SERVICE MANUAL

EXCAVATOR

JCB305, JS305

EN - 9813/6700 - ISSUE 1 - 12/2016

This manual contains original instructions, verified by the manufacturer (or their authorized representative).

www.jcb.com

Foreword

The Operator's Manual

⚠

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

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

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

Contents

18 - Operating Safety

Introduction

Training

Make sure that you have had adequate training and that you are confident in your ability to operate the machine safely before you use it. Practice using the machine and its attachments until you are completely familiar with the controls and what they do. With a careful, well trained and experienced operator, your machine is a safe and efficient machine. With an inexperienced or careless operator, it can be dangerous. Do not put your life, or the lives of others, at risk by using the machine irresponsibly. Before you start to work, tell your colleagues what you will be doing and where you will be working. On a busy site, use a signalman.

Before doing any job not covered in this manual, find out the correct procedure. Your local JCB distributor will be glad to advise you.

Fuel

Fuel is flammable, keep naked flames away from the fuel system. Stop the engine immediately if a fuel leak is suspected. Do not smoke while refuelling or working on the fuel system. Do not refuel with the engine running. Completely wipe off any spilt fuel which could cause a fire. There could be a fire and injury if you do not follow these precautions.

Machine Condition

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

Machine Limits

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

Engine/Steering Failure

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

Exhaust Gases

Machine exhaust gases can harm and possibly kill you or bystanders if they are inhaled. Do not operate the machine in closed spaces without making sure there is good ventilation. If possible, install an exhaust extractor. If you begin to feel drowsy, stop the machine at once and get into fresh air.

Worksites

Worksites can be hazardous. Examine the site before working on it. You could be killed or injured if the ground gives way under your machine or if piled material collapses onto it. Check for potholes and hidden debris, logs, ironwork etc. Any of these could cause you to lose control of your machine. Check for utilities such as electric cables (overhead and underground), gas and water pipes etc. Mark the positions of the underground cables and pipes. Make sure that you have enough clearance beneath overhead cables and structures.

Communications

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

Parking

An incorrectly parked machine can move without an operator. Follow the instructions in the Operator's Manual to park the machine correctly.

Banks and Trenches

Banked material and trenches can collapse. Do not work or drive too close to banks and trenches where there is danger of collapse.

Safety Barriers

Unguarded machines in public places can be dangerous. In public places, or where your visibility is reduced, place barriers around the work area to keep people away.

Sparks

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

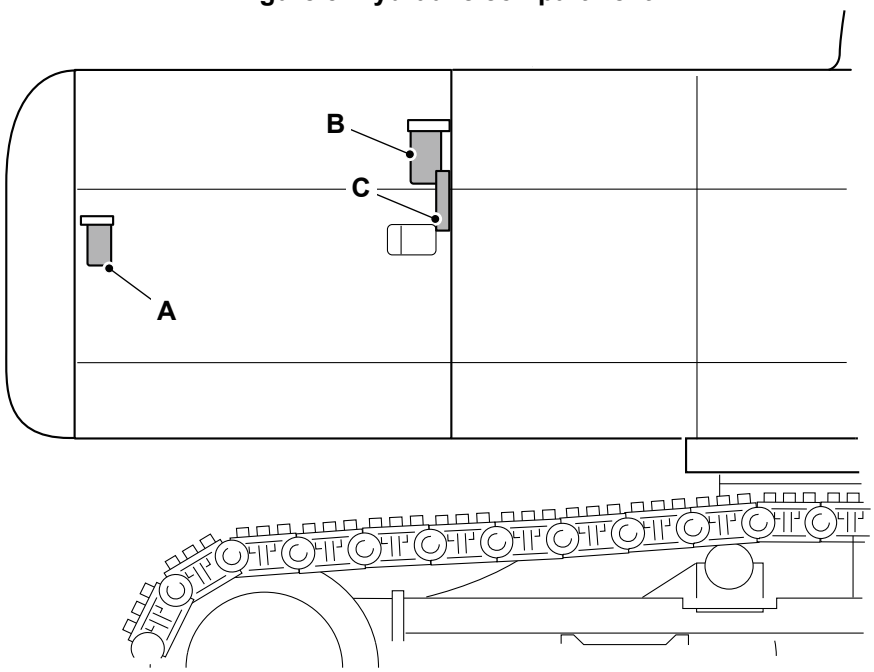
Hazardous Atmospheres

This machine is designed for use in normal out door atmospheric conditions. It must not be used in an enclosed area without adequate ventilation. Do not use the machine in a potentially explosive atmosphere, i.e. combustible vapours, gas or dust, without first consulting your JCB dealer.

Regulations

Obey all laws, worksite and local regulations which affect you and your machine.

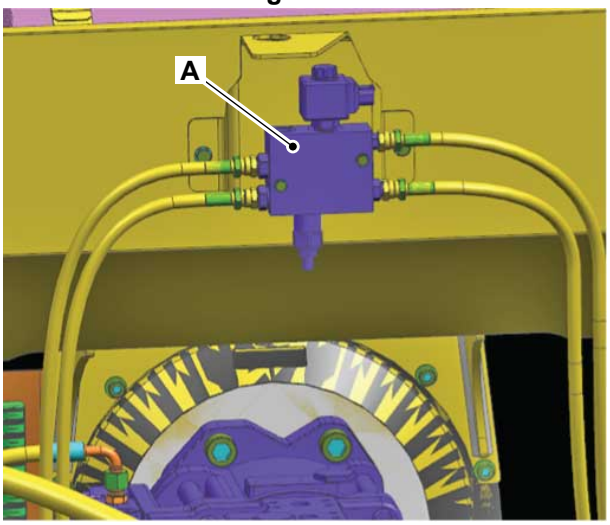
Figure 5. Hydraulic compartment



A Servo filter element
B In line drain filter element
C Hydraulic oil level gauge

Component Identification

Figure 10.



A Solenoid valve (located in the hydraulic compartment above the hydraulic pump)

Figure 11. Solenoid connectors (C155, C156)

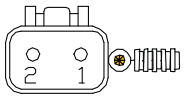


Figure 12. Harness switch connector (C121)

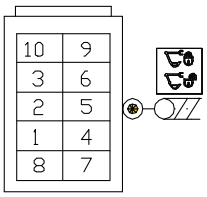
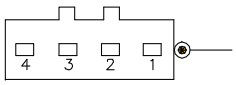


Figure 13. Joystick connector C095-X2 (green)



Operation

Quickhitch Unlock

The quickhitch switch is a momentary two position type. When the switch is not pressed it sets to the unlock position. Power is connected to the quickhitch pressure switch and quickhitch relay.

The quickhitch will not unlock unless the pressure switch and quickhitch button in the right joystick are closed at the same time. The system operates as follows.

When the operator closes the bucket fully the pressure switch contacts close and power is connected to the quickhitch button in the right joystick.

When the operator presses the quickhitch button at the same time, the quickhitch relay energises. The relay contacts close and power is connected to the quickhitch solenoid which energises. The quickhitch latch cylinder moves to the unlatch position. At the same time the quickhitch buzzer and red LED (Light Emitting Diode) in the quickhitch switch energise.

When the quickhitch relay energises it latches via the quickhitch diode. This means the relay remains energised and the quickhitch remains unlatched. The operator can release the quickhitch button and move the excavator controls to hitch or unhitch the attachments. The quickhitch buzzer and red LED in the quickhitch switch remain active.

Quickhitch Lock

The quickhitch switch is a momentary two position type. When the switch is pressed momentarily the system is set to the lock position as follows.

The power supply to the quickhitch relay is isolated momentarily. The relay unlatches and the contacts open. The quickhitch buzzer and red LED in the quickhitch switch de-activate.

The quickhitch solenoid de-energises and the latch cylinder moves to the lock position, due to force from its internal spring.

For information about the quickhitch pressure switch refer to PIL (33-90).

Close

1. To release the latch pull it up.
2. Close the covers.
3. Make sure the covers are closed correctly.
4. Use the ignition key to lock the cover.

15 - Tipping Linkage

Check (Condition)

1. Check all the link bushes and the pivot pins for wear or damage, replace as necessary.
2. Some tipping levers incorporate a lifting eye. This feature is classified as lifting equipment and must be tested and certified to comply with local regulations.

00 - General

Introduction

Pivot pins are a short shaft or pin that supports something that turns. Pivot pins are installed in numerous positions on the machine. There is usually a greasing point associated with the pivot pin. Make sure that the pivot points are greased at regular intervals. Refer to the Machine Maintenance Schedules. Refer to (PIL 78-24).

Slide Hammer Kit

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

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

75 - Fire Extinguisher

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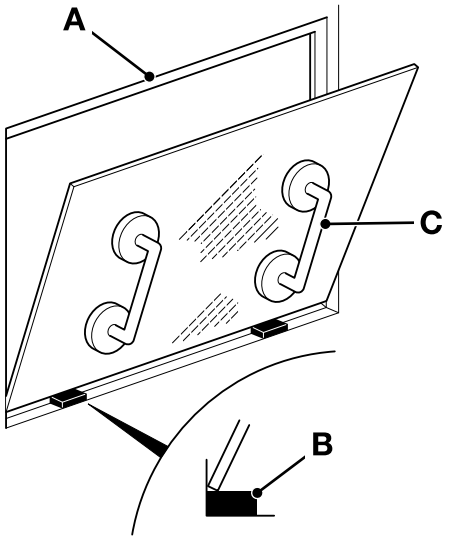
sized gap around the glass. Important: The glass edges must not touch the frame, otherwise movement of the frame will chip and eventually break the newly installed glass.

Special Tool: Glass Lifter (Qty.: 2)

Figure 44.

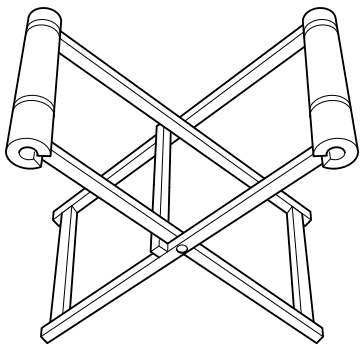


A Frame aperture
B Spacer blocks
C Glass lifters

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

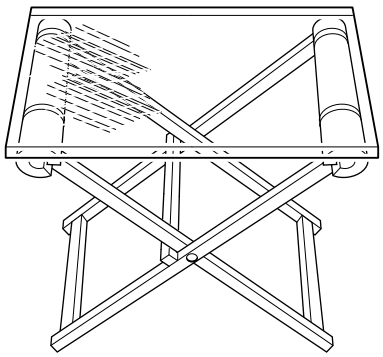
   Special Tool: Rubber Spacer Blocks (Qty.: 4)
   Special Tool: Folding Stand (Qty.: 1)

Figure 45.



3. Make sure the glass is positioned on the stand the correct way up (i.e. with the black ceramic ink band upwards) ready for application of primer etc.

Figure 46.



4. Clean the glass.

   4.1. Use surface cleaner to thoroughly clean and prime the black ceramic ink band printed on the glass (see Note). Use a lint free cloth to apply the cleaner, allow to dry. Important: Do not touch the glass after cleaning with the surface cleaner.

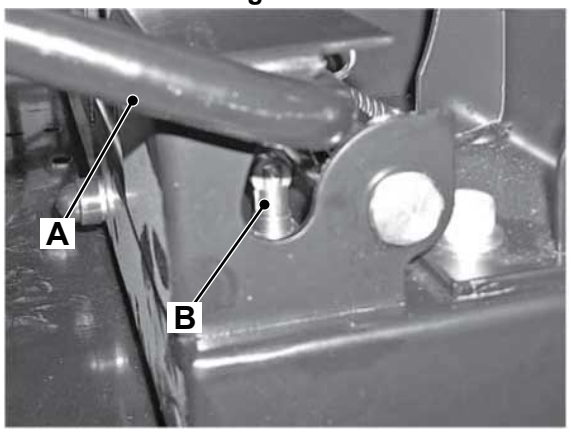
   Duration: 5min
   Consumable: Surface Cleaning Fluid

   4.2. If the glass does not have a black ceramic ink band, paint a band on the glass using Black Primer. Make sure that the band measures the correct width and that the edge is a neat straight line.

   Dimension: 25mm
   Consumable: Black Primer/Activator

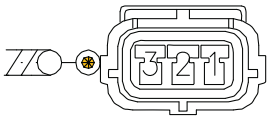
Component Identification

Figure 57.



A Lever lock lever
B Lever lock switch

Figure 58. Harness connectors (C063/C225)



Operation

When the lever lock is in the up position the lever lock switch 1 and lever lock switch 2 change state. The controls enable solenoid (C051) de-energises. At the same time there is no input at DECU (Display Electronic Control Unit) connector J1 pin 20. The DECU responds by switching off the output to the controls enable solenoid at connector J2 pin 5. The control isolation symbol comes ON in the DECU.

When the lever lock is in the lowered position the lever lock switch 1 and lever lock switch 2 change state. There is an input to the DECU at connector J1 pin 20. At the same time the controls enable solenoid is connected to + 24V. The control isolation symbol flashes ON and OFF in the DECU.

When the operator presses the controls enable switch (C122) there is a momentary earth connection at the DECU connector J1 pin 18. The DECU responds by switching on the low side output to the controls enable solenoid at connector J2 pin 5. The controls enable solenoid energises and the hydraulic controls are active. The control isolation symbol goes OFF in the DECU.

If the operator presses the controls enable switch again the DECU responds by switching off the output to the controls enable solenoid at connector J2 pin 5. The controls enable solenoid de-energises and the hydraulic controls isolate. The control isolation symbol flashes ON and OFF in the DECU.

When the controls are active lever lock switch 1 prevents the engine crank relay (C381) energising. The engine cannot be started unless the hydraulic controls are isolated.

The DECU monitors the status of the controls enable solenoid circuit in relation to the status of the lever lock switches. If the status is not as expected the relevant fault is reported.

30 - Trim Panel

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Acronyms Glossary

ATC	Automatic Temperature Control
ECU	Electronic Control Unit
FEAD	Front End Accessory Drive
HVAC	Heating Ventilation Air Conditioning
LCD	Liquid Crystal Display
PAG	Polyalkyline Glycol
PWM	Pulse Width Modulation
TXV	Thermal Expansion Valve

Figure 74. (Part 2 of 2)

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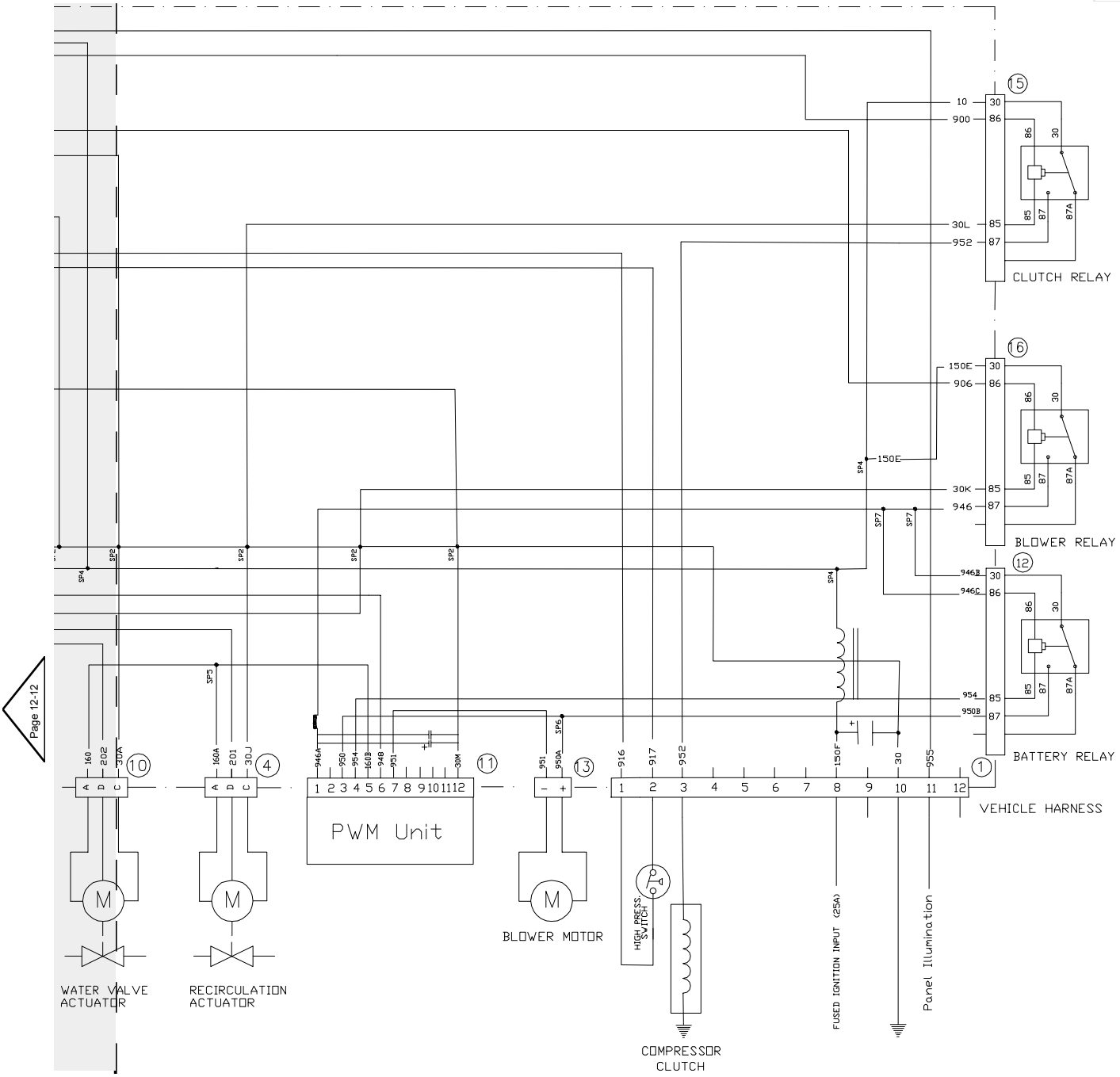

09 - Compressor

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00 - General

Introduction

Basic Description

The 6 cylinder mechanical engine has fuel ignited by compression ignition (C.I.). The engine operates on a four stroke cycle.

The engine is started by an electric starter motor. The starter motor turns the engine via a pinion and teeth on the engine flywheel, refer to (PIL 09-75).

When the engine runs the crankshaft drives the camshaft via gears. The camshaft opens and closes the inlet and exhaust valves and via push rods in time with the four stroke cycle. The engine has 24 valves, 2 inlet and 2 exhaust valves for each cylinder.

The crankshaft also drives a mechanical fuel injection pump via gears. The pump injects fuel via injectors, or atomisers into each cylinder in time with the four stroke cycle.

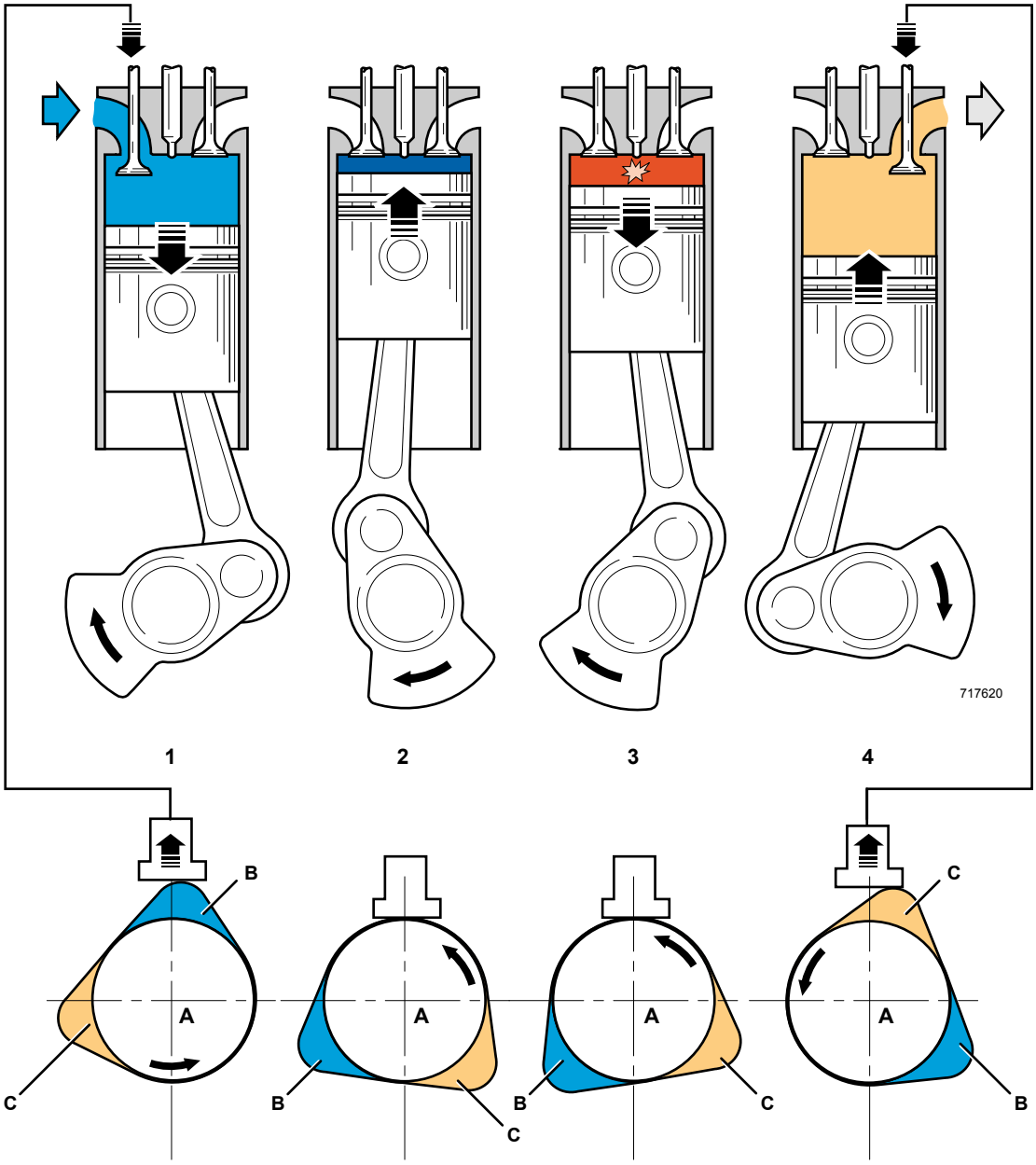
The pump injects fuel via injectors, or atomisers into each cylinder in time with the four stroke cycle. The pump is part of the mechanically actuated fuel injection system, refer to (PIL 18-00).

Air is drawn into the engine, via the inlet manifold and exhaust gases exit via the exhaust manifold. The engine uses a turbocharger which pressurises the air at the inlet manifold, refer to (PIL 18-36).

A mechanical lubrication oil pump is driven by the crankshaft via gears. The pump pressurises and circulates oil for engine lubrication and cooling purposes.

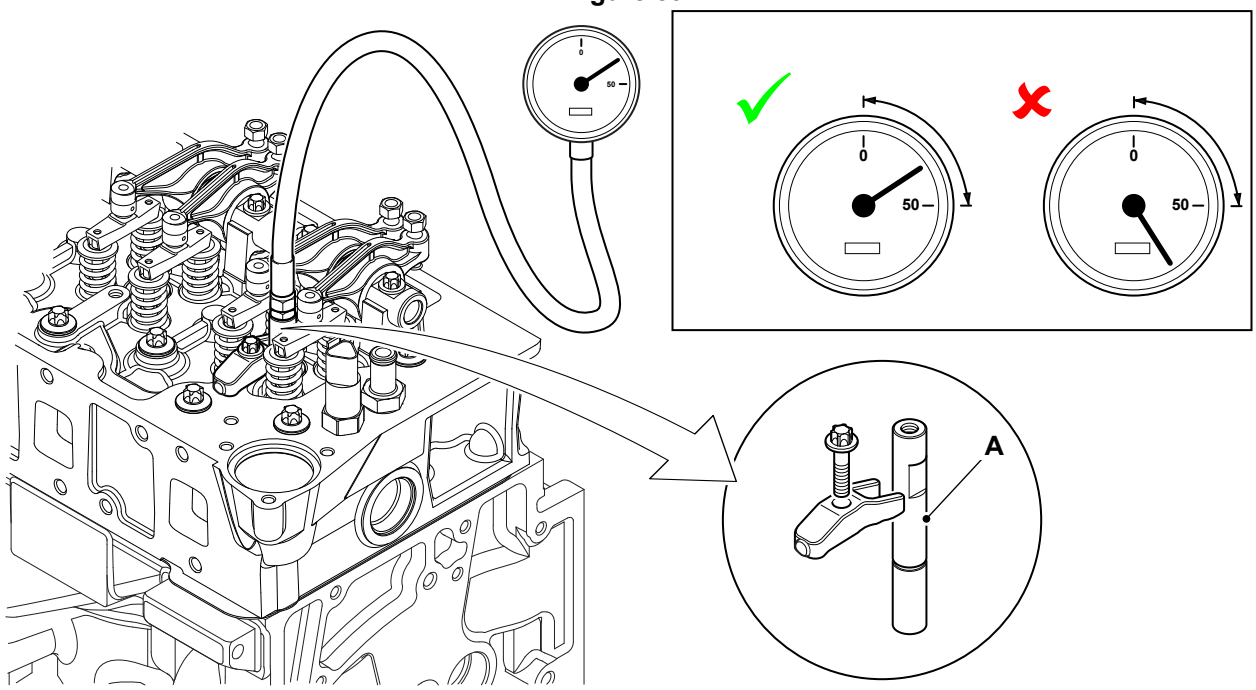
A drive belt driven by the crankshaft, drives a coolant circulation pump, alternator, radiator cooling fan and other ancillaries such as an air conditioning compressor.

