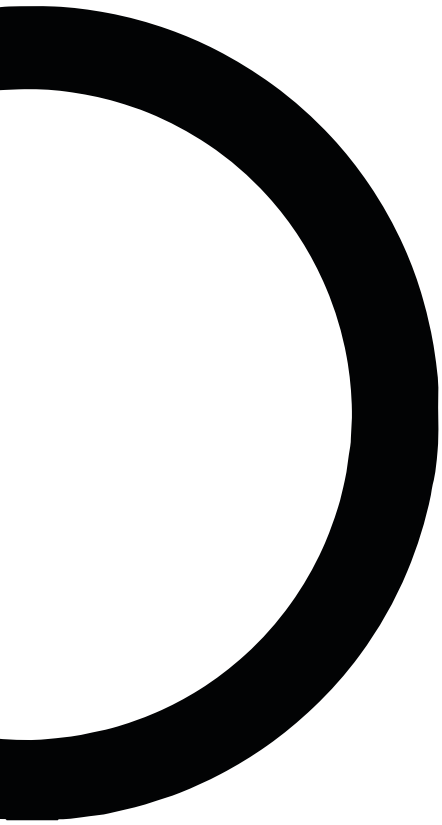
Gehl AL550
Mustang AL508
Manitou MLA 5-60

Articulated Loader
Service Manual

50940658 Rev. C 01/2022



Additional Service Documentation

For detailed information about specific major component internal repairs, refer to the following Manitou service manuals:

Axles:

- ZF Multitrac Axle Service Manual [Manitou # 50940485].
- ZF Transfer Case Service Manual [Manitou # 50940523].

Hydrostatics:

- Danfoss H1 Pump Service Manual [Manitou # 50940483].
- Danfoss H1B Motor Service Manual [Manitou # 50940482].

Engine:

- Deutz TD 2.2 L3 Engine Service Manual [Manitou # 50940733].

Standard Tightening Torques

Note: Use these torque values when tightening hardware (excluding: locknuts and self-tapping, thread forming and sheet metal screws) unless specified otherwise.

Hydraulic fittings with various seals (light application). All torque values are in lb.-ft. (Nm) unless marked otherwise.

Thread	Straight pipe fitting with thread and screwed plug (GE)			Non-return valve with elastic seal	Identification aid outside Ø
	Sealing washer	Elastic seal	O-ring		
M10X1.0	7 (9)	13 (18)	11 (15)	13 (18)	0.4 in. (10 mm)
M12X1.5	15 (20)	18 (25)	18 (25)	18 (25)	0.5 in. (12 mm)
M14X1.5	26 (35)	33 (45)	26 (35)	26 (35)	0.6 in. (14 mm)
M16X1.5	33 (45)	41 (55)	30 (40)	37 (50)	0.6 in. (16 mm)
M18X1.5	41 (55)	52 (70)	33 (45)	52 (70)	0.7 in. (18 mm)
M22X1.5	48 (65)	92 (125)	44 (60)	92 (125)	0.9 in. (22 mm)
M27X2.0	66 (90)	133 (180)	74 (100)	107 (145)	1.0 in. (27 mm)
M33X2.0	111 (150)	229 (310)	118 (160)	155 (210)	1.3 in. (33 mm)
M42X2.0	177 (240)	332 (450)	155 (210)	266 (360)	1.7 in. (42 mm)
M48X2.0	214 (290)	398 (540)	192 (260)	398 (540)	1.9 in. (48 mm)
G1/8A	7 (9)	13 (18)	11 (15)	13 (18)	0.4 in. (9.73 mm)
G1/4A	26 (35)	26 (35)	22 (30)	26 (35)	0.5 in. (13.16 mm)
G3/8A	33 (45)	52 (70)	33 (45)	37 (50)	0.7 in. (16.66 mm)
G1/2A	48 (65)	66 (90)	41 (55)	48 (65)	0.8 in. (20.96 mm)
G3/4A	66 (90)	133 (180)	74 (100)	103 (140)	1.0 in. (26.44 mm)
G1A	111 (150)	229 (310)	118 (160)	140 (190)	1.3 in. (33.25 mm)
G1 1/4A	177 (240)	332 (450)	155 (210)	266 (360)	1.7 in. (41.91 mm)
G1 1/2A	214 (290)	398 (540)	192 (260)	398 (540)	1.9 in. (47.80 mm)

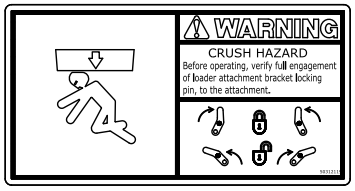
Hydraulic fittings with various seals (heavy application). All torque values are in lb.-ft. (Nm) unless marked otherwise.

Thread	Straight pipe fitting with thread and screwed plug (GE)			Non-return valve with elastic seal	Identification aid outside Ø
	Sealing washer	Elastic seal	O-ring		
M12X1.5	15 (20)	26 (35)	26 (35)	26 (35)	0.5 in. (12 mm)
M14X1.5	26 (35)	41 (55)	33 (45)	33 (45)	0.6 in. (14 mm)
M16X1.5	33 (45)	52 (70)	41 (55)	41 (55)	0.6 in. (16 mm)
M18X1.5	41 (55)	66 (90)	52 (70)	52 (70)	0.7 in. (18 mm)
M20X1.5	41 (55)	92 (125)	59 (80)	74 (100)	0.8 in. (20 mm)
M22X1.5	48 (65)	100 (135)	74 (100)	92 (125)	0.9 in. (22 mm)
M27X2.0	66 (90)	133 (180)	125 (170)	100 (135)	1.0 in. (27 mm)
M33X2.0	111 (150)	229 (310)	229 (310)	155 (210)	1.3 in. (33 mm)
M42X2.0	177 (240)	332 (450)	243 (330)	266 (360)	1.7 in. (42 mm)
M48X2.0	214 (290)	398 (540)	310 (420)	398 (540)	1.9 in. (48 mm)
G1/8A	26 (35)	41 (55)	33 (45)	33 (45)	0.5 in. (13.16 mm)
G1/4A	33 (45)	59 (80)	44 (60)	44 (60)	0.7 in. (16.66 mm)
G3/8A	48 (65)	85 (115)	55 (75)	74 (100)	0.8 in. (20.96 mm)
G1/2A	66 (90)	133 (180)	125 (170)	107 (145)	1.0 in. (26.44 mm)
G3/4A	111 (150)	229 (310)	229 (310)	192 (260)	1.3 in. (33.25 mm)
G1A	177 (240)	332 (450)	243 (330)	266 (360)	1.7 in. (41.91 mm)
G1 1/4A	214 (290)	398 (540)	310 (420)	398 (540)	1.9 in. (47.80 mm)

- The machine is most stable in the straight position (0° turn). The load rating decreases as the steering angle is increased. A 45° maximum turn is the lowest load capacity position.
- To avoid tipping, travel with the load/attachment as low as possible during transport and while turning. Observe the minimum ground clearance. Keep the bottom of the load no higher than wheel axle height during transport and turning.
- Operate the controls smoothly to prevent jerking and bouncing.
- Raise the lift structure only on level (laterally) ground.
- Be sure the surface can support the machine and load. Use extra care on loose ground. Working with heavy loads over loose, soft ground or uneven terrain can cause the machine to tip and could lead to death or serious injury. Traveling with a suspended load or an unbalanced load can also be hazardous.
- Be sure the surrounding ground has adequate strength to support the weight of the machine and the load. Stay away from:
  - Ditches
  - Overhangs
  - Weak support surfaces
  - Loading dock edges
  - Ramps
  - Excavations
  - Retaining walls
  - Trenches.
- To cross railroad tracks, ditches, curbs or similar surfaces, cross perpendicular to the obstacle and drive slowly.
- Never travel over obstacles or slopes that will cause the machine to tilt severely. Travel around any slope or obstacle that would cause a tilt greater than 10°.
- Avoid sharp turns and high speeds while carrying loads, especially on slopes. The stability of the machine is reduced during sharp turns, and the load may shift, greatly increasing the possibility of a rollover.
- When unloading trucks or raising loads off elevated surfaces, approach the load straight ahead and back straight away with the load.
- Load and unload only on solid, level ground. Rated capacity and stability specifications are based upon operation on a level surface.
- Maintain visibility with the attachment/load at all times.
- Do not try to exit the machine if tipping occurs. Trying to escape from a tipping machine can result in death or serious personal injury. If the machine becomes unstable and starts to tip, keep the seat belt fastened, hold on firmly and brace yourself. Lean away from the point of impact and stay with the machine. The machine is equipped with rollover protection, which can only protect the operator if they are in the operator's seat.
- Any damage or serious impact to the ROPS/FOPS requires ROPS/FOPS replacement. The ROPS/FOPS must be replaced if an rollover incident occurs. The protection offered by the ROPS/FOPS will be impaired if it has been damaged in a rollover incident.

ANSI-Style and Common Safety Decal Locations (Cont.)

H



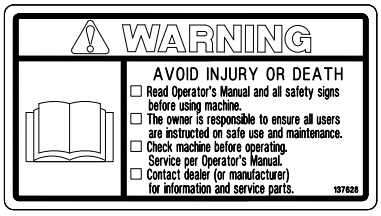
(Located on both sides of the lift structure near the attachment hitch)

Warning Decal

WARNING: CRUSH HAZARD

Before operating, verify full engagement of loader attachment bracket locking pin to the attachment.

I



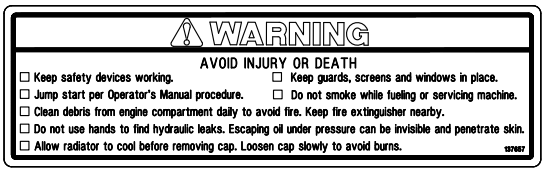
(Located on the manual storage box behind the operator's seat)

Warning Decal

WARNING: AVOID INJURY OR DEATH

- **Read Operator's Manual and all safety signs before using machine.**
- **The owner is responsible to ensure all users are instructed on safe use and maintenance.**
- **Check machine before operating. Service per Operator's Manual.**
- **Contact dealer (or manufacturer) for information and service parts.**

J



(Located in engine compartment on the DPF heat shield)

Warning Decal

WARNING: AVOID INJURY OR DEATH

- **Keep safety devices working.**
- **Keep guards, screens and windows in place.**
- **Jump start per Operator's Manual procedure.**
- **Do not smoke while fueling or servicing machine.**
- **Clean debris from engine compartment daily to avoid fire. Keep fire extinguisher nearby.**
- **Do not use hands to find hydraulic leaks. Escaping oil under pressure can be invisible and penetrate skin.**
- **Allow radiator to cool before removing cap. Loosen cap slowly to avoid burns.**

K

(Located on the column below the steering wheel)

Warning Decal

WARNING: AVOID INJURY OR DEATH

- **Maintain 3-point contact during entry and exit.**
- **Inspect work area; avoid all hazards.**
- **Look in the direction of travel. Keep children and bystanders away.**
- **Start and operate machine only from seat.**
- **Never carry riders. Do not raise personnel in bucket.**
- **Operate only in well ventilated area.**
- **Keep away from electric power lines, avoid contact.**
- **Do not wear loose clothing while operating or servicing machine.**
- **Wear any needed Personal Protective Equipment.**

6. Connect the lifting gear on both side of the machine at the front and rear lift points (Z, Fig. 13) as shown.

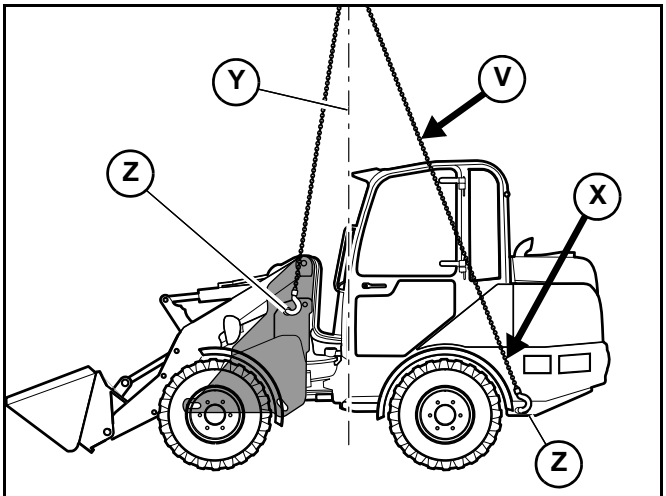


Fig. 13 – Crane Raising

NOTE: *Lift points (Z) are identified by the decal shown in Fig. 14.*

Fig. 14 – Lift Point Decal

⚠ CAUTION

To prevent damage to the ROPS/FOPS, the side and engine covers, or other installed components:

- **Insert a spreader bar between the two legs of the lifting gear at point (V), just above the ROPS/FOPS.**
- **Provide blocking between the lifting gear and the machine at points (X, Fig. 113).**

7. Carefully raise the machine, keeping it as level as possible.

Towing

Precautions

⚠ WARNING

Tow the machine with another vehicle ONLY. Do not tow loads or other vehicles with the machine.

