



Section E

Hydraulics

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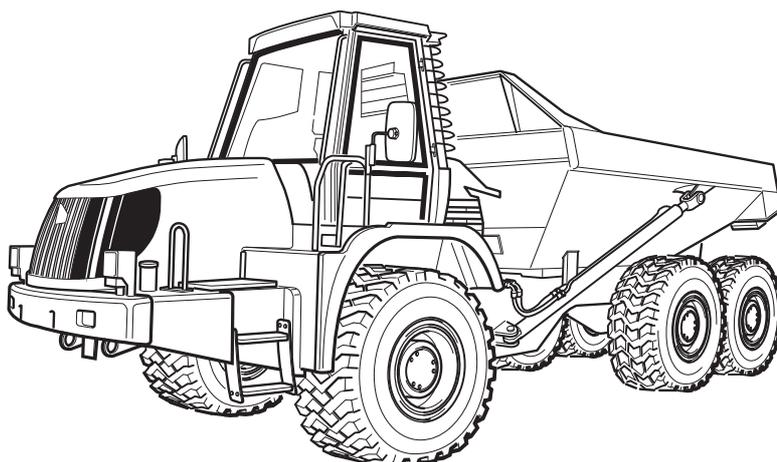
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Technical Data

Main System Components

Primary Pump

Type Axle piston (series 45); 90 cc/rev, variable displacement, load sensing self-aspirating pump.

Ground-drive Pump

Maximum Pump Flow 121 l/min (26.6 UK gal; 32 US gal)
 Maximum Pump Pressure 175 bar (2538 lb/in²)

Suspension Pump

Pump Flow 11 cc/rev

Main Control Manifold Block

Pump Pressure Compensator setting 210 bar (3046 lb/in²)
 Maximum Pump /flow (at tbc rev/min.) 190 l/min (41.8 UK gal/min; 50.2 US gal/min)
 Maximum Steering Flow 91 l/min (20 UK gal/min; 24 US gal/min)
 Maximum Steering Pressure 185 bar (2683 lb/in²) (protected by relief valve in LS line in Steer Valve)
 Maximum Lift Pressure 210 bar (3046 lb/in²)
 Maximum Brake Accumulator Charge Pressure 210 bar (3046 lb/in²)
 Minimum Brake Accumulator Charge Pressure 160 bar (2320 lb/in²)
 Pilot Supply Pressure 35 bar (508 lb/in²)

Hydraulic Rams

	Bore		Rod Dia.		Stroke	
	mm	in	mm	in	mm	in
Lift Ram	110	4.3	75	2.9	2100	82.7
Suspension Ram	80	3.15	80	3.15	140	5.5



Accumulator Pre-charge Pressures

Charging Gas: Air Free Dry Nitrogen

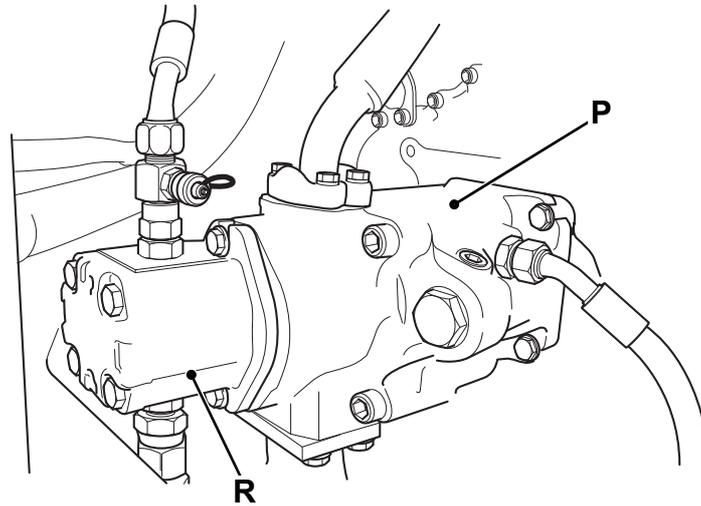
	Bar	kgf/cm²	lbf/in²
Suspension Accumulators	32	32.6	464
Suspension Backup	35	35.7	508
Brake Accumulators - 5 off (2 front, 3 rear)	85	86.7	1232
System Backup			

Filter (Return Line)

Filtration Size 10 Micron

Basic System Operation

Hydraulic Pumps



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Fig 1.

Primary Pump: The hydraulic system is powered by a variable displacement, load sensing, self-aspirating pump **P** with a rated flow of 90 cc/rev (5.5 cu. in/rev).

The pump is mounted at the rear of, and driven directly by, the machine's transmission.

Suspension Pump: Driven directly from the rear of the main hydraulic pump **P** is the suspension pump **R**. This pump has a rated displacement of 11cc/rev (0.7 cu.in/rev).

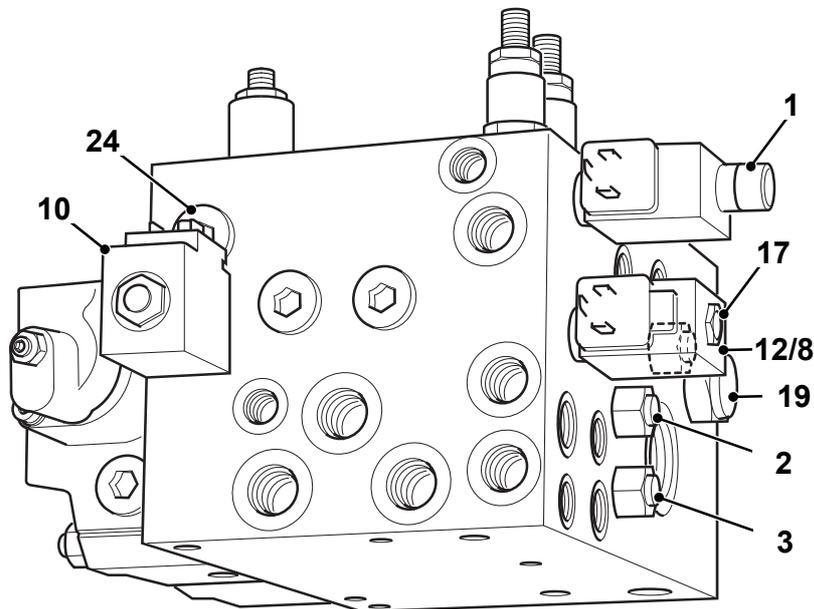
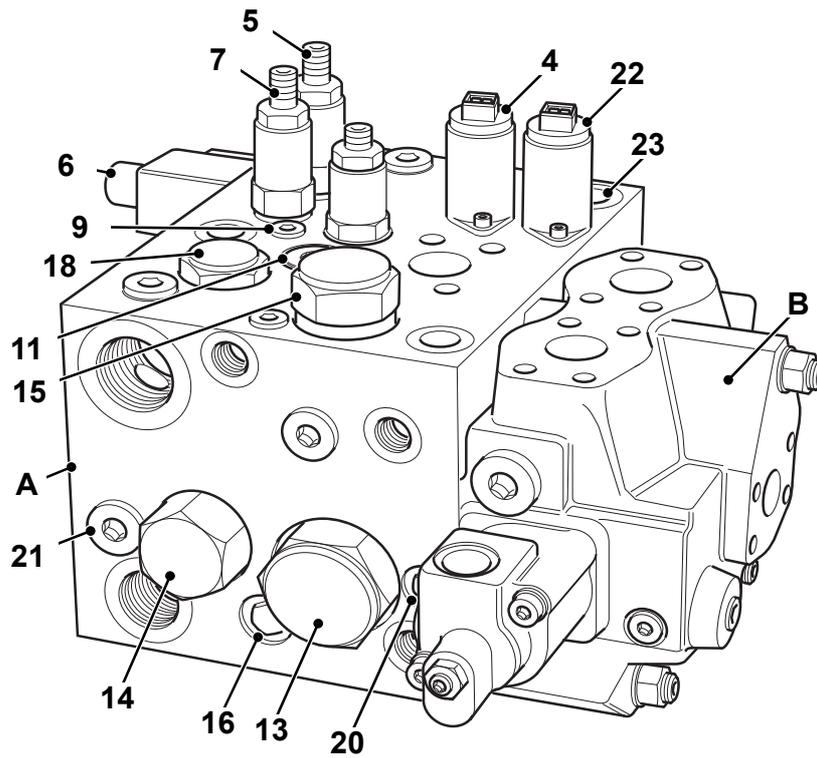
Main Control Manifold Block (to Machine No. 833199)

⇒ [Fig 2.](#) ([□ E-5](#)) The machine's hydraulic manifold block A is located on the vehicle's chassis just behind the cab. The manifold block integrates steering priority, brake charging, park brake function, hydraulic pilot supply, regulation of flow to the cooling function and relief valve protection for the main hydraulic pump into a single block to reduce the number of connecting hoses and possible leak points.

The Tipping Control Valve **B** is attached directly to the Manifold Block.

Component Key: ⇒ [Fig 2.](#) ([□ E-5](#))

- | | |
|--|--|
| <ol style="list-style-type: none"> 1 On/Off Solenoid Valve - Selects the parking brake. 2 Check Valve - Isolates Accumulator No.1 from the rest of the system. 3 Check Valve - Isolates Accumulator No.2 from the rest of the system 4 Proportional Electro-Hydraulic Pressure Control Valve - Applies a proportional hydraulic signal pressure to the Lift Valve to select body lift. 5 Pressure Reducing Valve - Limits the maximum brake pressure in Accumulators Nos. 1 and 2 to 160 bar 6 Brake Charging Valve - Maintains a minimum pressure at Accumulator No.3 of 170 bar. 7 Pressure Reducing Valve - Maintains a 35 bar pilot pressure for selection of the Lift Valve. 8 Check Valve - Isolates Accumulator No.3 from the rest of the system. 9 Orifice - Minimises the control flow within the brake charging system. 10 On/Off Solenoid Valve - Float Function to make sure head sides of tipping rams are drained to tank when the body is on the chassis 11 Relief Valve - Protects the components by arresting all pressure spikes in the system. 12 Orifice - Controls the charge flow rate to the accumulators. 13 Pressure Generating Priority/Logic Valve - Gives priority to the steering & charging functions over the fan drive & tipping functions. | <ol style="list-style-type: none"> 14 Bypass Sequence Valve - Unloads the Emergency Ground Drive Pump when not required. 15 Pressure Reducing Valve - Maintains the pressure at the steer valve equal to the steering demand pressure + 11 bar. 16 Shuttle Valve - Enables the higher load sense pressure from either the steering or brake charging function to act on the Pressure Generating Priority Valve and the Shuttle Valve (22). 17 On/Off Solenoid Valve - Cold Start Valve unloads the brake charging function during engine start. 18 Check Valve - Isolates the main steering flow from the emergency steer flow. 19 Check Valve - Isolates the emergency steer flow when required by the steering system from the rest of the system. 20 Shuttle Valve - Enables the higher of the load sense pressures from Shuttle Valve (16) or Lift Valve to be seen at the main pump. 21 Relief Valve - Limits the pressure at the Emergency Steer Pump to 175 bar. 22 Proportional Electro-Hydraulic Pressure Control Valve - Applies a proportional hydraulic signal pressure to the Lift Valve to select power down. 23 Limits the flow the pressure at the PPB port from the lift side of the cylinder when the body goes over-centre. 24 Isolates the main lift cylinder pressure from the PPB port until the body goes over-centre. |
|--|--|



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Fig 2. Component Identification

Tipping Control Valve (to Machine No. 833199)

⇒ [Fig 3. \(E-7\)](#). The hydraulic system incorporates a load sensing directional control valve with a three position spool and an electro-hydraulic controller for control of the machine's tipping function.

The spool **S**, on the control valve is linked, via the machine's controller and an Electro-hydraulic Proportional Pressure Control Valve to the Tipping Lever located in the operators cab.

When the 'raise' service is selected by the operator pulling back on the lever, a voltage of between 0 and 5 volts is sent to the machine's controller. The controller then converts this signal to an output current of between 250 and 800 mA dependent on how far the lever has been moved. This current is seen at the appropriate Electro-hydraulic Pressure Control Valve where it is converted into a pilot pressure of between 6 and 25 Bar.

This pilot pressure selects the main spool **S** in the control valve which moves to the position shown at **X**. The load sense pressure of the body lift rams loads the copy spool within the control valve which copies the pressure to the load sense port of the main pump via a shuttle valve. The main pump **P** then increases its displacement and flow passes via the main spool to port **A** of the tip control valve and the head side of the tipping rams and lifts the body.

Oil returning from the rod side of the body lift rams flows to port **B** of the Tip Control Valve and then to tank **T** via the Tipping Control Valve.

When the 'lower' service is selected by the operator pushing forward on the lever, the spool moves to the position shown at **Y**. Oil from the pump then flows via the inlet port and port **B** to the rod side of the body lift rams. Return oil from the head side of the body lift rams flows to the tank **T** via port **A**.

The tipper body may be held at any position above about 10° by releasing the tipper control lever which will spring back to the neutral position. Below 10° a proximity sensor will cause the On/Off Solenoid Float Valve **V** (shown at **Z**) to be energised and the spool **S** will return to the neutral position. In this position hydraulic fluid is vented to tank from the head side of the Tipping Rams. This allows the body to move up and down when the machine is travelling over rough terrain without causing a build up of pressure which would frequently 'blow' the Relief Valve.