Figure 88.



1 Induction stroke
2 Compression stroke
3 Power stroke
4 Exhaust stroke
A Camshaft
B Camshaft lobe - Inlet valve operation
C Camshaft lobe - Exhaust valve operation

Figure 89.



A Dummy Injector

Remove and Install

Special Tools

Tool Category	Description	Part No.	Qty.
Special Tool	Torque Wrench (10-100Nm)	993/70111	1

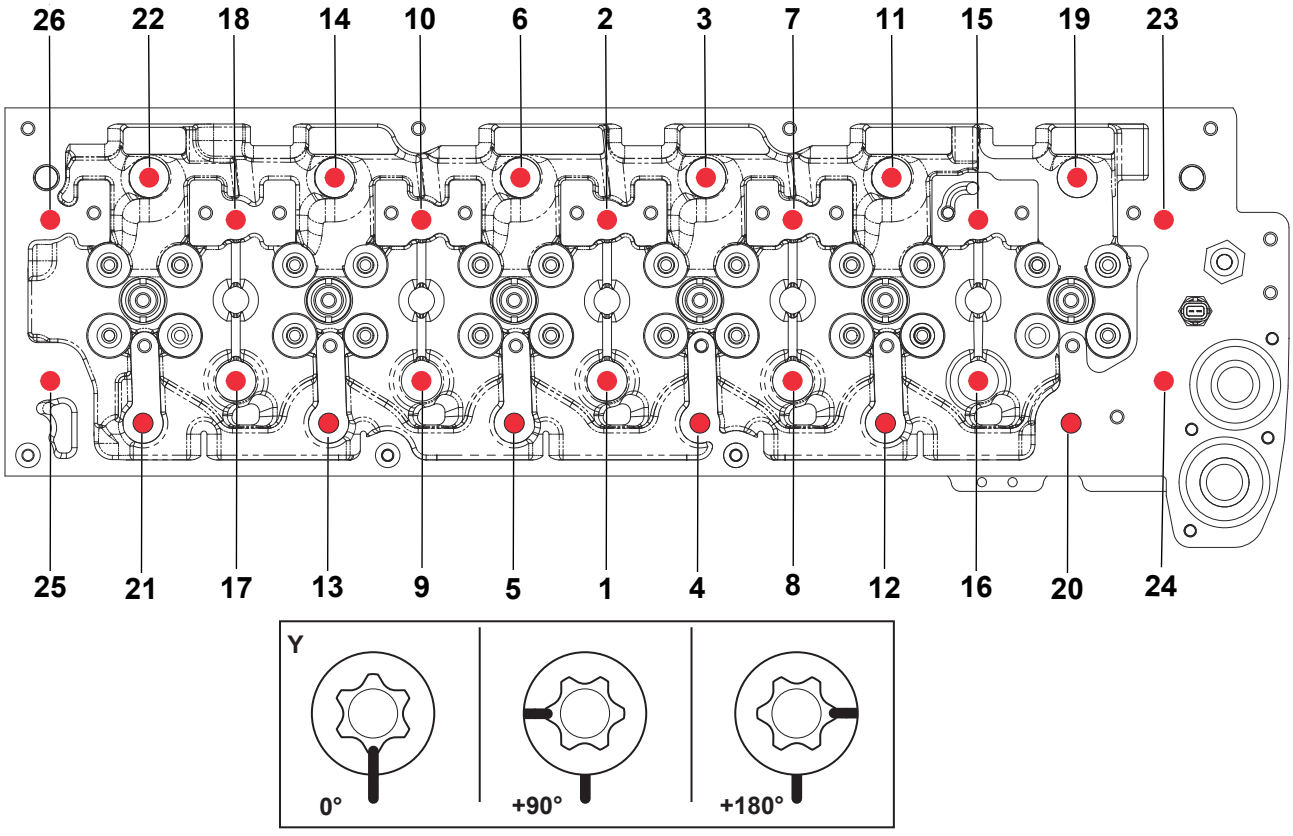
Consumables

Description	Part No.	Size
Cleaner/Degreaser - General purpose solvent based parts cleaner	4104/1557	0.4L

Before Removal

1. This procedure requires service parts. Make sure you have obtained the correct parts before you start, refer to Parts Catalogue.
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. Get access to the engine.
4. Remove the thermostat, refer to (PIL 21-12).
5. Remove the fuel pipes, refer to (PIL 18-96).
6. Remove the rocker cover, refer to (PIL 15-42).
7. Remove the fuel injectors, refer to (PIL 18-18).
8. Remove the rocker assembly, refer to (PIL 15-42).
9. Remove the exhaust manifold, refer to (PIL 18-24).
10. Remove the inlet manifold, refer to (PIL 18-24).

Figure 94.

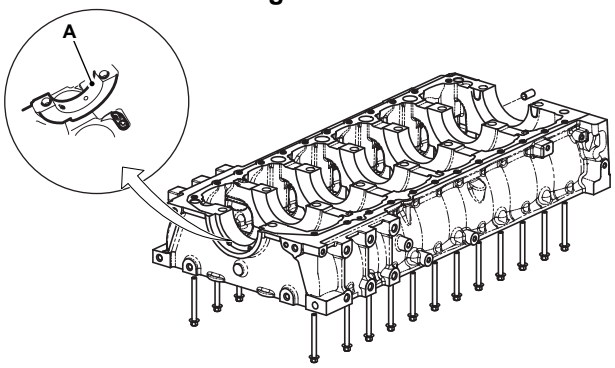


1-26 Cylinder head fixing bolts (26 off)
27 Cylinder head
28 Crankcase
29 Location dowels (2 off)
30 Head gasket

Check (Condition)

1. Check the main bearing surfaces for damage and excessive wear.

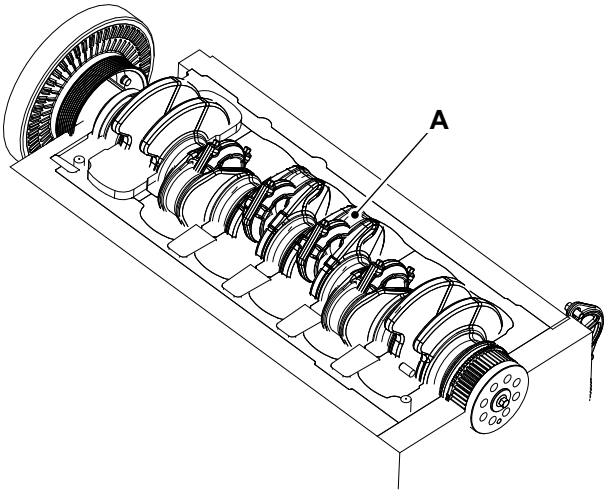
Figure 99.



A Main bearing shells

2. Measure the crankshaft diameters to confirm they are within service limits, refer to Technical Data (PIL 15-12).

Figure 100.



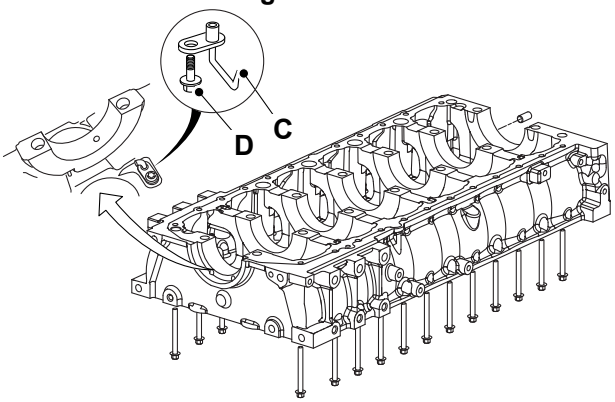
B Crankshaft

3. Check that the oil-way cross drillings in the crankshaft are clear and free from debris. Blocked or restricted oil-ways will cause oil starvation at the big end bearings.

4. Check that the piston cooling J-jets are clear. If the J-jets cannot be cleared remove the fixing screws. Remove the J-jets and discard them.

5. Install new J-jets.

Figure 101.



C J-jets
D Fixing screws

12 - Pulley

Remove and Install

Special Tools

Tool Category	Description	Part No.	Qty.
Special Tool	Torque Wrench (10-100Nm)	993/70111	1

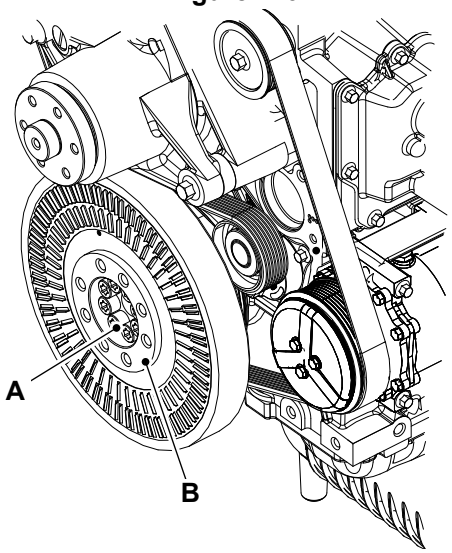
Before Removal

1. This procedure requires service parts. Make sure you have obtained the correct service parts before you start, refer to Parts Catalogue.
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. Get access to the engine.
4. Remove the drive belt. Refer to (PIL 15-18).

Remove

1. Remove the fixing bolts and withdraw the pulley from the crankshaft.

Figure 116.



A Fixing bolts (x8)
B Crankshaft pulley

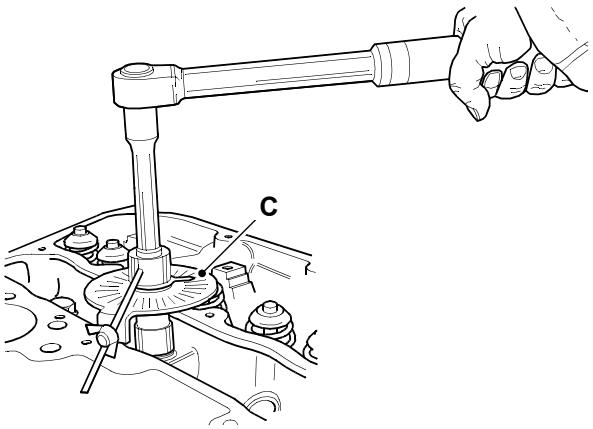
2. The bolts must not be reused. Discard the bolts.

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Make sure that all items are clean and free from damage and corrosion.
3. Renew the fixing bolts. Tighten the new bolts in three stages to the correct torque value.

   Special Tool: Torque Wrench (10-100Nm) (Qty.: 1)
4. The bolts are tightened using a torque and angle method. Refer to Fasteners and Fixings, General, Introduction (PIL 72-00).

Figure 117.



C Angle gauge (obtain locally)

After Replacement

1. Install the drive belt. Refer to (PIL 15-18).

Table 60.

Item	Torque Value (Nm)	Torque Angle (Degrees)
2 (1st stage)	30N·m	
2 (2nd stage)	75N·m	
2 (Final stage)		180°

00 - General

Introduction

A crankshaft pulley is used to drive a FEAD (Front End Accessory Drive) belt. The belt drives the coolant pump. Depending on the machine application, the belt is configured to drive engine mounted accessories, such as the alternator and cooling fan.

Some applications have a second pulley on the crankshaft which drives a dedicated fan belt. The belt drives an engine mounted cooling fan.

Health and Safety

Oil

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

CAUTION! *It is illegal to pollute drains, sewers or the ground. Clean up all spilt fluids and/or lubricants.Used fluids and/or lubricants, filters and contaminated materials must be disposed of in accordance with local regulations. Use authorised waste disposal sites.*

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

CAUTION! *The oil filter canister will contain some oil which could spill out when you remove the canister.*

00 - General

Introduction

The engine is installed with a filtered open loop crankcase ventilation (CCV) system.

Crankcase emissions are created during the combustion process. These emissions include unburned fuel and 'blow by gases' which contain hydrocarbon and engine oil contaminates. A large proportion of these emissions are prevented from entering the atmosphere by the crankcase ventilation filter assembly.

A series of ports in the crankcase, cylinder head and rocker cover allow pressure to vent from the crankcase. The vapour from the crankcase flows from the rocker cover to the filter assembly. Combined two stage filter elements remove around 90% of contaminates as the vapour passes from the inside to the outside of the filter elements. Trapped oil is allowed to drain back to the sump via a non return valve. The filtered vapour vents to the atmosphere.

If the pressure inside the filter assembly rises due to a blocked filter non return valve in the oil drain line prevents vapour being forced back into the crankcase.

The ventilation circuit incorporates a pressure relief valve. If the filter element becomes blocked the valve opens bypassing the filter and preventing a build up of pressure in the crankcase. Although this prevents serious engine damage it must be remembered that the filtration system does not function when bypassed. The filter element must be renewed at the intervals specified to ensure a bypass condition is avoided.

12 - Valve Spring

Remove and Install

Refer to Valve, General, Remove and Install (PIL 15-30-00).

00 - General

Introduction

The piston is acted upon by the pressure of the expanding combustion gases in the combustion chamber space at the top of the cylinder. This force then acts downwards through the connecting rod and on to the crankshaft.

The pistons are cast from aluminium alloys for increased strength and improved fatigue life.

The connecting rod is attached to the piston by a swivelling piston pin. This pin is mounted within the piston, The pin itself is of hardened steel and is fixed in the piston, but free to move in the connecting rod. The pins are prevented from moving sideways and the ends of the pin digging into the cylinder wall by circlips.

39 - Manifold

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Remove

1. Get access to the engine.
2. Remove the high pressure fuel pipes. Refer to Fuel Pipes (PIL 18-96).
3. Remove the fuel bleed off fuel pipes. Refer to Fuel Pipes (PIL 18-96).
4. Disconnect the electrical connector at the coolant temperature sensor. Refer to Engine Sensors (PIL 15-84).
5. Remove the bolts and lift the rocker cover from the cylinder head.
6. Discard the gasket.
7. The rocker cover injector seals must be replaced. Refer to Injector seals (PIL 18-18).

Install

1. Installation is the opposite of the removal procedure. Additionally do the following steps.
2. Remove all oil and sludge contamination from inside the rocker chamber.
3. Renew the injector seals. Refer to Injector seals (PIL 18-18).
4. Renew the rocker cover gasket.
5. Visually confirm the rocker cover seal is located within the seal groove.
   5.1. Prior to install make sure the rocker cover seal is not over hanging and it is fully seated within the groove of the rocker.
   5.2. Make sure to check the seal is not getting trapped or twisted during installation.
6. Prevent damage to the seals. Apply a rubber lubricant to the seals and then install the rocker cover.
7. Tighten the bolts to the correct torque value.
8. Remove the sleeves/covers.

Important: Make sure that the heat shield is not touching the rocker cover seal.

After Installation

1. The high pressure fuel pipes must be replaced with new parts. Refer to Fuel Pipes (PIL 18-96).
2. Start the engine and check for oil and fuel leaks.

Table 69. Torque Values

Item	Nm
B	24

Notes:

06 - Camshaft Gear

Remove and Install

The camshaft drive gear is an interference fit on the end of the camshaft and cannot be removed individually. If the gear is damaged or worn the complete camshaft and gear assembly must be replaced. Refer to Camshaft- Remove and Install (PIL 15-15).

Installation

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Make sure that all items are clean and free from damage and corrosion.
3. Align the flywheel location dowel.
4. Renew the fixing bolts. Tighten the new bolts to the correct torque value in three stages.

Tighten the bolts in sequence in diagonally opposing pairs. As a visual check, mark the bolts to the flywheel before you start. When the bolts have been angle tightened the marks will appear as at 120°.

Table 75. Torque Table

Item	Torque Value (Nm)	Angle (degrees)
2 (Ist Stage)	40	
2 (2nd Stage)	120	
2 (Final Stage)		+120

00 - General

Introduction

Engine mounts support the engine and in some cases the transmission, they dampen noise and vibration. The mounts isolate the engine and transmission from the chassis so that vibrations and noise are not transmitted to the rest of the machine.

Most engine mounts consist of metal attachment plates and large rubber insulator blocks. The rubber portions of the mount are flexible and provide the cushioning that dampens the engine vibrations. The metal bracket part of the mount provides the mechanical support and attachment points for the engine mounts.

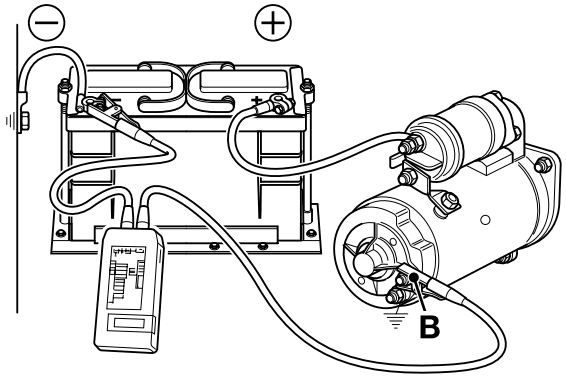
Health and Safety

- Ensure that the battery negative terminal is connected to the earthing cable.
- Never make or break connections to the battery or alternator, or any part of the charging circuit whilst the engine is running. Disregarding this instruction will result in damage to the regulator or rectifying diodes.
- Main output cables are 'live' even when the engine is not running. Take care not to earth connectors in the moulded plug if it is removed from the alternator.
- During arc welding on the machine, protect the alternator by removing the moulded plug (or if separate output cables installed, remove the cables).
- If slave starting is necessary, connect the second battery in parallel without disconnecting the vehicle battery from the charging circuit. The slave battery may then be safely removed after a start has been obtained. Take care to connect batteries positive to positive, negative to negative.

Technical Data

Technical data may differ between machine variants and installations. For full data relating to the alternator refer to the applicable parts information.

Figure 202.



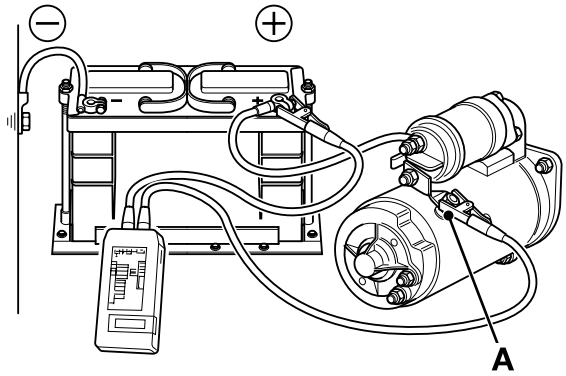
B Starter earth connection

5.1. If the reading is above the maximum permissible voltage, a high resistance in the earth lead or connections is indicated.

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

   Voltage: 0.25V

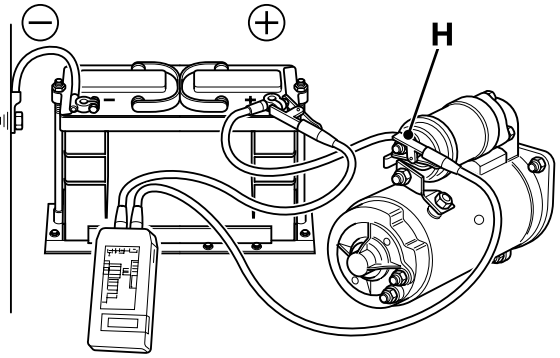
Figure 203.



A Starter main terminal

7. If the reading is above the maximum permissible voltage, a high resistance is present in the insulated lead or in the solenoid. Connect the multimeter between the battery positive and solenoid connection. If the multimeter now reads zero with the switch closed, the fault is in the solenoid.

Figure 204.



H Battery positive and solenoid connection

8. Finally install the engine stop fuse.

Adjust

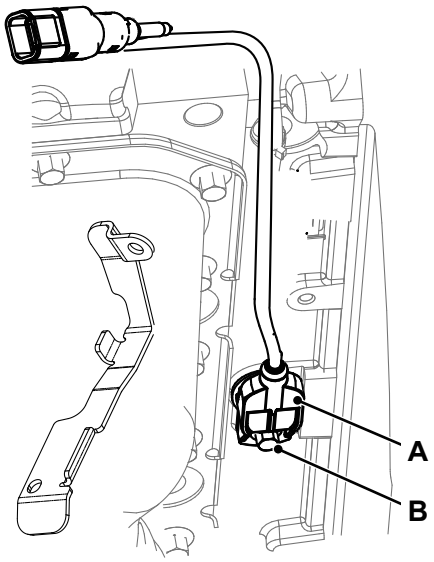
It is not possible to adjust the position of the engine speed sensor in relation to the crankshaft target disc. If there is a fault make sure that the speed sensor installation is correct.

Remove and Install

Before Removal

1. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
2. Clean the sensor and the adjacent area of the flywheel housing.

Figure 211.



A Crankshaft position sensor
B Bolt

Remove

1. Get access to the engine.
2. Remove the guard.
3. Disconnect the electrical connector at the sensor.
4. Remove the bolt.
5. Remove the sensor from underneath the timing gear casing.

The crankshaft position sensor is a non-serviceable item. If the sensor is defective it must be replaced.

Install

1. Replacement is the opposite of the removal procedure.
2. Tighten the bolt to the correct torque value.

Table 87. Torque Values

Item	Nm
B	8

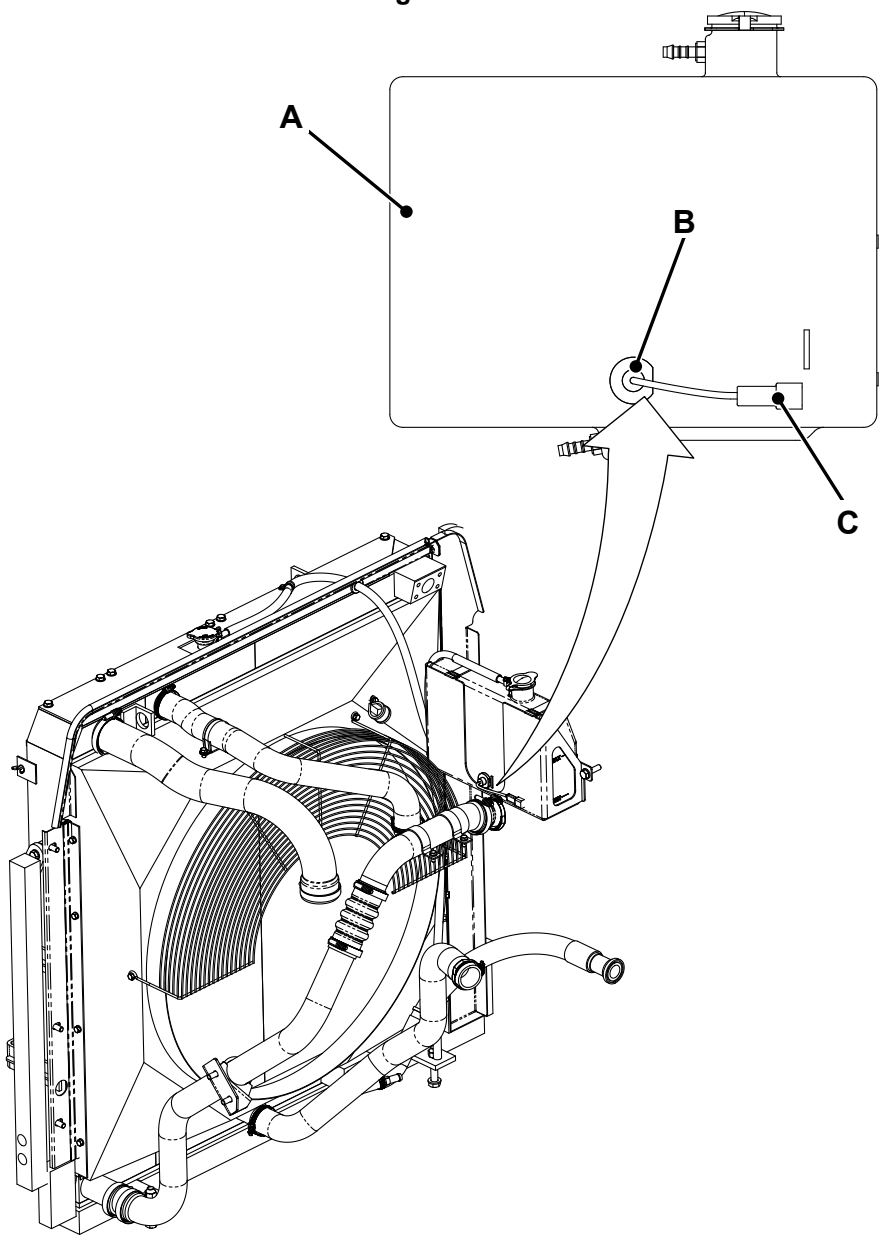
44 - Coolant Level

Introduction

The coolant level switch is located in the coolant expansion tank. The switch is a float type.

The coolant level switch is part of the expansion tank. If the switch is faulty the tank complete with switch must be replaced.

Figure 220.



A Expansion tank
B Coolant level switch
C Electrical connector

Health and Safety

Fuel

Fuel is flammable, keep naked flames away from the fuel system. Stop the engine immediately if a fuel leak is suspected. Do not smoke while refuelling or working on the fuel system. Do not refuel with the engine running. Completely wipe off any spilt fuel which could cause a fire. There could be a fire and injury if you do not follow these precautions.

