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Safety Notices

Important Information

T1-042

The Operator Manual

⚠ WARNING

You and others can be killed or seriously injured if you operate or maintain the machine without first studying the Operator Manual. You must understand and follow the instructions in the Operator Manual. If you do not understand anything, ask your employer or JCB dealer to explain it.

INT-1-4-2

Do not operate the machine without an Operator Manual, or if there is anything on the machine you do not understand.

Treat the Operator Manual as part of the machine. Keep it clean and in good condition. Replace the Operator Manual immediately if it is lost, damaged or becomes unreadable.

Safety Warnings



This safety alert system identifies important safety messages in this manual. When you see this symbol, be alert, your safety is involved, carefully read the message that follows, and inform other operators.

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

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Service Schedules - 446 and 456 to 1169000

Table 1. Key

☐ Regular Maintenance Check ○ Initial 100 Hour Check Only

Pre-start Cold Checks, Service Points and Fluid Levels	Operation	10 Hr(1)	100 Hr(2)	As and When	500 Hr	1000 Hr	2000 Hr	6000 Hr
ENGINE								
Oil Level	- Check	☐	☐					
Oil and Filter	- Change		○		☐	☐	☐	
Air Cleaner Outer Element	- Change			☐				
Air Cleaner Inner Element (Every 3rd Outer Element)	- Change			☐				
Fuel Filter	- Drain			☐				
Fuel Filter	- Change				☐	☐	☐	
Coolant Level	- Check	☐	☐		☐	☐		
Coolant Filter	- Change				☐			
Coolant	- Change				☐			
Antifreeze Strength	- Check			☐				
Coolant	- Change						☐	
Fuel Sedimenter	- Drain			☐				
Drive Belt Tension/Condition	- Check				☐	☐	☐	
Valve Clearances	- Check and Adjust						☐	
Engine Mount Security	- Check				☐	☐	☐	
Air Compressor Belt Tension/Condition (if fitted)	- Check				☐	☐	☐	
TRANSMISSION AND AXLES								
Transmission Oil Level	- Check		☐					
Transmission Oil	- Change					☐	☐	
Transmission Strainer/Filter	- Change					☐	☐	
Axle(s) Oil Level	- Check		☐					
Axle(s) Oil	- Change					☐	☐	
Hub Oil Levels	- Check		☐					
Hub Oil	- Change					☐	☐	
Rear Axle Pivots	- Grease		☐					
Prop. Shaft and Universal joints	- Grease					☐	☐	
Prop. Shaft Security	- Check					☐	☐	
Centre Prop. Shaft Slide	- Grease				☐	☐	☐	
Tyre Pressures and Condition	- Check		☐		☐	☐	☐	
Park Brake Operation	- Check and Adjust				☐			

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Fluids, Lubricants and Capacities

Introduction

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 below.*

446 from 540000, 456 to 1169000

Table 16.

Item	Capacity	Fluid/Lubricant	International Specification
Engine Oil			
-10 to 50° C (1)	18.9 litres (4.2 UK gal)	JCB Extreme Performance Engine Oil - 15W/40	ACEA E3/B3/A3 APICH-4A3
Gearbox	28 litres (6.2 UK gal)(2)	JCB HP Universal ATF	ZF TE-ML 09, 11, 12, 14
Axles	51 litres (11.2 UK gal)	JCB Gear Oil LS	API GL4, MIL-L-2105B(3)
Hydraulic System	215 litres (47.3 UK gal)(4)	JCB HP32 Hydraulic Fluid	ISO VG32
Cooling System	38 litres (8.4 UK gal)	Water/Anti-freeze	ASTM D3306-74
Fuel System	325 litres (71.5 UK gal)	Diesel	ASTM D975-66T Nos. 1D, 2D.
Grease Points		JCB HP Grease(5)	Lithium based

(1) If API CH-4 or ACEA E3/B3/A3 engine oil is not available, then the engine oil must be changed every 250 hours.
(2) The figure quoted is TOTAL system capacity. Use the 'MAX' and 'MIN' marks on the dipstick when refilling the system.
(3) Must be suitable for use with oil immersed brakes and Limited Slip Differentials (LSD).
(4) The total hydraulic system capacity depends on the equipment being used. Fill the system with all rams closed and watch the level indicator.
(5) If JCB Special MPL Grease is used, all 100 hour greasing operations must be carried out at ten (10) hour intervals.