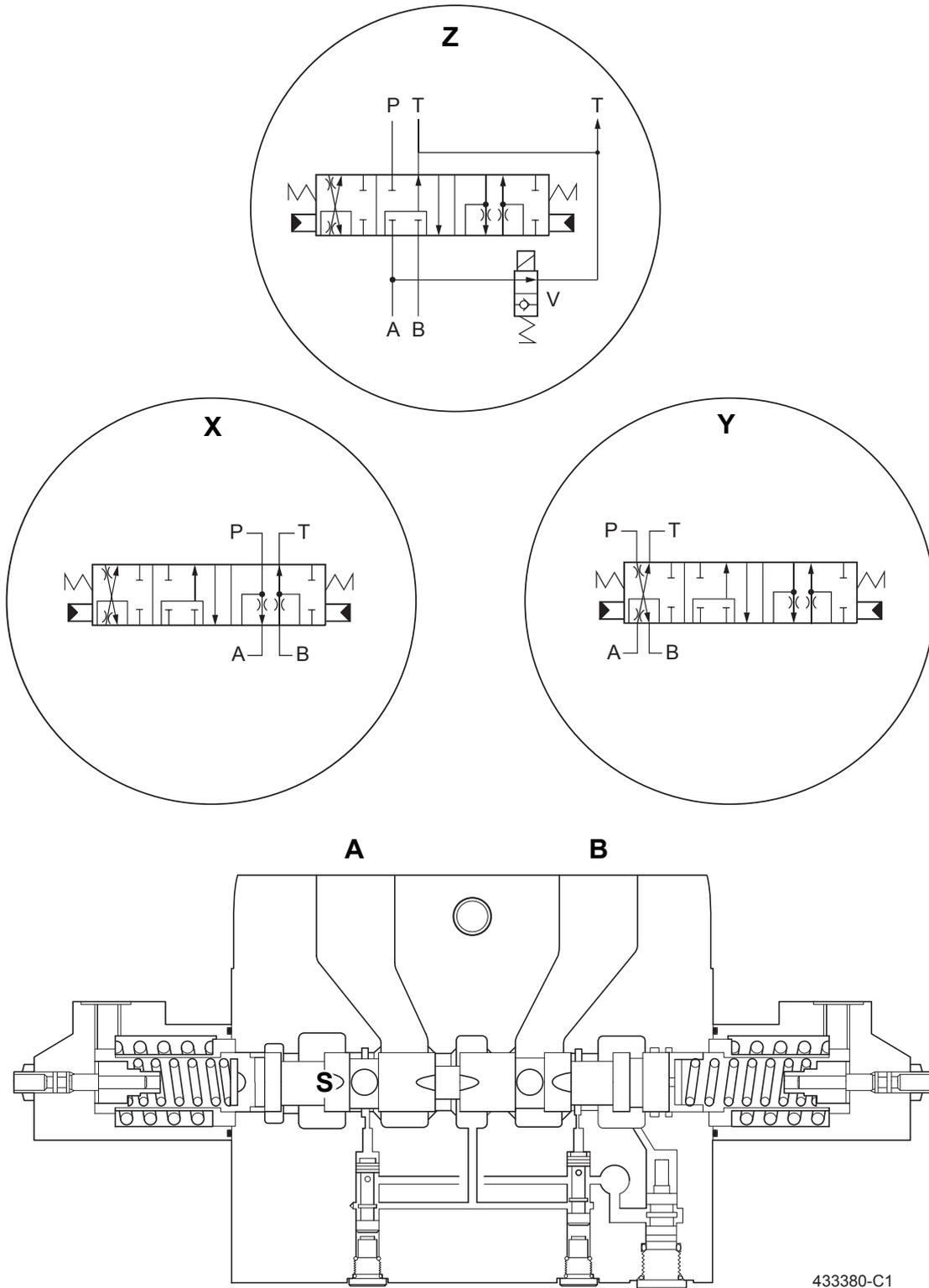


Fig 3.

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Circuit Descriptions (to Machine No. 833199)

⇒ [Fig 4.](#) ([□ E-10](#)). The main components of the hydraulic system are a variable displacement pump, a main control manifold block **A** which includes a load sensing directional tipping control valve **B**, a hydraulic tank, body lift rams and filters. For descriptions of the steering valves, brake valves and the suspension system please refer to the relevant sections.

Variable Displacement Pump

The main hydraulic power is provided by a main 85cc/rev variable displacement, load sensing pump **P**, driven from the transmission and supplying pressurised hydraulic oil to the body lift rams, hydraulic steering system, hydraulic suspension and braking system. A load sensing pressure generating logic valve **1** and a pressure reduction valve **2** work together to ensure that the steering and brake charging systems always have first demand on pump pressure.

If the main hydraulic pump **P** can no longer function (engine, transmission or internal pump failure), an emergency steering pump **GP**, (sometimes described as a ground driven pump) also driven from the transmission, provides flow to the steering circuit. This pump also assists with flow from the main pump to articulate the vehicle if the main pump cannot deliver the flow required by the operator. The emergency steering pump is protected from over-pressure by a relief valve **3**.

Manifold Block and Control Valve

The manifold block **A** contains a steering priority valve **4**, the brake charging and parking brake system, the pilot supply valve **5**, the bypass valve **6** for the emergency ground driven pump and the float function solenoid valve **7**.

The Tipping Control Valve **B**, attached to the manifold block **A**, features a three-position spool **8**. Two electro-hydraulic control valves **9** and **10** control the tipping function.

Tipping Function

With no demand from the steering, flow passes to the tipping control valve **B** with minimal pressure loss. If during tipping, the demand pressure from steering or brake charging is less than the requirement for tipping, the priority valve **1** remains open, allowing the requirements of the steering or charging circuits to be met. If, however, the demand pressure for charging or steering is higher than that demanded by the tipping function the system will cause the main pump to increase output to meet these requirements as well as simultaneously closing the priority valve **1** to reduce the flow to the tipping function.

When the operator pulls back on a lever in the machine's cab, the JCB's controller generates an output current which is converted to a pilot pressure to the tipping control valve **B**, selecting the valve's main spool **8** and causing the main pump to send pressurised oil to the body lift rams. The oil forces the piston along the bore of each ram to raise the tipper body. As the piston moves, oil is pushed from the opposite end of the ram, passes back through the lift valve **B** and returns to the hydraulic tank. Should the tipping control lever be released before the tipper body has risen above the range of the proximity switch (approx. 10°) the tipping control valve spool **8** is moved back to the central position and the float valve **7** is energised. This causes the body to float back down onto the chassis.

When the operator pushes forward on the lever, the main pump sends pressurised oil to the body lift rams to lower the tipper body. Returning oil passes through the main spool **8** and returns to the hydraulic tank.

If the tipper body should go over-centre (e.g. tipping with the vehicle on a slope) the pressure in the head side of the body lift rams will drop and harmful cavitation may occur. To prevent this, the hydraulic system is designed to ensure that some of the pilot pressure through the tipping control valve **B** flows to the head side of the body lift rams. The pilot pressure on the end of the main spool **8** will then drop, allowing the main spool to de-select slightly to keep control of the body and prevent cavitation in the body lift rams.

During lowering, the operator can fully select the lever into an electric detent within the lever base. Through the JCB's controller, this detent holds the lever in the power down position and allows the operator to drive the vehicle whilst the body is still lowering. When the descending body reaches a proximity switch on the chassis, the controller



Section E - Hydraulics Basic System Operation

Circuit Descriptions (to Machine No. 833199)

de-energises the electric detent, de-selects the main spool **8** within the lift valve and energises a float valve **7** that allows the body to float down to the chassis over the last few centimetres of travel. To prevent damage to the body hinge points or the body lift rams, this float valve **7** is energised whenever the body is on the chassis and the engine is running. This ensures that the head side of the body lift rams is always vented to tank.

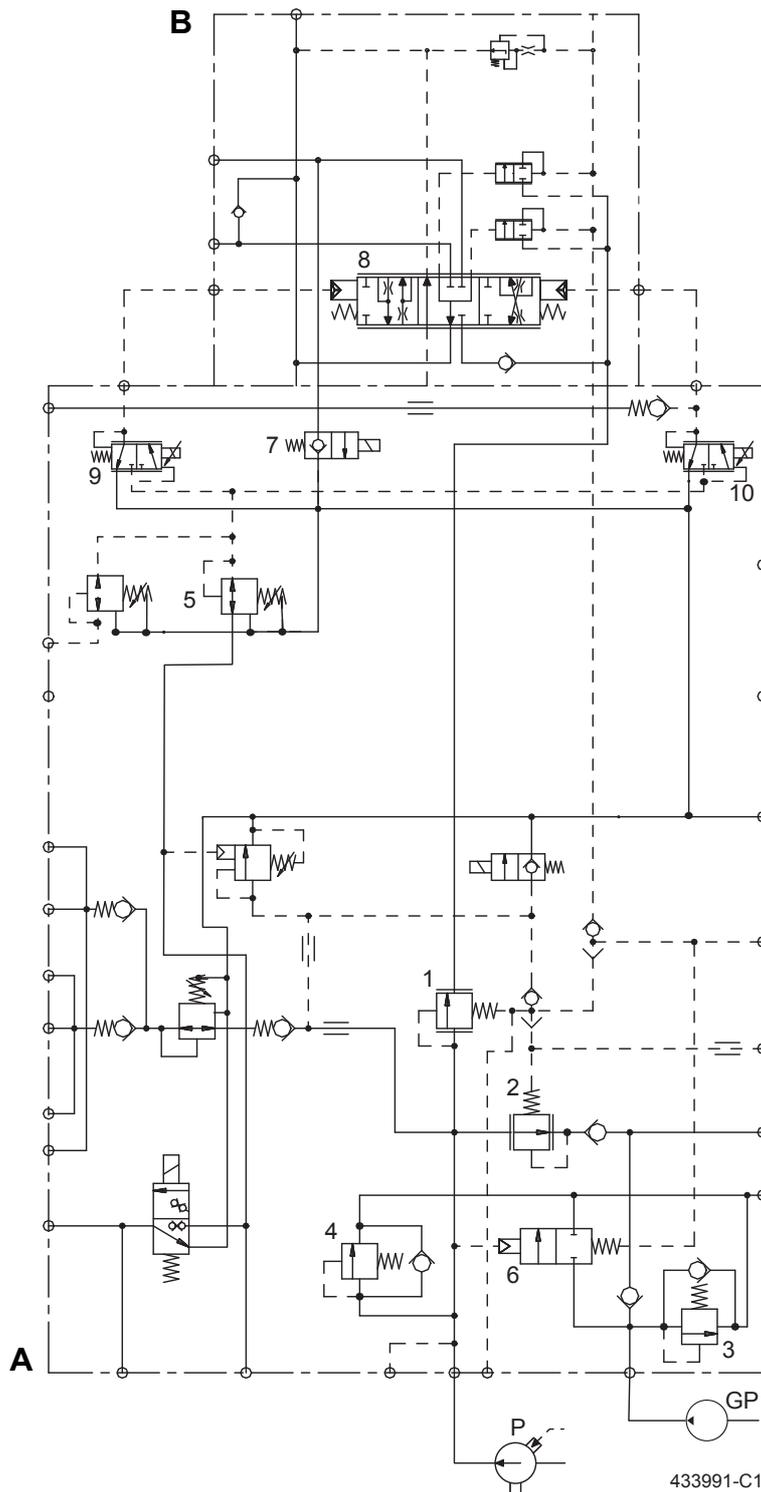


Fig 4. Main Control Manifold Block and Tipping Control Valve (To Machine No. 833199)



Main Control Manifold Block (from Machine no. 833200)

The machine's hydraulic manifold block is located on the vehicle's chassis just behind the cab. The manifold block integrates steering priority, brake charging, park brake function, hydraulic pilot supply, regulation of flow to the cooling function and relief valve protection for the main hydraulic pump into a single block to reduce the number of connecting hoses and possible leak points. It also incorporates the Tipping Valve and the control circuit for the hydraulically driven cooling fan.

Circuit Descriptions (from Machine No. 833200)

⇒ [Fig 5.](#) ([□ E-13](#)) The main components of the hydraulic system are a variable displacement pump, a main control manifold block which includes a load sensing directional tipping control valve, a hydraulic tank, body lift rams and filters. For descriptions of the steering valves, brake valves and the suspension system please refer to the relevant sections.

Variable Displacement Pump

The main hydraulic power is provided by a main 85cc/rev variable displacement, load sensing pump **P**, driven from the transmission and supplying pressurised hydraulic oil to the body lift rams, hydraulic steering system, hydraulic suspension and braking system. A load sensing pressure generating logic valve **1** ensures that the steering and brake charging systems always have first demand on pump pressure.

If the main hydraulic pump **P** can no longer function (engine, transmission or internal pump failure), an emergency steering pump **GP**, (sometimes described as a ground driven pump) also driven from the transmission, provides flow to the steering circuit. This pump also assists with flow from the main pump to articulate the vehicle if the main pump cannot deliver the flow required by the operator. The emergency steering pump is protected from over-pressure by a relief valve **3**.

Manifold Block and Control Valve

The manifold block contains a steering priority valve **4**, the brake charging and parking brake system, the pilot supply valve **5**, the bypass valve **6** for the emergency ground driven pump and the float function solenoid valve **7**. It also includes the tipping control valve **8** and the control circuitry for the hydraulically operated coolant fan **13**.

The tipping control valve features a five-position spool **8**. Two electro-hydraulic control valves **9** and **10** control the tipping function.

Tipping Function

The tipping function works in much the same way as on earlier machines, but on these machines the float function is controlled by the five -position valve rather than by a separate 'float' valve.