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 personal protective equipment. Hold a piece of cardboard close to suspected leaks and then examine the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

WARNING! *Do not open the high pressure fuel system with the engine running. Engine operation causes high fuel pressure. High pressure fuel spray can cause serious injury or death.*

Notice: *Do not allow dirt to enter the fuel system. Before disconnecting any part of the fuel system, thoroughly clean around the connection. When a component has been disconnected, for example a fuel pipe, always install protective caps and plugs to prevent dirt ingress. Failure to follow these instructions will lead to dirt entering the fuel system. Dirt in the fuel system will seriously damage the fuel injection equipment and could be expensive to repair.*

Notice: *The high pressure fuel system is extremely susceptible to damage if it is contaminated. Always clean the engine using the correct procedures before carrying out maintenance. Contamination of the fuel system can cause catastrophic failure of the engine.*

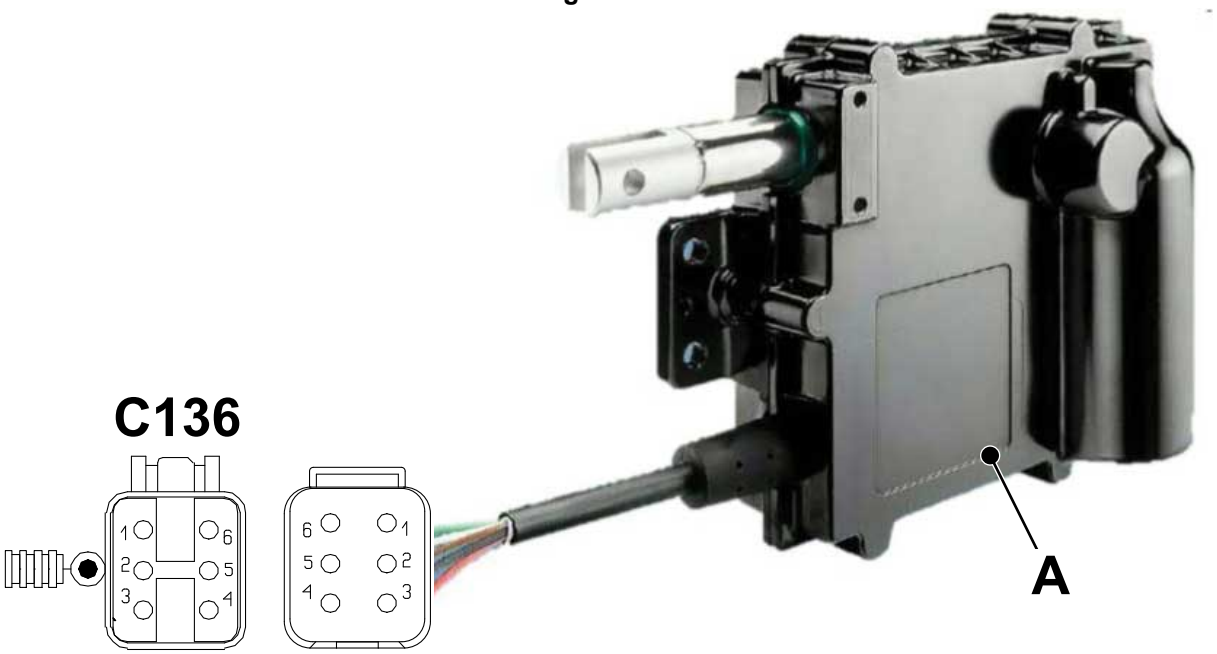
CAUTION! *Running the engine with air in the system could damage the fuel injection pump. After maintenance, the system must be bled to remove any air.*

Notice: *Clean the engine before you start engine maintenance. Obey the correct procedures. Contamination of the fuel system will cause damage and possible failure of the engine.*

CAUTION! *It is illegal to pollute drains, sewers or the ground. Clean up all spilt fluids and/or lubricants.Used fluids and/or lubricants, filters and contaminated materials must be disposed of in accordance with local regulations. Use authorised waste disposal sites.*

Component Identification

Figure 229.



A Throttle actuator

Table 94. Connector Pin C136

Pin number	Wire colour	Functions or Signal
1	Red	Positive
2	-	-
3	Black	Negative
4	Brown	CAN high
5	White	CAN shield
6	Green	CAN low

Clean

The diesel tank must be drained if there is a chance the fuel is contaminated or it has been filled with the incorrect fuel. Refer to: Fuel (Page 75-44).

1. Drain the diesel tank.
2. Change the fuel filters.
3. Refill the tank to the specified level with clean diesel.

   Percentage: 25%
4. Start the engine and leave it to run.

   Duration: 10min
5. Stop the engine.
6. Drain the water separator.

   Refer to: General (Page 18-45).
7. If there was any water or other liquid in the water separator, repeat 4 to 6.

12 - Water Separator

Contents **Page No.**

03 - Injector

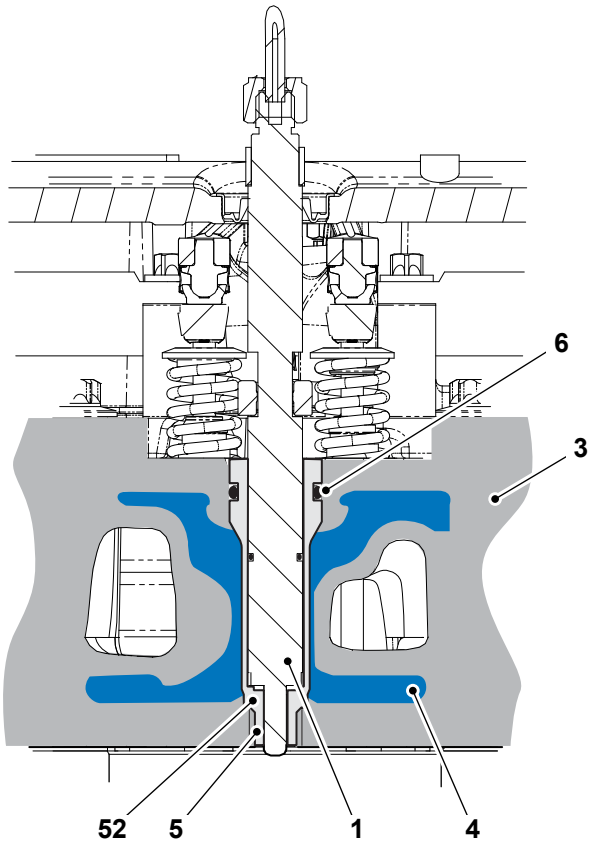
Introduction

The injectors are supplied with pressurised fuel by the high pressure fuel injection pump and when energised, the injector atomizes the fuel into a fine mist so that it can burn easily by the vehicle's engine.

The fuel injectors are mounted in the inlet manifold so that fuel is sprayed directly at the inlet valves.

The injector tips are located inside the combustion chambers, so effective cooling is essential. A special thin walled sleeve is screwed into the cylinder head which allows a coolant jacket close to the injector. The coolant jacket is sealed at the bottom by sealant on the sleeve thread and at the top by O-ring.

Figure 258.



1 Injector
2 Sleeve
3 Cylinder head
4 Coolant jacket
5 Sleeve thread
6 O-ring

After Installation

1. Reconnect the fuel inlet and return pipes.
2. Install the high pressure fuel pipes. Refer to (PIL 18-96).
3. Replace the fuel filters.
4. Bleed the fuel system. Refer to (PIL 18-00).
5. Start the engine and check for any leaks.

Table 102. Torque Values

Item	Nm
B	40
D	25
F	12
G	85
1	40
2	40
3	40
4	40

Health and Safety

Exhaust Gases

Machine exhaust gases can harm and possibly kill you or bystanders if they are inhaled. Do not operate the machine in closed spaces without making sure there is good ventilation. If possible, install an exhaust extractor. If you begin to feel drowsy, stop the machine at once and get into fresh air.

Sparks

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

Hazardous Atmospheres

This machine is designed for use in normal out door atmospheric conditions. It must not be used in an enclosed area without adequate ventilation. Do not use the machine in a potentially explosive atmosphere, i.e. combustible vapours, gas or dust, without first consulting your JCB dealer.

Hot Components

Touching hot surfaces can burn skin. The engine and machine components will be hot after the unit has been running. Allow the engine and components to cool before servicing the unit.

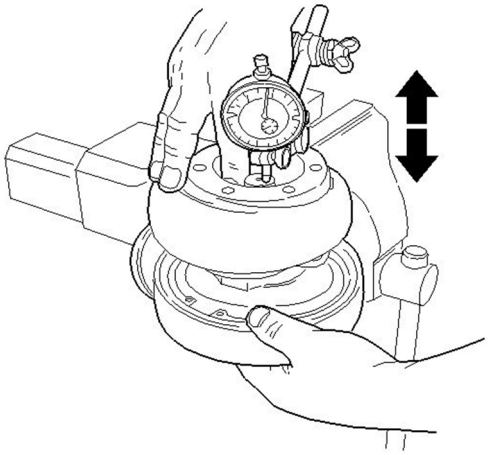
WARNING! *The engine has exposed rotating parts. Switch off the engine before working in the engine compartment. Do not use the machine with the engine cover open.*

Check (Condition)

Excessive smoke from the exhaust stack combined with a complaint of low power could be as a result of:

- Dirt or dust (unfiltered air) ingested directly into the engine, resulting in damage to the cylinder bores, there will also be a possible increase in oil consumption.
- Air leaks from the air hose connections.
- Exhaust manifold leaks.

Figure 287.



5.2. Move the shaft axially.

5.3. Make sure that the shaft end float is within the specified limits. Refer to Turbocharger, Technical Data (PIL 18-35).

Check (Operation)

To maximise the duration of the turbocharger follow the rules described below.

Start-up

Start the engine and keep it at idle speed for about a minute. The oil operating pressure is reached within a few seconds, but it is useful to allow the moving parts to warm up in good lubrication conditions. Immediately increasing the engine speed after start up will result in the turbocharger running at high rpm with less than optimal lubrication. This may lead to premature failure of the turbocharger.

After maintenance

When carrying out maintenance on the engine or turbocharger, pre-lubricate the oil inlet of the turbocharger by adding clean lubricant until it is completely full. After pre-lubrication, let the engine run via the starter motor without firing (engine / fuel pump stop out) to allow the oil to circulate through the complete system under pressure. Upon engine start-up, make it run at idle speed for a few minutes, allowing the oil and bearings system to work satisfactorily.

Low temperature air or engine inactivity

If the engine has been inactive for a certain period of time or the air temperature is very low, start the engine and then let it run at idle speed. This enables the oil to go into the lubrication system before applying high loads and speeds to the engine and turbocharger.

Engine shutdown

Before switching the engine off after intense activity, you must allow the turbocharger to cool down, let the engine run at idle speed for at least 2 minutes to allow the turbocharger to cool.

Engine at idle speed

Avoid running the engine at idle speed for long periods (above 20-30 minutes). Idle operation leads to low pressure values in the turbocharger, which may cause oil leaks from the seals at the ends of the turbo bearing shaft. Even if this does not cause damage, it can cause blue smoke from the exhaust when the engine speed and load are increased.

Notes:

06 - Expansion Tank

Contents **Page No.**

Check (Condition)

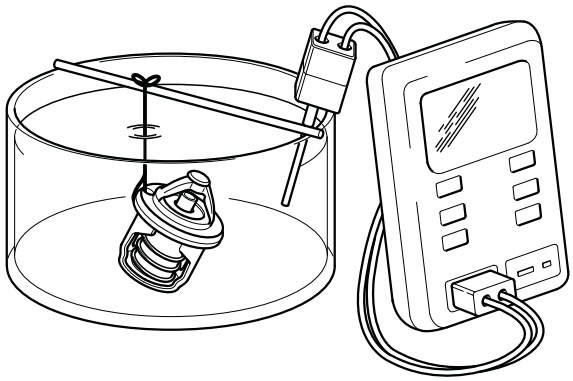
1. If the thermostat is suspected of being faulty, perform a thermostat test, refer to Thermostat - Check Operation (PIL 21-12) to confirm its serviceability. Note that the thermostat is a non-serviceable item. If the thermostat is faulty or damaged it must be renewed.
2. Inspect the seal for damage or splits. If necessary renew the seal. Make sure that the seal is correctly located.

Check (Operation)

A period of 3–5min before the thermostat valve starts to operate is normal because of the time required to heat soak the thermostat.

1. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
2. Remove the thermostat housing and the thermostat. Refer to (PIL 21-12).
3. Suspend the thermostat in a suitable container of coolant. Use an external heat source to gradually increase the temperature of the coolant. Note: When working with boiling water, all the necessary safety precautions must be taken. Refer to Figure 308.

Figure 308.

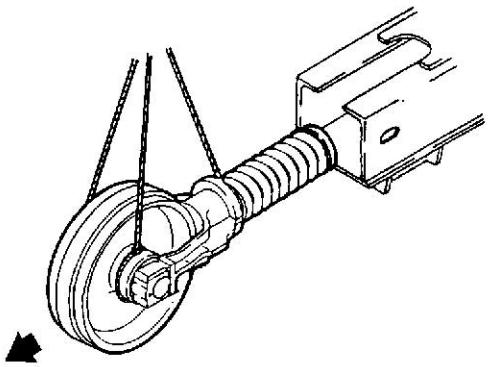


4. Use a thermometer to measure the temperature of the coolant.
5. When the coolant reaches the operating range of the thermostat the valve should start to open, the movement of the valve plate should be evident.
6. Record the start to open temperature, the fully open temperature and the amount of valve lift travel when fully open. Compare this with the data in Technical Data (PIL 21-00).

Table 121. Defaults to fast speed mode

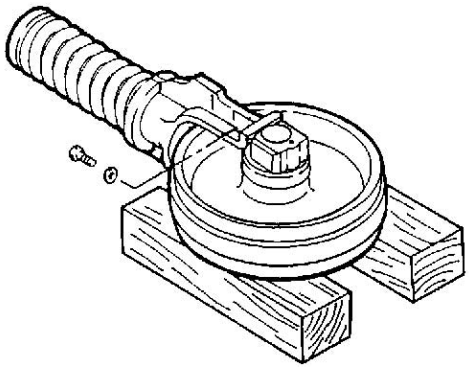
Cause	Remedy
Pressure switch fault	Check pressure switch operation. Refer to (PIL 33-90-00)
Travel speed solenoid - electrical fault	Carry out the low speed tracking test. Refer to Check (Operation) (PIL 27-38-00)

Figure 334.



4. Remove the bolts and remove the idler wheel from the recoil unit.

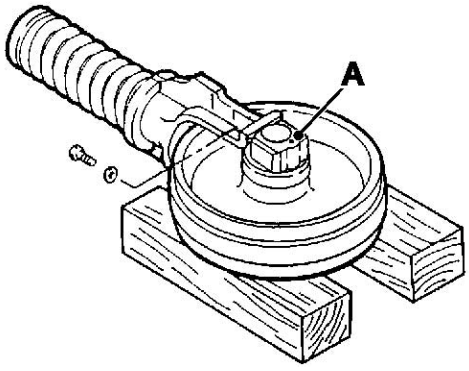
Figure 335.



Install

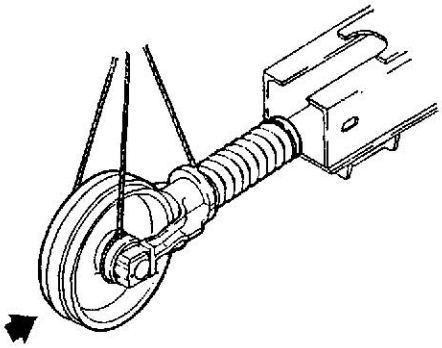
1. Before fitting the idler wheel, check the oil level at position A. If required, top up with the specified oil. Assemble the idler wheel to the recoil unit and fit the mounting bolts.

Figure 336.



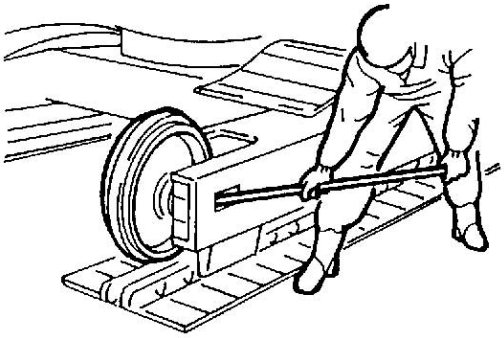
2. Fasten a sling around the idler wheel and recoil assembly and enter it into the undercarriage.

Figure 337.



3. Position the idler wheel in the undercarriage using a bar.

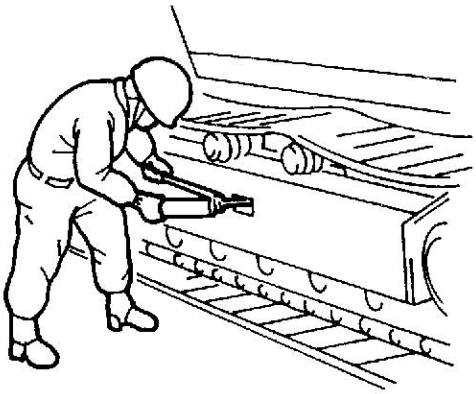
Figure 338.



4. Connect the track link. Apply grease through the check valve to adjust the track tension.

Refer to: Steel Track (Page 27-8).

Figure 339.



27 - Tensioner/Recoil unit

Disassemble and Assemble

(For: JS305)

⚠ **WARNING** RECOIL UNITS ARE DANGEROUS. They must not be dismantled without using suitable tools to compress the spring safely. The spring pressure can cause serious injury if suddenly released. Scrap units must be made harmless by compressing the spring in a hydraulic press and cutting through the end of the shaft before slowly releasing the pressure.

Disassemble

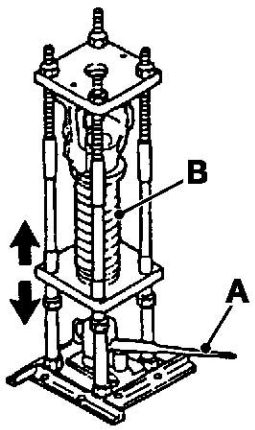
1. Remove the idler wheel assembly.

   Refer to: Idler Wheel (Page 27-17).

2. Prepare the jig for recoil spring removal. Place the re-coil spring unit in the jig. Refer to Figure 369.

   2.1. Operate the hydraulic jack and compress the recoil spring.

Figure 369.

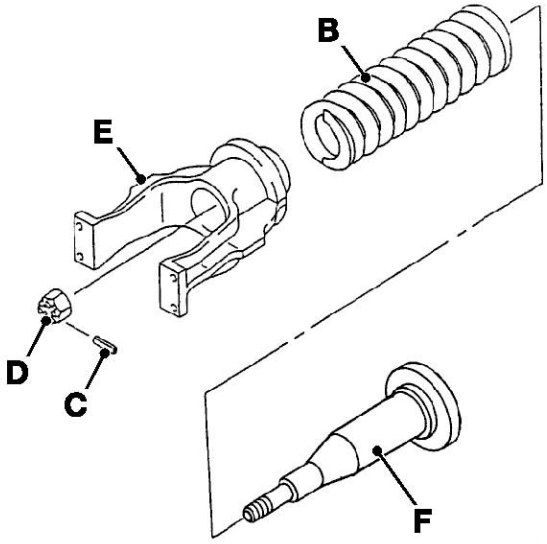


A Hydraulic jack
B Recoil spring

3. Remove the recoil spring. Pull out the spring pin and remove the castellated nut. Let the hydraulic jack down to relieve the pressure on the recoil spring.

   3.1. Remove the components from the jig, firstly the yoke, spring and finally, the spring retainer.

Figure 370.



B Recoil spring
C Spring pin
D Castellated nut
E Yoke
F Spring retainer

Install

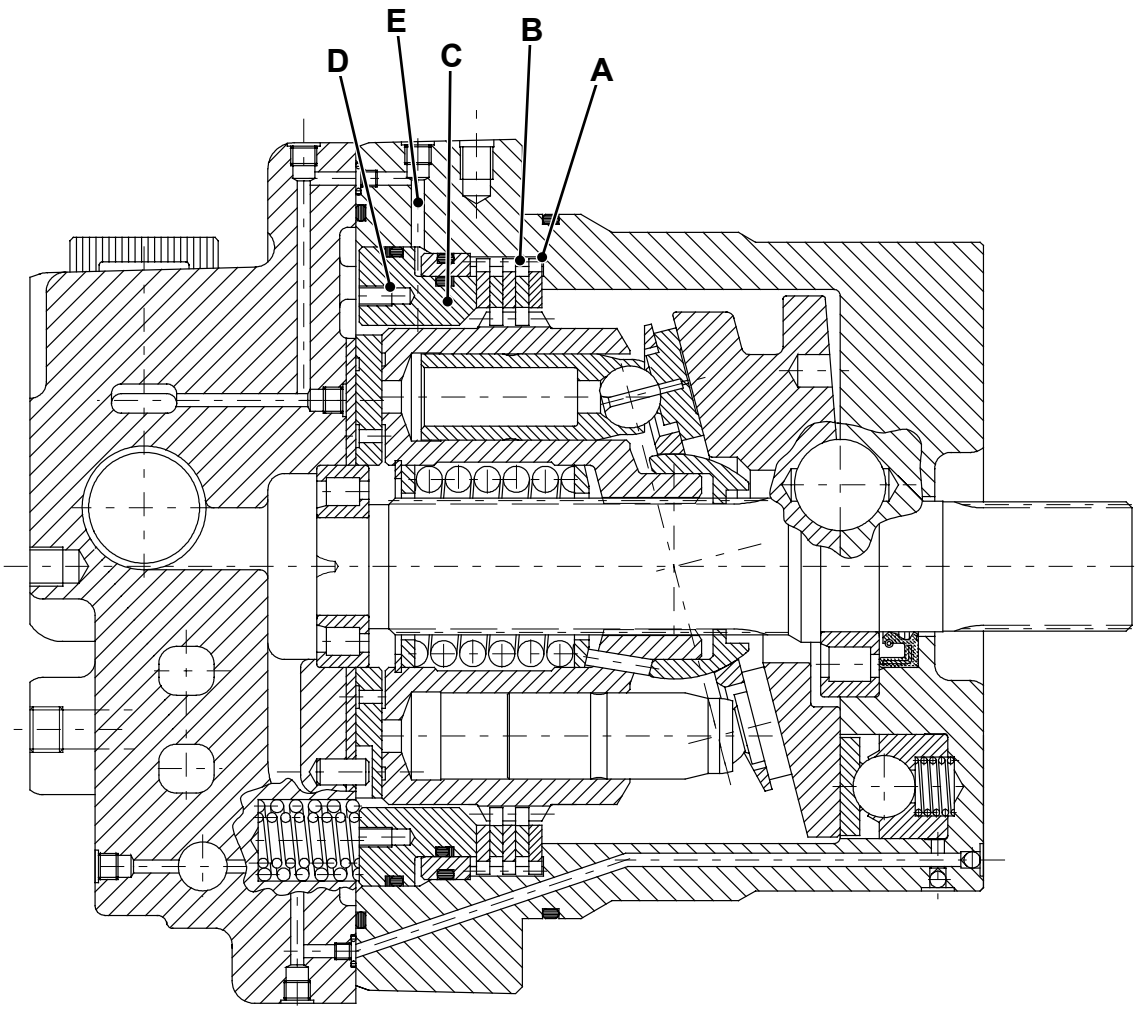
1. Set the components in the jig, firstly the spring retainer, then place the recoil spring on top, and finally, the yoke.
2. Extend the hydraulic jack and compress recoil spring.
3. Install the castellated nut on the threaded section of the spring retainer which protrudes through the yoke. Tighten nut, aligning the castellated segments with the pin hole.
4. Install a new spring pin.
5. Release the hydraulic jack carefully and allow recoil spring to expand.
6. Remove the assembly from the jig.

Parking Brake

The parking brake consists of alternate friction and counter plates, a piston and activating springs. Refer to Figure 379.

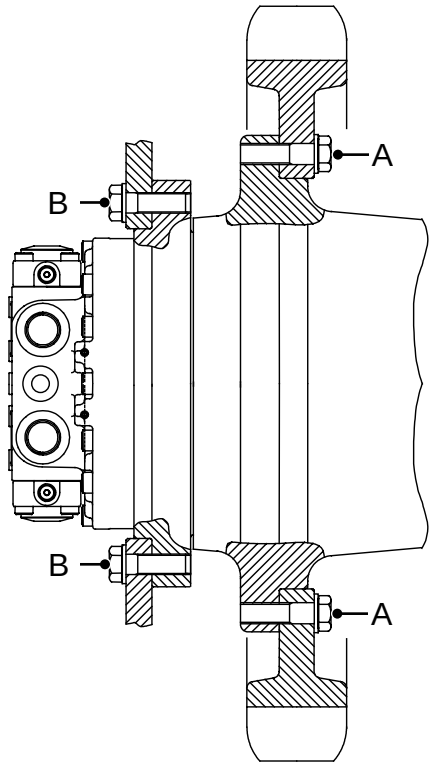
Pressurised oil flows via port to the parking brake release cylinder via the counter balance spool. The force on the brake piston overcomes the activating springs to force the brake piston across, thereby unclamping the friction and counter plates to release the parking brake. When parking or stopping the machine the shuttle function causes the pressurised oil in the parking brake cylinder to be released via the motor case drain. The brake piston is forced back by the activating springs to clamp the friction and counter plates and operate the parking brake.

Figure 379.



A Friction plate
B Counter plate
C Piston
D Activating spring
E Brake release cylinder port

Figure 393.

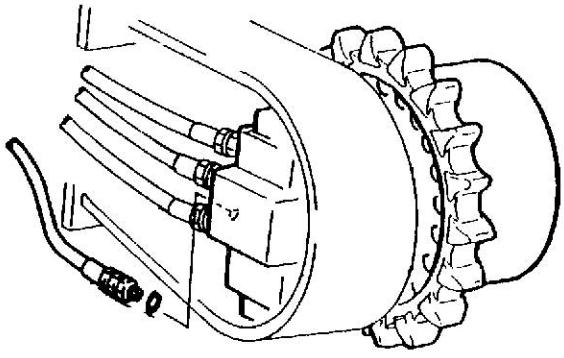


A Bolts 1
B Bolts 2

2.1. Tighten the bolts 2 in a diagonal sequence to the specified torque. Refer to Table 145.

3. Remove the plugs and connect the motor hoses.

Figure 394.