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Table 2. Torque Settings - UNF Grade 'S' Fasteners

Bolt Size		Hexagon (A/F)	Condition 1			Condition 2		
in.	mm	in.	Nm	kgf m	lbf ft	Nm	kgf m	lbf ft
1/4	6.3	7/16	11.2	1.1	8.3	10.0	1.0	7.4
5/16	7.9	1/2	22.3	2.3	16.4	20.0	2.0	14.7
3/8	9.5	9/16	40.0	4.1	29.5	36.0	3.7	26.5
7/16	11.1	5/8	64.0	6.5	47.2	57.0	5.8	42.0
1/2	12.7	3/4	98.00	10.0	72.3	88.0	9.0	64.9
9/16	14.3	13/16	140.0	14.3	103.2	126.0	12.8	92.9
5/8	15.9	15/16	196.0	20.0	144.6	177.0	18.0	130.5
3/4	19.0	1 1/8	343.0	35.0	253.0	309.0	31.5	227.9
7/8	22.2	1 15/16	547.0	55.8	403.4	492.0	50.2	362.9
1	25.4	1 1/2	814.0	83.0	600.4	732.0	74.6	539.9
1 1/8	31.7	1 7/8	1181.0	120.4	871.1	1063.0	108.4	784.0
1 1/4	38.1	2 1/4	1646.0	167.8	1214.0	1481.0	151.0	1092.3

Table 3. Torque Settings - Metric Grade 8.8 Fasteners

Bolt Size		Hexagon (A/F)	Condition 1			Condition 2		
ISO Metric Thread	mm	mm	Nm	kgf m	lbf ft	Nm	kgf m	lbf ft
M5	5	8	5.8	0.6	4.3	5.2	0.5	3.8
M6	6	10	9.9	1.0	7.3	9.0	0.9	6.6
M8	8	13	24.0	2.4	17.7	22.0	2.2	16.2
M10	10	17	47.0	4.8	34.7	43.0	4.4	31.7
M12	12	19	83.0	8.5	61.2	74.0	7.5	54.6
M16	16	24	205.0	20.9	151.2	184.0	18.8	135.7
M20	20	30	400.0	40.8	295.0	360.0	36.7	265.5
M24	24	36	690.0	70.4	508.9	621.0	63.3	458.0
M30	30	46	1372.0	139.9	1011.9	1235.0	125.9	910.9
M36	36	55	2399.0	244.6	1769.4	2159.0	220.0	1592.4

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Basic Operation

Preparation for Towing

Do not tow a machine unless there is no alternative. Remember that further damage might be caused to the machine by towing it. If at all possible repair the machine where it stands. If the machine must be towed, read the following CAUTION and use the procedure given here.

⚠ CAUTION

Towing a machine too far or too fast can damage the transmission. Do not tow the machine further than 10 Km (6 miles). Use a trailer for greater distances. When towing do not travel faster than 16 km/h (10 mph).

Use a rigid towbar. If you must use towing chains, then use two vehicles, One towing vehicle should be coupled to the front of the disabled machine. The other towing vehicle should be couple to the rear of the disabled machine, to provide braking power.

The towing vehicle(s) must have enough pulling and braking power to move and stop the machine.

4-2-5-4_2

⚠ WARNING

Block the loader arms before attaching the towbar.

4-2-5-2

1 Engage the parking brake.

2 Select Neutral (N)

3 If the engine and hydraulic systems are not damaged, raise the Loader Shovel to 900 mm (3 ft) above the ground, and fully 'close' the bucket. This allows a straight pull from the attachment point.

a If the engine cannot be run, the Loader Shovel must be hoisted into position as described above and secured.

The procedure for doing this will depend on the machine's condition and its hydraulic circuits.

4 Attach the drawbar (or chain) to the front chassis side plate hole (left or right).

5 Attach the chain to the rear towing point. (If using chains).

The machine is now ready for towing. Make sure you understand what the towing driver will be doing. Obey his instructions and all relevant regulations.

