

SERVICE MANUAL

SKIDSTEER LOADER
135 HD, 155 HD

EN - 9813/4450
ISSUE 2 - 03/2017

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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

01 - Machine

03 - Attachments, Couplings and Load Handling

06 - Body and Framework

09 - Operator Station

12 - Heating, Ventilating and Air-Conditioning (HVAC)

15 - Engine

18 - Fuel and Exhaust System

21 - Cooling System

24 - Brake System

27 - Driveline

30 - Hydraulic System

33 - Electrical System

72 - Fasteners and Fixings

75 - Consumable Products

78 - After Sales

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12 - Maintenance Safety

Introduction

Raised Machine

Never position yourself or any part of your body under a raised machine which is not correctly supported. If the machine moves unexpectedly you could become trapped and suffer serious injury or be killed.

Air Conditioning Maintenance

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

Compressed Air

Compressed air is dangerous. Wear personal protective equipment. Never point a compressed air jet at yourself or others.

Springs

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

Metal Splinters

You can be injured by flying metal splinters when driving metal pins in or out. Use a soft faced hammer or copper drift to remove and install metal pins. Always wear personal protective equipment.

Communications

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

Repairs

If your machine does not function correctly in any way, get it repaired straight away. Neglect of necessary repairs could result in an accident or affect your health. Do not try to do repairs or any other type of maintenance work you do not understand. To avoid injury and/or damage get the work done by a specialist engineer.

Hydraulic Pressure

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

'O' rings, Seals and Gaskets

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

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.

Counterweights

Your machine may be installed with counterweights. They are extremely heavy. Do not attempt to remove them.

Accumulators

The accumulators contain hydraulic fluid and gas at high pressure. Prior to any work being carried out on systems incorporating accumulators, the system pressure must be discharged by a JCB dealer, as the sudden release of the hydraulic fluid or gas may cause injury.

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.

Soft Ground

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

Figure 11.

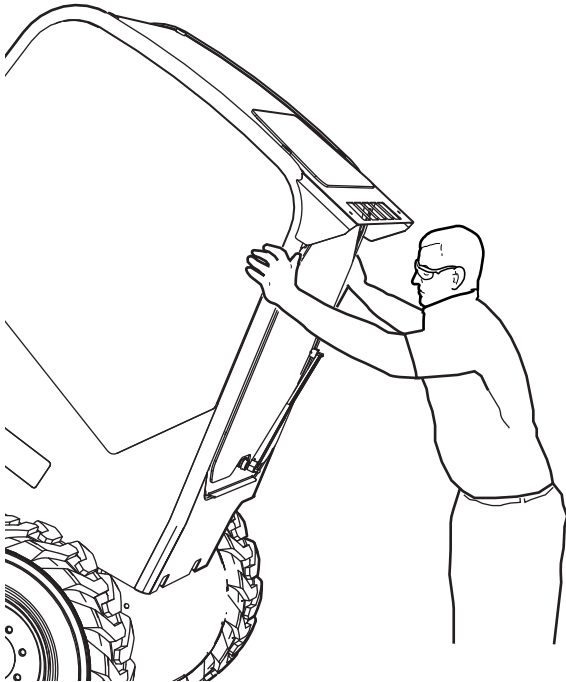
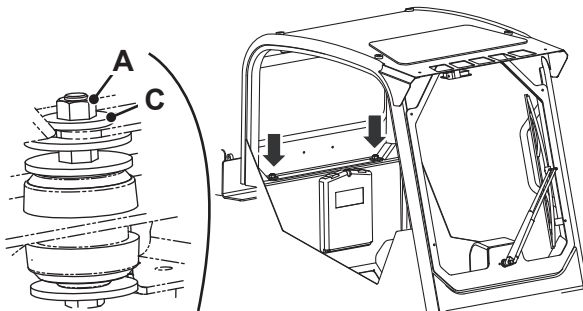
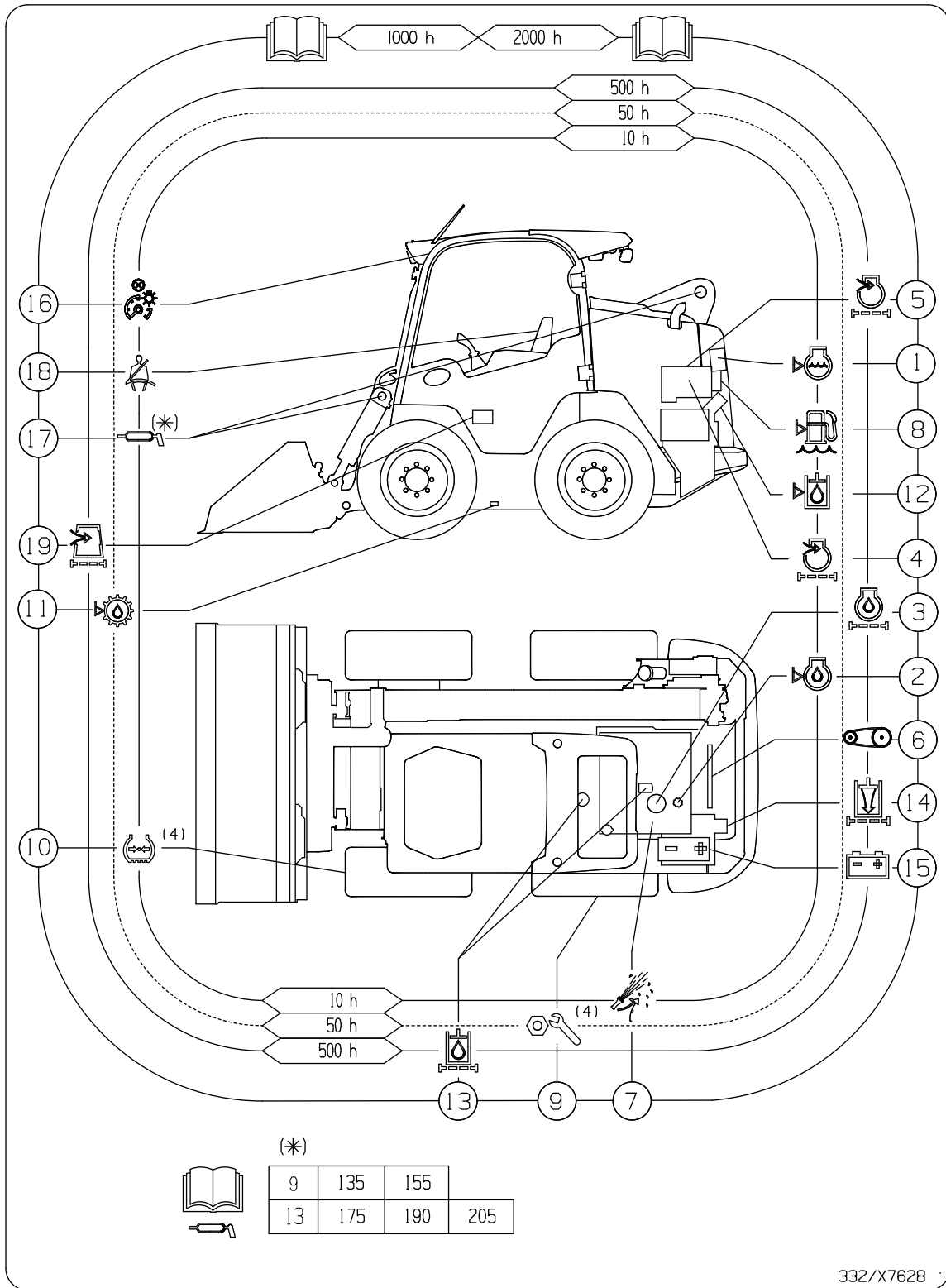


Figure 12.



- A Mounting nut
- C Compression plate

Figure 16. 135, 155



332/X7628



09 - Lift Arm Quickhitch

Contents	Page No.
03-09-00 General	03-7
03-09-03 Mechanical Quickhitch	03-9
03-09-09 Electronic Quickhitch	03-11

Health and Safety

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

Remove and Install

The Shovel remove and install procedure is similar to the Lift Arm Quickhitch remove and install procedure. Refer to Mechanical Quickhitch, Remove and Install (PIL 03-09).

Figure 22. Grapple Shovel

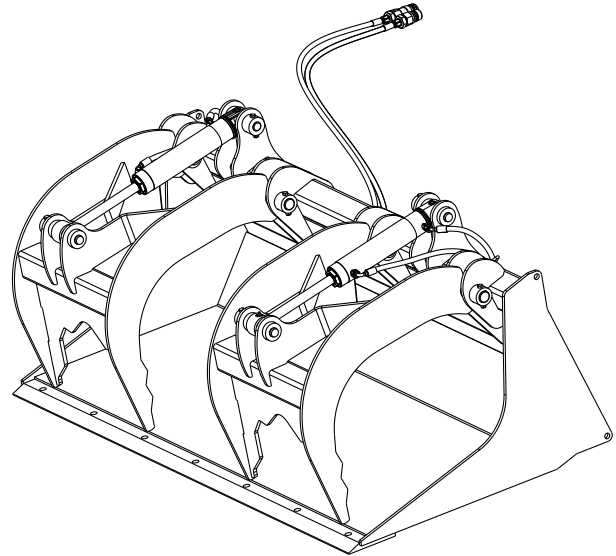
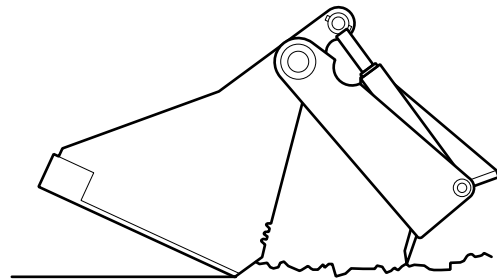


Figure 23. 6-in-1 Shovel





B Locking pin

6. Install it in its locking position.

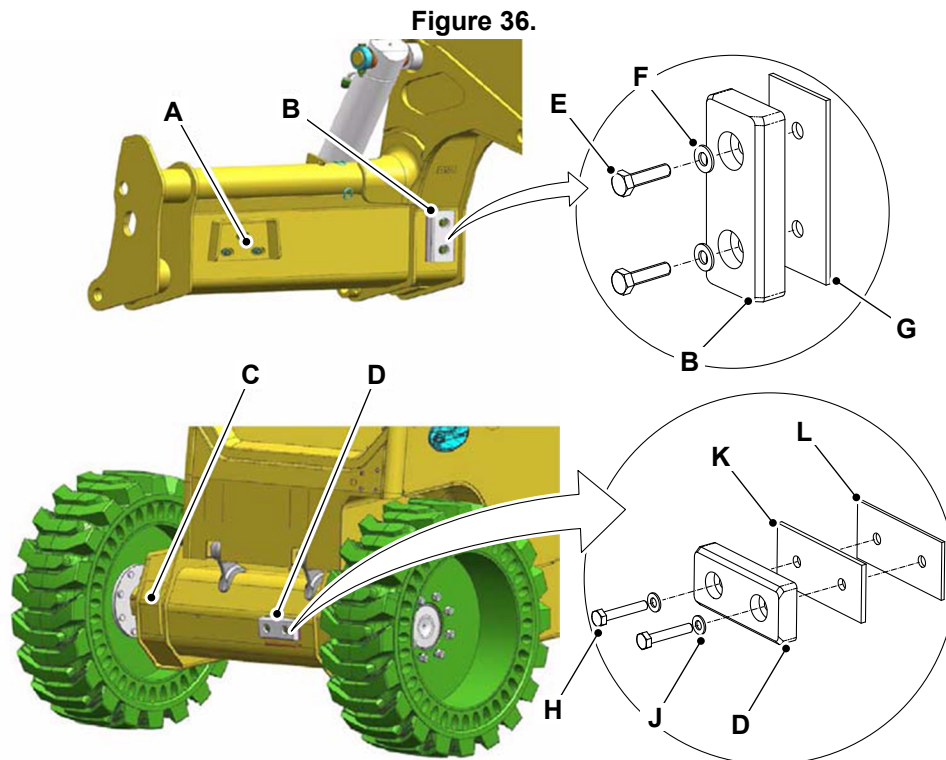
C Stowage position

Operation Position

1. Remove the locking pin from its locking position. Refer to Figure 26.
2. Install it in its stowage position. Refer to Figure 27.
3. Swing the door to the right and push it closed.
4. Lock the rear cover (if lock is installed).

Remove and Install

1. Remove the attachment from the lift arm. Refer to (PIL 03-09).
2. Make the machine safe with the lift arm raised. Refer to (PIL 01-03).
3. Remove the stop pad 1 from the lift arm as follows:
 - 3.1. Remove the bolt (x2) and the washer (x2).
 - 3.2. Remove the stop pad 1 from the machine.
 - 3.3. Remove the spacer 1.
4. Remove the stop pad 2 from the chassis as follows:
 - 4.1. Remove the setscrew (x2) and the washer 2 (x2).
 - 4.2. Remove the stop pad 2 from the machine.
 - 4.3. Remove the spacer 2 and spacer 3.



- A** Centering cup
C Support pad
E Bolt
G Spacer 1
J Washer 2
L Spacer 3

- B** Stop pad 1
D Stop pad 2
F Washer 1
H Setscrew
K Spacer 2

- 4.1. Remove the setscrew (x2) and the washer 2 (x2).
- 4.2. Remove the stop pad 2 from the machine.
- 4.3. Remove the spacer 2 and spacer 3.

Install

1. Installation is the opposite of the removal procedure. Additionally do the following step.
2. Adjust the stop pads. Refer to (PIL 06-12-33).



60 - Mirror

Contents

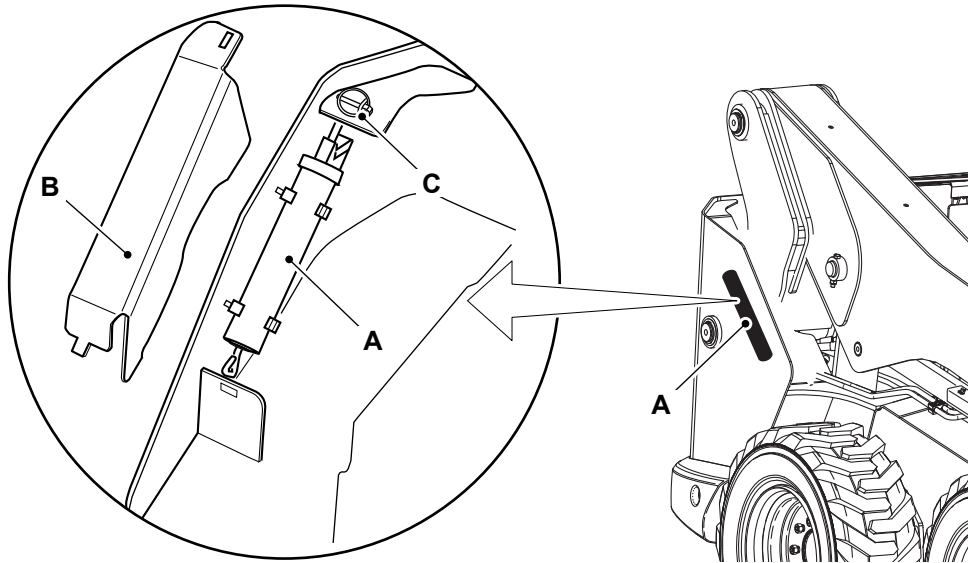
Page No.

06-60-06 Side Mirror 06-29

03 - Toolbox**Introduction**

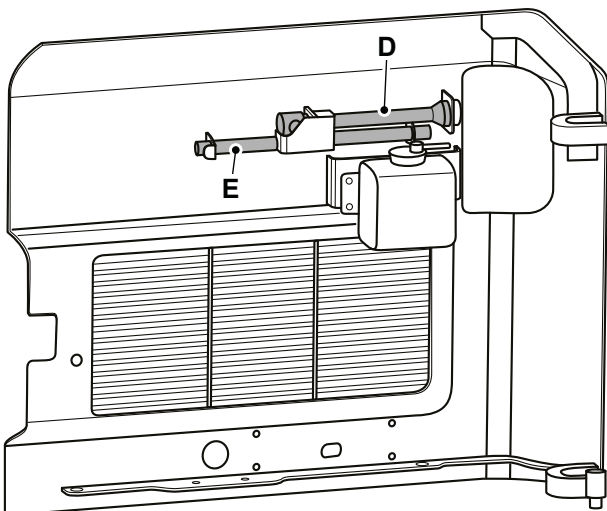
The grease gun is located under the cover on the lift arm tower, the cover is secured by a locking pin. The tommy bar and wheel brace (wheeled machines) are

located on the rear door. All tools must be secured in their correct positions when not in use.

Figure 43.

- A Grease gun
- C Locking pin

- B Cover

Figure 44.

- D Wheel brace
- E Tommy bar



00 - Operator Station

Contents

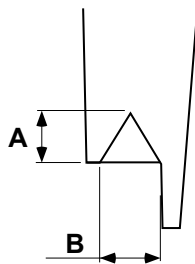
Page No.

09-00-00 General	09-3
------------------------	------

will be difficult to remove the cartridge from the applicator gun.

- 5.3. Pierce the front nozzle end of the cartridge to its maximum diameter.
- 5.4. Install the pre-cut nozzle.
- 5.5. Install the cartridge in the applicator gun.
 Note: Cold material will be very difficult to extrude. The cartridges must be pre-heated in a special oven for 1 hour to a temperature of 80°C (176°F). Pre-heating the cartridges makes the adhesive more workable and also brings the curing time down to 30 minutes.

Figure 61.

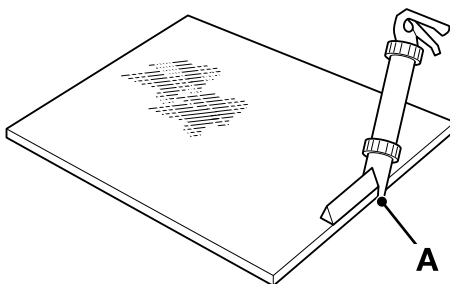


- A** 12.5mm
B 9mm

6. Apply the pre-heated adhesive to the glass (do not start in a corner). Keep the nozzle guide against the edge of the glass and make sure that the adhesive forms a continuous pyramid shape. Note: Once the pre-heated adhesive has been applied to the glass, install the glass in the aperture as soon as possible. If you wait too long then the sealant will form a skin, this will prevent the glass from bonding.

Duration: 10min

Figure 62.



- A** Nozzle guide

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

Remove and Install

Special Tools

Description	Part No.	Qty.
Glass Lifter	892/00842	2
Glass Extractor (Handles Only)	892/00846	1
Nylon Spatula	892/00847	1
Wire Starter	892/00848	1
Braided Cutting Wire	892/00849	1
Rubber Spacer Blocks	926/15500	2
Cut-Out Knife	992/12800	1
'L' Blades	992/12801	1

Consumables

Description	Part No.	Size
Black Polyurethane Sealant	4102/2310	0.31L
Black Primer/Activator	4104/2304	0.1L
Glass Replacement Kit	993/55701	-
Hand Cleaner	4104/1310	-
JCB Glass Cleaner	4006/3175	0.75L
Surface Cleaning Fluid	4103/1204	1L

Removal

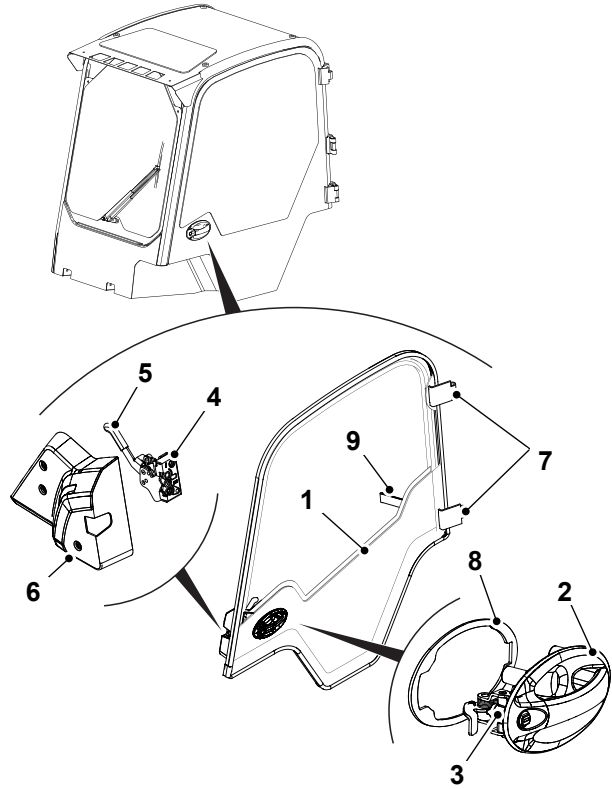
1. Position the machine on level ground and apply the park brake. Stop the engine. Put protective covers over the cab seat and control pedestals.
2. If a laminated pane breaks it will stay in one piece even though the glass is cracked. A toughened pane will shatter and fall apart. The method of removal of the glass depends upon which type it is.
 - 2.1. Laminated glass - leave installed until the old sealant has been cut away, after which it will be possible to lift the broken screen away from its frame housing in one piece.
 - 2.2. Toughened glass - remove as much of the shattered glass as possible prior to cutting out the old sealant.
3. Cut out the old sealant, leaving approximately 1 to 2 mm on the cab frame. There are several tools and techniques for doing this:
 - 3.1. Pneumatic Knife - This provides one of the easiest methods of removing the sealant around laminated glass. The tool, powered by compressed air, should be sourced locally. Press the handle to start the knife blade oscillating. Important: This tool must not be used on toughened glass. Insert the knife blade into the sealant. Slowly move the knife along the sealant with the blade positioned as close to the glass as possible.

00 - General

Component Identification	09-23
Remove and Install	09-24

Component Identification

The door assembly consists of the following components:

Figure 71.