4. Do not fit the track at this stage. Follow the start up and running in procedure. Refer to Store and Recommission.

   Refer to: General (Page 27-35).

5. Install the covers over the motor.

6. Check the track gearbox oil level.

   Refer to: Track (Page 30-65).

7. If applicable install the gearbox sprocket.

   Refer to: Gearbox Sprocket (Page 27-15).

8. Remove the wooden blocks.

9. Install the track.

   Refer to: Steel Track (Page 27-8).

Table 145. Torque Settings

Item	Bolt size	Torque N·m
B	M16	290
B	M24	923

Clean

Special Tools

Tool Category	Description	Part No.	Qty.
Special Tool	Hydraulic Flushing Rig	892/01255	1

Cleaning Operation

The purpose of cleaning oil is to remove contaminants of all types and sludge by filtering hydraulic fluid through a cleaning unit.

Procedure

1. Connect the Hydraulic flushing rig in place of the hydraulic filter.

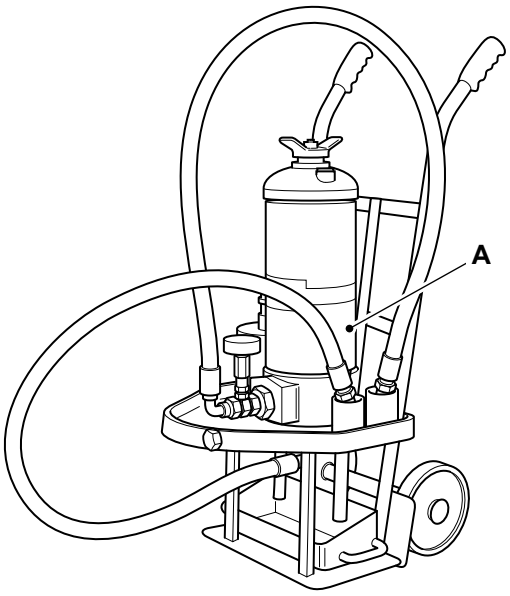
   Special Tool: Hydraulic Flushing Rig (Qty.: 1)

2. Run the system for sufficient time to pump all the hydraulic fluid through the unit.

3. Disconnect the cleaning unit and reconnect the filter.

4. Top up the system with clean hydraulic fluid as required.

Figure 397.



A Hydraulic flushing rig

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)

The 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.

Dipper out

Servo pressure from the hand controller is distributed as follows.

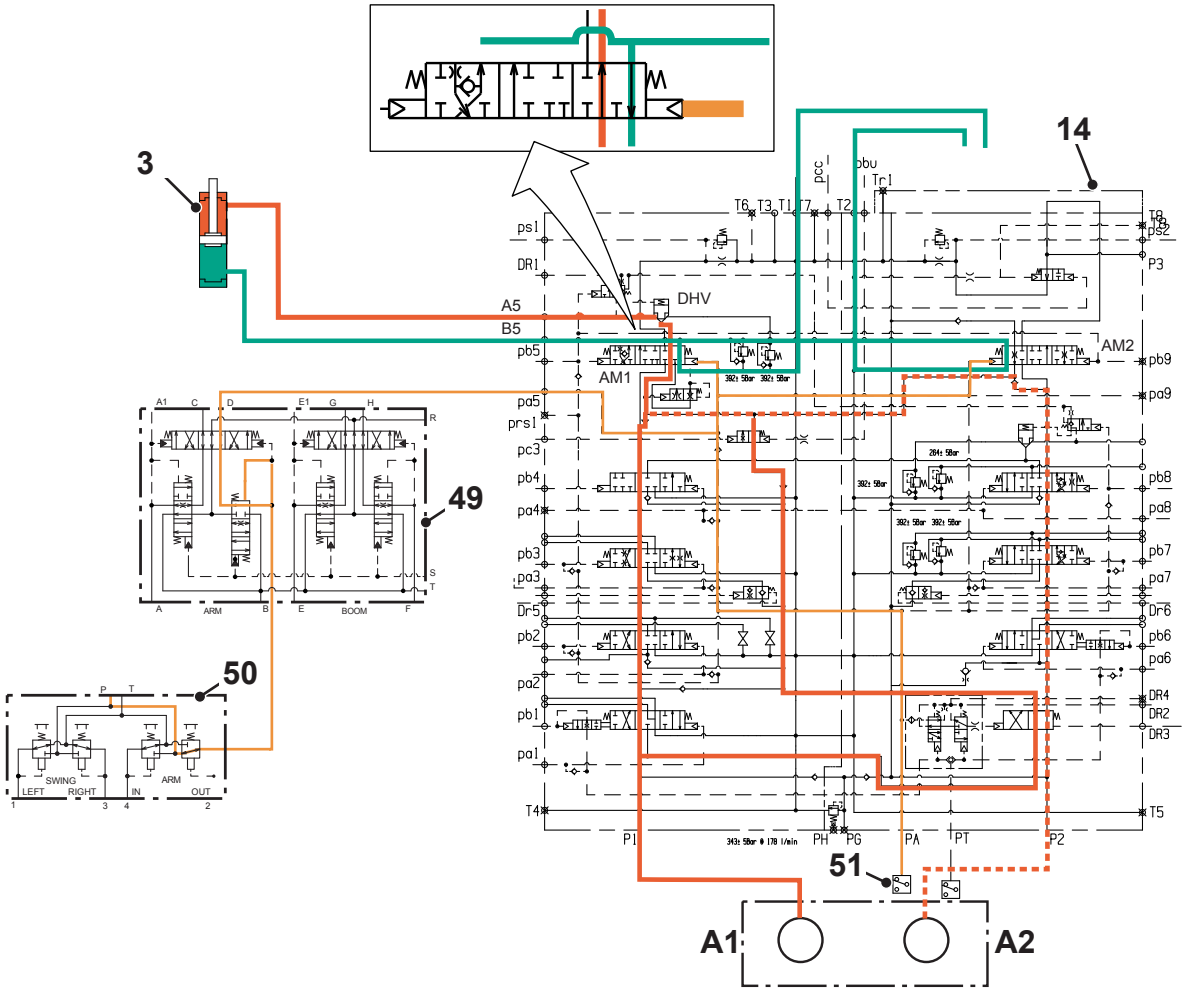
- To port B of the cushion control valve, through the valve leaving at port D.
- To port Pa5 on the main control valve selecting the dipper 1 spool, dipper 2 spool and the excavator pressure switch.

Flow from pump A1 is available at the dipper1 spool through the left hand neutral passage, and the linear travel spool through the parallel working passage. Flow from pump A2 is blocked at the dipper 2 spool and joins the flow from pump A1, just before the dipper 1 spool.

When the pressure from the pump is more than the load on the dipper ram, the dipper holding valve is forced off its seat. Oil flows to the ram via port A5 on the main control valve.

Exhaust oil from the ram enters the main control valve at port B5 and flows to the tank through the dipper 1 and dipper 2 spools.

Figure 404. Dipper out hydraulic schematic



3 Dipper ram
49 Cushion control valve
51 Excavator pressure switch
A2 Pump 2
14 Main control valve
50 Hand controller
A1 Pump 1

Fault-Finding

Table 155. The hydraulic system is not working well or not at all

Cause	Remedy
Pump fault	Test the pump pressures. Refer to (PIL 30-12)
	Test the negative control signal. Refer to (PIL 30-12)
	Test the horsepower control. Refer to (PIL 30-12)
	Test the maximum flow cut signal. Refer to (PIL 30-12)
	Test machine cycle times. Refer to (PIL 30-00-15)
MRV (Main Relief Valve) fault	Check the relief valve pressures. Refer to (PIL 30-50-03).
	Disassemble the MRV and clean. Refer to (PIL 30-50-03)
Main filter clogged	Install new filter. Refer to (PIL 30-04-03)
Suction strainer clogged	Clean or install new suction strainer. Refer to (PIL 30-03-12)
Servo filter filter clogged	Install new filter. Refer to (PIL 30-04)
Hydraulic oil level too low. Hydraulic oil contaminated	Check level or drain and fill the hydraulic oil as applicable. Refer to (PIL 30-03-00)
Pressure switch fault	Check pressure switch operation. Refer to (PIL 33-90-00)
Engine RPM (Revolutions Per Minute) setting incorrect or engine performance not as expected	Check operation of the engine speed setting. Fault find the engine. Refer to (PIL 15-00-00)

Table 156. Individual service not working well or not at all

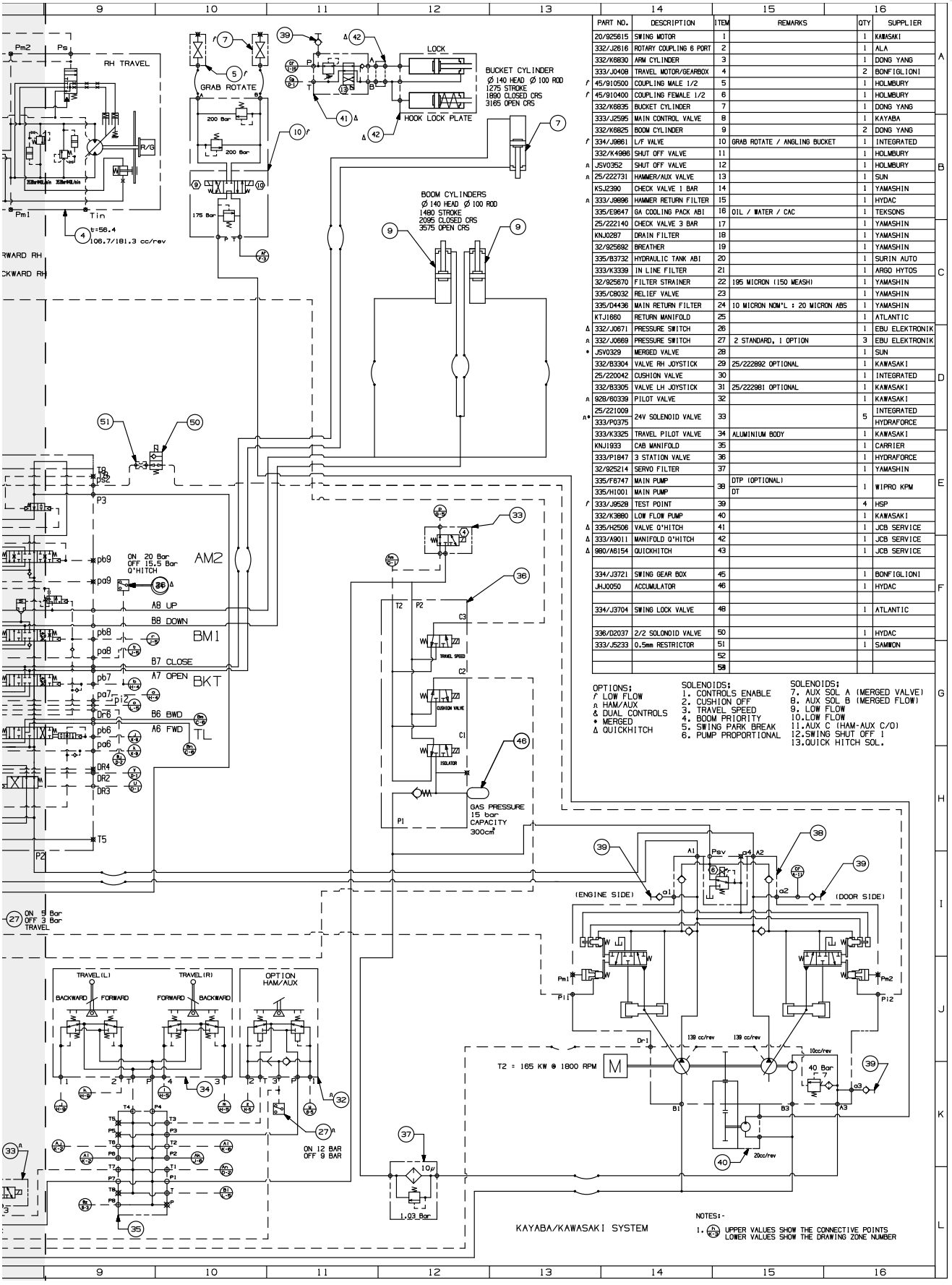
Cause	Remedy
Hydraulic ram fault	Test applicable machine cycle times. Refer to (PIL 30-00-15)
	Fault find applicable hydraulic ram. Check condition. Check for leaks. Refer to (PIL 30-15)
Load is too heavy	Test the pump pressures. Refer to (PIL 30-12)
Ram or servo hose runs are kinked	Check the hoses
Applicable control spool does not stroke fully or main control valve is faulty	Fault find the main control valve. Check the operation of the applicable spool. Refer to (PIL 30-50-00)
Applicable ARV (Auxiliary Relief Valve) fault	Check the applicable ARV pressures. Refer to (PIL 30-50-06)
	Fault find the applicable ARV. Check the operation of the applicable spool. Refer to (PIL 30-50-06)
Pressure switch fault	Check pressure switch operation. Refer to (PIL 33-90-00)

Table 157. Boom down operation is sudden

Cause	Remedy
Pump control fault	Test the pump negative control signal. Refer to (PIL 30-12)
Pressure switch fault	Check pressure switch operation. Refer to (PIL 33-90-00)

Page 30-44
Page 30-45

Figure 420. (Part 2 of 2)



	PART NO.	DESCRIPTION	ITEM	REMARKS	QTY	SUPPLIER
	20/925815	SWING MOTOR	1		1	KAWASAKI
	332/J2816	ROTARY COUPLING 6 PORT	2		1	ALA
	332/K6830	ARM CYLINDER	3		1	DONG YANG
	333/J0408	TRAVEL MOTOR/GEARBOX	4		2	BONFIGLIONI
f	45/910500	COUPLING MALE 1/2	5		1	HOLMBURY
f	45/910400	COUPLING FEMALE 1/2	6		1	HOLMBURY
	332/K6835	BUCKET CYLINDER	7		1	DONG YANG
	333/J2595	MAIN CONTROL VALVE	8		1	KAYABA
	332/K6825	BOOM CYLINDER	9		2	DONG YANG
f	334/J8861	L/F VALVE	10	GRAB ROTATE / ANGLING BUCKET	1	INTEGRATED
	332/K4986	SHUT OFF VALVE	11		1	HOLMBURY
∩	JSV0352	SHUT OFF VALVE	12		1	HOLMBURY
∩	25/222731	HAMMER/AUX VALVE	13		1	SUN
	KSJ2390	CHECK VALVE 1 BAR	14		1	YAMASHIN
∩	333/J9896	HAMMER RETURN FILTER	15		1	HYDAC
	335/E9647	GA COOLING PACK ABI	16	OIL / WATER / CAC	1	TEKSONS
	25/222140	CHECK VALVE 3 BAR	17		1	YAMASHIN
	KNJ0287	DRAIN FILTER	18		1	YAMASHIN
	32/925692	BREATHER	19		1	YAMASHIN
	335/B3732	HYDRAULIC TANK ABI	20		1	SURIN AUTO
	333/K3339	IN LINE FILTER	21		1	ARGO HYTOS
	32/925670	FILTER STRAINER	22	195 MICRON (150 MEASH)	1	YAMASHIN
	335/C8032	RELIEF VALVE	23		1	YAMASHIN
	335/D4436	MAIN RETURN FILTER	24	10 MICRON NOM'L : 20 MICRON ABS	1	YAMASHIN
	KTJ1680	RETURN MANIFOLD	25		1	ATLANTIC
Δ	332/J0671	PRESSURE SWITCH	26		1	EBU ELEKTRONIK
∩	332/J0669	PRESSURE SWITCH	27	2 STANDARD, 1 OPTION	3	EBU ELEKTRONIK
*	JSV0329	MERGED VALVE	28		1	SUN
	332/B3304	VALVE RH JOYSTICK	29	25/222892 OPTIONAL	1	KAWASAKI
	25/220042	CUSHION VALVE	30		1	INTEGRATED
	332/B3305	VALVE LH JOYSTICK	31	25/222981 OPTIONAL	1	KAWASAKI
∩	928/60339	PILOT VALVE	32		1	KAWASAKI
∩*	25/221009 333/P0375	24V SOLENOID VALVE	33		5	INTEGRATED HYDRAFORCE
	333/K3325	TRAVEL PILOT VALVE	34	ALUMINIUM BODY	1	KAWASAKI
	KNJ1933	CAB MANIFOLD	35		1	CARRIER
	333/P1847	3 STATION VALVE	36		1	HYDRAFORCE
	32/925214	SERVO FILTER	37		1	YAMASHIN
	335/F6747 335/H1001	MAIN PUMP MAIN PUMP	38	DTP (OPTIONAL) DT	1	WIPRO KPM
f	333/J9528	TEST POINT	39		4	HSP
	332/K3880	LOW FLOW PUMP	40		1	KAWASAKI
Δ	335/H2506	VALVE Q'HITCH	41		1	JCB SERVICE
Δ	333/A9011	MANIFOLD Q'HITCH	42		1	JCB SERVICE
Δ	980/A8154	QUICKHITCH	43		1	JCB SERVICE
	334/J3721	SWING GEAR BOX	45		1	BONFIGLIONI
	JHJ0050	ACCUMULATOR	46		1	HYDAC
	334/J3704	SWING LOCK VALVE	48		1	ATLANTIC
	336/D2037	2/2 SOLONOID VALVE	50		1	HYDAC
	333/J5233	0.5mm RESTRICTOR	51		1	SAMWON
			52			
			58			

OPTIONS:
f LOW FLOW
∩ HAM/AUX
& DUAL CONTROLS
* MERGED
Δ QUICKHITCH

SOLENOIDS:
1. CONTROLS ENABLE
2. CUSHION OFF
3. TRAVEL SPEED
4. BOOM PRIORITY
5. SWING PARK BREAK
6. PUMP PROPORTIONAL

SOLENOIDS:
7. AUX SOL A (MERGED VALVE)
8. AUX SOL B (MERGED FLOW)
9. LOW FLOW
10. LOW FLOW
11. AUX C (HAM-AUX C/O)
12. SWING SHUT OFF 1
13. QUICK HITCH SOL.

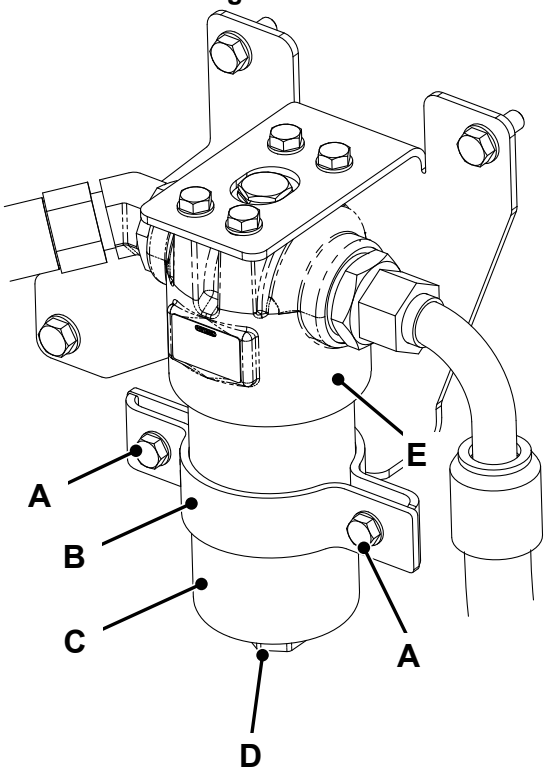
10 - Auxiliary Return Line

Remove and Install

Remove

1. Make the machine safe.
   Refer to: Safety (Page 01-1).
2. Discharge the hydraulic pressure.
   Refer to: General (Page 30-3).
3. Get access to the auxiliary return line filter assembly.
   3.1. Clean the area around the auxiliary return line filter to prevent contamination.
4. Support the filter bowl.
5. Remove the filter bowl securing bolts and bowl securing bracket.
6. Using a wrench on the hexagon at the base of the bowl, unscrew the filter bowl from the filter body. Take care not to spill the hydraulic oil.
7. Discard the O-ring and filter element.

Figure 426.

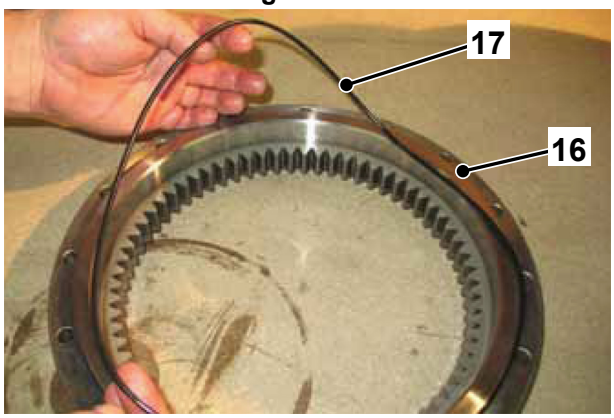


A Filter bowl securing bolts
B Filter bowl securing bracket
C Filter bowl
D Hexagon
E Filter body

Install

1. Installation is the opposite of the removal procedure.
2. Install a new filter bowl O-ring and lubricate with hydraulic fluid.
3. Install a new filter element into the filter bowl.
4. When refitting the filter bowl, it is important that the filter bowl is tightened carefully to avoid damaging the threads in the filter body.
5. Tighten the filter bowl to the specified torque. Refer to Table 169.
6. Start the engine.
   6.1. Operate the auxiliary services which are installed to the machine.
   6.2. Check the hydraulic oil level.
   Refer to: General (Page 30-47).

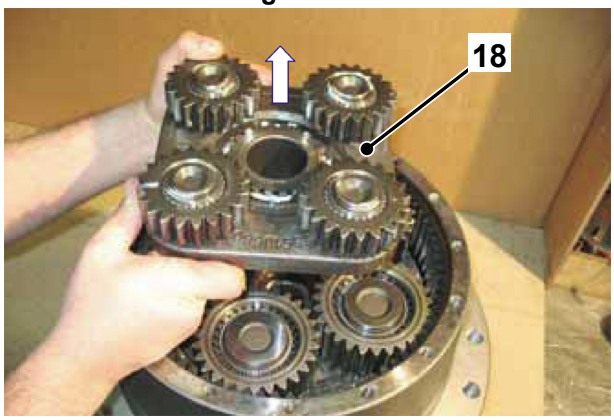
Figure 450.



16 Toothed ring
17 O-ring

19. Remove the 2nd reduction gear assembly.

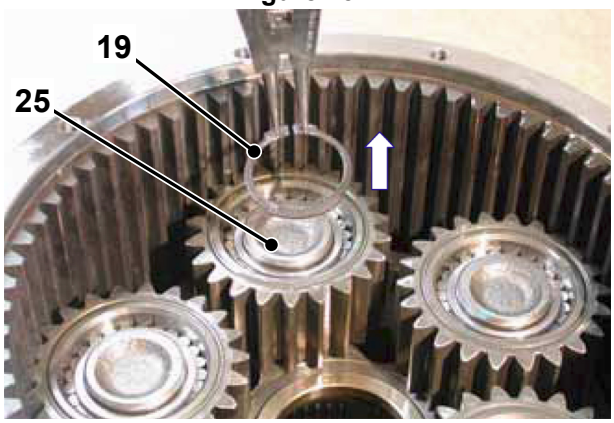
Figure 451.



18 2nd reduction gear assembly

20. By using circlip pliers remove the circlips from their seats in the hydraulic motor pins.

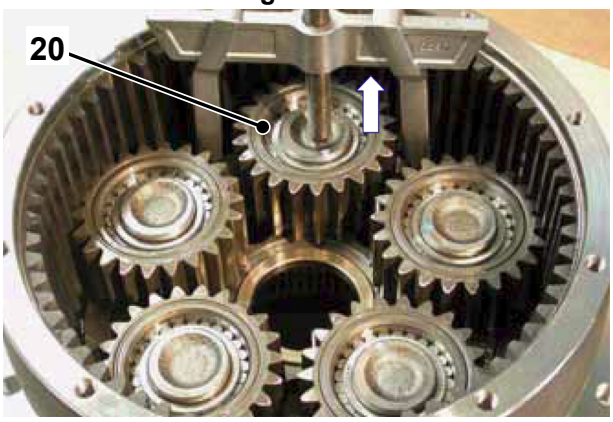
Figure 452.



19 Circlips
25 Hydraulic motor pins

21. By using a puller remove the planet gears from the 3rd reduction gear assembly.

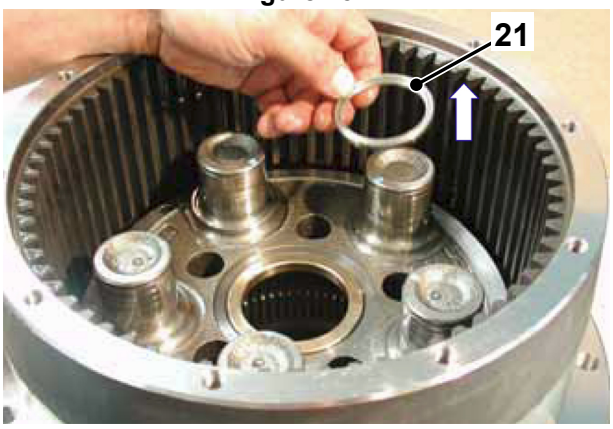
Figure 453.