IMPORTANT: *The machine cannot be tow-started because there is no direct mechanical connection between the wheels and the engine. Attempting to tow-start the machine may damage the drive system.*

Tow the machine only:

- If the steering and brakes are functional
- If the machine cannot be repaired on-site
- If the machine cannot be moved using any other method.

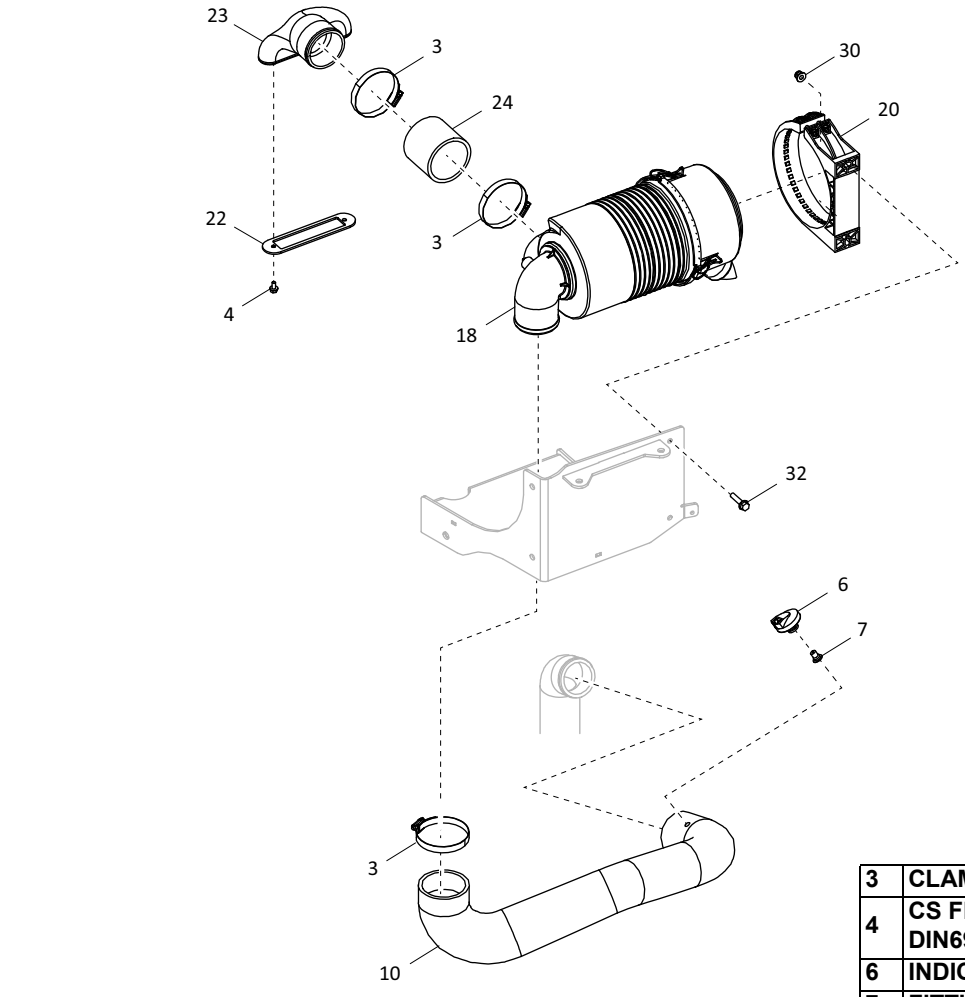
Tow the machine only until it is moved to a location where it can be safely repaired.

IMPORTANT: *Towing the machine over extended distances can cause hydraulic system overheating and damage. Use a flatbed truck or similar vehicle to transport the machine more than a few hundred meters. See “Loading and Transporting the Machine on a Transport Vehicle” on page 51.*

Towing Preparation

1. Position the lift structure as low as possible to allow for towing.
2. Perform the “Mandatory Safety Shutdown Procedure” on page 24.
3. Open the engine cover.
4. Remove the left side panel according to “Side Panel Removal/Replacement (Right Side Shown)” on page 237.

Engine Intake / Exhaust (2 of 3)



3	CLAMP/HOSE #52
4	CS FL M6-1.00X12 8.8 ZY SP DIN6921
6	INDICATOR/SERVICE
7	FITTING/DIRT INDICATOR
10	HOSE/INTAKE
18	AIR CLEANER
20	MOUNTING BAND/AIR CLEANER
22	SEAL/FOAM
23	NOZZLE/AIR CLEANER
24	HOSE/INTAKE 3IN X 3IN
30	LN INST FL M8-1.25 C8 ZY DIN6926
32	CS FL M8-1.25X35 8.8 ZY DIN6921

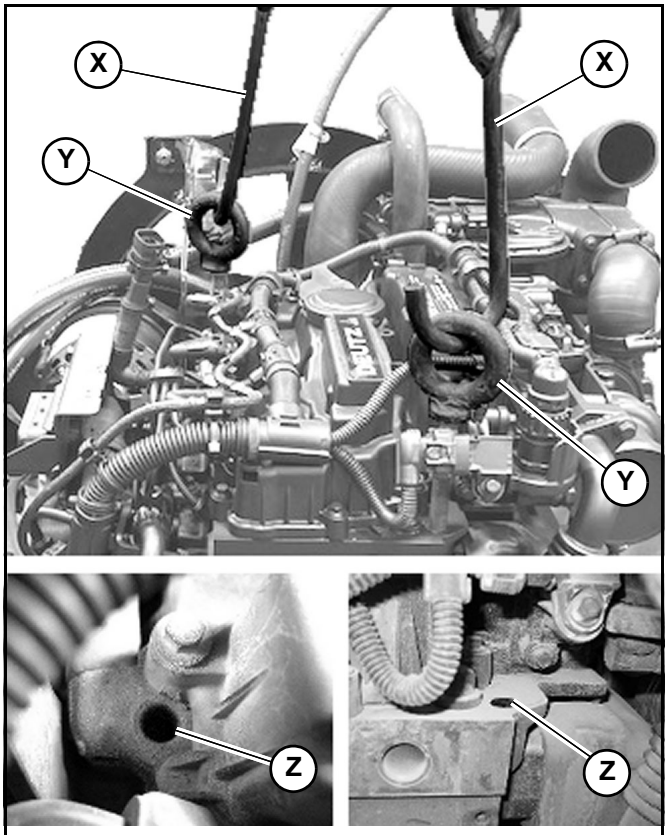


Fig. 41 – Engine Lifting

35. Remove the engine mount screws and nuts. Discard the nuts (F, Fig. 42).

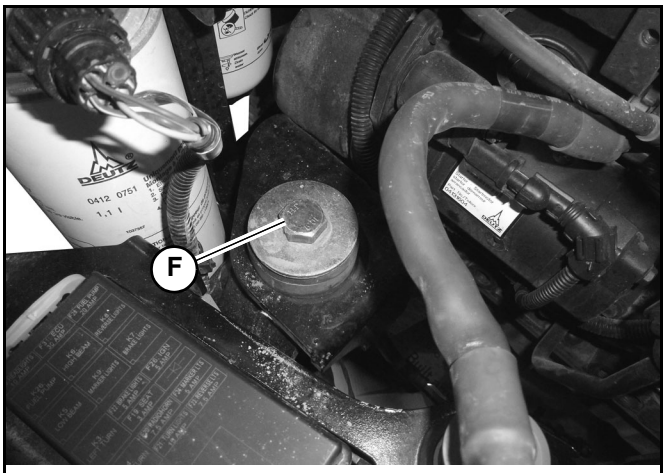


Fig. 42 – Engine Mount

NOTE: *The nuts have a thread-locking mechanism and should be replaced during installation. Refer to the parts manual for ordering information.*

⚠ CAUTION

Use caution when removing the engine to prevent damage. Hoses, wiring, and other components may need to be moved/adjusted when the engine is lifted for removal.

36. Slowly and carefully lift the engine out of the machine.

⚠ CAUTION

Use care when positioning the engine to not damage the DPF. The DPF is fragile and can be damaged by rough handling.

37. Store the engine in a safe, clean place, on an engine stand or wood blocks.

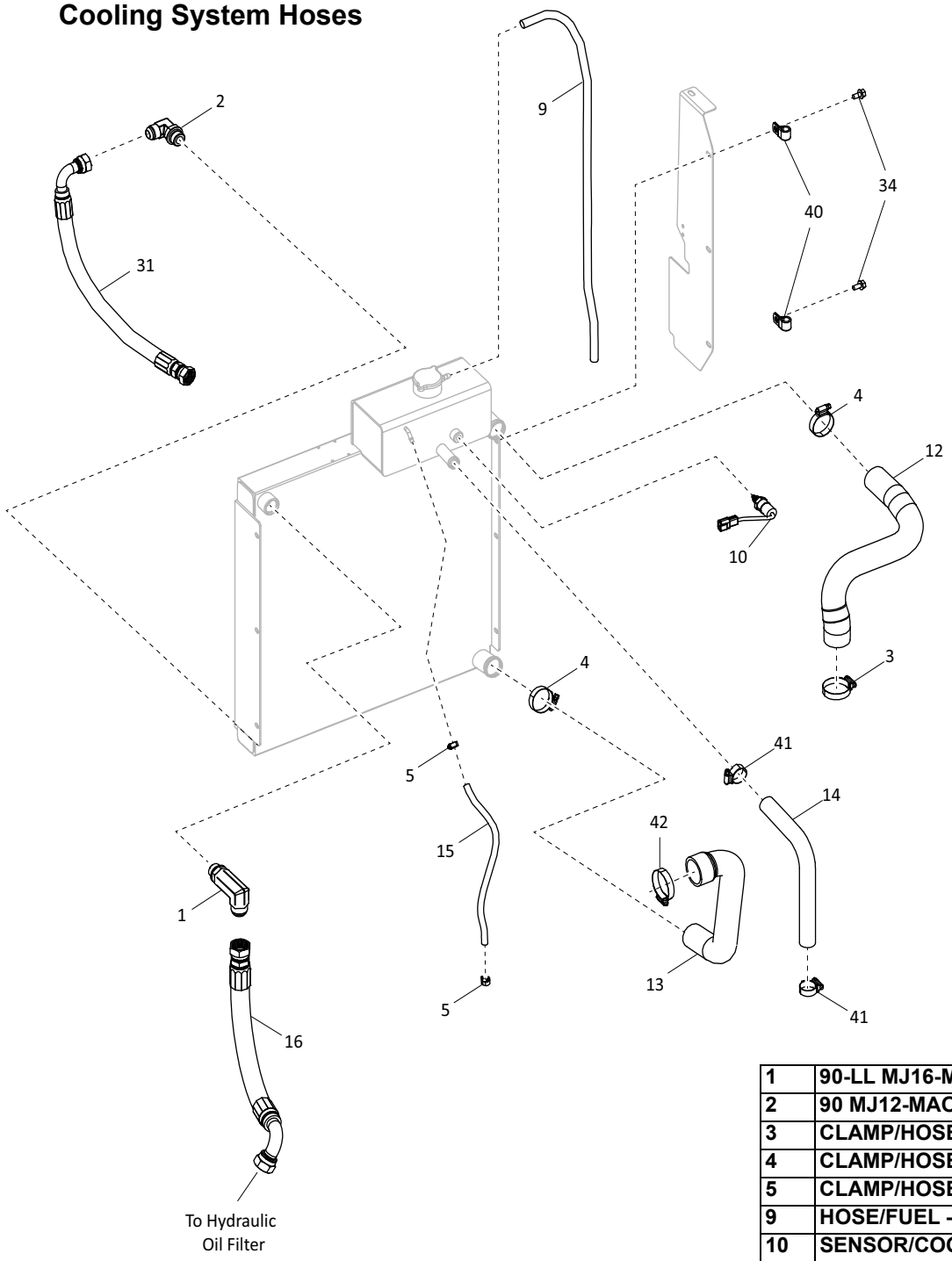
Table 17: Engine Diagnostic Trouble Codes (DTC)

