

SKYTRAK™



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Service Manual

Models

**6036, 6042, 8042,
10042, 10054, 12054**

**PVC 1911
31211388**

January 21, 2020 - Rev A

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EFFECTIVITY PAGE

DATE	REVISION	DESCRIPTION
January 21, 2020	A	Original Issue Of Manual

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Modifications

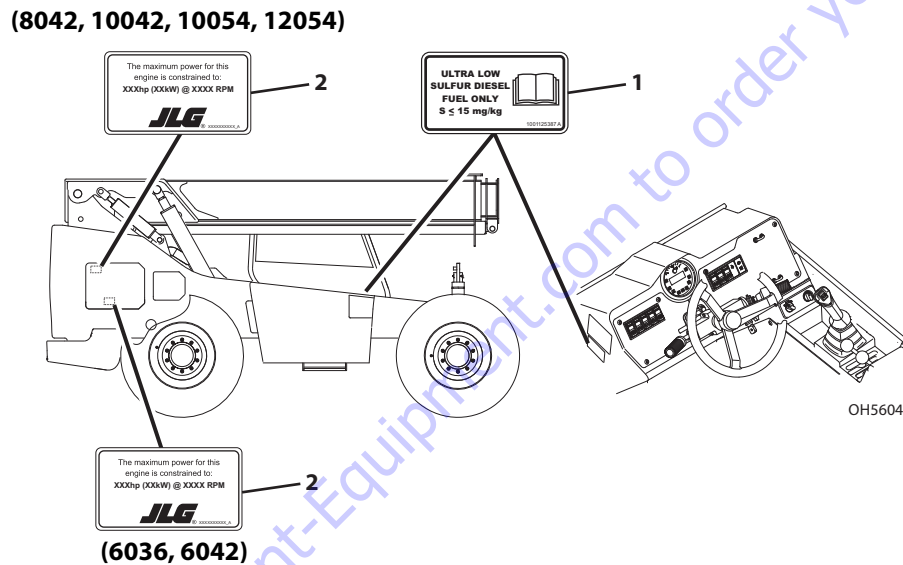
Modifications to this machine may affect compliance with Industry Standards and/or Governmental Regulations. Any modification must be approved by JLG.

Machine Configuration

Two configurations of each machine are included in this manual. Determine if machine is equipped with Ultra Low Sulfur Fuel Decal (1) as indicated below.

- If equipped with the Ultra Low Sulfur decal, all specific references to this machine configuration will be referred to as Ultra Low Sulfur (**ULS**) from this point forward.
- If **not** equipped with the Ultra Low Sulfur decal, all specific references to this machine configuration will be referred to as Low Sulfur (**LS**) from this point forward.

Maximum engine power can be found on the decals (2) located on the inside of the side engine compartment doors.



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Section 1

Safety Practices

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Safety Practices

1.1 INTRODUCTION

This service manual provides general directions for accomplishing service and repair procedures. Following the procedures in this manual will help assure safety and equipment reliability.

Read, understand and follow the information in this manual, and obey all locally approved safety practices, procedures, rules, codes, regulations and laws.

These instructions cannot cover all details or variations in the equipment, procedures, or processes described, nor provide directions for meeting every possible contingency during operation, maintenance, or testing. When additional information is desired consult your local authorized service distributor.

Many factors contribute to unsafe conditions: carelessness, fatigue, overload, inattentiveness, unfamiliarity, even drugs and alcohol, among others. For optimal safety, encourage everyone to think, and to act, safely.

Appropriate service methods and proper repair procedures are essential for the safety of the individual doing the work, for the safety of the operator, and for the safe, reliable operation of the machine. All references to the right side, left side, front and rear are given from the operator seat looking in a forward direction.

Supplementary information is available from JLG in the form of Service Bulletins, Service Campaigns, Service Training Schools, the manufacturer website, other literature, and through updates to the manual itself.

1.2 DISCLAIMER

All information in this manual is based on the latest product information available at the time of publication. The manufacturer reserves the right to make changes and improvements to its products, and to discontinue the manufacture of any product, at its discretion at any time without public notice or obligation.

1.3 OPERATION & SAFETY MANUAL

The mechanic must not operate the machine until the Operation & Safety Manual has been read and understood, training has been accomplished and operation of the machine has been completed under the supervision of an experienced and qualified operator.

An Operation & Safety Manual is supplied with each machine and must be kept in the manual holder located in the cab. In the event that the Operation & Safety Manual is missing, consult your local authorized service distributor before proceeding.

1.4 DO NOT OPERATE TAGS

Place Do Not Operate Tags on the ignition key switch and the steering wheel before attempting to perform any service or maintenance. Remove key and disconnect battery leads.

1.5 SAFETY INFORMATION

To avoid possible death or injury, carefully read, understand and comply with all safety messages.

In the event of an accident, know where to obtain medical assistance and how to use a first-aid kit and fire extinguisher/fire suppression system. Keep emergency telephone numbers (fire department, ambulance, rescue squad/paramedics, police department, etc.) nearby. If working alone, check with another person routinely to help assure personal safety.

1.5.1 Safety Alert System and Signal Words



DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.



1.6 SAFETY INSTRUCTIONS

Following are general safety statements to consider **before** performing maintenance procedures on the telehandler. Additional statements related to specific tasks and procedures are located throughout this manual and are listed prior to any work instructions to provide safety information before the potential of a hazard occurs.

For all safety messages, carefully read, understand and follow the instructions **before** proceeding.

1.6.1 Personal Hazards

PERSONAL SAFETY GEAR: Wear all the protective clothing and personal safety gear necessary to perform the job safely. This might include heavy gloves, safety glasses or goggles, filter mask or respirator, safety shoes or a hard hat.

LIFTING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist.

1.6.2 Equipment Hazards

LIFTING OF EQUIPMENT: Before using any lifting equipment (chains, slings, brackets, hooks, etc.), verify that it is of the proper capacity, in good working order, and is properly attached.

NEVER stand or otherwise become positioned under a suspended load or under raised equipment. The load or equipment could fall or tip.

DO NOT use a hoist, jack or jack stands only to support equipment. Always support equipment with the proper capacity blocks or stands properly rated for the load.

HAND TOOLS: Always use the proper tool for the job; keep tools clean and in good working order, and use special service tools only as recommended.

1.6.3 General Hazards

SOLVENTS: Only use approved solvents that are known to be safe for use.

HOUSEKEEPING: Keep the work area and operator cab clean, and remove all hazards (debris, oil, tools, etc.).

FIRST AID: Immediately clean, dress and report all injuries (cuts, abrasions, burns, etc.), no matter how minor the injury may seem. Know the location of a First Aid Kit, and know how to use it.

CLEANLINESS: Wear eye protection, and clean all components with a high-pressure or steam cleaner before attempting service.

When removing hydraulic components, plug hose ends and connections to prevent excess leakage and contamination. Place a suitable catch basin beneath the machine to capture fluid run-off.

It is good practice to avoid pressure-washing electrical/electronic components. In the event pressure-washing the machine is needed, ensure the machine is shut down before pressure-washing. Should pressure-washing be utilized to wash areas containing electrical/electronic components, it is recommended a maximum pressure of 750 psi (52 bar) at a minimum distance of 12 in (30,5 cm) away from these components. If electrical/electronic components are sprayed, spraying must not be direct and for brief time periods to avoid heavy saturation.

Check and obey all Federal, State and/or Local regulations regarding waste storage, disposal and recycling.



Safety Practices

1.6.4 Operational Hazards

ENGINE: Stop the engine before performing any service unless specifically instructed otherwise.

VENTILATION: Avoid prolonged engine operation in enclosed areas without adequate ventilation.

SOFT SURFACES AND SLOPES: NEVER work on a machine that is parked on a soft surface or slope. The machine must be on a hard level surface, with the wheels blocked before performing any service.

FLUID TEMPERATURE: NEVER work on a machine when the engine, cooling or hydraulic systems are hot. Hot components and fluids can cause severe burns. Allow systems to cool before proceeding.

FLUID PRESSURE: Before loosening any hydraulic or diesel fuel component, hose or tube, turn the engine OFF. Wear heavy, protective gloves and eye protection. **NEVER** check for leaks using any part of your body; use a piece of cardboard or wood instead. If injured, seek medical attention immediately. Diesel fluid leaking under pressure can explode. Hydraulic fluid and diesel fuel leaking under pressure can penetrate the skin, cause infection, gangrene and other serious personal injury.

Engine fuel lines are pressurized. **DO NOT** attempt repairs unless specific training has been completed. Refer to the engine manufacturers' manual for specific details concerning the fuel system.

Relieve all pressure before disconnecting any component, part, line or hose. Slowly loosen parts and allow release of residual pressure before removing any part or component. Before starting the engine or applying pressure, use components, parts, hoses and pipes that are in good condition, connected properly and are tightened to the proper torque. Capture fluid in an appropriate container and dispose of in accordance with prevailing environmental regulations.

COOLANT SYSTEM CAP: The cooling system is under pressure, and escaping coolant can cause severe burns and eye injury. To prevent personal injury, **NEVER** remove the radiator cap while the cooling system is hot. Wear safety glasses. Turn the radiator cap to the first stop and allow pressure to escape before removing the cap completely. Failure to follow the safety practices could result in death or serious injury.

Properly disconnect battery(s) prior to service the fuel or hydraulic systems.

FLUID FLAMABILITY: DO NOT service the fuel or hydraulic systems near an open flame, sparks or smoking materials.

NEVER drain or store fluids in an open container. Engine fuel and hydraulic fluid are flammable and can cause a fire and/or explosion.

DO NOT mix gasoline or alcohol with diesel fuel. The mixture can cause an explosion.

PRESSURE TESTING: When conducting any test, only use test equipment that is correctly calibrated and in good condition. Use the correct equipment in the proper manner, and make changes or repairs as indicated by the test procedure to achieve the desired result.

LEAVING MACHINE: Lower the forks or attachment to the ground before leaving the machine.

TIRES: Always keep tires inflated to the proper pressure to help prevent tipover. **DO NOT** over-inflate tires.

NEVER use mismatched tire types, sizes or ply ratings. Always use matched sets according to machine specifications.

MAJOR COMPONENTS: Never alter, remove, or substitute any items such as counterweights, tires, batteries or other items that may reduce or affect the overall weight or stability of the machine.

BATTERY: DO NOT charge a frozen battery. Charging a frozen battery may cause it to explode. Allow the battery to thaw before jump-starting or connecting a battery charger.

1.7 SAFETY DECALS

Check that all safety decals are present and readable on the machine. Refer to the Operation & Safety Manual supplied with machine for information.



Section 2

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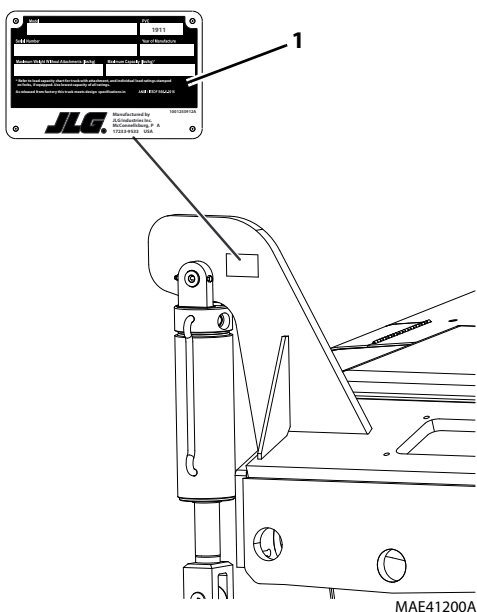
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2.1 REPLACEMENT PARTS AND WARRANTY INFORMATION



Before ordering parts or initiating service inquiries, make note of the machine serial number. The machine serial number plate (1) is located as indicated in the figure.

Note: The replacement of any part on this machine with any other than **JLG** authorized replacement parts can adversely affect the performance, durability, or safety of the machine, and will void the warranty. **JLG** disclaims liability for any claims or damages, whether regarding property damage, personal injury or death arising out of the use of unauthorized replacement parts.

A warranty registration form must be filled out by the **JLG** distributor, signed by the purchaser and returned to **JLG** when the machine is sold and/or put into use.

Registration activates the warranty period and helps to assure that warranty claims are promptly processed. To guarantee full warranty service, verify that the distributor has returned the business reply card of the warranty registration form to **JLG**.



2.2 SPECIFICATIONS

2.2.1 Travel Speeds

a. 6036, 6042

Transmission	6036	6042
First Gear	3.6 mph (5,8 km/hr)	3.6 mph (5,8 km/hr)
Second Gear	6.1 mph (9,8 km/hr)	6.1 mph (9,8 km/hr)
Third Gear	14.5 mph (23,3 km/hr)	14.5 mph (23,3 km/hr)
Fourth Gear	19.5 mph (31.4 km/hr)	19 mph (30,6 km/hr)

b. 8042

Transmission	If equipped for ULS	If equipped for LS/74 hp (55kW)
First Gear	3.3 mph (5,3 km/hr)	3 mph (4,8 km/hr)
Second Gear	5.5 mph (8,6 km/hr)	4.9 mph (7,9 km/hr)
Third Gear	13.3 mph (21,4 km/hr)	11.7 mph (18,8 km/hr)
Fourth Gear	18.7 mph (30,1 km/hr)	16.6 mph (26,7 km/hr)

c. 10042

Transmission	If equipped for ULS	If equipped for LS	If equipped for 74 hp (55kW)
First Gear	3.5 mph (5,6 km/hr)	3.5 mph (5,6 km/hr)	3.0 mph (4,8 km/hr)
Second Gear	5.8 mph (9,3 km/hr)	5.8 mph (9,3 km/hr)	4.9 mph (7,9 km/hr)
Third Gear	13.8 mph (23 km/hr)	13.8 mph (23 km/hr)	12.0 mph (19,3 km/hr)
Fourth Gear	19.6 mph (31,5 km/hr)	19.6 mph (31,5 km/hr)	16.2 mph (26,1 km/hr)

d. 10054

Transmission	If equipped for ULS/LS	If equipped for 74 hp (55kW)
First Gear	3.5 mph (5,6 km/hr)	3.0 mph (4,8 km/hr)
Second Gear	5.8 mph (9,3 km/hr)	4.9 mph (7,9 km/hr)
Third Gear	13.8 mph (23 km/hr)	12.0 mph (19,3 km/hr)
Fourth Gear	19.6 mph (31,5 km/hr)	16.2 mph (26,1 km/hr)



e. 12054

Transmission	If equipped for 110 hp	If equipped for 74 hp
First Gear	3.1 mph (5 km/hr)	3.1 mph (5 km/hr)
Second Gear	5.1 mph (8,2 km/hr)	5.2 mph (8,3 km/hr)
Third Gear	12.3 mph (19,8 km/hr)	12.2 mph (19,6 km/hr)
Fourth Gear	17.7 mph (28,5 km/hr)	16.9 mph (27,2 km/hr)

2.2.2 Hydraulic Cylinder Performance

Note: Machine with no attachment or load, engine at full throttle, hydraulic oil above 130°F (54°C) minimum, engine at operating temperature.

a. 6036, 6042, 8042, 10042 & 10054

FUNCTION	APPROXIMATE TIMES (seconds)				
	6036	6042	8042	10042	10054
Boom Extend	Less than 13.0	Less than 16.0	Less than 16.5	Less than 18.5 for ULS	Less than 19.5
				Less than 18.0 for LS/74 HP	
Boom Retract	Less than 12.0	Less than 15.0	Less than 13.5	Less than 16.0	Less than 16.0
Boom Lift Retracted	Less than 11.0	Less than 13.0	Less than 16.0	Less than 17.0	Less than 17.0
Boom Lower Retracted	Less than 8.0	Less than 11.0	Less than 14.0	Less than 17.0 for ULS	Less than 15.5 for ULS
				Less than 18.0 for LS/74 HP	Less than 17.0 for LS/74 HP
Attachment Tilt - Up	8.0	8.0	10.0	10.0	10.0
Attachment Tilt - Down	8.0	8.0	8.0	8.0	8.0
Frame Level Left to Right with Boom Down	12.0 - 14.0	12.0 - 14.0	12.0 - 14.0	12.0 - 14.0	12.0 - 14.0
Frame Level Left to Right with Boom Above 40° and Emergency Brake Engaged	—	23.0-33.0	23.0 - 33.0	23.0 - 33.0	23.0 - 33.0
Frame Level Right to Left with Boom Down	12.0 - 14.0	12.0 - 14.0	12.0 - 14.0	12.0 - 14.0	12.0 - 14.0
Frame Level Right to Left with Boom Above 40° and Emergency Brake Engaged	—	26.0-52.0	26.0 - 52.0	26.0 - 52.0	26.0 - 52.0
Outrigger - Left or Right, UP or DOWN	—	—	—	—	—



General Information and Specifications

b. 12054

FUNCTION	APPROXIMATE TIMES (seconds)			
	12054 110 HP		12054 74 HP	
	Min. Time	Max. Time	Min. Time	Max. Time
Boom Up	16.0	18.0	17.0	19.0
Boom Down*	15.0	17.5	17.0	19.0
Boom Extend	15.0	17.0	16.0	18.0
Boom Retract	14.0	16.5	16.5	18.5
Attachment Tilt Fwd	10.0	13.0	10.0	13.0
Attachment Tilt Back	8.0	10.0	8.0	10.0
Sway full right to full left	14.0	17.0	14.0	17.0
Sway full right to full left with boom above 40 degrees and park brake engaged	23.0	33.0	23.0	33.0
Sway full left to full right	12.0	14.0	12.0	13.5
Sway full left to full right with boom above 40 degrees and park brake engaged	26.0	52.0	26.0	52.0
Outriggers Extend Both	7.0	10.0	7.0	10.0
Outriggers Retract Both	5.0	8.0	5.0	8.0

*With standard fork tilt carriage installed.



2.2.3 Electrical System

Battery	
Type, Rating	12 BCI, Negative (-) Ground, Maintenance Free
Quantity	1
Cold Cranking Amps	3.8 Liter - 950 CCA @ 0° F (-18° C)
Reserve Capacity	205 Minutes @ 80° F (27° C)
Group/Series	Group 31 - 950
Alternator	12V, 135 Amps

2.2.4 Engine Performance Specifications

a. 6036 & 6042

Description	If Equipped for ULS	If Equipped for LS	If Equipped w/ 74hp (55kW)
Engine Make/Model	Cummins Turbo QSF3.8	Cummins Turbo QSF3.8	Cummins Turbo QSF3.8
Displacement	232 in ³ (3,8 liters)	232 in ³ (3,8 liters)	232 in ³ (3,8 liters)
Low Idle (no load)	1000 rpm	1000 rpm	1000 rpm
High Idle (no load)	2500 rpm	2500 rpm	2500 rpm
Horsepower	85 hp (63 kW) @ 2500 rpm	85 hp (63 kW) @ 2500 rpm	74 hp (55 kW) @ 2500 rpm
Peak Torque	340 lb-ft (461 Nm) @ 1400 rpm	340 lb-ft (461 Nm) @ 1400 rpm	295 lb-ft (400 Nm) @ 1300 rpm
Fuel Delivery	High Pressure Common Rail (HPCR) Fuel Injection		
Air Cleaner	Dry Type, Replaceable Primary and Safety Elements		

b. 8042, 10042, 10054 & 12054

Description	If Equipped for ULS	If Equipped for LS	If Equipped w/ 74hp (55kW)
Engine Make/Model	Cummins Turbo QSF3.8	Cummins Turbo QSF3.8	Cummins Turbo QSF3.8
Displacement	232 in ³ (3,8 liters)	232 in ³ (3,8 liters)	232 in ³ (3,8 liters)
Low Idle	1000 rpm	1000 rpm	1000 rpm
High Idle	2500 rpm	2500 rpm	2500 rpm
Horsepower	110 hp (82 kW) @ 2500 rpm	110 hp (82 kW) @ 2500 rpm	74 hp (55 kW) @ 2500 rpm
Peak Torque	348 lb-ft (472 Nm) @ 1500 rpm	348 lb-ft (472 Nm) @ 1500 rpm	295 lb-ft (400 Nm) @ 1300 rpm
Fuel Delivery	High Pressure Common Rail (HPCR) Fuel Injection		
Air Cleaner	Dry Type, Replaceable Primary and Safety Elements		

Note: No adjustment of the throttle is required. The engine Low Idle and High Idle are controlled by the engine ECM and cannot be adjusted without Cummins programming tools.



General Information and Specifications

2.2.5 Tires

Note: Standard wheel lug nut torque is 350 - 400 lb-ft (474 - 542 Nm).

Note: Pressure for foam filled tires are for initial fill ONLY.

a. 6036

Size	Tire Type	Minimum Ply/ Star Rating	Fill Type	Pressure
13.0 x 24	G-2/L2 Bias Ply Traction	12 Ply	Pneumatic	70 psi (4,8 bar)
			Foam - Approx 542 lb (246 kg)	
315/95x28	Solid Tires	NA	NA	NA
370/75x28	DuraForce	14 Ply	Pneumatic	76 psi (5,2 bar)
			Foam - Approx 464 lb (210 kg)	

b. 6042

Size	Tire Type	Minimum Ply/ Star Rating	Fill Type	Pressure
13.0 x 24	G-2/L-2 Bias Ply Traction	12 Ply	Pneumatic	70 psi (4,8 bar)
			Foam - Approx 542 lb (246 kg)	
	TG/G-3 Bias Ply Grader		Foam - Approx 542 lb (246 kg)	
315/95x28	Solid Tires	NA	NA	NA
370/75x28	DuraForce	14 Ply	Pneumatic	76 psi (5,2 bar)
			Foam - Approx 464 lb (210 kg)	

c. 8042

Size	Tire Type	Minimum Ply/ Star Rating	Fill Type	Pressure
15.5 x 25	G-2/L-2 Bias Ply Traction	12 Ply	Pneumatic	70 psi (4,8 bar)
			Foam - Approx 600 lb (272 kg)	
315/95x28	Solid Tires	NA	NA	NA
370/75x28	DuraForce	14 Ply	Pneumatic	76 psi (5,2 bar)
			Foam - Approx 464 lb (210 kg)	

d. 10042 & 10054

Size	Tire Type	Minimum Ply/ Star Rating	Fill Type	Pressure
17.50 x 25	G-2/L-2 Bias Ply Traction	16 Ply	Pneumatic	60 psi (4,1 bar)
		12 Ply	Foam - Approx 785 lb (356 kg)	
360/85x28	Solid Tires	NA	NA	NA
400/75x28	DuraForce	16 Ply	Pneumatic	76 psi (5,2 bar)
			Foam - Approx 570 lb (259 kg)	



e. 12054

Size	Tire Type	Minimum Ply/ Star Rating	Fill Type	Pressure
17.50 x 25	G-2/L-2 Bias Ply Traction	16 Ply	Pneumatic	65 psi (4,5 bar)
		12 Ply	Foam - Approx 785 lb (356 kg)	
400/75x28	DuraForce	16 Ply	Pneumatic	76 psi (5,25 bar)
			Foam - Approx 570 lb (259 kg)	
400/75x28	TLH 753	18 Ply	Pneumatic	76 psi (5,25 bar)
			Foam - Approx 570 lb (259 kg)	
360/85x28	Solid Tires	NA	NA	NA

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General Information and Specifications

2.3 FLUID & LUBRICANT CAPACITIES

2.3.1 Fluids

a. If Equipped for ULS

Compartment or System	Type and Classification	Viscosities	Ambient Temperature Range			
			°F		°C	
			Min	Max	Min	Max
Engine Crankcase	API CJ-4 Plus CES-20081 Fully Synthetic*	SAE 5W-40	-12	114	-24	45
		SAE 15W-40	15	114	-10	45
		SAE 10W-30	10	104	-12	40
		SAE 5W-30	-12	104	-24	40
		SAE 0W-30	-40	32	-40	0
Transmission and Transfer Case	MobilFluid 424	10W-30	-4	120	-20	49
	ZF TE-ML-03	75W-80	-20	15	-29	-10
Axle Differential and Wheel End	API GL5 with LS Additives	75W-90 LS	-20	114	-29	45
		80W-90 LS or 85W-90 LS	-4	114	-20	45
Hydraulic System	MobilFluid 424	10W-30	15	120	-10	49
	Exxon Univis HVI		-20	120	-29	49
Boom Wear Pad Grease	Mystik Tetrimoly	NLGI Grade 2	-4	104	-20	40
Grease Fittings	Extreme Pressure Grease	NLGI Grade 2 EP or NLGI Grade 3 EP with Moly Additive	5	114	-15	45
Boom Chain Lubricant	Gear Oil	80W-90	-20	114	-29	45
Engine Coolant	Ethylene Glycol and Water	50/50 Mix	Standard			
		60/40 Mix	Cold Weather			
Fuel	EN590 ASTM D975 Grade 1-D ASTM D975 Grade 2-D (Maximum B5 Biodiesel)	Ultra Low Sulfur (S ≤ 15 mg/kg)				
Diesel Exhaust Fluid (DEF) (85 or 110 HP)	ISO22241-1	32.5% Urea				
Brake Fluid	Mobil ATF-D/M		-20	114	-29	45
Air Conditioning	Refrigerant R-134A	Tetrafluoroethane				

Note: *See Note on page 2-16 for details.



b. If Equipped for LS

Compartment or System	Type and Classification	Viscosities	Ambient Temperature Range			
			°F		°C	
			Min	Max	Min	Max
Engine Crankcase	API CI-4 Multigrade CES-20078	SAE 5W-40	-12	114	-24	45
		SAE 15W-40	15	114	-10	45
		SAE 10W-30	10	104	-12	40
		SAE 5W-30	-12	104	-24	40
		SAE 0W-30	-40	32	-40	0
Transmission and Transfer Case	Mobilfluid 424	10W-30	-4	120	-20	49
	ZF TE-ML-03	75W-80	-20	15	-29	-10
Axle Differential and Wheel End	API GL5 with LS Additives	75W-90 LS	-20	114	-29	45
		80W-90 LS or 85W-90 LS	-4	114	-20	45
Hydraulic System	MobilFluid 424	10W-30	15	120	-10	49
	Exxon Univis HVI		-20	120	-29	49
Boom Wear Pad Grease	Mystik Tetrimoly	NLGI Grade 2	-4	104	-20	40
Grease Fittings	Extreme Pressure Grease	NLGI Grade 2 EP or NLGI Grade 3 EP with Moly Additive	5	114	-15	45
Boom Chain Lubricant	Gear Oil	80W-90	-20	114	-29	45
Engine Coolant	Ethylene Glycol and Water	50/50 Mix	Standard			
		60/40 Mix	Cold Weather			
Fuel	EN590 ASTM D975 Grade 1-D ASTM D975 Grade 2-D (Maximum B5 Biodiesel)	Low Sulfur (S ≤ 500 mg/kg)				
Brake Fluid	Mobil ATF-D/M		-20	114	-29	45
Air Conditioning	Refrigerant R-134A	Tetrafluoroethane				



General Information and Specifications

2.3.2 Capacities

Engine Crankcase Oil

Capacity w/Filter Change	12.7 quart (12,0 liter)
--------------------------	-------------------------

Fuel Tank

Capacity	35 gallon (133 liter)
----------	-----------------------

DEF Tank (if equipped for ULS 85 or 110 hp (63kW or 82kW))

Capacity	5 gallon (19 liter)
----------	---------------------

Cooling System

System Capacity	5 gallon (19 liter)
-----------------	---------------------

Hydraulic System

System Capacity	
6036, 6042 & 8042	46 gallon (174 liter)
10042 & 10054	52 gallon (196,8 liter)
12054	50 gallon (188 liter)
Reservoir Capacity to Full Mark	20.2 gallon (76,5 liter)

Transmission

Capacity with Filter Change	12.4 quart (11,8 liter)
-----------------------------	-------------------------

Axles

Differential Housing Capacity	
6036 & 6042	6.6 quart (6,3 liter)
8042	
Front Axle	7.9 quart (7,5 liter)
Rear Axle	8.2 quart (7,8 liter)
10042 & 10054	
Front Axle	12.7 quart (12 liter)
Rear Axle	7.9 quart (7,5 liter)
12054	
Front Axle	12.7 quart (12 liter)
Rear Axle	13.5 quart (12,7 liter)

Note: If axle fluid does not contain LS Additives, Friction Modifier may be added when replacing fluid. Pre-mix before placing in axle differential. Not pre-mixing fluids can lead to excessive brake noise.



Wheel End Capacity	
6036 & 6042	1.9 quart (1,8 liter)
8042	2.1 quart (2 liter)
10042, 10054 & 12054	
Front Axle	1.9 quart (1,8 liter)
Rear Axle	2.1 quart (2 liter)
Window Washer Bottle (if equipped)	
Capacity	2.2 quart (2,1 liter)
Air Conditioning System (if equipped)	
Capacity	1.9 lbs (0,86 kg)

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General Information and Specifications

2.4 SERVICE AND MAINTENANCE SCHEDULES

Note: If hour and year intervals are listed, perform maintenance at interval that occurs first.

2.4.1 Every 10 Hours



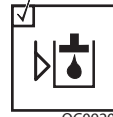
Drain Fuel/Water Separator



Check Engine Coolant Level



Check Engine Oil Level



Check Hydraulic Oil Level



Check Transmission Oil Level



Check Tire Condition and Pressure



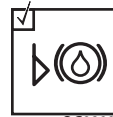
Check Air Cleaner



Check Fuel Level



Check DEF Level (if equipped for ULS/85 or 110HP)

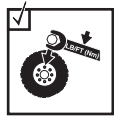


Check Brake Fluid Level

2.4.2 First 50 Hours

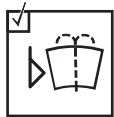


Check Boom Chain Tension



Check Wheel Lug Nut Torque

2.4.3 Every 50 Hours

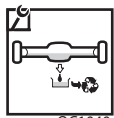


Check Washer Fluid

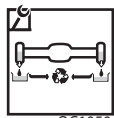


Lubrication Schedule

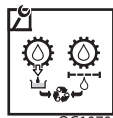
2.4.4 First 250 Hours



Change Axle Oil



Change Wheel End Oil



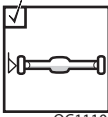
Change Transmission Fluid and Filter



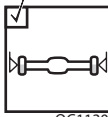
2.4.5 Every 250 Hours



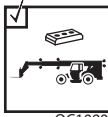
Lubrication Schedule



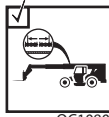
Check Axle Oil Level



Check Wheel End Oil Level



Check Boom Wear Pads



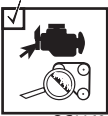
Check Boom Chains

2.4.6 First 500 Hours



Change Engine Oil and Filter (if equipped for ULS)

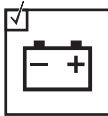
2.4.7 Every 500 Hours



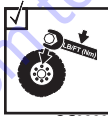
Check Fan Belt



Change Engine Oil and Filter (if equipped for LS)



Check Battery

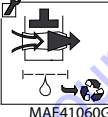


Check Wheel Lug Not Torque

2.4.8 Every 750 Hours



Change Hydraulic Fluid



Change Hydraulic Tank Breather (if equipped for ULS)



General Information and Specifications

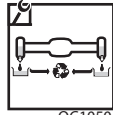
2.4.9 Every 1000 Hours



Lubrication
Schedule



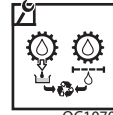
Change Axle Oil



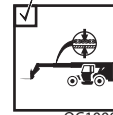
Change Wheel End
Oil



Change Engine Oil
and Filter (if
equipped for ULS)



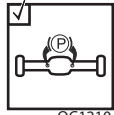
Change
Transmission Fluid
and Filter



Check Boom
Chain Tension



Grease Boom
Chains



Check Park Brake



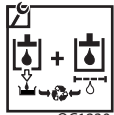
Change
Fuel Filters



Check Air Intake
System

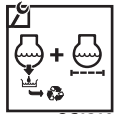
Note: If using fully synthetic oil, metal engine oil filter and fuel consumption is less than 11.4 liter per hour (3 gallon per hour), oil change intervals are 1,000 hours or 1 year. If any of the following are present, conventional oil, plastic engine oil filter or fuel consumption is greater than 11.4 liter per hour (3 gallon per hour), oil change intervals are 500 hours or 6 months.

2.4.10 Every 1500 Hours



Change Hydraulic
Fluid and Filters

2.4.11 Every 2000 Hours or 2 Year



Change Engine
Coolant and Clean
DEF Engine
Coolant Strainer
(if equipped for
ULS/85 or 110HP)



Change
DEF Tank Filter
(if equipped for
ULS/85 or 110 HP)



Change Engine
Coolant (if
equipped for LS)



2.4.12 Every 4000 Hours or 3 Years



Change
DEF Pump Filter
(if equipped for
ULS/85 or 110HP)

2.4.13 Every 5000 Hours or 4 Years



Engine Valve Lash
Adjustment

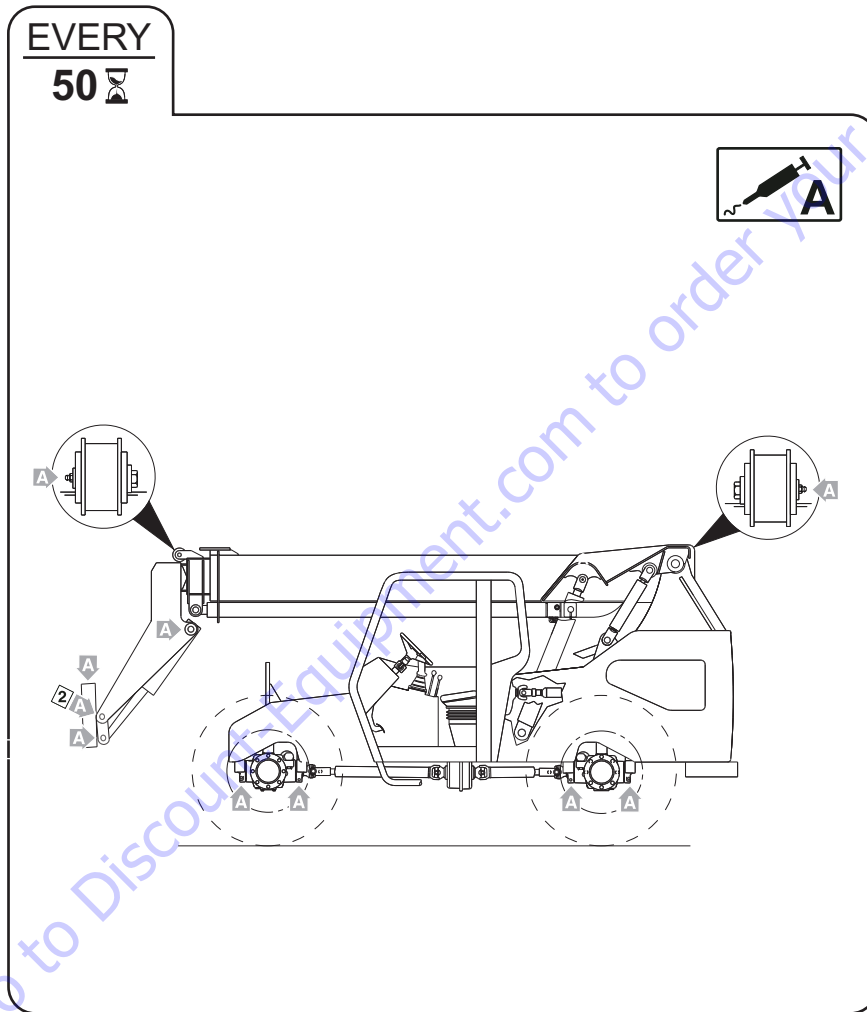
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2.5 LUBRICATION SCHEDULES

2.5.1 50 Hour

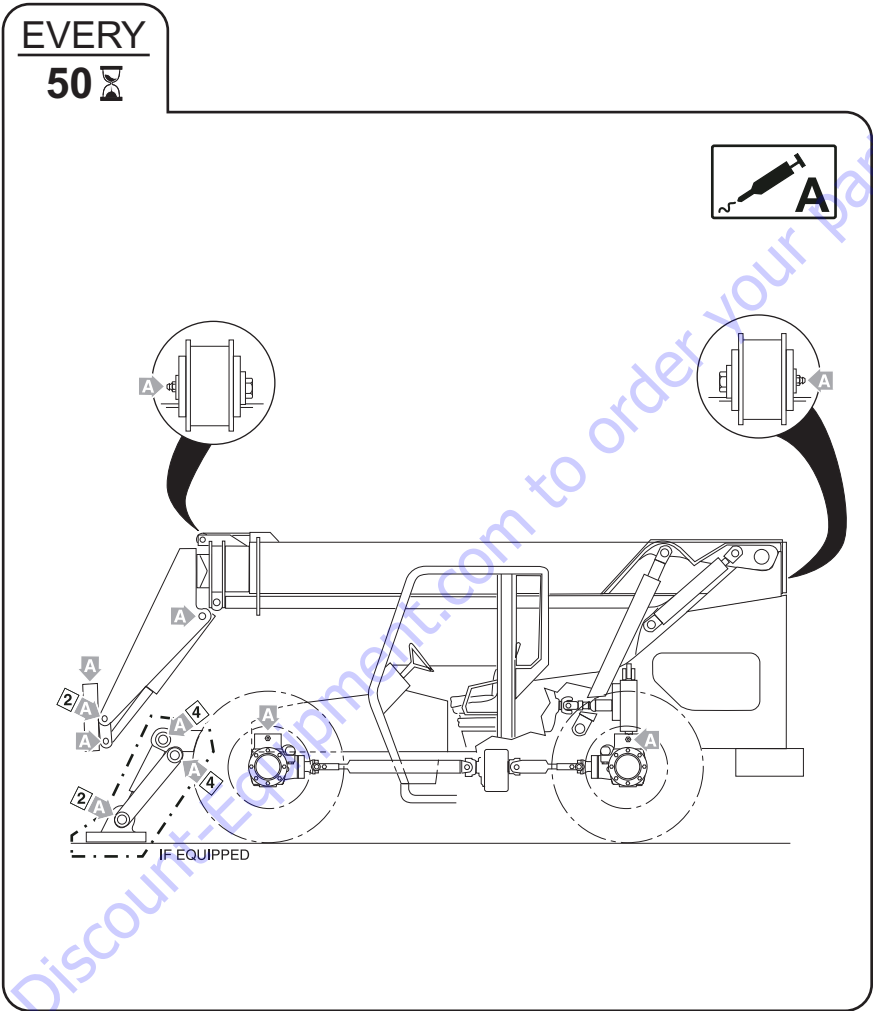
a. 6036 & 6042



OH5721



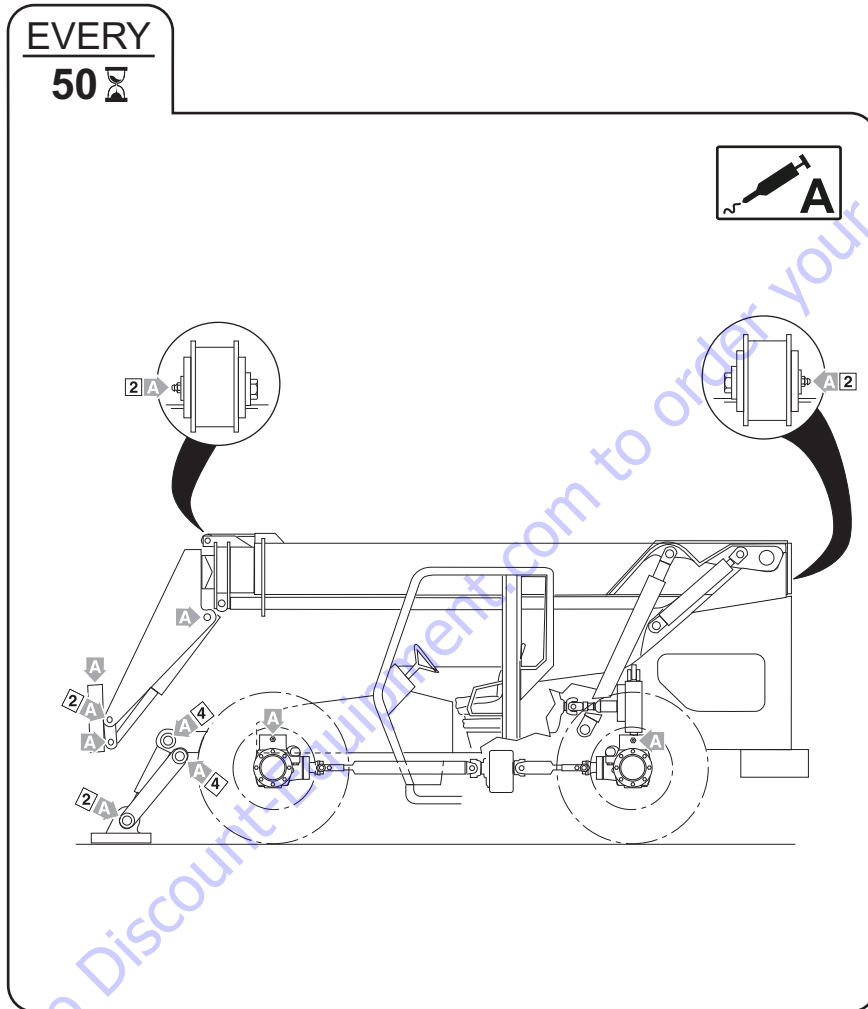
b. 8042 & 10042





General Information and Specifications

c. 10054 & 12054

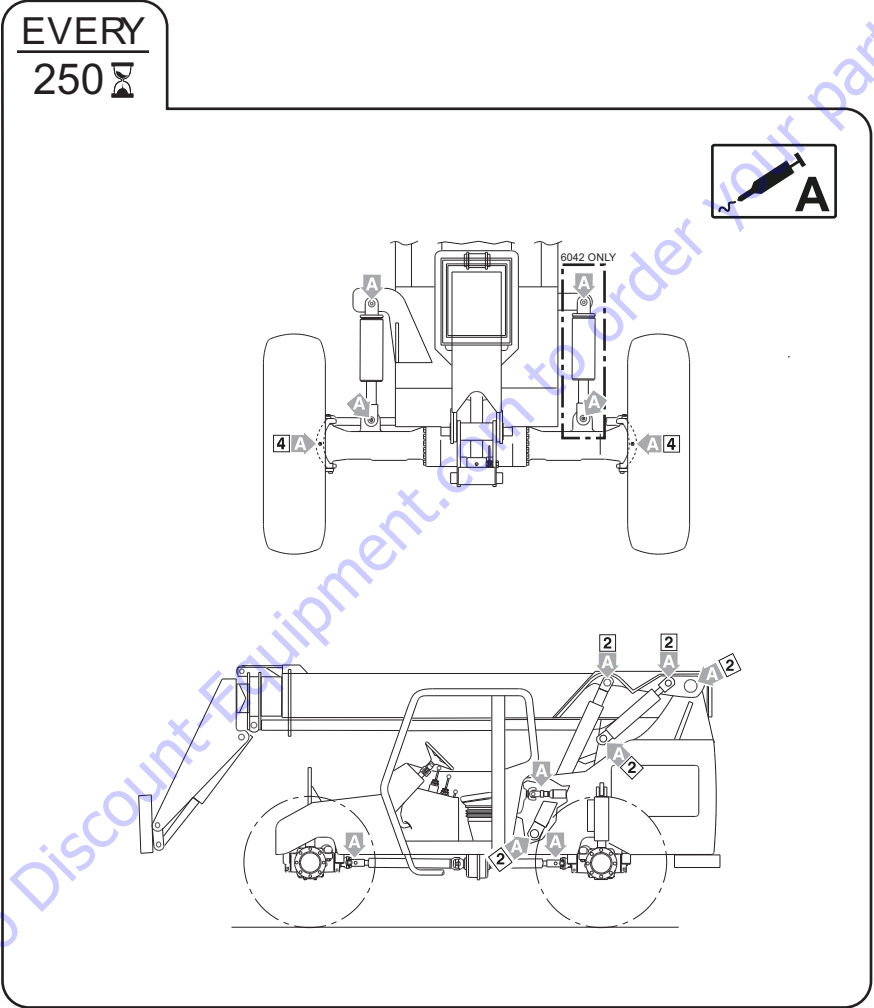


OH5711



2.5.2 250 Hour

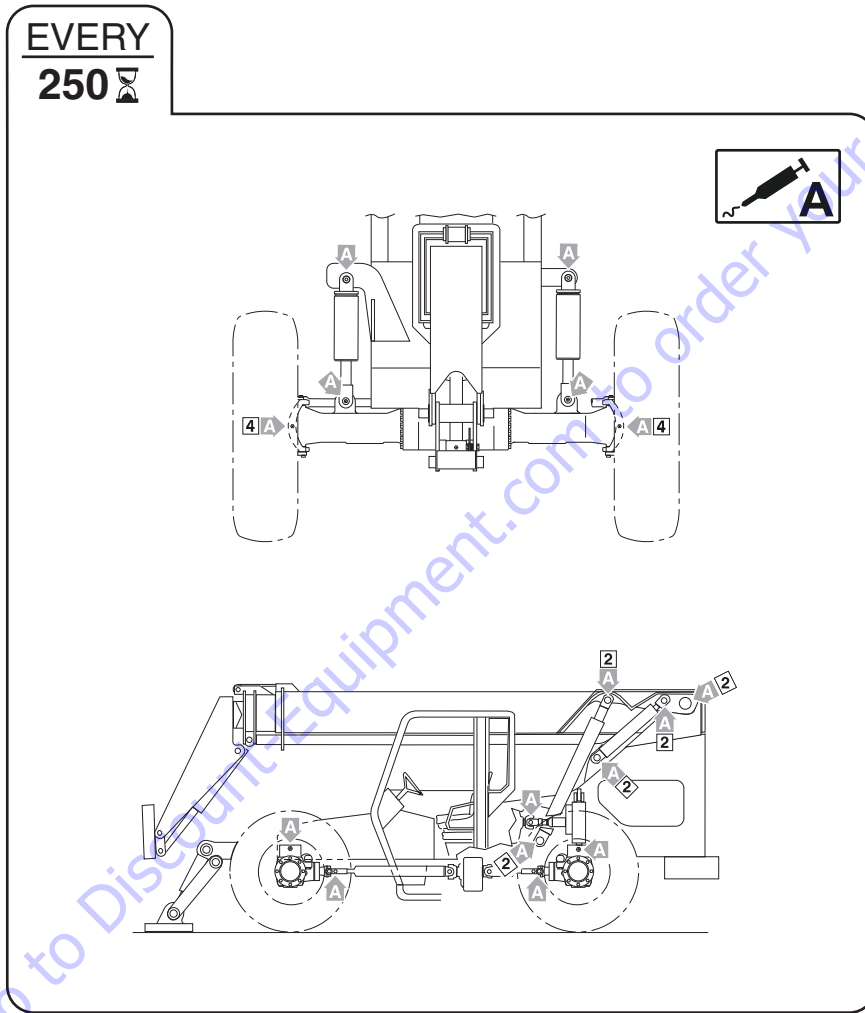
a. 6036 & 6042





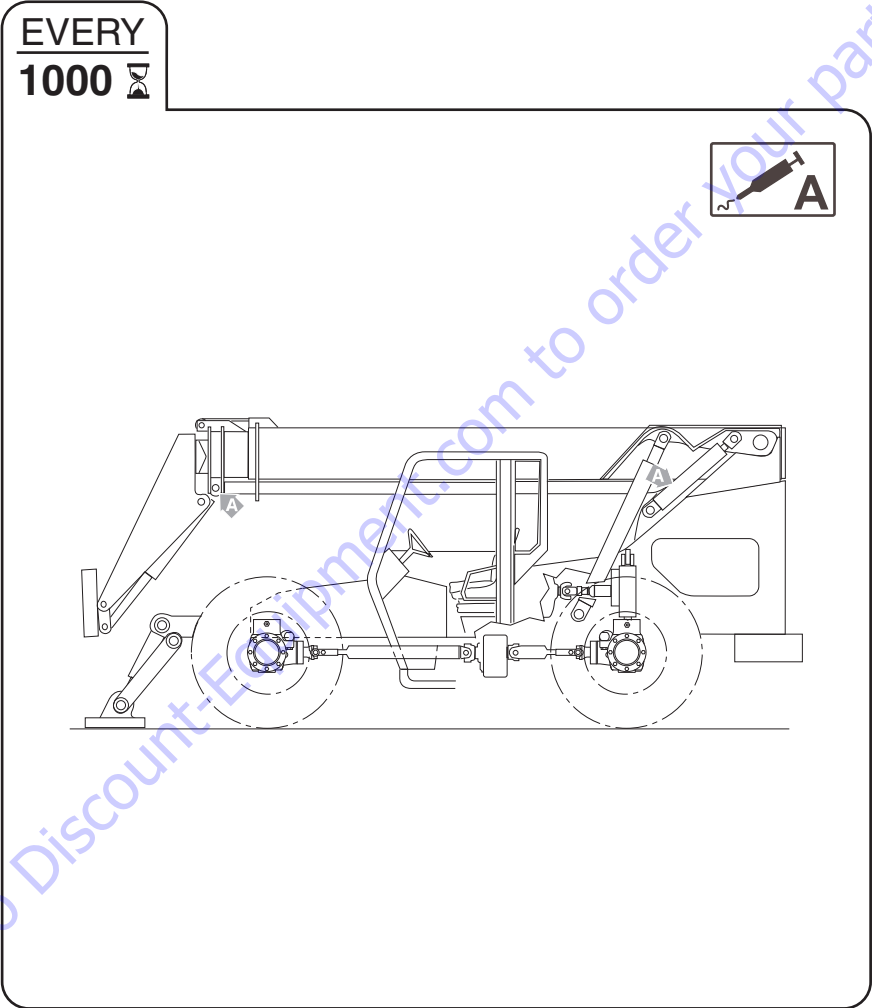
General Information and Specifications

b. 8042, 10042, 10054 & 12054





2.5.3 1000 Hour



OH4181



2.6 THREADLOCKING COMPOUND

JLG PN	Loctite®	ND Industries	Description
0100011	242™	Vibra-TITE™ 121	Medium Strength (Blue)
1001095650	243™	Vibra-TITE™ 122	Medium Strength (Blue)
0100019	271™	Vibra-TITE™ 140	High Strength (Red)
0100071	262™	Vibra-TITE™ 131	Medium - High Strength (Red)

Note: Loctite® 243™ can be substituted in place of Loctite® 242™. Vibra-TITE™ 122 can be substituted in place of Vibra-TITE™ 121.

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General Information and Specifications

2.7 TORQUE CHARTS

2.7.1 SAE Fastener Torque Chart

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)												
SAE GRADE 5 BOLTS & GRADE 2 NUTS												
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry)		Torque Lubricated		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ or Vibra-TITE™ 131)	
					IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	8	0.9	6	0.7				
	48	0.1120	0.00661	420	9	1.0	7	0.8				
6	32	0.1380	0.00909	580	16	1.8	12	1.4				
	40	0.1380	0.01015	610	18	2.0	13	1.5				
8	32	0.1640	0.01400	900	30	3.4	22	2.5				
	36	0.1640	0.01474	940	31	3.5	23	2.6				
10	24	0.1900	0.01750	1120	43	4.8	32	3.5				
	32	0.1900	0.02000	1285	49	5.5	36	4				
1/4	20	0.2500	0.0318	2020	96	10.8	75	9	105	12		
	28	0.2500	0.0364	2320	120	13.5	86	10	135	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	17	23	13	18	19	26	16	22
	24	0.3125	0.0580	3700	19	26	14	19	21	29	17	23
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48	28	38
	24	0.3750	0.0878	5600	35	47	25	34	40	54	32	43
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75	45	61
	20	0.4375	0.1187	7550	55	75	40	54	60	82	50	68
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116	68	92
	20	0.5000	0.1599	10700	90	122	65	88	100	136	80	108
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163	98	133
	18	0.5625	0.2030	12950	120	163	90	122	135	184	109	148
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	224	135	183
	18	0.6250	0.2560	16300	170	230	130	176	190	258	153	207
3/4	10	0.7500	0.3340	21300	260	353	200	271	285	388	240	325
	16	0.7500	0.3730	23800	300	407	220	298	330	449	268	363
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	646	386	523
	14	0.8750	0.5090	32400	470	637	350	475	520	707	425	576
1	8	1.0000	0.6060	38600	640	868	480	651	675	918	579	785
	12	1.0000	0.6630	42200	700	949	530	719	735	1000	633	858
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142	714	968
	12	1.1250	0.8560	47500	880	1193	660	895	925	1258	802	1087
1 1/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598	1009	1368
	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768	1118	1516
1 3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074	1322	1792
	12	1.3750	1.3150	73000	1680	2278	1260	1708	1750	2380	1506	2042
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754	1755	2379
	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128	1974	2676

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS

5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER



2.7.1 SAE Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.20		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
					IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474	1320	43	5				
10	24	0.1900	0.01750	1580	60	7				
	32	0.1900	0.02000	1800	68	8				
1/4	20	0.2500	0.0318	2860	143	16	129	15		
	28	0.2500	0.0364	3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	25	35	20	25	20	25
	24	0.3125	0.0580	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	7000	45	60	40	55	35	50
	24	0.3750	0.0878	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	9550	70	95	65	90	50	70
	20	0.4375	0.1187	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	12750	105	145	95	130	80	110
	20	0.5000	0.1599	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	16400	155	210	140	190	115	155
	18	0.5625	0.2030	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	20350	210	285	190	260	160	220
	18	0.6250	0.2560	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	30100	375	510	340	460	280	380
	16	0.7500	0.3730	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	41600	605	825	545	740	455	620
	14	0.8750	0.5090	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	51500	860	1170	770	1045	645	875
	12	1.0000	0.6630	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	142200	3555	4835	3200	4350	2665	3625

- NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
 3. * ASSEMBLY USES HARDENED WASHER

5000059K



General Information and Specifications

2.7.1 SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 5 BOLTS & GRADE 2 NUTS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
					IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	7	0.8				
	48	0.1120	0.00661	420	8	0.9				
6	32	0.1380	0.00909	580	14	1.5				
	40	0.1380	0.01015	610	14	1.6				
8	32	0.1640	0.01400	900	25	2.8				
	36	0.1640	0.01474	940	26	2.9				
10	24	0.1900	0.01750	1120	36	4.1				
	32	0.1900	0.02000	1285	42	4.7				
1/4	20	0.2500	0.0318	2020	86	9.7	80	9		
	28	0.2500	0.0364	2320	99	11.1	95	11		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	15	20	14	19	15	20
	24	0.3125	0.0580	3700	15	20	15	21	15	20
3/8	16	0.3750	0.0775	4940	25	35	25	34	25	34
	24	0.3750	0.0878	5600	30	40	28	38	25	34
7/16	14	0.4375	0.1063	6800	40	55	40	54	35	48
	20	0.4375	0.1187	7550	45	60	44	60	40	54
1/2	13	0.5000	0.1419	9050	65	90	60	82	55	75
	20	0.5000	0.1599	10700	75	100	71	97	65	88
9/16	12	0.5625	0.1820	11600	90	120	87	118	80	109
	18	0.5625	0.2030	12950	105	145	97	132	90	122
5/8	11	0.6250	0.2260	14400	130	175	120	163	115	156
	18	0.6250	0.2560	16300	145	195	136	185	125	170
3/4	10	0.7500	0.3340	21300	225	305	213	290	200	272
	16	0.7500	0.3730	23800	255	345	238	324	225	306
7/8	9	0.8750	0.4620	29400	365	495	343	466	320	435
	14	0.8750	0.5090	32400	400	545	378	514	355	483
1	8	1.0000	0.6060	38600	545	740	515	700	480	653
	12	1.0000	0.6630	42200	600	815	563	765	530	721
1 1/8	7	1.1250	0.7630	42300	675	920	635	863	595	809
	12	1.1250	0.8560	47500	755	1025	713	969	670	911
1 1/4	7	1.2500	0.9690	53800	955	1300	897	1219	840	1142
	12	1.2500	1.0730	59600	1055	1435	993	1351	930	1265
1 3/8	6	1.3750	1.1550	64100	1250	1700	1175	1598	1100	1496
	12	1.3750	1.3150	73000	1420	1930	1338	1820	1255	1707
1 1/2	6	1.5000	1.4050	78000	1660	2260	1560	2122	1465	1992
	12	1.5000	1.5800	87700	1865	2535	1754	2385	1645	2237

- NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
 3. * ASSEMBLY USES HARDENED WASHER

5000059K



2.7.1 SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
					IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474	1320	37	4				
10	24	0.1900	0.01750	1580	51	6				
	32	0.1900	0.02000	1800	58	7				
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	410	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

- NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
 3. * ASSEMBLY USES HARDENED WASHER

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General Information and Specifications

2.7.1 SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SOCKET HEAD CAPSCREWS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) or Precoat® 85 K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
					IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	415	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

- NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
 3. * ASSEMBLY USES HARDENED WASHER
 4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED

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2.7.1 SAE Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*										
SOCKET HEAD CAPSCREWS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE® 111 or 140) or Precoat® 85 K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
					IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
		In	Sq In	LB						
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	415	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

- NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K
 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
 3. * ASSEMBLY USES HARDENED WASHER
 4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.



General Information and Specifications

2.7.2 Metric Fastener Torque Chart

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*							
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS							
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™)	Torque (Lube)	Torque (Loctite® 262™ or 271™ or Vibra-TITE™ 131)	Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 141)
		Sq mm	KN	[N.m]		[N.m]	[N.m]
3	0.5	5.03	2.19	1.3	1.0	1.2	1.4
3.5	0.6	6.78	2.95	2.1	1.6	1.9	2.3
4	0.7	8.78	3.82	3.1	2.3	2.8	3.4
5	0.8	14.20	6.18	6.2	4.6	5.6	6.8
6	1	20.10	8.74	11	7.9	9.4	12
7	1	28.90	12.6	18	13	16	19
8	1.25	36.60	15.9	26	19	23	28
10	1.5	58.00	25.2	50	38	45	55
12	1.75	84.30	36.7	88	66	79	97
14	2	115	50.0	140	105	126	154
16	2	157	68.3	219	164	197	241
18	2.5	192	83.5	301	226	271	331
20	2.5	245	106.5	426	320	383	469
22	2.5	303	132.0	581	436	523	639
24	3	353	153.5	737	553	663	811
27	3	459	199.5	1080	810	970	1130
30	3.5	561	244.0	1460	1100	1320	1530
33	3.5	694	302.0	1990	1490	1790	2090
36	4	817	355.5	2560	1920	2300	2690
42	4.5	1120	487.0	4090	3070	3680	4290

- NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
 3. * ASSEMBLY USES HARDENED WASHER
 4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.



2.7.2 Metric Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*						
CLASS 10.9 METRIC (HEX HEAD) BOLTS, CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAPSCREWS M3 - M5*						
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K=0.20	Torque (Lube or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18	Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5			
7	1	28.90	18.0	25	23	19
8	1.25	36.60	22.8	37	33	27
10	1.5	58.00	36.1	70	65	55
12	1.75	84.30	52.5	125	115	95
14	2	115	71.6	200	180	150
16	2	157	97.8	315	280	235
18	2.5	192	119.5	430	385	325
20	2.5	245	152.5	610	550	460
22	2.5	303	189.0	830	750	625
24	3	353	222.0	1065	960	800
27	3	459	286.0	1545	1390	1160
30	3.5	561	349.5	2095	1885	1575
33	3.5	694	432.5	2855	2570	2140
36	4	817	509.0	3665	3300	2750
42	4.5	1120	698.0	5865	5275	4395

- NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K
 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
 3. * ASSEMBLY USES HARDENED WASHER
 4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.



General Information and Specifications

2.7.2 Metric Fastener Torque Chart (Continued)

Values for Magni Coated Fasteners (Ref 4150701)*						
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS						
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K=0.17	Torque (Lube or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16	Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.1	1.1	1.0
3.5	0.6	6.78	2.95	1.8	1.7	1.5
4	0.7	8.78	3.82	2.6	2.4	2.3
5	0.8	14.20	6.18	5.3	4.9	4.6
6	1	20.10	8.74	9	8.4	7.9
7	1	28.90	12.6	15	14	13
8	1.25	36.60	15.9	22	20	19
10	1.5	58.00	25.2	43	40	38
12	1.75	84.30	36.7	75	70	66
14	2	115	50.0	119	110	105
16	2	157	68.3	186	175	165
18	2.5	192	83.5	256	240	225
20	2.5	245	106.5	362	340	320
22	2.5	303	132.0	494	465	435
24	3	353	153.5	627	590	555
27	3	459	199.5	916	860	810
30	3.5	561	244.0	1245	1170	1100
33	3.5	694	302.0	1694	1595	1495
36	4	817	355.5	2176	2050	1920
42	4.5	1120	487.0	3477	3275	3070

NOTES:

1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

5000059K



2.7.2 Metric Fastener Torque Chart (Continued)

Values for Magni Coated Fasteners (Ref 4150701)*						
CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS, CLASS 12.9 SOCKET HEAD CAPSCREWS M6 AND ABOVE*						
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K=0.17	Torque (Lube or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18	Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5	13	12	11
7	1	28.90	18.0	21	20	19
8	1.25	36.60	22.8	31	29	27
10	1.5	58.00	36.1	61	58	55
12	1.75	84.30	52.5	105	100	95
14	2	115	71.6	170	160	150
16	2	157	97.8	265	250	235
18	2.5	192	119.5	365	345	325
20	2.5	245	152.5	520	490	460
22	2.5	303	189.0	705	665	625
24	3	353	222.0	905	850	800
27	3	459	286.0	1315	1235	1160
30	3.5	561	349.5	1780	1680	1575
33	3.5	694	432.5	2425	2285	2140
36	4	817	509.0	3115	2930	2750
42	4.5	1120	698.0	4985	4690	4395

- NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K
 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
 3. * ASSEMBLY USES HARDENED WASHER
 4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

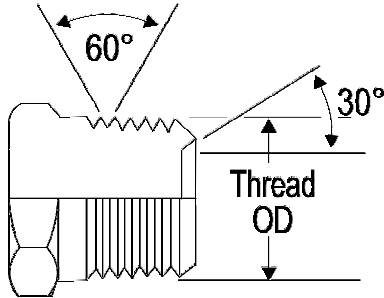


2.8 HYDRAULIC CONNECTION ASSEMBLY AND TORQUE SPECIFICATION

2.8.1 Definitions

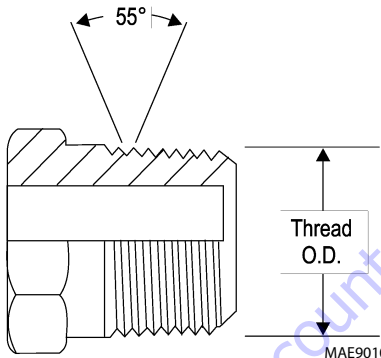
a. Tapered Thread Types

NPTF - National tapered fuel (dry seal) per SAE J476/J512



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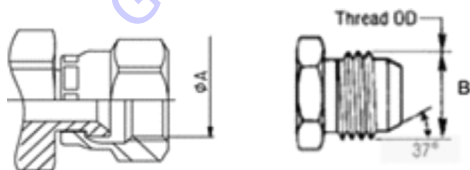
BSPT - British standard pipe tapered per ISO7-1



MAE9010

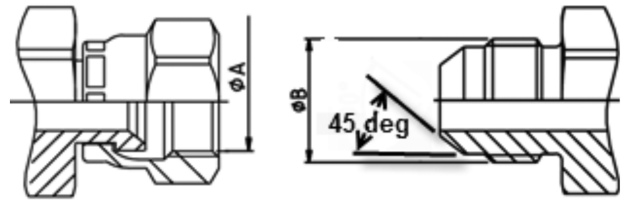
b. Straight Thread Types, Tube and Hose Connections

JIC - 37° flare per SAE J514



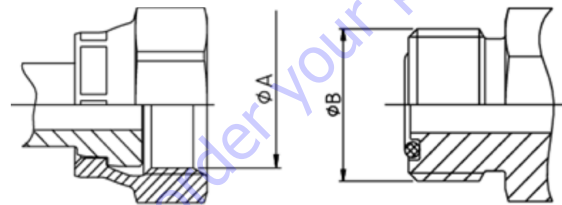
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SAE - 45° flare per SAE J512



MAE9030

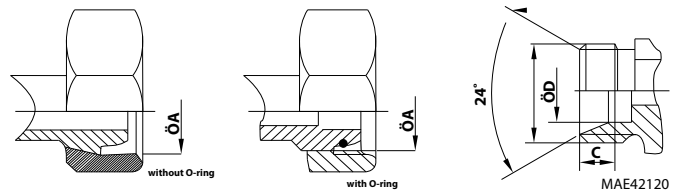
ORFS - O-ring face seal per SAE J1453



MAE9040

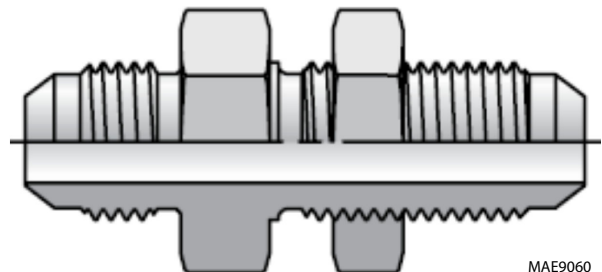
MBTL - Metric flareless bite type fitting, pressure rating L (medium) per ISO 8434, DIN 2353

MBTS - Metric flareless bite type fitting, pressure rating S (high) per ISO 8434, DIN 2353



MAE42120

BH - Bulkhead connection – JIC, ORFS, MBTL, or MBTS types



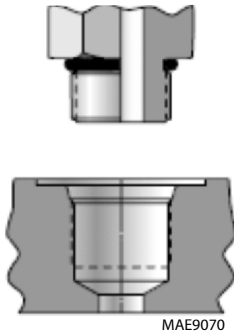
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c. Straight Thread Types, Port Connections

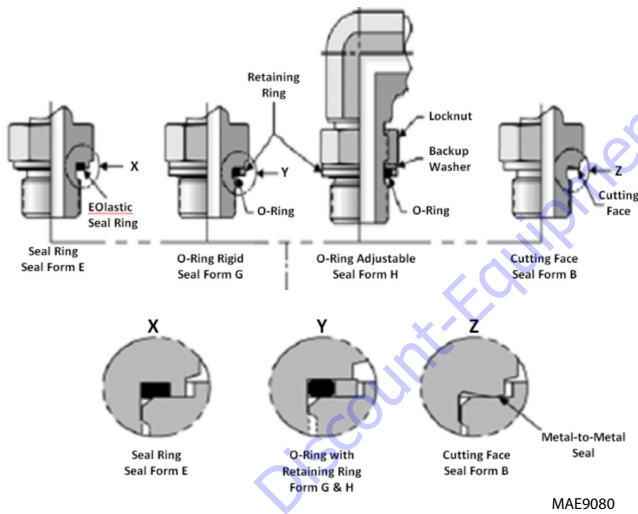
ORB - O-ring boss per SAE J1926, ISO 11926

MPP - Metric pipe parallel o-ring boss per SAE J2244, ISO 6149, DIN 3852



MFF - Metric flat face port per ISO 9974-1

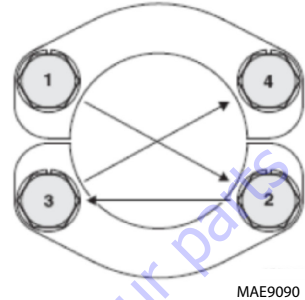
BSPP - British standard parallel pipe per ISO 1179-1, DIN 3852-2



d. Flange Connection Types

FL61 - Code 61 flange per SAE J518, ISO 6162

FL62 - Code 62 flange per SAE J518, ISO 6162



e. Tightening Methods

Torque - Application of a twisting force to the applicable connection by use of a precise measurement instrument (i.e. torque wrench).

Finger Tight (Hand Tight) - The point where the connector will no longer thread onto the mating part when tightened by hand or fingers. Finger Tight is relative to user strength and will have some variance. The average torque applied by this method is 3 ft-lb (4 Nm).

TFFT - Turns From Finger Tight; Application of a preload to a connection by first tightening the connection by hand (fingers) and applying an additional rotation counted by a defined number of turns by use of a tool.

FFWR (Flat method) - Flats From Wrench Resistance; Application of a preload to a connection by tightening to the point of initial wrench resistance and turning the nut a described number of flats. A flat is one side of the hexagonal tube nut and equates to 1/6 of a turn.

f. Assembly and Torque Specifications

Prior to selecting the appropriate torque from the tables within this section, it is necessary to properly identify the connector being installed.

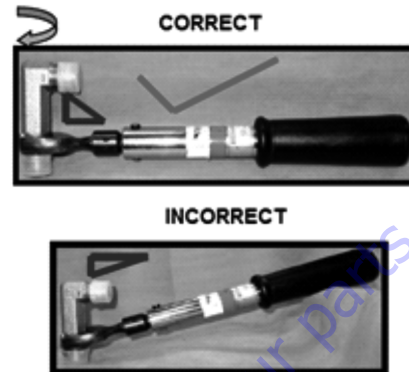


General Information and Specifications

g. General Tube Type Fitting Assembly Instructions

1. Take precautions to ensure that fittings and mating components are not damaged during storage, handling or assembly. Nicks and scratches in sealing surfaces can create a path for leaks which could lead to component contamination and/or failure.
2. When making a connection to tubing, compression or flare, inspect the tube in the area of the fitting attachment to ensure that the tube has not been damaged.
3. The assembly process is one of the leading causes for contamination in air and hydraulic systems. Contamination can prevent proper tightening of fittings and adapters from occurring.
 - a. Avoid using dirty or oily rags when handling fittings.
 - b. If fittings are disassembled, they should be cleaned and inspected for damage. Replace fittings as necessary before reinstalling.
 - c. Sealing compounds should be applied where specified; however, care should be taken not to introduce sealant into the system.
 - d. Avoid applying sealant to the area of the threads where the sealant will be forced into the system. This is generally the first two threads of a fitting.
 - e. Sealant should only be applied to the male threads.
 - f. Straight thread fittings do not require sealants. O-rings or washers are provided for sealing.
 - g. When replacing or installing an o-ring, care is to be taken while transferring the o-ring over the threads as it may become nicked or torn. When replacing an o-ring on a fitting, the use of a thread protector is recommended.
 - h. When installing fittings with o-rings, lubrication shall be used to prevent scuffing or tearing of the o-ring. Refer to Section 2.8.17, "O-ring Installation (Replacement)", for procedure.
4. Take care to identify the material of parts to apply the correct torque values.
 - a. Verify the material designation in the table headings
 - b. If specifications are given only for steel fittings and components, the values for alternate materials shall be as follows:
Aluminum and Brass - reduce steel values by 35%
Stainless Steel - Use the upper limit for steel.

5. To achieve the specified torque, the torque wrench is to be held perpendicular to the axis of rotation.



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6. Refer to the appropriate section in this manual for more specific instructions and procedures for each type of fitting connection.



General Information and Specifications

2.8.2 Assembly Instructions for American Standard Pipe Thread Tapered Connections

1. Inspect components to ensure male and female port threads are free of rust, splits, dirt, foreign matter, or burrs.
2. Apply a suitable thread sealant, such as low strength threadlocking compound, to the male pipe threads if not already applied. Ensure the first 1 to 2 threads are uncovered to prevent system contamination.
3. Assemble connection hand tight.
4. Mark fittings, male and female

NOTICE

Over tightening may cause deformation of the pipe fitting and damage to the joining fitting, flange or component may occur.

NOTICE

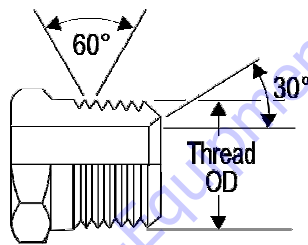
Never back off (loosen) pipe threaded connectors to achieve alignment. Meet the minimum required turns and use the last turn for alignment.

5. Rotate male fitting the number of turns as per below mentioned table. Refer to Section 2.8.15, "FFWR and TFFT Methods.", for procedure.

Note: TFFT values provided in below mentioned table are applicable for the following material configurations:

- a. Steel fittings with steel mating components
- b. Steel fittings with aluminum or brass mating components
- c. Aluminum or brass fittings with steel mating components
- d. Aluminum or brass fittings with aluminum or brass mating components.

a. NPTF Pipe Thread



ØA dimension is measured on the 4th pitch of the thread

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TYPE/FITTING IDENTIFICATION					Turns From Finger Tight (TFFT)**
Material	Dash Size	Thread Size (UNF)	ØA*		
			(in)	(mm)	
STEEL, ALUMINUM, OR BRASS FITTINGS WITH STEEL, ALUMINUM, OR BRASS MATING COMPONENTS	2	1/8 - 27	0.40	10.24	2 to 3
	4	1/4 - 18	0.54	13.61	2 to 3
	6	3/8 - 18	0.67	17.05	2 to 3
	8	1/2 - 14	0.84	21.22	2 to 3
	12	3/4 - 14	1.05	26.56	2 to 3
	16	1 - 11 1/2	1.31	33.22	1.5 to 2.5
	20	1 1/4 - 11 1/2	1.65	41.98	1.5 to 2.5
	24	1 1/2 - 11 1/2	1.89	48.05	1.5 to 2.5
	32	2 - 11 1/2	2.37	60.09	1.5 to 2.5

NOTE:

* ØA thread dimension for reference only.

** Refer to Section 2.8.15, "FFWR and TFFT Methods.", for TFFT procedure requirements.



2.8.3 Assembly Instructions for British Standard Pipe Thread Tapered Connections

1. Inspect components to ensure male and female port threads are free of rust, splits, dirt, foreign matter, or burrs.
2. Apply a suitable thread sealant, such as low strength threadlocking compound, to the male pipe threads if not already applied. Ensure the first 1 to 2 threads are uncovered to prevent system contamination.
3. Assemble connection hand tight.
4. Mark fittings, male and female.

NOTICE

Over tightening may cause deformation of the pipe fitting and damage to the joining fitting, flange or component may occur.

NOTICE

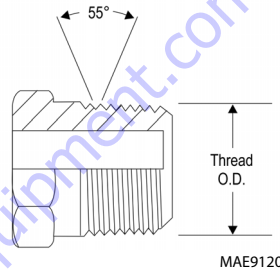
Never back off (loosen) pipe threaded connectors to achieve alignment. Meet the minimum required turns and use the last turn for alignment.

5. Rotate male fitting the number of turns as per below mention table.

Note: TFFT values provided in below table are applicable for the following material configurations:

- a. Steel fittings with steel mating components
- b. Steel fittings with aluminum or brass mating components
- c. Aluminum or brass fittings with steel mating components
- d. Aluminum or brass fittings with aluminum or brass mating components.

a. BSPT Pipe Thread



TYPE/FITTING IDENTIFICATION					Turns From Finger Tight (TFFT)**
Material	Dash Size	Thread Size (BSPT)	ØA*		
			(in)	(mm)	
STEEL, ALUMINUM, OR BRASS FITTINGS WITH STEEL, ALUMINUM, OR BRASS MATING COMPONENTS	2	1/8 - 28	0.38	9.73	2 to 3
	4	1/4 - 19	0.52	13.16	2 to 3
	6	3/8 - 19	0.66	16.66	2 to 3
	8	1/2 - 14	0.83	20.96	2 to 3
	12	3/4 - 14	1.04	26.44	2 to 3
	16	1 - 11	1.31	33.25	1.5 to 2.5
	20	1 1/4 - 11	1.65	41.91	1.5 to 2.5
	24	1 1/2 - 11	1.88	47.80	1.5 to 2.5
	32	2 - 11	2.35	59.61	1.5 to 2.5

NOTE:

*ØA thread dimension for reference only.

** Refer to Section 2.8.15, "FFWR and TFFT Methods.", for TFFT procedure requirements.



General Information and Specifications

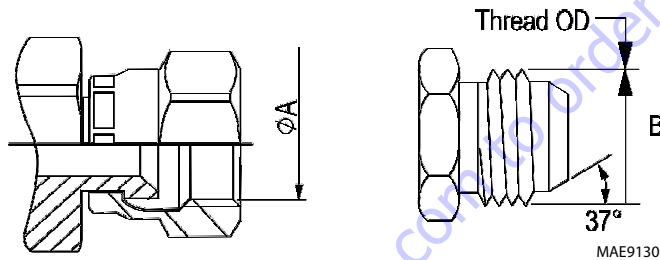
2.8.4 Assembly Instructions for 37° (JIC) Flare Fittings

1. Inspect the flare for obvious visual squareness
2. and concentricity issues with the tube OD. Ensure that surface is smooth, free of rust, weld and brazing splatter, splits, dirt, foreign matter, or burrs. If necessary, replace fitting or adapter.

NOTICE

DO NOT force a misaligned or short hose/tube into alignment. It puts undesirable strain onto the joint eventually leading to leakage.

a. 37° Flare (JIC) Thread - Steel



3. Align tube to fitting and start threads by hand.

NOTICE

The torque method should NOT be used on lubricated or oily fittings. No lubrication or sealant is required. The lubrication would cause increased clamping force and cause fitting damage.

4. Torque assembly to value listed in below mentioned table while using the Double Wrench Method.

Note: Torque values provided in below table are segregated based on the material configuration of the connection.

TYPE/FITTING IDENTIFICATION													Flats From Wrench Resistance (F.F.W.R)**
Material	Dash Size	Thread Size (UNF)	ØA*		ØB*		[Ft-Lb]			[Nm]			
			(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max	
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.28	7.00	0.31	7.75	6	7	7	8	9	10	--
	3	3/8-24	0.34	8.60	0.37	9.50	8	9	10	11	12	14	--
	4	7/16-20	0.39	10.00	0.44	11.10	13	14	14	18	19	19	1-1/2 to 1-3/4
	5	1/2-20	0.46	11.60	0.50	12.70	14	15	15	19	20	21	1 to 1-1/2
	6	9/16-18	0.51	13.00	0.56	14.30	22	23	24	30	31	33	1 to 1-1/2
	8	3/4-16	0.69	17.60	0.75	19.10	42	44	46	57	60	63	1-1/2 to 1-3/4
	10	7/8-14	0.81	20.50	0.87	22.20	60	63	66	81	85	89	1 to 1-1/2
	12	1 1/16-12	0.97	24.60	1.06	27.00	84	88	92	114	120	125	1 to 1-1/2
	14	1 3/16-12	1.11	28.30	1.19	30.10	100	105	110	136	142	149	1 to 1-1/2
	16	1 5/16-12	1.23	31.30	1.31	33.30	118	124	130	160	168	176	3/4 to 1
	20	1 5/8-12	1.54	39.20	1.63	41.30	168	176	185	228	239	251	3/4 to 1
	24	1 7/8-12	1.80	45.60	1.87	47.60	195	205	215	264	278	291	3/4 to 1
32	2 1/2-12	2.42	61.50	2.50	63.50	265	278	292	359	377	395	3/4 to 1	

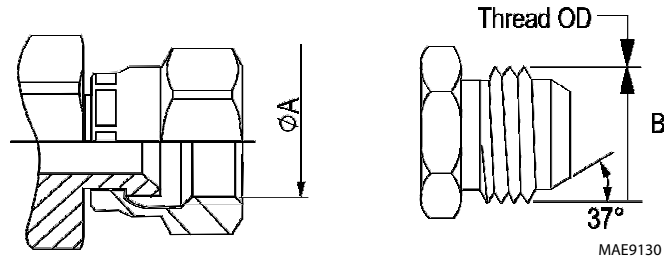
NOTE:

* ØA and ØB thread dimensions for reference only.

** Refer to Section 2.8.15, "FFWR and TFFT Methods.", for FFWR procedure requirements.



b. 37° Flare (JIC) Thread - Aluminum Brass



TYPE/FITTING IDENTIFICATION													
Material	Dash Size	Thread Size (UNF)	ØA*		ØB*		[Ft-Lb]			[Nm]			Flats From Wrench Resistance (F.F.W.R)**
			(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max	
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.28	7.00	0.31	7.75	4	4	5	5	6	7	--
	3	3/8-24	0.34	8.60	0.37	9.50	5	6	7	7	8	9	--
	4	7/16-20	0.39	10.00	0.44	11.10	8	9	9	11	12	13	1-1/2 to 1-3/4
	5	1/2-20	0.46	11.60	0.50	12.70	9	10	10	12	13	14	1 to 1-1/2
	6	9/16-18	0.51	13.00	0.56	14.30	14	15	16	19	20	21	1 to 1-1/2
	8	3/4-16	0.69	17.60	0.75	19.10	27	29	30	37	39	41	1-1/2 to 1-3/4
	10	7/8-14	0.81	20.50	0.87	22.20	39	41	43	53	56	58	1 to 1-1/2
	12	1 1/16-12	0.97	24.60	1.06	27.00	55	57	60	74	78	81	1 to 1-1/2
	14	1 3/16-12	1.11	28.30	1.19	30.10	65	68	72	88	93	97	1 to 1-1/2
	16	1 5/16-12	1.23	31.30	1.31	33.30	77	81	84	104	109	114	3/4 to 1
	20	1 5/8-12	1.54	39.20	1.63	41.30	109	115	120	148	155	163	3/4 to 1
	24	1 7/8-12	1.80	45.60	1.87	47.60	127	133	139	172	180	189	3/4 to 1
32	2 1/2-12	2.42	61.50	2.50	63.50	172	181	189	234	245	257	3/4 to 1	

NOTE:

*ØA and ØB thread dimensions for reference only.

** Refer to Section 2.8.15, "FFWR and TFFT Methods.", for FFWR procedure requirements.



General Information and Specifications

2.8.5 Assembly Instructions for 45° SAE Flare Fittings

1. Inspect the flare for obvious visual squareness and concentricity issues with the tube OD. Ensure that surface is smooth, free of rust, weld and brazing splatter, splits, dirt, foreign matter, or burrs. If necessary, replace fitting or adapter.

NOTICE

DO NOT force a misaligned or short hose/tube into alignment. It puts undesirable strain onto the joint eventually leading to leakage.

2. Align tube to fitting.
3. Tighten fitting by hand until hand tight.

NOTICE

The torque method should NOT be used on lubricated or oily fittings. No lubrication or sealant is required. The lubrication would cause increased clamping force and cause fitting damage.

Torque fitting to value listed in below table while using the Double Wrench Method outlined in this section.

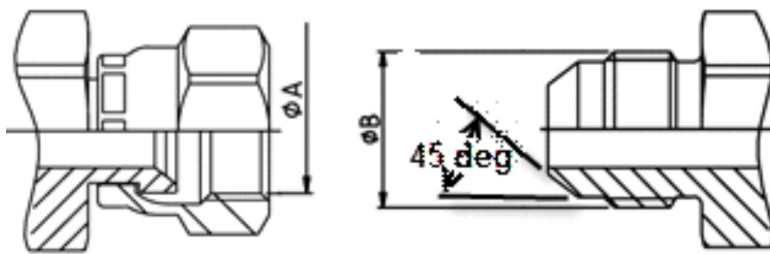
Note: Torque values provided in below table are segregated based on the material configuration of the connection.

'Aluminum/brass fittings or aluminum/brass mating components' indicate either the following material configurations:

- a. Steel fittings with aluminum or brass mating components
- b. Aluminum or brass fittings with steel mating components
- c. Aluminum or brass fittings with aluminum or brass mating components.



a. 45° Flare (SAE)



MAE9140

STEEL

TYPE/FITTING IDENTIFICATION							TORQUE					
Material	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[Nm]		
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	7/16-20	0.39	9.90	0.44	11.10	13	14	14	18	19	19
	6	5/8-18	0.56	14.30	0.63	15.90	22	23	24	30	31	33
	8	3/4-16	0.69	17.50	0.75	19.10	42	44	46	57	60	62
	10	7/8-14	0.81	20.60	0.87	22.20	60	63	66	81	85	89
	12	1 1/16-14	0.98	25.00	1.06	27.00	84	88	92	114	119	125

NOTE: *ØA and ØB thread dimensions for reference only.

ALUMINUM BRASS

TYPE/FITTING IDENTIFICATION							TORQUE					
Material	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[Nm]		
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	4	7/16-20	0.39	9.90	0.44	11.10	8	9	9	11	12	12
	6	5/8-18	0.56	14.30	0.63	15.90	14	15	15	19	20	20
	8	3/4-16	0.69	17.50	0.75	19.10	27	29	30	37	39	41
	10	7/8-14	0.81	20.60	0.87	22.20	39	41	43	53	56	58
	12	1 1/16-14	0.98	25.00	1.06	27.00	55	58	61	75	79	83

NOTE: *ØA and ØB thread dimensions for reference only.



General Information and Specifications

2.8.6 Assembly Instructions for O-Ring Face Seal (ORFS) Fittings

1. Ensure proper o-ring is installed. If o-ring is missing install per o-ring Installation (replacement). Refer to Section 2.8.17, "O-ring Installation (Replacement)", for procedure.
2. Ensure that surface is smooth, free of rust, weld and brazing splatter, splits, dirt, foreign matter, or burrs. If necessary, replace fitting or adapter.

NOTICE

Care to be taken when lubricating o-ring. Avoid adding oil to the threaded connection of the fitting. The lubrication would cause increased clamping force and cause fitting damage.

3. Pre-lubricate the o-ring with hydraulic oil.
4. Place the tube assembly against the fitting body so that the flat face comes in contact with the o-ring. Hand thread the nut onto the fitting body.
5. Torque nut to value listed in below mentioned table while using the Double Wrench Method. Refer to Section 2.8.15, "FFWR and TFFT Methods", for procedure if using the FFWR method.

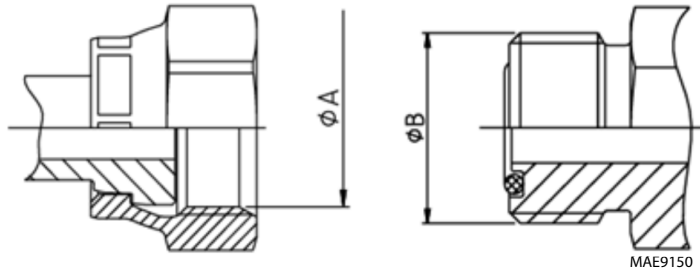
Note: Torque values provided in below table are segregated based on the material configuration of the connection.

Aluminum/brass fittings or aluminum/brass mating components' indicate either the following material configurations:

- a. Steel fittings with aluminum or brass mating components
- b. Aluminum or brass fittings with steel mating components
- c. Aluminum or brass fittings with aluminum or brass mating components.



a. O-ring Face Seal (ORFS)



STEEL

TYPE/FITTING IDENTIFICATION							TORQUE							
Material	Dash Size	Thread Size (UNF)	ØA*		ØB*		[Ft-Lb]			[Nm]			Tube Nuts	Swivel & Hose Ends
			(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max		
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	9/16-18	0.51	13.00	0.56	14.20	18	19	20	25	26	27	1/4 to 1/2	1/2 to 3/4
	6	11/16-16	0.63	15.90	0.69	17.50	30	32	33	40	43	45	1/4 to 1/2	1/2 to 3/4
	8	13/16-16	0.75	19.10	0.81	20.60	40	42	44	55	57	60	1/4 to 1/2	1/2 to 3/4
	10	1-14	0.94	23.80	1.00	25.40	60	63	66	81	85	89	1/4 to 1/2	1/2 to 3/4
	12	13/16-12	1.11	28.20	1.19	30.10	85	90	94	115	122	127	1/4 to 1/2	1/2 to 3/4
	16	17/16-12	1.34	34.15	1.44	36.50	110	116	121	149	157	164	1/4 to 1/2	1/2 to 3/4
	20	1 11/16-12	1.59	40.50	1.69	42.90	150	158	165	203	214	224	1/4 to 1/2	1/2 to 3/4
	24	2-12	1.92	48.80	2.00	50.80	230	242	253	312	328	343	1/4 to 1/2	1/2 to 3/4
32	2 1/2-12	2.43	61.67	2.50	63.50	375	394	413	508	534	560	1/4 to 1/2	1/2 to 3/4	

NOTE: *ØA and ØB thread dimensions for reference only.

ALUMINUM/BRASS

TYPE/FITTING IDENTIFICATION							TORQUE						FLATS FROM WRENCH RESISTANCE (F.F.W.R)**	
Material	Dash Size	Thread Size (UNF)	ØA*		ØB*		[Ft-Lb]			[Nm]			Tube Nuts	Swivel & Hose Ends
			(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max		
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENT; UN-LUBRICATED THREADS	4	9/16-18	0.51	13.00	0.56	14.20	12	13	13	16	18	18	1/4 to 1/2	1/2 to 3/4
	6	11/16-16	0.63	15.90	0.69	17.50	20	21	22	27	28	30	1/4 to 1/2	1/2 to 3/4
	8	13/16-16	0.75	19.10	0.81	20.60	26	28	29	35	38	39	1/4 to 1/2	1/2 to 3/4
	10	1-14	0.94	23.80	1.00	25.40	39	41	43	53	56	58	1/4 to 1/2	1/2 to 3/4
	12	13/16-12	1.11	28.20	1.19	30.10	55	58	61	75	79	83	1/4 to 1/2	1/2 to 3/4
	16	17/16-12	1.34	34.15	1.44	36.50	72	76	79	98	103	107	1/4 to 1/2	1/2 to 3/4
	20	1 11/16-12	1.59	40.50	1.69	42.90	98	103	108	133	140	146	1/4 to 1/2	1/2 to 3/4
	24	2-12	1.92	48.80	2.00	50.80	12	13	13	16	18	18	1/4 to 1/2	1/2 to 3/4
32	2 1/2-12	2.43	61.67	2.50	63.50	20	21	22	27	28	30	1/4 to 1/2	1/2 to 3/4	

NOTE: *ØA and ØB thread dimensions for reference only.
 ** Refer to Section 2.8.15, "FFWR and TFFT Methods," for FFWR procedure requirements.



General Information and Specifications

2.8.7 Assembly Instructions for DIN 24° Flare Bite Type Fittings (MBTL and MBTS)

NOTICE

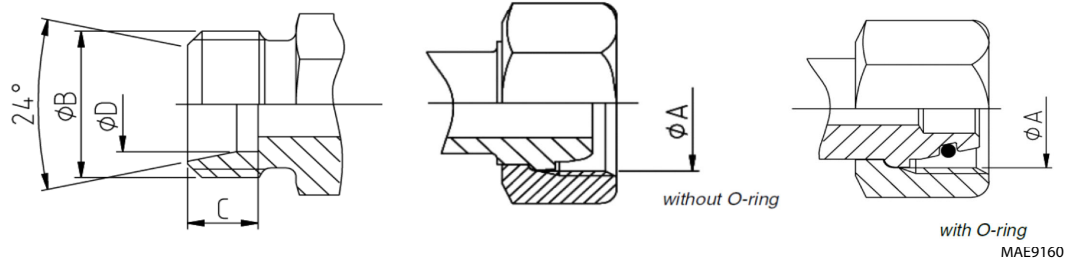
A non-square tube end can cause improperly seated fittings and leakage.

6. Inspect the components to ensure free of contamination, external damage, rust, splits, dirt, foreign matter, or burrs. Ensure tube end is visibly square. If necessary, replace fitting or tube.
7. Lubricate thread and cone of fitting body or hardened pre-assembly tool, as well as the progressive ring and nut threads.
8. Slip nut and progressive ring over tube, assuring that they are in the proper orientation.
9. Push the tube end into the coupling body.
10. Slide collet into position and tighten until finger tight. Mark nut and tube in the finger-tight position. Tighten nut to the number of flats listed while using the Double Wrench Method. The tube must not turn with the nut.

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a. DIN 24° CONE (MBTL & MBTS)



TYPE/FITTING IDENTIFICATION							DIN 24° CONE FLARELESS BITE FITTING (WITH OR WITHOUT O-RING)								
Material	Type	Tube O.D.	Thread M Size	ØA*	ØB*	C*	ØD*	Torque						Flats From Wrench Resistance (F.F.W.R)**	
		(mm)	(Metric)	(mm)	(mm)	(mm)	(mm)	[Ft-Lb]			[Nm]				
								Min	Nom	Max	Min	Nom	Max		
STEEL FITTINGS WITH STEEL MATING COMPONENTS	DIN 24° CONE FLARELESS BITE (MBTL) FITTING	6	M12x1.5	10.50	12.00	7.00	6.20	FFWR is the recommended method of fitting assembly. Torque values are application specific due to variability in the fitting supplier, coating, lubrication, and other physical characteristic of the connection. Consult Engineering on the generation of torque values for the particular application.						1.5 to 1.75	
		8	M14x1.5	12.50	14.00	7.00	8.20							1.5 to 1.75	
		10	M16x1.5	14.50	16.00	7.00	10.20							1.5 to 1.75	
		12	M18x1.5	16.50	18.00	7.00	12.20							1.5 to 1.75	
		15	M22x1.5	20.50	22.00	7.00	15.20							1.5 to 1.75	
		18	M26x1.5	24.50	26.00	7.50	18.20							1.5 to 1.75	
		22	M30x2	27.90	30.00	7.50	22.20							1.5 to 1.75	
		28	M36x2	33.90	36.00	7.50	28.20							1.5 to 1.75	
		35	M45x2	42.90	45.00	10.50	35.30							1.5 to 1.75	
	42	M52x2	49.90	52.00	11.00	42.30	1.5 to 1.75								
	DIN 24° CONE FLARELESS BITE (MBTS) FITTING	Type	6	M14x1.5	12.50	14.00	7.00	6.20	FFWR is the recommended method of fitting assembly. Torque values are application specific due to variability in the fitting supplier, coating, lubrication, and other physical characteristics of the connection. Consult Engineering on the generation of torque values for the particular application.						1.5 to 1.75
			8	M16x1.5	14.50	16.00	7.00	8.20							1.5 to 1.75
			10	M18x1.5	16.50	18.00	7.50	10.20							1.5 to 1.75
			12	M20x1.5	18.50	20.00	7.50	12.20							1.5 to 1.75
			14	M22x1.5	20.50	22.00	8.00	14.20							1.5 to 1.75
			16	M24x1.5	22.50	24.00	8.50	16.20							1.5 to 1.75
			20	M30x2	27.90	30.00	10.50	20.20							1.5 to 1.75
			25	M36x2	33.90	36.00	12.00	25.20							1.5 to 1.75
			30	M42x2	39.90	42.00	13.50	30.20							1.5 to 1.75
	38	M52x2	49.90	52.00	16.00	38.30	1.5 to 1.75								

NOTE: * ØA, ØB, C, & ØD thread dimensions for reference only.
 ** Refer to Section 2.8.15, "FFWR and TFFT Methods.", for FFWR procedure requirements.



General Information and Specifications

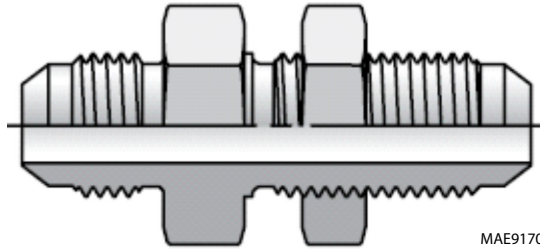
2.8.8 Assembly Instructions for Bulkhead (BH) Fittings

1. Ensure that threads and surface are free of rust, weld and brazing splatter, splits, burrs or other foreign material. If necessary, replace fitting or adapter.
2. Remove the locknut from the bulkhead assembly.
3. Insert the bulkhead side of the fitting into the panel or bulkhead bracket opening.
4. Hand thread the locknut onto the bulkhead end of the fitting body.
5. Torque nut onto fitting while using the Double Wrench Method.

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a. Bulkhead Fittings (BH) - INCH



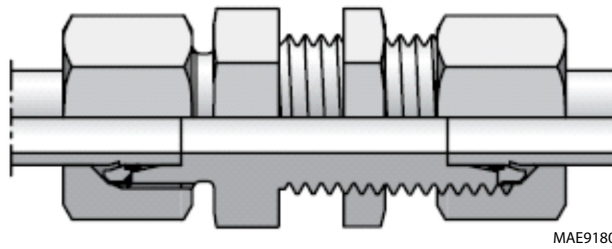
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TYPE/FITTING IDENTIFICATION				FASTENING JAM NUT FOR BULKHEAD CONNECTORS								
Material	Type	Dash Size	Thread Size	Torque								
				[Ft-Lb]			[Nm]					
				Min	Nom	Max	Min	Nom	Max			
STEEL FITTINGS	O-RING FACE SEAL (ORFS) BULKHEAD FITTING	4	9/16-18	15	16	17	20	22	23			
		6	11/16-16	25	27	28	34	37	38			
		8	13/16-16	55	58	61	75	79	83			
		10	1-14	85	90	94	115	122	127			
		12	13/16-12	135	142	149	183	193	202			
		14	15/16-12	170	179	187	230	243	254			
		16	17/16-12	200	210	220	271	285	298			
		20	1 1/16-12	245	258	270	332	350	366			
	24	2-12	270	284	297	366	385	403				
	37° FLARE (JLIC) BULKHEAD FITTING	Type	Dash Size	Thread Size (UNF)	Torque							
					[Ft-Lb]			[Nm]				
					Min	Nom	Max	Min	Nom	Max		
					3	3/8-24	8	9	9	11	12	12
					4	7/16-20	13	14	14	18	19	19
					5	1/2-20	20	21	22	27	28	30
					6	9/16-18	25	27	28	34	37	38
					8	3/4-16	50	53	55	68	72	75
					10	7/8-14	85	90	94	115	122	127
					12	1 1/16-12	135	142	149	183	193	202
					14	13/16-12	170	179	187	230	243	254
16					15/16-12	200	210	220	271	285	298	
20	15/8-12	245	258	270	332	350	366					
24	17/8-12	270	284	297	366	385	403					
32	2 1/2-12	310	326	341	420	442	462					



General Information and Specifications

b. Bulkhead Fittings (BH) - METRIC



TYPE/FITTING IDENTIFICATION				FASTENING JAM NUT FOR BULKHEAD CONNECTORS									
Material	Type	Connecting Tube O.D. (mm)	Thread M Size (metric)	Torque									
				[Ft-Lb]			[Nm]						
				Min	Nom	Max	Min	Nom	Max				
STEEL FITTINGS	DIN 24° CONE FLARELESS BITE (MBTL) BULKHEAD FITTING	6	M12x1.5	14	15	16	19	20	22				
		8	M14x1.5	17	18	19	23	24	26				
		10	M16x1.5	22	23	24	30	31	33				
		12	M18x1.5	35	37	39	47	50	53				
		15	M22x1.5	44	47	50	60	64	68				
		18	M26x1.5	70	75	80	95	102	108				
		22	M30x2	115	120	125	156	163	169				
		28	M36x2	150	157	164	203	213	222				
		35	M45x2	155	162	169	210	220	229				
	42	M52x2	220	230	240	298	312	325					
	DIN 24° CONE FLARELESS BITE (MBTS) BULKHEAD FITTING	Type	Connecting Tube O.D. (mm)	Thread M Size (metric)	Torque								
					[Ft-Lb]			[Nm]					
						Min	Nom	Max	Min	Nom	Max		
						6	M14x1.5	17	15	16	23	20	22
						8	M16x1.5	22	18	19	30	24	26
						10	M18x1.5	35	23	24	47	31	33
						12	M20x1.5	40	35	37	54	47	50
						14	M22x1.5	44	47	50	60	64	68
						16	M24x1.5	70	75	80	95	102	108
						20	M30x2	115	120	125	156	163	169
25						M36x2	150	157	164	203	213	222	
30	M42x2	155	162	169	210	220	229						
38	M52x2	220	230	240	298	312	325						



General Information and Specifications

2.8.9 Assembly Instructions for O-Ring Boss (ORB) Fittings

1. Inspect components to ensure that male and female port threads are free of rust, splits, dirt, foreign matter, or burrs.
2. Ensure proper o-ring is installed. If o-ring is missing install per o-ring Installation (replacement). Refer to Section 2.8.17, "O-ring Installation (Replacement)," for procedure.

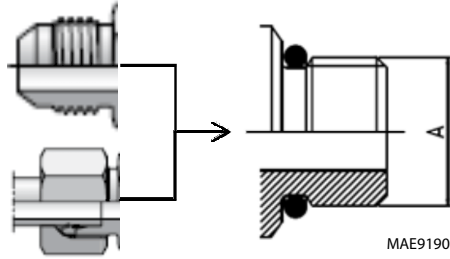
NOTICE

Care to be taken when lubricating o-ring. Avoid adding oil to the threaded connection of the fitting. The lubrication would cause increased clamping force and cause fitting damage.

3. Pre-lubricate the o-ring with hydraulic oil.
4. For non-adjustable and plugs, thread the fitting by hand until contact.
5. For adjustable fittings, refer to Section 2.8.16, "Adjustable Stud End Assembly," for proper assembly.
6. Torque the fitting or nut to value while using the Double Wrench Method.
 - a. The table headings identify the straight thread o-ring port and the type on the other side of the fitting. The torque will be applied to the straight thread o-ring port.
 - b. Torque values are segregated based on the material configuration of the connection. 'Aluminum/brass fittings or aluminum/brass mating components' indicate either the following material configurations:
 - Steel fittings with aluminum or brass mating components
 - Aluminum or brass fittings with steel mating components
 - Aluminum or brass fittings with aluminum or brass mating components.
7. Inspect to ensure the o-ring is not pinched and the washer is seated flat on the counter bore of the port.



a. O-ring Boss (ORB) - Table 1 of 6



TYPE/FITTING IDENTIFICATION					HEX TYPE PLUGS & STUD ENDS WITH 37° (JIC) OR L SERIES DIN (MBTL) OPPOSITE END					
Material	Dash Size	Thread Size	ØA*		Torque					
					[Ft-Lb]			[Nm]		
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(85)	(90)	(94)	10	10	11
	3	3/8-24	0.37	9.52	(155)	(163)	(171)	18	18	19
	4	7/16-20	0.44	11.11	22	23	24	29	31	33
	5	1/2-20	0.50	12.70	23	25	26	32	34	35
	6	9/16-18	0.56	14.28	29	31	32	40	42	43
	8	3/4-16	0.75	19.10	52	55	57	70	75	77
	10	7/8-14	0.87	22.22	85	90	94	115	122	127
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
24	1 7/8-12	1.87	47.60	305	321	336	415	435	456	
32	2 1/2-12	2.50	63.50	375	394	413	510	534	560	
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(55)	(58)	(61)	6	7	7
	3	3/8-24	0.37	9.52	(101)	(106)	(111)	11	12	13
	4	7/16-20	0.44	11.11	14	15	16	19	20	22
	5	1/2-20	0.50	12.70	15	16	17	20	22	23
	6	9/16-18	0.56	14.28	19	20	21	26	27	28
	8	3/4-16	0.75	19.10	34	36	37	46	49	50
	10	7/8-14	0.87	22.22	55	58	61	75	79	83
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
	32	2 1/2-12	2.50	63.50	244	256	268	331	347	363

NOTE:

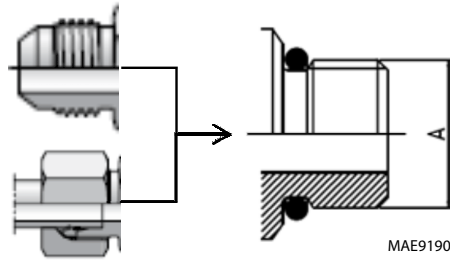
1. *ØA thread OD dimension for reference only.

2. Removal torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.



General Information and Specifications

b. O-ring Boss (ORB) - Table 2 of 6



TYPE/FITTING IDENTIFICATION					STUD ENDS WITH (ORFS) OR S ERIES DIN (MBTS) OPPOSITE END					
Material	Dash Size	Thread Size	ØA*		Torque					
					[Ft-Lb]			[Nm]		
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(85)	(90)	(94)	10	10	11
	3	3/8-24	0.37	9.52	(155)	(163)	(171)	18	18	19
	4	7/16-20	0.44	11.11	22	23	24	29	31	33
	5	1/2-20	0.50	12.70	23	25	26	32	34	35
	6	9/16-18	0.56	14.28	29	31	32	40	42	43
	8	3/4-16	0.75	19.10	52	55	57	70	75	77
	10	7/8-14	0.87	22.22	85	90	94	115	122	127
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
32	2 1/2-12	2.50	63.50	375	394	413	510	534	560	
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(55)	(58)	(61)	6	7	7
	3	3/8-24	0.37	9.52	(101)	(106)	(111)	11	12	13
	4	7/16-20	0.44	11.11	14	15	16	19	20	22
	5	1/2-20	0.50	12.70	15	16	17	20	22	23
	6	9/16-18	0.56	14.28	19	20	21	26	27	28
	8	3/4-16	0.75	19.10	34	36	37	46	49	50
	10	7/8-14	0.87	22.22	55	58	61	75	79	83
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
32	2 1/2-12	2.50	63.50	244	256	268	331	347	363	

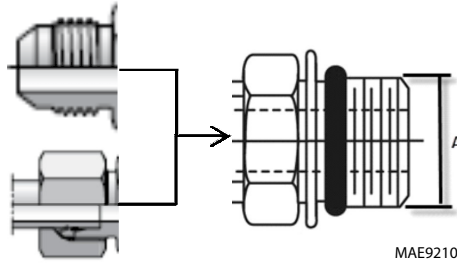
NOTE:

1. *ØA thread OD dimension for reference only.

2. Removal torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.



c. O-ring Boss (ORB) - Table 3 of 6



MAE9210

TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END WITH 37° (JIC) OR L SERIES DIN (MBTL) OPPOSITE END					
Material	Dash Size	Thread Size (UNF)	ØA*		Torque					
					[Ft-Lb]			[Nm]		
					Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(85)	(90)	(94)	10	10	11
	3	3/8-24	0.37	9.52	(155)	(163)	(171)	18	18	19
	4	7/16-20	0.44	11.11	22	23	24	29	31	33
	5	1/2-20	0.50	12.70	23	25	26	32	34	35
	6	9/16-18	0.56	14.28	29	31	32	40	42	43
	8	3/4-16	0.75	19.10	52	55	57	70	75	77
	10	7/8-14	0.87	22.22	85	90	94	115	122	127
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
32	2 1/2-12	2.50	63.50	375	394	413	510	534	560	
Material	Dash Size	Thread Size (UNF)	ØA*		Torque					
					[Ft-Lb]			[Nm]		
					Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(55)	(58)	(61)	6	7	7
	3	3/8-24	0.37	9.52	(101)	(106)	(111)	11	12	13
	4	7/16-20	0.44	11.11	14	15	16	19	20	22
	5	1/2-20	0.50	12.70	15	16	17	20	22	23
	6	9/16-18	0.56	14.28	19	20	21	26	27	28
	8	3/4-16	0.75	19.10	34	36	37	46	49	50
	10	7/8-14	0.87	22.22	55	58	61	75	79	83
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
32	2 1/2-12	2.50	63.50	244	256	268	331	347	363	

NOTE:

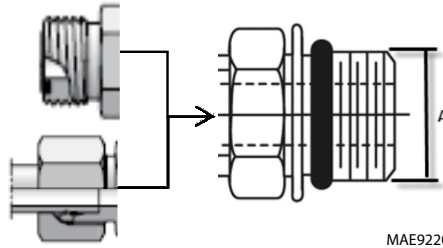
1. * ØA thread OD dimension for reference only.

2. Removal torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.



General Information and Specifications

d. O-ring Boss (ORB) - Table 4 of 6



MAE9220

TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END WITH (ORFS) OR S SERIES DIN (MBTS) OPPOSITE END					
Material	Dash Size	Thread Size	ØA*		Torque					
					[Ft-Lb]			[Nm]		
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	15	16	17	20	22	23
	5	1/2-20	0.50	12.70	30	32	33	40	43	45
	6	9/16-18	0.56	14.28	35	37	39	46	50	53
	8	3/4-16	0.75	19.10	60	63	66	80	85	89
	10	7/8-14	0.87	22.22	100	105	110	135	142	149
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
32	2 1/2-12	2.50	63.50	375	394	413	510	534	560	
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	10	11	11	14	15	15
	5	1/2-20	0.50	12.70	20	21	21	27	28	28
	6	9/16-18	0.56	14.28	23	24	24	31	33	33
	8	3/4-16	0.75	19.10	39	41	43	53	56	58
	10	7/8-14	0.87	22.22	65	69	72	88	94	98
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
32	2 1/2-12	2.50	63.50	244	256	268	331	347	363	

NOTE:

1. *ØA thread OD dimension for reference only.

2. Removal torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.



e. O-ring Boss (ORB) - Table 5 of 6



MAE9230

TYPE/FITTING IDENTIFICATION					HOLLOW HEX PLUGS					
Material	Dash Size	Thread Size	ØA*		Torque					
					[Ft-Lb]			[Nm]		
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(30)	(32)	(33)	3	4	4
	3	3/8-24	0.37	9.52	(55)	(58)	(61)	6	7	7
	4	7/16-20	0.44	11.11	10	11	11	14	15	15
	5	1/2-20	0.50	12.70	14	15	16	19	20	22
	6	9/16-18	0.56	14.28	34	36	38	46	49	52
	8	3/4-16	0.75	19.10	60	63	66	80	85	89
	10	7/8-14	0.87	22.22	100	105	110	135	142	149
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
32	2 1/2-12	2.50	63.50	375	394	413	510	534	560	
Material	Dash Size	Thread Size	ØA*		Torque					
					[Ft-Lb]			[Nm]		
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(20)	(21)	(21)	2	2	2
	3	3/8-24	0.37	9.52	(36)	(38)	(40)	4	4	5
	4	7/16-20	0.44	11.11	6	7	7	8	9	9
	5	1/2-20	0.50	12.70	9	10	10	12	14	14
	6	9/16-18	0.56	14.28	22	24	25	30	33	34
	8	3/4-16	0.75	19.10	39	41	43	53	56	58
	10	7/8-14	0.87	22.22	65	69	72	88	94	98
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
32	2 1/2-12	2.50	63.50	244	256	268	331	347	363	

NOTE:

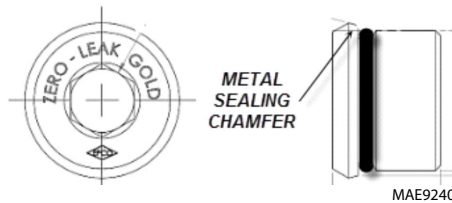
1. *ØA thread OD dimension for reference only.

2. Removal torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.



General Information and Specifications

f. O-ring Boss (ORB) - Table 6 of 6



TYPE/FITTING IDENTIFICATION					ZERO LEAK GOLD® HOLLOW HEX PLUGS					
Material	Dash Size	Thread Size	ØA*		Torque					
					[Ft-Lb]			[Nm]		
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	2	3	4	3	4	5
	3	3/8-24	0.37	9.52	3	4	5	4	5	7
	4	7/16-20	0.44	11.11	7	8	9	9	11	12
	5	1/2-20	0.50	12.70	9	10	11	12	14	15
	6	9/16-18	0.56	14.28	11	12	13	15	16	18
	8	3/4-16	0.75	19.10	28	30	32	38	41	43
	10	7/8-14	0.87	22.22	46	48	50	62	65	68
	12	1 1/16-12	1.06	27.00	51	54	57	69	73	77
	14	1 3/16-12	1.19	30.10	Fitting size greater than -12 not typically specified on Caterpillar applications. Consult specific service procedure if encountered.					
	16	1 5/16-12	1.31	33.30						
	20	1 5/8-12	1.63	41.30						
	24	1 7/8-12	1.87	47.60						
32	2 1/2-12	2.50	63.50							
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	2	3	4	3	4	5
	3	3/8-24	0.37	9.52	3	4	5	4	5	7
	4	7/16-20	0.44	11.11	7	8	9	9	11	12
	5	1/2-20	0.50	12.70	9	10	11	12	14	15
	6	9/16-18	0.56	14.28	11	12	13	15	16	18
	8	3/4-16	0.75	19.10	28	30	32	38	41	43
	10	7/8-14	0.87	22.22	46	48	50	62	65	68
	12	1 1/16-12	1.06	27.00	51	54	57	69	73	77
	14	1 3/16-12	1.19	30.10	Fitting size greater than -12 not typically specified on Caterpillar applications. Consult specific service procedure if encountered.					
	16	1 5/16-12	1.31	33.30						
	20	1 5/8-12	1.63	41.30						
	24	1 7/8-12	1.87	47.60						
	32	2 1/2-12	2.50	63.50						

NOTE:

1. *ØA thread OD dimension for reference only.

2. Removal torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.



General Information and Specifications

2.8.10 Assembly Instructions for Adjustable Port End Metric Fittings

1. Inspect components to ensure that male and female threads and surfaces are free of rust, splits, dirt, foreign matter, or burrs.
2. If o-ring is not pre-installed, install proper size, taking care not to damage it. Refer to Section 2.8.17, "O-ring Installation (Replacement).", for procedure.

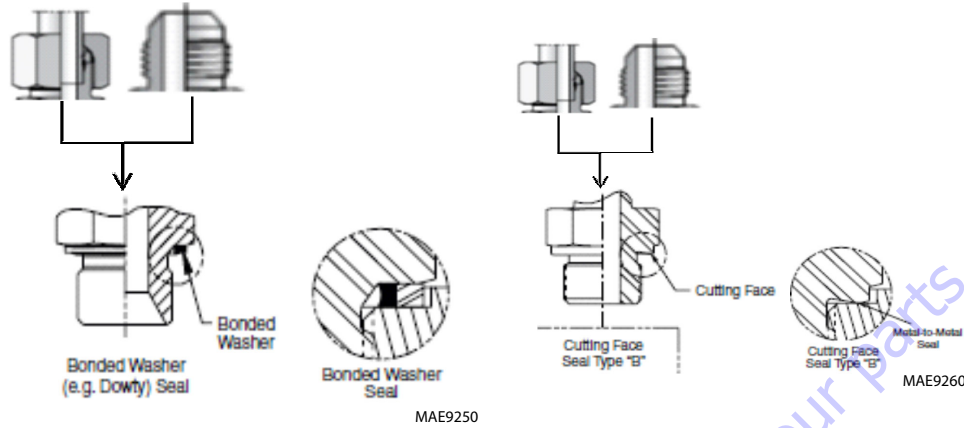
NOTICE

Care to be taken when lubricating o-ring. Avoid adding oil to the threaded connection of the fitting. The lubrication would cause increased clamping force and cause fitting damage.

3. Pre-lubricate the o-ring with hydraulic oil.
4. For non-adjustable fittings and plugs, thread the fitting by hand until contact.
5. For adjustable fittings, refer to Section 2.8.16, "Adjustable Stud End Assembly," for proper assembly.
6. Torque the fitting or nut to value while using the Double Wrench Method.
 - a. The table headings identify the Metric port and the type on the other side of the fitting. The torque will be applied to the Metric port.
 - b. Torque values are segregated based on the material configuration of the connection. 'Aluminum/brass fittings or aluminum/brass mating components' indicate either the following material configurations:
 - Steel fittings with aluminum or brass mating components
 - Aluminum or brass fittings with steel mating components
 - Aluminum or brass fittings with aluminum or brass mating components.
7. Inspect to ensure the o-ring is not pinched and the washer is seated flat on the counter bore of the port.



a. Metric Flat Face Port (MFF) L Series - Table 1 of 3

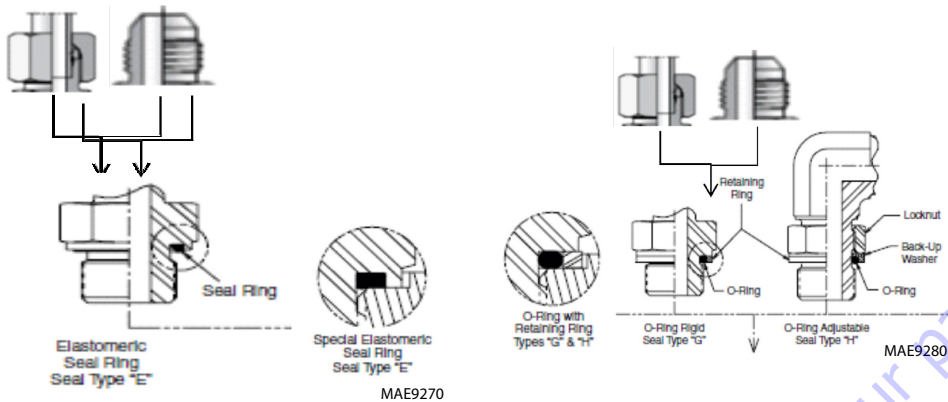


TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS WITH 37° (JIC) or L SERIES DIN (MBTL) OPPOSITE END						FORM B (CUTTING FACE) STUD ENDS WITH 37° (JIC) OR L SERIES DIN (MBTL) OPPOSITE END					
Material	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
			Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
(metric)	(mm)													
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	7	8	8	9	11	11	13	14	14	18	19	19
	M12x1.5	8	15	16	17	20	22	23	22	23	24	30	31	33
	M14x1.5	10	26	28	29	35	38	39	33	35	36	45	47	49
	M16x1.5	12	33	35	36	45	47	49	48	51	53	65	69	72
	M18x1.5	15	41	43	45	55	58	61	59	62	65	80	84	88
	M22x1.5	18	48	51	53	65	69	72	103	108	113	140	146	153
	M27x2	22	66	70	73	90	95	99	140	147	154	190	199	209
	M33x2	28	111	117	122	150	159	165	251	264	276	340	358	374
	M42x2	35	177	186	195	240	252	264	369	388	406	500	526	550
M48x2	42	214	225	235	290	305	319	465	489	512	630	663	694	
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	4	5	5	5	7	7	8	9	9	11	12	12
	M12x1.5	8	10	11	11	14	15	15	14	15	16	19	20	22
	M14x1.5	10	17	18	19	23	24	26	21	22	23	28	30	31
	M16x1.5	12	21	22	23	28	30	31	31	33	34	42	45	46
	M18x1.5	15	27	28	29	37	38	39	38	40	42	52	54	57
	M22x1.5	18	31	33	34	42	45	46	67	70	73	91	95	99
	M27x2	22	43	45	47	58	61	64	91	96	100	123	130	136
	M33x2	28	72	76	79	98	103	107	163	171	179	221	232	243
	M42x2	35	115	121	127	156	164	172	240	252	264	325	342	358
	M48x2	42	139	146	153	188	198	207	302	318	332	409	431	450



General Information and Specifications

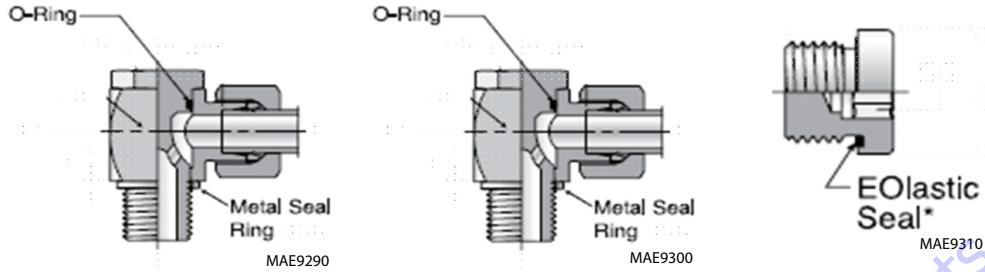
b. Metric Flat Face Port (MFF) L Series - Table 2 of 3



TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS WITH 37° (JIC) OR L SERIES DIN (MBTL) OPPOSITE END						FORM B (CUTTING FACE) STUD ENDS WITH 37° (JIC) OR L SERIES DIN (MBTL) OPPOSITE END					
Material	Thread M Size	Connecting Tube O.D	Torque						Torque					
			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	13	14	14	18	19	19	13	14	15	18	19	20
	M12x1.5	8	18	19	20	25	26	27	18	19	20	25	26	28
	M14x1.5	10	33	35	36	45	47	49	30	31	32	40	42	44
	M16x1.5	12	41	43	45	55	58	61	41	43	45	55	58	61
	M18x1.5	15	52	55	57	70	75	77	52	54	57	70	74	77
	M22x1.5	18	92	97	101	125	132	137	66	70	73	90	95	99
	M27x2	22	133	140	146	180	190	198	133	139	146	180	189	198
	M33x2	28	229	241	252	310	327	342	229	240	252	310	326	341
	M42x2	35	332	349	365	450	473	495	332	348	365	450	473	495
M48x2	42	398	418	438	540	567	594	398	418	438	540	567	594	
ALUMINUM/ BRASS FITTINGS OR ALUMINUM/ BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	8	9	9	11	12	12	8	9	9	11	12	12
	M12x1.5	8	12	13	13	16	18	18	12	13	13	16	18	18
	M14x1.5	10	21	22	23	28	30	31	19	20	21	26	27	29
	M16x1.5	12	27	28	29	37	38	39	26	28	29	36	38	39
	M18x1.5	15	34	36	37	46	49	50	34	35	37	46	48	50
	M22x1.5	18	60	63	66	81	85	89	43	45	47	59	61	64
	M27x2	22	86	91	95	117	123	129	86	91	95	117	123	129
	M33x2	28	149	157	164	202	213	222	149	157	164	202	213	222
	M42x2	35	216	227	237	293	308	321	216	227	237	293	308	321
	M48x2	42	259	272	285	351	369	386	259	272	285	351	369	386



c. Metric Flat Face Port (MFF) L Series - Table 3 of 3

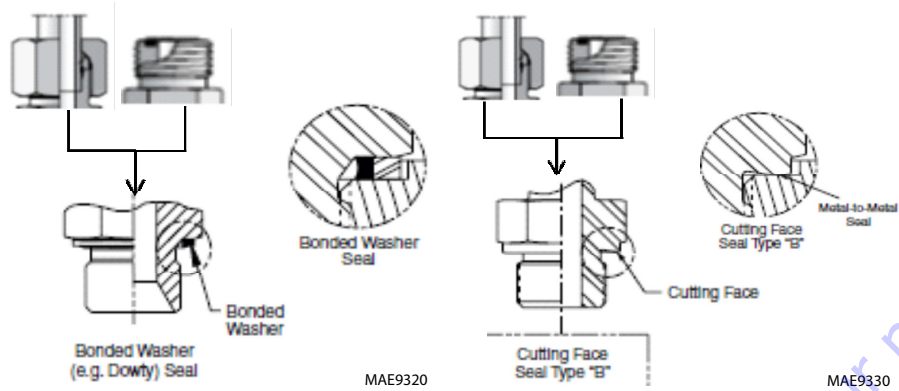


TYPE/FITTING IDENTIFICATION			BANJO FITTINGS WITH L SERIES DIN (MBTL) OPPOSITE END						HIGH PRESSURE BANJO FITTINGS WITH L SERIES DIN (MBTL) OPPOSITE END						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS					
Material	Thread M Size	Connecting Tube O.D	Torque						Torque						Torque					
			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	13	14	14	18	19	19	13	14	14	18	19	19	9	10	10	12	14	14
	M12x1.5	8	26	28	29	35	38	39	33	35	36	45	47	49	18	19	20	25	26	27
	M14x1.5	10	37	39	41	50	53	56	41	43	45	55	58	61	26	28	29	35	38	39
	M16x1.5	12	44	46	48	60	62	65	59	62	65	80	84	88	41	43	45	55	58	61
	M18x1.5	15	59	62	65	80	84	88	74	78	81	100	106	110	48	51	53	65	69	72
	M22x1.5	18	89	94	98	120	127	133	103	108	113	140	146	153	66	70	73	90	95	99
	M27x2	22	96	101	106	130	137	144	236	248	260	320	336	353	100	105	110	135	142	149
	M33x2	28	--	--	--	--	--	--	266	280	293	360	380	397	166	175	183	225	237	248
	M42x2	35	--	--	--	--	--	--	398	418	438	540	567	594	266	280	293	360	380	397
	M48x2	42	--	--	--	--	--	--	516	542	568	700	735	770	266	280	293	360	380	397
ALUMINUM/ BRASS FITTINGS OR ALUMINUM/ BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	8	9	9	11	12	12	8	9	9	11	12	12	6	7	7	8	9	9
	M12x1.5	8	17	18	19	23	24	26	21	22	23	28	30	31	12	13	13	16	18	18
	M14x1.5	10	24	26	27	33	35	37	27	28	29	37	38	39	17	18	19	23	24	26
	M16x1.5	12	29	30	31	39	41	42	38	40	42	52	54	57	27	28	29	37	38	39
	M18x1.5	15	38	40	42	52	54	57	48	51	53	65	69	72	31	33	34	42	45	46
	M22x1.5	18	58	61	64	79	83	87	67	70	73	91	95	99	43	45	47	58	61	64
	M27x2	22	62	66	69	84	89	94	153	161	169	207	218	229	65	69	72	88	94	98
	M33x2	28	--	--	--	--	--	--	173	182	190	235	247	258	108	114	119	146	155	161
	M42x2	35	--	--	--	--	--	--	259	272	285	351	369	386	173	182	190	235	247	258
	M48x2	42	--	--	--	--	--	--	335	352	369	454	477	500	173	182	190	235	247	258



General Information and Specifications

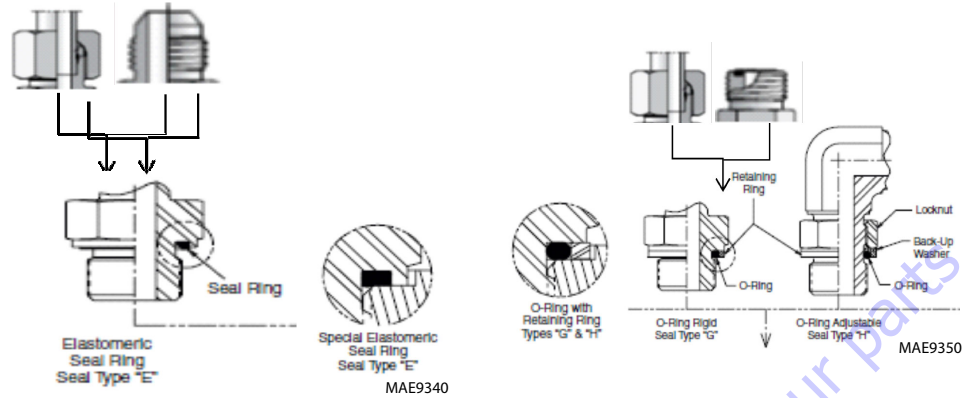
d. Metric Flat Face Port (MFF) S Series - Table 1 of 3



TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS WITH (ORFS) OR S SERIES DIN (MBTS) OPPOSITE END						FORM B (CUTTING FACE) STUD ENDS WITH (ORFS) OR S SERIES DIN (MBTS) OPPOSITE END					
Material	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M12x1.5	6	15	16	17	20	22	23	26	28	29	35	38	39
	M14x1.5	8	26	28	29	35	38	39	41	43	45	55	58	61
	M16x1.5	10	33	35	36	45	47	49	52	55	57	70	75	77
	M18x1.5	12	41	43	45	55	58	61	81	85	89	110	115	121
	M20x1.5	14	41	43	45	55	58	61	111	117	122	150	159	165
	M22x1.5	16	48	51	53	65	69	72	125	132	138	170	179	187
	M27x2	20	66	70	73	89	95	99	199	209	219	270	283	297
	M33x2	25	111	117	122	150	159	165	302	317	332	410	430	450
	M42x2	30	177	186	195	240	252	264	398	418	438	540	567	594
M48x2	38	214	225	235	290	305	319	516	542	568	700	735	770	
ALUMINUM/ BRASS FITTINGS OR ALUMINUM/ BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M12x1.5	6	10	11	11	14	15	15	17	18	19	23	24	26
	M14x1.5	8	17	18	19	23	24	26	27	28	29	37	38	39
	M16x1.5	10	21	22	23	28	30	31	34	36	37	46	49	50
	M18x1.5	12	27	28	29	37	38	39	53	56	58	72	76	79
	M20x1.5	14	27	28	29	37	38	39	72	76	79	98	103	107
	M22x1.5	16	31	33	34	42	45	46	81	86	90	110	117	122
	M27x2	20	43	45	47	58	61	64	129	136	142	175	184	193
	M33x2	25	72	76	79	98	103	107	196	206	216	266	279	293
	M42x2	30	115	121	127	156	164	172	259	272	285	351	369	386
M48x2	38	139	146	153	188	198	207	335	352	369	454	477	500	



e. Metric Flat Face Port (MFF) S Series - Table 2 of 3

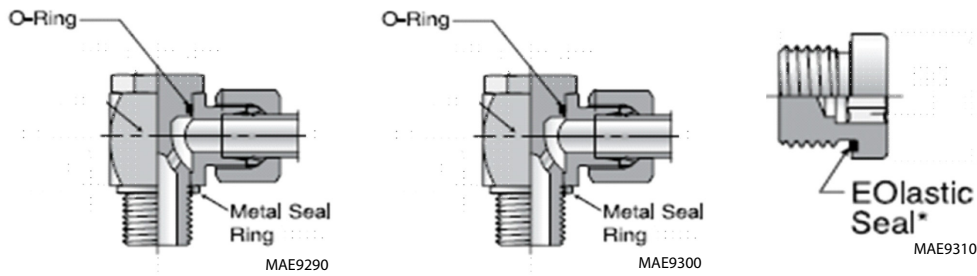


TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS WITH (ORFS) OR S SERIES DIN (MBTS) OPPOSITE END						FORM B (CUTTING FACE) STUD ENDS WITH (ORFS) OR S SERIES DIN (MBTS) OPPOSITE END					
Material	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	26	28	29	35	38	39	26	28	29	35	38	39
	M12x1.5	8	33	35	36	45	47	49	41	43	45	55	58	61
	M14x1.5	10	52	55	57	70	75	77	52	55	57	70	75	77
	M16x1.5	12	66	70	73	90	95	99	66	70	73	90	95	99
	M18x1.5	15	92	97	101	125	132	137	92	97	101	125	132	137
	M22x1.5	18	100	105	110	135	142	149	100	105	110	135	142	149
	M27x2	22	133	140	146	180	190	198	133	140	146	180	190	198
	M33x2	28	229	241	252	310	327	342	229	241	252	310	327	342
	M42x2	35	332	349	365	450	473	495	332	349	365	450	473	495
M48x2	42	398	418	438	540	567	594	398	418	438	540	567	594	
ALUMINUM/ BRASS FITTINGS OR ALUMINUM/ BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	17	18	19	23	24	26	17	18	19	23	24	26
	M12x1.5	8	21	23	23	29	31	32	27	28	29	37	38	39
	M14x1.5	10	34	36	37	46	49	50	34	36	37	46	49	50
	M16x1.5	12	43	45	47	58	61	64	43	45	47	58	61	64
	M18x1.5	15	60	63	66	81	85	89	60	63	66	81	85	89
	M22x1.5	18	65	69	72	88	94	98	65	69	72	88	94	98
	M27x2	22	86	91	95	117	123	129	86	91	95	117	123	129
	M33x2	28	149	157	164	202	213	222	149	157	164	202	213	222
	M42x2	35	216	227	237	293	308	321	216	227	237	293	308	321
M48x2	42	259	272	285	351	369	386	259	272	285	351	369	386	



General Information and Specifications

f. Metric Flat Face Port (MFF) S Series - Table 3 of 3



TYPE/FITTING IDENTIFICATION			BANJO FITTINGS WITH S SERIES DIN (MBTS) OPPOSITE END						HIGH PRESSURE BANJO FITTINGS WITH S SERIES DIN (MBTS) OPPOSITE END						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS					
Material	Thread M Size	Connecting Tube O.D	Torque						Torque						Torque					
			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	26	28	29	35	38	39	33	35	36	45	47	49	--	--	--	--	--	--
	M12x1.5	8	37	39	41	50	53	56	41	43	45	55	58	61	--	--	--	--	--	--
	M14x1.5	10	44	46	48	60	62	65	59	62	65	80	84	88	--	--	--	--	--	--
	M16x1.5	12	59	62	65	80	84	88	74	78	81	100	106	110	--	--	--	--	--	--
	M18x1.5	15	81	85	89	110	115	121	92	97	101	125	132	137	59	62	65	80	84	88
	M22x1.5	18	89	94	98	120	127	133	100	105	110	135	142	149	--	--	--	--	--	--
	M27x2	22	100	105	110	135	142	149	236	248	260	320	336	353	--	--	--	--	--	--
	M33x2	28	--	--	--	--	--	--	266	280	293	360	380	397	--	--	--	--	--	--
	M42x2	35	--	--	--	--	--	--	398	418	438	540	567	594	--	--	--	--	--	--
	M48x2	42	--	--	--	--	--	--	516	542	568	700	735	770	--	--	--	--	--	--
ALUMINUM/ BRASS FITTINGS OR ALUMINUM/ BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	17	18	19	23	24	26	21	22	23	28	30	31	--	--	--	--	--	--
	M12x1.5	8	24	26	27	33	35	37	27	28	29	37	38	39	--	--	--	--	--	--
	M14x1.5	10	29	30	31	39	41	42	38	40	42	52	54	57	--	--	--	--	--	--
	M16x1.5	12	38	40	42	52	54	57	48	51	53	65	69	72	--	--	--	--	--	--
	M18x1.5	15	53	56	58	72	76	79	60	63	66	81	85	89	38	40	42	52	54	57
	M22x1.5	18	58	61	64	79	83	87	65	69	72	88	94	98	--	--	--	--	--	--
	M27x2	22	65	69	72	88	94	98	153	161	169	207	218	229	--	--	--	--	--	--
	M33x2	28	--	--	--	--	--	--	173	182	190	235	247	258	--	--	--	--	--	--
	M42x2	35	--	--	--	--	--	--	259	272	285	351	369	386	--	--	--	--	--	--
	M48x2	42	--	--	--	--	--	--	335	352	369	454	477	500	--	--	--	--	--	--



General Information and Specifications

2.8.11 Assembly Instructions for Metric ISO 6149 Port Assembly Stud Ends

1. Inspect components to ensure that male and female threads and surfaces are free of rust, splits, dirt, foreign matter, or burrs.
2. If o-ring is not pre installed, install proper size, taking care not to damage it. Refer to Section 2.8.17, "O-ring Installation (Replacement)".

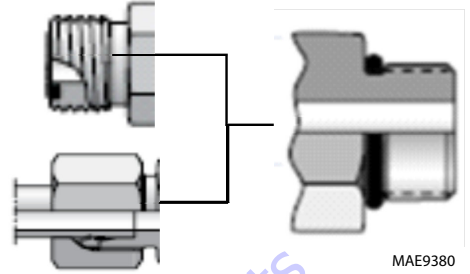
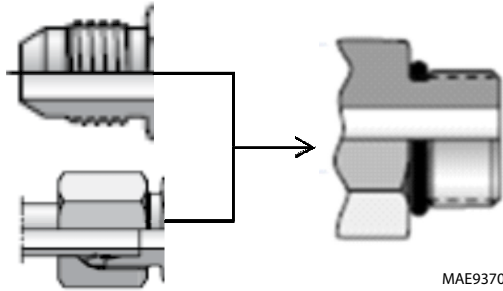
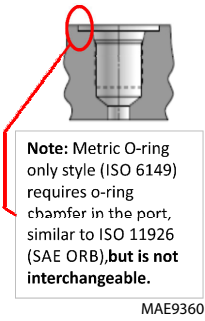
NOTICE

Care to be taken when lubricating o-ring. Avoid adding oil to the threaded connection of the fitting. The lubrication would cause increased clamping force and cause fitting damage.

3. Pre-lubricate the o-ring with hydraulic oil.
4. For non-adjustable fittings and plugs, thread the fitting by hand until contact.
5. For adjustable fittings, refer to Section 2.8.16, "Adjustable Stud End Assembly", for proper assembly.
6. Torque the fitting or nut to value while using the Double Wrench Method.
 - a. The table headings identify the Metric port and the type on the other side of the fitting. The torque will be applied to the Metric port.
 - b. Torque values are segregated based on the material configuration of the connection. 'Aluminum/brass fittings or aluminum/brass mating components' indicate either the following material configurations:
 - Steel fittings with aluminum or brass mating components
 - Aluminum or brass fittings with steel mating components
 - Aluminum or brass fittings with aluminum or brass mating components.
7. Inspect to ensure the o-ring is not pinched and the washer is seated flat on the counter bore of the port.



a. Metric Pipe Parallel O-Ring Boss (MPP)



TYPE/FITTING IDENTIFICATION			STUD ENDS WITH 37° (JIC) OR L SERIES DIN (MBTL) OPPOSITE END						STUD ENDS WITH (ORFS) OR S SERIES DIN (MBTS) OPPOSITE END					
Material	Thread M Size (metric)	Connecting Tube O.D. (mm)	Torque						Torque					
			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
			Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M8x1	4	6	7	7	8	9	9	8	9	9	10	12	12
	M10x1	6	11	12	12	15	16	16	15	16	17	20	22	23
	M12x1.5	8	18	19	20	25	26	27	26	28	29	35	38	39
	M14x1.5	10	26	28	29	35	38	39	33	35	36	45	47	49
	M16x1.5	12	30	32	33	40	43	45	41	43	45	55	58	61
	M18x1.5	15	33	35	36	45	47	49	52	55	57	70	75	77
	M20x1.5	--	--	--	--	--	--	--	59	62	65	80	84	88
	M22x1.5	18	44	46	48	60	62	65	74	78	81	100	106	110
	M27x2	22	74	78	81	100	106	110	125	132	138	170	179	187
	M30x2	--	95	100	105	130	136	142	175	184	193	237	249	262
	M33x2	25	120	126	132	160	171	179	230	242	253	310	328	343
	M38x2	--	135	142	149	183	193	202	235	247	259	319	335	351
	M42x2	30	155	163	171	210	221	232	245	258	270	330	350	366
M48x2	38	190	200	209	260	271	283	310	326	341	420	442	462	
M60x2	50	230	242	253	315	328	343	370	389	407	500	527	552	
ALUMINUM/ BRASS FITTINGS OR ALUMINUM/ BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M8x1	4	4	5	5	5	7	7	5	6	6	7	8	8
	M10x1	6	7	8	8	9	11	11	10	11	11	14	15	15
	M12x1.5	8	12	13	13	16	18	18	17	18	19	23	24	26
	M14x1.5	10	17	18	19	23	24	26	21	22	23	28	30	31
	M16x1.5	12	20	21	21	27	28	28	27	28	29	37	38	39
	M18x1.5	15	21	22	23	28	30	31	34	36	37	46	49	50
	M20x1.5	--	--	--	--	--	--	--	30	40	42	41	54	57
	M22x1.5	18	29	30	31	39	41	42	48	51	53	65	69	72
	M27x2	22	48	51	53	65	69	72	81	86	90	110	117	122
	M30x2	--	62	65	68	84	88	92	114	120	125	155	163	169
	M33x2	25	78	82	86	106	111	117	150	157	164	203	213	222
	M38x2	--	88	93	97	119	126	132	153	161	168	207	218	228
	M42x2	30	101	106	111	137	144	150	159	168	176	216	228	239
M48x2	38	124	130	136	168	176	184	202	212	222	274	287	301	
M60x2	50	150	157	164	203	213	222	241	253	265	327	343	359	



General Information and Specifications

2.8.12 Assembly Instructions for Adjustable Port End (BSPP) Fittings

1. Inspect components to ensure that male and female threads and surfaces are free of rust, splits, dirt, foreign matter, or burrs.
2. If o-ring is not pre installed, install proper size, taking care not to damage it. Refer to Section 2.8.17, "O-ring Installation (Replacement).", for instructions.

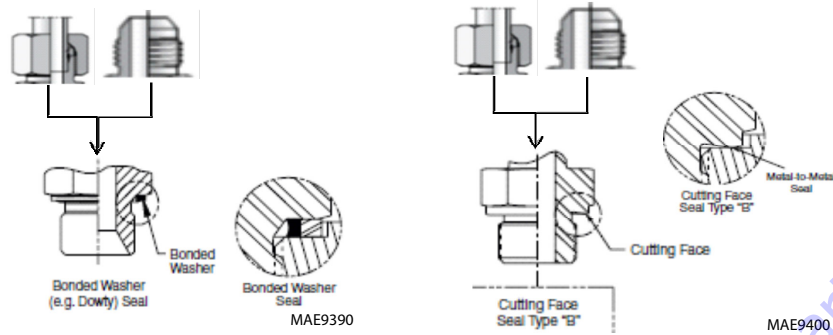
NOTICE

Care to be taken when lubricating o-ring. Avoid adding oil to the threaded connection of the fitting. The lubrication would cause increased clamping force and cause fitting damage.