20 Planet gears

22. Take out the spacers.

Figure 454.



21 Spacers

23. In order to proceed with the gearbox disassembly, it is now necessary to remove it from the machine and bring it to a properly equipped workshop.

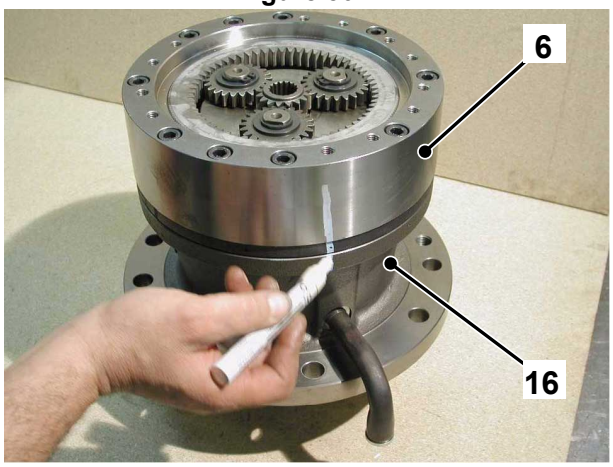
24. By using a punch remove the calkings on the ring nut.

Figure 455.

22 Ring nut

3. Make an alignment mark across the slew gearbox housing and cover to aid alignment during assembly.

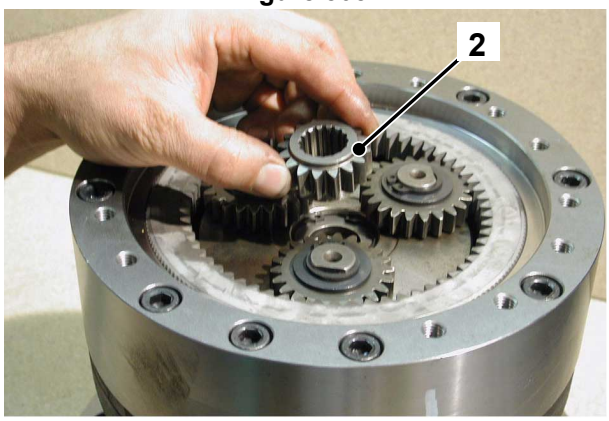
Figure 504.



6 Cover
16 Gearbox housing

4. Remove the first reduction sun gear.

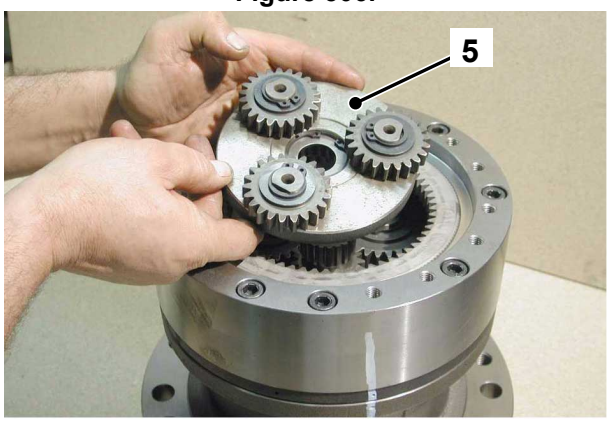
Figure 505.



2 First reduction sun gear

5. Remove the first reduction planet gear assembly.

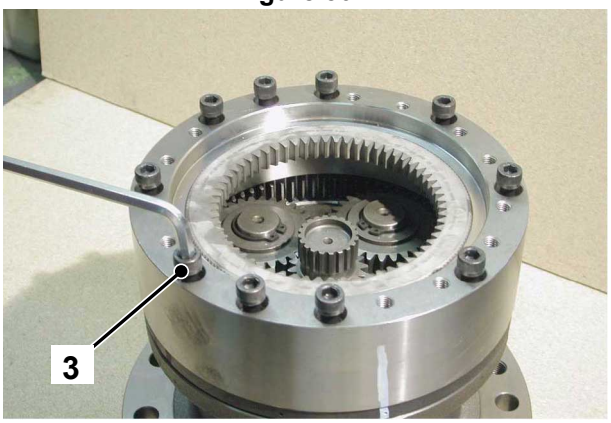
Figure 506.



5 First reduction planet gear

6. Remove the bolts which secure the cover to the ring gear and gear box cover.

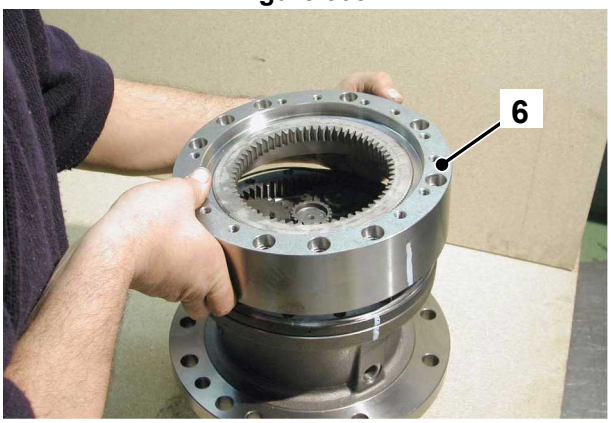
Figure 507.



3 Bolts

7. Remove the cover.

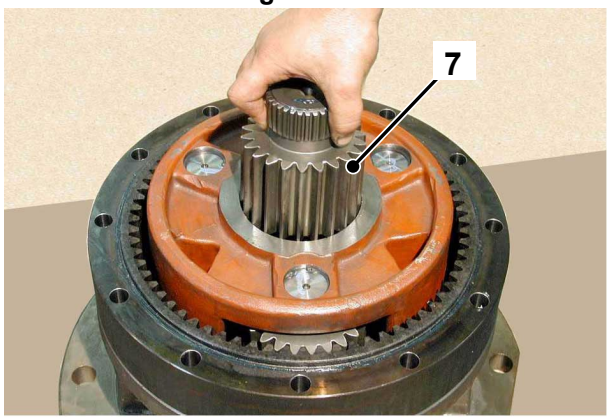
Figure 508.



6 Cover

8. Remove the second reduction sun gear.

Figure 509.

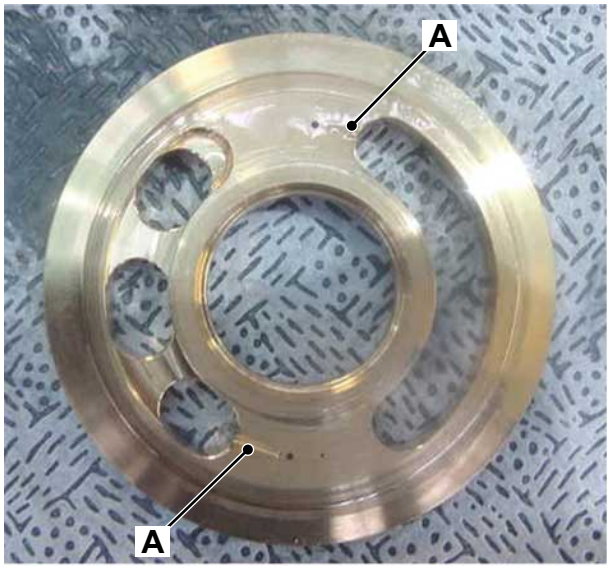


7 Second reduction sun gear

9. Remove O-ring 1 from the ring gear and discard.

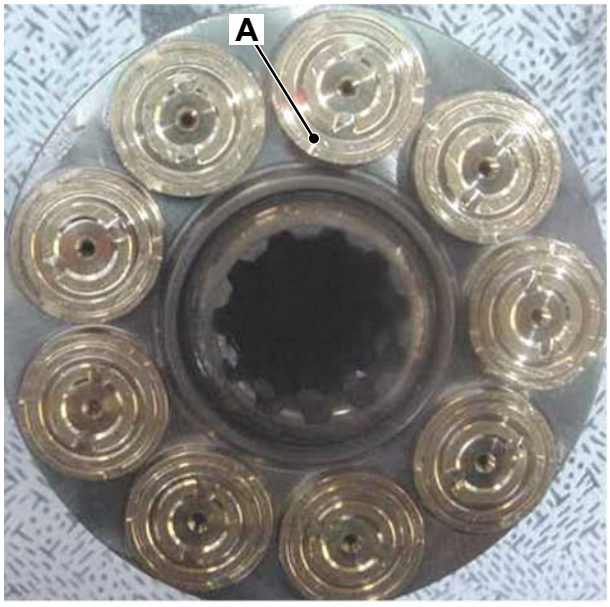
18 Shoe plate
19 Swash plate
20 Snap ring
21 Bearing spacers
22 Drive shaft
23 Valve plate
24 Plug 1
25 Plug 2
26 Servo piston
27 Tilting pin
28 Needle bearings
29 Coupling
30 Lock nut
31 Lock nut
32 Roller bearing
33 Socket head cap screws 5
35 Set screws
36 O-ring 2
37 O-ring 3
38 Pins
39 O-ring 4
40 Oil seal
X Servo pump

Figure 568. Example of valve plate defect due to contamination



A Scoring

Figure 569. Example of piston show defect due to contamination



A Scoring

Figure 587.

5. Attach the shoe plate to the swash plate. Place the pump casing with its regulator mounting face down, attach the tilting bush of the swash plate to the tilting pin, and attach the swash plate and shoe plate to the swash-plate support.

   5.1. Manually check that the swash plate can be moved smoothly.

   5.2. Apply clean oil to sliding sections of swash plate and swash plate support so that the drive shaft can be fitted easily.

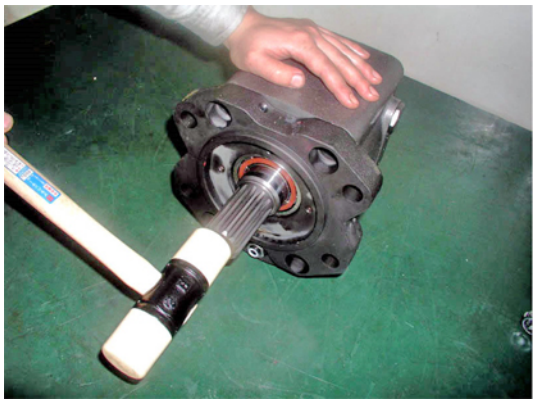
   5.3. Take care not to damage shoe plate surface.

6. Repeat step 5 for the other pump section.

Figure 588.

7. Install the drive shafts together with their bearing, bearing spacers and snap ring to each pump section.

Figure 589.



8. Install a new O-ring1 into the seal cover.

   8.1. Apply grease lightly to O-ring.

9. Install the seal cover on the swash plate support with socket head screws 4.

Figure 590.

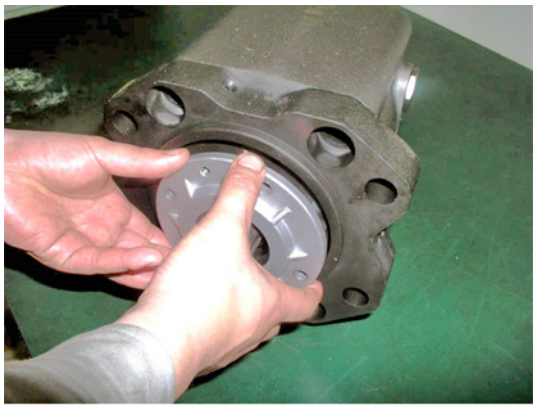
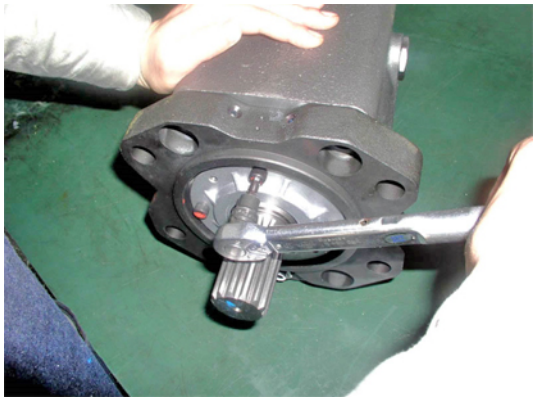


Figure 591.



   9.1. Take care not to damage the oil seal inside the seal cover.

10. Assemble the cylinder sub-assembly consisting of the cylinder, the piston sub-assemblies, set plate, the spherical bush and the cylinder spring.

Ram Seal Bypass

If the ram creep is in only one direction of the ram then it is unlikely to be caused by failed ram seals, if however the creep is excessive in both directions of the ram stroke then it is possible that the seals have failed.

Check for seal bypass as follows:

1. Place a load in the bucket of the machine.
2. Lower the bucket to the ground and vent all hydraulic pressure.
3. Blank off the port on the ram, which will be supporting the bucket.
4. Remove the hose from the other port on the ram, blank the hose and leave the port on the ram open to atmosphere.
5. Raise the bucket off the ground.
6. After initial movement, note the movement of the ram over the specified time period.

   Duration: 10min
7. After the initial movement of the ram when first raised from the ground, a continual movement of the ram or continuous trickle of oil from the open port of the ram would indicate that the ram seals require further inspection.

Auxiliary Relief Valve Failure

If the associated ARV (Auxiliary Relief Valve) has failed, if contamination is stuck on the valve seat or if the valve seat itself is damaged then this will allow oil to constantly bypass to tank causing ram creep.

A visual check can be made by removing the port relief valve and checking the condition of the valve seat and the seat in the valve casing, any damage of either of these two items would require rectification or replacement.

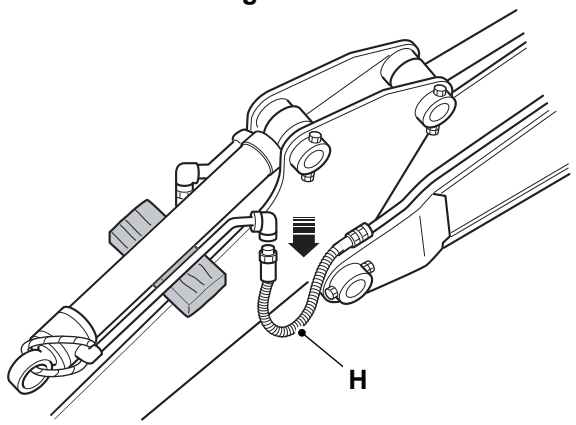
To check for a failed ARV, loosen the adjuster lock nut and wind the adjuster of the ARV fully in, until it locks the relief section. Re-check the ram creep rate, any change in the creep rate would indicate that further investigation of the ARV is required. If there is no change in the creep rate the cause may be the ARV seat in the valve block.

Disassemble and Assemble

Special Tools

Tool Category	Description	Part No.	Qty.
Special Tool	Ram Piston Nut Removal Installation Spanner 55mm A/F	993/99512	1
Special Tool	Ram Piston Nut Removal Installation Spanner 60mm A/F	993/99513	1
Special Tool	Ram Piston Nut Removal Installation Spanner 65mm A/F	993/99514	1
Special Tool	Ram Piston Nut Removal Installation Spanner 70mm A/F	993/99515	1
Special Tool	Ram Piston Nut Removal Installation Spanner 85mm A/F	993/99517	1
Special Tool	Ram Piston Nut Removal Installation Spanner 90mm A/F	993/99518	1
Special Tool	Ram Piston Nut Removal Installation Spanner 100mm A/F	993/99519	1
Special Tool	Ram Piston Nut Removal Installation Spanner 110mm A/F	993/99520	1
Special Tool	Ram Piston Nut Removal Installation	993/99521	1

Figure 643.

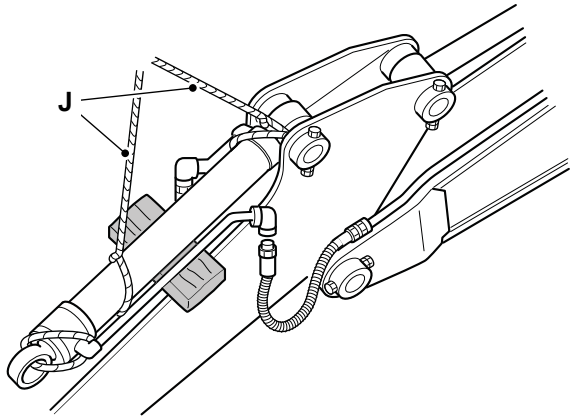


H Hoses

9. Attach suitable lifting slings to support the bucket ram. Refer to Figure 644.

   9.1. Make sure that the lifting slings are in tension and carry the weight of the ram.

Figure 644.



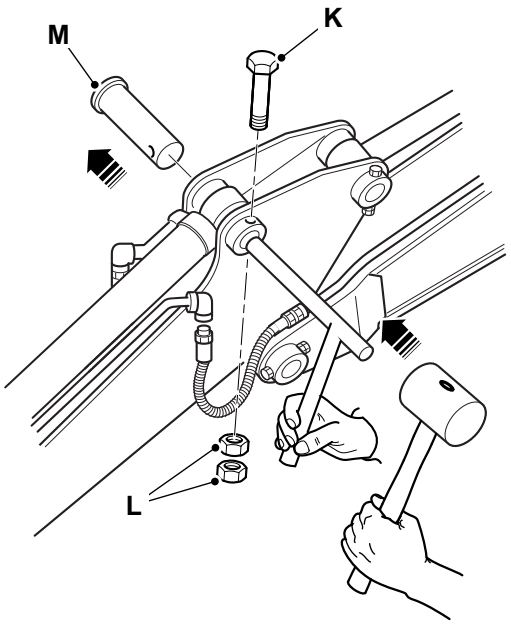
J Lifting slings

10. Remove the pivot pin retaining bolt and nuts and from the cylinder end of the bucket ram. Refer to Figure 645.

    10.1. Use a bar and hammer to remove the pivot pin from the cylinder end of the bucket ram. Refer to Figure 645.

    10.2. Remove the cylinder end pivot pin.

Figure 645.



K Retaining bolt
L Nuts
M Pivot pin (cylinder end)

11. Remove the bucket ram from the machine.

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

2. Attach suitable lifting slings to the ram and put it onto the dipper at correct position. Refer to Figure 646.

Figure 646.

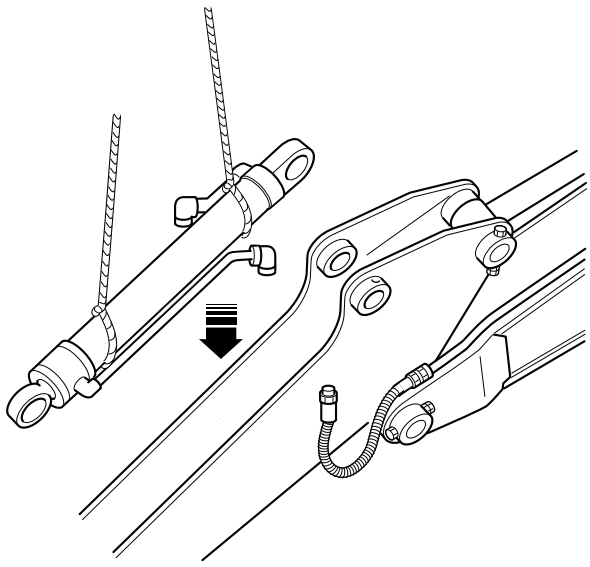
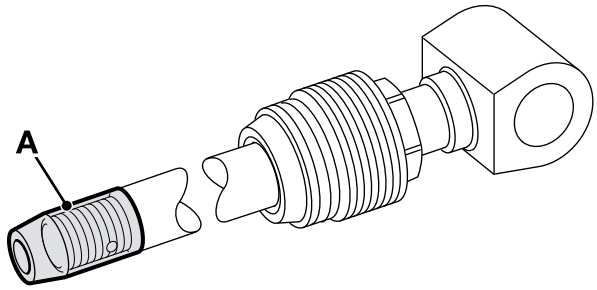


Figure 686.



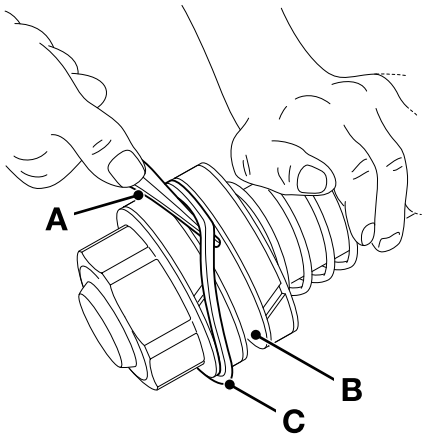
A Protection Sleeve (various sizes)

2. Install new head piston seals.

   2.1. Use the Piston seal assembly tool to lever the inner seal 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 that the marks are visible and the seal is free to rotate, if not remove the seal and retry.

   Special Tool: Ram Seal Assembly Tool (Qty.: 1)

Figure 687.



A Piston seal assembly tool
B Inner seal
C Outer seal

   2.2. Use the same procedure to install the outer seal as stated for the inner seal. Check that the external grooves are visible.

   2.3. Make sure that the O-ring is installed into the internal seal groove on the piston head. Screw the piston head on to the thread of the piston rod and tighten to the correct torque value.

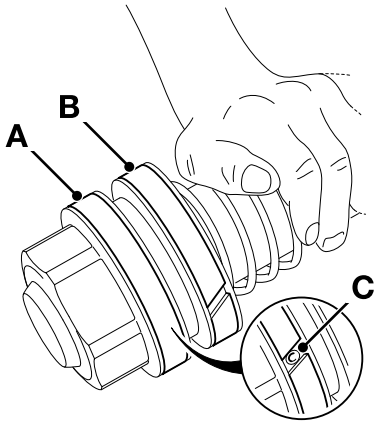
   Refer to: General (Page 30-127).

   2.4. Install the piston head retaining dowel.

   Refer to: General (Page 30-127).

   2.5. Install wear rings, rotate the wear rings so that the piston retention dowel is covered by the wear ring, not as shown at C.

Figure 688.



A Outer wear ring
B Inner wear ring
C Incorrect installation

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

   3.1. Insert the piston/rod assembly into the cylinder ram. Align the rod and head assembly until parallel with the cylinder ram then push the assembly into the cylinder.

   3.2. Install the end cap and assemble the ram assembly.

   Refer to: General (Page 30-127).

8. Disconnect all the hydraulic hoses that are attached to the rotary coupling.

   8.1. Plug all the open ports and hoses to prevent contamination.

   8.2. Put a label on the hoses to help installation.

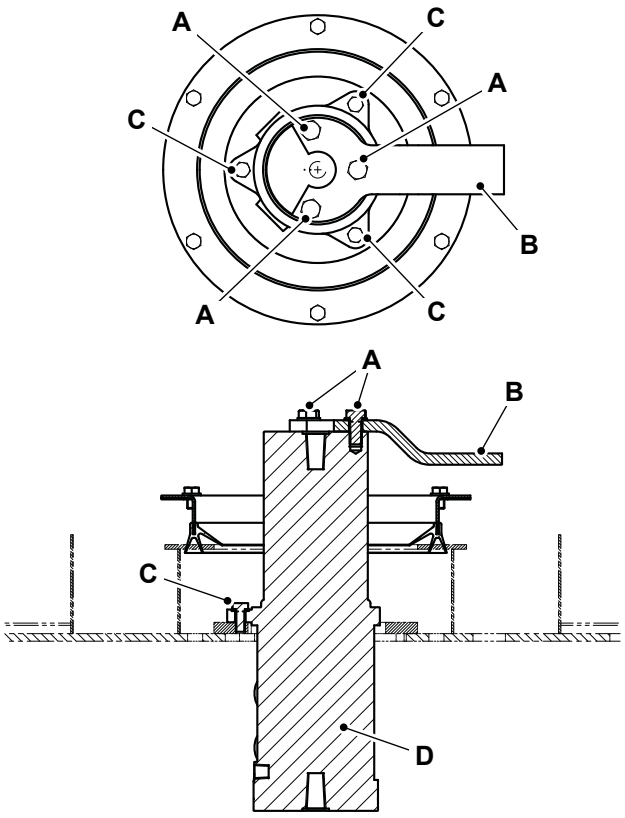
9. Remove the screws and washers that attach the lock bar to the rotary coupling. Refer to Figure 696.

   9.1. Remove the lock bar from the rotary coupling.

10. Remove the mount bolts that attach the rotary coupling to the machine. Refer to Figure 696.

    10.1. Remove the rotary coupling from the machine.

Figure 696.



A Screws
B Lock bar
C Bolts
D Rotary coupling

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.

2. Apply JCB Threadlocker and Sealer to the threads of the screws.

   Consumable: JCB Threadlocker and Sealer (High Strength)

   2.1. Tighten the screws to the correct specified torque value.

   Torque: 259N·m

3. Use the mount bolts to attach the rotary coupling to the machine.

   3.1. Tighten the bolts to the correct specified torque value.

   Torque: 116N·m

Table 207. Abnormal noise

Cause	Remedy
Large amount of air mixed in the oil or insufficient oil flow.	Check the oil in the tank and motor case.
	Thoroughly bleed the air.
Loosening of bolts or pipes.	Check if the piping connections, attachment mounting bolts, motor attachment bolts or other bolts are loose.
	Tighten to the specified torque.

Table 208. Oil leakage from mating surfaces

Cause	Remedy
O-ring is damaged.	-
	-
	Replace with new O-rings.
Seal face is damaged.	-
	-
	Repair seal face or renew.
Bolts are loose.	Check the bolt tightness.
	Tighten the bolts to the correct torque.

