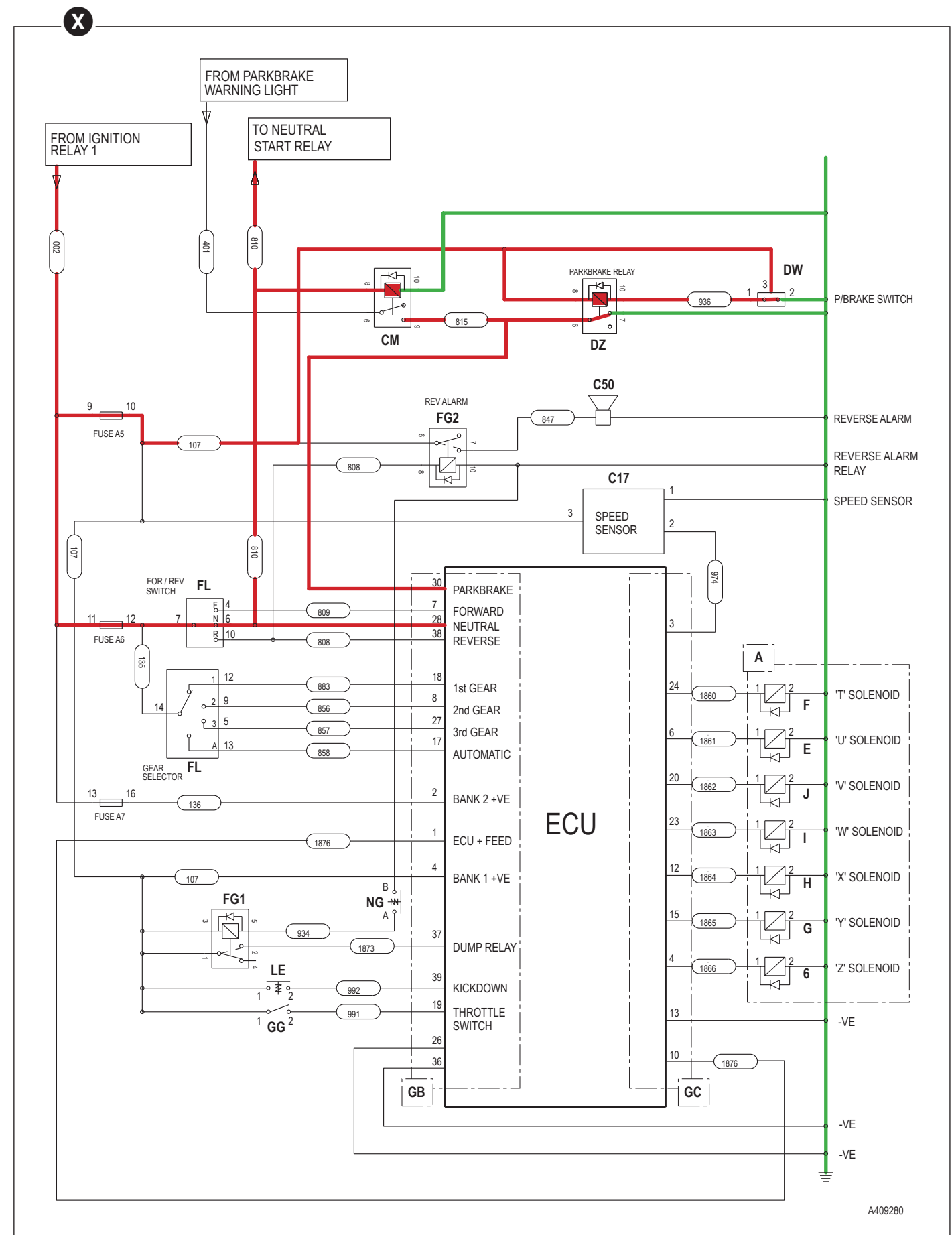


E.C.U. Power supply & Earths	Fuse	E.C.U. GB	E.C.U. GC	Earth Point
POWER FEED I	A5	4		
POWER FEED II	A7	2		
EARTH I		26		FB1
EARTH II		36		FB1
EARTH III			13	FB1

Column Switch FL Power supply	Fuse	Switch Connector FL
	A6	7, 14



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Powershift Gearbox - 6 Speed

Electrical Connections - Quick Reference

The tables show live connector pins and also relevant earth destinations for given gearbox functions/systems as follows: ECU feeds and earths (see previous pages)

Transmission Dump (see previous pages)

Park Brake ON (Transmission Dump) (see previous pages)

1, 2, 3, 4(A), 5(A), 6(A) Forward

Neutral

1, 2, 3, 4 Reverse

The information is intended as an aid when checking for faulty wires or connectors by means of continuity tests using a multimeter. DO NOT use a multimeter on the ECU connector pins (connectors A and B). Only test the associated wiring, uncouple connectors GB and GC and then use a multimeter at the pins inside these connectors as applicable. Use the ShiftMaster Diagnostics system to identify possible faults with the ECU See Powershift Gearbox - 6 Speed, ShiftMaster Diagnostics - User Guide.

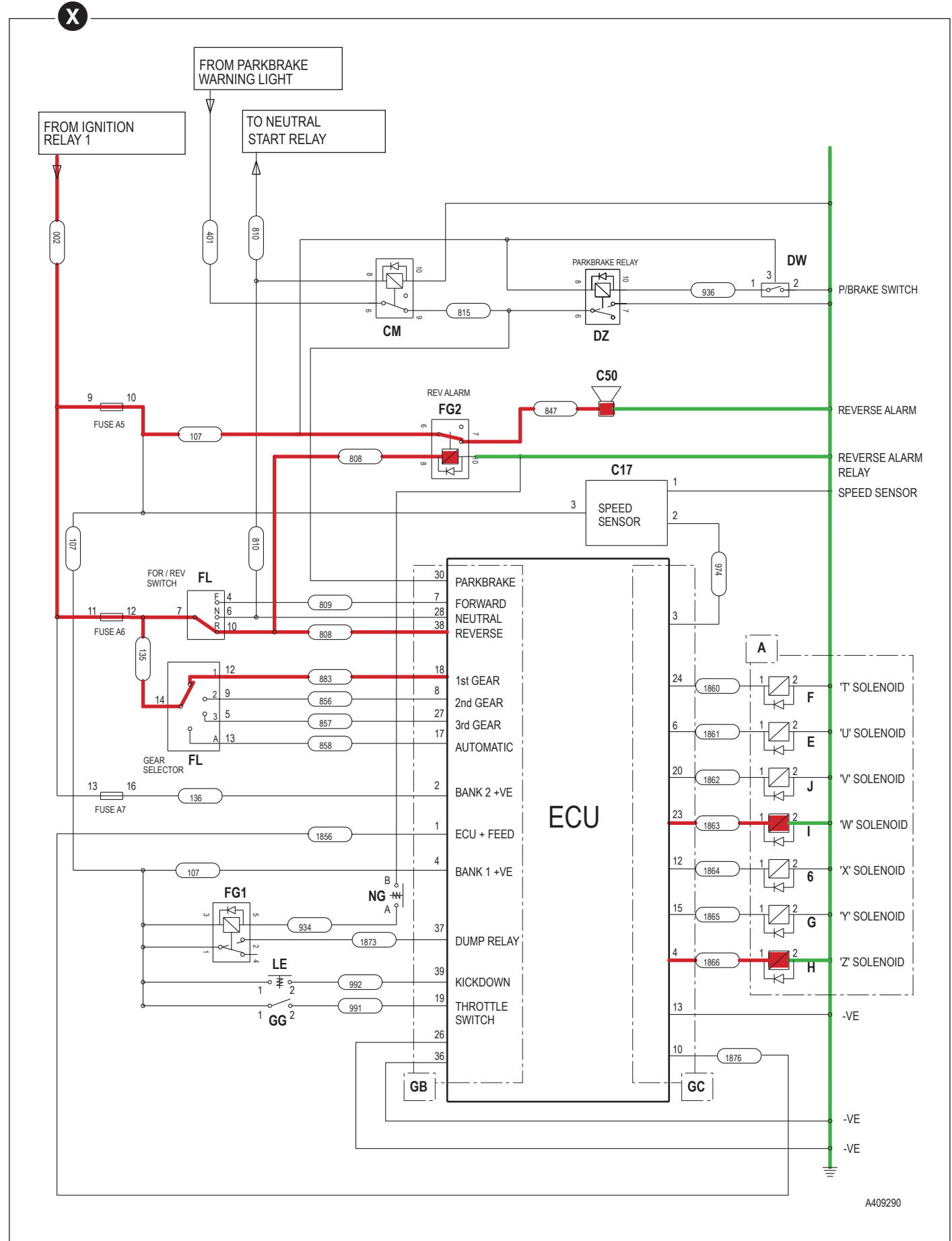
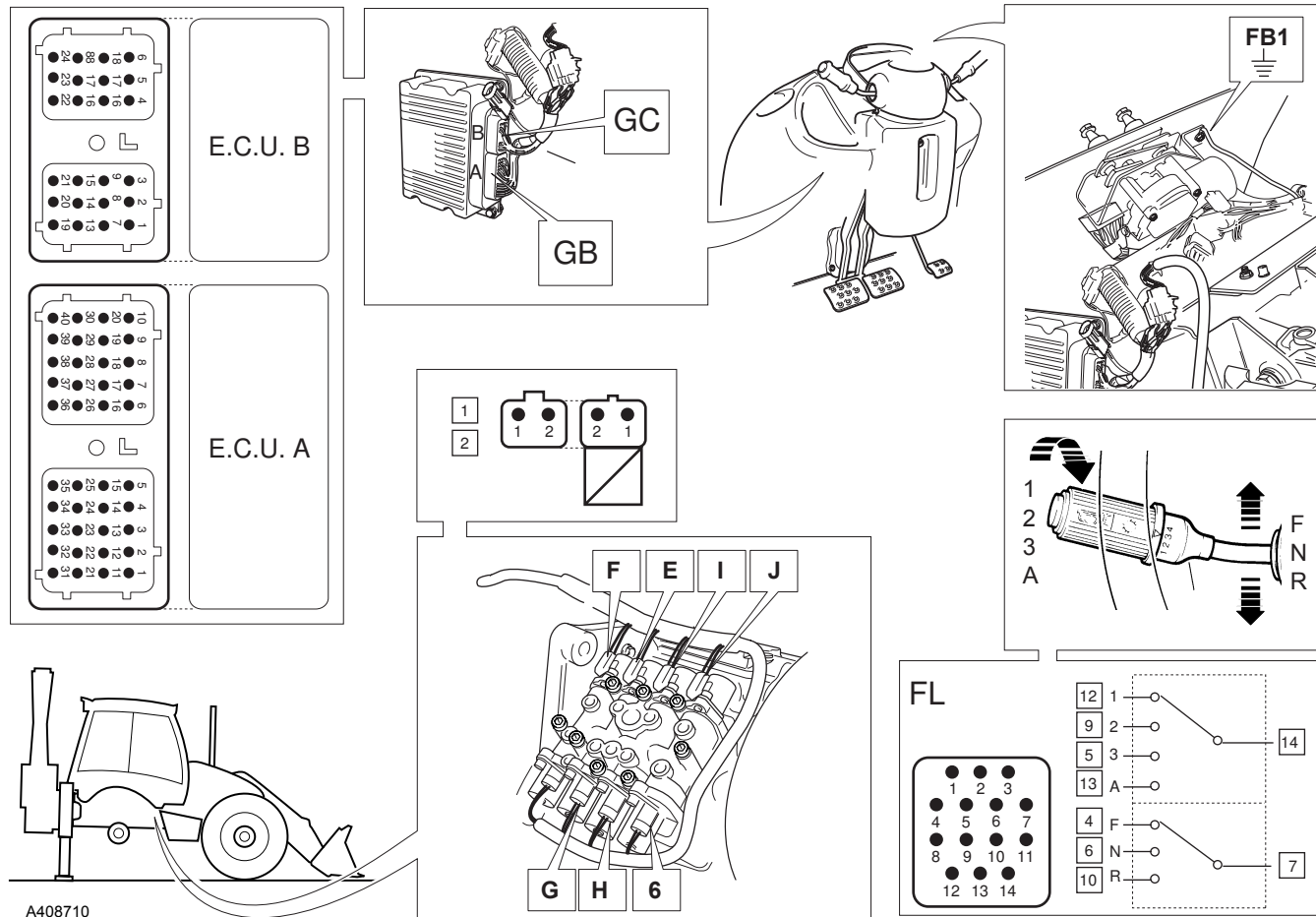
Remember that any interconnecting harness connectors are not shown here. For full details see the relevant expanded harness schematic in this section.

Diagram X

The diagram X (opposite) shows the electrical circuit for the gearbox control. It is shown with 1st gear reverse selected. 'Live feed' wires are coloured red and feed to earth are green.

Key

- A Gearbox solenoids
C50 Reverse alarm
CM Park brake warning light relay
DW Park brake switch
DZ Park brake relay
FL Column switch
FG1 Transmission dump relay
FG2 Reverse alarm relay
GB Harness connector - ECU 'A'
GC Harness connector - ECU 'B'
GG Throttle switch
LE Kick down switch
NG Transmission dump switch



Gearbox function	Column Switch FL	E.C.U. GB (Inputs)	E.C.U. GC (Outputs)	Solenoid Connector Labelled	Gearbox Solenoid
1st GEAR FORWARD	14 - 12 7 - 4	18 7	4 (Z) 12 (X)	+1, 2 (FB1) +1, 2 (FB1)	H 6
<b>1F</b>					
2nd GEAR FORWARD	14 - 9 7 - 4	8 7	4 (Z) 24 (T)	+1, 2 (FB1) +1, 2 (FB1)	H F
<b>2F</b>					
3rd GEAR FORWARD	14 - 5 7 - 4	27 7	4 (Z) 6 (U)	+1, 2 (FB1) +1, 2 (FB1)	H E
<b>3F</b>					
4th GEAR (A) FORWARD	14 - 13 7 - 4	17 7	15 (Y) 12 (X)	+1, 2 (FB1) +1, 2 (FB1)	G 6
<b>A</b>					
5th GEAR (A) FORWARD	14 - 13 7 - 4	17 7	15 (Y) 24 (T)	+1, 2 (FB1) +1, 2 (FB1)	G F
<b>A</b>					
6th GEAR (A) FORWARD	14 - 13 7 - 4	17 7	15 (Y) 6 (U)	+1, 2 (FB1) +1, 2 (FB1)	G E
<b>A</b>					

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Gearbox function	Column Switch FL	E.C.U. GB
NEUTRAL	7 - 6	28
<b>N</b>		

Gearbox function	Column Switch FL	E.C.U. GB (Inputs)	E.C.U. GC (Outputs)	Solenoid Connector Labelled	Gearbox Solenoid
1st GEAR REVERSE	14 - 12 7 - 10	18 38	4 (Z) 23 (W)	+1, 2 (FB1) +1, 2 (FB1)	H I
<b>1R</b>					
2nd GEAR REVERSE	14 - 9 7 - 10	8 38	4 (Z) 20 (V)	+1, 2 (FB1) +1, 2 (FB1)	H J
<b>2R</b>					
3rd GEAR REVERSE	14 - 5 7 - 10	27 38	15 (Y) 23 (W)	+1, 2 (FB1) +1, 2 (FB1)	G I
<b>3R</b>					
4th GEAR REVERSE	14 - 13 7 - 10	17 38	15 (Y) 20 (V)	+1, 2 (FB1) +1, 2 (FB1)	G J
<b>4R (A)</b>					

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## Powershift Gearbox - 6 Speed

### Electrical Connections - Wires and Connectors

Schematics are divided into 2 parts: **Input Controls** and **Gearbox Solenoid Actuation**.

On the electrical diagram opposite the electrical connectors (example, FA to LA) are shown looking on the mating face of each connector when they are disconnected.

The wire numbers and colours, where appropriate, are shown as an aid to identification whilst fault finding.

Before fault finding make sure that you understand how the the electrical circuits work. The most effective method of fault finding is by means of ShiftMaster Dagnostics software and a laptop PC, see **Service Procedures, Powershift Gearbox - 6 speed, ShiftMaster Dagnostics - User Guide**. Having identified a faulty system, use the schematics to identify the relevant wires and connectors, continuity checks can then be carried out using a multimeter. Gearbox solenoid coils can be checked for the correct resistance value as given in **Technical Data**. See **Service Procedures, Electrical Testing Methods** for more details.

### Input Controls

For gearbox solenoid actuation see subsequent pages.

#### Component Key (Input controls):

The following key identifies the component connectors on the opposite diagrams. Note that the wires coloured red show the electrical 'live feed' to the column gear lever and gearbox E.C.U..

- h1** Harness - 721/10937 Front console
- h2** Harness - 721/10971 Link
- h3** Harness - 721/10970 Side console
- h4** Harness - 721/10935 Engine/mainframe
- h5** Harness - 721/10941 Transmission

**Note:** For harness drawings see **Section C**.

#### Connectors (h1)

- FA** h1 → h2
- FB1** Earth point
- FG** Transmission dump relay
- Note:** Identify dump relay FG by locating wire 1873 at pin 2 of the corresponding relay base.
- FL** Column gear lever
- GB** E.C.U. connector A
- GC** E.C.U. connector B
- GG** Throttle switch

#### Connectors (h2)

- LA** h2 → h1
- LB** h2 → h3
- LC** h2 → h5
- LE** Kick down switch

#### Connectors (h3)

- CA** h3 → h4
- CB** h3 → h2
- CM** Park brake warning light relay
- CCA** Fuses
- DR2** Earth point
- DZ** Park brake relay
- DW** Park brake switch
- EA** Immobiliser
- EAB** Link - immobiliser (if immobiliser is not fitted)

#### Connectors (h4)

- NH** h4 → h3
- NG** Transmission dump switch
- MB1** Earth point

#### Splices (h1)

- SA**
- SC**
- SF**
- SJ**
- SL**
- SS**

#### Splices h2

- SB**
- SC**

#### Splices h3

- DW**
- TF**

#### Splices h4

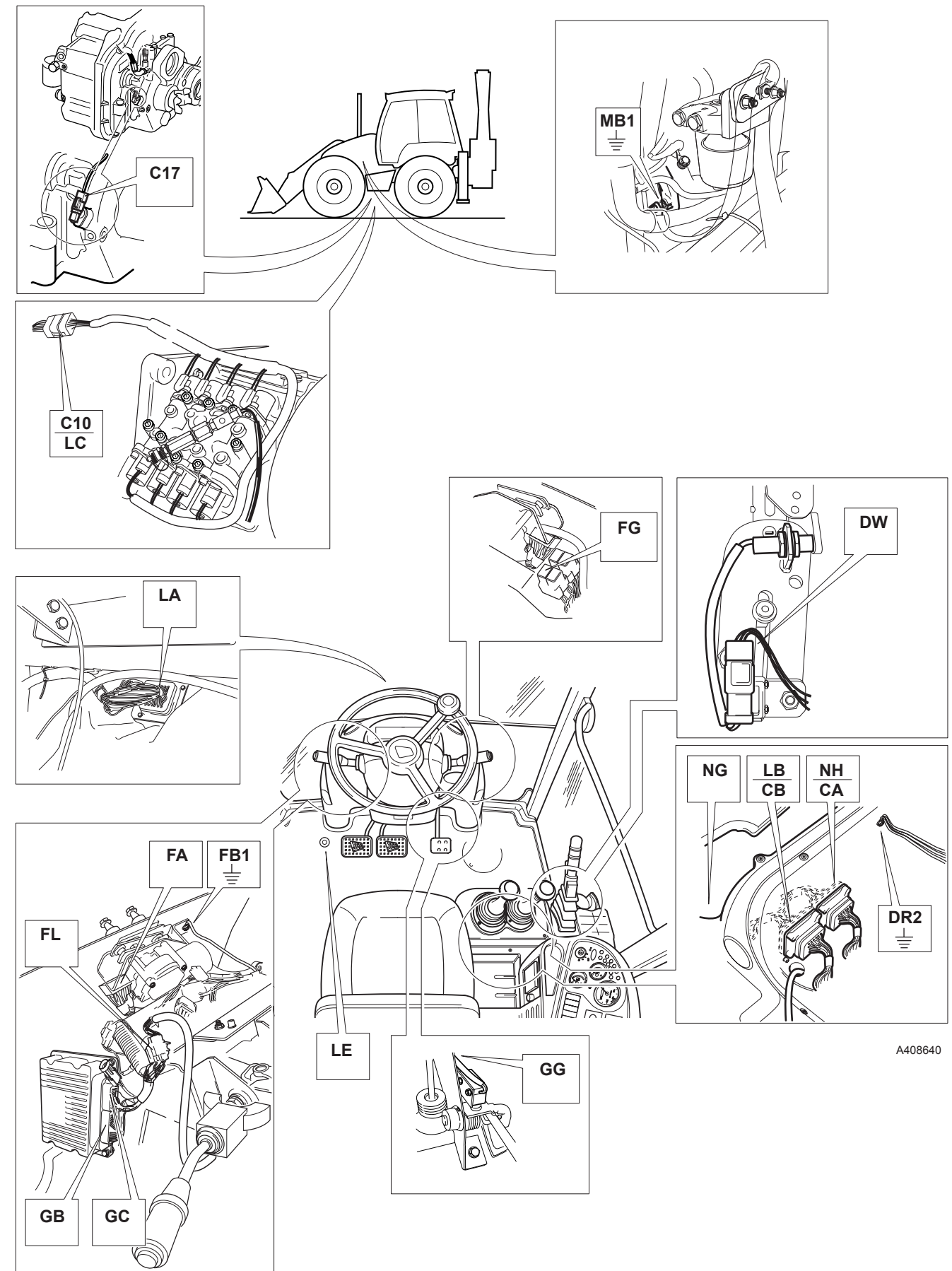
- SA**

#### Splices h5

- SA**

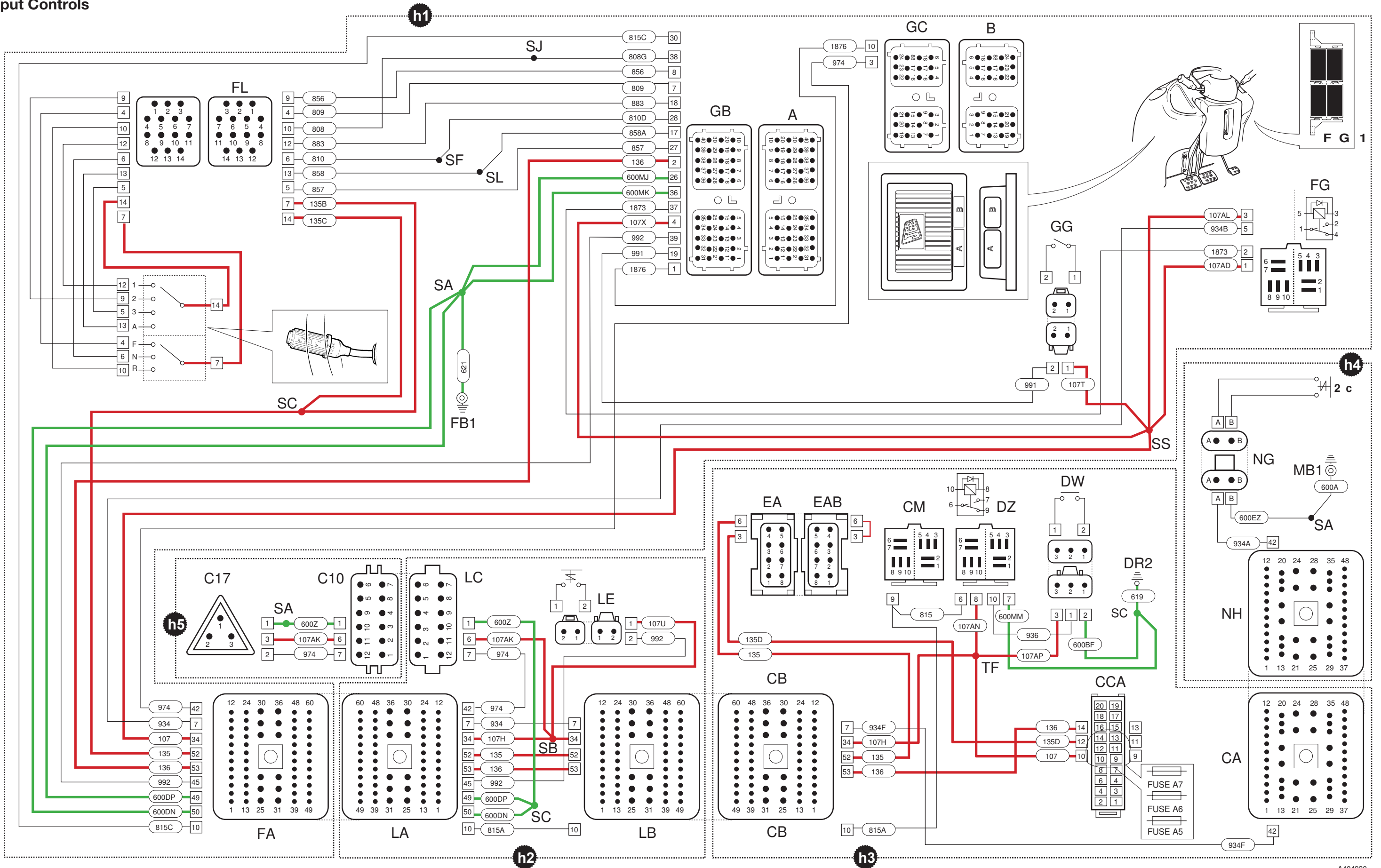
#### Earth Points

Faults may be caused by poor earth connections. Although earth connections are shown opposite, it must be remembered that the cab assembly is earthed via further earth strap and cable connections. For details of these connections see **Section C, Machine Earth Connections**.

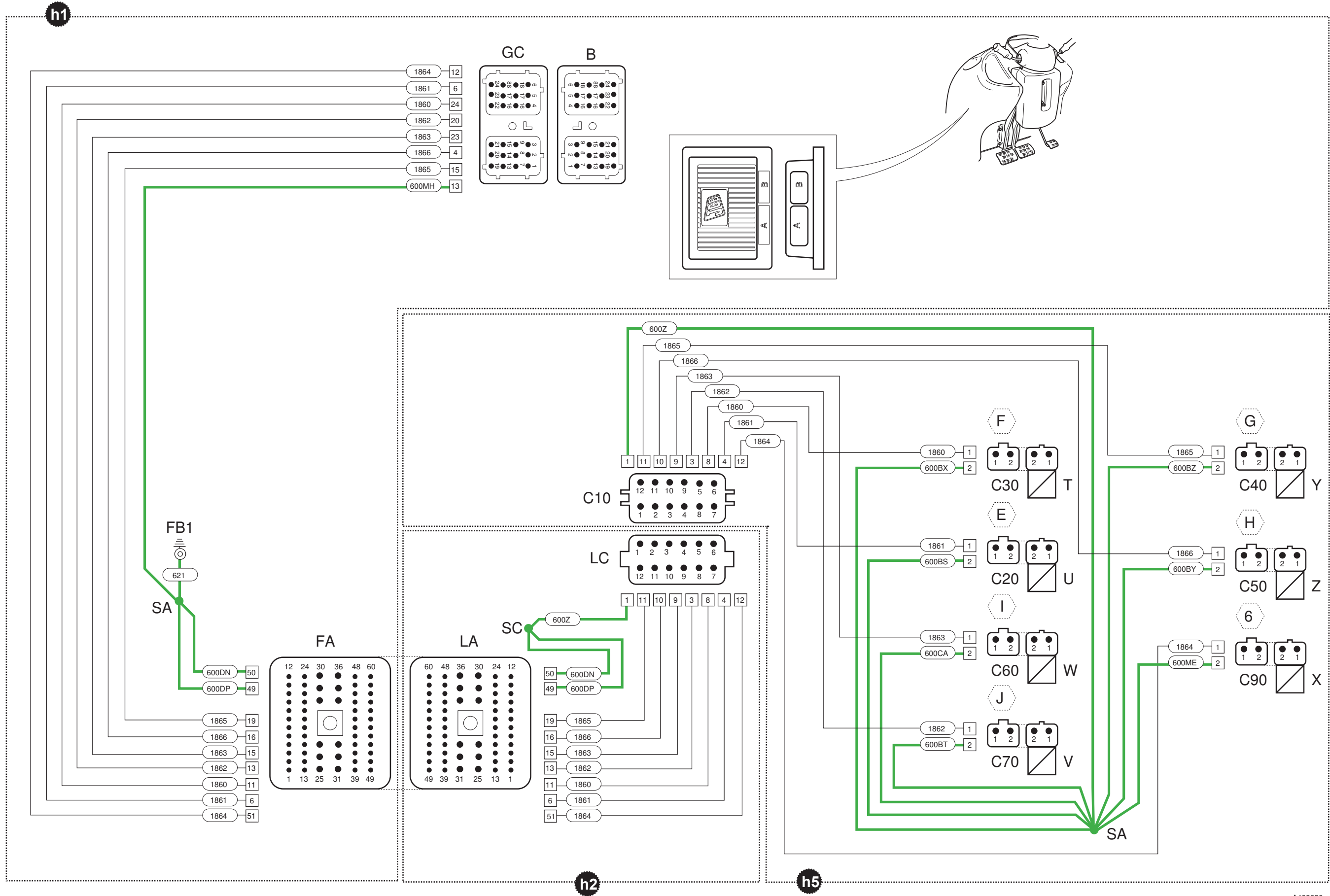


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Powershift Gearbox - 6 Speed  
Input Controls



Powershift Gearbox - 6 Speed  
Gearbox Solenoid Actuation



**Powershift Gearbox - 6 Speed (cont'd)****Electrical Connections - Wires and Connectors  
Gearbox Solenoid Actuation**

For input controls see previous page.

**Component Key** (solenoid activation):  
The following key identifies the component connectors on the diagrams opposite. Note that the wires coloured green show the electrical 'feed to earth' for the gearbox mounted solenoids and gearbox ECU.

**h1** Harness - 721/10937 Front console  
**h2** Harness - 721/10971 Link  
**h5** Harness - 721/10941 Gearbox

**Note:** For harness drawings see **Section C**.

**Connectors (h1)**

**GC** E.C.U. connector B  
**FA** h1 → h2  
**FB1** Earth point

**Connectors (h2)**

**LA** h1 → h2  
**LC** h2 → h5

**Connectors (h5)**

**C10** h5 → h2  
**C20** Gearbox solenoid U (labelled **E**)  
**C30** Gearbox solenoid T (labelled **F**)  
**C40** Gearbox solenoid Y (labelled **G**)  
**C50** Gearbox solenoid Z (labelled **H**)  
**C60** Gearbox solenoid W (labelled **I**)  
**C70** Gearbox solenoid V (labelled **J**)  
**C90** Gearbox solenoid X (labelled **6**)

**Splices (h1)**

**SA**

**Splices (h2)**

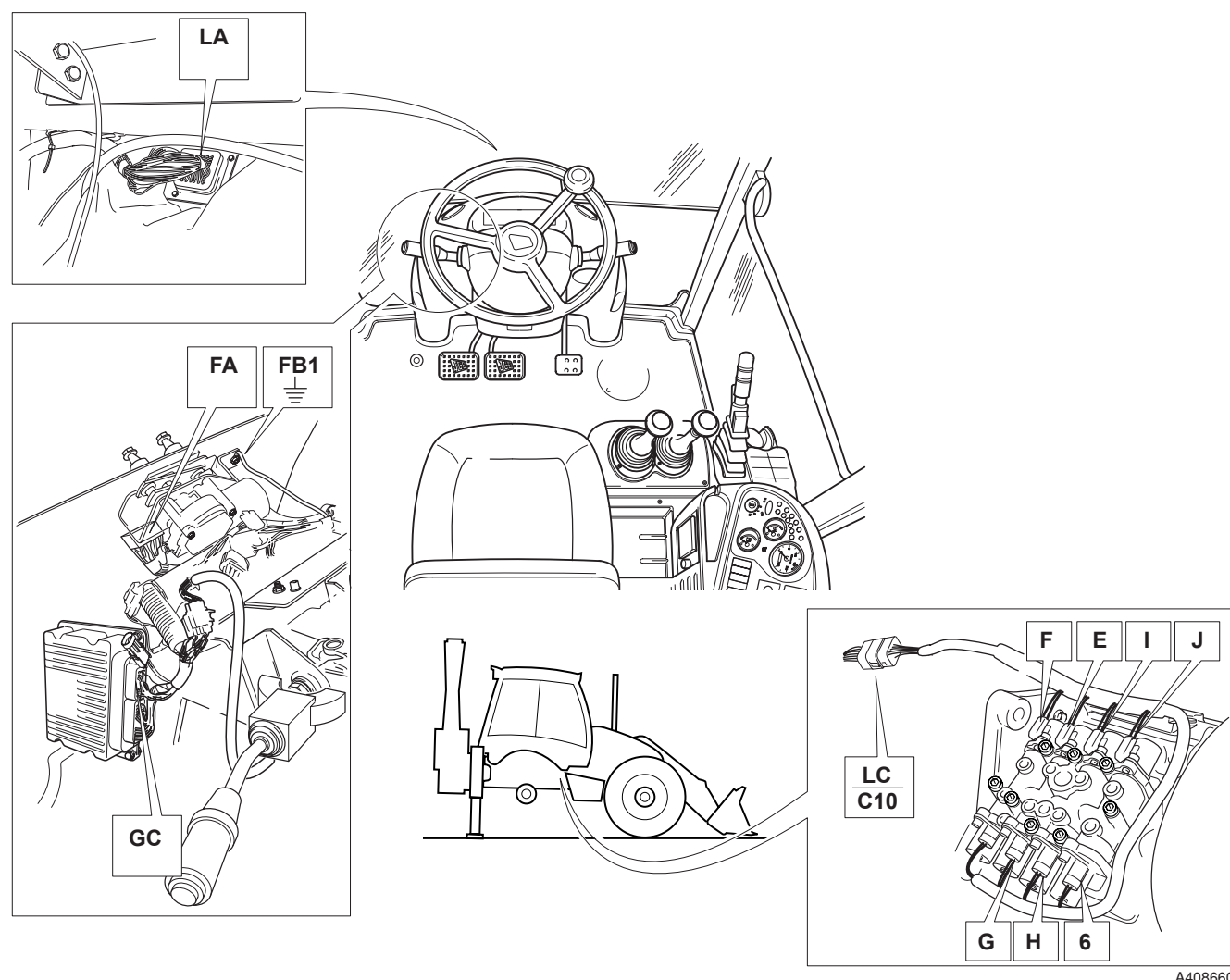
**SC**

**Splices (h5)**

**SA**

**Earth Points**

Faults may be caused by poor earth connections. Although earth connections are shown opposite, it must be remembered that the cab assembly is earthed via further earth strap and cable connections. For details of these connections see **Section C, Machine Earth Connections**.





## Synchro Shuttle Gearbox

Before carrying out the checks listed the machine should, if possible, be operated to determine the fault area(s), and bring the systems to their normal working temperatures.

Ensure that the correct quantity and grade of oil is used and that there are no obvious leaks.

- A** If the transmission is noisy, start at check 1.
- B** If the transmission is overheating, start at check 4.
- C** If the transmission will not pull, start at check 12.
- D** If there is no drive in one or both directions, start at check 17.
- E** If the transmission is jumping out of gear, start at check 29.
- F** If the transmission is sticking in gear, start at check 39.
- G** If ratios are 'crash changing', start at check 41.

CHECK	ACTION
1 Is there noise when selecting direction?	YES: Check 3 NO: Check 2
2 Is there noise when running with direction selector in neutral and ratio selector in 1st?	YES: Check 9 NO: Check 19
3 Is there air in the hydraulic system?	YES: Continue running to expel air. NO: Check 4
4 Is the fluid level correct?	YES: Check 5 NO: Check level only when machine is cold and top-up as required.
5 Are the oil passages restricted?	YES: Clear the restriction. NO: Check 6
6 Is the suction strainer restricted?	YES: Remove and clean strainer. NO: Check 7
7 Is pump pressure as specified?	YES: Check 9 NO: Check clutch pressure maintenance valve is free to operate.
8 When flow testing pump, is output low?	YES: Renew pump. NO: Check converter sprag clutch for wear or slip.
9 Does the noise continue when direction selector is in forward or reverse?	YES: Check 10 NO: Check 11
10 Is transmission misaligned?	YES: Renew mountings and check position. NO: Check 'converter out' pressure and flow.
11 Are the pump bushes worn?	YES: Renew NO: Check converter for wear or cooler for restriction to flow.
12 Is the transmission not pulling in one direction only?	YES: Check 16 NO: Check 13
13 Is the transmission not pulling in both Forward and Reverse?	YES: Stall test machine, Check 14. NO: Check 16

**Synchro Shuttle Gearbox (cont'd)**

CHECK	ACTION
14 Is 'converter in' pressure as specified?	YES: Check 15 NO: Inspect converter relief valve for damage. Check cooler bypass valve pressure setting.
15 Is pump being driven by converter?	YES: Check pump pressure. NO: Renew damaged parts.
16 Are clutch sealing rings damaged?	YES: Tap pressure gauge into clutch feed lines to monitor pressure. NO: Check clutch plates for damage.
17 Is there drive in one direction only?	YES: Check 19 NO: Check 18
18 Is the start switch in the run position and supplying current to the neutral start relay?	YES: Check 19 NO: Rectify.
19 Is the fault only when the transmission is hot?	YES: Dismantle solenoid and check components. NO: Check microswitches, relay and wiring loom.
20 Is the noise a growl, hum or grinding?	YES: Check gears for damage or wear. NO: Check 21
21 Is the noise a hiss, thump or bumping?	YES: Check bearings for damage or wear. NO: Check 22
22 Is the noise a squeal?	YES: Check free running gears for seizure. NO: Check 23
23 Is the noise present when in neutral or when in gear?	NEUTRAL: Check 24 IN GEAR: Check 27
24 Is the countershaft or its bearings worn or damaged?	YES: Renew damaged parts. NO: Check 25
25 Is there excessive backlash in the gears?	YES: Adjust by checking shaft end float. NO: Check 26
26 Is the mainshaft pilot bearing worn?	YES: Renew. NO: Check gear teeth for scuffing.
27 Is the mainshaft rear bearing worn?	YES: Renew. NO: Check 28
28 Are the sliding gear teeth worn or damaged?	YES: Renew gears. NO: Check 29
29 Are the selector forks loose?	YES: Tighten screws. NO: Check 30
30 Are the selector fork pads or grooves in gears worn?	YES: Renew worn parts. NO: Check 31
31 Are the dog gear teeth worn?	YES: Renew. NO: Check 32
32 Are the selector rod detent springs broken?	YES: Renew. NO: Check 33

**Synchro Shuttle Gearbox (cont'd)**

CHECK	ACTION
<b>33</b> Are the selector rods worn or damaged?	YES: Renew. NO: Check 34
<b>34</b> Are the selector fork pads out of position?	YES: Reposition or renew (check interlock). NO: Check 35
<b>35</b> Is there excessive end float in gears or shafts?	YES: Adjust. NO: Check thrust washers and mating faces.
<b>36</b> Is the synchroniser bronze worn?	YES: Renew synchro pack. NO: Check 37
<b>37</b> Are steel chips embedded in the bronze?	YES: Continue using, chips will either embed below bronze or be rejected. NO: Check 38
<b>38</b> Are the synchroniser components damaged?	YES: Renew. NO: Check free running gears for seizure or damage.
<b>39</b> Are the sliding gears tight on the splines?	YES: Free or renew. NO: Check 40
<b>40</b> Are chips wedged between splines of shaft or gear?	YES: Remove chips. NO: Ensure that clutch is disengaged when dump pedal is pressed.
<b>41</b> Are steel chips embedded in the bronze?	YES: Continue using, chips will either embed below bronze or be rejected. NO: Check 42
<b>42</b> Are the synchroniser spring pins damaged?	YES: Renew synchro. NO: Check 43
<b>43</b> Is the synchroniser bronze worn?	YES: Renew synchro. NO: Check blocker pins.

**Synchro Shuttle Gearbox - 2/4 Wheel Drive Clutch****4WD CANNOT BE ENGAGED**

In normal operation the 2/4 wheel drive clutch is spring loaded off and therefore disengaged to give 2 wheel drive. The clutch must be pressurised to give 4 wheel drive. Before starting the more detailed fault finding procedures - eliminate the obvious:

- 1 Check that the transmission oil level is correct.
- 2 Check that the fuse for the 2/4WD circuit is intact.
- 3 Check that the 4-wheel drive external pipework is not damaged and that the drive train is intact.
- 4 Check that all the electrical connections are clean and secure. Also check that the solenoid spool is not sticking (in the 2WD position).
- 5 Check that the mainline pressure is correct (see 'Low Mainline Pressure').
- 6 Check that the pump flow rate is correct.

If the fault is not rectified after eliminating the obvious, check the following:

Possible Cause	Remedy
<b>7</b> Low mainline pressure	<b>7</b> Identify if the fault is related to the 2/4WD disconnect:  <b>7.1</b> Disconnect the external pipework to the 2/4WD clutch. Cap and plug open orifices.  <b>7.2</b> Check the mainline pressure - if the pressure is correct, the fault must be within the 2/4WD (see step 8). If the reading is still low check the transmission in the normal manner.
<b>8</b> Low mainline pressure (due to 2/4WD clutch):  <b>8.1</b> 2/4WD solenoid spool sticking.  <b>8.2</b> 2/4WD solenoid spool O-ring failed.  <b>8.3</b> Clutch shaft sealing rings leaking.  <b>8.4</b> Excessive clutch shaft end float.  <b>8.5</b> Wrong type clutch piston fitted.  <b>8.6</b> Clutch piston O-ring failed.	<b>8</b> Rectify fault:  <b>8.1</b> Strip, clean and re-assemble solenoid valve, renew valve if required.  <b>8.2</b> Renew O-ring.  <b>8.3</b> Renew clutch shaft sealing rings.  <b>8.4</b> Rectify fault, renew parts as required, reset end float (should not exceed 0.03 mm; 0.001 in)  <b>8.5</b> Fit correct type clutch piston (ie, without bleed hole).  <b>8.6</b> Replace clutch piston O-ring.
<b>9</b> Defective 2/4WD clutch:  <b>9.1</b> Worn friction/counter plates  <b>9.2</b> Mechanical failure of 4WD unit  <b>9.3</b> Incorrect clutch pack end float.	<b>9</b> Rectify fault:  <b>9.1</b> Inspect friction/counter plates, renew as required.  <b>9.2</b> Strip and inspect 4WD unit. Check that the electrical and hydraulic circuits are functioning correctly.  <b>9.3</b> Measure clutch pack end float (should be 1.0 to 2.3 mm). Correct as required.

**Synchro Shuttle Gearbox - 2/4 Wheel Drive Clutch (cont'd)****2WD CANNOT BE ENGAGED**

No pressure is required to engage 2WD (spring loaded). Check that the solenoid spool is not sticking (in the 4WD position), then see below.

Possible Cause	Remedy
<b>10</b> Incorrect type of solenoid valve fitted.	<b>10</b> Check solenoid.  <b>Note:</b> Powershift and Synchro Shuttle machines have different types of solenoid - check parts list.
<b>11</b> Non-return valve faulty (noticeable because 2WD cannot be engaged).	<b>11</b> Check the non-return valve.
<b>12</b> 2/4WD solenoid permanently energised.	<b>12</b> Check the 2/4WD relay and select switch, replace as necessary.

## Powershift Gearbox

### Introduction

The fault finding procedures are given in the form of flow charts. There are a number of charts, each one dedicated to a particular fault. The charts are designed to identify possible causes by performing checks and where applicable, specific tests on the gearbox. Having identified a cause the suggested remedy is given. The charts are designed to identify causes through a process of elimination, starting with the simplest, most easily rectified faults.

- \* Gearbox faults may be caused by faulty electrical connectors or components as indicated in the fault finding charts. Full explanations of the relevant electrical systems for both 4 speed and 6 speed (Shiftmaster) gearboxes are given in **Electrical Connections**.

Due to the time and effort involved in removing, dismantling, assembling and replacing a gearbox, it is recommended that fault finding procedures are carried out until a fault can be identified with a good degree of certainty.

Full details of the test procedures referred to in the charts are given in **Service Procedures, Powershift Gearbox**.

### Fault Finding Charts:

**Chart A** - Machine drives but lacks power in all gears.  
Gearbox oil may also be overheating.

**Chart B** - Machine does not drive in any gear.

**Chart C** - Some gears fail to engage or lack power. 4WD fails to engage.

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

**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**.

**Chart E** - Gearbox oil overheats

**Chart F** - External oil leakage

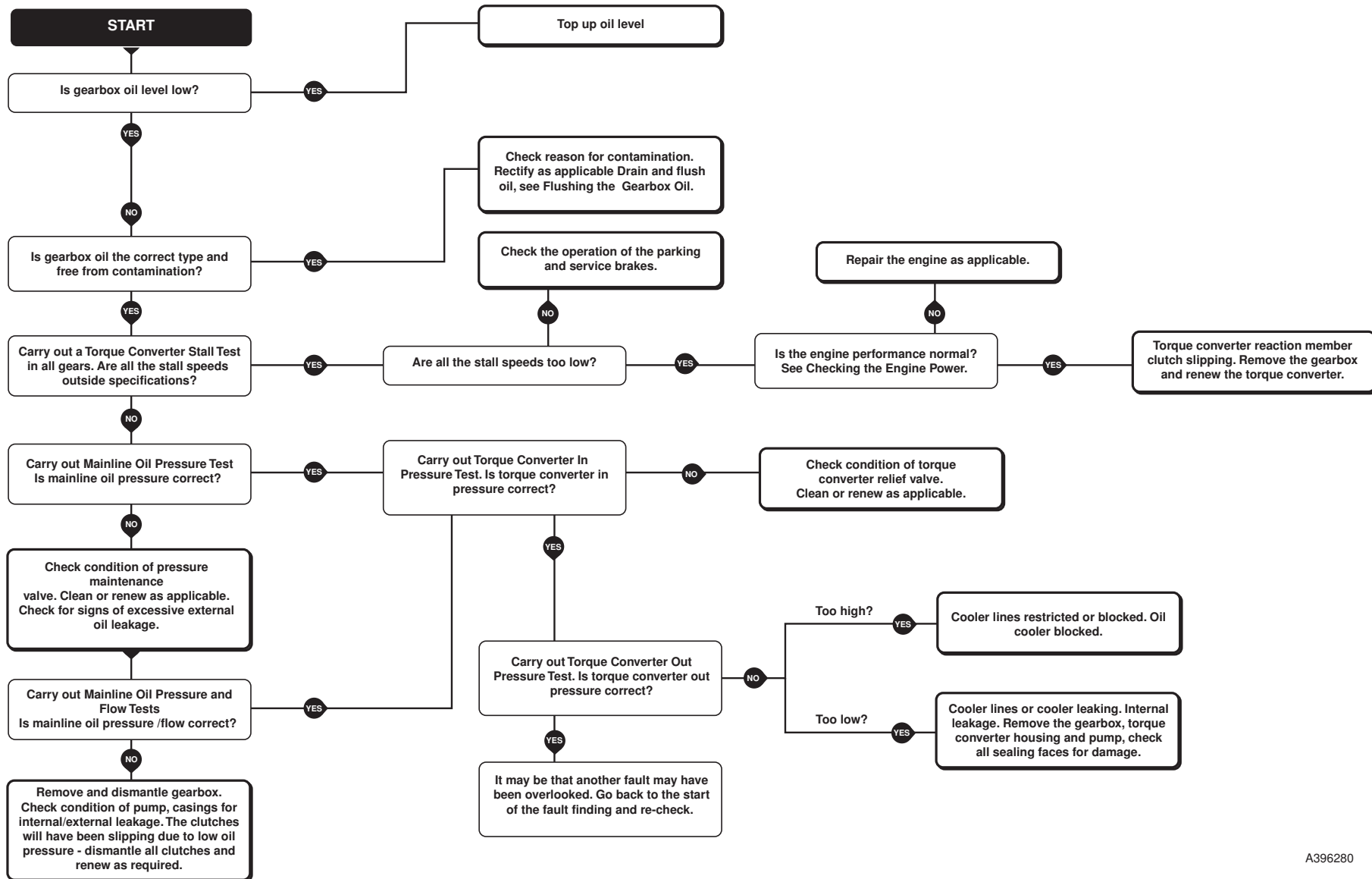
**Chart G** - Noisy operation

### Further Fault Finding Information

Gearbox Oil Contaminated with Water

**Powershift Gearbox**

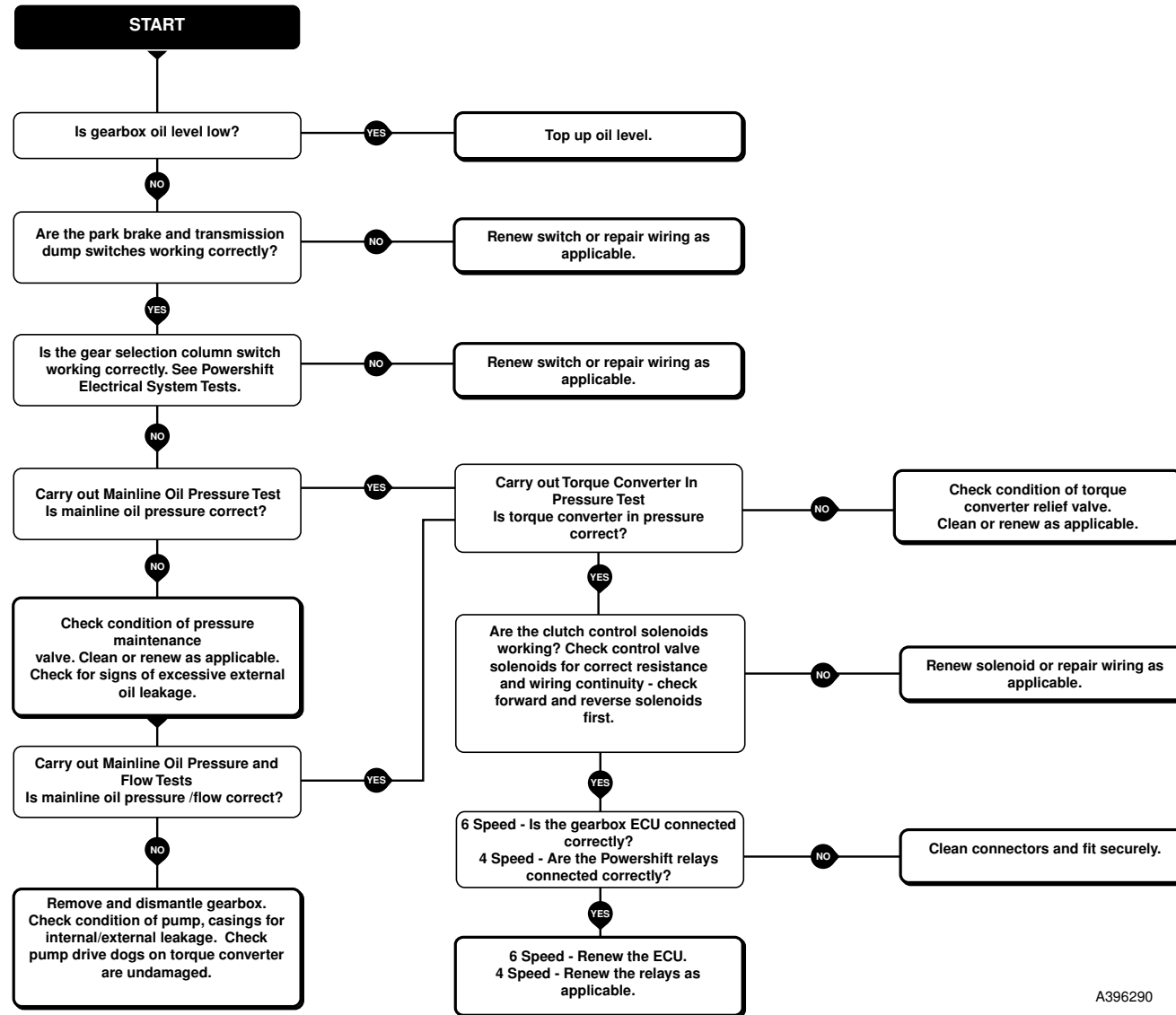
**Chart A - Machine drives but lacks power in all gears. Gearbox oil may also be overheating.**



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**Powershift Gearbox**

**Chart B - Machine does not drive in any gear.**

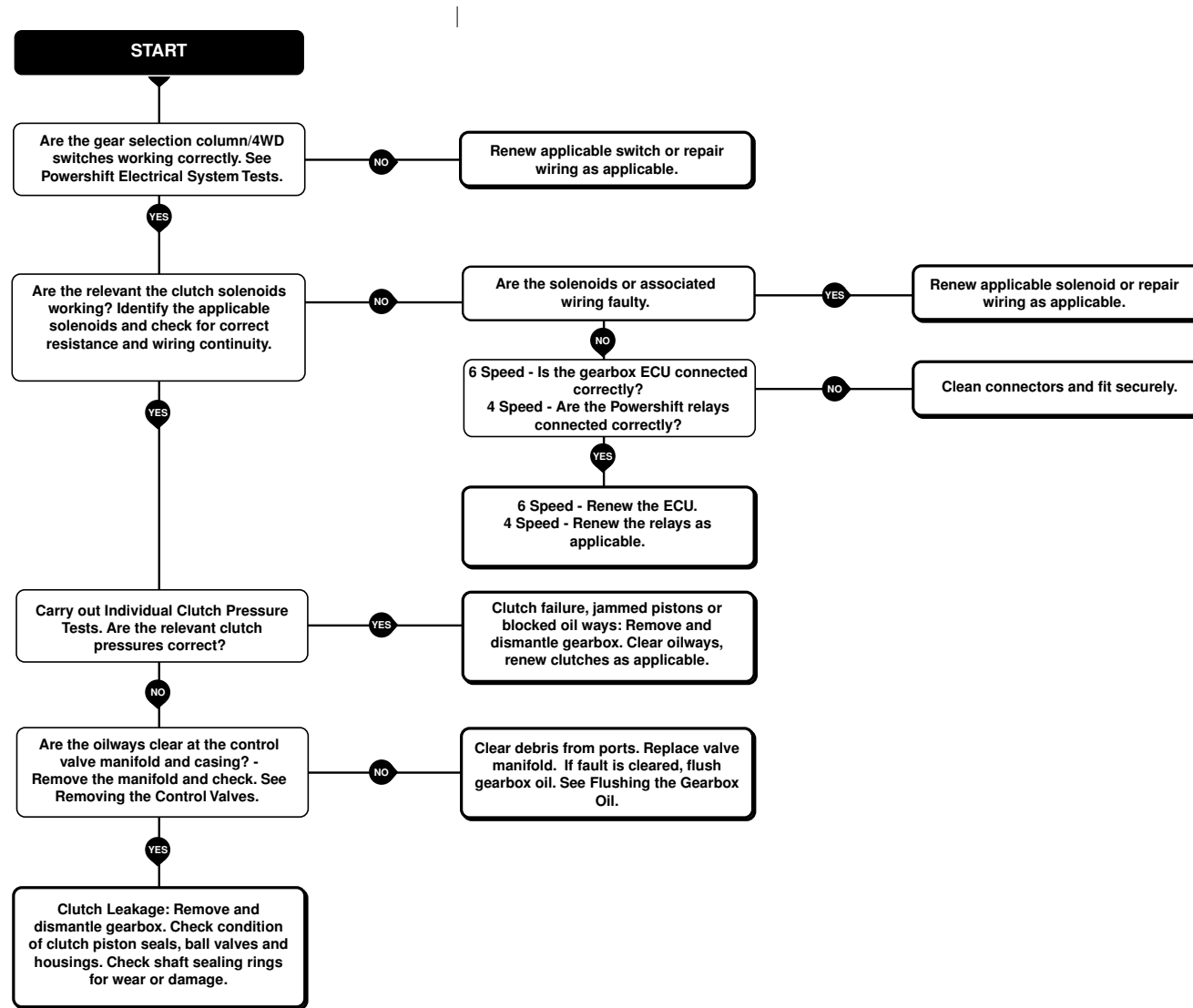


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## Powershift Gearbox

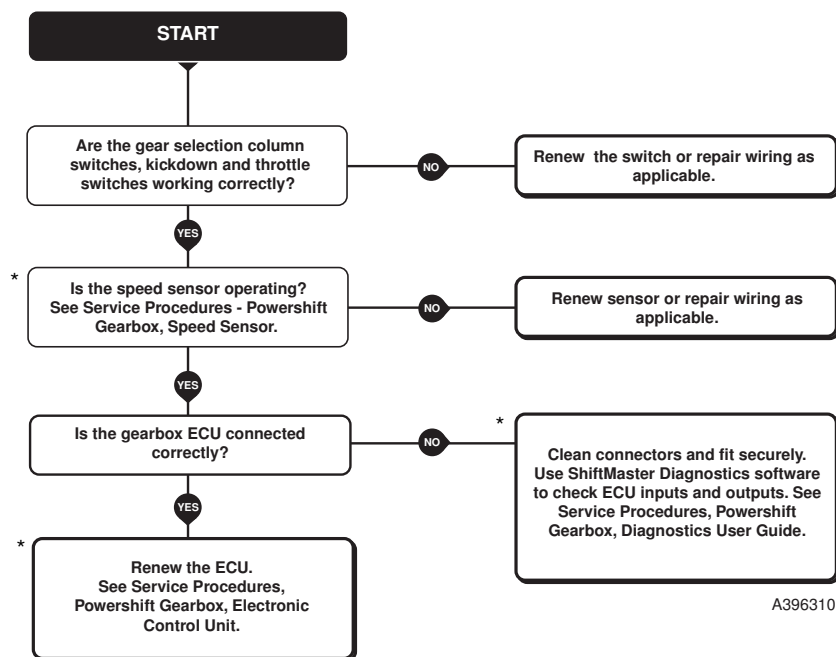
Chart C - Some gears fail to engage or lack power. 4WD fails to engage.



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## 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**.

\* The simplest and best way to fault find the 6 speed gearbox electrical system, (including the ECU) is by using ShiftMaster Diagnostics software and a laptop PC. See **Diagnostics User Guide**. This diagnostics system enables the engineer to quickly identify faults with specific electrical circuits or devices. The devices electrical connections, locations and wire identifications are given in **Electrical Connections - Powershift Gearbox - 6 Speed**. See also **Section C - Harness Data**.

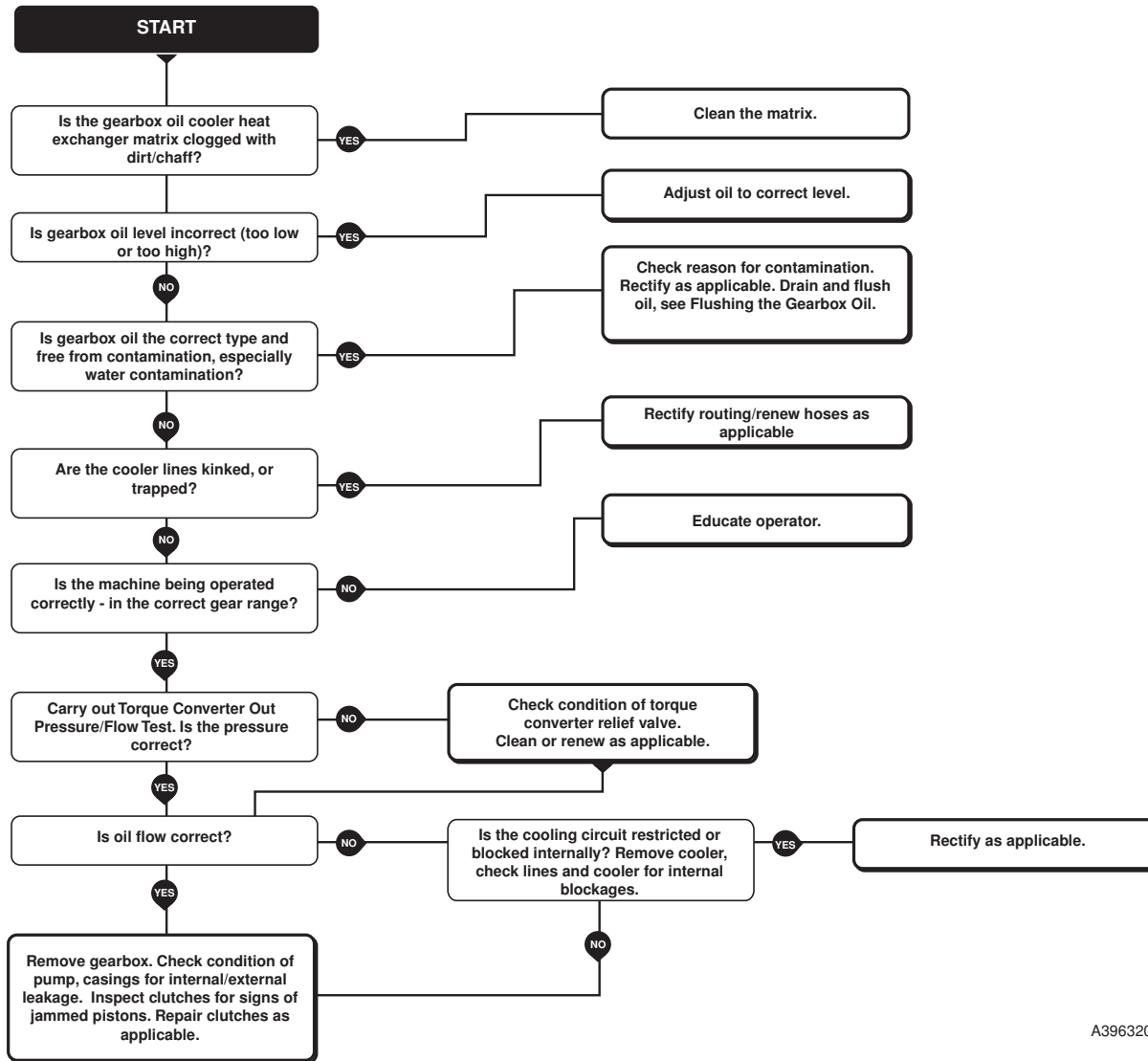
### 'Limp Modes'

When applicable the ShiftMaster ECU provides restricted or modified gearbox operation if faults are detected by the ECU. Typical 'Limp Mode' forms of operation are:

Limp Mode	Possible Reason
<b>Limp Mode 1</b> Machine autoshifts at different road speeds than normal. <b>2 Beeps at power-up.</b>	Internal 'Setup Data' ECU fault. If on power-up the ECU detects an internal fault with its 'Setup Data' it will revert to use of a default set of values.
<b>Limp Mode 2</b> Machine remains in neutral at all times. <b>1 Beep at power-up.</b>	Error with ECU 'Application Software'. If on power-up the ECU detects an internal fault with its 'core operating software' it will prevent operation of the gearbox.
<b>Limp Mode 3</b> Only 1st, 2nd, and 3rd gears available. <b>Machine will not autoshift.</b>	Error reading transmission speed. If the ECU does not detect any input from the speed sensor it will prevent selection of any gear above 3rd.
<b>Limp Mode 4</b> Machine holds a gear. <b>Repeating beeps until ECU power is reset.</b>	Error reading transmission speed. If the ECU detects an error with the speed sensor whilst operating it prevents autoshifting.

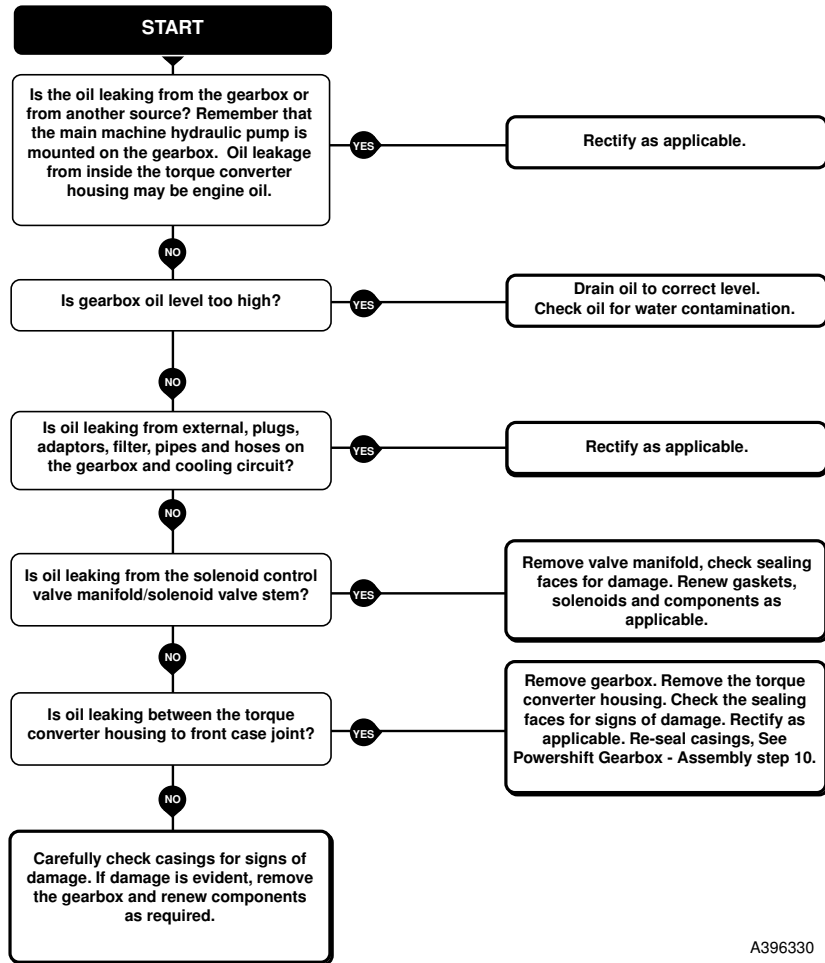
**Note:** On power-up the ECU will normally sound 3 beeps. These beeps can be masked by other audible warnings on start up.

**Powershift Gearbox**  
**Chart E - Gearbox oil overheats**



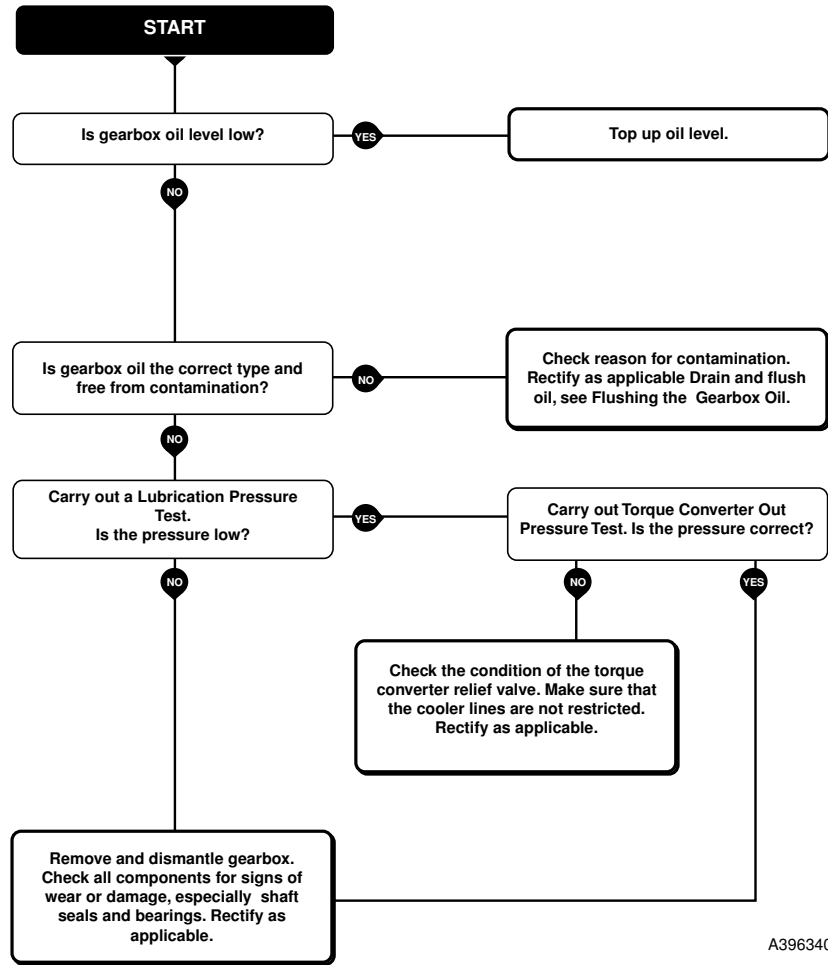
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### Powershift Gearbox Chart F - External oil leakage



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### Powershift Gearbox Chart G - Noisy operation



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## Powershift Gearbox

### Gearbox Oil Contaminated with Water

Carefully inspect the gearbox oil for signs of water contamination. Contaminated oil will contain water droplets or be visibly emulsified. Water droplets may be visible on the dipstick or inside the filler tube. For oil analysis purposes, the maximum permissible water content of the oil is 0.10%.

If the gearbox oil has been contaminated with water, faults or damage to the gearbox may be apparent as a result. Before remedying, thoroughly investigate and rectify the cause of the water contamination.

Note: The correct gearbox oil is given in Section 3, **Service Capacities and Lubricants**.

Possible Cause	Remedy
1 Water ingress during filling/topping up.	Carry out flushing procedure. Refill with the correct oil, see Section 3,
2 Missing/incorrect dipstick, damaged filler tube.	Renew missing/incorrect/damaged components. Carry out flushing procedure. Refill with the correct oil, see Section 3,
3 Machine operated in deep water.	Carry out flushing procedure. Refill with the correct oil, see Section 3,
4 Gearbox casings damaged.	Inspect, renew damaged components. Carry out flushing procedure. Refill with the correct oil, see Section 3,
5 Gearbox oil circuit pipes/hoses damaged.	Inspect, renew damaged components. Carry out flushing procedure. Refill with the correct oil, see Section 3,

Gearbox faults caused typically by water contamination and other factors related to the gearbox oil:

Fault	Possible Cause	Remedy
1 Pressurisation of gearbox casing - Dipstick blows out/oil leaking from dipstick tube.	Water in oil combined with heat from torque converter causes steam.	Replace/renew dipstick. Carry out flushing procedure. Refill with the correct oil, see Section 3,
	Gearbox over filled with oil.	Drain the oil level to the correct level, see <b>Routine Maintenance - Checking Transmission Oil Level</b> .
2 Clutch Failure - Friction Lining Separation.	Water ingress.	Renew friction plates. Carry out flushing procedure. Refill with the correct oil, see Section 3,
	Overheating transmission oil.	See <b>Fault Finding - Overheating</b> .
3 Badly worn/noisy bearings.	Water ingress.	Fit new bearings. Carry out flushing procedure. Refill with the correct oil, see Section 3,
	Insufficient lubrication.	

## Front Axle - SD55, SD70

### Renewing the Pinion Oil Seal

The pinion oil seal **3** may be renewed without removing the axle from the machine.

#### **⚠ WARNING**

**A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.**

**Disconnect the battery, to prevent the engine being started while you are beneath the machine.**

GEN-001

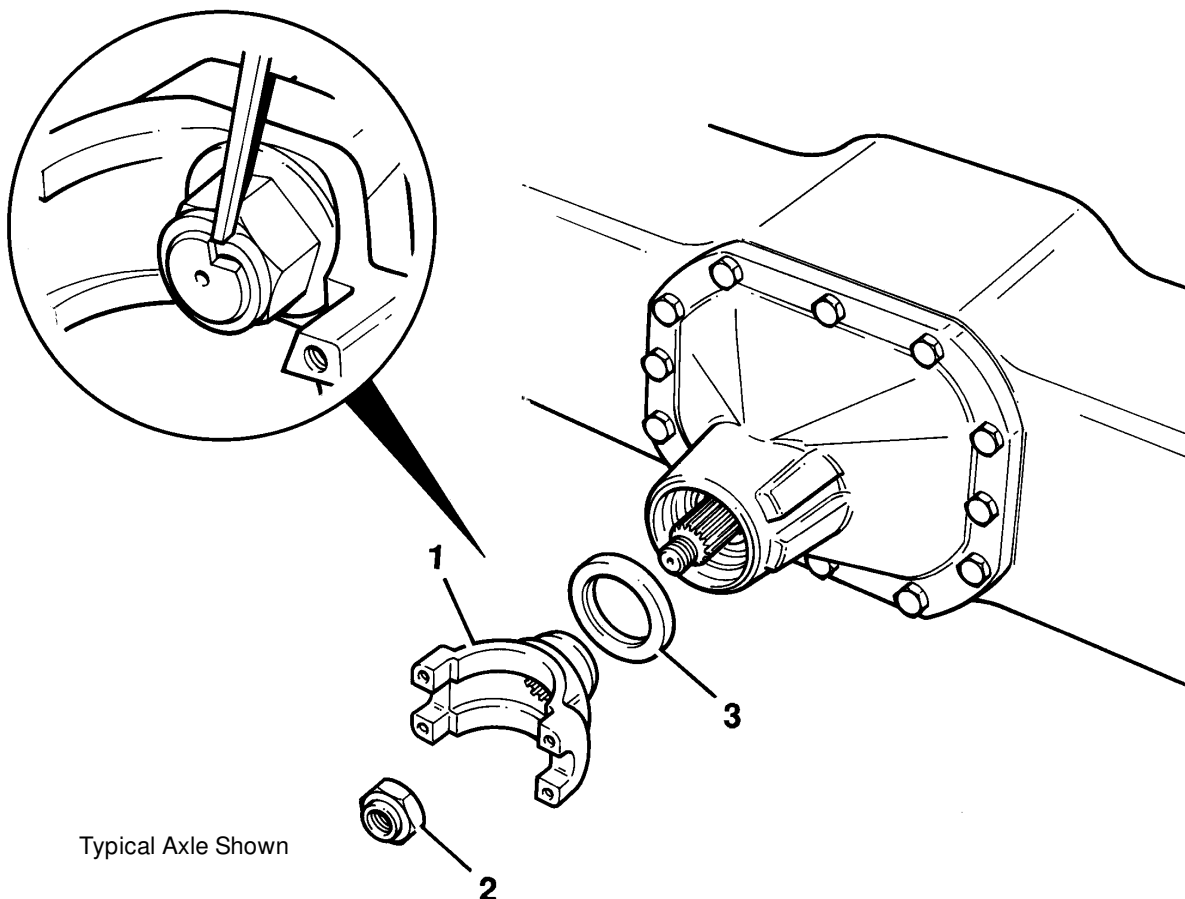
- 1 Remove the roadwheels and uncouple the axle propshaft. Measure the axle rolling torque and record the reading. Mark the relative positions of the pinion shaft **4** and nut **2** with a scriber.
- 2 Using Service Tool 892/00812, remove the drive yoke **1** together with its stake nut **2**.
- 3 Remove the seal **3** and fit a new one. Be sure not to damage the seal housing. Pack between the lips of the new seal with grease before fitting.

- 4 Check the sealing surface on the yoke for wear or damage. renew the yoke if necessary.
- 5 Fit the yoke and temporarily fit the old stake nut **2**. Tighten the nut with a torque wrench, aligning the scriber marks. Note the tightening torque required.
- 6 Remove and discard the old nut. Fit a new nut and tighten to the torque determined at step 5.
  - 6.1 Measure the rolling torque. The reading should be 0.5 to 1 Nm (0.37 to 0.74 lbf ft; 0.05 to 0.1 kgf m) more than that recorded in Step 1 (see Note).
  - 6.2 If necessary, progressively torque tighten the nut to a maximum of 300 Nm (221 lbf ft) to achieve correct rolling torque.

**Note:** If the rolling torque figure (new pinion seal fitted) exceeds the reading recorded in step 1 by 1 Nm (0.74 lbf ft; 0.1 kgf m) or more, or a minimum torque of 250 Nm (184 lbf ft) can not be achieved then the pinion assembly must be rebuilt using a solid spacer, see the appropriate axle assembly procedure.

**6.3** Stake the nut using a square ended staking tool.

- 7 Refit the roadwheels and couple the propshaft.



### **Rear Axle - SD80, PD70**

#### **Renewing the Pinion Oil Seal**

The rear axle pinion oil seal is renewed using the same procedure as **Front Axle SD55, SD70** but note the following:

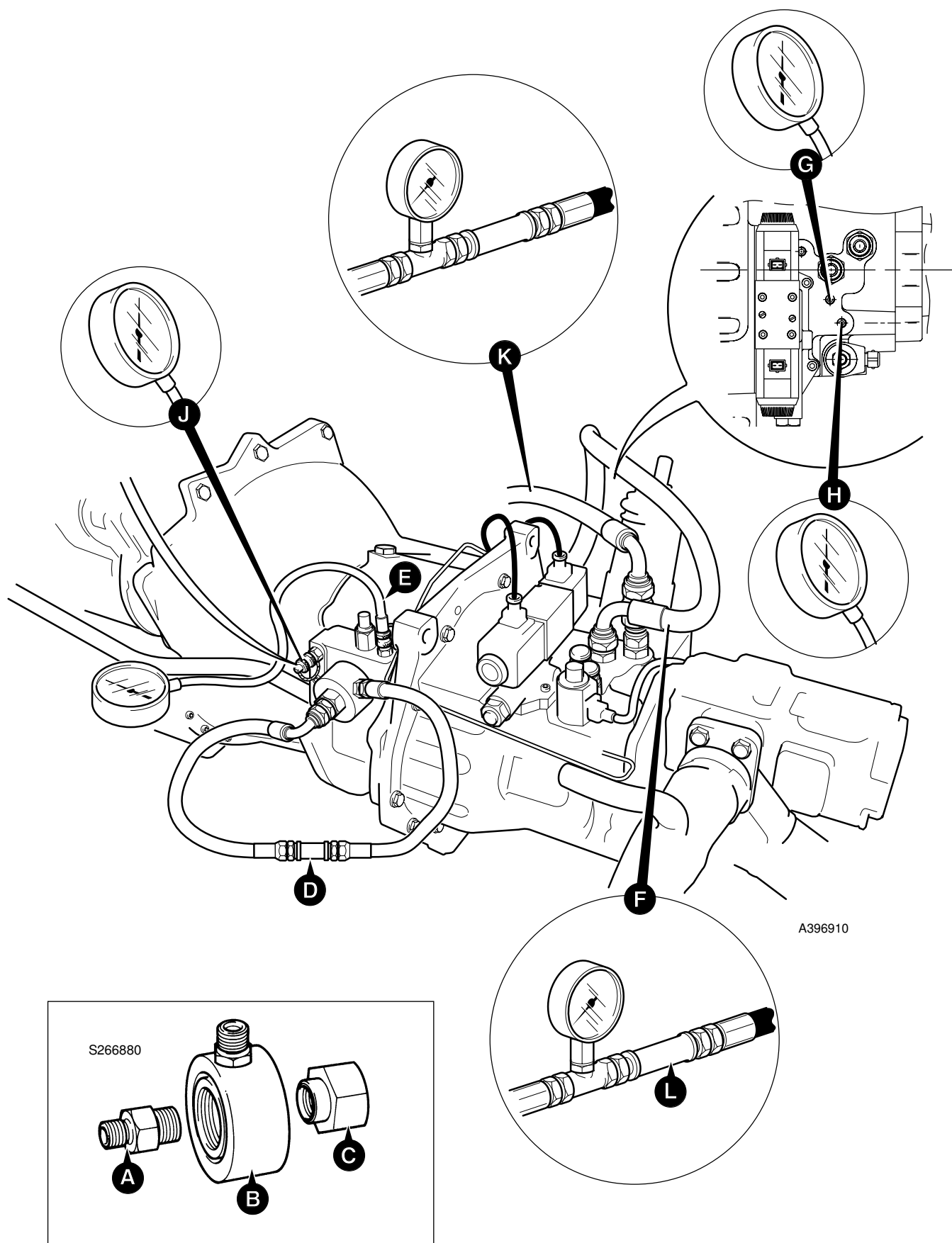
The rear axles are fitted with a brake disc/drive flange in place of the yoke on front axles. For the brake disc removal procedure see **Section G, Brakes, Service Procedures**.



**Rear Axle - SD80, PD70**

**Brakes - Testing for Piston Seal Leakage**

See **Section G, Brakes, Service Procedures.**



## Synchro Shuttle Gearbox

### Torque Converter Stall Test

Ensure that the engine and transmission are at normal working temperature. Run engine at maximum speed and check the **No Load Speed (High Idle Speed - U.S.A)**. See Engine Technical Data for correct figure; adjust if necessary.

Apply parking brake and footbrake firmly, select 4th Speed Forward and open throttle fully. Engine speed should be as specified at **Torque Converter Stall** in Transmission Technical Data. Select Reverse and repeat test.

**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.

**DO NOT** stall the converter for longer than 10 seconds or the transmission fluid will overheat.

If engine speeds are higher than the stated figures check the transmission for clutch slippage or internal leakage.

If engine speeds are below the stated figures either the engine is losing power and should be serviced/overhauled or the torque converter reaction member clutch is slipping. To check the engine, select Neutral, open throttle fully and operate an excavator service to 'blow off' the main relief valve. Engine speed should fall to slightly above the **Maximum Governed Speed** (see Engine Technical Data). If engine speed is correct the torque converter is faulty.

**Note: Maximum Governed Speed** is a datum figure only. It cannot be adjusted or checked with the engine installed in the machine.

### Pressure and Flow Test

**Note:** The tests must be carried out only in the following order, step by step.

#### WARNING

**Take care when disconnecting hydraulic hoses and fittings as the oil will be HOT.**

Trans 1-2

1 Stop engine, remove transmission filter and filter head adapter. Fit adapter **A** (892/00920) into the gearbox casing. Fit test adapter **B** (892/00301) and secure with adapter **C** (892/00302). Connect flowmeter **D** (892/00229) as shown and connect a 0-20 bar (0-300 lbf/in<sup>2</sup>) pressure gauge to test connector **E** (see Service Tools, Section 1).

2 Start engine and run at 1000 rev/min. The flowmeter will show the **Pump Flow** which should be as shown in Technical Data. A low reading indicates a worn pump or blocked suction strainer. The pressure gauge will show the **Main Line Pressure** (see Technical Data). A low reading can be caused by either a faulty pressure maintenance valve or a worn pump. A high reading indicates a faulty pressure maintenance valve or, if the pump flow is low, the oil cooler may be blocked.

3 Stop engine, remove flow test adapters and refit filter. Connect pressure gauge and flowmeter into converter out line as shown at **F**. Run engine at 1000 rev/min with transmission in Neutral and note **Converter Out Pressure** and **Oil Cooler Flow**, which should be as shown in Technical Data. A high pressure together with low flow could be caused by a blocked oil cooler. (See also check 7.)

4 With parking brake and footbrake firmly applied, select Forward and check flow reading, which should not fall by more than 4.5 litres (1 UK gal; 1.2 US gal) per minute. A low reading indicates a high leakage rate in that particular clutch, which could be caused by worn or broken piston seals or shaft sealing rings. Select Reverse and repeat the test.

5 If the clutch leakage rate is high, the **Clutch Pressures** may be checked by connecting the pressure gauge into ports **G** and **H** and repeating test 4. A low reading (see Technical Data) would confirm a high leakage rate in the particular clutch selected.

6 Stop engine, connect the pressure gauge into port **J** in the transmission, and fit a load valve **L** into the converter out line (see note).

**Note:** Make sure that the load valve **L** has been screwed fully out before starting the engine, otherwise the converter seals will be damaged.

Start engine, run at 1000 rev/min and slowly screw down the load valve whilst observing the gauge reading, which should rise to the setting of the **Converter Relief (Safety) Valve** (see Technical Data). **DO NOT** allow the pressure to exceed 10.3 bar (150 lbf/in<sup>2</sup>) or damage to the converter seals will be caused.

If the reading is higher than specified, the relief (safety) valve must be faulty. A low reading indicates a faulty relief (safety) valve, leaking converter 'piston ring' type seal or leaking pump seal.

7 Stop engine and connect pressure gauge and flowmeter into return line from oil cooler to transmission as shown at **K**. Start engine, and with transmission in Neutral check flowmeter reading, which will show the **Cooler Flow Rate** (see Technical Data). The pressure gauge will show the **Lubrication Pressure** (see Technical Data). Low flow and pressure readings could indicate a blocked oil cooler.

**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.

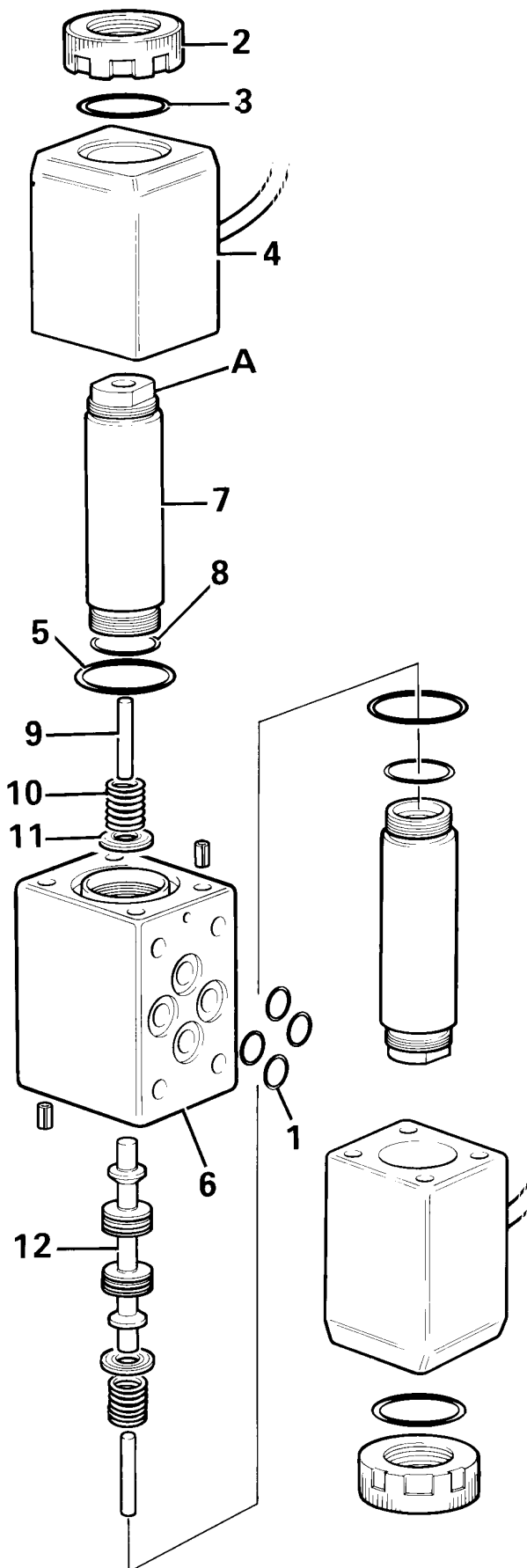
Renew all 'O' rings.

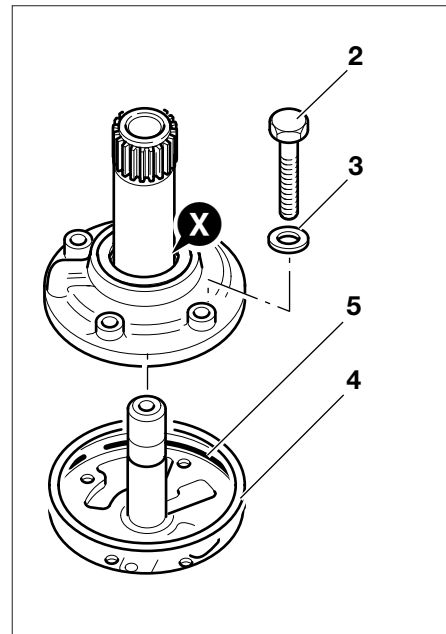
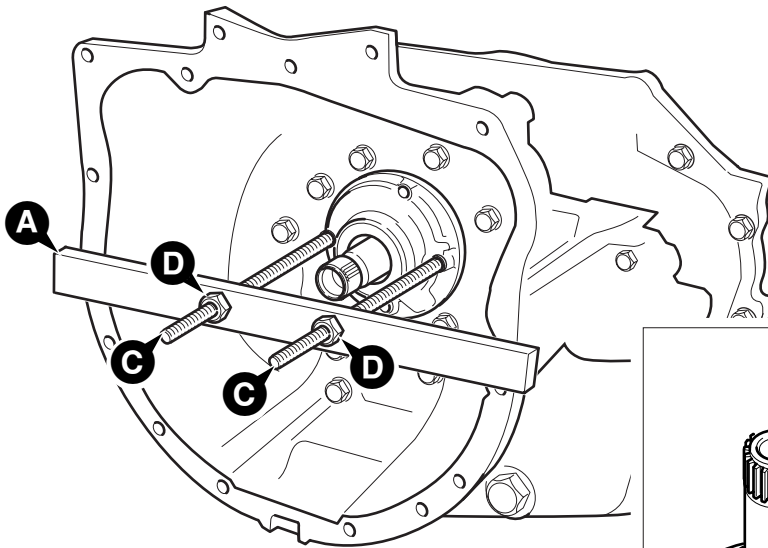
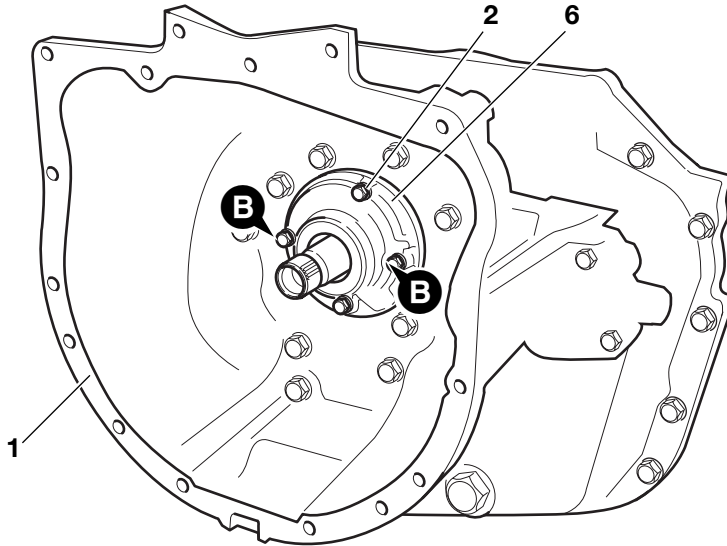
Lightly lubricate all parts with clean transmission fluid before assembling.

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





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## Powershift Gearbox

### Gearbox Hydraulic Pump - Removal and Replacement

The gearbox hydraulic pump is located at the input end of the gearbox. The gearbox must be removed from the machine to enable removal and replacement of the pump.

#### Removal

- 1 Remove the gearbox from the machine, see **Powershift Gearbox Removal and Replacement**.

**IMPORTANT NOTE:** After removing the gearbox DO NOT REMOVE THE TORQUE CONVERTER HOUSING **1** from the gearbox. A simple service tool (**A**) must be manufactured to enable the pump assembly to be removed. See **Transmission, Service Tools** for details.

- 2 Undo the 4 fixing bolts **2**. Discard the sealing washers **3**.
- 3 Using a set of M10 x 1.5 taps carefully tap the 2 holes **B** in the pump assembly **6**. Start with the taper tap (be sure not to damage the tapped holes in the gearbox front case beneath) and finish with the plug tap. Ensure that the thread is at least 35 mm (1.38 in) deep and both the pump body and stator are threaded. Be sure to remove ALL swarf before proceeding.
- 4 Screw in a 250 mm (10 in) length of M10 threaded rod **C** into each hole **B**. Position the reaction bar **A** as shown. Progressively screw down the M10 nuts **D** to withdraw the pump assembly from its housing.
- 5 Remove and discard the pump sealing ring **4**. Remove and discard the 'O' ring **5** from the pump locating bore in the housing **1**.

**Note:** The pump should be dismantled and inspected, see **Powershift Gearbox - Inspection**. Note that a pump which is badly worn or damaged may have caused further damage to the gearbox, see **Powershift Gearbox - Dismantling**.

#### Replacement

- 1 Fit a new 'O' ring **5** to the locating bore inside the housing **1**. Lightly oil the 'O' ring.
- 2 Make sure that the pump is fitted with a new oil seal, see **Powershift Gearbox, Inspection, step 4**. Fit a new sealing ring **4**. Locate the pump over the input shaft aligning the bolt holes. Apply JCB Threadlocker and Sealer to bolts **2**. Fit the bolts together with new sealing washers **3**. Progressively torque tighten the bolts to 28 Nm (20 lbf ft).
- 3 Pour some clean, new, oil into the pump at position **X**.

## Powershift Gearbox

### Suction Strainer - Removal and Replacement

#### Removal

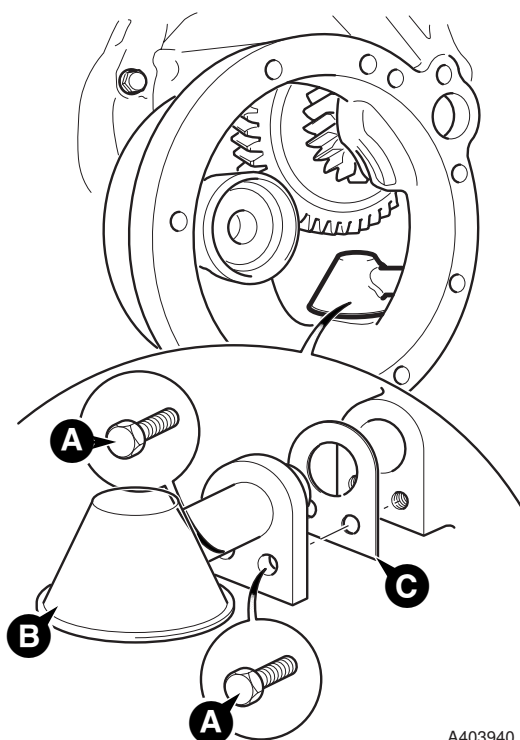
The suction strainer is located inside the gearbox front case. Access is gained by removing the 4WD clutch assembly.

- 1 Park the machine on level ground, apply the parking brake and chock the wheels.
- 2 Allow transmission oil to cool and then drain the oil, see **Powershift Gearbox, Changing the Oil, Routine Maintenance**.
- 3 Disconnect the propshaft from the 4WD unit, see **Propshaft, Removal and Replacement**.
- 4 Remove the 4WD unit, see **Powershift Gearbox, Dismantling Step 6 - Remove the 4WD Clutch Assembly**.
- 5 Using a 13 mm ring spanner, reach inside the casing and undo the 2 suction strainer retaining bolts **A**. Be sure to retrieve the bolts from inside the gearbox.
- 6 Push the suction strainer **B** away from you (towards the rear of the gearbox) to disengage it from the gearbox casing. Remove the strainer via the 4WD aperture.
- 7 Make sure that the gasket **C** is retrieved. Discard the gasket.
- 8 Clean the suction strainer by flushing with a solvent cleaner. Inspect the strainer mesh for tears or splits. Renew the suction strainer if the mesh is damaged.

#### Replacement

Replacement is the reverse of the removal sequence but note the following:

- 1 Fit a new gasket **C**.
- 2 Make sure that no loose components or debris have been left inside the gearbox casing.
- 3 Before replacing the 4WD assembly make sure that all traces of gasket or gasket compound have been removed from the mating faces, see **Powershift, Gearbox, Inspection**.



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## Powershift Gearbox

### Torque Converter Stall Test

The purpose of the stall test is to check the performance of the transmission by 'stalling' the torque converter. This is the point at which, due to torque applied by the engine the torque converter stops transmitting drive to the gearbox. The engine speed at which 'stalling' occurs is compared to speeds recorded for a machine in normal condition (given in **Technical Data**). Abnormal stall speed results can be used to identify a number of possible faults with the transmission, typically gearbox hydraulic and clutch faults.

**Note:** DO NOT stall the converter for longer than 10 seconds or the transmission fluid will overheat. Make sure that the oil level is correct and at normal operating temperature.

Before completing the following test, remove the transmission dipstick. If there is any sign of smoke emitting from the dipstick tube STOP THE TEST IMMEDIATELY and dismantle the transmission for servicing.

By performing the tests in the first 3 gears in forward and reverse we can see from the tables below that all the clutches in the gearbox will be engaged, ensuring faults will be easy to identify. Draw a table as shown so that you can record the results.

Stall Test Results - 6 Speed Powershift				
Gear	Clutches engaged			
	Forward	Rev/min	Reverse	Rev/min
1st	X,Z		W,Z	
2nd	T,Z		V,Z	
3rd	U,Z		W,Y	

Stall Test Results - 4 Speed Powershift				
Gear	Clutches engaged			
	Forward	Rev/min	Reverse	Rev/min
1st	T,Z		W,Z	
2nd	U,Z		V,Z	
3rd	T,Y		W,Y	

- 1 Ensure that the engine and transmission are at normal working temperature (the transmission oil must be above 50°C). Run engine at maximum speed and check the **No Load Speed (High Idle Speed - U.S.A)**. See Engine Technical Data for correct figure; adjust if necessary.
- 2 Apply parking brake and footbrake firmly. If necessary, set the machine against a fixed obstruction.

**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 Select 1st speed forward drive and open throttle fully. Record the engine speed from the tachometer. Repeat the test for 2nd and 3rd speed forward and record the readings.
- 4 Repeat step 3 except this time select 1st, 2nd and 3rd gear reverse drive respectively. Record the readings.
- 5 All recorded readings should be as specified at **Torque Converter Stall** in Transmission Technical Data.

#### Key to Clutches

- T - Forward low ratio clutch pressure
- U - Forward high ratio clutch pressure
- V - Reverse high ratio clutch pressure
- W - Reverse low ratio clutch pressure
- X - 6 speed clutch pressure (6 speed gearbox only)
- Y - Mainshaft clutch pressure
- Z - Layshaft clutch pressure



## Powershift Gearbox

### Torque Converter Stall Test, cont'd

#### Interpreting the Test Results

If all the engine speeds are below the stated figures either the engine is losing power and should be serviced/overhauled or the torque converter reaction member clutch is slipping. To check the engine, select Neutral, open throttle fully and operate an excavator service to 'blow off' the main relief valve. Engine speed should fall to slightly below the **Maximum Governed Speed** (see **Engine Technical Data**). If engine speed is correct the torque converter reaction member clutch is slipping.

If all the engine speeds are higher than the stated figures in all gears the torque converter safety relief valve may be faulty. Alternatively there may be internal oil leakage.

If engine speeds are higher than the stated figures in some gears, check the transmission for clutch slippage or internal leakage. Look at the example below and see how the results can be used to isolate a suspect clutch.

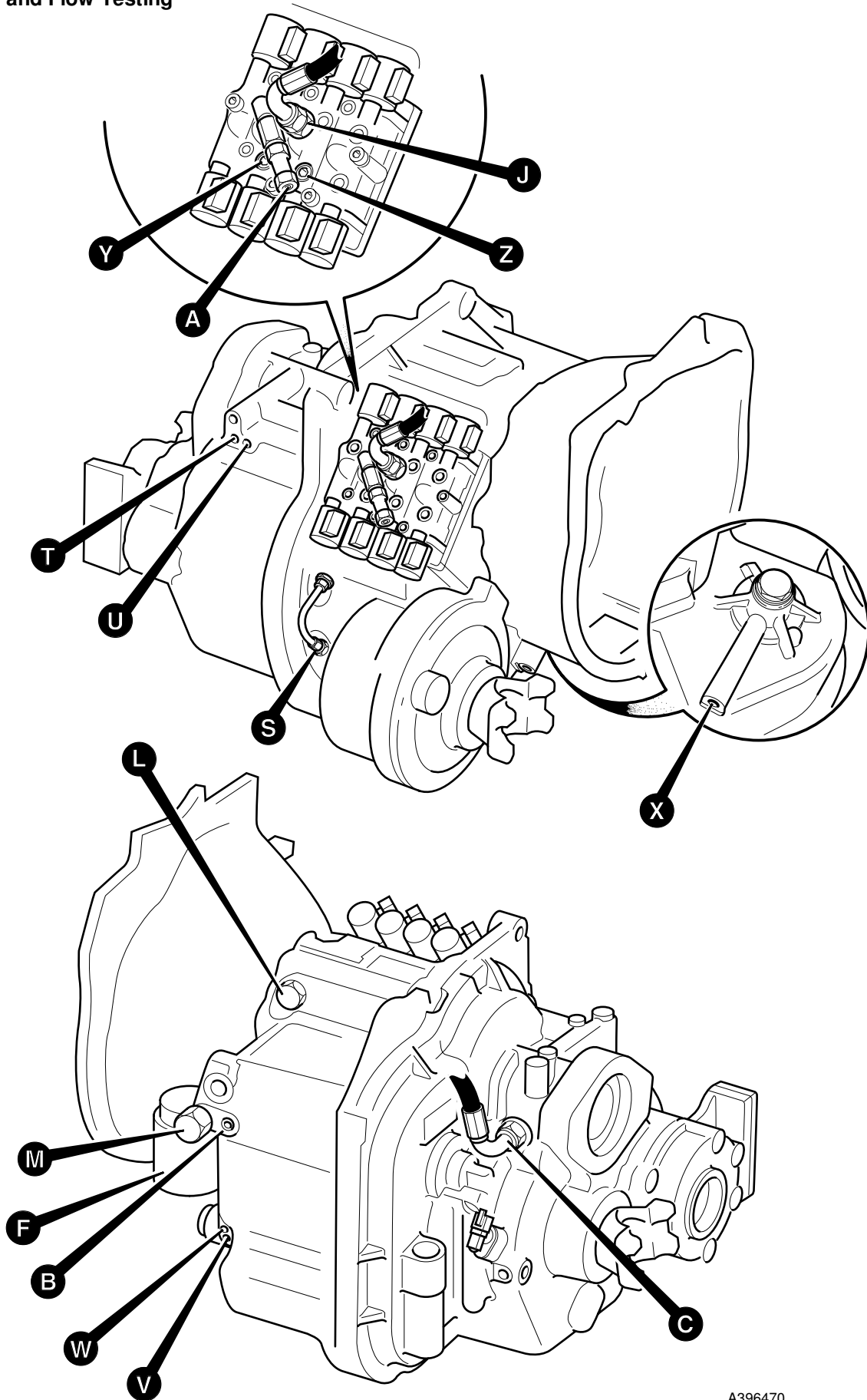
Stall Test Results - 6 Speed Powershift				
Gear	Clutches engaged			
	Forward	Rev/min	Reverse	Rev/min
1st	X,Z	1990	W,Z	1980
2nd	<b>T,Z</b>	<b>2060</b>	V,Z	1975
3rd	U,Z	1985	W,Y	1990

In the example shown, we can see that the engine speed is abnormally high when 2nd gear forward drive is selected, indicating a slipping clutch, possibly **T** or **Z**. We can now use the results to determine which clutch is at fault.

From the table we can see that there is no problem with clutch **Z** since it is engaged in other gears, the stall speeds for those gears are normal. This indicates that clutch **T** is slipping.

Clutches may slip for several reasons. Hydraulic leakage is possible and this can be confirmed by carrying out a pressure test, see **Pressure Testing - Individual Clutches**.

**Powershift Gearbox**  
**Pressure and Flow Testing**



A396470

## Powershift Gearbox

### Pressure and Flow Testing

Before completing any of the transmission pressure/flow tests, make sure that the oil level is correct and at normal operating temperature (not less than 50 °C).

All gauges etc used in the following pressure/flow tests are shown in **Service Tools**.

#### WARNING

Fine jets of hydraulic oil at high pressure can penetrate the skin. Do not use your fingers to check for hydraulic oil 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 oil. If hydraulic oil penetrates your skin, get medical help immediately.

HYD 1-1

#### WARNING

Take care when disconnecting hydraulic hoses and fittings as the oil will be HOT.

Trans 1-2

#### WARNING

DO NOT go underneath the machine with the engine running. Switch off the engine, apply the parking brake and chock both sides of all wheels before going underneath the machine.

Trans 2-1

#### WARNING

If a 4 wheel drive machine is to be raised and the engine/transmission run, make sure all four wheels are off the ground and supported by axle stands. If only one pair of wheels is raised, the machine could still drive through the other axle.

Trans 2-2/2

#### WARNING

Under no circumstances must the engine be run with the transmission in gear and only one driving wheel jacked clear of the ground, since the wheel on the ground will move the machine.

INT-3-1-16

#### TEST POINTS

- A - Mainline pressure
- B - Converter inlet/converter relief valve pressure
- C - Converter outlet pressure
- F - Pump flow (remove filter and fit adapters)
- J - Lubrication pressure

#### Clutches:

- S - 2/4 wheel drive clutch pressure
- T - Forward low ratio clutch pressure
- U - Forward high ratio clutch pressure
- V - Reverse high ratio clutch pressure
- W - Reverse low ratio clutch pressure
- X - 6 speed clutch pressure (6 speed gearbox only)
- Y - Mainshaft clutch pressure
- Z - Layshaft clutch pressure

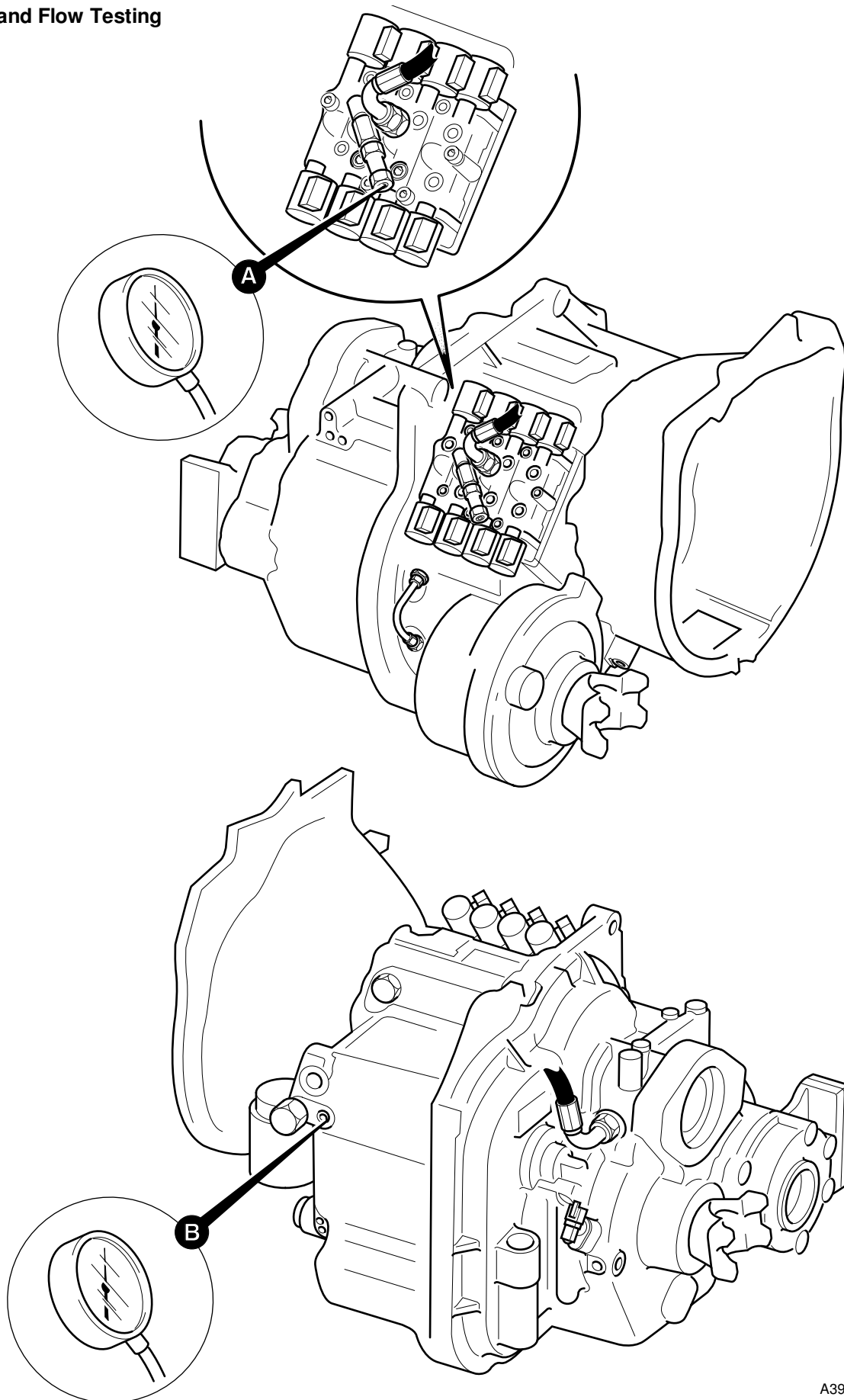
#### Other items:

- L - Torque converter relief valve
- M - Pressure maintenance valve

#### Test Procedures

- Pump Flow
- Mainline Pressure
- Converter In Pressure
- Converter Relief (Safety) Valve Pressure
- Converter Out Pressure/Oil Cooler Flow Rate
- Lubrication Pressure
- Clutches:-
  - Isolating a Suspect Clutch
  - Individual Clutch Leakage Test

**Powershift Gearbox**  
**Pressure and Flow Testing**



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**Powershift Gearbox****Pressure and Flow Testing, cont'd****Pump Flow**

- 1 Stop engine, remove the gearbox oil filter and fit adapter **X** (460/15708) into the gearbox casing. Connect flowmeter **W** (892/00268).
- 2 Start engine and run at 1000 rev/min. With the transmission in neutral the flowmeter will show the **Pump Flow** which should be as shown in **Technical Data**. A low reading indicates a worn pump or blocked suction strainer.
- 3 Repeat step 2 and note gauge readings with engine running at 2000 rev/min.
- 4 Stop engine and remove test adapters, refit filter.

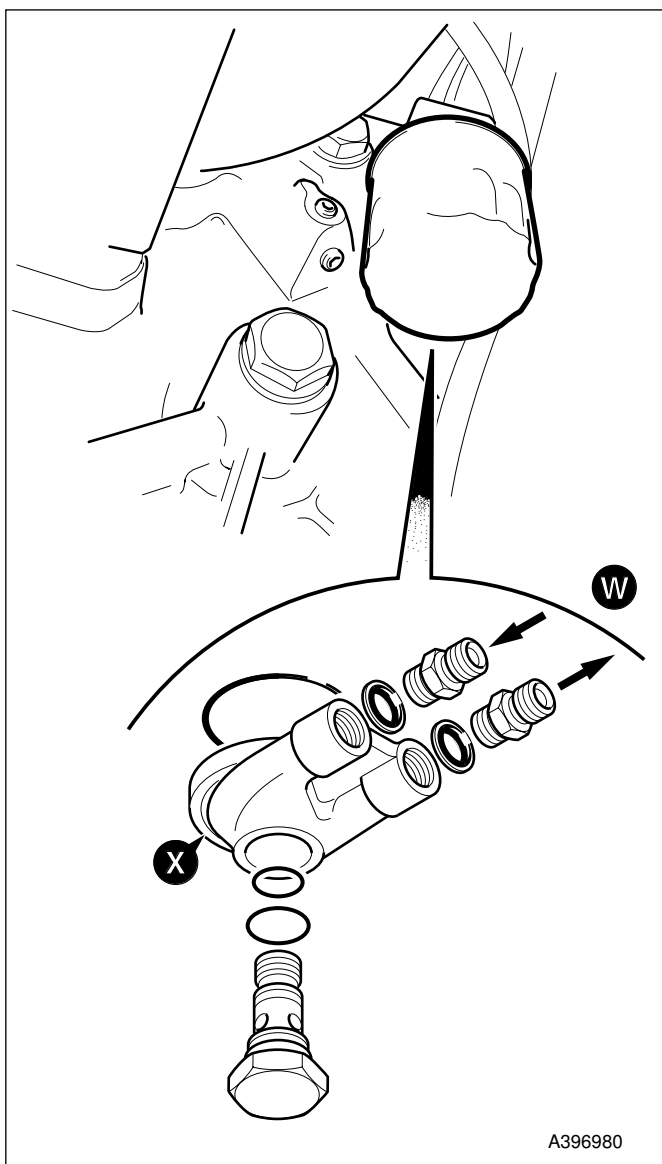
**Mainline Pressure**

- 1 Stop engine, connect a 0-20 bar (0-300 lbf/in<sup>2</sup>) pressure gauge to test connector **A**.
- 2 Start engine and run at 1000 rev/min. With the transmission in neutral the pressure gauge will show the **Main Line Pressure** which should be as shown in **Technical Data**. A low reading can be caused by either a faulty pressure maintenance valve or a worn pump. A high or low reading may indicate a faulty pressure maintenance valve.
- 3 Repeat step 2, with engine running at 2000 rev/min note gauge readings which should be as shown in **Technical Data**.
- 4 Stop engine and remove test gauge.

**Converter In Pressure**

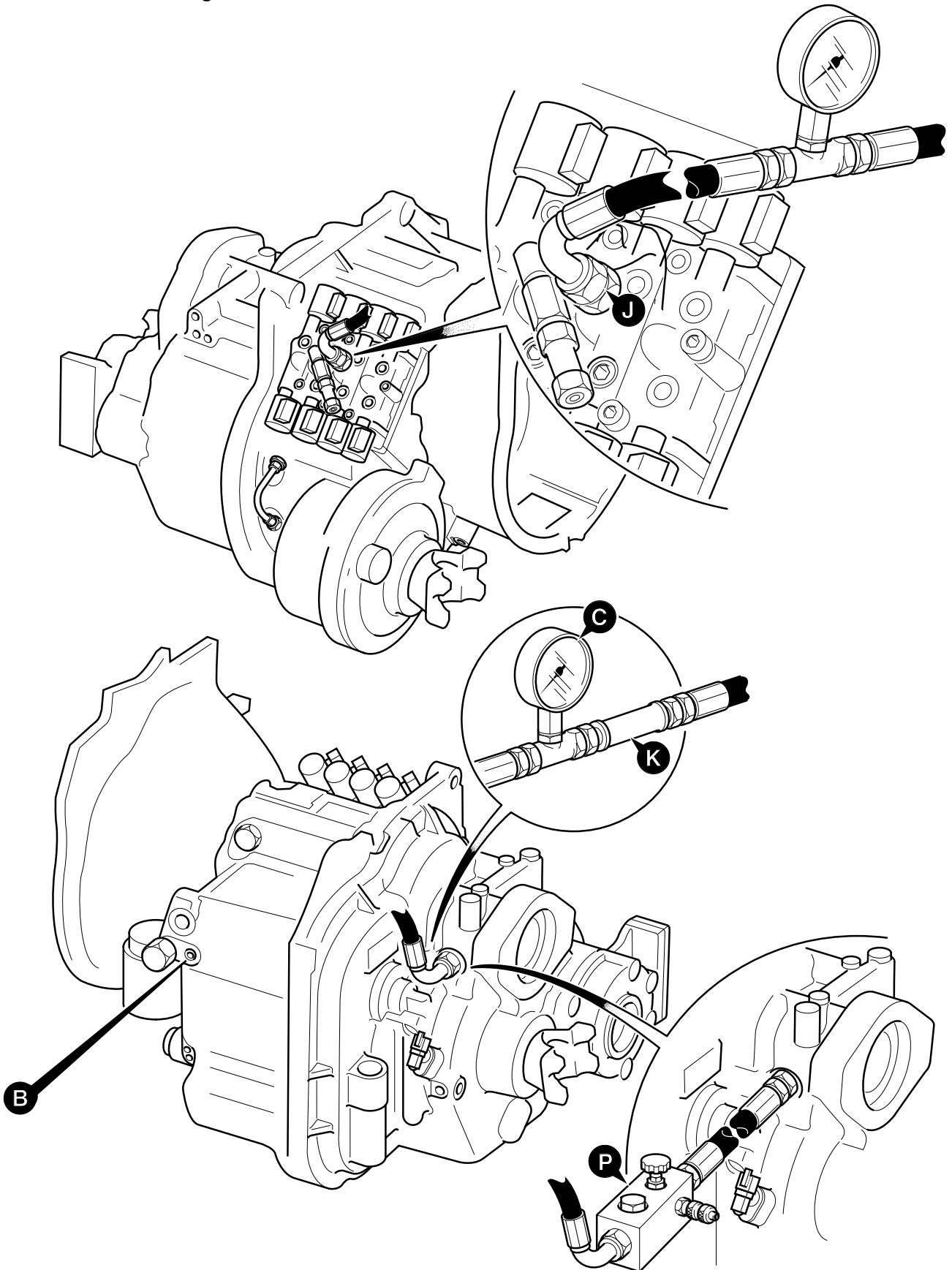
Note that the converter in pressure is affected by the torque converter relief valve operation. Before carrying out tests check the operation of the relief valve (see **Converter Relief (Safety) Valve Pressure**).

