

# LH517

## Service and Repair Manual

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## **2. GENERAL SAFETY INSTRUCTIONS**

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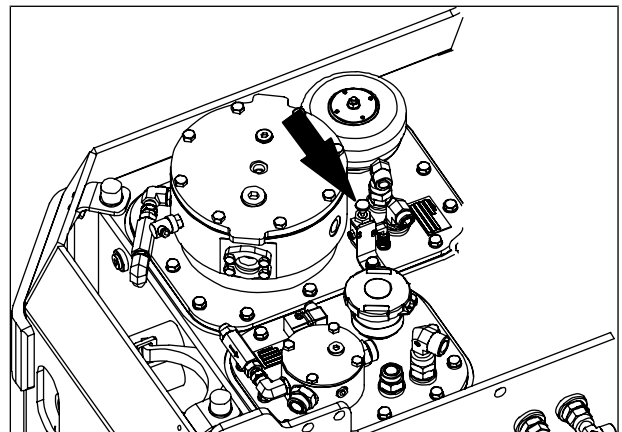
## **3. GENERAL REPAIR INSTRUCTIONS**

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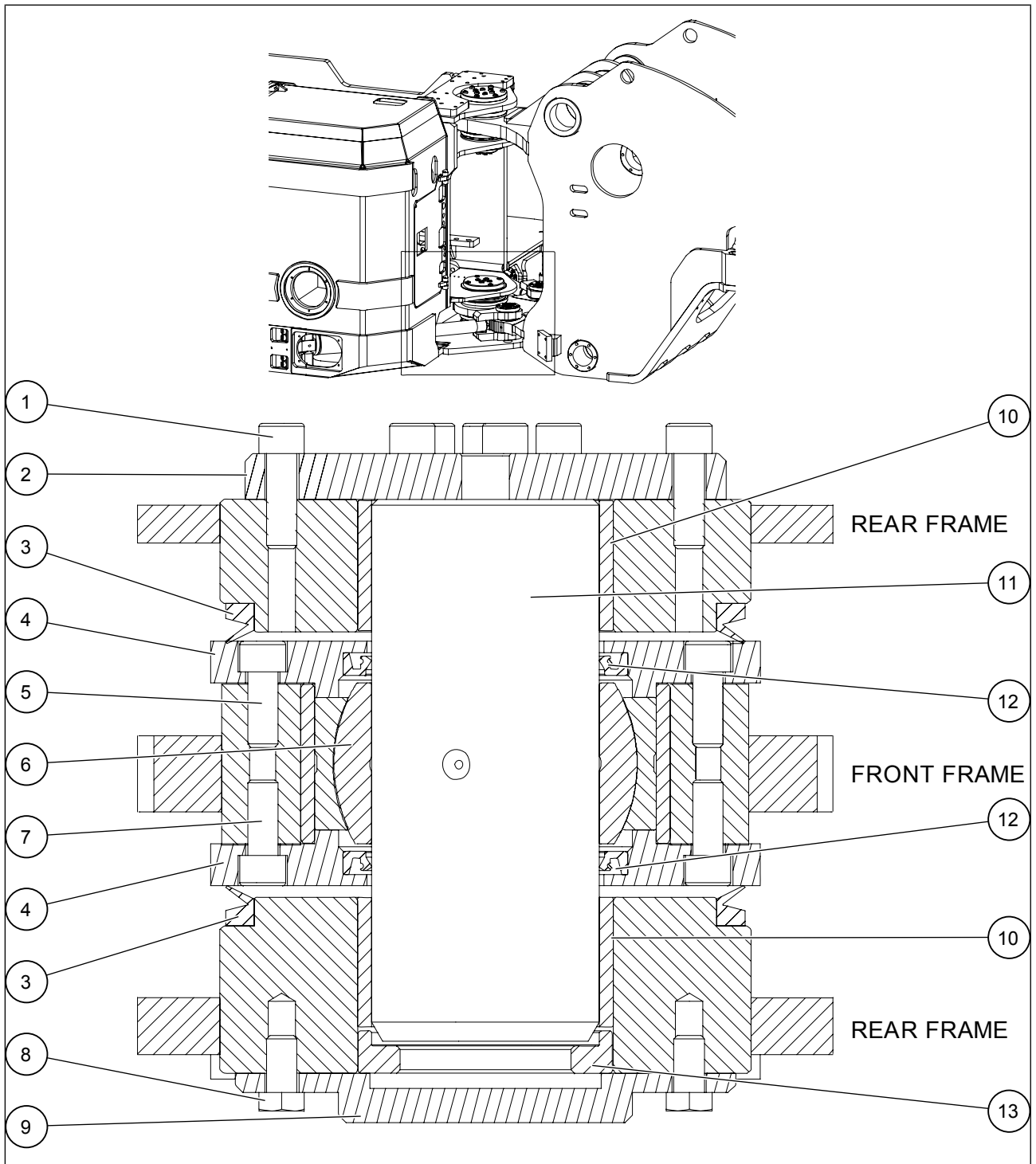
2. Install the frame articulation locking device.
  - See section "How to install the frame articulation locking device".
3. Remove the ignition key.
4. Turn the main switch off and padlock it.
5. Place a **DANGER - DO NOT START** warning sign on the main switch.
  - The sign may only be removed by a person who is fully aware of the current status of the work.
6. Remove the bucket.
- See section "Removing the bucket".
7. Support the dogbone to the swing lever to prevent its movement during lifting.
8. Install suitable lifting bar through the lift arm bushing.
  - **Never install a lifting bar the way it goes through the dogbone and the lift arm bushings at the same time Share force of the dogbone may cut the lifting bar causing severe injury or death.**
9. Attach lifting chains to the lifting bar.



10. Before performing any maintenance work on hydraulic system, the hydraulic oil tank must be de-pressurized.
  - Pressure is released by using the directional valve on top of the hydraulic oil tank.
  - Ensure the valve closes fully once all pressure is relieved.



4.2.2. Lower hinge pin



- |    |                  |    |                          |
|----|------------------|----|--------------------------|
| 1  | Screw M16X50 8.8 | 2  | Upper flange             |
| 3  | V-seal           | 4  | Flange                   |
| 5  | Screw M16X40 8.8 | 6  | Ball joint bearing       |
| 7  | Screw M16X40 8.8 | 8  | Screw M16X30 8.8         |
| 9  | Lower flange     | 10 | Steel bushing (in frame) |
| 11 | Pin              | 12 | Seal                     |
| 13 | Sleeve           |    |                          |

4.4.2. Pin removal



Only people who have been given specialized operation and service training are allowed to perform operations, service, and adjustment procedures. Read and ensure you understand the following instructions before servicing the equipment. To avoid potential damage and injuries, carefully plan your work beforehand.



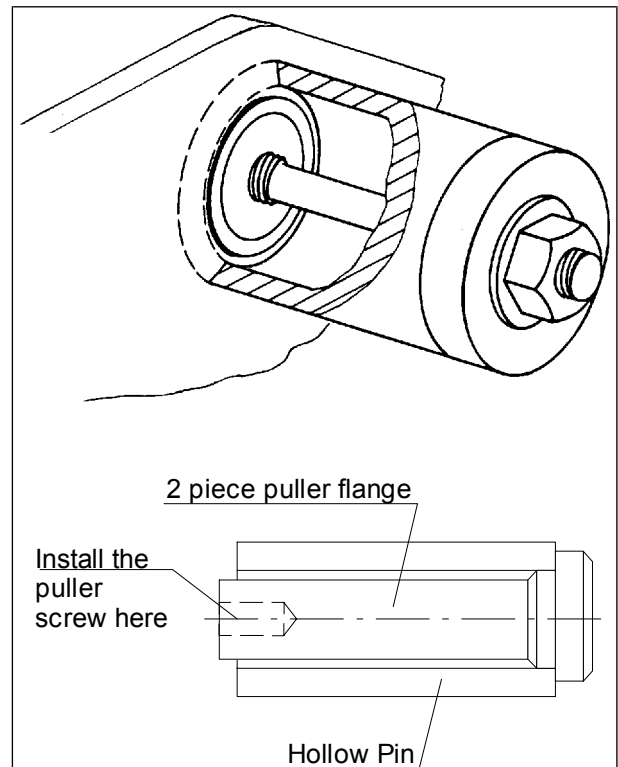
Only perform maintenance work when the machine is parked on a level, hard surface. Use the appropriate tools and safety equipment for the task and be sure you understand how to use them before performing any maintenance work. Replace or repair faulty tools and equipment. When performing maintenance and repair work, ensure there are no unauthorized persons in the working area.

Preparatory steps:

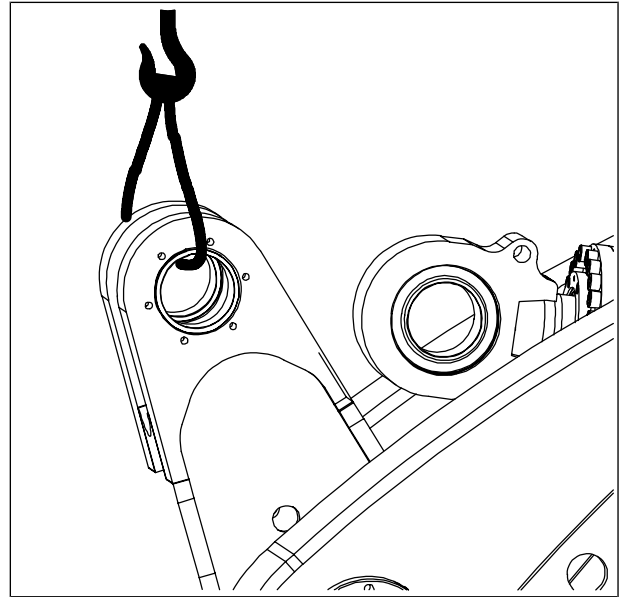
- Support the equipment carefully to prevent accidents and damages caused by heavy parts.
- If the greasing of the pin/frame gaps has been neglected, you can pump oil or rust-loosening agent through the nipple to ease removing.
- Remove lubrication lines (if installed).
- Remove locking flange (or bolt).

4.4.3. Pin removal with a puller

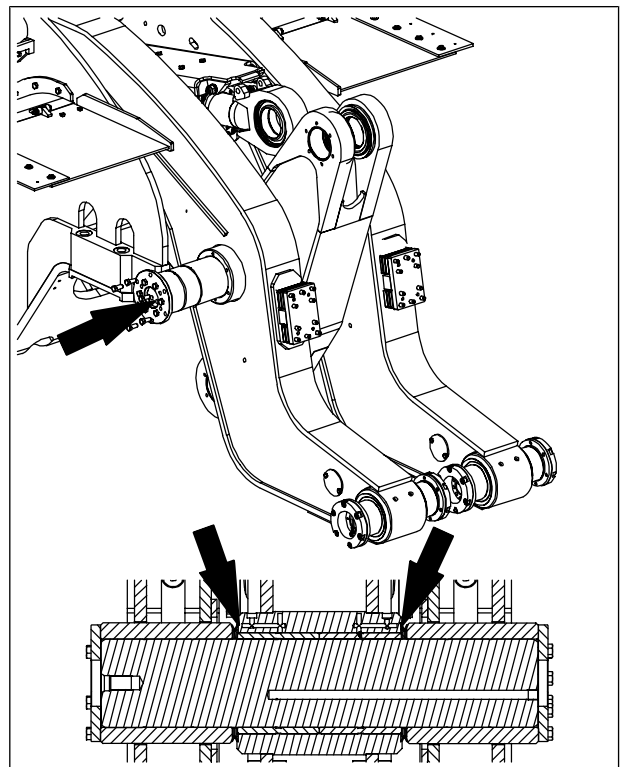
- Clean the threaded hole at end of the pin and oil it (Z-linkage) (Fig.)
- Hollow pins clean the hole.
- Clean the surrounding area where the puller will be fitted.
- Mount the puller. Oil the puller's threads.
- Use a wrench to turn the nut (be sure the wrench fits exactly).
- Tightening the nut will make the pin to move.
- If the pin is stuck badly, hit the other end of pin with a mallet while pulling from the other end.
- If you have a hydraulic puller, use it in the same way as described with mechanical puller.
- You can use a hydraulic jack to remove pins, such as for steering cylinders.
- The middle hinge pins can also be removed with a hydraulic jack.



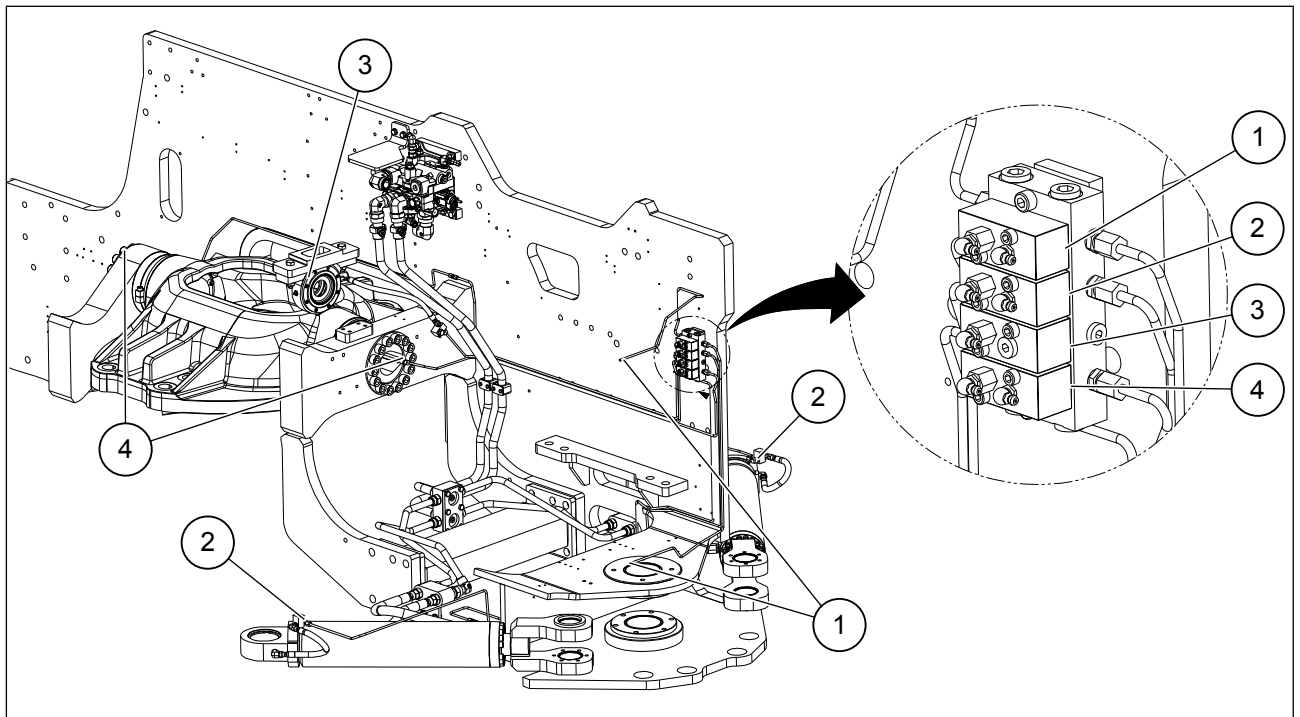
3. Attach a lifting device to the new or reconditioned swing lever and position it on place.
  - Do not use wire rope when lifting the swing lever because it can damage the bushings.



4. Fit the pin to the boom, installing the required spacers and V-seals and start to push the pin into the swing lever. Ensure that the V-seals are not damaged.
  - The weight of the pin is approximately 200 kg.

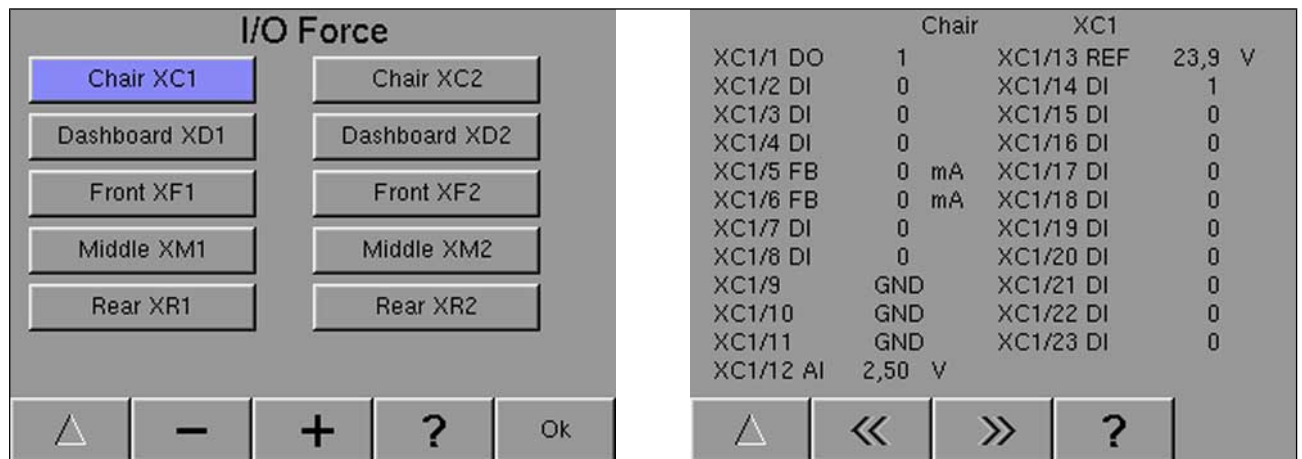


5.1.1. Lubrication points rear frame



- 1 Middle hinge joint
- 2 Steering cylinder
- 3 Cardan shaft bearing, rear
- 4 Oscillation axle ( front, rear )

Forcing the digital outputs of the modules



This window is used for forcing the digital outputs of each connector of a module on or off.

1. On the module menu (I/O Force), select the connector of the module whose outputs you want to force.
2. Press the Ok button, the forcing window of the connector you selected opens. The connector pin values are shown according to their status when the window was opened.
3. Switch the output (or outputs) to be forced on or off. "1" forces the output on, "0" forces the output off.
4. Start the forcing by pressing and holding the SEND button. The forcing stays active until you release the button.

**NOTICE** The SEND button forces all the digital outputs of the connector that has been selected to the status defined on the window.

The digital outputs of the automatic central lubrication:

Function	Module / connector	Connector pin
Operating voltage supply of the central lube reservoir empty sensor	Front XF2	2.1
The control valve of the automatic central lubrication	Front XF2	2.17
Current supply for pressure switches	Middle XM2	2.23

**6.1.9. Ansul Checkfire system (optional)**

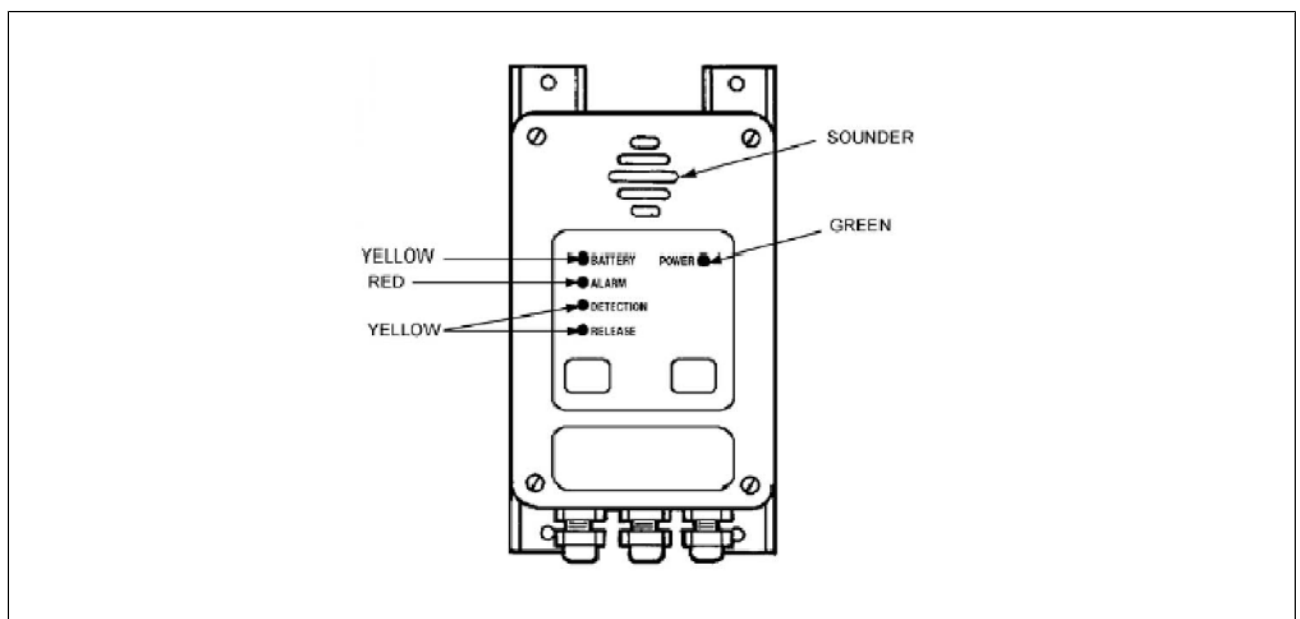
Checkfire system consists of detection wiring, control module, actuator with nitrogen cartridge, mounting bracket, and squib.

Checkfire system contains its own internal Lithium batteries as the power source. The 3.6 VDC internal lithium battery is connected to the control module by a removable type plug. The battery must be replaced annually or when the Yellow Battery LED and sounder are pulsing.



**See separate Ansul fire suppression system manual for detailed information of the checkfire system.**

**Checkfire control module front panel indicators**



**Battery (Yellow)**

- LED pulses once every 10 seconds when indicating battery trouble
- The yellow battery trouble LED will pulse when a low power condition is detected in either of the connected supplies (internal or external). If only one power source is used, the control module will automatically ignore the unconnected circuit upon resetting the control module. If a power source is once connected and recognized, a subsequent loss of that power source will be recognized as a Battery Trouble condition. If a power source is once connected, recognized, and then disconnected, the disconnected supply can be ignored by operating the RESET button.

**Power (Green)**

- LED pulses once every 3 seconds when indicating normal power.
- The green Power Normal LED pulses "on" once every 3 seconds indicating power is normal from both sources of input power. If the power drops below an acceptable level from either the internal or external source of input power, the green Power LED will be extinguished. If only one source of power is used, the green Power LED will extinguish when the voltage level drops below an acceptable level.

**7.1.3. Throttle pedal**

Engine revolutions are controlled with the throttle pedal that is connected to the chair module. The request for revolution count is sent to the engine ECM through the SAE J1939 bus, through which the information on actual engine revolutions returns to the VCM-System. When the machine is started, the system controls the throttle into idle running revolutions.

**Safety interlocks**

The system prevents engine revolutions control if the signal from the throttle pedal is above or below the allowed value.

**Inputs**

Actuator	Name	Signal level	Module	Connector pin
Throttle pedal	Analog value for throttle pedal (TPS)	0,5...4,5 V	Chair	XC3.8

**Outputs**

Actuator	Name	Signal level	Module	Connector pin
Throttle pedal	Operation voltage of throttle pedal	5 V	Chair	XC3.10
Throttle pedal	Earth of throttle pedal's operating voltage	GND	Chair	XC3.12
Engine ECM	J1939 Engine bus	Digital CAN signal	Chair	XC4.7 (CAN H), XC4.8 (CAN L)

6. If an air ride seat is fitted, remove the electrical wiring from the seat.
7. Ensure that lifting equipment is in good condition and correctly rated.
  - **Note!** The seat weighs approx. 45 kg.
8. Use a second person to hold and handle the seat during lifting.
  - The object being lifted is heavy and could swing.
9. Remove the seat from the cabin using a hoist.
10. Repair the seat if possible or replace it.

**7.13. VCM system troubleshooting**

Module	No	Alarm text	Alarm log
Chair	37	Module supply pin XC2/23 short to ground	X
Chair	38	Module supply pin XC2/23 short to external voltage	X

**Description 1:** Short circuit in voltage feed Power Supply XM3

- Door switch
- Blinkers switch
- Low / high beam switch
- Manual transmission switch
- Converter lock switch
- Bucket counter switch
- Boom floating switch
- Brake test switch
- Ride control switch
- Emergency steering test switch
- Wiper rear and front switch

**Action 1:** Coupling

- Detach the Chair module connector pin XC2.23.
- Turn off the system's operating voltage and turn it then back on.
- If the alarm does not go on again, the fault is in wire harness, short circuit to earth.
- Restart the VCM System after having repaired the wire harness.

**Action 2:** Module

- If action 1 does not correct the malfunction, the Chair module is broken. Change the module.

**Description 2:** Uncontrolled voltage in voltage feed for:

- Door switch
- Blinkers switch
- Low / high beam switch
- Manual transmission switch
- Converter lock switch
- Bucket counter switch
- Boom floating switch
- Brake test switch
- Ride control switch
- Emergency steering test switch
- Wiper rear and front switch

**Action 1:** Coupling

- Detach the Chair module connector pin XC2.23.
- If the alarm stopped, the fault is in wire harness, short circuit to operating voltage.
- Repair the wire harness.

**Inputs & Outputs**

**Inputs**

Actuator	Name	Signal level	Module	Connector pin
Ignition switch	Engine running position (S0004)	24 V / Float	Chair	XC1.8
Ignition switch	Engine stop position (S0004)	24 V / Float	Chair	XC3.21
Ignition switch	Parking position of the ignition switch (S0004)	24 V / Float	Dashboard	XD3.18
SEO button	Engine stop override	24 V / Float	Dashboard	XD3.19

**Outputs**

Actuator	Name	Signal level	Module	Connector pin
Ignition switch	Operating voltage of ignition switch	24 V / 0 V	Chair	XC2.22
Engine	Engine stopping	24 V / 0 V	Dashboard	XD2.7
SEO button	Operating voltage of SEO button	24 V / 0 V	Dashboard	XD2.23
Engine	Engine starting	24 V / 0 V	Middle	XM1.16
Engine	Engine override (SEO)	GND / Float	Rear	XR1.18

19. Disconnect the hydraulic hose from the bottom of the torque converter.

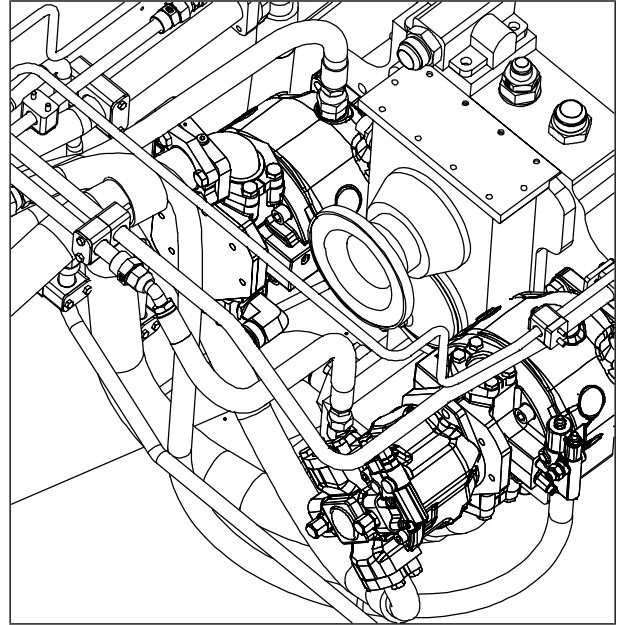
- Beware oil will spill from the hose and converter.
- Plug open ends.

20. Disconnect the other lines from the torque converter pressure regulator, lock up port, return port and breather.

- Beware oil will spill from the hoses.
- Plug disconnected hose fittings.

21. Remove the hydraulic hosing from the hydraulic pumps mounted on the converter and engine.

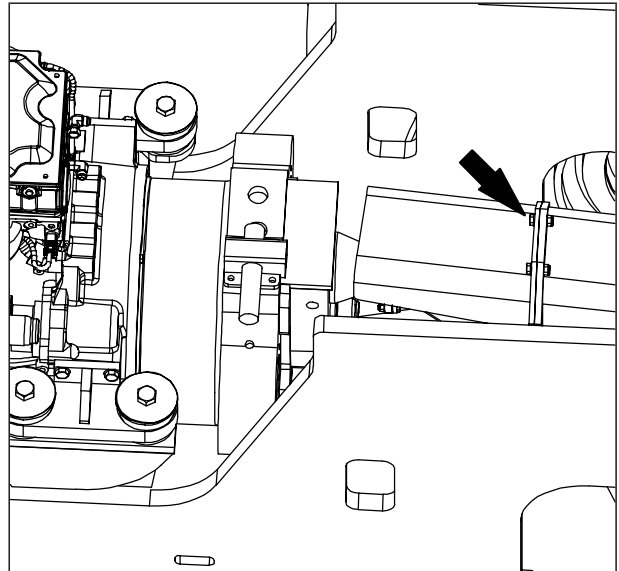
- Beware oil will spill from the hoses when disconnected.
- Plug disconnected hose fittings.