Important: *In some countries the above procedure may not be legally acceptable for recovery on public highways.*

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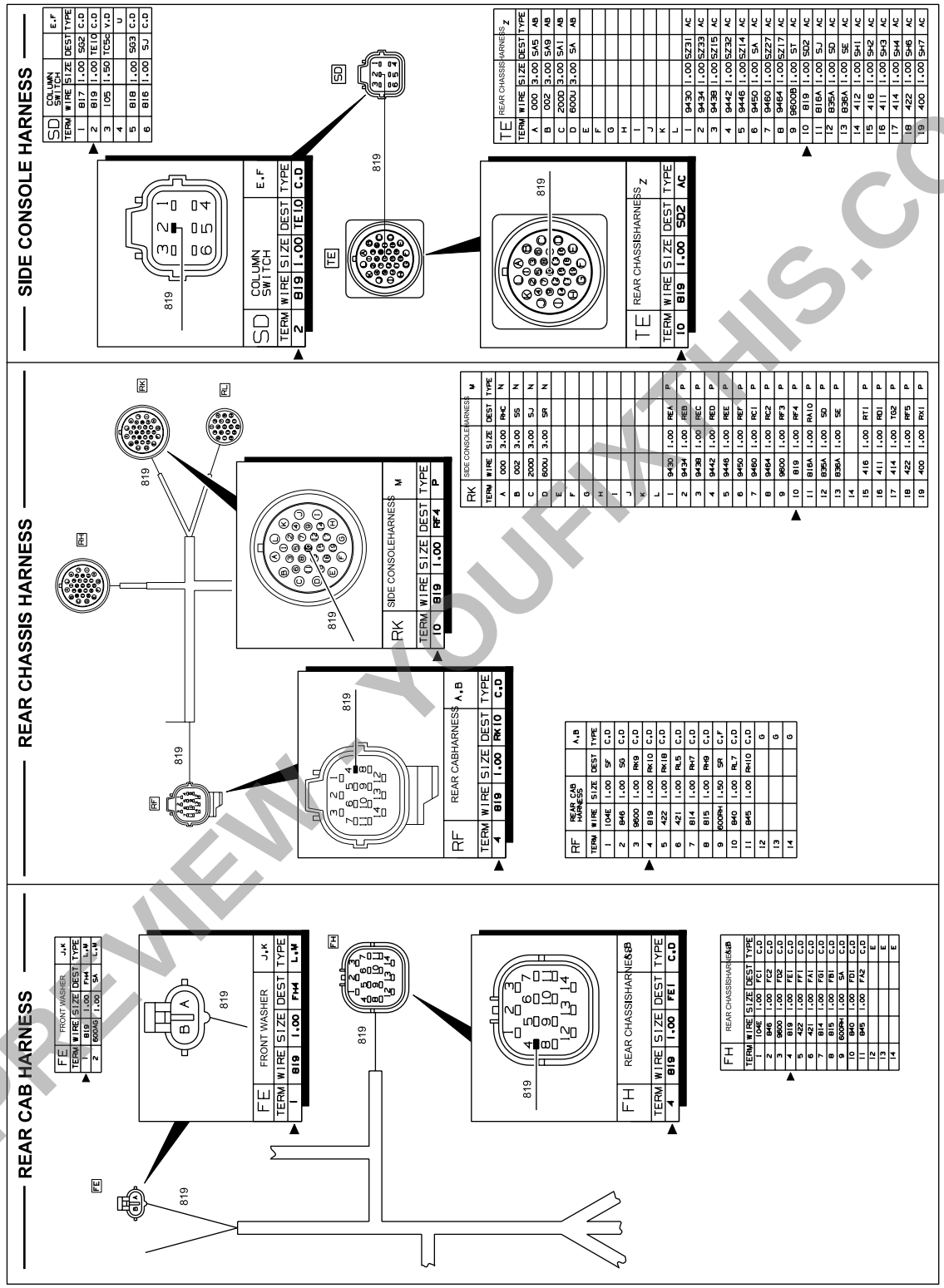


Fig 17.