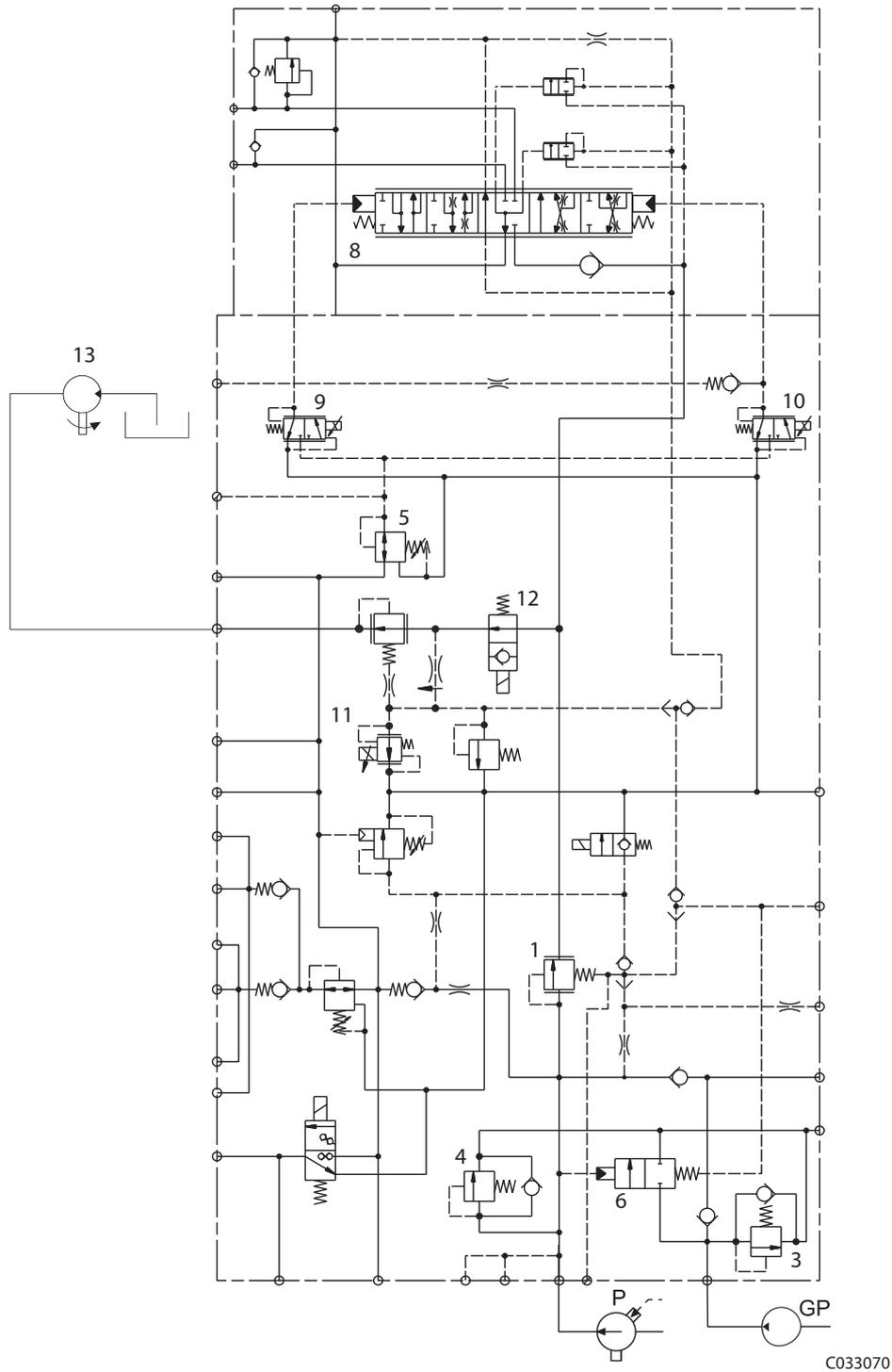


Fig 5. Main Control Manifold Block and Tipping Control Valve (From Machine No. 833200)

Introduction to Hydraulic Schematic Symbols

TE-001

General (Basic and Functional 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.

Table 1. General

	Spring
	Flow restriction affected by viscosity
	Direction of flow
	Indication of rotation
	Indication of direction and paths of flow
	Variable control

Table 2. Rams

	Single acting
	Double acting
	Double ended
	Double acting with damping at rod area end

Table 3. Pumps and 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

Table 4. Control Valves

	Used to enclose several valves indicating they are supplied as one unit
	3-Position, 4-port spring centered pilot operated valve
	3-position, 6-port spring centered pilot operated valve
	3-Position, 4-port spring centered solenoid & pilot pressure operated valve
	3-Position, 4-port spring centered detent hand operated valve
	Non-return valve
	Non-return valve with back pressure spring
	Pilot operated non-return valve
	One way restrictor
	High pressure selector (shuttle valve)

	Throttling orifice - normally closed
	Throttling orifice - normally open
	Relief valve
	Variable restrictor

Table 5. Energy Transmissions and Conditioning

	Working line, return or feed
	Pilot control
	Drain lines
	Flexible pipe
	Line junction
	Crossing lines
	Air bleed
	Line plugged, also pressure test point
	Line plugged with take off line
	Quick release couplings - connected
	Quick release couplings - disconnected
	Reservoir - return line above fluid level

	Reservoir - return line below fluid level
	Header tank
	Pressure sealed tank
	Accumulator
	Filter or strainer
	Water trap
	Cooler - with no indication of coolant flow
	Cooler - indicating direction of coolant flow
	Heater

Table 6. Control Mechanisms

	Rotating shaft - one direction
	Rotating shaft - two directions
	Detent
	Locking device
	Over centre device
	Simple linkage
	General control
	Push button operated
	Lever operated
	Pedal operated
	Stem operated
	Spring operated
	Roller operated
	Roller trip operated (one directional)

	Solenoid one winding
	Solenoid two windings
	Electric motor operated
	Internal pressure pilot operated
	External pressure pilot operated
	Pressure operated spring release
	Pilot operated by solenoid pilot valve
	Pilot operated by a solenoid or separate pilot valve
	Pressure guage
	Pressure switch

Control Valves

Control valves are usually represented by one or more square boxes.

⇒ [Fig 6. \(□ E-18\)](#) shows a control valve represented by three boxes. The number of boxes indicates the number of possible valve operating positions, (3 boxes - 3 positions etc).

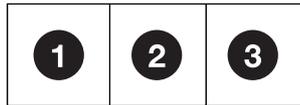


Fig 6.

⇒ [Fig 7. \(□ E-18\)](#) - 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).

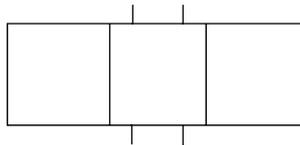


Fig 7.

⇒ [Fig 9. \(□ E-18\)](#) 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.

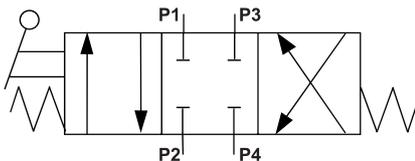


Fig 8.

If the valve spool was moved to Position 1, movement of the spool would connect Port P1 to Port P2, and Port P3 to Port P4. ⇒ [Fig 9. \(□ E-18\)](#).

If the valve spool was moved to Position 3, movement of the spool would connect Port P1 to Port P4, and Port P3 to Port P2. ⇒ [Fig 9. \(□ E-18\)](#).

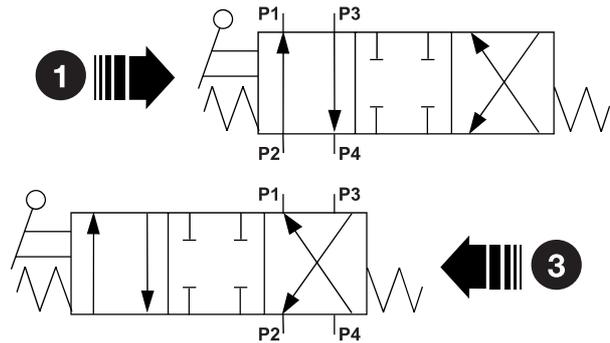


Fig 9.

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 9. \(□ E-18\)](#) shows a 'D' type spool.

⇒ [Fig 10. \(□ E-18\)](#) - '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'.

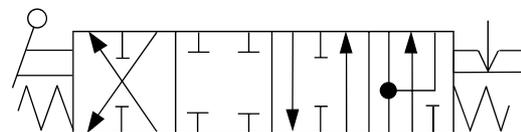


Fig 10.

⇒ [Fig 11. \(□ E-18\)](#) - '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

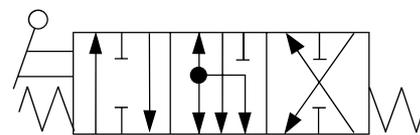


Fig 11.

Example of Schematic Circuit

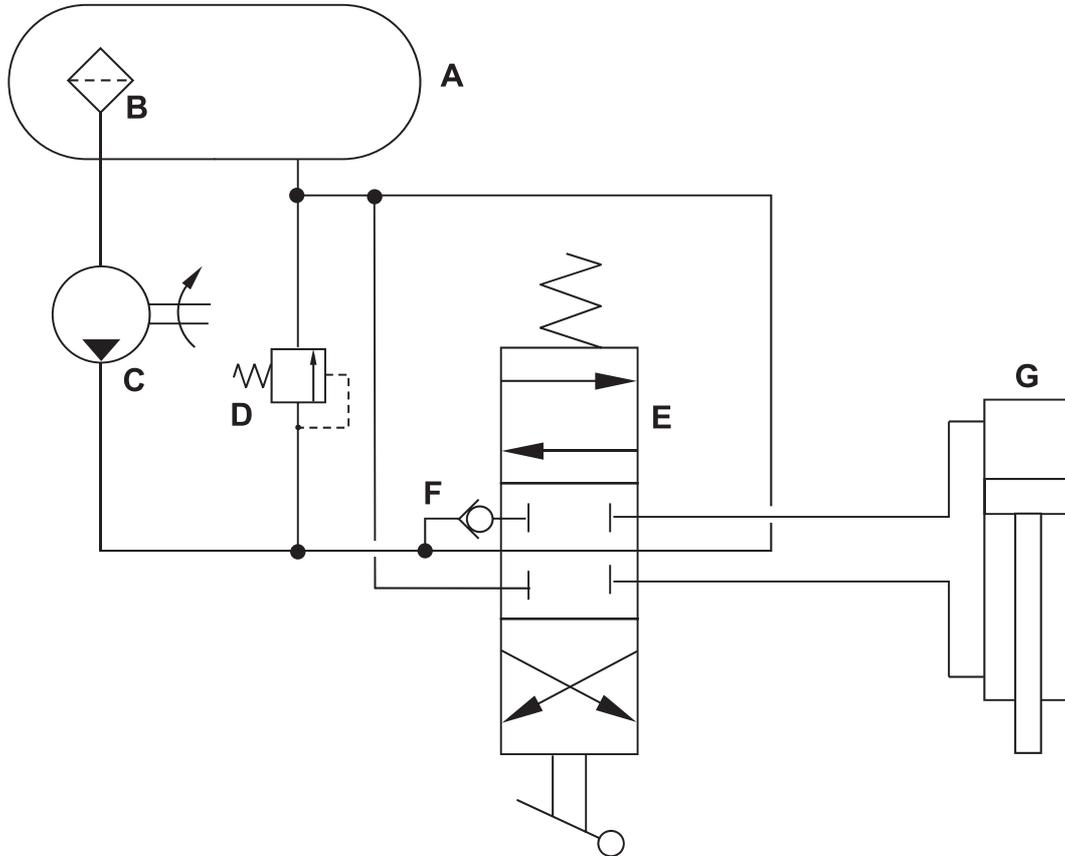


Fig 12. Simple Schematic Circuit

Some of the symbols described on the preceding pages have been arranged into a simple schematic circuit. → [Fig 12. \(E-19\)](#).

Hydraulic tank **12-A** is a pressurised tank with an internally mounted strainer **12-B** on the suction line to the fixed displacement pump **12-C**. System pressure is limited to the setting of relief valve **12-D**.

Valve spool **12-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 **12-G**. Notice that the fluid must first open one way valve **12-F** before flowing to the ram.

Example Circuit Key

- 12-A** Hydraulic Tank
- 12-B** Strainer
- 12-C** Fixed Displacement Pump
- 12-D** Relief Valve
- 12-E** Spool
- 12-F** One Way Valve
- 12-G** Double Acting Hydraulic Ram

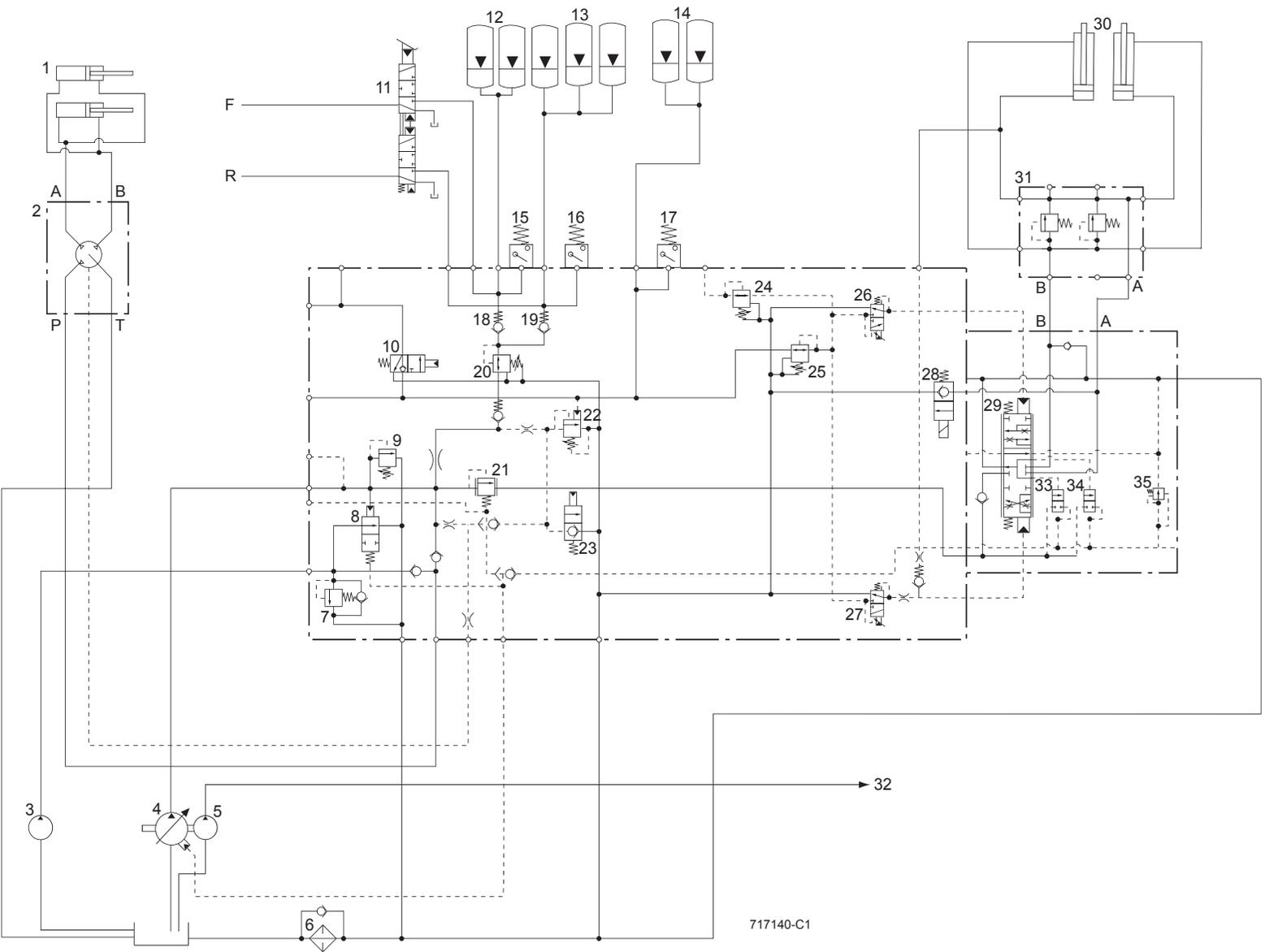
Schematic Circuit

Basic Machine (to Machine No. 833199)