22. Disconnect the electrical wiring from the converter sensors.

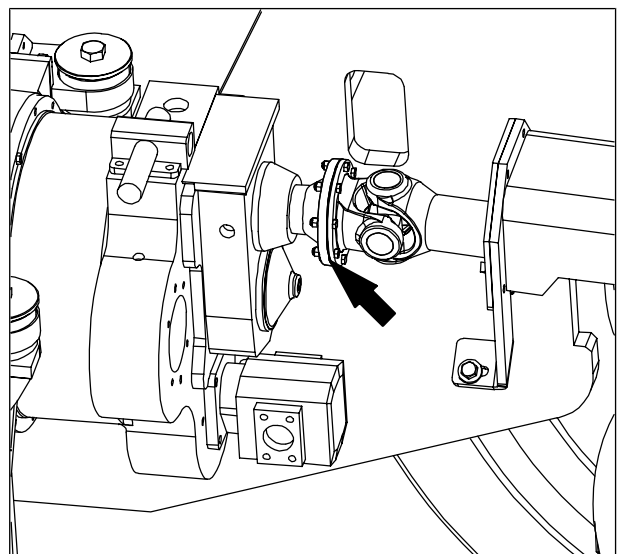
23. Remove the cardan shaft cover.

- Support the cardan shaft cover with an overhead hoist
- Open the cover fastening screws 4 pcs.
- Remove the cover using a hoist.



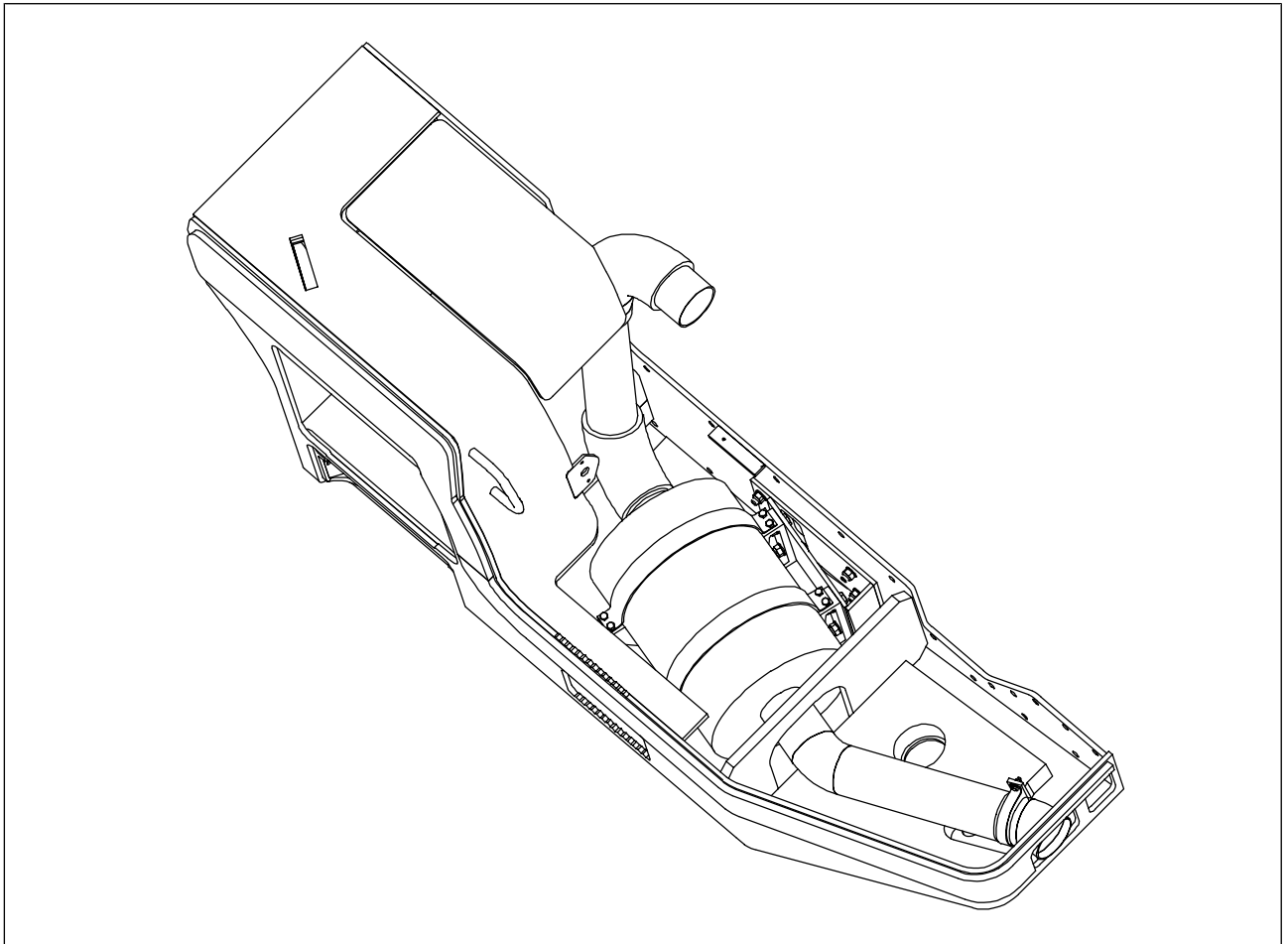
24. Remove cardan shaft flange fastening screws and secure the cardan shaft end away from the converter.

- Cardan shaft removal is presented in chapter *Powertrain*, section *Cardan shafts*.



25. Clearly label the electrical wiring from the alternator and all the wiring to the engine before disconnecting them.

**8.4. Exhaust system**



**8.4.1. System description**

Hot exhaust gas flowing from the exhaust manifold into the exhaust riser is used to drive the turbocharger. After that the exhaust fumes will flow through the exhaust piping to the silencer which contains a exhaust purifiers. Continuous particle burning and spark reduction take place in the exhaust purifiers. The purified exhaust fumes exit through the exhaust piping.

The exhaust system is manufactured from stainless steel to resist corrosion. The pipe consists of double wall construction, inner and outer metal exhaust wall. Between the double wall is heat lagging to reduce the exhaust surface temperatures. This reduces fire risk.

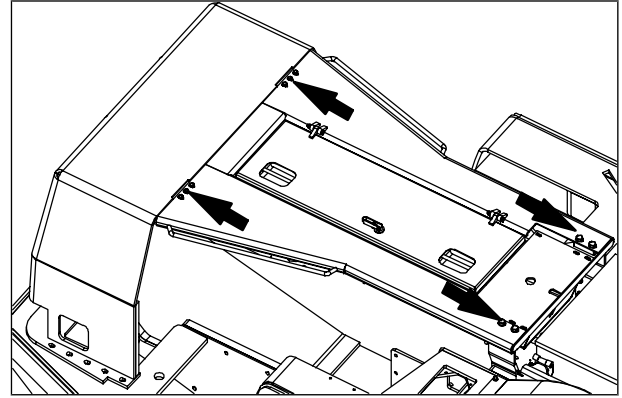
***Servicing the Exhaust system***

Check exhaust manifold retaining bolts and other connections.  
See Maintenance manual for further information.

**8.4.2. Exhaust piping**

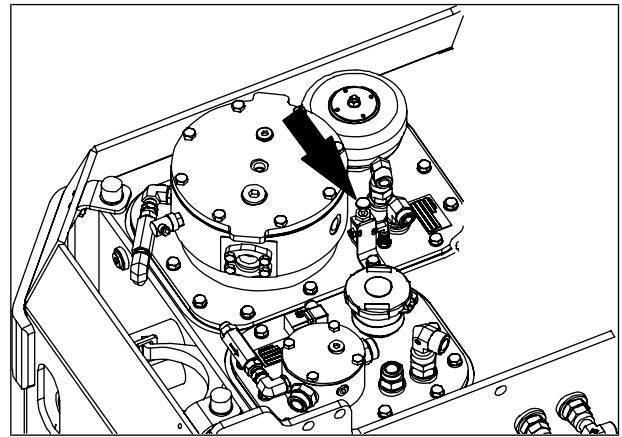
- |   |                  |   |              |
|---|------------------|---|--------------|
| 1 | Clamps           | 2 | Exhaust pipe |
| 3 | Exhaust purifier | 4 | Tail pipe    |

12. Support the engine covers before removal using a hoist. Remove engine cover mounting bolts 10 pcs. Using a hoist remove engine cover.



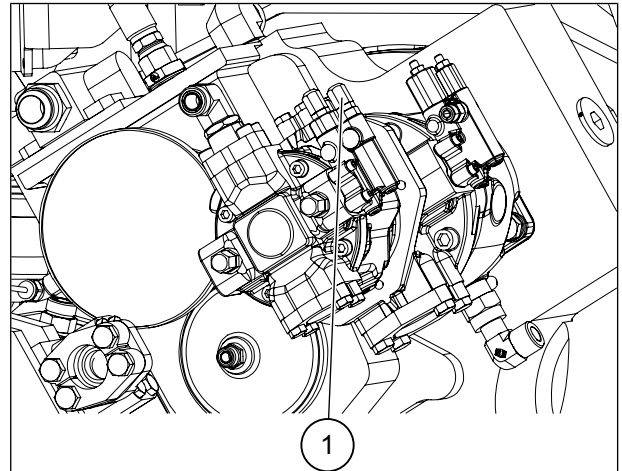
**Ensure that lifting equipment is in good condition and correctly rated.**

13. Before performing any maintenance work on hydraulic system, the hydraulic oil tank must be de-pressurized. Pressure is released by using the directional valve on top of the hydraulic oil tank. Ensure the valve closes fully once all pressure is relieved.

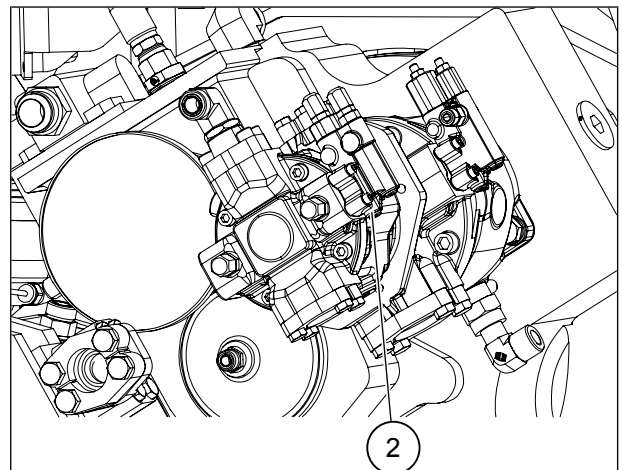


**Be careful when removing radiator hoses. Some pipes may contain hot fluids.**

5. Start the engine. Record the gauge reading.
  - The pressure should be 25 bar (± 5bar )
6. If the pressure is out of the given range, shut down the engine and adjust the stand-by pressure by turning the adjustment screw ( 1 ) and do the step 5 again.



7. Before checking the **MAXIMUM pressure** disconnect the electric connector from the blower pump controller.
8. Start the engine and operate it at full rpm. Record the gauge reading.
  - The pressure should be 280 bar (± 8bar )
9. If the pressure is out of the given range, shut down the engine and adjust the maximum pressure by turning the adjustment screw ( 2 ) and do the step 8 again.



10. Reconnect the electric connectors of the bucket pump controller and the blower pump controller.
11. Check the blower pump stand-by pressure.
 

**NOTE!** Before the blower pump stand-by pressure can be checked, the machine equipped with Volvo engine must be stopped and the main switch turned to off-position for 3 seconds after the electric connector is connected.
12. If necessary, repeat the steps above until the stand-by and maximum pressures are correct.



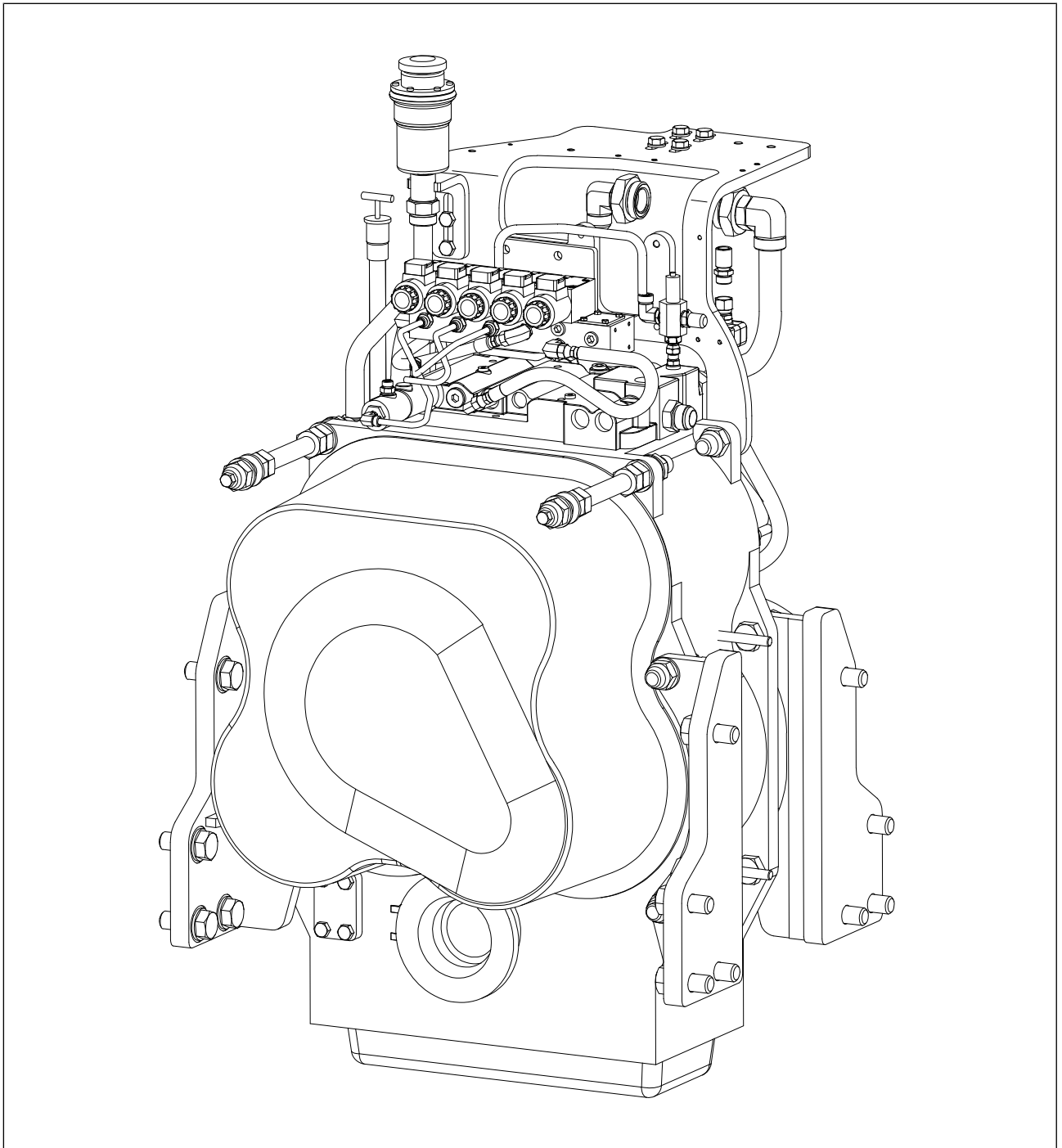
**Never adjust pump pressures when engine is running. The rotating cardan shaft can cause serious injury.**

**NOTICE**

**If the engine stalls when running at idle during checking the stand-by pressure, rev up until the engine is running smoothly and the checking can be done.**

9.3. Transmission

9.3.1. Gearbox



9.3.8. Installing the transmission



Only people who have been given specialized operation and service training are allowed to perform operations, service, and adjustment procedures. Read and ensure you understand the following instructions before servicing the equipment. To avoid potential damage and injuries, carefully plan your work beforehand.



Only perform maintenance work when the machine is parked on a level, hard surface. Use the appropriate tools and safety equipment for the task and be sure you understand how to use them before performing any maintenance work. Replace or repair faulty tools and equipment. When performing maintenance and repair work, ensure there are no unauthorized persons in the working area.

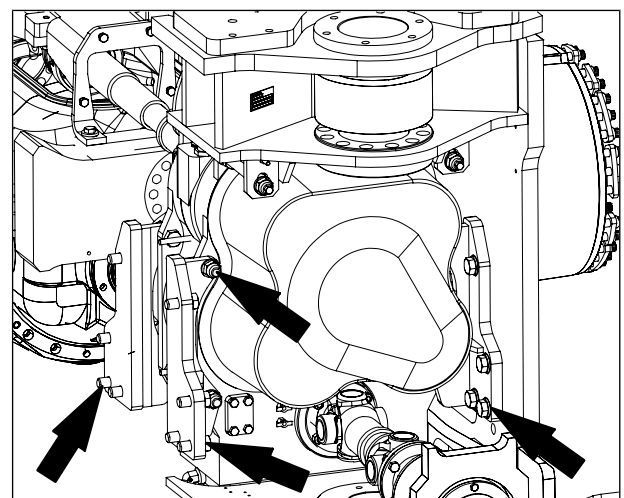


Ensure that lifting equipment is in good condition and correctly rated.



Ensure safe and environmentally protective disposal of process materials and exchange parts.

1. Clean the transmission bay and associated parts for reuse.
2. Fit chains to the transmission to take the weight, making sure that the transmission is well balanced.
  - Transmission weighs approx 830 kg.
3. Lift the transmission up over the machine in position for fitting.
4. Maneuver the transmission down and in until the transmission is in the correct position.
5. Install the mounting brackets to transmission. Ensure that the mounts are in same position as when removed. Do not tighten them yet to final torque.
6. First tighten the bracket mounting bolts to frame . Finally tighten the bracket to transmission mounting bolts and loosen the chains.



**Installation:**

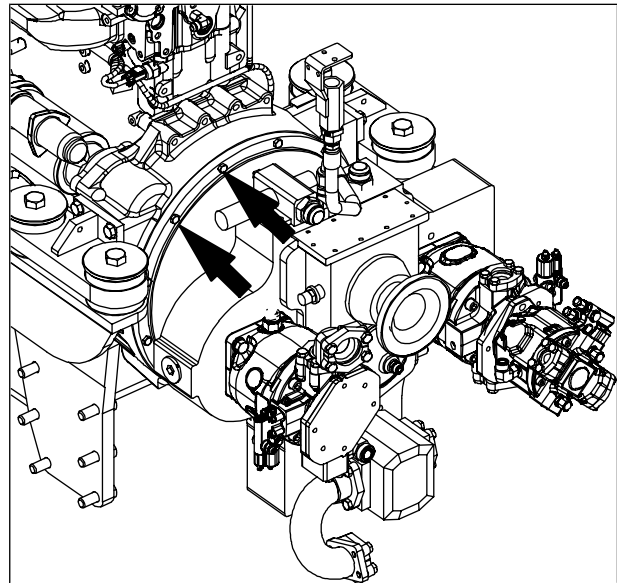
1. Carefully clean all the mounting and control surfaces and dry thoroughly.
2. Measure the crankshaft end float with a dial gauge and record the value.
3. Run a bolt through all the flex plate nuts to ensure the flex plate holes line up and the threads are clean.
4. Install two guide pins (90 mm) to the flywheel housing, .
  - Guide pins can be made out of 7/16" UNCx3,5" bolts by cutting the hex head off
5. Install two guide pins (100 mm) to the flexplate nuts.
  - Guide pin can be made out of 7/16" UNFx4" bolts by cutting the hex head off.
6. Turn the flywheel to align the flexplate guide pins with the flywheel screw holes.

7. Carefully slew the torque converter in the flywheel housing.

- Be careful not to bend the flex plates.

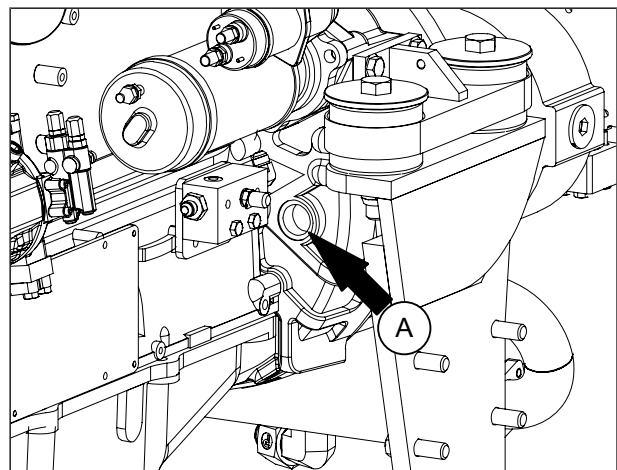
8. Remove the guide pins from the flywheel housing and tighten the converter mounting screws (12 pcs).

- Tightening torque: 61 Nm



9. Fasten the flexplate cap screws (8 pcs).

- Remove guide pins from flexplate.
- Fasten flexplate cap screws one at a time through the access hole (A) until finger tight.
- It may be necessary to slightly rotate the crankshaft back and forth when installing the second screw.
- Once all eight bolts are fitted tighten them to torque of 80...85 Nm.



**NOTICE**

**Do not try to force the screws. The flex plate can be supported e.g. by a bent welding rod through the lowest converter side engine mount screw hole (C).**

## 9.7.6. Tire mounting and dismounting on rim



Only perform maintenance work when the machine is parked on a level, hard surface. Use the appropriate tools and safety equipment for the task and be sure you understand how to use them before performing any maintenance work. Replace or repair faulty tools and equipment. When performing maintenance and repair work, ensure there are no unauthorized persons in the working area.



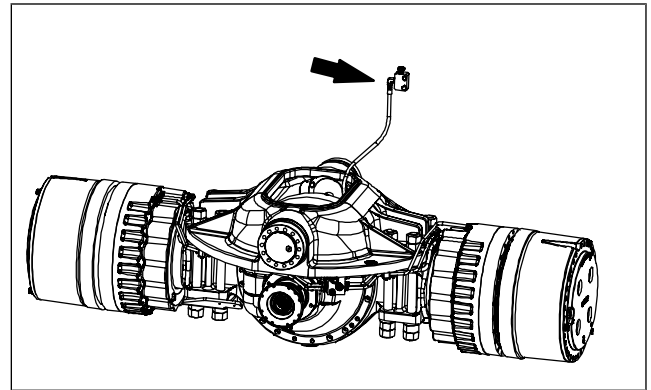
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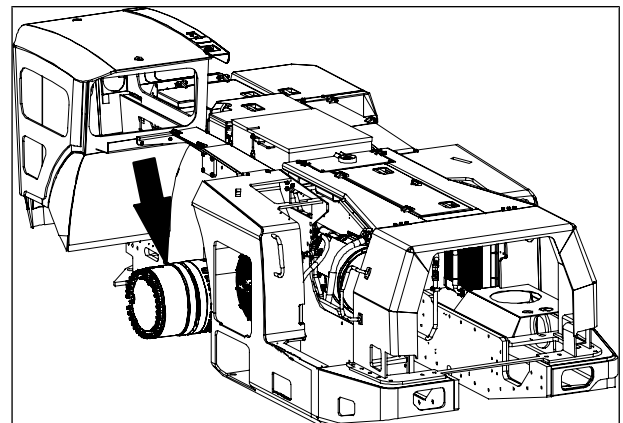
Crushing hazard. Can cause severe injury or death. Tire may overturn during handling.

General mounting procedures: The following procedures are required for all Tubeless Type tyres over 16" size, but are also applicable to smaller sizes.

14. Remove the axle breather.



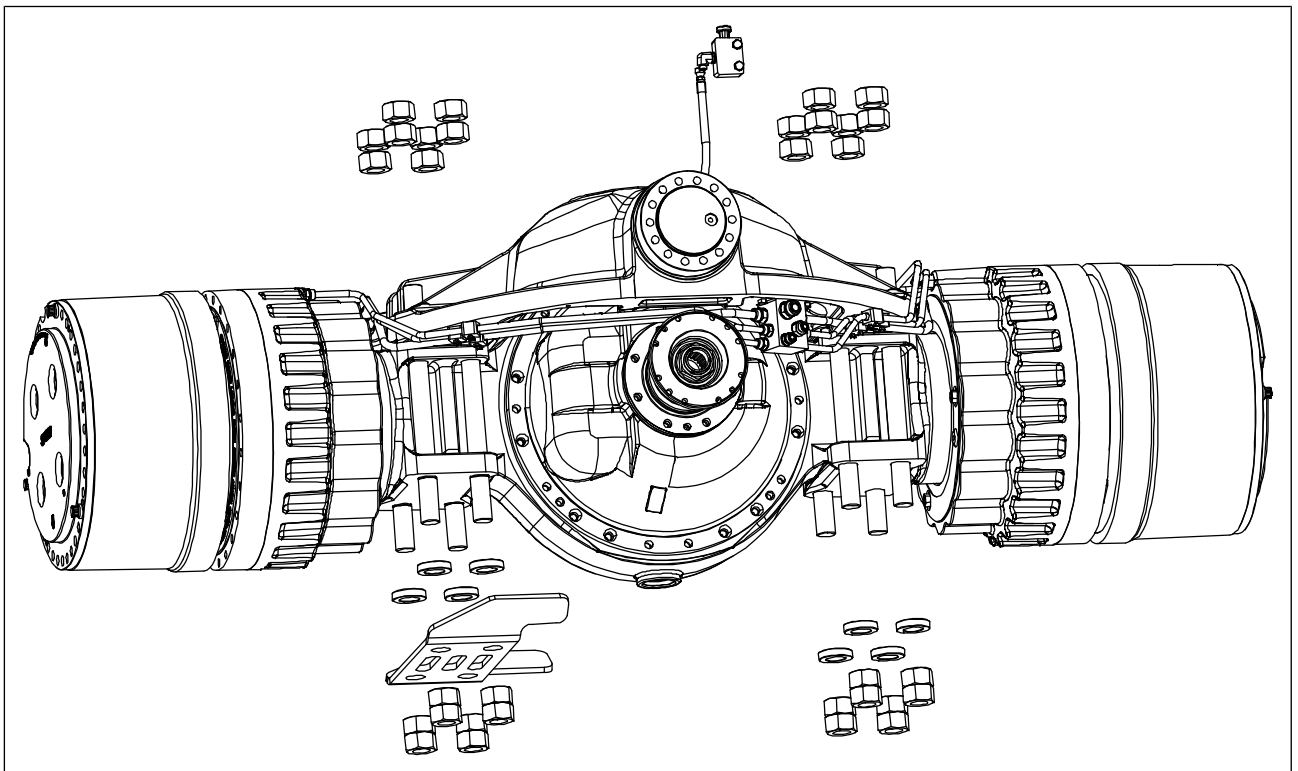
15. Place a lifting device or jacks under the rear axle. Support the weight of the rear axle.



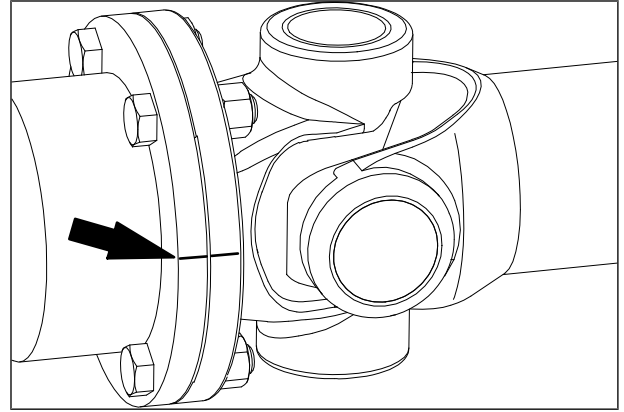
**NOTICE**

The weight of the rear axle assembly is approximately 2600 Kg.

16. Open axle stud bolts .



3. Before opening the flange joint fastening screws, support the cardan shaft with a hoist. Mark the flanges to allow for correct alignment when re-fitted.

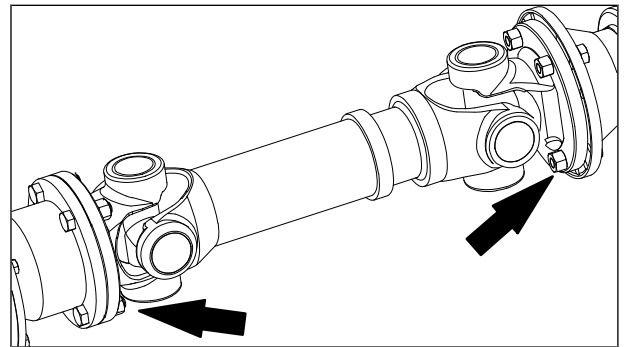


4. Use the brake releasing pump to release the brakes if necessary. Releasing the brakes makes cardan shaft removal easier by allowing free rotation of the cardan shaft.

**Note!** Do not turn the joints of the cardan shafts with crowbar because this may damage the grease nipples or seal arrangement on the bearings.



5. Open the flange joint of the cardan shaft by opening the fastening screws.



6. Lift out the cardan shaft using a hoist.

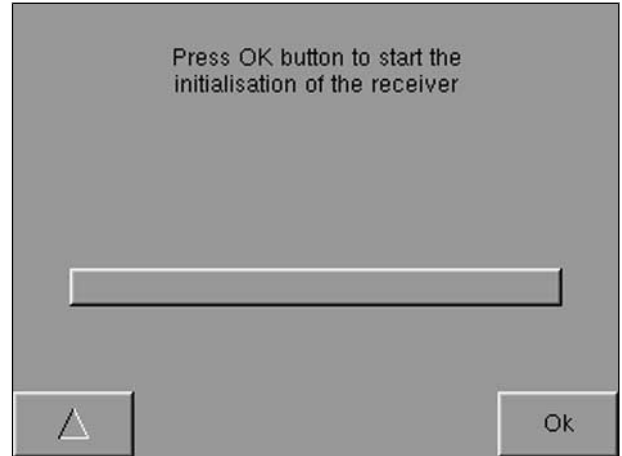
**NOTICE**

Cardan shafts should be transported in a horizontal position. For non-horizontal transportation additional precautions must be taken to prevent the splined parts from separating.