3. Pre-lubricate the o-ring with hydraulic oil.
4. For non-adjustable fittings and plugs, thread the fitting by hand until contact.
5. For adjustable fittings, refer to Section 2.8.16, "Adjustable Stud End Assembly.", for proper assembly.
6. Torque the fitting or nut to value while using the Double Wrench Method.
 - a. The table headings identify the BSPP port and the type on the other side of the fitting. The torque will be applied to the BSPP port.
 - b. Torque values are segregated based on the material configuration of the connection. 'Aluminum/brass fittings or aluminum/brass mating components' indicate either the following material configurations:
 - Steel fittings with aluminum or brass mating components
 - Aluminum or brass fittings with steel mating components
 - Aluminum or brass fittings with aluminum or brass mating components.
7. Inspect to ensure the o-ring is not pinched and the washer is seated flat on the counter bore of the port.



a. British Standard Parallel Pipe Port (BSPP) - L Series - Table 1 of 3



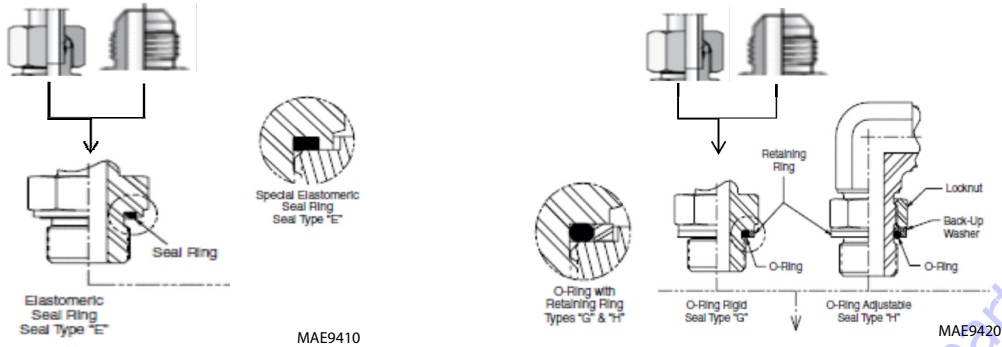
TYPE/FITTING IDENTIFICATION			FORM A**(SEALING WASHER) STUD ENDS WITH 37° (JIC) or L SERIES DIN (MBTL) OPPOSITE END						FORM B**(CUTTING FACE) STUD ENDS WITH 37° (JIC) OR L SERIES DIN (MBTL) OPPOSITE END					
Material	BSPP Thread G Size	Connecting Tube O.D. (mm)	Torque						Torque					
			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
			Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	7	8	8	9	11	11	13	14	14	18	19	19
	G 1/4A	8	26	28	29	35	38	39	26	28	29	35	38	39
	G 1/4A	10	26	28	29	35	38	39	26	28	29	35	38	39
	G 3/8A	12	33	35	36	45	47	49	52	55	57	70	75	77
	G 1/2A	15	48	51	53	65	69	72	103	108	113	140	146	153
	G 1/2A	18	48	51	53	65	69	72	74	78	81	100	106	110
	G 3/4A	22	66	70	73	90	95	99	133	140	146	180	190	198
	G 1A	28	111	117	122	150	159	165	243	255	267	330	346	362
	G 1-1/4A	35	177	186	195	240	252	264	398	418	438	540	567	594
G 1-1/2A	42	214	225	235	290	305	319	465	489	512	630	663	694	
ALUMINUM/ BRASS FITTINGS OR ALUMINUM/ BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	4	5	5	5	7	7	8	9	9	11	12	12
	G 1/4A	8	17	18	19	23	24	26	17	18	19	23	24	26
	G 1/4A	10	17	18	19	23	24	26	17	18	19	23	24	26
	G 3/8A	12	21	22	23	28	30	31	34	36	37	46	49	50
	G 1/2A	15	31	33	34	42	45	46	67	70	73	91	95	99
	G 1/2A	18	31	33	34	42	45	46	48	51	53	65	69	72
	G 3/4A	22	42	45	47	57	61	64	86	91	95	117	123	129
	G 1A	28	72	76	79	98	103	107	158	166	174	214	225	236
	G 1-1/4A	35	115	121	127	156	164	172	259	272	285	351	369	386

NOTE: ** Non typical for Straight Male Stud Fittings, reference only.



General Information and Specifications

b. British Standard Parallel Pipe Port (BSPP) - L Series - Table 2 of 3

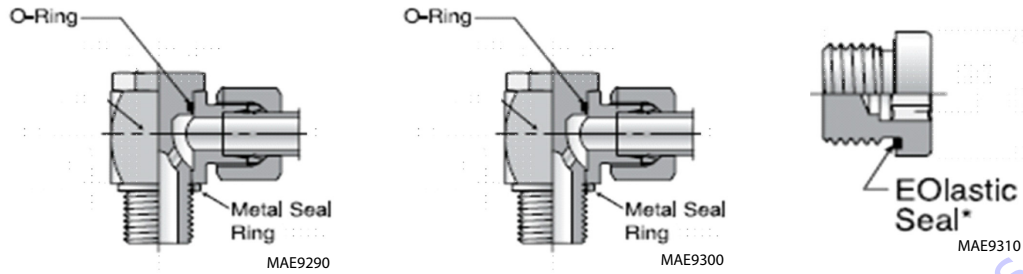


TYPE/FITTING IDENTIFICATION			FORM A** (SEALING WASHER) STUD ENDS WITH 37° (JIC) OR L SERIES DIN (MBTL) OPPOSITE END						FORM B** (CUTTING FACE) STUD ENDS WITH 37° (JIC) OR L SERIES DIN (MBTL) OPPOSITE END					
Material	BSPP Thread G Size	Connecting Tube O.D. (mm)	Torque						Torque					
			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
			Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	13	14	14	18	19	19	13	14	14	18	19	19
	G 1/4A	8	26	28	29	35	38	39	26	28	29	35	38	39
	G 1/4A	10	26	28	29	35	38	39	26	28	29	35	38	39
	G 3/8A	12	52	55	57	70	75	77	52	55	57	70	75	77
	G 1/2A	15	66	70	73	90	95	99	66	70	73	90	95	99
	G 1/2A	18	66	70	73	90	95	99	66	70	73	90	95	99
	G 3/4A	22	133	140	146	180	190	198	133	140	146	180	190	198
	G 1A	28	229	241	252	310	327	342	229	241	252	310	327	342
	G 1-1/4A	35	332	349	365	450	473	495	332	349	365	450	473	495
G 1-1/2A	42	398	418	438	540	567	594	398	418	438	540	567	594	
ALUMINUM/ BRASS FITTINGS OR ALUMINUM/ BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	8	9	9	11	12	12	8	9	9	11	12	12
	G 1/4A	8	17	18	19	23	24	26	17	18	19	23	24	26
	G 1/4A	10	17	18	19	23	24	26	17	18	19	23	24	26
	G 3/8A	12	34	36	37	46	49	50	34	36	37	46	49	50
	G 1/2A	15	43	45	47	58	61	64	43	45	47	58	61	64
	G 1/2A	18	43	45	47	58	61	64	43	45	47	58	61	64
	G 3/4A	22	86	91	95	117	123	129	86	91	95	117	123	129
	G 1A	28	149	157	164	202	213	222	149	157	164	202	213	222
	G 1-1/4A	35	216	227	237	293	308	321	216	227	237	293	308	321

NOTE: ** Non typical for Straight Male Stud Fittings, reference only.



c. British Standard Parallel Pipe Port (BSPP) L Series - Table 3 of 3

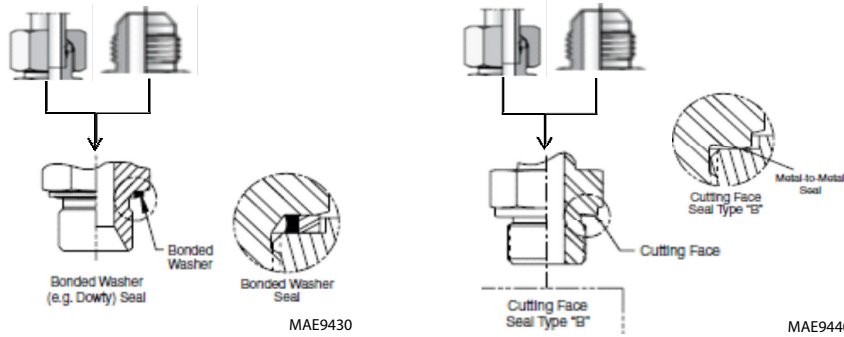


TYPE/FITTING IDENTIFICATION			BANJO FITTINGS WITH S SERIES DIN (MBTS) OPPOSITE END						HIGH PRESSURE BANJO FITTINGS WITH S SERIES DIN (MBTS) OPPOSITE END						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS														
Material	BSPP Thread G Size	Connecting Tube O.D. (mm)	Torque									Torque									Torque								
			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]											
			Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max						
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	13	14	14	18	19	19	13	14	14	18	19	19	10	11	11	13	15	15									
	G 1/4A	8	30	32	33	40	43	45	33	35	36	45	47	49	22	23	24	30	31	33									
	G 1/4A	10	30	32	33	40	43	45	33	35	36	45	47	49	22	23	24	30	31	33									
	G 3/8A	12	48	51	53	65	69	72	52	55	57	70	75	77	44	46	48	60	62	65									
	G 1/2A	15	66	70	73	90	95	99	89	94	98	120	127	133	59	62	65	80	84	88									
	G 1/2A	18	66	70	73	90	95	99	89	94	98	120	127	133	59	62	65	80	84	88									
	G 3/4A	22	92	97	101	125	132	137	170	179	187	230	243	254	103	108	113	140	146	153									
	G 1A	28	--	--	--	--	--	--	236	248	260	320	336	353	148	156	163	200	212	221									
	G 1-1/4A	35	--	--	--	--	--	--	398	418	438	540	567	594	295	313.5	332	400	425	450									
	G 1-1/2A	42	--	--	--	--	--	--	516	542	568	700	735	770	332	349	365	450	473	495									
ALUMINUM/ BRASS FITTINGS OR ALUMINUM/ BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	8	9	9	11	12	12	8	9	9	11	12	12	6	7	7	8	9	9									
	G 1/4A	8	20	21	21	27	28	28	21	22	23	28	30	31	14	15	16	19	20	22									
	G 1/4A	10	20	21	21	27	28	28	21	22	23	28	30	31	14	15	16	19	20	22									
	G 3/8A	12	31	33	34	42	45	46	34	36	37	46	49	50	29	30	31	39	41	42									
	G 1/2A	15	43	45	47	58	61	64	58	61	64	79	83	87	38	40	42	52	54	57									
	G 1/2A	18	43	45	47	58	61	64	58	61	64	79	83	87	38	40	42	52	54	57									
	G 3/4A	22	60	63	66	81	85	89	111	117	122	150	159	165	67	70	73	91	95	99									
	G 1A	28	--	--	--	--	--	--	153	161	169	207	218	229	96	101	106	130	137	144									
	G 1-1/4A	35	--	--	--	--	--	--	259	272	285	351	369	386	216	227	237	293	308	321									
	G 1-1/2A	42	--	--	--	--	--	--	335	352	369	454	477	500	216	227	237	293	308	321									



General Information and Specifications

d. British Standard Parallel Pipe Port (BSPP) S Series - Table 1 of 3

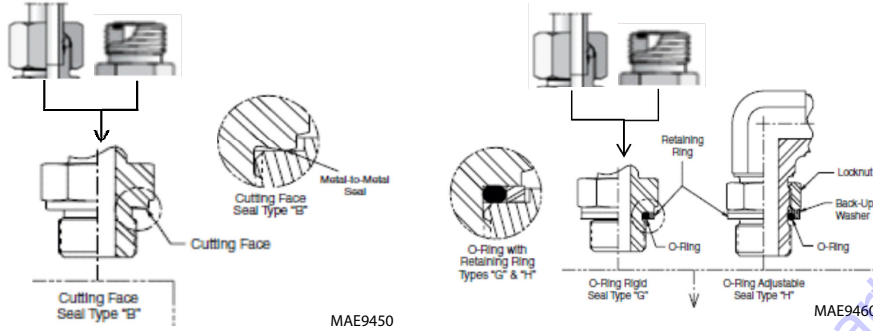


TYPE/FITTING IDENTIFICATION			FORM A** (SEALING WASHER) STUD ENDS WITH (ORFS) OR S SERIES DIN (MBTS) OPPOSITE END						FORM B** (CUTTING FACE) STUD ENDS WITH (ORFS) OR S SERIES DIN (MBTS) OPPOSITE END					
Material	BSPP Thread G Size	Connecting Tube O.D. (mm)	Torque						Torque					
			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
			Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	26	28	29	35	38	39	41	43	45	55	58	61
	G 1/4A	8	26	28	29	35	38	39	41	43	45	55	58	61
	G 3/8A	10	33	35	36	45	47	49	66	70	73	90	95	99
	G 3/8A	12	33	35	36	45	47	49	66	70	73	90	95	99
	G 1/2A	14	48	51	53	65	69	72	111	117	122	150	159	165
	G 1/2A	16	48	51	53	65	69	72	96	101	106	130	137	144
	G 3/4A	20	66	70	73	90	95	99	199	209	219	270	283	297
	G 1A	25	111	117	122	150	159	165	251	264	276	340	358	374
	G 1-1/4A	30	177	186	195	240	252	264	398	418	438	540	567	594
G 1-1/2A	38	214	225	235	290	305	319	516	542	568	700	735	770	
ALUMINUM/ BRASS FITTINGS OR ALUMINUM/ BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	17	18	19	23	24	26	27	28	29	37	38	39
	G 1/4A	8	17	18	19	23	24	26	27	28	29	37	38	39
	G 3/8A	10	21	22	23	28	30	31	43	45	47	58	61	64
	G 3/8A	12	21	22	23	28	30	31	43	45	47	58	61	64
	G 1/2A	14	31	33	34	42	45	46	72	76	79	98	103	107
	G 1/2A	16	31	33	34	42	45	46	62	66	69	84	89	94
	G 3/4A	20	43	45	47	58	61	64	129	136	142	175	184	193
	G 1A	25	72	76	79	98	103	107	163	171	179	221	232	243
	G 1-1/4A	30	115	121	127	156	164	172	259	272	285	351	369	386
G 1-1/2A	38	139	146	153	188	198	207	335	352	369	454	477	500	

NOTE: ** Non typical for Straight Male Stud Fittings, reference only.



e. British Standard Parallel Pipe Port (BSPP) S Series - Table 2 of 3



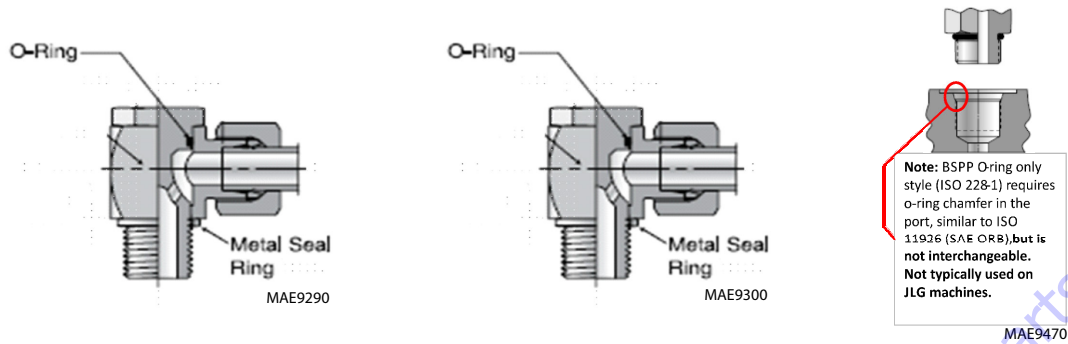
TYPE/FITTING IDENTIFICATION			FORM E* (EOLASTIC SEALING RING) STUD ENDS AND HEX TYPE PLUGS WITH (ORFS) or S SERIES DIN (MBTS) OPPOSITE END						FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS WITH (ORFS) OR S SERIES DIN (MBTS) OPPOSITE END					
Material	BSPP Thread G Size	Connecting Tube O.D. (mm)	Torque						Torque					
			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
			Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	41	43	45	55	58	61	26	28	29	35	38	39
	G 1/4A	8	41	43	45	55	58	61	26	28	29	35	38	39
	G 3/8A	10	59	62	65	80	84	88	52	55	57	70	75	77
	G 3/8A	12	59	62	65	80	84	88	52	55	57	70	75	77
	G 1/2A	14	85	90	94	115	122	127	66	70	73	90	95	99
	G 1/2A	16	85	90	94	115	122	127	66	70	73	90	95	99
	G 3/4A	20	133	140	146	180	190	198	133	140	146	180	190	198
	G 1A	25	229	241	252	310	327	342	229	241	252	310	327	342
	G 1-1/4A	30	332	349	365	450	473	495	332	349	365	450	473	495
G 1-1/2A	38	398	418	438	540	567	594	398	418	438	540	567	594	
ALUMINUM/ BRASS FITTINGS OR ALUMINUM/ BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	27	28	29	37	38	39	17	18	19	23	24	26
	G 1/4A	8	27	28	29	37	38	39	17	18	19	23	24	26
	G 3/8A	10	38	40	42	52	54	57	34	36	37	46	49	50
	G 3/8A	12	38	40	42	52	54	57	34	36	37	46	49	50
	G 1/2A	14	55	58	61	75	79	83	43	45	47	58	61	64
	G 1/2A	16	55	58	61	75	79	83	43	45	47	58	61	64
	G 3/4A	20	86	91	95	117	123	129	86	91	95	117	123	129
	G 1A	25	149	157	164	202	213	222	149	157	164	202	213	222
	G 1-1/4A	30	216	227	237	293	308	321	216	227	237	293	308	321
G 1-1/2A	38	259	272	285	351	369	386	259	272	285	351	369	386	

NOTE: * Typical for Straight Male Stud Fittings
 ***Typical for Adjustable Fittings.



General Information and Specifications

f. British Standard Parallel Pipe Port (BSPP) L Series - Table 3 of 3



TYPE/FITTING IDENTIFICATION			BANJO FITTINGS WITH S SERIES DIN (MBTS) OPPOSITE END						HIGH PRESSURE BANJO FITTINGS WITH S SERIES DIN (MBTS) OPPOSITE END						JIS/BSPP O-RING ONLY					
Material	BSPP Thread G Size	Connecting Tube O.D. (mm)	Torque						Torque						Torque					
			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
			Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	30	32	33	40	43	45	33	35	36	45	47	49	Fitting type not typically specified on Caterpillar applications. Refer to the specific procedure in this Service Manual.					
	G 1/4A	8	30	32	33	40	43	45	33	35	36	45	47	49						
	G 3/8A	10	48	51	53	65	69	72	52	55	57	70	75	77						
	G 3/8A	12	48	51	53	65	69	72	52	55	57	70	75	77						
	G 1/2A	14	66	70	73	90	95	99	89	94	98	120	127	133						
	G 1/2A	16	66	70	73	90	95	99	89	94	98	120	127	133						
	G 3/4A	20	92	97	101	125	132	137	170	179	187	230	243	254						
	G 1A	25	--	--	--	--	--	--	236	248	260	320	336	353						
	G 1-1/4A	30	--	--	--	--	--	--	398	418	438	540	567	594						
G 1-1/2A	38	--	--	--	--	--	--	516	542	568	700	735	770							
ALUMINUM/ BRASS FITTINGS OR ALUMINUM/ BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	20	21	21	27	28	28	22	22	23	30	30	31	Fitting type not typically specified on Caterpillar applications. Refer to the specific procedure in this Service Manual.					
	G 1/4A	8	20	21	21	27	28	28	22	22	23	30	30	31						
	G 3/8A	10	31	33	34	42	45	46	34	36	37	46	49	50						
	G 3/8A	12	31	33	34	42	45	46	34	36	37	46	49	50						
	G 1/2A	14	43	45	47	58	61	64	58	61	64	79	83	87						
	G 1/2A	16	43	45	47	58	61	64	58	61	64	79	83	87						
	G 3/4A	20	60	63	66	81	85	89	111	117	122	150	159	165						
	G 1A	25	--	--	--	--	--	--	153	161	169	207	218	229						
	G 1-1/4A	30	--	--	--	--	--	--	259	272	285	351	369	386						
G 1-1/2A	38	--	--	--	--	--	--	335	352	368	454	477	499							



General Information and Specifications

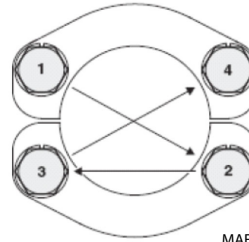
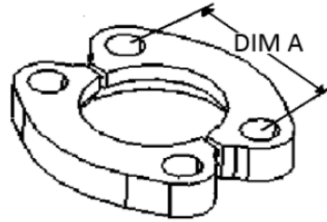
2.8.13 Assembly Instructions for Flange Connections (FL61 and FL62)

1. Ensure sealing surfaces are free of rust, splits, scratches, dirt, foreign matter, or burrs.
2. Pre-lubricate the O-ring with hydraulic oil.
3. Position flange and clamp halves.
4. Place lock washers on bolt and bolt through clamp halves.
5. Tighten all bolts by hand.
6. Torque bolts in diagonal sequence in two or more increments to the torque listed.

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a. Flange Code (FL61 & FL62) - Inch Fasteners



MAE9480

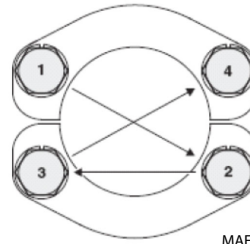
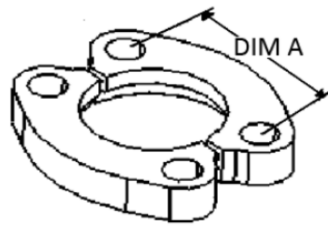
TYPE/FITTING IDENTIFICATION STEEL 4-BOLT FLANGE SAE J518 (INCH FASTENERS)																		
Type	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with GRADE 5 Screws						Fastener Torque for Flanges Equipped with GRADE 8 Screws					
							[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
		(in)	(mm)	(in)	(mm)		(UNF)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom
CODE 61 SPLIT FLANGE (FL61)	8	0.50	13	1.50	38.10	5/16-18	18	19	19	24	25	26	24	25	26	32	34	35
	12	0.75	19	1.88	47.75	3/8-16	32	33	35	43	45	47	44	46	49	60	63	66
	16	1.00	25	2.06	52.32	3/8-16	32	33	35	43	45	47	44	46	49	60	63	66
	20	1.25	32	2.31	58.67	7/16-14	52	54	57	70	74	77	68	71	75	92	97	101
	24	1.50	38	2.75	69.85	1/2-13	77	81	85	105	110	116	111	116	122	150	158	165
	32	2.00	51	3.06	77.72	1/2-13	77	81	85	105	110	116	111	116	122	150	158	165
	40	2.50	64	3.50	88.90	1/2-13	77	81	85	105	110	116	111	116	122	150	158	165
	48	3.00	76	4.19	106.43	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325
	56	3.50	89	4.75	120.65	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325
	64	4.00	102	5.13	130.30	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325
80	5.00	127	6.00	152.40	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325	
Type	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with GRADE 5 Screws						Fastener Torque for Flanges Equipped with GRADE 8 Screws					
							[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
		(in)	(mm)	(in)	(mm)		(UNF)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom
CODE 62 SPLIT FLANGE (FL62)	8	0.50	13	1.59	40.39	5/16-18	--	--	--	--	--	--	24	25	26	32	34	35
	12	0.75	19	2.00	50.80	3/8-16	--	--	--	--	--	--	44	46	49	60	63	66
	16	1.00	25	2.25	57.15	7/16-14	--	--	--	--	--	--	68	71	75	92	97	101
	20	1.25	32	2.62	66.55	1/2-13	--	--	--	--	--	--	111	116	122	150	158	165
	20	1.25	32	2.62	66.55	--	--	--	--	--	--	--	--	--	--	--	--	--
	24	1.50	38	3.12	79.25	5/8-11	--	--	--	--	--	--	218	228	239	295	310	325
	32	2.00	51	3.81	96.77	3/4-10	--	--	--	--	--	--	332	348	365	450	473	495

NOTE: * A dimension for reference only.



General Information and Specifications

b. Flange Code (FL61 & FL62) - Metric Fasteners



MAE9480

TYPE/FITTING IDENTIFICATION						STEEL 4-BOLT FLANGE SAE J518 (INCH FASTENERS)												
Type	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size (Metric)	Fastener Torque for Flanges Equipped with CLASS 8.8 Screws						Fastener Torque for Flanges Equipped with CLASS 10.9 Screws					
		(in)	(mm)	(in)	(mm)		[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
							Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
CODE 61 SPLIT FLANGE (FL61)	8	0.50	13	1.50	38.10													
	12	0.75	19	1.88	47.75	M8x1.25	18	19	19	24	25	26	18	19	19	24	25	26
	16	1.00	25	2.06	52.32	M10x1.5	37	39	41	50	53	55	37	39	41	50	53	55
	20	1.25	32	2.31	58.67	M10x1.5	37	39	41	50	53	55	37	39	41	50	53	55
	24	1.50	38	2.75	69.85	M10x1.5	37	39	41	50	53	55	37	39	41	50	53	55
	32	2.00	51	3.06	77.72	M12x1.75	68	71	75	92	97	101	68	71	75	92	97	101
	40	2.50	64	3.50	88.90	M12x1.75	68	71	75	92	97	101	68	71	75	92	97	101
	48	3.00	76	4.19	106.43	M12x1.75	68	71	75	92	97	101	68	71	75	92	97	101
	56	3.50	89	4.75	120.65	M16x2	155	163	170	210	221	231	155	163	170	210	221	231
	64	4.00	102	5.13	130.30	M16x2	155	163	170	210	221	231	155	163	170	210	221	231
80	5.00	127	6.00	152.40	M16x2	155	163	170	210	221	231	155	163	170	210	221	231	
Type	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size (Metric)	Fastener Torque for Flanges Equipped with GRADE 5 Screws						Fastener Torque for Flanges Equipped with GRADE 8 Screws					
		(in)	(mm)	(in)	(mm)		[Ft-Lb]			[Nm]			[Ft-Lb]			[Nm]		
							Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
CODE 62 SPLIT FLANGE (FL62)	8	0.50	13	1.59	40.39	M8x1.25	--	--	--	--	--	--	24	25	26	32	34	35
	12	0.75	19	2.00	50.80	M10x1.5	--	--	--	--	--	--	52	54	57	70	74	77
	16	1.00	25	2.25	57.15	M12x1.75	--	--	--	--	--	--	96	101	105	130	137	143
	20	1.25	32	2.62	66.55	M12x1.75	--	--	--	--	--	--	96	101	105	130	137	143
	20	1.25	32	2.62	66.55	M14x2	--	--	--	--	--	--	133	139	146	180	189	198
	24	1.50	38	3.12	79.25	M16x2	--	--	--	--	--	--	218	228	239	295	310	325
	32	2.00	51	3.81	96.77	M20x2.5	--	--	--	--	--	--	406	426	446	550	578	605

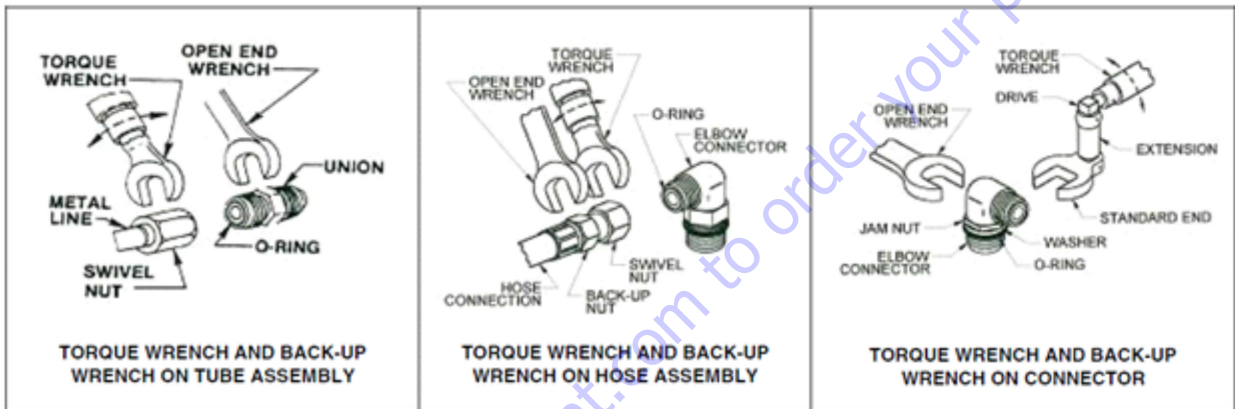
NOTE: *A dimension for reference only.



2.8.14 Double Wrench Method

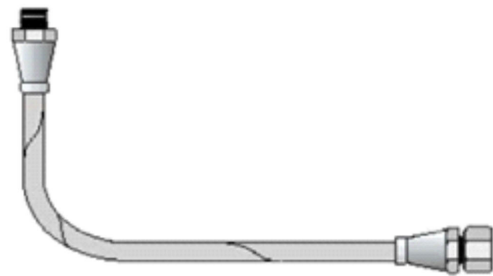
To prevent undesired hose or connector rotation, two wrenches must be used; one torque wrench and one back up wrench. If two wrenches are not used, inadvertent component rotation may occur which absorbs torque and causes improper joint load and leads to leaks. For hose connections, the 'layline' printed on the hose is a good indicator of proper hose installation. A twisted lay-line usually indicates the hose is twisted.

Double Wrench Method to Prevent Hose Twist



Correct

Incorrect



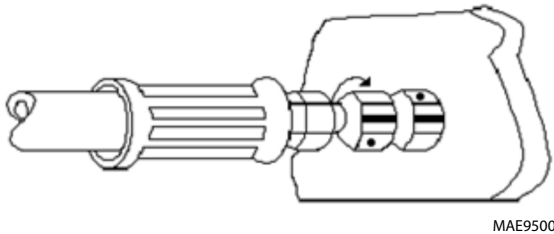
MAE9490



2.8.15 FFWR and TFFT Methods

1. FFWR (Flats from Wrench Resistance Method)
 - a. Tighten the swivel nut to the mating fitting until no lateral movement of the swivel nut can be detected; finger tight condition.
 - b. Mark a dot on one of the swivel hex nut flats and another dot in line on the connecting tube adapter.
 - c. Use the double wrench method per Appendix A, turn the swivel nut to tighten. The nut is to be rotated clockwise the number of hex flats.
 - d. After the connection has been properly tightened, mark a straight line across the connecting parts, not covering the dots, to indicate the connection has been properly tightened.

FFWR Method



2. TFFT (Turns from Finger Tight Method)
 - a. Tighten the swivel nut to the mating fitting until no lateral movement of the swivel nut can be detected; finger tight condition.
 - b. Mark a dot on one of the swivel hex nut flats and another dot in line on the connecting tube adapter.
 - c. Use the double wrench method per Appendix A, turn the swivel nut to tighten. The nut is to be rotated clockwise the number of turns.
 - d. After the connection has been properly tightened, mark a straight line across the connecting parts, not covering the dots, to indicate the connection has been properly tightened.

2.8.16 Adjustable Stud End Assembly

For Adjustable Stud End Connections; the following assembly steps are to be performed:

- a. Lubricate the o-ring with a light coat of hydraulic oil.
- b. Position #1 – The o-ring should be located in the groove adjacent to the face of the backup washer. The washer and o-ring should be positioned at the extreme top end of the groove as shown.
- c. Position #2 – Position the locknut to just touch the backup washer as shown. The locknut in this position will eliminate potential backup washer.

2.8.17 O-ring Installation (Replacement)

Care must be taken when installing o-rings over threads during replacement or installation. O-rings could become nicked or torn. A damaged o-ring could lead to leakage problems.

1. Inspect o-ring for tears or nicks. If any are found replace o-ring.
2. Ensure proper o-ring to be installed. Many o-rings look the same but are of different material, different hardness, or are slightly different diameters or widths.
3. Use a thread protector when replacing o-rings on fittings.
4. In ORB; ensure o-ring is properly seated in groove. On straight threads, ensure o-ring is seated all the way past the threads prior to installation.
5. Inspect o-ring for any visible nicks or tears. Replace if found.

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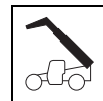
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Section 3 Boom

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Boom

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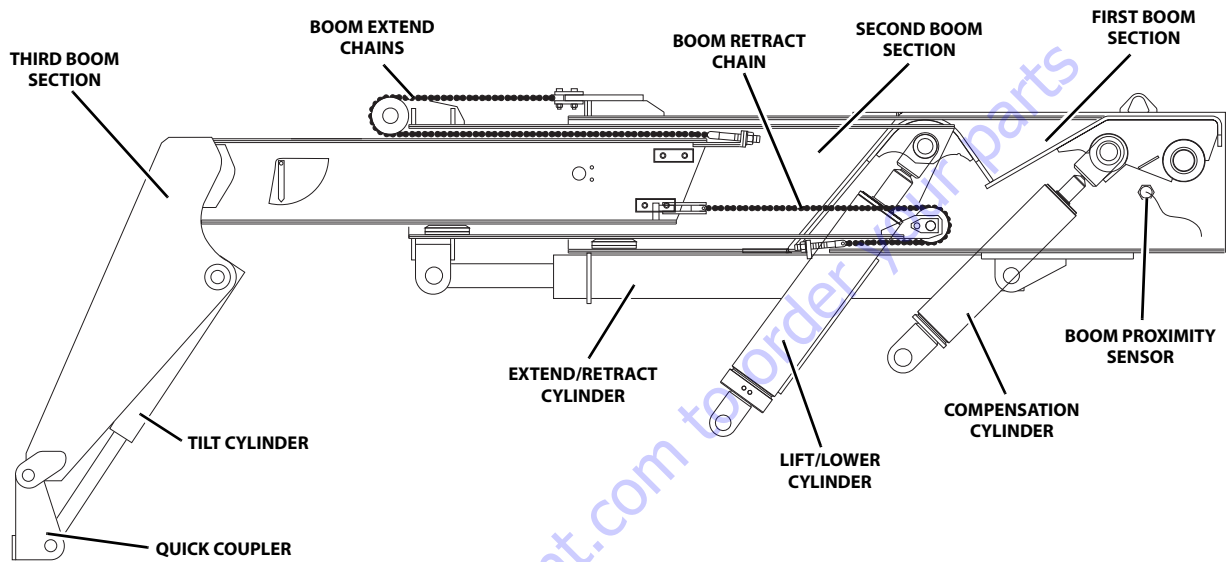
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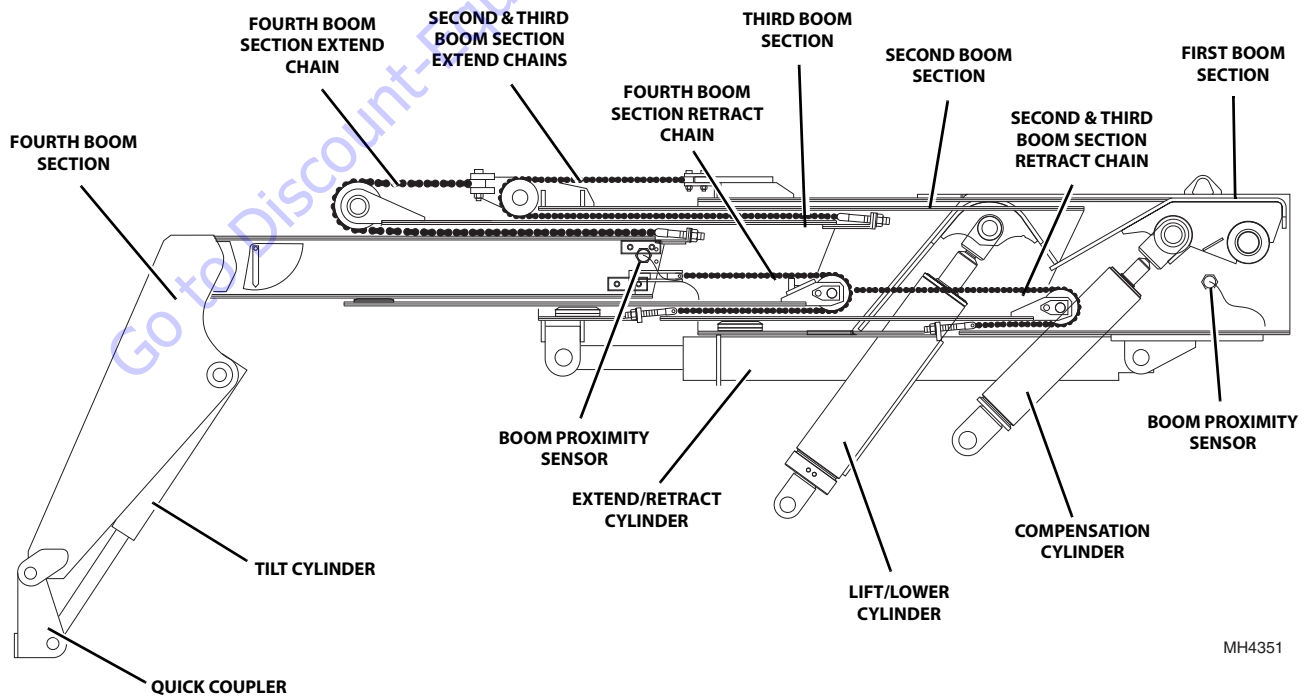
3.1 BOOM SYSTEM COMPONENT TERMINOLOGY

The following illustrations identify the components that are referred to throughout this section.

THREE SECTION BOOM (6036, 6042, 8042 & 10042)



FOUR SECTION BOOM (10054 & 12054)



MH4351



Boom

3.2 SAFETY INFORMATION

WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, "Safety Practices", of this manual.

3.3 BOOM SYSTEM - THREE SECTION (6036, 6042, 8042 & 10042)

3.3.1 Boom System Operation

The three section boom assembly consists of first, second and third boom section assemblies with double top boom extend chains and a single retract chain. Boom extension and retraction is accomplished via hydraulic power and chain movement.

As the Extend/Retract hydraulic cylinder, which is anchored at the rear of the second boom section and the rear of the first boom section, begins to extend, it forces the second boom section out of the first boom section.

The second and third boom sections are connected by extend and retract chains. These chains are routed around sheaves on the second boom section. As the second boom section is forced out, the extend chain pulls the third boom section out of the second boom section.

As hydraulic pressure is applied to the retract port on the Extend/Retract cylinder, the second boom section is pulled back into the first boom section, and retract chain pulls the third boom section back into the second section.

This mechanical linkage formed by the chains and supporting hardware extends and retracts the second and third boom sections at the same rate.

The first boom section does not extend or retract, but lifts and lowers via action of the lift/lower cylinder.

3.4 BOOM ASSEMBLY MAINTENANCE (6036, 6042, 8042 & 10042)

These instructions must be completed in sequence. The third boom section must be removed before removing the second boom section. The third and second boom section must be removed at one time before removing the first boom section.

Before beginning, conduct a visual inspection of the machine and work area, and review the task about to be undertaken. Read, understand and follow these instructions.

WARNING

NEVER weld or drill the boom unless approved in writing by the manufacturer. The structural integrity of the boom will be impaired if subjected to any repair involving welding or drilling.

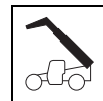
3.4.1 Boom Removal

1. Remove any attachment from quick coupler assembly.

Note: When removing a complete boom assembly use a hoist or crane with a minimum lift capacity of 8000 lb (3628,7 kg).

Note: If replacing the third section boom, remove the quick coupler from the third section. Refer to Section 3.9, "Quick Coupler".

2. Park the machine on a hard, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
3. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
4. Open the engine rear and side engine doors. Allow the system fluids to cool.
5. Move the attachment tilt joystick in both directions to relieve any trapped pressure in the attachment tilt system. If the machine is equipped with auxiliary controls, move the auxiliary hydraulic joystick in both directions to relieve any trapped pressure in the auxiliary hydraulic system.
6. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
7. Label, disconnect and cap the hydraulic hoses at the rear of the boom. Cap all fittings to keep dirt and debris from entering the hydraulic system.
8. Label and disconnect the boom proximity sensor at the rear of the boom.
9. Remove the pin from the rod end of the compensation cylinder being careful not to drop the cylinder. Lower the cylinder onto the frame rails.
10. Remove the pin from the rod end of the lift/lower cylinders. Lower the cylinders onto the frame rails.
11. Confirm that the boom assembly is balanced with the sling and remove the boom assembly pivot pin.
12. Lift the boom assembly from the machine and lower onto suitable supports.

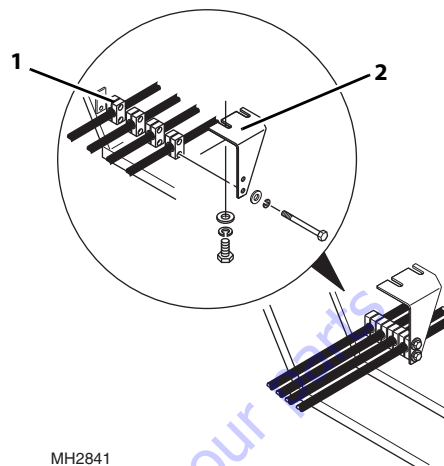


3.4.2 Third Boom Section Removal

1. Remove any attachment from quick coupler assembly.

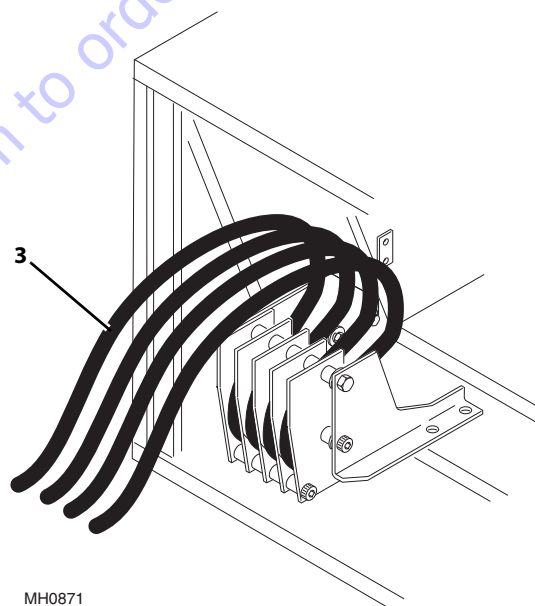
Note: If replacing the third section boom, remove the quick coupler from the third section. Refer to Section 3.9, "Quick Coupler".

2. Park the machine on a hard, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
3. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
4. Open the engine rear and side engine doors. Allow the system fluids to cool.
5. Move the attachment tilt joystick in both directions to relieve any trapped pressure in the attachment tilt system. If the machine is equipped with auxiliary controls, move the auxiliary hydraulic joystick in both directions to relieve any trapped pressure in the auxiliary hydraulic system.
6. Label, disconnect and cap the hoses attached to the attachment tilt cylinder. Cap all fittings to keep dirt and debris from entering the hydraulic system.
7. If the machine is equipped with auxiliary hydraulics, label, cap and remove the hoses from the bulkhead fittings.
8. If replacing the third boom section with a new boom section: Remove the female coupler, male nipple and bulkhead fittings from the bulkhead plate inside the boom head.
9. Remove the rear cover from the boom.
10. If equipped with Auxiliary hydraulics, inside the third boom section, loosen, but **DO NOT** remove the capscrews securing the left side wear pad and hose clamp support bracket to the top of the third boom section.



MH2841

11. Remove the stack clamps (1) and hose clamp support bracket (2) to the left side of the third boom section.

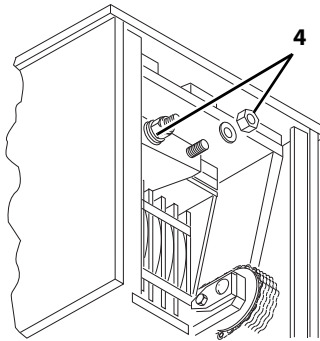


MH0871

12. Pull the free ends of the hydraulic hoses (3) from the inside the third boom section and out of the rear of the boom. Allow the hoses to hang from the rear of the boom.
13. Remove the top and side wear pads and spacers to the inside of the second boom section. Label and tag each set of wear pads being removed.

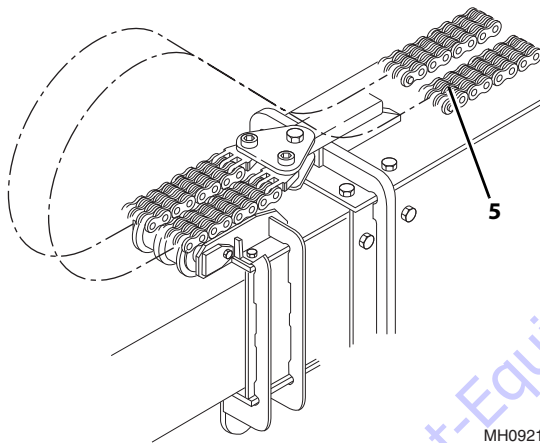


Boom



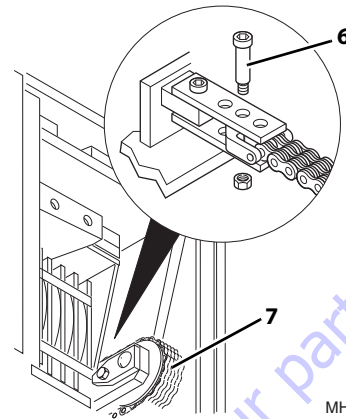
MH0912

- At the rear of the boom, measure the amount of threads protruding beyond each locknut (4) and record the measurement for reassembly. Remove the two locknuts and flat washers holding both extend chain clevis' to the anchor plate on the first boom section.



MH0921

- At the front of the second boom section, pull both extend chains (5) out from between the second and third boom sections. The extend chains can remain anchored between the yoke plates on the first boom section. Loop both chains over the top of the chain sheave and lay the chains on top of the boom.



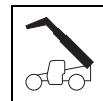
MH2551

Note: Record the location of the shoulder bolt (6) to ensure correct installation.

- At the rear of the boom, locate the retract chain (7) on the right side of the boom. In front of the retract chain sheave, locate the shoulder bolt which holds the retract chain to the anchor plates on the third boom section. Remove the locknut from the shoulder bolt. Allow the retract chain to hang out the rear of the boom.

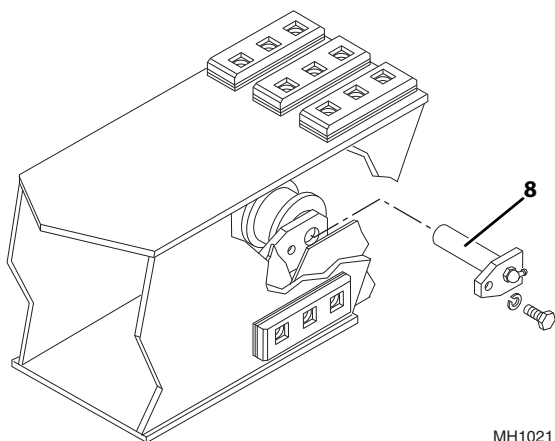
Note: If replacing the third boom section with a new boom section, the quick coupler assembly and the Attachment Tilt cylinder should be removed at this time. Refer to Section 3.9, "Quick Coupler". If the third boom section is not to be replaced, the quick coupler assembly and Attachment Tilt cylinder can remain in place.

- Using a sling or suitable support, pull the third boom section straight out of the second boom section. Reposition the slings as needed so the third boom section balances when removed from the second boom section. Set the boom section down on a hard, level surface. Support the boom as needed to prevent it from tipping over.
- At the rear of the third boom section, remove the remaining wear pads, shims and hardware. Label and tag each set of wear pads being removed.
- Inspect all wear pads for wear. Refer to Section 3.8, "Boom Wear Pads".

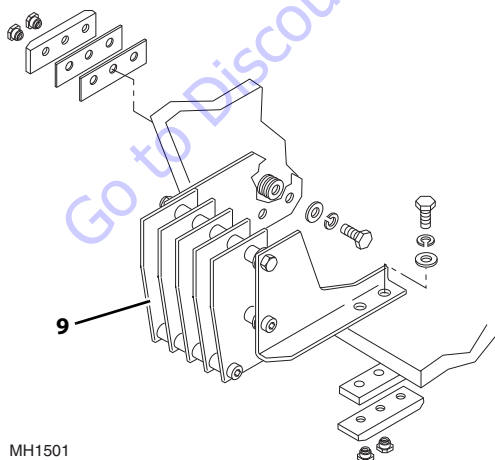


3.4.3 Second Boom Section Removal

1. At the front of the first boom section, remove the top, bottom and side wear pads to the inside of the boom. Label and tag each set of wear pads being removed.
2. Remove the capscrews and lockwashers holding the center wear pad spacer mount to the front of the first boom section. Label and tag each set of wear pads being removed.

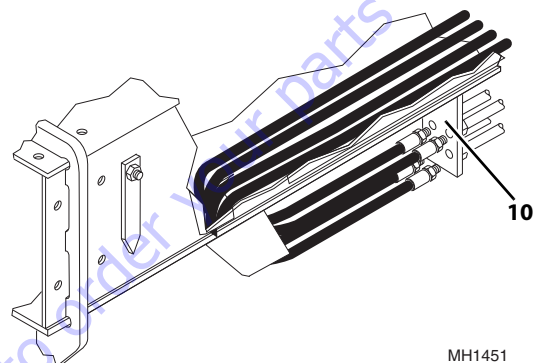


3. At the rear of the second boom section, remove the capscrew and lockwasher holding the retract chain sheave pin (8) to the mounting plate inside the boom.
4. Remove the retract chain sheave pin from the mount and the retract chain sheave. Remove the retract chain sheave from the second boom section.
5. Inspect the bushings inside the sheave. Replace the bushings if there are any signs of wear. Inspect the pin for wear or damage. Replace the pin if showing signs of wear.

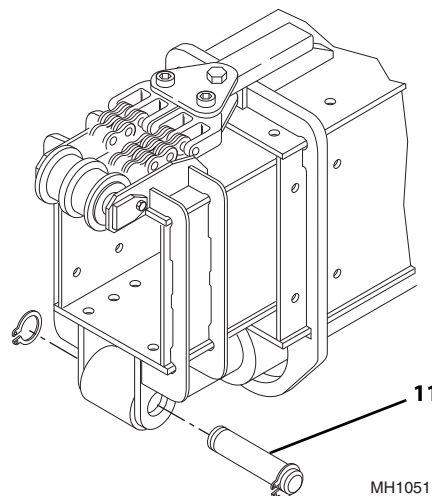


6. At the rear of the second boom section, remove the hose reel assembly (9), lower wear pad and spacer. Reassemble the capscrews, lockwashers and flat washers to hold the lower wear pad in place for second boom section removal.

7. Remove hose reel side plate, lower left side wear pad and shims. Label and tag each set of wear pads being removed.
8. Pull the hose reel, with hoses, out the back of the second boom section. Allow the hose reel assembly to slide down the hoses and rest it on the floor.
9. Label and remove the hoses from the hose reel. The center bolt can remain in place to hold the hose reel and side plates together.



10. Label, disconnect and cap the hydraulic hoses from the bottom tube assemblies at the mounting plate (10).
11. Pull the hose ends out from between the second and first boom sections and out the rear of the boom.
12. Using a suitable sling or support, secure the front of the Extend/Retract cylinder.

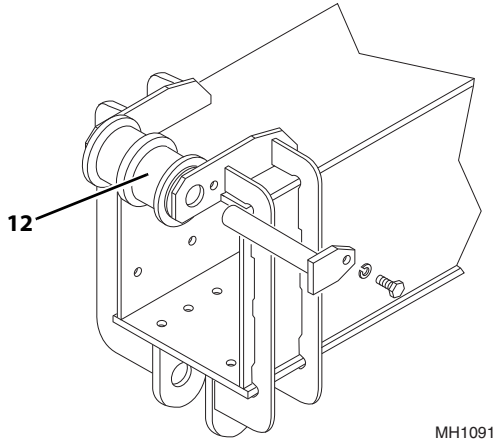


13. Remove the retaining ring from one side of the Extend/Retract cylinder rod end mounting pin (11).
14. Using a sling or suitable support, pull the second boom section straight out of the first boom section. Reposition the slings as needed so the second boom section balances when removed from the first boom section. Set the second boom section down on blocks on a hard, level surface.



Boom

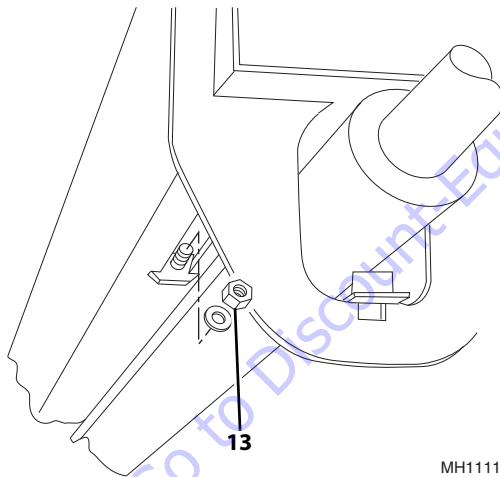
15. Remove the remaining wear pads. Label and tag each set of wear pads being removed.
16. Inspect all wear pads for wear. Refer to Section 3.8, "Boom Wear Pads".



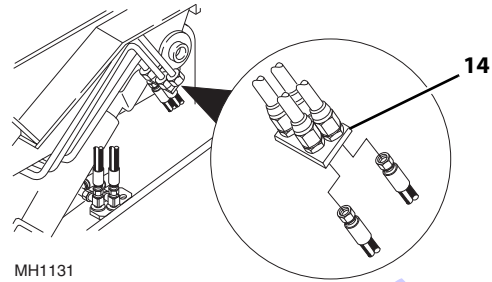
17. Remove the extend chain sheave (12).

3.4.4 First Boom Section Removal

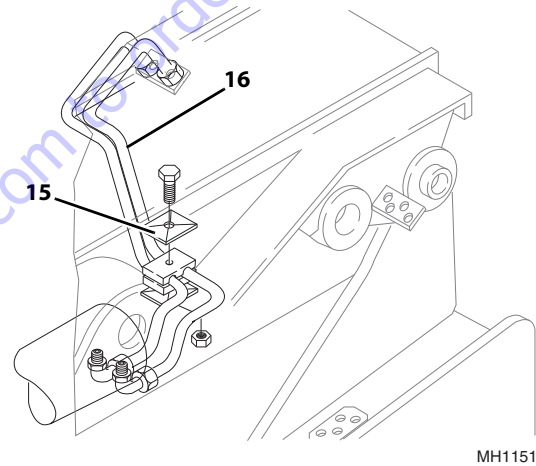
1. Use a suitable overhead lifting device and sling attached to the Lift/Lower cylinder; remove slack from the sling.



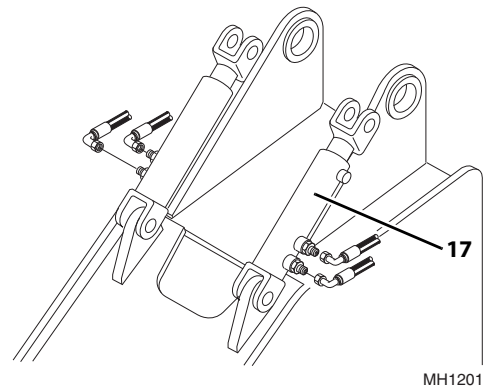
2. At the underside of the boom, locate the retract chain locknut (13). Measure the amount of threads protruding beyond the locknut and record that measurement for reassembly of the chain. Remove the locknut and flat washer.
3. Remove the retract chain by pulling it out through the rear of the boom. Place the retract chain on a clean surface.

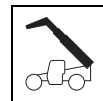


4. Label, disconnect and cap the hydraulic hoses from the bulkhead fittings on the mounting plate (14). Remove the tubes from the bulkhead fittings.
5. At the rear right side of the boom, label, disconnect and cap the boom Extend/Retract hoses from the bulkhead fittings on the mounting plate. Cap the fittings to keep dirt and debris from entering the hydraulic system.

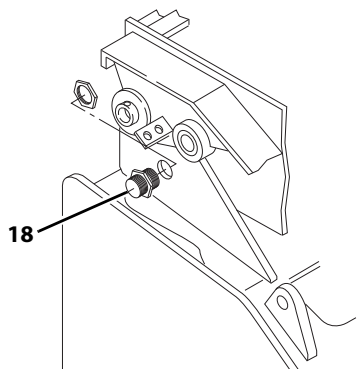


6. Remove the tube clamps (15) and clamp covers to the Extend and Retract tubes under the boom.
7. At the rear right side of the boom, label, disconnect and cap the Extend and Retract tubes (16) from the bulkhead fittings. Cap the fittings to keep dirt and debris from entering the hydraulic system.



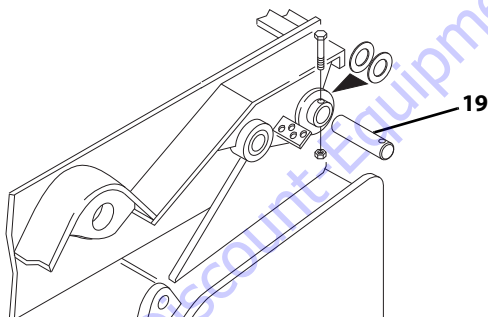


8. Label, disconnect and cap the hydraulic hoses attached to both compensation cylinders (17). Cap all fittings to keep dirt and debris from entering the hydraulic system.
9. Support the compensation cylinder on the right side of the machine. Remove the rod end pins securing the cylinder in position. Move the cylinder to a clean, flat surface. Repeat this procedure for the left side compensation cylinder.



MH1221

10. Remove the boom proximity sensor (18) from the right side boom pivot mounting plate.
11. Securely block up or support the right Lift/Lower cylinder. Remove the rod end pin. Repeat this procedure for the left Lift/Lower cylinder.



MH1241

12. Remove the boom pivot pins (19) to the frame. While removing the pins, note the location and quantity of shims between the outer boom and frame.
13. Using a sling or suitable support, carefully lift the first boom section away from the machine. Set the boom section down on a hard, level surface. Support the boom as required to allow removal of the Extend/Retract cylinder from the underside of the boom.
14. Use a hoist and slings to support the Extend/Retract cylinder. At the base end of the cylinder, remove a retaining ring from one side of the cylinder base end pin.

15. Lower the base end of the Extend/Retract cylinder and remove the rod end of the cylinder from the retainer at the front of the boom. Place the Extend/Retract cylinder on a clean, flat surface.
16. At the front of the first boom section, remove rubber bumper to the Extend/Retract cylinder retainer. Inspect the rubber bumper. If it is in good condition, the rubber bumper can be reused. If the bumper is showing signs of cracking or deterioration, it should be replaced.
17. Remove the two yoke plates to the mount at the front of the boom. Inspect the yoke plates for wear or distortion. If any wear or distortion is detected, both plates must be replaced. If no wear is detected, the plates can remain assembled to the extend chain clevis.
18. Inspect all wear pads for wear. Refer to Section 3.8, "Boom Wear Pads".

3.4.5 First Boom Section Installation

1. On the rear of the boom, assemble the extend and retract bulkhead fittings to the mounting plate on the right side. Insert the fittings from the bottom up and secure in place with the bulkhead fitting nuts on the top side. Tighten securely. Repeat this procedure for the attachment tilt fittings on the left side.

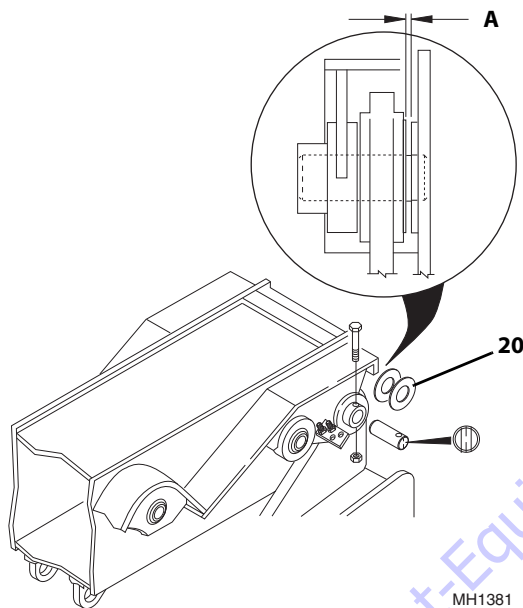
Note: Keep the caps on the threaded ends of the fittings to protect the threads from damage and to keep dirt and debris from entering the hydraulic system.

2. If equipped with auxiliary hydraulics, assemble the auxiliary hydraulic bulkhead fittings to the mounting plate on the left side. Insert the fittings from the bottom up into the outer set of holes and secure in place with the bulkhead fitting nuts on the top side. Tighten securely.
3. Using a sling, position the extend/retract cylinder to its original orientation under the boom.
4. Coat the base end of the cylinder with anti-seize compound. Insert the base end cylinder pin through both mounting ears and the base end of the Extend/Retract cylinder. Secure the pin in place with a retaining ring on each side of the pin.
5. Lift the rod end of the Extend/Retract cylinder enough to insert the threaded stud on the rubber bumper into the hole in the Extend/Retract cylinder retainer. Secure the rubber bumper in place with a locknut. Tighten securely. Lower the rod end of the Extend/Retract cylinder, and allow it to rest on the rubber bumper.



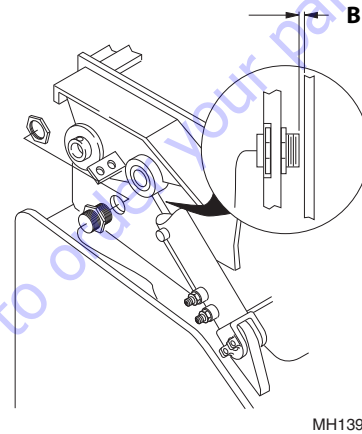
Boom

- Using a suitable hoist and slings, lift the boom assembly and position the boom on the frame. Align the mounting plates on the frame between the mounting hubs on each side of the boom assembly. Lower the boom assembly until the holes in the boom assembly and the mounting plates align.
- On the end of the boom pivot pin, closest to the capscrew hole, mark the capscrew mounting hole location. Coat the entire pin with anti-seize compound.
- Insert the pivot pin from the outside of the boom assembly, making sure the marks for the capscrew mounting hole stay in line with the capscrew mounting holes in the boom mounting hub.

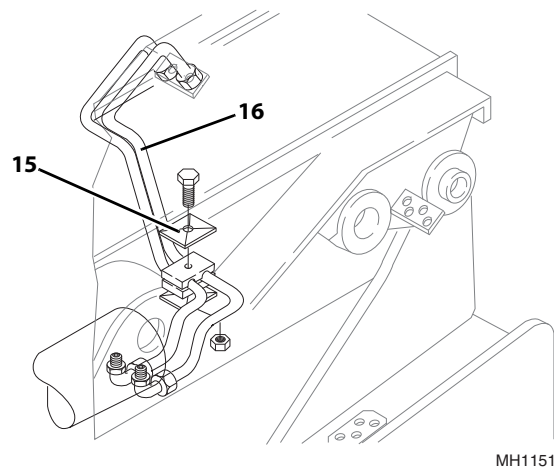


- Shim the boom as required using the shims (**20**) to maintain a 0.10" (2,5 mm) maximum gap (**A**) between the boom mounting hub and the self-aligning bearing in the frame. If an additional shim is required to maintain the maximum gap, the extra shim **MUST** be inserted on the right side of the boom.
- Align the rod end of the right Lift/Lower cylinder with the self-aligning bearing on the boom assembly. Coat the entire Lift/Lower cylinder pin with anti-seize compound. Insert the pin through the rod end of the cylinder and the self-aligning bearing. Secure with lock bolt. Repeat procedure with left Lift/Lower cylinder.

- Use a hoist or suitable support to position the right side compensation cylinder to its original orientation onto the lower cylinder mount. Coat the entire Compensation cylinder pin with anti-seize compound. Insert the pin through the rod end of the cylinder and the self-aligning bearing. Secure with lockbolt. Repeat procedure for left side Compensation cylinder.
- Install the boom proximity sensor on the right side mounting plate. With the boom properly shimmed, position the boom assembly all the way to the right side.



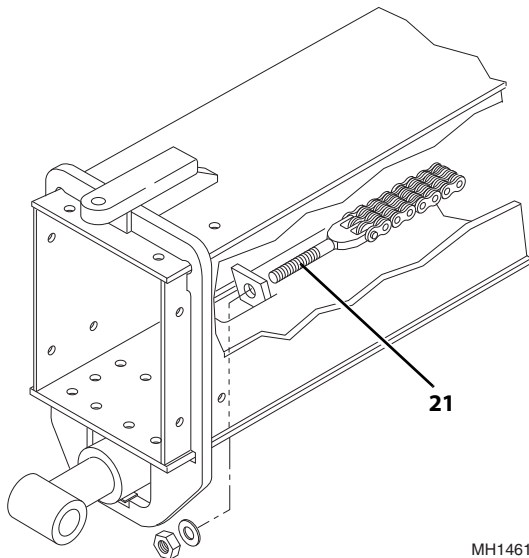
- Insert the boom proximity sensor through the hole in the right side mounting plate. Install the jam nut onto the boom proximity sensor on the inside of the plate. Adjust the inner and outer jam nuts on the sensor until the gap (**B**) between the sensor and the boom is 0.12 in. (3 mm). Torque the inside jam nut to 36 lb-in. (4,1 Nm), to hold the sensor in position.



- Install the Extend and Retract tubes (**16**) to the inside bulkhead fitting and the Extend/Retract cylinder.
- Install the Extend and Retract tube clamp halves (**15**).
- Uncap and connect the hydraulic hoses and attach to their appropriate cylinder locations.

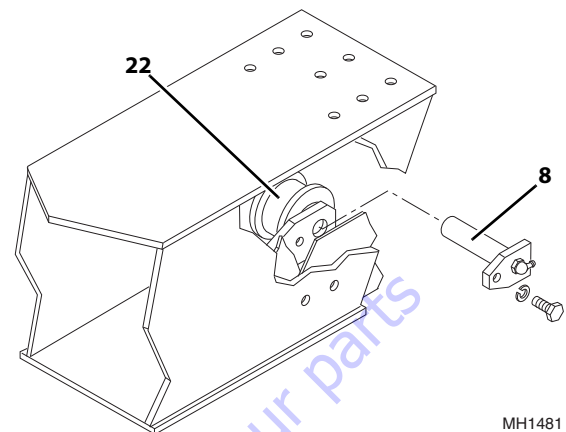


17. Install the Extend and Retract and Auxiliary (if equipped) tube assemblies to their appropriate bulkhead fittings. Secure with tube clamps.
18. Uncap and connect the previously labeled attachment tilt and auxiliary (if equipped) hydraulic hoses to their appropriate bulkhead fittings.

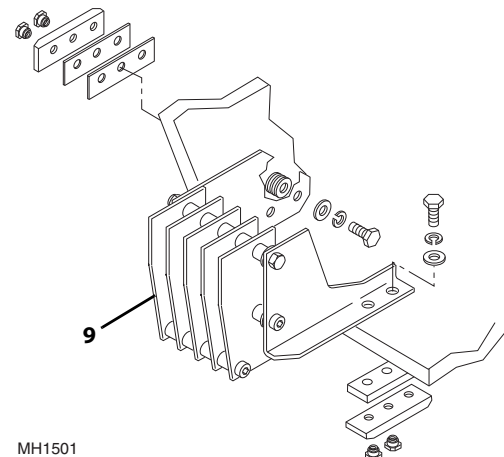


19. Inside the rear of the boom, slide the threaded clevis end (21) of the retract chain down the right side of the boom. Guide the threaded part of the clevis out through the hole in the tab on the bottom of the boom. Pull threaded part of clevis all the way through tab.
20. Coat the entire threaded portion of the clevis with multi-purpose grease. Install a flat washer and locknut onto the clevis. Thread the nut onto the clevis until the threads are flush with the top of the nut.
21. Install the bottom wear pads to the first boom section with the previously used hardware.

3.4.6 Second Boom Section Installation



1. At the rear of the second boom section, assemble the retract chain sheave (22) to the mounting ears on the right side of the boom. Place the sheave between the ears and insert the sheave pin (8) from the left side. Align the hole in the pin retainer plate with the threaded hole in the left ear. Secure the pin.
2. Apply grease to the grease fitting in the pin. Spin the sheave by hand to ensure the sheave spins freely on the pin and to distribute grease evenly.

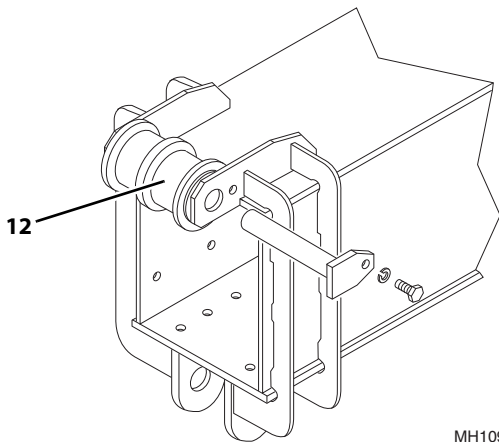


3. Install the hose reel assembly (9), left side and bottom wear pads to the rear of the second boom section.
4. Install the boom side and top wear pads.
5. Grease the sections of the boom in areas where the wear pads will slide.



Boom

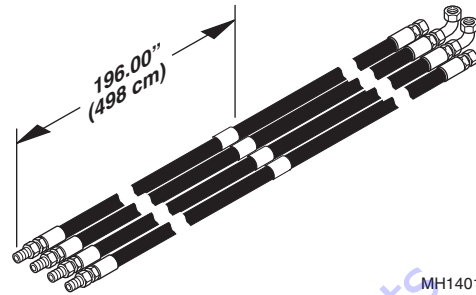
6. Before installing the second boom section into the first boom section, place a string (heavy enough to pull the attachment tilt and auxiliary hydraulic hoses) down the inside of the boom. Allow the string to hang out the rear of the boom. Pull the other end out the opening on the left side of the boom where the hoses will exit the boom. Position the strings all the way to the left side of the first boom section.
7. Using a suitable sling, carefully slide the second boom section into the first boom section. Leave enough room at the front of the boom to install the center wear pad.
8. Install the center wear pad mount and wear pad to the bottom front of the first boom section.
9. Install the side and top wear pads to the front of the first boom section.



MH1091

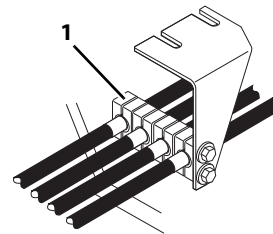
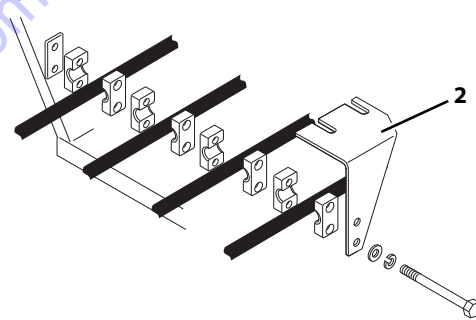
10. Install the double extend chain sheave (**12**) to the front of the second boom section.
11. With the sling still in place, install the rod end of the Extend/Retract cylinder, pin and retaining ring.
12. Install the front, bottom wear pads in the second boom section.

3.4.7 Third Boom Section Installation



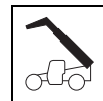
MH1401

1. Stretch the attachment tilt and auxiliary (if equipped) hoses out straight on a flat surface. Measure from the male end of each hose back 196 in. (498 cm) and apply tape around each hose at that point. The tape is for proper tensioning of the hoses during reassembly of the hose clamps.
2. Slide the elbow ends of the hoses down the third boom section and out the boom head. Be careful not to cross the hoses as you pull them out. Secure the hoses in place with hose clamps. **DO NOT** tighten the hose clamps at this time.

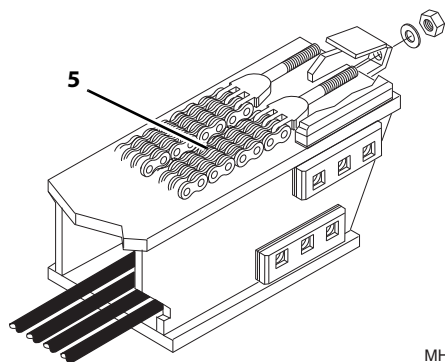


MH1631

3. Install the hose clamp support bracket (**2**) and top left side wear pad to the third boom section (Auxiliary hydraulics only).
4. Position the attachment tilt and auxiliary hydraulic hoses with the edge of the tape at the hose clamps (**1**). Hold the hoses in this position, and tighten the hose clamps.

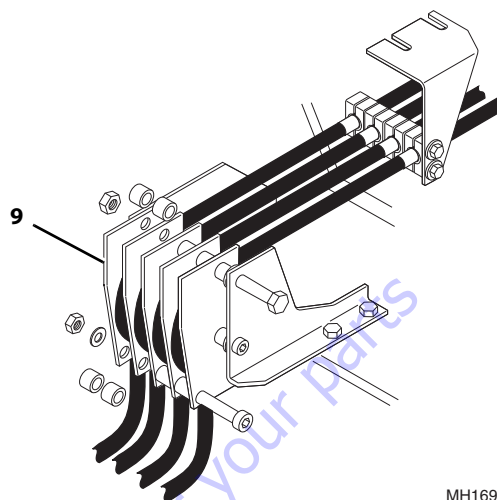


5. Install the top, bottom and side wear pads to the rear of the third boom section. If the machine is equipped with auxiliary hydraulics, the top left wear pad is already installed.



MH1651

6. Lay the two extend chains (5) on the top of the third boom section with the threaded clevis ends toward the rear of the boom. Coat the threads on each clevis with multi-purpose grease and insert the clevis' through the holes in the anchor plate. Install a washer and locknut onto each clevis. Tighten the locknut enough so the threads are even with the top of the locknut.
7. At the rear of the third boom section, place the male ends of the hydraulic hoses in the third boom section to prevent damage while installing the third boom section into the second boom section.
8. Grease the sections of the boom in areas where the wear pads will slide.
9. Using a suitable sling, carefully slide the third boom section into the second boom section. Leave enough room at the front of the boom to install the remaining wear pads.
10. Install the top and side wear pads to the inside of the second boom section.
11. Pull the male ends of the hydraulic hoses out the rear of the third boom section. Stretch the hoses out straight behind the machine.

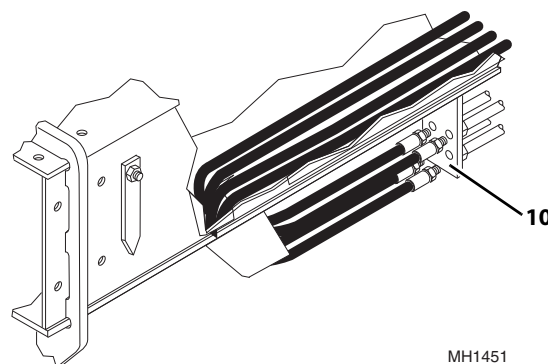


MH1691

12. Assemble the hoses to the hose reel (9) at the rear of the boom.

Note: Keep the hoses in the same order as they come from the hose clamps. **DO NOT** allow the hoses to cross.

13. Tie the strings (positioned inside the first boom section) to the male end of the hydraulic hoses coming off the bottom of the hose reel assembly.
14. Working from the front of the boom, pull each hose through the boom assembly through the opening at the bottom of the first boom section.
15. Remove the strings from the hoses.



MH1451

16. At the front of the first boom section, assemble the hose assemblies and tube assemblies to the mounting plate (10).

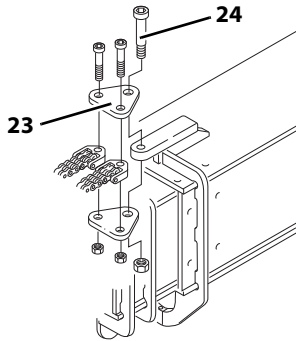
Note: Where the hose assemblies come out of the outer boom, lubricate the radius in the first boom section with soap and water to allow proper tensioning of hoses.

17. Place the retract chain up around the retract chain sheave on the right side of the boom. Stretch the chain forward and place the clevis between the two anchor plates. Align the hole in the clevis with the second hole from the rear of the anchor plates.



Boom

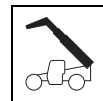
18. Insert the shoulder bolt from the top down and secure in place with a locknut.



19. Assemble the two extend chains to the mount if the yoke plates (23) were removed from the extend chains. Secure in place with a locknut. Tighten the locknut securely; but the yoke plates must pivot freely.
20. Align the holes in the yoke plates with the hole in the mount on the first boom section. Coat the shoulder bolt (24) with anti-seize compound and insert the shoulder bolt through the yoke plates and the mount on the boom. Secure in place with a locknut. Tighten the locknut securely; but the yoke plates must pivot freely.
21. Install the quick coupler and attachment tilt cylinder to the front of the boom. Refer to Section 3.9.2, "Quick Coupler Installation".
22. If necessary, install the auxiliary hydraulic fittings to the front of the boom.
23. Uncap and connect the previously labeled hoses to the attachment tilt cylinder.
24. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
25. Remove the Do Not Operate Tags from both ignition key switch and steering wheel.
26. Start the engine and operate all boom functions several times. Check the chain tension again and adjust as necessary. Check for leaks, and check the hydraulic fluid level in the tank; add fluid if required.
27. Clean up all debris, hydraulic fluid, etc., in, on, near and around the machine.
28. Install the rear cover to the boom.
29. Close and secure the engine rear and side engine doors.

3.4.8 Boom Installation

1. Park the machine on a hard, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Using suitable slings, balance the boom assembly, lift and guide the boom assembly into place. Align the frame pivot bores with the boom assembly pivot bores. Install the boom pivot pin.
3. Move the attachment tilt joystick in both directions to relieve any trapped pressure in the attachment tilt system. If the machine is equipped with auxiliary controls, move the auxiliary hydraulic joystick in both directions to relieve any trapped pressure in the auxiliary hydraulic system.
4. Refer to Section 2.6, "Threadlocking Compound", for all thread locking requirements.
5. With the sling still in place, install the rod end of the Compensation cylinder, pin and bolt. Torque lock bolt to 100 - 110 lb-ft (135 - 149 Nm).
6. With the sling still in place, install the rod end of each lift/lower cylinder, pin and bolt. Torque lock bolt to 200 - 215 lb-ft (271 - 291 Nm).
7. Uncap and connect the hydraulic hoses at the rear of the boom.
8. Connect the boom proximity sensor at the rear of the boom.
9. Recheck wear pad gaps to ensure they meet the minimum gap requirement. Shim as necessary.
10. Ensure that the boom chains are properly adjusted. Refer to Section 3.7.6, "Boom Chain Tension Adjustment (6036, 6042, 8042 & 10042)".
11. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
12. Start the engine and operate all boom functions several times. Check for leaks, and check the hydraulic fluid at the reservoir; add fluid if required.
13. Lower the boom assembly and shut engine OFF.
14. Remove Do Not Operate Tags from both ignition key switch and steering wheel.
15. Clean up all debris, hydraulic fluid, etc., in, on, near and around the machine.



3.5 BOOM SYSTEM - FOUR SECTION (10054 & 12054)

3.5.1 Boom System Operation

The four section boom consists of the fourth, third, second and first boom assemblies with double intermediate boom extend chains, a single inner boom extend chain, a single inner boom retract chain and a single intermediate boom retract chain.

As the Extend/Retract hydraulic cylinder, which is anchored at the front of the second boom section, and the rear of the first boom section begins to extend, it forces the second boom section out of the first boom section.

The fourth, third, second and first boom sections are connected by extend and retract chains. These chains are routed around sheaves on the third and second boom sections. As the second and third boom sections are forced out, the extend chain pulls the fourth boom section out of the third.

As hydraulic pressure is applied to the retract port on the Extend/Retract cylinder, the third boom section is pulled back into the fourth boom section, and the retract chain pulls the third and fourth boom sections back into the second boom section.

This mechanical linkage formed by the chains and supporting hardware, extends and retracts the second, third and fourth boom sections at the same rate.

The first boom section does not extend or retract, but lifts and lowers via action of the Lift/Lower cylinders.

3.6 BOOM ASSEMBLY MAINTENANCE (10054 & 12054)

These instructions must be completed in sequence. The fourth boom section must be removed before removing the third boom section. The third boom section must be removed before removing the second boom section. The fourth, third and second boom section must be removed at one time before removing the first boom section.

Before beginning, conduct a visual inspection of the machine and work area, and review the task about to be undertaken. Read, understand and follow these instructions.



WARNING

NEVER weld or drill the boom unless approved in writing by the manufacturer. The structural integrity of the boom will be impaired if subjected to any repair involving welding or drilling.

3.6.1 Boom Removal

While the boom sections can be separated from each other on the machine, it is more efficient to remove the complete boom assembly from the machine and place it on suitable supports for separation.

Note: When removing a complete boom assembly use a hoist or crane with a minimum lift capacity of 8000 lb (3628,7 kg).

1. Remove any attachment from quick coupler assembly.

Note: If replacing the fourth section boom, remove the quick coupler from the fourth section. Refer to Section 3.9, "Quick Coupler".

2. Park the machine on a hard, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
3. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
4. Open the engine rear and side engine doors. Allow the system fluids to cool.
5. Move the attachment tilt joystick in both directions to relieve any trapped pressure in the attachment tilt system. If the machine is equipped with auxiliary controls, move the auxiliary hydraulic joystick in both directions to relieve any trapped pressure in the auxiliary hydraulic system.
6. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
7. Label, disconnect and cap the hydraulic hoses at the rear of the boom. Cap all fittings to keep dirt and debris from entering the hydraulic system.
8. Label and disconnect the boom proximity sensor at the rear of the boom.
9. Remove the pin from the rod end of the compensation cylinder being careful not to drop the cylinder. Lower the cylinder onto the frame rails.
10. Remove the pin from the rod end of the lift/lower cylinders. Lower the cylinders onto the frame rails.
11. Confirm that the boom assembly is balanced with the sling and remove the boom assembly pivot pin.
12. Lift the boom assembly from the machine and lower onto suitable supports.



Boom

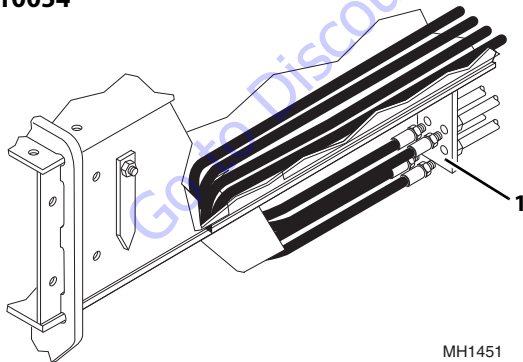
3.6.2 Fourth Boom Section Removal

1. Remove any attachment from quick coupler assembly.

Note: If replacing the fourth section boom, remove the quick coupler from the fourth section. Refer to Section 3.9, "Quick Coupler".

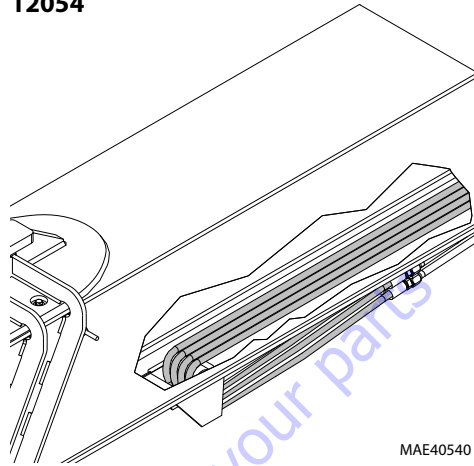
2. Park the machine on a hard, level surface, level the machine, fully retract the boom, lower the boom, place the transmission lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
3. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
4. Open the engine rear and side engine doors. Allow the system fluids to cool.
5. Move the attachment tilt joystick in both directions to relieve any trapped pressure in the attachment tilt system. If the machine is equipped with auxiliary controls, move the auxiliary hydraulic joystick in both directions to relieve any trapped pressure in the auxiliary hydraulic system.
6. Label, disconnect and cap the hoses attached to the attachment tilt cylinder. Cap all fittings to keep dirt and debris from entering the hydraulic system.
7. If the machine is equipped with auxiliary hydraulics, label, cap and remove the hoses from the bulkhead fittings.
If replacing the fourth boom section with a new boom section: Remove the female coupler, male nipple and bulkhead fittings from the bulkhead plate inside the boom head.
8. Remove the rear cover from the boom.

10054

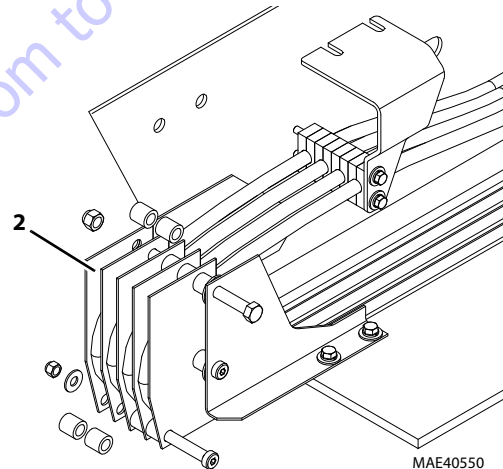


9. At the front of the first boom section, label and remove the hydraulic hoses from the bottom tube assemblies at the mounting plate (1). Cap the hose ends.

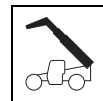
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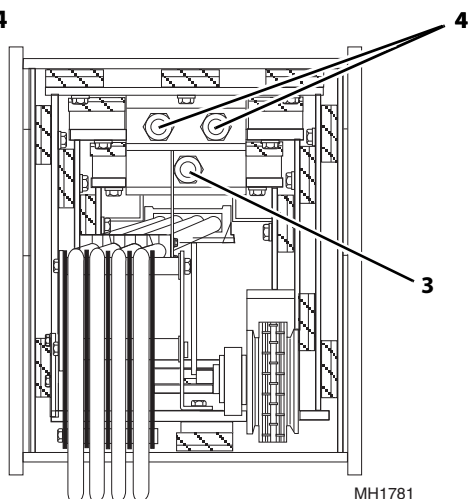
10. For 12054, remove hydraulic hoses from bottom tube assemblies. Cap the hose ends.



11. Label and remove the hydraulic hoses from the hose reel (2).

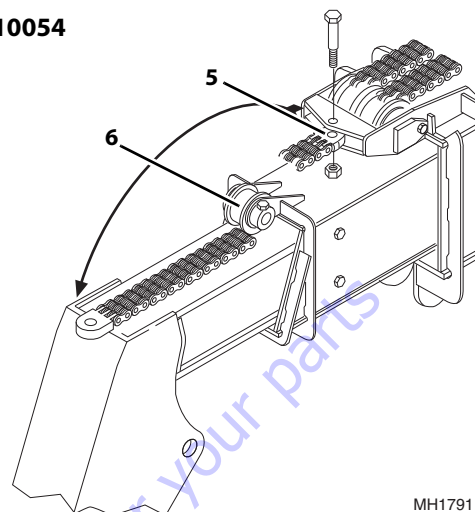


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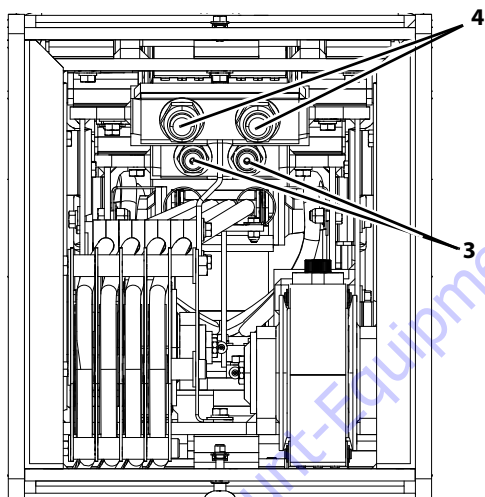
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10054



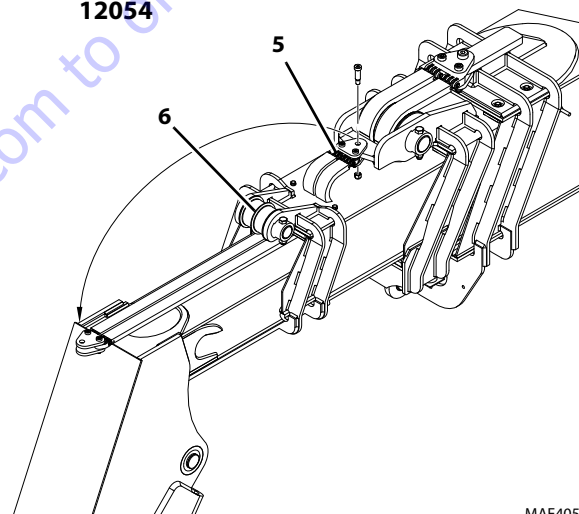
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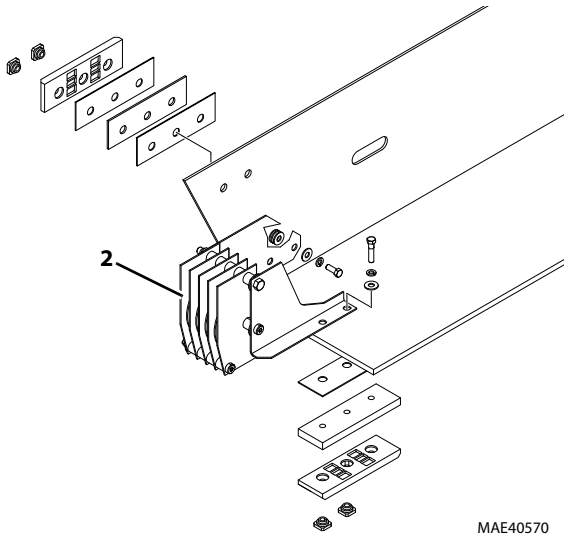


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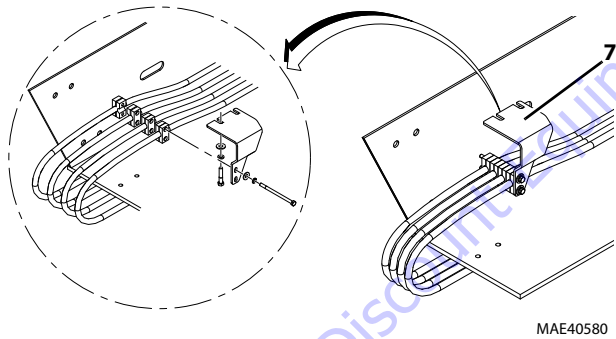
12. At the rear of the boom, locate the fourth boom section extend chain locknut (3). Measure the amount of threads protruding beyond the locknut and record the measurement for reassembly.
13. Loosen, but **DO NOT** remove the locknut.
14. At the rear of the boom, locate the third boom section extend chain locknuts (4). Measure the amount of threads protruding beyond each locknut and record the measurements for reassembly.
15. Loosen, but **DO NOT** remove the locknuts.
16. Return to the cab, start the engine and extend the boom approximately 2 in. (51 mm). Retract the boom slightly until there is slack in the fourth boom section extend chain. Shut the engine OFF.
17. At the front of the boom, disconnect the fourth boom section extend chain clevis (5) from the anchor plates on the second boom section. Pull the extend chain clevis from between the plates and lay over the front of the fourth boom section.
18. Remove the extend chain sheave (6).
19. Remove the top and side wear pads on the inside of the third boom section. Label and tag each set of wear pads being removed.



Boom



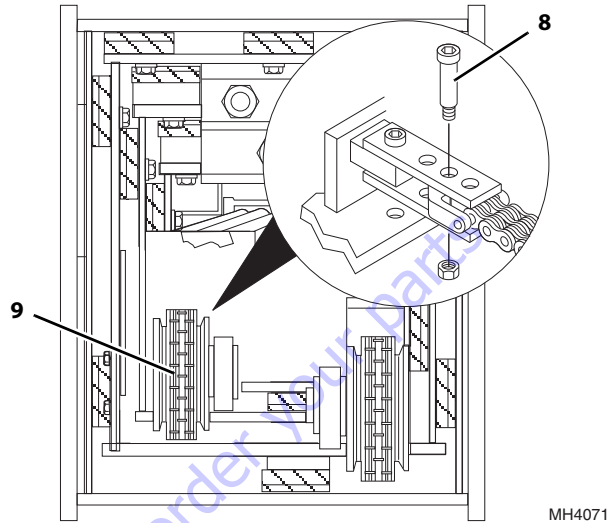
- 20. At the rear of the boom, remove the hose reel assembly (2). This requires removal of the bottom and side wear pads. Reinstall the wear pads for second boom section removal.



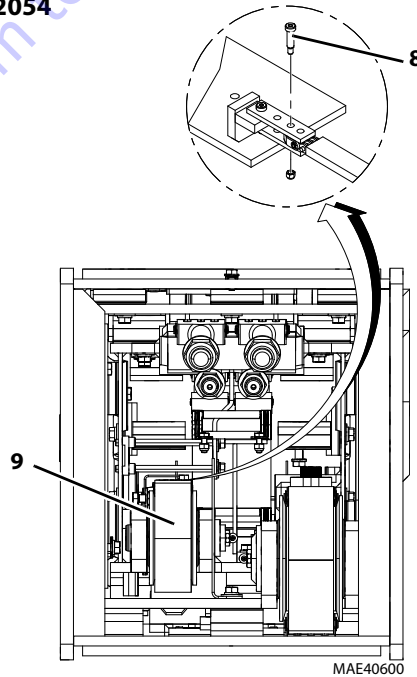
- 21. Inside the third boom section, remove the hose clamps and hose clamp support bracket (7).
- 22. Return to the cab, start the engine and fully retract the boom slowly. Shut the engine OFF.

Note: Record the location of the shoulder bolt to ensure correct installation.

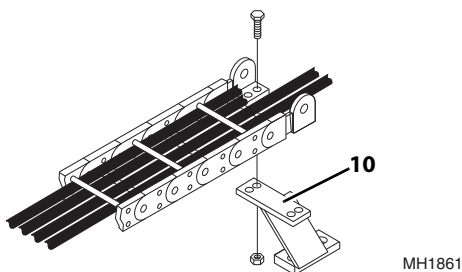
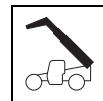
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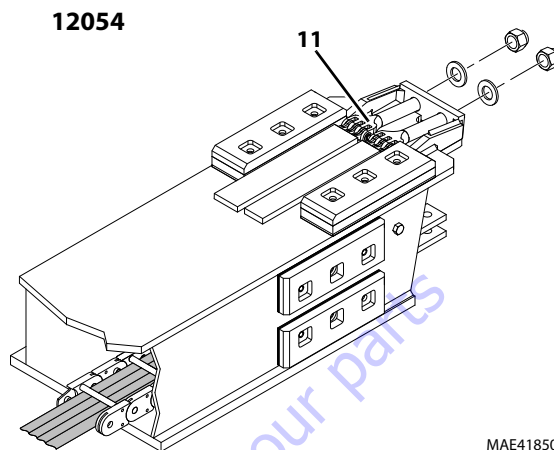
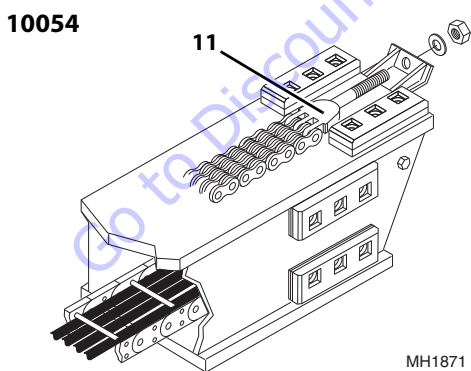
- 23. At the rear of the boom, remove the shoulder bolt (8) to the fourth boom section retract chain (9). Let the chain hang out the rear of the boom.



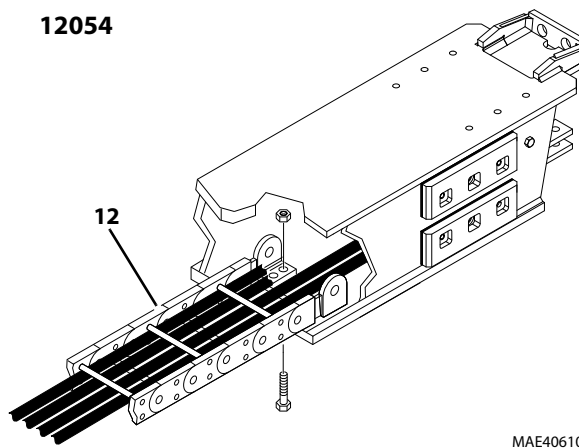
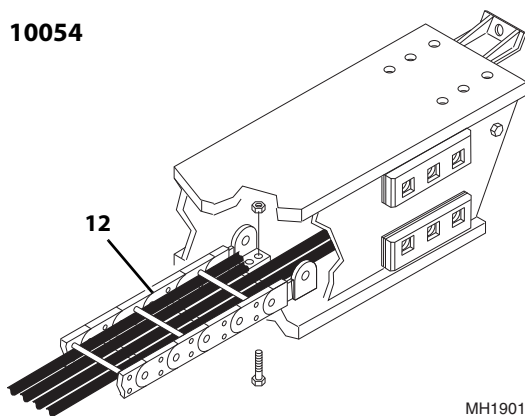
24. Remove the two capscrews and lockwashers holding the hose carrier support (10) and the lower wear pad to the third boom section.
25. Pull the hose carrier support with hose carrier attached toward the rear of the boom. Reinstall the capscrews and lockwashers to hold the wear pad in place. **DO NOT** fully tighten the capscrews.
26. Remove the hose carrier support from the hose carrier.

Note: If replacing the fourth boom section with a new boom section, the quick coupler assembly and the Attachment Tilt cylinder should be removed at this time. Refer to Section 3.9, "Quick Coupler".

27. Using a sling or suitable support, pull the fourth boom section straight out of the third boom section. Reposition the slings as needed so the fourth boom section balances when removed from the third boom section. Set the boom section down on a hard, level surface. Support the boom as needed to prevent it from tipping over.



28. At the rear of the boom section, remove the extend chain clevis (11) from the extend chain clevis anchor.
29. At the rear of the fourth boom section, remove the remaining wear pads, shims and hardware. Label and tag each set of wear pads being removed.
30. Inspect all wear pads for wear. Refer to Section 3.8, "Boom Wear Pads".

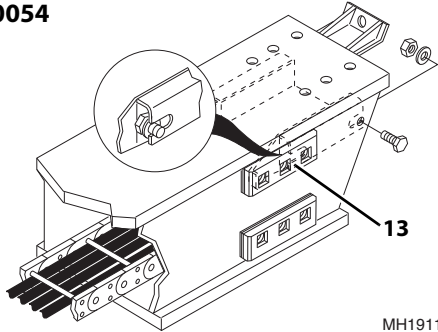




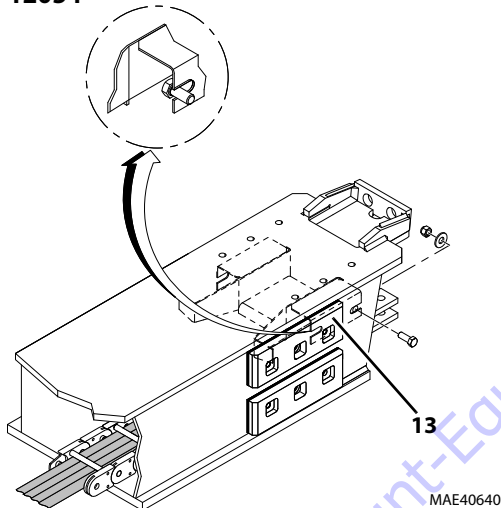
Boom

31. Inside the boom section, remove the hardware securing the hose carrier (12) to the bottom of the boom.
32. On each side of the boom, remove the hardware securing the rear of the hose carrier guide in place.

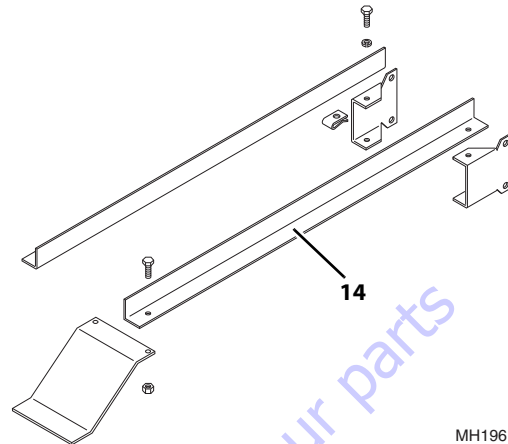
10054



12054



33. Loosen, but **DO NOT** remove the hardware holding the front of the hose carrier guide and the top wear pad (13) to each side of the boom.
34. Tilt the back of the hose carrier guide up. Label all hoses and their orientations. Pull the hoses from the channels inside the boom. Lay the hoses out behind the boom.
35. After the hoses are removed, remove the hose carrier guide by pulling the guide out the rear of the boom.

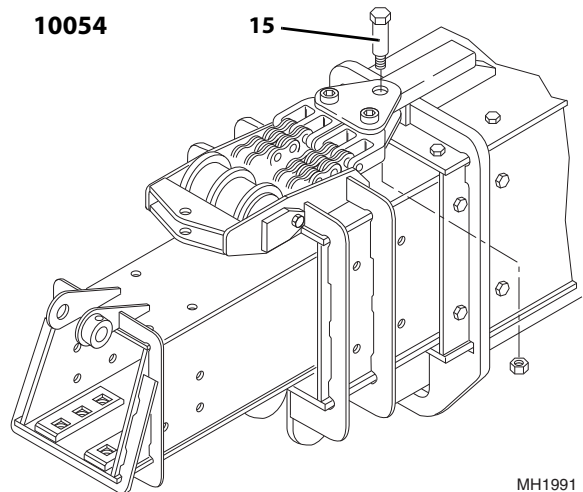


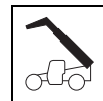
36. Remove the hose carrier assembly (14) from the boom by carefully pulling both the upper and lowers portions through the rear of the boom at the same time.
37. Carefully slide the hose channel assembly out of the rear of the boom.

3.6.3 Third Boom Section Removal

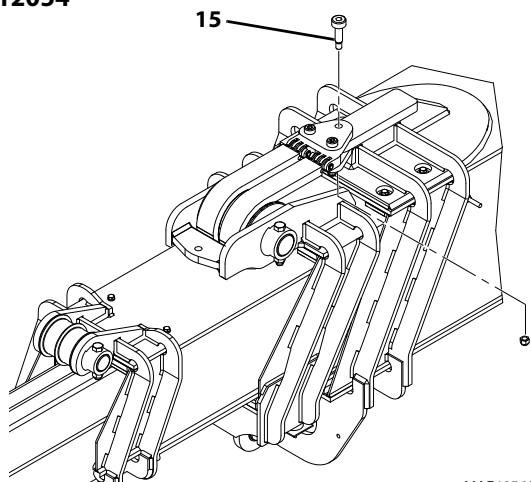
1. At the front of the second boom section, remove the top and side wear pads. Label and tag each set of wear pads being removed.

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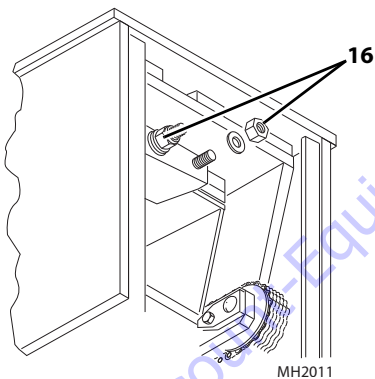


12054



MAE40560

2. Remove the shoulder bolt (15) holding the yoke plates to the mount at the front of the first boom section.
3. Remove the extend chain sheave pin and sheave on the third boom section.



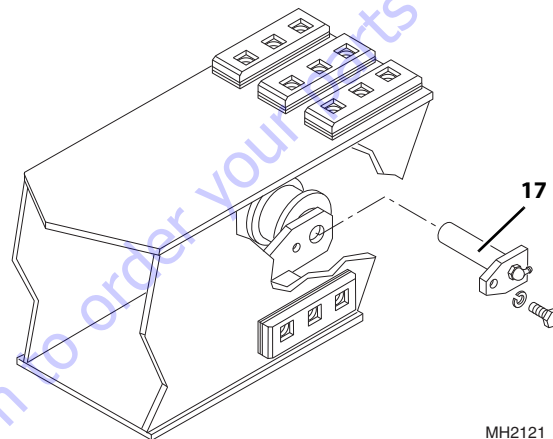
MH2011

4. Remove the locknuts (16) holding the threaded clevis of the extend chains to the anchor bracket on the rear of the third boom section.
5. Pull both extend chains out from the front of the boom.
6. At the rear of the third boom section, remove the retract chain sheave.
7. Remove the shoulder bolt. Let the retract chain hang out the rear of the boom.
8. Using a sling or suitable support, pull the third boom section straight out of the second boom section. Reposition the slings as needed so the third boom section balances when removed from the second boom section. Set the boom section down on a hard, level surface. Support the boom as needed to prevent it from tipping over.

9. Remove the remaining wear pads, shims and hardware. Label and tag each set of wear pads being removed.
10. Inspect all wear pads for wear. Refer to Section 3.8, "Boom Wear Pads".

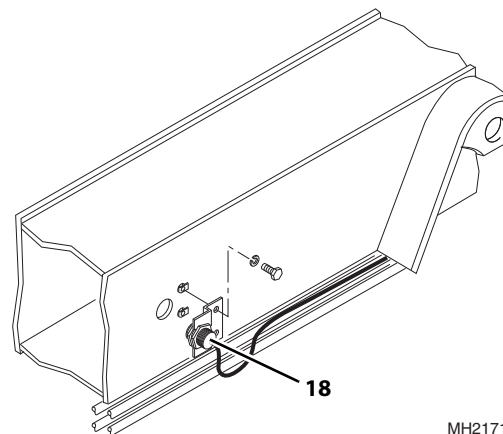
3.6.4 Second Boom Section Removal

1. At the front of the first boom section, remove the top, side and bottom wear pads. Label and tag each set of wear pads being removed.



MH2121

2. Remove the retract chain sheave by removing chain sheave pin (17) from the inside of the second boom section.
3. Using a suitable sling or support, secure the front of the Extend/Retract cylinder.
4. Remove the retaining ring from one side of the Extend/Retract cylinder rod end mounting pin.



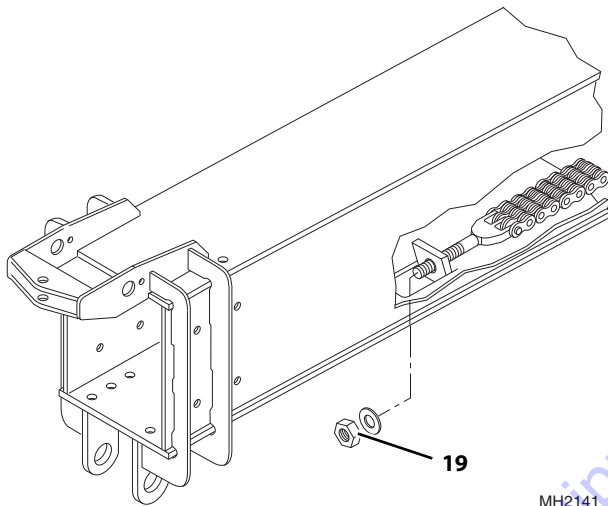
MH2171

5. On the left side of the first boom section, remove the boom extend interlock proximity sensor (18) and mounting bracket.



Boom

- Using a sling or suitable support, pull the second boom section straight out of the first boom section. Reposition the slings as needed so the second boom section balances when removed from the first boom section. While pulling the second boom section out of the first boom section, guide the retract chain into the rear of the boom. Set the boom section down on a hard, level surface. Support the boom as needed to prevent it from tipping over.
- Remove the remaining wear pads, shims and hardware. Label and tag each set of wear pads being removed.
- Inspect all wear pads for wear. Refer to Section 3.8, "Boom Wear Pads".

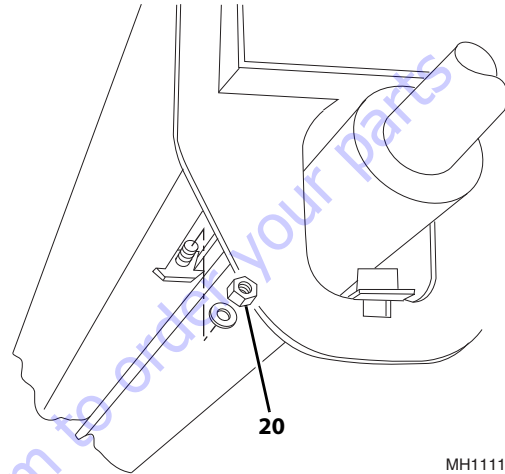


MH2141

- At the underside of the second boom section, remove the locknut (19) from the retract chain clevis. Pull the retract chain out of the boom through the rear of the boom.

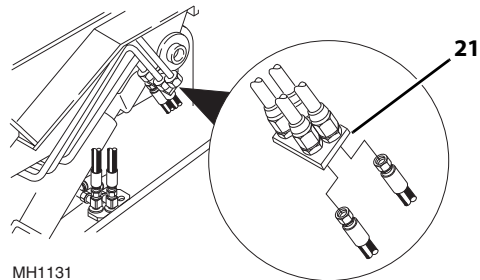
3.6.5 First Boom Section Removal

- Attach a suitable overhead lifting device and sling to the Lift/Lower cylinder, and remove slack in the sling.
- Securely support the first boom section.
- Remove all wear pads, shims and hardware. Label and tag each set of wear pads being removed.



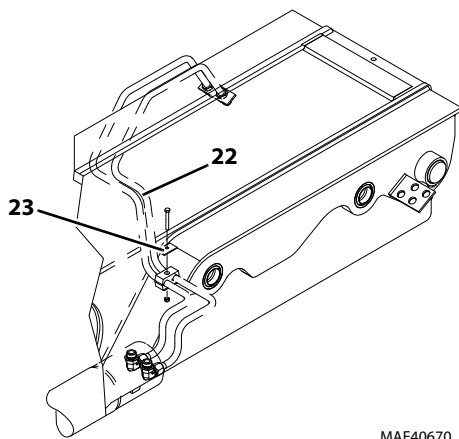
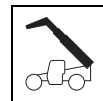
MH1111

- At the underside of the boom, remove the retract chain locknut (20). Measure the amount of threads protruding beyond the locknut and record the measurement for reassembly of the chain.
- Remove the retract chain by pulling it out the rear of the boom.



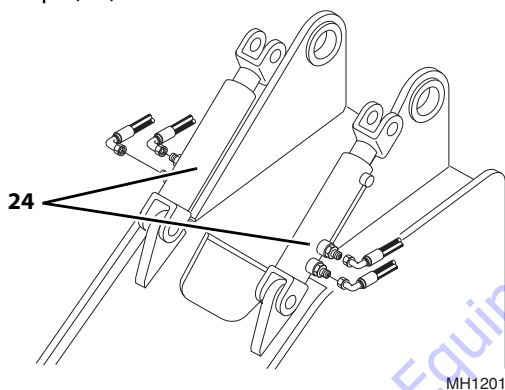
MH1131

- Label, disconnect and cap the attachment tilt and auxiliary (if equipped) hydraulic hoses on the mounting plate (21).
- Label, disconnect and cap the attachment tilt and auxiliary (if equipped) hydraulic tubes from the bulkhead fittings.
- Label, disconnect and cap the Extend/Retract hydraulic hoses from the bulkhead fittings.



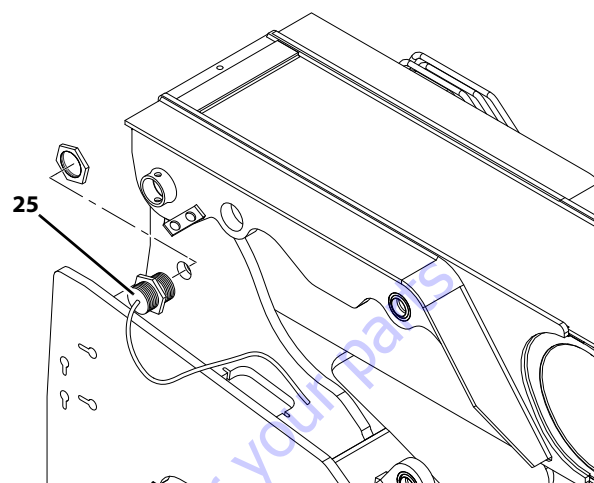
MAE40670

- Label, disconnect and cap the Extend/Retract hydraulic tubes (22) from the bulkhead fittings. Remove the tube clamps (23).



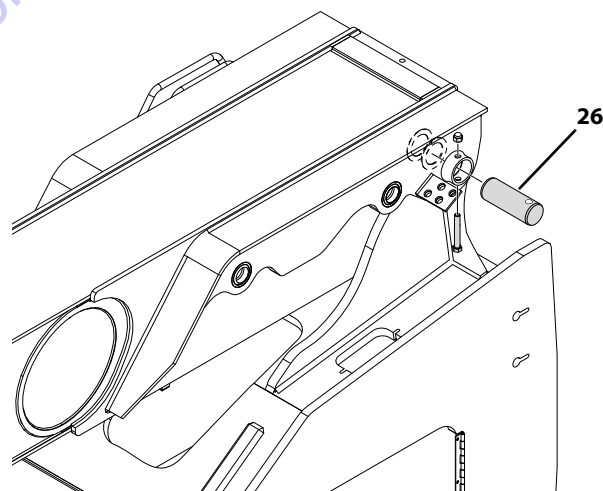
MH1201

- Label, disconnect and cap the hydraulic hoses attached to the compensation cylinders (24).
- Use a hoist and a sling to hold the left compensation cylinder in position. Remove the lockbolt from the compensation cylinder rod end mounting pin. Remove the locknut from the base end of compensation cylinder. Lift the compensation cylinder away from the machine. Repeat procedure for the right compensation cylinder.



MAE41810

- On the right side boom pivot mounting plate, remove the boom proximity sensor (25).
- With the boom securely supported, block the Lift/Lower cylinders. Remove the lockbolts from the rod end of the cylinders and lower the cylinders onto the machine.



MAE41840

- Remove the boom pivot pins (26) and lockbolts.
- Using a sling or suitable support, carefully lift the first boom section away from the machine. Set the boom section down on a hard, level surface. Support the boom as required to allow removal of the Extend/Retract cylinder from the underside of the boom.

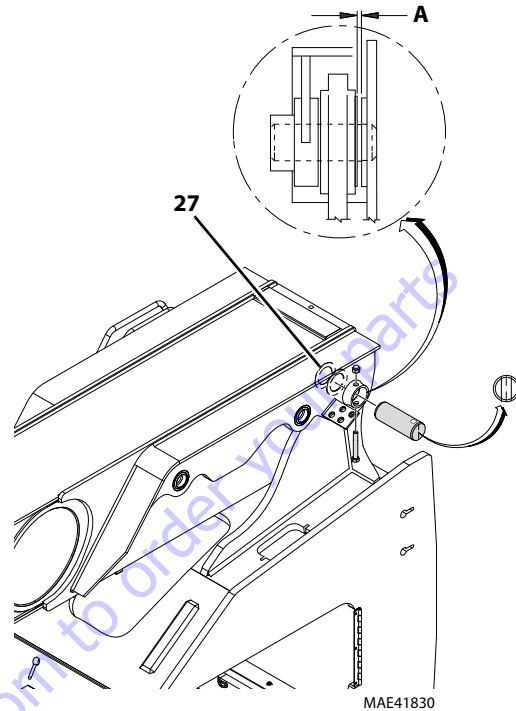


Boom

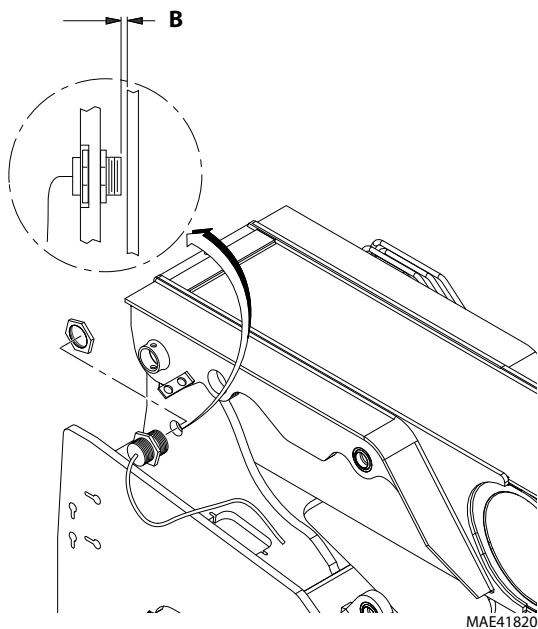
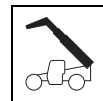
16. Inspect all wear pads for wear. Refer to Section 3.8, "Boom Wear Pads".
17. Use a hoist and slings to support the Extend/Retract cylinder.
18. Remove the retaining rings from the ends of the Extend/Retract cylinder.
19. Remove the rubber bumper from the Extend/Retract cylinder retainer. Inspect the rubber bumper. If it is in good condition, the rubber bumper can be reused. If the bumper is showing signs of cracking or deterioration, it should be replaced.
20. Remove the Extend/Retract cylinder from the boom.

3.6.6 First Boom Section Installation

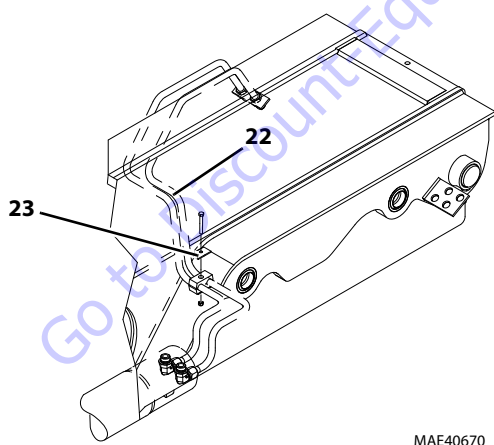
1. Using a suitable hoist and sling, position the Extend/Retract cylinder with the port elbows facing down. Place the rod end of the cylinder through the cylinder retainer at the front of the boom.
2. Coat the base end of the cylinder with anti-seize compound. Insert the base end cylinder pin through both mounting ears and the base end of the Extend/Retract cylinder. Secure the pin in place with a retaining ring on each side of the pin.
3. Lift the rod end of the Extend/Retract cylinder enough to insert the threaded stud on the rubber bumper into the hole in the Extend/Retract cylinder retainer. Secure the rubber bumper in place with a new locknut. Tighten securely. Lower the rod end of the Extend/Retract cylinder, and allow it to rest on the rubber bumper.
4. Using a suitable hoist and slings, lift the boom assembly and position the boom on the frame. Align the mounting plates on the frame between the mounting hubs on each side of the boom assembly. Lower the boom assembly until the holes in the boom assembly and the mounting plates align.
5. On the end of the boom pivot pin, closest to the capscrew hole, mark the capscrew mounting hole location. Coat the entire pin with anti-seize compound.
6. Insert the pivot pin from the outside of the boom assembly, making sure the marks for the capscrew mounting hole stay in line with the capscrew mounting holes in the boom mounting hub.



7. Shim the boom as required using the shims (27) to maintain a 0.02-0.06 in. (0.5-1.5 mm) maximum gap (A) between the boom mounting hub and the self-aligning bearing in the frame. If an additional shim is required to maintain the maximum gap, the extra shim **MUST** be inserted on the right side of the boom.
8. Align the rod end of the right Lift/Lower cylinder with the self-aligning bearing on the boom assembly. Coat the entire Lift/Lower cylinder pin with anti-seize compound. Insert the pin through the rod end of the cylinder and the self-aligning bearing. Secure with lock bolt. Repeat procedure with left Lift/Lower cylinder.
9. Use a hoist or suitable support to position the right side compensation cylinder to its original orientation onto the lower cylinder mount. Coat the entire Compensation cylinder pin with anti-seize compound. Insert the pin through the rod end of the cylinder and the self-aligning bearing. Secure with lockbolt. Repeat procedure for left side Compensation cylinder.
10. Install the boom proximity sensor on the right side mounting plate. With the boom properly shimmed, position the boom assembly all the way to the right side.

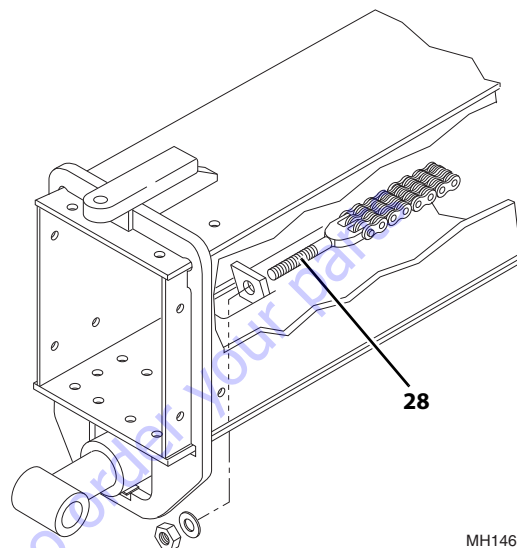


11. Insert the boom proximity sensor through the hole in the right side mounting plate. Install the jam nut onto the boom proximity sensor on the inside of the plate. Adjust the inner and outer jam nuts on the sensor until the gap (**B**) between the sensor and the boom is 0.12 in. (3 mm). Torque the inside jam nut to 36 lb-in (4,1 Nm), to hold the sensor in position.

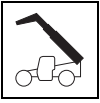


12. Install the Extend and Retract tubes (**22**) to the inside bulkhead fitting and the Extend/Retract cylinder.
13. Install the Extend and Retract tube clamp halves (**23**).
14. Uncap and connect the previously labeled hydraulic hoses and attach to their appropriate cylinder locations.
15. Install the extend and retract and auxiliary (if equipped) tube assemblies to their appropriate bulkhead fittings. secure with tube clamps.

16. Uncap and connect the previously labeled attachment tilt and auxiliary (if equipped) hydraulic hoses to their appropriate bulkhead fittings.

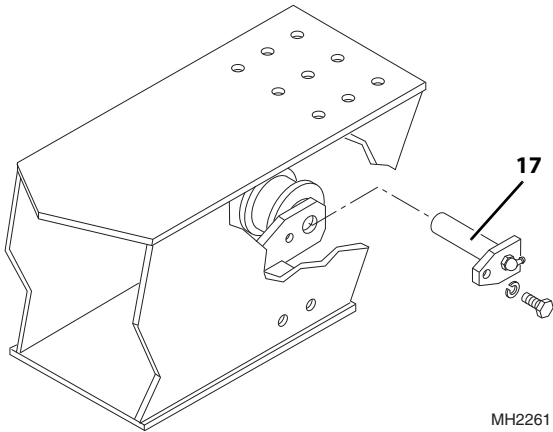


17. Inside the rear of the boom, slide the threaded clevis end (**28**) of the retract chain down the right side of the boom. Guide the threaded part of the clevis out through the hole in the tab on the bottom of the boom. Pull threaded part of clevis all the way through tab.
18. Coat the entire threaded portion of the clevis with multi-purpose grease. Install a flat washer and locknut onto the clevis. Thread the nut onto the clevis until the threads are flush with the top of the nut.
19. Install the bottom wear pads to the first boom section with the previously used hardware.

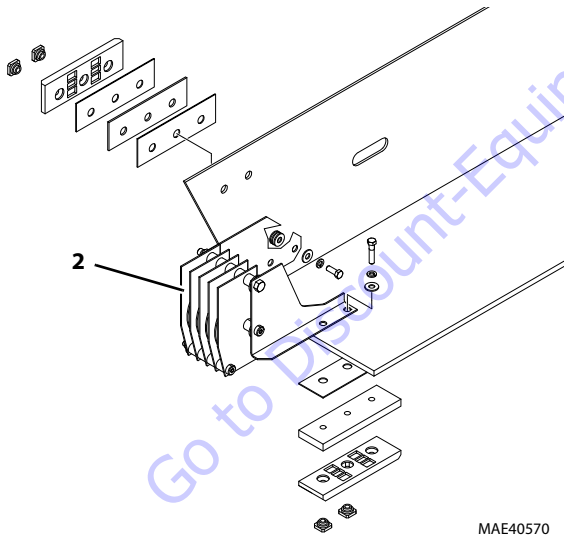


Boom

3.6.7 Second Boom Section Installation



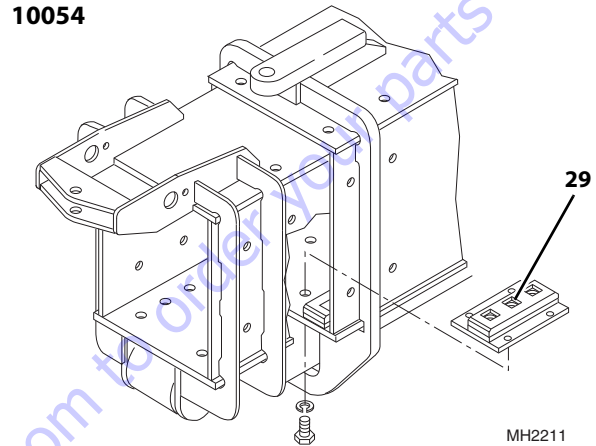
1. At the rear of the second boom section, assemble the retract chain sheave to the mounting ears on the right side of the boom. Place the sheave between the ears and insert the chain sheave (17) from the left side. Align the hole in the pin retainer plate with the threaded hole in the left ear. Secure the pin.
2. Apply grease to the grease fitting in the pin. Spin the sheave by hand to ensure the sheave spins freely on the pin and to distribute grease evenly.



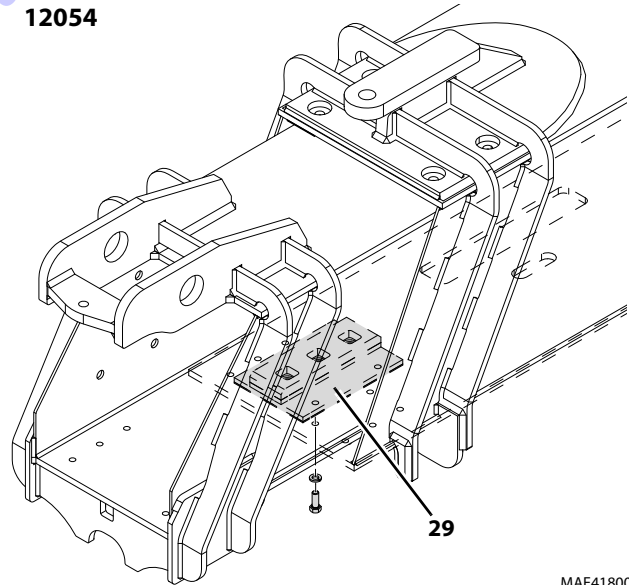
3. Install the hose reel assembly (2), left side and bottom wear pads to the rear of the second boom section.
4. Install the boom side and top wear pads of the second boom section.
5. Grease the sections of the boom in areas where the wear pads will slide.
6. Before installing the second boom section into the first boom section, place a string (heavy enough to pull the attachment tilt and auxiliary hydraulic hoses) down the

inside of the boom. Allow the string to hang out the rear of the boom. Pull the other end out the opening on the left side of the boom where the hoses will exit the boom. Position the strings all the way to the left side of the first boom section.

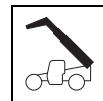
7. Using a suitable sling, carefully slide the second boom section into the first boom section. Leave enough room at the front of the boom to install the center wear pad.



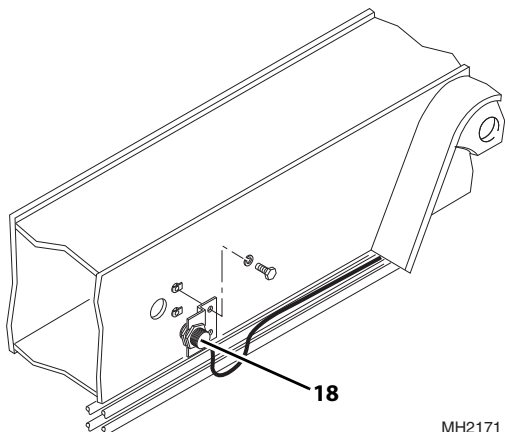
12054



8. Install the center wear pad mount (29) and wear pad to the bottom front of the first boom section.
9. Install the side and top wear pads to the front of the first boom section.
10. Install the double extend chain sheave to the front of the second boom section.
11. With the sling still in place, install the rod end of the Extend/Retract cylinder, pin and retaining ring.



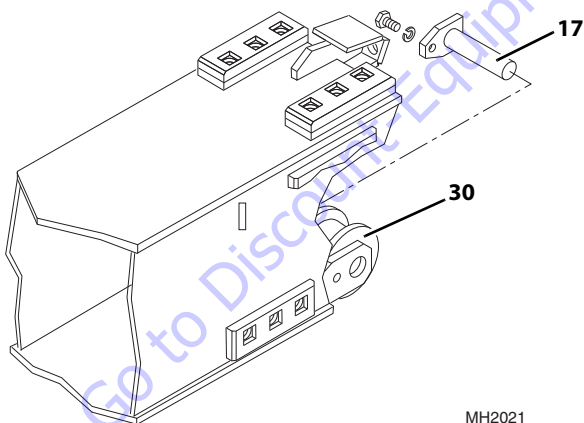
12. Install the front, bottom wear pads in the second boom section.



13. On the left side of the first boom section, reassemble the boom extend interlock sensor (18) with mounting bracket. Secure in place with the previously used hardware. Tighten securely.
14. Secure the boom extend interlock sensor wire to the attachment tilt tubes under the boom with new tie wraps.

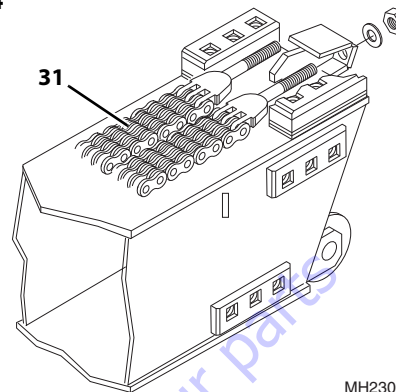
3.6.8 Third Boom Installation

1. Install the bottom, side and top wear pads to the rear of the third boom section.

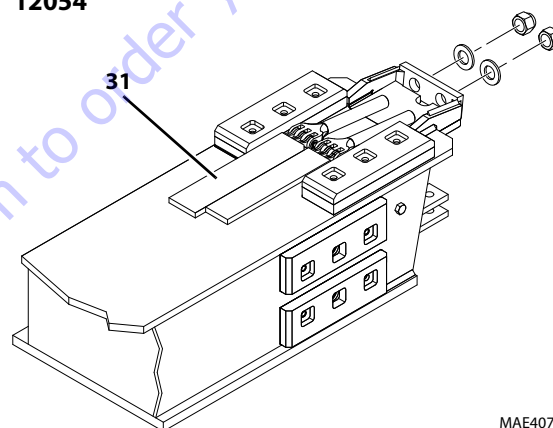


2. At the rear of the third boom section, assemble the retract chain sheave (30) to the mounting ears on the left side of the boom. Place the sheave between the ears and insert the sheave pin (17) from the right side. Line up the hole in the pin retainer plate with the threaded hole in the right ear. Secure the pin.
3. Apply grease to the grease fitting in the pin. Spin the sheave by hand to ensure the sheave spins freely on the pin and to distribute grease evenly.

4. Install the bottom front wear pads. **10054**



12054



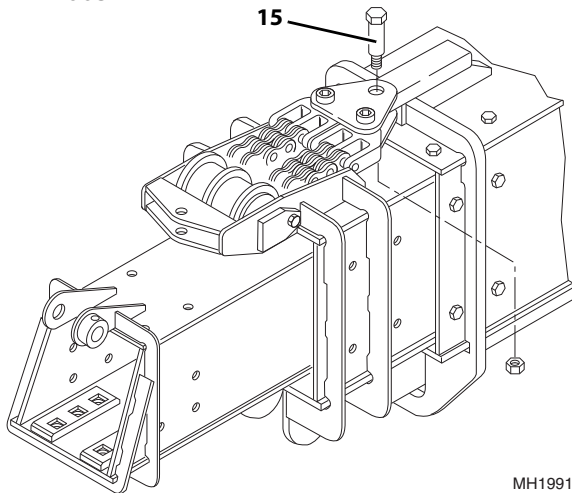
5. Lay the two extend chains (31) on the top of the third boom section with the threaded clevis ends toward the rear of the boom. Coat the threads on each clevis with multi-purpose grease and insert the clevis' through the holes in the anchor plate. Install a washer and locknut onto each clevis. Tighten the locknut enough so the threads are even with the top of the locknut.
6. Grease the sections of the boom in areas where the wear pads will slide.
7. Using a suitable sling, carefully slide the third boom section into the second boom section. Leave enough room at the front of the boom to install the remaining wear pads.
8. Install the top and side wear pads to the inside of the second boom section.
9. Place the two extend chains up through the double sheave mounting bracket on the front of the second boom section.



Boom

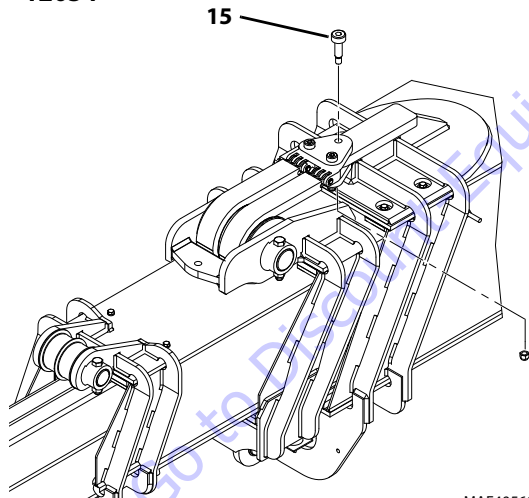
- Assemble the two extend chains to the mount if the yoke plates were removed from the extend chains. Secure in place with a locknut. Tighten the locknut securely; but the yoke plates must pivot freely.
- Install the double extend chain sheave. Apply grease to the sheave. Turn the sheave by hand to distribute the grease evenly.

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MH1991

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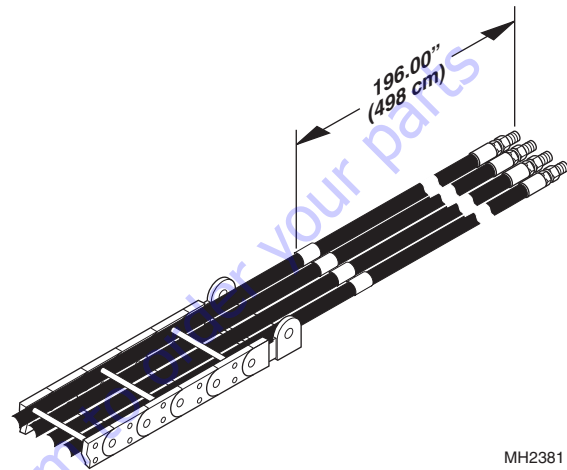


MAE40560

- Align the holes in the yoke plates with the hole in the mount on the first boom section. Coat the shoulder bolt with anti-seize compound and insert the shoulder bolt (**15**) through the yoke plates and the mount on the boom. Secure in place with a locknut. Tighten the locknut securely; but the yoke plates must pivot freely.

- Place the retract chain around the retract chain sheave on the right side of the boom. Stretch the chain forward and place the clevis between the two anchor plates. Align the hole in the clevis with the hole location recorded in the removal procedure. Insert the shoulder bolt and locknut, tighten securely.

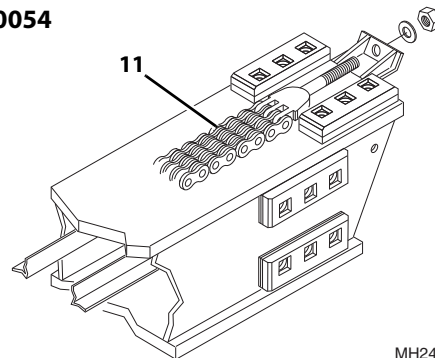
3.6.9 Fourth Boom Section Installation



MH2381

- Lay the hose carrier assembly out flat on a level surface. Stretch the four male ends of the hoses out straight from the hose carrier assembly. Measure from the male end of each hose back toward the hose carrier assembly 196 in. (498 cm) and apply tape around each hose at that point. The tape is for proper tensioning of the hoses during reassembly of the hose clamps.
- Insert the hose channel assembly into the rear of the fourth boom section. Slide the hose channel assembly into the boom and line up the holes for the side wear pads.
- Install the side, bottom and top wear pads.

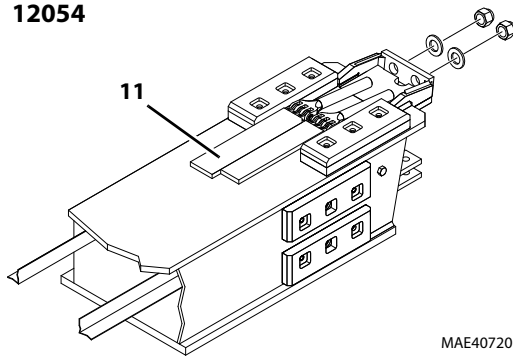
10054



MH2441



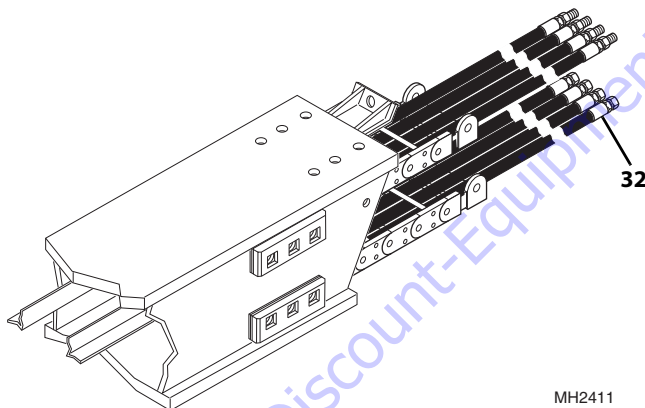
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MAE40720

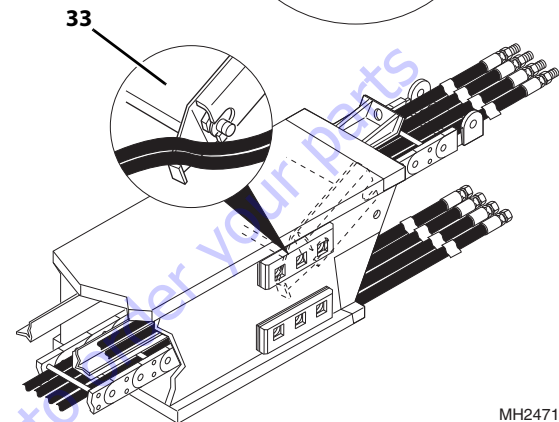
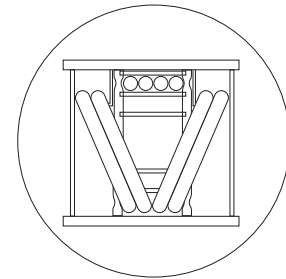
4. Lay the two extend chains (**11**) on the top of the fourth boom section with the threaded clevis ends toward the rear of the boom. Coat the threads on each clevis with multi-purpose grease and insert the clevis' through the holes in the anchor plate. Install a washer and locknut onto each clevis. Tighten the locknut enough so the threads are even with the top of the locknut

Note: The hose carrier only folds one way; **DO NOT** force it. **DO NOT** twist the hose carrier while folding.



MH2411

5. Fold the hose carrier assembly in half, ensure the female ends (**32**) of the hoses are on the bottom, and carefully slide the folded hose carrier into the fourth boom section.
6. Line up the lower mounting holes in the hose carrier assembly with the holes in the bottom of the fourth boom section. Secure with the previously used hardware.
7. Lift the upper part of the hose carrier assembly and place the hose carrier guide under the hose carrier with the angled guides toward the front. Slide the hose guide into the fourth boom section, and place the front notches onto the rear wear pad mounting capscrew. Be sure the notch in the side of the hose guide is under the flat washer on each side of the boom.



MH2471

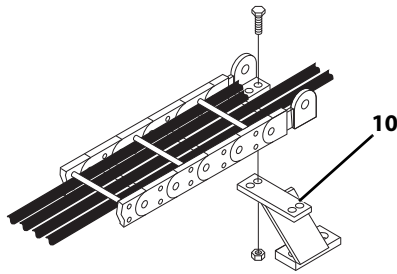
8. Rotate the back of the hose guide up toward the top of the fourth boom section as far as it will go. Tighten the rear wear pad mounting capscrews enough to hold the hose guide.
9. With the hose guide tilted up in the back, insert the female ends of the two left side hoses (from the hose carrier) one at a time over the top of the angled guide (**33**) on the front side of the hose guide. Push the hoses into the hose channel on the left side of the fourth boom section and down to the front of the boom section. Repeat this procedure for the two right side hoses into the hose channel on the right side of the boom.
10. Insert a capscrew through the hole in the fourth boom section. Secure the hose guide in place with a flat washer and locknut.
11. Run the hose carrier out and in by hand to check for interference.

Note: **DO NOT** allow the hydraulic hoses to cross inside the boom.

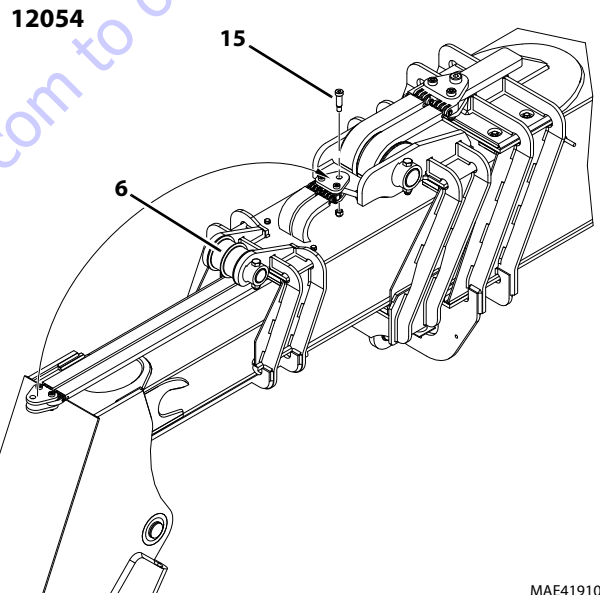
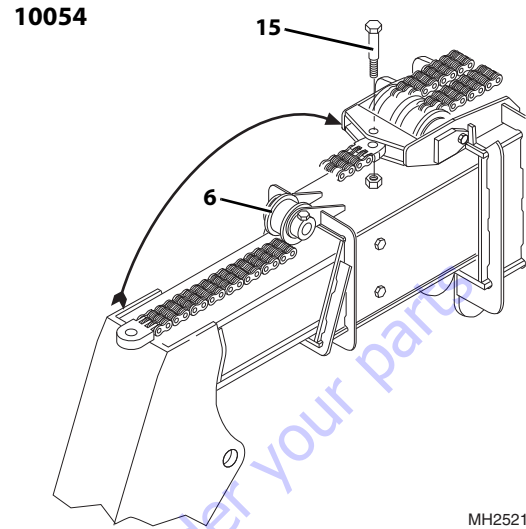
12. At the front of the boom, pull the previously labeled hydraulic hoses out the opening in the back of the boom head. Let the hoses hang out of the boom head.
13. Grease the sections of the boom in areas where the wear pads will slide.
14. Using a suitable sling, lift the fourth boom section. While guiding the hoses into the third boom section, carefully slide the fourth boom section into the front of the third boom section.



