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Safety Symbol and Signal Words

This manual and decals on the machine warn of safety hazards and should be read and observed closely.

Manitou Americas, in cooperation with the Society of Automotive Engineers, has adopted this:



Safety Alert Symbol

This safety alert symbol means ATTENTION! ALWAYS BE ALERT! YOUR SAFETY IS INVOLVED! This symbol is used throughout this operator's manual and on the decals on the machine.

⚠ DANGER

The word "DANGER" indicates an imminently hazardous situation, that, if not avoided, will result in serious injury or death.

⚠ WARNING

The word "WARNING" indicates a potentially hazardous situation that, if not avoided, could result in serious injury or death.

⚠ CAUTION

The word "CAUTION" indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury.

- Before operating the machine, read and study the safety information in this manual. Be sure that everyone who operates or works with the machine is familiar with the safety precautions. It is essential to have competent and careful operators, who are not physically or mentally impaired, and are thoroughly trained in the safe operation of the machine and the handling of loads. It is recommended that the operator be capable of obtaining a valid motor vehicle operator's license.
- The use of the machine is subject to certain hazards that cannot be eliminated by mechanical means, but only by exercising intelligence, care and common sense. Such hazards include, hillside operation, overloading, instability of the load, poor maintenance and using the machine for a purpose for which it is not intended or designed.
- Manitou Americas always takes operator's safety into consideration during the design process. Guards and shields are provided, which protect the operator and bystanders from moving parts and other hazards. Operators must be alert, however, because some areas cannot be guarded or shielded without preventing or interfering with proper operation. This Operator's Manual, and decals on the machine, warn of additional hazards, and these warnings should be read and observed closely.
- Replace a lost or damaged Operator's Manual. Always store this operator's manual in the storage compartment provided for it.
- Do not use the machine for any application or purpose other than those described in this manual, or in manuals supplied with any attachments used with the machine.
- Some photographs in this manual may show doors, guards or shields open or removed for illustrative purposes only. Be sure that all doors, guards and shields are in their proper operating positions before starting the engine to operate the machine.

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Indicators and Controls

⚠ WARNING

Become familiar with all controls before operating the machine. Know how to stop the machine before starting it. The machine is designed and intended to be used only with Manitou-approved attachments or accessories. Manitou cannot be responsible for operator safety if the machine is used with unapproved attachments.

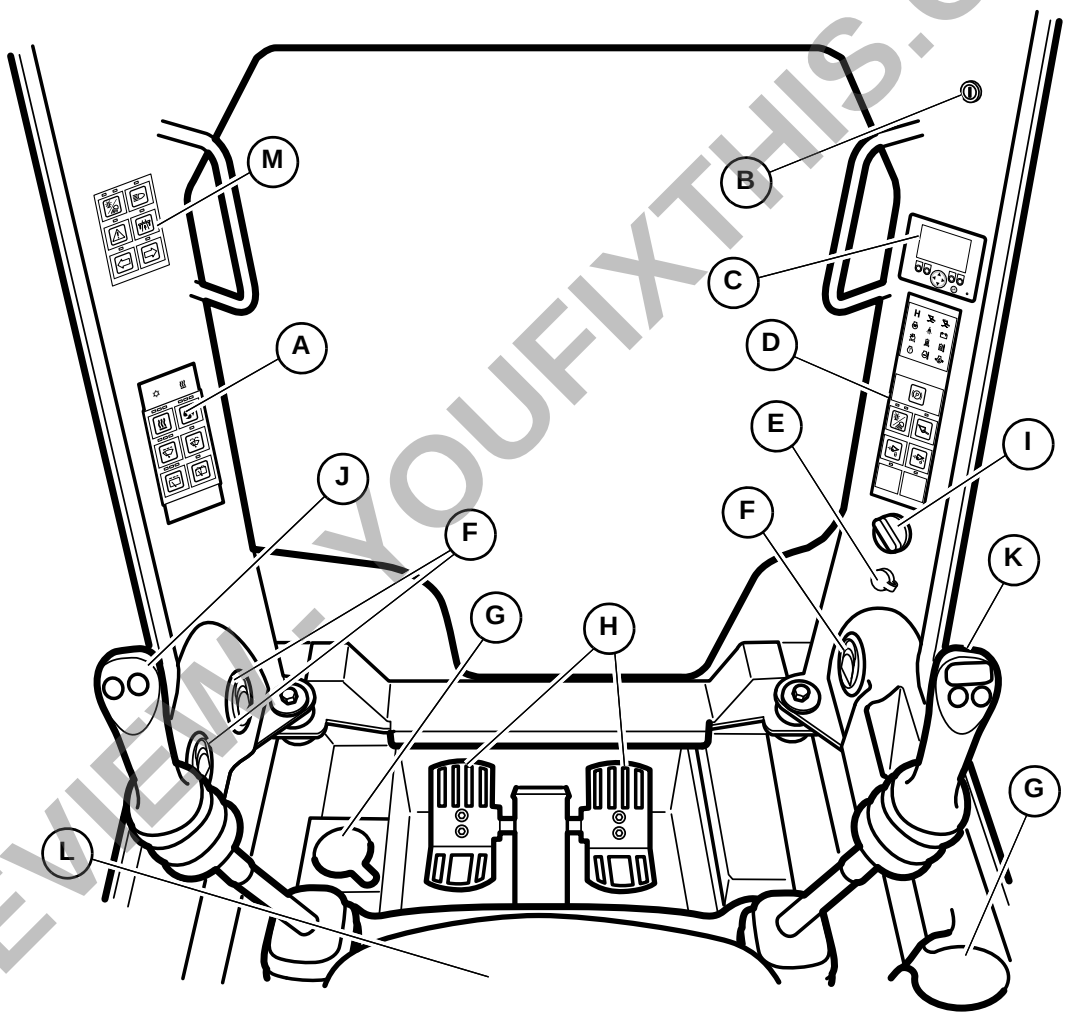


Fig. 19 – Controls (Hand/Foot Control Option Shown)