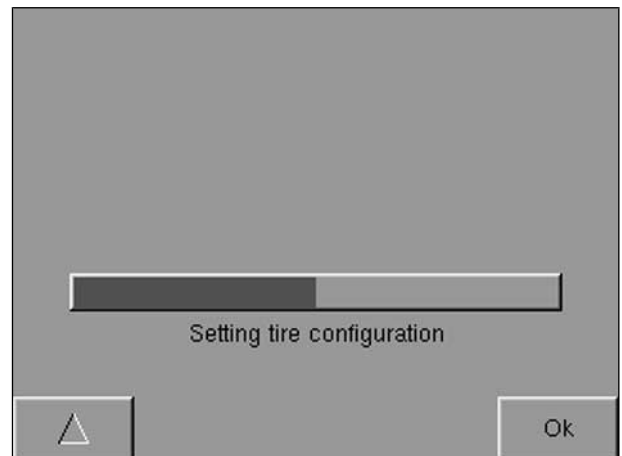
**Installation of the tire pressure monitoring system**

When the tire pressure monitoring system is installed the tire pressure receiver should be connected to machine's CAN bus (Chair CAN 2) before the control system is started. After the control system has been started, the display informs when it's time to screw pressure sensors to the tires' valve stem.

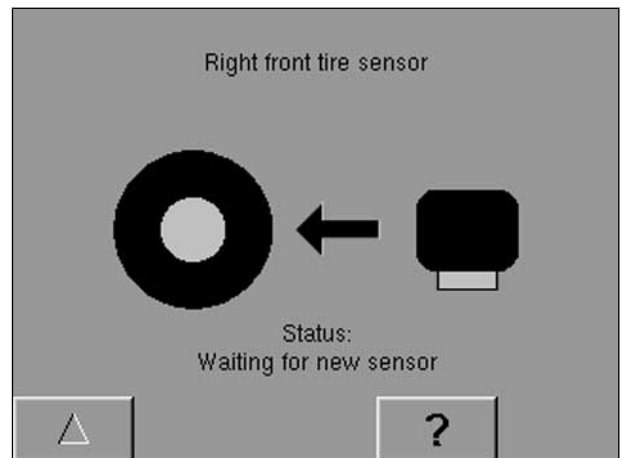
If the receiver is connected for the first time to the control system, the receiver initialization window appears after system boot up.



The receiver configuration settings are initialized automatically.



The display informs which tire the pressure sensor should be screwed to. After the pressure sensor is screwed to valve's stem, it takes awhile before the tire pressure receiver recognizes the plugged sensor before another sensor can be plugged. After all sensors are plugged, the display jumps automatically to the main window.



Module	No	Alarm text	Alarm log
Dashboard	30	Module supply pin XD1/1 short to ground	X
Dashboard	31	Module supply pin XD1/1 short to external voltage	X

**Description 1:** Short circuit in voltage supply.

**Action 1:** Coupling

- Detach the Dashboard module connector pin XD1.1.
- Turn off the system's operating voltage and turn the operating voltage on again.
- If the alarm is not repeated, the fault is in wire harness, short circuit to ground.
- When the wire harness is repaired, restart the VCM System.

**Action 2:** Module

- If action 1 does not correct the malfunction, the Dashboard module must be broken. Change the module.

**Description 2:** Voltage in uncontrolled output of voltage supply.

**Action 1:** Coupling

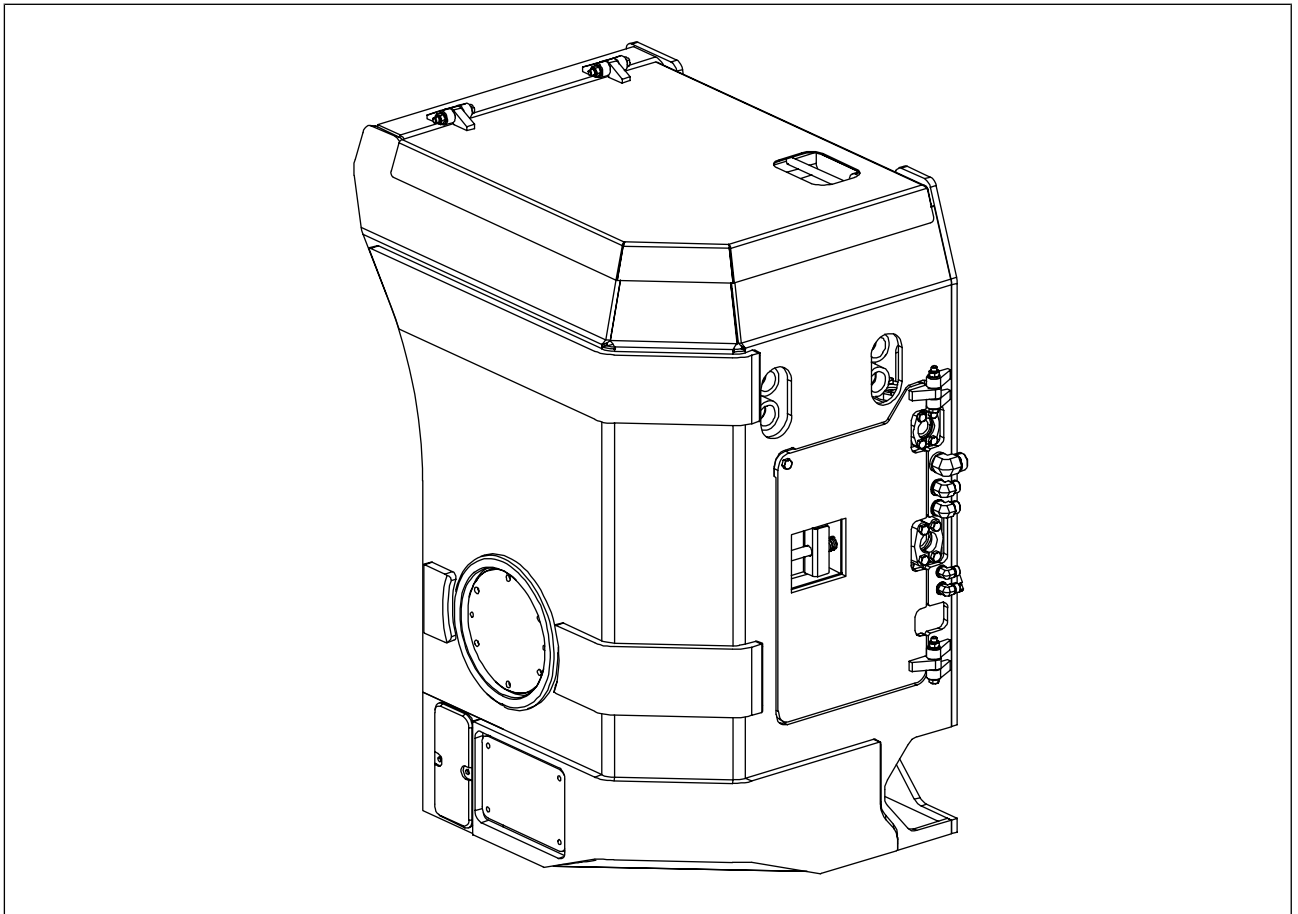
- Detach the Dashboard module connector pin XD1.1.
- Turn off the system's operating voltage and turn the operating voltage on again.
- If the alarm stops, the fault is in wire harness, short circuit to supply voltage.
- Repair the wire harness.

**Action 2:** Module

- If action 1 does not correct the malfunction, the Dashboard module must be broken. Change the module.

## 10.4. Hydraulic oil tanks

### 10.4.1. Design features



The vehicle has two separate hydraulic systems with two independent hydraulic tanks. One tank supplies the loading and steering. The other tank supplies the brake system.

The hydraulic oil tank capacity is 320 and the brake hydraulic oil tank is 75 l. The hydraulic oil tank is equipped with a filter breather that maintains 0-0,4 bar overpressure in hydraulic oil tank to prevent cavitation. The brake oil tank is vented to operate at atmospheric pressure.

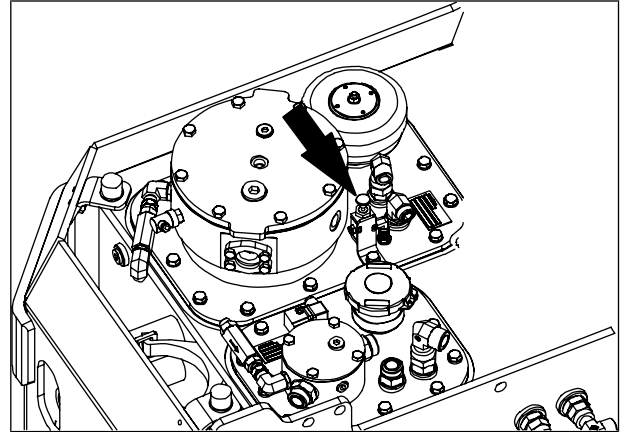
Suction pipes and replaceable return filters for hydraulics and brake flushing are inside the tanks. If filter restriction reaches a critical level, the relevant "filter clogged" light will warn the operator.

Two sight glasses in the hydraulic tank front make the checking of oil level easy. The oil level must be between the sight glasses when bucket is on ground when the oil is cold. At operating temperatures the oil level must be seen in upper sight glass. The brake hydraulic oil level should be between the sight glasses when the oil is cold and brakes engaged.

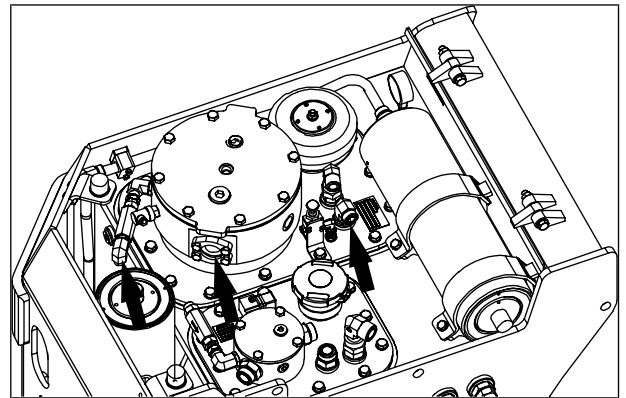


**Before performing any maintenance work on hydraulic system, the hydraulic oil tank must be de-pressurized. Pressure is released by using the directional valve on top of the hydraulic oil tank.**

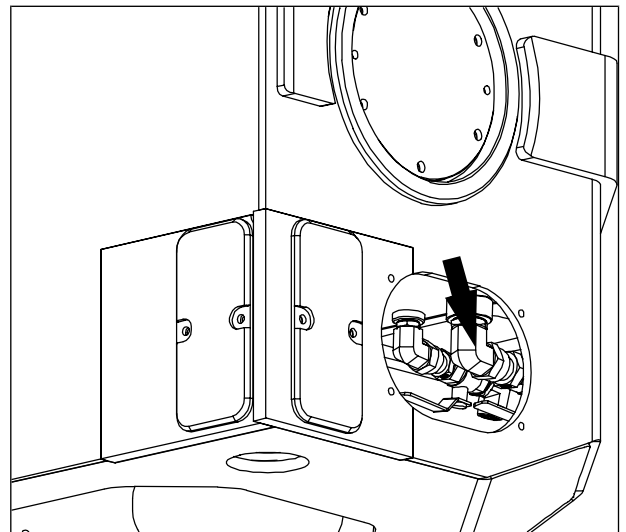
4. Before performing any maintenance work on hydraulic system, the hydraulic oil tank must be de-pressurized. Pressure is released by using the directional valve on top of the hydraulic oil tank. Ensure the valve closes fully once all pressure is relieved.



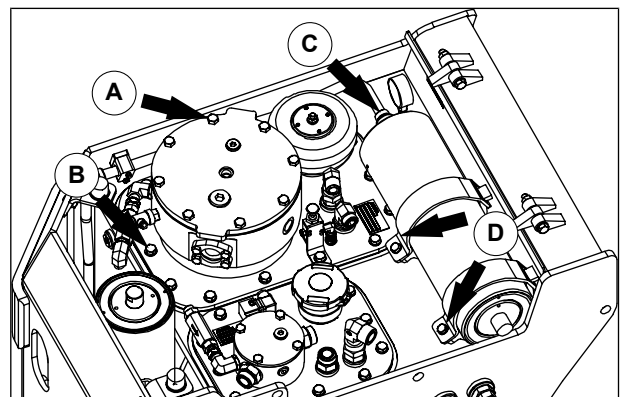
5. Open hydraulic hose connections from the return filter assembly and tank cover.



6. Drain the oil from the hydraulic tank. Remove the hose cap and open the tank drain tap to allow the oil to drain completely.



7. Remove the mounting bolts from filter housing cover (A) 8pcs. (M12x30 8.8). Remove the return filter.



10.8.1. Marking of hydraulic hoses

**R1T - 16 - 10300 - R16 B - R16 D - 180**

Hose code  
Size no  
Distance between sealing surfaces  
Thread system and the size for the thread or joint  
Fitting angle (no number when straight)  
Joint code

**Hose code**  
SAE 100 R standard code letters  
or 2040/2140 for thermoplastic hoses

**Size no**  
SAE 100 R standard size No. for hoses

**Thread system**  
M = metric  
R = R (BSP) 60°  
J = JIC 37° (UNF)  
F = Flange SAE 3000psi  
6F = Flange SAE 6000psi  
N = Banjo  
O = No joint  
V = ORFS (UNF)  
U = O-ring sealed (UNF) (refrigerant hoses)

**Joint code**  
A = straight (female)  
B = 90° (female)  
C = 90° long (female)  
D = 45° (female)  
I = straight pipe joint  
H = 45° pipe joint  
L = 90° pipe joint  
T = straight (male)

Size for thread or joint		R-system		ORFS tread (UNF)	
Size marking	thread	hose	pipe		
4 =	1/4"	9/16"	9/16"		
6 =	3/8"	11/16"	13/16"		
8 =	1/2"	11/16"	1"		
10 =	5/8"				
12 =	3/4"	13/16"	17/16"		
16 =	1"	17/16"	111/16"		
20 =	1 1/4"				
24 =	1 1/2"				
28 =	1 3/4"				
32 =	2"				

J- and S-system		Thread (UNF)	
Size marking			
4 =		7/16"	-20
5 =		1/2"	-20
6 =		9/16"	-18
8 =		3/4"	-16
10 =		7/8"	-14
12 =		1 1/16"	-12
14 =		1 3/16"	-12
16 =		1 5/16"	-12
20 =		1 5/8"	-12
24 =		1 7/8"	-12

## Installing the hydraulic oil cooler right side



Only people who have been given specialized operation and service training are allowed to perform operations, service, and adjustment procedures. Read and ensure you understand the following instructions before servicing the equipment. To avoid potential damage and injuries, carefully plan your work beforehand.



Only perform maintenance work when the machine is parked on a level, hard surface. Use the appropriate tools and safety equipment for the task and be sure you understand how to use them before performing any maintenance work. Replace or repair faulty tools and equipment. When performing maintenance and repair work, ensure there are no unauthorized persons in the working area.

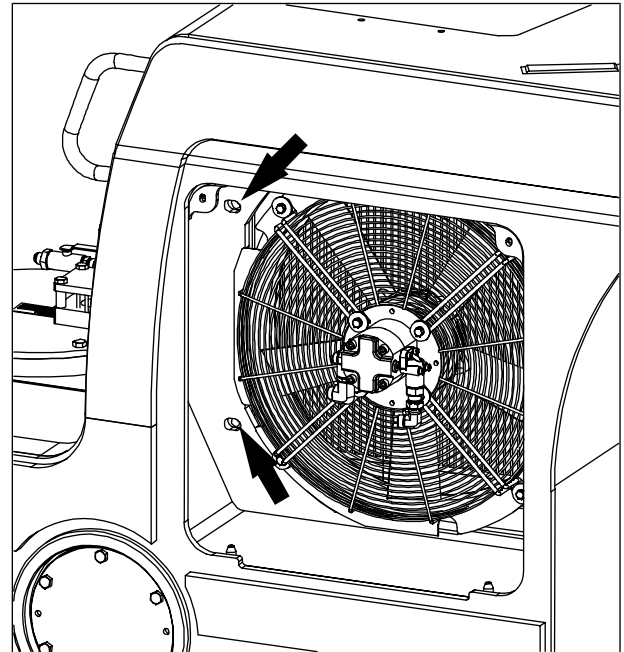


Assistance is required to install the coolers to the machine, as they are heavy.

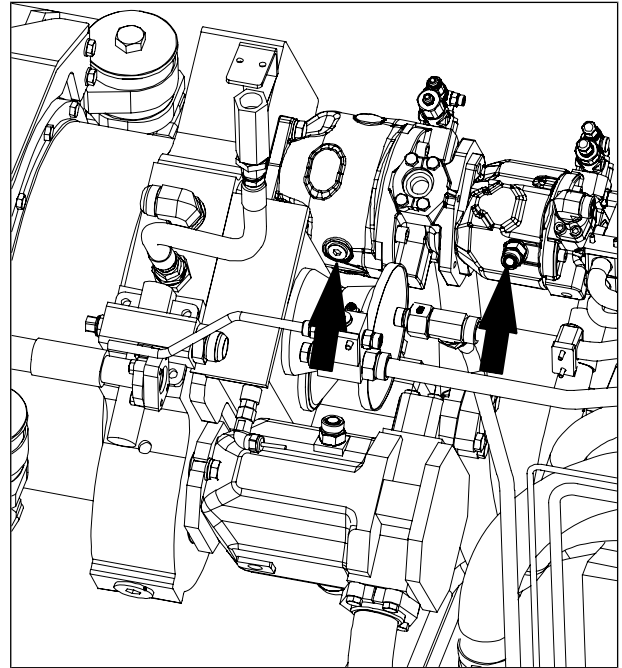


Be careful when handling hot oil. Wear suitable protective gloves, protective clothing and safety goggles when handling oil.

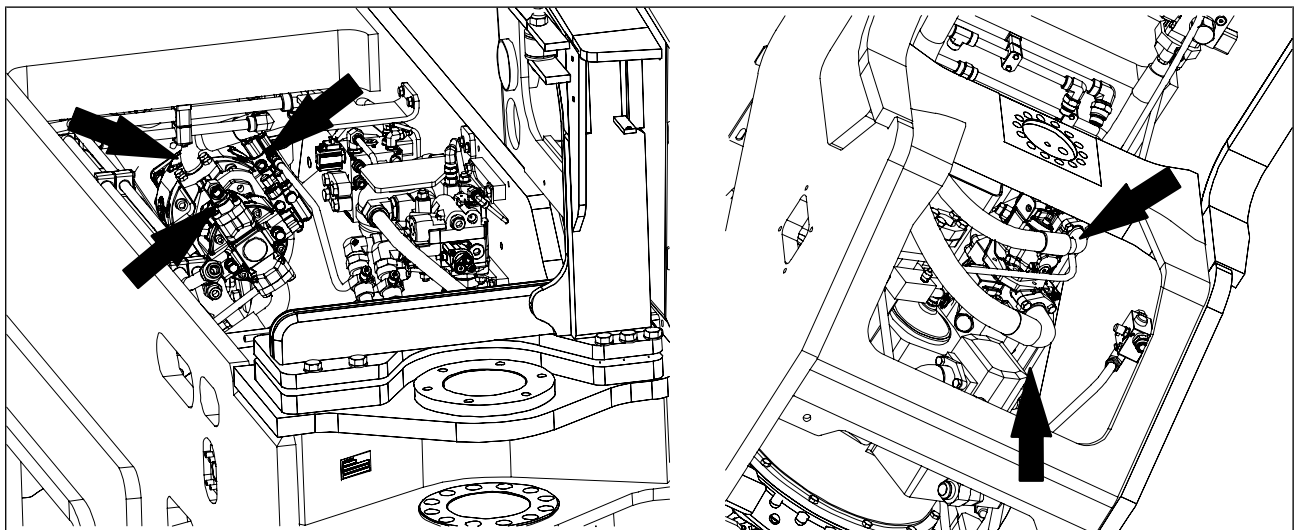
1. Clean the cooler mounting area
2. Fit the cooler to the machine installing the mounting bolts ( 4pcs ).



4. Prime the variable displacement type pump case drain with hydraulic oil. Prime both pumps.



5. Connect the hydraulic hoses to the connectors in the pump unit and replace the O-ring seals of the hydraulic hoses.
  - Fit all the hoses and wire harnesses that were disconnected from the machine when removing the pump unit.



6. Fill the hydraulic tank with recommended grade and quality of new hydraulic oil.
7. Prime variable displacement type bucket pump case drain with hydraulic oil and bleed the suction lines. See sections "*Bleeding the suction lines*" and "*Starting new pumps*".
8. Start the engine and check the hydraulic system for any leaks.
  - Stop the engine and correct the leaks, if any.
9. Run the pump unit on idle with no load for 5 minutes.
10. Check the oil level in the hydraulic tank and add, if necessary.
11. Check the stand-by and max pressure adjustments. See chapter *Steering*, section *Checking of the steering pump pressures* and chapter *Powerpack*, section *Checking of the blower pump pressures*.



Check the correct tightening torques from the appendice *The tightening torques for screws and nuts*.



See the separate manufactures service instructions manual for dismantling, assembly and inspection information.

Module	No	Alarm text	Alarm log
Middle	140	Brake oil temp sensor (B3068) high error	x
Middle	141	Brake oil temp sensor (B3068) low error	x

**Description 1:** The sensor current value is too high, the cable or sensor has shorted to the voltage.

**Action 1:** wire harness

- Measure the voltage from sensor pole A, must be 12 V.
- Fault in wire harness or Middle module connector pin XM1.12 (this will give a separate alarm).

**Action 2:** wire harness

- Detach the wire for Middle module connector pin XM1.12 and measure resistance to sensor pole B, the resistance should be approx. 0 ohm.
- The cable is broken, repair the wire harness.

**Action 3:** Sensor

- Measure sensor resistance between pole A and B. See correct resistance values from the table in chapter "General electrical system" section "signal level and scaling of the sensors".

**Action 4:** Module

- If the actions 1-3 do not correct the malfunctioning, the Middle module must be broken. Change the module.

**Description 2:** The sensor current value is too low, the cable or sensor has shorted to GND

**Action 1:** wire harness

- Measure the voltage from sensor pole A, must be 12 V.
- Fault in wire harness or Middle module connector pin XM1.12 (this will give a separate alarm).

**Action 2:** wire harness

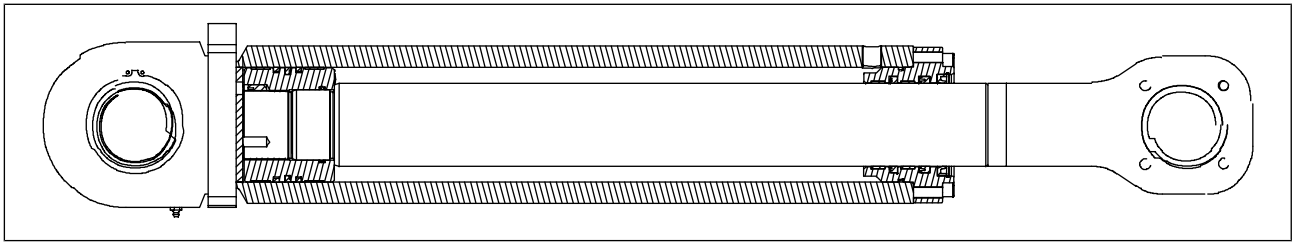
- Detach the wire for Middle module connector pin XM1.12 and measure resistance to sensor pole B, the resistance should be approx. 0 ohm.
- If the cable is broken, repair the wire harness.

**Action 3:** Module

- If the actions 1-2 do not correct the malfunctioning, the Middle module must be broken. Change the module.

Module	No	Alarm text	Alarm log
Middle	142	Transmission oil temp. high alarm	x
Middle	143	Transmission oil temp. high warning	x

**11.4.2. Steering cylinder**



Steering cylinders are single stage, double acting hydraulic cylinders. The steering cylinders are mounted between the front and rear frames on each side of the machine.

**11.4.3. Priority block**

The function of the priority block is presented in chapter general hydraulics.

**11.4.4. Steering pump**

The function of the pumps are presented in chapter general hydraulics.

**11.4.5. Steering limit switch**

When steering is near maximum steering angle, inductive sensor S3060 becomes active and slows the steering function. Physical stop limits steering angle to 42,5 degrees.

**11.5. Emergency steering (option)**

**11.5.1. System description**

The emergency steering activates automatically when the engine stops or stalls in unusual way. This function allows the operator to safely steer the unit out of the way of danger. When the engine stops suddenly, the system activates and an electric pump generates oil pressure to allow the steering to function for a few additional seconds. The amount of time that pump functions is 10 seconds.

Emergency steering is allowed, even when the parking brake is on. When the emergency stop is active, the emergency steering will not function.

The symbol to the right on the main window shows the status of the emergency steering. The symbol is grey when emergency steering is not activated, and becomes red when emergency steering is activated.

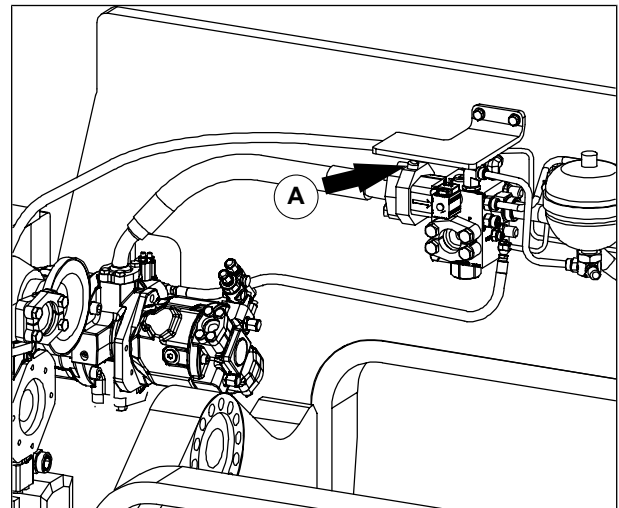


11.8.1. Checking of the steering pump pressures

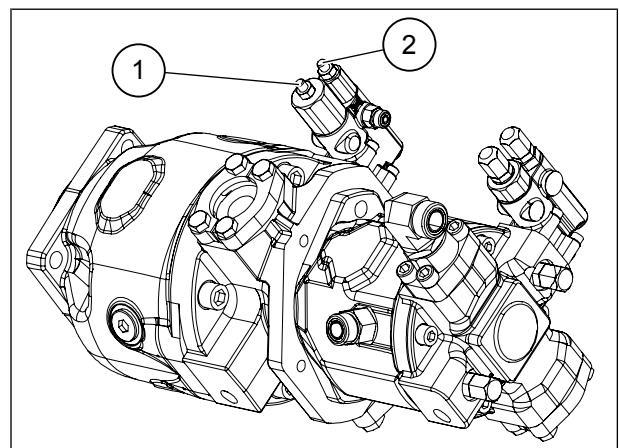


**Before performing steering pump pressure adjustment bucket main valve- and bucket pump pressures must be adjusted.**

1. Before checking the **maximum pressure** ensure that the machine is on an even surface, the parking brake is applied and movement is prevented with wheel chocks.
2. Install the frame locking device.
3. Connect a 400 bar pressure gauge to the steering pumps pressure line test point MP 101 (A).



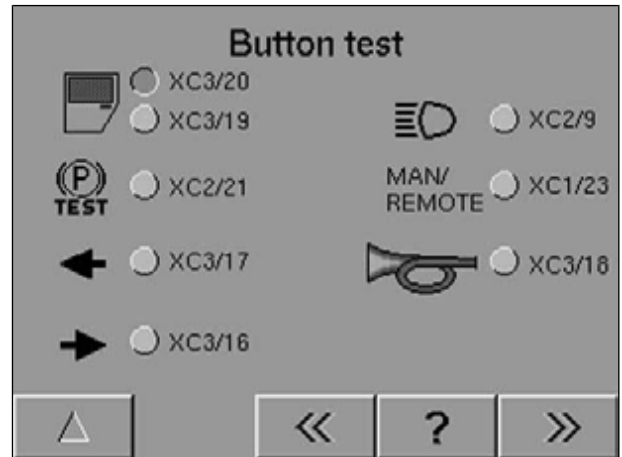
4. Start the engine.
5. Move the bucket control joystick to the boom down position and keep it there.
  - In case the engine stalls raise the rpm.
6. Record the gauge reading.
  - The correct maximum pressure is **280 bar** ( ± 8 bar ).
7. If the readings do not match the specification:
  - Shut down the engine and adjust the maximum pressure by turning the adjustment screw ( 1 ).