SPN	FMI	DTCode	Error Description	Possible Cause
51	5	1372	Throtte valve, open load.	
51	3	1375	Throtte valve, short circuit to battery1.	
51	3	1376	Throtte valve, short circuit to battery2.	
51	4	1377	Throtte valve, short circuit to ground1.	
51	4	1378	Throtte valve, short circuit to ground2.	
51	6	1379	Throttle valve, over load.	
51	7	1382	Status of diagnostic fault check valve jammed closed.	
51	7	1383	Status of diagnostic fault check valve jammed opened.	
51	3	1391	Throtte valve, short circuit to battery.	
51	4	1392	Throtte valve, short circuit to ground.	
91	14	871	Function monitoring: Monitoring of accelerator pedal position.	
91	3	1274	Sensor error accelerator pedal.Signal range check high.	
91	4	1280	Sensor error accelerator pedal.Signal is below the range.	
91	11	1323	Plausibility error between APP1 and APP2 or APP1 and idle switch.	
94	15	721	Low fuel pressure system, max. physical range exceeded.	Blocked fuel lines,Defect fuel pressure sensor.
94	3	723	Sensor error low fuel pressure, signal range check high.	
94	4	724	Sensor error low fuel pressure, signal range check low.	
94	1	725	Low fuel pressure system, warning threshold exceeded.	Blocked or damaged fuel lines,Blocked fuel filter,Defect fuel feed pump,Leakage in low fuel pressure system,Empty fuel tank.
94	1	726	Low fuel pressure, shut off threshold exceeded.	Blocked or damaged fuel lines,Blocked fuel filter,Defect fuel feed pump,Leakage in low fuel pressure system,Empty fuel tank.
94	1	1171	Fuel pressure build up during engine start not successful.	Blocked or damaged fuel lines,Blocked fuel filter,Defect fuel feed pump,Leakage in low fuel pressure system,Empty fuel tank.
97	3	709	DFC SAE J1939 error.	
97	4	710	Sensor error water in fuel, signal range check low.	
97	0	1587	Water in fuel level prefilter; maximum value exceeded.	

Table 17: Engine Diagnostic Trouble Codes (DTC)

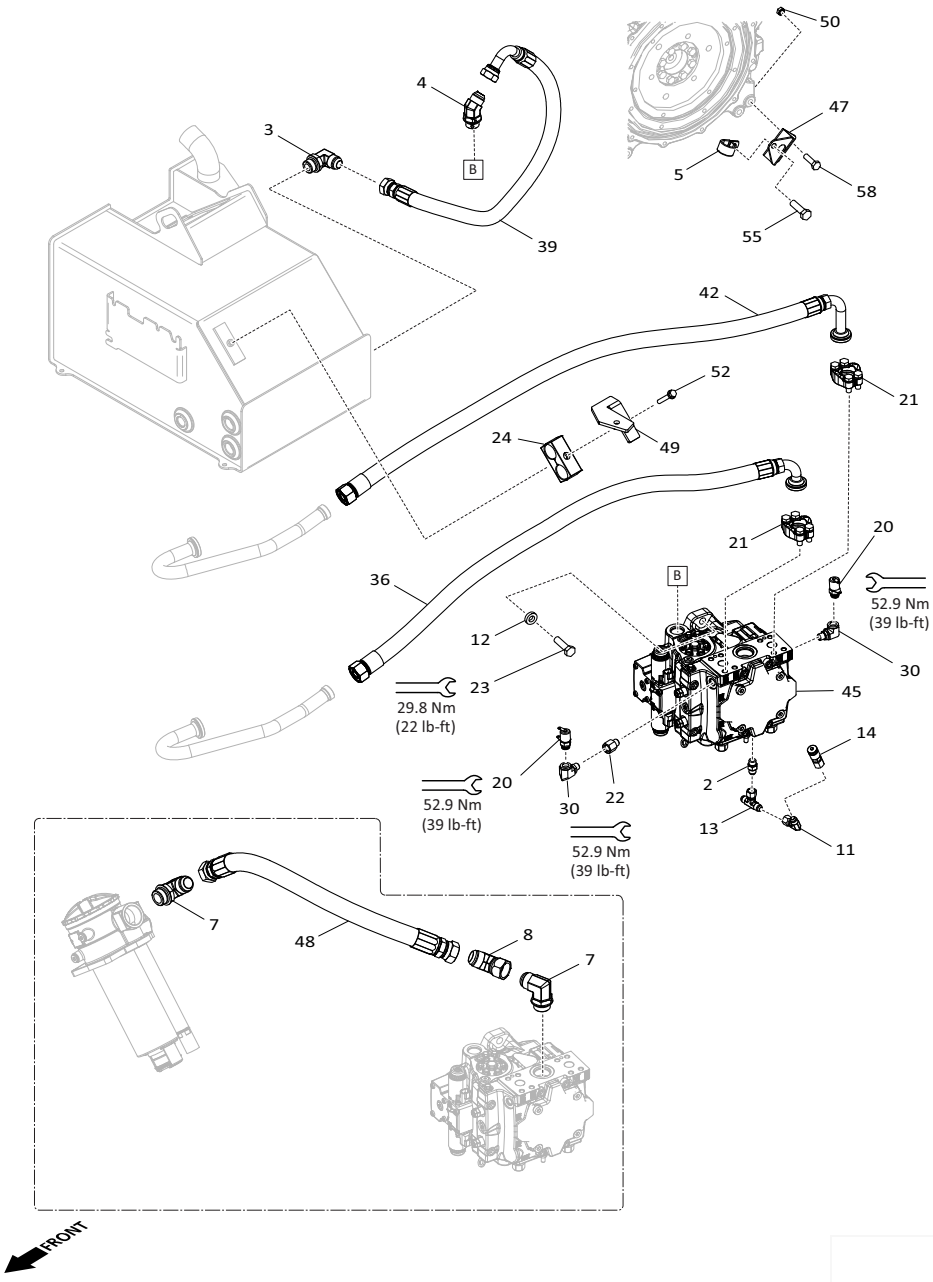
SPN	FMI	DTCode	Error Description	Possible Cause
3349	0	350	Timeout error of CAN-Receive-Frame Passive TSC1AE.	No detail informationen!
3349	0	351	Timeout error of CAN-Receive-Frame Active TSC1AR.	No detail informationen!
3349	0	352	Timeout error of CAN-Receive-Frame Passive TSC1AR.	No detail informationen!
3349	0	353	Timeout error of CAN-Receive-Frame TSC1TE - active.	
3349	0	354	Short circuit to ground error.	
3349	0	355	Timeout error of CAN-Receive-Frame TSC1TR.	
3349	0	356	Passive timeout error of CAN-Receive-Frame TSC1TR.	
3349	0	361	Timeout error of CAN-Receive-Frame TSC1AE.Traction Control.	
3349	0	363	Timeout error of CAN-Receive-Frame TSC1AR.Retarder.	
3349	0	365	Timeout error of CAN-Receive-Frame TSC1TE.Setpoint.	
3349	0	367	Timeout Error of CAN-Receive-Frame TSC1TR; control signal.	
3509	14	1289	Failure of sensor supply voltage 1.	
3509	0	1290	DFC generated from DemEvent SSpMon1OV: Overvoltage error at sensor supply 1 .	
3509	6	1291	DFC generated from DemEvent SSpMon1SCG: Short circuit to ground error at sensor supply 1.	
3509	1	1292	DFC generated from DemEvent SSpMon1UV: Undervoltage error at sensor supply 1 .	
3510	14	1293	Failure of sensor supply voltage 2.	
3510	0	1294	DFC generated from DemEvent SSpMon2OV: Overvoltage error at sensor supply 2.	
3510	6	1295	DFC generated from DemEvent SSpMon2SCG: Short circuit to ground error at sensor supply 2.	
3510	1	1296	DFC generated from DemEvent SSpMon2UV: Undervoltage error at sensor supply 2.	
3720	0	1084	DPF ash load exceeded shut off level.	
3720	16	1085	DPF ash load exceeded warning level.	

Cooling System Hoses



1	90-LL MJ16-MAORB12
2	90 MJ12-MAORB12
3	CLAMP/HOSE #28
4	CLAMP/HOSE #24
5	CLAMP/HOSE #04M
9	HOSE/FUEL -05 X 36IN
10	SENSOR/COOLANT LEVEL
12	HOSE/RADIATOR UPPER
13	HOSE/RADIATOR LOWER
14	HOSE/COMPENSATION
15	HOSE/FUEL -04 X 14.5IN
16	HOSE/HYD -16 X 19IN
31	HOSE/HYD -12 X 21.75IN
34	CS FL M8-1.25X16 8.8 ZY DIN6921
40	CLAMP/HOSE .56 X .41 HOLE
41	CLAMP/HOSE #16
42	CLAMP/HOSE #32

Hydrostatic Pump



2	ST MJ06-MORB06
3	90 MJ12-MAORB12
4	45 MJ12-MAORB12
5	CLAMP/HOSE 1.12 X .41 HOLE
7	90 MJ16-MAORB16
8	45 MJ16-FJS16
11	90 MJ06-FJS06
12	FW 17/32
13	TEE MJ06-MJ06-FJS06
14	TEST PORT/ -6 JICF
20	TEST PORT-9/16-18 UNF
21	DIN FLANGE KIT/-12 CD 62
22	ST MORB06-FORB06
23	CS 1/2X1-3/4 C8OCG SP
24	CLAMP/HOSE 30MM TWIN
30	90 MAORB06-FORB06
36	HOSE/HYD -12 X 42IN
39	HOSE/HYD -12 X 35IN
42	HOSE/HYD -12 X 45IN
45	PUMP/AXIAL PISTON/45CC
47	WLDMNT/CASE DRAIN
48	HOSE/HYD -16 X 25.5IN
49	BRACKET/CLAMP
50	LN INS M10-1.5 C8 ZY DIN985
52	CS FL M8-1.25X50 8.8 ZY DIN6921
55	CS M8-1.25X20 C8.8 ZY DIN933
58	CS M10-1.5X35 C8.8 ZY DIN933

Travel Motor Service

For detail travel motor service information, refer to the Danfoss H1B Motor Service Manual [Manitou # 50940482].

⚠ WARNING

AMPUTATION AND/OR SEVERE LACERATION HAZARD

When working on the drive motor, keep your hands and fingers away from the servo piston setting lug bore (B, Fig. 102) when the end cap, the valve segment (C), and the setting lug (D) are removed. If the servo piston bolt (A) is tightened when fingers are near an empty and exposed setting lug bore (B), finger amputation or severe laceration can result.