- 1 Stop engine, connect a 0-20 bar (0-300 lbf/in<sup>2</sup>) pressure gauge to test point **B**.
- 2 Start the engine and run at 1000 rev/min. With the transmission in neutral the pressure gauge will show **Converter In Pressure** which should be as shown in **Technical Data**. A high or low reading could indicate a faulty converter relief valve.
- 3 Remove pressure test gauge.



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**Powershift Gearbox**  
**Pressure and Flow Testing**



A397000

## Powershift Gearbox

### Pressure and Flow Testing, cont'd

#### Converter Relief (Safety) Valve Pressure

The purpose of the torque converter relief valve is to protect the torque converter from excessive oil pressure. Excessive oil pressure can be generated when the transmission oil temperature is below 50°C and/or the engine is run at over 2000 rev/min. In this event the relief valve opens and returns oil directly to the transmission sump, bypassing the torque converter, cooler and clutch lubrication circuits, protecting against damage due to excessive pressure. For this reason it is essential that the transmission oil is above 50°C and the engine is run between idle and 1000 rev/min when testing the relief valve.

- 1 Connect a 0-20 bar (0-300 lbf/in<sup>2</sup>) pressure gauge to test point **B**.
- 2 Fit a load valve **P** into the converter out line.

#### CAUTION

**Make sure the load valve is in the OPEN position, (the adjusting knob screwed fully OUT), before starting the following pressure test. Failure to do this could damage the pump.**

HYD 4-4/1

**DO NOT** allow the pressure to exceed 8.3 bar (120 lbf/in<sup>2</sup>) or damage to the converter seals will be caused.

- 3 Start the engine and run at 1000 rev/min. With the transmission in neutral, slowly screw down the load valve **P** whilst observing the gauge reading which should rise to the **Converter Relief (Safety) Valve** setting as specified in Technical Data.

Note that the gauge pressure will fall once the valve has opened. This is normal relief valve operation and does not indicate a fault. If necessary reset the load valve **P** and perform the test again, watching the pressure gauge carefully.

- 4 If the converter relief valve opens at a pressure higher than specified then the valve is faulty. A low opening pressure indicates a leaking pump to casing seal or a faulty converter relief valve.
- 5 Stop engine, remove test gauges and load valve. Refit hoses to original position.

#### Converter Out Pressure/Oil Cooler Flow Rate

Note that the converter out pressure and oil cooler flow rate are affected by the torque converter relief valve operation. Before carrying out tests check the operation of the relief valve (see **Converter Relief (Safety) Valve Pressure**).

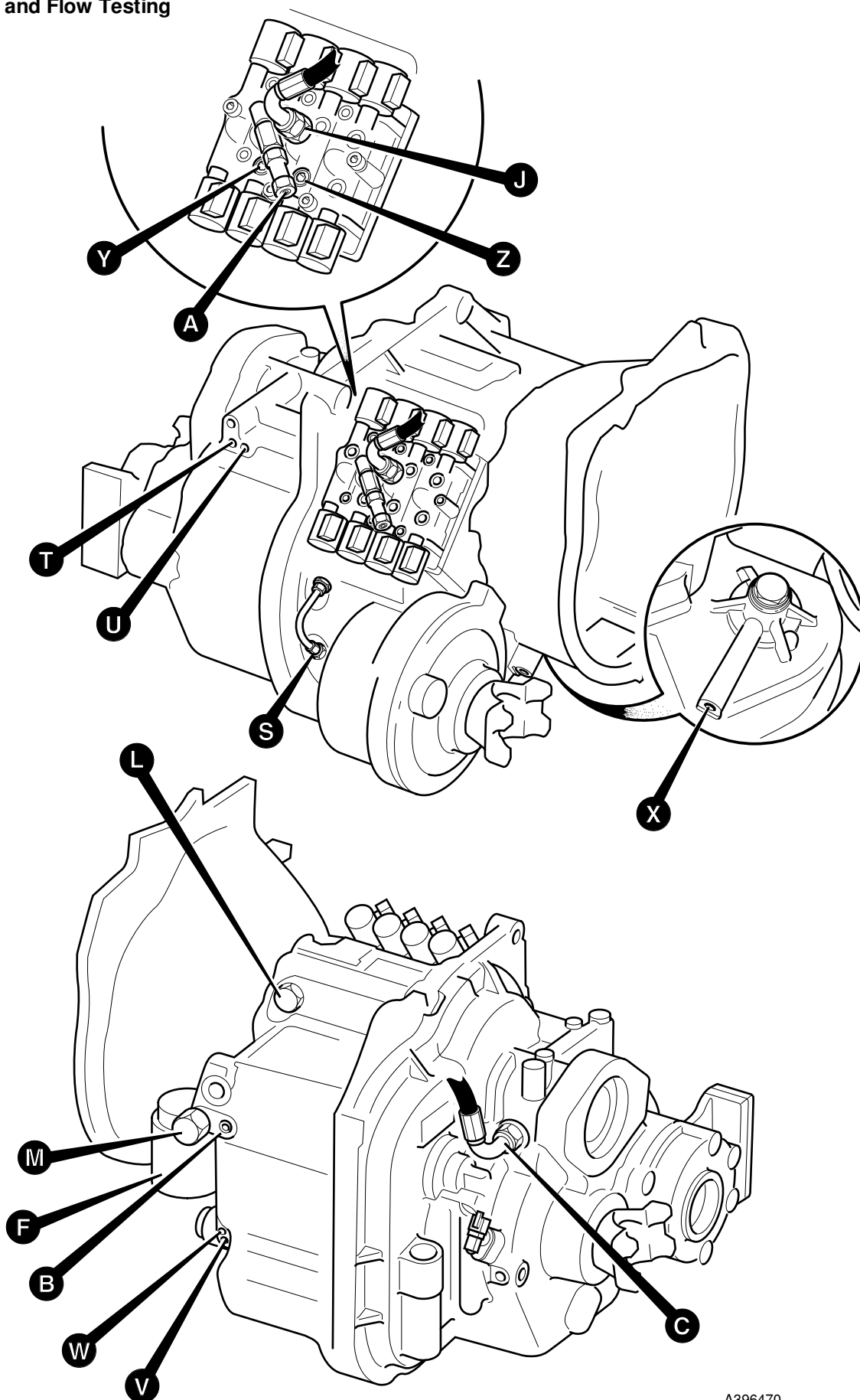
- 1 Stop engine, connect a 0-20 bar (0-300 lbf/in<sup>2</sup>) pressure gauge and flowmeter into the converter out line as shown at **C** and **K** respectively.
- 2 Run the engine at 1000 rev/min with transmission in neutral. The pressure gauge indicates the **Converter Out Pressure** and the flowmeter indicates the **Oil Cooler Flow Rate**, both readings should be as specified in **Technical Data**. A high pressure together with low flow could be caused by a blocked oil cooler or internal leakage.
- 3 Repeat step 2, with engine running at 2000 rev/min note gauge readings which should be as shown in **Technical Data**.
- 4 Stop engine, remove test gauges and refit hoses to original position.

#### Lubrication Pressure

Note that the lubrication pressure is affected by the torque converter relief valve operation. Before carrying out tests check the operation of the relief valve (see **Converter Relief (Safety) Valve Pressure**).

- 1 Stop engine, connect a suitable pressure gauge into the return line from the oil cooler to the transmission as shown at **J**.
- 2 Start the engine and run at 1000 rev/min. With the transmission in neutral the pressure gauge will indicate the **Lubrication Pressure** which should be as specified in **Technical Data**.
- 3 Repeat step 2 and note gauge readings with engine running at 2000 rev/min. If the pressure is high the oil cooler may be blocked, (see **Converter Out Pressure/Oil Cooler Flow Rate**).
- 4 Stop engine and remove pressure gauge.

**Powershift Gearbox**  
**Pressure and Flow Testing**



A396470



## 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 <sup>2</sup>	Reverse	bar	lbf/in <sup>2</sup>
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 <sup>2</sup>	Reverse	bar	lbf/in <sup>2</sup>
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<sup>2</sup>) 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 reverse. Record the pressure readings as shown in the example below:

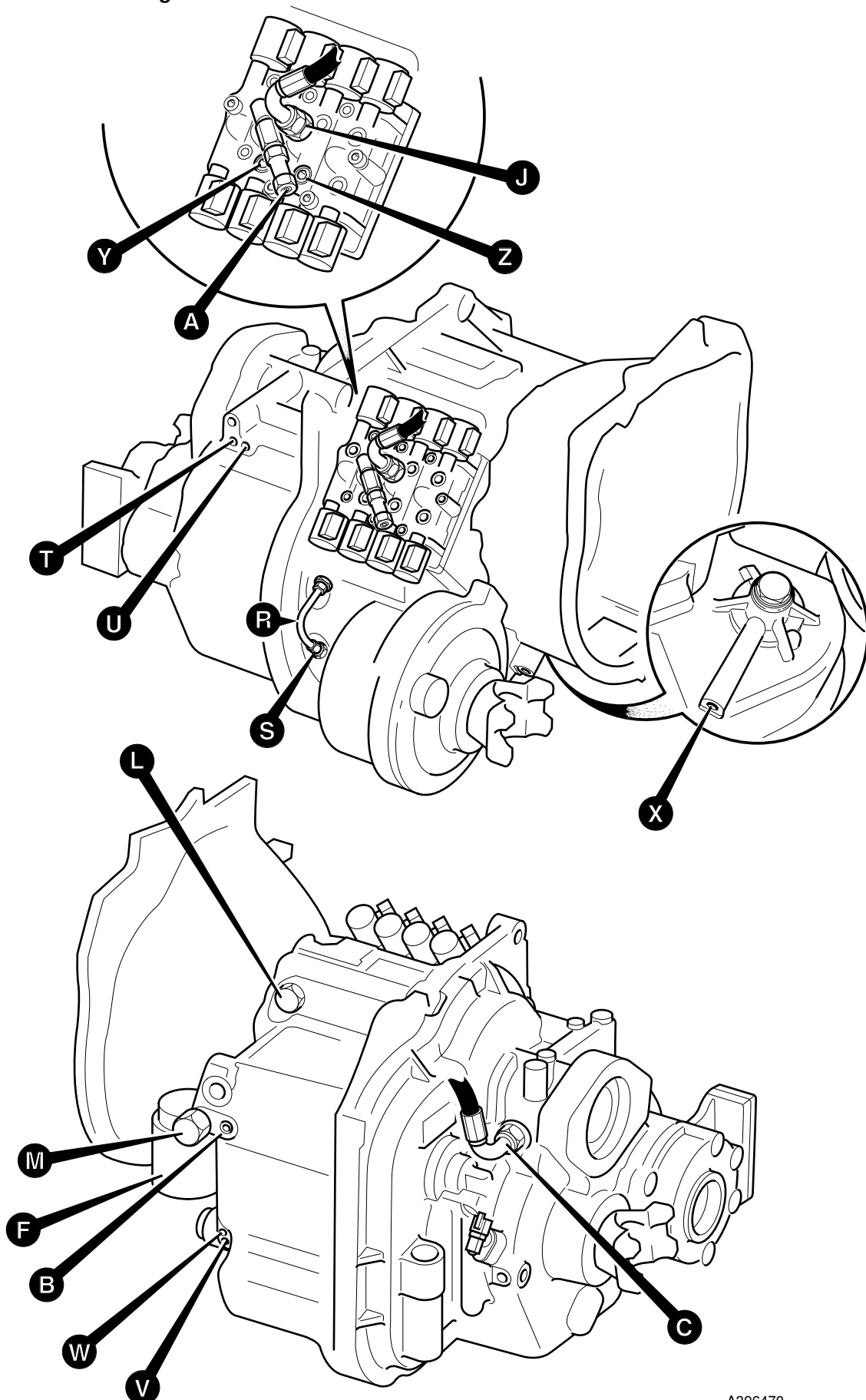
Clutch Pressure Test Results - 6 Speed Powershift						
Gear	Clutches engaged					
	Forward	bar	lbf/in <sup>2</sup>	Reverse	bar	lbf/in <sup>2</sup>
1st	X,Z	13.4	194	W,Z	13.4	194
2nd	<b>T,Z</b>	<b>12.0</b>	<b>175</b>	V,Z	13.6	197
3rd	U,Z	13.5	195	W,Y	13.5	195

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

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

**Powershift Gearbox**  
**Pressure and Flow Testing**



A396470

## Powershift Gearbox

### Pressure Testing - Clutches

#### Individual Clutch Leakage Test

When testing individual clutch pressures it is necessary to isolate the clutch being tested. So for instance, on a 6 speed gearbox, to check the **forward low clutch T** we must select 2nd gear forward - this would energise the **forward low (T) and layshaft (Z)** clutches. Because we only want to check the **forward low (T)** clutch pressure and not the **layshaft (Z)** clutch pressure, remove the electrical connector to the **6 speed** clutch solenoid **Zs** BEFORE selecting 2nd gear.

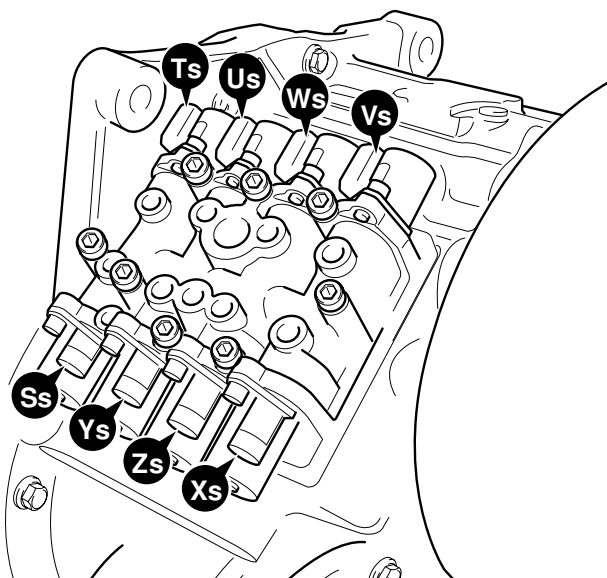
Use the table below to determine which solenoid electrical connectors should be removed when pressure testing individual clutches. Note that as the first 3 forward and reverse gears utilise all clutches, there is no need to select other gears when testing for leakage.

#### 6 Speed Gearbox

Gear Selected	Clutches Engaged (Solenoids Energised)	
1st Forward	6 Speed & Layshaft - X,Z	(Xs,Zs)
2nd Forward	Forward Low & Layshaft - T,Z	(Ts,Zs)
3rd Forward	Forward High & Layshaft - U,Z	(Us,sZ)
1st Reverse	Reverse Low & Layshaft - W,Z	(Ws,Zs)
2nd Reverse	Reverse High & Layshaft - V,Z	(Vs,Zs)
3rd Reverse	Reverse Low & Mainshaft - W,Y	(Ws,Ys)

#### 4 Speed Gearbox

Gear Selected	Clutches Engaged (Solenoids Energised)	
1st Forward	Forward Low & Layshaft - T,Z	(Ts,Zs)
2nd Forward	Forward High & Layshaft - U,Z	(Us,Zs)
3rd Forward	Forward Low & Mainshaft - T,Y	(Ts,Ys)
1st Reverse	Reverse Low & Layshaft - W,Z	(Ws,Zs)
2nd Reverse	Reverse High & Layshaft - V,Z	(Vs,Zs)
3rd Reverse	Reverse Low & Mainshaft - W,Y	(Ws,Ys)



In the following procedures the forward low clutch (**T**) is tested, therefore in step **2** a pressure gauge is connected to the forward low clutch test point.

When testing other suspect clutches connect a gauge to the relevant suspect clutch test point. Because the forward low clutch is suspect, a gear must be selected that will use the forward low clutch, in this instance 2nd gear forward.

**Note:** When testing the 2/4WD clutch remove the feed pipe **R** and fit service tool. This pipe incorporates a test point. Replace the original pipe when testing is complete.

- 1 Stop engine, connect a 0-20 bar (0-300 lbf/in<sup>2</sup>) pressure gauge to test connector **A**, (mainline pressure test point).
- 2 Connect a 0-20 bar (0-300 lbf/in<sup>2</sup>) pressure gauge to test connector **T** (forward low ratio clutch test point).
- 3 Remove the layshaft clutch solenoid feed connector **Zs**, at the solenoid control valve. This ensures that only the forward low clutch **T** is energised when 2nd gear forward is selected.
- 4 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.

- 5 Start engine and run at 1000 rev/min, select 2nd gear forward. Note the pressure readings on both gauges, which should not vary by more than 0.7 bar (10 lbf/in<sup>2</sup>). If the difference on the gauges is greater than 0.7 bar (10 lbf/in<sup>2</sup>) do the following:
  - a Stop the engine and interchange the gauges.
  - b Start the engine and run at 1000 rev/min, select 2nd gear forward. If the difference on the gauges is still greater than 0.7 bar (10 lbf/in<sup>2</sup>) dismantle the forward low clutch for servicing.
  - c If after interchanging the gauges, the readings are different than at step **5**, have the gauges calibrated and repeat the testing procedure.

## Powershift Gearbox Speed Sensor

Powershift machines fitted with an electronic control unit (ShiftMaster ECU) or a speedometer have a speed sensor **D** fitted. The speed sensor detects the speed of rotation of the gearbox output shaft and relays this information to the ECU or speedometer as applicable.

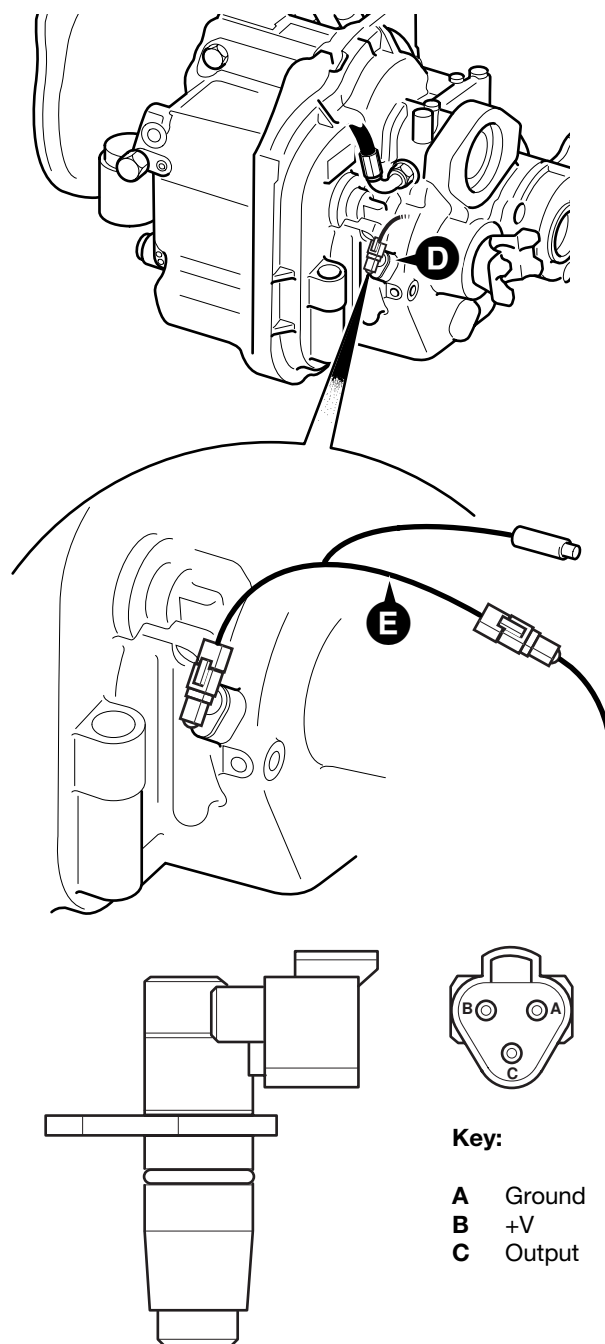
The sensor detects the passing of the gear teeth on the output gear. When adjacent to the top of a gear tooth the sensor electrical output turns ON, when adjacent to a gap between the teeth the sensor output turns OFF. In this way the frequency of the electrical signal changes according to the speed of gear rotation and therefore machine road speed.

The ShiftMaster ECU uses the input from the speed sensor to determine gear shift points. Failure of the speed sensor or its wiring will enable an ECU 'Limp Mode', preventing the use of 4th, 5th, and 6th gears. See **Fault Finding - Powershift Gearbox**.

### Testing

The speed sensor can be tested in situ without removing it by means of service test harness 892/01096 .

- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the loader arms to the ground. Switch OFF the engine and remove the starter key.
- 2 Connect the test harness **E** as shown. Tie back and secure the wires clear of the driveshaft and other moving components, in a position where the light emitting diode (LED) can be seen while operating the machine.
- 3 Turn the engine ON and drive the machine forward approximately 2 m (6 ft), make sure it is clear in front. Alternatively raise the wheels off the ground. If the sensor is operating correctly the LED will illuminate as the gear teeth pass the sensor, when the speed increases the LED will flash at a greater frequency until becoming continuously illuminated at higher speeds.
- 4 If the LED fails to illuminate carefully check the relevant wires and connectors for damage. Repair as required and re-test the sensor as described above. It should be noted that the speed sensor is normally a reliable component and a fault is more likely attributed to damaged wires or electrical connectors, see **Electrical Connections - Powershift Gearbox - 6 Speed**.



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## Powershift Gearbox - 6 Speed (ShiftMaster)

### Electronic Control Unit

The PS766 6 speed gearbox is controlled by an Electronic Control Unit (ShiftMaster ECU). The ECU is located behind the front console as shown at **A**.

The ECU is housed in a rugged case protected from ingress of dirt and moisture. Gearbox faults are more likely to be caused by faulty or damaged wiring, electrical components or hydraulic faults than by failure of the ShiftMaster ECU.

### Fault Finding

When fault finding note the following:

Make sure you understand the normal operation characteristics of the 6 speed gearbox. Some characteristics may be interpreted as faults by some operators. See **Basic Operation - ShiftMaster Operation Characteristics**.

The ShiftMaster ECU incorporates 'Limp Modes'. These modes can operate in response to other gearbox faults. Make sure you understand the characteristics of the 'Limp Modes', see **Fault Finding - Powershift Gearbox**.

The simplest and best way to fault find the 6 speed gearbox electrical system, (including the ECU) is by using ShiftMaster Diagnostics software and a laptop PC. See **Diagnostics User Guide**. This diagnostics system enables the engineer to quickly identify faults with specific electrical circuits or devices. The devices electrical connections, locations and wire identifications are given in **Electrical Connections - Powershift Gearbox - 6 Speed**. See also **Section C - Harness Data**.

If the facilities to use the ShiftMaster Diagnostics software system are not available, the gearbox and ECU can still be checked using a conventional multimeter, see **Electrical Connections - Powershift Gearbox - 6 Speed**. See also **Section C - Harness Data**.

### Software Upgrades

From time to time a ShiftMaster ECU 'Application Software' upgrades may be made available by JCB Service. If necessary 'Application Software' can be loaded into the ECU flash memory using a laptop PC and the **ShiftMaster Flash Programmer** application. This application is part of the **JCB Service Master** package found on the JCB Service Technical Information CD's. The Flash Programmer application includes comprehensive help files.

Note that the ECU contains 2 sets of software, 'Application Software' and 'Setup Data'. The 'Setup Data' is specific to a machine variant and can not be changed or replaced.

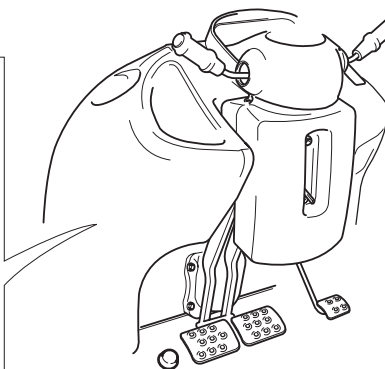
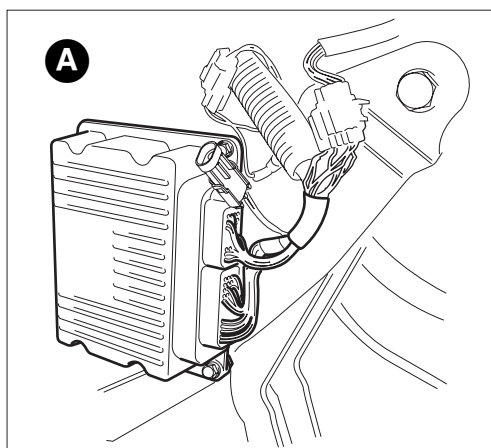
### Renewing The ECU

Before renewing the ECU note the following:

The ShiftMaster ECU is a **non serviceable part**. Any units returned under warranty found to have been tampered with will invalidate any claim.

ECU's are configured at the factory for each machine variant and are not interchangeable between machines. Although the part numbers may be the same, the internal software may not be. **DO NOT interchange ECU's between machines**.

Before renewing the ECU carry out all the relevant fault finding and diagnostics to **confirm ECU failure**. Units returned under warranty found not to be faulty will invalidate any claim.



A405370

## Powershift Gearbox - 6 speed ShiftMaster Diagnostics - User Guide

### 1. Introduction

**ShiftMaster Diagnostics** software is a PC based Diagnostics Tool designed to be an easy to use fault finding tool for the Service Engineer using a laptop PC. **ShiftMaster Diagnostics** employs the graphical strengths of the Microsoft Windows operating environment to simplify electrical fault finding within the ShiftMaster ECU control system used on Powershift PS766 6 speed gearboxes.

**ShiftMaster Diagnostics** is only intended for use with the ShiftMaster ECU and does not support older versions of Powershift Controllers used on the PS750 series gearboxes.

To utilise any supporting ShiftMaster Service Tools requires the use of the JCB Data Link Adaptor [or DLA] (717/ 20138) which is part of the standard JCB Electronic Service Tool Kit, part number 892/01033.



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This software is intended for use on IBM Compatible Personal Computers (**PCs**) running **Windows 9x** or **Windows2000** operating systems but is not compatible with either earlier versions of **Windows 3.x**.

All distributed software can be found on Disk 3 (CD3 - Adobe) of the JCB Technical Information Parts and Service CD-ROM set from **Issue 19** onwards. This disk is also supplied as part of the Electronic Service Tool Kit. Copies of this CD-ROM can be purchased from JCB Service. Alternatively, in due course software will become available for download over the internet via JCBs' Techweb service. Please refer to the available software for full installation instructions.

### 2. Care & Safety

#### **WARNING**

**Be sure to read and follow any on-screen instructions issued by ShiftMaster Diagnostics. Failure to follow correct procedure could result in death or injury.**



S404180

### 3. Installing ShiftMaster Diagnostics

The **ShiftMaster Diagnostics** tool is fully integrated within JCB ServiceMaster.

For full instructions on how to install the **ShiftMaster Diagnostics** software please refer to the documentation which accompanies JCB Service Master.

If you have successfully installed **ShiftMaster Diagnostics** but are experiencing difficulties with getting your PC to communicate with an ECU then there is a Troubleshooting Guide built into the **ShiftMaster Diagnostics** Help menu.

**Powershift Gearbox - 6 speed  
ShiftMaster Diagnostics - User Guide**

**4. Starting ShiftMaster Diagnostics**

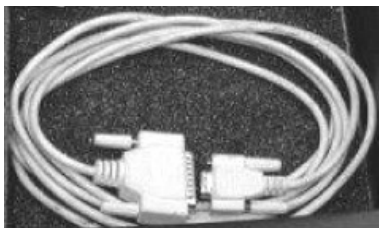
This document assumes that JCB Service Master has already been installed.

**Step 1:** Connect either the 'Serial PC Cable' (717/20138) or the 'Parallel PC Cable' (721/11071) between the DLA and a free port your laptop computer. The 'Parallel PC Cable' has a 25-way D-type connector on both ends or the lead.



S404190

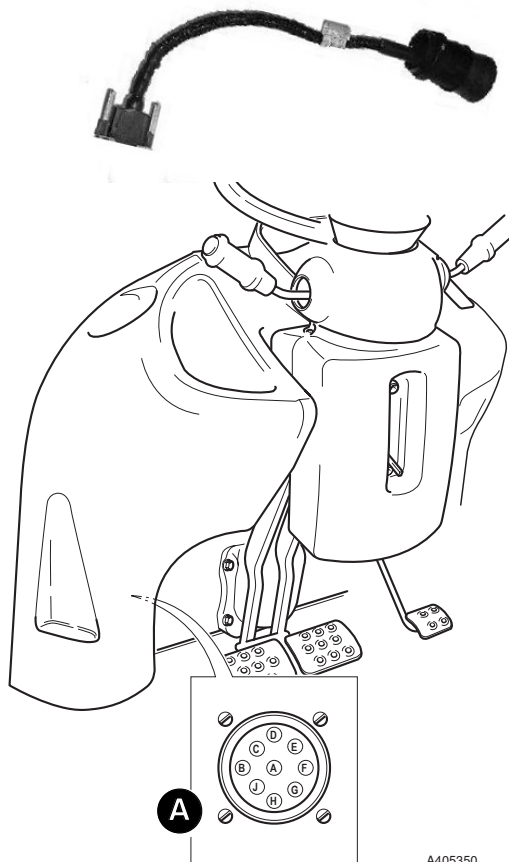
The 'Serial PC cable' has a 9-way D-type connector on one end and a 25-Way D-type connector on the other.



S404190

Plug the 25-way male connector into the DLA and the other connector into a free port on your laptop PC, remembering to tighten any thumb-screws appropriately.

**Step 2:** Connect the 'Machine Cable' between the DLA and the machines' Diagnostic Connector. The 'Machine Cable' has a 15-way D-type connector on one end and a 9-way CAN connector on the other. Plug the 15-way connector into the DLA and tighten the thumb-screws, then connect the 9-way CAN connector into the machines' Diagnostics Connector **A** and twist the lock-ring to secure it.



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**Step 3:** Turn ON the machine ignition and additionally start the engine if required (taking normal precautions).

**Note:** Be sure to follow all the cautionary notes given earlier and those which accompany the software.



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**Powershift Gearbox - 6 speed  
ShiftMaster Diagnostics - User Guide**

**Step 4:** Start **JCB Service Master**. And go to the BHL section.



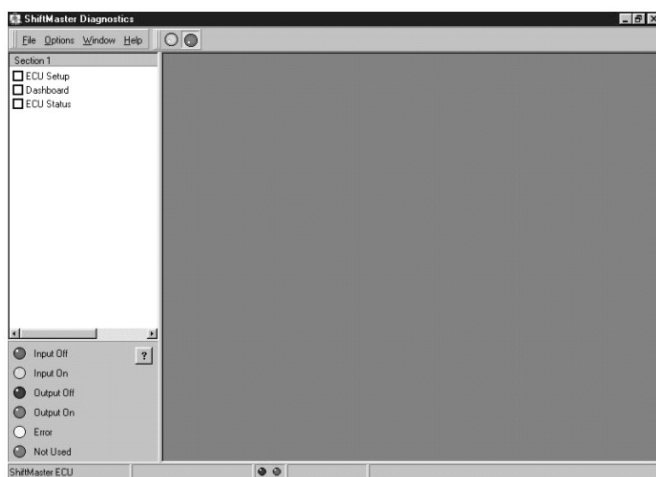
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**Step 5:** Start the diagnostics tool running by clicking on the **ShiftMaster Diagnostics** icon.



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**Step 6:** The **ShiftMaster Diagnostics** tool will then open up displaying the main window as shown here.



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**Step 7:** To start the **ShiftMaster Diagnostics** tool communicating with the ShiftMaster ECU either click on the **Start** button or select **Start Diagnostics** from the Options Menu. (See later sections for full details.)

**Connection Problems:**

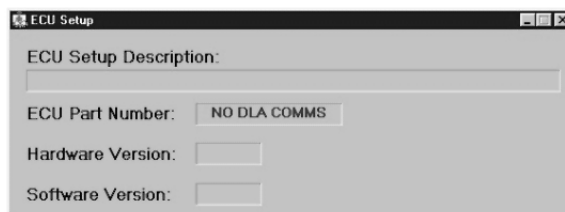
**ShiftMaster Diagnostics** will start and can be partly used even if there are connection problems.

In general, whenever there are problems communicating with the DLA there will be an error message displayed.



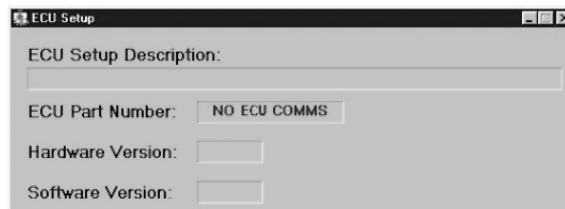
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More specifically, if communications can not be established with the DLA then the ECU Setup Page will display **'NO DLA COMMS'** where the ECU Part Number should be.



S404150

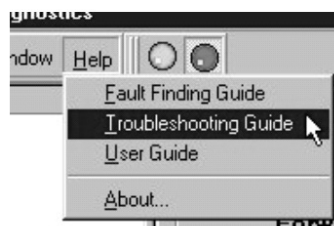
If communications can not be established with the ECU then the ECU Setup Page will display **'NO ECU COMMS'** where the ECU Part Number should be.



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**Note:** The ECU must be powered for communications to work, i.e. the machine ignition must be ON (but the engine need not be running).

For further details on possible communication problems please consult the **Troubleshooting Guide** included in the Help menu.



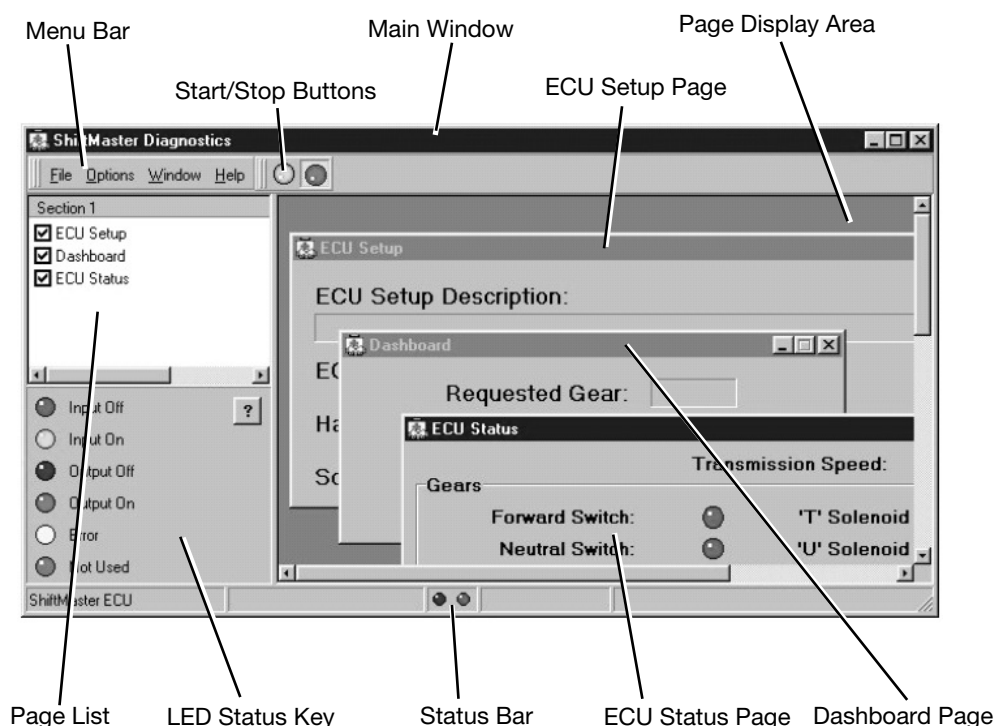
S404240



## Powershift Gearbox - 6 speed ShiftMaster Diagnostics - User Guide

### 5. ShiftMaster Diagnostics: Overview

There are several key elements to the **ShiftMaster Diagnostics** tool. These can be seen labelled below. Each element is explained in detail in later sections.



S404250

#### Navigating within ShiftMaster Diagnostics

Navigation is designed to be via a mouse. On Laptop PCs this may take the form of a small joystick or touch sensitive pad and some buttons, usually located near to the keyboard.

As with most Windows based programs, it is possible to navigate **ShiftMaster Diagnostics** using the keyboard by pressing certain combinations of keys.

**Note:** This can be particularly useful for certain Laptop PCs where the mouse/joystick can be over-sensitive. Try out the following, it may come in useful one day.

There are two main methods of navigation described below;

- Pressing the **ALT** key will cause the File option on the Menu Bar to be highlighted. You can then use the arrow keys to navigate the menus.
- Notice that all the menu items on the Menu Bar have a letter that is underlined (e.g. the 'F' in **File**). Holding down the ALT key and pressing the required letter key will activate that option (i.e. either open the menu or execute a function). For example, if you wish to open the Preferences Dialogue this can be done by pressing **ALT + O** (to open the **Options** menu) then **ALT + P** (to execute the **Preferences...** option).

**Powershift Gearbox - 6 speed  
ShiftMaster Diagnostics - User Guide**

**6. Menu Bar**

**File Menu**

The File Menu contains and **Exit** option to close down the program.



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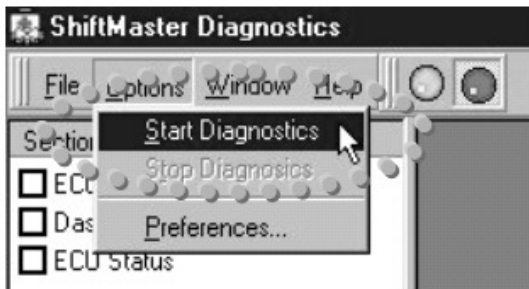
On exiting the program communications with both ECU and DLA are shut down.

**Options Menu**

Select either:

**Start Diagnostics** to commence communications with the ShiftMaster ECU.

or



S404270

**Stop Diagnostics** to cease communications.

Clicking on the **Preferences...** option opens up the Preference Dialogue.



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From the Preferences Dialogue there is support for multiple languages. Use the drop-down menu and scroll bar to chose the required language. Languages presently on offer are:



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- **English (British)**
- **French (Standard)**
- **German (Standard)**
- **Spanish (Modern Sort)**

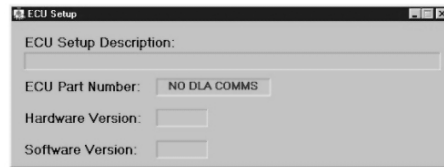
**Note:** The language option only effects text within the Main Window (e.g. Page List, LED Status Key, etc...). At present language support is not offered for the text within the Page displays.

The Preferences Dialogue also offers the ability to change the background colour of the Page displays. Select the required background colour using the radio buttons.



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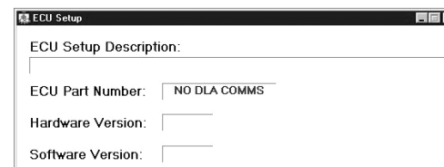
**Note:** When using a laptop PC it can often be difficult to see the screen in bright sunlight. Changing the background colour can help improve the contrast (especially with the different LED colours) and so make viewing the screen easier. Examples of the different colours are shown below;



S404310



S404320



S404330

Once your preferences have been selected either:

Click on **OK** to apply them or click on **Cancel** to leave them unchanged.

## Powershift Gearbox - 6 speed ShiftMaster Diagnostics - User Guide

### Window Menu

Like most other Windows based programs where there are multiple sub-windows or Pages used, there are usually options to organise how they are laid-out. **ShiftMaster Diagnostics** is no different and offers the following options;

- **Cascade**
- **Tile Horizontally**
- **Tile Vertically**

**Note:** Laptop PCs, particularly older ones, tend to have a low screen resolution. If this is the case then the Horizontal and Vertical tile options will probably be of little use and Cascade will offer the best advantage.

### Help Menu

To assist the Service Engineer, **ShiftMaster Diagnostics** is supplied with a set of documentary Guides. These Guides can be accessed directly from within the **ShiftMaster Diagnostics** tool itself, via the Help menu.

**Note:** All the Guides are provided in Adobe Acrobat PDF format. In order to read these guides the user must first have the Adobe Acrobat Reader installed on the PC. This software is supplied on the JCB CD-ROM where full installation instructions are provided.

At present these guides are as follows;

**User Guide:** This file is provided to explain how all the functions of the **ShiftMaster Diagnostics** tool operate.



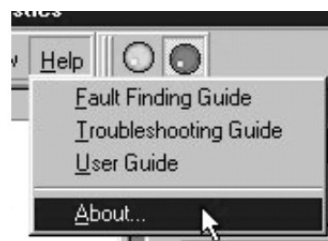
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**Troubleshooting Guide:** Sometimes users may experience problems with getting **ShiftMaster Diagnostics** to communicate properly with the ShiftMaster ECU. The Troubleshooting Guide has been provided to explain possible causes of problems with communications.



S404240

**Fault Finding Guide:** Provided to help the user to understand how the PS760 gearbox electrical system operates. This Guide also offers advice on fault diagnosis along with example scenarios, hints and tips.



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Selecting the **About...** option will bring up a window showing the JCB part number and the version number of the installed copy of **ShiftMaster Diagnostics**.



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## 7. Start/Stop Buttons

These offer the same function as the **Start Diagnostics** and **Stop Diagnostics** options within the Options Menu.

To start the **ShiftMaster Diagnostics** tool communicating with the ShiftMaster ECU simply click on the **Start Button** (big green LED) at the top of the Main Window. Similarly, click on the **Stop Button** (big red LED) to cease communications.

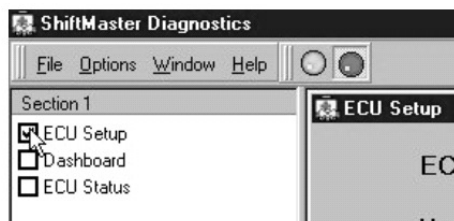


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## Powershift Gearbox - 6 speed ShiftMaster Diagnostics - User Guide

### 8. Page List

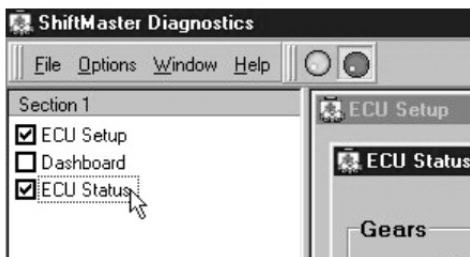
In the top left corner of the main window is displayed a list of pages which can be displayed.



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Clicking in the box next to the required page will make that page appear in the main window display area. (A tick will also appear in the box to show it is being displayed.)

At any time the user may swap between displayed pages simply by clicking on the title of the required page in the page list.



S404420

### 9. Status Bar

There are 2 items of interest displayed on the **Status Bar**, which is located along the bottom of the **ShiftMaster Diagnostics Main Window**.

**Connected ECU:** The type of ECU connected to the **ShiftMaster Diagnostics** tool is indicated on the far left side of the Status bar.



S404430

**CAN communications:** Two small LEDs indicate data being transmitted (red) and received (green) over the CAN communications link.

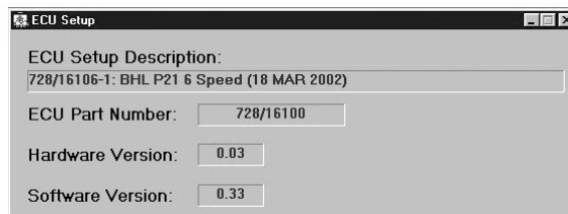


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These LEDs can be seen to be flashing rapidly as data is transported. This can be another useful aid to determining the state of any established communications.

### 10. ECU Setup Page

This page displays crucial information about the ECU configuration.



S404450

It is always useful to confirm that this is the correct configuration for the machine before commencing any fault finding.

The ECU Setup Page displays the following information;

#### ECU Part Number

This will display the part number of the connected ShiftMaster ECU.

If there are communications errors present then this will contain either;

- '**NO DLA COMMS**' if there are problems communication with the DLA, or
- '**NO ECU COMMS**' if the DLA is working but the ShiftMaster ECU is not responding.

**Note:** If communications problems are suspected then please consult the accompanying **Troubleshooting Guide** for further information.

#### Hardware Version

This hardware version is a reference to the build level of the electronics. Future developments may mean that hardware upgrades are required. This may effect which software can be used.

#### Software Version

The software version refers to the issue level of the ECU operating software. Again, future developments may require software revisions.

#### ECU Setup Description

As well as its' operating software, the ShiftMaster ECU also stores a group of **Setup Data** (or Settings). This Setup Data is used to tailor how a certain ECU part number functions. The Setup Data is loaded during the manufacturing process and has been approved for use in the intended application.

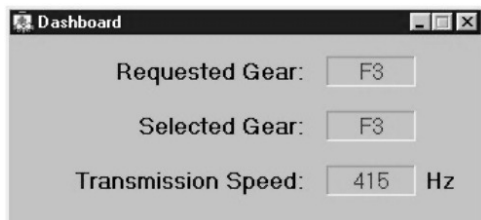
Contained as part of the Setup Data is a Description. This Description is what is displayed here. The Engineer can use this description to verify that the correct Setup Data is being used.

At present there is no service tool available to load new **Setup Data**.

## Powershift Gearbox - 6 speed ShiftMaster Diagnostics - User Guide

### 11. Dashboard

This offers a simple uncluttered display showing;



S404460

#### Requested Gear

This is the demand from the driver.

#### Selected Gear

This is the actual gear being selected by the ECU.

**Note:** The driver **Request Gear** is not always the same as the Selected Gear, e.g. when the ECU blocks shifts when offering protection.

#### Transmission Speed

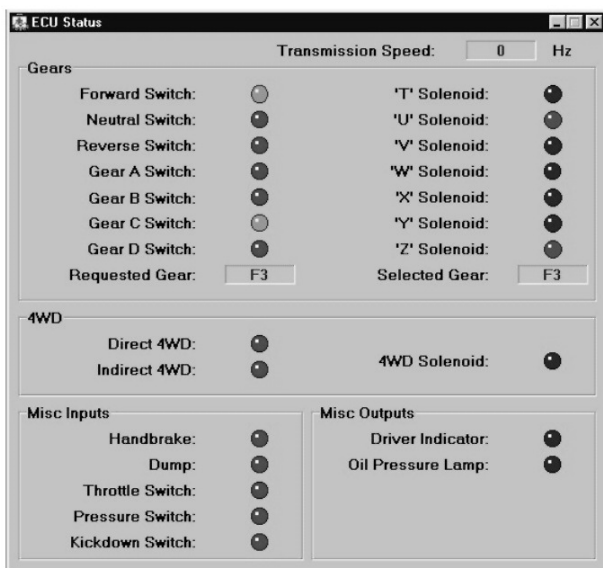
This is the current transmission output speed which is directly related to the road speed (through axle ratio and tyre size). The transmission speed sensor is located next to the output gear and detects the passing of the gear teeth. The sensor has a fixed installation, no adjustment is necessary.

The Transmission Speed value is a frequency reading and is displayed in Hertz (Hz), or teeth per second.

This signal is used by the ECU to determine gear-shifting and protection strategies.

### 12. ECU Status Page

This page gives a detailed picture of how the ECU is operating.



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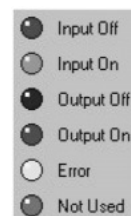
Information in this display is constantly updated in real-time. (Some older PCs may experience a slight delay in updating this page, but usually only less than one second.)

The left hand side shows the inputs to the ECU, their status indicated by green LEDs.

The right hand side shows the outputs from the ECU, their status shown by red LEDs.

The exact colour of the LED indicates the status of that feature.

A key in the bottom left corner of the main window explains the colours.



S404480

The following is a brief explanation of each feature. For further information and examples of typical scenarios please refer to the accompanying Fault Finding Guide accessible via the Help menu.

#### Transmission Speed

This is exactly the same signal as explained in the previous section.

#### Gears

**Inputs:** The items on the left show the signal lines connected to the gear selection lever. This lever is the left hand half of the control lever assembly mounted on the steering column.

**Outputs:** The items on the right are the power signals going down to the transmission solenoid valves. The LEDs will indicate which solenoids are being energised. Error detection on the output electrics is continually running. If any output were to develop a fault (e.g. open circuit or short circuit) then the LED will turn yellow. Fix the fault and the LED will revert back to red.

During certain gear-shifts the ShiftMaster ECU will perform electrical **Modulation** to improve gear-shift quality. The ECU does this by adding delays to off-going and/or on-coming clutches and so overlapping energised outputs. These delays are in the order of a few hundred milli-seconds but it is sometimes long enough to be observed on the status LEDs. Thus, during certain shifts it is quite normal to observe more than 2 outputs ON at any one time.

## Powershift Gearbox - 6 speed ShiftMaster Diagnostics - User Guide

### 4WD

The machine driver has 2 inputs which are used to influence the state of the 4WD solenoid output. These features interact as follows;

Firstly there is a **Direct 4WD** input which is, in general, connected to the machine footbrake switch (which in turn controls the brake lights). Whenever this signal is present the **4WD Solenoid output** is energised.

The second input is **Indirect 4WD** which is usually derived from a command from a console mounted '4WD selector' switch. (However, this switch arrangement may change between machines.) If the transmission speed is too high then the ECU will over-ride this signal and automatically disengage the 4WD.

### Misc. Inputs

These inputs are derived from the remaining driver controls. A brief summary follows but refer to the **Fault Finding Guide** for full details.

**Handbrake Switch:** Signal derived from the Parkbrake switch. Used to hold the transmission in Neutral if the parkbrake is applied.

**Dump Switch** (or Transmission Disconnect): Signal usually derived from a momentary switch fitted to a loader lever. Temporarily selects Neutral when pressed (usually to divert engine power to hydraulics).

**Throttle Switch:** Dedicated switch fitted to the machines' accelerator pedal. Used to interact with the Automatic Mode of gear-shifting.

**Pressure Switch:** Signal is derived from the transmission mounted Low Oil Pressure Switch.

**Kickdown Switch:** Another momentary button (mounted on the cab floor) used to temporarily select the next lowest gear.

### Misc. Outputs

These are the additional ECU outputs, generally used to control cab instrumentation like the low **Oil Pressure Lamp** and Driver **Indicator** (lamp and buzzer where fitted).

## 13. General Information

For all enquiries about the **ShiftMaster Diagnostics** tool please follow your normal channels of enquiry. This ensures that useful information can filter through to JCB Service personnel at all levels.

## Powershift Gearbox - 6 speed

### ShiftMaster Diagnostics - Troubleshooting Guide

#### 1. Introduction

If you are experiencing difficulties with getting **ShiftMaster Diagnostics** and your PC to communicate with a **ShiftMaster ECU** then please take a little time to read the following information which has been compiled to guide diagnosis of such problems.

To utilise any supporting ShiftMaster Service Tools requires the use of the **JCB Data Link Adaptor (DLA)** which is part of the standard **JCB Electronic Service Tool Kit**, part number **892/01033**.

This software is intended for use on IBM Compatible Personal Computers (**PCs**) running **Windows 9x** or **Windows2000** operating systems but is not compatible with either earlier versions of **Windows 3.x**.

It is known that some laptop PCs can experience problems with serial communications.

In a few rare cases the PCs hardware does not allow the diagnostics software access to communications (COM) ports.

JCB Service are in the process of compiling a 'recommended' list of laptops which we know to work satisfactorily with JCB Software.

In the majority of cases conflicts are caused by either software already running on the PC, or by certain 'driver' files which hog the COM port(s).

**Note:** a PC which has many users and uses is likely to contain some redundant software and drivers.

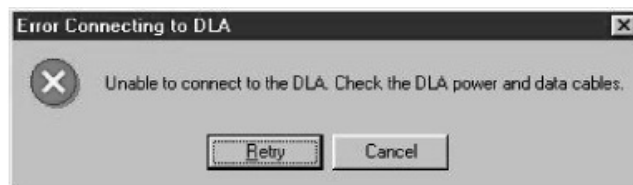
If you do not feel technically competent to adjust PC software & set-up, please enlist the help of someone suitably trained before proceeding.

#### 2. Elementary Checks

Please make sure that the correct communications leads are being used and are not damaged in any way.

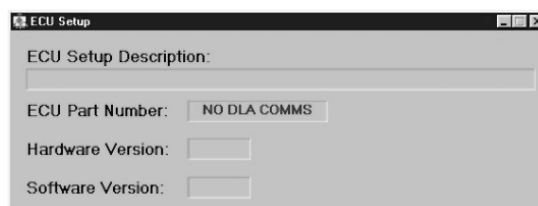
#### Non Communication with DLA

In general, whenever there are problems communicating with the DLA there will be an error message displayed.



S404140

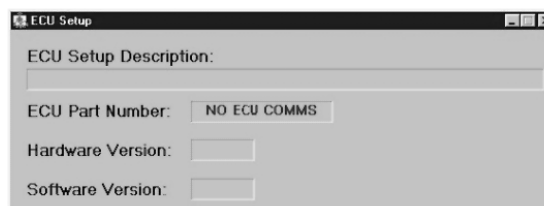
More specifically, if communications can not be established with the DLA then the ECU Setup Page will display '**NO DLA COMMS**' where the ECU Part Number should be.



S404150

#### Non Communication with ECU

If communications can not be established with the ECU then the ECU Setup Page will display '**NO ECU COMMS**' where the ECU Part Number should be.



S404160

**Note:** The ECU must be powered for communications to work, i.e. the machine ignition must be ON (but the engine need not be running).

## Powershift Gearbox - 6 speed

### ShiftMaster Diagnostics - Troubleshooting Guide

#### 3. DLA Drivers

The DLA has software 'drivers' (i.e. programs which handle communications) programmed into the unit. There are matching drivers that must also be resident on you PC.

The update of both these sets of drivers is handled by JCB Service Master. Please refer to the applicable supporting literature.

#### 4. PC Power Management

Some laptops' Power Management software can disrupt the COM ports.

This problem occurs with many other software applications and is not unique to JCB Service Master applications. The following advice is worth bearing in mind.

If the user experiences communications problems with a **ShiftMaster ECU** turn OFF the laptops' power management software.

Problems may be;

- (a) Complete failure to establish communications with an ECU.
- (b) A drop-out of communications (i.e. connects to the ECU and after a while the link fails).
- (c) Intermittent failure (i.e. seems to disconnect and re-connect at random intervals).

Item (a) is probably the most common.

To turn OFF the laptops power management open **Windows Control Panel** (Start > Settings > Control Panel). There will normally be an icon to run that particular laptops' power management software. Turn OFF the power management, close the tool and then close the control panel.

These power management tools are specific to the laptop. Some may require the PC to be re-booted before the changes take effect.

#### 5. IR Drivers

Many Laptop PCs have a built in InfraRed (IR) communications port. There is likely to be some resident software to control this port. If this type of port is present, but never used, then try disabling the driver;

System Properties > Device Manager > Ports > ..... (infrared)

#### 6. Modem Drivers

Check that only the correct modems are installed on the machine.

Experience has shown that multi-user PCs often contain many modems, perhaps installed for use other than in the office.

Disable any unused modems.

There has been no experience of correctly installed internal modems or PCMCIA cards (modem or network) causing significant problems.

#### 7. Windows XP & Windows NT

Please note the ShiftMaster Diagnostics software is NOT designed to run on Windows NT. In addition JCB can not guarantee that this software will be fully functional with the latest versions of Windows (e.g. WindowsXP) although JCB are continually developing support for different operating systems.

#### 8. Further Assistance

If a communication problem persists, then the following contacts may be able to provide further assistance;

- a). If applicable, try seeking assistance from your Computer Systems Engineer/Technician.
- b). The first port of call outside your company should be the laptop machine dealer or agent.
- c). Your next enquiries should be with the laptop machine OEM (Original Equipment Manufacturer). If the OEM is unable to assist they will make the relevant enquires on your behalf.

**If you continue to have a communications problem, note the applicable laptop make and model. Contact JCB Service so that further investigations can be made..**

For all enquiries about the ShiftMaster Diagnostics tool please follow your normal channels of enquiry. This ensures that useful information can filter through to JCB Service personnel at all levels.



## Propshafts

### Removing and Replacing

#### When Removing

Before removing propshafts always mark both companion flanges and also mark the sliding joints prior to removal.

#### When Replacing

Upon reassembly, after lubricating sliding joints with JCB MPL Grease, align the shafts against identification marks previously made or, in the case of a shaft being renewed, use the manufacturer's alignment markings.

Apply JCB Threadlocker and Sealer to threads of all flange bolts.

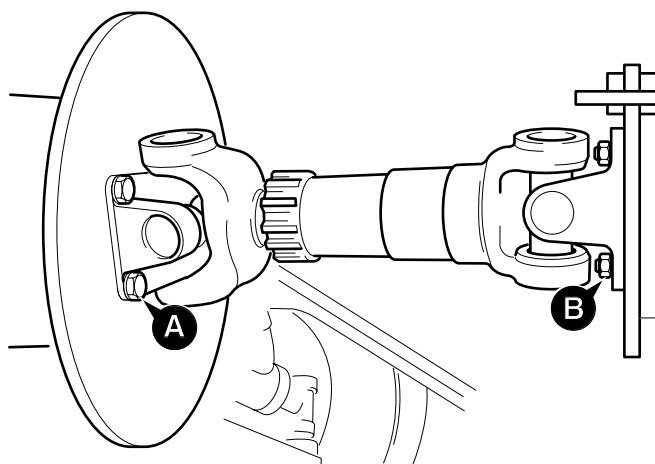
Retaining straps **C** stretch with use, therefore these straps must always be replaced with new ones.

The propshaft must have both ends exactly on the same plane as shown at **X**. The yokes must not be at right angles as at **Y** or at an intermediate angle as at **Z**.

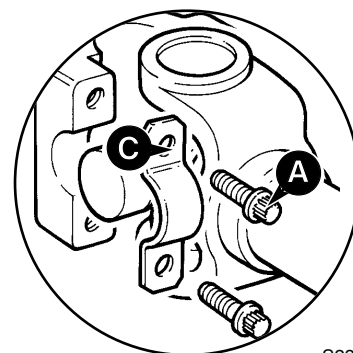
#### Torque Settings

Item	Nm	kgf m	lbf ft
A	75 - 85	7.7 - 8.7	55 - 63
B	118	12	87

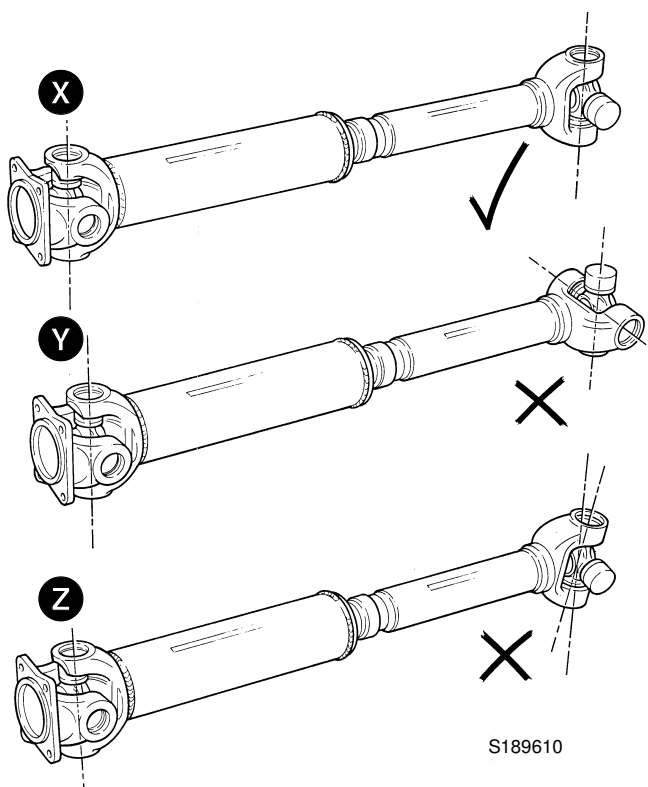
### REAR



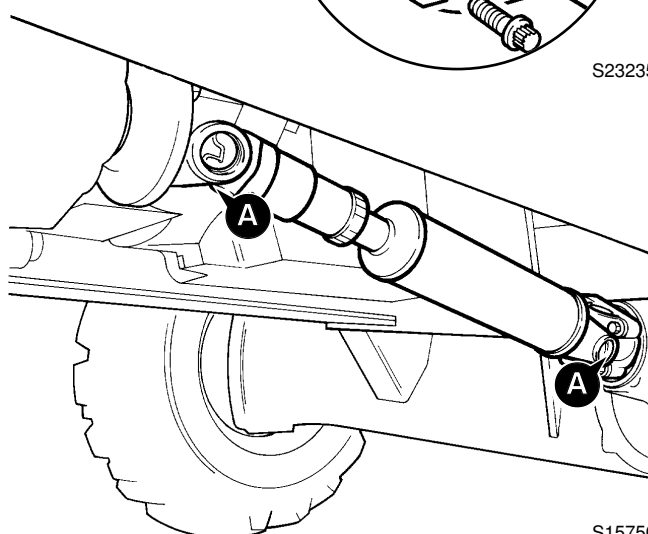
A396840



S232350



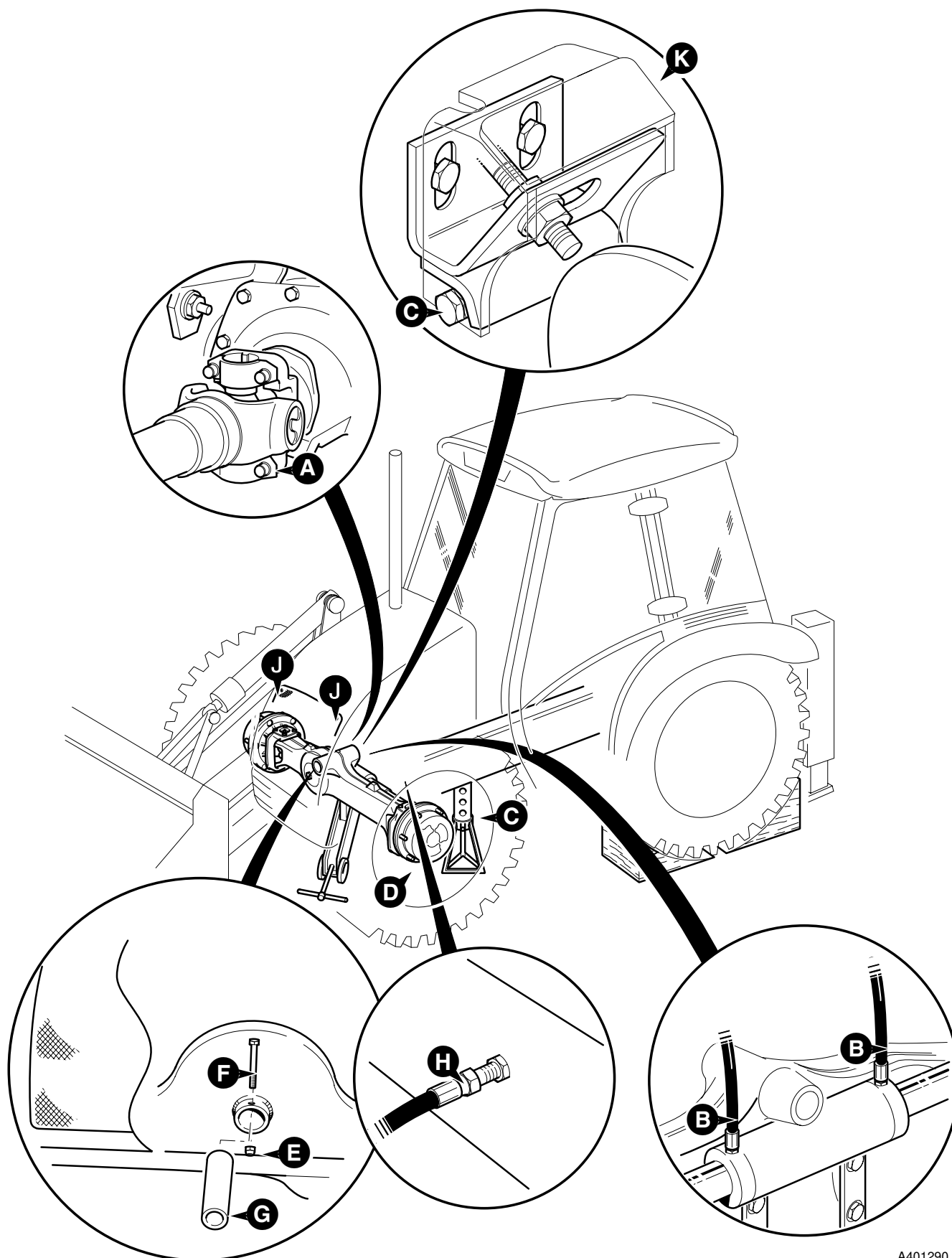
S189610



S157500

### FRONT

Removal and Replacement



A401290

## Removal and Replacement (cont'd)

**Note:** The following procedure can be applied to both AWS and 2WS machines. Dis-regard information not applicable to your machine type, for instance, 2 wheel steer machines will not have steering proximity switches fitted.

### WARNING

**A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.**

**Disconnect the battery, to prevent the engine being started while you are beneath the machine.**

GEN 1-1

### Removal

### 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

- 1 Release screws **J** and remove the front grille.
- 2 Remove the cover **K** from the proximity switch and then remove the bracket and switch assembly.
- 3 Using tool 892/00822 remove bolts **A** to disconnect the drive shaft from the axle.
- 4 Disconnect the hydraulic pipes **B** from the steer rams, blank off all exposed connections.
- 5 Disconnect remote grease nipple hose **H**.
- 6 Loosen the road wheel retaining nuts **D**.
- 7 Make sure that the rear wheels are blocked, use the loader arms to raise the front end of the machine.
- 8 Prop the machine on each side as shown at **C**.
- 9 Remove the front road wheels.
- 10 Position a jack underneath the balance point (see Note) of the axle and support the axle weight.

**Note:** Because the drivehead assembly is offset, the balance point of the axle is not the centre of the axle. Attach a 'cradle' to the jack that will partially embrace the axle.

- 11 Remove nut **E** and pivot pin retaining bolt **F**.
- 12 Remove pivot pin **G** seals, use puller (tool no. 993/68100) and remove the pivot pin **G** and axle shims.
- 13 Lower the jack so that the axle is clear of the mounting yoke and remove the axle.

## Removal and Replacement (cont'd)

### Replacement

Replacement is the reverse of the removal sequence.

### **⚠ WARNING**

If, for whatever reason, a wheel stud is renewed, all the studs for that wheel must be changed as a set, since the remaining studs may have been damaged.

2-3-2-8

Whenever a wheel has been removed, check the wheel nut torques every two hours until they stay correct.

Apply JCB Lock & Seal to the threads of bolts **A**.

The front axle must be shimmed to give a maximum fore and aft movement of 0.5 mm (0.020 in).

Nylon shims must be fitted as follows:

#### AWS Machines

- a Fit a 5.0 mm thick master shim (coloured blue) between the front of the axle and the yoke plate as shown at **X**.
- b Measure the fore and aft movement and subtract 0.5 mm to obtain the required shim thickness. Fit the correct thickness shim between the rear of the axle and the yoke plate as shown at **Y**.

#### 2WS Machines

- a Fit a 5.0 mm thick master shim (coloured blue) between the rear of the axle and the yoke plate as shown at **Y**.
- b Measure the fore and aft movement and subtract 0.5 mm to obtain the required shim thickness. Fit the correct thickness shim between the front of the axle and the yoke plate as shown at **X**.

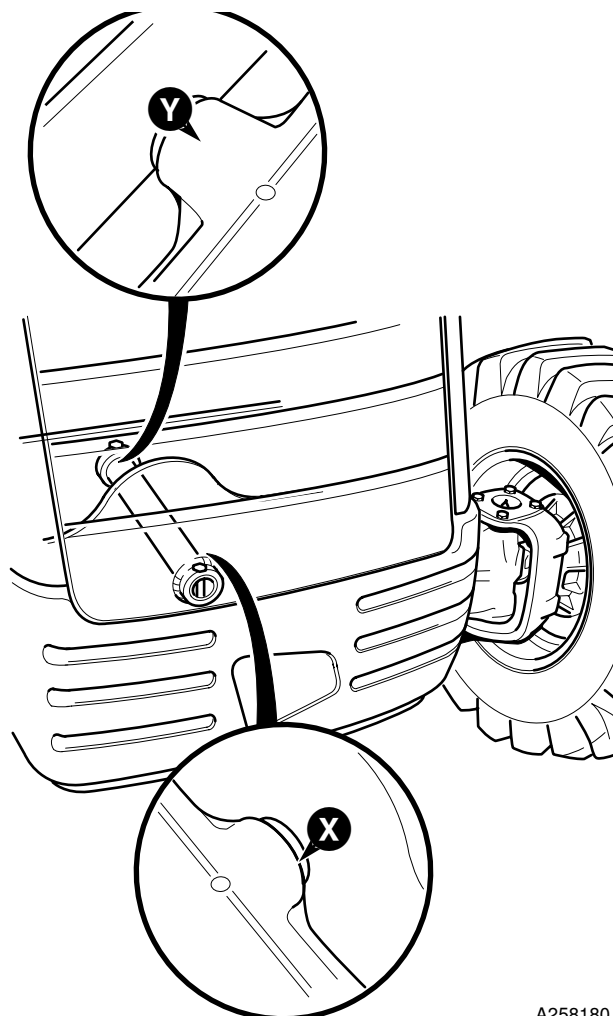
**Note 1:** DO NOT fit more than 2 shims (including the master shim).

**Note 2:** To assist assembly, use the double sided tape ring supplied to retain the shims on the yoke plate.

If the setting of the steering proximity switch has been disturbed, then complete the front axle proximity switch setting procedure, see **Section H, Service Procedures**.

#### Torque Settings

Item	Nm	kgf m	lbf ft
<b>A</b>	79	8	58
<b>D</b>	680	69	500



A258180

## Hub and Driveshaft - Dismantling

The following illustrations show the axle removed from the machine but the hubs may be dismantled without removing the axle.

### **⚠ WARNING**

**A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.**

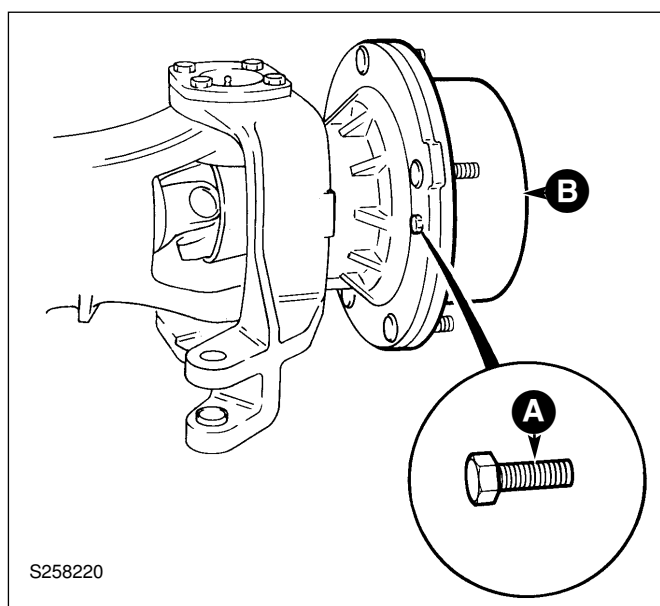
**Disconnect the battery, to prevent the engine being started while you are beneath the machine.**

GEN 1-1

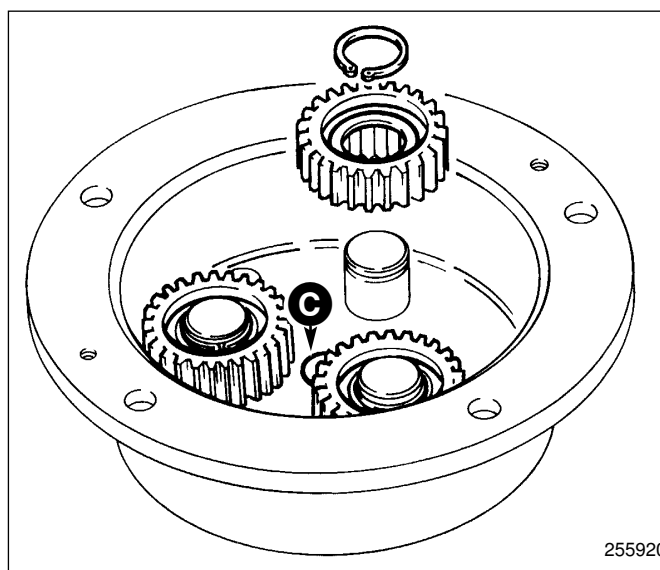
- 1 Disconnect the steering track rod. Drain oil from the hub.

**Note:** The illustration shows a typical axle.

- 2 Remove screws **A**.
- 3 Lever the planet gear carrier **B** off the bearing carrier. Clean off all traces of sealant from the mating faces or remove 'O' ring as applicable.

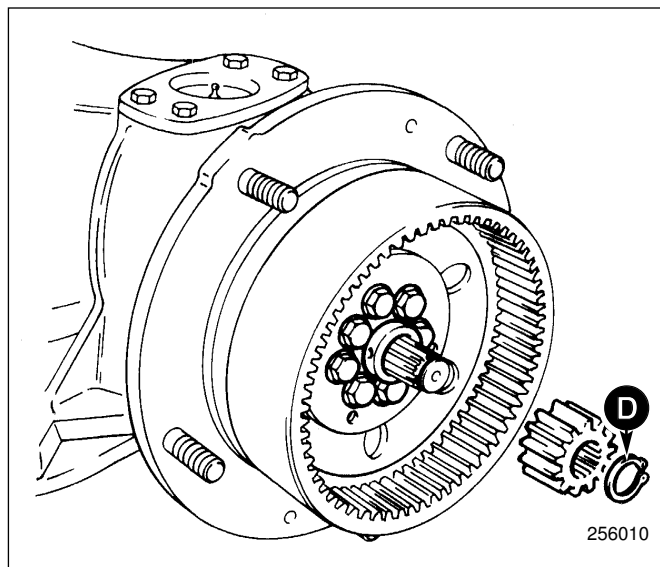


- 4 Remove planet gears only if defective. Note that gears can only be removed as assemblies, which comprise the gear, the bearing and two 'L' shaped circlips. To remove a planet gear, first remove the external circlip.
- 5 Pull off the planet gear.
- 6 The driveshaft thrust pad **C** is drilled and tapped M6 for removal purposes.

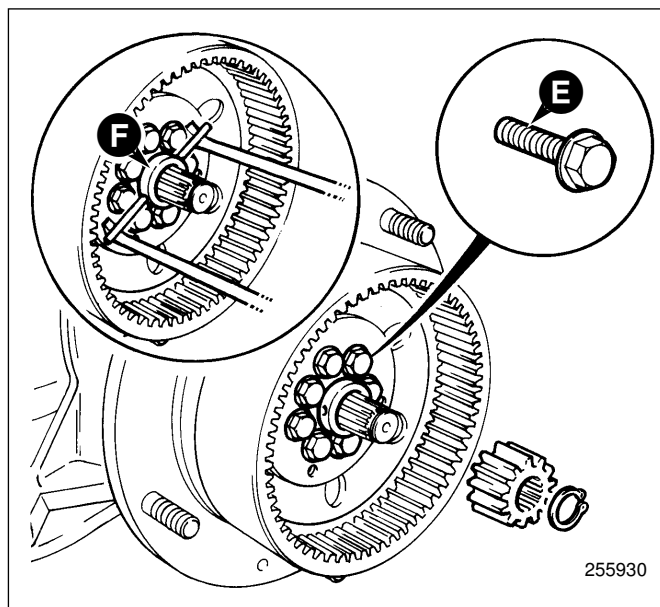


**Hub and Driveshaft - Dismantling (cont'd)**

- 7 Remove circlip **D** to allow the sun gear to be slid off the drive shaft.

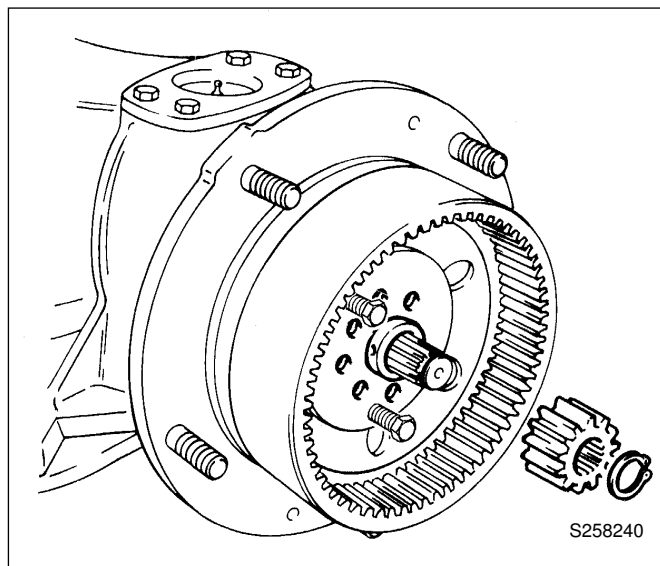


- 8 To remove the 'Verbus Ripp' bolts **E**, it is necessary to remove the spacer **F**. Revolve the spacer with a suitable drift to align the holes in the spacer with the space between the bolts.
- 9 Using two dowels and two heel bars, remove the spacer using the method shown.
- 10 Remove the 'Verbus Ripp' bolts using a special tool (part number 892/00333). These bolts are very tight and care must be taken not to distort the bolt heads. Use as short an extension bar as possible.



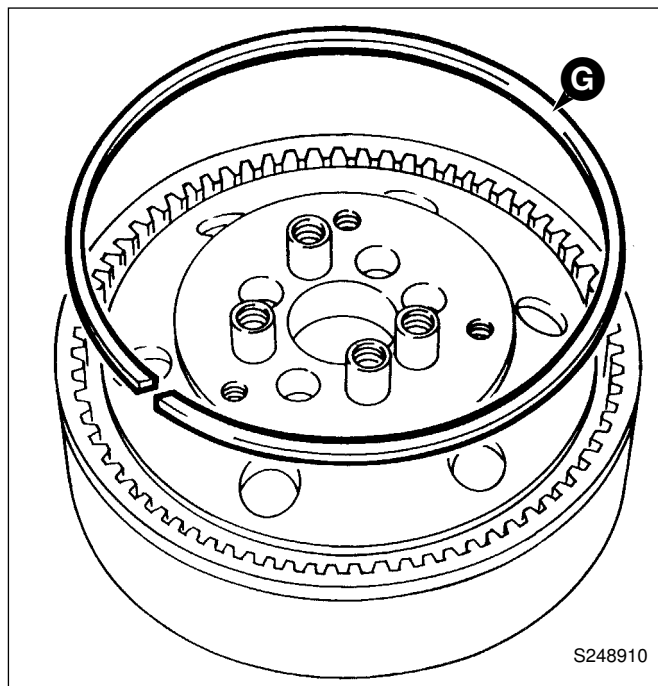
- 11 Using 2 high grade M14 bolts as jacking screws, remove the annulus carrier.

**Note:** Fretting between the hub swivel and annulus carrier mating faces might be evident; this condition is normal, do not attempt to repair. If the hub swivel and annulus carrier are to be re-used, the carrier must be assembled in the same angular position it was removed; match mark the hub swivel and carrier before removing the carrier.



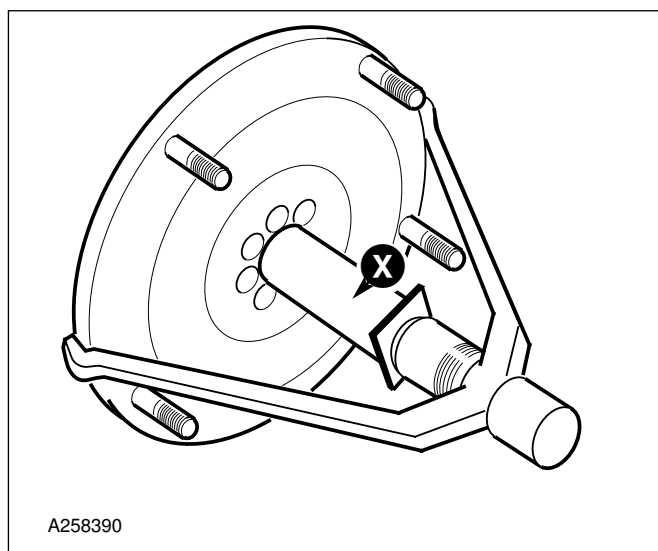
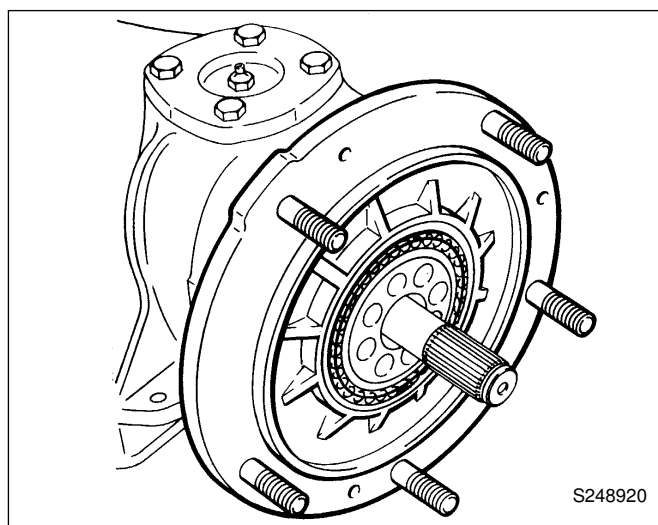
### Hub and Driveshaft - Dismantling (cont'd)

- 12 Remove circlip **G** to separate the annulus ring from the annulus carrier.



- 13 Pull off the bearing carrier together with the outer bearing cone and its bearing cup. Withdraw the inner bearing cup from the inboard side of the carrier.

**Note:** To prevent damaging the axle case inner seal, do not lever against the half shaft. Place a tube over the half shaft and lever against the tube, as shown at **X**.

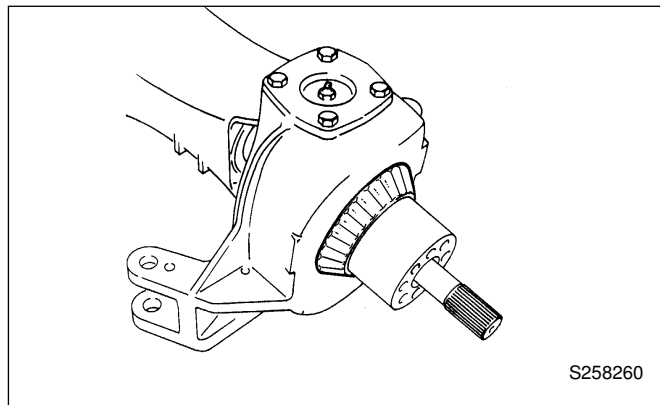


## Hub and Driveshaft - Dismantling (cont'd)

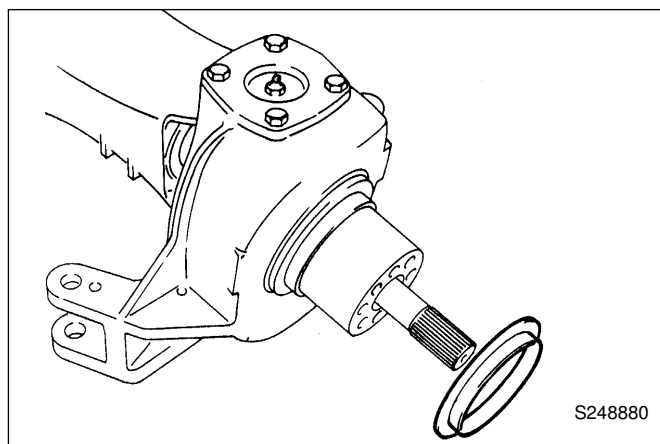
14 Pull off the inner bearing - see Note at step 13.

15 Remove and discard the seal.

**Note:** The inner bearing and oil seal may withdraw with the bearing carrier.

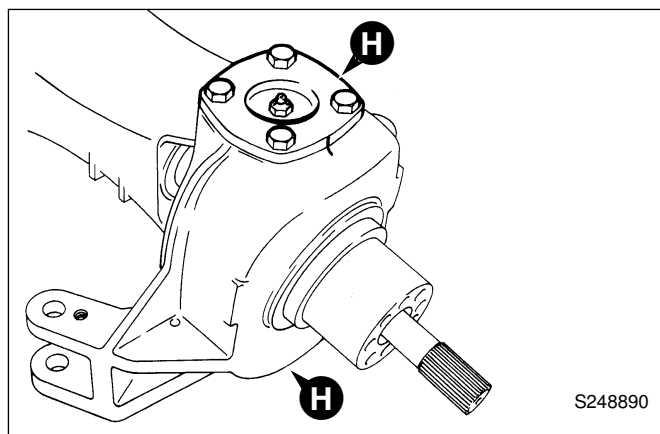


16 Remove and discard the combination seal. When assembling the axle, a new combination seal must be used.

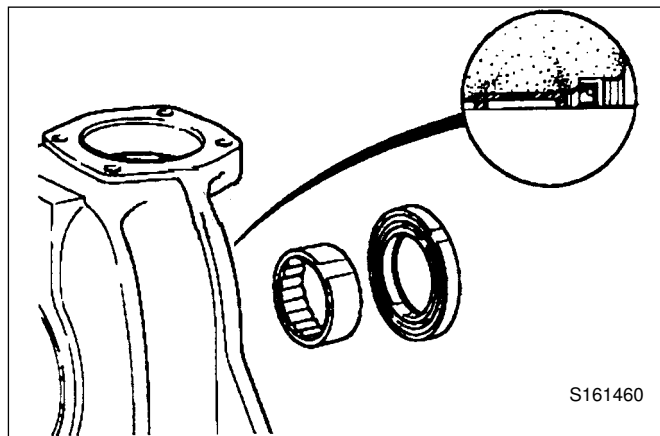


17 Mark position of top and bottom trunnions **H** and remove. Withdraw the hub carrier.

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



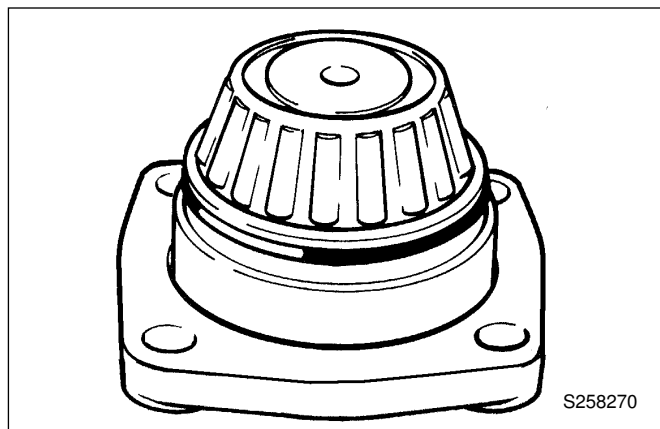
18 Use adaptor 993/59500 with slide hammer tool 892/00224 and remove driveshaft seal and needle roller bearing from the hub carrier.





**Hub and Driveshaft - Dismantling (cont'd)**

19 Use a puller to remove the trunnion seal and bearing.

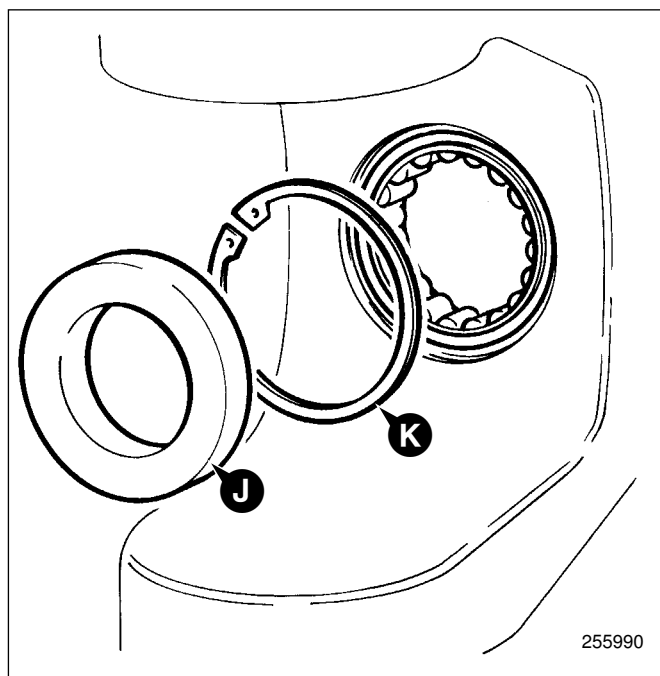


20 Withdraw drive shaft.

21 Prise out drive shaft inner oil seal **J**.

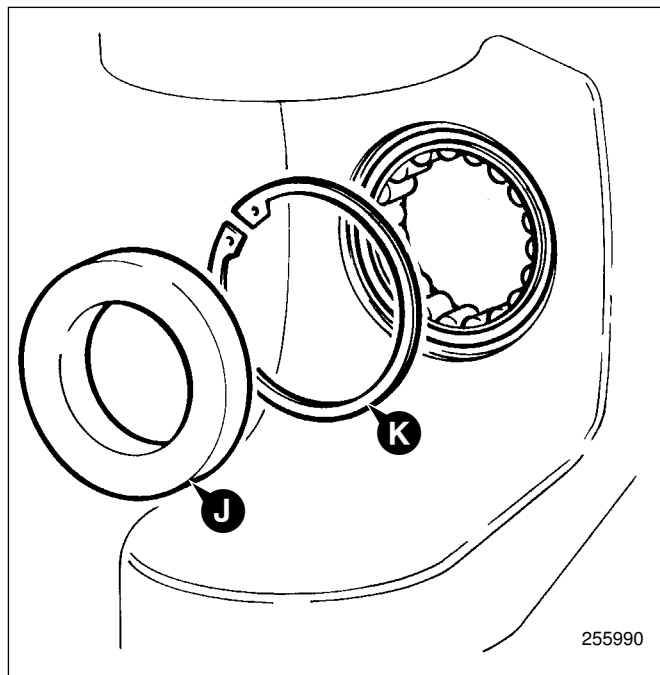
22 Remove circlip **K**

23 Remove bearing using tool 892/00225.

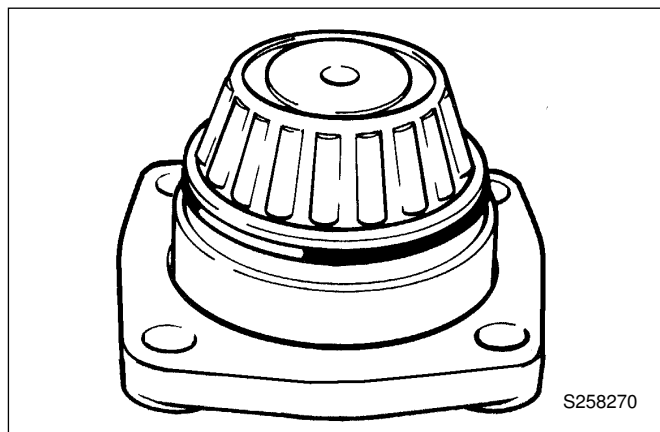


### Hub and Driveshaft - Assembly

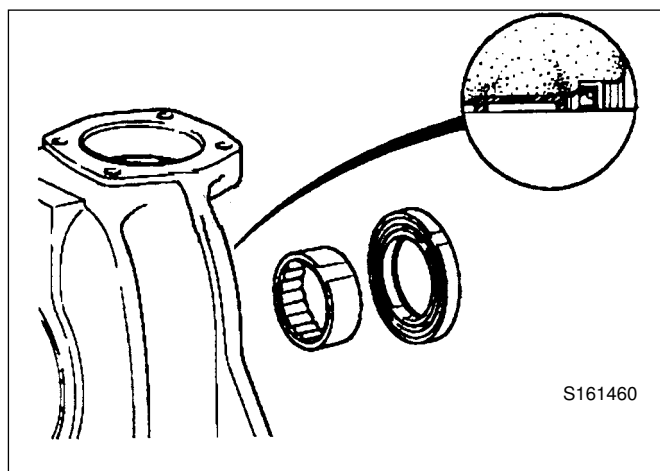
- 1 Tap drive shaft inner bearing into position and secure with circlip **K**.
- 2 Fit new oil seal **J**. Pack grease between lips of seal.
- 3 Fit drive shaft, taking care to locate inner end into splines of differential gears.



- 4 Press new trunnion oil seal into position followed by the bearing. Grease bearing and oil seal before fitting to axle.

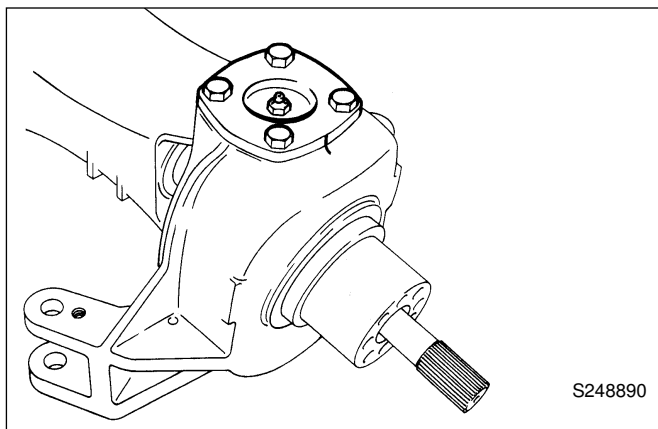


- 5 Fit driveshaft needle roller bearing to the hub carrier. Pack the cavity between the oil seal lips with grease and then fit the seal.

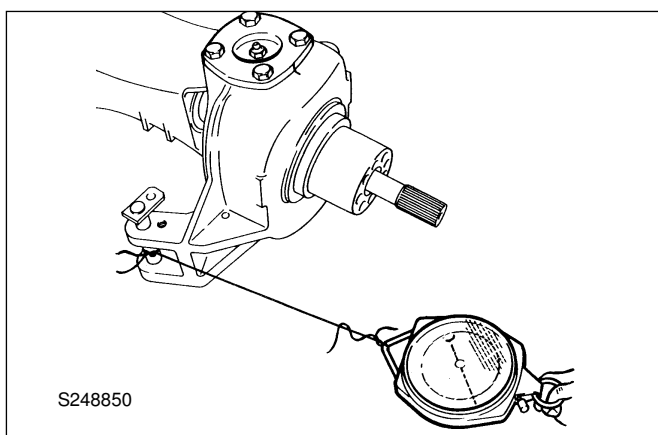


**Hub and Driveshaft - Assembly (cont'd)**

- 6 Locate hub carrier and fit bottom trunnion. Apply JCB Lock and Seal (part no. 4101/0202) to the bottom trunnion bolt threads, fit and tighten to 98Nm (72 lbf ft). Fit top trunnion and leave top trunnion bolts finger tight.

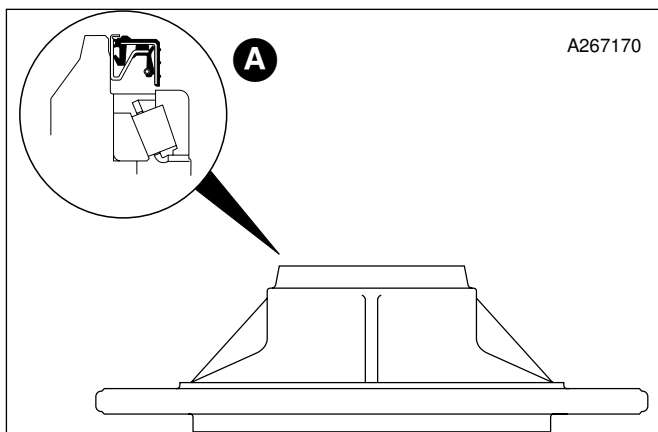


- 7 Attach a spring balance to track rod swivel as shown and note the reading. Tighten the top trunnion bolts to eliminate end float but no bearing pre-load, ie no increase in spring balance reading.



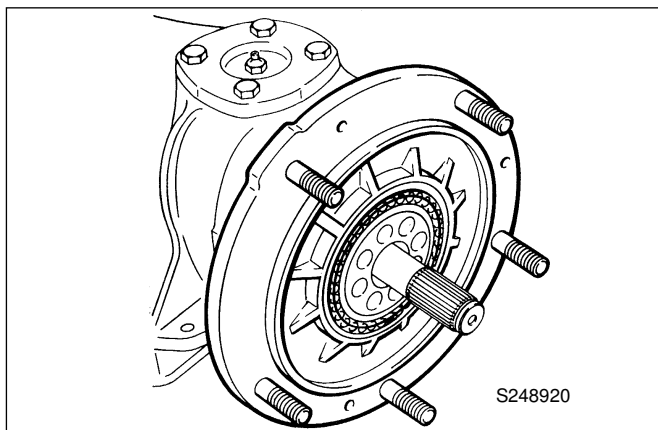
- 8 Refit top trunnion. Apply JCB Threadlocker and Sealer to the top trunnion bolt threads, fit and tighten to 98 Nm (72 lbf ft). Check spring balance reading which should be 4.5 kgf (10 lbf) more than the reading recorded at fig. 7.

- 9 Lightly oil the inner wheel bearing. Assemble the inner and outer bearing cups, and the inner bearing cone into the bearing carrier.



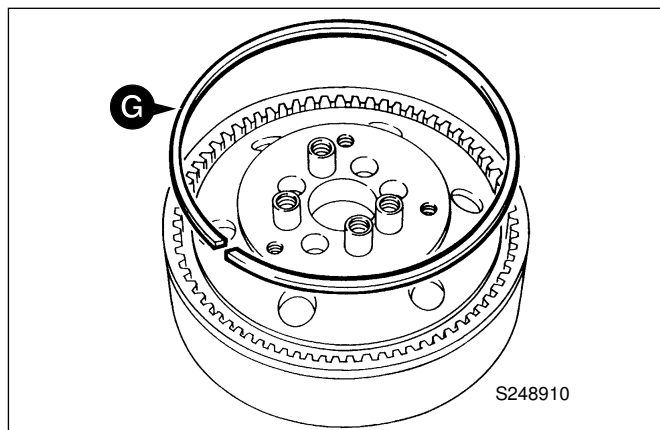
- 10 Fit a new combination oil seal. Do not lubricate before fitting. Drive the seal squarely into the carrier until the locating lip is flush as shown at A.

- 11 Fit the bearing carrier onto the axle arm. Lightly oil the outer wheel bearing race. Fit the bearing onto the axle arm. Rotate the bearing during fitting.



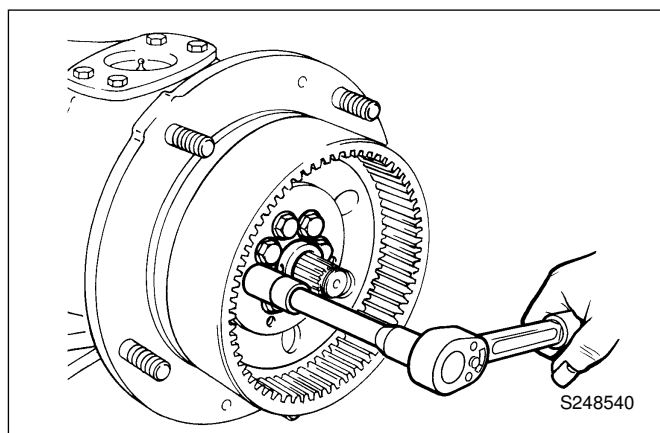
**Hub and Driveshaft - Assembly (cont'd)**

- 12 Assemble the annulus ring to the annulus carrier. Secure with the circlip **G**.



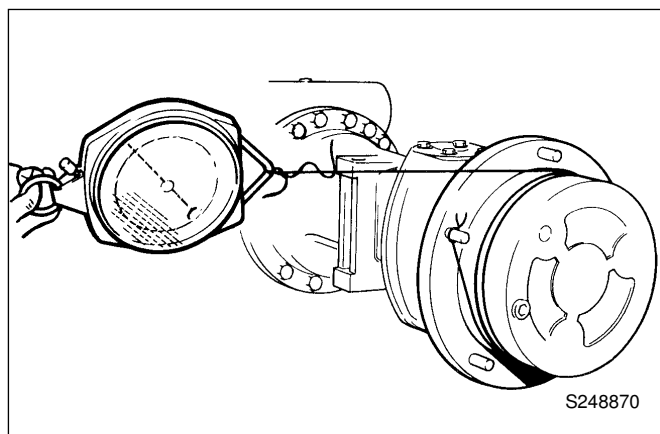
- 13 Fit annulus assembly in the same angular position as removal (see **Note, Dismantling**, step 11) using new 'Verbus Ripp' bolts. Do not fully tighten bolts but allow the bearing carrier to rock slightly. Measure seal drag rolling force - see step 14.

**Note:** Steps 13 to 16 describe measurement of rolling force. To measure rolling torque (simplified process), a special tool is required. Refer to **Service Tools**.

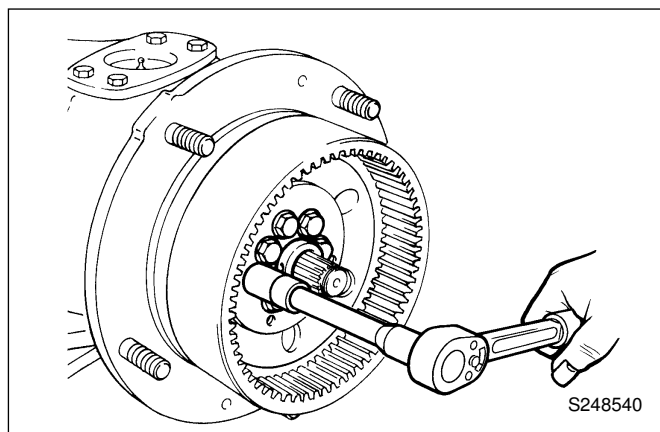


- 14 To measure seal drag rolling force:

- Refit the planet gear carrier - DO NOT FIT THE SUN GEAR.
- Use a spring balance and cord wrapped around the planet carrier flange as shown.
- Pull the spring balance so that the hub rotates, do several times to let the seal bed in and record the reading.
- Remove planet gear carrier.



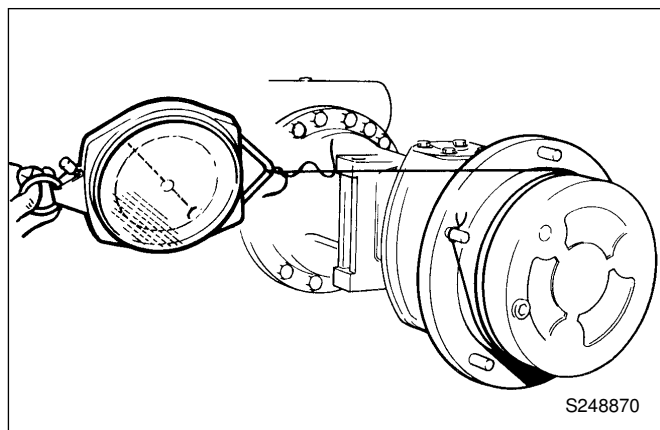
- 15 Tighten M14 Verbus Ripp bolts to 320 Nm (236 lbf ft, 33 kgf m) and then measure rolling force - see step 16.



**Hub and Driveshaft - Assembly (cont'd)**

16 To measure rolling force:

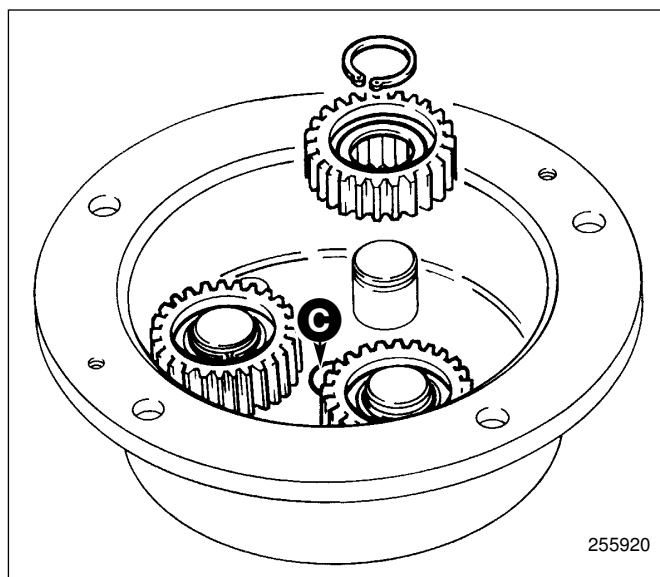
- Refit the planet gear carrier - DO NOT FIT THE SUN GEAR. Use a spring balance and cord wrapped around the planet gear carrier flange as shown. Pull the spring balance so that the hub rotates and record the reading.
- To get the rolling force, subtract seal drag rolling force (see step 14) from reading obtained at this step, the result should be 64 to 117 N (14 to 26 lbf).
- If the resulting figure is outside these limits check: the seal is fitted correctly; and/or renew bearings if necessary; and /or new fitted components.
- Remove planet gear carrier.



17 Press the drive shaft thrust pad **C** (chamfered side lowermost) into the recess in the planet carrier.

18 Fit new planet gears in place of any that were removed. (See step 4 in 'Dismantling'). Secure with circlip.

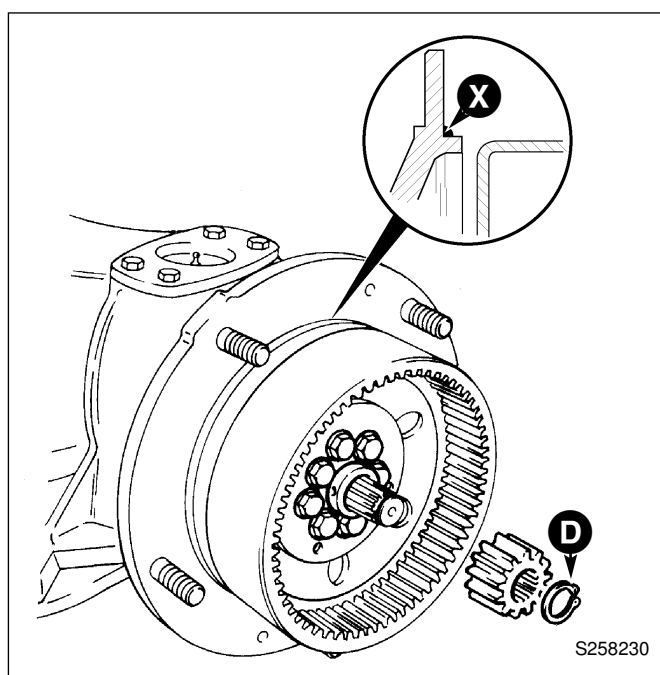
**Note:** Make sure that the SMALL radius on the gear bearing internal diameter is facing uppermost, that is at the circlip end of the planet pin.



19 Fit spacer and slide the sun wheel onto the driveshaft and secure with circlip **D**. Apply a fillet of sealant 4102/0900 evenly around the bearing carrier as shown at **X**.

**Note:** Some machines may have an 'O' ring instead of sealant - where appropriate fit a new 'O' ring.

**Note:** The sun gear must be fitted with the 1.5 mm (0.060 in) x 45° chamfer inboard.

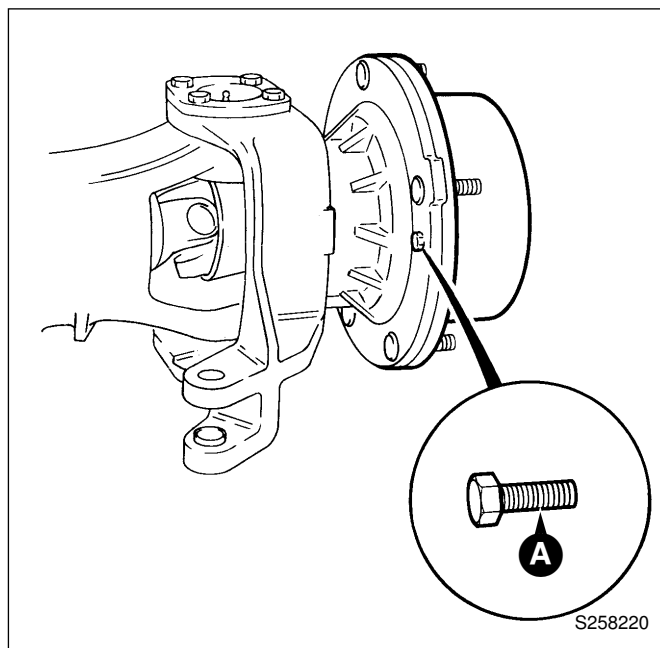


### Hub and Driveshaft - Assembly (cont'd)

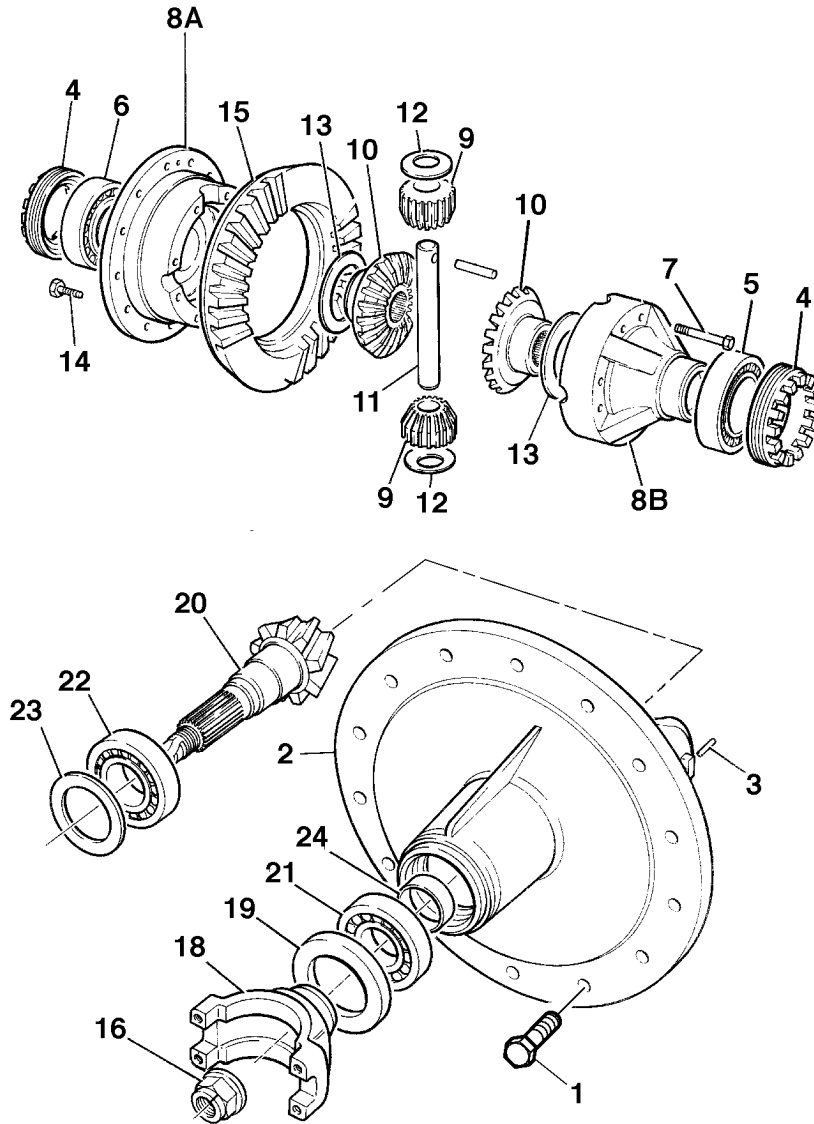
**20** Fit the planet carrier onto the bearing carrier, ensuring that the two tapped holes are in line with those on the bearing carrier. Fit and torque tighten screws **A** to 56Nm (41lbf ft; 5.7kgf m) after applying JCB Lock and Seal to the threads.

**Note:** Do not strike the centre of the planet gear carrier when fitting as this may dislodge the driveshaft thrust pad fitted at step 17.

Re-fill hubs with the correct grade oil.



Drive Head - Dismantling

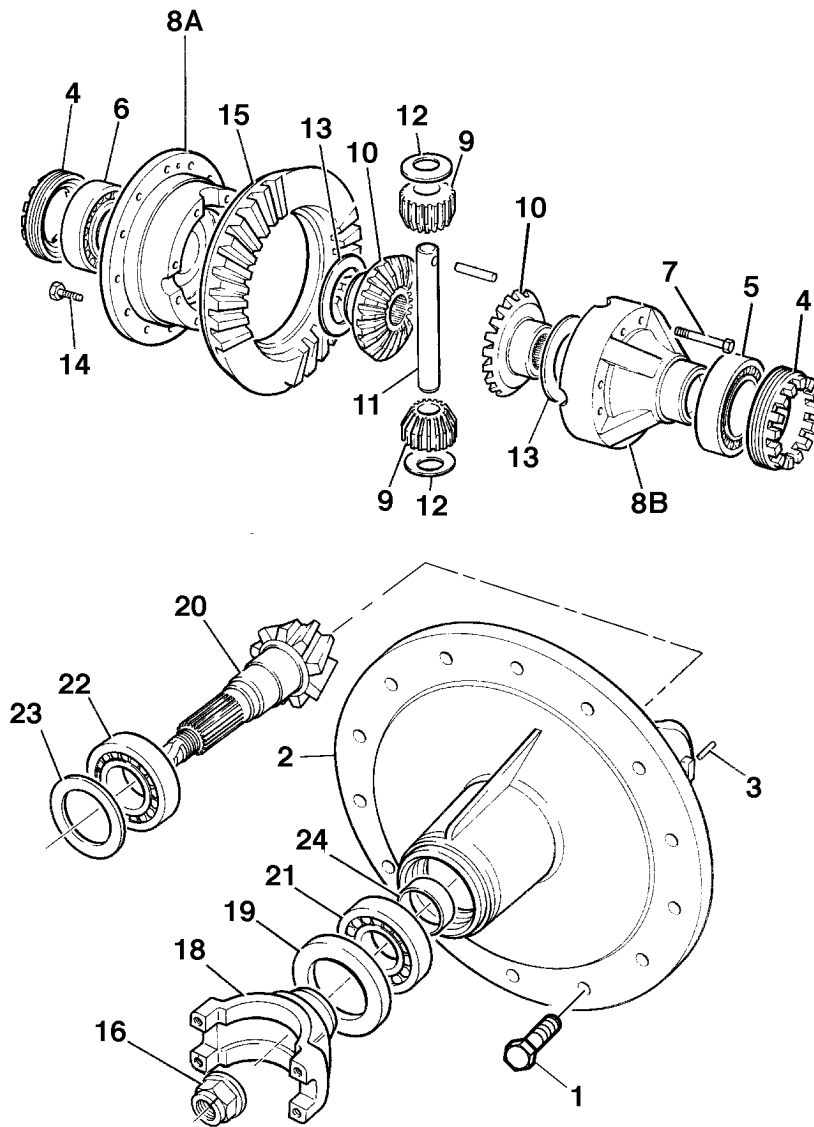


### Drive Head - Dismantling (cont'd)

- 1 Drain the oil from the drive head. Remove the propshaft.
- 2 To remove the drive head it is necessary to withdraw both drive shafts from the axle.
- 3 Remove the drive head carrier screws **1**. Mark the installation position of drive head carrier **2** relative to the axle housing.
- 4 Remove the drive head carrier from the axle housing.
- 5 Pull out the roll pins **3** and remove the castellated nuts **4**. Remove the outer races of bearings **5** and **6** from the drive head carrier bores.
- 6 Remove inner bearing races of **5** and **6**.
- 7 Remove differential assembly **8** from carrier.
- 8 Loosen the differential case half bolts **7** and pull the case halves **8A** and **8B** apart. Remove the axle bevel gears **9**, the differential bevel gears **10**, trunnion pin **11** and thrust washers **12** from the case halves.
- 9 Remove the thrust washers **13** from both case halves.
- 10 Pull off the bearing **6** from case half **8A**.
- 11 Remove the Verbus Ripp bolts **14** and separate the crownwheel **15** from the case half **8A**.
- 12 Remove pinion nut **16**. Use Service Tool 892/00812 to prevent drive yoke **18** from rotating.
- 13 Mark the position of the drive yoke on the splined shaft. Remove the drive yoke.
- 14 Drive pinion shaft **20** out of drive head carrier **2**.
- 15 Prise shaft seal **19** out of the bore.
- 16 Remove taper roller bearing **21** and tap out the outer bearing race.
- 17 Tap out the outer race of bearing **22** from the opposite bearing housing and remove the drive pinion shim(s) **23**.
- 18 Remove spacer **24** from drive pinion **20**. Prise taper roller bearing **22** to raise it sufficiently to insert bearing pullers. Pull the bearing from the pinion shaft.