8. Check the **dp-setting**.

**Testing the emergency steering button**

This window is used for testing the emergency steering with a testing button. In the test, control the emergency steering pump on and allow emergency steering. When pressing the emergency steering button, the picture of a button on the right-hand side of the symbol becomes black.

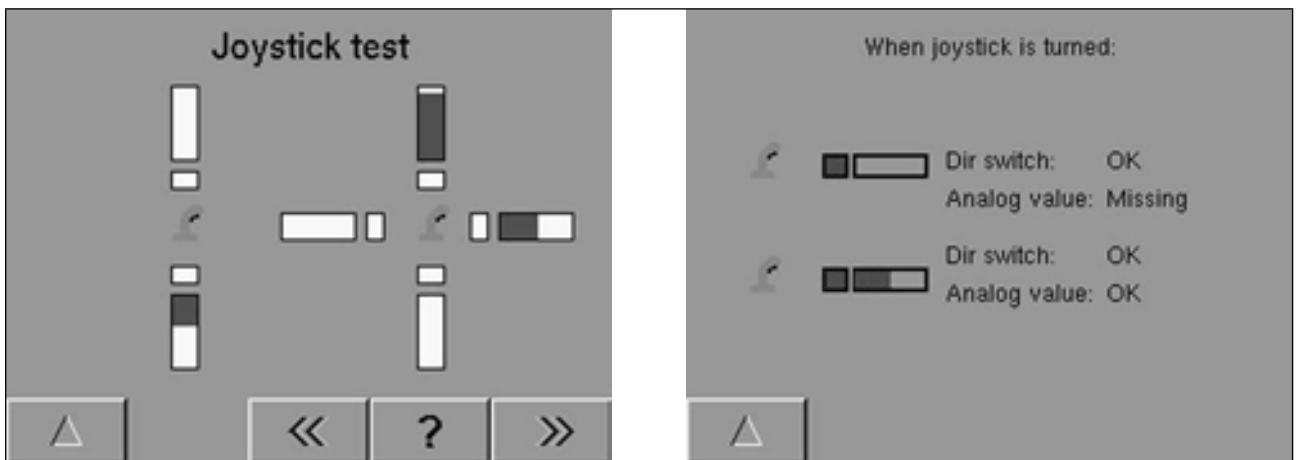


The emergency steering pump can be tested only for 30 seconds at a time. If wanted to continue the test, release the button and press and hold it again.

Emergency steering cannot be tested if the cabin door is open, the emergency stop is activated or the engine is running (an alert appears on the display in these situations).

The information window tells which button can be used for testing the emergency steering.

**Testing the movement of the steering joystick**



Test the movement of the steering joysticks to the left and to the right on this window. The longer boxes become darker according to the voltage from the steering joystick's potentiometer.

The window shows the status of the analog values of the potentiometer.

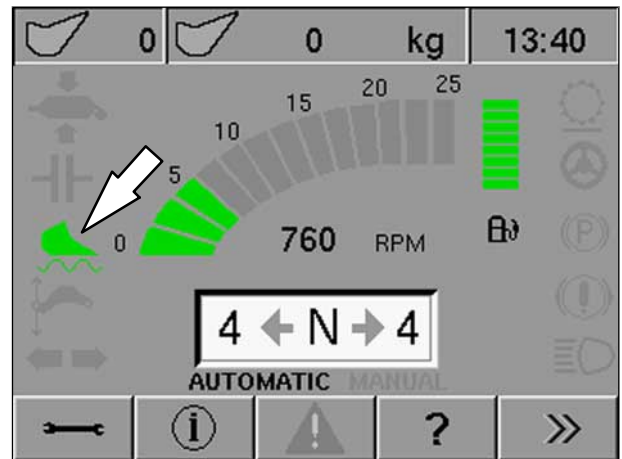


### 12.7. Boom float (option)

The purpose of this function is to let the bucket trail the ground, for example when you want to clear fallen stones off a road.

Boom float is taken into use by pressing the float button on the corner instrument panel. The boom's lower limit sensor S2036 must be activate. When float is engaged, boom must be lowered against the stoppers. Boom floating can also be activated with the display module's forced functions window. Boom float is deactivated by pressing the float button again. Controlling the boom or bucket will also deactivate float.

The symbol to the left on the main window tells the status of boom floating. The symbol is grey when floating is not activated, and becomes green when you activate floating.



When boom floating is activated, following situations occurred:

- Control valve Y2025 activated
- Tank line valve Y2059 activated

#### 12.7.1. Safety interlocks

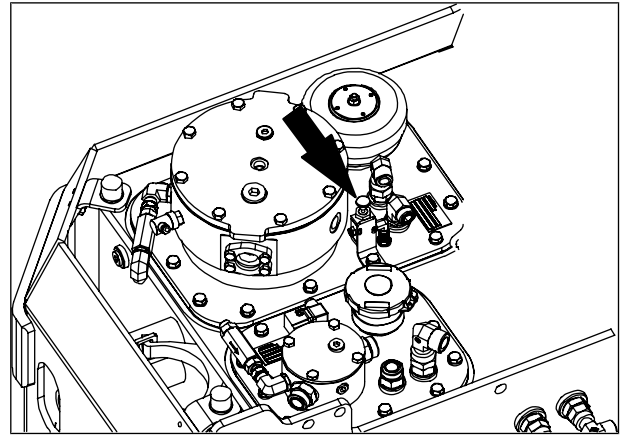
The system prevents boom float in the following situations:

- The boom's lower limit sensor is not activated (S2036).
- Controlling the bucket with control joystick
- Controlling the boom with control joystick
- General lockings of boom control

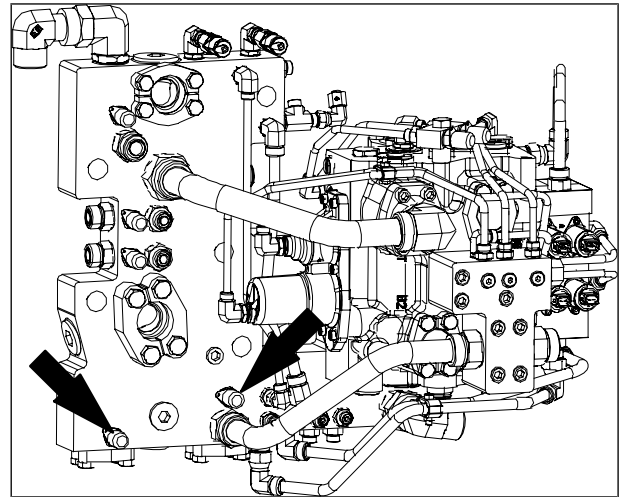
#### 12.7.2. Inputs

Actuator	Name	Signal level	Module	Connector pin
Control panel	Boom floating button (S0074)	24 V / Float	Chair	XC2.18
Limit switch	Boom lower limit (S2036)	24 V / Float	Front	XF1.19

3. Install frame locking device.
4. Before performing any maintenance work on hydraulic system, the hydraulic oil tank must be de-pressurized. Pressure is released by using the directional valve on top of the hydraulic oil tank. Ensure the valve closes fully once all pressure is relieved.

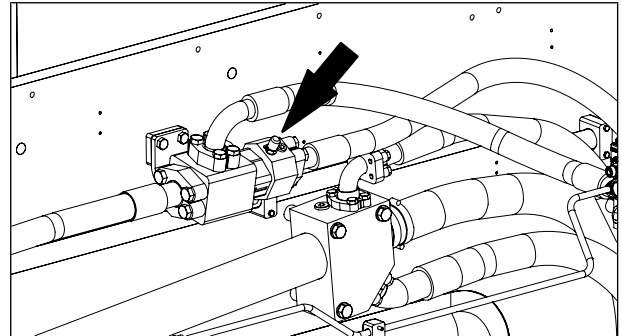


5. Release pressure from the ride control accumulators if the machine is equipped with the optional ride control system. See section Releasing pressure from the ride control pressure accumulators.
6. Place an oil drain container under the machine where the hoses are to be removed.
7. Bleed hydraulic pressure from lift cylinder by connecting a capillary test hose into the test point on the junction block.

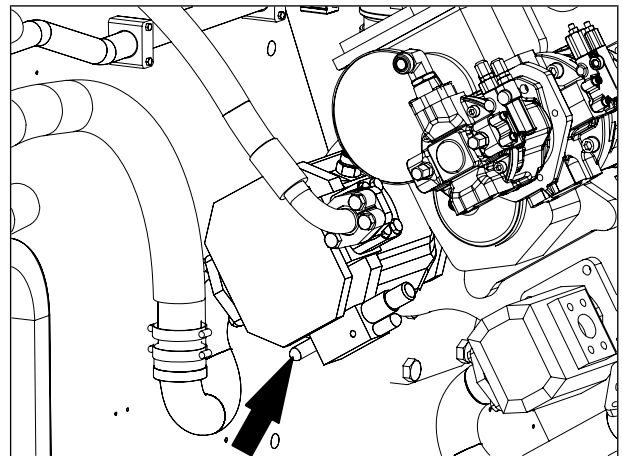


**Maximum pressure**

1. Check that the steering pump differential pressure is **25 bar** ( $\pm 2$  bar).
2. Connect a 400 bar pressure gauge to the bucket pump pressure line test point.
3. Start the engine.
4. Lower the boom against the stoppers and keep the boom control joystick in the down position.
5. Check the pressure from the gauge.
  - The correct pressure is **295 bar** ( $\pm 8$  bar)



6. Adjust the maximum pressure, if necessary.
  - **NOTE!** Never adjust pump pressures when engine is running. The rotating cardan shaft can cause serious injury.




7. Check the stand-by pressure.
  - If necessary, repeat the sections above until stand-by and maximum-pressure are correct.

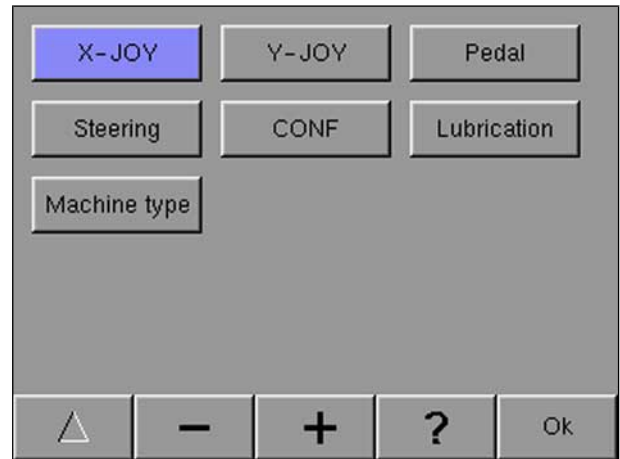
<b>DANGER</b>	
	<b>Never adjust pump pressures when engine is running. The rotating cardan shaft can cause serious injury.</b>



<b>NOTICE</b>	<b>When adjusting the pump stand-by pressure it will also affect to the pump maximum pressure and vice versa.</b>
---------------	---

12.10.10. Control joystick calibration (requires service password)

<b>NOTICE</b>	
	<p><b>It is very important, that the service password is not given to any unauthorized persons. Any unauthorized use of the service menus may result in serious malfunctions. The service password may only be given to a service person sufficiently trained by Sandvik Mining and Construction.</b></p>

The calibration windows are used for calibrating the X- and Y-movements of the control joysticks. On the calibration menu, select either the calibration window for boom control (X-JOY) or the calibration window for bucket control (Y-JOY). The CONF button opens the window for switching control directions (see section "Switching the control directions of the control joystick").



X-JOY CALIBRATION	Y-JOY CALIBRATION
<div style="display: flex; align-items: center;"> <div style="text-align: center; margin-right: 20px;"> <div style="border: 1px solid gray; padding: 2px;">2,68</div> V    <div style="border: 1px solid gray; padding: 2px;">2,68</div> V                 </div> <div> <p>Left Full      <span style="border: 1px solid gray; padding: 2px;">1,01</span> V</p> <p>Right Full    <span style="border: 1px solid gray; padding: 2px;">4,08</span> V</p> <p>Zero            <span style="border: 1px solid gray; padding: 2px;">2,68</span> V</p> <p>Dead band     40 %</p> </div> </div>	<div style="display: flex; align-items: center;"> <div style="text-align: center; margin-right: 20px;"> <div style="border: 1px solid gray; padding: 2px;">2,44</div> V    <div style="border: 1px solid gray; padding: 2px;">2,44</div> V                 </div> <div> <p>Down Full     <span style="border: 1px solid gray; padding: 2px;">0,91</span> V</p> <p>Up Full        <span style="border: 1px solid gray; padding: 2px;">4,15</span> V</p> <p>Zero            <span style="border: 1px solid gray; padding: 2px;">2,60</span> V</p> <p>Dead band     40 %</p> </div> </div>
CANT CALIBRATE WITH THESE VALUES	
<div style="display: flex; justify-content: space-around;"> <span>△</span> <span>-</span> <span>+</span> <span>Calib</span> <span>Ok</span> </div>	<div style="display: flex; justify-content: space-around;"> <span>△</span> <span>-</span> <span>+</span> <span>Calib</span> <span>Ok</span> </div>

The bar on the left-hand side of the calibration window shows the control joystick voltages for the extreme positions of the control joystick. The extreme positions of the X-movement are moving the control joystick to the left, the middle position, and moving it to the right. The extreme positions of the Y-movement are pushing the control joystick away from the operator, the middle position, and pulling it towards the operator.

In the fields on the right-hand side of the window, it is possible to calibrate new voltage values for the control joystick position. Perform the calibration by moving the control joystick first to its extreme positions and then returning it to the middle position. The new voltage values will be updated in the fields on the window. Save the calibration by pressing the Calib button. When the calibration is finished, a message appears at the bottom of the window.

On the window, the dead band of the middle position means the movement range of the control joystick before it starts controlling the function.

It is only possible to perform the calibration when the upper and lower values of the bar differ from the middle position value the amount of the dead band. If calibration is not possible, a warning message appears at the bottom of the window. The warning message will be removed when it is possible to perform calibration.

Module	No	Alarm text	Alarm log
Front	106	Boom pressure (suspension) sensor (B2022) high error	x
Front	107	Boom pressure (suspension) sensor (B2022) low error	x

**Description 1:** Sensor's value for current too high, cable or sensor in short circuit to voltage.

**Action 1:** Sensor

- Measure and check the value of current from the sensor on the Boom pressure calibration window (See section *Diagnostics, Sensor calibration*).
- Change the sensor if broken.

**Action 2:** wire harness

- Measure the voltage in sensor's A pin. It must be the same as the machine's operating voltage.
- Fault in wire harness or Front module connector pin XF1.1 (there is a separate alarm for this)

**Action 3:** wire harness

- Measure the connection from the sensor's B pin to GND. The cable is connected to the Front module connector pin XF1.11.

**Action 4:** Sensor

- Remove the wire of Front module connector pin XF3.8 and measure the current to earth through a 220-Ohm resistor. This should be approx. 4 mA at a pressure of 0 bar.

**Action 5:** Module

- If the actions 1 -4 do not correct the malfunction, the Front module is broken.
- Change the module.

**Description 2:** Sensor's value for current too low, cable or sensor in short circuit to GND.

**Action 1:** Sensor

- Measure and check the value for current from the sensor on the Boom pressure calibration window (See section *Diagnostics, Sensor calibration*).
- Change the sensor if broken.

**Action 2:** wire harness

- Measure the voltage in sensor's A pin. It must be the same as the machine's operating voltage.
- Fault in wire harness or Front module connector pin XF1.1 (there is a separate alarm for this)

**Action 3:** wire harness

- Measure the connection from the sensor's B pin to GND. The cable is connected to the Front module connector pin XF1.11.

**Action 4:** Sensor

- Remove the wire of Front module connector pin XF3.7 and measure the current to earth through a 220-Ohm resistor. This should be approx. 4 mA at a pressure of 0 bar.

**Action 5:** Module

- If the actions 1 -4 do not correct the malfunction, the Front module is broken.
- Change the module.

13.3.2. System description of VCM

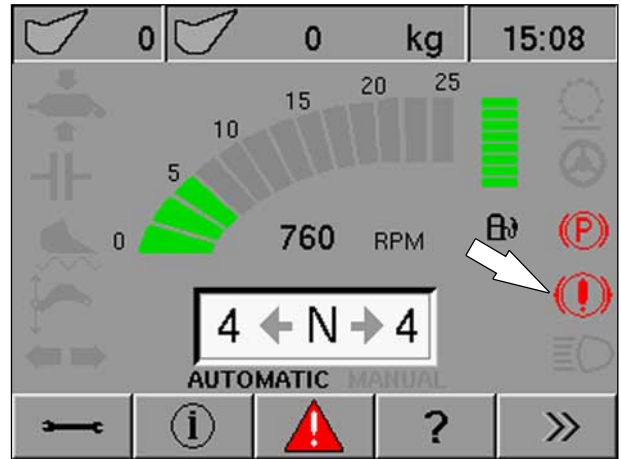
**Service brake**

The service brake is controlled by a pedal (pedal valve).

As a safety feature, the machine is equipped with double circuit brake systems, which both have pressure sensors. Pressing the brake pedal lights up the brake warning lights, if one or both circuit pressures are under the set parameter value.

The system informs with an alarm, if the brake’s hydraulic oil filter is clogged.

The state of the brake charging pressure is shown by a symbol in the right side of the main window. The symbol is grey when the charging pressure is within normal limits, yellow when the charging pressure is within the warning area and red when the charging pressure is within the alarm area.

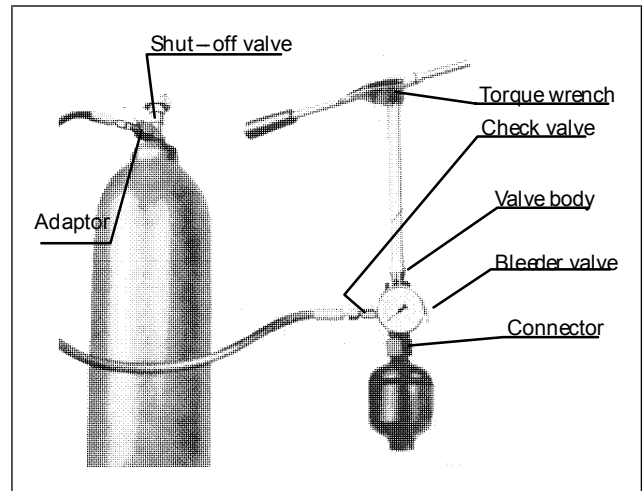




**Only perform maintenance work when the machine is parked on a level, hard surface. Use the appropriate tools and safety equipment for the task and be sure you understand how to use them before performing any maintenance work. Replace or repair faulty tools and equipment. When performing maintenance and repair work, ensure there are no unauthorized persons in the working area.**

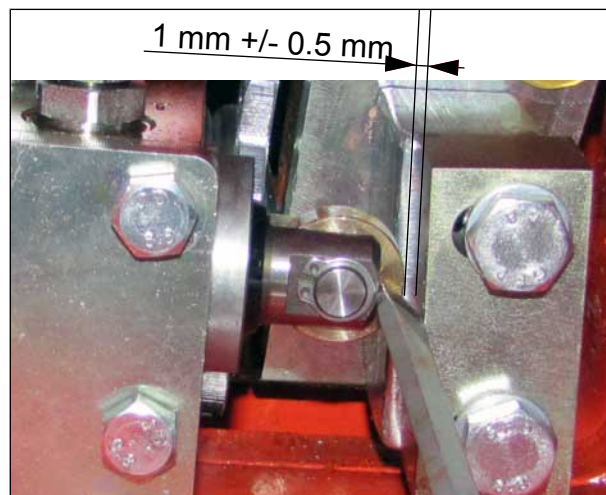
Check the valve and lock nut for accumulator connector thread M28 x 1,5. The adaptor connected to the high pressure tube for the German nitrogen cylinders can be replaced by adaptors to suit nitrogen cylinders used in other countries.

1. Clean carefully the external thread (M28 x 1,5) on the gas side of the diaphragm type accumulator, and its face surface (on which the o-ring of the charging device bears).
2. Tightly screw the adaptor of the high pressure tube to the nitrogen cylinder. Screw on the charging device. Before screwing the charging device onto the diaphragm type accumulator, make sure that the oring acting as a seal between the two parts is located correctly in its groove. The accumulator screw plug must be loosened with a socket wrench.
3. Close bleeder valve
4. Slightly open shutoff valve on the nitrogen cylinder, nitrogen flows into the diaphragm type accumulator. The shutoff valve must be closed after certain intervals of time and the prevailing gas pressure must be read off from the pressure gauge. When the desired gas pressure has been reached, it is necessary to wait a few minutes until the temperature in the accumulator has reached a point of equilibrium. During this time, the gas pressure may change slightly.
5. Close shutoff valve on the nitrogen cylinder. If the gas pressure is too high, it can be corrected by opening the drain valve on the charging device.



9. Check the clearance between the valve spool roll and the adjustment block.

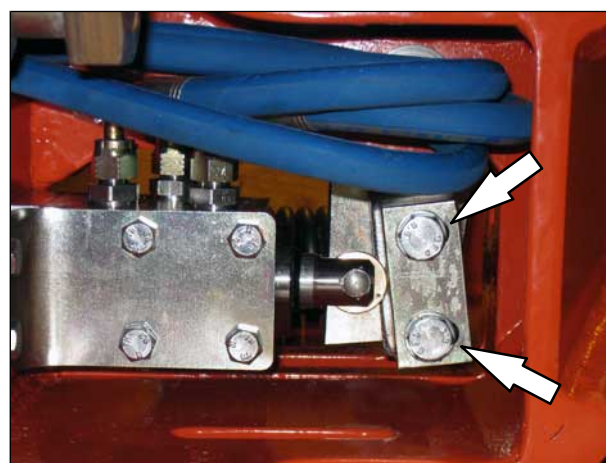
- The specified clearance is 1 mm +/- 0.5 mm.



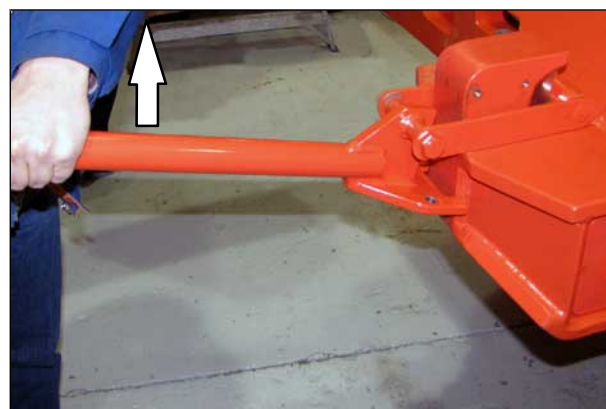
10. If necessary, adjust by moving the adjustment block.

- Use a 17 mm socket wrench.

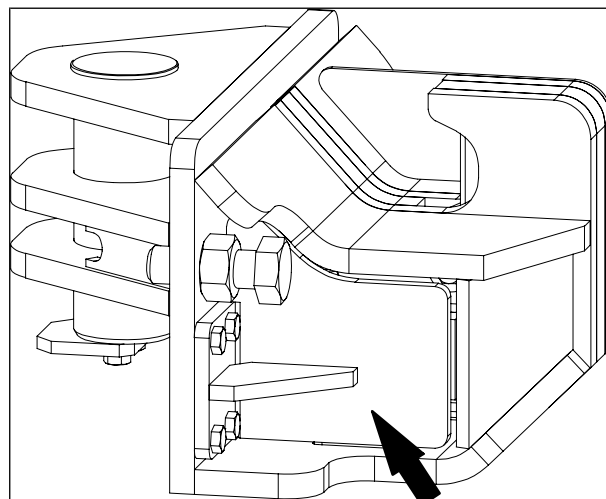
11. Tighten the adjustment block screws.



12. Release the hook valve activating tool.



13. Install the cover on the left side of the hook valve.



## 13.12.2. Brake pump pressure check / adjustment

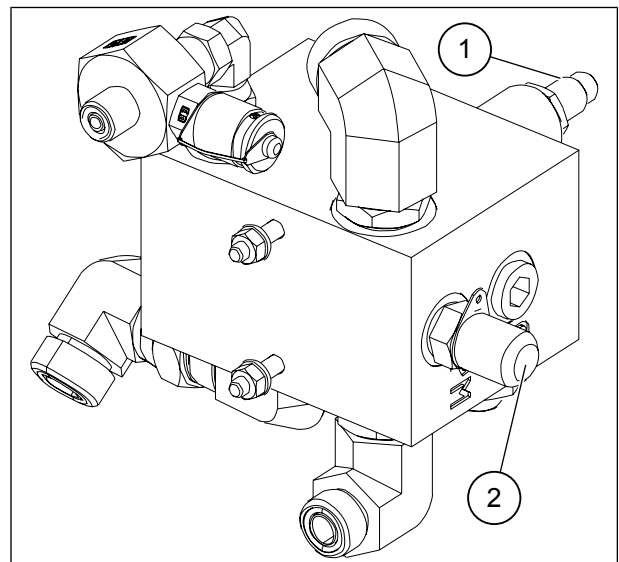


Only people who have been given specialized operation and service training are allowed to perform operations, service, and adjustment procedures. Read and ensure you understand the following instructions before servicing the equipment. To avoid potential damage and injuries, carefully plan your work beforehand.



Only perform maintenance work when the machine is parked on a level, hard surface. Use the appropriate tools and safety equipment for the task and be sure you understand how to use them before performing any maintenance work. Replace or repair faulty tools and equipment. When performing maintenance and repair work, ensure there are no unauthorized persons in the working area.

- Make sure that the hydraulic oil is at operating temperature!
  - Connect and disconnect pressure gauge(s) only when the circuit is not pressurized.
  - Use only appropriate couplings for pressure testing.
  - Do not overtighten couplings. When special couplings are used, finger tight is adequate. Over tightening can damage couplings and cause harmful leakage.
  - Use hose(s) long enough to read the gauge(s) outside the machine.
  - Attach all measuring point protection caps after the checking procedure.
1. Ensure that the machine is on an even surface, the parking brake is applied and movement is prevented by wheel chocks.
  2. Install the frame articulation locking device.
  3. Check maximum pressure:
    - a. Screw the sequence valve adjusting screw 513 (1) lightly down to closed position.
    - b. Connect a 400 bar pressure gauge to the sequence valve measuring point MP501 (2).
    - c. Start the engine.
    - d. Check from the gauge that maximum pressure is **280 bar** ( $\pm 8\text{bar}$ ).
    - e. Adjust the maximum pressure from screw 501 (4), if necessary.
    - f. Screw the sequence valve adjustment screw 513 (1) to fully open position and then  $\frac{1}{4}$  turn back.



**NOTICE**

This is based on all brakes plates being worn evenly, it may be possible due to uneven plate wear that some plate are unserviceable while the overall pack wide represented by the wear indicator appears to be serviceable.

Module	No	Alarm text	Alarm log
Middle	34	Rear brake circuit actual pressure sensor (B3057) high	x
Middle	35	Rear brake circuit actual pressure sensor (B3057) low	x

**Description 1:** Brake system malfunction

**Action 1:** Front brake circuit pressure high

- Check the pressures and function of brake hydraulics.

**Description 2:** The sensor current value is too high, the cable or sensor has shorted to the voltage.

**Action 1:** Wire harness

- Measure the voltage from the sensor pole A; must be the same as the machine's operating voltage.
- Fault in wire harness or Middle module connector pin XM2.23 (this will give a separate alarm).

**Action 2:** Wire harness

- Measure the connection from sensor pole B to GND. The cable is connected to Middle module connector pin XM3.11.

**Action 3:** Sensor

- Detach the cable for Middle module connector pin XM3.6 and measure the current to earth. With a 0-bar pressure, should be approx. 4 mA.

**Action 4:** Module

- If the actions 1-3 do not broken. Change the module.

**Description 3:** The sensor current value is too low, the cable or sensor has shorted to GND

**Action 1:** Wire harness

- Measure the voltage from the sensor pole A; must be the same as the machine's operating voltage.
- Fault in wire harness or Middle module connector pin XM2.23 (this will give a separate alarm).

**Action 2:** Wire harness

- Measure the connection from sensor pole B to GND. The cable is connected to Middle module connector pin XM3.11.

**Action 3:** Sensor

- Detach the cable for Middle module connector pin XM3.6 and measure the current to earth. With a 0-bar pressure, should be approx. 4 mA.

**Action 4:** Module

- If the actions 1-3 do not correct the malfunctioning, the Middle module must be broken. Change the module.

Actuator	Name	Signal level	Module	Connector pin
Relay	Front lights (left E2005, right E2006)	24 V / 0 V	Front	XF2.6
Relay	Rear lights (left E3014, right E3013)	24 V / 0 V	Dash	XD1.15
Relay	Rear lights above tank (left E3016, right E3015)	24 V / 0 V	Middle	XM1.14
Relay	Extra rear lights (left E3038, right E3039)	24 V / 0 V	Middle	XM1.14

**14.2.3. Parking lights**

The driving direction of the machine is shown by switching the parking lights on in only one end of the machine at a time. The rear park lights are on when the driving direction is forward (towards the bucket). The front park lights are on when the machine is being reversed.

Both the front and the rear parking lights are on when the gear is on neutral, the parking brake is on, or the main machine power is on.

**Inputs**

No Inputs.