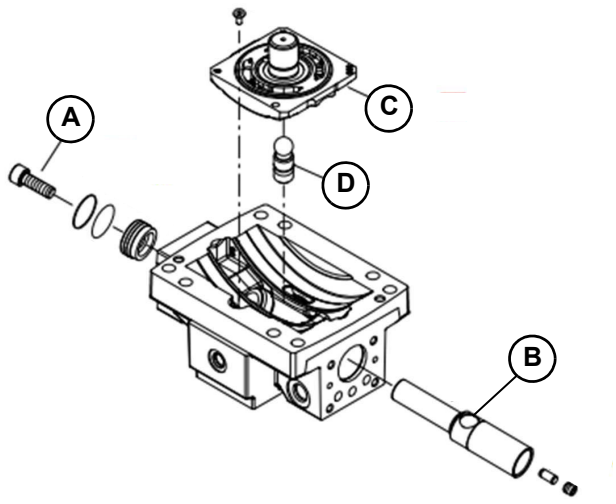
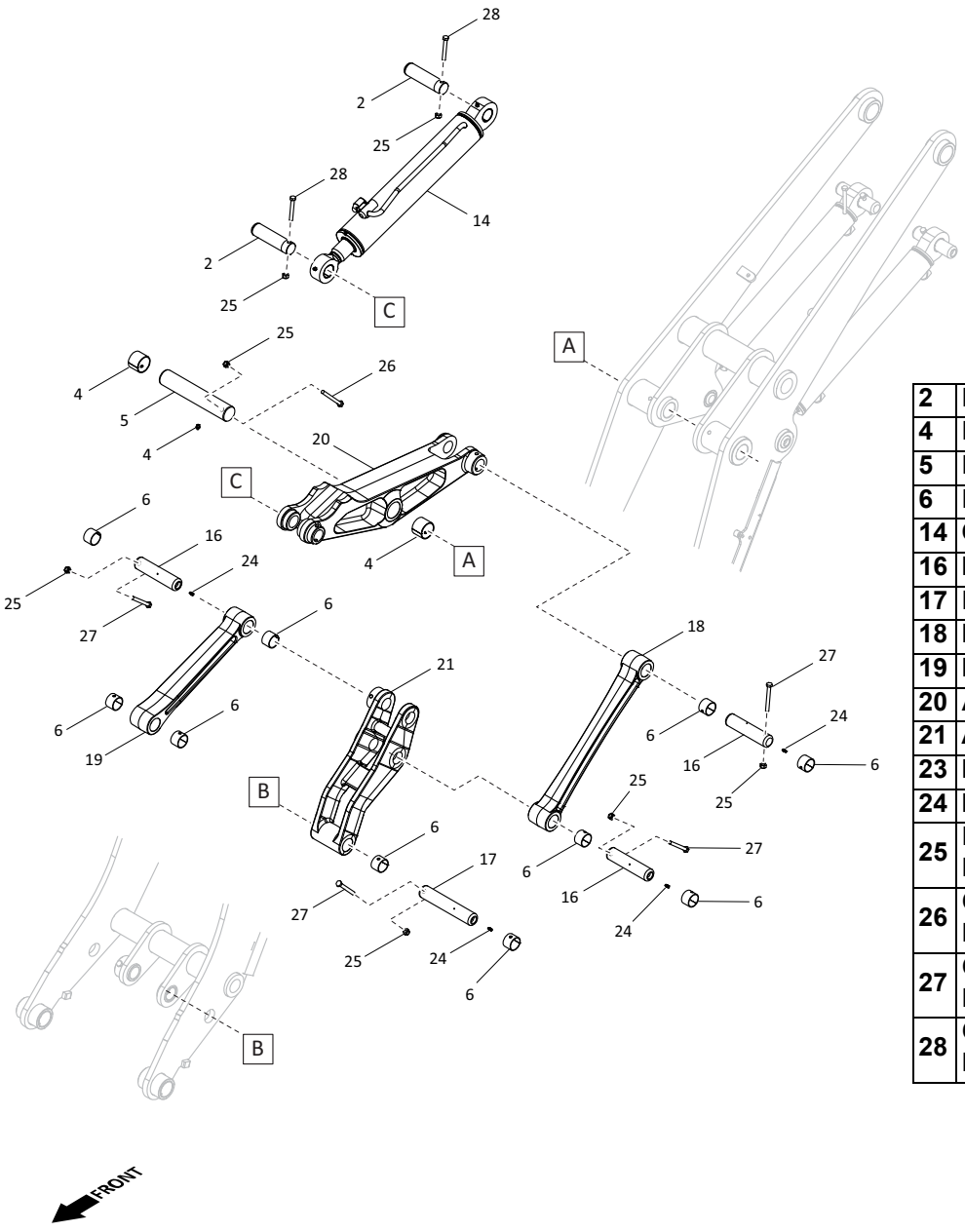


Fig. 102 – Drive Motor Servo Piston Lug Bore Hazard

050 - Lift Structure

Lift Structure (1 of 2)



2	PIN/PIVOT
4	BEARING/50MM I.D.
5	PIN/PIVOT 50MM
6	BEARING/40MM I.D.
14	CYLINDER/TILT
16	PIN/PIVOT
17	PIN/PIVOT 40MM
18	LINK/UPPER
19	LINK/LOWER
20	ARM/UPPER PIVOT
21	ARM/LOWER PIVOT
23	FITTING/GREASE M10X1
24	FITTING/GREASE M6X1
25	LN INS M10-1.5 C8 ZY DIN985
26	CS M10-1.5X110 C10.9 ZY DIN931
27	CS M10-1.5X90 C8.8 ZY DIN931
28	CS M10-1.5X75 C8.8 ZY DIN931

070 - Hydraulics

Hydraulic System General Information

- This section includes troubleshooting, testing, removal, installation and adjustment procedures for hydraulic system components.
- Power for the lift structure functions and auxiliary hydraulics is provided by a gear pump.
- Power for the wheel drive motor is provided by an hydrostatic-type system. For detailed hydrostatic information, refer to “Hydrostatic Travel Drive System” on page 176.
- An auxiliary hydraulics system is provided for attachment hookup. Connections for auxiliary hydraulics are located at the attachment hitch, and optionally on the back of the machine
- Refer to “Fluids/Lubricants Types and Capacities” on page 11 for recommended hydraulic fluids and capacities. Refer to the Operator’s Manual for recommended fluid and filter change intervals.
- For pump internal repair information, refer to “Additional Service Documentation” on page 9 and/or contact Manitou Americas.
- Refer to “Hydrostatic System” on page 35 for information about the hydrostatic drive pump.
- Refer to “Hydraulic System Troubleshooting” on page 174 and “Hydrostatic Travel Drive System Troubleshooting” on page 57 for potential hydraulic system problems, possible causes and remedies.
- If a specific hydraulic/hydrostatic system problem is not listed in the troubleshooting section on page 57, contact the Manitou Service Department.
- If a problem occurs, don’t overlook simple causes. Malfunctions can be caused by something as simple as low fluid level in the hydraulic reservoir.

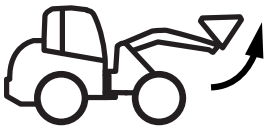
⚠ CAUTION

DO NOT attempt to service or repair major hydraulic system components unless authorized to do so. Unauthorized repairs may void the warranty.

Open-Type / Hydrostatic Systems

Hydraulic circuits used in fluid power applications are either an open- or an hydrostatic-type.

Open-Type



Open-type circuits are used in the machine to operate all hydraulic circuits with the exception of the travel drive system.

In the simplest terms, fluid in open-type circuits is constantly moving. The fluid is pulled from the tank, circulated, and then returns back to the reservoir.

Open circuits are relatively simple to maintain and repair, but they require a large volume of fluid to allow for proper cooling and useful operation.

The open-type system in the machine is driven by a hydraulic gear pump.

Hydrostatic-Type

Power for the wheel drive motors is provided by a closed loop hydrostatic system.

Main Control Valve Removal

NOTE: *Cap or plug all hydraulic hoses, tubes, fittings and control valve ports immediately after being disconnected to prevent fluid loss and hydraulic system contamination.*

NOTE: *It may be necessary to loosen hydraulic tubes at the other end of the tubes connected to the control valve to provide some free-play.*

1. Drain the hydraulic oil according to the Operator's Manual.
2. Remove the right console next to the operator's position.
3. Remove the ROPS/FOPS according to "ROPS/FOPS Removal" on page 241.
4. Disconnect the electrical connectors from the control valve.
5. Disconnect the tubes and hoses from the control valve.
6. Remove the screws fastening the control valve to the chassis and remove the control valve from the machine.

Main Control Valve Installation

1. If any fittings were removed from the control valve, replace them in the valve but do not tighten to allow for adjustment during installation.
2. Position the control valve on the chassis and secure with the screws removed during the control valve removal.
3. Connect the tubes/hoses on the control valve in the locations noted/photographed during the control valve removal.
4. Tighten any fittings that were left loose in step 1.
5. Install the ROPS/FOPS according to "ROPS/FOPS Installation" on page 247.
6. Install right console next to the operator's position.
7. Fill the hydraulic oil reservoir according to the Operator's Manual.
8. Start the machine and operate and test the lift/tilt functions. Move the auxiliary control rocker switch on the joystick to the forward and reverse positions to pressurize the circuit.
9. If the machine is equipped with high-flow auxiliary hydraulics, press both ends of the high-flow rocker switch on the switch panel to pressurize the circuit.
10. Stop the machine and check the control valve installation for leaks. Repair/replace as necessary.

⚠ WARNING

NEVER use your hands to search for hydraulic oil leaks when the machine is running. Use a piece of cardboard or paper if necessary to check for leaks when the machine is running. Escaping oil under pressure can be invisible and penetrate the skin causing serious injury. If any oil is injected into your skin, get medical attention immediately. Injected fluid MUST be surgically removed by a doctor familiar with this type of injury or gangrene may result.

⚠ WARNING

ALWAYS wear safety glasses when checking for hydraulic fluid leaks when the machine is running. Escaping fluid under pressure can be invisible and can cause permanent eyesight damage if safety glasses are not worn.

11. Check the hydraulic oil level. Add oil if necessary.

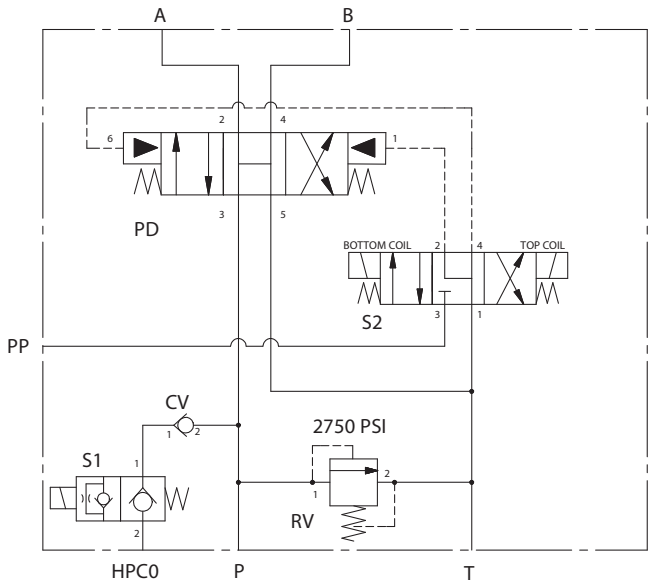


Fig. 138 – High-Flow Auxiliary Hydraulics Valve Schematic

NOTE: *Perform this procedure to test the valve if high-flow auxiliary hydraulics does not operate in either or both directions.*

1. Sit in the operator's seat and turn the ignition key to the ON/RUN position.
2. Press and hold the ok button (E, Fig. 139) on the display for 10 seconds until the secondary screens display.

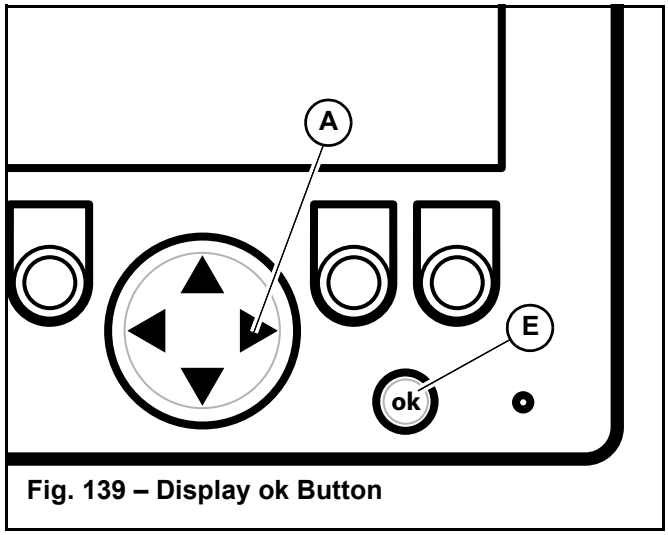


Fig. 139 – Display ok Button

3. Press the right side of the navigation rocker button (A) until the "INPUTS" screen (Fig. 140) is displayed.

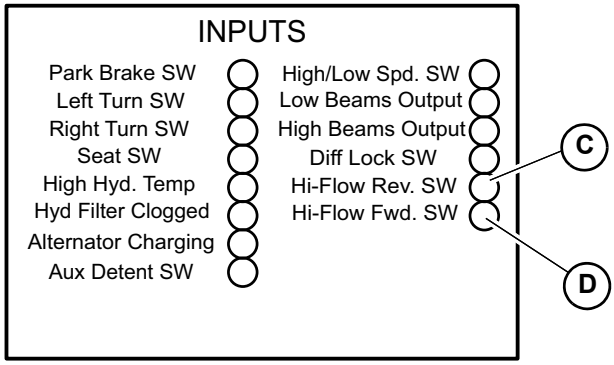


Fig. 140 – INPUTS Screen

4. Press one end of high-flow auxiliary switch (Fig. 141).

Either the "Hi-Flow Rev. SW" (C, Fig. 140), or the "Hi-Flow Fwd. SW" (D) indicators should be green.