Drive Head - Assembly (cont'd)



## 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.

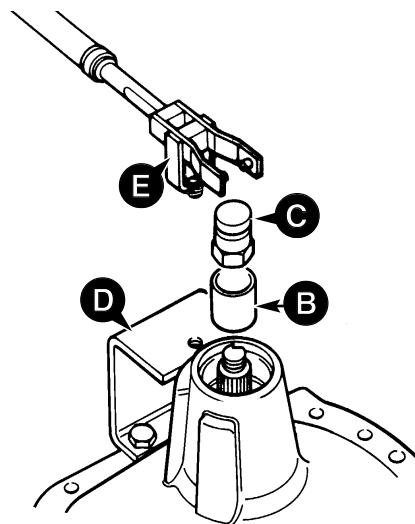
Make sure all bearings are lightly oiled before fitting and setting. Make sure bearings are rotated whilst being set.

- 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**.

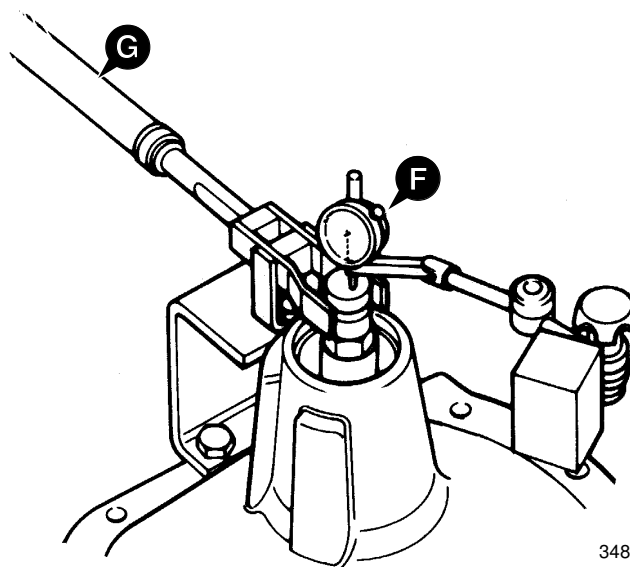
- 5 Fit special tool sleeve **B** and special pinion shaft adapter **C**. Tighten adapter **C** to approximately 50 Nm, making sure the pinion is free to rotate and there is end float, this will prevent any damage to the bearing. If the pinion is not free to rotate or there is no end float at this stage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



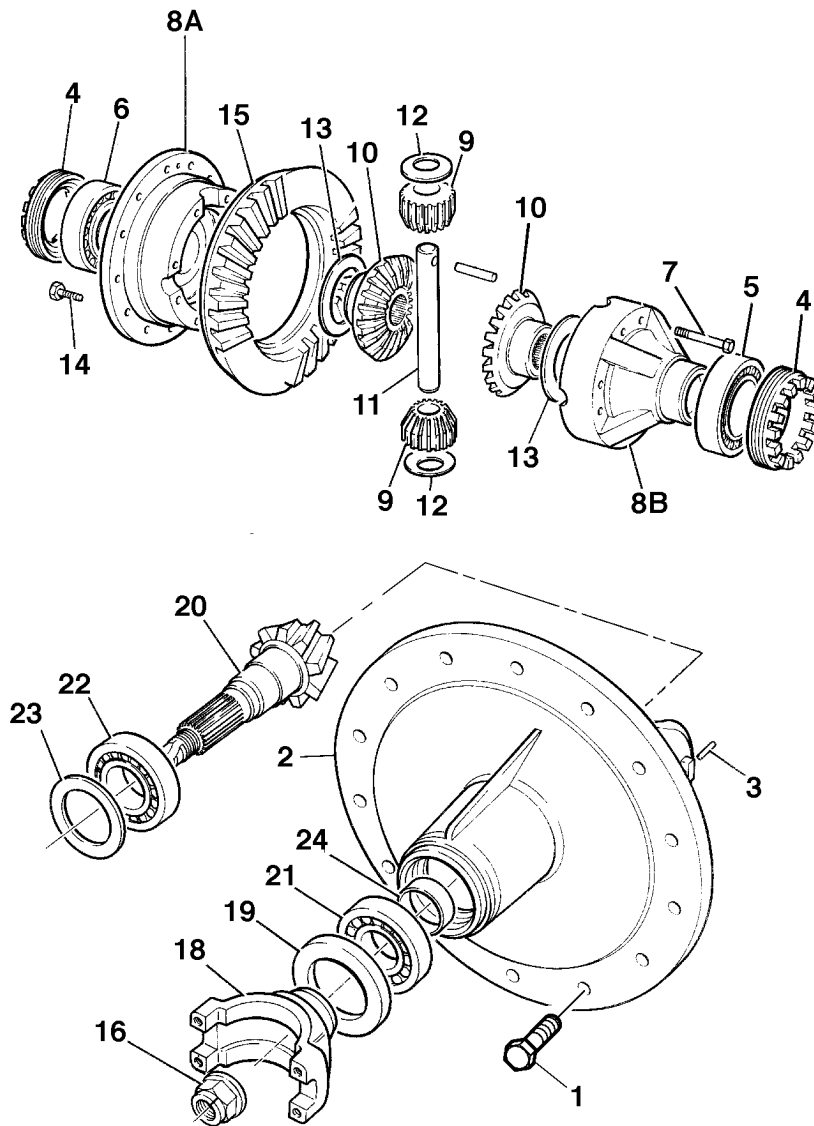
348030

- 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)



**Drive Head - Assembly (cont'd)**

- 9** To select the right size spacer **24**, 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 **19**, grease between seal lips before fitting. Fit coupling yoke **18** and NEW stake nut **16**.
- 14** Progressively torque tighten stake nut **16**, 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 **16** into the slot.

- 16** Assemble the trunnion pin **11**, bevel gears **9** and **10** and their thrust washers **12** and **13** into differential half case **8A**.

- 17** Position differential half case **8B** onto half case **8A**, aligning the match-mark letters. Apply JCB Threadlocker and Sealer to the threads of bolts **7**, then fit and torque tighten to 46 Nm (34 lbf ft, 4.7 kgf m). Check the gears for free rotation.

- 18** Fit crownwheel **15** using new Verbus Ripp bolts **14** tightened to 94 Nm (69 lbf ft, 9.59 kgf m).

- 19** Locate crownwheel assembly (without bearings) into housing.

- 20** Drive bearing cones **5** and **6** onto differential case spigots. Lightly oil the bearings then fit their bearing cups and castellated nuts **4** into drive head carrier **2**. Do not fit the roll pins **3** at this stage.

- 21** Adjust castellated nuts **4** 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 13.

- 22** Measure the backlash between crownwheel **15** and pinion **20**, which should be 0.17 - 0.28 mm (0.006 - 0.010 in). Adjust castellated nuts **4** by equal amounts when altering backlash. When backlash and preload are both correct, fit roll pins **3**.

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

- 24** 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 98 Nm (72 lbf ft, 10 kgf m).

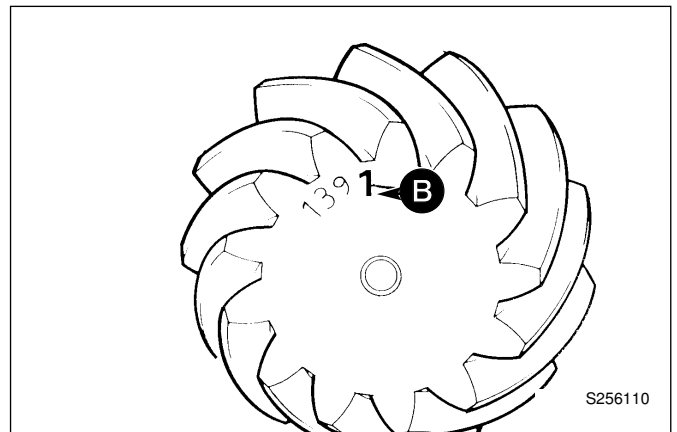
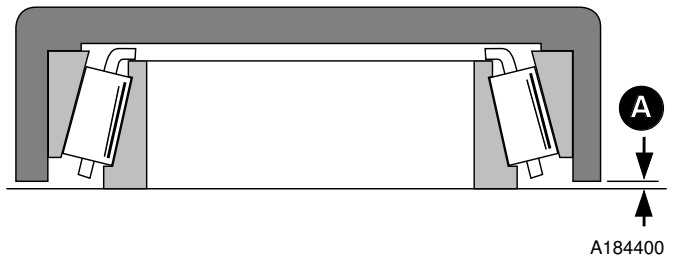
- 25** Reassemble both driveshafts and hub assemblies, refer to **Axle Hub and Driveshaft - Dismantling and Assembly**.

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

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

### Pinion Depth Setting

- 1 Place new pinion head inner bearing assembly on a flat surface and position service tool 892/00174 over the bearing. Measure gap **A** (e.g. 0.20 mm) and add this to the cup depth stamped on the tool (e.g. 30.01 mm) to obtain the bearing depth.
- 2 From the face of the pinion, obtain the etched deviation figure **B** (e.g. + 2) which is in units of 0.01 mm. If positive, add this to the bearing depth; if negative, subtract from the bearing depth.
- 3 Obtain the deviation figure **C** (e.g. - 1) stamped on the differential housing bolt flange. If negative, add to bearing depth; if positive, subtract from bearing depth.
- 4 Subtract the total of the above figures from the standard value of 31.19 mm. The result will be the thickness of shims required behind the pinion head bearing cup.



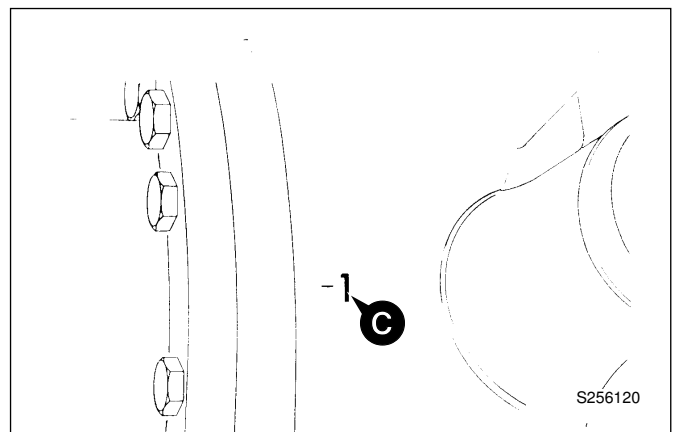
#### Example (all dimensions in millimetres)

Cup depth	30.01
Gap <b>A</b>	+0.20
Bearing depth	<u>30.21</u>
Pinion deviation <b>B</b> (+ 2)	+0.02
Housing deviation <b>C</b> (- 1)	+0.01
Total	<u>30.24</u>

Standard value	31.19
Less Total above	<u>30.24</u>
<b>Shim Thickness</b>	<u>0.95</u>

**Note:** In the event that the setting data stamp has been omitted from the drivehead casing, adopt the following setting procedure:

Revise the shim pack size by the difference in setting height marked on the old and new crownwheel pinion sets.

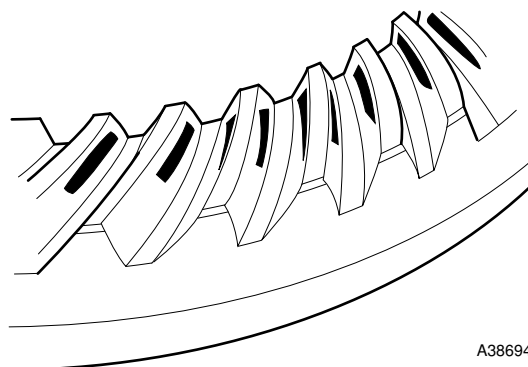


## Crownwheel and Pinion Meshing

Meshing of the gears should be checked by marking three of the pinion teeth with engineers marking compound and rotating the pinion.

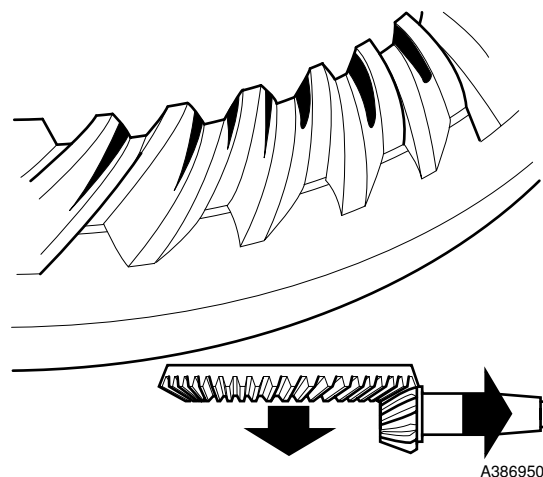
The marking will then be transferred to the crown wheel teeth.

### Correct tooth marking.



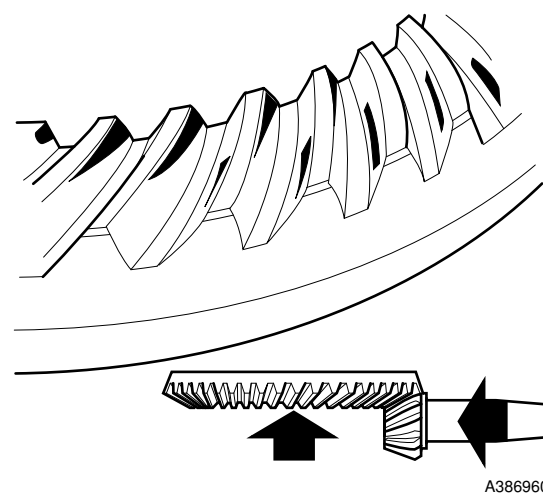
### Pinion too deeply in mesh.

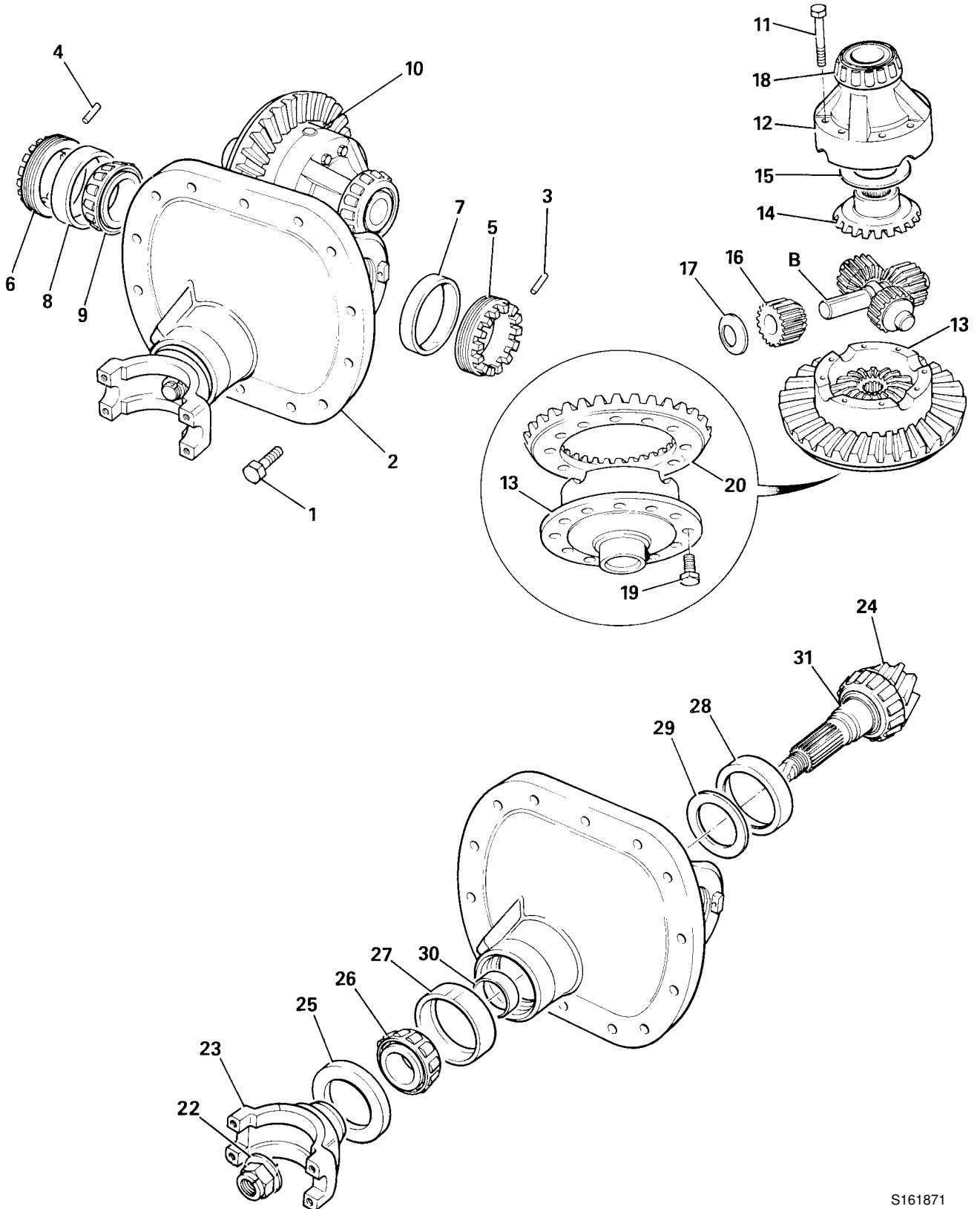
Decrease the shim thickness between the pinion inner bearing cup and the axle casing. Move the crown wheel towards the pinion to correct the backlash.



### Pinion too far out of mesh.

Increase the shim thickness between the pinion inner bearing cup and the axle casing. Move the crown wheel away from the pinion to correct the backlash.





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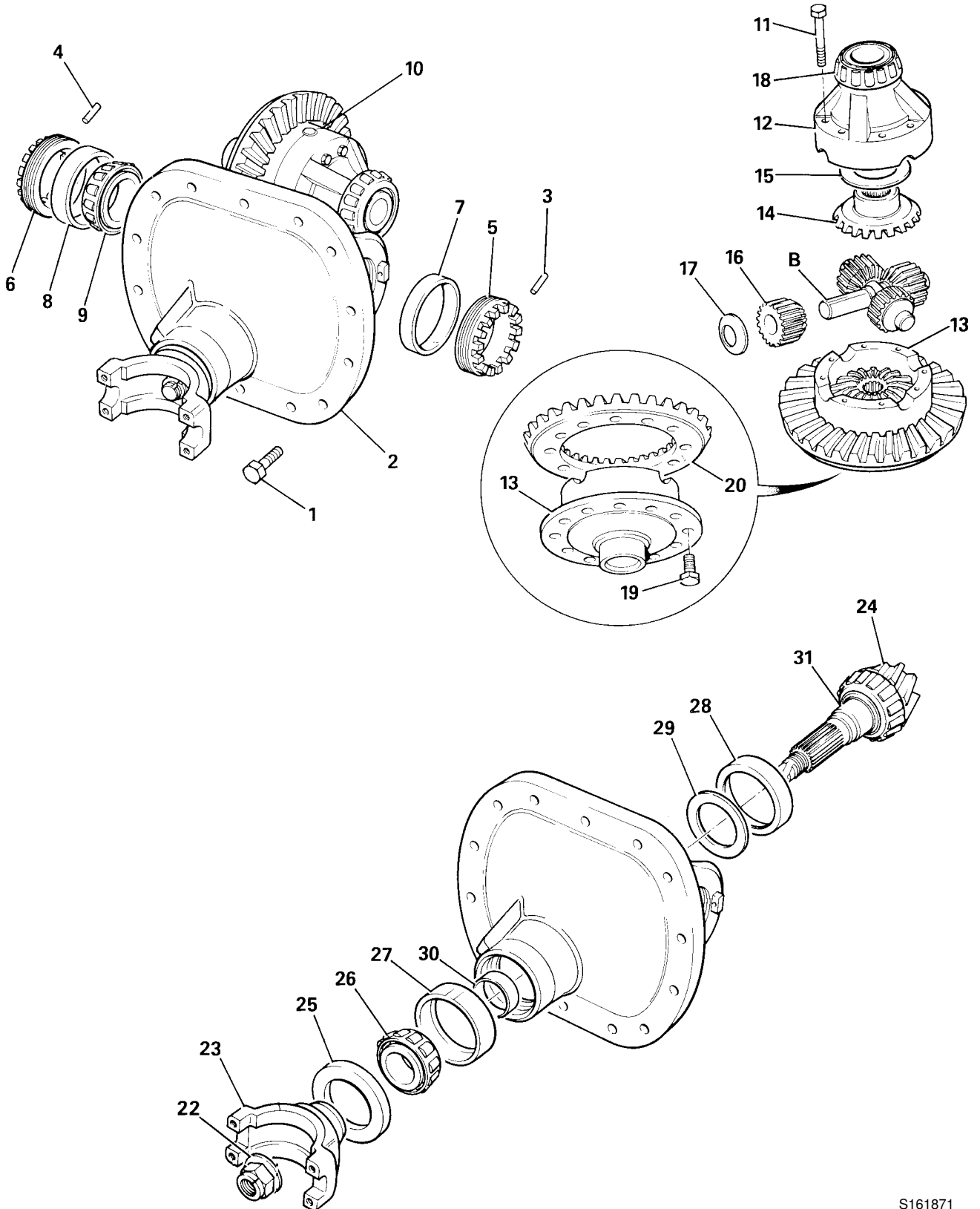
## Drivehead, SD70 - Dismantling

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

For assembly the sequence should be reversed.

- 1 Drain the oil from the axle centre casing. Remove the propshaft from the gearbox to the front axle.
- 2 Remove both hub assemblies complete with driveshafts (see **Hub and Driveshaft Dismantling**).
- 3 Mark the installation position of the drive head carrier, item **2**.
- 4 Remove the drive head carrier retaining bolts, item **1**, and remove the drive head carrier **2** from the axle casing.
- 5 Clean the drive head carrier and axle casing mating faces.
- 6 Pull out tension pins **3** and **4**, and remove castellated nuts **5** and **6**.
- 7 Remove bearing outer races **7** and **8**.
- 8 Drive off the taper roller bearing cone **9** from the crownwheel differential case half.
- 9 Remove the differential assembly **10** from the carrier.
- 10 Remove the differential assembly retaining bolts **11** and separate case halves **12** and **13**.
- 11 Remove the differential side gears and thrust washers **14** and **15** respectively (2 off each).
- 12 Remove planet gears and thrust washers **16** and **17** respectively (4 off each) from trunnion pins **B**.
- 13 Pull off taper roller bearing cone **18** from differential case half **12**.
- 14 Remove 'verbus ripp' bolts **19** and separate the crownwheel **20** from the differential case half **13**.
- 15 Mark the position of the drive yoke on the splined shaft. Use service tool 892/00812 to prevent drive yoke **23** from rotating and remove pinion nut **22**. Remove the drive yoke.
- 16 Press the pinion **24** from the drive head carrier **2**.
- 17 Withdraw the pinion oil seal **25** and taper roller bearing cone **26**. If necessary, remove bearing outer race **27**.
- 18 If necessary, drive out the pinion bearing outer race **28** and shim(s) **29** from inner side of the drive head carrier.
- 19 Remove the spacer **30** and taper roller bearing cone **31** from pinion **24**.





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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 **20** and pinion **24** and the bevel gears **14** and **16** are matched and should be renewed as sets if any of their components are damaged or excessively worn. The two differential housing halves **12** and **13** are also matched. Do not use unmatched halves.

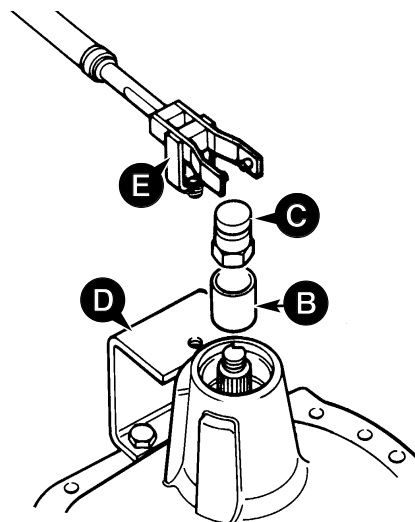
Make sure all bearings are lightly oiled before fitting and setting. Make sure bearings are rotated whilst being set.

- 1 Determine the correct thickness required for the shims **29**, refer to **Pinion Depth Setting**.
- 2 Fit shims **29** behind new bearing cup **28**.
- 3 Fit new pinion head bearing cone **28** onto pinion **24**.
- 4 Install pinion and bearings into the drive head casing. Install largest available solid spacer **30** e.g (14.20 mm) and fit pinion tail bearing **26** (lightly oiled). Do not fit the oil seal **25** 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 **30** it is acceptable to fit a collapsible spacer, refer to **Collapsible Spacer Assembly**.

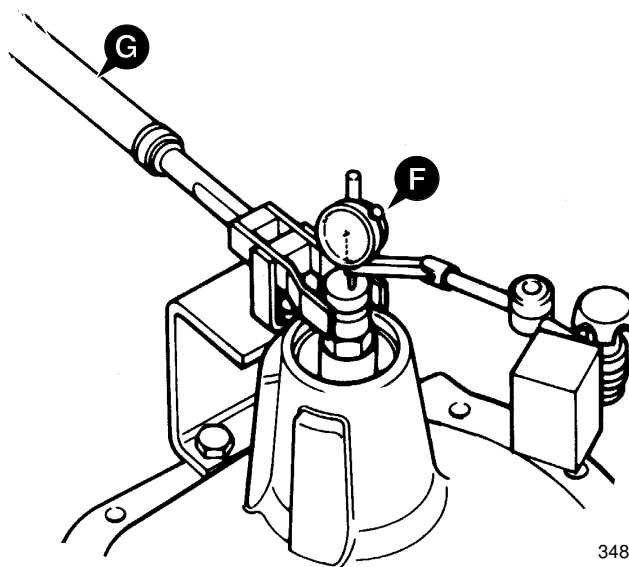
- 5 Fit special tool sleeve **B** and special pinion shaft adapter **C**. Tighten adapter **C** to approximately 50 Nm, making sure the pinion is free to rotate and there is end float, this will prevent any damage to the bearing. If the pinion is not free to rotate or there is no end float at this stage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

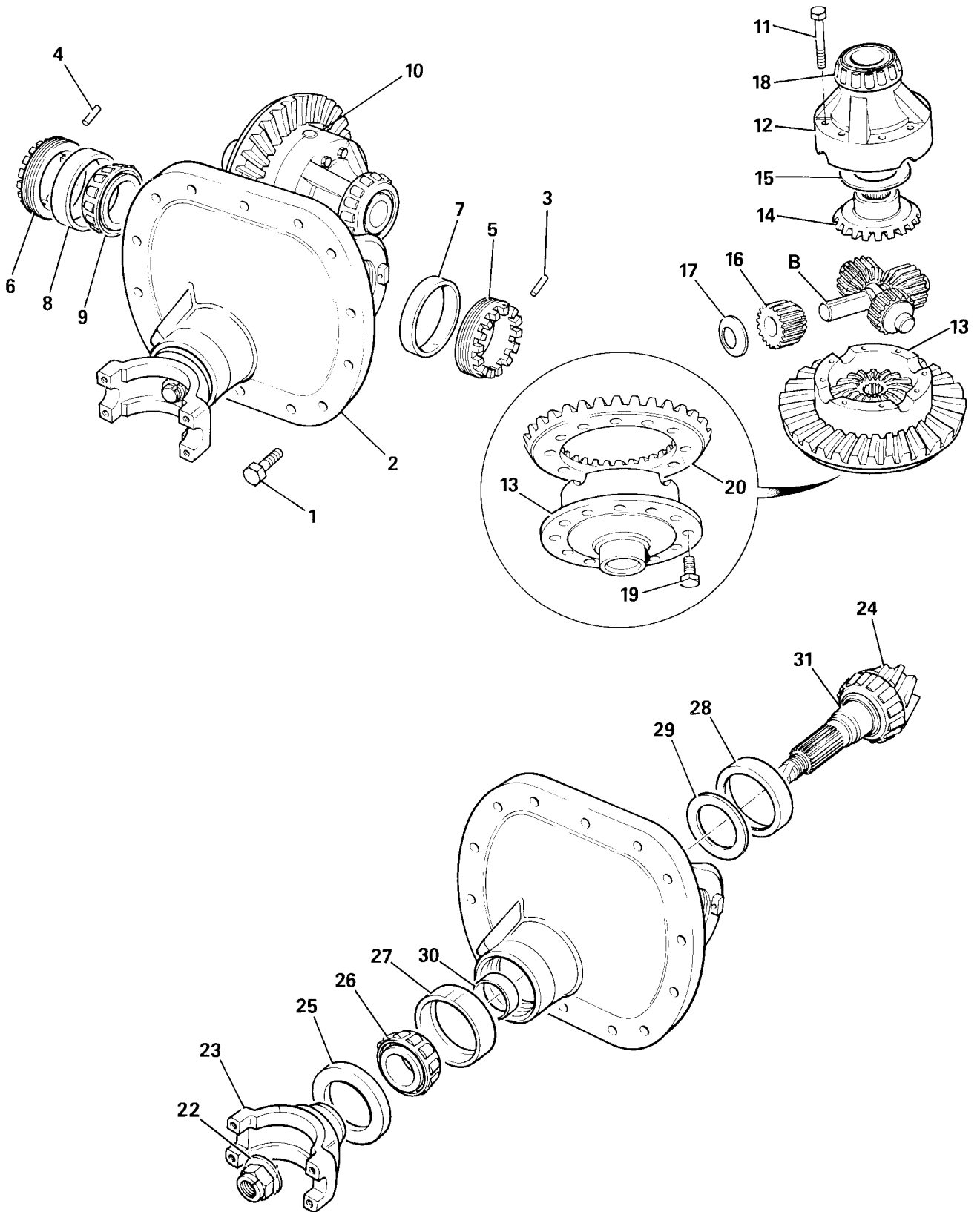


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- 7 Fit dial test indicator (DTI) **F**. Ensure that the DTI is mounted on the drive head and not on bracket **D**.
- 8 Set torque wrench **G** to 35 Nm (25.8 lbf ft) and measure the end float while rotating the shaft.



348040



**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** Install 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).

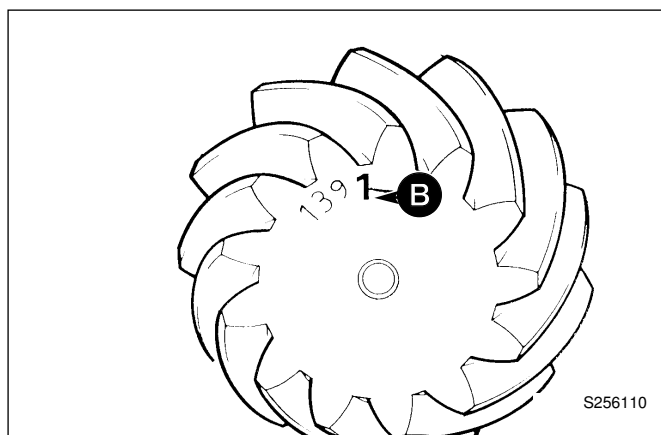
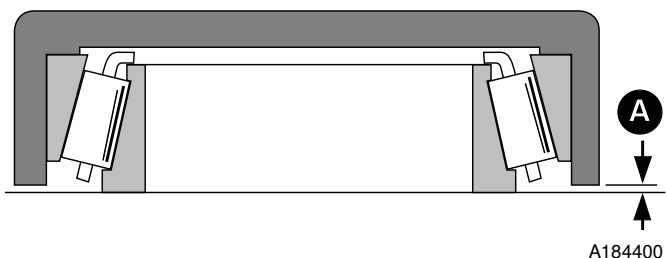
- 26** Reassemble both driveshafts and hub assemblies, refer to **Axle Hub and Driveshaft - Dismantling and Assembly**.

- 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**.

### Pinion Depth Setting

- 1 Place new pinion head inner bearing assembly on a flat surface and position service tool 892/00174 over the bearing. Measure gap **A** (e.g. 0.20 mm) and add this to the cup depth stamped on the tool (e.g. 30.01 mm) to obtain the bearing depth.
- 2 From the face of the pinion, obtain the etched deviation figure **B** (e.g. + 2) which is in units of 0.01 mm. If positive, add this to the bearing depth; if negative, subtract from the bearing depth.
- 3 Obtain the deviation figure **C** (e.g. - 1) stamped on the differential housing bolt flange. If negative, add to bearing depth; if positive, subtract from bearing depth.
- 4 Subtract the total of the above figures from the standard value of 31.19 mm. The result will be the thickness of shims required behind the pinion head bearing cup.



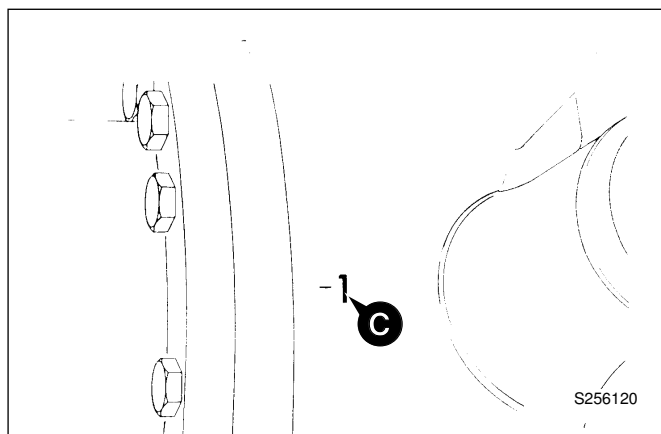
#### Example (all dimensions in millimetres)

Cup depth	30.01
Gap <b>A</b>	+0.20
Bearing depth	<u>30.21</u>
Pinion deviation <b>B</b> (+ 2)	+0.02
Housing deviation <b>C</b> (- 1)	+0.01
Total	<u>30.24</u>

Standard value	31.19
Less Total above	<u>30.24</u>
<b>Shim Thickness</b>	<u>0.95</u>

**Note:** In the event that the setting data stamp has been omitted from the drivehead casing, adopt the following setting procedure:

Revise the shim pack size by the difference in setting height marked on the old and new crownwheel pinion sets.

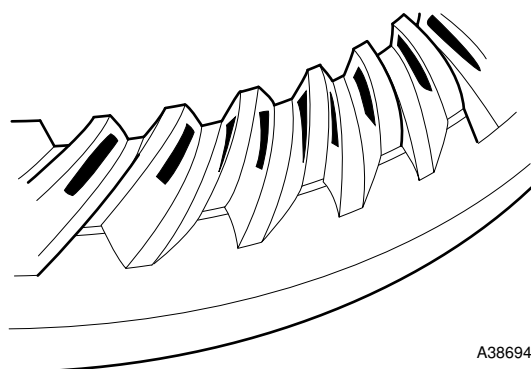


## Crownwheel and Pinion Meshing

Meshing of the gears should be checked by marking three of the pinion teeth with engineers marking compound and rotating the pinion.

The marking will then be transferred to the crown wheel teeth.

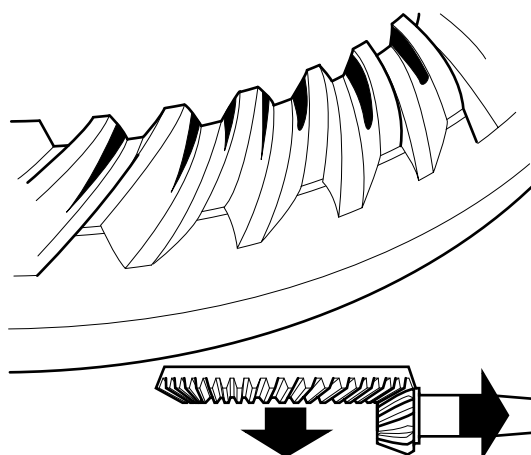
### Correct tooth marking.



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### Pinion too deeply in mesh.

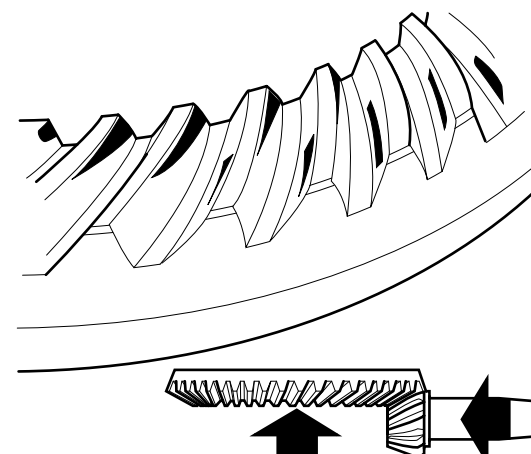
Decrease the shim thickness between the pinion inner bearing cup and the axle casing. Move the crown wheel towards the pinion to correct the backlash.



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### Pinion too far out of mesh.

Increase the shim thickness between the pinion inner bearing cup and the axle casing. Move the crown wheel away from the pinion to correct the backlash.



A386960

## **Removal and Replacement (2 Wheel Drive Machines)**

The removal and replacement procedures for the 2 wheel drive axle (beam type) is the same as described on pages F/80-1 and F/80-2. Dis-regard any information which is not pertinent to the 2 wheel drive axle.

Please note when using a 'cradle' to remove the axle from the machine, the balance point (see step 10, page F/80-2), of the axle on 2 wheel drive machines will be the centre of the axle, NOT offset as described on page F/80-2.

### Dismantling and Assembly (2 Wheel Drive Machines)

#### When Dismantling

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

For assembly the sequence should be reversed.

A suitable press will be required to remove and replace stub axle **22**.

#### When Assembling

Fit bushes **18** and **20** with open ends of grease grooves facing the axle beam.

Add shims **16** as required to give zero to 0.1mm (0.004in) clearance between axle beam and bearing **15**.

Apply JCB Lock and Seal to threads of bolt **9**.

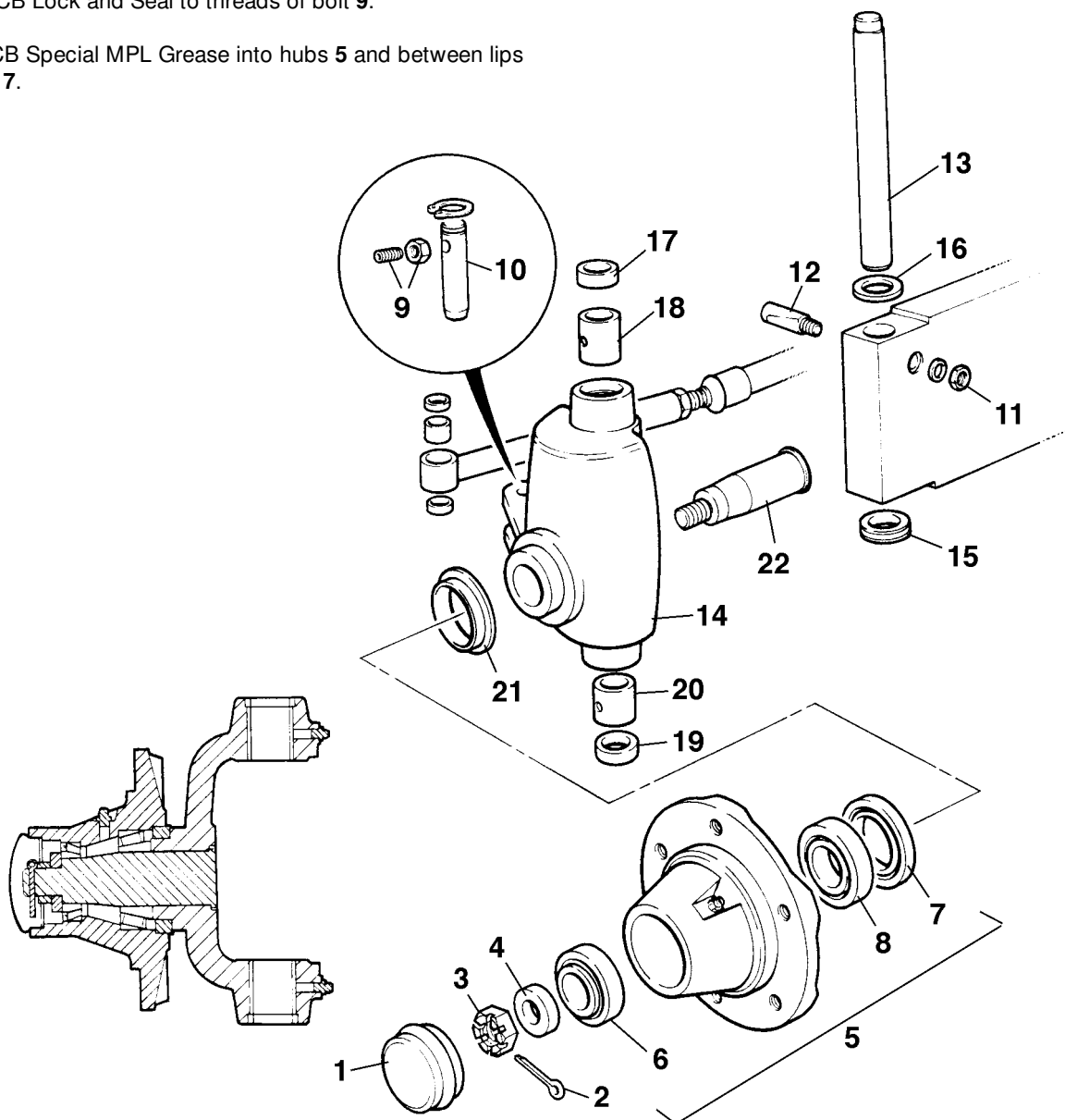
Pack JCB Special MPL Grease into hubs **5** and between lips of seals **7**.

Bed in bearings **6** and **8** by rotating hub in each direction whilst tightening nut **3**. When correct torque setting has been achieved, back off one flat and fit split pin **2**.

#### Torque Settings

Item	Nm	kgf m	lbf ft
3	40†	4.0†	30†
9	30	3.0	21

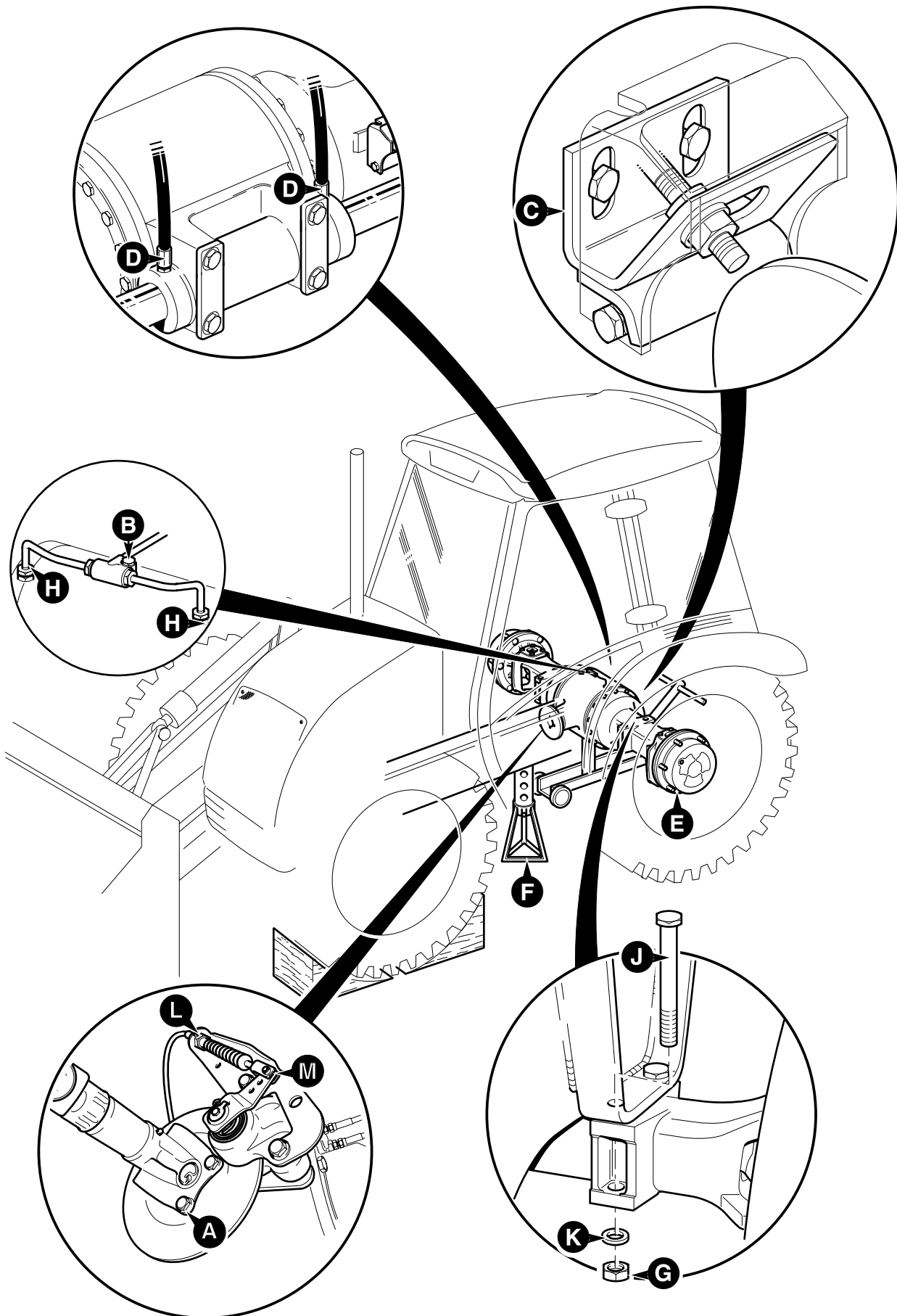
†Back off one flat before fitting split pin.



S258280



Removal and Replacement



## Removal and Replacement (cont'd)

### WARNING

A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN 1-1

### Removal

### WARNING

When the propshaft is disconnected the parking brake will no longer function. The machine must be securely chocked to prevent any machine movement before disconnecting the propshaft.

TRAN 1-3

### Removing

- 1 Release the parking brake. Loosen the parking brake cable bulkhead nuts at the bracket **L**. Disconnect the cable from the calliper **M**. Tie the cable up, out of harms way.
- 2 Remove bolts **A** to disconnect the drive shaft from the axle.
- 3 Disconnect the brake pipes from the brake piston housings, shown at **H**. Remove tee piece **B** retaining bolt and remove the tee piece. Blank off exposed connections.
- 4 **SD 80 Steer axles only**; Remove the cover **C** from the proximity switch and then remove the bracket and switch assembly.
- 5 **SD 80 Steer axles only**; Label and then disconnect hydraulic pipes **D** from the steer rams, blank off all exposed connections.
- 6 Loosen the road wheel retaining nuts **E**.
- 7 Make sure that the front wheels are blocked, use the stabiliser legs to raise the rear end of the machine with the wheels and tyres clear of the ground.
- 8 Prop the machine on each side as shown at **F**.
- 9 Remove the rear road wheels.
- 10 Position a jack underneath the balance point (centre) of the axle and support the axle weight.

**Note:** Attach a 'cradle' to the jack that will partially embrace the axle.

11 Remove nuts **G**, bolts **J** and washers **K**.

12 Lower the jack and remove the axle.

### Replacement

Replacement is the reverse of the removal sequence.

### WARNING

If, for whatever reason, a wheel stud is renewed, all the studs for that wheel must be changed as a set, since the remaining studs may have been damaged.

2-3-2-8

Whenever a wheel has been removed, check the wheel nut torques every two hours until they stay correct.

### WARNING

Bleed the brake system before driving the machine.

BRAK 1-6

Bleed the brake system as described in **Section G, Service Procedures**.

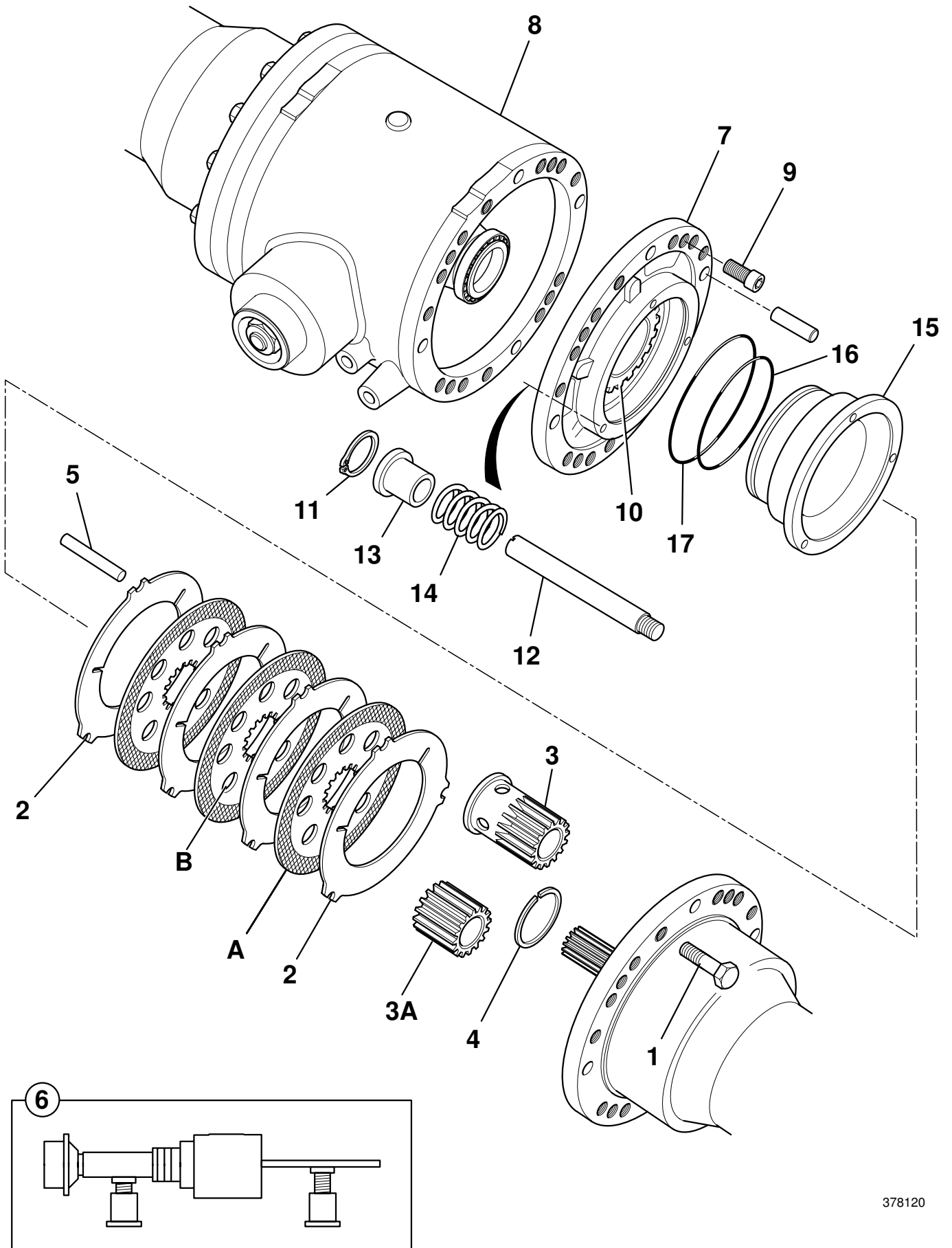
Check and adjust the operation of the parking brake as described in **Section G, Service Procedures**.

Apply JCB Threadlocker and Sealer to the threads of bolts **A**.

**SD 80 Steer axles only**; If the setting of the steering proximity switch has been disturbed, then complete the rear axle proximity switch setting procedure, as described in **Section H, Service Procedures**.

### Torque Settings

Item	Nm	kgf m	lbf ft
<b>A</b>	79	8	58
<b>E</b>	680	69	500
<b>G</b>	607	62	448



378120

**Brakes (with controlled back off)**

Axles are fitted with brake controlled back off to maintain a constant clearance of 0.6mm (0.02in) within the brake pack.

It is important that only one side at a time is dismantled to prevent damage to the bearings and preserve the crownwheel and pinion backlash setting.

**⚠ WARNING**

**A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.**

**Disconnect the battery, to prevent the engine being started while you are beneath the machine.**

GEN 1-1

**Dismantling**

- 1 It is recommended that the axle be removed from the machine when dismantling the rear axle brakes.
- 2 Remove bolts **1**. Use a heavy duty socket to unscrew them.
- 3 Jack the axle arm off the drive head, using the drive head securing bolts. Remove all traces of gasketing from the mating faces.
- 4 There are two counterplates **2**, one at each end of the brake pack, which are not secured to the plate carrier **3**. If the plates are to be re-used, note their positions and which way round they are then withdraw the brake pack.
- 5 Remove the circlip **4**. If the brake pack is to be re-used, note the positions of the plates before removing them.
- 6 Wear limit of friction plates is to the depth of the cross hatching **A**. Check all plates for flatness and damage. (Some scoring of the counterplates is normal.) Renew the brake pack complete if worn or damaged. Do not renew individual plates.
- 7 Remove the three reaction pins **5**. Inspect for damage.

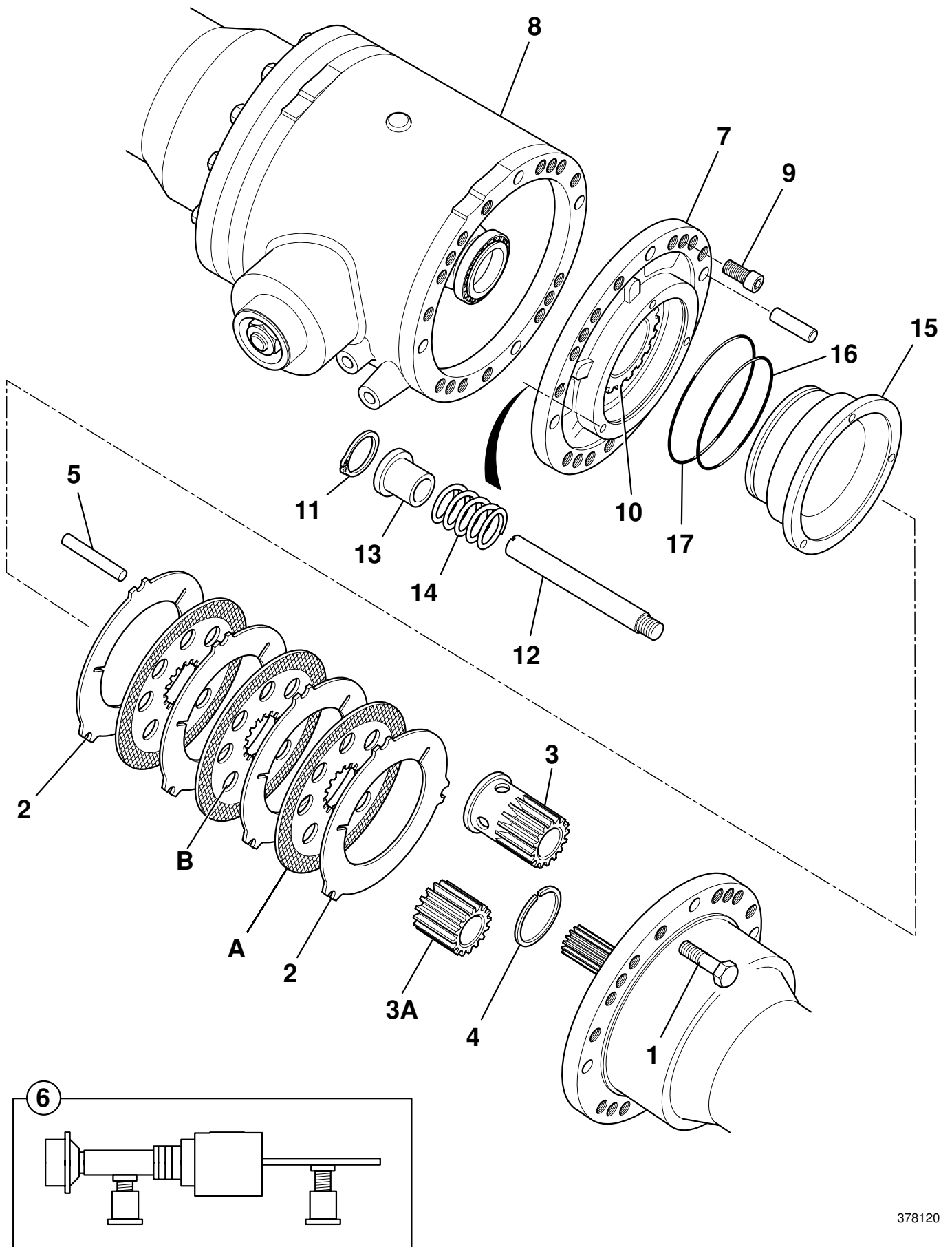
**Note:** If new brake and friction plates are being fitted new brake back off pins and tension bushes must also be fitted. Failure to do so could result in the brake being permanently on.

- 8 Before removing the brake housing and piston assembly support the differential with a drive shaft or other suitable support, as shown at **6**.

- 9 Match mark the brake piston housing **7** and the drive head. Undo four capscrews **9** and remove the brake housing and piston assembly.

**Note:** Do not disturb nut **10** otherwise the bearing pre load will have to be reset.

- 11 Remove circlips **11**, remove back off pins **12**, tension bushes **13** and springs **14**.
- 12 Remove brake piston **15** from brake housing **7**.
- 13 Remove and discard seals **16** and **17**. Inspect the housing bore for damage and scoring. Nicks or cuts in the seals may be responsible for loss of brake fluid.

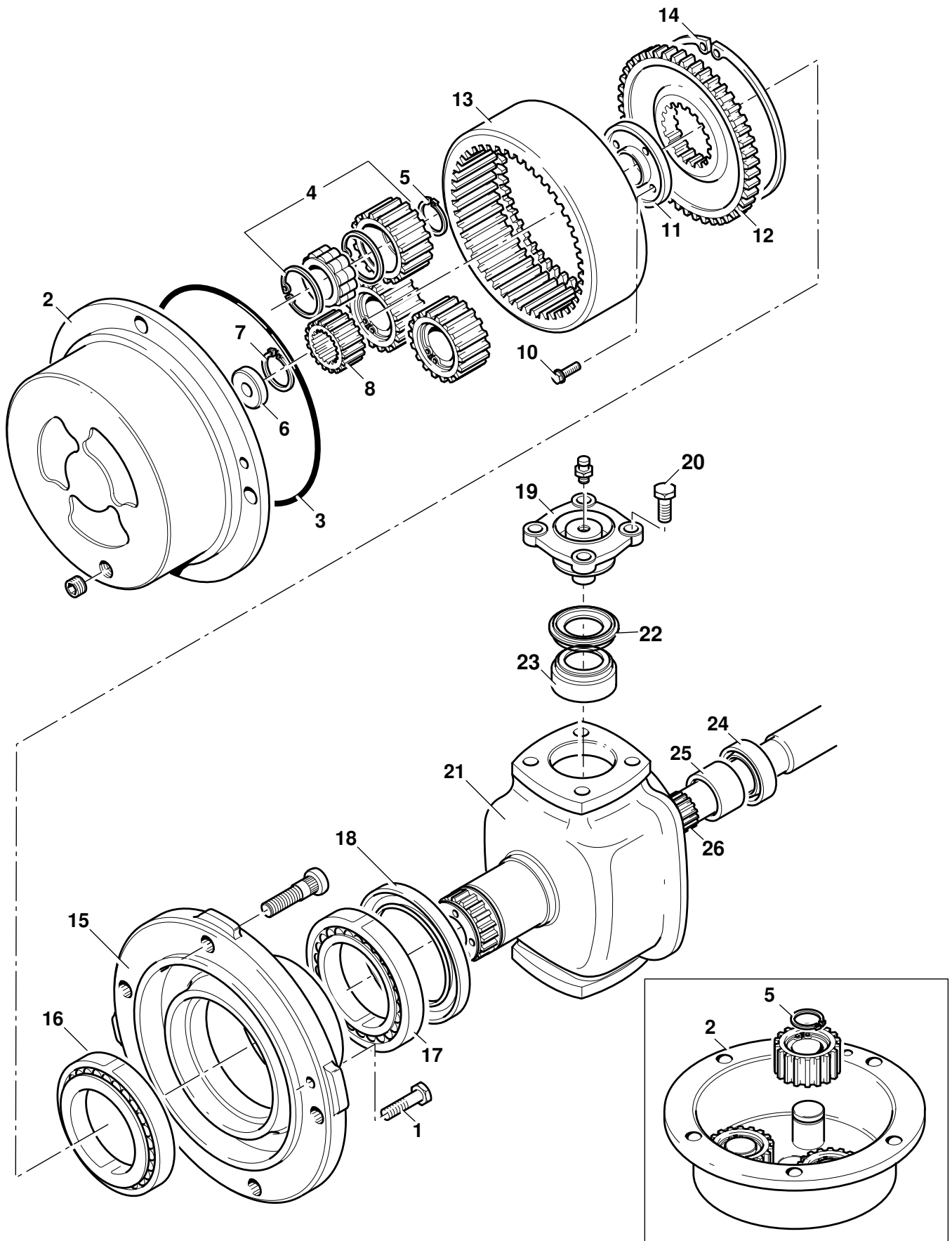


378120

## 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).



## Hub - Dismantling

### WARNING

**A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.**

**Disconnect the battery, to prevent the engine being started while you are beneath the machine.**

GEN 1-1

- 1 Disconnect power track rod. Drain oil from hub.
- 2 Remove screws **1**.
- 3 Lever off the planet gear carrier **2** at the levering points. Remove and discard the 'O' ring **3**.
- 4 Remove planet gears **4** only if defective. Note that gears can only be removed as assemblies, which comprise the gear, the bearing and two 'L' shaped circlips. To remove a planet gear, first remove the external circlip **5**.
- 5 Pull off the planet gear assembly **4**.
- 6 The driveshaft thrust pad **6** is drilled and tapped M6 for removal purposes.
- 7 Remove circlip **7** to allow the sun gear **8** to be slid off the drive shaft.
- 8 Remove Verbus Rip bolts **10**. These bolts are very tight and care must be taken not to distort the bolt heads. Use as short an extension bar as possible with a six sided socket. Discard the bolts after removal.

**Note:** Fretting between the hub swivel and annulus carrier mating faces might be evident; this condition is normal, do not attempt to repair.

If the hub swivel and annulus carrier are to be renewed they must be renewed as a pair, not individually

- 9 Remove retaining plate **11**.
- 10 Mark the relationship between the annulus carrier, annulus ring and hub swivel, remove the annulus carrier **12** with annulus ring **13**.
- 11 Remove circlip **14** to separate the annulus ring **13** from the annulus carrier **12**.
- 12 Pull off the bearing carrier **15** together with the outer bearing **16**.
- 13 Pull off the inner bearing **17**.

- 14 Remove and discard combination oil seal **18**.

- 15 Mark the position of top and bottom trunnions **19**, undo bolts **20** and remove trunnions **19**. Withdraw the hub carrier **21**.

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

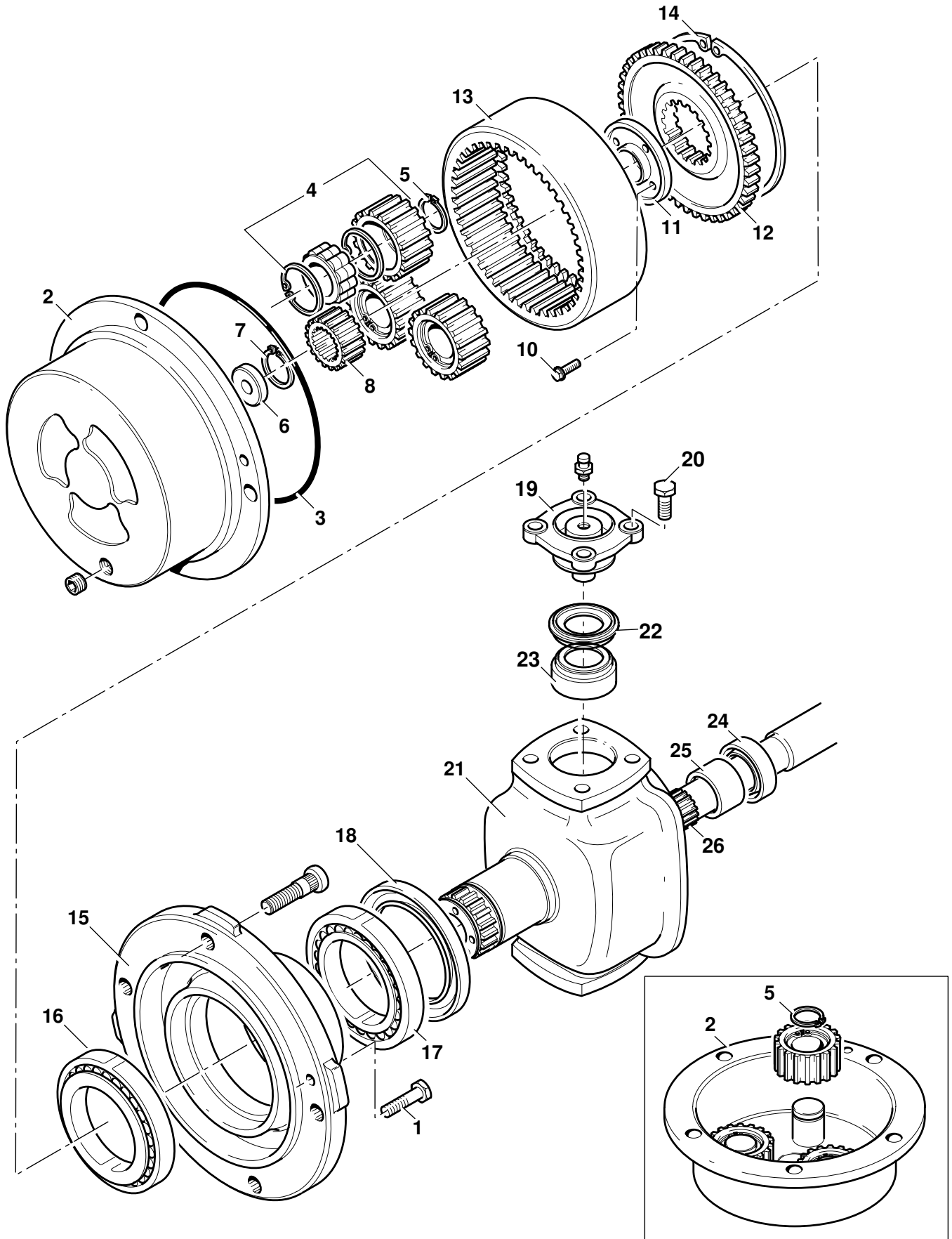
- 16 Using a puller, remove the trunnion seal **22** and bearing **23**.

- 17 Remove seal **24** and needle roller bearing **25** from hub carrier **21**.

**Note:** Seal and needle roller bearing may be left on drive shaft. Production axles may be fitted with foam 'masking rings'. These are used to protect the shaft from paint during axle spraying. The rings can be removed and discarded.

- 18 Withdraw drive shaft **26**.





## Hub-Assembly

- 1 Fit drive shaft **26** inner end into splines of differential gears.
- 2 Fit needle roller bearing **25** and seal **24** into hub carrier **21**. Pack grease between the lips of seal **24**.

**Note:** Do not force fit bearing **25** and make sure the manufacturer's mark is facing out.

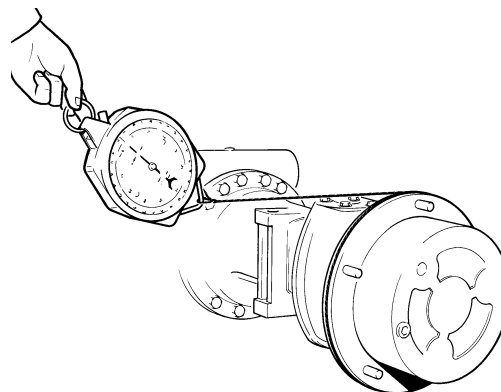
- 3 Locate hub swivel, aligning relationship lines, assemble top and bottom trunnions **19** together with trunnion seal **22** and bearing **23**. Apply Threadlocker and Sealer to the threads of bolt **20**, torque tighten trunnion retaining bolts **20** to 98 Nm (72 lbf ft).
- 4 Lightly oil the inner wheel bearing race. Assemble the bearing cup and bearing race **17** into the bearing carrier **15**.
- 5 Fit a new combination seal **18** into the bearing carrier **15** so that the chamfer faces the hub swivel. Do not disassemble seal or use excessive force when fitting. Do not lubricate before fitting. Use service tool (892/00891) and spacer to drive the seal squarely into the carrier until flush.
- 6 Lightly oil the outer wheel bearing race. Assemble the bearing cup and bearing race **16** into the bearing carrier **15**. Fit bearing carrier assembly onto axle stub.

**Note:** The bearing carrier must be fully supported during the fitting operation; do not allow any weight to rest on the bearings, otherwise the inner bearing will be displaced and damage the seal.

- 7 Align relationship marks made on dismantling. Assemble the annulus ring **13** to the annulus carrier **12**. Secure with circlip **14**.
- 8 Fit annulus assembly in the same angular position as removal, fit retaining plate **11** using new bolts **10**. Do not fully tighten bolts but allow the bearing carrier to rock slightly.

**Note:** Steps 10 to 12 describe measurement of rolling force. To measure rolling torque (simplified process), a special tool is required. See **Service Tools** in this section.

- 9 Measure seal drag rolling force as follows:
  - a Refit the planet gear carrier **2** - DO NOT FIT THE SUN GEAR **8**.
  - b Use a spring balance and cord wrapped around planet gear carrier **2** as shown. Pull the spring balance so that the hub rotates, do several times to let the seal bed in and record the reading. Remove planet gear carrier **2**.



- 10 Torque tighten bolts **10** evenly to 166 Nm (122 lb ft, 17 kgf).
- 11 Measure the rolling force as follows:
  - a Refit the planet gear carrier **2** - DO NOT FIT THE SUN GEAR **8**. Use a spring balance and cord wrapped around the planet carrier as shown. Pull the spring balance so that the hub rotates and record the reading.
  - b To get the rolling force, subtract seal drag rolling force (see step **9**) from reading obtained at this step, the result should be 64 to 117N (14 to 26 lbf).
  - c If the resulting figure is outside these limits, check: the seal is fitted correctly; and/or renew bearings if necessary; and/or new fitted components. Remove planet gear carrier **2**.
- 12 Press the drive shaft thrust pad **6** (chamfered side lowermost) into the recess in the planet carrier **2**.
- 13 Fit new planet gears **4** in place of any that were removed.
- 14 Slide the sun gear **8** (chamfer to be inboard) onto the drive shaft **26** and secure with circlip **7**. Fit a new 'O' ring **3** in place of the one discarded during dismantling.
- 15 Fit the planet carrier **2** onto the bearing carrier **15** ensuring that the two tapped holes are in line with those on the bearing carrier. Fit and tighten screws **1** after applying Threadlocker and Sealer to the threads. Torque tighten screws to 56 Nm (41 lb ft).
- 16 Fill hubs with correct grade oil.

### Hub-Dismantling & Assembly

The procedures for dismantling and assembling the hub on a PD70 axle are virtually the same as for a SD80 axle - described on the previous pages (F/92-1 to F/92-4).

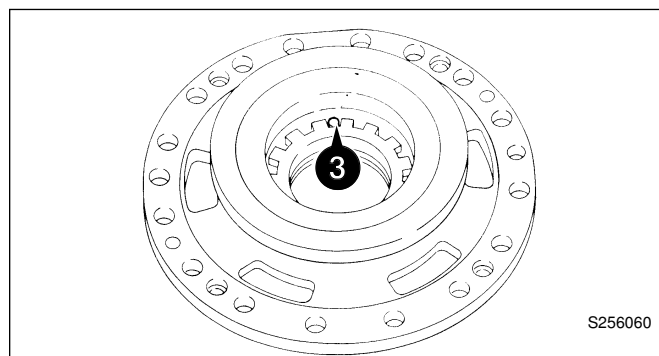
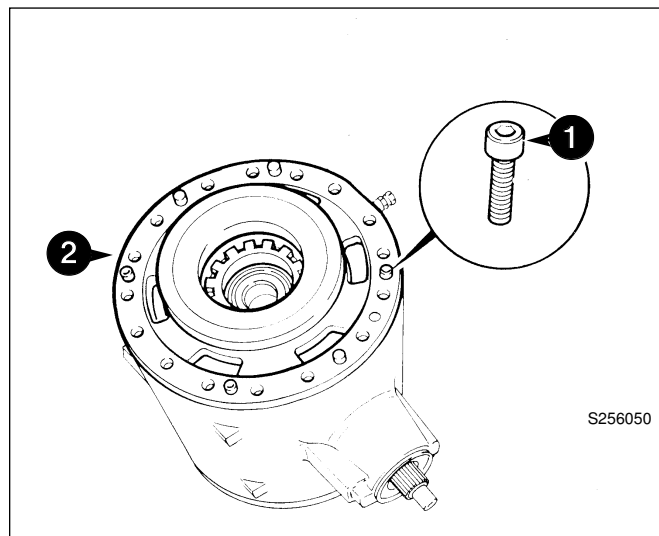
However, note that the wheel bearing carrier (shown as item **15** on page F/92-1) is mounted directly on to the axle arm. Disregard references to the hub carrier (shown as item **21** on page F/92-1).

### Drive Head-Dismantling

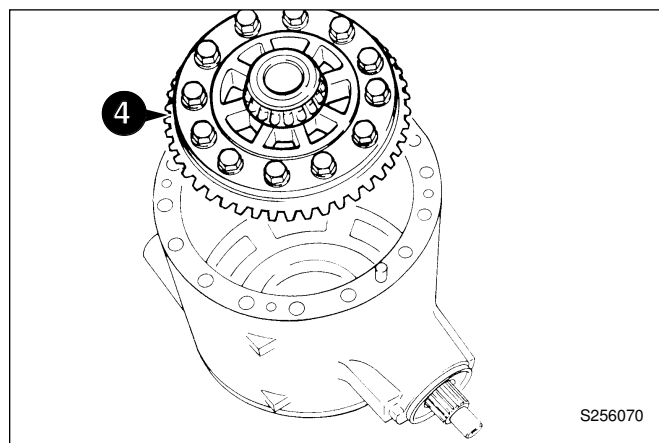
As the drivehead cannot be dismantled whilst fitted on the machine, we recommend that the complete axle is removed. See **Brakes** and **Hub and Driveshaft** for axle arm removal procedure.

The crownwheel and pinion are matched and should be renewed as a pair if either one is damaged or excessively worn. The two differential case halves are also matched as are the differential side gears and planet gears, do not use unmatched halves or gears.

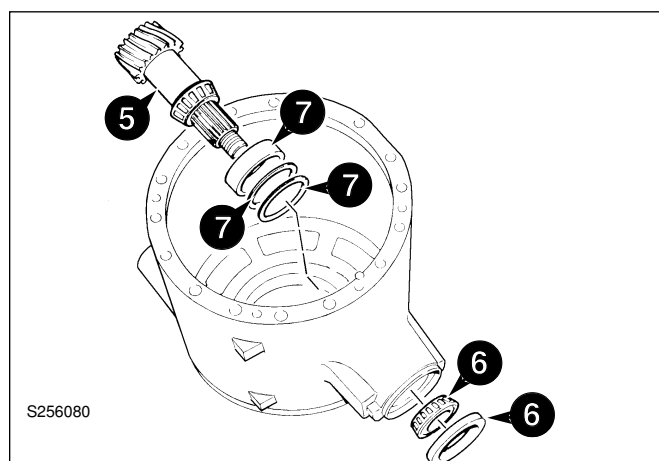
- 1 Position the drive head as shown, with the crownwheel at the top.
- 2 Match - mark the brake piston housing and drive head. Pull off the brake piston housing.
- 3 Drive out the differential side nut locking pin, to allow readjustment on assembly. Remove the other brake piston housing only if damaged, but remove its locking pin regardless (to allow sideload adjustment on assembly).



- 4 Lift out the crownwheel/differential assembly.
- Note:** If both brake piston housings are to be removed, mark the crownwheel end of the drive head casing to ensure that the assembly is returned to its original position.

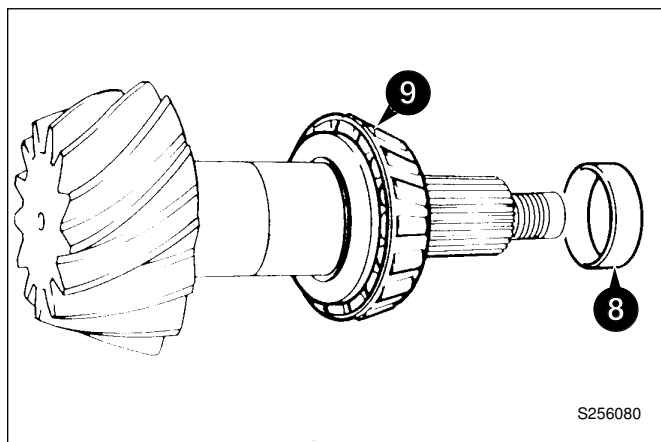


- 5 Using a soft faced hammer, hit the pinion end shaft until the pinion is free from its front bearing, then withdraw the pinion.
- 6 Withdraw the pinion seal and outer bearing cone.
- 7 If necessary, drive out the pinion inner bearing cup and shims. Discard the shims. Repeat for the outer bearing cup if required. Note that there are no shims for the outer bearing cup.

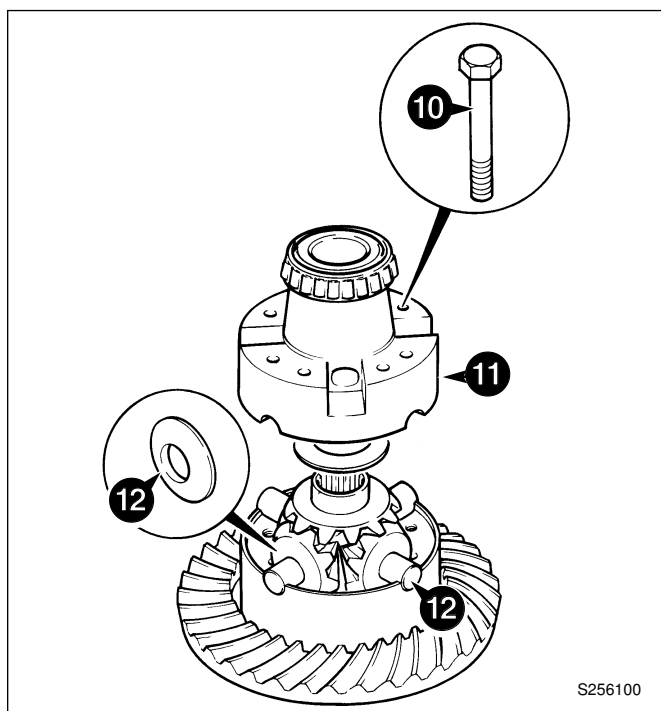


**Drive Head-Dismantling (cont'd)**

- 8 Remove the pinion spacer.
- 9 Pull off the bearing cone.



- 10 To dismantle the differential assembly, first remove bolts.
- 11 Lift off the top half housing.
- 12 Remove the differential gears and spherical washers. Pull off both differential bearing cones.



## Drive Head-Assembly

### Pinion Depth

Determine the pinion depth setting as follows:

**Note:** See page **Crownwheel and Pinion** for general guidance on crownwheel and pinion adjustment.

- 1 Assemble the pinion inner bearing and its cup on a flat surface.
- 2 Place Service Tool 892/00174 over the bearing assembly. Measure gap **A**. Add tool depth (30.01 mm) to gap **A** to give bearing depth.
- 3 Note the mounting distance figure **B** etched on the pinion and the deviation figure **C** on the drive head housing. Both figures are in units of 0.01 mm.

**Note:** The pinion depth may be etched on the gear face **B** or on the rear of a gear tooth **D**.

- 4 If dimension **B** is **positive**, **add** it to the bearing depth. If dimension **B** is **negative**, **subtract** it from the bearing depth.
- 5 If dimension **C** is **positive**, **subtract** it from the total. If dimension **C** is **negative**, **add** it to the total.
- 6 Subtract the result from the standard value of 31.19 mm to give the required shim thickness.

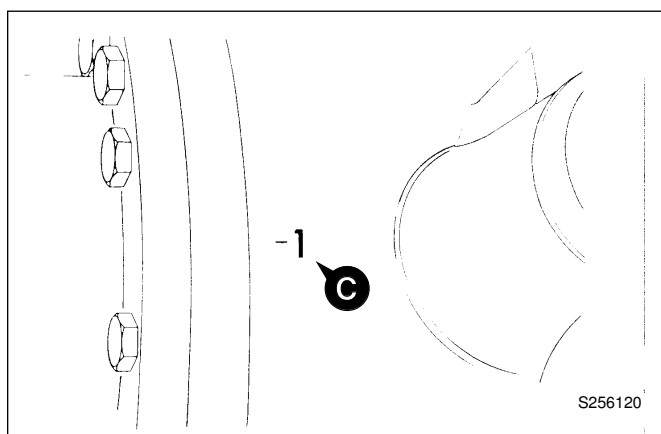
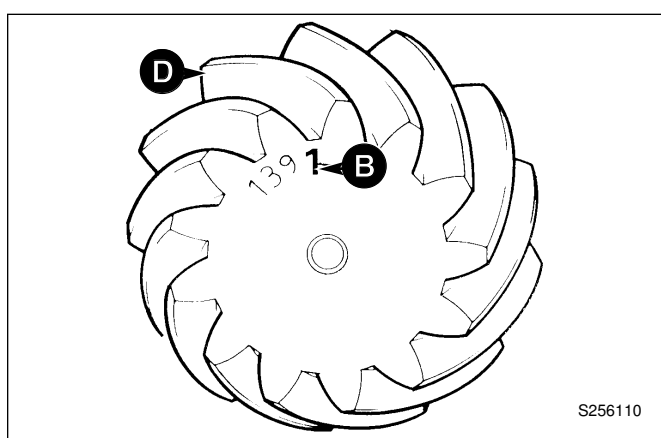
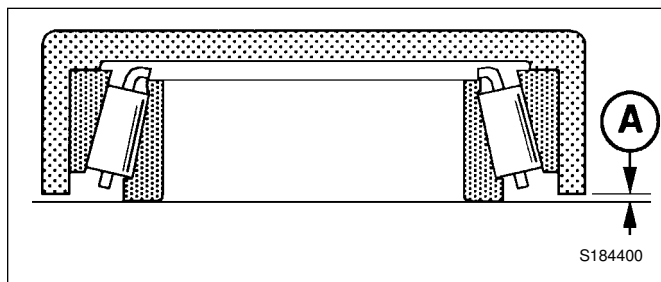
### Example (Dimensions in mm)

Dimension <b>A</b>	0.25
Add tool depth	+ 30.01
<b>Total</b>	<b>30.26</b>

Add dimension <b>B</b> if positive. (Subtract if negative.)	+ 0.01
<b>Total</b>	<b>30.27</b>

Add dimension <b>C</b> if negative. (Subtract if positive.)	+ 0.01
<b>Total</b>	<b>30.28</b>

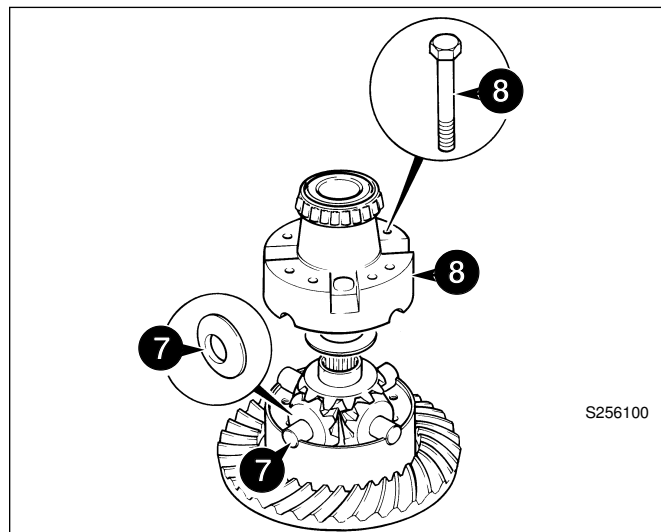
Standard Value	31.19
Less calculated total from above	- 30.28
<b>SHIM THICKNESS</b>	<b>0.91</b>



### Drive Head-Assembly (cont'd)

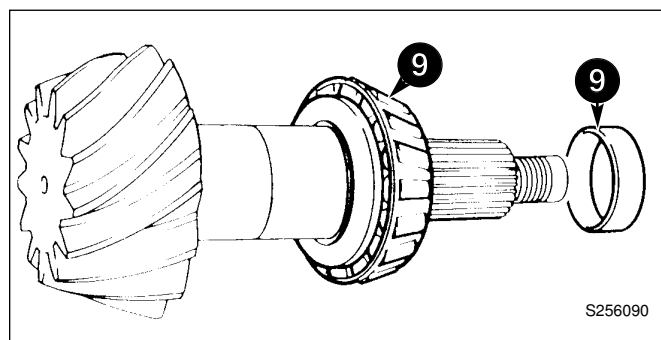
**Note:** The crown wheel and pinion are matched and should be renewed as a pair if either one is damaged or excessively worn. The two differential housing halves are also matched. Do not use unmatched halves. If required, fit a new crownwheel to the differential case half, torque tighten crownwheel retaining bolts to 166 Nm 122 lbf ft; 17 kgf m).

- 7 Assemble the differential gears and their spherical washers into the bottom half housing. Fit the differential bearing cones.
- 8 Position the top half housing onto the differential, aligning the match mark letters (see Note above). Apply JCB Threadlocker & Sealer to the threads of bolts, then fit and torque - tighten to 56 Nm (42 lbf ft, 6 kgf m). Check the gears for free rotation.

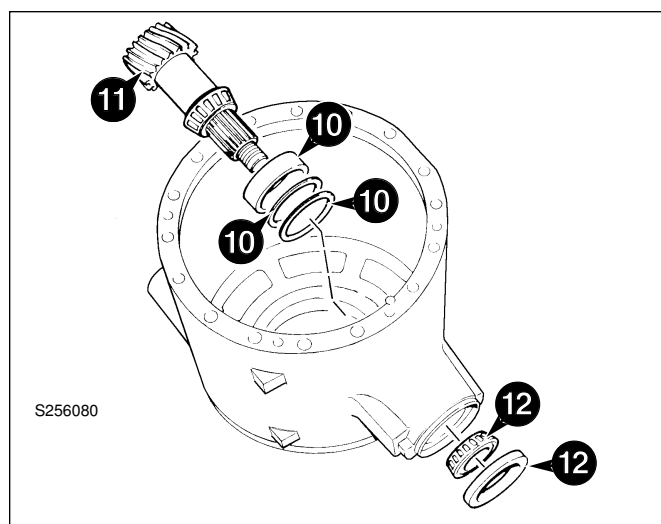


- 9 Fit the pinion inner bearing cone and the largest available spacer (e.g. 14.20 mm)

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



- 10 Fit the pinion inner bearing cup, together with the required thickness of shims to give correct pinion depth, see Pinion Depth, steps 1 to 6. To ensure the cup is fitted square, use a suitable puller assembly. Do not use a hammer. Fit the outer bearing cup.
- 11 Insert the pinion into its bore. (Before inserting, ensure that the pinion matches the crownwheel. The code numbers etched on the pinion end face and the crownwheel perimeter should be the same.
- 12 Fit the pinion outer bearing cone. Do not fit the oil seal at this stage.



**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**.

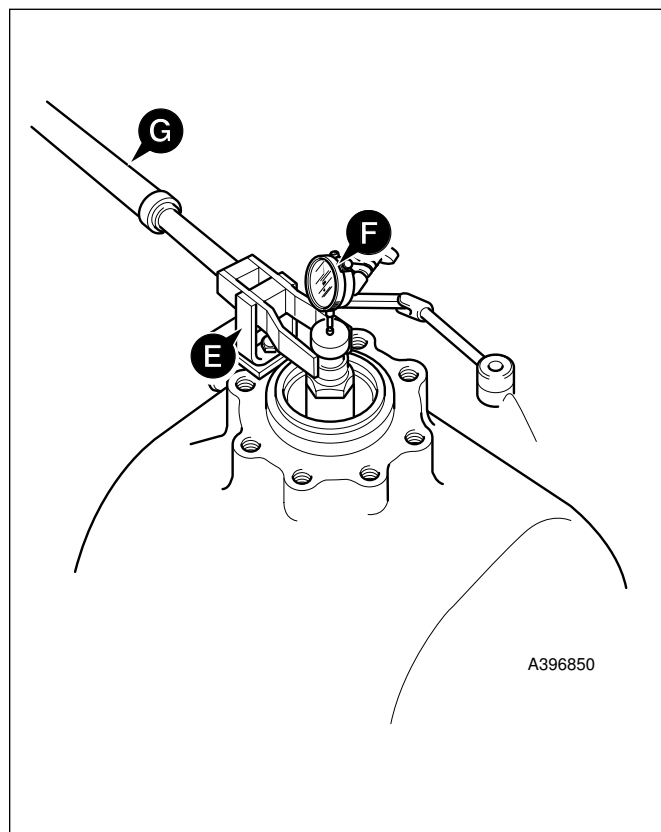
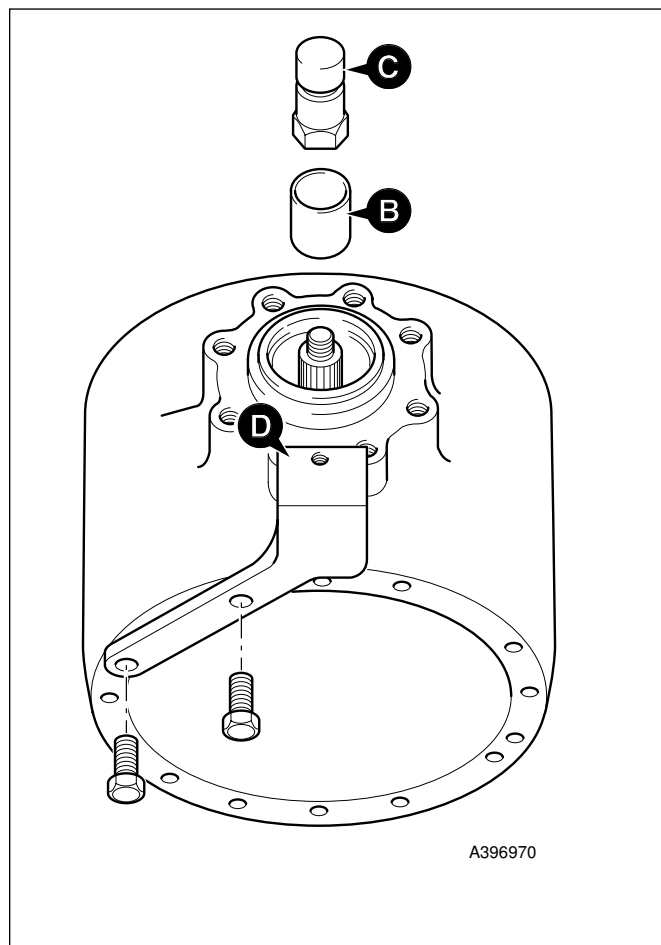
**Example**

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.





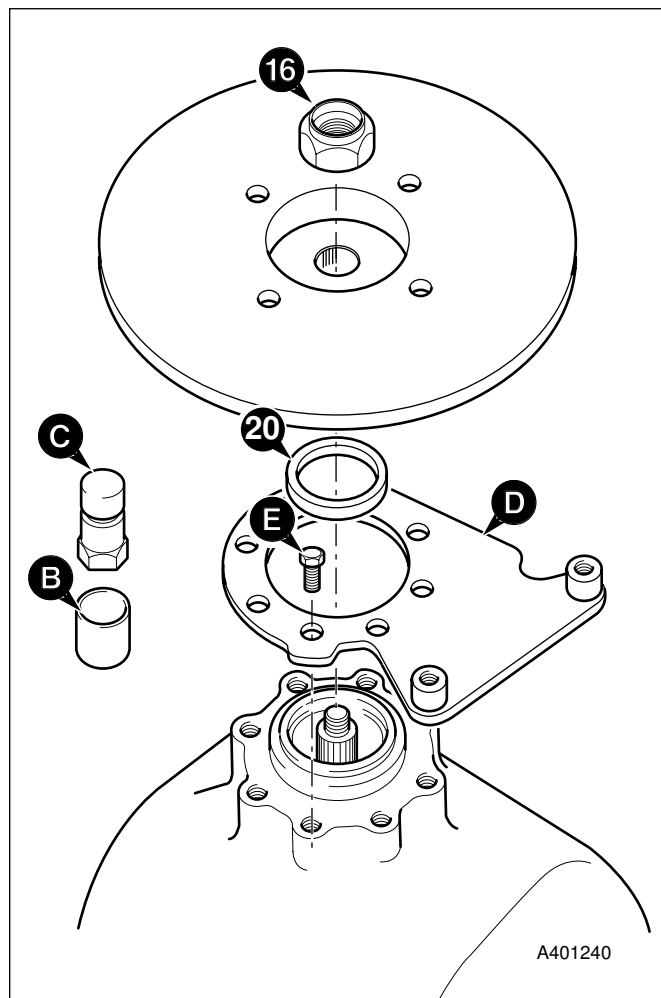
**19** If rolling torque measured at step 18 is too high, fit the next larger size spacer. If rolling torque is too low, fit the next smallest size spacer. If a correct spacer is not available from the range, check that drive head is assembled correctly.

**20** Remove adapter **C** and sleeve **B**. Fit a new oil seal, grease between seal lips before fitting. Fit the brake calliper bracket **D**. Apply JCB Threadlocker and Sealer to the fixing bolts **E**. Fit the brake disc/coupling and a NEW stake nut **16**.

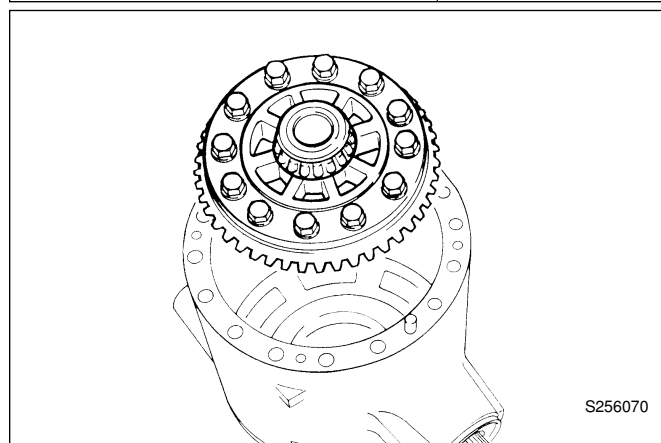
**21** Progressively torque tighten the stake nut, occasionally rotating coupling yoke, up to 250 Nm. Providing the correct size spacer has been selected the rolling torque should be between 2.3 and 3.4 Nm including seal drag.

**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.

**22** Finally stake the nut **16** into the slot.

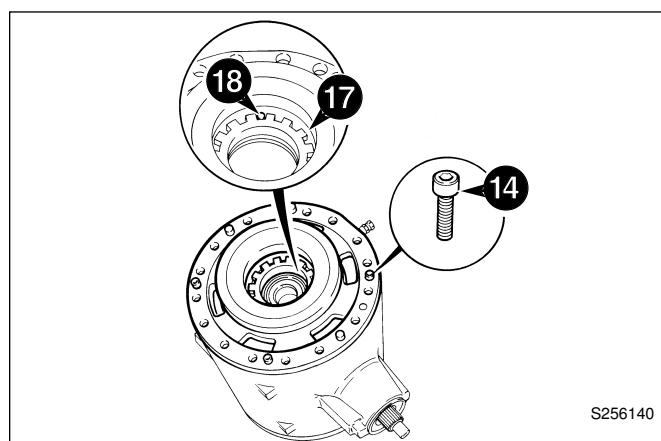


**23** If both brake piston housings were removed, fit the one at the opposite end to the crownwheel, using the procedure in Step 24. Then install the crownwheel /differential assembly into the drive head.

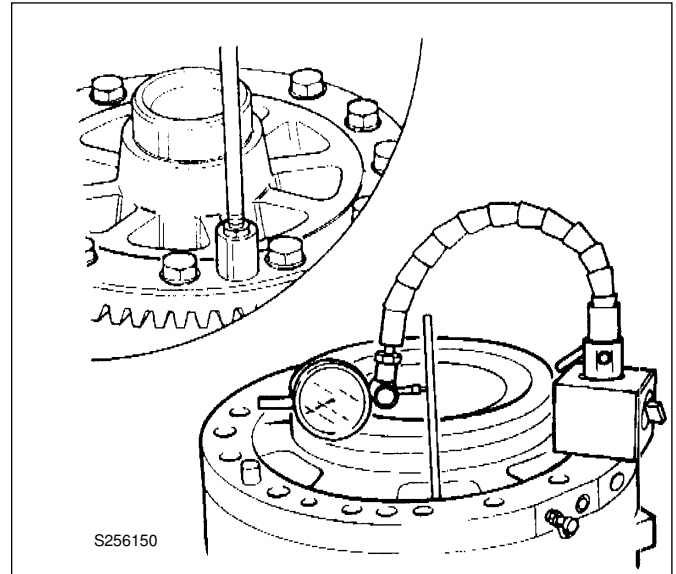


**24** Apply JCB Multi-Gasket to the drive head mating face, then fit the brake piston housing. Ensure that the match - marks made during dismantling are aligned. Fit capscrews. Torque - tighten to 56 Nm (42 lbf ft, 5.7 kgf m). (Applies to both piston housings.)

**25** Adjust differential side nuts to give a bearing preload of 1.13-2.26 Nm (0.8-1.6 lbf ft; 0.1-0.2 kgf m). (Measure the preload by taking another rolling torque reading and subtracting the torque figure measured at step 21. The difference is the bearing preload.)



- 26 Measure the crownwheel backlash, which should be 0.17-0.28 mm (0.006-0.010 in). Adjust the differential side nuts by equal amounts when altering backlash. When backlash and preload are both correct, fit the sidenut locking pins, see step 25.

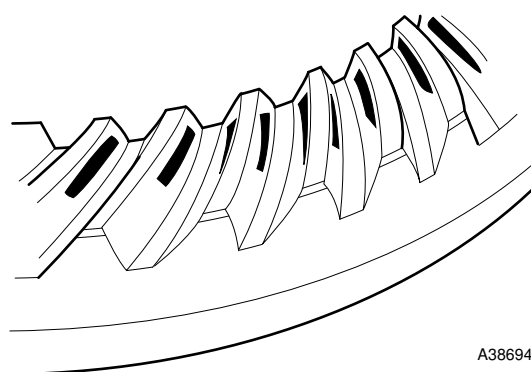


### Crownwheel and Pinion Meshing

Meshing of the gears should be checked by marking three of the pinion teeth with engineers marking compound and rotating the pinion.

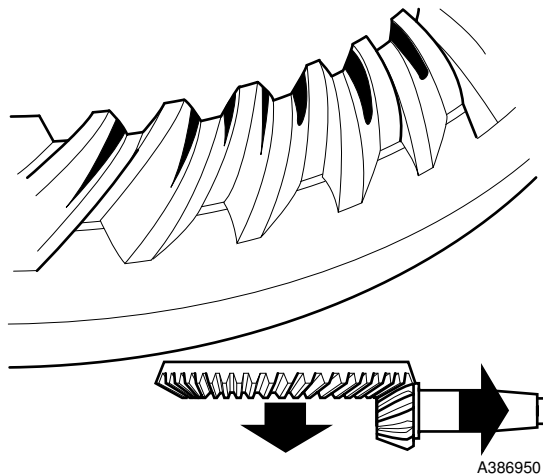
The marking will then be transferred to the crown wheel teeth.

#### Correct tooth marking.



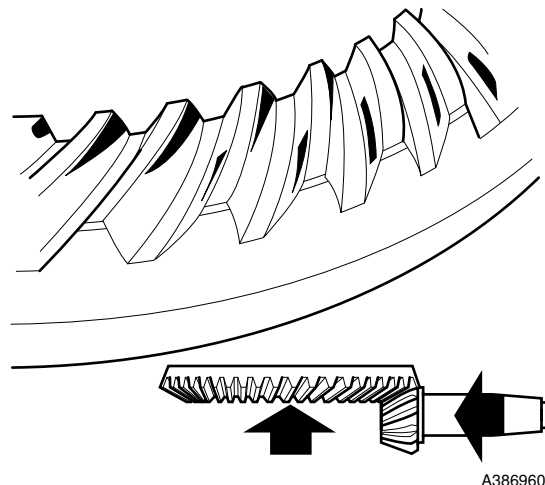
#### Pinion too deeply in mesh.

Decrease the shim thickness between the pinion inner bearing cup and the axle casing. Move the crown wheel towards the pinion to correct the backlash.



#### Pinion too far out of mesh.

Increase the shim thickness between the pinion inner bearing cup and the axle casing. Move the crown wheel away from the pinion to correct the backlash.



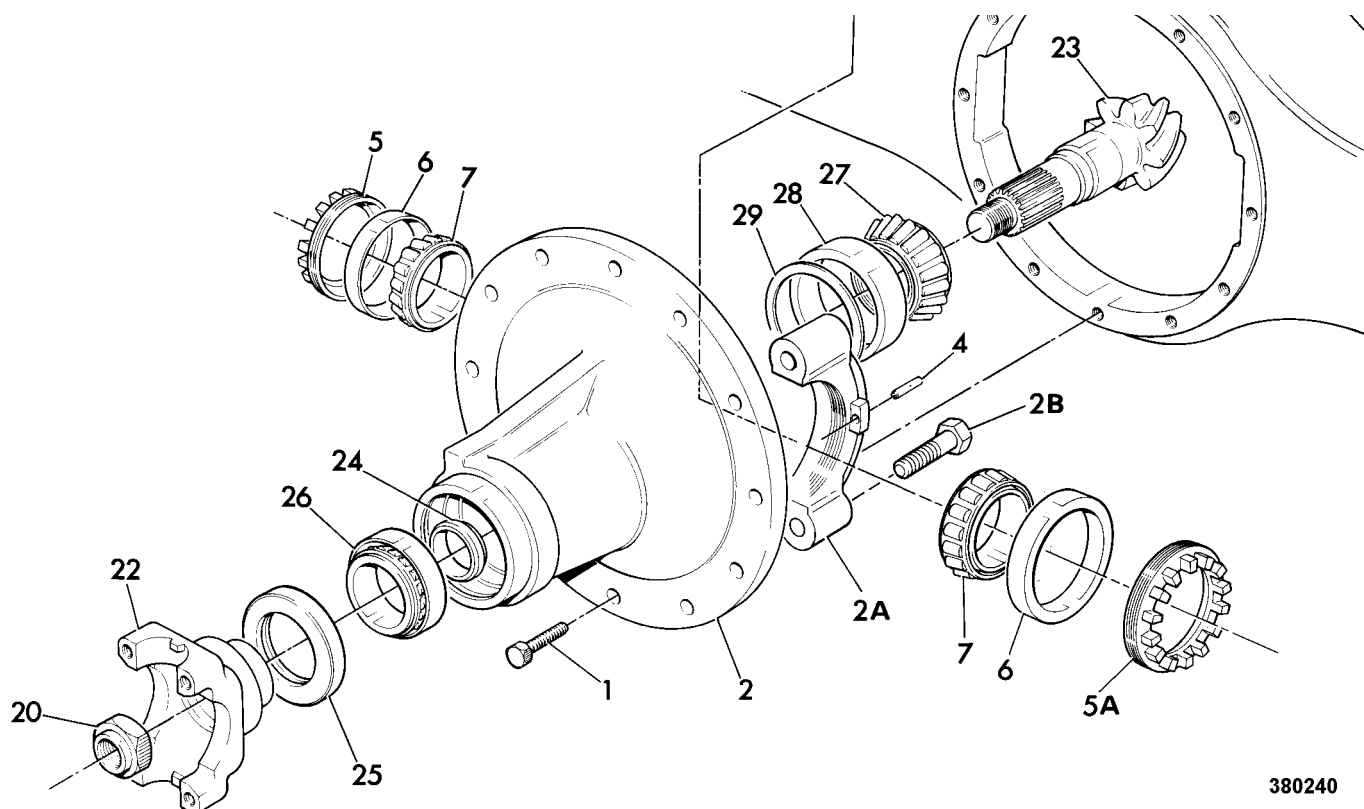
## Collapsible Spacer Assembly

When assembling the axle, if the special tools listed in the **Service Tools - Axles** section or if the correct size solid spacer is not available it is acceptable to fit a collapsible spacer using the procedure below. The illustration shows a typical axle, note that rear axles are fitted with a brake disc, not the yoke 22 shown.

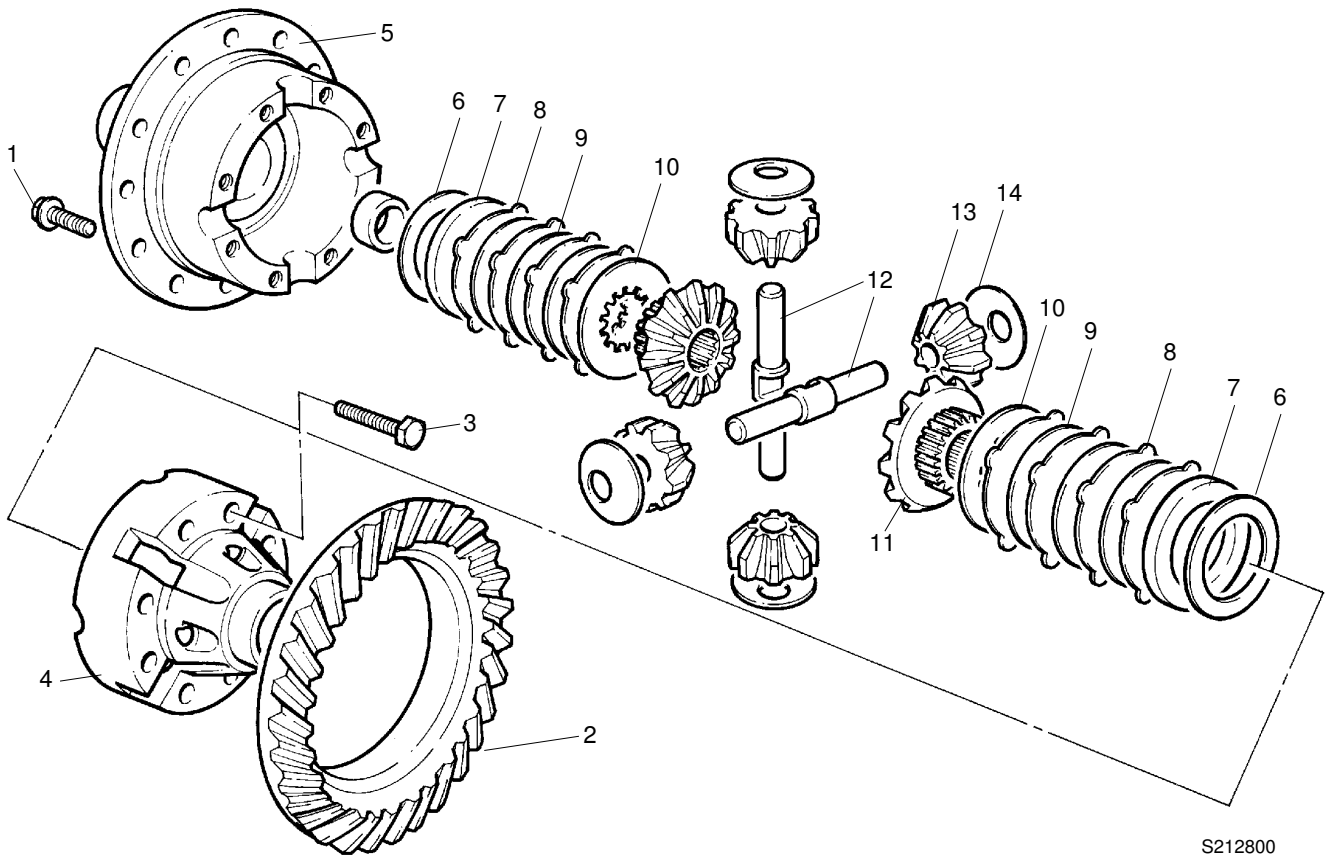
- 1 Smear output shaft inner bearing **27** with JCB HP Grease before refitting. Fit bearing cup **28** over pinion shaft **23** and assemble into drive head casing.
- 2 Fit NEW collapsible spacer **24**, after smearing with JCB HP Grease fit outer bearing **26** followed by a new oil seal **25**. Grease between seal lips before fitting. Assemble yoke **22** and NEW stake nut **20** with integral washer.
- 3 Tighten stake nut to achieve a rolling torque of 1.5 to 2.8 Nm (1.1 to 21. lbf ft), inclusive of seal drag.

**Note:** If this figure is accidentally exceeded the output shaft must be dismantled and the collapsible spacer **24** renewed.

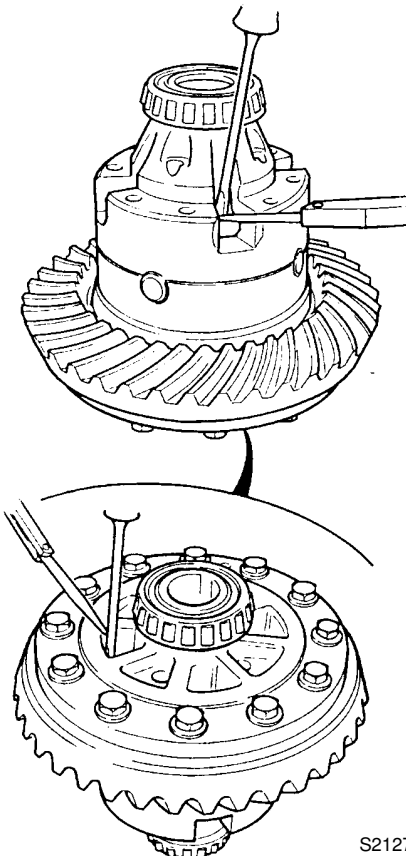
- 4 Finally stake nut into slot.



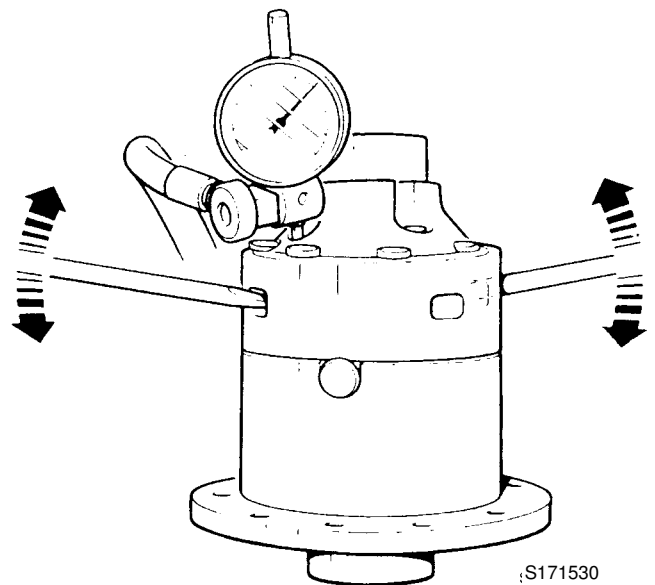
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S171530

**Dismantling and Assembly**

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

**When Dismantling**

Mark the two differential halves before dismantling, for subsequent assembly.

Note the relative positions of the friction and counter plates before dismantling, they must be fitted in the same positions.

If worn, the friction and counter plates must be renewed as a complete set.

**When Assembling**

- 1 Assemble trunnion pins **12**, side gears **11** with pressure plates **10**, counter plates **8**, friction plates **9**, planet gears **13** and thrust washers **14** into the 'crownwheel half of the differential assembly **5**.

**Note:** Do not fit the shims **6** at this point.

- 2 Align the two halves of the differential assembly with the marks made during dismantling. Assemble using bolts **3**.
- 3 Using a dial test indicator (or feeler gauges), with two screwdrivers or suitable levers, gently apply pressure to side gear **11** away from the trunnion pins **12** as shown. Measure and note the end-float of the side gear.
- 4 Turn the differential assembly over and repeat step 3 for the second side gear.
- 5 Dismantle the differential assembly. Add shims **6** to give end-float between 0.1 and 0.2mm (0.004 and 0.008in.).

**Note:** Shimming must be carried out whenever the differential is dismantled, however the end float 0.1 and 0.2 mm (0.004 and 0.008 in.) can be exceeded on previously assembled differential as this is only an initial setting figure which allows for bedding in.

- 6 Repeat steps 2, 3, and 4. If the end float is correct, tighten bolts **3** to 56 Nm (41 lbf ft).
- 7 Fit crownwheel **2** using new Verbus Ripp bolts **1**.

**Friction Plate Wear Limits**

Measure and note the thickness of the friction plate, the result must not be less than 1.25 mm (0.049 in).

Check the condition of the friction material, which should be even over both surfaces.

If in doubt, discard the set (friction and counter plates).