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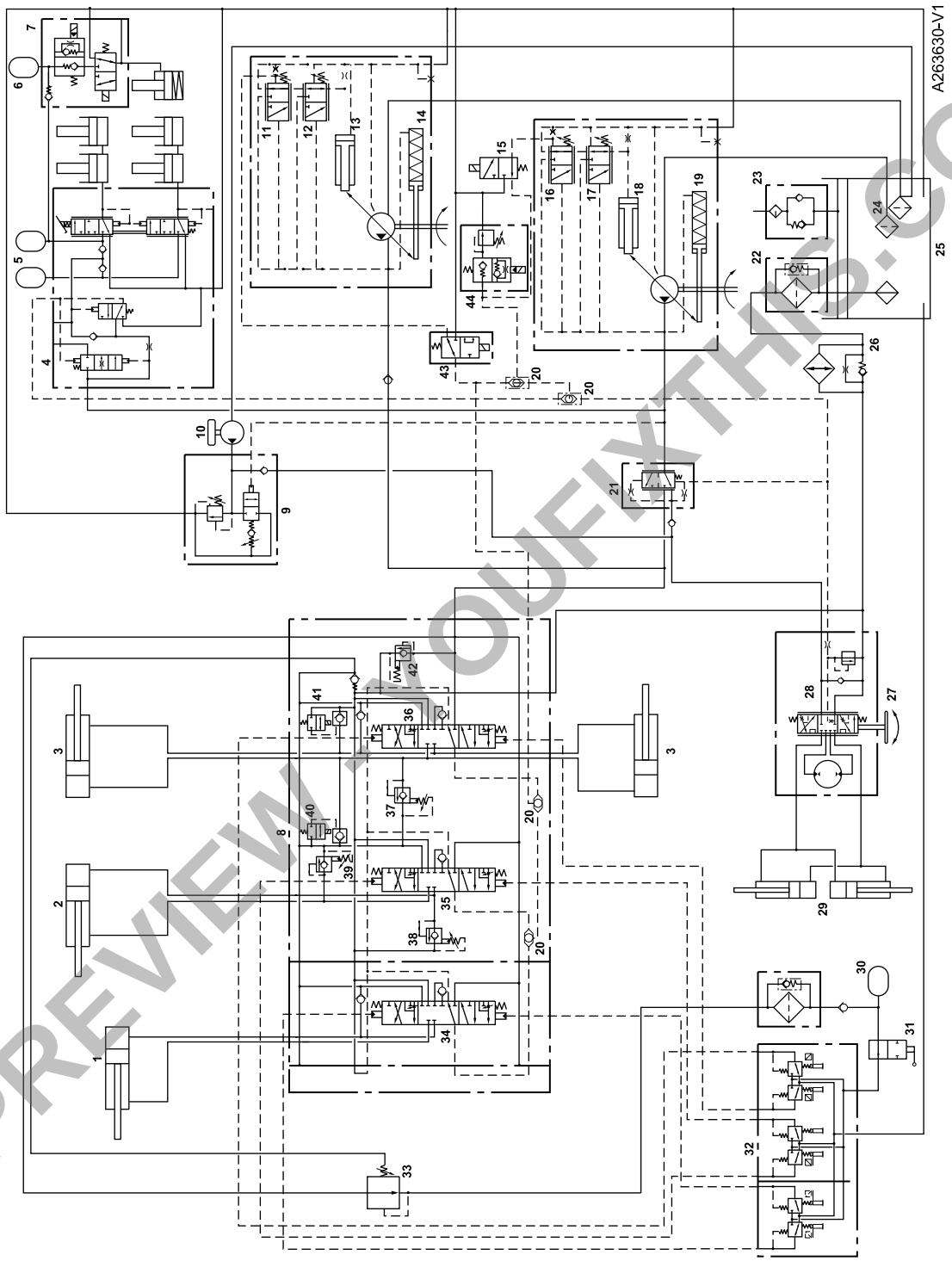


Fig 8.