Table 209. Slew brake does not release

Cause	Remedy
No hydraulic pressure at the slew brake piston	Check the brake pressure.
Pressure switch fault	Check operation. Refer to (PIL 33-90-00)
Slew brake solenoid electrical fault	Check related wires and electrical components. Refer to Operation (PIL 33-33-88)

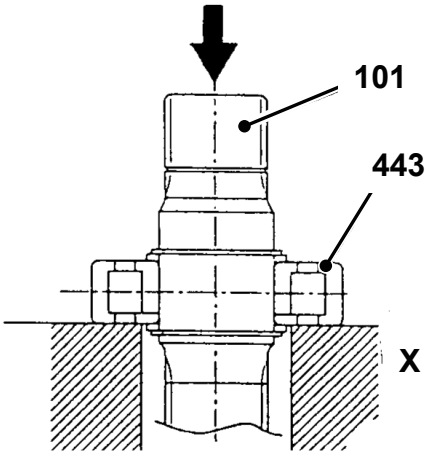
Table 210. Slew brake does not come on or is not effective

Cause	Remedy
Pressure switch fault	Check operation. Refer to (PIL 33-90-00)
Slew brake solenoid electrical fault	Check related wires and electrical components. Refer to Operation (PIL 33-33-88)
Worn or faulty slew brake components	Disassemble slew motor. Renew components as necessary. Refer to Disassemble and Assemble.

Table 211. Slew brake release is sudden

Cause	Remedy
Slew brake pressure is low	Check the brake pressure.
Slew brake piston seals leaking	Disassemble slew motor. Renew components as necessary. Refer to Disassemble and Assemble.

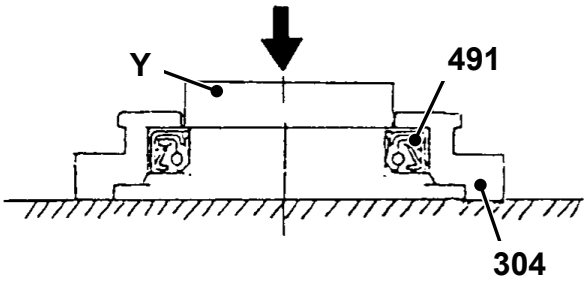
Figure 728.



101 Drive shaft
443 Cylindrical roller bearing race
X Support

21. To remove the oil seal, position the front cover on the bed of a press (as shown). Using a suitable diameter spacer, apply pressure to remove the oil seal. Discard the oil seal.

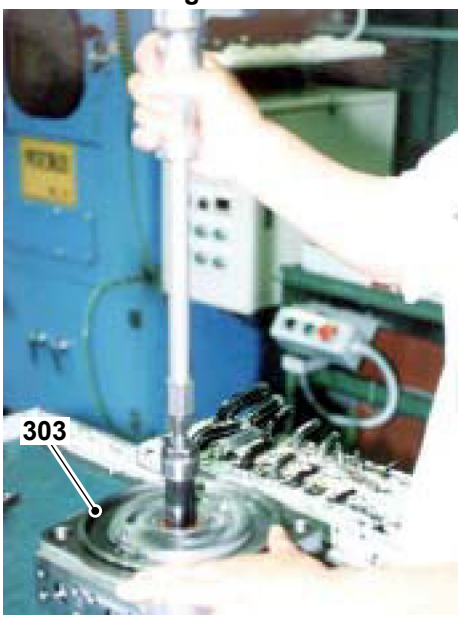
Figure 729.



304 Front cover
491 Oil seal
Y Spacer

22. If necessary, remove bearing from valve housing using a sliding hammer bearing puller.

Figure 730.



303 Valve housing

Assemble

1. Inspect all the parts before you assemble them.

   Refer to: Check (Condition) (Page 30-189).

   1.1. Use a carborundum paper to remove scratches.

   1.2. Use JCB Cleaner/Degreaser to clean all the parts.

   Consumable: Cleaner/Degreaser - General purpose solvent based parts cleaner

   1.3. Let all the parts dry.

2. Replace all the seals with new ones.

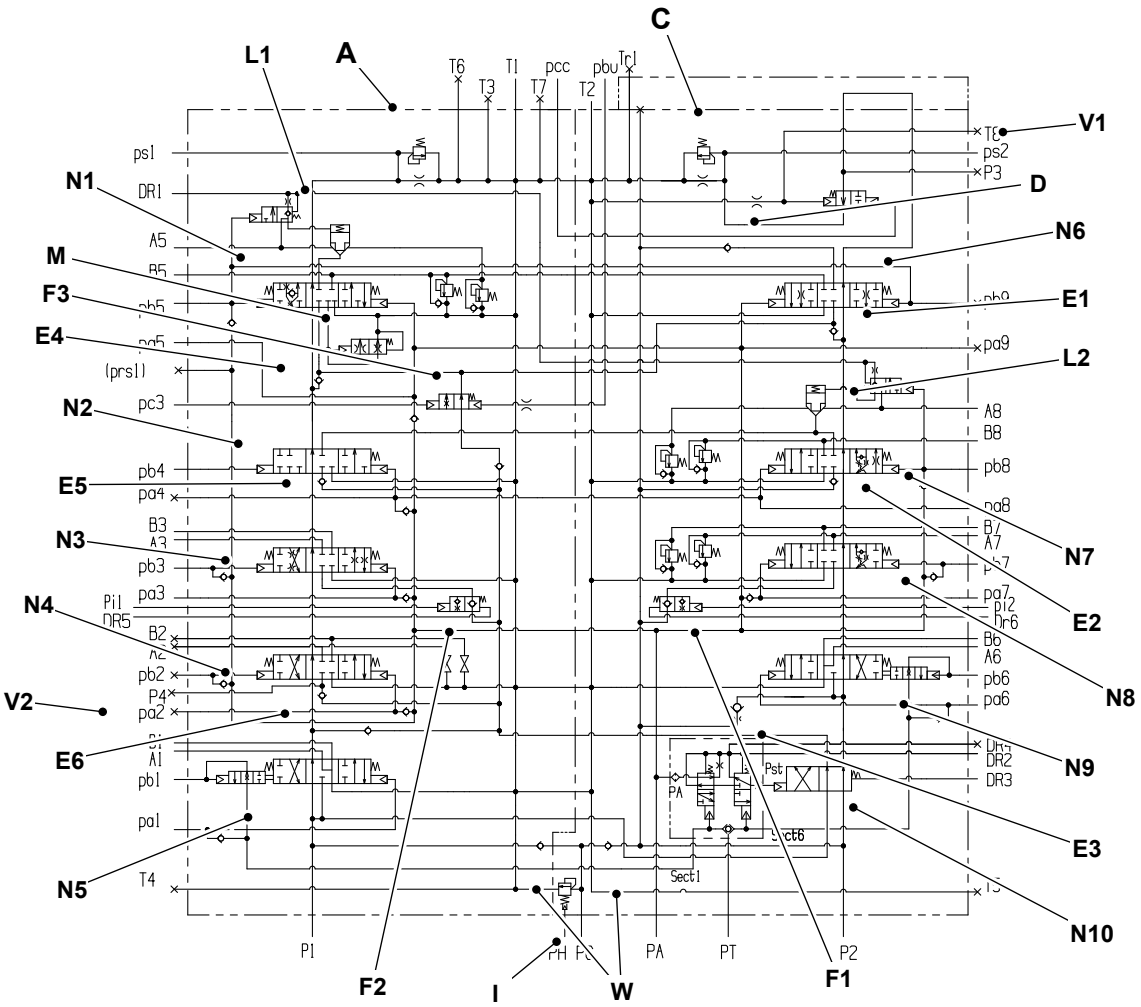
3. Apply clean hydraulic oil to all the sliding faces during the assembly.

4. Lap the sliding contact faces of the piston assemblies, balance plate and swash plate together on a flat surface. Refer to Figure 731.

Item	Description
F	Priority valve (F1 boom over bucket, F2 boom over slew, F3 slew over dipper
G	Blank
H	Pressure switch (H2 travel, H3 excavator)
I	MRV (Main Relief Valve)
L	Load holding valve (L1 dipper, L2 boom)
M	Regeneration valve - dipper
N	Spool (x10)
	N1 Dipper 1, N2 Boom 2, N3 Swing, N4 Option, N5 Travel Left, N6 Dipper 2, N7 Boom 1, N8 Bucket, N9 Travel Left, N10 Linear Travel (LT3)

Item	Description
O	Shuttle valve
P	P1- Pump 2 pressure in, P2- Pump 1 pressure in
Q1,Q2	Blank
S	End cap
V	V1 Merge out, V2 Merge in
W	MRV shuttle valve (X2)

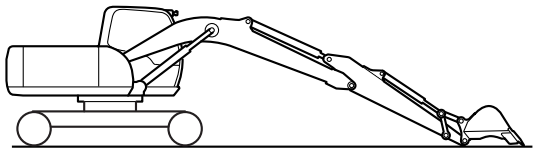
Figure 753. Main control valve schematic



Main relief valve pressure

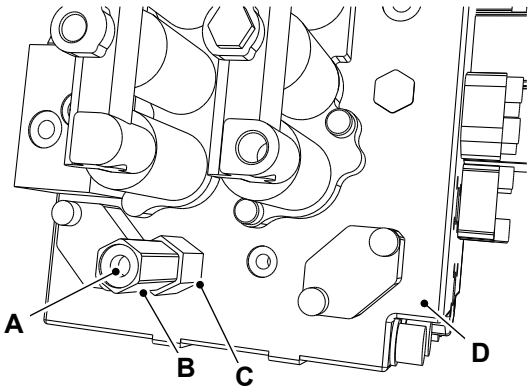
1. Prepare the machine and check the pressure.
   1.1. Operate the dipper out and lower the boom to set the bucket on the ground.

Figure 762.



   1.2. Make the machine safe. Refer to (PIL 01-03).
   1.3. Install a pressure gauge of the specified limit in TP1 or TP2.
   1.4. Start the engine and confirm that the engine is at its maximum no-load speed and it is in the H power band.
   1.5. Lift the boom and then operate the dipper out control. Read the pressure gauge with the dipper ram stalled at the end of its stroke.
   1.6. If the pressure is incorrect stop the engine and adjust the MRV (Main Relief Valve).
   1.7. For accurate setting, the pressure should be adjusted up to the required level.
2. Adjust the pressure setting.
   2.1. Make the machine safe. Refer to (PIL 01-03).

Figure 763.

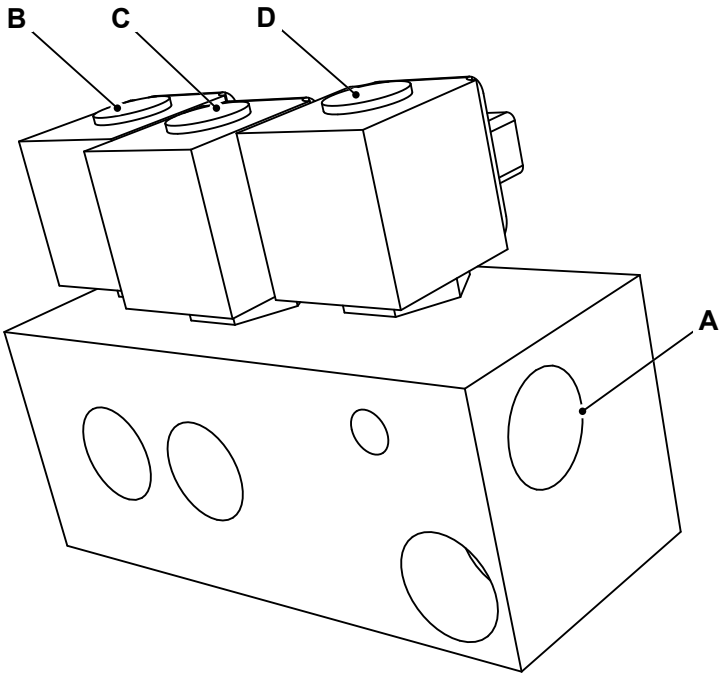


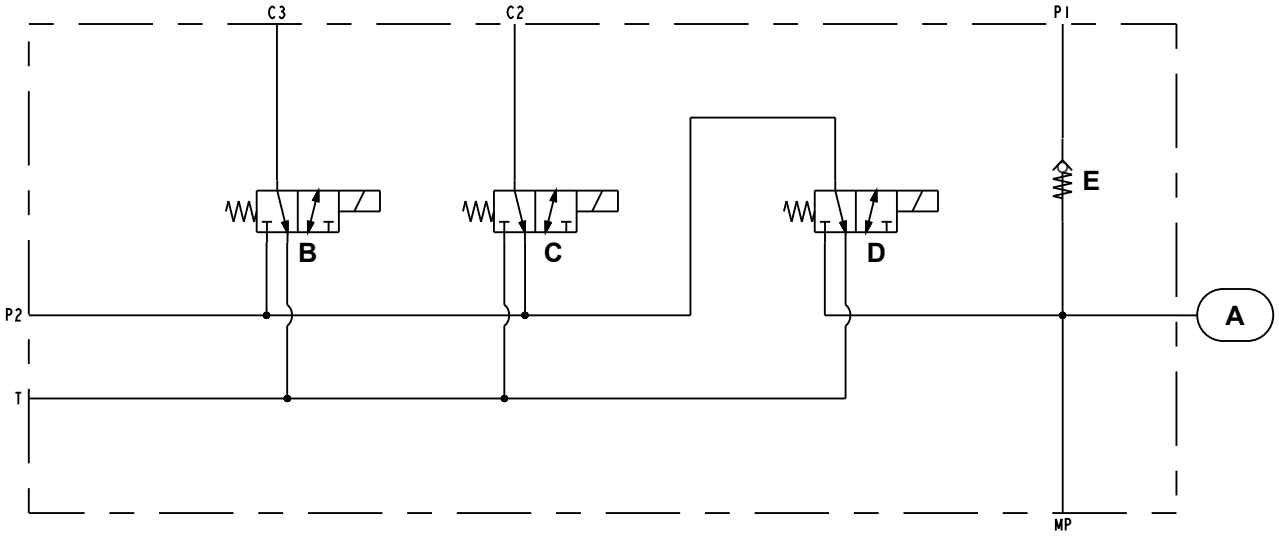
A Pressure setting nut
B Nut 1
C Nut 2
D Valve block

   2.2. Start the engine and confirm that the engine is at its maximum no-load speed and it is in the H power band.
   2.3. Stall the dipper.
   2.4. Hold the nut 2 and loosen the nut 1.
   2.5. Adjust the pressure setting nut as required. Turn the pressure setting nut clockwise to increase the pressure. Turn the pressure setting nut anticlockwise to decrease the pressure.
   2.6. Once required pressure is achieved on the pressure gauge, hold the nut 2 and tighten the nut 1.
3. Check the pressure.

Component Identification

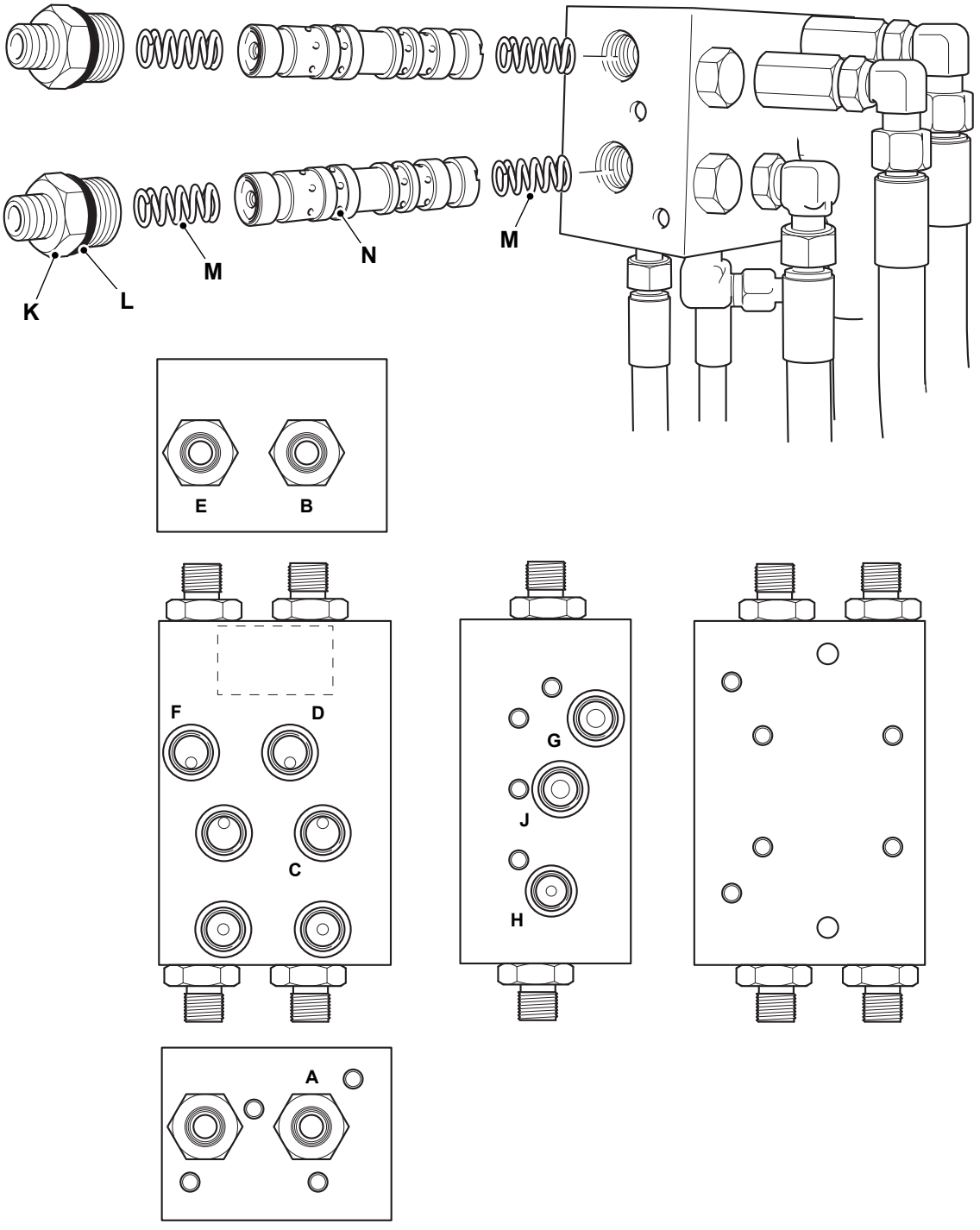
Figure 785.





A Accumulator - servo controls
B Travel speed solenoid valve (SV1)
C Cushion solenoid valve (SV2)
D Controls enable solenoid valve (SV3)
E Check valves

Figure 799.



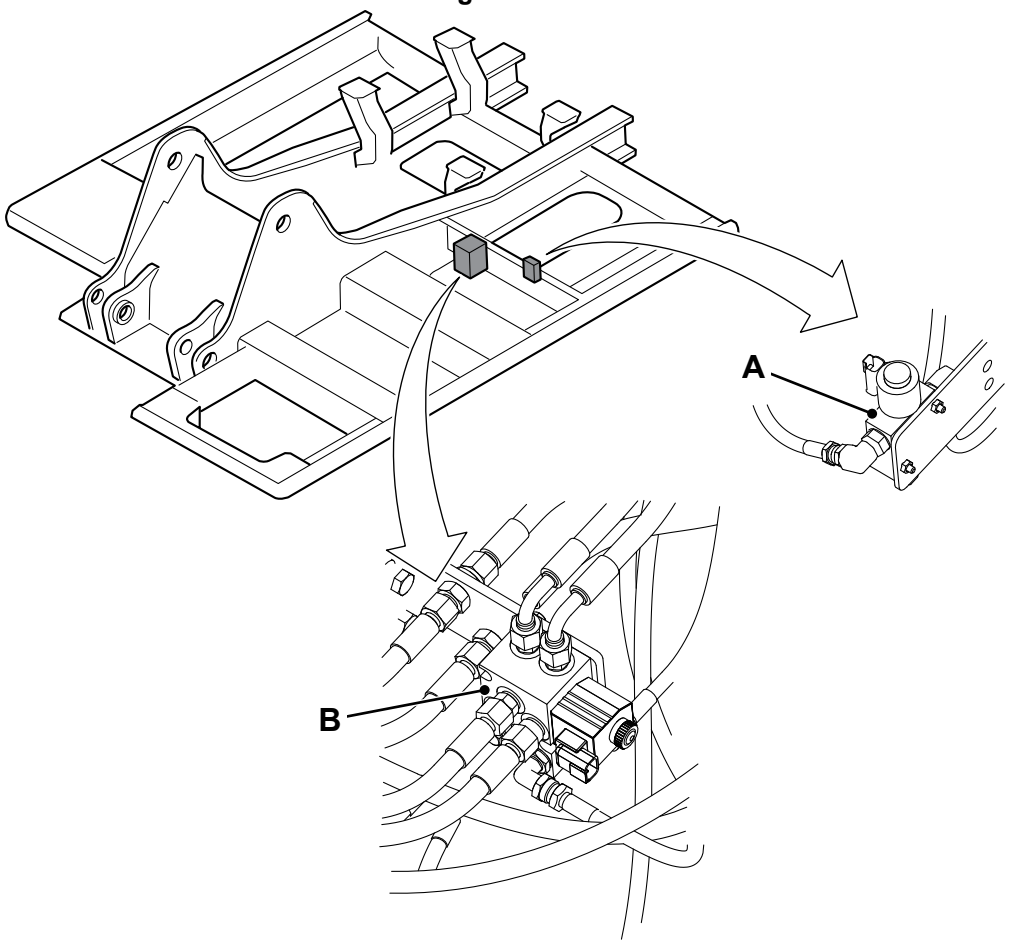
A Connector A (Pink hose)
B Connector B (Green hose)
C Connector C (Pink hose)
D Connector D (Green hose)
E Connector E (Blue hose)
F Connector F (Blue hose)
G Connector G (Yellow/Green hose)
H Connector H (Yellow/Yellow hose)
J Connector J (White/red hose)
K Adaptor
L O-ring
M Springs
N Spool

85 - Slew

Introduction

The slew brake control valves are located in the battery compartment.

Figure 810.



A Slew brake solenoid valve

B Slew shut off valve

- Periodically lubricate the internal locking balls on the female half of the coupling with silicone grease.

Essential Don'ts

- Never try to reconnect using a damaged half coupling as this will destroy the seals in the mating half and necessitate replacement of both halves.
- Do not leave the coupling where it may be run over by a machine or otherwise crushed, this will distort the sleeve and prevent connection and disconnection.
- Never try to turn the sleeve when the coupling is disconnected as this will cause the locking ball to jam under the locking sleeve and damage the coupling.
- Never try to strip the coupling down, there are no user serviceable parts. If the coupling is damaged it must be replaced with a new one.
- Never hit the centre poppet of the coupling to try and release the locked in pressure. This can cause irreparable damage to the coupling and serious injury.
- When connecting the couplings, never clamp on the sleeve of the female or nose of the male, this will cause distortion and/or damage.
- Never subject the couplings to external forces, especially side load. This can decrease the life of the coupling or cause failure.
- Never allow the torsional forces transmitted from the hoses to unscrew/screw together the couplings.
- Never use a coupling as a plug.
- Do not connect and disconnect with pressure in the line unless the coupling type is specifically designed to do so.

Disconnect and Connect

Some attachments are hydraulically powered. The following procedures show how to connect and disconnect the hydraulic hoses safely.

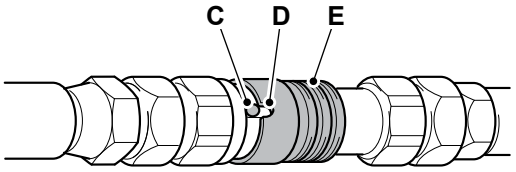
Connect

1. Make the machine safe.
   Refer to: Safety (Page 01-1).
2. Discharge the hydraulic pressure.
   Refer to: General (Page 30-3).
3. Wipe the two faces of the male and female couplings and make sure they are clean.
4. Make sure that ball in the female coupling is located in one of its slots.
5. Connect the male coupling into the female coupling.
6. Where applicable, rotate the sleeve half a turn and make sure that the locking ball does not align with the slot.

Disconnect

1. Make the machine safe.
   Refer to: Safety (Page 01-1).
2. Discharge the hydraulic pressure.
   Refer to: General (Page 30-3).
3. Where applicable, align the slot with ball.
4. Pull back the sleeve to release the coupling.

Figure 816.



C Ball
D Slot
E Sleeve

Health and Safety

Arc Welding

To prevent the possibility of damage to electronic components, disconnect the battery and the alternator before arc-welding on the machine or attached implements.

If the machine is equipped with sensitive electrical equipment, i.e. amplifier drivers, electronic control units (ECUs), monitor displays, etc., then disconnect them before welding. Failure to disconnect the sensitive electrical equipment could result in irreparable damage to these components.

Parts of the machine are made from cast iron, welds on cast iron can weaken the structure and break. Do not weld cast iron. Do not connect the welder cable or apply any weld to any part of the engine.

Always connect the welder earth (ground) cable to the same component that is being welded to avoid damage to pivot pins, bearings and bushes. Attach the welder earth (ground) cable a distance from the part being welded no more than 0.6m.