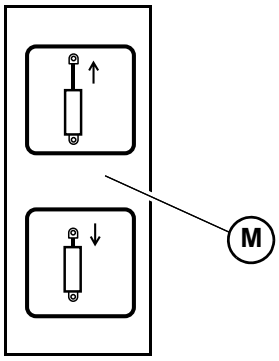


Fig. 141 – High-Flow Auxiliary Hydraulics Control Rocker Switch

An electrical malfunction is indicated if indicator (C or D) is yellow. A malfunction of the high-flow auxiliary control rocker switch is indicated if indicator (C or D) is blank.

Steering Priority Test

The steering priority ensures that proper hydraulic steering flow is always maintained. Steering priority is maintained by the main control valve and is tested remotely.

If steering is sluggish, test the priority function as follows:

⚠ CAUTION

Two pressure gauges with a minimum of 345 bar (5000 psi) are required for this procedure. Gauges of insufficient capacity may be damaged.

1. Remove any attachments from the attachment hitch and lower the lift structure to the ground.
2. Remove the right side panel according to "Side Panel Removal/Replacement" on page 237.
3. Connect a pressure gauge with a minimum capacity of 345 bar (5000 psi) to the auxiliary hydraulics test fitting (X, Fig. 163).

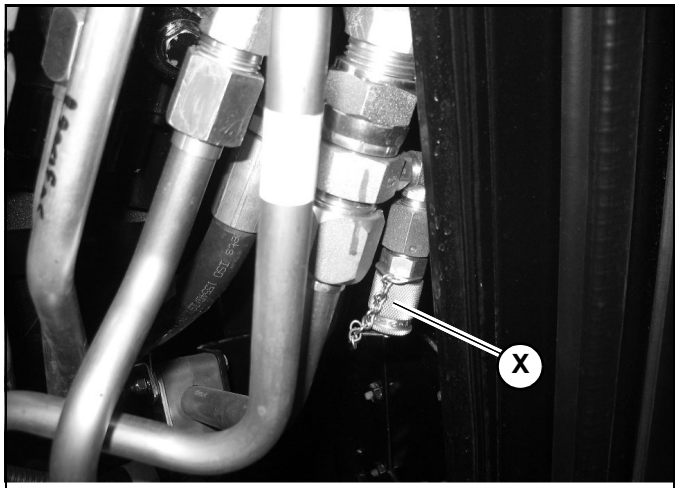


Fig. 163 – Hydraulics Main Pressure Test Fitting

NOTE: *The hydraulic test fitting (X) is located behind the right side panel.*

1. Remove the screws (S, Fig. 164) securing the top of the access panel (T) at the front of the ROPS/FOPS.

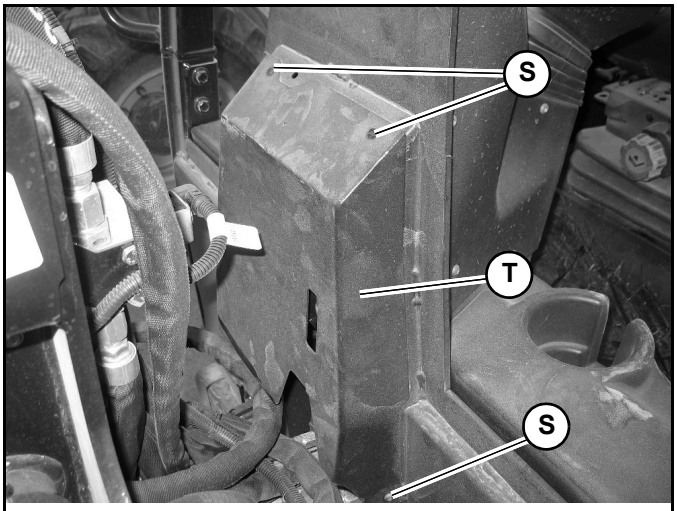


Fig. 164 – ROPS/FOPS Front Access Panel

2. Using a tee fitting, connect a pressure gauge with a minimum capacity of 345 bar (5000 psi) into the "P" port (P, Fig. 165) on the steering valve.

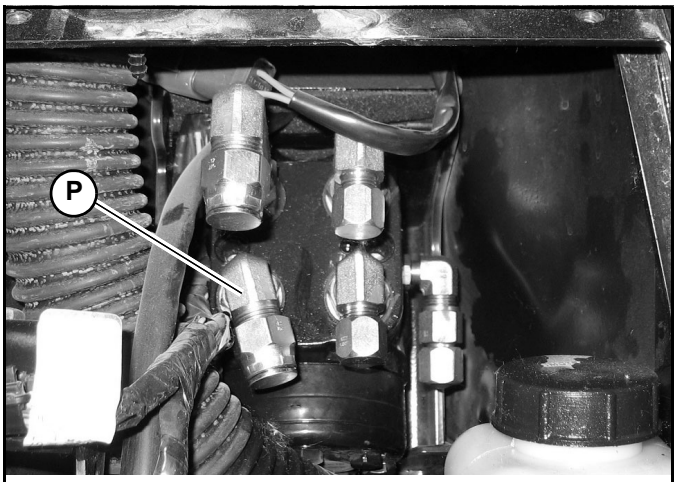
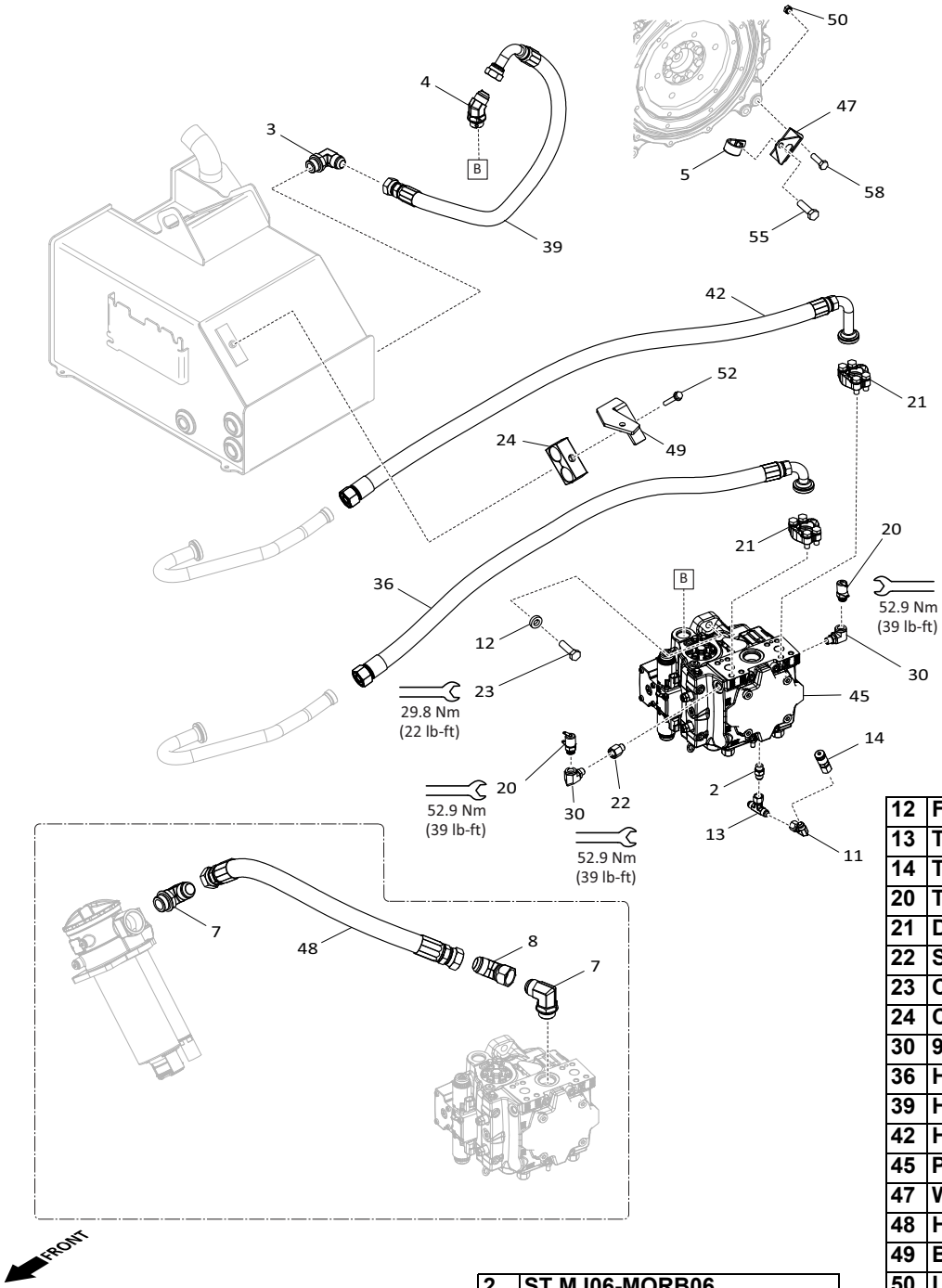


Fig. 165 – Steering Valve "P" Port (Hoses Shown Removed)

3. Start and run the machine until the hydraulic oil reaches operating temperature (approximately 50°C/120°F).
4. If necessary, use the hand throttle to set engine speed to low idle (1150 rpm).
5. Lift the parking brake lever to engage the parking brake.
6. If necessary, use the hand throttle to reduce engine speed to low idle (1150 rpm).
7. Rotate the steering wheel fully left and right to extend/retract the steering cylinder.

Hydrostatic Pump



2	ST MJ06-MORB06
3	90 MJ12-MAORB12
4	45 MJ12-MAORB12
5	CLAMP/HOSE 1.12 X .41 HOLE
7	90 MJ16-MAORB16
8	45 MJ16-FJS16
11	90 MJ06-FJS06

12	FW 17/32
13	TEE MJ06-MJ06-FJS06
14	TEST PORT/ -6 JICF
20	TEST PORT-9/16-18 UNF
21	DIN FLANGE KIT/-12 CD 62
22	ST MORB06-FORB06
23	CS 1/2X1-3/4 C5ZY SP
24	CLAMP/HOSE 30MM TWIN
30	90 MAORB06-FORB06
36	HOSE/HYD -12 X 42IN
39	HOSE/HYD -12 X 35IN
42	HOSE/HYD -12 X 45IN
45	PUMP/AXIAL PISTON/45CC
47	WLDMNT/CASE DRAIN
48	HOSE/HYD -16 X 25.5IN
49	BRACKET/CLAMP
50	LN INS M10-1.5 C8 ZY DIN985
52	CS FL M8-1.25X50 8.8 ZY DIN6921
55	CS M8-1.25X20 C8.8 ZY DIN933
58	CS M10-1.5X35 C8.8 ZY DIN933

080 - Electrical System

⚠ WARNING

Inspect the electrical components at regular intervals. Look for problems, such as loose connections or scorched cables. Repair any problems found before starting the machine.

Only trained technicians should work on the machine's electrical system.

Only use original equipment (OEM) electrical components, such as fuses and circuit breakers, with the correct specifications.

Turn off the machine immediately if there is any indication of a problem with the electrical system.

Before performing electrical service or arc welding on the machine, disconnect the battery.

Turn off all electrical equipment before connecting leads to the battery, including electrical switches on the battery charger or jump-starting equipment.

Sparks, open flames, and static discharge can ignite explosive battery gas. To prevent sparks, before working on the battery:

- **Turn off the engine and all switches**
- **Make sure the battery terminals are tight**
- **Avoid contacting the battery terminals with metal objects.**

When disconnecting the battery, remove the negative terminal cable first. When connecting the battery, connect the positive terminal cable first.