Component Key: → [Fig 13.](#) ([□ E-21](#))

1	Steer Rams	27	Proportional Electro Hydraulic Control Valve
2	Steering unit	28	Float Function Valve
3	Emergency Steer Pump	29	Body Control Spool
4	Main Hydraulic Pump	30	Body Lift Rams
5	Suspension Pump	31	Quick Release Valve
6	Oil Cooler	32	Supply to Suspension Circuit
7	Steer Relief Valve	33	Relief Valve
8	Emergency Steer By-Pass Sequence Valve	34	Relief Valve
9	System Relief Valve	35	Relief Valve
10	On/Off Solenoid - Park Brake		
11	Brake Valve		
12	Accumulators (X2) - Front Brake Circuit		
13	Accumulators (X3) Rear Brake Circuit		
14	Accumulators (X2) System		
15	Pressure Switch Front Circuit		
16	Pressure Switch rear Circuit		
17	Pressure Switch System		
18	Check Valve Front Circuit		
19	Check valve Rear Circuit		
20	Pressure Reducing Valve		
21	Pressure Generating Valve		
22	Brake Charge Valve		
23	Cold Start		
24	Pressure Reducing Valve		
25	Pressure Reducing Valve		
26	Proportional Electro Hydraulic Control Valve		





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Fig 13. Hydraulic Diagram (to Machine No. 833199)

Basic Machine (from Machine No. 833200)

Component Key: → [Fig 14.](#) (□ [E-23](#))

1	Steer Rams	29	Body Control Spool
2	Steering unit	30	Body Lift Rams
3	Emergency Steer Pump	31	Quick Release Valve
4	Main Hydraulic Pump	32	Supply to Suspension Circuit
5	Suspension Pump	33	Relief Valve
6	Oil Cooler	34	Relief Valve
7	Steer Relief Valve	35	Relief Valve
8	Emergency Steer By-Pass Sequence Valve	36	Coolant Fan Motor
9	System Relief Valve	37	Proportional Electro Hydraulic Control Valve
10	On/Off Solenoid - Park Brake	38	Solenoid Valve
11	Brake Valve		
12	Accumulators (X2) - Front Brake Circuit		
13	Accumulators (X3) Rear Brake Circuit		
14	Accumulators (X2) System		
15	Pressure Switch Front Circuit		
16	Pressure Switch rear Circuit		
17	Pressure Switch System		
18	Check Valve Front Circuit		
19	Check valve Rear Circuit		
20	Pressure Reducing Valve		
21	Pressure Generating Valve		
22	Brake Charge Valve		
23	Cold Start		
24	Not Fitted		
25	Pressure Reducing Valve		
26	Proportional Electro Hydraulic Control Valve		
27	Proportional Electro Hydraulic Control Valve		
28	Not Fitted		



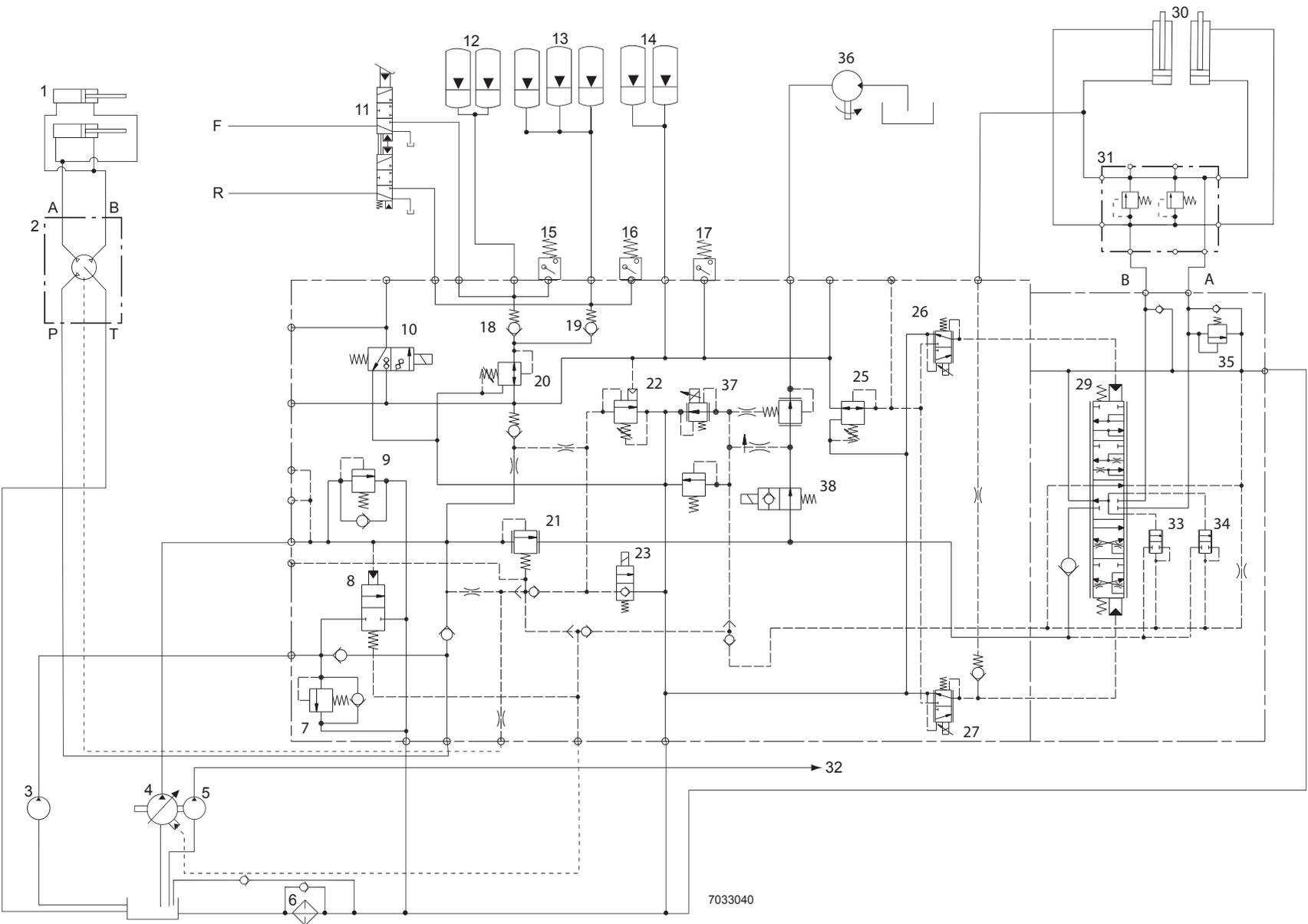


Fig 14. Hydraulic Diagram (From Machine No. 833200)

Fault Finding

Hydraulic System

Body Lift (Tipping) Function

The purpose of this section is to help you trace a particular fault. The tables identify possible causes and give a suggested action with specific tests where applicable.

Note: The item numbers (given in bold) refer to items in the main manifold block. ⇒ [Main Control Manifold Block \(E-42\)](#).

Remember, safety must always be the first priority. Refer to **Section 2, Care and Safety** for a reminder on safety practices.

Fault Finding Tables

Fault Descriptions:	
Body will not lift.	⇒ Table 7. (E-25)
Lift function too slow.	⇒ Table 8. (E-25)
Body will not lower.	Table 9. (E-26)
Body lowers too slowly.	⇒ Table 10. (E-26)
Power down available when body is on the chassis	⇒ Table 11. (E-26)
Body fails to slow down when reaching the proximity switch on the chassis.	⇒ Table 12. (E-26)
Body fails to go into float and stops before it reached the chassis	⇒ Table 13. (E-27)

Table 7.

Fault	Probable Cause	Action
Body will not lift.	Pressure level in the system not high enough.	Check pressure at the pump and readjust pressure cut off on pump.
	No electric current at the electro-hydraulic proportional pressure control valve (item 4).	Check voltage at the electric connector of for valve (item 4) when pulling back on the lever in the cab. If no voltage present refer to Section C, Electrics .
	Electro-hydraulic proportional pressure control valve (item 4) faulty.	Replace valve (item 4).
	Tipping control lever in the cab faulty.	See Section C, Electrics .
	Main spool in the tipping control valve sticking.	Replace manifold block.
	Copy spool in tipping control valve sticking.	Replace manifold block.
	Contamination in the load sense drillings and orifice.	Replace manifold block.
Main pump faulty.	⇒ Hydraulic Pump (□ E-40) .	

Table 8.

Fault	Probable Cause	Action
Lift function too slow.	Electro-hydraulic proportional pressure control valve (item 4) current not high enough.	See Section C, Electrics .
	Main spool in body lift valve not fully selecting.	Replace manifold block.
	Contamination in the load sense drillings and orifice.	Replace manifold block.
	Main pump faulty.	⇒ Hydraulic Pump (□ E-40) .
	Engine RPM too low.	See instruction for engine controller.
	Tipping control lever in the cab faulty.	See Section C, Electrics .

Table 9.

Fault	Probable Cause	Action
Body will not lower.	No electric current at the electro-hydraulic proportional pressure control valve (item 22).	See Section C, Electrics .
	Electro-hydraulic proportional pressure control valve (item 22) faulty.	Replace valve (item 22).
	Tipping control lever in the cab faulty.	Replace the lever.
	Proximity switch on the chassis reading high.	See Section C, Electrics .

Table 10.

Fault	Probable Cause	Action
Body lowers too slowly.	Not enough electric current at the electro-hydraulic proportional pressure control valve (item 22).	See Section C, Electrics .
	Pilot pressure not high enough.	Re-set pressure at valve (item 7). If it cannot be reset replace valve (item 7).
	Main spool in tipping control valve sticking.	Replace manifold block.
	Faulty main pump.	⇒ Hydraulic Pump (□ E-40) .
	Contamination in the load sense drillings and orifice.	Replace manifold block.

Table 11.

Fault	Probable Cause	Action
Power down available when body is on the chassis.	Faulty proximity switch on chassis.	See Section C, Electrics .

Table 12.

Fault	Probable Cause	Action
Body fails to slow down when reaching the proximity switch on the chassis.	Faulty proximity switch on chassis.	See Section C, Electrics .
	Faulty controller.	See Section C, Electrics .
	Main spool in the tipping control valve sticking.	Replace manifold block.



Section E - Hydraulics Fault Finding

Hydraulic System

Table 13.

Fault	Probable Cause	Action
Body fails to go into float and stops before it reached the chassis.	Faulty solenoid valve (item 10).	Replace valve (item 10).
	No voltage at the solenoid of valve (item 10).	See <i>Section C, Electrics</i> .



Parking Brake Function

The purpose of this section is to help you trace a particular fault. The tables identify possible causes and give a suggested action with specific tests where applicable.

Note: The item numbers (given in bold) refer to items in the main manifold block. [⇒ Main Control Manifold Block \(E-42\)](#).

Remember, safety must always be the first priority. Refer to **Section 2, Care and Safety** for a reminder on safety practices.

Fault Finding Tables

Fault Descriptions:	
Park brake fails to be effective.	⇒ Table 14. (E-29)
Park brake fails to release.	⇒ Table 15. (E-29)

Table 14.

Fault	Probable Cause	Action
Park brake fails to be effective.	<p>Fault with park brake calliper.</p> <p>Park brake solenoid (item 1) not functioning. Sticking in the selected position.</p>	<p>See Section G, Parking Brake.</p> <p>Check if there is hydraulic pressure at the park brake port. If there is a pressure present replace the park brake solenoid (item 1).</p>

Table 15.

Fault	Probable Cause	Action
Park brake fails to release.	<p>No voltage at the park brake solenoid (item 1) when the switch is activated in the cab.</p> <p>Park brake solenoid (item 1) fails to operated due to fault.</p> <p>Insufficient hydraulic charge pressure in accumulator No. 2.</p>	<p>See Section C, Electrics.</p> <p>Replace the park brake solenoid (item 1).</p> <p>⇒ Brake Charging System (E-30)</p>



Brake Charging System

The purpose of this section is to help you trace a particular fault. The tables identify possible causes and give a suggested action with specific tests where applicable.

Note: The item numbers (given in bold) refer to items in the main manifold block. [⇒ Main Control Manifold Block \(E-42\)](#).

Remember, safety must always be the first priority. Refer to **Section 2, Care and Safety** for a reminder on safety practices.

Fault Finding Tables

Fault Descriptions:	
Accumulators Nos. 1 and 2 not reaching the correct hydraulic charge pressure.	⇒ Table 16. (E-31)
Accumulators Nos. 1 and 2 do not hold their charge pressure for very long.	⇒ Table 17. (E-31)
Brake charging system fails to charge up after initial engine start.	⇒ Table 18. (E-31)
Accumulator No. 3 does not hold its hydraulic charge pressure.	⇒ Table 19. (E-32)

Table 16.

Fault	Probable Cause	Action
Accumulators Nos. 1 and 2 not reaching the correct hydraulic charge pressure.	Pressure reducing valve (item 5) not set correctly or faulty.	Reset valve (item 5) to the correct setting or, if faulty, replace.
	Pressure at accumulator no. 3 not high enough due to charging valve (item 6) not being set correctly.	Set the charge valve (item 6) to the correct setting.
	Precharge gas pressure in the accumulator not at the correct level.	Check the precharge level in the accumulator.

Table 17.

Fault	Probable Cause	Action
Accumulators Nos. 1 and 2 do not hold their charge pressure for very long.	Check valves (items 2 and 3) for leaking.	Replace check valves (items 2 and 3).
	Precharge gas pressure in the accumulator not at the correct level.	Check the precharge level in the accumulator.
	Brake modulating valve leaking.	See Section G, Service Brakes .
	Faulty seal in the accumulator piston.	Replace the accumulator.

Table 18.

Fault	Probable Cause	Action
Brake charging system fails to charge up after initial engine start.	Faulty charge valve (item 6).	Replace the charge valve (item 6).
	Contamination in orifice.	Clean orifice.
	Cold start solenoid (item 17) sticking open.	Replace valve (item 17).
	Air or contamination in the load sense system, especially when first running the machine after a new manifold block has been fitted.	Operate the body tip system several times to flush out the system.



Table 19.

Fault	Probable Cause	Action
Accumulator No. 3 does not hold its hydraulic charge pressure.	Accumulators No.s 1 and 2 are not holding their charge.	See Section G, Parking Brake.
	Gas charge pressure in the accumulators is not high enough or too high.	Check if there is hydraulic pressure at the park brake port. If there is a pressure present replace the park brake solenoid (item 1).
	Leakage across the valves (items 1, 4, 7, 18, 19 or 27) is too high.	Replace each valve one at a time until the fault is found.
	Accumulator piston seal leaking.	Replace the accumulator.