- 1 Door frame (PIL 09-18)
- 2 Exterior door handle (PIL 09-24)
- 3 Lock (PIL 09-20)
- 4 Latch (PIL 09-22)
- 5 Interior door handle (PIL 09-24)
- 6 Latch cover
- 7 Hinge (PIL 09-23)
- 8 Gasket
- 9 Checkstrap



Install

1. Installation is the opposite of the removal procedure.



00 - Heating, Ventilating and Air-Conditioning (HVAC)

Contents	Page No.
12-00-00 General	12-3



12 - Heating, Ventilating and Air-Conditioning (HVAC)

00 - Heating, Ventilating and Air-Conditioning (HVAC)

00 - General

005 Blower High Speed (Orange)

006 Temperature Switch Signal (Purple)



09 - Expansion Valve

[Introduction](#) 12-23
[Check \(Operation\)](#) 12-24

Introduction

The thermal expansion valve (TEV or TXV) is a component in the air conditioning system that controls the amount of refrigerant flow into the evaporator thereby controlling the heating at the outlet of the evaporator.

Thermal expansion valves are often referred to generically as metering devices. Flow control, or metering, of the refrigerant is accomplished by use of a temperature sensing bulb, filled with a similar gas as in the system, that causes the valve to open against the spring pressure in the valve body as the temperature on the bulb increases. As the suction line temperature decreases, so does the pressure in the bulb and therefore on the spring causing the valve to close.

Refer to Component Identification (PIL 12-00) [Refer to: Component Identification \(Page 12-6\)](#).



00 - General

Introduction	12-45
Check (Operation)	12-46
Remove and Install	12-46

Introduction

The heater water valve allows the flow of coolant through the heater core to be controlled, and switched on and off without affecting the operation of the rest of the cooling system.

Engine coolant leaking into a hot water valve into the heater core will increase the outlet air temperature and thus decrease the expected air conditioning performance.

If the refrigerant operating pressures are within the range for the given inlet air temperature, then check to make sure that the heater coolant valve is closed, and the heater core tubes are neutral or cool to the touch. If this is not the case then refer to Water Valve-Check Operation (PIL 12-21).

Refer to Component Identification (PIL 12-00).



Notes:

Table 21. Engine - Will Not Start or Difficult to Start (Exhaust Smoke)

Cause	Remedy
Starting procedure incorrect.	Verify proper starting procedure.
Air intake system blocked or restricted.	Visually check the air intake for blockage or obstruction, remove as required. Check the air filter elements for signs of blocking, replace as required.
Fuel is aerated.	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Fuel lift pump not operating correctly (fuel supply inadequate).	Check that the lift pump operates and delivers fuel to the high pressure fuel pump. Check the correct electrical wires for open or short circuits. Check fuses.
Fuel is contaminated or incorrect grade diesel fuel used.	STOP THE ENGINE. Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel. Monitor the engine performance. Dirty fuel will cause damage to the high pressure fuel pump and injectors.
Fuel filter(s) blocked, fuel supply restricted.	Check/replace the fuel filter(s). Check fuel lines for restriction.
Fuel drain return line blocked, not connected properly.	Verify that the fuel return line is not obstructed and connected to the top of the fuel tank.
Check fuel inlet restriction.	Maximum inlet restriction to fuel transfer pump must not exceed 100 mm Hg
One or more fuel injectors worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.
Inlet and exhaust valve clearances set incorrectly.	Set the valve clearances to the recommended clearances.
Engine compression low in one or more cylinders.	Check the engine compression.
Cranking speed too slow.	See Also: Table 22. Engine - Will Not Crank or Cranks Slowly
ECM or electrical sensor fault.	Check the electronic fault codes. Check the electrical connections at the ECM and sensors.
Worn or malfunctioning high pressure fuel pump.	Check the electronic fault codes. Do all the necessary fault finding checks before removal of the high pressure fuel pump.

Table 22. Engine - Will Not Crank or Cranks Slowly

Cause	Remedy
Starting electrical circuit connections loose or corroded.	Clean and tighten connections.
Battery charge low.	Check battery voltage, charge the battery or replace as required. Make sure that the alternator is functioning correctly and charging the battery.
No electrical connection to starter solenoid.	Check voltage to solenoid.
Crankshaft rotation restricted.	Use special tool 892/01147 (crankshaft turning tool) to manually turn the engine and check for any severe rotational resistance.
Solenoid or starter motor fault.	Replace starter motor.
Starter motor operating but not cranking.	Remove the starter motor and check for broken teeth on the ring gear or broken starter motor spring.

Check (Pressure)

Special Tools

Description	Part No.	Qty.
Pressure Gauge (0-40 Bar)	892/00278	1
Digital Hydraulic Pressure Test Kit	998/11051	1

Compression test

Important: Compression tests should only be used to compare pressures between cylinders of an engine. If one or more cylinders vary more than 3.5bar (50.7psi) then those cylinders may be damaged. The cylinder compression test should not be the only test for determining the condition of an engine.

The following conditions can affect the result of the cylinder compression test, make sure you check the following points before starting the test:

- The battery is in good condition.
 - The battery is fully charged.
 - The starter motor operates correctly.
 - The valve lash adjustment is set correctly.
 - The compression gauge is accurate.
1. Remove the fuel injector from the cylinder to measure the compression for that cylinder.
 2. Connect a suitable compression gauge to the cylinder.
 3. Disconnect the ESOS (Engine Shut-Off Solenoid).
 4. Operate the starter motor and record the pressure on the compression gauge.
 5. Repeat step 1 to step 4 for each cylinder.
 6. Repair the engine if the compression is lower than the repair limit. Refer to Table 39.

Important: Make sure that you measure the compression on all of the cylinders. If all of the cylinders are not checked an improper diagnosis may result. The compression pressure will vary with the change in engine RPM (Revolutions Per Minute). It is necessary to keep the engine RPM constant for all cylinders when you are taking a compression reading.

Table 39.

-	Standard at assembly	Repair limit
Compression pressure ⁽¹⁾	29.4bar (426.1psi)	24.5bar (355.1psi)

(1) The compression pressure is taken at 250 RPM.

Oil Pressure Test

Important: You must use a suitable pressure gauge that measures the oil pressure in the engine. An oil pressure gauge that has a defect can indicate low oil pressure.

1. Make sure that the engine is filled to the correct oil level.
2. Connect the pressure gauge to a pressure test point location for engine oil.
 Special Tool: Digital Hydraulic Pressure Test Kit (Qty.: 1)
 Special Tool: Pressure Gauge (0-40 Bar) (Qty.: 1)
3. Start the engine. Allow the engine to obtain normal operating temperature.
4. Keep the oil temperature constant with the engine at the rated RPM. Read the pressure gauge.
5. Check the engine oil pressure is correct. Refer to Table 40.

Table 40.

Oil Pressure ⁽¹⁾	
Oil pressure at high idle	1.96–4.41bar (28.4–63.9psi)
Oil pressure at low idle	0.49bar (7.1psi)

(1) The 011 temperature must be 80–110°C (175.9–229.8°F)



00 - General

Introduction	15-35
Technical Data	15-36
Check (Condition)	15-36
Calibrate	15-37
Remove and Install	15-38

Introduction

The cylinder head is located above the cylinders on top of the crankcase. It closes in the top of the cylinder, forming the combustion chamber. This joint is sealed by a cylinder head gasket.

The cylinder head also provides the space for the passages that feed air and fuel to the cylinder and allow the exhaust to escape. The cylinder head is also used to mount the valves and fuel injectors.

Check (Condition)

Check the condition of the main bearings by measuring the clearance between the two bearing halves.

If the crankshaft journals and the bores for the crankcase and connecting rods were measured, no further checks are necessary. If the bearing clearance measurement is necessary, the use of the plastic gauge is an acceptable method. The plastic gauge is less accurate on journals with small diameters if the clearances are less than 0.1mm. When you use the plastic gauge make a note of the following:

- Make sure that the backs of the bearings and the bores are clean and dry.
- Make sure that the bearing locking tabs are properly seated in the tab grooves.
- The crankshaft must be free of oil at the contact points of the plastic gauge.

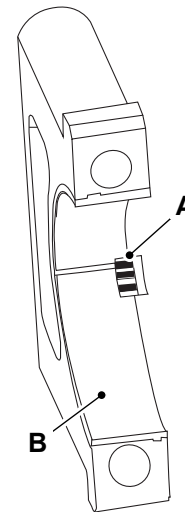
Table 49. Plastic Gauges

Colour code	Dimensions
Green	0.025–0.076mm
Red	0.051–0.152mm
Blue	0.102–0.229mm
Yellow	0.23–0.51mm

Measurement Procedure

1. Put the plastic gauge on the crown of the bearing that is in the cap.
2. Do not allow the plastic gauge to extend over the edge of the bearing.
3. Use the correct torque-turn specifications in order to install the bearing cap.
4. Do not use an impact wrench. Be careful not to dislodge the bearing when the cap is installed.
5. Do not turn the crankshaft when the plastic gauge is installed.
6. Carefully remove the cap, but do not remove the plastic gauge.

Figure 120.



- A** Plastic gauge
- B** Bearing

7. Measure the width of plastic gauge while the plastic gauge is in the bearing cap or on the crankshaft journal.
8. Remove all of plastic gauges before you install the bearing cap.

Check (Condition)

1. Inspect the camshaft gear teeth for signs of damage or excessive wear.
2. Inspect the cam lobes, the camshaft journals, and the cam bearing surfaces inside the crankcase for signs of excessive wear, or scoring. Make sure that the dimensions are within the service limits.
3. Inspect the bearing surfaces of the tappets for signs of excessive wear or damage. Check that the dimensions are within service limits.
4. Inspect the tappet bores inside the crankcase for signs of excessive wear or damage. Check that the dimensions are within service limits.
5. If any of the camshaft journals or lobes are worn or damaged then the relative oil feed galleries in the crankcase and camshaft may be blocked. Make sure all oil ways are clear and free from debris. Refer to (PIL 15-03).

Check (Condition)

At the recommended service interval, visually inspect the drive belt for damage.

1. Make the machine safe. Refer to (PIL 01-03).
2. Stop the engine and let it cool down.
3. Replace the drive belt if it has cracks or if it is frayed or has pieces of material missing.

00 - General

Introduction	15-79
Health and Safety	15-80
Check (Condition)	15-80
Remove and Install	15-81

Introduction

Introduction

Engine performance and durability will be severely affected if the quality of the air intake is poor.

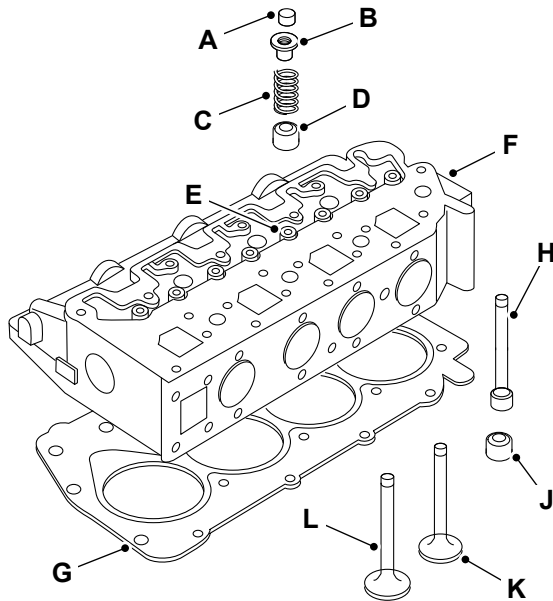
A dirty and blocked air filter will reduce the amount of air entering the combustion chamber which can cause engine misfiring, black smoke and low output power.

A dirty and blocked air filter can also lead to abrasion of the cylinder bores and valves (referred to as dusting). This will cause excessive oil consumption, black smoke, low output power and a reduced engine life.

This is a dry-type air filter with a replaceable paper filter cartridge.

Component Identification

Figure 150.



- A Collets
- B Valve spring retainer
- C Valve spring
- D Valve seal
- E Valve guide
- F Cylinder head
- G Cylinder head gasket
- H Push-rod
- J Tappet
- K Exhaust valve
- L Inlet valve

Operation

The inlet valve and the exhaust valve are opened and closed by the rotation and movement of the following components:

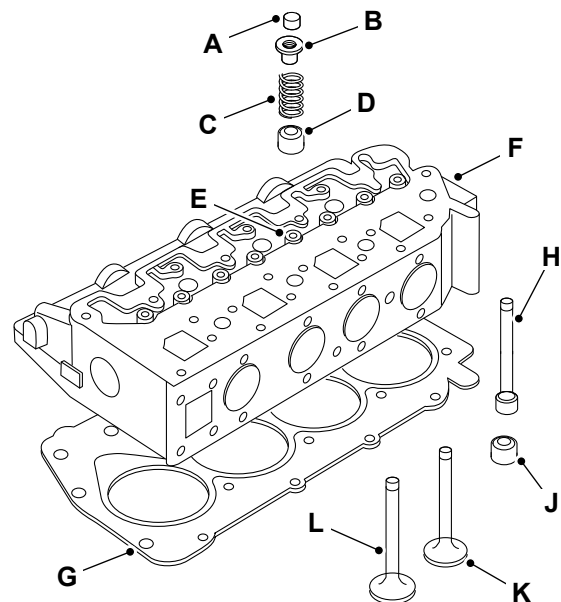
- Crankshaft
- Idler gear
- Camshaft
- Valve tappets
- Push-rods
- Rocker arms
- Valve springs

The camshaft drive gear is driven by the idler gear at half the speed of the crankshaft. The camshaft gear, the idler gear and the crankshaft gear are timed together. The camshaft lobes, two for each cylinder, (operating exhaust and inlet valves) actuate the valve tappets.

When the camshaft rotates the cam lobes act on the tappets. The push rods act on the rockers which pivot on the camshaft.

Each valve has a compression spring. The function of the spring is to close the valve and at the same time return the rocker arm and push rod to ensure that the tappets follow the camshaft lobes. The spring is located on the valve stem by a retainer and collets.

Figure 151.



- A Collets
- B Valve spring retainer
- C Valve spring
- D Valve seal
- E Valve guide
- F Cylinder head
- G Cylinder head gasket
- H Push-rod

00 - General

Introduction	15-101
Technical Data	15-102
Component Identification	15-103
Check (Condition)	15-103
Calibrate	15-104
Remove and Install	15-104
Disassemble and Assemble	15-105

Introduction

The connecting rod connects the piston to the crankshaft. They form a simple mechanism that converts reciprocating motion into rotating motion.

Connecting rods are usually made of high strength steel. They are not rigidly fixed at either end, so that the angle between the connecting rod and the piston can change as the rod moves up and down and rotates around the crankshaft.

The small end of the connecting rod attaches to the piston pin which is a press fit into the connecting rod.

The big end of the connecting rod connects to the bearing journal on the crank throw, they run on replaceable bearing shells that are accessible via the connecting rod bolts which hold the bearing cap on to the big end.

There is a pinhole bored through the bearing and the big end of the connecting rod so that pressurised lubricating engine oil squirts out on to the thrust side of the cylinder wall to lubricate the travel of the pistons and piston rings.

Technical Data

Table 64. Top piston ring

Description	Data	
	Standard	Service limit
Shape of ring	Curved Refer to Figure 164.	
Naturally aspirated	Barrel face	
Turbocharged	Half keystone	
Clearance between piston ring groove and top piston ring	0.07–0.11mm	0.25mm
Gap of top piston ring	0.2–0.35mm	0.1mm

Table 65. Intermediate ring

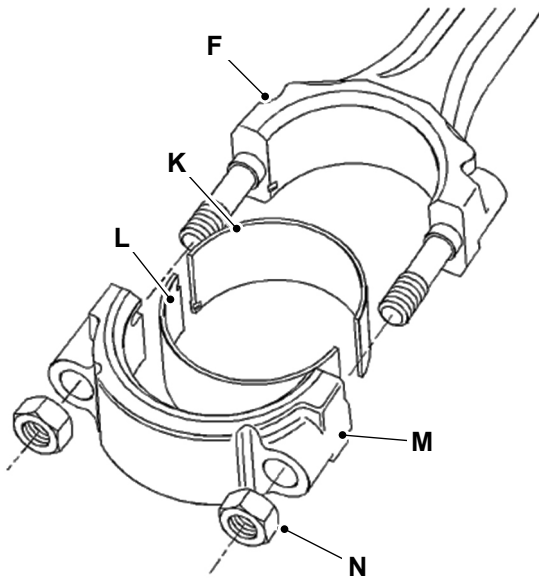
Description	Data	
	Standard	Service limit
Shape of ring	Taper Refer to Figure 164.	
Clearance between piston ring groove and intermediate piston ring	0.04–0.08mm	0.25mm
Gap of intermediate piston ring	0.2–0.4mm	0.1mm

Table 66. Oil control ring

Description	Data	
	Standard	Service limit
Clearance between piston ring groove and oil control ring	0.02–0.06mm	0.15mm
Gap of oil control ring	0.25–0.5mm	0.1mm

Table 67. Piston

Description	Data	
	Standard	Service limit
Diameter of the piston skirt	83.948–83.963mm	83.7mm
Clearance of the piston skirt to the cylinder wall	0.038–0.072mm	0.25mm
Diameter of the piston pin	27.994–28mm	27.98mm
Clearance between the hole for the piston pin and the piston pin	-0.001mm to +0.011mm	0.02mm

Figure 176.


- F** Connecting rod
- K** Connecting rod bearing (Upper half)
- L** Connecting rod bearing (Lower half)
- M** Connecting rod cap
- N** Nut

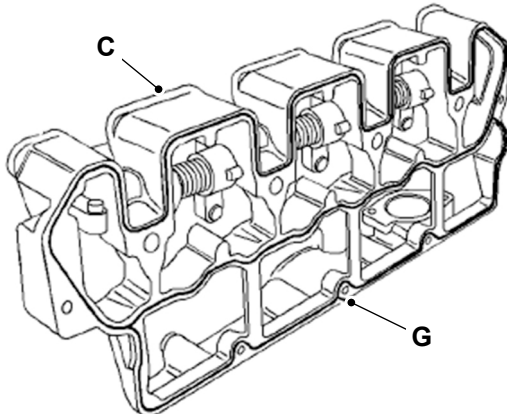
10. Remove the lower half of the connecting rod bearing from the connecting rod cap.
11. Remove the upper half of the connecting rod bearing from the connecting rod.
12. Keep the bearing shells together.
13. Check the condition of the connecting rod for wear or damage. If necessary, replace the connecting rod or the bush of the piston pin.

Assemble

1. Make sure that all the components are clean and free from wear or damage. If necessary, replace the worn or damaged components.
2. Install the piston rings on the piston as follows: Refer to Figure 174.
 - 2.1. Keep the spring at the correct position for the oil control ring into the oil ring groove in the piston.
 - 2.2. Make sure that the central wire is located inside the end of the spring.
 - 2.3. Install the oil control ring over the spring with the ring expander tool. Refer to Figure 175.
 - 2.4. Make sure that the central wire is at specified angle from the ring gap.
Angle: 180°

- 2.5. Install the compression ring² into the second groove in the piston with the ring expander tool. Refer to Figure 175.
- 2.6. Make sure that the letter "T" and the chamfer on the inner face of the compression ring² is facing upwards.
- 2.7. Install the compression ring¹ into the top groove in the piston with the ring expander tool. Refer to Figure 175.
- 2.8. Make sure that the letter "T" is facing upwards.
- 2.9. Position the piston ring gaps at the specified angle from each other.
Angle: 120°
3. Lubricate the bush in the connecting rod and lubricate the bore for the piston pin in the piston with a clean engine oil.
4. Keep the piston on a suitable surface with the crown facing downwards.
5. Install the connecting rod and the piston pin to the piston. Make sure that the name "Shibaura" inside the piston must align with the stamped number on the connecting rod.
 - 5.1. If you cannot install the piston pin by hand then heat the piston to the specified temperature and install the piston pin.
Temperature: 45 ± 5°C (112.9 ± 41.0°F)
 - 5.2. DO NOT use the heating torch to heat the piston.
6. Make sure that the orientation of the connecting rod in the piston is correct.
7. Install the retaining rings to the piston pin bore in the piston with the retaining ring pliers.
8. Make sure that the retaining rings are seated in the grooves in the correct piston.
9. Install the upper half of the connecting rod bearing to the connecting rod.
10. Install the lower half of the connecting rod bearing to the connecting rod cap.
11. Install the piston and the connecting rod. Refer to (PIL 15-36).

Figure 183.



C Rocker shaft assembly
G Joint

Install

1. Make sure that all the components are clean and free from wear or damage.
2. Install a new joint to the base of the rocker shaft assembly.
3. Apply clean engine lubricating oil to both ends of the push-rods.
4. Install the push-rods to the engine with the cup facing upwards.
5. Make sure that the push-rods are installed correctly in the socket of the valve tappets.
6. Lubricate the top of the valve stems with clean engine oil.
7. Install the cap to the valve stem.
8. Install the rocker shaft assembly to the cylinder head.
9. Make sure that the end of the adjustment screw correctly seats on the push-rod.
10. Install the nut². Use a deep socket to tighten the nuts. Begin at the centre of the rocker shaft and work outwards.
11. Install the bolt.
12. Tighten the bolt and the nut² to the correct torque value.
13. Adjust the valves. Refer to (PIL 15-30).
14. Install the rocker cover. Refer to (PIL 15-42).
15. Install the engine pipe. Refer to (PIL 15-96).

Disassemble and Assemble

▲ WARNING Personal injury can result from being struck by parts propelled by a released spring force. Make sure to wear all necessary protective equipment. Follow the recommended procedure and use all recommended tools to release the spring force.

Disassemble

1. Remove the rocker shaft assembly. Refer to (PIL 15-42).
2. Mark each of the rocker arms to help identification.
3. Install a suitable bolt into the end of the rocker shaft.
4. Pull the bolt to remove the rocker shaft from the base.
5. Remove the rocker arm, washer and the spring.
6. Remove the O-ring seal from the rocker shaft.
7. Remove the adjustment screw and the nut from the rocker arm.



00 - General

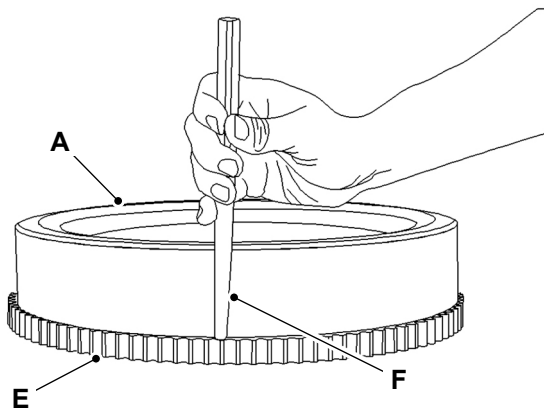
Introduction	15-145
Component Identification	15-146
Remove and Install	15-146

Introduction

The lubrication system is supplied by the oil sump that forms the lower part of the engine. Oil is taken from the sump by the gear pump and it is passed through an oil filter. The oil is then delivered under pressure through a system of passages drilled through the engine.