Engine Compartment Fuse Box

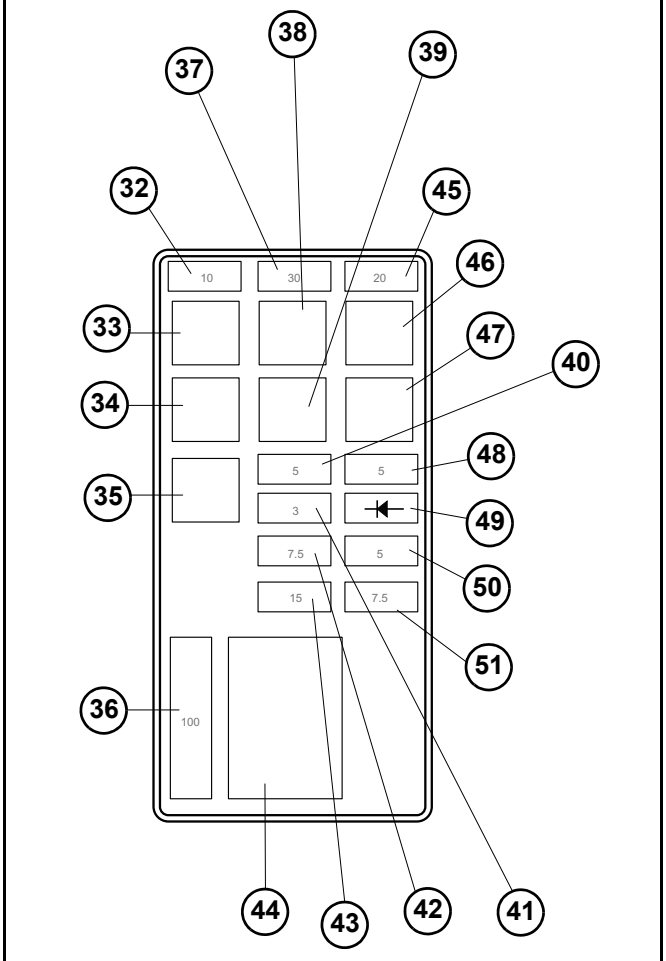


Fig. 189 – Fuse Box Fuses (Engine Compartment)

Table 25: Fuse Box Fuses (Engine Compartment) (Fig. 189)

Fuse	Rated Current (Amps)	Protected Circuit
32	10A	Headlights
33	Relay	Fuel Pump
34	Relay	Low Beam
35	Relay	Alternator Pre-Excitation
36	100A	Glow Plug
37	30A	ECU (Engine Control Unit)
38	Relay	High Beam
39	Relay	Marker Lights
40	5A	Brake Lights
41	3A	Operator's Seat/Dome Light
42	7.5A	Radio/Horn
43	15A	MCU Power
44	Relay	Glow Plug
45	20A	Fuel Pump
46	Relay	Reverse Lights
47	Relay	Brake Lights
48	5A	Ignition/Easy Manager
49	Diode	Diode (IMPORTANT: Match orientation when replacing)
50	5A	Marker Lights
51	7.5A	Reverse (Backup) Lights

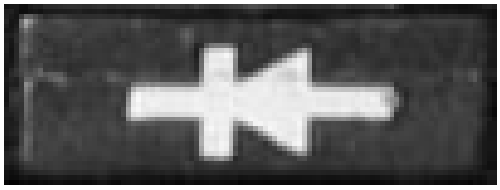
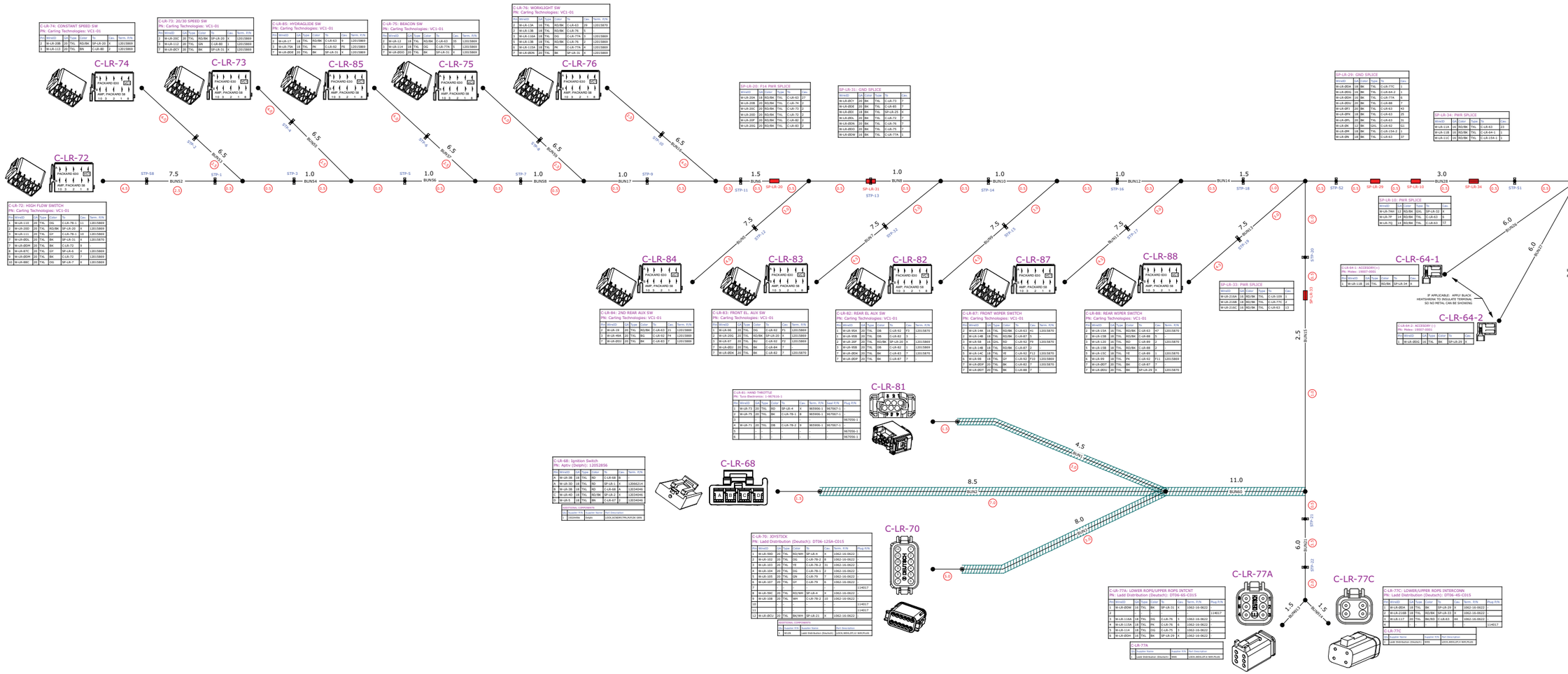


Fig. 190 – Correct Diode Installation Orientation

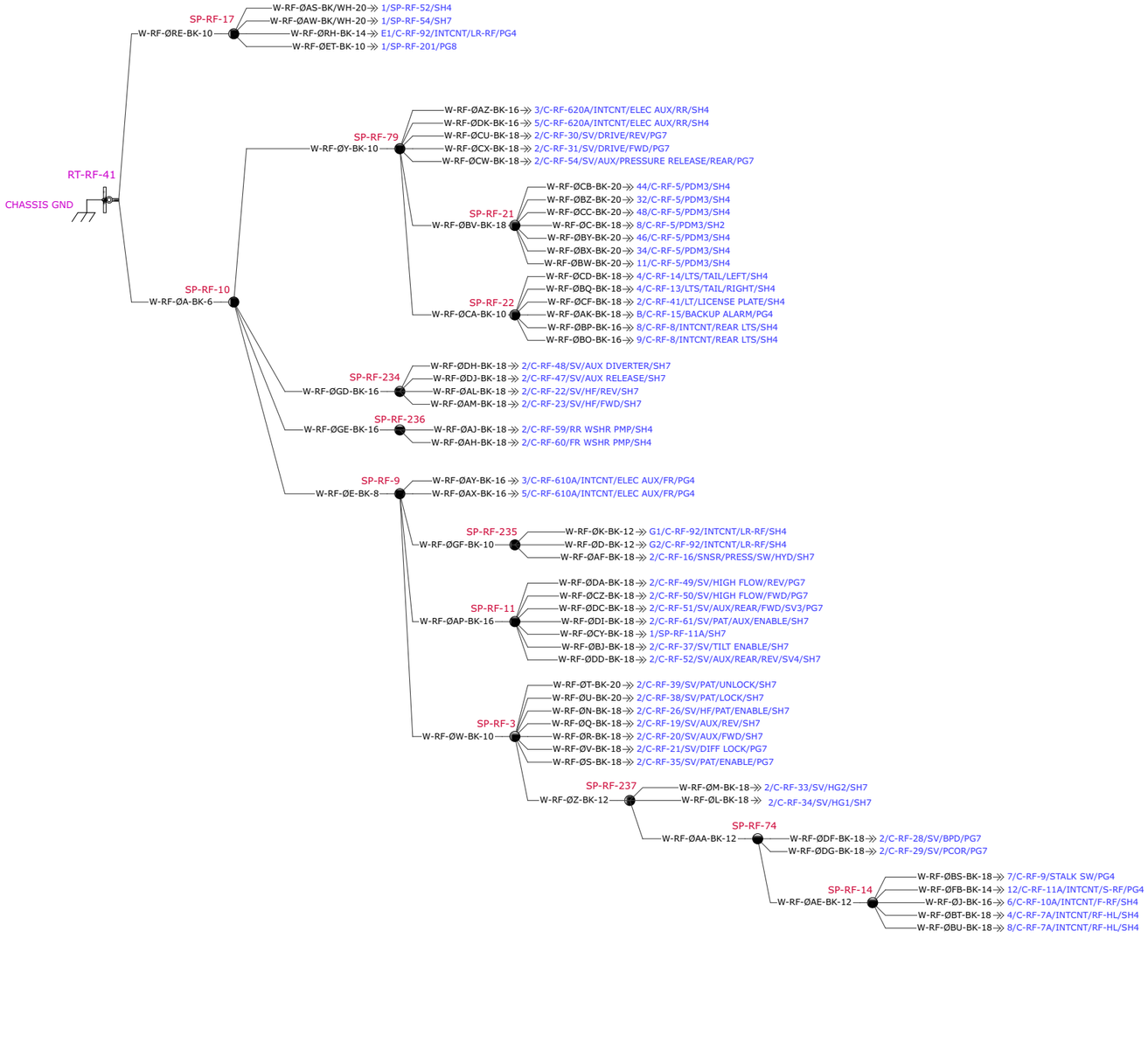
Wire Harness Diagram -- Lower ROPS/FOPS (1 of 2)