Steering System

The purpose of this section is to help you trace a particular fault. The tables identify possible causes and give a suggested action with specific tests where applicable.

Note: The item numbers (given in bold) refer to items in the main manifold block. → [Main Control Manifold Block \(E-42\)](#).

Remember, safety must always be the first priority. Refer to **Section 2, Care and Safety** for a reminder on safety practices.

Fault Finding Tables

Fault Descriptions:	
System does not reach the maximum operating pressure.	Table 20. (E-34)
Heavy steering due to a lack of flow being available at the steering valve but the differential pressure between the pump outlet and the load sense port is 15 to 22 bar (15.3 to 22.4 kf/cm ² ; 217.6 to 319.0 lb/in ²).	Table 21. (E-34)
Steering flow not available whilst the machine is travelling and the engine is switched off.	Table 22. (E-34)
With no operations being operated, the pressure at the emergency steer pump is too high.	Table 23. (E-35)

Table 20.

Fault	Probable Cause	Action
System does not reach the maximum operating pressure.	Fault with pump or pressure cut-off is incorrectly set.	⇒ Hydraulic Pump (□ E-40).
	Faulty relief valve (item 11).	Replace valve (item 11).
	Faulty pressure generating logic valve (item 13) - sticking open or wrong spring setting.	Replace valve (item 13).
	Sticking spool in pressure reducing logic valve (item 15).	Replace valve (item 15).

Table 21.

Fault	Probable Cause	Action
Heavy steering due to a lack of flow being available at the steering valve but the differential pressure between the pump outlet and the load sense port is 15 to 22 bar (15.3 to 22.4 kf/cm ² ; 217.6 to 319.0 lb/in ²)	Fault with pump or standby pressure incorrectly set.	⇒ Hydraulic Pump (□ E-40).
	Faulty orbital steer valve.	See Section H, Hydraulic Steering.
	Faulty pressure generating logic valve (item 13) - sticking open or wrong spring setting.	Replace valve (item 13).
	Sticking spool or wrong spring setting in pressure reducing logic valve (item 15).	Replace valve (item 15).
	Leaking shuttle valve (item 16).	Replace valve (item 16).

Table 22.

Fault	Probable Cause	Action
Steering flow not available whilst the machine is travelling and the engine is switched off.	Faulty emergency steer pump.	Replace the emergency steer pump.
	Bypass sequence valve (item 14) sticking open.	Replace valve (item 14).
	Faulty relief valve (item 21) - pressure setting too low.	Replace valve (item 21).



Section E - Hydraulics Fault Finding

Hydraulic System

Table 23.

Fault	Probable Cause	Action
With no operations being operated, the pressure at the emergency steer pump is too high.	Bypass sequence valve (item 14) sticking closed.	Replace valve (item 14).

Service Procedures

Hydraulic Contamination

TE-002_2

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. → Fig 15. (□ E-36). General Bulletin 011 also refers.

Procedure

Connect the cleaning unit in place of the hydraulic filter. → Fig 15. (□ E-36). 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.

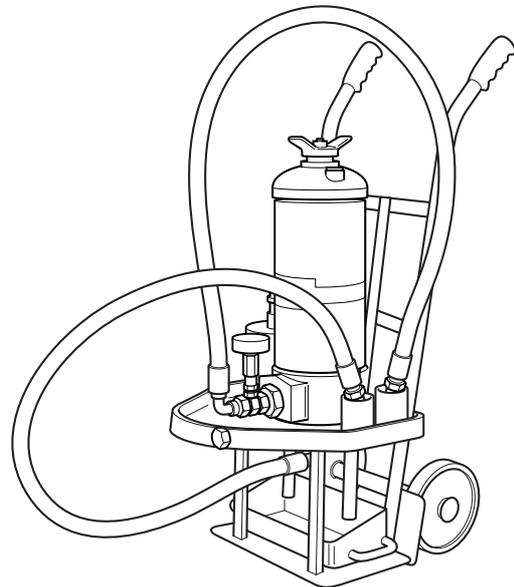


Fig 15. Cleaning Unit

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.

Pressure Testing

Testing the Main Relief Valve (MRV)

DANGER

Make sure the articulation safety lock is fitted before transporting the machine. The articulation safety lock must also be fitted if you are carrying out daily checks or doing any maintenance work in the articulation danger zone.

If the articulation lock is not fitted you could be crushed between the two parts of the chassis.

GEN-3-1_1

WARNING

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. Make sure the hose service line has been vented before connecting or removing hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11_2

- 1 Park the machine on firm level ground. Apply the parking brake and select neutral on the gear change lever.
- 2 Fit the articulation lock.
- 3 Stop the engine and operate the controls several times to vent the hydraulic pressure. Remove the starter key.
- 4 Gain access to the engine compartment by opening and supporting the engine cover.
- 5 The test point **A** is located on the left hand side of the machine at the rear of the cab. Remove the test point snap cover. Connect a 0 - 400 bar (0 - 6000 lbf/in²) pressure gauge to the snap connector at the pressure test point **A**.
- 6 Start the engine and set the speed to 1500 rpm.
- 7 Select lower at the body control lever. Record the maximum pressure shown on the pressure gauge when the body is fully down. The pressure gauge

should show the correct pressure, → [Technical Data \(E-1\)](#).

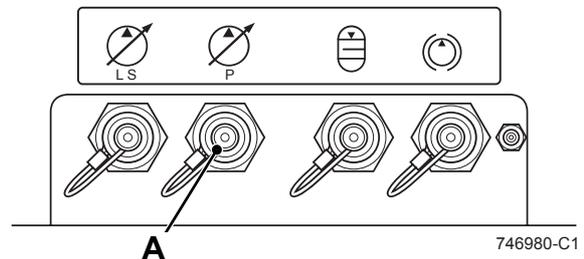


Fig 16.

Main Relief Valve Adjustment

If the pressure shown is incorrect, the main relief valve (located on the main control valve) will require replacing. There is no physical adjustment that can be made to this type of relief valve.

Testing the Steer Relief Valve

⚠ DANGER

Make sure the articulation safety lock is fitted before transporting the machine. The articulation safety lock must also be fitted if you are carrying out daily checks or doing any maintenance work in the articulation danger zone.

If the articulation lock is not fitted you could be crushed between the two parts of the chassis.

GEN-3-1_1

⚠ WARNING

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. Make sure the hose service line has been vented before connecting or removing hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11_2

- 1 Park the machine on firm level ground. Apply the parking brake and select neutral on the gear change lever.
- 2 Fit the articulation lock.
- 3 Stop the engine and operate the controls several times to vent the hydraulic pressure. Remove the starter key.
- 4 The test point **A** is located on the left hand side of the machine, to the rear of the cab. Remove the test point snap cover. Connect a 0 - 400 bar (0 - 6000 lbf/in²) pressure gauge to the snap connector at the pressure test point **A**.
- 5 Remove the articulation lock. The following steps require the machine's steering to be turned onto a full lock.
- 6 Start the engine and set the speed to 1500 rpm.
- 7 Keeping the gear change lever in neutral, turn the steering wheel to apply full lock.

- 8 Record the pressure shown on the pressure gauge. The pressure gauge should show the correct pressure, ⇒ [Technical Data \(E-1\)](#).
- 9 Stop the engine and operate the controls to vent hydraulic pressure before removing the pressure gauge.

Ensure the test point cover is correctly replaced.

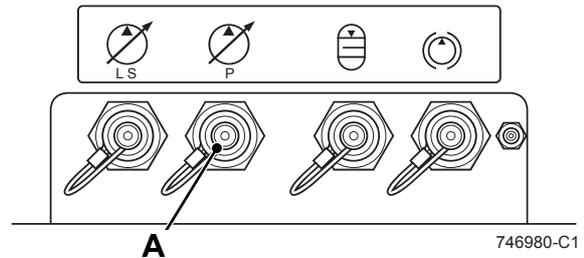


Fig 17.

Hydraulic Pump

Removal and Replacement

Removal

DANGER

Make sure the articulation safety lock is fitted before transporting the machine. The articulation safety lock must also be fitted if you are carrying out daily checks or doing any maintenance work in the articulation danger zone.

If the articulation lock is not fitted you could be crushed between the two parts of the chassis.

GEN-3-1_1

- 1 Fit the articulation lock. Stop the engine and release the hydraulic pressure by operating the controls several times. Remove the key.
- 2 Identify and label the hoses connected to the hydraulic pump to ensure correct reconnection.

WARNING

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. Make sure the hose service line has been vented before connecting or removing hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11_2

- 3 [→ Fig 18. \(□ E-41\)](#). Remove the hoses from the hydraulic pump **P**. Fit suitable plugs to the hoses and to the pump ports to avoid the ingress of dirt and excessive loss of hydraulic fluid.

WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

- 4 Remove the four bolts **A** securing the hydraulic pump **P** to the transmission.

- 5 Withdraw the hydraulic pump **P** from the transmission and then from the machine.

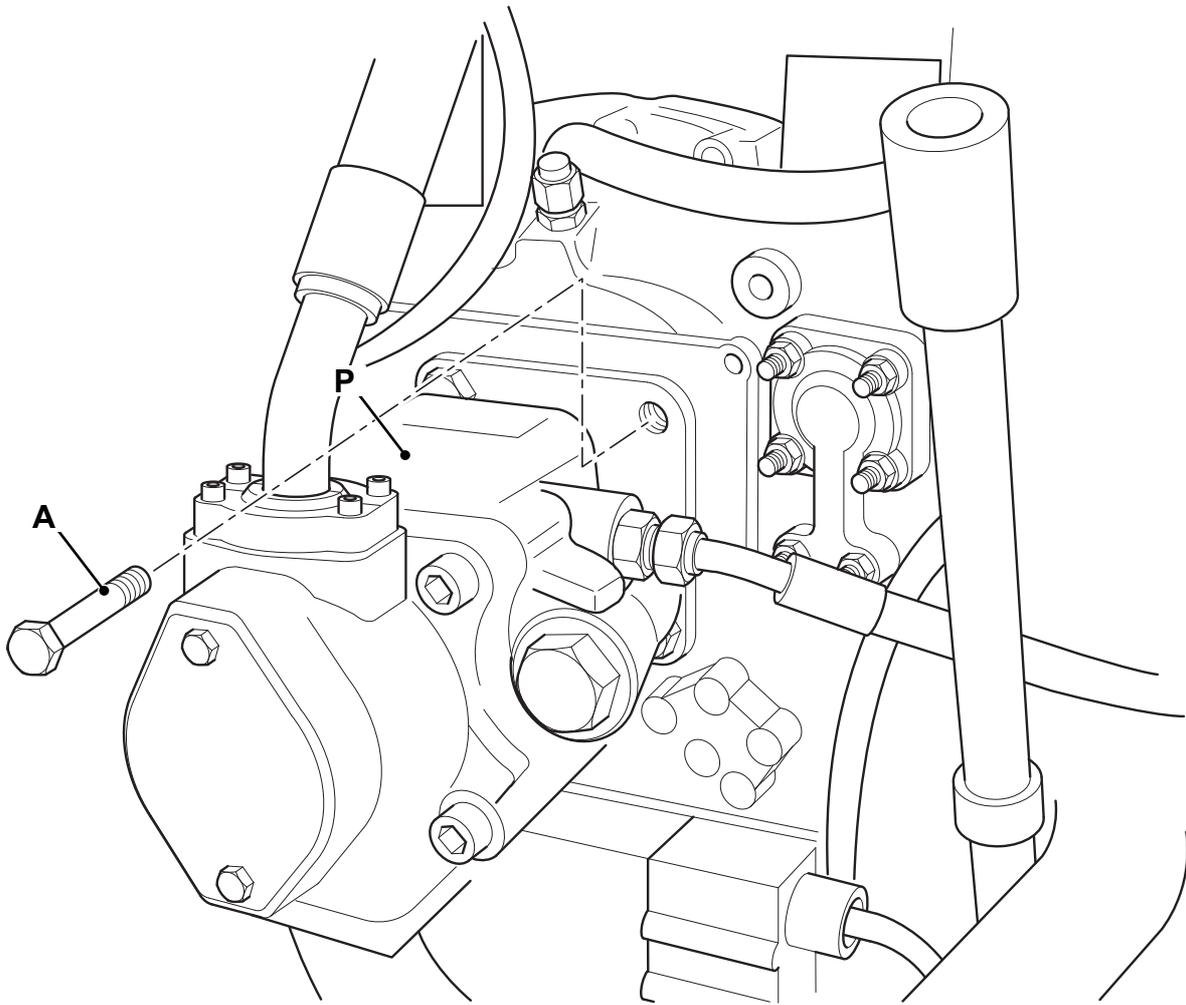
- 6 Remove and discard the O-ring

- 7 Check the condition of the drive shaft seal and renew as necessary.

Replacement

Replacement is the reverse of removal.

Note: Always use a new O-ring between the pump **P** and the transmission housing.



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Fig 18.

Main Control Manifold Block

Removal and Replacement

Note: It may not be necessary to remove the manifold block from the machine to work on the tipping control valve or to remove/replace its screw-in or plug-in components.

If you have decided that the manifold block/tipping control valve need to be removed, proceed as follows:

Removal

DANGER

Make sure the articulation safety lock is fitted before transporting the machine. The articulation safety lock must also be fitted if you are carrying out daily checks or doing any maintenance work in the articulation danger zone.

If the articulation lock is not fitted you could be crushed between the two parts of the chassis.

GEN-3-1_1

- 1 Fit the articulation lock. Stop the engine and release the hydraulic pressure by operating the controls several times. Remove the key.
- 2 → Fig 19. (E-43). Identify and label the hoses and electrical connections connected to the manifold block C to ensure correct reconnection when the work is complete.

WARNING

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. Make sure the hose service line has been vented before connecting or removing hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11_2

- 3 Remove the hoses from the manifold block C. Fit suitable plugs to the hoses and ports to avoid the ingress of dirt and excessive loss of hydraulic fluid.

WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

- 4 Remove the four bolts A and washers B securing the manifold block C to the mounting plate D.
- 5 Withdraw the manifold block from the machine.

Replacement

Replacement is the reverse of removal.

Note: Make sure that all hoses and electrical connections are reconnected before attempting to operate the machine.

WARNING

Fluid Under Pressure

Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of fluid under pressure and wear protective glasses. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

INT-3-1-10_2

Start the engine and slowly operate the body lifting mechanism until all air has been bled from the system.