Boom



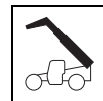
15. Reassemble the hose carrier support to the hose carrier on the right side. Install the hose carrier support (10) and lower wear pad with the previously used hardware.
16. Place the retract chain up around the retract chain sheave on the left side of the boom. Stretch the chain forward and place the clevis between the two anchor plates. Line up the hole in the clevis with the anchor plate hole location recorded during removal.
17. Insert the shoulder bolt and secure in place with a locknut. Tighten the locknut.
18. Install the side and top wear pads.
19. Place the fourth boom section extend chain sheave (6) between the mounts at the front of the third boom section. Insert the sheave pin through the mounts and the sheave. Secure in place with the previously used hardware.
20. After the sheave is assembled, apply a good grade of multi-purpose grease to the grease fitting at the end of the pin. Turn the sheave by hand to distribute grease evenly.
21. Place the fourth boom section extend chain up and around the sheave at the front of the third boom section.



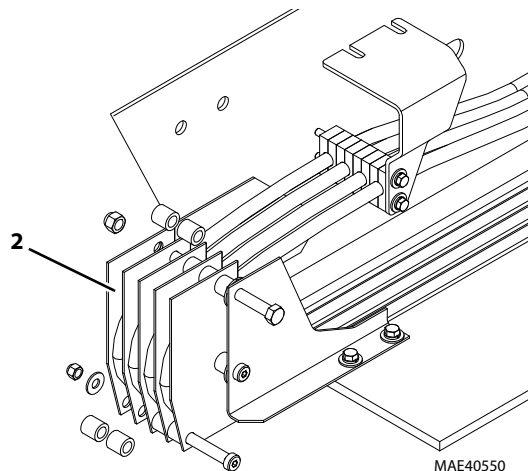
22. Place the extend chain clevis between the mounting plates at the front of the second boom section. Coat the shoulder bolt (15) with anti-seize compound and insert through the plates and clevis. Secure the shoulder bolt in place with a locknut. Tighten securely, but the chain clevis should pivot freely.

Note: Keep the four hoses in line as they come out of the hose carrier assembly at the rear of the boom. **DO NOT** allow the hoses to cross.

23. Install the hose clamp support bracket and top left side wear pad.

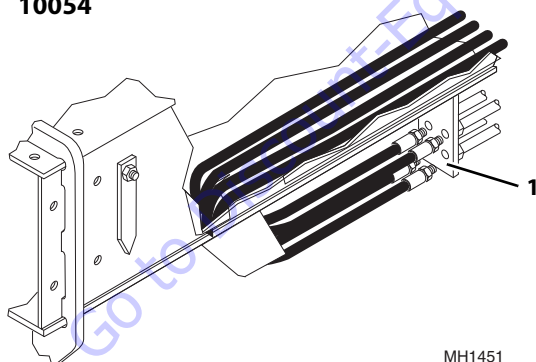


24. Position the hydraulic hoses with the edge of the tape at the hose clamps. Hold the hoses in this position, and tighten the hose clamps.



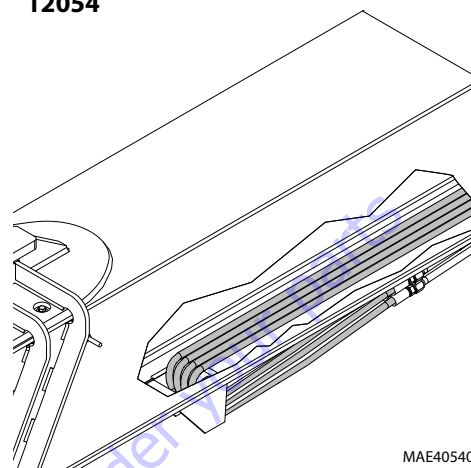
25. Assemble the hoses to the hose reel (2) at the rear of the boom.
26. Tie the strings (positioned inside the first boom section during installation) to the male end of the hydraulic hoses coming off the bottom of the hose reel assembly.
27. Working from the front of the boom, pull each hose through the boom assembly through the opening at the bottom of the first boom section.
28. Remove the strings from the hoses.

10054



29. At the front of the first boom section, assemble the hose assemblies and tube assemblies to the mounting plate (1).

12054



30. For 12054, assemble the hydraulic hoses to bottom tube assemblies.

Note: Where the hose assemblies come out of the outer boom, lubricate the radius in the first boom section with soap and water to allow proper tensioning of hoses.

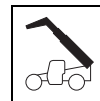
31. Install the quick coupler and attachment tilt cylinder to the front of the boom. Refer to Section 3.9.2, "Quick Coupler Installation".
32. Uncap and connect the previously labeled hoses to the attachment tilt cylinder.
33. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
34. Remove Do Not Operate Tags from both ignition key switch and steering wheel.
35. Start the engine and operate all boom functions several times. Check the chain tension again and adjust as necessary. Check for leaks, and check the hydraulic fluid level in the tank; add fluid if required.
36. Clean up all debris, hydraulic fluid, etc., in, on, near and around the machine.
37. Install the rear cover to the boom.
38. Close and secure the engine rear and side engine doors.



Boom

3.6.10 Boom Installation

1. Park the machine on a hard, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Using suitable slings, balance the boom assembly, lift and guide the boom assembly into place. Align the frame pivot bores with the boom assembly pivot bores. Install the boom pivot pin.
3. Move the attachment tilt joystick in both directions to relieve any trapped pressure in the attachment tilt system. If the machine is equipped with auxiliary controls, move the auxiliary hydraulic joystick in both directions to relieve any trapped pressure in the auxiliary hydraulic system.
4. Refer to Section 2.6, "Threadlocking Compound", for all threadlocking requirements.
5. With the sling still in place, install the rod end of the Compensation cylinder, pin and bolt. Torque lock bolt.
6. With the sling still in place, install the rod end of each lift/lower cylinder, pin and bolt. Torque lock bolt.
7. Uncap and connect the hydraulic hoses at the rear of the boom.
8. Connect the boom proximity sensor at the rear of the boom.
9. Recheck wear pad gaps to ensure they meet the minimum gap requirement. Shim as necessary.
10. Ensure that the boom chains are properly adjusted. Refer to Section 3.7.7, "Boom Chain Tension Adjustment (10054 & 12054)".
11. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
12. Start the engine and operate all boom functions several times. Check for leaks, and check the hydraulic fluid at the reservoir and add fluid if required.
13. Lower the boom assembly and shut engine OFF.
14. Remove Do Not Operate Tags from both ignition key switch and steering wheel.
15. Clean up all debris, hydraulic fluid, etc., in, on, near and around the machine.



3.7 BOOM EXTEND AND RETRACT CHAINS

3.7.1 Boom Chain Inspection

WARNING

Worn pins, stretched or cracked links or corrosive environments can cause chain failure. A chain failure could result in uncontrolled boom movement, loss of load or machine instability.

Under normal operating conditions the boom extend chains will need to be inspected every 250 hours of operation. The retract chains need to be exposed and inspected every 1000 hours of operation. Environmental conditions and dynamic impulse/shock loads can drastically affect normal operating conditions and require more frequent inspection intervals.

Environments in which material handling machines operate can vary widely from outdoor moisture to temperature to mildly corrosive or highly corrosive industrial atmospheres, in addition to abrasive exposures such as sand and grit. Some effects can be as follows:

- Moisture - Corrosive rusting reduces chain strength by pitting and cracking.
- Temperature - Low temperature reduces chain strength by embrittlement. Going in and out of cold storage results in moisture from condensation.
- Chemical Solutions or Vapors - Corrosive attack on the chain components and/or the mechanical connections between the chain components. Cracking can be (and often is) microscopic. Going from microscopic cracking to complete failure can be either abrupt or may require an extended period of time.
- Abrasives - Accelerated wearing and scoring of the articulating members of the chain (pins and plates), with a corresponding reduction in chain strength. Due to the inaccessibility of the bearing surfaces (pin surfaces and plate apertures), wear and scoring are not readily noticeable to the naked eye.

Following are some examples of dynamic shock loading which can impose abnormal loads above the endurance limit of a leaf chain.

- High velocity movement of load, followed by sudden, abrupt stops.
- Carrying loads in suspension over irregular surfaces such as railroad tracks, potholes, and rough terrain.
- Attempting to “inch” loads which are beyond the rated capacity of the machine.

The above load cycles and environmental conditions make it impossible to predict chain life. It is therefore necessary to conduct frequent inspections until replacement life can be predicted.

The boom chain's normal life expectancy can be expressed as a maximum percent of elongation. This is generally 3%. As the chain flexes back and forth over the sheave, the bearing joints (pins and inside link plates) gradually incur wear due to articulation.

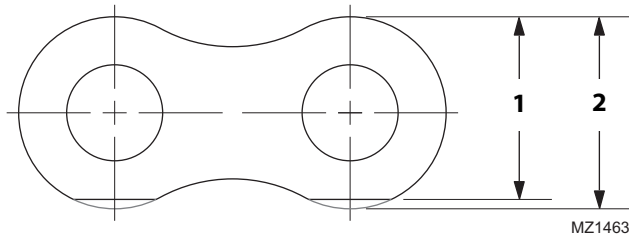
3.7.2 Inspection Guidelines

1. Park the machine on a firm, level surface, raise the boom to a horizontal (level) position, place the transmission in (N) NEUTRAL, engage the park brake switch.
2. Fully extend the boom until the extend chain is taut. Shut the engine off.
3. The extend chains will be visible for inspection with the machine in this state.
4. While doing the chain inspection, check all chain clevis ends for distortion or cracking and sheaves for bearing wear or grooving from the chain.
5. Inspect the retract chains every 1000 hours of operation.
6. Inspect the chains for the following conditions:



Boom

Edge Wear

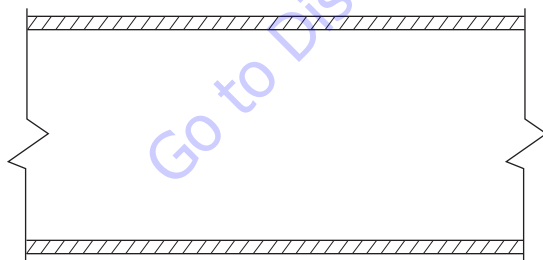
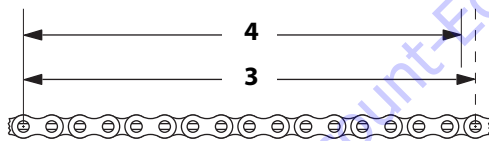


Check the chain for wear on the link plate edges caused by running back and forth over the sheave. The maximum reduction of material should not exceed 5%. Measure and compare to a normal link plate height by measuring a portion of chain that does not run over the sheave. If the measured plate height (1) is 5% less than the normal plate height (2), discard and replace the chain.

Elongation

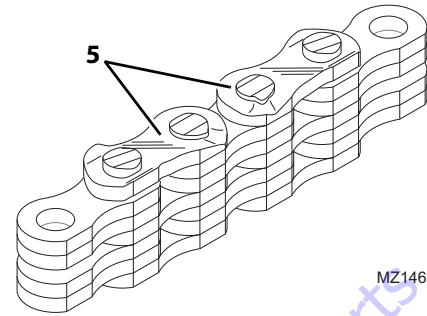
It is important to measure the chain in the section that moves over the sheaves because it receives the most frequent articulation. Measuring the chain near its clevis terminals could give an inaccurate reading. The ends of the chains, near the clevis terminal, will not have flexed as frequently, if at all, as the middle of the chains.

It is best to measure in 12 pin increments from pin center to pin center. For example, if the links are one inch from pin center to pin center, the distance should be 12 in. (305 mm). If the links are 3/4 in. (19,0 mm) apart, the distance after 12 pins should be 9 in. (228,6 mm).



If the distance measured (3) is 3% greater than the normal length (4), discard and replace the chain.

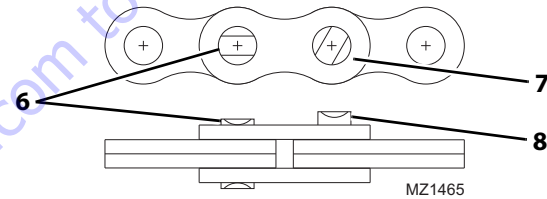
Distorted or Battered Link Plates



Distorted or battered link plates (5) on a leaf chain can cause tight joints and prevent flexing.

Turning or Protruding Pins

Highly loaded chain, operating with inadequate lubrication can generate abnormal frictional forces between pin and link plates. When chain is allowed to operate in this condition, a pin or series of pins, can begin to twist out of a chain, resulting in failure.



Examine the pin head rivets to determine if the "VEE" flats are still in correct alignment (6). Chain with rotated/displaced heads (7) or abnormal pin protrusion (8) should be replaced immediately.

DO NOT attempt to repair the chain by welding or driving the pin(s) back into the chain. Once the press fit integrity between outside plates and pins has been altered, it cannot be restored.

Any wear pattern on the pin heads or the sides of the link plates indicates misalignment in the system. This condition damages the chain as well as increases frictional loading and should be corrected.

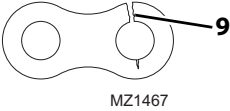
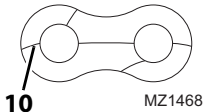


Cracked Plates

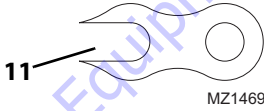

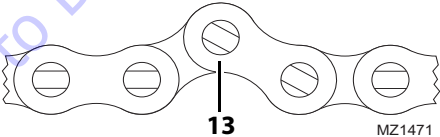
Inspect the chains very carefully, front and back as well as side to side, for any evidence of cracked plates. If any one crack is discovered, the chain should be replaced in its entirety.

It is important, however to determine the cause of the crack before installing a new chain so the condition does not repeat itself.

The types of cracks are:

- **Fatigue Cracking** - Fatigue cracks (**9**) are a result of repeated cyclic loading beyond the chain's endurance limit.  MZ1467
- **Stress Corrosion Cracking** - The outside link plates are particularly susceptible to stress corrosion cracking (**10**).  MZ1468
- **Corrosion Fatigue Cracking** - Corrosion fatigue cracks are very similar to fatigue cracks in appearance. Corrosion fatigue is the combined action of an aggressive environment and cyclic stress.

Other Modes of Failure

- **Ultimate Strength Failure** - These types of failures are caused by overloads far in excess of the design load. Either fractured plates (**11**) or enlarged holes (**12**) can occur. If either of these failures occurs, the chain should be replaced immediately.  MZ1469
- **Tight Joints** - All joints in the chain should flex freely. Tight joints (**13**) resist flexing. If the problem is caused by dirt or foreign substance packed in the joints, clean and lubricate thoroughly before re-installing the chain. If the problem is caused by corrosion and rust or bent pins, replace the chain.  MZ1470
- **Tight Joints** - All joints in the chain should flex freely. Tight joints (**13**) resist flexing. If the problem is caused by dirt or foreign substance packed in the joints, clean and lubricate thoroughly before re-installing the chain. If the problem is caused by corrosion and rust or bent pins, replace the chain.  MZ1471

3.7.3 Expose Chains for Inspection

c. Extend Chains

1. Park the machine on a firm, level surface. Place the transmission in (N) NEUTRAL, engage the park brake switch and raise the boom to a horizontal (level) position.
2. Fully extend the boom and shut the engine OFF.

The extend chains will be visible for inspection with the machine in this state.

While doing the chain inspection, check all chain clevis ends for distortion or cracking and sheaves for bearing wear or grooving from the chain.

If during the inspection, any chain is found to be damaged or stretched, the chain **must** be replaced. It is recommended that when any chain is replaced, that all the chains and clevises be replaced at the same time.

d. Retract Chains

The retract chains are only partially visible through the rear of the boom with all the sections retracted. It is possible to see a section of the retract chain as the boom is slowly extended. If there is ANY question that one or all the retract chains are damaged, the boom should be removed and disassembled with the retract chains being inspected and replaced if necessary.

Note: DO NOT attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis. It is recommended that when any chain is replaced, that all chains and clevises be replaced at the same time.



Boom

3.7.4 Chain Lubrication

After inspection and before being returned to service, chains must be lubricated. Refer to Section 2.3, "Fluid & Lubricant Capacities", for proper lubricant.

The lubricant must penetrate the chain joint to prevent wear. Applying lubricant to the external surfaces will prevent rust, but the chains should be articulated to make sure the lubricant penetrates to the working surfaces between the pins and links.

To prepare the chain for lubrication, the chain plates should be brushed with a stiff brush or wire brush to clear the space between the plates so that lubricant can penetrate to the working surfaces.

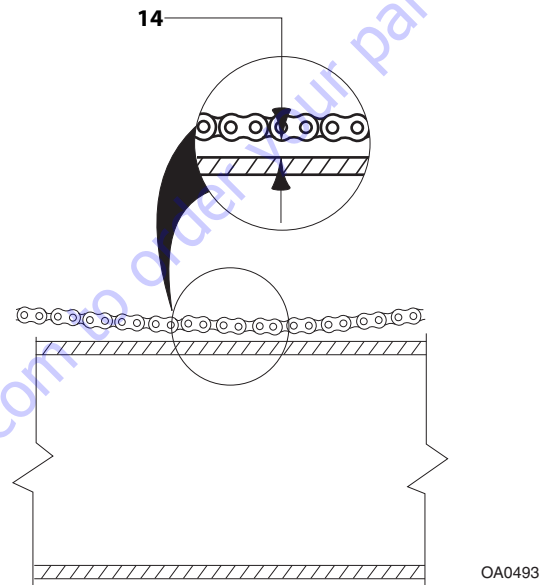
Lubricant may be applied with a narrow paint brush or directly poured on, but the chain should be well flooded with lubricant and the boom should be extended and retracted to be sure that the lubricant penetrates to the working surfaces. All surplus lubricant should be wiped away from the external surfaces. **DO NOT** use a solvent for this wiping operation.

Regular application of lubricant is necessary to make sure that all working surfaces are adequately lubricated. In extremely dusty conditions, it may be necessary to lubricate the chains more often. Refer to Section 2.4, "Service and Maintenance Schedules", and Section 2.5, "Lubrication Schedules", for detailed information.

Lubrication of chains on machines working consistently in extreme hot or cold conditions requires special consideration. It is important that a reputable lubrication specialist or a **JLG** distributor be consulted for guidance.

3.7.5 Boom Chain Tension Check

1. Make sure the attachment is attached to the boom head before doing the tension check.
2. Park the machine on level ground. Place the transmission in (N) NEUTRAL, engage the parking brake switch and level the boom.
3. Slowly, fully extend the boom and retract it about halfway. Fully extend the boom, then retract it 2 in. (51 mm) (one inch per section). Turn the engine OFF.



4. Measure the sag (**14**) in each of the double boom extend chains between the bottom of the extend chains and the top of the second boom section at their closest point. For 6036, 6042, 8042, 10042, 10054 & 12054 acceptable boom chain sag is between 1.5 in. (38 mm) and 2.5 in. (64 mm). For the 10054 & 12054, also measure the sag of the single extend chain between the bottom of the extend chain and the top of the third boom section at it's closest point. Acceptable boom chain sag is between 2.85 in. (72 mm) and 3.85 in. (98 mm).

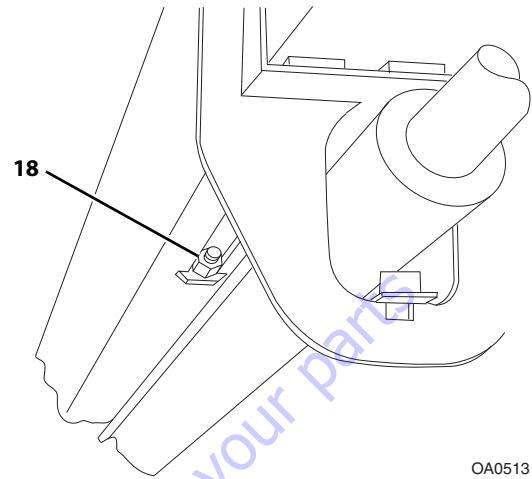
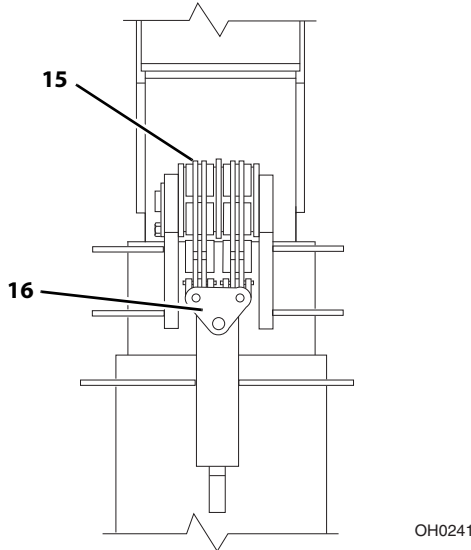
If the measurement is either less than, or greater than the range given, the boom chains need to be adjusted. Continue with Section 3.7.6, "Boom Chain Tension Adjustment (6036, 6042, 8042 & 10042)" or Section 3.7.7, "Boom Chain Tension Adjustment (10054 & 12054)", to adjust the chain system.

5. Start the engine, retract the boom completely and turn the engine OFF.

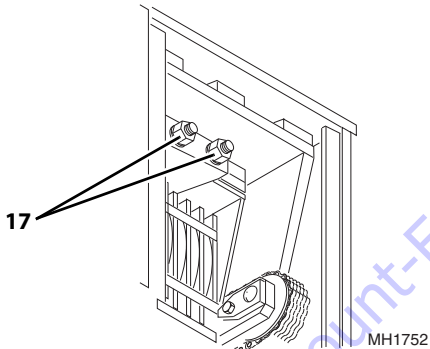


3.7.6 Boom Chain Tension Adjustment (6036, 6042, 8042 & 10042)

Note: Always perform Section 3.7.5, "Boom Chain Tension Check" before adjusting the boom chain tension.



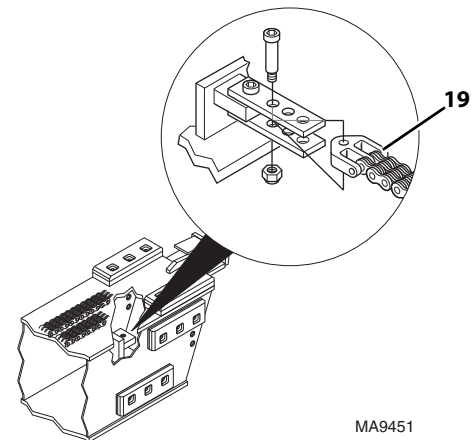
1. Adjust the two boom extend chains (15).



If the chain sag measurement (14) is less than 1.5 in. (38 mm), tighten the two extend chain adjustment locknuts (17). If the chain sag measurement is more than 2.5 in. (64 mm), loosen the two extend chain adjustment locknuts.

2. Tighten or loosen the two extend chain adjustment locknuts located at the rear of the boom. Be sure that each extend chain maintains the same tension. Equal chain tension can be checked by the position of the yoke (16) on the outer boom. The front of the yoke should be parallel with the front edge of the outer boom.

3. If there is no adjustment left on the extend chains, tighten the retract chain locknut (18) at the front on the underside of the outer boom.
4. Recheck chain tension. Refer to Section 3.7.5, "Boom Chain Tension Check".

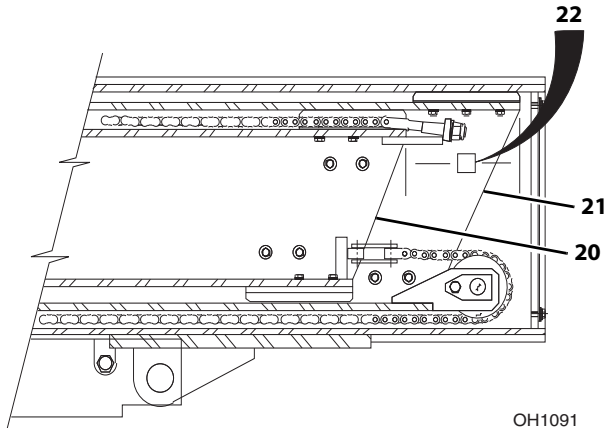


5. Further chain adjustment can be achieved by loosening all three chain locknuts and moving the rear retract chain clevis (19) from the original mounting hole in the anchor plate to the next hole. This is only acceptable when boom chain sag cannot be acquired and the chain elongation measurement is still less than 12.36 in. (313 mm). Follow the instructions in Section 3.7.6, a. "Component/Assembly Verification (6036, 6042 & 8042)".
6. Recheck chain tension. Refer to Section 3.7.5, "Boom Chain Tension Check".



Boom

a. Component/Assembly Verification (6036, 6042 & 8042)



OH1091

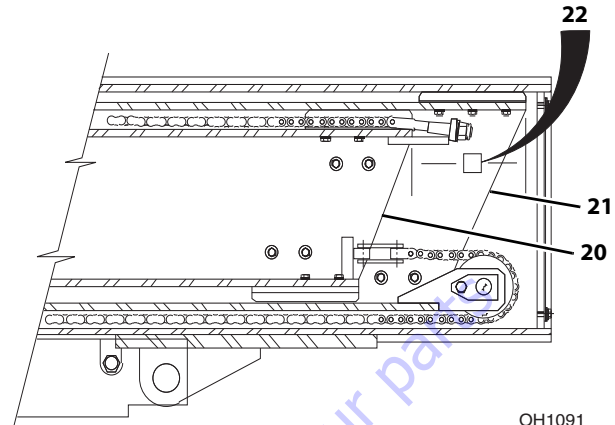
The third (20) to second (21) boom section separation should be checked when assembling new boom sections or chains, or when the rear retract chain clevis has been moved forward on the anchor plate.

Measure the separation (22) between the third and second boom section top plates. The distance should be at least 8.5 in. (216 mm) and not greater than 11 in. (279 mm) with the boom fully retracted and the chains properly tensioned. A distance of less than 8.5 in. (216 mm) could result in interference and cause damage to boom components.

If the distance is less than 8.5 in. (216 mm) or greater than 11 in. (279 mm):

1. Verify that the retract chain clevis (19) is not mounted in the last hole in the anchor plate.
2. Make sure that the chain system is properly tensioned. Refer to Section 3.7.5, "Boom Chain Tension Check".
3. **To increase the separation distance:** Loosen the retract chain locknut (18) on the bottom of the boom one or two turns and tighten the two extend chain locknuts equally the same number of turns. A minimum of one full thread on the clevis must protrude beyond the collar of the locknut.
4. **To decrease the separation distance:** Loosen the extend chain locknuts at the rear of boom equally one or two turns and tighten the retract chain locknut (18) the same number of turns. A minimum of one full thread on the clevis must protrude beyond the collar of the locknut.
5. Install the rear boom cover.
6. If the third to second boom separation distance cannot be achieved, contact your local **JLG** service distributor.

b. Component/Assembly Verification (10042)



OH1091

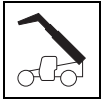
The third (20) to second (21) boom section separation should be checked when assembling new boom sections or chains, or when the rear retract chain clevis has been moved forward on the anchor plate.

Measure the separation (22) between the third and second boom section top plates. The distance should be at least 18.38 in. (467 mm) and not greater than 22.38 in. (568 mm) with the boom fully retracted and the chains properly tensioned. A distance of less than 18.38 in. (467 mm) could result in interference and cause damage to boom components.

If the distance is less than 18.38 in. (467 mm) or greater than 22.38 in. (568 mm):

1. Verify that the retract chain clevis (19) is not mounted in the last hole in the anchor plate.
2. Make sure that the chain system is properly tensioned. Refer to Section 3.7.5, "Boom Chain Tension Check".
3. **To increase the separation distance:** Loosen the retract chain locknut (5) on the bottom of the boom one or two turns and tighten the two extend chain locknuts equally the same number of turns. A minimum of one full thread on the clevis must protrude beyond the collar of the locknut.
4. **To decrease the separation distance:** Loosen the extend chain locknuts at the rear of boom equally one or two turns and tighten the retract chain locknut (18) the same number of turns. A minimum of one full thread on the clevis must protrude beyond the collar of the locknut.
5. Install the rear boom cover.

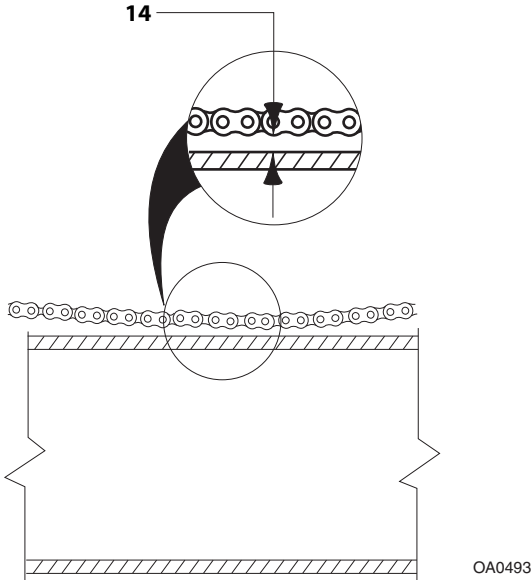
If the third to second boom separation distance cannot be achieved, contact your local **JLG** service distributor.



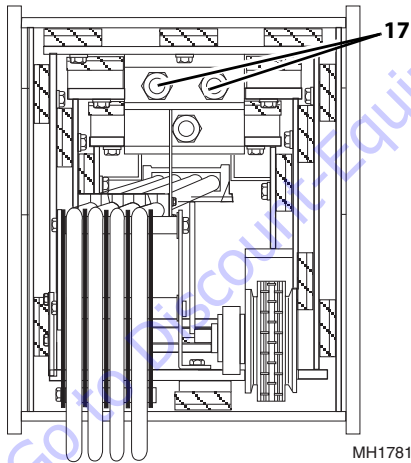
3.7.7 Boom Chain Tension Adjustment (10054 & 12054)

a. Outer Boom Chains Tension Adjustment

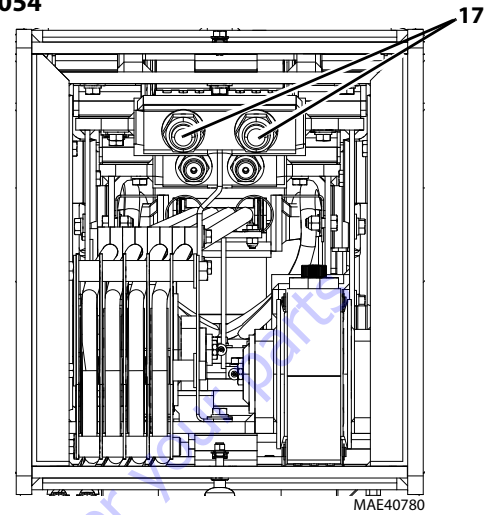
Note: Always perform Section 3.7.5, "Boom Chain Tension Check" before adjusting the boom extend chain tension.



10054

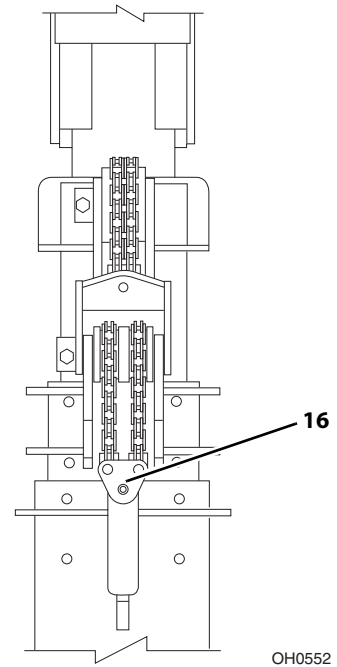


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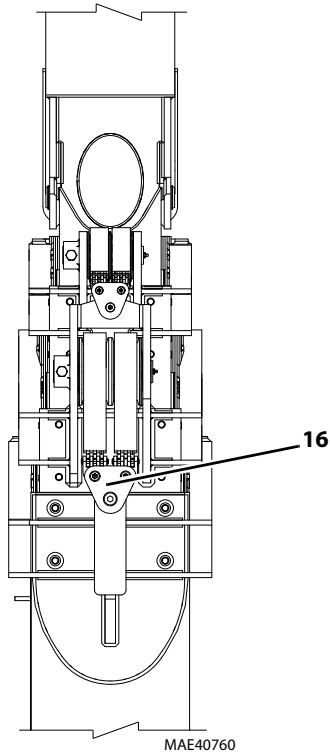
1. Adjust the two third boom section extend chains. If the chain sag measurement (14) is less than 1.5 in. (38 mm), tighten the two extend chain adjustment locknuts (17). If the chain sag measurement (14) is more than 2.5 in. (63,5 mm), loosen the two extend chain adjustment locknuts (17).

10054

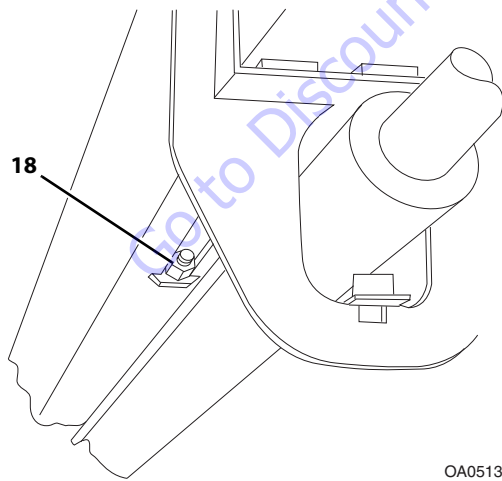




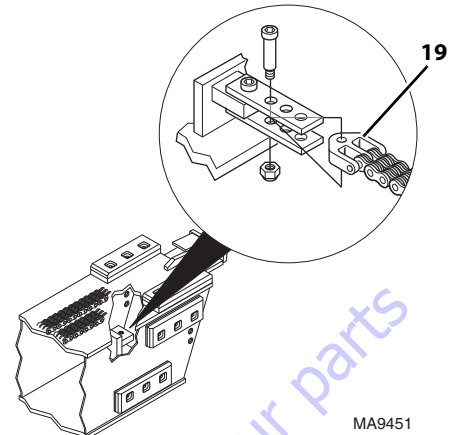
12054



2. Tighten or loosen the two extend chain adjustment locknuts (17) located at the rear of the boom. Be sure that each extend chain maintains the same tension. Equal chain tension can be checked by the position of the yoke (16) on the first boom section. The front of the yoke should be parallel with the front edge of the outer boom.



3. If there is no adjustment left on the extend chains, tighten the retract chain locknut (18) at the front on the underside of the boom.
4. Recheck chain tension. Refer to Section 3.7.5, "Boom Chain Tension Check".



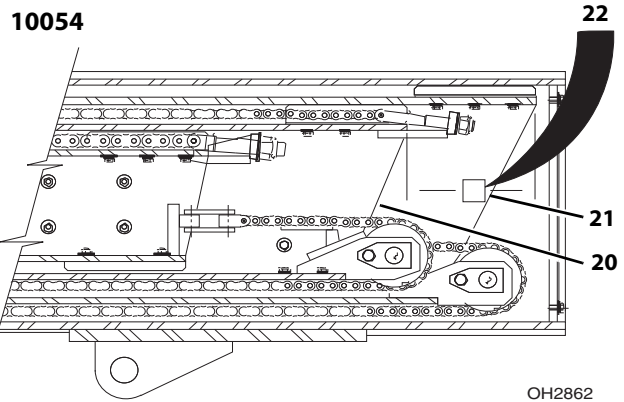
5. Further chain adjustment can be achieved by loosening all three chain locknuts and moving the rear retract chain clevis (19) from the original mounting hole in the anchor plate to the next hole.

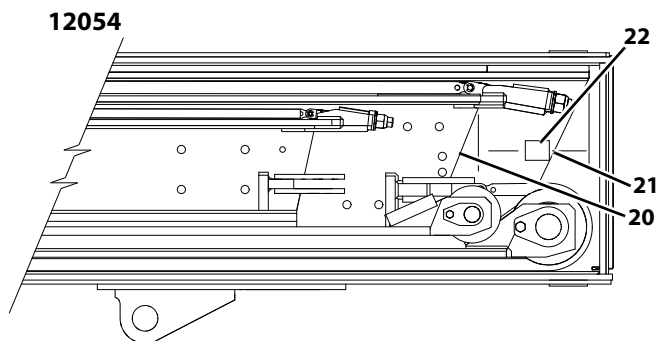
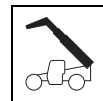
This is only acceptable when boom chain sag cannot be acquired and the chain elongation measurement is still less than 12.36 in. (313 mm). Follow the instructions in Section 3.7.7, b. "Component/Assembly Verification (10054 & 12054)".

6. Recheck chain tension. Refer to Section 3.7.5, "Boom Chain Tension Check".

b. Component/Assembly Verification (10054 & 12054)

The third to second boom section separation should be checked when assembling new boom sections or chains, or when the rear retract chain clevis has been moved forward on the anchor plate.





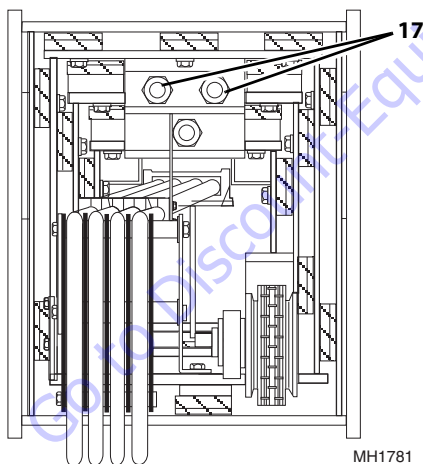
MAE40770

Measure the separation between the third (20) and second (21) section boom top plates. The distance (22) should be at least 8.5 in (216 mm) and not greater than 11 in. (279 mm) with the boom fully retracted and the chains properly tensioned. A distance of less than 8.5 in. (216 mm) could result in interference and cause damage to boom components.

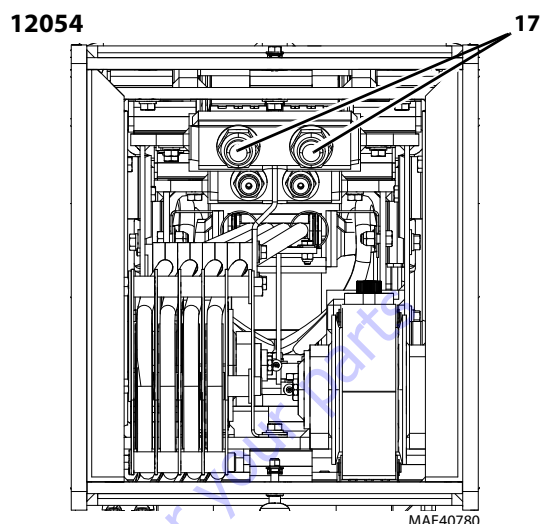
If the distance is less than 8.5 in. (216 mm) or greater than 11 in. (279 mm):

1. Verify that the retract chain clevis is not mounted in the last hole in the anchor plate.
2. Make sure that the chain system is properly tensioned. Refer to Section 3.7.5, "Boom Chain Tension Check".

10054



MH1781



MAE40780

3. **To increase the separation distance:** Loosen the retract chain locknut (18) on the bottom of the boom one or two turns and tighten the two extend chain locknuts (17) equally the same number of turns. A minimum of one full thread on the clevis must protrude beyond the collar of the locknut.
4. **To decrease the separation distance:** Loosen the extend chain locknuts (17) at the rear of boom equally one or two turns and tighten the retract chain locknut (18) the same number of turns. A minimum of one full thread on the clevis must protrude beyond the collar of the locknut.

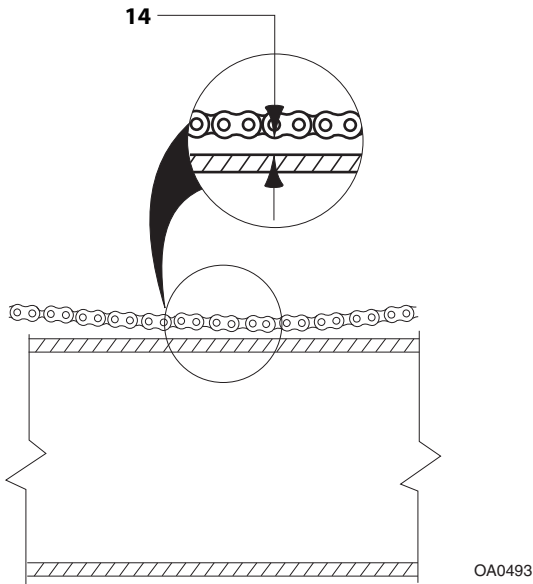
Note: If the third to second boom section separation distance cannot be achieved, contact your local authorized service distributor.



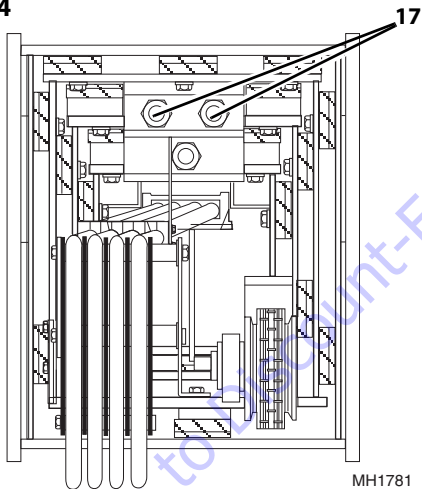
Boom

c. Inner Boom Chain Tension Adjustment (10054 & 12054)

Note: Always perform the Section 3.7.5, "Boom Chain Tension Check" before adjusting the fourth boom section extend chain tension.

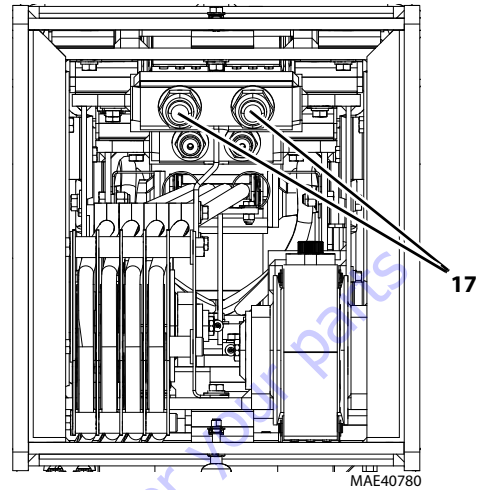


10054



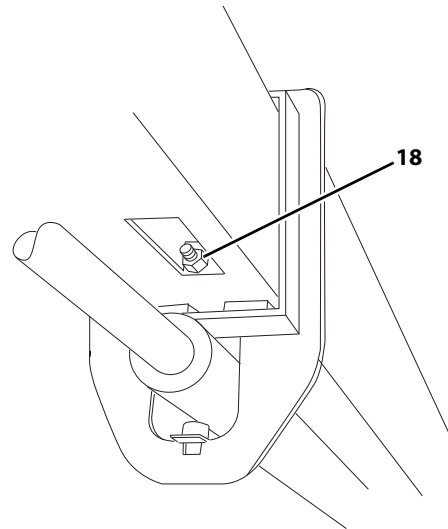
MH1781

12054



MAE40780

- Adjust the fourth boom section extend chain:
 - If the chain sag measurement (14) is less than 2.85 in. (72 mm), tighten the extend chain adjustment locknut (17).
 - If the chain sag measurement (14) is more than 3.85 in. (98 mm), loosen the extend chain adjustment locknut (17).



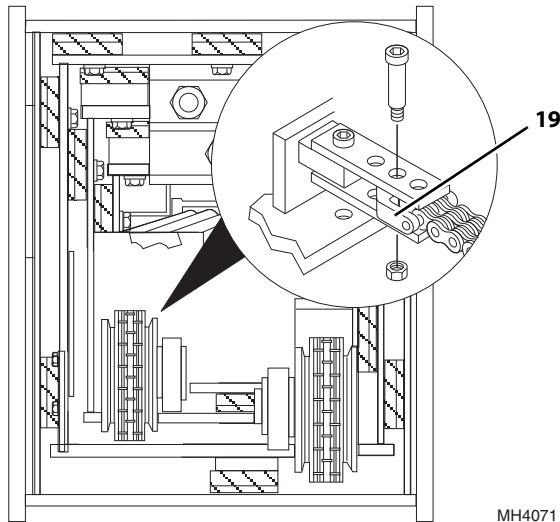
OH0661

- If there is no adjustment left on the extend chains, tighten the retract chain locknut (18) on the bottom of the second boom section several turns.



7. Recheck chain tension. Refer to Section 3.7.5, "Boom Chain Tension Check".

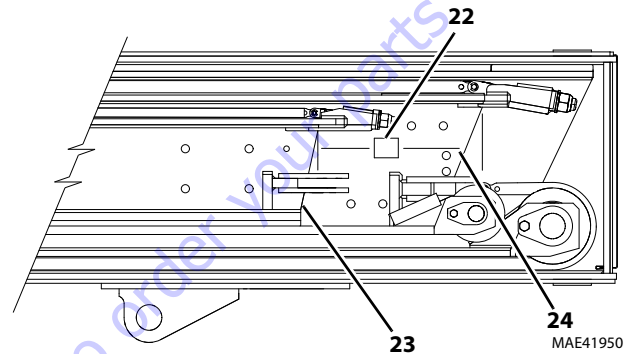
10054



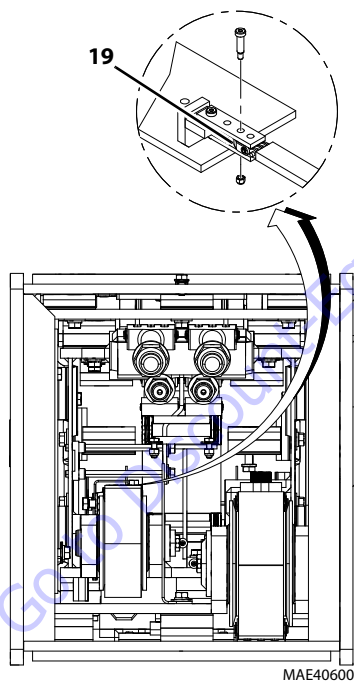
9. Recheck chain tension. Refer to Section 3.7.5, "Boom Chain Tension Check".

d. Component/Assembly Verification (10054 & 12054)

The fourth to third boom section separation should be checked when assembling new boom sections or chains, or when the rear retract chain clevis has been moved forward on the anchor plate.



12054



Measure the separation between the third (23) and fourth (24) boom section top plates. The distance (22) should be at least 13.75 in. (349 mm) and not greater than 14.25 in. (362 mm) with the boom fully retracted and the chains properly tensioned. A distance of less than 13.75 in. (349 mm) could result in interference and cause damage to boom components.

If the distance is less than 13.75 in. (349 mm) or greater than 14.25 in. (362 mm):

1. Verify that the retract chain clevis is not mounted in the last hole in the anchor plate.
2. Make sure that the chain system is properly tensioned. Refer to Section 3.7.5, "Boom Chain Tension Check".

8. Further chain adjustment can be achieved by loosening both chain locknuts and moving the rear retract chain clevis (19) from the original mounting hole in the anchor plate to the next hole.

This is only acceptable when boom chain sag cannot be acquired and the chain elongation measurement is still less than 12.36 in. (313 mm). Follow the instructions in Section 3.7.7, d. "Component/Assembly Verification (10054 & 12054)".



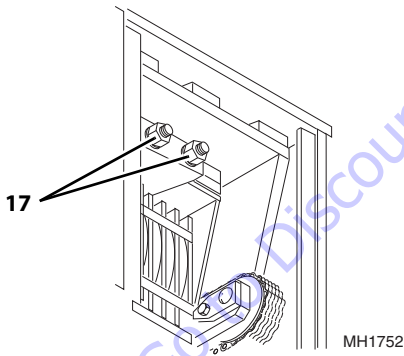
Boom

3. **To increase the separation distance:** Loosen the retract chain locknut on the bottom of the second boom section one or two turns and tighten the extend chain locknut the same number of turns. A minimum of one full thread on the clevis must protrude beyond the collar of the locknut.
4. **To decrease the separation distance:** Loosen the extend chain locknut at the rear of boom one or two turns and tighten the retract chain locknut on the bottom of the second boom section the same number of turns. A minimum of one full thread on the clevis must protrude beyond the collar of the locknut.

Note: If the fourth to third boom section separation distance cannot be achieved, contact your local authorized service distributor.

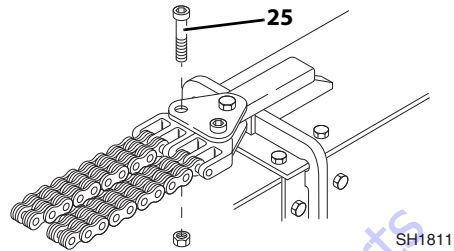
3.7.8 Extend Chains Removal and Replacement (6036, 6042, 8042 & 10042)

1. Park the machine on level ground. Place the transmission in (N) NEUTRAL, engage the parking brake switch, level the boom and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
4. Remove the boom rear cover.

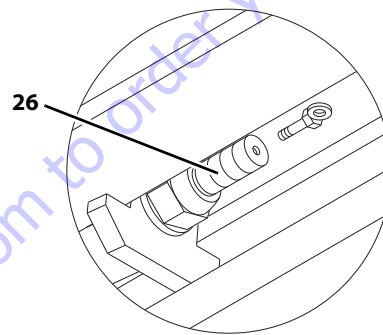


5. At the rear of the boom, locate the extend chain locknuts (17). Record the amount of threads extending beyond both the locknuts. These measurements will be the starting point for adjustment of the extend chains after installation.

6. Remove and replace the extend chains one at a time. Remove the right side locknut and flat washer, holding the clevis to the anchor plate.



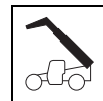
7. At the front of the boom, remove the capscrew (25) and locknut holding the right side extend chain clevis to the yoke plates. Replace the capscrew if damaged or worn.



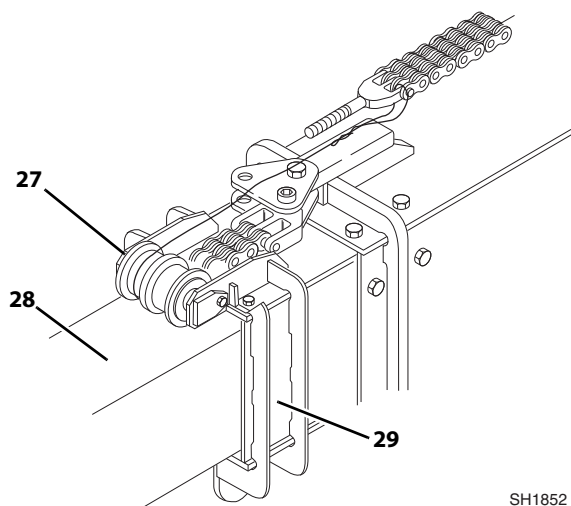
8. At the rear of the boom, attach one end of a wire to the threaded clevis (26) on the right side extend chain using a threaded eye or a flat washer tack welded to a capscrew. The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis.
9. Have an assistant pull the chain from the front of the boom while guiding the wires into the boom from the rear. Remove the wire from the clevis, but not from inside the boom.
10. Inspect wear and condition of the booms, chains, clevis', chain sheaves, Extend/Retract cylinder, chain rods, clevis anchors and all mounting hardware. Replace any worn or damaged parts. **DO NOT** attempt to make any repairs to the chain.

Note: Chains and clevis' are wear items and experience the same stress. **DO NOT** attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis'.

11. Coat the threads of the threaded clevis with multi-purpose grease.
12. Lay the new extend chain on top of the first boom section with the threaded clevis toward the front of the boom.



13. Attach the wire to the threaded clevis of the new extend chain using a threaded eye or a flat washer tack welded to a capscrew. The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis.



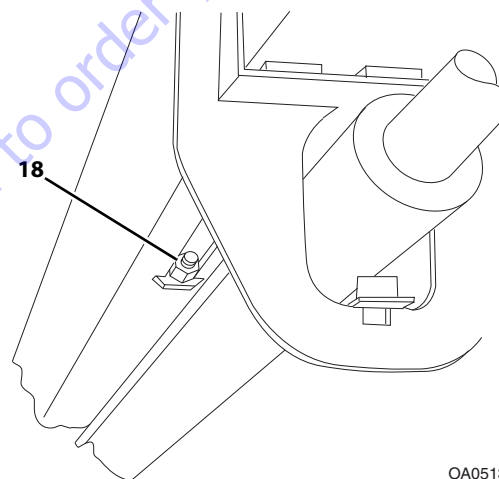
SH1852

14. Pull the extend chain forward and place over the right side of the chain sheave (27). Guide the wire and the threaded clevis under the chain sheave, and between the top of the third boom section (28) and the second boom section (29).
15. Have an assistant guide the extend chain into the front of the boom, while pulling on the wire from the rear of the boom. Guide the threaded clevis into the hole in the anchor plate.
16. Assemble the flat washer and locknut to the threaded clevis. Thread the locknut until the threads are flush with the top of the nut.
17. Pull the anchor clevis up around the double chain sheave and position the clevis between the yoke plates.
18. Coat the capscrew with anti-seize compound. Insert the capscrew through the yoke plates and clevis and secure in place with a locknut. Tighten securely; but the chain must pivot freely.
19. Remove the wire from the clevis.
20. Repeat this procedure for the left side extend chain.
21. At the rear of the boom, tighten the two locknuts on the extend chain clevis' until the amount of threads protruding beyond each locknut is the same as the measurement recorded during removal of the chains.
22. Check and adjust boom chain tension. Refer to Section 3.7.5, "Boom Chain Tension Check".
23. Install the boom rear cover.

24. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
25. Remove the Do Not Operate Tags from both ignition key switch and steering wheel.

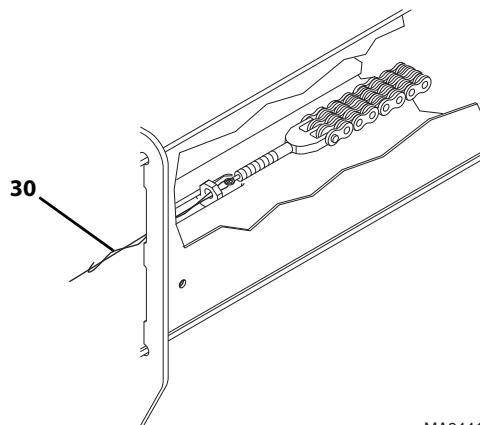
3.7.9 Retract Chain Removal and Replacement (6036, 6042, 8042 & 10042)

1. Park the machine on level ground. Place the transmission in (N) NEUTRAL, engage the parking brake switch, level the boom and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
4. Remove the boom rear cover.



OA0513

5. At the front underside of the boom, record the amount of threads extending beyond the locknut (18). This measurement will be the starting point for adjustment of the boom retract chain.
6. At the front underside of the boom, loosen the locknut far enough that it can be removed by hand.



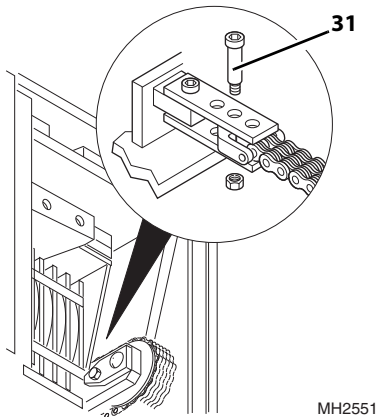
MA9441



Boom

7. Attach a wire or string (**30**) to the threaded clevis with a threaded eye or a flat washer tack welded to a capscrew. The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis. The wire or string will be used to pull the chain back through the boom during reassembly.
8. Remove the locknut and flat washer holding the retract chain threaded clevis to the mounting tab.

Note: Record the location of the shoulder bolt to ensure correct installation.

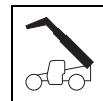


9. At the rear of the boom, locate the two retract chain anchor plates holding the retract chain to the third boom section just in front of the retract chain sheave. Remove the locknut and shoulder bolt (**31**) holding the retract chain clevis to the anchor plates. The two anchor plates can remain in place on the third boom section.
10. From the rear of the boom, pull the retract chain out of the rear of the boom.
11. Inspect wear and condition of the booms, chains, clevis, chain sheaves, Extend/Retract cylinder, chain rods, clevis anchors and all mounting hardware. Replace a worn or damaged chain. **DO NOT** attempt to make any repairs to the chain.

Note: Chains and clevis' are wear items and experience the same stress. **DO NOT** attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis'.

12. Remove the string from the old chain and attach it to the new clevis.
13. Coat the threads of the threaded clevis with multi-purpose grease.

14. From the rear of the boom, have an assistant push the threaded clevis end of the chain under the chain sheave and down between the second and first boom sections. Pull the front clevis using the string or wire. Keep the chain to the right side of the boom, push the threaded clevis down to the tab at the front underside of the first boom section.
15. Have an assistant guide the threaded end of the clevis through the hole in the tab.
16. Remove the string or wire from the end of the clevis.
17. Reassemble the flat washer and locknut onto the threaded clevis. Tighten the locknut until the threaded end of the clevis is flush with the top of the locknut.
18. At the rear of the boom, place the retract chain up and over the chain sheave. Place the clevis between the two anchor plates.
19. If re-installing a used chain, insert the saved shoulder bolt, in the same position in the plates and clevis recorded during removal.
20. If installing a new chain, line up the hole in the clevis with the second hole from the rear of the anchor plates. Insert the shoulder bolt, saved during removal of the old chain.
21. Secure the shoulder bolt in place with a locknut. Tighten the locknut securely.
22. Tighten the locknut on the retract chain clevis until the amount of threads protruding beyond the locknut is the same as the measurement recorded during removal of the retract chain.
23. Check and adjust retract chain tension. Refer to Section 3.7.5, "Boom Chain Tension Check".
24. Install the boom rear cover.
25. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
26. Remove the Do Not Operate Tags from both ignition key switch and steering wheel.

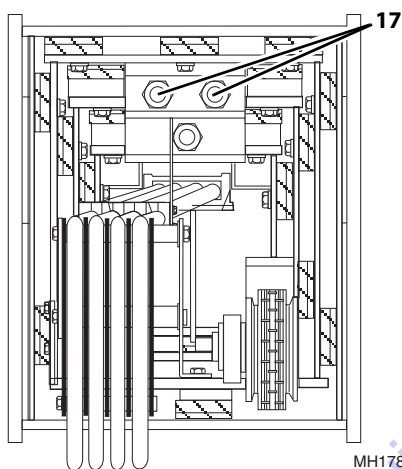


3.7.10 Extend Chains Removal and Replacement (10054 & 12054)

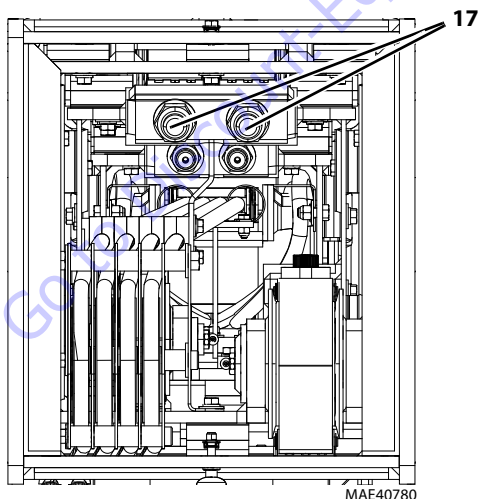
a. Second and Third Boom Section Extend Chains Removal and Replacement

1. Park the machine on level ground. Place the transmission in (N) NEUTRAL, engage the parking brake switch, level the boom and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
4. Remove the boom rear cover.

10054

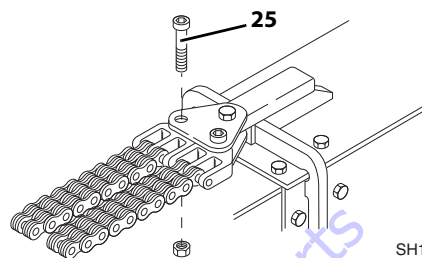


12054

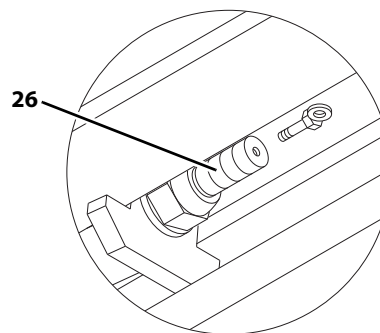


5. At the rear of the boom, locate the extend chain locknuts (17). Record the amount of threads extending beyond the locknuts. This measurement will be the starting point for adjustment of the extend chains after installation.

6. Remove and replace the boom extend chains one at a time. Remove the right side locknut and flat washer holding the right side chain clevis to the anchor plate.



7. At the front of the first boom section, remove the capscrews (25) and locknuts holding the extend chain clevis' to the yoke plates.
8. Inspect the capscrews for signs of wear or damage. Replace with new capscrews if damaged or worn.
9. At the front of the second boom section, remove the cap screw and lockwasher holding the extend chain sheave pin to the sheave mount bracket. Remove the pin from the mount bracket and the extend chain sheave. Remove the extend chain sheave from the mount.

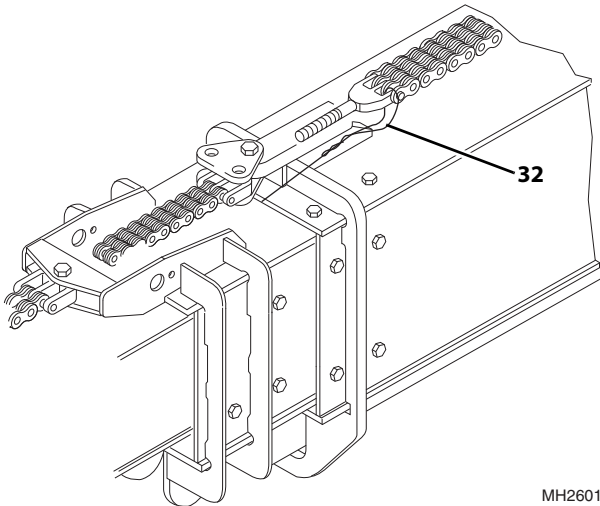


10. At the rear of the boom, attach one end of a wire to the threaded clevis (26) on the right side extend chain with a threaded eye or a flat washer tack welded to a cap screw. The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis.
11. Have an assistant pull the chain from the front of the boom while guiding the wire into the boom from the rear. Remove the wire from the clevis, but not from inside the boom.
12. Coat the threads of the threaded clevis with multi-purpose grease.
13. Lay the new extend chain on top of the first boom section with the threaded clevis toward the front of the boom.



Boom

14. Attach the wire to the threaded clevis of the new extend chain using a threaded eye or a flat washer tack welded to a capscrew. The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis.



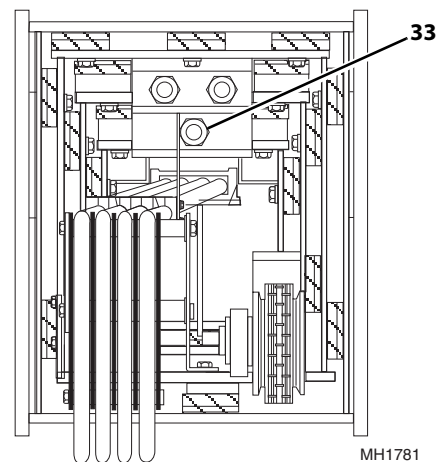
15. Pull the extend chain forward and place in between the chain sheave mounts. Guide the wire (32) and the threaded clevis into the boom by placing the threaded clevis between the top of the third boom section and the second boom section.
16. Have an assistant guide extend chain into the front of the boom while pulling the wire and threaded clevis toward the rear of the boom. Guide the threaded clevis into the hole in the anchor plate.
17. Place the flat washer onto the threaded end of the threaded clevis and assemble the locknut. Thread locknut onto the threaded clevis until the threads are flush with the top of the nut.
18. Remove the wire from the clevis.
19. Repeat this procedure for the left side extend chain.
20. After both of the chains are replaced inside the boom, assemble the double sheave to the mount at the front of the second boom section.
21. Place the double extend chain sheave between the mounts and under the extend chains at the front of the second boom section. Insert the sheave pin through the mounts and the double sheave. Line up the mounting hole in the sheave pin with the threaded hole in the sheave mount and secure in place with the capscrew and the lockwasher. Tighten securely.
22. Pull the anchor clevis' up around the double chain sheave and position the clevis' one at a time between the yoke plates.

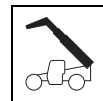
23. Coat the capscrews with anti-seize compound. Insert the capscrews through the yoke plates and clevis' and secure in place with locknuts. Tighten each locknut securely, but the chain clevis' must pivot freely.
24. At the rear of the boom, tighten the two locknuts on the chain clevis' until the amount of threads protruding beyond each locknut is the same as the measurement recorded during removal of the extend chains.
25. Check and adjust the retract chain tension. Refer to Section 3.7.5, "Boom Chain Tension Check".
26. Install the boom rear cover.
27. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
28. Remove the Do Not Operate Tags from both ignition key switch and steering wheel.

b. Fourth Boom Section Extend Chains Removal and Replacement

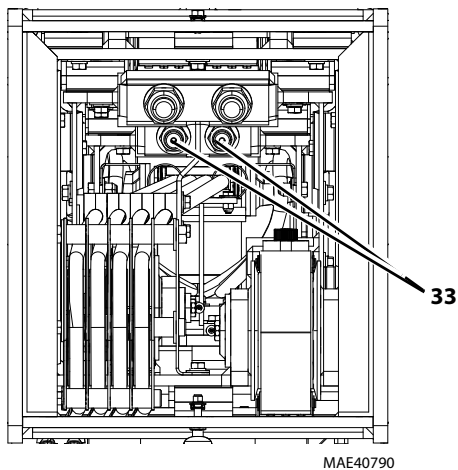
1. Park the machine on level ground. Place the transmission in (N) NEUTRAL, engage the parking brake switch, level the boom and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
4. Remove the boom rear cover.

10054



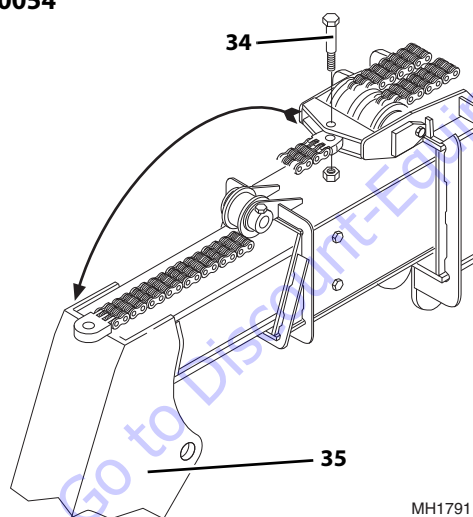


12054

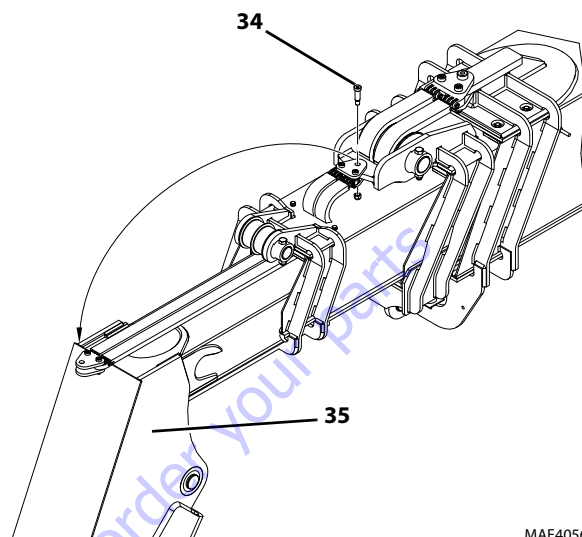


5. At the rear of the boom, locate the extend chain locknut (**33**). Record the amount of threads extending beyond the locknut. This measurement will be the starting point for adjustment of the extend chain after installation.
6. Remove the locknut and flat washer holding the extend chain clevis to the anchor plate on the boom.

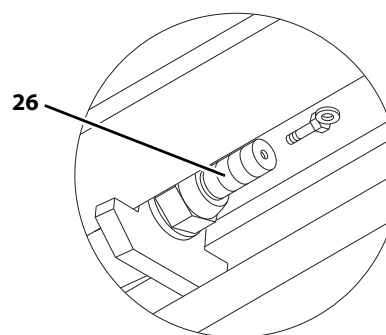
10054



12054



7. At the front of the boom, disconnect the extend chain clevis from the anchor plates on the second boom section. Remove the locknut holding the shoulder bolt (**34**) to the anchor plates. Pull the extend chain clevis from between the plates and lay over the front of the fourth boom section (**35**).
8. Remove the locknut and capscrew holding the extend chain sheave to the front of the third boom section.
9. Inspect the sheave pin for corrosion or damage. If the pin is damaged, it should be replaced. Minor corrosion can be repaired with fine emery cloth. Save the chain sheave, pin and capscrew.



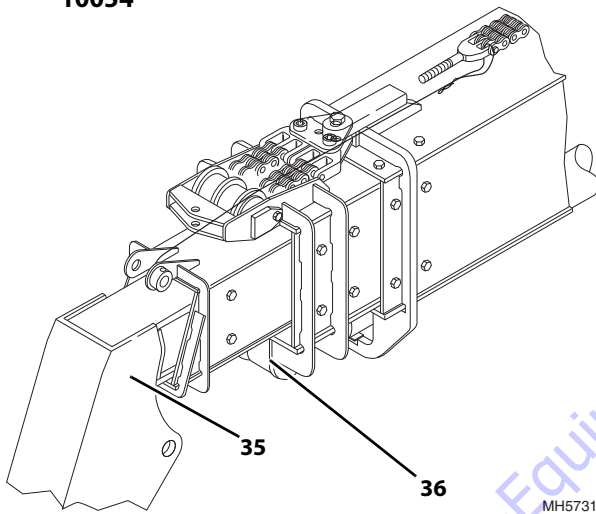
10. At the rear of the boom, attach one end of a wire to the threaded clevis (**26**) on the extend chain with a threaded eye or a flat washer tack welded to a capscrew. The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis.



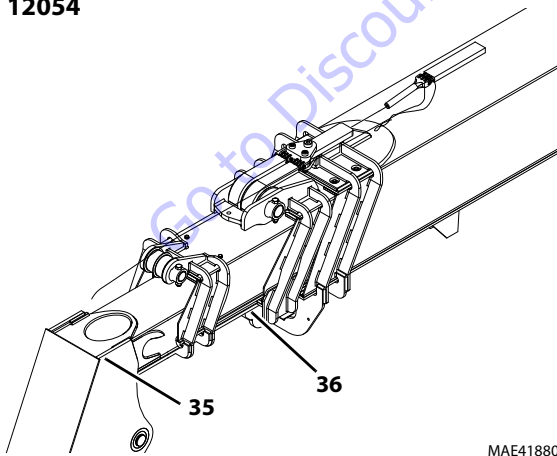
Boom

11. Have an assistant pull the chain from the front of the boom while guiding the wire into the boom from the rear. Remove the wire from the clevis, but not from inside the boom.
12. Coat the threads of the threaded clevis with multi-purpose grease.
13. Lay the new extend chains on top of the fourth boom section with the threaded clevis toward the front of the boom.
14. Attach the wire to the threaded clevis of the new extend chain with a threaded eye or a flat washer tack welded to a capscrew. The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis.

10054

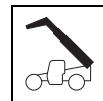


12054



15. Pull the extend chains forward and place in between the chain sheave mounts. Guide the wire and the threaded clevis into the boom by placing the threaded clevis between the third boom section (36) and the top of the fourth boom section (35).

16. Have an assistant guide the extend chain into the front of the boom while pulling the wire and threaded clevis into the hole in the anchor plate.
17. Place the flat washer onto the threaded end of the threaded clevis and assemble the locknut. Thread the locknut onto the threaded clevis until the threads are flush with the top of the nut.
18. Remove the wire from the clevis.
19. After the chain is replaced inside the boom, assemble the sheave to the mount at the front of the third boom section.
20. Place the extend chain sheave between the mounts at the front of the third boom section. Insert the sheave pin through the mounts and the sheave. Secure in place with the capscrew, saved, and a locknut. Tighten securely.
21. After the sheave is assembled, apply a good grade of multi-purpose grease to the grease fitting at the end of the pin. Turn the sheave by hand to distribute the grease evenly.
22. Pull the extend chain up and around the sheave at the front of the third boom section.
23. Place the extend chain clevis between the mounting plates at the front of the third boom section. Coat the saved shoulder bolt with anti-seize compound and insert through the plates and clevis. Secure the shoulder bolt in place with a locknut. Tighten securely, but the chain clevis should pivot freely.
24. At the rear of the boom, tighten the locknut on the extend chain clevis until the amount of threads protruding beyond the locknut is the same as the measurement recorded during removal of the extend chain.
25. Check and adjust the extend chain tension. Refer to Section 3.7.5, "Boom Chain Tension Check".
26. Install the boom rear cover.
27. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
28. Remove the Do Not Operate Tags from both ignition key switch and steering wheel.

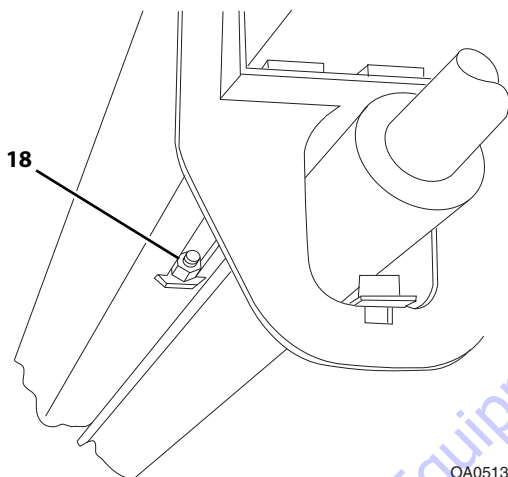


3.7.11 Retract Chain Removal and Replacement (10054 & 12054)

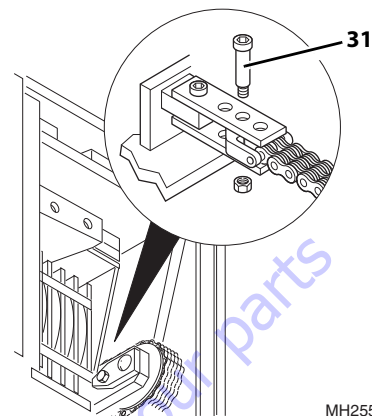
Note: Record the location of the shoulder bolt to ensure correct installation.

c. Third Boom Section Retract Chain Removal and Replacement

1. Park the machine on level ground. Place the transmission in (N) NEUTRAL, engage the parking brake switch, level the boom and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
4. Remove the boom rear cover.



5. At the front underside of the boom, locate the retract chain locknut (18). Record the amount of threads extending beyond the locknut. This measurement will be the starting point for adjustment of the retract chain after installation.
6. At the front underside of the fourth boom section, remove the locknut and flat washer holding the retract chain threaded clevis to the mounting tab.
7. Attach a wire or string to the threaded clevis with a threaded eye or a flat washer tack welded to a capscrew. The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis. The wire or string will be used to pull the chain back through the boom during reassembly.

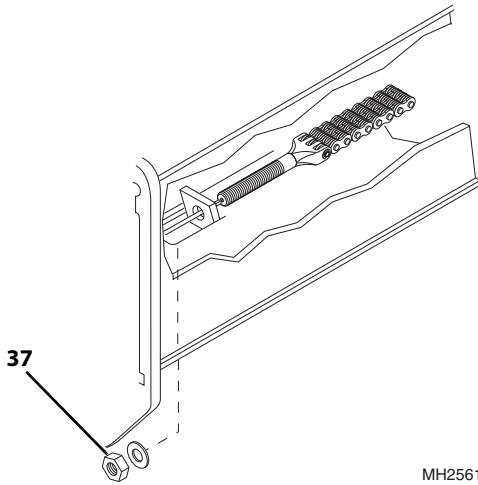


MH2551

8. At the rear of the boom, locate the two retract chain anchor plates. Remove the locknut and shoulder bolt (31) holding the retract chain clevis to the anchor plates. The two anchor plates can remain in place on the third boom section.
9. From the rear of the boom, pull the boom retract chain out of the rear of the boom.
10. Disconnect the string or wire from the retract chain clevis, and allow it to hang out the rear of the boom.
11. Coat the threads of the threaded clevis with multi-purpose grease.
12. At the rear of the boom, attach the string or wire to the new retract chain threaded clevis end with a threaded eye or a flat washer tack welded to a capscrew. The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis.
13. From the rear of the boom, have an assistant push the threaded clevis end of the new retract chain under the chain sheave and down between the second and first boom sections, while pulling the retract chain through the boom using the previously attached string or wire. Keep the retract chain to the right side of the boom, push and pull the threaded clevis down to the tab at the front underside of the boom.



Boom

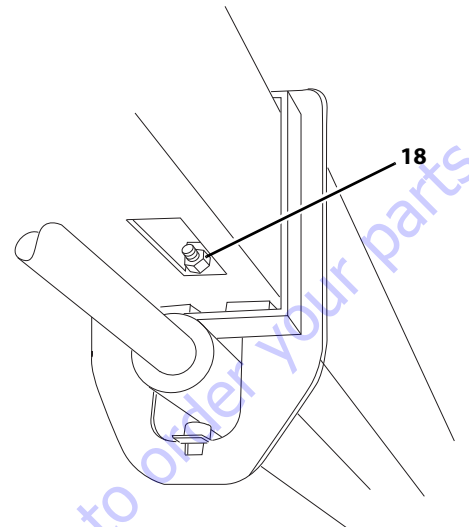


14. Reassemble the flat washer and a locknut (**37**) onto the threaded clevis. Tighten the locknut until the threaded end of the clevis is flush with the top of the locknut.
15. At the rear of the boom, place the retract chain up and over the chain sheave. Place the clevis between the two anchor plates. Line up the hole in the clevis with the anchor plate hole position recorded during removal.
16. Insert the shoulder bolt through the plates and clevis and secure in place with a locknut. Tighten the locknut securely.
17. Check and adjust the retract chain tension. Refer to Section 3.7.5, "Boom Chain Tension Check".
18. Install the boom rear cover.
19. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
20. Remove the Do Not Operate Tags from both ignition key switch and steering wheel.

d. Fourth Boom Section Retract Chain Removal and Replacement

1. Park the machine on level ground. Place the transmission in (N) NEUTRAL, engage the parking brake switch, level the boom and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
4. Remove the boom rear cover.
5. Start the engine and extend the boom until the retract chain adjustment nut on the bottom of the second boom section is visible. Shut the engine OFF.

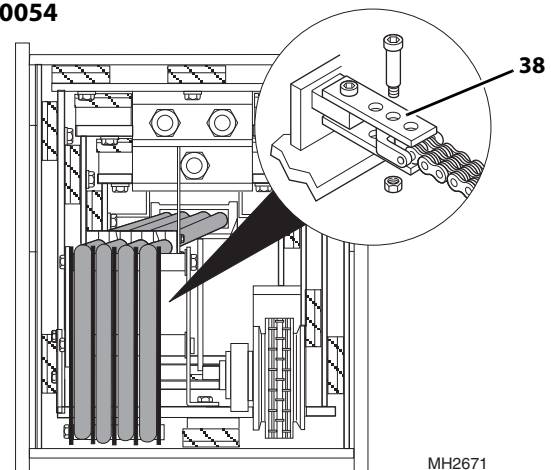
6. At the front underside of the boom, locate the retract chain locknut. Record the amount of threads extending beyond the locknut. This measurement will be the starting point for adjustment of the retract chain after installation.

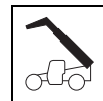


7. Loosen the locknut (**18**) on the retract chain clevis. **DO NOT** remove the locknut at this time, but loosen the nut as far as possible to gain as much slack as possible in the retract chain.
8. Return to the operator cab, start the engine and slowly retract the boom all the way back, and then extend the boom approximately 1 in. (25 mm) or just until all the tension on the retract chain is relieved. Shut the engine OFF.

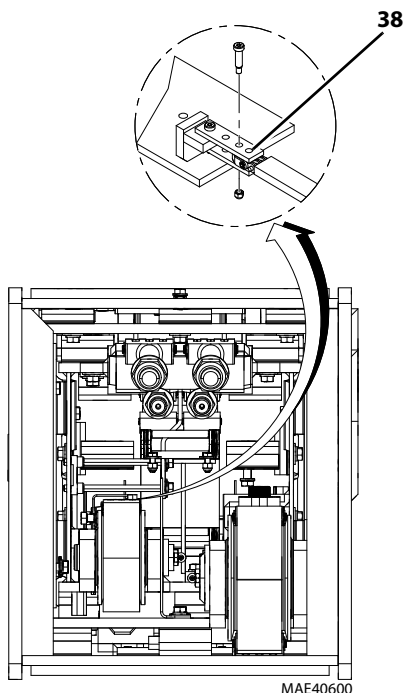
Note: Record the location of the shoulder bolt to ensure correct installation.

10054



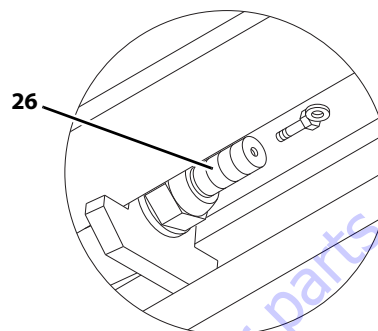


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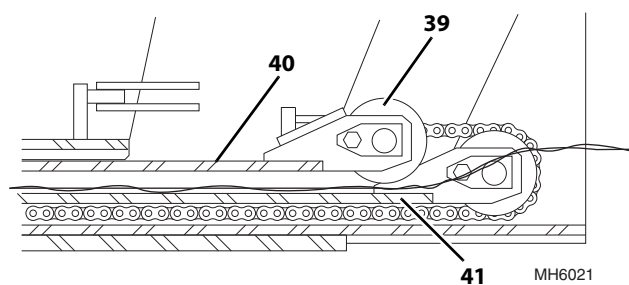
9. At the rear of the boom, locate the two retract chain anchor plates (38). The two anchor plates can remain in place on the fourth boom section.
10. Pull the retract chain clevis toward the rear of the boom, through the middle of the two center hoses on the chain reel and over the top of the chain reel. Let the clevis end of the retract chain hang out the rear of the boom. Use a piece of wire that is approximately 6 feet (1,8 m) long and tie it to the clevis end of the retract chain. This wire will be used to guide the chain back into the boom when the boom is extended to expose the other end for removal.
11. Have an assistant start the engine and slowly extend the boom. Guide the retract chain with the wire attached into the back of the boom. Extend the boom until the retract chain adjustment nut on the lower left side of the second boom section can be accessed and removed. Turn the engine OFF.

12. Remove the locknut and flat washer holding the threaded clevis on the retract chain to the tab in the second boom section.



MH6510

13. Attach a wire to the end of the retract chain clevis (26) with a threaded eye or a flat washer tack welded to a capscrew. The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis. The wire must be long enough to pull the clevis and chain through the boom. The wire must be heavy enough to pull the weight of the entire chain back through the boom during the reassembly.
14. From the rear of the boom, using the wire attached to the rear anchor clevis, pull the retract chain through the middle of the two center hoses on the chain reel and over the top of the chain reel and out of the rear of the boom.
15. Remove the wire still attached from the clevis on the old chain.
16. Install the wire still attached, to the new chain clevis.
17. Coat the threads of the threaded clevis on the new chain with multi-purpose grease.

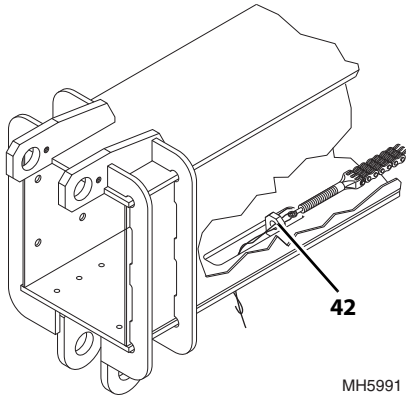


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Boom

- From the front of the boom, have an assistant pull on the tow wire while guiding the chain clevis between the two center hoses of the hose reel and under the chain sheave (39), on the left side of the boom and down the boom between the third (40) and second (41) boom sections. Keep the retract chain lined up squarely with the chain sheave and help feed the retract chain in while pulling on the wire from the front of the boom.

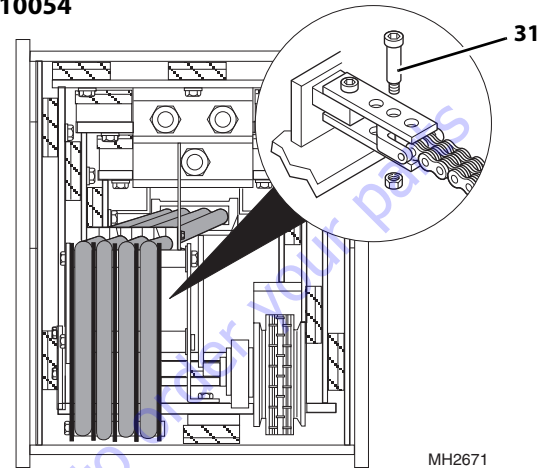


- Guide the threaded end of the clevis through the hole in the tab (42) on the second boom section.
- Remove the wire from the end of the clevis.
- Place the flat washer onto the threaded clevis. Assemble a locknut onto the threaded clevis. Turn the locknut only 2 or 3 turns onto the clevis to allow assembly of the other end of the retract chain.
- At the front of the boom, disconnect the extend chain clevis from the anchor plates on the second boom section. Remove the locknut holding the shoulder bolt to the anchor plates. Pull the extend chain clevis from between the plates and lay over the front of the fourth boom section.
- Return to the operator compartment and start the engine and slowly retract the boom. To avoid having the retract chain becoming entangled, keep tension on the chain coming out the back of the boom. Retract the boom as far as possible with the Extend/Retract cylinder. Turn the engine OFF.
- The fourth boom section will not retract completely and must be manually pushed in. To avoid having the retract chain becoming entangled, keep tension on the chain coming out the back of the boom while the fourth boom section is pushed in.

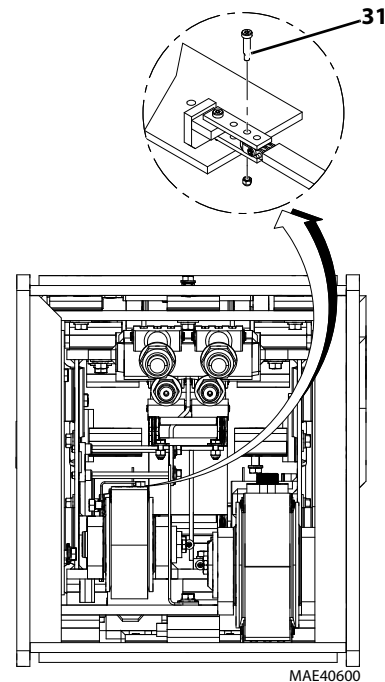
Note: Care should be taken not to push the fourth boom section in too far. If the fourth boom section is pushed in too far it could damage the hose reel at the back of the boom.

- Remove the wire from the anchor clevis at the rear of the boom. Place the retract chain up and over the chain sheave in front of the hose reel assembly. Place the clevis between the two anchor plates. Line up the hole in the clevis with the anchor plate hole position recorded during removal.

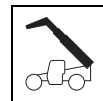
10054



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- Insert the shoulder bolt (31) through the plates and clevis and secure in place with a locknut. Tighten the locknut securely.
- Pull the extend chain up and around the sheave at the front of the third boom section.

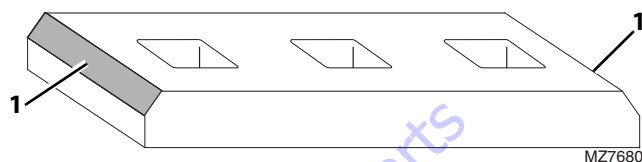


28. Place the extend chain clevis between the mounting plates at the front of the third boom section. Coat the shoulder bolt with anti-seize compound and insert through the plates and clevis. Secure the shoulder bolt in place with a locknut. Tighten securely, but the chain clevis should pivot freely.
29. Return to the operator compartment and start the engine. Slowly extend the boom to gain access to the retract chain adjustment nut on the lower left side of the second boom section. Shut the engine OFF.
30. Tighten the adjustment nut until the threads of the threaded clevis are flush with the top edge of the nut. This will be a starting point for adjustment of the fourth boom section retract chain.
31. Check and adjust the retract chain tension. Refer to Section 3.7.5, "Boom Chain Tension Check".
32. Install the boom rear cover.
33. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
34. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

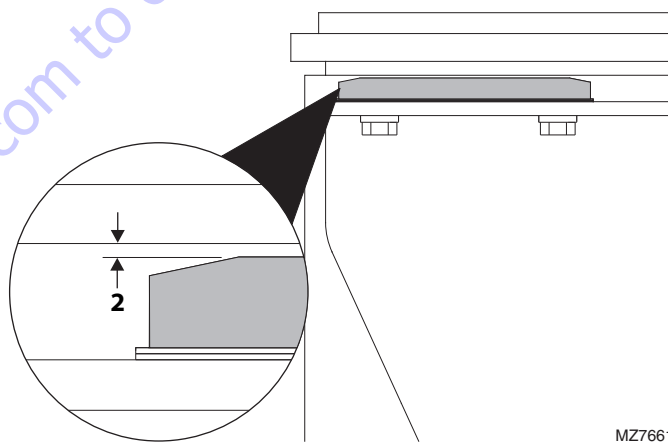
3.8 BOOM WEAR PADS

The wear pads on this machine are flat rectangular wear pads with metal inserts.

3.8.1 Wear Pad Inspection



1. Park the machine on level ground. Place the transmission in (N) NEUTRAL, engage the parking brake switch, level the boom and shut the engine OFF.
2. Inspect all wear pads for wear. If the angle indicators (1) on the ends of the wear pads are not visible, or show uneven wear, they should be replaced. Always replace pads as a set.



3. Measure all side and top wear pads for proper clearance. 0.02 - 0.059 in. (0.5 - 1.5mm) between the wear pad and the next boom section (2) is acceptable.
4. Shim each wear pad to within the above measurement if required.



Boom

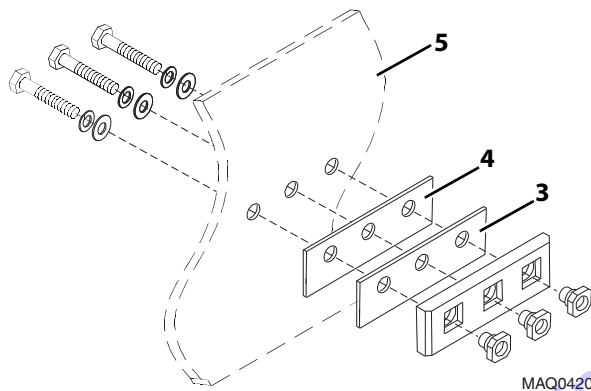
3.8.2 Wear Pad Installation and Lubrication

The boom has been factory lubricated for proper wear pad break-in and will normally require minor future lubrication. However, after replacing any wear pad(s), or prolonged periods of inoperation, lubrication of the boom wear surfaces with Schaffer 200S Silver Streak grease is recommended to keep the boom wear surfaces lubricated properly.

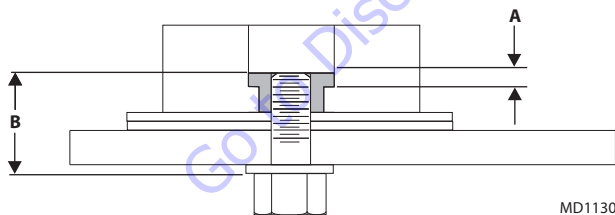
Lubrication of the boom wear surfaces is also recommended when the machine is stored, to help prevent rusting.

The following wear pad procedure must be followed to insure the proper wear pad installation:

- Maintain a total boom section clearance (2) of 0.02 - 0.059 in. (0.5 - 1.5mm) both the horizontal and vertical directions



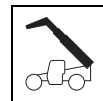
- A spacer (3) must be used before any shim (4) is used.
- A shim (4) must be inserted between the spacer (3) and wear pad support plate, block or boom section (5).
- The number of shims can vary at each shim point.
- The bottom wear pads must be shimmed equally on each side.



- The length of the wear pad bolt depends on the number of shims, spacers and washers being used.
- The bolt length can be ± 0.004 in. ($\pm 1,0$ mm) (A) from the face of the insert.
- The bolt length should be determined by measuring the distance from the face of the insert to the face of the boom (B) including any spacer, shim(s) and washer(s).
- One or two hardened washers are to be used on each wear pad bolt except where noted otherwise. **DO NOT** use more than two hardened washers.
- Use only one hardened washer if mounting bolts are recessed.
- Torque wear pad bolts as required.
- Lubricate the face and pockets of each wear pad after being installed.

Boom Section Wear Pad Pathway Lubrication:

- Clean and lightly grease all wear pad pathways with Mystik Tetrimoly grease.
- Clean and lightly grease the hose carrier guide bar pathways with Mystik Tetrimoly grease.



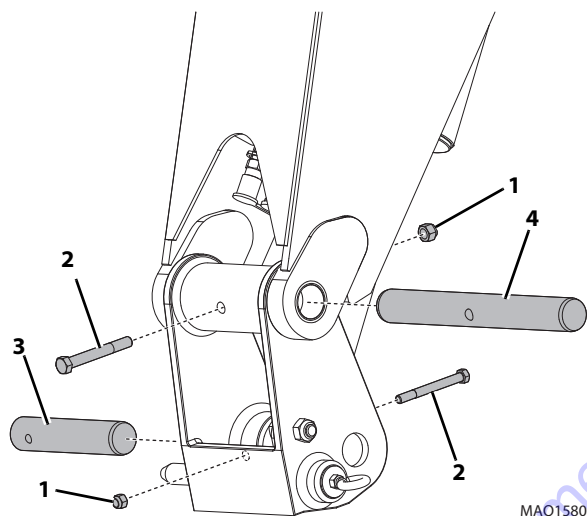
3.9 QUICK COUPLER

Note: The following procedure covers all styles of quick couplers.

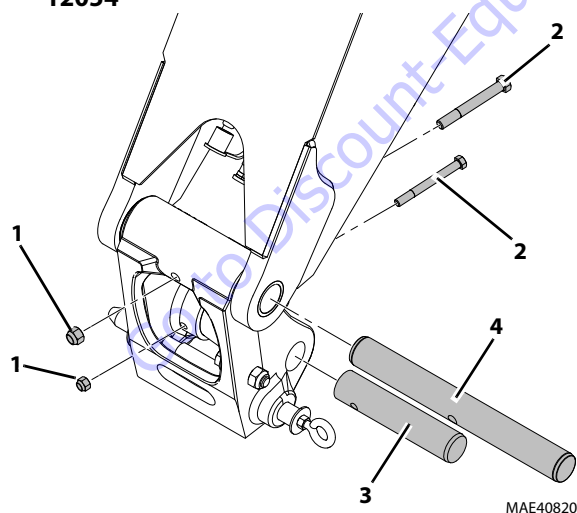
3.9.1 Quick Coupler Removal

1. Remove any attachment. Refer to Operation & Safety Manual for detailed removal instructions.
2. Lower boom, tilt forward to access coupler pin, set park brake and turn off engine.

6036, 6042, 8042, 10042 & 10054



12054



3. Remove the lock bolt (2) and nut (1) securing the tilt cylinder rod end pin (3) to the quick coupler assembly. Remove the rod end pin (3).

4. Support the quick coupler assembly. Remove the bolt (2) and nut (1) securing the quick coupler to the boom head. Remove the pin (4) from the quick coupler assembly.
5. Inspect the above pins for nicks or surface corrosion. Use fine emery cloth to fix minor nicks or corrosion. If damaged or if it cannot be repaired the pin must be replaced.

3.9.2 Quick Coupler Installation

1. Refer to Section 2.6, "Threadlocking Compound" for all thread locking requirements.
2. Assemble the quick coupler to the boom head. Line up the quick coupler between the mounts on the boom head. The quick coupler should be centered in the boom head.
3. Coat the quick coupler head pin (4) with an anti-seize compound. Insert the quick coupler head pin through the quick coupler and boom head. Secure with the previously removed bolt (2) and nut (1).
4. Align the quick coupler with the rod end tilt cylinder and insert the tilt cylinder pin (3). Secure with the previously removed bolt (2) and nut (1).
5. Install any attachment. Refer to Operation & Safety Manual for detailed installation instructions.

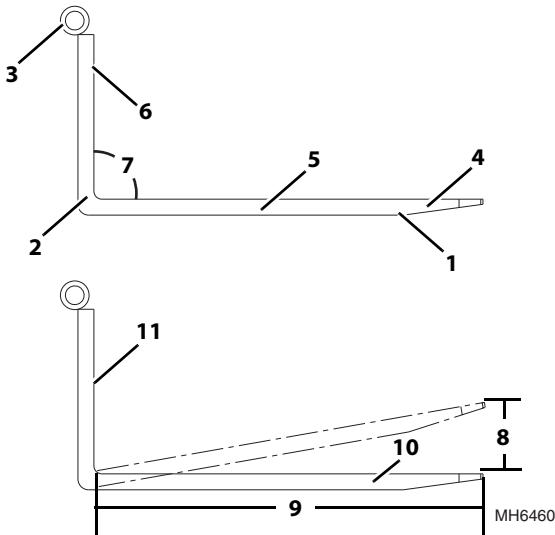


Boom

3.10 FORKS

Forks should be cleaned and inspected prior to being attached to carriage. If the following criteria is not met, forks must be removed from service immediately.

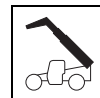
Daily Inspection



6. Inspect forks (1) for cracks, paying special attention to heel (2) and mounting tubes (3).
7. Inspect forks for broken or bent tips (4) and twisted blades (5) and shanks (6).

Yearly Inspection

1. Straightness of the upper face of blade (5) and the front face of shank (6) should not exceed 0.5 percent of the length of blade or height of shank.
2. Angle (7) between upper face of blade and front face of shank should not exceed 93 degrees.
3. Thickness of blade (10) and shank (11) should not be reduced to 90 percent of original thickness.
4. Ensure fork length (9) is adequate for intended loads.
5. Fork markings should be legible, re-stamp if required.
6. Compare fork tips (8) when mounted on a carriage. Maximum difference in height of fork tips is 3 percent of the length of the blade (10).



3.11 TROUBLESHOOTING

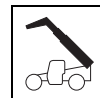
This section provides an easy reference guide covering the most common problems that occur during operation of the boom.

Problem	Cause	Remedy
1. Boom will not extend or retract	<ol style="list-style-type: none"> 1. Broken hydraulic hose(s) or tube(s) and/or connections leaking. 2. Extend/retract hydraulic system not operating properly. 3. Faulty extend/retract cylinder. 4. Broken chains or anchors 	<ol style="list-style-type: none"> 1. Locate break, replace hose(s) or tube(s), tighten connections. 2. Refer to Section 8.5.2, "Pressure Specifications". 3. Repair cylinder. Refer to Section 8.9.1, "General Cylinder Instructions". 4. Replace chains as needed
2. Boom shifts to right or left when extending.	<ol style="list-style-type: none"> 1. Boom side wear pads improperly shimmed or worn. 	<ol style="list-style-type: none"> 1. Shim wear pads to correct gap. Replace wear pads as needed. Refer to Section 3.8, "Boom Wear Pads".
3. Excessive pivot pin noise and/or wear.	<ol style="list-style-type: none"> 1. Insufficient lubrication. 2. Worn bearing(s). 	<ol style="list-style-type: none"> 1. Lubricate at regular intervals. Refer to Section 2.5, "Lubrication Schedules". Replace worn pins as needed. 2. Replace bearing(s) and lubricate at regular intervals Refer to Section 2.5, "Lubrication Schedules".
4. Excessive Compensation cylinder pivot pin noise and/or wear.	<ol style="list-style-type: none"> 1. Insufficient lubrication. 2. Worn bushing(s). 	<ol style="list-style-type: none"> 1. Lubricate at regular intervals. Refer to Section 2.5, "Lubrication Schedules". Replace worn pins as needed. 2. Replace bushing(s) and lubricate at regular intervals.
5. Boom will not raise or lower.	<ol style="list-style-type: none"> 1. Broken hydraulic hoses or tubes and/or connection leaks. 2. Lift/lower hydraulic system not operating properly. 3. Faulty lift/lower cylinder. 4. Seized boom pivot pin bearing. 	<ol style="list-style-type: none"> 1. Locate break, replace hose(s) or tube(s), tighten connections. 2. Refer to Section 8.5.2, "Pressure Specifications". 3. Repair cylinder. Refer to Section 8.9, "Hydraulic Cylinders". 4. Replace bearing.



Boom

Problem	Cause	Remedy
6. Drooping chain, or jerky boom extend or retract functions.	<ol style="list-style-type: none"> 1. Chain(s) tension not properly adjusted. 2. Chain(s) stretched or binding. 3. Wear pads loose, contaminated, excessively worn or damaged. 4. Contaminated, corroded or rusted wear pad sliding surfaces. 5. Extend/Retract hydraulic system not operating properly. 6. Damaged boom section. 	<ol style="list-style-type: none"> 1. Adjust chain(s). 2. Replace chains as needed. Refer to Section 3.7, "Boom Extend and Retract Chains". 3. Replace wear pad. Refer to Section 3.8, "Boom Wear Pads". 4. Remove contamination and/or corrosion from wear pad sliding surfaces and lubricate. If the surfaces cannot be reconditioned, replace the boom section(s). 5. Refer to Section 8.5.2, "Pressure Specifications". 6. Replace the damaged boom section. Refer to Section 3.4, "Boom Assembly Maintenance (6036, 6042, 8042 & 10042)".
7. Boom will not raise or lower.	<ol style="list-style-type: none"> 1. Broken hydraulic hoses or tubes and/or connection leaks. 2. Lift/Lower hydraulic system not operating properly. 3. Faulty Lift cylinder. 4. Seized boom pivot pin bushing. 	<ol style="list-style-type: none"> 1. Locate break, replace hose(s) or tube(s), tighten connections. 2. Refer to Section 8.5.2, "Pressure Specifications". 3. Repair cylinder. Refer to Section 8.9.1, "General Cylinder Instructions". 4. Replace bushing.
8. Excessive Lift/Lower cylinder pivot pin noise and/or wear.	<ol style="list-style-type: none"> 1. Insufficient lubrication. 2. Worn self-aligning bushing(s). 	<ol style="list-style-type: none"> 1. Lubricate at regular intervals. Refer to Section 2.4, "Service and Maintenance Schedules". Replace worn pins as needed. Refer to Section 8.9.1, "General Cylinder Instructions". 2. Replace bushing(s) and lubricate at regular intervals. Refer to Section 2.5, "Lubrication Schedules".



Problem	Cause	Remedy
9. Rapid boom pad wear.	<ol style="list-style-type: none"> 1. Incorrect wear pad gap. 2. Rapid cycle times with heavy loads. 3. Contaminated, corroded or rusted wear pad sliding surfaces. 4. Operating in extremely dusty/abrasive conditions. 	<ol style="list-style-type: none"> 1. Check wear pad gaps and correct as needed. Refer to Section 3.8, "Boom Wear Pads". 2. Reduce cycle times. 3. Remove contamination and/or corrosion from wear pad sliding surfaces and lubricate. If the surfaces cannot be reconditioned, replace the boom section(s). 4. Clean equipment frequently.
10. Auxiliary hydraulics will not operate.	<ol style="list-style-type: none"> 1. Auxiliary hydraulic system not operating properly. 	<ol style="list-style-type: none"> 1. Refer to Section 8.5.2, "Pressure Specifications".
11. Excessive chain wear.	<ol style="list-style-type: none"> 1. Improper chain adjustment. 2. Chain sheave(s) not properly lubricated. 3. Chain sheave(s) not rotating freely. 4. Improper chain lubrication. 	<ol style="list-style-type: none"> 1. Adjust to correct tension. Refer to Section 3.7.1, "Boom Chain Inspection". Replace chains as needed. 2. Lubricate chain sheave. (Refer to Section 2.4, "Service and Maintenance Schedules". 3. Lubricate chain sheave. Refer to Section 2.4, "Service and Maintenance Schedules". Repair or replace chain sheave(s) as needed. 4. Lubricate at regular intervals. Refer to Section 2.4, "Service and Maintenance Schedules". Replace chains as needed.



Section 4 Cab

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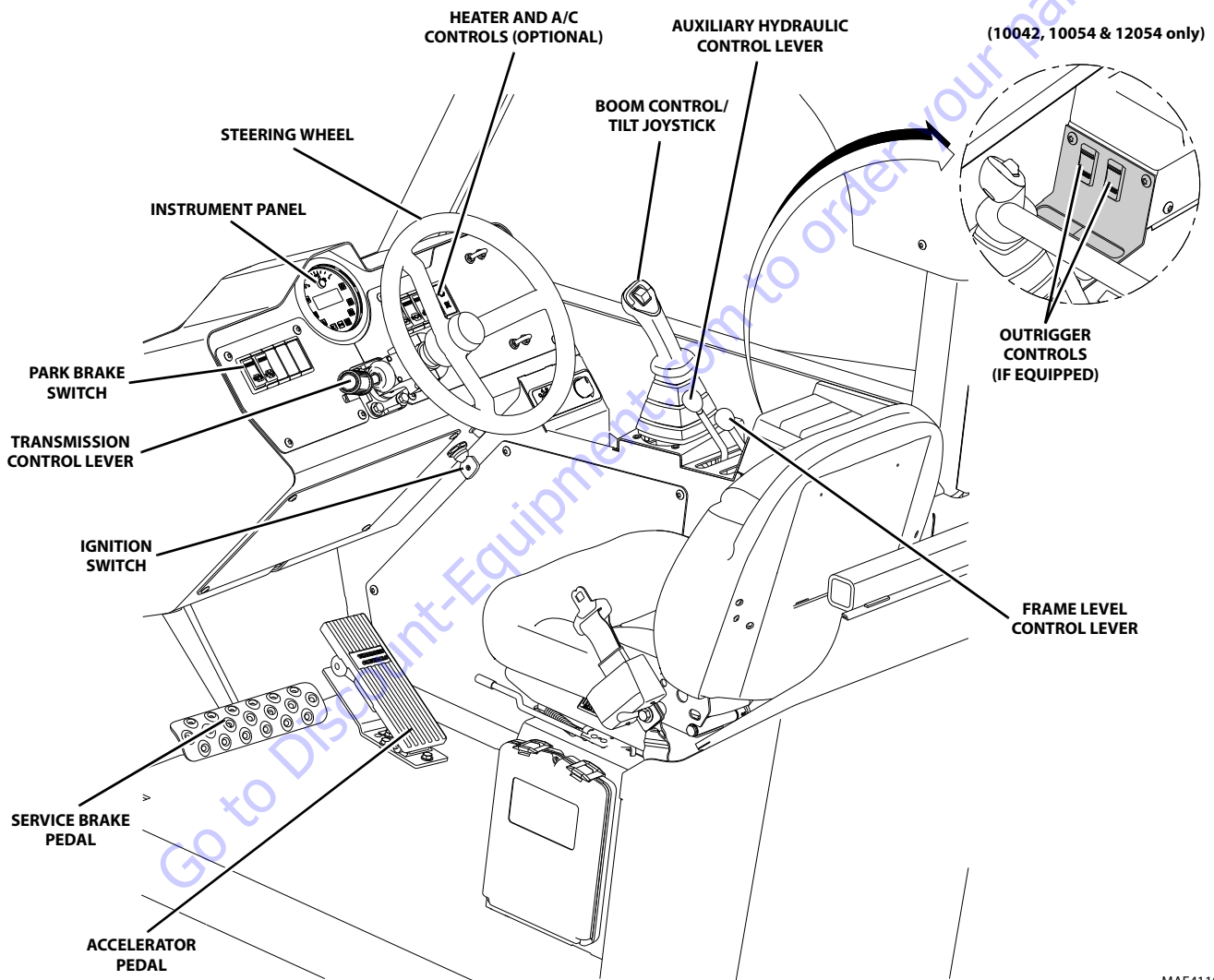
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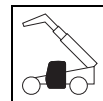
Cab

4.1 OPERATOR CAB COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the machine cab. The following illustration identifies the components that are referred to throughout this section.



MAE41190



4.2 OPERATOR CAB

! WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, "Safety Practices", section of this manual.

4.2.1 Operator Cab Safety

! WARNING

The protection offered by this ROPS/FOPS will be impaired if subjected to any modification or structural damage, at which time replacement is necessary. ROPS/FOPS must be properly installed using fasteners of correct size and grade, and torqued to their specified value.

! WARNING

DO NOT weld, grind, drill, repair or modify the cab in any way. Any modification or damage to cab structural components requires cab replacement.

4.2.2 Serial Number Plate

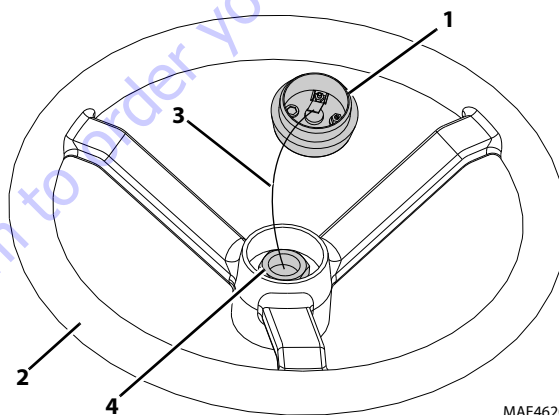
The cab serial number plate is located on the left side of the cab, behind the seat. Information specified on the serial number plate includes the cab model number, the cab serial number and other data. Write this information down in a convenient location to use in cab correspondence.

4.3 CAB COMPONENTS

4.3.1 Steering Wheel

a. Steering Wheel Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine covers. Allow system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.



5. Carefully pry horn button (1) out of steering wheel (2).
6. Remove horn wire (3) from back of horn button.
7. Mark steering wheel and shaft to ensure proper installation. Remove nut (4) securing the steering wheel (2) to splined steering column shaft.
8. Use a steering wheel puller to remove steering wheel (2) from splined shaft.

b. Steering Wheel Installation

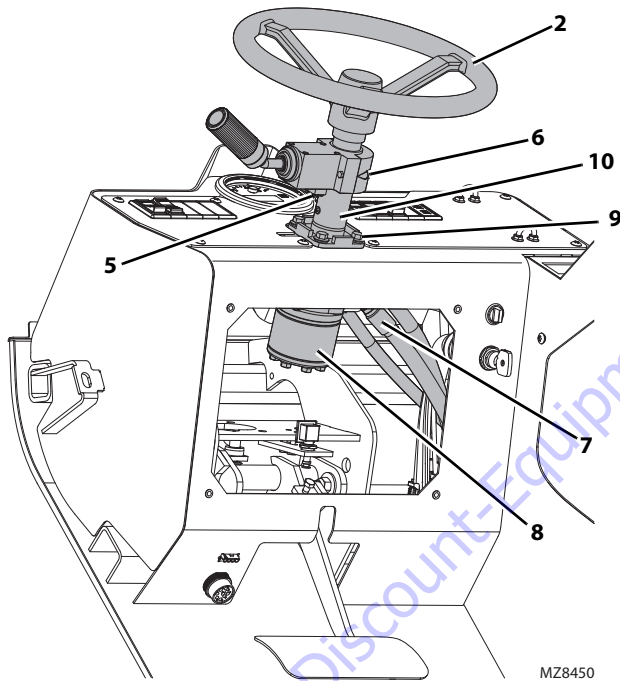
1. Install steering wheel (2) onto splined steering column shaft.
2. Secure steering wheel with nut (4). Torque as required.
3. Connect the previously remove horn connectors (3).
4. Press the horn button (1) onto steering wheel.
5. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
6. Close and secure engine covers.
7. Remove Do Not Operate Tag from ignition key switch and steering wheel.



4.3.2 Steering Column and Steering Valve

a. Steering Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Remove the lower dash panel.



6. Remove the steering wheel (2), disconnect the instrument panel harness connector (5), disconnect and remove the travel select lever (6).
7. Label, disconnect and cap the four hoses (7) from the side of the steering valve (8). Cap the fittings on the steering valve. Label, disconnect and plug the load sense hose at the front of the steering valve. Cap the fitting on the steering valve.
8. Disconnect the horn button wire from the cab wiring harness.
9. Support the bottom of the steering valve, and remove the four capscrews and lockwashers (9). Remove the steering valve (8) through the lower dash panel opening. Remove the steering column (10).

Note: *DO NOT* disassemble the steering valve. The steering valve is not serviceable and must be replaced in its entirety, if defective.

b. Steering Valve Installation

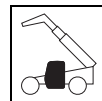
1. Install the steering column and steering valve, by inserting them through the lower dash panel opening. Position steering valve in the cab to its original orientation. Secure the steering valve and column with the previously used hardware. Torque to 13 lb-ft (18 Nm).

Note: *ALWAYS* use new o-rings when servicing the machine.

2. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
3. Uncap and connect the previously labeled load sense hose to the steering valve.
4. Install new o-rings into the steering valve fittings. Lubricate the o-rings with clean hydraulic oil.
5. Uncap and connect the remaining previously labeled four hoses to the steering valve.
6. Connect the horn button wire to the cab wiring harness.
7. Install the travel select lever, connect the instrument panel harness connector, install the steering wheel assembly. Torque the steering wheel nut to 50 lb-ft (68 Nm).
8. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
9. Remove Do Not Operate Tag from ignition key switch and steering wheel.
10. Start the engine and check the operation of steering system. Check for hydraulic fluid leaks. Check the hydraulic fluid level in the tank and add fluid as required.
11. Install the left, right and lower dash panels.
12. Close and secure the engine rear and side engine doors.

c. Steering Test

Conduct a pressure check of the steering hydraulic circuits at the main control valve. Refer to Section 8.5.1, "Pressure Checks and Adjustments".



4.3.3 Service Brake Pedal

a. Brake Valve Removal

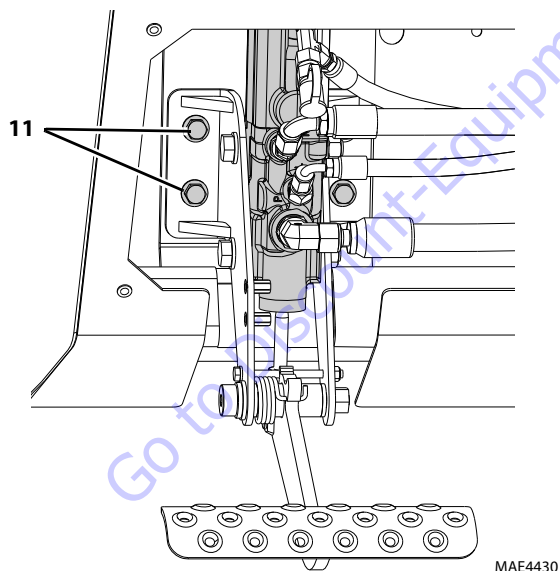
Refer to Section 8.8.2, "Service Brake Valve", for removal information.

b. Brake Valve Installation

Refer to Section 8.8.2, "Service Brake Valve", for installation information.

c. Service Brake Pedal Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Remove the lower dash panel.



6. Remove four bolts (11) securing the service brake pedal to the cab.
7. Remove the service brake pedal from the cab.

d. Service Brake Pedal Installation

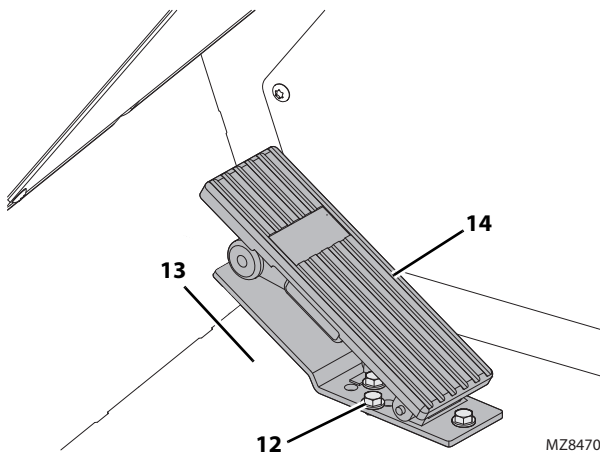
1. Position the service brake pedal in its mounting location within the cab.
2. Insert the two brake pedal pivots into mounting locations on the service brake pedal.
3. Install the service brake pedal with the previously used hardware.
4. Be sure the brake pedal has the correct range of motion. Secure pivot pin with bolt and lockwasher.
5. Adjust the service brake switch as needed.
6. Install the lower dash panel.
7. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
8. Remove Do Not Operate Tag from ignition key switch and steering wheel.
9. Close and secure the engine rear and side engine doors.



4.3.4 Throttle Pedal

a. Throttle Pedal Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.



4. Remove the bolts (12) securing the throttle pedal (14) to the cab floor (13).
5. Disconnect the electrical harness connector from the back side of the throttle pedal.
6. Remove the throttle pedal assembly from the cab.

b. Throttle Pedal Installation

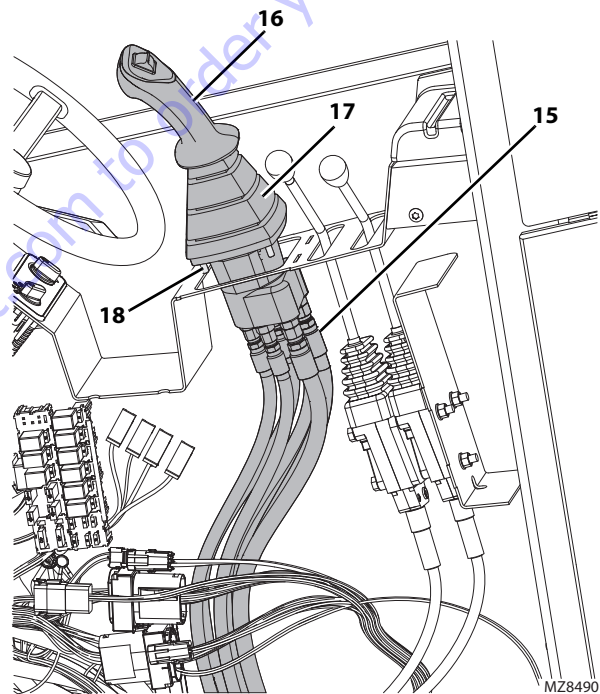
1. Position the throttle pedal in its mounting location within the cab.
2. Reconnect the wire harness plug to the backside of the throttle pedal.
3. Secure the throttle pedal in place with previously used hardware.
4. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
5. Remove Do Not Operate Tag from ignition key switch and steering wheel.

4.3.5 Joystick Assembly

These removal and installation instructions apply to the hydraulic joystick.

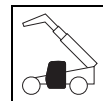
a. Joystick Assembly Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
4. Remove the console panel in the cab.



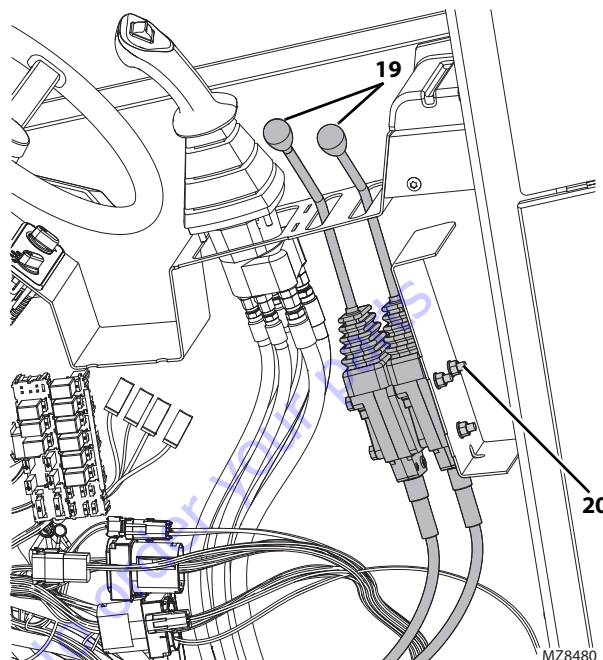
Note: Label all hydraulic hoses to ensure correct installation.

5. Label, disconnect and cap the hydraulic hoses (15) attached to joystick (16).
6. Disconnect the tilt function electrical connector.
7. Lift the joystick's rubber sleeve (17), remove the bolts (18) securing the boom joystick to the cab.
8. Remove the joystick assembly.



b. Joystick Assembly Installation

1. Secure the joystick to the cab with the previously used hardware.
2. Connect the tilt function electrical connector.
3. Uncap and connect the previously removed hydraulic hoses to the joystick.
4. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
5. Test the joystick function:
 - Move the joystick handle rearward, activating the boom lift function. The boom should RISE.
 - Move the joystick handle forward, activating the boom lower function. The boom should LOWER.
 - Move the joystick handle to the right, activating the boom extend function. The boom should EXTEND.
 - Move the joystick handle to the left, activating the boom retract function. The boom should RETRACT.
 - Move the joystick switch rearward, activating the attachment tilt function. The boom should TILT UP.
 - Move joystick switch forward, activating attachment tilt function. The boom should TILT DOWN.
6. Install console panel in the cab.
7. Remove Do Not Operate Tag from ignition key switch and steering wheel.



Note: Record the location, and label all cables to ensure correct installation.

5. Remove the knob on each control lever (19).
6. Loosen and remove the three bolts (20) securing the control levers.

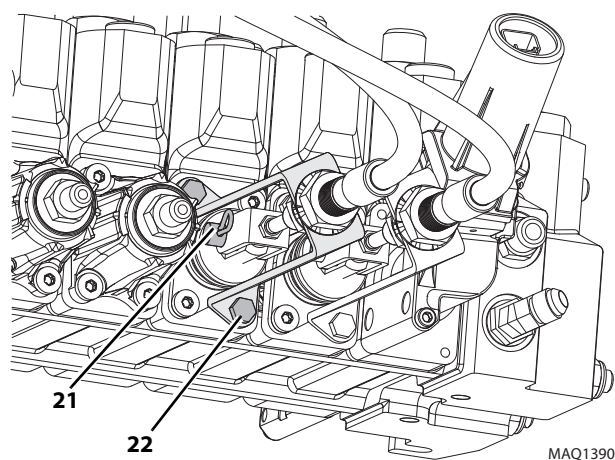
6036, 6042 - 85 hp (63 kW)

4.3.6 Auxiliary/Frame Level Lever Assemblies

These removal and installation instructions apply to the frame level and auxiliary hydraulic joysticks.

a. Lever Assembly Removal

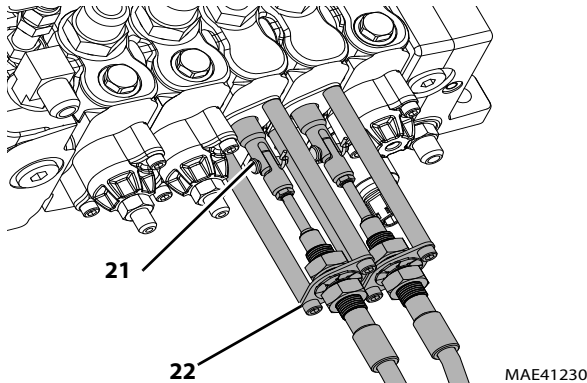
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
4. Remove the console panel in the cab.





Cab

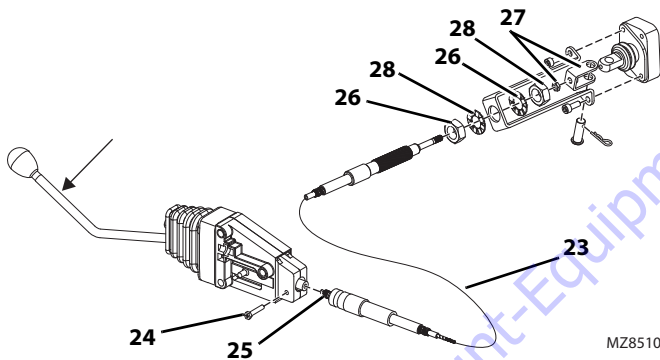
6036 (74hp), 6042 (74hp), 8042, 10042, 10054, 12054



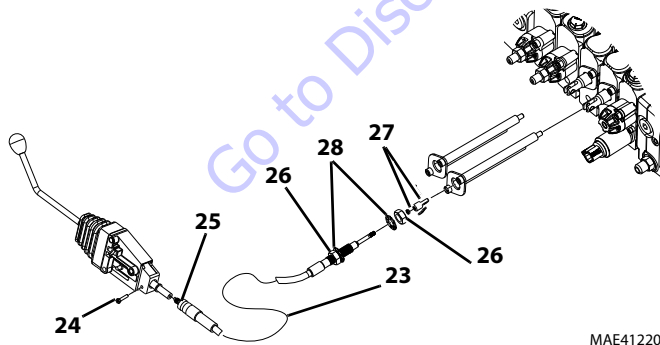
7. Remove the clip and anchor pin (21). Retain the clip and anchor pin for installation.
8. Loosen and remove the two bolts (22), and remove the control cable mount or bracket/control cable.

b. Cable Removal

6036, 6042 - 85 hp (63 kW)



6036 (74hp), 6042 (74hp), 8042, 10042, 10054, 12054



1. Disconnect control cable (23) at the lever control:
 - a. Remove the bolt (24) securing the control cable.
 - b. Push the control lever to expose the cable nut. Use a wrench on the flats to loosen the cable nut (25).
 - c. Remove the cable.

2. Mark the location of the adjusting nuts (26) on the main control valve end of the control cable.
3. Loosen lock nut (27) and remove clevis.
4. Remove adjusting nuts (26) and washers (28).

c. Cable Installation

1. Install one adjusting nut (26), and washer (28) on the control cable (23).
2. Install control cable mount (22) onto the control cable (23).
3. Install washer (28), nut (26) and lock nut (27) onto the control cable (23).
DO NOT tighten the adjusting nuts at this time.
4. Connect control cable (23) at the lever control:
 - a. Push the control lever and install the control cable.
 - b. Use a wrench on the flats to hold the slider head, and tighten the cable nut (25).
 - c. Install the bolt (24) securing the control cable.

d. Lever Assembly Installation

1. Secure the lever assembly(s) to the cab with the previously used hardware.
2. Secure the control cable(s) bracket to the main control valve with the previously removed hardware. Torque to 7.74 lb-ft (10.5 Nm).
3. Center the control levers and tighten the adjusting nuts (26) as required.
4. Install the previously removed knobs on each lever assembly.
5. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
6. Test the lever(s) function:

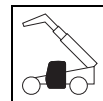
Frame Level Lever:

- Move rear lever to right, activating frame level function. The machine should move RIGHT.
- Move rear lever to left, activating frame level function. The machine should move LEFT.

Auxiliary Lever:

- Move the front lever to the right, the auxiliary attachment should LOWER/OPEN.
- Move the front lever to the left, the auxiliary attachment should RAISE/CLOSE.

7. Install console panel in the cab.
8. Remove Do Not Operate Tag from ignition key switch and steering wheel.



4.3.7 Windshield Wiper Assembly

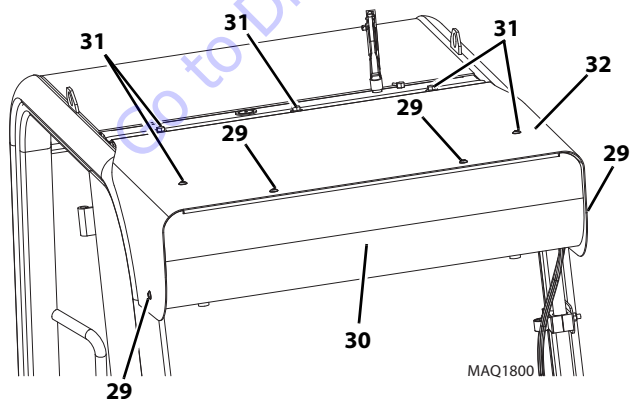
Refer to Section 9.10, "Window Wiper/Washer Windshield Wiper Motor", for removal and installation information.

4.3.8 Heater System (if equipped)

Note: If machine is equipped with air conditioning, **DO NOT** loosen or disconnect any air conditioning hoses until the air conditioning system has been properly drained by the local JLG dealer or certified air conditioning service center.

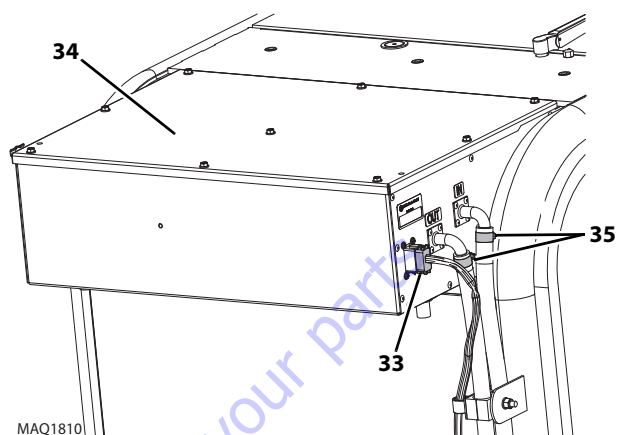
a. Cab Heater Assembly Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Place a suitable container beneath the radiator drain plug or petcock. Slowly turn the radiator cap to the first stop, and allow any pressure to escape. Remove the radiator cap.
6. Place a funnel at the base of the radiator to channel the drained coolant into the container. Loosen the drain plug or petcock and allow the coolant to drain.
7. Transfer the coolant to a container with a cover, and label as "Used Antifreeze". Dispose of the used coolant at an approved recycling facility.
8. Close the radiator drain plug or petcock.

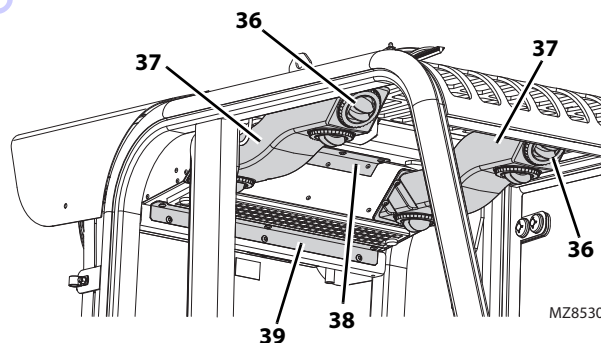


9. Loosen and remove the four bolts (29) securing the heater cover (30). Remove the heater cover.

10. Loosen and remove the five bolts (31) securing the heater hood (32). Remove the heater hood.



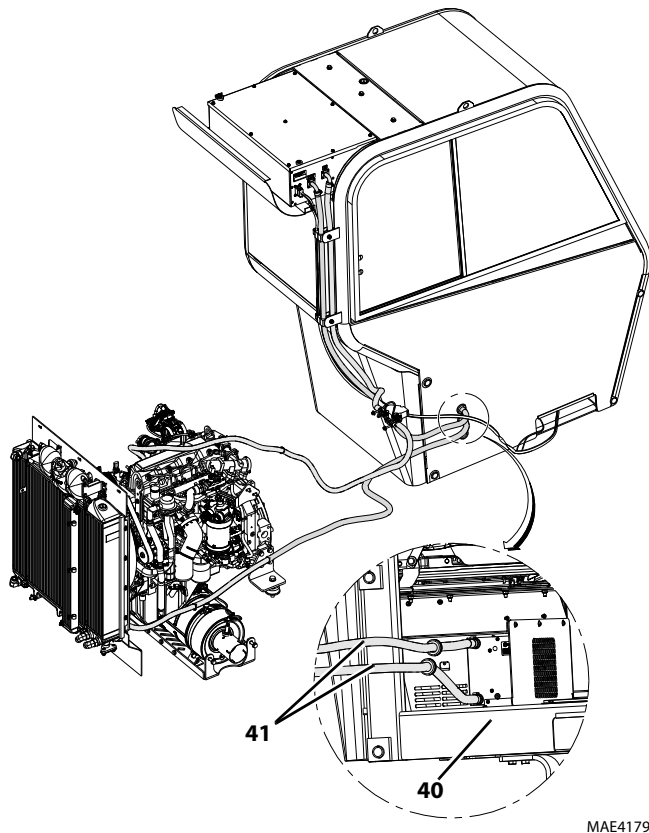
11. Disconnect the wiring harness connection (33) from the roof heater assembly (34).
12. Remove the two clamps (35) securing the heater hoses to the side of the cab.
13. Label, disconnect and cap the heater hoses. Pull the hoses away from the heater tubes.



14. Remove the left and right front air vents (36) to access and remove the duct mounting nuts.
15. Remove heater ducts (37) from heater assembly.
16. Remove brackets (38 & 39) securing heater assembly to cab.



Cab



17. Label and disconnect floor heater (40) electrical connections.
18. Label and remove hoses (41) connected to heater.
19. Remove the roof heater assembly (34).

b. Cab Heater Assembly Installation

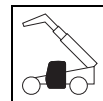
1. Install heater assembly (34) and secure with previously removed brackets (38 & 39).
2. Install heater ducts (37) to heater assembly.
3. Install previously removed left and right front air vent (36).
4. Uncap and connect the previously labeled heater hoses to the heater tubes.
5. Install the two clamps (35) securing the heater hoses to the side of the cab.
6. Connect the wiring harness connection (33) to the blower.
7. Install the heater access panel and secure with the previously used hardware.
8. Install brackets (38 & 39) securing heater assembly to cab.
9. Install heater cover (30) to heater assembly and secure with four bolts (29).
10. Fill the cooling system completely with coolant, allowing time for the coolant to fill the engine block. The cooling system capacity is listed in Section 2.3, "Fluid & Lubricant Capacities".
11. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
12. Remove Do Not Operate Tag from ignition key switch and steering wheel.
13. Start engine, run it briefly at low idle and check machine for any visual sign of fluid leakage.

Note: STOP engine immediately if any leakage is noted, and make any necessary repairs before continuing.

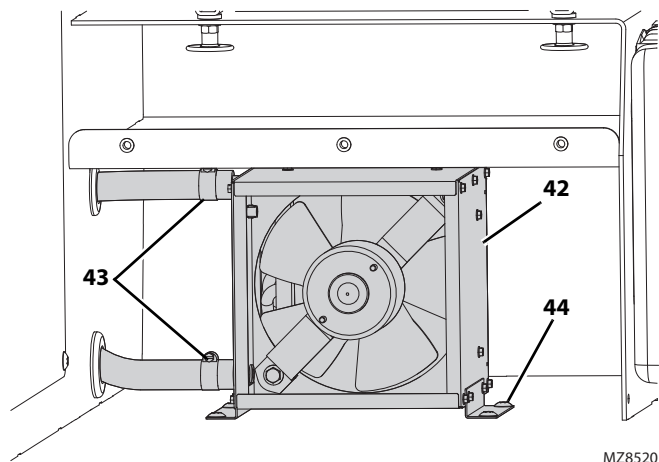
14. Wait for the engine to cool and check the coolant level. Add coolant as required to bring the coolant to the proper level.
15. Check the operation of cab heater.
16. Shut the engine OFF.

c. Under Seat Heater Assembly Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Place a suitable container beneath the radiator drain plug or petcock. Slowly turn the radiator cap to the first stop, and allow any pressure to escape. Remove the radiator cap.
6. Place a funnel at the base of the radiator to channel the drained coolant into the container. Loosen the drain plug or petcock and allow the coolant to drain.
7. Transfer the coolant to a container with a cover, and label as "Used Antifreeze". Dispose of the used coolant at an approved recycling facility.
8. Close the radiator drain plug or petcock.
9. Remove the heater access panel.



- Disconnect the wiring harness connections from the blower.



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- Label, disconnect and cap the seat heater hoses (43). Pull the hoses away from the heater tubes.
- Remove the four capscrews, nuts and lockwashers (44).
- Remove the seat heater assembly (42).

d. Under Seat Heater Assembly Installation

- Slide the seat heater assembly (42) into the seat riser, and secure with the four capscrews, lockwashers and nuts (44).
- Connect the wiring harness connections to the seat heater assembly (42).
- Uncap and connect the previously labeled hoses (43) to the heater tubes.
- Install the heater access panel and secure with the previously used hardware.
- Fill the cooling system completely with coolant, allowing time for the coolant to fill the engine block. The cooling system capacity is listed in Section 2.3, "Fluid & Lubricant Capacities".
- Remove Do Not Operate Tag from ignition key switch and steering wheel.
- Start engine, run it briefly at low idle and check machine for any visual sign of fluid leakage.

Note: STOP engine immediately if any leakage is noted, and make any necessary repairs before continuing.

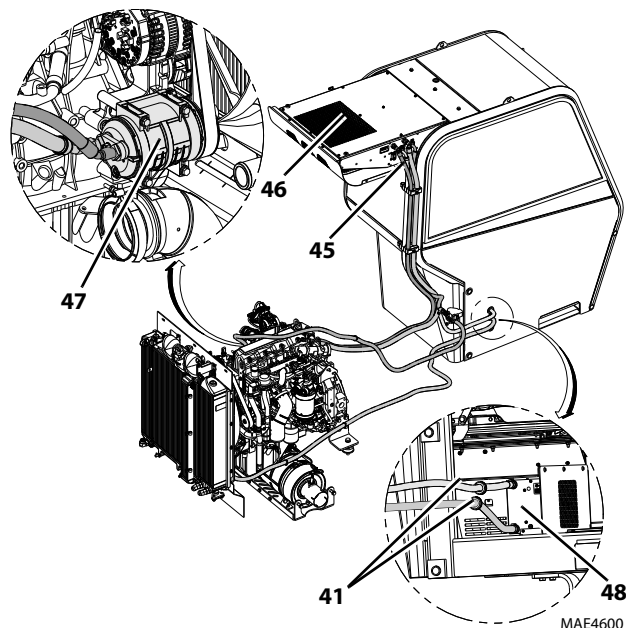
- Wait for the engine to cool and check the coolant level. Add coolant as required to bring the coolant to the proper level.
- Check the operation of cab heater.
- Shut the engine OFF.

4.3.9 Heater and A/C System (if equipped)

a. Removal

- Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission in (N) NEUTRAL, engage park brake and shut engine OFF.
- Place a Do Not Operate Tag on both ignition key switch and steering wheel.
- Open engine covers. Allow system fluids to cool.
- Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
- Place a suitable container beneath radiator. Slowly turn surge tank cap and allow any pressure to escape. Remove surge tank cap.
- Place a funnel at base of radiator to channel drained coolant into container. Remove drain plug and allow coolant to drain.
- Transfer coolant to a container with a cover, and label as "Used Coolant". Dispose of used coolant at an approved recycling facility.
- Tighten radiator drain plug.
- Drain the refrigerant from the air conditioning system.

Note: The local JLG dealer or certified air conditioning service center or personnel to perform the refrigerant removal from the system.



MAE4600

- Label and disconnect hoses (45) attached to the condenser assembly (46).
- Label and disconnect all electrical connections attached to the condenser assembly (46).



Cab

12. Remove bolts securing the condenser assembly (46) to cab roof. Remove condenser assembly from rear of the cab roof.
13. Label and disconnect all electrical connections attached to the heater and air conditioning assembly (48).
14. Label and remove hoses (41) connected to the heater and air conditioning assembly (48).
15. Label and disconnect air conditioning hoses attached to heater assembly.
16. Remove bolts securing heater assembly to cab. Remove heater assembly.
17. Label and disconnect air conditioning hoses attached to compressor (47).
18. Remove hardware securing compressor to engine. Remove compressor (47).

b. Installation

1. Install cab condenser assembly (46) to cab roof. Secure with previously removed hardware.
2. Connect previously labeled electrical connections to the condenser assembly (46).
3. Connect previously labeled hoses (41) to condenser assembly (46).
4. Position heater and air conditioning assembly (48) to original orientation to cab. Secure with previously removed hardware.
5. Connect previously labeled electrical connections to heater and air conditioning assembly.
6. Connect previously labeled heater hoses to appropriate locations.
7. Connect previously labeled air conditioning hoses to appropriate locations.
8. Connect previously labeled air conditioning hoses attached to compressor (47).
9. Install compressor (47) to engine.
10. Fill cooling system completely with coolant, allowing time for the coolant to fill the engine block. The cooling system capacity is listed in Section 2.3, "Fluid and Lubricant Capacities".
11. Fill air conditioning system completely with refrigerant. Refer Section 2.3, "Fluid and Lubricant Capacities", for refrigerant type and capacity.

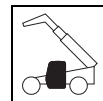
Note: Ensure that the petcock is closed for vehicle equipped with a cab heater, when one liter of coolant is drained from system and all air is purged.

Note: The local JLG dealer or certified air conditioning service center or personnel to perform the refrigerant installation to the system.

12. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
13. Start engine, run it briefly at low idle and check machine for any visual sign of fluid leakage.

Note: STOP engine immediately if any leakage is noted, and make any necessary repairs before continuing.