A. Accessory Keypad (page 41)	F. HVAC Vent Nozzle	K. Right Hand Control (page 56)
B. Ignition Keyswitch (page 49)	G. Cup Holder	L. Operator's Seat (page 29)
C. Information Center Electronic Display (page 43)	H. Foot Controls (page 56)	M. Optional Lights/Lockout Keypad (page 42)
D. Control Keypad (page 38)	I. Throttle Control (page 49)	
E. Electrical Accessory Socket	J. Left Hand Control (page 56)	

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NOTE: *Continuous flow amount is controlled using engine speed.*

To cancel continuous flow, either push trigger button (G) or move rocker switch (F) in either direction.

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Maintenance Schedules

Table 13: Inspection, Checks and Cleaning

Service Procedure	Maximum Interval		
	10 Hours (or Daily)	250 Hours	500 Hours (or Annually)
Remove foreign material (page 101).	X		
Check engine air cleaner restriction indicator (page 110).	X		
Check for loose or missing parts; repair/replace if necessary.	X		
Check engine oil level and condition (page 104).	X		
Check fuel level and fill if necessary (page 106).	X		
Check hydraulic oil level and condition (page 104).	X		
Check coolant level and condition (page 104).	X		
Check cooling system for dirt and debris (page 112).	X		
Check water separator; drain water, if present (page 106).	X		
Check windshield washer system and wiper blade, if applicable (page 123).	X		
Check tire pressures (page 119).	X		
Check bucket cutting edge (page 119).	X		
Test safety interlock system (page 32).	X		
Check hydraulic cylinder piston rods for damage/wear; clean if necessary.	X		
Check ROPS/FOPS structure – all fasteners must be installed and tightly secured.	X		
Check hydraulic hoses and tubes for cracks and/or debris (page 114).	X		
Grease hitch, hitch-related cylinder pivots and latch pins (page 100).	X		
Grease lift arm pins (page 100).	X		
Check wheel fastener torque (page 119).	X[1]	X	
Check oil level in chaincases (page 118).		X	
Check drive chain tension (page 118).		X	
Check alternator/fan belt tension and condition (page 111).		X	
Check battery (page 123).			X
Check engine mounting hardware (page 103).			X

1. Check wheel fastener torque before initial operation and every two hours until the wheel mounting hardware torque stabilizes. Check wheel nut torque every 250 hours thereafter. See “Wheel Nuts” on page 119.

Table 14: Leakage Check

Service Procedure	Maximum Interval		
	10 Hours (or Daily)	250 Hours	500 Hours (or Annually)
Check engine for oil/coolant leaks.	X		
Check cooling system for leaks.	X		
Check hydraulic system for leaks.	X		

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Hydrostatic System

Introduction

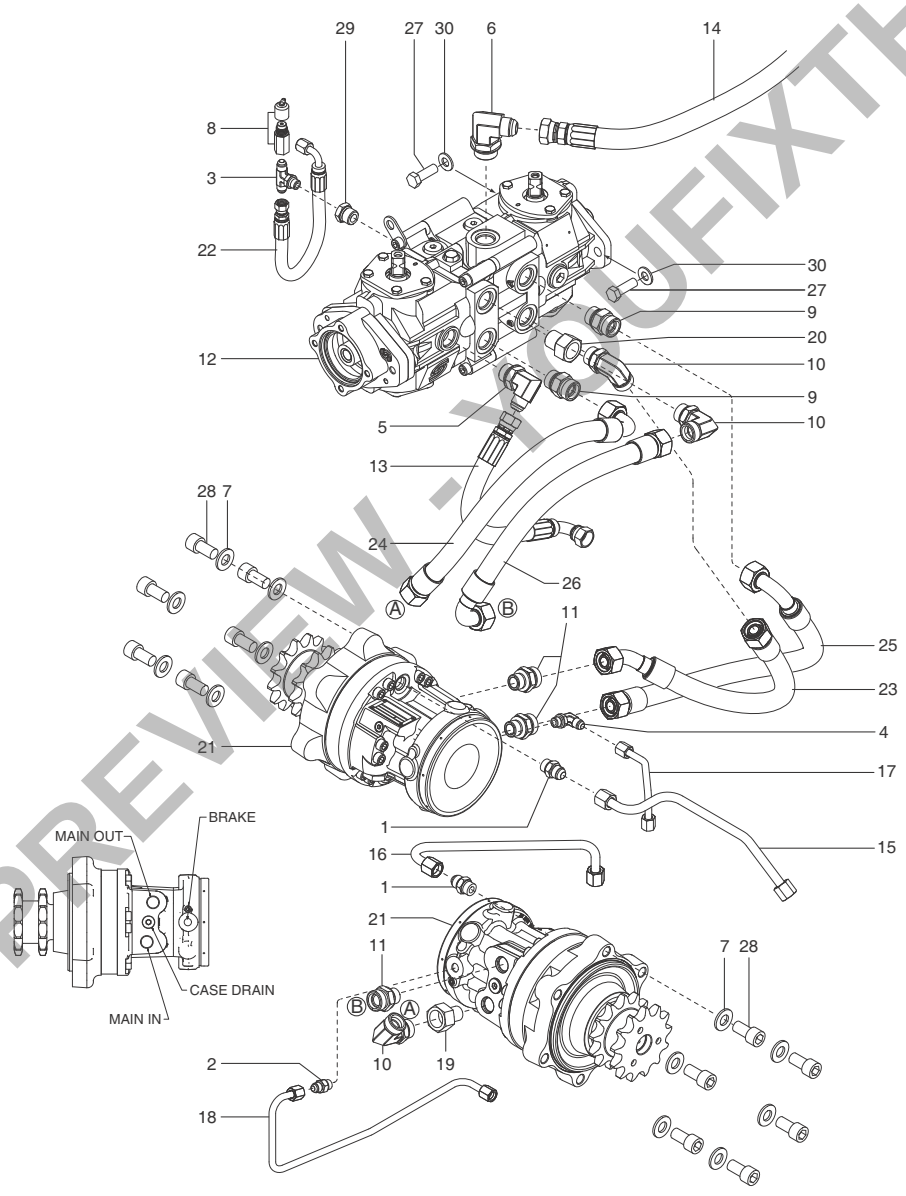
This section includes troubleshooting, testing and adjustment procedures for the tandem pump system.