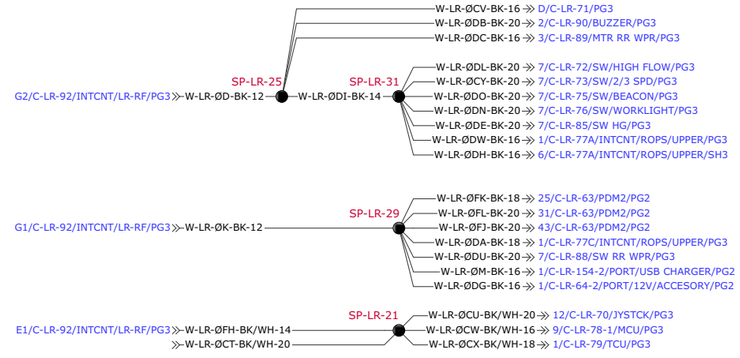
50321918-C-1

Electrical Schematic – Grounds

REAR FRAME HARNESS

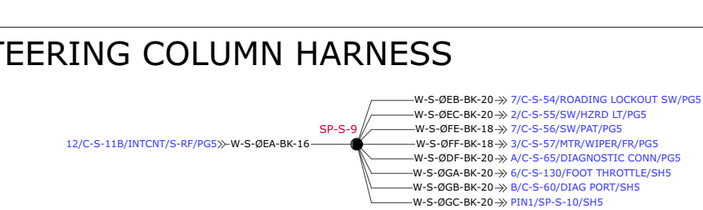


LOWER ROPS HARNESS



UPPER ROPS HARNESS

STEERING COLUMN HARNESS



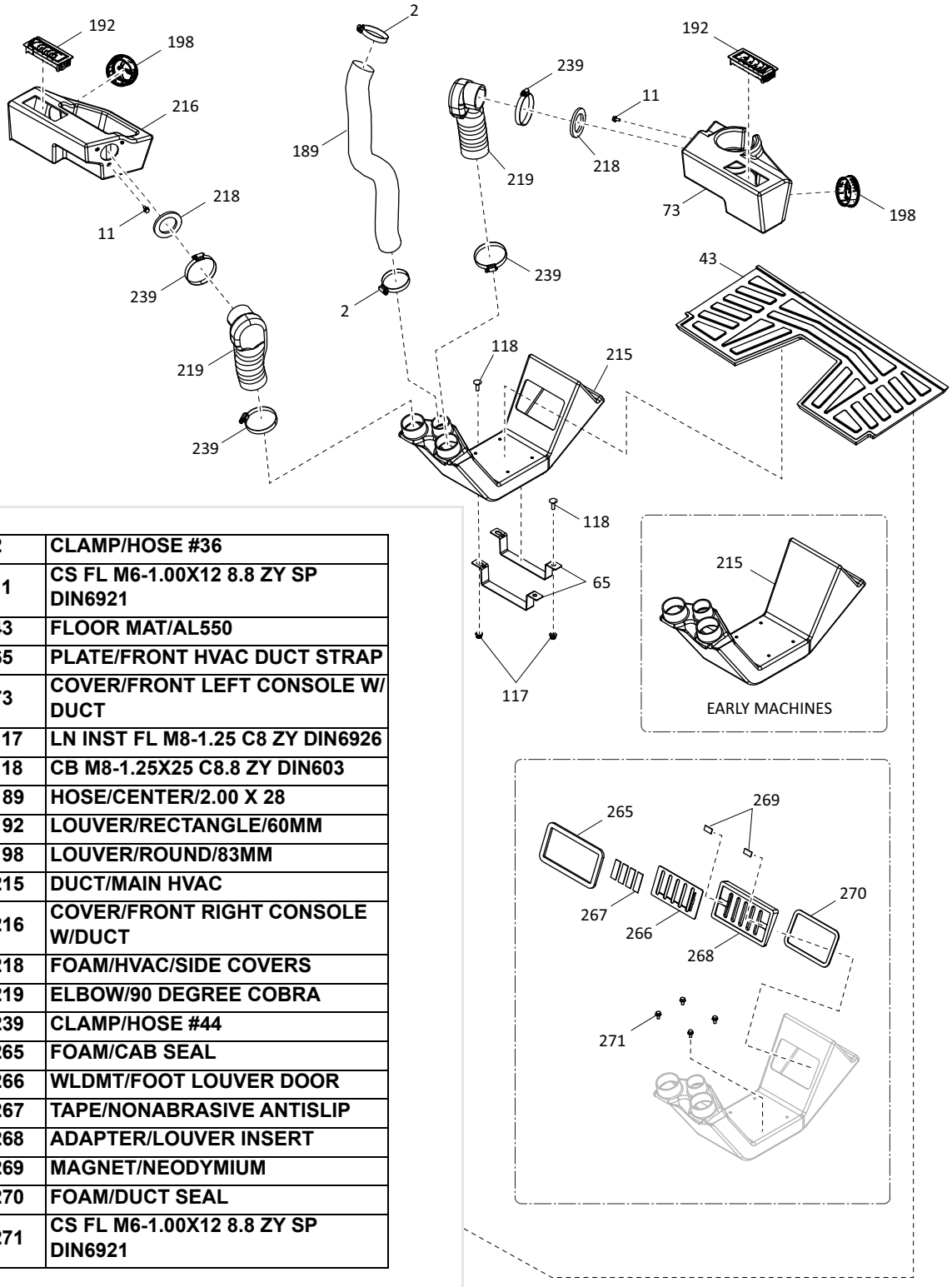
HVAC

50294085-A-13

085 - Operation Station

HVAC System

Cab Ducting



2	CLAMP/HOSE #36
11	CS FL M6-1.00X12 8.8 ZY SP DIN6921
43	FLOOR MAT/AL550
65	PLATE/FRONT HVAC DUCT STRAP
73	COVER/FRONT LEFT CONSOLE W/ DUCT
117	LN INST FL M8-1.25 C8 ZY DIN6926
118	CB M8-1.25X25 C8.8 ZY DIN603
189	HOSE/CENTER/2.00 X 28
192	LOUVER/RECTANGLE/60MM
198	LOUVER/ROUND/83MM
215	DUCT/MAIN HVAC
216	COVER/FRONT RIGHT CONSOLE W/DUCT
218	FOAM/HVAC/SIDE COVERS
219	ELBOW/90 DEGREE COBRA
239	CLAMP/HOSE #44
265	FOAM/CAB SEAL
266	WLDMT/FOOT LOUVER DOOR
267	TAPE/NONABRASIVE ANTISLIP
268	ADAPTER/LOUVER INSERT
269	MAGNET/NEODYMIUM
270	FOAM/DUCT SEAL
271	CS FL M6-1.00X12 8.8 ZY SP DIN6921

Rear Cover Removal/Replacement

CAUTION

The service covers (B, Fig. 214 and Fig. 215) weigh approximately 22 kg. (50 lbs.). Have an assistant help when removing/replacing the service covers.

1. Have an assistant support/position the rear cover (B).

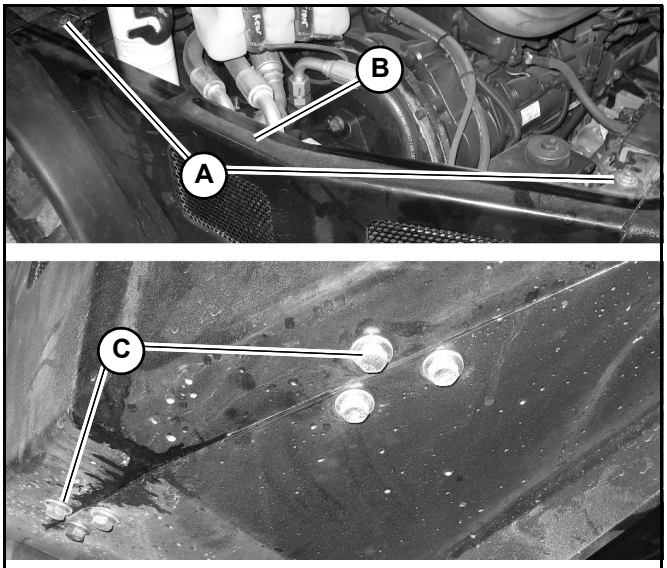


Fig. 214 – Left Rear Cover

2. Remove/attach the rear cover using the two screw on top (A) and the two on the bottom (C).

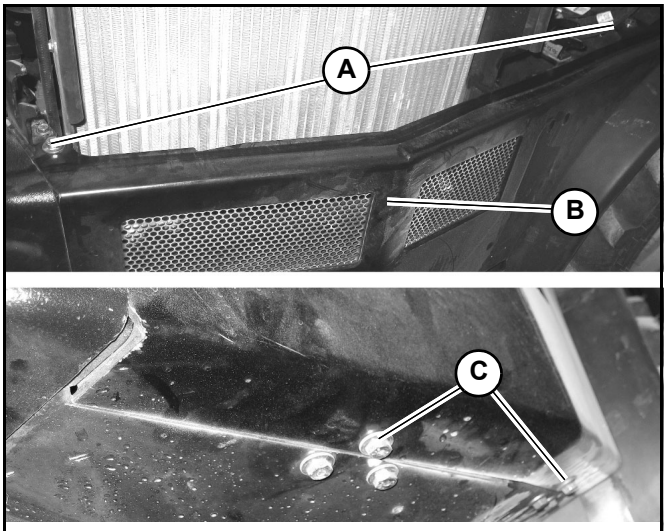


Fig. 215 – Right Rear Cover

Service Cover Removal/Replacement

The service covers (X, Fig. 216) are located under the machine at the rear. They can be removed for inspection, maintenance and service.

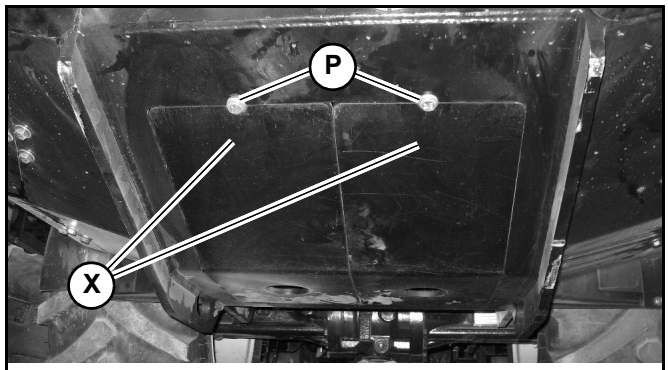


Fig. 216 – Service Covers

CAUTION

The service covers (X) weigh approximately 11 kg. (25 lbs.). Use care when removing the service covers. Injury can result from a falling service cover.

Service cover (X) removal:

1. Support the service cover (X).
2. Loosen and remove the fastener (P) securing the service cover (X).
3. Carefully lower and remove the service cover (X).

   NOTE: *The lip at the front service cover hooks onto the chassis.*

Service cover (X) replacement:

1. Lift the service cover (X) in place under the machine.

   NOTE: *The lip at the front service cover hooks onto the chassis.*

2. Have an assistant hold the service cover in place on the (X) machine and secure it using the fastener (P).
3. Tighten the fastener (P) securely.

14. Pull the rubber boot (G, Fig. 245) down around the joystick. Tuck the edges of the boot under the joystick boot retainer plate (I).

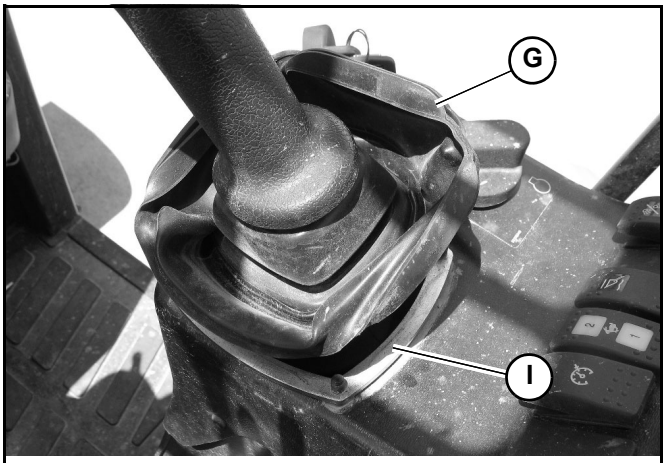


Fig. 245 – Joystick Boot

15. On cab-equipped machines:

    a. Connect the electrical connection for the HVAC blower (F, Fig. 246) under the ROPS/FOPS to the chassis harness [C-HRF-145].

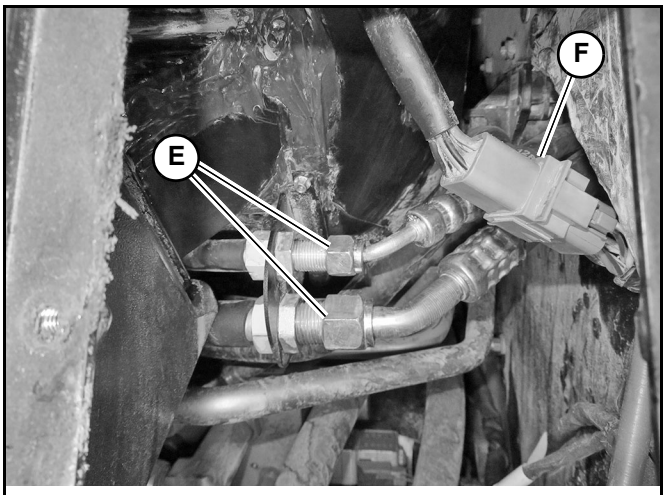


Fig. 246 – Air Conditioning Hose Connections

    b. Remove the caps/plugs and connect the air conditioning hoses (E) to the air conditioning unit. Tighten securely.

    c. On machines with air conditioning, fasten the kick plate access panel (D, Fig. 247) using the screws (C). Tighten securely.