14. Wait for engine to cool and check coolant level. Add coolant as required to bring coolant to proper level.
15. Wait for engine to cool and check coolant level. Add coolant as required to bring coolant to proper level.
16. Check the operation of cab heater and A/C.
17. Shut the engine OFF.
18. Close and secure the engine cover.
19. Remove Do Not Operate Tag from ignition key switch and steering wheel.



4.4 CAB REMOVAL

! WARNING

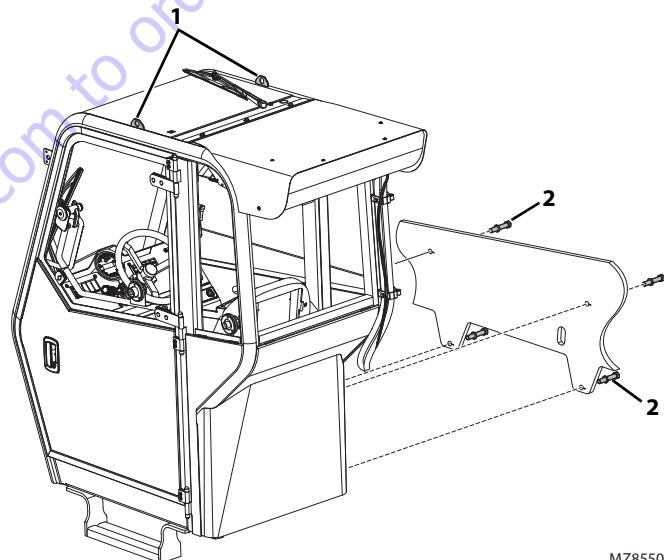
The protection offered by this ROPS/FOPS will be impaired if subjected to any modification or structural damage, at which time replacement is necessary. ROPS/FOPS must be properly installed using fasteners of correct size and grade, and torqued to their specified value.

Note: To help ensure safety and optimum performance, replace the cab if it is damaged. Refer to the appropriate parts manual for ordering information.

Inspect the cab, its welds and mounts. If modification, damage, a cracked weld and/or fatigued metal is discovered, replace the cab. Contact the local **JLG** dealer with any questions about the suitability or condition of a cab.

Note: Remove and label cab components as needed before removing the cab from the machine. Label, disconnect and cap hydraulic hoses. Transfer cab parts to the replacement cab after the replacement cab is securely mounted on the machine.

1. Park the machine on a firm, level surface. Allow sufficient overhead and side clearance for cab removal. Level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Block all four wheels to help prevent the machine from moving. Assure that there is sufficient overhead and side clearance for cab removal.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Place a suitable container beneath the radiator drain plug or petcock. Slowly turn the radiator cap to the first stop and allow any pressure to escape. Remove the radiator cap.
6. Place a funnel at the base of the radiator to channel the drained coolant into the container. Loosen the drain plug or petcock and allow the coolant to drain.
7. Transfer the coolant to a container with a cover, and label as "Used Antifreeze". Dispose of the used coolant at an approved recycling facility.
8. Close the radiator drain plug or petcock.
9. Remove the transmission covers.
10. Remove the heater access panel. If equipped, Label, disconnect and cap the cab heater hoses. Refer to Section 4.3.8, "Heater System (if equipped)".
11. Remove the console panel in the cab.
12. Label and disconnect the electrical connections. Push the connectors through the opening at the bottom of the cab.
13. Remove the frame level and auxiliary lever assemblies from the main control valve. Refer to Section 4.3.6, "Auxiliary/Frame Level Lever Assemblies".
14. Label, disconnect and cap all hydraulic hoses. Refer to Section 4.3.5, "Joystick Assembly". Cap all fittings to keep dirt and debris from entering the hydraulic system. Push the hoses through the opening at the bottom of the cab.
15. If necessary, remove mirrors and other cab components that may become damaged during cab removal.



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16. Attach a clevis to each of the cab lifting brackets (1). Route a sling with a minimum lifting capacity of 1000 lb (453 kg) to a hoist or overhead crane. Center the sling to ensure even lifting.
17. Remove the two upper cab-to-frame capscrews and two flat washers (2).
18. Remove the two lower cab-to-frame capscrews and two flat washers (2).
19. Carefully begin to lift the cab. Stop and check that all wiring, hydraulic hoses and fasteners are disconnected and removed.

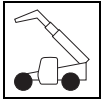


Cab

20. When all wiring, hydraulic hoses and fasteners are disconnected or removed, carefully and slowly lift the cab and remove it from the frame. Readjust the position of the sling as needed to help balance the cab during removal.
21. When the cab is completely clear of the machine, carefully lower it to the ground. Block up or support the cab so that it does not move or fall. Assure that no personnel enter the cab while it is being removed from the machine.
22. Inspect the condition of the fittings, clamps, hydraulic hoses, etc. Replace parts as indicated by their condition.
23. Inspect and replace other machine parts that are exposed with the cab removed. Repair or replace as required.

4.5 CAB INSTALLATION

1. Block all four wheels to help prevent the machine from moving. Assure that there is sufficient overhead and side clearance for cab installation.
 2. Attach a clevis to each of the cab lifting brackets. Route a sling with a minimum lifting capacity of 1000 lb (453 kg) to carry the weight of the cab through the clevis' to a hoist or over head crane. Make sure the sling is centered between the clevis' to ensure even lifting.
 3. Carefully begin to align the cab with the mounting holes in the frame. Stop and check that wiring, hydraulic hoses, cables, etc. will not be pinched or damaged as the cab is positioned. Readjust the position of the sling as needed to help balance the cab during installation.
 4. Install the two upper cab-to-frame capscrews and washers. Torque to 480 lb-ft (651 Nm).
 5. Install the two lower cab-to-frame capscrews and washers. Torque to 480 lb-ft (651 Nm).
 6. Push the hoses through the opening at the bottom of the cab. Uncap and connect the previously labeled hydraulic hoses. Refer to Section 4.3.5, "Joystick Assembly".
 7. Install the frame level and auxiliary lever assemblies from the main control valve. Refer to Section 4.3.6, "Auxiliary/Frame Level Lever Assemblies".
 8. Route the wiring harness connectors through the opening at the bottom of the cab. Connect the previously labeled connectors.
 9. If equipped, install the cab heater hoses. Refer to Section 4.3.8, "Heater System (if equipped)".
 10. Install the heater access panel.
 11. Install the console panel.
 12. Install the transmission covers.
 13. Fill the cooling system completely with coolant, allowing time for the coolant to fill the engine block. The cooling system capacity is listed in Section 2.3, "Fluid Specifications".
 14. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
 15. Carefully examine all cab components, fasteners, etc., one last time before engine start-up. Rectify any faulty conditions.
 16. Start the engine and check the operation of all controls. Check for hydraulic fluid leaks. Check the hydraulic fluid level in the tank and add fluid as required.
- Note:** When the engine is initially started, run it briefly at low idle and check the machine for any visual sign of fluid leakage. STOP the engine immediately if any leakage is noted, and make any necessary repairs before continuing.
17. Wait for the engine to cool and check the coolant level. Add coolant to the overflow bottle as required to bring the coolant to the proper level.
 18. Install the mirrors and all other cab components as needed, if removed.
 19. Unblock the wheels.
 20. Close and secure the engine rear and side engine doors.



Section 5

Axles, Drive Shafts, Wheels and Tires

Contents

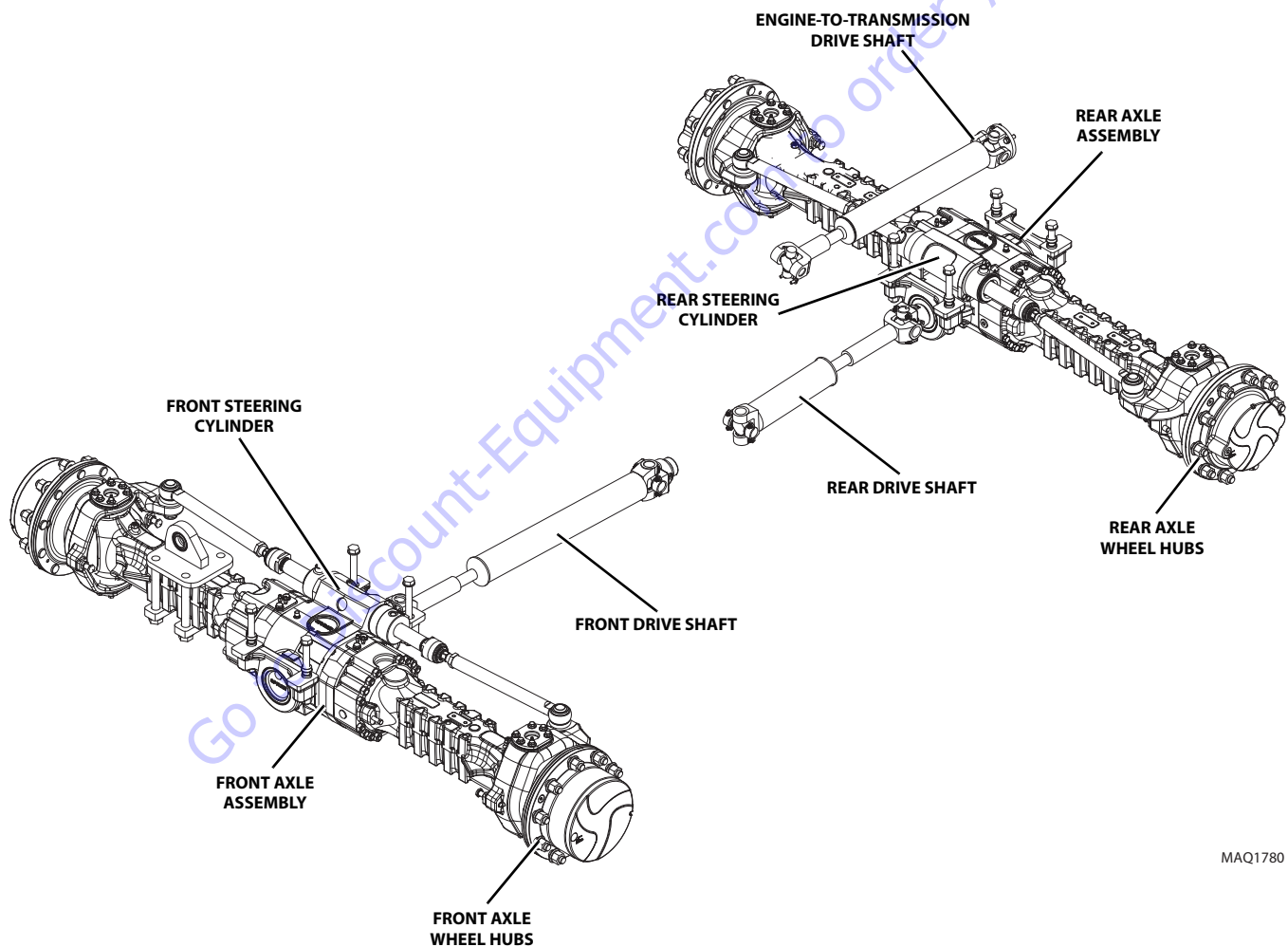
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5.1 AXLE, DRIVE SHAFT AND WHEEL COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the axles, drive shafts, wheels and tires. The following illustration identifies the components that are referred to throughout this section.

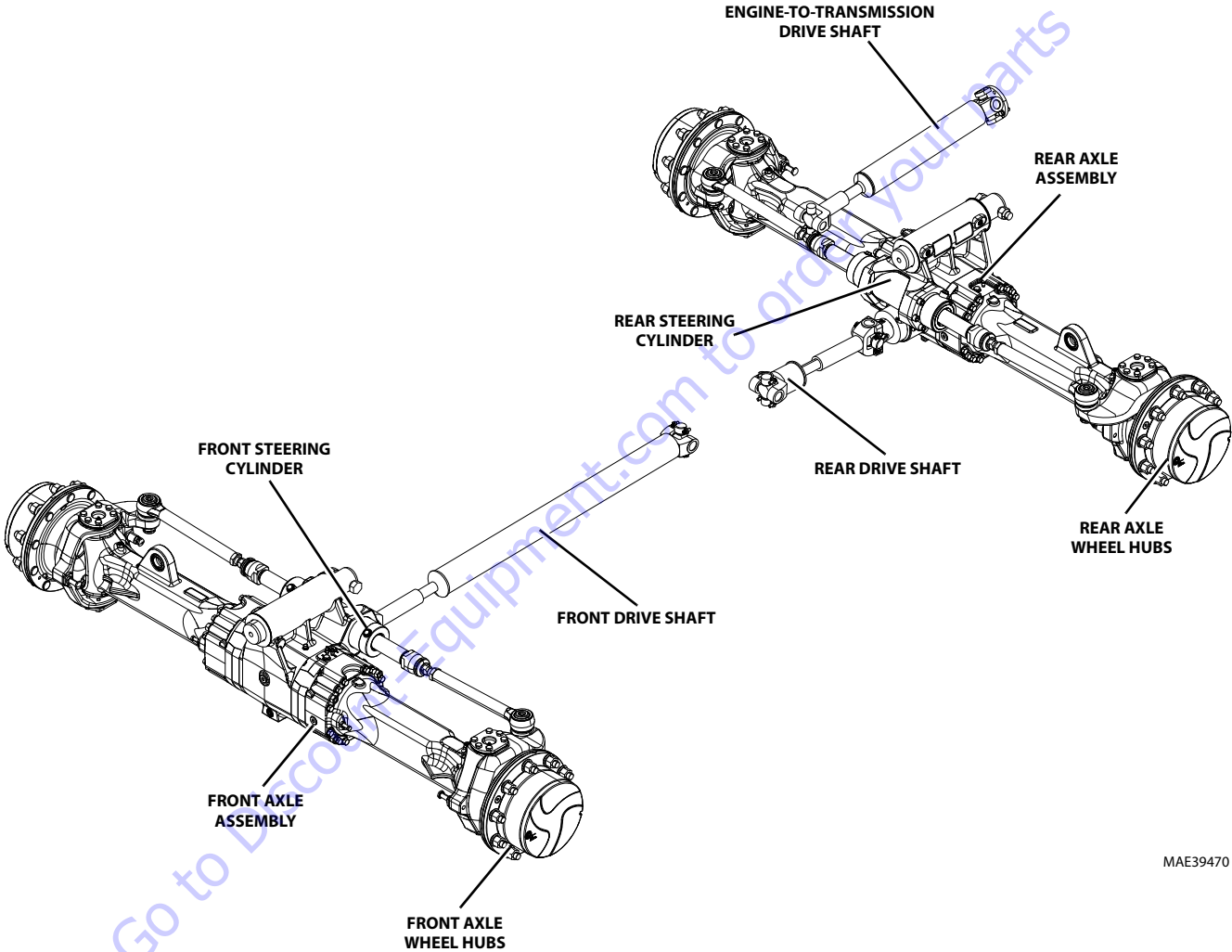
5.1.1 6036 & 6042



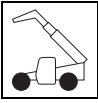
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5.1.2 8042

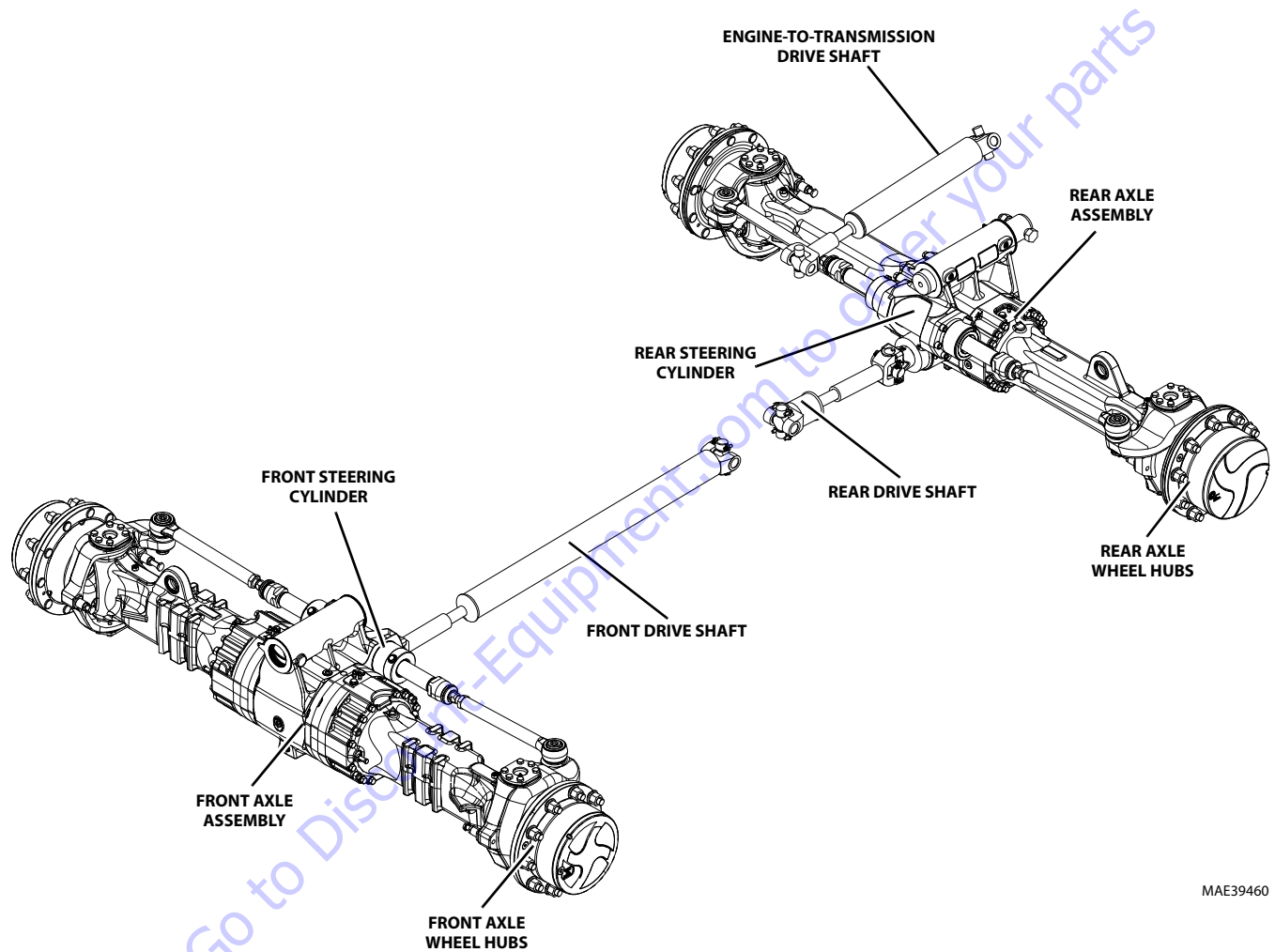


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Axles, Drive Shafts, Wheels and Tires

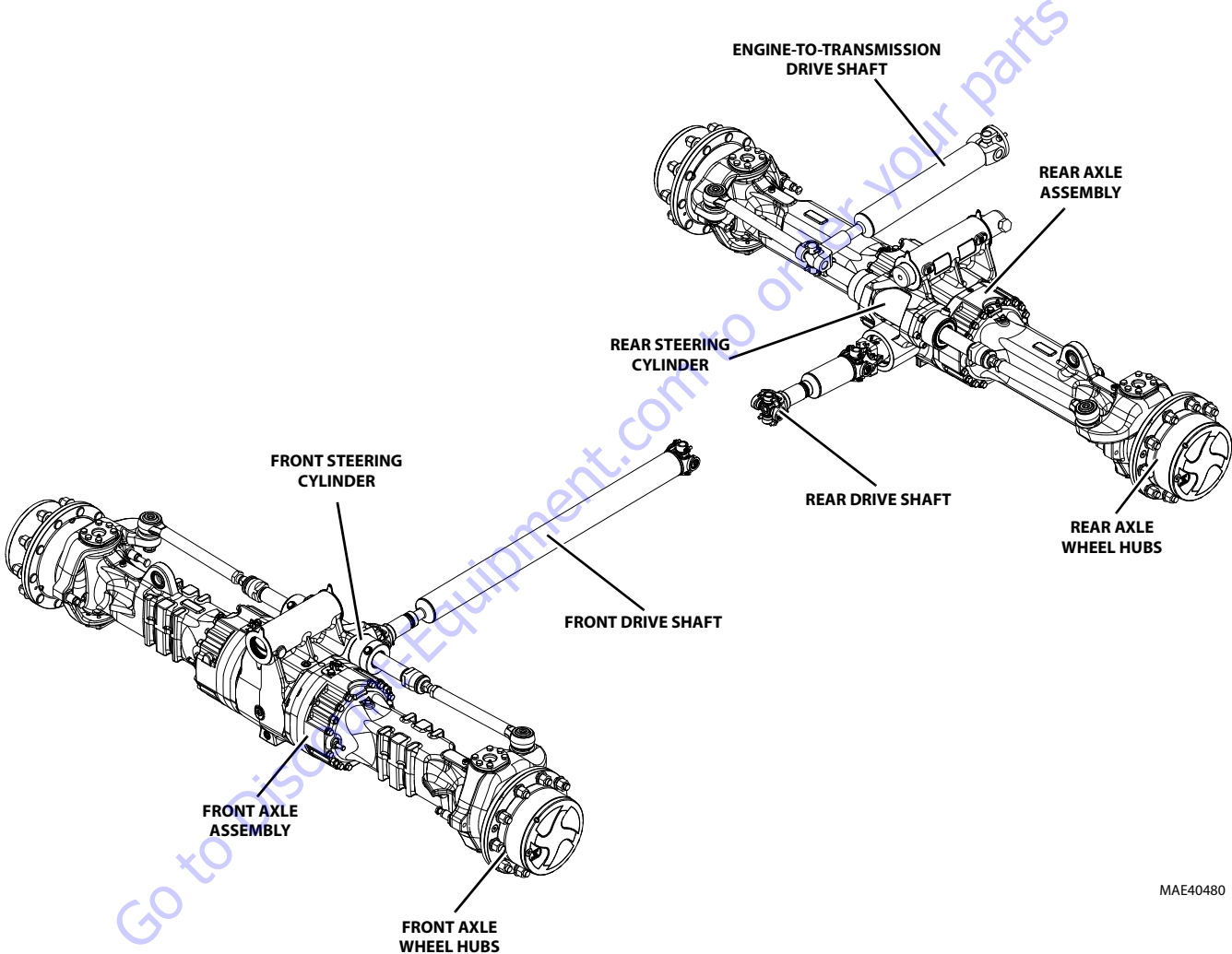
5.1.3 10042 & 10054



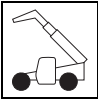
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5.1.4 12054



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5.2 GENERAL INFORMATION

! WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, "Safety Practices", of this manual.

Note: To help ensure optimum performance, the drive shaft assemblies are specially balanced as a unit at the factory. When servicing any flange yoke, slip yoke or drive shaft tube, order a complete assembly if components are bent or damaged. Refer to the appropriate parts manual for ordering information.

Before performing any inspection, maintenance or service operation, thoroughly clean the unit. The axles and drive shafts should be checked and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

Use suitable products to thoroughly clean all disassembled mechanical parts to help prevent personal injury to the worker and prevent damage to the parts. Carefully inspect the integrity of all moving parts (bearings, yokes, tubes, gears, shafts, etc.) and fasteners (nuts, bolts, washers, etc.) as they are subject to major stress and wear. Always replace any damaged, worn, cracked, seized or otherwise improper parts that could affect the safe and proper functioning of the machine, axles and drive shafts.

5.3 AXLE ASSEMBLIES

5.3.1 Axle Serial Number Plate

The front axle serial number plate is located on a mounting pad on the inboard portion of the right beam trumpet. The rear axle serial number plate is located on a mounting pad on the inboard portion of the left trumpet. Information on the serial number plate is required in correspondence regarding the axle.

Supply information from the axle serial number plate when communicating about an axle assembly or axle components.

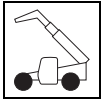
5.3.2 Axle Specifications

General axle specifications are found in Section 2.3, "Fluid & Lubricant Capacities".

5.3.3 Axle Internal Service

Detailed axle service instructions (covering the axle, differential, brakes and wheel-end safety, repair, disassembly, reassembly, adjustment and troubleshooting information) are provided in the appropriate Axle Repair Manual.

Machine	Manufacturer Model	Axle	PN
6036, 6042	212/A02	Front	31200162
	212/A03	Rear	
8042 - If Equipped with 100 hp (82 kW)	212HY/B03	Front	
	212HY/B04	Rear	
8042 - If Equipped with 74 hp (55 kW)	212HY/10057980	Front	
	212HY/10057981	Rear	
10042, 10054 - If Equipped with 100 hp (82 kW)	223/145	Front	31200239
	212HY/B07	Rear	31200162
10042, 10054 - If Equipped with 74 hp (55 kW)	223/10057982	Front	31200239
	212HY/10057983	Rear	31200162
12054	223/10057982	Front	31200239
	223/10102783	Rear	



5.3.4 Axle Maintenance

CLEANING: Clean parts with machined or ground surfaces (such as gears, bearings and shafts) with emulsion cleaners or petroleum-based cleaners. **DO NOT** steam clean internal components and the interior of the planetary hub and axle housing. Water can cause corrosion of critical parts. Rust contamination in the lubricant can cause gear and bearing failure. Remove old gasket material from all surfaces.

DRYING: Use clean, lintless towels to dry components after cleaning. **DO NOT** dry bearings by spinning them with compressed air; this can damage mating surfaces due to lack of lubrication. After drying, lightly coat components with oil or a rust-preventive chemical to help protect them from corrosion. If storing components for a prolonged period, wrap them in wax paper.

PERIODIC OPERATION REQUIREMENT: Every two weeks, drive the machine far enough to cause the drive-train components to make several complete revolutions. This will help ensure that internal components receive lubrication to minimize deterioration caused by environmental factors such as high humidity.

SUBMERSION: If the machine has been exposed to water deep enough to cover the hubs, disassemble the wheel ends and inspect for water damage and contamination. If the carrier housing was submerged in water, especially if the water level was above the vent tube (breather), drain the axle and inspect internal parts for water damage and contamination. Before assembling and refilling the unit with the specified lubricant(s), clean, examine and replace damaged parts as necessary.

Note: Use a suitable puller for bearing removal. Clean, inspect and lubricate all bearings just prior to reassembly. If replacement of a damaged bearing cup or cone is necessary, replace the cup and cone as a set.

5.3.5 Axle Replacement (6036 & 6042)

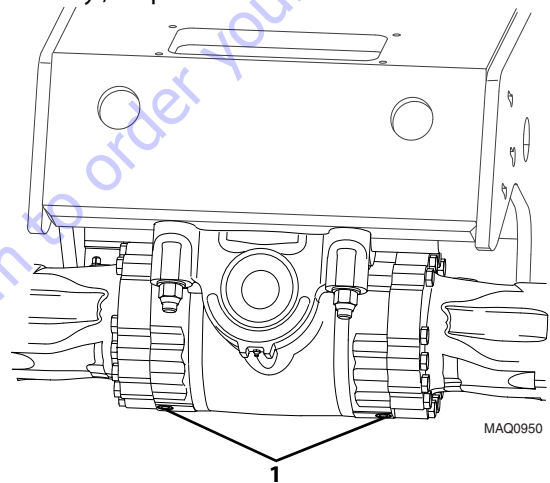
a. Axle Removal

The front and rear axle assemblies differ in that the front axle assembly is equipped with a parking brake mechanism and a limited-slip feature; the rear axle has neither. The following steps outline a typical axle removal procedure, suitable for either the front or the rear axle assembly.

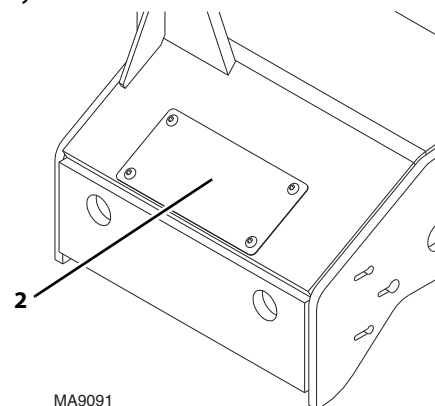
Cleanliness is extremely important. Before attempting to remove the axle, thoroughly clean the machine. Avoid spraying water or cleaning solution on the stabilizer solenoids and other electrical components. If using a steam cleaner, seal all openings before steam cleaning.

Note: Clear the work area of all debris, unnecessary personnel, etc. Allow sufficient space to raise the machine and to remove the axle.

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the parking brake, straighten all wheels and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.



5. If the axle will be disassembled after removal, place a suitable receptacle under the axle drain plug (1). Remove the drain plug and allow the axle oil to drain into the receptacle. Transfer the used axle oil into a suitable covered container, and label the container as "Used Oil". Dispose of used oil at an approved recycling facility.





Axles, Drive Shafts, Wheels and Tires

6. **Front Axle:** Remove the front access panel (2) to gain access to top of the front axle.

Rear Axle: Open the right and left side engine compartment doors to gain access to the rear hose connections and mounting bolts.

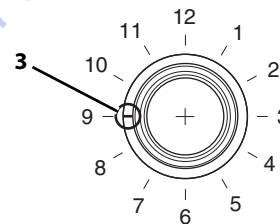
7. Label, disconnect and cap the steering and brake lines at the axle. Cap all fittings to prevent dirt and debris from entering the hydraulic system. Wipe up any spilled oil.
8. Block the front and rear of both tires on the axle that is not being removed. Ensure that the machine will remain in place during axle removal before proceeding.
9. Raise the machine using a suitable jack or hoist. Place suitable supports under both sides of the frame and lower the machine onto the supports. Ensure that the machine will remain in place during axle removal.
10. Support the axle that is being removed with a suitable jack, hoist or overhead crane and sling. **DO NOT** raise the axle or the machine.
11. Remove both wheel and tire assemblies from the axle that is being removed. Refer to Section 5.6.1, "Removing Wheel and Tire Assembly from Machine".

Note: The wheel and tire assemblies must be re-installed later with the directional tread pattern "arrows" facing in the direction of forward travel.

12. Remove the drive shaft assembly. Refer to Section 5.5.2, "Drive Shaft Removal".
13. Remove the capscrew and locknut securing the lower position cylinder-mount pin to the cylinder. Tap the cylinder mount pin out, and move the cylinder to prevent it from interfering with axle removal.
14. Remove the capscrews securing the axle supports to the machine frame.
15. Remove the axles from the machine using the jack, hoist or overhead crane and sling supporting the axle.
DO NOT raise or otherwise disturb the machine while removing the axle. Balance the axle and prevent it from tipping, turning or falling while removing it from beneath the machine. Place the axle on a suitable support or holding stand.

b. Axle Installation

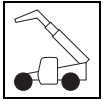
1. Before proceeding, ensure that the machine will remain in place during axle installation. Block the front and rear of both tires on the axle that is already installed on the machine.
2. If applicable, raise the machine using a suitable jack or hoist. Place suitable supports beneath the frame and lower the machine onto the supports, allowing enough room for axle installation. Ensure that the machine will remain in place during axle installation.
3. Using a suitable jack, hoist or overhead crane and sling, remove the axle from its support or holding stand. Balance the axle and prevent it from tipping, turning or falling while positioning it beneath the machine.
DO NOT raise or otherwise disturb the machine while installing the axle. Keep the axle supported and balanced on the jack, hoist or overhead crane and sling throughout the installation procedure.
4. Install the capscrews securing the axle to the frame. Torque to 500 - 560 lb-ft (678 - 759 Nm).



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Note: If new frame level (front) or stabilizer (rear) cylinder bearings (3) have been installed in the axles or machine frame, the fracture in the bearing race must be positioned at the 9 o'clock position as shown above.

5. Move the cylinder into position on the axle cylinder anchor. Insert a cylinder-mount pin through the cylinder and cylinder anchor. Secure the cylinder-mount pin with one capscrew and new locknut.
6. Apply multi-purpose grease through the self-tapping lube fitting to lubricate the self-align bearing and the cylinder-mount pin.
7. Install the drive shaft assemblies. Refer to Section 5.5.3, "Drive Shaft Installation".
8. If reinstalling an axle previously removed from the machine, position the driveshaft yoke on the axle according to the alignment marks made earlier. If installing a new axle, note the position of the driveshaft yoke at the transmission. Align the driveshaft yoke on the axle in the same plane as the yoke on the transmission.



9. Install the wheel and tire assemblies. Refer to Section 5.6.2, "Installing Wheel and Tire Assembly onto Machine".
10. Carefully remove the jack, hoist or overhead crane and sling supporting the axle.
11. Carefully raise the machine using a suitable jack or hoist. Remove the supports from beneath the frame and lower the machine to the ground.
12. Remove the blocks from the front and rear of both tires on the other axle.

Note: ALWAYS use new o-rings when servicing the machine.

13. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
14. Uncap and connect the steering and brake lines at their axle fittings.
15. Check the hydraulic reservoir oil level.
16. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
17. Remove Do Not Operate Tag from ignition key switch and steering wheel.
18. Start the engine. Turn the steering wheel several times lock to lock, operate the frame tilt function several times in both directions and check the function of the brakes. Check for hydraulic leaks, and tighten or repair as necessary.
19. **Front Axle:** Install the front access panel.
20. Close and secure the engine rear and side engine doors.

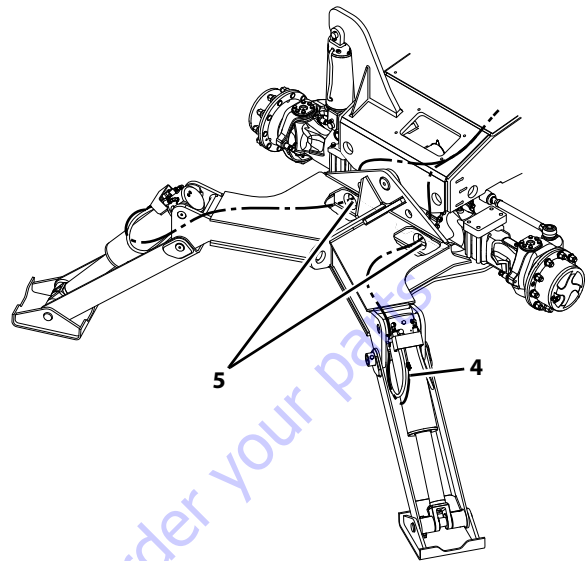
Note: The service brake circuit will need to be bled after axle installation. Refer to Section 8.8.4, "Brake Bleeding".

5.3.6 Axle Replacement (8042, 10042, 10054 & 12054)

a. Outrigger Removal (10042, 10054 & 12054 only)

On Models 10042, 10054 & 12054 equipped with outriggers, it is necessary to remove the outrigger assembly before removing the front axle.

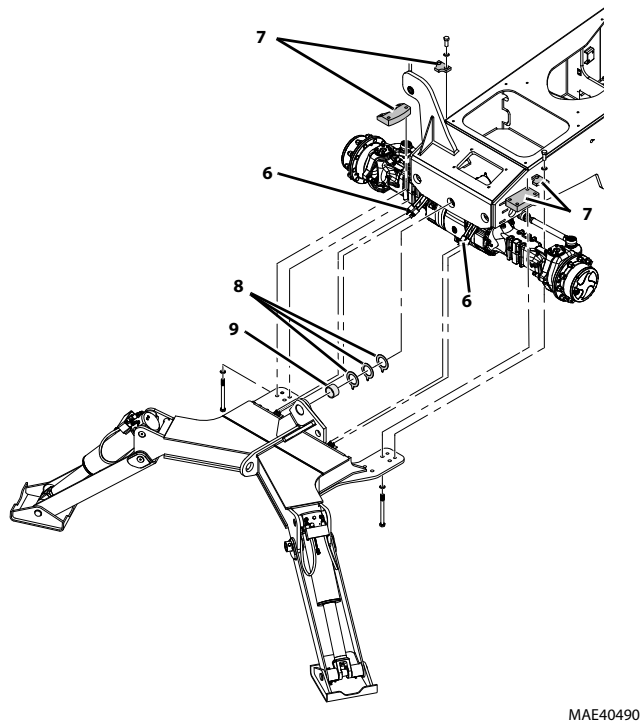
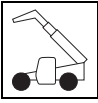
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the parking brake, straighten all wheels and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.



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Note: Steps 5 thru 7 apply to 10054 & 12054 Only.

5. Label and disconnect the wiring harness connectors at both outrigger cylinder pressure switches (4). Remove the wire ties securing the wiring harness to the outrigger cylinders.
6. Tie a length of string to each pressure switch wiring connector, and pull harness out through openings (5) at rear of outrigger housing.
7. Untie strings from wiring connectors and tape, or otherwise secure ends of strings to outrigger housing. These strings will be used to pull harness through housing during installation.



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8. Label, disconnect and cap the outrigger hydraulic hoses (6). Cap all fittings to keep dirt and debris from entering the hydraulic system.
 9. Support the outrigger assembly using a suitable jack, hoist or overhead crane.
 10. Remove the capscrews, hex nuts, flat washers and mount plates (7).
- Note:** Record the number and thickness of shims to ensure correct installation.
11. Remove the outrigger assembly using a suitable jack, hoist or overhead crane. Remove the shims (8) from the pivot pin.
 12. Move the outrigger assembly away from the machine and carefully lower it to the ground. Block up or support the assembly so that it does not move or fall.
 13. Inspect the pivot bearing (9). Replace the bearing if worn or damaged.

b. Outrigger Installation

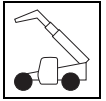
1. Using a suitable jack, hoist or overhead crane and sling, remove the outrigger assembly from its supports. Balance the assembly and prevent it from tipping, turning or falling while positioning it on the machine. **DO NOT** raise or otherwise disturb the machine while installing the outrigger assembly. Keep the assembly supported and balanced during the installation procedure.
2. Place the same number and thickness of shims (8) on the pivot pin, as recorded during removal.
3. Position the outrigger assembly onto the machine, aligning the hole in the assembly on the axle pivot pin and the mounting plate under the axle flanges.
4. Install the two mount plates (7) onto the top of the axle and secure with the previously used hardware.

Note: ALWAYS use new o-rings when servicing the machine.

5. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
6. Uncap and connect the previously labeled hydraulic hoses (6) to their appropriate locations.

Note: Steps 7 thru 8 apply to 10054 & 12054 Only.

7. Tie the strings left in the outrigger housing during removal to each pressure switch wiring connector, and pull the harness through the outrigger housing.
8. Connect the wiring connectors to the outrigger cylinder pressure switches. Secure the harnesses to the cylinders with wire ties.
9. Check the hydraulic reservoir oil level.
10. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
11. Remove Do Not Operate Tag from ignition key switch and steering wheel.
12. Start the engine. Turn the steering wheel several times lock to lock, operate the frame tilt function several times in both directions and check the function of the brakes. Check for hydraulic leaks, and tighten or repair as necessary.



c. Axle Removal

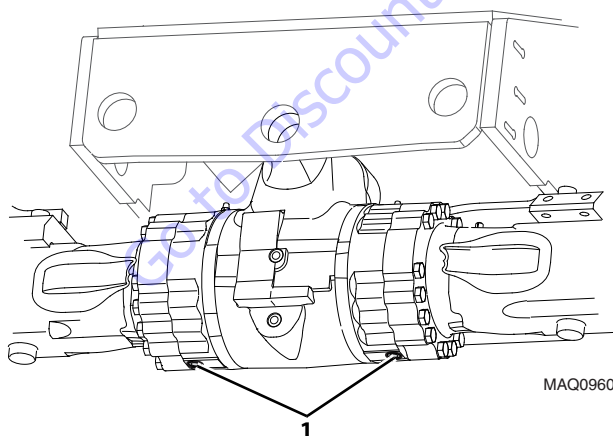
The front and rear axle assemblies differ in that the front axle assembly is equipped with a parking brake mechanism and a limited-slip feature; the rear axle has neither. The following steps outline a typical axle removal procedure, suitable for either the front or the rear axle assembly.

Cleanliness is extremely important. Before attempting to remove the axle, thoroughly clean the machine. Avoid spraying water or cleaning solution on the stabilizer solenoids and other electrical components. If using a steam cleaner, seal all openings before steam cleaning.

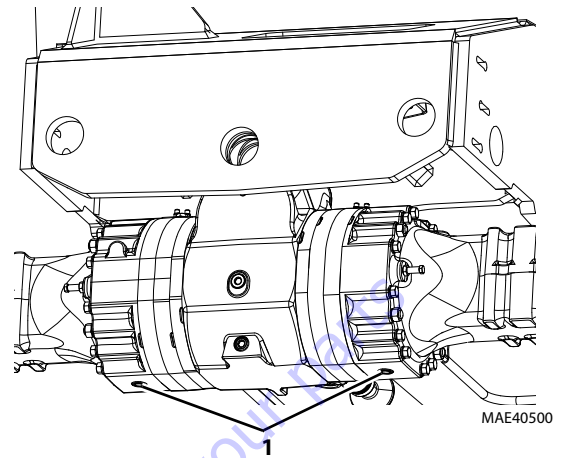
Note: Clear the work area of all debris, unnecessary personnel, etc. Allow sufficient space to raise the machine and to remove the axle.

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the parking brake, straighten all wheels and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Remove the fender assembly (if equipped).
6. Models 10042, 10054 and 12054 Front Axle Only: Remove outrigger assembly. Refer to Section 5.3.6, a. "Outrigger Removal (10042, 10054 & 12054 only)"

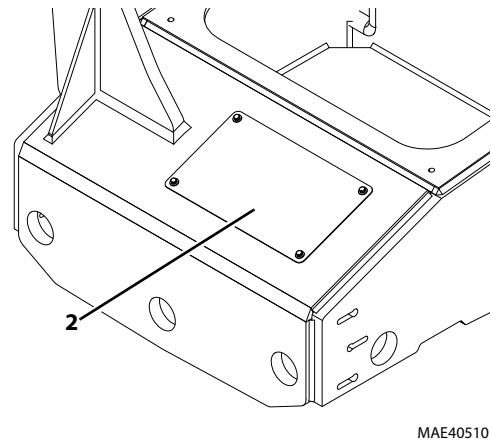
8042, 10042, 10054



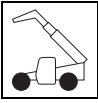
12054



7. If axle will be disassembled after removal, place a suitable receptacle under axle drain plugs (1). Remove drain plugs and allow axle oil to drain into receptacle. Transfer used axle oil into a suitable covered container, and label container as "Used Oil". Dispose of used oil at an approved recycling facility.



8. **Front Axle:** Remove the front access panel (2) to gain access to top of the front axle.
9. Label, disconnect and cap the steering and brake lines at the axle. Cap all fittings to prevent dirt and debris from entering the hydraulic system. Wipe up any spilled oil.
10. Block the front and rear of both tires on the axle that is not being removed. Ensure that the machine will remain in place during axle removal before proceeding.
11. Raise the machine using a suitable jack or hoist. Place suitable supports under both sides of the frame and lower the machine onto the supports. Ensure that the machine will remain in place during axle removal.



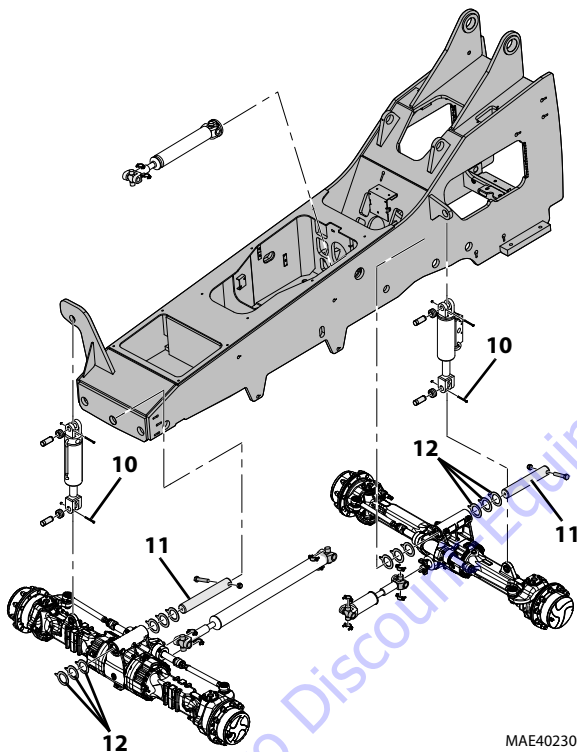
Axles, Drive Shafts, Wheels and Tires

12. Support the axle that is being removed with a suitable jack, hoist or overhead crane and sling. **DO NOT** raise the axle or the machine.
13. Remove both wheel and tire assemblies from the axle that is being removed. Refer to Section 5.6.1, "Removing Wheel and Tire Assembly from Machine".

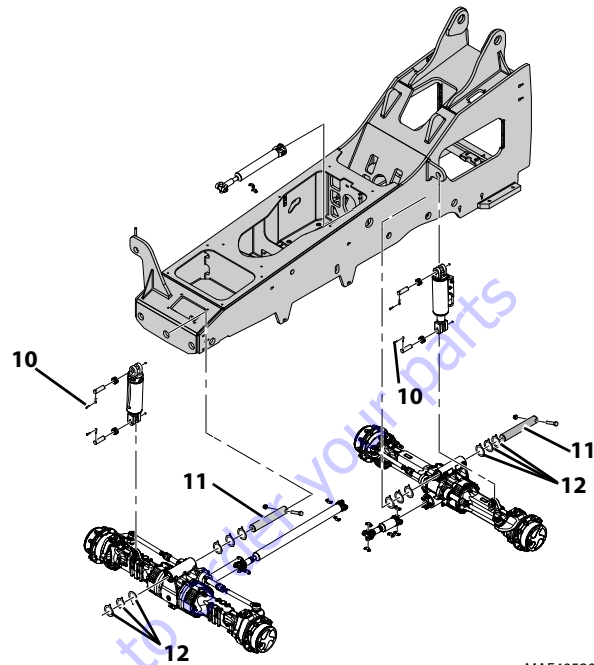
Note: The wheel and tire assemblies must be re-installed later with the directional tread pattern "arrows" facing in the direction of forward travel.

14. Remove the drive shaft assembly. Refer to Section 5.5.2, "Drive Shaft Removal".

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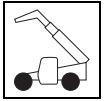
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15. Remove the capscrew and locknut securing the lower position cylinder-mount pin (**10**) to the cylinder. Tap the cylinder mount pin out, and move the cylinder to prevent it from interfering with axle removal.
16. Remove the capscrew and locknut securing the axle pivot pin (**11**) to the frame.

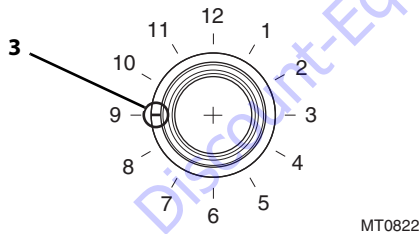
Note: Record the number and location of shims (**12**) to ensure correct installation.

17. Remove the pivot pin and shims.
18. Remove the axles from the machine using the jack, hoist or overhead crane and sling supporting the axle. **DO NOT** raise or otherwise disturb the machine while removing the axle. Balance the axle and prevent it from tipping, turning or falling while removing it from beneath the machine. Place the axle on a suitable support or holding stand.



d. Axle Installation

1. Before proceeding, ensure that the machine will remain in place during axle installation. Block the front and rear of both tires on the axle that is already installed on the machine.
2. If applicable, raise the machine using a suitable jack or hoist. Place suitable supports beneath the frame and lower the machine onto the supports, allowing enough room for axle installation. Ensure that the machine will remain in place during axle installation.
3. Using a suitable jack, hoist or overhead crane and sling, remove the axle from its support or holding stand. Balance the axle and prevent it from tipping, turning or falling while positioning it beneath the machine.
DO NOT raise or otherwise disturb the machine while installing the axle. Keep the axle supported and balanced on the jack, hoist or overhead crane and sling throughout the installation procedure.
4. Position the axle under the frame, and align the pivot pin bearings with the holes in the frame.
5. Coat the axle pivot pin (**11**) with a light film of clean engine or hydraulic oil; **DO NOT** use an anti-seize compound.
6. Install the axle pivot pin (**11**) and shims (**12**). Add or remove shims until a maximum gap of 0.6 in (1.5 mm) is obtained. Balance the number and thickness of shims equally of both sides. Secure the pivot pin with one capscrew and a new locknut.



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Note: If new frame level (front) or stabilizer (rear) cylinder bearings (**13**) have been installed in the axles or machine frame, the fracture in the bearing race must be positioned at the 9 o'clock position as shown below.

7. Move the cylinder into position on the axle cylinder anchor. Insert a cylinder-mount pin (**10**) through the cylinder and cylinder anchor. Secure the cylinder-mount pin with one capscrew and new locknut.
8. Apply multi-purpose grease through the self-tapping lube fitting to lubricate the self-align bearing and the cylinder-mount pin.
9. Install the drive shaft assemblies. Refer to Section 5.5.3, "Drive Shaft Installation".

10. If reinstalling an axle previously removed from the machine, position the driveshaft yoke on the axle according to the alignment marks made earlier. If installing a new axle, note the position of the driveshaft yoke at the transmission. Align the driveshaft yoke on the axle in the same plane as the yoke on the transmission.
11. Install the wheel and tire assemblies. Refer to Section 5.6.2, "Installing Wheel and Tire Assembly onto Machine".
12. Carefully remove the jack, hoist or overhead crane and sling supporting the axle.
13. Carefully raise the machine using a suitable jack or hoist. Remove the supports from beneath the frame and lower the machine to the ground.
14. Remove the blocks from the front and rear of both tires on the other axle.

Note: ALWAYS use new o-rings when servicing the machine.

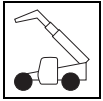
15. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
16. Uncap and connect the steering and brake lines at their axle fittings.
17. Models 10042, 10054 and 12054 Front Axle Only: Install outrigger assembly. Refer to Section 5.3.6, b. "Outrigger Installation".
18. Check the hydraulic reservoir oil level.
19. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
20. Remove Do Not Operate Tag from ignition key switch and steering wheel.
21. Start the engine. Turn the steering wheel several times lock to lock, operate the frame tilt function several times in both directions and check the function of the brakes. Check for hydraulic leaks, and tighten or repair as necessary.
22. Install the fender assembly (if equipped).
23. Close and secure the engine rear and side engine doors.

Note: The service brake circuit will need to be bled after axle installation. Refer to Section 8.8.4, "Brake Bleeding".



5.4 AXLE ASSEMBLY AND DRIVE SHAFT TROUBLESHOOTING

Problem	Cause	Remedy
1. Excessive axle noise while driving.	1. Oil level too low.	1. Fill oil to correct level. Refer to Section 2.3, "Fluid & Lubricant Capacities".
	2. Axle and/or wheel end housings filled with incorrect oil or oil level low.	2. Drain axle and/or wheel end housings and fill to correct level. Refer to Section 2.3, "Fluid & Lubricant Capacities".
	3. Incorrect alignment of ring and pinion gears.	3. Correct alignment by adding or removing shims as needed.
	4. Incorrect pinion (input) shaft bearing preload.	4. Correct bearing preload by adding or removing shims as needed.
	5. Worn or damaged bearings.	5. Replace bearings as needed.
	6. Worn or broken gear teeth.	6. Replace gears as needed.
	7. Contamination in the axle.	7. Drain axle and/or wheel end housings and fill to correct level. Refer to Section 2.3, "Fluid & Lubricant Capacities".
	8. Axle housing damaged.	8. Replace damaged parts.
2. Intermittent noise when traveling.	1. Universal joint(s) worn or damaged.	1. Repair or replace universal joints as needed.
	2. Differential ring and/or pinion gears damaged.	2. Determine cause and repair as needed.
3. Vibration or intermittent noise when traveling.	1. Drive shaft universal joint assembly(ies) incorrectly tightened.	1. Tighten capscrews to correct torque.
	2. Drive shaft universal joint(s) worn or damaged.	2. Repair or replace universal joints as needed.
	3. Drive shaft(s) damaged/unbalanced.	3. Replace drive shaft(s) as needed.

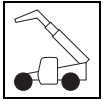


Problem	Cause	Remedy
<p>4. Oil leaking from axle (differential housing and/or axle housings).</p>	<ol style="list-style-type: none"> 1. Drain and/or inspection plugs loose and/or o-rings damaged or missing. 2. Hose fittings loose. 3. Axle shaft seal damaged or missing and/or worn or damaged shaft sealing surfaces. 4. Input shaft multi-seal ring damaged or missing and/or worn or damaged pinion (input) shaft sealing surfaces. 5. Axle casing to brake housing and/or brake housing to differential assembly o-rings and/or seals worn or damaged. 6. Axle housing mounting nuts and capscrews loose. 7. Differential and/or axle housing(s) damaged. 	<ol style="list-style-type: none"> 1. Replace o-rings as needed and tighten plugs to 96 lb-ft (130 Nm). 2. Tighten fittings. 3. Replace seal and/or joint coupling fork shaft (axle shaft). 4. Replace multi-seal ring and/or input shaft. Adjust ring and pinion alignment and bearing preload as described in the Dana Repair Manuals. 5. Replace o-rings and seals. 6. Tighten housing nuts and capscrews to 288 lb-ft (390 Nm). 7. Replace housing(s) as needed.
<p>5. Oil leaking from wheel end housing (planet carrier).</p>	<ol style="list-style-type: none"> 1. Oil level plugs loose and/or o-rings damaged or missing. 2. O-ring between hub and housing (planet carrier) damaged or missing. 3. Shaft seal damaged or missing and/or worn or damaged shaft sealing surfaces. 4. Housing capscrews loose. 5. Housing (planet carrier) damaged. 	<ol style="list-style-type: none"> 1. Replace o-rings as needed and tighten plugs to 96 lb-ft (130 Nm). 2. Replace o-ring. 3. Replace seal and/or fork joint shaft. 4. Tighten housing capscrews to 41 lb-ft (55 Nm). 5. Replace housing (planet carrier).
<p>6. Oil leaking from steering cylinder.</p>	<ol style="list-style-type: none"> 1. Hose fittings loose. 2. Steering cylinder o-rings and/or seals worn or damaged. 3. Piston rod seal worn or damaged. 4. Cylinder tube damaged. 	<ol style="list-style-type: none"> 1. Tighten fittings. 2. Replace o-rings and seals. 3. Replace piston rod seal. 4. Replace cylinder tube.



Axles, Drive Shafts, Wheels and Tires

Problem	Cause	Remedy
7. Axle overheating.	<ol style="list-style-type: none"> 1. Oil level too high. 2. Axle and/or wheel end housings filled with incorrect oil or oil contaminated or oil level low. 3. Dragging park brake. 	<ol style="list-style-type: none"> 1. Fill oil to correct level. Refer to Section 2.3, "Fluid & Lubricant Capacities". 2. Drain axle and fill to correct level. Refer to Section 2.3, "Fluid & Lubricant Capacities". 3. Adjust park brake cable as needed.
8. High steering effort required.	<ol style="list-style-type: none"> 1. Steering (hydraulic) system not operating properly. 2. Excessive joint housing swivel bearing preload. 3. Worn or damaged swivel bearings. 	<ol style="list-style-type: none"> 1. Refer to Section 8.5.2, "Pressure Specifications". 2. Correct bearing preload by adding or removing shims as needed. 3. Replace swivel bearings as needed.
9. Slow steering response.	<ol style="list-style-type: none"> 1. Steering (hydraulic) system not operating properly. 2. Steering cylinder leaking internally. 	<ol style="list-style-type: none"> 1. Refer to Section 8.5.2, "Pressure Specifications". 2. Repair or replace steering cylinder as needed.
10. Excessive noise when brakes are engaged.	<ol style="list-style-type: none"> 1. Brake discs worn. 2. Brake discs damaged. 	<ol style="list-style-type: none"> 1. Check brake discs for wear. Refer to Section 5.7.1, "Brake Disc Inspection". 2. Replace brake discs.
11. Brakes will not engage.	<ol style="list-style-type: none"> 1. Brake (hydraulic) system not operating properly. 2. Brake piston o-rings and seals damaged (leaking). 	<ol style="list-style-type: none"> 1. Refer to Section 8.5.2, "Pressure Specifications". 2. Replace o-rings and seals.
12. Brakes will not hold the machine or braking power reduced.	<ol style="list-style-type: none"> 1. Brake discs worn. 2. Brake (hydraulic) system not operating properly. 3. Brake piston o-rings and seals damaged (leaking). 	<ol style="list-style-type: none"> 1. Check brake discs for wear. Refer to Section 5.7.1, "Brake Disc Inspection". 2. Refer to Section 8.5.2, "Pressure Specifications". 3. Replace o-rings and seals.



5.5 DRIVE SHAFTS

5.5.1 Drive Shaft Inspection and Maintenance

Inspect areas where the drive shaft flange yokes and slip yokes mount to the drive shafts. Verify all straps and bolts are tight by attempting to turn each drive shaft in both directions. Look for excessive looseness, missing parts, cracks or other damage. Worn or damaged drive shafts and bearing cross assemblies may cause an excessive amount of vibration or noise.

Verify the mating surfaces between the driveshaft yoke, bearing cross and are clean and smooth.

Refer to Section 2.5, "Lubrication Schedules", for information regarding the lubrication of the grease fittings on the drive shafts.

Note: To ensure optimum performance, the driveshaft assemblies are specially balanced as a unit at the factory. When servicing any flange yoke, slip yoke or driveshaft tube, order a complete assembly if components are bent or damaged. Refer to the appropriate parts manual for ordering information.

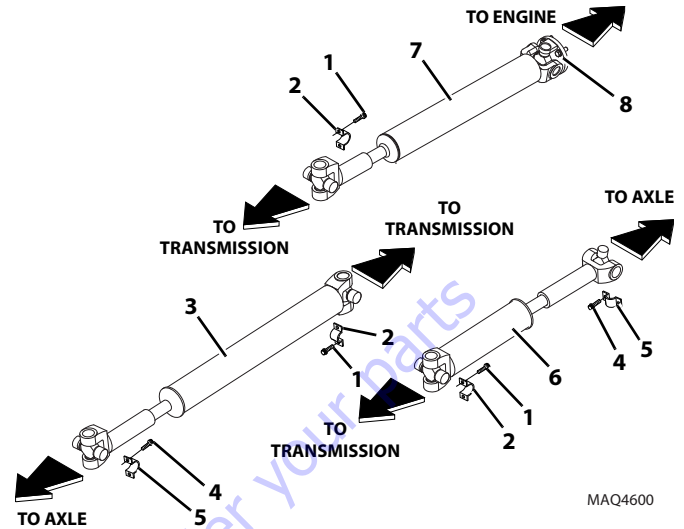
Note: Any bolt removed from the drive shaft assembly **MUST** be replaced. **DO NOT** re-torque.

Note: Refer to Section 2.6, "Threadlocking Compound", for all thread locking requirements.

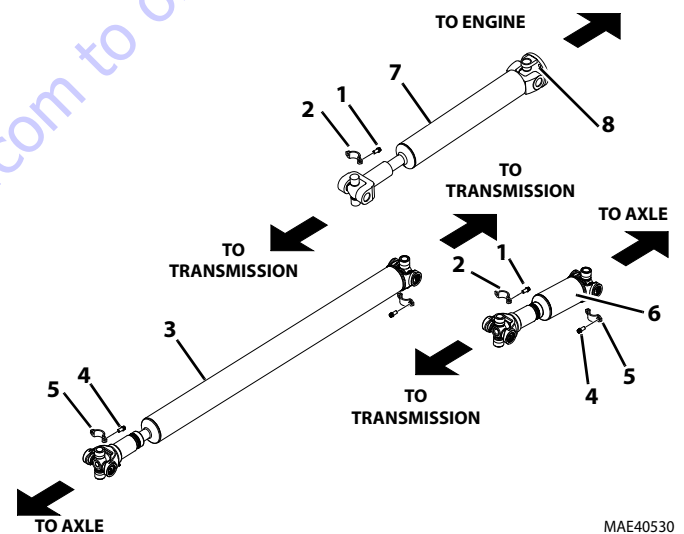
5.5.2 Drive Shaft Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Block the wheels.
6. The drive shaft assemblies are a balanced assembly. Mark the yoke and axle, transmission and the shaft and slip yoke so that these components can be returned to their original positions when reinstalled. Yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.
7. Remove the four bolts (1) and two straps (2) securing the bearing cross of front drive shaft assembly (3) to the transmission output shaft flange. Discard bolts.
8. Remove the four bolts (4) and two straps (5) securing the bearing cross of front drive shaft assembly (3) to the front axle. Discard bolts.
9. Remove the front drive shaft assembly (3).
10. Repeat the above procedure for the rear drive shaft assembly (6).
11. Remove the four bolts (1) and two straps (2) securing the bearing cross of engine/transmission drive shaft assembly (7) to the transmission output shaft flange. Discard bolts.
12. Remove the four bolts (8) securing the engine output

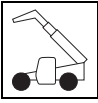
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7. Remove the four bolts (1) and two straps (2) securing the bearing cross of front drive shaft assembly (3) to the transmission output shaft flange. Discard bolts.
8. Remove the four bolts (4) and two straps (5) securing the bearing cross of front drive shaft assembly (3) to the front axle. Discard bolts.
9. Remove the front drive shaft assembly (3).
10. Repeat the above procedure for the rear drive shaft assembly (6).
11. Remove the four bolts (1) and two straps (2) securing the bearing cross of engine/transmission drive shaft assembly (7) to the transmission output shaft flange. Discard bolts.
12. Remove the four bolts (8) securing the engine output flange to the engine. Discard bolts.



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13. Remove the engine/transmission drive shaft assembly (7).
14. Remove Do Not Operate Tag from ignition key switch and steering wheel.

5.5.3 Drive Shaft Installation

1. Raise the drive shaft assembly into position. The slip-yoke end of the drive shaft mounts toward the axle. If reinstalling a drive shaft previously removed, align the flange yokes according to the alignment marks made during removal.

Note: The yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.

2. Install the two straps (2) and four new bolts (1) securing the bearing cross of front drive shaft assembly (3) to the transmission. Torque bolts to 60 lb-ft (81 Nm).
3. Install the two straps (5) and four new bolts (4) securing the bearing cross of front drive shaft assembly (3) to the axle. Torque bolts to 60 lb-ft (81 Nm).
4. Install front drive shaft assembly (3).
5. Repeat the above procedure for the rear drive shaft assembly (6).
6. Install the two straps (2) and four new bolts (1) securing the bearing cross of engine/transmission drive shaft assembly (7) to the transmission output shaft flange. Torque bolts to 35 lb-ft (47,5 Nm).
7. Install four new bolts (8) securing the engine output flange to the engine. Torque as required.
8. Install engine/transmission drive shaft assembly (7).

5.6 WHEELS AND TIRES

WARNING

Mismatched tire sizes, ply ratings or mixing of tire types (radial tires with bias-ply tires) may compromise machine stability and may cause machine to tip over.

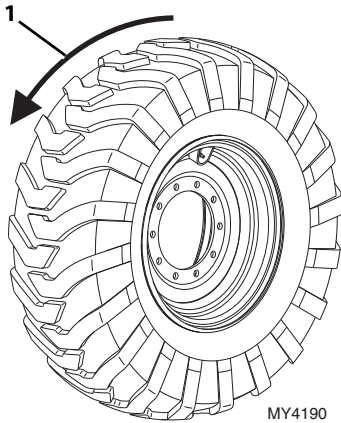
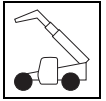
It is recommended that a replacement tire to be the same size, ply and brand as originally installed. Refer to the appropriate parts manual for ordering information. If not using an approved replacement tire, It is recommended that replacement tires have the following characteristics:

- Equal or greater ply/load rating and size of original.
- Tire tread contact width equal or greater than original.
- Wheel diameter, width and offset dimensions equal to the original.
- Approved for the application by the tire manufacturer (including inflation pressure and maximum tire load).

The rims installed have been designed for stability requirements which consist of track width, tire pressure and load capacity. Size changes such as rim width, center piece location, larger or smaller diameter, etc., without written factory recommendations, may result in unsafe condition regarding stability.

Foam filled tires have a positive effect on the weight, stability and handling characteristics of the machine, especially under load. The use of hydrofill as a tire-fill substance is not recommended because of possible environmental impact.

Large-bore valve stems are used to help expedite tire inflation and deflation. An inner tube may be used if a tire does not provide an airtight seal. Check tire inflation pressures when the tires are cold. When mounting a tire on the wheel, the tire must be mounted on the wheel respective of the directional tread pattern of the tire; this produces a left or right tire and wheel assembly.



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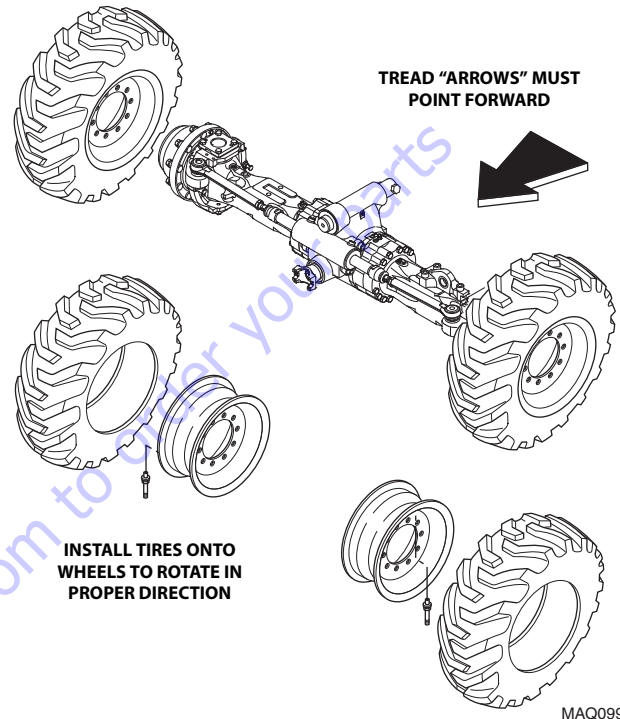
The wheel and tire assemblies must be installed with the directional tread pattern "arrows" (1) facing in the direction of forward travel.

5.6.1 Removing Wheel and Tire Assembly from Machine

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Loosen but **DO NOT** remove the lug nuts on the wheel and tire assembly to be removed.
4. Place a suitable jack under the axle pad closest to the wheel being removed. Raise the machine and position a suitable support beneath the axle. Allow sufficient room to lower the machine onto the support and to remove the wheel and tire assembly.
5. Lower the machine onto the support.
6. Remove lug nuts and lug washers in an alternating pattern.
7. Remove the wheel and tire assembly from the machine.

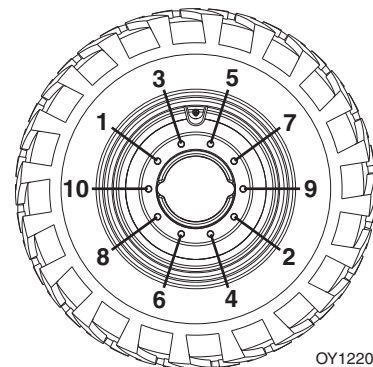
5.6.2 Installing Wheel and Tire Assembly onto Machine

Note: The wheel and tire assemblies must be installed with the directional tread pattern "arrows" facing in the direction of forward travel.



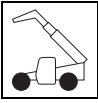
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1. Position wheel onto studs on wheel end of axle.
2. Start all nuts by hand to prevent cross threading. **DO NOT** use a lubricant on threads or nuts.



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3. Tighten lug nuts in an alternating pattern as indicated in figure. Refer to Section 2.2.5, "Tires", for proper torque value.
4. Remove machine from supports.



5.7 BRAKES

5.7.1 Brake Disc Inspection

A brake lining wear measurement on service brake (multi-disc brake) gives just limited information about the overall condition of the multi-disk package—without disassembly of the output.

Check the brake discs for wear every 1,000 hours of operation or yearly. Additionally, check brake discs if braking behavior has changed in any of following ways:

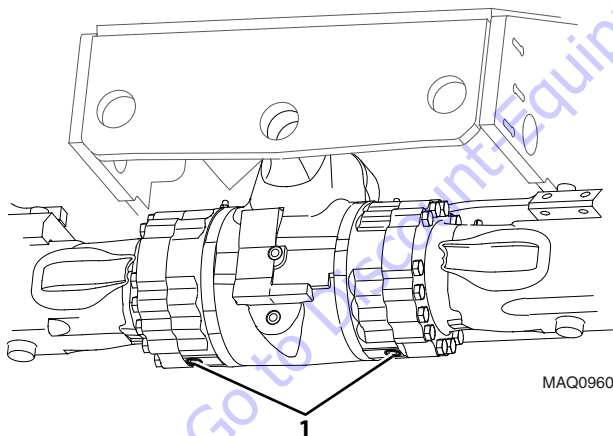
- Brake noises
- Reduced braking power
- Changed deceleration
- Changed brake oil level
- Changed braking pressure

Wear measurement must be carried out on **both** output sides of axle!

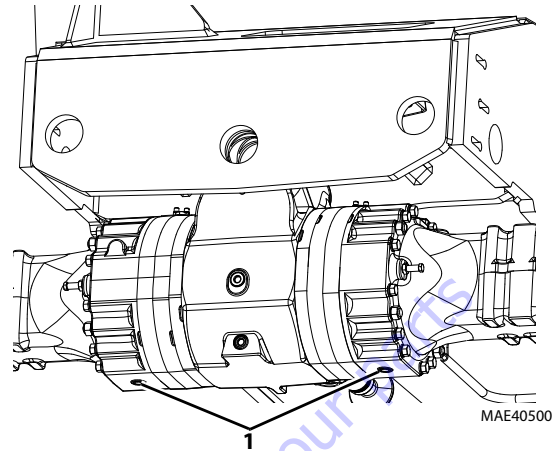
For more information on brake disc inspection, refer to the appropriate axle repair manual.

1. Block all four wheels to help prevent the machine from moving.

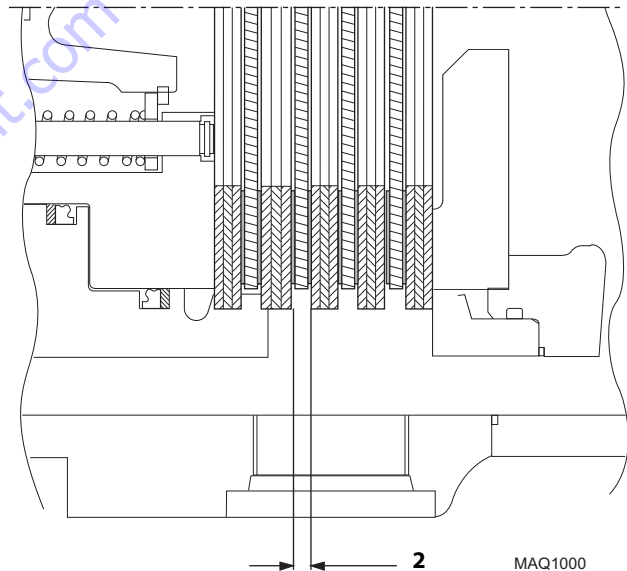
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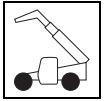
2. Place a suitable receptacle under axle drain plugs (1). Remove drain plugs and allow axle oil to drain into receptacle. Transfer used axle oil into a suitable covered container, and label container as "Used Oil". Dispose of used oil at an approved recycling facility.



3. Using a feeler gauge, check thickness of lined/inner disc (2). If thickness is less than 5.2 mm, replace the lined/inner discs.

Note: If discs are worn beyond their tolerance, discs must be replaced on both sides of axle at the same time.

4. Repeat step 3 for other side of axle.
5. Fill the axle through the axle fill hole until the oil level is even with both axle level holes. Fill the axle slowly, allow time for the oil to run across the differential.
6. Reassemble the level plugs using new o-rings.
7. Install the axle fill plug into axle housing.



5.8 TOWING A DISABLED MACHINE

5.8.1 Manually Releasing the Park Brake

1. Remove load from machine.
2. Fully retract the boom. Position attachment approximately 24 in (610 mm) above the ground.

WARNING

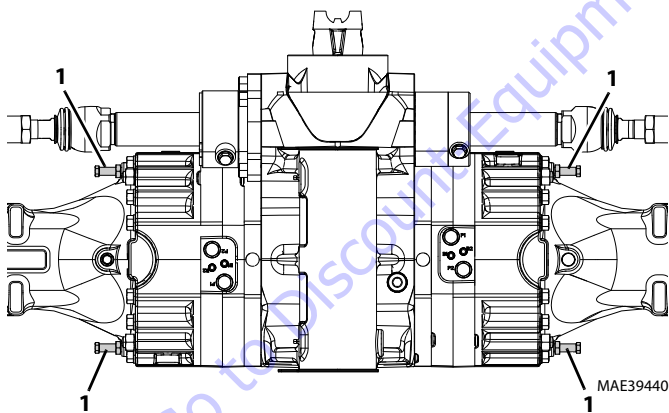
DO NOT attempt to tow a machine that is loaded or the boom/attachment is raised more than approximately 24 in (610 mm).

3. Place transmission in (N) NEUTRAL, engage park brake and shut the engine OFF.
4. Block all four wheels.

WARNING

Block all four wheels when preparing the machine for towing to prevent any unexpected movement.

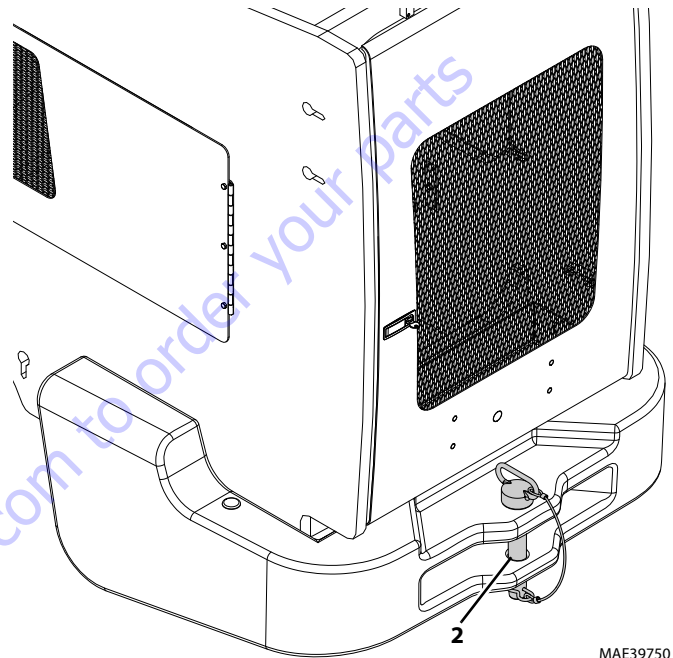
5. Remove front and rear drive shafts. Refer to Section 5.5, "Drive Shafts".



6. Loosen the nuts of the screws (1) for the manual release of the braking units. Draw the nuts back approximately 8 mm.
7. Tighten the screws until they are gently seated on the driving plate.
8. Carefully tighten each release screw a 1/4 turn at a time in sequence until all have been turned one full turn 360°.

9. Repeat steps 6 thru 8 for other side of differential.

Note: After machine has been towed to a secure location, reactivate park brake. Carefully follow procedures from start to finish. Contact local JLG dealer if you are unsure about any part of the procedure, or for specific instructions concerning your particular situation.



10. Secure machine to a suitable towing vehicle.

- a. For towing or retrieval from front of machine, attach towing equipment to lifting points on each side of the frame directly behind the outrigger weldments.
- b. For towing or retrieval from rear of machine, attach towing equipment to the retrieval hitch (2).

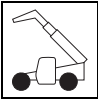
WARNING

Use a vehicle of sufficient capacity to tow the machine. Tow vehicle must be capable of providing braking for both vehicle and machine.

11. Clear area of any unnecessary personnel.
12. Have an operator seated in machine operator cab.
13. Remove blocks from all four wheels.
14. Disengage machine park brake.
15. Tow machine to a secure location.

Note: Tow machine at a very slow speed.

16. After towing is complete, engage park brake.
17. Block all four wheels.



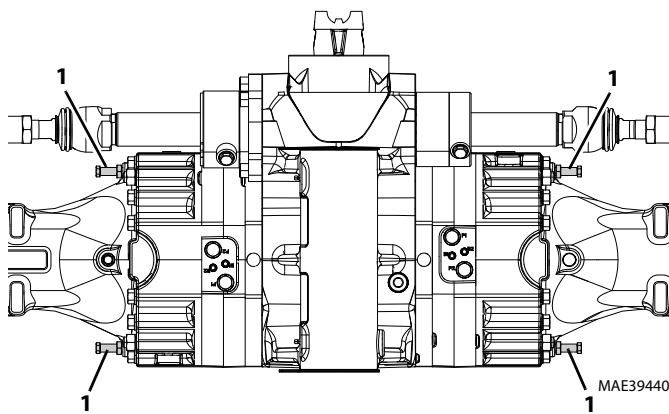
Axles, Drive Shafts, Wheels and Tires

18. Reinstall front and rear drive shafts. Refer to Section 5.5, "Drive Shafts".
19. Repair machine as necessary.

Note: Block the wheels of the machine BEFORE attempting to release the park brake. Once the park brake is released the machine's park brake AND service brakes are inoperable.

5.8.2 Manually Resetting the Park Brake

Note: Block the wheels of the machine BEFORE attempting to reset the machine's park brake. Once the park brake is released the machine's park brake AND service brakes are inoperable.



1. Loosen each release screw (1), only 1/4 turn at a time, in sequence, until each screw has lost contact with the guide pin.
2. Remove screws along with nuts and seals. Replace seals, lubricate screws with a silicone-based grease and re-install screws along with nuts.
3. Adjust the nut of the screw heads in relation to the arm by 1.18 in (30 mm).
4. Repeat steps 1 thru 3 for other side of differential.
5. After repairs to machine have been made, start machine and check park brake and service brakes for proper function. Refer to Section 8.8.4, "Brake Bleeding" and Section 8.8.6, "Steering Orbital Valve".

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Section 6 Transmission

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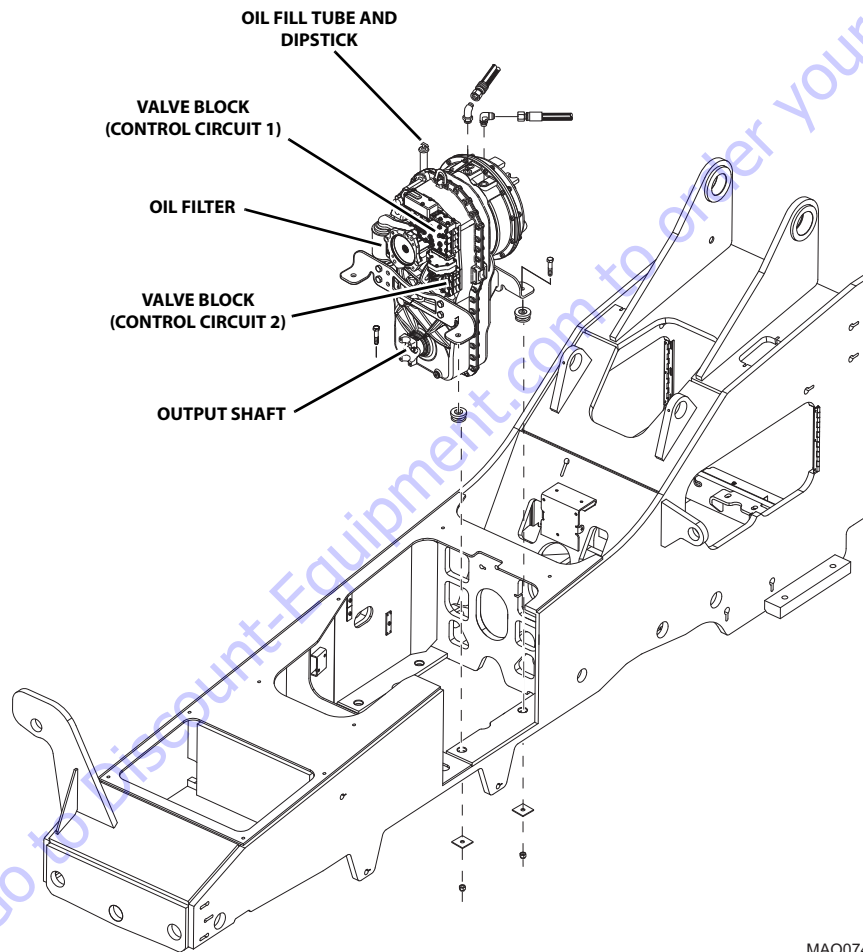
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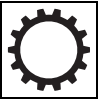
6.1 TRANSMISSION ASSEMBLY COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the transmission. The following illustration identifies the components that are referred to throughout this section.

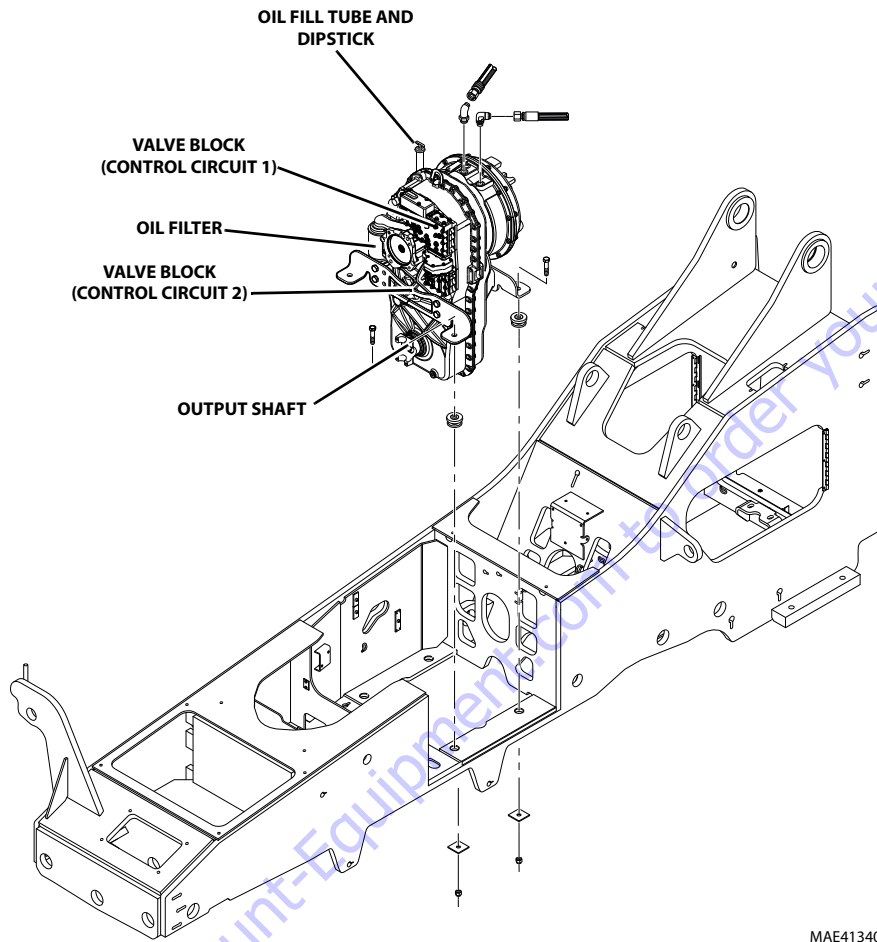
6.1.1 6036 & 6042



MAQ0741



6.1.2 8042, 10042, 10054 & 12054



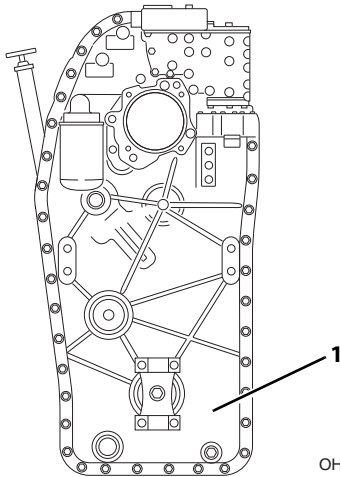
MAE41340



WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, "Safety Practices", of this manual.

6.2 TRANSMISSION SERIAL NUMBER



OH2381

Transmission serial number plate (1) is located on pump side (front) of transmission at bottom right toward machine frame. Information on serial number plate is required in correspondence regarding transmission.

6.3 TRANSMISSION SPECIFICATIONS AND MAINTENANCE INFORMATION

Refer to Section 2, "General Information and Specifications", for transmission, oil specifications and maintenance information.

Detailed transmission service instructions are provided in the following publications:

Model	Publication Type	Publication #
6036, 6042, 8042, 10042, 10054, 12054	Service Manual	8990455
6036, 6042,	Parts Manual	31211016
8042, 10042, 10054		31211017
12054		31211463

6.4 TRANSMISSION REPLACEMENT

Note: Contact your local JLG Service Department if internal transmission repair is required during the warranty period.

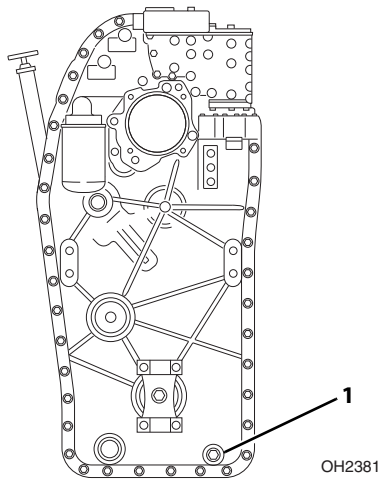
Note: Cleanliness is of extreme importance. Before attempting to remove transmission, thoroughly clean exterior of transmission to help prevent dirt from entering during replacement process. Avoid spraying water or cleaning solution onto or near transmission shift solenoids and other electrical components.

6.4.1 Transmission Removal

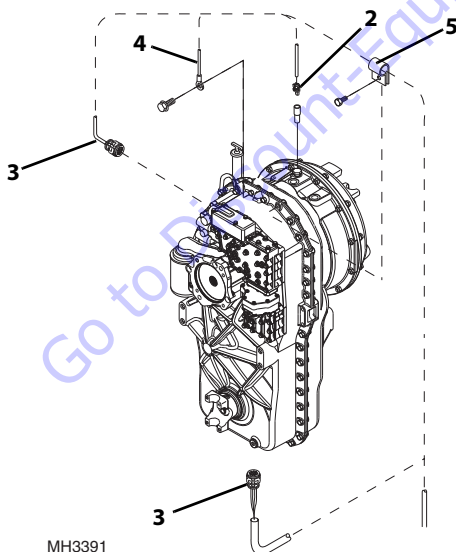
WARNING

NEVER lift a transmission alone; enlist the help of at least one assistant or use a suitable hoist or overhead crane and sling with the minimum lifting capacity of 1000 lb (454 kg).

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, raise the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Temporarily block up or support the boom.
4. Open the engine rear and side engine doors. Allow the system fluids to cool.
5. Drain the hydraulic oil reservoir. Refer to Section 8.6.1, "Hydraulic Oil Reservoir Draining".
6. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
7. Remove the transmission covers.
8. Thoroughly clean the transmission and surrounding area, including all hoses and fittings.

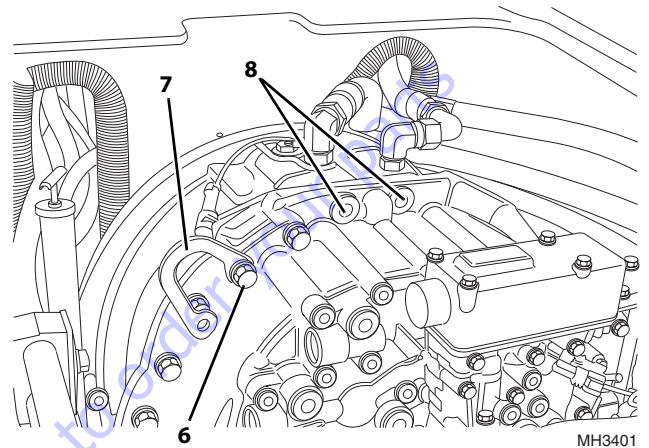


9. Place a suitable receptacle under transmission drain plug (1). Remove transmission drain plug, and allow transmission oil to drain into receptacle.
10. Transfer the used transmission oil into a suitable, covered container, and label the container as "Used Oil". Dispose of used oil at an approved recycling facility. Clean and reinstall the transmission drain plug.
11. Remove the engine-to- transmission and transmission-to-axle drive shafts. Refer to Section 5.5.2, "Drive Shaft Removal".
12. Remove the hydraulic pump. Refer to Section 8.7.1, "Pump Replacement".

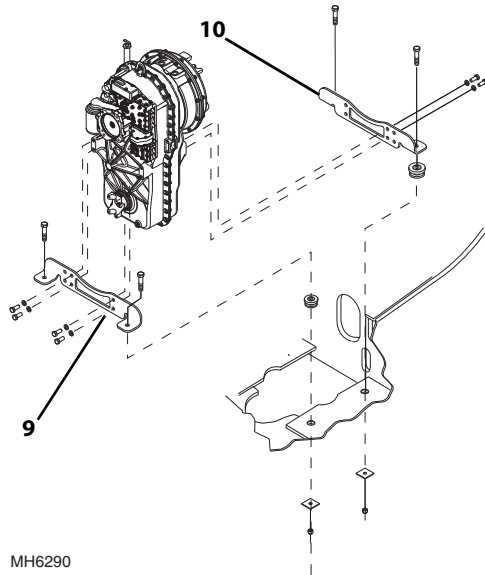


13. Label and disconnect the transmission temperature switch connector (2) and shift solenoid wiring harness connectors (3).

14. Remove the capscrew securing the black wire (4) to the transmission housing, and disconnect the wire. **DO NOT** reinstall the capscrew at this time.
15. Remove the capscrew securing the clamp (5) and wiring harness to the transmission housing and move the wiring harness safely out of the way. **DO NOT** reinstall the capscrew at this time.



16. Remove the capscrew (6) securing the lifting ring (7) to the transmission housing. Once the lifting ring has been removed, reinstall the capscrew into the hole.
17. Move the lifting ring to the holes (8) used to secure the black wire and clamp. Secure the lifting ring using the capscrews and tighten securely.
18. Label, disconnect and cap the transmission oil cooler inlet and outlet hoses on the transmission.
19. Connect a lifting strap or chain to the lifting eye at the top of the transmission and to a suitable hoist or overhead crane. Operate the hoist or crane to remove slack from the chain, but **DO NOT** raise the transmission at this time.
20. Place blocks under the transmission to help support it during removal.



MH6290

21. Remove the four capscrews and lockwashers securing the front transmission mount (9) to the transmission.
22. Remove the two capscrews, hex locknuts and rebound washers. Remove the front transmission mount.
23. Remove the four capscrews and lockwashers securing the rear transmission mount (10) to the transmission.
24. Remove the two capscrews, hex locknuts and rebound washers. Remove the rear transmission mount.
25. Inspect the rubber mounts. Replace the mounts if damaged.
26. Carefully remove the transmission from the machine. Avoid causing damage to the transmission or surrounding parts.
27. Lift the transmission clear of the machine and lower it onto suitable supports or secure it to a stand built especially for the transmission or engine service. Secure the transmission so that it will not move or fall.
28. Remove any external transmission components as required, including the transmission temperature switch, and inlet and outlet cooler hose fittings. Cover all transmission openings.
29. Remove the transmission oil filter and dispose of properly. Clean the filter mounting surface. Cover or cap the oil filter mount.

6.4.2 Transmission Inspection and Internal Repair

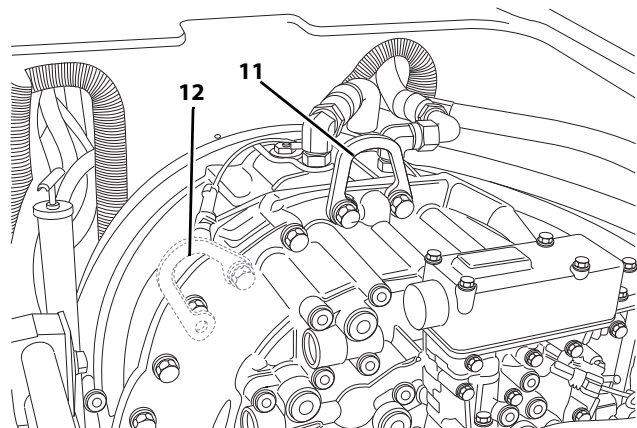
If replacing the entire transmission, transfer the transmission temperature switch to the replacement transmission. The gear shift solenoids are included with a new transmission.

6.4.3 Transmission Installation

WARNING

NEVER lift a transmission alone; enlist the help of at least one assistant or use a suitable hoist or overhead crane and sling with the minimum lifting capacity of 1000 lb (454 kg).

1. Install two rubber mounts and the rear transmission mount (10) in the machine frame. Secure the mount with the previously used hardware. Torque to 180-320 lb-ft (244-433,8 Nm)
2. Use a hoist or overhead crane and sling attached to the lifting eye at the top of the transmission. Raise and position the transmission within the chassis.
3. Attach the transmission to the rear mounting bracket with the previously used hardware. Torque to 107-191.7 lb-ft (145-260 Nm).
4. Install the two front rubber mounts and the front transmission mounting bracket (9) on the transmission with the previously used hardware. Torque to 107-191.7 lb-ft (145-260 Nm).
5. Attach the front mounting bracket to the frame with the previously used hardware. torque to 180-320 lb-ft (244-433,8 Nm).
6. Remove the hoist or overhead crane and sling.

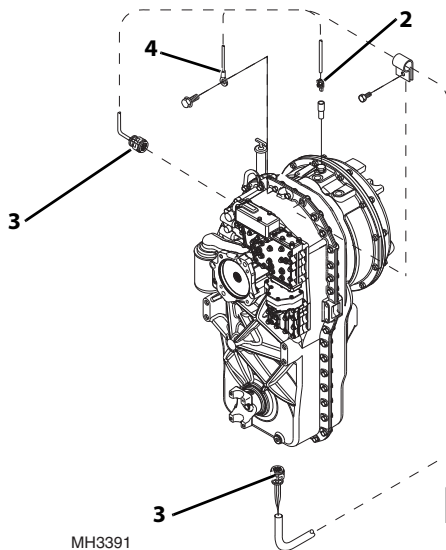


MH3411

Note: The lifting ring (11) must be repositioned to allow the covers to be installed.



7. Remove the two capscrews securing the lifting ring to the transmission housing. Save the capscrews for later use.
8. Remove the capscrew and secure the lifting ring in the storage position (12) on the transmission housing as shown.



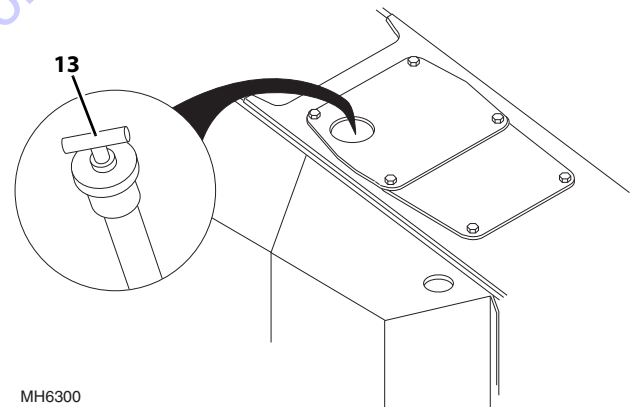
9. Connect the transmission temperature switch connector (2) and shift solenoid wiring harness connectors (3).
10. Attach the black wire (4) to the transmission housing with a capscrew removed in step 7.
11. Secure the wiring harness to the transmission housing using the clip and a capscrew removed in step 7.
12. Uncap and connect the previously labeled transmission oil cooler inlet and out hoses at the transmission.
13. Install the hydraulic pump. Refer to Section 8.7.1, "Pump Replacement".
14. Install the engine-to-transmission and transmission-to-axle drive shafts. Refer to Section 5.5.3, "Drive Shaft Installation".
15. Clean the transmission oil filter mounting surface.
16. Apply a thin film of clean oil to the new transmission filter gasket. Install the new filter and torque to 20-25 lb-ft (27-34 Nm).
17. Transmission oil may be added through the dipstick tube. Remove the dipstick and add oil. Check the oil level by taking intermittent dipstick readings as outlined in the appropriate Operation & Safety Manual. **DO NOT** overfill. Reinstall the dipstick when finished.
18. Install the transmission covers.
19. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.

20. Remove Do Not Operate Tags from ignition key switch and steering wheel.
21. Close and secure the engine rear and side engine doors.

6.4.4 After Transmission Service or Replacement

In general:

1. Check the transmission oil level and add oil as required.
2. Install a new transmission filter.
3. Check the torque on the drive shaft yoke cap screws.
4. When an overhauled or repaired transmission is installed, thoroughly clean the oil cooler lines to and from the transmission.
5. Drain and flush the entire system.
6. Disconnect and clean all transmission cooler hoses. When possible, remove transmission lines from the machine for cleaning.
7. Thoroughly clean transmission filter screens and cases, and replace transmission filter elements.



8. Reassemble all components and fill the transmission through the dipstick tube opening (13). Check the level by taking intermittent dipstick readings as outlined in the appropriate Operation & Safety Manual. **DO NOT** overfill. Reinstall the dipstick when finished.
9. Run the engine for two minutes at idle to help prime the torque converter and the transmission oil lines.
10. Recheck the level of the fluid in the transmission with the engine running at idle and at the normal operating temperature 180 - 200° F (83 - 94° C).
11. Add oil as necessary to bring the fluid level to within the "HOT" zone mark on the dipstick.
12. Recheck all drain plugs, lines, connections, etc., for leaks, and tighten where necessary.



6.5 TRANSMISSION TROUBLESHOOTING

This section provides an easy reference guide covering the most common problems that may occur during operation of the transmission.

Note: Contact the **JLG** Service Department if internal transmission repair is required during the warranty period.

The transmission should be checked, serviced and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

Problem	Cause	Remedy
1. Transmission will not engage or will not shift properly.	1. Oil level too high or low.	1. Fill transmission to correct level. Refer to Section 2.3, "Fluid & Lubricant Capacities".
	2. Transmission control lever not functioning properly and/or a fault in the wiring harness. Transmission control lever not functioning properly and/or a fault in the wiring harness.	2. Refer to Section 9.5, "Electrical System Schematics".
	3. Transmission valve body solenoids not functioning properly.	3. Refer to Section 9.5, "Electrical System Schematics".
	4. Pilot-operated shift valves not operating properly.	4. Clean the valve spool and housing. Replace return spring as needed.
	5. Pump output pressure low.	5. Refer to Section 6.5, "Transmission Troubleshooting", Problem 2 .
	6. Clutch piston o-rings damaged.	6. Replace o-rings.
	7. Clutch discs worn or damaged.	7. Replace clutch discs.
	8. Coupling shafts or gear teeth damaged.	8. Replace couplings.
2. Low or no pump flow or pressure.	1. Low oil level.	1. Fill transmission to correct level. Refer to Section 2.3, "Fluid & Lubricant Capacities".
	2. Transmission filled with incorrect oil, or oil contaminated.	2. Drain transmission and fill to correct level. Refer Section 2.3, "Fluid & Lubricant Capacities".
	3. Pump suction pipe screen clogged.	3. Clean, repair and/or replace suction pipe.
	4. Central shaft damaged.	4. Replace central shaft.
	5. Pump worn or damaged.	5. Repair or replace pump assembly.



Problem	Cause	Remedy
3. Low clutch pressure.	<ol style="list-style-type: none"> 1. Incorrect oil level. 2. Main pressure valve stuck open. 3. Broken or worn coupling shaft or piston o-rings. 4. Pressure reducing valve stuck open. 	<ol style="list-style-type: none"> 1. Fill transmission to correct level. Refer to Section 2.3, "Fluid & Lubricant Capacities". 2. Clean the valve spool and housing. 3. Replace coupling and/or o-rings. 4. Clean the valve spool and housing.
4. Lack of power.	<ol style="list-style-type: none"> 1. Park or service brake dragging. 2. Low engine rpm causes converter stall. 3. Pump output pressure is low. 4. Clutch discs worn or damaged. 5. Transmission overheating. 	<ol style="list-style-type: none"> 1. Refer to Section 8.5.2, "Pressure Specifications". 2. Adjust the engine rpm to specifications. Refer to Transmission Service Manual. 3. Refer to Section 6.5, "Transmission Troubleshooting", Problem 2 ". 4. Replace clutch discs. 5. Refer to Section 6.5, "Transmission Troubleshooting", Problem 5 ".
5. Transmission overheating (oil above 120° C (248° F)).	<ol style="list-style-type: none"> 1. Low oil level. 2. Clogged radiator. 3. Transmission filled with incorrect oil, or oil contaminated. 4. Excessive "roading." 5. Restriction in oil cooler hoses. 6. Pump worn or damaged. 7. Engine thermostat stuck. 	<ol style="list-style-type: none"> 1. Fill transmission to correct level. Refer to Section 2.3, "Fluid & Lubricant Capacities". 2. Remove debris from the radiator. 3. Drain transmission and fill to correct level. Refer to Section 2.3, "Fluid & Lubricant Capacities". 4. Stop and idle the engine. 5. Replace cooler hoses. 6. Repair or replace pump assembly. 7. Replace engine thermostat.



Transmission

Problem	Cause	Remedy
6. Grinding or “clunking” noise from transmission.	<ol style="list-style-type: none"> 1. Oil level too low. 2. Transmission filled with incorrect oil. 3. Incorrect clutch engagement. 4. Internal damage. 5. Broken diaphragm (flex plate). 6. Loose diaphragm (flex plate) mounting capscrews. 	<ol style="list-style-type: none"> 1. Fill oil to correct level. Refer to Section 2.3, “Fluid & Lubricant Capacities”. 2. Drain transmission and fill to correct level. Refer to Section 2.3, “Fluid & Lubricant Capacities”. 3. Refer to Section 9.12.2, “Transmission Solenoid Valves”. 4. Repair or replace parts as needed. 5. Replace diaphragm (flex plate). Refer to Section 6.4.1, “Transmission Removal”. 6. Tighten capscrews.
7. Oil leaking from transmission.	<ol style="list-style-type: none"> 1. Oil leaking from vent (high oil level). 2. Drain plug loose and/or o-rings damaged or missing. 3. Hose fittings loose. 4. Oil leaking at valve bodies (possible valve body gaskets damaged or missing and/or mounting capscrews not tight). 5. Housing capscrews loose. 6. Oil leaking at pump (possible pump-to-housing o-rings missing or damaged, and/or pump mounting capscrews not tight). 7. Oil leaking at converter bell (possible converter leak and/or input shaft seal damage). 8. Oil leaking at output shaft (output shaft seal damaged). 9. Housing damaged. 	<ol style="list-style-type: none"> 1. Remove drain plug and drain oil as needed, until oil is at correct level. Refer to Section 2.3, “Fluid & Lubricant Capacities”. Replace o-rings as needed and tighten plugs to 96 lb-ft (130 Nm). 2. Replace o-rings as needed and tighten plug to 26 lb-ft (35 Nm). 3. Tighten fittings. 4. Replace gaskets and/or tighten capscrews to 7 lb-ft (9,5 Nm). 5. Tighten capscrews to 34 lb-ft (46 Nm). 6. Replace o-rings and/or tighten capscrews to 85 lb-ft (115 Nm). 7. Replace converter and/or input shaft seal. 8. Replace output shaft seal. 9. Replace housing as needed.

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Section 7

Engine

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Engine

7.1 INTRODUCTION

WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, "Safety Practices", of this manual.

WARNING

Engine fuel lines are pressurized. **DO NOT** attempt repairs unless specific training has been completed.

7.1.1 Disclaimer and Scope

These instructions are written for worldwide use. In territories where legal requirements govern engine smoke emission, noise, safety factors, etc., apply all instructions, data and dimensions provided herein in such a way that after maintenance, service and repair of the engine, engine operation does not violate local regulations.

Note: These instructions cover only the routine maintenance, removal, installation and troubleshooting of engine. Refer to local Cummins Engine Distributor and the applicable Cummins Engine Service Manual for assistance with comprehensive engine diagnosis, repair and component replacement. A gradual running-in (break-in) of a new engine is not necessary. Full load can be applied to a new engine as soon as engine is put into service and the coolant temperature is at least 140° F (60° C). Extended light-load operation during early life of the engine is not recommended. **DO NOT** run the engine at high, no-load speeds. **DO NOT** apply an overload to the engine.

7.2 ENGINE SERIAL NUMBER

The engine serial number is located on the turbocharger side of the valve cover. Information contained in the serial number is required in correspondence with the engine manufacturer.

7.3 SPECIFICATIONS AND MAINTENANCE INFORMATION

For engine, coolant and oil specifications, and maintenance information, refer to Section 2, "General Information and Specifications".

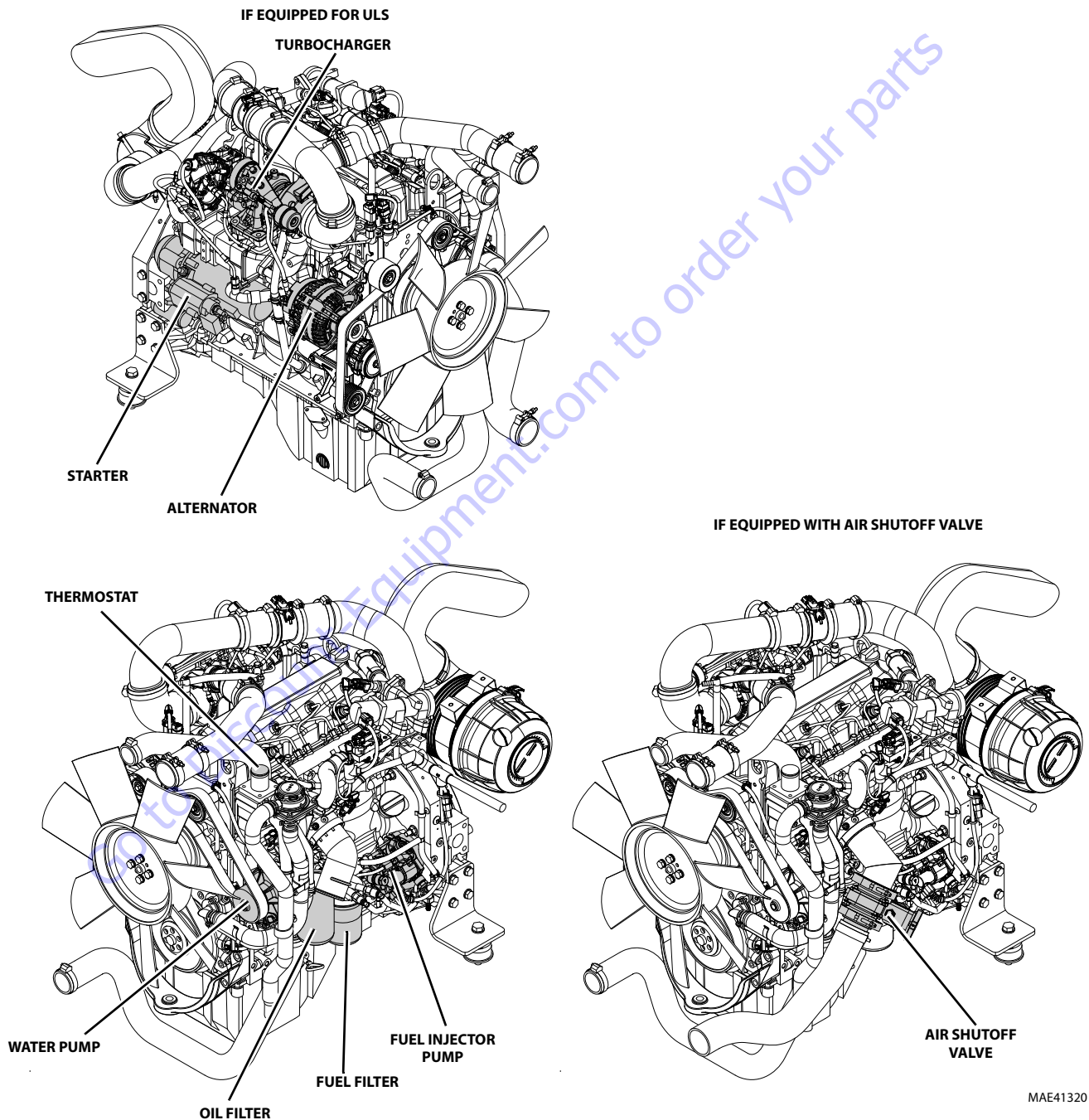
Note: Detailed Cummins engine service instructions (covering disassembly, inspection, internal repair, assembly, adjustment and troubleshooting) are provided in appropriate Cummins engine service manual.

Note: Refer to Section 9.20, "Engine Fault Codes", for error codes and troubleshooting.



7.3.1 Component Terminology

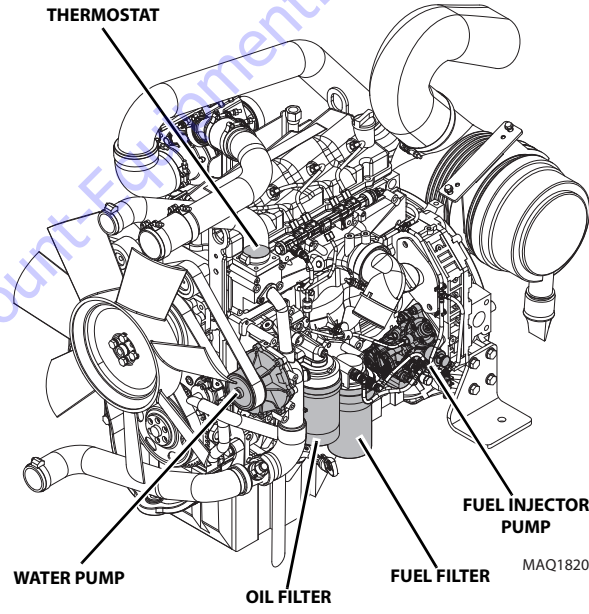
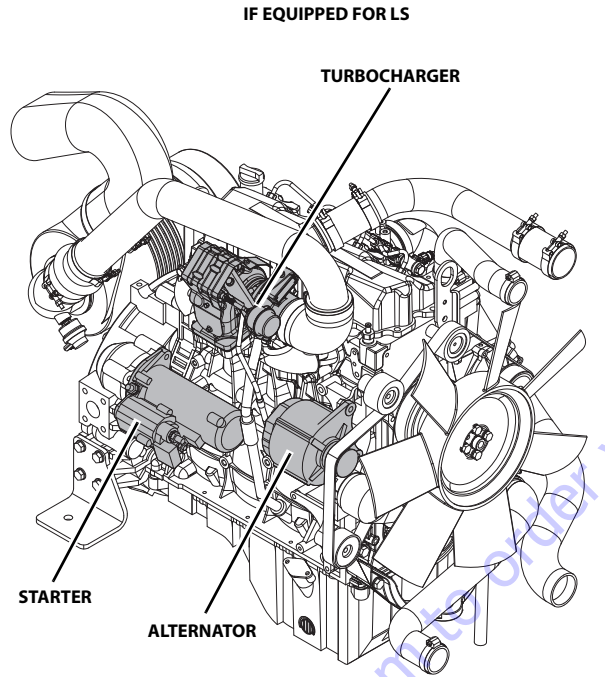
To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the engine components. The following illustration identifies the components that are referred to throughout this section.



MAE41320



Engine





7.4 ENGINE COOLING SYSTEM

7.4.1 Coolant System Pressure Cap

A 17 psi (120 kPa) cap is used on the surge tank. An incorrect or malfunctioning cap can result in the loss of coolant and a hot-running engine.

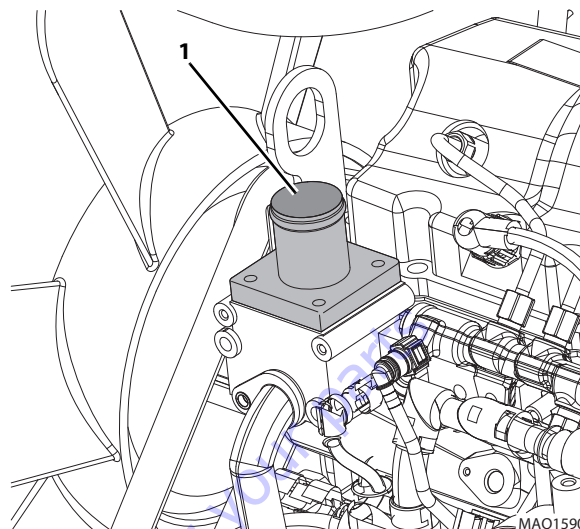
7.4.2 Thermostat Replacement

Before considering thermostat replacement, check the coolant level, fan belt tension and instrument cluster temperature indicator.

- If engine seems to take a long time to warm, thermostat may be stuck in the open position and requires replacement.
- If engine runs hot, check the temperature of the upper radiator hose.
- If hose is not hot, thermostat may be stuck in the closed position.
- If engine has overheated, performance may suffer, indicating other damage including a leaking cylinder head gasket, cracked cylinder head or block, and/or other internal engine damage.

a. Thermostat Removal

1. Park machine on a firm, level surface, level machine, fully retract the boom, lower boom, place transmission in (N) NEUTRAL, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery(s). Refer Section 9.8, "Battery", for procedure.
5. Slowly turn the surge tank cap to the first stop and allow any pressure to escape. Remove surge tank cap.
6. Place a funnel at base of radiator to channel drained coolant into a container. Loosen drain petcock and slowly allow coolant to drain. Transfer coolant into a properly labeled container. Dispose of properly if coolant needs to be replaced. Tighten the radiator drain petcock.
7. Loosen upper radiator hose clamp and remove the radiator hose from the thermostat housing.



8. Remove capscrews securing thermostat housing (1) to the engine.
9. Remove thermostat housing, old gasket and thermostat. Clean all gasket surfaces. **DO NOT** allow dirt or debris into the thermostat opening.

Note: ALWAYS use correct thermostat and new gasket. NEVER operate engine without a thermostat.

b. Thermostat Installation

1. Install engine thermostat, gasket and housing. Secure with previously removed bolts. Torque as required.
2. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
3. Open the surge tank cap and fill the radiator completely with a 50/50 mixture of ethylene glycol and water. Add coolant solution at a maximum rate of 1.3 gallons per minute (5 liters per minute). Replace and tighten surge tank cap. Add coolant to surge tank until 1/4 to 1/2 full. This overfilling will compensate for any air trapped in the cooling system.
4. Run engine to operating temperature. Visually check for leaks with engine running. Check coolant level in surge tank and fill, or drain, as necessary.
5. Close and secure the engine cover.
6. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

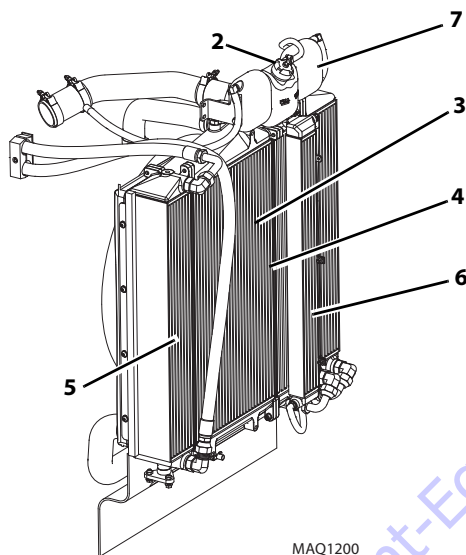


Engine

7.4.3 Radiator/Oil Cooler and Replacement

Before considering radiator or oil cooler replacement for other than obvious damage, conduct a cooling system pressure test, check coolant specific gravity, coolant level, fan belt tension and dash panel temperature indicator.

- If engine runs hot, check temperature of upper radiator hose.
- If hose is not hot, thermostat may be stuck in closed position.
- If engine has overheated, performance may suffer, indicating other damage including a leaking cylinder head gasket, cracked cylinder head or block, and/or other internal engine damage.



a. Radiator/Oil Cooler Removal

1. Park machine on a firm, level surface, level machine, fully retract the boom, lower boom, place transmission in (N) NEUTRAL, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery(s). Refer Section 9.8, "Battery", for procedure.
5. Slowly turn surge tank cap (2) to first stop and allow any pressure to escape. Remove surge tank cap.
6. Place a suitable container beneath radiator drain.

7. Place a funnel at base of radiator to channel drained coolant into a container. Loosen drain petcock and slowly allow coolant to drain. Transfer coolant into a properly labeled container. Dispose it properly if coolant needs to be replaced. Tighten the radiator drain petcock.
8. Label and disconnect all hoses and tubes attached to radiator (3), charge air cooler (4), oil cooler (5), and fuel cooler (6). Remove surge tank (7).
9. Working at rear of machine, remove capscrews and lock washers securing radiator assembly.
10. Remove radiator assembly through rear of machine.

b. Radiator/Oil Cooler Installation

1. Secure radiator (3), charge air cooler (4), oil cooler (5), and fuel cooler (6) to machine frame with previously used hardware. Reinstall surge tank (7).
2. Uncap and connect the all the previously labeled hoses and tubes to their appropriate locations.
3. Install the battery or batteries. Connect the battery positive (+) and negative (-) cables to the appropriate battery terminals.
4. Fill the radiator completely with coolant and secure cap. Refer to Section 2.3, "Fluid & Lubricant Capacities", for proper capacities.
5. Run engine to operating temperature. Visually check for leaks with engine running. Check coolant level in overflow bottle and fill, or drain, as necessary.
6. Close and secure side and rear engine cover.
7. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

7.5 ENGINE ELECTRICAL SYSTEM

The engine electrical system, including the starter, alternator and primary wiring, is described in Section 9, "Electrical System".



7.6 FUEL SYSTEM

7.6.1 Diesel Fuel

Fuel represents a major portion of machine operating costs and therefore must be used efficiently. ALWAYS use a premium brand of high-quality, clean diesel fuel. Low cost, inferior fuel can lead to poor performance and expensive engine repair.

Refer to Section 2.3, "Fluid & Lubricant Capacities", for approved fuel specification.

7.6.2 Fuel/Hydraulic Oil Tank

Note: The fuel/hydraulic oil tank is part of a one piece unit divided into a two compartment (tank) unit. It is located on the right side of the machine, across from the operator cab. If it is determined that either the fuel or hydraulic oil tank must be removed, both the fuel and hydraulic oil must be drained before tank removal. Always dispose of hydraulic oil or fuel properly.

a. Fuel/Hydraulic Oil Tank Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.

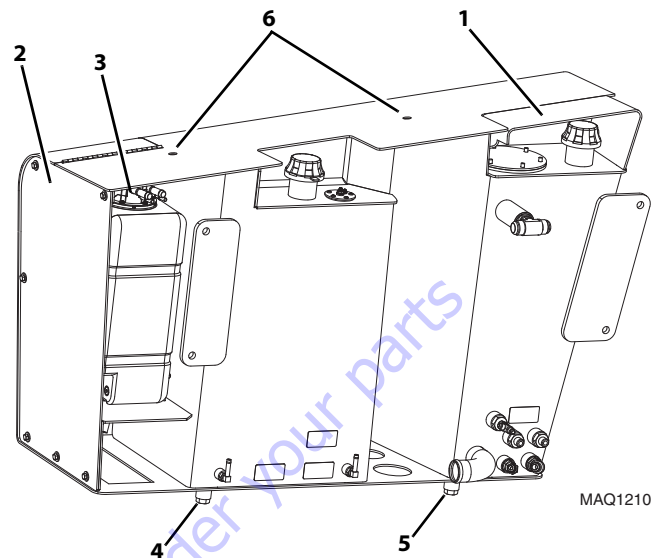
Note: If replacing the tank, remove all internal and external components from the old tank, and retain for use on the replacement tank.

Note: Have a dry chemical (Class B) fire extinguisher near the work area.



WARNING

NEVER drain or store fuel in an open container due to the possibility of explosion or fire. Discard the fuel in an approved manner.



5. Remove the hydraulic oil tank top cover (1).

Note: If equipped, the removal of the DEF tank is required to access the fuel/hydraulic oil tank mounting bolts.

6. Remove the DEF tank (3). Refer to Section 7.6.5, "Diesel Exhaust Fluid (DEF) Tank - 110 hp (82 kW) if equipped for ULS", for detailed removal instructions.
7. Drain the fuel tank (4). Remove the fuel tank drain plug and drain fuel into an approved and suitable container. Dispose of fuel properly.
8. Drain the hydraulic oil tank (5). Refer to Section 8.6.1, "Hydraulic Oil Reservoir Draining".
9. Label, disconnect and cap the fuel and hydraulic lines from the tank.
10. Label and disconnect the electrical components from the fuel/hydraulic oil tank.
11. Temporarily install two 1/2-13 lifting eye bolts in the top of the fuel/hydraulic tank (6).
12. Position and connect a suitable chain support to tank lifting point (6) and take up slack in the chain.
13. While supporting the tank, remove nuts and lock washers securing the tank to the machine frame.
14. Pull tank away from the tank carriage bolts and remove tank.



Engine

b. Disassembly

The fuel/hydraulic oil tank is a one-piece unit and cannot be disassembled. The fuel level indicator and hydraulic filters can be removed and reused on the new replacement tank. Dispose of the old tank according to local regulations concerning hazardous materials disposal.

c. Cleaning and Drying

If contaminated fuel or foreign material is in the tank, the tank can usually be cleaned.

Note: If a leak is suspected in the fuel tank, contact your local authorized Service Department.

To clean the fuel tank:

1. Have a dry chemical (Class B) fire extinguisher near the work area.
2. Depending on which side of the tank is contaminated (fuel or hydraulic oil), remove the fuel or oil tank drain plug, and safely drain any fuel or hydraulic oil into a suitable container. Dispose of fuel or hydraulic oil properly.
3. Clean the fuel/hydraulic oil tank with a high pressure washer, or flush the tank with hot water for five minutes and drain the water. Dispose of contaminated water properly.
4. For the fuel tank side, add a diesel fuel emulsifying agent to the tank. Refer to manufacturer's instructions for the correct emulsifying agent-to-water mixture ratio. Refill the tank with water, and agitate mixture for 10 minutes. Drain the tank completely. Dispose of contaminated water properly.
5. Refill the fuel tank with water until it overflows. Completely flush the tank with water. Empty the fuel tank, and allow it to dry completely.

d. Assembly

The fuel/hydraulic oil tank is a one piece-unit and cannot be disassembled. The fuel level indicator and hydraulic filters can be removed and reused on the new replacement tank. Dispose of the old tank according to local regulations concerning hazardous materials disposal regulations.

e. Inspection

Note: If a leak is suspected in the fuel tank, contact your local authorized Service Department.

1. Inspect the tank thoroughly for any cracks, slices, leaks or other damage.

2. With tank removed from machine, plug all openings except one elbow fitting. Install elbow fitting, and apply approximately 1 - 1.5 psi (7 - 10 kPa) of air pressure through elbow. Check reservoir for leaks by applying a soap solution to the exterior and look for bubbles to appear at cracked or damaged area.

f. Fuel/Hydraulic Oil Tank Installation

1. Attach tank to a suitable lifting device at lift point.
2. Place tank carriage bolts into slotted holes in frame.
3. Position the tank and insert carriage bolts through tank attachment holes. Install lock washers and finger tighten nuts onto carriage bolts. Slide the tank and carriage bolts toward the front of machine, until carriage bolts are bottomed out into the slotted frame holes. Tighten and torque as required.
4. Connect the previously labeled electrical components to the tank.
5. Uncap and connect the previously labeled hydraulic hoses to their appropriate locations.
6. Install the previously removed DEF tank. Refer to Section 7.6.5, "Diesel Exhaust Fluid (DEF) Tank - 110 hp (82 kW) if equipped for ULS", for detailed installation instructions.
7. Fill the hydraulic tank, fuel tank and DEF tank according to specifications. Refer to Section 2.3, "Fluid & Lubricant Capacities".
8. Fill the fuel tank.
9. Check tank for leaks.
10. Install the hydraulic oil tank cover.
11. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
12. Close and secure the engine cover.
13. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

7.6.3 After Fuel System Service

1. Drain and flush the fuel tank if it was contaminated.
2. Vent air from the fuel system in accordance with the instructions found in the appropriate Operation & Safety Manual.
3. Fill the fuel tank with fresh, clean diesel fuel as required.

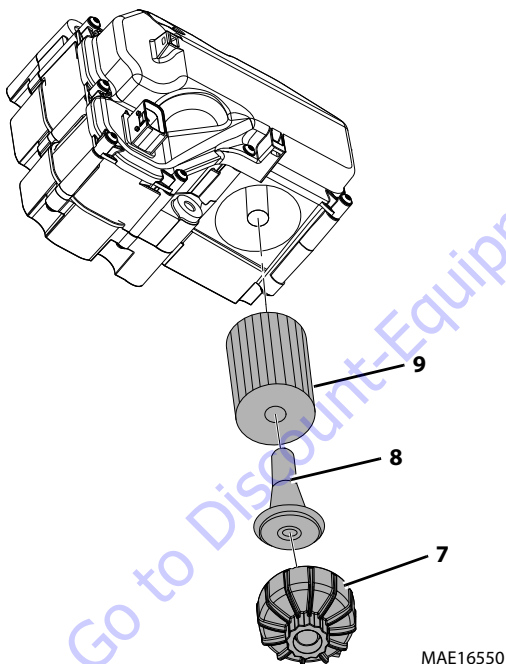


7.6.4 Diesel Exhaust Fluid (DEF) Pump Filter – 85 hp or 110 hp (63 kW or 82 kW) if equipped for ULS

The pump filter of the DEF System is only required to be replaced when system maintenance is required or exposed to contamination.

a. DEF Pump Filter Removal

1. Park the machine on a firm level surface, level machine, fully retract the boom, lower boom, place transmission in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery(s). Refer to Section 9.8, "Battery", for procedure.
5. Thoroughly clean the DEF pump and surrounding area.

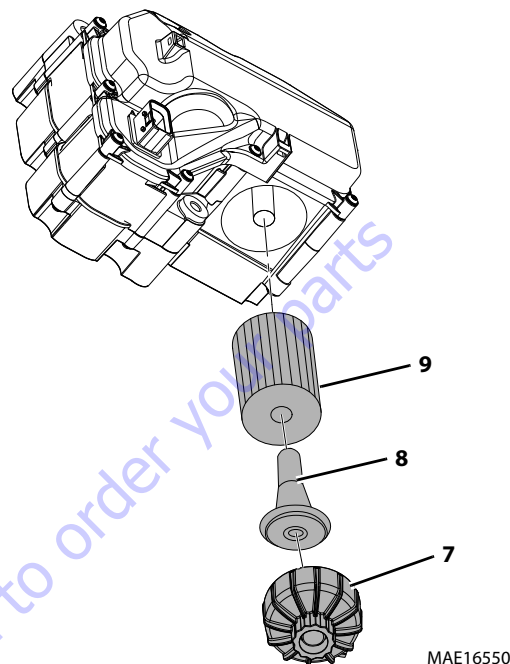


6. Remove the DEF pump filter cap (7), DEF seal assembly (8) and DEF pump filter (9). Discard the DEF pump filter (9).

b. DEF Pump Cleaning

1. Wipe out the inside area around the DEF pump filter housing with a mild dish washing soap and distilled water.
2. Thoroughly rinse the DEF pump filter housing with distilled water.

c. DEF Pump Filter Installation



1. Install new DEF pump filter (9) DEF seal assembly (8) and DEF pump filter cap (7). Tighten as required.
2. Properly connect the battery(s). Refer to Section 9.8, "Battery", for procedure.
3. Close and secure engine cover.
4. Remove Do Not Operate Tag from both ignition key switch and steering wheel.

7.6.5 Diesel Exhaust Fluid (DEF) Tank - 110 hp (82 kW) if equipped for ULS

Note: Contact Cummins at 1-800-CUMMINS for all service if the DEF tank assembly is still within warranty. Warranty may be voided if service is conducted by anyone other than Cummins service personnel.

Note: The following procedures are only to be performed when warranty is expired.

The DEF tank is located in the front of the fuel/hydraulic oil reservoir.

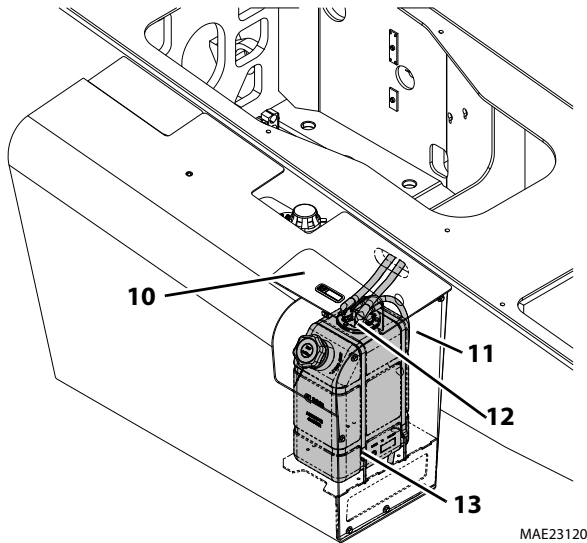
a. DEF Tank Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission in (N) NEUTRAL, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.

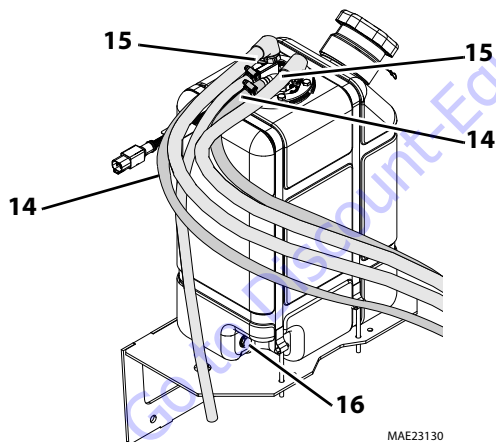


Engine

4. Properly disconnect battery. Refer Section 9.8, "Battery", for procedure.



5. Open DEF tank filler access cover (10).
6. Remove DEF tank access cover at the front of the hydraulic oil/fuel reservoir (11).
7. Thoroughly clean the DEF tank and surrounding area.
8. Disconnect electrical connection on top of DEF tank (12).



9. Loosen clamps, label, disconnect and plug and/or cap DEF tank coolant hoses (14).
10. Label, disconnect and plug and/or cap DEF tank DEF hoses (15).
11. Remove DEF tank drain plug (16) and transfer fluid into a suitable container. Dispose fluid at an approved recycling facility. Reinstall drain plug (16).
12. Remove straps (13) securing DEF tank to frame and remove DEF tank.

b. DEF Tank Inspection

1. If cleaning DEF tank, Refer to Section 7.6.8, "Diesel Exhaust Fluid (DEF) System Cleaning – 110 hp (82 kW) if equipped for ULS" for procedure.
2. If replacing DEF tank, remove all components and retain for use on replacement tank. Refer to Section 7.6.6, "Diesel Exhaust Fluid (DEF) Header – 110 hp (82 kW) if equipped for ULS".
3. Dispose of damaged DEF tank according to local regulations concerning hazardous material disposal.

c. DEF Tank Installation

1. Install all previously removed components. Refer to Section 7.6.5, "Diesel Exhaust Fluid (DEF) Tank - 110 hp (82 kW) if equipped for ULS", for detailed header installation procedure.
2. Install DEF tank and secure to frame with the previously removed straps (13).
3. Remove plugs and/or caps from the previously labeled DEF tank DEF hoses (15) and connect to their appropriate locations.
4. Remove plugs and/or caps from the previously labeled DEF tank coolant hoses (14) and connect to their appropriate locations. Tighten clamps.
5. Connect electrical connection on top of DEF tank (12).
6. Fill DEF tank according to specifications. Refer to Section 2.4, "Fluid and Lubricant Capacities".
7. Verify all DEF system hose connections are tight and secure from any sharp edges, moving parts and/or excessive heat.
8. Install DEF tank access cover at the front of the hydraulic oil/fuel reservoir (11).
9. Close DEF tank filler access cover (10).
10. Properly connect the battery(s). Refer to Section 9.8, "Battery", for procedure.
11. Close and secure engine cover.
12. Remove Do Not Operate Tag from ignition key switch and steering wheel.



7.6.6 Diesel Exhaust Fluid (DEF) Header – 110 hp (82 kW) if equipped for ULS

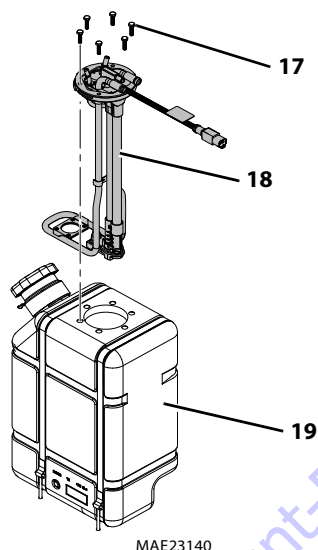
Note: Contact Cummins at 1-800-CUMMINS for all service if the DEF tank assembly is still within warranty. Warranty may be voided if service is conducted by anyone other than Cummins service personnel.

Note: The following procedures are only to be performed when warranty is expired.

The DEF header should be removed only when system maintenance is required.

a. DEF Header Removal

1. Refer to Section 7.6.5, "Diesel Exhaust Fluid (DEF) Tank - 110 hp (82 kW) if equipped for ULS", for DEF tank removal.

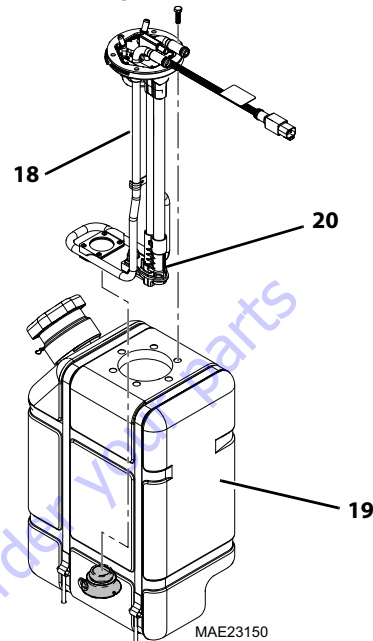


2. Loosen and remove six screws (17) securing header (18) to DEF tank (19).
3. Remove header (18) from DEF tank.

Note: Verify the orientation of the header for reassembly.

Note: In the event of DEF system contamination, the DEF system itself can be cleaned, but the DEF header must be discarded and replaced. Refer to Section 7.6.8, "Diesel Exhaust Fluid (DEF) System Cleaning – 110 hp (82 kW) if equipped for ULS" for DEF system cleaning.

b. DEF Header Filter Replacement



1. Remove old filter and discard.
2. Install new filter (20) to the header assembly (18).

c. DEF Header Installation

1. Orient and install the header assembly into the DEF tank (19).

Note: Verify the indent on the bottom of the header is located on the centering nub on the bottom of the DEF tank.

2. Install and secure the header (18) with the previously removed hardware (17).
3. Refer to Section 7.6.5, "Diesel Exhaust Fluid (DEF) Tank - 110 hp (82 kW) if equipped for ULS", for DEF tank installation.

7.6.7 Diesel Exhaust Fluid (DEF) Pump Filter – 85 hp or 110 hp (63 kW or 82 kW) if equipped for ULS

1. Refer to Section 7.6.4, "Diesel Exhaust Fluid (DEF) Pump Filter – 85 hp or 110 hp (63 kW or 82 kW) if equipped for ULS" for DEF pump filter information.



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7.6.8 Diesel Exhaust Fluid (DEF) System Cleaning – 110 hp (82 kW) if equipped for ULS

Note: Contact Cummins at 1-800-CUMMINS for all service if the DEF tank assembly is still within warranty. Warranty may be voided if service is conducted by anyone other than Cummins service personnel.

Note: The following procedures are only to be performed when warranty is expired.

Cleaning of the DEF System is only required when the system is exposed to contamination. If DEF quality is in question, obtain a sample from the DEF tank and place in a clear container. DEF should be crystal clear with a light ammonia smell. If the DEF appears cloudy, has a colored tint or has a strong ammonia smell, it is NOT likely to be within specifications.

Ensure the DEF solution is the correct specification. Cummins recommends using only DEF solutions that maintain 32.5% (+/- 1.5%) of urea content by weight. The urea content can be easily checked with a Refractometer (PN 70011925). The DEF solution must meet the requirements International Standard ISO 22241-1 for diesel engines. There is no acceptable substitute. For engines using Selective Catalytic Reduction (SCR) Systems, operating in the United States and Canada, DEF certified by the American Petroleum Institute (API) is recommended for use.

DEF should be stored in sealed containers and at 23° to 77° F (-5° to 25°C). Avoid storing containers in direct sunlight to assure better shelf life.

Note: The DEF header cannot be cleaned if contaminated. It must be replaced. Ensure a replacement header has been obtained before beginning DEF system cleaning procedures.

a. DEF Tank Cleaning

1. Refer to Section 7.6.5, "Diesel Exhaust Fluid (DEF) Tank - 110 hp (82 kW) if equipped for ULS" for DEF tank removal.
2. Refer to Section 7.6.6, "Diesel Exhaust Fluid (DEF) Header – 110 hp (82 kW) if equipped for ULS", for header removal.
3. Discard the contaminated header.
4. Remove the drain plug.
5. Thoroughly clean the DEF tank with a mild dish washing soap and distilled water.
6. Thoroughly flush the DEF tank with distilled water.
7. Install and tighten drain plug.

8. Refer to Section 7.6.6, "Diesel Exhaust Fluid (DEF) Header – 110 hp (82 kW) if equipped for ULS", for new filter and header installation.
9. Refer to Section 7.6.5, "Diesel Exhaust Fluid (DEF) Tank - 110 hp (82 kW) if equipped for ULS", for DEF tank installation.

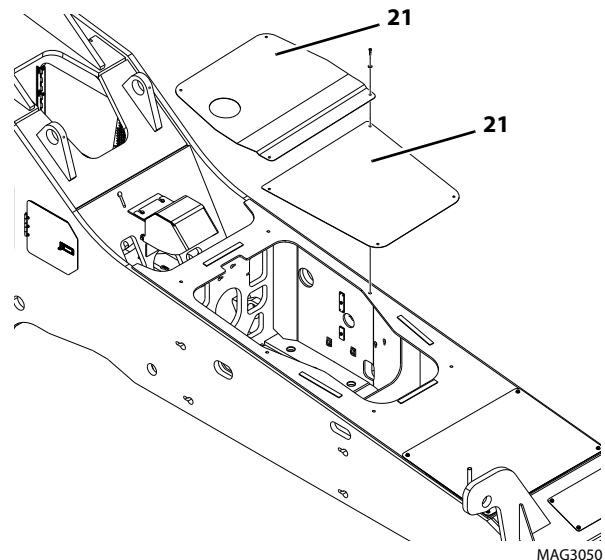
b. DEF Pump Cleaning

1. Refer to Section 7.6.4, "Diesel Exhaust Fluid (DEF) Pump Filter – 85 hp or 110 hp (63 kW or 82 kW) if equipped for ULS", for DEF pump filter cleaning procedure.

7.6.9 Diesel Exhaust Fluid (DEF) System – Engine Coolant Strainer Cleaning

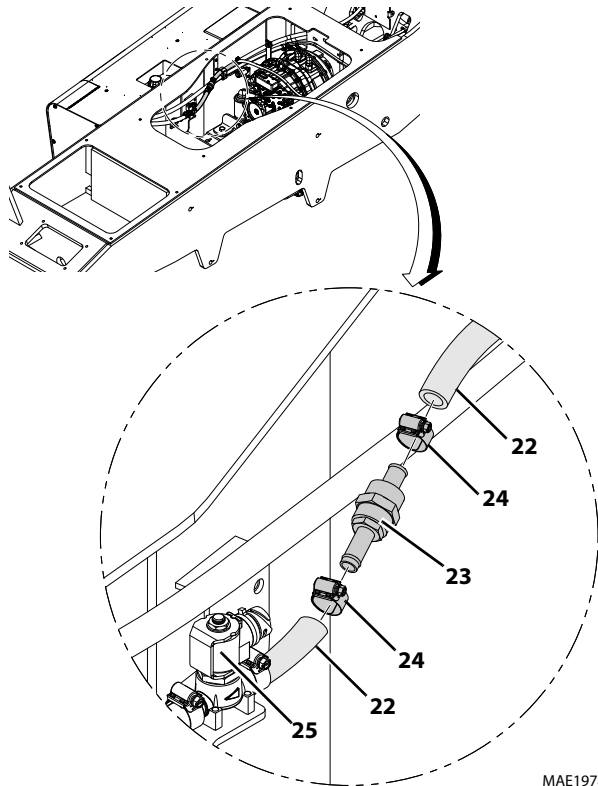
The engine coolant strainer is installed on the DEF engine coolant supply hose and should be cleaned every 2000 hours.

1. Park machine on a firm level surface, level machine, fully retract boom, level boom, place transmission in (N) NEUTRAL, engage park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side doors. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Remove and retain hardware and covers (21) from top of machine frame.

Note: Thoroughly clean DEF engine coolant supply hose, fittings, and surrounding area.



6. Clamp the DEF engine coolant supply hose (22) with hose pliers at each end of engine coolant strainer (23).

Note: Use a suitable container to catch coolant drainage beneath the engine compartment.

7. Loosen and remove two clamps (24) from DEF coolant supply hose (22). Remove engine coolant strainer (23).

Note: Prevent dirt, debris, and/or hose particles from entering exposed hose ends.

8. Loosen and separate the strainer housings. Remove the filter screen from inside strainer.

9. Brush any debris from the screen and upstream side of the housing.

Note: If the screen is damaged, replace engine coolant strainer.

10. Install the screen in its original location. To reassemble, connect strainer housings and torque from 35 - 45 ft.lbs (47 - 61 Nm).