A hydrostatic tandem pump assembly coupled to the engine drives two fixed-displacement hydrostatic drive motors. The motors rotate the wheels on both sides of the machine through a chain-and-sprocket system. The pumps and motors are controlled individually, allowing complete flexibility in forward, reverse, gradual, pivot and spin turns.

Refer to “Hydrostatic Drive System Troubleshooting” on page 313.

For detailed information on pump and motor internal repairs, consult the Manitou Americas Service Department or the component manufacturer’s service manual.

Hydrostatic Components - Single-Speed - R135/1350R



1	Straight Fitting
2	Straight Fitting
3	Tee Fitting
4	90° Fitting
5	90° Fitting
6	90° Fitting
7	Washer
8	Test Fitting
9	Straight Fitting
10	90° Fitting
11	Straight Fitting
12	Mechanical Drive Pump
13	Hose
14	Hose
15	Tube
16	Tube
17	Tube
18	Tube
19	Straight Fitting
20	Drive Motor
22	Hose
23	Hose
24	Hose
25	Hose
26	Hose
27	Screw
28	Screw
29	Straight Fitting
30	Washer

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Lift Arm Support

The lift arm support prevents the raised lift arm from lowering unexpectedly. The lift arm support must be applied whenever the lift arm is left in the raised position.

⚠ WARNING

A falling lift arm could result in severe injury or death. Never allow anyone under a raised lift arm without the lift arm support applied.

If the lift arm must be left in the raised position, BE SURE to properly apply the lift arm support.

The operator must not leave the operator's position if the lift arm is in the raised position unless the lift arm support is properly applied.

Applying and disengaging the lift arm support requires two people – one person inside the machine and another person outside the machine to apply and/or disengage the support device.

The lift arm support must be kept in proper operating condition at all times.

IMPORTANT: *A second person on the outside of the machine is required to assist with applying the lift arm support.*

Engage Lift Arm Support

1. Empty and remove the attachment (See "Connecting Attachments" on page 96).
2. Bring the machine to a complete stop on a level surface.
3. Lower the lift arm fully.
4. Stop the engine.
5. Have an assistant remove the lift arm support from its storage location on the left side of the machine. Remove lynchpin (T, Fig. 15) holding lift arm support (T) up against the lift arm. Allow lift arm support (T) device to pivot down into contact with the lift cylinder.



Fig. 15 – Lift Arm Support Storage Lynchpin Removal

6. Restart the engine.
7. Use the lift control to raise the lift arm until lift arm support (T, Fig. 16) drops over the end of the lift cylinder and around the cylinder rod.