7. Remove the flywheel.
8. Inspect the ring gear and the flywheel for wear or damage. If the ring gear or the flywheel is worn or damaged, it must be replaced.
9. If necessary, remove the ring gear from the flywheel as follows:
 - 9.1. Keep the flywheel on a suitable support to remove the ring gear from the flywheel.

Figure 198.



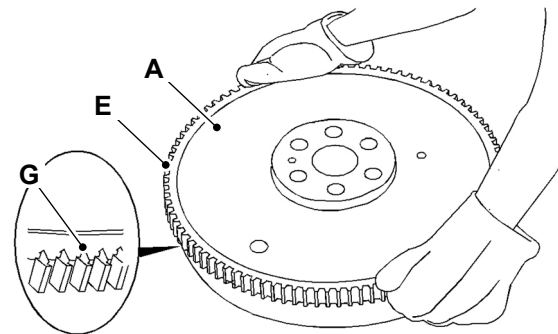
- A** Flywheel
- E** Ring gear
- F** Punch

- 9.2. Remove the ring gear from the flywheel with a hammer and a punch.

Install

1. If removed, install the ring gear to the flywheel as follows:
 - 1.1. Identify the orientation of the new ring gear to install the ring gear correctly onto the flywheel.
 - 1.2. Make sure that the chamfered side of the gear teeth are facing towards the starter motor when the flywheel is installed. This is to make sure that the starter motor engages correctly.

Figure 199.



- A** Flywheel
- E** Ring gear
- G** Chamfered side of the gear teeth

- 1.3. Heat the ring gear in an oven to a maximum specified temperature.
 Temperature: 150°C (301.8°F)
 Special Tool: Static Oven (240V) (Qty.: 1)
- 1.4. Do not use a heat torch to heat the ring gear.
- 1.5. Make sure that the orientation of the ring gear is correct and quickly install the ring gear onto the flywheel.

2. Clean the flywheel housing thoroughly.
3. Inspect the rear oil seal for leaks. If necessary, replace the rear oil seal. Refer to (PIL 15-54).
4. Install the guide stud (M10 x 1.25 mm by 80 mm) at the positions of bolt1 in the crankshaft. Refer to Figure 197.
5. Install the lifting bracket and a suitable lifting device to the flywheel.
6. Position the flywheel onto the guide studs.
7. Install the bolt2 (x4) and finger tighten them.
8. Remove the guide studs and install the bolt1 (x2).
9. Use a suitable tool to prevent the flywheel from rotating.
10. Tighten the bolts to the correct torque value.
11. Remove the lifting bracket and the lifting device from the flywheel.
12. Install the starter motor. Refer to (PIL 15-75).

Table 76. Torque Values

Item	Description	Nm
B	Bolt1	75
C	Bolt2	75

Remove and Install

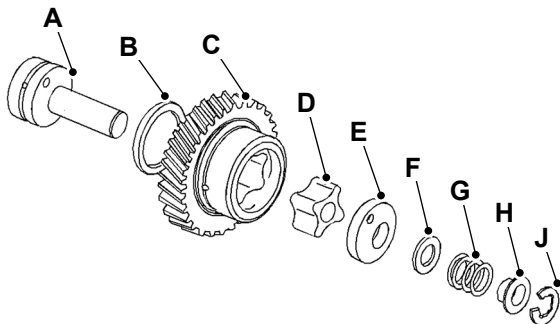
▲ WARNING Personal injury can result from being struck by parts propelled by a released spring force. Make sure to wear all necessary protective equipment. Follow the recommended procedure and use all recommended tools to release the spring force.

WARNING: Improper assembly of parts that are spring loaded can cause bodily injury. To prevent possible injury, follow the established assembly procedure and wear protective equipment.

Remove

1. Make the machine safe. Refer to (PIL 01-03).
2. Remove the timing gear front case. Refer to (PIL 15-54).
 - 2.1. If the front case is not installed, do not turn the crankshaft. Damage to the engine may occur.
3. Remove the oil pump from the idler hub as follows. Refer to Figure 211.
 - 3.1. Remove the C-clip that retains the idler gear on the idler hub.

Figure 211.



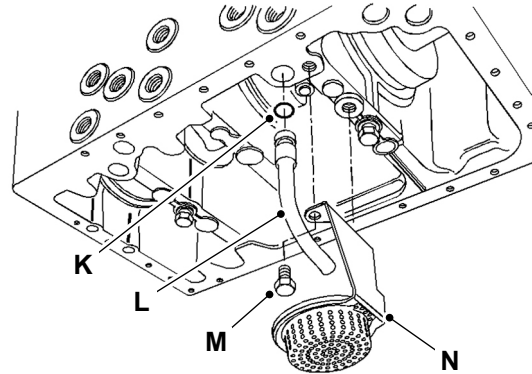
- A** Idler hub
- B** Thrust washer
- C** Idler gear
- D** Inner rotor
- E** Oil pump cover
- F** Shim
- G** Spring
- H** Collar
- J** Retaining ring

- 3.2. Remove the collar, spring, shim and the oil pump cover.
- 3.3. Remove the idler gear.
- 3.4. Remove the inner rotor.
- 3.5. Remove the thrust washer.

4. Remove the suction pipe as follows. Refer to Figure 212.

- 4.1. Remove the oil sump. Refer to (PIL 15-45).

Figure 212.



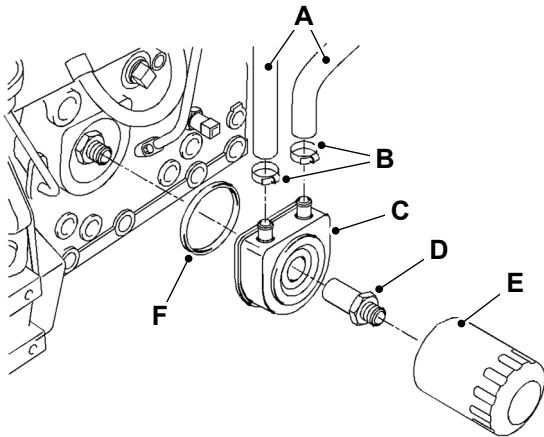
- K** O-ring seal
- L** Oil tube assembly
- M** Bolt1
- N** Oil strainer

- 4.2. Remove the bolt1 and the oil strainer from the crankcase.
 - 4.3. Inspect the oil strainer for damage. If damaged, replace the oil strainer.
 - 4.4. Remove the suction pipe from the crankcase.
 - 4.5. Remove the O-ring seal from the suction pipe.
5. Remove the idler hub as follows. Refer to Figure 213.
 - 5.1. Remove the camshaft. Refer to (PIL 15-15).
 - 5.2. Remove the bolt2 and the plate from the crankcase.

Component Identification

Operation

Figure 218.



- A** Hoses
- B** Hose clamps
- C** Oil cooler
- D** Adaptor
- E** Oil filter element
- F** O-ring seal

The oil cooler housing allows transfer of lubricating oil from the crankcase to the oil cooler and filter head. The cooled and filtered oil then passes back into the main oil gallery into the crankcase.

Install

1. Installation is the opposite of the removal procedure. Additionally do the following step.
2. Make sure that the alternator pulley is aligned with the crankshaft pulley.

Disassemble and Assemble

Voltage Regulator and Brushes

1. The voltage regulator and brush set is a combined assembly. Refer to (PIL 15-72-06).

Drive Pulley

1. Refer to (PIL 15-72-03).

03 - Solenoid

Remove and Install

The solenoid is an integral part of the starter motor, it is designed to relay a large electric current to the starter motor, which in turn sets the engine in motion. The solenoid also engages the starter pinion with the ring gear of the engine.

This part is a non-serviceable part if it fails, replace the complete starter motor (PIL15-75).

Check (Operation)

Special Tools

Description	Part No.	Qty.
Digital Multimeter	892/00298	1

The operational check of the coolant temperature sensor must be done when the engine is running.

1. Use a suitable digital multimeter to measure the resistance of the coolant temperature sensor.

Special Tool: Digital Multimeter (Qty.: 1)

2. When the temperature of the coolant is less than the specified, disconnect the wire connector from the coolant temperature sensor.

Temperature: 50°C (121.9°F)

3. Place one lead of the multimeter on the connector of the coolant temperature sensor. Place the other lead of the multimeter on a ground for the coolant temperature sensor.

4. Measure the resistance. Make sure that the resistance is within the specified limit.

Resistance: 54 ± 2Ω

5. Repeat the step 3 and 4 when the temperature of the coolant is approximately specified.

Temperature: 120°C (247.8°F)

6. Measure the resistance. Make sure that the resistance is not less than the specified value.

Resistance: 15Ω

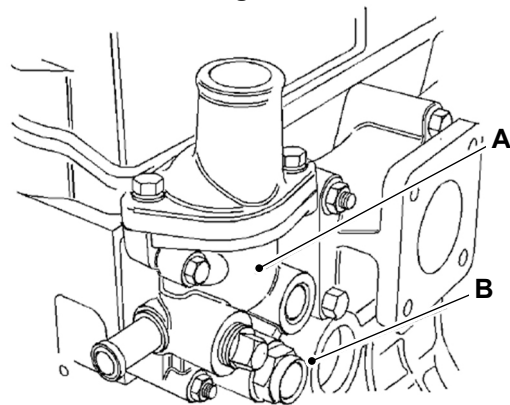
7. If the resistance through the coolant temperature sensor is not within the given resistances, replace the coolant temperature sensor.

Remove and Install

Remove

1. Drain the cooling system. Refer to (PIL 21-00).
2. Disconnect the harness from the coolant temperature sensor.
3. Remove the coolant temperature sensor from the thermostat housing.

Figure 238.



- A** Coolant temperature sensor
- B** Thermostat housing

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. If you install a used coolant temperature sensor, apply a thin layer of pipe sealant to the threads.
3. Tighten the coolant temperature sensor to the correct torque value.

Table 90. Torque Values

Item	Description	Nm
A	Coolant temperature sensor	27



18 - Air Filter Vacuum

Introduction	15-222
Component Identification	15-223
Diagram	15-223
Remove and Install	15-224

Introduction

The air filter vacuum switch is installed on the engine air filter. When the filter is blocked the vacuum increases and triggers the air filter vacuum switch and the ECM (Engine Control Module) input becomes grounded. This causes a CAN (Controller Area Network) message to be transmitted to the instrument panel ECU (Electronic Control Unit) which then illuminates the air filter warning lamp. The message "AIR FILTER" is displayed and the internal buzzer is sounded.

If the air filter input goes open circuit then all the warnings are turned off.



18 - Fuel and Exhaust System

Contents	Page No.
Acronyms Glossary	18-2
18-00 Fuel and Exhaust System	
18-00-00 General	18-3
18-00-30 Throttle Control System	18-10
18-03 Tank	
18-03-00 General	18-13
18-09 Filter	
18-09-00 General	18-15
18-09-03 Filter Element	18-17
18-12 Water Separator	
18-12-00 General	18-19
18-18 Injection	
18-18-00 General	18-21
18-18-03 Injector	18-24
18-18-07 Injector Seal	18-28
18-18-15 Pump	18-30
18-18-21 Governor	18-33
18-18-24 Adjuster	18-41
18-21 Fuel Pump	
18-21-00 General	18-45
18-24 Exhaust	
18-24-00 General	18-51
18-24-03 Inlet Manifold	18-53
18-24-04 Outlet Manifold	18-55
18-24-27 Spark Arrestor	18-60
18-35 Turbocharger	
18-35-00 General	18-63
18-35-06 Wastegate Valve	18-70
18-96 Fuel Pipe	
18-96-00 General	18-75



30 - Throttle Control System

[Introduction](#) 18-10
[Operation](#) 18-11

Introduction

The electronic throttle control system consists of:

- Speed sensor (magnetic pick up)
- Engine ECU
- Chassis ECU
- Engine Map Sensor-The manifold absolute pressure sensor provides instantaneous manifold pressure information to the engine ECU. The data is used to calculate air density and determine the engine air mass flow rate, which in turn determines the required fuel metering for optimum combustion.
- Throttle Solenoid
- Hand Throttle Control
- Foot Throttle Control pedal



00 - General

Introduction 18-21
Component Identification 18-22
Operation 18-22
Calibrate 18-23

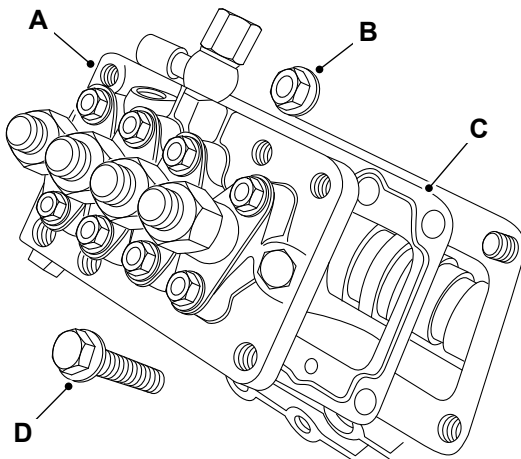
Introduction

Refer to Fuel and Exhaust System- General, Introduction (PIL 18-00).

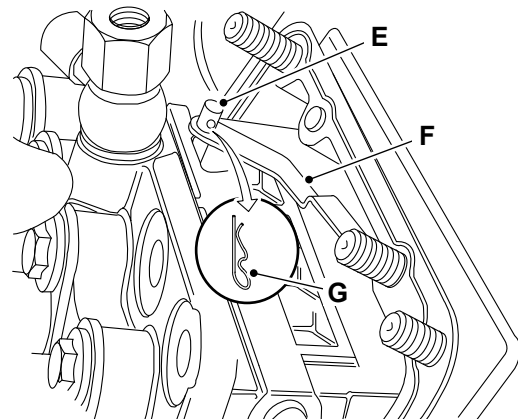
Remove and Install

Remove

1. Obey all fuel system health and safety information. Refer to (PIL 18-00).
2. Remove the ESOS (Engine Shut-Off Solenoid). Refer to (PIL 15-86).
3. Remove the fuel pipes. Refer to (PIL 18-96).
4. Gradually loosen the bolt and nut from the fuel injection pump.
5. Carefully raise the fuel injection pump and remove the clip.
6. Remove the fuel injection pump from the crankcase.
7. Remove the shims from the mounting face of the crankcase.
8. Make a note of the thickness and the number of the shims to help installation. The fuel injection timing is determined by the thickness of the shim pack between the fuel injection pump and the mounting face on the crankcase.

Figure 266.


- A Fuel injection pump
- B Nut
- C Shims
- D Bolt

Figure 267.


- E Fuel rack control
- F Link
- G Clip

Install

1. Clean the mating surfaces of the crankcase and the fuel injection pump.
2. Install the new shims. Make sure that you install the correct number and correct thickness of shims.
3. Position the fuel injection pump close to the mounting face of the crankcase.
4. Connect the link and the rack control with the clip.
5. Align the fuel injection pump with the studs on the crankcase.
6. Install the fuel injection pump.
7. Install the bolt and nut.
8. Install the fuel pipes. Refer to (PIL 18-96).
9. Install the fuel shutoff solenoid.

Table 97. Torque Values

Item	Description	Nm
B	Nut	15
D	Bolt	15



21 - Fuel Pump

Contents

Page No.

18-21-00 General	18-45
------------------------	-------

Check (Condition)

1. Check the manifold mating faces for signs of damage and distortion.
2. Check the manifold casting for signs of cracks.
3. Renew the manifold if there are any signs of defect.

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. Get access to the engine.

Remove

1. Disconnect the breather hose at the manifold connection.
2. Disconnect the air inlet hose.
3. Remove the bolts that attach the inlet manifold to the cylinder head.
4. Lift the inlet manifold from the cylinder head. Discard the gasket.
5. Cap the inlet ports with blanking caps to prevent ingress of dirt.

Install

1. Replacement is a reversal of the removal procedure.
2. Renew the manifold gasket.
3. Loosely assemble the manifold, together with the new inlet gasket to the cylinder head, use the two bolts (one at each end).
4. With the manifold and gasket in position, install the remaining bolts.
5. Tighten the bolts to the correct torque value.

Operation

The turbocharger is installed between the exhaust manifold and the intake manifold. The turbocharger is driven by exhaust gases which flow through the exhaust inlet. The energy of the exhaust gas turns the turbine wheel. Then, the exhaust gas flows out of the turbine housing through the exhaust outlet.

The turbine wheel and the compressor wheel are installed on the same shaft. Therefore, the turbine wheel and the compressor wheel rotate at the same RPM (Revolutions Per Minute). The compressor wheel is enclosed by the compressor housing. The compressor wheel compresses the intake air. The intake air flows into the engine cylinders through the inlet valves of the cylinders.

The oil from the main gallery of the crankcase flows through the oil inlet port to lubricate the turbocharger bearings (Bearing1 and bearing2). The pressurised oil passes through the bearing housing of the turbocharger. The oil is returned through the oil outlet port to the oil pan.

The turbocharger has a wastegate. The wastegate is controlled by the boost pressure. This allows some of the exhaust gases to bypass the turbine wheel at higher engine speeds. The wastegate is a type of flapper valve that automatically opens at a preset level of boost pressure in order to allow the exhaust gas to flow around the turbine. The wastegate allows the design of the turbocharger to be more effective at lower engine speeds.

Check (Condition)

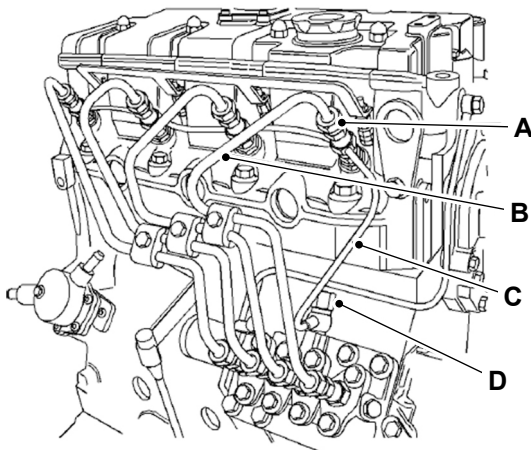
1. Inspect the compressor and turbine for damage.
2. Make sure that the compressor blades do not rub on the housing and rotate freely. It is normal to detect a bit of play on the blades.
3. Make sure that the shaft rotates freely.
4. Before you install the turbocharger, make sure that the code of the component is correct for the type of engine, as installation of the wrong turbocharger can damage the turbo and engine and void the warranty.

Remove and Install

Remove

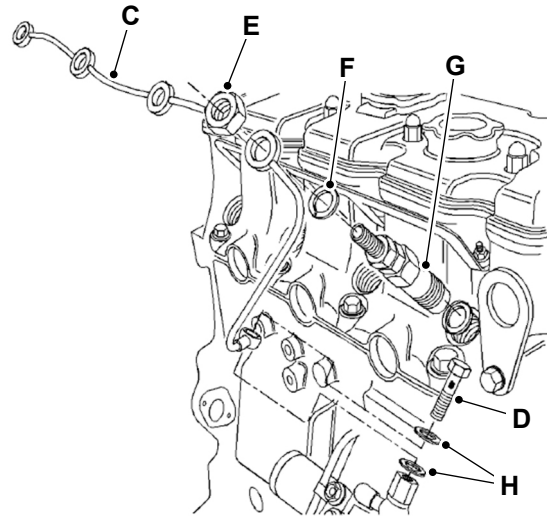
1. Make the machine safe. Refer to (PIL 01-03).
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. Turn the fuel supply to the OFF position.
4. Remove the nut1 from the fuel injector pipe.
5. Remove the fuel injection pipes from the engine.
6. Cap all the open ports of the pump immediately.
7. Remove the banjo bolt and washer 1.
8. Remove the nut 2 from the fuel injector.
9. Make sure that the fuel pipes are not distorted when you loosen the nut.
10. Remove the fuel return pipes and the washer 2 from the fuel injector.
11. Cap all the open fuel injector ports to prevent contamination.

Figure 292.



- A** Nut 1
- B** Fuel Injector pipes
- C** Fuel return pipes
- D** Banjo bolt

Figure 293.



- C** Return line
- D** Banjo bolt
- E** Nut 2
- F** Washer 1
- G** Fuel injector
- H** Washer 2

Install

1. Installation is the opposite of the removal procedure. Additionally do the following steps:
2. Tighten the nuts to the correct torque value.
3. Use a special tool to tighten the nut 1 at the fuel injector. Refer to Table 102.
4. Bleed the fuel system. Refer to (PIL 18-00).