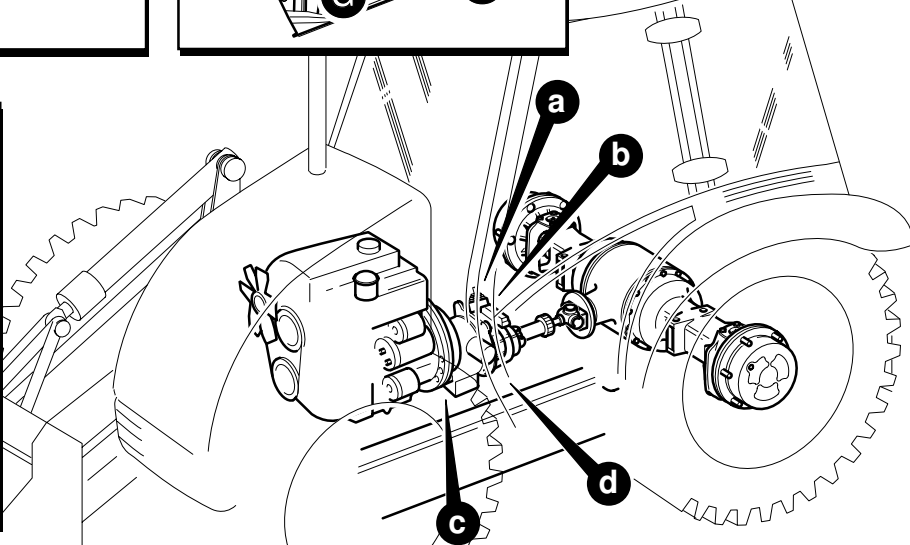
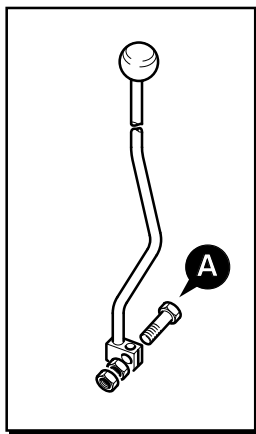
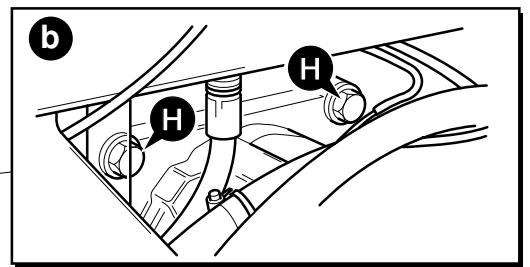
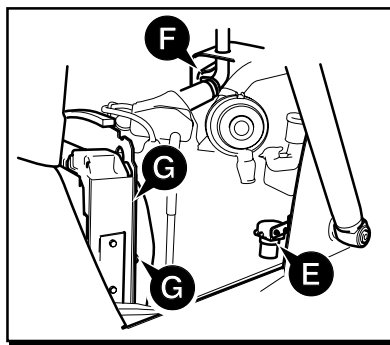
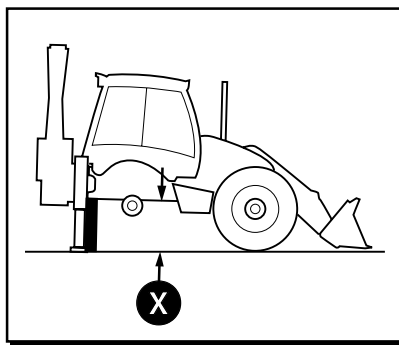
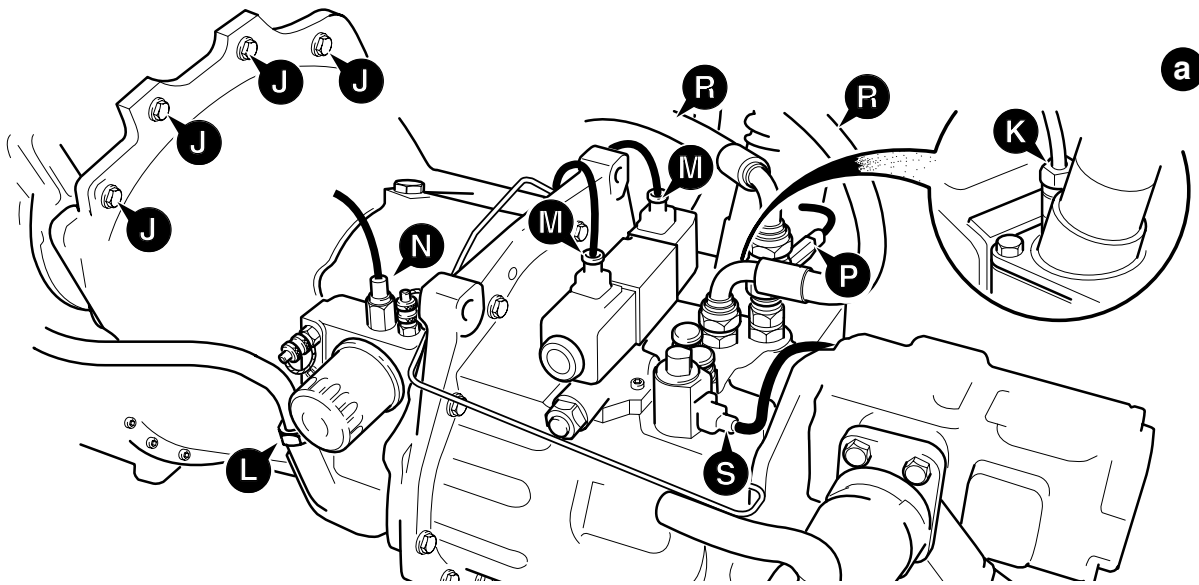
**Torque Settings****SD55**

<b>Item 1</b>	94 Nm	9.6 kgf m	70 lbf ft
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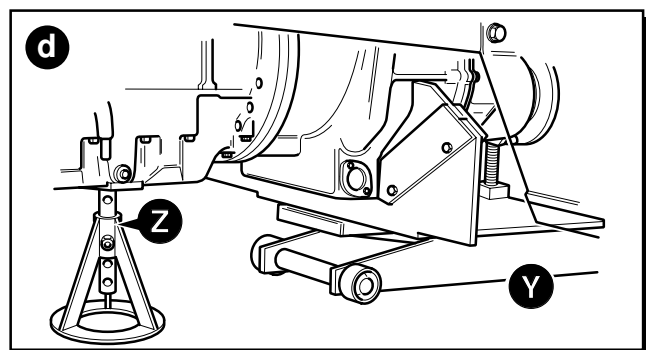
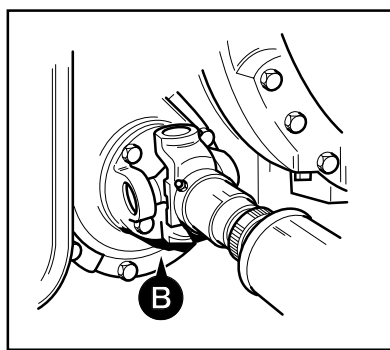
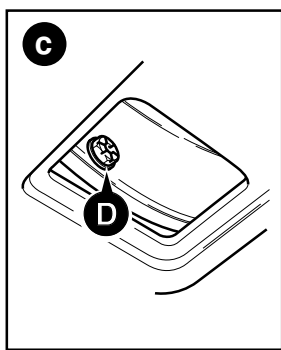
**SD70, PD70, SD80**

<b>Item 1</b>	166 Nm	16.9 kgf m	122 lbf ft
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Removal and Replacement



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## Removal and Replacement (cont'd)

**IMPORTANT:** The gearbox is heavy. Unless it is safely supported during removal and replacement it could fall and cause injury. Make sure that you have access to suitable jacks and a gearbox locating 'cradle' before attempting to remove the gearbox.

### WARNING

**A raised and badly supported machine can fall on you. Position the machine on a firm, level surface. Before raising one end ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.**

**Disconnect the battery, to prevent the engine being started while you are beneath the machine.**

GEN 1-1

### Removal

- 1 Park the machine on firm level ground. The gearbox is heavy. If the ground is soft or uneven it will not be possible to remove the gearbox safely.
  - 2 Loosen the right side rear wheel nuts. Rest the shovel on the ground and lower the stabilisers to raise the rear of the machine. Check dimension **X** which must be at least 800 mm. This will allow the gearbox to be pulled clear. Block/support the machine.
- Note:** On sideshift machines, suitable lengths of steel channel can be used as safety struts between the stabiliser feet and chassis, one at each stabiliser.
- 3 Remove the right hand side rear wheel.
  - 4 Remove the bonnet - see Section 3, **Routine Maintenance**.
  - 5 Disconnect the gearshift from the top of the gearbox, as shown at **A**.
  - 6 Remove the rear axle propshaft - see **Propshafts**.
  - 7 Disconnect the front axle driveshaft bolts **B** (use tool 892/00822).
  - 8 Drain the hydraulic tank and remove the main hydraulic pump (see Section E, **Service Procedures and Main Hydraulic Pump**). Tie the suction hose up clear of the gearbox.
  - 9 Drain the gearbox oil, see Section 3, **Routine Maintenance**.
  - 10 Remove the access bung/plate at the bottom of the torque converter housing. Through the access hole, loosen and remove the torque converter to engine flywheel retaining bolts **D**.

- 11 At a later stage the gearbox and engine assembly is tilted to allow access to fixing bolts. To prevent damage as the engine is tilted components must have their fixings removed as follows:

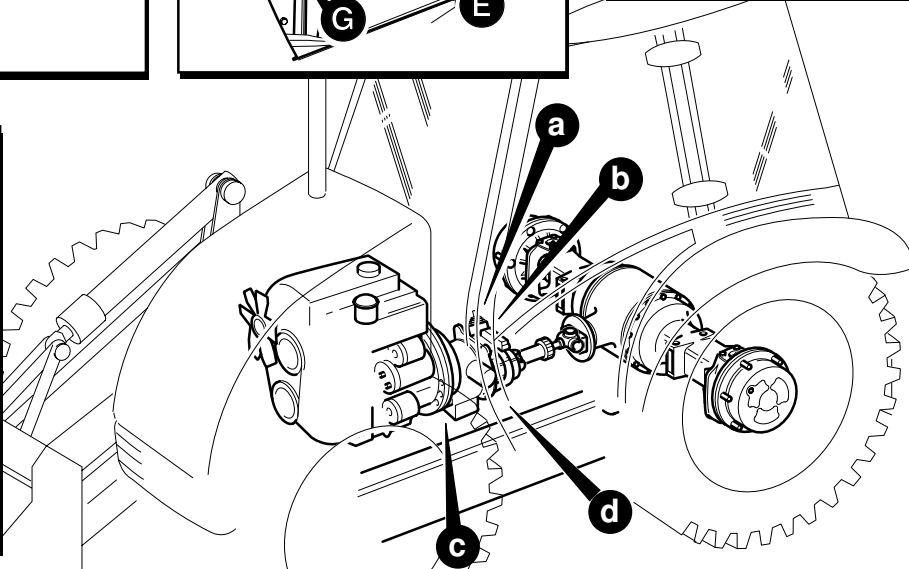
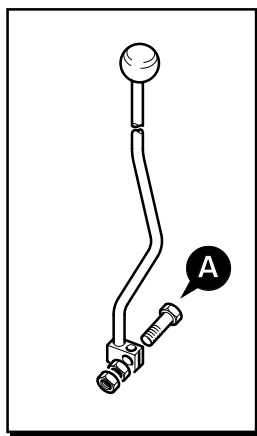
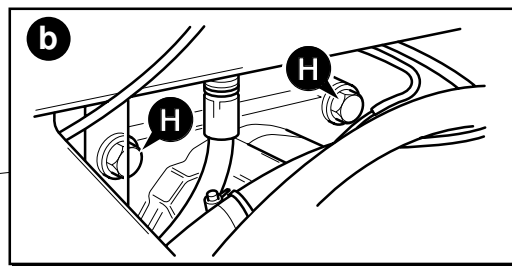
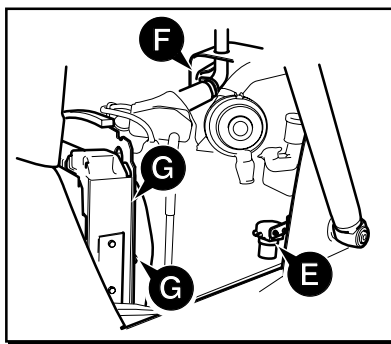
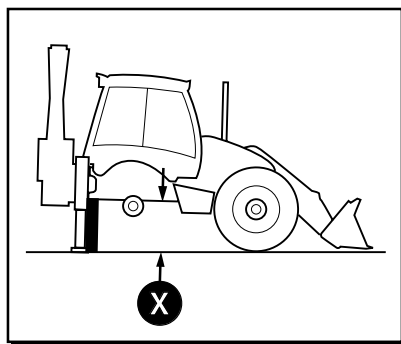
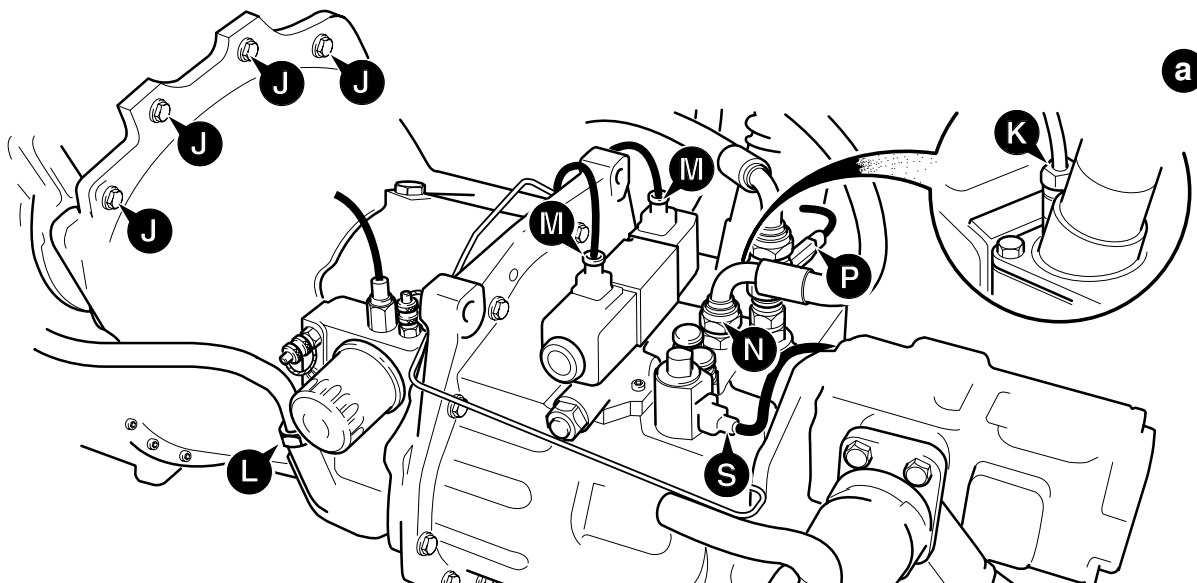
- a Fuel sediment bowl assembly **E** (2 bolts).
- b Exhaust stack fixing bracket **F** (2 bolts).
- d Radiator fan cowl **G** (4 bolts).

It is not necessary to remove these components, only release them from their fixings.

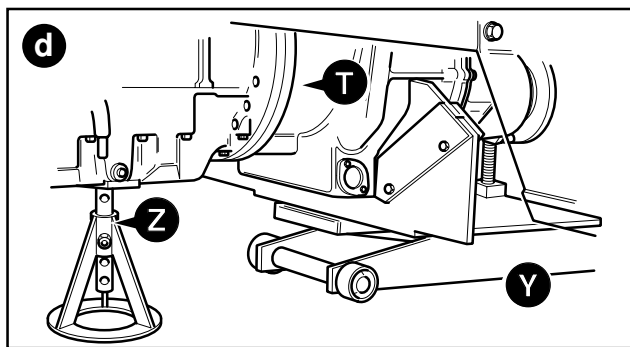
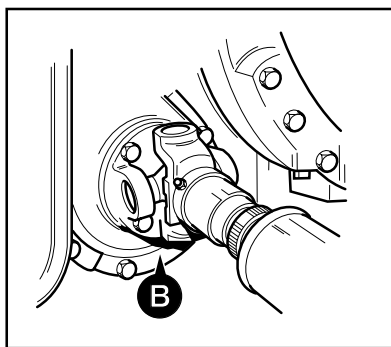
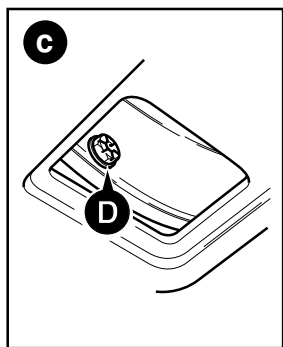
- 12 Support the gearbox using a suitable trolley jack and cradle. The gearbox must be securely located on the cradle as shown at **Y**.
- 13 Make sure that the weight of the gearbox is supported by the trolley jack and then remove the gearbox mounting bolts **H**.
- 14 Using the trolley jack, lower the gearbox and engine to gain access to the top torque converter housing to engine block retaining bolts **J**. Put a support under the engine as shown at **Z** to prevent it from dropping when the gearbox is removed.
- 15 Undo the four bolts **J** at the top of the torque converter housing. Note that the two outer most bolts have nuts instead of screwing into the engine block. Also note the position of the electrical earth straps.
- 16 Pull off the breather tube **K**. Undo the gearbox dipstick fixing nut **L** and then remove the dipstick tube.
- 17 Uncouple the forward/reverse solenoid valve connectors **M**, oil pressure sender **N** and temperature sender **P** (if fitted). Label the connectors for identification when refitting.
- 18 Disconnect the gearbox oil cooler hoses **R**.
- 19 On 4 wheel drive machines, uncouple the electrical connector at the 4WD solenoid **S**.
- 20 Remove the flywheel housing to engine bolts **T**.
- 21 Manoeuvre the gearbox with the torque convertor clear of the engine housing.
- 22 Lower the trolley jack and pull the gearbox and torque convertor clear of the machine.



Removal and Replacement (cont'd)



A401310



## 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.

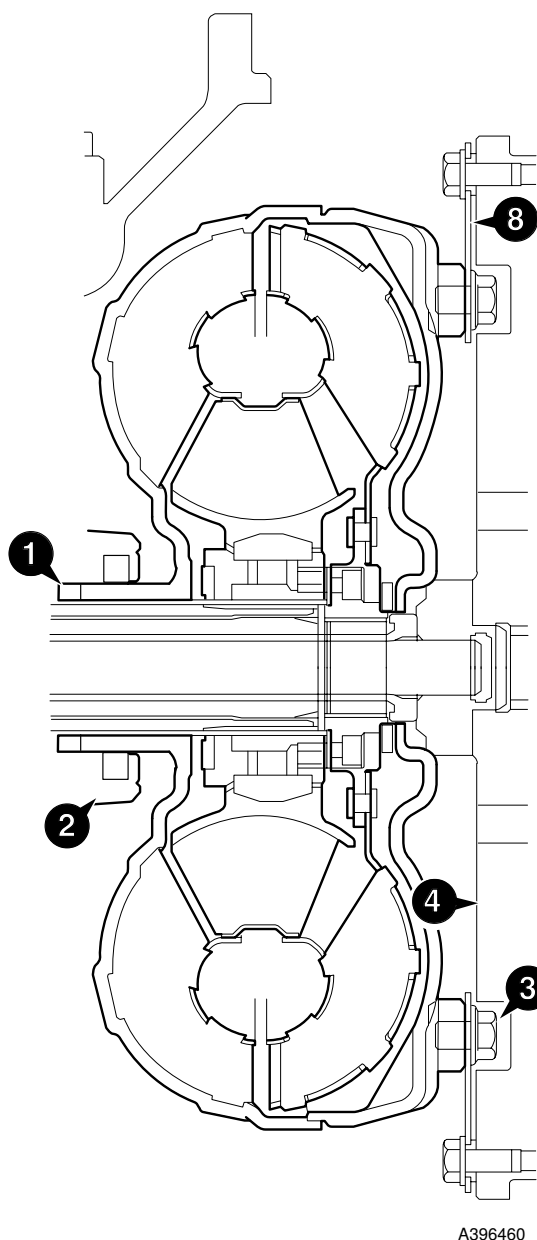
Before bolting the torque converter housing to the engine make sure the mating faces are fully together (DO NOT USE FORCE). The drive plate **8** should also be mated close to the flywheel. Do not force the components together with the fixing bolts.

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.

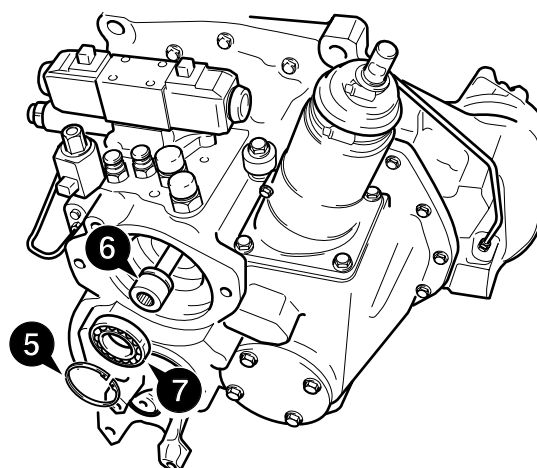
- 4 Fill the gearbox with the specified amount and type of oil (see **Section 3, Routine Maintenance**). Leave hose **N** off until the filling operation is complete. After filling refit hose **N**.

### 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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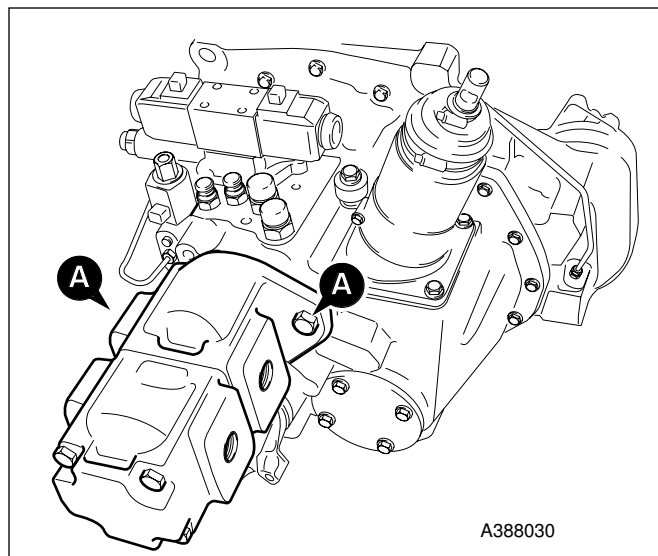
## Dismantling

Cleanliness is of the utmost importance when servicing the gearbox. All precautions to prevent any ingress of dirt, grit etc. must be taken. To this end wash the exterior of the gearbox assembly as follows;

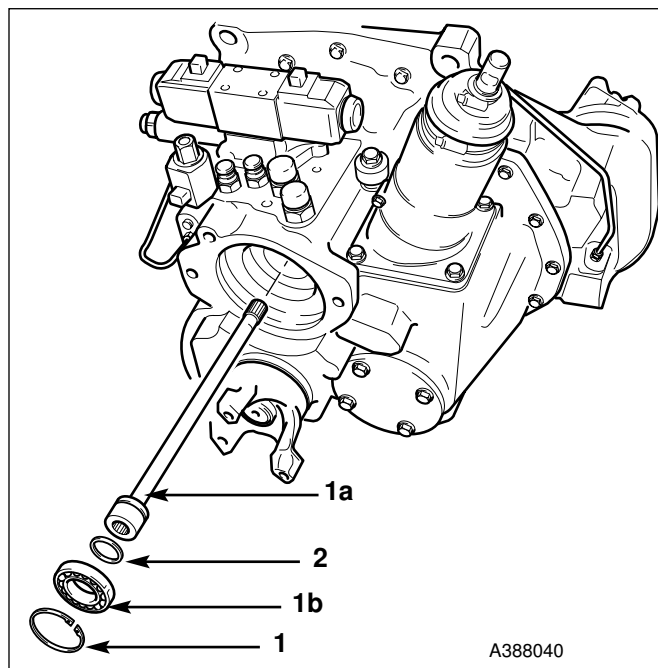
Make sure that all open ports and orifices are effectively plugged. Remove any deposits of dirt, grit and oil from the outer casings using a suitable degreaser and water. Dry the casings.

**Note:** For details of service tools referred to, see **Service Tools** at the front of this section.

**Note:** If the main hydraulic pump has not been removed, remove it. Support the pump, undo the 2 fixing bolts **A** and then withdraw the pump from the gearbox.

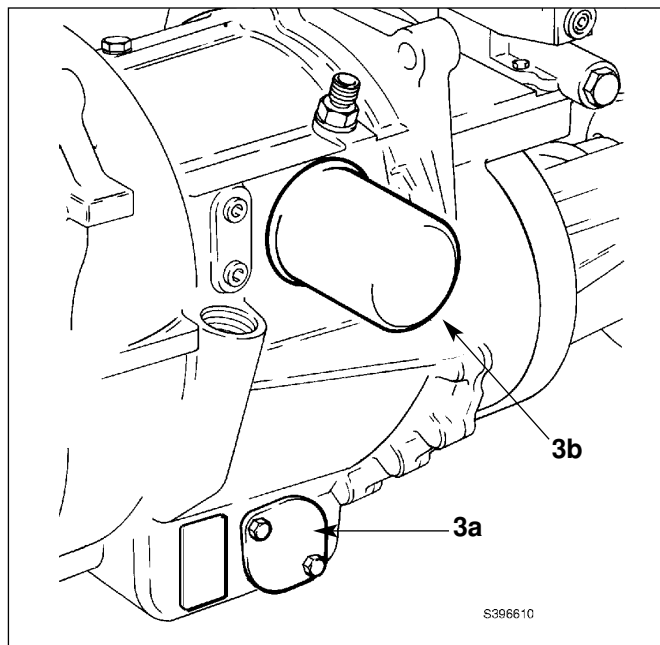


- 1 Remove the circlip and then withdraw the pump driveshaft **1a** together with its bearing **1b**.
- 2 Remove and discard the shaft sealing ring.

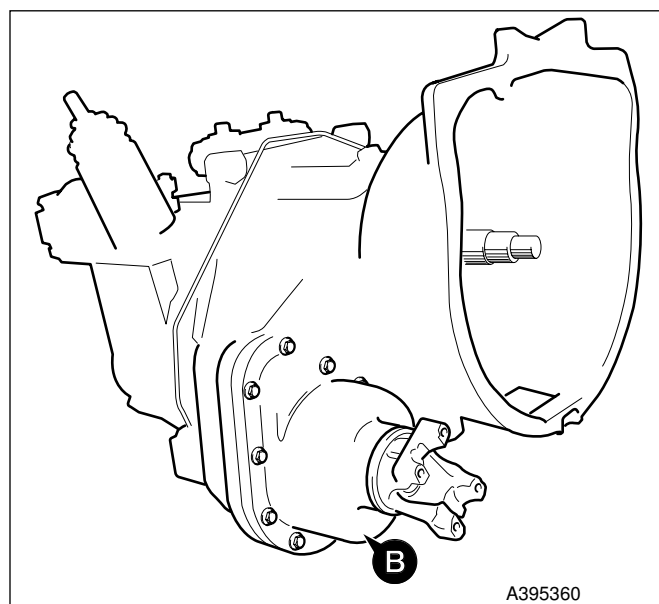


**Dismantling (cont'd)**

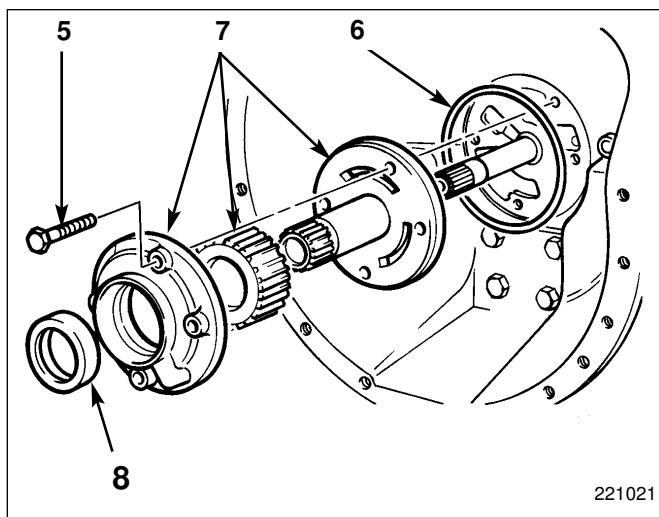
- 3 Drain the oil from the casing by removing the suction strainer **3a**. Remove and discard the oil filter **3b**.



- 4 If the gearbox is fitted with a 2/4 wheel drive unit **B**, remove it. For the correct procedure see **Hydraulic 2/4 wheel Drive Unit, Dismantling**.



- 5 Unscrew bolts and withdraw pump.  
6 Remove and discard pump sealing ring.  
7 Separate pump components. Note that the pump components are held together with a security screw at the rear of the assembly.  
8 Remove and discard oil seal from pump housing.



**Dismantling (cont'd)**

Position transmission vertically, standing on the face of the torque converter housing.

9 Unscrew capscrews and remove solenoid control valve.

Note 'O' rings fitted around ports on mating face of solenoid valve body.

**Note:** See **Service Procedures, Forward/Reverse Control Valve** for solenoid dismantle/assembly .

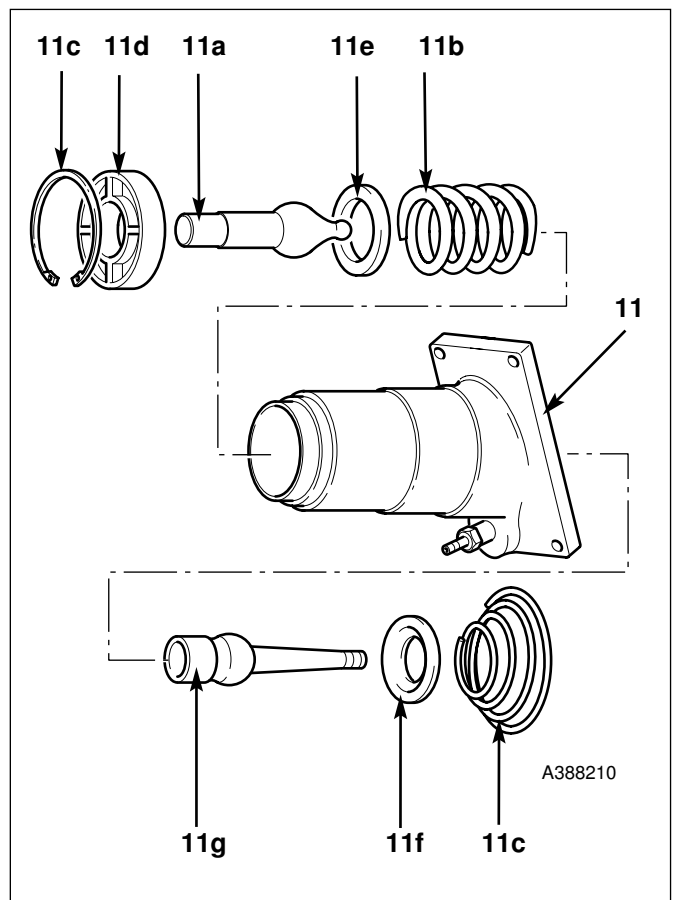
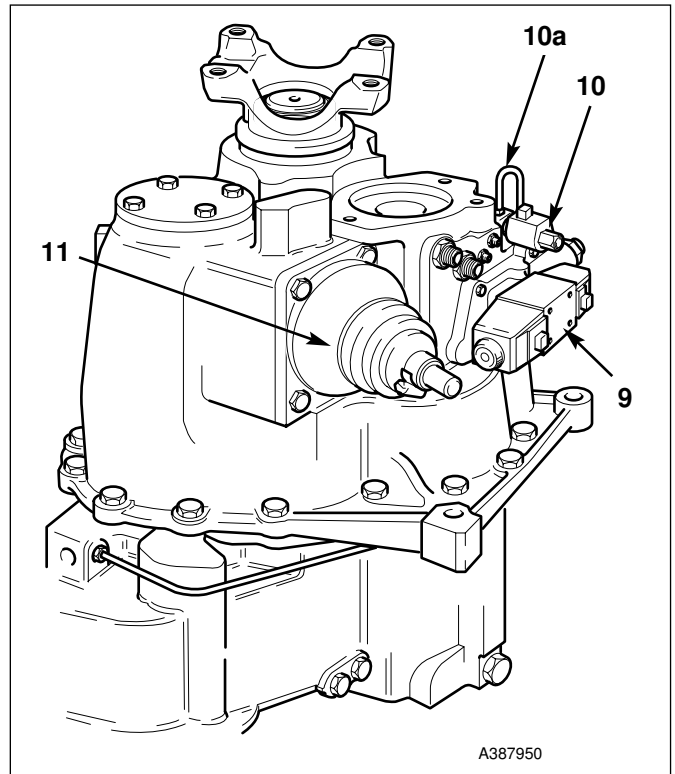
10 On 4 wheel drive transmissions remove the 4 wheel drive hydraulic pipe and control valve **10a**.

11 Undo the 4 bolts and remove the gear lever turret. Remove the baffle plate beneath if fitted. If necessary the turret assembly can be dismantled as follows:

- a Slacken worm drive clips and remove rubber boot.
- b Using a suitable press or clamp, carefully press the top lever **11a** down to compress spring **11b**, just enough to release pressure on circlip **11c**.

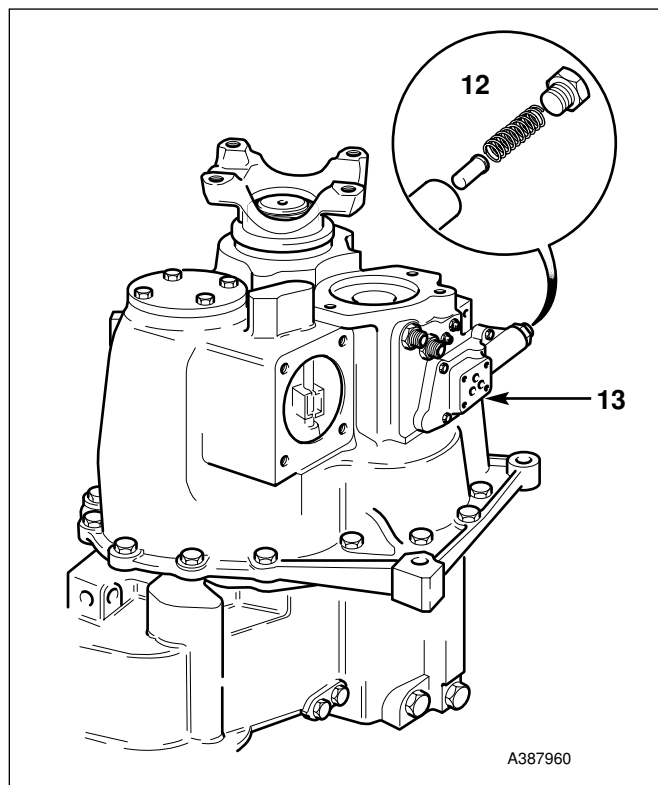
**Note:** BEWARE of spring pressure acting on nylon seat when circlip is removed.

- c Remove circlip **11c**.
- d Slowly release the pressure from the top lever **11a** and remove it, together with bush **11d**, washer **11e** and spring **11b**.
- e Rotate spring **11c** so as to disengage from the retaining tabs inside the turret **11**. Be aware that the spring may suddenly disengage while still under pressure. Repeat this operation until all the coils are disengaged and the spring can be removed.
- f Remove retainer **11f** and bottom lever **11g**.

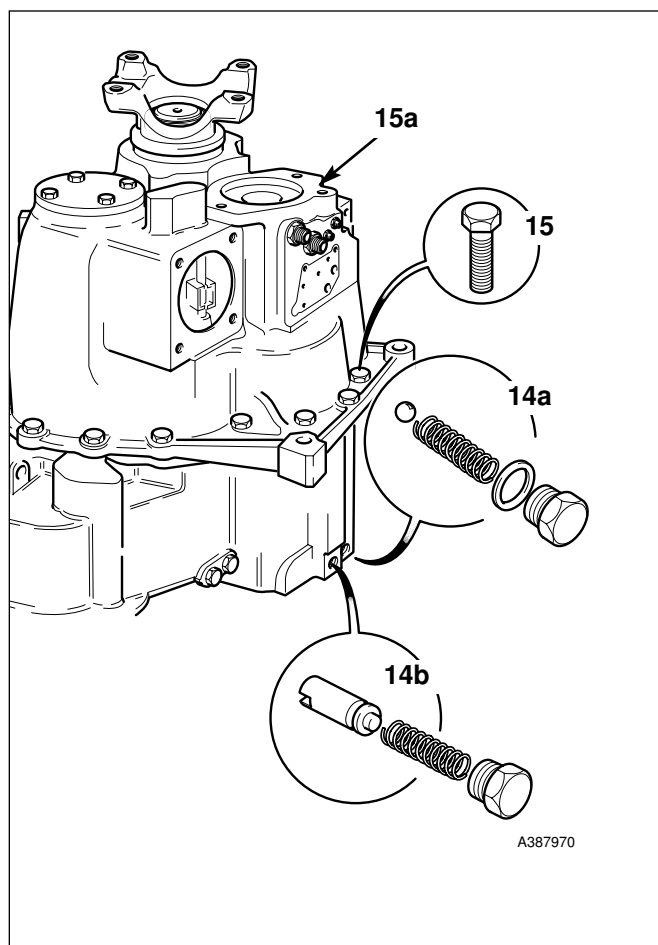


**Dismantling (cont'd)**

- 12 Unscrew plug and withdraw pressure maintenance valve spool and spring.
- 13 Unscrew four bolts and remove pressure maintenance valve body. Remove and discard gasket.

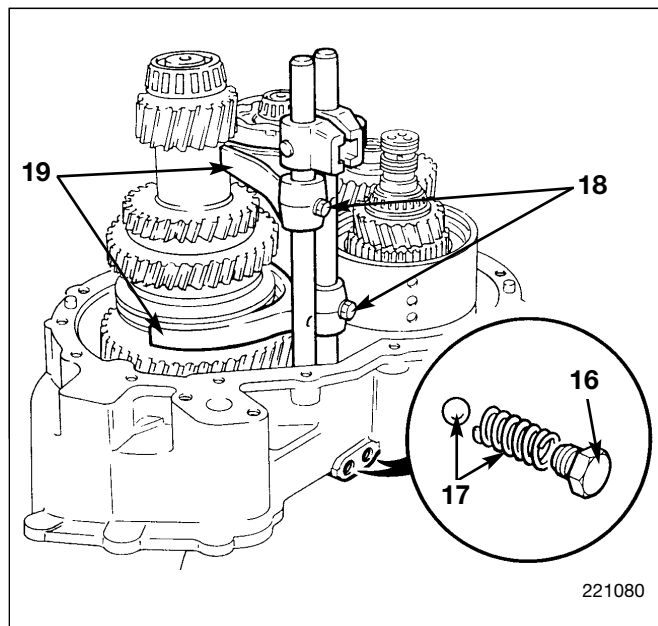


- 14 Remove the torque converter pressure relief valve ball and spring assembly **14a**. Remove the torque converter pressure regulating valve spool and spring assembly **14b**.
- 15 Unscrew bolts and lift off output end casing **15a**. Be sure to retrieve bearing outer cups from inside the casing. Keep the cups together with their associated bearing.

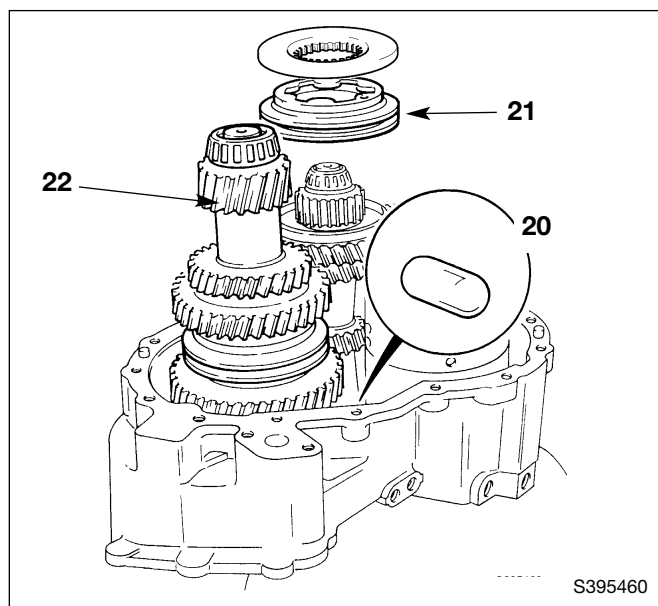


**Dismantling (cont'd)**

- 16 Unscrew selector detent plugs.
- 17 Remove selector detent balls and springs.
- 18 Unscrew selector fork retaining screws and lift out selector rods.
- 19 Note that the selector forks are not interchangeable. Mark the forks to ensure they are replaced correctly. Remove selector forks.

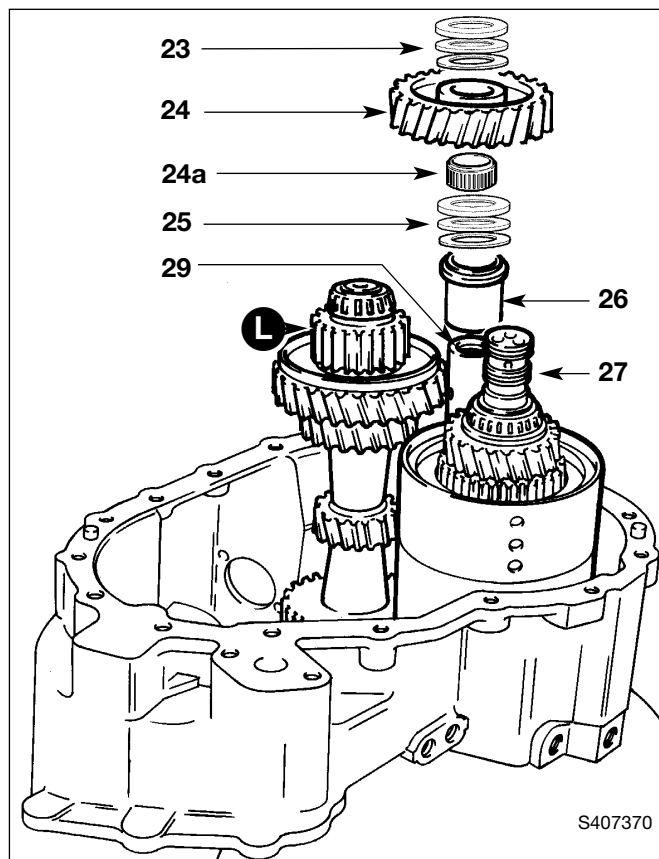


- 20 Push out the interlock plunger on disassembly.
- 21 Lift off 3rd/4th synchro-hub. Note the positions for refitting with mating cups.
- 22 Lift out layshaft assembly .

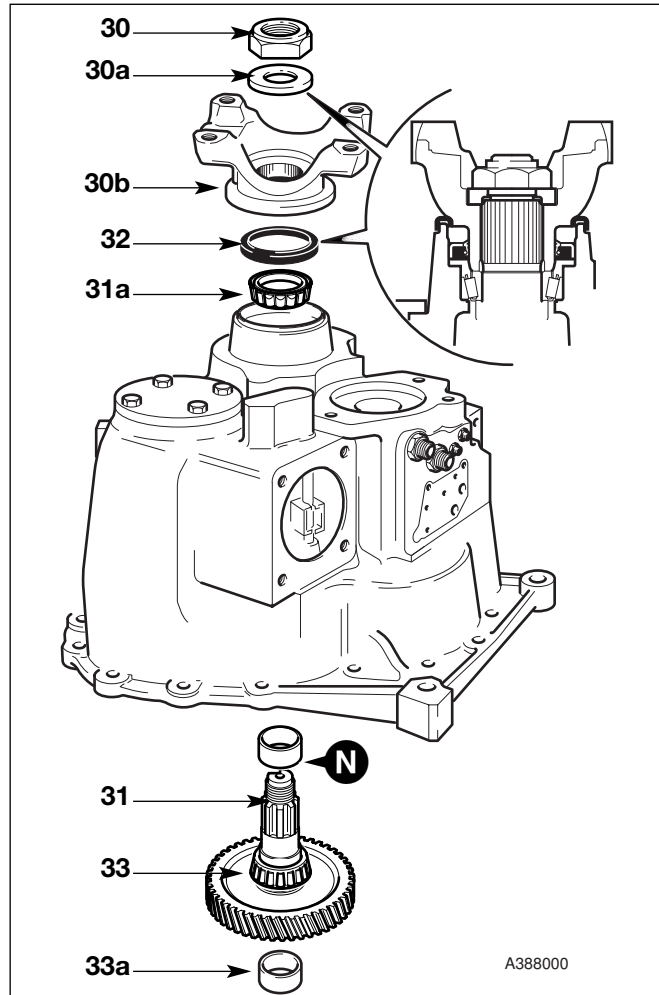


**Dismantling (cont'd)**

- 23 Remove idler gear upper thrust washers and bearing. Keep the thrust washers and bearing together.
  - 24 Tilt mainshaft **L** to one side and lift off idler gear together with its needle roller bearing **24a**.
  - 25 Remove idler gear lower thrust washers and bearing. Keep the thrust washers and bearing together.
  - 26 Lift off idler gear spacer.
  - 27 Tilt mainshaft **L** to one side and lift out the forward/reverse assembly. Discard sealing rings.
- Note:** See **2/4 Wheel Drive Clutch** for forward/reverse unit dismantling and assembly procedures.
- 28 Remove mainshaft **L**.
  - \* 29 The idler gear spindle is a press fit in the casing. Use a suitable puller screwed into the 1/2in. B.S.P. hole in the end of the spindle for extraction. Note that the spindle should only be removed if it is damaged and is required to be replaced.



- 30 Unstake the nut. Whilst holding the output yoke with service tool 892/00812, unscrew output shaft nut and remove the washer **30a** beneath. Support output shaft from beneath and lift off the yoke **30b**.
- 31 Withdraw output shaft assembly and lift out outer bearing **31a**. Remove spacer **N** and retain for assembly.
- 32 Prise out oil seal and discard.
- 33 Using a suitable puller, withdraw output shaft inner bearing. Remove the mainshaft bearing outer cup **33a** from the centre of the output shaft transfer gear.

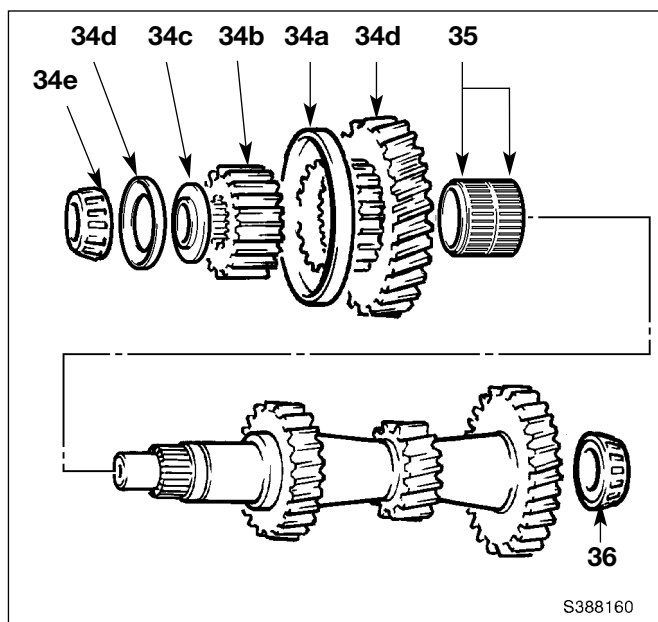




**Dismantling (cont'd)**

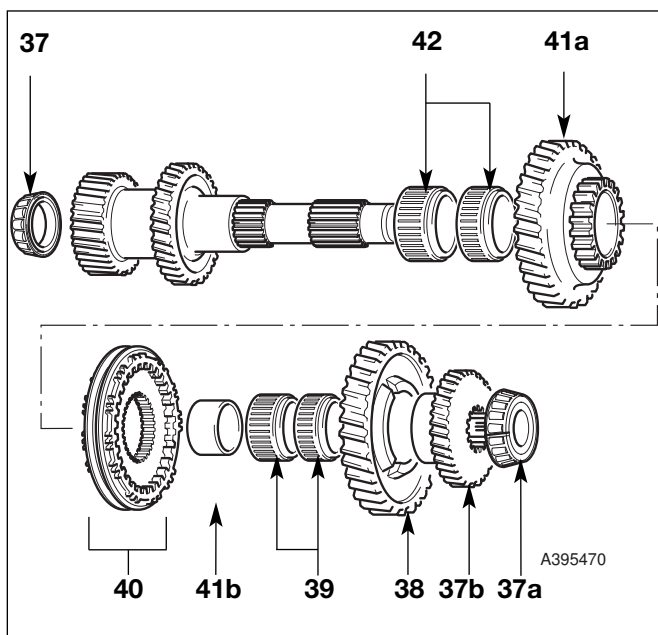
**Mainshaft**

- 34** Using service tool 892/00179 and adapter 992/06300 pull off 3rd gear together with synchro cup **34a**, gear **34b**, spacer washer **34c**, oil retention washer **34d** and bearing **34e**. Keep the synchro hubs and cups in their original relationship.
- 35** Remove needle roller bearings **35**.
- 36** Remove bearing from converter end of mainshaft using press 892/00179.



**Layshaft**

- 37** Remove the bearing **37**. Remove 4WD transfer gear **37b** and bearing **37a** from layshaft. On 2WD machines a spacer is fitted in place of the transfer gear.
- 38** Lift off 1st gear.
- 39** Remove 1st gear needle roller bearings.
- 40** Note that the 1st/2nd synchro unit **40** is of a different design to the 3rd/4th gear unit. There are components which may be lost during removal unless care is taken. Hold the unit together with the synchro cones on each side and lift off. Keep the synchro cones, rings and hubs in their original relationship.
- \* **41** Use a press to push off 2nd gear **41a**, synchro assembly **40** and 1st gear needle roller track ring **41b**.
- 42** Remove 2nd gear needle roller bearings.



## Dismantling (cont'd)

### Setting Ring Removal

The mainshaft and layshaft end float is controlled by a threaded 'setting ring' screwed into the casing.

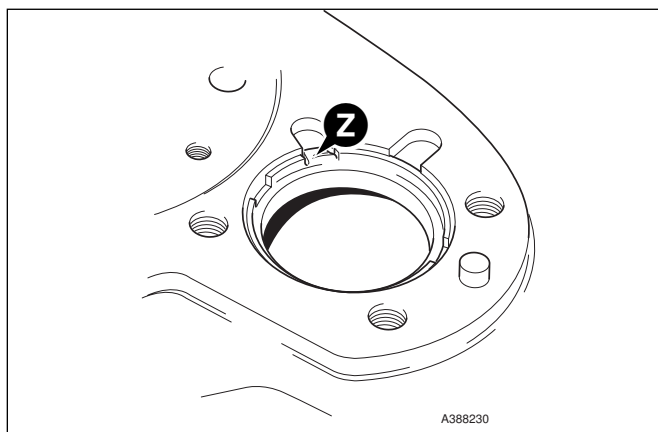
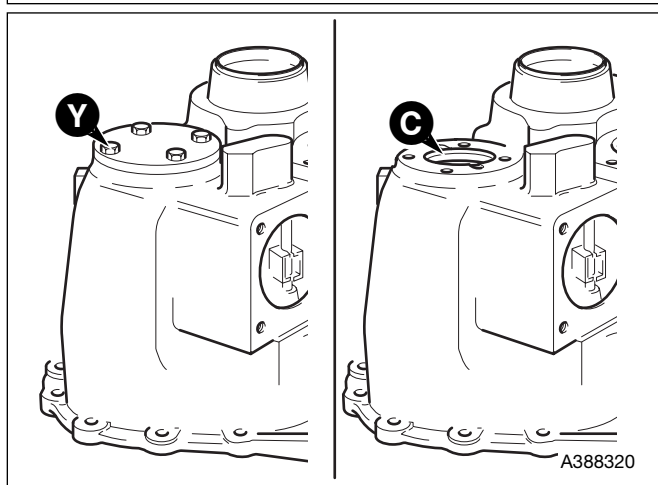
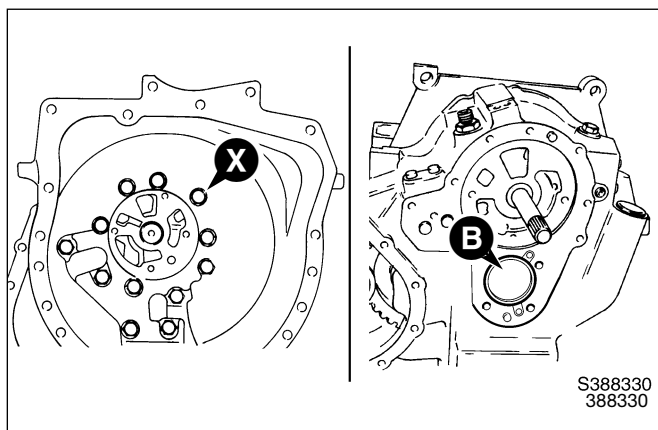
To enable access to the mainshaft setting ring the torque converter housing must be removed. Undo the 12 fixing bolts **X** and remove the housing. The setting ring is located at position **B**.

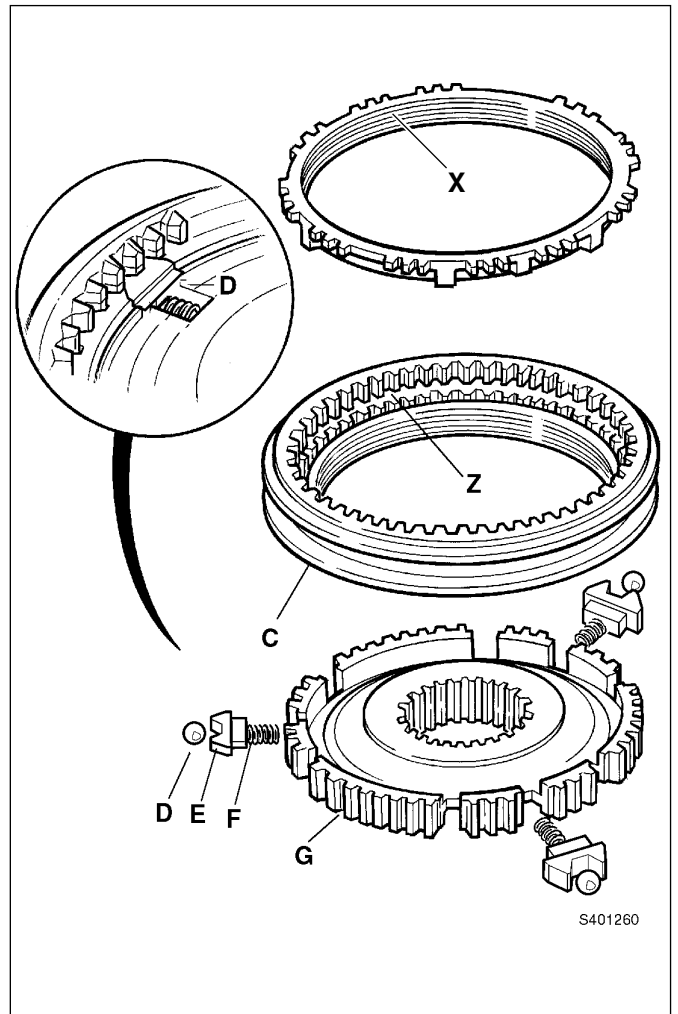
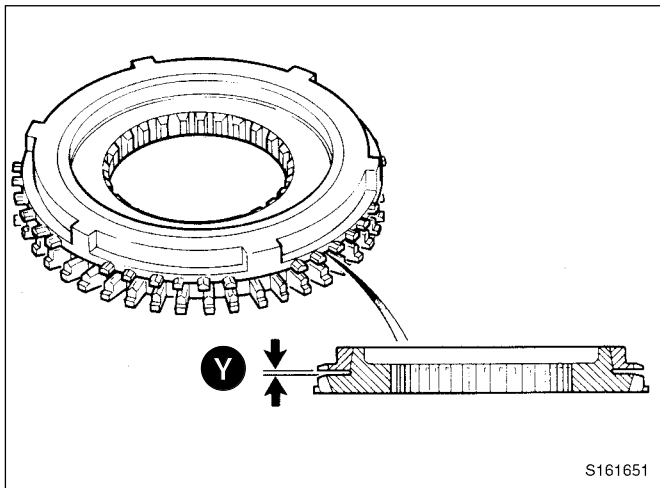
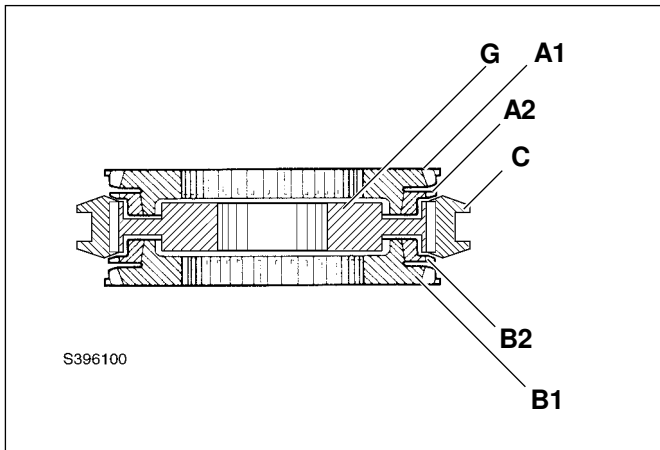
To enable access to the layshaft setting ring the bearing cover must be removed. Undo the 4 fixing bolts **Y**, remove the cover and discard the gasket beneath. The setting ring is located at position **C**.

If the bearings or shaft are to be renewed the associated setting ring must be removed and discarded as follows:

- 1 Carefully prise out the staked section of the ring **Z** clear of the casing.
- 2 Using the special socket adaptor, unscrew and discard the ring. (Use adaptor 892/01080 for the layshaft ring and 892/01079 for the mainshaft.)
- 3 Be sure to remove any shards of metal that may have fallen into the casing.

**Note:** Once removed, the setting rings must not be re-used. Discard the ring and obtain a new one. Note that the mainshaft and layshaft setting rings are not interchangeable.





## 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

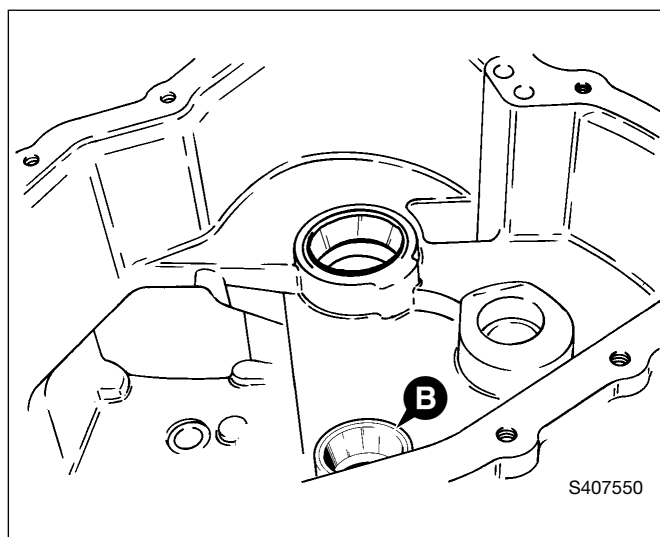
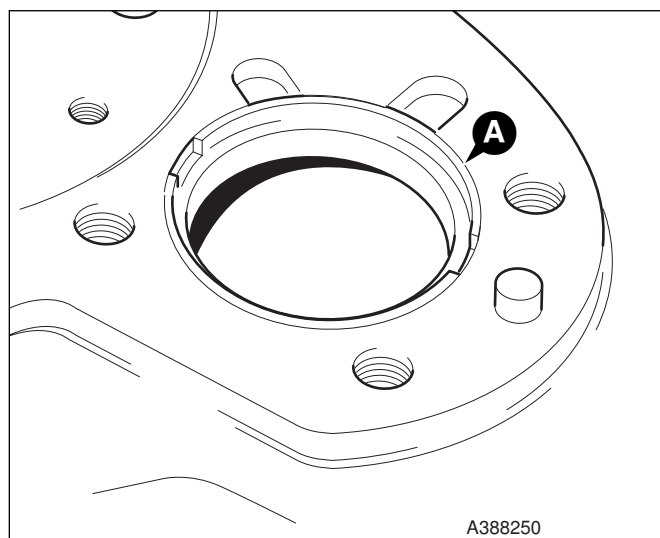
The 1st/2nd gear synchro unit must be checked for wear before assembly as follows:

- 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 outside 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

### Bearing Setting Rings

If the bearing outer cups and setting rings have been removed, fit new rings so that they are flush with the outer face of case as shown at **A**. Press in the outer bearing cups from the inside of the casing as shown at **B**. Push in the cup until it is up against the setting ring.

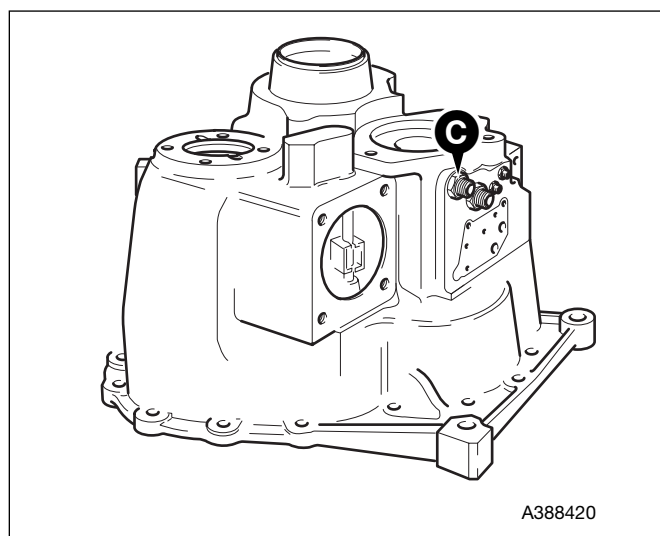


### Casings

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. Torque tighten plugs to 25 - 28 Nm (18.4 - 20 lbf ft).

Before fitting adapter **C**, be sure to fit the orifice restrictor inside the port.

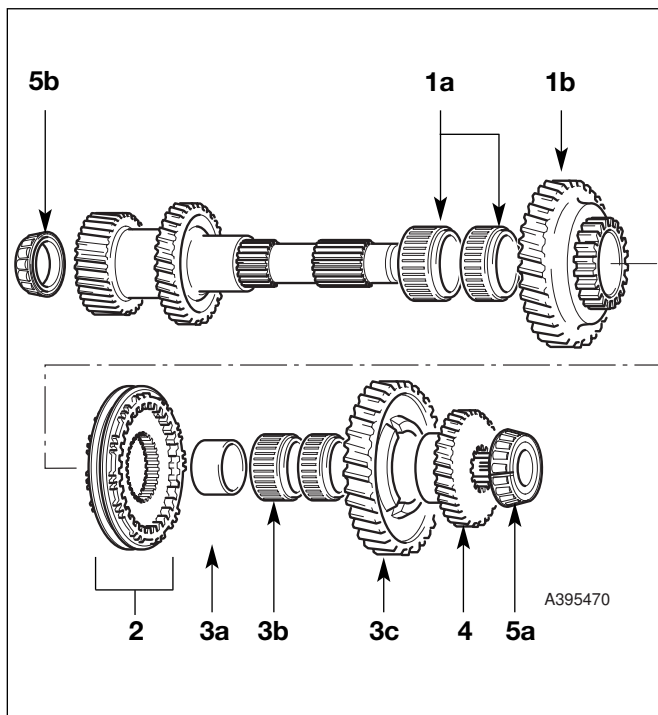


**Gearbox - Assembly (cont'd)**

If the torque converter housing has been removed, temporarily replace it. The gearbox can again be positioned standing on the face of the housing ready for assembly.

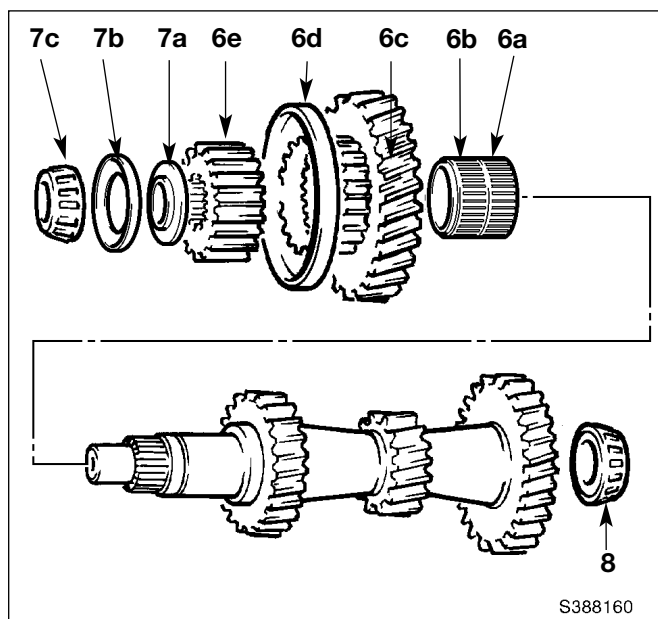
**Layshaft Assembly**

- 1 Smear bearing surface of shaft with JCB HP Grease and fit needle roller bearings **1a** (wider bearing first), followed by 2nd gear **1b**.
- \* 2 Fit the synchro assembly **2**, then press fit the bearing track **3a**.
- 3 Slide 1st gear needle roller bearings **3b** over the track. Smear bearings with oil. Fit 1st gear **3c** over needle roller bearings.
- \* 4 Assemble 4WD transfer gear **4** over splines. On 2WD machines slide spacer over splines.
- 5 Press bearing **5a** and **5b** onto the assembled layshaft. Smear the bearings with JCB HP Grease.



**Mainshaft Assembly**

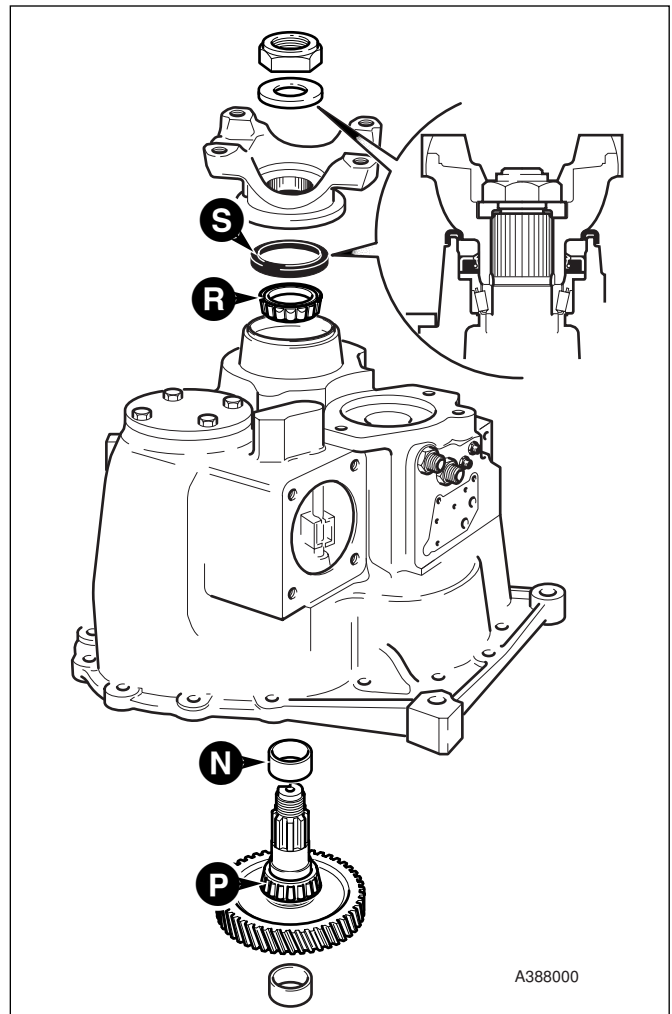
- 6 Smear bearing surface of mainshaft with JCB HP Grease. Fit the needle roller bearings **6a** and **6b**. Assemble 3rd gear **6c** and synchro-cup **6d**. Fit synchro gear **6e**.
- 7 Fit spacer washer **7a** and oil retention washer **7b**. Note the correct way round of components **7a** and **7b**. Press bearing **7c** onto shaft and smear with JCB HP Grease.
- 8 Press bearing onto assembled mainshaft and smear bearing with JCB HP Grease.



**Assembly (cont'd)****9 Transfer Gear/Output Shaft Assembly**

**Note:** Make sure that the layshaft bearing outer cup is fitted to the rear casing before fitting the transfer gear/output shaft.

- a Liberally coat output shaft inner bearing with JCB HP Grease before fitting inner bearing **P**.
- b Fit the service solid spacer **N** (13.70 mm) over output shaft and assemble into casing.
- c Lightly oil output shaft outer bearing and cup **R** and fit to output shaft, do not fit oil seal **S** at this stage.



- 10 a Fit special tool sleeve **A** which temporarily replaces the output yoke and secure with special tool nut **B**, torque tighten to 50 Nm (36.9 lbf ft).

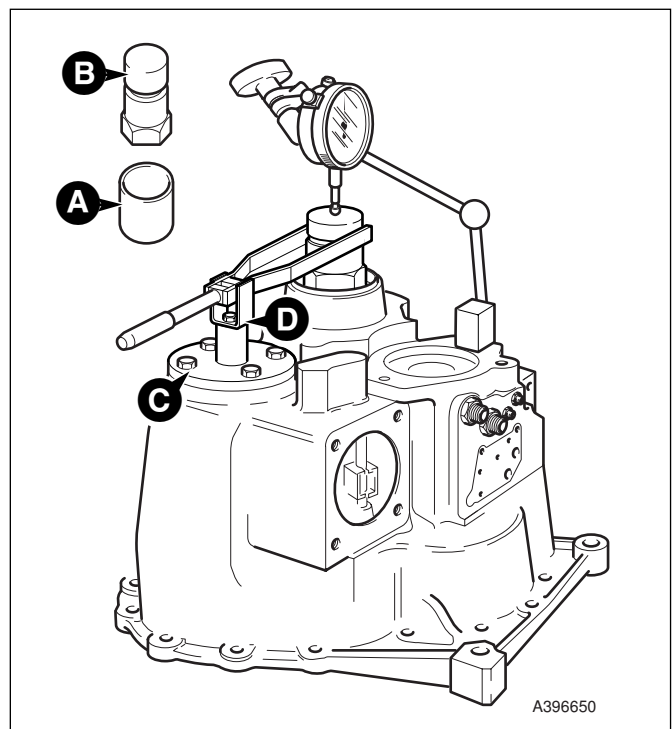
**Note:** Check for end float while tightening nut **B**, if there is no end float check:

The bearing cups are pushed fully into the casing.

The correct bearings are fitted, check parts catalogue.

The solid spacer **N** is 13.70 mm.

- b Ensure that the layshaft setting ring is slightly below layshaft cover facing on the rear case. Fit special tool support pillar **C** (892/01076) so that the fork end engages in special tool nut **B**, tighten bolt **D**.



**Assembly (cont'd)**

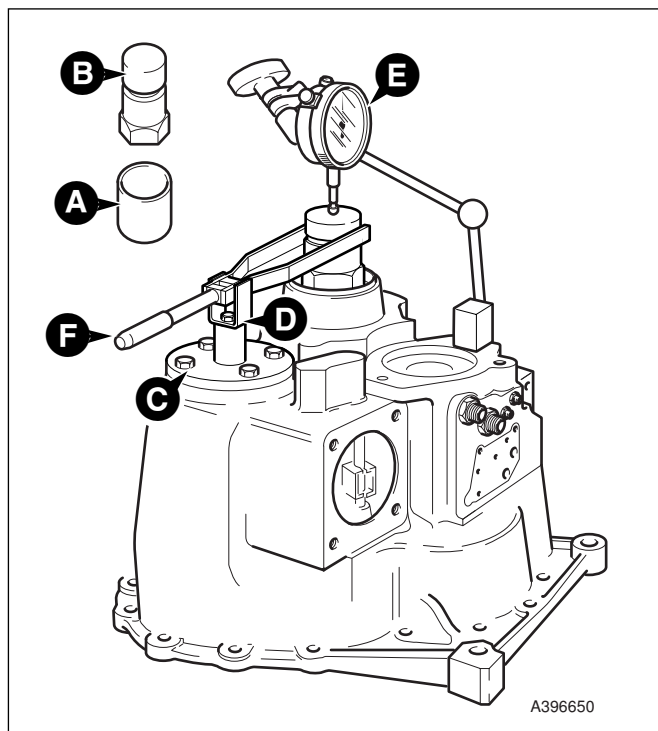
- 11 a** Fit dial test indicator **E** (DTI) .
- b** Set torque wrench **F** to 35 Nm and measure the end float while rotating the output shaft.
- c** To select the right size spacer, subtract the end float obtained at step **11b** from the solid spacer (13.70 mm). Also subtract 0.120 mm to allow for theoretical bearing tolerance and pre load. If there is no spacer of this size, fit the next smallest spacer.

**Example**

Service spacer	13.70
Subtract end float	<u>0.41</u>
<b>Total</b>	<b>13.29</b>
Subtract tolerance & preload	<u>0.12</u>
<b>Result</b>	<b>13.17</b>

Use next smallest spacer ie. **13.15**

- d** Remove special nut **B** and sleeve **A**. Remove rear bearing and 13.70 mm spacer. Fit correct size spacer (Do not fit the oil seal at this stage). Take care to avoid damaging the outer bearing.
- e** Fit sleeve **A** and initially tighten nut **B** to 50 Nm (36.9 lbf ft). Check there is no end float and rolling torque less than 1.5 Nm (1.0 lbf ft). If the rolling torque exceeds 1.5 Nm (1.0 lbf ft) check that the output shaft has been assembled correctly.
- f** If the rolling torque measured is too high, fit the next larger size spacer. If there is end float, fit the next smaller size spacer.



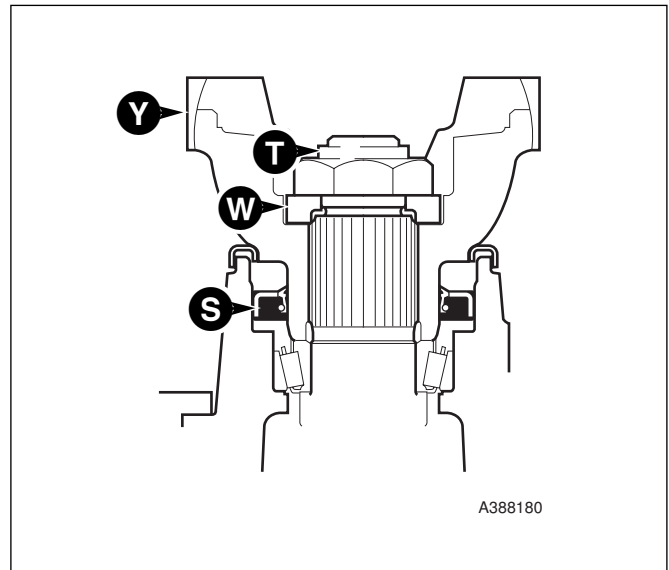


**Assembly (cont'd)**

- 12 a** Remove nut **B** and sleeve **A**. Fit new oil seal **S**, grease between seal lips before fitting. Note that the seal does not fix to the back of the housing - use service tool to locate the seal. Fit the output yoke **Y**.
- b** Fit the stepped washer **W** the correct way round with the plain face uppermost as shown.
- c** Fit NEW retaining nut **T** and progressively torque tighten to 300 Nm (221 lbf ft). Provided the correct size spacer has been selected, the rolling torque should be 2.0 Nm (1.5 lbf ft) when nut **T** is fully torque tightened.

**Note:** If the rolling torque measured is too high, fit the next larger size spacer. If the rolling torque is too low, fit the next smaller size spacer.

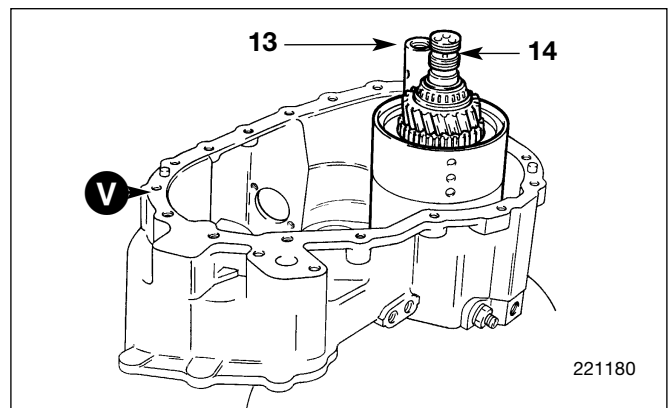
- d** Finally, carefully stake nut **T** into slot using a square-ended staking tool.



- 13** Press idler gear spindle into front casing.

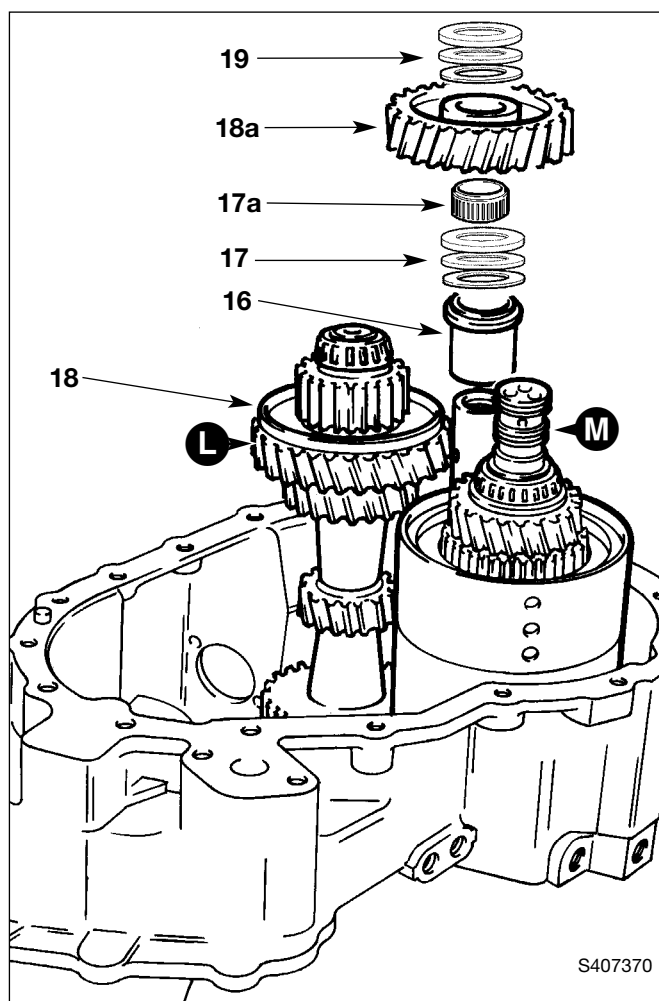
**Note:** Before proceeding further, make sure that the 3 shaft front bearing outer cups are correctly located inside the casing **V**.

- 14** Grease forward reverse shaft front bearing, then carefully lower forward/reverse unit into casing. Fit the shaft sealing rings and smear with grease.

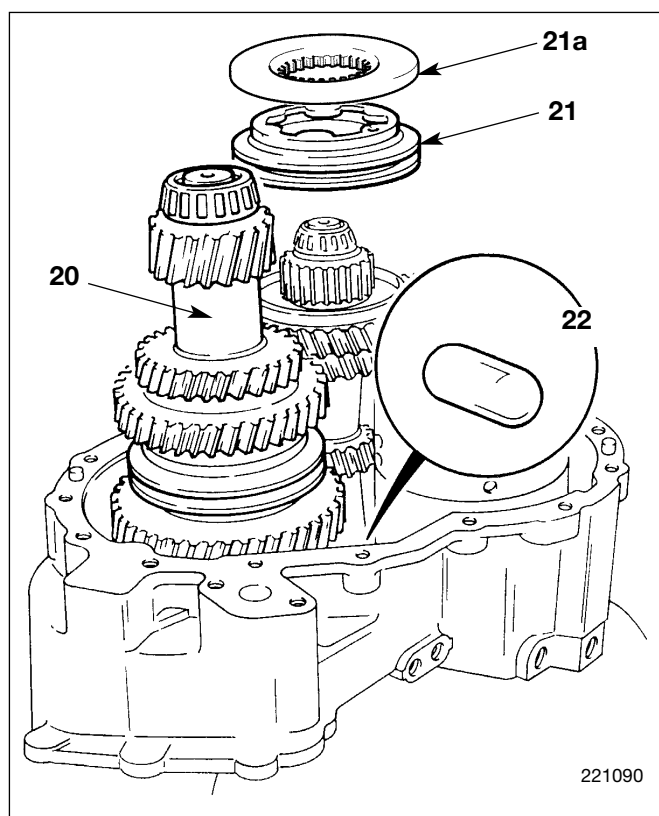


**Assembly (cont'd)**

- 15** Smear mainshaft output end bearing with JCB HP Grease and place mainshaft **L** in position, followed by the forward/reverse assembly **M**.
- 16** Fit idler gear spacer.
- \* **17** Fit thrust washers and bearing assembly. Lubricate and fit the needle roller bearing **17a**.
- 18** Fit synchro cone to 3rd gear (mainshaft **L**). Fit the idler gear **18a** to the spindle whilst tilting mainshaft **L** to one side.
- \* **19** Fit thrust washers and bearing assembly.

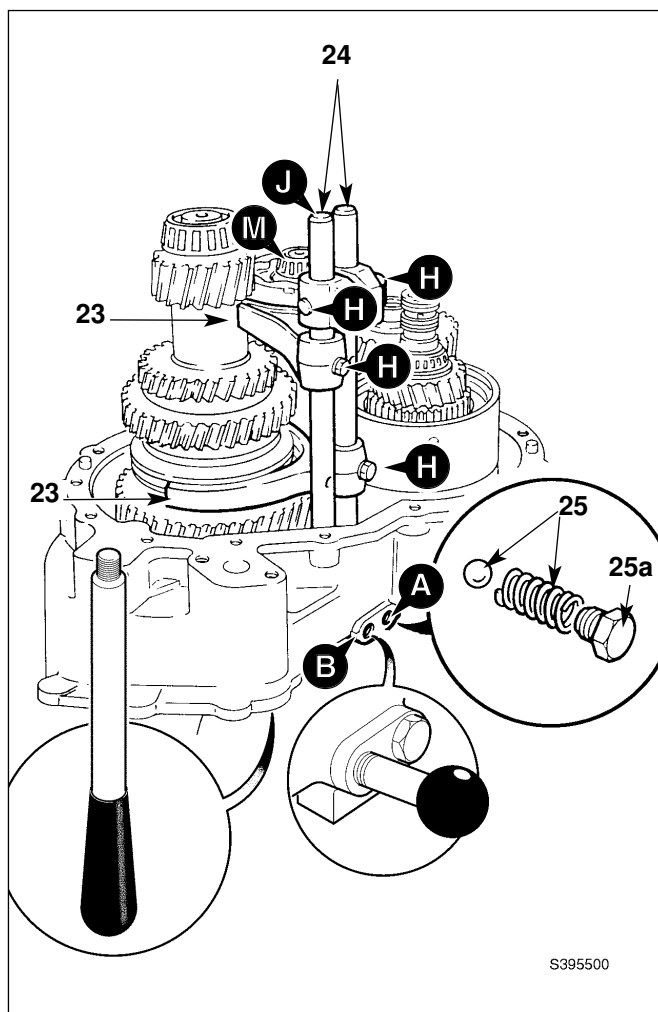


- 20** Smear front end bearing of layshaft with JCB HP Grease, and carefully lower layshaft into position.
- 21** If re-using synchro assembly fit the parts in their original positions.
- 22** Using a suitable wire support locate interlock plunger into its bore. A smear of grease will hold the plunger in position. If required, access is available via a  $\frac{1}{4}$  BSP side drilling.



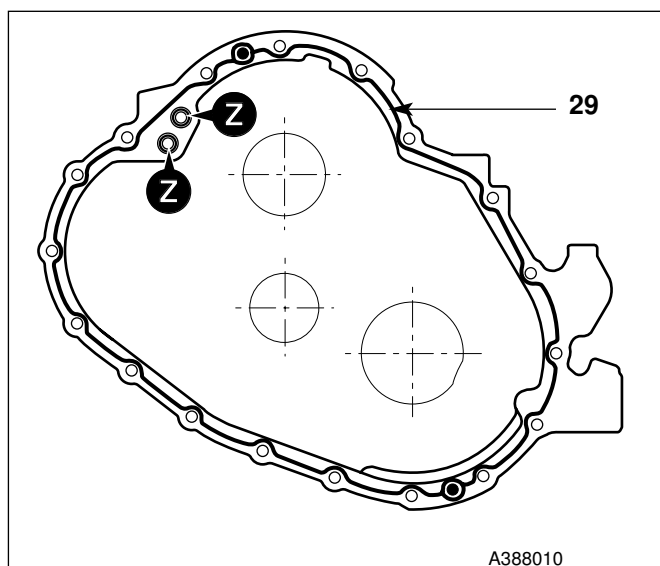
**Assembly (cont'd)**

- 23** Fit selector forks into position.
- 24** Slide selector rods into position, taking care not to dislodge the interlock plunger. Apply JCB Threadlocker and Sealer to selector fork retaining screws **H**, and tighten to 35 Nm (26 lbf ft).
- 25** Fit 1st gear selector detent ball and spring at position **A**. Apply JCB Threadlocker and Sealer to the detent plug **25a**, screw in and tighten.
- 26** Temporarily fit the 3rd and 4th gear selector detent assembly at position **B**, do not apply sealant to the plug at this stage.
- 27** Check that each gear engages fully, and that the interlock plunger prevents simultaneous engagement of 2 ratios.
- 28** Remove the 3rd and 4th gear selector detent assembly from position **B**. Lift the selector rod **J** to select 4th gear. With 4th gear selected, temporarily lock the rod in position by screwing in service tool 892/01077 at **B**. Temporarily fit service tool 892/01078 to the torque converter end of mainshaft **M**. If the tool is not available a suitable M8 bolt approximately 100 mm long can be used.



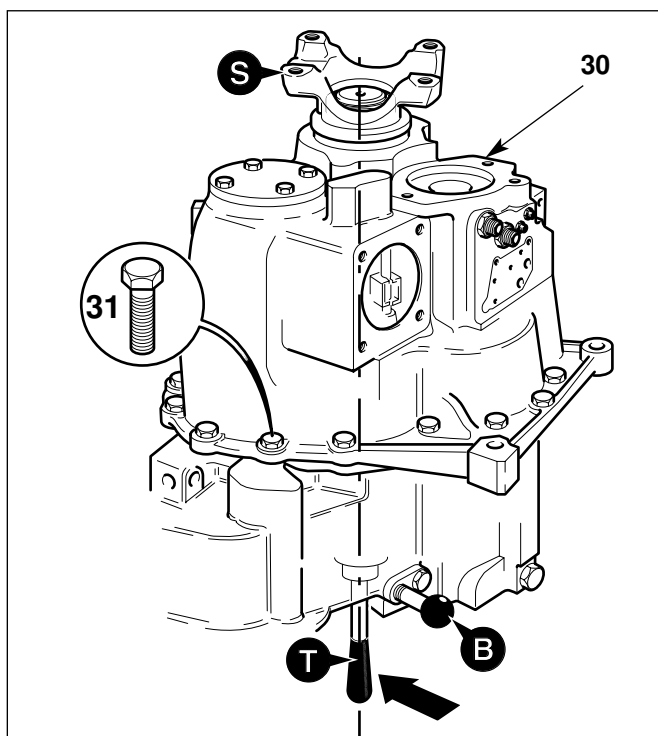
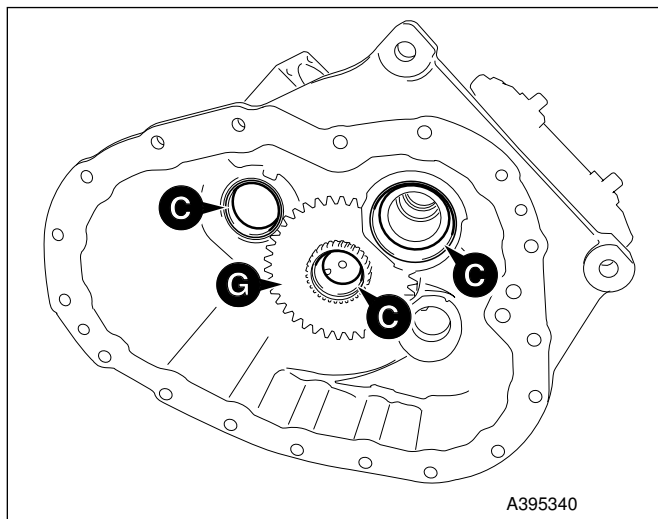
- 29** Apply a bead of JCB Multigasket to mating face of casing. Insert 'O' rings **Z**. Smear grease onto reverser shaft ring seals, and apply JCB HP Grease to bearings prior to fitting output end casing.

**Note:** Make sure that the forward/reverse shaft ring seals are in good condition before fitting output end casing.



**Assembly (cont'd)**

- 30** Make sure that the 3 bearing outer cups **C** are correctly located; note that 2 cups locate inside the casing and 1 locates in the centre of the output shaft transfer gear **G**. Carefully lower rear casing into position. Note that the forward/reverse unit shaft engages with the casing first, followed by 3rd/4th gear selector rod. To ensure that the mainshaft locates with the output shaft it will be necessary to push on tool **T** to keep the shaft correctly aligned. Rotate the output shaft **S** back and forth to engage the gears on the layshaft. Do not use excessive force when fitting the casing.
- 31** Apply JCB Threadlocker and Sealer to bolts and torque to 56 Nm (42 lbf ft).
- 32** Remove service tool at position **B**. Fit the detent ball and spring. Apply JCB Threadlocker and Sealer to selector detent plug, install and tighten.



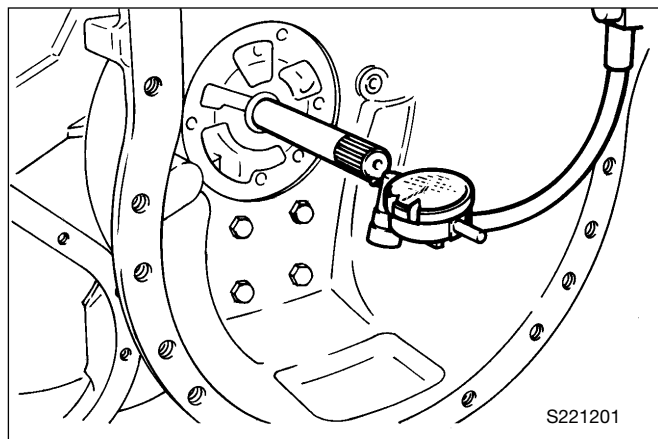
**Assembly (cont'd)****33 End Float Checking - Forward/Reverse Unit**

Measure end float of forward/reverse unit shaft which should be 0.01 to 0.16 mm (0.0004 to 0.006 in).

**Note:** Rotate shaft whilst measuring to seat bearings fully. Position pointer of dial test indicator (DTI) on the chamfer of the shaft, not the end face. This will ensure a constant reading is given.

The forward/reverse shaft and its associated components are manufactured using a 'Setright' system. Provided components are assembled correctly the end float will be within the limits given above.

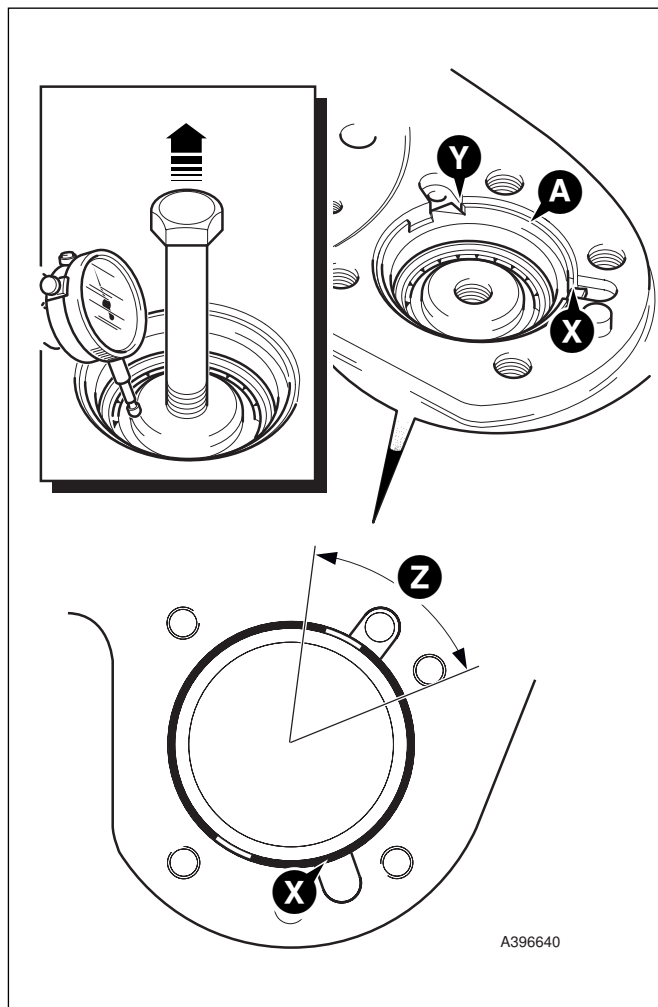
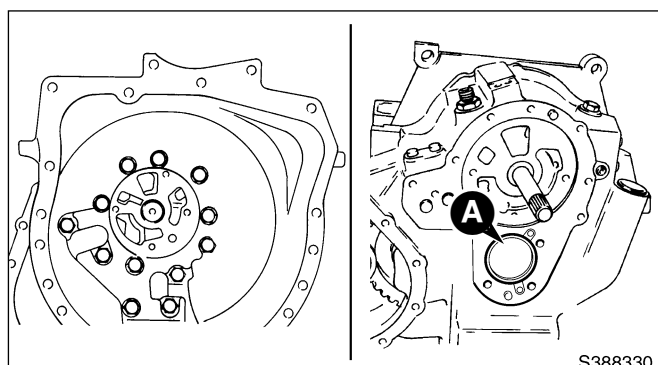
If there is no float, or too much end float, separate the casings and check that the bearings inner and outer cups are fitted correctly. If the forward/reverse shaft and clutch assemblies have been dismantled check that the assembly has been carried out correctly.

**34 End Float Setting - Mainshaft**

If the mainshaft, output shaft and/or associated bearings have been renewed, the shaft end float must be reset.

- Remove the torque converter housing and position the gearbox to gain access to setting ring **A**.
- Using service tool 892/01079 tighten the setting ring 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.
- 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.
- When the correct setting has been obtained, stake the setting ring to the casing as shown at **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 position **Y**, stake at position **X** instead. In this event the ring must also be folded on one side at position **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.



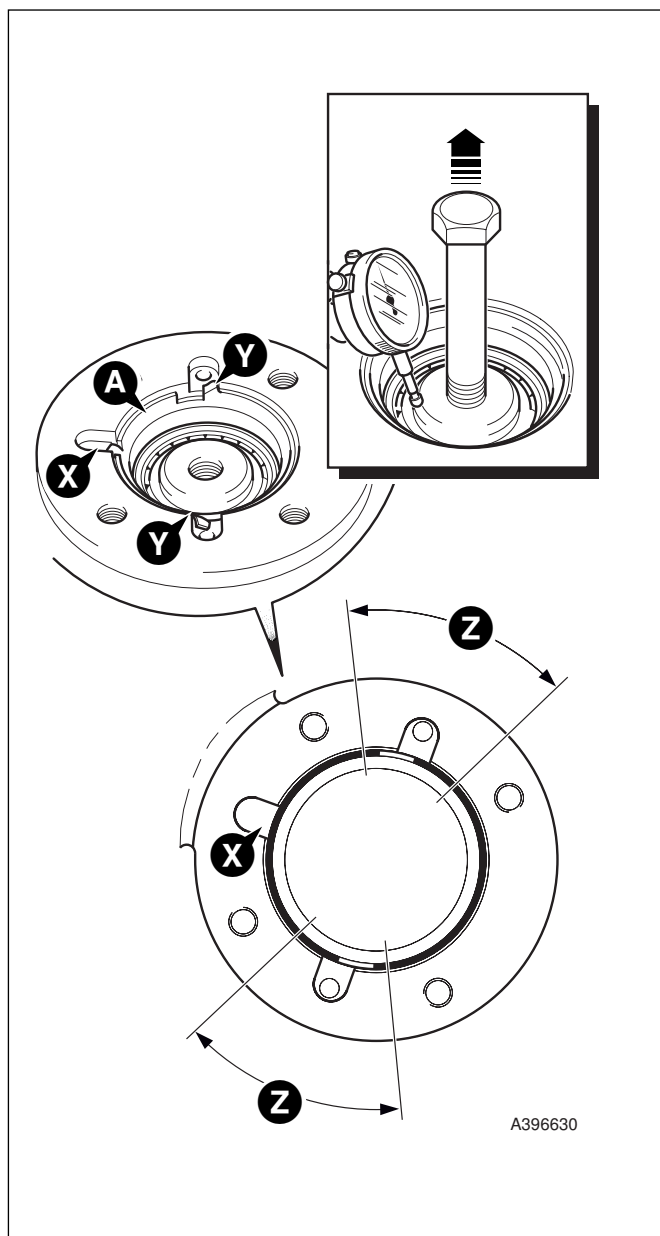
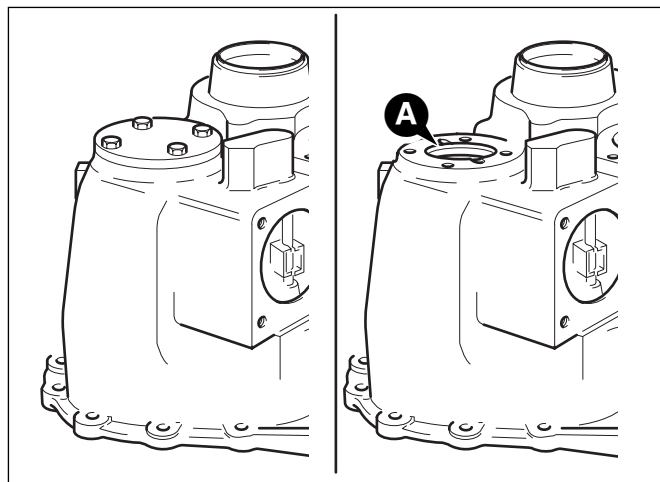
**Assembly (cont'd)****35 End Float Setting - Layshaft**

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.

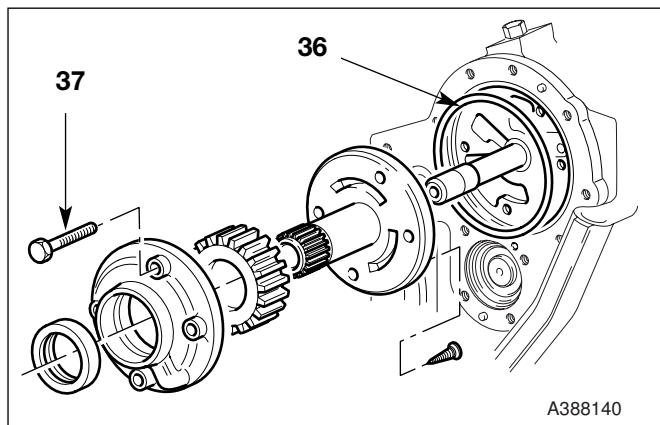
- e Using a new gasket, refit the layshaft bearing cover. Apply JCB Threadlocker and Sealer to the fixing bolts and tighten to 56 Nm (42 lbf ft).



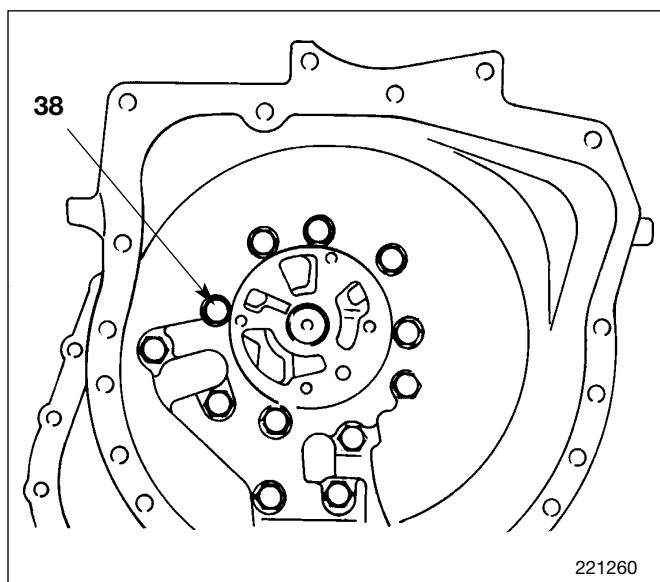
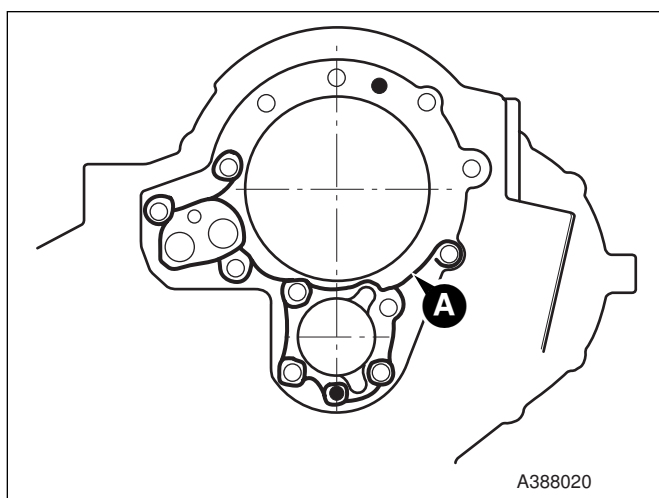
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**Assembly (cont'd)**

- 36** Place new pump sealing ring in position. Make sure that the charge pump drain hole is clear before fitting a new oil seal to the pump housing.
- 37** Install pump taking care to align mounting holes. Apply JCB Threadlocker and Sealer to bolts and, using new sealing washers, tighten to 28 Nm (21 lbf ft).



- 38** Apply a bead of JCB Multigasket to the mating face of the gearbox cover as shown at **A**. Refit the torque converter housing. Apply JCB Threadlocker and Sealer to the 12 bolts and tighten to 56 Nm (42 lbf ft).



**Assembly (cont'd)**

**39** Fit torque converter pressure relief valve assembly **39a**; Fit the valve ball and spring. Ensure that larger diameter of spring is located securely over the spigot on the plug. Use a new sealing washer, apply JCB Threadlocker and Sealer to the plug, then tighten. Fit the torque converter pressure regulating valve assembly **39b**; Fit the spool and spring. Apply JCB Threadlocker and Sealer to the plug, then tighten.

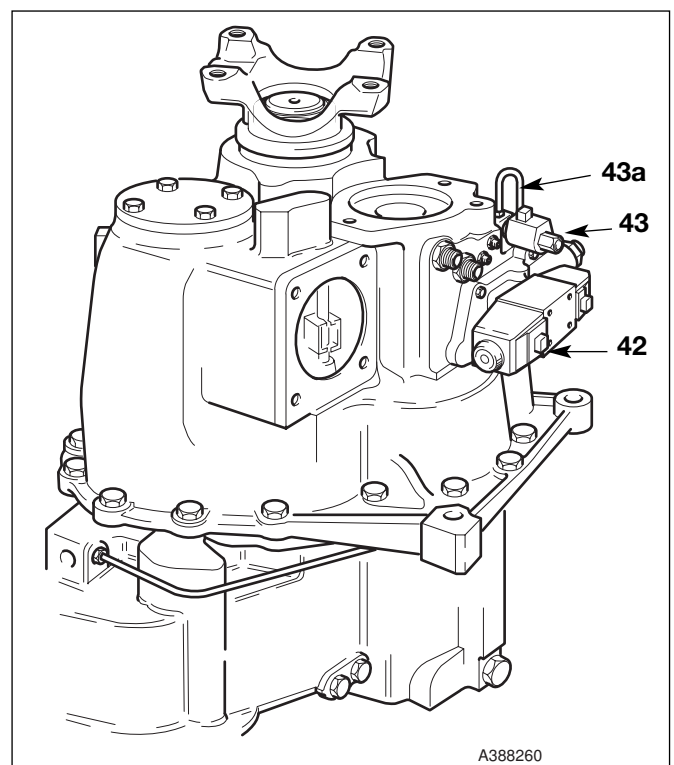
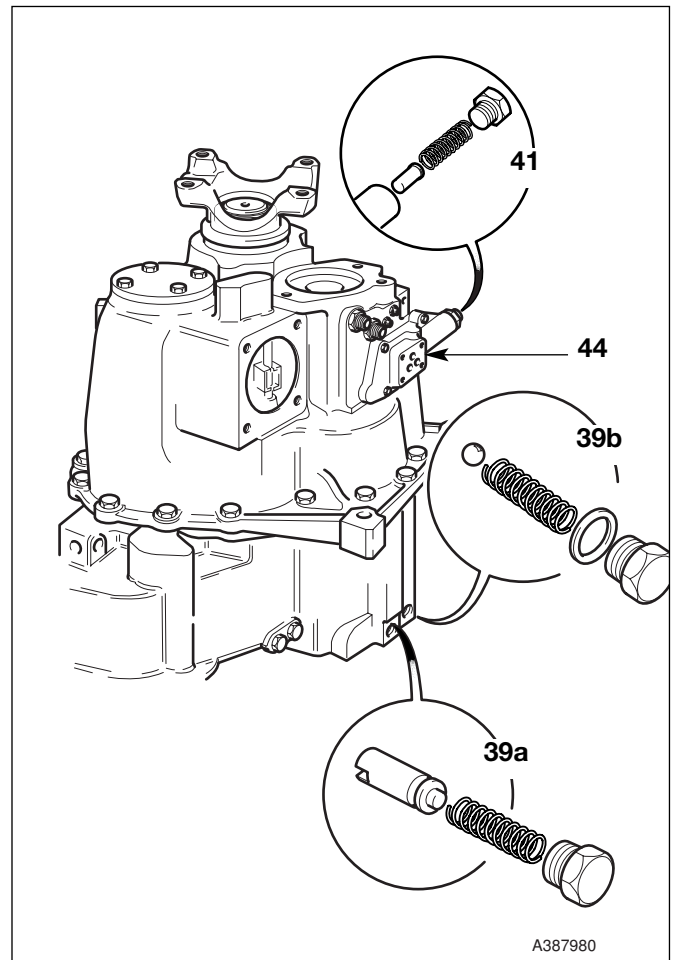
**40** Using a new gasket mount pressure maintenance valve onto casing. Apply JCB Threadlocker and Sealer to bolts and tighten to 10 Nm (7.4 lbf ft).

**Note:** To avoid contamination of sealant printed on gasket face keep in protective wrapper until needed.

**41** Assemble pressure maintenance valve spool and spring into adaptor block. Apply JCB Threadlocker and Sealer to plug, fit and tighten. **Do not overtighten** as damage to the aluminium housing could result.

**42** Fit new 'O' rings around ports on mating face of solenoid valve. Mount solenoid valve onto pressure maintenance valve, ensuring that port 'P' aligns with metering orifice in the pressure maintenance valve body. Apply JCB Threadlocker and Sealer to capscrews and tighten to 5Nm (3.7 lbf ft).

**43** Fit the 4 wheel drive solenoid valve. Fit the hydraulic pipe **43a**.

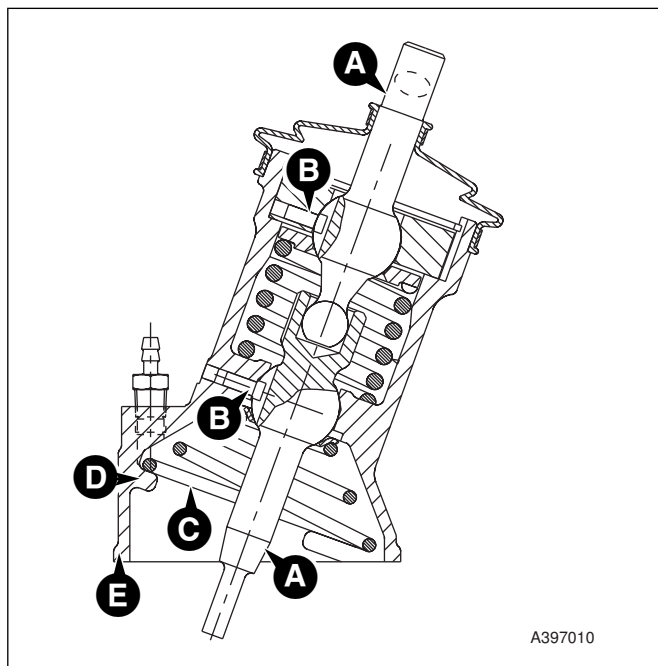




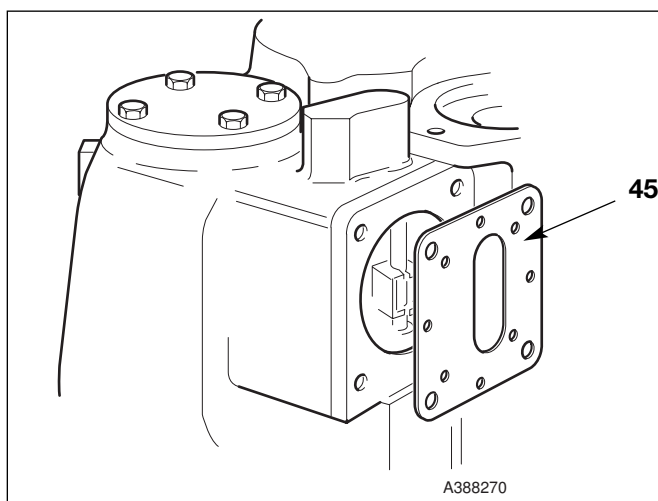
**Assembly (cont'd)**

**44** If the gear lever turret assembly has been dismantled, apply grease liberally to the working surfaces before assembling. Assembly is the reverse of the procedure detailed in **Gearbox - Dismantling**, Step 1, but note the following:

- \* **a** Be sure to locate the slots in the levers **A** with the pegs **B** in the housing **E**.
- b** After fitting spring **C**, rotate it so that the end of the bottom coil butts with the the spigot **D** in the housing **E**.

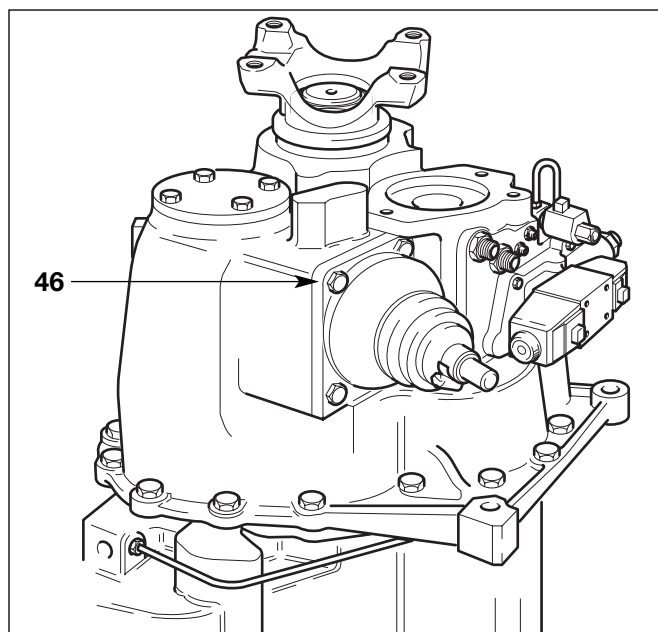


**45** Locate a new gasket (not shown) on the casing followed by the gear lever turret baffle plate. Make sure the plate is the correct way round.



**46** Locate a second gasket and then fit the turret assembly.

Apply JCB Threadlocker and Sealer to mounting bolts and tighten to 56 Nm (42 lbf ft). Check for gear selection.



**Assembly (cont'd)**

**Note:** It is recommended that a 75 micron (0.075mm) service suction strainer (892/00970) is fitted to clean the system after a major overhaul.

Remove the service strainer and fit a production strainer after the first 100 hours operation. Renew the oil.

**47** Using a new gasket, install suction strainer. Apply JCB Threadlocker and Sealer to bolts and tighten to 10 Nm (7 lbf ft).

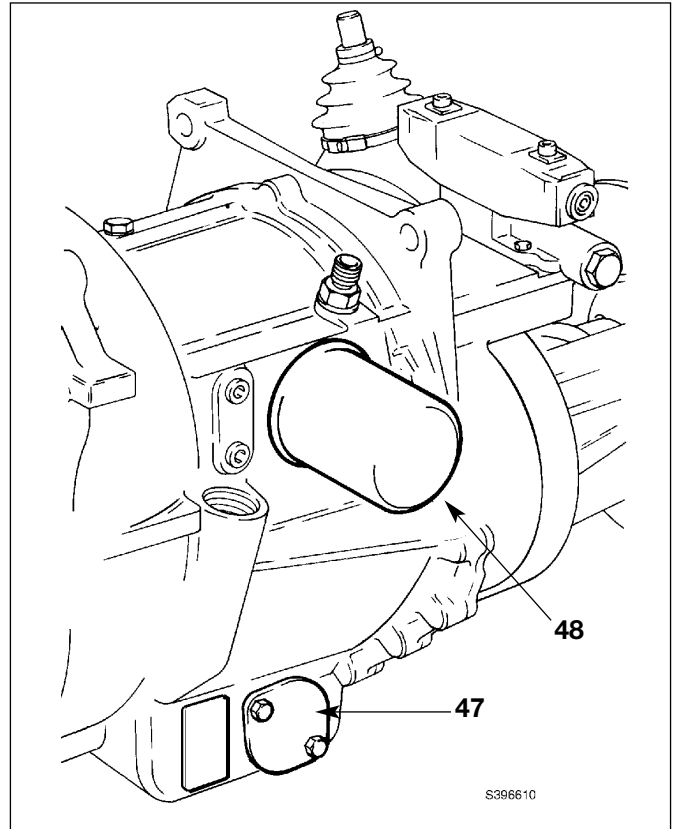
**48** Fit a new filter:

- a Smear seal with transmission oil.
- b Screw the filter on until it just contacts the filter head.
- c Turn the filter at least another 3/4 of a turn.

**49** Install dipstick/oil filler tube (not shown) as follows:

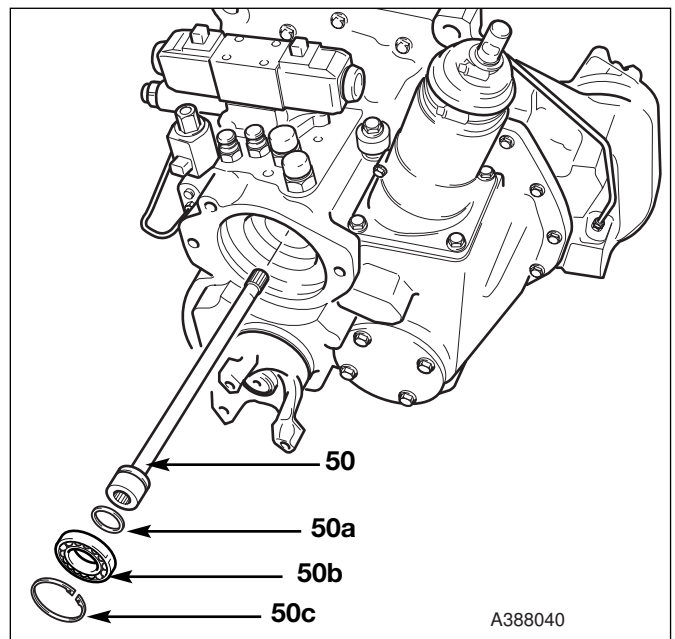
- a Fit nut to tube followed by seal.
- b Insert tube fully down bore in casing. Engage nut and tighten down loosely onto seal.
- c Tighten nut fully after tube has been correctly phased.

See **2/4 Wheel Drive Clutch** for hydraulic 4WD dismantling and assembly procedures.



**50** Fit a new sealing ring **50a** to the pump drive shaft. Insert the pump drive shaft followed by bearing **50b** and circlip **50c**.

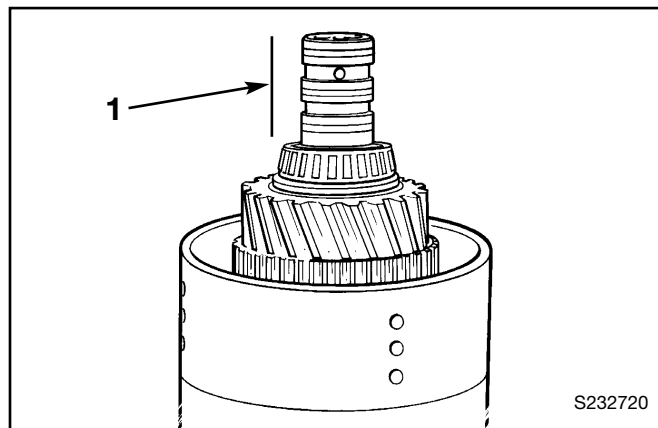
**Note:** The main hydraulic pump may be fitted at this stage, or, after the gearbox has been refitted to the machine.



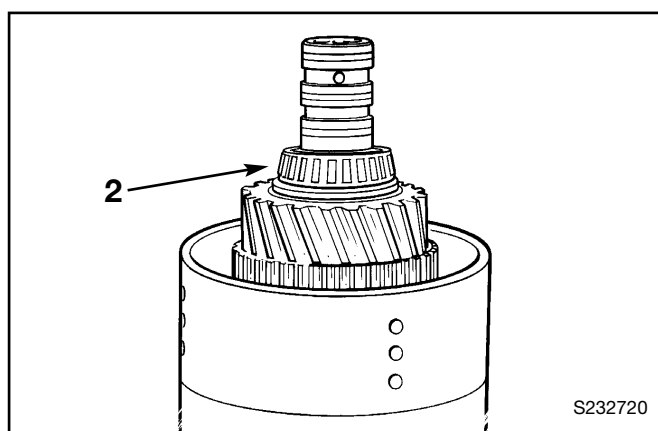
## Reverser Unit - Dismantling

- 1 Carefully remove piston ring seals.