11. Install strainer, oriented as shown, with the longer end pointing towards the DEF coolant valve (25). Secure with the two previously removed clamps. Orient clamps as shown.

12. Tighten and torque clamps to 40 in-lb (4,5 Nm).

13. Remove hose pliers from the DEF coolant supply hose.

14. Clean up debris, coolant, etc., in, on, near, and around the machine.

15. Properly connect the battery.

16. Start the engine and check strainer for leaks. Check the coolant level in the tank and add coolant as required.

17. Shut the engine OFF.

18. Reinstall covers to top of machine frame with previously removed hardware.

19. Close and secure the engine rear and side doors.

20. Remove Do Not Operate Tag from both ignition key switch and steering wheel.

21. Return machine to service.



Engine

7.7 ENGINE EXHAUST SYSTEM

Rattles and noise vibrations in the exhaust system are usually caused by misalignment or parts. When aligning the system, leave all capscrews and nuts slightly loose until all parts are properly aligned, then tighten all fasteners working from the front of the system to the rear.

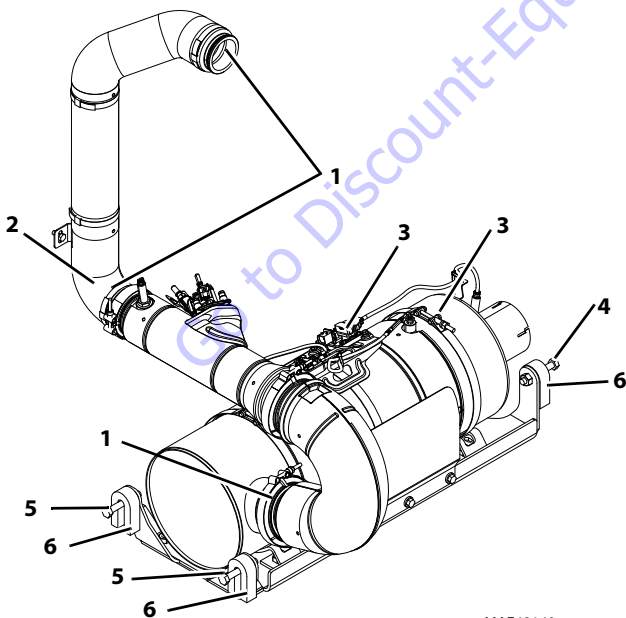
Before assembling components, use exhaust system sealer at all slip joint connections.

When installing exhaust system components, allow sufficient clearance between the components and other pipes, hoses and wiring that could be adversely affected by excessive heat.

7.7.1 Exhaust System - 85 hp or 110 hp (63 kW or 82 kW) if equipped for ULS

a. Exhaust Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure



5. Loosen three clamps (1) securing exhaust pipe to muffler and engine. Remove exhaust pipe (2).

6. Label and disconnect all coolant lines and electrical connections (3). Note the exact routing of all coolant and electrical lines.
7. Loosen two bolts (4) securing muffler mounting plate to machine frame on right side of machine. **Do Not Remove** bolts.
8. Remove two bolts (5) securing muffler mounting plate on left side of machine.

Note: For 12054 model, remove Spacer Block (6) from both the side of mounting plate.

9. Be sure to properly support muffler mounting plate and muffler for removal.
10. Drop muffler mounting plate down on left side.
11. Lift right side and slip bolts up and through slots on the right side of frame.
12. Place mounting plate on level surface and replace muffler, clamps and tailpipe. Note position of muffler for re-installation purposes.

b. Exhaust System Installation

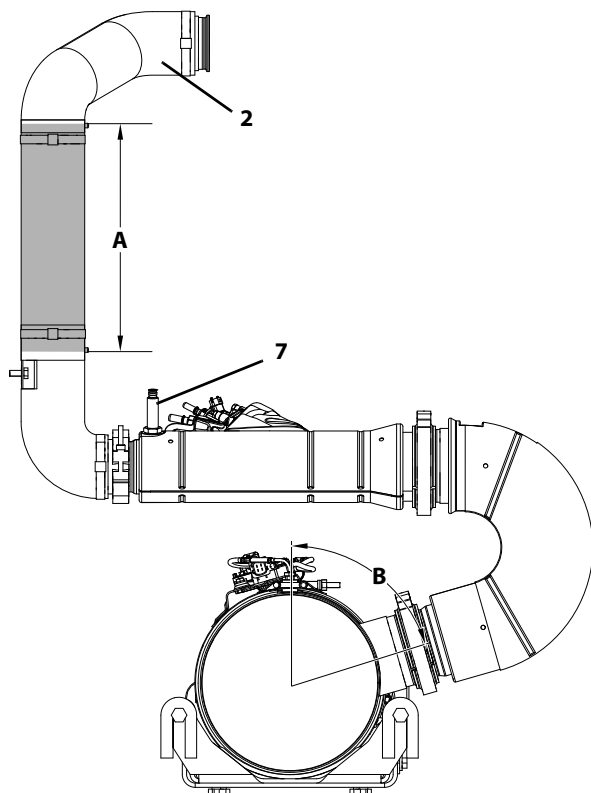
Note: Install muffler in proper direction.

Note: Keep all clamps loosened until entire exhaust system is in place.

1. Install muffler and tailpipe on muffler mounting plate using proper clamps in proper position.

Note: For 12054 model, Spacer Block (6) should be installed on both the side of mounting plate.

2. Lift muffler mounting plate up and slide mounting plate bolts (4) through slot in right side of frame.
3. Lift left side of muffler mounting plate up and re-install mounting plate bolts (5).
4. Tighten all mounting plate bolts and torque to 71.5 lb-ft (97 Nm).
5. Measure distance (A) 11.77 - 12.95 in. (299 - 329 mm) between the center of the locating pins on the flex pipe section of the exhaust pipe (2). Adjust if required.



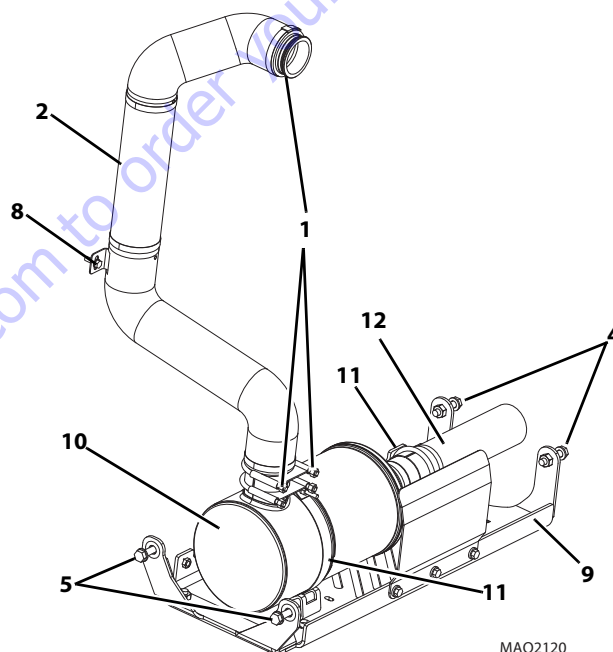
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6. Adjust the muffler intake tube to approximately (B) 74.0°.
7. Install exhaust pipe (2) to muffler and engine.
8. Verify NoX sensor (7) is mounted in the vertical position ($\pm 10^\circ$).
9. Adjust the muffler intake tube to approximately (B) 74.0°.
10. Tighten all clamps (1).
11. Install all previously removed coolant lines and reconnect electrical connections. Verify proper routing of all coolant and electrical lines.
12. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
13. Start engine and check for exhaust leaks at all exhaust connections. Adjust or repair as needed.
14. Close and secure the engine cover.
15. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

7.7.2 Exhaust System - 74 hp (55 kw) if equipped for ULS

a. Exhaust Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the rear door. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.



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5. Loosen three clamps (1) securing exhaust pipe to muffler and engine.
6. Loosen two bolts (8) securing exhaust pipe to frame.
7. Remove exhaust pipe (2).
8. Loosen two bolts (4) securing muffler mounting plate (9) to machine frame on right side of machine. **Do Not Remove** bolts.
9. Remove two bolts (5) securing muffler mounting plate on left side of machine.
10. Be sure to properly support muffler mounting plate and muffler for removal.
11. Drop muffler mounting plate down on left side.
12. Lift right side and slip bolts up and through slots on the right side of frame.



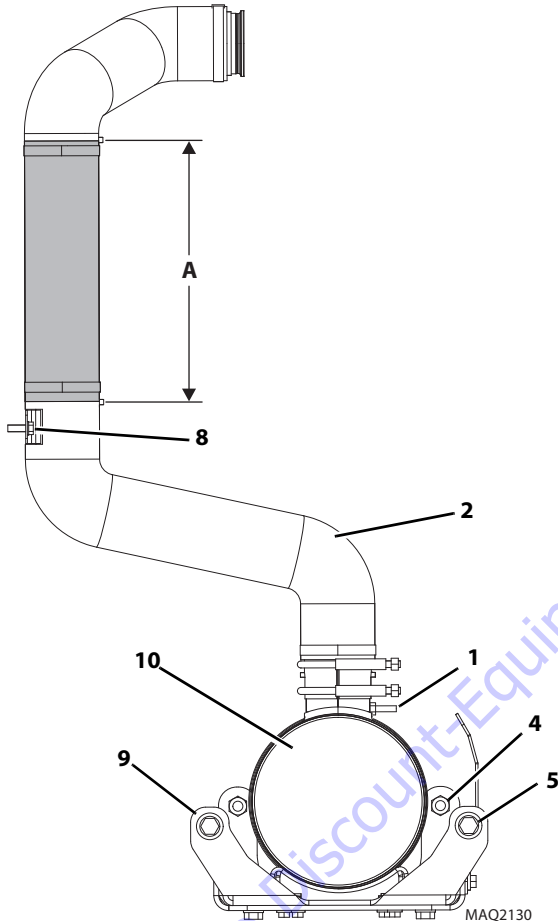
Engine

- Place mounting plate (9) on level surface and replace muffler (10), clamps (11) and tailpipe (12). Note position of muffler for re-installation purposes.

b. Exhaust System Installation

Note: Install muffler in proper direction.

Note: Keep all clamps loosened until entire exhaust system is in place.



- Install muffler (10) and tailpipe on muffler mounting plate (9) using proper clamps (1) in proper position. **DO NOT** tighten.
- Lift muffler mounting plate up and slide mounting plate bolts (4) through slot in right side of frame.
- Lift left side of muffler mounting plate up and re-install mounting plate bolts (5).
- Tighten all mounting plate bolts.
- Tighten band clamp (10) enough to hold the muffler in place.
- Install exhaust pipe (2) to muffler and engine.
- Install exhaust pipe mounting bolts (8) to frame.

- Measure distance (A) 11.77-12.95 in. (299-329 mm) between locating pins on the flex pipe section of the exhaust pipe (2).

The following steps may be required to achieve distance (A) (Expanded web).

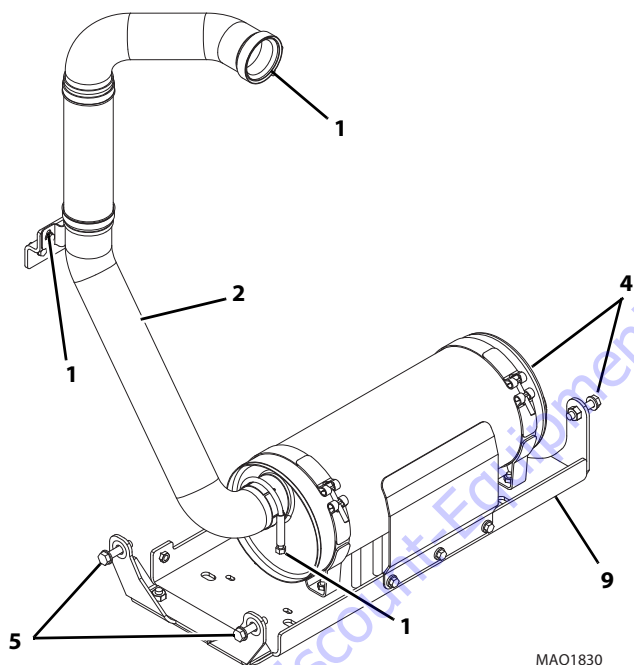
- Loosen the turbocharger clamp to allow rotation of the top exhaust pipe (2). Do Not remove clamp.
 - Pull up and out on exhaust pipe (2) to allow for a straight line and expansion of the flex pipe.
 - Tighten the turbocharger clamp while holding the exhaust pipe (2) in place.
 - If the flex pipe is in a "S" shape, loosen the band clamp (1) securing the muffler.
 - Rotate the muffler inlet tube forward until the flex pipe becomes straight.
 - It may be necessary to pull the muffler closer to the frame until the flex pipe becomes straight.
- Tighten the muffler band clamp and all remaining clamps.
 - Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
 - Start engine and check for exhaust leaks at all exhaust connections. Adjust or repair as needed.
 - Close and secure the rear door.
 - Remove Do Not Operate Tags from both ignition key switch and steering wheel.



7.7.3 Exhaust System - 85 hp (63 kW) if equipped for LS

a. Exhaust Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.



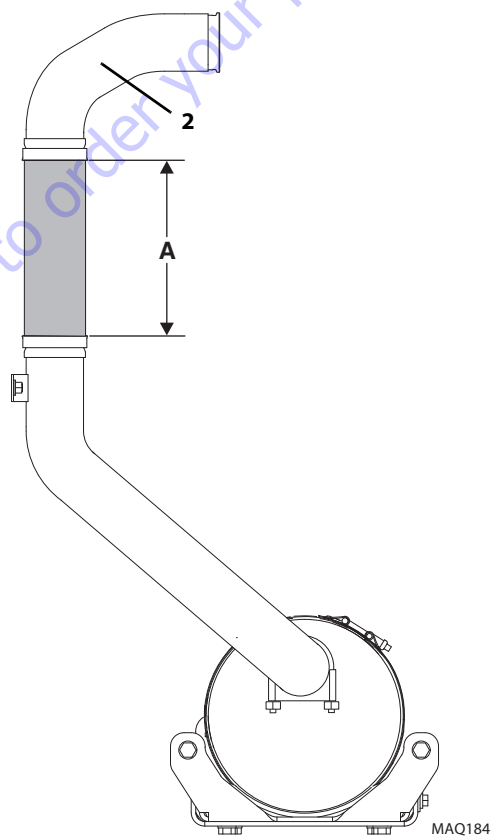
5. Loosen three clamps (1) securing exhaust pipe to muffler and engine. Remove exhaust pipe (2).
6. Loosen two bolts (4) securing muffler mounting plate to machine frame on right side of machine. **Do Not Remove** bolts.
7. Remove two bolts (5) securing muffler mounting plate on left side of machine.
8. Be sure to properly support muffler mounting plate and muffler for removal.
9. Drop muffler mounting plate down on left side.
10. Lift right side and slip bolts up and through slots on the right side of frame.
11. Place mounting plate on level surface and replace muffler, clamps and tailpipe. Note position of muffler for re-installation purposes.

b. Exhaust System Installation

Note: Install muffler in proper direction.

Note: Keep all clamps loosened until entire exhaust system is in place.

1. Install muffler and tailpipe on muffler mounting plate (9) using proper clamps in proper position.
2. Lift muffler mounting plate up and slide mounting plate bolts (4) through slot in right side of frame.
3. Lift left side of muffler mounting plate up and re-install mounting plate bolts (5).
4. Tighten all mounting plate bolts.



5. Measure distance (A) 11.95-12.75 in. (304-324 mm) of the flex pipe section of the exhaust pipe (2). Adjust if required.
6. Install exhaust pipe (2) to muffler and engine.
7. Tighten all clamps (1).
8. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
9. Start engine and check for exhaust leaks at all exhaust connections. Adjust or repair as needed.
10. Close and secure the engine cover.
11. Remove Do Not Operate Tags from both ignition key switch and steering wheel.



7.8 AIR CLEANER ASSEMBLY

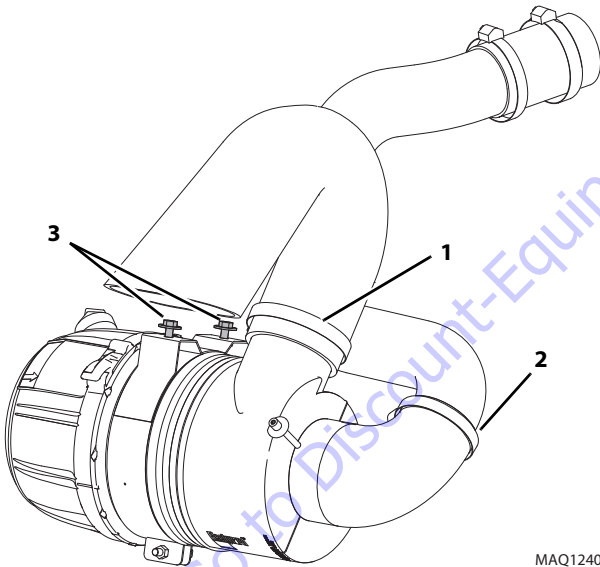
CAUTION

NEVER run the engine with only the inner safety element installed.

Note: Refer to the appropriate Operation & Safety Manual for the correct element change procedure.

7.8.1 Air Cleaner Assembly Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place the transmission in (N) NEUTRAL, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.



5. Loosen clamp securing air intake tube (1) and remove tube.
6. Loosen clamps securing air cleaner hose (2) to air cleaner assembly and remove elbow/hose from air cleaner assembly.
7. Remove capscrews and lock washers (3) securing mounting band to air cleaner bracket. Remove air cleaner assembly.

7.8.2 Air Cleaner Assembly Installation

Note: Refer to Section 2.6, "Threadlocking Compound" for all thread locking requirements.

1. Secure air cleaner assembly to air cleaner bracket with previously used hardware (3).
2. Install the air cleaner assembly.
3. Install air cleaner hose (2) to the air cleaner assembly and secure with clamps.
4. Install air intake tube (1) and secure with clamp.
5. Tighten all clamps.
6. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
7. Close and secure engine cover.
8. Remove Do Not Operate Tags from both ignition key switch and steering wheel.



7.9 ENGINE REPLACEMENT

7.9.1 Engine Removal

Note: Engine Lift Bracket Kit PN 1001177168 is required for proper engine removal.

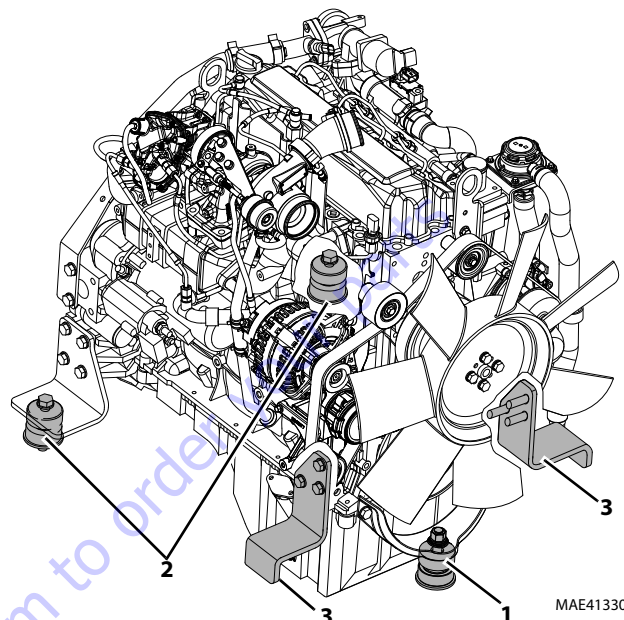
Note: The radiator and oil cooler must be removed from the machine before engine removal. Refer to Section 7.4, "Engine Cooling System" Several additional components must be removed before engine removal. They will be addressed in the following procedures.

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Remove the engine cover.
6. Drain and remove radiator assembly. Refer to Section 7.4.3, "Radiator/Oil Cooler and Replacement".
7. Label, disconnect and cap the heater hoses attached to the engine (if equipped).

Note: The engine harness is routed and attached to the engine using hold-down clamps and plastic wire ties at various places on the engine. Before removing engine, ensure that the harness has been completely separated (disconnected) from the engine. Move the harness clear of the engine, and with the help of an observer, ensure that the engine clears the harness during removal.

8. Label and disconnect all electrical wire connections on the engine.
9. Label, disconnect and cap the fuel inlet line at the fuel lift pump.
10. Label, disconnect and cap the fuel return line from the injector pump.
11. Remove the engine-to-transmission drive shaft. Refer to Section 5.5.2, "Drive Shaft Removal".
12. Loosen the clamps on the sleeve reducer at the engine and on the air suction pipe.
13. Remove air intake hoses and pre-cleaner. It is not necessary to remove air cleaner assembly before engine is removed from frame.

14. Remove the exhaust pipe and muffler system. Refer to Section 7.7.1, "Exhaust System - 85 hp or 110 hp (63 kW or 82 kW) if equipped for ULS".



15. At the front right engine mount (1), remove the hardware securing the mount to the frame.
16. Remove hardware securing rear engine mounts (2).
17. Remove the exhaust pipe bracket.
18. Install left and right engine lift brackets (3).
19. Position a fork truck behind the machine, and drive forward, placing the forks underneath the rear engine mount and front engine lift brackets. Slightly lift the engine, and slowly back engine out of the machine. Have an assistant ensure that the engine clears all frame components during removal.
20. Place engine on a flat, level surface.
21. If replacing engine, attach a lifting chain to the front and rear engine lift brackets, and lift engine clear of the ground.
22. Remove the two engine lift brackets (3).
23. Remove the three engine mounting brackets.
24. Remove air intake assembly.



Engine

7.9.2 Engine Installation

Note: The engine harness is routed and attached at various places on the engine using hold-down clamps and plastic wire ties. Before installing engine and with the help of an assistant, ensure that the engine clears the harness during installation.

1. If replacing the engine, attach a lifting strap or chain to the front and rear engine lift brackets, and lift the engine clear of the ground.
2. Install the engine mounting brackets. Torque to 93-100 lb-ft (125-135 Nm).
3. Install left and right engine lift brackets (3).
4. Place the engine on a flat, level surface.
5. Position a fork truck behind the engine, and drive forward, placing the forks underneath the rear engine mount and front right and left engine lift brackets. Lift the engine and slowly drive it into the back of the machine. Have an assistant ensure that the engine clears all frame, hose and harness components during installation. Position the engine brackets over rear and front frame mounts.
6. Secure the rear engine mounts (2) to the frame using the previously used hardware. Torque to 135 lb-ft (100 Nm).
7. Secure front (1) engine mount to frame using previously used hardware. Torque to 135 lb-ft (100 Nm).
8. Remove the two engine lift brackets (3).
9. Install exhaust pipe mount bracket.
10. Install the radiator overflow tube, overflow tank and hose support.
11. Install the engine-to-transmission drive shaft. Refer to Section 5.5.3, "Drive Shaft Installation".
12. Uncap and connect the previously labeled fuel return line to the injector pump.
13. Uncap and connect the previously labeled fuel inlet line to the fuel lift pump.
14. Connect the previously labeled electrical wire connections on the engine.
15. Uncap and connect the previously labeled heater hoses to the engine (if equipped).
16. Install the complete radiator assembly. Refer to Section 7.4.3, "Radiator/Oil Cooler and Replacement".
17. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
18. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

19. Check that all hydraulic system, electrical system, cooling system, fuel system and exhaust system connections are correct and connected tightly.

Note: Have an assistant stand by with a Class B fire extinguisher.

20. Start the engine and run to normal operating temperature then shut off the engine. While the engine is cooling, check for leaks.
21. Allow the engine to cool. Check the radiator coolant level, and add coolant if needed. Replace the radiator cap.
22. Check for leaks from the engine, main hydraulic pump and lines, transmission, hydraulic reservoir and fuel tank. Check the levels of all fluids and lubricants. Fill as required.

Note: During the full throttle check:

- **DO NOT** operate any hydraulic function.
 - **DO NOT** steer or apply any pressure to the steering wheel.
 - Place the transmission in (N) NEUTRAL.
23. Obtain and connect an appropriate engine analyzer or tachometer. Check the engine rpm at full throttle.
 24. Purge the hydraulic system of air by operating all boom functions through their entire range of motion several times. Check the hydraulic oil level.
 25. Check for proper operation of all components.
 26. Turn the engine OFF.
 27. Install the side and rear engine covers.



7.10 ISOLATION COUPLER

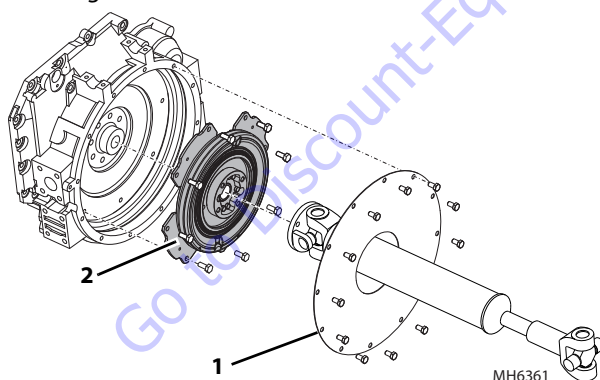
7.10.1 Isolation Coupler Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.

Note: Rotating the fan belt by hand gives greater access to removing the drive shaft mounting capscrews.

5. Remove the capscrews and straps that secure the drive shaft to the transmission yoke.
6. Remove the capscrews and lock washers securing the drive shaft to the coupling flange.

Note: It may be necessary to loosen/remove the motor mounts on either side of the engine to gain access to the bottom capscrews on the outer half of the coupler. Place a jack under the bell housing (use a wood block to support the engine) and carefully lift the engine until the bottom edge of the bell housing is at the top edge of the frame member that mounts the rear axle to the frame. Watch the fan-to-radiator clearance as you are lifting the engine. If necessary, turn the fan slightly by hand to gain additional clearance.



7. Remove the capscrews and lock washers securing the access cover plate (1).
8. Remove the capscrews securing the coupler (2) to the flywheel.

Note: The coupler is heavy and requires two people, one on each side, to remove.

9. Remove the coupler assembly.

10. At this time, use a suitable cleaner/solvent and thoroughly clean the mounting lip of the flywheel. Wipe any debris from the inside of the bell housing. Use the cleaner to clean the threaded holes around the flange of the bell housing.

7.10.2 Isolation Coupler Installation

1. Use cleaner to clean the backside of the coupler, where it comes in contact with the flywheel.

Note: Refer to Section 2.6, "Threadlocking Compound" for all thread locking requirements.

Note: The new coupler is heavy and requires two people, one on each side, to install.

2. Place the new coupler into the indentation of the flywheel and use new hardware to secure the coupler to the flywheel. **DO NOT** fully tighten until all capscrews are in place.
3. After all capscrews are in place, check to be sure the coupler is resting squarely in the indentation of the flywheel. Torque all the capscrews to 40.5 lb-ft (55 Nm).

Note: Before assembling the drive shaft to the coupling; be sure the access cover plate is placed on the engine-side of the frame member that mounts the rear axle to the frame.

4. Install the access cover plate over the drive shaft and assemble the drive shaft flange to the coupler using new hardware. Torque to 48 lb-ft (65 Nm).
5. If engine mounts were previously removed or loosened, carefully lower the engine down onto the front engine mounts. Reassemble the rebound washer and secure in place with a new locknut. Torque to 60 lb-ft (81 Nm). Repeat this procedure for the engine mount on the other side.
6. Thoroughly clean the transmission yoke and secure in place with new straps and hardware. Torque to 55 – 60 lb-ft (75 – 81 Nm).
7. After the drive shaft is in place, grease both u-joints and the slip joint using multi-purpose grease.
8. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
9. Close and secure the engine cover.
10. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

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Section 8

Hydraulic Section

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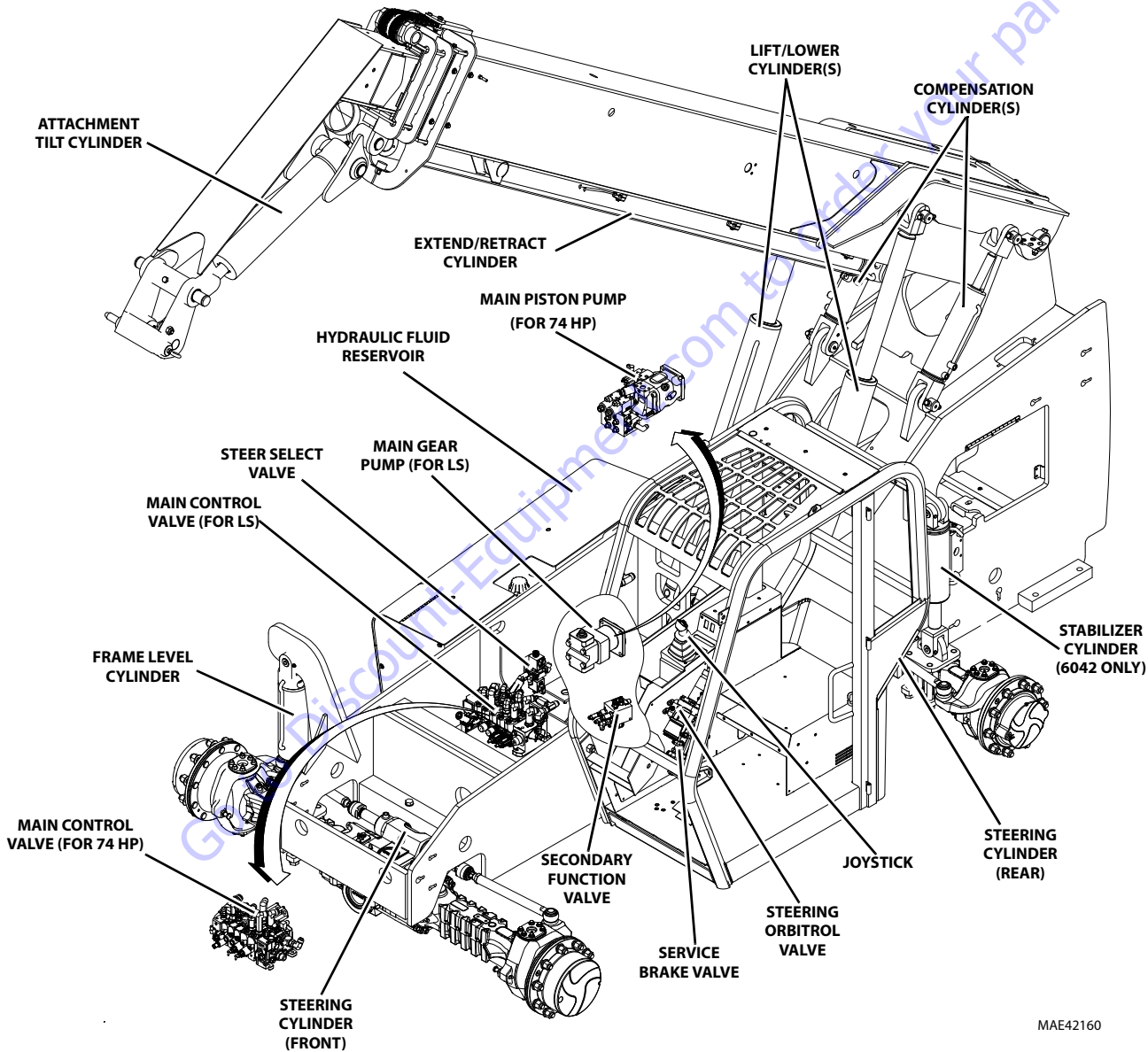
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8.1 HYDRAULIC COMPONENT TERMINOLOGY

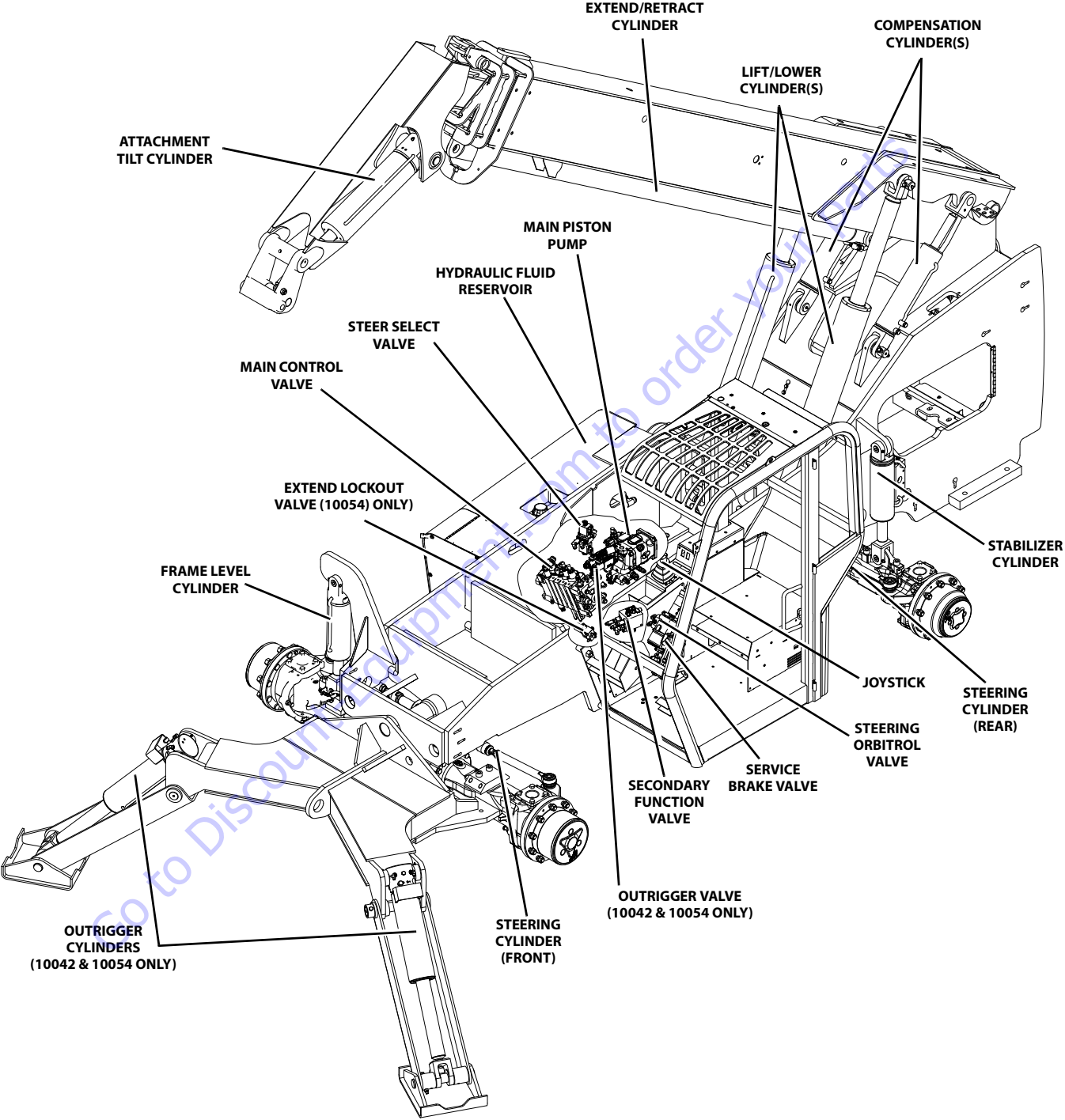
To understand the safety, operation and service information presented in this section, it is necessary that the operator/mechanic be familiar with the name and location of the hydraulic components of the machine. The following illustration identifies the components that are referred to throughout this section.

6036 & 6042





8042, 10042 & 10054

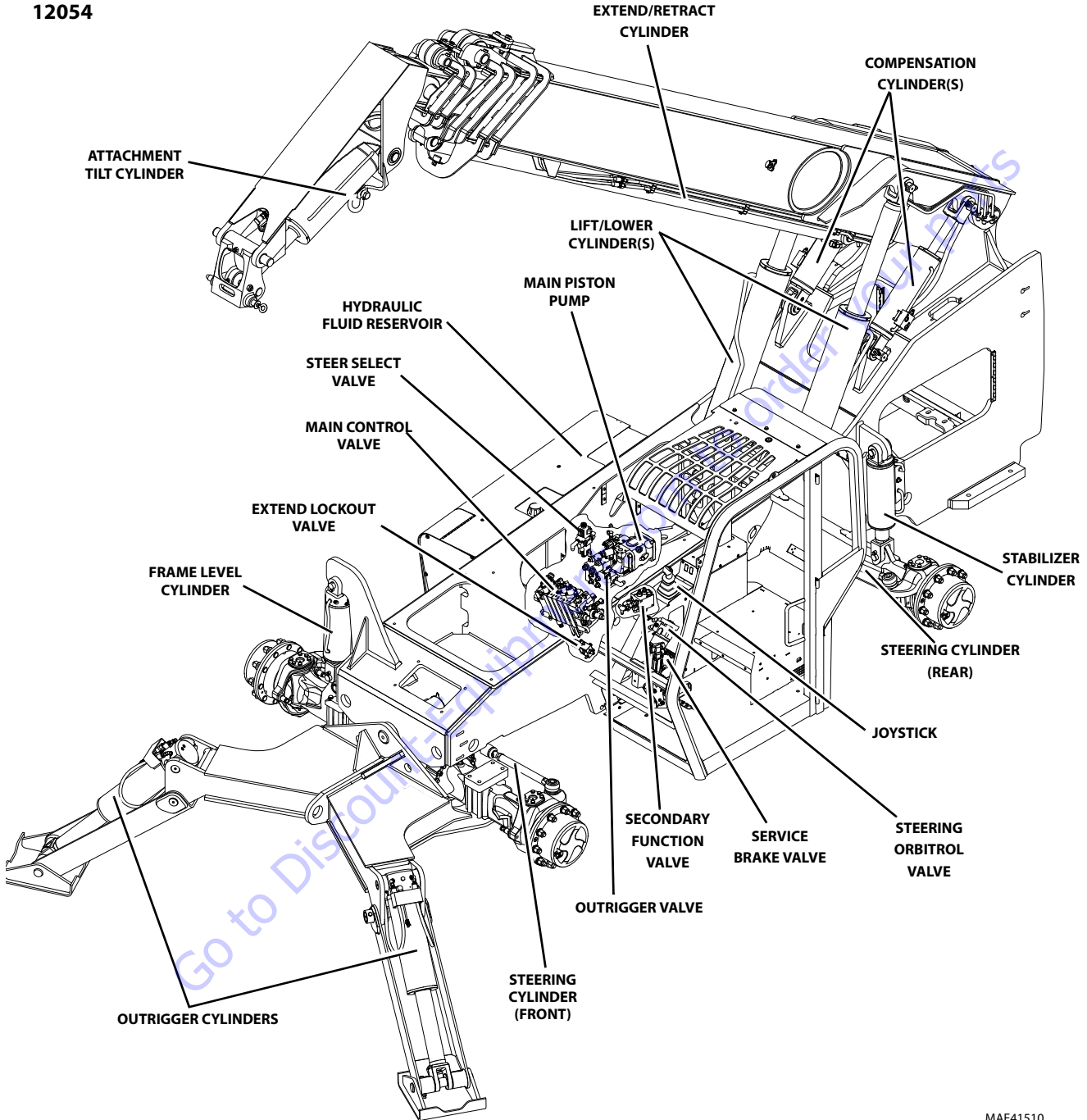


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Hydraulic Section

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8.2 SAFETY INFORMATION

WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, "Safety Practices", of this manual.

Petroleum-based hydraulic fluids are used in this machine. Temperature of hydraulic fluid increases during operation of various hydraulic functions. A heated petroleum-based hydraulic fluid presents a fire hazard, especially when an ignition source is present. Hydraulic fluid has a flash point that ranges from 300 - 600° F (150 - 318° C) and an auto-ignition temperature of 500 - 750° F (262 - 402° C).

Accordingly, periodically inspect all hydraulic system components, hoses, tubes, lines, fittings, etc. Carefully examine any deterioration and determine whether any further use of the component would constitute a hazard. If in doubt, replace the component.

Operate the hydraulic controls after the engine has stopped to relieve trapped pressure.

Whenever you disconnect a hydraulic line, coupler, fitting or other component, slowly and cautiously loosen the part involved. A hissing sound or slow seepage of hydraulic fluid may occur in most cases. After the hissing sound has ceased, continue removing the part. Any escaping oil should be directed into an appropriate container. Cap or otherwise block off the part to prevent further fluid seepage.

Hydraulic system maintenance will, at times, require that the engine be operated. Always follow safety precautions.

A major cause of hydraulic component failure is contamination. Keeping the hydraulic fluid as clean as possible will help avoid downtime and repairs. Dirty or contaminated hydraulic oil can damage internal components and void the manufacturer's warranty. When servicing the system, cap or plug hydraulic fittings, hoses and tube assemblies. Plug all cylinder ports, valves and the hydraulic reservoir, and pump openings until installation occurs. Protect threads from contamination and damage.

Manufacturer's recommended hydraulic oil cleanliness levels are based on the three digit ISO code for 6 micron/ 14 micron particle sizes found in one ml of fluid (reference ISO 4406: 199(E)). The acceptable level is 17/14 or below; anything higher requires system cleaning and filter replacement.

Note: *The human eye can only distinguish particles down to 40 microns.*

Reference Section 2.4, "Service and Maintenance Schedules", for the appropriate maintenance intervals based on hours of operation, but if your equipment is exposed to extremely dirty or hostile conditions service may be required more frequently. Always use OEM filters to assure the necessary filtration requirements are met.

Some hydraulic functions are actuated by interfacing with electrical system components (switches, solenoids and sensors). When the hydraulic system is not functioning properly, check the electrical aspect of the malfunctioning circuit also. Refer to Section 9.5, "Electrical System Schematics".

8.3 SPECIFICATIONS

Refer to Section 2.2, "Specifications", for hydraulic system specifications.



8.4 HYDRAULIC CIRCUITS

This section covers the hydraulic circuits and includes listings for all hydraulic function pressures, where and how to check those pressures and a hydraulic schematic.

Electrical and hydraulic functions are often related. Verify that electrical components of the circuit are functioning properly whenever troubleshooting the hydraulic circuit.

Always check the following before beginning to troubleshoot a circuit that is not functioning correctly.

1. Check hydraulic oil level in reservoir. Level should be in middle of sight glass with all cylinders retracted.
2. Check hoses, tubes, fittings and other hydraulic components for leaks, bends, kinks, interference, etc.
3. Check for air in the hydraulic system. Erratic machine performance and/or spongy cylinder operation are signs of air in the hydraulic system. If air in the hydraulic system is suspected, you will hear air leakage when hydraulic fittings are loosened and see air bubbles in the hydraulic fluid.
4. Loose fittings, faulty o-rings or seals, trapped oil, leaks, system opened for service, etc., can cause air in the system. Determine what is causing air to enter the system and correct it. Bleed air from the system.

8.5 HYDRAULIC PRESSURE DIAGNOSIS

8.5.1 Pressure Checks and Adjustments

When diagnosing trouble in the hydraulic system, use the hydraulic testing information in Section 8.5.2, "Pressure Specifications".

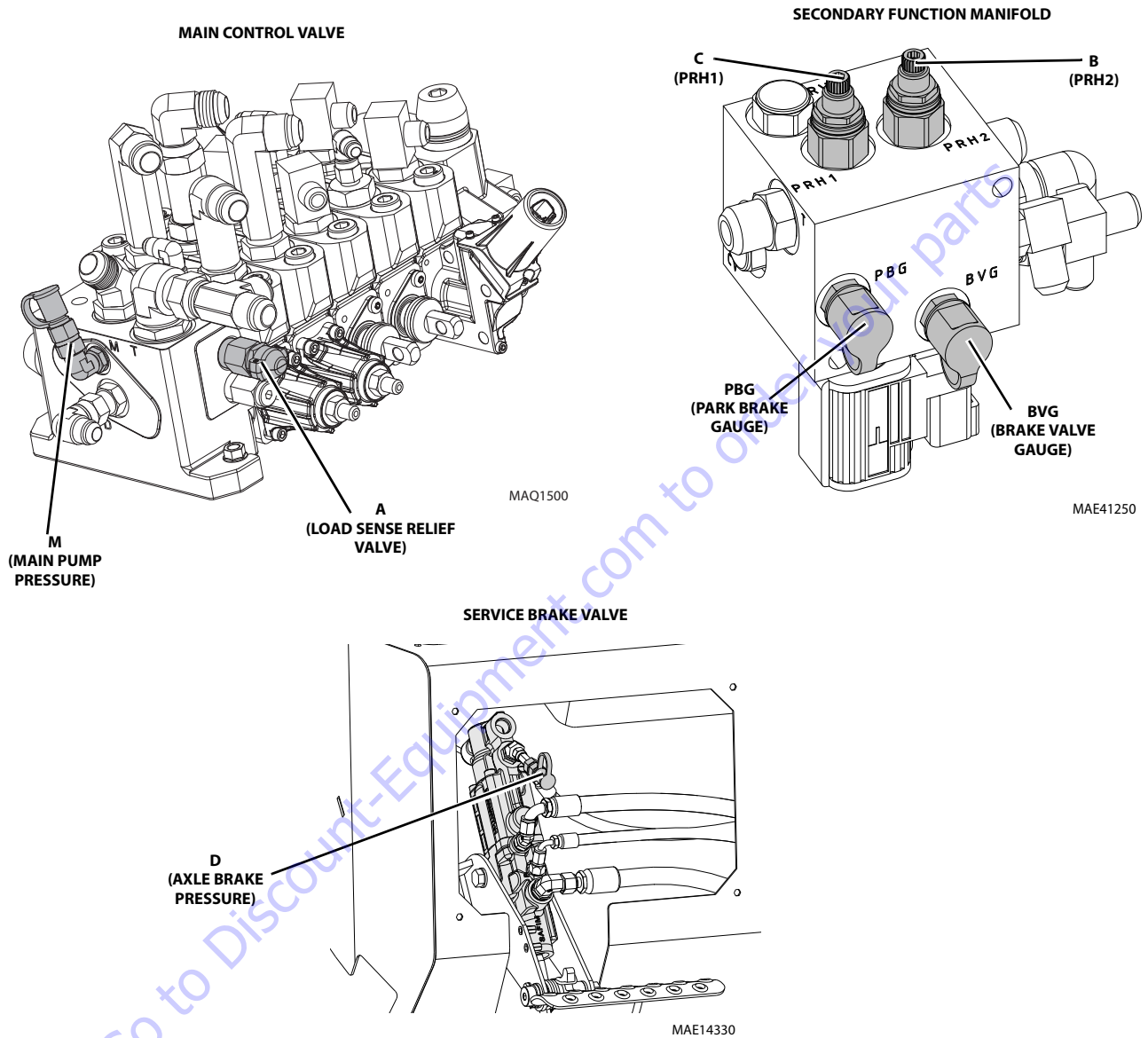
In general, follow the steps below whenever conducting pressure checks and performing adjustments:

1. Park the machine on a firm, level surface, engage the park brake, place the transmission in (N) NEUTRAL, level the boom and turn the engine OFF.
2. Install a digital or a 5000 psi (345 bar) at the appropriate test port.
3. All hydraulic pressures are factory set and/or adjusted at an ambient temperature between 60-80°F (15,5-26,6°C).
4. Start the engine. If necessary, operate machine functions several times to allow hydraulic oil to reach operating temperature.
5. Refer to Section 8.5.2, "Pressure Specifications", for testing procedures.
6. Fully depress accelerator pedal if required. Place and hold joystick in position needed to operate the particular machine function being checked. Continue holding the joystick in position until pressure is stable and readings are taken.
7. Check pressure gauge reading. It should read as specified in Pressure Readings column of the charts found in Section 8.5.2, "Pressure Specifications". If the reading is not as specified, turn the engine OFF and check other components in the system. Verify that all related hydraulic components and electrical switches, sensors, solenoids, etc. are operating correctly.



8.5.2 Pressure Specifications

a. 6036 - 85 hp (63 kW)



Note: Install pressure gauge at test port M on main control valve BEFORE Starting engine. All pressures must be checked in numerical order.

Note: Only operate the functions that are specified in the particular pressure check. Operating other functions than those specified may cause false readings.

Note: Boom level unless otherwise noted.



Hydraulic Section

	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/ Pressure	Notes
1	Standby (low idle)	M	Connect gauge to M port, run engine at low idle, no function.	NA	325 - 375 psi (22,4 - 25,8 bar)	Park Brake - ON
2	Standby (high idle)	M	Connect gauge to M port, run engine at high idle, no function.	NA	525 - 575 psi (36,2 - 39,6 bar)	Park Brake - ON
3	Main Pump/Load Sense (high idle)	M	Connect gauge to M port, run engine at high idle, fully retract extend/retract cylinder. NOTE: When bottoming Lift, Tilt, Frame Level or Auxiliary at high idle, the pressure seen at the M port should be within 100 psi (6,4 bar) of the noted extend/retract cylinder pressure.	LS (A)	3050-3100 psi (210,3-213,7 bar)	Park Brake - ON
4	Steering (low idle)	M	Connect gauge to M port, run engine at low idle, in front steer mode, turn steering lock to lock.	NA	2600-2700 psi (179,3-186,2 bar)	Park Brake - ON Front Steering Mode Selected
5	Secondary Function Manifold (Service Brake) (high idle)	BVG	Connect gauge to BVG port, run engine at high idle, fully retract extend/retract cylinder.	PRH2(B)	550-560psi (37,9-38,6 bar)	Park Brake ON
6	Secondary Function Manifold (Service Brake) (high idle)	BVG	Connect gauge to BVG port, run engine at high idle, stall steering. Pressure should not increase more than 30 psi (2,0 bar) from pressure 5.	NA	580-590psi (39,9-40,6 bar)	Park Brake - ON
7	Secondary Function Manifold (Park Brake Pressure) (high idle)	PBG	Connect gauge to PBG port, run engine at high idle, fully retract extend/retract cylinder. NOTE: Range/Pressure should repeat in all machine conditions with park brake ON.	NA	0-10 psi (0-0,7 bar)	Park Brake - ON
8	Secondary Function Manifold (Park Brake Pressure) (high idle)	PBG	Connect gauge to PBG port, run engine at high idle, fully retract extend/retract cylinder, switch park brake OFF.	PRH1(C)	380-390 psi (26,2-26,8 bar)	Park Brake - OFF
9	Steering (high idle)	PBG	Connect gauge to PBG port, run engine at high idle, stall steering. Pressure should not increase more than 30 psi (2,0 bar) from pressure 8.	PRH1(C)	410-420 psi (28,2-28,9 bar)	Park Brake - OFF
10	Service Brake (low idle)	D	Block tire, connect gauge to D port. Start engine and run at low idle. Do Not apply brake pedal pressure.	NA	0 psi (0 bar)	Park Brake - OFF



	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/ Pressure	Notes
11	Service Brake (low idle)	D	Connect gauge to D port, run engine at low idle, apply maximum brake pedal effort.	NA	650 psi (44,8 bar) Minimum	Park Brake - OFF
12	Service Brake (low idle)	D	Connect gauge to D port. Verify machine is parked on flat ground, Run engine at low idle, transmission in (N) Neutral, turn engine OFF, wait 3 seconds, apply maximum brake pedal effort.	NA	80 psi (5,5 bar) Minimum	Park Brake - OFF

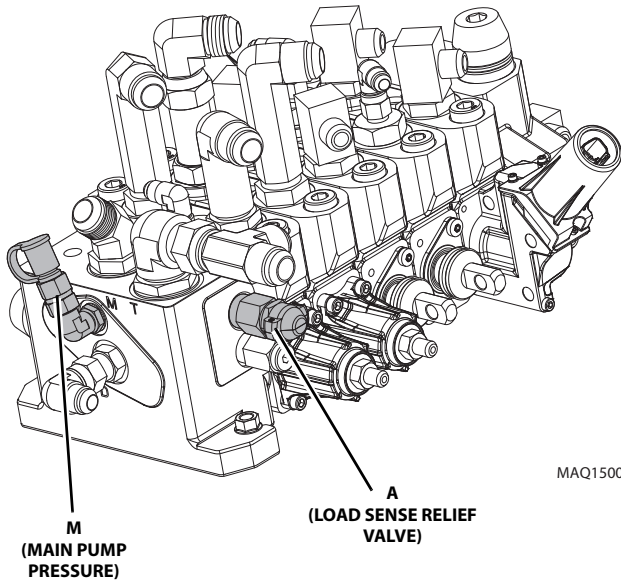
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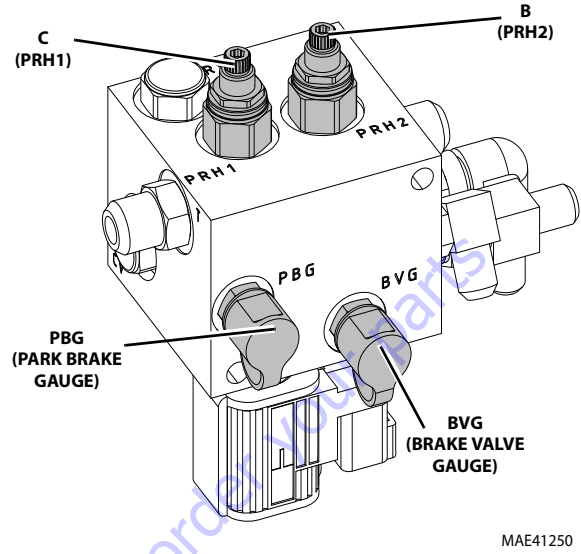
Hydraulic Section

b. 6042 - 85 hp (63 kW)

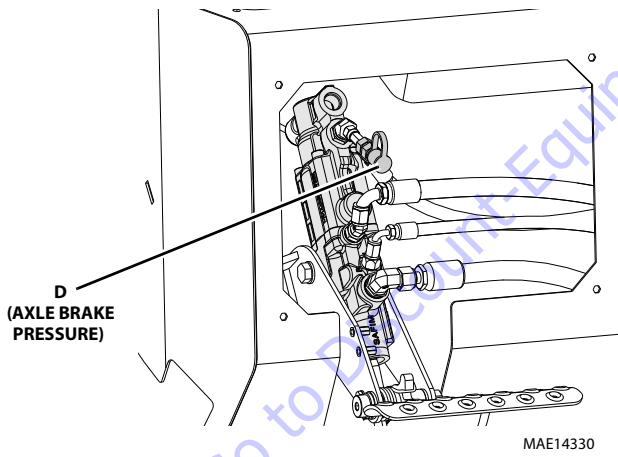
MAIN CONTROL VALVE



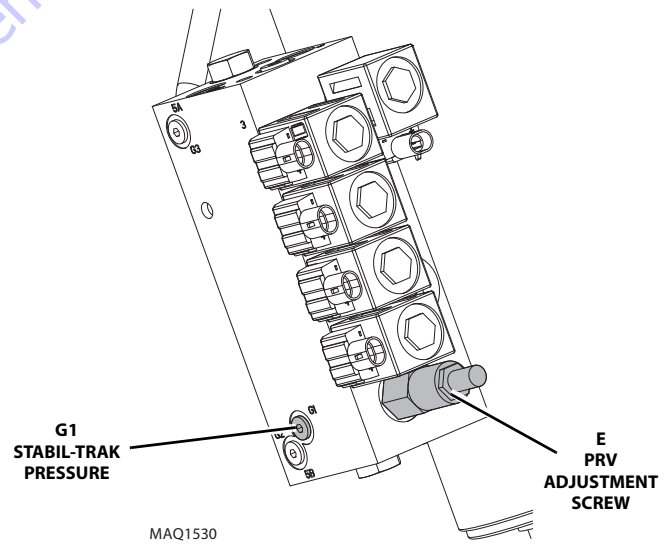
SECONDARY FUNCTION MANIFOLD



SERVICE BRAKE VALVE



STABIL-TRAK VALVE





Note: Install pressure gauge at test port M on main control valve BEFORE Starting engine.
All pressures must be checked in numerical order.

Note: Only operate the functions that are specified in the particular pressure check. Operating other functions than those specified may cause false readings.

Note: Boom level unless otherwise noted.

	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/Pressure	Notes
1	Standby (low idle)	M	Connect gauge to M port, run engine at low idle, no function.	NA	325-375 psi (22,4-25,8 bar)	Park Brake - ON
2	Standby (high idle)	M	Connect gauge to M port, run engine at high idle, no function.	NA	525-575 psi (36,2-39,6 bar)	Park Brake - ON
3	Main Pump/ Load Sense (high idle)	M	Connect gauge to M port, run engine at high idle, fully retract extend/retract cylinder. NOTE: When bottoming Lift, Tilt, Frame Level or Auxiliary at high idle, the pressure seen at the M port should be within 100 psi (6,4 bar) of the noted extend/retract cylinder pressure.	LS (A)	3050-3100 psi (210,3-213,7 bar)	Park Brake - ON
4	Steering (low idle)	M	Connect gauge to M port, run engine at low idle, in front steer mode, turn steering lock to lock.	NA	2600-2700 psi (179,3-186,2 bar)	Park Brake - ON Front Steering Mode Selected
5	Secondary Function Manifold (Service Brake) (high idle)	BVG	Connect gauge to BVG port, run engine at high idle, fully retract extend/retract cylinder.	PRH2(B)	550-560psi (37,9-38,6 bar)	Park Brake ON
6	Secondary Function Manifold (Service Brake) (high idle)	BVG	Connect gauge to BVG port, run engine at high idle, stall steering. Pressure should not increase more than 30 psi (2,0 bar) from pressure 5.	NA	580-590psi (39,9-40,6 bar)	Park Brake - ON
7	Secondary Function Manifold (Park Brake Pressure) (high idle)	PBG	Connect gauge to PBG port, run engine at high idle, fully retract extend/retract cylinder. NOTE: Range/Pressure should repeat in all machine conditions with park brake ON.	NA	0-10 psi (0-0,7 bar)	Park Brake - ON
8	Secondary Function Manifold (Park Brake Pressure) (high idle)	PBG	Connect gauge to PBG port, run engine at high idle, fully retract extend/retract cylinder, switch park brake OFF.	PRH1(C)	380-390 psi (26,2-26,8 bar)	Park Brake - OFF



Hydraulic Section

	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/Pressure	Notes
9	Steering (high idle)	PBG	Connect gauge to PBG port, run engine at high idle, stall steering. Pressure should not increase more than 30 psi (2,0 bar) from pressure 8.	PRH1(C)	410-420 psi (28,2-28,9 bar)	Park Brake - OFF
10	Service Brake (low idle)	D	Block tire, connect gauge to D port. Start engine and run at low idle. Do Not apply brake pedal pressure.	NA	0 psi (0 bar)	Park Brake - OFF
11	Service Brake (low idle)	D	Connect gauge to D port, run engine at low idle, apply maximum brake pedal effort.	NA	650 psi (44,8 bar) Minimum	Park Brake - OFF
12	Service Brake (low idle)	D	Connect gauge to D port. Verify machine is parked on flat ground, Run engine at low idle, transmission in (N) Neutral, turn engine OFF, wait 3 seconds, apply maximum brake pedal effort.	NA	80 psi (5,5 bar) Minimum	Park Brake - OFF
13	Stabil-Trak Valve (low idle)	G1	Verify Ignition is in the OFF position. Remove plug G1 and replace with Test Port Fitting (SAE-4 O-Ring Boss 7/16-20 UNF 2B) and connect pressure gauge. Start machine with boom lowered, frame leveled left at low idle.	PRV (E)	75-150 psi (5,1-10,3 bar)	Park Brake - ON
14	Stabil-Trak Valve (low idle)	G1	Low idle with boom lowered, frame level left - 200 psi (13,7 bar) Maximum Pressure No Adjustment Pressure over 200 psi (13,7 bar) indicates a Stabil-Trak Valve or cylinder failure	NA	200 psi (13,7 bar) Maximum	Park Brake - ON
15	Stabil-Trak Valve (low idle)	G1	Low idle with boom lowered, frame level right - 50 psi (3,4 bar) No Adjustment. Pressure under 50 psi (3,4 bar) indicates a Stabil-Trak Valve or cylinder failure	NA	50 psi (3,4 bar) Minimum	Park Brake - ON



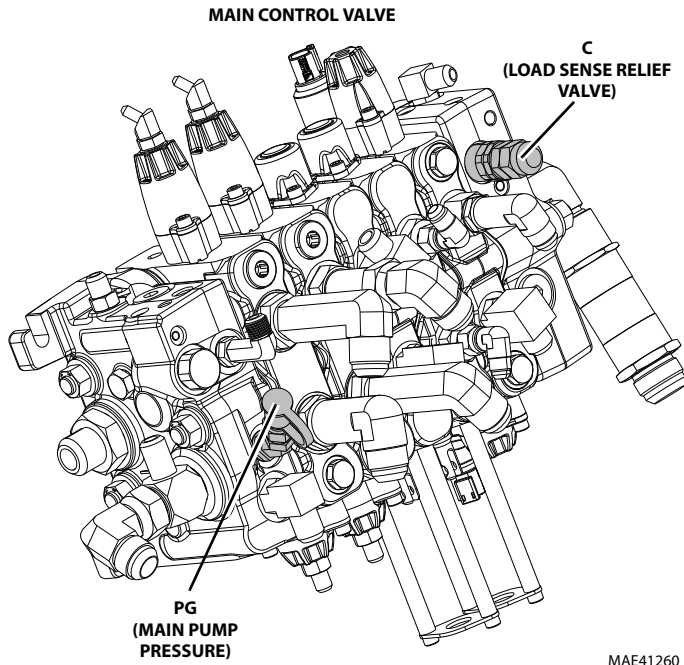
	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/Pressure	Notes
16	Stabil-Trak Brake Switch (low idle)	D	<p>Block tire, connect gauge to D port. Start engine and run at low idle, raise boom above 40° (verify boom angle sensor is OFF), place the transmission in 4th gear Forward and release the park brake.</p> <p>A. With the service brake released - the Stabil-Trak light must be OFF.</p> <p>B. Slowly apply the service brake - the Stabil-Trak light must be ON with a service brake pressure of 200 - 300 psi (13,7 - 20,6 bar) Adjust service brake switch if required.</p>	NA	200-300 psi (13,7-20,6 bar)	Park Brake - OFF

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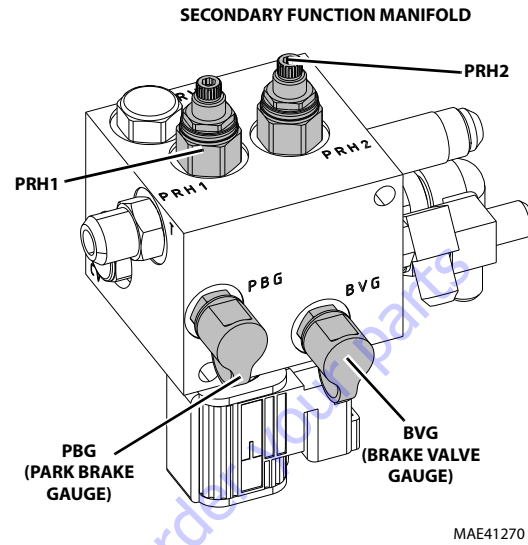


Hydraulic Section

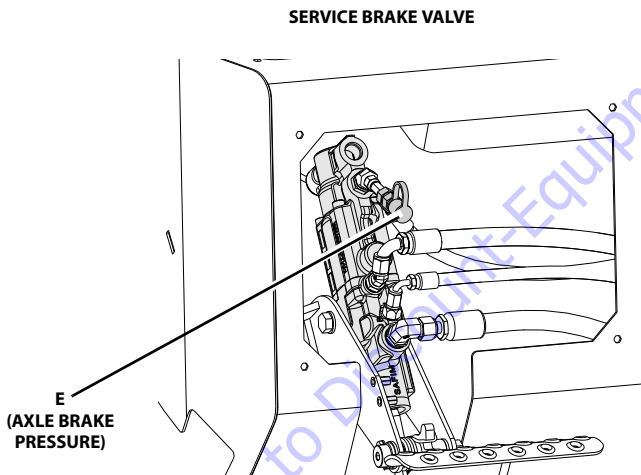
c. 6036 - 74 hp (55 kW)



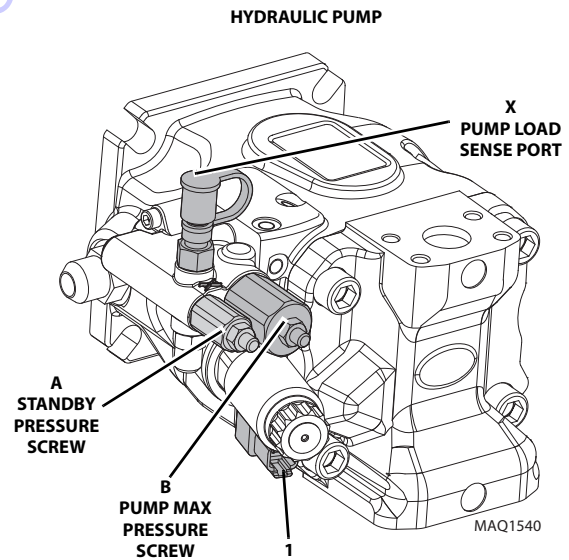
MAE41260



MAE41270



MAE14330



MAQ1540



Note: Install pressure gauge at test port PG on main control valve BEFORE Starting engine.
All pressures must be checked in numerical order.

Note: Only operate the functions that are specified in the particular pressure check. Operating other functions than those specified may cause false readings.

Note: Boom level unless otherwise noted.

	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/Pressure	Notes
1	Load Sense (low idle)	X	Connect gauge to X port. All hydraulic functions and transmission in Neutral.	NA	50-100 psi (3,4-6,8 bar)	Park Brake - ON *Record Load Sense Value for use in Step 2
2	Standby (low idle)	PG	Connect gauge to PG port, run engine at low idle, no function. *Standby pressure should read 320-350 PSI (22,0-24,1 bar) higher than the Load Sense pressure measured in Step 1. Example - If 80 psi (5,5 bar) is recorded in Step 1, the Standby pressure should read 400-430 PSI (27,5-29,6 bar).	A	*400-430 psi (27,5-29,6 bar)	Park Brake - ON
3	Load Sense Relief (high idle)	PG	Connect gauge to PG port, run engine at high idle, fully retract extend/retract cylinder. NOTE: When bottoming Lift, Tilt, Frame Level or Auxiliary at high idle, the pressure seen at the port PG should be within 100 psi (6,4 bar) of the noted extend/retract cylinder pressure.	LS (C)	3050-3100 psi (210,2-213,7 bar)	Park Brake - ON
4	Steering (low idle)	PG	Connect gauge to PG port, run engine at low idle, in front steer mode, turn steering lock to lock.	NA	2600-2800 psi (179,1-193,0 bar)	Park Brake - ON Front Steering Mode Selected
5	Main Pump High Pressure Cutoff (high idle)	PG	Temporarily increase the Load Sense Relief pressure by turning the adjustment screw (PRH1) two turns clockwise. Connect gauge to PG port, run engine at high idle, retract and stall extend/retract cylinder.	B	3250 -3310 psi (224,1-228,2 bar)	Only needed if step 2, 3 & 4 cannot be achieved
6	Secondary Function Manifold (Service Brake) (high idle)	BVG	Connect gauge to BVG port, run engine at high idle, fully retract extend/retract cylinder.	PRH2	550-560 psi (37,9-38,6 bar)	Park Brake - ON

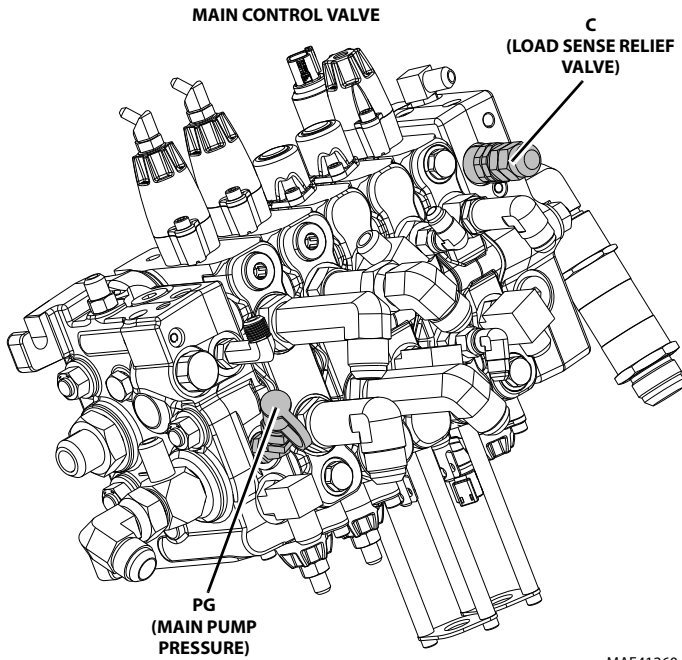


Hydraulic Section

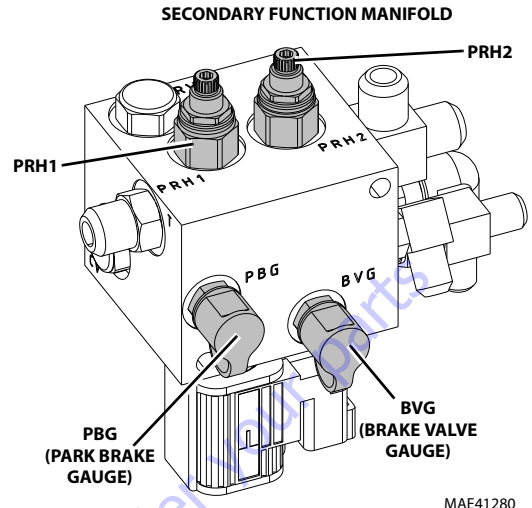
	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/Pressure	Notes
7	Secondary Function Manifold (Park Brake Pressure) (high idle)	PBG	Connect gauge to PBG port, run engine at high idle, fully retract extend/retract cylinder. NOTE: Range/Pressure should repeat in all machine conditions with park brake ON.	NA	0 psi (0 bar)	Park Brake - ON
8	Secondary Function Manifold (Park Brake Pressure) (high idle)	PBG	Connect gauge to PBG port, run engine at high idle, fully retract extend/retract cylinder, switch park brake OFF.	PRH1	365-380 psi (25,1-26,2 bar)	Park Brake - OFF
9	Service Brake (Idle)	E	Block tire, connect gauge to E port. Start engine and run at idle. Do Not apply brake pedal pressure.	NA	0 psi (0 bar)	Park Brake - OFF
10	Service Brake (Idle)	E	Connect gauge to E port, run engine at idle, apply maximum brake pedal effort.	NA	650 psi (44,8 bar) Minimum	Park Brake - OFF
11	Service Brake (low idle)	E	Connect gauge to E port. Verify machine is parked on flat ground, Run engine at low idle, transmission in (N) Neutral, turn engine OFF, wait 3 seconds, apply maximum brake pedal effort.	NA	80 psi (5,5 bar) Minimum	Park Brake - OFF



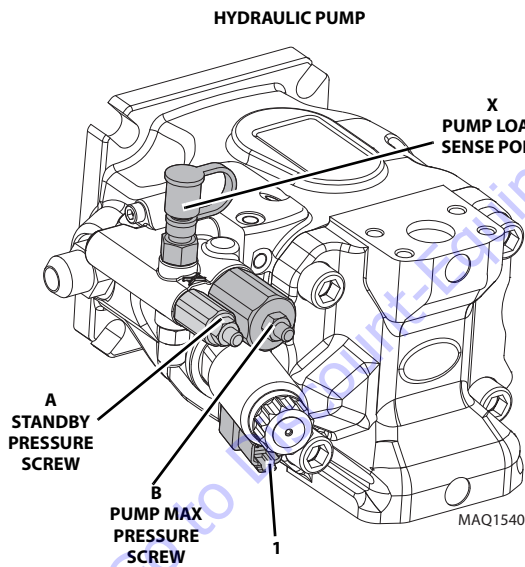
d. 6042 - 74 hp (55 kW)



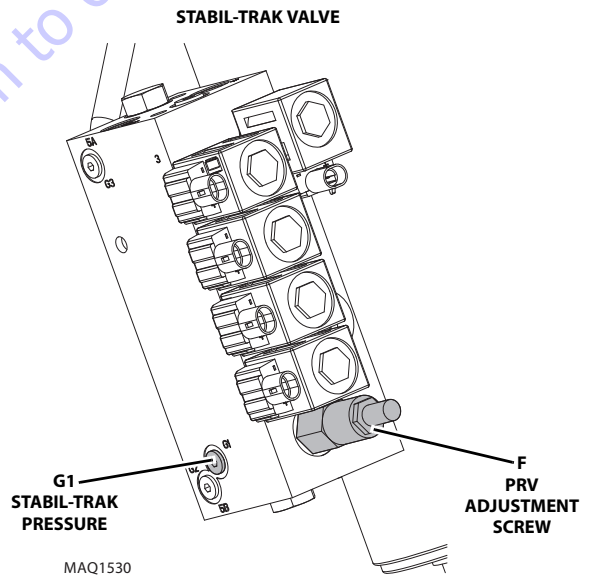
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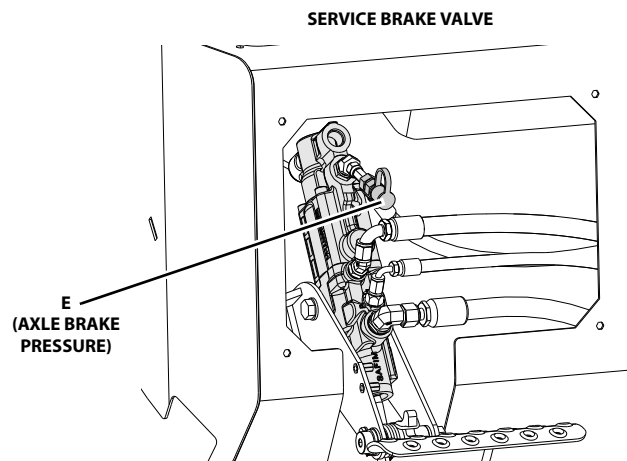
MAE41280



MAQ1540



MAQ1530



MAE14330



Hydraulic Section

Note: Install pressure gauge at test port PG on main control valve BEFORE Starting engine.
All pressures must be checked in numerical order.

Note: Only operate the functions that are specified in the particular pressure check. Operating other functions than those specified may cause false readings.

Note: Boom level unless otherwise noted.

	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/Pressure	Notes
1	Load Sense (low idle)	X	Connect gauge to X port. All hydraulic functions and transmission in Neutral.	NA	50-100 psi (3,4-6,9 bar)	Park Brake - ON *Record Load Sense Value for use in Step 2
2	Standby (low idle)	PG	Connect gauge to PG port, run engine at low idle, no function. *Standby pressure should read 320-350 psi (22,0-24,1 bar) higher than the Load Sense pressure measured in Step 1. Example - If 80 psi (5,5 bar) is recorded in Step 1, the Standby pressure should read 400-430 psi (27,5-29,6 bar).	A	*400-430 psi (27,5-29,6 bar)	Park Brake - ON
3	Load Sense Relief (high idle)	PG	Connect gauge to PG port, run engine at high idle, fully retract extend/retract cylinder. NOTE: When bottoming Lift, Tilt, Frame Level or Auxiliary at high idle, the pressure seen at the port PG should be within 100 psi (6,4 bar) of the noted extend/retract cylinder pressure.	LS (C)	3050-3100 psi (210,2-213,7 bar)	Park Brake - ON
4	Steering (low idle)	PG	Connect gauge to PG port, run engine at low idle, in front steer mode, turn steering lock to lock.	NA	2600-2800 psi (179,1-193,0 bar)	Park Brake - ON Front Steering Mode Selected
5	Main Pump High Pressure Cutoff (high idle)	PG	Temporarily increase the Load Sense Relief pressure by turning the adjustment screw (C) two turns clockwise. Connect gauge to PG port, run engine at high idle, retract and stall extend/retract cylinder.	B	3250 -3310 psi (224,1-228,2 bar)	Only needed if step 2, 3 & 4 cannot be achieved
6	Secondary Function Manifold (Service Brake) (high idle)	BVG	Connect gauge to BVG port, run engine at high idle, fully retract extend/retract cylinder.	PRH2	550-560 psi (37,9-38,6 bar)	Park Brake ON



	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/Pressure	Notes
7	Secondary Function Manifold (Park Brake Pressure) (high idle)	PBG	Connect gauge to PBG port, run engine at high idle, fully retract extend/retract cylinder. NOTE: Range/Pressure should repeat in all machine conditions with park brake ON.	NA	0 psi (0 bar)	Park Brake - ON
8	Secondary Function Manifold (Park Brake Pressure) (high idle)	PBG	Connect gauge to PBG port, run engine at high idle, fully retract extend/retract cylinder, switch park brake OFF.	PRH1	365-380 psi (25,1-26,2 bar)	Park Brake - OFF
9	Service Brake (Idle)	E	Block tire, connect gauge to E port. Start engine and run at idle. Do Not apply brake pedal pressure.	NA	0 psi (0 bar)	Park Brake - OFF
10	Service Brake (Idle)	E	Connect gauge to E port, run engine at idle, apply maximum brake pedal effort.	NA	650 psi (44,8 bar) Minimum	Park Brake - OFF
11	Service Brake (low idle)	E	Connect gauge to E port. Verify machine is parked on flat ground, Run engine at low idle, transmission in (N) Neutral, turn engine OFF, wait 3 seconds, apply maximum brake pedal effort.	NA	80 psi (5,5 bar) Minimum	Park Brake - OFF
12	Stabil-Trak Valve (Idle)	G1	Verify Ignition is in the OFF position. Remove plug G1 and replace with Test Port Fitting (SAE-4 O-Ring Boss 7/16-20 UNF 2B) and connect pressure gauge. Start machine with boom lowered, frame leveled left at idle.	PRV (F)	75-150 psi (5,1-10,3 bar)	Park Brake - ON
13	Stabil-Trak Valve (Idle)	G1	Idle with boom lowered, frame level left - 200 psi (13,7 bar) Maximum Pressure No Adjustment Pressure over 200 psi (13,7 bar) indicates a Stabil-Trak Valve or cylinder failure	NA	200 psi (13,7 bar) Maximum	Park Brake - ON

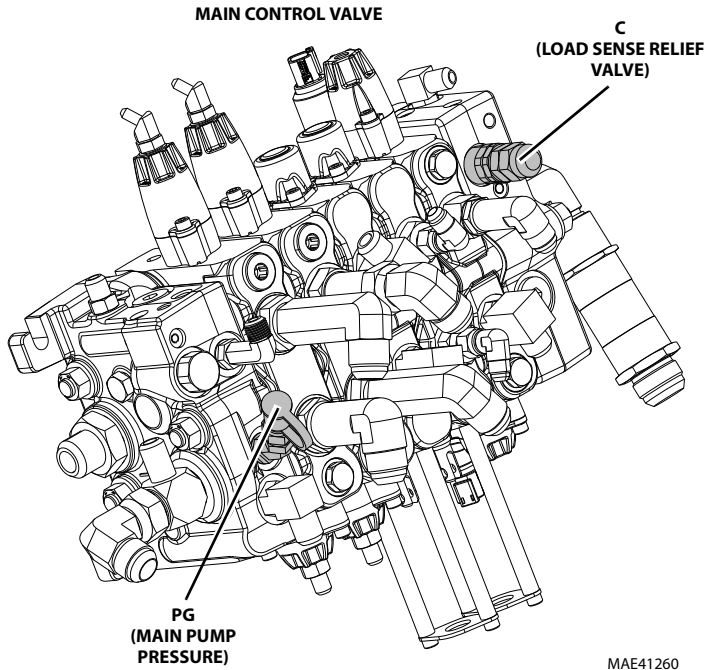


Hydraulic Section

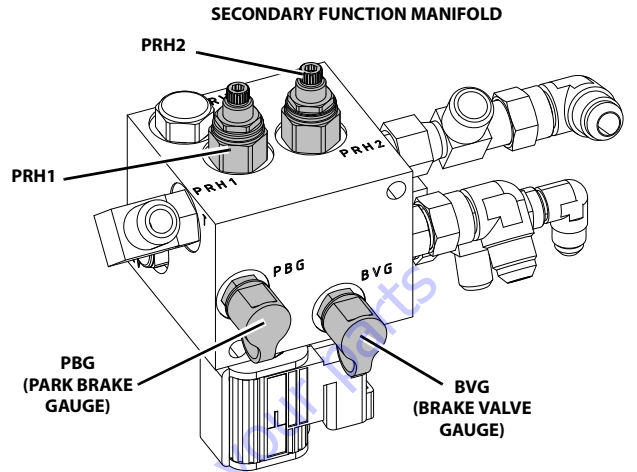
	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/Pressure	Notes
14	Stabil-Trak Valve (Idle)	G1	Idle with boom lowered, frame level right - 50 psi (3,4 bar) No Adjustment. Pressure under 50 psi (3,4 bar) indicates a Stabil-Trak Valve or cylinder failure	NA	50 psi (3,4 bar) Minimum	Park Brake - ON
15	Stabil-Trak Brake Switch (low idle)	E	Block tire, connect gauge to E port. Start engine and run at low idle, raise boom above 40° (verify boom angle sensor is OFF), place the transmission in 4th gear Forward and release the park brake. A. With the service brake released - the Stabil-Trak light must be OFF. B. Slowly apply the service brake - the Stabil-Trak light must be ON with a service brake pressure of 200 - 300 psi (13,7 - 20,6 bar) Adjust service brake switch if required.	NA	200-300 psi (13,7-20,6 bar)	Park Brake - OFF



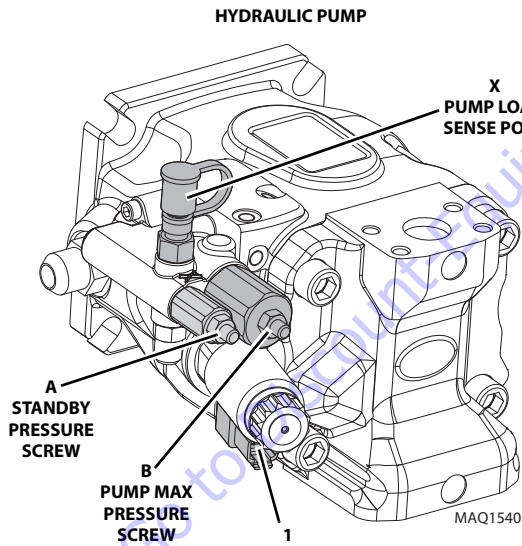
e. 8042, 10042, 10054



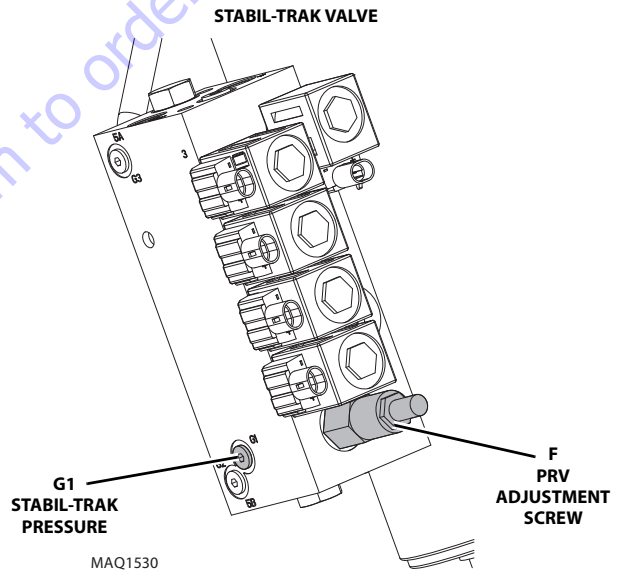
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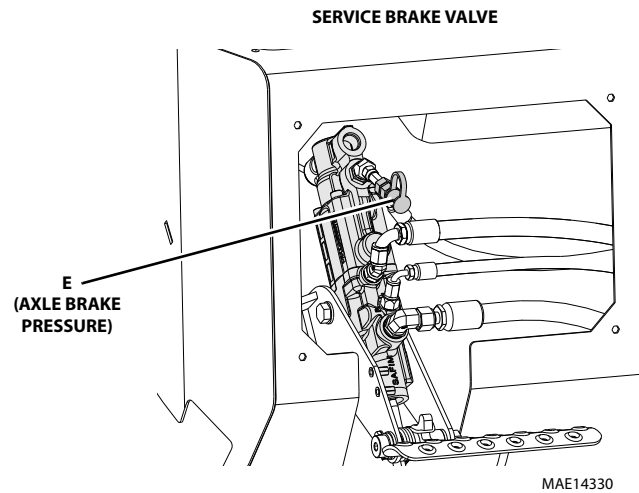
MAE41290



MAQ1540



MAQ1530



MAE14330



Hydraulic Section

Note: Install pressure gauge at test port PG on main control valve BEFORE Starting engine.
All pressures must be checked in numerical order.

Note: Only operate the functions that are specified in the particular pressure check. Operating other functions than those specified may cause false readings.

Note: Boom level unless otherwise noted.

	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/Pressure	Notes
1	Load Sense (low idle)	X	Connect gauge to X port. All hydraulic functions and transmission in Neutral.	NA	50-100 psi (3,4-6,9 bar)	Park Brake - ON *Record Load Sense Value for use in Step 2
2	Standby (low idle)	PG	Connect gauge to PG port, run engine at low idle, no function. *Standby pressure should read 320-350 psi (22,0-24,1 bar) higher than the Load Sense pressure measured in Step 1. Example - If 80 psi (5,5 bar) is recorded in Step 1, the Standby pressure should read 400-430 psi (27,5-29,6 bar).	A	*400-430 psi (27,5-29,6 bar)	Park Brake - ON
3	Load Sense Relief (high idle)	PG	Connect gauge to PG port, run engine at high idle, fully retract extend/retract cylinder. NOTE: When bottoming Lift, Tilt, Frame Level or Auxiliary at high idle, the pressure seen at the port PG should be within 100 psi (6,4 bar) of the noted extend/retract cylinder pressure.	LS (C)	3050-3100 psi (210,2-213,7 bar)	Park Brake - ON
4	Steering (low idle)	PG	Connect gauge to PG port, run engine at low idle, in front steer mode, turn steering lock to lock.	NA	2600-2800 psi (179,1-193,0 bar)	Park Brake - ON Front Steering Mode Selected
5	Main Pump High Pressure Cutoff (high idle)	PG	Temporarily increase the Load Sense Relief pressure by turning the adjustment screw (C) two turns clockwise. Connect gauge to PG port, run engine at high idle, retract and stall extend/retract cylinder.	B	3250 -3310 psi (224,1-228,2 bar)	Only needed if step 2, 3 & 4 cannot be achieved
6	Secondary Function Manifold (Service Brake) (high idle)	BVG	Connect gauge to BVG port, run engine at high idle, fully retract extend/retract cylinder.	PRH2	550-560 psi (37,9-38,6 bar)	Park Brake ON



	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/Pressure	Notes
7	Secondary Function Manifold Park Brake Pressure (Idle)	PBG	Connect gauge to PBG port, run engine at idle, fully retract the extend/retract cylinder, switch park brake switch ON. NOTE: Range/Pressure should repeat in all machine conditions with park brake ON.	NA	0 psi (0 bar)	Park Brake - ON
8	Secondary Function Manifold (Park Brake Pressure) (Idle)	PBG	Connect gauge to PBG port, run engine at idle, fully retract extend/retract cylinder, switch park brake OFF.	PRH1	365-380 psi (25,1-26,2 bar)	Park Brake - OFF
9	Service Brake (Idle)	E	Block tire, connect gauge to E port. Start engine and run at idle and transmission in (N) neutral. Do Not apply brake pedal pressure.	NA	0 psi (0 bar)	Park Brake - OFF
10	Service Brake (Idle)	E	Connect gauge to E port, run engine at idle and transmission in (N) Neutral, apply maximum brake pedal pressure.	NA	650 psi (44,8 bar) Minimum	Park Brake - OFF
11	Service Brake (low idle)	E	Connect gauge to E port. Verify machine is parked on flat ground, Run engine at low idle, transmission in (N) Neutral, release Park Brake, turn engine OFF, wait 3 seconds, apply maximum brake pedal pressure.	N/A	80 psi (5,5 bar) Minimum	Park Brake - OFF
12	Stabil-Trak Valve (Idle)	G1	Verify Ignition is in the OFF position. Remove plug G1 and replace with Test Port Fitting (SAE-4 O-Ring Boss 7/16-20 UNF 2B) and connect pressure gauge. Start machine with boom lowered at idle.	PRV (F)	75-150 psi (5,1-10,3 bar)	Park Brake - ON
13	Stabil-Trak Valve (Idle)	G1	Engine at idle with boom lowered, frame level left - 200 psi (13,7 bar) Maximum Pressure No Adjustment Pressure over 200 psi (13,7 bar) indicates a Stabil-Trak Valve or cylinder failure	NA	200 psi (13,7 bar) Maximum	Park Brake - ON

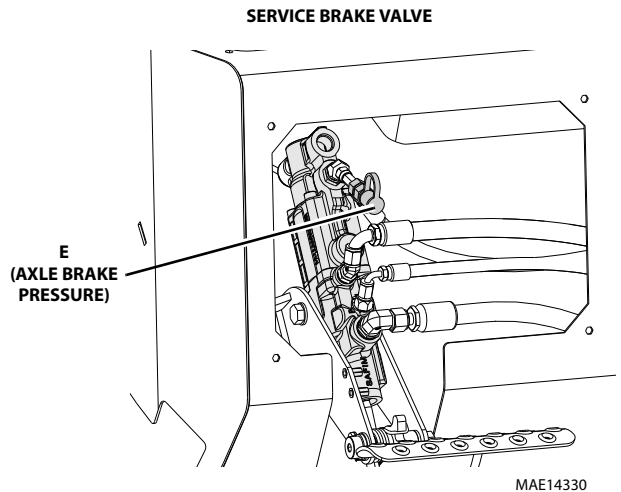
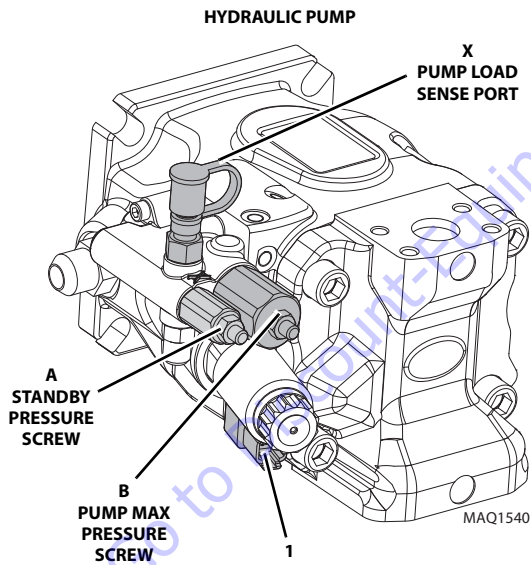
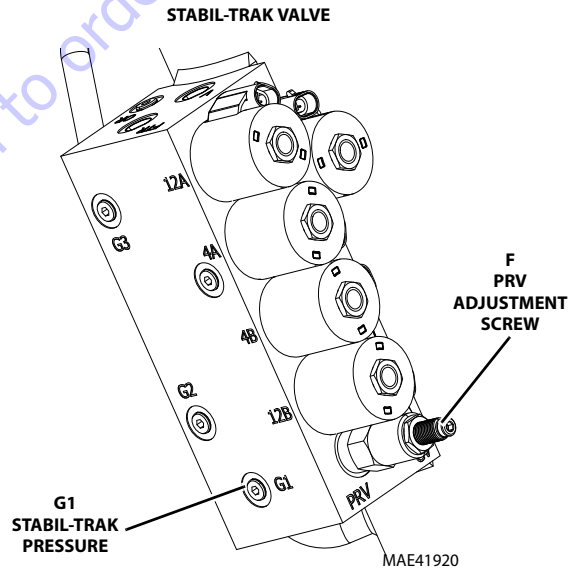
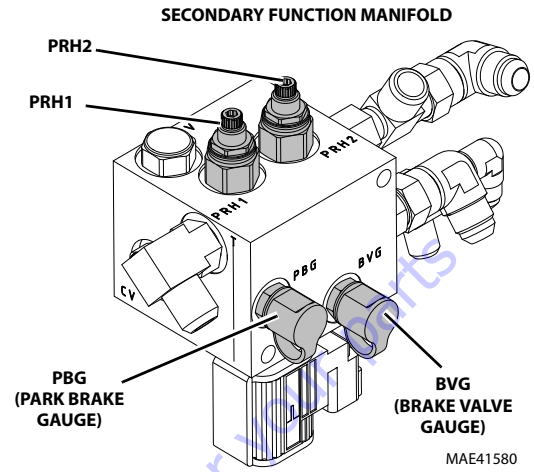
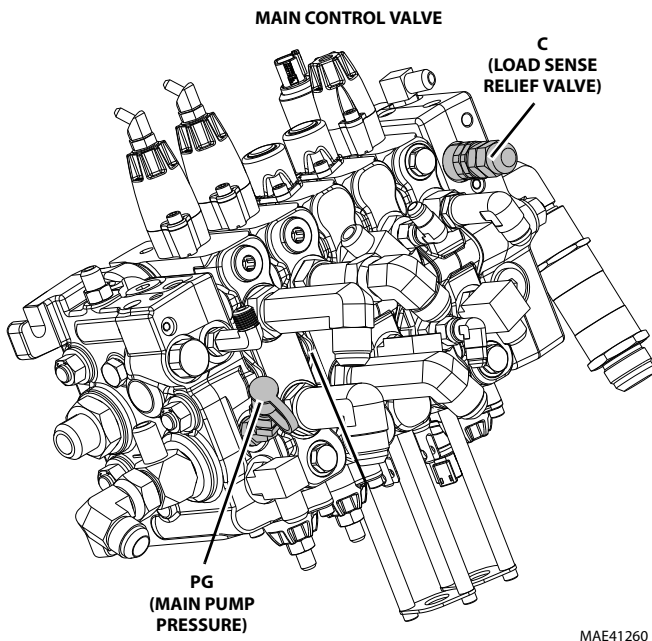


Hydraulic Section

	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/Pressure	Notes
14	Stabil-Trak Valve (Idle)	G1	Engine at idle with boom lowered, frame level right - 50 psi (3,4 bar) No Adjustment. Pressure under 50 psi (3,4 bar) indicates a Stabil-Trak Valve or cylinder failure	NA	50 psi (3,4 bar) Minimum	Park Brake - ON
15	Stabil-Trak Brake Switch (low idle)	E	Block tire, connect gauge to E port. Start engine and run at low idle, raise boom above 40° (verify boom angle sensor is OFF), place the transmission in 4th gear Forward and release the park brake. A. With the service brake released - the Stabil-Trak light must be OFF. B. Slowly apply the service brake - the Stabil-Trak light must be ON with a service brake pressure of 200 - 300 psi (13,7 - 20,6 bar) Adjust service brake switch if required.	NA	200-300 psi (13,7-20,6 bar)	Park Brake - OFF



f. 12054





Hydraulic Section

Note: Install pressure gauge at test port PG on main control valve BEFORE Starting engine.
All pressures must be checked in numerical order.

Note: Only operate the functions that are specified in the particular pressure check. Operating other functions than those specified may cause false readings.

Note: Boom level unless otherwise noted.

	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/Pressure	Notes
1	Load Sense (low idle)	X	Connect gauge to X port. All hydraulic functions and transmission in Neutral.	NA	50-100 psi (3,4-6,9 bar)	Park Brake - ON *Record Load Sense Value for use in Step 2
2	Standby (low idle)	PG	Connect gauge to PG port, run engine at low idle, no function. *Standby pressure should read 319-349 psi (21,9-24,0 bar) higher than the Load Sense pressure measured in Step 1. Example - If 80 psi (5,5 bar) is recorded in Step 1, the Standby pressure should read 400-430 psi (27,5-29,6 bar).	A	*400-430 psi (27,5-29,6 bar)	Park Brake - ON
3	Load Sense (high idle)	PG	Connect gauge to PG port, run engine at high idle, fully retract extend/retract cylinder. NOTE: When bottoming Lift, Tilt, Frame Level or Auxiliary at high idle, the pressure seen at the port PG should be within 100 psi (6,4 bar) of the noted extend/retract cylinder pressure.	LS (C)	3050-3100 psi (210,3-213,7 bar)	Park Brake - ON
4	Steering (low idle)	PG	Connect gauge to PG port, run engine at low idle, in front steer mode, turn steering lock to lock.	NA	2600-2800 psi (179,1-193,0 bar)	Park Brake - ON Front Steering Mode Selected
5	Main Pump High Pressure Cutoff (high idle)	PG	Temporarily increase the Load Sense Relief pressure by turning the adjustment screw (C) two turns clockwise. Connect gauge to PG port, run engine at high idle, retract and stall extend/retract cylinder.	B	3250 -3300 psi (224,0-227,5 bar)	Only needed if step 2, 3 & 4 cannot be achieved
6	Secondary Function Manifold (Service Brake) (Idle)	BVG	Connect gauge to BVG port, run engine at idle, fully retract extend/retract cylinder.	PRH2	550-560 psi (37,9-38,6 bar)	Park Brake ON



	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/Pressure	Notes
7	Secondary Function Manifold (Park Brake Pressure) (high idle)	PBG	Connect gauge to PBG port, run engine at idle, fully retract extend/retract cylinder. NOTE: Range/Pressure should repeat in all machine conditions with park brake ON.	NA	0 psi (0 bar)	Park Brake - ON
8	Secondary Function Manifold (Park Brake Pressure) (high idle)	PBG	Connect gauge to PBG port, run engine at idle, fully retract extend/retract cylinder, switch park brake OFF.	PRH1	365-380 psi (25,1-26,2 bar)	Park Brake - OFF
9	Service Brake (Idle)	E	Block tire, connect gauge to E port. Start engine and run at idle and transmission in (N) Neutral. Do Not apply brake pedal pressure.	NA	0 psi (0 bar)	Park Brake - OFF
10	Service Brake (Idle)	E	Connect gauge to E port, Start engine and run at idle and transmission in (N) Neutral, apply maximum brake pedal effort.	NA	650 psi (44,8 bar) Minimum	Park Brake - OFF
11	Service Brake (low idle)	E	Connect gauge to E port. Verify machine is parked on flat ground, Run engine at low idle, transmission in (N) Neutral, turn engine OFF, wait 3 seconds, apply maximum brake pedal effort.	NA	80 psi (5,5 bar) Minimum	Park Brake - OFF
12	Stabil-Trak Valve (Idle)	G1	Verify Ignition is in the OFF position. Remove plug G1 and replace with Test Port Fitting (SAE-4 O-Ring Boss 7/16-20 UNF 2B) and connect pressure gauge. Start machine with boom lowered, frame leveled left at idle.	PRV (F)	75-150 psi (5,1-10,3 bar)	Park Brake - ON
13	Stabil-Trak Valve (Idle)	G1	Idle with boom lowered, frame level left - 200 psi (13,7 bar) Maximum Pressure No Adjustment Pressure over 200 psi (13,7 bar) indicates a Stabil-Trak Valve or cylinder failure	NA	200 psi (13,7 bar) Maximum	Park Brake - ON



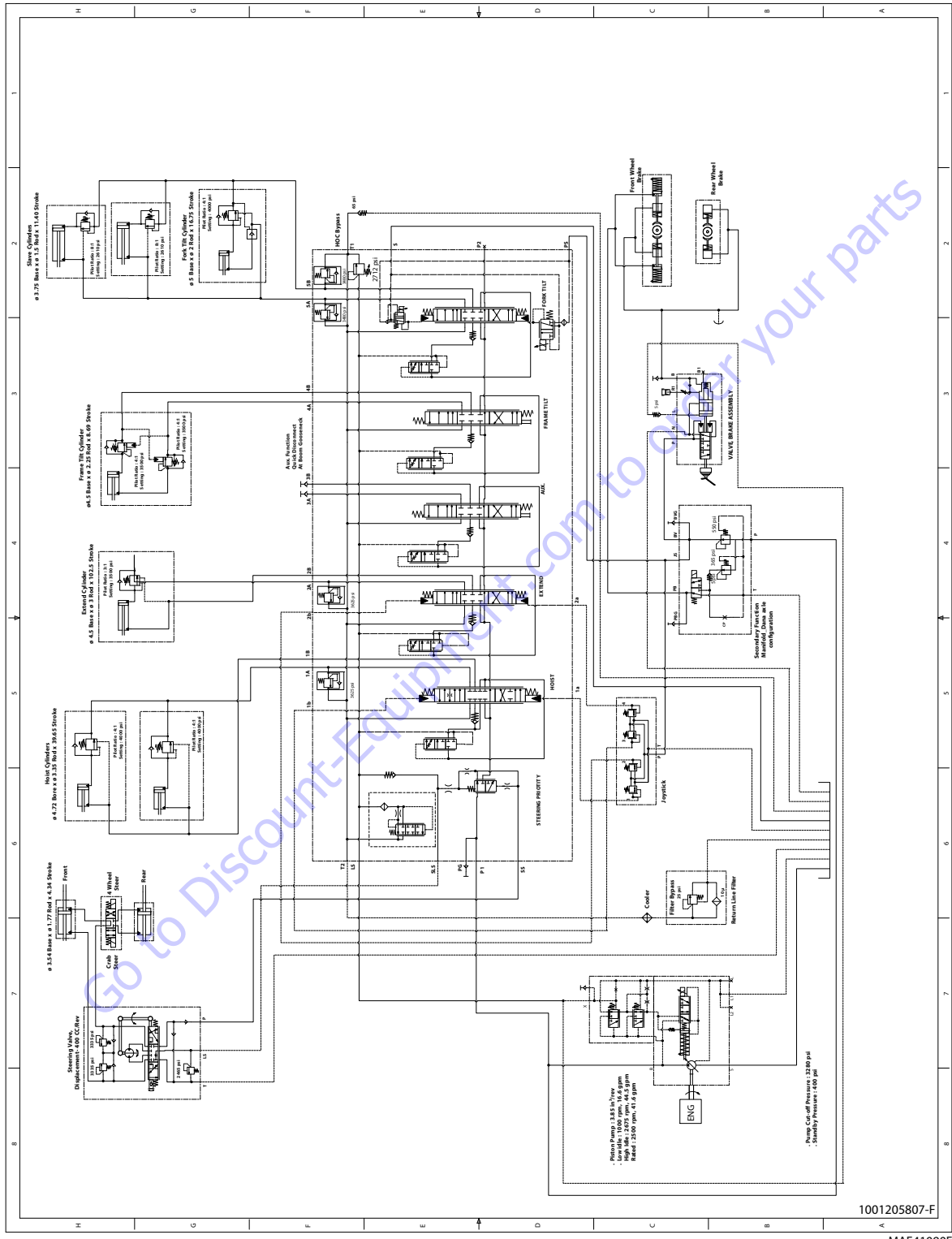
Hydraulic Section

	Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Range/Pressure	Notes
14	Stabil-Trak Valve (Idle)	G1	Idle with boom lowered, frame level right - 50 psi (3,4 bar) No Adjustment. Pressure under 50 psi (3,4 bar) indicates a Stabil-Trak Valve or cylinder failure	NA	50 psi (3,4 bar) Minimum	Park Brake - ON
15	Stabil-Trak Brake Switch (low idle)	E	Block tire, connect gauge to E port. Start engine and run at low idle, raise boom above 40° (verify boom angle sensor is OFF), place the transmission in 4th gear Forward and release the park brake. A. With the service brake released - the Stabil-Trak light must be OFF. B. Slowly apply the service brake - the Stabil-Trak light must be ON with a service brake pressure of 200 - 300 psi (13,7 - 20,6 bar) Adjust service brake switch if required.	NA	200-300 psi (13,7-20,6 bar)	Park Brake - OFF



Hydraulic Section

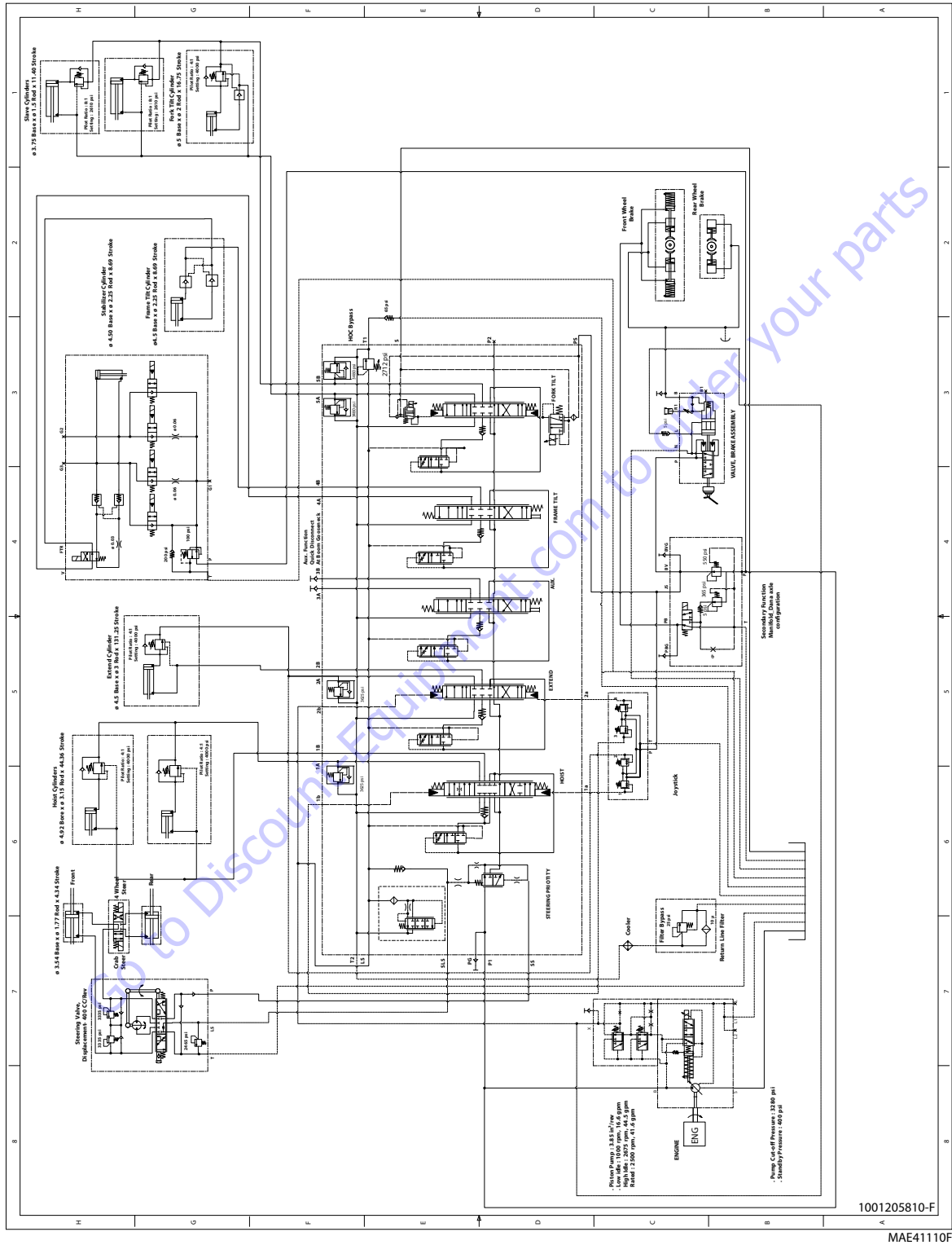
b. 6036 - 74 hp (55 kW) Engine





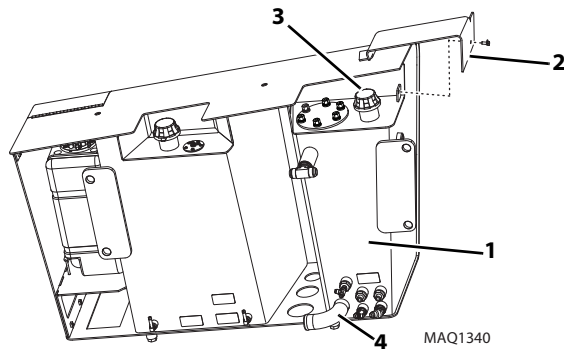
Hydraulic Section

d. 6042 - 74 hp (55 kW) Engine





8.6 HYDRAULIC RESERVOIR



Hydraulic oil reservoir (1) and fuel tank are one unit located on the right side of the frame. The hydraulic fluid filler/breather and filter are accessed under filter access cover (2).

Occasionally, fluid may seep, leak or be more forcefully expelled from the filler/breather cap (3) when system pressure exceeds the rating of the breather. If the return filter becomes plugged, return hydraulic oil will bypass the filter when pressure reaches 25 psi (1,7 bar) and return to the reservoir unfiltered.

Carefully examine fluid seepage or leaks from the hydraulic reservoir to determine the exact cause. Clean the reservoir and note where any seepage occurs.

Leaks from a cracked or damaged reservoir require that the reservoir be removed from the machine, flushed completely with water and repaired by a certified welder using approved techniques. If these conditions cannot be met, the reservoir must be replaced in its entirety.

8.6.1 Hydraulic Oil Reservoir Draining

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Remove filter access cover (2).
6. Remove the filler/breather cap (3) on the hydraulic oil reservoir (1). Remove the drain plug (4) on the bottom of the hydraulic oil reservoir.
7. Transfer the used hydraulic oil into a suitable covered container, and label as "Used Oil". Dispose of used oil at an approved recycling facility. Clean and reinstall the drain plug (4).

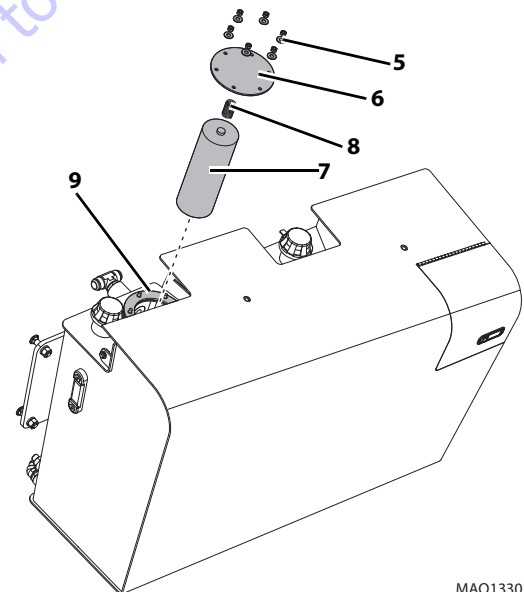
8. Wipe up any hydraulic fluid spillage in, on, near and around the machine and the work area.

8.6.2 Hydraulic Oil Reservoir Filling

1. Be sure the reservoir is clean and free of all debris.
2. Install a new hydraulic oil filter. Refer to Section 8.6.3, "Hydraulic Filter Replacement".
3. Fill the hydraulic reservoir. Refer to Section 2.3, "Fluid & Lubricant Capacities".
4. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
5. Remove Do Not Operate Tag on both ignition key switch and steering wheel.
6. Close and secure the engine cover.

8.6.3 Hydraulic Filter Replacement

1. Be sure the hydraulic oil reservoir is clean and free of all debris.



2. Loosen and remove the six nuts (5) securing the filter cover (6) to the hydraulic reservoir.
3. Remove the filter (7) and spring (8) from the hydraulic reservoir allowing any excess hydraulic oil to drain into the reservoir.
4. Replace the hydraulic filter head gasket (9) if necessary.
5. Install the new hydraulic filter and spring. Lower the hydraulic filter assembly into the hydraulic reservoir.
6. Install the six previously removed nuts securing the hydraulic filter cover to the hydraulic reservoir. Torque the nuts to 75 lb-in (8.5 Nm).
7. Install the previously removed access cover (2).



Hydraulic Section

- Wipe up any hydraulic fluid spillage in, on, near and around the machine and the work area.

8.6.4 Hydraulic Oil Reservoir Replacement

The hydraulic reservoir and the fuel tank are one unit and are removed together. Refer to Section 7.6.2, "Fuel/Hydraulic Oil Tank", for information on hydraulic reservoir/fuel tank replacement.

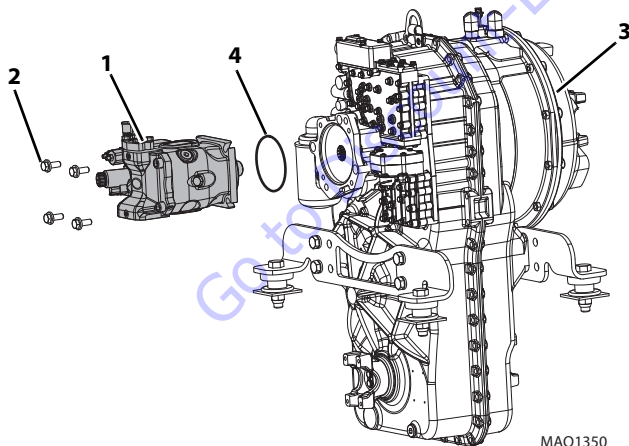
8.7 HYDRAULIC SYSTEM PUMP

For internal service instructions contact your local authorized service distributor.

8.7.1 Pump Replacement

a. Pump Removal

- Park the machine on a firm, level surface, level the machine, fully retract the boom, raise the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
- Place a Do Not Operate Tag on both ignition key switch and steering wheel.
- Properly support the boom.
- Open the engine cover. Allow the system fluids to cool.
- Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
- Drain the hydraulic reservoir. Refer to Section 8.6.1, "Hydraulic Oil Reservoir Draining".



- Thoroughly clean the pump (1) and surrounding area.
- Label, disconnect and cap the hydraulic hoses attached to the pump.
- Remove the bolts (2), lockwashers and washers securing the pump to the transmission (3).

- Remove the o-ring (4) located between the transmission and the pump. Wipe up any hydraulic oil spillage.
- Remove the hydraulic fittings from the pump to use for later installation.

Note: Before removing any fittings from the pump, note their orientation to ensure correct installation.

Note: **DO NOT** disassemble the operating pump. The pump is pre-set from the manufacturer. Any adjustments or repairs performed by anyone other than an authorized dealer could void the warranty.

b. Pump Installation

- Install the fittings on the pump in the same orientation as noted during removal.
- Place the pump and a new, oiled o-ring into position on the transmission. Align the pump shaft with the internal transmission gear, so that the machined teeth mesh together.
- Align the bolt holes with the pump mount holes. Secure the pump to the transmission with the previously used hardware.
- Uncap and connect the previously labeled hydraulic hoses to their appropriate locations.
- Fill the hydraulic reservoir. Refer to Section 8.6.2, "Hydraulic Oil Reservoir Filling".
- Prime the pump by filling the case drain port with fresh, filtered hydraulic oil from a clean container before installing the case drain connector and hose.
- Check all routing of hoses and tubing for sharp bends or interference with any rotating members. All tube and hose clamps must be tight.
- Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
- Remove boom support.
- Remove Do Not Operate Tag on both ignition key switch and steering wheel.
- Close and secure the engine cover.
- Start engine and run at approximately one-third to one-half throttle for about one minute without moving the machine or operating any hydraulic functions.
- Inspect for leaks and check all fluid levels. The hydraulic reservoir oil level must be to the middle of the sight gauge.



c. Pump Test

1. Refer to Section 8.5.1, "Pressure Checks and Adjustments".

8.8 VALVES AND MANIFOLDS

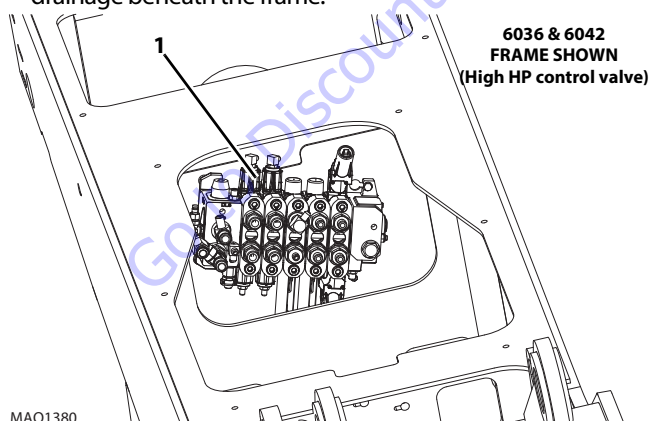
8.8.1 Main Control Valve

The main control valve is mounted on the frame under the lower transmission cover.

The main control valve assembly consists of individual working sections with their own valve assemblies, each providing a specific hydraulic function.

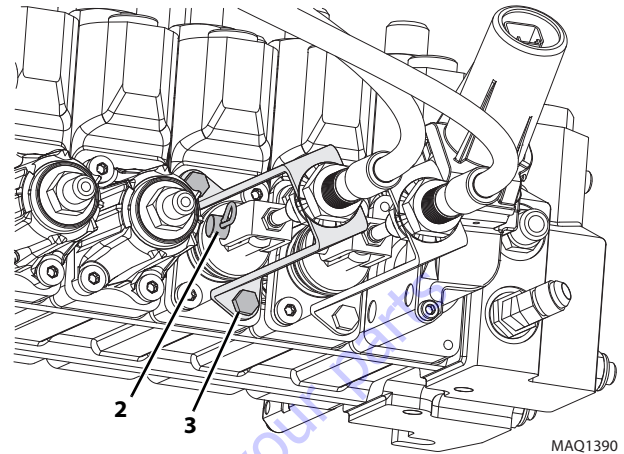
a. Main Control Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, raise the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Temporarily block up or support the raised boom.
4. Open the engine cover. Allow the system fluids to cool.
5. With the engine OFF, operate all the hydraulic functions to relieve trapped pressure.
6. Remove the transmission covers. Thoroughly clean the main control valve and surrounding area, including all hoses and fittings, before proceeding.
7. Place a suitable container to collect hydraulic fluid drainage beneath the frame.

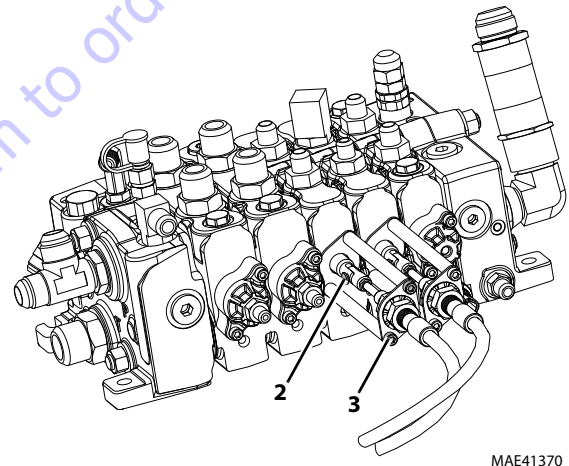


8. Label, disconnect and cap all the hydraulic hoses, tubes and wires at the main control valve (1).
9. Wipe up any hydraulic fluid spillage in, on, near and around the machine and the work area.

6036, 6042 - 85 hp (63 kW)



6036 (74hp), 6042 (74hp), 8042, 10042, 10054, 12054



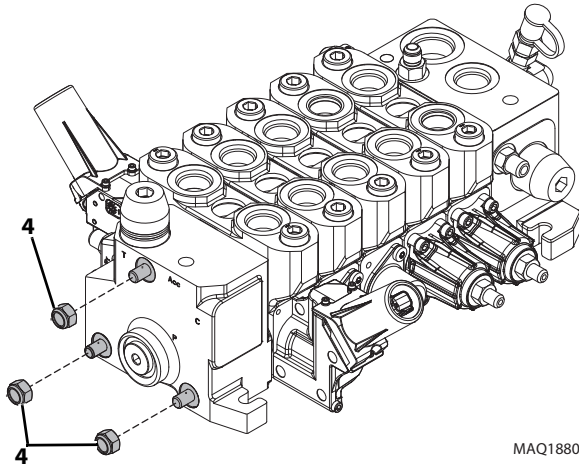
Note: Record the location, and label all cables to ensure correct installation.

10. Disconnect the control cables:
 - a. Remove the clip and anchor pin (2). Retain the clip and anchor pin for installation.
 - b. Loosen and remove the two bolts (3), and remove the control cable mount or bracket/control cable.
 - c. Route the cable clear of the main control valve.
 - d. Repeat steps for the remaining control cables.
11. Remove the bolts and nuts securing the main control valve to the frame.
12. Remove the main control valve from the frame.



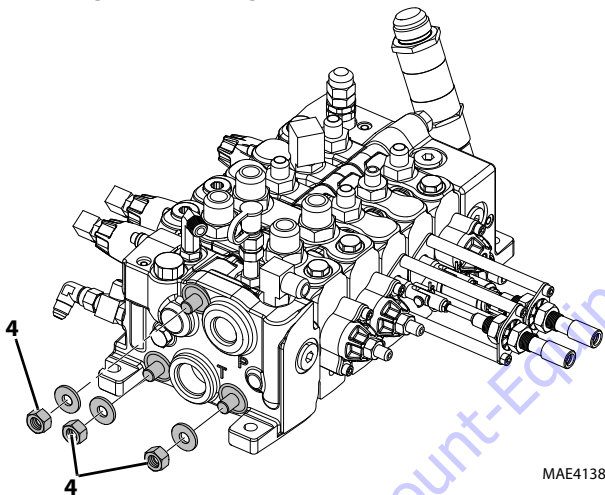
b. Main Control Valve Disassembly

6036, 6042 - 85 hp (63 kW)



MAQ1880

6036 (74hp), 6042 (74hp), 8042, 10042, 10054, 12054



MAE41380

1. To disassemble the individual sections of the main control valve, remove the three nuts from one end of the tie rods.
2. Disassemble each section assembly as required.

Some sections include a pre-adjusted relief valve that regulates pressure in a specific circuit.

Note: DO NOT adjust any of the relief valve assemblies. Tampering with a relief valve will irrevocably alter pressure in the affected circuit, requiring recalibrating or a new relief valve. Disassemble each Valve Section.

1. Carefully separate the load sense outlet section from the next section.
2. Remove the o-rings from between the two sections.
3. Carefully separate each remaining sections, being careful not to lose the load sense shuttle ball.

4. Remove both end caps from each end of the valve sections then remove each control spool.
5. Remove any check valves, compensator valves, anti-cavitation valves or shock valves from individual valve section if equipped.
6. Keep all parts being removed from individual valve sections tagged and kept together.

c. Main Control Valve Parts Cleaning

Clean all components with a suitable cleaner, such as trichloroethylene, before continuing. Blow dry.

d. Main Control Valve Parts Inspection

Inspect all parts and internal passageways for wear, damage, etc. If inner surfaces of any component **DO NOT** display an ultra-smooth, polished finish, or are damaged in any way, replace the damaged part. Often, dirty hydraulic fluid causes failure of internal seals, damage to the polished surfaces within the component, and wear of and/or harm to other parts.

e. Main Control Valve Assembly

Note: ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.

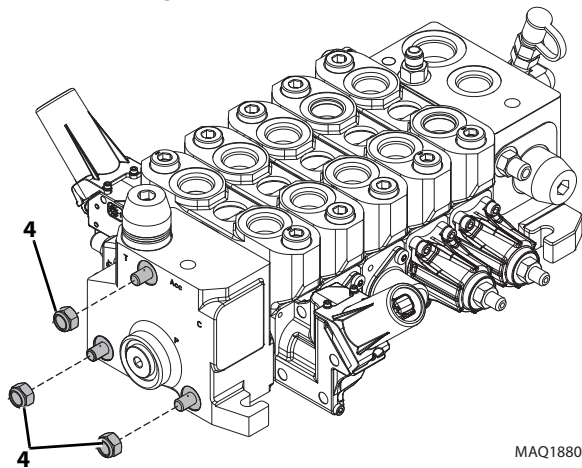
Assemble each Valve Section

1. Reassemble any check valves, compensator valves, anti-cavitation valves or shock valves from each individual valve sections if equipped.
2. Install the control spool being careful not to nick or scratch the valve section bore or the control spool.
3. Install the end caps on each end of the valve section.



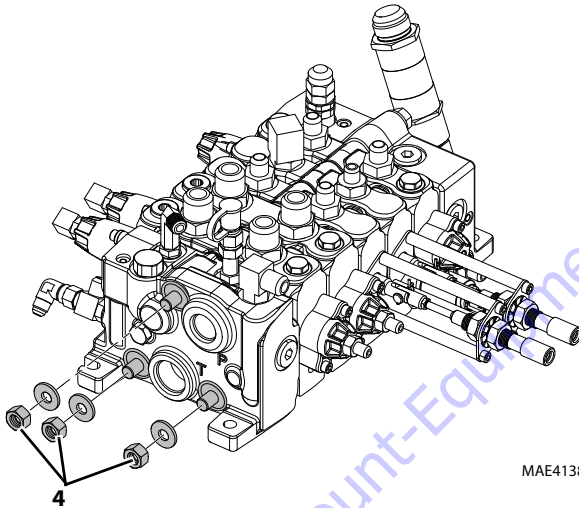
Assemble the Main Control Valve

6036, 6042 - 85 hp (63 kW)



MAQ1880

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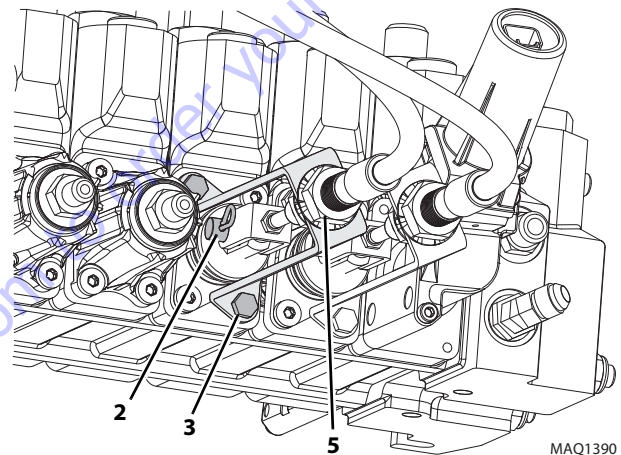
MAE41380

1. Stand the end main control valve section on end.
2. Install the proper o-rings and load sense shuttle on the inner face of the end main control valve section. Align the next valve section over the three tie rods and slide onto the end main control valve section.
3. Using the proper o-rings and load sense shuttle, repeat step two for the remaining valve sections and lastly the inlet end valve section.
4. Install the three nuts on the tie rods. Torque the three nuts (4) to 82-90 lb-ft (111 - 122 Nm).
5. Replace all fittings in the previously noted locations and torque as required.

f. Main Control Valve Installation

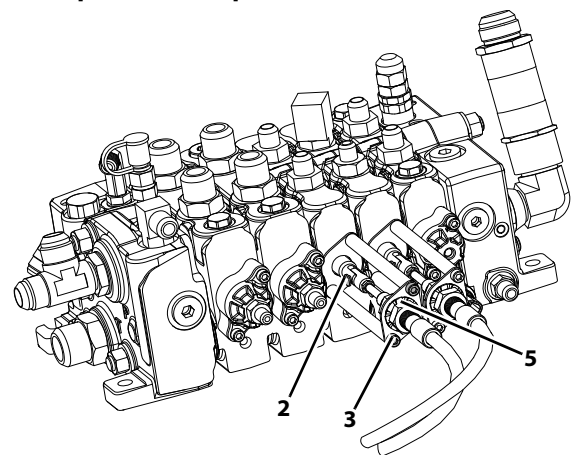
1. Install the main control valve onto the frame, aligning the bolts with the holes in the end sections of the main control valve. Slide the main control valve into position, and tighten the bolts. Torque as required.
2. Prime the main control valve by filling the inlet openings with fresh, filtered hydraulic oil from a clean container, before attaching the hoses.
3. Use new oiled o-rings as required. Uncap and connect all previously labeled hoses, clamps, etc. to the main control valve.

6036, 6042 - 85 hp (63 kW)



MAQ1390

6036 (74hp), 6042 (74hp), 8042, 10042, 10054, 12054



MAE41370

4. Connect the control cables to the main control valve:
 - a. Install the two bolts (3), and secure the control cable mount/bracket to the main control valve. Torque the bolt of mount to 7.74 lb-ft (10,5 Nm)
 - b. Connect the end of the cable to the shaft from the control valve. Secure with the pin and clip (2).



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- c. If required, adjust the jam nuts (5) until the distance from the outer jam nut to the end of the ferrule is the same as recorded during removal. Tighten the jam nuts.
 - d. Repeat steps for remaining control cables.
5. Check routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install the tie wraps and/or the protective conduit as required. Tighten all the tube and hose clamps.
 6. Fill the hydraulic fluid reservoir. Refer to Section 8.6.2, "Hydraulic Oil Reservoir Filling".
 7. Start engine and run at approximately one-third to one-half throttle for about one minute without moving the machine or operating any hydraulic functions.
 8. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.

9. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
10. Install the transmission covers.
11. Close and secure the engine cover.
12. Remove Do Not Operate Tag from ignition key switch and steering wheel.

g. Main Control Valve Test

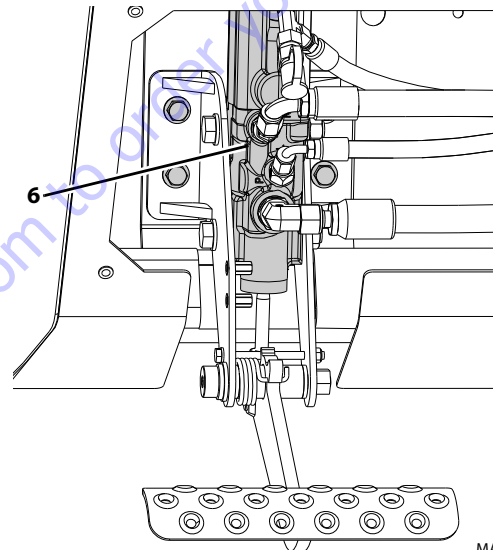
Conduct a pressure check of the hydraulic system in its entirety. Adjust pressure(s) as required. Refer to Section 8.5.1, "Pressure Checks and Adjustments".

Note: **DO NOT** loosen, disassemble or attempt to adjust any of pressure valves unless specifically instructed by manufacturer to do so. Tampering with a pressure valve will irrevocably alter pressure in the affected circuits.

8.8.2 Service Brake Valve

a. Service Brake Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Remove the lower and front dash panels.



6. Label, disconnect and cap all hose attached to the service brake valve (6).
7. Remove the four capscrews and four lockwashers mounting the service brake valve to the steering column support.

Note: **DO NOT** disassemble the service brake valve. The service brake valve is not serviceable and must be replaced in its entirety, if defective.



8.8.3 Service Brake Valve Installation

1. Install the service brake valve with the four capscrews and four lockwashers onto the steering column support.

Note: *ALWAYS* replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.

2. Use new oiled o-rings as required. Uncap and connect the previously labeled hoses to the service brake valve.
3. Check the routing of all hoses, and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.
4. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
5. Remove Do Not Operate Tag on both ignition key switch and steering wheel.
6. Start the engine and run at approximately one-third to one-half throttle for about one minute, without moving the machine or operating any of the hydraulic functions.
7. Inspect the service brake valve and connections for leaks, and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks, and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

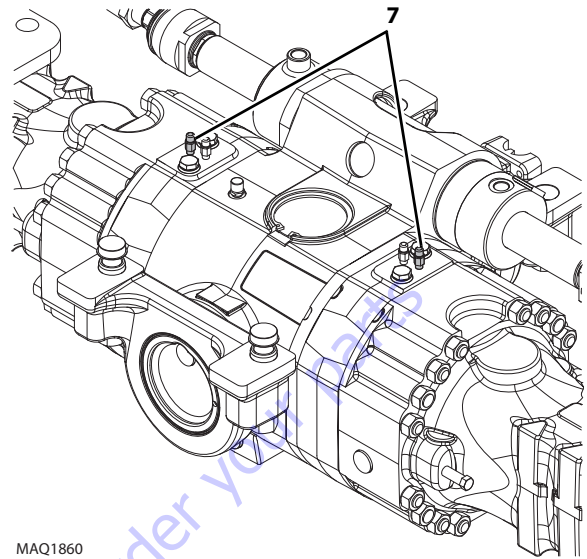
8. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
9. Install the lower and front dash panels.
10. Close and secure the engine cover.

8.8.4 Brake Bleeding

Carefully bleed the brake lines as soon as the brake valve is installed in the machine. Air in the system will not allow the brakes to apply properly. There are four brake bleeder locations on the axles & one brake bleeder in the machine. Work with an assistant to perform this procedure.

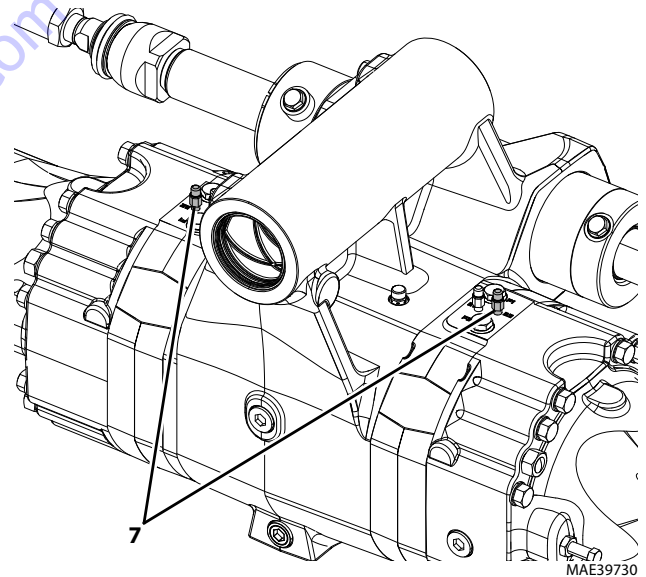
1. Place the transmission in (N) NEUTRAL, engage the park brake, and start the engine.

6036, 6042



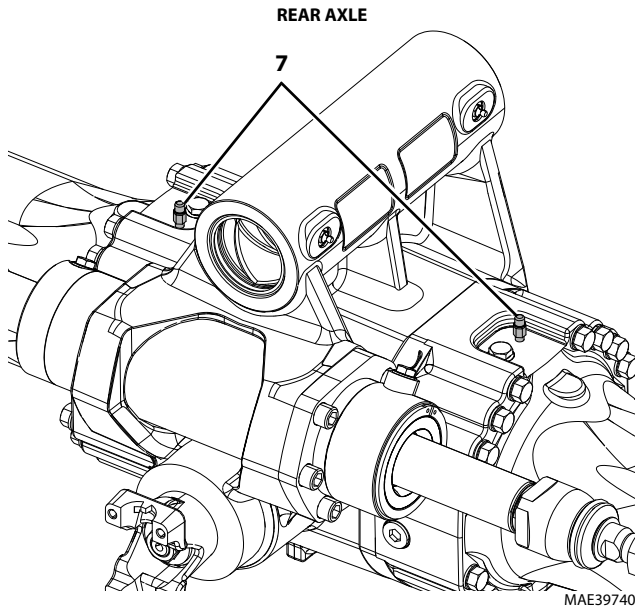
8042, 10042, 10054, 12054

FRONT AXLE

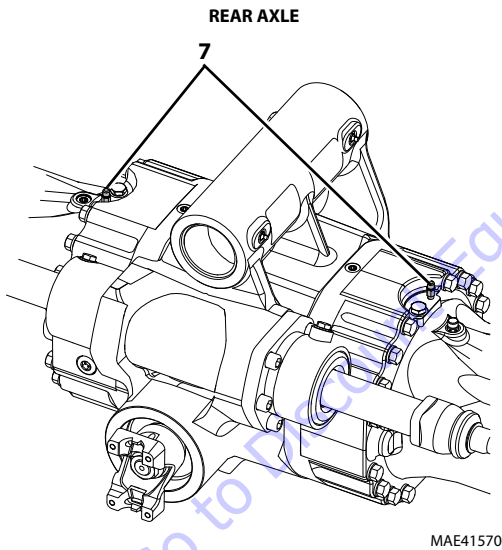




8042, 10042, 10054



12054



Note: Verify brake reservoir oil is at the full mark. **DO NOT** allow the brake reservoir oil to go below the minimum level during the bleeding procedure.

2. Depress the brake pedal 4 - 5 times, then hold at the bottom of the last stroke.

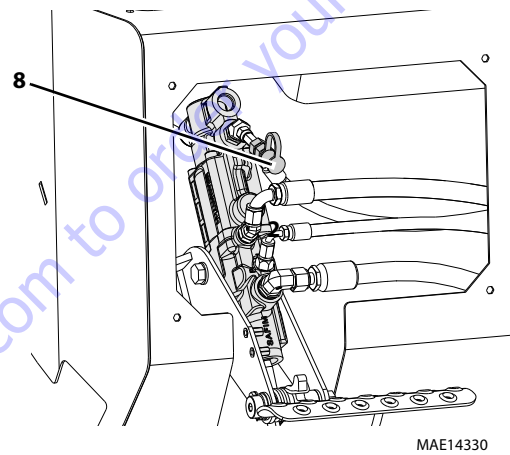
Note: Work with an assistant to perform this procedure.

3. Attach one end of a length of transparent tubing over the brake bleeder at left hand side of the rear axle. Place the other end of this tubing in a suitable transparent container that is partially filled with automatic transmission fluid (ATF oil). The end of the tubing must be below the oil level in the container.

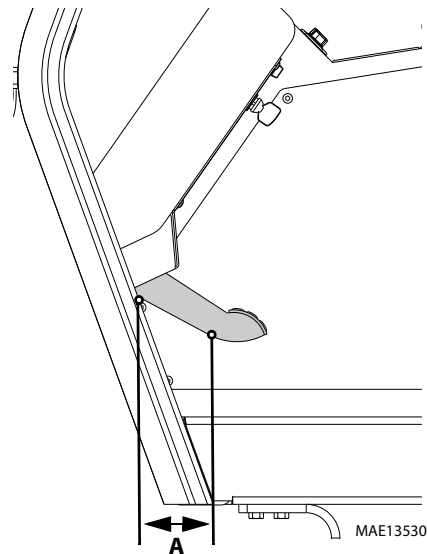
4. Remove the bleed screw (7) with a wrench and allow the fluid to escape. As the fluid escapes, maintain the same pressure on the brake pedal not allowing it to raise. Close the brake bleeder when brake pedal is fully depressed. Repeat the procedure until oil is not aerated further. Remove the tubing from the brake bleeder.
5. Repeat steps 2, 3 and 4 for remaining brake bleeders (7) in this order, the right-rear axle bleed screw, the left-front axle screw, the right-front axle screw, and the center bleeder.

8.8.5 Brake System Check

1. Place the transmission in (N) NEUTRAL, engage the park brake, and start the engine.



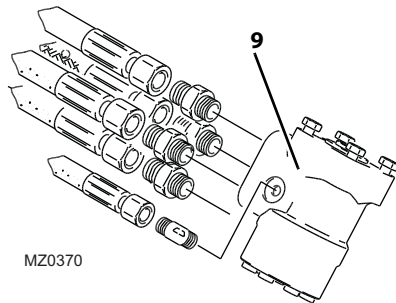
2. Attach pressure gauge to brake pressure tap (8).
3. Apply service brakes with a single pedal press to STOP. Hold the brake pedal in this position and measure the gauge pressure. the allowable pressure limit is 725 - 760 psi (50 - 52,4 bar).



4. Measure the distance from the back of the pedal arm to cab firewall. This distance should be 2.88 in. (73 mm).

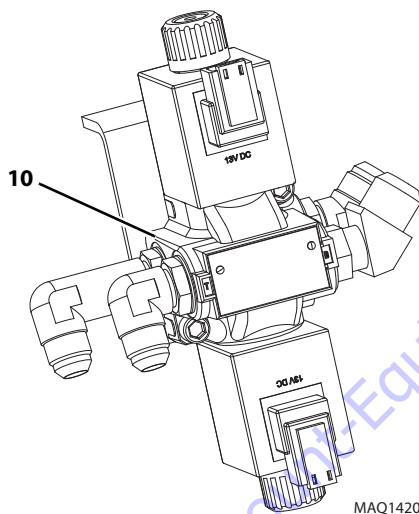


8.8.6 Steering Orbital Valve



The power steering valve (9) is located at the base of the steering wheel shaft, concealed by the lower dash cover. The valve is not serviceable and must be replaced in its entirety if defective. For detailed information refer to Section 4.3.2, "Steering Column and Steering Valve".

8.8.7 Steer Select Valve



The machine can be used in the front-wheel, four-wheel or crab steering mode. The steer select valve (10) controls the direction of hydraulic fluid flow to the steering cylinders mounted on each axle. The steer select valve is attached to a manifold mounted to a mounting plate inside the frame near the fuel tank.

Verify the correct operation of the steer select valve solenoids before considering replacement of the valve. The housing of the steer select valve is not serviceable and must be replaced if defective.

a. Steer Select Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, raise the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Temporarily block up or support the raised boom.
4. Open the engine cover. Allow the system fluids to cool.
5. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
6. Remove the transmission covers.
7. Label, disconnect and cap hydraulic hoses and electrical plugs connected to steering select valve.
8. Remove the bolts holding the steer select valve to the mounting plate on the frame.
9. Remove steer select valve from machine. Wipe up any hydraulic fluid spillage in, on, near and around the machine.

b. Steer Select Valve Disassembly, Cleaning, Inspection and Assembly

1. Place the steer select assembly on a suitable work surface.
2. Separate the steer select valve from the manifold by removing the four socket head capscrews. Discard the four o-rings.
3. Remove the solenoid valves and spool from the steer select housing.
4. Clean all the components with a suitable cleaner before inspection.
5. Inspect the solenoids for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check the spring is intact. Inspect the cartridge interior for contamination.
6. Inspect internal passageways of the steer select manifold and valve for wear, damage, etc. If inner surfaces of the manifold **DO NOT** display an ultra-smooth, polished finish, or components are damaged in any way, replace the manifold or appropriate part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the valve.