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Hub and Driveshaft

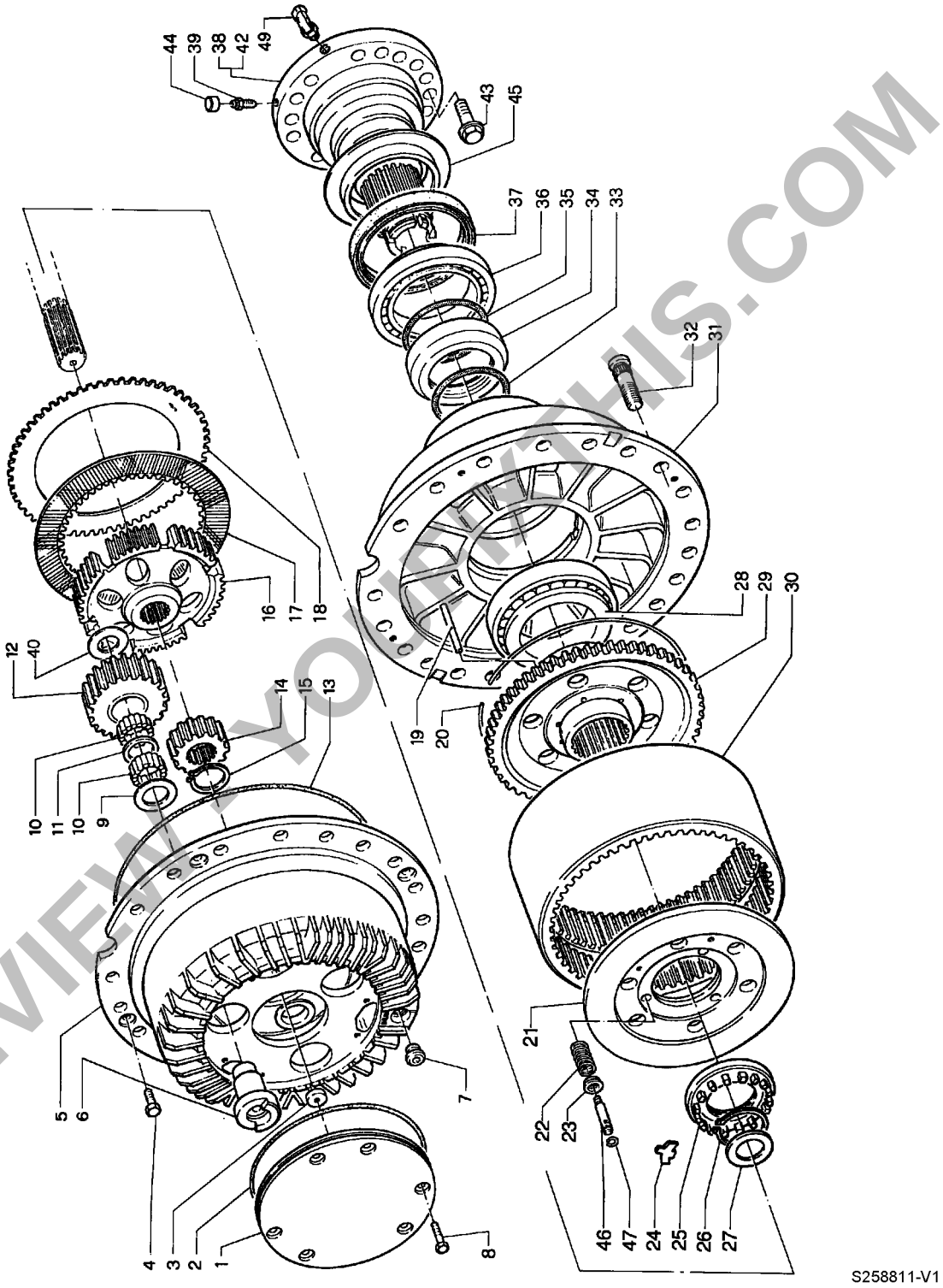


Fig 6.

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ZF Error Codes

The Electronic Monitoring System will display an error code in the event of a fault developing in the transmission system.

The code will be displayed on the top line of the EMS display panel in the format: **ZFCB ERROR?**

Further details of the EMS system can be found in ***Section C - Electrics***.

FC	Fault Code (Hex)	SPN	Serial Parameter Number	FMI	Failure Mode Indicator
IC	Internal Code (Dec)	TCU	Transmission Control Unit	SC	Short Circuit
OC	Open Circuit	EMS	Electronic Monitoring System	CS	Customer Specific

Table 21. ZF Error Codes

FC	SPN	FMI	IC	Description of the Fault Code	Reaction of the TCU	Repair Procedures
11	5000	12	48	A Logical Error for the Selected Gear Range		
				The TCU senses an incorrect signal combination for the selected gear range: -A cable from the shift lever to the TCU is broken -A cable is defective, it has a SC to the battery or earth -The shift lever is defective	TCU shifts the transmission to neutral OP-Mode: transmission shutdown	Check the cables from the TCU to the shift lever Check the signal combinations at the shift lever positions for the gear range Note: A failure can not be detected in a system with a DW2/DW3 shift lever Note: The fault is reset if the TCU senses the correct signal for that shift lever position
12	5010	12	46	A Logical Error for the Selected Direction		
				The TCU senses an incorrect signal combination for the selected direction: -A cable from the shift lever to the TCU is broken -A cable is defective, it has a SC to the battery or earth -The shift lever is defective	TCU shifts the transmission to neutral OP-Mode: transmission shutdown	Check the cables from the TCU to the shift lever Check the signal combinations at the shift lever positions F-N-R Note: The fault is reset if the TCU senses the correct signal for that direction at the shift lever
13	5020	12	95	A Logical Error at the Engine Derating Device		
				The TCU does not sense a reaction from the engine when the derating device is active	After neutral is selected the TCU changes to, OP-Mode: limp home	Check the engine derating device Note: The fault is reset after the power-up of the TCU

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Troubleshooting

Possible faults

Stop the engine immediately when:

- The engine RPMs suddenly increase and decrease
- A sudden and unusual noise is heard
- The colour of the exhaust fumes suddenly darkens
- The oil pressure indicator light comes on while the engine is running

Table 1.