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

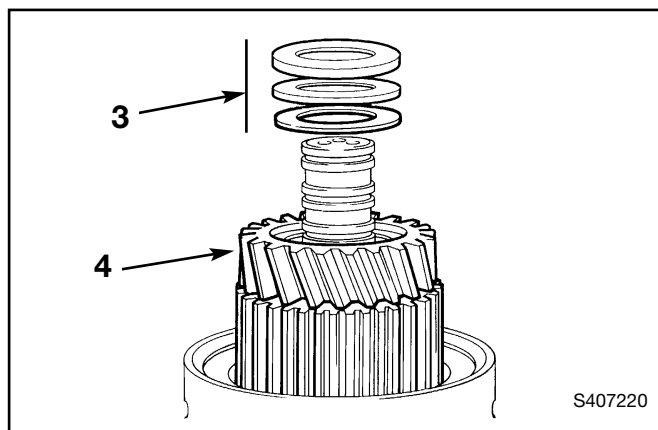


- \* 2 Remove the taper bearing using pullers.



- \* 3 Remove the thrust bearing and thrust washers.

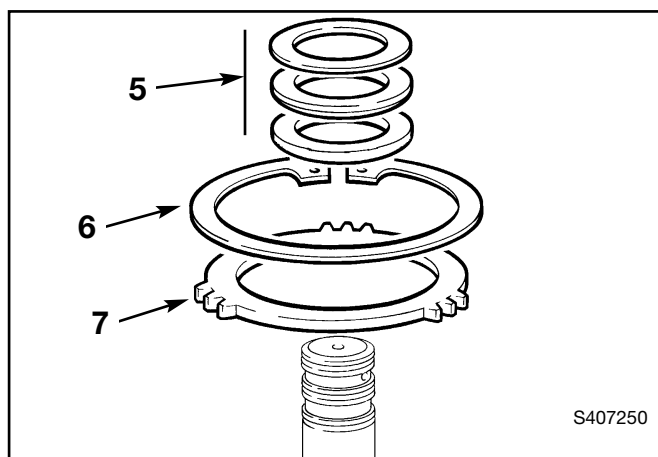
- \* 4 Withdraw the gear and splined hub assembly 4 with the needle roller bearing and spacer. Note the location of the spacer to ensure it is returned to its original position on re-assembly.



- \* 5 Remove the thrust bearing and thrust washers.

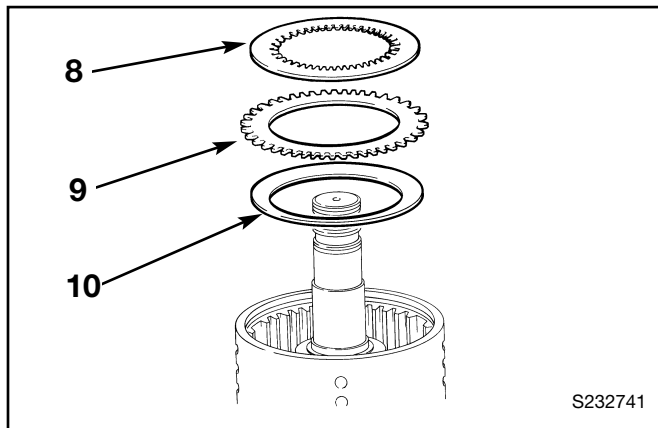
- 6 Remove the clutch friction/counter plates retaining circlip.

- 7 Remove pressure (end) plate.

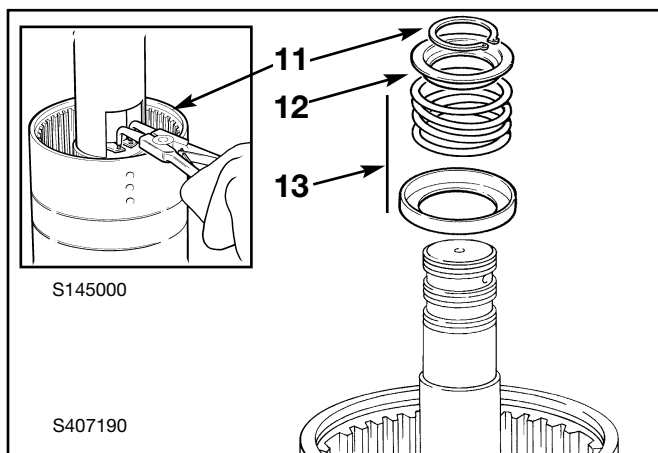


**Reverser Unit - Dismantling (cont'd)**

- 8 Remove the clutch friction/counter plates. Keep them together in sets, DO NOT mix the plates with those from other clutches.
- 9 Remove last counter plate.
- \* 10 Remove disc spring.

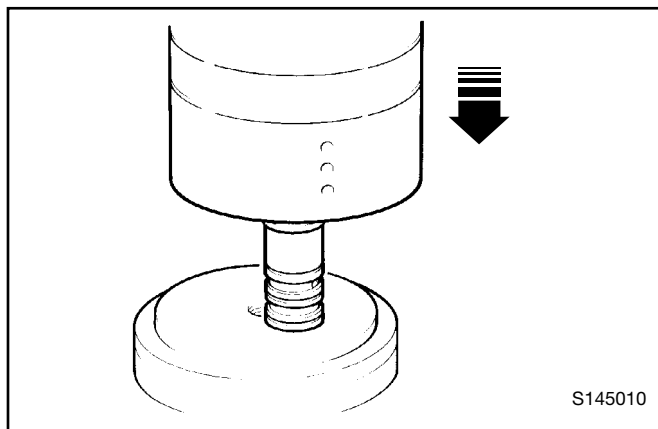


- 11 Position clutch assembly in press to compress piston spring then remove circlip.
- 12 Lift off spring retaining plate.
- \* 13 Remove spring and oil baffle.

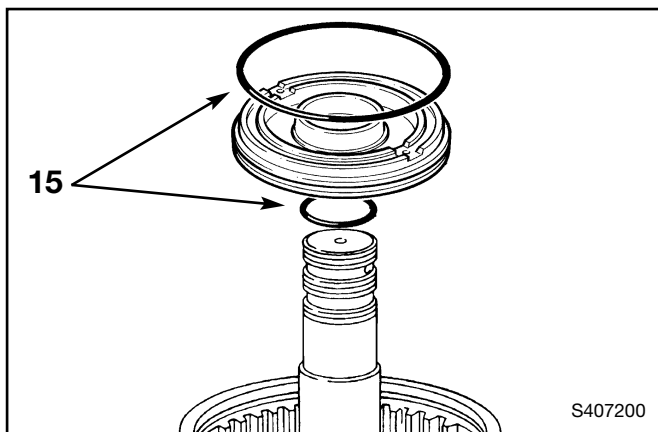


- 14 Knock the clutch shaft on a piece of aluminium (or wood) to remove the piston.

**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.

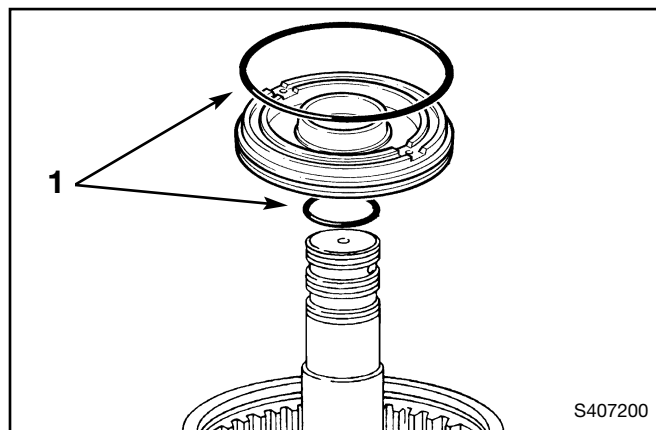


- \* 15 Remove and discard piston and shaft 'O' rings.
- \* 16 Repeat steps 2 to 15 to dismantle the opposite clutch. Note that a spacer is not fitted on the opposite (Forward) clutch. Refer to step 4.

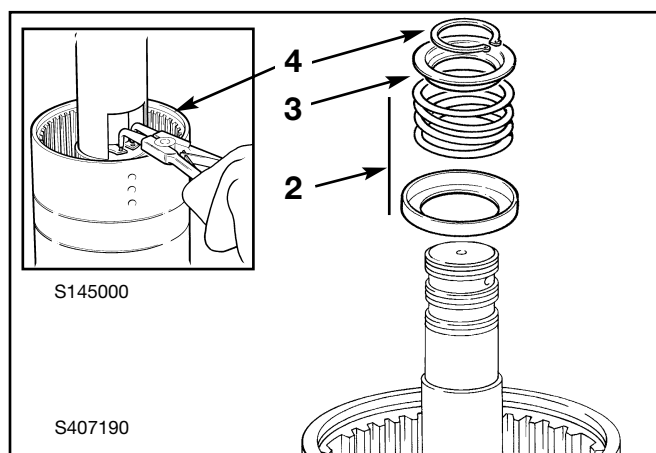


**Reverser Unit - Assembly**

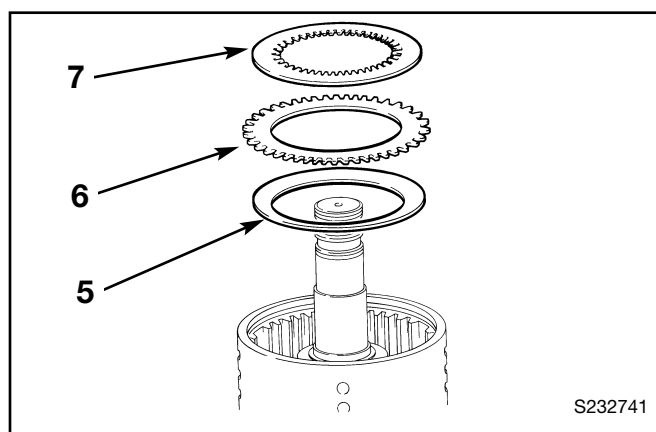
- 1 Fit new 'O' rings onto the piston and shaft, lubricate with oil then press piston fully into bore of clutch housing.



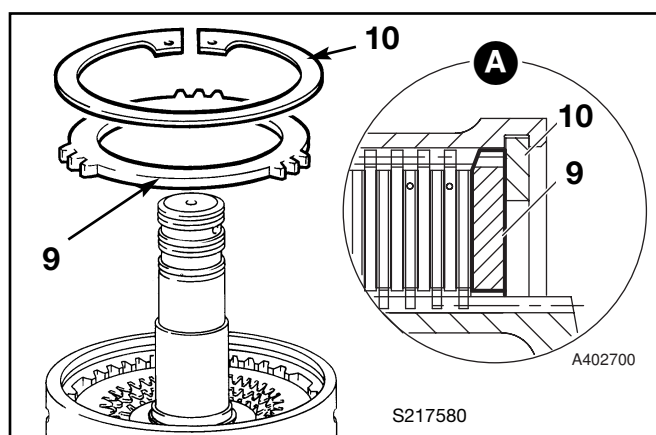
- \* 2 Install the oil baffle and piston spring, make sure the spring seats in the piston.
- 3 Fit the spring retaining plate.
- 4 Compress spring and secure with circlip.



- 5 Fit the disc spring assembly. Fit the assembly so that the outer diameter curves away from the clutch piston.
- 6 Firstly, fit one counter plate.
- 7 Fit one friction plate followed by one steel counter plate.
- 8 Continue fitting alternate friction and plain steel plates, finishing with a friction plate.



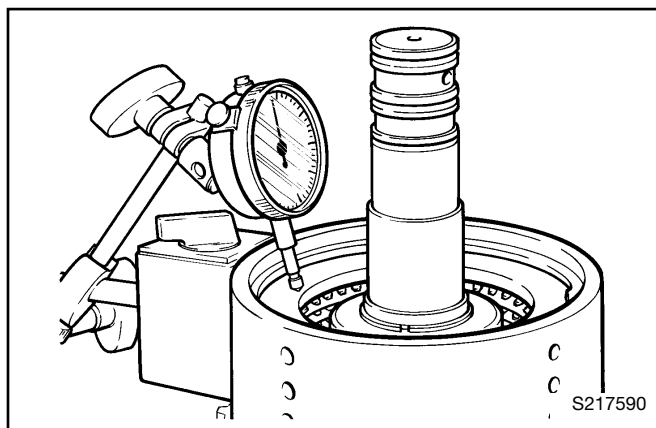
- 9 Fit the pressure (end) plate. Make sure that the chamfered face is fitted facing the clutch pack as shown at **A**. Make sure that the prongs on the pressure plate DO NOT locate in the large grooves in the hub (the ones with drilled holes).
- \* 10 Fit the clutch friction/counter plates retaining circlip. Using an air line, blow air down the shaft oil inlet hole and check the piston and clutch pack is free to operate smoothly.



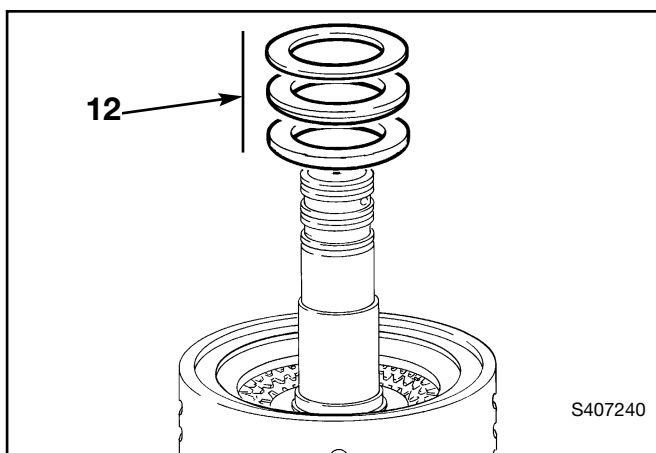
**Reverser Unit - Assembly (cont'd)**

- 11 Using a dial test indicator as shown, measure the end float of the pressure (end) plate, which should be 3.2 to 4.4 mm (0.126 to 0.173 in). If necessary, fit shim between the retaining circlip and pressure (end) plate to correct end float inaccuracies.

\*



- 12 Fit the thrust bearing and thrust washers.



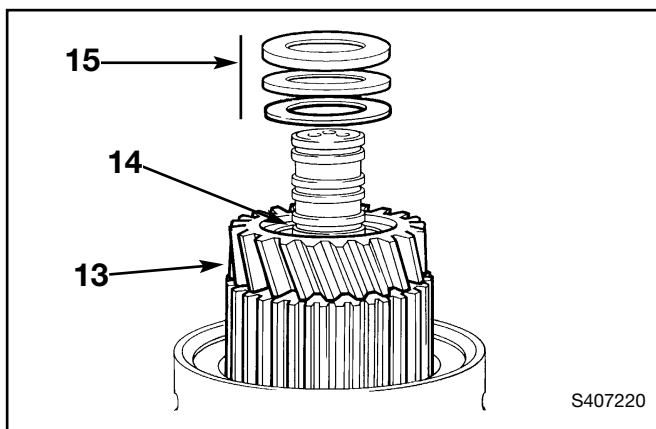
- 13 Fit gear and splined hub assembly.

**Note:** Prior to fitting gear, align teeth of clutch plates using a thin rod (screwdriver).

- \* 14 Fit the spacer followed by the needle roller bearing.

\* **Note:** Ensure that the spacer is fitted first.

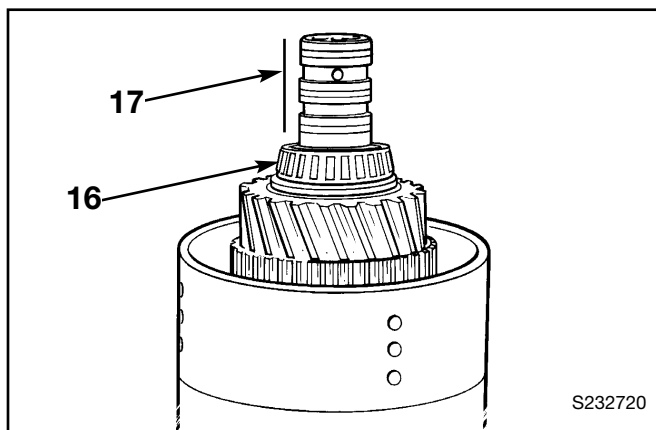
- \* 15 Fit the thrust bearing and thrust washers.



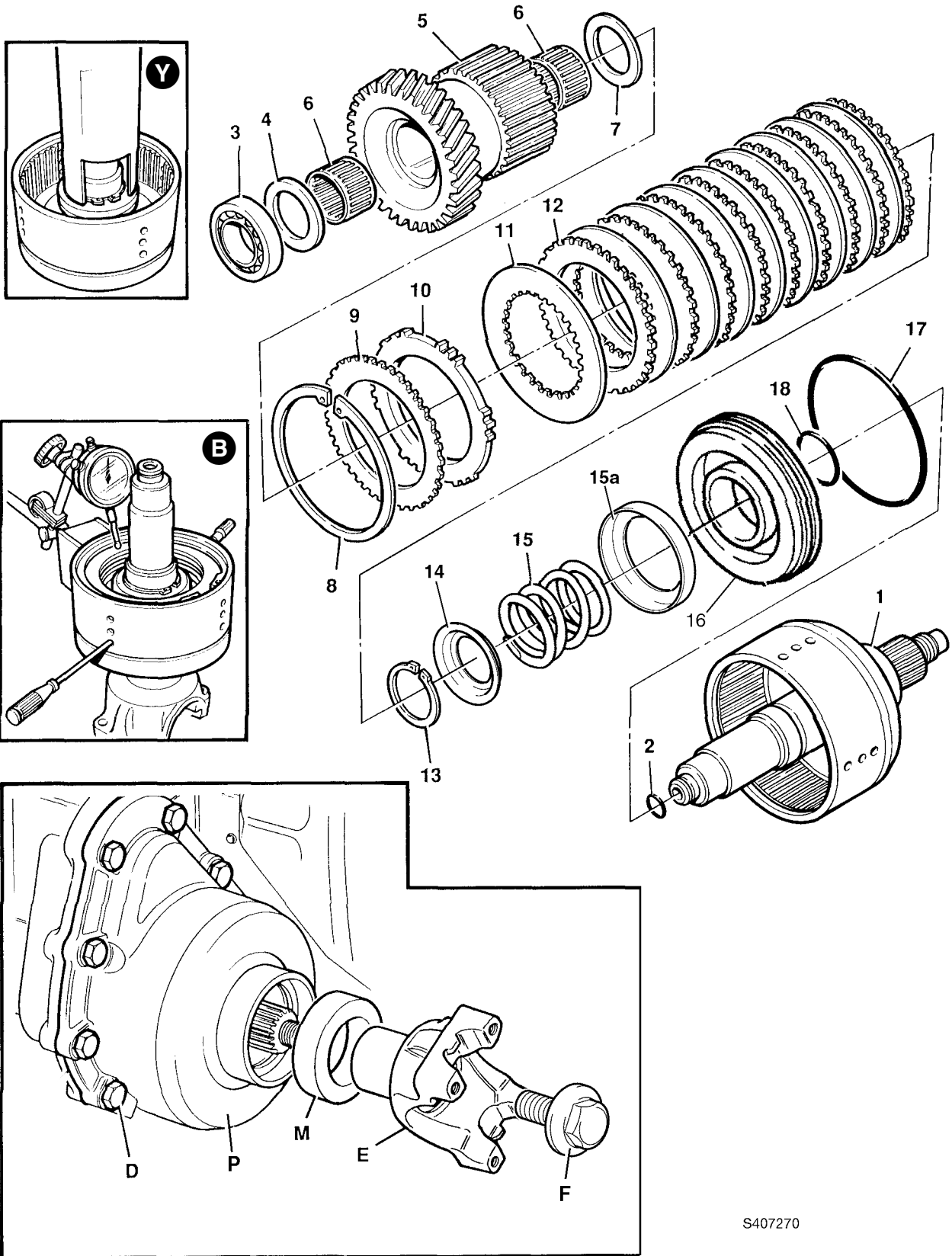
- 16 Smear the clutch end bearing with JCB HP Grease and press the bearing onto shaft.

- \* 17 Fit piston ring seals, refer to **Piston Ring Seals - Fitting Procedure**.

- \* 18 Repeat steps 1 to 16 for the opposite clutch. Note that a spacer is not fitted on the opposite (Forward) clutch. Refer to step 14.



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



S407270

## 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 Using a puller remove 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.

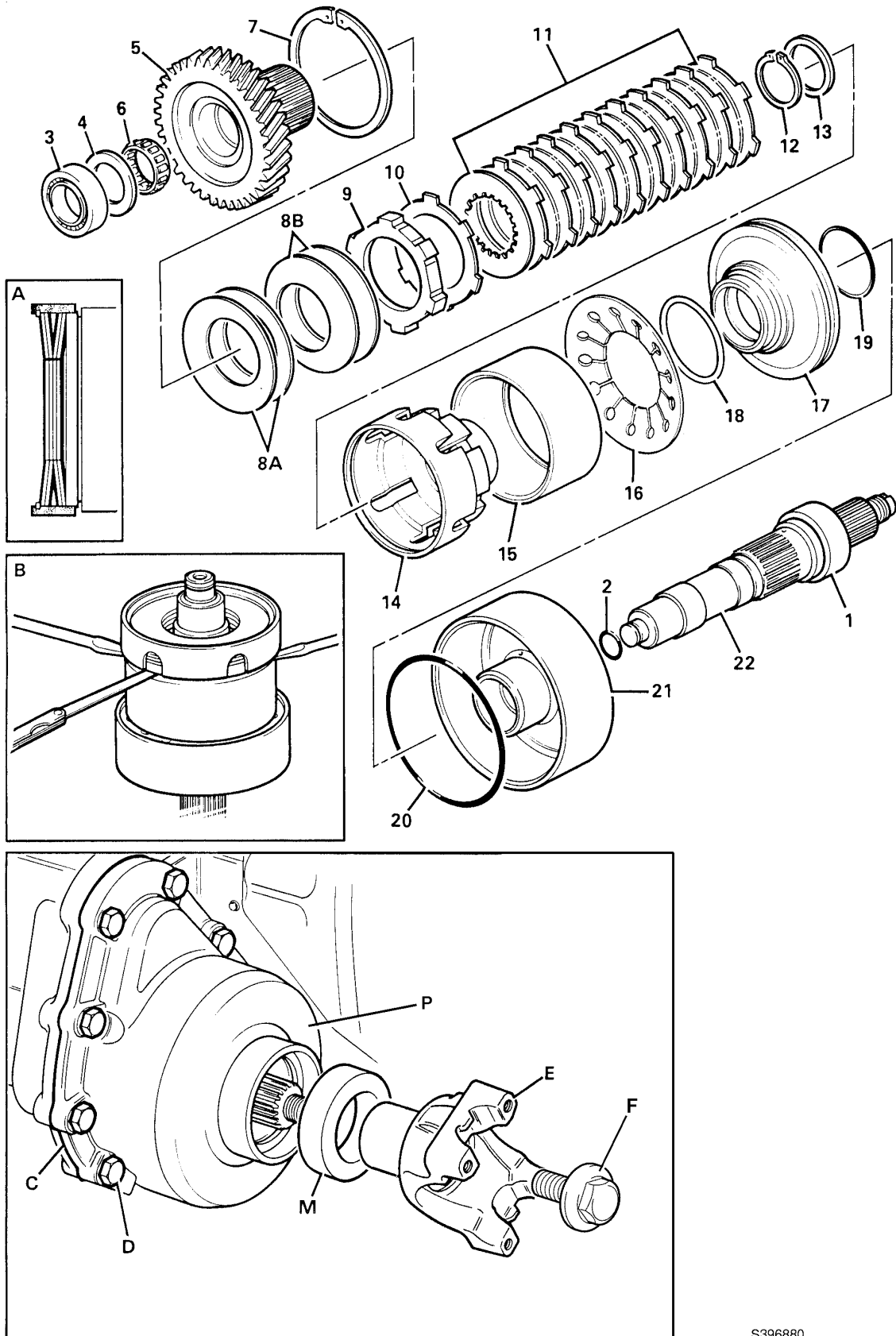
### Assembly

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.
  - 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**. Using an air line, blow air down the shaft oil inlet hole and check the piston and clutch pack is free to operate smoothly.
  - 6 Measure the clutch pack end float using two screwdrivers as shown at **B**. End float should be between 1.0 mm and 2.3 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 **D** 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 be 0.01 to 0.16 mm (0.0004 to 0.006 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 runs 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.



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



S396880

## Hydraulic 2/4 Wheel Drive Unit (4WD Spring ON)

### Dismantling and Assembly

**Note:** Before dismantling the unit drain the gearbox oil.

#### Dismantling

- 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 bearing **6** and thrust washer **4**.
- 6 Using a suitable press, compress disc springs **8A**, **8B** and remove the circlip **7**.

**CAUTION:** There is approximately 26700N (6000lbf) clamping force acting on the springs.

- 7 Remove disc springs **8A**, **8B**, pressure plate **9**, shim(s) **10** (keep the shim(s) separate from the counter plates), and clutch pack friction plates and counter plates **11**.
- 8 Remove the clutch drum retaining circlip **12** and support washer **13**.
- 9 Remove clutch drum **14** and actuating sleeve **15**.
- 10 Remove disc spring **16**.
- 11 Remove the piston **17** and its spring steel ring **18**.
- 12 Remove and discard piston O-rings **19** and **20**.
- 13 Remove the piston housing **21** only if necessary, the housing is a press fit on shaft **22**.

### 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.

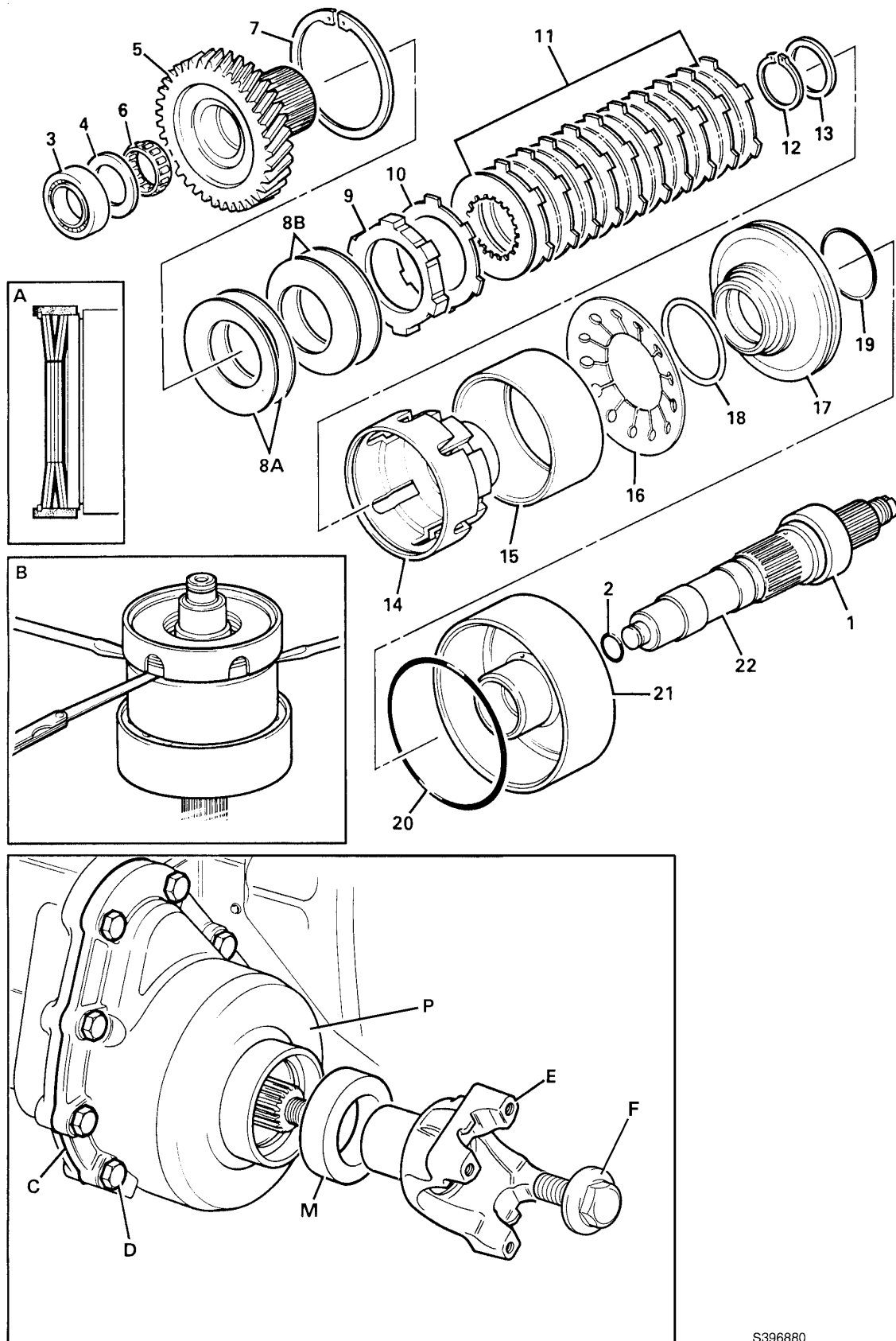
Do not mix old, new and worn plates.

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.

### Assembly

**Note:** Use the pressure test adaptor and clamp assembly (see **Service tools**) to 'bench test' the clutch. Bench testing will ensure the clutch operates correctly prior to - assembling and installing in the machine. Refer to **Hydraulic 2/4 Wheel Drive Unit, Pressure Testing the 2/4 WD Clutch**.

- 1 Grease the shaft **22** then fit the piston housing **21** by pressing the shaft squarely into the housing (make sure the housing is securely supported on the centre boss).
- 2 Fit new O-rings **19** and **20** to piston **17**, locate the piston into housing **21**. Fit spring steel ring **18** ensuring that it seats firmly in its groove.
- 3 Place the disc spring **16** into the housing **21**.
- 4 Position the actuating sleeve **15** onto the disc spring **16**.
- 5 Install the clutch drum **14** in the housing. Fit support washer **13** and drum securing circlip **12**.
- 6 Build up the clutch pack **11**, installing friction plates and counter plates alternately, starting with a counterplate and finishing with a friction plate.
- 7 Install shim(s) **10** and pressure plate **9**.
- 8 Use the output gear **5** to align the clutch plate splines. Ensure that all the plates are engaged with the gear shaft splines. Rotate the output gear back and forth to create maximum backlash then withdraw the gear taking care not to disturb the pack.
- 9 Place the first two disc springs **8B** with their convex sides uppermost, onto the clutch pack. (There are four disc springs, which are identical). Place the other two disc springs **8A**, with their convex sides down, onto the first two - refer to inset **A**.



S396880

## Hydraulic 2/4 Wheel Drive Unit (4WD Spring ON)

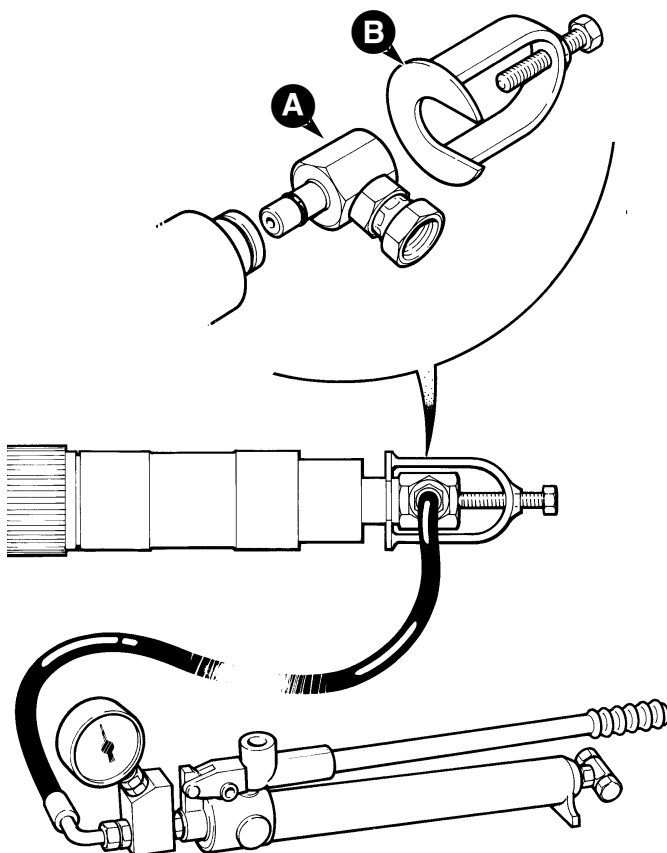
### Assembly (continued)

- 10 Using a suitable press, compress the disc springs **8A** and **8B**, fit circlip **7**.
- 11 Use levers to remove free play, as shown at **B**. Measure the gap between pressure plate **9** and actuating sleeve **15**. The gap should be 0.75 - 1.5 mm; 0.030 - 0.059 inches. If necessary fit new shim **10** to achieve the correct gap. (Shim **10** can be a combination of a single counter plate, shim (thinner than the counter plate) or both counter plate and shim). Check that the clutch pack splines are still aligned - see step 8.
- 12 Install the 4WD output gear **5** and its needle roller bearing **6**.
- 13 Install thrust washer **4** and bearing **3**.
- 14 Fit sealing ring **2** and bearing **1**.
- 15 Fit the 2/4WD unit to the gearbox.
- 16 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 **D** and progressively torque tighten to 56 Nm, 46 lbf ft.  
\*
- 17 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 be 0.01 to 0.16 mm (0.0004 to 0.006 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 runs roughly, dismantle the unit and check for correct assembly.
- 18 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.

**Pressure Testing the 2/4WD Clutch**

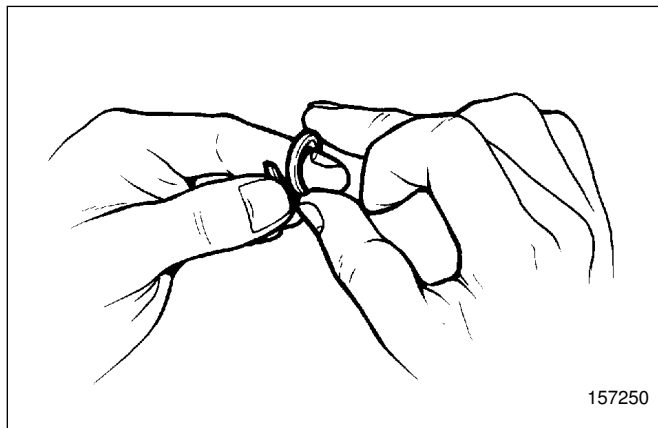
- 1 Assemble the 2/4 wheel drive clutch, as described in 'Assembly'.
- 2 Check the clutch pack end float and adjust as required (see **Assembly**).
- 3 Using special tool 993/59300, insert the adaptor **A** into the oil gallery in the end of the 2/4 wheel drive clutch shaft as shown. Hold the adaptor in position with clamp **B**.
- 4 Use a hand pump to pressurise the clutch assembly until gear, item **5** can be turned by hand. Note the pressure gauge reading - DO NOT EXCEED 200 lb/in<sup>2</sup> (13.8 bar).
- 5 If the pressure gauge reading is between 125 - 135 lbf/in<sup>2</sup> (8.6 - 9.3 bar) then the clutch is operating correctly and can be fitted in the transmission.
- 6 If however the pressure gauge reading is above 135 lbf/in<sup>2</sup> (9.3 bar) then check the clutch for assembly defects, especially the clutch pack end float (the shim may not be to the correct thickness). -test after checking for (and rectifying) assembly defects.



S185720

### Polytetrafluoroethylene (PTFE) Piston Ring Seals - Fitting Procedure

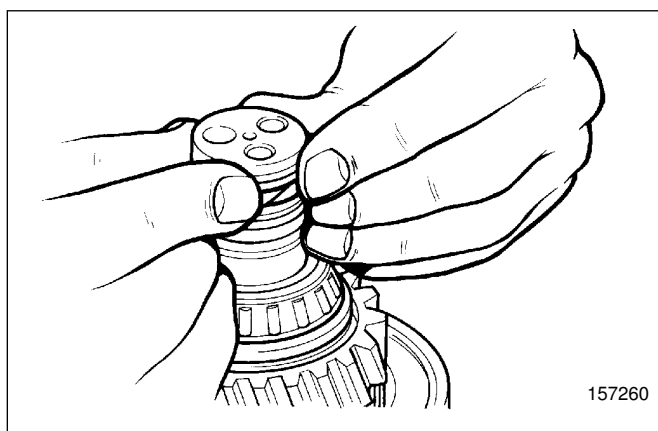
- 1 Wind the PTFE piston ring seal around your finger as shown, so that the seal forms a 'coil'.



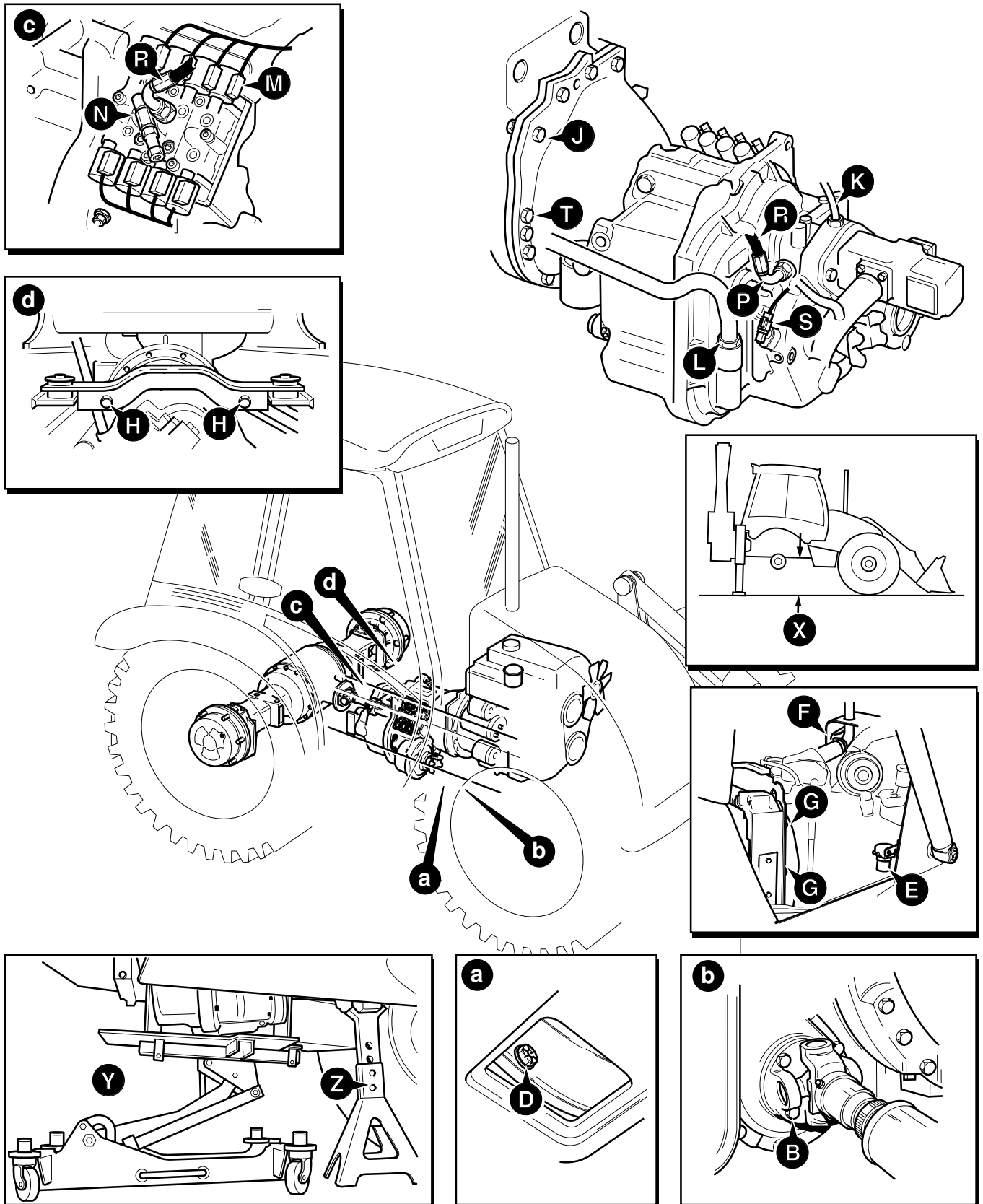
- 2 Smear the seal with grease and then fit the seal to the shaft.

Make sure that the seal sits below or flush with the outer diameter of the shaft. If necessary, use finger pressure as shown to make the seal flush with the shaft.

**CAUTION:** If the seal is not set below or flush with the outer diameter of the shaft, then the seal will 'cut' when the shaft is fitted to its mating component.



Removal and Replacement



A401320

## Removal and Replacement (cont'd)

**IMPORTANT:** The gearbox is heavy. Unless it is safely supported during removal and replacement it could fall and cause injury. Make sure that you have access to suitable jacks and a gearbox locating 'cradle' before attempting to remove the gearbox.

### **WARNING**

**A raised and badly supported machine can fall on you. Position the machine on a firm, level surface. Before raising one end ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.**

**Disconnect the battery, to prevent the engine being started while you are beneath the machine.**

GEN 1-1

### Removal

- 1 Park the machine on firm level ground. The gearbox is heavy. If the ground is soft or uneven it will not be possible to remove the gearbox safely.
  - 2 Loosen the right side rear wheel nuts. Rest the shovel on the ground and lower the stabilisers to raise the rear of the machine. Check dimension **X** which must be at least 800 mm. This will allow the gearbox to be pulled clear. Block/support the machine.
- Note:** On sideshift machines, suitable lengths of steel channel can be used as safety struts between the stabiliser feet and chassis, one at each stabiliser.
- 3 Remove the right hand side rear wheel.
  - 4 Remove the bonnet - see Section 3, **Routine Maintenance**.
  - 5 Remove the rear axle propshaft - see **Propshafts**.
  - 6 Disconnect the front axle driveshaft bolts **B** (use tool 892/00822).
  - 7 Drain the hydraulic tank and remove the main hydraulic pump (see Section E, **Service Procedures and Main Hydraulic Pump**). Tie the suction hose up clear of the gearbox.
  - 8 Drain the gearbox oil, see Section 3, **Routine Maintenance**.
  - 9 Remove the access bung/plate at the bottom of the torque converter housing. Through the access hole, loosen and remove the torque converter to engine flywheel retaining bolts **D**.

- 10 At a later stage the gearbox and engine assembly is tilted to allow access to fixing bolts. To prevent damage as the engine is tilted components must have their fixings removed as follows:

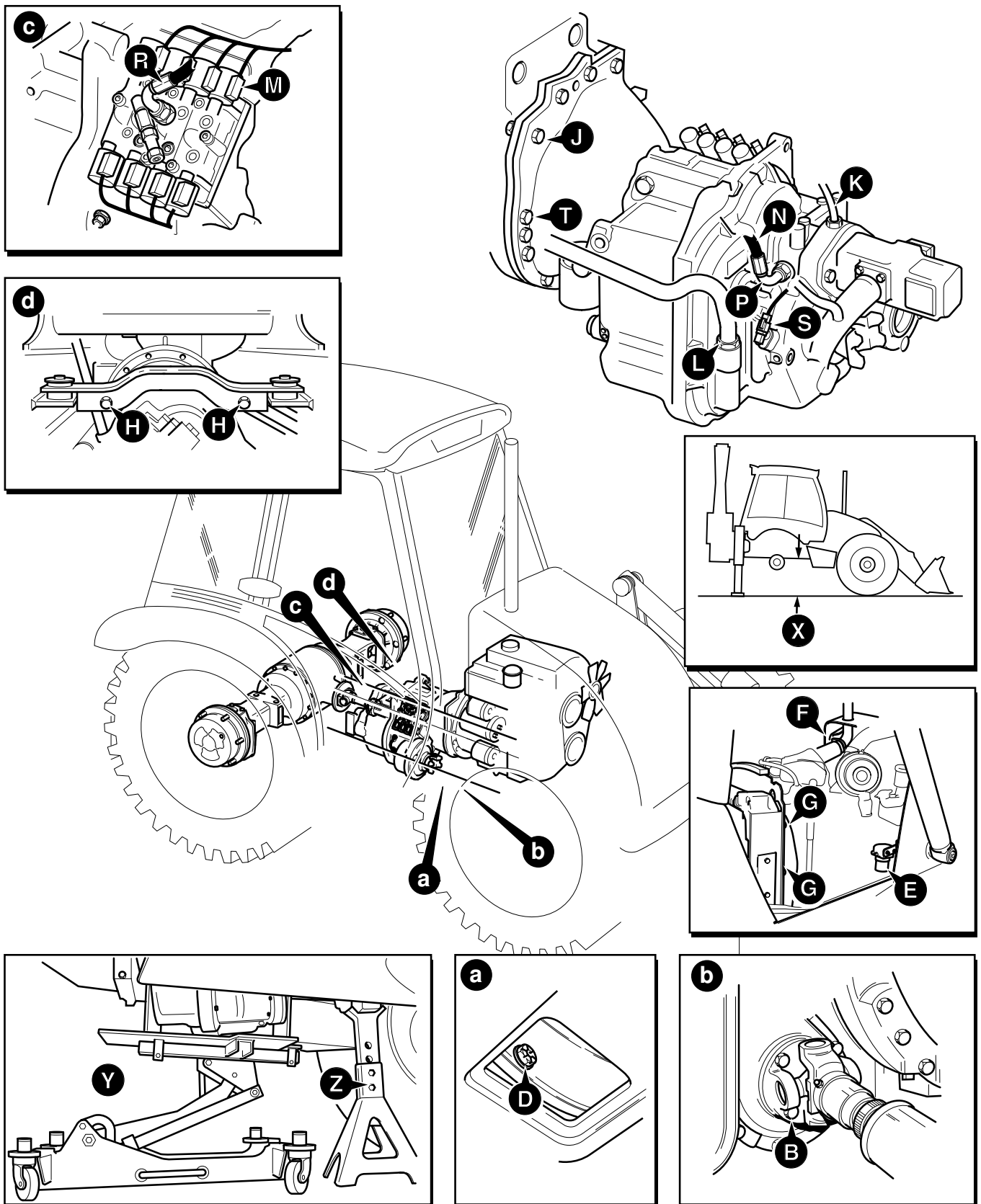
- a Fuel sediment bowl assembly **E** (2 bolts).
- b Exhaust stack fixing bracket **F** (2 bolts).
- d Radiator fan cowl **G** (4 bolts).

It is not necessary to remove these components, only release them from their fixings.

- 11 Support the gearbox using a suitable trolley jack and cradle. The gearbox must be securely located on the cradle as shown at **Y**.
- 12 Make sure that the weight of the gearbox is supported by the trolley jack and then remove the gearbox mounting bolts **H**.
- 13 Using the trolley jack, lower the gearbox and engine to gain access to the top torque converter housing to engine block retaining bolts **J**. Put a support under the engine as shown at **Z** to prevent it from dropping when the gearbox is removed.
- 14 Undo the four bolts **J** at the top of the torque converter housing. Note that the two outer most bolts have nuts instead of screwing into the engine block. Also note the position of the electrical earth straps.
- 15 Pull off the breather tube **K**. Undo the gearbox dipstick fixing nut **L** and then remove the dipstick tube.
- 16 Label and then uncouple the solenoid control valve electrical connectors **M**, oil pressure sender **N** and temperature sender **P** (if fitted). Uncouple the electrical connector at the speed sensor **S**.
- 17 Disconnect the gearbox oil cooler hoses **R**.
- 18 Remove the flywheel housing to engine bolts **T**.
- 19 Manoeuvre the gearbox with the torque converter clear of the engine housing.
- 20 Lower the trolley jack and pull the gearbox and torque converter clear of the machine.



Removal and Replacement (cont'd)



A401320

## 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.

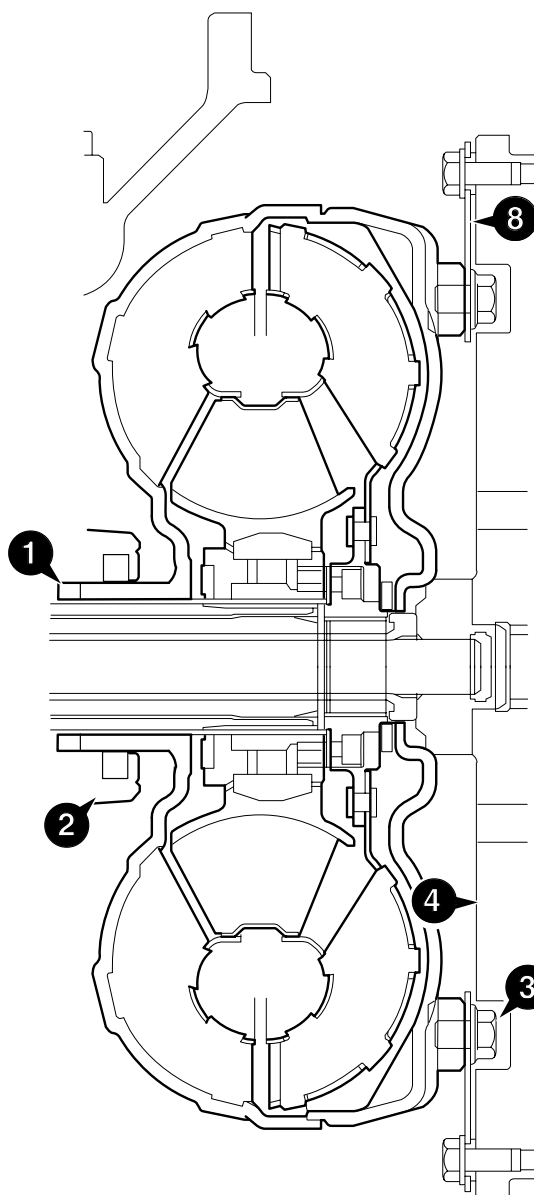
Before bolting the torque converter housing to the engine make sure the mating faces are fully together (DO NOT USE FORCE). The drive plate **8** should also be mated close to the flywheel. Do not force the components together with the fixing bolts.

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.

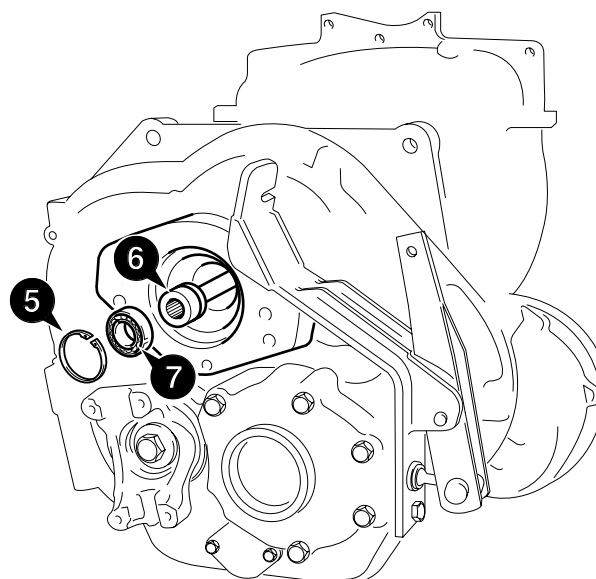
- 4 Fill the gearbox with the specified amount and type of oil (see **Section 3, Routine Maintenance**). Leave hose **N** off until the filling operation is complete. After filling refit hose **N**.

### Torque Settings

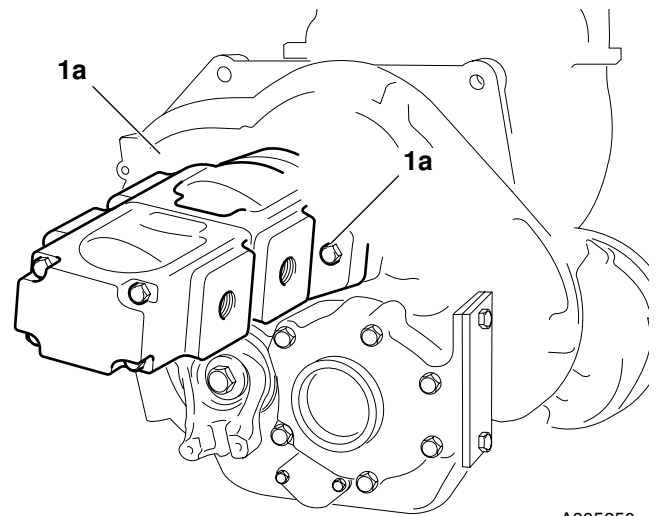
Item	Nm	kgf m	lbf ft
<b>B</b>	79	8	58
<b>D</b>	44	4.5	32
<b>H</b>	237	24	175
<b>J,T</b>	98	10	72



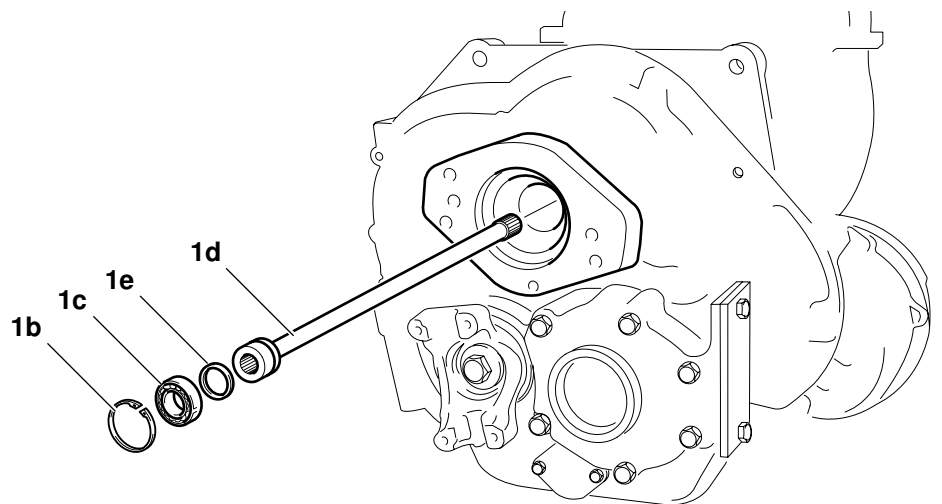
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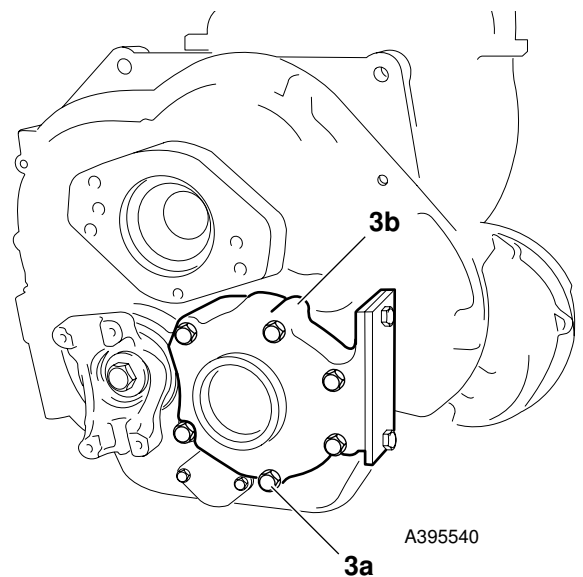
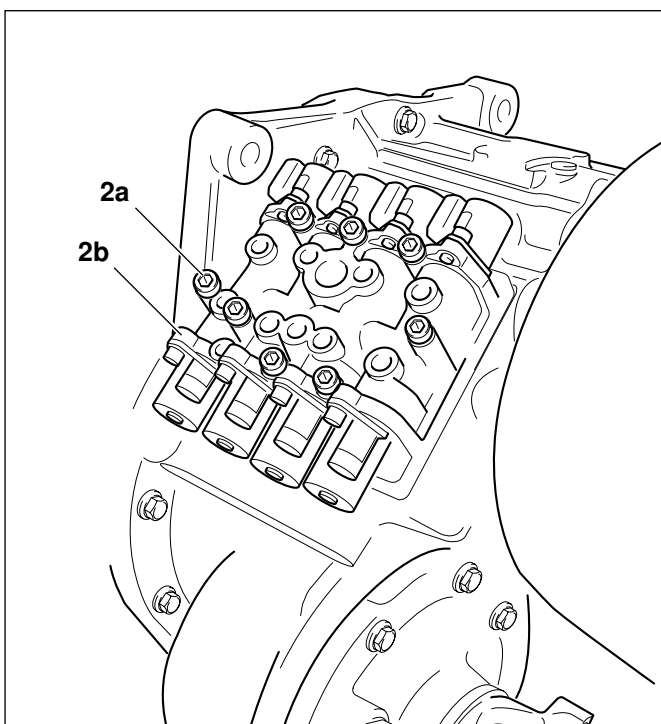
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A395540

## Dismantling

**Note:** The Dismantling, Inspection and Assembly procedures in this manual illustrate and describe the 6x4 gearbox. Procedures for the 4x4 version of the gearbox are identical in most respects. Where there are differences procedures are identified under the heading '**4x4 Gearbox**'.

With the gearbox removed from the machine, place suitable wooden blocks to securely support the assembly.

Cleanliness is of the utmost importance when servicing the gearbox. All precautions to prevent any ingress of dirt, grit etc. must be taken. To this end wash the exterior of the gearbox assembly as follows;

Make sure that all open ports and orifices are effectively plugged. Remove any deposits of dirt, grit and oil from the outer casings using a suitable degreaser and water. Dry the casings.

### 1 Remove the Main Hydraulic Pump and Driveshaft

- a If the main hydraulic pump has not already been removed proceed as follows. Support the pump, undo the 2 bolts **1a**. Draw the pump away from the gearbox, disengaging the drive shaft. Lift the pump clear.
- b Remove the circlip **1b** followed by bearing **1c**. Withdraw the driveshaft **1d**. Remove the sealing ring **1e**.

### 2 Remove the Solenoid Control Valve Block

- a Undo the 8 socket head cap screws **2a** and lift off the valve block assembly **2b**. Do not use a screwdriver to lever the block, the sealing faces will be damaged. If the block is difficult to remove, lightly tap the manifold block with a soft faced hammer.

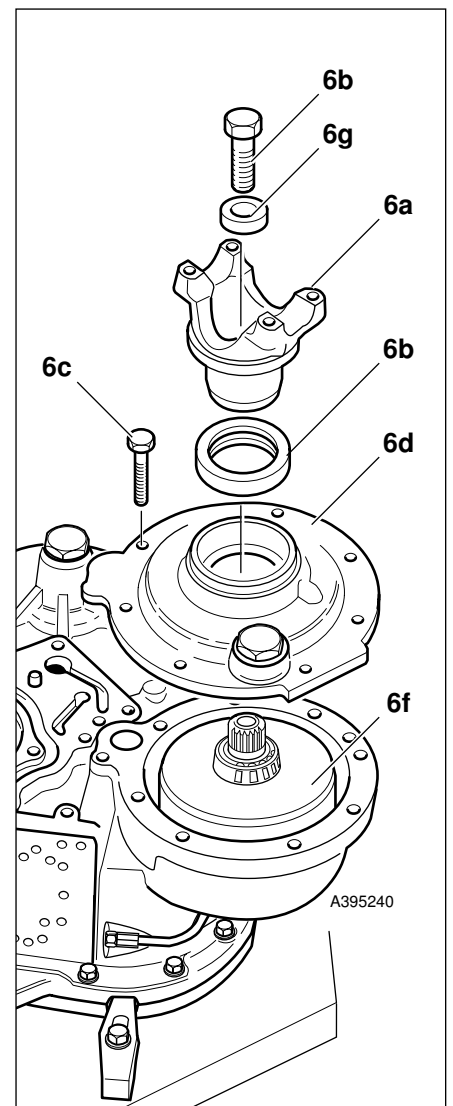
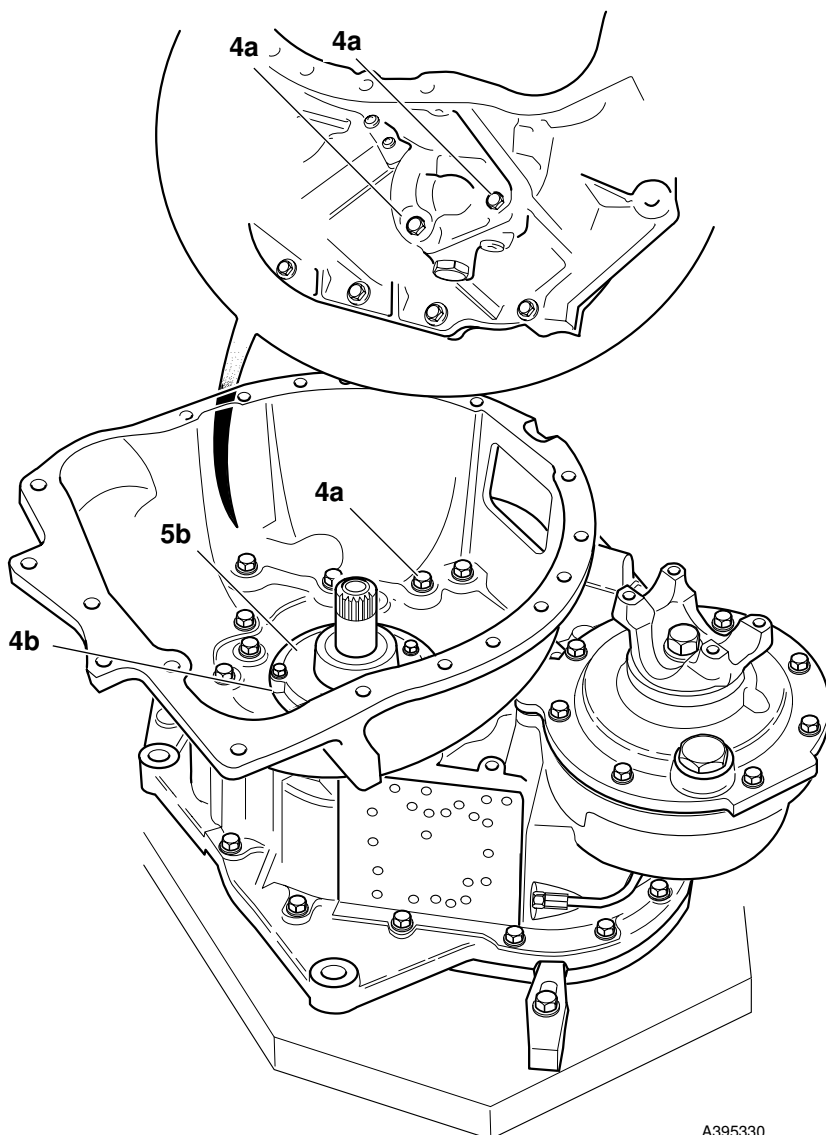
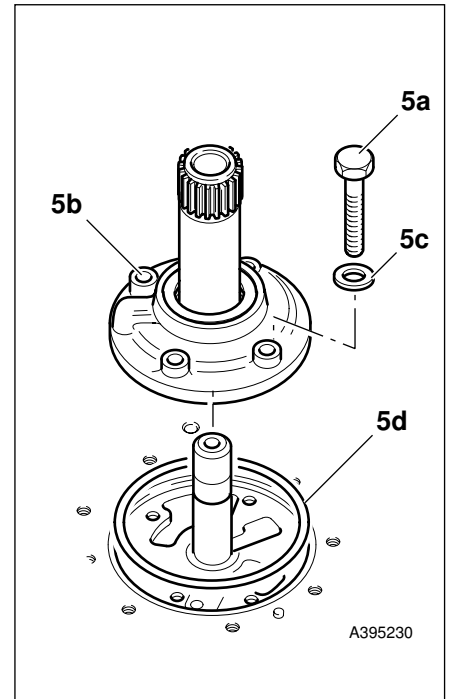
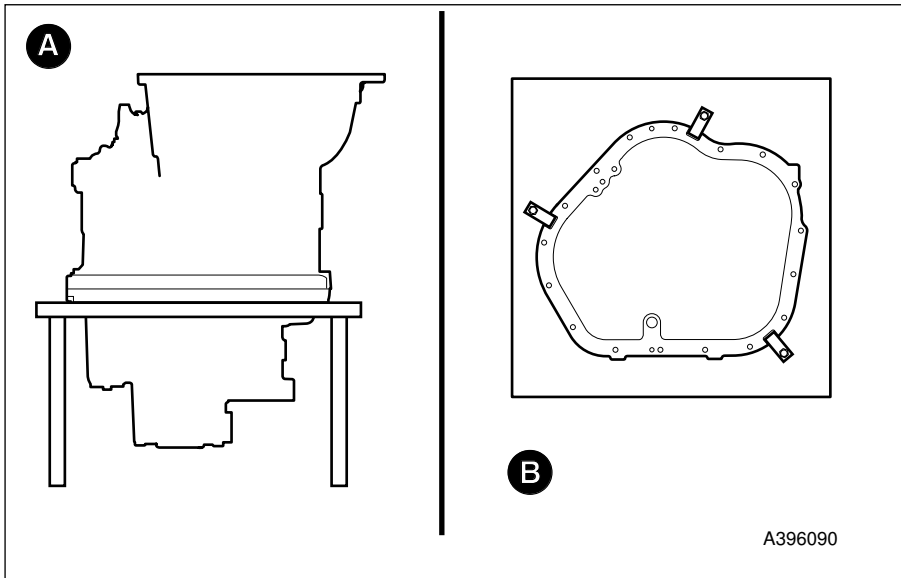
**Note:** Some gearboxes are fitted with a valve block sub-base plate. Be sure to retrieve the plate. The plate is thin, make sure it is not damaged when removing. Take care not to damage the surfaces of the plate.

- b Remove and discard the valve block sealing gasket. The gasket may disintegrate on removal, make sure all traces are removed and discarded. Gearboxes fitted with a sub-base plate have two gaskets, one each side of the plate.

### 3 Remove the Layshaft Cover

**Note:** Unless the casings are to be renewed, or the gearbox oil has been contaminated it is not necessary to remove the cover.

- a Undo the 6 bolts **3a** and lift off the cover **3b**.



## Dismantling (cont'd)

Using suitable lifting equipment locate the gearbox in a work cradle (892/01082) as shown at **A**. Clamp the gearbox in position at the 3 clamping points on the rear casing as shown at **B**. DO NOT ATTEMPT TO DISMANTLE THE GEARBOX FURTHER UNLESS IT IS SAFELY LOCATED IN A SUITABLE WORK CRADLE.

### 4 Remove the Torque Converter Housing

- \* **a** Undo the bolts **4a**<sup>†</sup>. Note that 2 bolts are located on the outside of the housing just above the oil filter mounting. Lift off the housing. Retrieve the sealing 'O' ring **4b**.  
<sup>†</sup>Early gearboxes feature a total of 18 bolts while late gearboxes have 23 bolts

### 5 Remove the Gearbox Hydraulic Pump

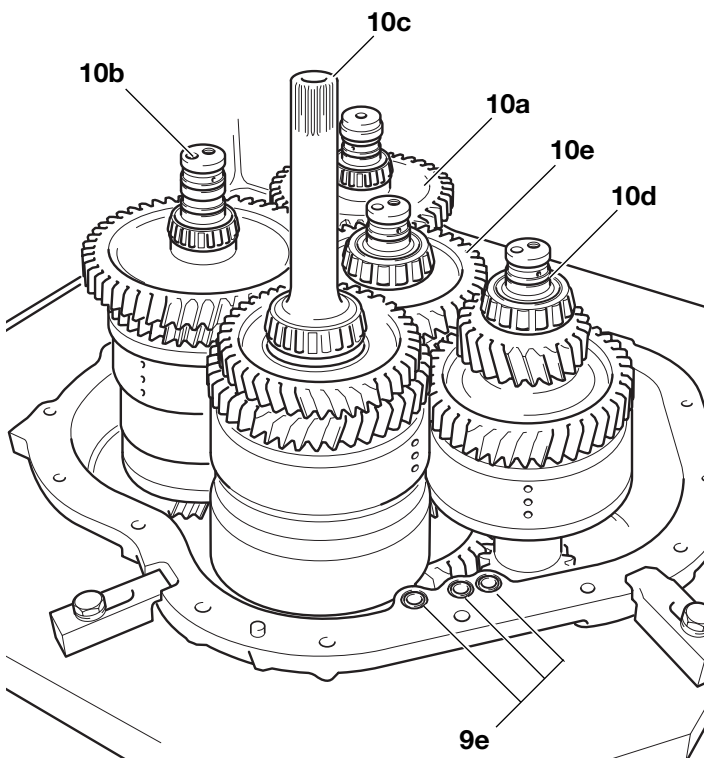
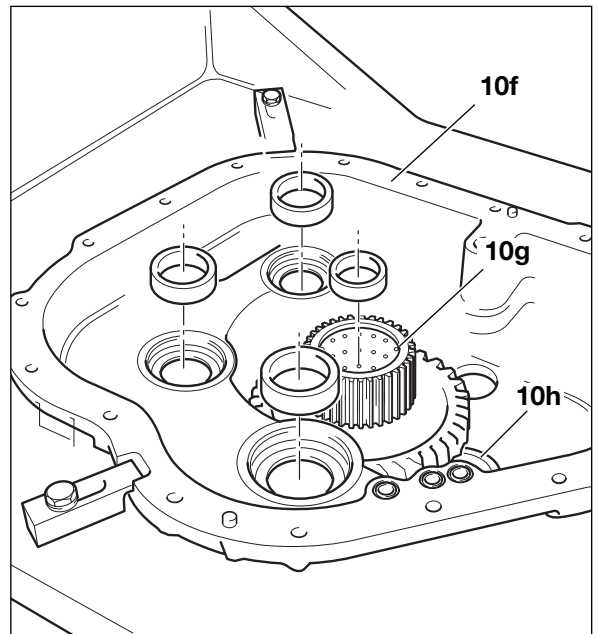
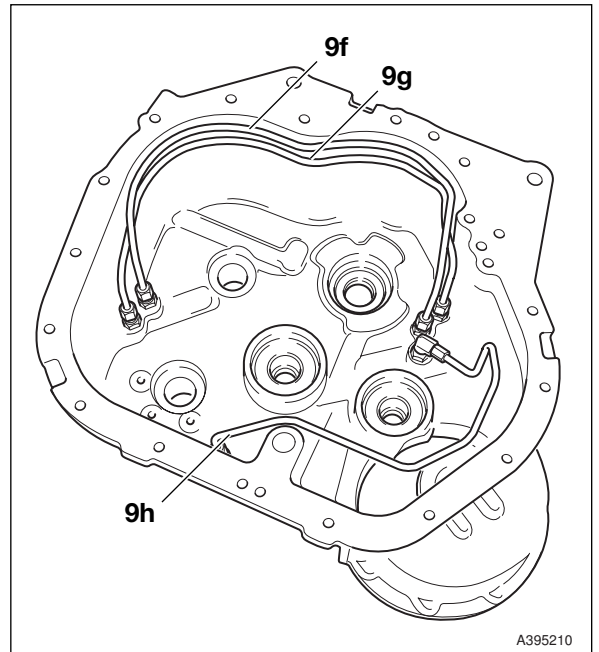
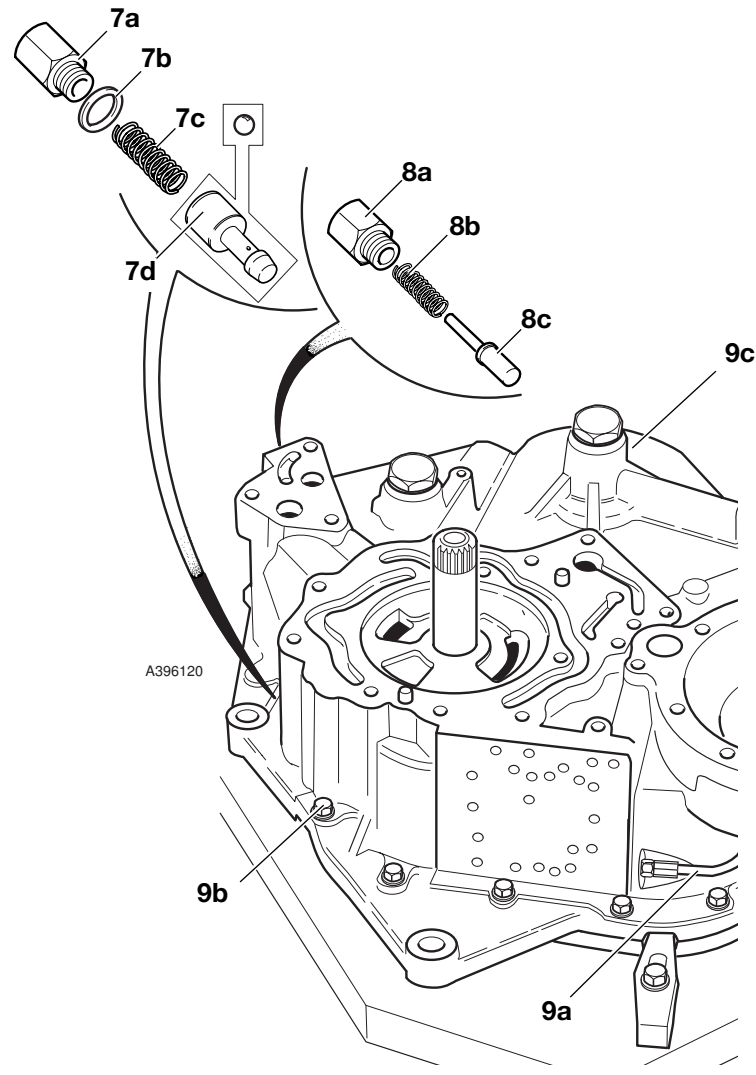
- a** Undo the 4 fixing bolts **5a** and lift the pump assembly **5b** off the input shaft. Retrieve the 4 sealing washers **5c** and pump sealing ring **5d**.

**Note:** A pump which is worn or damaged may have caused further damage to the gearbox. Dismantle and inspect the gearbox fully. For details of dismantling and inspecting the pump, see **Powershift Gearbox - Inspection**.

### 6 Remove the 4WD Clutch Assembly

- a** Using service tool 892/00812 hold the output yoke **6a** and at the same time undo the bolt **6b**. The bolt is very tight, the help of an assistant will be required.
- b** Remove the thick washer **6g** and yoke **6a**. Undo the 8 bolts **6c** and lift off the cover **6d**, be sure to retrieve the bearing outer cup from inside the cover. Remove the output shaft oil seal **6b**. Take care not to damage the seal housing.
- c** Lift the clutch and shaft assembly **6f** from the housing. Retrieve the inner bearing outer cup from the casing.

For 4WD clutch dismantling and assembly procedure see **4WD Clutch - Dismantling and Assembly** in this section.



## Dismantling (cont'd)

### 7 Remove the Torque Converter Relief Valve

- \* a Undo the plug **7a** and remove the sealing washer **7b**, spring **7c** and poppet **7d**. Note that some gearboxes are fitted with a ball instead of a poppet.

### 8 Remove the Pressure Maintenance Valve

- a Undo the plug **8a**, remove spring **8b** and valve spool **8c**.

### 9 Separate the Front and Rear Casings

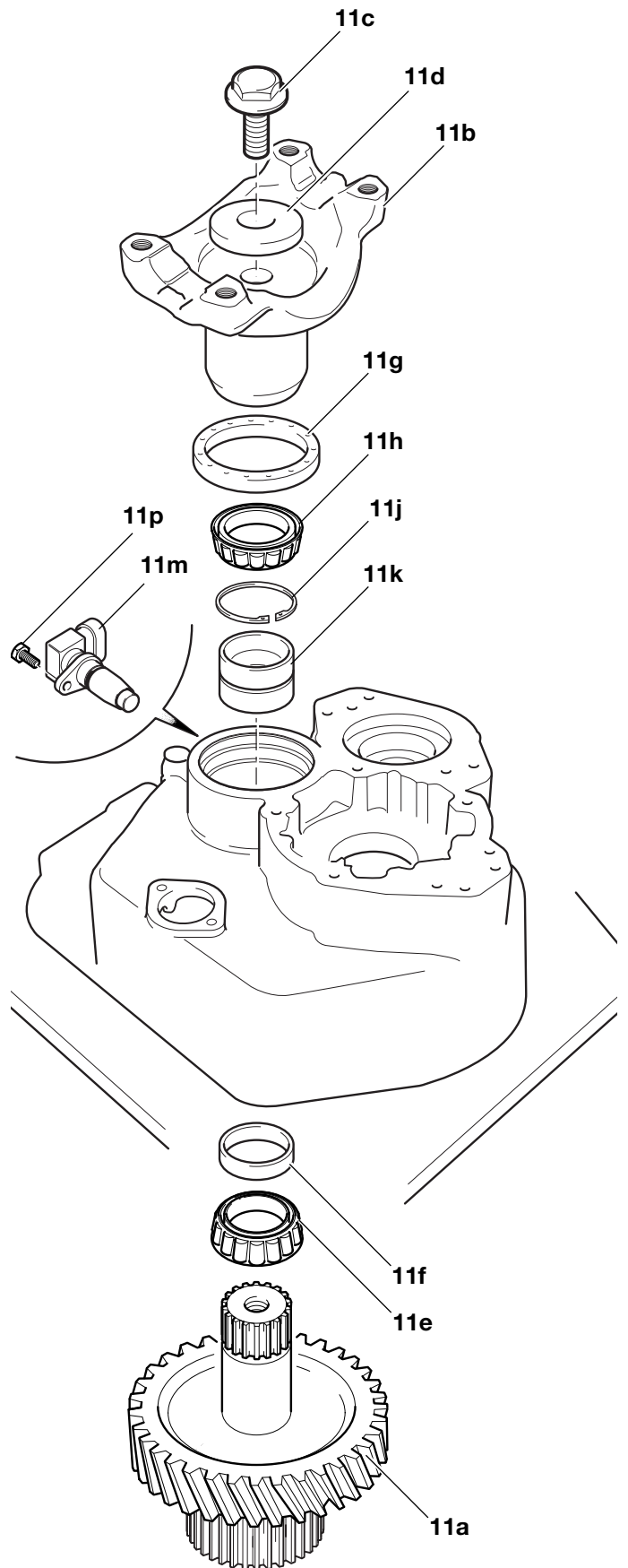
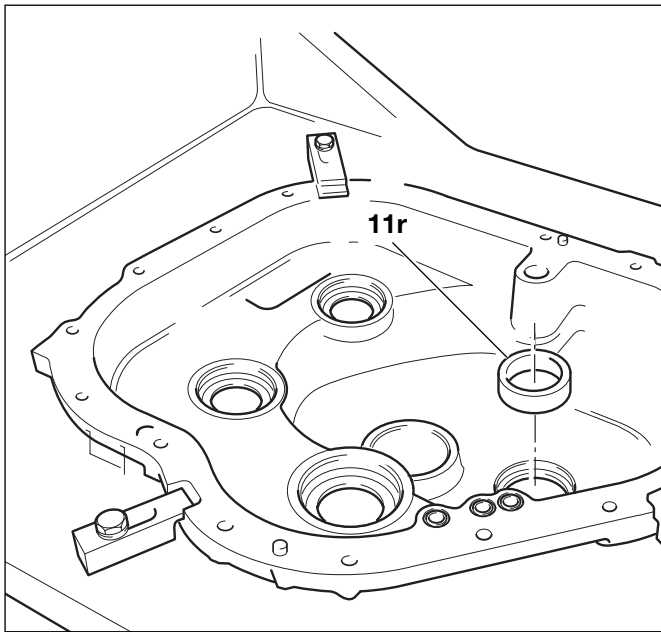
- a Remove the 4WD clutch oil pipe **9a**.
- b Undo the 17 casing bolts **9b**.
- c Using suitable lifting equipment carefully lift off the front case **9c**. Be sure to retrieve all the shaft bearing outer cups. The cups may be left on the bearings, or inside the front case. Keep the cups with their associated bearings.
- d Remove and discard the 3 sealing 'O' rings **9e** from the front case.

**Note:** The 3 oil transfer pipes **9f**, **9g** and **9h** located inside the front case need not be removed unless they are damaged, or the gearbox oil has been contaminated. If they are to be removed see **Powershift Gearbox - Inspection**.  
**4x4 Gearbox:** pipe **9h** not fitted.

### 10 Remove the Clutch/Shaft Assemblies

- a Carefully lift out the clutch/shaft assemblies in the following order:
  - 10a** - 6 speed clutch shaft (not fitted to **4x4 Gearbox**)
  - 10b** - Reverse clutch unit
  - 10c** - Forward/Input clutch shaft
  - 10d** - Layshaft clutch
  - 10e** - Mainshaft clutch
- b Retrieve the bearing outer cups from the rear case **10f** and centre of the transfer gear **10g**. Note that the layshaft bearing cup **10h** can not be removed until the transfer gear/output shaft has been removed, see step 11. Keep the cups together with their associated bearings.





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## Dismantling (cont'd)

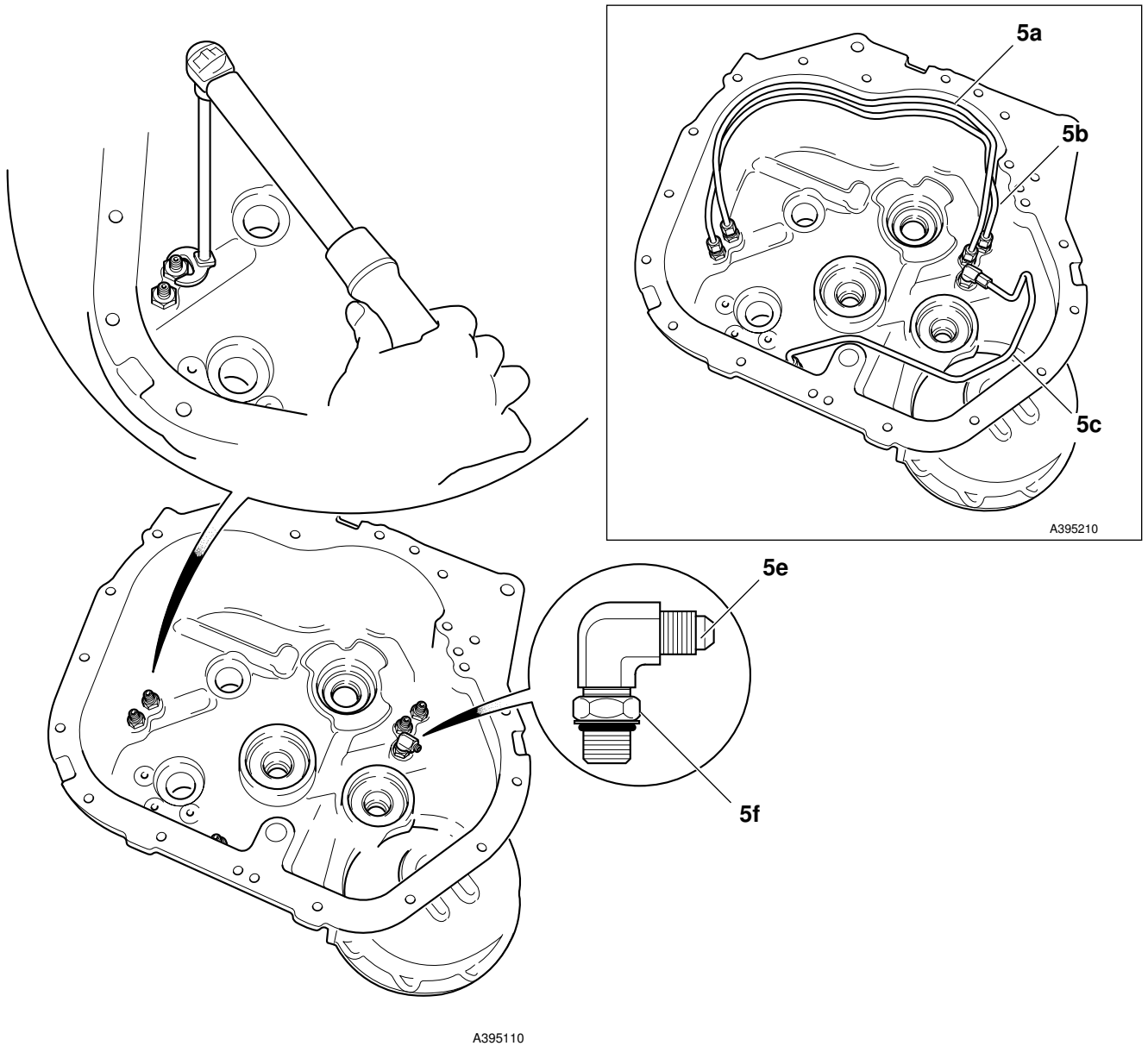
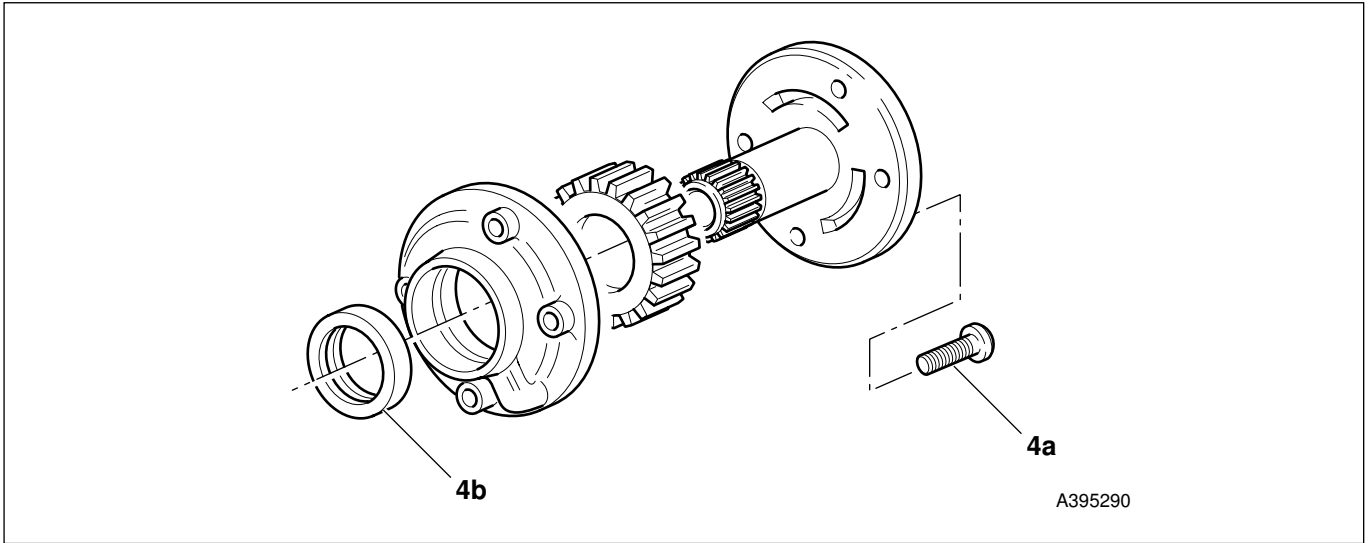
### 11 Remove the Transfer Gear

- b** Using service tool 892/00812 hold the output yoke **11b** and at the same time undo the bolt **11c**. The bolt is very tight, the help of an assistant will be required. Remove the bolt, thick washer **11d** followed by the yoke.
- c** Remove and discard the oil seal **11g**. Take care not to damage the seal housing.
- d** Support the transfer gear/shaft assembly **11a**. Withdraw the gear from inside the casing. The assembly will lift away complete with the inner taper roller bearing **11e** and spacer **11f**.
- e** Remove the outer taper roller bearing **11h**.
- f** Remove circlip **11j** followed by bearing double outer cup **11k**.

**Note:** The inner and outer taper roller bearing assembly (comprising double outer cup **11k**, inner bearing **11e**, spacer **11f** and outer bearing **11h**) is a matched set. Keep all the components together in their original relationships. Components from another set are not interchangeable. If any components are worn or damaged the whole assembly must be renewed as a complete matched set.

- g** Retrieve the layshaft bearing outer cup **11r** from the rear casing.
- h** If the speed sensor **11m** is to be removed, undo bolt **11p** and withdraw the sensor together with its sealing 'O' ring.

Inspection



## 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:

\* **Note:** When removing gasket compound use a gasket removal product such as Loctite Chisel. Take care not to damage the mating faces. Clean the faces with a fine carborundum paper. Use a solvent cleaner and a clean cloth to finally remove all traces of oil or debris.

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.  
Pressure maintenance valve bore (front case)

- 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.

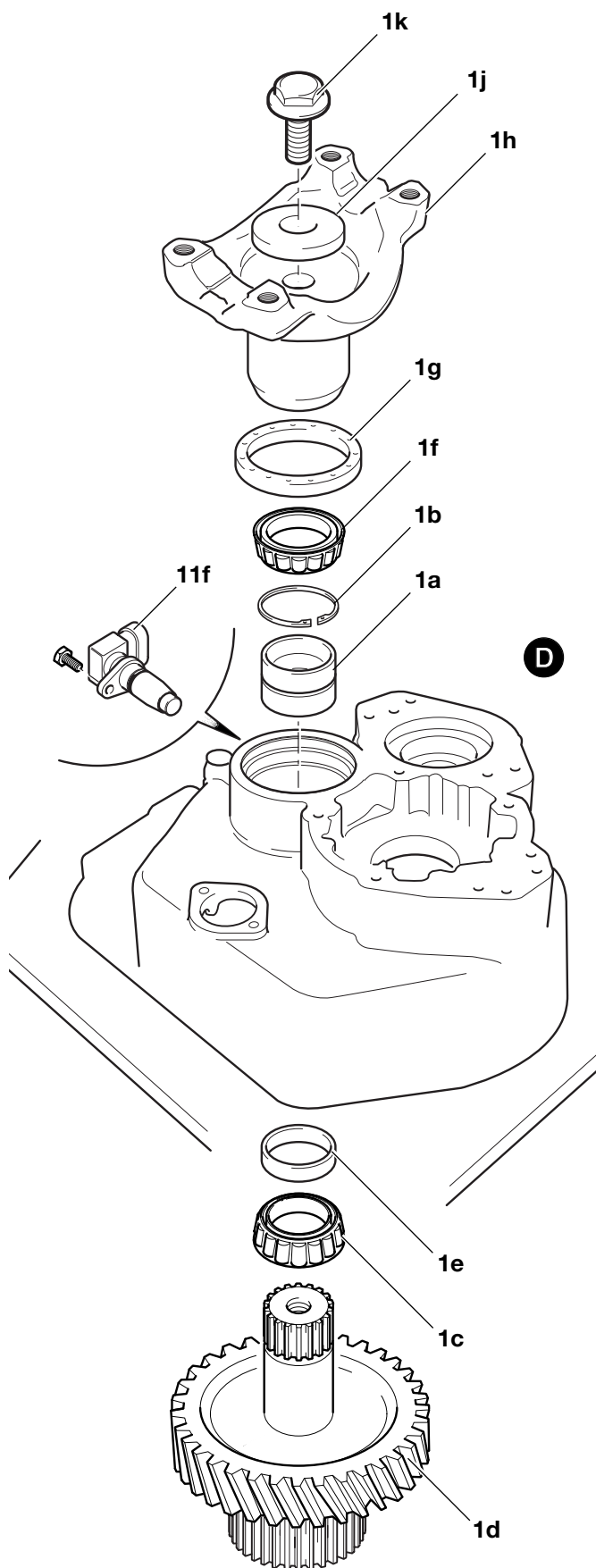
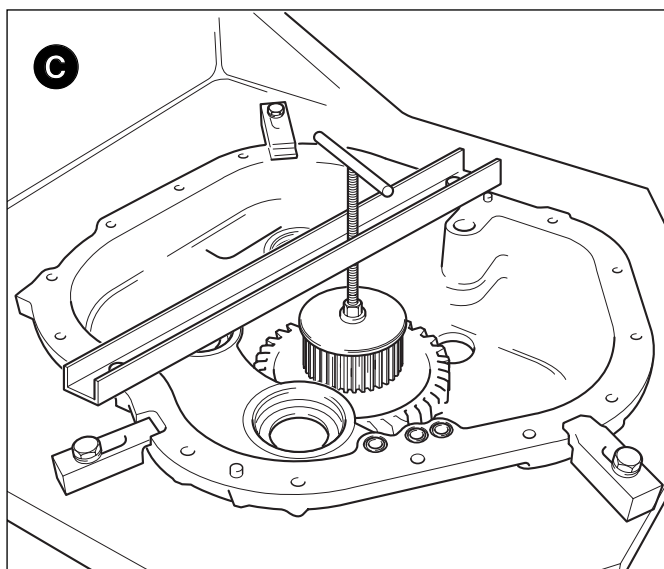
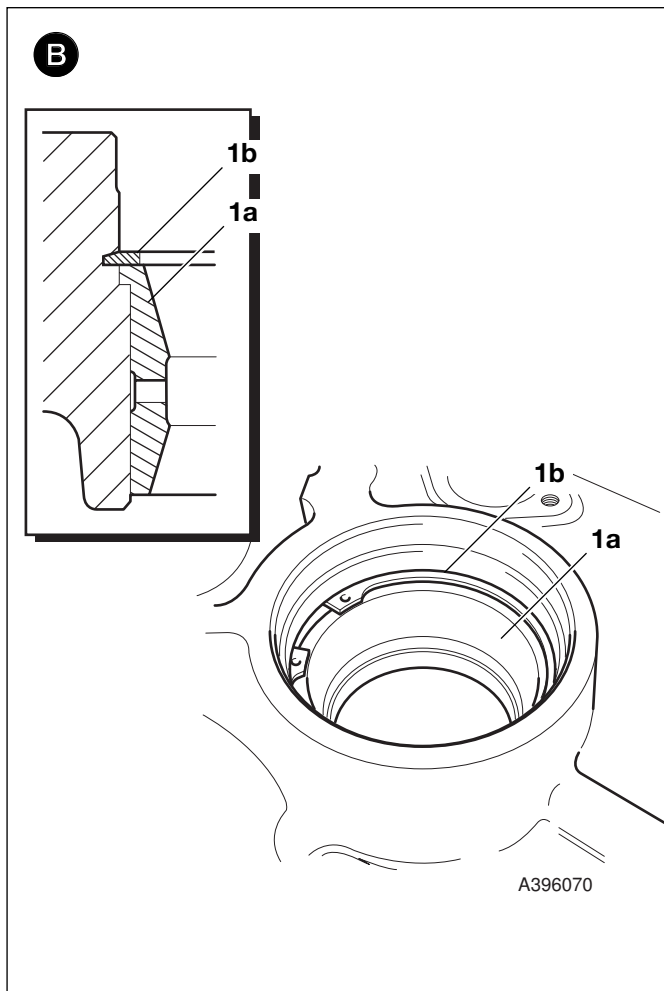
**All Gearboxes:** Torque tighten the pipes to 30 Nm.

### 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.

\* **Note:** Early gearboxes feature a '18 bolt fix' torque converter housing. It is strongly recommended that a new '23 bolt fix' housing and matching front case is fitted on assembly of the gearbox. A compatible torque converter relief valve will also be required.



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## Assembly

Using suitable lifting equipment locate the gearbox rear casing in a work cradle. Clamp the casing in position at the 3 clamping points as shown at **A**.

DO NOT ATTEMPT TO ASSEMBLE THE GEARBOX UNLESS IT IS SAFELY LOCATED IN A SUITABLE WORK CRADLE.

Where 'oil' is referred to, use new, clean transmission oil of the correct specification for the gearbox. See **Section 3, Lubricants and Capacities**.

### 1 Assemble the Transfer Gear/Output Shaft

**Note 1:** Before fitting the transfer gear/output shaft assembly **1d**, fit the layshaft outer bearing cup to the casing (shown at **E**).

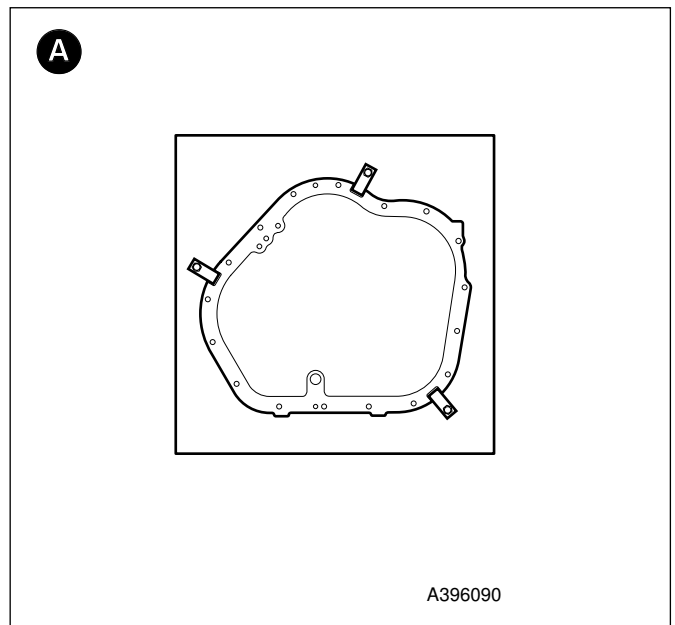
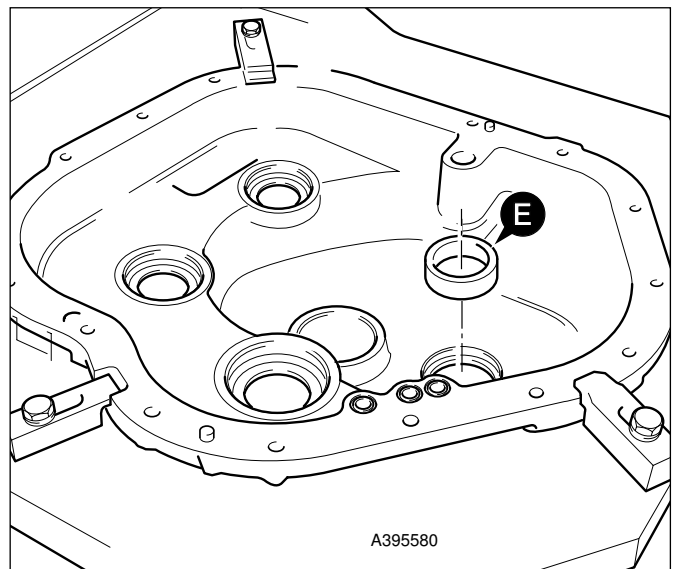
Position the casing as shown at **D**.

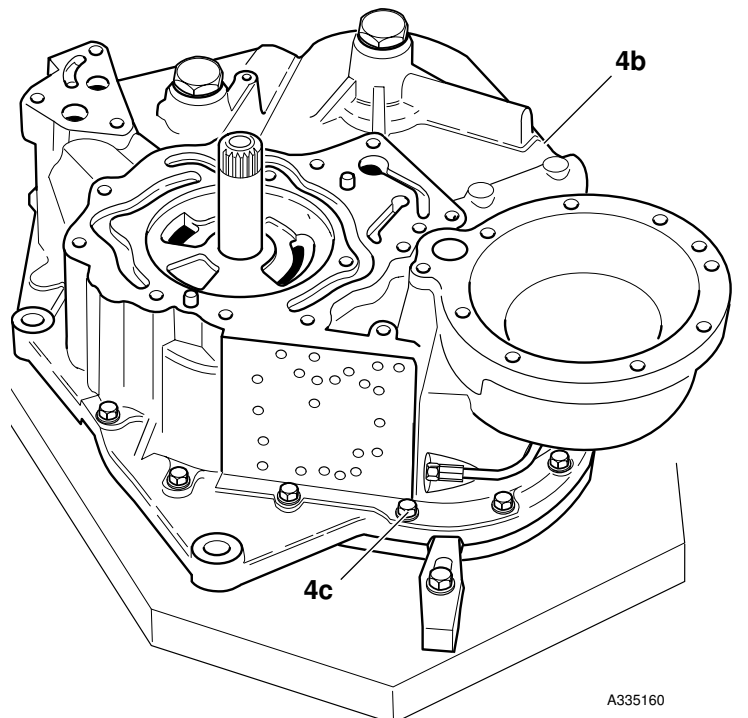
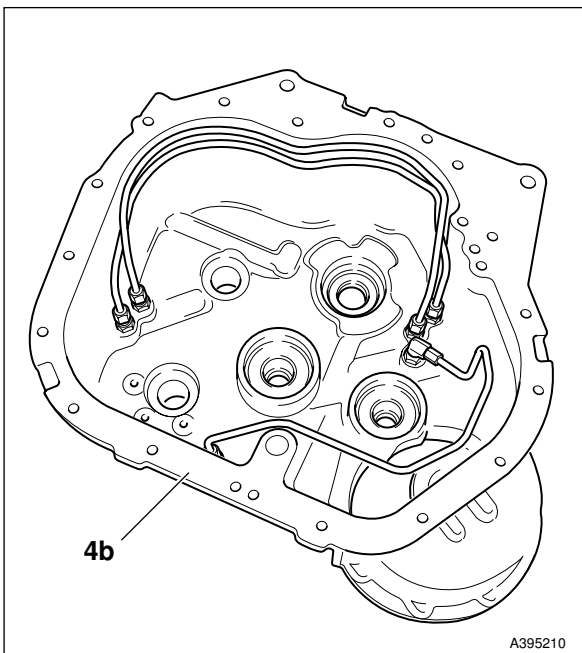
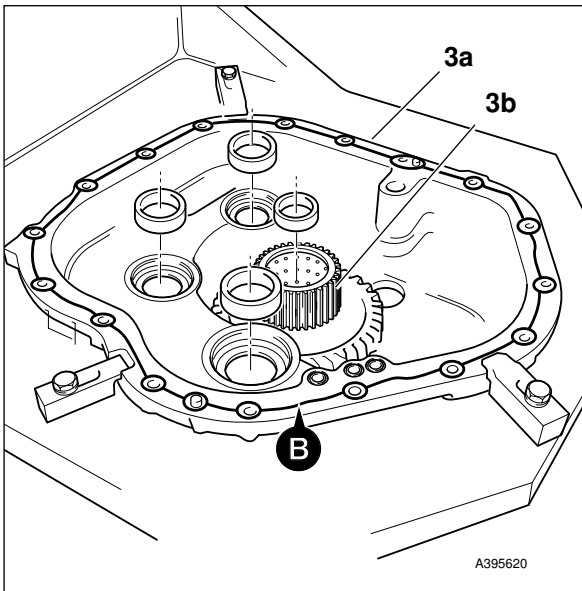
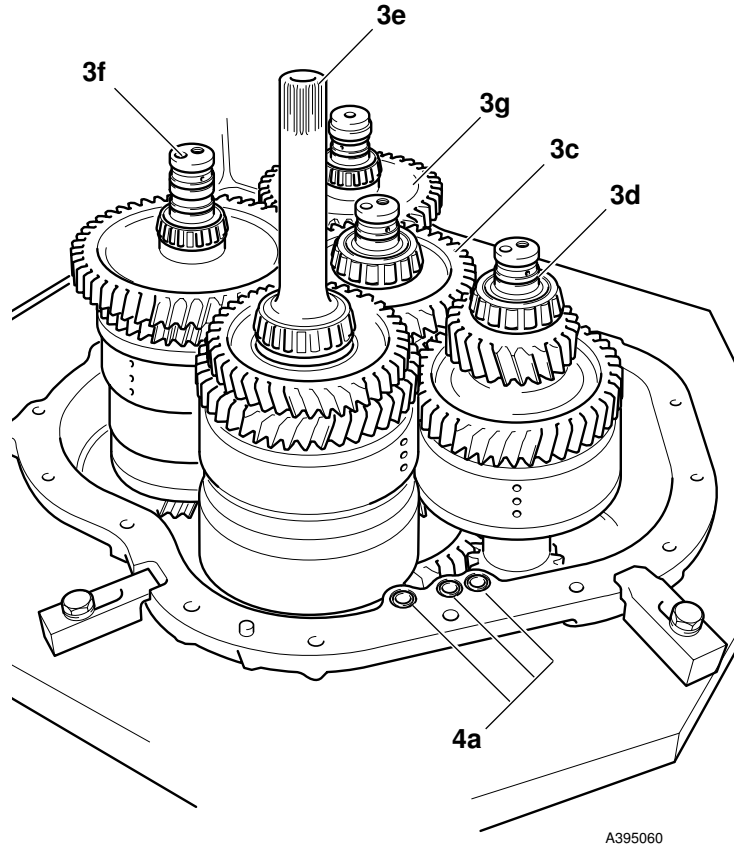
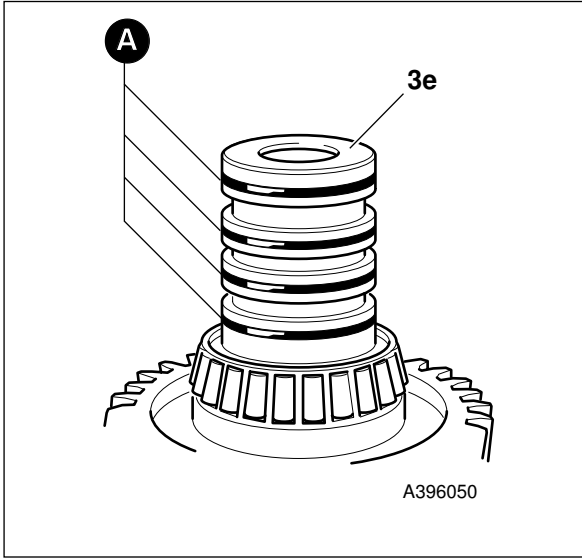
**Note 2:** The inner and outer taper roller bearing assembly (comprising double outer cup **1a**, inner bearing **1c**, spacer **1e** and outer bearing **1f**) is a matched set. Keep all the components together in their original relationships. Components from another set are not interchangeable. If any components are worn or damaged the whole assembly must be renewed as a complete matched set.

- a** Make sure that you have fitted the layshaft outer bearing cup, see **Note 1** above. Fit the bearing double outer cup **1a** into the casing. Note the correct way up of circlip **1b**, with the chamfer uppermost. Make sure that the circlip locates fully in its groove as shown at **B**. The tangs of the circlip must not overhang the inner diameter of the bearing cup **1a**. An incorrectly located circlip can foul and damage the outer bearing.
- b** Push the inner bearing **1c** onto the transfer gear/shaft **1d** followed by spacer **1e**.
- d** Locate the transfer gear assembly in the casing from inside. Using service tool 892/01083 retain the gear in position (shown at **C**). If the gear is not held in position the bearings may be damaged during assembly.
- c** Using service tool 892/01084 push on the outer bearing **1f**. Using service tool 892/01085 fit a new oil seal **1g**. Make sure the seal is pushed square to the housing.
- e** Fit yoke **1h** followed by thick washer **1j** and bolt **1k**. Hold the yoke using service tool 892/00812 and torque tighten the bolt to 400 Nm (295 lbf ft).
- f** If applicable fit the speed sensor **11f**. Make sure that the sealing 'O' ring is correctly located and then torque tighten the bolt to 28Nm (20 lbf ft).

### 2 Checking Transfer Gear/Output Shaft Assembly End Float

The transfer gear/output shaft and its associated components are manufactured using a 'Setright' system. Measure the rolling torque at the yoke **1h**. Provided components have been assembled correctly the torque will be between 0.6 and 2.2 Nm (0.5 and 1.6 lbf ft).





## Assembly (cont'd)

### 3 Fit the Clutch/Shaft Assemblies

- a Fit the bearing outer cups at their correct locations in the rear case **3a** and centre of the transfer gear **3b**.
- b Carefully fit the clutch/shaft assemblies in the following order:

**Note:** When fitting the layshaft clutch take care not to damage the rear bearing on the transfer gear teeth.

**Note:** Before fitting the input clutch shaft make sure that the 4 sealing rings (shown at **A**) are in good condition and lubricated with oil.

**3c** - Mainshaft clutch

**3d** - Layshaft clutch

**3e** - Forward/Input clutch shaft

**3f** - Reverse clutch unit

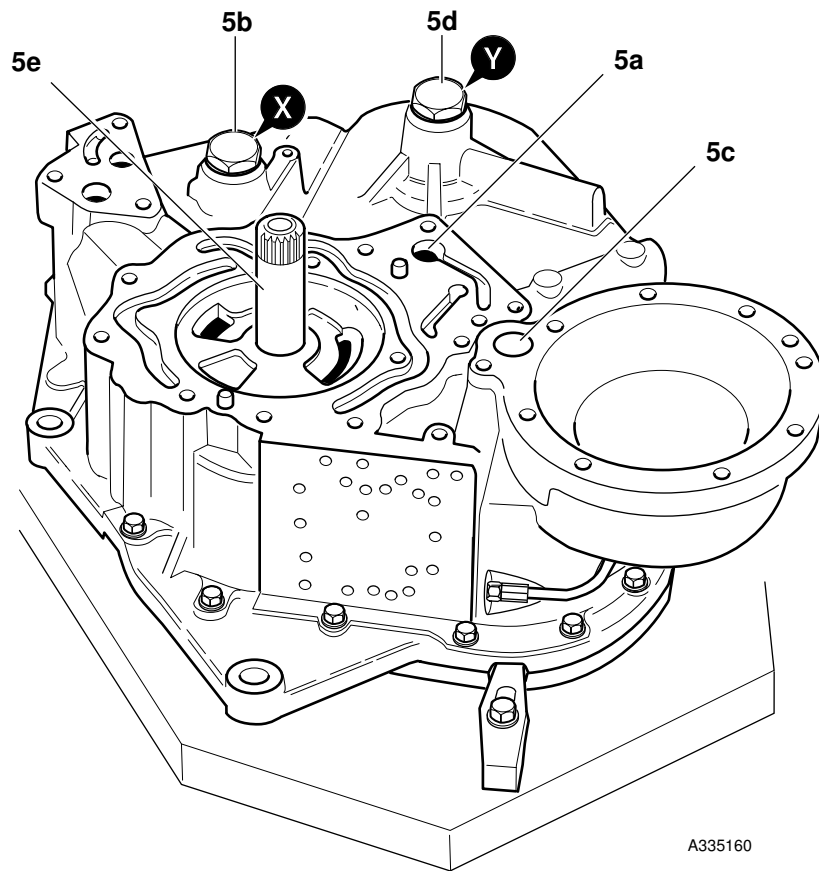
**3g** - 6 speed clutch shaft (not fitted to **4x4 Gearbox**)

- c Make sure that the sealing rings on the ends of the clutch shafts **3c**, **3d**, **3f** and **3g** are in good condition and lubricated with oil.  
**4x4 Gearbox:** clutch **3g** (6 speed) not fitted.

### 4 Assemble the Front and Rear Casings

- a Make sure that the 3 off 'O' rings **4a** are correctly fitted to the rear case.
- b Apply a thin bead of JCB Multigasket to the rear casing mating face as shown at **B**.
- c Make sure that the shaft bearing outer cups are correctly located in the front case **4b** and then carefully lower the case over the clutch shafts until it mates with the rear case. Do not use excessive force when fitting the case.
- d Fit the 17 casing bolts **4c** and progressively torque tighten to 56 Nm (41 lbf ft).





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## Assembly (cont'd)

### 5 Checking the Clutch Shaft End Floats

Provided components are assembled correctly the end float will be within the limits given. Check that the shafts can be rotated by hand (turn the input shaft and output yoke). The shafts should rotate smoothly. The end floats can be checked to confirm correct assembly.

End float for all shafts will be within the range 0.02 mm to 0.16 mm (0.0008 to 0.0063 in).

#### All shafts except the Input Shaft:

Shaft **5a** - Mainshaft

Shaft **5b** - Reverse clutch unit

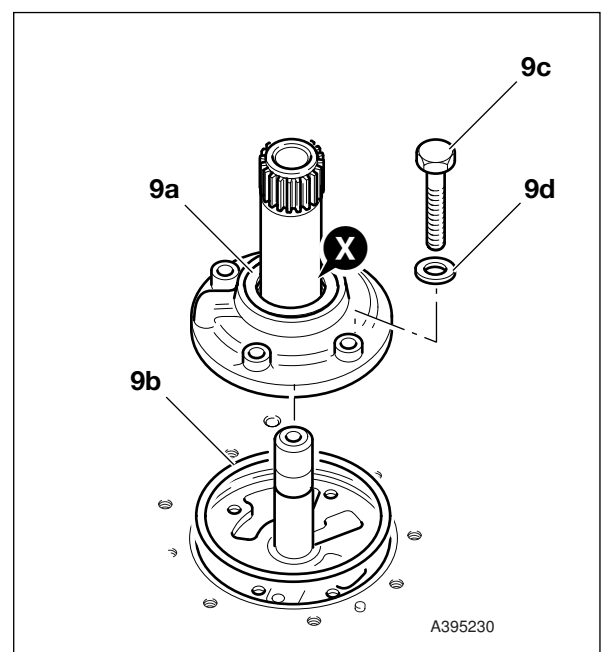
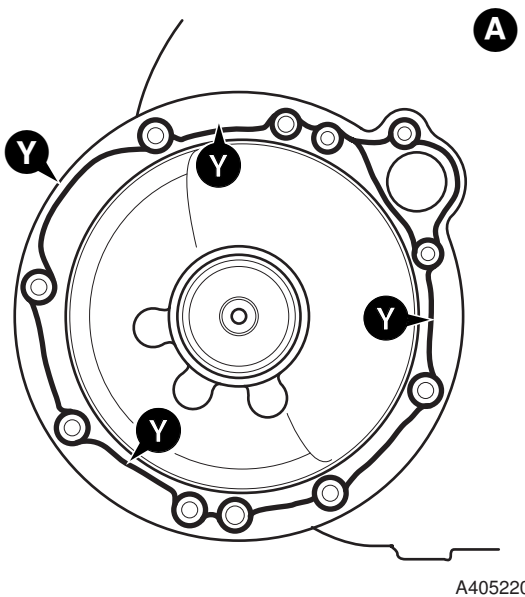
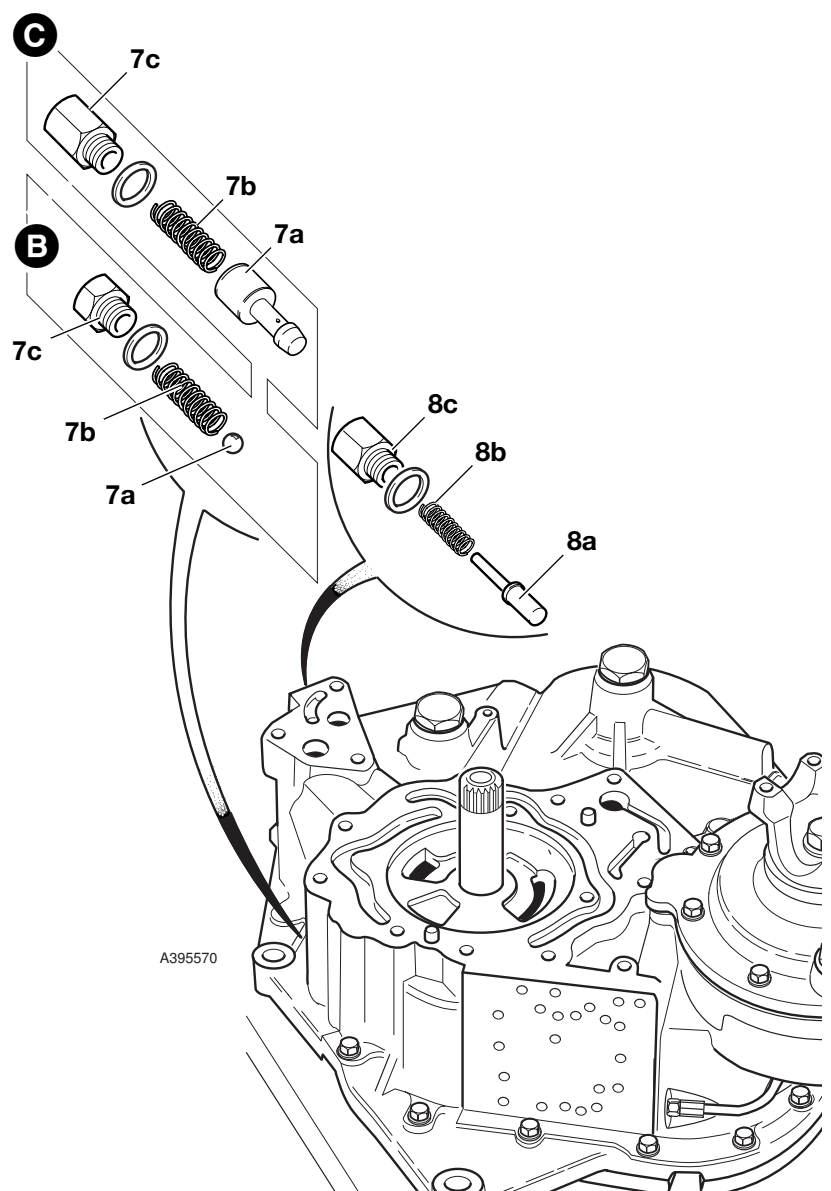
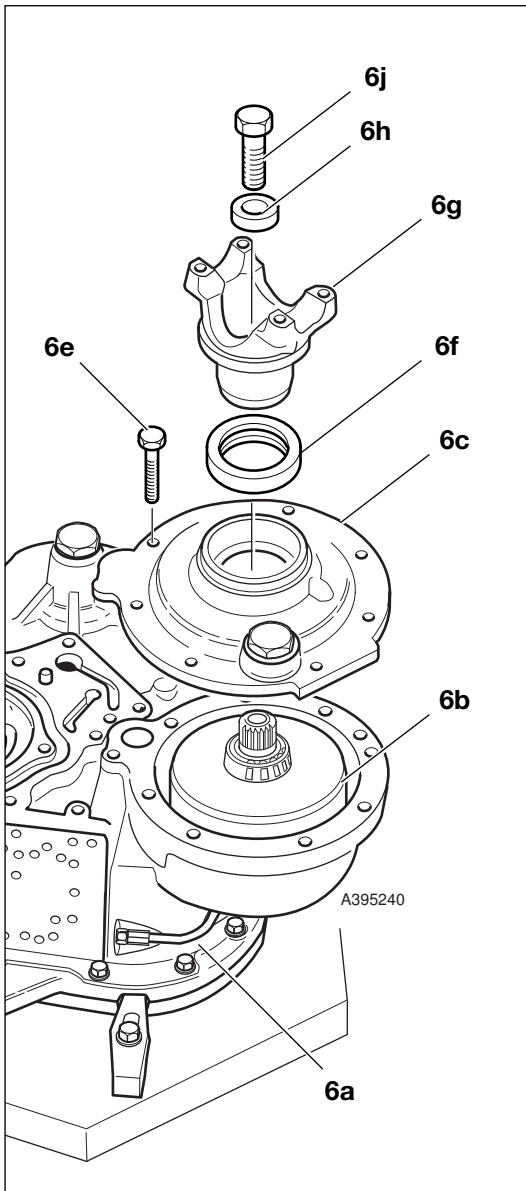
Shaft **5c** - Layshaft

Shaft **5d** - 6 speed shaft (not fitted to 4x4 gearboxes)

- a Remove the plugs **X** and **Y** from the front casing.  
**4x4 Gearbox:** plug **Y** not fitted.
- b Fit a bolt to the threaded hole in the end of the shafts. Pull up on the bolt to detect excessive end float. Remove the bolt.
- c Apply JCB Threadlocker and Sealer to the plugs **X** and **Y** as applicable. Torque tighten the plugs to 102 Nm (75 lbf ft).