Table 102. Special tool

Part number	27610294
Part name	Injector pipe nut tool
Qty.	1

Table 103. Torque Values

Item	Nm
A	23
E	27

Check (Condition)

High coolant temperatures can be caused by many conditions. Use the following procedure to determine the cause of higher coolant temperatures:

1. Check the coolant level in the cooling system. Refer to (PIL 21-00)
 - 1.1. If the coolant level is too low, air will get into the cooling system. Refer to the steps 3.1 to 3.5.
2. Check the coolant for contamination.
 - 2.1. If contamination is suspected, drain the cooling system and fill with new clean coolant. Refer to (PIL 21-00).
3. Check for air in the cooling system. Air can enter the cooling system in different ways.
 - 3.1. The most common causes of air in the cooling system is by not filling the cooling system correctly and combustion gas leakage into the cooling system.
 - 3.2. The combustion gas can get into the system through inside cracks, a damaged cylinder head, or a damaged cylinder head gasket.
 - 3.3. Air in the cooling system will cause a reduction in coolant flow and bubbles in the coolant.
 - 3.4. The air bubbles will keep the coolant away from the engine parts, which will prevent the transfer of heat to the coolant.
 - 3.5. A low coolant level is caused by leaks or incorrectly filling of the expansion tank.
4. Check the coolant sender unit.
 - 4.1. The temperature sensor in the engine sends signals to the sender unit. The sender unit converts these signals to an electrical impulse which is used by the coolant gauge.
 - 4.2. If the sender unit malfunctions, the gauge can show an incorrect reading.
 - 4.3. If the electric wire unit breaks or if there is a short circuit, the gauge can show an incorrect reading.
5. Check the radiator.
 - 5.1. Check the radiator for a restriction to coolant flow.
 - 5.2. Check the radiator for debris, dirt, or deposits on the inside of the core. The debris, dirt, or deposits will restrict the flow of coolant through the radiator.
 - 5.3. Check for debris or damage between the fins of the radiator core. The debris between the fins of the radiator core restricts air flow through the radiator core.
6. Check the filler cap.
 - 6.1. The pressure drop in the cooling system can cause the boiling point to be lower. This can cause the cooling system to boil. Refer to (PIL 21-00).
7. Check the fan and the fan shroud.
 - 7.1. Make sure that the fan shroud is the correct size and the fan shroud is positioned correctly.
8. Check for loose drive belts.
 - 8.1. A loose fan drive belt will cause a reduction in the air flow across the radiator.
 - 8.2. Check the fan drive belt for correct belt tension.
 - 8.3. If necessary, adjust the tension of the fan drive belt. (PIL 15-18).
9. Check the cooling pump for correct operation. Refer to (PIL 21-09).
10. Check the cooling pump for damage. If necessary, replace the pump. Refer to (PIL 21-09).
 - 10.1. A cooling pump with a damaged impeller does not pump enough coolant for correct engine cooling.
11. Check the cooling system hoses and clamps.
 - 11.1. Damaged hoses with leaks can normally be seen.
 - 11.2. The hoses that have no visual leaks can soften during operation. The soft areas of the hose can become kinked or crushed during operation. These areas of the hose can cause a restriction in the coolant flow.
 - 11.3. The hoses become soft and get cracks after a period of time. The inside of a hose can deteriorate and the loose particles of the hose can cause a restriction of the coolant flow.
12. Check for a restriction in the air inlet system.
 - 12.1. The restriction of the air that is coming into the engine can cause high cylinder temperatures. The high cylinder temperatures require higher than the normal temperatures in the cooling system.

Remove and Install

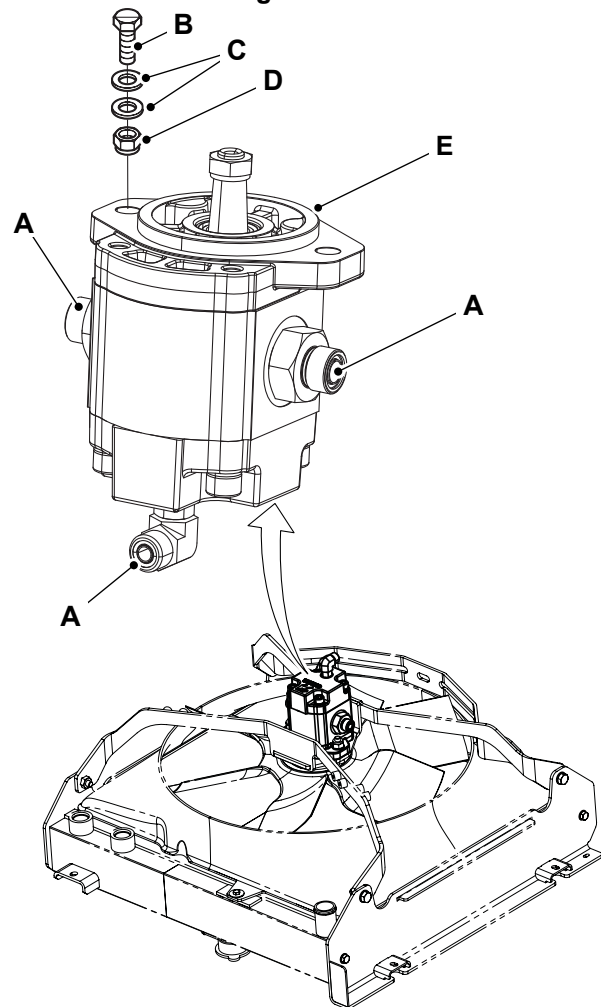
Hydraulic Pressure

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

Remove

1. Make the machine safe with the lift arm lowered. Refer to (PIL 01-03).
2. Remove the charge filter. Refer to (PIL 30-04).
3. Put a label on the hoses to help installation.
4. Remove the hoses. Cap the ends with blanking caps to prevent loss of fluid and ingress of dirt.
5. Disconnect the electrical connections.
6. Support the hydraulic motor with suitable lifting equipment.
 - 6.1. Remove the bolt (x4) that hold the fan assembly to the cooler.
7. Remove the hydraulic fan motor away from the machine.

Figure 298.



- A** Adaptor
- B** Bolt
- C** Washer
- D** Nut
- E** Hydraulic fan motor

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following step.
2. Make sure that all the hoses and the ports are clean and free from dirt.

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09 - Pump

Contents

Page No.

21-09-00 General 21-33

03 - Housing

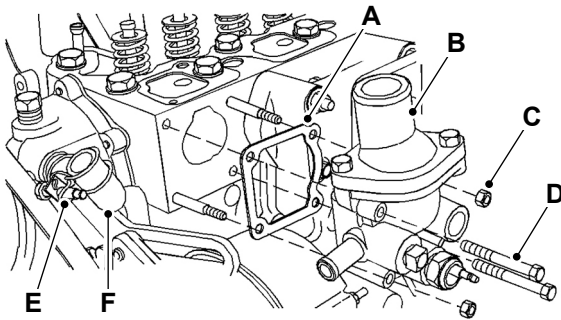
Remove and Install

Table 112. Torque Values

Item	Description	Nm
C	Nut	10

Remove

1. Drain the cooling system. Refer to (PIL 21-00).
2. Loosen the hose clamp and disconnect the hose from the thermostat housing.
3. Remove the bolt and the nut.
4. Remove the thermostat housing from the cylinder head.
5. Remove the joint from the cylinder head.
6. If necessary, remove the thermostat. Refer to (PIL 21-12).

Figure 328.


- A** Joint
- B** Thermostat housing
- C** Nut
- D** Bolt
- E** Clamp
- F** Hose

Install

1. Make sure that the mating surfaces of the cylinder head and the thermostat housing are clean and free from damage.
2. Install a new joint to the cylinder head.
3. Install thermostat housing to the cylinder head.
4. Install the bolt and the nut.
5. Tighten the nut to the correct torque value.
6. Connect the hose to thermostat housing.
7. Tighten the hose clamp.
8. If removed, install the thermostat. Refer to (PIL 21-12).
9. Fill the cooling system. Refer to (PIL 21-00).

00 - General

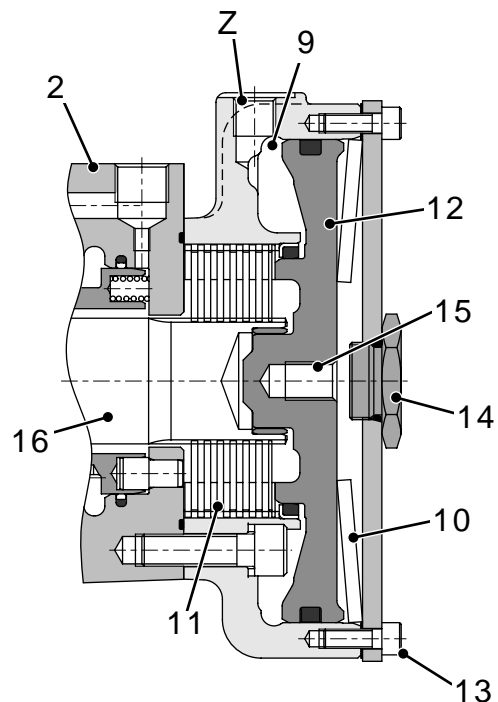
Introduction	24-5
Technical Data	24-6
Operation	24-6
Check (Operation)	24-7
Remove and Install	24-7
Disassemble and Assemble	24-8

Introduction

The park brake assembly is mounted on to the rear wheel motor case (refer to PIL 27-32) and connects via the brake shaft.

A brake disc pack, with alternate discs splined to the brake shaft and brake housing, is compressed by the force of a disc spring that acts through a piston. The friction between the discs generates a holding torque.

Figure 329.



- Z** Brake port
- 2** Rear wheel motor case
- 9** Annular area
- 10** Brake disc spring
- 11** Brake disc pack
- 12** Brake piston
- 13** Cover screws
- 16** Brake shaft

Operation

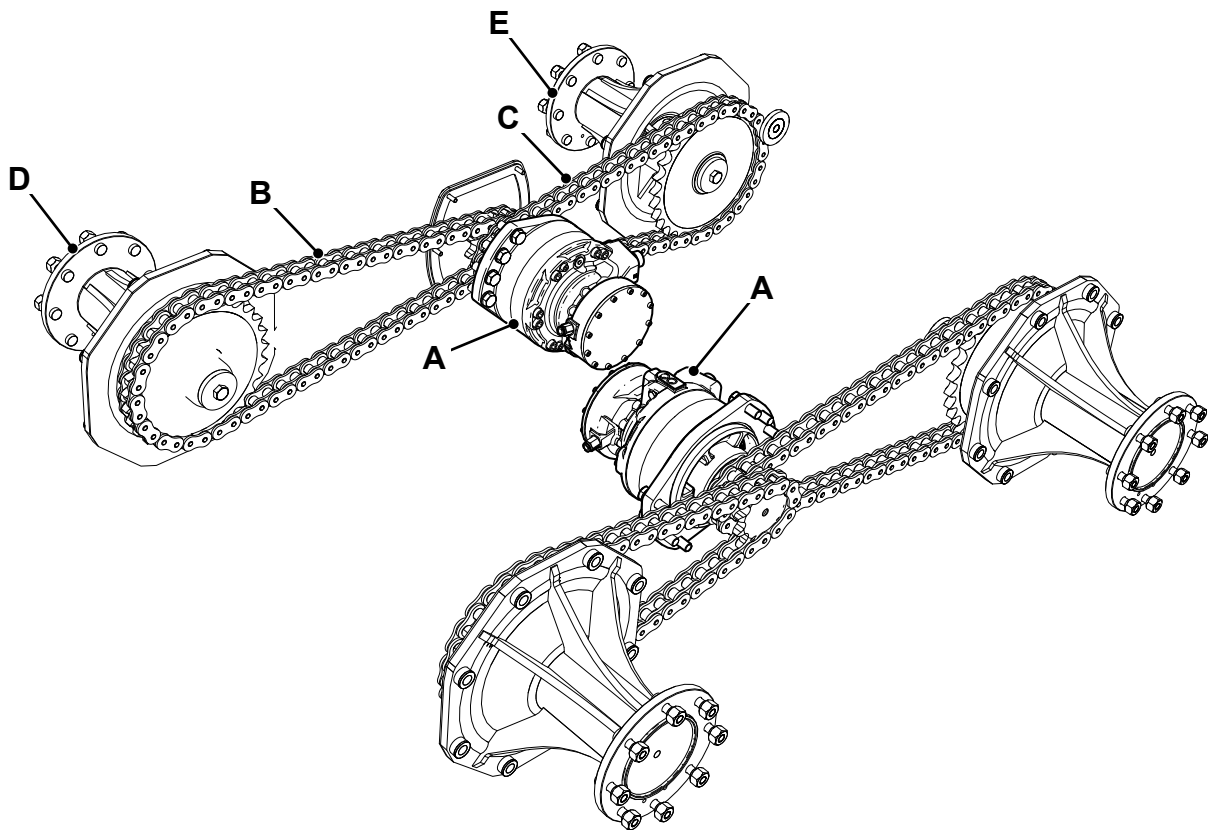
Wheeled Machines

The hydraulic motors are bolted to the inner side of the drive chain cases. A double sprocket is splined into the motor output shaft which extend into the chain case. Each motor transmits the drive by means

of two chains to sprockets mounted on short drive shafts within the wheel hub assemblies.

Lubrication of the hub assemblies occurs due to oil picked up by the chains and sprockets which runs along the driveshafts and into the bearings.

Figure 336.



A Hydraulic motor
C Chain
E Wheel hub assembly

B Chain
D Wheel hub assembly

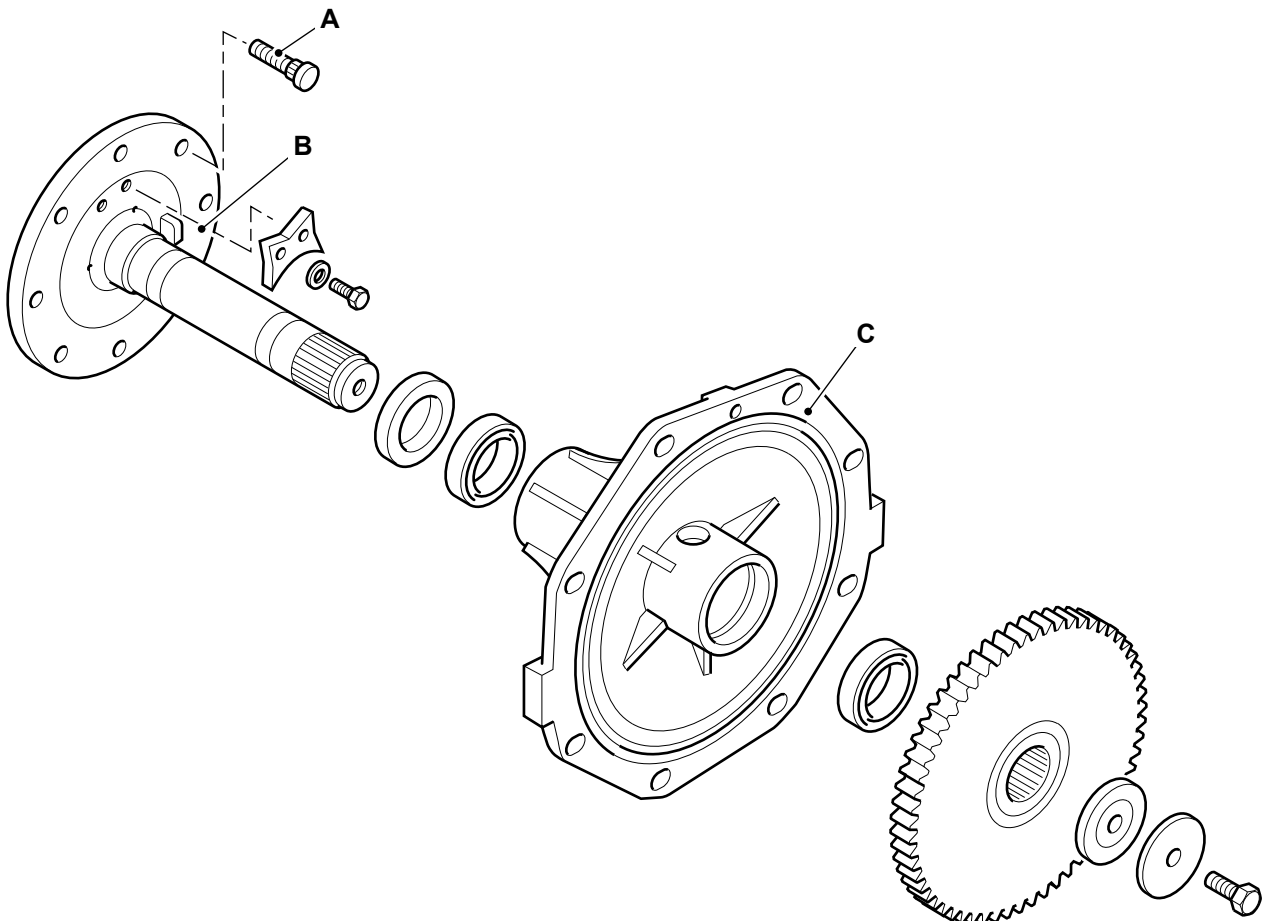
Remove and Install

It is the same procedure to remove the hub on both sides of the machine.

Remove

1. Make the machine safe with the lift arm and cab raised, refer to (PIL 01-03).
2. Drain the oil from the drive chain case, refer to (PIL 27-63).
3. Raise and support the machine on the side to be worked on.
4. Remove the front and rear wheels refer to (PIL 27-30).
5. Remove the chain case access cover.
6. Support the hub assembly and remove the 8 bolts that secure the hub. Note: If the rear hub is to be removed, both hubs on that side must be rotated to slacken both chains.
7. Remove the chain case cover plate. Lift off the appropriate chain from the motor drive sprocket. Note: The rear hub is driven by the inner chain, therefore the front chain will need to be lifted off first.
8. Lift the hub assembly clear of the aperture.
9. Remove the chain from the sprocket then move the hub away from the machine.
10. Remove and discard the O-ring seal.

Figure 341.



A Bolts
C Hub case

B Axle shaft

Adjust

The only adjustment possible with this pump is adjusting the pressure, refer to Check (Pressure) and Technical Data (PIL 27-31).

Remove and Install

Consumables

Description	Part No.	Size
JCB Threadlocker and Sealer (Medium Strength)	4101/0250	0.01L
	4101/0251	0.05L

Lifting Equipment

You can be injured if you use incorrect or faulty lifting equipment. You must identify the weight of the item to be lifted then choose lifting equipment that is strong enough and suitable for the job. Make sure that lifting equipment is in good condition and complies with all local regulations.

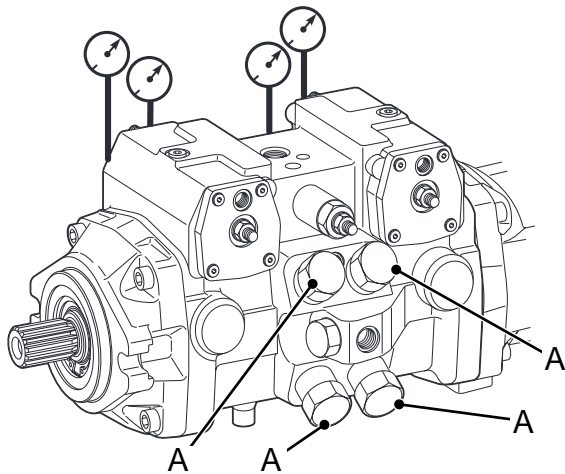
Remove

1. Make the machine safe with the lift arm and cab raised. Refer to (PIL 01-03).
2. Drain the hydraulic tank. Refer to (PIL 30-03).
3. Label all the hose connections to enable correct installation. Disconnect the hoses and plug the exposed hydraulic connections.
4. Sling the complete pump unit using suitable lifting equipment.
5. Remove the bolts and ease the unit away from the engine. Once the pump coupling has separated from the engine, the unit can be lifted clear.
6. The loader pump can now be separated from the transmission pump.

Install

1. Using suitable lifting equipment, ease the pump unit into position, make sure that the pump/engine coupling engages smoothly and completely.
2. Coat the threads of the flange bolts with JCB Threadlocker and Sealer, install and tighten to the correct torque value.
[Consumable: JCB Threadlocker and Sealer \(Medium Strength\)](#)
3. Install the hydraulic connections and tighten to the correct torque value. Note: Refill the pumps with filtered, clean oil via the pump outlets before you finally tighten the outlet connections.
4. Refill the hydraulic tank. Refer to (PIL 30-03).
5. Prime the system. Refer to Store and Recommission. Refer to (PIL 27-31).

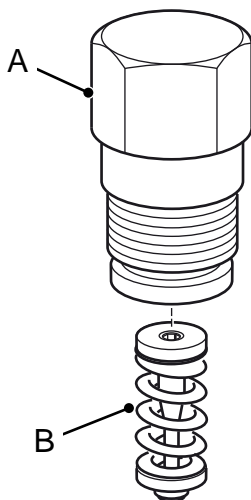
Figure 383.



A Valve Cap

2. Operate the valves for a short time only to avoid overheating.
3. If necessary, Adjust the valve.
 - 3.1. Remove the cap then lift out the valve cartridge.

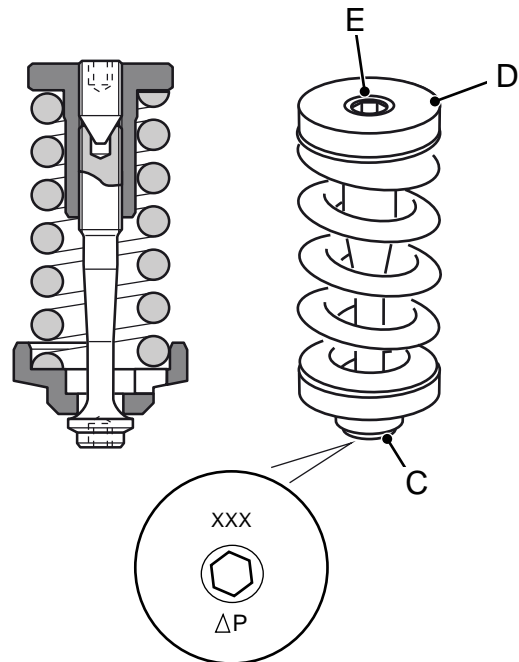
Figure 384.



A Valve cap
B Cartridge

- 3.2. Hold the top of the cartridge with a suitable pair of pliers.
- 3.3. Loosen the lock screw using a 3mm Allen key.

Figure 385.



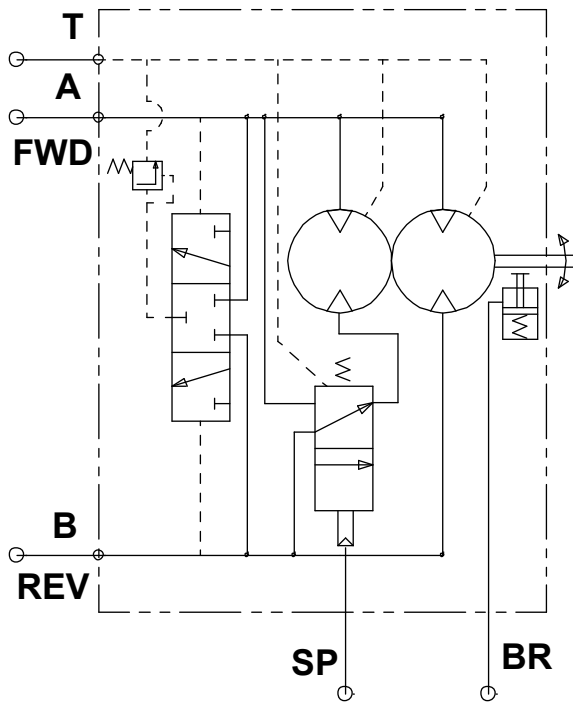
C Factory pressure setting
D Cartridge
E Allen screw

- 3.4. While still holding the cartridge, turn the valve stem clockwise to increase the setting. One turn increases the pressure by the amount shown.
Pressure: 44bar (637.7psi)
- 3.5. Tighten the lock screw.
- 3.6. Tighten the valve cap to the correct torque value. Install the valve assembly to the pump and re-check the setting. The factory pressure setting is stamped on the top face of the cartridge.