**Outputs**

Actuator	Name	Signal level	Module	Connector pin
Led light	Rear parking light (E2009, E2001)	24 V / 0 V	Front	XF2.8
Led light	Ground of rear parking lights	GND	Front	XF2.14
Led light	Front parking light (E3018, E3011)	24 V / 0 V	Middle	XM1.8
Led light	Ground of front parking lights	GND	Middle	XM1.11





14.6.2. Removing the batteries



Only perform maintenance work when the machine is parked on a level, hard surface. Use the appropriate tools and safety equipment for the task and be sure you understand how to use them before performing any maintenance work. Replace or repair faulty tools and equipment. When performing maintenance and repair work, ensure there are no unauthorized persons in the working area.



Only people who have been given specialized operation and service training are allowed to perform operations, service, and adjustment procedures. Read and ensure you understand the following instructions before servicing the equipment. To avoid potential damage and injuries, carefully plan your work beforehand.

 <b>DANGER</b>	
  	<p><b>EXPLOSION HAZARD!</b></p> <p>Explosion of batteries will cause death or severe injury.</p> <p>Keep all ignition sources away area where working with batteries. Batteries generate explosive gases and a small spark, flame or burning cigarette to set off explosion.</p>



**WARNING! CHEMICAL BURN HAZARD!**

Spilled or splashed electrolyte can cause burn and severe eye injury and destroy clothing.

Handle batteries with extreme care to avoid spilling and splashing electrolyte.

Wear protective clothing, eye-protector and protective gloves when working with batteries.



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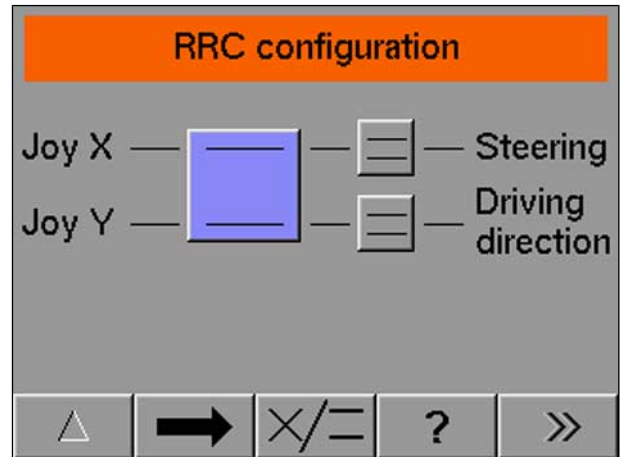
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**14.9.3. RRC configuration for the steering and the driving direction**

Configuration of the steering and the driving direction is similar to the boom and the bucket configuration.

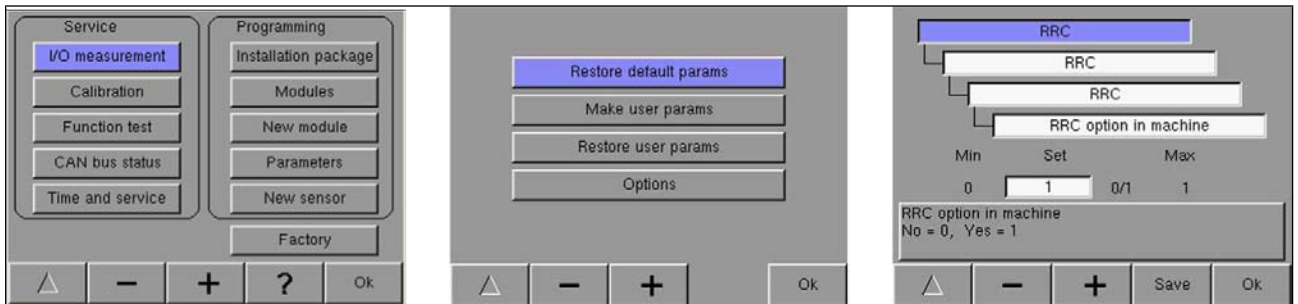
When all the selections are "=", directions should be as following:

- JOY X right turns the machine steering to right
- JOY X left turns the machine steering to left
- JOY Y up, forward driving direction
- JOY Y down, reverse driving direction



**14.9.4. Enabling the RRC option (service level password required)**

Before the RRC can be configured, the RRC option should be enabled. The RRC option can be enabled from the service level by selecting Options behind the Parameters selection.

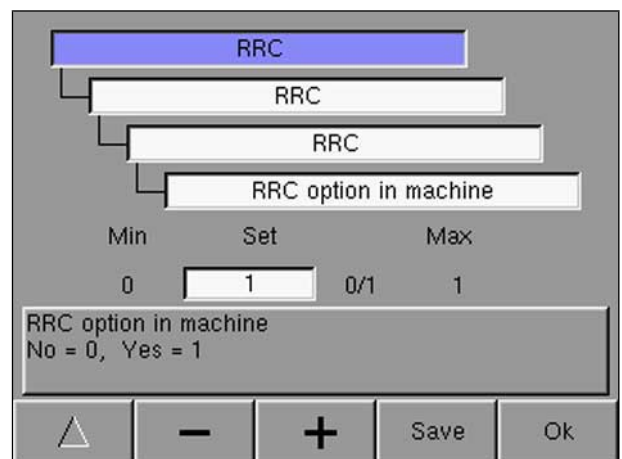


**Selecting the RRC-interface**

The RRC interface can be selected from the service level by selecting Options behind the Parameters selection.

The RRC interface type has 4 selections available:

- 0 = Traditional
- 1 = HBC 719/727
- 2 = HBC 735
- 3 = Cattron



Module	No	Alarm text
Display	81	Pressure1DiscrepancyError

**Description:** At the end of the weighing (sampling), the discrepancy average for the pressure 1 is higher than the limit defined in calibration (param. n°257). Boom speed is highly variable of the machine swing.

**Action 1:** Carry out weighing correctly on a smooth surface.

**Action 2:** Check condition of pressure sensors.

Module	No	Alarm text
Display	82	BoomSpeedError

**Description:** Boom speed error during weighing (up direction). For weighing, the sampling/weighing duration has been less than 600ms or more than 10.0 seconds.

**Action 1:** Check weighing technique.

- Use full RPM for a weighing.
- Use full joystick control for a weighing.

**Action 2:** If an error occurs during calibration then check RPM setting for calibration (calibration speed).

- Increase to speed 1 if necessary.

Module	No	Alarm text
Display	85	AccDecreasedBucketOpenWarning

**Description:** A bucket is open or open during weighing. At the end of sampling the bucket has been detected as open for more than 10% of the time during the sampling.

**Action 1:** Keep the bucket full back position during weighing.

**Action 2:** Check condition of bucket limit switch.

**Action 3:** Adjust the bucket limit switch.

Module	No	Alarm text
Display	86	AccDecreasedLoadGapWarning

**Description:** After sampling, the difference between the calculated load and the closest reference load is higher than the value of parameter n°377 (in percent).

**Action 1:** Check weighing technique.

**Action 2:** Check condition of pressure sensors.

Module	No	Alarm text
Display	87	AccDecreasedSecondaryParamMissingWarning

**Description 1:** The average of the temperature value during sampling was lower than -40 °C or higher than +110 °C.

**Description 2:** The average of the inclination value during sampling was higher than 30° or lower than -30°.

**Description 3:** The average of the RPM value during sampling was lower than 0 or higher than 4000.

**Action:** Check condition of temperature sensors and Inclinometer.

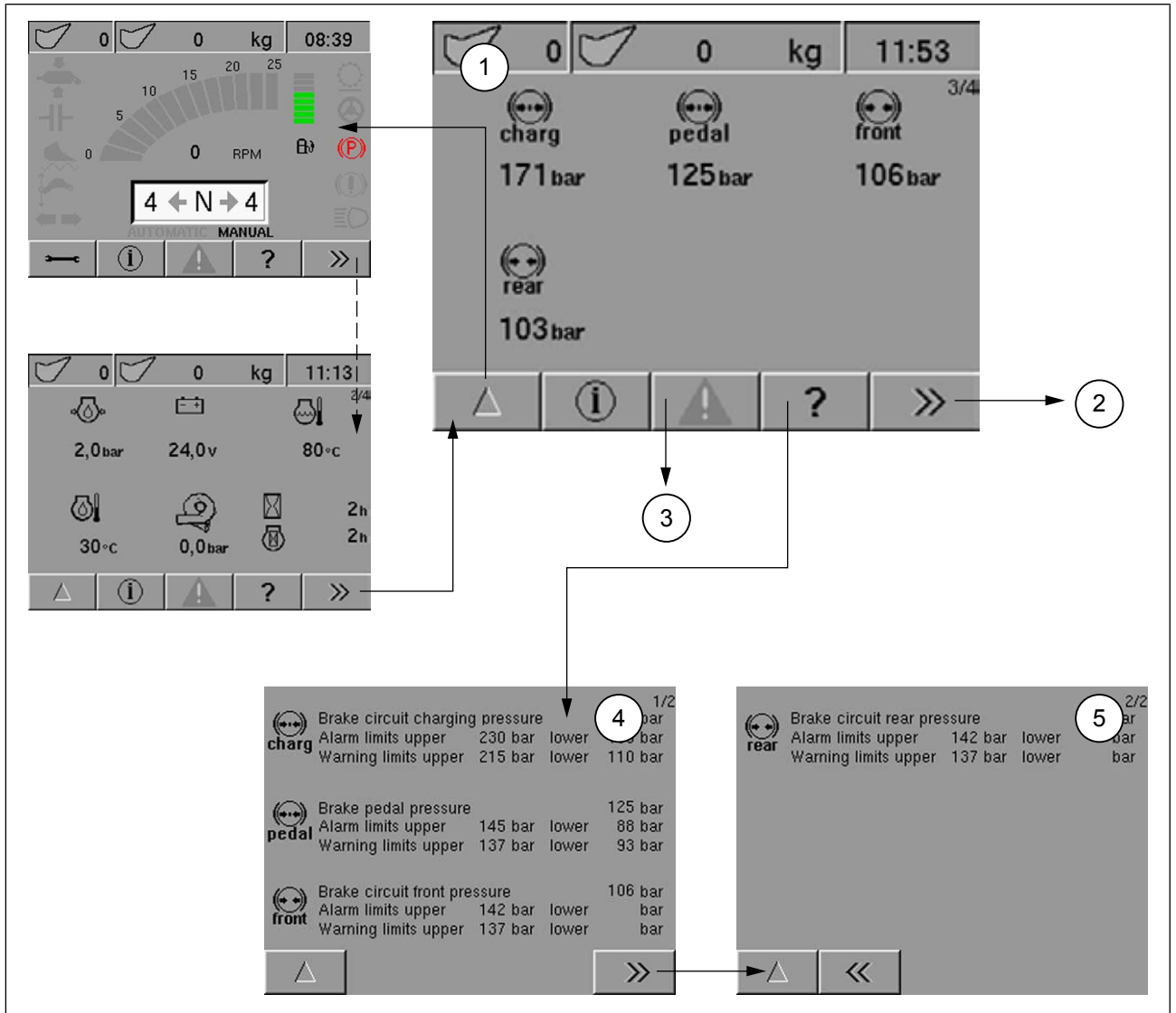


Figure: Gauge window 3

- 1 Gauge window 3
- 2 Gauge window 4
- 3 Alarm log
- 4 Information window 1
- 5 Information window 2

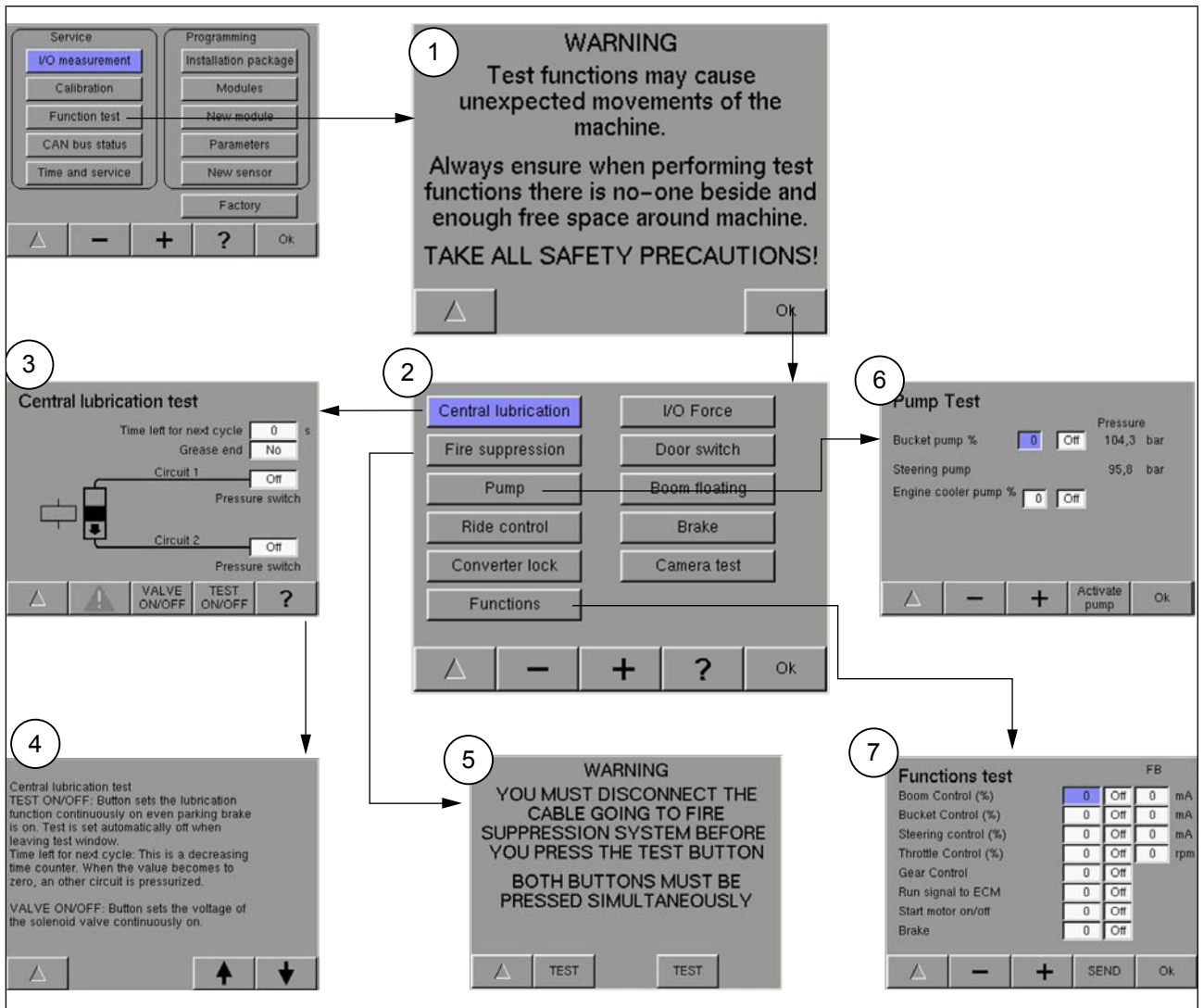


Figure: Forcing windows for functions: Automatic central lubrication, machine functions, fire extinguisher and pump pressure

- |   |                          |   |                       |
|---|--------------------------|---|-----------------------|
| 1 | Warning window           | 2 | Forced functions menu |
| 3 | Central lubrication test | 4 | Information window    |
| 5 | Fire extinguisher        | 6 | Pump pressure         |
| 7 | Machine functions        |   |                       |

## 14.15.5. Checking emergency stop and shutdown system



Only perform maintenance work when the machine is parked on a level, hard surface. Use the appropriate tools and safety equipment for the task and be sure you understand how to use them before performing any maintenance work. Replace or repair faulty tools and equipment. When performing maintenance and repair work, ensure there are no unauthorized persons in the working area.



Read the general maintenance instructions before starting to work on the electric components (Electric system maintenance and Battery maintenance).

1. Check all emergency stop buttons for damage. There are three emergency stop buttons, one inside the cabin and two on the rear of the machine, one on either side.
2. Check that none of the emergency stop buttons are pushed.
3. Start the engine.
4. First check the Emergency Stop button in the cabin. Push button in and engine should stop instantly.
5. Pull the Emergency Stop Button out to release the emergency stop circuit.
6. Restart the engine.

**NOTICE**

**Wait 30 Seconds before restarting - allows starting system to cool.**

7. Push the Emergency Stop button on the left rear side of the machine, the engine should stop instantly.
8. Pull the Emergency Stop Button out to release the emergency stop circuit.
9. Restart the engine.

**NOTICE**

**Wait 30 Seconds before restarting - allows starting system to cool.**

10. Push in the remaining Emergency Stop button on the right hand rear side of machine, and the engine should stop instantly.
11. If engine does not shut down, locate the fault and repair the fault according to the wiring diagrams.

Module	No	Alarm text	Alarm log
Front	24	Stop hammering for a moment to reduce rammer temperature	X

**Description:** Stop hammering for a moment to reduce rammer temperature.

**Action:** Stop hammering until the hammer has cooled down.

Module	No	Alarm text	Alarm log
Front	25	Low beam front lights relays signal short to ground	X
Front	26	Low beam front lights relays signal short to ext. voltage	X
Front	27	High beam front lights relays signal short to ground	X
Front	28	High beam front lights relays signal short to ext. voltage	X
Front	29	Loading lights relays signal short to ground	X
Front	30	Rotation beacon signal short to external voltage	X
Front	33	Parking lights signal short to ground	X
Front	34	Parking lights signal short to external voltage	X
Front	67	Right front brake and blinker light short to ground	X
Front	68	Right front brake and blinker light short to ext. voltage	X
Front	69	Left front brake and blinker light short to ground	X
Front	70	Left front brake and blinker light short to external voltage	X
Front	72	Customer options control 1 signal short to ground	X
Front	73	Customer options control 1 signal short to ground	X
Front	59	Green driving direction light short to external voltage	X
Front	160	Green driving direction light short to ground	X

**Description 1:** Short circuit in the output of the lights connected to Front module.

**Action 1:** Coupling

- Detach the connector pin that caused the alarm from the Front module:

Alarm No	Connector pin	Function
25	XF2.5	Low beam front lights
27	XF2.6	High beam front lights
29	XF2.7	Loading light
33	XF2.8	Rear parking light
67	XF2.9	Right front brake and blinker light
69	XF2.10	Left front brake and blinker light
72	XF1.22	Customer option (Red direction light forward)
160	XF1.23	Customer option (Green direction light forward)

- Check whether the alarm stops when you force the output in question on the I/O Forcing window (see section "Forced functions", section "Forcing the digital outputs of the modules").
- If the alarm stopped, the fault is in wire harness, short circuit to operating voltage.
- Repair the wire harness.

**Action 2:** Module

- If action 1 does not correct the malfunction, the Front module is broken. Change the module.

Module	No	Alarm text	Alarm log
Rear	51	Voltage below lower limit. Not standby any more	X

**Description:** Voltage below lower limit.

**Action 1:**

- AutoMINE standby mode aborted due low battery voltage.
- Charging of battery is recommended.

Module	No	Alarm text	Alarm log
Rear	52	Machine in sleeping mode in level 1	X
Rear	53	Machine in sleeping mode in level 2	X

**Description:** Sleep (power save) mode active.

**Action 1:**

- No actions required.

Module	No	Alarm text	Alarm log
Rear	64	Camera control 1 signal short to ground	X
Rear	66	Camera control 1 signal short to external voltage	X
Rear	71	Camera control 2 Short cut	X
Rear	72	Camera control 2 Voltage in pin	X
Rear	87	Camera control 3 signal short to ground	X
Rear	88	Camera control 3 signal short to external voltage	X
Rear	107	Camera control 4 signal short to ground	X
Rear	108	Camera control 4 signal short to external voltage	X

**Description 1:** Short circuit in the output of lights connected to the Rear module.

**Action 1:** Coupling

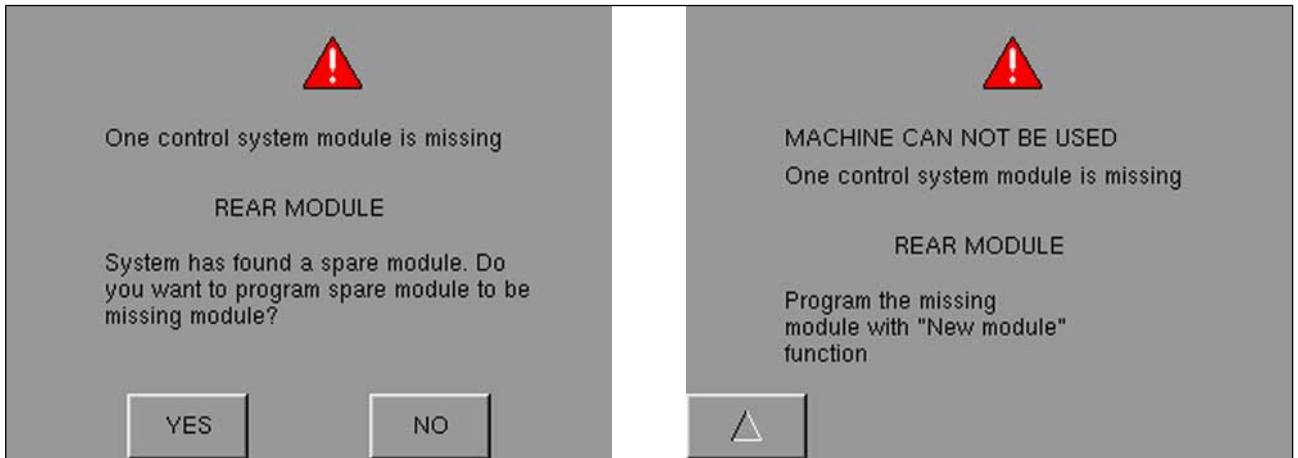
- Detach the connector pin that caused the alarm from the Rear module:

Alarm no	Connector pin	Function
67	XR2.9	Camera control 1
71	XR2.10	Camera control 2

Sensor / use	I/O name	Conn	Pin	Type	Type detail	Definition
SENSOR & SWITCH SUPPLY (XM3)	B2021, B2041 B2065	XF2	23	DO	24 V / 0 V	
SENSOR & SWITCH SUPPLY	B2008, B3054	XF3	1			
		XF3	2			
GND	B2021, B2041 B2065	XF3	3			
GND	S2038, S2064	XF3	4			
Bucket position	B2065	XF3	5	AI	4 - 20 mA	min - max lenght
Tilt Sensor	B2041	XF3	6	AI	4 - 20 mA	
Boom Pressure 2	B2022	XF3	7	AI	4 - 20 mA	0 - 400 bar
Boom pressure 1 (Ride control)	B2021	XF3	8	AI	4 - 20 mA	0 - 400 bar
SENSOR & SWITCH SUPPLY	S2038	XF3	9			
		XF3	10			
		XF3	11			
		XF3	12			
Brake temperature front	B2008	XF3	13	AI		Not in use
Brake temperature rear	B3054	XF3	14	AI		Not in use
		XF3	15			
Cardan speed A	S2038	XF3	16	PI	24 V / Float	0 - 1000 Hz
Cardan speed B	S2064	XF3	17	PI	24 V / Float	0 - 1000 Hz
Steering limit switch	S3060	XF3	18	DI	24 V / Float	24 V = End at- tenuation
		XF3	19			
		XF3	20			
Bucket limit switch for scale	S2117	XF3	21	DI	24 V / Float	
Boom down limit switch for scale	S2115	XF3	22	DI	24 V / Float	
Boom up limit switch for scale	S2116	XF3	23	DI	24 V / Float	
GND		XF4	1			
CANopen / CAN High		XF4	2			
GND		XF4	3			


**Rejecting program loading**

If you select NO when the system identifies a new module in connection with turning on the operating voltage for a new module, a display window appears telling that the machine cannot be used:



In this case, the new module must be programmed via the display module's "New module" connector. See Section "Programming a new module".

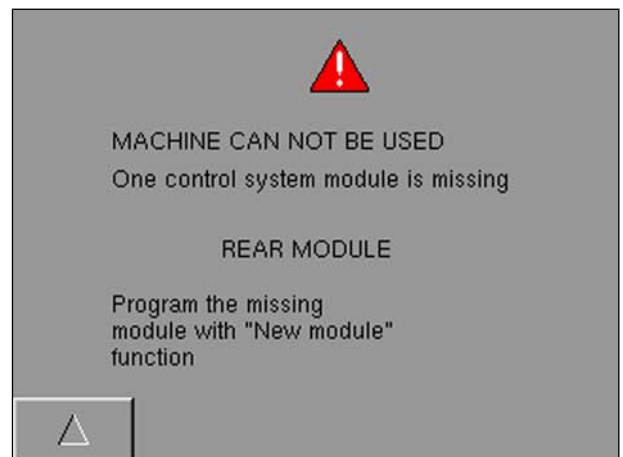
**14.18.3. Changing several I/O modules**

 <b>DANGER</b>	
	<p><b>Only authorized person may take all I/O modules from another machine and replace the machine's own modules with these. There is a danger that you lose machine's own parameters or parameters are replaced with wrong machine type parameters. This may cause severe malfunctions and danger for operator.</b></p>

If during system start-up more than one module is missing, a display window appears telling that the machine cannot be used:

In this case, the new modules must be programmed via the display module's "New module" connector. See section "Programming a new module".

The display window also shows the missing modules. You can also enter the main window without program loading.

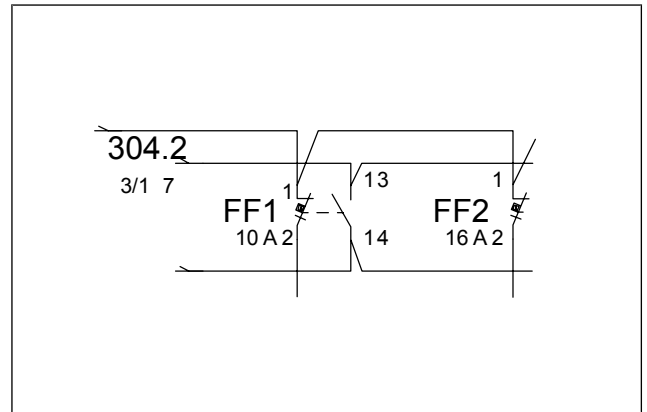


9. 304.2

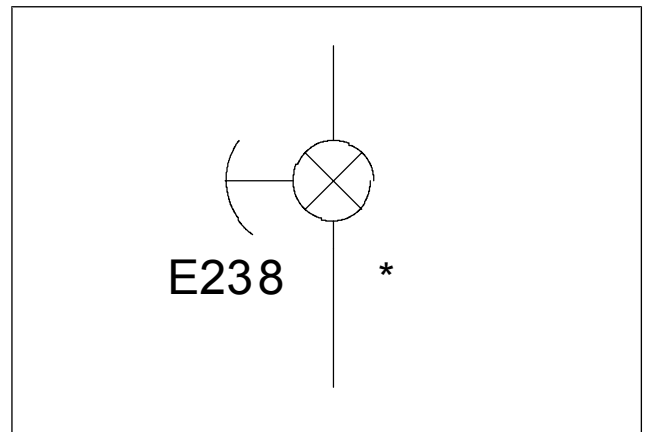
304 = wire number.

2 = junction number which is used only in the drawings.

3/17 Address where wire continues (on page 3, column 17).