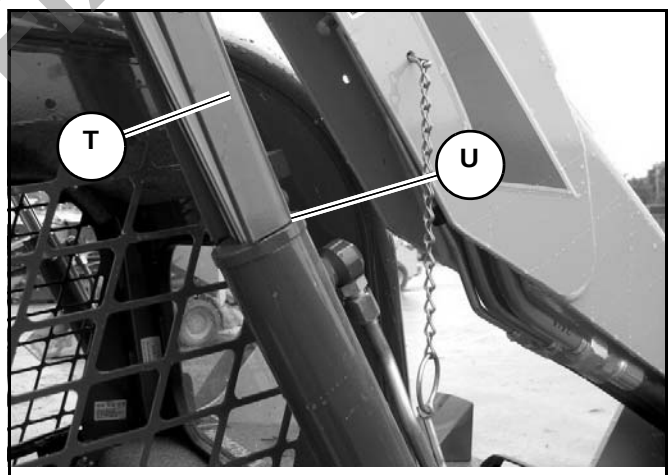


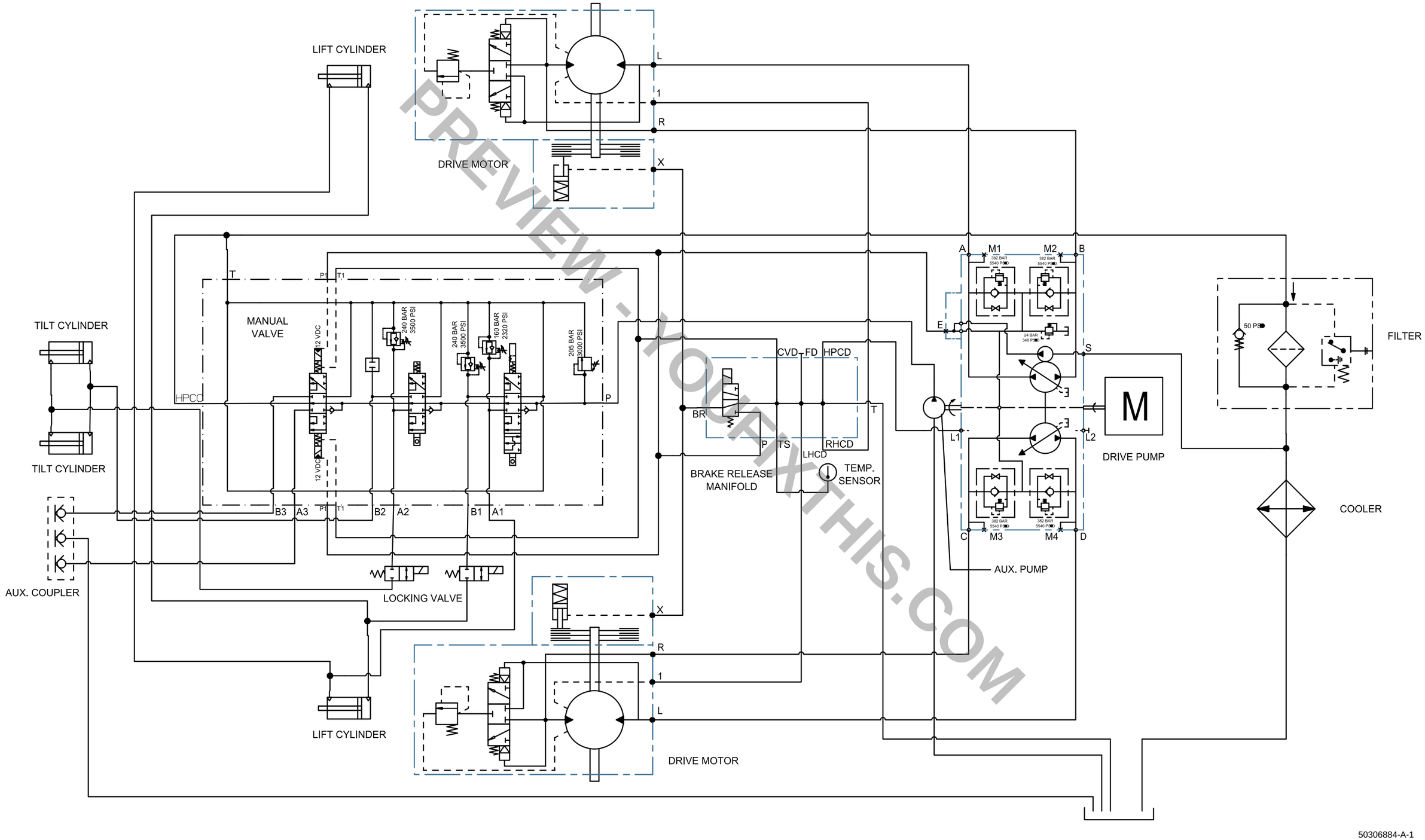
Fig. 16 – Lift Arm Support Engaged

8. Slowly lower the lift arm until the free end of the support device contacts the top end of the lift cylinder (U).
9. Check the support device to ensure it is secure against the cylinder end.
10. Stop the engine.
11. Move the lift control to verify the control does not cause the lift arm to move.
12. Unfasten the seat belt, remove the ignition key and take it with you. Exit the machine using the hand-holds.

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Hydraulic Schematic – Models 135R/1350R