Charge Pressure Relief Valve Adjustment

1. Make sure that the pressure gauge is connected to the port G. Refer to Figure 386.

Figure 397. 2 Speed Machines



- A** Main port
- B** Main port
- T** Tank Port
- BR** Brake Release
- SP** 2 Speed port



33 - Tyre

Contents

Page No.

27-33-00 General	27-71
------------------------	-------

00 - General

Introduction	30-3
Health and Safety	30-4
Technical Data	30-5
Operation	30-6
Diagram	30-6
Fault-Finding	30-7
Discharge and Pressurise	30-10
Drain and Fill	30-10
Clean	30-11
Check (Level)	30-12
Check (Pressure)	30-13
Bleed	30-16

Introduction

The hydraulic system is a power transmission system that uses the force of flowing liquids to transmit power to specific components in a machine.

To help you trace specific hydraulic problems to a faulty unit (valve, actuator, ram etc.), refer to Fault finding (PIL 30-00). Once you have traced the faulty unit, refer to the relevant section for removal, disassembly and checking instructions.

To help identify circuits, valves, rams etc. mentioned in the fault finding procedures. Refer to the hydraulic schematic diagrams (PIL 30-00-50).

- Before you begin fault finding, read the Health and Safety Information. Refer to (PIL 30-00).
- Make simple checks before you remove or disassemble a major component.
- Make sure that the hydraulic fluid is at the correct working temperature 50°C (121.9°F).
- Whatever the fault, check the condition of the hydraulic fluid. Drain and replace if necessary. Refer to Hydraulic fluid quality in this procedure and Hydraulic System - Clean (PIL 30-00).
- Make sure you remove ALL contamination and if possible identify its origin. It may be part of a component from elsewhere in the circuit.

Hydraulic Fluid Quality

This machine uses a large volume of fluid in the hydraulic system for power transmission, equipment lubrication, rust prevention and sealing. According to a survey conducted by a pump manufacturer, seventy per cent of the causes of problems in hydraulic equipment were attributable to inadequate maintenance of the quality of the hydraulic fluid. Therefore, it is obvious that control of the quality of the hydraulic fluid helps prevent hydraulic equipment problems and greatly improves safety and reliability. Furthermore from an economic angle it extends the life of the hydraulic fluid if quality is maintained.

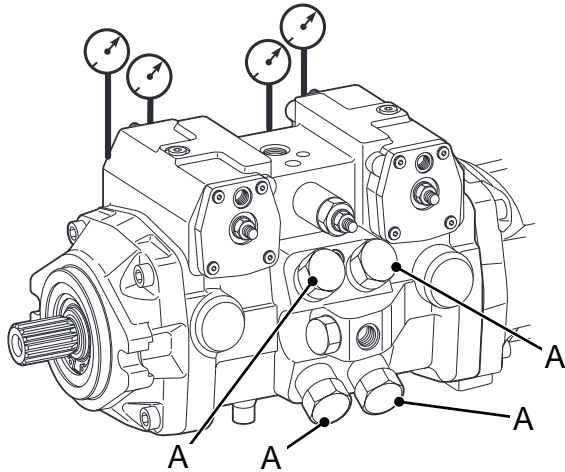
Hydraulic Contamination

Once inside the system, hydraulic circuit contaminants greatly affect the performance and life of hydraulic equipment. For example, contaminants in a hydraulic pump develop internal wear to cause internal leakage and hence lower discharges. Wear particles generated will circulate with the hydraulic fluid to cause further deterioration in the performance of this and other equipment. Contaminants also enter principal sliding sections of the equipment causing temporary malfunction, scuffing, sticking and leakage and can lead to major problems. The main contaminants can be classified as follows:

1. Connect 0 - 400 bar pressure gauges into blanked off motor feed ports.

Special Tool: Pressure Gauge (0-400 Bar) (Qty.: 4)

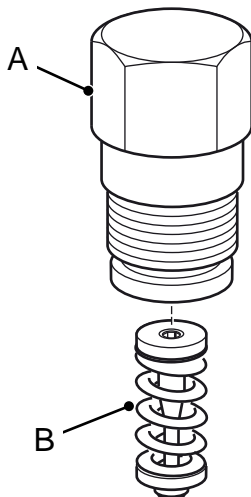
Figure 418.



A Valve Cap

2. Operate the valves for a short time only to avoid overheating.
3. To adjust the valve first remove it from the pump by unscrewing the cap and lifting out the valve cartridge. Adjust the cartridge as follows:
 - 3.1. Hold the top of the cartridge with a suitable pair of pliers.

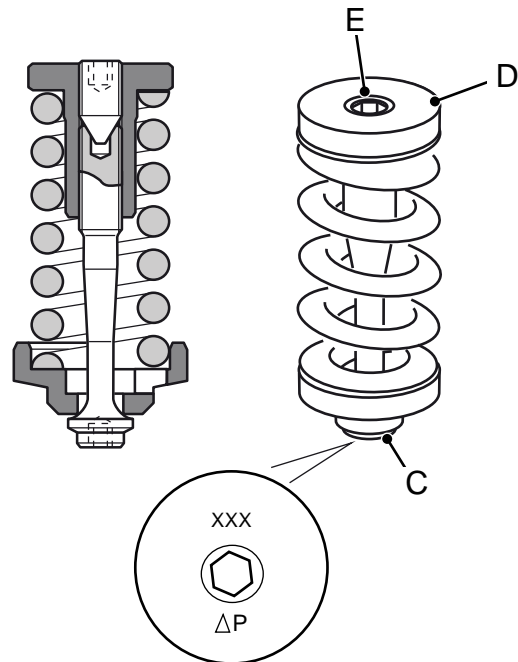
Figure 419.



A Valve cap
B Cartridge

- 3.2. Loosen the lock screw using a 3mm Allen key.

Figure 420.



C Factory pressure setting
D Cartridge
E Allen screw

- 3.3. While still holding the cartridge, turn the valve stem clockwise to increase the setting, 1 turn =
Pressure: 44bar (637.7psi)
- 3.4. Re-tighten the lock screw.
- 3.5. Tighten the valve cap to the correct torque value. Install the valve assembly to the pump and re-check the setting. The factory pressure setting is stamped on the top face of the cartridge.

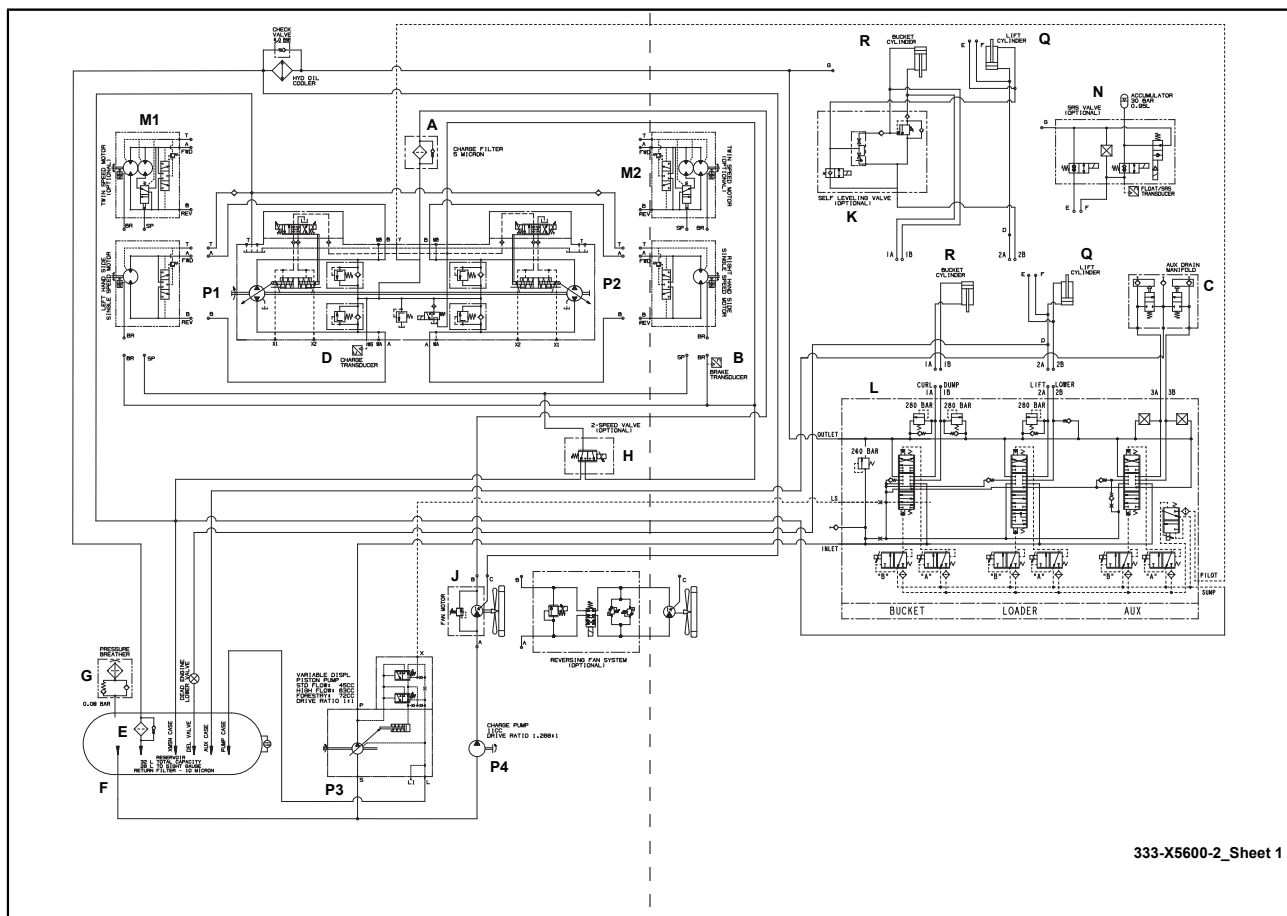
Mechanical Zero Position

Pressure testing must only be carried out when the hydraulic oil is at normal operating temperature 50°C (121.9°F)

1. Connect 0 - 600 bar pressure gauges to ports MA and MB, one pair for each pump.

Special Tool: Pressure Gauge (0-600 Bar) (Qty.: 4)

Figure 424.



333-X5600-2_Sheet 1

00 - General

Introduction

Hydraulic filters are an important part of the machines hydraulic system. Metal particles are continually produced by mechanical components and need to be removed along with other contaminants.

The hydraulic filter assemblies are designed to filter all the contamination that is generated through use to the required level of cleanliness.

Filters are positioned in many different locations. Refer to the relevant hydraulic filter for the location and removal procedure.

The filters must be serviced to the requirements of the machine maintenance schedules. To ensure optimum performance and reliability it is important that the machine's hydraulic system is serviced periodically in accordance with the manufacturers requirements.

Technical Data

Table 166. Standard Pump (P3) - Flow Rates

Description	Flow Rates
Maximum flow ⁽¹⁾	90.8L/min

(1) At 2400 rev/min and 230 bar (3335 lbf/in²)

Table 167. High Flow Pump (P3 and P5) - Flow Rates

Description	Flow Rates
Maximum flow - Lift Arm Section P3 ⁽¹⁾	90.8L/min
Maximum flow - High Flow Section P5 ⁽¹⁾	41.6L/min

(1) At 2400 rev/min and 230 bar (3335 lbf/in²)

Table 168. Displacement

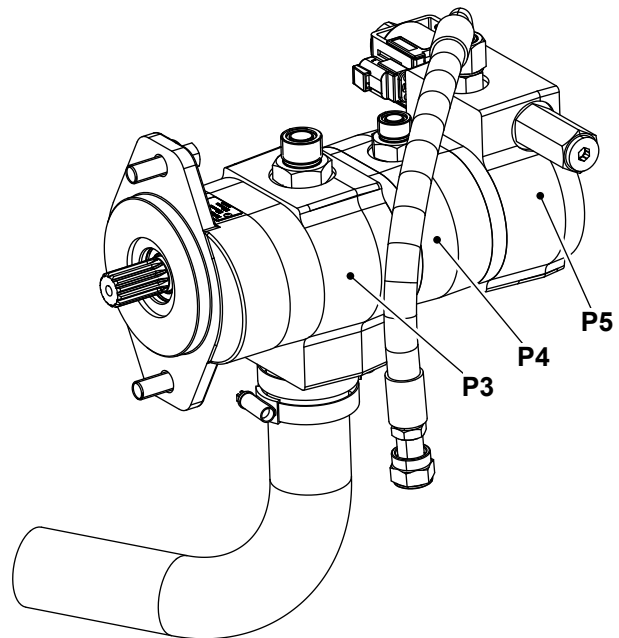
Pump	Description	Volume
P3	Loader Pump	0.038L
P4	Charge Pump	0.014L
P5	High Flow Pump	0.017L

Operation

The loader pump P3 delivers oil flow to the machines services. The oil flow passes through the main control valve and joins the flow from high-flow gear pump P5 (if fitted), Oil returns to tank via a filter and cooler.

The charge pump P4 delivers oil flow to the main pumps P1 and P2 via filter F1 and the hydraulic fan. Flow is then provided to the loader and transmission servo joysticks.

Note: The pump shown is for illustration purposes only, the pump can vary depending on the machine specification.

Figure 432.


- P3** Loader pump
- P4** Charge pump
- P5** High flow pump



00 - General

Introduction 30-69
Health and Safety 30-70
Technical Data 30-71
Component Identification 30-72
Disassemble and Assemble 30-73

Introduction

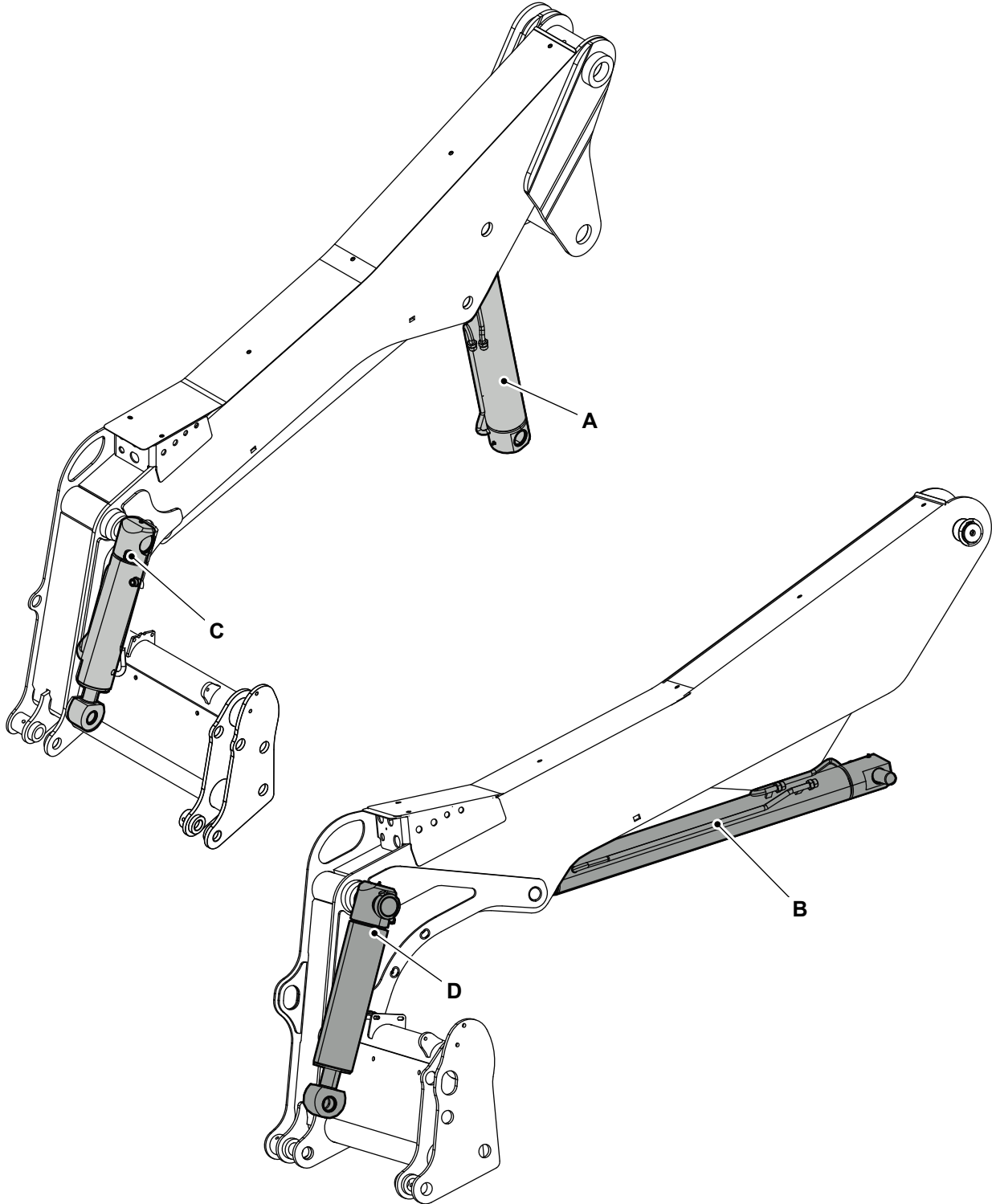
A hydraulic cylinder ram is a mechanical actuator that is used to give a unidirectional force through a unidirectional stroke. It is used in many applications, the cylinder gets the power from pressurised hydraulic oil. The hydraulic cylinder consists of a cylinder barrel, in which a piston connected to a piston rod moves back and forth.

The barrel is closed on one end by the cylinder cap and the other end by the cylinder head where the piston rod comes out of the cylinder. The piston has sliding rings and seals. The piston divides the inside of the cylinder into two chambers, the bottom chamber (cap end) and the piston rod side chamber (rod end / head end).

11 - Lift Arm Crowd**Introduction**

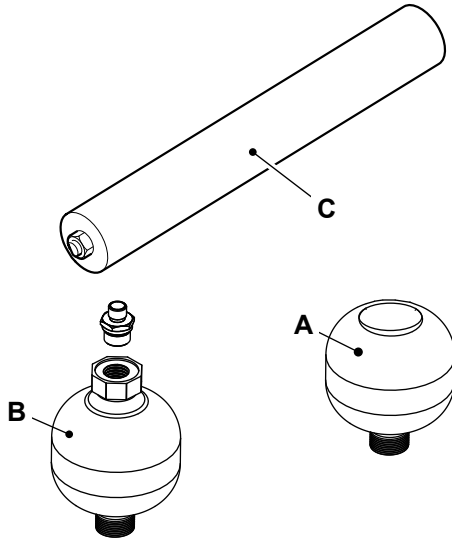
Introduction	30-80
Remove and Install	30-82

There are two variations of lift arm crowd cylinder ram, one for vertical lift machines and one for radial lift machines.

Figure 475.

Component Identification

Figure 486.



- A** Diaphragm (sealed for life)-Non Rechargeable
- B** Diaphragm (with gas valve)-Rechargeable
- C** Piston Bladder-Rechargeable

Discharge and Pressurise

Special Tools

Description	Part No.	Qty.
Accumulator Charging Kit (Piston Type)	892/00239	1

General

The accumulator charging kit is required to check the pre-charge pressure of an accumulator and to fill and vent the nitrogen. The charging kit is screwed into the accumulator's gas valve and connected to a nitrogen source with the hose supplied. If only the pre-charge pressure is to be checked or reduced the hose is not required.

Note: Some accumulators are factory sealed for life and cannot be serviced, if they do not have a gas recharging point, replace the accumulator if faulty. This procedure only applies to accumulators with a gas charging point.

Note: The threads on the top of the nitrogen gas bottles can vary widely worldwide, you may need to source an adaptor locally, for specifications and further details, refer to www.hydac.com.au.

Pressurise

1. Make the machine safe. Refer to (PIL 01-03).
2. Remove the relevant accumulator from the machine, refer to Accumulator-Remove and Install (PIL 30-18).
3. Remove the protective cap from the accumulator gas valve.
4. Connect the nitrogen charging tool kit and adaptor to the accumulator gas valve.
Special Tool: Accumulator Charging Kit (Piston Type) (Qty.: 1)
5. Connect the charging tool flexible hose to a bottle of compressed nitrogen gas installed with a pressure regulator valve, set to the minimum pressure.
6. Screw the spindle three turns anti-clockwise to open the accumulator gas valve.
7. Open the charging tool bleed valve. Carefully open the nitrogen gas bottle valve and confirm that nitrogen gas flows freely. Close the gas bottle valve and the bleed valve.
8. Carefully open the nitrogen gas bottle valve and watch the gauge, allow nitrogen to flow by increasing the pressure regulator setting until the required pre-charge pressure is achieved. Close the gas bottle valve.