10. Components / functions which are marked with \* are optional equipment.



<b>DISPLAY Alarm number</b>	<b>Alarm text</b>	<b>Chapter / Section</b>
90	Set zero point, zeroing remind	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
91	Overload!	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
93	RECALIBRATE SCALE!	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
95	RRC throttle joystick calibrated	VCM-System ERROR CODES / VCM-System troubleshooting
94	Bad weighing! Do new weighing rightly!	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
184	Shock load Pressure 1 Max peak Pressure	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
185	Shock load Pressure 2 Max peak Pressure	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
189	Weighing error	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
192	LoadCalculationNotCompletedDownError	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
193	BoomSpeedDownError	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
194	ScaleErrorCheckWeighingLogErroCount	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting

<b>CHAIR Alarm number</b>	<b>Alarm text</b>	<b>Chapter / Section</b>
4	CANopen transmit buffer full (bus overloaded)	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
5	CANopen error frames detected	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
9	Chair module temperature low	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
10	Chair module temperature high	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
24	E-stop circuit supply voltage short to ground	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
25	Estop circuit has short to external voltage	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
26	VCM-System module missing. E-stop activated	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
27	E-stop active. Safety object from Infra-FREE not OK Note! Updated version of this same message is: E-stop activated. Control station message timeout	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting

MIDDLE Alarm number	Alarm text	Chapter / Section
68	Bucket pump (Y3057) control signal wire broken (no FB)	GENERAL HYDRAULICS / VCM-System troubleshooting
69	Wrong parameter value in bucket pump control	GENERAL HYDRAULICS / VCM-System troubleshooting
70	Uncontr. Bucket pump (Y3057) signal (FB without contr)	GENERAL HYDRAULICS / VCM-System troubleshooting
71	Parking brake engage, engine cut out	BRAKE SYSTEM / VCM-System troubleshooting
72	Parking brake engaged. E-stop activated	BRAKE SYSTEM / VCM-System troubleshooting
73	Bucket pump control signal short to gnd (XM2/2)	GENERAL HYDRAULICS / VCM-System troubleshooting
74	Bucket pump control signal short to external voltage (XM2/2)	GENERAL HYDRAULICS / VCM-System troubleshooting
75	Transmission oil pressure high alarm	POWER TRAIN / VCM-System troubleshooting
76	Transmission oil press. high warning	POWER TRAIN / VCM-System troubleshooting
77	Transmission oil pressure low warning	POWER TRAIN / VCM-System troubleshooting
78	Transmission oil pressure low alarm	POWER TRAIN / VCM-System troubleshooting
79	Transmission oil pressure sensor (B3005) high error	POWER TRAIN / VCM-System troubleshooting
80	Transmission oil pressure sensor (B3005) low error	POWER TRAIN / VCM-System troubleshooting
81	Bucket pump control short to ground	GENERAL HYDRAULICS / VCM-System troubleshooting
83	Unable to release parking brake. E-stop activated	BRAKE SYSTEM / VCM-System troubleshooting
84	Parking brake engaged, door open!	BRAKE SYSTEM / VCM-System troubleshooting
85	Fuel level low warning	POWERPACK / VCM-System troubleshooting
86	Fuel level low alarm	POWERPACK / VCM-System troubleshooting
87	Fuel level sensor (B3011) high error	POWERPACK / VCM-System troubleshooting
88	Fuel level sensor (B3011) low error	POWERPACK / VCM-System troubleshooting
89	Module ref 5V out of limits (pins XM3/2 or XM3/10)	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting
90	Module ref 12V out of limits (pins XM3/1 or XM3/9)	GENERAL ELECTRICAL SYSTEM / VCM-System troubleshooting

**SBO**

**Návod k provozu  
Membránové  
akumulátory**

**Betriebsanleitung  
Membranspeicher**

**Betjeningsvejledning  
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**Instrucciones de servicio  
Acumuladores a  
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**Notice d'utilisation  
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Ταμιευτήρες μεμβράνης**

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Membranackumulator**

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## 3 SAFETY

### 3.1 Warnings

**WARNING! Use only nitrogen (N2) in pre-charging the accumulator; never use oxygen (can cause an explosion).**

**WARNING! Do not open the gas valve; if the accumulator is connected with the system.**

### 3.2 General

- \* Maintain this operation instruction during the whole life of the accumulator. This manual gives instruction of the accumulator correct use and service.
- \* The accumulator structure and action can't be changed in any way.
- \* For your own safety, read exactly this manual before you put the accumulator in use.
- \* Read manufacturer/ retail dealer duties in page 7 and ensure that you get your accumulator the like instructions show.
- \* The user must know the accumulator completely, because the user has the full responsibility for the safety of themselves and others.
- \* The user must be old enough and capable to work with the accumulator.
- \* We recommend that the users are at least 16 years old. Even then older and experienced person must guide a younger person to work with the accumulator.
- \* So by avoiding trouble factors, when working with the accumulator, it is recommended that there aren't unnecessary persons near the accumulator.

### 3.3 Before working

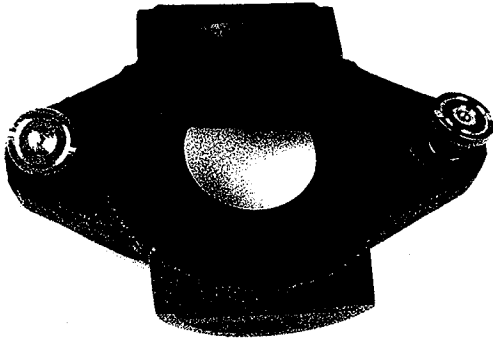
- \* Ensure that the accumulator's maximum working pressure and pre-charge pressure are suitable.
- \* Ensure, that the right temperature range is in use.
- \* Use only nitrogen (N2) in pre-charging the accumulator.
- \* Use only spare parts, witch your manufacturer recommends.

**WARNING! Use only nitrogen (N2) in pre-charging the accumulator; never use oxygen (can cause an explosion).**

### 3.4 Pre-charging

- \* The pre-charge pressure must be measured one month after introduction and there then every 6 months.
- \* See pre-charging instructions in the accumulator service instructions.

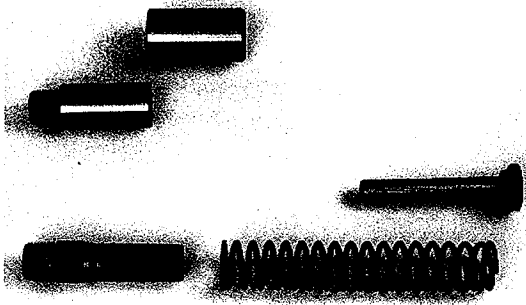
**WARNING! Use only nitrogen (N2) in pre-charging the accumulator; never use oxygen (can cause an explosion).**



K6

Schwenkwiegen in Standard - Ausführung stehen für rechte oder linke Antriebsdrehrichtung zur Verfügung. Ebenso wird zusätzlich für leistungsgeregelte Pumpen die rechte und linke Schwenkwiege angeboten.

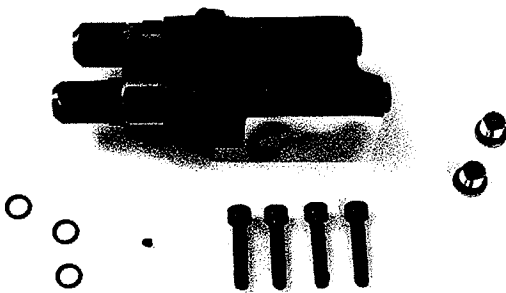
*We offer swash plates for cw or ccw rotating units in the serial design or for horse power controlled pumps by our spare part service. (Order your direction of rotation)*



K7

Die Abb. li zeigt die Verstellteile ohne Anschläge. Ggf können auch Verstellteile mit Anschlägen bezogen werden ( s. dazu auch RD 90 124)

*Picture leftt shows the control device parts without the stopper parts. Order with stopper parts if necessary ( see RE 90 124 ).*



K8

Als geprüftes und voreingestelltes Ventil kann das Steuer-ventil für p- und Q-Regelung bezogen werden. Wenige Handgriffe ermöglichen ggf. Modifikationen in der Steuerventilausführung. (Abb. li zeigt Steuerventil für A10 NG 18 bis 100; NG 140 mit Ventil-NG 6 - s. Titelbild bzw. Abb 10\* S. 5)

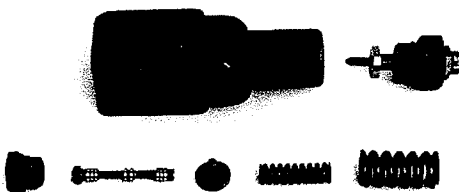
*Order a checked and preadjusted pilot valve to control the pump for pressure compensator and flow control. Easy handling is possible to convert the design of the pilot valve. (Picture left shows valve of pump size 18 ..100; size 140 must have valve size 6 - see cover picture or 10\* this page)*



9\*

Steuerventilausführung für NG 18 bis 100:  
X-Adapter am DFR-Steuerventil für metrische Verrohrung des Steueranschlusses X (ohne Blende).

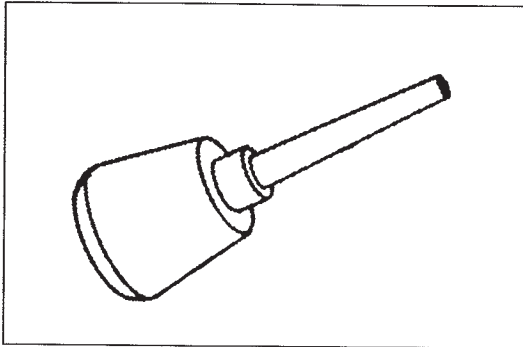
*Pilot valve design 18 to 100:  
Adapter without orifice of the DFR - pilot valve, if you use a metric pilot pipe connection X.*



10\*

Die Abb. zeigt den zerlegten Druckregler als Zwischenplattenventil (NG 140). Als zweite Ventilachse wird der Förderstromregler außen am Druckregler angeflanscht.

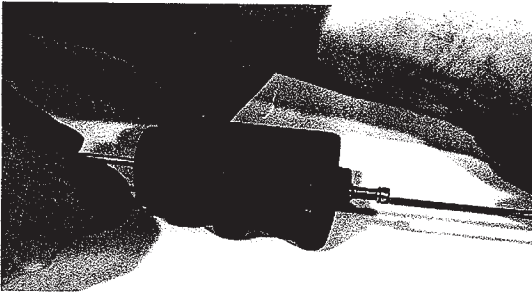
*Picture left shows the pressure compensator disassembled as a sandwich valve (of pump size 140). Mount on top of the pressure compensator housing the valve housing for the flow control.*



61

Einkleben der Düse ( auf verstopfte Düse ist beim Klebevorgang zu achten ).

*Be careful when loctiting the orifice.*



62

Laufeigenschaft der Reglerkolben prüfen, keine Beschädigungen der Kolben und der Bohrungen.

*Check the movement of the pilot valve spools, and drillings should not be damaged.*



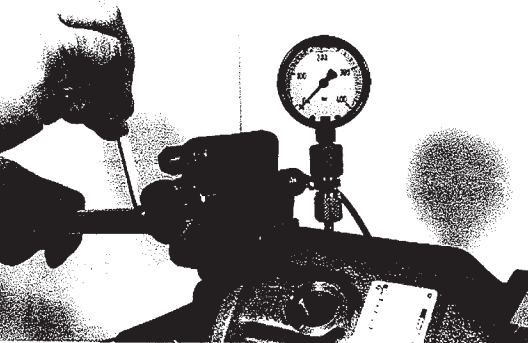
63

Einstellungen der Bypaßblende (s. auch S. 16):

- 1) Schlitz in Längsrichtung ( entspr. der Abb. ): Blende geöffnet.
- 2) Schlitz quergestellt: Blende geschlossen

*Adjustments of the bypass orifice (see page 16, too ):*

- 1) *open position of the orifice: like shown on the picture*
- 2) *turn the orifice 90° to close it.*



64

Einstellen des Steuerventils siehe Einstellhinweise ( s. S. 23 ).

*For adjustment of the pilot valve see set up instructions ( page 23 ).*

Siehe S. 17.

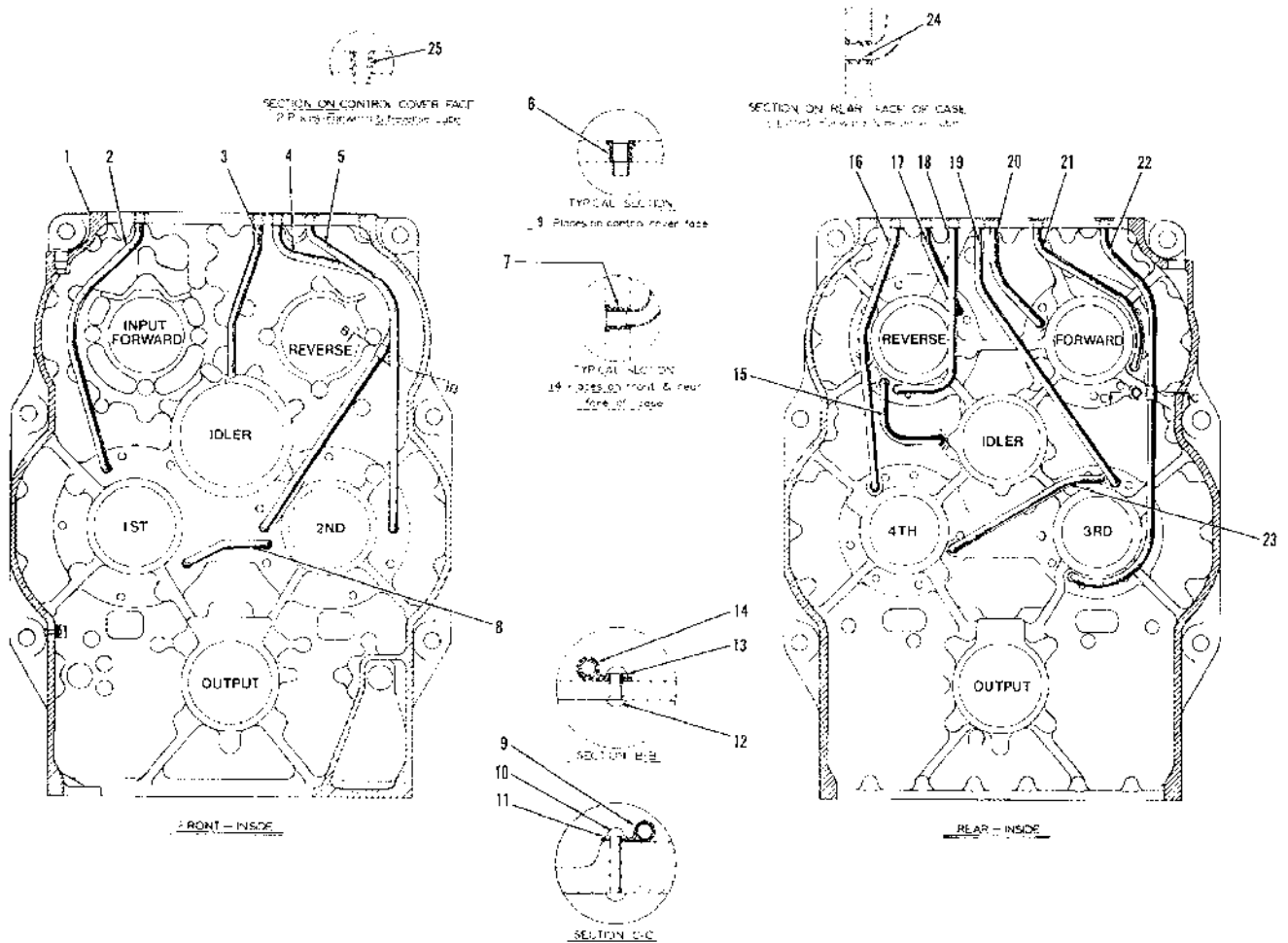
*see page 17.*

65

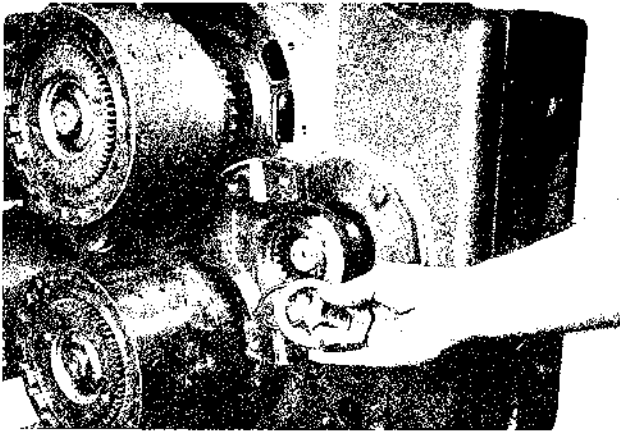
Für die Steuerventilausführung der Pumpen NG 140 sind keine weiteren Angaben gemacht. Sinngemäß sind die o. a. Hinweise zu beachten.

*Pilot valve of pump size 140 doesn't have own instructions. However see the given hints on top.*

## TRANSMISSION CASE ASSEMBLY

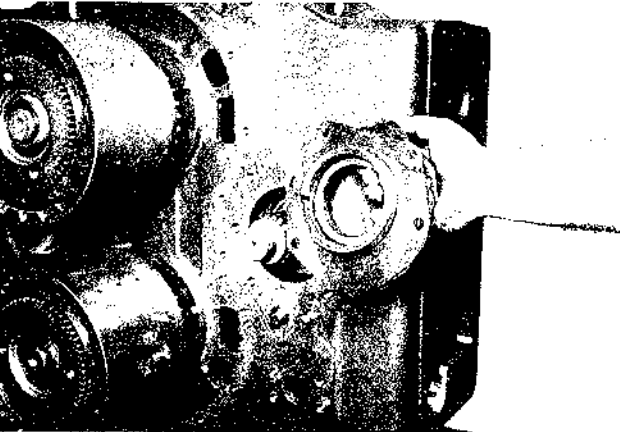


ITEM	DESCRIPTION	QTY.	ITEM	DESCRIPTION	QTY.
1	Transmission Case . . . . .	1	13	Washer . . . . .	1
2	1st Clutch Pressure Tube . . . . .	1	14	Tube Clip . . . . .	1
3	Idler Front Bearing Lube Tube . . . . .	1	15	Reverse to Idler Cross Over Lube Tube . . . . .	1
4	2nd Clutch Lube Tube . . . . .	1	16	4th Clutch Pressure Tube . . . . .	1
5	2nd Clutch Pressure Tube . . . . .	1	17	Reverse Clutch Pressure Tube . . . . .	1
6	Tube Sleeve . . . . .	9	18	Reverse Clutch Lube Tube . . . . .	1
7	Tube Sleeve . . . . .	14	19	3rd Clutch Lube Tube . . . . .	1
8	2nd to 1st Cross Over Lube Tube . . . . .	1	20	Forward Lube Tube . . . . .	1
9	Tube Clip . . . . .	1	21	Forward Clutch Pressure Tube . . . . .	1
10	Rivet . . . . .	1	22	3rd Clutch Pressure Tube . . . . .	1
11	Washer . . . . .	1	23	3rd to 4th Cross Over Lube Tube . . . . .	1
12	Rivet . . . . .	1	24	Tube Sleeve . . . . .	2
			25	Tube Sleeve . . . . .	2



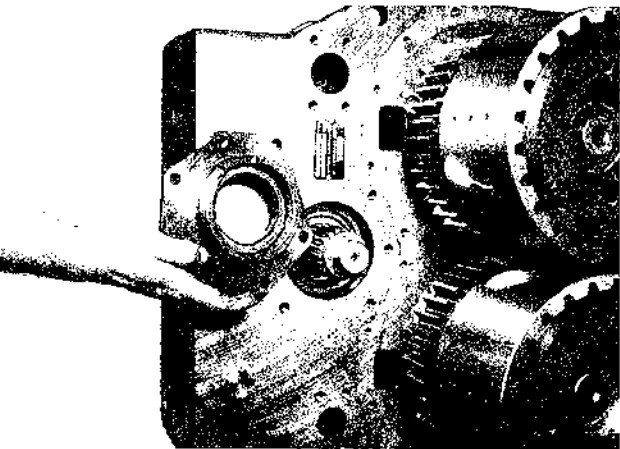
**Figure 11**

Remove output flange nut, washer, "O" ring and output flange on both front and rear of transmission. If axle disconnect is used remove disconnect as an assembly.



**Figure 12**

Remove output shaft bearing cap bolts. Remove bearing cap and shims.

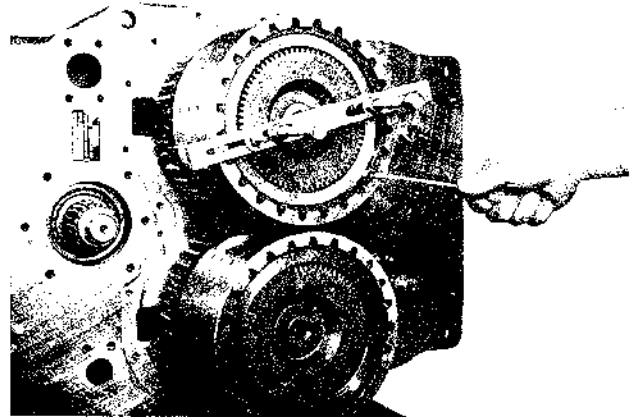


**Figure 13**

Remove rear output shaft bearing cap.

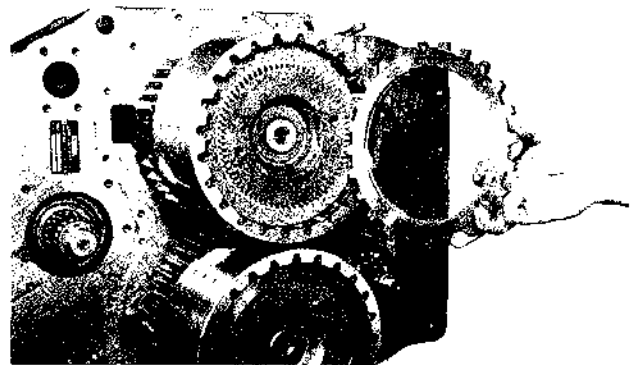
## CLUTCH DISASSEMBLY

**NOTE:** 1st, 2nd, 3rd and 4th clutches are disassembled in a similar manner. The 1st and 2nd clutches are larger than the 3rd and 4th clutches and the 1st and 2nd clutch drums have a removable and replacable clutch drum hub gear. Clutch being disassembled is the 2nd speed clutch.



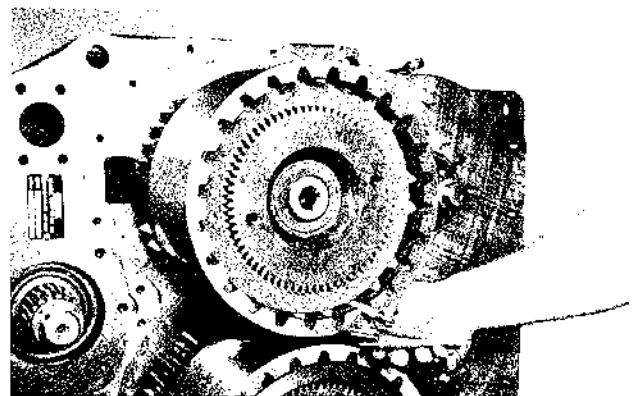
**Figure 14**

Depress end plate and remove end plate retainer ring.



**Figure 15**

Remove end plate.



**Figure 16**

Remove clutch piston return springs and pins.

SEE PAGES 58 & 59 FOR PROPER SELECTION OF VARIABLE THICKNESS TANG WASHER & SELECTED VARIABLE THICKNESS SNAP RING.

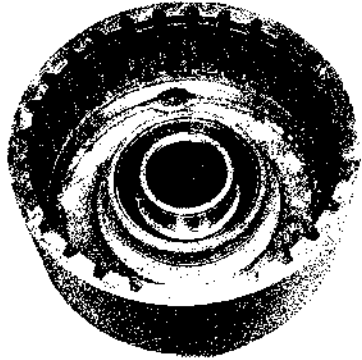


Figure 95

Position clutch drum and cup assembly on clutch support. Be sure the proper drum is matched to the proper support. See note following Figure 94.

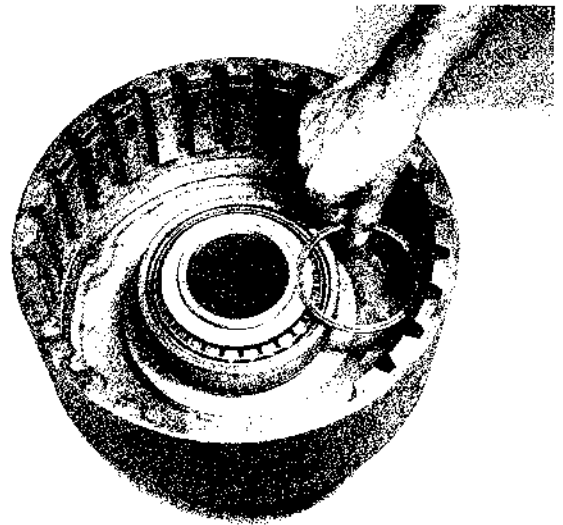


Figure 98

Clutch drum retainer ring is selected at assembly for proper thickness. Variable thickness rings are used in snap ring grooves to assure proper taper bearing tightness. Check ring as shown for tight ring to bearing fit. (See pages 58 & 59 for proper selection of snap ring.)

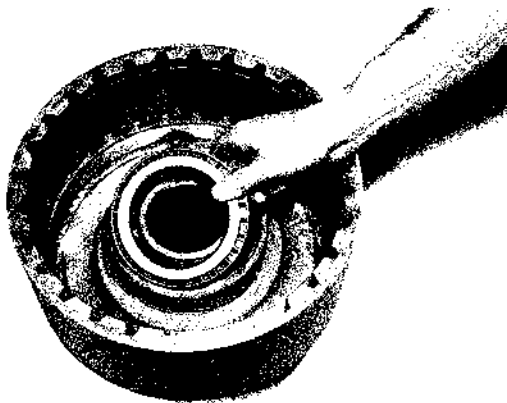


Figure 96

Install outer taper bearing.

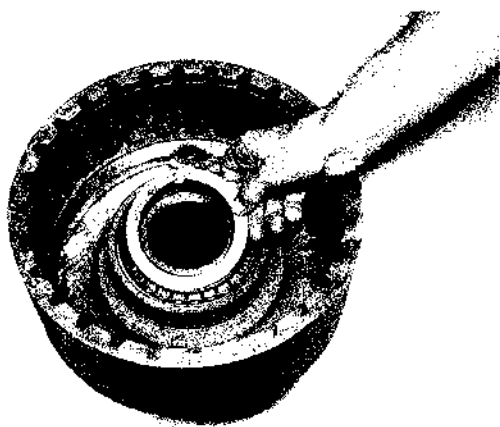


Figure 97

Position outer bearing retainer washer on clutch support aligning tang on washer with notch on support. (See pages 58 & 59 for proper selection of washer).

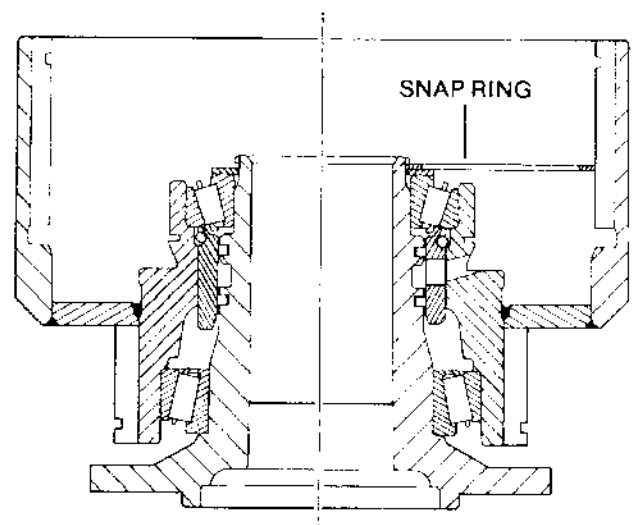


Figure 99

## TRANSMISSION CLUTCH LEAKAGE

Check clutch pressures at low engine idle with oil at operating temperatures 180 - 200 F. [82, 2 - 93, 3° C]. Engine speed must remain constant during entire leakage check. Shift lever into forward 4 or 8 speeds. Record pressures. Shift lever in reverse and 1st. Record pressure. All pressure must be equal within 5 p.s.i. [34,5 kPa]. If clutch pressure varies in any one clutch more than 5 p.s.i. [34,5 kPa], repair clutch.

If a flow meter is available install in line coming out of converter pump. See flow diagram for location of pressure on flow checks. Check pump volume at 2000 RPM and at low engine idle. Record readings. See pump volume specifications at 2000 RPM.

Install flow meter in the line coming from transmission to converter. Check oil volume at 2000 RPM and at low idle in the following speed selections. Record readings.

Forward — Low speed thru High

Reverse — Low speed

Subtract readings in each speed from pump volume reading to get transmission clutch leakage.

Example:	Pump Volume at idle	8 gal.	Pump volume	8 gal.
	Forward—Low speed thru High	6 gal.	Forward — Low speed	6 gal.
	Reverse—Low speed	6 gal.	Clutch leakage	2 gal.

If clutch leakage varies more than 1 gal. from one clutch to another, repair clutch.

### LEAKAGE IN TRANSMISSION CLUTCHES

Leakage in 3000 series must not exceed 4 gal. max.

Leakage in 5000 series must not exceed 4 gal. max.

Leakage in 8000 series must not exceed 6 gal. max.

Leakage in 16000 series must not exceed 7 gal. max.

## CONVERTER LUBE FLOW

Disconnect CONVERTER DRAIN BACK line at transmission with engine running at 2000 RPM and measure oil into a gallon container. Measure oil leakage for 15 seconds and multiply the volume of oil by four to get gallons per minute leakage.

### LEAKAGE IN CONVERTER

Leakage in C270 series not to exceed 2 gal. max.

Leakage in C5000 series not to exceed 3 gal. max.

Leakage in C8000 series not to exceed 5 gal. max.

Leakage in C16000 series not to exceed 5 gal. max.

### LOW CLUTCH PRESSURE WITH NORMAL CLUTCH LEAKAGE

#### CAUSE

1. Low Oil Level.
2. Broken spring in transmission regulator valve.
3. Clutch pressure regulator valve spool stuck in open position.
4. Faulty charging pump.

#### REMEDY

1. Fill to proper level.
2. Replace spring.
3. Clean valve spool and sleeve.
4. See paragraph on charging pump output.

### LOW CLUTCH PRESSURE WITH EXCESSIVE CLUTCH LEAKAGE

1. Broken or worn clutch piston sealing rings.
2. Clutch drum bleed valve ball stuck in open position.
3. Broken or worn sealing rings on clutch support.
4. Low converter charging pump output.

1. Replace sealing rings.
2. Clean bleed valve thoroughly.
3. Replace sealing rings.
4. See paragraph on charging pump output.