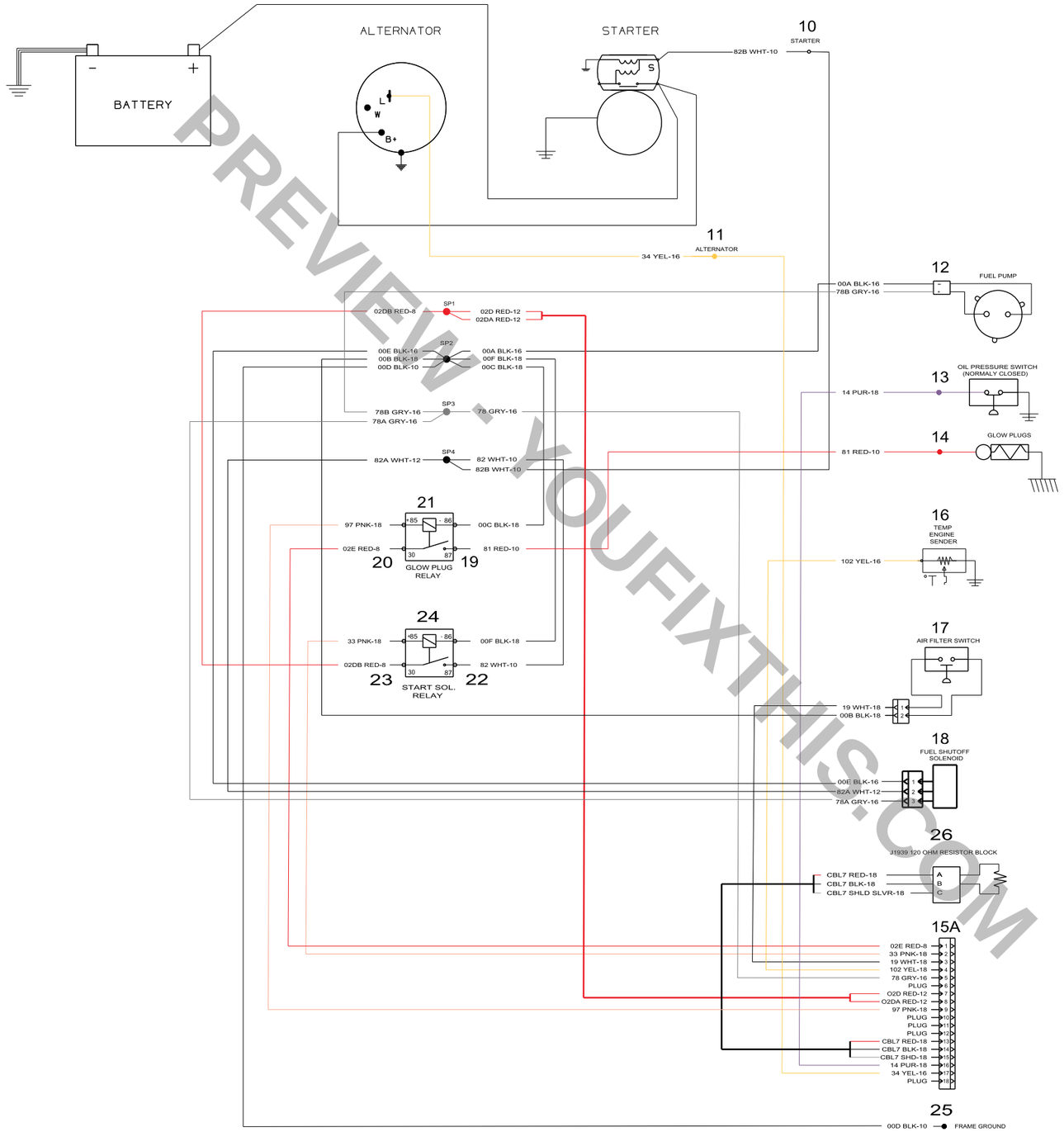
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Schematics

Electrical Schematic – Models R135/R150 Engine (Interim Tier 4)



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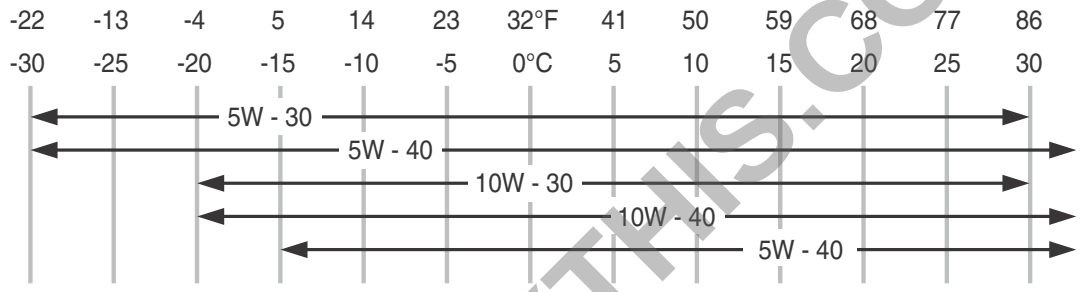
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Specifications

Fluid Capacities/Lubricants

Table 32: Fluid Capacities/Lubricants

Component/ Application	Type	R135/1350R	R150/1500R	R165/1650R
Engine Oil (with filter)	Refer to the Engine Operator's Manual for specific engine oil recommendations Service Classification: API-CJ-4 SM	6.7 L (7.1 qts) (w/out filter)		9.5 L (10 qts)
				
Hydraulic Oil Tank	Petro Canada HVI60, Mobil DTE 15M or equivalent, which contain anti-rust, anti-foam and anti-oxidation additives, and conforms to ISO VG46	37.9 L (10 gal.)	41.6 L (11 gal.)	
Hydraulic System – Total	HVLPD 46 (HYD0530) Biodegradable oil: AVILUB Syntofluid 46; PANOLIN HLP Synth 46	53.0 L (14 gal.)	56.8 L (15 gal.)	
Grease Fittings, Lift Arm	Lithium-saponified, brand-name multi-purpose grease MPG-A	As Required		
Battery Terminals	SP-B acid-proof grease	As Required		
Diesel Fuel Tank	DPF Models: ULSD[1] ultra-low sulfur only, below 15 PPM ASTM D975 with biodiesel content limited to 5% of DIN EN14214 type (no additives allowed!)	62.5 L (16.5 gal.)		
	Non-DPF Models: ASTM D975-94 (no additives allowed!) DIN EN14214 Biodiesel (no additives allowed!) LSD or ULSD[1] low sulfur or ultra-low sulfur, below 500 PPM. Up to 5% (B5) mixture of BioDiesel allowed			
Engine Coolant	Long life coolant ASTM D4985, D6210 (United States) SAE J814C, J1941, J1034 or J2036 (international) (See "Coolant Compound Mixtures" on page 350)	9.5 L (2.5 gal.)		14.4 L (3.8 gal.)