3B Auxiliary flow B

16 - Smooth Ride System (SRS)

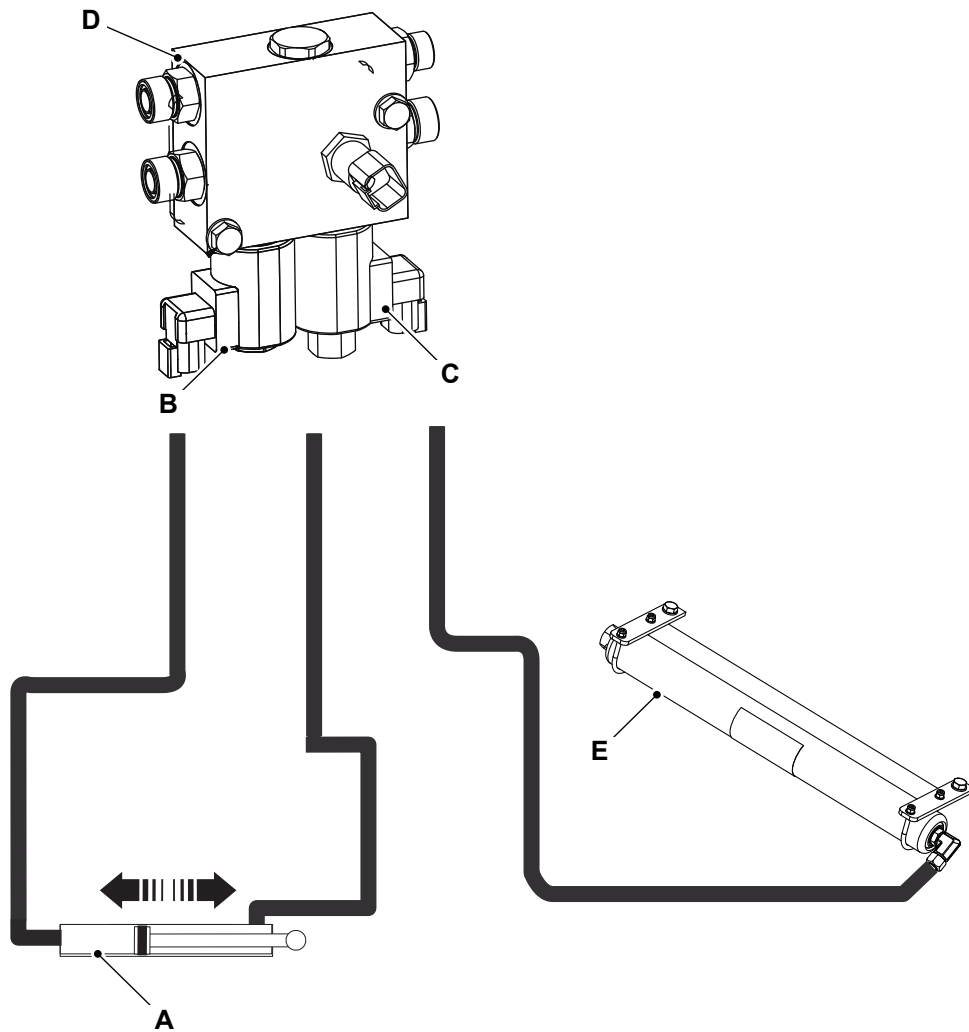
Introduction 30-113
 Operation 30-114
 Diagram 30-116

Introduction

The SRS (Smooth Ride System) enhances the comfort of the ride by damping out the forces imposed on the machine by the movement of the lift arm as the machine travels over uneven surfaces.

This is achieved by connecting the head side of the loader rams to a pressurised piston accumulator.

Figure 507.

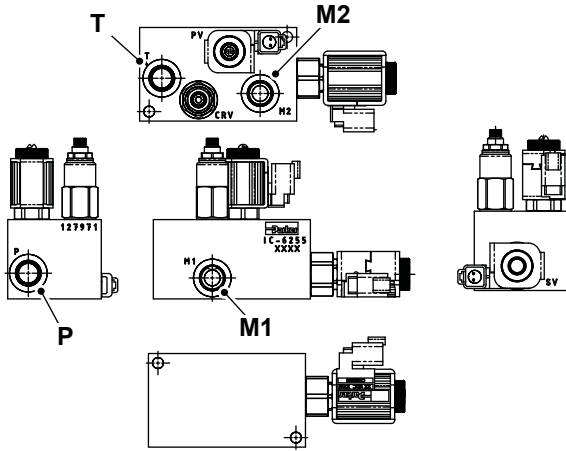


- A Lift arm
- C SRS check solenoid
- E Piston accumulator

- B SRS accumulator solenoid
- D SRS valve block

Component Identification

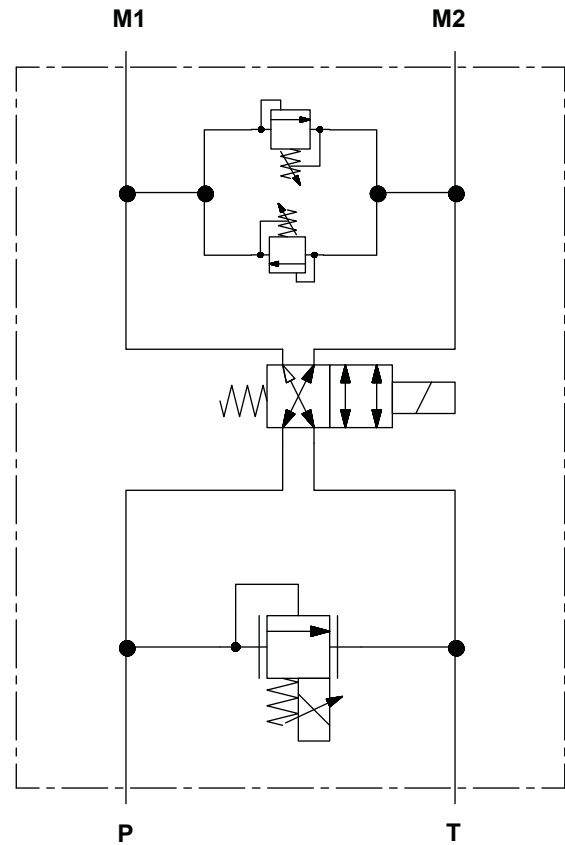
Figure 517.



- M1** Left hand side single speed motor
- M2** Right hand side single speed motor
- P** Pilot supply port
- T** Tank supply port

Diagram

Figure 518.



- M1** Left hand side single speed motor
- M2** Right hand side single speed motor
- P** Pilot supply
- T** Tank supply

- 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.

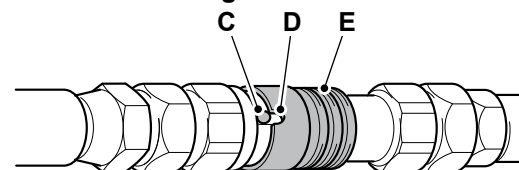
Connect

1. Make the machine safe. Refer to (PIL 01-03).
2. Discharge the hydraulic pressure. Refer to (PIL 30-00).
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 (PIL 01-03).
2. Discharge the hydraulic pressure. Refer to (PIL 30-00).
3. Where applicable, align the slot with ball.
4. Pull back the sleeve to release the coupling.

Figure 525.



- C Ball
- D Slot
- E Sleeve

Figure 539. 335/E0009 (Sheet 3 of 7)

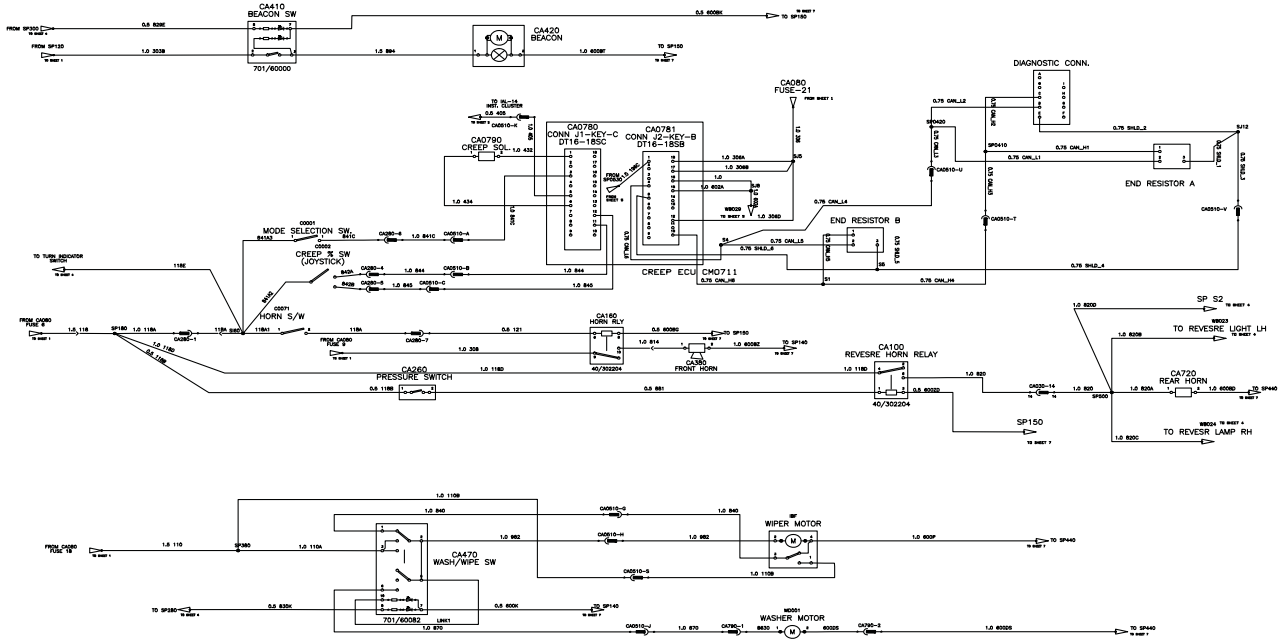
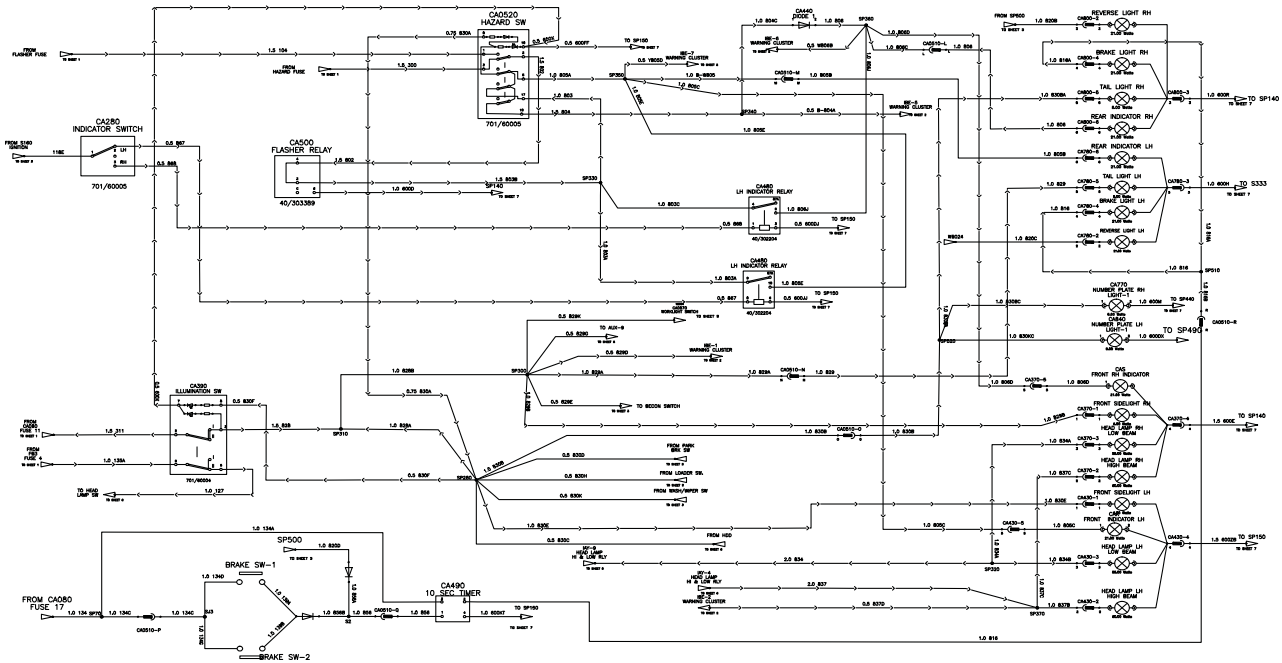


Figure 540. 335/E0009 (Sheet 4 of 7)



- Never charge a battery at a voltage in excess of 15.8V.
- Never continue to charge a battery after it begins to gas.

Quiescent Current Drain

If the machine has no permanently live circuits there should be zero quiescent current drain, when the key-switch is off and all the lights are switched off.

It should be noted that some permanently live circuits will place a quiescent drain on the battery. Typically the quiescent drain will be in the range of 10–20 mA. If the quiescent drain measures 40 mA or more, there is a problem with the wiring insulation or the accessories, if the fault is not rectified it will continue to drain the battery.

Health and Safety

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

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

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

Re-charge the battery away from the machine, in a well ventilated area. Switch the charging circuit off before connecting or disconnecting the battery. When you have installed the battery in the machine, wait 5min before connecting it up.

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

WARNING Keep metal watch straps and any metal fasteners on your clothes, clear of the positive (+) battery terminal. Such items can short between the terminal and nearby metal work. If it happens you can get burned.

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

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

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

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

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

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

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

DANGER If you try to charge a frozen battery, or jump start and run the engine, the battery could explode. Do not use a battery if its electrolyte is frozen. To prevent the battery electrolyte from freezing, keep the battery at full charge.

CAUTION Damaged or spent batteries and any residue from fires or spillage must be



00 - General

Introduction

The cables connect the battery positive and negative terminals to the machine electrical system.

Health and Safety

▲ **WARNING** In addition to the warnings incorporated into this procedure, extreme care should be taken when handling the gas heating tool to ensure that the flame does not damage or set fire to any items in the vicinity of the repair, i.e. other wires, floor panels, floor mats, sound proofing, paintwork, etc. This tool should not be used in any restricted location prohibiting the use of "Naked Flames" or where risk of explosive gas or similar safety parameters apply. No other heat source should be used to attempt a sealed joint.

Notice: When installing auxiliary electrical components always ensure that the additional load rating is suitable for that particular circuit. It is unacceptable to simply increase the fuse rating as this can cause overloading and consequential failure of wiring, along with failure of integral circuit components, which the fuse is protecting.

CAUTION When the heater is in use, the reflector and the air coming out are extremely hot. Keep away to avoid accidental burns. Do not touch the reflector until it has had time to cool down after switching off. If flame reappears at the reflector when the heater is in use, the catalytic element is damaged or used up. Stop work immediately and replace the heater.



33 - Electrical System

12 - Harness

04 - Chassis



Figure 584. (Part 2 of 2)

CA780
TAIL LAMP LH

Cov #	Tag	Size	Destination
1	7210	0	O100
2	820C	1.0	SP500-4
3	600H	1.0	SP490 CHASSIS-6
4	816	1.0	SP510-1
5	829	1.0	CA0510-N
6	805B	1.0	CA0510-M

6 WAY MT090 FEM HSG NATURAL : 1 : 7216/0051

CA790
WASHER BOTTLE

Cov #	Tag	Size	Destination
1	870	1.0	CA0510-J
2	600DS	1.0	SP440 CHASSIS-14

2 Way Pos Lock Housing T Type : 1 : 7232/0003

CA800
TAIL LAMP RH

Cov #	Tag	Size	Destination
1	7210	0	O100
2	820B	1.0	SP500-3
3	600R	1.0	SP490 CHASSIS-7
4	816A	1.0	SP510-2
5	830BA	1.0	SP520-3
6	806	1.0	CA0510-L

6 WAY MT090 FEM HSG NATURAL : 1 : 7216/0051

S4

Cov #	Tag	Size	Destination
1	CAN_L40	75	CA0510-U
2	CAN_L50	75	CO04-B
3	CAN_L60	75	CA0781-4

In Line Ultrasonic Splice : 1 : 7000/3104
Adhesive Lined Heatshrink : 45.0 : 7000/3212

CA830
CHASSIS EARTH

Cov #	Tag	Size	Destination
1	600KK	8.0	SP490 CHASSIS-9

Ring Terminal M10 6.0-10.0 : 1 : 7207/1510
Adhesive Lined Heatshrink : 30.0 : 7000/3212

CA820
WIPER MOTOR

Cov #	Tag	Size	Destination
1	110B	1.0	CA0510-S
2	982	1.0	CA0510-H
3	840	1.0	CA0510-G
4	600P	1.0	SP440 CHASSIS-3

4 WAY ET250 MALE HSG UNSEALED : 1 : 7214/0068

CO04
END RESISTOR_B

Cov #	Tag	Size	Destination
A	CAN_H5	0.75	S1-2
B	CAN_L3	0.75	S4-2
C	SHLD	3.0	S5-2

3 WAY DT08 SOC HSG NO END CAP : 1 : 7213/0015
3 Way DT08 Wedge : 1 : 7213/0018
3 Way DT04 CAN Terminating Resistor J1939/11 : 1 : 727/00002

SP400

Cov #	Tag	Size	Destination
1	531A	1.0	CA560-10
2	531	1.0	CA550-1
3	531B	1.0	CA740-4

In Line Ultrasonic Splice : 1 : 7000/3104
Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP410

Cov #	Tag	Size	Destination
1	532A	1.0	CA560-11
2	532	1.0	CA510-1
3	532B	1.0	CA740-2
4			

In Line Ultrasonic Splice : 1 : 7000/3104
Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP420

Cov #	Tag	Size	Destination
1	526A	1.0	CA560-2
2	526	1.0	CA570-1
3	526B	1.0	CA740-1
4	526C	1.0	CA740-3

In Line Ultrasonic Splice : 1 : 7000/3104
Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP430

Cov #	Tag	Size	Destination
1	524B	1.0	CA550-2
2	524C	1.0	CA510-2
3	524A	1.0	CA560-9
4	524	1.0	CA570-2

In Line Ultrasonic Splice : 1 : 7000/3104
Adhesive Lined Heatshrink : 45.0 : 7000/3212

CA850
CHASSIS EARTH

Cov #	Tag	Size	Destination
1	600KZ	60116.0	2.0CA590-1CA030-21

Ring Terminal M10 16-25 : 1 : 7207/1505
Adhesive Lined Heatshrink : 30.0 : 7000/3212

SJ5

Cov #	Tag	Size	Destination
1	306	1.0	CA0510-E
2	306A	1.0	CA0781-18
3	306B	1.0	CA0781-17
4	306D	1.0	CA0781-12

SP440 CHASSIS

Cov #	Tag	Size	Destination
1	600BC	0.75	CA660-2
3	600P	1.0	CA820-4
5	600BD	1.0	CA720-2
6	600	8.0	CA590-1
7	600HK	1.0	CO05-2
8	600BF	0.75	CA670-2
9			
11	600M	1.0	CA770-2
12	600DD	0.75	CA650-C
13	600GK	0.5	CO03-2
14	600DS	1.0	CA790-2
15	600ZN	1.0	CA610-2
16	600NC	3.0	SP490 CHASSIS-8
17	600BX	0.5	CA760-2
18			
19			
20			

In Line Ultrasonic Splice : 1 : 7000/3104
Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP450

Cov #	Tag	Size	Destination
1	105	1.0	CA030-26
2	105A	1.0	CA750-1
3	105B	1.0	CA610-1

In Line Ultrasonic Splice : 1 : 7000/3104
Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP460

Cov #	Tag	Size	Destination
1	200	8.0	CA730-1
2	200A	4.0	CA030-1
3	200B	4.0	CA030-2

In Line Ultrasonic Splice : 1 : 7000/3104
Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP470

Cov #	Tag	Size	Destination
1	201	8.0	CA730-2
2	201A	4.0	CA030-3
3	201B	3.0	CA030-4

In Line Ultrasonic Splice : 1 : 7000/3104
Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP480

Cov #	Tag	Size	Destination
1	108	1.0	CA750-2
2	108A	1.0	CA680-2
3	108B	1.0	CA750-4

In Line Ultrasonic Splice : 1 : 7000/3104
Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP500

Cov #	Tag	Size	Destination
1	820	1.0	CA030-14
2	820A	1.0	CA720-1
3	820B	1.0	CA800-2
4	820C	1.0	CA780-2
5	820AB	1.0	CO02-3

In Line Ultrasonic Splice : 1 : 7000/3104
Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP510

Cov #	Tag	Size	Destination
1	816	1.0	CA780-4
2	816A	1.0	CA800-4
3	816B	1.0	CA0510-R

In Line Ultrasonic Splice : 1 : 7000/3104
Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP520

Cov #	Tag	Size	Destination
1	830BC	1.0	CA770-1
2	830B	1.0	CA0510-0
3	830BA	1.0	CA800-5
4	830KC	1.0	CA840-1
5			

In Line Ultrasonic Splice : 1 : 7000/3104
Adhesive Lined Heatshrink : 45.0 : 7000/3212

CA0790
CREEP SOLENOID

Cov #	Tag	Size	Destination
1	434	1.0	CA0780-6
2	432	1.0	CA0780-1

2 Way DT06 Socket Housing : 1 : 7212/0052
2 Way DT06 Wedge : 1 : 7212/0054
2 WAY BLUE DT06 WEDGE : 1 : 7212/0054

713
52
3128
5
114/0068
70010
1214/0068
2/0010
12/0044
212/0128



Figure 587. (Part 1 of 2)