#### Input Clutch Shaft:

- a Pull on the input shaft **5e** to detect excessive end float.



## Assembly (cont'd)

### 6 Fit the 4WD Clutch Assembly

- a Fit the 4WD clutch oil feed pipe **6a** at the casing.
- b Make sure the shaft bearing outer cup is correctly located in the front casing (not shown) and then locate the clutch and shaft assembly **6b** in the the housing.
- \* c Make sure that the front and 4WD casing (**6c**) mating faces are clean and undamaged. Apply a 3 mm bead of Loctite 509 to the front casing as shown at **A**. Note that the bead is applied near the inner or outer edge of the flange as applicable at positions **Y**. Make sure that the shaft bearing outer cup (not shown) is correctly located inside the 4WD casing and then fit the casing. Fit 8 off bolts **6e** and progressively torque tighten to 56 Nm

#### Check the 4WD clutch shaft end float:

Provided components are assembled correctly the end float will be within the limits given. Rotate the shaft by hand, it should rotate smoothly.

The end float can be checked to confirm correct assembly. End float must be within the range 0.01 mm to 0.16 mm (0.0004 to 0.0063 in).

- d Fit a bolt to the threaded hole in the end of the shaft. Pull up on the bolt to detect excessive end float.
- e Fit a new oil seal **6f**. Make sure the seal is pushed square to the housing.
- f Fit the output yoke **6g**, followed by thick washer **6h** and bolt **6j**. Hold the yoke using service tool 892/00812 and at the same time torque tighten the bolt to 400 Nm (295 lbf ft).

### 7 Fit the Torque Converter Relief Valve

- \* **Note:** The torque converter relief valve may be of a ball type (shown at **B**), or poppet type (shown at **C**).

- a Fit the ball or poppet (see note above) **7a** followed by the spring **7b**. Using a new sealing washer fit plug **7c**.

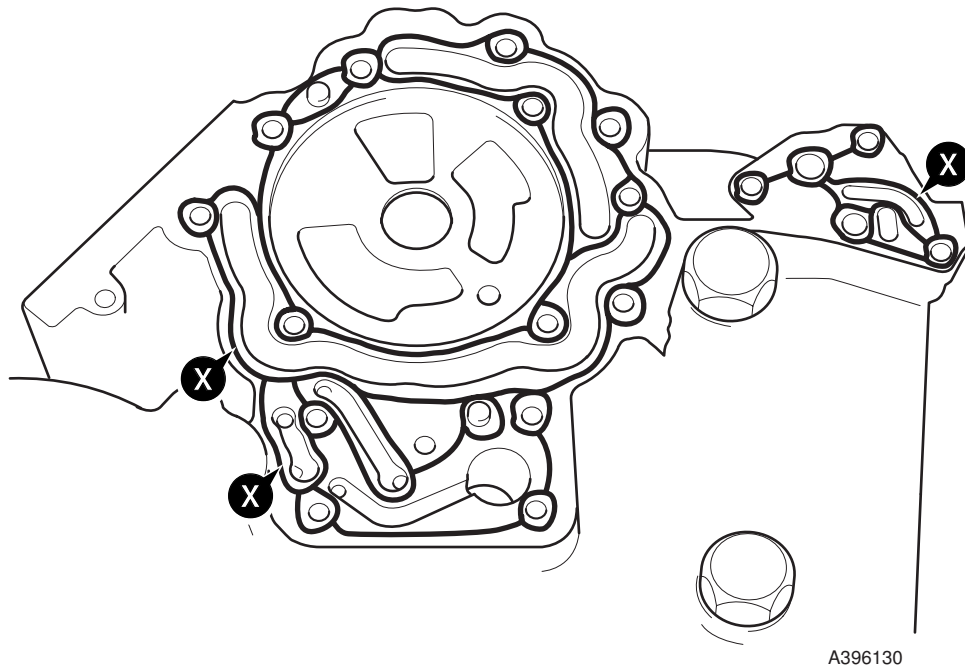
### 8 Fit the Pressure Maintenance Valve

- a Oil the spool **8a** and fit to the casing. Fit spring **8b**. Apply JCB Threadlocker and Sealer to the plug **8c**. Using a new sealing washer fit plug.

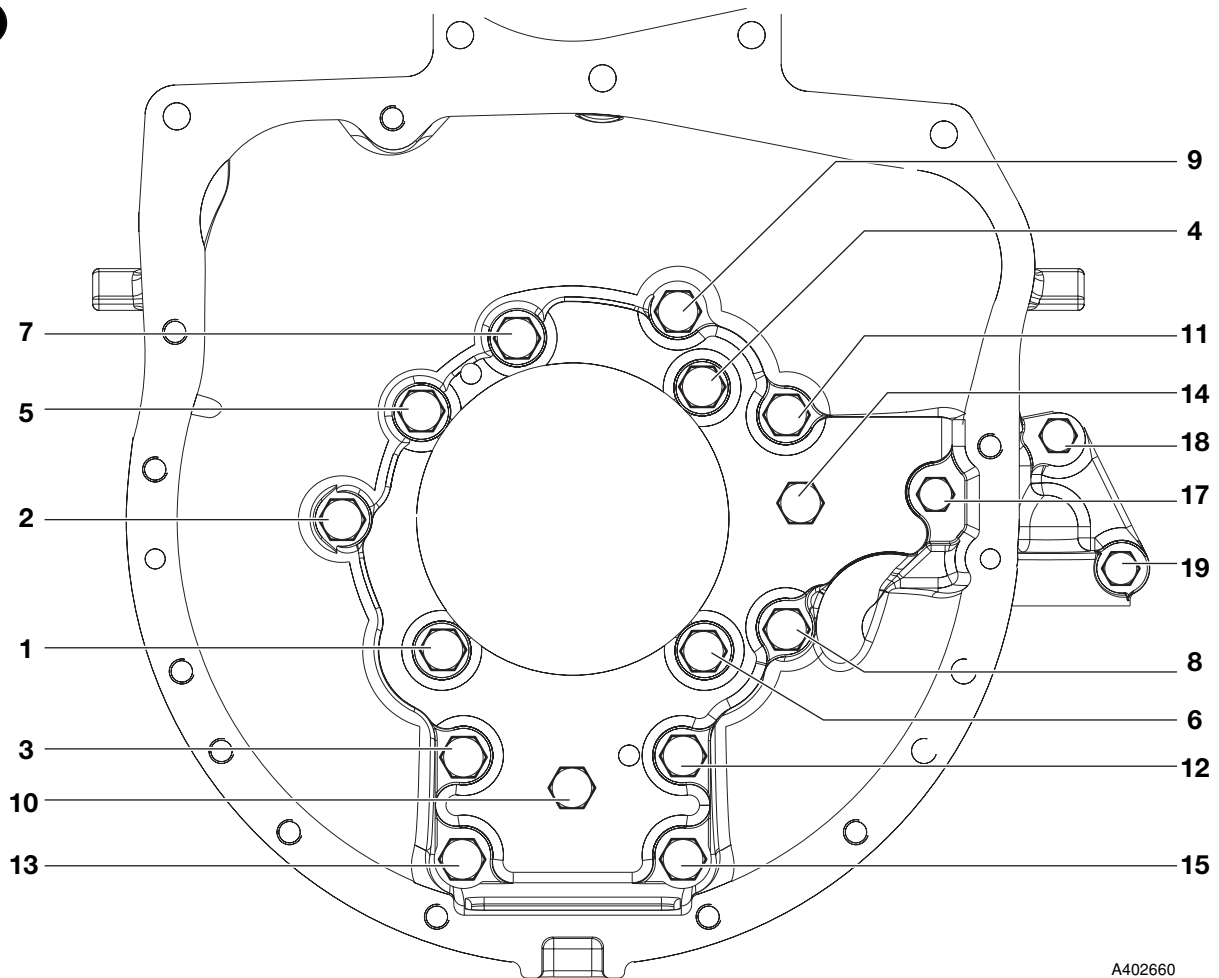
### 9 Fit the Gearbox Hydraulic Pump

- 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**.

A



B



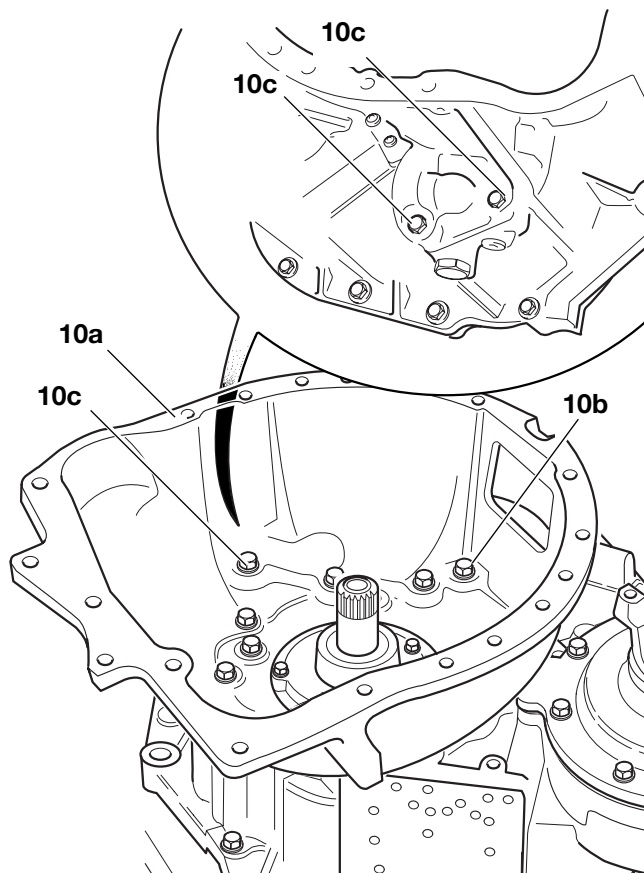
**Assembly (cont'd)**

**10 Fit the Torque Converter Housing - Gearboxes with 18 bolt fix only**

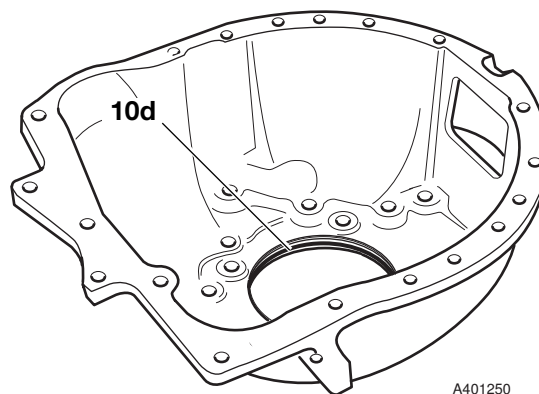
\* **Important Note:** Only the specified sealant can be used. The machine **MUST NOT** be operated for at least 6 hours after sealant has been applied and the converter housing assembled. This is to allow time for the sealant to cure.

**a** Make sure that the front case and torque converter housing (**10a**) mating faces are clean, dry and undamaged. Apply a 3 mm wide bead of Bondloc B574 sealant to the front casing as shown at **A** (pump not shown for clarity). Make sure that sealant is applied between all the port channels as shown. Take extra special care in the area **X** as sealing is critical in these areas. Be sure not to block galleries with sealant. Fit a new 'O' ring **10d** to the housing **10a**.

**b** Carefully locate the torque converter casing on the front case. Fit new 10.9 grade bolts as follows:  
 M10 bolts **10b** (15 off). Note that spacers are fitted under bolts at positions 10 and 14.  
 M8 bolts **10c**. (3 off)  
 Progressively torque tighten the bolts in the sequence shown. Note that the bolt at position 1 is re-torqued after tightening the bolt at position 15.

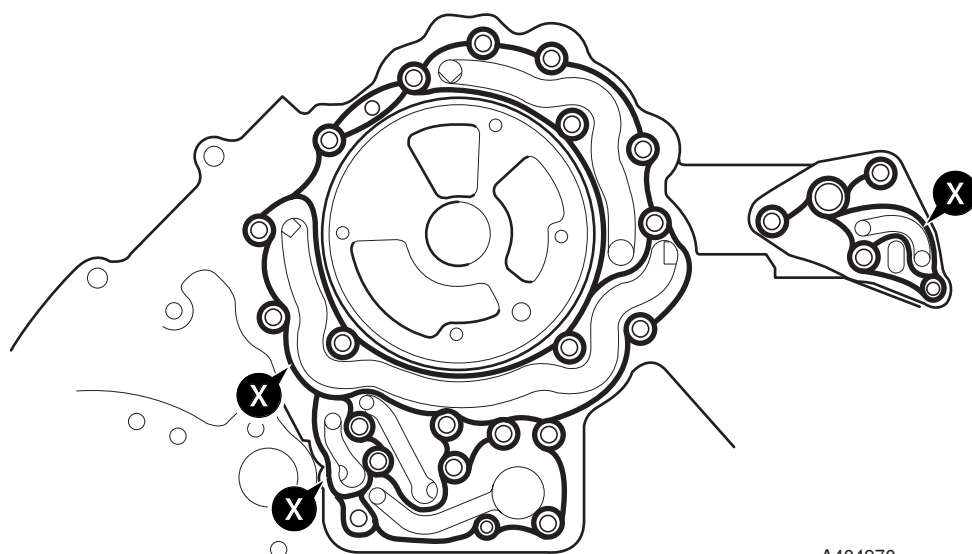


Sequence	Bolt Position (shown at B)	Torque	
		Nm	lbf ft
1 - 9	1 - 9	78	57.5
10	10	60	44.25
11 - 13	11 - 13	78	57.5
14	14	60	44.25
15	15	78	57.5
16	1 (Re-torque)	78	57.5
17 - 19	17 - 19	38	28



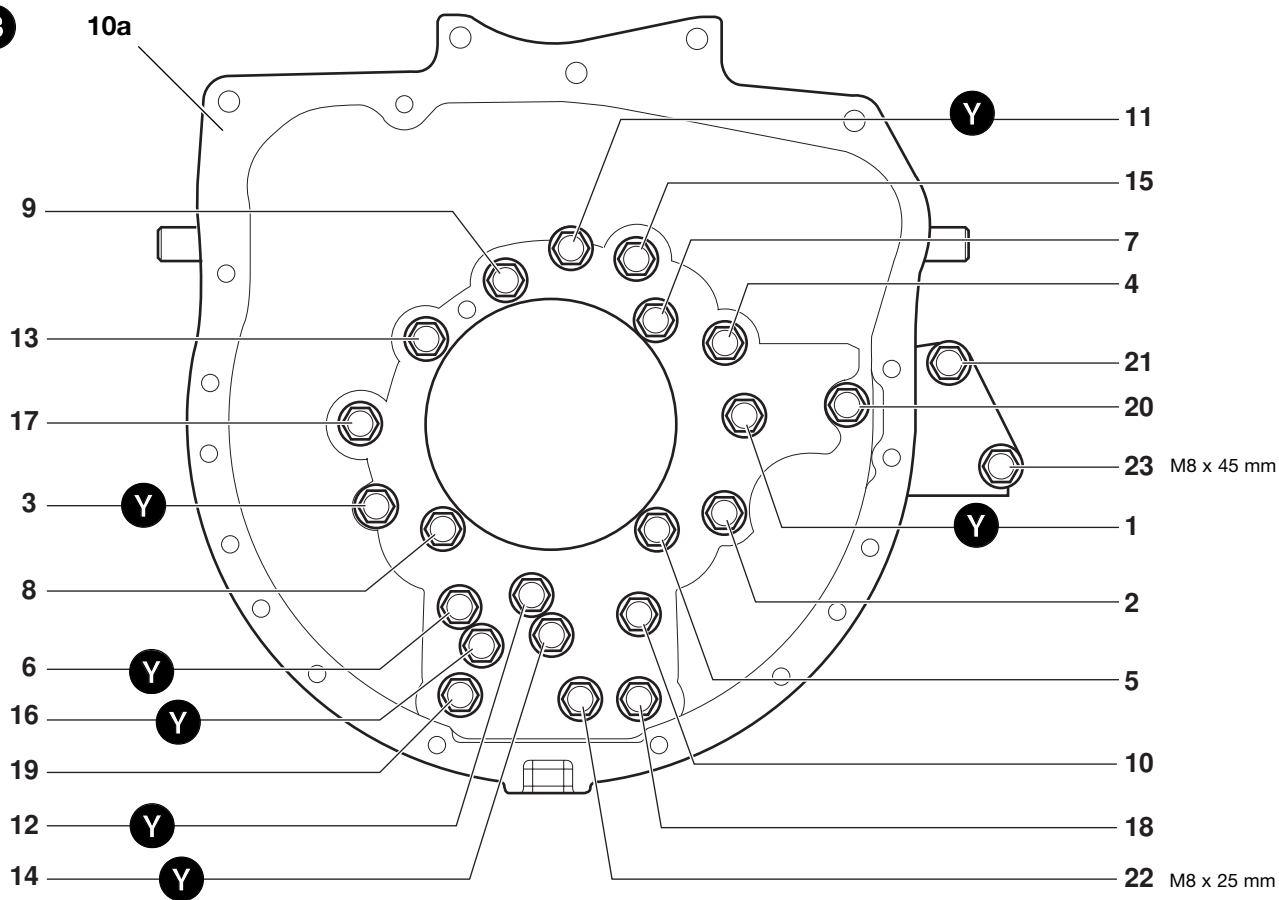
A401250

**A**



A404970

**B**



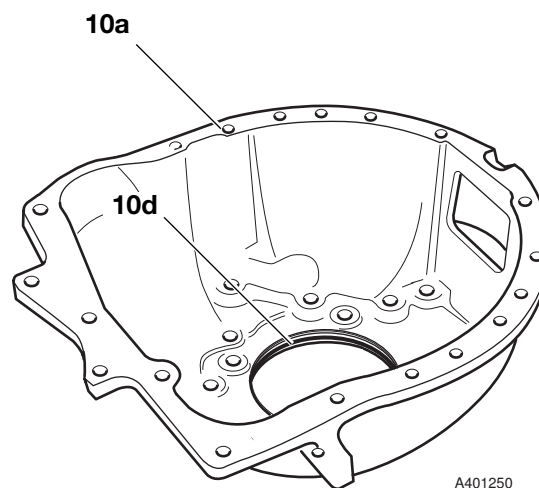
A404980

**Assembly (cont'd)****10 Fit the Torque Converter Housing - Gearboxes with 23 bolt fix only**

**Important Note:** Only the specified sealant can be used. The machine **MUST NOT** be operated for at least 6 hours after sealant has been applied and the converter housing assembled. This is to allow time for the sealant to cure.

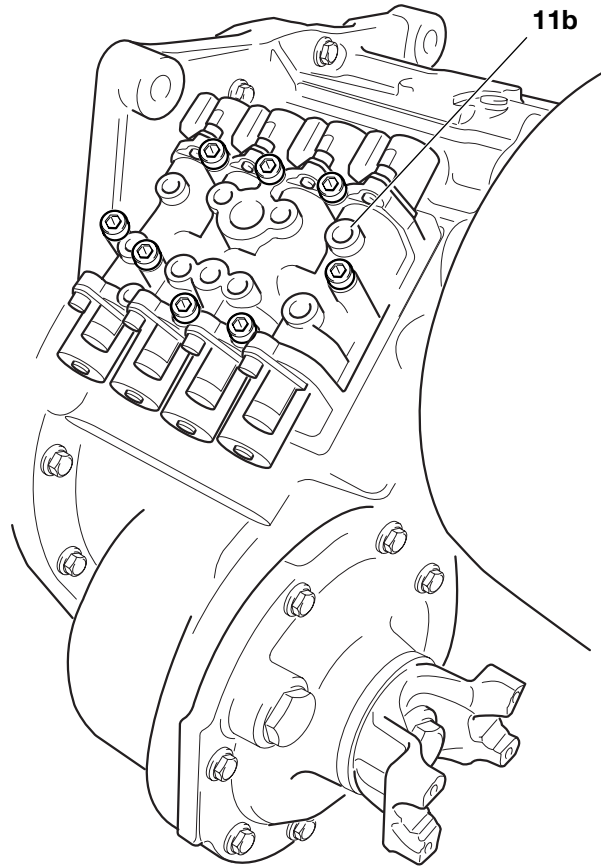
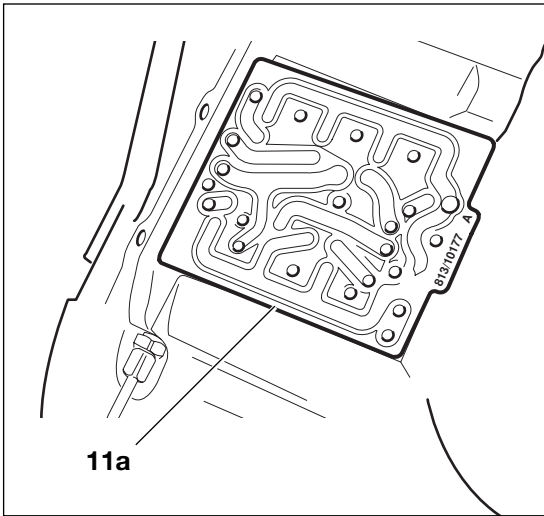
**a** Make sure that the front case and torque converter housing (**10a**) mating faces are clean, dry and undamaged. Apply a 3 mm wide bead of Loctite 509 sealant to the front casing as shown at **A** (pump not shown for clarity). Make sure that sealant is applied between all the port channels as shown. Take extra special care at positions **X** as sealing is critical in these areas. Be sure not to block galleries with sealant. Fit a new 'O' ring **10d** to the housing **10a**.

**b** Carefully locate the torque converter casing on the front case. Fit new 10.9 grade bolts (shown at **B**) as follows:  
M10 x 35 mm bolts (21 off). Note that on some gearboxes spacers are fitted under bolts at positions **Y**.  
M8 x 25 mm bolt at position 22.  
M8 x 45 mm bolt at position 23.  
Progressively torque tighten the bolts in the sequence shown.

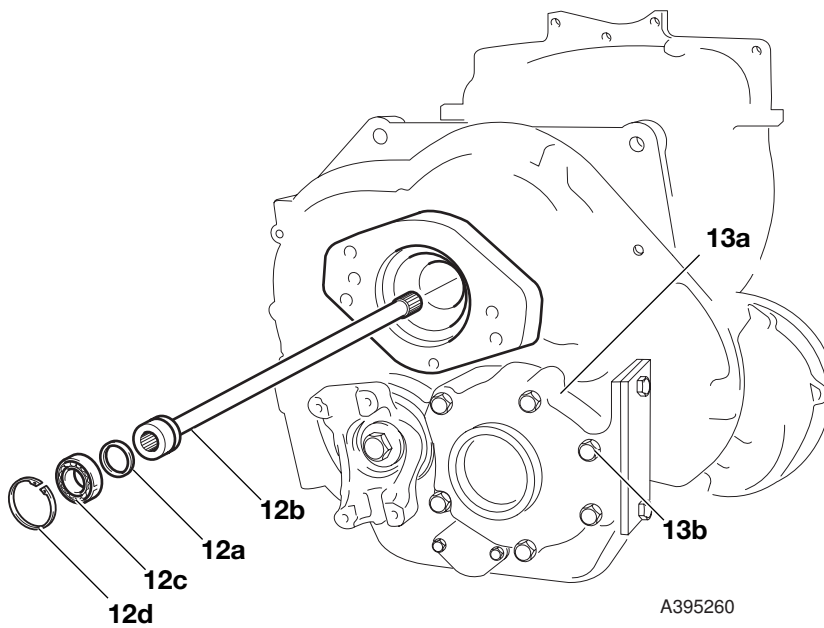


Sequence	Bolt Position (shown at <b>B</b> )	Torque	
		Nm	lbf ft
1 - 21	1 - 21	78	57.5
22 - 23	22 - 23	35 - 40	26 - 30





A390510



A395260

**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**

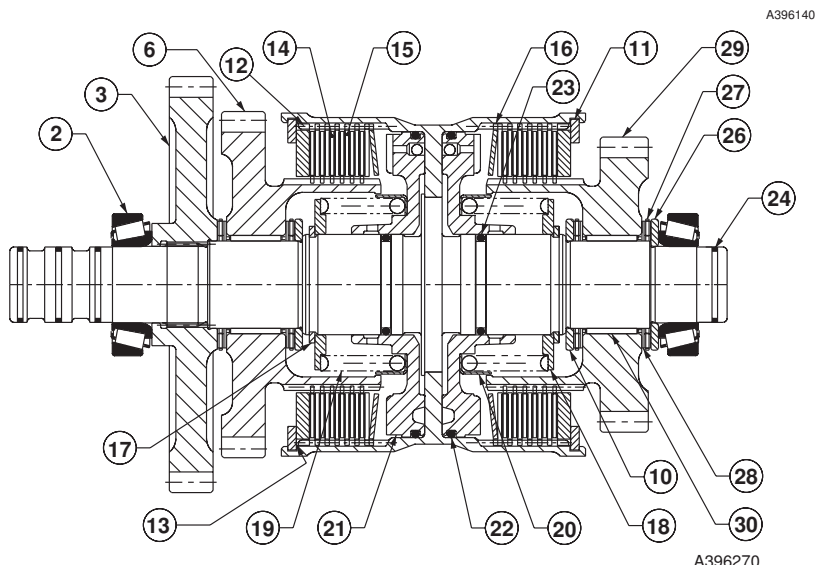
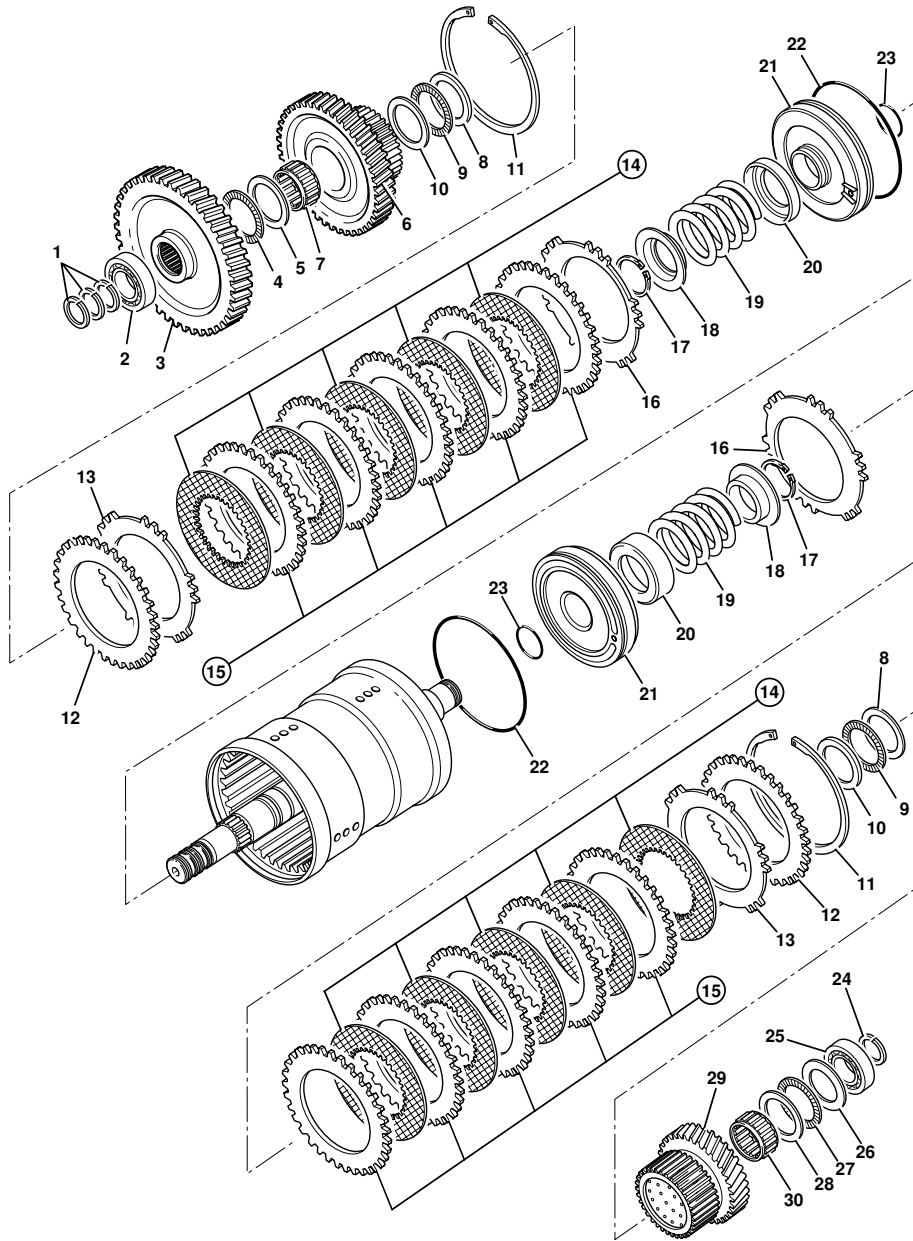
- a** Fit a new sealing ring **12a** to the shaft **12b**. Apply clean oil to the sealing ring and fit the shaft inside the gearbox.
- b** Apply clean oil to the ball bearing **12c**. Fit the bearing followed by circlip **12d**.

**13 Fit the Layshaft Cover**

- a** If applicable fit the layshaft cover **13a**. Make sure the casing mating faces are 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.**

PS 760 - Forward/Input & Reverser Clutch - Dismantling



A396140

A396270

## PS 760 - Forward/Input & Reverser Clutch - Dismantling

**Note:** The illustration shows a reverser shaft assembly for the 6 - speed transmission. The input shaft assembly has some small differences. An explanation of the differences will be given as they occur in the procedure. The input and reverser shaft assemblies for the 6 - speed transmission 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**. The input shaft does not have piston ring seals fitted at this end of the shaft.

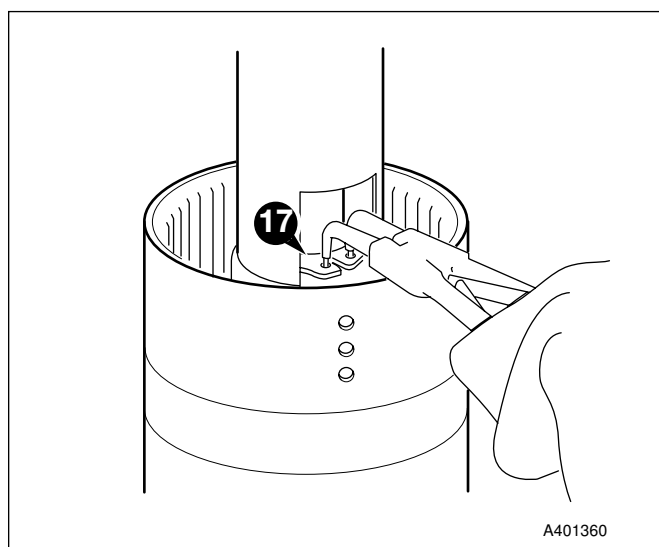
**Note:** If the piston ring seals are excessively worn then check for burrs or damage on the shaft grooves. If necessary remove burrs with a fine grade abrasion paper and oil.

- 2 Remove the clutch end bearing **2** and gear **3**, using a puller or press.
- 3 Remove the thrust bearing **4** and thin thrust washer **5**.
- 4 Withdraw the gear and splined hub **6** with the needle roller bearing **7**.
- 5 Remove thrust bearing **9** and thick and thin thrust washers **8** and **10**.
- 6 Remove the friction/counter plates retaining circlip **11**.
- 7 Remove pressure end plate **13** and shim **12**, if fitted.
- 8 Remove the friction plates **14** and counter plates **15**. Keep them together in sets, DO NOT mix the plates with those from other clutches.
- 9 Remove disc spring assembly **16**.
- 10 Position clutch assembly in a suitable press, with a cut away tube compress the piston spring then remove circlip **17**.

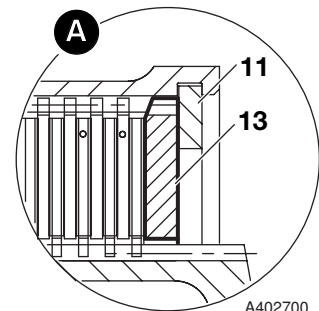
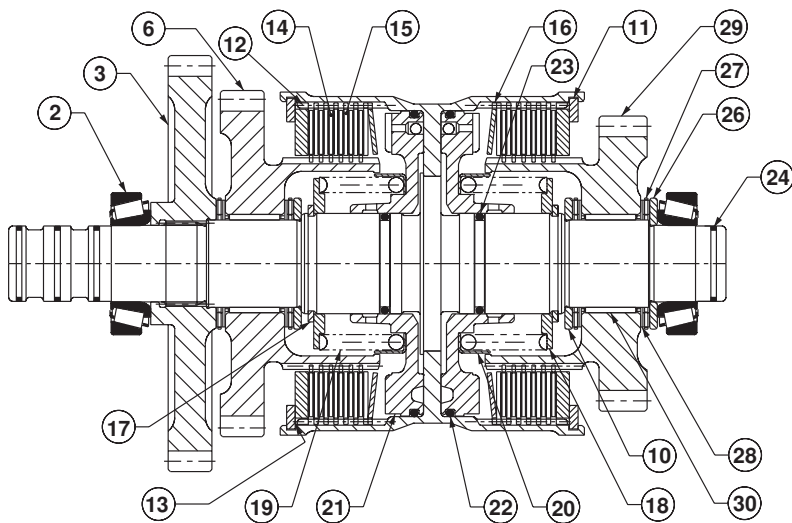
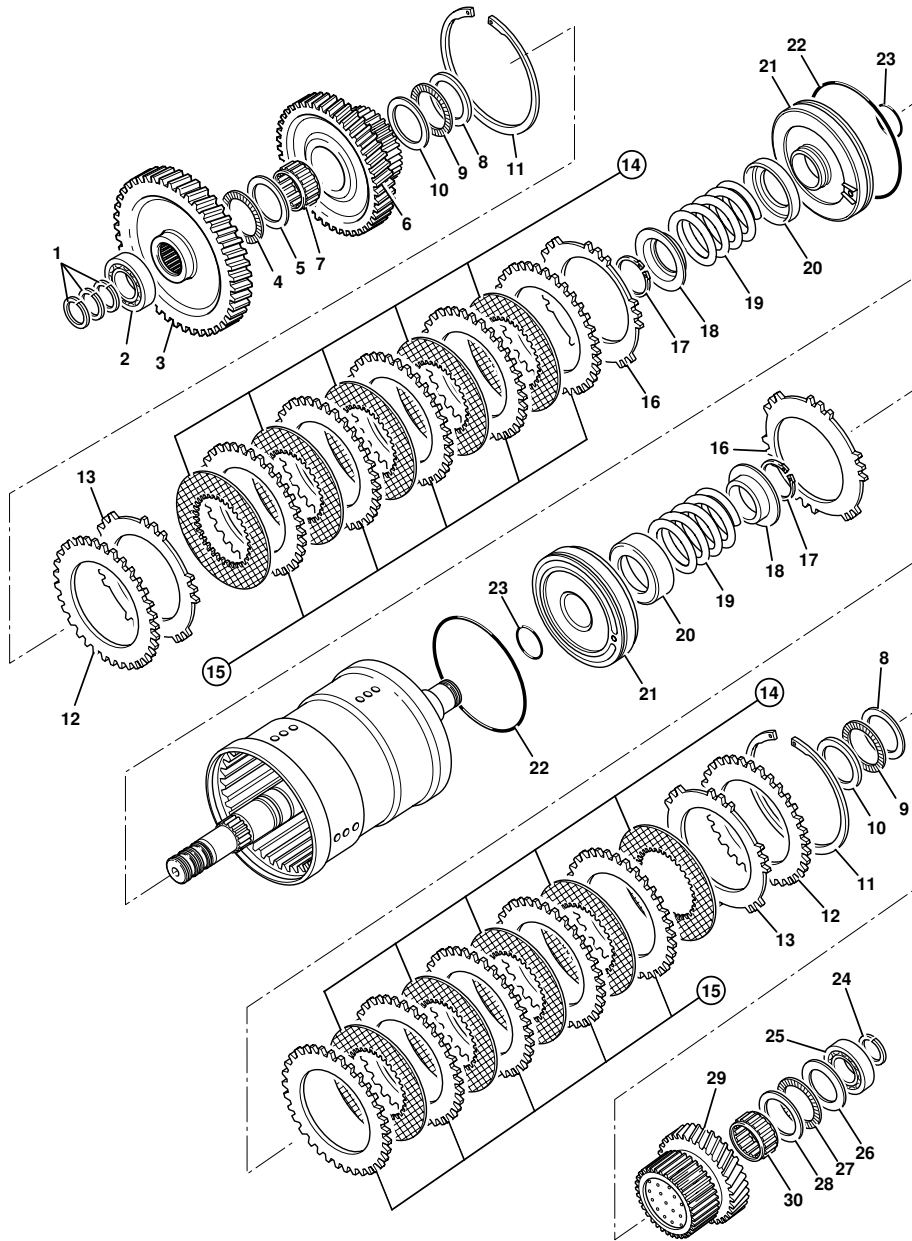
- 11 Lift off spring retaining plate **18**.
- 12 Remove spring **19** and oil baffle **20**.
- 13 Turn the assembly over and knock the clutch shaft on a piece of aluminium (or wood) to loosen the piston **21**.

**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.

- 14 Remove the piston **21**. Remove and discard the piston 'O' ring **22** and shaft 'O' ring **23**.
- 15 To dismantle the opposite clutch, carefully remove piston ring seal **24**. The input shaft has four piston ring seals fitted at this end of the shaft.
- 16 Loosen the clutch end bearing **25** and remove using a puller.
- 17 Remove thrust bearing **27** and thick and thin thru washers **26** and **28**.
- 18 Withdraw the gear and splined hub **29** with the needle roller bearing **30**.
- 19 Repeat steps **5** to **14** to dismantle the clutch assembly.



PS 760 - Forward/Input & Reverser Clutch - Assembly



A396140

A396270

## PS 760 - Forward/Input & Reverser Clutch - 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 and new 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.

Take care when handling disc spring assemblies **16** to avoid marking or damage, which could result in stress cracking. If in doubt fit a new disc spring.

**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 occur.

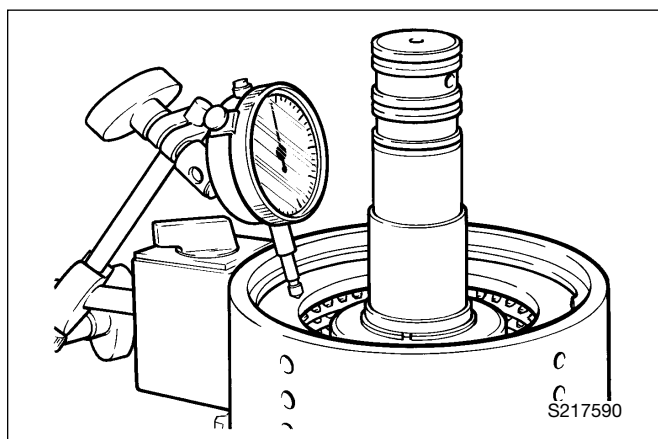
- 1 Fit new 'O' rings **23** and **22**. Lubricate the piston **21** with oil and press fully into bore of clutch housing.
- 2 Fit the oil baffle **20**, piston spring **19**, make sure the spring seats in the piston.
- 3 Fit the spring retaining plate **18**.
- 4 Compress the spring and secure with circlip **17**.
- 5 Fit the disc spring assembly **16**. Make sure that the disc spring is fitted with the teeth towards the clutch pack. Make sure the teeth are not aligned with the lubrication slots in the housing.
- 6 Fit one counter plate **15**, followed by one friction plate **14**. Continue fitting alternate counter and friction plates, finishing with a friction plate.
- \*7 Fit the pressure end plate **13**. Make sure that the chamfered face is fitted facing the clutch pack as shown at **A**. Make sure the teeth are not aligned with the lubrication slots in the housing. Do not fit shim **12** at this stage.
- 8 Fit the clutch friction/counter plates retaining circlip **11**.

- 9 Using a dial test indicator as shown, measure the end float of the pressure end plate **13**, which should be 1.90 to 2.50 mm (0.075 to 0.098 in).

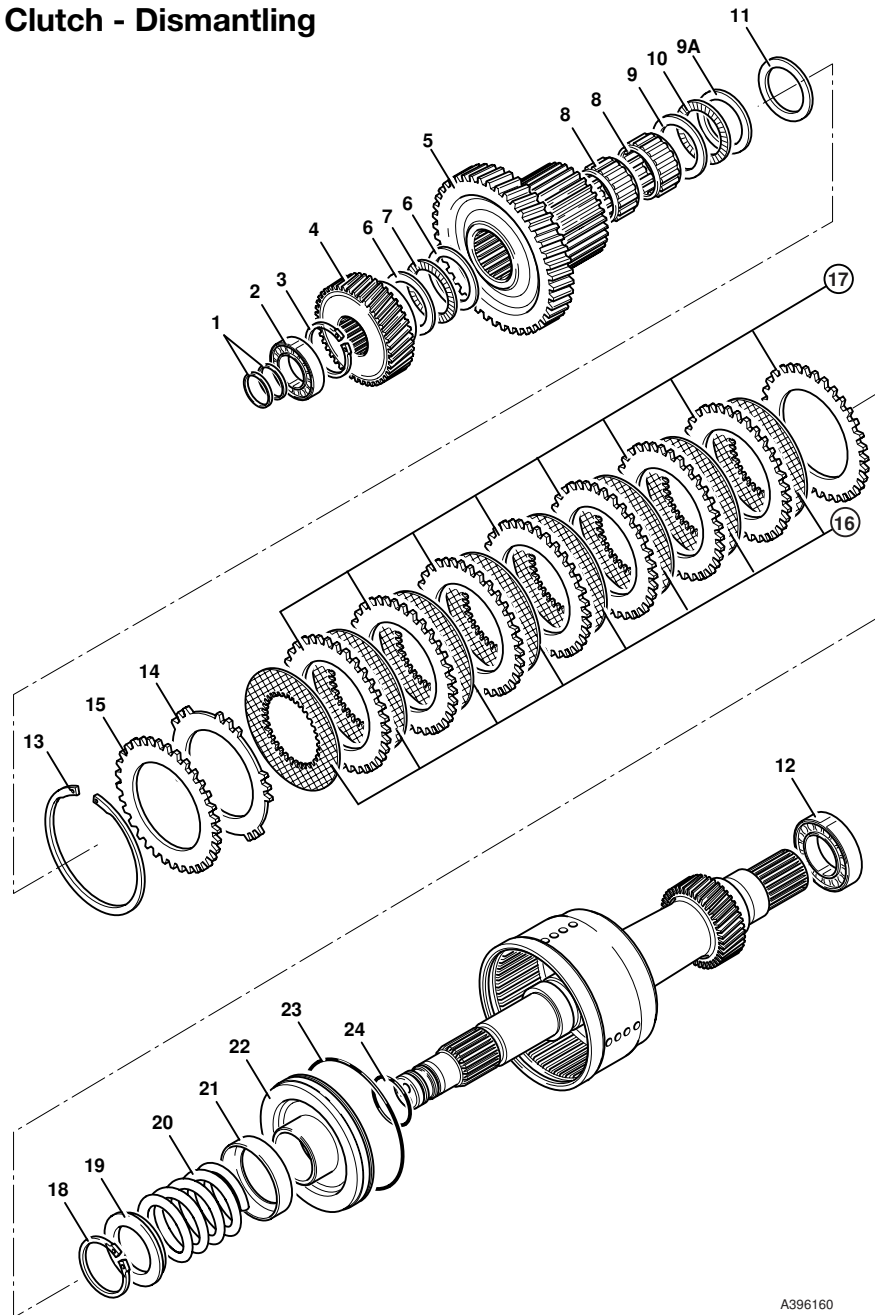
If it is necessary to adjust the end float to bring it within tolerance, there is a choice of fitting a 6.0mm (0.23in) or 6.5mm (0.25in) thick pressure end plate **13**, with either a shim **12** or an extra counter plate **15** between the retaining circlip **11** and pressure end plate **12**.

Use an airline to check the operation of the clutch.

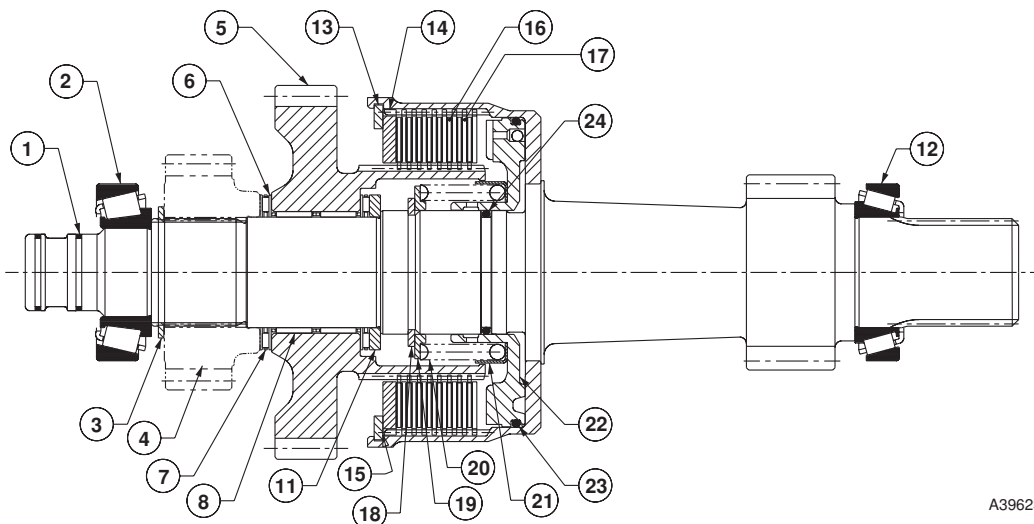
- 10 Fit thick and thin thrust washers **8** and **10**, and thrust bearing **9**.
- 11 Carefully align the teeth of the clutch plates using a thin rod (or screwdriver) and fit the gear and splined hub **6**.
- 12 Fit needle roller bearing **7**.
- 13 Fit thrust bearing **4** and thin thrust washer **5**.
- 14 Smear the clutch end bearing with gearbox oil and press the gear **3** and bearing **2** onto the shaft.
- 15 Fit piston ring seals **1**, refer to **Piston Ring Seals - Fitting Procedure**. The input shaft does not have piston ring seals fitted at this end of the shaft.
- 16 To assemble the opposite clutch repeat steps **1** to **10**.
- 17 Carefully align the teeth of the clutch plates using a thin rod (or screwdriver) and fit the gear and splined hub **29**.
- 18 Fit needle roller bearing **30**.
- 19 Fit thrust bearing **27** and thick and thin thrust washers **26** and **28**.
- 20 Smear the clutch end bearing with gearbox oil and press bearing **25** onto the shaft.
- 21 Fit piston ring seal **24**, refer to **Piston Ring Seals - Fitting Procedure**. The input shaft has four piston ring seals fitted at this end of the shaft.



PS760 - Layshaft Clutch - Dismantling



A396160



A396230

## PS760 - Layshaft Clutch - Dismantling

**Note:** The illustration shows a layshaft assembly for a 6 - speed transmission. The layshaft assembly for a 4 - speed transmission has some small differences. An explanation of the differences will be given as they occur in the procedure.

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 suitable puller or press.

3 Remove circlip 3 and withdraw the 4 wheel drive transfer gear 4. Make a note which way round the gear is fitted for assembly. The 2 wheel drive machines have a spacer fitted instead of a gear.

4 Withdraw the gear and splined hub 5 together with thin thrust washers 6 and thrust bearing 7.

5 Remove the two needle roller bearing assemblies 8. 4-speed transmissions have only one needle roller bearing fitted.

6 \* Remove the thin thrust washer 9, thrust bearing 10, thin thrust washer 9A (if fitted) and thick thrust washer 11.

7 If end bearing 12 is to be removed it must be renewed. Remove the bearing using puller. Discard the bearing.

**Note:** This bearing would not normally be removed unless it was damaged. If a collet tool is not available, then it is permissible to use standard bearing puller, although damage to the bearing cage may be incurred which will require a new bearing.

8 Remove the clutch friction/counter plates retaining circlip 13.

9 Remove pressure end plate 14 and shim 15, if fitted.

10 Remove the clutch friction plates 16 and counter plates 17. Keep them together in sets, DO NOT mix the plates with those from other clutches.

11 Position clutch assembly in a suitable press, with a cut away tube compress the piston spring as shown, then remove circlip 18.

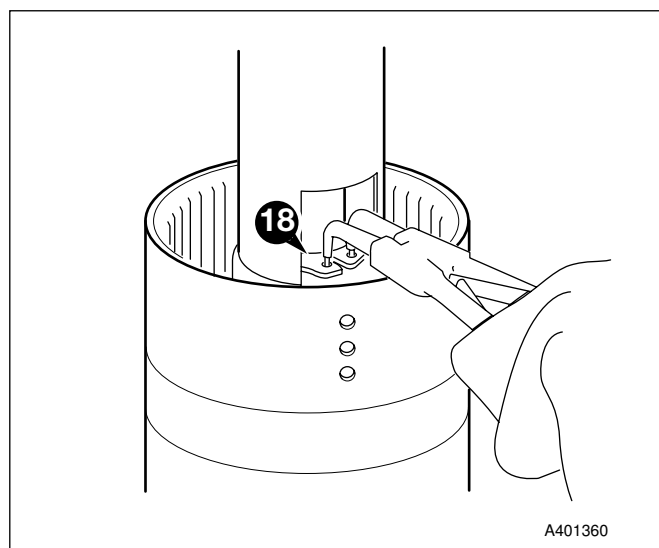
12 Lift off spring retaining plate 19.

13 Remove the spring 20 and oil baffle 21.

14 Turn the assembly over and knock the clutch shaft on a piece of aluminium (or wood) to loosen the piston 22.

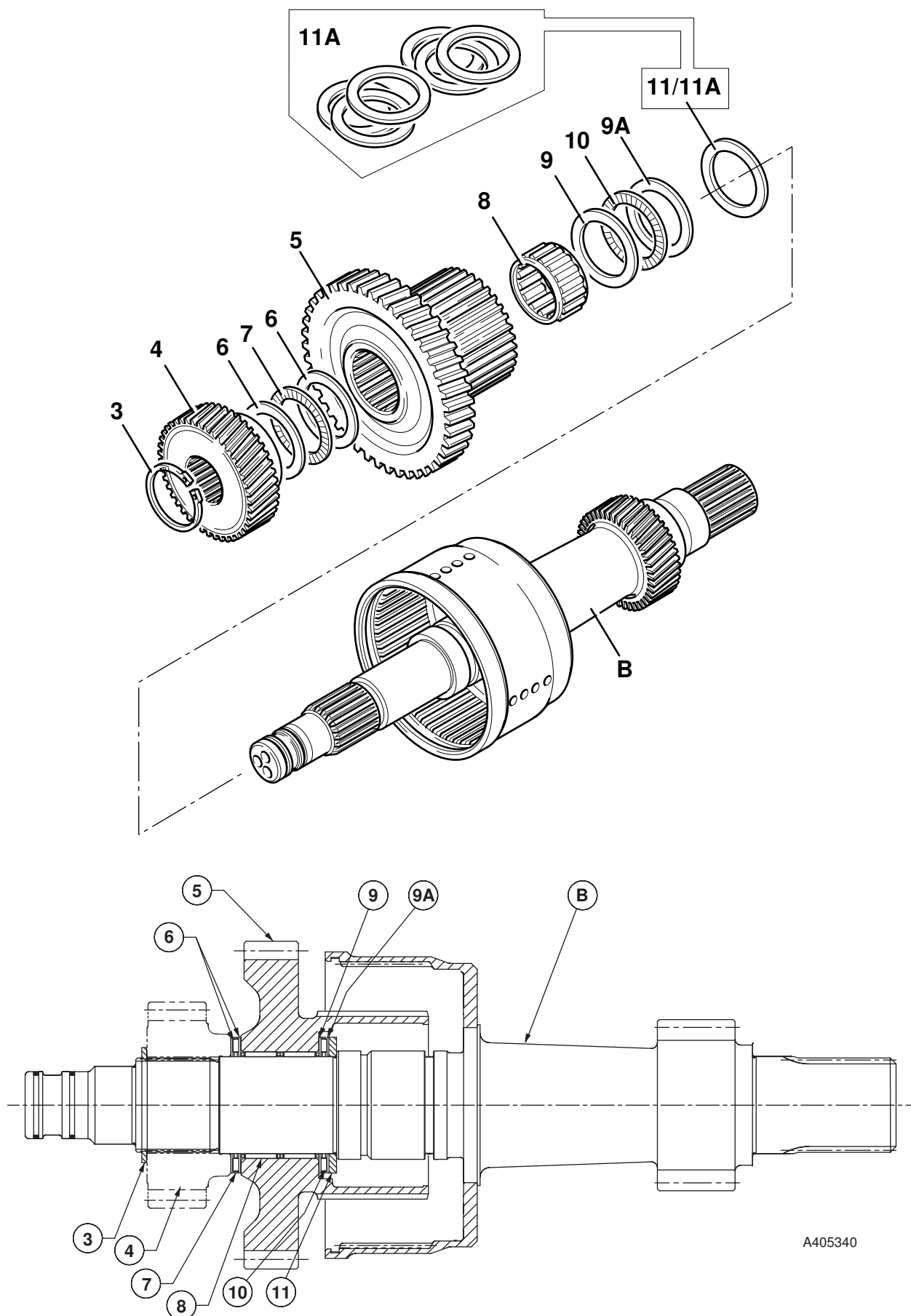
**Note:** If the piston does not loosen when the clutch shaft is knocked on aluminium, then hand pump air down the shaft oil inlet hole.

15 Remove the piston 22. Remove and discard the piston 'O' ring 23 and shaft 'O' ring 24.





PS760 - Layshaft Clutch - Assembly



A405340

## PS760 - Layshaft Clutch - Assembly

### End Float Setting - Plate Carrier and Gear

(Only clutch assemblies fitted with thrust washer **9A**)

Later clutch assemblies feature an additional thrust washer **9A**. If any of the components listed below are to be renewed, the end float of gear **5** must be measured and reset as required:

#### Item

- B** Shaft assembly
- 5** Gear and plate carrier assembly
- 6,7** Thrust washer assembly
- 9,10** Thrust washer assembly
- 4** 4WD transfer gear or spacer as applicable

Check and reset the endfloat of gear **5** as follows:

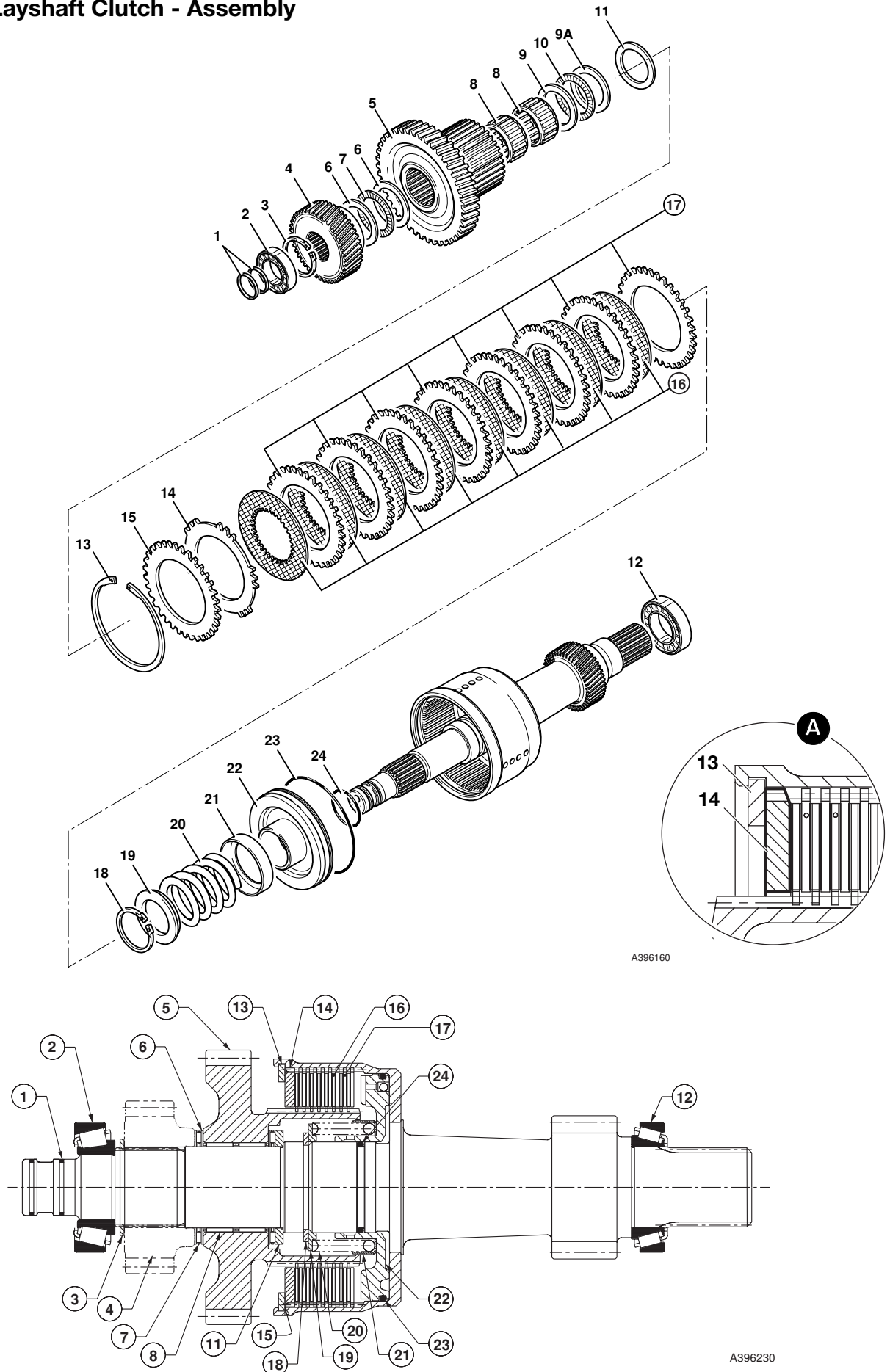
- 1** Temporarily fit thick thrust washer **11**, thin thrust washer **9A**, thrust bearing **10** and thin thrust washer **9**. Fit needle roller bearing **8**.
- 2** Temporarily fit the gear and plate carrier assembly **5**. Fit the thin thrust washer **6** and thrust bearing **7** followed by the remaining thrust washer **6**.
- 3** Temporarily fit the 4 wheel drive transfer gear **4** onto the layshaft spline. Make sure that the gear is fitted the correct way round. 2 wheel drive machines have a spacer fitted instead of a gear. Fit the circlip **3**.
- 4** Make sure that the 4 wheel drive gear (or spacer) is fully seated against circlip **3**. Measure the end float of gear **5**. It must be between 0.01 to 0.15 mm (0.0004 to 0.006 in). If the end float requires adjustment select a suitable thrust washer from **11A** and reassemble the components as described above.

Note: **11A** = kit 823/10420 - comprises 6 thrust washers of the following thicknesses:

- 4.3 mm (0.169 in)
- 4.4 mm (0.173 in)
- 4.5 mm (0.177 in)
- 4.6 mm (0.181 in)
- 4.7 mm (0.185 in)
- 4.8 mm (0.189 in)

- 5** Recheck the end float and then dismantle the components. Assemble the clutch as detailed on the next page. Be sure to fit the correct thrust washer **11** on final assembly.

PS760 - Layshaft Clutch - Assembly



## PS760 - Layshaft Clutch - 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 and new 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 occur.

- 1 Fit new 'O' rings **24** and **23**. Lubricate the piston **22** with oil and press fully into bore of clutch housing.
- 2 Fit oil baffle **21**, piston spring **20**, make sure the spring seats in the piston.
- 3 Fit the spring retaining plate **19**.
- 4 Compress the spring and secure with circlip **18**.
- 5 Fit one counter plate **17** followed by one friction plate **16**. Continue fitting alternate counter and friction plates, finishing with a friction plate.
- 6 Fit the pressure end plate **14**, do not fit shim **15** at this stage. Make sure that the chamfered face is fitted facing the clutch pack as shown at **A**. Make sure the teeth are not aligned with the lubrication slots in the housing.

**Note:** A spring disc is not fitted in this clutch pack.

- 7 Fit the clutch friction/counter plates retaining circlip **13**.
- 8 Using a dial test indicator as shown, measure the end float of the pressure end plate **14**, which should be 1.9 to 2.5 mm (0.075 to 0.098 in).

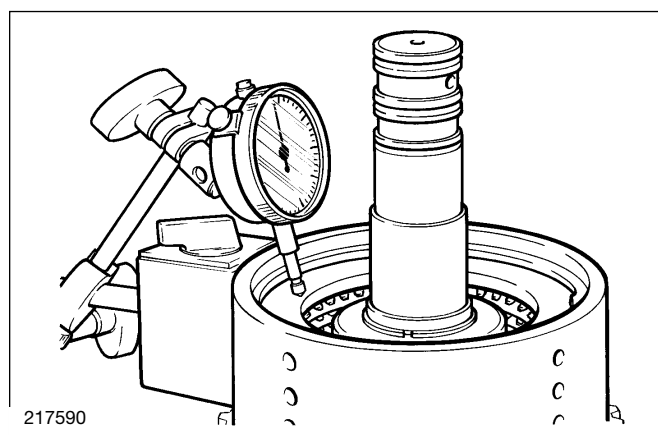
If it is necessary to adjust the end float to bring it within tolerance, there is a choice of fitting a 6.0mm (0.23in) or 6.5mm (0.25in) thick pressure end plate **14**, with either a shim **15** or an extra counter plate **17** between the retaining circlip **13** and pressure end plate **14**.

Use an airline to check the operation of the clutch.

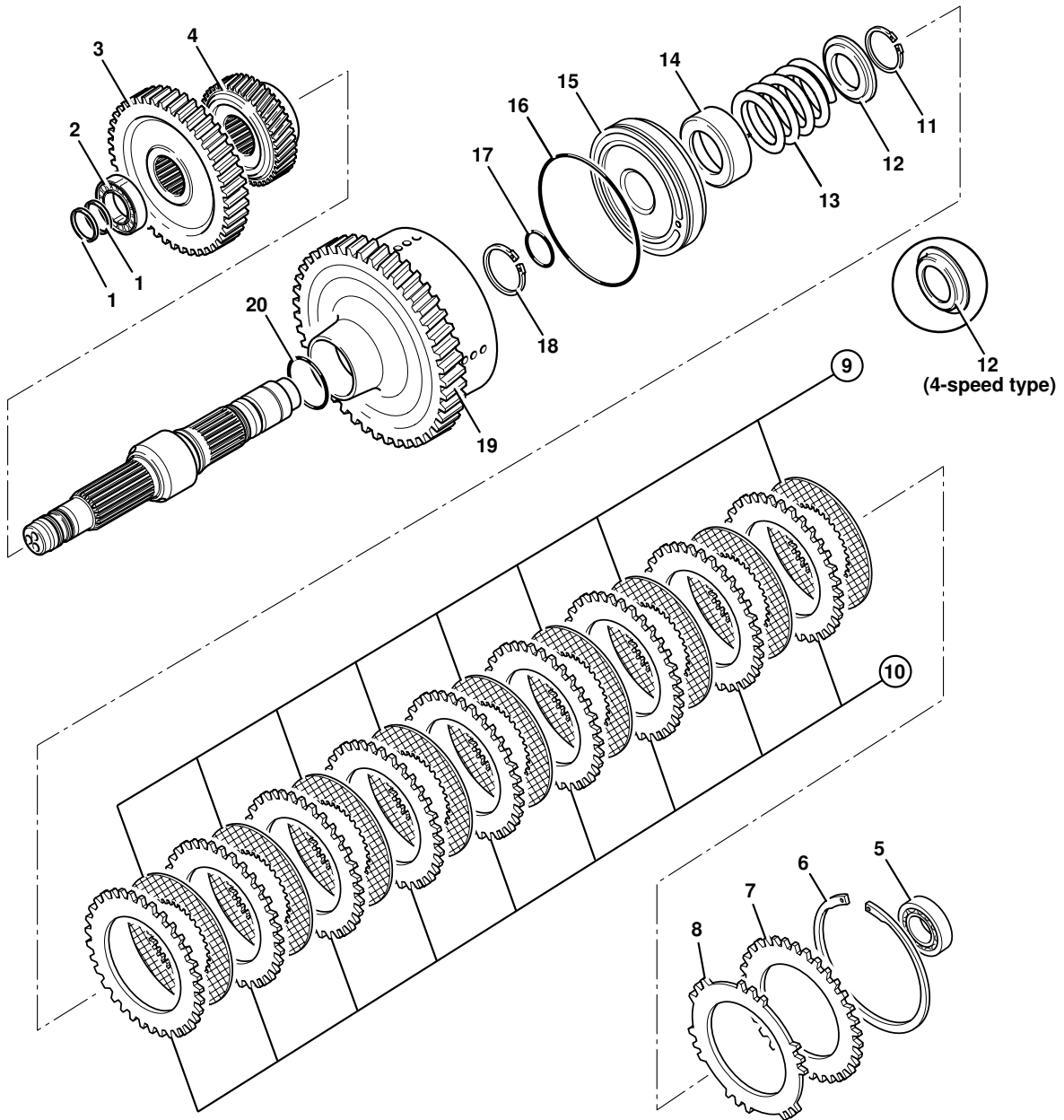
- 9 \* Fit the thick thrust washer **11**, thin thrust washer **9A**†, thrust bearing **10** and thin thrust washer **9**.

\* † Thrust washer **9A** not fitted to early clutch assemblies.

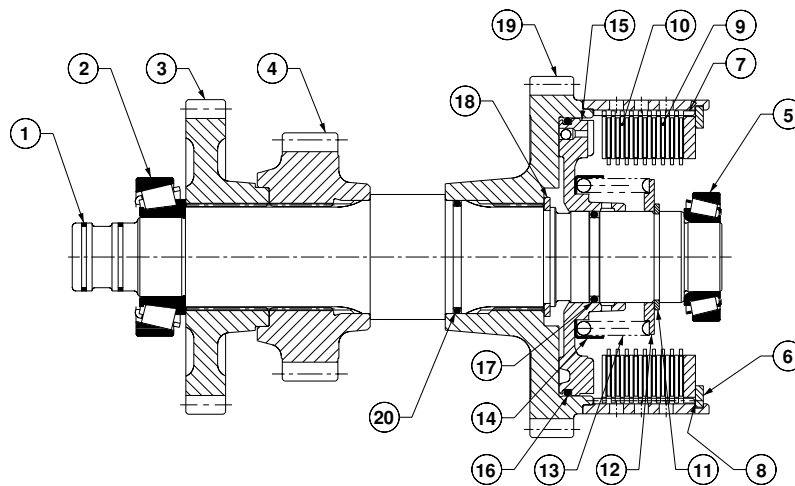
- 10 Fit the two needle roller bearings **8**. The 4-speed transmissions have only one needle roller bearing fitted.
- 11 Carefully align the teeth of the clutch plates using a thin rod (or screwdriver) and fit the gear and splined hub **5**.
- 12 Fit the thin thrust washers **6** and thrust bearing **7**.
- 13 Fit the 4 wheel drive transfer gear **4** onto the layshaft spline. Make sure that the gear is fitted the correct way round. The 2 wheel drive machines have a spacer fitted instead of a gear. Fit the circlip **3**.
- 14 Smear the clutch end bearings **2** and **12** with gearbox oil. Oil and press the bearings onto the shaft.
- 15 Fit piston ring seals **1**, refer to **Piston Ring Seals - Fitting Procedure**.



PS760 - Mainshaft Clutch - Dismantling



A396150



A396250

## 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 occur 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.

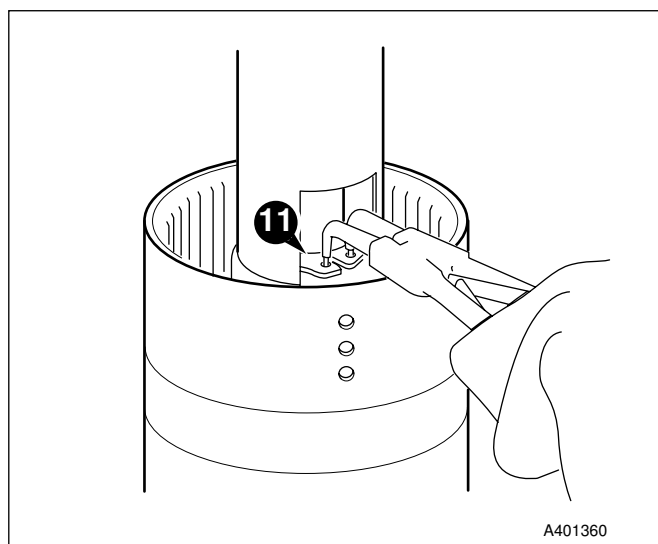
- 10 Remove the spring 13 and oil baffle 14.

- 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.

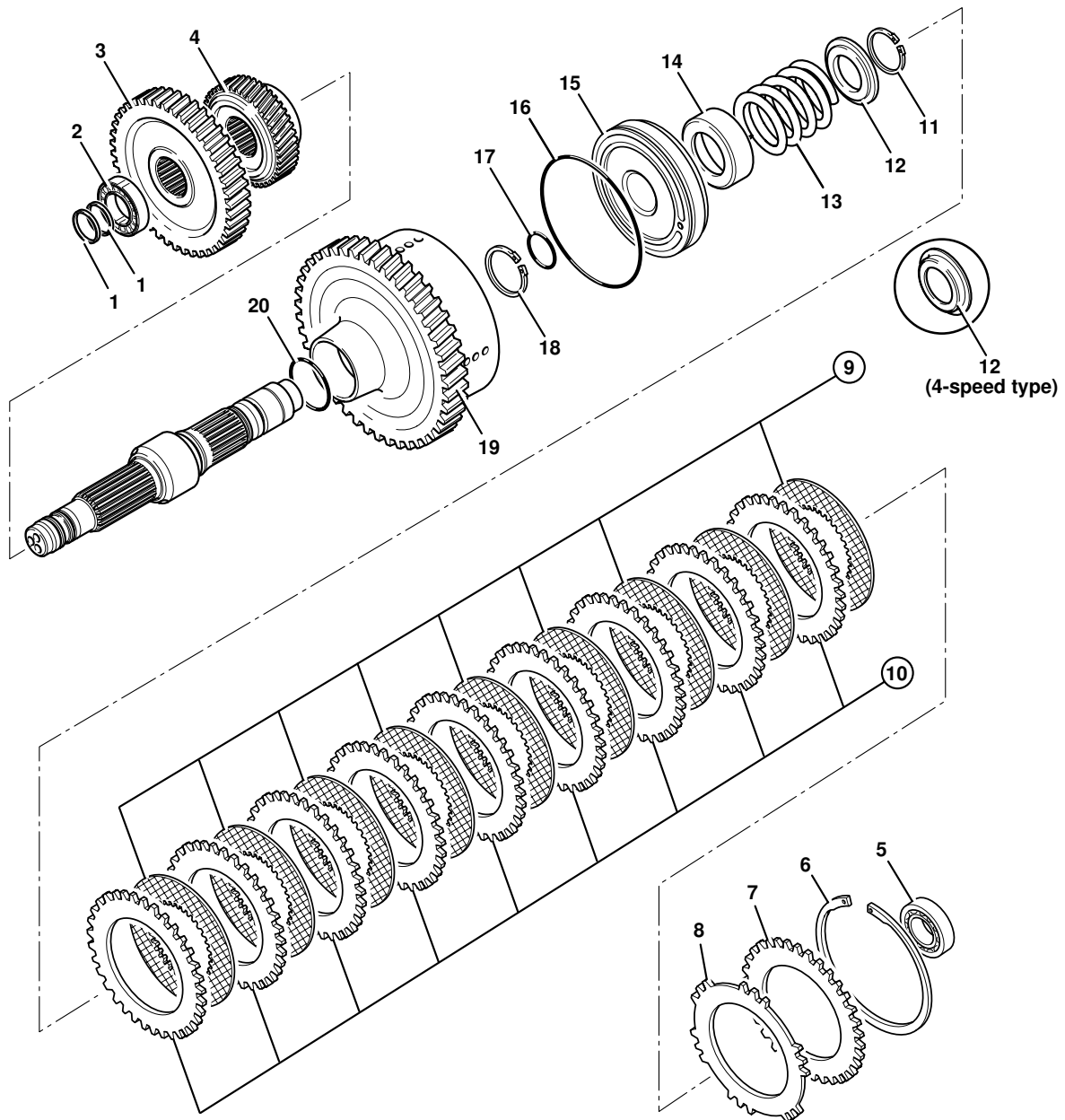
- 12 Remove the piston 15. Remove and discard the piston 'O' ring 16 and shaft 'O' ring 17.

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

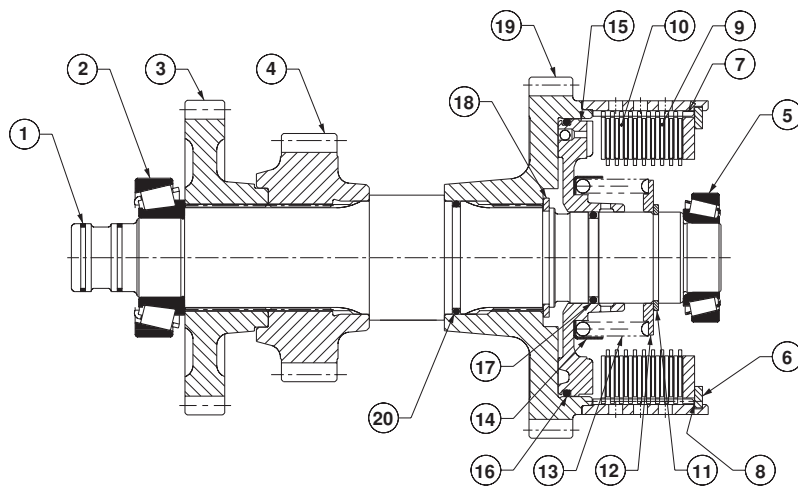


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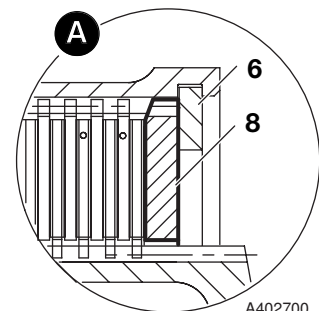
PS760 - Mainshaft Clutch - Assembly



A396150



A396250



A402700

## PS760 - Mainshaft Clutch - 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 and new 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 occur.

- 1 Fit a new 'O' ring **20**.
- 2 Press the clutch housing **19** onto the shaft spline and fit circlip **18**.
- 3 Fit a new 'O' rings **17** and **16**. Lubricate the piston **15** with oil and press fully into bore of clutch housing.
- 4 Fit oil baffle **14**, piston spring **13**, make sure the spring seats in the piston.
- 5 Fit the spring retaining plate **12**. The 4 - speed transmissions have a different shaped spring retaining plate fitted.
- 6 Compress the spring and secure with circlip **11**.
- 7 Fit one counter plate **8** followed by one friction plate **9**. Continue fitting alternate counter and friction plates, finishing with a friction plate.
- \* 8 Fit pressure end plate **7**. Make sure that the chamfered face is fitted facing the clutch pack as shown at **A**. Make sure the teeth are not aligned with the lubrication slots in the housing. Do not fit shim **7** at this stage.

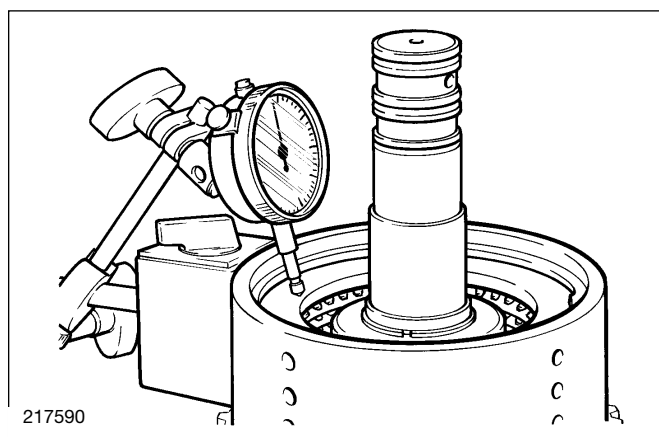
**Note:** A spring disc is not fitted in this clutch pack.

- 9 Fit the clutch friction/counter plate retaining circlip **6**.
- 10 Using a dial test indicator as shown, measure the end float of the pressure end plate **7**, 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 **7**, with either a shim **8** or an extra counter plate **10** between the retaining circlip **6** and pressure end plate **7**.

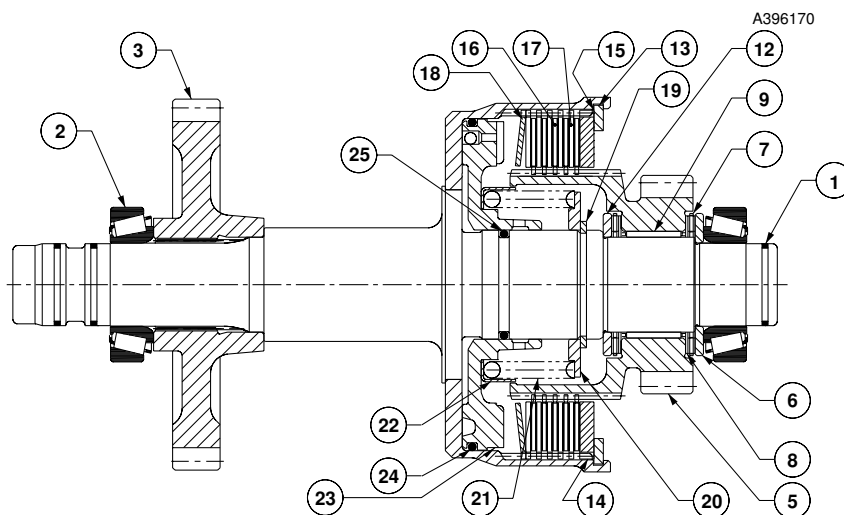
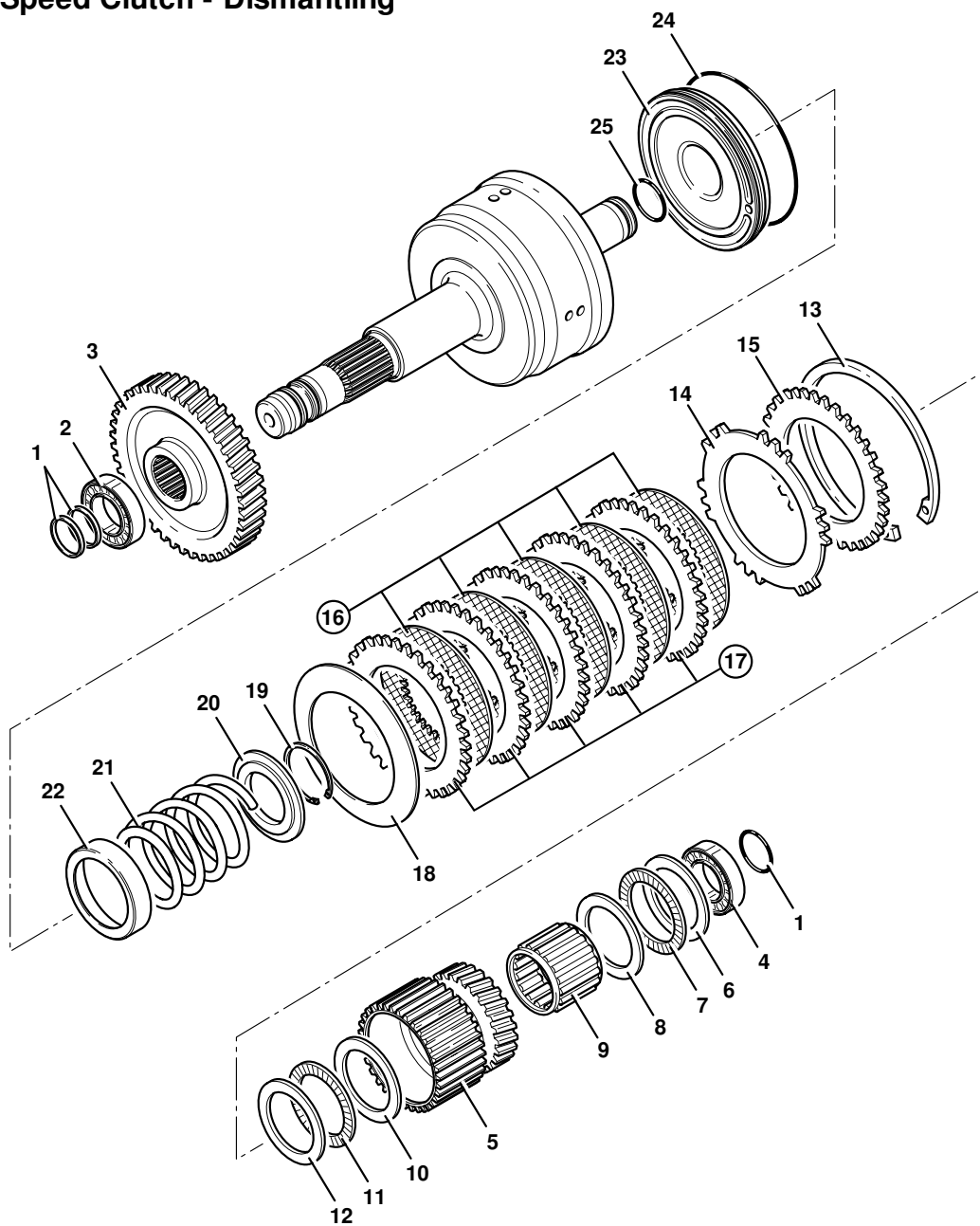
Use an airline to check the operation of the clutch.

- 11 Smear the taper roller bearing **5** with gearbox oil and press the bearing onto the shaft.
- 12 At the opposite end press gears **3** and **4** onto shaft spline. Make sure that the gears are fitted the correct way round.
- 13 Smear the taper roller bearing **2** with gearbox oil and press the bearing onto the shaft.
- 14 Fit piston ring seals **1**, refer to **Piston Ring Seals - Fitting Procedure**.





PS760 - 6 Speed Clutch - Dismantling



A396240

## PS760 - 6 Speed Clutch - Dismantling

- 1 Carefully remove piston ring seals **1** at each end of the shaft.

**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 collet tool and press.
- 3 Withdraw the gear **3**. Make a note which way round the gear is fitted for assembly.
- 4 At the opposite end, remove the clutch end bearing **4** using a puller.
- 5 Withdraw the gear and splined hub **5** together with thick thrust washer **6**, thrust bearing **7** and thin thrust washer **8**.
- 6 Remove the needle roller bearing **9**.
- 7 Remove the thin thrust washer **10**, thrust bearing **11** and thick thrust washer **12**.
- 8 Remove the clutch friction/counter plates retaining circlip **13**.
- 9 Remove pressure end plate **14** and shim **15**, if fitted.
- 10 Remove the clutch friction plates **16** and counter plates **17**. Keep them together in sets, DO NOT mix the plates with those from other clutches.
- 11 Remove the disc spring assembly **18**.
- 12 Position clutch assembly in a suitable press, with a cut away tube compress the piston spring as shown, then remove circlip **19**.

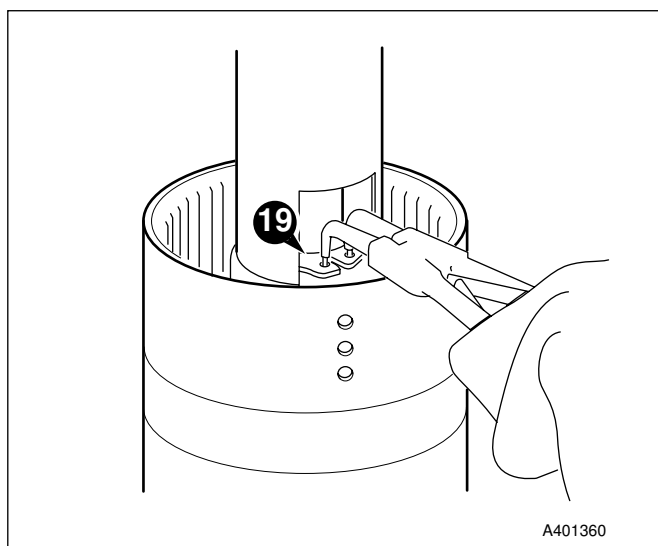
- 13 Lift off spring retaining plate **20**.

- 14 Remove the spring **21** and oil baffle **22**.

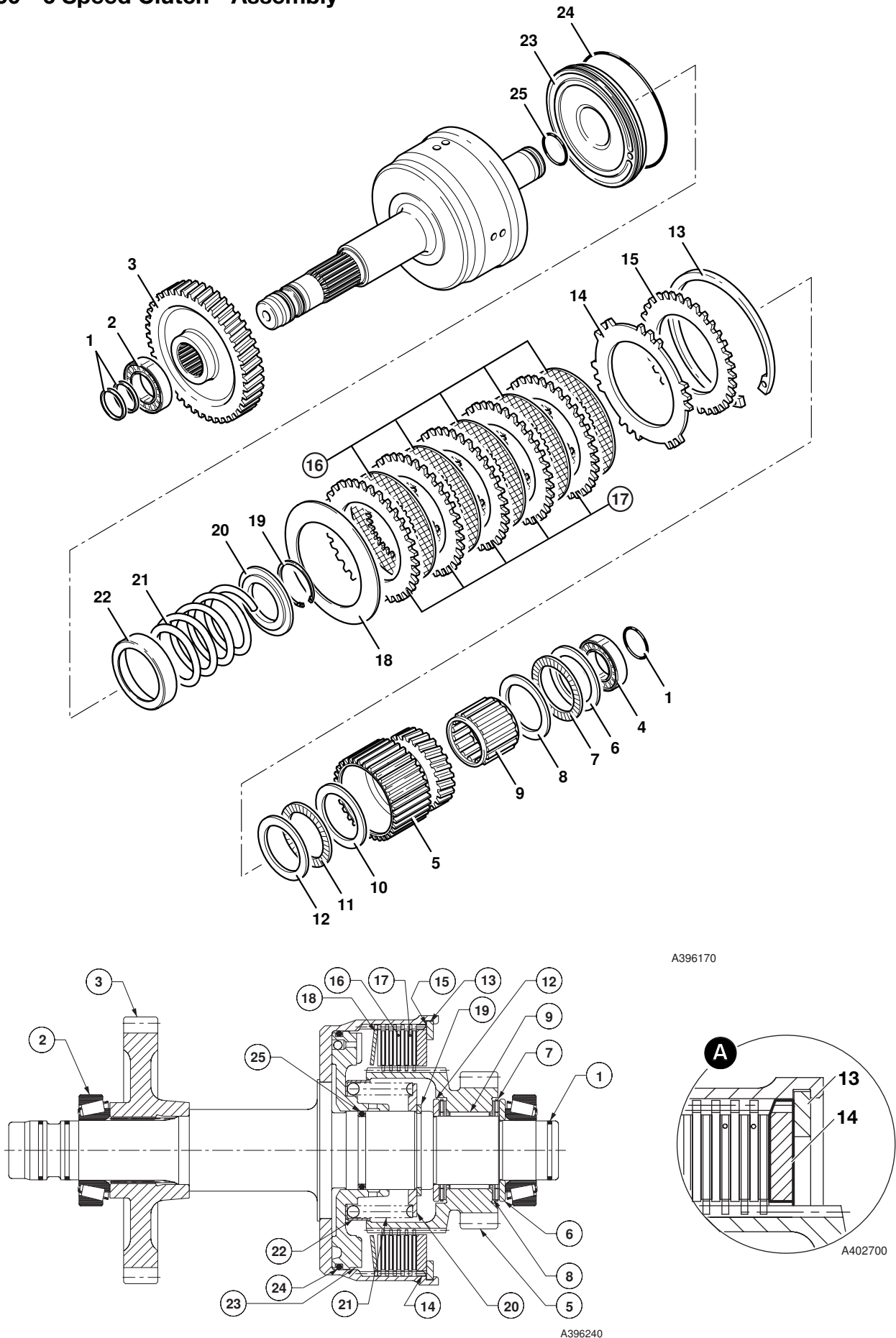
- 15 Turn the assembly over and knock the clutch shaft on a piece of aluminium (or wood) to loosen the piston **23**.

**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.

- 14 Remove the piston **23**. Remove and discard the piston 'O' ring **24** and shaft 'O' ring **25**.



PS760 - 6 Speed Clutch - Assembly



## PS760 - 6 Speed Clutch - 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 and new 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.

Take care when handling disc spring assemblies **18** to avoid marking or damage, which could result in stress cracking. If in doubt fit a new disc spring.

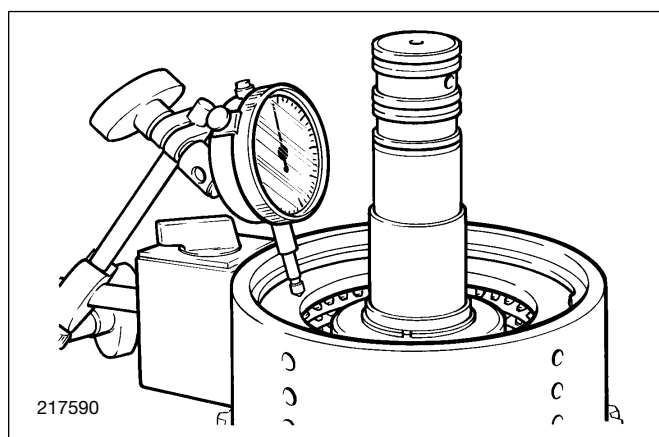
**Note:** The piston incorporates a small check valve. Visually inspect the piston to ensure the ball is in place and that the seat is free from contamination. If necessary clean the valve by blowing through with an air line. DO NOT use a wire rod (or screwdriver) as damage to the valve seat could occur.

- 1 Fit new 'O' rings **25** and **24**. Lubricate the piston **23** with oil and press fully into bore of clutch housing.
- 2 Fit oil baffle **22**, piston spring **21**, make sure the spring seats in the piston.
- 3 Fit the spring retaining plate **20**.
- 4 Compress the spring and secure with circlip **19**.
- 5 Fit the disc spring assembly **18**. Make sure that the disc spring is fitted with the teeth towards the clutch pack. Make sure the teeth are not aligned with the lubrication slots in the housing.
- 6 Fit one counter plate **17** followed by one friction plate **16**. Continue fitting alternate counter and friction plates, finishing with a friction plate.
- \* 7 Fit the pressure end plate **14**, do not fit shim **15** at this stage. Make sure that the chamfered face is fitted facing the clutch pack as shown at **A**. Make sure the teeth are not aligned with the lubrication slots in the housing.
- 8 Fit the clutch friction/counter plates retaining circlip **13**.

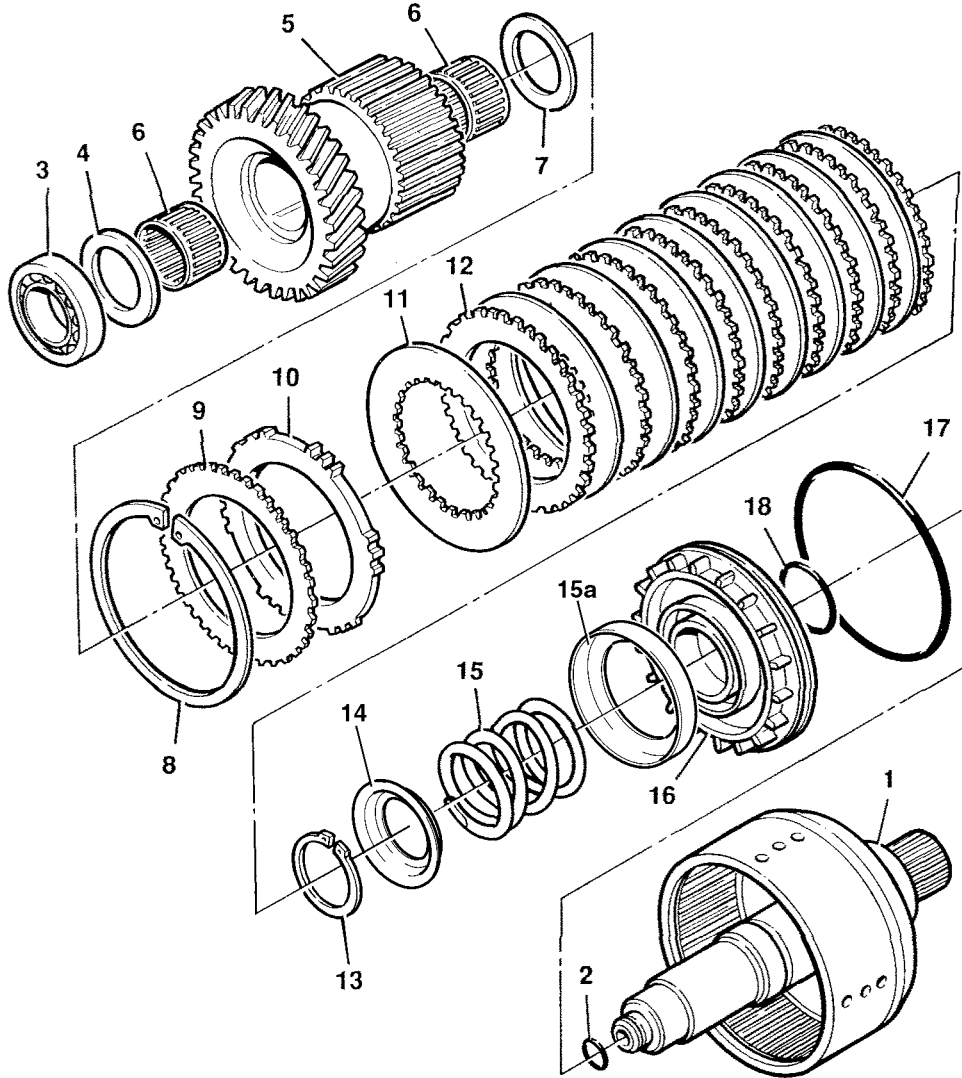
- 9 Using a dial test indicator as shown, measure the end float of the pressure end plate **14**, which should be 1.9 to 2.5 mm (0.075 to 0.098 in).

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 **14**, with either a shim **15** or an extra counter plate **17** between the retaining circlip **13** and pressure end plate **14**. Use an airline to check the operation of the clutch.

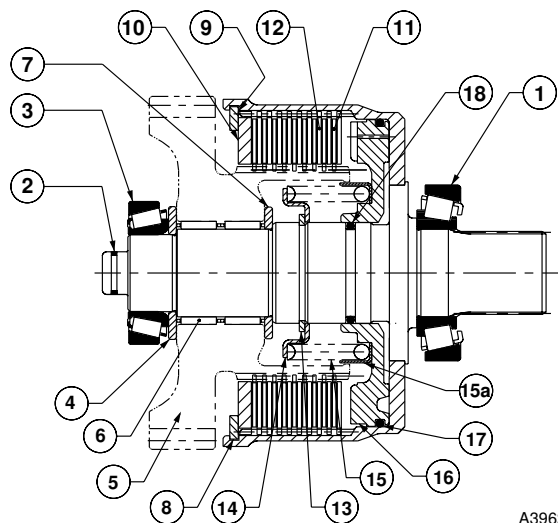
- 10 Fit the thick thrust washer **12**, thrust bearing **11** and thin thrust washer **10**.
- 11 Fit the needle roller bearing **9**.
- 12 Carefully align the teeth of the clutch plates using a thin rod (or screwdriver) and fit the gear and splined hub **5**.
- 13 Fit the thin thrust washer **8**, thrust bearing **7** and thick thrust washer **6**.
- 14 Smear the clutch end bearing **4** with gearbox oil and press the bearing onto the shaft.
- 15 At the opposite end, press the gear **3** onto the shaft spline. Make sure that the gear is fitted the correct way round.
- 16 Smear the clutch end bearing **2** with gearbox oil and press the bearing onto the shaft.
- 17 Fit piston ring seals **1** at each end of the shaft, refer to **Piston Ring Seals - Fitting Procedure**.



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



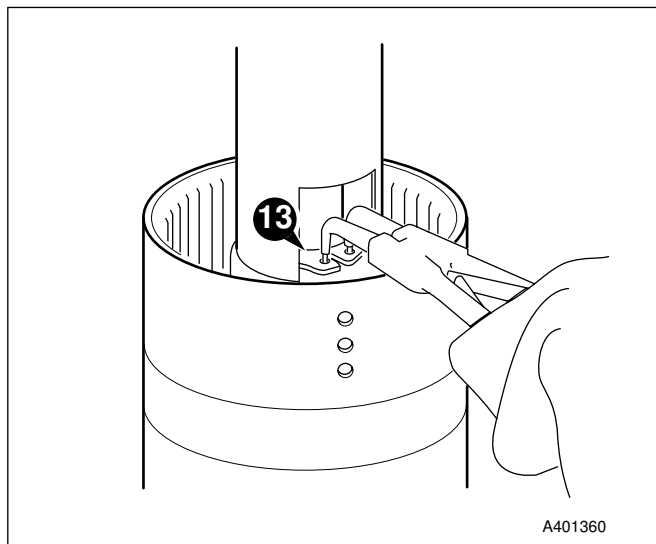
S396200



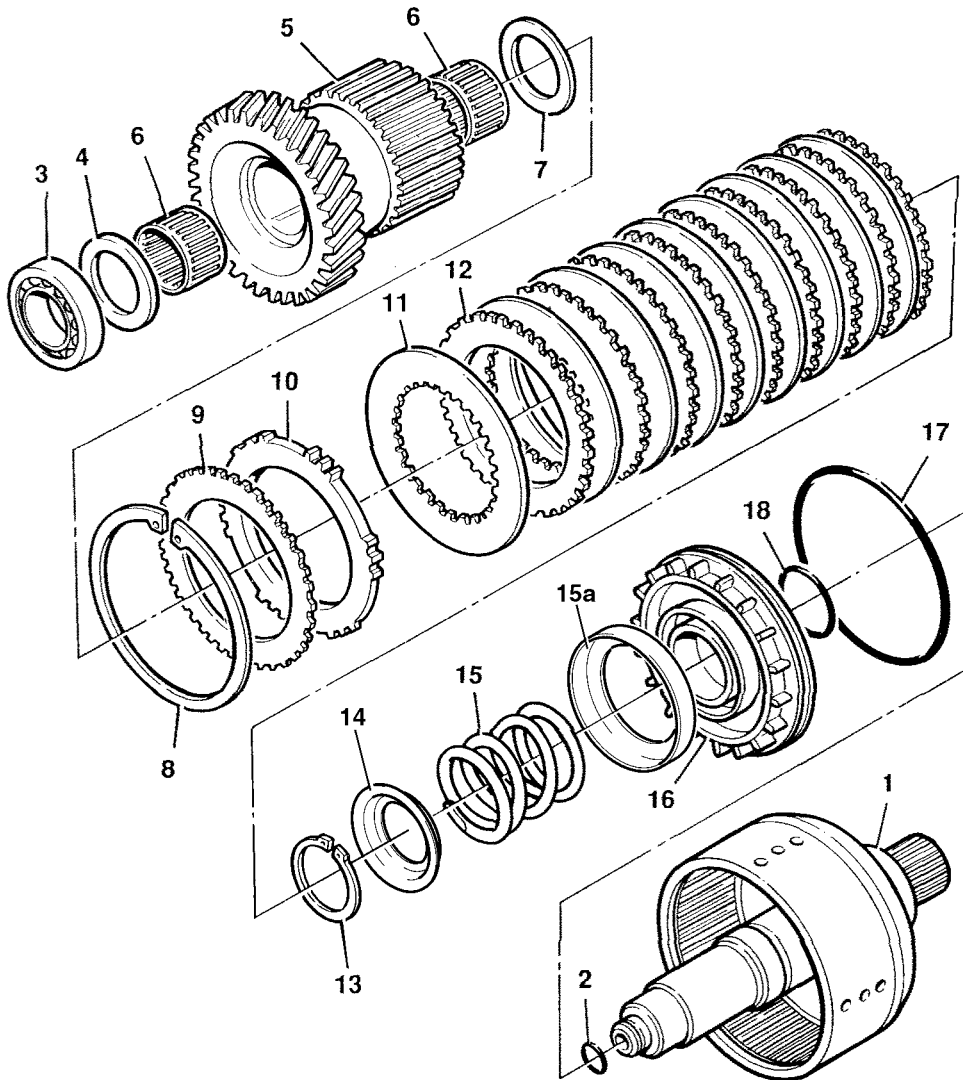
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## PS 760 - 2/4WD Clutch (Pressure ON) - Dismantling

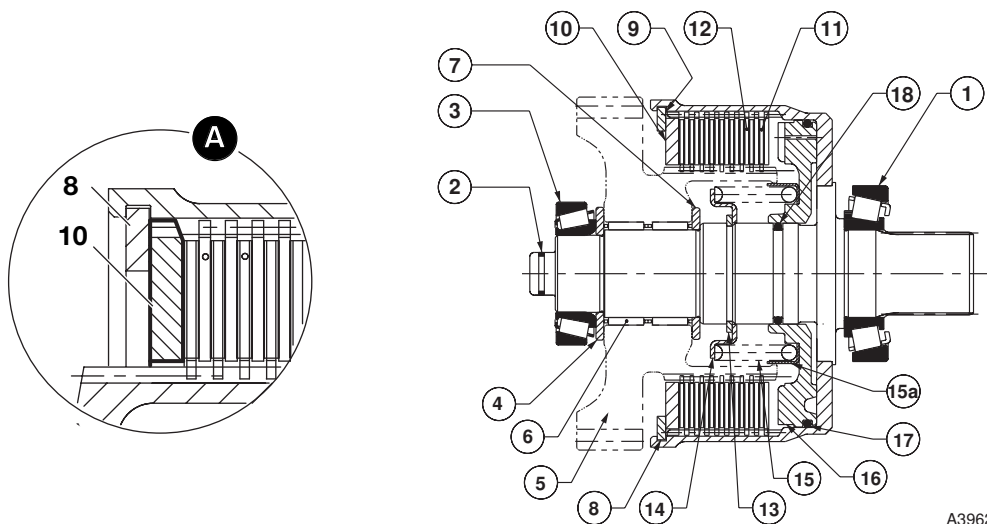
- 1 Remove bearing 1, only if to be renewed.
  - 2 Carefully remove piston ring seal 2. Note, If the piston ring seal is damaged or excessively worn then check for burrs or damage on the shaft groove. If necessary remove burrs with a fine grade abrasion paper and oil.
  - 3 Using a puller or press, withdraw the 4WD gear and splined hub 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).
  - 4 Remove the clutch friction/counter plates retaining circlip 8.
  - 5 Remove pressure end plate 10 and shim 9, if fitted.
  - 6 Remove the clutch friction plates 11 and counter plates 12. Keep them together in sets, DO NOT mix the plates with those from other clutches.
  - 7 Position clutch assembly in a suitable press, with a cut away tube compress the piston spring as shown, then remove circlip 13.
  - 8 Lift off spring retaining plate 14.
  - 9 Remove the spring 15 and oil baffle 15A.
  - 10 Turn the assembly over and knock the clutch shaft on a piece of aluminium (or wood) to loosen the piston 16.
- 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.
- 11 Remove the piston 16. Remove and discard the piston 'O' ring 17 and shaft 'O' ring 18.



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



S396200



A396260

## 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.

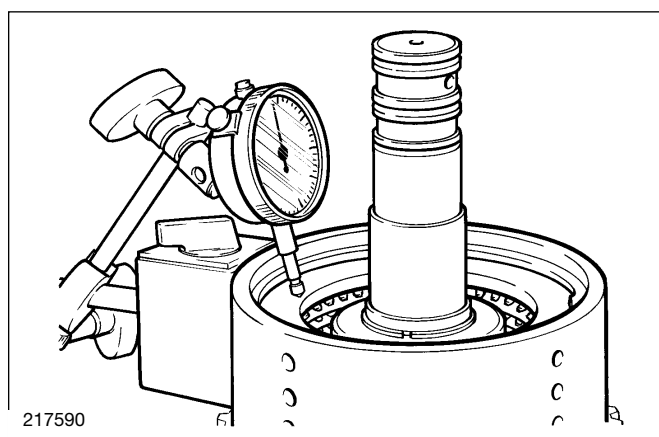
**Note:** The piston incorporates a small check valve. Visually inspect the piston to ensure the ball is in place and that the seat is free from contamination. If necessary clean the valve by blowing through with an air line. DO NOT use a wire rod (or screwdriver) as damage to the valve seat could occur.

- 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 that the chamfered face is fitted facing the clutch pack as shown at **A**. 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**.





**Polytetrafluoroethylene (PTFE) Piston Ring Seals - Fitting Procedure**

See Synchro Shuttle Gearbox, Piston Ring Seals - Fitting Procedure.

## Torque Converter

### Removal

See the relevant gearbox removal procedure for torque converter removal.

### Replacing

Ensure that flywheel face, drive plate, and hardware are clean and free from burrs or other surface imperfections.

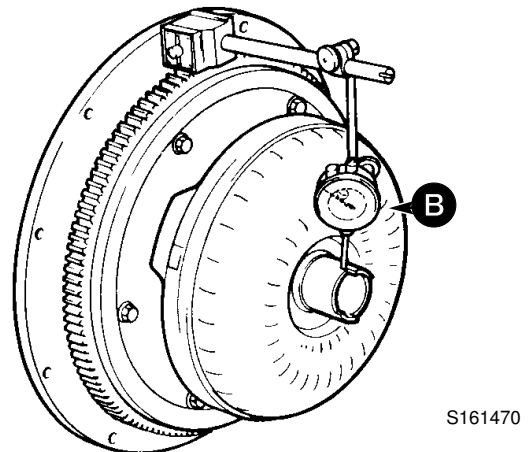
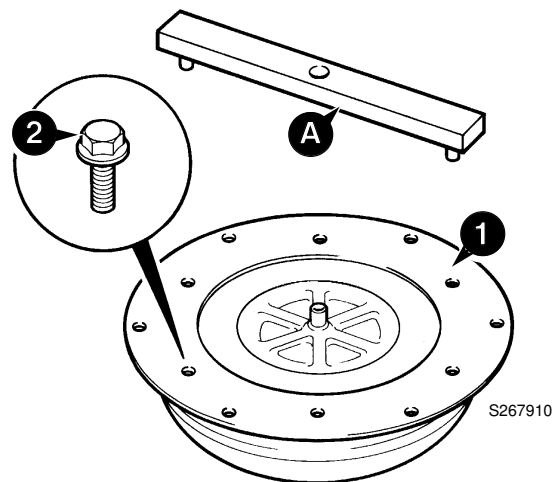
### When Replacing

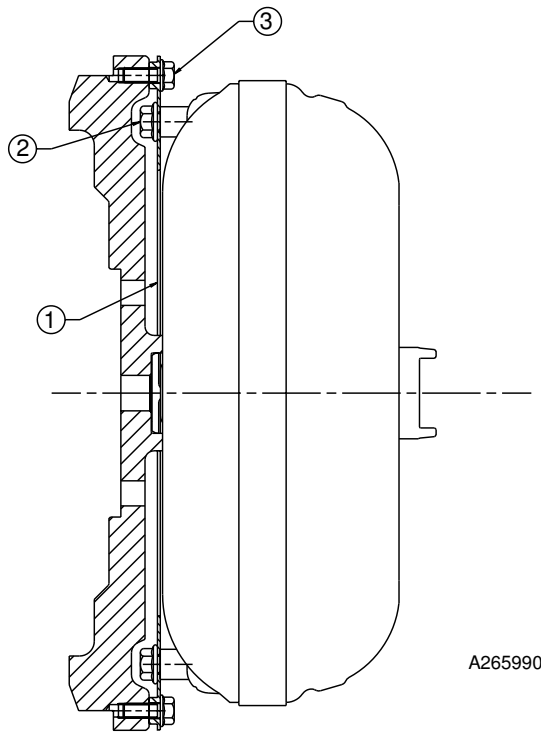
- 1 Offer drive plate **1** to the torque converter.
- 2 Place the torque converter alignment tool **A** over the torque converter spigot, make sure that the tool locates in two of the converter bolt holes as shown. It is important to note that the converter drive tube must be protected against damage or contamination at all times.
- 3 Fit four of the M10 flanged bolts **2** and torque tighten to 84 Nm (62 lbf ft). Remove the alignment tool and fit the remaining two retaining bolts **2**.
- 4 Offer the torque converter and drive plate assembly to the flywheel, bolt the drive plate to the flywheel (use only 3 bolts). Check the converter run-out as shown at **B**, which should not exceed 0.38mm (0.015 in.).

**Note:** In the unlikely event that the run-out exceeds 0.38 mm (0.015 in.), remove the converter and check the spigot for burrs, remove the drive plate and rotate it 180° on the torque converter, repeat steps **2** to **4**.

- 5 Remove the torque converter and drive plate assembly from the flywheel.
- 6 Install the torque converter with its drive plate assembly onto the transmission input shaft, make sure that the dogs on the converter pump drive shaft engage with the recesses in the pump, also take care not to damage the oil seal.
- 7 Rotate the engine flywheel so that one bolt hole is in a six O' clock position.
- 8 Rotate the torque converter and drive plate assembly so that one bolt hole is in a six O' clock position.
- 9 Install the transmission/torque converter assembly to the engine. See the relevant gearbox replacement procedure. **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.
- 10 Remove the access plate from the bottom of the engine flywheel housing and through the access hole fit and hand tighten one M8 flanged bolt (item 3) in the six 'O' clock position

- 11 Rotate the flywheel until the next bolt hole is accessible, fit and hand tighten the next bolt **3**. Repeat the operation until all bolts are fitted. Finally torque tighten bolts **3** to 44 Nm (32 lbf ft), rotating the flywheel each time to align bolts **3** with access hole. Refit access plate.





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**System Type**

Hydraulic servo assisted service brakes in rear axle only, operated from  
\* separate pedals. Independant cable operated parking brake in the drive to  
the rear wheels.

**Service Brake**

Type	JCB Oil-immersed multi-plate disc
Actuation	Hydraulic - vacuum servo assisted
Location	Rear axle centre casing (2 brake packs)
Friction Plates (5 per brake pack)	
Outside Diameter	220 mm (7.992 in)
Inside Diameter	160 mm (6.299 in)
Nominal Facing Area per Plate	18603 mm <sup>2</sup> (28.8 in <sup>2</sup> )
Hydraulic Piston Diameter	216 mm (8.5 in)

**Master Cylinder (combined servo assistance)**

Number of Cylinders	2
Type	Compensated master cylinder
Piston Diameter (each)	22.22 mm (0.875 in)

**Parking Brake**

Type	Disc brake, manually adjusted calliper
Actuation	Cable operated
Location	* Mounted on the rear axle drive head.
Disc Diameter	279.4 mm (11 in)

**Note:** Because the service brakes are located in the rear axle, instructions for dismantling and assembly are shown in Section F - **Rear Axle Brakes**.

## Compensating Master Cylinder

### Description

Compensating master cylinders overcome the problem of unequal wear between the right and left brake. The units incorporate both master cylinder and compensating valve.

Each brake has its own master cylinder **A**, **A1**, brake pedals **B**, **B1**, servo units **N**, **N1** and associated pipework. Both master cylinders have one common reservoir **C**.

**Note:** Dual pedal braking is applicable only to 2WS machines. 4WS machines have a single brake pedal.

### Pedals Locked - Normal Operation

When the brake pedals are pushed down (the brake pedals are mechanically locked together), rod **D** pushes the plunger **E** down the bore of the master cylinder. Pressurised oil acting on centre valve seal **F** via valve stem **G** causes the seal to close off the reservoir supply port. As the plunger continues to move down the bore, pressurised oil flows to the brake pack **H** via service port **J** and the associated pipework.

Master cylinder **A1** operates in the same way to feed brake pack **H1**.

With valve stem **G** at maximum travel, further movement of plunger **E** causes valve **K** to lift off its seat. Both master cylinders are interconnected via bridge pipe **M**, therefore hydraulic pressure in both cylinders will be equal.

If the brake packs **H** and **H1** have worn equally, then the amount of oil displacement between cylinders will be minimal and the brakes will be applied evenly.

### Pedals Locked - Compensating Operation

When the brake pedals are pushed down (the brake pedals are mechanically locked together), actuation of the brake packs **H** and **H1** is as described in Pedals Locked - Normal Operation. If however, the brakes have not worn equally, then the amount of fluid displaced from each master cylinder will vary and some form of compensation is required.