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Error Codes

The tables in this section describe error codes which may be reported on the information center electronic display screen. More than one error can be reported at one time and may be display on more than one screen. See page 58.

Engine Diagnostic Trouble Codes (DTC)

Table 31: Yanmar Engine Diagnostic Trouble Codes (DTC)

DTC			Error Item	
SPN	FMI	P-Code	Part	State
28	0	P1126	Acceleration Sensor 3	Sensor failure (foot pedal in open position)
	1	P1125	Acceleration Sensor 3	Sensor failure (foot pedal in closed position)
	2	P0224	Acceleration Sensor 3	Intermittent fault
	3	P0223	Acceleration Sensor 2	Acceleration sensor 2 fault (high voltage)
	4	P0222	Acceleration Sensor 2	Acceleration sensor 2 fault (low voltage)
29	0	P1226	Accelerator Pedal Position Sensor "B"	Above normal operation range
	1	P1225	Accelerator Pedal Position Sensor "B"	Below normal operation range
	3	P0227	Acceleration Sensor 3	Acceleration sensor 3 fault (high voltage)
		P0228	Acceleration Sensor 3	Acceleration sensor 3 fault (high voltage)
	8	P1127	Acceleration Sensor 3	Sensor failure (pulse communication)
		P1227	Accelerator Pedal Position Sensor "B"	Communication fault
	15	P1228	Accelerator Pedal Position Sensor "B"	Not available
51	3	P02E9	Intake Throttle Opening Sensor	Intake throttle opening sensor fault (high voltage)
	4	P02E8	Intake Throttle Opening Sensor	Intake throttle opening sensor fault (low voltage)
91	2	P0124	Acceleration Sensor 1	Intermittent Fault
	3	P0123	Acceleration Sensor 1	Acceleration sensor 1 fault (high voltage)
	4	P0122	Acceleration Sensor 1	Acceleration sensor 1 fault (low voltage)
100	1	P1198	Oil Pressure Switch	Low oil pressure fault alarm
	4	P1192	Oil Pressure Switch	Oil pressure switch open circuit
102	3	P0238	EGR Low Pressure Side Sensor	EGR low pressure side sensor fault (high voltage)
	4	P0237	EGR Low Pressure Side Sensor	EGR low pressure side sensor fault (low voltage)
	13	P0236	EGR Low Pressure Side Sensor	Abnormal learning value
105	3	P040D	Intake Air Temperature Sensor	Intake air temperature sensor fault (high voltage)
	4	P040C	Intake Air Temperature Sensor	Intake air temperature sensor fault (low voltage)
108	2	P2230	Barometric Pressure Sensor	Intermittent fault
	3	P2229	Atmospheric Pressure Sensor	Atmospheric pressure sensor fault (high voltage)
	4	P2228	Atmospheric Pressure Sensor	Atmospheric pressure sensor fault (low voltage)
	10	P1231	Atmospheric Pressure Sensor	Atmospheric pressure sensor characteristic fault

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Engine Troubleshooting

Table 25: Engine Troubleshooting

Problem	Possible Cause	Corrective Action
Engine does not turn over	Blown fuse.	Check circuit and replace fuse. See “Fuses, Relays and Diodes” on page 151.
	Dead battery.	Charge or replace battery—see “Jump-starting” on page 90.
	Battery disconnect switch in open position or malfunctioning.	Place battery disconnect switch into closed position—Repair or replace if necessary.
	Starter malfunction.	Repair/replace starter.
	Operator not in operator’s seat.	Operator’s seat must be occupied for the engine to start.
	Malfunctioning seat/restraint bar/door switch/wiring.	Replace seat/restraint bar/door switch. Check wiring for poor connections, broken leads; repair wiring or connection.
	Cab door open (if equipped).	Close cab door.
	Engine electronics logic error.	Resolve error
	Engine fault code(s) displayed.	Identify problem and correct.
	Relay malfunction.	Replace relay.
	Solenoid malfunction.	Troubleshoot circuit per wiring diagram. Replace solenoid as necessary.
Engine turns over but will not start	Engine cranking speed too slow.	Check battery and charge/replace as necessary—tighten battery terminals.
		In cold temperatures, pre-warm the engine.
	Fuel tank empty.	Fill tank and vent fuel system if necessary.
	Fuel filter plugged or restricted.	Change fuel filter.
	Fuel paraffin separation in winter.	Use winter grade diesel fuel.
	Fuel line leak.	Tighten all threaded connections and clamps; replace fuel line as necessary.
	Fuel shut-off solenoid not energizing.	Check electrical connections/voltage to shut-off solenoid.
	Fuel filter restricted/fuel hose restriction.	Replace filter/check for pinched fuel hose.
	Fuel pump malfunction.	Repair/replace fuel pump.
	Water in fuel filter.	Purge water from filter.
	Fuel valve on water separator in the OFF position.	Turn the valve to the ON position.
	Engine fault code(s) displayed.	Identify problem and correct.
	Engine too cold/ambient temperature too low.	Pre-heating module malfunction; check connection and voltage and charge/replace as necessary. Install block heater.