Fault	Possible Cause
The engine does not start	No fuel
	Discharged battery
	Cable connections are uncertain or incorrect
	Tank cap vent hole is clogged
	Fuel filter is clogged
	Air or water leaks in the fuel system
	Blocked fuel line
	Defective fuel feeding pump
	Defective starting motor
	Defective glow plugs
	Burnt fuse on the pre-heating glow plugs
	Defective glow plug control relay
	Defective starting switch
	Broken or loose supplementary start-up spring
	Incorrect tuning of the injection components
	Governor linkage is incorrectly set
	Binding of the injection pump control rod
	Rings are worn or sticking
	Incorrectly sealed intake valve
	Worn cylinder

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Identifying your Machine

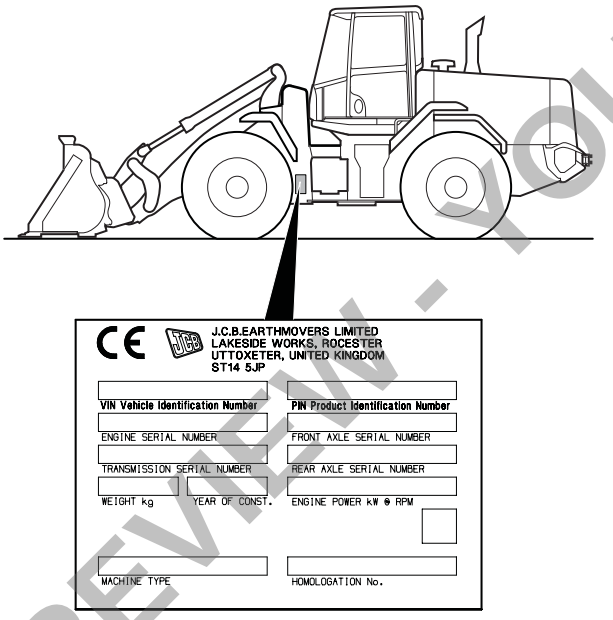
Machine Identification Plate

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

Note: *The machine model and build specification is indicated by the PIN. Refer to* ***Typical Product Identification Number (PIN)****.*

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.



T033550-2

Fig 2.

Typical Vehicle Identification Number

1	2	3	4	5
SLP	456	V	E	539000

1 World Manufacturer Identification, SLP = JCB

2 Machine Model, 456ZX

3 Year of Manufacture (P = 1993, R = 1994, S = 1995, T = 1996, V = 1997, W = 1998, X = 1999, Y = 2000, 1 = 2001, 2 = 2002, 3 = 2003, 4 = 2004)

4 Manufacturers Location (E = England)

5 Machine Serial Number (0539001)

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.

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Greasing

Introduction

T3-028_2

You must grease the machine regularly to keep it working efficiently. Regular greasing will also lengthen the machine's working life. Refer to the ***Service Schedule*** for the correct intervals.

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

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. Use only the recommended type of grease. Do not mix different types of grease, keep them separate.

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.

Note: *Where applicable, refer to the manufacturers manual for instructions on the maintenance of optional attachments.*

⚠ CAUTION

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

Preparing the Machine for Greasing

Make the machine safe before you start a greasing procedure. Refer to ***Prepare the Machine for Maintenance***.

Important: You can complete most of the greasing procedures with the loader arm lowered. If you lift the loader arm to get access for greasing, you must install the maintenance strut on the loader arm.

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Table 3. Uni-Directional Motor

Component Key: ⇒ *Fig 17. (B-95)*

1	Circlip
2	Seal
3	Front housing
4	Back-up seal
5	E-seal
6	Front bearing block
7	O-ring
8	Locating dowels
9	Gear housing
10	O-ring
11	Idler gear
12	Driveshaft gear
13	Rear bearing block
14	E-seal
15	Back-up seal
16	Rear housing
17	Proportional relief valve cartridge
18	Measuring coupling
19	Spring
20	Ball
21	Valve seat
22	Washer
23	Bolt

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Last Minutes Running Data Information