## CONVERTER EXPLODED VIEW

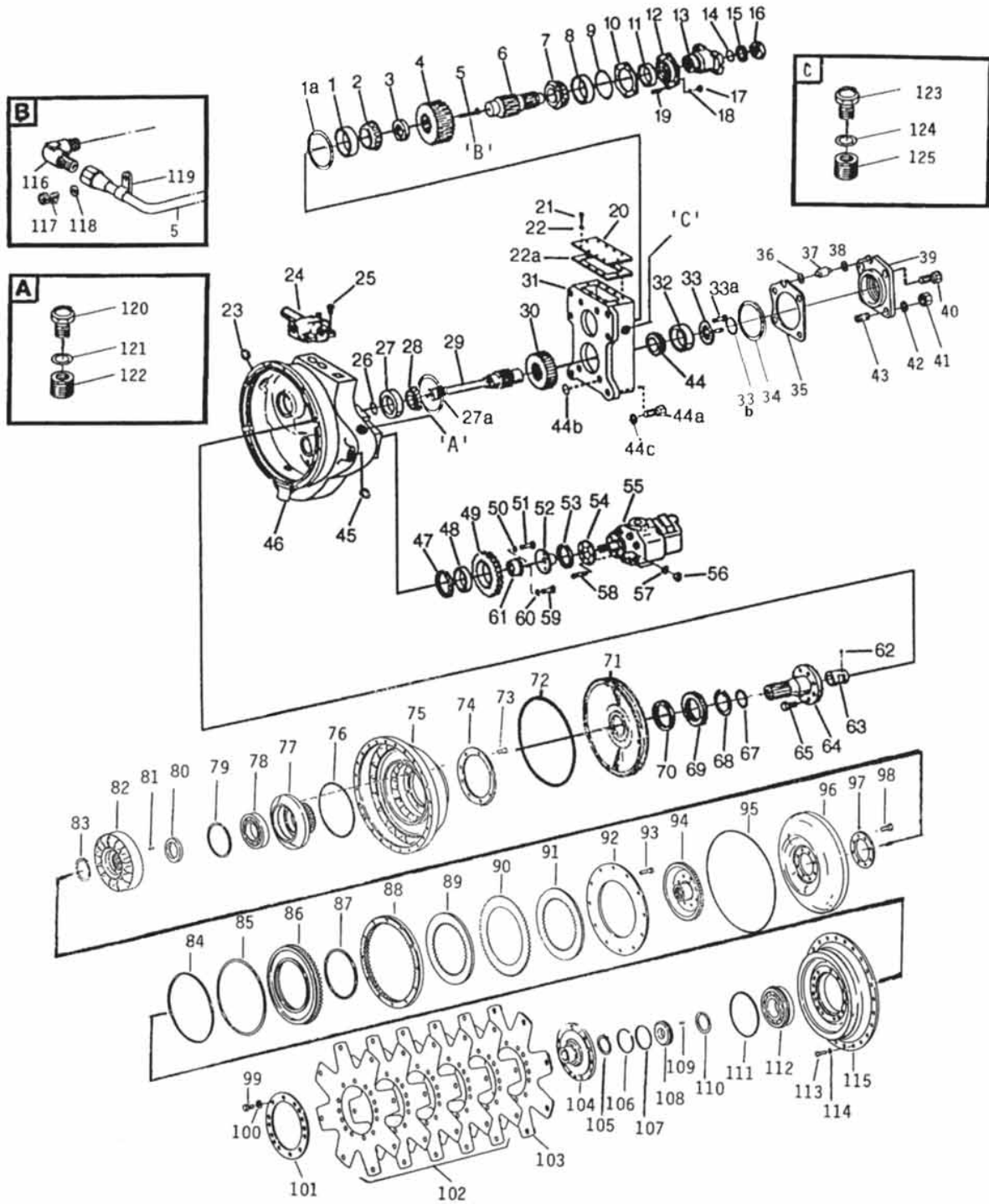






Figure 54  
Remove (4) output shaft bearing  
cap stud nuts and lock washers.



Figure 57  
Remove lube tube and o-rings.



Figure 55  
Remove turbine shaft bearing cap.



Figure 58  
Remove turbine shaft bearing cap shims.



Figure 56  
Remove o-ring and bearing cup  
from turbine shaft bearing cap.



Figure 59  
Remove output shaft bearing cap.



Figure 58  
Coat impeller hub o-ring with grease.



Figure 61  
Install (16) NEW impeller hub screws.  
NOTE: Screws have thread locking compound pre-applied to threads and cannot be reused.



Figure 59  
Install impeller on impeller hub.  
IMPORTANT: Take care to not disturb o-ring.



Figure 62  
Tighten impeller hub screws to 58-64 LBF/FT [79-87 Nm].  
IMPORTANT: Assembly must be completed within a 15 minute period from start of screw installation.



Figure 60  
Install impeller hub screw backing ring.

### Baffle Installation

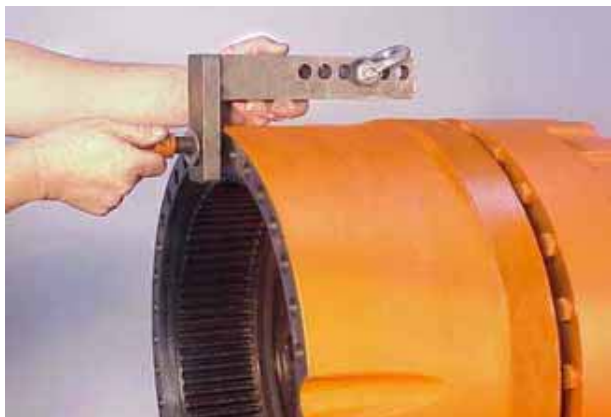


Figure 63  
Apply thin continuous coat of Loctite 620 or equivalent to baffle oil seal and seal bore. Using appropriate driver install seal.

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Brake Piston Removal .....	45		

ITEM DESCRIPTION	QTY	FASTENER TORQUE/COMMENTS
9 Housing Wear Sleeve	1	Grease O.D. during final assembly.
39 Plug - Vent	1	Tighten to 25-30 lbs. ft. (34 - 41N•m).
100 Front Trunnion Support	1	
101 Trunnion Bushing	1	Apply Loctite 620 or equivalent to O.D Grease I.D. during final assembly.
102 Front Trunnion Wiper Seal	2	Apply continuous coat of grease.
103 O-Ring	2	
104 Front Trunnion Lower Vent (not shown)	1	Apply Teflon thread sealant to threads.
105 Front Trunnion Support Top Plug	1	Apply Teflon thread sealant to threads. Tighten to 7-10 lbs. ft. (9.5-13.5 N•m)
106 Rear Trunnion Support	1	
107 Trunnion Bushing	1	Apply Loctite 620 or equivalent to O.D Grease I.D. during final assembly.
108 Thrust Plate	1	
109 Thrust Washer	2	Apply continuous coat of grease to both sides.
110 Thrust Washer Retainer	1	Apply RTV sealant to mounting face.
111 Rear Trunnion Wiper Seal	1	Apply continuous coat of grease.
112 O-Ring	1	
113 Thrust Washer Retainer Screw	20	Apply Loctite 262 or equivalent. to threads. Tighten to 128-141 lbs. ft. (174-191 N•m)
114 Thrust Washer Retainer Washer	20	
115 Thrust Plate Screw	16	Apply Loctite 262 or equivalent to threads. Tighten to 170-190 lbs. ft. (230-258 N•m)
116 Thrust Plate Washer	16	
117 Thrust Washer Retainer Vent	1	Apply Teflon thread sealant to threads.
118 Rear Trunnion Top and Bottom Plug	2	Apply Teflon thread sealant to threads. Tighten to 7-10 lbs. ft. (9.5-13.5 N•m)



**FIGURE 13:** Install lifting device. (Refer to “Wheel Hub and Brake Lifting Tool”, on page 81.)



**FIGURE 14:** Install (2) screws with flat washers at 4:00 and 8:00 positions as shown to retain internal gear.



**FIGURE 15:** Remove hub assembly.

## Face Seal Removal



**FIGURE 16:** Carefully pry face seal from hub. Avoid making contact with seal bore or sealing surfaces that could cause damage and leaks. (Refer to “Face Seal Installation”, on page 66.)



**FIGURE 17:** Remove face seal from hub.



**FIGURE 18:** Remove face seal from brake housing.

## Hub Reassembly



**FIGURE 107:** Align the ring gear hub on ring gear and gently tap ring gear hub down evenly.



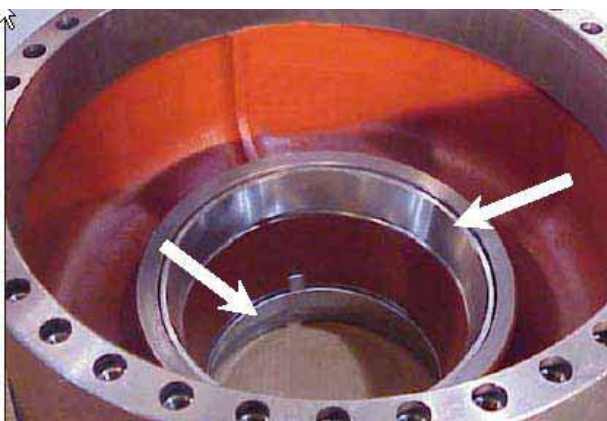
**FIGURE 110:** Using a 0.002 in. feeler gage, check that the bearing cups are seated against the shoulder. When cup is seated, feeler gage should not fit between cup and hub shoulder. Check in several locations.



**FIGURE 108:** Place the ring gear retaining clip into the groove on the ring gear.



**FIGURE 111:** Lubricate bearing cup with axle lubricant.



**FIGURE 109:** Install inner and outer bearing cups. (Refer to "Bearing Heating and Freezing Guidelines", on page 22.)



**FIGURE 112:** Lubricate inner cone with axle lubricant and install.

## Spindle and Brake Installation

### Spindle and Brake Installation



**FIGURE 193:** Apply grease to spindle housing seal ring and install.



**FIGURE 194:** Apply grease to spindle pilot seal ring and install.



**FIGURE 195:** Apply grease to spindle pilot bore in axle housing.



**FIGURE 196:** Install alignment pin in upper spindle screw hole.

**NOTE:**

Threaded end of pin must engage threads in axle housing a minimum of 1.5 times pin diameter or 2.0 (50.8 mm).



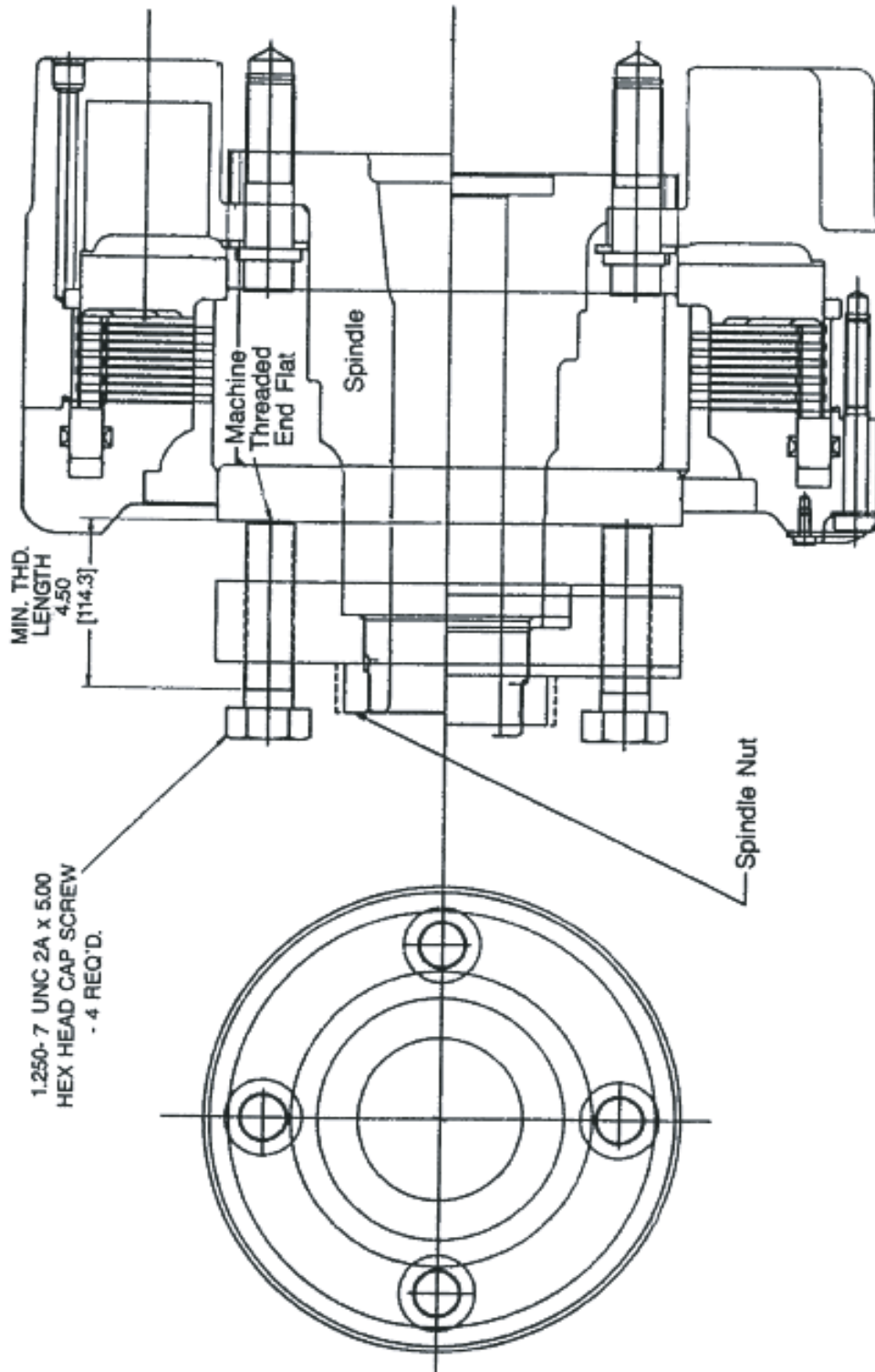
**FIGURE 197:** Install spindle.

**NOTE:**

Spindle pilot needs to be fully engaged in axle housing. A soft mallet may be necessary to drive spindle into position.

# Brake Spring Compression Tool

## Brake Spring Compression Tool Installation (Dana P/N L3958)

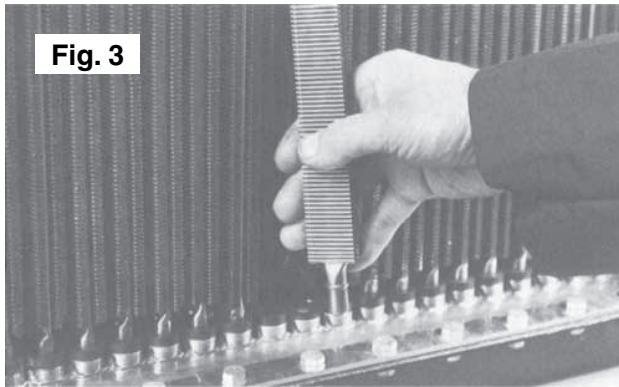


## Tube Removal (continued)

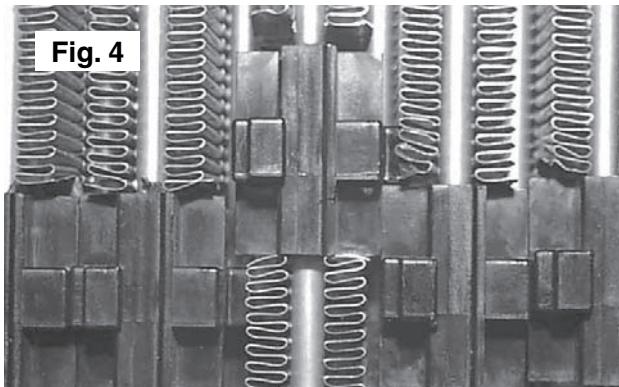
### STEP 3.

Put down tool and swing tube out just far enough to allow it to be pulled down and out of its top seal, as shown in **Fig. 3**.

Remove all tubes in the row, repeating the above procedure.



If you are working with any of L&M's ITS™ or stay systems with interlocking tabs, the tube must be raised high enough so that the interlocking tab clears the adjacent groove, as shown in **Fig. 4**.



## Cleaning Tube Ends

Before the original tubes are reinstalled, the tube ends must be clean of foreign material. L&M recommends polishing the tube ends with a polishing wheel (Grainger #5A725 – use Qty. 5 together) and a copper polishing compound (Grainger #3W769).

If the debris cannot be removed by polishing, L&M recommends using a piece of fine grit emery cloth or steel wool. If there is a lot of debris on the tube ends, use a 6" or 8" diameter wire wheel brush with a wire size of .006 or .008. Larger diameter wire sizes could damage the tube ends. Try installing a tube.

If it does not slide easily into the top and bottom seals, try polishing the tube ends as per above.

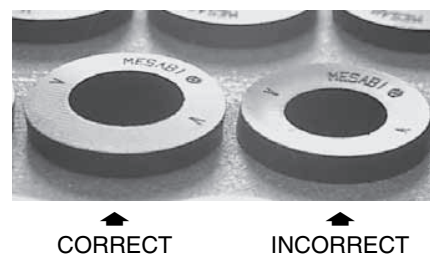
## Seal Installation

### HELPFUL HINTS:

- L&M recommends installing new MESABI® seals when tubes are removed.
- After removing the old seals, clean the plate holes of any foreign debris with L&M P/N 99785 header plate hole cleaning brush placed in an electric or air drill.
- Clean out inside of tanks and blow out plate holes with air.
- Install new seals in clean dry holes. **Do not apply any lubricant to header plate holes.**
- If the core has a center tank, do not install seals at the bottom of the top core until all the tubes are installed in the bottom core.
- For ease of seal installation, soak seals in hot water just prior to installing.
- Make sure you use proper seal part number (see Seal & Lube Chart on page 3).

With your thumb, start the new MESABI® seals into the holes and push them part way in. Care must be taken not to install seals too far into the header plate. A properly installed seal has a crowned or convex top surface, and the tube hole is slightly flared at the opening. A seal that is installed too far into the header has a concave top surface and the tube hole is noticeably smaller in diameter as shown in **Fig.5**. Over-installed seals will make tube installation more difficult and are much more likely to be damaged during tube installation.

The use of a hammer directly on the seal can easily cause seals to be installed too far into the header plate. L&M recommends the use of a flat plate 3/8" x 3" x 6" placed over the seals. Hitting with a rubber mallet will allow the seals to be properly installed.



**Fig. 5**

ON THE LEFT:  
Properly installed seal.  
RIGHT:  
Seal installed too far into header.

## Lubricating Seals and Tube Ends

For ease of tube installation and to minimize the chance of scuffing or tearing rubber seals during tube installation, both top and bottom seals and both tube ends must be thoroughly lubricated, using L&M lube (see Seal & Lube Chart on page 3 for proper lube part number). Using a 1/2" diameter brush (L&M P/N 63451) and a minimal amount of lubricant, apply a thin film into each seal hole and onto each tube end.



SPICER GELENKWELLENBAU

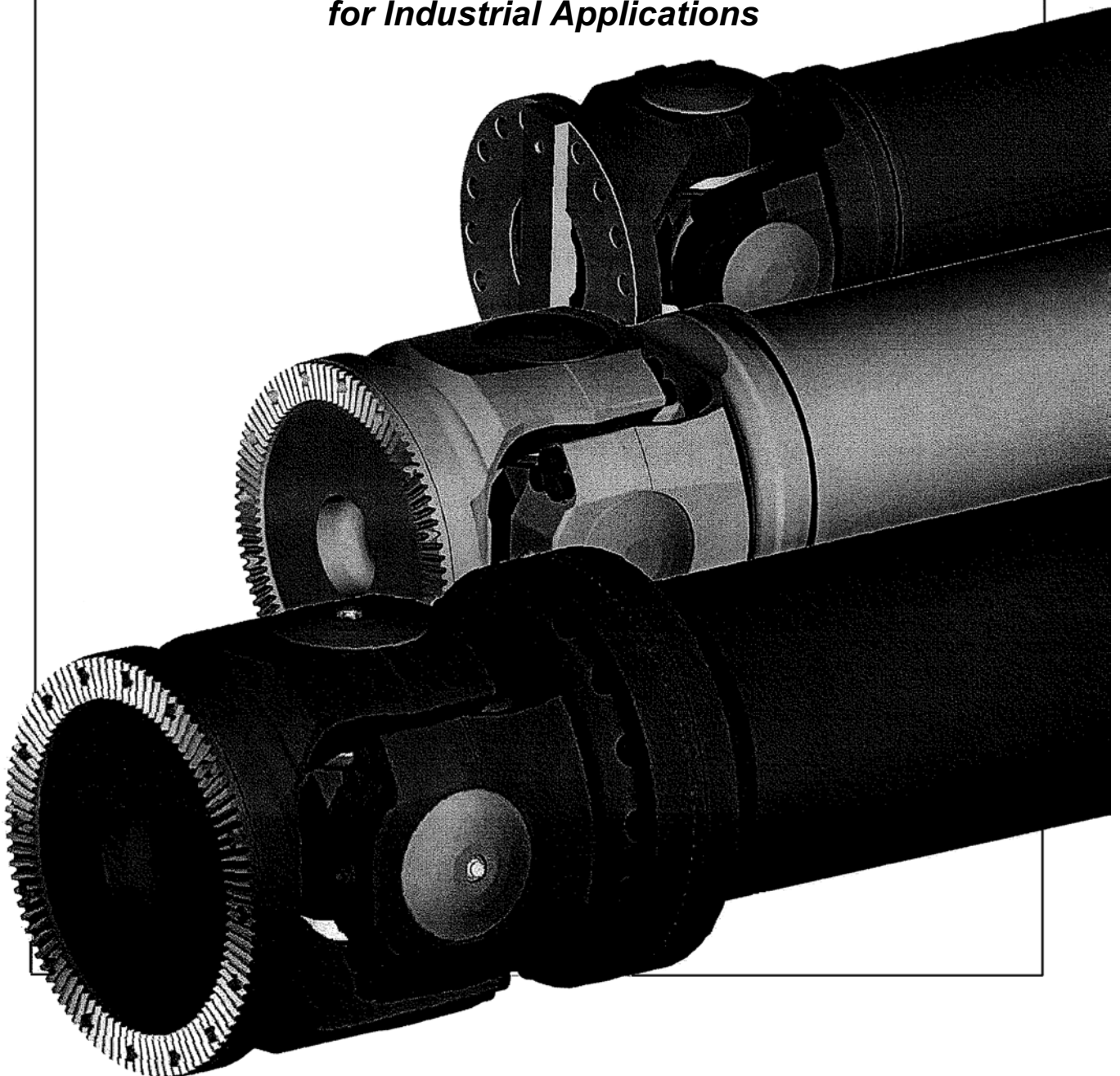


# Gelenkwellen

für Industrie-Anwendungen

## *Cardan Shafts*

*for Industrial Applications*



# Proper Air Cleaner Service is Essential

Proper air cleaner servicing results in maximum engine protection against the ravages of dust. Proper servicing can also save you time and money by maximizing filter life and air cleaning efficiency.

## Two of the most common problems are:

- **Over Servicing.**

New filters increase in dust cleaning efficiency as dust builds up on the media. Don't be fooled by filter appearance! A used filter should look dirty. By using proper filter measurement tools, you will use the full life of the filter at maximum efficiency.

- **Improper Servicing.**

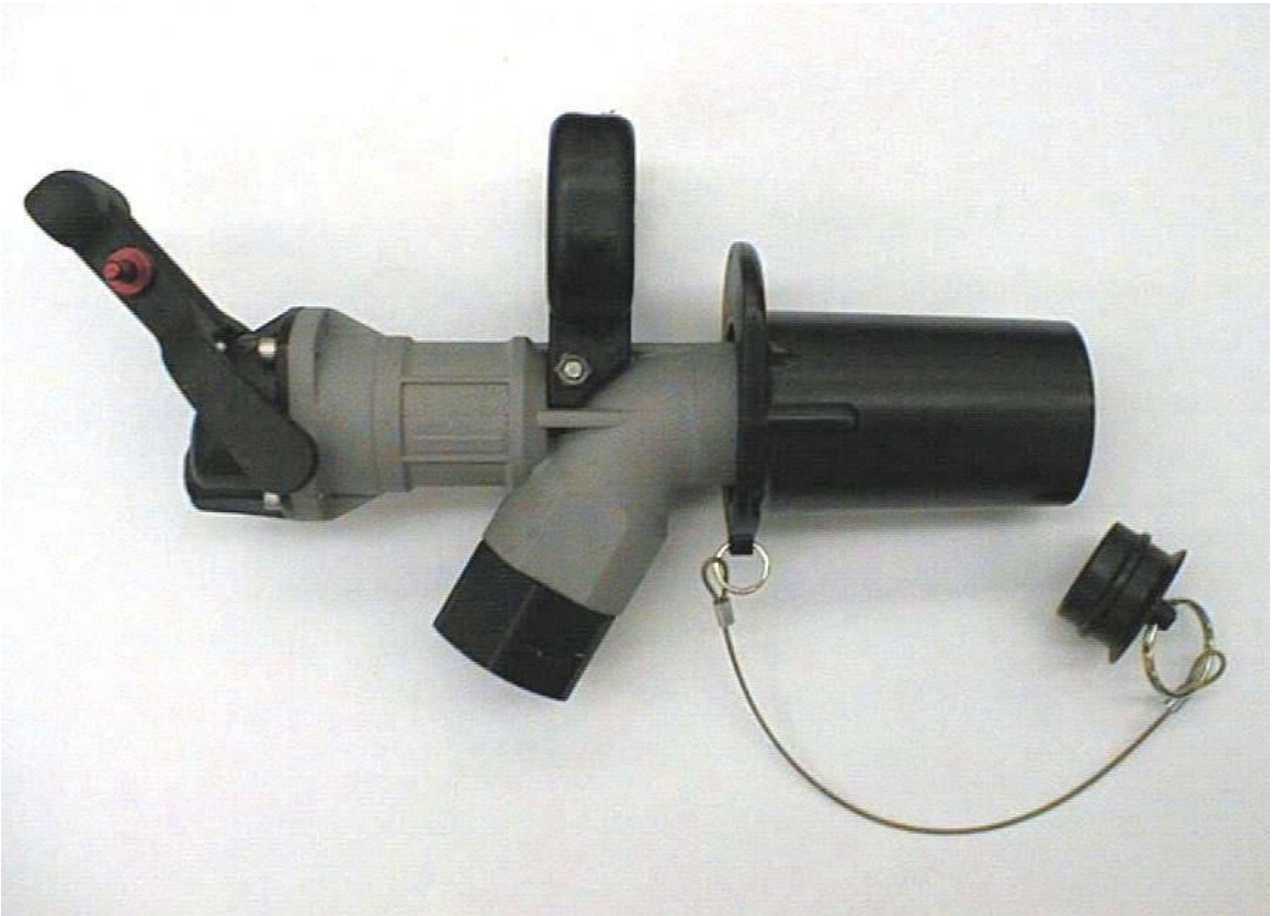
Your engine is vulnerable to abrasive dust contaminants during the servicing process. The most common cause of engine damage is improper servicing procedures.

*By following the steps listed in this section, you can avoid unnecessary risk to the engine.*

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## ***WIGGINS ZZ9A1 – Diesel Refueling Nozzle***

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**PARTS AND SERVICE MANUAL  
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## SANDVIK – FS1000 FIRE SUPPRESSION SYSTEMS

### PARTS LIST – FOAM

PART NUMBER	UNITS	DESCRIPTION
69-335-611	LITRES	FOAM FIREADE AFFF – BULK (see note below)
69-335-611-19	EACH	FOAM FIREADE AFFF – 19 LITRE DRUM
69-335-611-200	EACH	FOAM FIREADE AFFF – 200 LITRE DRUM

#### PLEASE NOTE:

Bulk foam is supplied in 200 litre drums and must be ordered in 200 litre increments with a minimum order quantity of 200 litres.

#### PRE-PACKAGED FOR SYSTEM CHARGING (FOAM ONLY)

PART NUMBER	UNITS	DESCRIPTION
69-344-620-20	EACH	FOAM CHARGE FIREADE AFFF - 20L TANK
69-344-620-25	EACH	FOAM CHARGE FIREADE AFFF - 25L TANK
69-344-620-45	EACH	FOAM CHARGE FIREADE AFFF - 45L TANK
69-344-620-65	EACH	FOAM CHARGE FIREADE AFFF - 65L TANK
69-344-620-110	EACH	FOAM CHARGE FIREADE AFFF - 110L TANK

Foam is also available as part of servicing packs which includes other parts required to carry out regular annual system maintenance. For details refer to parts list page for charging and servicing in this manual.

#### PLEASE NOTE:

Foam concentrate must be stored in original containers as supplied by Sandvik.