Stop the engine and check for leaks.

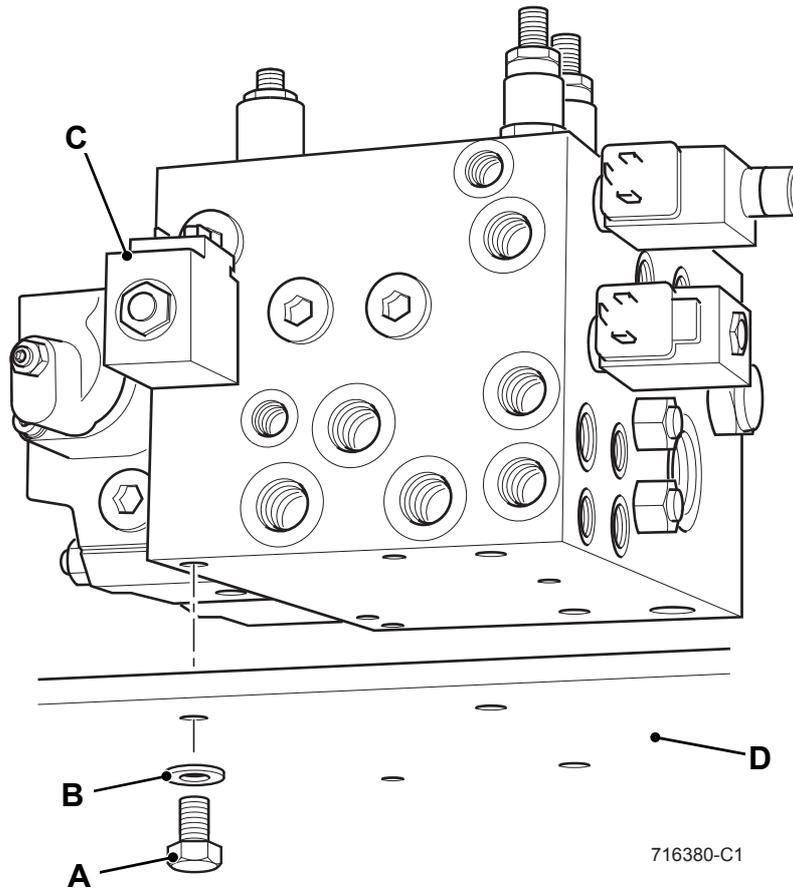


Fig 19.

Dismantle and Assemble

Main Manifold Block Components

⇒ [Fig 20. \(□ E-47\)](#). A number of screw-in and plug-in items are attached directly to the main body of the manifold block. These are not user-serviceable items but are easily removed for checking, using readily available tools. If necessary, replace with new units as required.

Note: Fit suitable plugs to any ports exposed by the removal of components to avoid the ingress of dirt and excessive loss of hydraulic fluid.

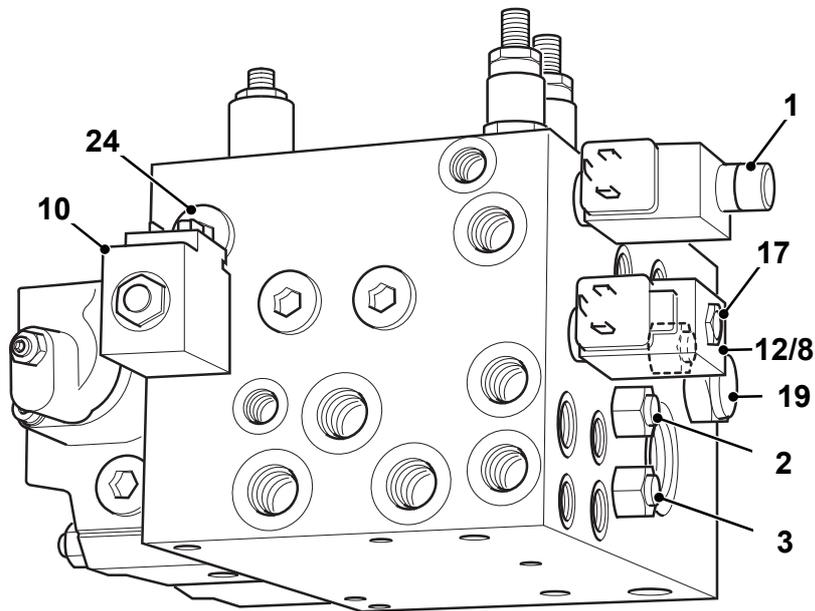
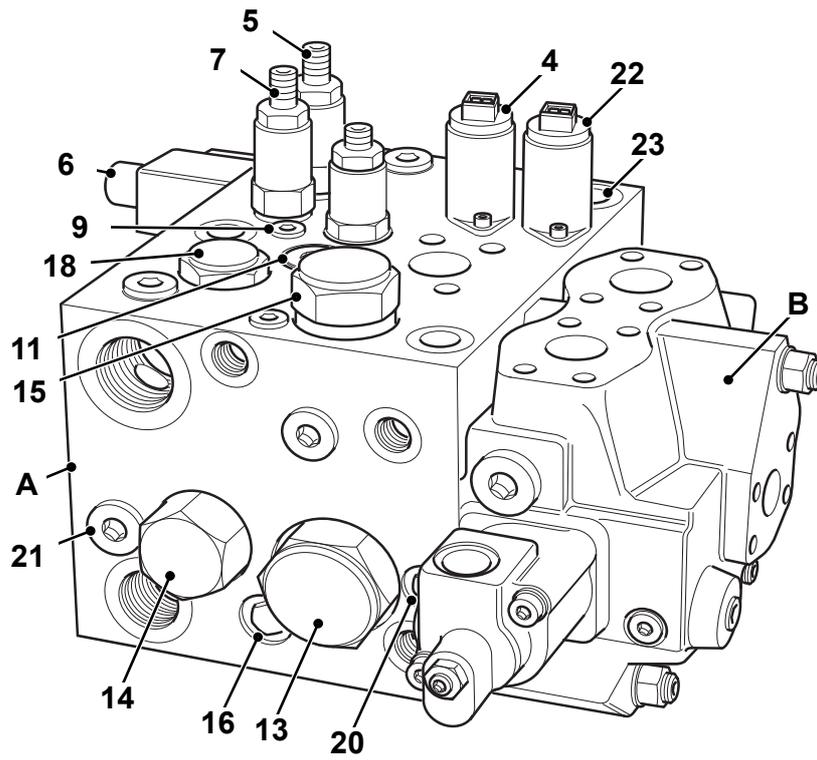
- 1 Remove the main control manifold block and tipping control valve from the machine. ⇒ [Removal and Replacement \(□ E-42\)](#).
- 2 Put the manifold block **A** and attached tipping control valve **B** on a suitable work surface.
- 3 Remove the required items discarding any seals.

The following items are as follows:

- a On/Off Solenoid Valve **1** - Selects the parking brake.
- b Check Valve **2** - Isolates Accumulator No.1 from the rest of the system.
- c Check Valve **3** - Isolates Accumulator No.2 from the rest of the system.
- d Proportional Electro-Hydraulic Pressure Control Valve **4** - Applies a proportional hydraulic signal pressure to the Lift Valve to select body lift.
- e Pressure Reducing Valve **5** - Limits the maximum brake pressure in Accumulators Nos. 1 and 2 to 160 bar.
- f Brake Charging Valve **6** - Maintains a minimum pressure at Accumulator No.3 of 170 bar.
- g Pressure Reducing Valve **7** - Maintains a 35 bar pilot pressure for selection of the Lift Valve.
- h Check Valve **8** - Isolates Accumulator No.3 from the rest of the system.

- i Orifice **9** - Minimises the control flow within the brake charging system.
- j On/Off Solenoid Valve **10** - Float Function to make sure head sides of tipping rams are drained to tank when the body is on the chassis.
- k Relief Valve **11** - Protects the components by arresting all pressure spikes in the system.
- l Orifice **12** - Controls the charge flow rate to the accumulators.
- m Pressure Generating Priority/Logic Valve **13** - Gives priority to the steering & charging functions over the fan drive & tipping functions.
- n Bypass Sequence Valve **14** - Unloads the Emergency Ground Drive Pump when not required.
- o Pressure Reducing Valve **15** - Maintains the pressure at the steer valve equal to the steering demand pressure + 11 bar.
- p Shuttle Valve **16** - Enables the higher load sense pressure from either the steering or brake charging function to act on the Pressure Generating Priority Valve and the Shuttle Valve (22).
- q On/Off Solenoid Valve **17** - Cold Start Valve unloads the brake charging function during engine start.
- r Check Valve **18** - Isolates the main steering flow from the emergency steer flow.
- s Check Valve **19** - Isolates the emergency steer flow when required by the steering system from the rest of the system.
- t Shuttle Valve **20** - Enables the higher of the load sense pressures from Shuttle Valve (**16**) or Lift Valve to be seen at the main pump.
- u Relief Valve **21** - Limits the pressure at the Emergency Steer Pump to 175 bar.

- v** Proportional Electro-Hydraulic Pressure Control Valve **22** - Applies a proportional hydraulic signal pressure to the Lift Valve to select power down.
 - w** Item **23** - Limits the flow the pressure at the PPB port from the lift side of the cylinder when the body goes over-centre.
 - x** Item **24** - Isolates the main lift cylinder pressure from the PPB port until the body goes over-centre.
- 4** Inspect the removed item(s) for wear or damage.
- 5** Either clean and refit the item or fit a new item as appropriate. Use new seals.



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Fig 20.

Removing the Tipping Control Valve

The manifold block contains only a limited number of user-removable components. These consist of the attached tipping control valve as well as a number of valves and other ancillary items that screw- or plug-in directly into the Manifold Block.

Note: *It may not be necessary to remove the tipping control valve from the main manifold block to work on the valve.*

If you have decided that it is necessary to separate the tipping control valve from the manifold block, proceed as follows:

Removal

- 1 Remove the main control manifold block and tipping control valve from the machine. → [Removal and Replacement \(□ E-42\)](#).
- 2 → [Fig 21. \(□ E-49\)](#). Put the manifold block **A** and attached tipping control valve **B** on a suitable work surface.
- 3 Remove the three nuts **C** and washers **D** attaching the control valve to the main manifold block.
- 4 Withdraw the control valve carefully from the studs **E** attached to the manifold block.

Note: *Make sure that all seals are removed with the tipping control valve.*

- 5 Fit suitable plugs to any ports, on the manifold block or the tipping control valve, exposed by the removal of the tipping control valve to avoid the ingress of dirt and excessive loss of hydraulic fluid.

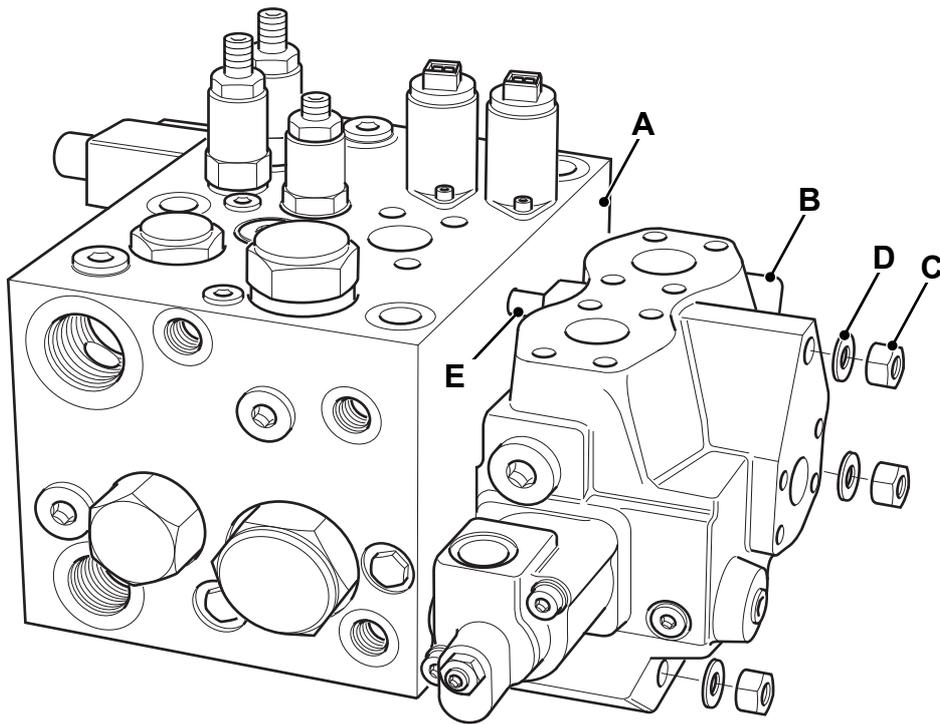
Replacement

Replacement is the reverse of removal.

Important: *Over tightening of the control valve mounting bolts may cause distortion of the control valve. This may cause the spool to jam.*

The nuts must be tightened evenly to avoid distorting the control valve.

Torque tighten the nuts to 80 Nm (8.16 kgf m; 59 lbf ft).



716390-C1

Fig 21. Removing the Tipping Control Valve

Tipping Control Valve

Dismantle and Assemble

The tipping control valve offers limited scope for dismantling and assembly. In particular, note that the main spool is not user-serviceable.

Note: Care must be taken when dismantling and assembling to avoid damage to the spool and the seal grooves. Seals should be removed using a suitable tool with rounded ends.

Note: Disassembly of the tipping control valve involves the removal of small/delicate components. Make sure these are stored appropriately when they have been removed and that their locations are plugged to avoid the ingress of dirt or the excessive loss of hydraulic fluid.

Dismantle

⇒ Fig 22. (□ E-52).

- 1 If necessary remove the tipping control valve from the manifold block, ⇒ [Removing the Tipping Control Valve \(□ E-48\)](#).

Note: At all stages, check carefully to make sure that all the components referred to have been removed from the body of the tipping control valve.

- 2 **Anti-cavitation assembly:** Use a suitable tool to remove the plug **B** from the end of the anti-cavitation assembly, then withdraw the O-ring **C**, sleeve **D**, poppet **E**, spring **F**, sleeve **G** and poppet **H**.
- 3 **Left-hand cap assembly:** Using a suitable hexagonal socket, undo the two screws **L** and washers **M** holding the cap **N** to the tipping control valve **A**.
- 4 Remove the cap **N** and O-ring **O**, then withdraw the large spring **P**, spring retainer **Q**, spring retainer **R** and small spring **S** from the body of the tipping control valve.
- 5 If it is necessary to remove the adjuster assembly, use a suitable hexagon spanner to remove the nut **I** from the end of the left-hand cap assembly, then withdraw the pre-set adjuster **J** and O-ring **K**.