Note: *ALWAYS* replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.



7. Install the solenoid valves in the steer select housing.
8. Attach steer select valve to the manifold using four new, oiled o-rings and four socket head capscrews.

c. Steer Select Valve Installation

1. Install the steer select valve to the mounting plate on the frame using two capscrews.
2. Connect all the previously labeled hydraulic hoses, fittings, solenoid wire terminal leads, etc., to the steer select valve.
3. Check the routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all hose clamps.
4. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
5. Remove Do Not Operate Tag on both ignition key switch and steering wheel.
6. Start the engine and run at approximately 1/3-1/2 throttle for about one minute without moving the machine or operating any hydraulic functions.
7. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.

8. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
9. Install the transmission covers.
10. Close and secure the engine cover.

d. Steering Test

Refer to Section 8.5.2, "Pressure Specifications".

1. Conduct a pressure check of the steering hydraulic circuit.
2. Check each steering mode for proper function.

8.8.8 Secondary Function Manifold

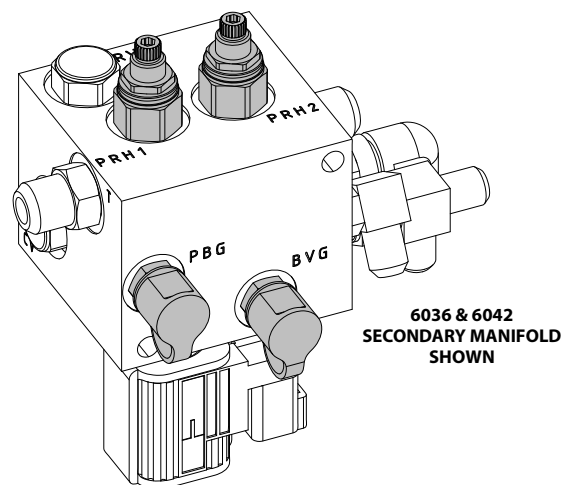
The secondary function manifold is a directional control valve. Hydraulic oil from the pump flows into the secondary function manifold where the pressure is reduced before the oil is directed to the park brake.

The secondary function manifold is a machined block with the ports for two pressure reducing valves, a pressure relief valve, two park brake solenoid valves (one normally open and one normally closed), a check valve and diagnostic test nipples. The secondary function manifold is secured on the left side of the frame with two carriage bolts and two hex flange nuts.

Verify the correct operation of the solenoids before considering replacement of the secondary function manifold. The manifold itself is not serviceable and must be replaced if defective.

a. Secondary Function Manifold Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, raise the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Temporarily block up or support the raised boom.
4. Open the engine cover. Allow the system fluids to cool.
5. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
6. Remove the transmission covers.



MAE41250

7. Label, disconnect and cap hydraulic hoses and electrical plugs connected to secondary manifold.
8. Remove the bolts holding the secondary manifold to the mounting plate on the frame.



9. Remove secondary manifold with attached steer select valve from machine. Wipe up any hydraulic fluid spillage in, on, near and around the machine.

b. Secondary Function Manifold Disassembly, Cleaning, Inspection and Assembly

1. Secure the secondary function manifold assembly in a suitable bench vise if possible. Label and remove the solenoid nut, coil, reducing valve(s) and test ports from the valve.
2. Clean all components with a suitable cleaner before inspection.
3. Inspect the solenoid cartridge for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check the spring is intact. Inspect the cartridge interior for contamination.
4. Inspect internal passageways and the secondary manifold overall for wear, damage, etc. If inner surfaces of the component **DO NOT** display an ultra-smooth, polished finish, or are damaged in any way, replace the valve assembly. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the valve.

Note: *ALWAYS* replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.

5. Install the solenoid valve.
6. Install previously removed reducing valve(s) and test ports. Torque as required.

c. Secondary Function Manifold Installation

1. Place the secondary function manifold into position on the mounting plate on the machine frame.
2. Install bolt and nut securing valve to frame.
3. Connect all the previously labeled hydraulic hoses, fittings, solenoid wire terminal leads, etc., to the secondary function manifold.
4. Check the routing of all hoses and wiring for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all hose clamps.
5. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
6. Remove Do Not Operate Tag on both ignition key switch and steering wheel.
7. Start the engine and run at approximately 1/3 - 1/2 throttle for about one minute without moving the machine or operating any hydraulic functions.

8. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to reservoir as needed.*

9. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
10. Install the transmission covers.
11. Close and secure the engine cover.

8.8.9 Outrigger Valve (10042, 10054 & 12054 only)

The outrigger valve allows the left and right outriggers to be raised or lowered depending on the position of the outrigger switches located on the side console in the cab.

Verify the correct operation of the outrigger valve solenoids before considering replacement of the valve.

a. Outrigger Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, raise the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Temporarily block up or support the raised boom.
4. Open the engine cover. Allow the system fluids to cool.
5. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
6. Remove the transmission covers.
7. Label, disconnect and cap the hydraulic hoses and the electrical plugs connected to the outrigger valve.
8. Remove the two flange nuts and two carriage bolts securing the outrigger valve to the frame. Remove the outrigger valve from the machine.
9. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.

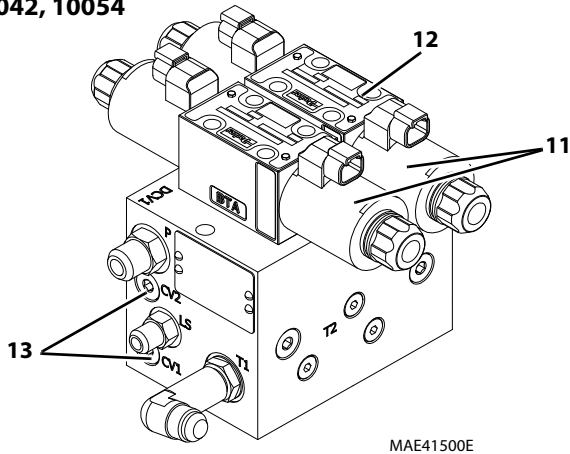


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b. Outrigger Valve Disassembly, Cleaning, Inspection and Assembly

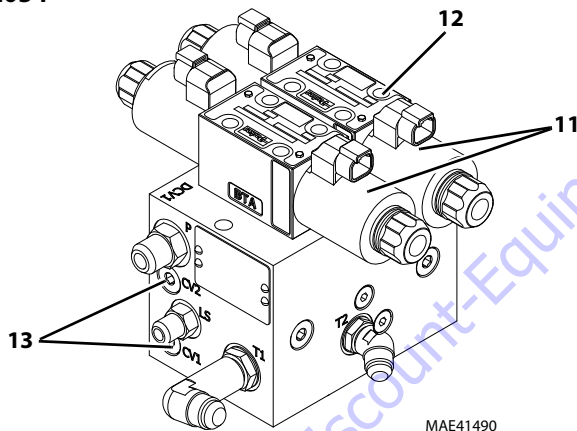
1. Place the outrigger valve assembly on a suitable work surface.

10042, 10054



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12054



MAE41490

2. Remove the solenoid valve assemblies (11) from the outrigger valve by removing the four cap screws (12). Discard the four o-rings.
3. Remove four shuttle cartridges (13) from outrigger valve. CV3 and CV4 are located on the opposite end of the valve body.
4. Clean all components with a suitable cleaner before inspection.
5. Inspect the solenoid cartridges for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check that the spring is intact. Inspect the cartridge interior for contamination.

6. Inspect internal passageways of the outrigger valve for wear, damage, etc. If inner surfaces of the valve **DO NOT** display an ultra-smooth, polished finish, or components are damaged in any way, replace the valve or appropriate part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the valve block.

Note: *ALWAYS* replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.

7. Install the shuttle cartridges into the outrigger valve. Torque to 35 lb-ft (48 Nm).
8. Attach the solenoid assemblies to the outrigger valve using four new, oiled o-rings and the previously used capscrews.

c. Outrigger Valve Installation

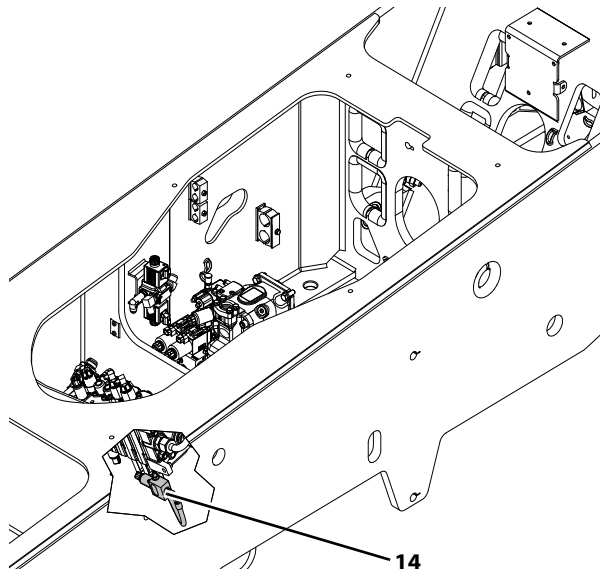
1. Insert the previously used bolts through the bottom of the outrigger valve and loosely attach the flange nuts to the carriage bolts.
2. Position the outrigger valve so that the heads of the carriage bolts go through the slots in the frame. Tighten the flange nuts.
3. Connect all the previously labeled hydraulic hoses, fittings, solenoid wire terminal leads, etc., to the outrigger valve.
4. Check the routing of all hoses and wiring for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all hose clamps.
5. Properly connect the battery. Refer to Section 9.8, "Battery", for procedure.
6. Remove Do Not Operate Tag on both ignition key switch and steering wheel.
7. Start the engine and run at approximately 1/3 - 1/2 throttle for about one minute without moving the machine or operating any hydraulic functions.
8. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

9. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
10. Install the transmission covers.
11. Close and secure the engine cover.



8.8.10 Extend Lockout Valve (10054 & 12054 only)



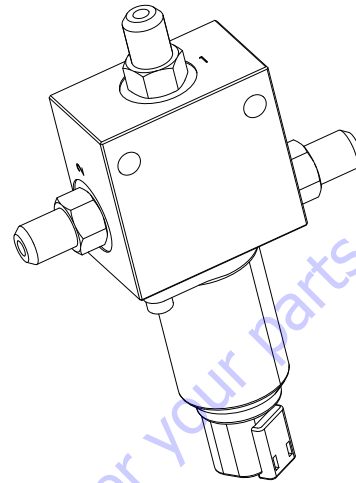
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Model 10054 & 12054 has an extend lockout valve (**14**) which prevents the boom from being extended beyond 42 feet unless the outriggers are lowered onto firm terrain. Once the outriggers are lowered, pressure switches located on each outrigger cylinder close and energize the solenoid on the boom extend lockout valve. The boom can then be fully extended.

a. Extend Lockout Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, raise the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Temporarily block up or support the raised boom.
4. Open the engine cover. Allow the system fluids to cool.
5. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
6. Remove the transmission covers.
7. Label, disconnect and cap hydraulic hoses and electrical plugs connected to extend lockout valve.
8. Remove nut and bolt securing extend lockout valve to the frame. Remove the valve from the machine.
9. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.

b. Extend Lockout Valve Disassembly, Cleaning, Inspection and Assembly



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1. Secure the extend lockout valve assembly in a suitable bench vise if possible. Remove the cartridge nut and adaptors from the valve.
2. Clean all components with a suitable cleaner before inspection.
3. Inspect internal passageways and the extend lockout valve overall for wear, damage, etc. If inner surfaces of the component **DO NOT** display an ultra-smooth, polished finish, or are damaged in any way, replace the extend lockout valve. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the valve.

Note: ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.

4. Install the cartridge nut and adaptors.
5. Install the pressure sensing valve. Torque to 65 lb-ft (88 Nm).



c. Extend Lockout Valve Installation

1. Place the extend lockout valve into position on the mounting plate on the machine frame.
2. Install bolt and nut securing valve to frame.
3. Connect all the previously labeled hydraulic hoses, fittings, solenoid wire terminal leads, etc., to the extend lockout valve.
4. Check the routing of all hoses and wiring for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all hose clamps.
5. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
6. Remove Do Not Operate Tag on both ignition key switch and steering wheel.
7. Start the engine and run at approximately 1/3 - 1/2 throttle for about one minute without moving the machine or operating any hydraulic functions.
8. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: Check for leaks and repair as required before continuing. Add hydraulic fluid to reservoir as needed.

9. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
10. Install the transmission covers.
11. Close and secure the engine cover.

d. Extend Lockout Valve Test

Conduct a test of the extend lockout valve.

1. Park the machine on a firm, level surface.
2. With the boom fully retracted and lowered, lower the outriggers.
3. Extend the boom to 54 ft (16,5 m). The boom should extend fully and should not stop at 42 ft (12,8 m).

8.9 HYDRAULIC CYLINDERS

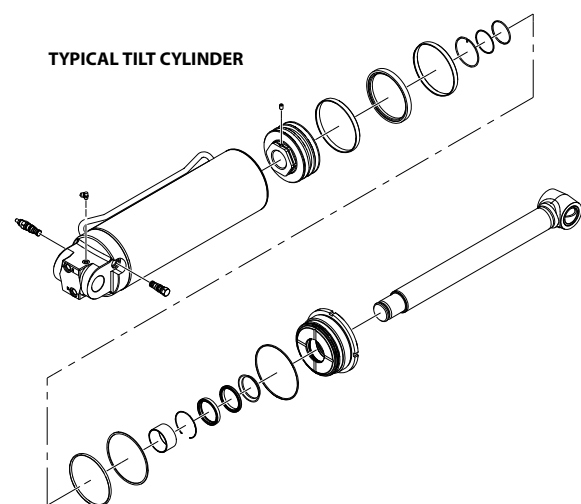
8.9.1 General Cylinder Instructions

a. Cylinder Removal

1. Remove any attachment from the machine. Park the machine on a firm level surface and fully retract the boom. Allow sufficient work space around the hydraulic cylinder being removed. Support the boom if the lift/lower cylinder is being removed. Place the transmission in (N) NEUTRAL, engage the park brake, shut the engine OFF and chock wheels.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Label, disconnect and cap or plug hydraulic hoses in relation to the cylinder.
5. Attach a suitable sling to an appropriate lifting device and to the cylinder. Make sure the device used can actually support the cylinder.
6. Remove the lock bolt and/or any retaining clips securing the cylinder pins. Remove the cylinder pins.
7. Remove the cylinder.
8. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.

b. Cylinder Disassembly

1. Clean the cylinder with a suitable cleaner before disassembly. Remove all dirt, debris and grease from the cylinder.



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- Clamp the barrel end of the cylinder in a soft-jawed vise or other acceptable holding equipment if possible.

WARNING

Significant pressure may be trapped inside the cylinder. Exercise caution when removing a counterbalance valve or a pilot-operated check valve from a cylinder.

Note: Avoid using excessive force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube.

- If applicable, remove the counterbalance valve from the side of the cylinder barrel.

Note: **DO NOT** tamper with or attempt to adjust the counterbalance valve cartridge. If adjustment or replacement is necessary, replace the counterbalance valve with a new part.

- Extend the rod as required to allow access to the base of the cylinder.

Note: Protect the finish of the rod at all times. Damage to the surface of the rod can cause seal failure.

- Using a pin spanner wrench, unscrew the head gland from the tube. A considerable amount of force will be needed to remove the head gland. Carefully slide the head gland down along the rod toward the rod eye and piston, away from the cylinder barrel.

Note: When sliding the rod and piston assembly out of the barrel, prevent the threaded end of the barrel from damaging the piston. Keep the rod centered within the barrel to help prevent binding.

- Carefully pull the rod assembly along with the head gland out of the cylinder barrel.
- Fasten the rod eye in a soft-jawed vise, and place a padded support under and near the threaded end of the rod to prevent any damage to the rod.
- Remove the set screw from the piston head.
- Remove the lock nut from the piston rod.

Note: It may be necessary to apply heat to break the bond of the sealant between the piston and the rod before the piston can be removed.

Some cylinder parts are sealed with a special organic sealant and locking compound. Before attempting to disassemble these parts, remove any accessible seals from area of bonded parts. Wipe off any hydraulic oil, then heat part(s) uniformly to break bond. A temperature of 300 - 400° F (149 - 204° C) will destroy bond. Avoid overheating, or parts may become distorted or damaged. Apply sufficient torque for removal while parts are still hot. The sealant often leaves a white, powdery residue on threads and other parts, which must be removed by brushing with a soft brass wire brush prior to reassembly.

- Remove the piston head from the rod and carefully slide the head gland off the end of the rod.
- Remove all seals, backup rings and o-rings from piston head and all seals, backup rings and o-rings from the head gland.

Note: The head gland bearing will need to be inspected to determine if replacement is necessary.

DO NOT attempt to salvage cylinder seals, sealing rings or o-rings. **ALWAYS** use a new, complete seal kit when rebuilding hydraulic components. Consult the parts catalog for ordering information.

c. Cylinder Cleaning Instructions

- Discard all seals, backup rings and o-rings. Replace with new items from seal kit to ensure proper cylinder function.
- Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

Note: If a white powdery residue is present on threads or parts, it can be removed by using a soft brass wire brush. Wipe clean with Threadlocking Cleaner prior to reassembly.

d. Cylinder Inspection

- Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the cylinder barrel does not display a smooth finish, or is scored or damaged in any way, replace the barrel.
- Remove light scratches on the piston, head gland, rod with a 400 - 600 grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
- Proper honing is required to smooth the inner surface of the cylinder barrel.
- Check the piston rod assembly for run-out. If the rod is bent, it must be replaced.
- Inspect rod eye bushing and replace if worn or damaged.

e. Cylinder Assembly Instructions

- Use the proper tools for specific installation tasks. Clean tools are required for installation.
- Install new seals, backup rings and o-rings on the piston and new seals, backup rings, o-rings and bearing on the head gland.

Note: The extend/retract cylinder has a spacer that **MUST** be installed over the rod **AFTER** the head gland and **BEFORE** the piston head.

- Fasten the rod eye in a soft-jawed vise, and place a padded support under and near the threaded end of the rod to prevent any damage to the rod.



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Note: Protect the finish on the cylinder rod at all times. Damage to the surface of the rod can cause seal failure.

4. Lubricate and slide the head gland over the cylinder rod. Install the piston head on to the end of the cylinder rod. Medium Strength Threadlocking Compound and install the set screw in the piston head. Refer to Section 8.9.4, "Cylinder Torque Specifications", for torque specifications for the piston head and the set screw.

Note: Avoid using excess force when clamping the cylinder barrel in a vise. Apply only enough force to hold the cylinder barrel securely. Excessive force can damage the cylinder barrel.

5. Place the cylinder barrel in a soft-jawed vise or other acceptable holding devise.

Note: When sliding the rod and piston assembly into the cylinder barrel, prevent the threaded end of the cylinder barrel from damaging the piston head. Keep the cylinder rod centered within the barrel to prevent binding.

6. Carefully insert the cylinder rod assembly into the cylinder barrel.
7. Screw the head gland into the cylinder barrel and tighten with a spanner wrench. Refer to Section 8.9.4, "Cylinder Torque Specifications", for torque specifications for the head gland.
8. If applicable, install new counter balance valve into block on the cylinder barrel.

f. Cylinder Installation

1. Grease the bushings at the ends of the hydraulic cylinder. Using an appropriate sling, lift the cylinder into it's mounting position.
2. Align cylinder bushing and install pin, lock bolt or retaining clip.
3. Connect the hydraulic hoses in relation to the labels or markings made during removal.
4. Before starting the machine, check fluid level of the hydraulic fluid reservoir and if necessary fill to full mark.
5. Start the machine and run at low idle for about one minute. Slowly activate hydraulic cylinder function in both directions allowing the cylinder to fill with hydraulic oil.
6. Inspect for leaks and check level of hydraulic fluid in reservoir. Add hydraulic fluid if needed. Shut the engine OFF.
7. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
8. Close and secure the engine cover.

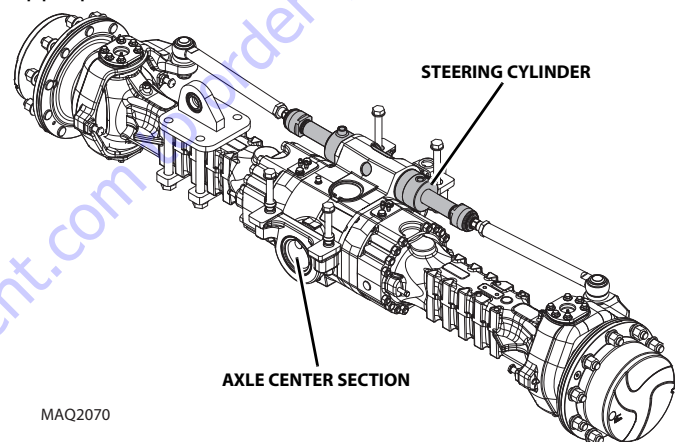
8.9.2 Cylinder Pressure Checking

Attach a digital or 4000 psi (276 bar) gauge to test port on hydraulic pump to check system pressure. For more information, refer Section 8.5.1, "Pressure Checks and Adjustments".

Note: If a hydraulic cylinder pressure is greater than main control valve pressure, increase main control valve pressure by adjusting the main relief. Generally, one half turn clockwise will be adequate to check an individual circuit. Activate circuit and if pressure is obtained turn main relief counter clockwise one half turn. Re-check main relief setting and adjust if necessary.

8.9.3 Steering Cylinders

The steer cylinder is attached to each axle center housing. The steer cylinder assembly can be found in Section 5.3, "Axle Assemblies". The steer cylinder is covered in the appropriate manufacturer's axle literature.





8.9.4 Cylinder Torque Specifications

a. Lift/Lower Cylinder

Model	Head	Piston	Piston Lock Nut	Valve	Set Screw
6036, 6042	295 lb-ft (400 Nm)	966 lb-ft (1310 Nm)	NA	33 - 37 lb-ft (45 - 50 Nm)	7.4 lb-ft (10 Nm)
8042	NA	NA	NA	33 - 37 lb-ft (45 - 50 Nm)	NA
10042, 10054	300 - 400 lb-ft (407 - 542 Nm)	NA	1750 - 2000 lb-ft (2372 - 2556 Nm)	30 - 35 lb-ft (41 - 47 Nm)	10 - 26 lb-ft (13 - 35 Nm)
12054	360 lb-ft (488 Nm)	1450 lb-ft (1966 Nm)	NA	33 lb-ft (45 Nm)	21 lb-ft (28 Nm)

b. Extend/Retract Cylinder

Model	Head	Piston	Valve	Set Screw
6036	300 - 400 lb-ft (407 - 542 Nm)	330 - 390 lb-ft (447 - 529 Nm)	40 - 50 lb-ft (54 - 67 Nm)	9 - 11 lb-ft (12 - 15 Nm)
6042	300-400 lb-ft (407-542 Nm)	330-390 lb-ft (447-529 Nm)	40 - 50 lb-ft (54 - 67 Nm)	9 - 11 lb-ft (12 - 15 Nm)
8042, 10042, 10054, 12054	300 - 400 lb-ft (407 - 542 Nm)	390 - 460 lb-ft (529 - 624 Nm)	150 - 160 lb-ft (203 - 217 Nm)	9 - 11 lb-ft (12 - 15 Nm)

c. Tilt Cylinder

Model	Head	Piston	Piston Locknut	Valve	Set Screw
6036, 6042	300 - 400 lb-ft (407-542 Nm)	240 - 280 lb-ft (325 - 380 Nm)	NA	30 - 35 lb-ft (41 - 47 Nm)	9 - 11 lb-ft (12 - 15 Nm)
8042, 10042, 10054	500 - 600 lb-ft (678-813 Nm)	NA	1850 - 2000 lb-ft (2508 - 2712 Nm)	30 - 35 lb-ft (41 - 47 Nm)	N/A
12054	360 lb-ft (488 Nm)	1450 lb-ft (1966 Nm)	NA	33 lb-ft (45 Nm)	21 lb-ft (28 Nm)

d. Frame Level Cylinder

Model	Head	Piston Locknut	Valve	Plug
6036, 6042, 8042, 10042, 10054	300 - 400 lb-ft (407 - 542 Nm)	1100 - 1250 lb-ft (1491 - 1695 Nm)	35 - 40 lb-ft (47 - 54 Nm)	10 - 12 lb-ft (13 - 16 Nm)
12054	250 - 350 lb-ft (339 - 475 Nm)	2200 - 2650 lb-ft (2983 - 3593 Nm)	30 - 35 lb-ft (41 - 47 Nm)	NA



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e. Stabil-TRAK Cylinder

Model	Head	Piston Locknut	Check Valve	Set Screw	Pressure Reducing/PO Check Valve	Solenoid Coil
6042, 8042, 10042, 10054	250 - 350 lb-ft (339 - 475 Nm)	1175 - 1400 lb-ft (1593 - 1898 Nm)	20 - 25 lb-ft (27 - 34 Nm)	3 - 4 lb-ft (4 - 5 Nm)	35 - 40 lb-ft (47 - 54 Nm)	25 - 30 lb-ft (34 - 41 Nm)
12054	250 - 350 lb-ft (339 - 475 Nm)	1175 - 1400 lb-ft (1593 - 1898 Nm)	20 - 25 lb-ft (27 - 34 Nm)	3 - 4 lb-ft (4 - 5 Nm)	35 - 40 lb-ft (47 - 54 Nm)	25 - 30 lb-ft (34 - 41 Nm)

f. Compensation Cylinder

Model	Head	Locknut	Valve	Set Screw
6036, 6042	250 - 350 lb-ft (339 - 474 Nm)	650 - 700 lb-ft (881 - 949 Nm)	30 - 35 lb-ft (40 - 47 Nm)	3 - 4 lb-ft (4 - 5 Nm)
8042, 10042, 10054	300 - 400 lb-ft (407 - 542 Nm)	900 - 1050 lb-ft (1220 - 1424 Nm)		NA
12054	360 lb-ft (488 Nm)	1000 lb-ft (1356 Nm)	33 lb-ft (45 Nm)	NA

g. Swing Carriage Cylinder (If Equipped)

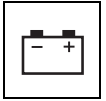
Piston	Head	Set Screw	Valves
425 - 500 lb-ft (576 - 678 Nm)	250 - 350 lb-ft (339 - 474 Nm)	85 - 95 lb-ft (115 - 129 Nm)	30 - 35 lb-ft (41 - 47 Nm)

h. Side Tilt Carriage Cylinder (If Equipped)

Head	Locknut	Valve
300-400 lb-ft (407-542 Nm)	550 - 650 lb-ft (745 - 881 Nm)	30 - 35 lb-ft (41 - 47 Nm)

i. Outrigger Cylinder

Model	Head	Locknut	Valves
10042, 10054	250 - 350 lb-ft (339 - 475 Nm)	1650 - 1800 lb-ft (2237 - 2440 Nm)	30 - 35 lb-ft (41 - 47 Nm)
12054	250 - 350 lb-ft (339 - 475 Nm)	2200 - 2650 lb-ft (2983 - 3593 Nm)	30 - 35 lb-ft (41 - 47 Nm)



Section 9

Electrical System

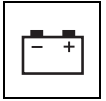
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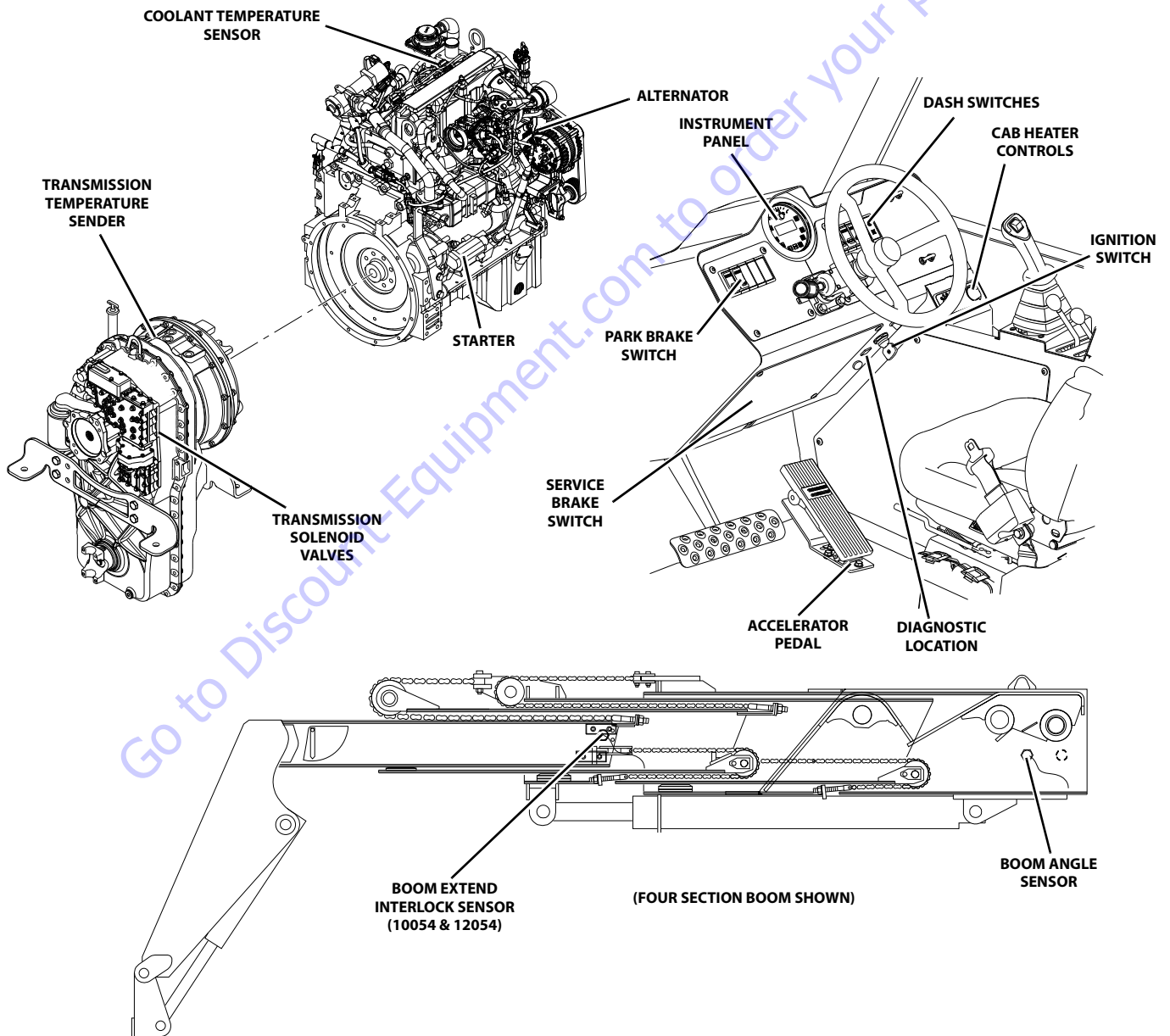
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9.1 ELECTRICAL COMPONENT TERMINOLOGY

To understand the safety, operation, and service information presented in this section, it is necessary that the operator/mechanic be familiar with the name and location of the electrical components of the machine. The following illustration identifies the components that are referred to throughout this section.

9.1.1 General Overview



MAE41300



Electrical System

9.2 SPECIFICATIONS

Electrical system specifications are listed in Section 2, "General Information and Specifications".

9.3 SAFETY INFORMATION

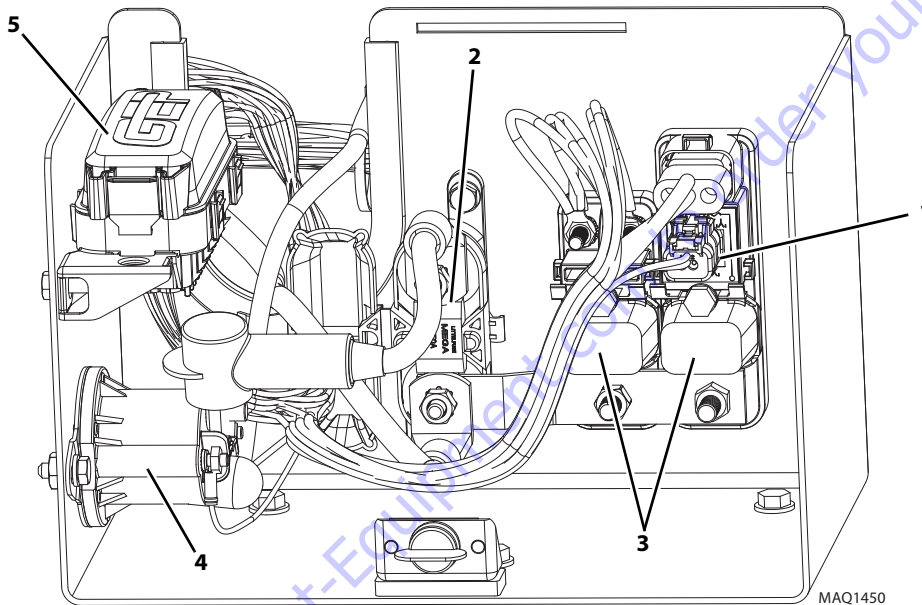
WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, "Safety Practices", of this manual.

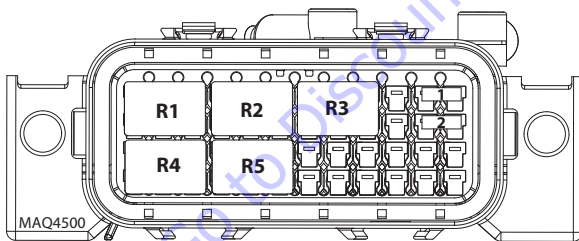
9.4 FUSES AND RELAYS

9.4.1 Engine Compartment Fuse and Relays

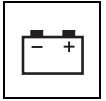
Starter relay (1), one 250 amp fuse (2) two 60 amp power module fuses (3) 150 amp relay for cold start grid heater (4) and DEF System Power Module (5) are located inside engine compartment in protective case next to battery.



MAQ1450

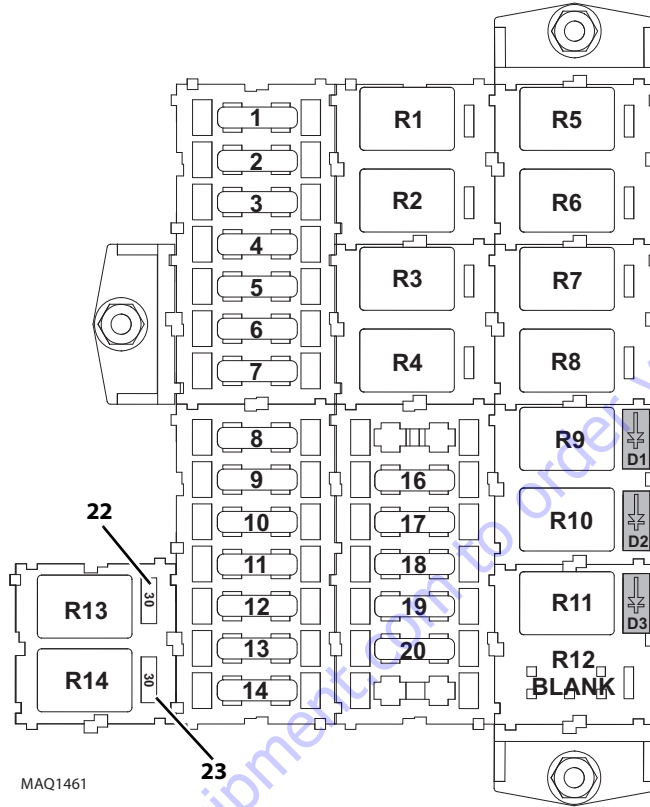


No.	Amp	Circuit
R1	35 Amp	Starter Lockout Relay
R2	35 Amp	DEF Heater Suction Relay
R3	35 Amp	DEF Heater Diagnostic Relay
R4	35 Amp	DEF Heater Pressure Relay
R5	35 Amp	DEF Heater Supply Module Relay
1	15 Amp	Supply Module Heater
2	15 Amp	DEF Heater

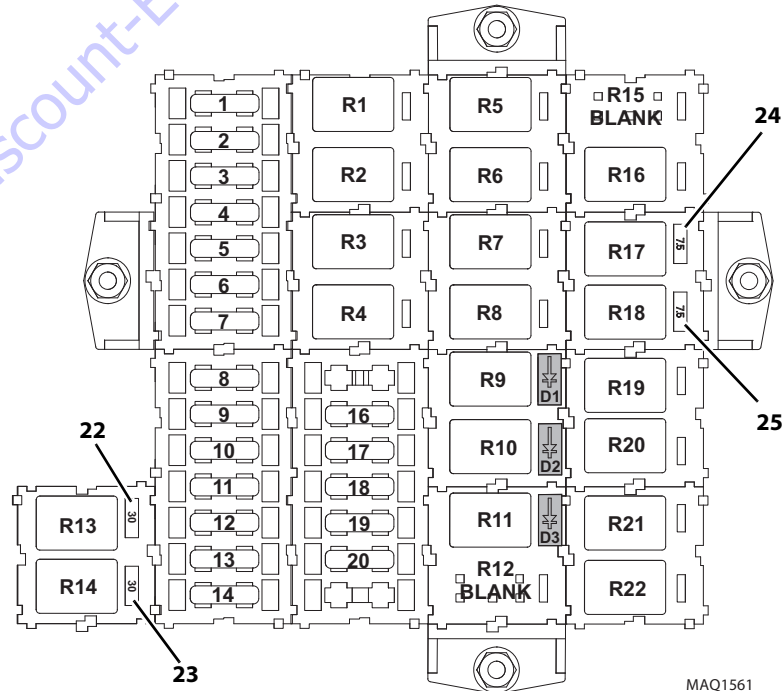


9.4.2 Cab Harness Fuses and Relays

6036, 6042, 8042 & 10042



10054 & 12054

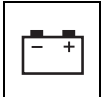




Electrical System

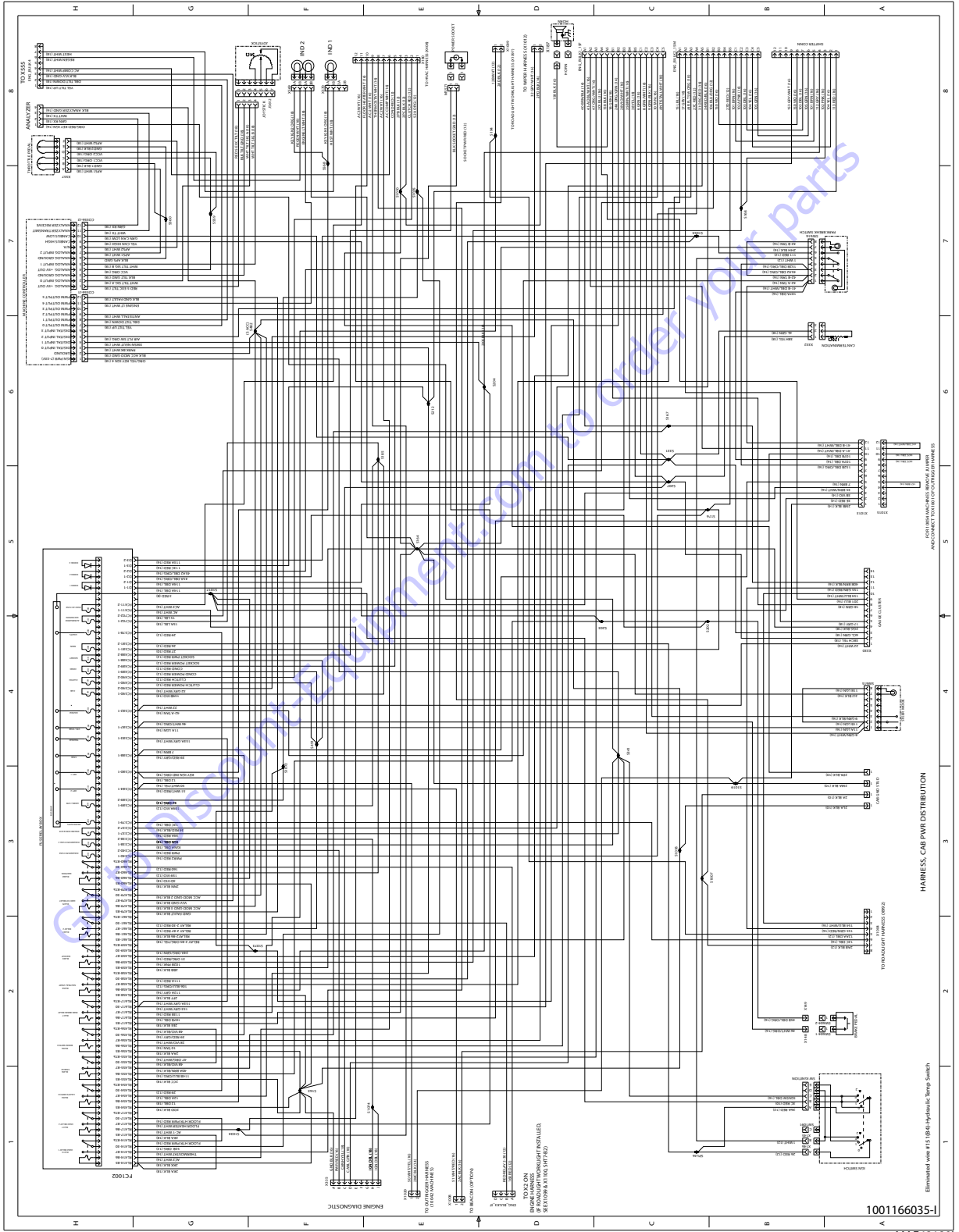
No.	Amp	Circuit
1	20 Amp	Hazard Lights
2	15 Amp	Outriggers/Beacon
3	7.5 Amp	Work Lights Relay
4	10 Amp	Boom Switch
5	7.5 Amp	Park Brake Disengage/Transmission
6	10 Amp	Steering/Stabilizer
7	10 Amp	Gauge Cluster/Park Brake Interlock
8	20 Amp	Work Lights Relay
9	7.5 Amp	AC Switch
10	20 Amp	Heater Blower Motor
11	7.5 Amp	Accessory Plug
12	10 Amp	AC Relay
13	20 Amp	Horn/Heater
14	5 Amp	Alternator Excite
15		BLANK
16	10 Amp	Diagnostic Battery
17	10 Amp	Diagnostic Ignition
18	5 Amp	ECM Key Switch
19	10 Amp	Wipers
20	40 Amp	Main
21		BLANK
22	30 Amp	Work Lights (if equipped)
23	30 Amp	Road Lights (if equipped)
R1	35 Amp	Boom Switch (Removed on 6036)
R2	35 Amp	Park Brake Switch
R3	35 Amp	Neutral Relay
R4	35 Amp	Backup Relay
R5	35 Amp	Relay 2
R6	35 Amp	Ground Fault Relay
R7	35 Amp	HVAC Relay 1
R8	35 Amp	HVAC Relay 2
R9	35 Amp	Lights Relay (*Diode)
R10	35 Amp	Stabilizer Lock Relay (*Diode) (Removed on 6036)
R11	35 Amp	Ignition Relay (*Diode)
R12		BLANK
R13	35 Amp	Work Lights (if equipped)
R14	35 Amp	Road Lights (if equipped)
R15		BLANK
R16	35 Amp	Stabilizer Interlock
R17	35 Amp	Stabilizer Lockup
R18	35 Amp	Boom Extend Interlock

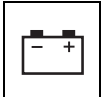
No.	Amp	Circuit
R19	35 Amp	Right Outrigger Lock Out
R20	35 Amp	Left Outrigger Lock Out
R21	35 Amp	Park Brake Interlock
R22	35 Amp	Boom Extension Lock Out
24	7.5 Amp	Outrigger 1 (Mini-Fuse)
25	7.5 Amp	Outrigger 2 (Mini-Fuse)



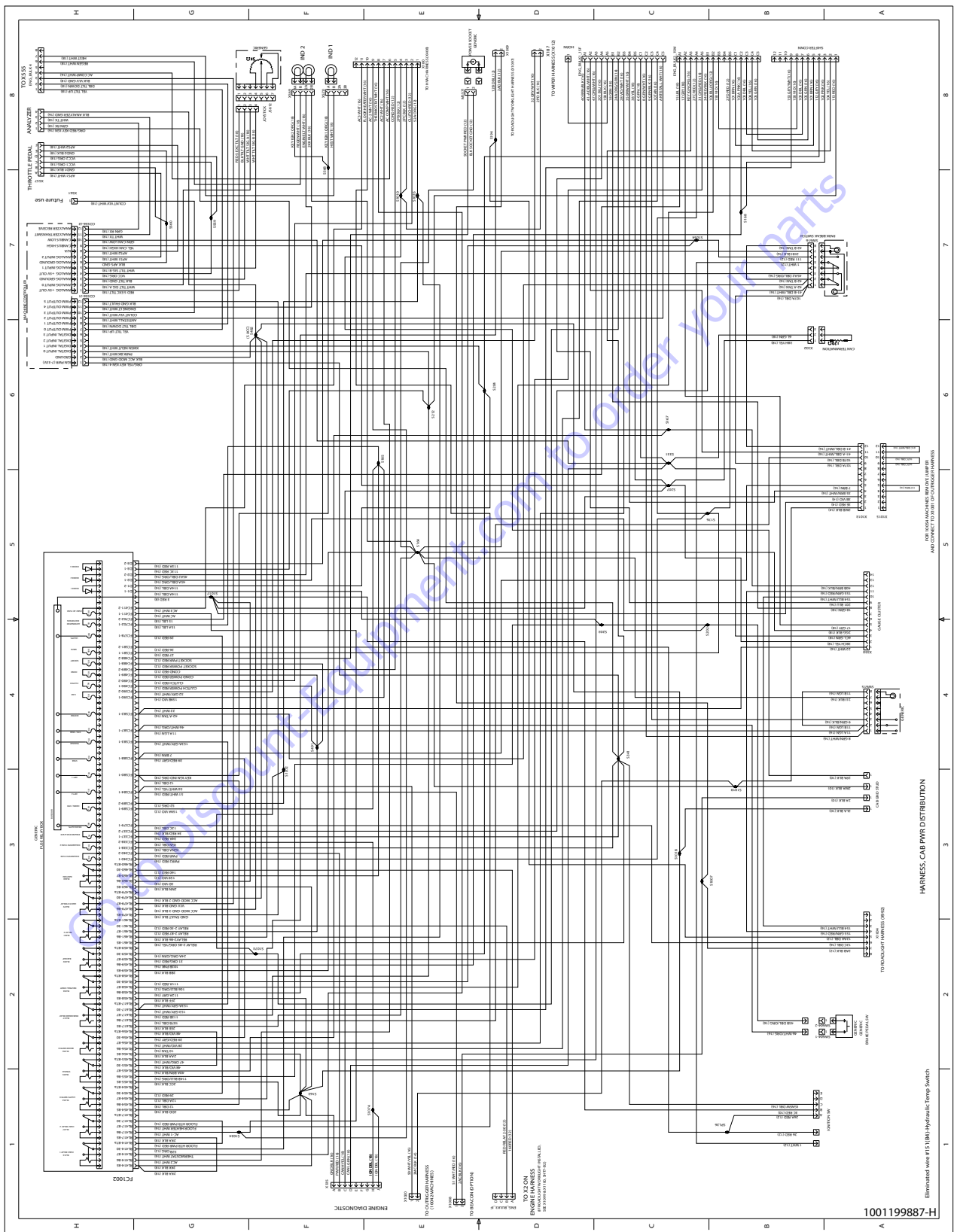
9.5 ELECTRICAL SYSTEM SCHEMATICS

9.5.1 Cab Schematic (85 hp (63 kW), 110 hp (82 kW) if equipped for ULS)





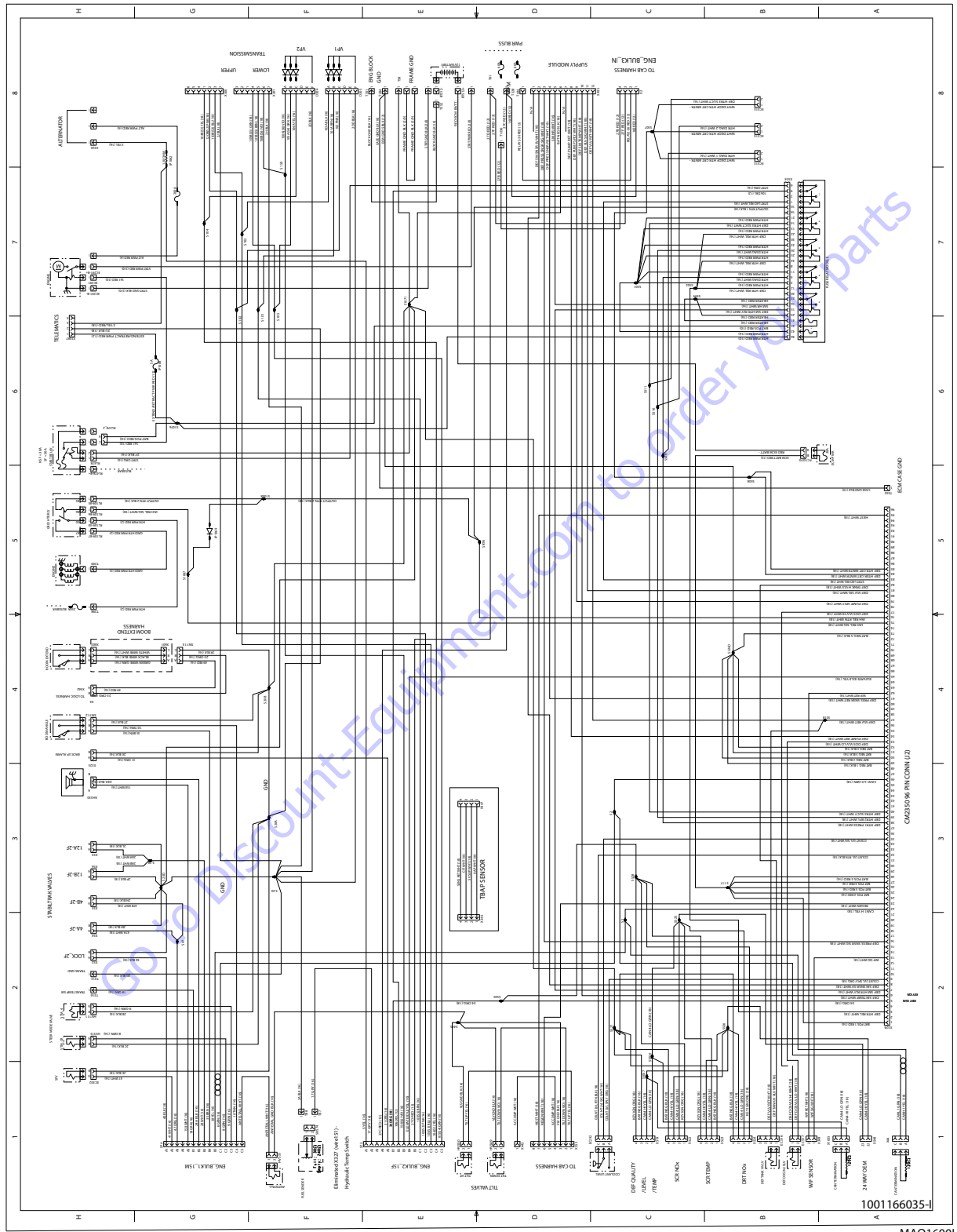
9.5.3 Cab Schematic (74 hp (55 kW) if equipped)





Electrical System

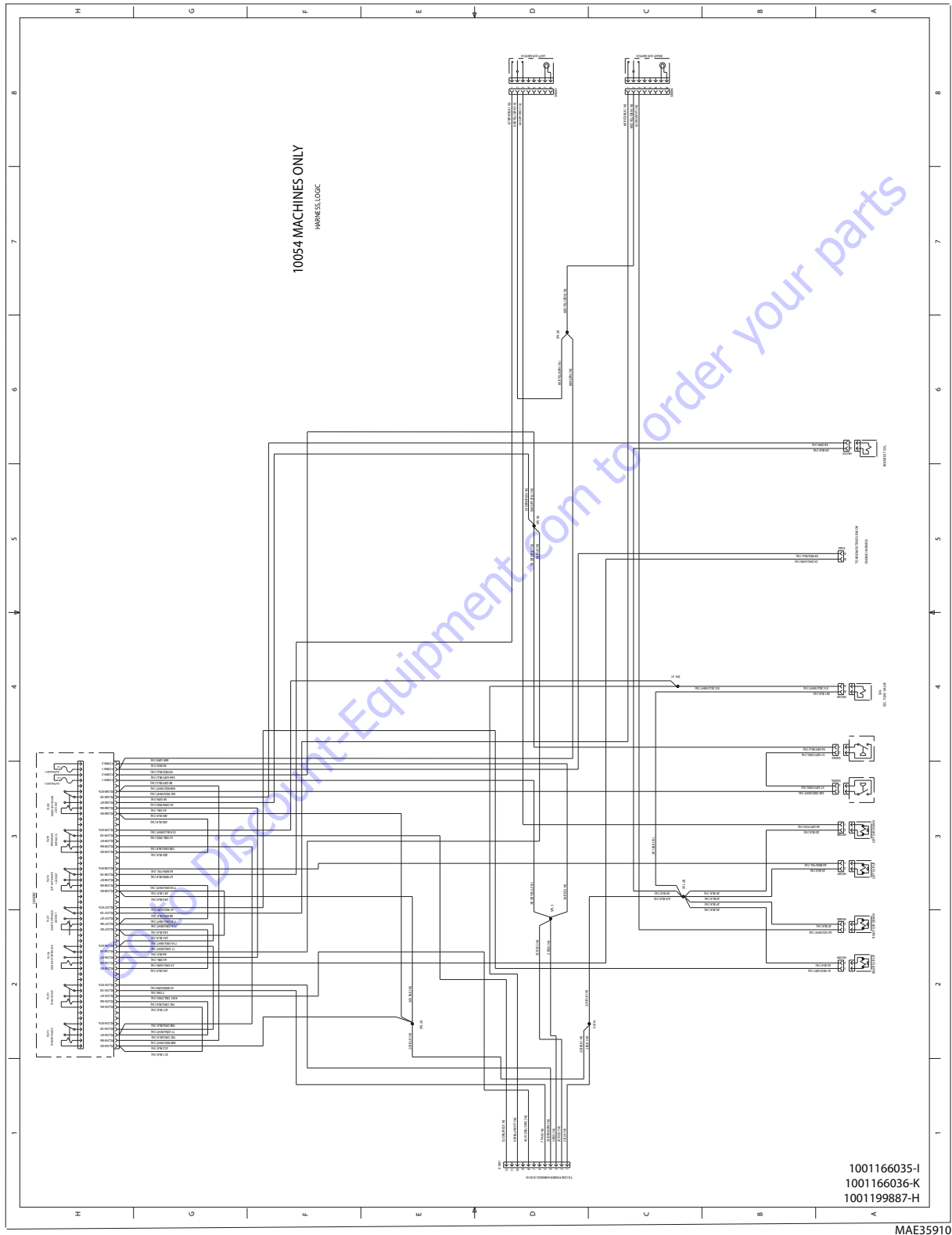
9.5.4 Chassis - Engine Schematic (85 hp (63 kW), 110 hp (82 kW) if equipped for ULS)





Electrical System

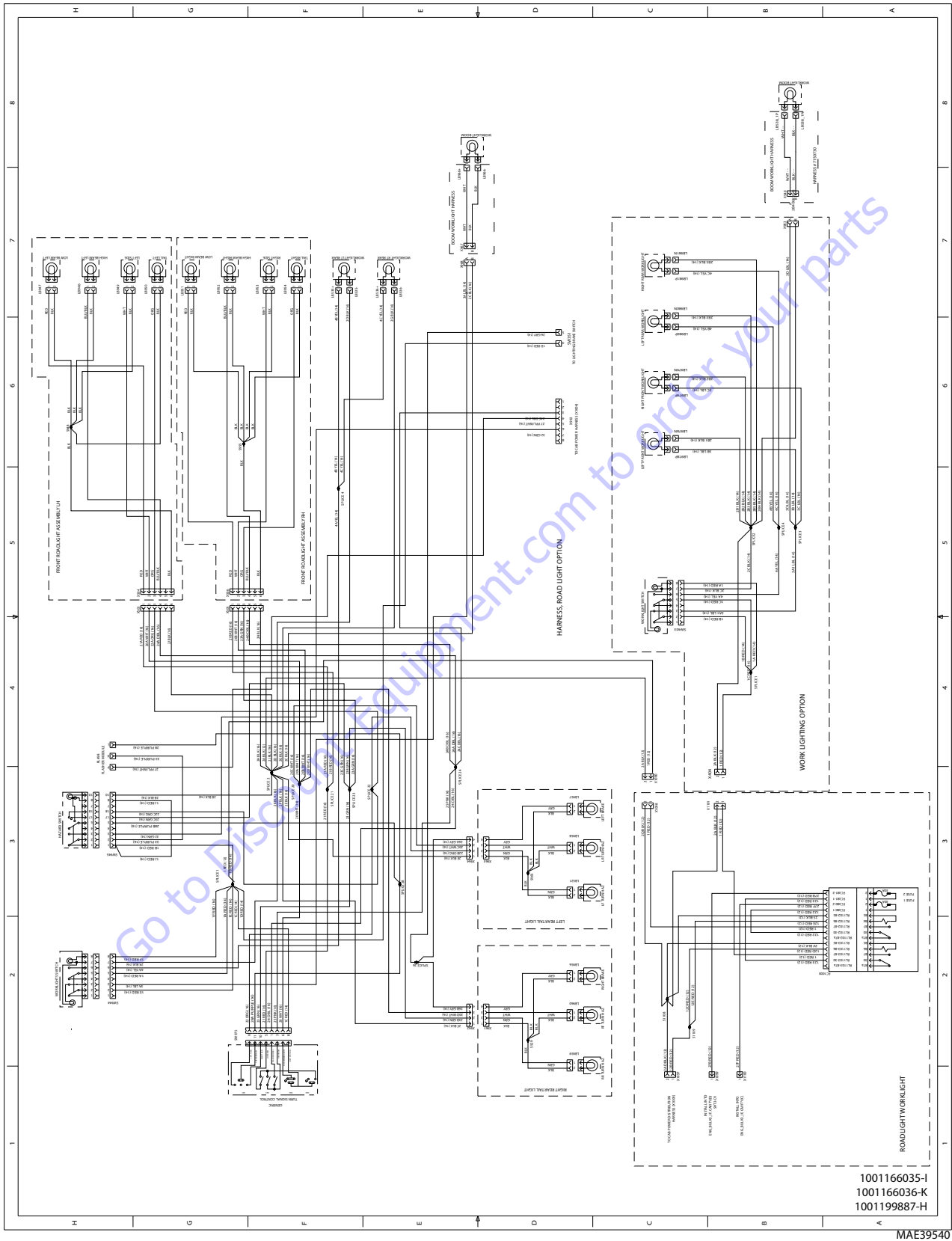
9.5.8 Cab O/R Option Schematic (10054 only)

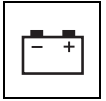




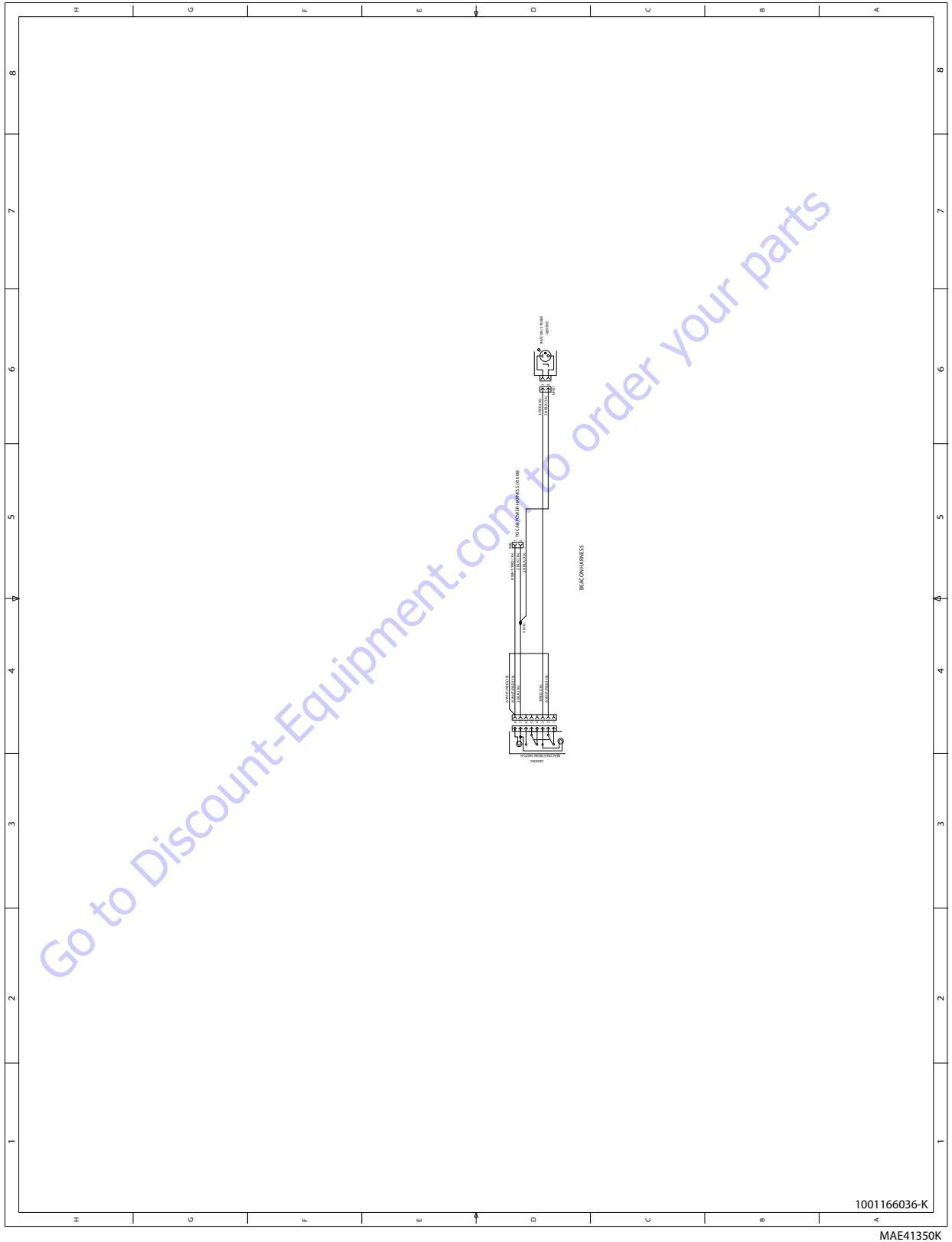
Electrical System

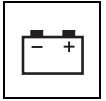
9.5.10 Roadlights Option/Worklights Option/Roadlights-Worklights Schematic



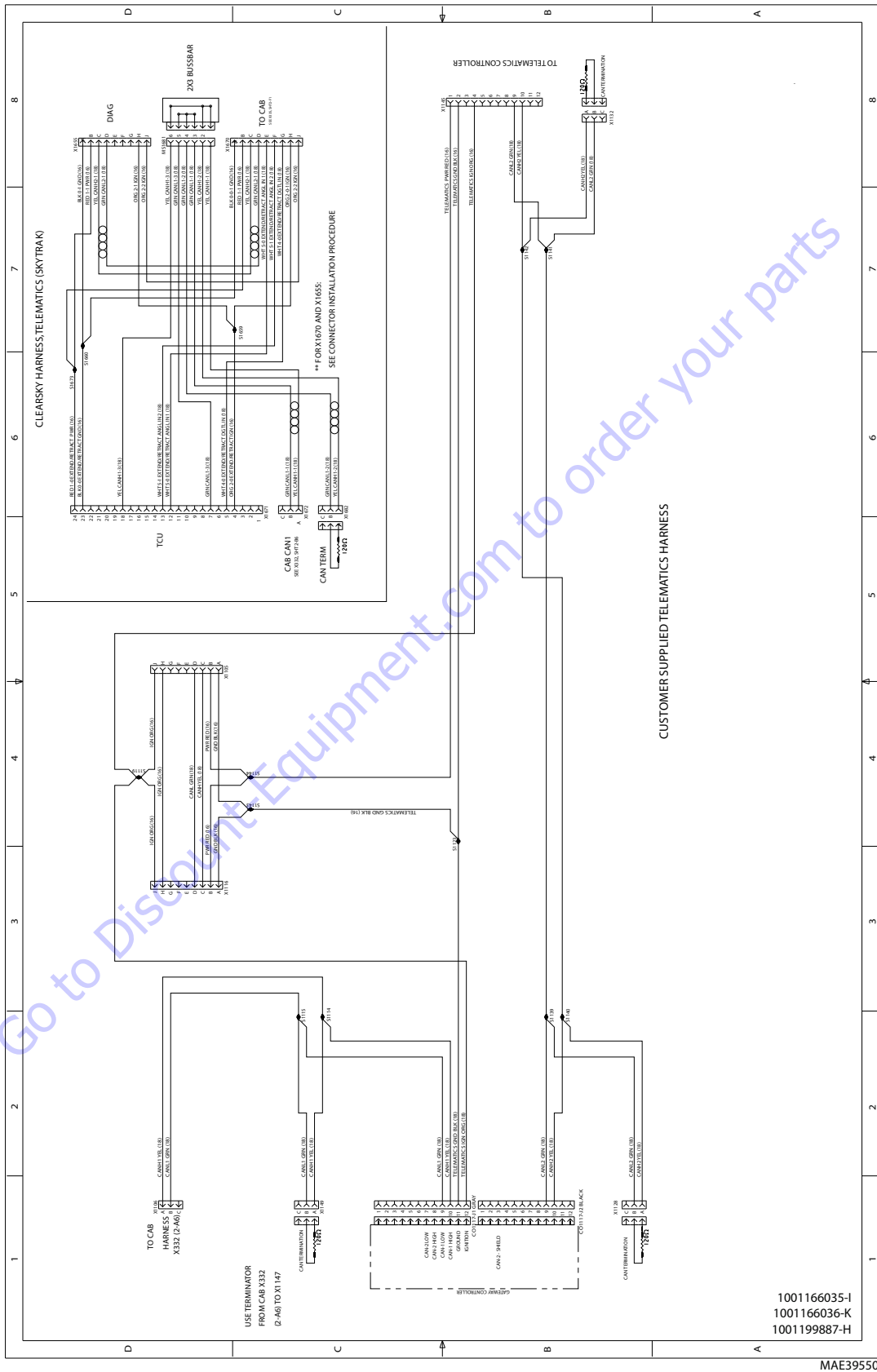


9.5.11 Beacon Option Schematic





9.5.13 Telematics Option



1001166035-I
 1001166036-K
 1001199887-H

MAE39550



9.6 DIELECTRIC GREASE APPLICATION

Dielectric grease helps to prevent corrosion of electrical contacts and improper conductivity between contacts from moisture intrusion. Non-waterproof connectors benefit from the application of dielectric grease.

9.6.1 Installation

1. The following is general guidance for the installation of dielectric grease in a connector system.
2. Use dielectric grease in a tube for larger connection points or apply with a syringe for small connectors.
3. Apply dielectric grease to plug/male connector housing which typically contains sockets contact/female terminals.
4. Leave a layer of dielectric grease on the mating face of the connector, completely covering each connector terminal hole. Refer the pictures shown below.
5. Assemble the connector system immediately to prevent moisture ingress or dust contamination.

The following connector systems are specifically addressed because of their widespread use at JLG. However, this guidance may be applied to similar devices.

AMP Mate-N-Lok

This connector system is widely used inside enclosures for general-purpose interconnect. Follow the general guidance for installation.



Improper

Proper

AMP Faston

This connector system is typically used on operator switches at JLG. Follow the general guidance for installation.

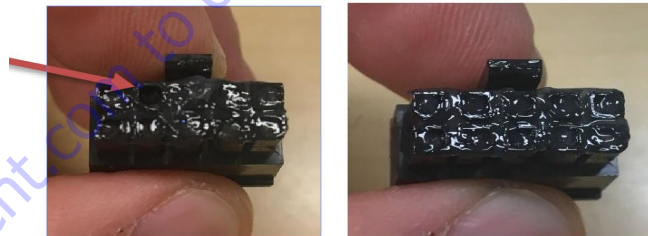


Improper

Proper

AMP Micro-Fit

This connector system is typically used on control modules at JLG. Follow the general guidance for installation.

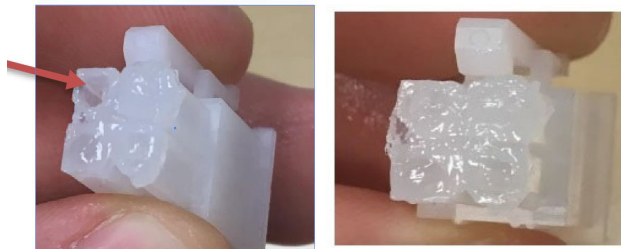


Improper

Proper

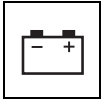
AMP Mini Fit Jr

This connector system is typically used on control modules at JLG. Follow the general guidance for installation.



Improper

Proper



Mini Fit Sr

This connector system is typically used on control modules at JLG. Follow the general guidance for installation.

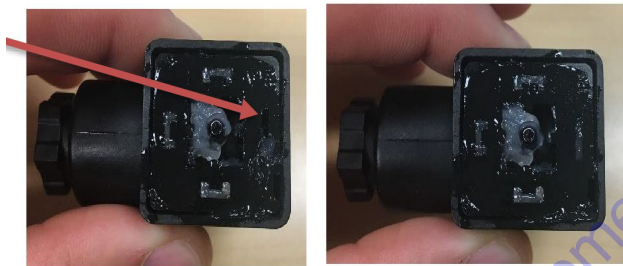


Improper

Proper

DIN Connectors

This connector is typically used on hydraulic valves. Follow the installation instructions.



Improper

Proper

Exceptions

Some waterproof connector applications do benefit from dielectric grease, and some non waterproof connectors do not benefit from dielectric grease.

In the exceptions below, we have found dielectric grease is not needed for some applications, and in some cases can interfere with the intended connection. Dielectric grease shall be used as an exception in other applications.

Enclosures

Application of dielectric grease is not required in properly sealed enclosures. To meet criteria, the enclosure must be rated to at least IP56 (dust protected; protected from powerful jets of water).

Carling Switch Connectors

Carling switches may experience high impedance, or discontinuity, due to silicone dielectric grease ingress when switching inductive loads. Therefore, dielectric grease shall not be applied to Carling switch mating connectors unless specifically noted.

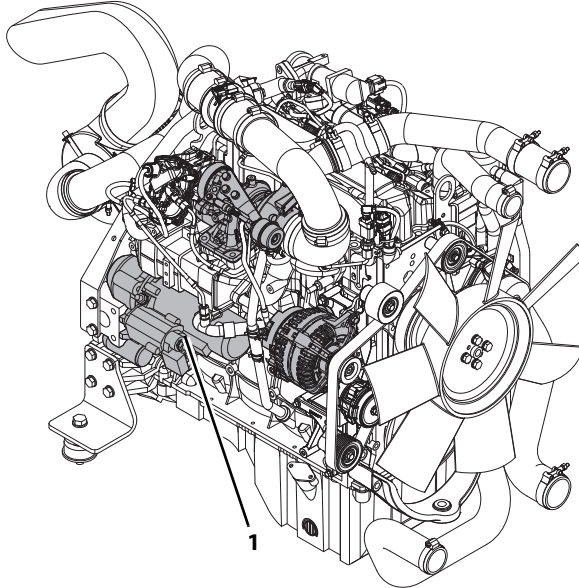
Go to www.360court-equipment.com to order your parts



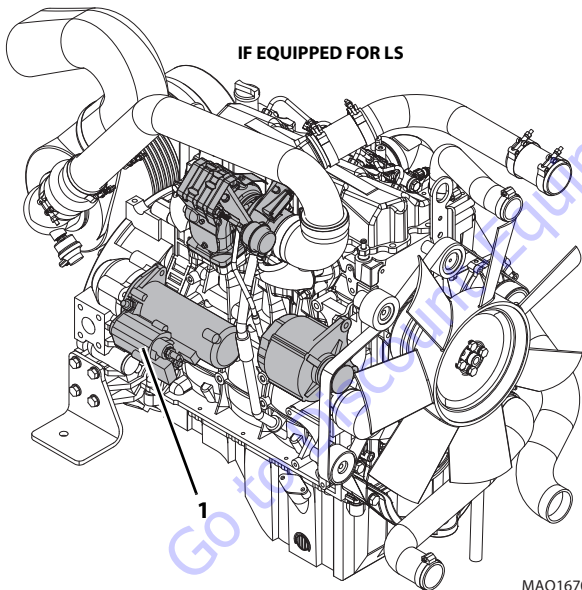
9.7 ENGINE START CIRCUIT

9.7.1 Starter

IF EQUIPPED FOR ULS



IF EQUIPPED FOR LS



MAQ1670

The starter (1) is located on the left side of the engine.

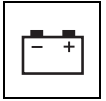
a. Testing the Starter on the Engine

If the starter (1) does not engage when the ignition key switch is turned, check the following:

1. The main fuse may be blown, requiring replacement. Check for the cause of the blown fuse.
2. There may be a defect in the ignition key switch, ignition wiring or starter solenoid.
3. Check battery condition. Clean the battery posts and the connectors at each end of the battery cables.
4. Check for broken wiring and damaged insulation on the wiring. Replace all broken or damaged wiring.
5. Check all connections at the starter solenoid, key switch and wiring harness plugs. Clean and tighten all connections.
6. If the starter still does not operate after these checks have been performed, check the starting circuit.

b. Starter Circuit Checks

1. Check wires and connections for looseness, corrosion, damage, etc.
2. If a "whirring" noise is heard but engine does not turn over, starter is spinning but not engaging flywheel. Starter drive or solenoid that pushes drive forward to engage flywheel may be defective. Missing or damaged teeth on flywheel can also prevent starter from cranking engine.
3. If starter only "clicks" it may indicate that battery is discharged, or that there is a loose or corroded battery cable connection. Check battery state of charge and battery condition first, then check cables and cable connections.
4. For additional information on the starting circuit, refer to Section 9.5, "Electrical System Schematics".



c. Starter Removal

Remove the starter only if it fails. To remove the starter:

1. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
2. Open the rear and side engine doors. Allow the system fluids to cool.
3. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
4. Remove wires from solenoid stud. Remove positive (+) battery cable from starter. Label and disconnect wire from starter solenoid housing stud. Record how wires are installed to ensure correct installation later.
5. Loosen, but **DO NOT** remove, fasteners securing starter to flywheel housing. Support starter securely, as it is relatively heavy and will fall if not supported.
6. Support starter and remove fasteners securing starter to engine. Remove negative (-) ground cable from its starter mounting bolt.
7. Remove the starter from the machine.

d. Starter Installation

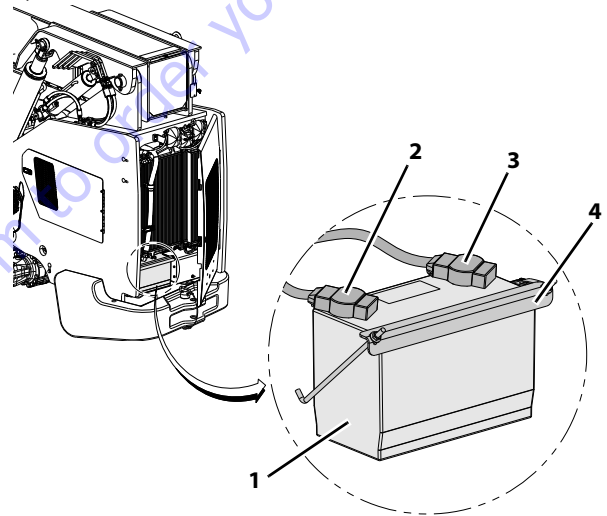
1. Position starter in its mounting on flywheel housing. Position ground cable over correct starter mounting bolt. Secure starter with previously used hardware.
2. Connect positive (+) battery cable to upper solenoid stud. Install wires to upper solenoid stud, and secure with lock washer and nut.
3. Connect the wire to the solenoid mounting stud.
4. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
5. Close and secure the rear and side engine doors.
6. Remove Do Not Operate Tag from ignition key switch and steering wheel.

9.8 BATTERY

Note: Eye protection is recommended before inspecting and/or replacing the battery.

9.8.1 Battery Inspection

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission in (N) NEUTRAL, engage parking brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine cover at rear side of the frame. Allow system fluids to cool.



4. Visually inspect the battery (1).
5. Check terminals for corrosion.
6. Replace the battery if it has a cracked, melted or damaged case.
7. Close and secure engine cover.
8. Remove Do Not Operate Tag from ignition key switch and steering wheel.



Electrical System

9.8.2 Battery Removal/Installation

a. Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission in (N) NEUTRAL, engage parking brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine cover at rear side of the frame. Allow system fluids to cool.
4. Turn OFF electrical master switch.
5. Disconnect Negative battery cable (2).
6. Disconnect Positive battery cable (3).
7. Loosen and remove clamp (4) securing battery (1).
8. Remove battery (1).

a. Installation

1. Properly install battery (1) and secure in place with previously removed clamp (4).
2. Connect Positive battery cable (3).
3. Connect Negative battery cable (2).
4. Turn ON electrical master switch.
5. Close and secure engine cover.
6. Remove Do Not Operate Tag from ignition key switch and steering wheel.

9.8.3 Battery Disconnect/Connect

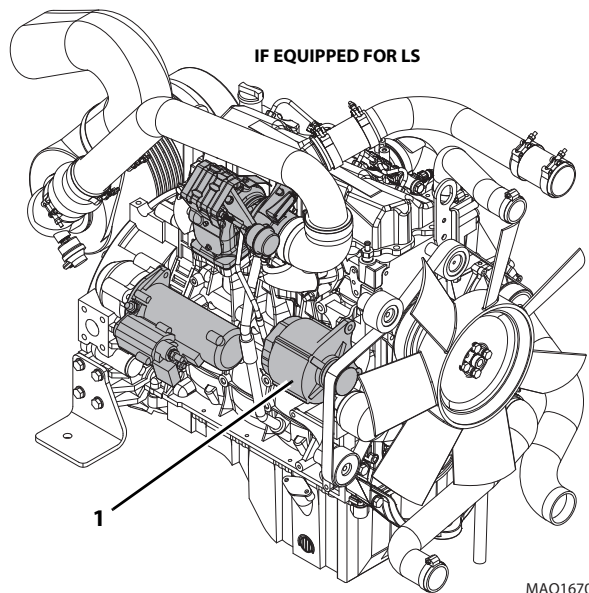
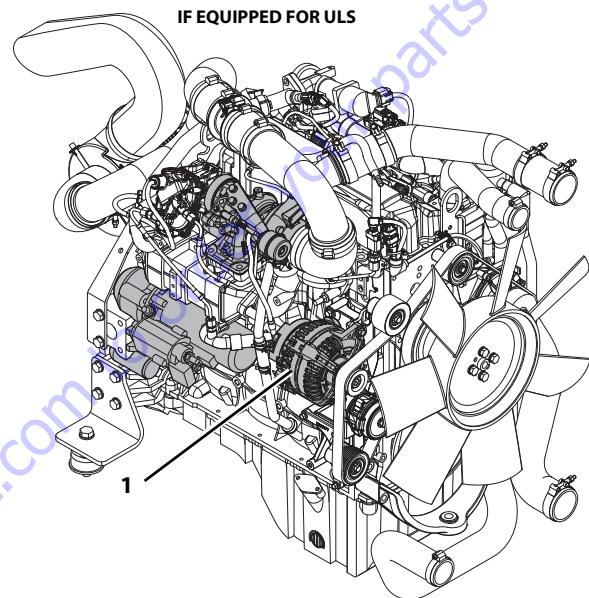
a. Disconnect

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission in (N) NEUTRAL, engage parking brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine cover at rear side of the frame. Allow system fluids to cool.
4. Disconnect Negative battery cable (2).
5. Disconnect Positive battery cable (3).

b. Connect

1. Connect Positive battery cable (3).
2. Connect Negative battery cable (2).
3. Close and secure engine cover.
4. Remove Do Not Operate Tag from ignition key switch and steering wheel.

9.9 CHARGING CIRCUIT



MAQ1670

Before using a battery charger, an attempt can be made to recharge the battery by jump-starting the machine (Refer to the appropriate Operation & Safety Manual). Allow the engine to run, which will enable the alternator (1) to charge the battery.



If the engine alternator charging warning indicator illuminates, perform the following checks:

1. Check all battery cable connections at the battery, and verify that they are clean and tight.
2. Check the external alternator wiring and connections, and verify that they are in good condition.
3. Check the fan belt condition and tension.
4. Run the engine and check the alternator for noise. A loose drive pulley, loose mounting hardware, worn or dirty internal alternator bearings, a defective stator or defective diodes can cause noise. Replace a worn or defective alternator.

9.9.1 Alternator

a. Alternator Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission in (N) NEUTRAL, engage parking brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Install a drive ratchet into the square hole in the serpentine belt tensioner bracket.
6. While lifting the automatic belt tensioner away from the belt, remove the fan serpentine belt.

Note: Record how the alternator is installed to ensure correct installation later.

7. Label and disconnect the wire leads attached to the alternator.
8. Remove the lower mounting capscrew securing the alternator to the lower mounting hole on the engine.
9. While supporting the alternator, remove upper mounting hardware from the upper alternator mount. Remove the alternator from the machine.

b. Alternator Installation

1. Position the alternator and align with the upper alternator mount on the engine bracket. Insert the upper (longer) mounting hardware through the alternator mount. Thread the longer capscrew into the alternator front mount. **DO NOT** tighten completely at this time.
2. Align the lower alternator mount hole with the lower mounting bracket on the engine, and insert the lower mounting capscrew. Tighten the lower capscrew and upper capscrew securely.
3. Place a drive ratchet into the square hole on the serpentine belt tensioner bracket. Apply pressure against the tensioner bracket and route the serpentine belt onto the alternator and engine pulleys. Release and check the tensioner pulley to verify that it is pivoting freely in order to provide the proper tension on the belt. Check for proper belt alignment. (Refer to the appropriate Operation & Safety Manual.)
4. Connect the previously labeled wire leads to the alternator.
5. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
6. Close and secure the rear and side engine doors.
7. Remove Do Not Operate Tags from ignition key switch and steering wheel.



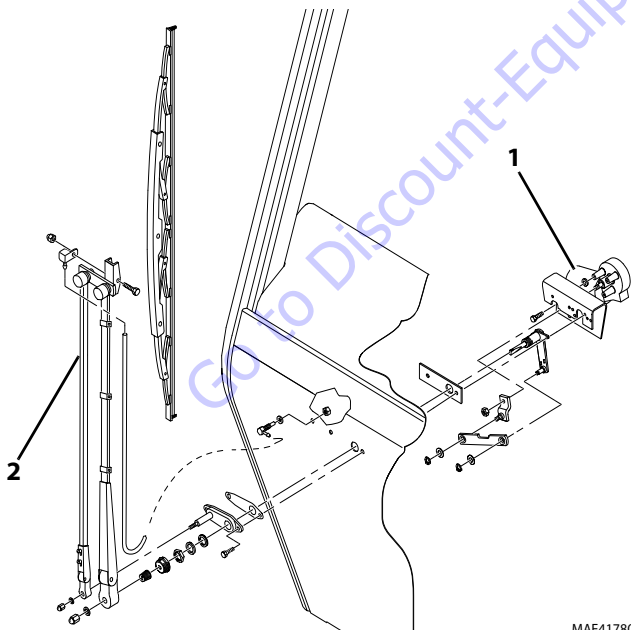
9.10 WINDOW WIPER/WASHER WINDSHIELD WIPER MOTOR

9.10.1 Windshield Wiper Motor

a. Removal

Note: It may be necessary to remove several hydraulic hoses from behind the dash in order to remove and install the wiper motor housing. Refer to Section 4.3.2, "Steering Column and Steering Valve".

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Remove the right side instrument panel.
6. Remove the lower access panel below the instrument panel.
7. Disconnect the right side defroster hose from the dash panel hose connector.



8. Disconnect the cab harness connectors from the wiper motor (1).

9. From the outside and front of the cab, remove the windshield wiper blade arm (2) nuts and washer from the motor shaft.
10. Disconnect the washer hose from the hose connector.
11. Remove the wiper arms, knurled driver and rubber cap from the motor shaft.
12. Remove the metal hex jam nut and metal washer from the motor shaft.
13. Remove the motor mounting bolts, pan adapter and gasket from the motor shaft.

Note: Retain all hardware removed from the wiper assembly for possible reuse on the replacement motor housing.

14. Remove the motor from the inside of the cab.

b. Disassembly

DO NOT disassemble the motor. The motor is not serviceable. Replace motor if found to be defective.

c. Inspection and Replacement

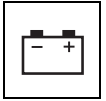
Inspect the motor terminals for continuity. Replace motor if continuity is not found.

d. Installation and Testing

1. Install all required hardware to the motor assembly. Align spacer and wiper motor bracket, and apply masking tape in order to hold the two components together during installation.
2. Align motor with the mounting holes and insert motor through cab.
3. Have an assistant insert gasket, pan to adapter onto the motor shaft. Insert bolts through front cab holes and thread into motor housing. Tighten bolts.
4. Install metal washer and metal hex jam nut. Tighten metal hex jam nut. Install rubber cap and knurled driver onto the motor shaft.

Note: Align the wiper blade arm with the hex jam nut. Tighten shaft to ensure wiper stroke covers window area, and it does not swipe past the glass area.

5. Install wiper blade arm (2) at 90° from the motor shaft flat.
6. Connect the cab harness connectors to windshield wiper motor connectors.
7. If previously removed, install hydraulic hoses under the dash. Refer to Section 4.3.2, "Steering Column and Steering Valve".
8. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.

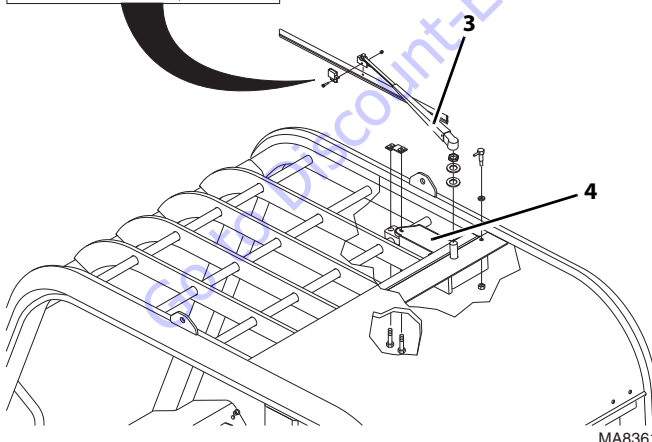
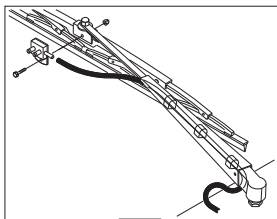


9. Turn ignition key switch to the RUN position, and operate windshield wiper in both LOW and HIGH speeds to ensure proper operation and that correct wiper travel is achieved.
10. Install the previously removed dash panels.
11. Close and secure the engine rear and side engine doors.
12. Remove Do Not Operate Tags from ignition key switch and steering wheel.

9.10.2 Skylight Wiper Motor

a. Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the rear side door of the engine. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.



5. Remove the wiper arm (3) from the wiper motor shaft.
6. Disconnect the washer hose from the top hose fitting.
7. From inside the cab, remove screws from top locknut plate.
8. Unclip the plastic motor cover (4) and remove.

9. From the top of the cab, remove the nut from the wiper motor shaft.
10. From inside the cab, pull the wiper motor down and away from the roof.
11. Label and disconnect the cab harness connectors from the wiper motor.

b. Disassembly

DO NOT disassemble the motor. The motor is not serviceable. Replace motor if found to be defective.

c. Inspection and Replacement

Inspect the motor terminals for continuity. Replace motor if continuity is not found.

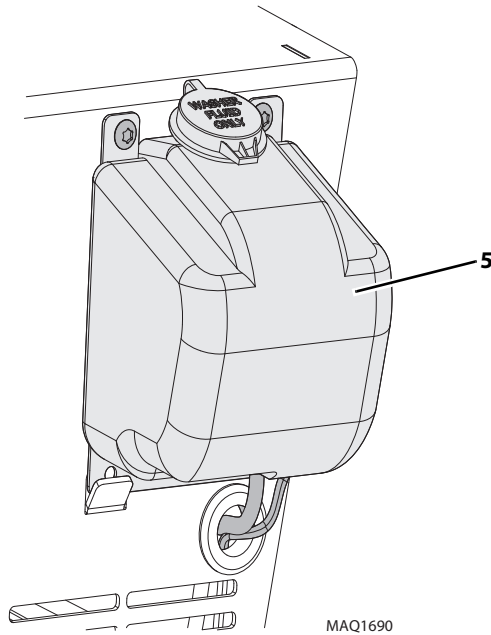
d. Installation and Testing

1. Hold wiper motor up toward cab top and install the cab harness connectors.
2. With the help of an assistant, insert the wiper motor through the roof hole and have the assistant thread the nut onto the wiper motor shaft. Ensure that the motor housing is facing the front of the cab.
3. Install the wiper arm (3) onto the wiper motor shaft.
4. Install the screws through the plastic motor cover (4) and into the top locknut plate and tighten.
5. Connect washer hose to top hose fitting.
6. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
7. Turn the ignition key to the RUN position and turn skylight wiper switch to the ON position. Ensure wiper stays on the window through a full stroke. Turn the skylight wiper switch to the OFF position.
8. Engage the washer switch and ensure washer fluid is sprayed on the skylight window. Turn the ignition key switch to the OFF position.
9. Close and secure the engine rear and side engine doors.
10. Remove Do Not Operate Tags from ignition key switch and steering wheel.



Electrical System

9.10.3 Windshield Washer Reservoir



The windshield washer motor and reservoir (5) is a unit and cannot be serviced separately.

a. Removal

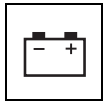
1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission in (N) NEUTRAL, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Remove the nuts and the lock washers from the washer mounting bolts.
6. Pull the washer reservoir out and away from the mounting bracket.
7. Rotate the washer reservoir, label and remove the cab harness connectors from the washer reservoir connectors.
8. Remove the windshield washer hose from the reservoir.

b. Disassembly

DO NOT disassemble the pump. The pump is not serviceable. Replace pump if found to be defective.

c. Installation and Testing

1. Connect windshield washer hoses to reservoir.
2. Connect the cab wiring harness connectors to the reservoir connectors.
3. Install the reservoir tank onto the welded studs.
4. Install the lock washers and nuts and secure.
5. Fill the washer fluid reservoir with washer fluid.
6. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
7. Turn the ignition key switch to the RUN position and press the washer switch. Verify that fluid is sprayed on both the windshield and rear glass.
8. Close and secure the engine rear and side engine doors.
9. Remove Do Not Operate Tags from ignition key switch and steering wheel.

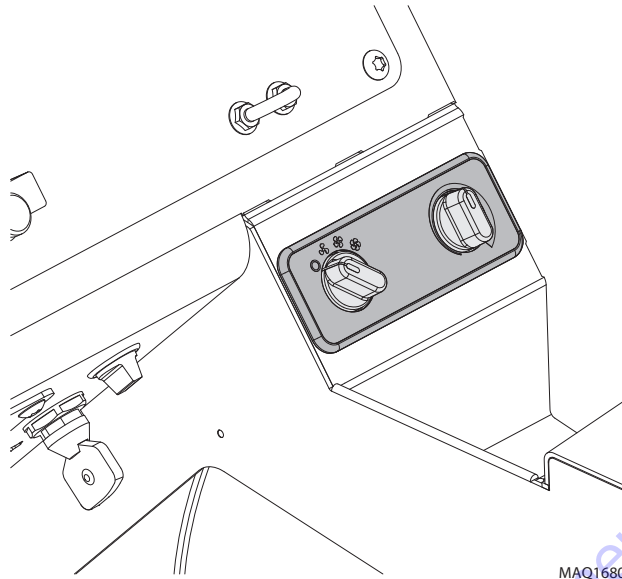


9.11 CAB HEATER AND FAN

9.11.1 Cab Heater Controls

Note: If the suspect component is found to be within the heater box, the heater box must be removed as a complete unit and replaced.

a. Cab Heater Controls Removal



1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Remove the setscrew from the variable speed fan control knob or temperature control knob.
6. Remove the right side control panel screws.
7. Remove the screws and backing locknuts from the cab heater and fan control panel.
8. Pull the control panel out from the dash panel, and if removing variable speed fan control, remove the cab harness connector.
9. If removing the temperature control knob, disconnect the cable connector and remove control knob.
10. Remove the locknut from the suspect control shaft.
11. Remove the control panel from the panel.

b. Disassembly

DO NOT disassemble the cab heater and fan controls. The controls are not serviceable. Replace controls if found to be defective.

c. Installation and Testing

1. Check that the variable speed fan control is in the OFF position.
2. If installing the temperature control, attach the control cable to the back of the control.
3. Insert the control shaft through the panel, ensuring that the knob is in the VERTICAL position.
4. Install the locknut on the shaft and tighten.
5. Connect the cab harness connector to the variable speed fan control.
6. Install the screws and backing locknuts securing the control panel to the dash panel.
7. Install the setscrew securing the knob to the control.
8. Install the right side control panel.
9. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
10. Turn the ignition key to the ON position and check the fan speeds. If further repair is needed, refer to Section 9.5, "Electrical System Schematics".
11. Start the machine and allow engine to warm to operating temperature. Check heat control at different levels.
12. Close and secure the engine rear and side engine doors.
13. Remove Do Not Operate Tags from ignition key switch and steering wheel.

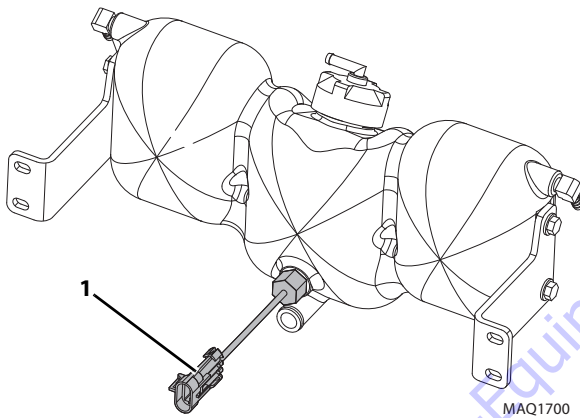


9.12 SOLENOIDS, SENSORS AND SENDERS

9.12.1 Coolant Level Sensor

a. Coolant Level Sensor Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, raise the boom, place transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Temporarily block up or support the boom.
5. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.



6. Label and disconnect the wiring connector from the Coolant Level Sensor (1).
7. Unthread switch from surge tank.

b. Coolant Level Sensor Disassembly

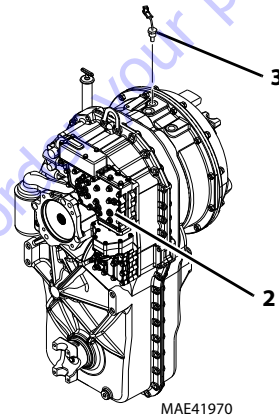
DO NOT disassemble the Coolant Level Sensor. Replace a defective switch with a new part.

c. Coolant Level Sensor Installation

1. Thread switch into engine. Tighten securely.
2. Connect previously labeled wiring connector to switch.
3. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.

4. Start engine. Allow it to reach operating temperature and observe the operator instrument cluster for warning indication. If switch is not defective, problem could be elsewhere; possibly in a shorted wire, improper running engine, improper or low coolant, obstructed or faulty radiator, coolant pump, loose fan belt, defective instrument cluster, etc.
5. Close and secure the engine rear and side engine doors.
6. Remove Do Not Operate Tags from ignition key switch and steering wheel.

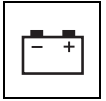
9.12.2 Transmission Solenoid Valves



Note: If the transmission is not shifting properly, the transmission shift control switch (travel select lever), wiring harness or transmission shift solenoids (2) should be checked in order to determine which component is defective. Specific information to determine which travel position and corresponding component is not responding can be found in the detailed transmission service instructions (covering repair, disassembly, reassembly and adjustment information) are provided in the ZF 4 WG-98 TC Repair Manual PN 5871 135 002 (JLG PN 8990455). and can be obtained by calling your local Authorized Service Department.

The transmission should be checked, serviced and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

Note: Contact your local authorized Service Department if internal transmission repair is required during the warranty period.



9.12.3 Transmission Temperature Sender

a. Transmission Temperature Sender Removal

The transmission temperature sender (3) is threaded into the top of the transmission housing.

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission in (N) NEUTRAL, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Temporarily block up or support the boom.
6. Remove the transmission covers.
7. Unplug the transmission temperature sender connector from the wiring harness connector.
8. The sender is threaded into the transmission housing. Remove the sender.

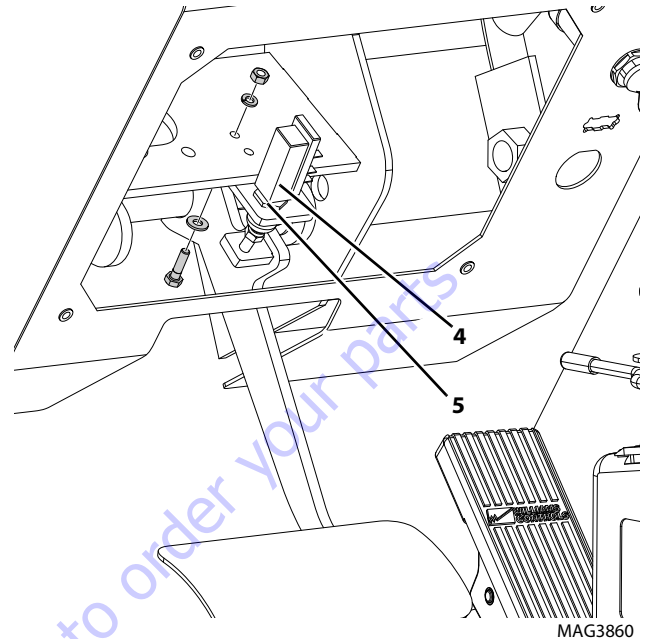
b. Transmission Temperature Sender Inspection and Replacement

Inspect the sender and the wiring harness connector terminals for continuity. Replace a defective or faulty sender with a new part.

c. Transmission Temperature Sender Installation and Testing

1. Thread the transmission temperature sender into the transmission housing snugly, then connect the sender connector to the wiring harness connector.
2. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
3. Check for proper fluid level.
4. Start the engine, allow it to reach operating temperature and observe the operator display cluster for warning indication. If the sender is not defective, the problem could be elsewhere; possibly in a shorted wire, damaged transmission, improper or low fluid, etc.
5. Install the transmission covers.
6. Close and secure the engine rear and side engine doors.
7. Remove Do Not Operate Tags from ignition key switch and steering wheel.

9.12.4 Service Brake Switch



The service brake switch (4) works in conjunction with the Stabil-TRAK system. With the boom above 40°, the transmission shifter in either forward or reverse, and the service brake depressed, the Stabil-TRAK system engages. If the Service Brake Switch is suspect in the proper operation of the Stabil-TRAK system, refer to Section 10.7, "Stabil-TRAK™ System Test".

a. Service Brake Switch Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission in (N) NEUTRAL, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and the steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Label and disconnect the electrical connectors attached to the service brake switch (4).
6. Loosen locknut (5) and remove switch dust cover. Remove switch body.



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b. Service Brake Switch Installation

1. Ensure that there is only one thread showing above the locknut on the shaft of the switch body.
2. Insert switch body through the top of the service brake switch bracket.
3. Thread the switch dust cover onto the switch body until finger tight against the service brake switch bracket.
4. Use a wrench and fully tighten the locknut against the service brake switch bracket. There should now be approximately two or three threads showing above the locknut.
5. Thread the bottom lip of the switch plunger through the hole in the bottom of the dust cover.
6. Connect the cab harness electrical connectors to the service brake switch connectors.
7. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
8. Remove Do Not Operate Tags from ignition key switch and steering wheel.
9. Adjust the brake switch. Refer to Section 9.12.4, "Service Brake Switch".

c. Service Brake Switch Adjustment

Note: The service brake switch adjustment will require two people. Enlist the help of an assistant before attempting to follow the adjustment procedure.

1. Remove the lower access panel.
2. Loosen locknut securing the switch body to the service brake switch bracket.
3. Connect a 1000 psi (69 bar) pressure gauge to the test port on the service brake valve.



WARNING

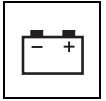
NEVER attempt to adjust the service brake switch without an assistant. Anytime the engine is running and the parking brake is disengaged, there must be an operator located in the cab and the two front tires must be blocked.

4. Block both front tires.
5. Start the engine and run at low idle.
6. Position the boom above 40°, release the park brake and place the transmission in forward 4th gear.
7. Slowly depress and hold the brake pedal to maintain 200-300 psi (13,8-20,6 bar) brake pressure.

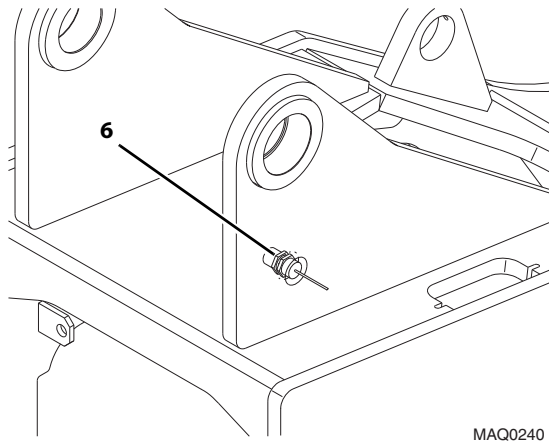
8. Using the switch dust cover and the locknut in combination, position the brake switch so the Stabil-TRAK dash light comes ON at the 200-300 psi (13,8-20,6 bar) brake pressure.
9. Repeat steps 6 through 8 until the Stabil-TRAK dash light comes ON at 200-300 psi (13,8-20,6 bar) brake pressure.
10. After the required pressure is achieved, use a wrench and fully tighten the locknut against the service brake switch bracket.

In order to test the switch for proper operation, the boom must be raised above the 40° position, the parking brake switch must be in the OFF position and the machine must be in a forward or reverse gear mode. Proper operation of the switch will activate the Stabil-TRAK dash panel indicator. If the Stabil-TRAK indicator does not activate when all conditions are met, the boom angle sensor must be adjusted. Refer to Section 9.12.5, "Boom Angle Sensor".

11. Shut off the engine.
12. Remove the blocks from the front tires.
13. Remove the pressure gauge.
14. Install the lower access panel.



9.12.5 Boom Angle Sensor



The boom angle sensor (6) is located at the rear of, and on the right side of the machine. When the boom is lifted above 40°, the boom sensor sends a signal to the Stabil-TRAK indicator on the instrument cluster.

a. Boom Angle Sensor Removal

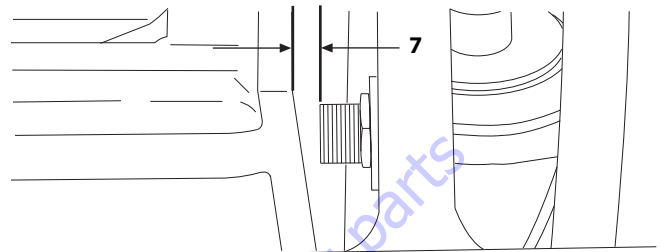
1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission in (N) NEUTRAL, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Unplug the engine boom angle sensor connector from the wiring harness connector.
6. Loosen and remove the sensor locknut.
7. Remove the sensor from the outside of boom frame.

b. Disassembly

DO NOT disassemble the sensor. The sensor is not serviceable. Replace the sensor if found to be defective.

c. Boom Angle Sensor Installation

1. Install boom angle sensor (6) through outside of boom frame.
2. Install locknut onto sensor.



3. Measure the clearance between the sensor and frame, and adjust sensor distance (7) to 0.120" (3,05 mm) and tighten locknut.
4. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
5. Close and secure the engine rear and side engine doors.
6. Remove Do Not Operate Tags from ignition key switch and steering wheel.

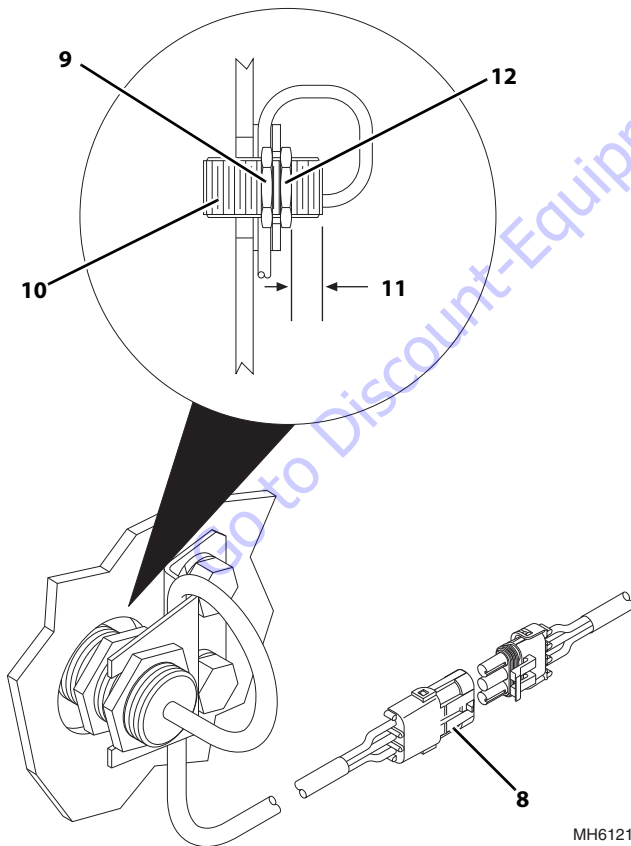


9.12.6 Boom Extend Interlock Sensor (10054 & 12054 only)

The boom extend interlock sensor is located on the left side of the machine, on the outer boom frame and just behind the cab. The boom extend interlock sensor prohibits the last boom section from extending unless both outriggers are down and pressure is applied to the ground surface.

a. Boom Extend Interlock Sensor Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission in (N) NEUTRAL, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Make note of wire tie locations and clip wire ties where necessary.



6. Disconnect the boom interlock sensor electrical connector (8).

7. Loosen the inside locknut (9) on the sensor (10).
8. Slide the sensor out of the bracket and remove.

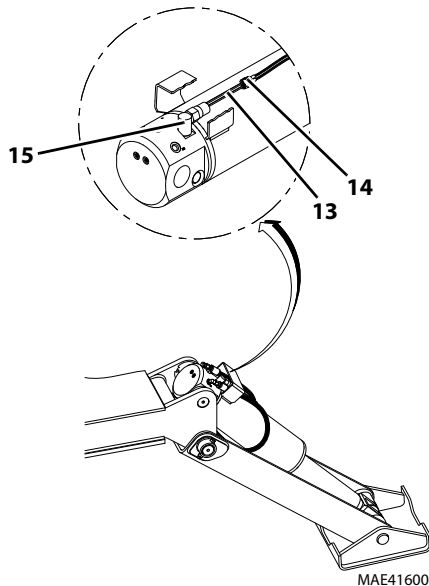
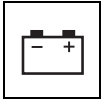
b. Boom Extend Interlock Sensor Installation

1. Partially install inside locknut (9) onto the sensor (10).
2. Make sure that there are four to six threads, approximately 0.975 in (24,7mm) and 1.0 in (25,4mm) (11), between the outside locknut (12) and the end of the sensor.
3. Make sure that the wire harness is between the bracket and the sensor, and slide the sensor into the bracket.
4. Connect the boom extend interlock sensor connector (8) to the boom extend harness connector.
5. Replace wire ties as necessary.
6. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
7. Remove Do Not Operate Tags from ignition key switch and steering wheel.
8. Close and secure the engine rear and side engine doors.

9.12.7 Outrigger Pressure Switches (10054 & 12054 Only)

a. Removal

1. Park the machine on a firm, level surface. Level the machine, ground the attachment, place the transmission in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position and engage the parking brake switch.
2. Raise both outriggers fully, and shut the engine OFF.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
5. Place a Do Not Operate Tag on both ignition key switch and steering wheel.



6. Disconnect the pressure switch wiring connector (13) from the harness connector (14).
7. Remove the outrigger pressure switch (15) from the outrigger cylinder.
8. Wipe up any spilled hydraulic oil.

b. Installation

1. Install the pressure switch (15), and torque to 25-38 lb-ft (34-41 Nm).
2. Connect the pressure switch wiring connector (13) to the harness connector (14).
3. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
4. Close and secure the engine rear and side engine doors.
5. Remove Do Not Operate Tags from ignition key switch and steering wheel.

9.12.8 Reverse Alarm

The reverse alarm is located at the rear of the machine and will automatically sound when the transmission is in (R) REVERSE.

The reverse alarm must not sound when the transmission is in (N) NEUTRAL or (F) FORWARD. With the ignition key switch in the RUN position, the reverse alarm should sound when the transmission is shifted into (R) REVERSE.

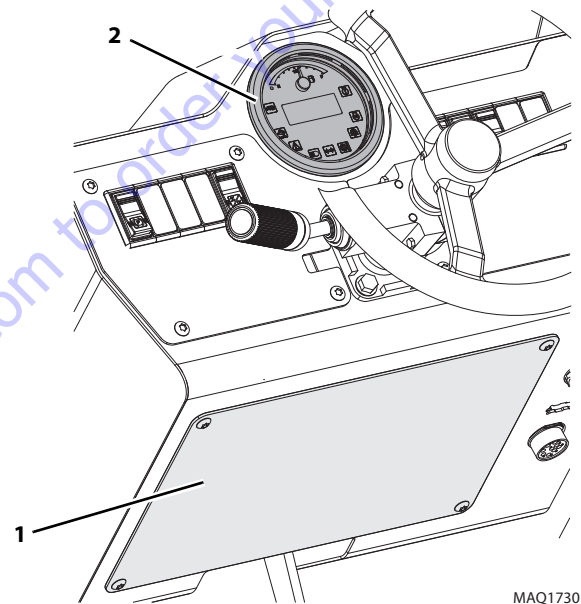
a. Disassembly

DO NOT disassemble the reverse alarm. Replace a defective or faulty alarm with a new part.

9.13 DISPLAY MONITOR

a. Display Monitor Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.



5. Remove the bottom access panel (1).
6. Loosen and remove the wing nuts from the back of the display monitor (2) and remove the mounting bracket. Pull the instrument cluster up and away from the cut-out, and unplug the harness connector.

b. Display Monitor Installation

1. Connect the harness connector to the display monitor (2).
2. Place the display monitor into the cut-out, and secure with the previously removed hardware.
3. Install the bottom access panel (1).
4. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
5. Close and secure the engine doors.
6. Remove Do Not Operate Tags from ignition key switch and steering wheel.



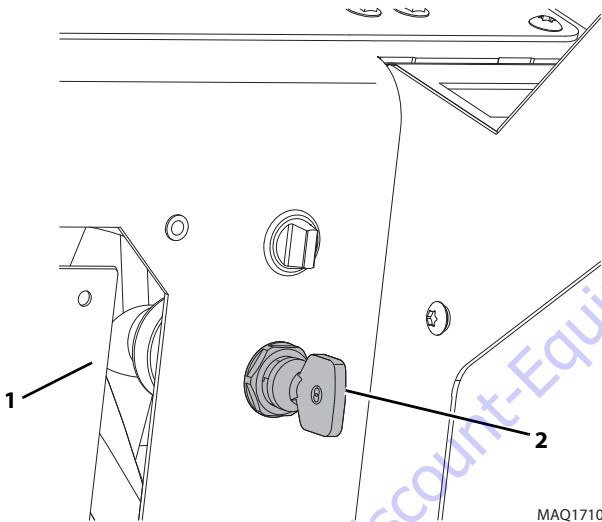
9.14 DASH SWITCHES

Note: For information on the front windshield wiper, rear window wiper and washer systems, refer to Section 9.10, "Window Wiper/Washer Windshield Wiper Motor".

9.14.1 Ignition Key Switch

a. Ignition Switch Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.



5. Remove the screws securing the lower dash panel (1).
6. From under the dash, remove the hex nut securing the ignition key switch (2) to the dash.
7. Lower the dash panel to gain access to the rear of the ignition switch. Push the switch through the panel.
8. Label and disconnect the ignition switch connectors and remove the switch from the machine.

b. Disassembly

DO NOT disassemble the ignition switch. Replace a defective switch with a new part.

c. Inspection and Replacement

To determine the proper operation of the ignition key switch, test the terminals on the back of the switch for continuity with an ohmmeter.

Test the ignition key switch for continuity, by checking from the ignition (BLUE) wire to each of the following wires in each corresponding switch position. Continuity (X) should be present as indicated in the following chart:

Switch Position			
Test from BLUE wire to:	OFF	RUN	START
GRN Wire (8 ga), Pin B on 3 Pin Connector			X

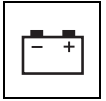
Test the ignition key switch for continuity, by checking from the ignition (RED) wire to each of the following wires in each switch position. Continuity (X) should be present as indicated in the following chart:

Switch Position			
Test from RED wire to:	OFF	RUN	START
YEL Wire (10 ga), Pin B on 5 Pin Connector		X	X
YEL Wire (16 ga), Pin C on 5 Pin Connector		X	X

If all terminals do not show proper continuity, replace the ignition switch.

d. Ignition Switch Installation

1. Connect the previously labeled electrical connections to the ignition key switch.
2. The ignition switch has a drain hole located on the shaft, between the backing nut and the face of the ignition switch cylinder, behind the dash panel. Align the ignition switch so that when it is in the OFF position, the key slot is positioned vertically (straight up and down) and the indicator mark for the drain hole, is pointing down. Install the nut securing the ignition switch (2) to the dash. DO NOT overtighten.
3. Install the lower dash panel (1).
4. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
5. Close and secure the engine doors.
6. Start engine to verify proper operation of the ignition switch.



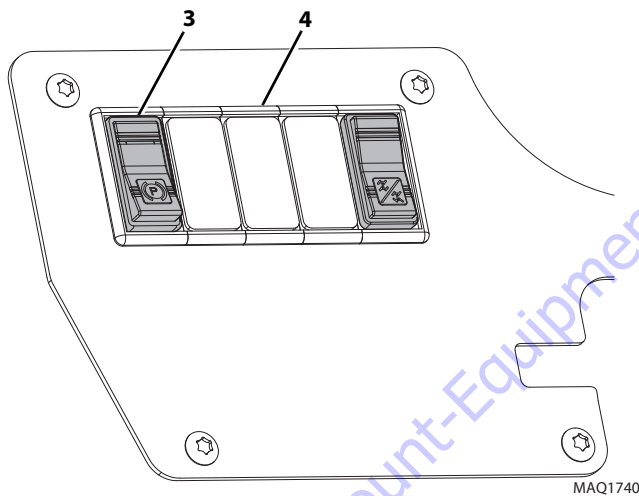
- Remove Do Not Operate Tags from ignition key switch and steering wheel.

Note: If further information is needed, refer to Section 9.5, "Electrical System Schematics".

9.14.2 Dash Switches

a. Switch Removal

- Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the park brake and shut the engine OFF.
- Place a Do Not Operate Tag on both ignition key switch and steering wheel.
- Open the engine doors. Allow the system fluids to cool.
- Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.



- Pull the frame (4) out of the dash, disconnect the harness connector to the switch (3) and push the switch out of the frame.

b. Disassembly

DO NOT disassemble the dash switch. Replace a defective switch with a new part.

c. Inspection and Replacement

Inspect the switch terminals for continuity and shorting in both the engaged and disengaged positions. Replace a defective or faulty switch with a new switch.

d. Switch Installation

- Connect the switch to the cab harness connector.
- Position the switch over the rectangular switch bezel and snap into position.
- Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
- Start the machine and check the replaced switch for proper function.
- Close and secure the engine doors.
- Remove Do Not Operate Tags from both ignition key switch and steering wheel.

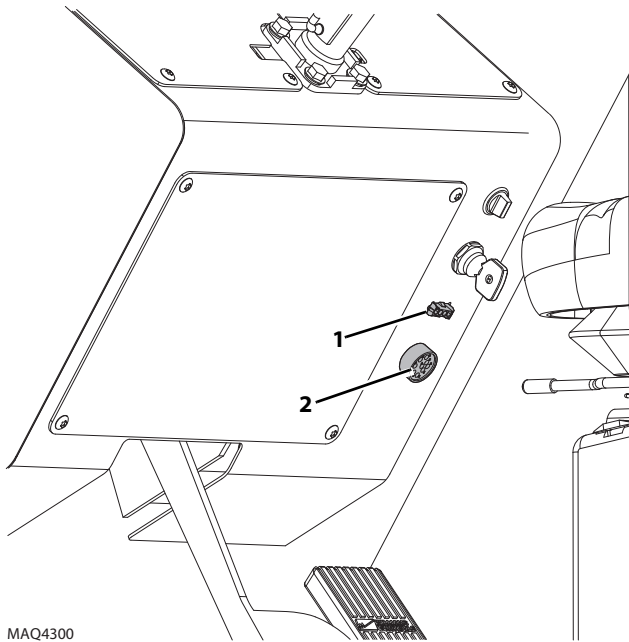


Electrical System

9.15 MACHINE DATA

9.15.1 Machine Data Access

Machine and engine data can be accessed by connecting to the appropriate locations shown below.



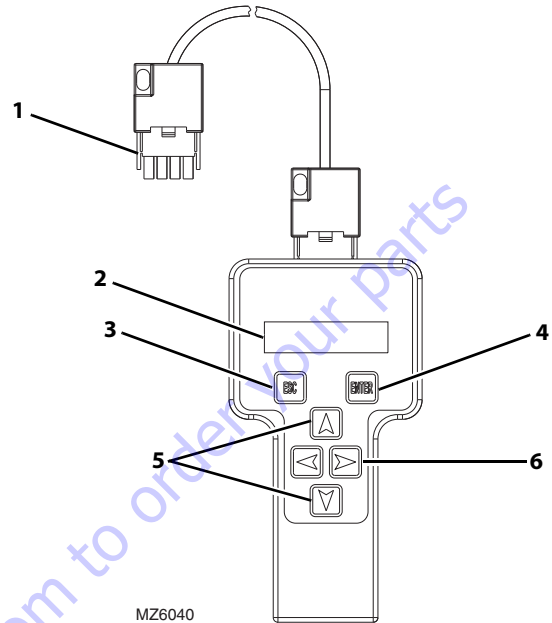
The machine analyzer plugs into connector (1) directly below the ignition key. For machine diagnostics, refer to Section 9.18.1, "Fault Detection".

The engine data can be accessed through connector (2). For engine diagnostics, refer to Section 9.18.2, "Offboard Diagnostics".

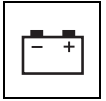
For more information, contact the local JLG dealer.

9.15.2 Hand Held Analyzer

The hand held Analyzer (PN 1001249695) provides machine diagnostic, configuration and troubleshooting capabilities.

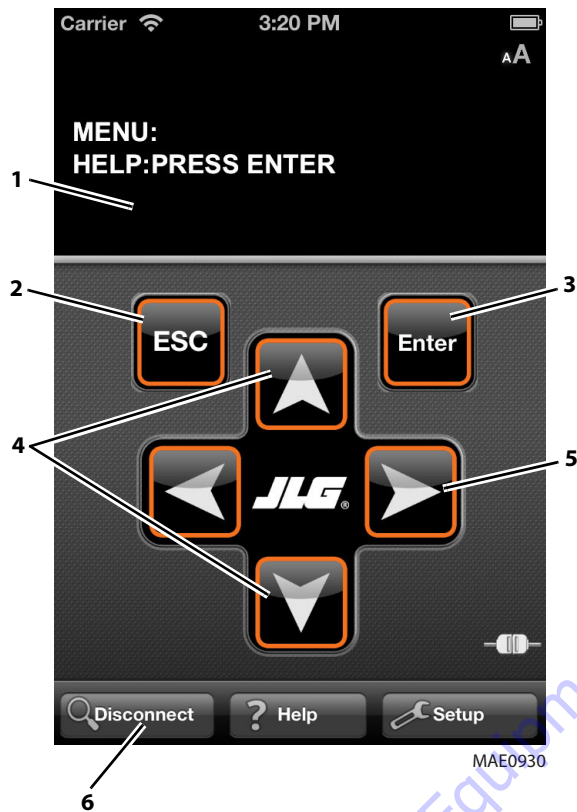


1. Cable Connector.
2. Analyzer Display Screen.
3. Escape Key: To return home or access previous menu.
4. Enter Key: Stores and selects Top Level, Sub Level and Items Menu.
5. Up/Down Arrow Keys: Change adjustable values.
6. Left and Right Arrow Keys: Used to move between Top Level, Sub Levels and Item Menu.



9.15.3 Mobile Analyzer

The mobile analyzer (PN 1001147542) is a Wi-Fi enabled evolution of the hand held analyzer kit provides machine diagnostic, configuration and troubleshooting capabilities with an extended operator range of up to 150 ft (45,72 m).

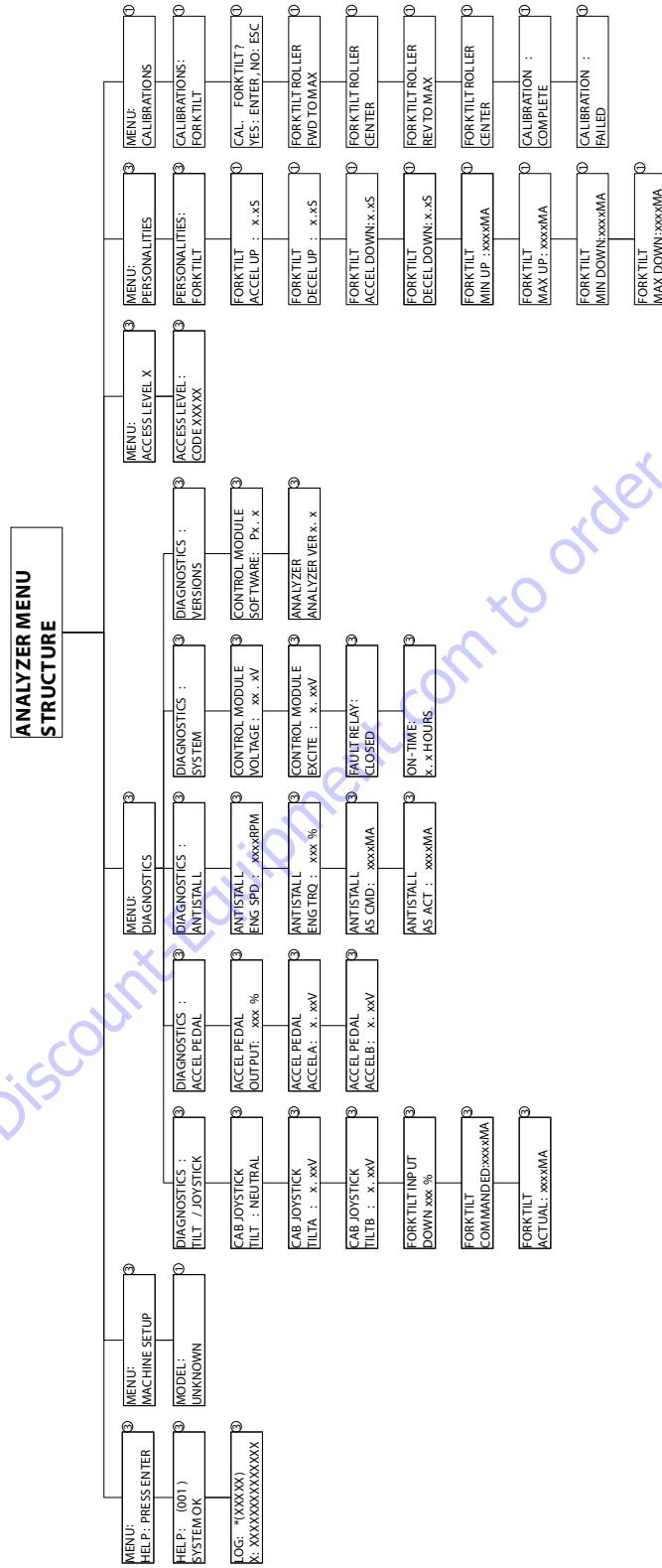


1. Analyzer Display Screen: To display full description readouts.
2. Escape Key: To return home or access previous menu.
3. Enter Key: Stores and selects Top Level, Sub Level and Items Menus.
4. Up/Down Arrow Keys: Change adjustable values.
5. Left and Right Arrow Keys: Used to move between Top Level, Sub Levels and Item Menus.
6. Disconnect: To disconnect the connection of the mobile from the system.



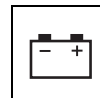
9.15.4 Analyzer Software Version P2.8

Note: The layout shows all possible analyzer screens. Please note, some screens may not be available depending upon machine configuration.



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1001210705-H
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9.16 ANALYZER SOFTWARE ACCESSIBILITY

9.16.1 Access Level

The access level screen allows to enter a five digit numeric code to qualify user capability. Code entry determines level of access.

- a. Operator (Access Level 3) - No code required.
- b. Service (Access Level 2) - 33271.

Note: Options listed in each analyzer menu may vary based on machine configuration.

9.16.2 Diagnostics

Menu	Description	Access Level
Tilt/Joystick	Displays the parameter related to the joystick	Access Level 3
Accel Pedal	Displays the cabin joystick input for the auxiliary	Access Level 3
Antistall	Displays the parameter related to the outrigger functions if equipped	Access Level 3
System	Displays the parameter related to the frame leveling.	Access Level 3
Versions	Displays the version of the software, hardware and constant data of control modules in the machine	Access Level 3

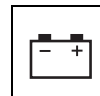


Electrical System

9.16.3 Machine Set-up

Menu	SETTING	Description	Access Level
Model	UNKNOWN	Allows to configure the model number and Engine for the telehandler	Access Level 2
	6036 63KW HRC		
	6036 63KW LRC		
	6036 55KW		
	6042 63KW HRC		
	6042 63KW LRC		
	6042 55KW		
	8036 55KW		
	8042 82KW HRC		
	8042 82KW LRC		
	8042 55KW		
	10042 82KW HRC		
	10042 82KW LRC		
	10042 55KW		
	10054 82KW HRC		
	10054 82KW LRC		
10054 55KW			
12054 82KW HRC			
12054 82KW LRC			
12054 55KW			

Note: Settings in **BOLD** are default values.



9.16.4 Personalities

Menu/ Sub- menu Items	Function	Description	Default Values (Range)	Access Level
			6036, 6042, 8042, 10042, 10052, 10054, 12054	
Fork Tilt	Accel Up: x.xS	Fork tilt screen allows the operator to view the parameters (min/ max values) related to fork tilt	0.1 (0.0 – 2.0 S)	Access Level 2
	Decel Up: x.xS		0.3 (0.0 – 1.0 S)	
	Accel Down: x.xS		0.1 (0.0 – 2.0 S)	
	Decel Down: x.xS		0.3 (0.0 – 1.0 S)	
	Min Up: xxxmA		600 mA (100 – 1000 mA)	
	Max Up: xxxmA		1300 mA (500 – 1700 mA)	
	Min Down: xxxmA		600 mA (100 – 1000 mA)	
	Max Down: xxxmA		1300 mA (500 – 1700 mA)	

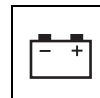
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Electrical System

9.16.5 Calibrations

Menu	Sub-Menu	Description	Access Level
Fork Tilt	Cal. Fork Tilt? Yes: Enter, No: Esc	Allows the operator to calibrate the cabin joystick's fork tilt roller. Press Enter to continue or ESC to exit from the menu.	Access Level 2
	Fork Tilt Roller Fwd To Max	Knurl the fork tilt roller to +AR position and press Enter key to confirm.	
	Fork Tilt Roller Center	Release the fork tilt roller to center position and press Enter key to confirm.	
	Fork Tilt Roller Rev To Max	Knurl the fork tilt roller to -AR position and press Enter key to confirm.	
	Fork Tilt Roller Center	Release the fork tilt roller to center position to and press Enter key to confirm.	
	Complete	The control system will display this message if the procedure is successful. Press the ESC key to exit from the menu.	
	Failed	The control system will display this message if the procedure is failed. Press the ESC key to exit from the menu.	



9.17 TELEMATICS GATEWAY

Personnel using machines equipped with an optional telematics gateway will be able to view the following data through their telematics device:

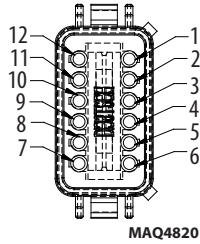
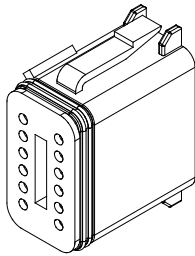
JLG LABEL	DESCRIPTION	UNIT
Engine Speed	Actual engine speed.	RPM
DEF Tank Level (If Equipped)	If machine is equipped, indicates level of DEF (diesel exhaust fluid) within DEF tank. <ul style="list-style-type: none"> • 0% = Empty • 100% = Full 	Percentage (%)
JLG Machine Faults: Active / Not-Active	<ul style="list-style-type: none"> • 00 - No Machine Faults • 01 - Active Machine Fault • 10 - Error • 11 - Not available 	Bit
Total Idle Fuel Used	Total amount of fuel used during vehicle operation during idle conditions.	Liters
Total Idle Hours	Total time of engine operation during idle conditions.	Seconds
Total Engine Hours	Total time of engine operation.	Seconds
Total Fuel Used	Total amount of fuel used during vehicle operation.	Liters
Fuel Rate	Amount of fuel consumed by engine per unit of time.	Liters/Hour
Fuel Level	Ratio of fuel volume to total volume of fuel storage container. When a low fuel limit switch is present, fuel level indicates "full" until switch opens, indicating 10% fuel remaining. When Fuel Level 2 (SPN 38) is not used, Fuel Level 1 represents total fuel in all fuel storage containers. When Fuel Level 2 is used, Fuel Level 1 represents fuel level in primary or left side fuel storage container.	Percentage (%)
DM1 Engine Faults	Shows actual engine fault codes.	N/A



Electrical System

9.17.1 Telematics-Ready (TCU) Plug

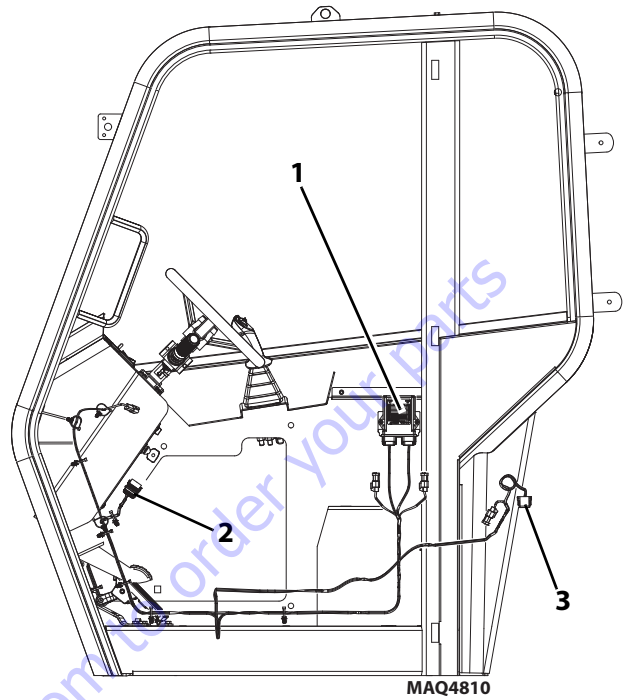
The telematics-ready (TCU) plug is a standard 12-pin Deutsch connector. Pin-out locations are shown below:



MAQ4820

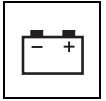
1. POWER	7. Not Used
2. GROUND	8. Not Used
3. Not Used	9. CAN-LO 2
4. IGNITION	10. CAN-HI 2
5. Not Used	11. Not Used
6. Not Used	12. Not Used

9.17.2 Component Locations



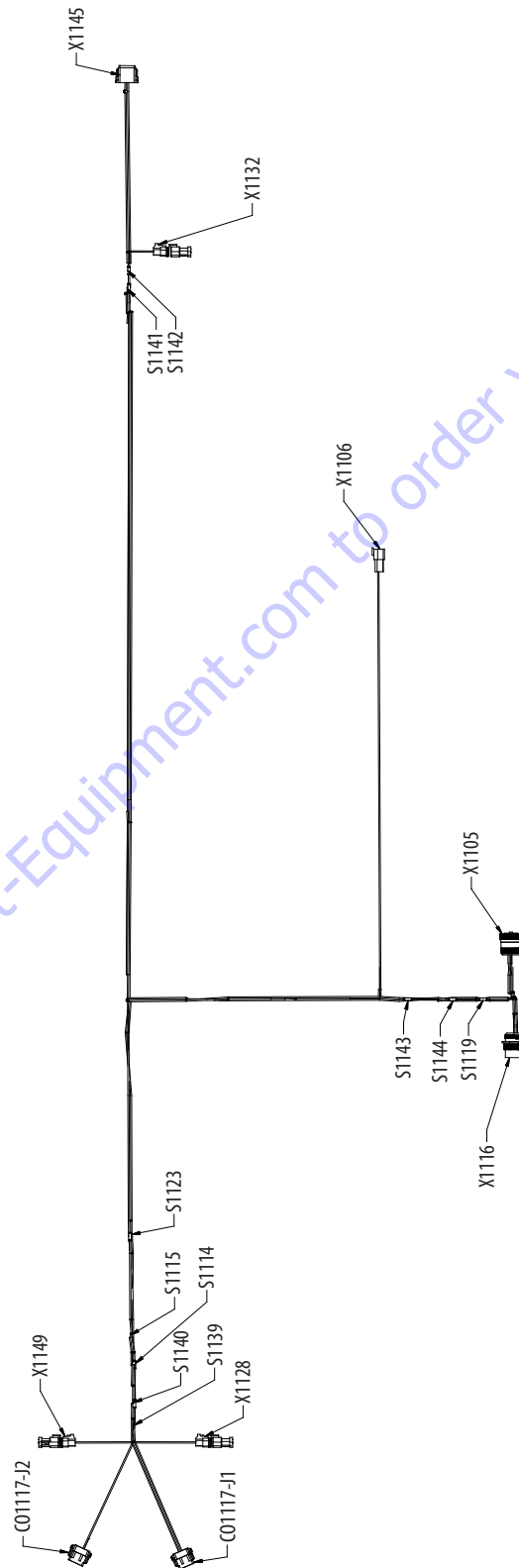
- 1. Gateway Module
- 2. Diagnostics Plug

- 3. Telematics-Ready (TCU) Plug



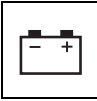
9.17.3 Telematics Gateway Harness Breakdown

a. 2D Harness View



MAQ4830

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Electrical System

b. Connector Tables

C01117-J1 (GATEWAY1)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
9	GRN	CANL1	18AWG	GXL	S1115(1)
10	YEL	CANH1	18AWG	GXL	S1114(1)
11	BLK	TELEMATICS GND	18AWG	GXL	S1123(2)
12	ORN	TELEMATICS IGN	16AWG	GXL	S119(2)

C01117-J2 (GATEWAY2)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
9	GRN	CANL1	18AWG	GXL	S1139(1)
10	YEL	CANH1	18AWG	GXL	S1140(1)

X1128 (CAN2 TERMINATOR)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	YEL	CANH2	18AWG	GXL	S1140(1)
B	GRN	CANL2	18AWG	GXL	S1139(1)

X1149 (CAN1 TERMINATOR)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	YEL	CANH1	18AWG	GXL	S1114(1)
B	GRN	CANL2	18AWG	GXL	S1115(1)

S1139					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	GRN	CANL2	18AWG	GXL	C01117-J2(9)
1	GRN	CANL2	18AWG	GXL	X1128(B)
2	GRN	CANL2	18AWG	GXL	S1141(1)

S1140					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	CANH2	18AWG	GXL	C01117-J2(10)
1	YEL	CANH2	18AWG	GXL	X1128(A)
2	YEL	CANH2	18AWG	GXL	S1142(1)

S1114					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	CANH1	18AWG	GXL	C01117-J1(10)
1	YEL	CANH1	18AWG	GXL	X1149(A)
2	YEL	CANH1	18AWG	GXL	X1106(A)

S1115					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	GRN	CANL1	18AWG	GXL	C01117-J1(9)
1	GRN	CANL1	18AWG	GXL	X1149(B)
2	GRN	CANL1	18AWG	GXL	X1106(B)

S1123					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	BLK	TELEMATICS GND	16AWG	GXL	S1143(2)
1	BLK	TELEMATICS GND	16AWG	GXL	X1145(2)
2	BLK	TELEMATICS IGN	16AWG	GXL	C01117-J1(11)

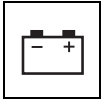
S1143					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	BLK	GND	16AWG	GXL	X1105(A)
1	BLK	GND	16AWG	GXL	X1116(A)
2	BLK	TELEMATICS GND	16AWG	GXL	S1123(1)

S1144					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	RED	PWR	16AWG	GXL	X1105(B)
1	RED	PWR	16AWG	GXL	X1116(B)
2	RED	TELEMATICS PWR	16AWG	GXL	X1145(1)

S1119					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	ORN	IGN	16AWG	GXL	X1105(J)
1	ORN	IGN	16AWG	GXL	X1116(J)
2	ORN	TELEMATICS IGN	16AWG	GXL	C01117-J1(12)
2	ORN	TELEMATICS IGN	16AWG	GXL	X1145(4)

X1116 (DIAGNOSTIC)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	BLK	GND	16AWG	GXL	S1143(1)
B	RED	PWR	16AWG	GXL	S1144(1)
C	YEL	CANH	18AWG	GXL	X1105(C)
D	GRN	CANL	18AWG	GXL	X1105(D)
H	ORN	IGN	16AWG	GXL	X1105(H)
J	ORN	IGN	16AWG	GXL	S1119(2)

X1105 (CAB PWR)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	BLK	GND	16AWG	GXL	S1143(1)
B	RED	PWR	16AWG	GXL	S1144(1)
C	YEL	CANH	18AWG	GXL	X1116(C)
D	GRN	CANL	18AWG	GXL	X1116(D)
H	ORN	IGN	16AWG	GXL	X1116(H)
J	ORN	IGN	16AWG	GXL	S1119(I)



X1145 (TELEMATICS)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	RED	TELEMATICS POWER	16 AWG	GXL	S1144 (2)
2	BLK	TELEMATICS GND	16 AWG	GXL	S1123 (1)
4	ORN	TELEMATICS IGN	16 AWG	GXL	S1119 (2)
9	GRN	CANL2	16 AWG	GXL	S1141 (2)
10	YEL	CANH2	16 AWG	GXL	S1142 (2)

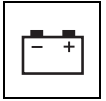
X1106 (CAB CAN1)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	YEL	CANH1	18 AWG	GXL	S1114 (2)
B	GRN	CANL1	18 AWG	GXL	S1115 (2)

S1142					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	CANH2	18 AWG	GXL	S1140 (2)
2	YEL	CANH2	16 AWG	GXL	X1145 (10)
2	YEL	CANH2	18 AWG	GXL	X1132 (A)

S1141					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	GRN	CANL2	18 AWG	GXL	S1139 (2)
2	GRN	CANL2	16 AWG	GXL	X1145 (9)
2	GRN	CANL2	18 AWG	GXL	X1132 (B)

X1132 (CAN2 TERMINATOR)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	YEL	CANH2	18 AWG	GXL	S1142 (2)
B	GRN	CANL2	18 AWG	GXL	S1141 (2)

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9.18 TROUBLESHOOTING

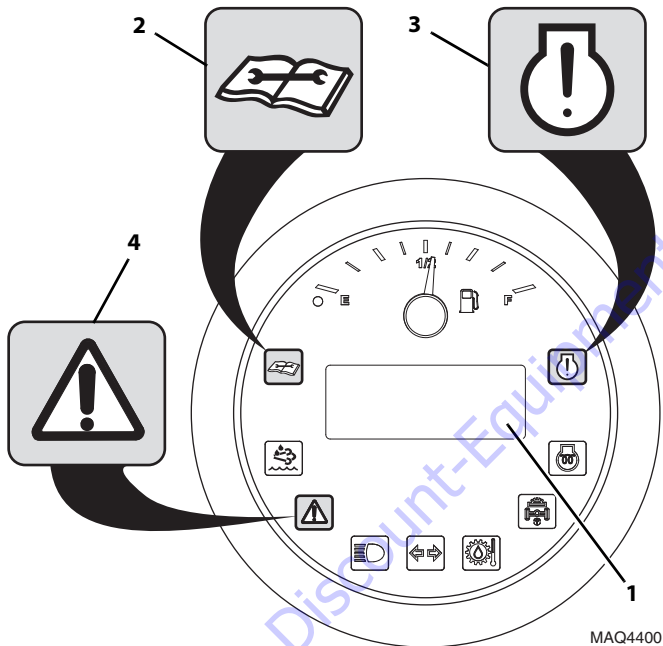
9.18.1 Fault Detection

Faults are detected while key switch is in RUN position, during operation of machine itself. If a fault becomes active (currently detected) at this time, a fault is logged in memory and a snapshot of engine parameters is logged. In addition, engine faults will appear as a SPN:FMI fault. Fault codes will display in the instrument cluster display (1).