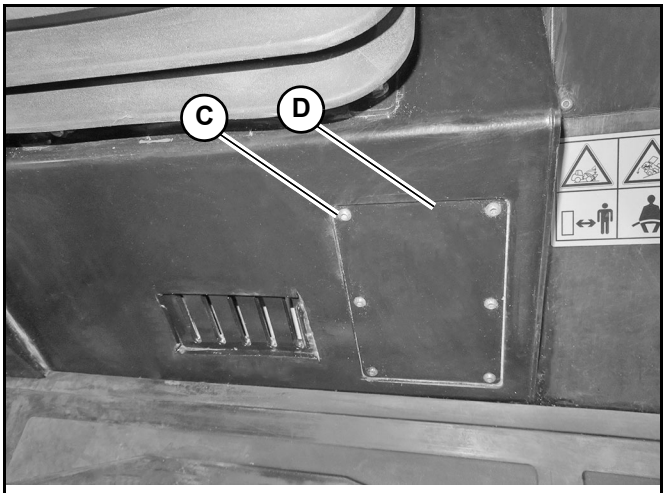


Fig. 247 – Kick Plate Access Panel

16. Remove the caps/plugs and connect the brake hose (B, Fig. 248) to the brake master cylinder. Tighten securely.

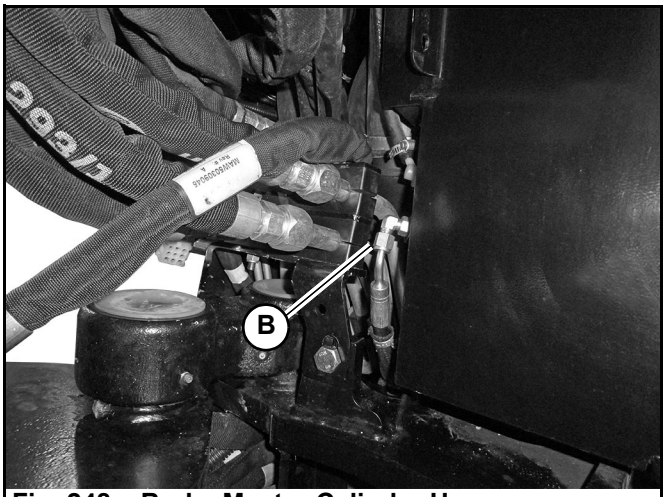


Fig. 248 – Brake Master Cylinder Hose

Table 32: Main Control Unit LEDs/Pins

LED	Description	LED State		In/Out	Pin
HIGH HYD TEMP	High hydraulic system temperature	On	Incoming signal from hydraulic over-temperature sensor	In	J2-6
		Off	No incoming signal from hydraulic over-temperature sensor	In	
HYD FIL CLOG	Hydraulic system filter clogged	On	Incoming signal from hydraulic filter restriction sensor	In	J2-18
		Off	No incoming signal from hydraulic filter restriction sensor	In	
POWER-A-TACH SW	The powered attachment switch is pressed	On	Incoming signal from powered attachment switch	In	J2-7
		Off	No incoming signal from powered attachment switch	In	
PARKING BRAKE SW	Parking brake switch is closed	On	Incoming signal from parking brake switch	In	J1-12
		Off	No incoming signal from parking brake switch	In	
HIGH FLOW REV SW	The high flow auxiliary hydraulics reverse switch is closed	On	Incoming signal from high flow auxiliary hydraulics reverse switch	In	J1-11
		Off	No incoming signal from high flow auxiliary hydraulics reverse switch	In	
HIGH FLOW FWD SW	The high flow auxiliary hydraulics forward switch is closed	On	Incoming signal from high flow auxiliary hydraulics forward switch	In	J1-10
		Off	No incoming signal from high flow auxiliary hydraulics forward switch	In	
AUX DETENT SW	Auxiliary hydraulics flow latching	On	CAN activity indicates continuous auxiliary hydraulics flow is activated	In	J1-2
		Off	CAN activity indicates continuous auxiliary hydraulics flow is deactivated	In	
DIFF LOCK SW	The differential lock button/ switch is closed	On	Incoming signal from differential lock button/switch	In	J2-31
		Off	No incoming signal from differential lock button/switch	In	
LOW BEAM SWITCH	The control stalk low beam switch is closed	On	Incoming signal from the low beam switch	In	J2-30
		Off	No incoming signal from the low beam switch	In	
KEY SWITCH START	The key switch is in the START position	On	Incoming signal from the start switch	In	J2-19
		Off	No incoming signal from the start switch	In	
HI SPEED PUSHBUTTON	The high speed pushbutton switch is closed	On	Incoming signal from the high speed pushbutton switch	In	J2-8
		Off	No incoming signal from the high speed pushbutton switch	In	
HIGH BEAM SWITCH	The control stalk high beam switch is closed	On	Incoming signal from the high beam switch	In	J2-20
		Off	No incoming signal from the high beam switch	In	

Ignition/Starting Electrical Functional Detail

Table 34: Ignition/Starting Electrical Functional Detail

Function	Inputs/Conditions	Outputs/Actions	Malfunction Causes
Power On	• Ignition switch in ON/RUN position.	• COMM STATUS LEDs on MCU (green). • All indicator lights and audible alarm activate for 3 seconds to test; test interrupted if the ignition switch is turned to the START position.	• Ignition switch malfunction. • Electrical fault (switch, components, connections or battery). • Component/safety interlock system malfunction. **NOTE:** If display and/or keypad does not power up: • Make sure battery disconnect switch is in the ON position. • Check battery terminal connections. • Check for sufficient battery voltage (12VDC). • Check for power to display at pin #2 (12VDC). • If no power to display and/or keypad, check fuse and also electrical connections in the fuse box. • Check for proper grounding on display at pin #3.
Power Off	• Ignition switch in OFF position. • Seat switch CLOSED (seat occupied).	• COMM STATUS LED on MCU (yellow). • Display OFF. Machine power-down.	• Ignition switch malfunction. • Electrical fault (switch, components, connections or battery). • Component/safety interlock system malfunction.

Table 39: Lighting Electrical Functional Detail

Function	Inputs/Conditions	Outputs/Actions	Malfunction Causes
High Beam Lights Activation (optional road lights installed)	• Ignition switch in ON/RUN or START position. • Knob of the end of the control lever rotated to the road lights ON position. • Control lever in the DOWN (high beam) position. • High Beams SW (green) on INPUTS screen.	• Turns on optional marker/position road lights. • Turns on high-beam lights. • Turns off low-beam lights. **NOTE:** Marker/position lights are activate when the low/high beams road lights are activated.	Electrical/mechanical fault (components, connections or battery).
Right Turn (Directional) Signal Light Activation (optional road lights installed)	• Ignition switch in ON/RUN or START position. • Control lever in the forward (right turn) position. • Right Turn SW (green) on INPUTS screen.	• Turns on right directional light and indicator (flashes at 60 flashes/min). • Right Turn Out (green) on OUTPUTS screen.	Electrical/mechanical fault (components, connections or battery).
Left Turn (Directional) Signal Light Activation (optional road lights installed)	• Ignition switch in ON/RUN or START position. • Control lever in the rearward (left turn) position. • Left Turn SW (green) on INPUTS screen.	• Turns on left directional light and indicator (flashes at 60 flashes/min). • Left Turn Out (blank) on OUTPUTS screen.	Electrical/mechanical fault (components, connections or battery).
Hazard Lights Activation (optional road lights installed)	• Hazard lights button on the control keypad is pressed. • Hazard Light PB (green) on INPUTS screen. • Right Turn SW (green) on INPUTS screen. • Left Turn SW (green) on INPUTS screen.	• Turns on hazard (right and left directional) lights and hazard lights indicator flash (lights flashes at 60 flashes/min). Subsequent presses of the hazard lights button toggles these hazard lights and indicator on/off. • Right Turn Out (green) flash (ON/OFF) on OUTPUTS screen. • Left Turn Out (green) flash (ON/OFF) on OUTPUTS screen. • **NOTE:** Left/right directional signal lights are disabled when hazard lights are activated.	Electrical/mechanical fault (components, connections or battery).

Table 42: CAN System Outputs Screen

Item	Input/Output	Description	Status	Condition
Right Turn Out	• ON/OFF right turn digital electrical signal (12VDC ON/OFF) from control lever switch to MCU. • CAN “Right Turn SW” message output from MCU to display. • CAN “Right Turn Out” message output from MCU to display. • ON/OFF digital electrical signal (12VDC ON/OFF) from MCU to right turn indicator lights.	Road lights right turn indicator CAN message/digital electrical output signal status.	Green	• Control lever in the right turn signal ON position. • Right turn indicator lights activated.
			Yellow	Short circuit (overload) or open circuit (no load) in right indicator light electrical circuit.
			Blank	• Control lever NOT in the right turn signal ON position. • Right turn indicator lights deactivated.
Left Turn Out	• ON/OFF left turn digital electrical signal (12VDC ON/OFF) from control lever switch to MCU. • CAN “Left Turn SW” message output from MCU to display. • CAN “Left Turn Out” message output from MCU to display. • ON/OFF digital electrical signal (12VDC ON/OFF) from MCU to left turn indicator lights.	Road lights left turn indicator CAN message/digital electrical output signal status.	Green	• Control lever in the left turn signal ON position. • Left turn indicator lights activated.
			Yellow	Short circuit (overload) or open circuit (no load) in left indicator light electrical circuit.
			Blank	• Control lever NOT in the left turn signal ON position. • Left turn indicator lights deactivated.

Table 44: MCU CAN Error Codes

DTC		Error Item	
SPN	FMI	Description	Type
520611	3	Auxiliary Hydraulics Forward/Reverse	Voltage above normal or shorted to high source
	4		Voltage below normal or shorted to low source
520612	31	Parking Brake	Malfunctioning or disconnected switch
520613	31	Start	Malfunctioning or disconnected switch
520614	31	Spare Digital in 1	Malfunctioning or disconnected switch
520615	3	Fuel	Voltage above normal or shorted to high source
	4		Voltage below normal or shorted to low source
520616	31	Air Filter Clogged	Malfunctioning or disconnected switch
520617	31	Alternator Pre-Excitation	Malfunctioning or disconnected switch
520618	31	Hydraulic Filter Clogged	Malfunctioning or disconnected switch
520619	3	Spare Config 1	Voltage above normal or shorted to high source
	4		Voltage below normal or shorted to low source
	5		Current below normal or open circuit
	6		Current above normal or grounded circuit
520620	3	Battery (+)	Voltage above normal or shorted to high source
520621	3	Battery (+)	Voltage above normal or shorted to high source
520622	31	High Speed	Malfunctioning or disconnected switch
520623	31	High Speed 20/30	Malfunctioning or disconnected switch
520624	31	Differential Lock	Malfunctioning or disconnected switch
520625	31	Aux Detent	Malfunctioning or disconnected switch
520626	31	Rear Window Defrost	Malfunctioning or disconnected switch
520627	31	High Flow Forward	Malfunctioning or disconnected switch
520628	31	High Flow Reverse	Malfunctioning or disconnected switch
520629	31	Marker Lights	Malfunctioning or disconnected switch
520630	31	AC On	Malfunctioning or disconnected switch
520631	3	5V Sensor Power	Voltage above normal or shorted to high source
	4		Voltage below normal or shorted to low source
520632	5	Rear Window Defrost	Current below normal or open circuit
	6		Current above normal or grounded circuit
520633	5	Auxilary Hydraulics Forward	Current below normal or open circuit
	6		Current above normal or grounded circuit
520634	5	Auxilary Hydraulics Reverse	Current below normal or open circuit
	6		Current above normal or grounded circuit
520635	5	Differential Lock	Current below normal or open circuit
	6		Current above normal or grounded circuit
520636	5	Fan Reverse	Current below normal or open circuit
	6		Current above normal or grounded circuit
520637	5	High Flow Reverse	Current below normal or open circuit
	6		Current above normal or grounded circuit
520638	5	High Flow Forward	Current below normal or open circuit
	6		Current above normal or grounded circuit