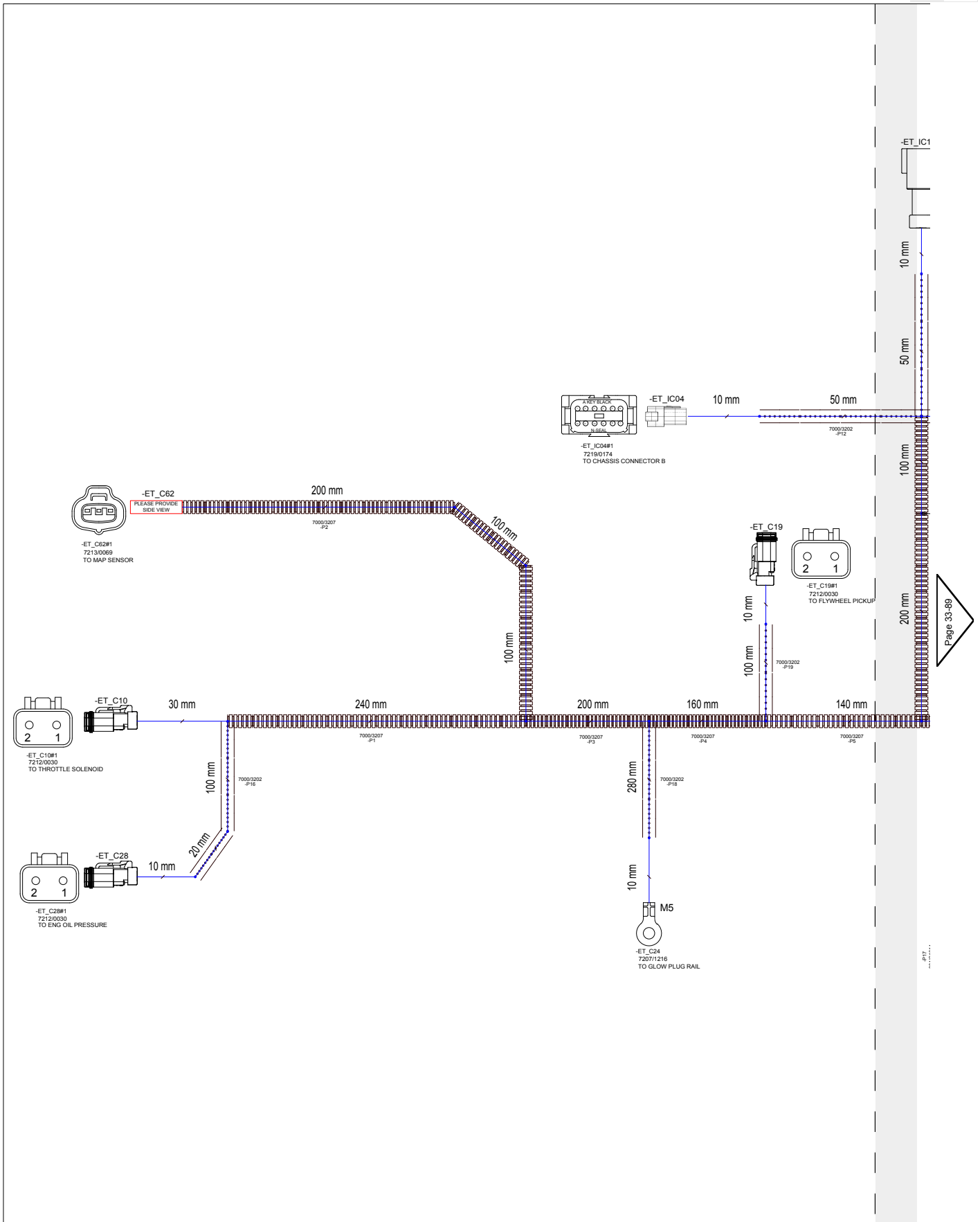


Figure 591. (Part 2 of 2)

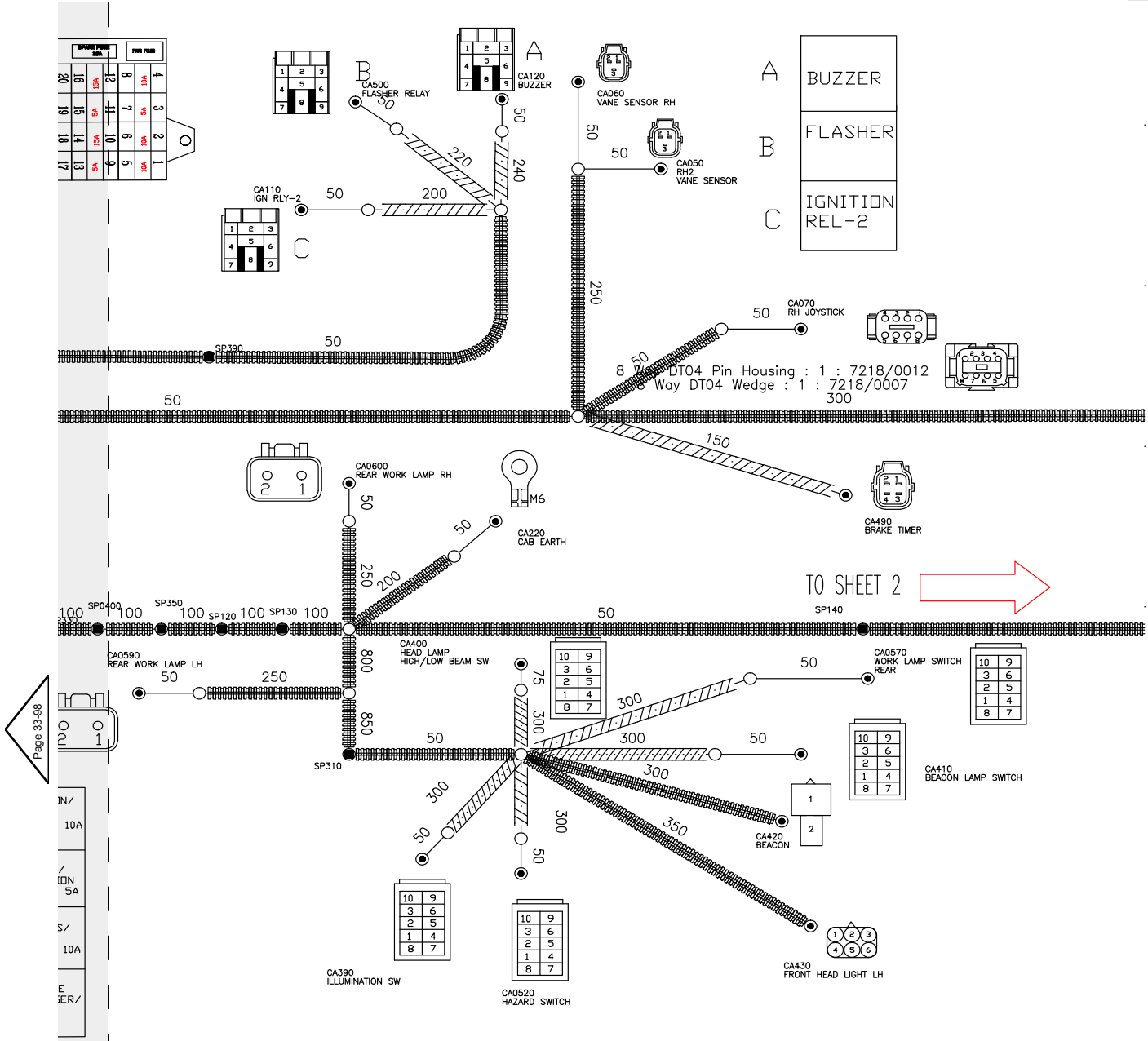




Figure 594. (Part 1 of 2)

CA030 TO CHASSIS

Cov ID	Tag	Size	Destination	Cov ID	Tag	Size	Destination	Cov ID	Tag	Size	Destination
1	200A	4.0	SP050-1	11	930	0.5	CA330-22	21	601	2.0	SJ6-3
2	200B	4.0	SP080-3	12	003D	1.0	SP090-1	22	422	0.5	CA330-10
3	201A	4.0	SP060-5	13	408	0.5	CA330-20	23	407	0.5	CA330-28
4	201B	3.0	CA110-8	14	820	1.0	CA100-5	24	196	1.0	SP010-3
5	409	0.5	CA330-13	15	107	0.75	CA080-29	25	864	0.75	CA100-9
6	602K	2.0	SJ10-1	16	938	1.0	CA170-9	26	105	1.0	CA080-6
7	412	0.5	CA330-15	17	853	0.5	CA0550-2	27	425	0.5	CA330-2
8	402	0.5	CA330-21	18	506	1.0	CA070-3	28	600JL	0.5	CA330-16
9	421	0.5	CA330-23	19	505	1.0	CA070-2	29	7210/0052		
10	842	2.0	CA080-22	20	517	1.0	CA070-4				

29 Way HDP Bulkhead Pin Housing : 1 : 7220/0060
Size 24 Lockwasher : 1 : 7210/0047
Size 24 Plastic Jam Nut : 1 : 7210/0048

CA050 RH2 VANE SENSOR

Cov ID	Tag	Size	Destination
1	857	0.5	SP030-1
2	7210/0001		
3	861	0.5	CA240-1

3 Way HW090 Socket Housing : 1 : 7213/0005
3 Way HW090 Socket Retainer : 1 : 7213/0007

CA060 VANE SENSOR RH

Cov ID	Tag	Size	Destination
1	841	0.5	CA290-3
2	7210/0001		
3	199G	0.5	SP030-3

3 Way HW090 Socket Housing : 1 : 7213/0005
3 Way HW090 Socket Retainer : 1 : 7213/0007

CA070 RH JOYSTICK

Cov ID	Tag	Size	Destination
1	199B	1.0	SP030-2
2	505	1.0	CA030-19
3	506	1.0	CA030-18
4	517	1.0	CA030-20
5	7210/0030		
6	7210/0030		
7	7210/0030		
8	7210/0030		

8 Way DT06 Socket Housing : 1 : 7218/0013
8 Way DT06 Wedge : 1 : 7218/0009
8 Way DT04 Pin Housing : 1 : 7218/0012
8 Way DT04 Wedge : 1 : 7218/0007

SJ10 GND-REL

Cov ID	Tag	Size	Destination
1	602K	2.0	CA030-6
2	602B	2.0	CA0580-10
3	602N	0.5	CA340-7
4	602P	0.5	CA350-7
5	602L	1.0	CA170-6
6	602J	1.0	CA130-3
7	602R	1.0	CA130-6
8	602H	0.5	CA100-6

CA100 HORN RELAY/AUX RELAY

Cov ID	Tag	Size	Destination
1	881	0.5	CA260-2
2			
3	600ZD	0.5	SP150-15
4	118D	1.0	SP180-4
5	820	1.0	CA030-14
6	602H	0.5	SJ10-8
7			
8	487A	0.5	SP260-1
9	863A,864	0.5,0.75	CA450-1,CA030-75
10	837	1.0	CA360-3

10 WAY W/H RELAY PLATE MRB MISO 2P-NY 66B : 1 : 7241/0060

CA080 FUSE BOX

Cov ID	Tag	Size	Destination	Cov ID	Tag	Size	Destination
1	201C	1.0	SP060-4	25	007J	1.0	SP040-7
2	001A	1.0	SP130-3	26	200Z	0.5	SP050-5
3	001	0.75	SP130-2	27	199	1.0	SP030-5
4	200F	1.5	SP050-3	28	007G	1.5	SP040-4
5	304	1.0	SP190-1	29	107,107D	0.75,0.5	CA030-15,CA030-2
6	105	1.0	CA030-26	30	320	0.5	CA330-12
7	133	0.5	CA110-6	31	007D	1.0	SP040-10
8	303	1.5	SP120-1	32	104	1.5	CA0520-1
9	007A	1.0	SP040-3	33	007L	1.0	SP040-8
10	007B	1.5	SP040-2	34	007C	1.5	SP040-5
11	007H	0.75	SP040-1	35	007F	1.0	SP040-9
12	200K	1.5	SP080-4	36	200P	2.0	SP080-2
13	114	1.0	CA230-1	37	134	1.0	SP70-1
14	118	1.5	SP180-2	38	110	1.5	SP380-2
15	G106	0.75	SP290-2	39	135	2.0	SP390-3
16	310	1.5	CA0580-4	40	317	2.0	CA150-4
17	200G	1.0	SP050-4	41	200K	1.5	SP080-1
18	010	2.0	CA310-7	42			
19	200R	1.5	SP050-6	43			
20	200N	2.0	SP050-2	44			
21	308	1.0	CA160-9	45	300	1.5	CA0520-3
22	842	2.0	CA030-10	46			
23	311	1.5	CA390-2	47			
24	309	2.0	CA150-10	48			

24 FUSE CASSETTE FUSE HOLDER ASSY : 1 : 7241/0054
5A ATO Fuse : 6 : 716/05703
10A ATO Fuse : 9 : 716/05705
15A ATO Fuse : 5 : 716/05706
20A ATO Fuse : 3 : 716/05707
25A ATO Fuse : 1 : 716/05708

CA110 IGN RLY-2

Cov ID	Tag	Size	Destination
1			
2	007	3.0	SP040-6
3			
4	600B	0.5	SP140-1
5			
6	133	0.5	CA080-7
7			
8	201B	3.0	CA030-4
9			

40A RELAY BASE BLACK : 1 : 7241/0058

CA120 BUZZER

Cov ID	Tag	Size	Destination
1			
2	106C	0.75	SP290-1
3			
4			
5			
6	411	0.5	CA330-11
7			
8			
9			

40A RELAY BASE BLACK : 1 : 7241/0058

CA130 PARK BRAKE RELAY-1

Cov ID	Tag	Size	Destination
1	413A	0.5	CA130-9
2	401G	0.5	CA330-4
3	602J	1.0	SJ10-6
4			
5	600HH	1.0	SP150-13
6	602R	1.0	SJ10-7
7	413I	0.5	CA0540-2
8	401C	0.5	SP270-3
9	413A,196A	0.5,1.0	CA130-1,SP010-2
10	941	1.0	CA350-3

10 WAY W/H RELAY PLATE MRB MISO 2P-NY 66B : 1 : 7241/0060

SJ6

Cov ID	Tag	Size	Destination
1	601B	2.0	CA0580-9
2	601A	0.5	CA0580-6
3	601	2.0	CA030-21

Figure 597. Cab Harness - Work Lights
334/Y0028 Issue 2 (Sheet 1 of 6)

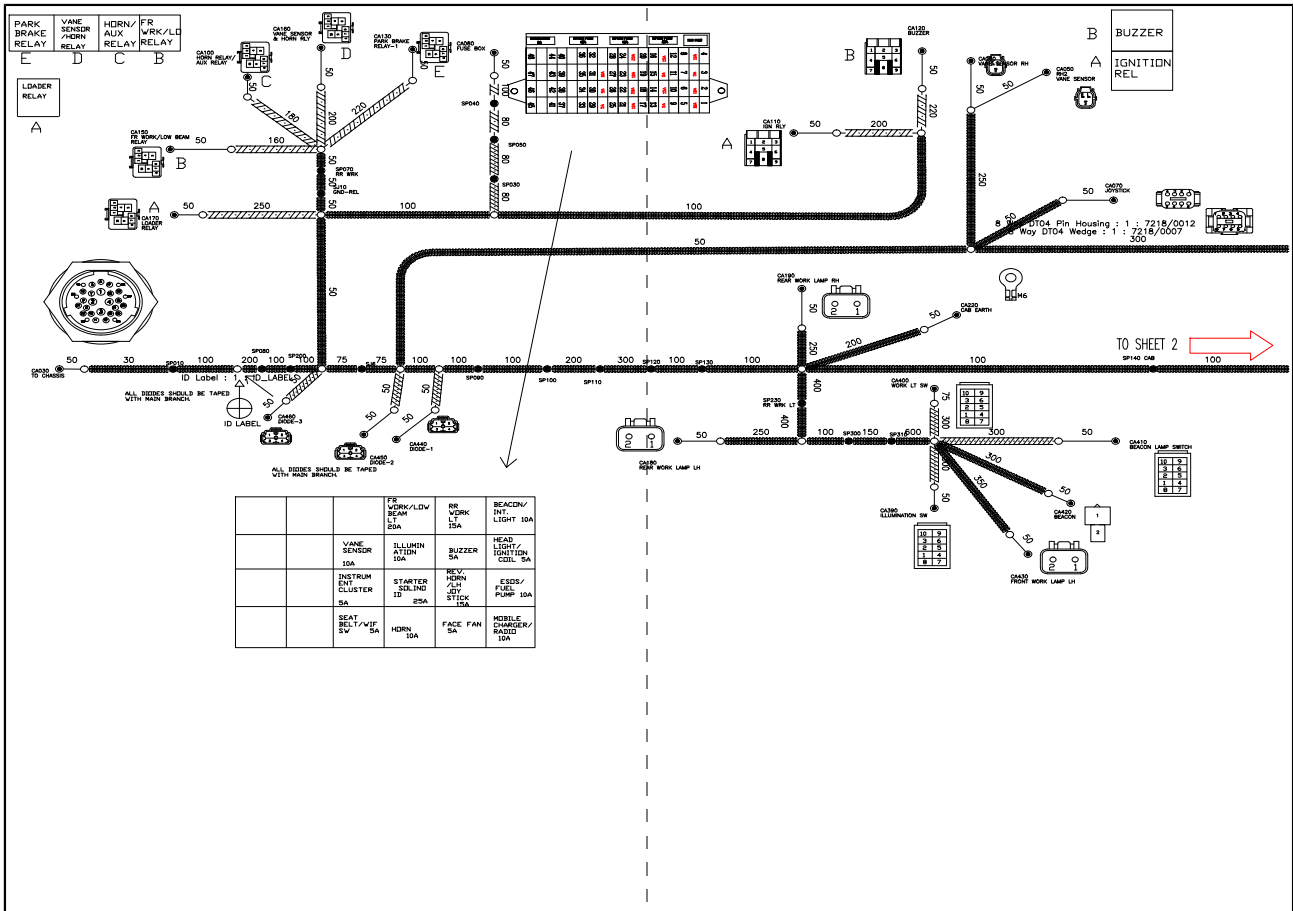






Figure 602. (Part 2 of 2)

SP180

Cov ID	Tag	Size	Destination
1	118B	0.5	CA260-1
2	118	1.5	CA080-14
3	118A	1.0	CA280-1
4	118D	1.0	CA100-4
5			

In Line Ultrasonic Splice : 1 : 7000/3104
 Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP190

Cov ID	Tag	Size	Destination
1	304	1.0	CA080-5
2	304A	1.0	CA270-2
3			
4			

In Line Ultrasonic Splice : 1 : 7000/3104
 Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP200

Cov ID	Tag	Size	Destination
1	133D	0.5	CA400-5
2	133	1.0	CA080-7
3	133C	0.5	CA400-2
4	133B	0.5	CA110-6
5			
6			
7			

In Line Ultrasonic Splice : 1 : 7000/3104
 Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP210

Cov ID	Tag	Size	Destination
1	940	1.0	CA160-5
2	940A	1.0	CA360-2
3	940G	1.0	CA360-5
4	940E	1.0	SP220-3
5	940AB	0.5	CA360-8
6			

In Line Ultrasonic Splice : 1 : 7000/3104
 Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP220

Cov ID	Tag	Size	Destination
1	940C	1.0	CA350-2
2	940D	1.0	SP250-1
3	940E	1.0	SP210-4
4	940M	1.0	CA350-5
5			

In Line Ultrasonic Splice : 1 : 7000/3104
 Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP230
RR WRK LT

Cov ID	Tag	Size	Destination
1	137A	0.75	CA400-6
2	137B	0.5	CA150-3
3	137	0.5	CA460-2

In Line Ultrasonic Splice : 1 : 7000/3104
 Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP240

Cov ID	Tag	Size	Destination
1	488B	1.0	CA450-4
2	488	1.0	CA340-6
3	488A	0.5	CA170-8

In Line Ultrasonic Splice : 1 : 7000/3104
 Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP250

Cov ID	Tag	Size	Destination
1	940D	1.0	SP220-2
2	940DA	1.0	CA340-2
3	940DB	1.0	CA340-5
4			

In Line Ultrasonic Splice : 1 : 7000/3104
 Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP260

Cov ID	Tag	Size	Destination
1	487A	0.5	CA100-8
2	487	1.0	CA360-6
3	487B	1.0	CA450-2
4			
5			

In Line Ultrasonic Splice : 1 : 7000/3104
 Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP270

Cov ID	Tag	Size	Destination
1	401B	1.0	CA440-4
2	401	1.0	CA350-6
3	401C	0.5	CA130-8

In Line Ultrasonic Splice : 1 : 7000/3104
 Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP280

Cov ID	Tag	Size	Destination
1	830F	0.5	CA390-8
2	830AA	0.5	CA340-10
3	828A	1.0	SP310-2
4	830BB	0.5	CA350-10

In Line Ultrasonic Splice : 1 : 7000/3104
 Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP290

Cov ID	Tag	Size	Destination
1	106C	0.5	CA120-2
2	G106	0.75	CA080-15
3	106A	0.5	CA330-9

In Line Ultrasonic Splice : 1 : 7000/3104
 Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP300

Cov ID	Tag	Size	Destination
1	829D	0.5	CA330-7
2	829C	0.5	CA400-8
3	829E	0.5	CA410-8
4	828B	1.0	SP310-3
5	829G	0.5	CA360-10

In Line Ultrasonic Splice : 1 : 7000/3104
 Adhesive Lined Heatshrink : 45.0 : 7000/3212

SP310

Cov ID	Tag	Size	Destination
1	828	1.5	CA390-3
2	828A	1.0	SP280-3
3	828B	1.0	SP300-4

In Line Ultrasonic Splice : 1 : 7000/3104
 Adhesive Lined Heatshrink : 45.0 : 7000/3212

4
212

Page 33-142

2



Figure 605. (Part 1 of 2)