For more information, contact your local authorized engine service distributor.

Note: If indicator (2 & 3) illuminates, refer to Section 9.20, "Engine Fault Codes," for a full list of fault codes.

Note: If indicator (4) illuminates, refer to Section 9.19.1, "Help Comment (00X)," for a full list of fault codes.



9.18.2 Offboard Diagnostics

INSITE™, is the Windows®-based PC service/programming/diagnostic tool for the Cummins engine. It is used to help troubleshoot and repair the engine with extended fault diagnostics and processing power. INSITE™ allows the user to view active and inactive faults and clear the inactive faults. It provides a monitor function that allows the service technician to monitor measured parameters, actuator status and some calculated values. It also provides the technician with the capability to turn on certain drivers such as the grid heaters and lift pump as well as running diagnostic tests such as single cylinder cutout.



Electrical System

9.19 MACHINE FAULT CODES

Note: Some fault codes may not be applicable depending upon machine configuration.

9.19.1 Help Comment (00X)

Help Message	DTC	Actions	Trigger	Latch Condition
EVERYTHING OK	001	-	The system detects no problems exist.	-

9.19.2 Power-Up (21x)

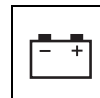
Help Message	DTC	Actions	Trigger	Latch Condition
POWER CYCLE	211	-	Triggered every power cycle	-
JOYSTICK ROLLER NOT IN NEUTRAL POSITION AT POWER UP	216	<ul style="list-style-type: none"> Fork Tilt Up Valve prevented Fork Tilt Down Valve prevented 	One of the following occur at power-up: <ul style="list-style-type: none"> Tilt Position A not 0% Tilt Position B not 0% 	Fork Tilt A Position and Fork Tilt B Position 0%
THROTTLE PEDAL NOT RELEASED AT POWER UP	2130	<ul style="list-style-type: none"> Closed Throttle RPM forced 	Accel Pedal A greater than or equal to 10% at power-up	Accel Pedal A less than 10%

9.19.3 Platform Inputs (22x)

Help Message	DTC	Actions	Trigger	Latch Condition
FUNCTION PROBLEM – JOYSTICK CALIBRATION FAULTY	2239	<ul style="list-style-type: none"> Fork Tilt Up Valve prevented Fork Tilt Down Valve prevented 	Tilt Cal OK is NO; refer to Fork Tilt Calibration OK functionality	Tilt Cal OK is YES (calibration completed)

9.19.4 Cabin Controls (23x)

Help Message	DTC	Actions	Trigger	Latch Condition
FORK TILT JOYSTICK – VOLTAGE DISAGREEMENT	2397	<ul style="list-style-type: none"> Fork Tilt Up Valve prevented Fork Tilt Down Valve prevented 	Tilt Position A and Tilt Position B differ by more than 25% for at least 1000mS	Power cycled
FORK TILT JOYSTICK – OUT OF RANGE HIGH	2398	<ul style="list-style-type: none"> Fork Tilt Up Valve prevented Fork Tilt Down Valve prevented 	One of the following occur: <ul style="list-style-type: none"> Tilt Voltage A greater than 4.85 V Tilt Voltage B greater than 4.85 V 	Power cycled
FORK TILT JOYSTICK – OUT OF RANGE LOW	2399	<ul style="list-style-type: none"> Fork Tilt Up Valve prevented Fork Tilt Down Valve prevented 	One of the following occur: <ul style="list-style-type: none"> Tilt Voltage A less than 0.15 V Tilt Voltage B less than 0.15 V 	Power cycled
FUNCTION PROBLEM – THROTTLE PEDAL CALIBRATION FAULTY	23194	<ul style="list-style-type: none"> Closed Throttle RPM forced 	Pedal Cal OK is NO; refer to Accelerator Pedal Calibration OK functionality	Pedal Cal OK is YES (calibration completed)

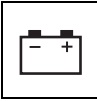


9.19.5 Function Prevented (25x)

Help Message	DTC	Actions	Trigger	Latch Condition
MODEL CHANGED – HYDRAULICS SUSPENDED – CYCLE EMS	259	<ul style="list-style-type: none"> Fork Tilt Up Valve prevented Fork Tilt Down Valve prevented 	Machine Setup's MODEL changed via the JLG Analyzer	Power cycled

9.19.6 Output Drivers (33x)

Help Message	DTC	Actions	Trigger	Latch Condition
FORK TILT UP VALVE – OPEN CIRCUIT	33191	-	All of the following occur for 1000 mS: <ul style="list-style-type: none"> Fork Tilt Up Command greater than 250 mA Fork Tilt Up Actual less than 75 mA DTC33192 not active 	Power cycled
FORK TILT VALVES – SHORT TO BATTERY	33192	<ul style="list-style-type: none"> Fork Tilt Up Valve prevented Fork Tilt Down Valve prevented Low-Side Fault Relay de-energized 	One of the following occur: <ul style="list-style-type: none"> Fork Tilt Up Command is 0 mA and driver feedback is low Fork Tilt Down Command is 0 mA and driver feedback is low 	Power cycled
FORK TILT UP VALVE – SHORT TO GROUND	33193	<ul style="list-style-type: none"> Fork Tilt Up Valve prevented 	All of the following occur with no debounce: <ul style="list-style-type: none"> Fork Tilt Up Actual greater than 20 mA Driver feedback is low 	Power cycled
FORK TILT DOWN VALVE – OPEN CIRCUIT	33194	-	All of the following occur for 1000 mS: <ul style="list-style-type: none"> Fork Tilt Down Command greater than 250 mA Fork Tilt Down Actual less than 75 mA DTC33192 not active 	Power cycled
FORK TILT DOWN VALVE – SHORT TO GROUND	33195	<ul style="list-style-type: none"> Fork Tilt Down Valve prevented 	All of the following occur with no debounce: <ul style="list-style-type: none"> Fork Tilt Down Actual greater than 20 mA Driver feedback is low 	Power cycled
ANTI-STALL VALVE – SHORT TO BATTERY	33426	-	All of the following occur: <ul style="list-style-type: none"> Torque-Based or Speed-Based Anti-Stall enabled Anti-Stall Command is 0 mA Driver feedback is low 	Power cycled
ANTI-STALL VALVE – OPEN CIRCUIT	33427	-	All of the following occur for 500 mS: <ul style="list-style-type: none"> Torque-Based or Speed-Based Anti-Stall enabled Anti-Stall Valve Actual (mA) < Anti-Stall Valve Open-Circuit Limit (mA) DTC 33426 not active 	Power cycled
ANTI-STALL VALVE – SHORT TO GROUND	33428	<ul style="list-style-type: none"> Anti-Stall Valve prevented 	All of the following occur for 500mS: <ul style="list-style-type: none"> Torque-Based or Speed-Based Anti-Stall enabled Anti-Stall Valve Actual (mA) > Anti-Stall Valve Short to Ground Limit (mA) 	Power cycled



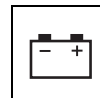
Electrical System

9.19.7 Engine (43x)

Help Message	DTC	Actions	Trigger	Latch Condition
AIR FILTER RESTRICTION	4321	None	Air filter restriction detected, see Air Filter Restriction, and the Model selected is: 6036 63KW LRC, 6042 63KW LRC, 8042 82KW LRC, 10042 82KW LRC, 10054 82KW LRC, or 12054 82KW LRC	Power cycled
THROTTLE PEDAL – VOLTAGE OUT OF RANGE	4337	Engine speed set to Closed Throttle RPM	One of the following occur: <ul style="list-style-type: none"> • Pedal A Voltage greater than 4.50 V • Pedal B Voltage greater than 4.50 V • Pedal A Voltage less than 0.40 V • Pedal B Voltage less than 0.40 V 	Power cycled
THROTTLE PEDAL – VOLTAGE DISAGREEMENT	4338	Engine speed set to Closed Throttle RPM	Accel Pedal A (%) and Accel Pedal B (%) differ by more than 6%	Power cycled
WRONG ENGINE SELECTED	4367	Engine speed set to Closed Throttle RPM	Machine Setup's MODEL is 6036 63KW HRC, 6036 63KW LRC, 6042 63KW HRC, 6042 63KW LRC, 8042 82KW HRC, 8042 82KW LRC, 10042 82KW HRC, 10042 82KW LRC, 10054 82KW HRC, 10054 82KW LRC, 12054 82KW HRC, or 12054 82KW LRC; SPN166 Eng Rated Power < 57KW	Power cycled
WRONG ENGINE SELECTED	4367	Engine speed set to Closed Throttle RPM	Machine Setup's MODEL is 6036 55KW, 6042 55KW, 8042 55KW, 10042 55KW, 10054 55KW, or 12054 55KW; SPN166 Eng Rated Power < 53KW or > 57KW	Power cycled

9.19.8 Battery Supply (44x)

Help Message	DTC	Actions	Trigger	Latch Condition
BATTERY VOLTAGE TOO LOW – SYSTEM SHUTDOWN	441	<ul style="list-style-type: none"> • Fork Tilt Up Valve prevented • Fork Tilt Down Valve prevented • Anti-Stall Valve prevented • Engine speed set to Closed Throttle RPM 	Ignition Voltage < 8.0 V for 3000 mS	Ignition Voltage > 10.0 V for 3000 mS
BATTERY VOLTAGE TOO HIGH – SYSTEM SHUTDOWN	442	<ul style="list-style-type: none"> • Fork Tilt Up Valve prevented • Fork Tilt Down Valve prevented • Anti-Stall Valve prevented • Low-Side Fault Relay de-energized • Engine speed set to Closed Throttle RPM 	Ignition Voltage > 16.0 V for 3000 mS	Power cycled
VOLTAGE REFERENCE OUT OF RANGE	447	<ul style="list-style-type: none"> • Fork Tilt Up Valve prevented • Fork Tilt Down Valve prevented • Anti-Stall Valve prevented • Low-Side Fault Relay de-energized • Engine speed set to Closed Throttle RPM 	Analog Voltage Reference > 5.4 V or < 4.6 V for 1000 mS	Power cycled



9.19.9 Communications (66x)

Help Message	DTC	Actions	Trigger	Latch Condition
CANBUS FAILURE – ENGINE CONTROLLER	666	<ul style="list-style-type: none"> • SPN1172 InletTemp defaults to +20°C • All other signals from the ECM default to 0 	CANbus messages from ECM not detected for at least 1000 mS	Messages resume for 1000 mS

9.19.10 Hardware (99x)

Help Message	DTC	Actions	Trigger	Latch Condition
EEPROM FAILURE – CHECK ALL SETTINGS	998	<ul style="list-style-type: none"> • Fork Tilt Up Valve prevented • Fork Tilt Down Valve prevented • Anti-Stall Valve prevented • Low-Side Fault Relay de-energized • Engine speed set to Closed Throttle RPM 	<p>One of the following occur:</p> <ul style="list-style-type: none"> • Machine Setup setting outside adjustment limits • Personality setting outside adjustment limits • Calibration setting outside calibration limits <ul style="list-style-type: none"> • Non-volatile storage checksum issue 	Machine Setup's MODEL changed to trigger defaults; power-cycled

Go to Discount-Equipment.com to order your parts

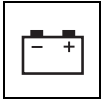


Electrical System

9.20 ENGINE FAULT CODES

Note: For more information, contact your local authorized engine service distributor.

SPN	FMI	Fault Code	SPN Description	Description
27	2	1228	Engine Exhaust Gas Recirculation 1 Valve Position	EGR Valve Position - Data erratic, intermittent or incorrect
27	4	2272	Engine Exhaust Gas Recirculation 1 Valve Position	EGR Valve Position Circuit - Voltage below normal, or shorted to low source
51	3	6497	Engine Intake Throttle Actuator Position Sensor Circuit	Engine Intake Throttle Actuator Position Sensor Circuit- Voltage above normal, or shorted to high source
51	4	6498	Engine Intake Throttle Actuator Position Sensor Circuit	Engine Intake Throttle Actuator Position Sensor Circuit- Voltage above normal, or shorted to low source
81	16	2754	Engine Diesel Particulate Filter Intake Pressure	Engine Diesel Particulate Filter Intake Pressure - Data Valid But Above Normal Operating Range - Moderately Severe Level
84	2	241	Wheel-Based Vehicle Speed	Wheel-Based Vehicle Speed - Data erratic, intermittent or incorrect
84	9	3526	Wheel-Based Vehicle Speed	Wheel-Based Vehicle Speed - Abnormal update rate
84	10	242	Wheel-Based Vehicle Speed	Wheel-Based Vehicle Speed Sensor Circuit tampering has been detected - Abnormal rate of change
84	19	3525	Wheel-Based Vehicle Speed	Wheel-Based Vehicle Speed - Received Network Data In Error
91	0	148	Accelerator Pedal Position 1	Accelerator Pedal or Lever Position Sensor 1 - Data valid but above normal operational range - Most Severe Level
91	1	147	Accelerator Pedal Position 1	Accelerator Pedal or Lever Position 1 Sensor Circuit Frequency - Data valid but below normal operating Range
91	2	1242	Accelerator Pedal Position 1	Accelerator Pedal or Lever Position Sensor 1 - Data erratic, intermittent or incorrect
91	3	131	Accelerator Pedal Position 1	Accelerator Pedal or Lever Position Sensor 1 Circuit - Voltage above normal, or shorted to high source
91	3	1358	Accelerator Pedal Position 1	Accelerator Pedal or Lever Position Sensor 1 Circuit - Voltage above normal, or shorted to high source

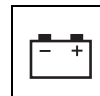


SPN	FMI	Fault Code	SPN Description	Description
91	4	132	Accelerator Pedal Position 1	Accelerator Pedal or Lever Position Sensor 1 Circuit - Voltage below normal, or shorted to low source
91	4	1359	Accelerator Pedal Position 1	Accelerator Pedal or Lever Position Sensor 1 Circuit - Voltage below normal, or shorted to low source
91	9	3326	Accelerator Pedal Position 1	SAE J1939 Multiplexed Accelerator Pedal or Lever Sensor System - Abnormal update rate
91	19	1515	Accelerator Pedal Position 1	SAE J1939 Multiplexed Accelerator Pedal or Lever Sensor System - Received Network Data In Error
93	2	528	Engine Net Brake Torque	Auxiliary Alternate Torque Validation Switch - Data erratic, intermittent or incorrect
94	0	4615	Engine Fuel Delivery Pressure	Engine Fuel Delivery Pressure - Data Valid but Above Normal Operational Range - Most Severe Level
94	3	546	Engine Fuel Delivery Pressure	Fuel Delivery Pressure Sensor Circuit - Voltage above normal, or shorted to high source
94	4	547	Engine Fuel Delivery Pressure	Fuel Delivery Pressure Sensor Circuit - Voltage below normal, or shorted to low source
94	15	2261	Engine Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid But Above Normal Operating Range - Least Severe Level
94	17	2262	Engine Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid But Below Normal Operating Range - Least Severe Level
94	18	2215	Engine Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid But Below Normal Operating Range - Moderately Severe Level
95	16	2372	Engine Fuel Filter Differential Pressure	Fuel Filter Differential Pressure - Data Valid But Above Normal Operating Range - Moderately Severe Level
97	3	428	Water In Fuel Indicator	Water in Fuel Indicator Sensor Circuit - Voltage above normal, or shorted to high source
97	4	429	Water In Fuel Indicator	Water in Fuel Indicator Sensor Circuit - Voltage below normal, or shorted to low source
97	15	418	Water In Fuel Indicator	Water in Fuel Indicator - Data Valid But Above Normal Operating Range - Least Severe Level
97	16	1852	Water In Fuel Indicator	Water in Fuel Indicator - Data Valid But Above Normal Operating Range - Moderately Severe Level
98	0	688	Engine Oil Level	Engine Oil Level - Data valid but above normal operational range - Most Severe Level

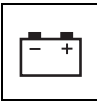


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
98	1	253	Engine Oil Level	Engine Oil Level - Data valid but below normal operational range - Most Severe Level
98	17	471	Engine Oil Level	Engine Oil Level - Data Valid But Below Normal Operating Range - Least Severe Level
100	1	415	Engine Oil Pressure	Engine Oil Rifle Pressure - Data valid but below normal operational range - Most Severe Level
100	2	435	Engine Oil Pressure	Engine Oil Rifle Pressure - Data erratic, intermittent or incorrect
100	3	135	Engine Oil Pressure	Engine Oil Rifle Pressure 1 Sensor Circuit - Voltage above normal, or shorted to high source
100	4	141	Engine Oil Pressure	Engine Oil Rifle Pressure 1 Sensor Circuit - Voltage below normal, or shorted to low source
100	18	143	Engine Oil Pressure	Engine Oil Rifle Pressure - Data Valid But Below Normal Operating Range - Moderately Severe Level
101	0	556	Engine Crankcase Pressure	Crankcase Pressure - Data valid but above normal operational range - Most Severe Level
101	2	1942	Engine Crankcase Pressure	Crankcase Pressure - Data erratic, intermittent or incorrect
101	3	1843	Engine Crankcase Pressure	Crankcase Pressure Circuit - Voltage above normal, or shorted to high source
101	4	1844	Engine Crankcase Pressure	Crankcase Pressure Circuit - Voltage below normal, or shorted to low source
101	15	1974	Engine Crankcase Pressure	Crankcase Pressure - Data Valid But Above Normal Operating Range - Least Severe Level
101	16	555	Engine Crankcase Pressure	Crankcase Pressure - Data Valid But Above Normal Operating Range - Moderately Severe Level
102	2	2973	Engine Intake Manifold #1 Pressure	Intake Manifold 1 Pressure - Data erratic, intermittent or incorrect
102	3	122	Engine Intake Manifold #1 Pressure	Intake Manifold 1 Pressure Sensor Circuit - Voltage above normal, or shorted to high source
102	4	123	Engine Intake Manifold #1 Pressure	Intake Manifold 1 Pressure Sensor Circuit - Voltage below normal, or shorted to low source
102	10	3361	Engine Intake Manifold #1 Pressure	Intake Manifold 1 Pressure - Abnormal rate of change



SPN	FMI	Fault Code	SPN Description	Description
102	16	124	Engine Intake Manifold #1 Pressure	Intake Manifold 1 Pressure - Data Valid But Above Normal Operating Range - Moderately Severe Level
102	18	125	Engine Intake Manifold #1 Pressure	Intake Manifold 1 Pressure - Data Valid But Below Normal Operating Range - Moderately Severe Level
103	2	686	Engine Turbocharger 1 Speed	Turbocharger 1 Speed - Data erratic, intermittent or incorrect
103	15	2288	Engine Turbocharger 1 Speed	Turbocharger 1 Speed - Data Valid But Above Normal Operating Range - Least Severe Level
103	16	595	Engine Turbocharger 1 Speed	Turbocharger 1 Speed - Data Valid But Above Normal Operating Range - Moderately Severe Level
103	18	687	Engine Turbocharger 1 Speed	Turbocharger 1 Speed - Data Valid But Below Normal Operating Range - Moderately Severe Level
104	18	3917	Engine Turbocharger Lube Oil Pressure 1	Engine Turbocharger Lube Oil Pressure - Data Valid But Below Normal Operating Range - Moderately Severe Level
105	0	155	Engine Intake Manifold 1 Temperature	Intake Manifold 1 Temperature - Data valid but above normal operational range - Most Severe Level
105	2	436	Engine Intake Manifold 1 Temperature	Intake Manifold 1 Temperature - Data erratic, intermittent or incorrect
105	3	153	Engine Intake Manifold 1 Temperature	Intake Manifold 1 Temperature Sensor Circuit - Voltage above normal, or shorted to high source
105	4	154	Engine Intake Manifold 1 Temperature	Intake Manifold 1 Temperature Sensor Circuit - Voltage below normal, or shorted to low source
105	15	2964	Engine Intake Manifold #1 Temperature	Intake Manifold 1 Temperature - Data Valid But Above Normal Operating Range - Least Severe Level
105	16	488	Engine Intake Manifold Temperature	Intake Manifold 1 Temperature - Data Valid But Above Normal Operating Range - Moderately Severe Level
105	18	3385	Engine Intake Manifold 1 Temperature	Intake Manifold 1 Temperature - Data Valid But Below Normal Operating Range - Moderately Severe Level
107	15	5576	Engine Air Filter 1 Differential Pressure	Engine Air Filter Differential Pressure - Data Valid But Above Normal Operating Range - Least Severe Level
107	16	3341	Engine Air Filter 1 Differential Pressure	Engine Air Filter Differential Pressure - Data Valid But Above Normal Operating Range - Moderately Severe Level
108	2	295	Barometric Pressure	Barometric Pressure - Data erratic, intermittent or incorrect

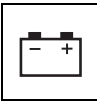


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
108	3	221	Barometric Pressure	Barometric Pressure Sensor Circuit - Voltage above normal, or shorted to high source
108	4	222	Barometric Pressure	Barometric Pressure Sensor Circuit - Voltage above normal, or shorted to low source
109	3	231	Engine Coolant Pressure	Coolant Pressure Sensor Circuit - Voltage above normal, or shorted to high source
109	4	232	Engine Coolant Pressure	Coolant Pressure Sensor Circuit - Voltage below normal, or shorted to low source
109	18	233	Engine Coolant Pressure	Coolant Pressure - Data Valid But Below Normal Operating Range - Moderately Severe Level
110	0	151	Temperature	Engine Coolant Temperature - Data valid but above normal operational range - Most Severe Level
110	2	334	Engine Coolant Temperature	Engine Coolant Temperature - Data erratic, intermittent or incorrect
110	3	144	Engine Coolant Temperature	Engine Coolant Temperature 1 Sensor Circuit - Voltage above normal, or shorted to high source
110	4	145	Engine Coolant Temperature	Engine Coolant Temperature 1 Sensor Circuit - Voltage below normal, or shorted to low source
110	14	1847	Engine Coolant Temperature	Engine Coolant Temperature - Special Instructions
110	15	2963	Engine Coolant Temperature	Engine Coolant Temperature - Data Valid But Above Normal Operating Range - Least Severe Level
110	16	146	Engine Coolant Temperature	Engine Coolant Temperature - Data Valid But Above Normal Operating Range - Moderately Severe Level
110	18	2789	Engine Coolant Temperature	Engine Coolant Temperature - Data Valid But Below Normal Operating Range - Moderately Severe Level
110	31	2646	Engine Coolant Temperature	Engine Coolant Temperature - Condition Exists
110	31	2659	Engine Coolant Temperature	Engine Coolant Temperature - Condition Exists
111	1	235	Engine Coolant Level	Coolant Level - Data valid but below normal operational range - Most Severe Level
111	2	422	Engine Coolant Level	Coolant Level - Data erratic, intermittent or incorrect



SPN	FMI	Fault Code	SPN Description	Description
111	3	195	Engine Coolant Level	Coolant Level Sensor 1 Circuit - Voltage above normal, or shorted to high source
111	3	6522	Engine Coolant Level	Coolant Level Sensor 1 Circuit - Voltage above normal, or shorted to high source
111	4	196	Engine Coolant Level	Coolant Level Sensor 1 Circuit - Voltage below normal, or shorted to low source
111	4	6523	Engine Coolant Level	Coolant Level Sensor 1 Circuit - Voltage below normal, or shorted to low source
111	9	3613	SAE J1939 Multiplexing PGN Timeout	SAE J1939 Multiplexing PGN Timeout Error - Abnormal update rate
111	17	2448	Engine Coolant Level	Coolant Level - Data Valid But Below Normal Operating Range - Least Severe Level
111	17	5167	Engine Coolant Level	Coolant Level - Data Valid But Below Normal Operating Range - Least Severe Level
111	18	197	Engine Coolant Level	Coolant Level - Data Valid But Below Normal Operating Range - Moderately Severe Level
111	18	3366	Engine Coolant Level	Coolant Level - Data Valid But Below Normal Operating Range - Moderately Severe Level
111	19	3614	SAE J1939 Multiplexing PGN Timeout	Coolant Level Sensor - Received Network Data in Error
157	0	449	Engine Injector Metering Rail 1 Pressure	Injector Metering Rail 1 Pressure - Data valid but above normal operational range - Most Severe Level
157	1	2249	Engine Injector Metering Rail 1 Pressure	Injector Metering Rail 1 Pressure - Data valid but below normal operational range - Most Severe Level
157	2	554	Engine Injector Metering Rail 1 Pressure	Injector Metering Rail 1 Pressure - Data erratic, intermittent or incorrect
157	3	451	Engine Injector Metering Rail 1 Pressure	Injector Metering Rail 1 Pressure Sensor Circuit - Voltage above normal, or shorted to high source
157	4	452	Engine Injector Metering Rail 1 Pressure	Injector Metering Rail 1 Pressure Sensor Circuit - Voltage below normal, or shorted to low source
157	7	755	Engine Injector Metering Rail 1 Pressure	Injector Metering Rail 1 Pressure - Mechanical system not responding or out of adjustment
157	15	4727	Engine Injector Metering Rail 1 Pressure	Injector Metering Rail 1 Pressure - Data Valid But Above Normal Operating Range - Least Severe Level

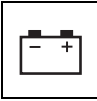


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
157	16	553	Engine Injector Metering Rail 1 Pressure	Injector Metering Rail 1 Pressure - Data Valid But Above Normal Operating Range - Moderately Severe Level
157	18	559	Engine Injector Metering Rail 1 Pressure	Injector Metering Rail 1 Pressure - Data Valid But Below Normal Operating Range - Moderately Severe Level
168	15	6256	Battery Potential / Power Input 1	Battery 1 Voltage - Data Valid But Above Normal Operating Range - Moderately Severe Level
168	16	442	Battery Potential / Power Input 1	Battery 1 Voltage - Data Valid But Above Normal Operating Range - Moderately Severe Level
168	17	3724	Battery Potential / Power Input 1	Battery 1 Voltage - Data Valid But Below Normal Operating Range - Least Severe Level
168	17	6257	Battery Potential / Power Input 1	Battery 1 Voltage - Data Valid But Below Normal Operating Range - Moderately Severe Level
168	18	441	Battery Potential / Power Input 1	Battery 1 Voltage - Data Valid But Below Normal Operating Range - Moderately Severe Level
171	2	2398	Ambient Air Temperature	Ambient Air Temperature - Data erratic, intermittent or incorrect
171	3	249	Ambient Air Temperature	Ambient Air Temperature Sensor 1 Circuit - Voltage above normal, or shorted to high source
171	4	256	Ambient Air Temperature	Ambient Air Temperature Sensor 1 Circuit - Voltage below normal, or shorted to low source
171	9	3531	Ambient Air Temperature	Ambient Air Temperature - Abnormal update rate
171	19	3532	Ambient Air Temperature	Ambient Air Temperature - Received Network Data In Error
174	0	266	Engine Fuel Temperature 1	Engine Fuel Temperature - Data valid but above normal operational range - Most Severe Level
174	2	535	Engine Fuel Temperature 1	Engine Fuel Temperature - Data erratic, intermittent or incorrect
174	3	263	Engine Fuel Temperature 1	Engine Fuel Temperature Sensor 1 Circuit - Voltage above normal, or shorted to high source
174	4	265	Engine Fuel Temperature 1	Engine Fuel Temperature Sensor 1 Circuit - Voltage below normal, or shorted to low source
174	16	261	Engine Fuel Temperature 1	Engine Fuel Temperature - Data Valid But Above Normal Operating Range - Moderately Severe Level

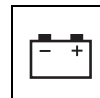


SPN	FMI	Fault Code	SPN Description	Description
175	0	214	Engine Oil Temperature 1	Engine Oil Temperature - Data valid but above normal operational range - Most Severe Level
175	2	425	Engine Oil Temperature 1	Engine Oil Temperature - Data erratic, intermittent or incorrect
175	3	212	Engine Oil Temperature 1	Engine Oil Temperature Sensor 1 Circuit - Voltage above normal, or shorted to high source
175	3	6524	Engine Oil Temperature 1	Engine Oil Temperature Sensor 1 Circuit - Voltage above normal, or shorted to high source
175	4	213	Engine Oil Temperature 1	Engine Oil Temperature Sensor 1 Circuit - Voltage below normal, or shorted to low source
175	4	6525	Engine Oil Temperature 1	Engine Oil Temperature Sensor 1 Circuit - Voltage below normal, or shorted to low source
175	16	421	Engine Oil Temperature 1	Engine Oil Temperature - Data Valid But Above Normal Operating Range - Moderately Severe Level
188	16	3715	Engine Speed At Idle, Point 1 (Engine Configuration)	Engine Speed At Idle - Data Valid But Above Normal Operating Range - Moderately Severe Level
188	18	3716	Engine Speed At Idle, Point 1 (Engine Configuration)	Engine Speed At Idle - Data Valid But Below Normal Operating Range - Moderately Severe Level
190	0	234	Engine Speed	Engine Crankshaft Speed/Position - Data valid but above normal operational range - Most Severe Level
190	2	689	Engine Speed	Engine Crankshaft Speed/Position - Data erratic, intermittent or incorrect
190	2	2321	Engine Speed	Engine Crankshaft Speed/Position - Data erratic, intermittent or incorrect
190	16	1992	Engine Speed	Engine Crankshaft Speed/Position - Data Valid But Above Normal Operating Range - Moderately Severe Level
190	16	2468	Engine Speed	Engine Crankshaft Speed/Position - Data Valid But Above Normal Operating Range - Moderately Severe Level
191	9	3328	Transmission Output Shaft	Transmission Output Shaft Speed - Abnormal update rate
191	16	349	Transmission Output Shaft Speed	Transmission Output Shaft Speed - Data Valid But Above Normal Operating Range - Moderately Severe Level

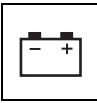


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
191	18	489	Transmission Output Shaft Speed	Transmission Output Shaft Speed - Data Valid But Below Normal Operating Range - Moderately Severe Level
191	19	3418	Transmission Output Shaft Speed	Transmission Output Shaft Speed - Received Network Data In Error
237	2	4722	Vehicle Identification Number	Vehicle Identification Number - Data erratic, intermittent or incorrect
237	13	4517	Vehicle Identification Number	Vehicle Identification Number - Out of Calibration
237	31	4721	Vehicle Identification Number	Vehicle Identification Number - Condition Exists
251	2	319	Real Time Clock	Real Time Clock - Data erratic, intermittent or incorrect
411	2	1866	Engine Exhaust Gas Recirculation 1 Differential Pressure	Exhaust Gas Recirculation Differential Pressure - Data erratic, intermittent or incorrect
411	3	2273	Engine Exhaust Gas Recirculation 1 Differential Pressure	Exhaust Gas Recirculation Differential Pressure Sensor Circuit - Voltage above normal, or shorted to high source
411	4	2274	Engine Exhaust Gas Recirculation 1 Differential Pressure	Exhaust Gas Recirculation Differential Pressure Sensor Circuit - Voltage below normal, or shorted to low source
412	2	1867	Engine Exhaust Gas Recirculation 1 Temperature	Exhaust Gas Recirculation Temperature - Data erratic, intermittent or incorrect
412	3	2375	Engine Exhaust Gas Recirculation 1 Valve Position	Exhaust Gas Recirculation Temperature Sensor Circuit - Voltage above normal, or shorted to high source
412	4	2376	Engine Exhaust Gas Recirculation 1 Temperature	Exhaust Gas Recirculation Temperature Sensor Circuit - Voltage below normal, or shorted to low source
412	15	2961	Engine Exhaust Gas Recirculation 1 Temperature	Exhaust Gas Recirculation Temperature - Data Valid But Above Normal Operating Range - Least Severe Level
412	16	2962	Engine Exhaust Gas Recirculation 1 Temperature	Exhaust Gas Recirculation Temperature - Data Valid But Above Normal Operating Range - Moderately Severe Level
441	3	293	Auxiliary Temperature 1	Auxiliary Temperature Sensor Input 1 Circuit - Voltage above normal, or shorted to high source
441	4	294	Auxiliary Temperature 1	Auxiliary Temperature Sensor Input 1 Circuit - Voltage below normal, or shorted to low source

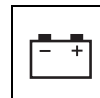


SPN	FMI	Fault Code	SPN Description	Description
441	14	292	Auxiliary Temperature 1	Auxiliary Temperature Sensor Input 1 - Special Instructions
441	14	6583	Auxiliary Temperature 1	Auxiliary Temperature Sensor Input 1 - Special Instructions
442	3	3765	Auxiliary Temperature 2	Auxiliary Temperature Sensor Input 2 Circuit - Voltage above normal, or shorted to high source
442	4	3766	Auxiliary Temperature 2	Auxiliary Temperature Sensor Input 2 Circuit - Voltage below normal, or shorted to low source
521	2	4526	Brake Pedal Position	Brake Pedal Position - Data erratic, intermittent or incorrect
558	2	431	Accelerator Pedal 1 Low Idle Switch	Accelerator Pedal or Lever Idle Validation Switch - Data erratic, intermittent or incorrect
558	9	3528	Accelerator Pedal 1 Low Idle Switch	Accelerator Pedal or Lever Idle Validation Switch - Abnormal update rate
558	13	432	Accelerator Pedal 1 Low Idle Switch	Accelerator Pedal or Lever Idle Validation Switch Circuit - Out of Calibration
558	19	3527	Accelerator Pedal 1 Low Idle Switch	Accelerator Pedal or Lever Idle Validation Switch - Received Network Data In Error
563	9	3488	Anti-Lock Braking (ABS) Active	Anti-Lock Braking (ABS) Controller - Abnormal update rate
563	31	4215	Anti-Lock Braking (ABS) Active	Anti-Lock Braking (ABS) Active - Condition Exists
596	2	3841	Cruise Control Enable Switch	Cruise Control Enable Switch - Data erratic, intermittent or incorrect
596	7	3839	Cruise Control Enable Switch	Cruise Control Enable Switch - Mechanical system not responding or out of adjustment
596	13	3842	Cruise Control Enable Switch	Cruise Control Enable Switch - Out of Calibration
597	3	769	Brake Switch	Brake Switch Circuit - Voltage above normal, or shorted to high source
597	4	771	Brake Switch	Brake Switch Circuit - Voltage below normal, or shorted to low source
599	2	2721	Cruise Control Set Switch	Cruise Control Set Switch - Data erratic, intermittent or incorrect

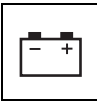


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
611	2	523	System Diagnostic Code #1	Auxiliary Intermediate (PTO) Speed Switch Validation - Data erratic, intermittent or incorrect
612	2	115	System Diagnostic Code #2	Engine Magnetic Speed/Position Lost Both of Two Signals - Data erratic, intermittent or incorrect
625	9	291	Proprietary Datalink	Proprietary Datalink Error (OEM/Vehicle Datalink) - Abnormal update rate
626	3	2738	Engine Start Enable Device 1	Start Enable Device 1 Circuit (Ether Injection) - Voltage above normal, or shorted to high source
626	4	2739	Engine Start Enable Device 1	Start Enable Device 1 Circuit (Ether Injection) - Voltage below normal, or shorted to low source
626	18	487	Engine Start Enable Device 1	Start Enable Device 1 Canister Empty (Ether Injection) - Data Valid But Below Normal Operating Range
629	12	111	Controller #1	Engine Control Module Critical Internal Failure - Bad intelligent device or component
629	12	343	Controller #1	Engine Control Module Warning Internal Hardware Failure - Bad intelligent device or component
629	31	2661	Controller #1	At Least One Unacknowledged Most Severe Fault - Condition Exists
629	31	2662	Controller #1	At Least One Unacknowledged Moderately Severe Fault - Condition Exists
630	12	3697	Engine Control Module Calibration Memory	Engine Control Module Calibration Memory - Bad intelligent device or component
633	31	2311	Engine Fuel Actuator 1 Control Command	Electronic Fuel Injection Control Valve Circuit - Condition Exists
639	2	426	J1939 Network #1, Primary Vehicle Network (previously SAE J1939 Data Link)	J1939 Network #1 - Data erratic, intermittent or incorrect
639	9	285	J1939 Network #1, Primary Vehicle Network (previously SAE J1939 Data Link)	SAE J1939 Multiplexing PGN Timeout Error - Abnormal update rate
639	9	427	J1939 Network #1, Primary Vehicle Network (previously SAE J1939 Data Link)	SAE J1939 Datalink - Abnormal update rate
639	13	286	J1939 Network #1, Primary Vehicle Network (previously SAE J1939 Data Link)	SAE J1939 Multiplexing Configuration Error - Out of Calibration

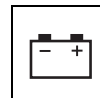


SPN	FMI	Fault Code	SPN Description	Description
640	14	599	Engine External Protection Input	Auxiliary Commanded Dual Output Shutdown - Special Instructions
641	7	2387	Engine Variable Geometry Turbocharger Actuator #1	VGT Actuator Driver Circuit (Motor) - Mechanical system not responding or out of adjustment
641	9	1894	Engine Variable Geometry Turbocharger Actuator #1	VGT Actuator Driver Circuit - Abnormal update rate
641	9	2636	Engine Variable Geometry Turbocharger Actuator #1	VGT Actuator Driver Circuit - Abnormal update rate
641	11	2198	Engine Variable Geometry Turbocharger Actuator #1	VGT Actuator Driver Circuit - Root Cause Not Known
641	12	2634	Engine Variable Geometry Turbocharger Actuator #1	VGT Actuator Controller - Bad intelligent device or component
641	13	1898	Engine Variable Geometry Turbocharger Actuator #1	VGT Actuator Controller - Out of Calibration
641	13	2449	Engine Variable Geometry Turbocharger Actuator #1	VGT Actuator Controller - Out of Calibration
641	15	1962	Engine Variable Geometry Turbocharger Actuator #1	VGT Actuator Driver Over Temperature (Calculated) - Data Valid But Above Normal Operating Range - Least Severe Level
641	15	1976	Engine Variable Geometry Turbocharger Actuator #1	VGT Actuator Driver Over Temperature (Calculated) - Data Valid But Above Normal Operating Range - Least Severe Level
641	31	2635	Engine Variable Geometry Turbocharger Actuator #1	VGT Actuator Driver Circuit - Condition Exists
644	2	237	Engine External Speed Command Input	External Speed Command Input (Multiple Unit Synchronization) - Data erratic, intermittent or incorrect
647	3	2377	Engine Fan Clutch 1 Output Device Driver	Fan Control Circuit - Voltage above normal, or shorted to high source
647	3	6263	Engine Fan Clutch 1 Output Device Driver	Fan Control Circuit - Voltage above normal, or shorted to high source
647	4	245	Engine Fan Clutch 1 Output Device Driver	Fan Control Circuit - Voltage below normal, or shorted to low source
647	4	6264	Engine Fan Clutch 1 Output Device Driver	Fan Control Circuit - Voltage below normal, or shorted to low source

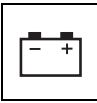


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
649	3	5271	Engine Exhaust Back Pressure Regulator Control Circuit	Engine Exhaust Back Pressure Regulator Control Circuit - Voltage Above Normal, or Shorted to High Source
649	4	5272	Engine Exhaust Back Pressure Regulator Control Circuit	Engine Exhaust Back Pressure Regulator Control Circuit - Voltage Below Normal, or Shorted to Low Source
649	5	5273	Engine Exhaust Back Pressure Regulator Control Circuit	Engine Exhaust Back Pressure Regulator Control Circuit - Current Below Normal or Open Circuit
651	5	322	Engine Injector Cylinder #01	Injector Solenoid Driver Cylinder 1 Circuit - Current below normal or open circuit
651	7	1139	Engine Injector Cylinder #01	Injector Solenoid Driver Cylinder 1 - Mechanical system not responding or out of adjustment
652	5	331	Engine Injector Cylinder #02	Injector Solenoid Driver Cylinder 2 Circuit - Current below normal or open circuit
652	7	1141	Engine Injector Cylinder #02	Injector Solenoid Driver Cylinder 2 - Mechanical system not responding or out of adjustment
653	5	324	Engine Injector Cylinder #03	Injector Solenoid Driver Cylinder 3 Circuit - Current below normal or open circuit
653	7	1142	Engine Injector Cylinder #03	Injector Solenoid Driver Cylinder 3 - Mechanical system not responding or out of adjustment
654	5	332	Engine Injector Cylinder #04	Injector Solenoid Driver Cylinder 4 Circuit - Current below normal or open circuit
654	7	1143	Engine Injector Cylinder #04	Injector Solenoid Driver Cylinder 4 - Mechanical system not responding or out of adjustment
655	5	323	Engine Injector Cylinder #05	Injector Solenoid Driver Cylinder 5 Circuit - Current below normal or open circuit
655	7	1144	Engine Injector Cylinder #05	Injector Solenoid Driver Cylinder 5 - Mechanical system not responding or out of adjustment
656	5	325	Engine Injector Cylinder #06	Injector Solenoid Driver Cylinder 6 Circuit - Current below normal or open circuit
656	7	1145	Engine Injector Cylinder #06	Injector Solenoid Driver Cylinder 6 - Mechanical system not responding or out of adjustment
657	5	1548	Engine Injector Cylinder #7	Injector Solenoid Driver Cylinder 7 Circuit - Current below normal or open circuit
658	5	1549	Engine Injector Cylinder #8	Injector Solenoid Driver Cylinder 8 Circuit - Current below normal or open circuit

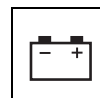


SPN	FMI	Fault Code	SPN Description	Description
659	5	1622	Engine Injector Cylinder #9	Injector Solenoid Driver Cylinder 9 Circuit - Current below normal or open circuit
660	5	1551	Engine Injector Cylinder #10	Injector Solenoid Driver Cylinder 10 Circuit - Current below normal or open circuit
661	5	1552	Engine Injector Cylinder #11	Injector Solenoid Driver Cylinder 11 Circuit - Current below normal or open circuit
662	5	1553	Engine Injector Cylinder #12	Injector Solenoid Driver Cylinder 12 Circuit - Current below normal or open circuit
663	5	1554	Engine Injector Cylinder #13	Injector Solenoid Driver Cylinder 13 Circuit - Current below normal or open circuit
664	5	1555	Engine Injector Cylinder #14	Injector Solenoid Driver Cylinder 14 Circuit - Current below normal or open circuit
665	5	1556	Engine Injector Cylinder #15	Injector Solenoid Driver Cylinder 15 Circuit - Current below normal or open circuit
666	5	1557	Engine Injector Cylinder #16	Injector Solenoid Driver Cylinder 16 Circuit - Current below normal or open circuit
677	3	584	Engine Starter Motor Relay	Starter Relay Driver Circuit - Voltage above normal, or shorted to high source
677	4	585	Engine Starter Motor Relay	Starter Relay Driver Circuit - Voltage below normal, or shorted to low source
697	3	2557	Auxiliary PWM Driver #1	Auxiliary PWM Driver 1 Circuit - Voltage above normal, or shorted to high source
697	4	2558	Auxiliary PWM Driver #1	Auxiliary PWM Driver 1 Circuit - Voltage below normal, or shorted to low source
701	14	4734	Auxiliary I/O #01	Auxiliary Input/Output 1 - Special Instructions
702	3	527	Auxiliary I/O #02	Auxiliary Input/Output 2 Circuit - Voltage above normal, or shorted to high source
702	5	4724	Auxiliary I/O #02	Auxiliary Input/Output 2 Circuit - Current below normal or open circuit
702	6	4725	Auxiliary I/O #02	Auxiliary Input/Output 2 Circuit - Current above normal or grounded circuit
703	3	529	Auxiliary I/O #03	Auxiliary Input/Output 3 Circuit - Voltage above normal, or shorted to high source

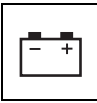


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
723	2	778	Engine Speed 2	Engine Camshaft Speed / Position Sensor - Data erratic, intermittent or incorrect
723	2	2322	Engine Speed 2	Engine Camshaft Speed / Position Sensor - Data erratic, intermittent or incorrect
723	7	731	Engine Speed 2	Engine Speed / Position Camshaft and Crankshaft Misalignment - Mechanical system not responding or out of adjustment
729	3	2555	Engine Intake Air Heater Driver #1	Engine Intake Air Heater 1 Circuit - Voltage above normal, or shorted to high source
729	3	6556	Engine Intake Air Heater Driver #1	Engine Intake Air Heater 1 Circuit - Voltage above normal, or shorted to high source
729	4	2556	Engine Intake Air Heater Driver #1	Engine Intake Air Heater 1 Circuit - Voltage below normal, or shorted to low source
729	4	6557	Engine Intake Air Heater Driver #1	Engine Intake Air Heater 1 Circuit - Voltage below normal, or shorted to low source
748	9	3641	Transmission Output Retarder	Transmission Output Retarder - Abnormal update rate
862	3	3733	Crankcase breather Heater Circuit	Crankcase Breather Filter Heater Circuit - Voltage above normal, or shorted to high source
862	3	6336	Crankcase breather Heater Circuit	Crankcase Breather Filter Heater Circuit - Voltage above normal, or shorted to high source
862	4	3734	Crankcase breather Heater Circuit	Crankcase Breather Filter Heater Circuit - Voltage below normal, or shorted to low source
862	4	6337	Crankcase breather Heater Circuit	Crankcase Breather Filter Heater Circuit - Voltage below normal, or shorted to low source
974	3	133	Remote Accelerator Pedal Position	Remote Accelerator Pedal or Lever Position Sensor 1 Circuit - Voltage above normal, or shorted to high source
974	4	134	Remote Accelerator Pedal Position	Remote Accelerator Pedal or Lever Position Sensor 1 Circuit - Voltage below normal, or shorted to low source
974	19	288	Remote Accelerator Pedal Position	SAE J1939 Multiplexing Remote Accelerator Pedal or Lever Position Sensor System - Received Network Data In Error
976	2	6563	PTO Governor State	Auxiliary Intermediate (PTO) Speed Switch Validation - Data erratic, intermittent or incorrect

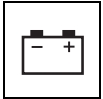


SPN	FMI	Fault Code	SPN Description	Description
1072	3	2182	Engine (Compression) Brake Output #1	Engine Brake Actuator Driver 1 Circuit - Voltage above normal, or shorted to high source
1072	3	6418	Engine (Compression) Brake Output #1	Engine Brake Actuator Driver 1 Circuit - Voltage above normal, or shorted to high source
1072	4	2183	Engine (Compression) Brake Output #1	Engine Brake Actuator Driver 1 Circuit - Voltage below normal, or shorted to low source
1072	4	6419	Engine (Compression) Brake Output #1	Engine Brake Actuator Driver 1 Circuit - Voltage below normal, or shorted to low source
1073	3	2367	Engine (Compression) Brake Output #2	Engine Brake Actuator Driver Output 2 Circuit - Voltage above normal, or shorted to high source
1073	3	6421	Engine (Compression) Brake Output #2	Engine Brake Actuator Driver Output 2 Circuit - Voltage above normal, or shorted to high source
1073	4	2363	Engine (Compression) Brake Output #2	Engine Brake Actuator Driver Output 2 Circuit - Voltage below normal, or shorted to low source
1073	4	6422	Engine (Compression) Brake Output #2	Engine Brake Actuator Driver Output 2 Circuit - Voltage below normal, or shorted to low source
1075	3	2265	Engine Electric Lift Pump for Engine Fuel Supply	Electric Lift Pump for Engine Fuel Supply Circuit - Voltage above normal, or shorted to high source
1075	3	6258	Engine Electric Lift Pump for Engine Fuel Supply	Electric Lift Pump for Engine Fuel Supply Circuit - Voltage above normal, or shorted to high source
1075	4	2266	Engine Electric Lift Pump for Engine Fuel Supply	Electric Lift Pump for Engine Fuel Supply Circuit - Voltage below normal, or shorted to low source
1075	4	6259	Engine Electric Lift Pump for Engine Fuel Supply	Electric Lift Pump for Engine Fuel Supply Circuit - Voltage below normal, or shorted to low source
1081	7	3494	Engine Wait to Start Lamp	Engine Wait to Start Lamp - Mechanical system not responding or out of adjustment
1081	9	3555	Engine Wait to Start Lamp	Engine Wait to Start Lamp - Abnormal update rate
1081	19	3556	Engine Wait to Start Lamp	Engine Wait to Start Lamp - Received Network Data In Error
1081	31	4252	Engine Wait to Start Lamp	Engine Wait to Start Lamp - Condition Exists
1109	0	3931	Engine Protection System Approaching Shutdown	Engine Protection System Approaching Shutdown - Data valid but above normal operational range - Most



Electrical System

SPN	FMI	Fault Code	SPN Description	Description
1112	3	2368	Engine (Compression) Brake Output #3	Engine Brake Actuator Driver 3 Circuit - Voltage above normal, or shorted to high source
1112	4	2365	Engine (Compression) Brake Output #3	Engine Brake Actuator Driver Output 3 Circuit - Voltage below normal, or shorted to low source
1127	7	3683	Engine Turbocharger 1 Boost Pressure	Engine Turbocharger 1 Boost Pressure - Mechanical system not responding or out of adjustment
1136	2	699	Engine ECU Temperature	Engine ECU Temperature - Data erratic, intermittent or incorrect
1136	3	697	Engine ECU Temperature	Engine ECU Temperature Sensor Circuit - Voltage above normal, or shorted to high source
1136	4	698	Engine ECU Temperature	Engine ECU Temperature Sensor Circuit - Voltage below normal, or shorted to low source
1172	2	693	Engine Turbocharger 1 Compressor Intake Temperature	Turbocharger 1 Compressor Intake Temperature - Data erratic, intermittent or incorrect
1172	3	691	Engine Turbocharger 1 Compressor Intake Temperature	Turbocharger 1 Compressor Intake Temperature Circuit - Voltage above normal, or shorted to high source
1172	4	692	Engine Turbocharger 1 Compressor Intake Temperature	Turbocharger 1 Compressor Intake Temperature Circuit - Voltage below normal, or shorted to low source
1172	9	3369	Engine Turbocharger 1 Compressor Intake Temperature	Turbocharger 1 Compressor Intake Temperature Sensor - Abnormal update rate
1172	19	3371	Engine Turbocharger 1 Compressor Intake Temperature	Turbocharger 1 Compressor Intake Temperature Sensor - Received Network Data In Error
1176	1	3348	Engine Turbocharger 1 Compressor Intake Pressure	Turbocharger 1 Compressor Intake Pressure - Data valid but below normal operational range - Most Severe Level
1176	2	743	Engine Turbocharger 1 Compressor Intake Pressure	Turbocharger 1 Compressor Intake Pressure - Data erratic, intermittent or incorrect
1176	3	741	Engine Turbocharger 1 Compressor Intake Pressure	Turbocharger 1 Compressor Intake Pressure Circuit - Voltage above normal, or shorted to high source
1176	4	742	Engine Turbocharger 1 Compressor Intake Pressure	Turbocharger 1 Compressor Intake Pressure Circuit - Voltage below normal, or shorted to low source
1176	9	3372	Engine Turbocharger 1 Compressor Intake Pressure	Turbocharger 1 Compressor Intake Pressure - Abnormal update rate

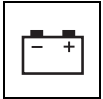


SPN	FMI	Fault Code	SPN Description	Description
1176	18	629	Engine Turbocharger 1 Compressor Intake Pressure	Turbocharger 1 Compressor Intake Pressure - Data Valid But Below Normal Operating Range - Moderately
1176	19	3373	Engine Turbocharger 1 Compressor Intake Pressure	Turbocharger 1 Compressor Intake Pressure - Received Network Data In Error
1194	13	3298	Anti-theft Encryption Seed Present Indicator	Anti-theft Encryption Seed - Out of Calibration
1195	2	269	Anti-theft Password Valid Indicator	Antitheft Password Valid Indicator - Data erratic, intermittent or incorrect
1209	2	2554	Engine Exhaust Gas Pressure 1	Exhaust Gas Pressure 1 - Data erratic, intermittent or incorrect
1209	3	2373	Engine Exhaust Gas Pressure 1	Exhaust Gas Pressure Sensor 1 Circuit - Voltage above normal, or shorted to high source
1209	4	2374	Engine Exhaust Gas Pressure 1	Exhaust Gas Pressure Sensor 1 Circuit - Voltage below normal, or shorted to low source
1209	16	2764	Engine Exhaust Gas Pressure 1	Exhaust Gas Pressure 1 - Data Valid But Above Normal Operating Range - Moderately Severe Level
1213	9	3535	Malfunction Indicator Lamp	Malfunction Indicator Lamp - Abnormal update rate
1231	2	3329	J1939 Network #2	J1939 Network #2 - Data erratic, intermittent or incorrect
1235	2	3331	J1939 Network #3	J1939 Network #3 - Data erratic, intermittent or incorrect
1239	16	4726	Engine Fuel Leakage 1	Engine Fuel Leakage - Data Valid But Above Normal Operating Range - Moderately Severe Level
1267	3	338	Idle Shutdown Vehicle Accessories Relay Driver Circuit	Idle Shutdown Vehicle Accessories Relay Driver Circuit - Voltage above normal, or shorted to high source
1267	4	339	Idle Shutdown Vehicle Accessories Relay Driver Circuit	Idle Shutdown Vehicle Accessories Relay Driver Circuit - Voltage below normal, or shorted to low source
1322	31	1718	Engine Misfire for Multiple Cylinders	Engine Misfire for Multiple Cylinders - Condition Exists
1323	31	1654	Engine Misfire Cylinder #1	Engine Misfire Cylinder 1 - Condition Exists
1324	31	1655	Engine Misfire Cylinder #2	Engine Misfire Cylinder 2 - Condition Exists

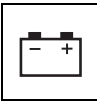


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
1325	31	1656	Engine Misfire Cylinder #3	Engine Misfire Cylinder 3 - Condition Exists
1326	31	1657	Engine Misfire Cylinder #4	Engine Misfire Cylinder 4 - Condition Exists
1327	31	1658	Engine Misfire Cylinder #5	Engine Misfire Cylinder 5 - Condition Exists
1328	31	1659	Engine Misfire Cylinder #6	Engine Misfire Cylinder 6 - Condition Exists
1347	3	272	Engine Fuel Pump Pressurizing Assembly #2	Engine Fuel Pump Pressurizing Assembly 1 Circuit - Voltage above normal, or shorted to high source
1347	4	271	Engine Fuel Pump Pressurizing Assembly #1	Engine Fuel Pump Pressurizing Assembly 1 Circuit - Voltage below normal, or shorted to low source
1347	7	281	Engine Fuel Pump Pressurizing Assembly #3	Engine Fuel Pump Pressurizing Assembly 1 - Mechanical system not responding or out of adjustment
1349	3	483	Engine Injector Metering Rail 2 Pressure	Injector Metering Rail 2 Pressure Sensor Circuit - Voltage above normal, or shorted to high source
1349	4	484	Engine Injector Metering Rail 2 Pressure	Injector Metering Rail 2 Pressure Sensor Circuit - Voltage below normal, or shorted to low source
1377	2	497	Engine Synchronization Switch	Multiple Unit Synchronization Switch - Data erratic, intermittent or incorrect
1378	31	649	Engine Oil Change Interval	Engine Oil Change Interval - Condition Exists
1383	31	611	Engine was Shut Down Hot	Engine Shut Down Hot - Condition Exists
1387	3	1539	Auxiliary Pressure #1	Auxiliary Pressure Sensor Input 1 Circuit - Voltage above normal, or shorted to high source
1387	4	1621	Auxiliary Pressure #1	Auxiliary Pressure Sensor Input 1 Circuit - Voltage below normal, or shorted to low source
1388	3	297	Auxiliary Pressure #2	Auxiliary Pressure Sensor Input 2 Circuit - Voltage above normal, or shorted to high source
1388	4	298	Auxiliary Pressure #2	Auxiliary Pressure Sensor Input 2 Circuit - Voltage below normal, or shorted to low source
1388	14	296	Auxiliary Pressure #2	Auxiliary Pressure Sensor Input 2 - Special Instructions

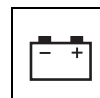


SPN	FMI	Fault Code	SPN Description	Description
1388	14	6584	Auxiliary Pressure #2	Auxiliary Pressure Sensor Input 2 - Special Instructions
1563	2	1256	Incompatible Monitor/Controller	Control Module Identification Input State Error - Data erratic, intermittent or incorrect
1563	2	1257	Incompatible Monitor/Controller	Control Module Identification Input State Error - Data erratic, intermittent or incorrect
1569	31	3714	Engine Protection Torque Derate	Engine Protection Torque Derate - Condition Exists
1590	2	784	Adaptive Cruise Control Mode	Adaptive Cruise Control Mode - Data erratic, intermittent or incorrect
1623	9	3186	Tachograph output shaft speed	Tachograph Output Shaft Speed - Abnormal update rate
1623	13	5248	Tachograph Output Shaft Speed	Tachograph Output Shaft Speed - Out of Calibration
1623	19	3213	Tachograph output shaft speed	Tachograph Output Shaft Speed - Received Network Data In Error
1632	14	2998	Engine Torque Limit Feature	Engine Torque Limit Feature - Special Instructions
1632	31	5193	Engine Torque Limit Feature	Engine Torque Limit Feature - Condition Exists
1639	0	4789	Fan Speed	Fan Speed - Data Valid but Above Normal Operational Range - Most Severe Level
1639	1	4791	Fan Speed	Fan Speed - Data Valid but Below Normal Operational Range - Most Severe Level
1639	2	6469	Fan Speed	Fan Speed - Data Erratic, Intermittent, or Incorrect
1639	15	6467	Fan Speed	Fan Speed - Data Valid but Above Normal Operational Range - Most Severe Level
1639	17	6468	Fan Speed	Fan Speed - Data Valid but Below Normal Operational Range - Most Severe Level
1668	2	4437	J1939 Network #4 - Data erratic	J1939 Network #4 - Data erratic, intermittent or incorrect
1675	31	3737	Engine Starter Mode	Engine Starter Mode Overcrank Protection - Condition Exists

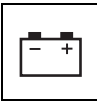


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
1761	1	1673	Aftertreatment 1 Diesel Exhaust Fluid Tank Level	Aftertreatment 1 Diesel Exhaust Fluid Tank Level - Data valid but below normal operational range -Most Severe Level
1761	2	1699	Aftertreatment 1 Diesel Exhaust Fluid Tank Level	Aftertreatment 1 Diesel Exhaust Fluid Tank Level Sensor - Data erratic, intermittent or incorrect
1761	3	1669	Aftertreatment 1 Diesel Exhaust Fluid Tank Level	Aftertreatment 1 Diesel Exhaust Fluid Tank Level Sensor Circuit - Voltage above normal, or shorted to high source
1761	4	1668	Aftertreatment 1 Diesel Exhaust Fluid Tank Level	Aftertreatment 1 Diesel Exhaust Fluid Tank Level Sensor Circuit - Voltage below normal, or shorted to low source
1761	5	4679	Aftertreatment 1 Diesel Exhaust Fluid Tank Level	Aftertreatment 1 Diesel Exhaust Fluid Tank Level Sensor Circuit - Current below normal or open circuit
1761	6	4738	Aftertreatment 1 Diesel Exhaust Fluid Tank Level	Aftertreatment 1 Diesel Exhaust Fluid Tank Level Sensor Circuit - Current above normal or grounded circuit
1761	9	4677	Aftertreatment 1 Diesel Exhaust Fluid Tank Level	SAE J1939 Multiplexing PGN Timeout Error - Abnormal update rate
1761	10	4769	Aftertreatment 1 Diesel Exhaust Fluid Tank Level	Aftertreatment 1 Diesel Exhaust Fluid Tank Level Sensor - Abnormal Rate of Change
1761	11	4739	Aftertreatment 1 Diesel Exhaust Fluid Tank Level	Aftertreatment 1 Diesel Exhaust Fluid Tank Level Sensor - Root Cause Not Known
1761	11	6562	Aftertreatment 1 Diesel Exhaust Fluid Tank Level	Aftertreatment 1 Diesel Exhaust Fluid Tank Level Sensor - Root Cause Not Known
1761	13	4732	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature	Aftertreatment 1 Diesel Exhaust Fluid Tank Level Sensor - Out of Calibration
1761	13	6526	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature	Aftertreatment 1 Diesel Exhaust Fluid Tank Level Sensor - Out of Calibration
1761	17	3497	Aftertreatment 1 Diesel Exhaust Fluid Tank Level	Aftertreatment 1 Diesel Exhaust Fluid Tank Level - Data Valid But Below Normal Operating Range - Least Severe Level
1761	18	3498	Aftertreatment 1 Diesel Exhaust Fluid Tank Level	Aftertreatment 1 Diesel Exhaust Fluid Tank Level - Data Valid But Below Normal Operating Range - Moderately Severe Level
1800	16	2263	Battery 1 Temperature	Battery Temperature - Data Valid But Above Normal Operating Range - Moderately Severe Level
1800	18	2264	Battery 1 Temperature	Battery Temperature - Data Valid But Below Normal Operating Range - Moderately Severe Level

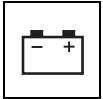


SPN	FMI	Fault Code	SPN Description	Description
1818	31	3374	ROP Brake Control active	Roll Over Protection Brake Control Active - Condition Exists
2006	9	5133	Source Address 6	Source Address 6 - Abnormal Update Rate
2623	3	1239	Accelerator Pedal #1 Channel 2	Accelerator Pedal or Lever Position Sensor 2 Circuit - Voltage above normal, or shorted to high source
2623	4	1241	Accelerator Pedal #1 Channel 2	Accelerator Pedal or Lever Position Sensor 2 Circuit - Voltage below normal, or shorted to low source
2629	15	2347	Engine Turbocharger 1 Compressor Outlet Temperature	Turbocharger Compressor Outlet Temperature (Calculated) - Data Valid But Above Normal Operating Range
2630	2	3478	Engine Charge Air Cooler 1 Outlet Temperature	Engine Charge Air Cooler Outlet Temperature - Data erratic, intermittent or incorrect
2630	3	2571	Engine Charge Air Cooler 1 Outlet Temperature	Engine Charge Air Cooler Outlet Temperature - Voltage above normal, or shorted to high source
2630	4	2572	Engine Charge Air Cooler 1 Outlet Temperature	Engine Charge Air Cooler Outlet Temperature - Voltage below normal, or shorted to low source
2633	7	3616	Engine Variable Geometry Turbocharger (VGT) 1 Nozzle Position	Engine VGT Nozzle Position - Mechanical system not responding or out of adjustment
2634	3	1776	Power Relay	Power Relay Driver Circuit - Voltage above normal, or shorted to high source
2634	4	1777	Power Relay	Power Relay Driver Circuit - Voltage below normal, or shorted to low source
2789	15	2346	Engine Turbocharger 1 Calculated Turbine Intake Temperature	Turbocharger Turbine Intake Temperature - Data Valid But Above Normal Operating Range - Least Severe
2789	16	2451	Engine Turbocharger 1 Calculated Turbine Intake Temperature	Turbocharger Turbine Intake Temperature - Data Valid But Above Normal Operating Range - Moderately Severe Level
2791	5	2349	Engine Exhaust Gas Recirculation 1 (EGR1) Valve Control	EGR Valve Control Circuit - Current below normal or open circuit
2791	6	2353	Engine Exhaust Gas Recirculation 1 (EGR1) Valve Control	EGR Valve Control Circuit - Current above normal or grounded circuit
2791	7	2357	Engine Exhaust Gas Recirculation 1 (EGR1) Valve Control	EGR Valve Control Circuit - Mechanical system not responding or out of adjustment
2791	7	6555	Engine Exhaust Gas Recirculation 1 (EGR1) Valve Control	EGR Valve Control Circuit - Mechanical system not responding or out of adjustment



Electrical System

SPN	FMI	Fault Code	SPN Description	Description
2791	9	1893	Engine Exhaust Gas Recirculation 1 (EGR1) Valve Control	EGR Valve Control Circuit - Abnormal update rate
2791	13	1896	Engine Exhaust Gas Recirculation 1 (EGR1) Valve Control	EGR Valve Controller - Out of Calibration
2791	15	1961	Engine Exhaust Gas Recirculation 1 (EGR1) Valve Control	EGR Valve Control Circuit Over Temperature - Data Valid But Above Normal Operating Range - Least Severe Level
2797	13	2765	Engine Injector Group 1	Engine Injector Bank 1 Barcodes - Out of Calibration
2884	9	3735	Engine Auxiliary Governor Switch	Engine Auxiliary Governor Switch - Abnormal update rate
2978	9	3838	Estimated Engine Parasitic Losses - Percent Torque	Estimated Engine Parasitic Losses - Percent Torque - Abnormal update rate
3031	2	1679	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature - Data erratic, intermittent or incorrect
3031	3	1678	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature Sensor - Voltage above normal, or shorted to high source
3031	4	1677	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature Sensor - Voltage below normal, or shorted to low source
3031	4	6559	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature Sensor - Voltage below normal, or shorted to low source
3031	5	4682	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature Sensor Circuit - Current below normal or open circuit
3031	6	4736	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature Sensor Circuit - Current above normal or grounded circuit
3031	9	4572	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature - Abnormal Update Rate
3031	11	4737	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature - Root Cause Not Known
3031	13	4731	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature	Aftertreatment 1 Diesel Exhaust Fluid Tank Temperature Sensor - Out of Calibration
3060	18	3243	Engine Cooling System Monitor	Engine Cooling System Monitor - Data Valid But Below Normal Operating Range - Moderately Severe Level

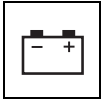


SPN	FMI	Fault Code	SPN Description	Description
3216	2	3228	Aftertreatment 1 Intake NOx	Aftertreatment 1 Intake NOx Sensor - Data erratic, intermittent or incorrect
3216	4	1885	Aftertreatment 1 Intake NOx	Aftertreatment 1 Intake NOx Sensor Circuit - Voltage below normal, or shorted to low source
3216	9	3232	Aftertreatment 1 Intake NOx	Aftertreatment 1 Intake NOx Sensor - Abnormal update rate
3216	10	3725	Aftertreatment 1 Intake NOx	Aftertreatment 1 Intake NOx Sensor - Abnormal rate of change
3216	10	6621	Aftertreatment 1 Intake NOx	Aftertreatment 1 Intake NOx Sensor - Abnormal rate of change
3216	13	3718	Aftertreatment 1 Intake NOx	Aftertreatment 1 Intake NOx - Out of Calibration
3216	16	3726	Aftertreatment 1 Intake NOx	Aftertreatment 1 Intake NOx - Data Valid But Above Normal Operating Range - Moderately Severe Level
3216	20	3748	Aftertreatment 1 Intake NOx	Aftertreatment 1 Intake NOx Sensor - Data not Rational - Drifted High
3216	20	6458	Aftertreatment 1 Intake NOx	Aftertreatment 1 Intake NOx Sensor - Data not Rational - Drifted High
3216	21	6459	Aftertreatment 1 Intake NOx	Aftertreatment 1 Intake NOx Sensor - Data not Rational - Drifted High
3217	2	1861	Aftertreatment 1 Intake O2	Aftertreatment Intake Oxygen Sensor - Data erratic, intermittent or incorrect
3218	2	3682	Aftertreatment 1 Intake Gas Sensor Power Status	Aftertreatment 1 Intake NOx Sensor Power Supply - Data erratic, intermittent or incorrect
3226	2	1694	Aftertreatment 1 Outlet NOx	Aftertreatment 1 Outlet NOx Sensor - Data erratic, intermittent or incorrect
3226	2	6464	Aftertreatment 1 Outlet NOx	Aftertreatment 1 Outlet NOx Sensor - Data not Rational - Drifted High
3226	4	1887	Aftertreatment 1 Outlet NOx	Aftertreatment 1 Outlet NOx Sensor Circuit - Voltage below normal, or shorted to low source
3226	4	6521	Aftertreatment Outlet NOx Sensor Circuits	Aftertreatment Outlet NOx Sensor Circuit- Voltage below normal or shorted to low source
3226	9	2771	Aftertreatment 1 Outlet NOx	Aftertreatment 1 Outlet NOx Sensor - Abnormal update rate



Electrical System

SPN	FMI	Fault Code	SPN Description	Description
3226	10	3545	Aftertreatment 1 Outlet NOx	Aftertreatment 1 Outlet NOx Sensor - Abnormal rate of change
3226	10	6565	Aftertreatment 1 Outlet NOx	Aftertreatment 1 Outlet NOx Sensor - Abnormal rate of change
3226	13	3717	Aftertreatment 1 Outlet NOx	Aftertreatment 1 Outlet NOx Sensor - Out of Calibration
3226	20	3749	Aftertreatment 1 Outlet NOx	Aftertreatment 1 Outlet NOx Sensor - Data not Rational - Drifted High
3226	20	6462	Aftertreatment 1 Outlet NOx	Aftertreatment 1 Outlet NOx Sensor - Data not Rational - Drifted High
3226	21	6463	Aftertreatment 1 Outlet NOx	Aftertreatment 1 Outlet NOx Sensor - Data not Rational - Drifted High
3227	9	2683	Aftertreatment 1 Outlet O2	Aftertreatment Outlet Oxygen Sensor Circuit - Abnormal update rate
3228	2	3681	Aftertreatment 1 Outlet Gas Sensor Power Status	Aftertreatment 1 Outlet NOx Sensor Power Supply - Data erratic, intermittent or incorrect
3228	2	6582	Aftertreatment 1 Outlet Gas Sensor Power Status	Aftertreatment 1 Outlet NOx Sensor Power Supply - Data erratic, intermittent or incorrect
3242	0	3311	Aftertreatment 1 Diesel Particulate Filter Intake Gas Temperature	Aftertreatment 1 Diesel Particulate Filter Intake Temperature - Data valid but above normal operation
3242	2	3318	Aftertreatment 1 Diesel Particulate Filter Intake Gas Temperature	Aftertreatment 1 Diesel Particulate Filter Intake Temperature - Data erratic, intermittent or incorrect
3242	3	3317	Aftertreatment 1 Diesel Particulate Filter Intake Gas Temperature	Aftertreatment 1 Diesel Particulate Filter Intake Temperature Sensor Circuit - Voltage above normal, or shorted to high source
3242	4	3316	Aftertreatment 1 Diesel Particulate Filter Intake Gas Temperature	Aftertreatment 1 Diesel Particulate Filter Intake Temperature Sensor Circuit - Voltage below normal, or shorted to low source
3242	15	3254	Aftertreatment 1 Diesel Particulate Filter Intake Gas Temperature	Aftertreatment 1 Diesel Particulate Filter Intake Temperature - Data Valid But Above Normal Operating Range
3242	16	3253	Aftertreatment 1 Diesel Particulate Filter Intake Gas Temperature	Aftertreatment 1 Diesel Particulate Filter Intake Temperature - Data Valid But Above Normal Operating Range
3246	0	3312	Aftertreatment 1 Diesel Particulate Filter Outlet Gas Temperature	Aftertreatment 1 Diesel Particulate Filter Outlet Temperature - Data valid but above normal operation

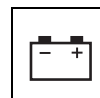


SPN	FMI	Fault Code	SPN Description	Description
3246	2	3322	Aftertreatment 1 Diesel Particulate Filter Outlet Gas Temperature	Aftertreatment 1 Diesel Particulate Filter Outlet Temperature - Data erratic, intermittent or incorrect
3246	3	3319	Aftertreatment 1 Diesel Particulate Filter Outlet Gas Temperature	Aftertreatment 1 Diesel Particulate Filter Outlet Temperature Sensor Circuit - Voltage above normal, or shorted to high source
3246	4	3321	Aftertreatment 1 Diesel Particulate Filter Outlet Gas Temperature	Aftertreatment 1 Diesel Particulate Filter Outlet Temperature Sensor Circuit - Voltage below normal, or shorted to low source
3246	15	3256	Aftertreatment 1 Diesel Particulate Filter Outlet Gas Temperature	Aftertreatment 1 Diesel Particulate Filter Outlet Temperature - Data Valid But Above Normal Operating Range
3246	16	3255	Aftertreatment 1 Diesel Particulate Filter Outlet Gas Temperature	Aftertreatment 1 Diesel Particulate Filter Outlet Temperature - Data Valid But Above Normal Operating Range
3249	17	2742	Aftertreatment 1 Exhaust Gas Temperature 2	Aftertreatment Exhaust Gas Temperature 2 - Data Valid But Below Normal Operating Range - Least Severe Level
3249	18	2743	Aftertreatment 1 Exhaust Gas Temperature 2	Aftertreatment Exhaust Gas Temperature 2 - Data Valid But Below Normal Operating Range - Moderately Severe Level
3251	0	1922	Aftertreatment 1 Diesel Particulate Filter Differential Pressure	Aftertreatment Diesel Particulate Filter Differential Pressure - Data valid but above normal Operating Range
3251	2	1883	Aftertreatment 1 Diesel Particulate Filter Differential Pressure	Aftertreatment Diesel Particulate Filter Differential Pressure Sensor - Data erratic, intermittent or incorrect
3251	3	1879	Aftertreatment 1 Diesel Particulate Filter Differential Pressure	Aftertreatment Diesel Particulate Filter Differential Pressure Sensor Circuit - Voltage above normal
3251	4	1881	Aftertreatment 1 Diesel Particulate Filter Differential Pressure	Aftertreatment Diesel Particulate Filter Differential Pressure Sensor Circuit - Voltage below normal
3251	15	2639	Aftertreatment 1 Diesel Particulate Filter Differential Pressure	Aftertreatment Diesel Particulate Filter Differential Pressure - Data valid but above normal Operating Range
3251	16	1921	Aftertreatment 1 Diesel Particulate Filter Differential Pressure	Aftertreatment Diesel Particulate Filter Differential Pressure - Data Valid But Above Normal Operating Range
3255	9	4145	Aftertreatment 2 Intake NOx	Aftertreatment 2 Intake NOx Sensor - Abnormal update rate
3265	9	3988	Aftertreatment 2 Outlet NOx	Aftertreatment 2 Outlet NOx - Abnormal Update Rate
3353	3	4953	Alternator 1 Status	Alternator 1 Status - Voltage Above Normal, or Shorted to High Source

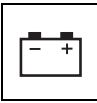


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
3353	4	4954	Alternator 1 Status	Alternator 1 Status - Voltage Below Normal, or Shorted to Low Source
3361	2	2976	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Temperature - Data erratic, intermittent or incorrect
3361	3	3558	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit - Voltage above normal, or shorted to high source
3361	4	3559	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit - Voltage below normal, or shorted to low source
3362	31	1682	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Input Lines	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Input Lines - Condition Exists
3363	3	1683	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Heater	Aftertreatment 1 Diesel Exhaust Fluid Tank Heater - Voltage above normal, or shorted to high source
3363	3	6479	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Heater	Aftertreatment 1 Diesel Exhaust Fluid Tank Heater - Voltage above normal, or shorted to high source
3363	4	1684	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Heater	Aftertreatment 1 Diesel Exhaust Fluid Tank Heater - Voltage below normal, or shorted to low source
3363	4	6481	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Heater	Aftertreatment 1 Diesel Exhaust Fluid Tank Heater - Voltage below normal, or shorted to low source
3363	7	3242	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Heater	Aftertreatment 1 Diesel Exhaust Fluid Tank Heater - Mechanical system not responding or out of adjustment
3363	7	6475	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Heater	Aftertreatment 1 Diesel Exhaust Fluid Tank Heater - Mechanical system not responding or out of adjustment
3363	16	1713	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Heater	Aftertreatment 1 Diesel Exhaust Fluid Tank Heater - Data Valid But Above Normal Operating Range - Moderately Severe Level
3363	18	1712	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Heater	Aftertreatment 1 Diesel Exhaust Fluid Tank Heater - Data Valid But Below Normal Operating Range - Moderately Severe Level
3363	18	6476	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Heater	Aftertreatment 1 Diesel Exhaust Fluid Tank Heater - Data Valid But Below Normal Operating Range - Moderately Severe Level
3364	1	3866	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Quality	Aftertreatment Diesel Exhaust Fluid Quality - Data valid but below normal operational range - Most Severe Level
3364	2	3878	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Quality	Aftertreatment Diesel Exhaust Fluid Quality - Data erratic, intermittent or incorrect

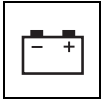


SPN	FMI	Fault Code	SPN Description	Description
3364	3	1686	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Quality	Aftertreatment Diesel Exhaust Fluid Quality Sensor Circuit - Voltage above normal, or shorted to high source
3364	4	1685	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Quality	Aftertreatment Diesel Exhaust Fluid Quality Sensor Circuit - Voltage below normal, or shorted to low source
3364	5	4741	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Quality	Aftertreatment Diesel Exhaust Fluid Quality Sensor Circuit - Current below normal or open circuit
3364	6	4742	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Quality	Aftertreatment Diesel Exhaust Fluid Quality Sensor Circuit - Current above normal or grounded circuit
3364	7	3876	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Quality	Aftertreatment Diesel Exhaust Fluid Quality Sensor - Mechanical system not responding or out of adjustment
3364	9	3868	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Quality	Aftertreatment Diesel Exhaust Fluid Quality - Abnormal update rate
3364	10	4277	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Quality	Aftertreatment Diesel Exhaust Fluid Quality - Abnormal Rate of Change
3364	11	1715	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Quality	Aftertreatment Diesel Exhaust Fluid Quality - Root Cause Not Known
3364	12	3877	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Quality	Aftertreatment Diesel Exhaust Fluid Quality Sensor - Bad intelligent device or component
3364	13	1714	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Quality	Aftertreatment Diesel Exhaust Fluid Quality - Out of Calibration
3364	15	4842	Aftertreatment Diesel Exhaust Fluid Quality	Aftertreatment Diesel Exhaust Fluid Quality - Data Valid But Above Normal Operating Range - Least Severe Level
3364	18	3867	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Quality	Aftertreatment Diesel Exhaust Fluid Quality - Data Valid But Below Normal Operating Range - Moderate Severe Level
3364	18	6752	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Quality	Aftertreatment Diesel Exhaust Fluid Quality - Data Valid But Below Normal Operating Range - Moderate Severe Level
3364	19	4241	Aftertreatment 1 Diesel Exhaust Fluid Tank 1 Quality	Aftertreatment Diesel Exhaust Fluid Quality - Received Network Data In Error
3464	3	6493	Electronic Throttle Control Actuator Driver Circuit	Electronic Throttle Control Actuator Driver Circuit- Voltage above normal, or shorted to high source
3464	4	6494	Electronic Throttle Control Actuator Driver Circuit	Electronic Throttle Control Actuator Driver Circuit- Voltage above normal, or shorted to low source



Electrical System

SPN	FMI	Fault Code	SPN Description	Description
3464	5	6496	Electronic Throttle Control Actuator Driver Circuit	Electronic Throttle Control Actuator Driver Circuit- Voltage above normal, or shorted to high source
3480	2	1926	Aftertreatment Fuel Pressure	Aftertreatment Fuel Pressure Sensor - Data erratic, intermittent or incorrect
3480	3	1927	Aftertreatment Fuel Pressure	Aftertreatment Fuel Pressure Sensor Circuit - Voltage above normal, or shorted to high source
3480	4	1928	Aftertreatment Fuel Pressure	Aftertreatment Fuel Pressure Sensor Circuit - Voltage below normal, or shorted to low source
3480	17	2881	Aftertreatment Fuel Pressure	Aftertreatment Fuel Pressure Sensor - Data Valid But Below Normal Operating Range - Least Severe Level
3481	16	2778	Aftertreatment 1 Fuel Rate	Aftertreatment Fuel Rate - Data Valid But Above Normal Operating Range - Moderately Severe Level
3482	2	1925	Aftertreatment 1 Fuel Enable Actuator	Aftertreatment Fuel Shutoff Valve - Data erratic, intermittent or incorrect
3482	3	1923	Aftertreatment 1 Fuel Enable Actuator	Aftertreatment Fuel Shutoff Valve Circuit - Voltage above normal, or shorted to high source
3482	4	1924	Aftertreatment 1 Fuel Enable Actuator	Aftertreatment Fuel Shutoff Valve Circuit - Voltage below normal, or shorted to low source
3482	7	1963	Aftertreatment 1 Fuel Enable Actuator	Aftertreatment Fuel Shutoff Valve - Mechanical system not responding or out of adjustment
3482	13	2741	Aftertreatment 1 Fuel Enable Actuator	Aftertreatment Fuel Shutoff Valve Swapped - Out of Calibration
3482	16	4568	Aftertreatment 1 Fuel Enable Actuator	Aftertreatment Fuel Shutoff Valve - Data Valid But Above Normal Operating Range - Moderately Severe
3490	3	3224	Aftertreatment 1 Purge Air Actuator	Aftertreatment Purge Air Actuator Circuit - Voltage above normal, or shorted to high source
3490	4	3223	Aftertreatment 1 Purge Air Actuator	Aftertreatment Purge Air Actuator Circuit - Voltage below normal, or shorted to low source
3490	7	3225	Aftertreatment 1 Purge Air Actuator	Aftertreatment Purge Air Actuator - Mechanical system not responding or out of adjustment
3509	3	386	Sensor supply voltage 1	Sensor Supply 1 Circuit - Voltage above normal, or shorted to high source
3509	4	352	Sensor supply voltage 1	Sensor Supply 1 Circuit - Voltage below normal, or shorted to low source

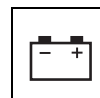


SPN	FMI	Fault Code	SPN Description	Description
3510	3	227	Sensor supply voltage 2	Sensor Supply 2 Circuit - Voltage above normal, or shorted to high source
3510	4	187	Sensor supply voltage 2	Sensor Supply 2 Circuit - Voltage below normal, or shorted to low source
3511	3	239	Sensor supply voltage 3	Sensor Supply 3 Circuit - Voltage above normal, or shorted to high source
3511	4	238	Sensor supply voltage 3	Sensor Supply 3 Circuit - Voltage below normal, or shorted to low source
3512	3	2185	Sensor supply voltage 4	Sensor Supply 4 Circuit - Voltage above normal, or shorted to high source
3512	4	2186	Sensor supply voltage 4	Sensor Supply 4 Circuit - Voltage below normal, or shorted to low source
3513	3	1695	Sensor supply voltage 5	Sensor Supply 5 - Voltage above normal, or shorted to high source
3513	4	1696	Sensor supply voltage 5	Sensor Supply 5 - Voltage below normal, or shorted to low source
3514	3	515	Sensor supply voltage 6	Sensor Supply 6 Circuit - Voltage above normal, or shorted to high source
3514	4	516	Sensor supply voltage 6	Sensor Supply 6 Circuit - Voltage below normal, or shorted to low source
3515	2	4242	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2 - Data erratic, intermittent or incorrect
3515	3	4233	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2 Sensor Circuit - Voltage above normal, or shorted to high source
3515	4	4234	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2 Sensor Circuit - Voltage below normal, or shorted to low source
3515	5	4743	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2 Sensor Circuit - Current below normal or open circuit
3515	6	4744	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2 Sensor Circuit - Current above normal or grounded
3515	10	4243	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2 - Abnormal Rate of Change
3515	10	6619	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2 - Abnormal Rate of Change

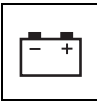


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
3515	11	4745	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2	Aftertreatment 1 Diesel Exhaust Fluid Temperature 2 - Root Cause Not Known
3521	11	4768	Aftertreatment 1 Diesel Exhaust Fluid Property	Aftertreatment 1 Diesel Exhaust Fluid Property - Root Cause Not Known
3521	31	4235	Aftertreatment 1 Diesel Exhaust Fluid Property	Aftertreatment 1 Diesel Exhaust Fluid Property - Condition Exists
3555	17	1943	Ambient Air Density	Ambient Air Density - Data Valid But Below Normal Operating Range - Least Severe Level
3556	2	1932	Aftertreatment Hydrocarbon Doser	Aftertreatment Doser - Data erratic, intermittent or incorrect
3556	5	1977	Aftertreatment Hydrocarbon Doser	Aftertreatment Doser Circuit - Current below normal or open circuit.
3556	7	1964	Aftertreatment Hydrocarbon Doser	Aftertreatment Doser - Mechanical system not responding or out of adjustment
3556	18	3167	Aftertreatment Hydrocarbon Doser	Aftertreatment Doser - Data Valid But Below Normal Operating Range - Moderately Severe Level
3597	2	1117	ECU Power Output Supply Voltage #1	Power Supply Lost With Ignition On - Data erratic, intermittent or incorrect
3597	3	1939	ECU Power Output Supply Voltage #1	ECU Power Output Supply Voltage 1 - Voltage above normal, or shorted to high source
3597	4	1941	ECU Power Output Supply Voltage #1	ECU Power Output Supply Voltage 1 - Voltage below normal, or shorted to low source
3597	12	351	ECU Power Output Supply Voltage #1	Injector Power Supply - Bad intelligent device or component
3597	17	6499	ECU Power Output Supply Voltage #1	ECU Power Output Supply Voltage 1 - Data Valid But Below Normal Operating Range - Moderately Severe Level
3597	18	1938	ECU Power Output Supply Voltage #1	ECU Power Output Supply Voltage 1 - Data Valid But Below Normal Operating Range - Moderately Severe Level
3610	2	3135	Aftertreatment Diesel Particulate Filter Outlet Pressure	Aftertreatment 1 Diesel Particulate Filter Outlet Pressure - Data erratic, intermittent or incorrect
3610	2	6553	Aftertreatment Diesel Particulate Filter Outlet Pressure	Aftertreatment 1 Diesel Particulate Filter Outlet Pressure - Data erratic, intermittent or incorrect

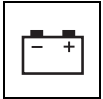


SPN	FMI	Fault Code	SPN Description	Description
3610	3	3133	Aftertreatment Diesel Particulate Filter Outlet Pressure	Aftertreatment 1 Diesel Particulate Filter Outlet Pressure Sensor Circuit - Voltage above normal, or shorted to high source
3610	3	6551	Aftertreatment Diesel Particulate Filter Outlet Pressure	Aftertreatment 1 Diesel Particulate Filter Outlet Pressure Sensor Circuit - Voltage above normal, or shorted to high source
3610	4	3134	Aftertreatment Diesel Particulate Filter Outlet Pressure	Aftertreatment 1 Diesel Particulate Filter Outlet Pressure Sensor Circuit - Voltage below normal, or shorted to low source
3610	4	6552	Aftertreatment Diesel Particulate Filter Outlet Pressure	Aftertreatment 1 Diesel Particulate Filter Outlet Pressure Sensor Circuit - Voltage below normal, or shorted to low source
3667	2	5221	Engine Air Shutoff Status	Engine Air Shutoff Status - Data erratic, intermittent or incorrect
3667	3	3139	Engine Air Shutoff Status	Engine Air Shutoff Circuit - Voltage above normal, or shorted to high source
3667	4	3141	Engine Air Shutoff Status	Engine Air Shutoff Circuit - Voltage below normal, or shorted to low source
3667	7	4484	Engine Air Shutoff	Engine Air Shutoff - Mechanical System Not Responding or Out of Adjustment
3695	2	4213	Aftertreatment Regeneration Inhibit Switch	Aftertreatment Regeneration Inhibit Switch - Data erratic, intermittent or incorrect
3695	2	6568	Aftertreatment Regeneration Inhibit Switch	Aftertreatment Regeneration Inhibit Switch - Data erratic, intermittent or incorrect
3703	31	2777	Diesel Particulate Filter Active Regeneration Inhibited Due to Inhibit Switch	Particulate Trap Active Regeneration Inhibited Due to Inhibit Switch - Condition Exists
3713	31	3753	Diesel Particulate Filter Active Regeneration Inhibited Due to System Timeout	Diesel Particulate Filter Active Regeneration Inhibited Due to System Timeout - Condition Exists
3713	31	6596	Diesel Particulate Filter Active Regeneration Inhibited Due to System Timeout	Diesel Particulate Filter Active Regeneration Inhibited Due to System Timeout - Condition Exists
3750	14	5938	Diesel Particulate Filter 1 Conditions Not Met for Active Regeneration	Diesel Particulate Filter 1 Conditions Not Met for Active Regeneration - Condition Exists
3750	31	3396	Diesel Particulate Filter 1 Conditions Not Met for Active Regeneration	Diesel Particulate Filter 1 Conditions Not Met for Active Regeneration - Condition Exists

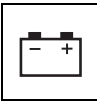


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
3826	18	4573	Aftertreatment 1 Diesel Exhaust Fluid Average Consumption	Aftertreatment 1 Diesel Exhaust Fluid Average Consumption - Data Valid But Below Normal Operating Range
3936	7	3245	Aftertreatment 1 Diesel Particulate Filter System	Aftertreatment 1 Diesel Particulate Filter System - Mechanical system not responding or out of adjustment
3936	7	6265	Aftertreatment 1 Diesel Particulate Filter System	Aftertreatment 1 Diesel Particulate Filter System - Mechanical system not responding or out of adjustment
3936	14	4584	Aftertreatment Diesel Particulate Filter System	Aftertreatment Diesel Particulate Filter System - Special Instructions
3936	15	1981	Aftertreatment Diesel Particulate Filter System	Aftertreatment 1 Diesel Particulate Filter System - Data Valid But Above Normal Operating Range - Level
4094	31	3543	NOx limits exceeded due to Insufficient Diesel Exhaust Fluid Quality	NOx limits exceeded due to Insufficient Reagent Quality - Condition Exists
4096	31	3547	NOx limits exceeded due to Empty Diesel Exhaust Fluid Tank	Aftertreatment Diesel Exhaust Fluid Tank Empty - Condition Exists
4097	3	2732	Aftertreatment 1 Fuel Drain Actuator	Aftertreatment Fuel Drain Valve Circuit - Voltage above normal, or shorted to high source
4097	4	2733	Aftertreatment 1 Fuel Drain Actuator	Aftertreatment Fuel Drain Valve Circuit - Voltage below normal, or shorted to low source
4097	7	2878	Aftertreatment 1 Fuel Drain Actuator	Aftertreatment Fuel Drain Valve - Mechanical system not responding or out of adjustment
4182	4	3695	Generator Output Frequency Adjust Potentiometer Circuit	Generator Output Frequency Adjust Potentiometer Circuit - Voltage below normal, or shorted to low source
4183	4	3696	Drop Adjust Potentiometer Circuit	Drop Adjust Potentiometer Circuit - Voltage below normal, or shorted to low source
4184	4	3694	Gain Adjust Potentiometer Circuit	Gain Adjust Potentiometer Circuit - Voltage below normal, or shorted to low source
4185	31	1427	Overspeed Shutdown Relay Driver	Overspeed Shutdown Relay Driver Diagnostic has detected an error - Condition Exists
4186	31	1428	Low Oil Pressure Shutdown Relay Driver	Low Oil Pressure (LOP) Shutdown Relay Driver Diagnostic has detected an error - Condition Exists

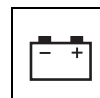


SPN	FMI	Fault Code	SPN Description	Description
4187	31	1429	High Engine Temperature Shutdown Relay Driver	High Engine Temperature (HET) Shutdown Relay Driver Diagnostic has detected an error - Condition Exists
4188	31	1431	Pre-Low Oil Pressure Indicator Relay Driver	Pre-Low Oil Pressure Warning Relay Driver Diagnostic has detected an error - Condition Exists
4223	31	1432	Pre-High Engine Temperature Warning Relay Driver	Pre-High Engine Temperature Warning Relay Driver Diagnostic has detected an error - Condition Exists
4331	18	4658	Aftertreatment 1 Diesel Exhaust Fluid Actual Dosing Quantity	Aftertreatment SCR Actual Dosing Reagent Quantity - Data Valid But Below Normal Operating Range - Mo
4334	2	3596	Aftertreatment 1 Diesel Exhaust Fluid Doser Absolute Pressure	Aftertreatment 1 Diesel Exhaust Fluid Pressure Sensor - Data erratic, intermittent or incorrect
4334	3	3571	Aftertreatment 1 Diesel Exhaust Fluid Doser Absolute Pressure	Aftertreatment 1 Diesel Exhaust Fluid Pressure Sensor - Voltage above normal, or shorted to high source
4334	4	3572	Aftertreatment 1 Diesel Exhaust Fluid Doser Absolute Pressure	Aftertreatment 1 Diesel Exhaust Fluid Pressure Sensor - Voltage below normal, or shorted to low source
4334	16	3575	Aftertreatment 1 Diesel Exhaust Fluid Doser Absolute Pressure	Aftertreatment 1 Diesel Exhaust Fluid Pressure Sensor - Data Valid But Above Normal Operating Range
4334	18	3574	Aftertreatment 1 Diesel Exhaust Fluid Doser Absolute Pressure	Aftertreatment 1 Diesel Exhaust Fluid Pressure Sensor - Data Valid But Below Normal Operating Range
4337	2	4244	Aftertreatment 1 Diesel Exhaust Fluid Dosing Dosing Temperature	Aftertreatment 1 Diesel Exhaust Fluid Dosing Temperature - Data erratic, intermittent or incorrect
4337	3	4174	Aftertreatment 1 Diesel Exhaust Fluid Dosing Temperature Sensor	Aftertreatment 1 Diesel Exhaust Fluid Dosing Temperature Sensor - Voltage Above Normal, or Shorted to High Source
4337	4	4175	Aftertreatment 1 Diesel Exhaust Fluid Dosing Temperature Sensor	Aftertreatment 1 Diesel Exhaust Fluid Dosing Temperature Sensor - Voltage below normal, or shorted to low source
4337	10	4249	Aftertreatment 1 Diesel Exhaust Fluid Dosing Temperature	Aftertreatment 1 Diesel Exhaust Fluid Dosing Temperature - Abnormal Rate of Change
4339	31	4586	Aftertreatment 1 SCR Feedback Control Status	Aftertreatment 1 SCR Feedback Control Status - Condition Exists
4340	3	3237	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 1 State	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 1 Circuit - Voltage above normal, or shorted to high source

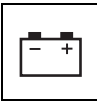


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
4340	3	6531	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 1 State	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 1 Circuit - Voltage above normal, or shorted to high source
4340	4	3238	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 1 State	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 1 Circuit - Voltage below normal, or shorted to low source
4340	4	6532	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 1 State	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 1 Circuit - Voltage below normal, or shorted to low source
4340	5	3258	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 1 State	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 1 Circuit - Current below normal or open circuit
4340	5	6482	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 1 State	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 1 Circuit - Current below normal or open circuit
4342	3	3239	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 2 State	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 2 Circuit - Voltage above normal, or shorted to high source
4342	3	6533	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 2 State	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 2 Circuit - Voltage above normal, or shorted to high source
4342	4	3241	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 2 State	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 2 Circuit - Voltage below normal, or shorted to low source
4342	4	6534	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 2 State	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 2 Circuit - Voltage below normal, or shorted to low source
4342	5	3261	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 2 State	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 2 Circuit - Current below normal or open circuit
4342	5	6483	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 2 State	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 2 Circuit - Current below normal or open circuit
4344	3	3422	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 3 State	Aftertreatment Diesel Exhaust Fluid Line Heater 3 Circuit - Voltage above normal, or shorted to high source
4344	3	6535	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 3 State	Aftertreatment Diesel Exhaust Fluid Line Heater 3 Circuit - Voltage above normal, or shorted to high source
4344	4	3423	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 3 State	Aftertreatment Diesel Exhaust Fluid Line Heater 3 Circuit - Voltage below normal, or shorted to low source
4344	4	6536	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 3 State	Aftertreatment Diesel Exhaust Fluid Line Heater 3 Circuit - Voltage below normal, or shorted to low source

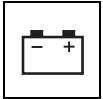


SPN	FMI	Fault Code	SPN Description	Description
4344	5	3425	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 3 State	Aftertreatment Diesel Exhaust Fluid Line Heater 3 Circuit - Current below normal or open circuit
4344	5	6484	Aftertreatment 1 Diesel Exhaust Fluid Line Heater 3 State	Aftertreatment Diesel Exhaust Fluid Line Heater 3 Circuit - Current below normal or open circuit
4360	0	3229	Aftertreatment 1 SCR Catalyst Intake Gas Temperature	Aftertreatment 1 SCR Intake Temperature - Data valid but above normal operational range - Most Severe Level
4360	2	3144	Aftertreatment 1 SCR Catalyst Intake Gas Temperature	Aftertreatment 1 SCR Intake Temperature Sensor - Data erratic, intermittent or incorrect
4360	3	3142	Aftertreatment 1 SCR Catalyst Intake Gas Temperature	Aftertreatment 1 SCR Intake Temperature Sensor Circuit - Voltage above normal, or shorted to high source
4360	4	3143	Aftertreatment 1 SCR Catalyst Intake Gas Temperature	Aftertreatment 1 SCR Intake Temperature Sensor Circuit - Voltage below normal, or shorted to low source
4360	15	3164	Aftertreatment 1 SCR Catalyst Intake Gas Temperature	Aftertreatment 1 SCR Intake Temperature - Data Valid But Above Normal Operating Range - Least Severe
4360	16	3231	Aftertreatment 1 SCR Catalyst Intake Gas Temperature	Aftertreatment 1 SCR Intake Temperature - Data Valid But Above Normal Operating Range - Moderately Severe Level
4360	16	5247	Aftertreatment 1 SCR Intake Temperature	Aftertreatment 1 SCR Intake Temperature - Data Valid But Above Normal Operating Range - Moderately Severe Level
4363	0	3165	Aftertreatment 1 SCR Catalyst Outlet Gas Temperature	Aftertreatment 1 SCR Outlet Temperature - Data valid but above normal operational range - Most Severe
4363	2	3148	Aftertreatment 1 SCR Catalyst Outlet Gas Temperature	Aftertreatment 1 SCR Outlet Temperature Sensor - Data erratic, intermittent or incorrect
4363	3	3146	Aftertreatment 1 SCR Catalyst Outlet Gas Temperature	Aftertreatment 1 SCR Outlet Temperature Sensor Circuit - Voltage above normal, or shorted to high source
4363	3	6569	Aftertreatment 1 SCR Catalyst Outlet Gas Temperature	Aftertreatment 1 SCR Outlet Temperature Sensor Circuit - Voltage above normal, or shorted to high source
4363	4	3147	Aftertreatment 1 SCR Catalyst Outlet Gas Temperature	Aftertreatment 1 SCR Outlet Temperature Sensor Circuit - Voltage below normal, or shorted to low source
4363	4	6571	Aftertreatment 1 SCR Catalyst Outlet Gas Temperature	Aftertreatment 1 SCR Outlet Temperature Sensor Circuit - Voltage below normal, or shorted to low source

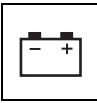


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
4363	16	3235	Aftertreatment 1 SCR Catalyst Outlet Gas Temperature	Aftertreatment 1 SCR Outlet Temperature - Data Valid But Above Normal Operating Range - Moderately Severe Level
4364	17	6517	Aftertreatment 1 SCR Conversion Efficiency	Aftertreatment SCR Catalyst Conversion Efficiency - Data Valid But Below Normal Operating Range - Moderately Severe Level
4364	18	3582	Aftertreatment 1 SCR Conversion Efficiency	Aftertreatment SCR Catalyst Conversion Efficiency - Data Valid But Below Normal Operating Range - Moderately Severe Level
4376	3	3577	Aftertreatment 1 Diesel Exhaust Fluid Return Valve	Aftertreatment Diesel Exhaust Fluid Return Valve - Voltage above normal, or shorted to high source
4376	4	3578	Aftertreatment 1 Diesel Exhaust Fluid Return Valve	Aftertreatment Diesel Exhaust Fluid Return Valve - Voltage below normal, or shorted to low source
4376	7	4157	Aftertreatment 1 Diesel Exhaust Fluid Return Valve	Aftertreatment Diesel Exhaust Fluid Return Valve - Mechanical system not responding or out of adjust
4376	7	6527	Aftertreatment 1 Diesel Exhaust Fluid Return Valve	Aftertreatment Diesel Exhaust Fluid Return Valve - Mechanical system not responding or out of adjust
4490	9	3367	Specific Humidity	Specific Humidity Sensor - Abnormal update rate
4490	19	3368	Specific Humidity	Specific Humidity Sensor - Received Network Data In Error
4765	2	3315	Aftertreatment Diesel Oxidation Catalyst Intake Temperature	Aftertreatment 1 Diesel Oxidation Catalyst Intake Temperature - Data erratic, intermittent or incorrect
4765	2	6539	Aftertreatment Diesel Oxidation Catalyst Intake Temperature	Aftertreatment 1 Diesel Oxidation Catalyst Intake Temperature - Data erratic, intermittent or incorrect
4765	3	3314	Aftertreatment Diesel Oxidation Catalyst Intake Temperature	Aftertreatment 1 Diesel Oxidation Catalyst Intake Temperature Sensor Circuit - Voltage above normal, or shorted to high source
4765	4	3313	Aftertreatment Diesel Oxidation Catalyst Intake Temperature	Aftertreatment 1 Diesel Oxidation Catalyst Intake Temperature Sensor Circuit - Voltage below normal, or shorted to low source
4765	13	3325	Aftertreatment Diesel Oxidation Catalyst Intake Temperature	Aftertreatment 1 Diesel Oxidation Catalyst Intake Temperature Swapped - Out of Calibration
4765	16	3251	Aftertreatment Diesel Oxidation Catalyst Intake Temperature	Aftertreatment 1 Diesel Oxidation Catalyst Intake Temperature - Data Valid But Above Normal Operating Range

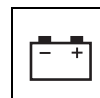


SPN	FMI	Fault Code	SPN Description	Description
4766	0	5387	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature - Data Valid But Above Normal Operating Range - Most Severe Level
4766	2	5386	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature - Data Erratic, Intermittent, or Incorrect
4766	3	4533	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature Sensor Circuit	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature Sensor Circuit - Voltage above normal, or shorted to high source
4766	4	4534	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature Sensor Circuit	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature Sensor Circuit - Voltage below normal, or shorted to low source
4766	15	5389	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature - Data Valid But Above Normal Operating Range - Least Severe Level
4766	16	5388	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature	Aftertreatment 1 Diesel Oxidation Catalyst Outlet Gas Temperature - Data Valid But Above Normal Operating Range - Moderately Severe Level
4792	7	3751	Aftertreatment SCR Catalyst System	Aftertreatment SCR Catalyst System - Mechanical system not responding or out of adjustment
4792	14	4585	Aftertreatment 1 SCR Catalyst System	Aftertreatment 1 SCR Catalyst System - Special Instructions
4793	31	3158	Aftertreatment Warm Up Diesel Oxidation Catalyst	Aftertreatment Warm Up Diesel Oxidation Catalyst Missing - Condition Exists
4794	31	3151	Aftertreatment 1 SCR Catalyst System	Aftertreatment 1 SCR Catalyst System Missing - Condition Exists
4795	31	1993	Aftertreatment 1 Diesel Particulate Filter Missing	Aftertreatment 1 Diesel Particulate Filter Missing - Condition Exists
4796	31	1664	Aftertreatment 1 Diesel Oxidation Catalyst Missing	Aftertreatment 1 Diesel Oxidation Catalyst Missing - Condition Exists
4796	31	6726	Aftertreatment 1 Diesel Oxidation Catalyst Missing	Aftertreatment 1 Diesel Oxidation Catalyst Missing - Condition Exists
4809	2	3154	Aftertreatment Warm Up Diesel Oxidation Catalyst Intake Temperature	Aftertreatment Warm Up Diesel Oxidation Catalyst Intake Temperature - Data erratic, intermittent or incorrect
4809	3	3152	Aftertreatment Warm Up Diesel Oxidation Catalyst Intake Temperature	Aftertreatment Warm Up Diesel Oxidation Catalyst Intake Temperature Sensor Circuit - Voltage above normal

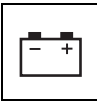


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
4809	4	3153	Aftertreatment Warm Up Diesel Oxidation Catalyst Intake Temperature	Aftertreatment Warm Up Diesel Oxidation Catalyst Intake Temperature Sensor Circuit - Voltage below normal
4809	13	3166	Aftertreatment Warm Up Diesel Oxidation Catalyst Intake Temperature	Aftertreatment Warm Up Diesel Oxidation Catalyst Intake Temperature Sensor Swapped - Out of Calibration
4809	16	3247	Aftertreatment Warm Up Diesel Oxidation Catalyst Intake Temperature	Aftertreatment Warm Up Diesel Oxidation Catalyst Intake Temperature - Data Valid But Above Normal Operating Range
4810	0	3162	Aftertreatment Warm Up Diesel Oxidation Catalyst Outlet Temperature	Aftertreatment Warm Up Diesel Oxidation Catalyst Outlet Temperature - Data valid but above normal operating Range -Most Severe level
4810	2	3157	Aftertreatment Warm Up Diesel Oxidation Catalyst Outlet Temperature	Aftertreatment Warm Up Diesel Oxidation Catalyst Outlet Temperature - Data erratic, intermittent or incorrect
4810	3	3155	Aftertreatment Warm Up Diesel Oxidation Catalyst Outlet Temperature	Aftertreatment Warm Up Diesel Oxidation Catalyst Outlet Temperature Sensor Circuit - Voltage above normal
4810	4	3156	Aftertreatment Warm Up Diesel Oxidation Catalyst Outlet Temperature	Aftertreatment Warm Up Diesel Oxidation Catalyst Outlet Temperature Sensor Circuit - Voltage below normal
4810	15	3249	Aftertreatment Warm Up Diesel Oxidation Catalyst Outlet Temperature	Aftertreatment Warm Up Diesel Oxidation Catalyst Outlet Temperature - Data Valid But Above Normal Operating Range
4810	16	3169	Aftertreatment Warm Up Diesel Oxidation Catalyst Outlet Temperature	Aftertreatment Warm Up Diesel Oxidation Catalyst Outlet Temperature - Data Valid But Above Normal Operating Range
5018	11	2637	Aftertreatment Diesel Oxidation Catalyst	Aftertreatment 1 Diesel Oxidation Catalyst Face Plugged - Root Cause Not Known
5019	2	3138	Engine Exhaust Gas Recirculation 1 Outlet Pressure	Engine Exhaust Gas Recirculation Outlet Pressure - Data erratic, intermittent or incorrect
5019	3	3136	Engine Exhaust Gas Recirculation 1 Outlet Pressure	Engine Exhaust Gas Recirculation Outlet Pressure Sensor Circuit - Voltage above normal, or shorted to high source
5019	4	3137	Engine Exhaust Gas Recirculation 1 Outlet Pressure	Engine Exhaust Gas Recirculation Outlet Pressure Sensor Circuit - Voltage below normal, or shorted to low source
5024	10	3649	Aftertreatment 1 Intake Gas NOx Sensor Heater Ratio	Aftertreatment 1 Intake NOx Sensor Heater - Abnormal rate of change
5031	10	3583	Aftertreatment 1 Outlet Gas NOx Sensor Heater Ratio	Aftertreatment 1 Outlet NOx Sensor Heater - Abnormal rate of change

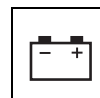


SPN	FMI	Fault Code	SPN Description	Description
5031	10	6581	Aftertreatment 1 Outlet Gas NOx Sensor Heater Ratio	Aftertreatment 1 Outlet NOx Sensor Heater - Abnormal rate of change
5097	3	4293	Engine Brake Active Lamp Data	Engine Brake Active Lamp - Voltage Above Normal, or Shorted to High Source
5097	4	4294	Engine Brake Active Lamp Data	Engine Brake Active Lamp - Voltage below normal, or shorted to low source
5125	3	3419	Sensor supply voltage 7	Sensor Supply 7 Circuit - Voltage above normal, or shorted to high source
5125	4	3421	Sensor supply voltage 7	Sensor Supply 7 Circuit - Voltage below normal, or shorted to low source
5245	31	4863	Aftertreatment Selective Catalytic Reduction Operator Inducement Active	Aftertreatment Diesel Exhaust Fluid Tank Low Level Indicator
5246	0	3712	Aftertreatment SCR Operator Inducement Severity	Aftertreatment SCR Operator Inducement - Data valid but above normal operational range - Most Severe level
5298	17	2638	Aftertreatment 1 Diesel Oxidation Catalyst Conversion Efficiency	Aftertreatment 1 Diesel Oxidation Catalyst Conversion Efficiency - Data Valid But Below Normal Operating Range - Moderately Severe Level
5298	18	1691	Aftertreatment 1 Diesel Oxidation Catalyst Conversion Efficiency	Aftertreatment 1 Diesel Oxidation Catalyst Conversion Efficiency - Data Valid But Below Normal Operating Range - Moderately Severe Level
5319	31	3376	Aftertreatment 1 Diesel Particulate Filter Incomplete Regeneration	Aftertreatment Diesel Particulate Filter Incomplete Regeneration - Condition Exists
5357	31	4713	Engine Fuel Injection Quantity Error for Multiple Cylinders	Engine Fuel Injection Quantity Error for Multiple Cylinders - Condition Exists
5380	11	4936	Engine Fuel Valve 1	Engine Fuel Valve 1 - Root Cause Not Known
5380	13	4937	Engine Fuel Valve 1	Engine Fuel Valve 1 - Out of Calibration
5394	2	3755	Aftertreatment Diesel Exhaust Fluid Dosing Valve	Aftertreatment Diesel Exhaust Fluid Dosing Valve - Data erratic, intermittent or incorrect
5394	5	3567	Aftertreatment Diesel Exhaust Fluid Dosing Valve	Aftertreatment Diesel Exhaust Fluid Dosing Valve - Current below normal or open circuit

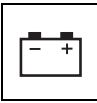


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
5394	7	3568	Aftertreatment Diesel Exhaust Fluid Dosing Valve	Aftertreatment Diesel Exhaust Fluid Dosing Valve - Mechanical system not responding or out of adjustment
5395	16	3337	Engine Idle Fuel Quantity	Engine Idle Fuel Quantity - Data Valid But Above Normal Operating Range - Moderately Severe Level
5395	18	3338	Engine Idle Fuel Quantity	Engine Idle Fuel Quantity - Data Valid But Below Normal Operating Range - Moderately Severe Level
5396	31	3377	Engine Crankcase Ventilation Hose Disconnected	Engine Crankcase Ventilation Hose Disconnected - Condition Exists
5397	31	3375	Aftertreatment 1 Diesel Particulate Filter Regeneration too Frequent	Aftertreatment Diesel Particulate Filter Regeneration too Frequent - Condition Exists
5484	3	3633	Engine Fan Clutch 2 Output Device Driver	Engine Fan Clutch 2 Control Circuit - Voltage above normal, or shorted to high source
5484	3	6456	Engine Fan Clutch 2 Output Device Driver	Engine Fan Clutch 2 Control Circuit - Voltage above normal, or shorted to high source
5484	4	3634	Engine Fan Clutch 2 Output Device Driver	Engine Fan Clutch 2 Control Circuit - Voltage below normal, or shorted to low source
5484	4	6457	Engine Fan Clutch 2 Output Device Driver	Engine Fan Clutch 2 Control Circuit - Voltage below normal, or shorted to low source
5491	3	3562	Aftertreatment 1 Diesel Exhaust Fluid Line Heater Relay	Aftertreatment Diesel Exhaust Fluid Line Heater Relay - Voltage above normal, or shorted to high source
5491	3	6477	Aftertreatment 1 Diesel Exhaust Fluid Line Heater Relay	Aftertreatment Diesel Exhaust Fluid Line Heater Relay - Voltage above normal, or shorted to high source
5491	4	3563	Aftertreatment 1 Diesel Exhaust Fluid Line Heater Relay	Aftertreatment Diesel Exhaust Fluid Line Heater Relay - Voltage below normal, or shorted to low source
5491	4	6478	Aftertreatment 1 Diesel Exhaust Fluid Line Heater Relay	Aftertreatment Diesel Exhaust Fluid Line Heater Relay - Voltage below normal, or shorted to low source
5491	7	3713	Aftertreatment 1 Diesel Exhaust Fluid Line Heater Relay	Aftertreatment 1 Diesel Exhaust Fluid Line Heater Relay - Mechanical system not responding or out of adjustment
5491	7	6537	Aftertreatment 1 Diesel Exhaust Fluid Line Heater Relay	Aftertreatment 1 Diesel Exhaust Fluid Line Heater Relay - Mechanical system not responding or out of adjustment

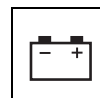


SPN	FMI	Fault Code	SPN Description	Description
5571	0	3741	High Pressure Common Rail Fuel Pressure Relief Valve	High Pressure Common Rail Fuel Pressure Relief Valve - Data valid but above normal operational range
5571	3	4262	High Pressure Common Rail Fuel Pressure Relief Valve	High Pressure Common Rail Fuel Pressure Relief Valve - Voltage Above Normal, or Shorted to High Source
5571	4	4263	High Pressure Common Rail Fuel Pressure Relief Valve	High Pressure Common Rail Fuel Pressure Relief Valve - Voltage below normal, or shorted to low source
5571	7	3727	High Pressure Common Rail Fuel Pressure Relief Valve	High Pressure Common Rail Fuel Pressure Relief Valve - Mechanical system not responding or out of adjustment
5571	11	4265	High Pressure Common Rail Fuel Pressure Relief Valve	High Pressure Common Rail Fuel Pressure Relief Valve - Root Cause Not Known
5571	15	5585	High Pressure Common Rail Fuel Pressure Relief Valve	High Pressure Common Rail Fuel Pressure Relief Valve - Data Valid But Above Normal Operating Range - Least Severe Level
5571	31	4867	High Pressure Common Rail Fuel Pressure Relief Valve	High Pressure Common Rail Fuel Pressure Relief Valve - Condition Exists
5585	18	4691	Engine Injector Metering Rail 1 Cranking Pressure	Engine Injector Metering Rail 1 Cranking Pressure - Data Valid But Below Normal Operating Range - Mo
5603	9	3843	Cruise Control Disable Command	Cruise Control Disable Command - Abnormal update rate
5603	31	3845	Cruise Control Disable Command	Cruise Control Disable Command - Condition Exists
5605	31	3844	Cruise Control Pause Command	Cruise Control Pause Command - Condition Exists
5625	2	5274	Engine Exhaust Back Pressure Regulator Position	Engine Exhaust Back Pressure Regulator Position - Data Erratic, Intermittent or Incorrect
5625	3	5275	Engine Exhaust Back Pressure Regulator Position Sensor Circuit	Engine Exhaust Back Pressure Regulator Position Sensor Circuit - Voltage Above Normal, or Shorted to High Source
5625	4	5276	Engine Exhaust Back Pressure Regulator Position Sensor Circuit	Engine Exhaust Back Pressure Regulator Position Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
5626	13	5277	Engine Exhaust Back Pressure Regulator	Engine Exhaust Back Pressure Regulator - Out of Calibration

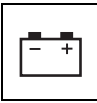


Electrical System

SPN	FMI	Fault Code	SPN Description	Description
5741	2	4451	Aftertreatment 1 Outlet Soot	Aftertreatment 1 Outlet Soot - Data erratic, intermittent or incorrect
5741	3	4143	Aftertreatment 1 Outlet Soot Sensor	Aftertreatment 1 Outlet Soot Sensor - Voltage Above Normal, or Shorted to High Source
5741	4	4144	Aftertreatment 1 Outlet Soot Sensor	Aftertreatment 1 Outlet Soot Sensor - Voltage below normal, or shorted to low source
5742	3	4161	Aftertreatment Diesel Particulate Filter Temperature Sensor Module	Aftertreatment Diesel Particulate Filter Temperature Sensor Module - Voltage Above Normal, or Shorted to high source
5742	4	4162	Aftertreatment Diesel Particulate Filter Temperature Sensor Module	Aftertreatment Diesel Particulate Filter Temperature Sensor Module - Voltage below normal, or shorted to low source
5742	9	4151	Aftertreatment Diesel Particulate Filter Temperature Sensor Module	Aftertreatment Diesel Particulate Filter Temperature Sensor Module - Abnormal update rate
5742	11	4259	Aftertreatment Diesel Particulate Filter Temperature Sensor Module	Aftertreatment Diesel Particulate Filter Temperature Sensor Module - Root Cause Not Known
5742	12	4158	Aftertreatment Diesel Particulate Filter Temperature Sensor Module	Aftertreatment Diesel Particulate Filter Temperature Sensor Module - Bad intelligent device or component
5742	16	4163	Aftertreatment Diesel Particulate Filter Temperature Sensor Module	Aftertreatment Diesel Particulate Filter Temperature Sensor Module- Data Valid But Above Normal Operating Range
5743	3	4164	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module - Voltage Above Normal, or Shorted to high source
5743	4	4165	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module - Voltage below normal, or Shorted to low source
5743	9	4152	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module - Abnormal update rate
5743	11	4261	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module - Root Cause Not Known
5743	12	4159	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module - Bad intelligent device or component
5743	16	4166	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module	Aftertreatment Selective Catalytic Reduction Temperature Sensor Module - Data Valid But Above Normal

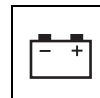


SPN	FMI	Fault Code	SPN Description	Description
5745	3	4168	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater - Voltage Above Normal, or Shorted to High
5745	4	4169	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater - Voltage below normal, or shorted to low source
5745	17	6513	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater - Data Valid But Below Normal Operating Range
5745	18	4171	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater - Data Valid But Below Normal Operating Range
5746	3	4155	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater Relay	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater Relay - Voltage Above Normal, or Shorted to high source
5746	3	6529	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater Relay	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater Relay - Voltage Above Normal, or Shorted to high source
5746	4	4156	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater Relay	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater Relay - Voltage below normal, or shorted to low source
5747	3	4153	Aftertreatment 1 Outlet Soot Sensor Heater	Aftertreatment 1 Outlet Soot Sensor Heater - Voltage Above Normal, or Shorted to High Source
5747	4	4154	Aftertreatment 1 Outlet Soot Sensor Heater	Aftertreatment 1 Outlet Soot Sensor Heater - Voltage below normal, or shorted to low source
5747	10	4449	Aftertreatment 1 Outlet Soot Sensor Heater	Aftertreatment 1 Outlet Soot Sensor Heater - Abnormal rate of change
5793	9	4284	Desired Engine Fueling State	Desired Engine Fueling State - Abnormal Update Rate
5797	3	4254	Aftertreatment Warm Up Diesel Oxidation Catalyst Temperature Sensor Module	Aftertreatment Warm Up Diesel Oxidation Catalyst Temperature Sensor Module - Voltage Above Normal, or shorted to high source
5797	4	4255	Aftertreatment Warm Up Diesel Oxidation Catalyst Temperature Sensor Module	Aftertreatment Warm Up Diesel Oxidation Catalyst Temperature Sensor Module - Voltage below normal, or shorted to low source
5797	11	4258	Aftertreatment Warm Up Diesel Oxidation Catalyst Temperature Sensor Module	Aftertreatment Warm Up Diesel Oxidation Catalyst Temperature Sensor Module - Root Cause Not Known
5797	12	4253	Aftertreatment Warm Up Diesel Oxidation Catalyst Temperature Sensor Module	Aftertreatment Warm Up Diesel Oxidation Catalyst Temperature Sensor Module - Bad intelligent device



Electrical System

SPN	FMI	Fault Code	SPN Description	Description
5797	16	4256	Aftertreatment Warm Up Diesel Oxidation Catalyst Temperature Sensor Module	Aftertreatment Warm Up Diesel Oxidation Catalyst Temperature Sensor Module - Data Valid But Above Normal Operating Range – Moderately Severe Level
5798	2	4245	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater Temperature	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater Temperature - Data erratic, intermittent or incorrect
5798	10	4251	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater Temperature	Aftertreatment 1 Diesel Exhaust Fluid Dosing Unit Heater Temperature - Abnormal Rate of Change
5838	31	4485	EGR Valve Malfunction	EGR Valve Malfunction - Condition Exists
5839	31	4486	Diesel Exhaust Fluid Consumption Malfunction	Diesel Exhaust Fluid Consumption Malfunction - Condition Exists
5840	31	4487	Diesel Exhaust Fluid Dosing Malfunction	Diesel Exhaust Fluid Dosing Malfunction - Condition Exists
5841	31	4488	Diesel Exhaust Fluid Quality Malfunction	Diesel Exhaust Fluid Quality Malfunction - Condition Exists
5842	31	4489	SCR Monitoring System Malfunction	SCR Monitoring System Malfunction - Condition Exists
6301	3	4688	Water in Fuel Indicator 2 Sensor Circuit	Water in Fuel Indicator 2 Sensor Circuit - Voltage above normal, or shorted to high source
6301	4	4689	Water in Fuel Indicator 2 Sensor Circuit	Water in Fuel Indicator 2 Sensor Circuit - Voltage below normal, or shorted to low source
6653	16	4841	Cold Start Injector Metering Rail 1 Pressure	Cold Start Injector Metering Rail 1 Pressure - Data Valid But Above Normal Operating Range - Moderate Severe Level
6655	3	4951	ECU Power Lamp	Maintain ECU Power Lamp - Voltage Above Normal, or Shorted to High Source
6655	3	6511	ECU Power Lamp	Maintain ECU Power Lamp - Voltage Above Normal, or Shorted to High Source
6655	4	4952	ECU Power Lamp	Maintain ECU Power Lamp - Voltage Below Normal, or Shorted to Low Source
6655	4	6512	ECU Power Lamp	Maintain ECU Power Lamp - Voltage Below Normal, or Shorted to Low Source

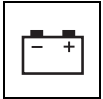


SPN	FMI	Fault Code	SPN Description	Description
6713	9	5177	VGT Actuator Driver Circuit	VGT Actuator Driver Circuit - Abnormal update rate
6713	13	4956	Variable Geometry Turbocharger Actuator	Variable Geometry Turbocharger Actuator Software - Out of Calibration
6713	31	4957	Variable Geometry Turbocharger Actuator	Variable Geometry Turbocharger Actuator Software - Condition Exists
6799	2	6473	Engine Fan Blade Pitch	Fan Blade Pitch - Mechanical system not responding or out of adjustment
6799	3	5183	Engine Fan Blade Pitch	Fan Blade Pitch Position Sensor Circuit - Voltage Above Normal, or Shorted to High Source
6799	3	6471	Engine Fan Blade Pitch	Fan Blade Pitch Position Sensor Circuit - Voltage Above Normal, or Shorted to High Source
6799	4	5184	Engine Fan Blade Pitch	Fan Blade Pitch Position Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
6799	4	6472	Engine Fan Blade Pitch	Fan Blade Pitch Position Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
6799	7	5185	Engine Fan Blade Pitch	Fan Blade Pitch - Mechanical system not responding or out of adjustment
6802	31	5278		Aftertreatment 1 Diesel Exhaust Fluid Dosing System Frozen - Condition Exists
6881	9	5653	SCR Operator Inducement Override Switch	SCR Operator Inducement Override Switch - Abnormal Update Rate
6881	13	5654	SCR Operator Inducement Override Switch	SCR Operator Inducement Override Switch - Out of Calibration
6882	3	5393	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module - Voltage Above Normal or Shorted to High Source
6882	4	5394	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module - Voltage Below Normal or Shorted to Low Source
6882	9	5391	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module - Abnormal Update Rate



Electrical System

SPN	FMI	Fault Code	SPN Description	Description
6882	11	5395	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module - Root Cause Not Known
6882	12	5392	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module - Bad Intelligent Device or Component
6882	16	5396	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module	Aftertreatment Diesel Oxidation Catalyst Temperature Sensor Module - Data Valid But Above Normal Operating Range - Moderately Severe Level
6918	31	5632	SCR System Cleaning Inhibited Due to Inhibit Switch	SCR System Cleaning Inhibited Due to Inhibit Switch - Condition Exists
6928	31	5631	SCR System Cleaning Inhibited Due to System Timeout	SCR System Cleaning Inhibited Due to System Timeout - Condition Exists
6928	31	6597	SCR System Cleaning Inhibited Due to System Timeout	SCR System Cleaning Inhibited Due to System Timeout - Condition Exists
7848	31	6634	Diesel Particulate Filter 1 Conditions Not Met for Active Regeneration	Diesel Particulate Filter 1 Conditions Not Met for Active Regeneration - Condition Exists
520199	3	193	Cruise Control	Cruise Control (Resistive) Signal Circuit - Voltage above normal, or shorted to high source
520199	4	194	Cruise Control	Cruise Control (Resistive) Signal Circuit - Voltage below normal, or shorted to low source
520320	7	2699	Crankcase Depression Valve	Crankcase Depression Valve - Mechanical system not responding or out of adjustment
520332	3	2755	Cruise Control	Cruise Control (Resistive) #2 Signal Circuit - Voltage above normal, or shorted to high source
520332	4	2756	Cruise Control	Cruise Control (Resistive) #2 Signal Circuit - Voltage below normal, or shorted to low source
520435	12	3222	Glow Plug Module	Glow Plug Module - Bad intelligent device or component
520595	2	4288	Closed Crankcase Ventilation System Pressure	Closed Crankcase Ventilation System Pressure - Data erratic, intermittent or incorrect
520595	3	4286	Closed Crankcase Ventilation System Pressure Sensor	Closed Crankcase Ventilation System Pressure Sensor - Voltage Above Normal, or Shorted to High Source



SPN	FMI	Fault Code	SPN Description	Description
520595	4	4287	Closed Crankcase Ventilation System Pressure Sensor	Closed Crankcase Ventilation System Pressure Sensor - Voltage below normal, or shorted to low source
520668	31	4452	Aftertreatment 1 Outlet NOx Sensor Closed Loop Operation	Aftertreatment 1 Outlet NOx Sensor Closed Loop Operation - Condition Exists
520716	3	4752	Aftertreatment 1 Diesel Exhaust Fluid Dosing Valve 1 Heater	Aftertreatment 1 Diesel Exhaust Fluid Dosing Valve 1 Heater - Voltage Above Normal, or Shorted to High Source
520716	4	4753	Aftertreatment 1 Diesel Exhaust Fluid Dosing Valve 1 Heater	Aftertreatment 1 Diesel Exhaust Fluid Dosing Valve 1 Heater - Voltage Below Normal, or Shorted to Low Source
520791	2	5215	Engine Boost Curve Selection	Engine Boost Curve Selection - Data erratic, intermittent or incorrect
520808	31	5291	Engine Emergency Shutdown Switch Activated	Engine Emergency Shutdown Switch Activated - Condition Exists
520809	31	5292	Excessive Time Since Last Engine Air Shutoff Maintenance Test	Excessive Time Since Last Engine Air Shutoff Maintenance Test - Condition Exists
520953	3	5866		Aftertreatment Diesel Exhaust Fluid Dosing Unit Relay Feedback- Voltage Above Normal or Shorted to High Source.
520953	4	5867		Aftertreatment Diesel Exhaust Fluid Dosing Unit Relay Feedback- Voltage Below Normal or Shorted to Low Source.
520968	9	5939		Machine Constrained Operation- Abnormal Update Rate. No Communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the machine electronic control unit.
520968	19	5941		Machine Constrained Operation- Received Network Data in Error. The received J1939 datalink message was not valid.
524286	31	5617	Aftertreatment 1 Diesel Oxidation Catalyst System	Aftertreatment 1 Diesel Oxidation Catalyst System- Special Instruction
524286	31	9491		Reserved for temporary use - Condition Exists
524286	31	9999		Reserved for temporary use - Condition Exists

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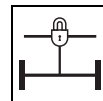
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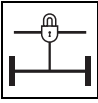


Section 10

Stabil-TRAK™ System and Boom Interlock System

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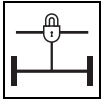
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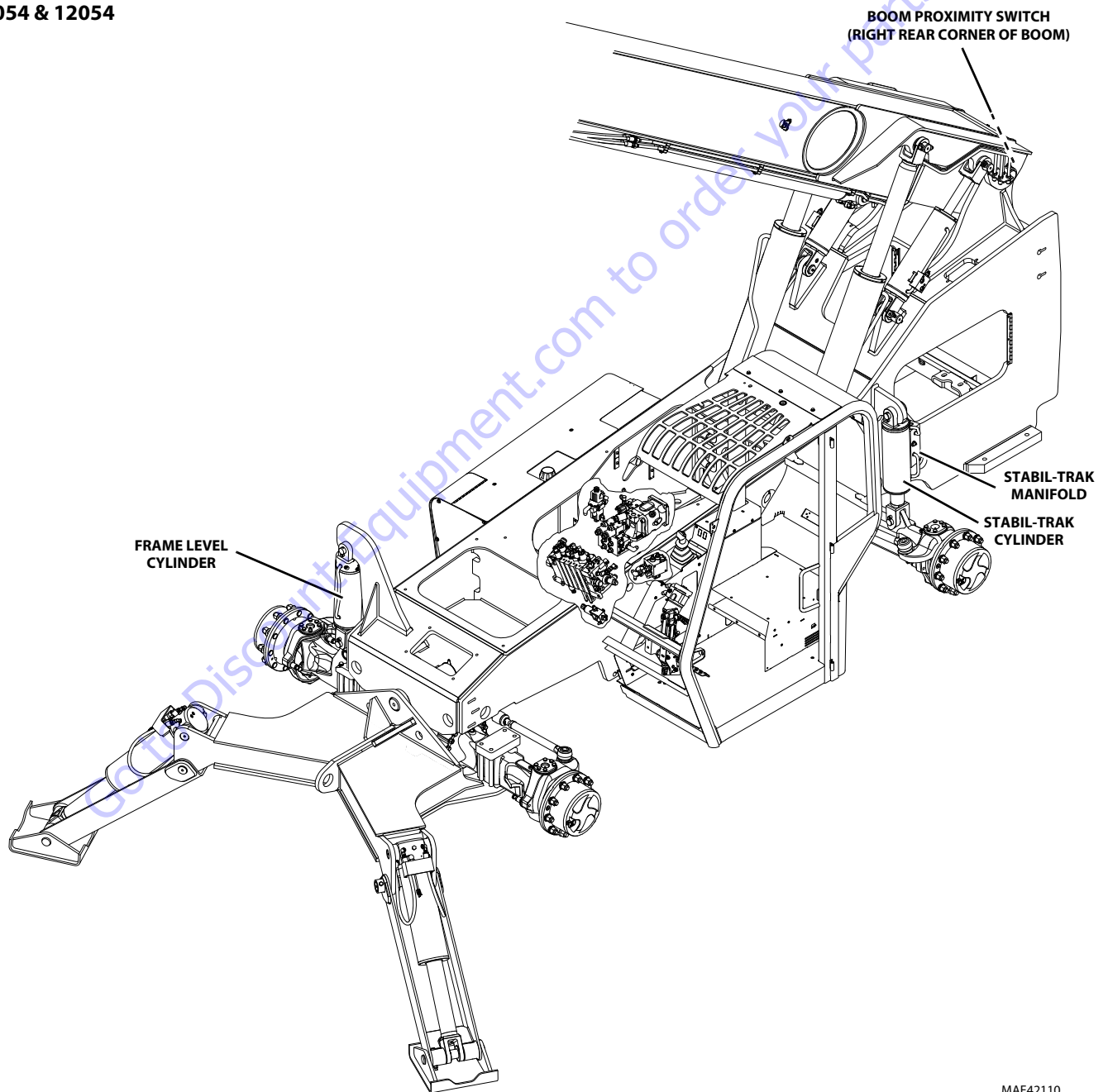
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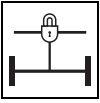
10.1 STABIL-TRAK™ SYSTEM COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the Stabil-TRAK system. The following illustration identifies the components that are referred to throughout this section.

10054 & 12054

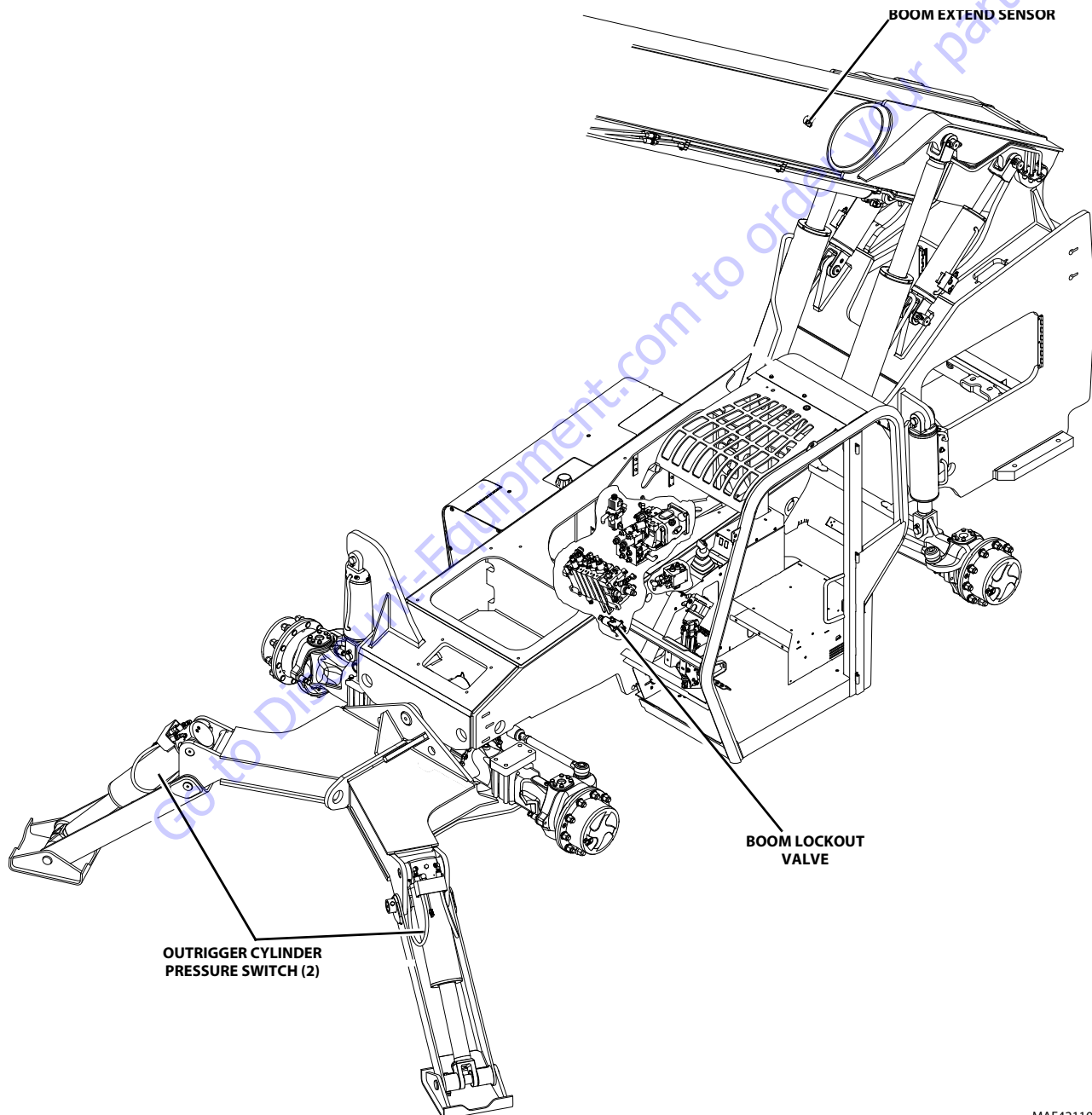


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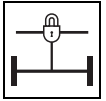


10.2 BOOM EXTEND INTERLOCK SYSTEM COMPONENT TERMINOLOGY (10054 & 12054 ONLY)

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the boom extend interlock system. The following illustration identifies the components that are referred to throughout this section.

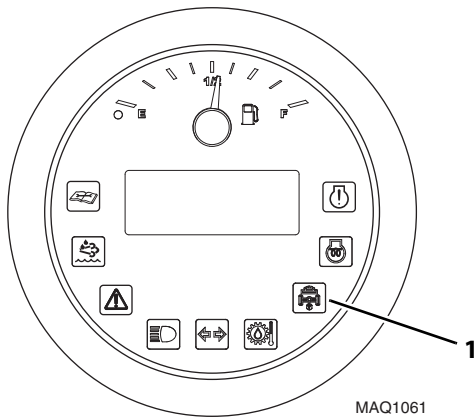


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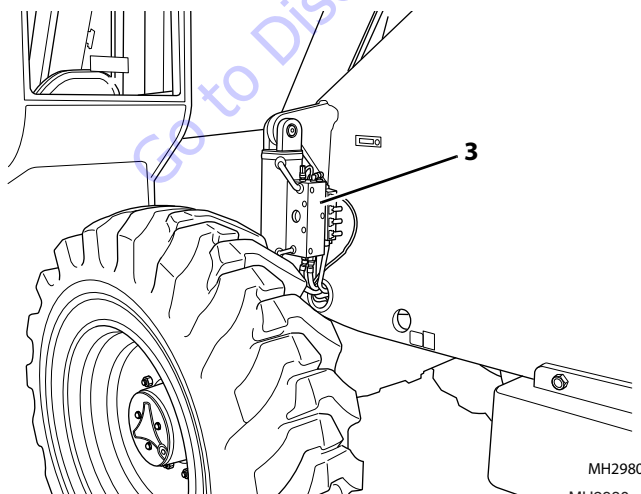
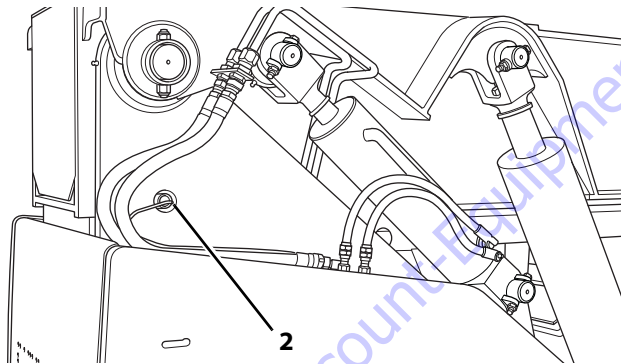


10.3 STABIL-TRAK™ DESCRIPTION

Patented rear axle lock or Stabil-TRAK system works to stabilize machine under various conditions. Appropriate Operation and Safety Manual contains basic Stabil-TRAK information; a copy of Operation and Safety Manual should always be available in the storage compartment located in the cab.

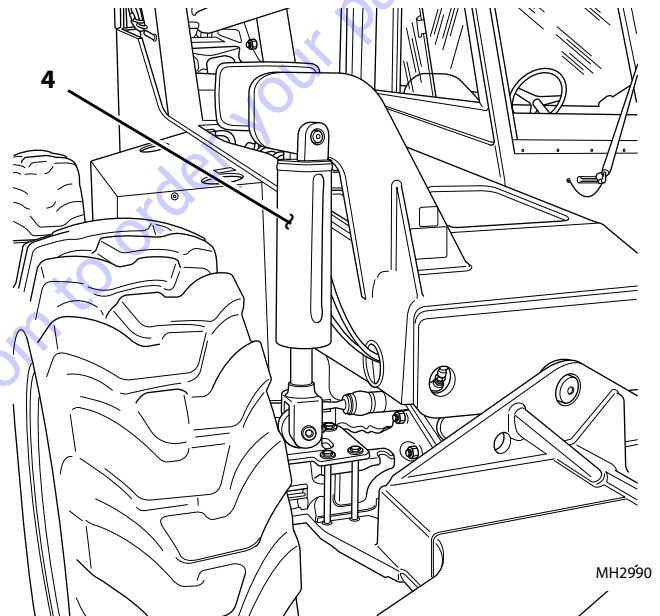


The operator's instrument cluster Stabil-TRAK light (1) will be ON when the Stabil-TRAK system is in the LOCKED mode.



The stabilizing system operates via an interface between:

- Boom proximity switch (2),
- Park brake switch,
- Service brake switch,
- Transmission in (N) NEUTRAL,
- Hydraulic circuits,
- Electrical circuits and
- Five solenoid-operated valves on Stabil-TRAK manifold (3)

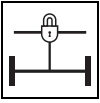


Frame level cylinder (4) is also involved in Stabil-TRAK system, but only passively, as hydraulic oil travels between frame level cylinder and Stabil-TRAK manifold to accommodate Stabil-TRAK system operation.

The Stabil-TRAK lock mode will be activated when the boom angle is **greater than 40°** and **one or more** of the following functions are activated:

- Engaging the Parking Brake Switch
- Placing the Transmission in (N) NEUTRAL
- Depressing and holding the Service Brake
- Model 10054 & 12054 Only: Lowering both outriggers onto solid terrain, and extending the boom beyond a point between the "E" and "F" boom extend letters (approximately 40ft [12 m])

With the boom lowered to an angle of **less than 40°**, the free pivot mode is active and none of these functions will affect the Stabil-TRAK system.

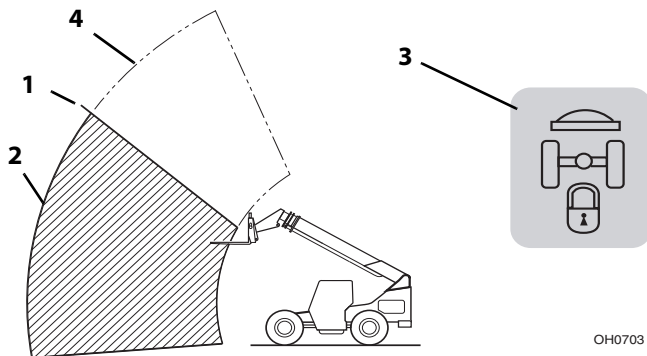


Stabil-TRAK™ System and Boom Interlock System

10.4 STABIL-TRAK™ OPERATION

10.4.1 Understanding Stabil-TRAK™ System

The following is a description of modes in the patented Stabil-TRAK system. The machine may operate in any one of the following modes.