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

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

Page 33-18

Figure 828. 336-E7355 Issue 3 Sheet 4 of 19 - Secondary Fuses and Power Distribution

Page 33-19

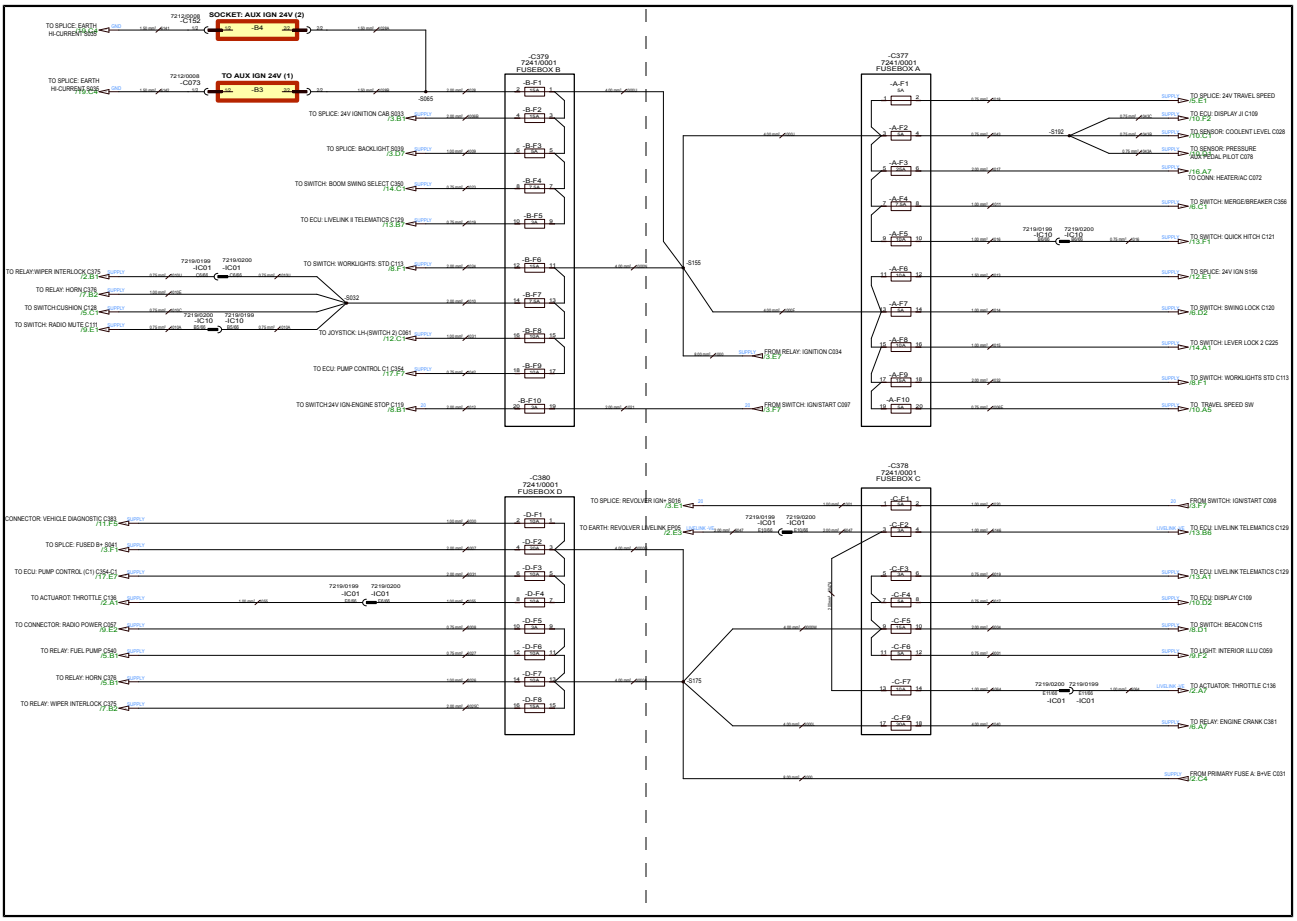


Figure 831. (Part 1 of 2)

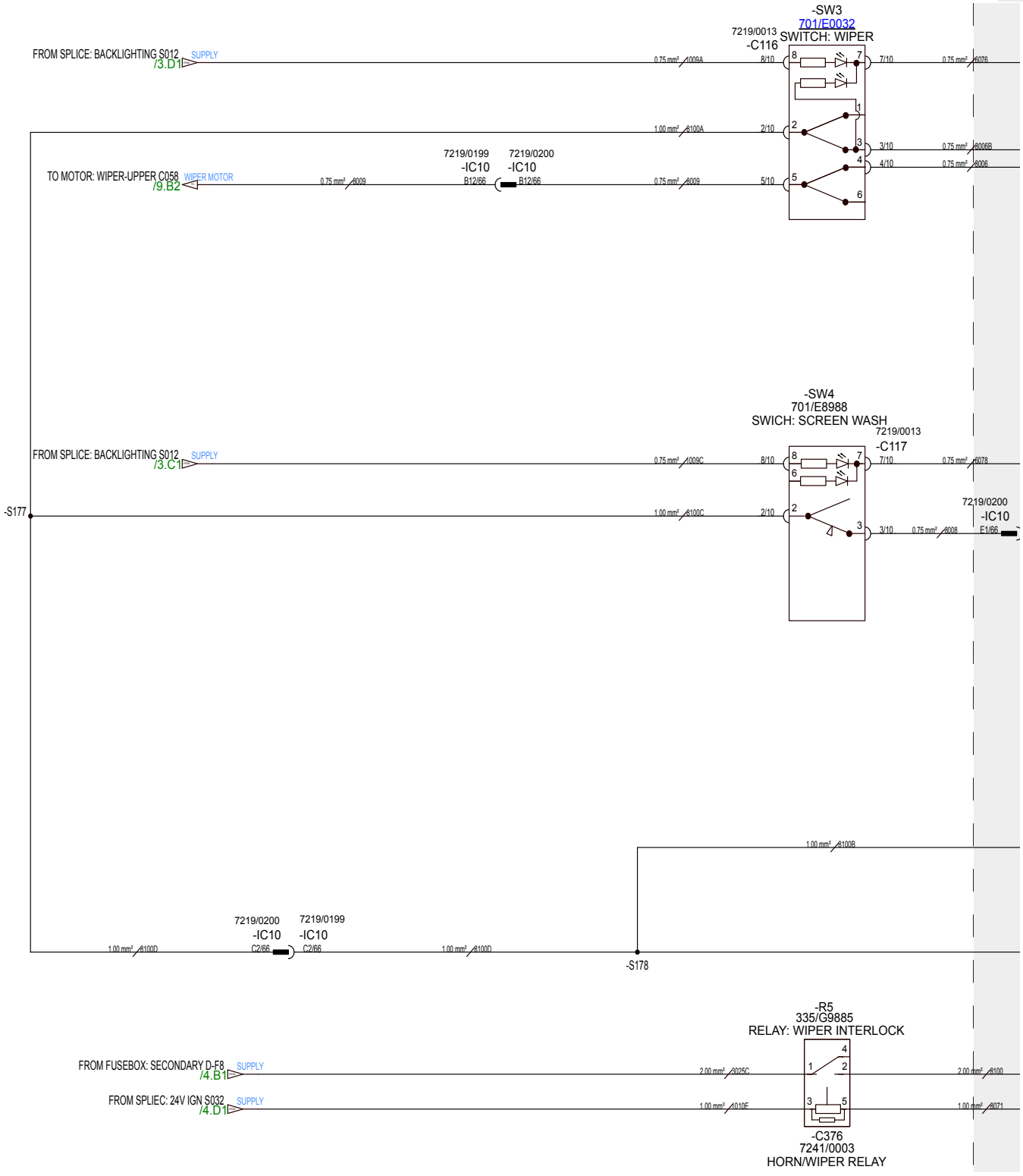


Figure 834. (Part 2 of 2)

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Page 33-70

Figure 841. 336-E7355 Issue 3 Sheet 17 of 19 - PFECU

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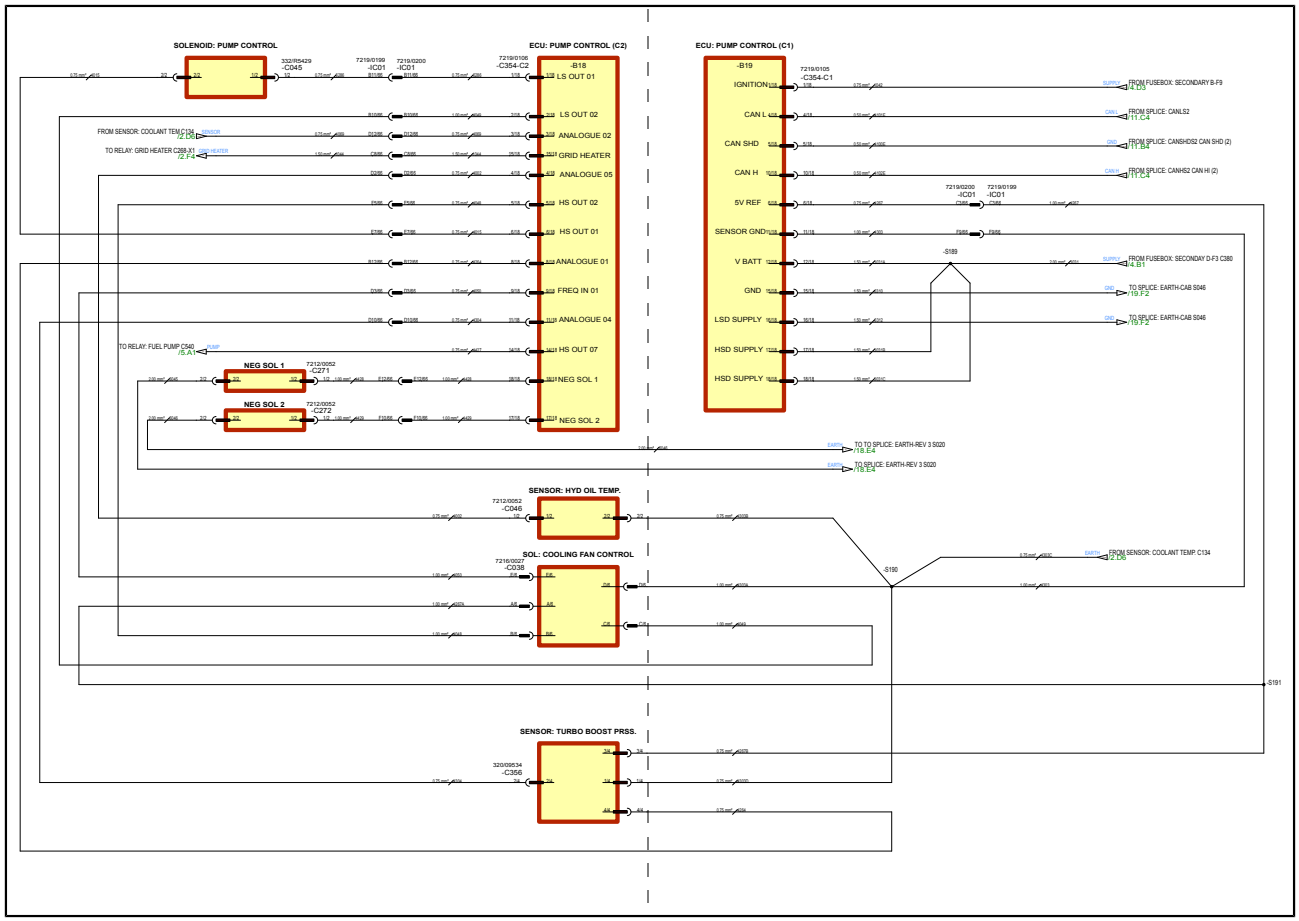


Connector Code	Device	Harness Location	Sheet
C145	Primary fusebox positive	Mainframe harness	2
C151	Socket auxiliary (1) 12V	Fascia harness	3
C152	Socket auxiliary (1) 24V	Cab harness	4
C155	Quick hitch solenoid	Mainframe harness	13
C156	Quick hitch pressure sensor	Mainframe harness	13
C160	Auxiliary on/off low flow solenoid A	Auxiliary harness	14
C161	Auxiliary on/off low flow solenoid B	Auxiliary harness	14
C162	Light - work light boom right hand	Boom harness	8
C163	Socket auxiliary 12V	Cab harness	3
C164	Auxiliary on/off high flow solenoid A	Auxiliary harness	14
C165	Auxiliary on/off high flow solenoid B	Auxiliary harness	14
C167	Hammer aux changeover solenoid	Cab harness	6
C173	Merge flow solenoid A	Auxiliary hydraulics harness	14
C174	Merge flow solenoid B	Auxiliary hydraulics harness	14
C200	CAN termination resistor	Fascia harness	11
C225	Lever lock (2) switch	Cab harness	14
C268	Grid heater relay	Mainframe harness	2
C271	Negative solenoid (1)	Mainframe harness	17
C272	Negative solenoid (2)	Mainframe harness	17
C350	Boom priority switch	Cab harness	14
C351	Livelink ignition relay - R12	Cab harness	13
C351	Boom/slew priority relay - R13	Cab harness	14
C354	PFECU	Cab harness	17
C356	Turbo boost pressure sensor	Mainframe harness	17
C357	Auxiliary low flow relay A - R7	Cab harness	12
C357	Auxiliary low flow relay B - R8	Cab harness	12
C359	Merge flow switch	Cab harness	6
C362	Auxiliary high flow relay A - R9	Cab harness	12
C362	Auxiliary high flow relay B - R10	Cab harness	12
C364	Warning buzzer	Cab harness	13
C365	Quick hitch diode	Cab harness	13
C366	Quick hitch relay - R11	Cab harness	13
C366	Travel speed relay	Cab harness	5
C368	Slew enable solenoid	Mainframe harness	6
C370	Left hand joystick diode	Cab harness	12
C371	Right hand joystick diode	Cab harness	12

Disconnect and Connect

⚠ **Notice:** Before you install a pair of batteries to a machine, make sure you know the machines voltage. Some machines require two batteries but have a 12 V electrical system. This means the batteries need to be connected in parallel.

For 24 V machines, the batteries must be connected in series. Incorrect voltage may result in serious damage to the electrical system.

The illustrations show typical battery connections. The actual battery connections installed on your machine may look different.

Make sure you connect the batteries correctly for your machine.

Disconnect

1. Make the machine safe. Refer to (PIL 01-03).
2. Get access to the battery or batteries (depending on the specification of your machine). The actual installation on your machine may vary from those shown below.
3. If the machine has a battery isolator, move the switch to the OFF position, then remove the key. Refer to (PIL 33-03-03).
4. Disconnect the negative battery lead first.
5. Disconnect the positive battery lead and store away from the batteries.
6. Disconnect and remove the battery link lead or leads.

Figure 847. Parallel and Series Connection (Example)

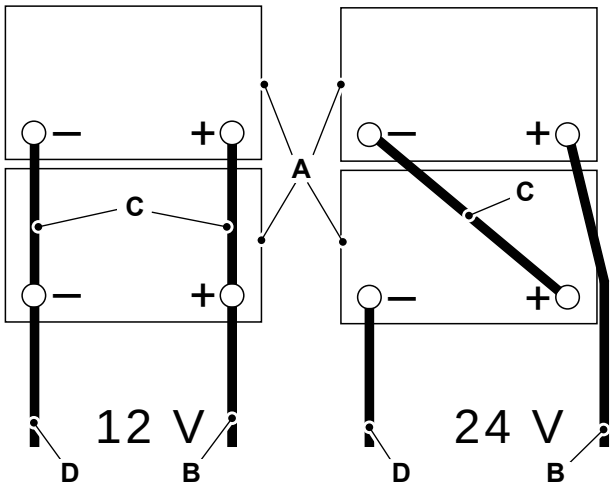
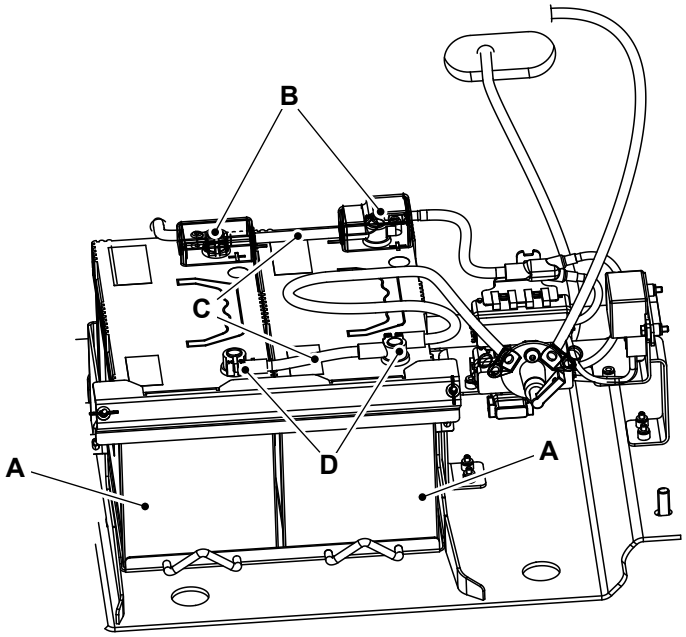


Figure 848. Twin Battery 12V Machines- Parallel Connection (Example)



A Battery
B Positive lead
C Battery link lead
D Negative lead

Component Identification

Fuses - Cab

Figure 855.

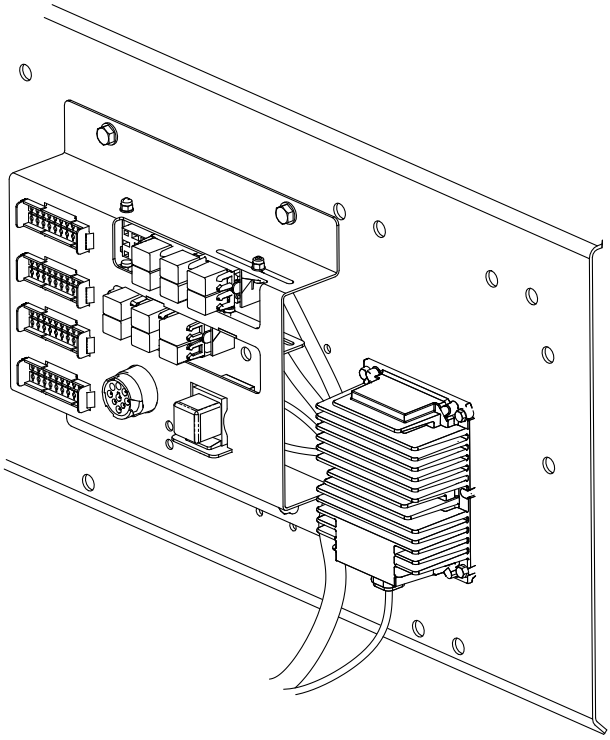


Figure 864. (Part 2 of 2)

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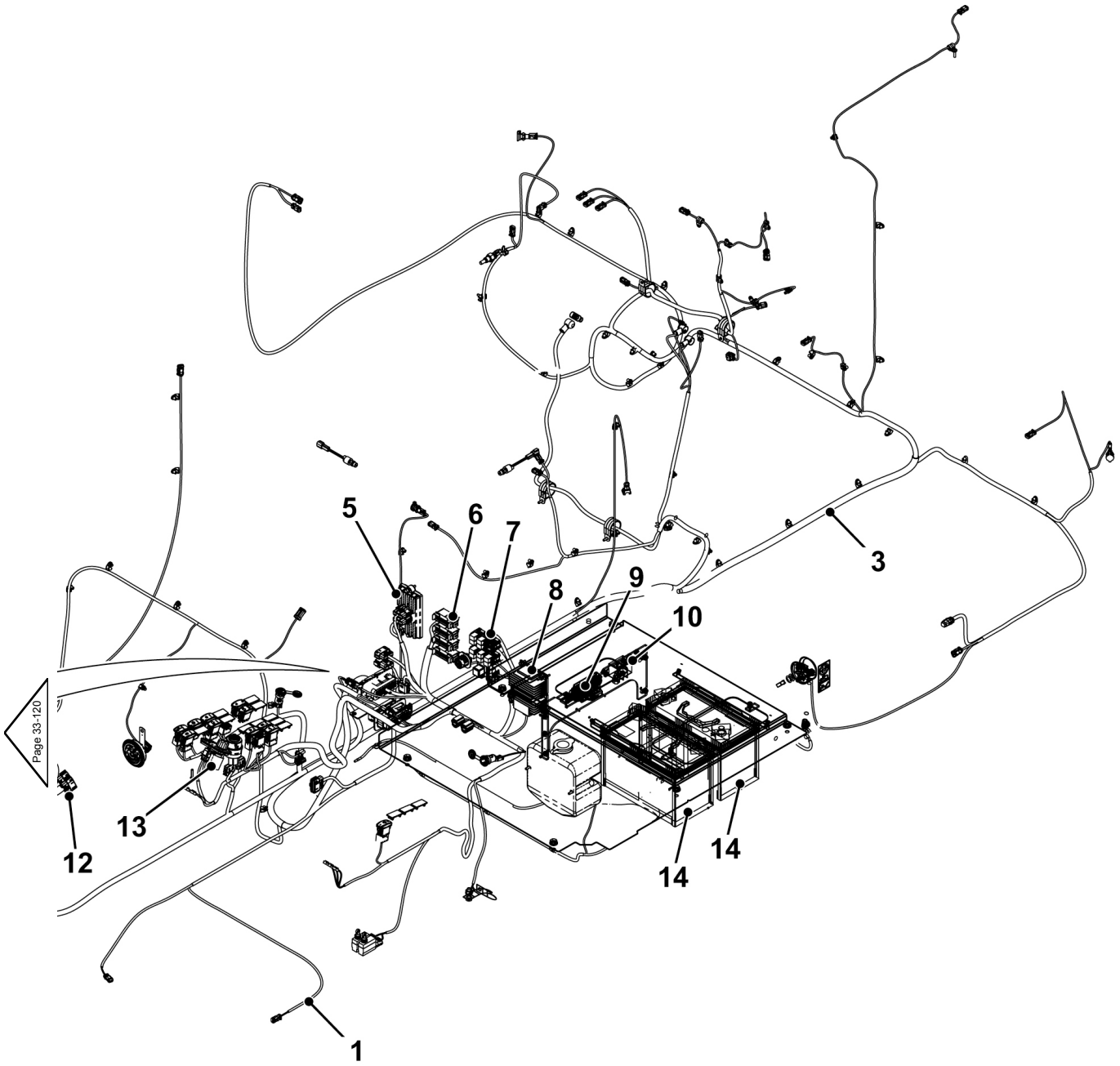


24 - Instruments

Contents **Page No.**

12 - Coolant Temperature Gauge

Introduction

An analog type coolant temperature gauge is part of the DECU (Display Electronic Control Unit).

Figure 905.

A Coolant temperature gauge

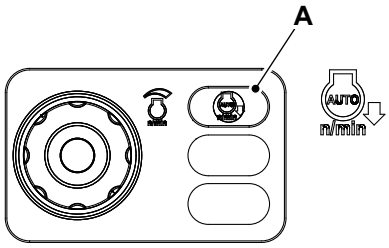
16 - Throttle Auto-Idle

Introduction

The auto-idle switch is part of the switch panel next to the throttle control knob. The switch is a non latching push button type. Pressing the button activates the auto-idle function. Pressing the button again de-activates the auto-idle function. When auto-idle is active an icon displays on the applicable instrument panel.

The auto idle switch forms part of the throttle control system. Refer to: Throttle Control System (Page 18-13).

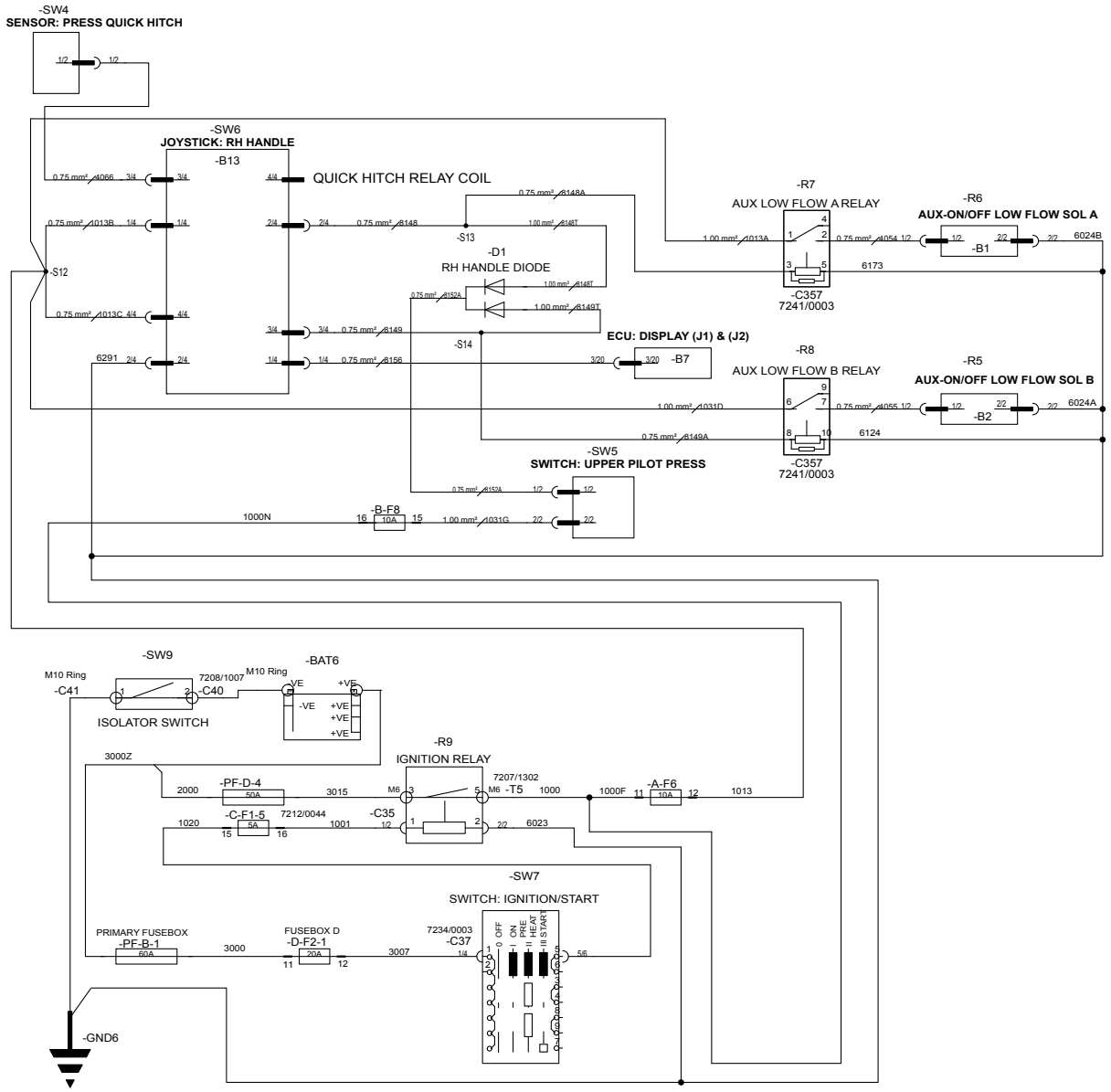
Figure 915.