Running Data Prior to Event

Time [s]	Engine Speed [rpm]	Axle Speed [kp/h]	Engine Coolant Temp [°F]	Trans. Oil Temp [°F]	Hydr.Oil Temp [°F]
0	540	15.2	171	199	117
-5	540	15.2			
-10	540	15.2	172	201	117
-15	540	15.2			
-20	540	15.2	172	201	117
-25	540	15.2			
-30	540	15.2	172	201	117
-35	540	15.2			
-40	540	15.2	172	201	117
-45	540	15.2			
-50	540	15.2	171	320	117
-55	540	15.2			

Close

A278050-V1

Fig 26. Last One Minute of Running Data Screen

Some events also have some extra data associated with them. This extra data is the last one minutes worth of important engine information prior to the events occurrence. Events which have this extra information have a running data icon in the “More” column of the grid. The running data icon looks like this:.



There is more than one way to bring this data onto the screen, but the simplest method is to double click the running data icon. Regardless of how the information was called, a window such as the one shown will appear ⇨ *Fig 26. (C-38)*.

Note: *The time starts at 0s and decreases down to -55s. The 0s sample is the most recent data available at the time the event occurred. The -55s sample is the data from 55 seconds before the event occurred.*

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Loader Auxiliaries (Proportional)

Table 15.

Main Components: See ⇒ *Fig 113.* (C-135)

AB	ECU4 Auxiliary Controller
AD	Joystick Auxiliary/Detent
AE	ECU4 Indicator
AF	Changeover Relay
AK	Resistor 3.3 Ohms
AL	Diode Pack ECU4
BB	3rd Spool A Solenoid
BC	3rd Spool B Solenoid
BD	4th Spool A Solenoid
BE	4th Spool B Solenoid
FG	4th Spool Changeover Solenoid
FT	4th Spool Changeover Switch
HB	Quickhitch Isolator Switch
HC	Servo Isolator Switch
NH	Quickhitch Locking Solenoid
NL	Servo Isolator Solenoid

Fuses: See ⇒ *Fuses and Relays from 1169000 (456), 1181000 (446)* (C-11)

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No.	Harness	Issue	Remarks	Drawing
31	**12V Trailer Harness**			⇨ C-302)
	332-W8238	1		
32	**Cab CAN Harness Large**			⇨ C-305)
	332-U0784	2		
33	**Ergotraction Harness**			⇨ C-306)
	333-T5718	2		

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Fig 245.

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Hydraulic Rams

Introduction

The following information is for rams used on wheeled loading shovel machines as detailed below:

Machine	Ram	Description
446ZX	Shovel	160/80
446ZX/HT	Lift	140/75
446/456HT	Shovel	130/75
456ZX	Shovel	180/90
456ZX/HT	Lift	160/80

Dismantling the Piston Rod from Cylinder Tube

Necessary Equipment

Assembly bench

Overhead crane

Cleaning facilities

Socket wrench

Note: *Disassembly should be done vertically.*

1 Clean the cylinder carefully. Use high-pressure cleaning and solvent (⇨ ***Fig 99. (E-146)***). Empty the oil from the cylinder.

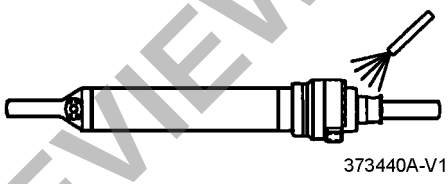


Fig 99.

2 Unfasten the cylinder head screws. Keep screws in place (⇨ ***Fig 100. (E-146)***).

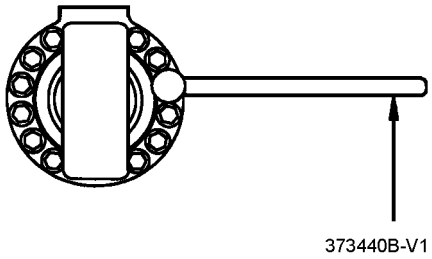


Fig 100.

3 Position the cylinder vertically (⇨ ***Fig 101. (E-146)***).

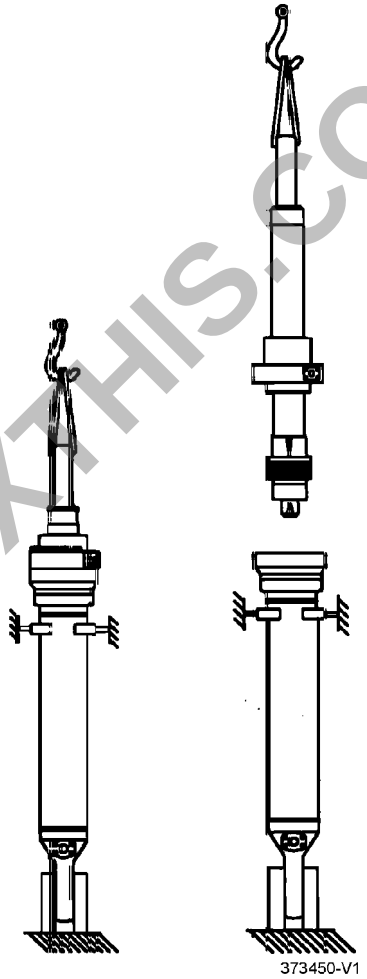


Fig 101.