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Torque Specifications

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)

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After Starting

1. Check that the charge ( ) and oil pressure ( ) indicators go out after the engine starts.

IMPORTANT: *If the charge ( ) and/or the engine oil pressure ( ) indicators do not go out when the engine is running, shut down the engine immediately and correct the problem. Damage to the engine may result if engine is run and the problem is not corrected.*

2. Press the parking brake button (Fig. 58) on the control keypad to release the parking brake.



Fig. 58 – Parking Brake Button

NOTE: *The parking brake ( ) indicator on the control keypad is lit when the parking brake is engaged.*

3. Perform restraint bar safety interlock system test on page 32.
4. Check for proper steering operation.
5. Check for excessively smoky exhaust (“Engine Troubleshooting” on page 159):
   - Black smoke indicates poor and/or incomplete diesel fuel combustion.
   - Blue smoke indicates engine oil combustion.
   - White smoke indicates incomplete diesel combustion and/or coolant in the combustion chamber. Watch for persons hazardously close to the machine after starting and during machine operation.

IMPORTANT: *Do not run the engine at full throttle until it reaches operating temperature, or damage to the engine can result. Perform the following warm up procedure after starting before using the machine.*

IMPORTANT: *Do not run the engine at high speed (above 20% of full throttle) for extended periods when the machine is not under load. Damage to the engine can result.*

Warm Up

⚠ WARNING

Do not operate the machine until the hydraulic system reaches operating temperature. When cold, hydraulic response is slow and can be unpredictable, presenting an unsafe condition. Damage to the machine can also result.

1. After starting, allow the engine to run at low idle with no load for a minimum of 5 minutes without operating the drive, lift, tilt or auxiliary functions.
2. Run the engine at 1800 rpm with no load for 5 minutes.
3. Raise the lift arm so the attachment is off the ground.
4. Extend and retract each of the cylinders several times with no load.
5. Travel slowly forward and backward several times.
6. In cold weather, tilt the attachment all the way forward and keep it there for 20-25 seconds. Repeat this step until the attachment tilt speed is normal.

Run-In Period

The performance and service life of the machine is heavily dependent on using the machine carefully during its first 100 operating hours.

- Do not operate the machine at the maximum rated operating capacity.
- Do not run the engine at a high speed for extended periods of time.

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Axle and Wheel Bearing Disassembly/Assembly

Models R165/1650R, R150/1500R, R135 (SN FOE193365 and Up), 1350R (SN DOE187213 and Up)

Disassembly

⚠ CAUTION

Use caution when clamping cast parts to avoid damage them.

1. Clamp the axle housing assembly in a workbench vise. Use caution not to clamp cast web members in a way they might be damaged.
2. Using a retaining ring pliers, remove the external retaining ring and washers from the axle shaft.
3. Remove the inner bearing cup and cone from the axle shaft.
4. Remove the axle from the axle housing.
5. Remove the axle seal from the axle housing.
6. Remove the inner bearing cone from the axle shaft.
7. Turn the housing assembly over and remove the inner bearing cup from the axle housing assembly.
8. Thoroughly clean/flush all the disassembled parts.

Assembly

IMPORTANT: *Pack the tapered bearing cones with synthetic grease before assembling. Use suitable drivers or a press to countersink components until they bottom out.*



Fig. 129 – Axle Bearing Greasing

1. Install the bearing cup in the axle housing with a force of 6000 lbf-ft (26,7 kN) using a bearing press.



Fig. 130 – Outer Bearing Cup

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Table 23: Main Control Unit LEDs/Pins

LED	Description	LED State	In/Out	Pin
(No LED)	Engine Temperature (+5VDC)	N/A		J2-4
	Fuel Level (+5VDC)			J2-15
	Engine Oil Pressure (+5VDC) (interim tier 4 engine)			J2-16
	Alternator pre-excitation (PCI)			J2-14
	Spare analog in 1			J2-9
	Auxiliary forward/reverse			J2-10
	Throttle pedal			J2-22
	CAN high			J2-5
	CAN low			J2-17
	V-IGN			J1-1
	V-IGN			J1-6
	V-IGN			J1-3
	Ground			J1-9
	Signal ground			J1-8

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27. Disconnect wiring connectors (T and U, Fig. 365) from ECU (X).