Pedal application moves plungers **E** down the bores of master cylinders **A** and **A1**. Linings of brake **H** are brought into contact before the linings of brake **H1** because they have not worn as severely.

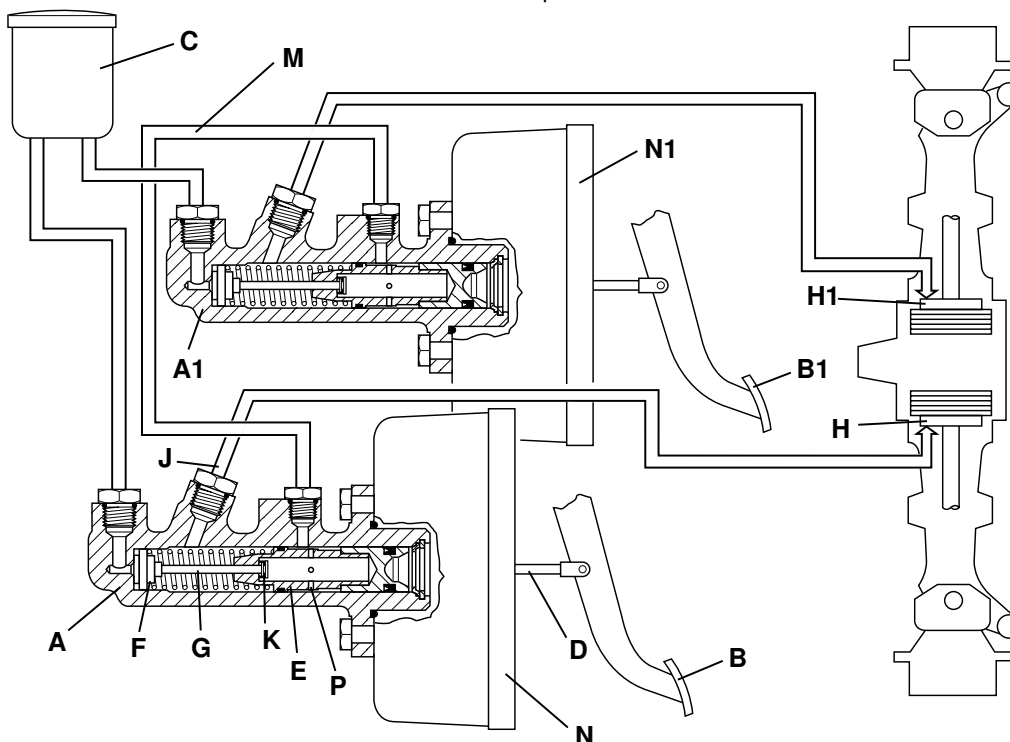
If further displacement took place at the linings, brake **H** would be applied before brake **H1**. Therefore master cylinder **A** begins to compensate for master cylinder **A1**.

Fluid is displaced from **A** to **A1** via bridge pipe **M** until the pressures are equalised. In this condition both compensating valves are open and both brakes are applied evenly.

### Pedals Unlocked - Normal Operation

When a single brake pedal is pushed down, rod **D** pushes the plunger **E** down the bore of the master cylinder. Pressurised oil acting on centre valve seal **F** via valve stem **G** causes the seal to close off the reservoir supply port. As the plunger continues to move down the bore, pressurised oil flows to the brake pack **H** via service port **J** and associated pipework, thus braking one wheel only.

With valve stem **G** at maximum travel, further movement of plunger **E** causes valve **K** to lift off its seat. Fluid is displaced through drillings **P** from the active cylinder **A** via bridge pipe **M** to passive cylinder **A1**. Valve **K1** in the passive cylinder is held on its seat by the displaced pressurised fluid.



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## Brake System

**Note:** The brakes generate a high temperature when operating, this means that the casing will be hot to touch, this condition is normal. Note also that 4WS machines do not have dual pedal braking.

FAULT	POSSIBLE CAUSE	ACTION
<b>A</b> One or both brakes do not apply. (Brake travel not excessive, brakes not pulling to one side).	1 Master cylinder fault.	1 Check master cylinder in single and coupled pedal modes to identify fault area, service as required.
	2 Friction/counter plate distortion.	2 Check friction/counter plates.
<b>B</b> Pedal travel excessive (but not touching floor).	1 Air in hydraulic system.	1 Check fluid reservoir level. Check for fluid/air leaks, rectify as required.
	2 Leak in hydraulic system.	2 Check for fluid loss at master cylinder and brake piston, all pipes and fittings for loose connections. Rectify as required.
	3 Friction/counter plate distortion.	3 Renew friction/counter plates - BOTH sides.
<b>C</b> Applying one brake (pedals unlocked) also partially engages the other brake.	1 Valve stem seal inside (non-active) master cylinder piston not sealing.	1 Renew master cylinder piston.
<b>D</b> Pedal hard to operate.	1 Tightness at pedal pivot.	1 Inspect pedal pivot. Free-off/lubricate.
	2 Fluid contamination/seal damage.	2 Flush system and renew all hydraulic seals.
	3 Misaligned push rod/pedal.	3 Check and rectify as required.
	4 Kinked or crushed brake pipes.	4 Check/renew brake pipework.
	Items 5 to 7 are for machines fitted with servo assisted brakes only:	
	5 Vacuum failure due to low vacuum at source.	5 Inspect/service engine mounted exhaust unit as required.
	6 Blocked/leaking vacuum pipe.	6 Check/renew vacuum pipe.
7 Servo defect.	7 Renew servo unit.	
<b>E</b> Pedals touch floor under constant pressure - no fluid loss.	1 Master cylinder fault.	1 Check master cylinder in single and coupled pedal modes to identify fault area, service as required.
	2 Friction/counter plate distortion.	2 Renew friction/counter plates - BOTH sides.
	3 Air in hydraulic system.	3 See item B.1.
<b>F</b> Pedals touch floor under constant pressure - and fluid loss.	1 External fluid leaks.	1 Visually check brake circuit for fluid loss, service as required.
	2 Internal fluid leaks.	2 Refer to <b>Service Procedures - Brake Piston Seal Leakage Test</b> .
<b>G</b> Pulling to one side when pedals locked together.	1 Compensating feature not working.	1 Inspect master cylinder compensating operation. Check if blockage in bridging pipe. Service as required.

FAULT	POSSIBLE CAUSE	ACTION
<b>G</b> Pulling to one side when pedals locked together (cont'd).	2 Braking system inoperative on one side. 3 Friction plates worn beyond limits or distorted on one side. 4 Badly adjusted push rods. 5 Servo operating rod out of adjustment. 6 Annular piston fault (see item J6).	2 Unlatch pedals to test circuits individually. 3 Renew friction/counter plates - BOTH sides. 4 Adjust push rod (1mm minimum). 5 Adjust servo operating rod. 6 See item J6.
<b>H</b> Poor braking (not pulling to one side).	1 Friction plates worn beyond limits or distorted on one side. 2 Master cylinder fault. 3 Annular piston fault (see item J6). 4 Incorrect/low axle oil. 5 Vacuum failure (machines fitted with servo assisted brakes only).	1 Renew friction/counter plates - BOTH sides. 2 Check master cylinder in single and coupled pedal modes to identify fault area, service as required. 3 See item J6. 4 Fill axle with correct type of oil. 5 Inspect vacuum source/pipes, service as required.
<b>J</b> One or both brakes not releasing.	1 Brake pedal spring fault. 2 Master cylinder fault (plunger stuck in bore). 3 Blocked hole in master cylinder reservoir cap. 4 Brake pedal free travel incorrect. 5 Fluid contamination/seal damage. 6 Annular brake piston(s) binding in axle. 7 Kinked or crushed brake pipes. 8 Friction/counter plates not free on splines and/or dowels.	1 Fit a new spring. 2 Service as required. 3 Fit a new reservoir cap. 4 Adjust pedal free travel. 5 Flush system and renew hydraulic seals. 6.1 Check that correct brake fluid has been used (incorrect fluid could swell the annular brake piston seals). 6.2 Check if annular brake piston seals in good condition. 6.3 Check that annular brake piston rotates freely in its housing with no seals fitted. 6.4 Check that the annular brake piston seal retracts the piston approximately 0.5mm (0.020 in). 7 Check and renew pipes as required. 8 Check friction/counter plates for free movement, replace if required - BOTH sides.



FAULT	POSSIBLE CAUSE	ACTION
<p><b>K</b> Poor braking when hot.</p>	<p>1 Moisture in system vapourizing when axle is hot.</p>	<p>1 Strip axle and clean annular piston to remove moisture. Remove master cylinders and check for corrosion, service as required. Flush hydraulic brake system.</p>
<p><b>L</b> Excessive brake noise in operation.</p> <p><b>Note:</b> Due to the metal to metal contact of oil immersed brakes, limited noise can be heard which is consistent with this type of design - this is normal.</p>	<p>1 Deterioration of axle oil or wrong type of axle oil.</p> <p>2 Axle oil loss.</p> <p>3 Friction plates worn beyond limits.</p> <p>4 Friction/counter plates in poor condition.</p>	<p>1 Change axle oil.</p> <p>2 Refill axle with correct oil and check for leaks.</p> <p>3 Renew friction/counter plates.</p> <p>4 Check for distortion or surface pitting and/or roughness of friction/counter plates (annular grooving of counter plates is acceptable).</p>
<p><b>M</b> Fluid loss when machine standing, for instance - overnight (see note).</p> <p><b>Note:</b> Confirm fault is as indicated by checking that the pedals DO NOT touch floor under constant pressure.</p>	<p>1 Slight cut or nick in the brake piston seal, refer to <b>Service Procedures - Brake Piston Seal Leakage Test</b>.</p>	<p>1 Strip axle, replace seal.</p>

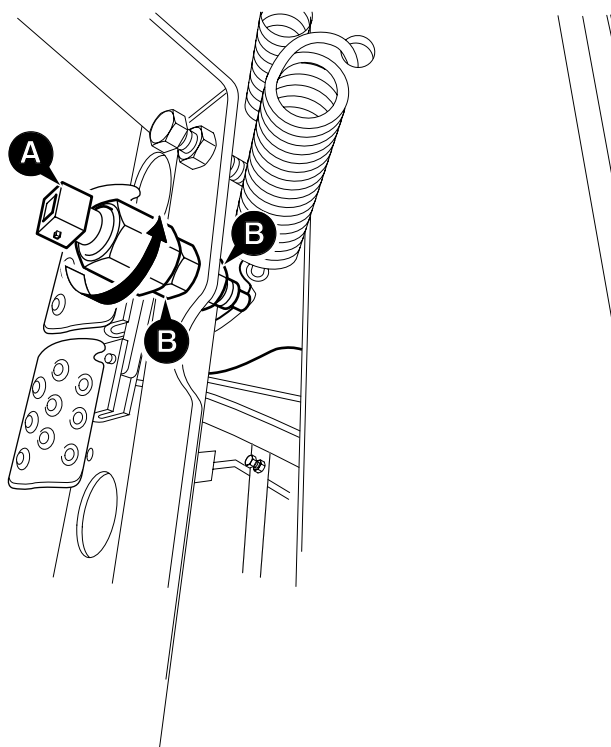
## Service Brakes

### 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>B</b>	29	2.95	21



## Service Brakes

### Brake Piston Seal Leakage Test

The following procedure explains how to check if a brake piston seal is severely damaged/perished or if the seal has a small cut or nick. The test must only be done when the axle is COLD.

#### **⚠ WARNING**

Before working on the brake system make sure the machine is on level ground and chock all four wheels.

BRAK 1-4

#### **⚠ WARNING**

Do not drive the machine with any part of its brake system disconnected. When the following test has been completed reconnect all brake pipes and bleed the brake system using the recommended procedure.

BRAK 2-1

- 1 Remove and cap brake piston feed pipe **A**.
- 2 Fill the brake piston housing with JCB Light Hydraulic Fluid.
- 3 Check for severe piston seal damage:
  - a Install a hand pump fitted with a 0 - 40 bar (0 - 600 lbf/in<sup>2</sup>) pressure gauge to port **B**, as shown at **X**.

**Note:** The hand pump MUST be filled with JCB Light Hydraulic Fluid. DO NOT exceed 69bar (1000 lbf/in<sup>2</sup>).

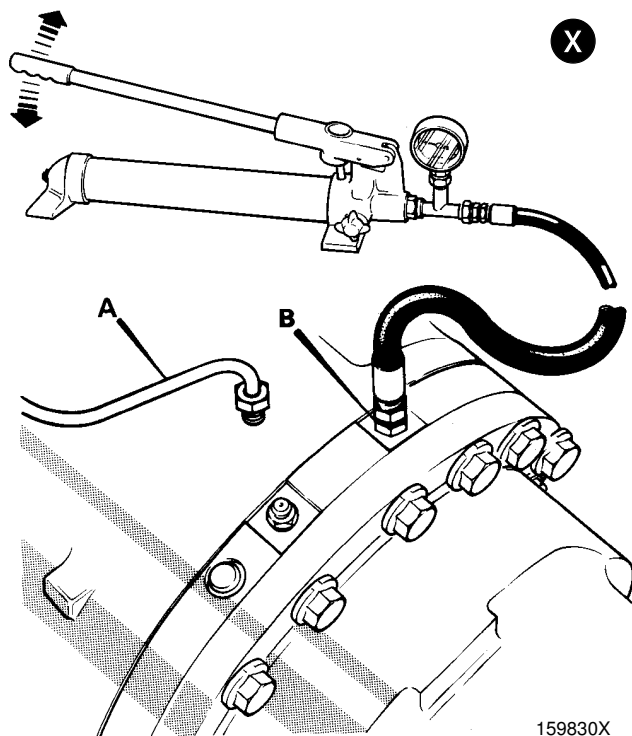
- b Use the hand pump to generate a pressure in the brake piston housing.
  - c If the pressure falls off rapidly, or if no pressure reading can be obtained, the seal is severely damaged and needs replacing with a new one.
- 4 Check for small cuts or nicks in the piston seal:

- a Install an adapter fitted with a piece of clear tube to the brake piston port **B**, as shown at **Y**.

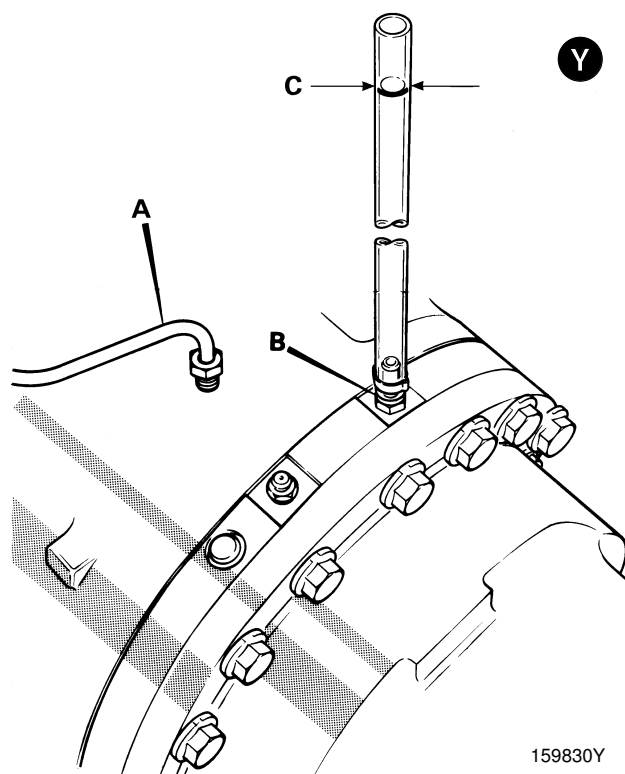
**Note:** The tube must be kept vertical during the test, use tape to attach the tube to the side of the machine.

- b Fill the tube until approximately three quarters full with JCB Light Hydraulic Fluid
  - c Using a suitable pen, mark the level line of the brake fluid on the tube, as shown at **C**.
  - d After approximately 1/2 hour, check if the level has dropped below the original marked line, if it has then check the brake piston seal for slight nicks, cuts or generally for wear.

- 5 Repeat steps 1 to 4 for the opposite brake piston seal.
- 6 Reconnect all brake pipes and bleed the brake system. Refer to **Service Brakes - Bleeding**.



159830X



159830Y

## Parking Brake - Testing

**SAFETY NOTICE:** Ensure all routine health and safety precautions are observed before operating machines.

### ⚠ WARNING

Before testing the parking brake make sure the area around the machine is clear of people.

2-2-4-5

- 1 Enter the machine. Fasten your seat belt and park the machine on a level dry surface.
- 2 Fully apply the parking brake 1.
- 3 On machines with two brake pedals ensure they are locked together.
- 4 Start the engine and raise the attachments to the appropriate travelling position.
- 5 Select fourth gear, 2 for synco shuttle machines or 3 for powershift machines.
- 6 Push down hard on foot brake pedal 4.
- 7 Select forward drive 5.

### ⚠ WARNING

If the machine starts to move during the following test, immediately apply the foot brakes and reduce the engine speed.

2-2-5-1

Test the parking brake as follows:

- 8 Move the parking brake lever fractionally forward until the warning light 6 is just extinguished.
- 9 Slowly release the foot brake pedal 4.
- 10 If the machine has not moved, use the accelerator pedal to gradually increase the engine speed to 1500 RPM. The machine should not move.
- 11 Do not do this test for longer than 20 seconds.
- 12 Reduce the engine speed to idle and select neutral 5.
- 13 Return the park brake lever 1 to the fully on position from its partially applied position.
- 14 Lower attachments and stop the engine.
- 15 If the machine moved during this test, adjust the parking brake and repeat the test. See **Service Procedures, Parking Brake - Adjustment**.

If you have any queries concerning this test procedure or parking brake adjustment, consult your local JCB distributor.

### ⚠ WARNING

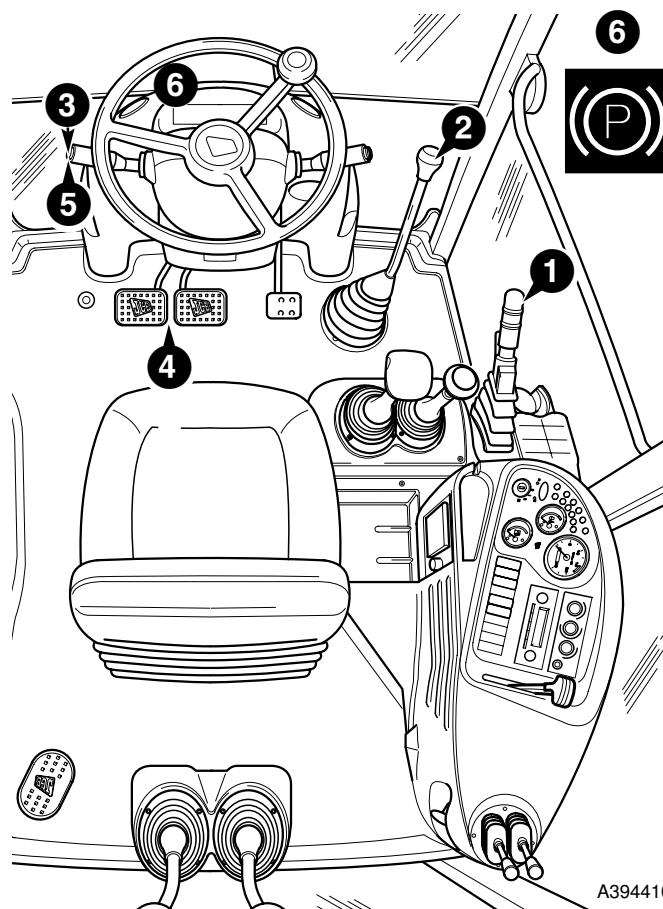
Do not use a machine with a faulty parking brake.

3-2-3-10

### ⚠ CAUTION

Non approved modifications to axle ratios, machine weight or wheel and tyre sizes may adversely affect the performance of the parking brake.

3-2-3-11



## Parking Brake - Adjustment

### ⚠ CAUTION

The parking brake must not be used to slow the machine from travelling speed, except in an emergency, otherwise the efficiency of the brake will be reduced.

Whenever the parking brake has been used in an emergency, always renew both brake pads.

4-2-1-1/2

### ⚠ WARNING

Before working on the parking brake, make sure that the machine is on level ground. Put chocks each side of all four wheels. Disconnect the battery so that the engine cannot be started. If you do not take these precautions the machine could run over you.

2-3-2-4/1

The parking brake should be fully engaged when the lever is vertical. The parking brake indicator light should light when the brake is engaged with the forward/reverse lever away from neutral (starter switch at IGN).

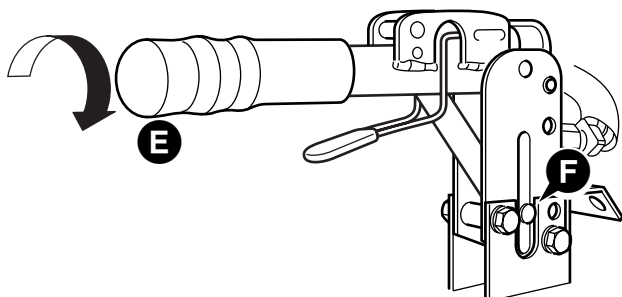
### ⚠ WARNING

Over adjustment of the parking brake could result in the parking brake not fully releasing

0011

### Lever Adjustment

- 1 Disengage the parking brake (lever horizontal).
- 2 Turn handle grip **E** clockwise, half a turn.
- 3 Test the parking brake, refer to **Parking Brake - Testing**.
- 4 If the brake fails the test, repeat steps 1, 2 and 3. If there is no more adjustment and pin **F** is at the end of its travel adjust the cable.



A390850

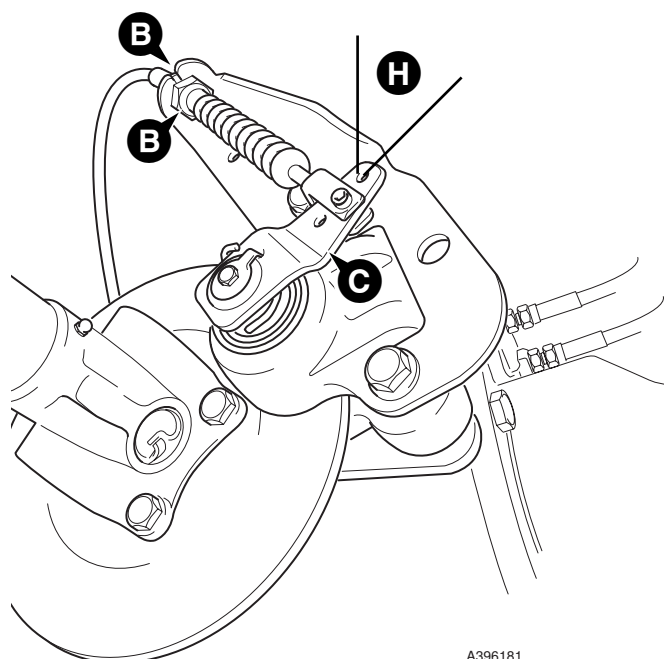
### Cable Adjustment

Adjust the cable at the calliper if there is insufficient adjustment at the parking brake lever.

If there is no adjustment at the lever or the calliper, change the brake pads, refer to **Parking Brake - Renewing the Brake Pads**.

Always renew a worn or damaged cable.

- 1 Disengage the parking brake (lever horizontal).
- 2 Turn hand grip **E** anti-clockwise to centre the pin **F** in its slot.
- 3 Release the two locknuts at **B** and adjust the cable length to give 10 to 15mm (0.40 to 0.60 in) of caliper lever movement at the outer cable fixing hole **H**. The total clearance between the brake pad to brake disc should be 0.5 to 0.75 mm (0.02 to 0.3 in).
- 4 Make sure there is adequate freedom of movement of operating lever **C** to ensure a positive brake application, and that the lever returns to the rest position when the parking brake is released.
- 5 Test the parking brake, refer to **Parking Brake - Testing**. Make final adjustments at the park brake lever if the brake fails the test. Refer to **Lever Adjustment**.



A396181

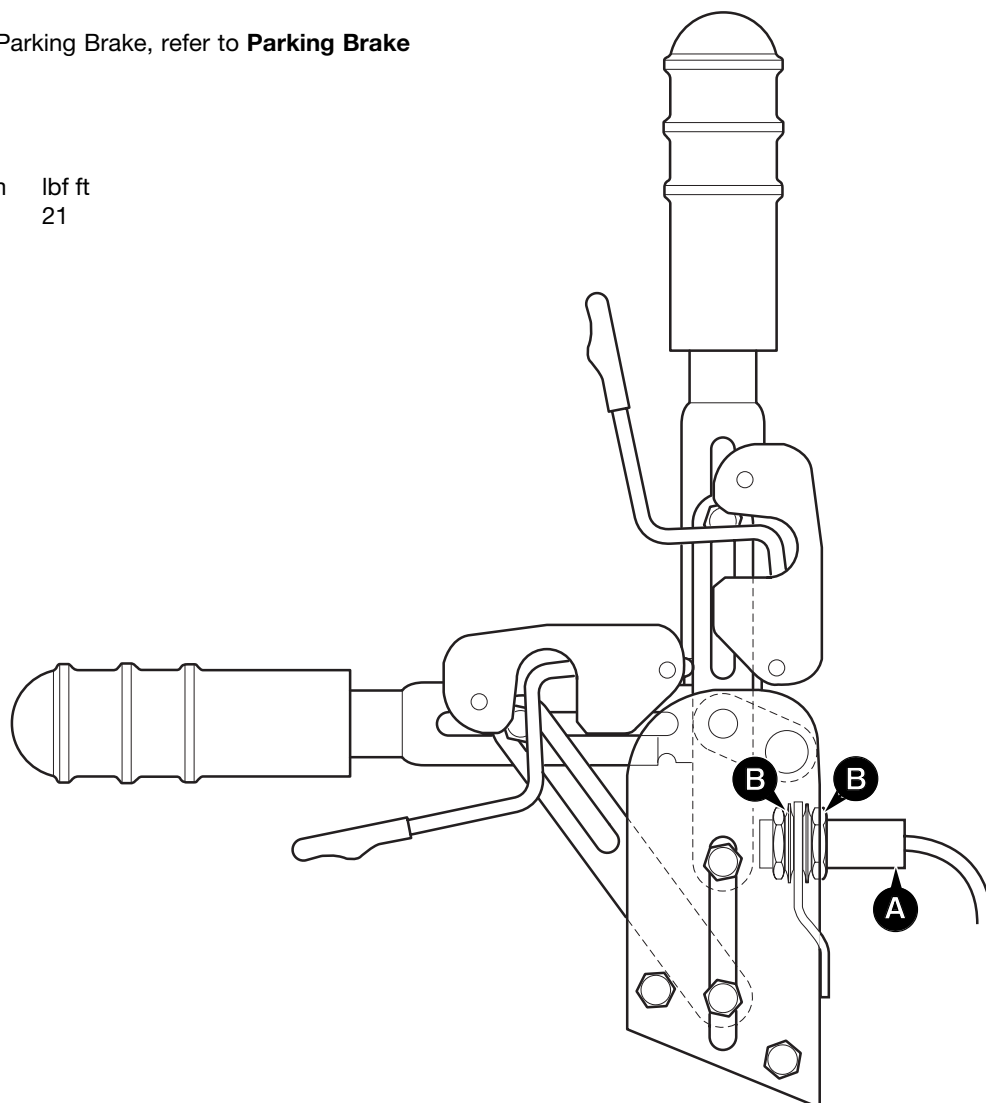
## Parking Brake - Switch Adjustment

- 1 Select the starter key switch to the ON position, do not start the engine.
- 2 Select either forward or reverse.
- 3 Raise the handbrake to the ON position.
- 4 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 handbrake lever. The light emitting diode (L.E.D.) on the switch should be illuminated and the audible alarm should sound.
- 5 Secure the switch in position by tightening locknuts **B**.
- 6 Release the parking brake and the audible alarm should cease.

For adjustment of the Parking Brake, refer to **Parking Brake - Adjustment**.

### Torque Settings

Item	Nm	kgf m	lbf ft
<b>B</b>	29	2.95	21



A396440

## Parking Brake - Renewing the Brake Pads

### WARNING

This is a safety critical installation. Do not attempt to do this procedure unless you are skilled and competent to do so.

Installation and mounting of the parking brake calliper requires tightening of the mounting bolts to a specific torque figure. Do not attempt to do this job unless you have the correct tools available.

0010

### WARNING

Before working on the parking brake, park on level ground and put chocks each side of all four wheels. Stop the engine and disconnect the battery so that the engine cannot be started. If you do not take these precautions the machine could run over you.

BRAK 8-8

### WARNING

Brake pads generate dust which if inhaled, may endanger health. Wash off the calliper before commencing work. Clean hands thoroughly after work.

13-3-1-3

## Pad Removal

- 1 Remove the parking brake calliper from the axle mounting bracket, refer to **Parking Brake - Calliper Removal and Replacement**.
- 2 Press carrier side pad 1 into housing 15 and remove. Ensure any residual silicone used for pad retention during assembly is removed.
- 3 Carefully lever pad 2 from the rotor inside the housing using a flat blade screwdriver. Take care to prevent damage to the plastic clip in the centre of the rotor 9 (there is no need to remove the rotor from the calliper).

## Pad Inspection

### WARNING

Oil on the brake disc will reduce brake effectiveness. Keep oil away from the brake disc. Remove any oil from the disc with a suitable solvent. Read and understand the solvent manufacturer's safety instructions. If the pads are oily, new ones must be fitted.

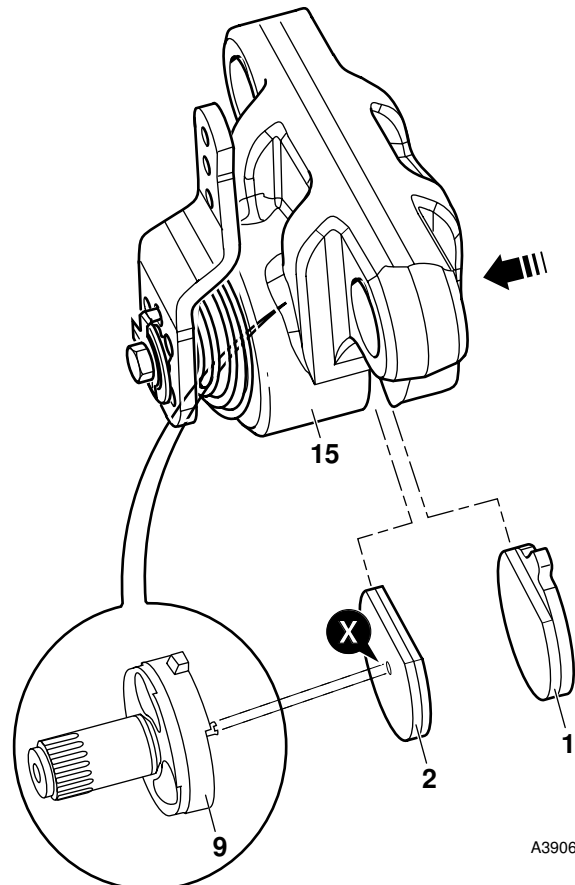
2-3-2-3/3

- 1 The minimum thickness of the friction material on either pad is 1mm (0.04 in), but it is recommended new pads are fitted as pads worn to this limit may not be able to be adjusted.
- 2 Check the condition of the disc surface. Renew the disc if badly warped, pitted or worn. For brake disc removal, refer to **Parking Brake, Brake Disc - Removal and Replacement**.
- 3 Renew the cable if worn or damaged.

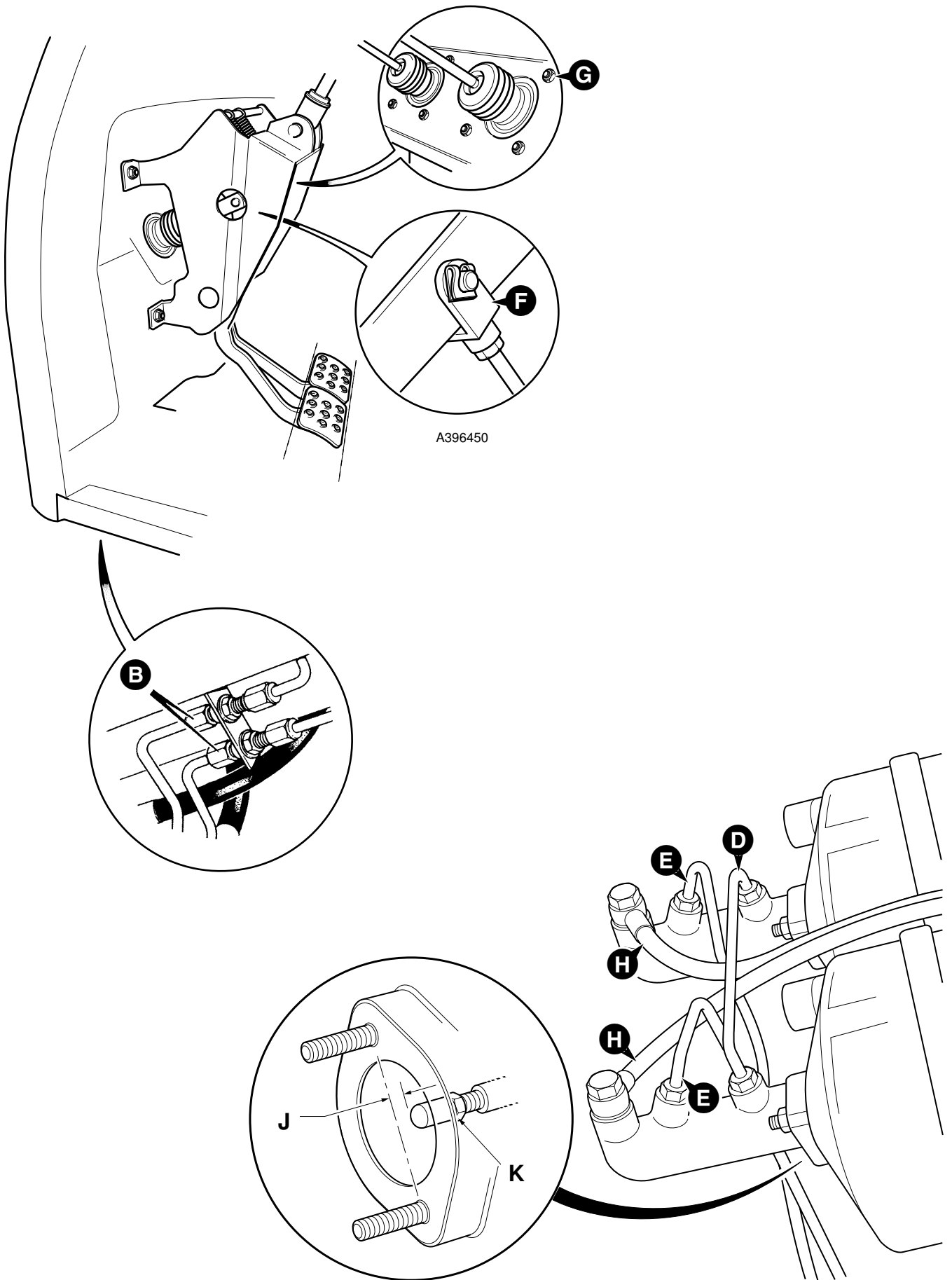
## Pad Replacement

- 1 Fit the pad 2 to the lever side of the calliper. Position the pad inside housing 15. Locate the plastic clip in the centre of the rotor 9 into the hole X, and press the pad into place.
- 2 Fit the pad 1 to the carrier side of the calliper. Add a small amount of silicon sealant to the back outer edge of the backing plate to hold the pad in place within the housing.
- 3 Replace the calliper, refer to **Parking Brake - Calliper Removal and Replacement**.

**Note:** If there is insufficient adjustment after fitting new pads change the brake cable.



A390680



A396450

327340



## Removal and Replacement

### WARNING

Before working on the brake system make sure the machine is on level ground and chock all four wheels.

BRAK 1-4

#### Removal

- 1 Gain access to the the brake pedal box assembly. Remove the steering wheel, column switches and console assembly. See **Section D, Steering Column - Removal** for procedures.
- 2 Working outside the cab, loosen and remove brake pipe unions **B**, plug and cap to prevent loss of fluid and ingress of dirt.
- 3 Remove the brake pipes from the master cylinders: master cylinders bridging pipe **D**; axle feed pipes **E** and reservoir supply pipes **H**.
- 4 Working inside the cab, remove the brake pedals clevis **F** and disengage the brake pedal from the servo unit (both pedals).
- 5 Loosen and remove the servo unit retaining nuts **G** (both units).
- 6 Tag the cylinders (left and right hand). Remove the master cylinder and servo units.

#### Replacement

Replacement is a reversal of the removal sequence.

Refit the cylinders in their original positions.

If the brake master cylinders or brake servo units are removed it is recommended that the servo brake assembly operating rod measurement is checked.

If the rod length is not checked it may result in differing brake pedal travel which could result in uneven braking.

- 1 With the brake master cylinder removed, measure from the face of the servo unit to the end of the servo brake rod as shown at **J** which should be 8.5 to 8.3mm (0.334 to 0.326in).
- 2 Adjust measurement **J** by screwing domed bolt **K** in/out as required, secure in position with JCB Threadlocker & Sealer.

**Note:** If no adjustment is required make sure the domed bolt **K** can not be rotated by finger pressure.

### WARNING

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

BRAK 1-1

- 3 Fill the brake system with JCB Light Hydraulic Fluid and bleed the system. Refer to **Service Brakes - Bleeding**.

**Note:** 4WS machines do not have dual pedal braking. Procedures described still apply to a single pedal application.

- 4 Unlatch pedals and ensure that pedal pads are level with each other and fully back against their stops.
- 5 Adjust pedal linkages for free movement to give 1 mm (0.040 in) on each pushrod.
- 6 With pedals still unlatched, apply an equal force to each pedal and check if pedals remain level. If necessary adjust by increasing the clearance on one of the pushrods. Do not decrease either clearance below 1 mm (0.040 in).
- 7 On completion bleed the brake system and check the brakes operate correctly and that machine stops in a straight line. Refer to **Service Brakes - Bleeding**.
- 8 Latch pedals and check for straight line braking; if satisfactory straight line braking cannot be achieved refer to **Fault Finding**.

#### Torque Settings

Item	Nm	kgf m	lbf ft
H	30-34	3.0-3.5	22-25

## Dismantling and Assembly

**Note 1:** The servo unit (not shown) is a non serviceable part. A faulty servo unit must be replaced with a new one.

**Note 2:** Seal kits are no longer available for the master cylinders, the only servicing permitted is a major repair kit which comprises of a full piston assembly. A faulty master cylinder and piston assembly must be replaced with new ones.

### Dismantling

- 1 Remove circlip **1** and washer **2**.
- 2 Shake the cylinder body, or use compressed air, to eject piston assembly **3**. Take care not to damage the piston assembly or the bore of the cylinder body.
- 3 Examine the working surfaces of piston and cylinder. If these are not in perfect condition the master cylinder assembly must be renewed. The piston assembly **3** cannot be dismantled. If it is damaged (including seal **5**), the complete piston/seal assembly must be renewed, see Note 2:

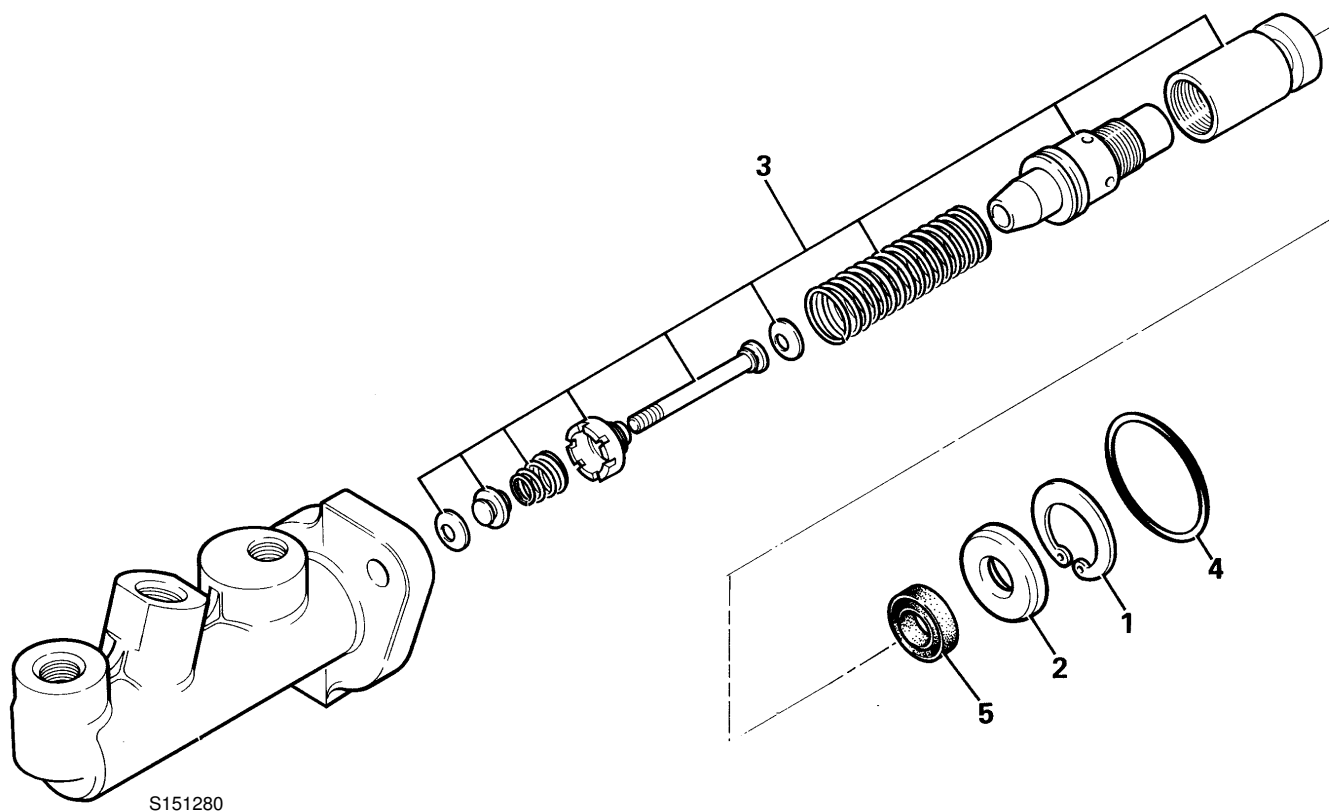
### Assembly

#### **⚠ WARNING**

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

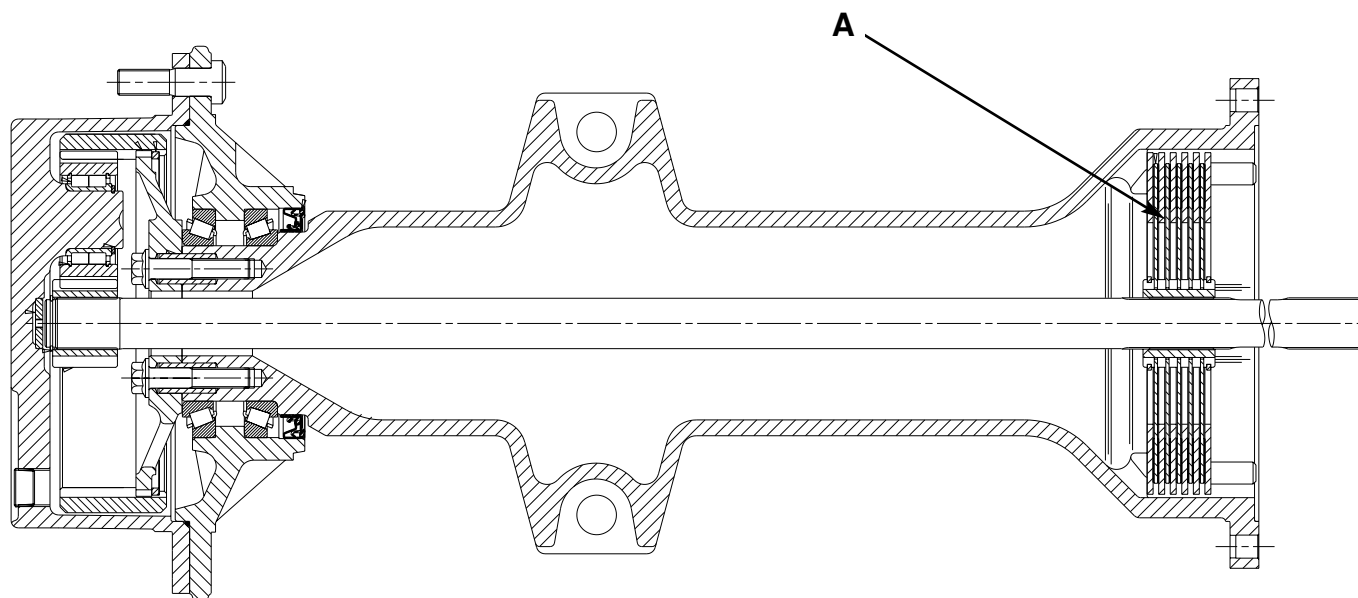
BRAK 1-1

- 1 Clean and lubricate all components, including new seals, with JCB Special Hydraulic Fluid. DO NOT USE CONVENTIONAL BRAKE FLUID OR SERIOUS DAMAGE WILL BE CAUSED.
- 2 Take care not to damage the machined faces of piston assembly **3** when assembling.



### Dismantling and Assembly

The service brakes are located in the rear axle, as shown at **A**. Instructions for dismantling and assembly of the brake are described in Section F - **Rear Axle Brakes**.



A264180

## 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.

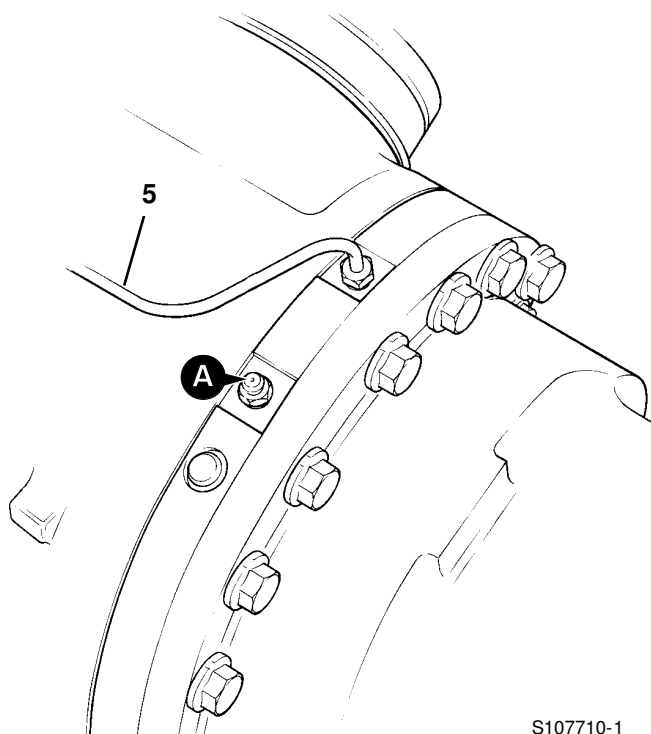
BRAK 1-2

### **⚠ 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

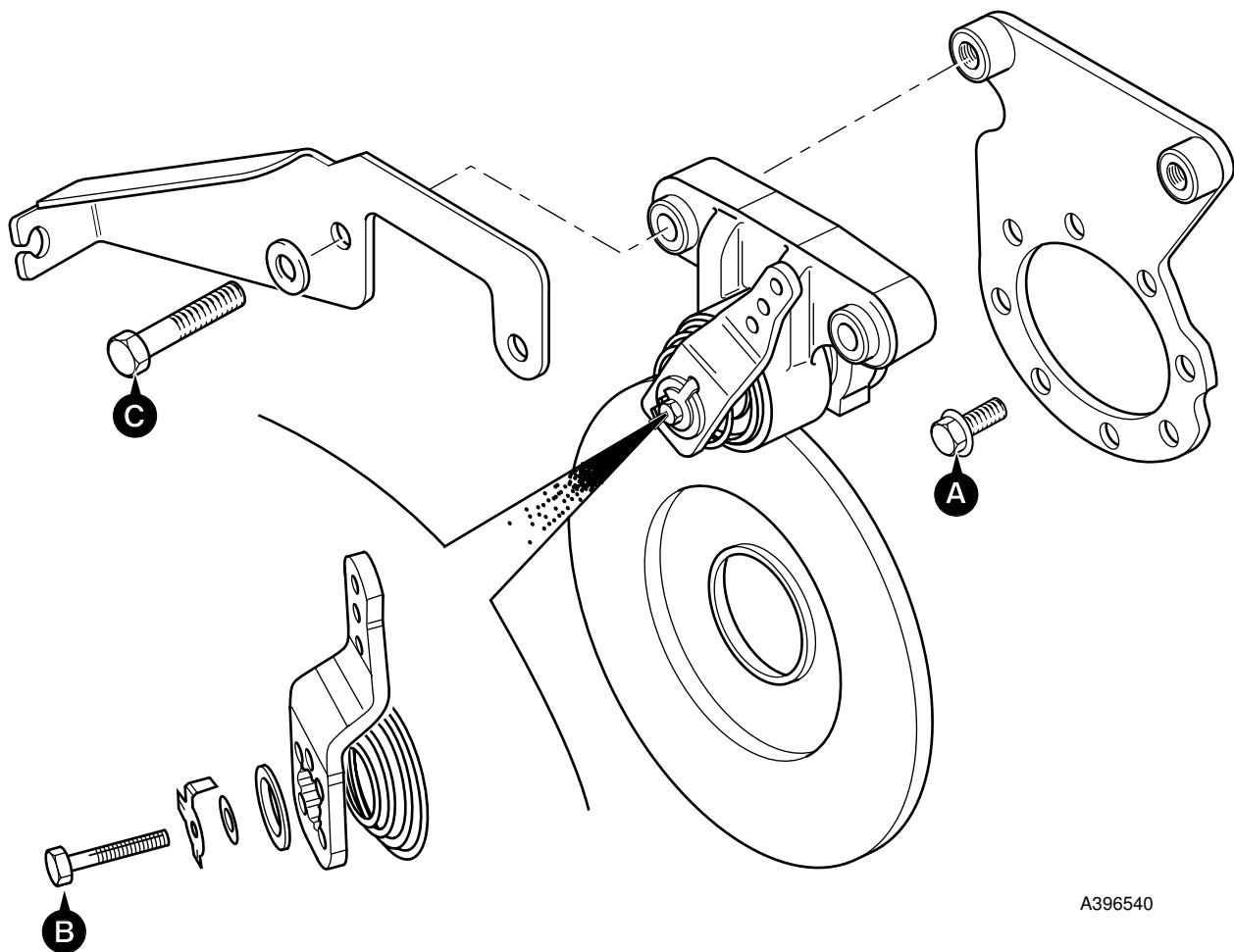
**Torque Figures**

The illustration shows a typical installation.

Where appropriate, the grade of bolt is indicated in parenthesis eg. (10.9). Refer also to relevant dismantling and assembly procedures.

**Torque Settings**

Item	Nm	lbf ft	
A	166	122	(12.9)
B	13-15	9-12	
C	255	188	(10.9 Tuflok)



A396540

## Calliper Removal and Replacement

### **⚠ WARNING**

This is a safety critical installation. Do not attempt to do this procedure unless you are skilled and competent to do so.

Installation and mounting of the parking brake calliper requires tightening of the mounting bolts to a specific torque figure. Do not attempt to do this job unless you have the correct tools available.

0010

### **⚠ WARNING**

Before working on the parking brake, park on level ground and put chocks each side of all four wheels. Stop the engine and disconnect the battery so that the engine cannot be started. If you do not take these precautions the machine could run over you.

BRAK 8-8

### **⚠ WARNING**

Brake pads generate dust which if inhaled, may endanger health. Wash off the calliper before commencing work. Clean hands thoroughly after work.

13-3-1-3

#### Removal

- 1 Release the parking brake lever (lever horizontal).
- 2 Disconnect clevis **A**, note which of the three holes on the lever is used.
- 3 Undo locknuts **B** and disconnect the cable from the bracket **D**.
- 4 Support the calliper and remove the two mounting bolts and hardened washers **C**. Lift the calliper and bracket **D** clear of the brake disc.

**Note:** Do not remove axle mounting bracket **F** unless it needs to be renewed.

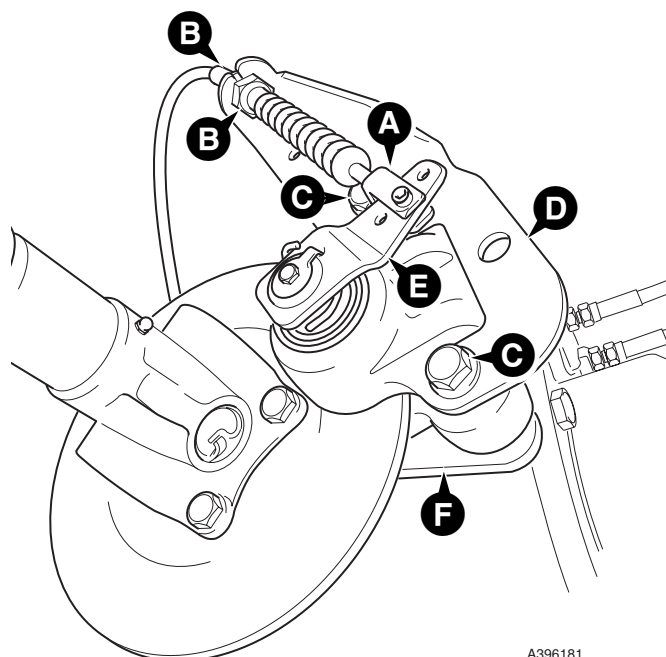
#### Replacement

Replacement is the reverse of the removal sequence.

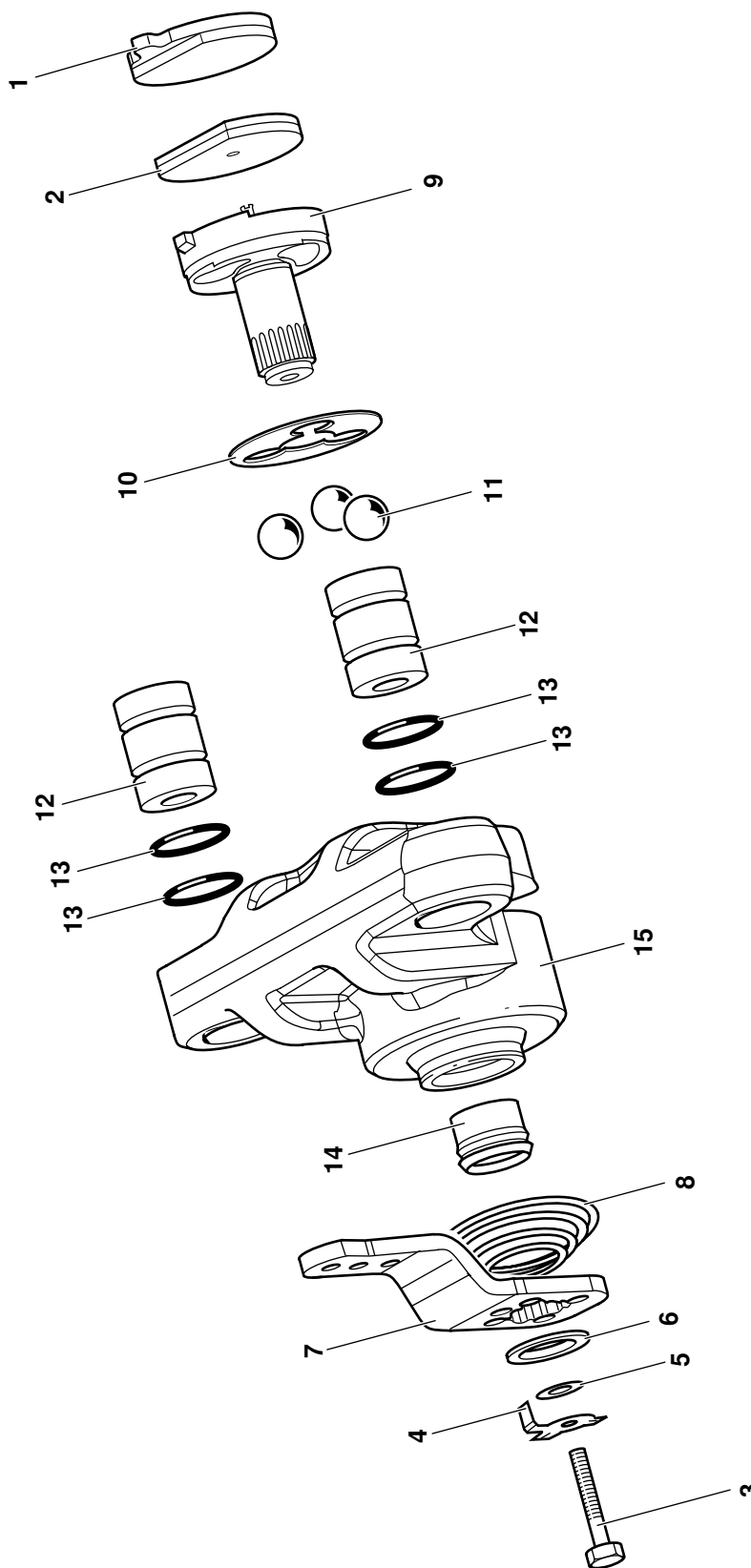
- 1 Locate the calliper on the brake disc and fit new mounting bolts **C** with hardened washers, torque tighten to 255 Nm (188 lbf ft).
- 2 Insert cable into bracket **D**, do not tighten locknuts **B** at this stage as the brake will need adjusting.
- \* 3 Refit the clevis **A** into the hole in the operating lever **E** as shown.
- 4 Make sure there is adequate freedom of movement of operating lever **E** to ensure a positive brake application, and that the lever returns to the rest position when the parking brake is released.
- 5 Adjust the parking brake, see **Service Procedures, Parking Brake Adjustment**. Never unscrew the clevis **A** to adjust the cable.

#### Torque Settings

Item	Nm	lbf ft
<b>C</b>	255	188



A396181



**Component Listing:**

- 1 Carrier Side Pad
- 2 Lever Side Pad
- 3 Bolt
- 4 Anti-rotation Clip
- 5 Washer
- 6 Washer
- 7 Lever
- 8 Spring
- 9 Rotor
- 10 Ball Spacer
- 11 Ball Bearings
- 12 Mounting Bush
- 13 O-ring
- 14 Shaft Seal
- 15 Housing

228362

## Calliper Dismantling and Assembly

### Dismantling

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

#### WARNING

**This is a safety critical installation. Do not attempt to do this procedure unless you are skilled and competent to do so.**

**Installation and mounting of the parking brake calliper requires tightening of the mounting bolts to a specific torque figure. Do not attempt to do this job unless you have the correct tools available.**

0010

#### WARNING

**Before working on the parking brake, park on level ground and put chocks each side of all four wheels. Stop the engine and disconnect the battery so that the engine cannot be started. If you do not take these precautions the machine could run over you.**

BRAK 8-8

#### WARNING

**Brake pads generate dust which if inhaled, may endanger health. Wash off the calliper before commencing work. Clean hands thoroughly after work.**

13-3-1-3

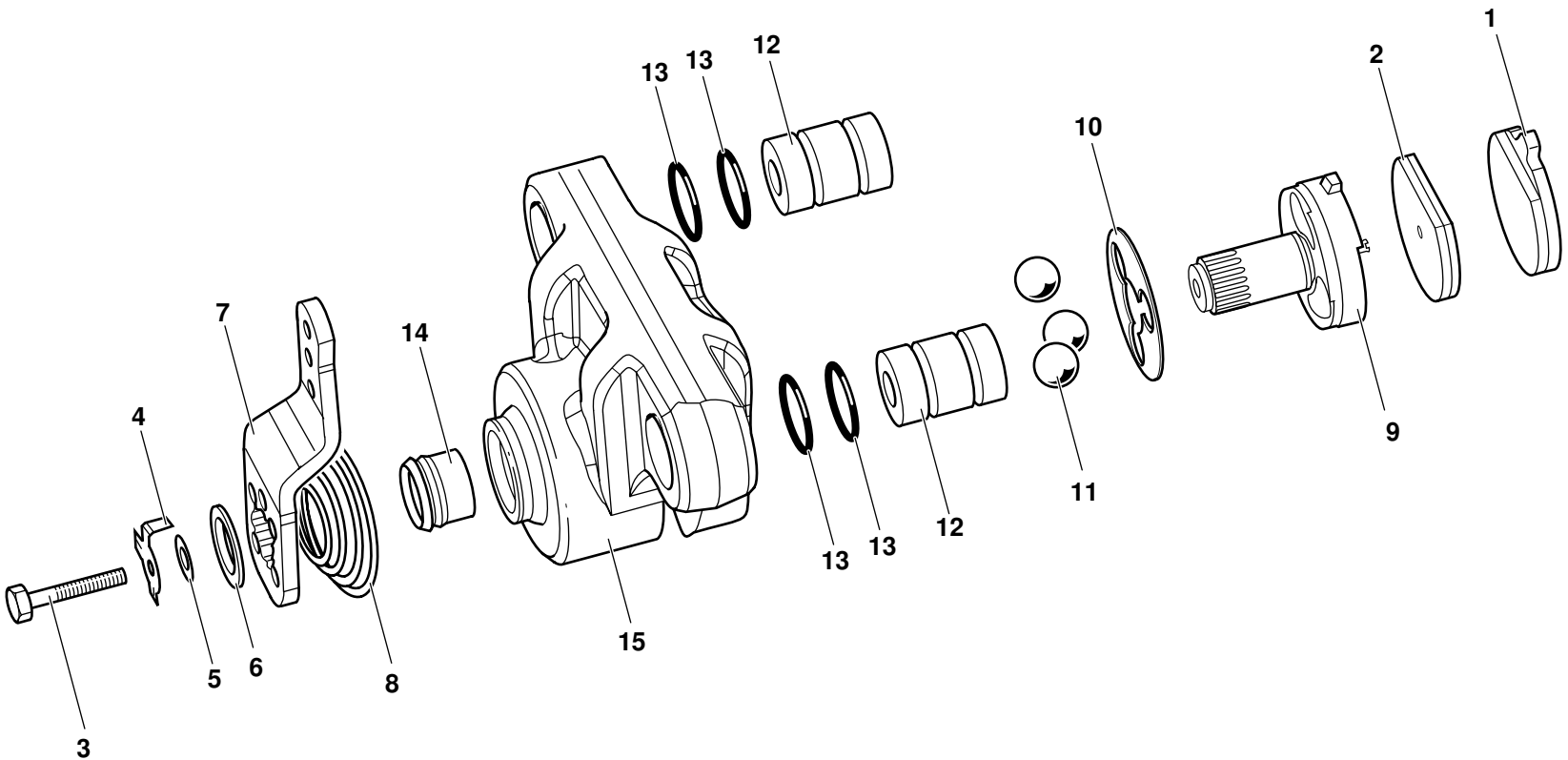
- 1 Remove the calliper and brake pads, refer to **Calliper - Removal and Replacement**.
- 2 Bend the tabs on anti-rotation clip **4**. Remove bolt **3**, anti-rotation clip **4** and washers **5** and **6**. Hold lever **7** against the tension of the spring as the bolt is removed.
- 3 Note the position of lever **7** and the splines of the shaft. Mark the end of the shaft and lever **7** to aid assembly. Remove lever **7** and spring **8**.
- 4 Push out rotor **9** and remove ball spacer **10** and ball bearings **11**. Take care not to lose the ball bearings.
- 5 Push out mounting bushes **12** and remove O-rings **13**.

**Note:** Shaft seal **14** will not need to be renewed unless excessively worn or damaged. If removal is necessary, press the seal out from inside the housing using a suitable spacer block and bench press. Clean out any remains of the seal after removal.

### Inspection

- 1 Clean and dry all parts. Check all parts are free from excessive wear, damage or corrosion. Light scores or stains should be removed. Renew corroded or deeply scored parts.
- 2 Check rotor **9** for damage or distortion. Renew if necessary.  
  
Always renew both brake pads if the parking brake has been used in an emergency.
- 3 Check the ball pockets in housing **15** for signs of scoring, pitting, damage or corrosion. Renew the housing if damaged.
- 4 Check spring **8** is not broken or distorted.
- 5 Check the condition of the disc surface. Renew the disc if badly warped, pitted or worn.



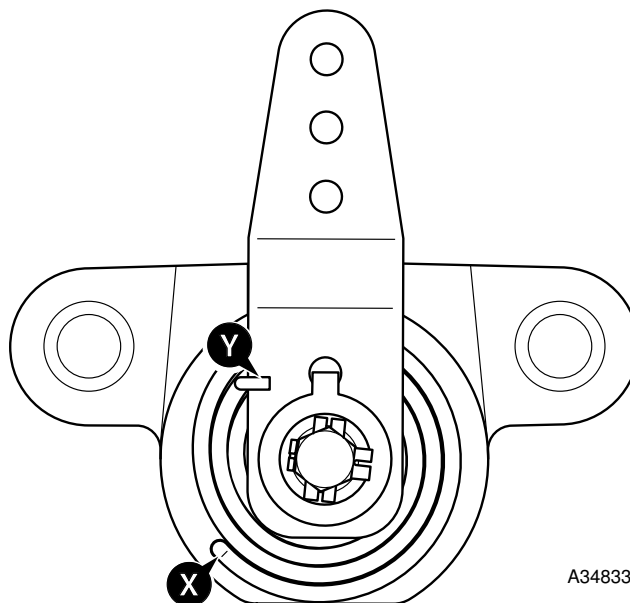


## Dismantling and Assembly (cont'd)

### Assembly

Before assembly make sure all parts are clean and serviceable.

- 1 Fit a new shaft seal **14** if removed. Install the seal as shown. Press the seal into the housing using a suitable spacer block and bench press.
- 2 Coat the the shaft and ball pockets of rotor **9** and the ball pockets of housing **15** with silicone grease.
- 3 Insert the three ball bearings **11** into the pockets in the housing **15**. Insert ball spacer **10**.
- 4 Slide rotor **9** through the casting and seat the ball pockets against the bearings.
- 5 Position spring **8** over the shaft of rotor **9**. Insert the large diameter end of the spring into hole **X** in the face of the housing.
- 6 Locate the small diameter end of spring **8** around the outside edge of lever **7** as shown at **Y**.
- 7 Fit lever **7**. Align the lever to the mark made during dismantling.
- 8 Hold the lever against the tension of the spring and fit washers **6** and **5**, and new anti-rotation clip **4**. Fit bolt **3** and tighten to 13-16 Nm (9-12 lbf ft).
- 9 Bend up a tab of the anti-rotation clip that aligns with one of the flats on the bolt.
- 10 Fit the new brake pads, refer to **Service Procedures - Parking Brake - Renewing the Brake Pads**.
- 11 Lubricate the O-rings **13** and bushes **12** with silicone grease. Fit O-rings into the housing and insert mounting bushes. Wipe off any excess grease.
- 12 Before fitting the calliper, ensure the lever rotates smoothly and that the lever side pad **2** returns to the off position when the lever is released.
- 13 Refit the brake calliper. Refer to **Calliper - Removal and Replacement**.
- 14 Adjust the parking brake, refer to **Service Procedures - Parking Brake - Adjustment**.



A348331

### Torque Settings

Item	Nm	lbf ft
3	13-16	9-12

## Brake Disc - Removal and Replacement

### WARNING

This is a safety critical installation. Do not attempt to do this procedure unless you are skilled and competent to do so.

### WARNING

Before working on the parking brake, park on level ground and put chocks each side of all four wheels. Stop the engine and disconnect the battery so that the engine cannot be started. If you do not take these precautions the machine could run over you.

BRAK 8-8

### Removal

- 1 Disconnect the propshaft to the rear axle, refer to Section F **Propshafts - Removal and Replacement**.
- 2 Remove the calliper from the axle mounting bracket F, refer to **Calliper Removal and Replacement**.
- 3 Undo the stake nut and withdraw the brake disc from the drive pinion shaft.

**Note:** If the axle is not mounted to a machine, fit flange spanner (service tool 992/04800) to prevent brake disc and drive pinion shaft turning when loosening or tightening the stake nut. Refer to Section F - **Service Tools**.

### Replacement

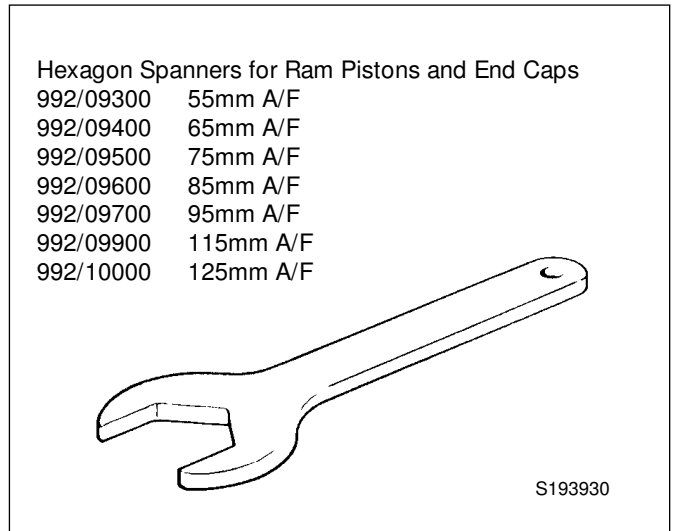
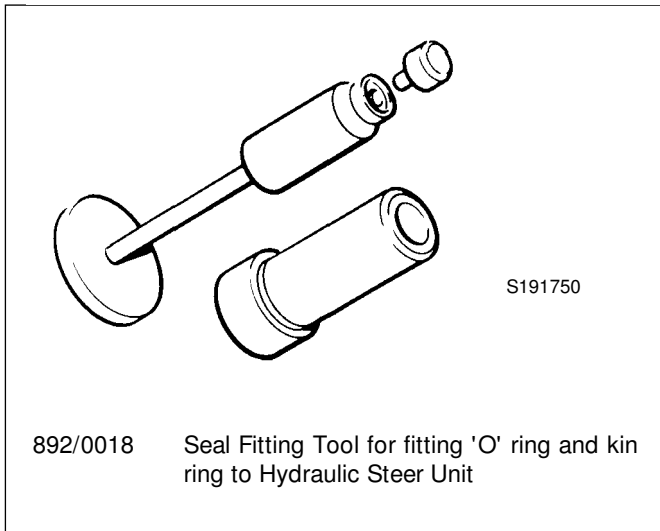
Replacement is the reverse of the removal sequence.

- 1 Fit a new stake nut and torque tighten to 300 Nm (221 lbf ft), see Note:
- 2 Re-stake the nut using a square ended staking tool.

### Torque Settings

Item	Nm	kgf m	lbf ft
1	300	30.6	221

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Removal and Replacement	50 - 1
Dismantling and Assembly	50 - 3



**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 <sup>2</sup>	1740 ± 50 lbf/in <sup>2</sup>
- Shock Valve Operating Pressure	175 - 190bar	178 - 199 kgf/cm <sup>2</sup>	2538 - 2756 lbf/in <sup>2</sup>
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 <sup>2</sup>	1740 ± 50 lbf/in <sup>2</sup>

**PRIORITY VALVE - FIG 2**

-Stand by Pressure	7 bar	7.1 kgf/cm <sup>2</sup>	102 lbf/in <sup>2</sup>
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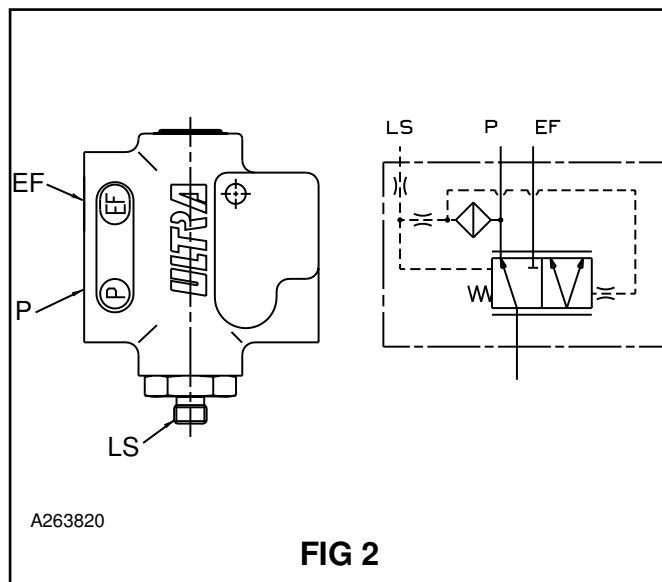
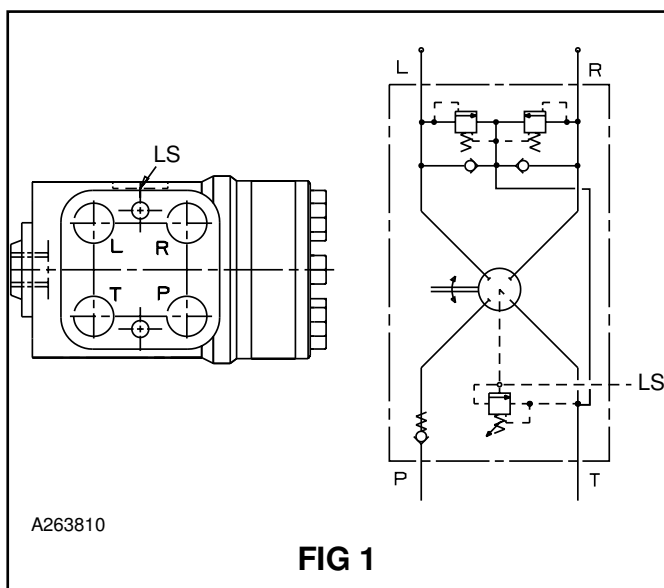
**4 Wheel Steer Machines**

**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 <sup>2</sup>	1740 ± 50 lbf/in <sup>2</sup>
- Shock Valve Operating Pressure	175 - 190bar	178 - 199 kgf/cm <sup>2</sup>	2538 - 2756 lbf/in <sup>2</sup>

**PRIORITY VALVE - FIG 2**

-Stand by Pressure	7 bar	7.1 kgf/cm <sup>2</sup>	102 lbf/in <sup>2</sup>
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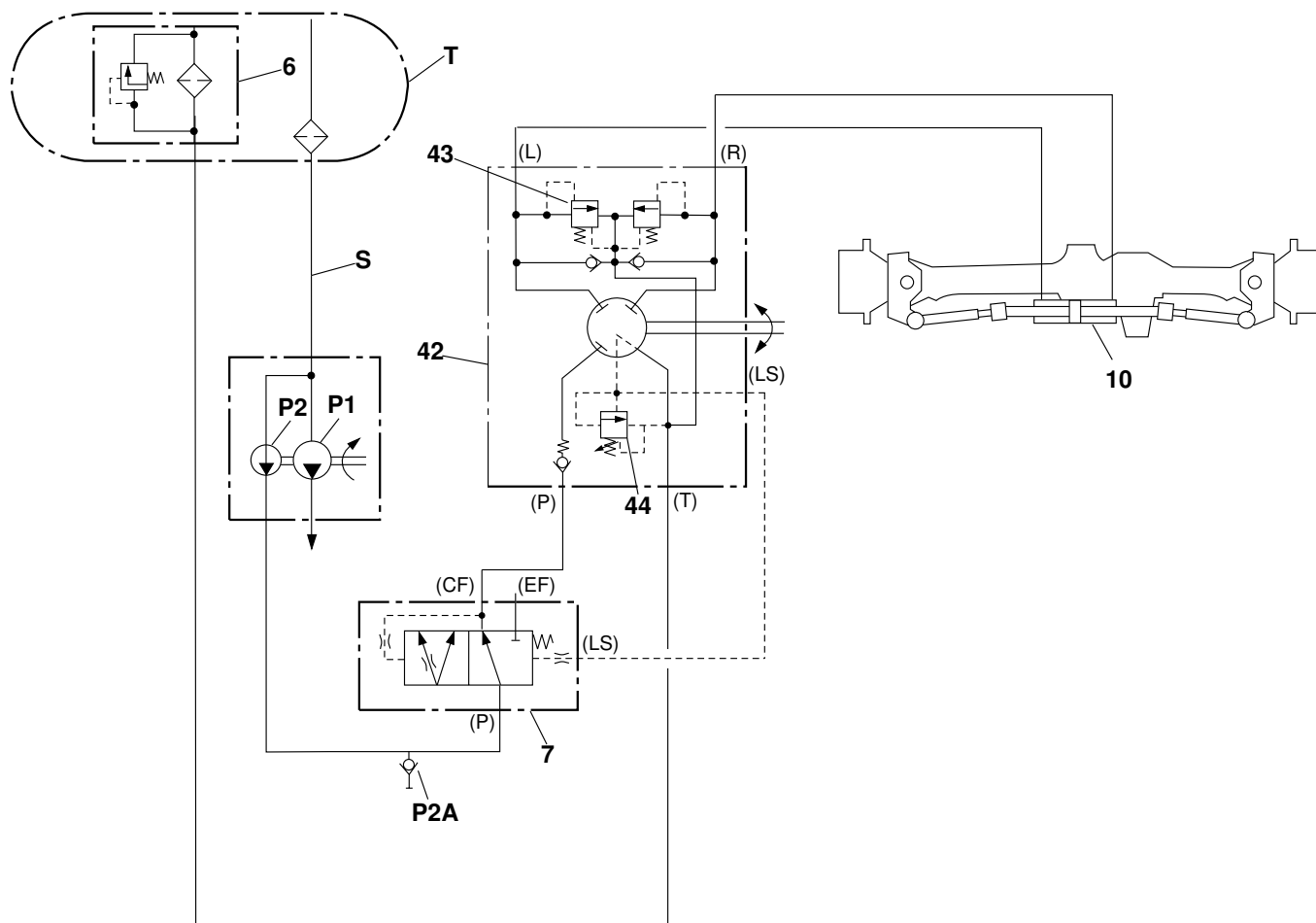
## 2 Wheel Steer Machines

### Steer System Schematics

#### Component Key:

- P1 Pump, Main Section
- P2 Pump, Secondary Section
- P2A Pressure Test Point
- S Suction Line
- T Tank
- 6 In-tank Filter
- 7 Priority Valve
- 10 Front Power Track Rod Ram
- 42 Steer Unit
- 43 Shock Valve
- 44 Steer Unit Relief Valve

**Note:** Hydraulic component port identification letters are shown in parenthesis, e.g. (LS). The same letters will be stamped on the actual component.



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## 2 Wheel Steer Machines

### Hydraulic Operation

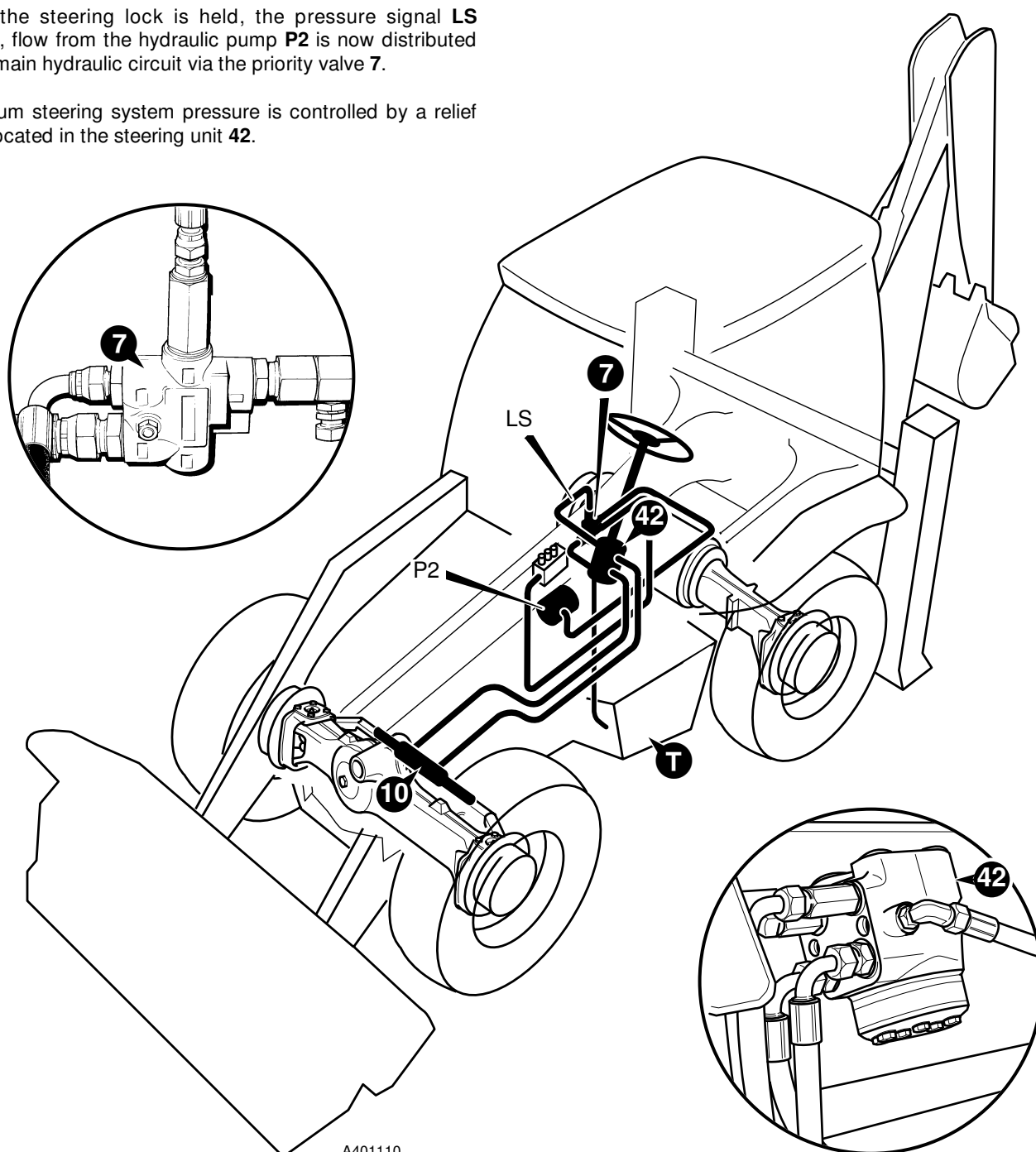
The main components of the steering system are the priority valve **7**, load sensing steer unit **42**, hydraulic tank **T** and the front power track rod ram **10**.

When the steering wheel is turned, a pressure demand is sensed at the priority valve **7** via load sensing line **LS**.

Oil from the hydraulic pump **P2** is then distributed via the priority valve to the steer unit **42**, which then directs the oil to the front power track rod ram **10** until the required steering lock is achieved.

When the steering lock is held, the pressure signal **LS** ceases, flow from the hydraulic pump **P2** is now distributed to the main hydraulic circuit via the priority valve **7**.

Maximum steering system pressure is controlled by a relief valve located in the steering unit **42**.



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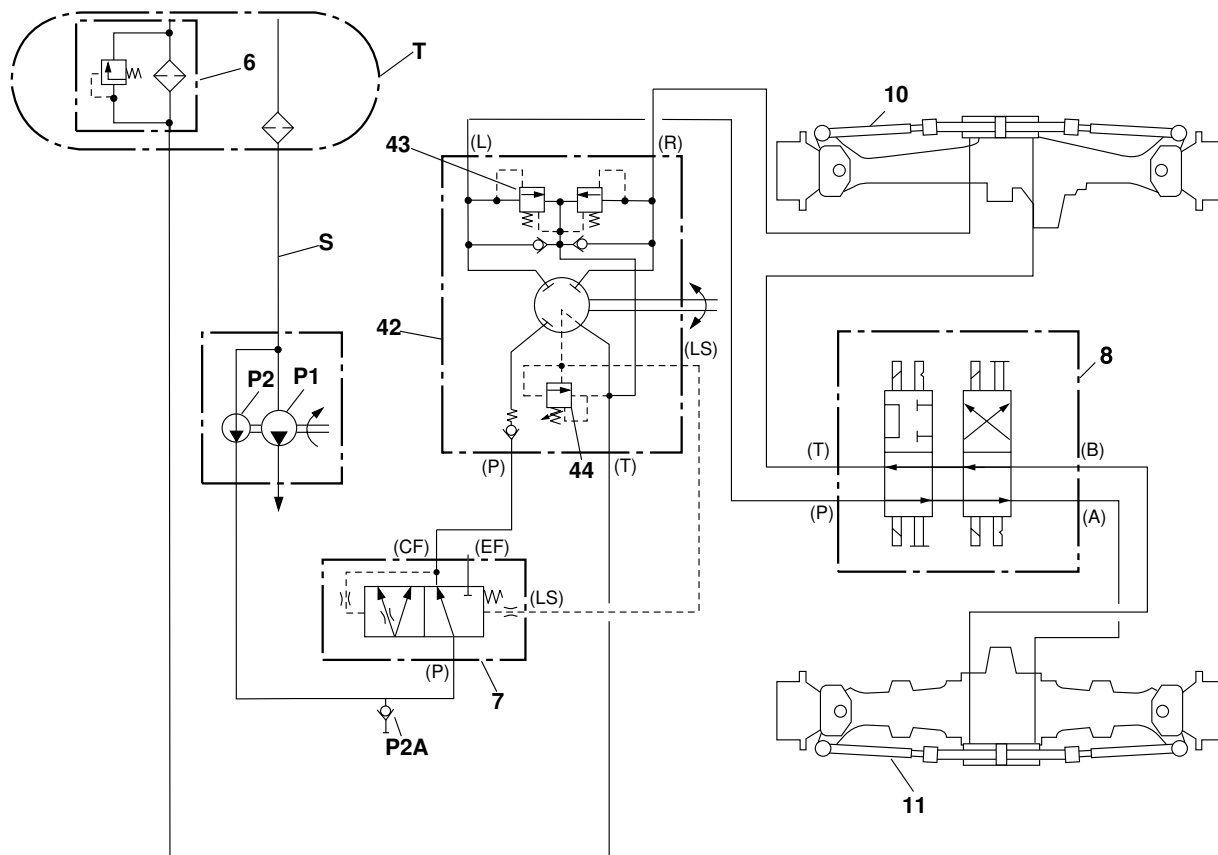
### 4 Wheel Steer Machines

### Steer System Schematics

**Component Key:**

- P1 Pump, Main Section
- P2 Pump, Secondary Section
- P2A Pressure Test Point
- S Suction Line
- T Tank
- 6 In-tank Filter
- 7 Priority Valve
- 8 Steer Mode Control Valve
- 10 Front Power Track Rod Ram
- 11 Rear Power Track Rod Ram
- 42 Steer Unit
- 43 Shock Valve
- 44 Steer Unit Relief Valve

**Note:** Hydraulic component port identification letters are shown in parenthesis, e.g. (LS). The same letters will be stamped on the actual component.



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## 4 Wheel Steer Machines

### Hydraulic Operation

The main components of the steering system are the priority valve **7**, load sensing steer unit **42**, hydraulic tank **T**, front power track rod ram **10** and rear power track rod ram **11**.

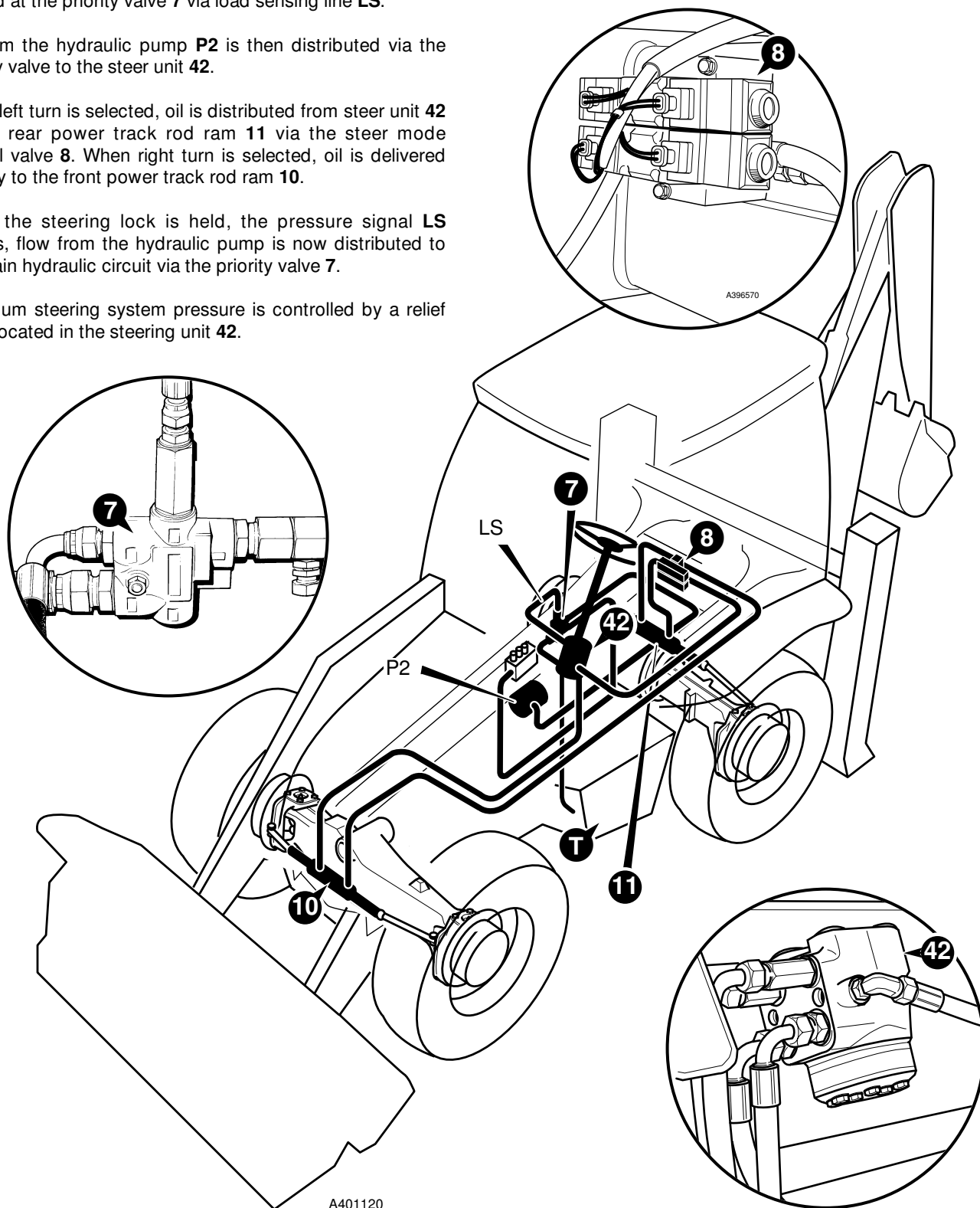
When the steering wheel is turned, a pressure demand is sensed at the priority valve **7** via load sensing line **LS**.

Oil from the hydraulic pump **P2** is then distributed via the priority valve to the steer unit **42**.

When left turn is selected, oil is distributed from steer unit **42** to the rear power track rod ram **11** via the steer mode control valve **8**. When right turn is selected, oil is delivered directly to the front power track rod ram **10**.

When the steering lock is held, the pressure signal **LS** ceases, flow from the hydraulic pump is now distributed to the main hydraulic circuit via the priority valve **7**.

Maximum steering system pressure is controlled by a relief valve located in the steering unit **42**.



## 4 Wheel Steer Machines

### Electrical Operation

Three steering modes are available:

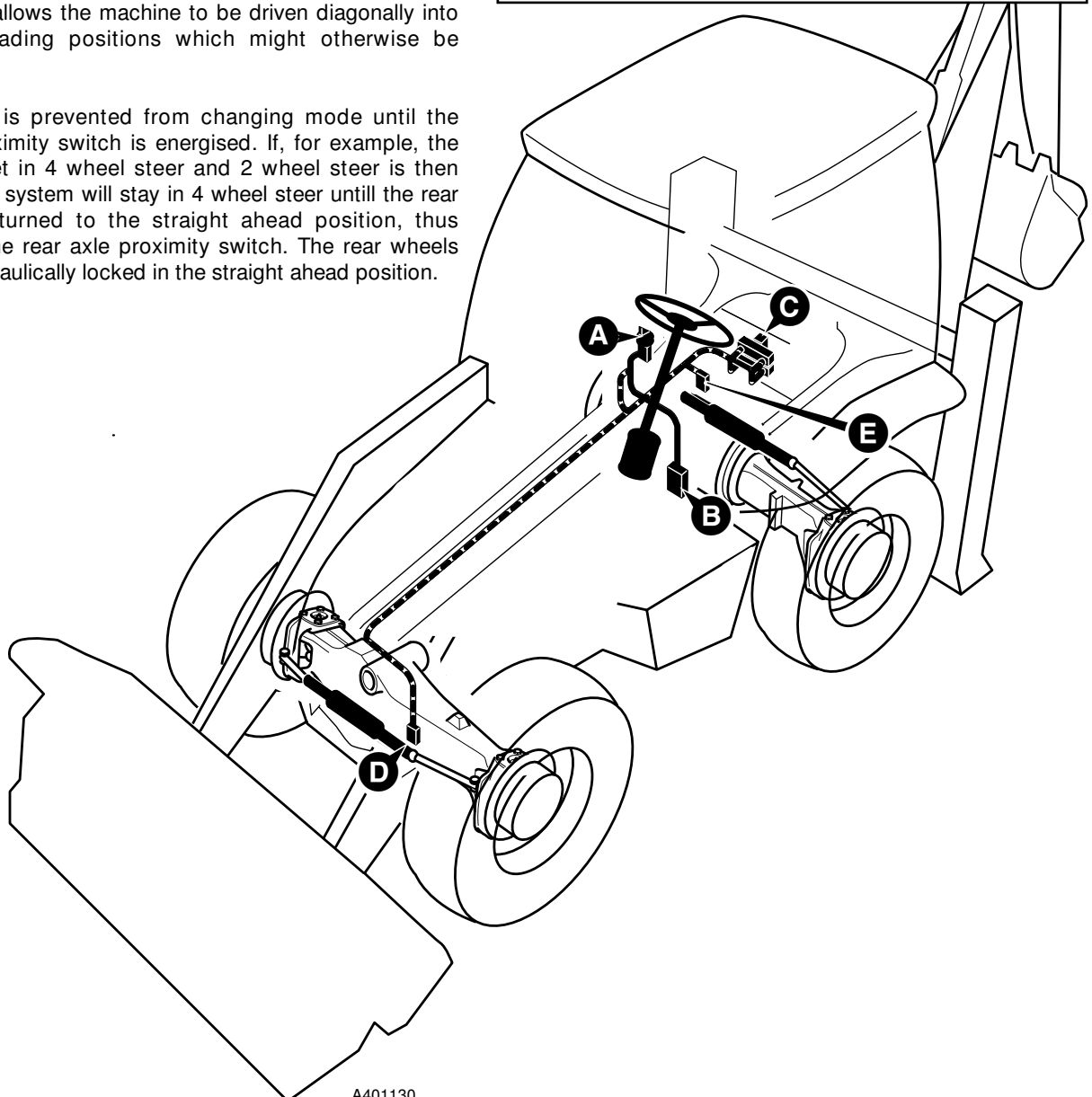
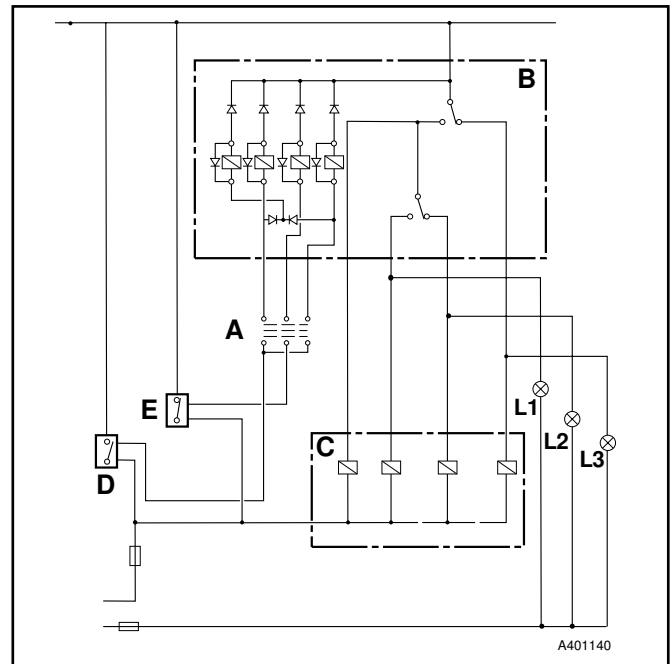
- 2 Wheel Steer (front axle)
- 4 Wheel Steer
- Crab Steer

The three modes are selected in the cab from a three position switch **A** which operates relays in the steer mode control unit **B**. The relays switch the energising supplies to the solenoid operated steer mode control valve **C**. Proximity switches on the front **D** and rear **E** axles signal when the wheels are in the straight ahead position.

Lights **L1**, **L2** or **L3** on the instrument panel illuminate to indicate the steer mode currently operative.

In 2 wheel steer mode only the front wheels are steered. In 4 wheel steer mode both axles are steered, giving a smaller turning circle and so improving manoeuvrability. The crab steer mode allows the machine to be driven diagonally into loading/unloading positions which might otherwise be inaccessible.

The system is prevented from changing mode until the relevant proximity switch is energised. If, for example, the system is set in 4 wheel steer and 2 wheel steer is then selected, the system will stay in 4 wheel steer until the rear wheels are turned to the straight ahead position, thus energising the rear axle proximity switch. The rear wheels are then hydraulically locked in the straight ahead position.



## Steer Unit Operation - 2 Wheel Steer Machines

On 2 wheel steer machines the hydraulic steer unit operation is identical to that described for the 4 wheel steer machines, except the unit pumps oil out directly to a power track rod ram fitted on the front axle only. Also, therefore the 2 wheel steer machines do not have a steer mode control valve.

Refer to, **Steer Unit Operation - 4 Wheel Steer Machines.**

**Steer Unit Operation**  
**- 4 Wheel Steer Machines**

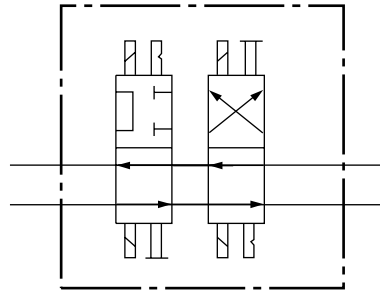
**4 Wheel Steer Mode**  
**- Neutral**

Flow from the priority valve enters the steering unit through the bottom right hand port past the non-return valve **43C**. When the steering wheel is stationary the inner spool **A** and sleeve **B** are held in the neutral position by the centring springs **K**. As the unit is 'closed centre' the flow from the pump is dead ended by the steering unit.








**Component Key:**

- A** Inner Spool
- B** Sleeve
- D** Stator
- K** Centring Springs
- X** Steer Mode Control Valve
- 43C** Non-Return Valve

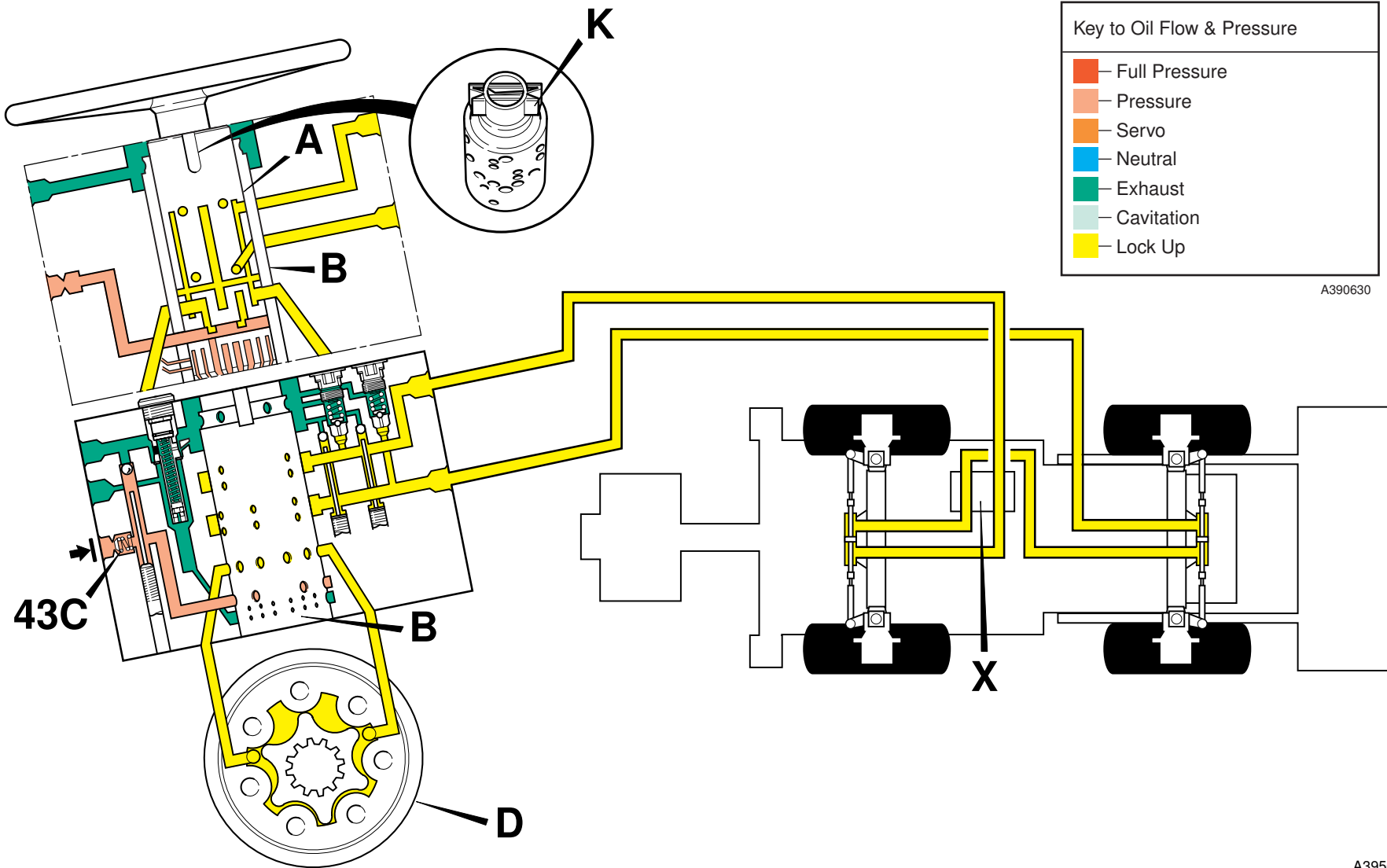
In 4 wheel steer mode the spools of the steer mode control valve **X** are configured as shown.



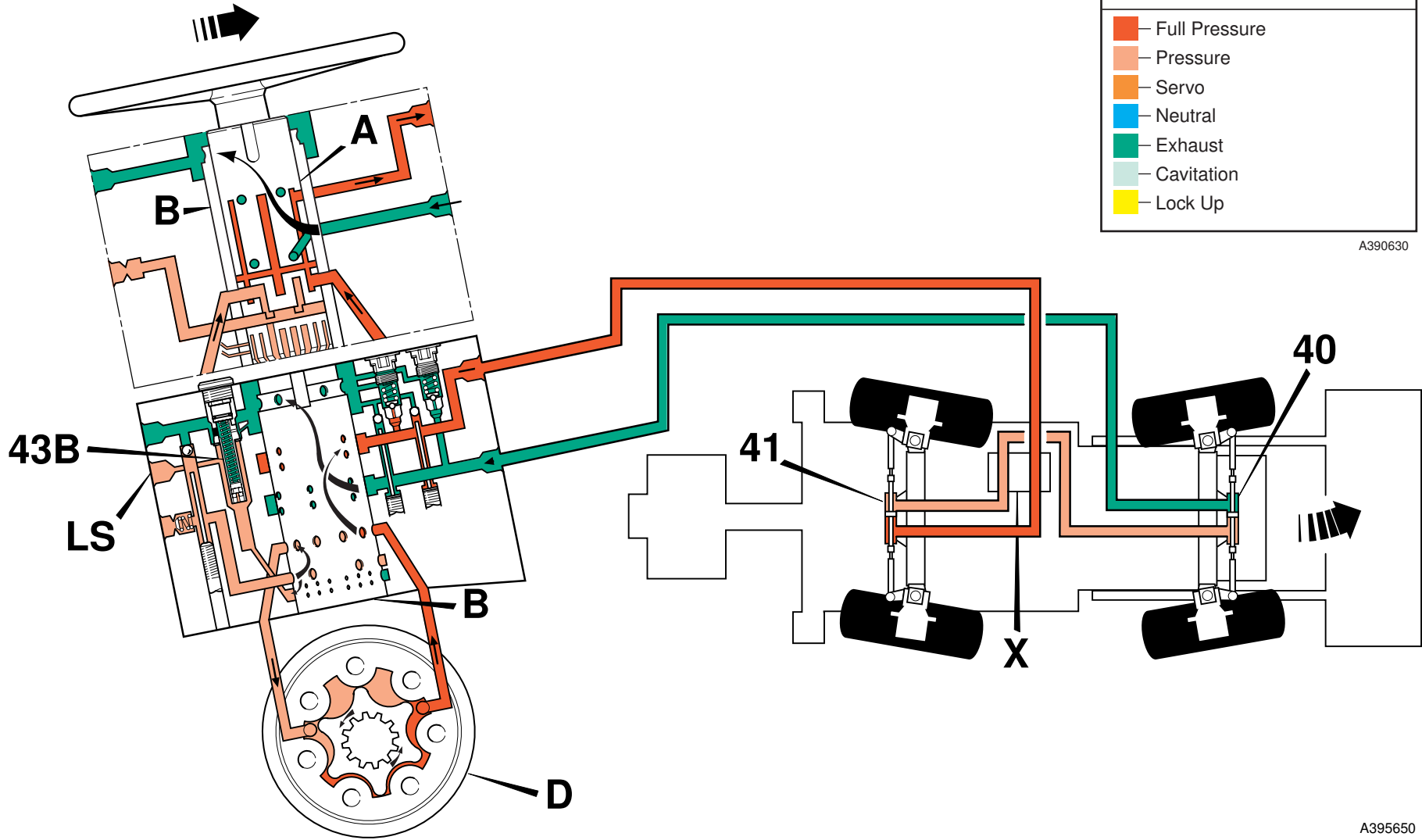
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Key to Oil Flow & Pressure	
	Full Pressure
	Pressure
	Servo
	Neutral
	Exhaust
	Cavitation
	Lock Up

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## 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



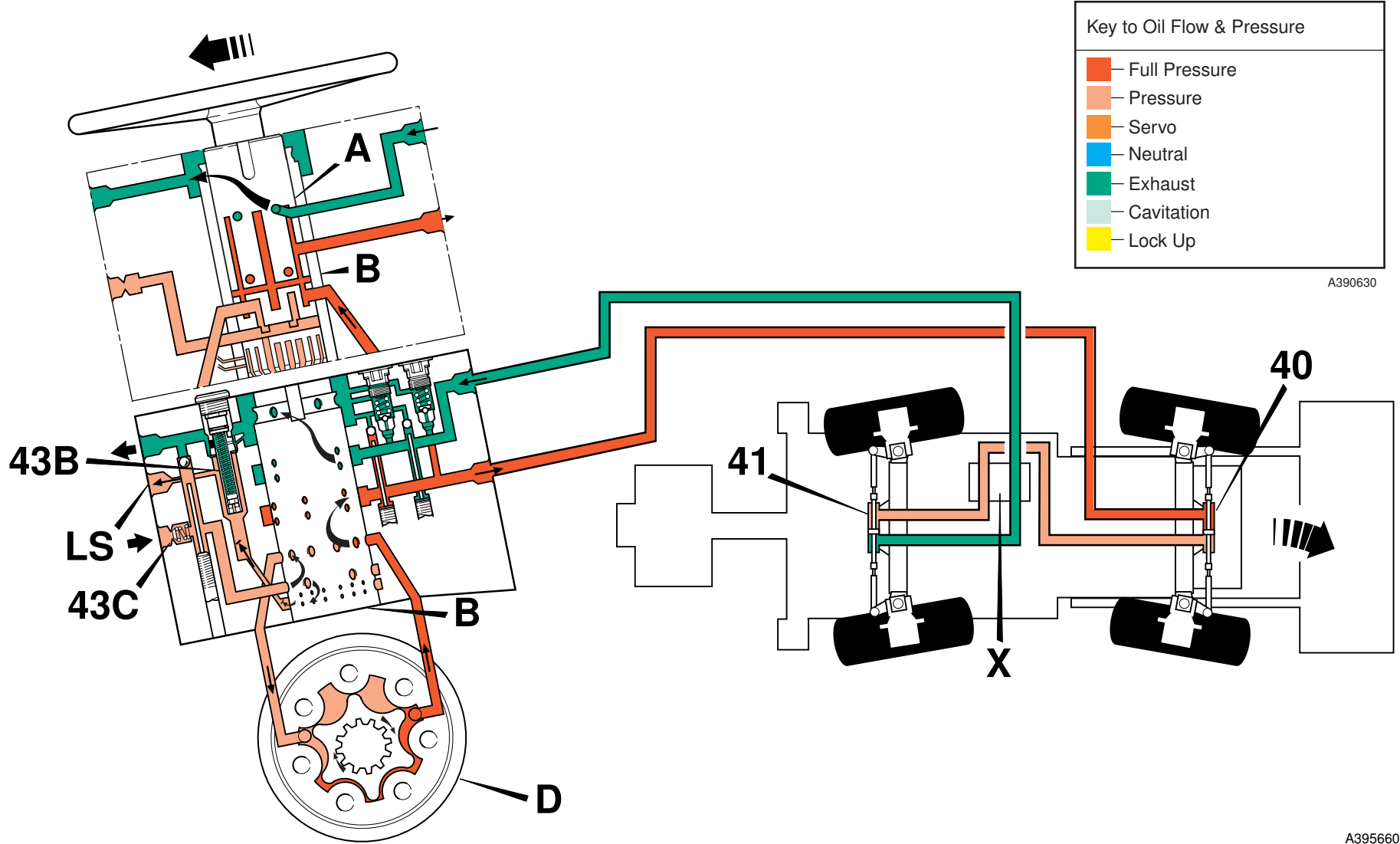
## Steer Unit Operation - 4 Wheel Steer Machines

### 4 Wheel Steer Mode - Right Turn

The illustration shows the flow through the steering unit in a right hand turn condition. The operation is identical to that described for a left hand turn, except that the oil is diverted by spool **A** to the other side of stator **D** and power track rod rams **40** and **41**.

#### Component Key:

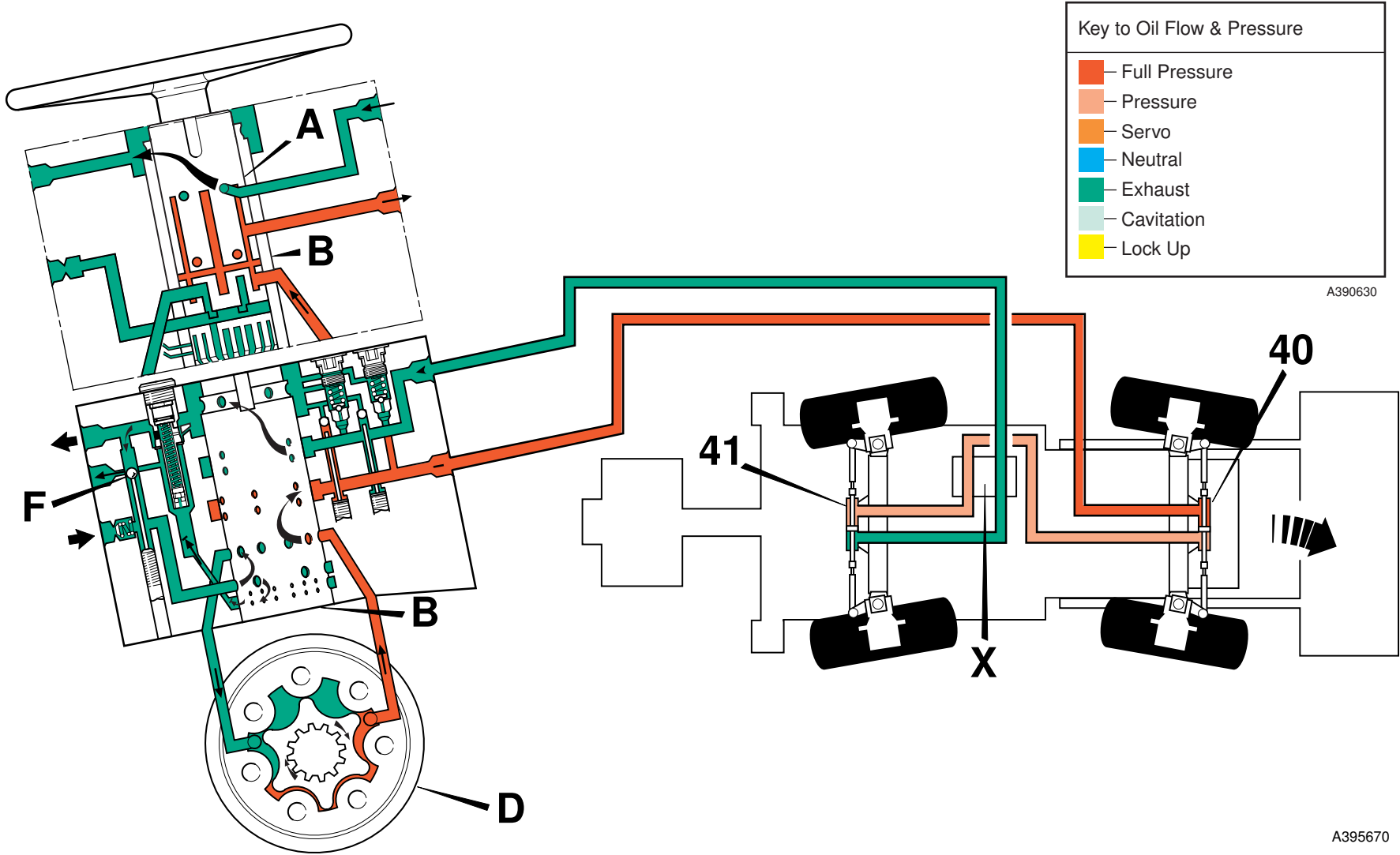
- A** Inner Spool
- B** Outer Spool
- D** Stator
- LS** Load Sensing Port
- X** Steer Mode Control Valve
- 40** Front Power Track Rod Ram
- 41** Rear Power Track Rod Ram
- 43B** Relief Valve
- 43C** Non-Return Valve



Key to Oil Flow & Pressure	
<span style="color: darkorange;">█</span>	Full Pressure
<span style="color: lightorange;">█</span>	Pressure
<span style="color: orange;">█</span>	Servo
<span style="color: blue;">█</span>	Neutral
<span style="color: green;">█</span>	Exhaust
<span style="color: lightgreen;">█</span>	Cavitation
<span style="color: yellow;">█</span>	Lock Up

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## Steer Unit Operation - 4 Wheel Steer Machines

### 4 Wheel Steer Mode - Right Turn, Unassisted

The illustration shows the circuit operation with the engine stopped. Turning the steering wheel rotates the inner spool **A** until the cross pin engages with and rotates outer sleeve **B**, metering oil to the stator **D**, and pumping it out to power track rod rams **40** and **41** under manual pressure only.

As there is no supply from the pump, oil from one side of the power track rod rams, supplemented by exhaust oil if necessary, is used to feed the other side via non-return valve **F**.