4 Release the end cover and pull out the piston rod pack.

Note: *Handle the piston rod with care to avoid damage. Put some soft material between piston rod and shims during transport and at storage. Fasten the covers for the end flange.*

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3 Pre-assemble 2-stage pressure control valve.

Close the bores with Ø 4.5mm ball bearings **63** (5 off).

Install the following components into the shift-control housing **23**:

a Spool **49**, shim ring (if fitted) **48**, spring **47** (Lo 70.9mm) and screw plug **45** with new O-ring **46**.

b Cylindrical roller **44** (6 x 32 mm), shim ring(s) **43**, spool **42** and screw plug **40** with new O-ring **41**.

c Spring **53** (Lo 34.9mm), spool **52** and screw plug **50** with new O-ring **51**.

Note: *Pay attention to the installation position of spool **42**, bore is facing the screw plug.*

4 Install two M6 screws and nuts in place of the end two socket head screws and position gasket **24**.

Pull pre-assembled pressure control valve together by means of nuts against shoulder and fasten it subsequently by means of flat washers and socket head screws **22**.

Torque screws **22** to 9.5Nm (7 lbf ft).

5 Into the left hand side of control valve block, introduce spool **39**, spring **38** (Lo 51.3mm), preload and fix them by means of stop plate **37**.

6 Install the following components:

a Spring **13** (Lo 51.3mm), control spool **12** (total length 39.5mm).

b Spring **15** (Lo 51.3mm), control spool **14**.

c Reducing valve spool **21**, spring **20** (Lo 37.1mm).

d Retaining plate **19**, socket head screws **18**.

e Spring **17** (Lo 51.3mm), pilot spool **16** (total length 52.5mm).

7 Insert the solenoid valves **10** and fix them by means of washers **30-8**, retaining plates **9** and socket head screws **7** (5 off each). Torque screws to 5.5Nm (4 lbf ft).

Note: *Pay attention to the radial installation position of the solenoid valves. Also, ensure that the washer goes between the valve body and the retaining plate.*

8 Using new gasket, install complete cable harness **6** using socket head screws **4** and fixing plate **5**.

9 Connect solenoid valves. Insert new seal **3** and fix the cover **2** by means of the spring clip **1**.

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FC	SPN	FMI	IC	Description of the Fault Code	Reaction of the TCU	Repair Procedures
1C	5070	5	152	An Open Circuit, Customer Specific Function-2		
				The TCU senses an incorrect voltage at the output pin that could be an OC: -A cable is defective, it is not connected to the TCU -A CS function-2 device has an internal defect -A connector is not connected to the TCU	CS	Check the cables and the connectors between the TCU and the CS function-2 device Check the resistance of the CS function-2 device
1D	5080	4	154	A Short Circuit to Earth, Customer Specific Function-3		
				The TCU senses an incorrect voltage at the output pin that could be a SC to earth: -A cable is defective, it has a SC to earth -A CS function-3 device has an internal defect -A connector pin has a SC to earth	CS	Check the cables and the connectors between the TCU and the CS function-3 device Check the resistance of the CS function-3 device
1E	5080	3	156	A Short Circuit to the Battery, Customer Specific Function-3		
				The TCU senses an incorrect voltage at the output pin that could be a SC to the battery: -A cable is defective, it has a SC to the battery -A CS function-3 device has an internal defect -A connector pin has a SC to the battery	CS	Check the cables and the connectors between the TCU and the CS function-3 device Check the resistance of the CS function-3 device
1F	5080	5	155	An Open Circuit, Customer Specific Function-3		
				The TCU senses an incorrect voltage at the output pin: -A cable is defective, it is not connected to the TCU -A CS function-3 device has an internal defect -A connector is not connected to the TCU	CS	Check the cables and the connectors between the TCU and the CS function-3 device Check the resistance of the CS function-3 device

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