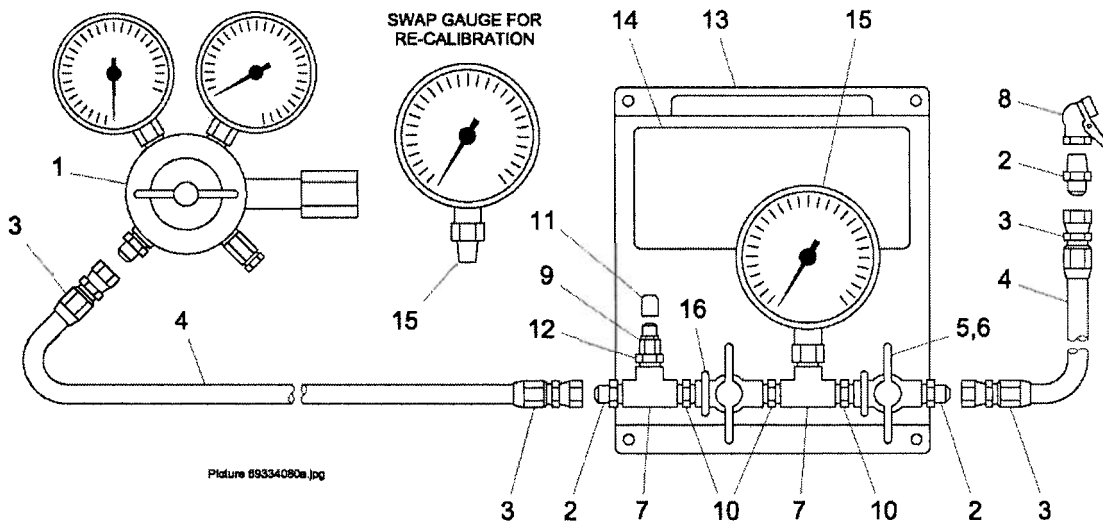
Foam concentrate must not be decanted into alternative containers. Improper decanting can lead to foam contamination and may affect system performance.

Storage temperature should not generally exceed 25°C.

Stock turnover of foam concentrate should not exceed three (3) years.

**PARTS LIST – CHARGING AND SERVICING**  
**CHARGING RIG ASSEMBLY 69-334-080**

**OPTIONAL**



ITEM	PART NUMBER	DESCRIPTION
1	69-335-071	INERT GAS REGULATOR
2	69-335-072	NIPPLE 1/4" x -4
3	69-344-150	HOSE END ASSEMBLY -4 Consists of 69-335-445 Hose Tail 69-335-446 Ferrule 69-335-159 O-Ring
4	69-335-444	HOSE RED -4 PARKER (approx. 5m total length)
5	69-335-203	VALVE BALL – NO HANDLE
6	69-335-186	HANDLE WIDE YELLOW
7	69-335-263	TEE 1/4" BSPP BRASS
8	69-335-073	COUPLING GAS (ACORN)
9	69-335-074	VALVE PRESSURE RELIEF
10	69-335-213	NIPPLE 1/4" BSP
11	69-335-259	CAP RED PRESSURE RELIEF VALVE
12	69-335-257	BUSH 1/4" x 1/8" BSP
13	69-335-496	PLATE CHARGING RIG
14	69-335-497	LABEL CHARGING RIG
15	69-335-498	GAUGE CHARGING RIG
16	69-335-499	U-BOLT
17	69-335-500	CASE CHARGING RIG (Not shown)



**SYSTEM COMPONENTS**

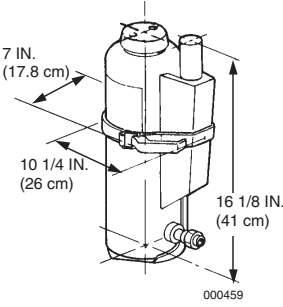
**TANK ASSEMBLY**

The tank assemblies, nominal 10, 20, and 30 lb. size, are factory filled with 8.5, 17, and 25 lb. respectively of FORAY dry chemical. Each tank is finished in red enamel paint. A nameplate is affixed to the exterior and contains information on recharge and maintenance. Two style of tanks are available: a tank containing a cartridge receiver and pneumatic actuator and a tank with 1/4 in. adapter for a pressure line from a remote cartridge. See Figure 1.

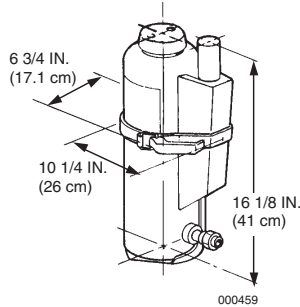
**TANK BRACKET**

The tank mounting bracket assemblies consist of heavy gauge steel back plates and clamp arms. Each style bracket is constructed to properly retain the agent tank from movement or damage in the rugged environment that these systems are normal used. Each tank bracket contains rubber pads to minimize the shock and vibration effect on the tank. The brackets are finished with red, air dry enamel paint. See Figure 2.

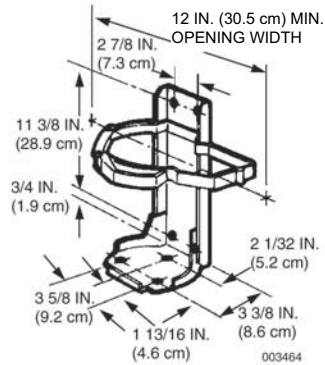
**A-101 MODEL 10**  
**PART NO. 24855**



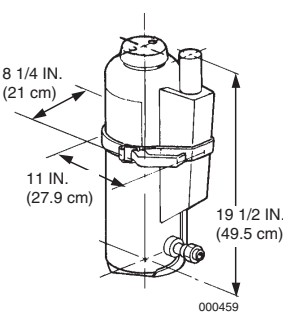
**LT-101 MODEL 10**  
**PART NO. 24966**



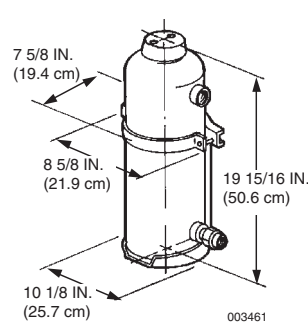
**A-101 MODEL 10 / LT-A-101 MODEL 10**  
**PART NO. 24854**



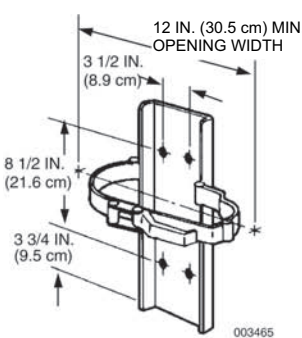
**A-101 MODEL 20**  
**PART NO. 24970**



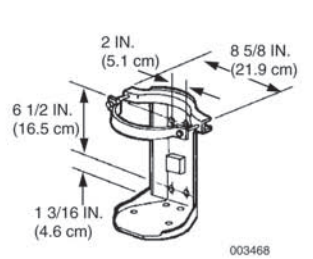
**LT-101 MODEL 20**  
**PART NO. 24894**



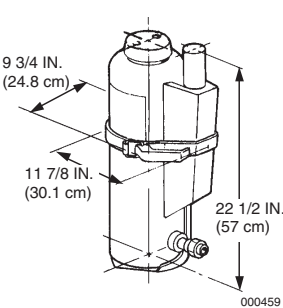
**A-101 MODEL 20**  
**PART NO. 24971**



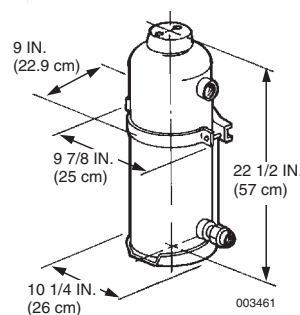
**LT-A-101 MODEL 20**  
**PART NO. 24895**



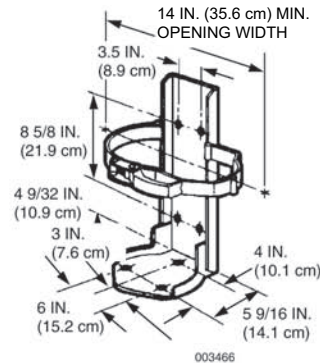
**A-101 MODEL 30**  
**PART NO. 53000**



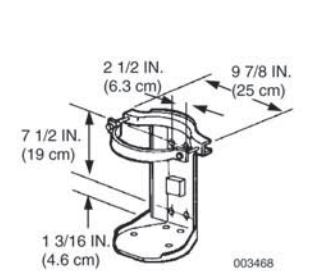
**LT-101 MODEL 30**  
**PART NO. 29375**



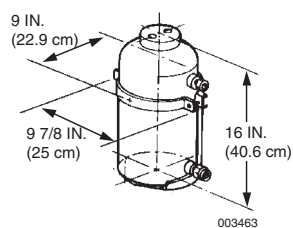
**A-101 MODEL 30**  
**PART NO. 14098**



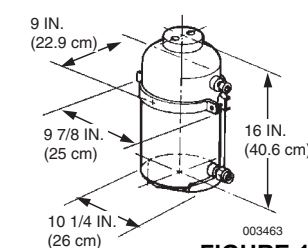
**LT-A-101 MODEL 30**  
**PART NO. 30494**



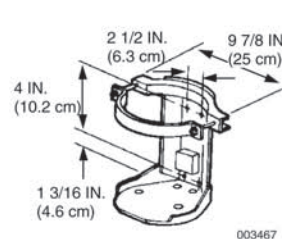
**LP-101 MODEL 20-B**  
**PART NO. 24427**



**LT-A-101 MODEL 20-B**  
**PART NO. 24425**



**LP-A-101 MODEL 20B / LT-LP-A-101 MODEL 20**  
**PART NO. 31171**



**FIGURE 1**

**FIGURE 2**

**DISTRIBUTION SYSTEM REQUIREMENTS (Continued)**

**Supply and Branch Line Requirements (Continued)**

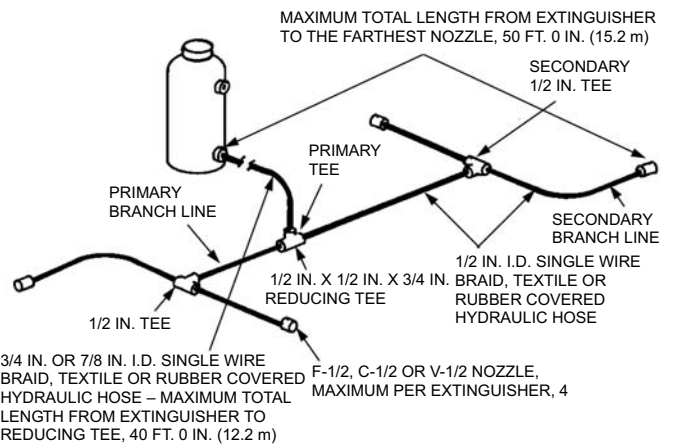
**20, 30 lb. 4 Nozzle Balanced System With Reducing Tee**  
See Figure 14 and Figure 14A.

- Maximum supply line length from extinguisher to triple tee is 40 ft. 0 in. (12.2 m).
- Maximum total length from extinguisher to farthest nozzle is 50 ft. 0 in. (15.2 m).
- Any combination of F-1/2, C-1/2, or V-1/2 nozzles are acceptable. Four (4) nozzles maximum.
- Linear length of the primary branch line on one side of the primary tee to the secondary tee must be within 10% of the linear length of the other primary branch line from the primary tee to the secondary tee.

Also, the linear length of the secondary branch line on one side of the secondary tee must be within 10% of the linear length of the other secondary branch line sharing the same tee.

**NOTE:** See Page 6-5 for fitting and bend limitations.

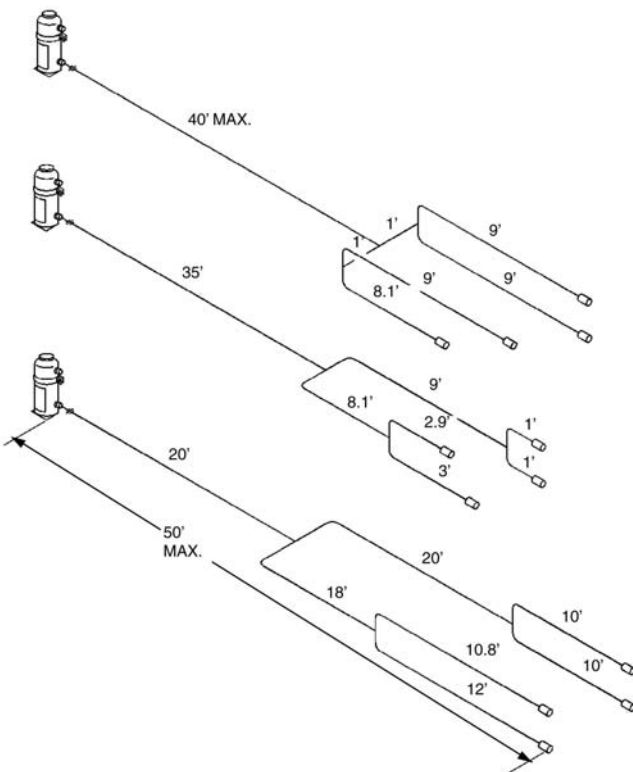
**4 NOZZLE BALANCED WITH REDUCING TEE – 20 LB.-30 LB. SYSTEMS**



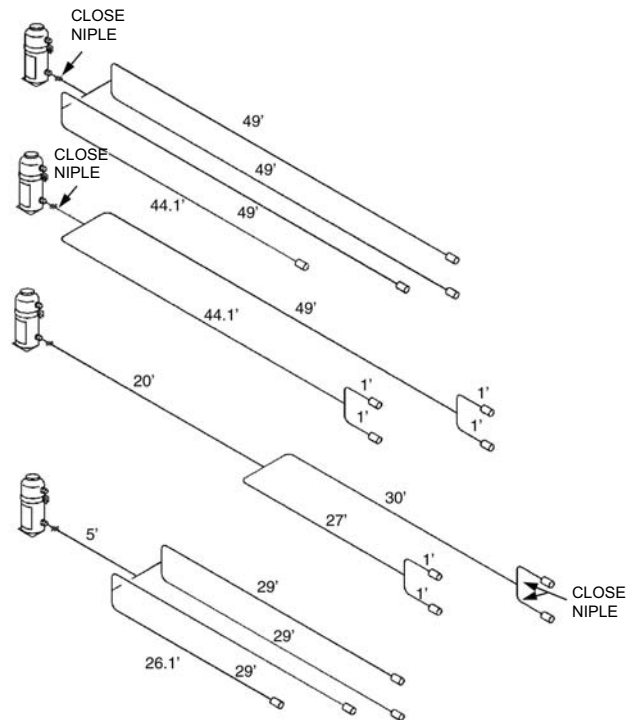
**FIGURE 14**

003499

**EXAMPLES OF TYPICAL 4 NOZZLE SYSTEMS**



**EXAMPLES OF TYPICAL 4 NOZZLE SYSTEMS**



**FIGURE 14A**

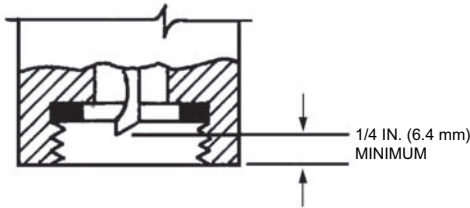
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## INSTALLING ACTUATION AND EXPELLANT GAS LINES (Continued)

### Installing The Actuation Gas line(s) and Pneumatic Actuator(s) (Continued)

Complete the installation of all dry chemical actuation lines and components by completing the following:

1. Install all pneumatic actuators as follows:
  - a. When removing actuator from the carton, check pin to make certain it is in the upright position. See Figure 14.



**FIGURE 14**  
004357

- b. Securely hand tighten the pneumatic actuator cartridge body to cartridge.
- c. Position actuator and cartridge assembly into bracket.
- d. Using two wrenches, one on the swivel nut and one on the bottom portion, loosen the swivel nut, and rotate the top portion of the actuator to the correct position to align the two actuation line ports with the incoming and outgoing 1/4 in. actuation line(s).

### CAUTION

Each actuator contains two (2) 1/4 in. actuation ports. If both ports are not utilized, the open port must be plugged with a 1/4 in. pipe plug. Failure to plug the port will cause loss of actuation gas pressure upon system actuation.

2. Install required 1/4 in. actuation lines from the remote actuator outlet port to all actuation ports on the upper portion of each pneumatic actuator.
3. Once all lines are securely installed, wrench tighten the swivel nut on the upper portion of each pneumatic actuator.

### Installing Expellant Gas Line(s)

The expellant gas line is the 1/4 in. line between the remote expellant gas cartridge and the agent tank. The gas line is only required when the system is using either an LT or LP type tank. See Figure 13.

The maximum length of 1/4 in. expellant gas line is 20 ft. (6.1m).

Make certain the hose meets all the requirements as stated in the Design section.

## INSTALLING THE DETECTION SYSTEM

When automatic detection is part of the total system design, see the appropriate Design, Installation Manual for detailed Information.

- CHECKFIRE ELECTRIC SERIES I SYSTEM – Manual Part No. 54894
- CHECKFIRE SC-N ELECTRIC SYSTEM – Manual Part No. 423522
- CHECKFIRE MP-N ELECTRIC SYSTEM – Manual Part No. 427310

## INSTALLING ACTUATION CARTRIDGES

1. Weigh each manual actuator cartridge to make certain it is within the weight specifications stamped on the cartridge body. This weight check must be performed with the shipping cap removed. Refer to appropriate manual for detailed installation instructions if the system contains an automatic CHECKFIRE Detection System.
2. Check that the puncture pin in each manual actuator is fully retracted so that the pin will not pierce the cartridge seal during installation.
3. Install an LT-10 nitrogen cartridge into each manual actuator and hand tighten firmly.
4. At this time, the cartridge may be installed in the CHECKFIRE detection system actuator.
5. Finally, document the entire installation with drawing, photographs, and/or written description of the entire vehicle system and store these documents in a permanent file for future reference.

**NOTES:**

## **SECTION II – SYSTEM DESCRIPTION**

5-15-02 Page 2-2

REV. 1

### **DETECTION**

Several types of electric automatic detection systems with various detector options are available for the LT-A-101-25/250 systems.

#### **Electric**

Electric detection systems (CHECKFIRE SC-N, Series I, and MP-N) are available to provide rugged, automatic detection for vehicle protection. These systems are either powered by the vehicle battery or by the internal module battery or both.

The electric detection systems can use either linear heat detection, spot detectors, or pneumatic linear detectors.

This manual is intended for use with the CHECKFIRE® SC-N Electric Detection and Actuation System.

Those who install, operate, inspect, or maintain this system should read this entire manual. Specific sections will be of particular interest depending upon one's responsibilities.

As with all electro-mechanical equipment, the electric detection and actuation system needs periodic care to provide maximum assurance that it will operate effectively and safely. Inspection frequency should be based on the requirements of the equipment on which the system is installed and the environment in which the equipment will operate. On equipment working 24 hours/day, seven days/week, maintenance should be performed on the detection and actuation system at 250, 500, and 1000-hour intervals. On equipment that does not work continuously, maintenance should be performed at least every six months.

The application and use of the CHECKFIRE SC-N system is limited to the application and uses described in this manual. For other applications, contact your local Ansul distributor or the Ansul technical representative in your area.

### MOUNTING THE CONTROL MODULE

The CHECKFIRE SC-N Control Module can be mounted to either a flat, rigid surface or utilizing one of the three bracket options.

If mounting the control module to a flat, rigid surface, use the appropriate fasteners.

If mounting the control module to the SC-N bracket, complete the following steps:

1. With the bracket securely mounted, position the holes in the control module mounting flanges over the threaded studs on the bracket. Using the supplied mounting hardware, securely fasten the control module to the bracket with four lock washers and nuts.
2. If utilizing the SC retrofit bracket, first fasten the retrofit bracket onto the existing SC bracket by using the supplied fasteners. With the SC retrofit bracket securely fastened, position the holes in the control module mounting flanges over the threaded studs and securely fasten.

Remove the cover from the control module. **If the internal 3.6 VDC battery is in place, disconnect the wire plug until the field wiring is complete.**

If the strain relief(s) and plug(s) are not in place, coat the male threads with Dow Corning 737 RTV Sealant or equal and install in holes of module back box.

At this point, the external field wiring can be installed.

### REMOTE HIGH LEVEL ALARM INSTALLATION

1. Using the alarm as a template, carefully mark the location of the four mounting holes. Use either the bottom or rear set of mounting holes depending on the mounting location. Secure the alarm using appropriate length of 5/16 in. bolts with lock washers and nuts. See Figure 24.

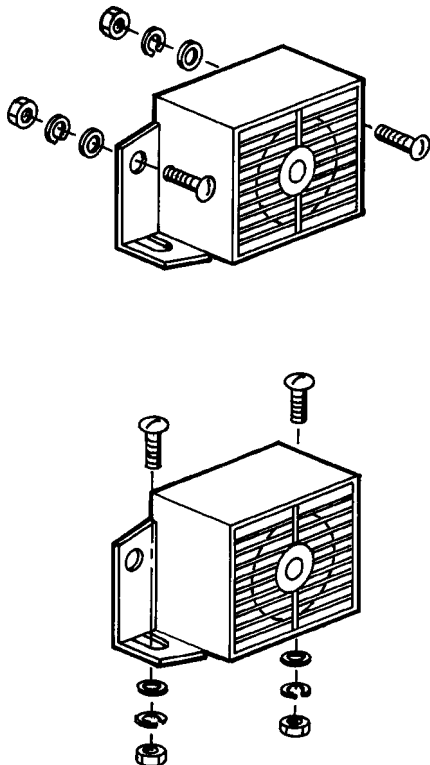


FIGURE 24  
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2. Wire the alarm to the control module in accordance with the diagram in Figure 25 using 20 AWG wire. Make certain the jumper is installed between the HI and LO terminals on the alarm terminal block. Certain alarm models may have only one positive terminal in which case a jumper is not used. The ends of stranded wire must be tinned with 60/40 rosin core solder, using a low wattage soldering pencil, before installation. On the terminal block at the control module, install the wires to Terminals 11 (NO) and 12 (C).

NOTE: Use 0.13 to 0.25 in. diameter round jacketed cable to maintain water tight integrity of control module strain reliefs.

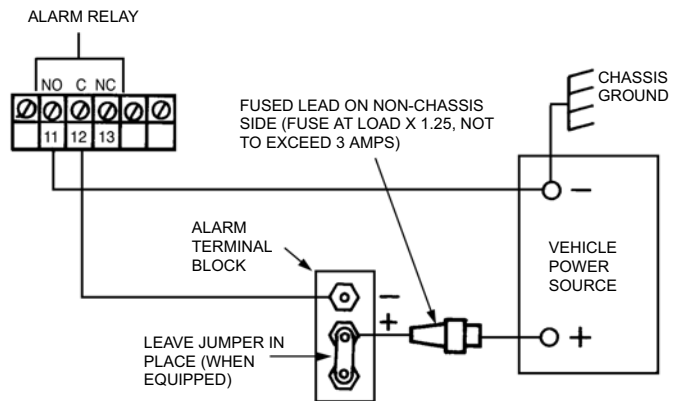


FIGURE 25  
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# TROUBLESHOOTING

<u>Condition</u>	<u>Green Power Normal</u>	<u>Yellow Power Fault</u>	<u>Red Alarm</u>	<u>Yellow Detection Fault</u>	<u>Yellow Release Fault</u>	<u>Audio Alarm</u>	<u>Alarm Relay</u>	<u>Shutdown Relay</u>	<u>Trouble Relay</u>	<u>Agent Release</u>
manual pull circuit activated (0-30 seconds after system activation)	pulsing once every 30 seconds	off	pulsing 4 times per second	off	off*	pulsing 4 times per second	transferred	transferred	transferred	fired
pressure switch activated detection fault (30+ seconds after system activation)	pulsing once every 3 seconds	off	pulsing once every 10 seconds	pulsing once every 10 seconds	pulsing once every 10 seconds	pulsing once every 10 seconds	transferred	transferred	transferred	off

\* Will pulse if circuit opens as a result from release

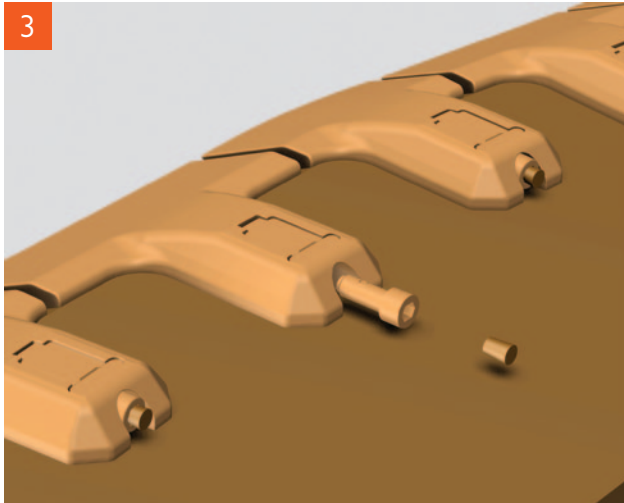
\*\* Can be silenced at this time

# SKF SGH-50 - Hydraulic pumping unit for dual-line SKF DuoFlex system

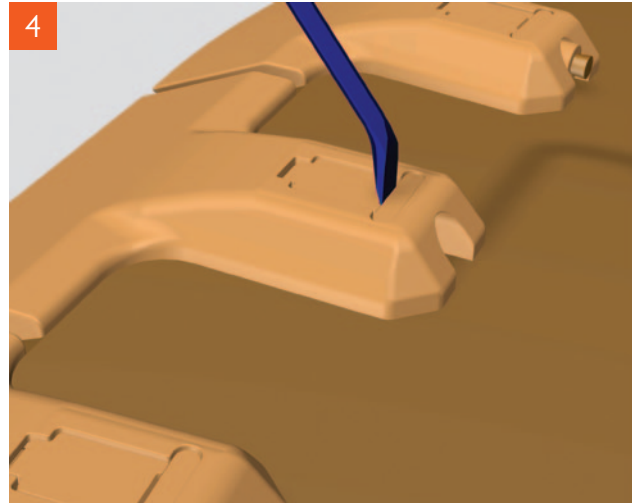
(Original operating and maintenance instructions according to EU Directive 2006/42/EC)



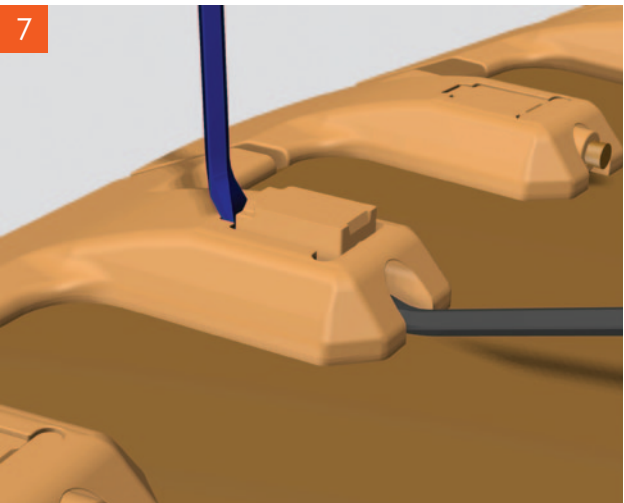




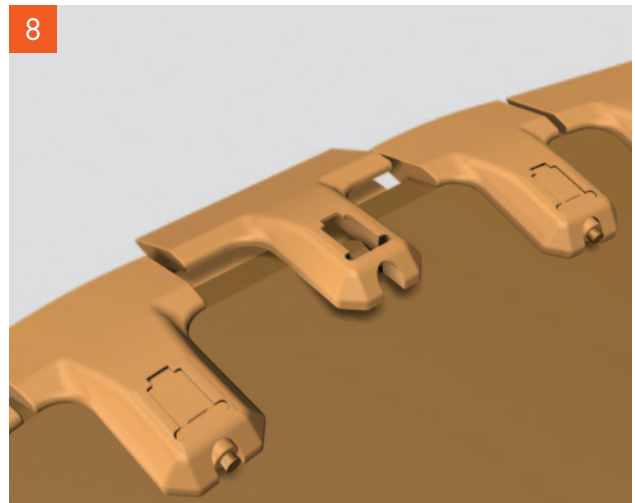
Remove the bolt plug from the rear of the cap screw. Then turn the cap screw counter clockwise and remove the cap screw from the pin assembly.



Insert a pry bar into the slot between the spacer and the pin block. Then push the pin block forward to break the seal between them.



Using two pry bars lever out the pin block.



The shroud can now be removed from the lip. Following removal, wash down the lip using a power washer, ensuring the lip profile is clean and ready for installation of the replacement shroud.



Before performing maintenance work all personnel should ensure they are wearing approved personal protective equipment. Under NO circumstances should hardened hammers be used on lip shrouds. If required, a brass-tipped hammer should be used.

### Sandvik GET 32 mm Series 2 assembly parts

Item	Sandvik part number	Supplier part number	Description
1	69039976	SBP32-SKS2	Service kit
2	69039977	SBP32-CS2	Cap screw
3	69039978	SBP32-SS2	Spacer
4	69039979	SBP32-BP2	Bolt plug (pack of 50)

For detailed parts numbers, see pages 17–19.

### Sandvik GET 50 mm Series 2 assembly parts

Item	Sandvik part number	Supplier part number	Description
1	69039956	SBP50-SKS2	Service kit
2	69039957	SBP50-CS2	Cap screw
3	69039958	SBP50-SS2	Spacer
4	69039959	SBP50-BP2	Bolt plug (pack of 50)

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