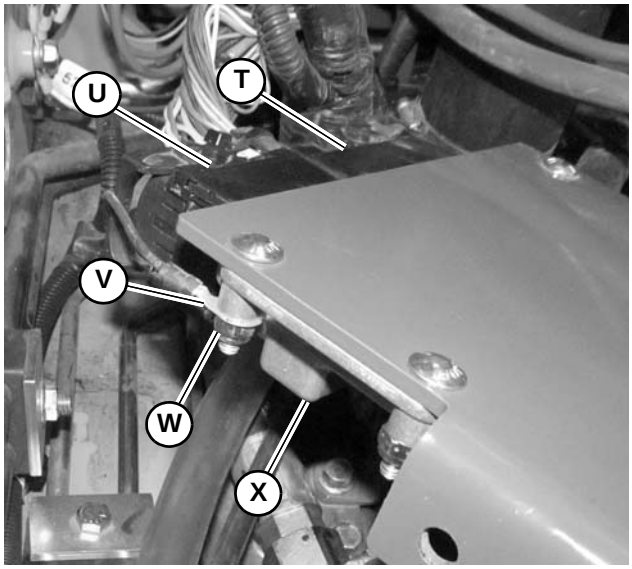


Fig. 365 – Disconnect ECU Wiring Connectors

28. Remove locknut (W) and disconnect wiring connector (V) from ECU (X).

NOTE: *To prevent hydraulic oil contamination, cap/plug all openings.*

29. Remove nut and washer (Y, Fig. 366). Disconnect wiring connector (Z).

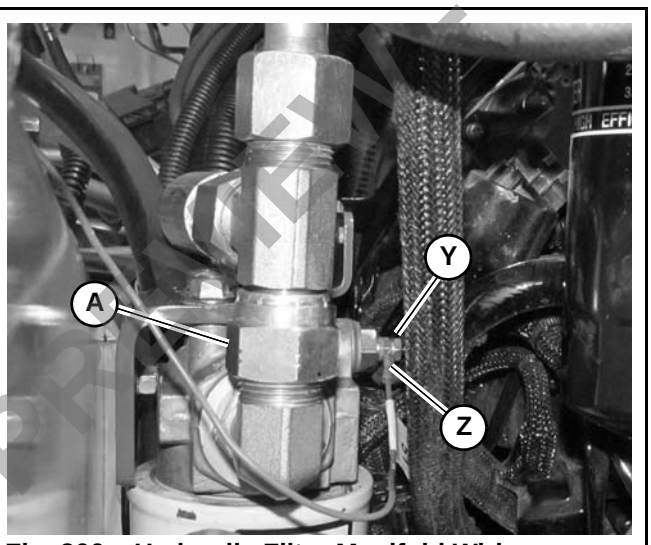


Fig. 366 – Hydraulic Filter Manifold Wiring Connector and Hydraulic Fitting

30. Disconnect hydraulic fitting (A) from the hydraulic filter manifold.

31. Disconnect fitting (B, Fig. 367) and two hose clamps (C) from the hydraulic filter manifold.

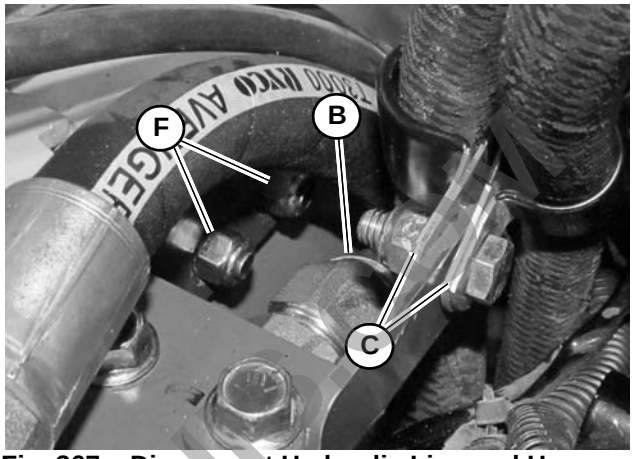


Fig. 367 – Disconnect Hydraulic Line and Hose Bracket from Hydraulic Filter Manifold

32. Remove two locknuts and two carriage bolts (F). Remove the hydraulic filter manifold.

33. Label and disconnect wiring connectors from solenoids (G and H, Fig. 368).

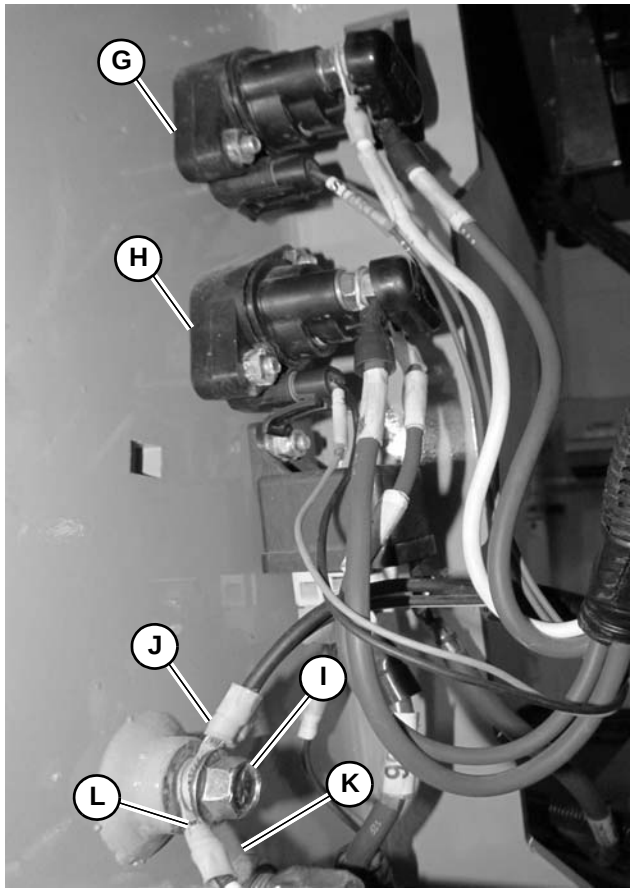


Fig. 368 – Solenoid Wiring Connectors and Ground Wires

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