OH0703

a. Free Pivot Mode

Boom **below 40°** (1), Stabil-TRAK system is in FREE PIVOT MODE (2). Rear axle is allowed to pivot freely. Frame level control will function normally with or without outriggers down. Stabil-TRAK indicator will be OFF (3).

b. Slow Pivot Mode

Boom **above 40°** (1), Stabil-TRAK system is now in SLOW PIVOT MODE (4). In this mode, rear axle is UNLOCKED and is allowed to pivot, but will respond **SLOWLY** to changes in terrain. Stabil-TRAK indicator (3) will be OFF when:

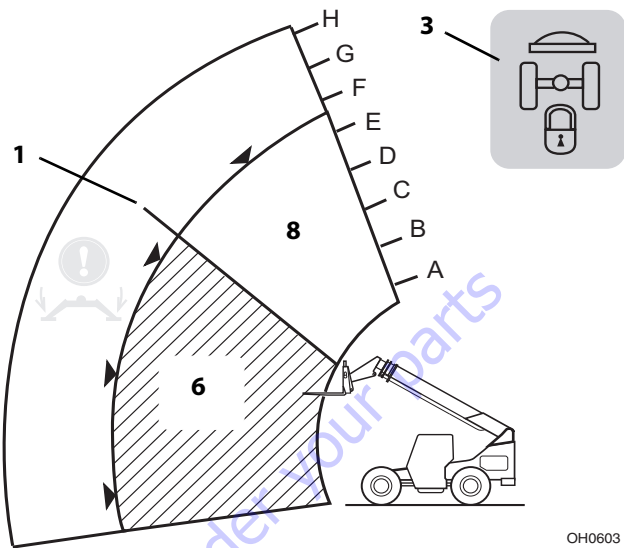
- Transmission is in gear
- Service brake is disengaged

Frame level control function will act normally in this mode.

c. Locked Mode

With boom **above 40°** (1) and by activating one or more of functions (as follows), Stabil-TRAK system is in LOCKED MODE and rear axle is LOCKED so it is rigid with frame. Stabil-TRAK indicator (3) will be ON when

- Engaging parking brake switch
- Placing transmission in (N) NEUTRAL
- Depressing and holding service brake pedal

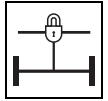


OH0603

Model 10054 & 12054 has an additional boom extend interlock system. This system prevents boom from being extended beyond a point between "E" and "F" boom extend letters (approximately 40 ft (12 m), unless both outriggers have been lowered onto solid terrain.

Once this system has been activated, machine will automatically place Stabil-TRAK system in LOCKED MODE. System will remain in LOCKED MODE, until boom has been retracted. (Refer to Section 10.6, "Boom Extend Interlock System Operation (10054 & 12054 Only)", for more information).

Frame level control will function slower than normal in this mode with or without the outriggers down.



10.4.2 Stabil-TRAK™ Solenoid Valves

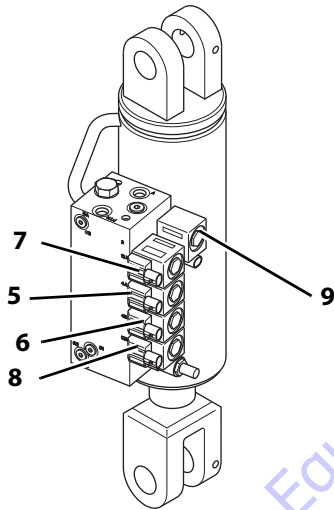
There are five Stabil-TRAK solenoid valves installed in the Stabil-TRAK manifold, attached to the stabilizer cylinder above the left side of the rear axle.

If a solenoid valve is suspected of malfunctioning, disconnect the coil wiring lead and test the coil for proper resistance (7-9 ohms) and for proper voltage from the harness (12 VDC). Replace the solenoid coil if open or shorted to ground.

Also inspect the valve cartridge, o-rings, and the other hydraulic and electrical components in the circuit to accurately determine the cause of the problem.

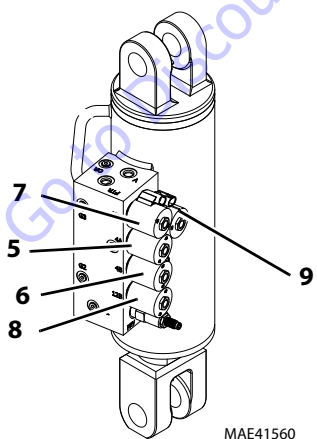
All solenoid coils are identical and can be interchanged for diagnostic purposes.

6036,6042,8042,10042,10054



MT3131

12054



MAE41560

Cartridge valves 4A (5), 4B (6), 12A (7) and 12B (8) are identical and can be interchanged for diagnostic purposes.

Note: Make sure 0.060 in. orifices are in place when installing solenoid valves 4A (5) and 4B (6).

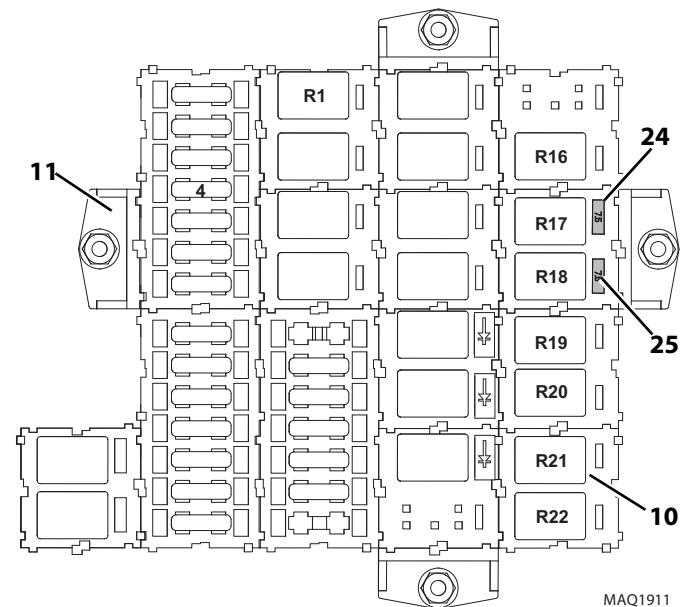
In general, if there is a problem with the Stabil-TRAK system beyond common electrical troubles, the involved electrical and hydraulic circuits should each be checked and the exact source of the problem diagnosed before any parts are replaced.

10.4.3 Logic Wiring Harness (10054 & 12054 Only)

The Model 10054 & 12054 uses an additional logic wiring harness, that includes all wiring, fuses and relays needed for the operation of the boom interlock, Stabil-TRAK and outrigger systems.

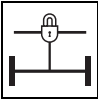
The logic harness has a fuse panel (10) that is attached to the fuse panel (11) from cab harness. The logic harness includes all the additional relays (R16 through R22) and fuses (24 and 25) required for the operation of the boom interlock, Stabil-TRAK and outrigger systems.

Refer to Section 10.9, "Stabil-TRAK™ and Boom Interlock Electrical Circuit Operation and Troubleshooting (10054 & 12054)" for electrical troubleshooting information.



MAQ1911

Note: DO NOT interchange solenoid valves 4A (5), 4B (6), 12A (7) or 12B (8) with solenoid valve 3 (9). These valves will fit into the other locations, but are configured differently internally and will not operate properly if interchanged.



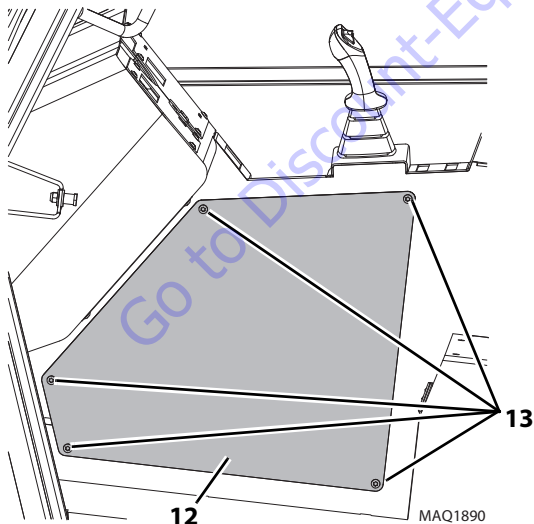
Stabil-TRAK™ System and Boom Interlock System

No.	Amp	Circuit
4	10 Amp	Boom Switch
R1	35 Amp	Boom Switch
R16	35 Amp	Stabilizer Interlock
R17	35 Amp	Stabilizer Lockup
R18	35 Amp	Boom Extend Interlock Relay
R19	35 Amp	Right Outrigger Lock Out
R20	35 Amp	Left Outrigger Lock Out
R21	35 Amp	Park Brake Interlock Relay
R22	35 Amp	Boom Extension Lock Out
24	7.5 Amp	Outrigger 1 (Mini-Fuse)
25	7.5 Amp	Outrigger 2 (Mini-Fuse)

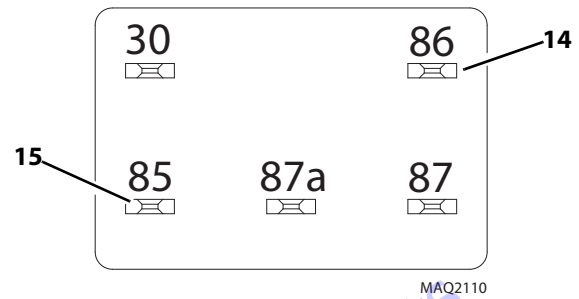
10.4.4 Relay Testing

If after checking the electrical system, a relay is suspect, test the relay as follows:

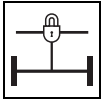
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the parking brake, straighten all wheels and shut the engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open the engine rear and side engine doors. Allow the system fluids to cool.
4. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.



5. Fuse block relays are located in fuse block and is mounted behind right side console access panel (12). To gain access, remove screws (13) that secure right side panel in place.



6. Remove suspect relay from fuse panel.
7. Apply proper voltage to relay coil at terminal 86 (14) and attach the ground (-) probe to terminal 85 (15), ground. An audible click should be heard indicating that relay is functioning properly.
8. When reassembling right side console access panel (12), torque screws (13) to 3–5 lb-ft (13–22 Nm).
9. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
10. Close and secure rear engine compartment door.
11. Remove Do Not Operate Tags from ignition key switch and steering wheel.

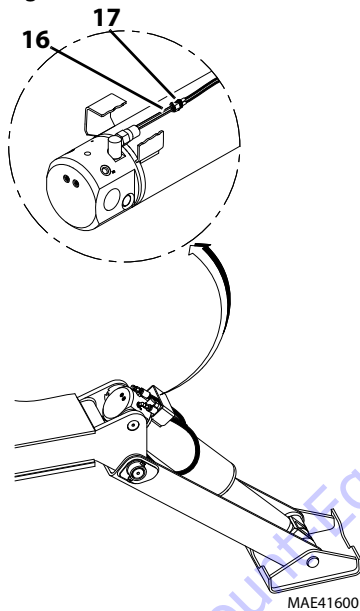


10.4.5 Outrigger Pressure Switches (10054 & 12054 Only)

a. Testing

If after checking the electrical system, a pressure switch is suspect, test the switch as follows:

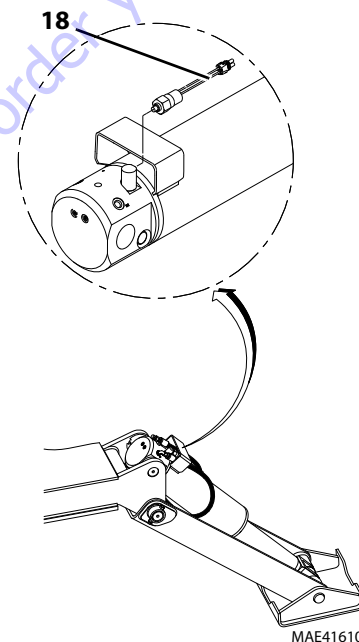
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the parking brake, straighten all wheels.
2. Lower the outriggers onto firm terrain, and shut the engine OFF.
3. Place a Do Not Operate Tag on both ignition key switch and steering wheel.



4. Disconnect the pressure switch wiring connector (17) from the harness connector (16).
5. Check for continuity across the red and black wires at the pressure switch wiring connector (17). If there is no continuity across the red and black wires, replace the switch.
6. Remove Do Not Operate Tags from ignition key switch and steering wheel.

b. Removal

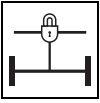
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission in (N) NEUTRAL, engage the parking brake, straighten all wheels.
2. Lower the outriggers onto firm terrain, and shut the engine OFF.
3. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
4. Open the engine rear and side engine doors. Allow the system fluids to cool.
5. Properly disconnect the battery. Refer Section 9.8, "Battery", for procedure.
6. Disconnect the pressure switch wiring connector (17) from the harness connector (16).



7. Remove the outrigger pressure switch (18) from the outrigger cylinder.
8. Wipe up any spilled hydraulic oil.

c. Installation

1. Install pressure switch (18), and tight against the port surface without interfering with the port to cylinder barrel weld.
2. Connect the pressure switch wiring connector (17) to the harness connector (16).
3. Properly connect the battery. Refer Section 9.8, "Battery", for procedure.
4. Close and secure rear engine compartment door.
5. Remove Do Not Operate Tags from ignition key switch and steering wheel.

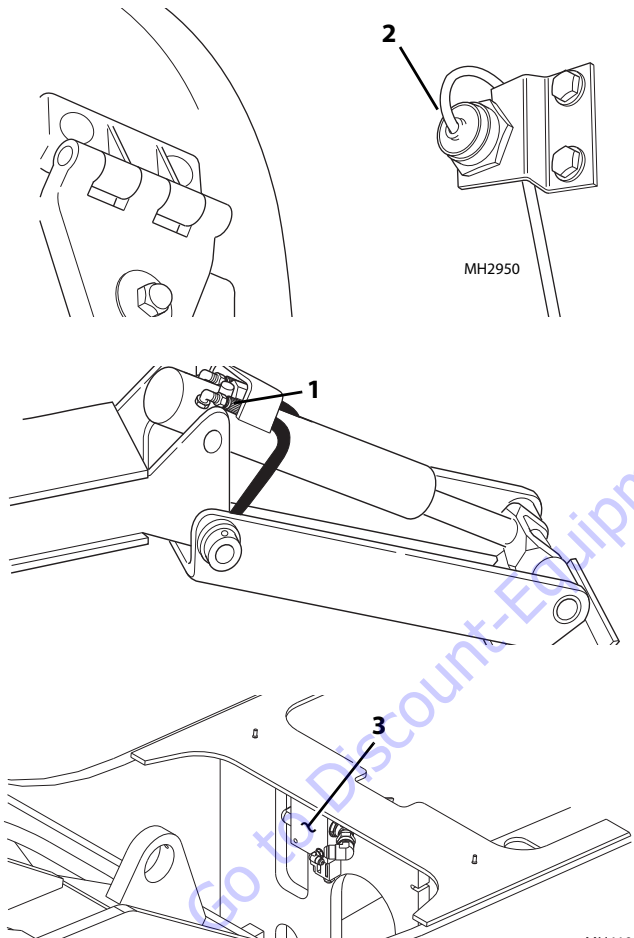


10.5 BOOM EXTEND INTERLOCK SYSTEM DESCRIPTION

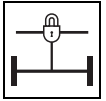
Note: The boom interlock system is used only on the Model 10054 & 12054.

Boom extend interlock system is designed to provide additional stability, allowing boom to be extended to its maximum limits. Appropriate Operation and Safety Manual contains boom extend interlock basic information. A copy of Operation and Safety Manual should always be available in storage compartment located in cab.

Boom extend interlock system can only be activated when both outriggers are lowered onto firm terrain. Once boom extend interlock system has been activated, machine will automatically place Stabil-TRAK system in LOCKED MODE. The Stabil-TRAK system will remain in LOCKED MODE, until boom has been retracted. (Refer to Section 10.4, "Stabil-TRAK™ Operation", for more information.)



The interlock system operates via an interface between the outrigger pressure switches (1), boom extend sensor (2), boom lockout valve (3) and the logic wiring harness.



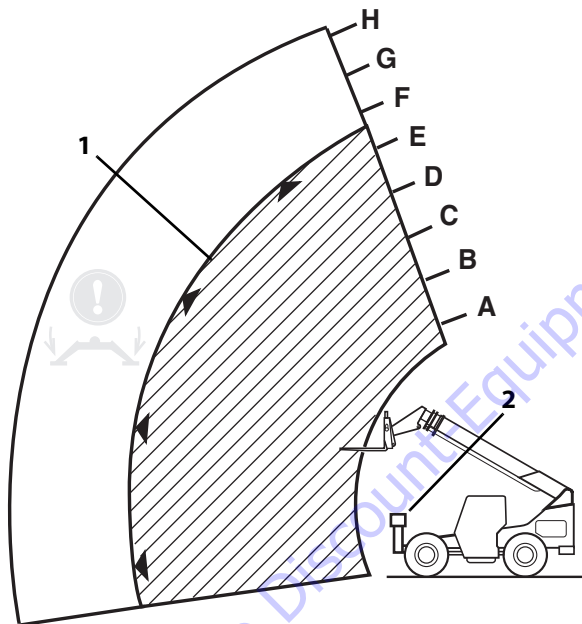
10.6 BOOM EXTEND INTERLOCK SYSTEM OPERATION (10054 & 12054 ONLY)

The ultimate purpose of this system is to add an extra measure of stability, allowing the boom to be extended to its maximum limits. The boom extend interlock system may operate in one of the two following modes:

10.6.1 Extend Interlock Mode

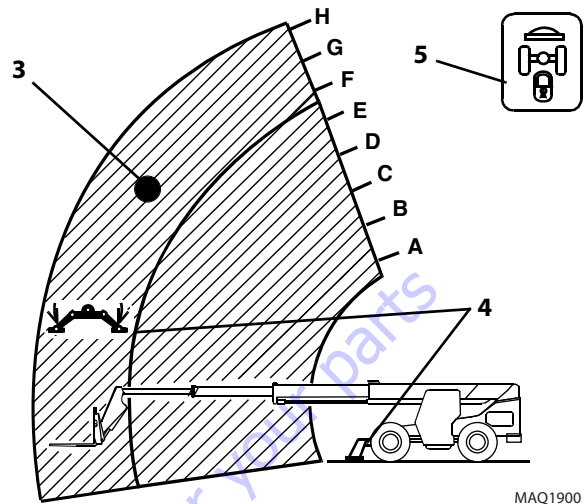
EXTEND INTERLOCK MODE, limits boom extension (1) to a point after letter "E" has appeared on side of boom and before letter "F" appears. A sensor in boom will automatically STOP boom from extending past this point, approximately 40 ft (12m) until outriggers have been lowered onto firm terrain.

Retract function will still operate normally in this mode.



With the outriggers RAISED (2) and the boom inside of the extension limit (1) the machine will function normally. The Stabil-TRAK system will perform as designed.

Note: As an added measure of safety, ALWAYS remember to shift the Transmission to (N) NEUTRAL, move the neutral lock lever to NEUTRAL LOCK position, and engage the park brake when lowering the outriggers.



10.6.2 Outrigger Interlock Mode

OUTRIGGER INTERLOCK MODE, allows for full boom extension (3) only as long as **both** outriggers (4) have been lowered onto **firm** terrain (outriggers DOWN). Once this condition is met, the boom is allowed to extend to its full limits.

As the boom is extended past the "F" boom extend letter, the machine will automatically place the Stabil-TRAK system in the LOCKED MODE. It will remain in this mode until the boom has been retracted to a point where the boom extend sensor is activated.

With outrigger interlock engaged additional systems are automatically activated that enhance stability of machine:

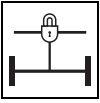
- Stabil-TRAK is in the LOCKED Mode.
- Transmission has been DECLUTCHED.
- Parking brake is ENGAGED.
- Outrigger RAISE function is inoperable.
- Stabil-TRAK light will be ON (5).

Other effects you will experience while the outrigger interlock is engaged:

- With Stabil-TRAK active, frame level will be slower than normal.
- Outriggers are still allowed to **lower** to adjust for any changes in outrigger footing.

Not until the boom has been retracted past the extension limit will any of these conditions change.

It is important that you regularly check that this system is functioning properly. To check that Stabil-TRAK System is functioning properly, refer to Section 10.7, "Stabil-TRAK™ System Test", for proper system function.



Stabil-TRAK™ System and Boom Interlock System

10.7 STABIL-TRAK™ SYSTEM TEST

Note: The operator must know that the Stabil-TRAK system is active and functioning properly.

To test the function of the Stabil-TRAK system, read the Stabil-TRAK System Test instructions and follow Steps 1 through 9 of Section 10.7.2, “Stabil-TRAK™ System Test Procedures”

10.7.1 Stabil-TRAK™ System Test Instructions

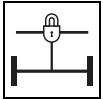
- Test the Stabil-TRAK system with the machine on a level surface.
- Remove any attachment from the quick coupler before performing the test.
- **DO NOT** extend the boom at any time during the test. Perform the test with the boom fully retracted.
- **DO NOT** raise the boom above 60° for Steps 3-6.
- **DO NOT** raise the boom above 45° for Steps 7-9.
- Follow Steps 1 through 9 of the Stabil-TRAK system test procedure **exactly** as written.


Note: If the Stabil-TRAK light goes OFF and the front left tire lowers to the ground at any time during Steps 4 through 7, the test was not performed properly or the Stabil-TRAK system is not functioning properly. **Carefully** repeat the steps starting with Step 1.

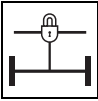
If Stabil-TRAK light goes OFF and front left tire lowers to ground consistently during Steps 4 through 7, the Stabil-TRAK system is not functioning properly and test should be **stopped immediately**. If the Stabil-TRAK system is not functioning properly, follow the procedures in Section 10.11, “Stabil-TRAK Hydraulic Circuit Operation and Troubleshooting,” to repair the system.

10.7.2 Stabil-TRAK™ System Test Procedures

If Steps 1 through 9 prove positive, the Stabil-TRAK system is functioning properly, and machine can be returned to service. If any of these steps indicate that the Stabil-TRAK system is not functioning properly, follow procedures in Section 10.11, “Stabil-TRAK™ Hydraulic Circuit Operation and Troubleshooting”, to repair system.

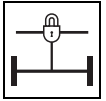


Stabil-TRAK System Test Procedures	
FREE PIVOT MODE	<p>Step 1</p> <ul style="list-style-type: none"> a. Place the machine on a level surface with 0° level. b. Have the boom fully retracted and horizontal. c. Place an 8in (203 mm) wood or cement block in front of the front left tire. d. Enter the machine. e. Fasten the seat belt. f. Turn the key to the RUN position. g. Check to be sure the Stabil-TRAK light is OFF. 
	<p>Step 2</p> <ul style="list-style-type: none"> a. Start the engine. b. Turn the parking brake switch OFF. c. Move the transmission to (1) FIRST gear. d. Move the transmission to the (F) FORWARD position. e. Drive the machine up on the block and stop by applying service brake with left foot. f. Use the frame level control to level the machine back to 0°.
	<p>Step 3</p> <ul style="list-style-type: none"> a. Place the transmission in(N) NEUTRAL.
	<p>b. Raise the boom to approximately 60°. The Stabil-TRAK light should come ON when the boom angle is at about 40° and remain ON.</p>
	<p>Step 4</p> <ul style="list-style-type: none"> a. Continue using your left foot to depress the service brake pedal. b. With transmission in (2) SECOND gear, move travel select lever to (R) REVERSE position. c. Ease your left foot partially off the service brake pedal, make sure that the Stabil-TRAK light remains ON. d. With your right foot, increase the engine rpm slightly, as necessary, just enough to back the machine off the block. While backing off the block, the front left tire should remain off the ground.
	<p>IMPORTANT: Perform Steps 5 thru 9 with the engine rpm at idle.</p>
	<p>Step 5</p> <ul style="list-style-type: none"> a. Keep the service brake pedal depressed. b. Place the transmission in (N) NEUTRAL. c. Take your foot off the service brake pedal. The Stabil-TRAK light should remain ON and the front left tire should remain off the ground.
<p>Step 6</p> <ul style="list-style-type: none"> a. With the transmission in (N) NEUTRAL, engage the parking brake switch. b. Move the transmission to the (F) FORWARD position. The Stabil-TRAK light should remain ON and the front left tire should remain off the ground. 	





Stabil-TRAK™ System and Boom Interlock System

Stabil-TRAK System Test Procedures	
LOCKED MODE	Step 7
	a. With the parking brake switch ON, place the transmission in(N) NEUTRAL.
	b. Lower the boom no lower than 45° .
	c. Frame level the machine no more than 5° to the left.
	d. Frame level the machine back to 0°.
	e. Frame level the machine no more than 5° to the right.
	Note: Observe that frame level will be slower than normal during this test.
f. The Stabil-TRAK light should remain ON and the front left tire should remain off the ground. The front left tire should not raise or lower during frame level.	
g. Frame level back toward 0°, leaving the machine leveled to the right approximately 1° to 2°.	
SLOW PIVO	Step 8
	a. Depress the service brake pedal.
	b. Disengage the parking brake switch.
	c. With the transmission in (1) FIRST gear, move the travel select lever to the (R) REVERSE position.
	d. Release the service brake pedal to deactivate the Stabil-TRAK system.
	e. The Stabil-TRAK light should go OFF.
	f. The front left tire should return to the ground while the machine travels in reverse.
g. Depress the service brake pedal to stop the machine.	
LOCKED MODE	Step 9
	a. With the service brake pedal depressed and the boom angle exactly 45° move the transmission to (3) THIRD gear.
	b. Move the travel select lever to (F) FORWARD.
	c. Release the service brake pedal to deactivate the Stabil-TRAK system. The Stabil-TRAK light should go OFF.
	d. Slowly drive the machine forward against the block to stop the machine from moving forward.
	e. With the front left tire against the block, frame level the machine no more than 5° to the left.
	f. Check that front left tire remains on ground. It is normal for front left tire to raise slightly when leveling to left, but tire should immediately lower when frame level function is stopped.
	g. Frame level the machine back to 0° and pause briefly.
	h. Frame level the machine no more than 5° to the right.
	i. Check that the front right tire remains on the ground. It is normal for the front right tire to raise slightly when leveling to the right, but the tire should immediately lower when the frame level function is stopped.
	j. Frame level the machine back to 0°.
	k. Depress the service brake pedal.
	l. Place the transmission in(N) NEUTRAL.
SLOW PIVOT MODE	m. Lower the boom.



10.8 STABIL-TRAK™ ELECTRICAL CIRCUIT OPERATION AND TROUBLESHOOTING (6042/8042/10042)

Note: Before using the 6042, 8042 and 10042 Stabil-TRAK System Troubleshooting chart and diagrams, complete the Section 10.7.2, “Stabil-TRAK™ System Test Procedures,” to determine what part of the system is not functioning properly.

6042, 8042 and 10042 Stabil-TRAK System Troubleshooting			
	FREE PIVOT MODE	SLOW PIVOT MODE	LOCKED MODE
	Refer to Section , “6042, 8042 and 10042 Stabil-TRAK Electrical Circuit FREE PIVOT Mode.”	Refer to Section , “6042, 8042 and 10042 Stabil-TRAK Electrical Circuit SLOW PIVOT Mode.”	Refer to Section , “6042, 8042 and 10042 Stabil-TRAK Electrical Circuit LOCKED MODE.”
Switch/ Relay Solenoid 	Machine Conditions 	Ignition On Boom Below 40° Boom Retracted PB & SB Released Trans. in Forward or Reverse	Ignition On Boom Above 40° Boom Retracted PB & SB Released Trans. in Forward or Reverse
Solenoid 12A	E	DE	DE
Solenoid 12B	E	DE	DE
Solenoid 3	DE	DE	E
Solenoid 4A	DE	E	DE
Solenoid 4B	DE	E	DE
Boom Angle Sensor	C	O	O
Boom Switch Relay	E	DE	DE
Stabilizer Lock Relay	DE	DE	E
Stabilizer Light	OFF (DE)	OFF (DE)	ON (E)
Ignition Switch	C	C	C
Park Brake Switch	O	O	C
Service Brake Switch	O	O	C
Secondary Function Manifold Park Brake Solenoids	E	E	DE
Park Brake Disengage Relay	E	E	DE
Neutral Start Relay	DE	DE	DE

Definitions:

PB = Park Brake

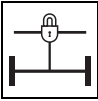
SB = Service Brake

DE = De-energized

E = Energized

C = Closed

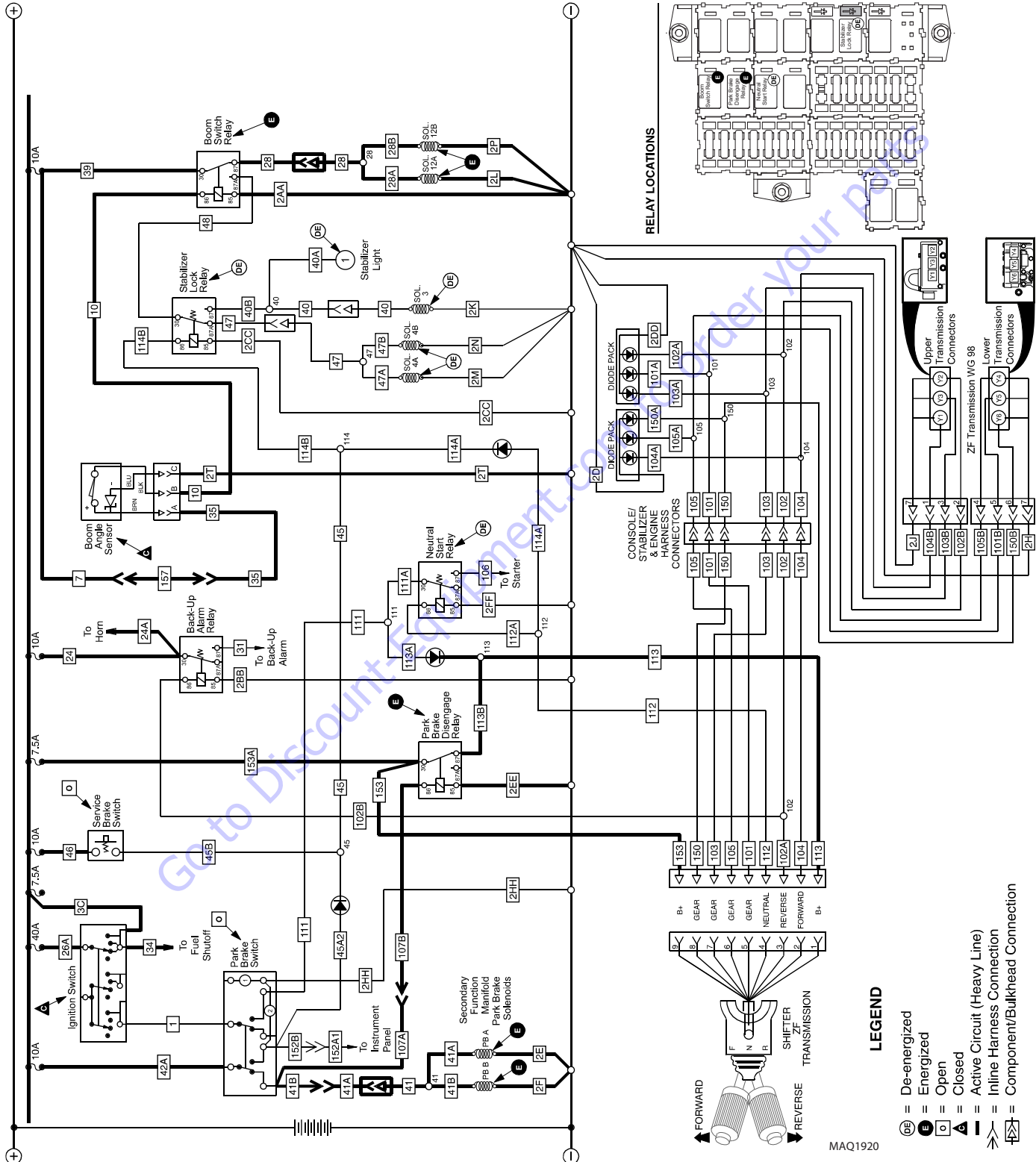
O = Open



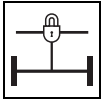
Stabil-TRAK™ System and Boom Interlock System

6042, 8042 and 10042 Stabil-TRAK Electrical Circuit FREE PIVOT Mode

FREE PIVOT MODE	1.	2.	3.	4.	5.
Conditions	Ignition "ON"	Boom Below 40°	Boom Retracted	PB & SB Released	Transmission in Fwd. or Rev.

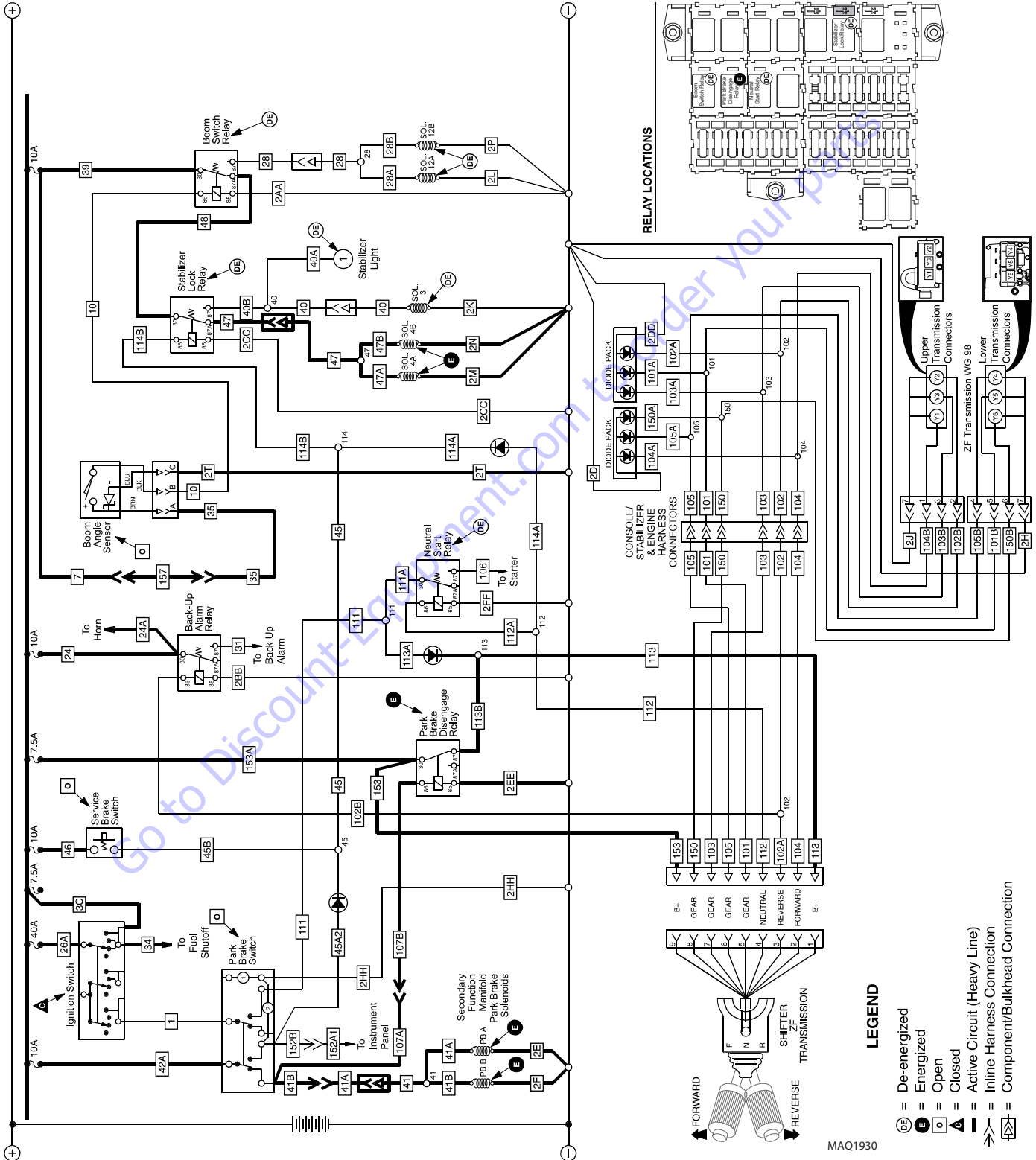


Stabil-TRAK™ System and Boom Interlock System

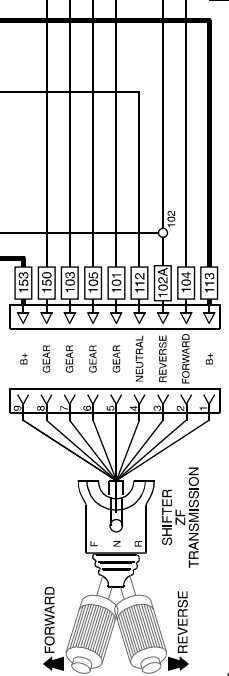
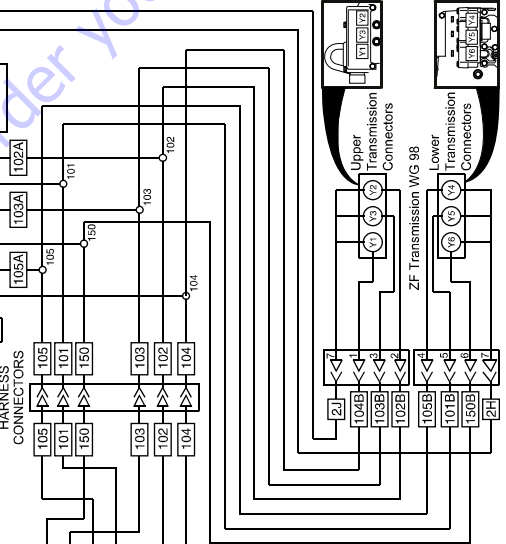
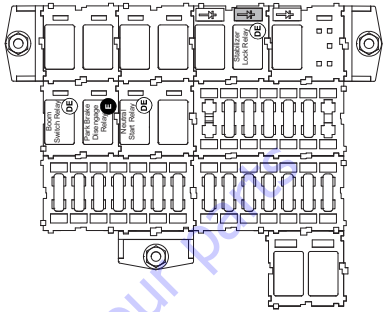


SLOW PIVOT MODE	1.	Ignition "ON"	4.	PB & SB Released
Conditions	2.	Boom Above 40°	5.	Transmission in Fwd. or Rev.
	3.	Boom Retracted		

6042, 8042 and 10042 Stabil-TRAK Electrical Circuit SLOW PIVOT Mode

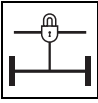


RELAY LOCATIONS



- LEGEND**
- ⊖ = De-energized
 - ⊕ = Energized
 - ⊖ = Open
 - ⊕ = Closed
 - = Active Circuit (Heavy Line)
 - = Inline Harness Connection
 - = Component/Bulkhead Connection

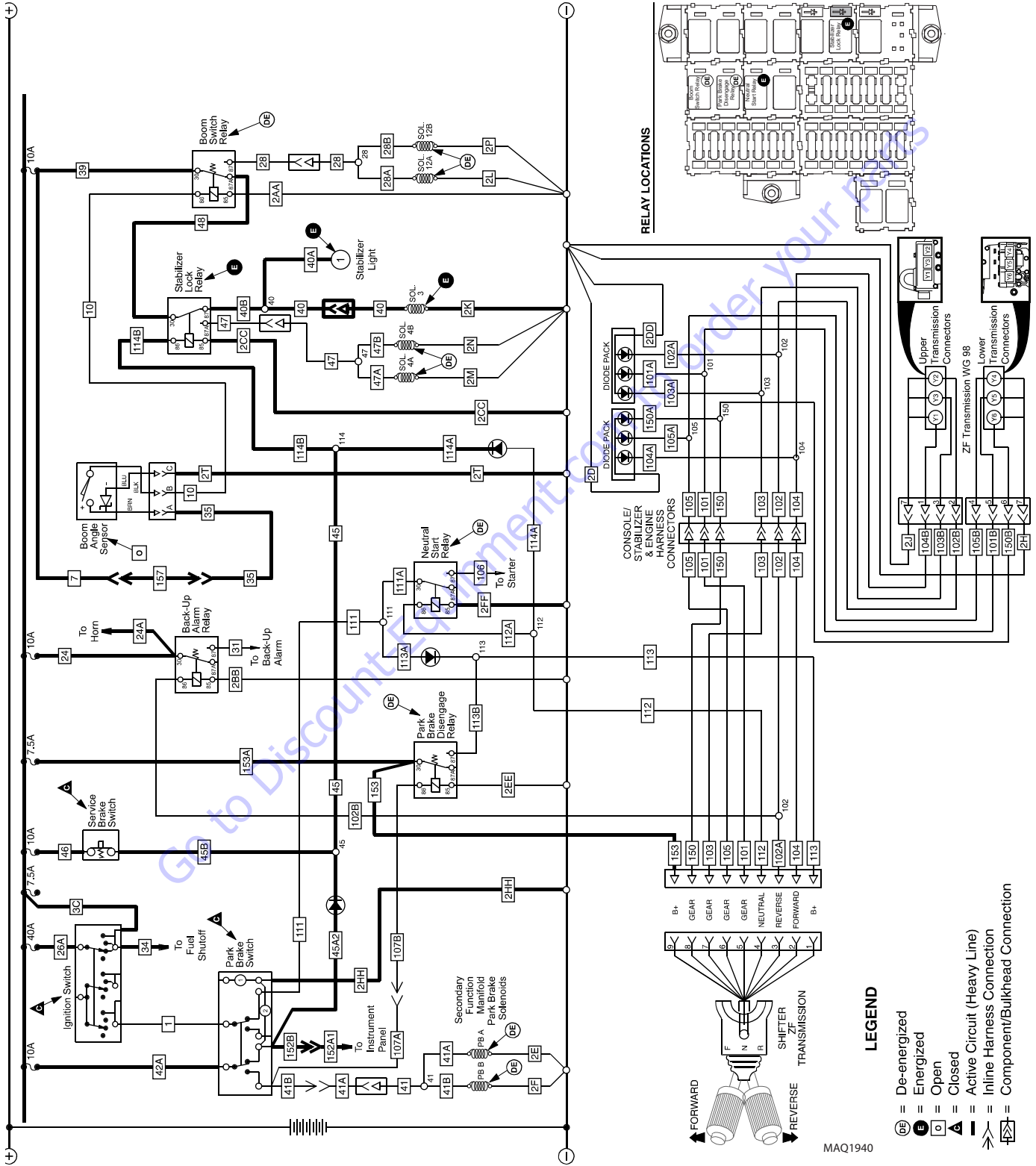
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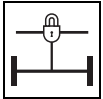


Stabil-TRAK™ System and Boom Interlock System

6042, 8042 and 10042 Stabil-TRAK Electrical Circuit LOCKED MODE

LOCKED MODE	1.	Ignition "ON"	4.	PB & SB Applied
Conditions	2.	Boom Above 40°	5.	Transmission in Neutral
	3.	Boom Retracted		



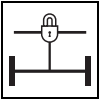


10.9 STABIL-TRAK™ AND BOOM INTERLOCK ELECTRICAL CIRCUIT OPERATION AND TROUBLESHOOTING (10054 & 12054)

Note: Before using the 10054 & 12054 Stabil-TRAK System Troubleshooting chart and diagrams, complete Section 10.7.2, “Stabil-TRAK™ System Test Procedures,” and Section 10.10, “Boom/Outrigger Interlock System Test,” to determine what part of the system is not functioning properly.

10054 & 12054 Stabil-TRAK System Troubleshooting				
		BOOM EXTEND MODE 1	BOOM EXTEND MODE 2	BOOM EXTEND MODE 3
		Refer to the mode Section , “10054 & 12054 Stabil-TRAK Electrical Circuit Boom Extend Mode 1.”	Refer to the mode Section , “10054 & 12054 Stabil-TRAK Electrical Circuit Boom Extend Mode 2.”	Refer to the mode Section , “10054 & 12054 Stabil-TRAK Electrical Circuit Boom Extend Mode 3.”
Switch/ Relay Solenoid	Machine Conditions	Ignition On Boom Below 40° Boom Retracted PB Released Trans. Fwd. or Rev. Outriggers Raised	Ignition On Boom Below 40° Boom Extended To 42 Series Extension Limit PB Released Trans. Fwd. or Rev. Outriggers Raised	Ignition On Boom Below 40° Boom Extended Beyond 42 Series Extension Limit PB Applied By Interlock Sys. Trans. In Neutral By Interlock Sys. Outriggers Lowered
	Solenoid 12A	Stabil-TRAK Components Affected By Boom Interlock System	E	E
Solenoid 12B	E		E	DE
Solenoid 3	DE		DE	E
Solenoid 4A	DE		DE	DE
Solenoid 4B	DE		DE	DE
Boom Angle Sensor	C		C	O
Boom Switch Relay	E		E	DE
Stabilizer Lock Relay	DE		DE	E
Stabilizer Light	OFF (DE)		OFF (DE)	ON (E)
Ignition Switch	C		C	C
Park Brake Switch	O		O	O
BOOM EXTEND INTERLOCK SYSTEM TROUBLESHOOTING				
Boom Extend Interlock Sensor	C	O	O	
Boom Extend Interlock Relay	E	DE	DE	
Boom Extend Lockout Relay	E	DE	DE	
Outrigger Pressure Switches	O	O	C	
Left Outrigger Lockout Relay	DE	E	E	
Right Outrigger Lockout Relay	DE	E	E	
Stabilizer Interlock Relay	DE	DE	E	
Stabilizer Lock-Up Relay	DE	DE	E	
Extend Circuit Solenoid Valve	E	E	E	
Secondary Function Manifold Park Brake Solenoids	E	E	DE	
Park Brake Interlock Relay	DE	DE	E	
Park Brake Disengage Relay	E	E	DE	

Note: If an outrigger is raised or a pressure switch is defective, boom on the 10054 & 12054 will not extend beyond the 42 Series extension limit.



Stabil-TRAK™ System and Boom Interlock System

Definitions:

Boom Retracted = Less than 42 Series extension limit

Boom Extended = Boom at 42 Series extension limit or greater (See Figure at Right).

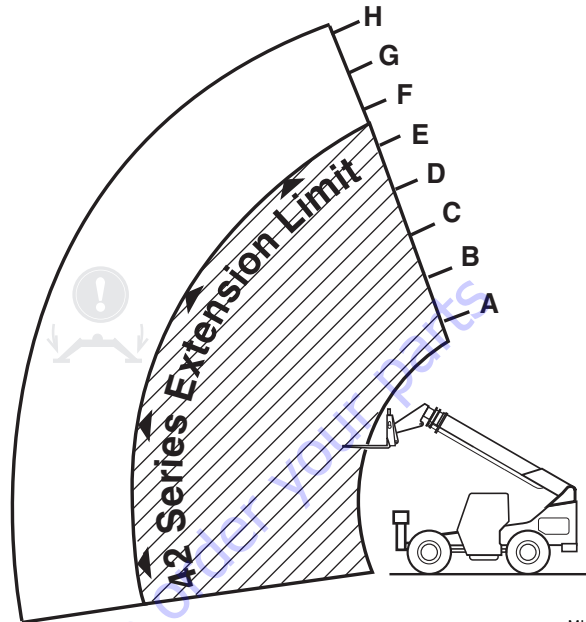
PB = Park Brake

DE = De-energized

E = Energized

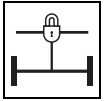
C = Closed

O = Open



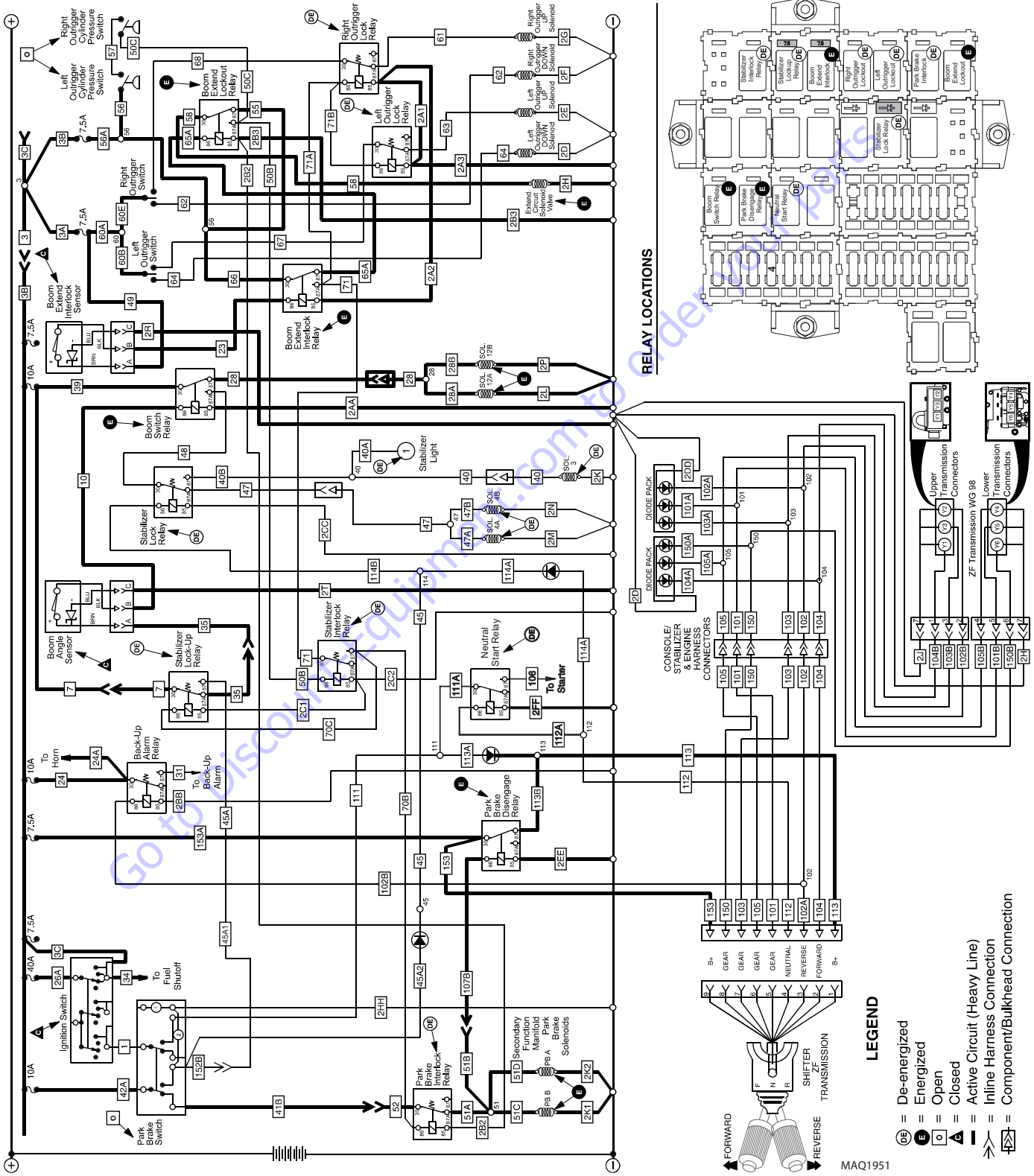
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Stabil-TRAK™ System and Boom Interlock System

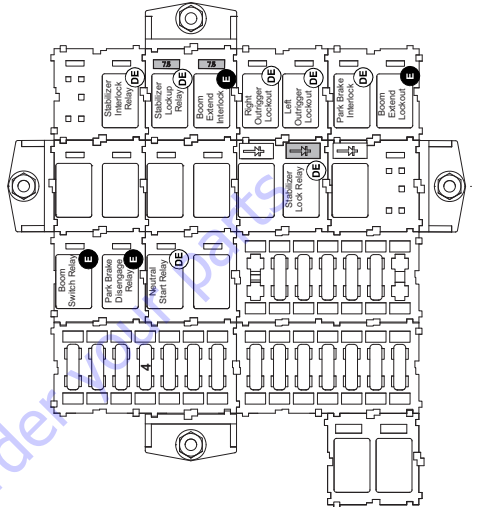


10054 & 12054 Stabil-TRAK Electrical Circuit Boom Extend Mode 1

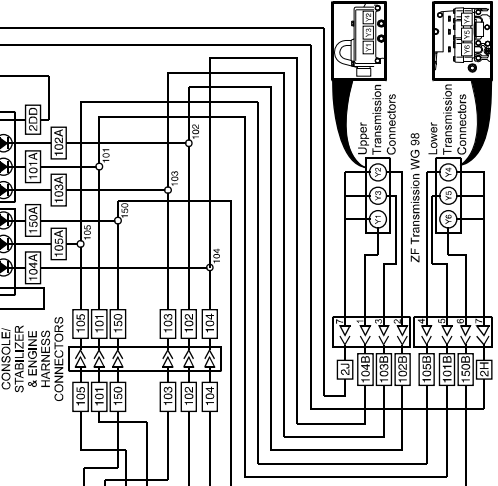
MODE 1	1.	Ignition "ON"	4.	PB Released
Conditions	2.	Boom Below 40°	5.	Transmission in Fwd. or Rev.
	3.	Boom Retracted	6.	Outriggers Raised



RELAY LOCATIONS

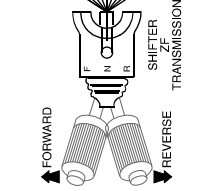


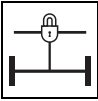
CONSOLE/STABILIZER & ENGINE CONNECTORS



LEGEND

- ⊖ = De-energized
- ⊕ = Energized
- ⊔ = Open
- ⊓ = Closed
- ⊕ = Active Circuit (Heavy Line)
- ⊖ = Inline Harness Connection
- ⊕ = Component/Bulkhead Connection

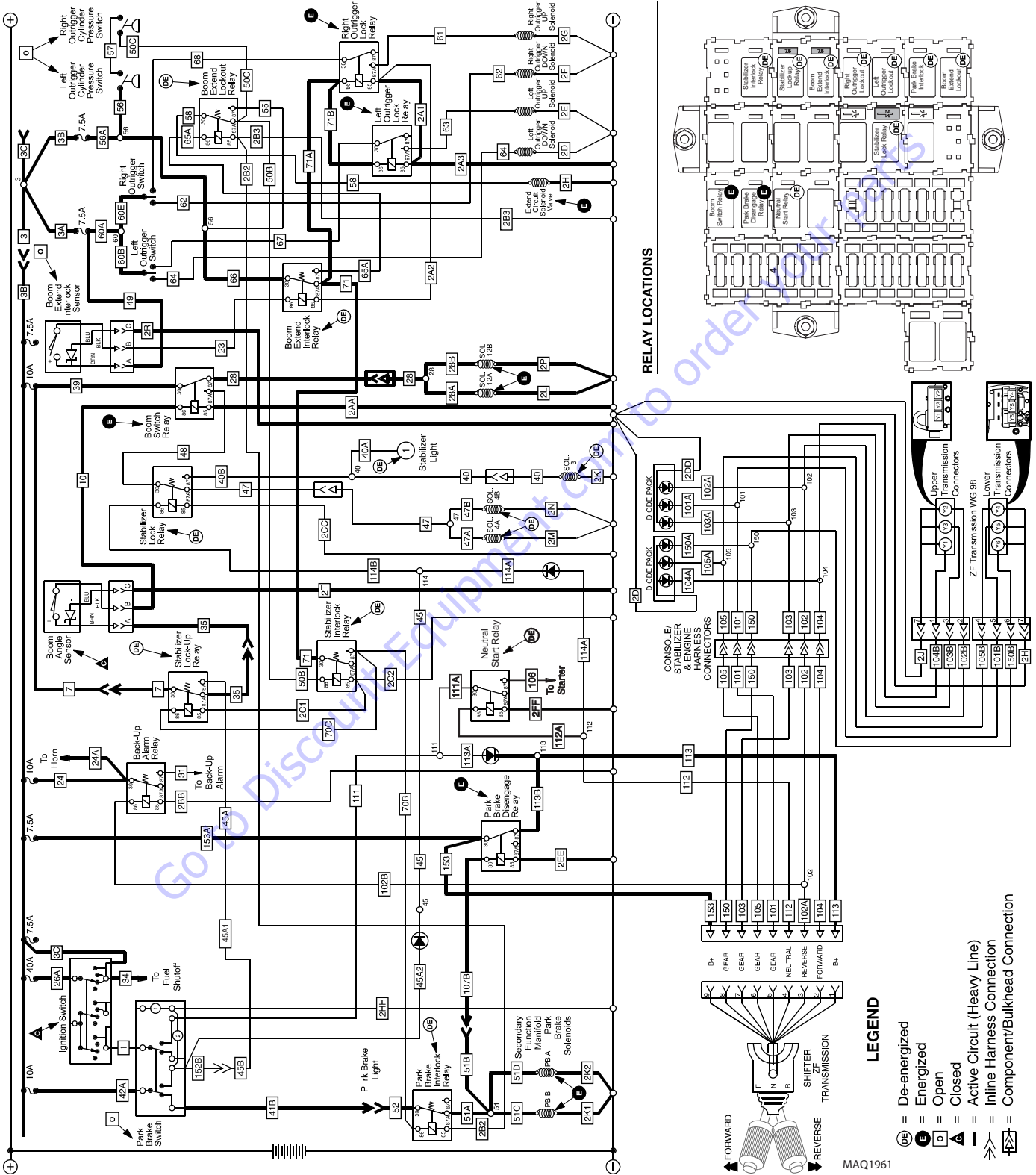




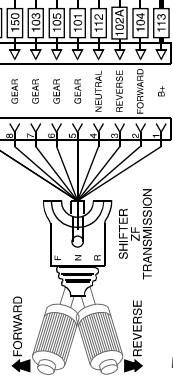
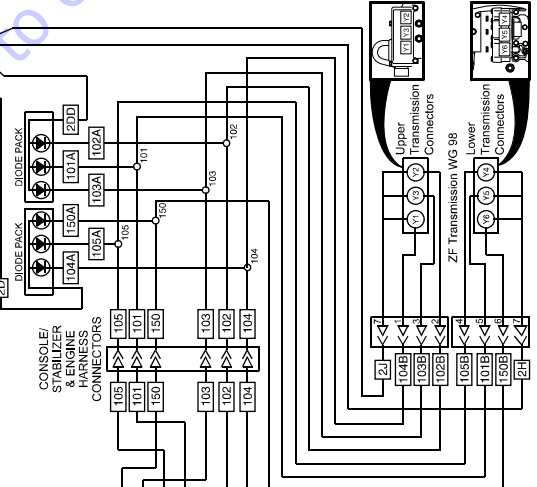
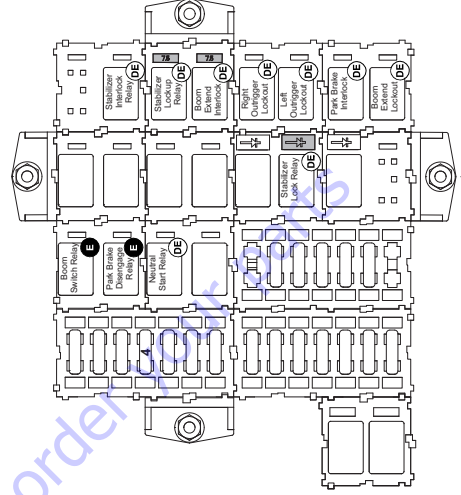
Stabil-TRAK™ System and Boom Interlock System

MODE 2	1.	Ignition "ON"	4.	PB Released
Conditions	2.	Boom Below 40°	5.	Transmission in Fwd. or Rev.
	3.	Boom Ext. To 42 Foot Ext. Limit	6.	Outriggers Raised

10054 & 12054 Stabil-TRAK Electrical Circuit Boom Extend Mode 2

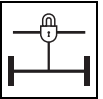


RELAY LOCATIONS



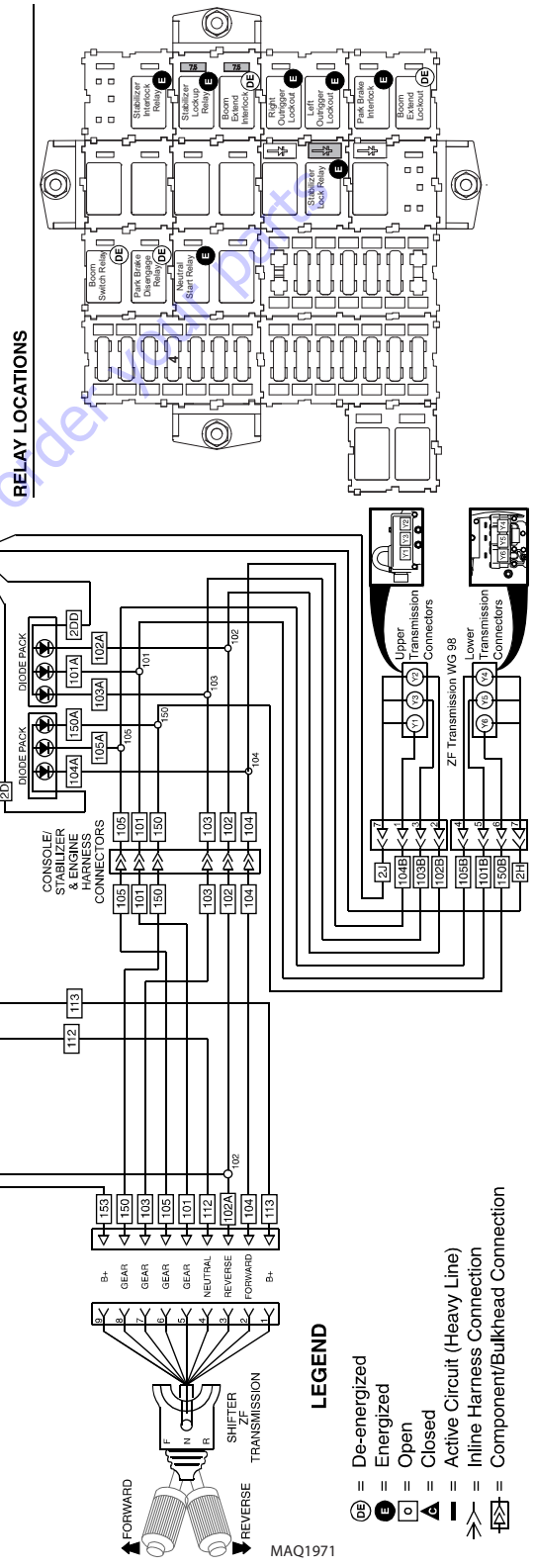
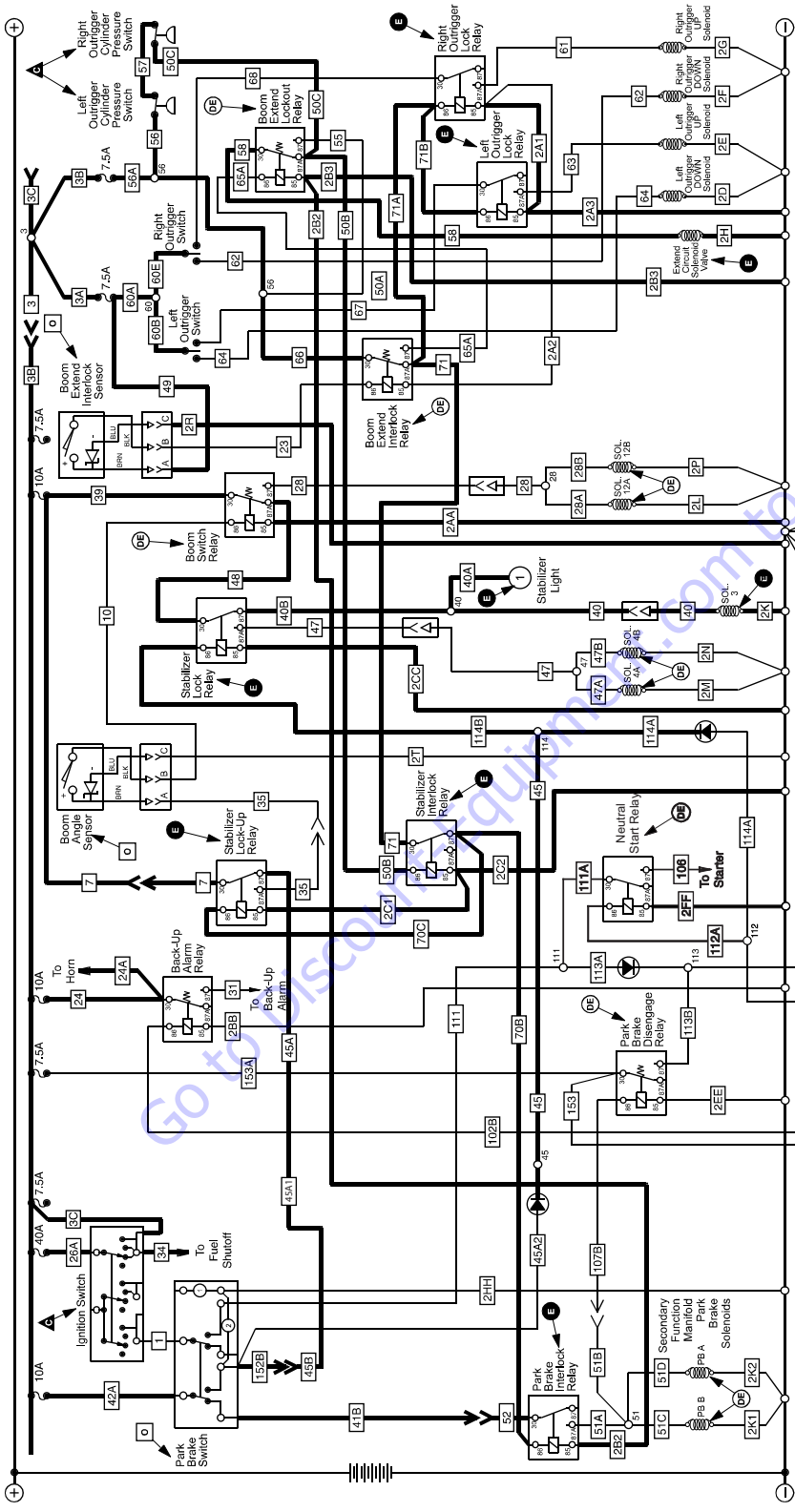
- LEGEND**
- = De-energized
 - = Energized
 - = Open
 - ◻ = Closed
 - = Active Circuit (Heavy Line)
 - = Inline Harness Connection
 - = Component/Bulkhead Connection

Stabil-TRAK™ System and Boom Interlock System



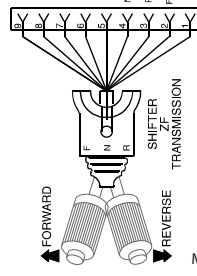
10054 & 12054 Stabil-TRAK Electrical Circuit Boom Extend Mode 3

MODE 3	1.	Ignition "ON"	4.	PB Applied By Interlock Sys.
Conditions	2.	Boom Below 40°	5.	Trans. in Neutral By Interlock Sys.
	3.	Boom Ext. Beyond 42 Foot Ext. Limit	6.	Outriggers Lowered

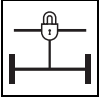


RELAY LOCATIONS

CONSOLE/STABILIZER & ENGINE CONNECTORS



- LEGEND**
- (⊖) = De-energized
 - (⊕) = Energized
 - (□) = Open
 - (■) = Closed
 - (—) = Active Circuit (Heavy Line)
 - (—) = Inline Harness Connection
 - (—) = Component/Bulkhead Connection



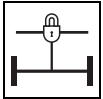
10.10 BOOM/OUTRIGGER INTERLOCK SYSTEM TEST

Before performing the following Boom/Outrigger Interlock System Test, perform Section 10.7, “Stabil-TRAK™ System Test,” to determine if the Stabil-TRAK system is working properly. If necessary, repair Stabil-TRAK system before testing boom/outrigger interlock system.

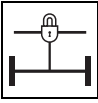
10.10.1 System Test Procedures

If Steps 1 through 5 prove positive, the Boom/Outrigger Interlock System is functioning properly, and the machine can be returned to service. If any of these steps indicate that the Boom/Outrigger Interlock system is not functioning properly, follow the procedures in Section 10.12, “Boom Extend System Hydraulic Circuit Operation and Troubleshooting”, to repair the system.

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Boom/Outrigger Interlock System Test Procedures	
BOOM EXTEND MODE 1	Step 1
	<ul style="list-style-type: none"> a. Place the machine with no load on a hard, level surface such as blacktop or concrete. b. Fasten your seat belt.
BOOM EXTEND MODE 2	Step 2
	<ul style="list-style-type: none"> a. With outriggers in the raised position and the boom in a horizontal position, extend the boom. The boom should extend until the letter "E" appears and then should STOP. If the boom extends beyond the letter "F", retract the boom fully and have the system repaired before using the machine again. b. Attempt to frame level the machine to the right and left; it should frame level normally.
BOOM EXTEND MODE 3	Step 3
	<ul style="list-style-type: none"> a. Lower both outriggers to the ground. DO NOT lift the front wheels of the machine off the ground at this time. The Stabil-TRAK light should come ON when the outriggers are lowered. b. With the boom still in a horizontal position, extend the boom beyond the letter "F". c. Attempt to raise both outriggers; they should not rise. If the outriggers rise, STOP and retract the boom and have the system repaired before using the machine again. d. If the outriggers cannot be raised, attempt to lower the outriggers fully until both front wheels are off the ground; the outriggers should lower.
	Step 4
	<ul style="list-style-type: none"> a. Place the travel select lever in the (F) FORWARD position and the gear select lever in the (1) FIRST gear position. b. Attempt to accelerate the machine; the machine should not move. c. If the machine attempts to move, STOP and have the system repaired before using the machine again.
IMPORTANT: Perform Steps 5 thru 9 with the engine rpm at idle.	
BOOM EXTEND MODE 1	Step 5
	<ul style="list-style-type: none"> a. Attempt to frame level the machine to the right and left; it should frame level, but at a SLOWER speed than normal. b. The Stabil-TRAK light should remain ON. c. Return the machine to a level position.
	Step 6
BOOM EXTEND MODE 1	<ul style="list-style-type: none"> a. Place the transmission in (N) NEUTRAL, move the neutral lock lever to the NEUTRAL LOCK position. b. Fully retract the boom. c. Raise the outriggers. d. Engage the parking brake switch, shut the engine OFF and remove the key. e. Exit the machine using both handholds.



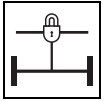
10.11 STABIL-TRAK™ HYDRAULIC CIRCUIT OPERATION AND TROUBLESHOOTING

The function of the Stabil-TRAK system varies under different operating conditions. The basic modes include the FREE PIVOT MODE, SLOW PIVOT MODE and LOCKED MODE.

The hydraulic operation and troubleshooting information for each of these modes will be described on the following pages.

Troubleshooting Symptom Chart

Symptom	Conditions	Reference
With the boom below 40°, when leveling the frame to right, left front tire comes off the ground.	Ignition ON, engine running Boom angle is below 40° Travel select lever is in (F) FORWARD or (R) REVERSE Park brake OFF Service brake DISENGAGED	Refer to Section 10.11.2, "Hydraulic Circuit Operation - FREE PIVOT Mode, Rod Oil Out" and Section 10.11.3, "Hydraulic Troubleshooting - FREE PIVOT Mode, Rod Oil Out"
With the boom below 40°, when leveling the frame to left, right front tire comes off the ground.	Ignition ON, engine running Boom angle is below 40° Travel select lever is in (F) FORWARD or (R) REVERSE Park brake OFF Service brake DISENGAGED	Refer to Section 10.11.4, "Hydraulic Circuit Operation - FREE PIVOT Mode, Base Oil Out" and Section 10.11.5, "Hydraulic Troubleshooting - FREE PIVOT Mode, Base Oil Out"
While traveling, ride feels spongy (riding on 3 wheels).	Ignition ON, engine running Boom angle is above 40° Travel select lever is in (F) FORWARD or (R) REVERSE Park brake OFF Service brake DISENGAGED	Refer to Section 10.11.6, "Hydraulic Circuit Operation - SLOW PIVOT Mode, Rod Oil Out" and Section 10.11.7, "Hydraulic Troubleshooting - SLOW PIVOT Mode, Rod Oil Out"
Stabil-TRAK light in instrument cluster is not ON.	Ignition ON, engine running Boom angle is above 40° Transmission is in (N) NEUTRAL, or Park brake ON or Service brake ENGAGED	Refer to Section 10.11.10, "Hydraulic Circuit Operation - LOCKED MODE" and Section 10.11.12, "Hydraulic Troubleshooting - LOCKED MODE, Will Not Frame Level Right" or Section 10.11.14, "Hydraulic Troubleshooting - LOCKED MODE, Will Not Frame Level Left"
With the boom above 40°, when leveling the frame to right, left front tire comes off the ground.	Ignition ON, engine running Boom angle is above 40° Transmission is in (N) NEUTRAL, or Park brake ON or Service brake ENGAGED	Refer to Section 10.11.11, "Hydraulic Circuit Operation - LOCKED MODE, Frame Level Right" and Section 10.11.12, "Hydraulic Troubleshooting - LOCKED MODE, Will Not Frame Level Right"
With the boom above 40°, when leveling the frame to left, right front tire comes off the ground.	Ignition ON, engine running Boom angle is above 40° Transmission is in (N) NEUTRAL, or Park brake ON or Service brake ENGAGED	Refer to Section 10.11.13, "Hydraulic Circuit Operation - LOCKED MODE, Frame Level Left" and Section 10.11.14, "Hydraulic Troubleshooting - LOCKED MODE, Will Not Frame Level Left"

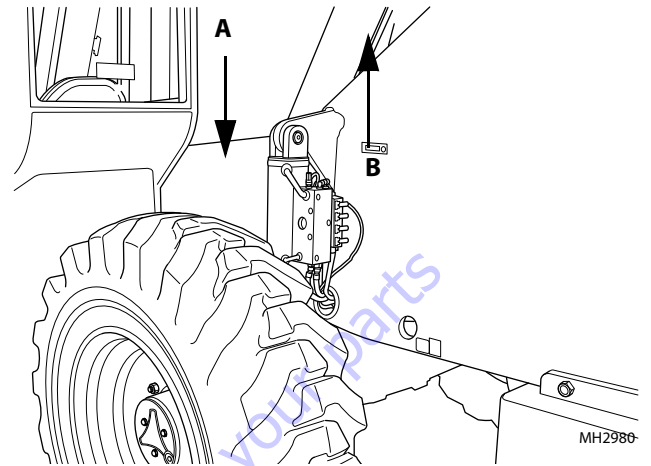


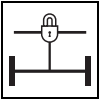
10.11.1 Stabil-TRAK™ Cylinder Oil Flow

In the FREE PIVOT and SLOW PIVOT MODES, oil flow from the stabilizer cylinder will be in one of two directions; ROD OIL OUT or BASE OIL OUT.

ROD OIL OUT flow will occur when the left side of the rear axle is lower than the right side (left wheel in a pothole, or the right wheel passing over an obstruction), causing the cylinder to extend (**A**).

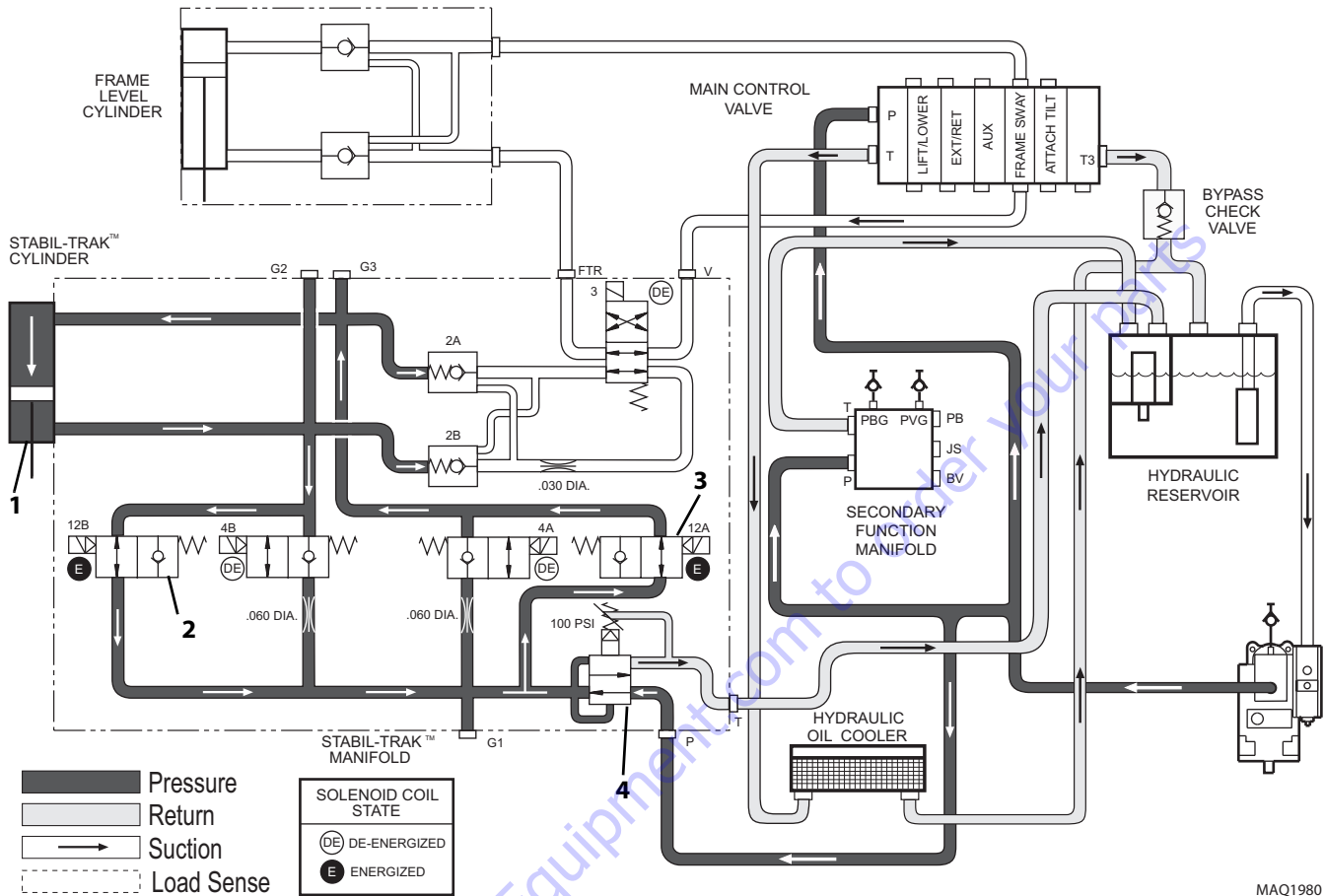
BASE OIL OUT flow will occur when the right side of the rear axle is lower than the left (right wheel in a pothole, or the left wheel passing over an obstruction), causing the cylinder to compress (**B**).





Stabil-TRAK™ System and Boom Interlock System

10.11.2 Hydraulic Circuit Operation - FREE PIVOT Mode, Rod Oil Out



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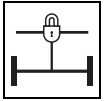
Conditions:

- Boom angle is below 40°
- Rear axle pivots freely
- Travel select lever in (F) FORWARD or (R) REVERSE position
- Park brake OFF
- Service brake DISENGAGED

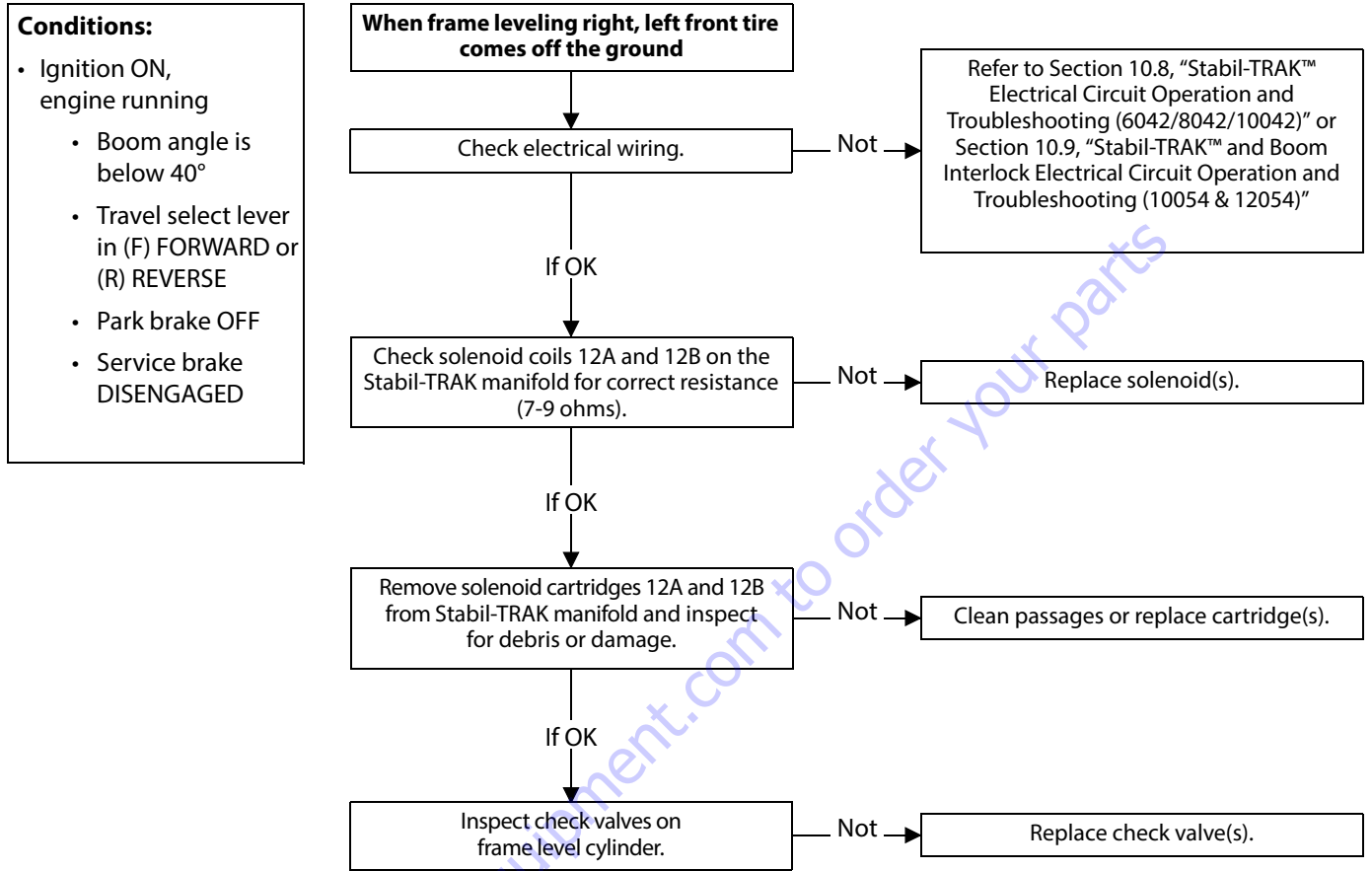
Operation:

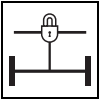
When the conditions are met, solenoids 12A and 12B are energized. As the left side of the rear axle moves down, the rod extends, forcing hydraulic oil out from the rod end of the Stabil-TRAK cylinder (1). The oil then flows through the solenoid-operated valves 12B (2) and 12A (3), to the base side of the Stabil-TRAK cylinder.

Because the volume of oil needed on the base side is greater than that needed on the rod side, the extra oil needed is supplied from the main hydraulic system through a 100 psi (7 bar) reducing cartridge (4) in the Stabil-TRAK manifold.



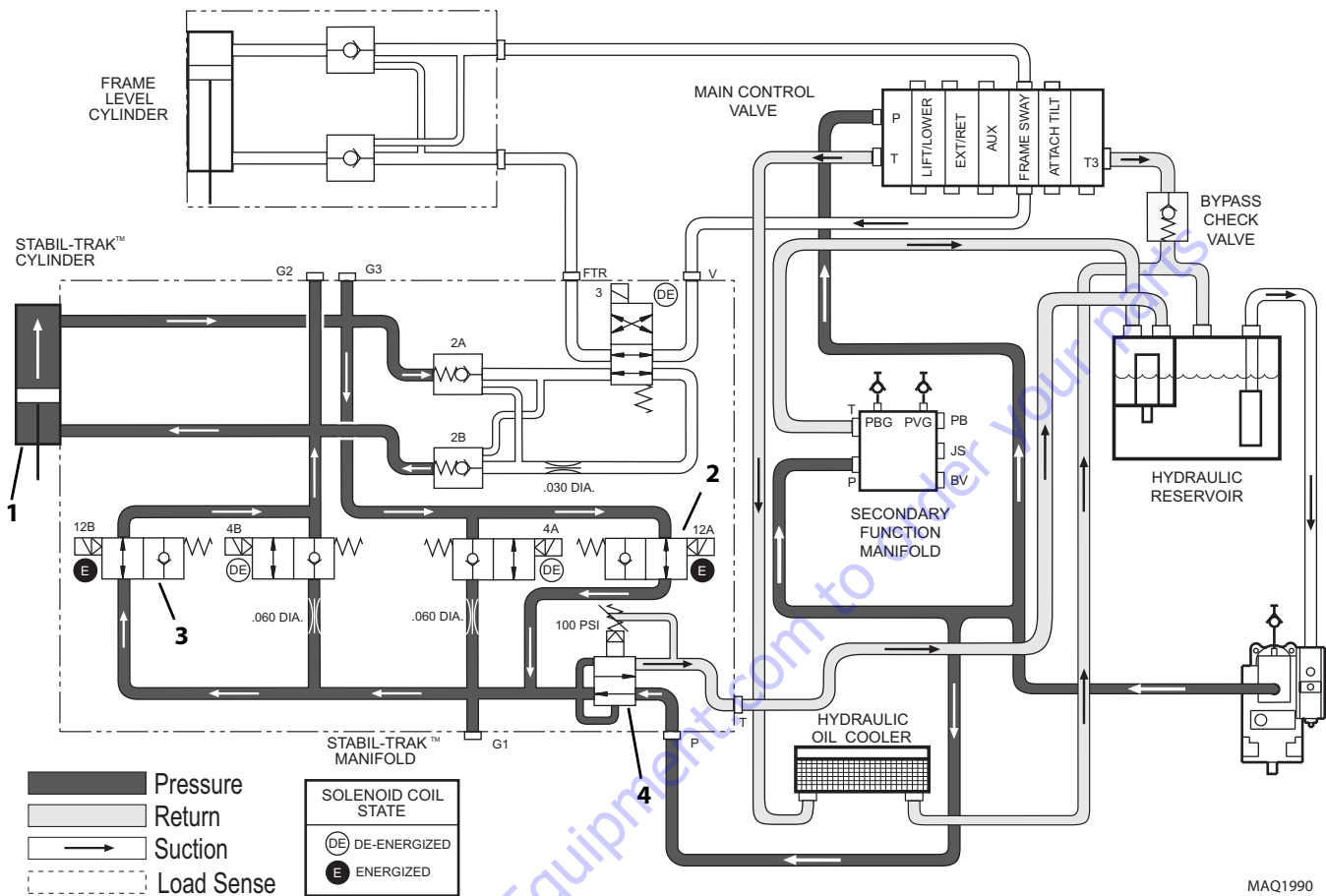
10.11.3 Hydraulic Troubleshooting - FREE PIVOT Mode, Rod Oil Out





Stabil-TRAK™ System and Boom Interlock System

10.11.4 Hydraulic Circuit Operation - FREE PIVOT Mode, Base Oil Out



MAQ1990

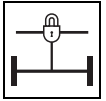
Conditions:

- Boom angle is below 40°
- Rear axle pivots freely
- Travel select lever in (F) FORWARD or (R) REVERSE position
- Park brake OFF
- Service brake DISENGAGED

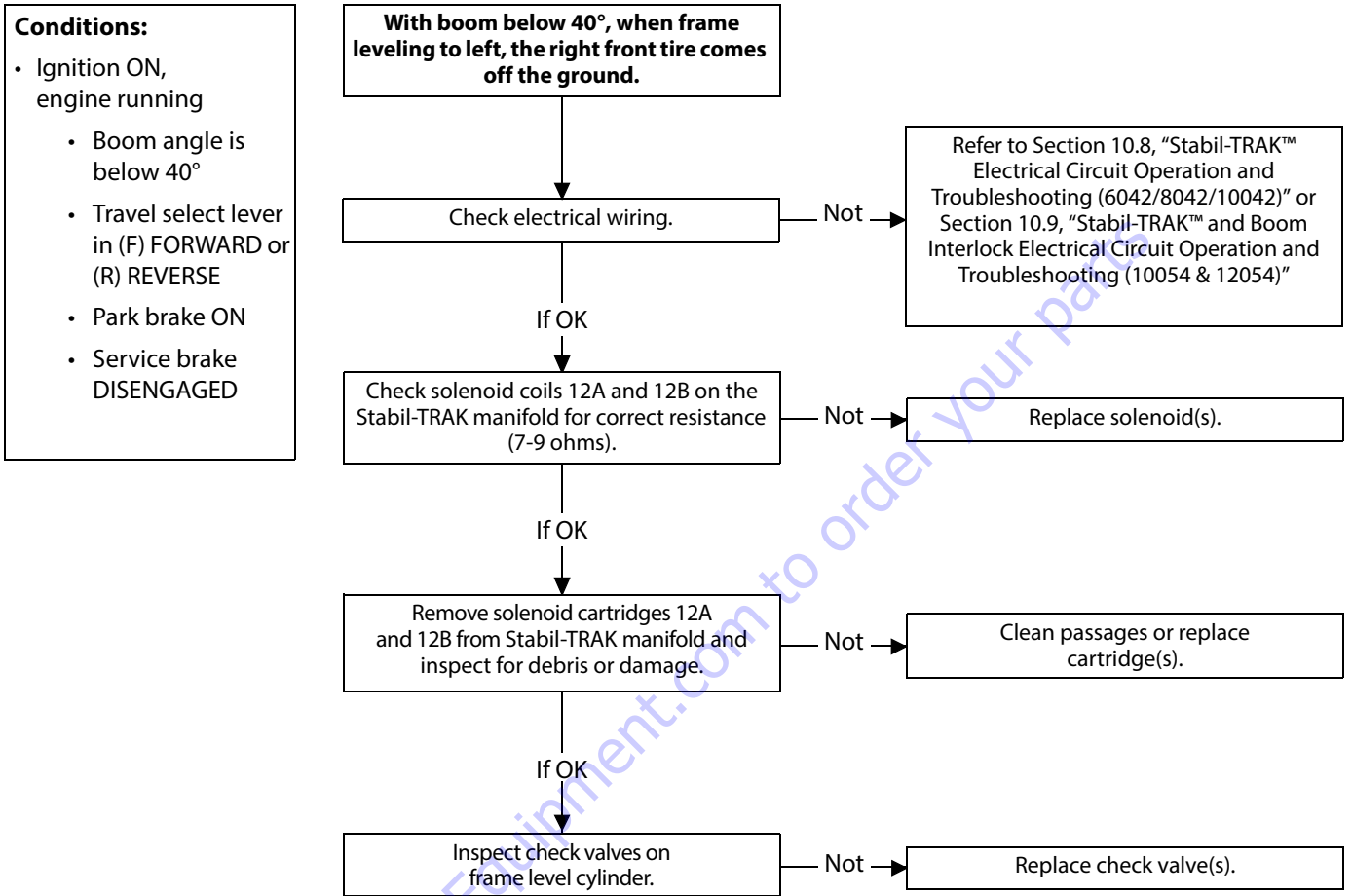
Operation:

When the conditions are met, solenoids 12A and 12B are energized. As the left side of the rear axle moves down, the rod is forced up, forcing hydraulic oil out from the base end of the Stabil-TRAK cylinder (1). The oil then flows through the solenoid-operated valves 12A (2) and 12B (3), to the rod side of the Stabil-TRAK cylinder.

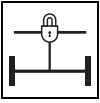
Because the volume of oil needed on the rod side is less than that needed on the base side, excess oil is returned to the tank through a 100 psi (7 bar) reducing cartridge (4) in the Stabil-TRAK manifold.



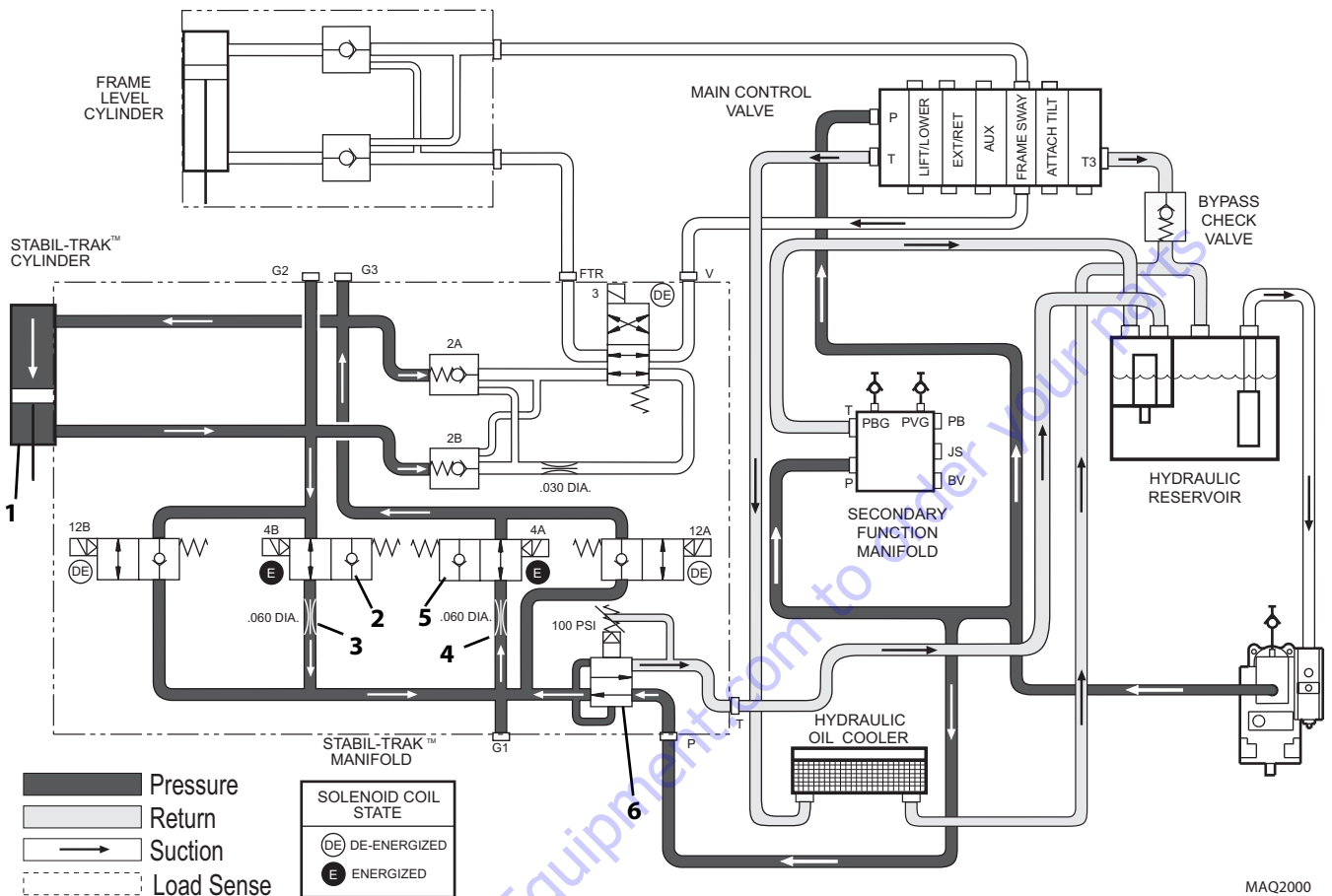
10.11.5 Hydraulic Troubleshooting - FREE PIVOT Mode, Base Oil Out



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10.11.6 Hydraulic Circuit Operation - SLOW PIVOT Mode, Rod Oil Out



MAQ2000

Conditions:

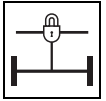
- Boom angle is above 40°
- Park brake OFF
- Service brake DISENGAGED
- Travel select lever in (F) FORWARD or (R) REVERSE position

Operation:

As the boom is raised above 40°, the boom proximity switch is deactivated, causing solenoids 12A and 12B to de-energize and solenoids 4A and 4B to energize. This allows oil to flow from the rod end of the Stabil-TRAK cylinder (1), through solenoid-operated valve 4B (2), through a 0.060 inch orifice (3), through another 0.060 inch orifice (4), then through solenoid-operated valve 4A (5), then to the base end of the Stabil-TRAK cylinder.

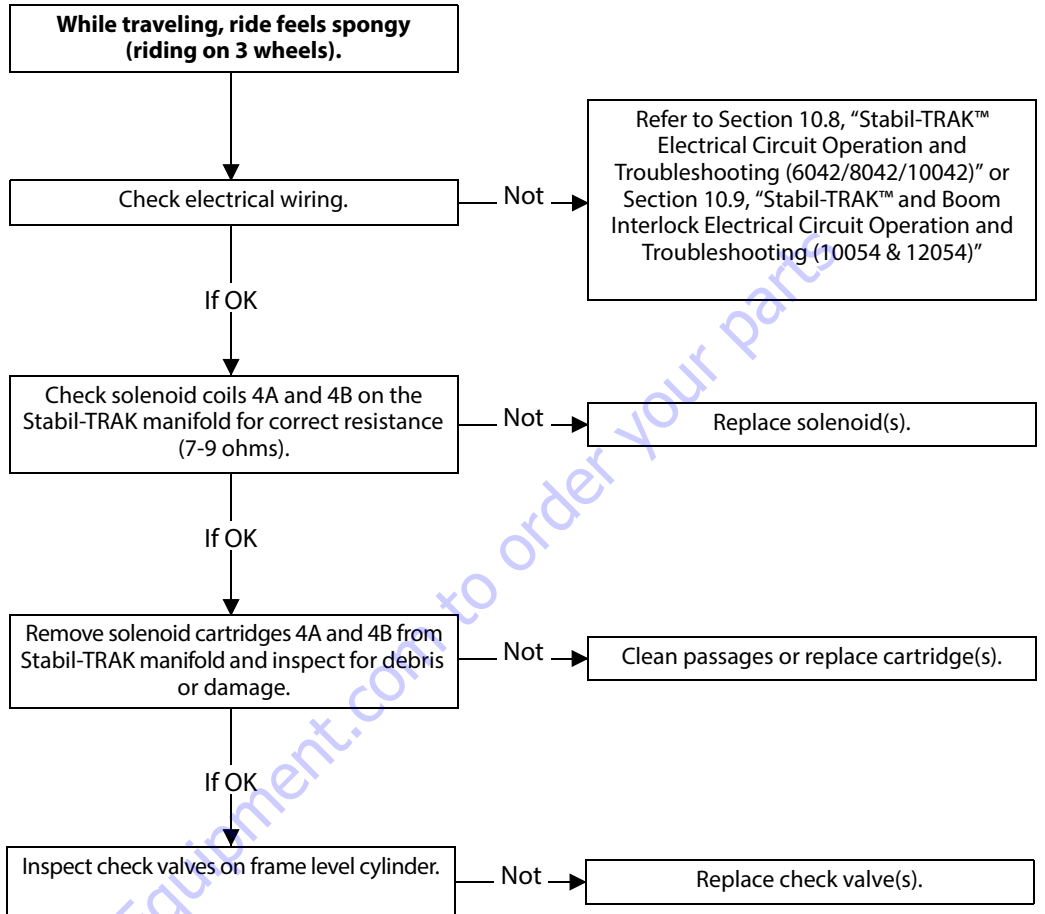
The 0.060 inch orifices (3 and 4) in solenoid-operated valves 4A (5) and 4B (2) will slow the movement of the rear axle in reaction to terrain changes. The frame level will react normally in this mode.

Because of greater volume of oil required, extra oil is required from system through the 100 psi (7 bar) reducing cartridge (6) in the Stabil-TRAK manifold. Restrictions produce the slow movement, or SLOW PIVOT mode.

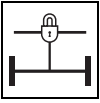


10.11.7 Hydraulic Troubleshooting - SLOW PIVOT Mode, Rod Oil Out

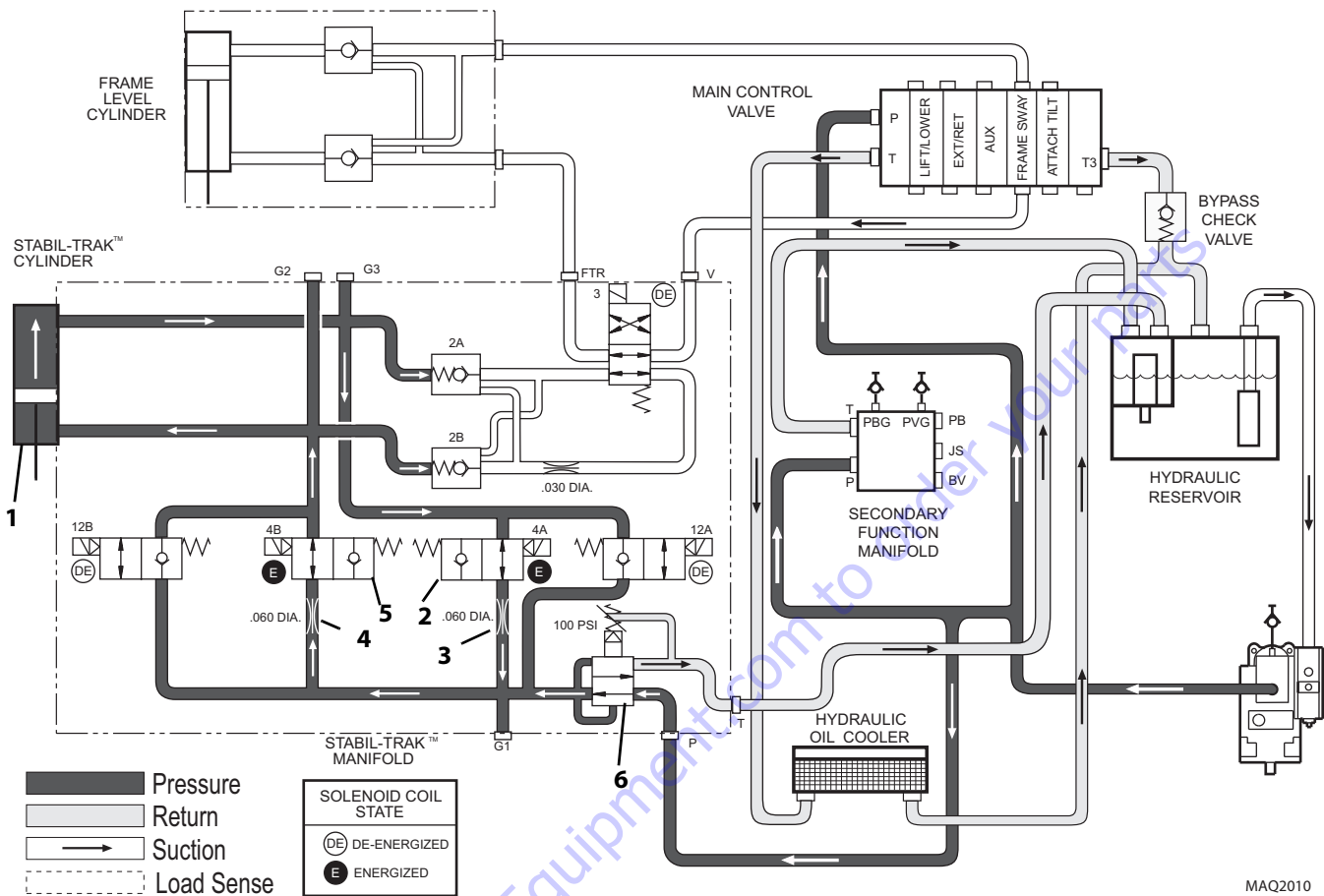
- Conditions:**
- Ignition ON, engine running
 - Boom angle is above 40°
 - Travel select lever in (F) FORWARD or (R) REVERSE
 - Park brake OFF
 - Service brake DISENGAGED



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10.11.8 Hydraulic Circuit Operation - SLOW PIVOT Mode, Base Oil Out



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Conditions:

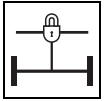
- Boom angle is above 40°
- Park brake OFF
- Service brake DISENGAGED
- Travel select lever in (F) FORWARD or (R) REVERSE position

Operation:

As the boom is raised above 40°, the boom proximity switch is deactivated causing solenoids 12A and 12B to de-energize and solenoids 4A and 4B to energize. This allows oil to flow from the base end of the Stabil-TRAK cylinder (1), through solenoid-operated valve 4A (2), through a 0.060 inch orifice (3), through another 0.060 inch orifice (4), then through solenoid-operated valve 4B (5), to the rod end of the Stabil-TRAK cylinder.

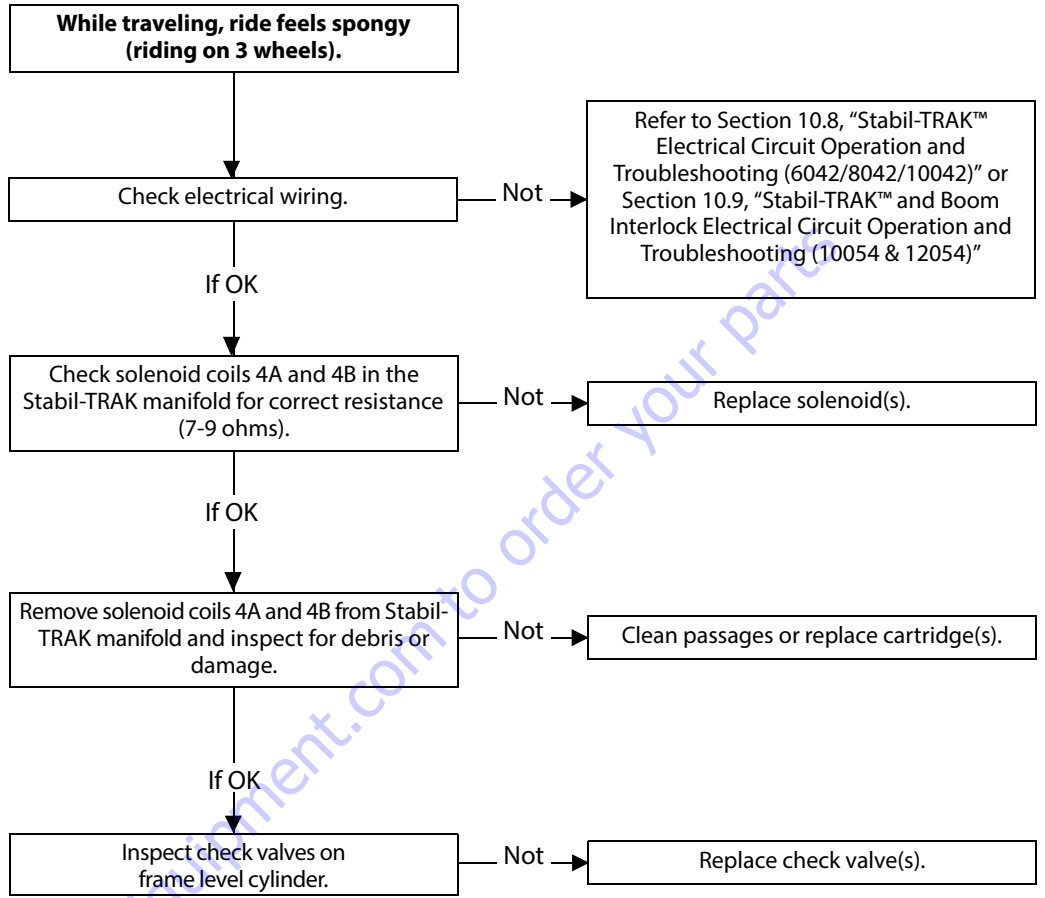
The 0.060 inch orifices (3 and 4) in solenoid-operated valves 4A and 4B will slow the movement of the rear axle in reaction to terrain changes. The frame level will react normally in this mode.

Because of greater volume of oil in base end, extra oil is returned to the tank through the 100 psi (7 bar) reducing cartridge (6) in the Stabil-TRAK manifold. Restrictions produce slow movement, or SLOW PIVOT mode.

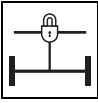


10.11.9 Hydraulic Troubleshooting - SLOW PIVOT Mode, Base Oil Out

- Conditions:**
- Ignition ON, engine running
 - Boom angle is above 40°
 - Travel select lever in (F) FORWARD or (R) REVERSE
 - Park brake OFF
 - Service brake DISENGAGED



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10.11.10 Hydraulic Circuit Operation - LOCKED MODE

a. Conditions:

- Boom angle is above 40°
- Park brake ON, or service brake ENGAGED, or transmission in (N) NEUTRAL

b. Operation:

When the conditions are met, solenoids 4A, 4B, 12A and 12B are de-energized and solenoid 3 is energized. In the LOCKED MODE, oil is prevented from flowing through the Stabil-TRAK manifold due to check valves in solenoid-operated valves 4A (1), 4B (2), 12A (3), and 12B (4).

10.11.11 Hydraulic Circuit Operation - LOCKED MODE, Frame Level Right

When joystick control is placed in frame level mode, cables activate the frame level valve in the main control valve assembly. As the joystick is moved to the right, the frame level spool valve is shifted, allowing oil to flow through the valve, to the Stabil-TRAK manifold, port V.

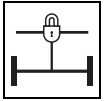
Oil entering the Stabil-TRAK manifold at port V flows through solenoid cartridge valve 3 (5), through a 0.030 inch orifice (6) and check valve 2A (7), to the base end of the Stabil-TRAK cylinder (8). The orifice slows the movement of the frame level.

Some of this oil is diverted to the pilot line of check valve 2B (9), opening the valve.

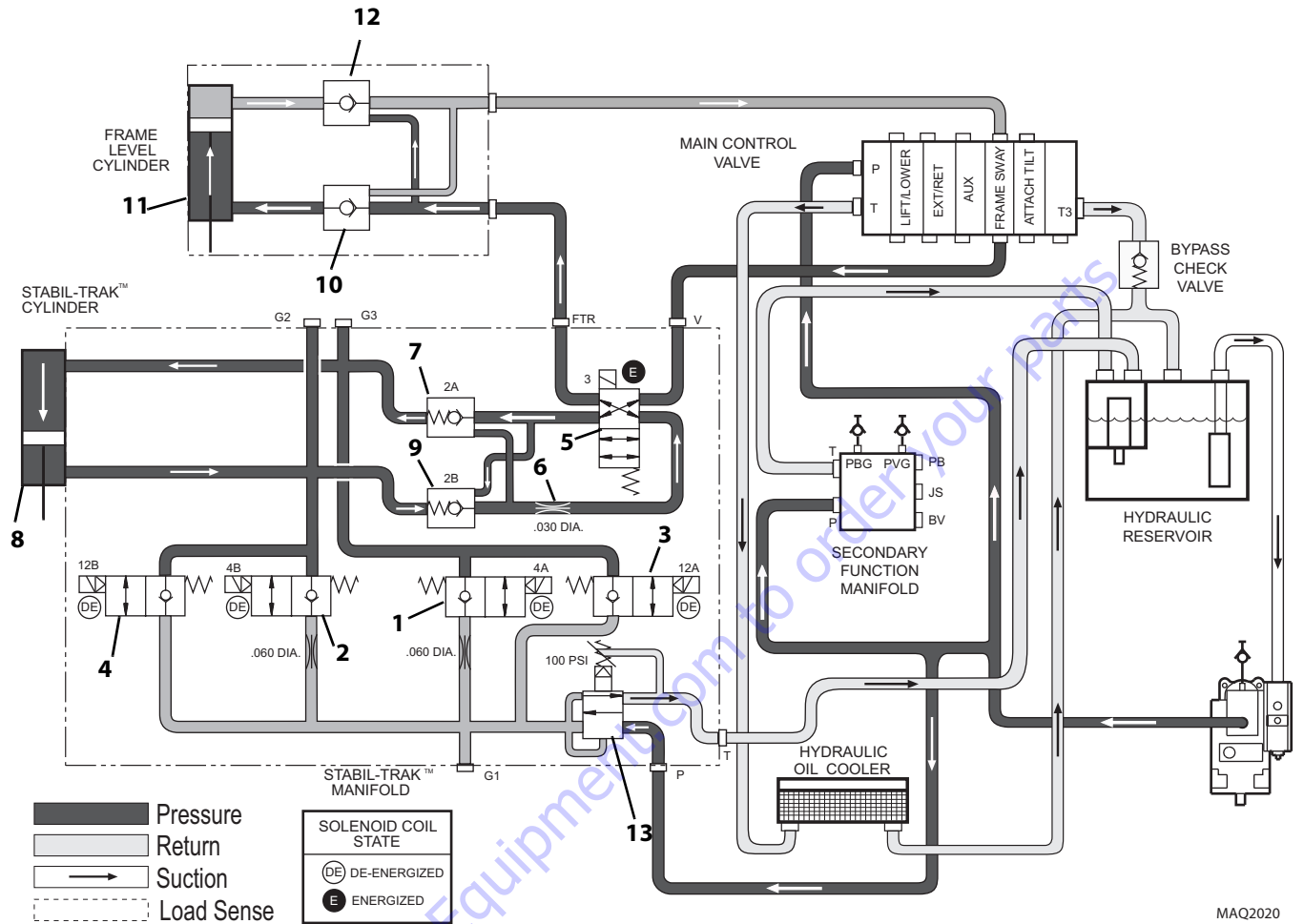
Rod end oil from the Stabil-TRAK cylinder flows through check valve 2B (9), opened by pilot pressure in the Stabil-TRAK manifold. The oil then flows through cartridge valve 3 (5), out of the Stabil-TRAK manifold at port FTR, through a check valve (10), to the rod end of the frame level cylinder (11).

Oil from the base end of the frame level cylinder flows through a piloted-open check valve (12) and back through the frame level spool valve in the frame level section of the main control valve, dumping the returned oil to the reservoir.

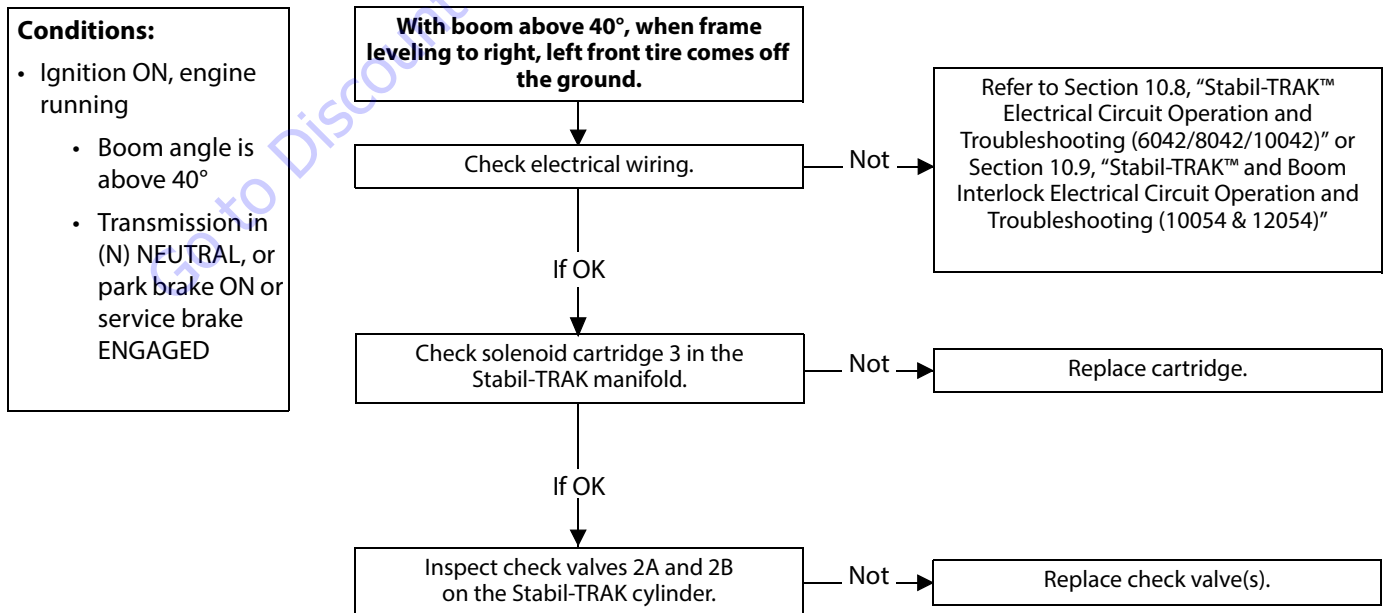
Pressurized oil entering Stabil-TRAK manifold at port P is stopped at the four closed solenoid-operated valves 4A (1), 4B (2), 12A (3) and 12B (4). At this time pilot pressure will cause the 100 psi relief valve (13) to change position, allowing the excess oil to vent to the reservoir.

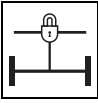


10.11.12 Hydraulic Troubleshooting - LOCKED MODE, Will Not Frame Level Right



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Stabil-TRAK™ System and Boom Interlock System

10.11.13 Hydraulic Circuit Operation - LOCKED MODE, Frame Level Left

a. Conditions

- Boom angle is above 40°
- Park brake ON, or service brake ENGAGED, or transmission in (N) NEUTRAL

b. Operation

When the joystick control is placed in the frame level mode, cables activate the frame level valve in the main control valve assembly. As the joystick is moved to the right, the frame level spool valve is shifted, allowing oil to flow through the valve, through the check valve (1) to the base end of the frame level cylinder (2).

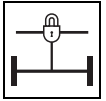
Some of this oil is diverted to the pilot line of the check valve (3) on the return side of the frame level cylinder, opening the valve.

Oil from rod end of the frame level cylinder flows through the check valve (3) opened by incoming pilot pressure oil, to the FTR port of the Stabil-TRAK manifold.

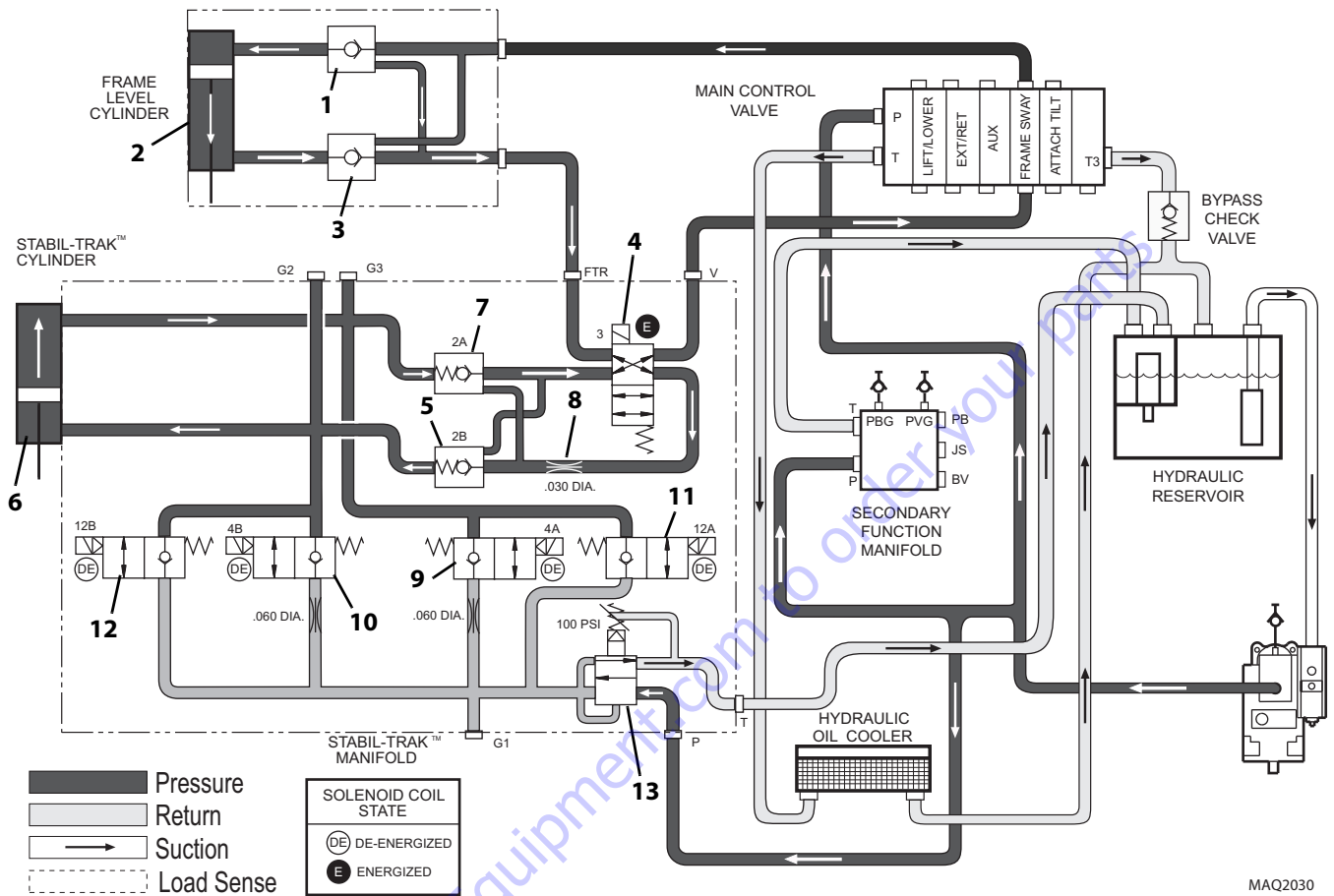
Oil entering at port FTR flows through solenoid valve 3 (4) through check valve 2B (5), to the rod end of the Stabil-TRAK cylinder (6). Some of this oil is diverted to the pilot line of check valve 2A (7), opening the valve.

Oil from the base end of the Stabil-TRAK cylinder flows through check valve 2A (7) and through a 0.030 inch orifice (8). This orifice slows the movement of the frame level. The oil then flows through solenoid-operated valve 3 (4), through port V, to the frame level spool valve in the main control valve. Oil flows through the valve, dumping the returned oil to the reservoir.

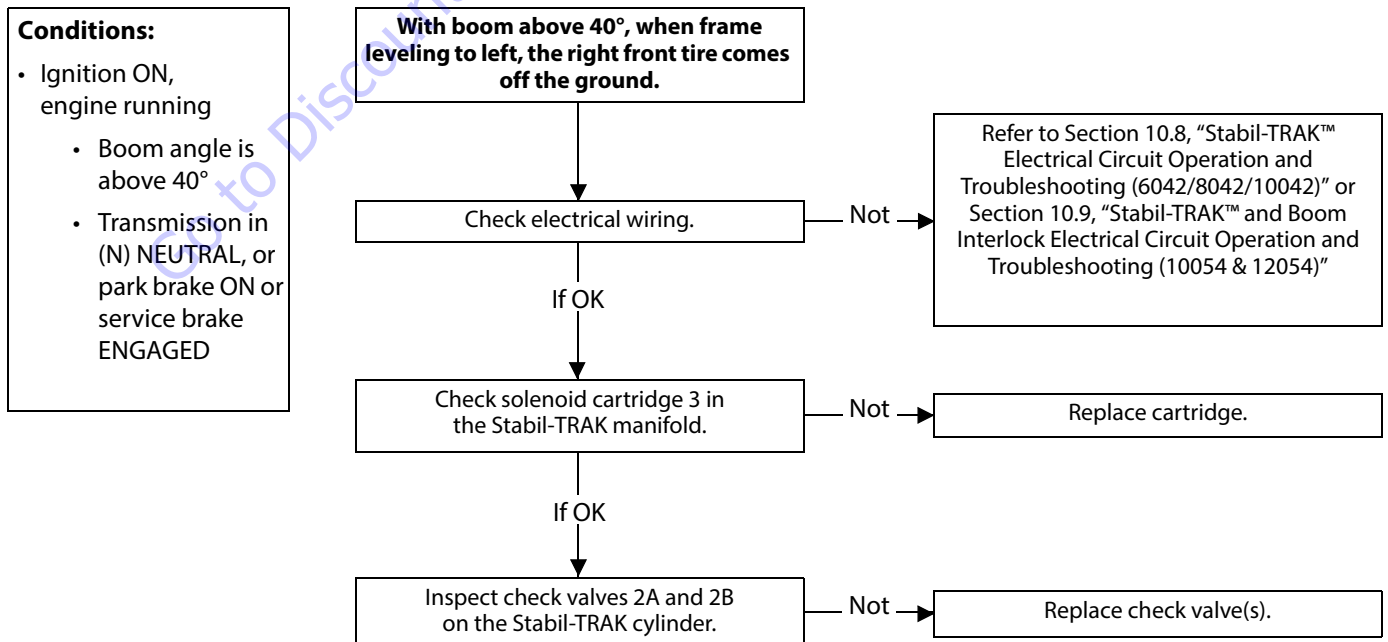
Pressurized oil entering Stabil-TRAK manifold at port P is stopped at the four closed solenoid-operated valves 4A (9), 4B (10), 12A (11), and 12B (12). At this time pilot pressure will cause the 100 psi relief valve (13) to change position, allowing the excess oil to vent to the reservoir.

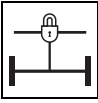


10.11.14 Hydraulic Troubleshooting - LOCKED MODE, Will Not Frame Level Left



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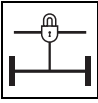
10.12 BOOM EXTEND SYSTEM HYDRAULIC CIRCUIT OPERATION AND TROUBLESHOOTING

The function of the boom extend interlock system varies under different operating conditions. The basic modes include the EXTEND INTERLOCK MODE and OUTRIGGER INTERLOCK MODE.

Hydraulic operation and troubleshooting information for each of these modes will be described on the following pages.

10.12.1 Troubleshooting Symptom Chart

Symptom	Conditions	Reference
With both outriggers RAISED, the boom will not extend.	Ignition ON, engine running Both outriggers RAISED	Refer to Section 10.12.2, "Hydraulic Circuit Operation - Extend Interlock Mode" and Section 10.12.3, "Hydraulic Troubleshooting - Extend Interlock Mode".
With both outriggers lowered onto firm terrain, the boom will not extend to its full limits.	Ignition ON, engine running Both outriggers lowered onto firm terrain	Refer to Section 10.12.4, "Hydraulic Circuit Operation - Outrigger Interlock Mode" and Section 10.12.5, "Hydraulic Troubleshooting - Outrigger Interlock Mode".



Stabil-TRAK™ System and Boom Interlock System

10.12.2 Hydraulic Circuit Operation - Extend Interlock Mode

Operation:

When the outriggers in the RAISED position, the outrigger pressure switches (1 and 2) are open.

As the boom is extended past the boom extend switch, the switch opens, de-energizing the boom lockout solenoid (3). This allows pressurized oil to flow through the valve body (4)

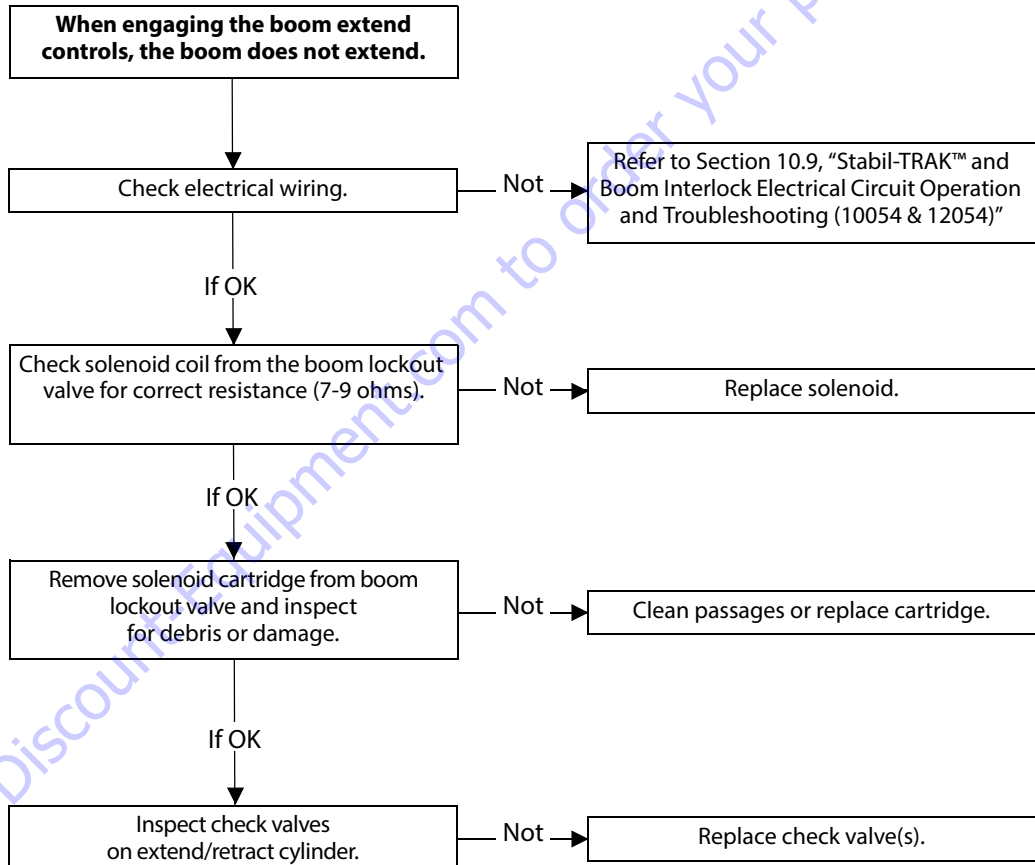
to the piston side of the pilot-operated valve (5), causing it to close. This prevents oil flow to the extend/retract cylinder (6), preventing the boom from being extended further.

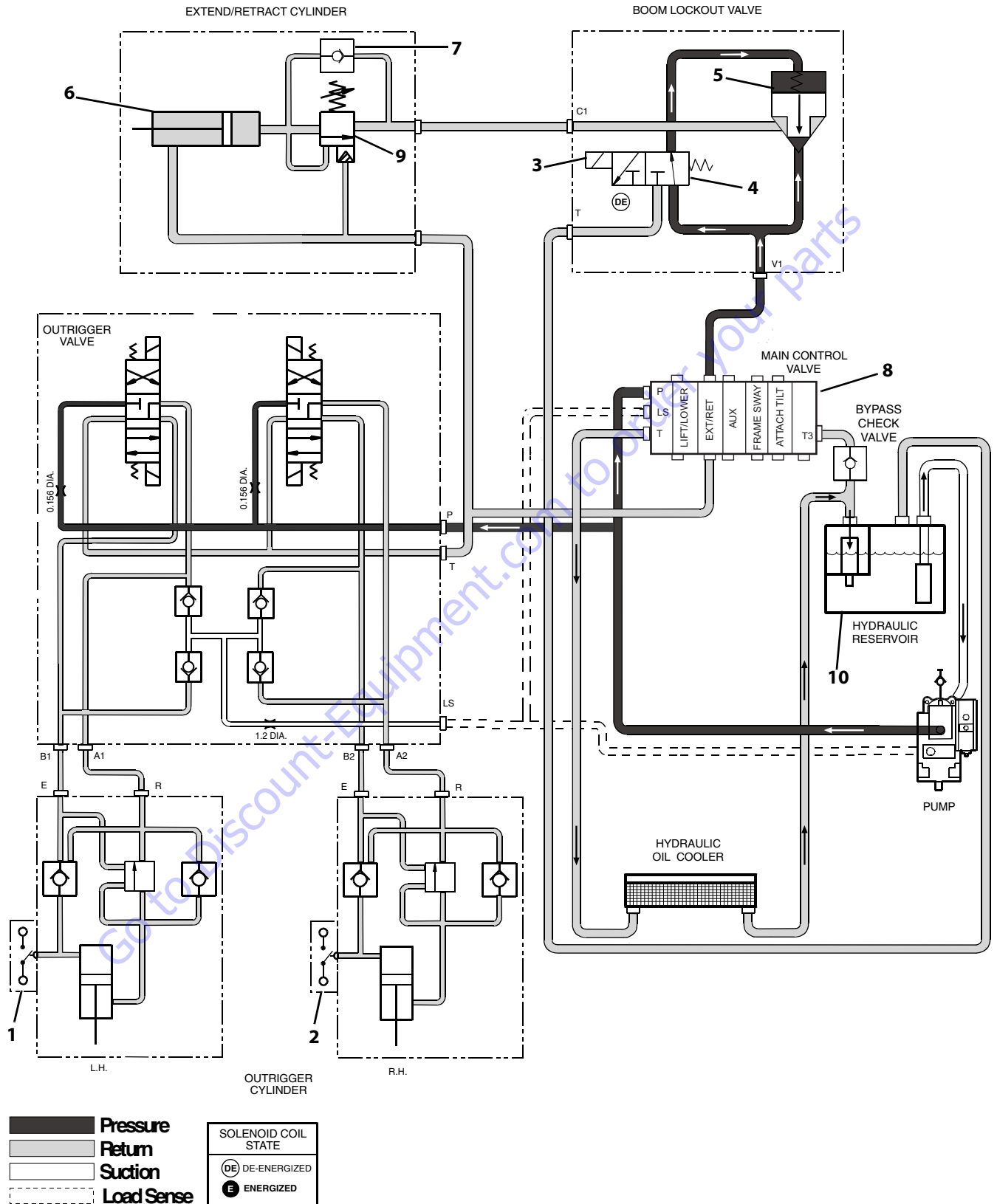
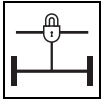
Retract function is still allowed, as oil flow through MCV (8) reversed, forcing the counterbalance valve (9) to open. The oil flow will cause the pilot-operated valve (5) to open, returning oil to the main control valve (8) and reservoir (10).

10.12.3 Hydraulic Troubleshooting - Extend Interlock Mode

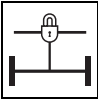
Conditions:

- Ignition ON, engine running
- Outriggers RAISED
- Travel select lever in (F) FORWARD or (R) REVERSE
- Park brake OFF
- Service brake DISENGAGED





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Stabil-TRAK™ System and Boom Interlock System

10.12.4 Hydraulic Circuit Operation - Outrigger Interlock Mode

Operation:

When the outriggers are lowered onto firm terrain, pressure within the outrigger cylinders close the outrigger pressure switches (1 and 2), energizing the boom extend lockout solenoid valve (3).

As the boom extends past the boom extend switch, the switch opens. The boom extend lockout solenoid valve (3), remains energized by the circuit provided by the outrigger pressure switches.

Pressurized oil flows over the free-flow check valve (4), into the base of the extend/retract cylinder (5) allowing the cylinder to extend.

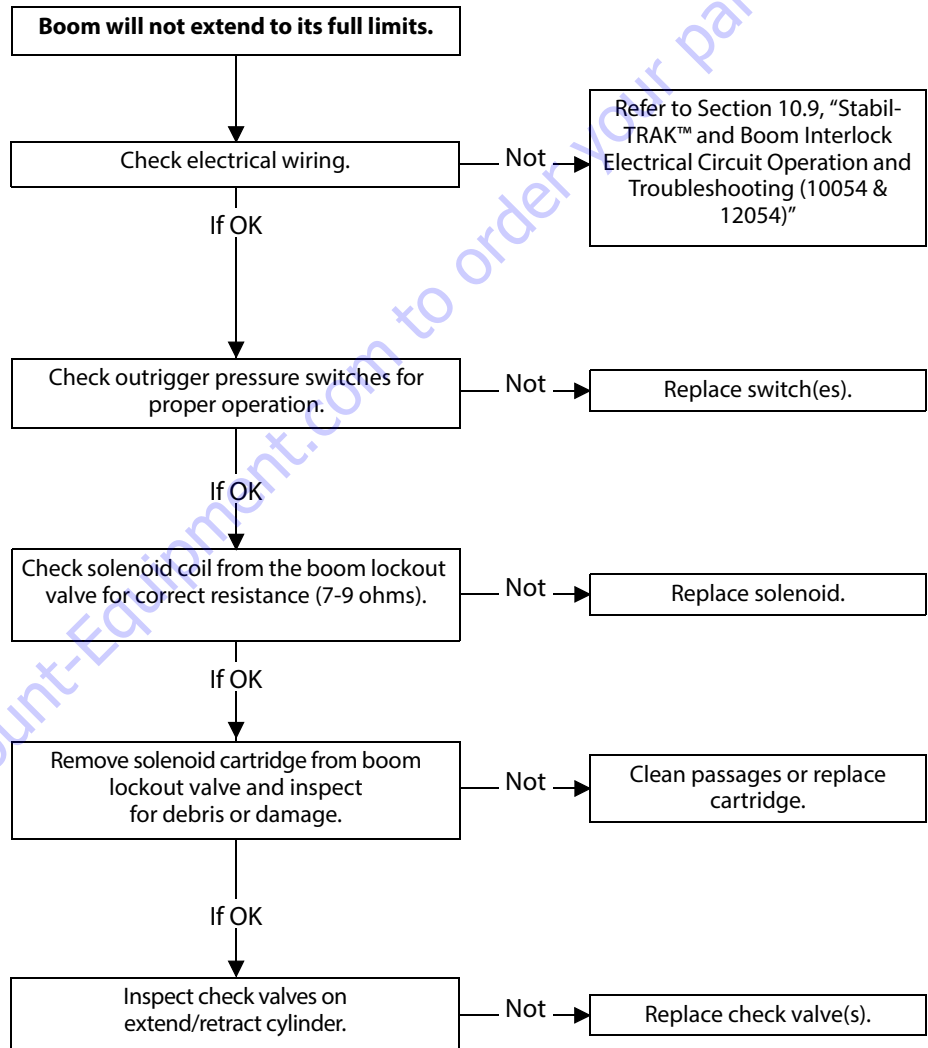
10.12.5 Hydraulic Troubleshooting - Outrigger Interlock Mode

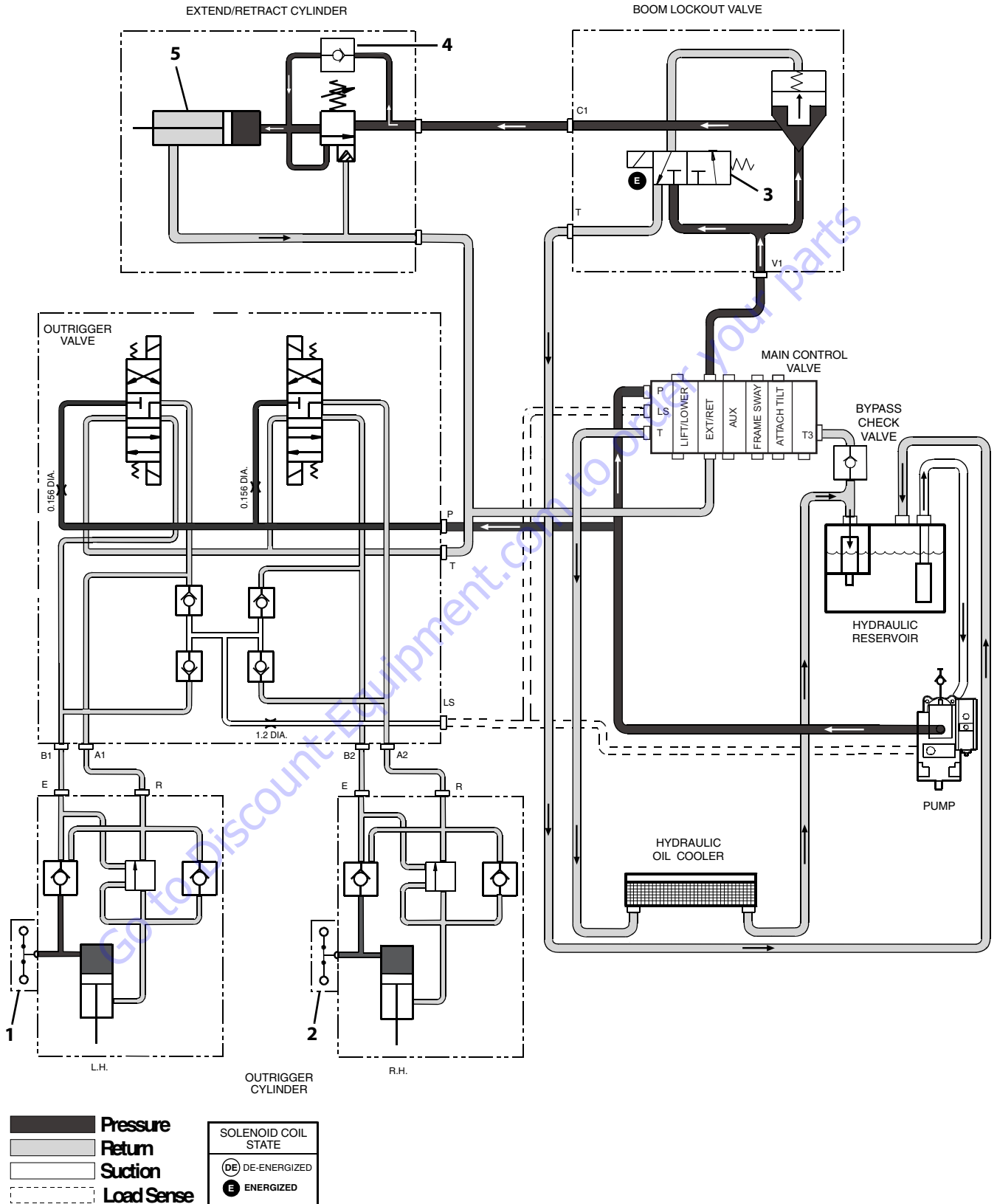
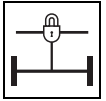
Conditions:

- Both outriggers lowered onto firm terrain.

Note: When the outrigger interlock mode is engaged, the following systems are automatically activated:

- Stabil-TRAK system is in LOCKED MODE. (Refer to Section 10.4, "Stabil-TRAK Operation," for more information.)
- Transmission has been DECLUTCHED.
- Park brake ENGAGED.
- Outrigger RAISE function has been DISABLED. However, the LOWER function is still active, to allow for any changes in outrigger footing.





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