Important: The pre-set adjuster assembly, consisting of a nut **I**, assembly **J** and O-ring **K**, should not be removed unless it is absolutely necessary and you are qualified to do so. Under normal circumstances, leave these components within the cap assembly **N**.

- 6 **Right-hand cap assembly:** Repeat steps 2, 3 and 4 for the right-hand cap assembly located on the opposite side of the tipping control valve body.
- 7 **Plugs:** Using a suitable tool remove the plug **T** and O-ring **U** from the left-hand side of the tipping control valve.
- 8 Using a suitable tool remove the plug **V** and O-ring **W** from the front face of the tipping control valve.
- 9 Using a suitable tool remove the plug **FF** and sealing ring **GG** from the left-hand side of the tipping control valve.
- 10 Use a suitable tool to remove the plug **HH**, O-ring **II**, O-ring **JJ** and back-up ring **KK** from the right-hand side of the tipping control valve.
- 11 **LD Adaptor:** Using a suitable tool, remove the plug **X** and O-ring **Y**, then withdraw the LD spool **Z** and spring **AA** from the front of the tipping control valve.
- 12 **Copy spools:** Using a suitable tool, remove the plug **BB**, O-ring **CC**, travel stop **DD**, and spool **EE** from the underside of the tipping control valve.
- 13 Repeat step 12 for the second copy spool, also located on the underside of the tipping control valve.

Assemble

Assembly is the reverse of dismantling.

Note: Ensure that the assemblies are tightened to the correct torque figures, as follows:

Table 24. Torque Settings

Item	Nm	kgf m	lbf ft
Cap Assembly (L)	10	1.02	7.4



Section E - Hydraulics Tipping Control Valve

Dismantle and Assemble

Item	Nm	kgf m	lbf ft
Anti-cav. Assembly (B)	80	8.16	59.0
Plug (T)	15	1.53	11.1
Plug (V)	15	1.53	11.1
LD Adaptor (X)	30	3.06	22.1
Copy Spools (BB)	15	30.6	22.1
Plug (FF)	15	3.06	22.1
Y2 Plug (HH)	80	8.16	59.0

Differential Locks

Removal and Replacement

⇒ Fig 23. (□ E-54). There are two differential lock solenoid valves. The valve **X** controls the differential lock on the front axle, valve **Y** the differential lock on the rear axles. The two valves are identical.

They are located at the rear of the front chassis and are mounted on a right hand side vertical support close to the exhaust.

Removal

DANGER

Make sure the articulation safety lock is fitted before transporting the machine. The articulation safety lock must also be fitted if you are carrying out daily checks or doing any maintenance work in the articulation danger zone.

If the articulation lock is not fitted you could be crushed between the two parts of the chassis.

GEN-3-1_1

- 1 Fit the articulation lock. Stop the engine and release the hydraulic pressure by operating the controls several times. Remove the key.

WARNING

The exhaust pipe becomes extremely hot when the engine is running and will remain so for some time after the engine is stopped. If you touch the hot pipe you could be severely burned.

13-2-4-11

- 2 Allow the exhaust pipe to cool before starting work.
- 3 Identify and label the hoses and electrical connections connected to the two differential locks **X** and **Y** to ensure correct reconnection on replacement.

WARNING

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. Make sure the hose service line has been vented before connecting or removing hoses. Make sure the engine cannot be started while the hoses are open.

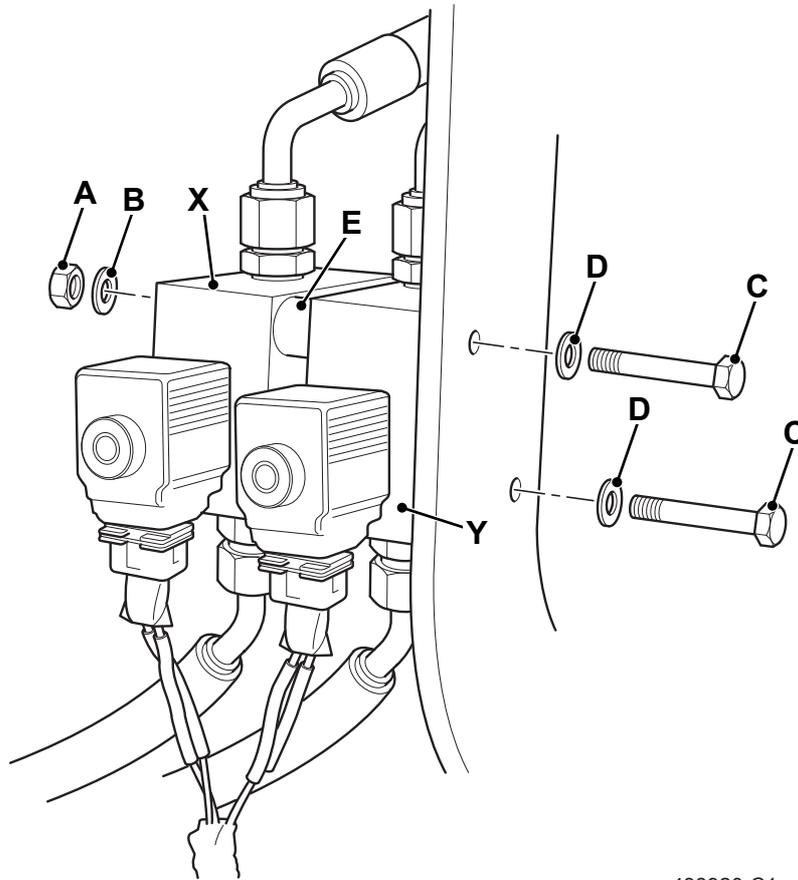
INT-3-1-11_2

- 4 Remove the hoses from the differential locks **X** and **Y**. Fit suitable plugs to the hoses and ports to avoid the ingress of dirt and excessive loss of hydraulic fluid.
- 5 Remove the electrical connections from the solenoids.
- 6 Remove the two nuts **A** and washers **B** securing the differential locks **X** and **Y** to the chassis.
- 7 Withdraw the bolts **C** making sure that you collect the spacers **E** and washers **D**.

Replacement

Replacement is the reverse of removal.

Make sure that the spacers **E** are fitted between the two valves.



433920-C1

Fig 23.

Hydraulic Rams

Precautions During Use

TE-006

Installation

- 1 Precautions when installing the ram on the machine.
 - a When installing and removing from the machine, suspend the ram safely.
 - b Suspending the ram by the piping is not only dangerous, but can also cause damage to the cylinder.
 - c Secure the piston rod with a band. It is very dangerous if the rod extends unexpectedly. Also, the rod can be damaged and become unusable.
- 2 Welding after installing the ram may result in damage.
 - a If electric welding is done even at a point away from the ram, there may be sparking inside the ram and it will become necessary to replace the ram with a new one.
- 3 When painting the machine, mask the ram.
 - a If paint adheres to the rod surface or to the wiper ring and the ram is operated, the wiper ring will not function properly and foreign matter and paint can easily enter the ram. This will cause damage to the seals, drastically shortening the life of the ram.
- 4 Install the ram only when it is clean.

Caution During Use

- 1 Use only under designated conditions.
 - a If hydraulic oil other than the designated oil is used, the seals quickly degenerate and become damaged. If the relief valve is set at a value higher than specified, it may cause ram damage and is dangerous.
 - b In high temperature environments (approx. 90°C and above) or low temperature environments (below -20°C), seals quickly become damaged.

Special seal materials are necessary so check to see if the ram that you are using is suitable or not.

- c The number one cause of ram oil leakage is rod damage. Be careful not to damage the rod.
- 2 Warm up sufficiently before beginning work.
 - a In cold conditions the rod seals may be frozen, so if the ram is operated at maximum pressure and maximum speed, the seals will be damaged.
 - b There is a large amount of air in a new ram or one which has been left for a long time, so the ram will not operate smoothly. Also, if pressure is applied suddenly without bleeding the air, high temperatures will be generated due to adiabatic compression and the seals may burn.
 - c Before beginning work, always move the ram at full stroke with no load and expel air from the cylinder.
 - 3 When stopping or storing, do it at a safe and fixed position.
 - a The installed ram cannot maintain the same position for a long period of time, because the oil inside the ram may leak and the hydraulic oil volume decreases as it cools. Stop or store the machine in a safe and fixed position.

Maintenance, Inspection Points

- 1 Carry out daily maintenance and inspection.
 - a The key point for correct long-term ram function is daily maintenance and inspection. Carry out maintenance and inspection so that the ram functions fully at all times. Always remove any mud, water, dust or oil film adhering to the rod and keep it in normal condition. However, when cleaning the wiper ring and seals, do not get them wet with water but wipe clean with a rag. To prevent rust forming during storage, the amount of exposed ram piston rod should be kept to a

minimum. If leaving for more than one week, apply a light coating of suitable grease or petroleum jelly to the exposed part of the ram piston rod.

- 2** Use genuine JCB parts when replacing parts.
 - a** If parts other than genuine JCB parts are used, the desired results may not be obtained. Use only genuine JCB parts.
- 3** Caution during dismantling and reassembly.
 - a** Dismantling the ram while it is still installed on the machine can be dangerous as unexpected movements of the machine can occur. Remove the ram from the machine and then dismantle.
 - b** If reassembled with dirty hands, foreign matter can enter the ram causing a shorter life span and also the other hydraulic equipment may be damaged. Reassemble in a clean state.
 - c** Follow the instructions in the diagrams regarding torque tightening for screwed parts. If the torque is too high or too low, it can cause damage.

Removal and Replacement

Lift Rams

Removal

DANGER

Make sure the articulation safety lock is fitted before transporting the machine. The articulation safety lock must also be fitted if you are carrying out daily checks or doing any maintenance work in the articulation danger zone.

If the articulation lock is not fitted you could be crushed between the two parts of the chassis.

GEN-3-1_1

- 1 Park the machine on firm level ground and fit the articulation lock. Stop the engine and remove the starter key.

WARNING

Metal Splinters

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

INT-3-1-3_2

WARNING

The tipper body rams are heavy and must be supported as they are disconnected from the tipper body. Failure to do so could result in injury to people or damage to the machine.

7-3-7-5

- 2 → [Fig 24.](#) ([E-58](#)). Support the ram to be removed. Working at the rod end of the body ram, remove the nut **A** and locking bolt **B** and drive out the pivot pin **C**.
- 3 Start the engine and operate the control lever to retract the ram.
- 4 Stop the engine and operate the body control lever several times to vent system pressure. Remove the starter key.

- 5 Label the hoses to ensure correct reconnection, then disconnect the hoses and plug them to avoid the ingress of dirt and excessive loss of hydraulic fluid.
- 6 Lower the ram onto a suitable support.
- 7 At the chassis end of the ram, remove the Bolt **D**. Drive out the pin **E** in the direction shown at **F**.

Replacement

Replacement is the reverse of removal.

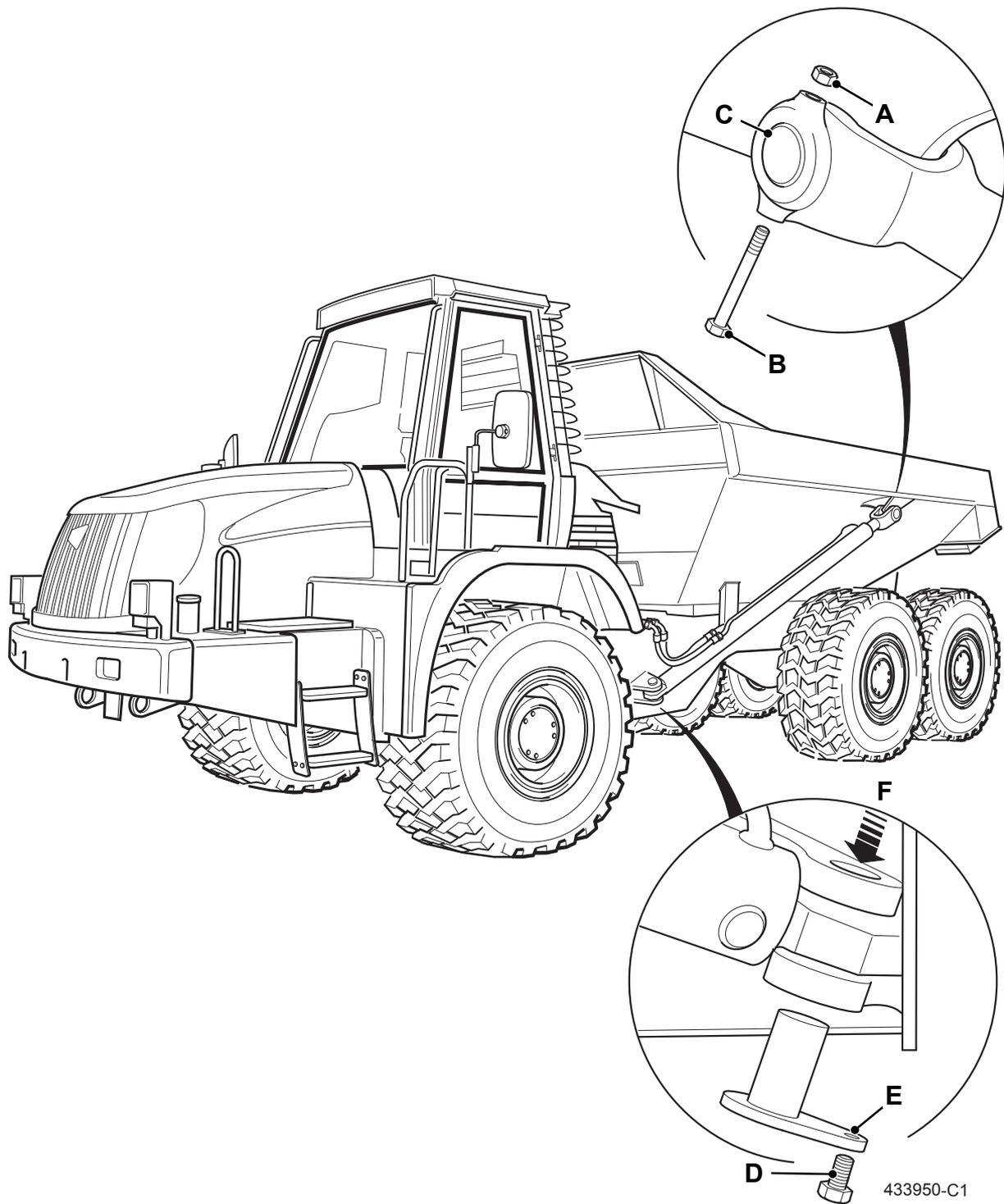


Fig 24. Lift Rams

Dismantle and Assemble

Lift Rams

⇒ [Fig 27. \(□ E-61\)](#). The numerical is intended as a guide to dismantling.