#### Component Key:

- A** Inner Spool
- B** Outer Spool
- D** Stator
- F** Non-Return Valve
- X** Steer Mode Control Valve
- 40** Front Power Track Rod Ram
- 41** Rear Power Track Rod Ram

## Steer Unit Operation - 4 Wheel Steer Machines

### 4 Wheel Steer Mode - Shock Valve

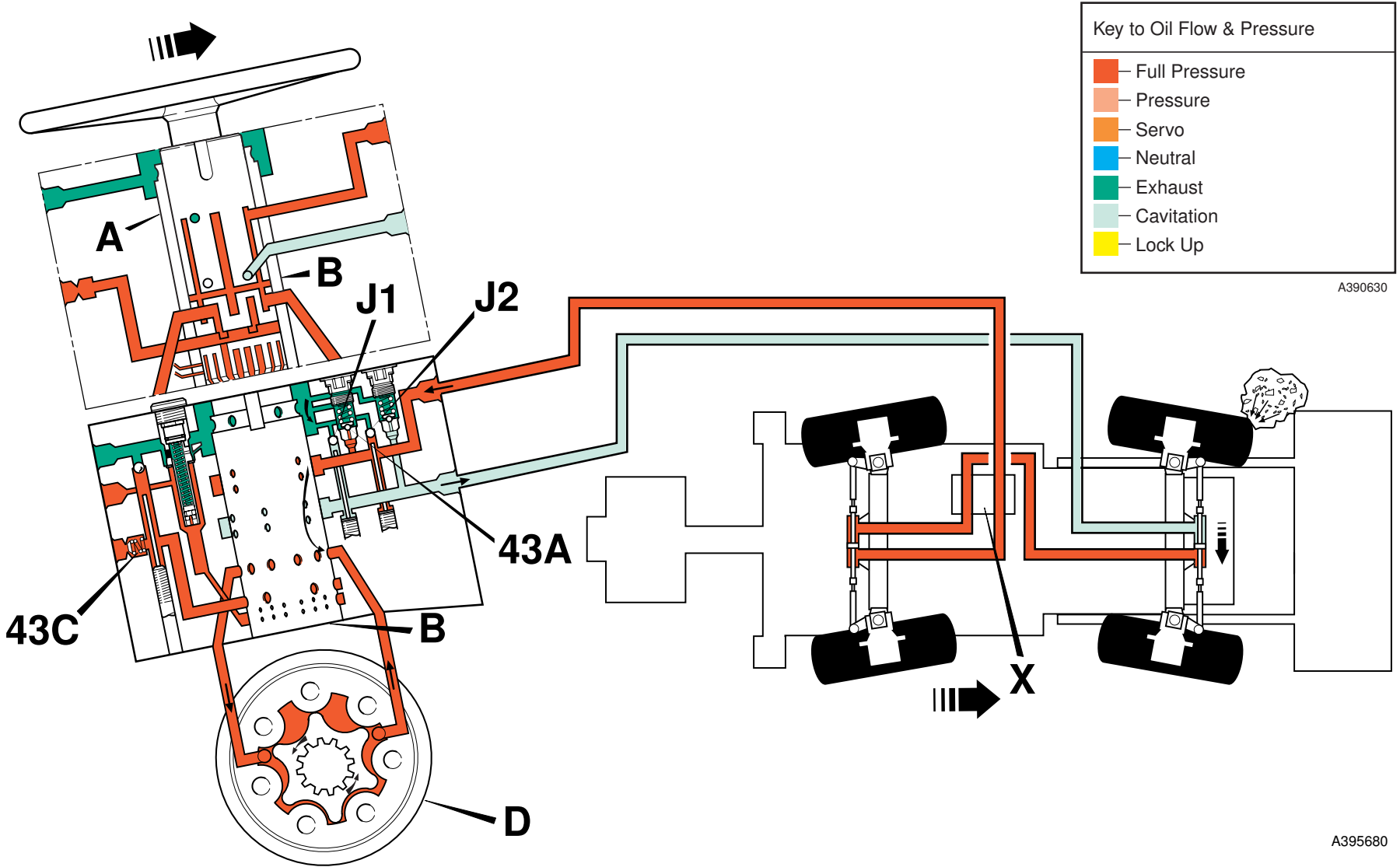
In normal operation oil flow from the pump enters the steering unit via the right hand port, opening a spring-loaded non-return valve **43C**. The flow is directed by the steering unit to achieve the desired turn (right hand shown).








In the event of a pressure shock wave being generated in the system by an outside force, shock valve **43A** vents this pressure to exhaust preventing damage to the steering unit.

Non-return valve **J2** is held on its seat by the generated pressure and non-return valve **43C** closes to prevent the shock wave being fed back to the pump. Some of the excess flows via non-return valve **J1** to the opposite side of the power track rod ram to prevent cavitation occurring.

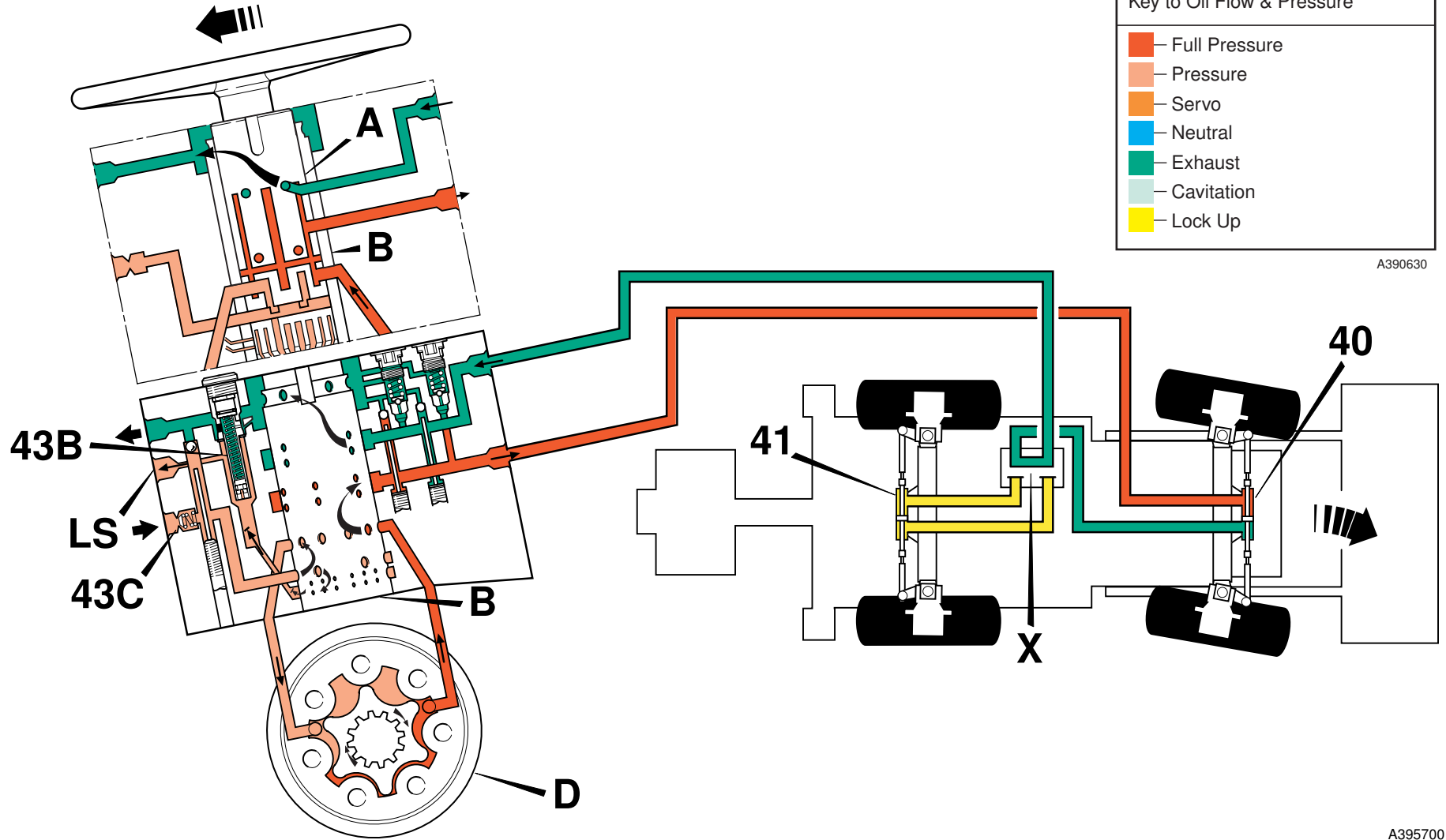
#### Component Key:

- A** Inner Spool
- B** Outer Spool
- D** Stator
- X** Steer Mode Control Valve
- J1** Non-Return Valve
- J2** Non-Return Valve
- 43A** Shock Valve
- 43C** Non-Return Valve



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

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## Steer Unit Operation - 4 Wheel Steer Machines

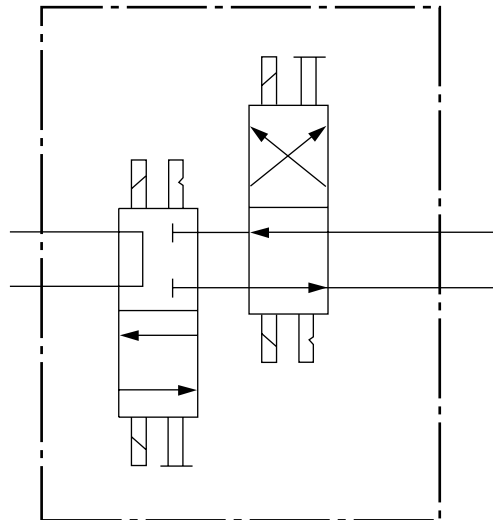
### 2 Wheel Steer Mode - Right Turn

The illustration shows the flow through the steering unit in a right hand turn condition. The operation is identical to that described for the 4 wheel steer mode, except the steer mode control valve **X** isolates the oil flow to the rear power track rod ram **41**, consequently the rotor lobes pump oil out to the front power track rod only. The rear wheels are held in the straight ahead position by the locked-up oil in the rear power track rod ram.

#### 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
- 43C** Non-Return Valve

In 2 wheel steer mode the spools of the steer mode control valve **X** are configured as shown.



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## Steer Unit Operation - 4 Wheel Steer Machines

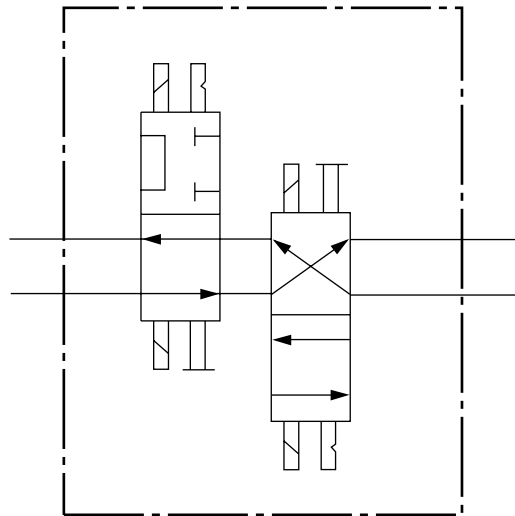
### Crab Steer Mode - Right Turn

The illustration shows the flow through the steering unit in a right hand turn condition. The operation is identical to that described for the 4 wheel steer mode, except the steer mode control valve **X** directs the pressurised oil from the front power track rod ram **40** to the other side of the rear power track rod ram **41**, hence turning the rear wheels in the same direction as the front wheels, causing the machine to crab to the right.

#### Component Key:

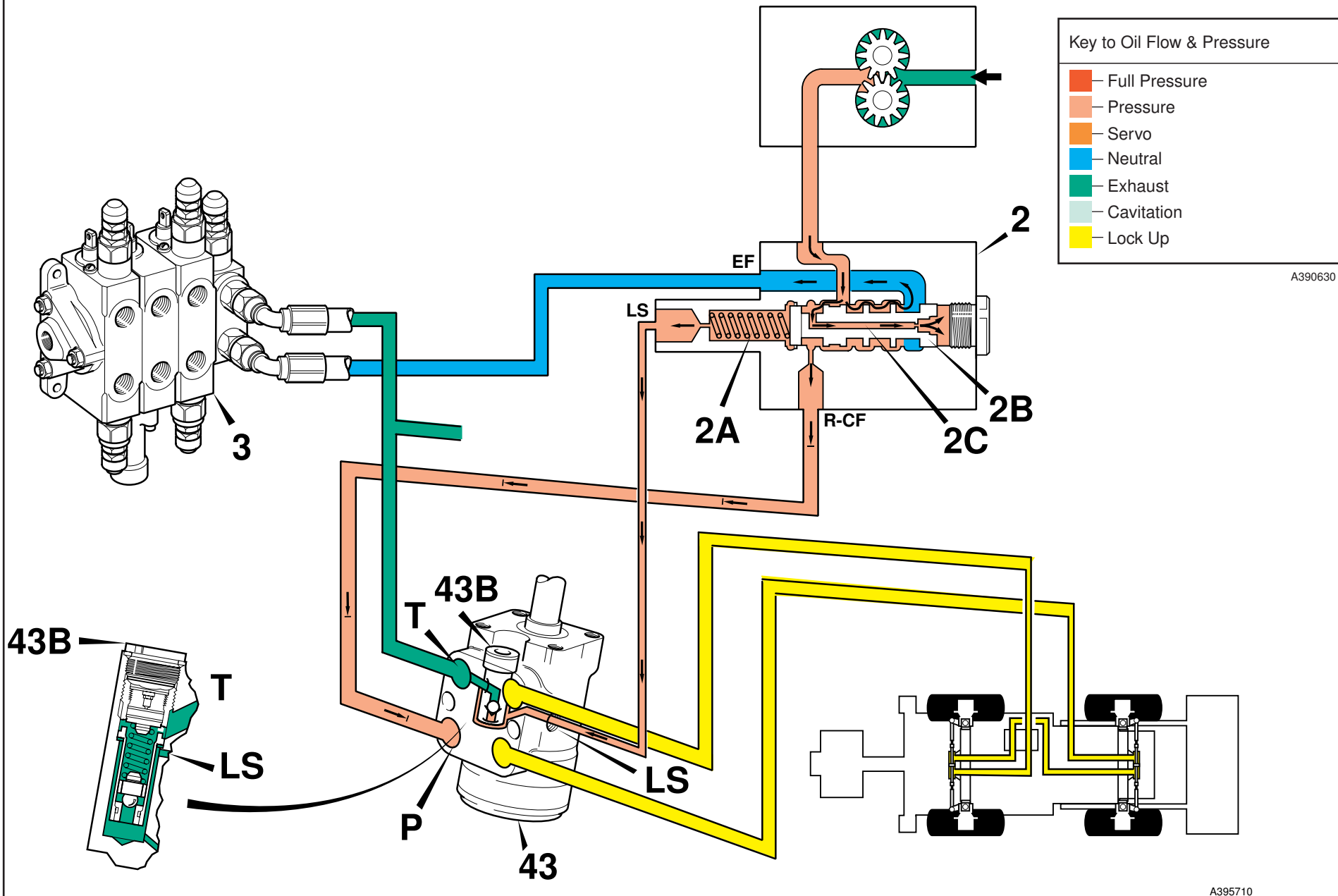
- A** Inner Spool
- B** Outer Spool
- D** Stator
- LS** Load Sensing Port
- X** Steer Mode Control Valve
- 40** Front Power Track Rod Ram
- 41** Rear Power Track Rod Ram
- 43B** Relief Valve
- 43C** Non-Return Valve

In crab steer mode the spools of the steer mode control valve **X** are configured as shown.



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## Priority Valve Operation 1 - Neutral

When the steering is not being operated, flow to the steering circuit is dead ended by the closed centre steering unit **43** and no load is sensed in line **LS**. Pressure from the main pump to the priority valve is fed via a drilling **2C** to the rear of spool **2B**. The high pressure differential created across the spool causes it to move to the left against the force of the spring **2A**. This allows full pump flow to the loader control valve **3**.

### Component Key:

- LS** Load Sensing Port
- P** From pump
- T** To Loader Valve
- 2** Priority Valve
- 2A** Spring
- 2B** Spool
- 2C** Drilling
- 3** Loader Valve
- 43** Steer Unit
- 43B** Relief Valve

## Priority Valve Operation 2 - Turning

As the steering unit **43** is operated, pressure is applied to the spring end of the priority valve spool **2B** via sensing line **LS** from the steering unit.

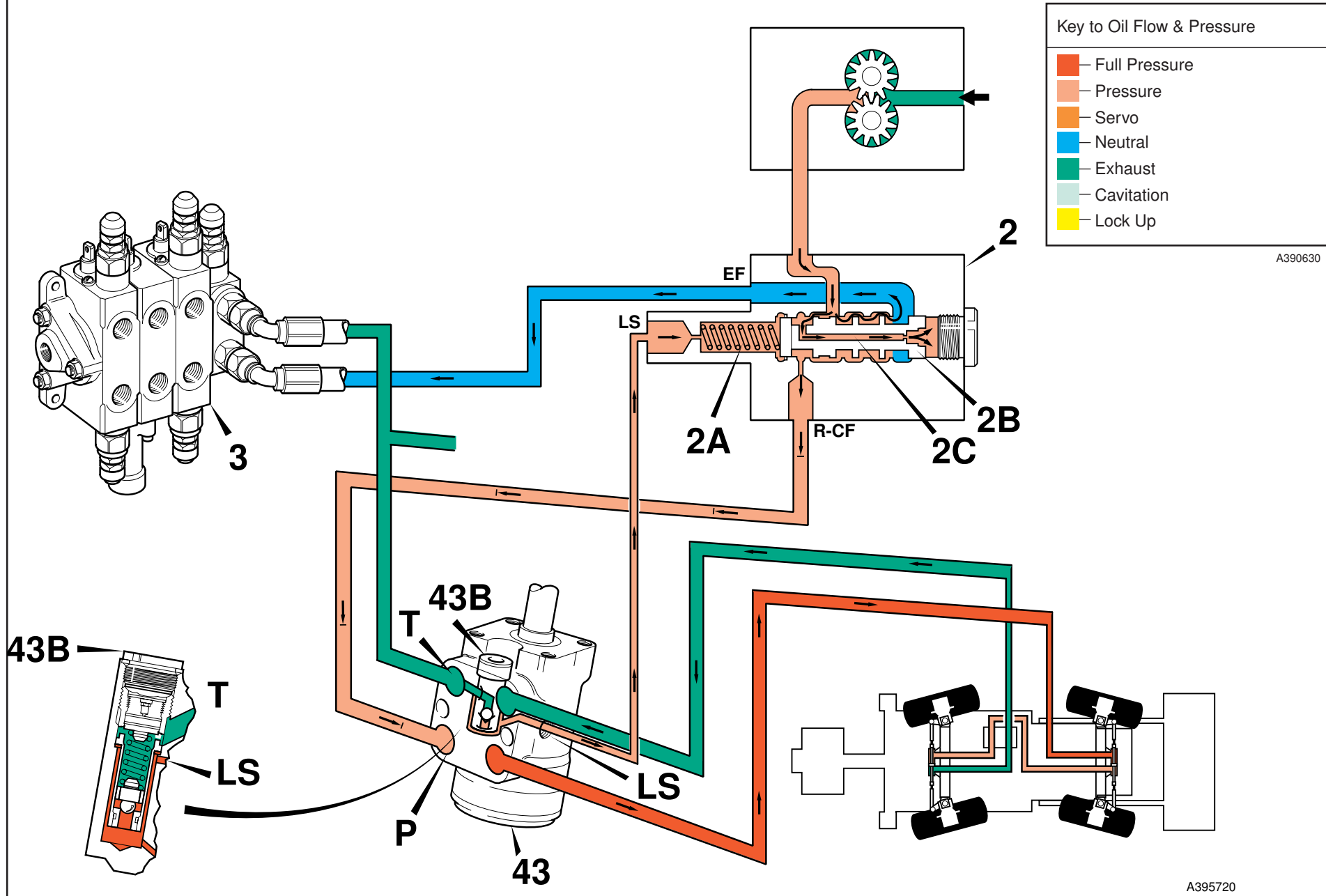
This reduces the pressure differential across the spool, causing it to move to the right under spring force. This allows priority valve flow to the steering unit which directs the flow to the power track rod rams **40** and **41** until the required steering lock is reached. When the steering lock is held the pressure signal across the side port **LS** of the steering unit ceases, restoring the pressure differential across spool **2B**. The spool moves back to the left, allowing full pump flow to the loader control valve **3**.

Because the pump output is always greater than the flow required to operate the steering system, flow to the loader valve is never completely cut off.

Maximum steering system pressure is controlled by relief valve **43B**, located in the steering unit **43**.

### Component Key:

- LS** Load Sensing Port
- P** From pump
- T** To Loader Valve
- 2** Priority Valve
- 2A** Spring
- 2B** Spool
- 2C** Drilling
- 3** Loader Valve
- 40** Front Power Track Rod Ram
- 41** Rear Power Track Rod Ram
- 43** Steer Unit
- 43B** Relief Valve



Key to Oil Flow & Pressure

Red	Full Pressure
Orange	Pressure
Blue	Servo
Green	Neutral
Dark Green	Exhaust
Light Green	Cavitation
Yellow	Lock Up

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**Fault Finding Contents**

**Introduction**

	<b>Page No.</b>	
Introduction	10 - 1	The purpose of this section is to help you trace hydraulic faults to a faulty unit (valve, actuator, ram etc). Once you have traced the faulty unit, refer to the appropriate dismantling, inspecting and test instructions given elsewhere in the steering section.
Steering wheel difficult to turn	10 - 1	
Steering wheel turns on its own	10 - 2	To help identify circuits, valves, rams etc mentioned in the fault finding procedures, refer to the hydraulic schematic diagrams (near the beginning of the Hydraulics Section).
Machine will not turn when the steering wheel turned.	10 - 2	
Steering fails to respond to selected mode (4WS Machines only)	10 - 3	

- 1** Before you begin fault finding, read the Safety information at the beginning of this manual.
- 2** Make simple checks before say, stripping a major component.
- 3** Make sure that the hydraulic fluid is at correct working temperature (50 °C, 122 °F).
- 4** What ever the fault, check the condition of the hydraulic fluid. Drain and replace if necessary.
- 5** Make any relevant electrical checks before moving on to the hydraulics.
- 6** Be sure to remove ALL contamination and if possible identify its origin. It may be part of a component from elsewhere in the circuit.
- 7** Replace any seals such as 'O' rings before re-assembling hydraulic components.

Fault	Probable Cause	Action
1 Steering wheel difficult to turn.	Tyres not inflated to correct pressure  Insufficient hydraulic fluid.  Leaks in the relevant hoses or component connections  Air in the hydraulic system.  Low pump flow.  Steer relief valve set incorrectly  Worn or damaged parts in the steer control valve.	Inflate tyres to correct pressure  Check for leaks and top up the hydraulic tank as required.  Check hoses and connections for leaks  Bleed system - bleed the load sense line.  Check pump flow, if required service or replace pump.  Check pressure setting of steer unit relief valve, adjust as required.  Remove and inspect.  ..... continued

Fault	Probable Cause	Action
<p>1 Steering wheel difficult to turn. (continued)</p>	<p>Priority valve not operating correctly</p> <p>Steer mode valve not operating correctly (4WS Machines only)</p> <p>Mechanical failure</p>	<p>Check if the priority valve is sticking, rectify as required.</p> <p>Check the load sense line from the steer unit to the priority valve for signs of leaking or poor connection.</p> <p>Check if spools sticking, rectify as required</p> <p>Check if solenoids operating, replace solenoids as required</p> <p>Check for damaged axle components, such as rams, trackrods, linkages etc.</p>
<p>2 Steering wheel turns on its own.</p>	<p>Dirt in the steer control unit (causing sleeves to stick open)</p> <p>Steer control valve centring springs damaged, broken or missing.</p> <p>Steer control valve - position of rotor to shaft slot incorrect.</p>	<p>Clean and inspect unit.</p> <p>Check steer unit.</p> <p>Refer to <b>Hydraulic Steer Unit - Dismantling and Assembly</b>. Correct as required.</p>
<p>3 Machine will not turn when the steering wheel turned.</p>	<p>Insufficient hydraulic fluid.</p> <p>Leaks in the relevant hoses or component connections</p> <p>Air in the hydraulic system.</p> <p>Low pump flow.</p> <p>Steer relief valve set incorrectly</p> <p>Worn or damaged parts in the steer control valve.</p>	<p>Check for leaks and top up the hydraulic tank as required.</p> <p>Check hoses and connections for leaks</p> <p>Bleed system - bleed the load sense line.</p> <p>Check pump flow, if required service or replace pump.</p> <p>Check pressure setting of steer unit relief valve, adjust as required.</p> <p>Remove and inspect.</p>



Fault	Probable Cause	Action
<p><b>3</b> Machine will not turn when the steering wheel turned (continued).</p>	<p>Priority valve not operating correctly</p> <p>Steer mode valve not operating correctly (4WS Machines only)</p> <p>Mechanical failure</p> <p>Steer column splined shaft not fully engaged in steer valve.</p> <p>Power track rod failure</p>	<p>Check if the priority valve is sticking, rectify as required.</p> <p>Check the load sense line from the steer unit to the priority valve for signs of leaking or poor connection.</p> <p>Check if spools sticking, rectify as required</p> <p>Check if solenoids operating, replace solenoids as required</p> <p>Check for damaged axle components, such as rams, trackrods, linkages etc.</p> <p>Check shaft engagement.</p> <p>Check power track rod for signs of damage, leaks etc.</p>
<p><b>4</b> Steering fails to respond to selected mode (4WS Machines only)</p>	<p>Selector switch faulty</p> <p>Proximity switches not operating correctly</p> <p>Steer mode valve not operating correctly</p> <p>Leaks in the relevant hoses or component connections</p> <p>Electrical failure</p>	<p>Check selector switch, replace as required</p> <p>Check setting of Proximity switches, reset or replace switches as required.</p> <p>Check if spools sticking, rectify as required</p> <p>Check if solenoids operating, replace solenoids as required.</p> <p>Check hoses and connections for leaks</p> <p>Check relevant electrical connectors, if problem still persists, do a wiring continuity check on relevant circuits.</p>

## Steering System - Bleeding

Whenever any hydraulic steering component is disconnected or removed the system must be bled as follows.

With the engine running, the following procedure must be carried out in the correct order that is laid down. You must not alter the order of selections and operations.

### 1 Select 2 Wheel Steer

- (a) Turn steering wheel to left, until front wheels are fully locked to the left.
- (b) Turn steering wheel to right, until front wheels are fully locked to the right.

### 2 Select 4 Wheel Steer

- (a) Turn steering wheel to left, until front wheels are fully locked to the left.

### 3 Select 2 Wheel Steer

- (a) Turn steering wheel to full right lock.
- (b) Turn steering wheel to full left lock.
- (c) Turn steering wheel to full right lock.

### 4 Select 4 Wheel Steer

- (a) Turn steering wheel to left, until the front wheels are fully locked to the left.

### 5 Select 2 Wheel Steer

- (a) Turn steering wheel to full right lock.
- (b) Turn steering wheel to full left lock.
- (c) Turn steering wheel to full right lock.

### 6 Select 4 Wheel Steer

- (a) Turn steering wheel to left, until front wheels are fully locked to the left.

### 7 Select 2 Wheel Steer

- (a) Turn steering wheel to full right lock.
- (b) Turn steering wheel to full left lock.
- (c) Turn steering wheel to full right lock.

### 8 Select 4 Wheel Steer

- (a) Turn steering wheel to left, until the front and rear wheels are fully locked.

## Steering System - Pressure Testing

- 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.

### ⚠ 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

- 3 Connect a 0-400 bar (0-6000 lbf/in<sup>2</sup>) pressure gauge to test adaptor **A**.

**Note:** The pressure test point for the steering circuit is fitted next to the priority valve as shown.

- 4 Run the engine at 1500 revs/min and turn the steering to full lock. Check the gauge reading which should equal the relief valve pressure, refer to **Technical Data**.

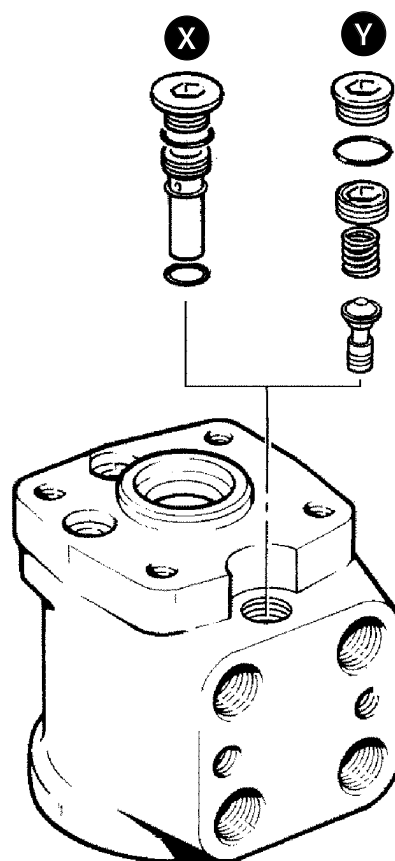
**Note:** The steering wheel must be held on full lock whilst the gauge reading is being checked.

- 5 If necessary, adjust the pressure setting by removing plug **B**, on the hydraulic steer unit.

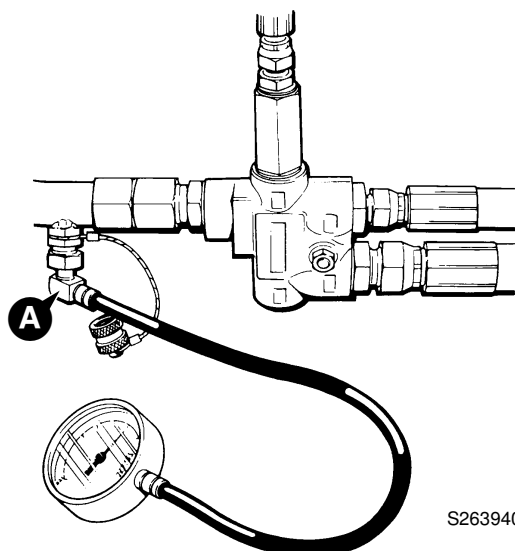
- 6 Adjust screw **C** using an 'allen key' until the correct pressure is shown on the gauge.

**Note:** Detail **X** shows a relief valve which has a 4 mm hexagon adjusting screw. Detail **Y** shows a valve which has a 6 mm hexagon adjusting screw.

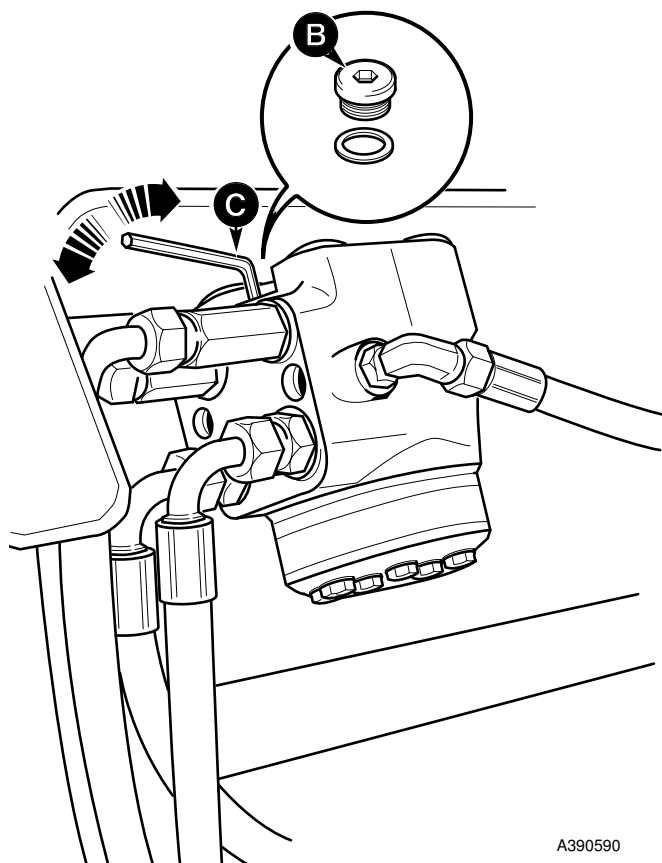
- 7 Refit plug **B**.



S212750



S263940



A390590

## 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.

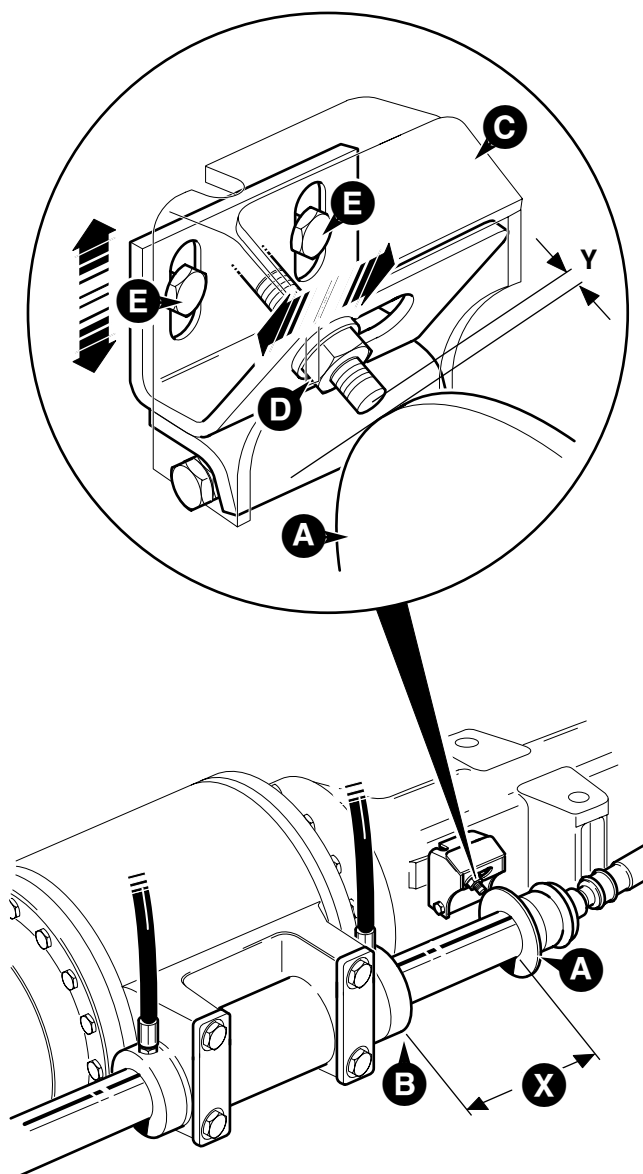
- 1 Align the wheels in the straight ahead position. Check if straight ahead by measuring the steering ram position.

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

## Steer Mode Valve

### - Checking Solenoid Operation

The solenoids operate according to the steer mode that is selected.

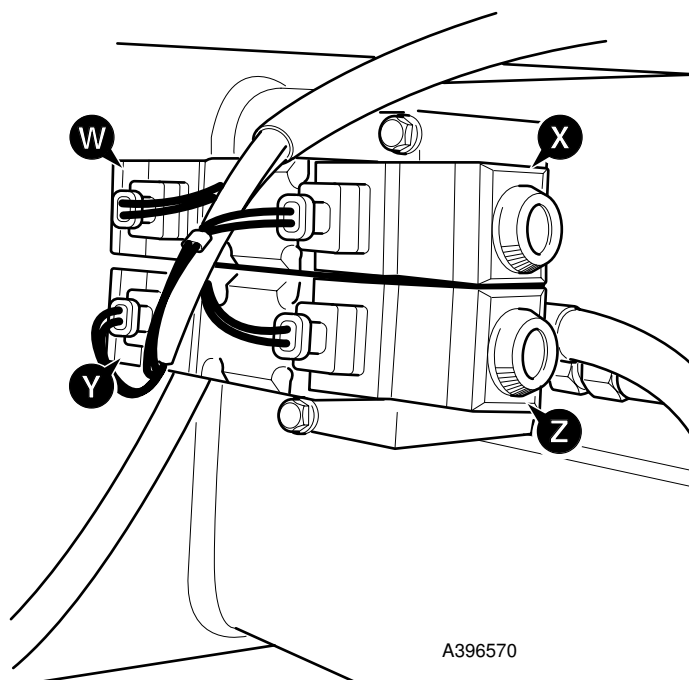
Mode:	Solenoid(s) Energised:
2 Wheel Steer	W
4 Wheel Steer	X, Z
Crab Steer	X, Y

Operation (energisation) of a solenoid can be easily detected by placing a steel object (e.g. screwdriver blade) close to the outer casing. A magnetic attraction of the steel object towards the solenoid indicates energisation.

If a solenoid is not energising carryout the following checks:

- 1 Check the fuse is intact. If not, renew and then check that all steer mode solenoid combinations function correctly.
- 2 If the fuse is intact remove the electrical connector from the malfunctioning solenoid(s) and check that the 12V supply is present across the connector pins. If not, check the supply circuit.
- 3 Check the solenoid coil resistance which should measure a few ohms (if unsure of the value compare with a known good solenoid).

Renew the solenoid if the reading indicates a short circuit (zero ohms) or open circuit (infinite resistance). If a reading somewhere between the two is obtained, reverse the two instrument probes and repeat for a valid check.



A396570

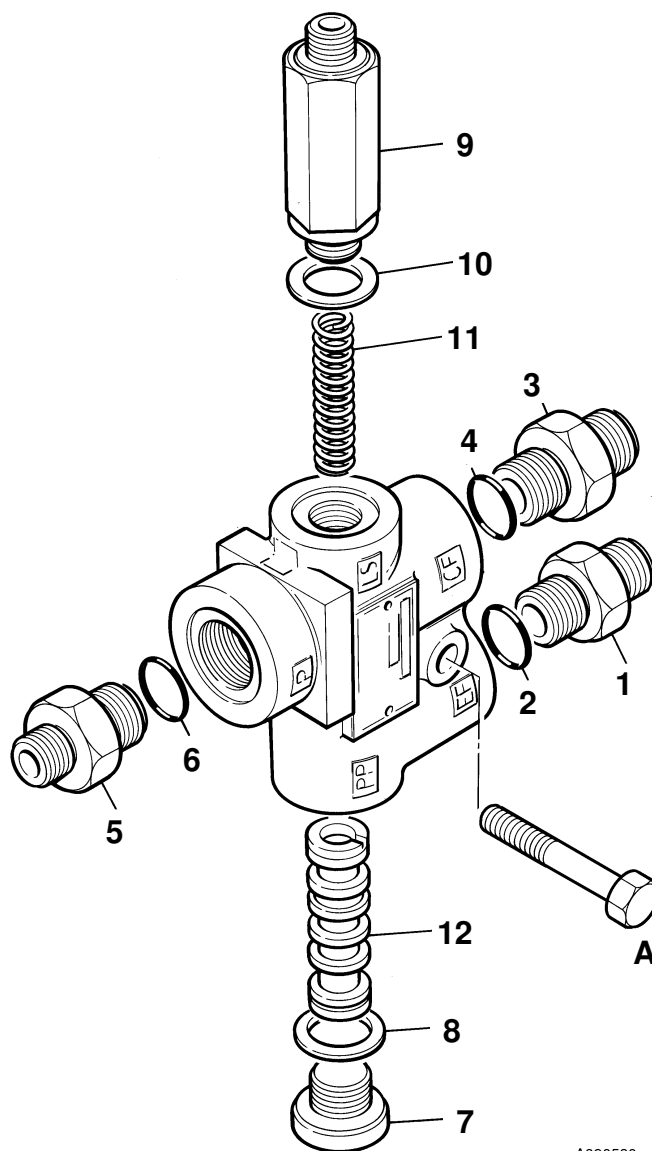
## Priority Valve - Cleaning

The priority valve spool and spring may be removed for cleaning.

- 1 Remove the priority valve from the machine. Refer to **Priority Valve - Removal and Replacement**.
- 2 Unscrew adaptor **9** and extract the priority valve spring **11**.
- 3 Remove the blanking plug **7**. Press out the priority valve spool **12** using a nylon pin. Take care not to damage the bore of the valve.
- 4 Clean these components in clean paraffin paying particular attention to the orifices at each end of the spool. Dry off and lubricate with clean hydraulic fluid.
- 5 Refit the priority valve spool **12** making sure that the spring seat end of the spool faces towards the **LS** port. Refit blanking plug **7** and torque tighten.
- 6 Refit the priority valve spring **11** and adaptor **9** and torque tighten.
- 7 Refit the valve onto the machine. Refer to **Priority Valve - Removal and Replacement**.
- 8 Bleed the load sensing line. Refer to **Priority Valve - Bleeding**.

### Torque Settings

Item	Nm	lbf ft
7	50	37
9	50	37



A390580

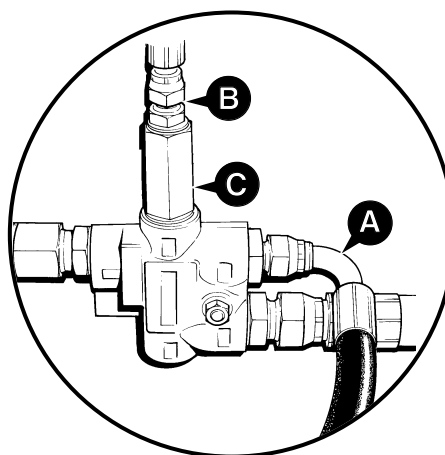
### Priority Valve - Standby Pressure Testing

- 1 Disconnect hose **A** and install a 0 - 40 bar (0 - 580 lbf/in<sup>2</sup>) pressure test gauge into the valve port. Position the open end of hose **A** into a clean container in order to collect any oil drainage.
- 2 Disconnect hose **B** from load sensing port adaptor **C** and blank off.
- 3 Set the steering to neutral, i.e. do not turn the steering wheel, and start the engine. Gradually increase the engine speed to 1000 rev/min while checking the maximum pressure gauge reading which should be 5.9 to 8.7 bar (86 to 126 lbf/in<sup>2</sup>)

If the pressure is outside the limits try cleaning the priority valve, refer to **Priority Valve - Cleaning**.

If cleaning the valve does not rectify, check the hydraulic pump flow rate, refer to Section E **Main Pump - Flow and Pressure Testing**.

If the hydraulic pump flow and pressure tests are satisfactory, then the priority valve must be renewed.



## Removal and Replacement

This procedure is for a typical power steering track rod 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

### **⚠ 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

### Removal

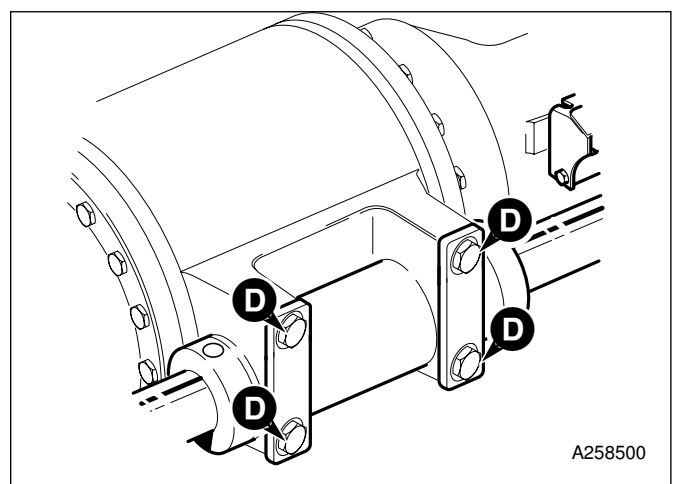
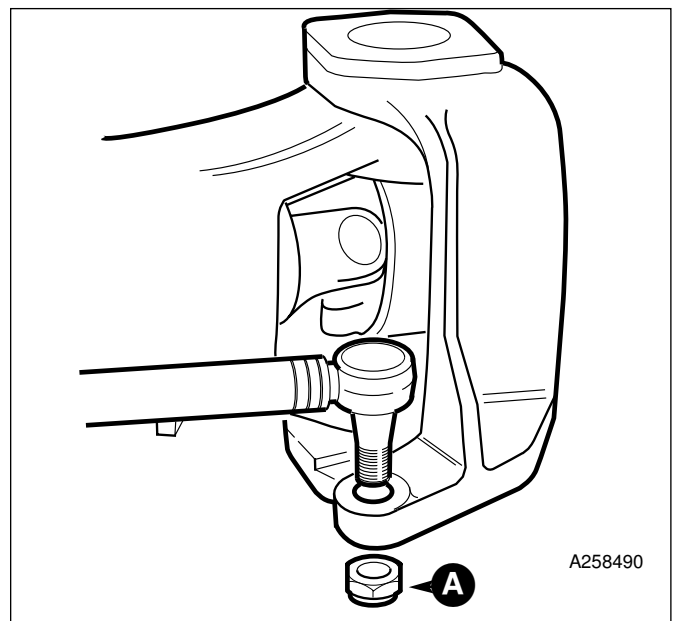
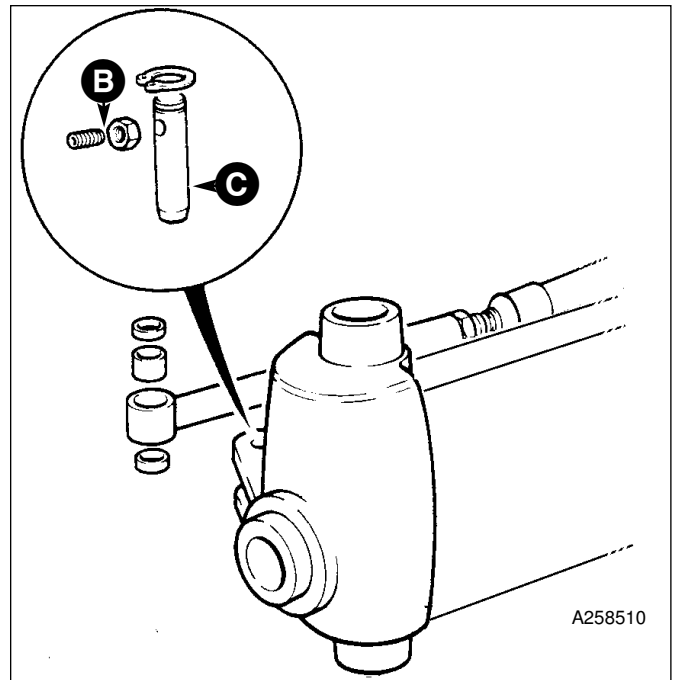
- 1 Disconnect and cap hydraulic hoses to prevent loss of fluid and ingress of dirt. Label hoses for identification and correct refitting.
- 2 On 4WD machines remove the split pin and nut **A**. Remove the track rod ball joint from the wheel hub assembly.  
  
On 2WD machines, remove lock assembly **B** and pin **C** to remove the track rod pivot from the wheel hub assemblies.
- 3 Remove the four fixing bolts **D**.

### Replacement

- 1 Replace the power track rod by reversing the removal procedure. On 4WD machines make sure that the split pin is fitted.
- 2 After connecting hoses check hydraulic fluid level, if necessary top up.
- 3 Bleed hydraulic steering system, refer to **Service Procedures, Steering System - Bleeding**.

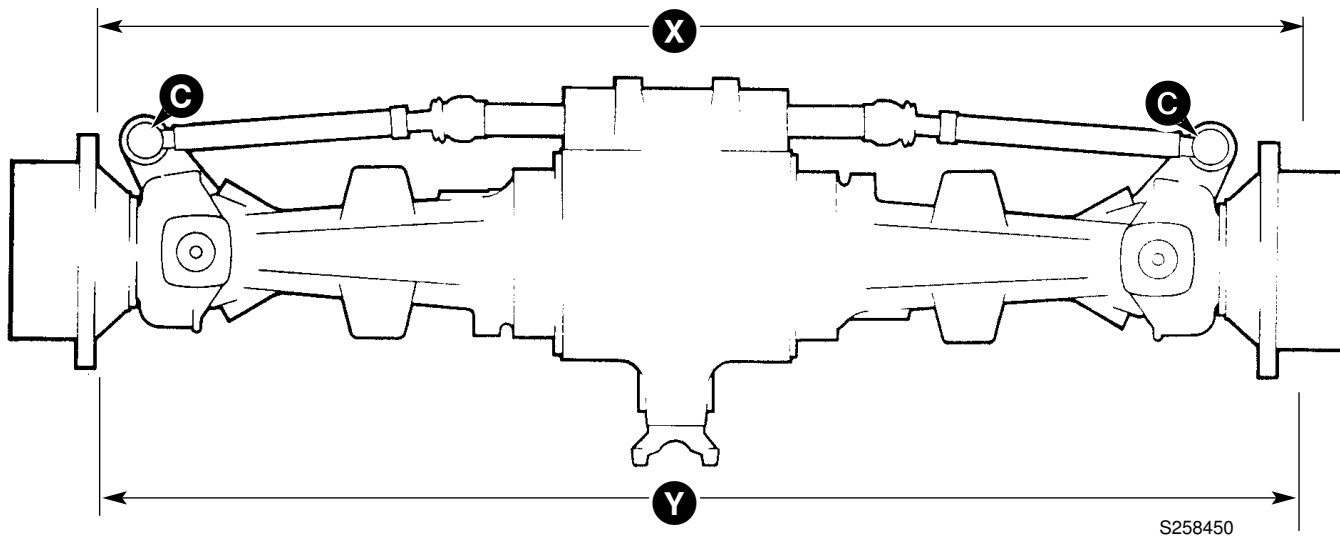
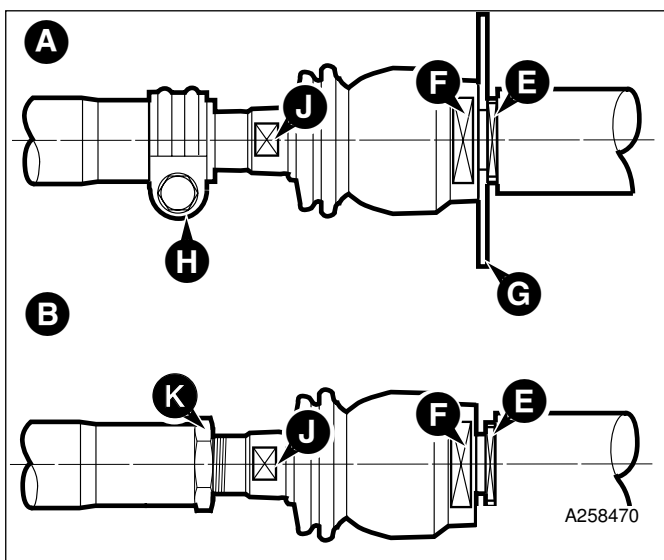
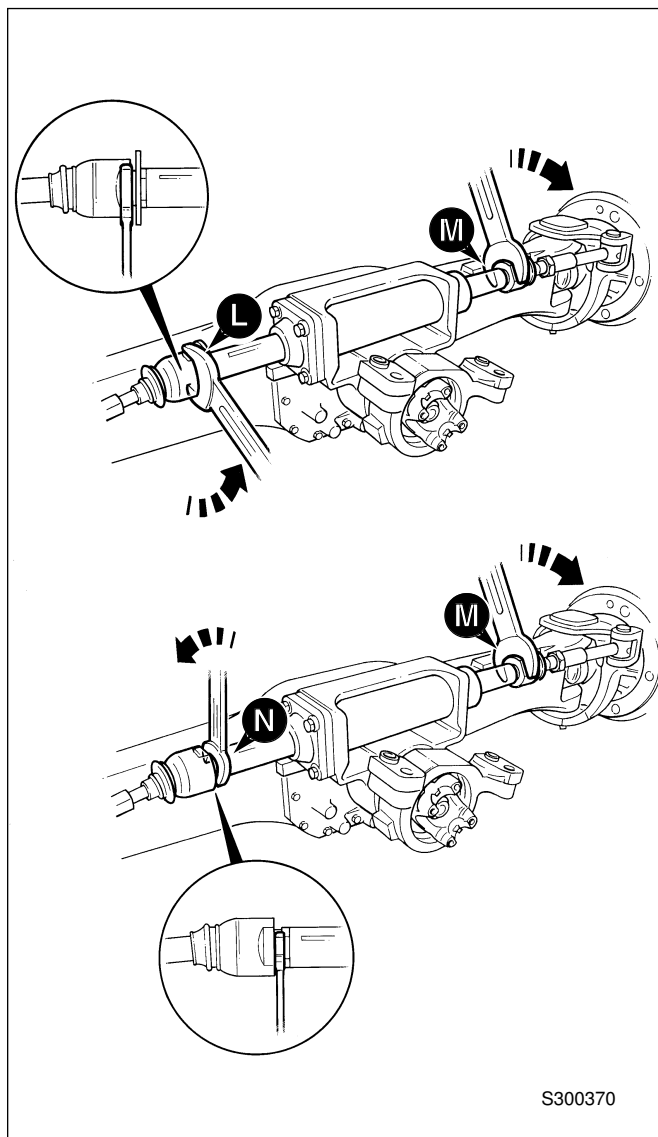
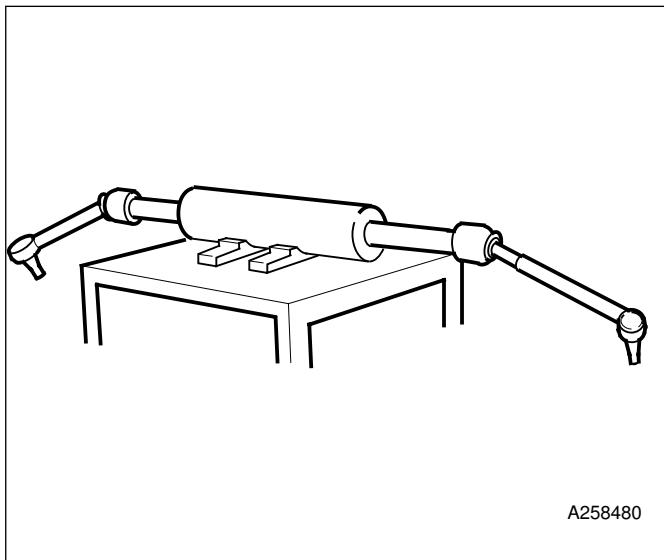
### Torque Settings

Item	Nm	kgf m	lbf ft
A			
D	620	63	457





Link Arms - Removal and Replacement



## Link Arms - Removal and Replacement

### Removal

- 1 Fix the assembly on a locally made strip/rebuild bench as shown.
- 2 Using two suitable open ended spanners at **L** and **M** react against each other until one ball joint unscrews.
- 3 Unscrew the ball joint **L** until an open ended spanner can be fitted on the rod **N**. Screw the ball joint against the spanner to secure the spanner and to prevent damage to the rod.
- 4 By reacting against the spanner at **N** and **M** undo the other ball joint.

#### Note 1: Flats at 'E' are:

2 Wheel drive machines - 32 mm A/F x 4 mm wide.

4 Wheel drive machines - 40 mm A/F x 4 mm wide.

**Note 2:** The piston rod operates at full length, any damage to the surface will cause fluid leaks. DO NOT attempt to grip the rod diameter with pipe grips etc.

- 5 Repeat the procedure for the remaining link arm assembly.
- 6 Where applicable remove the target disc **G**.

**Note 3:** If the inner or outer ball joints need to be renewed, then a replacement link arm assembly must be fitted.

### Replacement

Replacement is the reverse of removal but note the following:

- 1 Remember to fit the target disc **G** (where applicable).
- 2 Use JCB Threadlocker & Sealer on the trackrod link arms.
- 3 If the link arms have been renewed, the wheel alignment must be checked as follows:
  - a Set the wheels to the straight ahead position and measure dimensions **X** and **Y** (at the outer edge of the wheel hub). Alignment is correct if the difference between **X** and **Y** is a maximum of 1 mm.
  - b To adjust the wheel alignment undo the lock nuts (**H** or **K** as applicable). Turn the threaded adjusters **J** equally to obtain the correct alignment. Tighten the lock nuts (**H** or **K** as applicable).

**Note 4:** AWS machines shown at **A**. 2 wheel steer machines shown at **B**.

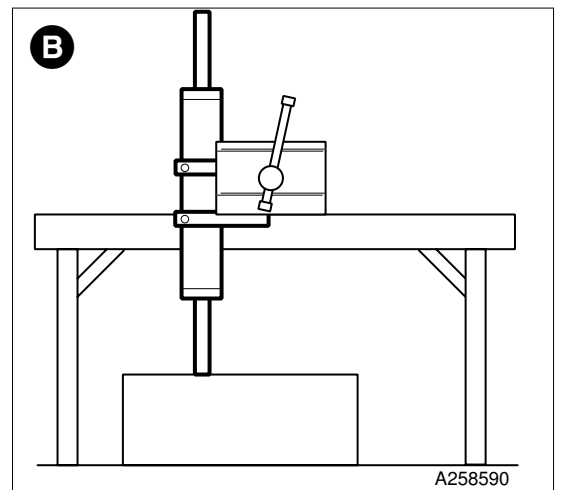
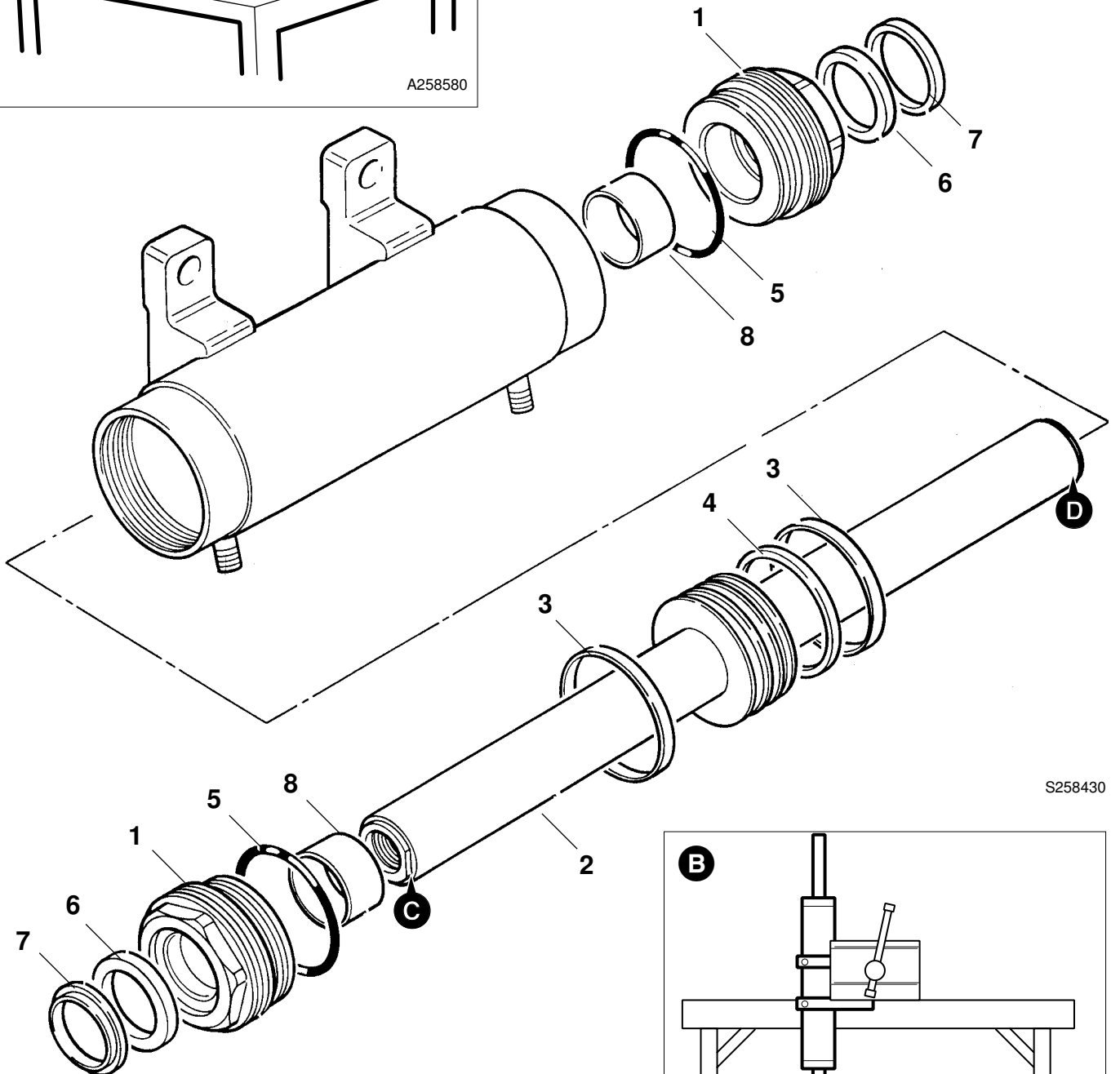
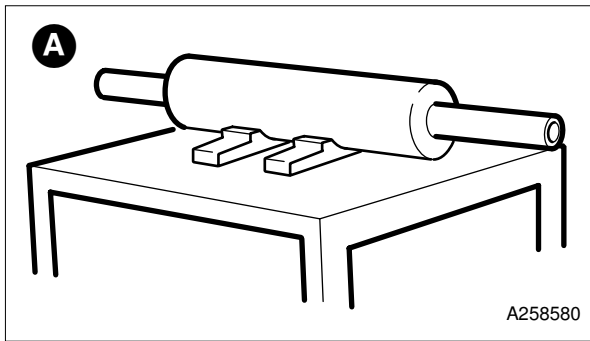
- 4 Check the proximity switch setting (where applicable). Refer to **Service Procedures, Proximity Switch - Setting**.

### Torque Settings

<b>2WS/4WD</b>	<b>C</b> 180 Nm (132 lbf ft)	<b>H</b> 45/50 Nm (33/36 lbf ft)	<b>E</b> 240/260 Nm (177/184 lbf ft)
<b>2WS/4WD</b>	<b>C</b> 140/150 Nm (103/110 lbf ft)	<b>K</b> 300 Nm (221 lbf ft)	<b>E</b> 240/260 Nm (177/184 lbf ft)
<b>AWS/4WD</b>	<b>C</b> 270/280 Nm (199/206 lbf ft)	<b>H</b> 70/85 Nm (51/62 lbf ft)	<b>E</b> 450 Nm (331 lbf ft)
<b>AWS/4WD</b>	<b>C</b> 270/280 Nm (199/206 lbf ft)	<b>K</b> 390/410 Nm (287/302 lbf ft)	<b>E</b> 450 Nm (331 lbf ft)
<b>2WS/2WD</b>	<b>C</b> N/A	<b>K</b> 240/260 Nm (177/184 lbf ft)	<b>E</b> 240/260 Nm (177/184 lbf ft)

Rams

Dismantling and Assembly



## Rams

### Dismantling and Assembly

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

For assembly the sequence should be reversed.

#### Dismantling

- 1 Fix the ram assembly on a locally manufactured strip/rebuild bench as shown at **A**.
- 2 Remove both end caps, using a special spanner (refer to **Service Tools**). Pull the piston rod assembly from the cylinder.

**Note 1:** DO NOT allow the piston rod to come into contact with the cylinder bore. The cylinder bore may be damaged by careless dismantling.

- 3 Position the piston rod assembly on a bench in place of the ram cylinder. Remove the seal and wear rings from the piston head.

**Note 2:** The piston head cannot be removed from the rod. If there is damage to the rod or piston head, replace the complete assembly.

- 4 Carefully inspect the bore of the cylinder and the piston rod outer diameter for scoring, nicks and burrs. If such damage is visible the components must be renewed.

**Note 3:** If burrs are evident on the ends of the piston rod at positions **C** or **D** remove by careful filing.

Both end cap assemblies are the same, dismantle as follows:

- 5 Remove the 'O' ring **5**, end cap seal **6** and wiper seal **7**.
- 6 The bearing bush **8** can be renewed if necessary. However, time will be saved if a complete end cap and bush assembly is obtained.

#### Assembly

- 1 Clean the threads of the end caps and cylinder using a wire brush.
- 2 Use JCB Cleaner & Degreaser to ensure that all threads are free from grease, hydraulic oil and sealant. Allow 15 minutes for solvent to dry before applying JCB Threadlocker and Sealer (High Strength).

Ensure that lubricants used during assembly do not come into contact with the JCB Threadlocker and Sealer (High Strength).

- 3 Refer to Section E **Rams - JCB Ram Sealing Procedure** for the correct method of fitting seals to the end cap and piston head.
- 4 Clamp the cylinder vertically and lower the piston rod assembly in from the top, as shown at **B**. Take care not to allow the piston rod to come into contact with the cylinder bore. Be sure to engage the piston head new wear rings and seal carefully into the cylinder. If the piston head wear rings or seal are damaged during this stage, they must be renewed.
- 5 Apply JCB Activator to threads of the end caps and cylinder. Allow Activator to dry for 15 minutes before bringing into contact with the JCB Threadlocker and Sealer (High Strength).

**Note 4:** Neither the JCB Threadlocker and Sealer (High Strength) nor Activator must be allowed to contact seals, bearing rings or 'O' rings.

- 6 Apply JCB Threadlocker and Sealer (High Strength) to threads of the ends caps, fit new 'O' ring **5**.
- 7 Ensure that there are no burrs at the ends of the piston rod, see **Dismantling - Note 3**:
- 8 Fit an end cap over the piston rod. Apply light hand pressure to the cap to engage the gland seal on the piston rod. DO NOT use excessive force. Screw on the first end cap and then fix the assembly on the strip/rebuild bench as shown at **A**. Fit the remaining cap and then torque tighten both caps.

**Note 5:** If hydraulic oil contacts the uncured JCB Threadlocker and Sealer (High Strength) a weakening of the bond will result. Cure times vary according to the ambient temperature. Allow a minimum of 2 hours between assembly and filling the ram with oil.

#### Torque Settings

Item	Nm	kgf m	lbf ft
1	678	69.2	500

**Note 6:** Cold weather operation. When operating in conditions which are consistently below freezing, it is recommended that the track rod is operated slowly to its full extent in both directions before commencing normal working.

## Removal and Replacement

### **⚠ 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

The priority valve is mounted on the right hand side chassis member, adjacent to the loader valve block. It is attached to the chassis member by one bolt **A**, and is accessible from underneath the machine.

When replacing always renew sealing 'O' rings **2**, **4**, **6**, and **10**.

## Dismantling and Assembly

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

For assembly the sequence should be reversed.

**Note 1:** The priority valve is not serviceable beyond the removal of foreign matter (Refer to **Service Procedures, Priority Valve - Cleaning**). A faulty unit must be replaced.

### Dismantling

Press out the spool item **12** using a nylon pin. Take care not to damage the bores of the valve.

### Assembly

Make sure that spring seat of spool **12** faces toward **LS** connection.

Clean all parts in clean paraffin.

Lubricate all parts with hydraulic fluid.

Renew aluminium washers **8** and **10**.

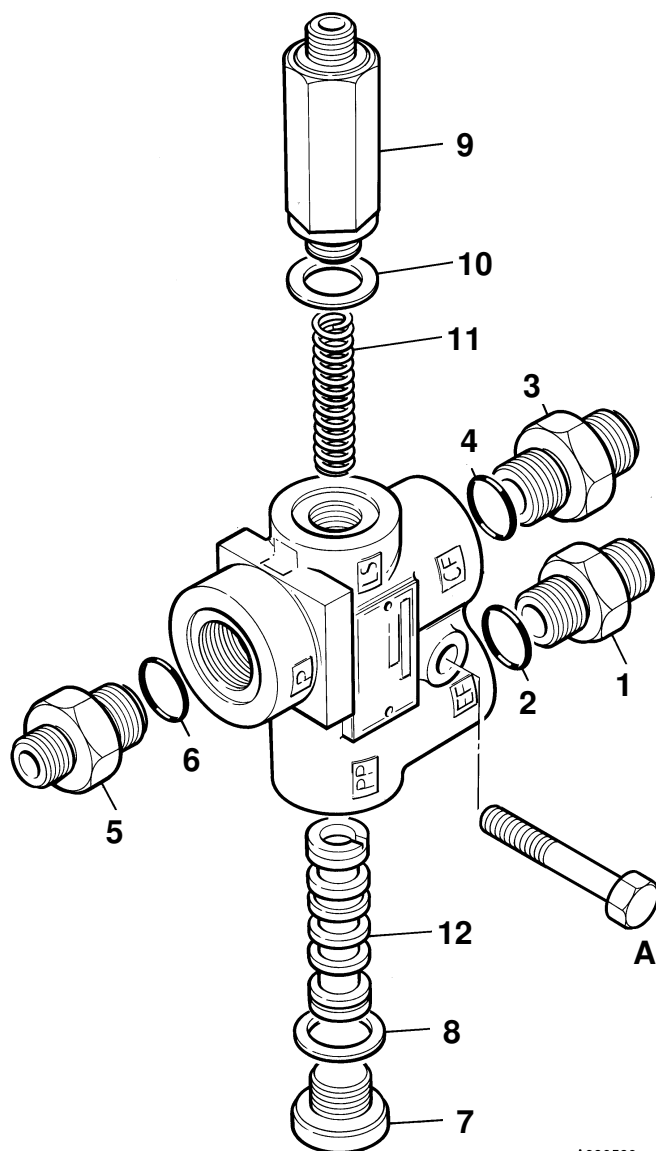
**Note 2:** All hydraulic adapters that are installed together with a bonded sealing washer must also have JCB Threadseal applied to the threads of the adapter.

### Torque Settings

Item	Nm	lbf ft
7	50	37
9	50	37

### Bleeding

To bleed the **LS** line, start the engine, loosen the connection on the valve, turn and hold the steering wheel fully in either direction. When bubble free oil flows from the joint, tighten the connection.



A390580

## 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

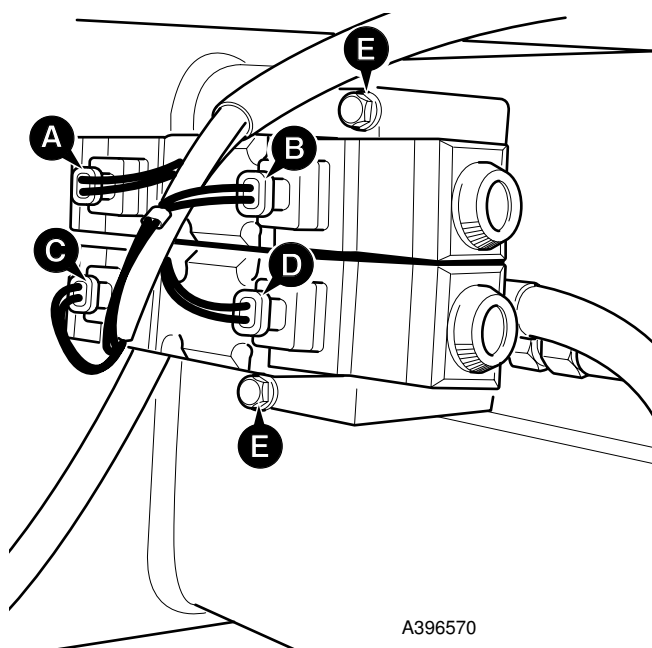
Replacement is a reversal of the removal sequence.

- 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**.



A396570

### Dismantling and Assembly

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

For assembly the sequence should be reversed.

#### Dismantling

- 1 Before dismantling scratch an alignment mark **X** along the faces of the solenoid valves and the manifold block.

**Note 1:** Take care not to lose the detent balls **A** from items **16** and **18**.

**Note 2:** The illustration depicts a complete strip down, but to carry out specific servicing/repairs, e.g. renewal of one of the solenoids **3** and **6**, it is only necessary to dismantle the relevant components.

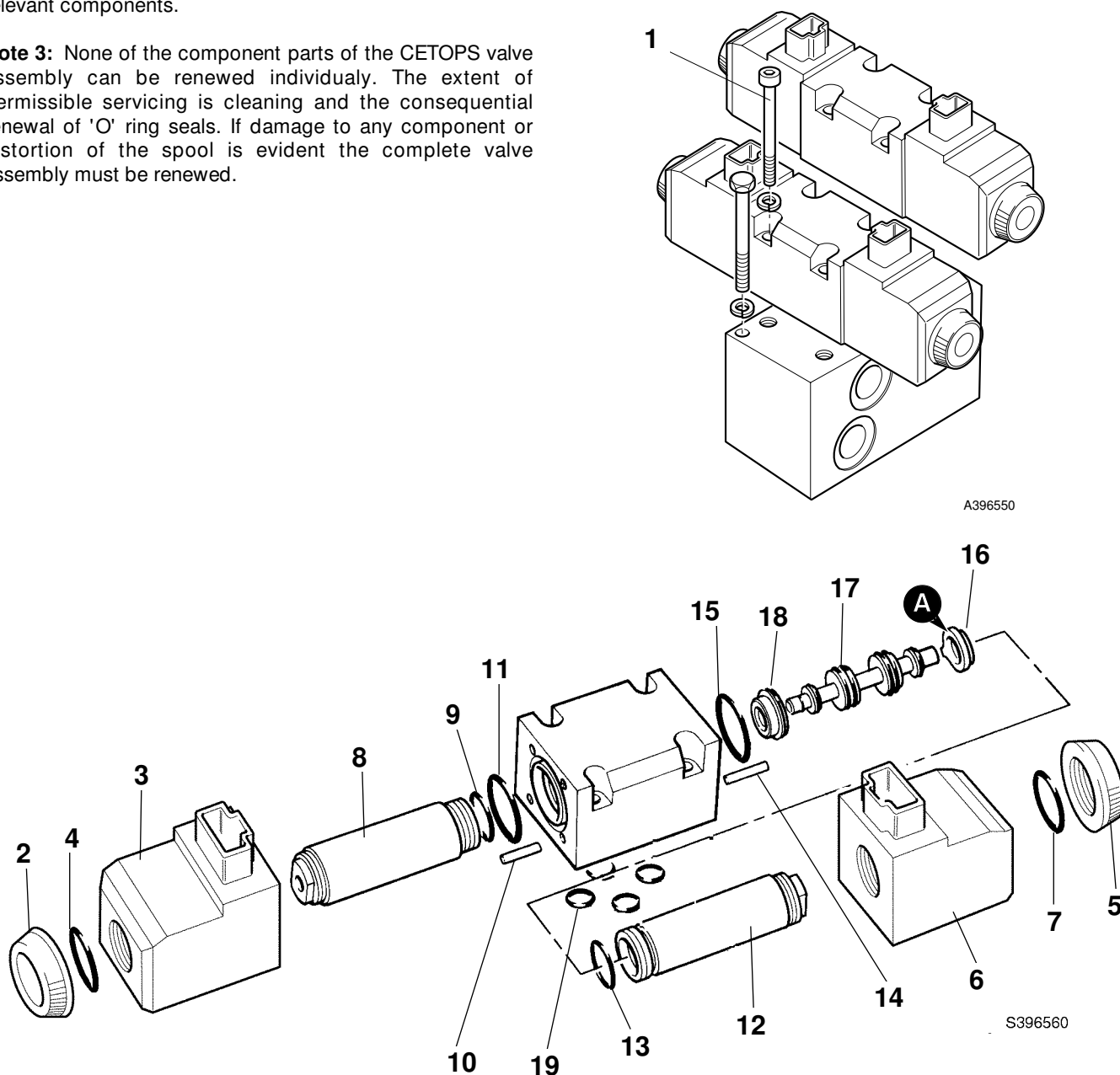
**Note 3:** None of the component parts of the CETOPS valve assembly can be renewed individually. The extent of permissible servicing is cleaning and the consequential renewal of 'O' ring seals. If damage to any component or distortion of the spool is evident the complete valve assembly must be renewed.

#### Assembly

- 1 Renew all 'O' rings.
- 2 Lubricate parts with JCB Special Hydraulic fluid before assembling.
- 3 Use the alignment marks **X** (see **dismantling**) to ensure that the solenoids and the manifold block are assembled correctly.

#### Torque Settings

Item	Nm	lbf in
1	7.1-9.1	63-80



## Removal and Replacement

### Removal

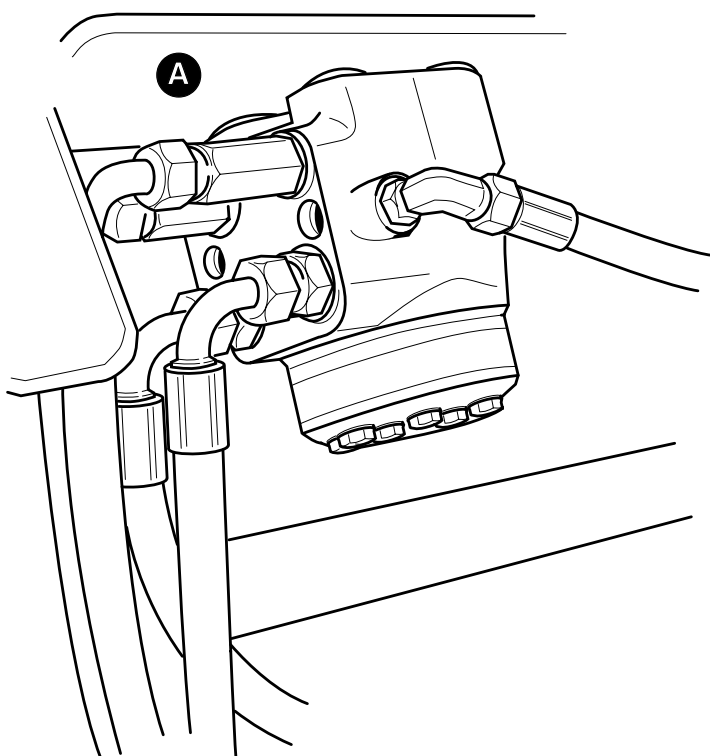
#### **⚠ DANGER**

##### 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

- 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.
- 3 Disconnect and cap all hydraulic hoses from the steering unit as shown at **A**. Label the hoses to ensure correct refitting.
- 4 Get an assistant to hold the steering unit, and, working inside the cab, loosen and remove 4 bolts **B**. Lift the steering unit from the machine.



### Replacement

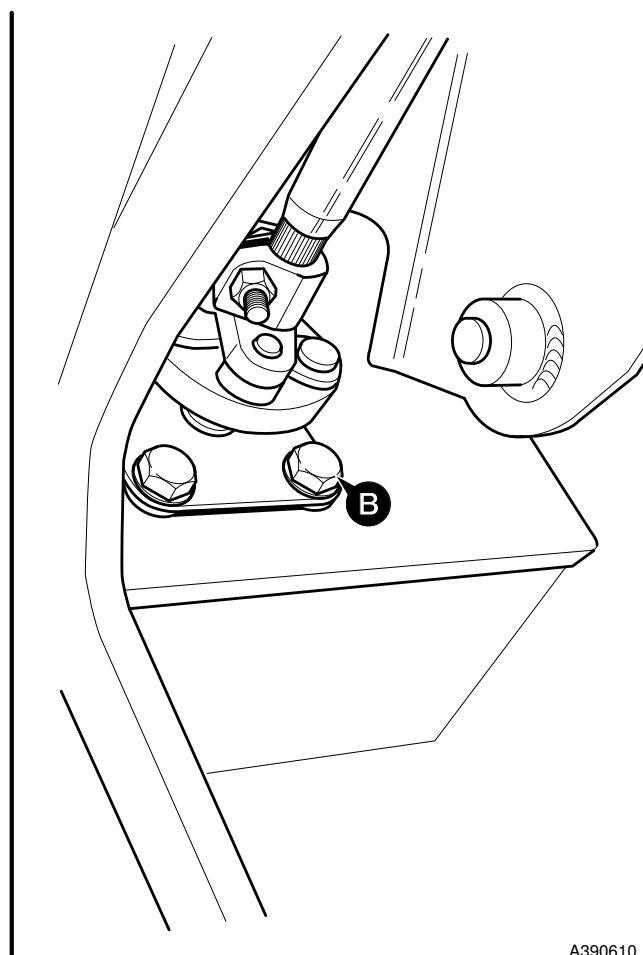
#### **⚠ WARNING**

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

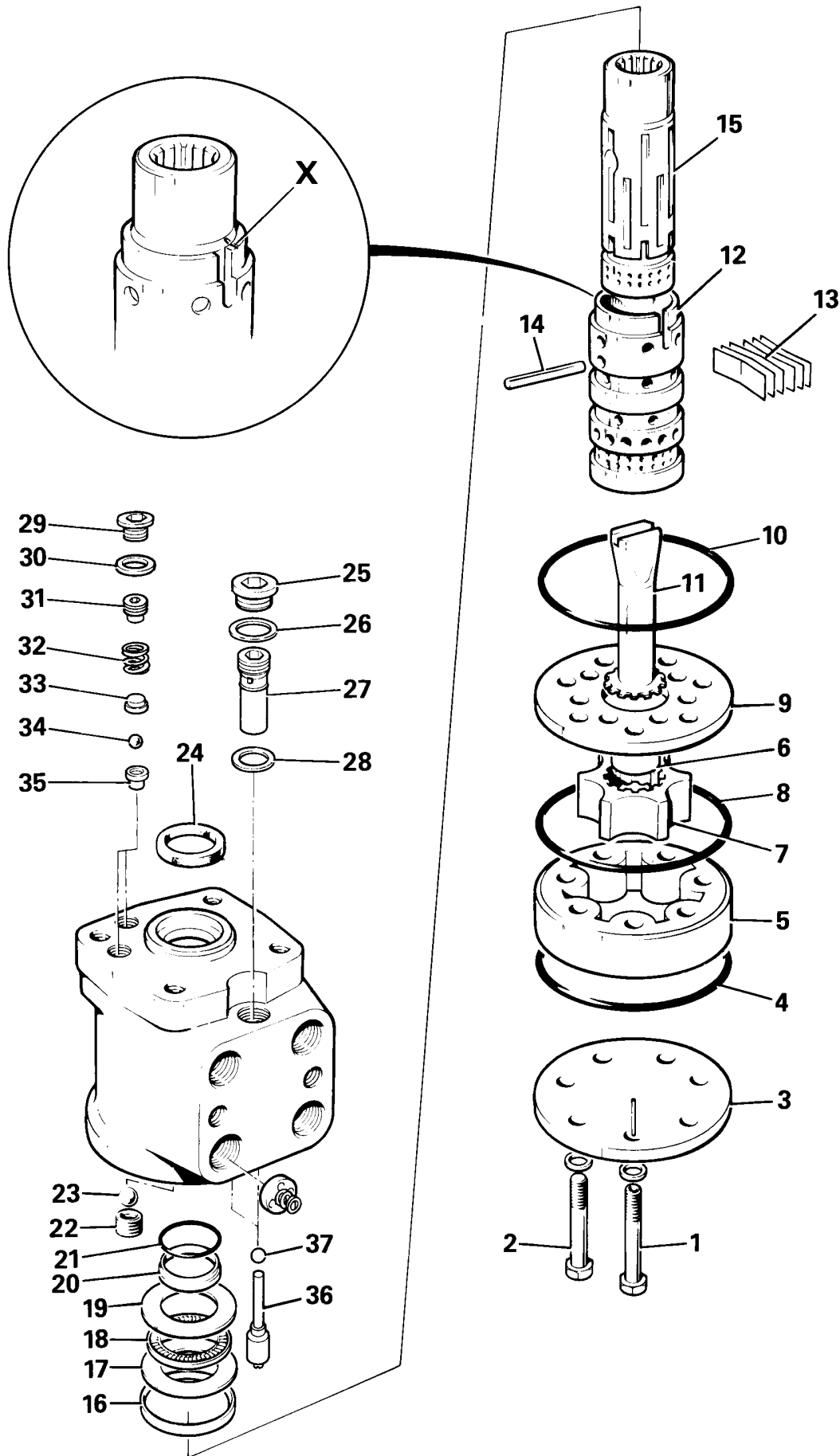
- 1 Replacement is a reversal of the removal sequence. Make sure that the hoses are correctly installed.
- 2 Bleed the steering system. Refer to **Service Procedures, Steering System - Bleeding**.
- 3 If a new steering unit has been fitted then the system relief valve must be tested for correct pressure setting. Refer to **Service Procedures, Steering System - Pressure Testing**.

**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.



A390610





S10221A

## Dismantling and Assembly

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

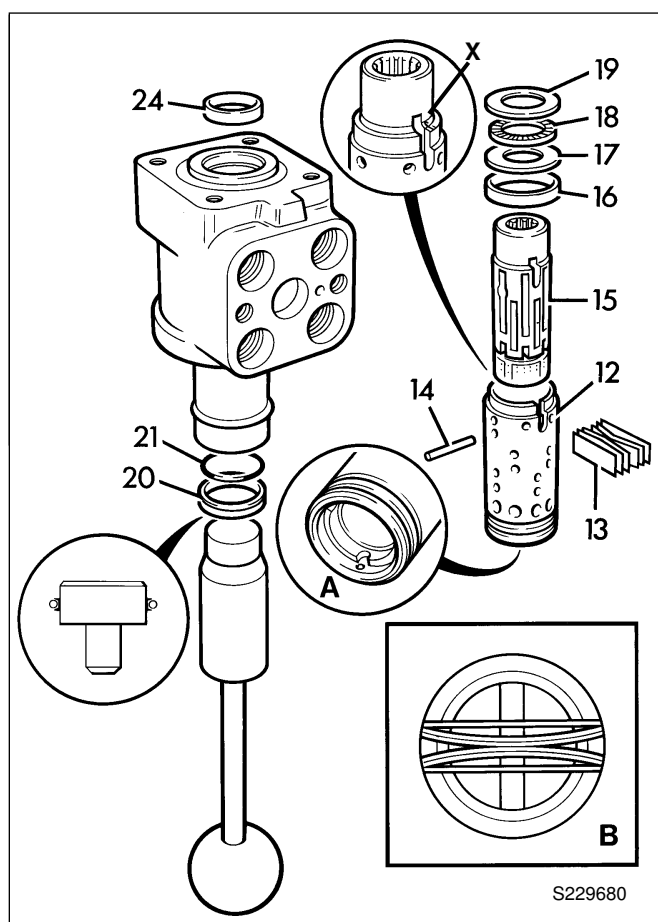
**Note: 1** During manufacture, a small mark **X** will have been made on sleeve **12** and spool **15**, close to one of the slots for the centring springs **13**. Before removing the centring springs, check that this mark is visible; if not, make a new mark to ensure correct assembly.

**Note: 2** Shock valves (items **29** to **35**) are pressure set during manufacture and the adjusting screw **31** secured with Loctite. Due to the difficulty of resetting the pressure it is recommended that the valves are not disturbed. If dismantling is unavoidable, however, measure and record the depth of adjusting screw **31** below the top face of the steering unit before removing the screw.

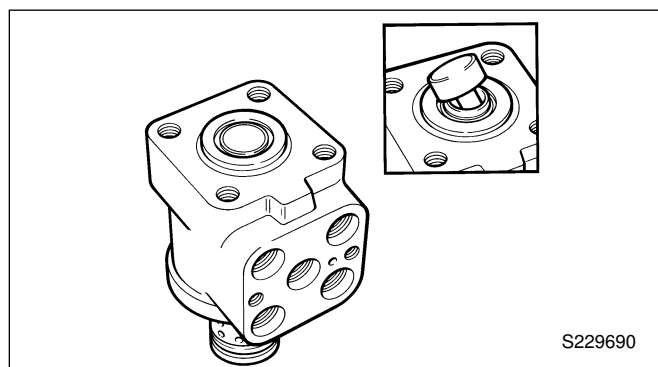
**Note: 3** The unit illustrated in the following sequence represents a typical hydraulic steer valve. The relief valve (items **25** to **28**) and shock valves (items **29** to **35**) are not therefore shown in the following illustrations.

### Assembly

- 1 Fit spool **15** into sleeve **12**, aligning slots for centring springs **13** and checking that the small marks **X** are aligned. Ensure that three slots in spool partially uncover three holes in sleeve, as at **A**.
- 2 Fit two flat centring springs **13** with four curved springs between them, as shown at **B**.
- 3 Fit seal **24** into steer unit body and insert sleeve of service tool 892/00180. Fit back up ring **20** and seal **21** onto plastic boss, and position on tool spindle, as shown.
- 4 Lower steering unit body and tool sleeve over tool spindle until plastic bush is flush with end of bore. Assemble sleeves **12** and **15** with cross pin **14** and centring springs **13**. Fit bearing components **16** to **19** with chamfered face of **17** facing away from bearing **18**.

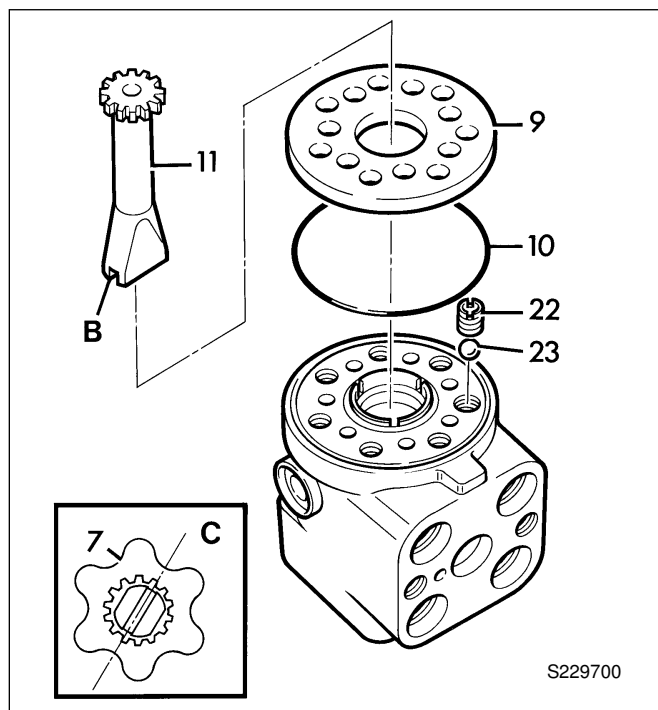


- 5 Remove body from tool leaving plastic bush in position, and lower body over assembled spool.
- 6 Apply downward pressure on body until plastic boss is forced out of bore, leaving seals correctly located.

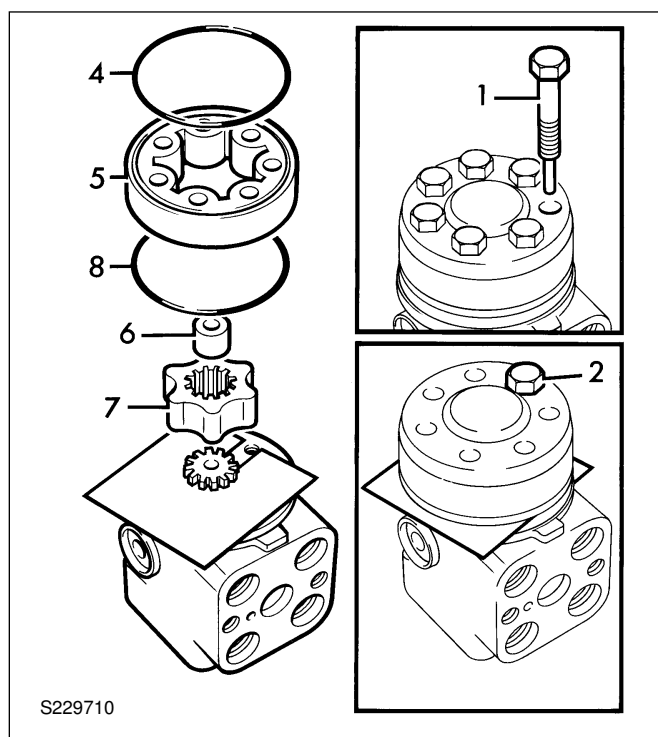


**Assembly (Continued)**

- 7 Invert unit and place on a suitable hollow support so that body does not rest on protruding sleeve, thus preventing displacement of the new seals. Place ball 23 into check valve hole and fit bush 22.
- 8 Fit new 'O' ring 10.
- 9 Fit distributor plate 9 ensuring that holes align. Locate shaft 11 onto cross-pin 14, noting position of slot. When rotor 7 is fitted, slot must align with hollows of rotor as shown at C.



- 10 Use a suitable piece of rigid flat material, 0.25mm (0.010 in.) thick, to support the shaft and ensure positive engagement with the splines of rotor 7.
- 11 Locate rotor onto shaft, ensuring alignment as at C. Fit spacing bush 6 into rotor.
- 12 Fit 'O' rings 4 and 8 each side of body 5, then position body over rotor.
- 13 Refit the end plate and fit at least one bolt 2 before removing support material.
- 14 Fit remaining bolts, ensuring that special bolt 1 is correctly located. Tighten all bolts to 29Nm (22 lbf ft).

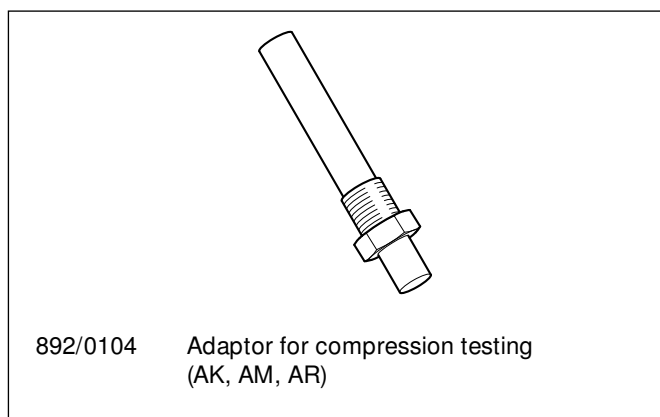
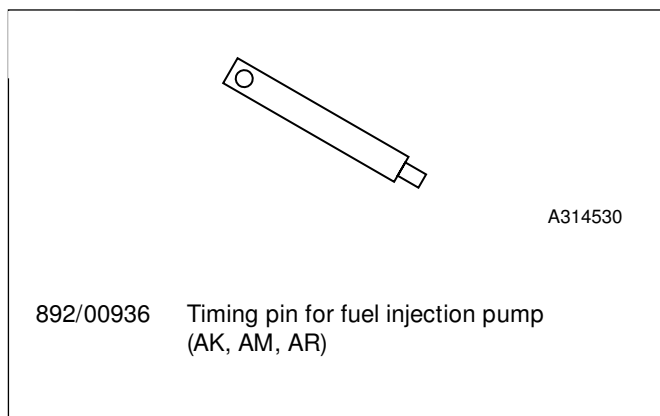
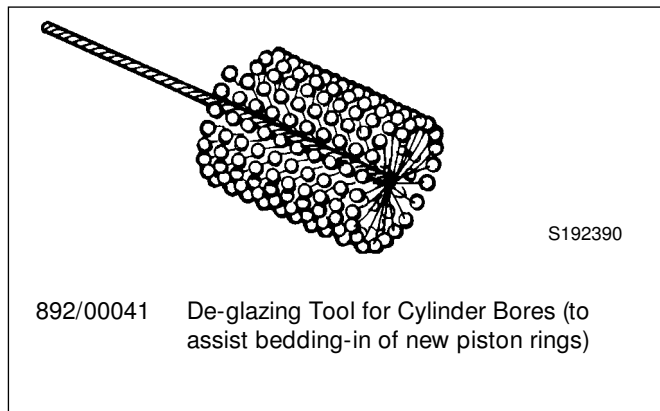
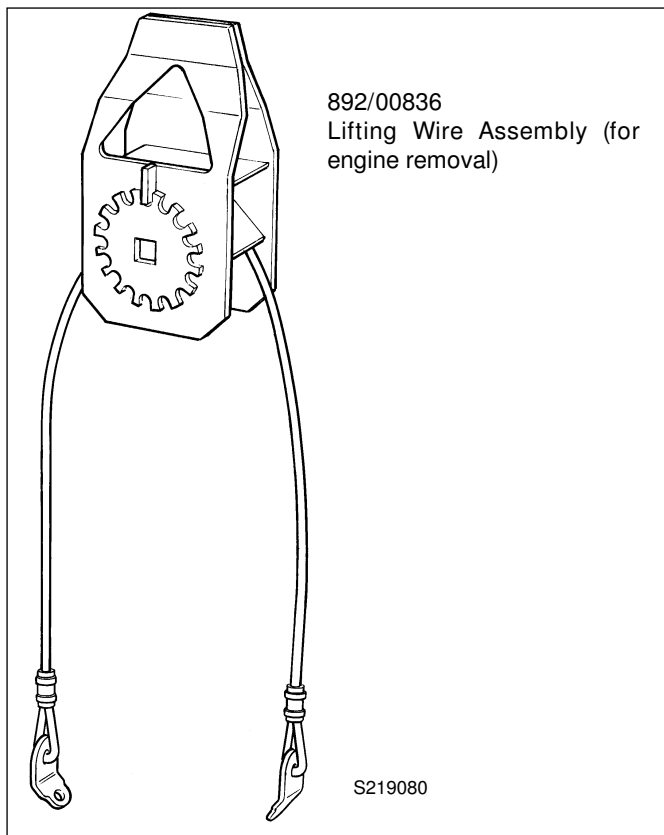
**Pressure Relief Valve Cartridge**

After renewing the 'O' ring, torque tighten the cartridge to 50 Nm (37 lbf ft). The relief valve is preset, refer to **Technical Data** for the valve setting. The relief valve setting should be rechecked after fitting the steering unit to the machine. Refer to **Service Procedures, Steer System - Pressure Testing**.

**Shock Valves**

If the shock valves have been dismantled, clean the threads of adjusting screw 31 and the threads in the bore of the steering unit body using JCB Cleaner/Degreaser, allow to dry. Assemble seat 35, ball 34, cap 33 and spring 32 then coat threads of screw 31 with JCB Threadlocker and Sealer. Assemble screw to depth measured during dismantling then fit plug 29 and washer 30.

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For details of other engine service tools refer to Engine Service Manual, Publication No. 9806/0100 or 9806/2140 for low emission engines.

Type	1000 Series 4 cylinder Engines AB - Turbocharged AA - Naturally Aspirated AK - Turbocharged AM - Turbocharged and Intercooled AR - Naturally Aspirated	
Engine Build List Number	AA50608 - AR50656, AR50654, AR50678 - 56kw (75bhp), AK50745 60kw (80bhp) AA50606 - 56kw (75bhp) AB50607 - 67.5 kw (90.5bhp), AK50628 - 68.5 kw (92bhp) AB50609 - 71.5kw (96bhp), AK50640 - 74.6 kw (100bhp) AM50647 85.5 kw (115bhp)	
Bore	AA, AB, AK, AM 100mm (3.937 in) AR 103mm (4.055 in)	
Stroke	127mm (5.000 in)	
Swept Volume	AB, AA, AK, AM	4 litres (243 in <sup>3</sup> )
	AR	4.23 litres (258 in <sup>3</sup> )
Compression Ratio	AB	16.0:1
	AA	16.5:1
	AK, AM	17.25:1
	AR	18.5:1
Compression Pressure	28 bar (400 lbf/in <sup>2</sup> ) [maximum variation between cylinders 3.5 bar (50 lbf/in <sup>2</sup> )]	
Injection Sequence	1,3,4,2	
Valve Clearance - Cold	- Inlet	0.20mm (0.008 in)
	- Exhaust	0.45mm (0.018 in)
Oil Pressure (hot) at maximum speed	- AA	2.1 bar (30 lbf/in <sup>2</sup> )
	- AB, AK, AM	2.6 bar (40 lbf/in <sup>2</sup> )
	- AR	2.0 bar (30 lbf/in <sup>2</sup> )
Maximum Air Cleaner Restriction	559mm (22 in H <sup>2</sup> O)	
Injection System Details - Refer to appropriate Engine Service Manual.		
Idling Speed	- All builds	880 - 930 rev/min
Maximum Governed Speed	- All builds	2200 rev/min
Maximum No-load Speed (High Idle)	- All builds	2400 - 2440 rev/min
Cooling System		
Coolant Pressure	0.48 bar (7 lbf/in <sup>2</sup> )	
Coolant Temperature (Normal)	80-85 °C (176-185 °F)	
Temperature Warning Light operates at:	98 °C (208 °F)	

**Note:** For further details of the engines refer to the following Engine Service Manuals:

Publication No. 9806/0100 (AA, AB)

Publication No. 9806/2140 (AK, AM, AR)

## Fuel Lift Pump - Cleaning the Strainer

To remove and fit pump, see Engine Service Manual.

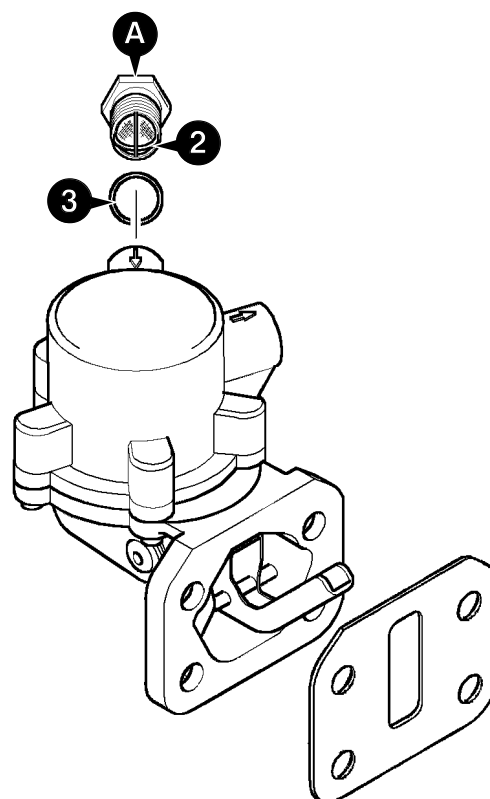
Remove and clean fuel inlet strainer **2** if blockage is suspected ie. low engine power, difficult to start, fuel tank contamination.

- 1 Allow the engine to cool. Remove the fuel filler cap to vent the system and reduce loss of fuel. Disconnect the fuel inlet pipe to the lift pump.
- 2 Unscrew the fuel filter **A**. Remove strainer **2** and O-ring **3**.
- 3 Clean the strainer in clean diesel fluid and dry with low pressure compressed air. Renew the strainer and O-ring if damaged.
- 4 Fit the strainer into the fuel inlet connection. Fit the inlet connector **A** and tighten to 20Nm (15 lbf ft). Fit the fuel inlet pipe carefully to prevent damage to the strainer, and tighten the union nut.

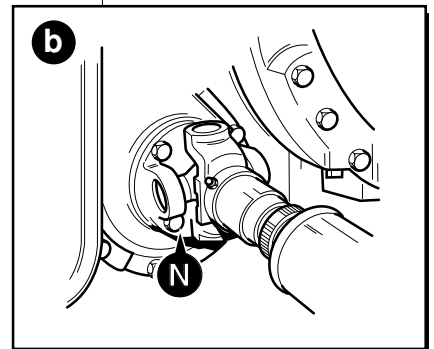
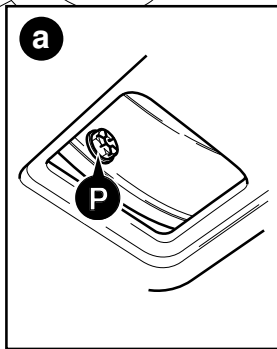
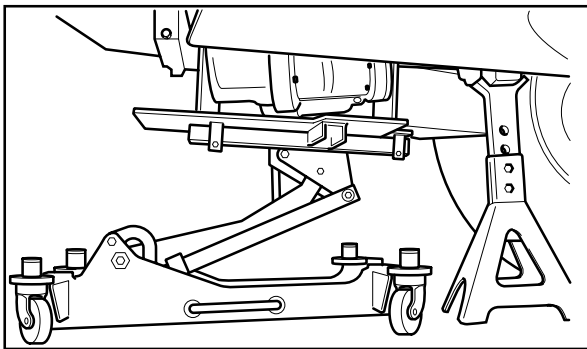
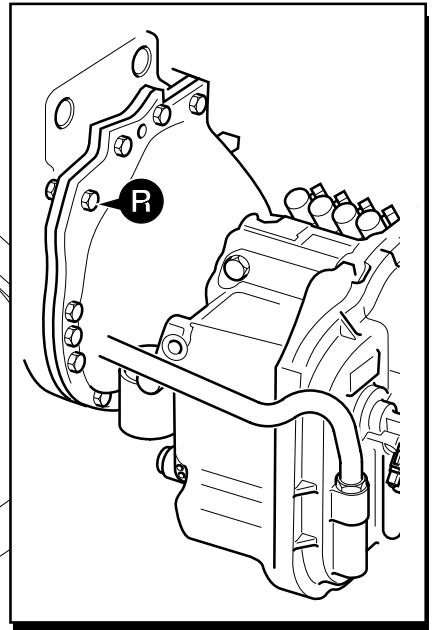
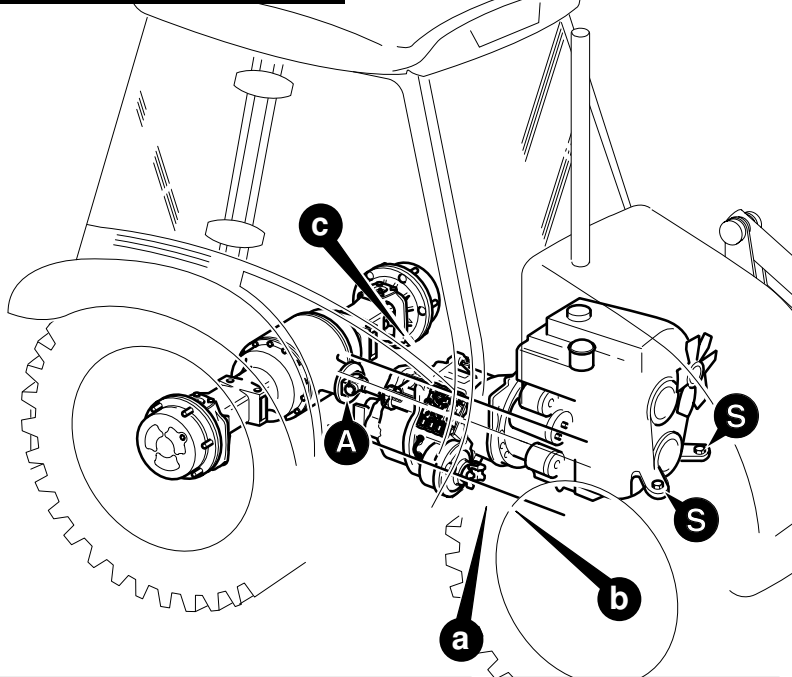
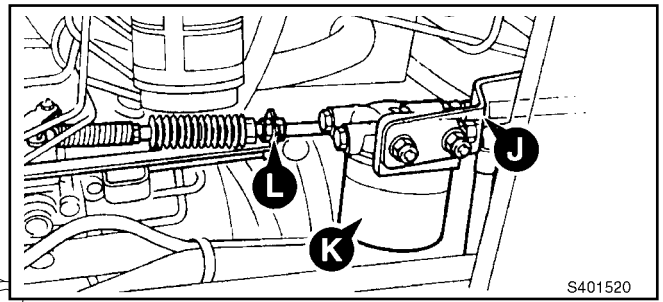
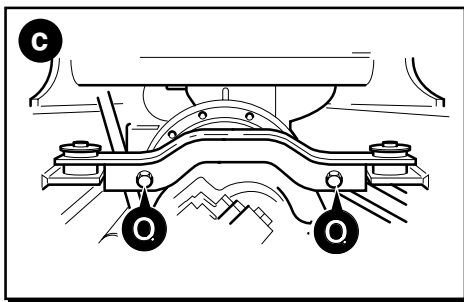
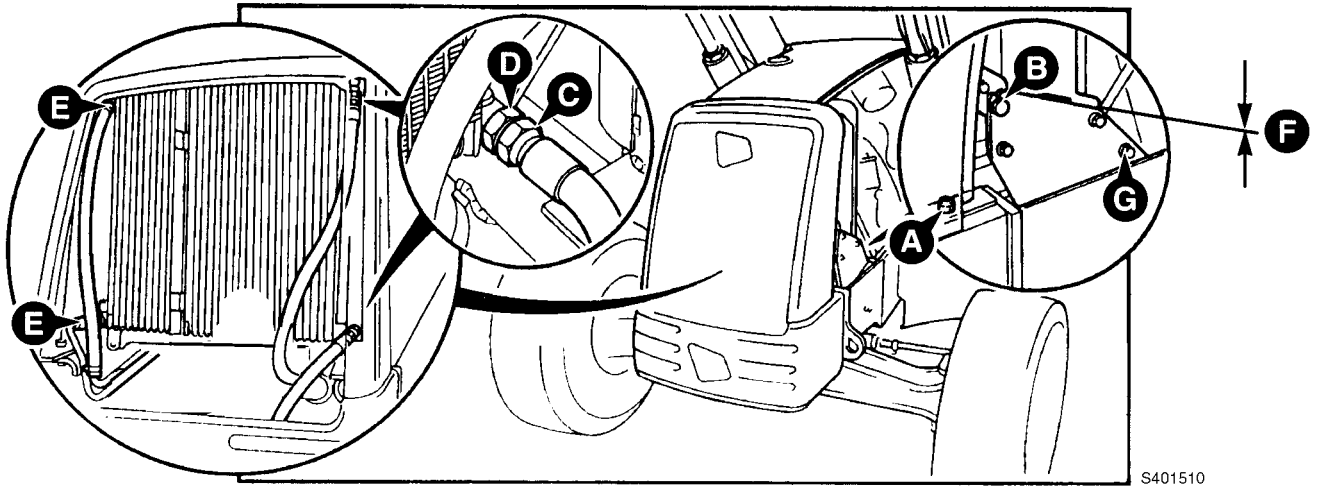
**IMPORTANT: The fuel strainer can be damaged and fuel flow can be restricted if the fuel pipe is inserted too far into the inlet connection. This should be checked if a fuel restriction is suspected.**

Make sure the olive on the fuel inlet pipe is in good condition and forms an effective seal. Renew the olive or pipe if necessary to prevent air entering the fuel system.

- 5 Fit the tank cap and prime the fuel system. Start the engine and check for fuel leakage.



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## Removal and Replacement

### Removal

- 1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Chock the road wheels.
- 2 Raise the loader arms and fit the loader arm safety strut.

**Note:** In the event of engine failure, the loader arms will have to be raised using suitable lifting equipment. Make sure that the loader control lever is in the 'raise arms' position before manually lifting the loader arms.

- 3 Remove the engine side panels
- 4 Remove the engine cover (including the exhaust stack).
- 5 Disconnect the battery. When disconnecting the battery, take off the earth (black) lead first.
- 6 Remove retaining bolts and then lift off the front grille.
- 7 Remove retaining bolts **A** and **B** (both sides) and lift off the front nose guard.
- 8 Disconnect the hydraulic oil cooler hoses **C** from the hydraulic oil cooler. Plug and cap open ports to prevent ingress of dirt.

**Note:** When installing and removing hoses from the cooler, it is essential to note that adaptor **D** 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.

- 9 Drain the cooling system.
- 10 Remove the transmission oil cooler hoses **E**.
- 11 Remove the radiator top hose and bottom hose.
- 12 Remove the coolant bottle pipe.
- 13 Make a suitable alignment mark to allow correct repositioning of the radiator shroud, as shown at **F**.
- 14 If an engine fan guard is fitted, remove retaining bolts and lift off the guard.
- 15 Remove retaining bolts **G** (both sides) and lift off the radiator sub-assembly including radiator, hydraulic and transmission coolers, and shroud. Take care not to damage the engine fan, note also that the sub-assembly is heavy, use suitable lifting equipment.

**Note:** If required, the shroud, radiator and coolers can be removed as individual items.

- 16 Loosen and remove the exhaust silencer retaining bolts, remove the silencer.
- 17 Loosen and remove the retaining clamp for the heater hose. Remove the hose.
- 18 Loosen and remove the retaining clamp for the air filter intake hose.
- 19 Remove the air intake filter. Use tape to close the opening in the air intake manifold, this will prevent ingress of dirt.
- 20 Loosen and remove the brake master cylinder reservoir retaining bolts. Do not remove the pipes attached to the master cylinder reservoir but put the reservoir out of the way. Make sure that the fluid level does not drain down.
- 21 Label and remove all electrical connections, the number of connectors will vary depending on the ancillary equipment fitted to the engine. Typical electrical connectors are:
  - i) starter motor
  - ii) alternator
  - iii) coolant pressure switch
  - iv) coolant temperature sender
  - v) engine oil pressure switch
  - vi) engine temperature sender
  - vii) engine shut off solenoid
  - viii) ether cold start (if fitted)
  - ix) air conditioning compressor (if fitted)

- 22 If air conditioning is fitted:

**Note:** The air conditioning is a pressurised closed loop system, do not disconnect the hoses to the compressor. Leave the hoses to the compressor intact.

- a Remove the belt from the clutch of the air conditioning compressor.
  - b Disconnect the electrical connectors at the compressor.
  - c Loosen and remove the air conditioning compressor retaining bolts.
  - d Put the air conditioning compressor out of the way (do not allow the compressor to 'hang' on its hoses).
- 23 Loosen and disconnect the fuel lines **J** from the fuel sedimenter. Plug and cap open orifices to prevent ingress of dirt and loss of fuel.
  - 24 Loosen and remove the retaining bolts for the fuel sedimenter, remove the sedimenter **K**.

.....cont'd

## Removal and Replacement

### Removal (continued)

- 25 If fitted, loosen and disconnect the ether cold start fuel line from the engine. Plug and cap open orifices to prevent ingress of dirt and loss of fluid.
- 26 If fitted, loosen and remove the ether cold start canister retaining bolts, lift off the canister and retaining bracket assembly.
- 27 Disconnect the throttle linkage **L** from the arm on the fuel injection pump. Leave at least one of the locking nuts in position, this will ensure that the engine revs are set correctly when reassembling.
- 28 Loosen and remove the rear propshaft to gearbox retaining bolts **M**.
- 29 On 4WD machines, loosen and remove the front propshaft to gearbox retaining bolts **N**.
- 30 Remove the access bung located at the base of the gearbox. Through the access hole, loosen and remove the torque converter to engine flywheel retaining bolts **P** (turn the flywheel to align bolts with access hole).
- 31 If manual gearbox fitted, disconnect the gearshift lever from the top of the gearbox.
- 32 Use a suitable trolley jack and support the weight of the gearbox.

**Note:** Attach a 'cradle' to the trolley jack that will evenly support the weight of the gearbox. Refer to **Service Tools**.

- 33 Use a suitable stand and support the weight of the engine.
- 34 Loosen and remove the gearbox mounting bolts **Q**.
- 35 Remove the gearbox to engine retaining bolts **R**, pull the transmission and converter clear of the engine, make sure that the converter stays mounted on the gearbox shaft.
- 36 Attach suitable lifting chains to the engine (see Lifting Wire Assembly, service tool 892/00836 in **Service Tools**). Take the weight of the engine on the hoist.
- 37 Loosen and remove the engine mounting bolts **S** (both sides).
- 38 Lift the engine clear of the machine.
- 39 Put the engine on a suitable stand, the correct dismantling and assembly procedures are detailed in the Engine Service Manual, publication number 9806/0100.

### Replacement

Replacement is a reversal of the removal procedure.

- 1 When mating the gearbox/torque converter to engine, ensure that the drive tangs are correctly located in the gearbox pump. See Section F **Gearbox Replacement** for a detailed procedure.

**Note:** 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.

- 2 When you are satisfied that the torque converter is located correctly, use the access hole in the bottom of the gearbox to fit and tighten the flexi-plate to engine flywheel retaining bolts. Rotate the flywheel to align the next bolt hole, fit and tighten all retaining bolts.
- 3 When fitting the radiator sub-assembly, including radiator, cooler and shroud take care not to damage the engine fan, align the shroud using alignment mark made at step 13 in **Removal**.
- 4 Make sure that the front nose guard and the engine cover are correctly aligned.
- 5 Refill cooling system using correct mixture of water/anti-freeze.
- 6 Check engine, coolant and brake oil levels.
- 7 When connecting the battery, connect the earth (black) lead last.

Make sure that the engine idle speed is correct, adjust as required, refer to **Technical Data**.

### Torque Figures

Item	Nm	Kgf m	lbf ft	Description
<b>M</b>	118	12	87	Rear propshaft bolts
<b>N</b>	79	8	58	Front propshaft bolts
<b>P</b>	44	4.5	32	Flexi-plate to flywheel bolts
<b>Q</b>	237	24	175	Gearbox mounting bolts
<b>R</b>	98	10	72	Gearbox to engine bolts
<b>S</b>	85	8.7	63	Engine mounting bolts

**Note:** The engine oil pressure switch, water temperature switch and water temperature sensor torque figure varies depending on the material it is screwed into.

	Nm	Kgf m	lbf ft
Plastic	4	0.4	3.0
Aluminium	30	3.0	22