A Auto-idle switch

Diagram

Figure 924. Electrical diagram - Low flow auxiliary

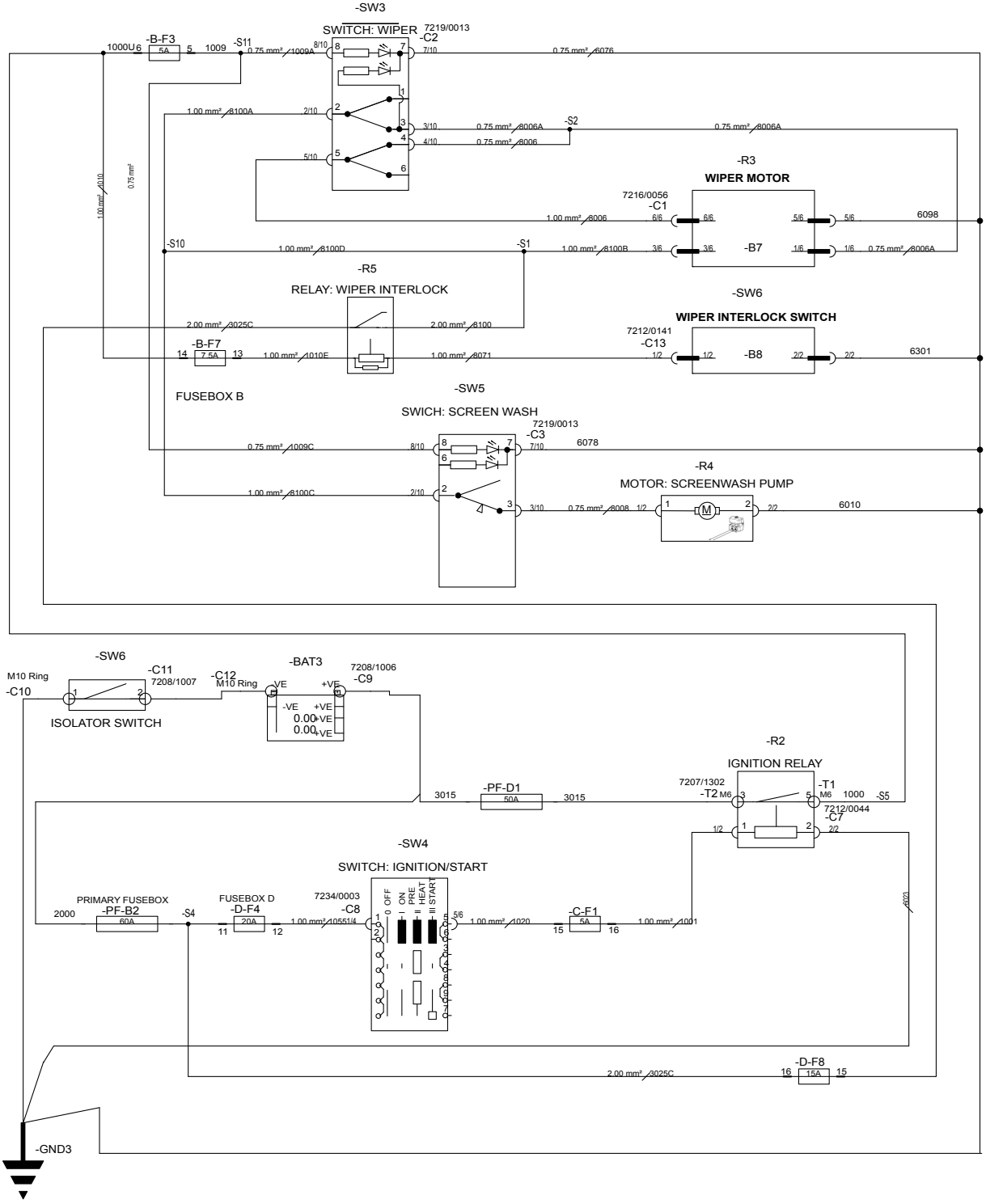


SW4	Quickhitch pressure sensor	**SW6**	Right joystick (low flow auxiliary buttons)
D1	Right joystick diode	**R7**	Auxiliary low flow relay A
R6	Auxiliary ON/OFF low flow solenoid A	**R5**	Auxiliary ON/OFF low flow solenoid B
R8	Auxiliary low flow relay B	**SW5**	Excavator pressure switch
B7	DECU (Display Electronic Control Unit) J1 and J2	**B-F8**	Fuse box B
BAT6	Battery	**SW9**	Isolator switch
PF-D-4	Primary fuse box	**C-F1-5**	Fuse box C
R9	Ignition relay	**PF-B-1**	Primary fuse box
D-F2-1	Fuse box D	**SW7**	Ignition switch
GND6	Earth		

Notes:

Diagram

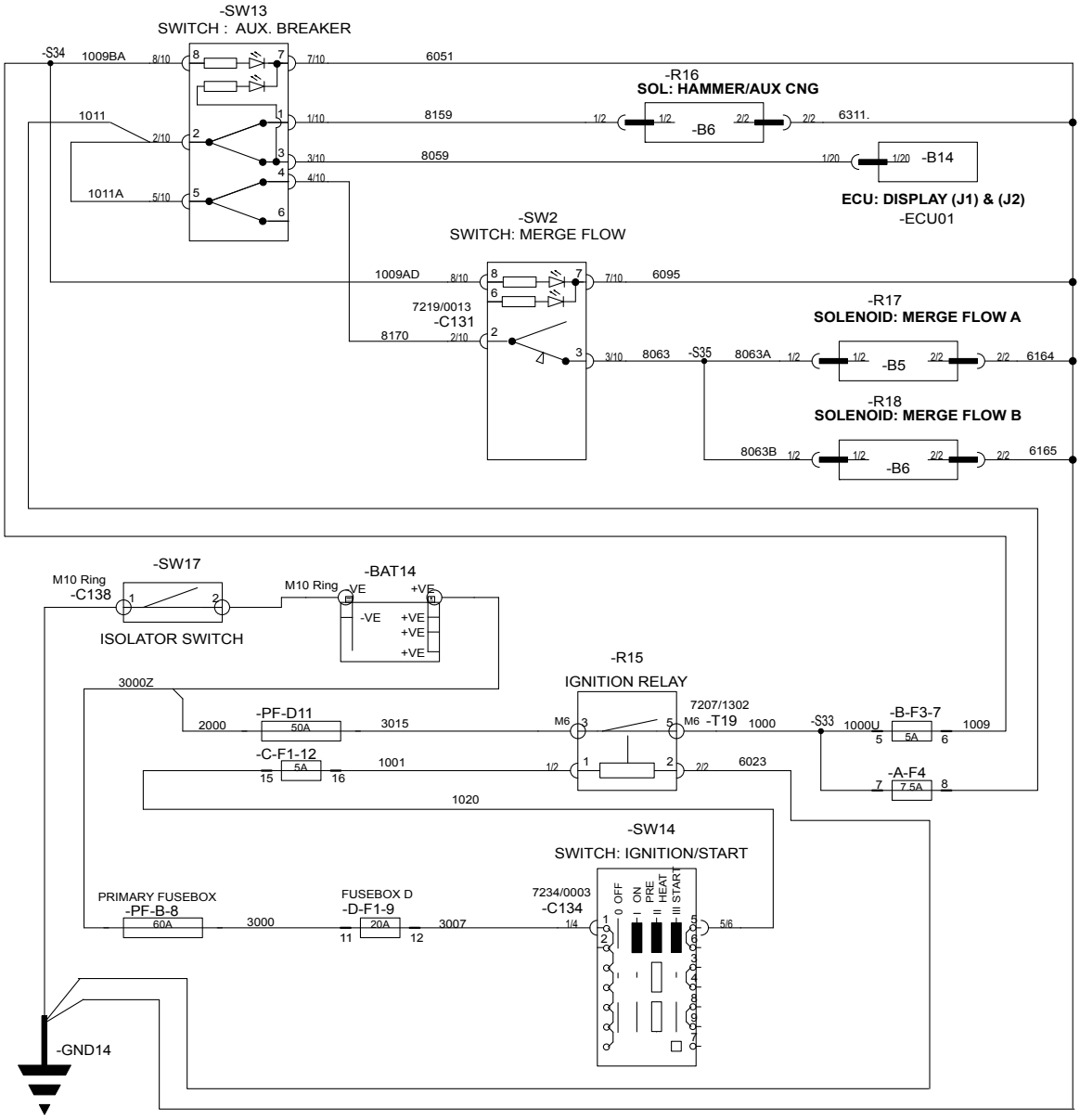
Figure 941. Electrical Diagram



SW3	Wiper switch	**SW4**	Ignition/Start switch
SW5	Screenwash switch	**SW6**	Wiper interlock switch
R2	Ignition relay	**R3**	Wiper motor
R4	Screenwash pump motor	**PF-B2**	Primary fusebox

Diagram

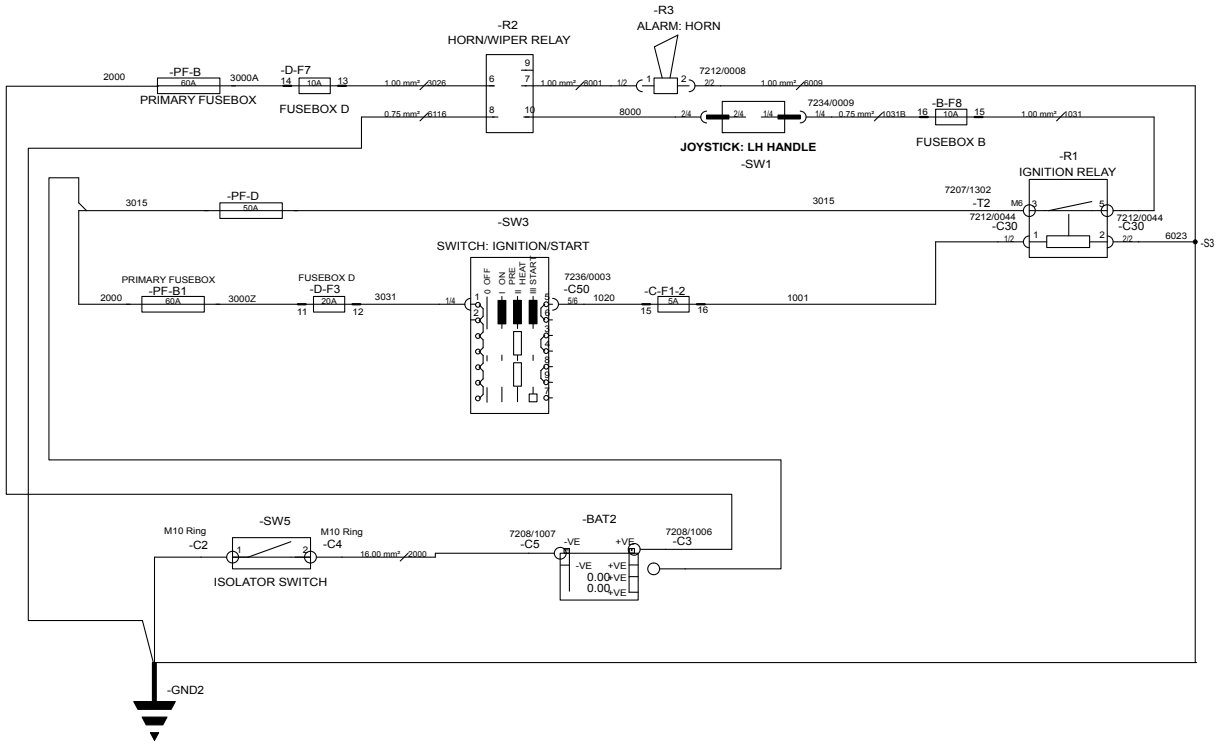
Figure 946. Electrical diagram



BAT	Batteries	**A-F4**	Fuse box A
B-F3	Fuse box B	**C-F1**	Fuse box C
D-F1	Fuse box D	**ECU01**	DECU (Display Electronic Control Unit)
GND	Earth point	**PF-B**	Primary fuse
PF-D	Primary fuse	**R15**	Ignition relay
R16	Rockbreaker / bi-direction changeover solenoid	**R17**	Merge flow 'A' solenoid
R18	Merge flow 'B' solenoid	**SW2**	Merge flow switch
SW13	Rockbreaker / bi-direction switch	**SW14**	Ignition switch
SW17	Battery isolator		

Diagram

Figure 953. Electrical diagram



PF-B	Primary fuse box	**D-F7**	Fusebox D
R2	Horn relay	**R3**	Horn
SW1	Left joystick (horn button)	**B-F8**	Fuse box B
R1	Ignition relay	**PF-D**	Primary fuse box
PF-B1	Primary fuse box	**D-F3**	Fuse box D
SW3	Ignition switch	**C-F1-2**	Fuse box C
SW5	Isolator switch	**BAT2**	Battery
GND2	Earth		

Component Identification

Figure 969.

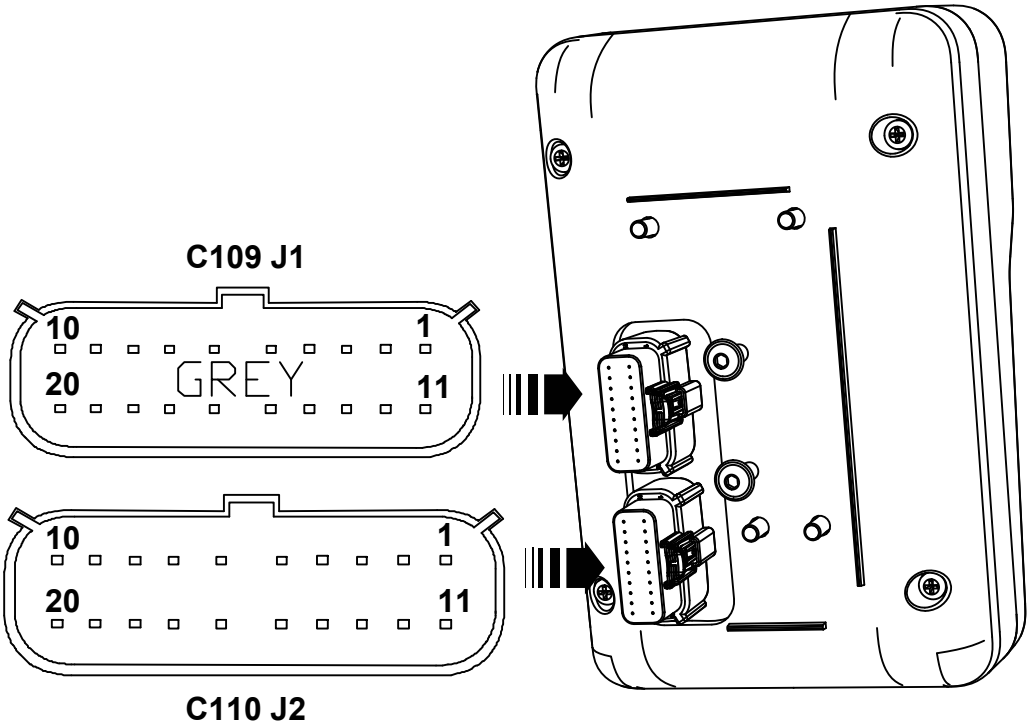


Table 264. Harness Connector C109 J1

Pin	Configuration	Function
1	Digital, active high, wake up	Rockbreaker enable switch
2	Digital, active high, wake up	Ignition supply
3	Digital, active low	One touch idle button
4	Digital, active high, wake up	Machine work lights
5	Digital, active high, wake up	Starting aid signal
6	CAN (Controller Area Network) shield	Termination resistor 1, Livelink, Throttle actuator, Termination resistor 2
7	CAN low	
8	CAN high	
9	Ground	
10	Vbatt	
11	Frequency output	Engine speed sensor signal
12	Digital, active high, wake up	Auxiliary pilot pressure switch
13	Digital, active high, wake up	Coolant level switch
14	Digital, active high, wake up	Slew lock switch
15	Digital, active low	Engine oil level switch
16	Digital, active low	Engine oil pressure switch
17	Digital, active low	Air filter switch
18	Digital, active low	Controls enable switch
19	Digital, active low	Water in fuel sensor
20	Digital, active low	Lever lock switch

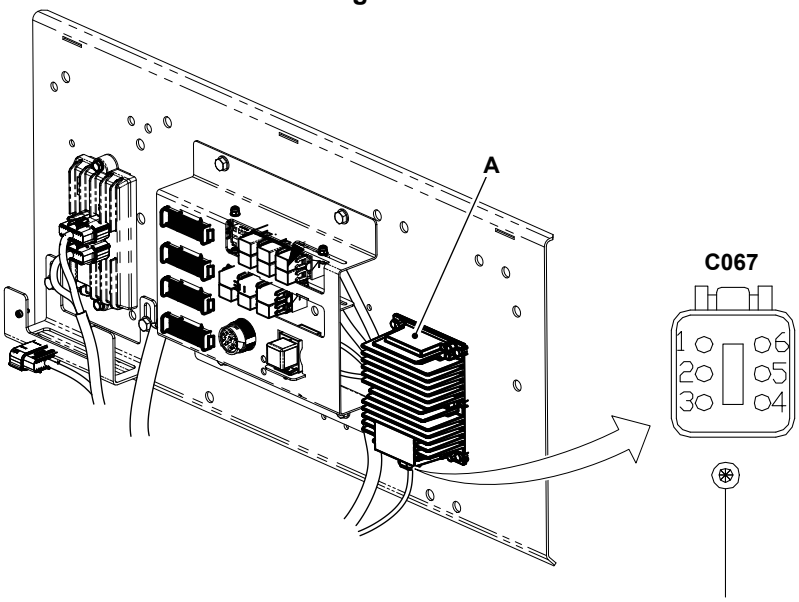
03 - Radio

Introduction

The radio operates on a 24V supply from the machine batteries.

Component Identification

Figure 992.



A Voltage converter 24/12V

C067 Harness connector

Check (Operation)

The expected pressure switch states are shown in the table. Operate the machine and check the pressure switch operation for each service function.

Table 271. Pressure switch

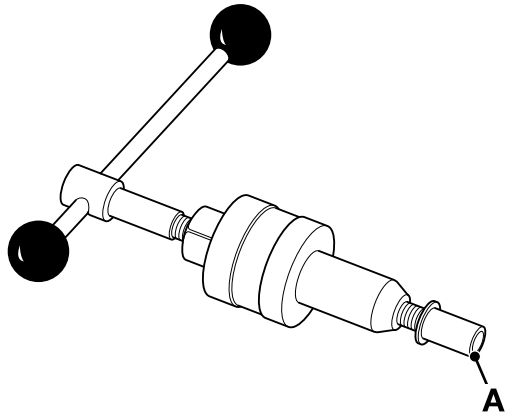
Services	Rockbreaker/auxilairy Pressure Switch	Slew Pressure Switch	Travel Pressure Switch	Excavator Pressure Switch	Boom Up Pressure Switch
Boom up	Off	Off	Off	On	On
Dipper in	Off	Off	Off	On	Off
Dipper out	Off	Off	Off	On	Off
Bucket in and out	Off	Off	Off	On	Off
Slew left and right	Off	On	Off	On	Off
Travel	Off	Off	On	Off	Off
Rockbreaker/auxiliary	On	Off	Off	On	Off

Pressure Switch Status Mode

Use the DECU (Display Electronic Control Unit) to select the pressure switch status mode. Pressure switch status is shown graphically on the DECU display. Refer to: Operation (Page 33-240).

Notes:

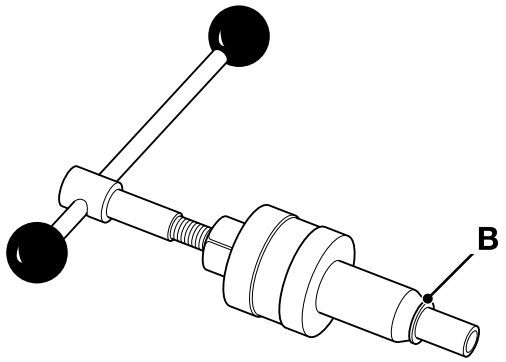
Figure 1007.



A Threaded insert

4. Wind the body of the installation tool down the threaded mandrel until it touches the head of the threaded insert.

Figure 1008.

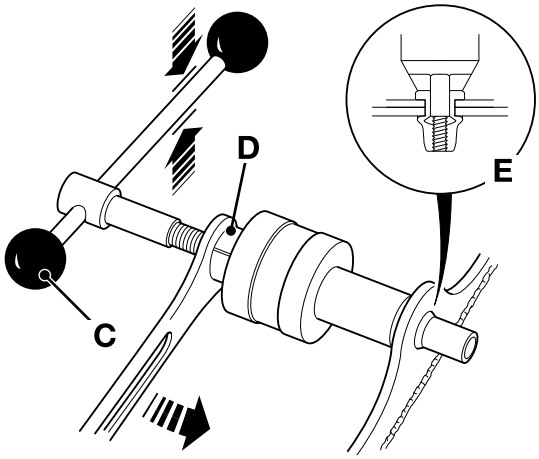


B Head of threaded insert

5. Insert the threaded insert (assembled to the tool) into the hole drilled in step 1.

6. Hold handle and at the same time draw the mandrel into the installation tool by turning nut. The threaded insert will contract in length and form an upset (smooth bulge) seating itself against the body/ framework. Note: The thread of the threaded insert must not be stripped, take care when upsetting the threaded insert.

Figure 1009.



C Handle
D Nut
E Body/Framework

7. Remove the installation tool.

03 - Engine

Introduction

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).

The choice of lubricant viscosity should be made based on the lowest ambient temperature at which the machine will be started and the maximum ambient temperature at which it will operate.

The technical data section provides guidance as to the temperature range that can be accommodated by standard oil viscosities and can be used to select an appropriate grade.

When selecting the oil viscosity grade, make sure that the oil conforms with or exceeds the recommended specification.

Health and Safety

⚠ **CAUTION** The cooling system is pressurised when the coolant is hot. When you remove the cap, hot coolant can spray out and burn you. Make sure that the engine is cool before you work on the cooling system.

CAUTION Antifreeze can be harmful. Obey the manufacturer's instructions when handling full strength or diluted antifreeze.

Technical Data

Table 301.

Item	Fluid
Engine coolant	Antifreeze HP/Coolant ASTM D6210

Subsection	Commercial name	Product Number	Colour	Shelf life	Technical data	Comments
Industrial grade epoxy adhesive	Loctite Hysol E-214 HP	333/Y7062	Light Grey Paste	-	307bar (4,449.3psi) tensile strength	Single component, heat activated formulation develops tough, strong, structural bonds which provide excellent peel resistance and impact strength. When fully cured, the product offers superior thermal shock resistance, excellent mechanical and electrical resistance properties and withstands exposure to a wide variety of solvents and chemicals. Bonds to a wide variety of materials, including metals, glass, ceramics and plastics. Cure at 120°C (247.8°F) or above until completely firm. Heat up to 150°C (301.8°F) for 2h, to maximize properties.
Anaerobic adhesive (Dimethacrylate)	Scotchweld RT-20	333/L9575	Green	365d	-	Single component anaerobic adhesives designed to secure cylindrical metal assemblies such as bearings on shafts, bushings, sleeves, housings, and keyways. Help prevent loosening, corrosion and leakage caused by shock and vibration. Full cure time 24h. Temperature range = -54°C (129.1°F) to 450°C (841.4°F). Not recommended for use on most plastics due to potential cracking of plastic parts.
Direct glazing	Terostat 8597 CT	4102/4900	Black	540d in original packaging	-	Cure rate: approx. 3–4mm/24h. Glazing time: maximum 20min (period of time between beginning of material application until inserting of the pane).
Direct glazing	Teroson 939CT / Terostat MS939	4102/5000	Black, off-white, grey, black	365d in original packaging	-	Skin formation time: approx. 10min. Cure rate: approx. 3mm/24h.
Direct glazing	Terostat 8900 HV	4103/4000	Black	180d	80bar (1,159.4psi) tensile strength	One component, pumpable adhesive/sealant based on polyurethane, which cures by reaction with moisture to an elastic rubber. The skin formation and curing time are dependent on humidity, temperature and depth of joint. High temperature and high moisture reduces curing time. Sag resistant, temperature range of -40°C (103.9°F) to 90°C (193.9°F).
Direct glazing	Terostat 8594 HMLC	4103/4100	Black	270d	85bar (1,231.9psi) tensile strength	Single component, moisture curing, adhesive/sealant for repair. Product with high shear modulus and low conductivity. Suitable for all applications that require very high electrical insulation of the adhesive used for the bonding of windows. Sag resistant.