Dismantle

- 1 Place the ram assembly on a locally manufactured strip/rebuild bench as shown.

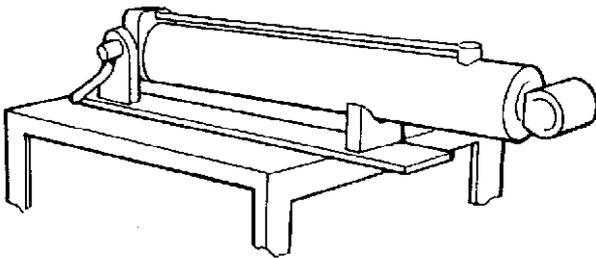


Fig 25.

- 2 Slacken the end cap **1** using a special spanner (see **Section 1, Service Tools**) and remove the piston rod assembly 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

- 3 Position the piston rod assembly on the bench in place of the ram cylinder. Remove the piston head seals **2, 3** and **4**.
- 4 Extract dowel **5** from the piston head using a metric screw (M3) threaded into the extractor hole.

Note: Any attempt to remove the piston head without removing the dowel will cause damage to both the piston head and rod.

- 5 Remove piston head **6** from rod **7** using a special spanner (see **Section 1, Service Tools**). Remove the piston head internal 'O' ring **8**.

- 6 Remove the end cap **1** from the piston rod and remove the inner and outer seals **9, 10** and **11**.
- 7 Ensure that all metal components are free from scoring, nicks and burrs. A damaged rod will impair the life of the inner rod and wiper seals.

Assembly is the reverse of removal.

Assemble

- 1 Renew all seals and 'O' rings.
- 2 Thoroughly clean the threads of the piston rod, piston head, end cap and cylinder using a wire brush. Use JCB Cleaner and Degreaser to ensure that all threads are free from grease and hydraulic oil. Allow 15 minutes for the solvent to dry.
- 3 Fit the locking dowel **5** to the piston head/rod as follows:

- a New rod and piston head.

If both are required, the following procedure should be followed.

- i Drill through the piston head into the piston rod. Use an undersized diameter drill first as a guide and then drill using the correct size diameter drill to suit, ⇒ [Fig 26. \(□ E-60\)](#) and ⇒ [Table 25. Drill Diameters and Depths \(□ E-60\)](#).

- ii Remove all swarf and contamination. Insert dowel **5** into the drilled hole, making sure that the tapped extractor hole is to the outside.

- b New piston head fitted to a **pre-drilled piston rod**.

- i 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 procedure described in step 3a.

- c 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.

- i Use a drill of 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.
- ii Use an under size diameter drill as a guide and drill into the piston rod to the required depth → [Table 25. Drill Diameters and Depths \(E-60\)](#). Make sure that the drill has centred correctly on the 'centre mark' made in step 3ci.
- iii Use the correct size diameter drill to suit the dowel and drill to the required depth, → [Table 25. Drill Diameters and Depths \(E-60\)](#).
- iv Remove all swarf and contamination. Insert the dowel **5** into the drilled hole, making sure that the tapped extractor hole is to the outside.

- 4 Fit the piston head seals **2, 3** and **4**.
- 5 Position the cylinder on the bench and install the rod assembly into the cylinder.
- 6 Apply JCB Threadlocker and Sealer (High Strength) to the first three threads of the cylinder. Fit the end cap and torque tighten.

Note: If hydraulic oil contacts 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.

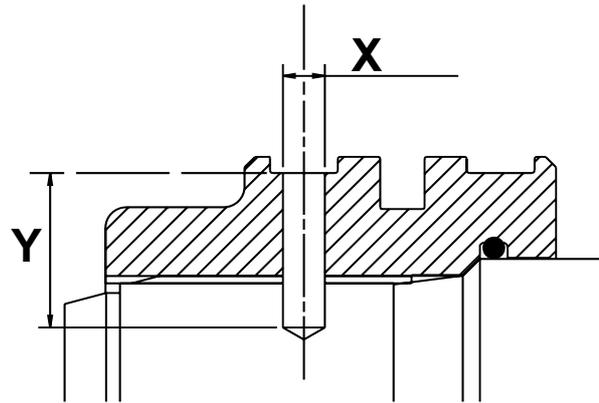
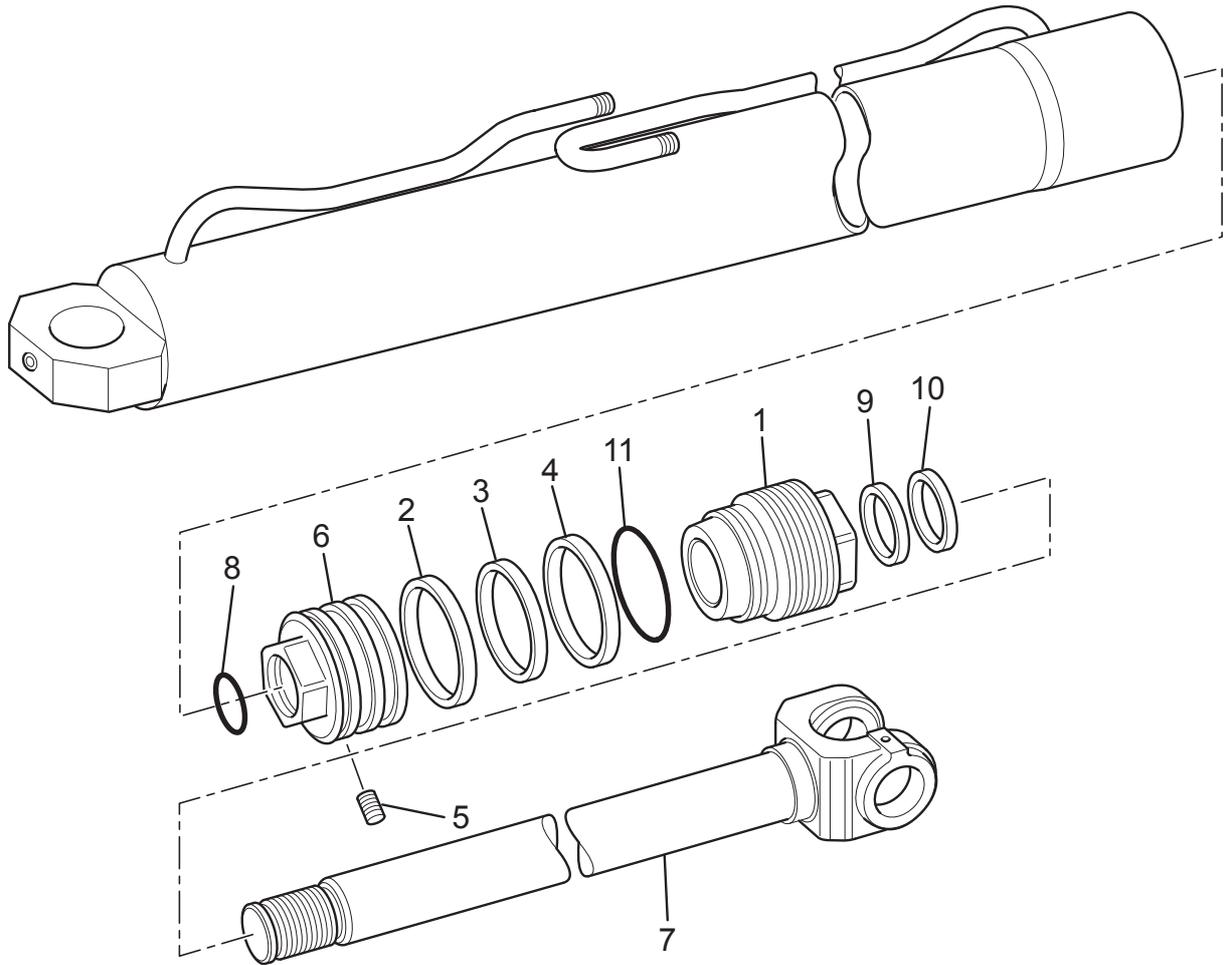


Fig 26.

Table 25. Drill Diameters and Depths

All dimension are in mm

Ram Size	Dowel Size	Guide Drill Ø	Guide Drill Depth	Dowel Drill Ø X	Dowel Drill Depth Y
50 x 25	20 x 6Ø	4	19	6.02-6.1	23-22
60 x 30	20 x 6Ø	4	19	6.02-6.1	23-22
70 x 40	20 x 6Ø	4	19	6.02-6.1	23-22
80 x 50	20 x 6Ø	4	19	6.02-6.1	23-22
100 x 60	35 x 12Ø	8	33	12.02-12.1	37-38
110 x 75	30 x 12Ø	8	36	12.02-12.1	32-33



433960-C1

Fig 27. Lift Rams

JCB Ram Sealing Procedure

TE-005

1 Fit new rod seals.

Use seal fitting tool **28-A** to fit rod seals, the size (diameter) and position of pins **28-B** is determined by the diameter and radial width of the rod seal being fitted.

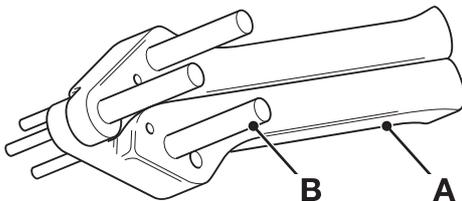


Fig 28. Seal Fitting Tool

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.

- a Open the tool and insert the new rod seal **29-A**. The seal must be fitted behind the two front pins but in front of the rear pin as shown.

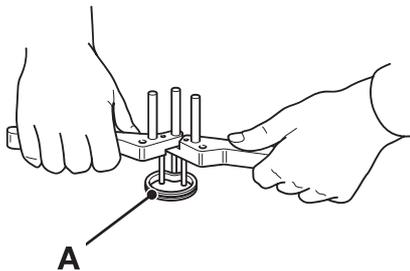


Fig 29.

Note: Later ram end caps and piston heads are metric threads. The seals are also different, make sure the correct seals are fitted. On metric threaded rams make sure the seals are fitted the correct way round, as shown at **30-A** and **30-B**.

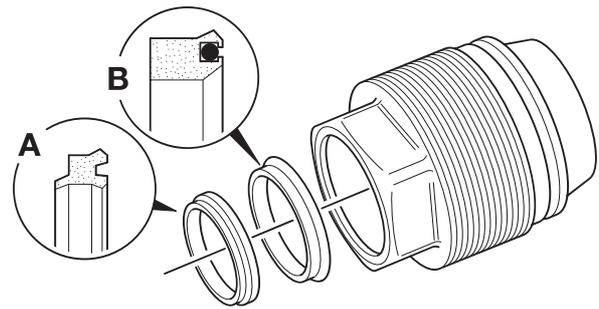


Fig 30.

- b Close the tool. [⇒ Fig 31. \(□ E-62\)](#). The seal must form a reniform (kidney shape).

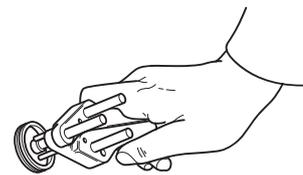


Fig 31.

- c Before fitting the rod seals check the seal grooves are free of contamination and sharp edges.
- d Locate the seal in the end cap groove. [⇒ Fig 32. \(□ E-62\)](#). 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.



Fig 32.

- e Fit rod wiper seal **30-A** into seal groove. Make sure the seal is correctly installed as shown.

Note: Some rod wipers, i.e. 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.

- f Sleeve **33-A** 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**, Section 1. Make sure the hexagon on the end cap is towards the eye end of the rod.

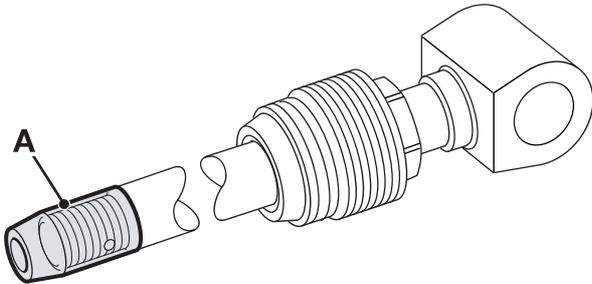


Fig 33.

2 Fit new head piston seals.

- a Use a blunt instrument **34-A** (Part no. 892/01027) to lever the inner seal **34-B** 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.

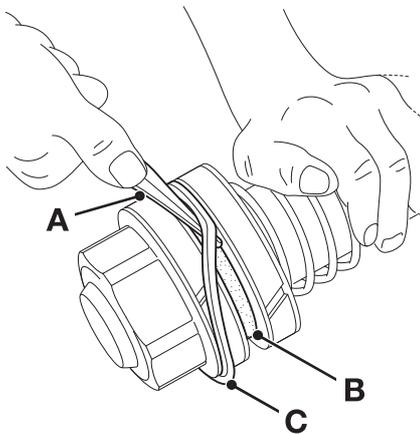


Fig 34.

- b Fit outer seal **34-C** using the same procedure as stated for seal **34-B**. Check the external grooves are visible.

- c Ensure the 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.
- d Fit the piston head retaining dowel, refer to the relevant section for torque figure and completion of ram assembly.
- e Fit wear rings **35-A** and **35-B**. Rotate the wear rings so that the piston retention dowel is covered by the wear ring, Not as shown at **35-C**.

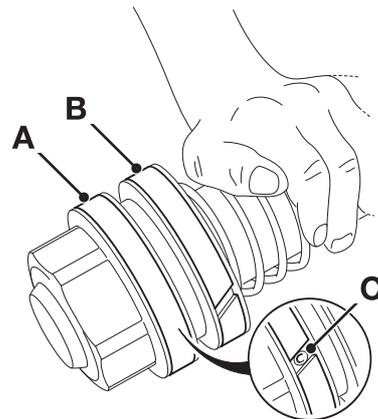


Fig 35.

3 Fit the piston rod and head assembly into the cylinder.

- a 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.
- b Fit the end cap, refer to the relevant section for torque figure and completion of ram assembly.



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