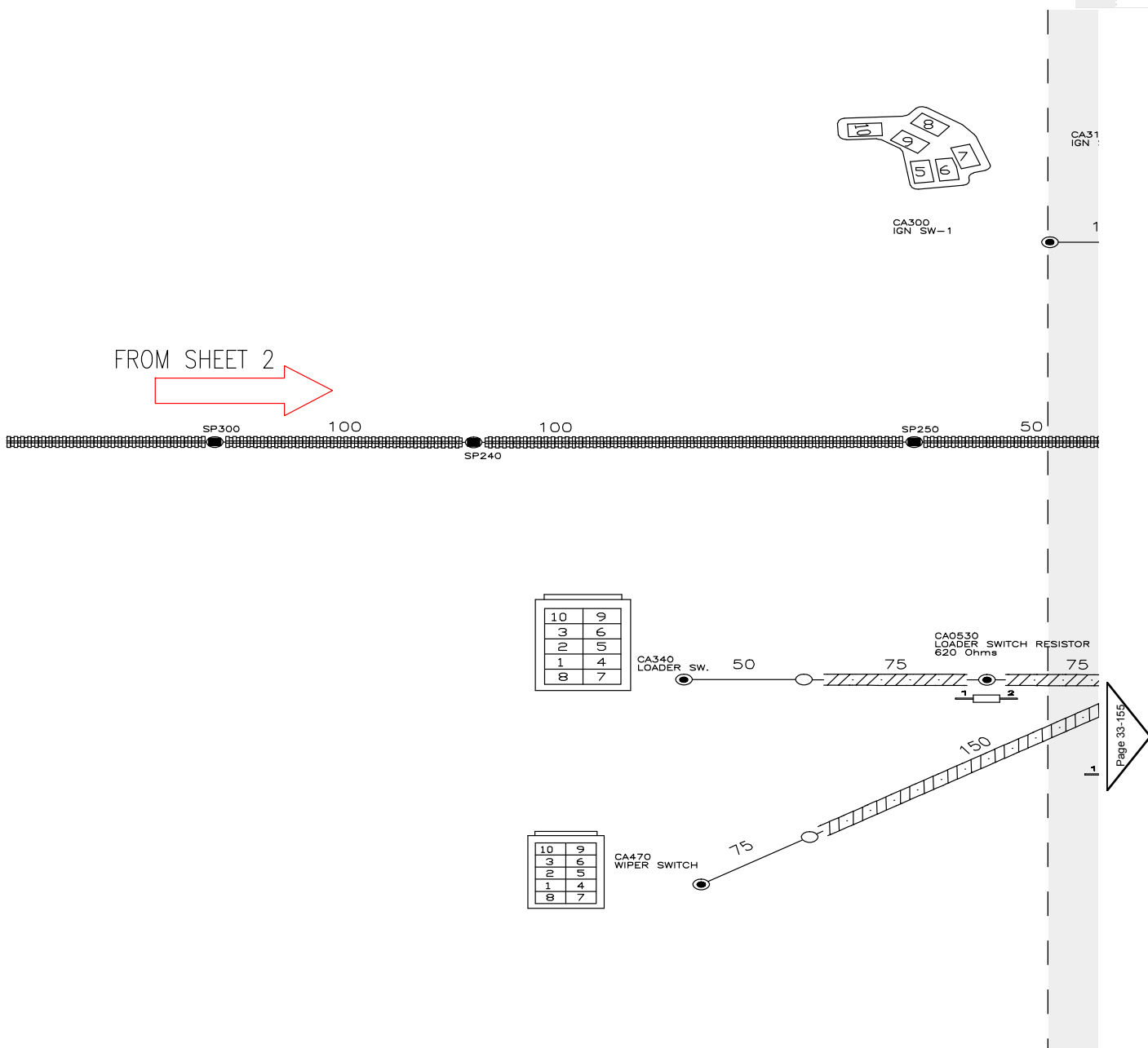


Figure 608. Cab Harness - Creep and Road Lights 334/Y9887 Issue 3 (Sheet 6 of 6)

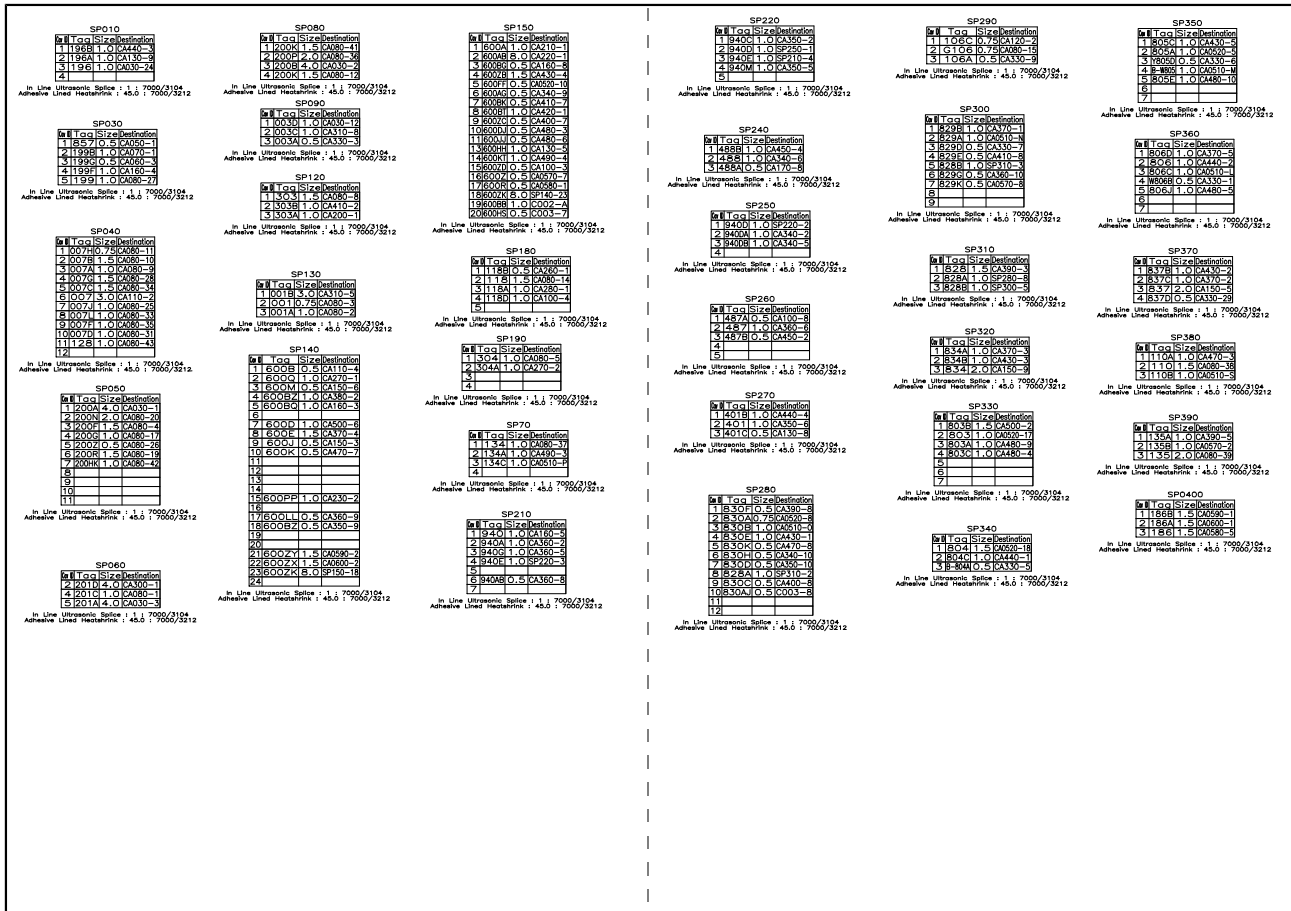






Figure 613. (Part 2 of 2)

CA490
LOADER SWITCH RESISTOR
620 OHM

Con ID	Tag	Size	Destination
1	951	0.5	CA340-8
2	950	0.5	CA170-7

Resistor 680R Metal Film 0.6W 1% : 1 : 332/C2495
Adhesive Lined Heatshrink : 1.0 : 7000/3212

C003
END RESISTOR_A

Con ID	Tag	Size	Destination
A	CAN_H1	0.75	S1-1
B	CAN_L1	0.75	S2-1
C	SHLD_1	0.75	S3-1

3 WAY DT06 SOC HSG NO END CAP : 1 : 7213/0015
3 Way DT06 Wedge : 1 : 7213/0016
3 Way DT04 CAN Terminating Resistor J1939/11 : 1 : 727/00002

CA170
LOADER/ TRAVEL
RELAY

Con ID	Tag	Size	Destination
1	601A	0.5	SJ6-2
2			
3	873	0.5	CA240-3
4	601B	2.0	SJ6-1
5	602B	2.0	SJ10-2
6	602L	1.0	SJ10-5
7	950	0.5	CA490-2
8	488A	0.5	SP240-3
9	938,863D	1.0	CA00-16,CA50-3
10	942	1.0	CA340-3

10 WAY W/H RELAY PLATE MRB MISO
2P-NY 66B : 1 : 7241/0060

C001
HI FLOW SW

Con ID	Tag	Size	Destination
1			
2	129	1.0	CA080-47
3	877	1.0	CA030-29
4			
5			
6			
7	600HS	0.5	SP150-16
8	830AJ	0.5	SP280-5
9			
10			

10 Way 6.3 Fastin Switch Hsg : 1 : 7219/0013

S1

Con ID	Tag	Size	Destination
1	CAN_H1	0.75	C003-A
2	CAN_H2	0.75	CA0510-T
3	CAN_H3	0.75	C002-C

In Line Ultrasonic Splice : 1 : 7000/3104
Adhesive Lined Heatshrink : 45.0 : 7000/3212

C002
DIAGNOSTIC CONN

Con ID	Tag	Size	Destination
A	600BX	1.0	SP140 CAB-4
B	306G	1.0	CA080-46
C	CAN_H3	0.75	S1-3
D	CAN_L3	0.75	S2-3
E	SHLD_3	0.75	S3-3
F	7210	/0030	
G	7210	/0030	
H	7210	/0030	
J	7210	/0030	

9 Way Male J1939 Housing Jam Nut Type : 1 : 7219/0098
Jam Nut Plastic M35 : 1 : 7210/0116
ATC10 Dust Cover with Lanyard (Amphenol) : 1 : 7210/0117

CA0510
TO CHASSIS

Con ID	Tag	Size	Destination	Con ID	Tag	Size	Destination	Con ID	Tag	Size	Destination
A	7210	/0030		J	7210	/0030		R	7210	/0030	
B	844	1.0	CA280-4	K	405	0.5	CA330-27	S	7210	/0030	
C	841C	1.0	CA280-6	L	7210	/0030		T	CAN_H2	0.75	S1-2
D	845	1.0	CA280-5	M	7210	/0030		U	CAN_L2	0.75	S2-2
E	306	1.0	CA080-46	N	7210	/0030		V	SHLD_2	0.75	S3-2
F	7210	/0030		O	7210	/0030		W	7210	/0030	
G	7210	/0030		P	7210	/0030		X	7210	/0030	
H	7210	/0030		Q	7210	/0030		~			

23 Way HDP Bulkhead Pin Housing : 1 : 7220/0048
Size 24 Lockwasher : 1 : 7210/0047
Size 24 Plastic Jam Nut : 1 : 7210/0048

38

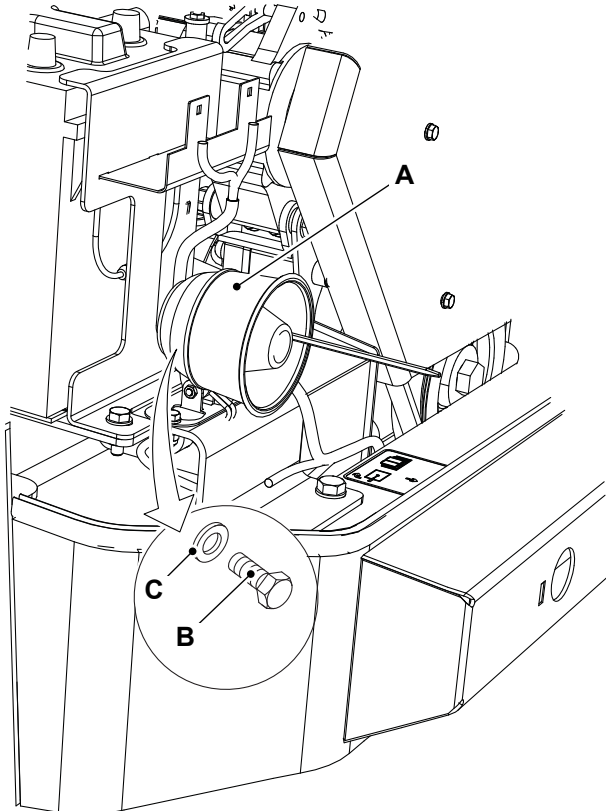
Page 33-186

Remove and Install

Remove

1. Make the machine safe. Refer to (PIL 01-03).
2. Disconnect the battery. Refer to (PIL 33-03).
3. Open the engine compartment cover. Refer to (PIL 06-06).
4. Disconnect the electrical connection.
5. Remove the bolt (x2) and the washer (x2).
6. Remove the reverse alarm from the machine.


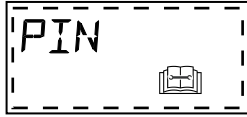
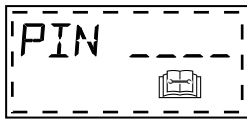

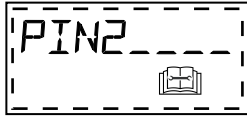
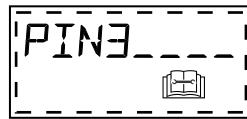
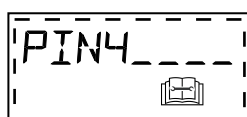
Figure 618.



- A** Reverse alarm
- B** Bolt
- C** Washer

Install

1. The installation procedure is the opposite of the removal procedure.

Item	Screen	Graphic	Description
AH	Switch Panel Software		Displays the joystick proportional signal voltage
			Press the "i" button to display screens AJ, AK, AL, AM, AN and AP if the keyless start feature is enabled.
AJ	Versions		Displays the PIN information
AK	PIN		Owner PIN code required to continue
AL	PIN 1		PIN 1 is displayed and number entry is possible
AM	PIN 2		PIN 2 is displayed and number entry is possible
AN	PIN 3		PIN 3 is displayed and number entry is possible
AP	PIN 4		PIN 4 is displayed and number entry is possible

12 - Front Direction Indicator

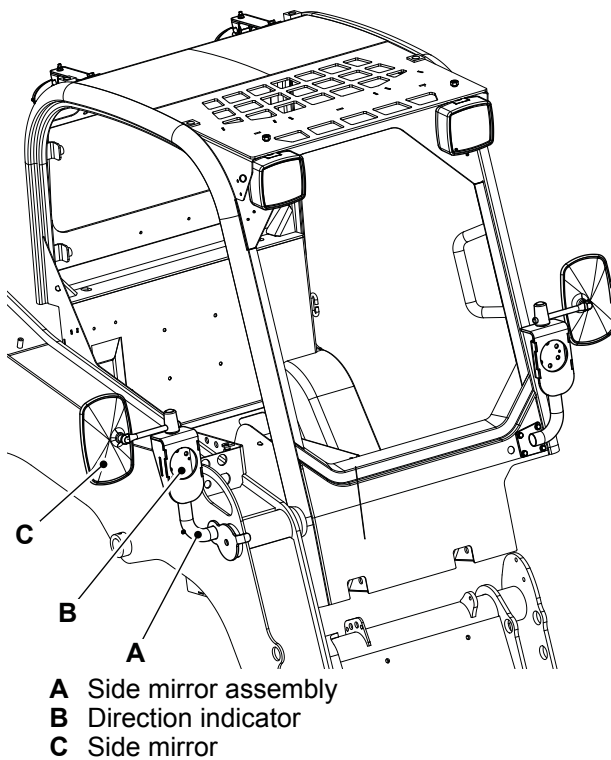
Remove and Install

Remove

The direction indicator is mounted inside the side mirror assembly.

1. Make the machine safe with the lift arm lowered. Refer to (PIL 01-03).
2. Remove the screw, disconnect the electrical connection, remove the direction indicator out of the side mirror assembly.

Figure 623.



Install

1. Replacement is a reversal of the removal procedure. For bulb specifications, refer to Bulbs-Technical Data (PIL 33-40).



00 - General

Introduction	33-231
Component Identification	33-232
Diagram	33-233

Introduction

The wash/wipe system is used to remove rain and debris from the front or rear window. The main components of the system are:

- Wiper Arm.
- Wiper Blade.
- Nozzle (jet).
- Wiper Motor Mechanism.
- Tank (reservoir).
- Washer Pump.
- Wash/Wipe Switch.
- Multifunction Switch (intermittent speed settings).

The wiper assembly consists of an arm, pivoting at one end with a long rubber blade attached to the other. The blade is swung back and forth over the glass, pushing water from its surface. The speed is normally adjustable, with several continuous speeds and often one or more intermittent settings. Some machines may use two wiper arms.

The wipers operate together with the washer system. The washer pump supplies a mixture of water, alcohol, and detergent (washer fluid) from a tank to the windows through a hose. The fluid is dispensed through small nozzles mounted below the screen. It is essential the correct washer fluid is used as an incorrect fluid could freeze in colder climates and damage the pump. Although antifreeze is chemically similar to windscreen wiper fluid, it should not be used because it can damage the paintwork.



84 - Sensor

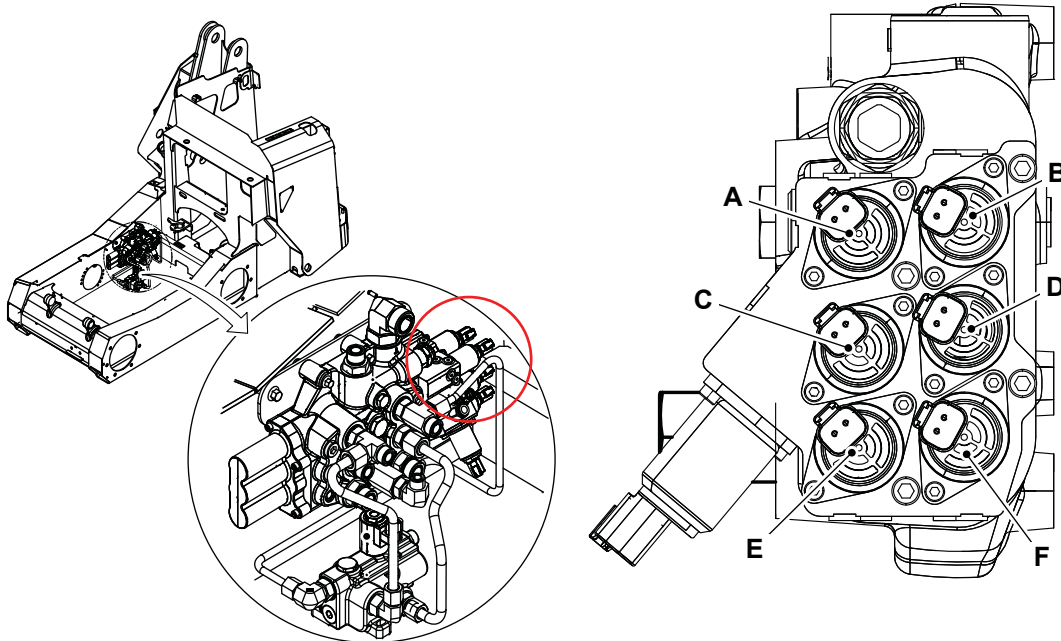
Contents	Page No.
33-84-06 Hydraulic Oil Temperature	33-243

Remove and Install

Remove

1. Make the machine safe with the lift arm lowered. Refer to (PIL 01-03).
2. Disconnect the battery. Refer to (PIL 33-03).
3. Raise the operator station. Refer to (PIL 09-00).
4. Mark all the electrical connectors to help installation.
5. Disconnect the relevant electrical connection.
6. Remove the relevant solenoid.

Figure 640.



A Crowd
C Raise
E Aux A

B Dump
D Lower
F Aux B



Notes:



06 - Bolts

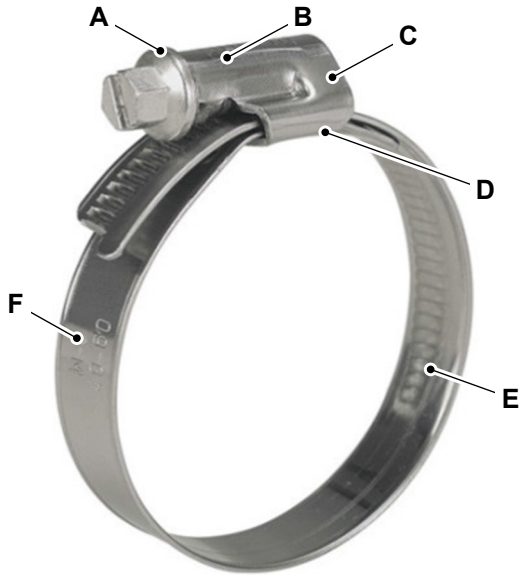
Contents

Page No.

72-06-00 General 72-11

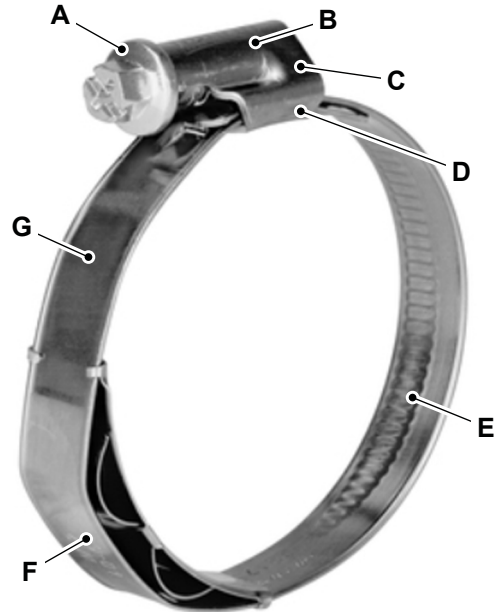
Component Identification

Figure 656. Standard Worm Drive Clip



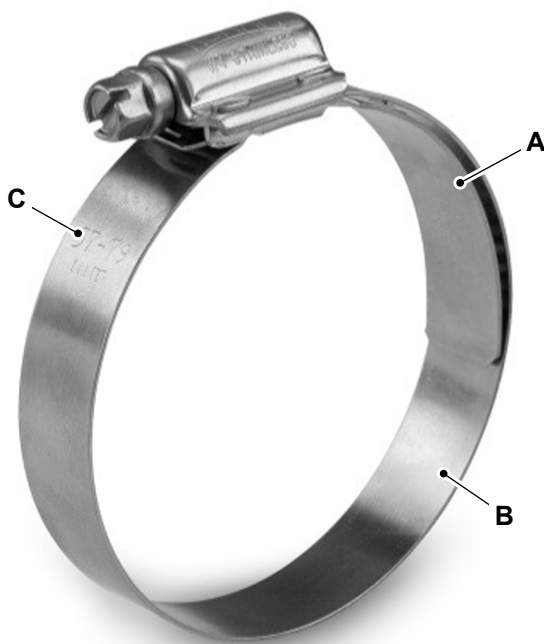
- A Screw support flange
- B Asymmetric housing
- C Asymmetric extension
- D Short housing saddle
- E Stamped inside
- F Identification of material/clamping range

Figure 658. Spring Assisted Worm Drive Clip



- A Screw support flange
- B Asymmetric housing
- C Asymmetric extension
- D Short housing saddle
- E Stamped inside
- F Spring insert
- G Identification of material/clamping range

Figure 657. Heavy Duty Worm Drive Clip



- A Extended bridge
- B Band width (16mm)
- C Identification of clamping range

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